Eastern Mechanical Services, Inc.

Hotel Marcel
HVAC Controls
O&M Manual

EMS Job: 5072

3 Starr Street
Danbury, CT 06810
203-792-7668 • Fax 203-748-0385
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MITSUBISHI ELECTRIC TRANE HVAC US

CONTROLS APPLICATIONS
RECORD CONTROL DRAWING

PROJECT NAME:	PIRELLI BUILDING
PROJECT ADDRESS:	500 SARGENT DRIVE, NEW HAVEN, CT 06511
DATE:	AUGUST 17, 2022

MITSUBISHI ELECTRIC TRANE HVAC US

1340 Satellite Blvd.
Suwanee, GA 30024
Tel.: (800) 433-4822

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1340 Satellite Blvd.
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Section 1: Record Control Drawings

MITSUBISHI ELECTRIC TRANE HVAC US

MARCEL HOTEL (PIRELLI BUILDING)

500 SARGENT DRIVE, NEW HAVEN, CT 06511

CONTROLS ENGINEER: DT

PROJECT MANAGER: TJ

RECORD DRAWING

REVISION DATE: AUGUST 17, 2022

FILE NAME: PIRELLI BLDG_METUS CONTROLS APPLICATIONS DRAWING_RECORD.VSD

PROJECT NUMBER: PR-002076

LAST REVISION DATE: AUGUST 17, 2022

SHEET NUMBER: PAGE 2 OF 57

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1	RECORD DRAWING	8/17/2022	DT

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MARCEL HOTEL (PIRELLI BLDG)

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LOCATION: NEW HAVEN, CT
CONTROLS ENGINEER: DT
PROJECT MANAGER: TJ

MITSUBISHI ELECTRIC TRANE HVAC US

MITSUBISHI ELECTRIC TRANE
HVAC US LLC
1340 SATELLITE BLVD.
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HVAC LEGEND	
ABBREVIATION	**DESCRIPTION**
absorption	Indicates a chiller which uses absorption driven by hot water (as opposed to vapor compression).
ac	Indicates an alternating current (AC) electrical quantity or device.
active	Applied to an electrical power point to indicate active power or real power, typically measured in "kW".
AE	Actuator
ahu	Air Handler Unit which heats and/or cools air.
ahuRef	Associate an entity such as a vav with an ahu.
air	Point associated with the measurement or control of air.
airCooled	Indicates chiller which uses air to cool the hot refrigerant.
apparent	Applied to an electrical power point to indicate apparent power, typically measured in "kVA".
barometric	Defines the mean atmospheric pressure at sea level measured in millibar or inHg.
BAS	Building Automation System
BATT	Battery
blowdown	Paired with water to indicate control or measurement of the blowdown water expelled from a coolingTower or boiler to remove mineral build up.
boiler	Boiler equip used to generate hot water or steam for heating.
bypass	If used with valve indicates a by-pass in a piping system.
CBL	Cable
CC	Central Controller
centrifugal	Indicates chiller compressor which uses a continuous flow of fluid through an impeller.
chilled	Marker tag used with water for the chilled water system between the plant and ahu.
chilledBeamZone	Marker for an ahu which delivers air to zones via chilled beam terminal units.
chilledWaterCool	Indicates that a unit has cooling capability using chilled water.
chilledWaterPlant	Models the entire plant and its system of equipment used to generate chilled water.
chilledWaterPlantRef	Associate a record such as an ahu with its chilledWaterPlant.
chiller	Chillers remove heat from a liquid via a vapor compression or an absorption refrigeration cycle.
circ	Indicates a pump designed to circulate a fluid through an equipment such as a boiler.
circuit	An equip which models an electric circuit housed in an elecPanel.
closedLoop	Indicates coolingTower which keeps the working fluid separate from the fluid used for heat transfer into the atmosphere.
cmd	Classifies a point as an output, AO/BO, command, or actuator.
CN	Distech Controller
CNX	Distech Controller Expansion
co	Carbon monoxide level point measured in "ppm".
CO	Carbon Dioxide Sensor
co2	Carbon dioxide level point measured in "ppm".
coldDeck	Associated with the cold air ductwork in a dualDuct or tripleDuct AHU.
condensate	Paired with water to indicate control or measurement of the condensate water in a coolingTower or boiler.
condenser	When combined with the water tag, this indicates points in a condenser water system between a chiller and coolingTower.
connection	Marker tag for a logical network connection between two devices using a specific communications protocol.
constantVolume	Marks an ahu as delivering a constant volume of air flow.
cool	Cooling coil as bool or numeric point used with ahu equip.
cooling	Associated with the cooling mode of an HVAC system.
coolingCapacity	Measurement of a chiller ability to remove heat measured in "tonref", "BTU/h", or "kW".
coolingTower	Cooling towers are used to transfer process waste heat to the atmosphere.
coolOnly	Indicates a cooling only VAV without a fan.
CP	Control Panel
CSR	Current Switch
cur	Marker tag which indicates the point has capability for subscription to its real-time, current value.
curErr	Error message associated when curStatus indicates an error condition.
current	Models a point associated with electrical current; should be paired with one of the following tags
curStatus	Current status of a point curVal as one of the predefined strings
curVal	Current value of a point or other value record
damper	Marker tag on point which indicates a damper used to regulate or control the flow or pressure of air.
dc	Indicates a direct current (DC) electrical quantity or device.
DC	Diamond Controller (Terminal Controller)
delta	Indicates a differential of air, water, or steam between the entering and leaving sensors.
device	Models a physical device on a communication network.
device1Ref	Models the first end point device of a connection
device2Ref	Models the second end point device of a connection
dew	Defines the dew point temperature of a weather station.
DIN	Dinrail
directZone	Marker for an ahu which delivers air directly to a zone.

HVAC LEGEND	
ABBREVIATION	**DESCRIPTION**
dis	Short display name for an entity.
discharge	Associated with the discharge air an ahu or vav.
diverting	Indicates a three way valve which inputs one pipe and diverts between two output pipes.
domestic	Paired with water to indicate control or measurement of tap water used for drinking, washing, cooking, and flushing of toliets.
DPS	Differential Pressure Switch
DPTE	Differential Pressure Transmitter
DST	Distech Controller
dualDuct	Indicates an ahu which discharges into two ducts which are some combinatin of hotDeck, coldDeck, or neutralDeck.
ductArea	Config point on a vav for duct area measured in ft² or m².
dxCool	Indicates that a unit has cooling capability using direct expansion mechanical cooling.
effective	Used to indicate the effective setpoint which takes into account various other mode based setpoints the equip might define.
efficiency	Efficiency point of a chiller measured in "COP" or "kW/ton".
elec	Used on point or equip entities relating to electricity.
elecHeat	Indicates that a unit has heating capability using electric heat.
elecMeterLoad	Equip or point which consumes energy as electrial load.
elecMeterRef	Associates a piece of equipment with an elec meter.
elecPanel	An equip which models the physical housing for electric circuits.
elecPanelOf	Associates a circuit with its elecPanel.
elecReheat	Indicates a VAV with electric reheat.
EM	Expansion Module
enable	Secondary on/off point of an equip especially used with a vfd.
energy	Applied to point entities which measure energy consumption.
entering	Indicates water or steam entering a piece of equipment like a boiler or chiller.
enum	Comma separated list of text names to use for Bool or Str point.
EOL	End of Line Resistor
equip	Equipment asset.
equipRef	Association with an equip entity.
ES	End Switch
evaporator	Indicates points on the evaporator mechanism used to convert a refrigerant from its liquid to gageous state.
exhaust	Associated with the exhaust air an ahu.
export	Models the power or energy exported to the electric grid.
faceBypass	A point of an ahu indicating air flow is by-passing the heating/cooling elements.
fan	Fan point or equip associated with an ahu, vav, or coolingTower.
FAN	Fan
fanPowered	Indicates a VAV with a fan.
fcu	Fan coil units are unitary heating/cooling assets which use the zone itself for supply air.
filter	Differential pressure across the filter of an ahu.
flow	Marker tag on a point which measures rate of volume currently flowing through a flow meter, duct, or pipe .
flue	Indicates points placed in the flue-gas stack of a boiler system.
FM	Flow Meter
freezeStat	A boolean point of an ahu indicating a freezing condition which might require a control sequence to protect the equipment.
freq	Electrical A/C frequency point measured in "Hz" for elec meter or a vfd.
FS	Flow Switch
gas	Used on point or equip entities relating to natural gas.
gasHeat	Indicates that a unit has heating capability using gas heat.
gasMeterLoad	Equip or point which consumes fuel gas as load.
header	Header pipe used as central connection or manifold for other piping runs.
heat	Heating coil as bool or float point on an ahu or vav.
heatExchanger	Heat exchangers are used to transfer heat from one medium to another.
heating	Associated with the heating mode of an HVAC system.
heatPump	Heat pumps are unitary assets which use a refrigeration cycle for both heating and cooling.
heatWheel	Bool point which models the on or off state of an ahu heat wheel.
hot	Paired with water to indicate control or measurement of hot water.
hotDeck	Associated with the hot air ductwork in a dualDuct or tripleDuct AHU.
hotWaterHeat	Indicates that a unit has heating capability using hot water.
hotWaterPlant	Plant level tag for system which outputs hot water
hotWaterPlantRef	Associate an entity such as an ahu with its hotWaterPlant.
hotWaterReheat	Indicates a VAV with hot water reheat.
HTE	Humidity Transmitter

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REVISIONS			
REV	DESCRIPTION	DATE	REVISED BY
1	RECORD DRAWING	8/17/2022	DT

MARCEL HOTEL (PIRELLI BLDG)

REF: ABBREVIATIONS 1 OF 2

LOCATION: NEW HAVEN, CT
CONTROLS ENGINEER: DT
PROJECT MANAGER: TJ

MITSUBISHI ELECTRIC TRANE HVAC US
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HVAC LEGEND	
ABBREVIATION	**DESCRIPTION**
humidifier	Boolean or numeric point of an ahu used to indicate if if the humidifier is on or off.
humidity	Humidity measured in %RH (percent relative humidity).
hvac	Associated with HVAC (Heating, Ventilating, Air Conditioning)
id	Unique identifier for an entity.
imbalance	In electrical power systems, models an ac volt or current phase imbalance measured in "%".
import	Models the power or energy imported from the electric grid.
irradiance	Combined with solar to measure the amount of energy arriving at the earth's surface measured in W/m².
isolation	Indicates a valve or damper used to isolate a piece of equipment from a piping system or ductwork respectively.
kind	Defines a tag value type using a predefined string constant.
leaving	Indicates water or steam exiting a piece of equipment like a boiler or chiller.
level	Indicates the fill level of a tank as a percentage where 0% is empty and 100% is filled.
lighting	Indicates association with the lighting system.
lightLevel	Light level sensor point under lightsGroup measured in "lux" or "lumen".
lights	Lighting on/off status as a boolean or if dimmable a numeric between 0% and 100%.
lightsGroup	Equip level of the lighting system which is a group of one or more lights points.
load	Models a point on a chiller used to command or measure the chiller's load as a percentage from "0%" to "100%".
mag	Models the magnitude of a volt or current point.
makeup	Paired with water to indicate control or measurement of the makeup water in a coolingTower or boiler used to replace water lost through leaks, evaporation, or blowdown.
mau	Used with ahu to mark an AHU as a makeup air handling unit which conditions 100% outside air, and no recirculated air.
max	Associated with a maximum value.
maxVal	Applied to point to define the maximum value to read from a sensor or to write from a command/setpoint.
meter	Equip which meters usage of elec energy, thermal energy, gas, water or steam.
min	Associated with a minumum value.
minVal	Applied to point to define the minumum value to read from a sensor or to write from a command/setpoint.
mixed	Associated with the mixed air of an ahu.
mixing	Indicates a three way valve which inputs two pipes and outputs a mixture between the two to a single output pipe.
multiZone	Marker for an ahu which delivers air to its zones via a ductwork manifold which splits the air into a duct per zone.
net	Models the net power or energy exchange with the electric grid following the load convention: import minus export.
network	Network models a communication network between multiple devices.
networkRef	Models the network of a connection
neutralDeck	Associated with the neutral air ductwork in a dualDuct or tripleDuct AHU.
NWS	Ethernet Switch
occ	Marker tag used to indicate a setpoint is associated with occupied mode.
occupancyIndicator	Occupancy sensor under lightsGroup.
occupied	Marker tag used with a boolean point to indicate whether a site or zone is occupied (true) or unoccupied (false).
openLoop	Indicates coolingTower which uses the working fluid itself for evaporation into the atmosphere.
outside	Associated with outside air, often used to model ahu points.
PAC	Packaged Relay Kit
parallel	Indicates the VAV fan pulls air from outside the primary airflow.
PC	Computer
perimeterHeat	Auxiliary heating points associated with a vav.
pf	Power factor of an elec meter as a unitless number between 0.0 and 1.0 which represents the ratio of active power to apparent power.
phase	Association of one or more phases in a three-phase electrical system.
PND	Panduit
PNL	Panel
point	Data point such as a sensor or actuator.
power	Applied to point entities which measure energy consumed per unit time.
precipitation	Amount of atmospheric water vapor fallen which includes rain, drizzle, sleet, snow, and hail measured in mm or inches.
pressure	Static pressure associated with the measurement or control of fluids such as air, oxygen, water, steam, gas, oil, etc.
pressureDependent	VAV damper modulates to control space temp.
pressureIndependent	VAV damper or a control valve that modulates to maintain desired flow setpoint, independent of the duct or piping pressure.
primaryFunction	Enumerated string applied to a site record to indicate the building's primary function.
primaryLoop	Indicates equipment and points which are associated with a chiller or boiler plant's primary loop - the pipework within the central plant.
protocol	String enumeration for a connection communication protocol.
PS	Power Sourse
pump	Marker tag for an equip or point which models a pump.
R	Relay
reactive	Applied to an electrical power point to indicate reactive power or imaginary power, typically measured in "kVAR".
reciprocal	Indicates chiller compressor which uses pistons driven by a crankshaft.
refrig	Indicates points associated with the measurment or control of the refrigerant substance in a cooling system like a chiller.

HVAC LEGEND	
ABBREVIATION	**DESCRIPTION**
reheat	Reheat point of a vav.
reheating	Associated with the reheating mode of a VAV.
return	Associated with the return air an ahu.
rooftop	Used with ahu to mark an AHU as a packaged rooftop unit (RTU).
run	Primary on/off point of an equip especially used with a vfd.
screw	Indicates chiller compressor which uses a rotary mechanism.
secondaryLoop	Indicates equipment and points which are associated with a chiller or boiler plant's secondary loop - the pipework from the central plant to the building.
sensor	Classifies a point as an input, AI/BI, or sensor.
series	Indicates the VAV pulls air from the primary airflow.
singleDuct	Indicates an ahu which uses a single duct for all air flow.
site	Building or other type of facility with unique street address.
siteMeter	Applied to a meter which exclusively meters a single site identified by siteRef.
sitePanel	Marker tag for a elecPanel to indicate its the main site-level panel.
siteRef	Association with a site entity.
solar	Point associated with the measurement of the sunlight.
sp	Classifies a point as a setpoint, soft point, or process control variable.
speed	When used as a vfd point it is speed measured in "%" where 0% is off and 100% is the fastest speed.
stage	Indicates the stage of an AHU cooling or heating element.
standby	Marker tag used to indicate a setpoint is associated with standby mode.
steam	Point associated with the measurement or control of steam.
steamHeat	Indicates that a unit has heating capability using steam.
steamMeterLoad	Equip or point which consumes steam as load.
steamPlant	Plant level tag for system which outputs steam
steamPlantRef	Associate an entity such as an ahu with its steamPlant.
submeterOf	This tag is applied to submeters and references the parent meter.
subPanelOf	Ref tag to indicate that an elecPanel is positioned underneath another panel in the electric distribution system.
SWr	Software
tank	Marker tag for an equip which models a storage tank vessel.
TE	Thermostatic Electric
temp	Temperature measured in °C or °F.
thd	In electrical power systems, models the total harmonic distortion of a volt or current pointmeasured in "%".
tripleDuct	Indicates an ahu which discharges into three ducts which are the hotDeck, coldDeck, and neutralDeck.
TTE	Temperature Transmitter
unit	Unit of measurement identifier from unit database.
unocc	Marker tag used to indicate a setpoint is associated with unoccupied mode.
UPS	Uninterruptible Power Supply
uv	Unit ventilators are unitary heating/cooling assets which have direct access to outside fresh air.
valve	Marker tag on point which indicates a valve used to regulate or control the flow or pressure of a fluid.
variableVolume	Marks an ahu as delivering a variable volume of air flow.
vav	Variable Volume Volume supply duct equip.
vavMode	Enumerated Str point which specifies a VAV's operating mode as one the following standardized string values
vavZone	Marker for an ahu which delivers air to zones via vav terminal units.
vfd	Marker for a motor equip with variable frequency drive.
VNT	Ventilation
volt	Models a point associated with electrical voltage; should be paired with one of the following tags
volume	Marker tag on a point which measures total volume which has flowed through a meter, duct, or pipe.
water	Point associated with the measurement or control of water.
waterCooled	Indicates chiller which uses water to cool the hot refrigerant.
waterMeterLoad	Equip or point which consumes water as load.
wetBulb	Associates a point with the wet-bulb temperature.
writable	Annotates a point as a writable output with 16-level priority array.
writeErr	Error message associated when writeStatus indicates an error condition.
writeLevel	Current priority level for writeVal as number between 1 and 17.
writeStatus	Current status of a writable point output
writeVal	Current desired value to write to output.
XFMR	Transformer
zone	Associated with a conditioned zone of a building.

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MARCEL HOTEL (PIRELLI BLDG)

REF: ABBREVIATIONS 2 OF 2

LOCATION: NEW HAVEN, CT
CONTROLS ENGINEER: DT
PROJECT MANAGER: TJ

MITSUBISHI ELECTRIC TRANE HVAC US

MITSUBISHI ELECTRIC TRANE
HVAC US LLC
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SUWANEE, GA 30024
PHONE: (800) 433-4822
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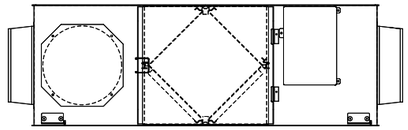
MITSUBISHI EQUIPMENT LEGEND

LOSSNAY



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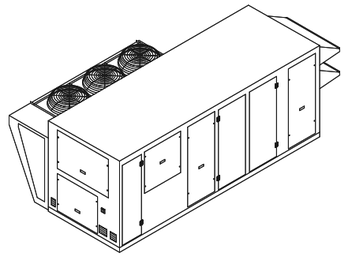

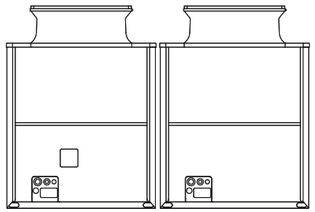

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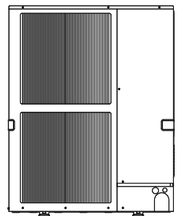

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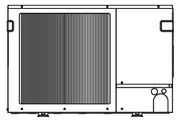

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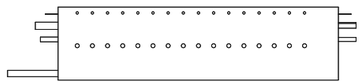
BRANCH CONTROLLER



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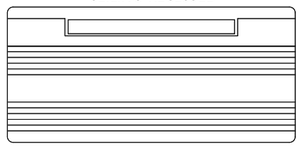
CEILING-RECESSED



INDOOR UNIT

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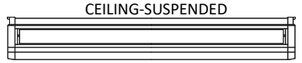
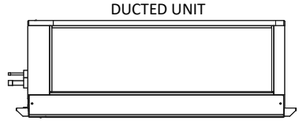


INDOOR UNIT

PEFY
DUCTED UNIT



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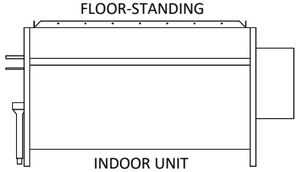
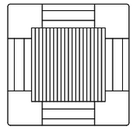


INDOOR UNIT

PKFY
WALL-MOUNTED

INDOOR UNIT

PLFY
CEILING-RECESSED



INDOOR UNIT

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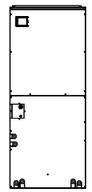
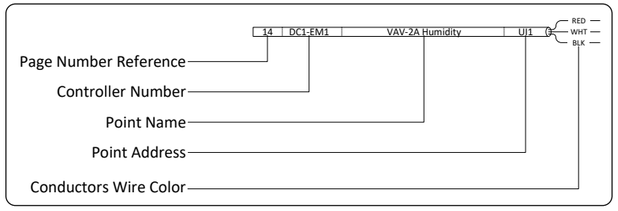
MULTI-POSITION



INDOOR UNIT

POINT BLOCK LEGEND



DRAWING TAGS LEGEND

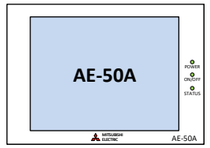
1	Installation Note
1	Revision Tag
	Revision Cloud

MITSUBISHI SYMBOL LEGEND

CENTRAL CONTROLLERS

AE-200A

AE-50A



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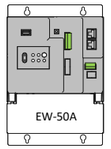

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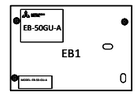
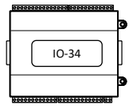


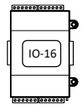
JACE

DC-8000

DC-8000-R-34



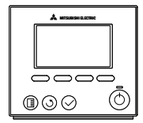
DC-8000-R-16



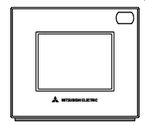
REMOTE CONTROLLERS

SIMPLE MA

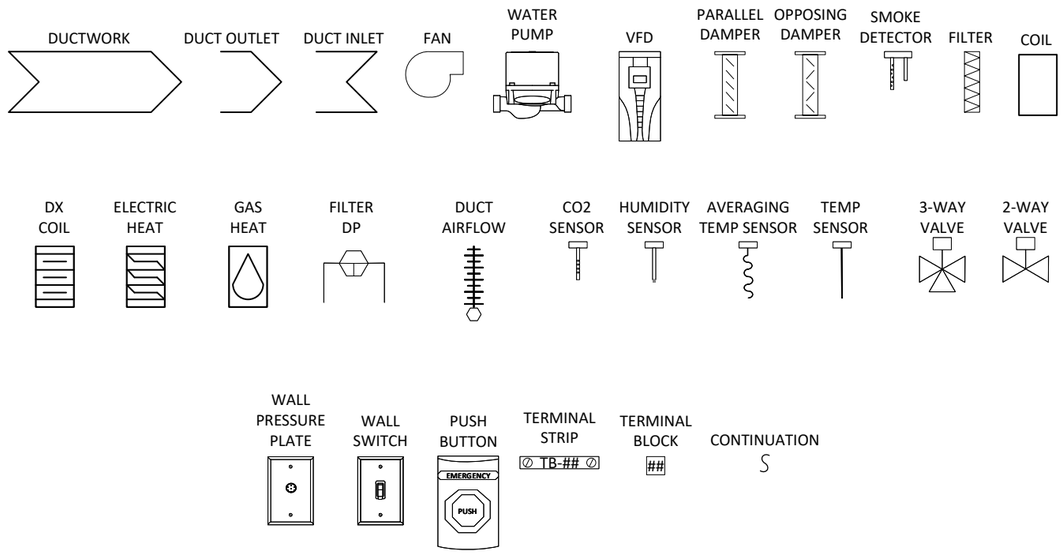
WIRED MA



SMART ME



OBJECT SYMBOL LEGEND



REVISIONS			
REV	DESCRIPTION	DATE	REVISED BY
1	RECORD DRAWING	8/17/2022	DT

PROJECT NUMBER: PR-002076

LAST REVISION DATE: AUGUST 17, 2022

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MARCEL HOTEL (PIRELLI BLDG)

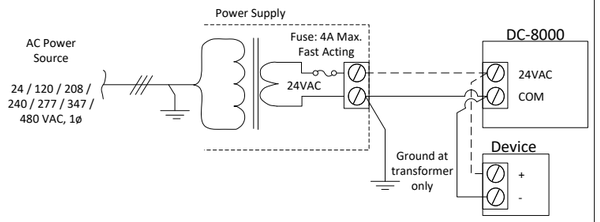
REF: SYMBOLS DETAIL LEGEND

LOCATION: NEW HAVEN, CT
CONTROLS ENGINEER: DT
PROJECT MANAGER: TJ

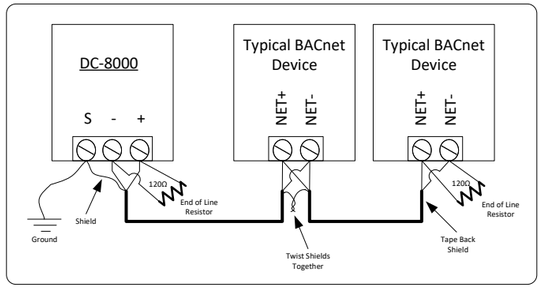
MITSUBISHI ELECTRIC TRANE HVAC US

MITSUBISHI ELECTRIC TRANE
HVAC US LLC
1340 SATELLITE BLVD.
SUWANEE, GA 30024
PHONE: (800) 433-4822
FAX: (800) 889-9904

POWER WIRING NOTES



BACNET MS/TP DEVICE WIRING



GENERAL NOTES

1. ONLY DEVICES LISTED ON BILL OF MATERIAL ARE SUPPLIED BY MITSUBISHI; ALL OTHER MATERIAL IS EITHER EXISTING OR SUPPLIED BY OTHERS.
2. FIELD VERIFY TERMINATIONS TO ALL EXISTING DEVICES
3. ALL DEVICES MUST BE INSTALLED ACCORDING TO INSTALLATION INSTRUCTIONS WITH DEVICE, UNLESS SPECIFICALLY DIRECTED OTHERWISE BY AN AUTHORIZED MITSUBISHI REPRESENTATIVE.
4. DO **NOT** APPLY POWER TO CONTROL PANELS UNTIL PRELIMINARY CHECKOUT HAS BEEN COMPLETED BY AN AUTHORIZED MITSUBISHI REPRESENTATIVE.
5. EACH MITSUBISHI CONTROL PANEL REQUIRES A DEDICATED 120VAC, 15A POWER SOURCE.
6. ALL WIRING MUST COMPLY WITH NATIONAL, STATE, AND LOCAL ELECTRICAL CODES.
7. ALL WIRING TO BE TAGGED WITH POINT NAME AS OF SHOWN ON DRAWINGS AT BOTH ENDS OF WIRE.
8. ALL MODIFICATIONS REQUIRED IN THE DRAWINGS MUST BE DOCUMENTED CLEARLY AND READABLE. RETURN THE NOTES WRITTEN ON THE DRAWINGS TO THE MITSUBISHI REPRESENTATIVE SO RECORD DRAWINGS CAN BE CREATED FOR THE COMPLETION OF THE PROJECT.

M-NET WIRING NOTES

Specifications	Detail
Conductor	#16 AWG STR BC
Insulation	FLEXGUARD
Cable	2 conductor: 1 white, 1 black
Shield	Alum./Poly. +18 AWG STR TC DRAIN + POLY. Barrier
Jacket	.013" Wall FLEXGUARD. Natural Overall O.D. - .186" Nom. - Color: White
Print Legend	(UL File No.) Type CL3P/CMP 16 SWG (UL)

Industry Standards	Detail
National Electric Code	Article 725
UL Standard 13	Type CL3P
National Electrical Code	Article 800
UL Standard 444	Type CMP

Electrical Specifications	Detail
Mutual Capacitance	59 PF/FT NOM. @ 1KHZ
Ground Capacitance	106 PF/FT NOM. @ 1MHZ
Suggested Working Voltage	300V

BACnet MS/TP WIRING NOTES

1. DO **NOT** USE DIFFERENT WIRE TYPES OR GAUGES ON THE SAME BACNET MS/TP SEGMENT. THE STEP CHANGE IN LINE IMPEDANCE CHARACTERISTICS CAUSES UNPREDICTABLE REFLECTIONS ON THE BUS.
2. IN NOISY (HIGH EMI) ENVIRONMENTS, AVOID WIRE RUNS PARALLEL TO NOISY POWER CABLES, OR LINES CONTAINING LIGHTING DIMMER SWITCHES, AND KEEP AT LEAST 3IN (76MM) OF SEPARATION BETWEEN NOISY LINES AND THE BACNET MS/TP CABLE.
3. DO **NOT** ROUTE ANY NETWORK WIRES CLOSE TO HIGH VOLTAGE OR HIGH CURRENT WIRES. IT IS RECOMMENDED THAT NETWORK WIRING BE IN ITS OWN CONDUIT TROUGH. IT MAY, HOWEVER, BE ROUTED WITH LOW VOLTAGE WIRES. IF THE NETWORK CABLE MUST CROSS HIGH VOLTAGE OR CURRENT WIRES, THE NETWORK CABLE MUST CROSS PERPENDICULAR TO THE HIGH VOLTAGE OR CURRENT WIRES.
4. MAKE SURE THAT THE BACNET MS/TP SHIELD IS **NOT** BROKEN THROUGHOUT THE ENTIRE LENGTH OF CABLE.
5. CONNECT THE SHIELD TO THE EARTH GROUND AT **ONE** END OF THE BUS **ONLY**.
6. TIE TOGETHER AND TAP BACK THE SHIELD AT EACH DEVICE.
7. **DO NOT CONNECT THE SHIELD TO THE CONTROLLER COMMON TERMINALS.**
8. **NO T-TAPS, STUBS, STARS, SPURS** OF ANY LENGTH ARE ALLOWED IN BUS WIRING. ALWAYS USE POINT-TO-POINT, DAISY CHAIN WIRING, INCLUDING INSIDE THE CABINETS.

CABLE TYPE RECOMMENDATIONS

Jacket Color	Conductor Colors	Manufacturer	Gauge	Conductors	Plenum	Uses	Shielded	Stranded	Notes
White	Wht,Blk	Connect-Air	18	2	W181P-2051	I/O, 24V Power	Yes	Yes	
White	Wht,Blk	Connect-Air	16	2	W161P-2062	24V Power	No	Yes	
White	Wht,Blk	Connect-Air	14	2	W141P-2013	24V Power	No	Yes	
Blue	Not polarity sensitive	Connect-Air	22	2	W221P-2001B	Lon 1 pair	No	Yes	
Blue	Wht, Blk	Connect-Air	24	2	W241P-2000FBLRB	Distech BACnet MS/TP	Yes	Yes	
		Connect-Air	18	2	W181P-2090RIB	Honeywell BACnet MS/TP	Yes	Yes	
White	Wht, Blk	ME HVAC	16	2	CW162S-1000	M-Net	Yes	Yes	
White	Wht, Blk	Connect-Air	20	2	W201P-2053RIB	Smart-ME	No	Yes	
Black	Wht, Blk	Connect-Air	14	4	WI14-04VNTC	Mr. Slim	No	Yes	4th conductor is ground wire
Orange	Wht, Blk, Yel	Connect-Air	24	3 (1.5pair)	W241.5P-5400BLN	BACnet MSTP	Yes	Yes	

Jacket Color	Conductor Colors	Manufacturer	Gauge	Conductors	Non-Plenum	Uses	Shielded	Stranded	Notes
Grey	Blk,Red	Connect-Air	18	2	W181P-1002	I/O, 24V Power	No	Yes	
Grey	Wht/Blu, Blu/Wht & Wht/Org, Org/Wht	Belden	24	4 (2pair)	9842	ABB VFD 2 Pair BACnet MSTP	Yes	Yes	

PROJECT NUMBER: PR-002076

LAST REVISION DATE: AUGUST 17, 2022

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T:\PROJECTS\PR-002076 PIRELLI BLDG (MARCEL HOTEL)\07_JOB CLOSE OUT\O&M MANUALS\CONTROL DRAWING\PIRELLI BLDG_METUS CONTROLS APPLICATIONS DRAWING_RECORD.VSD

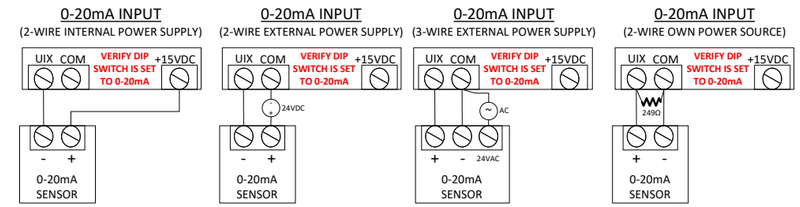
MARCEL HOTEL (PIRELLI BLDG)

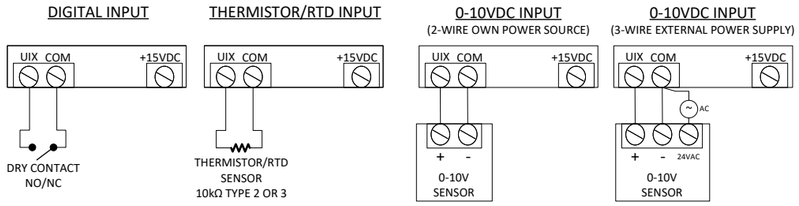
REF: WIRING DETAILS

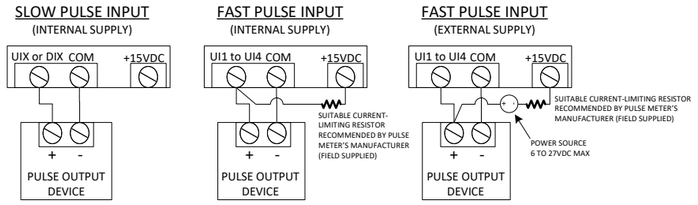
LOCATION: NEW HAVEN, CT
CONTROLS ENGINEER: DT
PROJECT MANAGER: TJ

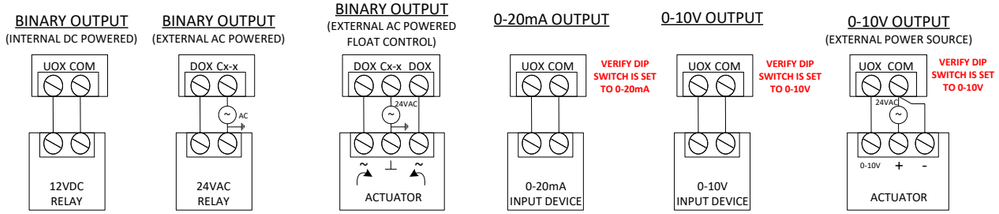
MITSUBISHI ELECTRIC TRANE HVAC US
MITSUBISHI ELECTRIC TRANE
HVAC US LLC
1340 SATELLITE BLVD.
SUWANEE, GA 30024
PHONE: (800) 433-4822
FAX: (800) 889-9904

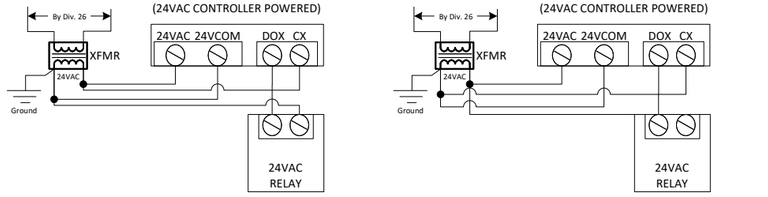
DISTECH ECB-300, 400, and 600 SERIES IO WIRING

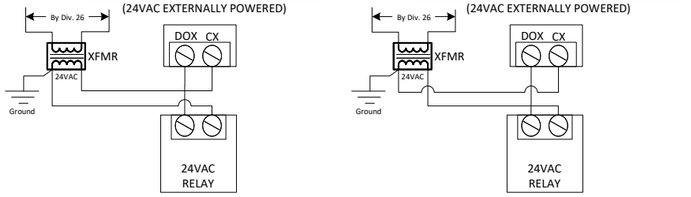




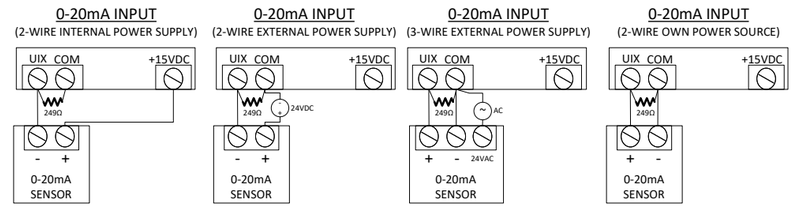


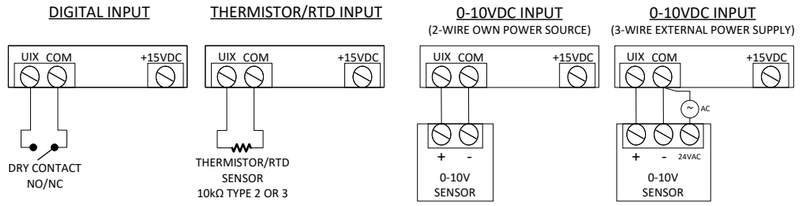


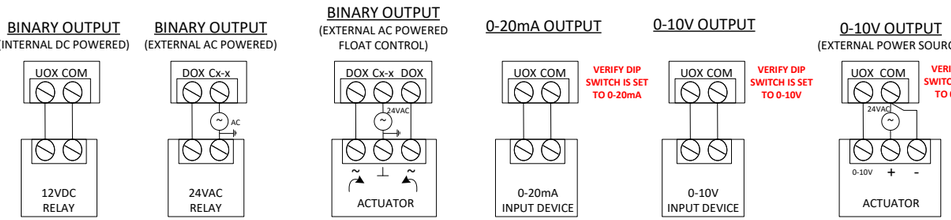


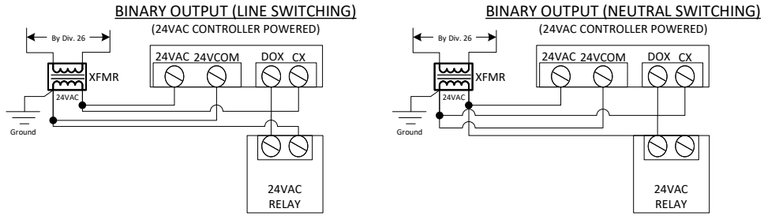


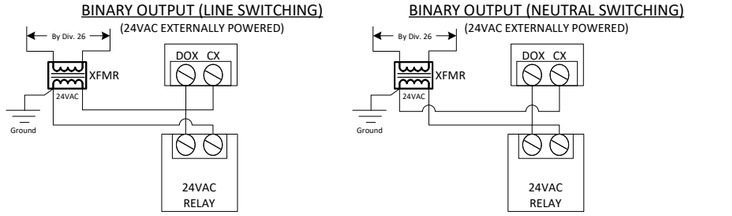
DISTECH ECB-203 SERIES IO WIRING











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MARCEL HOTEL (PIRELLI BLDG)

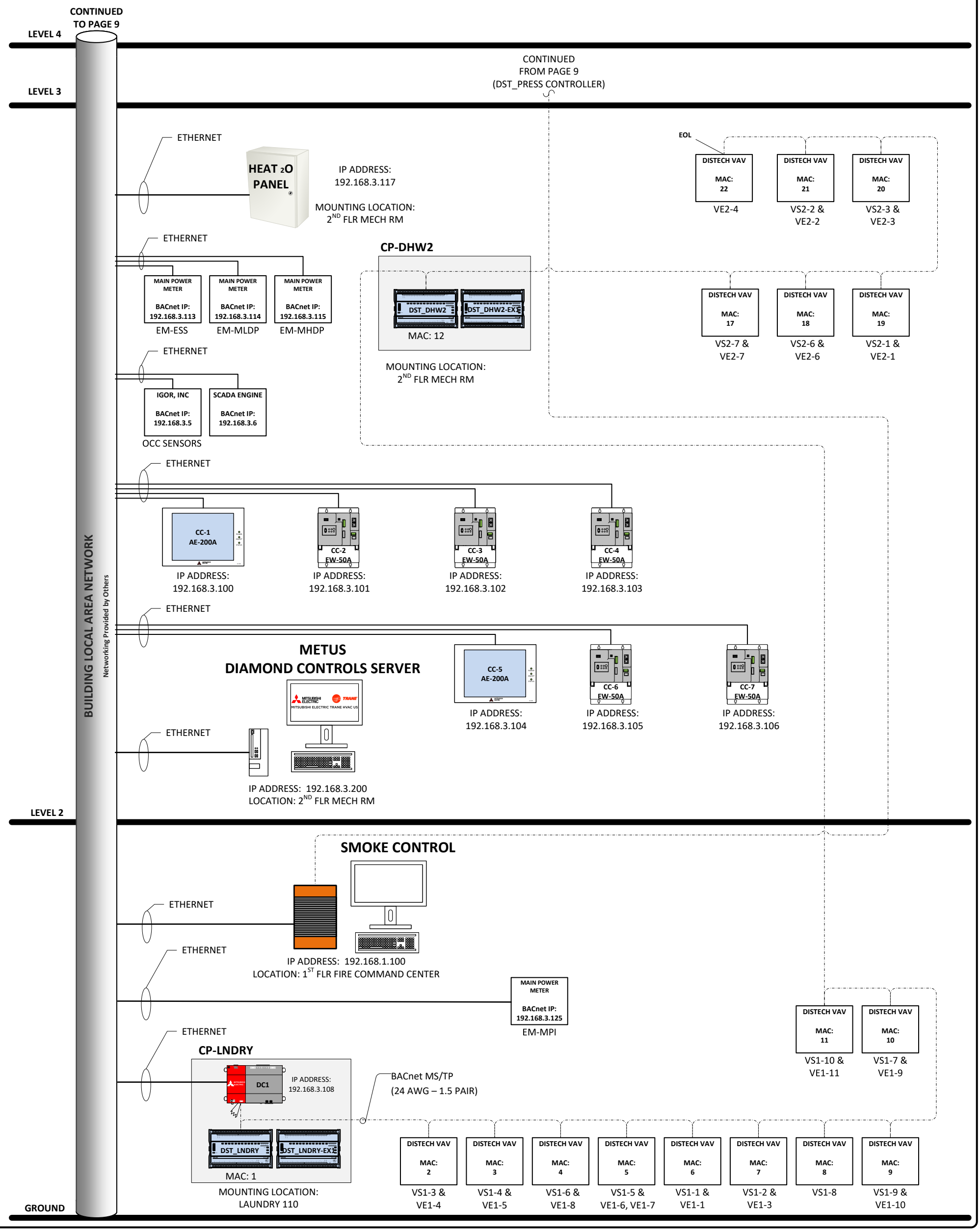
REF: DISTECH ECB WIRING DETAIL

LOCATION: NEW HAVEN, CT
CONTROLS ENGINEER: DT
PROJECT MANAGER: TJ

MITSUBISHI ELECTRIC TRANE HVAC US

MITSUBISHI ELECTRIC TRANE
HVAC US LLC
1340 SATELLITE BLVD.
SUWANEE, GA 30024
PHONE: (800) 433-4822
FAX: (800) 889-9904

Bill of Materials				
Ref. Tag	**Description**	**Manufacturer**	**Model #**	**Qty**
MONITOR	DELL 24" MONITOR	DELL	E2420H	1
COMPUTER	DELL PRECISION 3650 TOWER PC	DELL	PRECISION 3650 TOWER	1
	NIAGARA 4 SUPERVISOR W/ 10 NIAGARA NETWORK CONNECTIONS	LYNXSPRING	JENE-SUP-10	1
	SUPERVISOR 10 - INITIAL 18 MONTH MAINTENANCE	LYNXSPRING	JENE-SUP-10-SMA-INIT	1
	NIAGARA 4; 500 FIELD DEVICES AND 25,000 POINTS	LYNXSPRING	JENE-SUP-DEVICE-500	2
EOL	120 OHM 1/4W +/-5% RESISTOR	KELE	58K5008	6
BACnet REPEATER	BACnet REPEATER	DISTECH	NC-BACNETREPXO	3
	DC POWER SUPPLY CONVERTER	DISTECH	PW-PSM24A24DAS	3



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1340 SATELLITE BLVD.
SUWANEE, GA 30024
PHONE: (800) 433-4822
FAX: (800) 889-9904

MARCEL HOTEL (PIRELLI BLDG)

BUILDING CONTROL NETWORK 1 OF 2

LOCATION: NEW HAVEN, CT
CONTROLS ENGINEER: DT
PROJECT MANAGER: TJ

REVISIONS			
REV	DESCRIPTION	DATE	REVISED BY
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PROJECT NUMBER: PR-002076

LAST REVISION DATE: AUGUST 17, 2022

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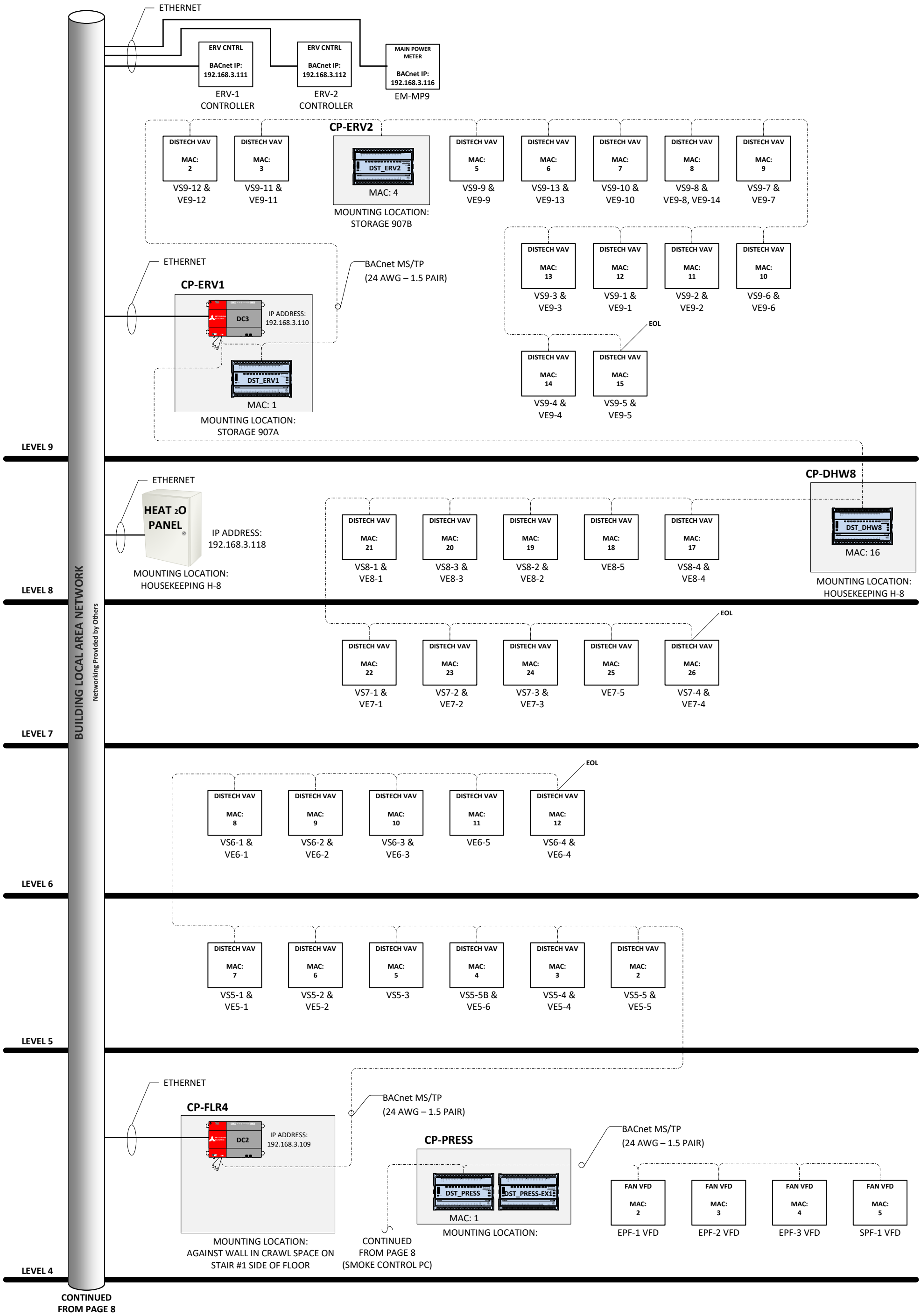

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SUWANEE, GA 30024
PHONE: (800) 433-4822
FAX: (800) 889-9904

MARCEL HOTEL (PIRELLI BLDG)

BUILDING CONTROL NETWORK 2 OF 2

LOCATION: NEW HAVEN, CT
CONTROLS ENGINEER: DT
PROJECT MANAGER: TJ

REVISIONS			
REV	DESCRIPTION	DATE	REVISED BY
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PROJECT NUMBER:
PR-002076

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MITSUBISHI ELECTRIC TRANE HVAC US

CONTROL VALVE SCHEDULE

PROJECT NAME: PIRELLI BUILDING | **DATE:** August 17, 2022 | **PROJECT NUMBER:** PR-002076
LOCATION: NEW HAVEN, CT | **REV:** RECORD DRAWING | **ENGINEER:** DT

VALVE IDENTIFICATION				DESIGN			VALVE PART ASSEMBLY					VALVE						ACTUATOR			NOTES
												VALVE BODY									
ASSOCIATED EQUIPMENT	SERVICE TYPE	VALVE TAG		QTY	PIPE SIZE (inch)	WATER GPM	VALVE ASSEMBLY PART NUMBER	VALVE BODY PART NUMBER	VALVE BODY MANUFACTURER	ACTUATOR PART NUMBER	ACTUATOR MANUFACTURER	SIZE (inch)	STYLE	TYPE	VALVE CONNECTION	VALVE ΔP (psi)	VALVE CONFIG	FAIL TYPE	SIGNAL TYPE	CLOSE-OFF PRESSURE (psi)	
DHW	TANK #1 ISO VALVE (LEVEL 2)	V-	1	1	0.75	5	B218B/TFRB24-NC	B218B	*BELIMO*	TFRB24-NC	*BELIMO*	0.75	2W	CCV	FxF	0.46	NC	SR	2-POS (24V)	200	
DHW	TANK #2 ISO VALVE (LEVEL 2)	V-	2	1	0.75	5	B218B/TFRB24-NC	B218B	*BELIMO*	TFRB24-NC	*BELIMO*	0.75	2W	CCV	FxF	0.46	NC	SR	2-POS (24V)	200	
DHW	TANK #1 ISO VALVE (LEVEL 8)	V-	3	1	0.75	5	B218B/TFRB24-NC	B218B	*BELIMO*	TFRB24-NC	*BELIMO*	0.75	2W	CCV	FxF	0.46	NC	SR	2-POS (24V)	200	
DHW	TANK #2 ISO VALVE (LEVEL 8)	V-	4	1	0.75	5	B218B/TFRB24-NC	B218B	*BELIMO*	TFRB24-NC	*BELIMO*	0.75	2W	CCV	FxF	0.46	NC	SR	2-POS (24V)	200	

NOTES:

2W - TWO WAY, **3W** - THREE WAY, **FxF** - FEMALE TO FEMALE THREADED,
NO - NORMALLY OPEN, **NC** - NORMALLY CLOSED, **FTC** - FAIL TO COIL, **FTB** - FAIL TO BYPASS
SR - SPRING RETURN, **NSR** - NON SPRING RETURN, **FLT** - FLOATING, **PRP** - PROPORTIONAL, **0-10V** - VOLTAGE, **2-10V** - VOLTAGE

CONTROL VALVE SCHEDULE

PROJECT NUMBER: PR-002076
LAST REVISION DATE: AUGUST 17, 2022
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MARCEL HOTEL (PIRELLI BLDG)

CONTROL VALVE SCHEDULE

LOCATION: NEW HAVEN, CT
CONTROLS ENGINEER: DT
PROJECT MANAGER: TJ

MITSUBISHI ELECTRIC TRANE HVAC US

MITSUBISHI ELECTRIC TRANE
HVAC US LLC
1340 SATELLITE BLVD.
SUWANEE, GA 30024
PHONE: (800) 433-4822
FAX: (800) 889-9904

SEQUENCE OF OPERATION – ERV
UNITS WILL OPERATE CONTINUOUSLY.

STARTUP:
THE UNIT WILL BE ENABLED IN EITHER "AUTOMATIC" ENERGY RECOVERY MODE, OR "ECONOMIZER" MODE. IF UNIT IS DISABLED, THE UNIT WILL BE IN "STAND BY" MODE WITH THE OUTSIDE AIR AND EXHAUST AIR DAMPERS CLOSED. DURING UNIT STARTUP, UNIT OUTDOOR AIR AND EXHAUST AIR DAMPERS WILL BE OPENED. ONCE DAMPERS ARE PROVEN OPEN, THE EXHAUST FANS WILL BE ENABLED AND RAMPED UP TO MINIMUM SPEED FOR 5 MINUTES (ADJ.), THEN SUPPLY FANS WILL BE ENABLED AND RAMPED UP TO MINIMUM SPEED. ONCE BOTH SETS OF FANS HAVE REACH MINIMUM SPEED THEY WILL MODULATE AS NECESSARY TO MAINTAIN DUCT STATIC PRESSURE SET POINTS (SEE SEQUENCE BELOW). DURING UNIT SHUTDOWN, ONCE FANS HAVE BEEN DISABLED, ALL DAMPERS ARE TO CLOSE.

FAN CONTROL:
ENERGY RECOVERY VENTILATOR WILL BE OPERATED ON VARIABLE VOLUME CONTROL BASED UPON SUPPLY AIR DUCT AND EXHAUST AIR DUCT STATIC PRESSURE SET POINTS. THE DUCT STATIC PRESSURE SENSOR WILL BE LOCATED IN THE AIR DUCTS NEAR THE END OF THE LONGEST DUCT BRANCH. SUPPLY AND EXHAUST FAN ECMS WILL BE UTILIZED FOR SYSTEM STATIC PRESSURE SET POINT. FANS WILL OPERATE ON A STATIC PRESSURE RESET SUCH THAT IF ANY V.A.V. IS OPEN 90% OR GREATER (ADJ.) THE STATIC SET POINT RISES 0.1" (ADJ.) EVERY MINUTE (ADJ.). WHEN THE MOST OPEN V.A.V. IS OPEN 70% (ADJ.) THE STATIC SET POINT WILL DROP 0.1" (ADJ.) EVERY MINUTE (ADJ.).

TEMPERATURE CONTROL:
THE SUPPLY AIR DISCHARGE TEMPERATURE SET POINT WILL BE SENT TO THE FACTORY ALTERNATING DAMPER CONTROLLER. FACTORY WILL OPERATE THE DAMPERS TO MAINTAIN A DISCHARGE AIR TEMPERATURE AT SET POINT BASED ON THE SCHEDULE. PROVIDE A PROGRAMMED DISCHARGED AIR SET POINT RESET SCHEDULE BASED ON OUTDOOR AIR TEMPERATURE, 74°F AT 0°F OUTSIDE (ADJ.), 68°F AT 70°F OUTSIDE (ADJ.) AND ABOVE. ECONOMIZER MODE WILL BE UTILIZED AS INDICATED BELOW TO ACHIEVE THE DESIRED SUPPLY AIR TEMPERATURE.

POST CONDITIONING OF SUPPLY AIR WILL BE WITH VRF DIRECT EXPANSION COIL. INSTALL FACTORY SUPPLIED DISCHARGE AIR TEMPERATURE SENSOR AND WIRE BACK TO LOCAL VRF CONTROL PANEL. THE VRF SYSTEM WILL CONTROL ALL ASPECTS OF AIR TEMPERATURE CONTROL INCLUDING REVERSING VALVE POSITION, THERMAL EXPANSION VALVE MODULATION, ETC. THE DDC SYSTEM WILL MONITOR FINAL SUPPLY DISCHARGE AIR TEMPERATURE AND HUMIDITY.

IN THE EVENT THAT THE FACTORY SUPPLY OR RETURN DUCT SMOKE DETECTOR IN THE ENERGY RECOVERY VENTILATOR IS INITIATED, THE SUPPLY AND EXHAUST FANS WILL BE DISABLED, OUTDOOR AIR AND EXHAUST AIR DAMPERS WILL BE CLOSED. THIS SIGNAL WILL BE PROVIDED FROM THE BUILDING FIRE ALARM SYSTEM.

PROVIDE USER PROGRAMMABLE SET POINTS FOR SUPPLY AND EXHAUST STATIC PRESSURE SET POINTS, SUPPLY AIR TEMPERATURE SET POINT.

ALARM POINTS:
- OUTDOOR AIR DAMPER FAIL
- EXHAUST AIR DAMPER FAIL
- SUPPLY FAN FAIL
- EXHAUST FAN FAIL
- SUPPLY AIR FILTER D.P. HIGH
- DISCHARGE AIR PRESSURE LOW/HIGH
- RETURN AIR HUMIDITY HIGH
- SUPPLY AIR TEMPERATURE HIGH
- SUPPLY AIR TEMPERATURE LOW
- ERV FACTORY CONTROLLER ALARM
- DUCT DETECTOR FAULT

ERV (Swegon)
Factory Controller BACnet Points List

Point Description	BACnet Point Type	BACnet Point #
SA Air Flow	AI	4
EA Air flow	AI	6
SA Duct Pressure	AI	8
EA Duct Pressure	AI	10
SA AHU Filter Pressure Level	AI	27
SA AHU Filter Pressure Alarm Level	AI	28
EA AHU Filter Pressure Level	AI	29
EA AHU Filter Pressure Alarm Level	AI	30
SA Fan Level	AI	37
EA Fan Level	AI	38
SA Temperature	AI	64
EA Temperature	AI	66
Outdoor Temperature	AI	73
Heat Exchanger Regulator Level	AI	91
Reheat Regulator Level	AI	94
Cool Regulator Level	AI	101
Re-heat anti frost temp/overheat	AI	153
Triggered Alarm #1	AI	604
SA Low Speed Air Flow Set Point	AV	3
EA Low Speed Air Flow Set Point	AV	4
SA High Speed Air Flow Set Point	AV	5
EA High Speed Air Flow Set Point	AV	6
SA Low Speed Pressure Set Point	AV	19
EA Low Speed Pressure Set Point	AV	20
SA High Speed Pressure Set Point	AV	21
EA High Speed Pressure Set Point	AV	22
ERS 1 Diff	AV	118
SA Temperature Set Point	AV	132
EA/Room Temperature Set Point	AV	135
SA Min Temp Set Point	AV	136
SA Max Temp Set Point	AV	137
Operation Active	BI	1
Damper Operation Active	BI	2
Low Speed Oepration Active	BI	3
High Speed Operation Active	BI	4
A-alarm Active	BI	13
B-alarm Active	BI	14
Re-heat output	BI	38
Alarm Reset	BV	1
Operation Level	MI	592
Communication Operation Level	MV	793

ENERGY RECOVERY UNIT SYSTEM
SEQUENCE OF OPERATION

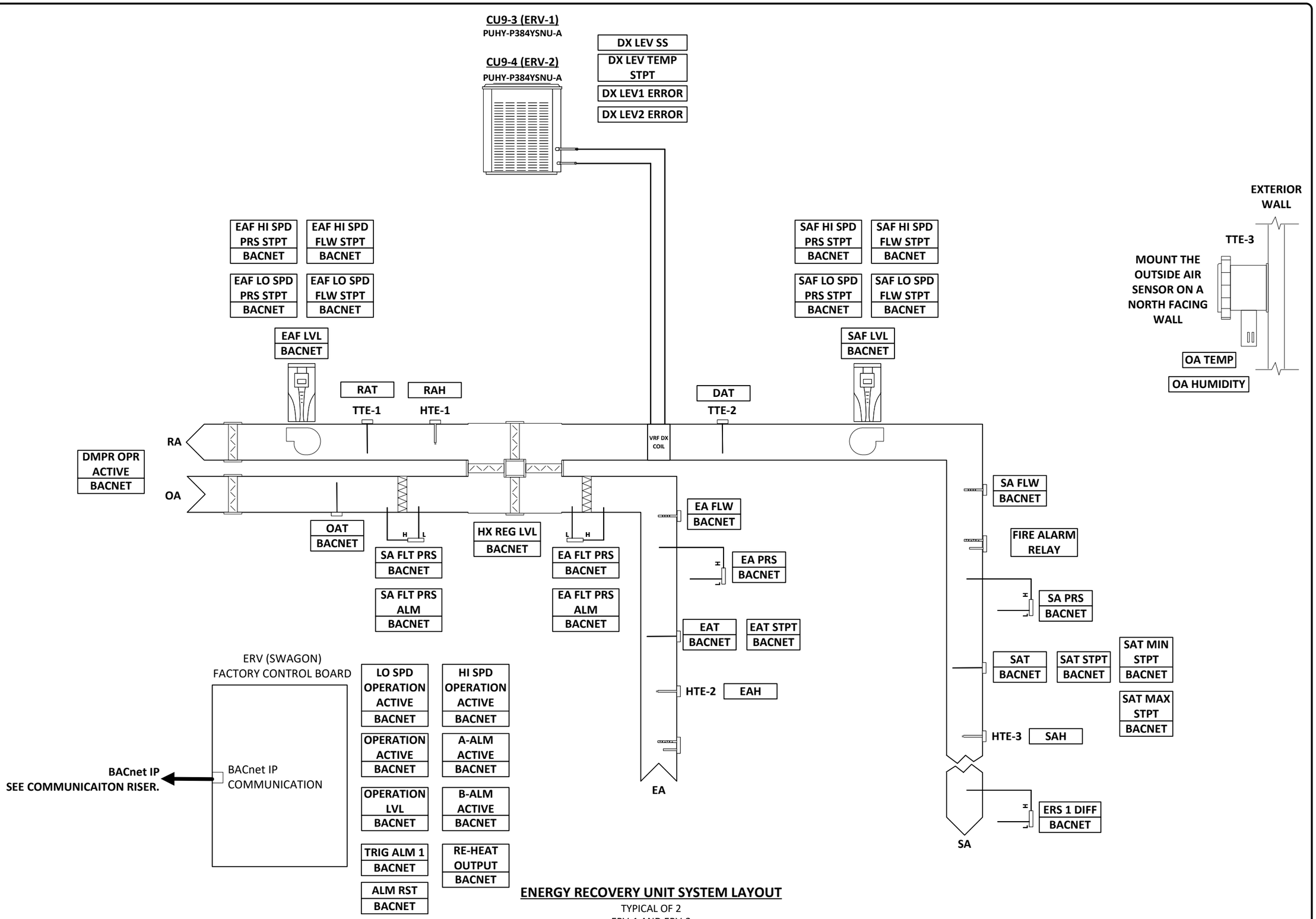
PROJECT NUMBER: PR-002076
LAST REVISION DATE: AUGUST 17, 2022
SHEET NUMBER: PAGE 11 OF 57

REV	DESCRIPTION	DATE	REWSED BY
1	RECORD DRAWING	8/17/2022	DT

T:\PROJECTS\PR-002076 PIRELLI BLDG (MARCEL HOTEL)\07_JOB CLOSE OUT\O&M MANUALS\CONTROL DRAWING\PIRELLI BLDG_MITS CONTROLS APPLICATIONS DRAWING_RECORD.VSD

MARCEL HOTEL (PIRELLI BLDG)
ENERGY RECOVERY UNIT SYSTEM SEQUENCE
LOCATION: NEW HAVEN, CT
CONTROLS ENGINEER: DT
PROJECT MANAGER: TJ

MITSUBISHI ELECTRIC TRANE HVAC US
MITSUBISHI ELECTRIC TRANE
HVAC US LLC
1340 SATELLITE BLVD.
SUWANEE, GA 30024
PHONE: (800) 433-4822
FAX: (800) 889-9904



ENERGY RECOVERY UNIT SYSTEM LAYOUT

TYPICAL OF 2
ERV-1 AND ERV-2

PROJECT NUMBER: PR-002076

LAST REVISION DATE: AUGUST 17, 2022

SHEET NUMBER: PAGE 12 OF 57

REVISIONS			
REV	DESCRIPTION	DATE	REVISED BY
1	RECORD DRAWING	8/17/2022	DT

T:\PROJECTS\PR-002076 PIRELLI BLDG (MARCEL HOTEL)\07_JOB CLOSE OUT\O&M MANUALS\CONTROL DRAWING\PIRELLI BLDG_MITS CONTROLS APPLICATIONS DRAWING_RECORD.VSD

MARCEL HOTEL (PIRELLI BLDG)

ENERGY RECOVERY UNIT SYSTEM LAYOUT

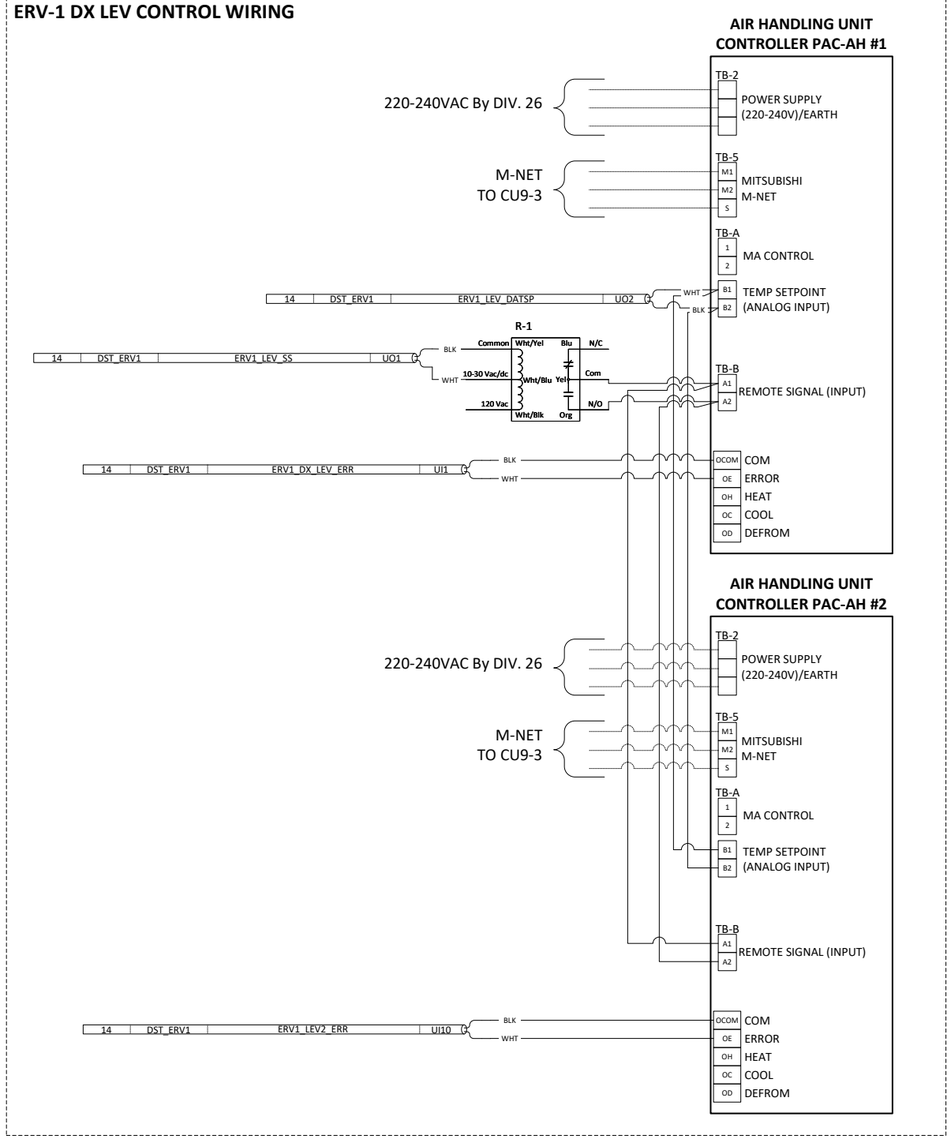
LOCATION: NEW HAVEN, CT
CONTROLS ENGINEER: DT
PROJECT MANAGER: TJ

MITSUBISHI ELECTRIC TRANE HVAC US

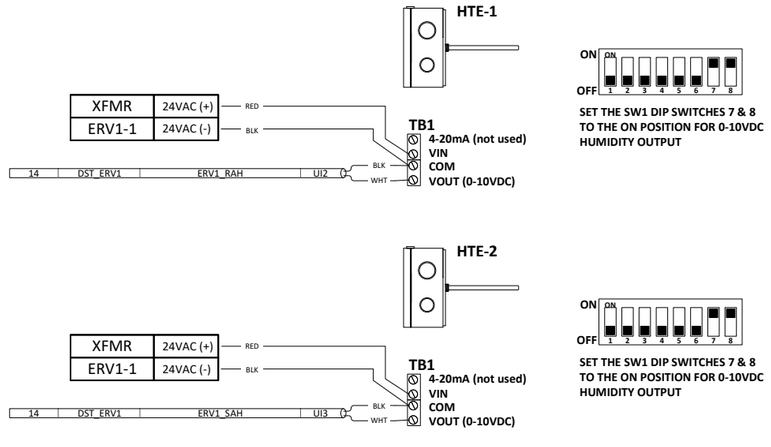
MITSUBISHI ELECTRIC TRANE
HVAC US LLC
1340 SATELLITE BLVD.
SUWANEE, GA 30024
PHONE: (800) 433-4822
FAX: (800) 889-9904

Bill of Materials				
Ref. Tag	**Description**	**Manufacturer**	**Model #**	**Qty**
HTE-1~2	5% DUCT RH SENSOR	ACI	A/RH5-D	2
HTE-3	5% OA RH W/TEMP SENSOR	ACI	A/RH5-AN-O	1
R-1	ENCLOSED PILOT RELAY 10A SPDT W/10-30VAC	FUNCTIONAL DEVICES	RIBU1C	1
TTE-1~2	DUCT MOUNTED, 10K OHM TYPE 3, 8" TEMP PROBE	ACI	A/AN-D-8-GD	2

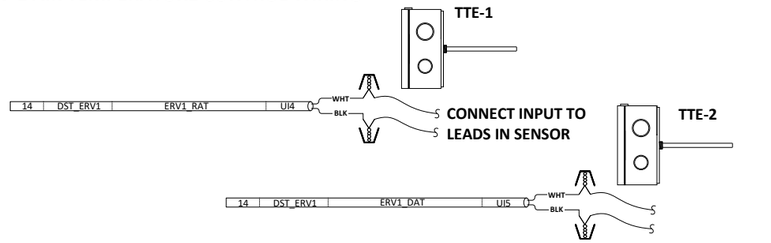
ERV-1 DX LEV CONTROL WIRING



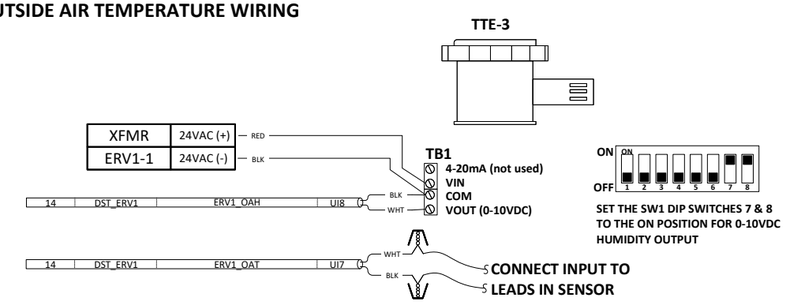
ERV-1 AIR HUMIDITY CONTROL WIRING



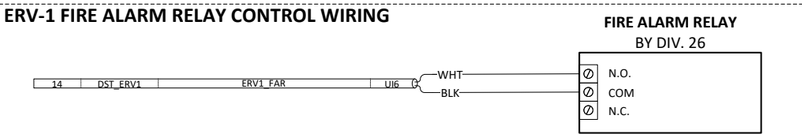
ERV-1 AIR TEMPERATURE CONTROL WIRING



OUTSIDE AIR TEMPERATURE WIRING



ERV-1 FIRE ALARM RELAY CONTROL WIRING



ERV-1 SYSTEM WIRING

PROJECT NUMBER: PR-002076

LAST REVISION DATE: AUGUST 17, 2022

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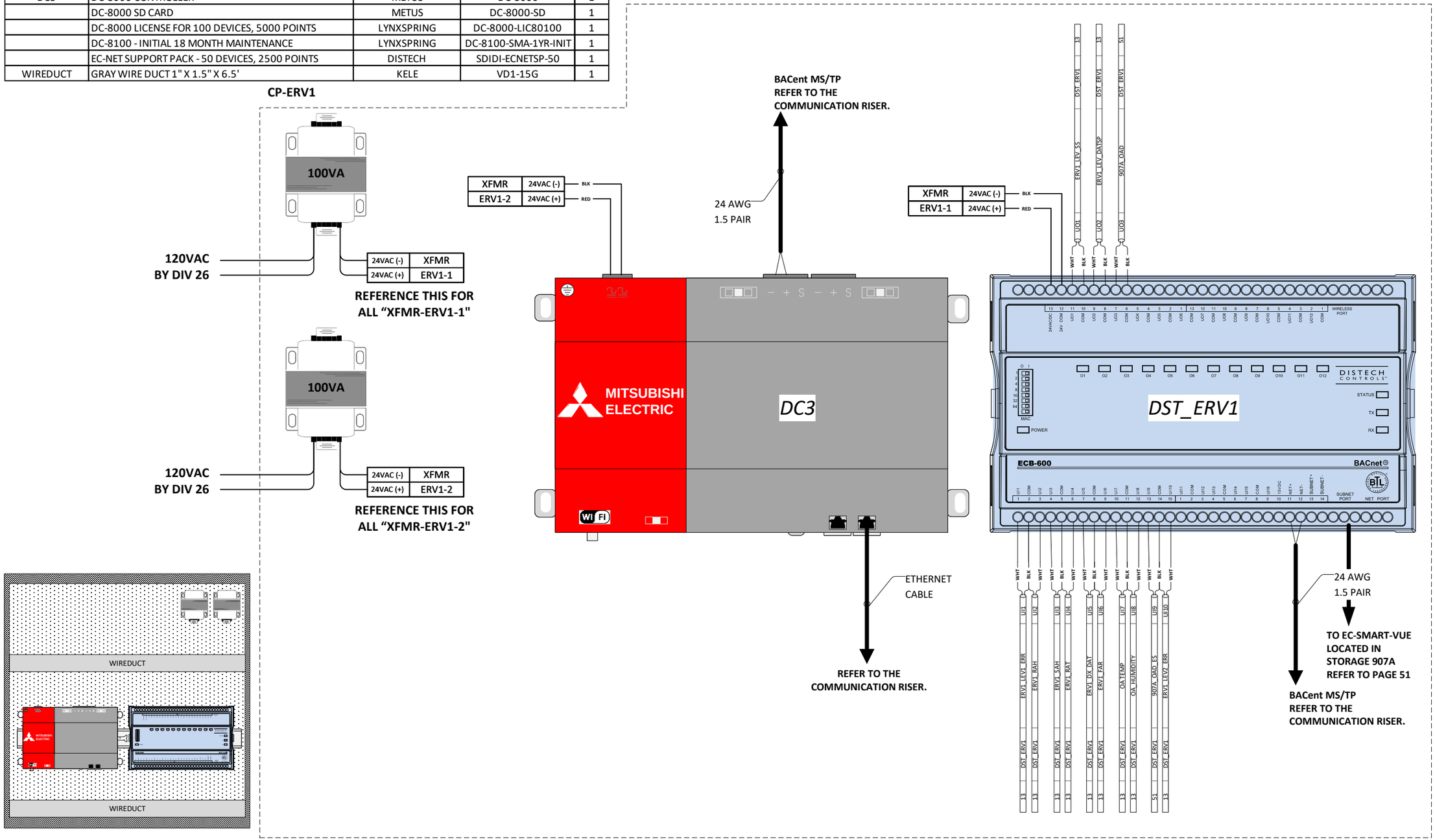
MARCEL HOTEL (PIRELLI BLDG)

ERV-1 SYSTEM WIRING

LOCATION: NEW HAVEN, CT
CONTROLS ENGINEER: DT
PROJECT MANAGER: TJ

MITSUBISHI ELECTRIC TRANE HVAC US
MITSUBISHI ELECTRIC TRANE HVAC US LLC
1340 SATELLITE BLVD.
SUWANEE, GA 30024
PHONE: (800) 433-4822
FAX: (800) 889-9904

Bill of Materials				
Ref. Tag	**Description**	**Manufacturer**	**Model #**	**Qty**
CP-ERV1	24x24x8 NEMA1 ENCLOSURE W/PERF PANEL	HOFFMAN	A-24N24BLPP	1
DIN-ERV1	DIN RAIL ALUMINUM	KELE	BAM-1000	1
DST_ERV1	ECB-600; 16UI and 12UO POINTS	DISTECH	CDIB-600X-00	1
XFMR-ERV1-1~2	TRANSFORMER 100VA, 120 to 24VAC	FUNCTIONAL DEVICES	TR100VA001	2
DC3	DC-8000 CONTROLLER	METUS	DC-8000	1
	DC-8000 SD CARD	METUS	DC-8000-SD	1
	DC-8000 LICENSE FOR 100 DEVICES, 5000 POINTS	LYNXSPRING	DC-8000-LIC80100	1
	DC-8100 - INITIAL 18 MONTH MAINTENANCE	LYNXSPRING	DC-8100-SMA-1YR-INIT	1
	EC-NET SUPPORT PACK - 50 DEVICES, 2500 POINTS	DISTECH	SDIDI-ECNETSP-50	1
WIREDUCT	GRAY WIRE DUCT 1" X 1.5" X 6.5'	KELE	VD1-15G	1



PANEL

NOT DRAWING TO SCALE

ERV-1 SYSTEM
DISTECH CONTROLLER WIRING

PROJECT NUMBER: PR-002076

LAST REVISION DATE: AUGUST 17, 2022

SHEET NUMBER: PAGE 14 OF 57

REVISIONS			
REV	DESCRIPTION	DATE	REVISED BY
1	RECORD DRAWING	8/17/2022	DT

MARCEL HOTEL (PIRELLI BLDG)
ERV-1 SYSTEM DISTECH CONTROLLER WIRING

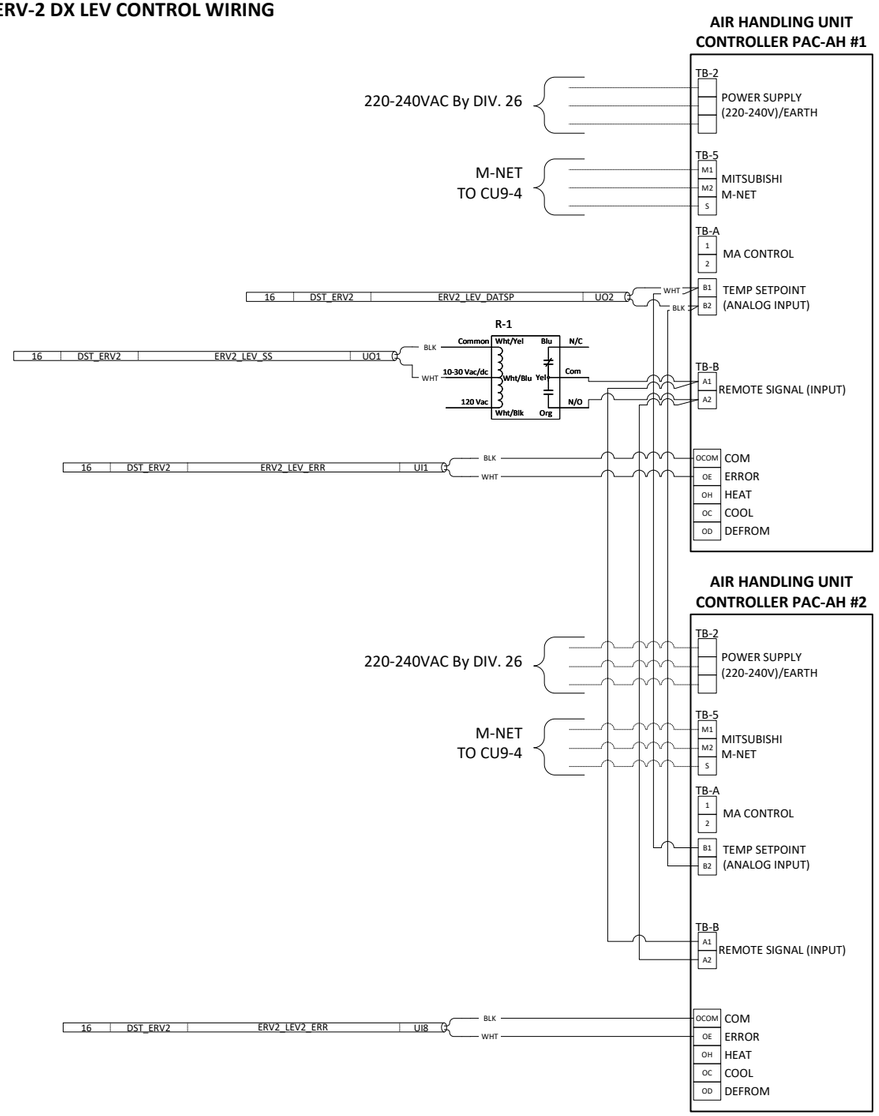
LOCATION: NEW HAVEN, CT
CONTROLS ENGINEER: DT
PROJECT MANAGER: TJ

MITSUBISHI ELECTRIC TRANE HVAC US

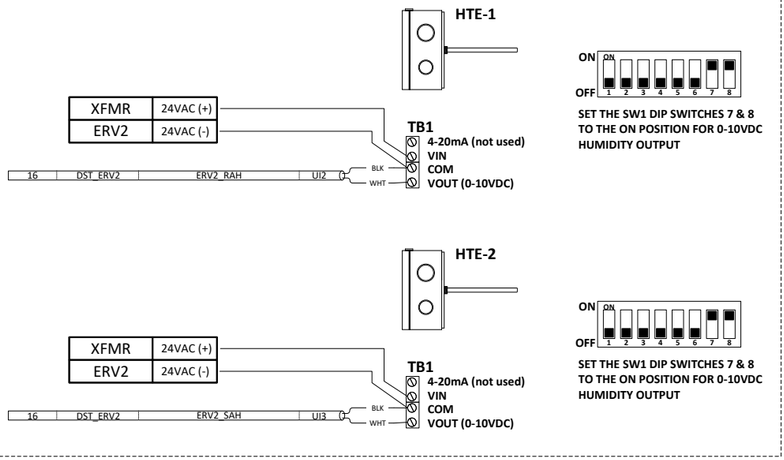
MITSUBISHI ELECTRIC TRANE HVAC US LLC
1340 SATELLITE BLVD.
SUWANEE, GA 30024
PHONE: (800) 433-4822
FAX: (800) 889-9904

Bill of Materials				
Ref. Tag	**Description**	**Manufacturer**	**Model #**	**Qty**
HTE-1~2	5% DUCT RH SENSOR	ACI	A/RH5-D	2
R-1	ENCLOSED PILOT RELAY 10A SPDT W/10-30VAC	FUNCTIONAL DEVICES	RIBU1C	1
TTE-1~2	DUCT MOUNTED, 10K OHM TYPE 3, 8" TEMP PROBE	ACI	A/AN-D-8-GD	2

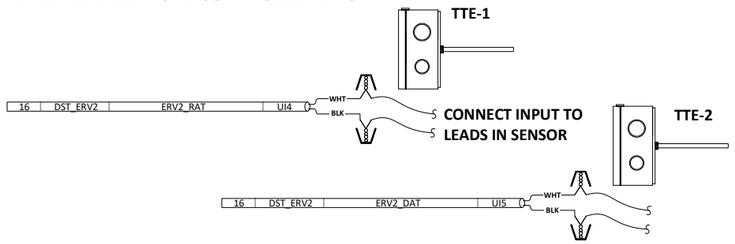
ERV-2 DX LEV CONTROL WIRING



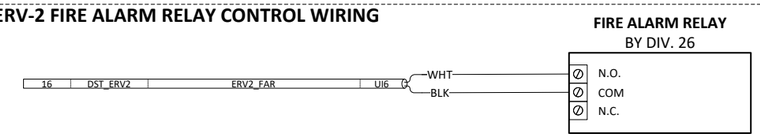
ERV-2 AIR HUMIDITY CONTROL WIRING



ERV-2 AIR TEMPERATURE CONTROL WIRING



ERV-2 FIRE ALARM RELAY CONTROL WIRING



ERV-2 SYSTEM WIRING

PROJECT NUMBER: PR-002076

LAST REVISION DATE: AUGUST 17, 2022

SHEET NUMBER: PAGE 15 OF 57

REVISIONS			
REV	DESCRIPTION	DATE	REVISED BY
1	RECORD DRAWING	8/17/2022	DT

MARCEL HOTEL (PIRELLI BLDG)

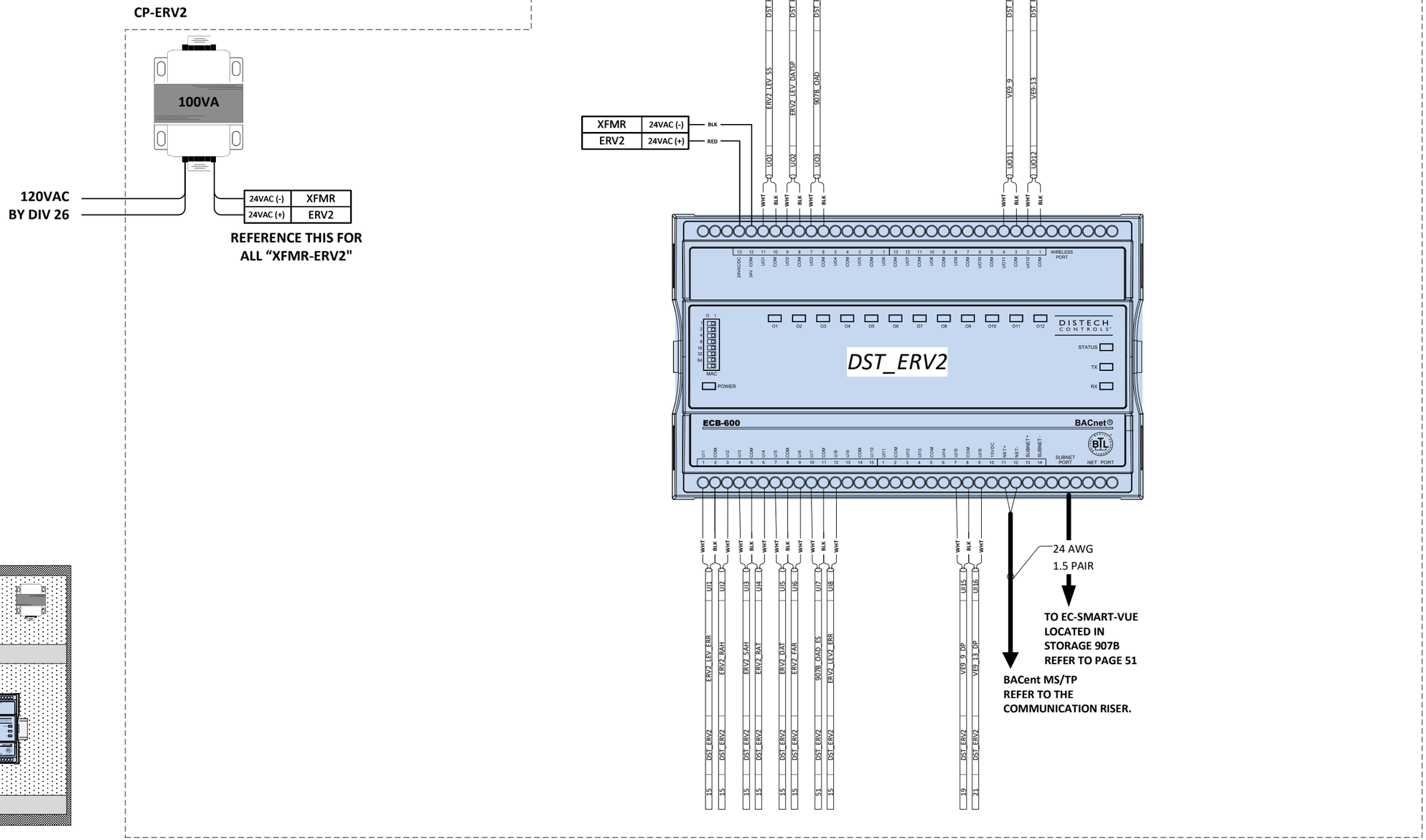
ERV-2 SYSTEM WIRING

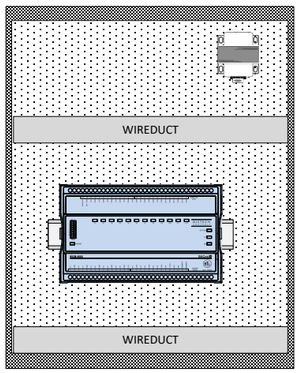
LOCATION: NEW HAVEN, CT
CONTROLS ENGINEER: DT
PROJECT MANAGER: TJ

MITSUBISHI ELECTRIC TRANE HVAC US

MITSUBISHI ELECTRIC TRANE
HVAC US LLC
1340 SATELLITE BLVD.
SUWANEE, GA 30024
PHONE: (800) 433-4822
FAX: (800) 889-9904

Bill of Materials				
Ref. Tag	**Description**	**Manufacturer**	**Model #**	**Qty**
CP-ERV2	16x16x6 NEMA1 ENCLOSURE W/PERF PANEL	HOFFMAN	A-16N16ALPP	1
DIN-ERV2	DIN RAIL ALUMINUM	KELE	BAM-1000	1
DST_ERV2	ECB-600; 16UI and 12UO POINTS	DISTECH	CDIB-600X-00	1
XFMR-ERV2	TRANSFORMER 100VA, 120 to 24VAC	FUNCTIONAL DEVICES	TR100VA001	1
WIREDUCT	GRAY WIRE DUCT 1" X 1.5" X 6.5'	KELE	VD1-15G	1





PANEL

NOT DRAWING TO SCALE

ERV-2 SYSTEM
DISTECH CONTROLLER WIRING

PROJECT NUMBER: PR-002076

LAST REVISION DATE: AUGUST 17, 2022

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REVISIONS			
REV	DESCRIPTION	DATE	REVISED BY
1	RECORD DRAWING	8/17/2022	DT

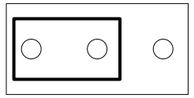
MARCEL HOTEL (PIRELLI BLDG)
ERV-2 SYSTEM DISTECH CONTROLLER WIRING

LOCATION: NEW HAVEN, CT
CONTROLS ENGINEER: DT
PROJECT MANAGER: TJ

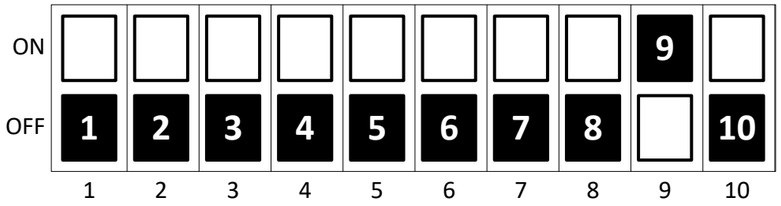
MITSUBISHI ELECTRIC TRANE HVAC US

MITSUBISHI ELECTRIC TRANE
HVAC US LLC
1340 SATELLITE BLVD.
SUWANEE, GA 30024
PHONE: (800) 433-4822
FAX: (800) 889-9904

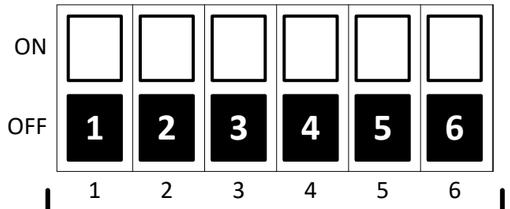
SWE



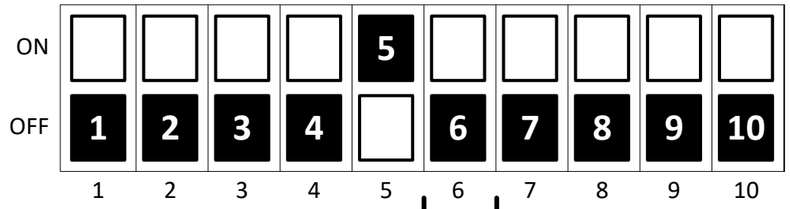
SW1



SW2 (CAPACITY SETTING)

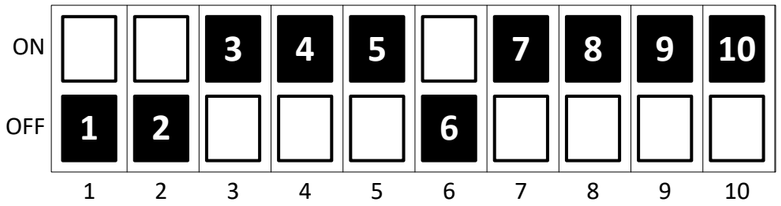


SW3



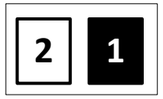
CAPACITY CODE SETTING

SW4

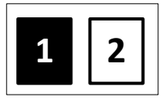


SWA

SW5



SWC



ERV-1 & 2 LEV DIP SWITCH SETTINGS

PROJECT NUMBER: PR-002076

LAST REVISION DATE: AUGUST 17, 2022

SHEET NUMBER: PAGE 17 OF 57

REVISIONS				
REV	DESCRIPTION	DATE	REVISED BY	
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T:\PROJECTS\PR-002076 PIRELLI BLDG (MARCEL HOTEL)\07_JOB CLOSE OUT\O&M MANUALS\CONTROL DRAWING\PIRELLI BLDG_METUS CONTROLS APPLICATIONS DRAWING_RECORD.VSD

MARCEL HOTEL (PIRELLI BLDG)

ERV-1 & 2 LEV DIP SWITCH SETTINGS

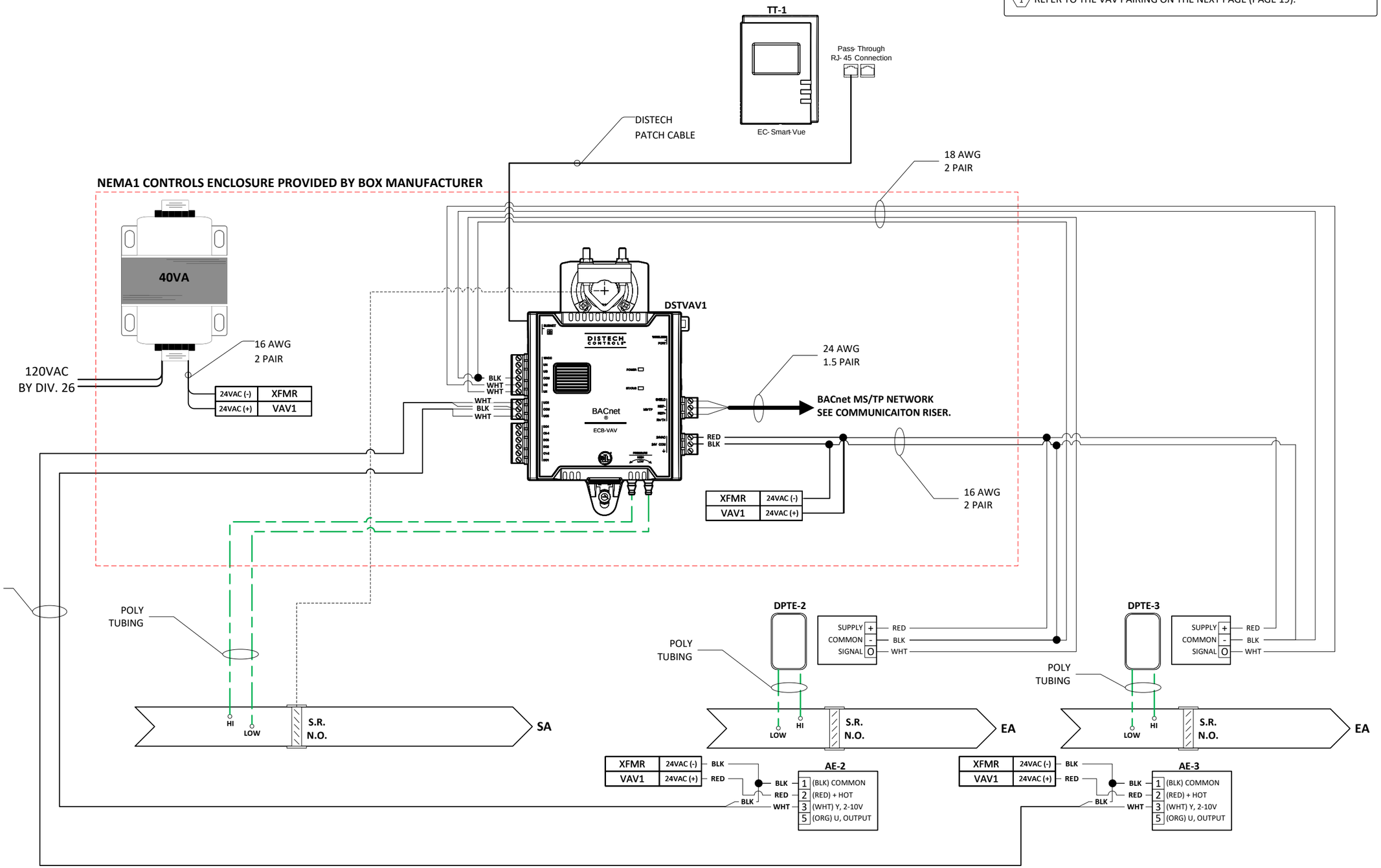
LOCATION: NEW HAVEN, CT
CONTROLS ENGINEER: DT
PROJECT MANAGER: TJ

MITSUBISHI ELECTRIC TRANE HVAC US

MITSUBISHI ELECTRIC TRANE
HVAC US LLC
1340 SATELLITE BLVD.
SUWANEE, GA 30024
PHONE: (800) 433-4822
FAX: (800) 889-9904

NOTES:

1. REFER TO THE VAV PAIRING ON THE NEXT PAGE (PAGE 19).



ERV VAV DEMAND CONTROLLED VENTILATION (CO2)

APPLICATION:
OFFICES & CONFERENCE ROOMS

PROJECT NUMBER: PR-002076

LAST REVISION DATE: AUGUST 17, 2022

SHEET NUMBER: PAGE 18 OF 57

REVISIONS			
REV	DESCRIPTION	DATE	REVISED BY
1	RECORD DRAWING	8/17/2022	DT

MARCEL HOTEL (PIRELLI BLDG)
ERV VAV DEMAND CONTROLLED VENTILATION (CO2)
LOCATION: NEW HAVEN, CT
CONTROLS ENGINEER: DT
PROJECT MANAGER: TJ

MITSUBISHI ELECTRIC TRANE HVAC US
MITSUBISHI ELECTRIC TRANE
HVAC US LLC
1340 SATELLITE BLVD.
SUWANEE, GA 30024
PHONE: (800) 433-4822
FAX: (800) 889-9904

Bill of Materials				
Ref. Tag	Description	Manufacturer	Model #	Qty
DSTVAV1	ECB-VAV, VAV CONTROLLER W/BUILT-IN DIFF PRESS TRANSDUCER	DISTECH	CDIB-VAXX-IMP	14
XFMR-VAV1	TRANSFORMER 40VA, 120 TO 24VAC	FUNCTIONAL DEVICES	TR40VA001	14
TT-1	COMMUNICATING ROOM TEMP, HUMIDITY, CO2 SENSOR	DISTECH	PDITE-SMRTVUCH-00	14
CBL-1	GENERIC PATCH CORD, CT5E, FT6, 100 FEET CABLE	DISTECH	CB-GPATCH5eFT6WH100	14
AE-2	DAMPER ACTUATOR, 22IN-LB, SR, 2-10V MODULATING	BELIMO	TFB24-SR	12
DPTE-2	MULTI RANGE DIFF PRESS TRANSDUCER, 0-10VDC	MAMAC	PR274-R2-VDC	12
AE-3	DAMPER ACTUATOR, 22IN-LB, SR, 2-10V MODULATING	BELIMO	TFB24-SR	1
DPTE-3	MULTI RANGE DIFF PRESS TRANSDUCER, 0-10VDC	MAMAC	PR274-R2-VDC	1

NOTES:

1. VE9-9 DEVICES WIRED TO ERV-2 DISTECH CONTROLLER.
   REFER TO THE ERV-2 DISTECH CONTROLLER WIRING ON PAGE 16.

PIRELLI BLDG - VAV PAIRING			
FLOOR	APPLICATION	SUPPLY VAV	EXHAUST VAV
1	DSTVAV1	VS1-7	VE1-9
1	DSTVAV1	VS1-8	
1	DSTVAV1	VS1-9	VE1-10
1	DSTVAV1	VS1-10	VE1-11
2	DSTVAV1	-	VE2-4
9	DSTVAV1	VS9-2	VE9-2
9	DSTVAV1	VS9-3	VE9-3
9	DSTVAV1	VS9-5	VE9-5
9	DSTVAV1	VS9-6	VE9-6
9	DSTVAV1	VS9-7	VE9-7
9	DSTVAV1	VS9-8	VE9-8
9	DSTVAV1		VE9-14
9	DSTVAV1	VS9-9	VE9-9 (1)
9	DSTVAV1	VS9-10	VE9-10
9	DSTVAV1	VS9-11	VE9-11

SEQUENCE OF OPERATION – ERV VAV CO2

APPLICATIONS
- OFFICES
- CONFERENCE ROOMS

START-UP
ERV WILL OPERATE CONTINUOUSLY.

VARIABLE VOLUME BOXES (CO2 OPERATION)
THE SUPPLY AIR AND EXHAUST AIR VENTILATION V.A.V.'S WILL OPEN 30% +/-5% (ADJ.) OF FULL FLOW AND RUN CONTINUOUSLY. EACH ZONE MINIMUM AND MAXIMUM SET POINTS ARE TO BE INDIVIDUALLY ADJUSTABLE AND DISPLAYED ON EACH ROOMS GRAPHICS. EACH V.A.V. ZONE WILL MONITOR CO2 VALUES. SUPPLY V.A.V. WILL MODULATE TO MAINTAIN SPACE CO2 BELOW SET POINT 900PPM (ADJ.); EXHAUST V.A.V. WILL TRACK SUPPLY. NO V.A.V. POSITION WILL BE LESS THAN 10% (ADJ.) OF FULL OPEN POSITION.

NORMALLY UNOCCUPIED BUILDING HOURS (SCHEDULE ESTABLISHED BY OWNER) WILL CALL VAV BOXES CLOSED TO 10% OF DESIGN AIRFLOW. CO2 WILL OVERRIDE SETBACK UNDER ALL CONDITIONS.

WHERE THERE ARE MULTIPLE SPACES SERVED BY A SINGLE VAV BOX (SUCH AS 2ND FLOOR OFFICES), THE VAV WILL BE CONTROLLED BY THE WORST CASE CO2 SENSOR READING.

ALARM POINTS
- SUPPLY V.A.V. AIR VOLUME LOW
- EXHAUST V.A.V. AIR VOLUME LOW
- SUPPLY V.A.V. AIR VOLUME HIGH
- EXHAUST V.A.V. AIR VOLUME HIGH
- SPACE CO2 LEVEL HIGH (1500 PPM ADJ)

ERV VAV DEMAND CONTROLLED VENTILATION (CO2)
SEQUENCE OF OPERATION & BOM
APPLICATION:
OFFICES & CONFERENCE ROOMS

PROJECT NUMBER: PR-002076
LAST REVISION DATE: AUGUST 17, 2022
SHEET NUMBER: PAGE 19 OF 57

REVISIONS			
REV	DESCRIPTION	DATE	REVISED BY
1	RECORD DRAWING	8/17/2022	DT

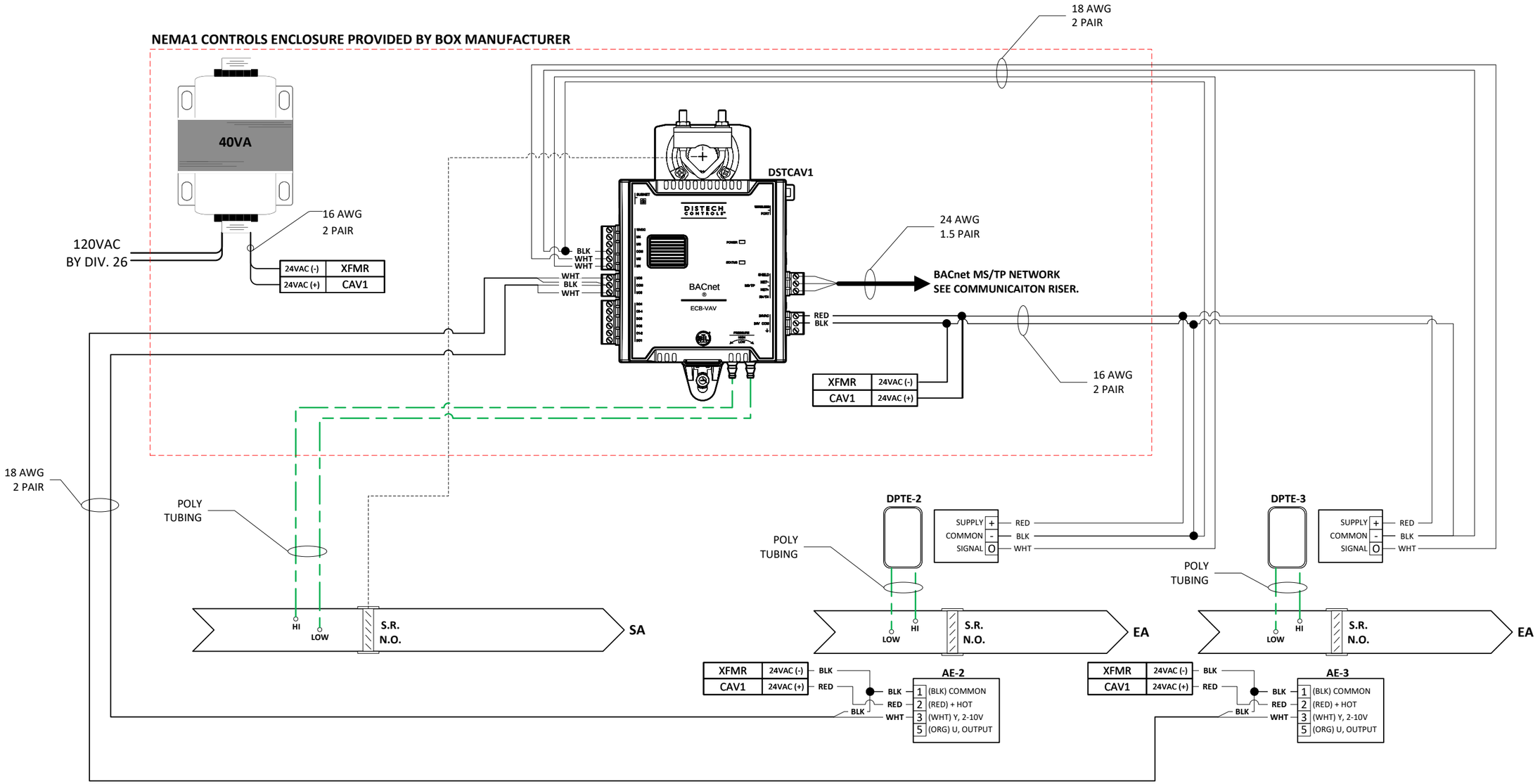
T:\PROJECTS\PR-002076 PIRELLI BLDG (MARCEL HOTEL)\07_JOB CLOSE OUT\O&M MANUALS\CONTROL DRAWING\PIRELLI BLDG_MEP15 CONTROLS APPLICATIONS DRAWING_RECORD.VSD

MARCEL HOTEL (PIRELLI BLDG)
ERV VAV DEMAND CONTROLLED VENTILATION (CO2) SEQUENCE & BOM
LOCATION: NEW HAVEN, CT
CONTROLS ENGINEER: DT
PROJECT MANAGER: TJ

MITSUBISHI ELECTRIC TRANE HVAC US
MITSUBISHI ELECTRIC TRANE HVAC US LLC
1340 SATELLITE BLVD.
SUWANEE, GA 30024
PHONE: (800) 433-4822
FAX: (800) 889-9904

NOTES:

1. REFER TO THE VAV PAIRING ON THE NEXT PAGE (PAGE 21).



ERV CONSTANT VOLUME VENTILATION

APPLICATION:
CORRIDORS, RESTROOMS, LOCKER ROOMS, LOBBIES

PROJECT NUMBER: PR-002076

LAST REVISION DATE: AUGUST 17, 2022

SHEET NUMBER: PAGE 20 OF 57

REV	DESCRIPTION	DATE	REVISED BY
1	RECORD DRAWING	8/17/2022	DT

MARCEL HOTEL (PIRELLI BLDG)

ERV CONSTANT VOLUME VENTILATION

LOCATION: NEW HAVEN, CT
CONTROLS ENGINEER: DT
PROJECT MANAGER: TJ

MITSUBISHI ELECTRIC TRANE HVAC US
MITSUBISHI ELECTRIC TRANE
HVAC US LLC
1340 SATELLITE BLVD.
SUWANEE, GA 30024
PHONE: (800) 433-4822
FAX: (800) 889-9904

Bill of Materials				
Ref. Tag	Description	Manufacturer	Model #	Qty
DSTCAV1	ECB-VAV, VAV CONTROLLER W/BUILT-IN DIFF PRESS TRANSDUCER	DISTECH	CDIB-VAXX-IMP	16
XFMR-CAV1	TRANSFORMER 40VA, 120 TO 24VAC	FUNCTIONAL DEVICES	TR40VA001	16
TT-1	COMMUNICATING ROOM TEMP, HUMIDITY, CO2 SENSOR	DISTECH	PDITE-SMRTVUCH-00	16
CBL-1	GENERIC PATCH CORD, CT5E, FT6, 100 FEET CABLE	DISTECH	CB-GPATCH5eFT6WH100	16
AE-2	DAMPER ACTUATOR, 22IN-LB, SR, 2-10V MODULATING	BELIMO	TFB24-SR	13
DPTE-2	MULTI RANGE DIFF PRESS TRANSDUCER, 0-10VDC	MAMAC	PR274-R2-VDC	13
AE-3	DAMPER ACTUATOR, 22IN-LB, SR, 2-10V MODULATING	BELIMO	TFB24-SR	1
DPTE-3	MULTI RANGE DIFF PRESS TRANSDUCER, 0-10VDC	MAMAC	PR274-R2-VDC	1

PIRELLI BLDG - VAV PAIRING

FLOOR	APPLICATION	SUPPLY VAV	EXHAUST VAV	
1	DSTCAV1	VS1-1	VE1-1	
1	DSTCAV1	VS1-2		
1	DSTCAV1		VE1-3	
1	DSTCAV1	VS1-3	VE1-4	
1	DSTCAV1	VS1-4	VE1-5	
2	DSTCAV1	VS2-3	VE2-3	
2	DSTCAV1	-	VE2-5	1
2	DSTCAV1	-	VE2-5A	1
5	DSTCAV1	VS5-3	-	
5	DSTCAV1	VS5-4	VE5-4	
5	DSTCAV1	VS5-5B	VE5-6	
6	DSTCAV1	VS6-3	VE6-3	
6	DSTCAV1	-	VE6-5	3
7	DSTCAV1	VS7-3	VE7-3	
7	DSTCAV1	-	VE7-5	3
8	DSTCAV1	VS8-3	VE8-3	
8	DSTCAV1	-	VE8-5	3
9	DSTCAV1	VS9-12	VE9-12	
9	DSTCAV1	VS9-13	VE9-13	2

NOTES:

1. VE2-5 & VE2-5A DEVICES WIRED TO DHW-2 DISTECH CONTROLLER. REFER TO THE DHW-2 DISTECH CONTROLLER WIRING ON PAGE 43.
2. VE9-13 DEVICES WIRED TO ERV-2 DISTECH CONTROLLER. REFER TO THE ERV-2 DISTECH CONTROLLER WIRING ON PAGE 16.
3. DISTECH VAV CONTROLLER MOUNTED AND WIRED TO EXHAUST VAV.

SEQUENCE OF OPERATION – ERV CONSTANT VOLUME VENTILATION

APPLICATIONS
- CORRIDORS
- RESTROOMS
- LOCKER ROOMS
- LOBBIES

START-UP
ERV WILL OPERATE CONTINUOUSLY.

CONSTANT VOLUME BOXES
THE CONSTANT VOLUME V.A.V. BOXES WILL MODULATE OPEN TO MAINTAIN CONSTANT DESIGN AIRFLOW. THE EXHAUST AIR VAV BOX WILL TRACK THE SUPPLY AIR VAV FOR BALANCED SYSTEM.

ALARM POINTS
- SUPPLY V.A.V. AIR VOLUME LOW
- EXHAUST V.A.V. AIR VOLUME LOW
- SUPPLY V.A.V. AIR VOLUME HIGH
- EXHAUST V.A.V. AIR VOLUME HIGH

ERV CONSTANT VOLUME VENTILATION
SEQUENCE OF OPERATION & BOM
APPLICATION:
CORRIDORS, RESTROOMS, LOCKER ROOMS, LOBBIES

PROJECT NUMBER: PR-002076
LAST REVISION DATE: AUGUST 17, 2022
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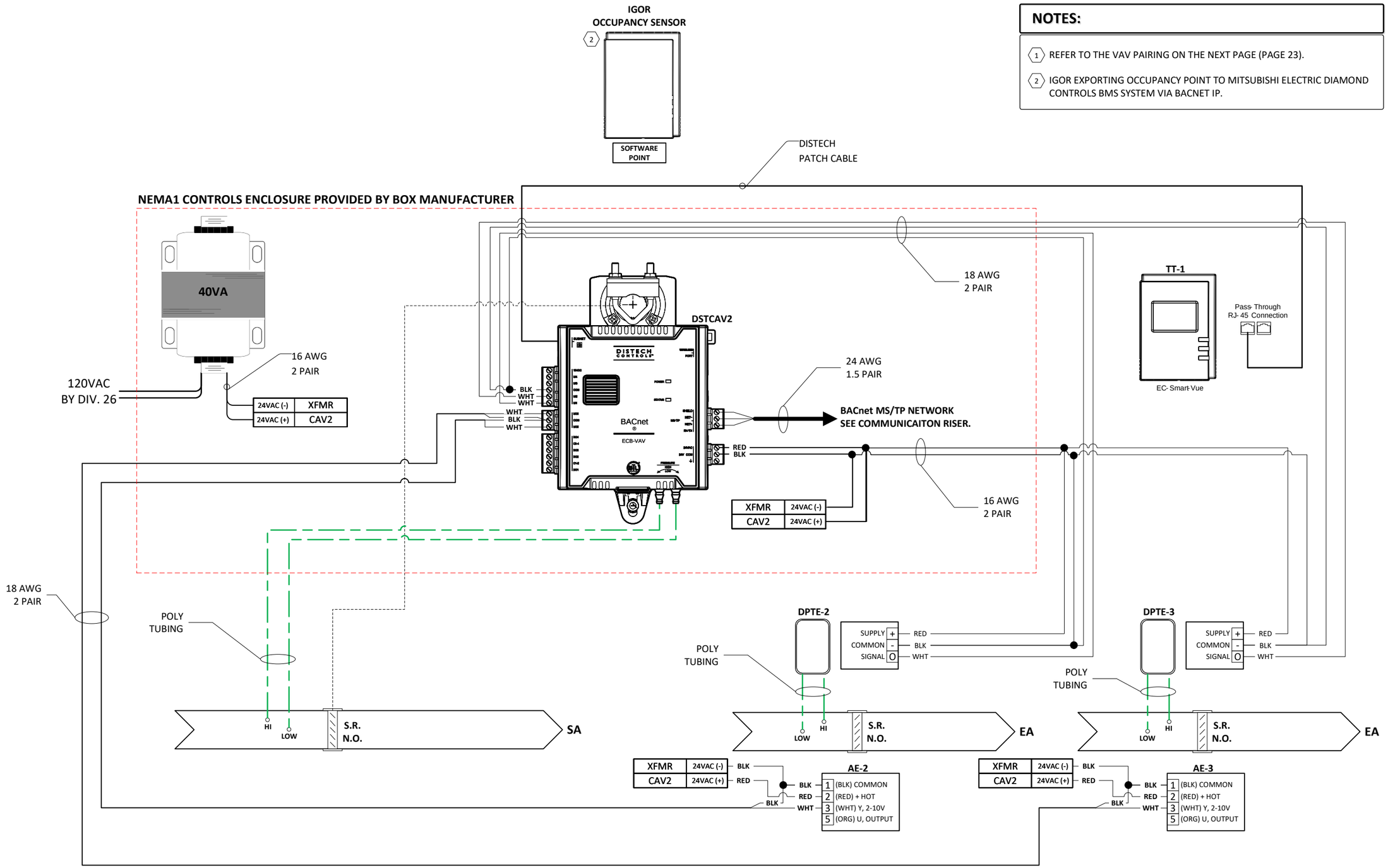
T:\PROJECTS\PR-002076 PIRELLI BLDG (MARCEL HOTEL)\07_JOB CLOSE OUT\O&M MANUALS\CONTROL DRAWING\PIRELLI BLDG_MEP15 CONTROLS APPLICATIONS DRAWING_RECORD.VSD

MARCEL HOTEL (PIRELLI BLDG)
ERV CONSTANT VOLUME VENTILATION SEQUENCE & BOM
LOCATION: NEW HAVEN, CT
CONTROLS ENGINEER: DT
PROJECT MANAGER: TJ

MITSUBISHI ELECTRIC TRANE HVAC US
MITSUBISHI ELECTRIC TRANE
HVAC US LLC
1340 SATELLITE BLVD.
SUWANEE, GA 30024
PHONE: (800) 433-4822
FAX: (800) 889-9904



NOTES:

1. REFER TO THE VAV PAIRING ON THE NEXT PAGE (PAGE 23).
2. IGOR EXPORTING OCCUPANCY POINT TO MITSUBISHI ELECTRIC DIAMOND CONTROLS BMS SYSTEM VIA BACNET IP.

ERV CONSTANT VOLUME VENTILATION W/ OCC SENSOR

APPLICATION:

CAFÉ 111, KITCHEN 112, SERVICE 124, FEMALE 901, MALE 902, KITCHEN 905

PROJECT NUMBER: PR-002076

LAST REVISION DATE: AUGUST 17, 2022

SHEET NUMBER: PAGE 22 OF 57

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REV	DESCRIPTION	DATE	REVISED BY
1	RECORD DRAWING	8/17/2022	DT

T:\PROJECTS\PR-002076 PIRELLI BLDG (MARCEL HOTEL)\07_JOB CLOSE OUT\O&M MANUALS\CONTROL DRAWING\PIRELLI BLDG_METUS CONTROLS APPLICATIONS DRAWING_RECORD.VSD

MARCEL HOTEL (PIRELLI BLDG)

ERV CONSTANT VOLUME VENTILATION W/ OCC SENSOR

LOCATION: NEW HAVEN, CT

CONTROLS ENGINEER: DT

PROJECT MANAGER: TJ

MITSUBISHI ELECTRIC TRANE HVAC US

MITSUBISHI ELECTRIC TRANE
HVAC US LLC
1340 SATELLITE BLVD.
SUWANEE, GA 30024
PHONE: (800) 433-4822
FAX: (800) 889-9904

Bill of Materials				
Ref. Tag	**Description**	**Manufacturer**	**Model #**	**Qty**
DSTCAV2	ECB-VAV, VAV CONTROLLER W/BUILT-IN DIFF PRESS TRANSDUCER	DISTECH	CDIB-VAXX-IMP	4
XFMR-CAV2	TRANSFORMER 40VA, 120 TO 24VAC	FUNCTIONAL DEVICES	TR40VA001	4
TT-1	COMMUNICATING ROOM TEMP, HUMIDITY, CO2 SENSOR	DISTECH	PDITE-SMRTVUCH-00	4
CBL-1	GENERIC PATCH CORD, CT5E, FT6, 100 FEET CABLE	DISTECH	CB-GPATCH5eFT6WH100	4
AE-2	DAMPER ACTUATOR, 22IN-LB, SR, 24V, 2-10V MODULATING	BELIMO	TFB24-SR	4
DPTE-2	MULTI RANGE DIFF PRESS TRANSDUCER, 0-10VDC	MAMAC	PR274-R2-VDC	4
AE-3	DAMPER ACTUATOR, 22IN-LB, SR, 24V, 2-10V MODULATING	BELIMO	TFB24-SR	1
DPTE-3	MULTI RANGE DIFF PRESS TRANSDUCER, 0-10VDC	MAMAC	PR274-R2-VDC	1

PIRELLI BLDG - VAV PAIRING			
FLOOR	**APPLICATION**	**SUPPLY VAV**	**EXHAUST VAV**
1	DSTCAV2	VS1-5	VE1-6
1	DSTCAV2		VE1-7
1	DSTCAV2	VS1-6	VE1-8
9	DSTCAV2	VS9-1	VE9-1
9	DSTCAV2	VS9-4	VE9-4

SEQUENCE OF OPERATION – ERV CONSTANT VOLUME VENTILATION

Applications

- Corridors
- Restrooms (See Sequence)
- Locker Rooms
- Lobbies
- Kitchens (See Sequence)

Startup:
ERV will operate continuously.

Constant Volume Boxes with Occupancy Sensor:
Controls system will monitor the occupancy sensors in the spaces listed to have occupancy sensors (and not indicated below). When there is no occupancy detected for 30 minutes (adj.) the corresponding supply and exhaust VAV boxes will reduce to their minimum flow values listed on the VAV schedules. When occupancy is sensed in the corresponding space, the supply and exhaust VAVs will open to deliver design airflow. See below for VE1-7 and VE1-8 Sequences:

VE1-7 Staff Café III: When no occupancy is detected in Staff Café III, VE1-7 is to reduce to 125 CFM (adj.) and the corresponding supply VAV VS1-5 is to reduce to 600 CFM (adj.).

VE1-8 Kitchen 112 (Occupied): When occupancy is detected in Kitchen 112, VE1-8 is to open to design airflow 2,000 CFM (adj.) and VS1-6 will open to 1,000 CFM (adj.), VS1-1 will open to 1,000 CFM (adj.) and VE1-1 will close to 0 CFM (adj.). If CO2 levels in Restaurant 103 exceed set point (900 PPM adj.) values, VS1-1 will increase flow to reduce 1,200 CFM (adj.) and VE1-1 will open to 200 CFM (adj.). VS1-1 will modulate up as necessary to reduce CO2 levels in the space and VE1-1 will modulate to match the flow of VS1-1 minus 1,000 CFM (adj.). When CO2 values have decreased and VS1-1 flow is to reduce below 1,200 CFM, VE1-1 will close and VS1-1 will close to 1,000 CFM and resume normal operation.

VE1-8 Kitchen 112 (Unoccupied): When no occupancy is detected in Kitchen 112, VE1-8 is to reduce to 500 CFM (adj.) and the corresponding supply VAV VS1-6 is to reduce to 500 CFM (adj.). VS1-1 will reduce to 510 CFM (adj.) and VE1-1 will match the flow of VS1-1. If CO2 levels rise above set point, VS1-1 will modulate up to 700 CFM (adj.). If after 10 minutes at this flow the CO2 values have not reduced, VE1-8 will open to 1,500 CFM (adj.) and VS1-1 will open to design flow of 1,700 CFM (adj.) until CO2 values have decreased. After CO2 has decreased, VE1-8 will return to 500 CFM (adj.) and VS1-1 will reduce to 700 CFM (adj.) and then continue reducing to 510 CFM (adj.) and VE1-1 will match VS1-1 flow.

ALARM POINTS

- SUPPLY V.A.V. AIR VOLUME LOW
- EXHAUST V.A.V. AIR VOLUME LOW
- SUPPLY V.A.V. AIR VOLUME HIGH
- EXHAUST V.A.V. AIR VOLUME HIGH
- SPACE CO2 LEVEL HIGH (1500 PPM ADJ)

ERV CONSTANT VOLUME VENTILATION W/ OCC SENSOR
SEQUENCE OF OPERATION & BOM
APPLICATION:
CAFÉ 111, KITCHEN 112, SERVICE 124, FEMALE 901, MALE 902, KITCHEN 905

PROJECT NUMBER: PR-002076
LAST REVISION DATE: AUGUST 17, 2022
SHEET NUMBER: PAGE 23 OF 57

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1	RECORD DRAWING	8/17/2022	DT

T:\PROJECTS\PR-002076 PIRELLI BLDG (MARCEL HOTEL)\07_JOB CLOSE OUT\O&M MANUALS\CONTROL DRAWING PIRELLI BLDG_METUS CONTROLS APPLICATIONS DRAWING_RECORD.VSD

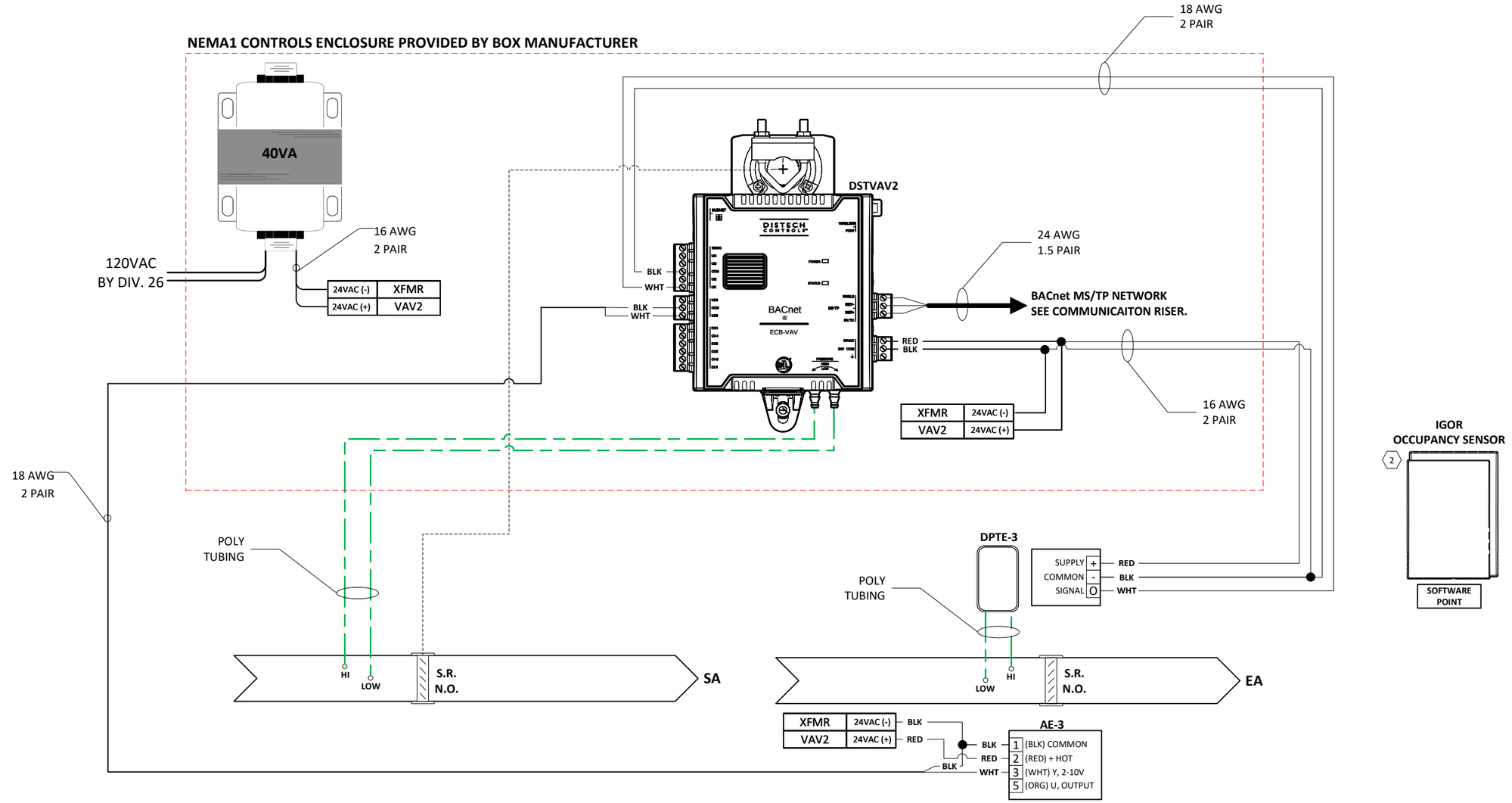
MARCEL HOTEL (PIRELLI BLDG)
ERV CONSTANT VOLUME VENTILATION W/ OCC SENSOR SEQUENCE & BOM

LOCATION: NEW HAVEN, CT
CONTROLS ENGINEER: DT
PROJECT MANAGER: TJ

MITSUBISHI ELECTRIC TRANE HVAC US
MITSUBISHI ELECTRIC TRANE HVAC US LLC
1340 SATELLITE BLVD.
SUWANEE, GA 30024
PHONE: (800) 433-4822
FAX: (800) 889-9904

NOTES:

1. REFER TO THE VAV PAIRING ON THE NEXT PAGE (PAGE 25).
2. IGOR EXPORTING OCCUPANCY POINT TO MITSUBISHI ELECTRIC DIAMOND CONTROLS BMS SYSTEM VIA BACNET IP.



ERV VAV DEMAND CONTROLLED VENTILATION

APPLICATION:
GUEST ROOMS

PROJECT NUMBER: PR-002076

LAST REVISION DATE: AUGUST 17, 2022

SHEET NUMBER: PAGE 24 OF 57

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1	RECORD DRAWING	8/17/2022	DT

T:\PROJECTS\PR-002076 PIRELLI BLDG (MARCEL HOTEL)\07_JOB CLOSE OUT\O&M MANUALS\CONTROL DRAWING\PIRELLI BLDG_METI'S CONTROLS APPLICATIONS DRAWING_RECORD.VSD

MARCEL HOTEL (PIRELLI BLDG)
ERV VAV DEMAND CONTROLLED VENTILATION

LOCATION: NEW HAVEN, CT
CONTROLS ENGINEER: DT
PROJECT MANAGER: TJ

MITSUBISHI ELECTRIC TRANE HVAC US

MITSUBISHI ELECTRIC TRANE
HVAC US LLC
1340 SATELLITE BLVD.
SUWANEE, GA 30024
PHONE: (800) 433-4822
FAX: (800) 889-9904

Ref. Tag	Description	Manufacturer	Model #	Qty
DSTVAV2	ECB-VAV, VAV CONTROLLER W/BUILT-IN DIFF PRESS TRANSDUCER	DISTECH	CDIB-VAXX-IMP	16
XFMR-VAV2	TRANSFORMER 40VA, 120 TO 24VAC	FUNCTIONAL DEVICES	TR40VA001	16
AE-1	DAMPER ACTUATOR, 22IN-LB, SR, 24V, 2-10V MODULATING	BELIMO	TFB24-SR	16
DPTE-1	MULTI RANGE DIFF PRESS TRANSDUCER, 0-10VDC	MAMAC	PR274-R2-VDC	16

PIRELLI BLDG - VAV PAIRING

FLOOR	APPLICATION	SUPPLY VAV	EXHAUST VAV
2	DSTVAV2	VS2-1	VE2-1
2	DSTVAV2	VS2-2	VE2-2
2	DSTVAV2	VS2-6	VE2-6
2	DSTVAV2	VS2-7	VE2-7
5	DSTVAV2	VS5-1	VE5-1
5	DSTVAV2	VS5-2	VE5-2
5	DSTVAV2	VS5-5	VE5-5
6	DSTVAV2	VS6-1	VE6-1
6	DSTVAV2	VS6-2	VE6-2
6	DSTVAV2	VS6-4	VE6-4
7	DSTVAV2	VS7-1	VE7-1
7	DSTVAV2	VS7-2	VE7-2
7	DSTVAV2	VS7-4	VE7-4
8	DSTVAV2	VS8-1	VE8-1
8	DSTVAV2	VS8-2	VE8-2
8	DSTVAV2	VS8-4	VE8-4

SEQUENCE OF OPERATION – ERV VAV

APPLICATIONS
- GUEST ROOMS

START-UP
ERV WILL OPERATE CONTINUOUSLY.

CONTROLS WILL PROVIDE A “BUTTON” ON THE GRAPHICS THAT ENABLES EITHER VARIABLE VOLUME OR CONSTANT VOLUME MODE FOR EACH TRACKING PAIR OF VAV BOXES. THE DEFAULT VALUE WILL BE CONSTANT VOLUME.

CONSTANT VOLUME MODE:
DURING CONSTANT VOLUME MODE, THE SUPPLY VAV WILL OPERATE AT DESIGN FLOW CONTINUOUSLY. THE CORRESPONDING EXHAUST VAV WILL TRACK THE SUPPLY VAV.

VARIALBE VOLUME MODE:

VARIABLE VOLUME BOXES (UNOCCUPIED OPERATION)
DURING UNOCCUPIED HOURS THE SUPPLY AND EXHAUST AIR V.A.V.’S WILL BE CLOSED TO LIMIT AIRFLOW TO 30% (+/-5%) OF DESIGN AIR FLOW VALUES.

VARIABLE VOLUME BOXES (OCCUPIED OPERATION)
WHERE MULTIPLE ZONES ARE SUPPORTED BY SINGLE VENTILATION AIR ZONE, OCCUPANCY SENSED IN ANY OF THE SPACES WITHIN THE VENTILATION ZONE WILL INITIATE AND OCCUPIED CONDITION.

DURING OCCUPIED HOURS, THE SUPPLY AIR AND EXHAUST AIR VENTILATION V.A.V.’S WILL OPEN TO 100% OF DESIGN AIRFLOW AND RUN CONTINUOUSLY. OPERATE IN OCCUPIED MODE FOR 60 MINUTES (ADJ.) AFTER LAST OCCUPANCY DETECTED.

ALARM POINTS
- SUPPLY V.A.V. AIR VOLUME LOW
- EXHAUST V.A.V. AIR VOLUME LOW

ERV VAV DEMAND CONTROLLED VENTILATION
SEQUENCE OF OPERATION & BOM
APPLICATION:
GUEST ROOMS

PROJECT NUMBER: PR-002076
LAST REVISION DATE: AUGUST 17, 2022
SHEET NUMBER: PAGE 25 OF 57

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1	RECORD DRAWING	8/17/2022	DT

MARCEL HOTEL (PIRELLI BLDG)
ERV VAV DEMAND CONTROLLED VENTILATION SEQUENCE & BOM
LOCATION: NEW HAVEN, CT
CONTROLS ENGINEER: DT
PROJECT MANAGER: TJ

MITSUBISHI ELECTRIC TRANE HVAC US
MITSUBISHI ELECTRIC TRANE
HVAC US LLC
1340 SATELLITE BLVD.
SUWANEE, GA 30024
PHONE: (800) 433-4822
FAX: (800) 889-9904

SEQUENCE OF OPERATION – ELEVATOR PRESSURIZATION CONTROL

SUPPLY FANS (EPF-1, 2 & 3) SERVING THE ELEVATOR SHAFT WILL BE UTILIZED FOR SHAFT PRESSURIZATION IN THE EVENT OF A FIRE. THE FANS WILL BE DDC CONTROLLED USING ELECTRONIC ACTUATION AND INTERLOCK WITH THE BUILDING FIRE ALARM SYSTEM WITH HARDWIRED SIGNALS. THE EQUIPMENT WILL OPERATE AS FOLLOWS:

WHEN THE SMOKE CONTROL SYSTEM IS ACTIVATED, THE BMS IS TO SEND A SUPERVISORY SIGNAL TO THE FIRE ALARM SYSTEM INDICATING THAT THE SYSTEM IS ACTIVE. THE FIRE ALARM SYSTEM WILL SEND A SIGNAL TO THE BMS TO ACTIVATE THE PRESSURIZATION SYSTEM IN THE EVENT OF A FIRE (SEE CONTINUED SEQUENCE BELOW). IF THERE IS A COMPONENT FAILURE BY ANY OF THE PRESSURIZATION SYSTEMS, THE BMS IS TO SEND A TROUBLE ALARM TO THE FIRE ALARM SYSTEM.

IN THE EVENT OF A FIRE THE BUILDING MANAGEMENT SYSTEM WILL RECEIVE A SIGNAL FROM THE FIRE ALARM SYSTEM THAT WILL BE HARDWIRED TO ENABLE THE FANS. THE CONTROL SIGNAL WILL COMMAND ALL OUTDOOR AIR DAMPERS OPEN. ONCE CONFIRMED OPEN VIA DAMPER SHAFT POSITION SENSORS, THE RESPECTIVE FANS WILL BE ENABLED.

THE FAN SPEEDS WILL BE CONTROLLED BY THE BUILDING MANAGEMENT SYSTEM TO MAINTAIN THE WORST CASE ELEVATOR SHAFT DIFFERENTIAL PRESSURE AT A MINIMUM OF 0.10 IN W.C. (ADJ.). THE BMS WILL MONITOR THE STATIC PRESSURE TRANSMITTERS AND IF ANYONE IS FAILED, IT WILL EXCLUDE THAT READING FROM THE CONTROL ALGORITHM. IF ALL STATIC PRESSURE TRANSMITTERS ARE FAILED, THE BMS WILL SET THE FAN SPEED DETERMINED BY THE BALANCING CONTRACTOR.

THE FOLLOWING CONTROL SIGNALS WILL BE MONITORED BY THE DDC CONTROL SYSTEM AND TRANSMITTED TO THE BUILDING FIRE ALARM SYSTEM:
- FAN RUN STATUS VIA CURRENT SENSORS INSTALLED ON THE LOAD SIDE OF EACH OF THE VFDS.
- FAN TROUBLE STATUS VIA VFD FAULTS OR LOSS OF CURRENT THROUGH CURRENT SENSORS DURING A CALL FOR OPERATION.
- OA DAMPER ACTUATOR POWER STATUS VIA A RELAY THAT IS ENERGIZED WHEN POWER IS SENT TO THE ACTUATORS.
- OA DAMPER POSITION VIA SHAFT POSITION SENSORS INDEPENDENT OF DAMPER ACTUATOR END SWITCHES. SIGNALS TO BE SENT TO THE FIRE ALARM SYSTEM WHEN THE DAMPER IS GREATER THAN 90% OPEN AND WHEN THE DAMPER IS LESS THAN 10% OPEN.

THE FOLLOWING FIRE ALARM SIGNALS WILL BE TRANSMITTED TO THE BUILDING MANAGEMENT SYSTEM:
- ACTIVE FIRE ALARM CONDITION – PRESSURIZATION SYSTEM WILL BE STARTED.
- SUPPLY FAN TEST – A MOMENTARY INPUT WILL INITIATE THE WEEKLY TESTING OF THE PRESSURIZATION SYSTEM. THE BMS WILL DISABLE THE SYSTEM AFTER AN ADJUSTABLE TIME DELAY.
- HOA SWITCH IN THE OFF POSITION.
- HOA SWITCH IN THE AUTO POSITION.
- HOA SWITCH IN THE HAND POSITION.

FIRE COMMAND PANEL SMOKE CONTROL SYSTEM OVERRIDE

A HAND-OFF-AUTO SWITCH WILL BE LOCATED AT THE FIRE ALARM COMMAND PANEL TO MANUALLY OVERRIDE THE SYSTEM ON WHEN IN "HAND" POSITION AND OFF WHEN IN "OFF" POSITION. THE BMS WILL RECEIVE AN INPUT SIGNAL FOR EACH SWITCH POSITION. THE HAND-OFF-AUTO INPUT SIGNALS TO THE BMS WILL BE HARDWIRED TO OVERRIDE ANY ON/OFF COMMANDS BY THE BMS.

THE FOLLOWING VISUAL STATUS INDICATORS WILL BE INSTALLED AT THE FIRE ALARM COMMAND CENTER:
- WHITE = FANS, DAMPERS AND OTHER OPERATING EQUIPMENT IN "NORMAL" STATUS.
- RED = FANS, DAMPERS AND OTHER OPERATING EQUIPMENT IN "OFF" OR "CLOSED" STATUS.
- GREEN = FANS, DAMPERS AND OTHER OPERATING EQUIPMENT IN "ON" OR "OPEN" STATUS.
- YELLOW/AMBER = FANS, DAMPERS AND OTHER OPERATING EQUIPMENT IN "FAULT" STATUS

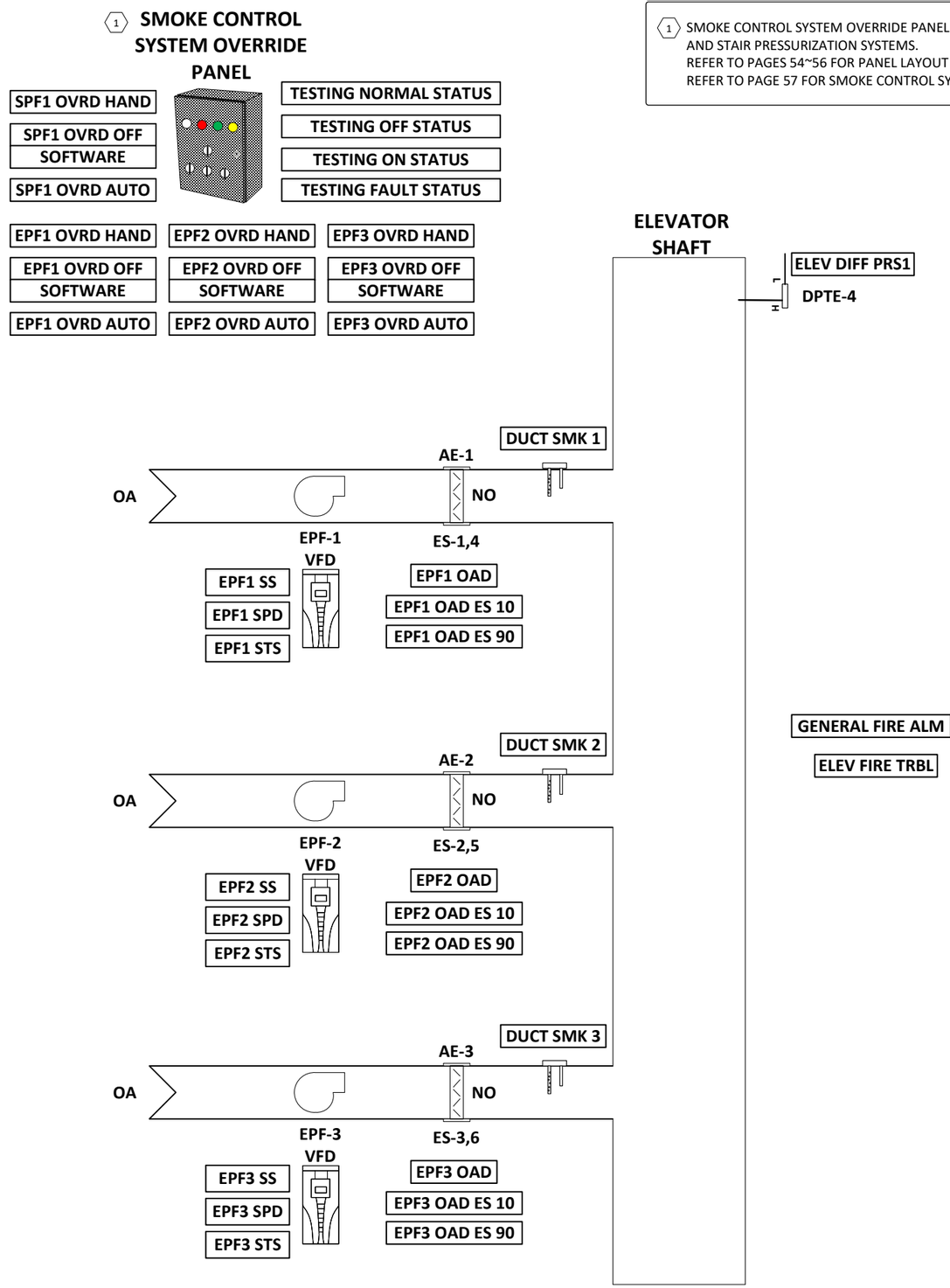
WEEKLY SYSTEM TEST

THE FIRE ALARM CONTROL PANEL WILL HAVE THE ABILITY TO MANUALLY INITIATE A SYSTEM TEST. THE BMS WILL RECEIVE AN INPUT SIGNAL THE FIRE ALARM SYSTEM AND THE BMS WILL ENABLE THE FAN SYSTEM AND LET IT RUN FOR A SET AMOUNT OF TIME (ADJ.). SHOULD THE FAN NOT START OR THE DAMPER FAIL TO OPEN, THE BMS AND FIRE ALARM SYSTEM WILL RECEIVE AN ALARM. THE BMS WILL HAVE THE ABILITY TO SCHEDULE THE WEEKLY TEST INDEPENDENTLY OF THE FIRE ALARM SYSTEM.

ALARM POINTS

ALL BMS ALARMS WILL HAVE THE ABILITY TO BE SENT DIRECTLY TO EMAIL ACCOUNTS OR TEXT MESSAGES.

FIRE MARSHALL REQUESTED THAT EACH FAN HAVE AN INDIVIDUAL SMOKE DETECTOR TO BE INTERLOCKED WITH OPERATION. THESE ARE DESIGNATED AS DUCTSMOKE1-3.



ELEVATOR PRESSURIZATION SYSTEM LAYOUT

NOTES:

1. SMOKE CONTROL SYSTEM OVERRIDE PANEL CONTROLS BOTH ELEVATOR AND STAIR PRESSURIZATION SYSTEMS.
   REFER TO PAGES 54~56 FOR PANEL LAYOUT AND WIRING.
   REFER TO PAGE 57 FOR SMOKE CONTROL SYSTEM RISER.

PROJECT NUMBER: PR-002076

LAST REVISION DATE: AUGUST 17, 2022

SHEET NUMBER: PAGE 26 OF 57

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T:\PROJECTS\PR-002076 PIRELLI BLDG (MARCEL HOTEL)\07_ADB CLOSE OUT\O&M MANUALS\CONTROL DRAWING\PIRELLI BLDG_PIETIS CONTROLS APPLICATIONS DRAWING_RECORD.VSD

MARCEL HOTEL (PIRELLI BLDG)
ELEVATOR PRESSURIZATION SYSTEM LAYOUT

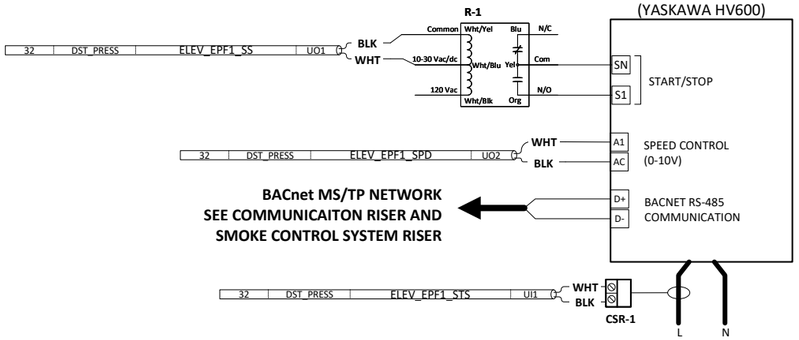
LOCATION: NEW HAVEN, CT
CONTROLS ENGINEER: DT
PROJECT MANAGER: TJ

MITSUBISHI ELECTRIC TRANE HVAC US

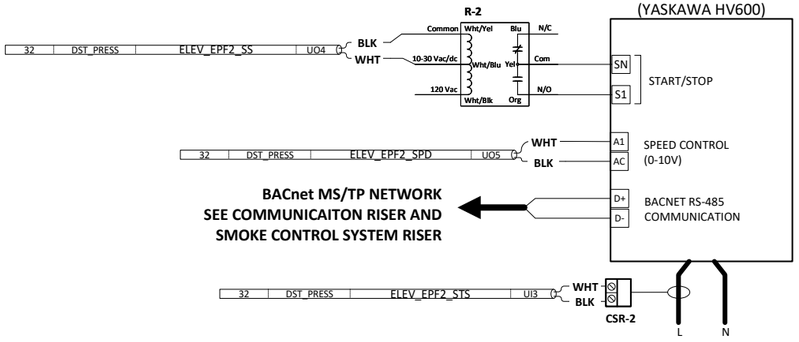
MITSUBISHI ELECTRIC TRANE
HVAC US LLC
1340 SATELLITE BLVD.
SUWANEE, GA 30024
PHONE: (800) 433-4822
FAX: (800) 889-9904

Bill of Materials				
Ref. Tag	**Description**	**Manufacturer**	**Model #**	**Qty**
AE-1~3	DAMPER ACTUATOR, 180IN/LB, SR, 24VAC, 2-10VDC	BELIMO	AFB24-SR	3
CSR-1~3	CURRENT SWITCH, FIXED 0.35A TRIP POINT, SPLIT CORE	FUNCTIONAL DEVICES	RIBXGTF	3
ES-1~6	NON-MERCURY DAMPER SWITCH, SPDT, 1/2" DAMPER SHAFT	KELE	TS-475	6
R-1~3	ENCLOSED RELAY 10A SPDT W/10-30 VAC/DC/120VAC COIL	FUNCTIONAL DEVICES	RIBU1C	3

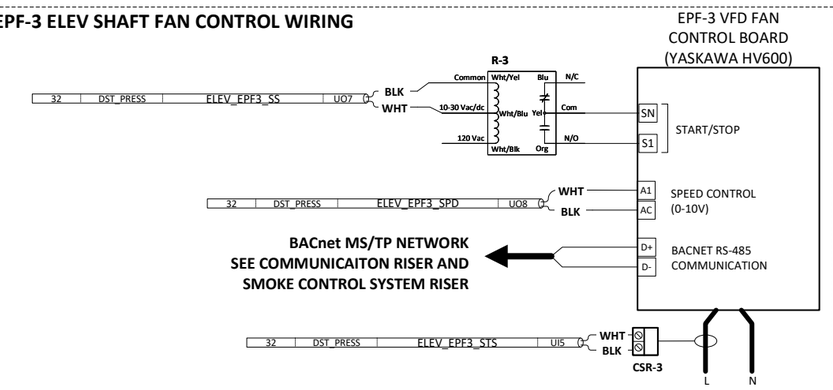
EPF-1 ELEV SHAFT FAN CONTROL WIRING



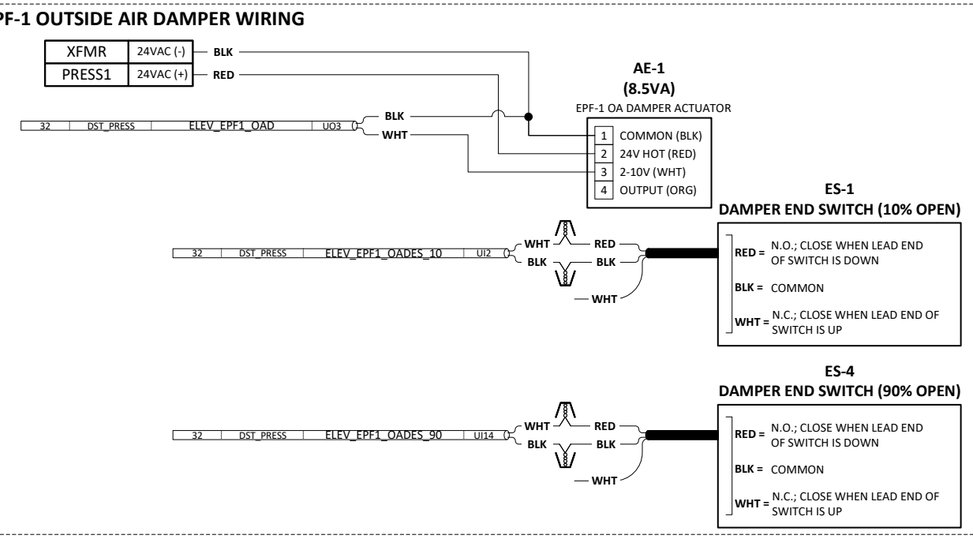
EPF-2 ELEV SHAFT FAN CONTROL WIRING



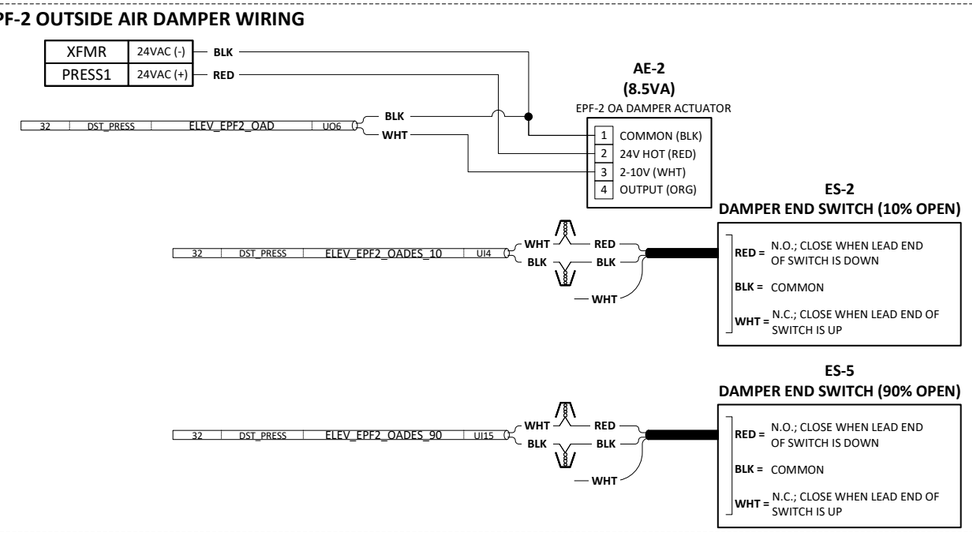
EPF-3 ELEV SHAFT FAN CONTROL WIRING



EPF-1 OUTSIDE AIR DAMPER WIRING



EPF-2 OUTSIDE AIR DAMPER WIRING



ELEVATOR PRESSURIZATION SYSTEM WIRING (1 OF 2)

PROJECT NUMBER: PR-002076

LAST REVISION DATE: AUGUST 17, 2022

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REVISIONS			
REV	DESCRIPTION	DATE	REVISED BY
1	RECORD DRAWING	8/17/2022	DT

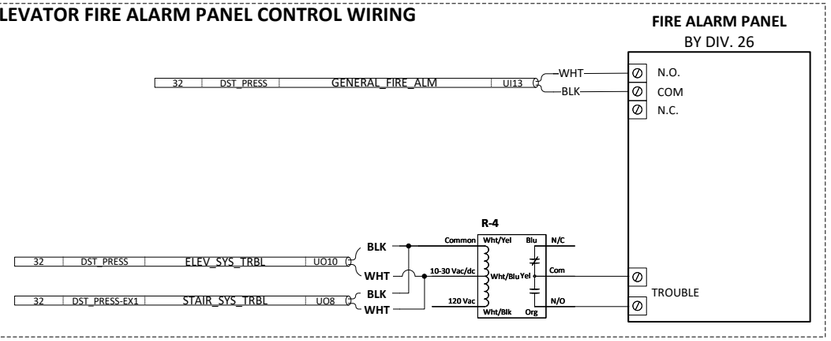
MARCEL HOTEL (PIRELLI BLDG)
ELEVATOR PRESSURIZATION SYSTEM WIRING (1 OF 2)

LOCATION: NEW HAVEN, CT
CONTROLS ENGINEER: DT
PROJECT MANAGER: TJ

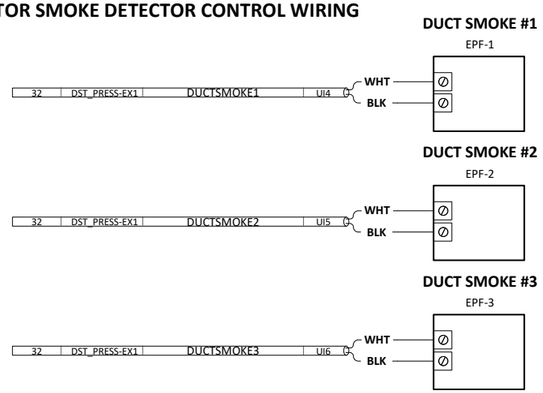
MITSUBISHI ELECTRIC TRANE HVAC US
MITSUBISHI ELECTRIC TRANE HVAC US LLC
1340 SATELLITE BLVD.
SUWANEE, GA 30024
PHONE: (800) 433-4822
FAX: (800) 889-9904

Bill of Materials				
Ref. Tag	**Description**	**Manufacturer**	**Model #**	**Qty**
DPTE-4	DIFF PRS XMTR, 0-1"WC, +/-0.5"WC, 4-20MA, NO LCD, WALL	MAMAC	PR274-R2-MA	1
	DUCT STATIC PRS TIP, 1/4" COMPRESSION	KELE	A-301-K	1
R-4	ENCLOSED RELAY 10A SPDT W/10-30 VAC/DC/120VAC COIL	FUNCTIONAL DEVICES	RIBU1C	1

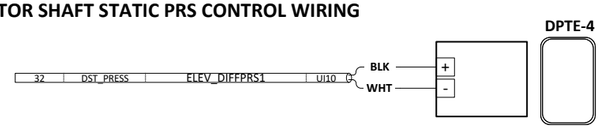
ELEVATOR FIRE ALARM PANEL CONTROL WIRING



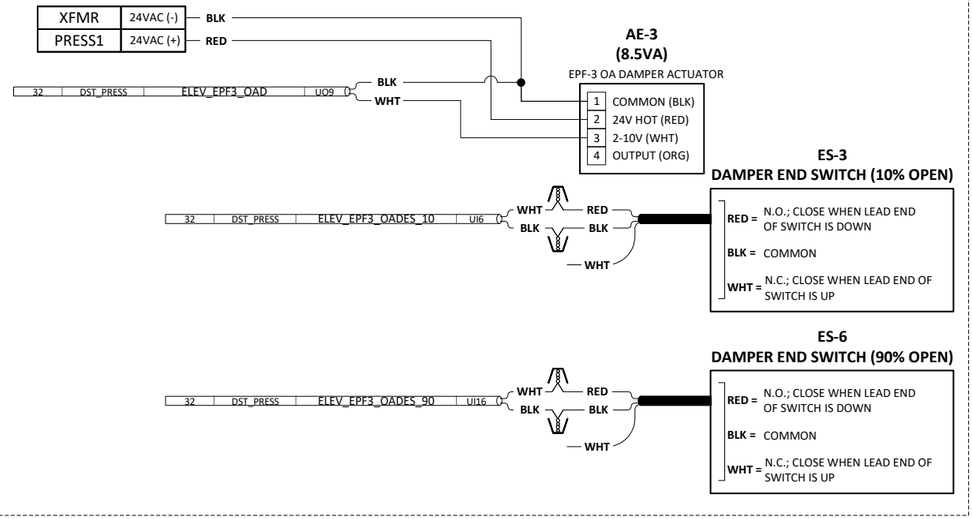
ELEVATOR SMOKE DETECTOR CONTROL WIRING



ELEVATOR SHAFT STATIC PRS CONTROL WIRING



EPF-3 OUTSIDE AIR DAMPER WIRING



ELEVATOR PRESSURIZATION SYSTEM
WIRING (2 OF 2)

PROJECT NUMBER: PR-002076

LAST REVISION DATE: AUGUST 17, 2022

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REVISIONS			
REV	DESCRIPTION	DATE	REVISED BY
1	RECORD DRAWING	8/17/2022	DT

MARCEL HOTEL (PIRELLI BLDG)
ELEVATOR PRESSURIZATION SYSTEM
WIRING (2 OF 2)

LOCATION: NEW HAVEN, CT
CONTROLS ENGINEER: DT
PROJECT MANAGER: TJ

MITSUBISHI ELECTRIC TRANE HVAC US
MITSUBISHI ELECTRIC TRANE
HVAC US LLC
1340 SATELLITE BLVD.
SUWANEE, GA 30024
PHONE: (800) 433-4822
FAX: (800) 889-9904

SEQUENCE OF OPERATION – STAIR PRESSURIZATION CONTROL

SUPPLY FAN (SPF-1) SERVING STAIRWELL #2 WILL BE UTILIZED FOR STAIRWAY PRESSURIZATION IN THE EVENT OF A FIRE. THE FAN WILL BE DDC CONTROLLED USING ELECTRIC ACTUATION AND INTERLOCK WITH THE BUILDING FIRE ALARM SYSTEM WITH HARDWIRED SIGNALS. THE EQUIPMENT WILL OPERATE AS FOLLOWS:

WHEN THE SMOKE CONTROL SYSTEM IS ACTIVATED, THE BMS IS TO SEND A SUPERVISORY SIGNAL TO THE FIRE ALARM SYSTEM INDICATING THAT THE SYSTEM IS ACTIVE. THE FIRE ALARM SYSTEM WILL SEND A SIGNAL TO THE BMS TO ACTIVATE THE PRESSURIZATION SYSTEM IN THE EVENT OF A FIRE (SEE CONTINUED SEQUENCE BELOW). IF THERE IS A COMPONENT FAILURE BY ANY OF THE PRESSURIZATION SYSTEMS, THE BMS IS TO SEND A TROUBLE ALARM TO THE FIRE ALARM SYSTEM.

IN THE EVENT OF A FIRE THE BUILDING MANAGEMENT SYSTEM WILL RECEIVE A SIGNAL FROM THE FIRE ALARM SYSTEM THAT WILL BE HARDWIRED TO ENABLE THE FANS. THE CONTROL SIGNAL WILL COMMAND ALL OUTDOOR AIR DAMPERS OPEN. ONCE CONFIRMED OPEN VIA END SWITCH, THE FAN WILL BE ENABLED.

THE FAN SPEED WILL BE CONTROLLED BY THE BUILDING MANAGEMENT SYSTEM TO MAINTAIN THE WORST CASE STAIRWELL DIFFERENTIAL PRESSURE AT A MINIMUM OF 0.10 IN W.C. (ADJ.). THE BMS WILL MONITOR THE STATIC PRESSURE TRANSMITTERS AND IF ANYONE IS FAILED, IT WILL EXCLUDE THAT READING FROM THE CONTROL ALGORITHM. IF ALL STATIC PRESSURE TRANSMITTERS ARE FAILED, THE BMS WILL SET THE FAN SPEED DETERMINED BY THE BALANCING CONTRACTOR.

THE FOLLOWING CONTROL SIGNALS WILL BE MONITORED BY THE DDC CONTROL SYSTEM AND TRANSMITTED TO THE BUILDING FIRE ALARM SYSTEM:
- FAN RUN STATUS VIA CURRENT SENSORS INSTALLED ON THE LOAD SIDE OF THE VFD.
- FAN TROUBLE STATUS VIA VFD FAULTS OR LOSS OF CURRENT THROUGH CURRENT SENSORS DURING A CALL FOR OPERATION.
- OA DAMPER ACTUATOR POWER STATUS VIA A RELAY THAT IS ENERGIZED WHEN POWER IS SENT TO THE ACTUATORS.
- OA DAMPER POSITION VIA SHAFT POSITION SENSORS INDEPENDENT OF DAMPER ACTUATOR END SWITCHES. SIGNALS TO BE SENT TO THE FIRE ALARM SYSTEM WHEN THE DAMPER IS GREATER THAN 90% OPEN AND WHEN THE DAMPER IS LESS THAN 10% OPEN.

THE FOLLOWING FIRE ALARM SIGNALS WILL BE TRANSMITTED TO THE BUILDING MANAGEMENT SYSTEM:
- ACTIVE FIRE ALARM CONDITION – PRESSURIZATION SYSTEM WILL BE STARTED.
- SUPPLY FAN TEST – A MOMENTARY INPUT WILL INITIATE THE WEEKLY TESTING OF THE PRESSURIZATION SYSTEM. THE BMS WILL DISABLE THE SYSTEM AFTER AN ADJUSTABLE TIME DELAY.
- HOA SWITCH IN THE OFF POSITION.
- HOA SWITCH IN THE AUTO POSITION.
- HOA SWITCH IN THE HAND POSITION.

FIRE COMMAND PANEL SMOKE CONTROL SYSTEM OVERRIDE

A HAND-OFF-AUTO SWITCH WILL BE LOCATED AT THE FIRE ALARM COMMAND PANEL TO MANUALLY OVERRIDE THE SYSTEM ON WHEN IN "HAND" POSITION AND OFF WHEN IN "OFF" POSITION. THE BMS WILL RECEIVE AN INPUT SIGNAL FOR EACH SWITCH POSITION. THE HAND-OFF-AUTO INPUT SIGNALS TO THE BMS WILL BE HARDWIRED TO OVERRIDE ANY ON/OFF COMMANDS BY THE BMS.

THE FOLLOWING VISUAL STATUS INDICATORS WILL BE INSTALLED AT THE FIRE ALARM COMMAND CENTER:
- WHITE = FANS, DAMPERS AND OTHER OPERATING EQUIPMENT IN "NORMAL" STATUS.
- RED = FANS, DAMPERS AND OTHER OPERATING EQUIPMENT IN "OFF" OR "CLOSED" STATUS.
- GREEN = FANS, DAMPERS AND OTHER OPERATING EQUIPMENT IN "ON" OR "OPEN" STATUS.
- YELLOW/AMBER = FANS, DAMPERS AND OTHER OPERATING EQUIPMENT IN "FAULT" STATUS

WEEKLY SYSTEM TEST

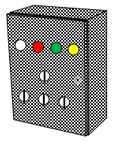
THE FIRE ALARM CONTROL PANEL WILL HAVE THE ABILITY TO MANUALLY INITIATE A SYSTEM TEST. THE BMS WILL RECEIVE AN INPUT SIGNAL THE FIRE ALARM SYSTEM AND THE BMS WILL ENABLE THE FAN SYSTEM AND LET IT RUN FOR A SET AMOUNT OF TIME (ADJ.). SHOULD THE FAN NOT START OR THE DAMPER FAIL TO OPEN, THE BMS AND FIRE ALARM SYSTEM WILL RECEIVE AN ALARM. THE BMS WILL HAVE THE ABILITY TO SCHEDULE THE WEEKLY TEST INDEPENDENTLY OF THE FIRE ALARM SYSTEM.

ALARM POINTS

ALL BMS ALARMS WILL HAVE THE ABILITY TO BE SENT DIRECTLY TO EMAIL ACCOUNTS OR TEXT MESSAGES.

FIRE MARSHALL REQUESTED THAT EACH FAN HAVE AN INDIVIDUAL SMOKE DETECTOR TO BE INTERLOCKED WITH OPERATION. THESE ARE DESIGNATED AS DUCTSMOKE4.

(1) **SMOKE CONTROL SYSTEM OVERRIDE PANEL**



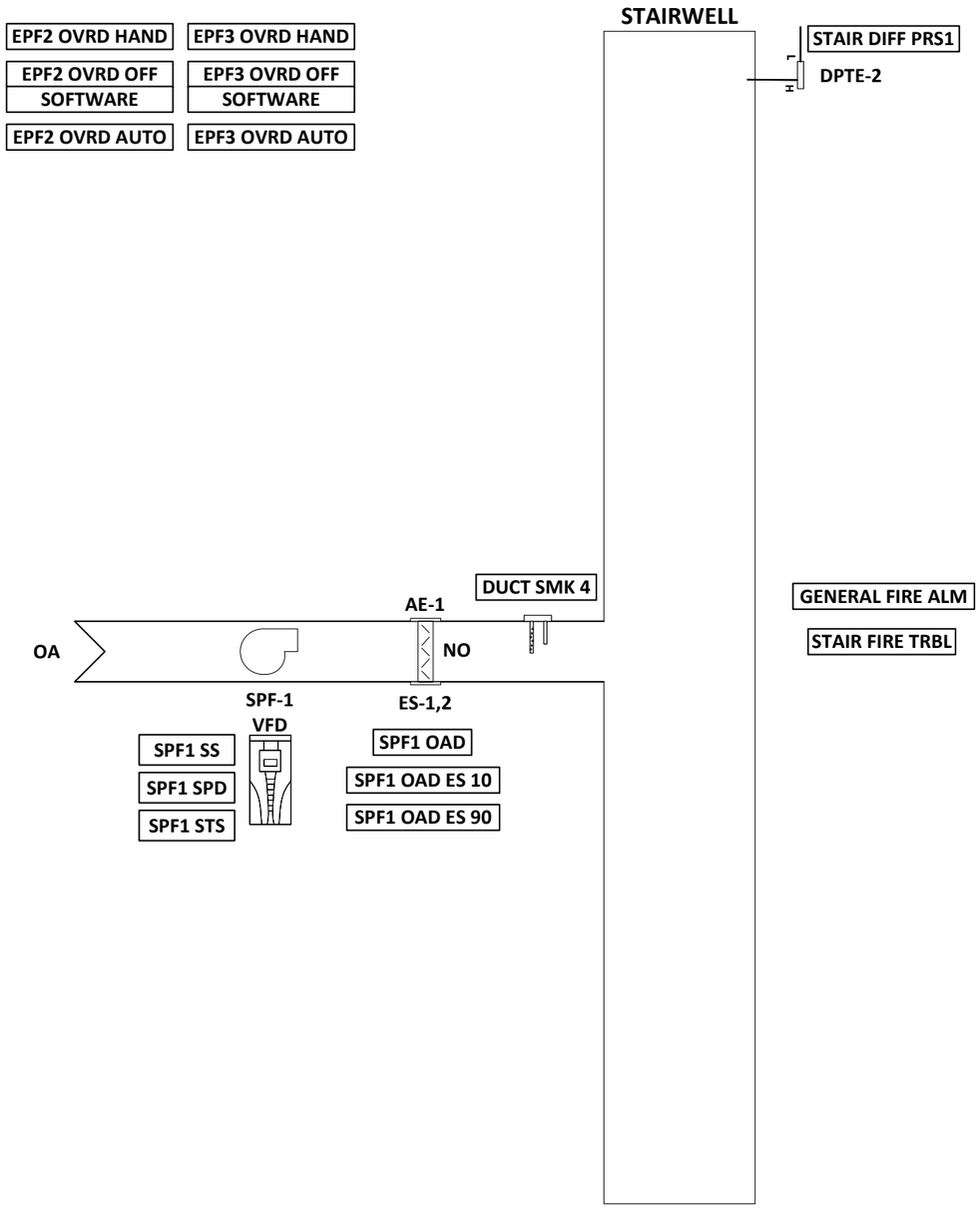
SPF1 OVRD HAND
SPF1 OVRD OFF SOFTWARE
SPF1 OVRD AUTO

TESTING NORMAL STATUS
TESTING OFF STATUS
TESTING ON STATUS
TESTING FAULT STATUS

EPF1 OVRD HAND | EPF2 OVRD HAND | EPF3 OVRD HAND
EPF1 OVRD OFF SOFTWARE | EPF2 OVRD OFF SOFTWARE | EPF3 OVRD OFF SOFTWARE
EPF1 OVRD AUTO | EPF2 OVRD AUTO | EPF3 OVRD AUTO

NOTES:

(1) SMOKE CONTROL SYSTEM OVERRIDE PANEL CONTROLS BOTH ELEVATOR AND STAIR PRESSURIZATION SYSTEMS.
REFER TO PAGES 54~56 FOR PANEL LAYOUT AND WIRING.
REFER TO PAGE 57 FOR SMOKE CONTROL SYSTEM RISER.



STAIR PRESSURIZATION SYSTEM LAYOUT

PROJECT NUMBER: PR-002076

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T:\PROJECTS\PR-002076 PIRELLI BLDG (MARCEL HOTEL)\07_JOB CLOSE OUT\O&M MANUALS\CONTROL DRAWING\PIRELLI BLDG_PIETIS CONTROLS APPLICATIONS DRAWING_RECORD.VSD

MARCEL HOTEL (PIRELLI BLDG)

STAIR PRESSURIZATION SYSTEM LAYOUT

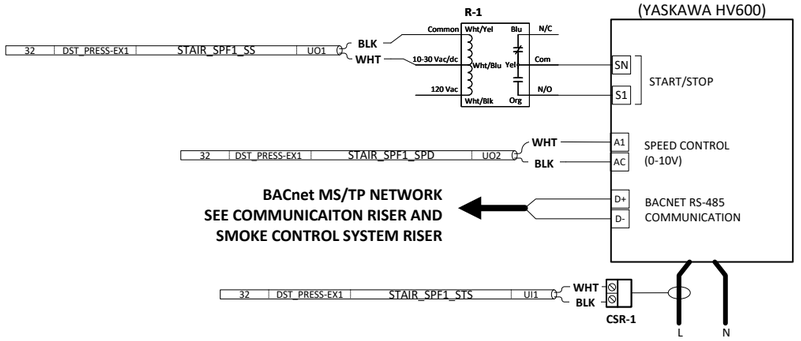
LOCATION: NEW HAVEN, CT
CONTROLS ENGINEER: DT
PROJECT MANAGER: TJ

MITSUBISHI ELECTRIC TRANE HVAC US

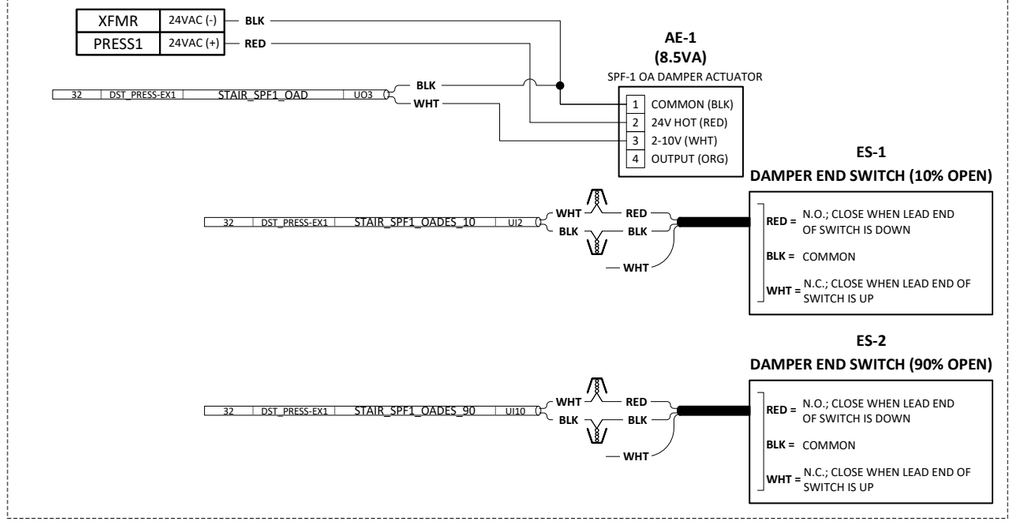
MITSUBISHI ELECTRIC TRANE
HVAC US LLC
1340 SATELLITE BLVD.
SUWANEE, GA 30024
PHONE: (800) 433-4822
FAX: (800) 889-9904

Bill of Materials				
Ref. Tag	**Description**	**Manufacturer**	**Model #**	**Qty**
AE-1	DAMPER ACTUATOR, 180IN/LB, SR, 24VAC, 2-10VDC	BELIMO	AFB24-SR	1
CSR-1	CURRENT SWITCH, FIXED 0.35A TRIP POINT, SPLIT CORE	FUNCTIONAL DEVICES	RIBXGTF	1
ES-1~2	NON-MERCURY DAMPER SWITCH, SPDT, 1/2" DAMPER SHAFT	KELE	TS-475	2
R-1	ENCLOSED RELAY 10A SPDT W/10-30 VAC/DC/120VAC COIL	FUNCTIONAL DEVICES	RIBU1C	1
DPTE-2	DIFF PRS XMTR, 0-1"WC, +/-0.5"WC, 4-20MA, NO LCD,WALL	MAMAC	PR274-R2-MA	1
	DUCT STATIC PRS TIP, 1/4" COMPRESSION	KELE	A-301-K	1

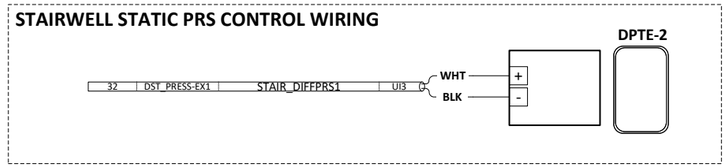
SPF-1 STAIRWELL FAN CONTROL WIRING



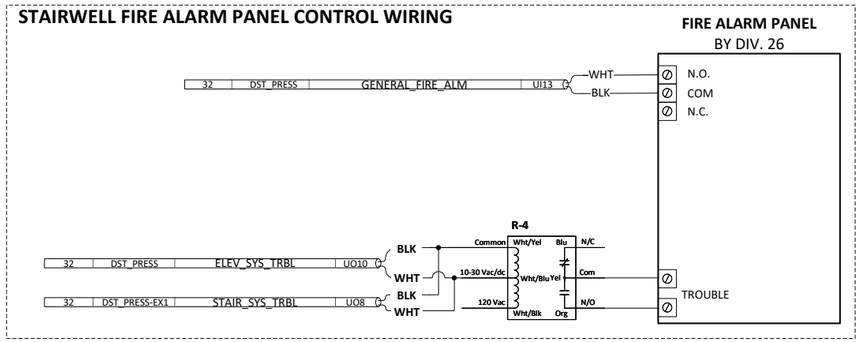
SPF-1 OUTSIDE AIR DAMPER WIRING



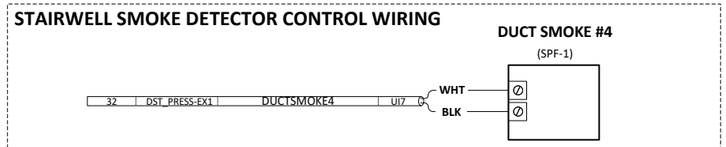
STAIRWELL STATIC PRS CONTROL WIRING



STAIRWELL FIRE ALARM PANEL CONTROL WIRING



STAIRWELL SMOKE DETECTOR CONTROL WIRING



STAIR PRESSURIZATION SYSTEM WIRING

PROJECT NUMBER: PR-002076

LAST REVISION DATE: AUGUST 17, 2022

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T:\PROJECTS\PR-002076 PIRELLI BLDG (MARCEL HOTEL)\07_JOB CLOSE OUT\O&M MANUALS\CONTROL DRAWING\PIRELLI BLDG_METUS CONTROLS APPLICATIONS DRAWING_RECORD.VSD

MARCEL HOTEL (PIRELLI BLDG)

STAIR PRESSURIZATION SYSTEM WIRING

LOCATION: NEW HAVEN, CT
CONTROLS ENGINEER: DT
PROJECT MANAGER: TJ

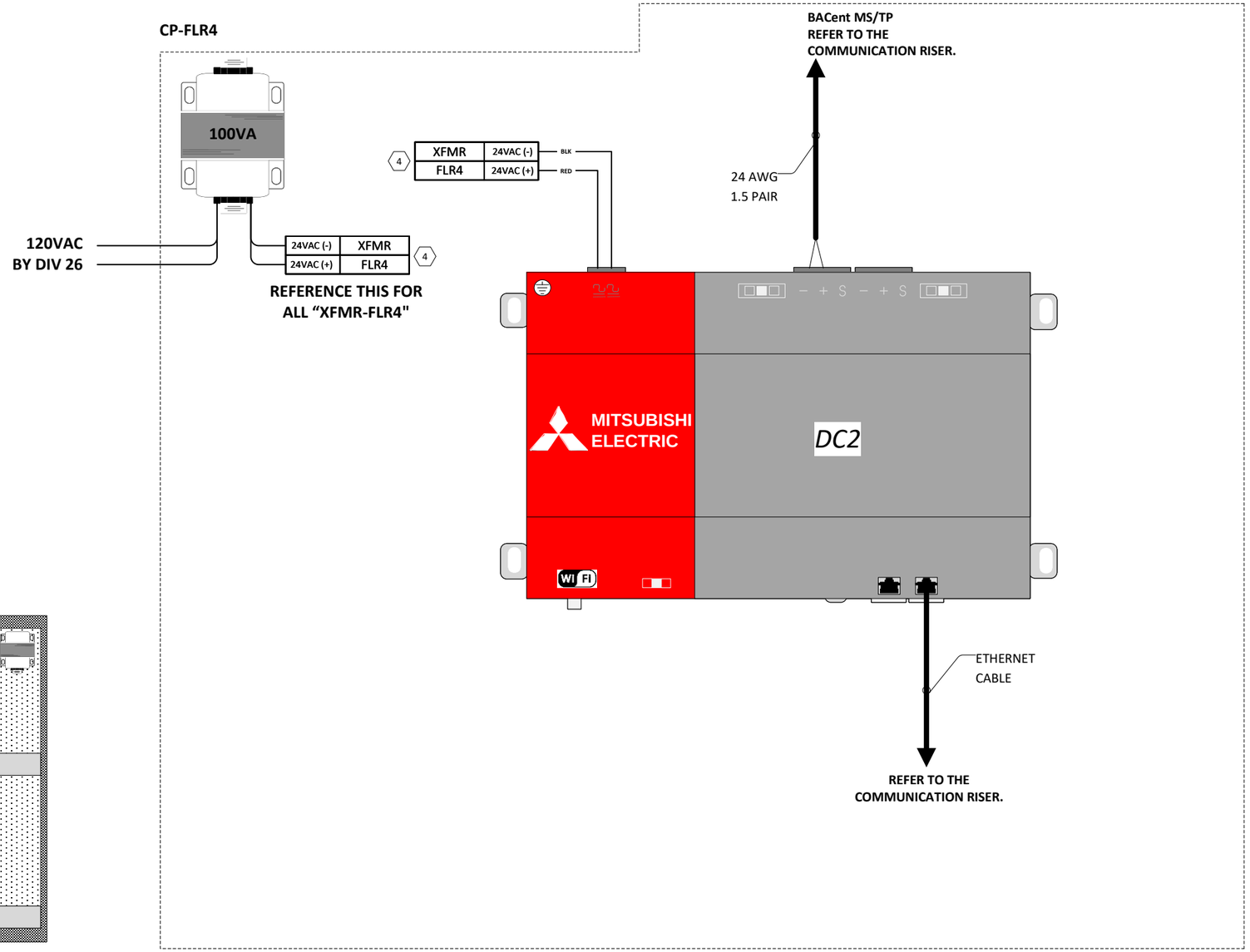
MITSUBISHI ELECTRIC TRANE HVAC US

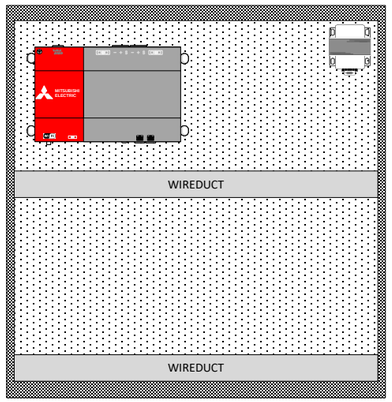
MITSUBISHI ELECTRIC TRANE
HVAC US LLC
1340 SATELLITE BLVD.
SUWANEE, GA 30024
PHONE: (800) 433-4822
FAX: (800) 889-9904

Bill of Materials				
Ref. Tag	**Description**	**Manufacturer**	**Model #**	**Qty**
CP-FLR4	24x24x8 NEMA1 ENCLOSURE W/PERF PANEL	HOFFMAN	A-24N24BLPP	1
DIN-FLR4	DIN RAIL ALUMINUM	KELE	BAM-1000	1
XFMR-FLR4	TRANSFORMER 100VA, 120 to 24VAC	FUNCTIONAL DEVICES	TR100VA001	1
DC2	DC-8000 CONTROLLER	METUS	DC-8000	1
	DC-8000 SD CARD	METUS	DC-8000-SD	1
	DC-8000 LICENSE FOR 25 DEVICES, 1250 POINTS	LYNXSPRING	DC-8000-LIC8025	1
	DC-8025 - INITIAL 18 MONTH MAINTENANCE	LYNXSPRING	DC-8025-SMA-1YR-INIT	1
	EC-NET SUPPORT PACK - 25 DEVICES, 1250 POINTS	DISTECH	SDIDI-ECNETSP-25	1
WIREDUCT	GRAY WIRE DUCT 1" X 1.5" X 6.5'	KELE	VD1-15G	1

NOTES:

1. REFER TO REFERENCE PAGE 7 (REF: DISTECH ECB WIRING DETAIL) FOR DETAILED IO WIRING.
2. LABEL WIRING ON BOTH ENDS IS REQUIRED. DOCUMENT WIRING LABELS FOR RECORD DRAWINGS.
3. WIRE SELECTION: 18 AWG – 2 PAIR
4. WIRE SELECTION: 16 AWG – 2 PAIR





PANEL

NOT DRAWING TO SCALE

4TH FLOOR DC-8000 CONTROLLER WIRING

PROJECT NUMBER: PR-002076

LAST REVISION DATE: AUGUST 17, 2022

SHEET NUMBER: PAGE 31 OF 57

REVISIONS			
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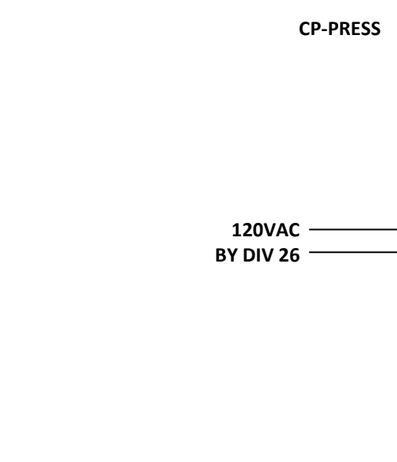
MARCEL HOTEL (PIRELLI BLDG)

4TH FLOOR DC-8000 CONTROLLER WIRING

LOCATION: NEW HAVEN, CT
CONTROLS ENGINEER: DT
PROJECT MANAGER: TJ

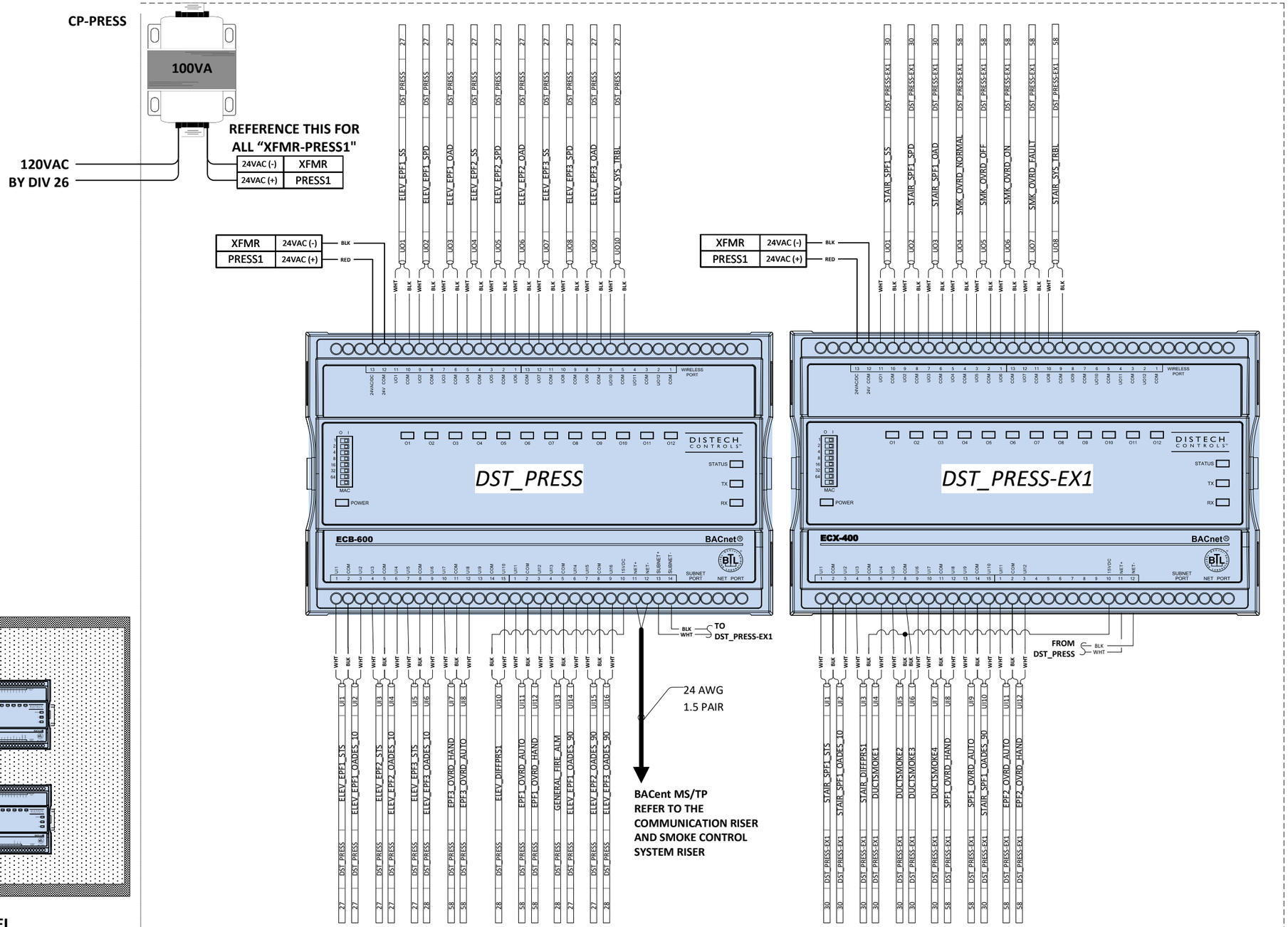
MITSUBISHI ELECTRIC TRANE HVAC US
MITSUBISHI ELECTRIC TRANE
HVAC US LLC
1340 SATELLITE BLVD.
SUWANEE, GA 30024
PHONE: (800) 433-4822
FAX: (800) 889-9904

Bill of Materials				
Ref. Tag	**Description**	**Manufacturer**	**Model #**	**Qty**
CP-PRESS	NEMA 4X FIBER GLASS 16X14 ENCLOSURE W/PERF	VYNCKIER	RVJ1614HW-P	1
DIN-PRESS	DIN RAIL ALUMINUM	KELE	BAM-1000	1
DST_PRESS	ECB-600; 16UI and 12UO POINTS; UL 834 UUKL	DISTECH	CDIB-600U-00	1
DST_PRESS-EX1	ECX-400; 12UI and 12UO POINTS; UL 834 UUKL	DISTECH	CDIX-400U-00	1
XFMR-PRESS1	TRANSFORMER 100VA, 120 to 24VAC	FUNCTIONAL DEVICES	TR100VA001	1



PANEL

NOT DRAWING TO SCALE



ELEVATOR & STAIR PRESSURIZATION SYSTEM DISTECH CONTROLLER WIRING

REVISIONS			
REV	DESCRIPTION	DATE	REVISED BY
1	RECORD DRAWING	8/17/2022	DT

PROJECT NUMBER: PR-002076

LAST REVISION DATE: AUGUST 17, 2022

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MARCEL HOTEL (PIRELLI BLDG)
ELEV & STAIR PRESS SYSTEM DISTECH CONTROLLER WIRING

LOCATION: NEW HAVEN, CT
CONTROLS ENGINEER: DT
PROJECT MANAGER: TJ

MITSUBISHI ELECTRIC TRANE HVAC US

MITSUBISHI ELECTRIC TRANE HVAC US LLC
1340 SATELLITE BLVD.
SUWANEE, GA 30024
PHONE: (800) 433-4822
FAX: (800) 889-9904

SEQUENCE OF OPERATION – DOMESTIC HOT WATER FLOW

CONTROLS SYSTEM TO CONNECT TO THE WATER METERS TO MONITOR DOMESTIC WATER. THE GRAPHICS WILL DISPLAY THE TOTAL FLOW (CONSUMPTION) OVER A SPECIFIC PERIOD OF TIME (CURRENT CALENDAR MONTH) AND INSTANTANEOUS RATE AND SHOW TOTAL USAGE. THE OWNER/OPERATOR WILL HAVE THE ABILITY TO ADJUST THE TIME PERIOD TO BE DISPLAYED FOR CONSUMPTION FROM A SPECIFIC DAY AND TIME (DOWN TO THE HOUR) UP TO CURRENT DAY/TIME. THE RATE WILL HAVE THE ABILITY TO BE TRENDED WITH MIN/MAX/AVERAGE TRENDED FOR A SELECTABLE TIME PERIOD (DAY/TIME TO DAY/TIME). FOR THE CALCULATED DISPLAYS (SEE BELOW) THE ABILITY TO TOGGLE ON AND DISPLAY THE ACTUAL REGISTERED VALUES ALONG WITH THE CALCULATED VALUES. SEE BELOW FOR VALUES TAKEN FOR EACH METER.

- ***WM-1 FULL BUILDING WATER FLOW:*** THIS METER WILL DISPLAY TOTAL GALLONS USED FOR HOTEL. THIS METER WILL DISPLAY RATE IN GALLONS PER MINUTE.

- ***WM-3:*** WATER METER FOR HOTEL FLOORS 4-9 DHW. THIS METER WILL DISPLAY TOTAL GALLONS USED FOR HOTEL FLOORS 4-9 DHW. THIS METER WILL DISPLAY RATE IN GALLONS PER MINUTE.

- ***WM-4:*** WATER METER FOR LAUNDRY DCW. THIS METER WILL DISPLAY TOTAL GALLONS USED FOR LAUNDRY DCW. THIS METER WILL DISPLAY RATE IN GALLONS PER MINUTE.

- ***WM-5:*** WATER METER FOR LAUNDRY DHW. THIS METER WILL DISPLAY TOTAL GALLONS USED FOR LAUNDRY DHW. THIS METER WILL DISPLAY RATE IN GALLONS PER MINUTE.

- ***WM-6***: WATER METER FOR KITCHEN DHW. THIS METER WILL DISPLAY TOTAL GALLONS USED FOR KITCHEN DCW. THIS METER WILL DISPLAY RATE IN GALLONS PER MINUTE.

- ***WM-7:*** WATER METER FOR KITCHEN DHW FLOW. THIS METER WILL DISPLAY TOTAL GALLONS USED BY SUBTRACTING THE WM-8 KITCHEN DHWR TOTAL GALLONS FROM THE WM-7 READING. THIS METER WILL DISPLAY RATE IN GALLONS PER MINUTE BY SUBTRACTING WM-8 RATE FROM WM-7 READING.

- ***WM-8:*** WATER METER FOR KITCHEN DHWR. THIS METER WILL DISPLAY TOTAL GALLONS USED FOR KITCHEN DHWR. THIS METER WILL DISPLAY RATE IN GALLONS PER MINUTE.

- ***WM-9:*** WATER METER FOR HOTEL FLOORS 1-2 DCW (TOTAL FLOW IS REGISTERED). THIS METER WILL DISPLAY TOTAL GALLONS USED BY SUBTRACTING THE WM-10 HOTEL FLOORS 1-2 DHW TOTAL GALLONS FROM THE WM-9 READING. THIS METER WILL DISPLAY RATE IN GALLONS PER MINUTE BY SUBTRACTING WM-10 RATE FROM WM-9 READING.

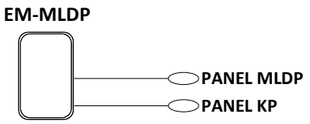
- ***WM-10:*** WATER METER FOR HOTEL FLOORS 1-2 DHW. THIS METER WILL DISPLAY TOTAL GALLONS USED FOR HOTEL FLOORS 1-2 DHW BY SUBTRACTING THE WM-8 KITCHEN DHWR TOTAL GALLONS FROM THE WM-10 READING. THIS METER WILL DISPLAY RATE IN GALLONS PER MINUTE BY SUBTRACTING WM-8 RATE FROM WM-10 READING.

MAPPED OBJECTS FROM MAIN PANEL POWER METER

- AVERAGE VOLTAGE OF PHASES
- AVERAGE CURRENT OF PHASES
- READ TIME CLOCK (DATE/TIME)
- SET TIME CLOCK (DATE/TIME)
- PEAK DEMAND
- ENERGY USAGE (KWH)
- REAL POWER DEMAND
- APPARENT POWER DEMAND
- POWER FAIL
- LOSS OF PHASE
- ACCUMULATED ENERGY RESET
- VOLTAGE SAGS
- VOLTAGE SWELLS
- POWER QUALITY ALARM
- GENERAL OVER-CURRENT ALARM
- SYSTEM STATUS
- SYSTEM ALARM

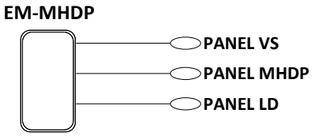
DOMESTIC WATER METER (WM-1)
METERING: FULL BUILDING
LOCATION: FLR 1 – LAUNDRY 110

DOMESTIC WATER METER (WM-6)
METERING: KITCHEN DCW
LOCATION: FLR 1 – BOH MALE 122



MAIN POWER METER (EM-MLDP)
METERING: ELEC PANEL MLDP
LOCATION: FLR 2 – ELECTRICAL 022

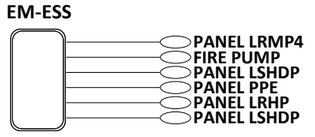
DOMESTIC WATER METER (WM-7)
METERING: KITCHEN DHW
LOCATION: FLR 1 – BOH MALE 122



MAIN POWER METER (EM-MHDP)
METERING: ELEC PANEL MHDP
LOCATION: FLR 2 – ELECTRICAL 022

DOMESTIC WATER METER (WM-3)
METERING: HOTEL FL 4-9 DHW
LOCATION: FLR 8 – HOUSEKEEPING H-8

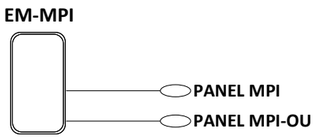
DOMESTIC WATER METER (WM-8)
METERING: KITCHEN DHWR
LOCATION: FLR 1 – BOH MALE 122



MAIN POWER METER (EM-ESS)
METERING: ELEC PANEL ESS
LOCATION: FLR 2 – ELECTRICAL 022

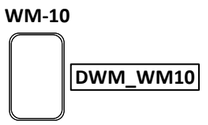
DOMESTIC WATER METER (WM-4)
METERING: LAUNDRY TOTAL (DISPLAY DCW)
LOCATION: FLR 1 – LAUNDRY 110

DOMESTIC WATER METER (WM-9)
METERING: HOTEL FL 1-2 TOTAL (DISPLAY DCW)
LOCATION: FLR 1 – BOH MALE 122

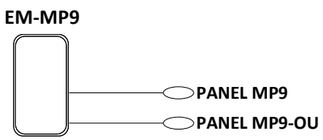


MAIN POWER METER (EM-MPI)
METERING: ELEC PANEL MPI
LOCATION: FLR 2 – ELECTRICAL 022

DOMESTIC WATER METER (WM-5)
METERING: LAUNDRY DHW
LOCATION: FLR 1 – LAUNDRY 110



DOMESTIC WATER METER (WM-10)
METERING: HOTEL FL 1-2 DHW
LOCATION: FLR 2 – MAINTENANCE 026



MAIN POWER METER (EM-MP9)
METERING: ELEC PANEL MP9
LOCATION: FLR 2 – ELECTRICAL 022

DOMESTIC WATER & MAIN POWER METER

PROJECT NUMBER: PR-002076
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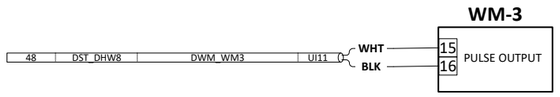
T:\PROJECTS\PR-002076 PIRELLI BLDG (MARCEL HOTEL)\07_JOB CLOSE OUT\O&M MANUALS\CONTROL DRAWING\PIRELLI BLDG_METI5 CONTROLS APPLICATIONS DRAWING_RECORD.VSD

MARCEL HOTEL (PIRELLI BLDG)
DOMESTIC WATER & MAIN POWER METER
LOCATION: NEW HAVEN, CT
CONTROLS ENGINEER: DT
PROJECT MANAGER: TJ

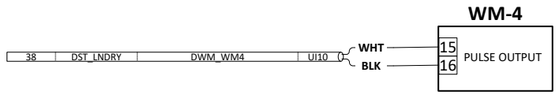
MITSUBISHI ELECTRIC TRANE HVAC US
MITSUBISHI ELECTRIC TRANE
HVAC US LLC
1340 SATELLITE BLVD.
SUWANEE, GA 30024
PHONE: (800) 433-4822
FAX: (800) 889-9904

DOMESTIC WATER METER (WM-1) WIRING

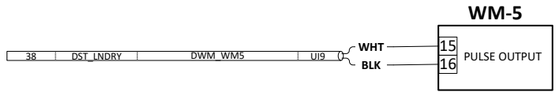
DOMESTIC WATER METER (WM-3) WIRING



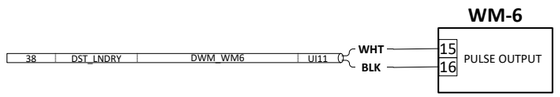
DOMESTIC WATER METER (WM-4) WIRING



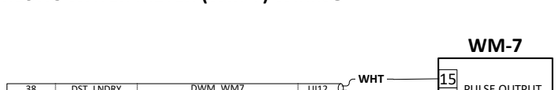
DOMESTIC WATER METER (WM-5) WIRING



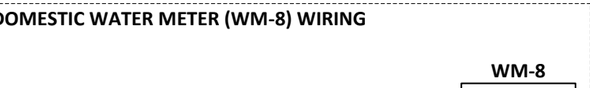
DOMESTIC WATER METER (WM-6) WIRING



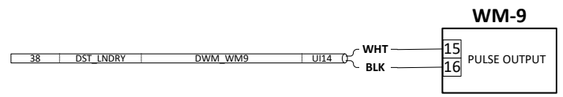
DOMESTIC WATER METER (WM-7) WIRING



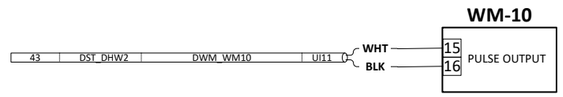
DOMESTIC WATER METER (WM-8) WIRING



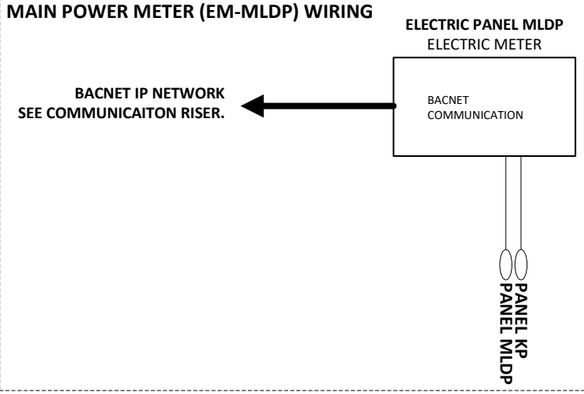
DOMESTIC WATER METER (WM-9) WIRING



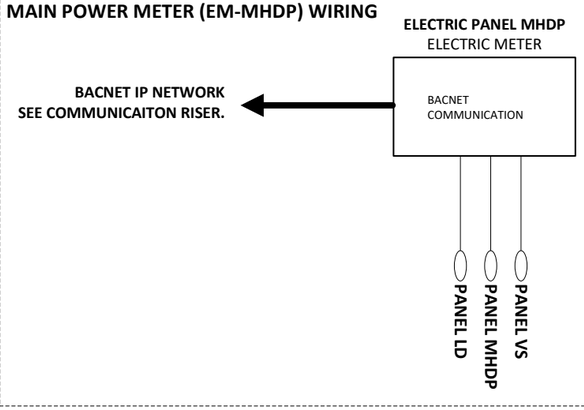
DOMESTIC WATER METER (WM-10) WIRING



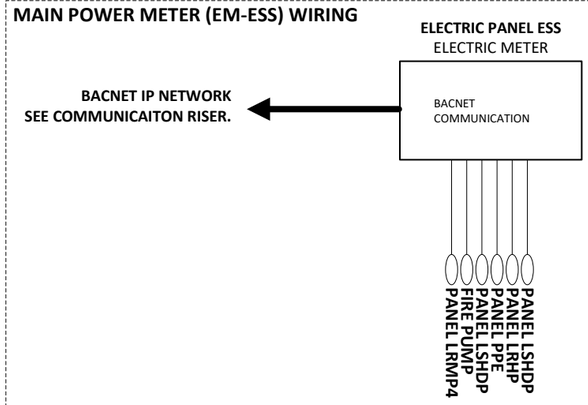
MAIN POWER METER (EM-MLDP) WIRING



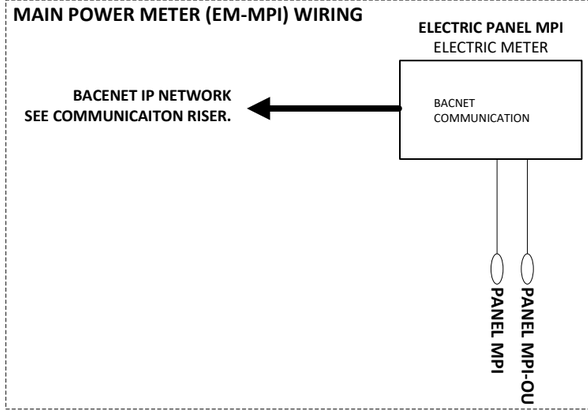
MAIN POWER METER (EM-MHDP) WIRING



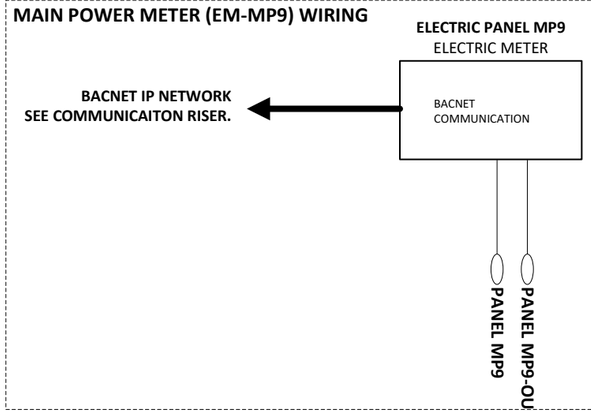
MAIN POWER METER (EM-ESS) WIRING



MAIN POWER METER (EM-MPI) WIRING



MAIN POWER METER (EM-MP9) WIRING



DOMESTIC WATER & MAIN POWER METER WIRING

PROJECT NUMBER: PR-002076

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T:\PROJECTS\PR-002076 PIRELLI BLDG (MARCEL HOTEL)\07_JOB CLOSE OUT\O&M MANUALS\CONTROL DRAWING\PIRELLI BLDG_METUS CONTROLS APPLICATIONS DRAWING_RECORD.VSD

MARCEL HOTEL (PIRELLI BLDG)
DOMESTIC WATER & MAIN POWER METER WIRING

LOCATION: NEW HAVEN, CT
CONTROLS ENGINEER: DT
PROJECT MANAGER: TJ

MITSUBISHI ELECTRIC TRANE HVAC US
MITSUBISHI ELECTRIC TRANE
HVAC US LLC
1340 SATELLITE BLVD.
SUWANEE, GA 30024
PHONE: (800) 433-4822
FAX: (800) 889-9904

SEQUENCE OF OPERATION – LAUNDRY DRYER MAKE-UP AIR SYSTEM

START-UP

THE SYSTEM WILL RUN 24/7 AND 365 DAYS A YEAR.

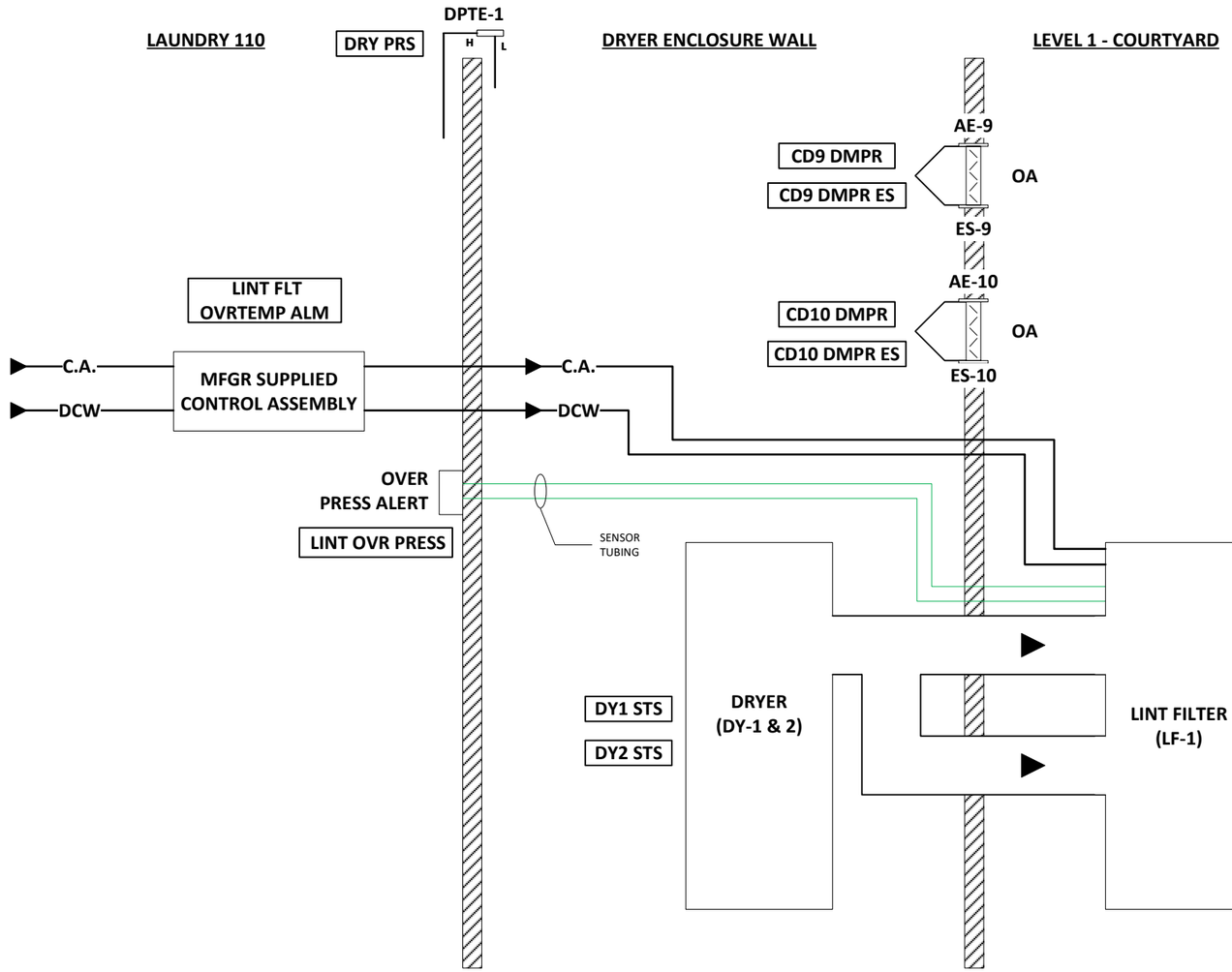
WHEN EITHER DRYER IS ACTIVATED, THE OUTDOOR AIR INTAKE DAMPERS ARE TO OPEN. WHEN BOTH DRYERS ARE DEACTIVATED, THE OUTDOOR AIR ARE TO CLOSE.

LINT FILTER

MONITOR THE LINT FILTER DIFFERENTIAL PRESSURE ALERT SIGNAL TO THE BMS AND PROGRAM AS AN ALARM. MONITOR THE OVER TEMP CONTROLLER TO THE BMS AND PROGRAM AS AN ALARM. SET UP THE FILTER BLOW DOWN TIMER TO OPERATE WHEN THE DRYERS AE NOT NORMALLY IN OPRATION.

ALARM POINTS

- DAMPER FAILURE
- DRYER ENCLO. S.P. OUT OF RANGE
- LINT FILTER HIGH D.P. ALERT
- LINT FILTER OVER TEMP ALARM



LAUNDRY DRYER MAKE-UP AIR SYSTEM

LOCATION: FLR 1 – LAUNDRY 110

PROJECT NUMBER: PR-002076

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MARCEL HOTEL (PIRELLI BLDG)

LAUNDRY DRYER MAKE-UP AIR SYSTEM

LOCATION: NEW HAVEN, CT

CONTROLS ENGINEER: DT

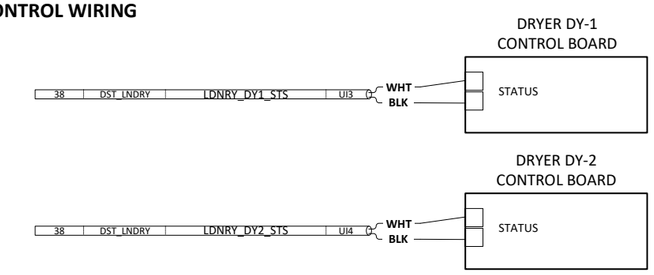
PROJECT MANAGER: TJ

MITSUBISHI ELECTRIC TRANE HVAC US

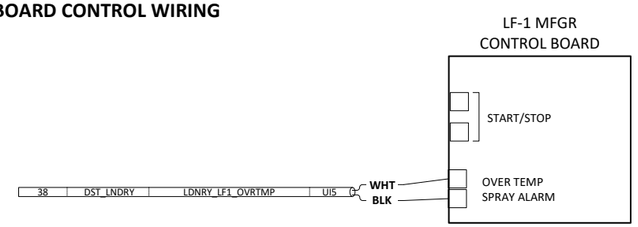
MITSUBISHI ELECTRIC TRANE
HVAC US LLC
1340 SATELLITE BLVD.
SUWANEE, GA 30024
PHONE: (800) 433-4822
FAX: (800) 889-9904

Bill of Materials				
Ref. Tag	**Description**	**Manufacturer**	**Model #**	**Qty**
AE-9~10	DAMPER ACTUATOR, 180IN-LB, SR, 24VAC, 2-10VDC	BELIMO	AFB24-SR	2
ES-9~10	NON-MERCURY DAMPER END SWITCH	KELE	TS-475	2
DPTE-1	MULTI RANGE DIFF PRESS TRANSDUCER, 4-20mA SIGNAL	MAMAC	PR-274-R3-MA	1
	STATIC PRESSURE TIP, 1/4 INCH COMPRESSION	KELE	A-301-K	2

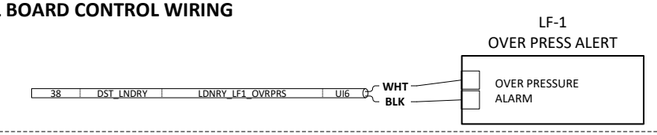
DRYER (DY-1 & 2) CONTROL WIRING



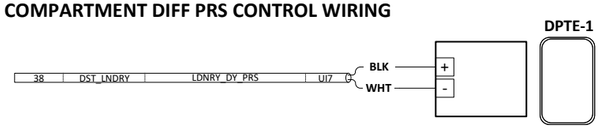
LF-1 MFGR CONTROL BOARD CONTROL WIRING



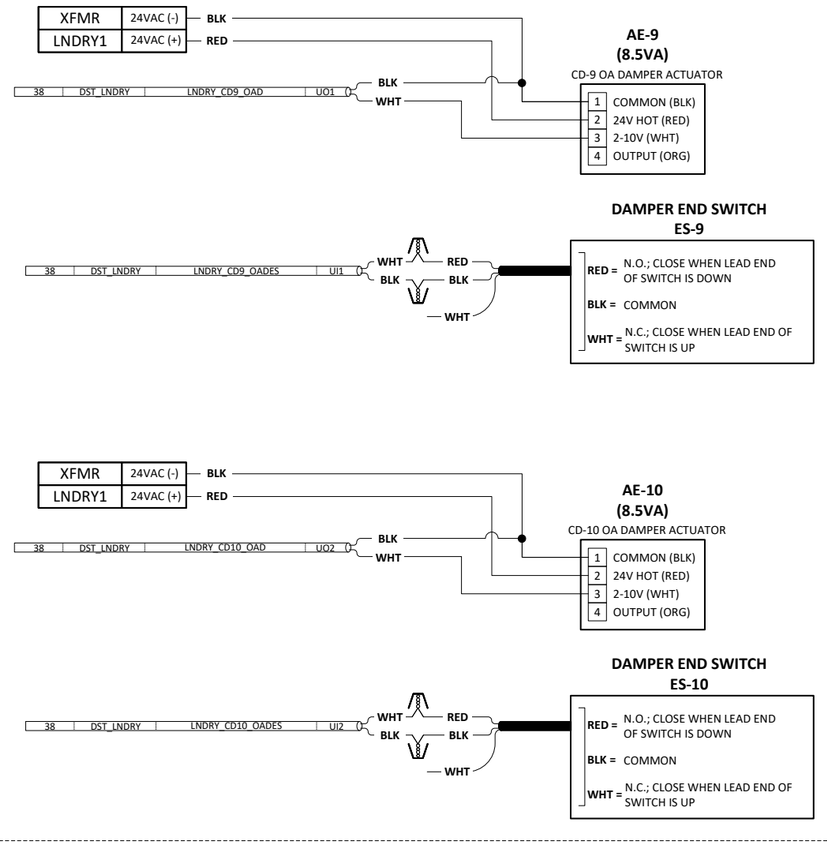
LF-1 MFGR CONTROL BOARD CONTROL WIRING



DRYER COMPARTMENT DIFF PRS CONTROL WIRING



LAUNDRY OUTSIDE AIR DAMPER ACTUATOR WIRING



LAUNDRY DRYER MAKE-UP AIR SYSTEM WIRING

PROJECT NUMBER: PR-002076

LAST REVISION DATE: AUGUST 17, 2022

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MARCEL HOTEL (PIRELLI BLDG)
LAUNDRY DRYER MAKE-UP AIR SYSTEM WIRING

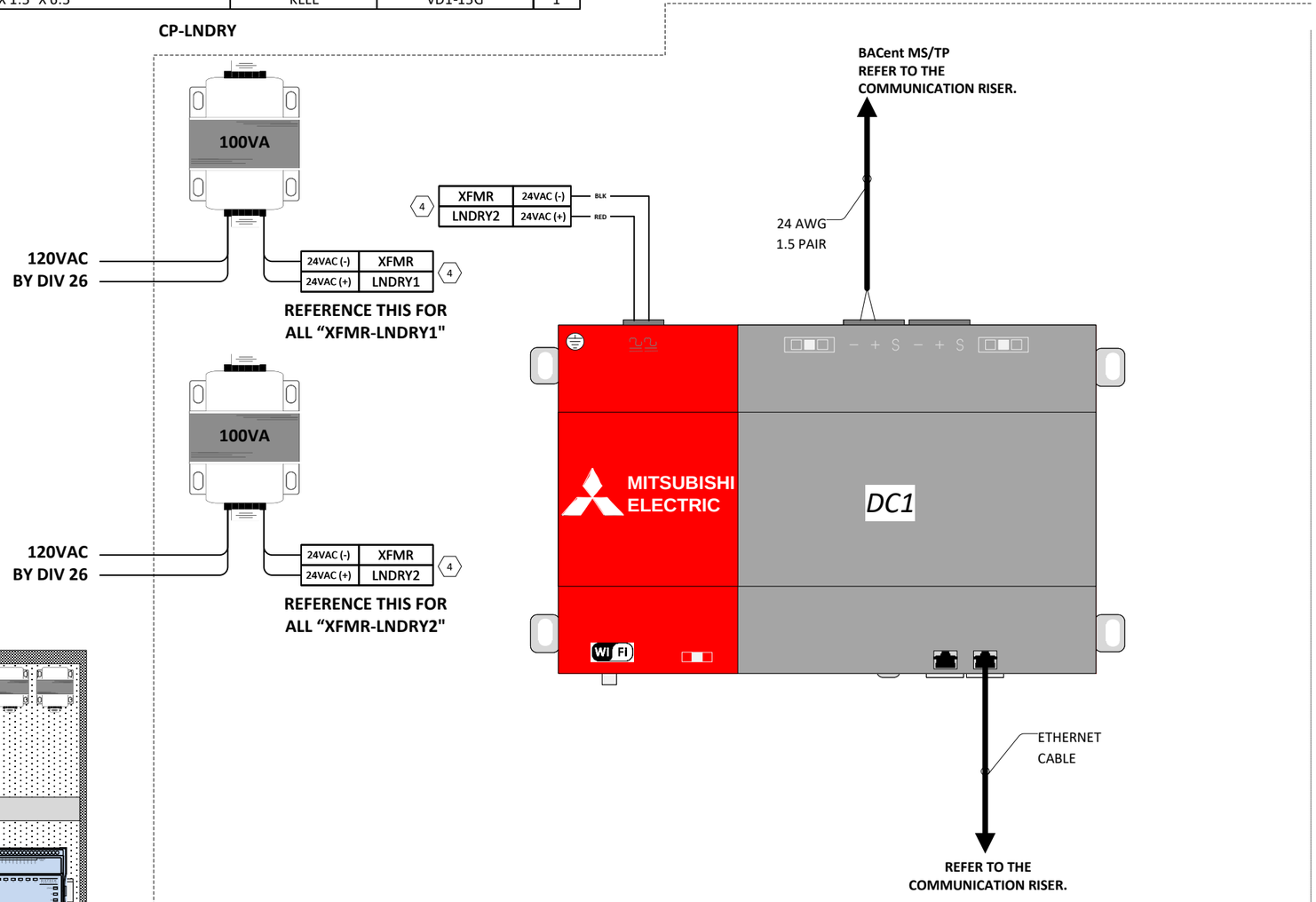
LOCATION: NEW HAVEN, CT
CONTROLS ENGINEER: DT
PROJECT MANAGER: TJ

MITSUBISHI ELECTRIC TRANE HVAC US
MITSUBISHI ELECTRIC TRANE
HVAC US LLC
1340 SATELLITE BLVD.
SUWANEE, GA 30024
PHONE: (800) 433-4822
FAX: (800) 889-9904

Bill of Materials				
Ref. Tag	**Description**	**Manufacturer**	**Model #**	**Qty**
CP-LNDRY	24x24x8 NEMA1 ENCLOSURE W/PERF PANEL	HOFFMAN	A-24N24BLPP	1
DIN-LNDRY	DIN RAIL ALUMINUM	KELE	BAM-1000	1
DST_LNDRY	ECB-600; 16UI and 12UO POINTS	DISTECH	CDIB-600X-00	1
DST_LNDRY-EX1	ECX-400; 12UI and 12UO POINTS	DISTECH	CDIX-400X-00	1
XFMR-LNDRY1~2	TRANSFORMER 100VA, 120 to 24VAC	FUNCTIONAL DEVICES	TR100VA001	2
DC1	DC-8000 CONTROLLER	METUS	DC-8000	1
	DC-8000 SD CARD	METUS	DC-8000-SD	1
	DC-8000 LICENSE FOR 100 DEVICES, 5000 POINTS	LYNXSPRING	DC-8000-LIC8100	1
	DC-8100 - INITIAL 18 MONTH MAINTENANCE	LYNXSPRING	DC-8100-SMA-1YR-INIT	1
	EC-NET SUPPORT PACK - 50 DEVICES, 2500 POINTS	DISTECH	SDIDI-ECNETSP-50	1
WIREDUCT	GRAY WIRE DUCT 1" X 1.5" X 6.5'	KELE	VD1-15G	1

NOTES:

1. REFER TO REFERENCE PAGE 7 (REF: DISTECH ECB WIRING DETAIL) FOR DETAILED IO WIRING.
2. LABEL WIRING ON BOTH ENDS IS REQUIRED. DOCUMENT WIRING LABELS FOR RECORD DRAWINGS.
3. WIRE SELECTION: 18 AWG – 2 PAIR
4. WIRE SELECTION: 16 AWG – 2 PAIR



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PANEL

NOT DRAWING TO SCALE

LAUNDRY SYSTEM
DISTECH CONTROLLER WIRING (1 OF 2)

PROJECT NUMBER: PR-002076

LAST REVISION DATE: AUGUST 17, 2022

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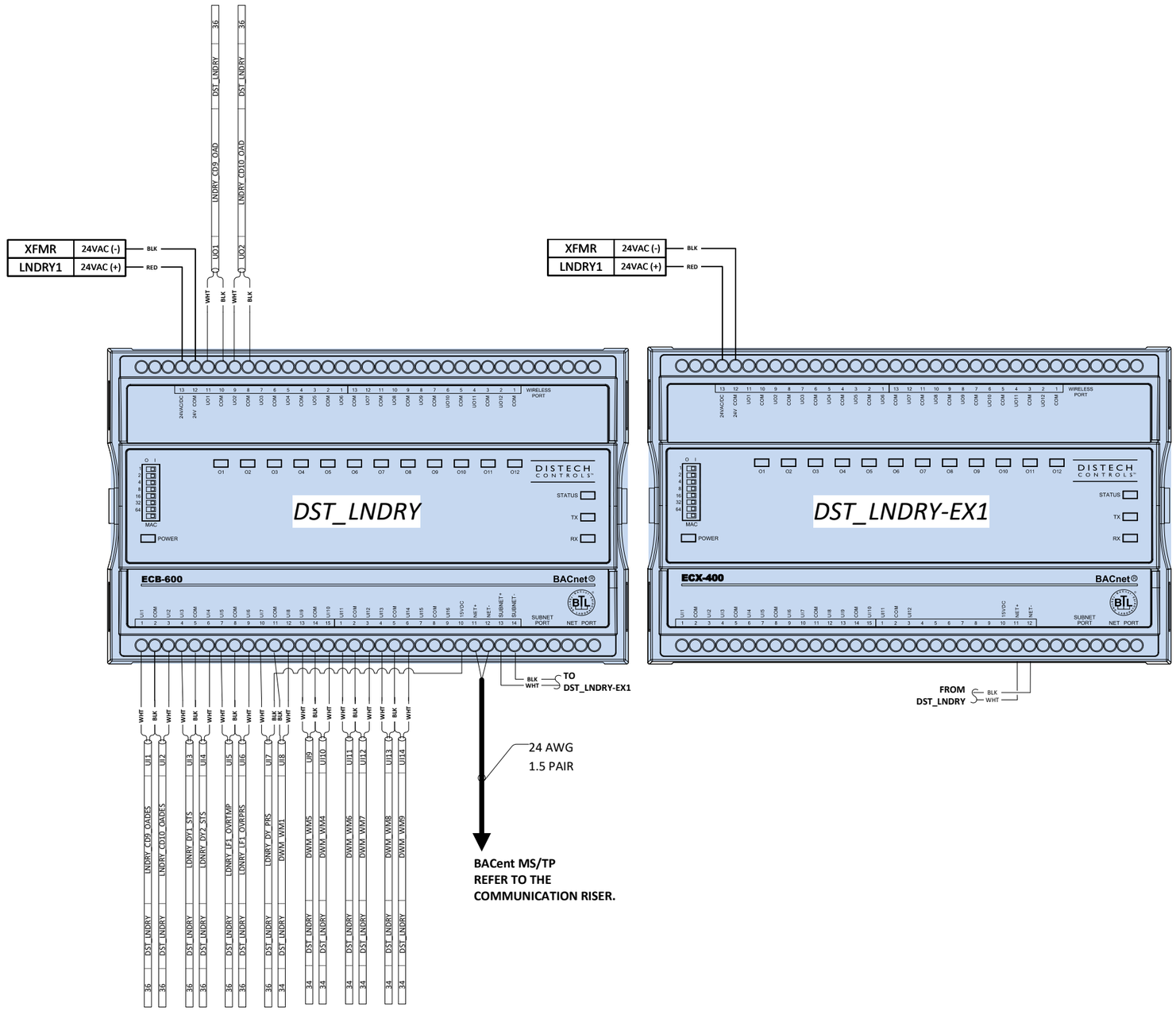
MARCEL HOTEL (PIRELLI BLDG)
LAUNDRY SYSTEM DISTECH CONTROLLER WIRING (1 OF 2)

LOCATION: NEW HAVEN, CT
CONTROLS ENGINEER: DT
PROJECT MANAGER: TJ

MITSUBISHI ELECTRIC TRANE HVAC US

MITSUBISHI ELECTRIC TRANE
HVAC US LLC
1340 SATELLITE BLVD.
SUWANEE, GA 30024
PHONE: (800) 433-4822
FAX: (800) 889-9904

CP-LNDRY



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LAUNDRY SYSTEM
DISTECH CONTROLLER WIRING (2 OF 2)

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REV	DESCRIPTION	DATE	REVISED BY
1	RECORD DRAWING	8/17/2022	DT

PROJECT NUMBER: PR-002076

LAST REVISION DATE: AUGUST 17, 2022

SHEET NUMBER: PAGE 38 OF 57

MARCEL HOTEL (PIRELLI BLDG)
LAUNDRY SYSTEM DISTECH CONTROLLER WIRING (2 OF 2)

LOCATION: NEW HAVEN, CT
CONTROLS ENGINEER: DT
PROJECT MANAGER: TJ

MITSUBISHI ELECTRIC TRANE HVAC US

MITSUBISHI ELECTRIC TRANE
HVAC US LLC
1340 SATELLITE BLVD.
SUWANEE, GA 30024
PHONE: (800) 433-4822
FAX: (800) 889-9904

SEQUENCE OF OPERATION – DOMESTIC WATER HEATING & OUTDOOR HP WATER HEATER SYSTEM

START-UP

WATER METER: INSTANTANEOUS FLOW RATE AND FLOW VOLUME WILL BE MONITORED AND RECORDED TO THE SYSTEM.

DOMESTIC WATER HEATER WH-1: UNIT WILL OPERATE FROM ITS OWN CONTROLS TO MAINTAIN SET HOT WATER DISCHARGE SET POINT (INITIAL SETTING 140°F). UNIT WILL BE MONITORED TO THE B.M.S.

RECIRC. PUMP RP-1: (HIGH TEMP. DHW) THIS PUMP WILL RUN CONTINUOUSLY DURING KITCHEN OPERATING HOURS. PROVIDE A PROGRAMMED TIME CLOCK SCHEDULE BASED ON THE KITCHEN MANAGERS INDICATED HOURS OF OPERATION.

RECIRC. PUMP RP-2: (DHW DISTRIBUTION) THIS PUMP WILL OPERATE AT ALL TIMES WHEN THE RETURN WATER TEMPERATURE IS BELOW SET POINT TEMPERATURE (INITIAL SETTING OF 115°F).

OUTDOOR HEAT PUMP WATER HEATER OPERATION

THE OUTDOOR HEAT PUMP UNITS HP1-01, HP1-02 AND HP1-03 WILL OPERATE BASED ON MANUFACTURER'S CONTROLS. THE CONTROLS SYSTEMS WILL UTILIZE MANUFACTURER'S PROVIDED SENSORS TO OPERATE THE PUMPS AND HEAT PUMP UNITS TO MAINTAIN BOTH WS-1 TANKS (FOR EACH SYSTEM) AT THE TANK TEMPERATURE SET POINT (140°F INITIAL SETTING ADJ). A FAILURE OF THE HEAT PUMP SYSTEM WILL SEND AN ALARM TO THE BMS.

RECIRC. PUMP RP-4: (ADDITIONAL CAPCITY/HP FAILURE HEATING) THE TWO (2) STORAGE TANK (WS-1) TEMPERATURES WILL BE MONITORED BY THE BMS.

IF THE HEAT PUMP WATER HEATER SYSTEM(S) ARE OPERATIONAL (NO FAILURE), WHENEVER THE STORAGE TANK #2 TEMPERATURE DROPS TO 100°F (ADJ), THE CONTROL VALVE WILL BE OPENED AND RP-4 WILL OPERATE AS NECESSARY TO MAINTAIN THE TANK TEMPERATURE AT 100°F (ADJ). IF THE WATER HEATER DISCHARGE TEMPERATURE DROPS BELOW 134°F, THE PUMP WILL BE STOPPED. PROVIDE DEAD BAND TO LIMIT CYCLING.

IF THE HEAT PUMP WATER HEATER SYSTEM(S) ARE NOT OPERATION (FAILURE MODE), THE STORAGE TANKS WILL BE CHARGED FROM THE WATER HEATER IN SEQUENCE. WHEN THE STORAGE TANK #2 TEMPERATURE DROPS BELOW 130°F, THE CONTROL VALVE WILL BE OPENED AND RP-4 OPERATED AS NECESSARYTO MIANTAIN TANK TEMPERATURE. WHEN TANK REACHES 135°F, THE PUMP WILL STOP AND THE VALVE CLOSED. IF TANK #2 IS AT SET POINT AND TANK #1 DROPS BELOW 125°F, THE RESPECTIVE CONTROL VALVE WILL OPEN AND RP-4 OPERATED UNTIL TANK REACHES 130°F. ANYTIME THE WATER HEATER DISCHARGE TEMPERATURE DROP SBELOW 134°F, RP-4 WILL BE STOPPED AND THE CONTROL VALVES CLOSED.

ALARM POINTS

- DOM. WATER HEATER WH-1 FAULT
- WH-1 DISCHARGE TEMP. LOW
- DIST. DHW TEMPERATURE LOW
- DIST. DHW TEMPERATURE HIGH
- RECIRC. PUMP RP-1 FAIL
- RECIRC. PUMP RP-2 FAIL
- RECIRC. PUMP RP-4 FAIL
- STOR. TANK WS-1 TEMP. HIGH
- OUTDOOR HEAT PUMP WATER HEATER FAILURE

DOMESTIC WATER HEATING & HEAT RECOVERY SYSTEM SEQUENCE OF OPERATION

TYPICAL FOR LEVEL 2 DOM. WATER HEATING SYSTEM
SIMILAR FOR THE LEVEL 8 DOM. WATER HEATER SYSTEM, LESS RP-1

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LAST REVISION DATE: AUGUST 17, 2022

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REV	DESCRIPTION	DATE	REVISED BY
1	RECORD DRAWING	8/17/2022	DT

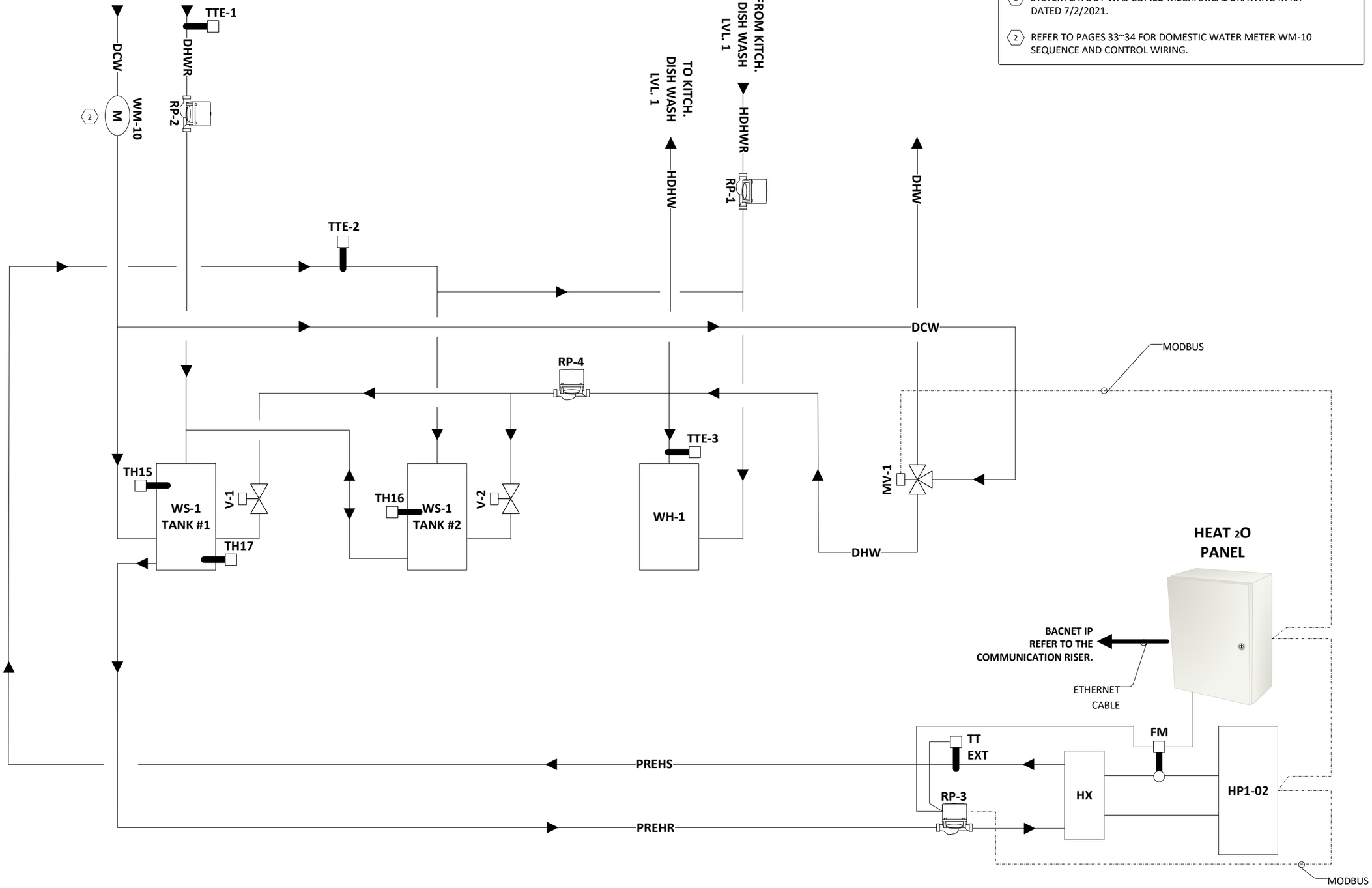
T:\PROJECTS\PR-002076 PIRELLI BLDG (MARCEL HOTEL)\07_JOB CLOSE OUT\O&M MANUALS\CONTROL DRAWING\PIRELLI BLDG_METUS CONTROLS APPLICATIONS DRAWING_RECORD.VSD

MARCEL HOTEL (PIRELLI BLDG)
DOMESTIC WATER HEATING & HEAT RECOVERY SYSTEM SEQUENCE
LOCATION: NEW HAVEN, CT
CONTROLS ENGINEER: DT
PROJECT MANAGER: TJ

MITSUBISHI ELECTRIC TRANE HVAC US
MITSUBISHI ELECTRIC TRANE
HVAC US LLC
1340 SATELLITE BLVD.
SUWANEE, GA 30024
PHONE: (800) 433-4822
FAX: (800) 889-9904

NOTES:

1. SYSTEM LAYOUT WAS COPIED MECHANICAL DRAWING M407 DATED 7/2/2021.
2. REFER TO PAGES 33~34 FOR DOMESTIC WATER METER WM-10 SEQUENCE AND CONTROL WIRING.



DOMESTIC WATER HEATING & HEAT RECOVERY SYSTEM LAYOUT

LEVEL 2 DOM. WATER HEATING SYSTEM

PROJECT NUMBER: PR-002076

LAST REVISION DATE: AUGUST 17, 2022

SHEET NUMBER: PAGE 40 OF 57

REVISIONS			
REV	DESCRIPTION	DATE	REVISED BY
1	RECORD DRAWING	8/17/2022	DT

MARCEL HOTEL (PIRELLI BLDG)

DOMESTIC WATER HEATING & HEAT RECOVERY SYSTEM LAYOUT (LVL 2)

LOCATION: NEW HAVEN, CT

CONTROLS ENGINEER: DT

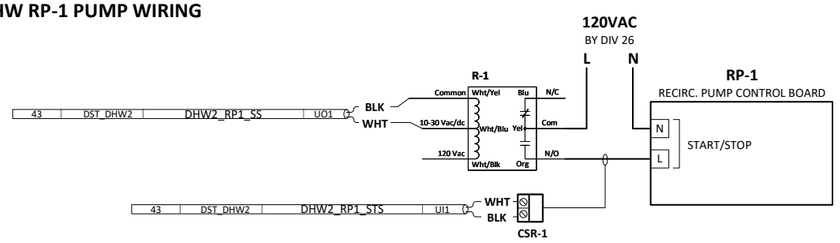
PROJECT MANAGER: TJ

MITSUBISHI ELECTRIC TRANE HVAC US

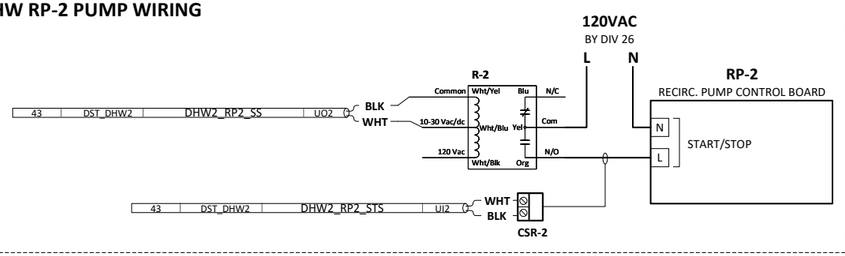
MITSUBISHI ELECTRIC TRANE HVAC US LLC
1340 SATELLITE BLVD.
SUWANEE, GA 30024
PHONE: (800) 433-4822
FAX: (800) 889-9904

Bill of Materials				
Ref. Tag	**Description**	**Manufacturer**	**Model #**	**Qty**
CSR-1~2,4	CURRENT SWITCH, FIXED 0.35A TRIP POINT, SPLIT CORE	FUNCTIONAL DEVICES	RIBXGTF	3
R-1~2,4~6	RELAY 10A SPDT W/ 10-30 VAC/DC/120 VAC COIL	FUNCTIONAL DEVICES	RIBU1C	5
V-1~2	SEE VALVE SCHEDULE			

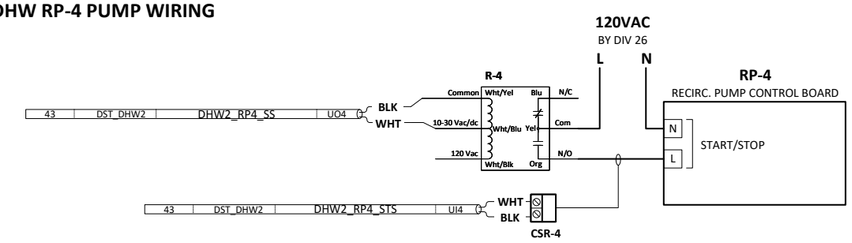
DHW RP-1 PUMP WIRING



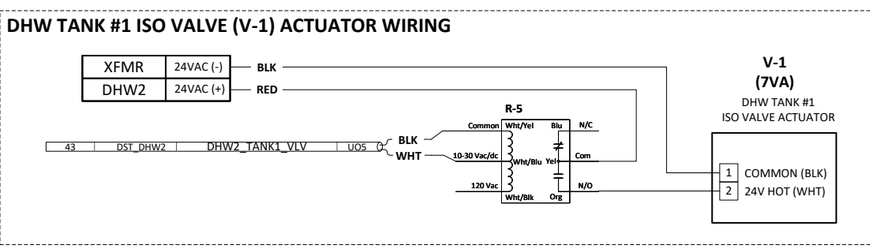
DHW RP-2 PUMP WIRING



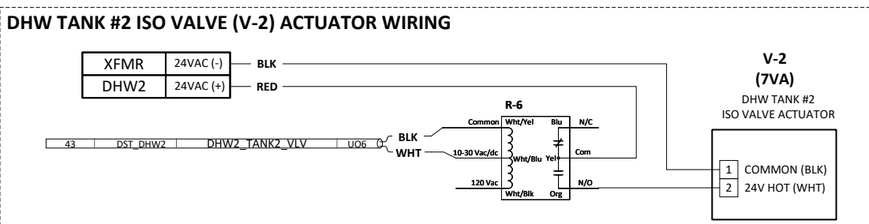
DHW RP-4 PUMP WIRING



DHW TANK #1 ISO VALVE (V-1) ACTUATOR WIRING



DHW TANK #2 ISO VALVE (V-2) ACTUATOR WIRING



LEVEL 2 - DOMESTIC WATER HEATING &
HEAT RECOVERY SYSTEM WIRING (1 OF 2)

PROJECT NUMBER: PR-002076

LAST REVISION DATE: AUGUST 17, 2022

SHEET NUMBER: PAGE 41 OF 57

REVISIONS			
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1	RECORD DRAWING	8/17/2022	DT

T:\PROJECTS\PR-002076 PIRELLI BLDG (MARCEL HOTEL)\07_JOB CLOSE OUT\O&M MANUALS\CONTROL DRAWING\PIRELLI BLDG_METI CS CONTROLS APPLICATIONS DRAWING_RECORD.VSD

MARCEL HOTEL (PIRELLI BLDG)
LVL2 - DOMESTIC WATER HEATING & HEAT RECOVERY SYSTEM WIRING (1 OF 2)

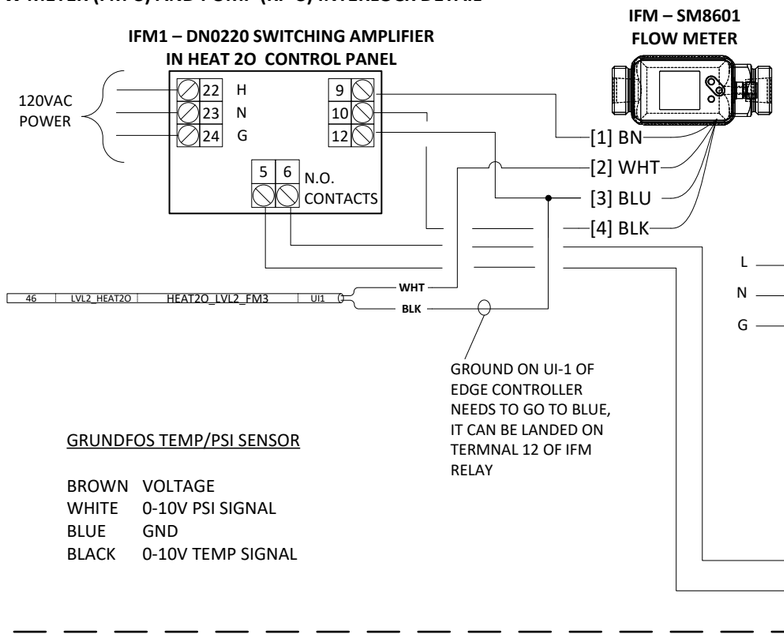
LOCATION: NEW HAVEN, CT
CONTROLS ENGINEER: DT
PROJECT MANAGER: TJ

MITSUBISHI ELECTRIC TRANE HVAC US

MITSUBISHI ELECTRIC TRANE
HVAC US LLC
1340 SATELLITE BLVD.
SUWANEE, GA 30024
PHONE: (800) 433-4822
FAX: (800) 889-9904

Bill of Materials				
Ref. Tag	**Description**	**Manufacturer**	**Model #**	**Qty**
TTE-1~3	IMMERSION SENSOR, 10K (TYPE III), 4" THERMISTOR W/WELL	ACI	A/AN-I4-GD	3
CSR-5~7	CURRENT SWITCH, 0-50A, 0-5VDC, SOLID CORE	FUNCTIONAL DEVICES	RIBXKTV5-50	3

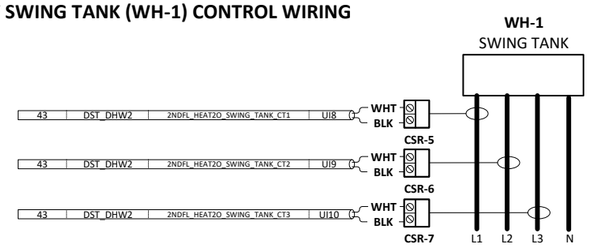
FLOW METER (FM-3) AND PUMP (RP-3) INTERLOCK DETAIL



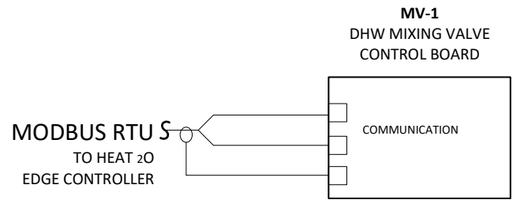
GRUNDFOS TEMP/PSI SENSOR

BROWN	VOLTAGE
WHITE	0-10V PSI SIGNAL
BLUE	GND
BLACK	0-10V TEMP SIGNAL

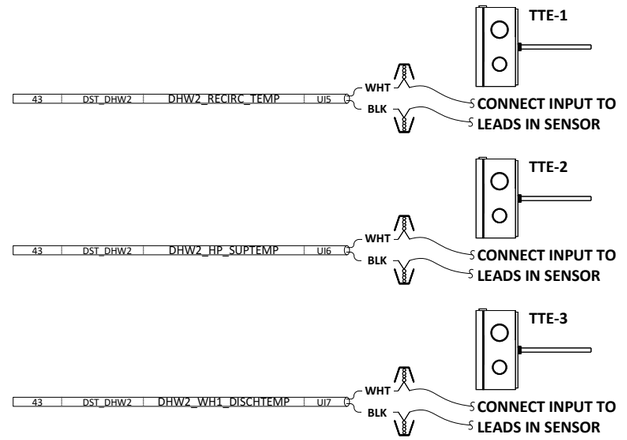
DHW SWING TANK (WH-1) CONTROL WIRING



DHW MIXING VALVE (MV-1) CONTROL WIRING



DHW TEMPERATURE SENSOR WIRING



LEVEL 2 - DOMESTIC WATER HEATING &
HEAT RECOVERY SYSTEM WIRING (2 OF 2)

PROJECT NUMBER: PR-002076

LAST REVISION DATE: AUGUST 17, 2022

SHEET NUMBER: PAGE 42 OF 57

REVISIONS			
REV	DESCRIPTION	DATE	REVISED BY
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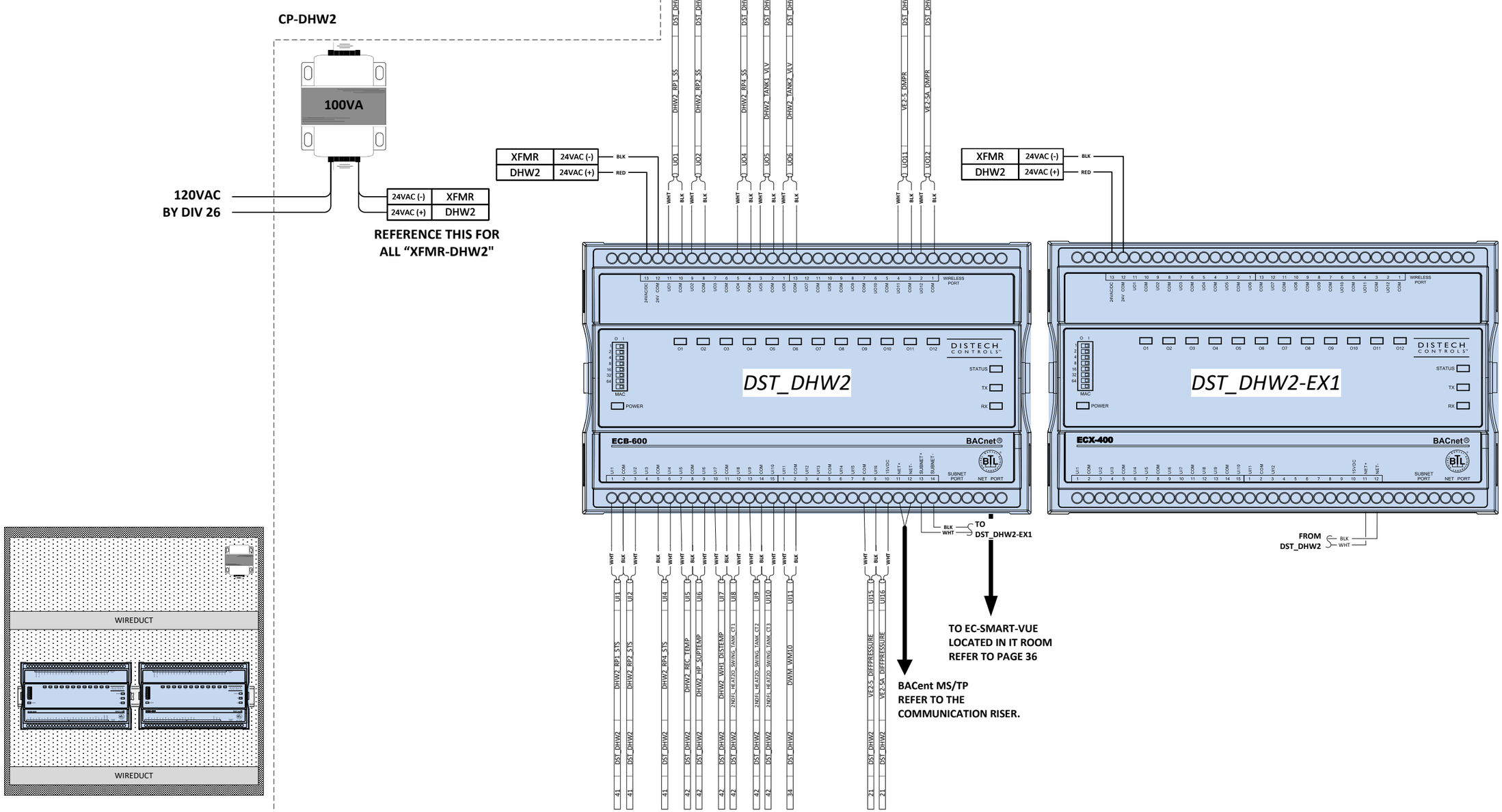
MARCEL HOTEL (PIRELLI BLDG)
LVL2 - DOMESTIC WATER HEATING & HEAT RECOVERY SYSTEM WIRING (2 OF 2)
LOCATION: NEW HAVEN, CT
CONTROLS ENGINEER: DT
PROJECT MANAGER: TJ

MITSUBISHI ELECTRIC TRANE HVAC US
MITSUBISHI ELECTRIC TRANE HVAC US LLC
1340 SATELLITE BLVD.
SUWANEE, GA 30024
PHONE: (800) 433-4822
FAX: (800) 889-9904

Bill of Materials				
Ref. Tag	**Description**	**Manufacturer**	**Model #**	**Qty**
CP-DHW2	24x24x8 NEMA1 ENCLOSURE W/PERF PANEL	HOFFMAN	A-24N24BLPP	1
DIN-DHW2	DIN RAIL ALUMINUM	KELE	BAM-1000	1
DST_DHW2	ECB-600; 16UI and 12UO POINTS	DISTECH	CDIB-600X-00	1
DST_DHW2-EX1	ECX-400; 12UI and 12UO POINTS	DISTECH	CDIX-400X-00	1
XFMR-DHW	TRANSFORMER 100VA, 120 to 24VAC	FUNCTIONAL DEVICES	TR100VA001	2
WIREDUCT	GRAY WIRE DUCT 1" X 1.5" X 6.5'	KELE	VD1-15G	1



PANEL

NOT DRAWING TO SCALE

LEVEL 2 - DOMESTIC HOT WATER DISTECH CONTROLLER WIRING

PROJECT NUMBER:	LAST REVISION DATE:	SHEET NUMBER:
PR-002076	AUGUST 17, 2022	PAGE 43 OF 57

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1	RECORD DRAWING	8/17/2022	DT

T:\PROJECTS\PR-002076 PIRELLI BLDG (MARCEL HOTEL)\07_JOB CLOSE OUT\O&M MANUALS\CONTROLS DRAWING\PIRELLI BLDG_MIETUS CONTROLS APPLICATIONS DRAWING_RECORD.VSD

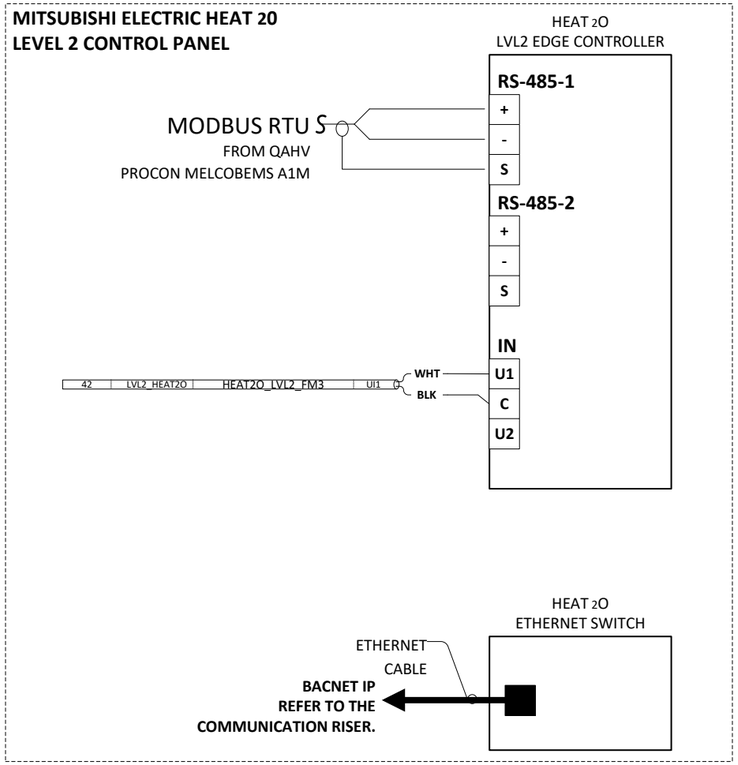
MARCEL HOTEL (PIRELLI BLDG)
LVL2 - DOMESTIC HOT WATER SYSTEM
DISTECH CONTROLLER WIRING

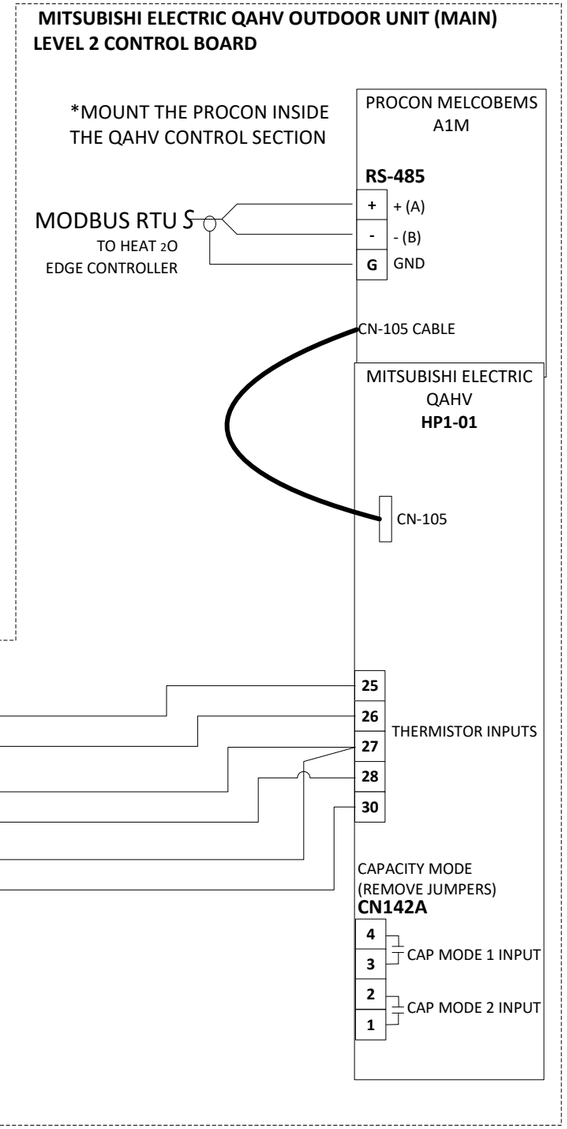
LOCATION: NEW HAVEN, CT
CONTROLS ENGINEER: DT
PROJECT MANAGER: TJ

MITSUBISHI ELECTRIC TRANE HVAC US

MITSUBISHI ELECTRIC TRANE
HVAC US LLC
1340 SATELLITE BLVD.
SUWANEE, GA 30024
PHONE: (800) 433-4822
FAX: (800) 889-9904

Bill of Materials				
Ref. Tag	**Description**	**Manufacturer**	**Model #**	**Qty**
HEAT 2O PNL	QAHV INTERACTIVE CONTROL PANEL	METUS	QAHV-CONTROLS-1	1
PROCON	PROCON MELCOBEMS MINI (A1M)	METUS	PAC-UKPRC001-CN-1	1
TH15~TH17	FURNISHED BY MECHANICAL CONTRACTOR	METUS	TW-TH16E	3





LEVEL 2 – HEAT 2O CONTROL WIRING

PROJECT NUMBER: PR-002076

LAST REVISION DATE: AUGUST 17, 2022

SHEET NUMBER: PAGE 44 OF 57

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MARCEL HOTEL (PIRELLI BLDG)

LVL2 - HEAT 2O CONTROL WIRING

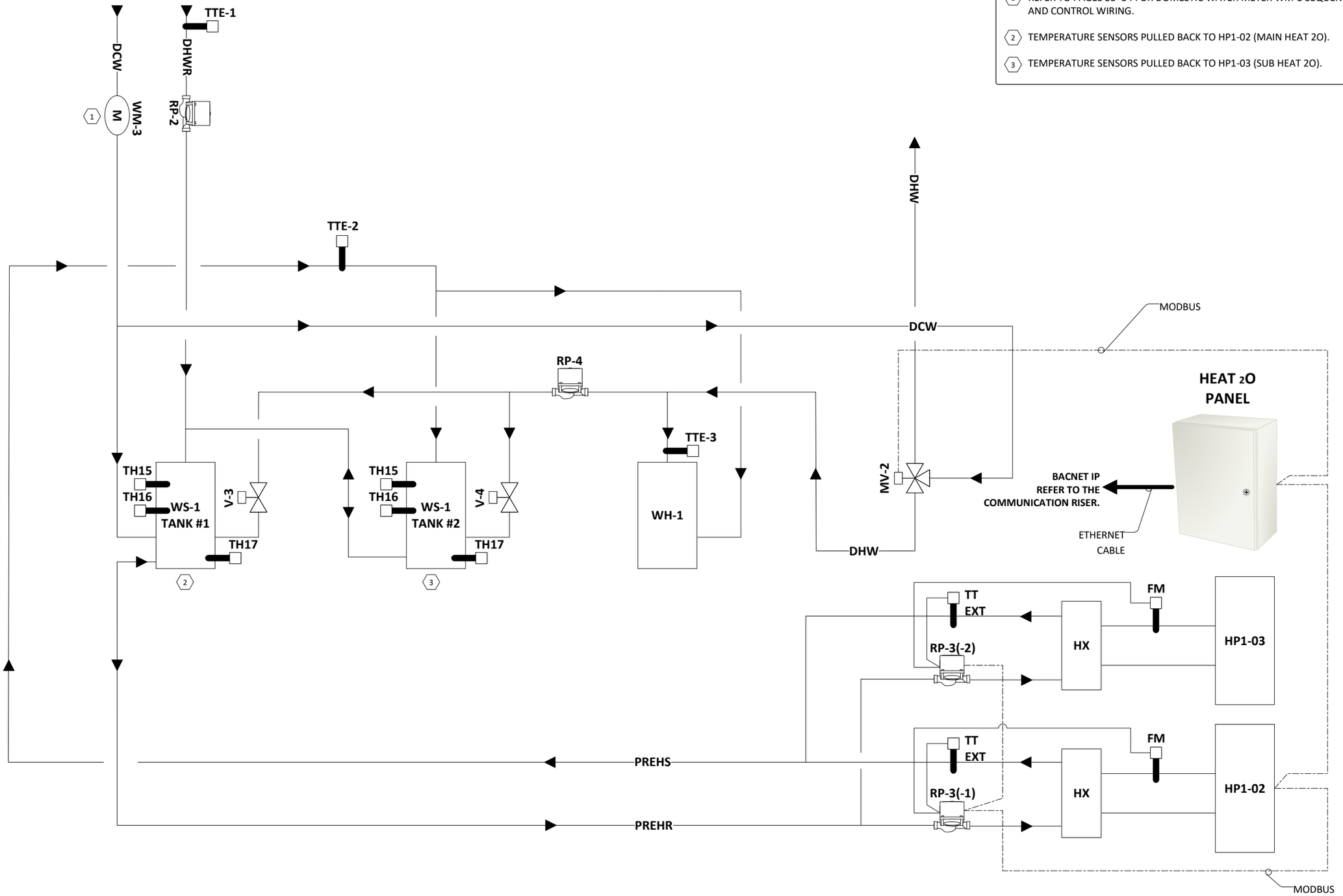
LOCATION: NEW HAVEN, CT
CONTROLS ENGINEER: DT
PROJECT MANAGER: TJ

MITSUBISHI ELECTRIC TRANE HVAC US

MITSUBISHI ELECTRIC TRANE
HVAC US LLC
1340 SATELLITE BLVD.
SUWANEE, GA 30024
PHONE: (800) 433-4822
FAX: (800) 889-9904

NOTES:

1. REFER TO PAGES 33~34 FOR DOMESTIC WATER METER WM-3 SEQUENCE AND CONTROL WIRING.
2. TEMPERATURE SENSORS PULLED BACK TO HP1-02 (MAIN HEAT 2O).
3. TEMPERATURE SENSORS PULLED BACK TO HP1-03 (SUB HEAT 2O).



DOMESTIC WATER HEATING & HEAT RECOVERY SYSTEM LAYOUT

TYPICAL FOR LEVEL 8 DOM. WATER HEATING SYSTEM

PROJECT NUMBER: PR-002076

LAST REVISION DATE: AUGUST 17, 2022

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MARCEL HOTEL (PIRELLI BLDG)
DOMESTIC WATER HEATING & HEAT RECOVERY SYSTEM LAYOUT (LVL 8)

LOCATION: NEW HAVEN, CT

CONTROLS ENGINEER: DT

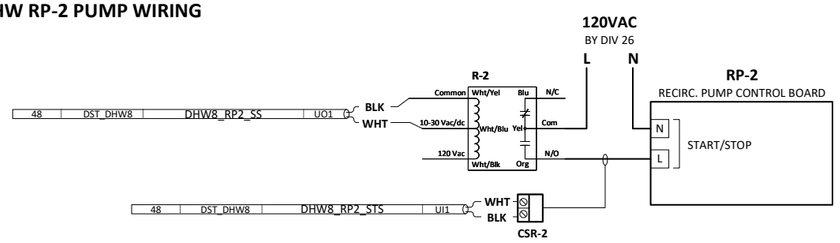
PROJECT MANAGER: TJ

MITSUBISHI ELECTRIC TRANE HVAC US

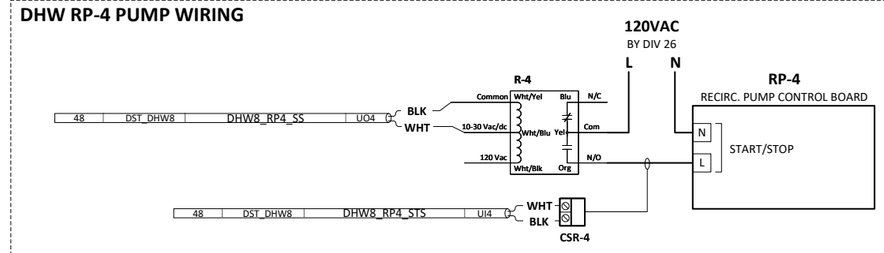
MITSUBISHI ELECTRIC TRANE
HVAC US LLC
1340 SATELLITE BLVD.
SUWANEE, GA 30024
PHONE: (800) 433-4822
FAX: (800) 889-9904

Bill of Materials				
Ref. Tag	**Description**	**Manufacturer**	**Model #**	**Qty**
CSR-2~4	CURRENT SWITCH, FIXED 0.35A TRIP POINT, SPLIT CORE	FUNCTIONAL DEVICES	RIBXGTF	4
R-2~6	RELAY 10A SPDT W/ 10-30 VAC/DC/120 VAC COIL	FUNCTIONAL DEVICES	RIBU1C	6
V-3~4	SEE VALVE SCHEDULE			

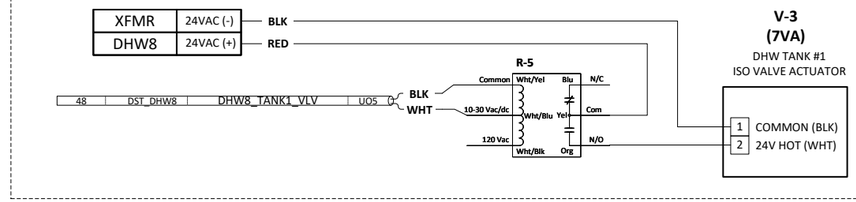
DHW RP-2 PUMP WIRING



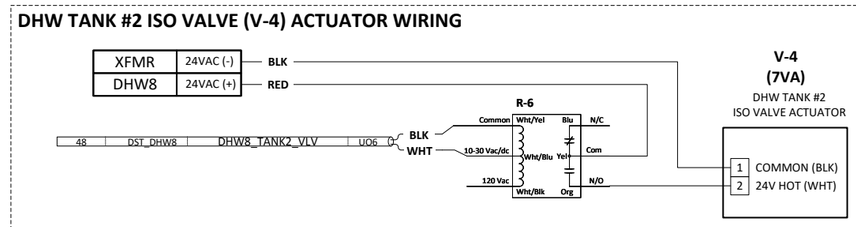
DHW RP-4 PUMP WIRING



DHW TANK #1 ISO VALVE (V-3) ACTUATOR WIRING



DHW TANK #2 ISO VALVE (V-4) ACTUATOR WIRING



LEVEL 8 - DOMESTIC WATER HEATING & HEAT RECOVERY SYSTEM WIRING (1 OF 2)

PROJECT NUMBER: PR-002076

LAST REVISION DATE: AUGUST 17, 2022

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REV	DESCRIPTION	DATE	REVISED BY
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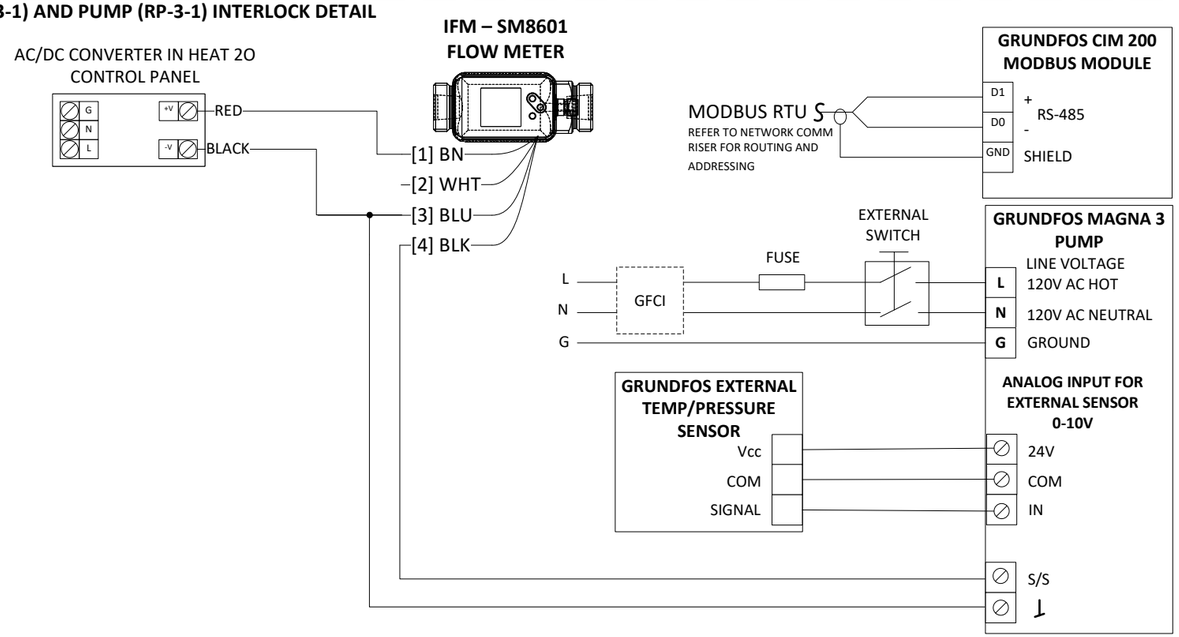
T:\PROJECTS\PR-002076 PIRELLI BLDG (MARCEL HOTEL)\07_JOB CLOSE OUT\O&M MANUALS\CONTROL DRAWING\PIRELLI BLDG_METUS CONTROLS APPLICATIONS DRAWING_RECORD.VSD

MARCEL HOTEL (PIRELLI BLDG)
LVL8 - DOMESTIC WATER HEATING & HEAT RECOVERY SYSTEM WIRING (1 OF 2)
LOCATION: NEW HAVEN, CT
CONTROLS ENGINEER: DT
PROJECT MANAGER: TJ

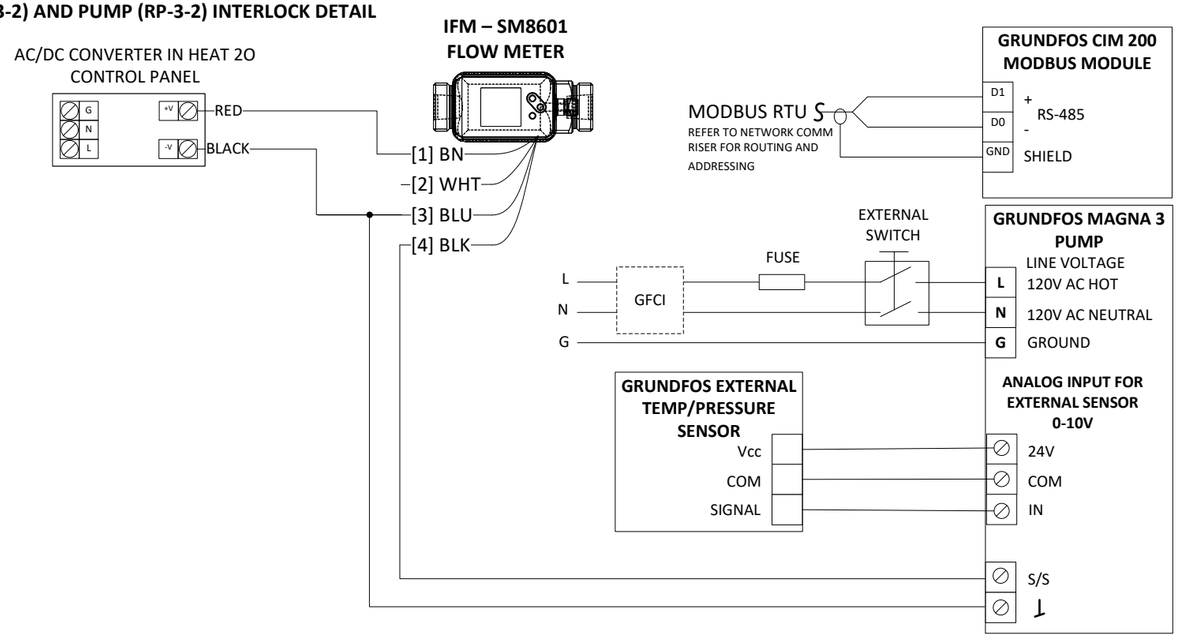
MITSUBISHI ELECTRIC TRANE HVAC US
MITSUBISHI ELECTRIC TRANE HVAC US LLC
1340 SATELLITE BLVD.
SUWANEE, GA 30024
PHONE: (800) 433-4822
FAX: (800) 889-9904

Bill of Materials				
Ref. Tag	**Description**	**Manufacturer**	**Model #**	**Qty**
TTE-1~3	IMMERSION SENSOR, 10K (TYPE III), 4" THERMISTOR W/WELL	ACI	A/AN-I4-GD	3
CSR-4	CURRENT SWITCH, 0-50A, 0-5VDC, SOLID CORE	FUNCTIONAL DEVICES	RIBXKTV5-50	1

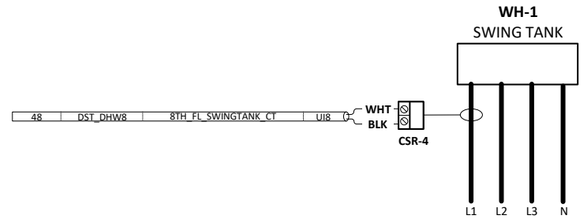
FLOW METER (FM-3-1) AND PUMP (RP-3-1) INTERLOCK DETAIL



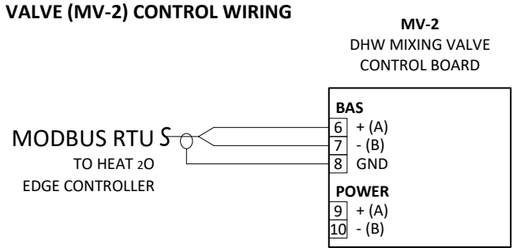
FLOW METER (FM-3-2) AND PUMP (RP-3-2) INTERLOCK DETAIL



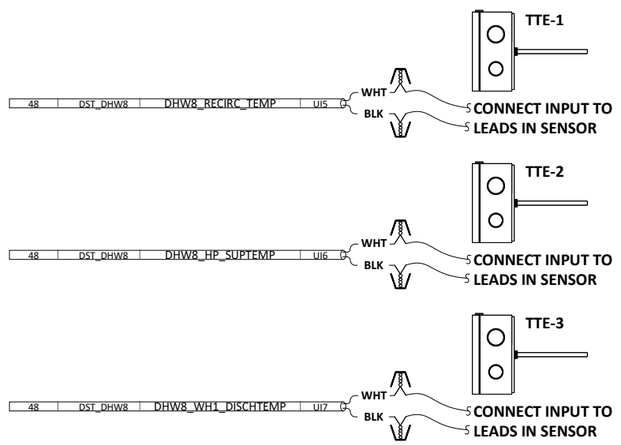
DHW SWING TANK (WH-1) CONTROL WIRING



DHW MIXING VALVE (MV-2) CONTROL WIRING



DHW TEMPERATURE SENSOR WIRING



LEVEL 8 - DOMESTIC WATER HEATING & HEAT RECOVERY SYSTEM WIRING (2 OF 2)

PROJECT NUMBER: PR-002076

LAST REVISION DATE: AUGUST 17, 2022

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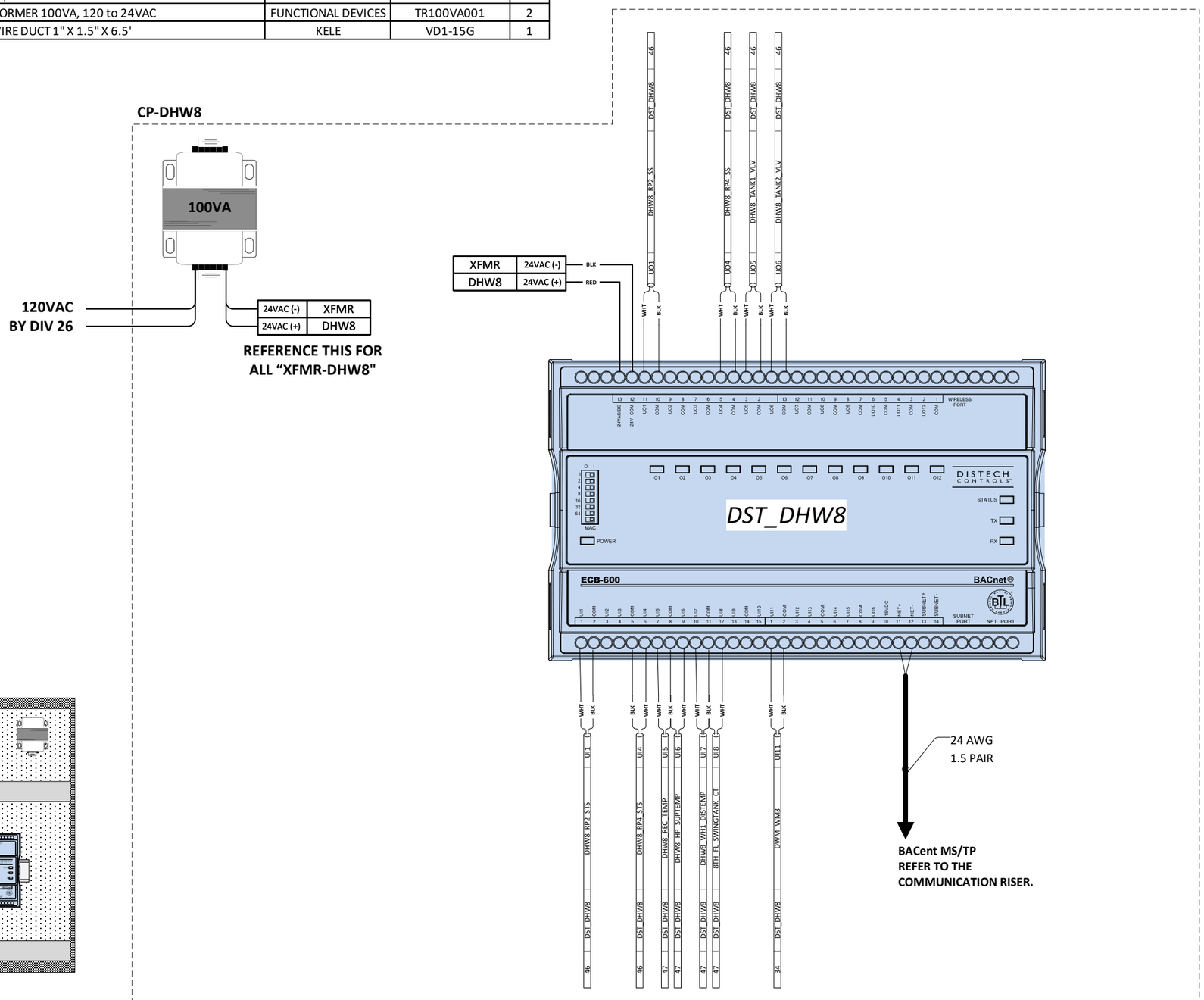
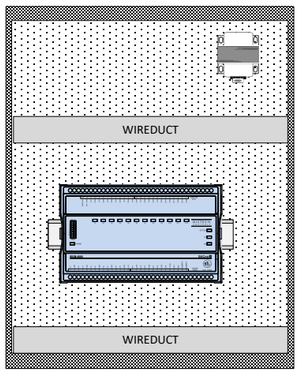
MARCEL HOTEL (PIRELLI BLDG)
LVL8 - DOMESTIC WATER HEATING & HEAT RECOVERY SYSTEM WIRING (2 OF 2)

LOCATION: NEW HAVEN, CT
CONTROLS ENGINEER: DT
PROJECT MANAGER: TJ

MITSUBISHI ELECTRIC TRANE HVAC US
MITSUBISHI ELECTRIC TRANE HVAC US LLC
1340 SATELLITE BLVD.
SUWANEE, GA 30024
PHONE: (800) 433-4822
FAX: (800) 889-9904

Bill of Materials				
Ref. Tag	**Description**	**Manufacturer**	**Model #**	**Qty**
CP-DHW	16x16x6 NEMA1 ENCLOSURE W/PERF PANEL	HOFFMAN	A-16N16ALPP	1
DIN-DHW	DIN RAIL ALUMINUM	KELE	BAM-1000	1
DST_DHW	ECB-600; 16UI and 12UO POINTS	DISTECH	CDIB-600X-00	1
DST_DHW-EX1	ECX-400; 12UI and 12UO POINTS	DISTECH	CDIX-400X-00	1
XFMR-DHW1~2	TRANSFORMER 100VA, 120 to 24VAC	FUNCTIONAL DEVICES	TR100VA001	2
WIREDUCT	GRAY WIRE DUCT 1" X 1.5" X 6.5'	KELE	VD1-15G	1





PANEL

NOT DRAWING TO SCALE

LEVEL 8 - DOMESTIC HOT WATER
DISTECH CONTROLLER WIRING

PROJECT NUMBER:	PR-002076
LAST REVISION DATE:	AUGUST 17, 2022
SHEET NUMBER:	PAGE 48 OF 57

REV	DESCRIPTION	DATE	REVISED BY
1	RECORD DRAWING	8/17/2022	DT

T:\PROJECTS\PR-002076 PIRELLI BLDG (MARCEL HOTEL)\07_JOB CLOSE OUT\O&M MANUALS\CONTROL DRAWING\PIRELLI BLDG_METUS CONTROLS APPLICATIONS DRAWING_RECORD.VSD

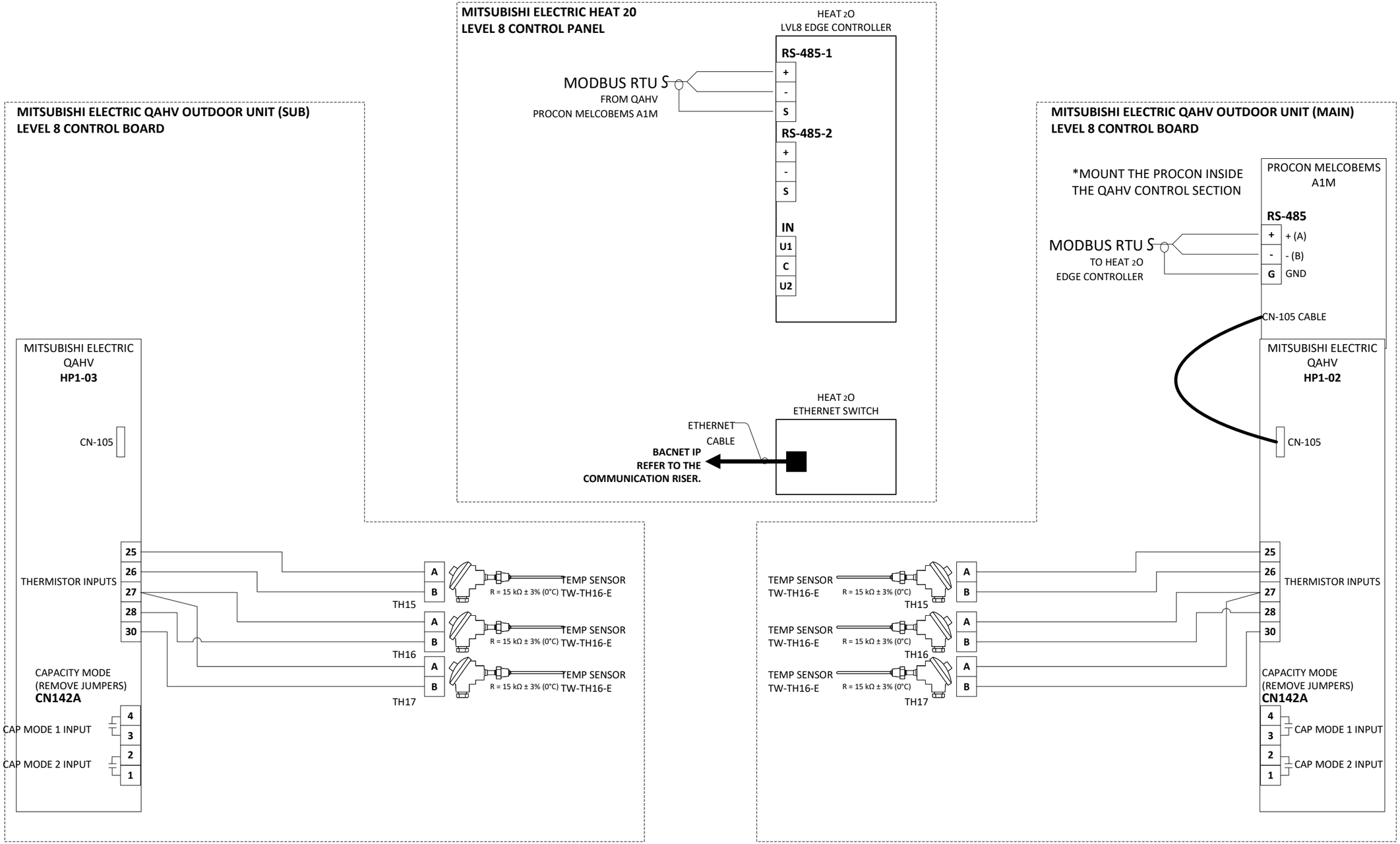
MARCEL HOTEL (PIRELLI BLDG)
LVL8 - DOMESTIC HOT WATER SYSTEM
DISTECH CONTROLLER WIRING

LOCATION: NEW HAVEN, CT
CONTROLS ENGINEER: DT
PROJECT MANAGER: TJ

MITSUBISHI ELECTRIC TRANE HVAC US

MITSUBISHI ELECTRIC TRANE
HVAC US LLC
1340 SATELLITE BLVD.
SUWANEE, GA 30024
PHONE: (800) 433-4822
FAX: (800) 889-9904

Bill of Materials				
Ref. Tag	**Description**	**Manufacturer**	**Model #**	**Qty**
HEAT 2O PNL	QAHV INTERACTIVE CONTROL PANEL	METUS	QAHV-CONTROLS-1	1
PROCON	PROCON MELCOBEMS MINI (A1M)	METUS	PAC-UKPRC001-CN-1	1
TH15~TH17	FURNISHED BY MECHANICAL CONTRACTOR	METUS	TW-TH16E	6



LEVEL 8 – HEAT 2O CONTROL WIRING

PROJECT NUMBER: PR-002076

LAST REVISION DATE: AUGUST 17, 2022

SHEET NUMBER: PAGE 49 OF 57

REVISIONS			
REV	DESCRIPTION	DATE	REVISED BY
1	RECORD DRAWING	8/17/2022	DT

MARCEL HOTEL (PIRELLI BLDG)

LVL8 - HEAT 2O CONTROL WIRING

LOCATION: NEW HAVEN, CT
CONTROLS ENGINEER: DT
PROJECT MANAGER: TJ

MITSUBISHI ELECTRIC TRANE HVAC US

MITSUBISHI ELECTRIC TRANE
HVAC US LLC
1340 SATELLITE BLVD.
SUWANEE, GA 30024
PHONE: (800) 433-4822
FAX: (800) 889-9904

SEQUENCE OF OPERATION – SINGLE ZONE VRF SYSTEM

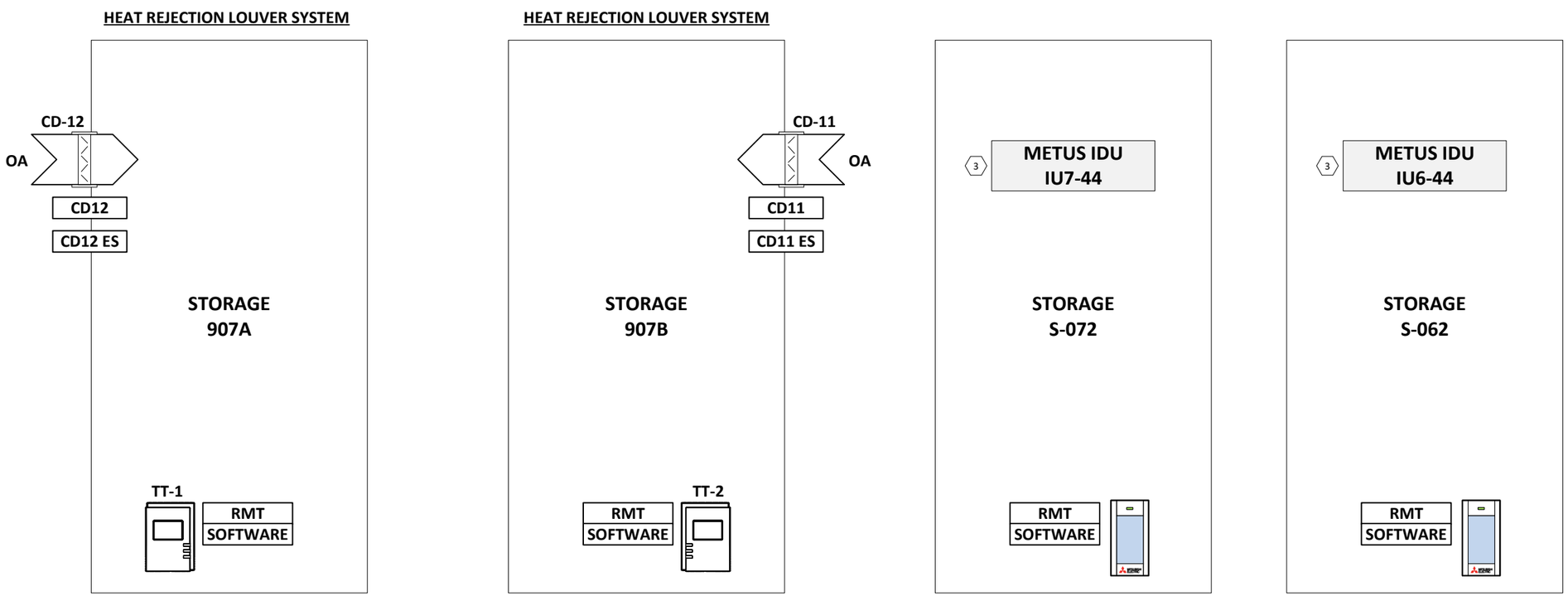
THE SINGLE ZONE THE VRF SYSTEMS WILL OPERATE BASED ON MANUFACTURER'S CONTROLS TO MAINTAIN THE BATTERY ROOMS (STORAGE S-062 AND S-072) AT SET POINT. THE SET POINT IN THESE SPACES WILL BE COORDINATED WITH THE MULTI-ZONE VRF HEAT PUMP HEAD WITHIN EACH SPACE. THE MULTI-ZONE VRF SYSTEM WILL BE THE PRIMARY SOURCE OF COOLING IN THE ROOM AND THE SET POINT IS TO BE SET AT 6°F (ADJ.) BELOW THE SINGLE ZONE VRF SET POINT (FOR EXAMPLE, MULTI-ZONE VRF SYSTEM SET POINT CAN BE 75°F (ADJ.) AND THE SINGLE ZONE VRF SYSTEM TO BE 81°F (ADJ.)).

THE OUTDOOR UNITS WILL START/STOP AND MODULATE ON FACTORY CONTROLS AS REQUIRED TO MAINTAIN SPACE TEMPERATURE SET POINTS FOR EACH INDOOR UNIT IN OPERATION.

A DDC TEMPERATURE SENSOR WILL BE INSTALLED FOR SPACE TEMPERATURE MONITORING (UNLESS VRF SYSTEM TEMPERATURE CAN BE UTILIZED THROUGH THE BACNET CONNECTION). PROVIDE HIGH/LOW TEMPERATURE ALARMS.

SEQUENCE OF OPERATION – STORAGE 907A AND 907B

THE SPACE TEMPERATURE WILL BE CONTINUOUSLY MONITORED. THE OUTDOOR AIR TEMPERATURE WILL BE CONTINUOUSLY MONITORED (FROM GLOBAL SENSORS). WHENEVER THE SPACE TEMPERATURE IN EITHER STORAGE ROOM RISES ABOVE SET POINT OF 90°F (ADJ.) AND THE SPACE IS ABOVE THE OUTDOOR AIR TEMPERATURE (BOTH CONDITIONS MUST BE TRUE), THE CORRESPONDING CONTROL DAMPER WILL OPEN. WHEN THE SPACE FALLS BELOW THE SPACE SET POINT, THE CONTROL DAMPER WILL CLOSE.



STORAGE SYSTEM LAYOUT

LOCATION: FLR 9 – STORAGE 907A & 907B
FLR 7 – STORAGE S-072
FLR 6 – STORAGE S-062

PROJECT NUMBER: PR-002076

LAST REVISION DATE: AUGUST 17, 2022

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1	RECORD DRAWING	8/17/2022	DT

MARCEL HOTEL (PIRELLI BLDG)

STORAGE SYSTEM LAYOUT

LOCATION: NEW HAVEN, CT
CONTROLS ENGINEER: DT
PROJECT MANAGER: TJ

MITSUBISHI ELECTRIC TRANE HVAC US
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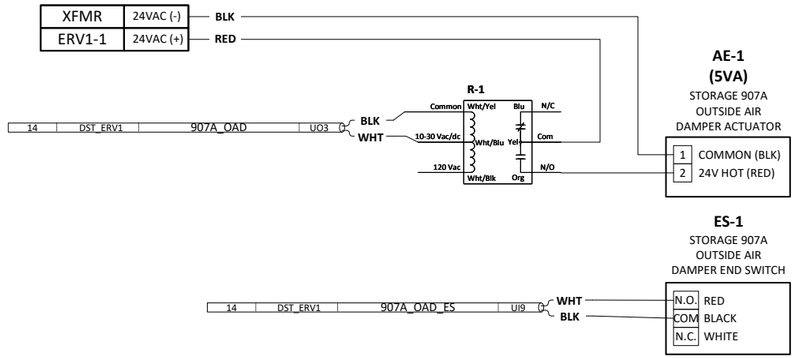
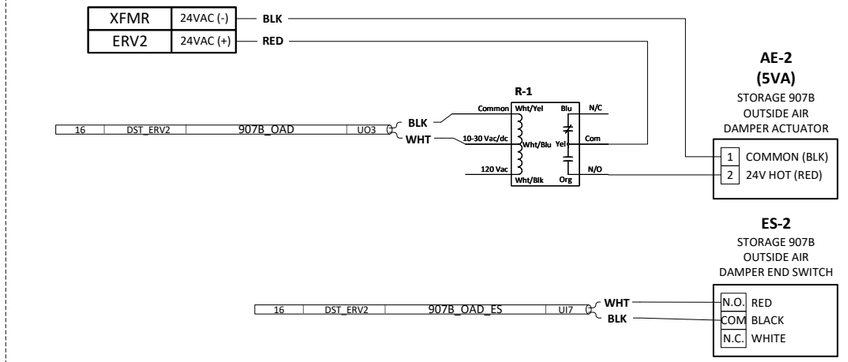
HVAC US LLC
1340 SATELLITE BLVD.
SUWANEE, GA 30024
PHONE: (800) 433-4822
FAX: (800) 889-9904

Bill of Materials				
Ref. Tag	**Description**	**Manufacturer**	**Model #**	**Qty**
AE-1~2	ACTUATOR, 180IN-LB, 24V ON/OFF	BELIMO	AFB24	2
ES-1~2	NON-MERCURY DAMPER END SWITCH, SPDT, 1/2" DAMPER SHAFT	KELE	TS-475	2
R-1~2	RELAY 10A SPDT W/ 10-30 VAC/DC/120 VAC COIL	FUNCTIONAL DEVICES	RIBU1C	2
TTE-1~2	ALLURE EC-SMART-VUE ROOM TEMP SENSOR	DISTECH	PDITE-SMRTVUE-01	2
CBL-1~2	GENERIC PATCH CORD, CAT5e, FT6, 50FT	DISTECH	CB-GPATCH5eFT6WH050	2

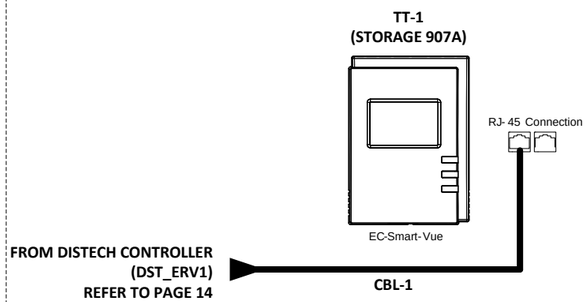
STORAGE 907A DAMPER ACTUATOR WIRING



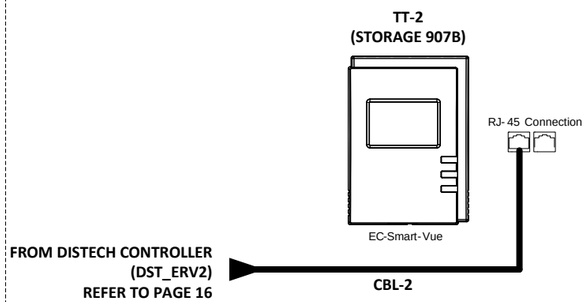
STORAGE 907B DAMPER ACTUATOR WIRING



STORAGE 907A SPACE TEMPERATURE WIRING



STORAGE 907B SPACE TEMPERATURE WIRING



STORAGE SYSTEM WIRING (1 OF 2)

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MARCEL HOTEL (PIRELLI BLDG)

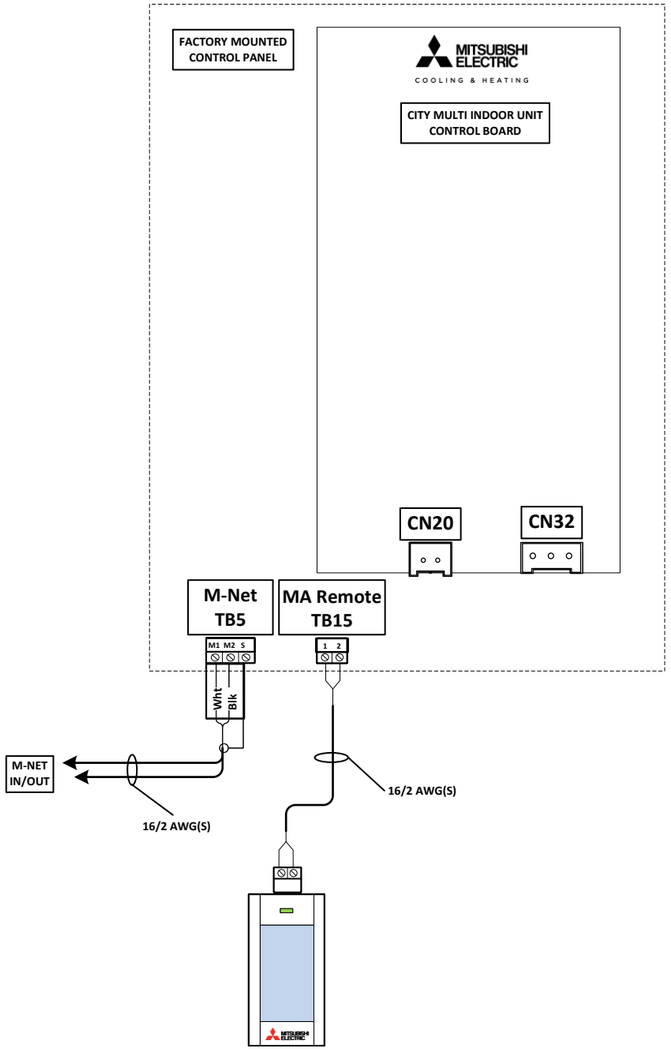
STORAGE SYSTEM WIRING (1 OF 2)

LOCATION: NEW HAVEN, CT
CONTROLS ENGINEER: DT
PROJECT MANAGER: TJ

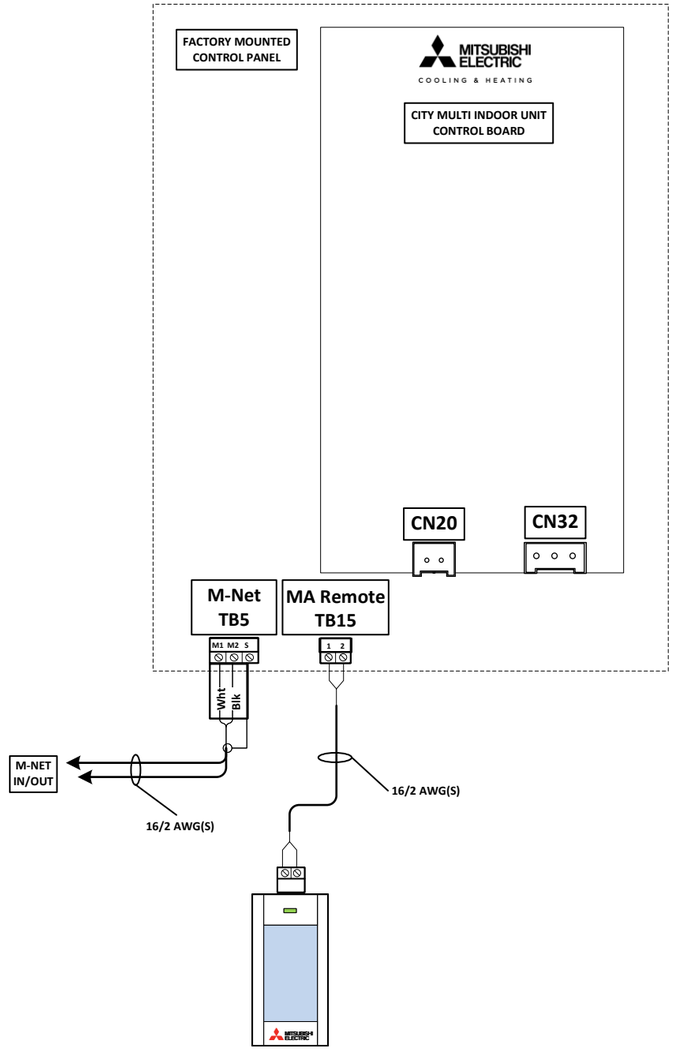
MITSUBISHI ELECTRIC TRANE HVAC US

MITSUBISHI ELECTRIC TRANE
HVAC US LLC
1340 SATELLITE BLVD.
SUWANEE, GA 30024
PHONE: (800) 433-4822
FAX: (800) 889-9904

STORAGE S-072 INDOOR UNIT WIRING



STORAGE S-062 INDOOR UNIT WIRING



STORAGE SYSTEM WIRING (2 OF 2)

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MARCEL HOTEL (PIRELLI BLDG)

STORAGE SYSTEM WIRING (2 OF 2)

LOCATION: NEW HAVEN, CT

CONTROLS ENGINEER: DT

PROJECT MANAGER: TJ

MITSUBISHI ELECTRIC TRANE HVAC US

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1340 SATELLITE BLVD.
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FAX: (800) 889-9904

SEQUENCE OF OPERATION – MULTI-ZONE VRF SYSTEM

THE VRF SYSTEM WILL BE UTILIZED FOR HEATING AND COOLING. INDOOR UNIT FAN OPERATION AND TEMPERATURE SET POINT WILL BE CONTROLLABLE BY THE BUILDING AUTOMATION SYSTEM.

THE MULTI-ZONE OUTDOOR UNITS WILL START/STOP AND MODULATE ON FACTORY CONTROLS AS REQUIRED TO MAINTAIN SPACE TEMPERATURE SET POINTS FOR EACH INDOOR UNIT IN OPERATION.

ALARM POINTS:

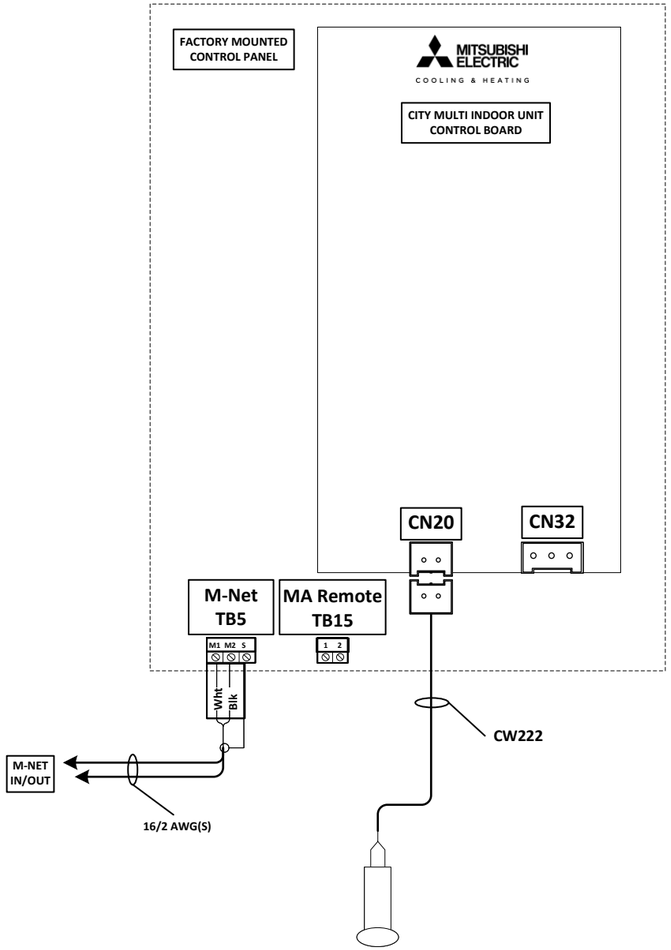
- ZONE TEMPERATURE HIGH
- ZONE TEMPERATURE LOW
- FAN COIL UNIT FAIL

SEQUENCE OF OPERATION – SINGLE ZONE VRF SYSTEM (ONLY APPLIES TO IU4-7 & OU4-2)

THE SINGLE ZONE THE VRF SYSTEMS WILL OPERATE BASED ON MANUFACTURER'S CONTROLS TO MAINTAIN THE BATTERY ROOMS (STORAGE S-062 AND S-072) AT SET POINT. THE SET POINT IN THESE SPACES WILL BE COORDINATED WITH THE MULTI-ZONE VRF HEAT PUMP HEAD WITHIN EACH SPACE. THE MULTI-ZONE VRF SYSTEM WILL BE THE PRIMARY SOURCE OF COOLING IN THE ROOM AND THE SET POINT IS TO BE SET AT 6°F (ADJ.) BELOW THE SINGLE ZONE VRF SET POINT (FOR EXAMPLE, MULTI-ZONE VRF SYSTEM SET POINT CAN BE 75°F (ADJ.) AND THE SINGLE ZONE VRF SYSTEM TO BE 81°F (ADJ.)).

THE OUTDOOR UNITS WILL START/STOP AND MODULATE ON FACTORY CONTROLS AS REQUIRED TO MAINTAIN SPACE TEMPERATURE SET POINTS FOR EACH INDOOR UNIT IN OPERATION.

A DDC TEMPERATURE SENSOR WILL BE INSTALLED FOR SPACE TEMPERATURE MONITORING (UNLESS VRF SYSTEM TEMPERATURE CAN BE UTILIZED THROUGH THE BACNET CONNECTION). PROVIDE HIGH/LOW TEMPERATURE ALARMS.



CITY MULTI INDOOR UNITS

TYPICAL OF 282

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MARCEL HOTEL (PIRELLI BLDG)

CITY MULTI INDOOR UNITS

LOCATION: NEW HAVEN, CT
CONTROLS ENGINEER: DT
PROJECT MANAGER: TJ

MITSUBISHI ELECTRIC TRANE HVAC US

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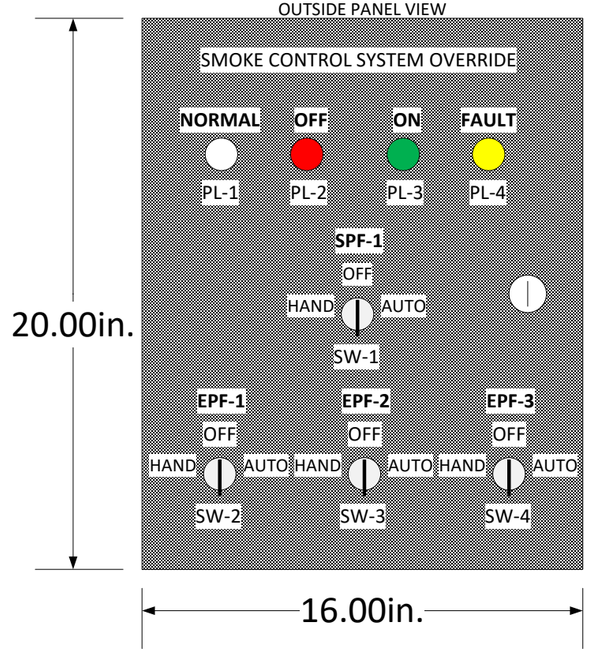
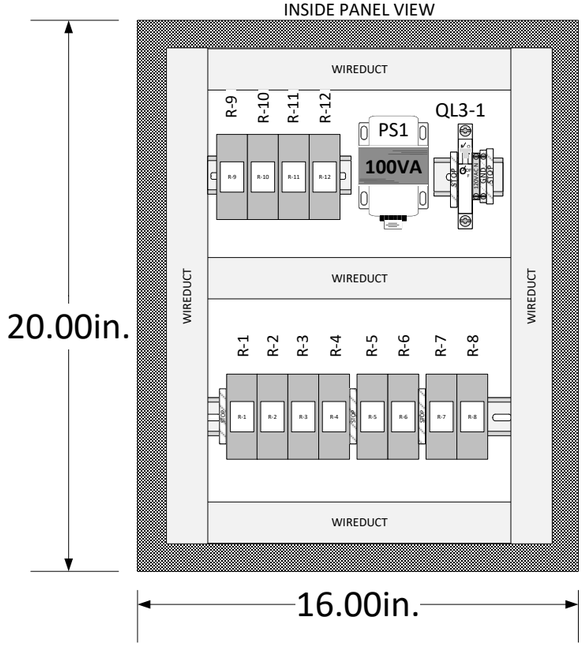
HVAC US LLC
1340 SATELLITE BLVD.
SUWANEE, GA 30024
PHONE: (800) 433-4822
FAX: (800) 889-9904

BILL OF MATERIALS				
REF. TAG	**DESCRIPTION**	**MANUFACTURER**	**MODEL#**	**QTY**
DINRAIL	1 METER ALUMINIUM DINRAIL	IDEC	BNDN-1000	1
WIREDUCT	WIRE DUCT	C3	WD-B40X80N	2
PANEL	ENCLOSURE 18"x16"x6"	SAGINAW	SCE-20N1606LP	1
	SUB-PANEL 18"x14"	SAGINAW	SCE-20N16MP	1
	CYLINDER LOCK	SAGINAW	SCE-DLKLDB	1
	EXTERNAL STOP	SAGINAW	SCE-128577	1
PS1	TRANSFORMER, 100VA, 120VAC-24VAC	FUNCTIONAL DEVICES	TR100VA001	1
SW-1~4	SELECTOR SWITCH, 3 POSITION, 2 NORNALLY OPEN	IDEC	ASW320	4
	CUSTOM ADHESIVE LABEL			13
STOP	DINRAIL TERMINAL BLOCK STOP	WAGO	249-116	5
QL3-1	CIRCUIT BREAKER, 3A, 1-POLE, DIN MOUNTED	CIRCUIT BREAKERS (CBI)	QL-1-13-DM-KM-03	1
TB	TERMINAL BLOCK, 2-CONDUCTOR, GRAY	WAGO	2002-1201	1
GND	GROUND, TERMINAL BLOCK, 2-CONDUCTOR, GREEN-YELLOW	WAGO	2002-1207	1
R-1~12	DIN MOUNT RELAY 10A SPDT W/24VAC COIL; SPDT	IDEC	RH1B-ULAC24V	12
	DIN MOUNT RELAY SOCKET	IDEC	SH1B-05	12
PL-1	WHITE PILOT LIGHT	IDEC	APW199D-W-24	1
PL-2	RED PILOT LIGHT	IDEC	APW199D-R-24	1
PL-3	GREEN PILOT LIGHT	IDEC	APW199D-G-24	1
PL-4	YELLOW/AMBER PILOT LIGHT	IDEC	APW199D-A-24	1

OUTSIDE PANEL VIEW



INSIDE PANEL VIEW



SMOKE CONTROL SYSTEM OVERRIDE PANEL LAYOUT

MOUNTING LOCATION:

SCALE 1:5.5

PROJECT NUMBER: PR-002076

LAST REVISION DATE: AUGUST 17, 2022

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T:\PROJECTS\PR-002076 PIRELLI BLDG (MARCEL HOTEL)\07_JOB CLOSE OUT\O&M MANUALS\CONTROL DRAWING\PIRELLI BLDG_METI'S CONTROLS APPLICATIONS DRAWING_RECORD.VSD

MARCEL HOTEL (PIRELLI BLDG)

SMOKE CONTROL SYSTEM OVERRIDE PANEL LAYOUT

LOCATION: NEW HAVEN, CT

CONTROLS ENGINEER: DT

PROJECT MANAGER: TJ

MITSUBISHI ELECTRIC TRANE HVAC US

MITSUBISHI ELECTRIC TRANE HVAC US LLC
1340 SATELLITE BLVD.
SUWANEE, GA 30024
PHONE: (800) 433-4822
FAX: (800) 889-9904

SMOKE CONTROL SYSTEM OVERRIDE PANEL WIRING

SCALE 1:4

PROJECT NUMBER: PR-002076

LAST REVISION DATE: AUGUST 17, 2022

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MARCEL HOTEL (PIRELLI BLDG)
SMOKE CONTROL SYSTEM OVERRIDE PANEL WIRING

LOCATION: NEW HAVEN, CT
CONTROLS ENGINEER: DT
PROJECT MANAGER: TJ

MITSUBISHI ELECTRIC TRANE HVAC US

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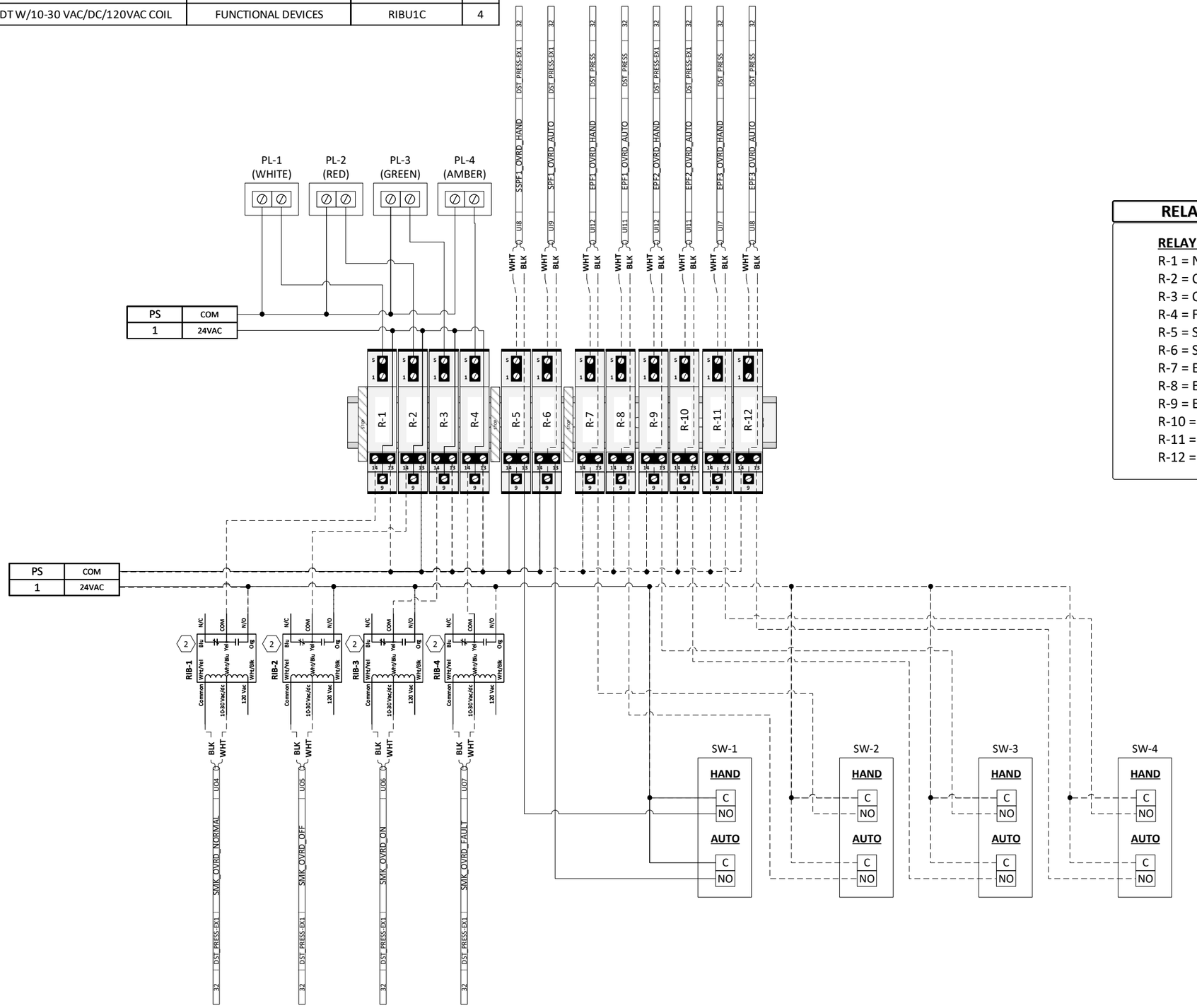
HVAC US LLC
1340 SATELLITE BLVD.
SUWANEE, GA 30024
PHONE: (800) 433-4822
FAX: (800) 889-9904

Bill of Materials				
Ref. Tag	**Description**	**Manufacturer**	**Model #**	**Qty**
RIB-1~4	ENCLOSED RELAY 10A SPDT W/10-30 VAC/DC/120VAC COIL	FUNCTIONAL DEVICES	RIBU1C	4



SMOKE CONTROL SYSTEM OVERRIDE PANEL
RELAY WIRING

RELAY LABELS:

RELAY # = LABEL
R-1 = NORMAL
R-2 = OFF
R-3 = ON
R-4 = FAULT
R-5 = SPF-1 HAND
R-6 = SPF-1 AUTO
R-7 = EPF-1 HAND
R-8 = EPF-1 AUTO
R-9 = EPF-2 HAND
R-10 = EPF-2 AUTO
R-11 = EPF-2 HAND
R-12 = EPF-2 AUTO

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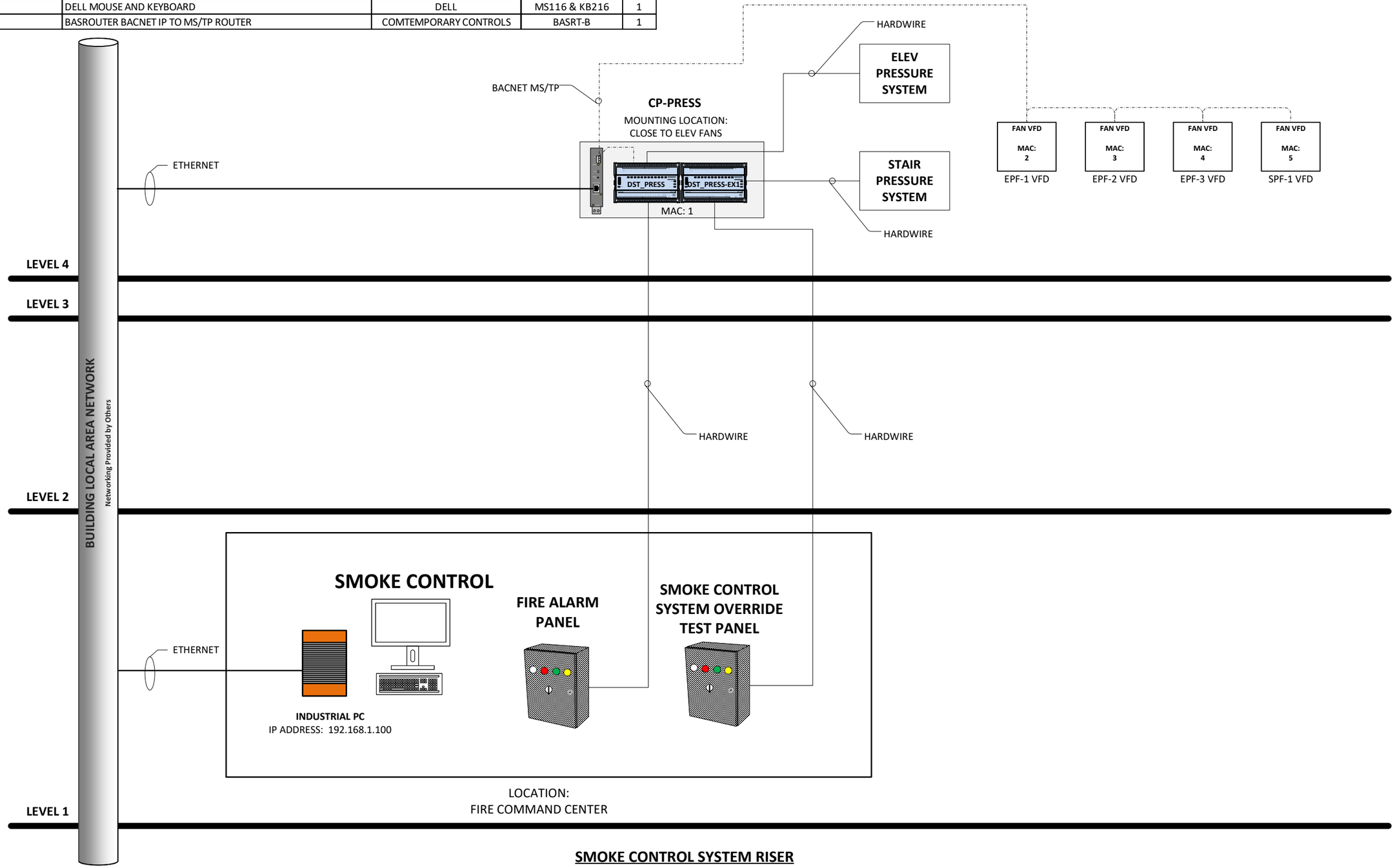
MARCEL HOTEL (PIRELLI BLDG)
SMOKE CONTROL SYSTEM OVERRIDE PANEL
RELAY WIRING

LOCATION: NEW HAVEN, CT
CONTROLS ENGINEER: DT
PROJECT MANAGER: TJ

MITSUBISHI ELECTRIC TRANE HVAC US
MITSUBISHI ELECTRIC TRANE HVAC US LLC
1340 SATELLITE BLVD.
SUWANEE, GA 30024
PHONE: (800) 433-4822
FAX: (800) 889-9904

Bill of Materials				
Ref. Tag	**Description**	**Manufacturer**	**Model #**	**Qty**
SMOKE CONTROL PC	ML100G SERIES INDUSTRIAL PC	ONLOGIC	ML100G-53	1
	NIAGARA 4 SUPERVISOR W/ 0 NIAGARA NETWORK CONNECTIONS	LYNXSPRING	JENE-SUP-0	1
	SUPERVISOR 0 - INITIAL 18 MONTH MAINTENANCE	LYNXSPRING	JENE-SUP-0-SMA-INIT	1
	NIAGARA 4; 10 FIELD DEVICES AND 500 POINTS	LYNXSPRING	JENE-SUP-DEVICE-10	1
	EC-NET SUPPORT PACK - 5 DEVICES, 250 POINTS	DISTECH	SDIDI-ECNETSP-5	1
	DELL 24" MONITOR	DELL	E2422H	1
	DELL MOUSE AND KEYBOARD	DELL	MS116 & KB216	1
	BASROUTER BACNET IP TO MS/TP ROUTER	COMTEMPORARY CONTROLS	BASRT-B	1



SMOKE CONTROL SYSTEM RISER

PROJECT NUMBER: PR-002076

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T:\PROJECTS\PR-002076 PIRELLI BLDG (MARCEL HOTEL)\07_JOB CLOSE OUT\O&M MANUALS\CONTROL DRAWING PIRELLI BLDG_METOS CONTROLS APPLICATIONS DRAWING_RECORD.VSD

MARCEL HOTEL (PIRELLI BLDG)

SMOKE CONTROL SYSTEM RISER

LOCATION: NEW HAVEN, CT
CONTROLS ENGINEER: DT
PROJECT MANAGER: TJ

MITSUBISHI ELECTRIC TRANE HVAC US

MITSUBISHI ELECTRIC TRANE
HVAC US LLC
1340 SATELLITE BLVD.
SUWANEE, GA 30024
PHONE: (800) 433-4822
FAX: (800) 889-9904

1340 Satellite Blvd.
Suwanee, GA 30024
Tel.: (800) 433-4822

Section 2: Valve Schedule

BELIMO

Bronze Body, Stainless Steel Ball and Stem

Technical data sheet B2050VS-04

2-year warranty

Technical data

Functional data	Valve Size	0.5" [15]
	Fluid	chilled or hot water, up to 60% glycol, steam
	Fluid Temp Range (water)	-22...280°F [-30...138°C]
	Body Pressure Rating	600 psig WOG
	Close-off pressure Δps	600 psi
	Flow characteristic	modified equal percentage
	Max Differential Pressure (Steam)	35 psi
	Flow Pattern	2-way
	Leakage rate	ANSI Class VI
	Controllable flow range	90° rotation
	Cv	4
	Maximum Inlet Pressure (Steam)	35 psi [241 kPa]
	Body pressure rating note	600 psig WOG
	Maximum Velocity	15 FPS
Materials	Valve body	Bronze B584-C84400
	Housing seal	PTFE
	Stem seal	RPTFE
	Seat	RPTFE
	Lock nut	stainless steel
	Pipe connection	NPT female ends
	Retainer	B16 Brass
	Ball	316 stainless steel
Suitable actuators	Non-Spring	LMB(X) GRCB(X) GRB(X)

Safety notes

- WARNING: This product can expose you to lead which is known to the State of California to cause cancer and reproductive harm. For more information go to www.p65warnings.ca.gov

Product features

Application

This valve is typically used in air handling units on heating or cooling coils, and fan coil unit heating or cooling coils. Some other common applications include Unit Ventilators, VAV Box re-heat coils and bypass loops. This valve is suitable for use in a hydronic system with variable flow.

This valve is designed with MFT functionally which facilitates the use of various control input.

Up to 35 psi steam

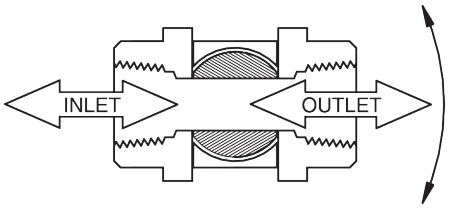
1/2" - 2" 600 PSIG WOG, Cold Non-Shock

Federal Specification: WW-V-35C, Type II

Composition: BZ

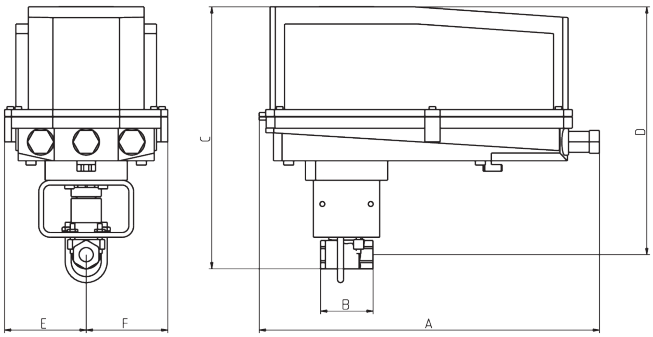
Style: 3

Flow/Mounting details



Dimensions

Dimensional drawings



B2050VS..+GRC..N4

A	B	C	D	E	F
14.11" [358.5]	2.17" [55.5]	10.87" [276]	10.28" [261]	3.39" [86]	3.39" [86]

Technical data sheet LF24 US

On/Off, Spring Return, AC/DC 24 V

On/Off, Spring Return, 24V, Torque min. 35 in-lb, for control of air dampers

5-year warranty

Technical data

Electrical data	Nominal voltage	AC/DC 24 V
	Nominal voltage frequency	50/60 Hz
	Power consumption in operation	5 W
	Power consumption in rest position	2.5 W
	Transformer sizing	7 VA (class 2 power source)
	Electrical Connection	18 GA appliance cable, 3 ft [1 m], with 1/2" conduit connector
	Overload Protection	electronic throughout 0...95° rotation
	Electrical Protection	actuators are double insulated
Functional data	Torque motor	35 in-lb [4 Nm]
	Direction of motion motor	selectable with switch 0/1
	Direction of motion fail-safe	reversible with cw/ccw mounting
	Angle of rotation	Max. 95°,
	Running Time (Motor)	75 s
	Running time fail-safe	<25 s @ -4...122°F [-20...50°C], <60 s @ -22°F [-30°C]
	Noise level, motor	50 dB(A)
	Noise level, fail-safe	62 dB(A)
	Shaft Diameter	3/8...1/2" round, centers on 1/2"
	Position indication	Mechanical
Safety data	Degree of protection IEC/EN	IP54
	Degree of protection NEMA/UL	NEMA 2 UL Enclosure Type 2
	Agency Listing	cULus acc. To UL 873 and CAN/CSA C22.2 No. 24-93
	Quality Standard	ISO 9001
	Ambient temperature	-22...122°F [-30...50°C]
	Storage temperature	-40...176°F [-40...80°C]
	Ambient humidity	max. 95% r.H., non-condensing
	Servicing	maintenance-free
Weight	Weight	3.2 lb [1.5 kg]
Materials	Housing material	galvanized steel

Product features

Application

For On/Off, fail-safe control of dampers in HVAC systems. Actuator sizing should be done in accordance with the damper manufacturer's specifications. Control is On/Off from an auxiliary contact or a manual switch. The actuator is mounted directly to a damper shaft from 3/8" up to 1/2" in diameter by means of its universal clamp, 1/2" shaft centered at delivery. For shafts up to 3/4" use K6-1 accessory. A crank arm and several mounting brackets are available for applications where the actuator cannot be direct coupled to the damper shaft.

Operation

The LF series actuators provide true spring return operation for reliable fail-safe application and positive close off on air tight dampers. The spring return system provides consistent torque to the damper with, and without, power applied to the actuator. The LF series provides 95° of rotation and is provided with a graduated position indicator showing 0° to 95°. The actuator may be stalled anywhere in its normal rotation without the need of mechanical end switches. Power consumption is reduced in holding mode. The actuator is double insulated so an electrical ground connection is not necessary.

Typical specification

On/Off spring return damper actuators shall be direct coupled type which require no crank arm and linkage and be capable of direct mounting to a shaft up to a 3/4" diameter and center on a 1/2" shaft (default). Actuator shall deliver a minimum output torque of 35 in-lbs. The actuator must be designed so that they may be used for either clockwise or counter clockwise failsafe operation. Actuators shall be protected from overload at all angles of rotation. If required, one SPDT auxiliary switch shall be provided with one switch having the capability of being adjustable. Actuators with auxiliary switch must be constructed to meet the requirement for Double Insulation so an electrical ground connection is not required to meet agency listings. Actuators shall be cULus listed, have a 5 year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo.

Accessories

Electrical accessories

Description	Type
Auxiliary switch, mercury-free	P475
Auxiliary switch, mercury-free	P475-1
Signal Siumlator, Power supply AC 230 V	PS-100
Transformer, AC 120 V to AC 24 V, 40 VA	ZG-X40

Mechanical accessories

Description	Type
Shaft extension 170 mm Ø10 mm for damper shaft Ø 6...16 mm	AV6-20
End stop indicator	IND-LF
Shaft clamp for LF..	K6 US
Shaft clamp reversible, clamping range Ø16...20 mm	K6-1
Ball joint suitable for damper crank arm KH8 / KH10	KG10A
Ball joint suitable for damper crank arm KH8	KG6
Ball joint suitable for damper crank arm KH8	KG8
Actuator arm, clamping range Ø8...16 mm, Slot width 8.2 mm	KH-LF
V-bolt Kit for KH-LF.	KH-LFV
Damper crank arm Slot width 8.2 mm, for Ø1.05"	KH12
Damper crank arm Slot width 6.2 mm, clamping range Ø10...18 mm	KH6
Damper crank arm Slot width 8.2 mm, clamping range Ø10...18 mm	KH8
Anti-rotation bracket LF.	LF-P
Push rod for KG10A ball joint (36" L, 3/8" diameter).	SH10
Push rod for KG6 & KG8 ball joints (36" L, 5/16" diameter).	SH8
Wrench 8 mm and 10 mm	TOOL-06
Angle of rotation limiter, with end stop	ZDB-LF
Form fit adapter 8x8 mm	ZF8-LF
Mounting Bracket: ZS-260 Right Angle	ZG-109
Linkage kit	ZG-110
Mounting bracket for LF..	ZG-112
Damper clip for damper blade, 3.5" width.	ZG-DC1
Damper clip for damper blade, 6" width.	ZG-DC2
LF crankarm adaptor kit (includes ZG-112).	ZG-LF112
LF crankarm adaptor kit (T bracket included).	ZG-LF2
Shaft extension for 3/8" diameter shafts (4" L).	ZG-LMSA-1
Shaft extension for 1/2" diameter shafts (5" L).	ZG-LMSA-1/2-5
Weather shield 13x8x6" [330x203x152 mm] (LxWxH)	ZS-100
Base Plate, for ZS-100	ZS-101
Weather shield 16x8-3/8x4" [406x213x102 mm] (LxWxH)	ZS-150
Explosion Proof Housing 16x10x6.435" [406x254x164 mm] (LxWxH), UL and CSA, Class I, Zone 1&2, Groups B, C, D, (NEMA 7), Class III, Hazardous (classified) Locations	ZS-260
Weather shield 17-1/4x8-3/4x5-1/2" [438x222x140 mm] (LxWxH), NEMA 4X, with mounting brackets	ZS-300

Weather shield 17-1/4x8-3/4x5-1/2" [438x222x140 mm] (LxWxH), NEMA 4X, with mounting brackets	ZS-300-5
Shaft extension 1/2"	ZS-300-C1
Shaft extension 3/4"	ZS-300-C2
Shaft extension 1"	ZS-300-C3

Electrical installation

Warning! Live Electrical Components!
During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

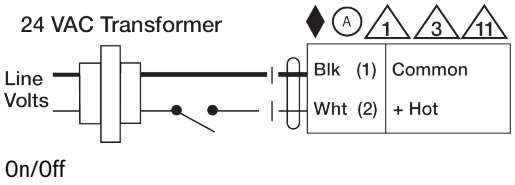
Meets cULus requirements without the need of an electrical ground connection.

A Actuators with appliance cables are numbered.

1 Provide overload protection and disconnect as required.

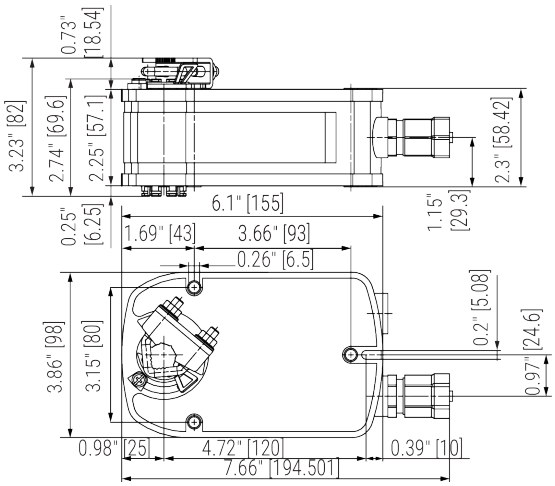
3 Actuators may also be powered by 24 VDC.

11 Actuators may be connected in parallel if not mechanically linked. Power consumption and input impedance must be observed.



Dimensions

Dimensional drawings



INSTRUCTION MANUAL

B2 VS and B2 VSS Ball Valves

B2 VS Series Ball Valves

Technical Data	
Service	chilled or hot water, 60% glycol, 35 lb. steam
Flow characteristic	modified equal percentage
Action	90° rotation valve open CCW, valve closed CW
End fitting	female NPT
Materials:	
Body	B584-C84400 bronze
Ball	316 stainless
Seats	MPTFE, RPTFE
Stem	A276-316 stainless steel, 316 stainless steel
Stem bearing	RPTFE, PEEK/PTFE
Stem packing	MPTFE
Body seal	PTFE
Retainer	B16 brass, B584-C84400 bronze
Gland	B16 brass
Jam nut	Stainless steel
Belleville washer	Stainless steel
Pressure rating	600 psig WOG
Media temp. range	-22...280°F [-30...138°C]
Maximum velocity rating	15 fps
Leakage rating	ANSI Class VI

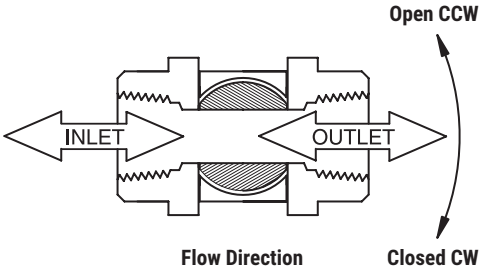
NOTE:
B2050VS-01, B2050VS-02, B2050VS-04, and B2050VS-15 are rated for single temperature applications only (chilled or hot water).

B2 VSS Series Ball Valves

Technical Data	
Service	chilled or hot water, 60% glycol, 50 lb. steam
Flow characteristic	modified equal percentage
Action	90° rotation valve open CCW, valve closed CW
End fitting	female NPT
Materials:	
Body	A351-CF8M stainless steel
Ball	A276-316 stainless steel, 316 stainless steel
Seats	RPTFE, MPTFE
Stem	A276-316 stainless steel
Stem bearing	RPTFE, PEEK/PTFE
Stem packing	MPTFE
Body seal	PTFE
Retainer	A351-CF8M stainless steel, A276-316 stainless steel
Gland	A276-316 stainless steel
Jam nut	Stainless steel
Belleville washer	Stainless steel
Pressure rating	2000 psi WOG (½...1") 1500 psi WOG (2")
Media temp. range	-22...298°F [-30...148°C]
Maximum velocity rating	15 fps
Leakage rating	ANSI Class VI

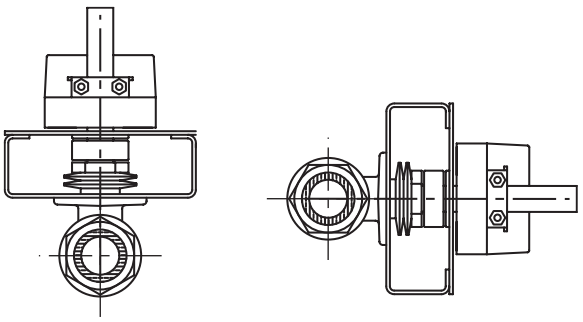
NOTE:
B2050VSS-15 is rated for single temperature applications only (chilled or hot water).

Flow Pattern



NOTE:
To avoid torque increase during off season shut down, or other periods of inactivity longer than 1 month - the valve should be exercised (actuator or manually driven full open-closed cycle) at least once per month. This is necessary to avoid any application problems after an off season shut down.

Piping/Mounting Orientation



71434-00001.D

Installation

1. Inspect shipping package, valve, linkage, and actuator for physical damage. If shipping damage has occurred notify appropriate carrier. Do not install.
2. If a replacement, remove existing valve, linkage and actuator from the piping system.
3. If actuator and linkage are removed, they must be reinstalled correctly. The actuator must be rotated so that the valve sits properly for close off.
4. Install valve with the proper ports as inlets and outlets. Check that inlet and outlet of 2-way valves are correct. Flow direction arrows must be correct. See supplied drawings on previous page.
5. Blow out all piping and thoroughly clean before valve installation.
6. Clean male pipe threads with wire brush and rag. If threads have been damaged or exposed to weather, running a tap or die over the threads may straighten them. Clean pipes, threads, and valve threads before installation; check for any foreign material that can become lodged in trim components. Strainers should be cleaned after initial startup.
7. Pipe sealing compound should be applied sparingly after cleaning and may not be applied to the two lead threads of a screwed pipe, which are innermost inside the valve. Sealing compound is to be placed on male threads only. The purpose is to lubricate the pipes when tightening.
8. Valve must be installed per the mounting drawings shown.
9. Start the connection by turning the valve or pipe by hand as far as possible. Be certain the threads mate by the "feel" of the connection.
10. Use wrenches to tighten the valve to the pipe. Do not over tighten or strip the threads. Two wrenches are necessary to avoid damaging the valve.
11. Two-way valve Normally Open or Closed configurations must be verified by examining both the mechanical drawings and the valve and actuator. See details below.

Valve Maintenance

External stem leakage is common over the life of the valve. To stop leakage due to normal wear, tighten packing gland screw clockwise by 1/8 turn increments until observed leakage is halted. Do not exceed values displayed in Table 1.

Table 1: Stem Nut Torque

Valve Size	Stem Nut Torque (in-lb)
½"	50
¾...1¼"	75
1½...2"	150

Warning!

Valve should not be used for combustible gas applications. Gas leaks and explosions may result. Do not install in systems which exceed the ratings of the valve.

- Avoid installations where valve may be exposed to excessive moisture, corrosive fumes, vibration, high ambient temperatures, elements, or high traffic areas with potential for mechanical damage.
- Valve assembly location must be within ambient ratings of actuator.
- The valve assembly will require heat shielding, thermal isolation, or cooling if combined effect of medium and ambient temperatures – conduction, convection, and radiation – is above 122°F for prolonged time periods at the actuator.
- Strainers should be installed before coil and valve.
- Visual access must be provided. Assembly must be accessible for routine scheduled service. Contractor should provide unions for removal from line and isolation valves.
- Avoid excessive stresses. Mechanical support must be provided where reducers have been used and the piping system may have less structural integrity than full pipe sizes.
- Sufficient upstream and downstream piping runs must be provided to ensure proper valve capacity and flow response. Five diameters in each direction are recommended.
- Life span of valve stems and packing is dependent on maintaining non-damaging conditions. Poor water treatment or filtration, corrosion, scale, other particulate can result in damage to trim components. A water treatment specialist should be consulted.
- Normal thread engagement between male pipe thread and valve body should be observed. Pipe run that is in too far will damage the valve.

WARNING:
This product can expose you to lead which is known to the State of California to cause cancer and reproductive harm. For more information go to

www.P65Warnings.ca.gov

1340 Satellite Blvd.
Suwanee, GA 30024
Tel.: (800) 433-4822

Section 3: Workstation & Software

data sheet

niagara 4 supervisor

PRODUCT DEFINITION

The Niagara Supervisor is part of the portfolio of Java-based controller/server products, software applications and tools powered by the Niagara Framework®. It provides server-level functions for a network of JACE, Niagara Edge and other field devices. The Niagara Supervisor serves real-time graphical information to standard web-browser clients and performs essential functions such as analytics, centralized data logging/trending, archiving to external databases, alarming, dashboarding, system navigation, master scheduling, database management and integration with other enterprise software applications. Additionally, the Niagara Supervisor provides a comprehensive graphical engineering toolset for application development and configuration.

The Niagara Supervisor allows the networking of multiple Niagara-based JACE® and Niagara Edge™ controllers, along with other IP-based controllers and field devices. It enables the design, configuration and maintenance of a unified, real-time controls network.

key features

- Centralized system management
- Utilize tags to quickly navigate to buildings, systems and equipment when diagnosing operational problems or emergencies
- Compare data between buildings
- Export system data to external databases
- Integrate a Building Automation System (BAS) with other enterprise applications
- Integrate with other applications, such as work order management, analytics, etc.
- Single tool used to program JACE, Niagara Edge controllers and Supervisor
- Remotely back up JACE and Edge applications to Supervisor
- Batch provisioning of JACE and Edge firmware upgrades, security credentials, applications and commissioning options from Supervisor
- Robust built-in analytic capabilities supported by standard Niagara components and visualizations
- Includes Niagara Analytics, which features data source, functional and mathematical programming blocks that enable sophisticated analytic algorithms
- Compatibility with Niagara Enterprise Security access control and security application. Allows integration of BAS and access control to save energy and optimize operations
- Eligible for accreditation under the Federal Risk Management Framework (RMF)
- FIPS 140-2 Level 1 conformance available

powered by niagara framework®

SPECIFICATIONS

Features a HTML5 and Java-enabled user interface (UI), and includes a JavaScript data interface library (BajaScript)

Supports an unlimited number of users over the internet/intranet with a standard web browser (depending on the host PC resources)

Optional enterprise-level data archival using SQL, MySQL or Oracle databases, and HTTP/HTML/XML, CSV or text formats

“Audit Trail” of database changes, database storage and backup, global time functions, calendar, central scheduling, control and energy management routines

Sophisticated alarm processing and routing, including email alarm acknowledging

Access to alarms, logs, graphics, schedules and configuration data with a standard web browser

Niagara follows industry best practices for cyber security, with support for features such as strong, hashed passwords, TLS for secure communications and certificate management tools for authentication. A built-in Security Dashboard provides a comprehensive and actionable view of the security posture of your Niagara deployment

HTML-based help system that includes comprehensive online system documentation

Supports multiple Niagara-based stations connected to a local Ethernet network or the internet

Provides online/offline use of the Niagara Framework® Workbench graphical configuration tool and a comprehensive Java Object Library

Optional direct Ethernet-based driver support for most Open IP field bus protocols (see supported drivers document)

SOFTWARE & DRIVERS

Every Niagara Supervisor comes with a Niagara 4 software license, along with multiple open-protocol IP drivers that are compatible with standard control networks. If required, other drivers can be purchase separately. For an up-to-date list of supported drivers, visit the resource library on tridium.com.

SOFTWARE MAINTENANCE

Purchase of a software maintenance agreement (SMA) is required with initial Niagara Supervisor licensing. The initial SMA is for 18 months, with extended agreements of 3 years and 5 years available for discounted rates.

If a Software Maintenance Agreement is not in effect for any period, the price of maintenance for the next period for which it is purchased will be priced at a cost equal to the maintenance fee for the period(s) for which maintenance was not purchased, up to a maximum of 5 years, plus the maintenance fee for the next year.

For an up-to-date list of supported drivers, visit the resource library on tridium.com.

ORDERING INFORMATION

Part number	Description
SUP-0	No Niagara network – Devices only. 18mo SMA required
SUP-0-SMA-INIT	18mo initial SMA required (3YR or 5YR can be substituted)
SUP-1	1 Niagara network connection (18mo SMA req)
SUP-1-SMA-INIT	18mo initial SMA required (3YR or 5YR can be substituted)
SUP-2	2 Niagara network connections (18mo SMA req)
SUP-2-SMA-INIT	18mo initial SMA required (3YR or 5YR can be substituted)
SUP-3	3 Niagara network connections (18mo SMA req)
SUP-3-SMA-INIT	18mo initial SMA required (3YR or 5YR can be substituted)
SUP-10	10 Niagara network connections (18mo SMA req)
SUP-10-SMA-INIT	18mo initial SMA required (3YR or 5YR can be substituted)
SUP-100	100 Niagara network connections (18mo SMA req)
SUP-100-SMA-INIT	18mo initial SMA required (3YR or 5YR can be substituted)
SUP-UNL	Unlimited Niagara network connections (18mo SMA req)
SUP-UNL-SMA-INIT	18mo initial SMA required (3YR or 5YR can be substituted)
SUP-UP-1	Adds 1 additional Niagara connection to Supervisor
SUP-STATION-5UP	Adds 5 additional Niagara connections to Supervisor
SUP-UP-100	Upgrades small Supervisor to 100 Niagara connections
SUP-UP-UNL	Upgrades Supervisor 100 to unlimited Niagara connections
SUP-DEVICE-10	10 device upgrade (standard drivers included)
SUP-DEVICE-25	25 device upgrade (standard drivers included)
SUP-DEVICE-50	50 device upgrade (standard drivers included)
SUP-DEVICE-100	100 device upgrade (standard drivers included)
SUP-DEVICE-200	200 device upgrade (standard drivers included)
SUP-DEVICE-500	500 device upgrade (standard drivers included)
SUP-DEVICE-1000	1000 device upgrade (standard drivers included)
SP-S-FIPS	Provides FIPS 140-2 Level 1 conformance for 4.6 and later
SUP-AX	Enables Supervisor to run Niagara AX (v3.8)
SUP-[0-UNL]-SMA-[1,3,5]YR	Supervisor [0-UNL] Maintenance – [1,3,5] YR extensions

Technical Document

Niagara Station Security Guide

July 25, 2019

Niagara Station Security Guide

Tridium, Inc.
3951 Westerre Parkway, Suite 350
Richmond, Virginia 23233
U.S.A.

Confidentiality

Trademark notice

Copyright and patent notice

Contents

About this guide

This topic contains important information about the purpose, content, context, and intended audience for this document.

Product Documentation

This document is part of the Niagara technical documentation library. Released versions of Niagara software include a complete collection of technical information that is provided in both online help and PDF format. The information in this document is written primarily for Systems Integrators. In order to make the most of the information in this book, readers should have some training or previous experience with Niagara 4 or NiagaraAX software, as well as experience working with JACE network controllers.

Document Content

This document provides guidance and best practices designed to help you configure and maintain secure stations while taking advantage of the benefits that internet connectivity offers.

Document change log

This log provides the date this document was released and lists any subsequent document updates that have occurred.

July 25, 2019

Many changes throughout to support the Niagara 4.8 release, including the following edits:

- In Chapter 1, added a section on the "Security Dashboard feature".
- In Chapter 3, edited "Configuring a user for Client Certificate Authentication", and added a new procedure for "Enabling a kiosk-like mode using client certificate authentication".
- In Chapter 4, added a note to the "Reviewing permissions" procedure.
- In Chapter 5, added a component topic on the "nss-SecurityService", and view topic on the "nss-SecurityDashboard". Also added information about the Station Link Config property to the "nss-SecurityService" component topic. Edited the "wbutil-PermissionsBrowser" topic, to add information on improvements to the **Permissions Browser** view.

February 11, 2019

- In Chapter 3, edited the "Authentication Schemes" topic to add information on the Client Certificate Authentication Scheme and the GoogleAuthenticationScheme.
- In Chapter 3, added two sections with associated procedures: the "Admin workflow for client certificate authentication" and "User workflow for client certificate authentication".
- Added these component topics to Chapter 5: "clientCertAuth-ClientCertificateAuthenticationScheme" and "gauth-GoogleAuthenticationScheme".

November 14, 2018

- Edited the component topic, "saml-SAMLAttributeMapper", to add information on a recent configuration change to handle multiple values returned from the IdP for the prototypeName attribute.
- Edited the component topic, "saml-SAMLAuthenticationScheme", to add information on SAML metadata URL which can automatically generate the station's SAML metadata XML.
- Added the component topic, "saml-SamlXmlDecrypter" which you can add to a SAMLAuthenticationScheme to configure a certificate for decryption.
- Edited component topics, "wbutil-CategoryBrowser" and "wbutil-CategorySheet" to add note on behavior new in Niagara 4.8.
- Minor changes in the procedure, "Customizing SAML attribute mapping".

August 8, 2018

Correction to specified SP metadata in prerequisites for “Configuring the SAML Authentication Scheme” procedure.

May 17, 2018

Added a caution regarding giving admin write permissions on the Role Service to the following topics: Roles and permissions”, “Role Service”, and “Role Manager”.

March 2, 2018

In the “Single Sign On” and “Components” sections, added information on the baja-UserPrototype which is required for SAML authentication; also added the procedure, “Creating a User Prototype for SAML authentication”.

February 15, 2018

Edited the procedure, Configuring the SAML Authentication scheme,” to add information on required SAML SP metadata that must be shared with the SAML IdP. Expanded on information provided in the “saml-SAMLAttributeMapper” component topic, and added a procedure for “Customizing SAML attribute mappings”.

January 24, 2018

Changed the topic title “Auto Logoff" to “Station Auto Logoff” and clarified wording throughout. Also edited property descriptions for Auto Logoff settings in the “baja-UserService” component topic.

November 13, 2017

In the topic, “About station security”, under authorization management list item, deleted a note discussing unsupported tagged categories.

October 12, 2017

- In the User Authentication chapter, edited the “Authentication Schemes” topic; added the “Single Sign On” and “Auto Logoff” topics; and added these procedures: “Configuring the SAML Authentication Scheme” and “Logging in with SSO”.
- In the Components chapter, added the “saml-SAMLAttributeMapper”, and “saml-SAMLAuthenticationScheme” topics; and edited the “baja-SSOConfiguration”, and “baja-UserService” topics.
- Significantly edited the topics in the Secure Communication chapter, rewriting “Creating a server certificate,” adding “Creating a root CA certificate, and “Creating a code-signing certificate.”
- Added “Provisioning a job to install a certificate” to the same chapter.
- Added references to code-signing certificates through the chapter.
- Added “Certificate Export windows” to the Components, views and windows chapter.

September 20, 2017

- Added the topic “When a certificate expires” to the “Certificate Setup” chapter.
- Updated multiple topics in the “Certificate Setup” chapter to include the code-signing certificate.

September 14, 2017

Updated the WebService property description in web-WebService topic.

September 13, 2017

Updates to WebService properties and descriptions in the web-WebService component topic

August 31, 2017

The following list of modifications are included in this update:

- In the topic baja-UserService, added the description about "Effect of property changes on user session"
- In the topic "Configuring Secure Platform Communication" and "Platform TLS Setting" modified the description for Platform TLS setting window.
- Created new topic WebService cacheControl under the chapter Components, views, and windows.
- Restored Network User content (formerly found only in legacy documentation) and updated that content to reflect user synchronization feature support currently in Niagara 4.
- Added baja-AuthenticationService components to the Components section.
- Revised the Preface section to remove content which now makes up the chapter, "About station security."
- In the User Authentication chapter, updated several topics to update the name of the LegacyDigestScheme which changed to AXDigestScheme in Niagara 4.

July 13, 2016

Updated to support rebranding (minor changes throughout)

November 6, 2015

Updates to WebService properties description in web-WebService component topic

August 23, 2015

Initial release document

Related documents

Following is a list of related guides.

- *Niagara Drivers Guide*
- *Niagara Platform Guide*
- *Niagara 4 Hardening Guide* (available on *www.tridium.com\resources\library*)

Chapter 1 About station security

Topics covered in this chapter

♦ Security precautions
♦ Security best practices
♦ Security Dashboard overview

Security begins with the way you configure and monitor each station. It involves setting up secure communication, secure email, secure user credentials, and configuring components, categories, hierarchies, and roles to grant users access only to the system objects they need to do their jobs. Ultimately, your system will only be secure if you take full advantage of Niagara 4's enterprise security features, and if you configure your network effectively. Although the defaults are designed to be as secure as possible, your system will remain vulnerable if you rely solely on factory defaults. The aspects of station security that require configuration are settings for secure communication, user authentication and authorization management.

- *Secure communication* provides:
  - Server identity verification, which prevents man-in-the-middle and spoofing attacks. To set up the digital certificates that verify server identity. you use the **Certificate Manager** view.
  - Data encryption (foxs/https/platformtls), which prevents eavesdropping during the actual transmission of data. You define the key size used to encrypt data transmission when you create each certificate.
  - Secure email communication. To configure email security, you use the **`EmailService`**.
- *User authentication* protects against malicious access by ensuring that only legitimate users (human or station) can log in using Workbench or a web browser. You use the **`AuthenticationService`** to activate the authentication schemes the station needs, and the **`UserService`** to assign the authentication scheme and login credentials to individual users (human or another station). You can add multiple schemes, each of which may be used by a different user.
- *Authorization management* involves defining which component slots, files and histories are accessible, which users may modify them, and what modifications users may make Niagara uses role-based access control, where users are assigned roles that are mapped to component permissions. You use the **`CategoryService`** to set up component categories (groups of components), the **`RoleService`** to assign permissions, and the **`UserService`** to assign roles to users.

NOTE: Platform security is beyond the scope of this document.

Security precautions

Whether you are protecting assets in a single building or in a large, multi-site application, station security is critical. The practical implementation of a secure device network relies on basic common sense.

Do not connect any station directly to the Internet. If you need remote access, use a VPN (Virtual Private Network) solution where your devices are protected behind a fire wall, but remotely accessible. Your VPN solution should incorporate RSA two-factor authentication.

Do not share accounts (log on using someone else's credentials). Always log on as yourself.

Do not create a certificate (and key pair) on a local computer and download the certificate into the **User Key Store** of each remote controller. Each host requires its own unique certificate, public and private keys, which should be generated by the controller and should reside only in the

controller or on a backup medium that is physically protected. Transmitting a certificate with its private key exposes the key to the risk of capture during transmission.

Do not commission a remote controller over the internet. If it becomes necessary to replace a controller, physically travel to the location, take the controller off the network, connect a cross-over cable, and import the backed-up stores. While the Key and Trust Stores are backed up with the station, they are not part of a station copy.

Do not mix secure platforms with platforms that are not secure on the same network. All controllers and Supervisor stations must be secure.

Do not use self-signed certificates. In a CA-signed certificate, the **`Issued By`** property is not the same as the **`Subject`**.

Do not use guest accounts. They are easy to hack.

Do not use default passwords or passwords that can be easily guessed by attackers, such as birth dates, short words, and real words. Use different passwords for each entity. For example, use different usernames and passwords for your system password, platform credentials and station credentials. Implement strong passwords and change them frequently. Store and use passwords securely, strictly controlling access to file systems.

Do not rely on an NTP (Network Time Protocol) server that you do not directly control. If your Niagara network depends on an external NTP server for the time of day, and that server is compromised or spoofed, your Niagara system may be harmed. For example, locks may be turned off, the alarm system disabled, etc. If you use an NTP server, it must be an internal server that is physically controlled by your trusted organization.

Be warned. If your Niagara system is dependent on an external weather service, and if that weather service is compromised or spoofed, any logic in your system that uses the temperature for heating or cooling, or any other purpose may be harmed.

Security best practices

In today's world, ensuring the security of your device network is extremely important. While managing digital certificates and passwords may seem like an excessive burden, the cost of the alternative is so substantial that you must assign resources and take the time to implement the best practices covered by this topic.

Always upgrade your platform and station to the latest software version. Install all patches and software updates.

Physical security is crucial. Secure all computer equipment in a locked room. Make sure that each station is only accessible by authorized users.

Physically protect wiring to prevent an unauthorized person from plugging in to your network.

Use digital certificates to secure data transmission over wires or wireless connections. If you must connect a host station directly to the public Internet, make sure you are using CA-signed certificates.

If your company is acting as its own CA (Certificate Authority), your root CA certificate must be separately installed in each station's **User Trust Store** and each browser.

Physically protect the medium (usually a USB thumb drive) you use to back up and transport exported certificates.

Install browsers using only a trusted installation program. The program you use installs third-party certificates from CAs, such as VeriSign and Thawte. These must be trustworthy certificates.

For high-traffic stations (especially stations that provide public access to a controller network), secure **`Niagarad`** with a separate certificate from that used for your **`FoxService`** and **`WebService`**.

Back up each station regularly. Embedded systems, such as JACE controllers write audit information to a rolling buffer. To avoid losing a station's audit trail, regularly export audit histories to a Supervisor station.

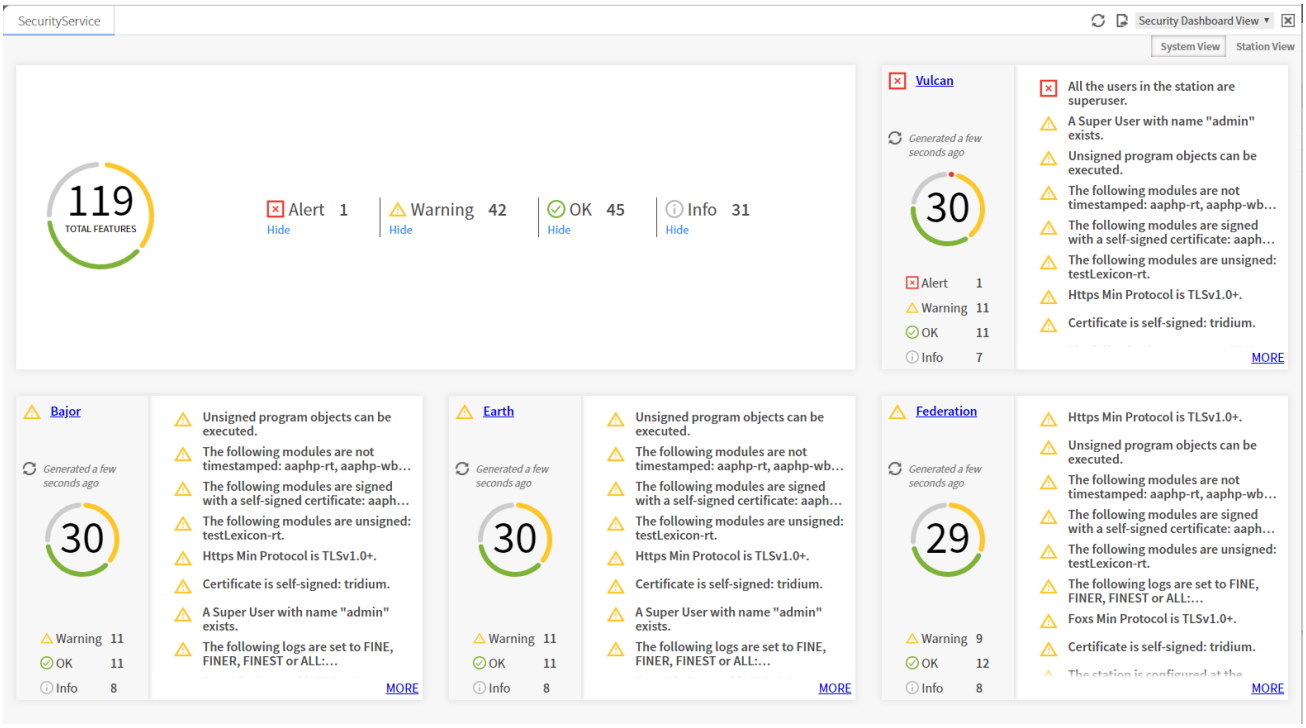
Security Dashboard overview

In Niagara 4.8 and later, the Security Dashboard feature provides (for admin and other authorized users) a bird's eye view of the security configuration of your station. This allows you to easily monitor the security configuration in many station services, and identify any security configuration weaknesses on the station.

CAUTION: The **Security Dashboard View** may not display every possible security setting, and should not be considered as a guarantee that everything is configured securely. In particular, third party modules may have security settings that do not register to the dashboard.

The **Security Dashboard** view is the main view on the station's SecurityService. The view alerts you to security weaknesses such as poor password strength settings; expired, self-signed or invalid certificates; unencrypted transport protocols, etc., indicating areas where the configuration should be more secure. Other reported data includes: system health, number of active accounts, inactive accounts, number of accounts with super-user permissions, etc.

Figure 1 Example Security Dashboard View



The Summary card in the upper left corner of the view summarizes the number and type of security status messages that are generated for all Services on the station. Each "card" (or pane) in the view provides security configuration data for a particular service. Typically, each card provides a hyperlink to that service (or to a component) so that you can easily change a configuration. In cases where there is no component to link to, no hyperlink is provided on the card.

For complete details, see " nss-SecurityDashboardView, page 114" in the "Components and views" chapter of this guide.

Chapter 2 Secure communication

Topics covered in this chapter

- ♦ Client/server relationships
- ♦ Certificates
- ♦ Certificate stores
- ♦ CSR folder structure
- ♦ Certificate set up
- ♦ Configuring secure platform communication
- ♦ Configuring secure station communication
- ♦ Enabling clients and configuring them for the correct port
- ♦ Securing email
- ♦ Secure communication troubleshooting

A Public Key Infrastructure (PKI) supports the distribution and identification of public encryption keys used to protect the exchange of data over networks, such as the Internet. PKI verifies the identity of the other party and encodes the actual data transmission. Identity verification provides non-repudiated assurance of the identity of the server. Encryption provides confidentiality during network transmission. Requiring signed code modules ensures that only expected code runs in the system.

To provide secure networks using PKI, Niagara 4 supports the TLS (Transport Layer Security) protocol, versions 1.0, 1.1 and 1.2. TLS replaces its predecessor, SSL (Secure Sockets Layer).

Each Niagara installation automatically creates a default certificate, which allows the connection to be encrypted immediately. However, these certificates generate warnings in the browser and Workbench and are generally not suitable for end users. Creating and signing custom digital certificates allows a seamless use of TLS in the browser, and provides both encryption as well as server authentication.

Beyond communication security, each module of computer code that runs in the system is protected with a digital signature. Added program objects require this signature or they do not run.

NOTE: Verifying the server, encrypting the transmission and ensuring that only signed code runs do not secure data stored on a storage device. You still need to restrict physical access to the computers and controllers that manage your building model, set up user authentication with strong passwords, and secure components by controlling permissions.

Niagara 4.0 supports and uses secure communication and signed code by default. You do not need to purchase an additional license.

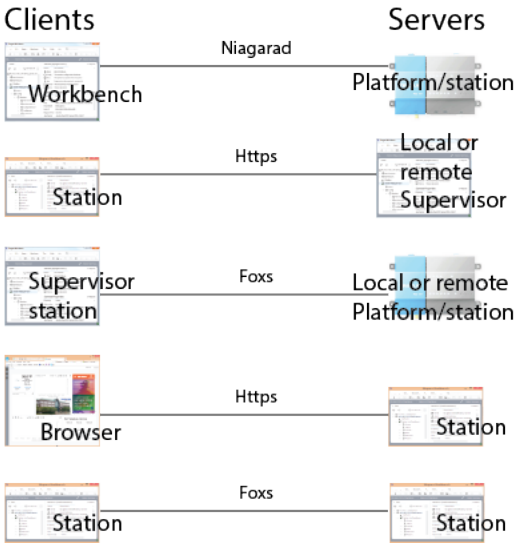
Security is an ongoing concern. While you will find much valuable information in the secure communication topics, expect future updates and changes.

Client/server relationships

Client/server relationships identify the connections that require protection. Niagara 4.0 client/server relationships vary depending on how you configure and use a system.

Workbench is always a client. A platform is always a server. A station may be a client and a server.

Figure 2 Communication relationships



The system protocols that manage communications between these entities are:

- Platform connections from Workbench (client) to controller or Supervisor PC platform daemon (server) use Niagarad. A secure platform connection is sometimes referred to as platformtls. You enable platformtls using the Platform Administration view.
- Local station connections (Supervisor and platform) use Foxs. You enable these connections in a station's FoxService (**Config→Services→FoxService**).
- Browser connections use Https, as well as Foxs if you are using the Java Applet profile. You enable these connections using the station's WebService (**Config→Services→WebService**).
- Client connections to the station's email server, if applicable. You enable secure email using the station's EmailService (**Config→Services→EmailService**).

These relationships determine an entity's certificate requirements. For example, a station requires a signed server certificate, which it uses when it functions as a server, and a copy of the root CA certificate, which it uses when it functions as a client. Setting up digital certificates for identity verification involves creating separate certificates to verify the identity of each server. Each server's unique certificate, signed by a CA (Certificate Authority), resides in its **User Key Store**. Each client requires the root CA certificate used to sign each server certificate. The root CA certificate resides in the platform/station **System** or **User Trust Store**.

Certificates

A certificate is an electronic document that uses a digital signature to bind a *public key* with a person or organization. Certificates may serve a variety of purposes depending on how you configure the certificate's **`Key Usage`** property. Their primary purpose in this system is to verify the identity of a server so that communication can be trusted.

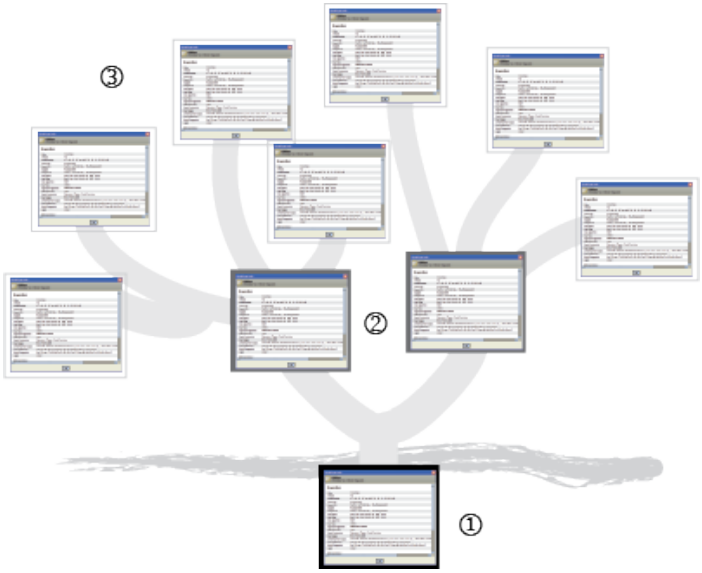
Niagara supports these types of certificates:

- A *CA (Certificate Authority) certificate* is a self-signed certificate that belongs to a CA. This could be a third party or a company serving as its own CA.
- A *root CA certificate* is a self-signed CA certificate whose private key is used to sign other certificates creating a trusted certificate tree. With its private key, a root CA certificate may be exported, stored on a USB thumb drive in a vault, and brought out only when certificates need to be signed. A root CA certificate's private key requires the creation of a password on export and the provision of the same password when you use it to sign other certificates.

- An *intermediate certificate* is a CA certificate signed by a root CA certificate that is used to sign server certificates or other intermediate CA certificates. Using intermediate certificates isolates a group of server certificates.
- A *server certificate* represents the server-side of a secure connection.

  While you may set up a separate certificate for each protocol (Foxs, Https, Webs). While you may configure a platform and station (as server) with separate server certificates, for simplicity most systems usually use the same server certificate.
- A *code-signing* certificate is a certificate used to sign program objects and modules. Systems integrators use this certificate to prevent the introduction of malicious code when they customize the framework.

Identity verification uses multiple certificates in a trusted *certificate tree* Setting up identity verification may involve a third-party CA (Certificate Authority) or you may decide to serve as your own CA.



In the illustration above:

1. Below the ground is the root CA certificate.
2. The major branches represent intermediate certificates.
3. The leaves are server certificates.

How many certificates you need depends on your configuration. At a minimum you need a unique server certificate for each server (controller) and a single root CA certificate to sign your server certificates. If your company is large, you may need an intermediate certificate for each geographical division or location. An individual server may have multiple certificates: one each to secure its Fox, Http and Niagarad (platformtls) connections. Although each platform and station usually share the same certificate, you may create a separate platform certificate and a different station certificate.

If your network is large and getting thousands of certificates signed would be difficult, you may sign a wildcard certificate. Instead of identifying a specific IP or domain (for example, server1.domain.com), a wildcard certificate uses *.domain.com.

Self-signed certificates

A self-signed certificate is one that is signed by default using its own private key rather than by the private key of a root CA (Certificate Authority) certificate.

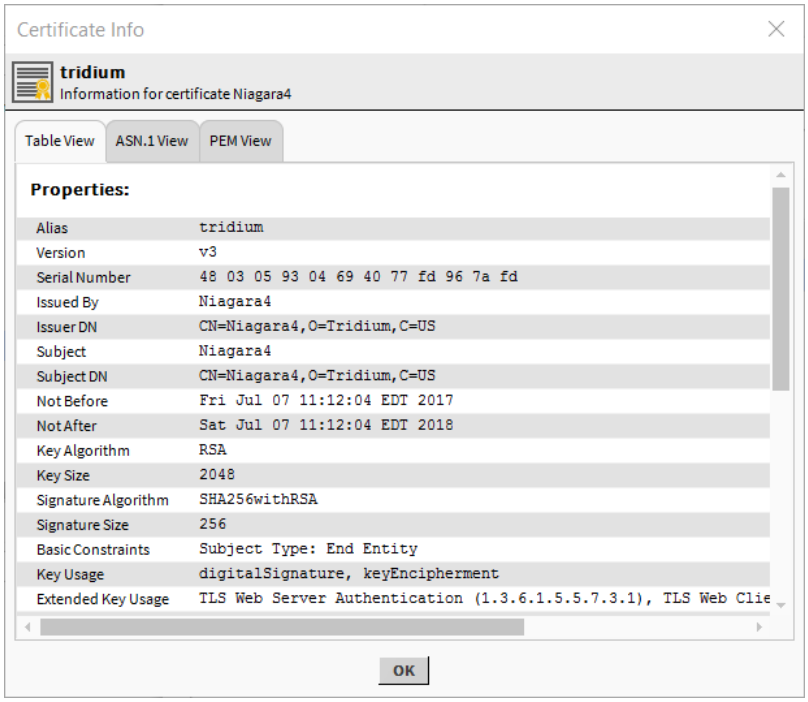
The system supports two types of self-signed certificates:

- A *root CA certificate* is implicitly trusted because there is no higher authority than the CA (Certificate Authority) that owns this certificate. For this reason, CAs, whose business it is to endorse other people's

certificates, closely guard their root CA certificate(s) and private keys. Likewise, if your company is serving as its own CA, you should closely guard the root CA certificate you use to sign other certificates.

- *A default, self-signed certificate*: The first time you start an instance of Workbench, a platform or a station after installation (commissioning), the system creates a default, self-signed server certificate with the alias of `tridium`.

Figure 3 Example of a self-signed certificate



Since the `Issuer DN` (Distinguished Name) and `Subject DN` are the same, the certificate is said to be self-signed using its own 2048–bit, private key. The purpose of a self-signed certificate is to allow secure access to the platform and station before a trusted certificate tree with signed server certificates is established. Since a client cannot validate this type of certificate, it is not recommended for robust, long-term security.

When presented with a self-signed certificate, always confirm that it is the expected certificate before you manually approve its use. Once approved, you do not have to approve the certificate each time you make a connection to the server.

NOTE: Do not export this certificate and import it into any store of another platform or station. Although possible, doing so decreases security and increases vulnerability.

To minimize the risk of a man-in-the-middle attack when using self-signed certificates, all your platforms should be contained in a secure private network, off line, and without public access from the Internet.

CAUTION: To use self-signed certificates, before you access the platform or station from Workbench for the first time, make sure that your PC and the platform are not on any corporate network or the Internet. Once disconnected, connect the PC directly to the platform, open the platform from Workbench, and approve its self-signed certificate. Only then should you reconnect the platform to a corporate network.

Keys

A pair of asymmetric *keys* (one public and the other private) makes server verification and encryption possible. The term "asymmetric" means that the two keys are different, but related. The system can use the private key to read messages encrypted with the public key and vice versa.

The signing of certificates with the private key is required to verify authenticity. Both keys are required to encrypt information. In advance, key generation software running on remote controller or station generates this pair of asymmetric keys.

- A *public key* is a string of bytes included in the certificate. This key resides in the server's **System** or **User Trust Store** and is used to identify the authenticity of the connecting client certificate.
- A *private key* is also a string of bytes that resides on the server. The root CA certificate's private key must be physically protected for a certificate tree to remain secure. A private key must not be sent via email, and, if necessary, should be physically transported (on a thumb drive or other medium that is not connected to the Internet).

How certificates verify identity

Once you set up a certificate tree, identity verification takes place during the client/server handshake, before transmission begins and before the system authenticates each user by prompting for credentials (user name and password).

This is how digital certificates verify identity:

1. A unique server certificate resides with its public and private keys in the **User Key Store** of each server (platform/station and Supervisor).
2. When a client connects to a server, the server sends its certificate to the client.
3. The client station validates the server certificate against a root CA certificate in its **System** or **User Trust Store** by matching keys, ensuring that the `Subject` of the root CA certificate is the same as the `Issuer` of a server certificate, and confirming other factors. A client browser does the same. Each browser has a trust store of root CA certificates.
4. If the server certificate is valid, the system establishes a trusted connection between the server and client, and encrypted communication begins. If the certificate is not valid, the station or browser notifies the client and communication does not begin.
5. You may choose to approve a rejected certificate if you know that, although unsigned, it can be trusted.

   NOTE: Always verify the issuer name on any certificate presented by the system as untrusted. Do not approve a certificate from an entity that you do not recognize.

Encryption

Encryption is the process of encoding data transmission so that it cannot be read by untrusted third parties. TLS uses encryption to transmit data between the client and server. While it is possible to make an unencrypted connection using only the fox or http protocols, you are strongly encouraged not to pursue this option. Without encryption, your communications are potentially subject to an attack. Always accept the default Foxs or Https connections.

The following summarizes how encryption works:

1. At the start of a TLS session, the system encrypts the server/client handshake using the client and server certificates' key pairs.
2. During the handshake the system verifies server identity and negotiates encryption keys.
3. Once communication is established, identity verification is no longer needed, and encrypted data transmission begins using the negotiated keys.

Key size is directly related to encryption security. The larger (more complex) the key, the more secure the data transmission. Large keys do not slow encryption, but they do take longer to initially generate.

Naming convention

The **User Key Store**, **User Trust Store**, and **System Trust Store** form the heart of the configuration. Certificates look a lot alike, and the various default self-signed certificates are named identically. While developing

a naming convention is not a requirement (the system will function just fine if the certificates are called “cert1,” “cert2,” etc.), a consistent naming scheme can make the process much easier to follow.

Consider using the **Alias** of each certificate to identify the certificate’s purpose. Certificate aliases might include:

- The words "root," "intermediate," “server,” “client,” “code-signing”
- The geographic location of the remote controllers protected by the certificate
- The host name of the server
- The IP address of the server

Certificate stores

Certificate management uses four stores to manage certificates: a **User Key Store**, **System Trust Store**, **User Trust Store** and **Allowed Hosts** list.

The **User Key Store** is associated with the server side of the client-server relationship. This store holds certificates, each with its public and private keys. In addition, this store contains the self-signed certificate initially created when you launched Workbench or booted the platform for the first time.

The **User** and **System Trust Stores** are associated with the client side of the client-server relationship. The **System Trust Store** comes pre-populated with standard public certificates: root CA certificates from well-known Certificate Authorities, such as VeriSign, Thawte and Digicert. The **User Trust Store** holds root CA and intermediate certificates for companies who serve as their own certificate authority.

The **Allowed Hosts** list contains server certificate(s) for which no trusted root CA certificate exists in the client’s **System** or **User Trust Stores**, but the server certificates have been approved for use anyway. This includes servers for which the host name of the server is not the same as the `Common Name` in the server certificate. You approve the use of these certificates on an individual basis. While communication is secure, it is better to use signed server certificates.

Accessing the stores

The system supports two sets of stores: a set for Workbench, and another shared set for each platform and station. Workbench provides access to each set of stores.

Step 1 Launch Workbench or Workbench in the browser.

Step 2 Open a supervisor or remote platform/station.

Step 3 Do one of the following:

a. To access the Workbench stores, click **Tools→Certificate Management**.

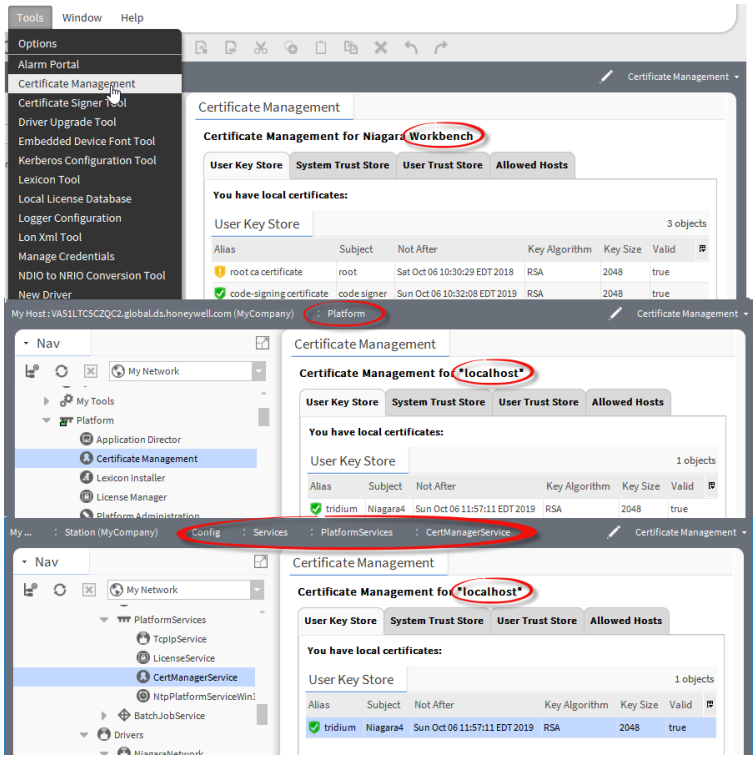
b. To access the platform/station stores, expand **Platform** and double-click **Certificate Management** in the Nav tree. To access the stores this way, the station must be idle.

Since a platform/station may function at different times as a client or a server, it must have a server certificate in its shared **User Key Store** and a trusted root CA certificate in its **System** or **User Trust Store**.

c. If your station is running, you can access the platform/station stores by expanding **Station→Config→Services→PlatformServices** and double-clicking **CertManagerService** in the Nav tree.

The station shares the root CA certificate with the platform, but may have its own server certificate (when it functions as a server) located in the same **User Key Store**.

Step 4 To confirm that you have accessed the correct stores, check the name in the screen title and above the stores.



The platform and station stores are actually the same stores.

Stores folder structure

The Workbench and platform/station stores reside in separate locations on a Supervisor and remote platform.

The following table lists the default user homes that contain the stores, which are considered configuration files. If the folder paths have been changed, these locations no longer apply. `username` is the Windows user name of the person starting the Workbench application.

Table 1 Default user homes

Stores	Nav tree node	Default folder path
Workbench[1]	**My Host→My File System→User Home→security**	`C:\Users\username\Niagara4.0\security`
Supervisor or engineering workstation[2]	**Platform→RemoteFileSystem→User Home (Read Only)→security**	`ProgramData\Niagara4.0\security`
remote controller[3]	**Platform→RemoteFileSystem→User Home (Read Only)→security**	`\home\niagara\security`

1. Each Workbench user has their own User Home.
2. These platform and station stores (same stores) are in the Platform daemon User Home of the Supervisor or any engineering workstation.
3. These platform and station stores (same stores) are in the Platform daemon User Home of the remote controller.

Stores file names

The folders that contain the Workbench and platform/station stores each contain a set of three data files, one per type of store.

NOTE: Only the appropriate Workbench, platform or station tools may be used to modify these data files. Attempts to modify them by other means renders them corrupt and unusable.

- `keystore.jceks` is the **User Key Store**. In Workbench it contains a company's root CA, intermediate, and code-signing certificates. In a server, it contains the server certificate.
- `cacerts.jceks` is the **User Trust Store**. In a client it contains the root CA and intermediate certificates with only their public keys.
- `exemptions.tes` is the **Allowed Hosts** list. In a client it contains the certificate for hosts (servers) with whom the client may securely communicate even though the client either:
  - does not have a root CA certificate in its **System** or **User Trust Store** for the server, or
  - may have a matching root CA certificate, but the `Common Name` or `Alternate Server Name` of the server certificate is not the same as the host name of the server being authenticated.
- `.bks` is the FIP compliance file for access control.

NOTE: A certificate in the Workbench **User Key Store** may have the same name as a certificate in a platform/station **User Key Store**, but they may not be the same certificate. Similarly, files in these stores may have differing alias names, and, in fact, contain the same public keys. It is the public/private key pair that defines a certificate, not the certificate's name.

CSR folder structure

You may create CSRs (Certificate Signing Requests), store them in, and import signed certificates (.pem files) from any folder on your Supervisor or engineering PC. The default location is a working folder in the user file space.

The first time you access the Certificate Management view from Workbench, the system creates an empty **certManagement** folder in the following location:

`c:\Users\username\Niagara4.0\certManagement`, where `username` is the name you use to log in to the computer.

In the Nav tree, this location is: **My File System→User Home→certManagement**.

This folder, in Workbench's user space, is a working folder for storing CSRs and .pem files exported and imported by the **Certificate Manager**. Within this folder, you may create a structure for managing exports and imports or you may use a different location for exports and imports.

NOTE: Do not confuse the `certManagement` folder with the `certificates` folder that stores one or more certificates used to validate the authenticity of Niagara system licensing files. The `certificates` folder has nothing to do with secure communication.

The platform and station folders do not have a `certManagement` folder.

Creating a CSR folder structure

A CSR (Certificate Signing Request) folder structure helps to organize a large number of server certificates for easy retrieval. You create this structure under the **`certManagement`** folder, which is an automatically-created folder in your personal niagara_user_home.

Step 1 Using Windows Explorer, locate your niagara_user_home: `C:\Users\username\niagara4.0\brand\certManagement`, where

`username` is your name or other text used to identify you as the user of your computer.

`brand` is your company name or other name used to label personal information.

Step 2 Create folders under `certManagement`.

For example:

```
certManagement
rootCertificate
intermediateCertificates
serverCertificates
code-signingCertificates
```

Certificate set up

Configuring a network for secure communication using digital certificates involves accessing the appropriate stores; creating certificates and certificate signing requests; signing certificates; importing them into hosts **User Key Store**s; and importing the root CA certificate (or intermediate certificate) into client **User Trust Store**s.

CAUTION: If the private key of your root CA and intermediate certificates fall into the wrong hands, your entire network can be in danger of a significant cyber attack. To ensure security, always create the root CA and intermediate certificates, and use them to sign other certificates inWorkbench running on a secure computer, which is located under lock and key. Use this computer for only one purpose: to manage and sign certificates. Never connect this computer to the Internet, and ever access it over your company network. Carefully protect any thumb drive that contains any certificate with its private key.

You may use a third-party CA (Certificate Authority), such as VeriSign or Thawte to sign your certificates, or you may serve as your own CA.

Unless absolutely necessary, do not use a Supervisor or engineering PC to access a controller remotely for the purpose of generating a server certificate and CSR. The preferred best practice is to set up certificates before distributing each controller to its remote location. If controllers are already in the field, travel to the remote location, take the controller off the Internet and corporate LAN, then connect your engineering PC directly to the controller using a cross-over cable.

Root and intermediate certificate checklist

This checklist assumes that you are serving as you own CA (Certificate Authority). It summarizes the steps for setting up digital certificates using the Workbench **User Key Store** of a physically and electronically secure computer.

Use the check list to make sure you perform all necessary configuration tasks.

☐ Computer and device network disconnected from the company LAN and global Internet. See Chapter 2 Secure communication, page 15.

☐ Needed certificates identified: one root CA certificate, two or more intermediate certificates (optional) and one server certificate per controller. You need a code-signing certificate if you will be customizing the system by adding program objects. See Certificates, page 16.

☐ Logical certificate naming convention established (a naming convention is not required, but it will help you differentiate among your certificates). See Naming convention, page 19.

☐ CSR folder structure under the **certManagement** folder in the niagara_user_home created. See Creating a CSR folder structure, page 22.

☐ Root CA certificate and any intermediate certificates created. See Creating a root CA certificate, page 27.

☐ CSR for each intermediate and code-signing certificate created. See Creating a CSR, page 33.

☐ Any intermediate and code-signing certificates signed using the root CA certificate. See Signing a certificate, page 33.

☐ Any signed intermediate certificates imported back into the Workbench User Key Store where they were originally created. See Importing the signed certificate back into the User Key Store, page 35.

☐ Backup of the root CA certificate and the signed intermediate certificates created. See Exporting a certificate, page 36.

☐ Root CA certificate with only its public key exported in preparation to import it into the platform/station Trust Stores. See Exporting a certificate, page 36

Supervisor/engineering PC checklist

Use this checklist to verify that you completed all required tasks to set up a Supervisor or engineering PC platform and station.

☐ **`NiagaraNetwork`** enabled. See Enabling the NiagaraNetwork, page 26.

☐ Remote controller(s) set up as Supervisor/engineering PC client(s). See Confirming client/server relationships, page 27.

☐ Server certificate for the Supervisor/engineering PC platform/station created. See Creating a server certificate, page 30.

☐ CSR for the server certificate generated. See Creating a CSR, page 33.

☐ Server certificate CSR signed by the root CA or intermediate certificate's private key. See Signing a certificate, page 33.

☐ Signed server certificate imported back into the platform/station's **User Key Store**. See Importing the signed certificate back into the User Key Store, page 35.

☐ The existence of the third-party's root CA certificate in the platform/station's **System Trust Store** confirmed or root CA certificate imported into the platform/station's **User Trust Store**. See Manually importing a certificate into a User Trust Store, page 37.

☐ Certificate .pem file deleted.

☐ Confirmed platform (Niagarad) enabled. See Configuring secure platform communication, page 40.

☐ Secure **`FoxService`** confirmed (the default) and **`Foxs Cert`** selected. See Configuring secure station communication, page 41

☐ Secure **`WebService`** confirmed (the default) and **`Https Cert`** selected. See Configuring secure station communication, page 41

Platform and station checklist

Use this checklist to verify that you completed all required tasks to set up a new platform and station.

☐ **`NiagaraNetwork`** enabled. See Enabling the NiagaraNetwork, page 26.

☐ Supervisor set up as controller client. See Confirming client/server relationships, page 27.

☐ Server certificate(s) created on each platform/station. If needed, a separate server certificate created for each communication protocol: foxs, https, and platformtls created. See Creating a server certificate, page 30.

☐ CSR(s) generated on each platform/station. See Creating a CSR, page 33.

☐ CSR(s) signed by the root CA or intermediate certificate's private key. See Signing a certificate, page 33.

☐ Signed server certificate(s) imported back into the platform/station **User Key Store**. See Importing the signed certificate back into the User Key Store, page 35.

☐ Certificate(s) .pem files deleted.

☐ If using a third-party CA, the existence of the third-party's root CA certificate in the platform/station's **System Trust Store** confirmed.

☐ If serving as the CA, company's root CA certificate imported into the platform/station's **User Trust Store** either one at a time, or using a provisioning job. See Manually importing a certificate into a User Trust Store, page 37 and Installing a certificate, page 37.

☐ Confirmed platform (Niagarad) enabled and correct certificate assigned. See Configuring secure platform communication, page 40.

☐ Secure **FoxService** confirmed (the default) and **Foxs Cert** selected. For the specific procedure, see Configuring secure station communication, page 41.

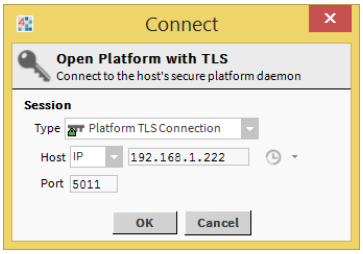
☐ Secure **WebService** confirmed (the default) and **Https Cert** selected. For the specific procedure, see Configuring secure station communication, page 41.

Opening a secure platform connection (niagarad)

Even before you configure digital certificates to provide server identity verification, every connection you make from a client to a server can be secure because you can manually verify the authenticity of the server.

Step 1 Right-click **My Host** (for Supervisor) or an IP address (for a controller) and click **Open Platform**.

The **Connect** window opens with `Platform TLS Connection` already selected.



This window identifies the entity to which you are connecting: your local computer, a Supervisor platform, or a controller with an IP address.

Step 2 If needed, enter the host IP and click **OK**.

If you are accessing the platform for the first time, the system displays an identity verification warning and a self-signed, default certificate.

This message and certificate are expected for these reasons:

- The `Subject` or `CN` (Common Name) of the default `tridium` certificate (`Niagara4`) does not match the host name, which is usually the host IP address or domain name.
- The default certificate's `Issued By` and `Subject` are the same indicating that the certificate is self-signed. No third-party CA (Certificate Authority) has verified the server's authenticity.
- The certificate is signed, but no root CA certificate in the client's **User** or **System Trust Store** can verify its signature.

Step 3 If you are presented with this warning and a certificate, make sure you recognize the certificate's `Issued By` and `Subject` properties.

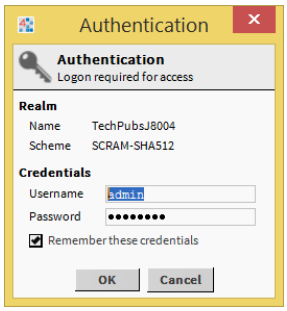
CAUTION: Do not approve a certificate if you do not recognize these properties. The weakest link in the security chain is the user who simply clicks OK without thinking.

Step 4 Assuming that this is the default `tridium` certificate, which can be trusted, click **Accept**.

Accepting the certificate creates an approved host exemption in the platform/station **Allowed Hosts** list.

NOTE: Although the name of the default certificate (`tridium`) is the same for each controller and for Workbench, the content of each certificate is unique. Do not attempt to export and use the same `tridium` certificate for each controller in your network.

The system asks you to enter or confirm your platform credentials.

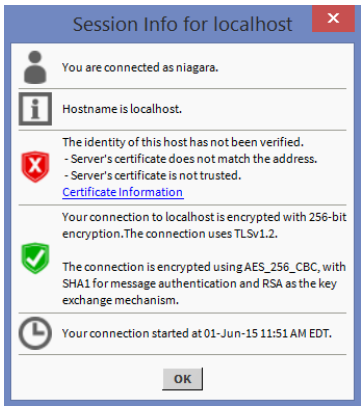


Step 5 Enter your platform credentials and click **OK**.

The platform is now connected over a secure connection. All data transmitted are encrypted. If you logged on for the first time and accepted the default certificate, only the server's identity cannot be validated.

Step 6 To confirm that you are using the self-signed certificate, right-click **Platform** in the Nav tree and click `Session Info`.

The system displays session information.



- The red shield with the X indicates that the handshake was unable to verify the authenticity of the server's certificate. To view the certificate, click the link (`Certificate Information`).
- The green shield with the check mark indicates that encryption is enabled. In this example, the secure connection is using `TLSv1.2` as the protocol and data is encrypted using `AES_256_CBC` (Advanced Encryption Standard) with `SHA1` (hash function) and `RSA` (Rivest-Shamir-Adleman), the most widely used public key cryptography algorithm.

Step 7 Click **OK**.

The tiny lock on the platform icon in the Nav tree indicates a secure, encrypted connection.

Enabling the NiagaraNetwork

The NiagaraNetwork provides the physical connections for data transmission. Secure communication ensures that data are transmitted securely between trusted entities.

Step 1 Right-click the node in the **Drivers** container and click **Views→Property Sheet**.

Step 2 Expand the **`NiagaraNetwork`** property.

Step 3 Confirm that the `true` check box is selected for **`Enabled`**.

Confirming client/server relationships

At any given time the Supervisor station may be the client of a controller station and vice versa. This procedure confirms that a client for the Supervisor station exists in the controller station and a client for the controller station exists in the Supervisor station.

Step 1 Expand the **Drivers→NiagaraNetwork** node in the Supervisor Nav tree. It should contain a node for each controller.

Step 2 Expand the **Drivers→NiagaraNetwork** in a controller Nav tree. It should contain a node for the Supervisor station.

Step 3 If either node does not exist, discover the station.

Creating a root CA certificate

A root CA certificate is used to sign intermediate, server and code-signing certificates. It resides a **User Key Store** with both its public and private keys. You export it with only its public key so that you can import it into each client's **User Trust Store**.

Prerequisites: You have the required authority to create certificates. You are working in Workbench on a computer that is dedicated to certificate management, is not on the Internet or the company's LAN and is physically secure in a vault or other secure location.

Step 1 Access the Workbench stores by clicking **Tools→Certificate Management.**

The **Certificate Management** view opens to the **User Key Store**.

Step 2 Click the **New** button at the bottom of the view.

The **Generate Self Signed Certificate** window opens.

All certificates begin as self-signed certificates. Only the root CA certificate remains self-signed because it sits at the top of the certificate chain.

Step 3 Give the certificate at least an **Alias**, **Common Name (CN)**, **Organization**, **Locality**, **State/Province**, and **Country Code**.

- Use **Alias** to identify this as a root certificate.
- The **Common Name (CN)** becomes the **Subject** (also known as the Distinguished Name). For a root CA certificate, the **Common Name (CN)** may be the same as the **Alias**.
- Although **Locality** and **State/Province** are not required and are arbitrary, leaving them blank generates a warning message.
- The two-digit **Country Code** is required and must be a known value, such as: US, IN, CA, FR, DE, ES, etc. (see countrycode.org for a list).
- **Not Before** and **Not After** define the period of validity for the certificate.
- **Key Size** defaults to 2048. A larger key improves security and does not significantly affect communication time. The only impact it has is to lengthen the time it takes to create the certificate initially.

Step 4 For **Certificate Usage**, select CA, and click **OK**.

The **Private Key Password** window opens.

Step 5 Enter and confirm a strong password, and click **OK**.

The system informs you that the certificate has been submitted. Soon the certificate appears behind the Info message.

Step 6 To continue, click **OK**.

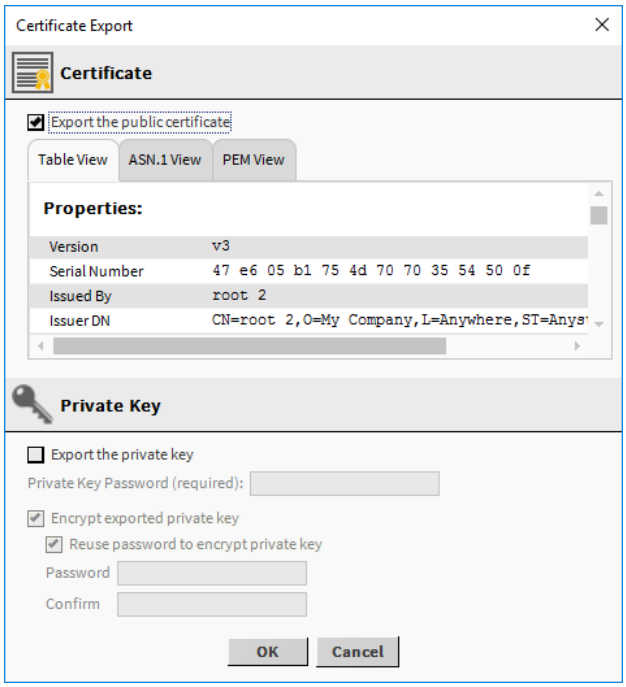
The root CA certificate now exists with both its keys in the Workbench **User Key Store**. From this location you can use it to sign other certificates (intermediate, server, and code-signing). For this

certificate to authenticate the certificates it signs, you now need to export it with only its public key and import it into the **User Trust Store** of each client computer and platform/station.

NOTE: Since this certificate is not signed by any higher certificate authority, it is always identified with an exclamation icon ( ). As the self-signed certificate, it cannot be trusted. This is why you must protect the computer (and thumb drive) on which it resides by keeping the computer off the Internet, corporate LAN, and most securely, in a locked physical location.

Step 7 Select the new root CA certificate and click the **Export** button at the bottom of the view.

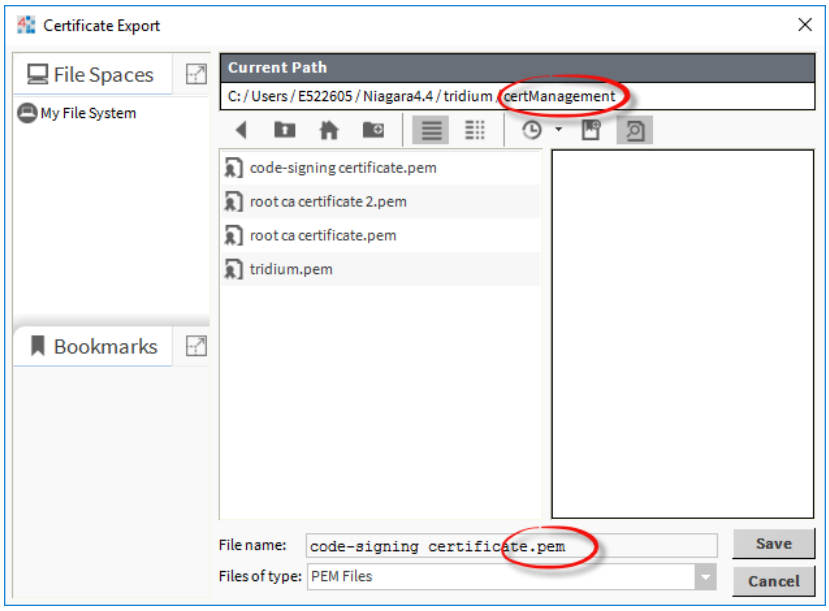
The **Certificate Export** window opens.



CAUTION: Do not Click the check box to **`Export the private key`**.The only time you click this check box is when you are backing up the certificate to another location for safe keeping.

Step 8 To create the root CA certificate that will reside in each client's **User Trust Store**, click **OK**.

The Certificate Export window opens with the file ready to export as a .pem file.



Notice the Current Path. This is where the system stores the exported certificate.

Step 9 Navigate to a location on a thumb drive, and click **Save**.

The system reports that it exported the certificate successfully.

Step 10 To complete the export, click **OK**.

When exported with only its public key, the root CA certificate may be freely distributed. You are ready to manually import the root CA certificate with only its public key into the **User Trust Store** of the computer, usually a Supervisor (or engineering) computer, from which to either manually, or with a provisioning job, install this certificate in the **User Trust Store** of all remote platforms and stations.

Password strength

To protect each certificate's private key you must supply a private key password. When backing up certificate private keys by exporting certificates, you may use an additional encryption password. (The default encryption password is the same as the private key password.) To prevent unauthorized access, your passwords need to be strong.

A strong platform or station password:

- Has 10 or more characters.
- Includes letters, punctuation, symbols, and numbers.
- Is unique for each set of credentials.

  CAUTION: Do not reuse passwords.
- Avoids dictionary words in any language, words spelled backwards or words that use common misspellings and abbreviations, sequences or repeated characters, personal information such as your birthday, driver's license, passport number, etc.

These precautions were adapted from information at microsoft.com, which provides a secure password checker you can use to test the strength of any password. Niagara 4 allows you to control password strength for user authentication. The password strength configuration for user authentication does not apply to certificate passwords.

Creating a server certificate

Each Supervisor PC, engineering laptop, remote controller, and remote station requires a server certificate for those times when it functions as a server. If you plan to use as a server certificate the default, self-signed, certificate that you approve when you log in to Workbench or boot a platform for the first time, you may skip this procedure. If it is important to you for each certificate to identify the Locality and State, use this procedure to make a new certificate for each server.

Prerequisites: You have the required authority to create and manage certificates. You are either running Workbench on your PC or laptop, or are connected to the remote controller on which you are creating the certificate.

TIP: While not a requirement when creating a remote server certificate, as a best practice, you should disconnect both your computer and the controller platform from the Internet and company LAN, then connect your Workbench computer to the platform using a crossover cable.

Step 1 To open the certificate stores do one of the following in the Nav tree:

a. Expand **Platform** and double-click **Certificate Management**.

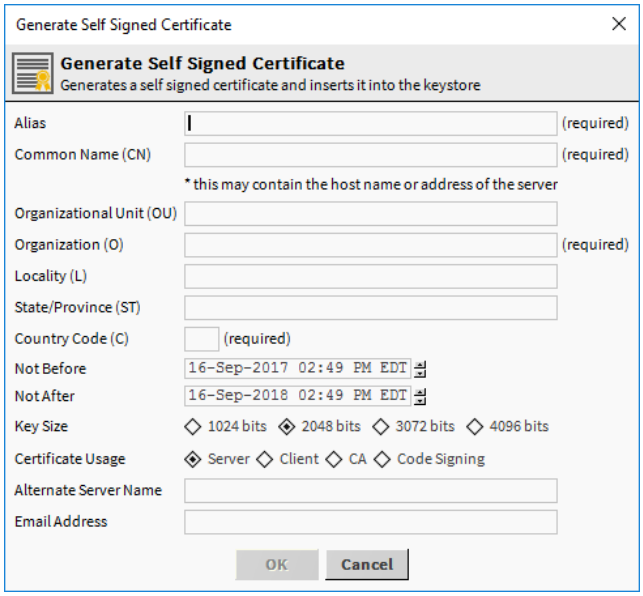
b. Expand **Station→Config→Services→PlatformServices** and double-click **CertManaerService**.

Both steps open the same stores. Which to use depends on how you are connected to the platform/station.

Step 2 Confirm that the title at the top of the view identifies the host for which you are creating the server certificate. For a remote controller, this is the IP address.

Step 3 Click the **New** button at the bottom of the view.

The **Generate Self Signed Certificate** window opens.



Step 4 Give the certificate at least an **`Alias`**, **`Common Name (CN)`**, **`Organization`**, **`Locality`**, **`State/Province`**, and **`Country Code`**.

- Use **`Alias`** to identify this as a server certificate, including in the name the company, geography or department.
- **`Common Name (CN)`** should be the same as the host name, which is how a server identifies itself. The common name becomes the **`Subject`** (also known as the Distinguished Name). The IP address of a controller or its Fully Qualified Domain Name (FQDN) are appropriate **`Alias`** and **`Common Name`**s for a remote controller or Supervisor station.

An FQDN is the **Hostname** plus the **Primary Dns Suffix**. For a computer, you can see this name in My Computer Properties: "Full computer name." For a controller, there is no good place to see this name, but it would be something like: mycontroller.mydomain.com or mycontroller.mydomain.net.

NOTE: Do not use the same name for **Common Name (CN)** of a server certificate that you use for a root or intermediate certificate's **Common Name (CN)**.

- Although **Locality** and **State/Province** are not required and are arbitrary, leaving them blank generates a warning message. Third-party CAs may not sign certificates without these properties defined.
- The two-digit **Country Code** is required and must be a known value, such as: US, IN, CA, FR, DE, ES, etc. (See countrycode.org for a list.).
- **Not Before** and **Not After** define the period of validity for the certificate.
- **Key Size** defaults to 2048. A larger key improves security and does not significantly affect communication time. The only impact it has is to lengthen the time it takes to create the certificate initially.

  If a third-party will sign the certificate, consult with your CA (Certificate Authority) to determine the acceptable key size. Some CAs support a limited number of key sizes.
- For **Certificate Usage**, select **Server** for a platform/station.
- For server certificates, if **Common Name** is an IP address, use a Fully Qualified Domain Name for the **Alternate Server Name**.

Step 5 When you have filled in all information, click **OK**.

The system submits the certificate for processing in the background. A pop-up window in the lower right of your screen advises you regarding the time it may take to generate the certificate. The length of time it takes depends on the key size and the platform's processing capability. When created, the certificate appears as a row in the **User Key Store** table.

Step 6 To view the certificate from the platform/station's **User Key Store**, double-click it or select it and click **View**.

Notice that the `Issuer` and `Subject` are the same and the certificate is identified with a yellow shield icon ( ). These factors indicate that this is a self-signed certificate.

Step 7 Confirm that the information is correct.

NOTE:

To change a certificate you just created, delete it and create a new certificate. Do not delete a certificate that is already in use.

Repeat this procedure to create additional certificates.

Creating a code-signing certificate

The system signs code objects using a code-signing certificate that is password protected. This procedure explains how to generate a code-signing certificate using Workbench. You may use a third-party tool to generate a code-signing certificate followed by importing it into your Workbench **User Key Store**. Such an imported certificate must have a code-signing set as its extended key usage. This is a standard certificate extension.

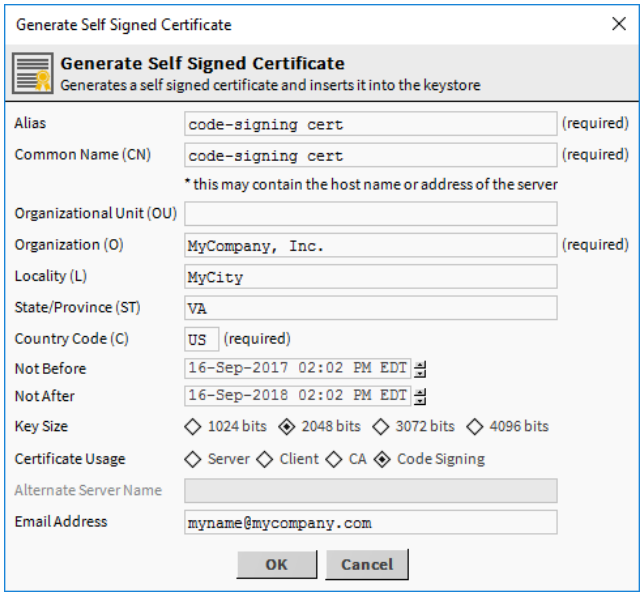
Prerequisites: You are working in Workbench running on a Supervisor or engineering PC.

Step 1 Click **Tools→Certificate Management**.

The **Certificate Management** view opens.

Step 2 Click the **New** button at the bottom of the view.

The **Generate Self Signed Certificate** window opens.



Step 3 Fill in the properties.

In addition to the required properties, define your **`Locality (L)`** (city) and **`State/Province (ST)`**. Without these properties the system reports an error message.

`Country Code` is a two-digit code (must be US or us, not USA).

Choose `Code Signing` for **`Certificate Usage`**.

The **OK** button activates when all required information is provided.

Step 4 To create the certificate, click **OK**

The **Private Key Password** window opens.

Step 5 Enter a strong password and click **OK**.

Your password must be at least 10 characters long. At least one character must be a digit; one must be lower case; and one must be upper case.

The system submits the certificate for processing in the background.

Step 6 When the certificate has been created, click **OK**.

This self-signed certificate appears as a row in the **`User Key Store`** tab, identified by a yellow shield icon ( ).

Protect this certificate and password! If someone steals your certificate and knows your password, they could damage your operation by using your certificate to sign their own malicious code.

Creating a CSR

A CSR (Certificate Signing Request) creates a .csr file for each intermediate, server, and code-signing certificate. This file can be signed by a root or intermediate CA certificate.

Prerequisites: For creating intermediate and code-signing certificates you are viewing the Workbench stores. For creating server certificates you are viewing the platform/station stores.

Step 1 Select the certificate to sign, and click **Cert Request**.

The **Certificate Request Info** window opens.

Step 2 Confirm that the certificate properties are correct and click **OK**.

One of the following happens:

- If you are preparing a CSR for a server certificate, the system displays the **certManagement** folder for you to choose the location to store the CSR.
- If you are creating a CSR for a CA certificate (root or intermediate) or a code-signing certificate, the **Certificate Manager** prompts you for the private key password. Enter the password and click **OK**. The system displays the **certManagement** folder for you to choose the location to store the CSR.

The **`Alias`** for the certificate is used as the file name of the CSR.

Step 3 Use the default folder, or select a different folder in which to store the CSR and click **Save**.

The system displays, `CSR generation complete`.

Step 4 To confirm completion, click **OK**.

NOTE: Once you create a CSR, do not delete the original certificate from which you created the CSR. Later in the process you will import a signed certificate back into the **User Key Store** where its public key must match the private key of the original certificate. Creating a new certificate with the same name does not generate the same key pair and results in errors when you try to import the signed certificate. If it is absolutely necessary (for example, if the computer on which the certificate is stored is vulnerable), you may export the original certificate with its private key and import it into the **User Key Store** when you receive the signed certificate. But, ideally, you should leave the original certificate in the **User Key Store** of the original secure host.

Step 5 If an external CA, such as VeriSign or Thawte, will sign your server certificates, follow the CSR submission procedure as required by the CA.

The CA verifies that you are who you claim to be, that each certificate is for a server your organization actually maintains, and other important information. They then return a signed server certificates (one for each server).

The CA may compress both the new signed certificate and a copy of the root CA certificate containing only the public key with password protection, put both on a website, email the links to you, and phone you with the password for the compressed, password-protected files. The root CA certificate with its public key does not have to be protected and can be sent via email.

Signing a certificate

Signing a certificate is the job of a CA (Certificate Authority). A variety of certificate-signing software tools are available. You are not required to use Niagara and Workbench to sign certificates. This procedure documents how to sign certificates. It applies to companies who serve as their own CA. In a large installation, you use your root CA certificate to sign any intermediate certificates and the intermediate certificates to sign your server and code-signing certificates. In a small installation, you may use your root CA certificate to sign all certificates.

Prerequisites:

- You are working in Workbench on a physically and electronically secure PC that is never connected to the Internet, and is used exclusively to sign certificates.

- The root CA or intermediate certificate that will do the signing is in the Workbench **`User Key Store`**.
- You know the password of the CA signing certificate (root or intermediate) that will sign the certificate(s).
- You have one or more CSR files (signing requests) ready to sign.

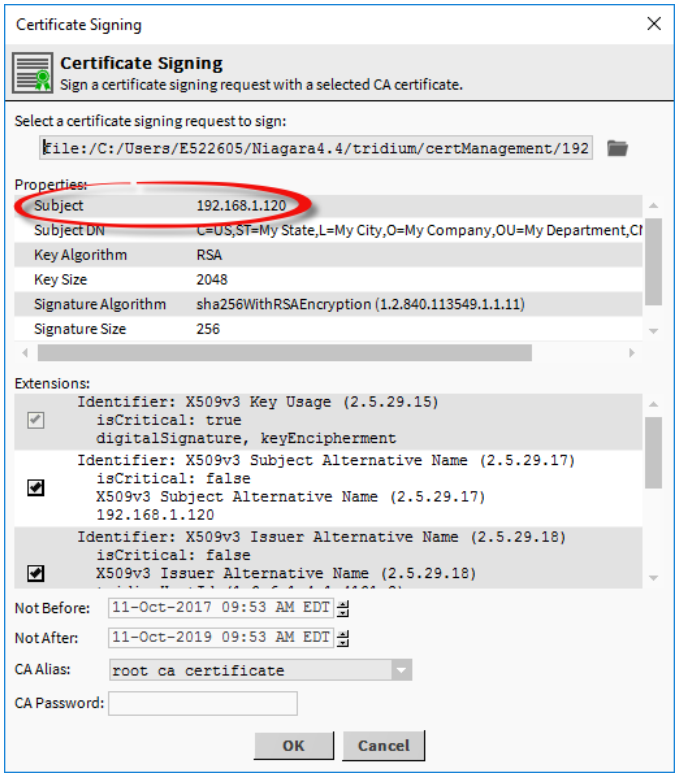
NOTE: To ensure network security, always sign certificates using Workbench on a computer that is disconnected from the Internet and from the company LAN. Maintain this computer in a physically secure location.

Step 1 In Workbench on your physically and electronically secure (and never connected to the Internet) PC that is used exclusively to sign certificates, click **Tools→Certificate Signer Tool**.

The **Certificate Signing** window opens.

Step 2 Click the folder icon, locate, and open the CSR for the certificate you wish to sign.

The **Certificate Signing** window expands to show certificate details.



Step 3 Confirm that this is the correct CSR by checking the **Subject**.

Step 4 Select the date on which the certificate becomes effective (**`Not Before`**) and the date after which it expires (**`Not After`**).

Step 5 For **CA Alias**, use the drop-down list to select the certificate (root or intermediate) whose private key will sign this certificate.

Step 6 Supply the CA certificate's password and click **OK**.

Signing is done by the private key of the root or intermediate certificate.

The same file folder, `C:/Users/[username]/Niagara4.x/certManagement`, displays with the file name (extension: .pem) filled in for you.

You may modify this file structure to aid in the management of these files.

Step 7 To complete the signing, click **Save**.

Step 8 Copy the signed certificate .pem file to a thumb drive and import it back into the **User Key Store** of the computer that created the certificate and generated the CSR.

Repeat this procedure for each CSR.

Importing the signed certificate back into the User Key Store

Signing a certificate creates a .pem file, which is only intended for importing back into the **User Key Store** that contains the original certificate with the matching private key. For a server certificate this is the platform/station **User Key Store** that originally created the certificate and CSR. For an intermediate certificate or a code-signing certificate, this is, most likely, the Workbench **User Key Store** on the secure computer, which you use to sign other certificates.

Prerequisites: You have the signed .pem files. The focus is on the User Key Store in the appropriate stores location (Workbench or platform/station).

Step 1 Click **Import**.

Step 2 Locate and select the signed certificate's .pem file (the output of the certificate signer or the .pem file you received from a third-party CA) and click **Open**.

The **Certificate Import** window opens.

Step 3 Confirm that you are importing the correct certificate and click **OK**.

If the `Alias` of the certificate you are importing is not the same as the `Alias` of the certificate you are replacing, the system prompts you for the `Alias` of the certificate to replace.

Step 4 If needed, enter the **Alias** and click **OK**.

The green shield icon ( ) replaces the yellow shield icon ( ) next to the certificate `Alias` in the **User Key Store** tab.

Step 5 Using the operating system, delete the .pem file(s) from the secureWorkbench computer.

Installing a root certificate in the Windows trust store

For communication to be secure when accessing a station using the web UI, a company's root certificate must be imported into the Windows trust store.

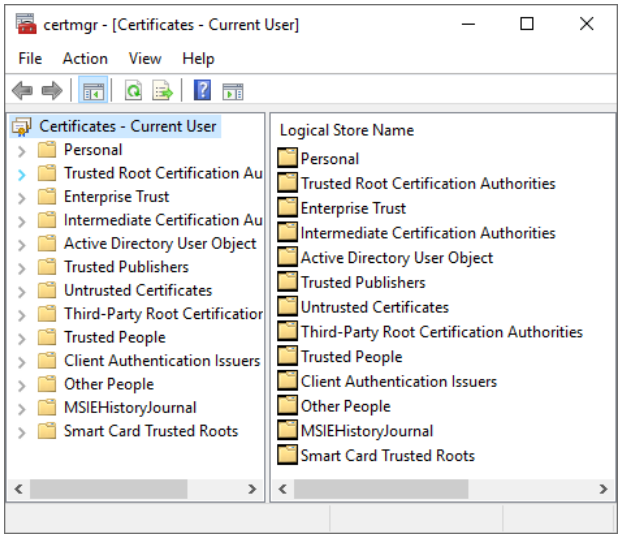
Prerequisites: Using Workbench, you exported the root certificate into a directory you can access from the PC. (The extension for a root certificate file name is .pem.).

Step 1 On the PC, open a Windows command prompt by clicking **Start** and typing `cmd`.

The **Command Prompt** window opens.

Step 2 Type `certmgr.msc` and press **Enter**.

The certificate manager window opens.



Step 3 In the column to the right, right-click the **Trusted Root Certificate Authorities** folder and click **All Tasks→Import**.

the Certificate Import wizard window opens.

Step 4 Follow the steps of the wizard to browse to the User Home where the root certificate .pem file is located, select to view All Files..., select the file and click **Open**.

Step 5 Finish the wizard.

Exporting a certificate

There are two reasons to export certificates: 1) to create a root CA certificate with only its public key for each client's **User Trust Store** and browser, and 2) to create a backup, for safe keeping, of all certificates with their private keys.

As soon as you finish importing all certificate .pem files back into their respective **User Key Store**s, make a backup of all of certificates and store the backup on a thumb drive in a separate, physically secure location. You back up each certificate one at a time.

NOTE: To protect your backups create strong passwords and store backup media in a vault. These backups contain the key(s) used to sign all server certificates.

Step 1 Open the stores that contain the certificate(s) to export.

Step 2 On the **User Key Store** tab, select the certificate and click **Export**.

The system opens the **Certificate Export** window.

Step 3 Do one of the following:

In addition to the private key password, you should use an encryption password to provide double-password protection. The default encryption password is the same as the private key password.

- To create a CA certificate (root or intermediate) for importing into a client **User Trust Store**, just click **OK** (do not select `Export the private key`).
- To back up a certificate with its private key, click `Export the private key`, deselect `Reuse password to encrypt private key` under `Encrypt exported private key`, and supply the additional password.

Step 4 Navigate to a location on a thumb drive and click **Save**.

The system reports that the export was successful.

Step 5 To complete the action, click **OK**.

Manually importing a certificate into a User Trust Store

If your **System Trust Stores** already contain the root CA certificate of the CA (Certificate Authority) that signed your intermediate, server or code-signing certificates, you do not need to import anything. If you are serving as your own CA, you must import the root CA certificate you exported (without its private key) into the **User Trust Store** of each client. Each platform and station share the same stores. This procedure documents how to manually import the root CA certificate into an individual client.

Prerequisites: The focus is on the User Trust Store in the appropriate stores location, which would be the platform/station User Trust Store for a server certificate and the Workbench User Trust Store for a code-signing certificate.

NOTE: There is no need to import the server certificates or the intermediate CA certificates to any **User Trust Store**. Each signed server certificate carries within it any intermediate and root CA certificate information.

Step 1 Select the **User Trust Store** tab.

Step 2 Click **Import**.

Step 3 Locate and select the root CA certificate's .pem file on the thumb drive and click **Open**.

The **Certificate Import** window opens.

Step 4 Confirm that the **Subject** property identifies the correct certificate and click **OK**.

The system imports the certificate, identifying it with a green shield icon ( )

You may repeat this procedure for each client platform/station, or use a provisioning job to automate the process.

Installing a certificate

If your **System Trust Store** already contains the root CA certificate of the CA (Certificate Authority) that signed your intermediate, server or code-signing certificates, you do not need to run a provisioning job. If your company serves as its own CA, you must install a root CA or intermediate certificate in the **User Trust Store** of all platform/stations that serve as system clients. To do this, use an Install Certificate provisioning job. This can be useful before running a signed provisioning robot on several stations.

Prerequisites:

- The BatchJobService and ProvisioningNwExt components are available under your NiagaraNetwork.
- The root CA or signed intermediate certificate is available on a thumb drive.
- The **provisioningNiagara** palette is open.

Step 1 Open the platform/station stores on a Supervisor (or engineering) computer and click the **User Trust Store** tab.

NOTE: Make sure you are in the platform/station stores. You cannot complete this procedure if you import the certificate into the Workbench **User Trust Store** of your Supervisor or engineering computer.

Step 2 Click the **Import** button, navigate to the location on the thumb drive that contains the root CA certificate and click **Open**.

Step 3 Confirm that the `Subject` of the certificate identifies it as the root CA certificate and click **OK**.

The system imports the certificate in preparation for the provisioning job.

Step 4 Navigate to the location in the station where you manage provisioning jobs.

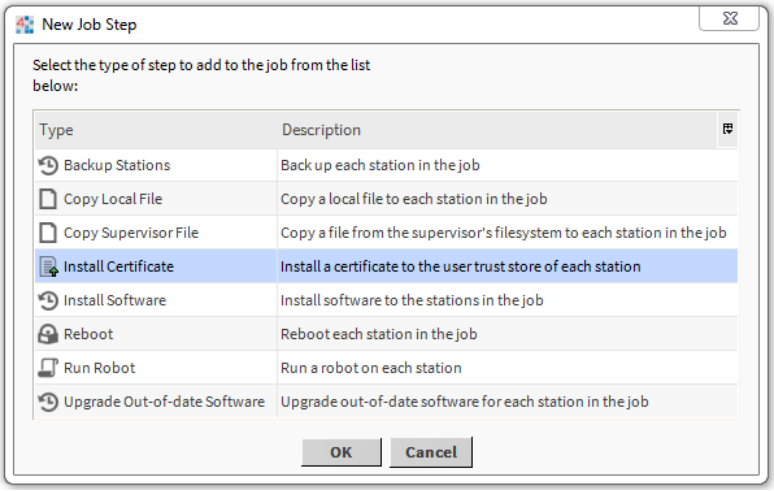
Step 5 Drag a NiagaraNetworkJobPrototype component to this location and name the component something like, “Root CA certificate provisioning.”

Step 6 Double-click the new component.

The **Niagara Network Prototype View** opens.

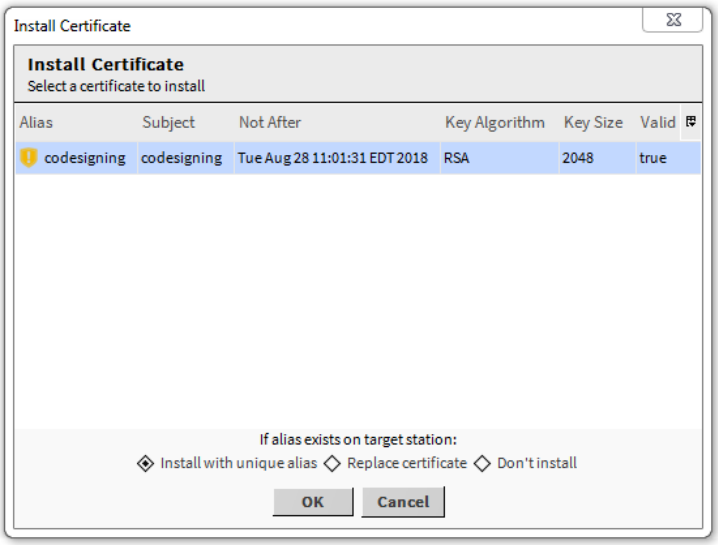
Step 7 In the **Steps to run for each station** pane, click the plus icon.

The **New Job Step** window opens.



Step 8 Select **`Install Certificate`** and click **OK**.

The **Install Certificate** window opens.



Step 9 To complete the installation, select the root CA certificate and click **OK**.

Step 10 Define the stations to include in the job.

The system copies the certificate from the Supervisor station's **User Trust Store** to the **User Trust Store**s of the other clients.

Station health confirmation

When you finish configuring a client or server, stop and restart a secure station and check station health. The system does not validate existing connections against new certificates until you restart the station. The system does not automatically change connections from Http and Fox to Https and Foxs, even when you enable **`Https Only`** and **`Foxs Only`**, until you reestablish the connection.

Viewing session information

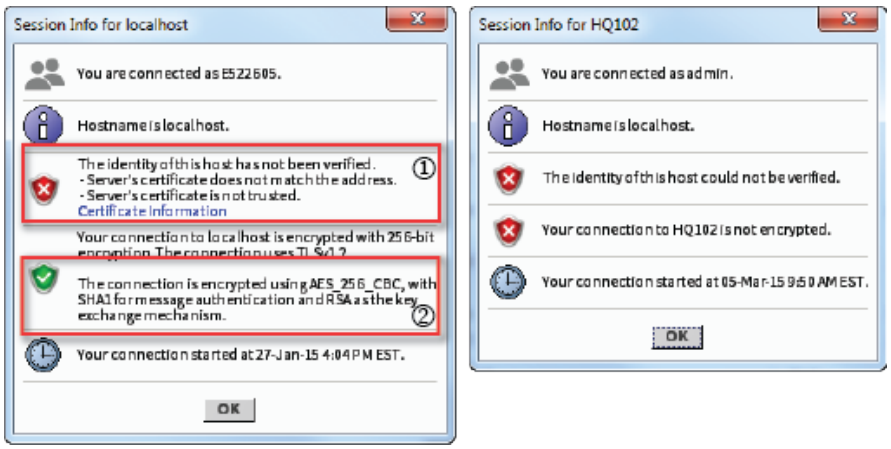
The **Session Info** window provides useful information and a graphical representation of certificate status (green and red icons).

Prerequisites: Workbench is running.

Step 1 To view session information, do one of the following:

- Click the Session Info icon ( ) in the row of icons at the top of the page.
- Right-click the station name in the Nav tree and click **Session Info**.

The system displays one of two **Session Info** windows.



- The **Session** Info message on the left indicates that you have made a secure connection.

  For the Server identity section (1), a red shield with a white X indicates that the client is unable to verify the authenticity of the Fox host. There are multiple reasons why this host may not be authentic.

  A green shield with a white check mark indicates that a root CA certificate in the client's **System** or **User Trust Store** was able to validate the signature on the server certificate, verifying the authenticity of the Fox host.

  For the Connection encryption section (2), a red shield with a white X indicates that the Fox session connection is not sufficiently encrypted.

  A green shield with a white check mark indicates that the Fox session connection is sufficiently encrypted.

  Communication is the most secure when both shields are green.

- The Session Info message on the right indicates that you have made a regular connection (a connection that is not secure). Communication is the least secure when both shields are red.

Step 2 Click the `Certificate Information` link.

The system displays the details of the Fox server certificate.

Allowed hosts management

If you used self-signed certificates to get started, more than one exemption may be allowed in your **Allowed Hosts** list. Once you have set up signed certificates for all hosts, delete the exemptions from each **Allowed Hosts** list (Workbench, and platform/station).

- To access the Workbench **Allowed Hosts** list, click **Tools→Certificate Management**, and click the **Allowed Hosts** tab.

- To access the platform/station **Allowed Hosts** list, expand **Platform** and double-click **Certificate Management** in the Nav tree. Then, click the **Allowed Hosts** tab.
- You may also access the platform/station stores by expanding **Station→Config→Services→PlatformServices** and double-clicking **CertManagerService** in the Nav tree.

When a certificate expires

Each root, intermediate, server, and code-signing certificate remains valid for a specific period of time (**Valid From** and **Valid To** dates). When a certificate expires, system users receive error messages.

Ensuring continued secure system access requires advance planning. There is no certificate renewal process. For each expiring certificate, you must create a new, replacement certificate, get it signed, import it into the **User Key Store**, and ensure that the root CA certificate used to sign it is in each station's **User Trust Store**. If your company uses a third-party CA, the whole process can take a couple of weeks. As a best practice, keep track of each certificate expiration date, and plan ahead to replace old certificates before they expire.

The code-signing certificate provides an exception to this rule. As long as your code-signing certificate is time-stamped, you may continue to use it even after it expires.

Deleting a certificate

As a general rule, third-party certificates may be renewed but not changed. Some CAs will not allow any changes once the certificate is signed. If you need to make a change, delete the certificate and start again with a new certificate.

ATTENTION: Do not delete a certificate until its replacement is in place and configured. If you delete a certificate that is in use, the platform, **FoxService** or **WebService** could fail to restart. If you have the services configured for **Https Only** a secure platform connection using TLS (Platform TLS settings) or **Foxs Only**, a missing certificate could prohibit connectivity using encrypted connections. Workbench gives no warning if you delete a certificate that is currently being used by Workbench or the platform/station.

Step 1 Connect to the platform.

Step 2 Do one of the following:

a. To access the Workbench stores for managing the root CA, intermediate, and code-signing certificates, click **Tools→Certificate Management**.

b. To access the platform/station stores, expand **Platform** and double-click **Certificate Management** in the Nav tree. To access the stores this way, the station must be idle.

Step 3 Select the certificate in the **User Key Store** and click **Delete**.

The system asks you to confirm the deletion.

Step 4 Carefully consider your action and click **Yes** (or **No**).

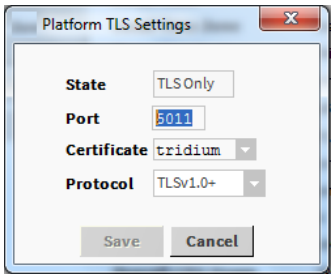
Configuring secure platform communication

Platform and station security are independent of one another. The system defaults to enabling secure communication for both platform and station. Configuring a platform (Niagarad) for secure communication (platformtls) involves confirming the port, selecting the signed server certificate to use, and, if required, restricting the TLS protocol version.

A station's window into the platform-resident secure communication features is just like any other **Platform Service** under the station's **Platform Administration** node in the Nav tree. This means that anything configured for a platform is independent of whatever station is running. Follow this procedure for the Supervisor and all remote controller platforms.

Step 1 Double-click **Platform→Platform Administration** and double-click **Change TLS Settings**.

The **Platform TLS Settings** window opens.



The default **State** is `TLS only` and the Daemon HTTP **Port** indicates 3011 (disabled in TLS settings) in the **Platform Administration** view. However,**State** can be changed on the controller to `Enable` or `Disable`. If you are using a separate certificate for verifying niagarad communication, this is where you select the **Certificate**.

Step 2 Configure the properties and click **Save**.

Configuring secure station communication

This topic explains how to set up secure Foxs and Https communication for Supervisor and controller stations.

Follow this procedure for both Foxs and Webs.

Step 1 Make a secure connection to the station.

Step 2 Right-click **FoxService** or **WebService** under **Config→Services** in the Nav tree.

The **Property Sheet** opens and click **Views→Property Sheet**.

Step 3 Confirm that the `true` check box is selected for **Foxs Enabled** or **Https Enabled**.

Step 4 From the **Foxs Cert** or **Https Cert** list, select the appropriate certificate.

Each platform/station should have its own unique, signed server certificate. Do not use the same server certificate for more than one platform/station. If you choose to use a different certificate for your **FoxService** from that used for your **WebService**, this is where you specify it.

Enabling clients and configuring them for the correct port

While not directly related to secure communication, setting up each platform/station as a client and server is important for setting up basic communication relationships.

Step 1 If it is not already open, double-click the **NiagaraNetwork** node in the Nav tree of both the Supervisor and the controller stations.

The **Station Manager** view opens.

Step 2 Double-click the client station under the client in the **Database** pane.

For the Supervisor station, this is the controller station as client; and for the controller station, this is the Supervisor station as client.

Step 3 For each client, confirm that the **Fox Port** is set to `4911`, and that **Use Foxs** is set to `true`.

Securing email

Niagara supports secure outgoing and incoming email using TLS (Transport Layer Security).

Prerequisites: The **EmailService** is in your **Services** container with both **IncomingAccount** and **OutgoingAccount** components. If not, add the **EmailService** component from the **email** palette before you begin. You may have multiple incoming and outgoing accounts, which allow you to set up connections to servers that support secure communication and others that may not.

Follow this procedure for both your incoming and outgoing accounts.

Step 1 In the station's Nav tree, right-click the **IncomingAccount** or **OutgoingAccount** node under the **EmailService** container and click **Views→Property Sheet**.

The account **Property Sheet** opens.

The system provides two secure communication options:

- The default, **`Use Ssl`**, encrypts the connection before it is ever opened. To do the encryption, it automatically uses either SSL v3 or TLS (depending on email server requirements). This provides the most secure data transmission since the connection is encrypted from the start.
- **`Use Start Tls`** makes it possible to connect to an unprotected email server. The handshake occurs without encryption, then switches to encrypt the message itself.

`Use Ssl` and **`Use Start Tls`** are mutually exclusive. Both may be `false`.

Step 2 To provide secure email, set one property to `true`, and the other `false`.

The example shows the configuration when **`Transport`** is set to `Smtp`.

Incoming and outgoing messages use different ports for secure communication as follows:

Table 2 Email ports based on transport type

	Outgoing (SMTP)	Incoming (IMAP)	Incoming (POP3)
Not encrypted	25	143	110
Use Start Tls	587	143	110
Use Ssl	465	993	995

Not all servers follow these rules. You may need to check with your ISP (Internet Service Provider).

NOTE: Do not enable or disable the **`Use Ssl`** or **`Use Start Tls`** properties without configuring the **`Port`**.

Step 3 Change the **`Port`** to the appropriate port number (defaults are: 25 for outgoing and 110 for incoming email).

The system also provides server identity verification. For most email servers, the root certificate is already in the **System Trust Store**.

Step 4 If no root CA certificate for the email server is in the station's **System Trust Store** (third-party signed certificate) or in the **User Trust Store** (your own certificate if you provide your own secure email server), either:

- Import your own or a third-party signed root CA certificate into the station's **User Trust Store**.
- Or, if you do not have a signed certificate yet, accept the system-generated, self-signed certificate when challenged. This creates an exemption in the **Allowed Hosts** list. Later, import the root CA certificate and delete this temporary exemption.

Secure communication troubleshooting

This topic suggests solutions for common connection security problems.

When I attempt to import the signed server certificate back into the host User Key Store, I get errors.

This may happen if you deleted the original certificate created on the host from which you created the CSR. If you backed up this certificate, import it back into the **User Key Store** and import the CSR again. Generating a new certificate with the same name does not generate the same key pair and will result in errors when you attempt to import a signed certificate whose keys do not match.

For months I have been able to log in without being prompted to accept a certificate. All of a sudden the software is asking me to accept the certificate again.

One or more of the following may be occurring:

- The client may no longer contain the host's root CA certificate in the **User Trust Store** (for whatever reason). Check the certificate and import a matching root CA certificate into the **User Trust Store**.
- The root CA certificate may have expired or changed and you need to import new certificates. Check the server certificate carefully to make sure it is trusted and temporarily approve it, creating an exemption in the **Allowed Hosts** list. Create or acquire a new root CA certificate and create new server certificates. Get the new server certificates signed by the new root CA certificate. Finally, import the certificates into the appropriate stores, deleting any expired certificates and any temporary exemptions you approved in the **Allowed Hosts** list.
- There may be a problem with the Fox port. Check the **`FoxService`** on the client **NiagaraNetwork** to ensure the correct Fox port: 4911 for Foxs; 1911 for Fox.
- You may be subject to a man-in-the-middle attack and no trusted root CA certificate exists for the attacker in the platform/station **Trust Stores**. Check the certificate's `Issued By` and `Issuer DN` (Distinguished Name) carefully. Do not manually approve a certificate for an issuer you do not recognize.

The Session Info window (right-click Station→Session Info) shows a red shield with a white x in the section that reports host identity authentication.

There may be a number of reasons for this:

- If you are serving as your own Certificate Authority, a platform and station requires your root CA certificate in its **User Trust Store**. When you start the platform or station for the first time the **User Trust Store** is empty. This causes the system to generate a self-signed certificate and display it for you to approve before it establishes the connection. Compare the `Issued By` and `Subject` properties. They are the same for a self-signed certificate. If you recognize the name, you can manually approve the certificate and rest assured that communication is secure. If you do not recognize the name, do not manually approve the certificate. If you are configuring the host for the first time, import your root CA certificate to the host's **User Trust Store** as soon as possible and delete the default, self-signed certificate.
- If, in a hurry, you allowed a certificate without checking its `Issued By` and `Issuer DN` (Distinguished Name), and you are worried about what you approved, open the platform/station stores (**Config→Services→Platform Services→CertManagerService**); click the **Allowed Hosts** tab; locate the certificate and, if you do not recognize it, click **Unapprove**.

When running in a browser, the Https in the address is crossed through with a red X next to it.

This indicates that you are using a self-signed certificate for which no client certificate exists in the browser's trust store. Using Google Chrome, the browser caches nothing. You can still access the platform and station, but system performance is less than desirable. To speed performance, set up and import your own root CA certificate into the browser's trust store, or purchase and install a signed client certificate from a CA (Certificate Authority).

I enabled SSL and logged in using a secure connection, but the platform icon does not include the lock symbol. Why did the platform boot with a connection that is not secure?

Most likely there is something wrong with the certificate. If a certificate fails, or for any reason secure communication cannot start, rather than lock you out of the platform, the system enables a connection without security. Restart the platform.

NOTE: If you have to replace a platform certificate, assuming you exported the keys, you can import them to configure the new platform for secure communication.

I enabled SSL and logged in using a secure connection. The platform icon shows the lock symbol, but no communication is occurring.

A firewall or secure router may be blocking or ignoring a port. Consult your firewall or router documentation for a list of blocked ports, then either unblock the port in the firewall or router, or change the port using Workbench.

I'm using a signed server certificate, but the message "Unable to verify host identity" still appears when connecting to the platform.

The system cannot find a root CA certificate in a **Trust Store** that matches the server certificate. Import the root CA certificate used to sign the server certificate into the **User Trust Store**.

My platform or Supervisor private key has been compromised, what should I do?

Get on site as quickly as possible. Take the entire network off the Internet. Configure security again for each compromised platform creating and signing all new certificates.

When importing a root CR certificate into a client User Trust Store I get the message, "The 'Import' command encountered an error" or the certificate simply did not import.

Click the **Details** button to view the Workbench console. Investigate these possibilities:

- You may be attempting to import a private key into the **User Trust Store**. This cannot be done.

  Export the root CA certificate from the Workbench **User Key Store** without its private key and try to import it again into the client **User Trust Store**.

- The `Issuer` of the certificate you are importing must be the same as the `Subject` of the certificate that is below it in the certificate tree (the certificate used to sign the one that is causing the error). This may be an intermediate certificate or the root CA certificate. Beginning at the bottom of the tree, the issuer-subject relationship is something like this:

  Issuer, SubjectC, DB, CA, B

  Where "A" is the root CA (Certificate Authority) at the root of the certificate tree. "D" is the subject of the final server certificate in the tree. The rest are intermediate certificates.

  If necessary, delete the certificate, create a new certificate, sign it using the certificate below it in the trusted certificate tree, and attempt to import again.

I'm trying to get two stations to connect and it is not working.

If this is the first time you are making this connection, check the **Allowed Hosts** list. The station serving as the client may not have a certificate in its **User Trust Store** for the station that is serving as the server. In the **Allowed Hosts** list, analyze the exemption, then select the certificate to make sure that you recognize its `Issued By` and `Issuer DN` (Distinguished Name) and click **Approve**. Check the certificate for the correct name and port number in the Host column.

If you have been connecting successfully but suddenly you are unable to connect, try to figure out what changed. Check the daemon logs for an error message.

If you are using root and intermediate certificates, check the `Issuer` name on your signed intermediate and server certificates. It should be the same as the `Subject` name on the root CA certificate. When it is unable to validate the certificate tree, the software prevents communication.

We use self-signed certificates. All hosts are approved in the Allowed Hosts list, and we've been able to connect to our platforms without getting the message that our hosts are not trusted. All of a sudden we're getting that message again. What happened?

If the IP address of the platforms changed, the entry in the **Allowed Hosts** list is no longer valid.

I get the message, "Cannot connect. Ensure server is running on specified port." when I attempt to log in to a secure station:

This is a general message. A number of things could be wrong:

- There may be a problem with the controller. Ensure that the controller is connected to power and the power is on.

- You entered invalid credentials or, for some other reason, you are having difficulty logging on (the station may have stopped running). Confirm your credentials, start the platform and use the Platform Application Director to start the station, then connect again.
- Your secure **`WebService`** (Https) or **`FoxService`** (Foxs) may not be enabled (set to `true`). Both must be enabled to make a secure station connection. Make a regular station connection by clicking **File→Open→Open Station**, select `Station Connection`, provide credentials, then, on the **`FoxService` Property Sheet**, confirm that **`Foxs`** is enabled (set to `true`), close the station and connect to it again. Make sure you select a `Station TLS Connection` for **`Type`** in the **Connect** window.

Default TCP/IP ports

The various system protocols (fox, foxs, etc.) manage communication across specific ports.

This table summarizes the default TCP/IP port numbers following commissioning. You may change these ports as needed. If a firewall or router blocks a port, communication fails. Be aware of this potential and make appropriate exemption rules where necessary.

Protocol	Default port	Type of communication	Security	To change this port...
fox	1911	station	not secure	expand **Config→Services**, and double-click**FoxServices**.
foxs	4911	station	secure	
platform daemon	3011	niagarad (platform)	not secure	use the **Change HTTP Port** button under **PlatformPlatform Administration**.
platformtls (Platform Port)	5011	niagarad (platform)	secure	use the **Change TLS Settings** button under **PlatformPlatform Administration**.
http	80	browser	not secure	expand **Config→**, and double-click**FoxServices**.
https	443	browser	secure	
email, incoming account	110	receive	not secure	expand **Config→**, and double-click**EmailServices**. **NOTE:** Do not enable Use Ssl or Use Start Tls without configuring the port as indicated in this table. Refer to the *Secure Communication* chapter for more information about these ports and properties.
email, outgoing account	25	send	not secure	
email, incoming account, **`Use Ssl`**	993 (IMAP), 995 (POP3)	receive	secure	
email outgoing account, **`Use Ssl`**	465	send	secure	
email, incoming account, **`Use Start Tls`**	143 (IMAP), 110 (POP3)	receive	secure	
email, incoming account, **`Use Start Tls`**	587	send	secure	

After changing a port for an individual station, disconnect from the station, and restart the station using **`Application Director`**. If you change the fox or foxs port, when you reconnect, use **File→Open→Open Station**. This gives you the opportunity to change the default communication port: 1911 for fox and 4911 for foxs. Otherwise, you will be unable to connect.

Certificate management when replacing a controller

When replacing JACE controller in the field, you may reuse backups of the **User Key Store** and **User Trust Store** from the old controller. If no station backup is available, you must generate a new server certificate and sign it or get it signed.

Prerequisites: You are on site. Remotely importing a security backup into JACE controller is not recommended because you should not restore the **User Key Store** and **User Trust Store** while the station is connected to the Internet.

Step 1 Make sure that the JACE controller is not on the Internet.

Step 2 Reboot the controller and restore the station.

Step 3 Either restore from the station backup, or import the stores from a previously exported file.

Chapter 3 User authentication

Topics covered in this chapter

♦ User authentication checklist
♦ Authentication schemes
♦ Set up client certificate authentication
♦ Logging in via browser using client certificate authentication
♦ Logging in via Workbench using client certificate authentication
♦ Enabling a kiosk-like mode using ClientCertAuth
♦ Setting up Google authentication
♦ Single Sign On
♦ Network users
♦ Station-to-station users
♦ Adding or editing a user
♦ Assigning authentication schemes to users
♦ Password management
♦ Logging on to a station
♦ Station Auto Logoff
♦ Changing your password
♦ User authentication troubleshooting

User authentication validates the identity of a subject, which can be a human user, a system, or an application. The **AuthenticationService** is designed to be extensible by supporting a variety of authentication schemes. In addition, the **gauth** palette (Google Authenticator app) provides a two-factor mechanism that requires a user to enter their password as well as a single-use token to authenticate.

All stations must have an **AuthenticationService**, with the **Authenticator** property for each user set to one of the supported schemes.

When a station attempts a connection, it checks the user's login credentials: user name, password, and token (if using the Google Authenticator app) against the users under the station's **UserService**. This process is called *user authentication*. The actual process depends on the authentication scheme and on the type of connection:

- Workbench-to-station (**FoxService**)

  When a user opens a station (**File→Open→Open Station**), Workbench prompts for user name and password (and token if using the Google Authenticator app). When using Niagara 4, this type of authentication defaults to the **DigestScheme**. Connections to older software versions (NiagaraAX) default to the **AXDigestScheme**.

- HTTPs browser-to-station (**WebService**)

  When a user opens a station from a browser, the system prompts for user name and password (and token if using the Google Authenticator app). The authentication mechanism used depends on the scheme selected in the **AuthenticationService**.

- Station-to-station (**FoxService**)

  As for Workbench-to-station connection, a station-to-station connection requires an assigned authentication scheme and a pre-configured user name and password. The role assigned to a station user (machine-to-machine communication) should grant only the permissions needed by the accessing station.

User authentication checklist

Use this checklist to verify that you completed all required tasks to set up user authentication.

- Connections are secure (https rather than http; foxs rather than fox).

- Each user has been created.
- The authentication scheme has been selected for each user.
- If you are using the Google Authenticator, the app has been installed on the user's mobile device.
- Credentials (user name and password) have been set up for each user.
- User roles has been identified. You need to determine what each user can do with each component in the system. Objects to protect are components, files, and histories. Each of these is assigned a category.
- Roles have been created and assigned to each user. This assignment grants permission for the user to access each category of object. The user's role defines exactly what each user can do with each object in the system.
- The audit log has been set up for later analysis.

Authentication schemes

An authentication scheme verifies that a user is authorized to access a station. All authentication requests are routed through the system's **AuthenticationService**.

These default authentication schemes are provided as standard components of the **`AuthenticationService`**:

- **DigestScheme**: With this scheme, a user password is never directly sent to the station. Instead, proof is sent that the user knows the password. This scheme connects Niagara 4 supervisor to Niagara 4 station.
- **AXDigestScheme**: With this scheme, several messages are passed back and forth to prove that the client knows the password. The client's password is never actually transmitted, which helps protect the system if another layer of security, such as secure TLS communication fails.

  This scheme provides compatibility with stations running previous software versions. Stations running NiagaraAX must have been upgraded with the following security updates: 3.8, 3.7u1, 3.6u4, or 3.5u4. This scheme allows Niagara 4 supervisor to connect to NiagaraAX station.

NOTE: Both the **DigestScheme** and **AXDigestScheme** use SCRAM-SHA (Salted Challenge Response Authentication Mechanism) to secure the transmission of clear-text passwords over a channel protected by TLS (Transport Layer Security). This authentication mechanism conforms to the RFC 5802 standard as defined by the IETF (Internet Engineering Task Force). It is the same mechanism for both schemes. The main difference between the two schemes has to do with the order of operations that is required to support the differences between NiagaraAX and Niagara 4.

Additional schemes

A station can support more than one authentication scheme. Schemes may be added to or removed from the **AuthenticationSchemes** container in the **AuthenticationService** under the **Services** container.

Each user account is associated with a specific scheme. This allows some user accounts to use one scheme, while other accounts use different schemes. For example, a digest scheme is appropriate for human users, whereas a Certificate or HTTP-Basic scheme is more appropriate for devices. The system supports only schemes that have been added to the **AuthenticationService**.

CAUTION: Deleting a scheme may leave your users with an invalid reference to a non-existent scheme.

Additional schemes are in the **`baja`**, **`ldap`**, and **`saml`**, and **`clientCertAuth`** palettes. Other schemes may be found in other palettes, and developers may create new authentication schemes. Third-party schemes may also be available.

The following schemes (which require the use of an LDAP server and additional properties must be configured) are in the **`ldap`** palette:

- LdapScheme
- KerberosScheme

Client Certificate Authentication Scheme

In Niagara 4.8 and later, the **clientCertAuth** palette contains the **ClientCertAuthScheme** which provides authentication using a user's certificate. Each user's certificate is directly bound to the user by storing the user's public certificate on the User object. Each user's public certificate matches the user certificate's private key. During a login attempt, the user is prompted to upload his or her certificate, the certificate is verified against the certificate stored on the User object. For more details, see Admin workflow for client certificate authentication, page 49 and User workflow for client certificate authentication, page 51 in the "User Authentication" chapter; and clientCertAuth-ClientCertAuthScheme , page 101 in the "Components, views, and windows" chapter.

Google Authentication Scheme

The **gauth** palette contains the **GoogleAuthenticationScheme** (Google Auth Authenticator) which provides two-factor authentication using a password and single-use token sent to the user's mobile phone. The authenticator app is time based and automatically updates the tokens every 30 seconds.

In addition to adding the **GoogleAuthenticationScheme** to the standard AuthenticationService, this scheme requires that the Google Authenticator app be installed on the user's phone.

SAML Authentication Scheme

The **saml** palette contains the **SAMLAuthenticationScheme**, which can be added to the **AuthenticationSchemes** container to configure the station for SAML Single Sign On. Authentication schemes that support Single Sign-On allow supported users to bypass entering a username in the pre-login step. Instead, the users are redirected to an alternate login page. For more details, see saml-SAMLAuthenticationScheme, page 108.

Set up client certificate authentication

Setting up client certificate authentication is a multi-step process where some procedures must be performed by the station Admin, and other procedures by the User.

The station Admin's part in the process is to obtain several pieces of information from the local IT network administrator and then configure the User for client certificate authentication.

While the User must complete several tasks as well as provide the station Admin with the client certificate (public key).

Refer to the following Admin and User workflows for the list of procedures for each.

Admin workflow for client certificate authentication

This workflow is performed by the station admin in order to configure the station for client certificate authentication.

Client authentication is a method for users to securely access a remote station (via browser) by exchanging a client certificate with the remote station. The certificate effectively represents a user identity and handles logging-in and authenticating to the station.

Typically, only the user (client) has access to the private key of their certificate for client certificate authentication. However, the public key of the certificate is not considered private data, and can be shared. For this workflow the station admin first needs to acquire the user's public client certificate, then create the station user account, and then set that certificate in the server authenticator. The following procedure details the configuration method.

Configuring a user for client certificate authentication

This procedure is preformed by a station admin user. It describes the steps to configure a new user account to use the ClientCertAuthScheme, and assigns the user's public certificate to the user's ClientCertAuthenticator.

Prerequisites:

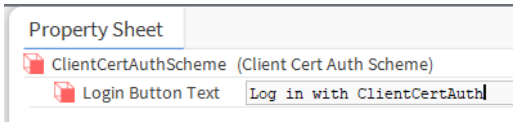
- You are working in a properly licensed Niagara 4.8 Workbench installation.
- You have already acquired the public certificate created by the user.

  NOTE: A separate workflow for the user is provided in this chapter that describes how to create a client certificate, export it with private and public keys, and install the certificate in a browser. For details, see User workflow for client certificate authentication, page 51.

Step 1 In the Workbench Nav tree, expand the station's **Services→AuthenticationService→AuthenticationSchemes** node.

Step 2 Open the **clientCertAuth** palette and drag the **ClientCertAuthScheme** to the AuthenticationSchemes folder.

Step 3 Expand the AuthenticationSchemes and double-click the ClientCertAuthScheme to open the Property Sheet view, and edit the default **Login Button Text** as needed.



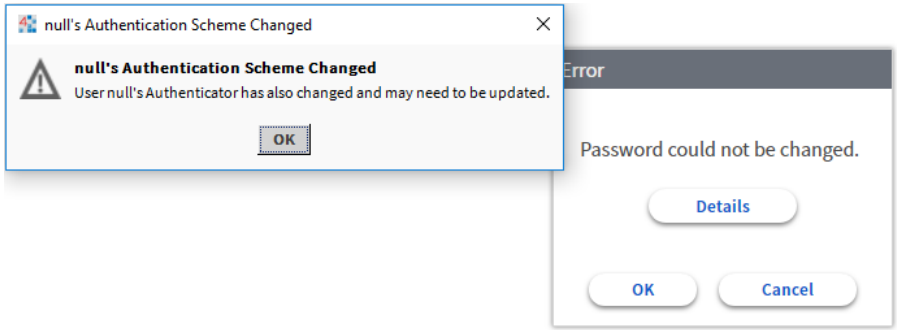
This login button is added to the login window for a browser station connection (in addition to any SSO login buttons for other configured SSO schemes).

Step 4 Double-click **UserService**, and in the **User Manager** click **New** to create a new user.

Step 5 In the configuration popup window click **OK** to accept default entries for **Type to add** and **Number to add**.

Step 6 In the second configuration window. enter user details (include a password otherwise you will be prompted to enter one), click the **Authentication Scheme Name** dropdown list, select the **ClientCertAuthScheme**, and click **OK**.

NOTE: At this point, you may see the following messages. If so, disregard the messages, click **OK** to close each popup window, and continue with the next step.

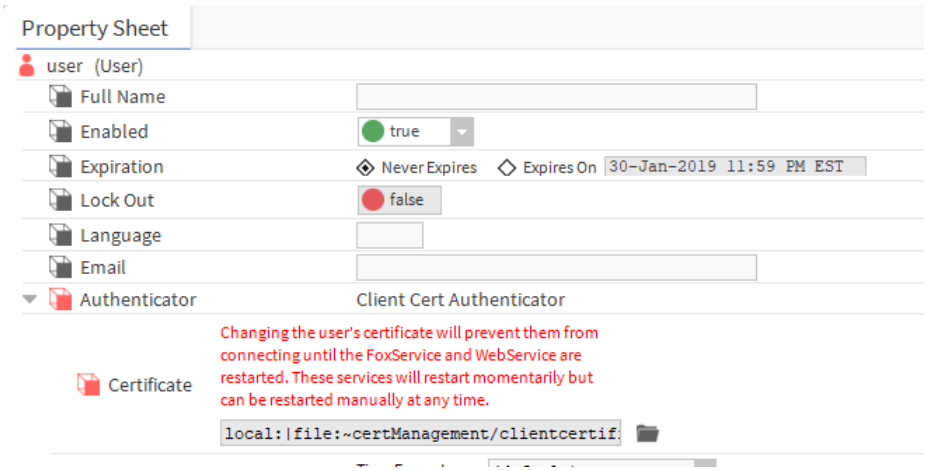


The new user is added in the **User Manager** view.

Step 7 Double-click the new user to open a **Property Sheet** view, and click to expand **Authenticator**.

Step 8 Under **Certificate**, click **Choose File** to open a File Chooser window and browse to locate and select the user-provided public certificate (`*.pem`) file and click **OK**.

A notice appears alerting you that the user's certificate change will prevent them from connecting until the FoxService and WebService are restarted.



Step 9 Click **Save**.

NOTE: The **Save** action triggers a timer to restart the Fox and Web services in 2-minutes. You can also restart the services manually. The restart is necessary for your changes to take effect.

After this configuration is successfully completed, when the user attempts to login to the station via browser, the browser first prompts the user to select the private certificate to use to authenticate to the station. Next, the browser displays the station prelogin window where the user simply clicks the **Login With ClientCertAuth** button and immediately authenticates to the station. There is no need to enter username/password credentials. For more details, see the procedure "Logging in via browser using client certificate authentication".

User workflow for client certificate authentication

This workflow is performed by a user as a preliminary step. This is done prior to the station admin setting up for client certificate authentication.

First, you will generate a new client certificate, and then export it in two different formats. Export the client certificate first with a public key which simply means that it is not considered protected data, you can share it as needed. Export the client certificate again but this time with an encrypted private key.

Afterwards, give the certificate with public key to the Station Admin who will use it in setting up Client Certificate Authentication on the station.

The exported certificate with encrypted private key should be saved to a safe location on our PC file system for later use. The private key is sensitive data and should be kept well protected. Do not store it somewhere where it might be accessible to others.

In a subsequent procedure, you will install your certificate with private key on your web browser.

Creating a client certificate

This procedure is done by the User. It describes the steps to generate a new client certificate that will be used for client certificate authentication. This method uses the Workbench **Certificate Management** tool to generate the certificate, rather than the station's certificate stores. By generating it this way, the private certificate is installed on Workbench which you may need.

Prerequisites:

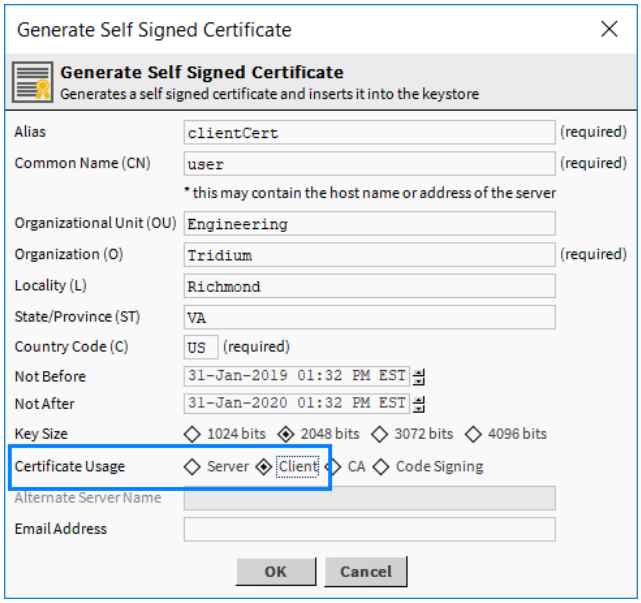
- You have the required authority to create certificates.
- You are running a Niagara 4.8 Workbench on your PC.

NOTE: Those end users who do not have Workbench will need to use some other tool (e.g. OpenSSL) to generate a client certificate.

Step 1 In Workbench, click **Tools→Certificate Management**.

Step 2 Click the **New** button at the bottom of the view.

The **Generate Self Signed Certificate** window opens.



Step 3 Give the certificate at least the required information**Alias**, **Common Name (CN)** , **Organization**, and **Country Code**.

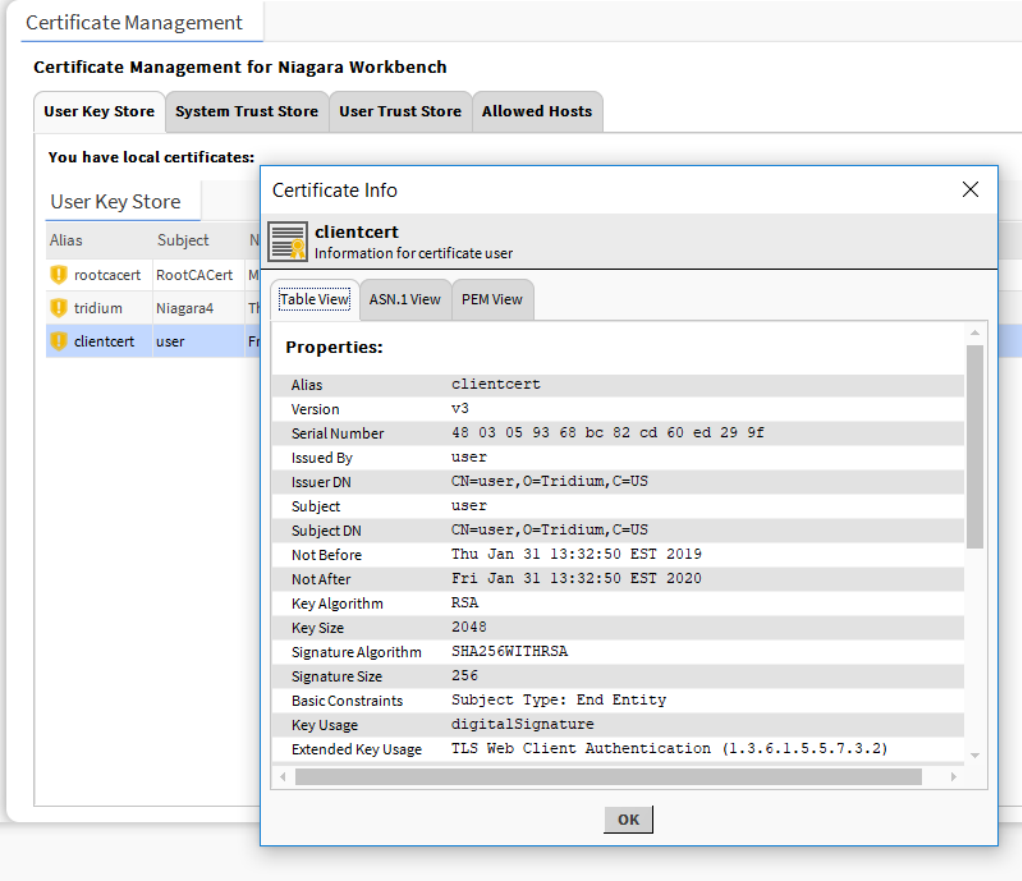
- Use **Alias** to identify this as a client certificate.
- Entering your station username in the **Common Name** field facilitates later authentication on the station.
- The two-digit **Country Code** is required and must be a known value, such as: US, IN, CA, FR, DE, ES, etc. (See countrycode.org for a list.).

Step 4 For **Certificate Usage**, select **Client**.

Step 5 When you have filled in the required fields and selected "Client" for certificate usage, click **OK**.

The system submits the certificate for processing in the background. A pop-up window in the lower right portion of your screen advises you regarding the time it may take to generate the certificate. The length of time it takes depends on the key size and the platform's processing capability.

When created, the certificate appears as a new row in the **User Key Store** table.



The next part of the workflow is to export this client certificate in two different formats: public and private.

Exporting a client certificate

This procedure describes the steps to export your client certificate in two formats: public key and private key. The certificate with **Public** key is not considered protected data, you can share it as needed. By contrast, the certificate with an encrypted **Private** key is protected data, for your use only. It is part of your digital identity, and should be kept in a safe location, not accessible by anyone else.

Prerequisites:

- You are running a Niagara 4.8 Workbench on your PC.
- You are logged in to the station
- You have already generated a client certificate which places it in your certificate **User Key Store**

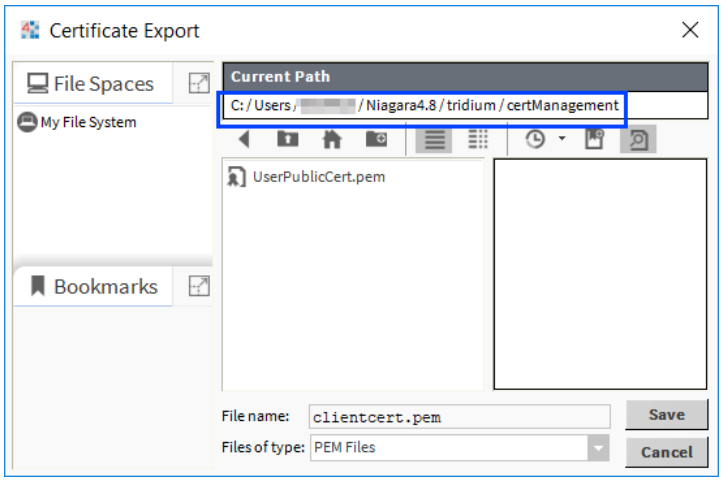
Step 1 In Workbench, open the **Certificate Management** view.

Step 2 On the **User Key Store** tab, select your client certificate and click **Export**.

The system opens the **Certificate Export** window.

Step 3 To export the **Public** certificate, just click **OK** (do not select `Export the private key`).

Step 4 Use the default location on your PC's file system (or navigate to another location) and click **Save**.

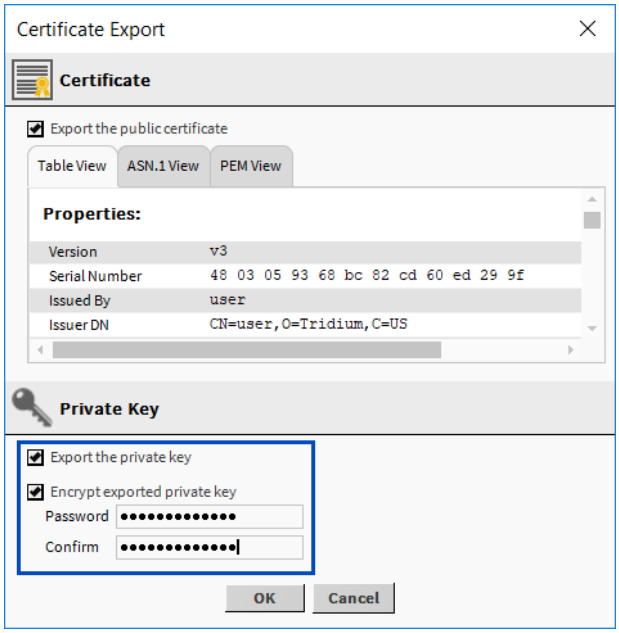


The system confirms that the certificate export was successful. To close the confirmation window, click **OK**.

Proceed with the remaining steps (5–7) to export the **Private** certificate.

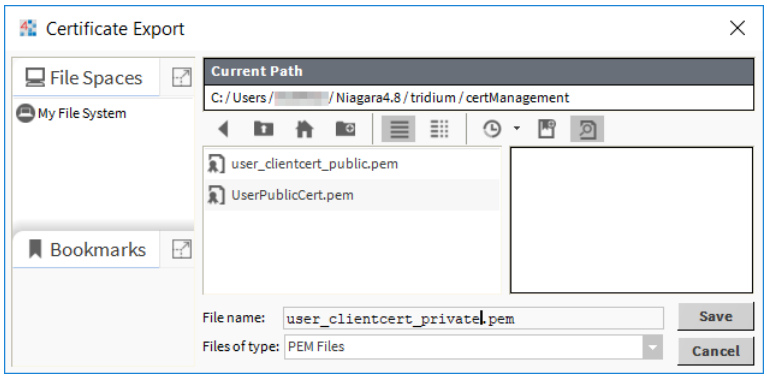
Step 5 On the **User Key Store** tab, where your client certificate is still selected and click **Export** a second time.

Step 6 This time in the **Certificate Export** window, click `Export the private key` and under `Encrypt exported private key` supply the additional password, and click **OK**.



NOTE: Be sure to make note of this password, and keep it in a secure place. Later, when authenticating to a station using the client certificate, you will be prompted to enter this private key password.

Step 7 Use the default location on your PC's file system (or navigate to another location) and click **Save**. Make sure this location is safe, and not accessible by anyone else.



The system confirms that the certificate export was successful. To close the confirmation window, click **OK**.

Your public and private client certificates are saved as `*.pem` files to the `~certManagement` folder in your User Home, or in the location you selected during the export.

Give the public certificate file to the Station Admin who will use it in setting up Client Certificate Authentication on the station. In a separate procedure, you will install the private certificate file in your browser trust store for use when logging in to the station.

Installing the private client certificate in your browser trust store

This procedure describes the steps to install your client certificate with **Private** key in your browser's certificate trust store. This private certificate will be referenced on station login via browser, when the station is configured for client certificate authentication.

Prerequisites:

- You have previously generated a client certificate and exported it with encrypted private key.
- If needed, you have used a third-party conversion tool to convert your private certificate `*.pem` file to the certificate file format required by your browser (e.g. `*.pfx` or `*.p12` /`*.pkcs12`).

  NOTE: Not all browsers will accept private certificate files in `*.pem` file format. Instead, they require other formats (`*.pfx`, `*.p12`, etc.). If your browser requires other than `*.pem` files, conversion tools (e.g. OpenSSL, etc.) are readily available which you can use to convert your private certificate file to the required format.

This procedure describes installing the private certificate in the Chrome web browser certificate stores using the Certificate import tool available there. The procedure varies somewhat depending on which browser you use, but it should be similar to what is described here.

Step 1 In the Chrome browser's **Settings** view, click on the **Main Menu** icon (upper left) and click **Advanced→Privacy and security**.

Step 2 On the **Privacy and security** view, scroll down and click **Manage certificates**.

Step 3 In the **Certificates** window on the **Personal** tab, click **Import** and follow prompts in the **Certificate Import Wizard** to import your converted private certificate file to the browser trust store.

Use the default file location indicated by the import tool. For example, by default the import tool in Chrome indicates the Personal trust store location.

Your private certificate is successfully installed in your browser's certificate trust store.

At this point, you have completed the user workflow for client certificate authentication. If the station is properly configured, you should be able to log in via browser (or Workbench) using client certificate authentication.

Logging in via browser using client certificate authentication

This procedure describes the steps to login via your browser to a station configured for client certificate authentication.

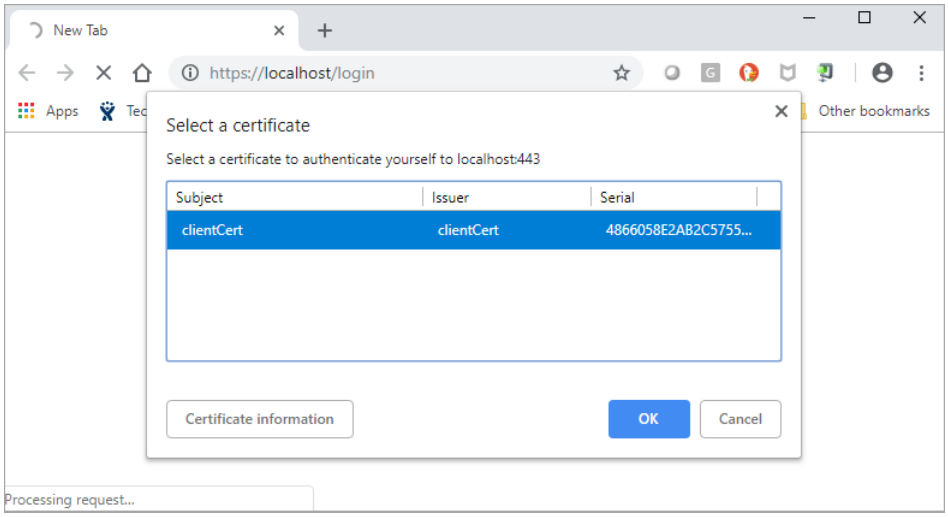
Prerequisites:

- You are running a Niagara 4.8 Workbench installation
- You have previously generated a client certificate (your **public** certificate) and given this *.pem file to the station admin.
- The station admin has already configured your user account for ClientCertAuthentication.
- You have also previously generated a client certificate with private key (your **private** certificate) and saved it to your PC file system.
- You have already installed your private certificate in the browser's certificate trust stores.

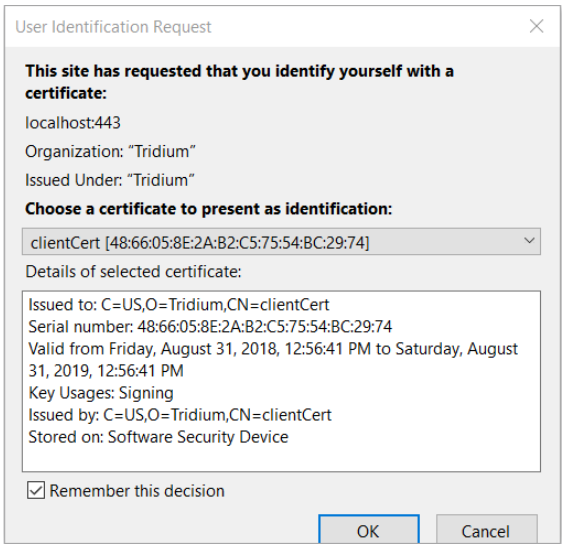
Step 1 In the browser, enter the station address and press Enter.

The browser opens a window, prompting you to select a certificate to authenticate yourself to the station.

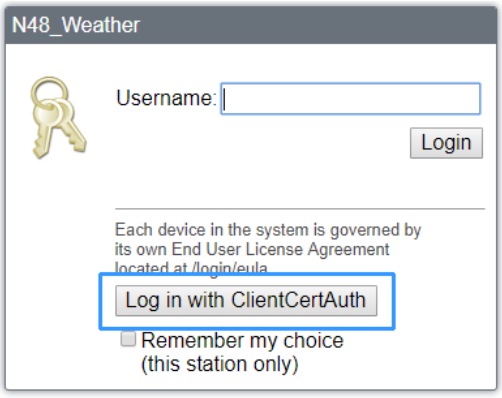
Step 2 In the **Select a certificate** window, click to select your private certificate and click **OK**.



NOTE: Different browsers will present different dialogs, but all browsers will allow you to select a certificate to identify yourself. For example, the **Select a certificate** dialog (above) is seen when using Chrome, while the **User Identification Request** dialog (below) is seen when using Firefox.

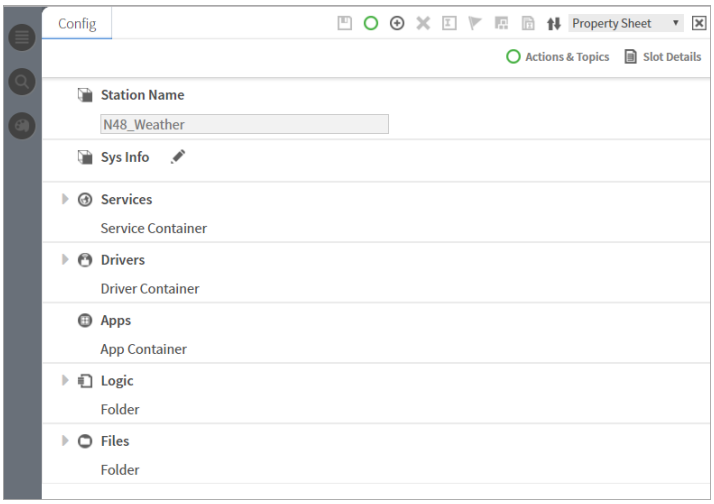


Step 3 In the station **Pre-Login** window, simply click the **Login With ClientCertAuth** button.



NOTE: There is no need to enter username/password credentials.

Upon clicking the button, you immediately authenticate to the station.



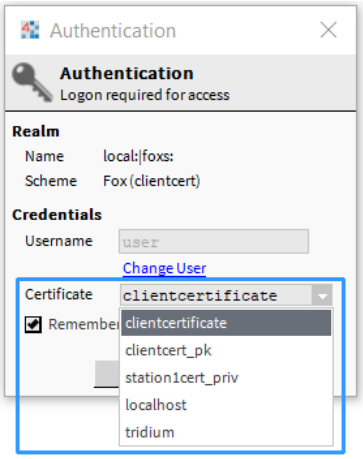
Logging in via Workbench using client certificate authentication

This procedure describes the steps to login via your Workbench to a station configured for client certificate authentication.

Prerequisites:

Step 1 In Workbench, initiate the station connection.

Step 2 When prompted, select your private certificate from the dropdown list.



NOTE: There is no need to enter username/password credentials.

Step 3 Click **OK** to continue.

You are immediately authenticated to the station.

Enabling a kiosk-like mode using ClientCertAuth

In Niagara 4.8 and later, you can use the Client Certificate Authentication feature to facilitate a "kiosk-like" application. This would be useful for the purpose of providing an information display in a lobby, or an operator terminal in a mechanical room, where the browser automatically connects and authenticates to the station without user interaction. This procedure is performed by the Station Admin.

Prerequisites:

- A station running Niagara 4.8 with the AuthenticationService already configured for Single Sign On.
- Admin privileges adequate for certificate management and creating/configuring station users.

Step 1 In a **Property Sheet** view of the station's **Services** container, click to expand **AuthenticationService→SSO Configuration** and confirm that the **`Auto Attempt Single Sign On`** property is set to **false**.

This allows authentication to bypass the automatic SSO logon prompt when a user access the station.

Step 2 Follow the workflows provided to "Set up client certificate authentication" (described in the Station Security Guide, User Authentication chapter).

NOTE: You will need to complete the procedures for both the Admin and User workflows for client certificate authentication. You will be creating a client certificate for a new user for the kiosk-like mode on this station, and you will also configuring this user for client certificate authentication.

Step 3 In the NavTree, double-click on the UserService to open the **User Manager** view, and click **New** to create a new station user (e.g., "kioskUser"), and configure the new user as follows:

a. For **`Auto Logoff Enabled`**, click the checkbox to deselect (disable) it.

b. For the **Authentication Scheme Name** click the dropdown list and click to select ClientCertAuthScheme

c. For **Password**, enter the required Private Key Password for the user's client certificate.

Step 4 In **User Manager** view, click the **Views** dropdown list and click on **Permissions Browser**.

Step 5 In the **Permissions Browser** expand folders and confirm that this new user has a limited permissions set, appropriate for this kiosk-like mode.

Setting up Google authentication

The Google Authentication Scheme is a two-factor authentication mechanism that requires the user to enter their password as well as a single-use token when logging in to a station. This protects a user's account even if their password is compromised. This authentication scheme relies on TOTP (Time-based One Time Password) and the Google Authenticator app on the user's mobile device to generate and verify single-use authentication tokens. Google authentication is time based, so there is no dependency on network communication between the user's mobile device, the station, or external servers. Since the authenticator is time based, the time in the station and time in the phone must stay relatively in sync. The app provides a buffer of plus or minus 1.5 minutes to account for clock skew.

Prerequisites: The user's mobile phone requires the Google Authentication app. You are working in Workbench. The user exists in the station database.

Step 1 Open the **gauth** palette and add the **GoogleAuthenticationScheme** to the **Services→AuthenticationService→AuthenticationSchemes** node in the Nav tree.

Step 2 Right-click **UserService**, and double-click the user in the table.

The **Edit** view for the user opens.

Step 3 Configure the **Authentication Scheme Name** as needed and click **Save**.

Step 4 Click the button next to **Secret Key** under the user's authenticator and follow the prompts.

Step 5 To complete the configuration, click **Save**.

Depending the view you are using, you may have to open the user again or refresh after saving.

Single Sign On

Niagara has an extensible Single Sign On (SSO) framework that can support many types of SSO. For example, the Kerberos scheme is an SSO scheme. And in Niagara 4.4 and later, there is added support for SAML SSO, which is the main supported SSO scheme and the focus of this topic.

About SSO

SSO is an access control method that allows for automatic logging in to multiple related, but independent software systems. In the current implementation, SSO works via a browser connection to a station. When accessing multiple stations configured for Single Sign On, the user is only required to enter credentials once to access all stations. SSO also makes it possible to log in to individual stations without being prompted for user name or password each time.

Figure 4 Login dialog for a station configured for SAML SSO

The advantages of this are evident for customers with more than one JACE controller:

- Users can log into one controller, and will not be prompted to log into other controllers which improves usability.
- There is a centralized management of credentials, meaning that users no longer need to maintain multiple copies of the same identity/role information, eliminating the errors inherent in duplication and being out of sync.
- One controlled authentication point, making authentication less complicated and ultimately, more secure.

A result of using SSO is that all credentials (identity information, authorization information via roles) are stored and managed centrally, and authentication is controlled centrally as well.

NOTE: Role names are managed centrally, but what the roles map to still needs to be managed by each individual station. For example, an Identity Provider might tell me that my role is "Party Planner", but the station needs to have a role with that name that maps to categories, etc., on that station.

About SAML SSO

Starting in Niagara 4.4, SAML SSO is the main supported SSO scheme. The **`SAMLAuthenticationScheme`**, found in the **saml** palette, is added to a station to configure it for SAML Single Sign-On. This scheme stores configuration properties required for communications with a SAML Identity Provider (IdP). With SSO, when a user tries to access the station and has not been authenticated, the station delegates authentication to the configured IdP.

The Niagara SSO SAML scheme uses SAML 2.0 (Security Assertion Markup Language v.2.0). This is an open standard for exchanging authentication and authorization data in the form of encrypted messages passed between security domains. Specific protocols process the SAML request-response message exchanges over a secure connection. SSO via web browser uses the SAML 2.0 Web Browser SSO profile to define how to use SAML messages and bindings between browser-connected Supervisor and JACE stations.

With SSO, the process of SAML request-response message exchanges occurs between the following system entities:

- Service Provider (SP) which is a station typically running on a JACE controller
- Identity Provider (IdP) which stores and maintains the authentication and authorization information.

  For Niagara SAML SSO the IdP must be external, located on a third-party IdP server. The SSO SAML authentication process uses an approach similar to LDAP authentication in that it also stores authentication credentials external to the station.

To configure a station for SAML SSO, in addition to the default authentication schemes (Digest and AxDigest), the station's Authentication Service must contain a properly configured SAML authentication scheme. The Authentication Service also contains SSO Configuration properties which allow you to tailor the authentication workflow as needed.

NOTE: In Niagara 4.4 and later, there is an added baja-UserPrototype component that is implemented with the User Service. This UserPrototype is required for SAML authentication.

More details are available in the "Components" section of this guide, see baja-UserService, saml-SAMLAuthenticationScheme, saml-SAMLAttributeMapper, and saml-SamlXmlDecryptor.

Creating a User Prototype for SAML Authentication

SAML Authentication requires a user prototype of the type "baja:UserPrototype". This procedure describes how to create this new prototype and configure the **Alternate Default Prototype** for the UserService.

Prerequisites:

- You have connected to an existing station
- You have the **baja** palette open
- You have already obtained the necessary IdP configuration metadata that is required for authentication by the IdP. Specifically, you'll need to know the value of the SAML attribute: `prototypeName`.

Step 1 Open a Property Sheet view of the station's **UserService**.

Step 2 Drag the **UserPrototype** component from the **baja** palette to the **User Prototypes** folder under the **UserService**.

Step 3 In the **Name** window, enter a name for this prototype that exactly matches the value of the `prototypeName` attribute being used by your SAML IdP and click **OK**.

NOTE: If the SAML IdP is sending the attribute `prototypeName=SAMLPrototype`, then the prototype that you create must be named, "`SAMLPrototype`".

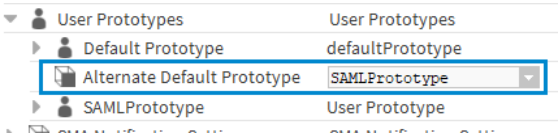
Step 4 In the Nav tree, right-click the station and click **Save Station**.

The new UserPrototype is added to the dropdown list for Alternate User Prototypes.

Step 5 Click the **Alternate Default Prototype** dropdown list, click to select your new prototype, and click **Save**.

NOTE: If there is a mismatch on the SAML `prototypeName` attribute value and your prototype name, the UserService will default to the Default Prototype.

You have created a new prototype of the type "baja:UserPrototype", and configured the UserService **Alternate Default Prototype** to be this new prototype, as shown.



Configuring the SAML Authentication Scheme

SAML SSO is enabled by adding a SAML Authentication Scheme to the station. The scheme must be configured for a particular Identity Provider (IdP). You will need to obtain several configuration metadata from your IdP and use it in configuring the scheme. You will also need to provide the IdP with your station's SP metadata. This SAML metadata is used to share configuration information between the IdP and the SP (for more details see the Prerequisites section in this topic.). The metadata is defined in XML files. Once the SAML authentication scheme is properly configured the station is able to exchange SAML authentication messages with the IdP.

Prerequisites:

- You have the **saml** palette open
- You have already obtained the necessary IdP configuration metadata that is required for authentication by the IdP. Typically, these values are provided by the IdP SAML Server administrator. The configuration metadata, which may be provided in an XML file, is as follows:

  - HTTP-Redirect URL (corresponds to IdP Host URL, IdP Host Port, and IdP Login Path properties)
  - IdP Cert

  NOTE: Since SAML is an open standard, a number of third-party SAML Servers are available (i.e. OpenAM, Salesforce, etc.).

- You have provided the IdP SAML server administrator with an XML file containing your station's SP metadata and SAML public certificate. The SP metadata typically includes the SP "Entity ID" and the "Assertion Consumer Service". The IdP needs the metadata, which uniquely identifies the SP, and the certificate which is used to validate messages sent by the station.

  NOTE: The Entity ID is simply a unique name that you choose as an SP, usually a URL. For example, the Entity ID typically is something like this: `https://jace.domain.com:portNumber/saml`, where you would use your JACE's hostname. Note that a port number is required. The "Assertion Consumer Service" metadata would be another URL, for example: `https://jace.domain.com:portNumber/saml/assertionConsumerService`, again using your JACE's hostname. Once you have generated your SP metadata, save it in XML format and share the file with the IdP SAML server administrator.

- You have already created an Alternate Default Prototype for SAML authentication using the UserPrototype component in the **baja** palette.

  NOTE: This UserPrototype is required for SAML authentication.

Step 1 In the Nav tree, expand the station's **Config→Services→AuthenticationService** node and drag the **SAMLAuthenticationScheme** component from the **saml** palette onto the Authentication Schemes folder.

Step 2 In the **Name** dialog, enter a name (or use the default text) and click **OK**.

Step 3 Expand Authentication Schemes and double-click on the SAMLAuthenticationScheme to open a property sheet view, and enter values for the following properties:

  a. **Login Button Text**: enter the preferred text label for the SSO login button that appears on the**Login** dialog.

  b. **IdP Host URL**: enter the host of your Identity Provider (obtained from IdP admin).

  c. **IdP Host Port**: enter the port number of your Identity Provider (obtained from IdP admin).

  d. **IdP Login Path**: enter the location on the Identity Provider that you must navigate to that triggers the SAML authentication (obtained from IdP admin).

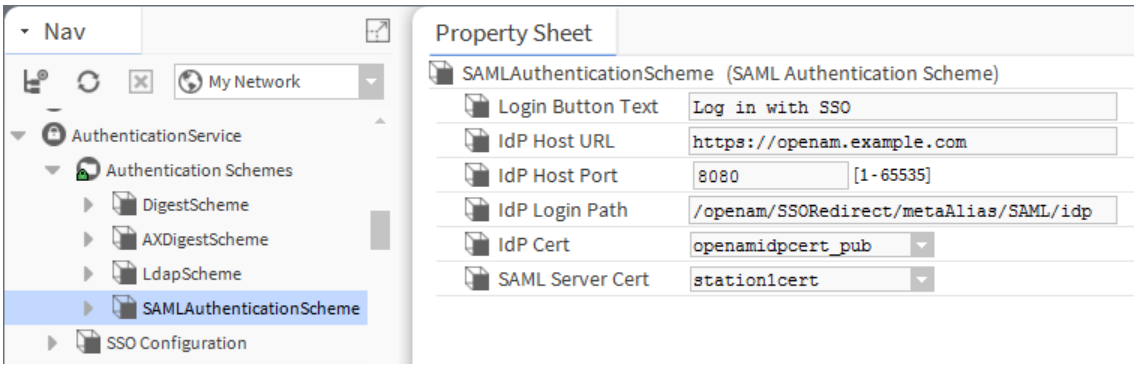
  e. **IdP Cert**: enter the certificate used to encrypt messages sent to the IdP, and to validate messages signed by the IdP (obtained from IdP admin).

  f. **SAML Server Cert**: enter the certificate used by the station to sign the messages being sent back to the IdP, and is used to decrypt messages sent by the IdP.

  NOTE: In order for the IdP to read and validate the messages sent by the station, the public certificate must be provided to the IdP SAML server administrator as well.

Step 4 On completion click **Save**.

Shown here is an example of the SAML Authentication Scheme configured for the third-party OpenAM Idp.



Customizing SAML attribute mapping

This optional procedure describes how to configure the station to map arbitrarily named SAML attributes to User properties. Useful when the default mappings are not suitable, the property/attribute mappings may be customized as described here.

Prerequisites:

- You have already configured the SAMLAuthenticationScheme for the station.
- You have identified which SAML attributes are coming in from the IdP.
- You have the **saml** palette open.

NOTE: Refer to the IdP-provided documentation to determine which SAML attributes are coming in from the IdP. As an alternative, you can install a SAML add-on to your web browser which lets you view the attributes coming in from the IdP. For example, there is the SAML DevTools extension for Chrome which you can use.

Step 1 In the station, navigate to the SAMLAuthenticationScheme.

Step 2 From the **saml** palette, drag the SAMLAttributeMapper to the SAMLAuthenticationScheme.

Step 3 Click "+" to expand the SAMLAttributeMapper field editor.

An editor for a new mapping appears.

Step 4 In the editor, replace "attributeName" with the name of the attribute sent by the SAML IdP. For example, `employeeGroup`.

Step 5 Click on the dropdown list to select a property in the user prototype. For example, **PrototypeName**.

This maps the SAML attribute "employeeGroup" to the "PrototypeName" slot in the UserPrototype.

NOTE: Certain properties may require additional information to map an attribute. In this case, an extra field editor or checkbox will appear. For example, "Expiration" requires additional information - the format in which the expiration time will be sent, so that the date/time can be appropriately parsed. Similarly, "PrototypeName" provides a checkbox to be selected in cases where an IdP returns a Distinguished Name (DN) for the prototypeName attribute. For more details, see "saml-AttributeMapper" in the Components section of this document.

Step 6 Repeat steps 3–5 as needed to map additional attributes and click **Save** when finished.

Logging in with SAML SSO

In Niagara 4.4 and later, SAML SSO works via a browser connection to a station. With SSO, you log into one station and you are automatically allowed access to all other networked stations that are also configured for SSO. You will not be prompted for credentials when logging into the other networked stations.

Prerequisites:

- Your station is already configured for SSO
- You have already provided your IdP admin with any required data
- Web browser

NOTE: When entering the URL for the station in the browser, communications are bound by the domain specified to the Identity Provider (such as station1.domain.com). This means that you cannot make a local connection using https:\\localhost, instead you would use https:\\station1.domain.com. Note that this actually depends on the IdP requirements. Different IdPs may require different information and in a different format. For example, for the Salesforce IdP there is a field to specify the host name that you will use; and for the OpenAM IdP, you need to provide a specially formatted XML file that supplies the hostname and other data. You will need to ask the IdP admin how to provide the information.

Step 1 In the web browser, open a station connection.

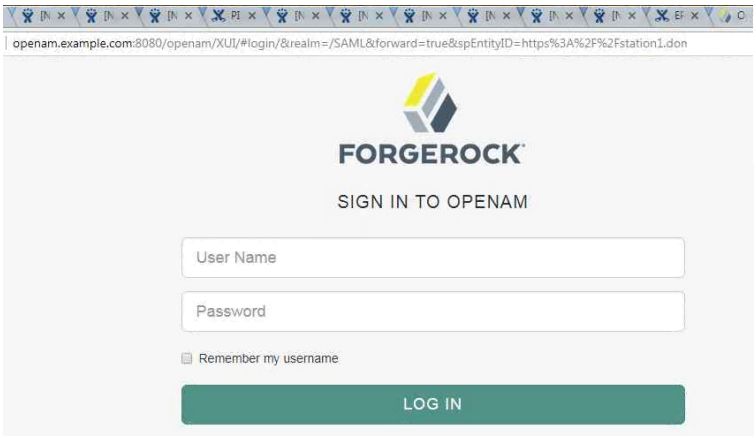
Step 2 In the **Login** window, enter your username and click **Log In with SSO** (actual button text may differ depending on the SSO scheme configuration).

Note that the **Remember my choice** option is most useful when there are multiple SAML authentication schemes in the station. In that situation, a separate SSO Login button displays for each SSO scheme. When checked, the chosen SSO Login button is remembered and automatically used on subsequent attempts to access the station. This setting can also apply when there is just one SSO scheme. If the station is not set for auto-SSO, clicking this checkbox simulates auto-SSO by attempting to log in with the saved scheme.

If you have already logged in with SSO, you will access this station immediately.

If this is the first time you are logging in with SSO your browser is redirected to the Identity Provider's site.

Step 3 In the Identity Provider's login window, enter your station credentials (Username and Password) and click **Log In**. The example shown here shows the OpenAM IdP SSO Login window.



On successful authentication completion, you are logged into the station and the browser is immediately redirected there. Also, you immediately gain access to this station and to all other networked stations. Additionally, you have an active session with the IdP, which allows you to bypass entering credentials the next time you try to log in to a station. Actually, you still are redirected to the IdP but it knows you have already logged in and redirects you right back to the station.

Network users

The UserService (`baja` module) and NiagaraNetwork (niagaraDriver module) permit "centralized management" of users in a multi-station system. This section provides an overview, summarizing the Challenge, User Service changes, and NiagaraNetwork changes.

NOTE: The "network user" feature is available between stations that all use the standard **UserService**. This feature is not supported between any stations using an LDAP authentication scheme (from `ldap` module). In that scenario, centralized user management depends on the LDAP or Active Directory server. For related details, refer to the *Niagara LDAP Guide*.

Challenge

In any Niagara station database, station users are represented as individual User components, located under the station's user service. Typically, you use the **User Manager** view of this service to add, modify, and delete users. Until recent station security changes, you were able to manually copy user components from one station to other stations. However, this method no longer works, due to more secure password storage. It also never provided change coordination. If an edit is needed for such a user, the same change had to be made to that user in each (separate) station. This was an inefficient process.

Solution: Stations are configurable to allow users to be added, modified, or deleted in one station, and then have those changes automatically replicated (or "synchronized") in other stations. The term "network user" applies to these users. Related are configurable user "prototypes." When adding users, prototypes can be used in network user "strategies" between station. Note these station user changes are standard, but optional—accomplished with additional slots on existing components.

User Service changes

Every User component (user) in the station has 2 related configuration properties: **`Network User`** (boolean) and **`Prototype Name`** (string). Currently, prototype name matters only if the user is network user, as this can be used in a "sync strategy" for distributing changes to network users.

Related to this, the UserService has a frozen child container slot **User Prototypes**, with a frozen child Default Prototype user component. If establishing network users, you can duplicate and edit additional user prototypes. User prototypes currently have the same properties as users, and are seen in the Nav tree and in the property sheet of the UserService–but are not listed in the **User Manager** view. Instead, when you add a User, the new property **`Prototype Name`** provides a selection list of available prototypes.

NOTE: In the **User Manager** view of the user service in any station, whenever you manually add a new user, property values in the **Default Prototype** are always used as defaults (regardless of whatever **Prototype Name** you may select in the **Add** dialog). In this way, the Default Prototype serves as a "template" to populate a new user's properties (all except password).

This can simplify user management even in a "non network user" scenario, to specify typical user property settings in the UserService's Default Prototype. For more details see "Default Prototype".

For more details on UserService items related to network users, see:

- "Network user related properties"
- "About User prototypes"

NiagaraNetwork changes

Each NiagaraStation (device component) under the station's NiagaraNetwork has a Users device extension, in addition to other standard device extensions like Points, Histories, Schedules, and Alarms. The Users extension contains properties that enable/configure network user synchronization "in" and "out" of this station, in relation to the station with its NiagaraNetwork. There is no special view (apart from property sheet) on this Users device extension, nor is it a container for other components.

Associated with this device extension is a view on the parent NiagaraNetwork: the **User Sync Manager**. This tabular view provides an aggregate look at all Users device extensions (one for each NiagaraStation). Each row represents a station, and columns lets you see every station's Users properties for sync configuration, sync status, sync strategy, and so on. You can select any or all rows for an edit dialog to make configuration changes, or issue manual sync commands.

NOTE: User synchronization requires stations (Supervisor, JACEs) to be using compatible password storage mechanisms. Otherwise, a user sync will fail. The corresponding NiagaraStation's Users device extension will also be in fault.

NOTE: In Niagara 4, Sync In is supported between N4 stations, and Sync Out is supported between N4 stations (N4-to-N4). However, when syncing between N4 and AX stations, you can only Sync Out from an N4 station to an AX station (N4-to-AX). Additionally, roles are not created during the synchronization process. For any role assigned to a network user on the sending station, you must setup a matching role on the receiving station.

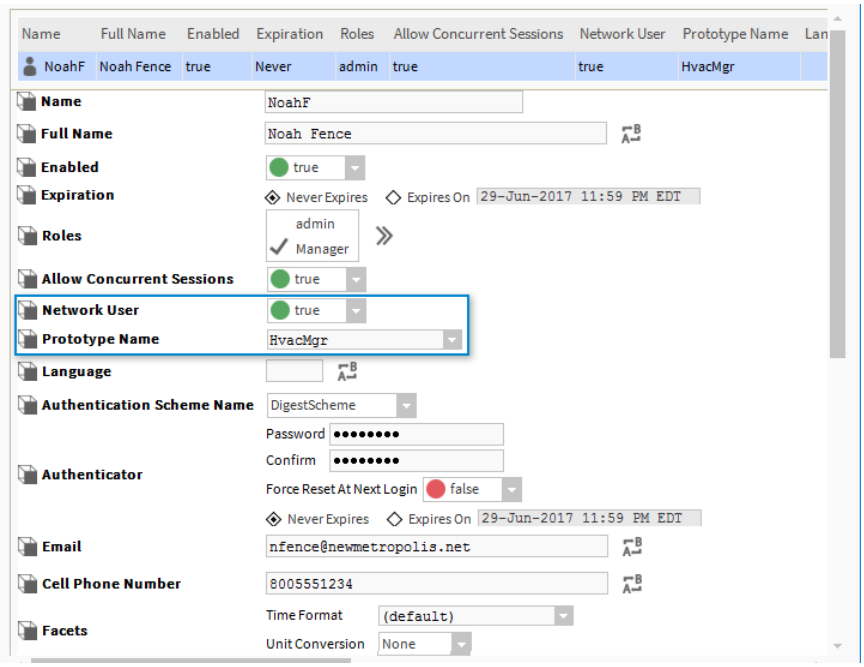
For more details on the "NiagaraNetwork side" of network users, see these sections in the *Niagara Drivers Guide*:

- "About the Users extension"
- "About the User Sync Manager"

Network user related properties

Among User component properties are two that apply to the "network users" function.

Figure 5 User properties related to network user



NOTE: These properties are unused for any users in a station with an LDAP user service (e.g. LdapV3UserService).

NOTE: In Niagara 4, each user is assigned one or more roles which control that user's access to station objects, hierarchies, views, etc. During the user synchronization process a user's role assignment is sent to the receiving station however the actual role(s) is not created on the receiving station. You must setup matching roles on each receiving station.

These properties are described as follows:

Type	Value	Description
`Network User`	true, false (default)	A boolean that specifies whether this user can be made available in other stations. When set to true, this user can be synchronized with other stations. When using the **User Manager** to add new users, this typically defaults to "false" (unless the "**User Prototypes→Default Prototype**" component has been edited from defaults, where it has been set to "true". Leave the default or set to false whenever you wish this user to be local to this particular station only. For an overview of this feature, see "Network users".
`Prototype Name`	text string	Pick from a selection list showing available local User Prototypes. Blank or no selection is effectively the same as the frozen Default Prototype. Currently, this property setting applies only if the **`Network User`** property is "true".

User prototypes

The importance of user prototypes are described in the following topics.

Properties of User Prototypes

User prototypes under a station's UserService have the same properties as User components. The importance of user prototypes can be divided between the frozen "Default Prototype", and any Additional (non-default) User Prototypes you add, for example by duplicating and renaming. Currently, non-default user prototypes are only used when synchronizing network users between different stations. In this case, (identically-named) prototypes in both the source station and receiving station can be used in a "sync strategy" of "Prototype Required."

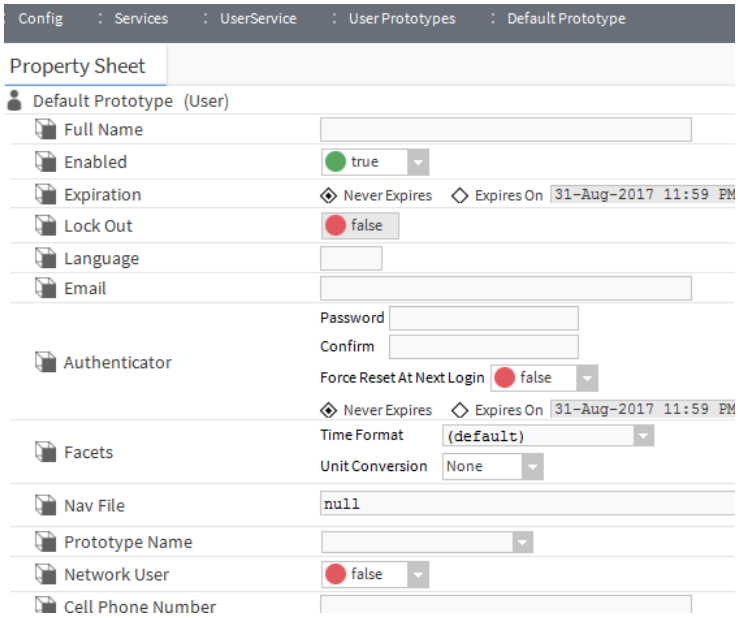
NOTE: In Niagara 4, each user is assigned one or more roles which control that user's access to station objects, hierarchies, views, etc. During the user synchronization process a user's role assignment is sent to the receiving station however the actual role(s) is not created on the receiving station. You must setup matching roles on each receiving station.

Note that alternative authentication schemes, such as the **Ldap Authentication Scheme**, leverage user prototypes as well. When using an alternative authentication scheme (in place of the standard **UserService**), you also create user prototypes. However, operation differs from the "network user" usage under the UserService. For details refer to "Setting up user prototypes" in the *Niagara LDAP Guide*.

Default Prototype

Among User Prototypes, the "Default Prototype" is important in any station with any user service, as it is always the default source of User property values whenever you use the service's **User Manager** view to add a New user to the station.

Figure 6 Default Prototype of the UserService's Default Prototypes is source of default user properties



In this regard, all of the **Default Prototype** properties can be considered important—with one exception: password—which is not copied up to a new user created in the **User Manager**.

However, all other property values (except password) in the **Default Prototype** are used as "defaults" when you create any new user in the **User Manager**. This can be useful, for example, if you have some (minimum) collection of permissions for all users, or a typical Nav file, and so on.

NOTE: User Prototypes have a child "Password Configuration" container, just like User components. Inside are two properties as follows:

- **Force Reset At Next Login** - The default is "false" for any new station. If you find yourself typically changing this each time you create a new User, change it to desired value in the **Default Prototype**.
- **Expiration** - Default value is "Never expires". Typically you leave this at default. However, it is possible you might change this to some "far future" date in the **Default Prototype**.

  For more details on the operation and configuration of these two properties, see "About password expiration and reset".

Default Prototype importance in Network users scenario

Additionally, in a multi-station job where you are using "Network users", the user "sync strategy" of "Use Default Prototype," the default prototype (in each station receiving network users) specifies the "local properties" that override the received properties of any network user. Note that by default only 2 properties are "local override" types: Permissions, and Nav File.

However, by going to the slot sheet of the Default Prototype (in each station receiving network users), and setting the "user defined 1" config flag, you can specify additional properties as "local override" types. You can also use this same technique with other (non-default) User Prototypes in stations that receive network users. For details, see "Specifying additional "local override" properties".

Additional (non-default) User Prototypes

The importance of properties in an additional (non-default) User Prototypes vary among stations that are either sending or receiving network users:

- In a user-sending station (e.g. Supervisor) non-default user prototypes are important only in "name", where you can simply duplicate the "Default Prototype" and rename each duplicate uniquely. Property values in these replicated prototypes are not used in any users—whether a user is local only to the Supervisor, or specified as a network user with this "Prototype Name."
- In a user-receiving station (e.g. JACE) non-default user prototypes are important both in "name", where matching prototype names in "user sending" stations provide sync strategy options, and also (by default) in two "local override" properties, described below.
  - Permissions - (either a permissions matrix of local categories and rights, or a "Super User")
  - Nav File - (referencing a specific nav file under the local station's file structure)

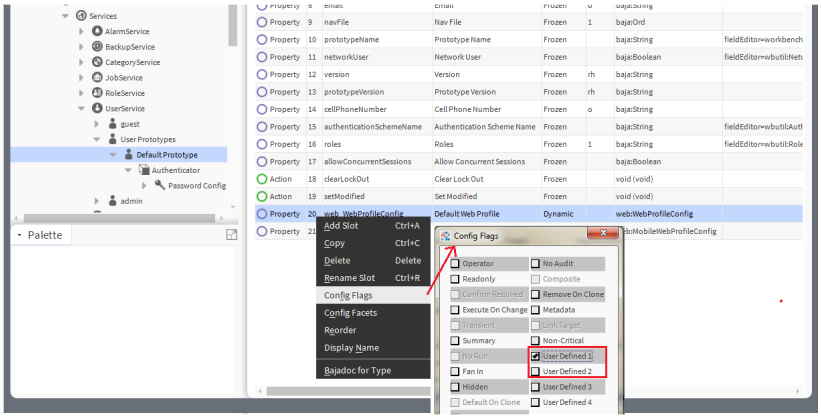
When a network user is added or modified in a "user sending" station, the two properties above are used in the "user receiving" station, instead of those same properties in the source network user. Note prototypes are configurable for other local overrides—see "Specifying additional "local override" properties".

Specifying additional "local override" properties

In a "network user receiving" station (e.g. JACE) you can specify other properties of User Prototypes to act as "local overrides" for network users created in its station. This applies both to the single **Default Prototype**, as well as any additional (non-default) User Prototypes.

Do this from the slot sheet of the User Prototype: right-click the property, and select **Config Flags**, as shown being done for the `web_WebProfileConfig` slot (Default Web Profile) .

Figure 7 Example config flag being set in the Default Prototype of a "user receiving station"



In the Config Flags dialog, click the "User Defined 1" flag and click **OK**. Notice that in the slot sheet view, the "Flags" column now includes a "1" for that property, similar to the permissions and navFile slots. When a network user sync occurs for a user referencing this prototype, all properties with this flag use the local values as overrides.

Naming User Prototypes

If creating additional User Prototypes (apart from the "Default Prototype"), it is recommended that you name them using descriptive text that can be logically associated with groups of station users, such as AdminHvac, GenOperations, LtgAndAlarms, and so on. You pick from these names when adding a new user and selecting a "Prototype Name."

Keep in mind that in a multi-station job, if you choose a network "sync strategy" based upon the "Prototype Required" scheme, network users in the "user sending" station are replicated/sync'ed in the "user receiving" stations only if the UserService in each remote station has an identically named user prototype. Note there is also an alternative "Use Default Prototype" sync strategy you can use instead.

For related details, refer to the "About Users sync strategy" section in the *Drivers Guide*.

Station-to-station users

A station-to-station user requires a machine user as opposed to a human user.

By convention, a station-to-station user should be named something memorable (perhaps a name that is unique to your company or even to a job site).

NOTE: A station-to-station user should have only the permissions it requires. To improve system security, do not make a station-to-station user a super user.

As with all user, human and machine, you should carefully guard user passwords. Although frequently a station-to-station user is assigned a role with many `admin`-level Write permissions, every user, human and machine should be assigned roles that permit them (it) to access only the components required to do their job.

When adding this user, properties, such as **`Facets`**, **`Nav File`**, and **`Web Profile`**, which apply to browser access are inconsequential.

NOTE: Do not use a station-to-station user to log in as a human user to a station! Instead, you reference this user in another station, when adding a device under a NiagaraNetwork.

Adding or editing a user

Users define possible connections to the station. Under the station's `Services` container, the **UserService** provides a default **User Manager** view for you to add, delete, and edit users.

Prerequisites: A local or remote station is open.

Step 1 Double-click the **UserService** node in the station Nav tree.

The **User Manager** view opens.

Step 2 To create a new user, click the **New** button, otherwise, to edit an existing user select the user and click the **Edit** button.

The **New** or **Edit** window opens.

NOTE: If the **Secure Only Password Set** property is set to `true`, and the connection to the station is not secure (using Fox or HTTP instead of Foxs or HTTPs), the **New** button is disabled.

Step 3 Create or modify user properties and click **Save**.

Assigning authentication schemes to users

Each user is assigned their own AuthenticationScheme. This allows different users to use different schemes appropriate to the user type. Some schemes apply to both Fox and Web. Other schemes, such as HTTP-Basic, apply only to certain web logins (for example, Obix clients). These schemes do not work over Fox or even via the form login.

Prerequisites: The authentication scheme to use has been added to the **AuthenticationService**.

By default, each new station comes with the **DigestScheme** and **AXDigestScheme** already installed. The **DigestScheme** is assigned to all users, so that in simple cases no additional setup is required.

Step 1 Right-click **UserService** in the Nav tree and click **Views→User Manager**.

The **User Manager** view opens.

Step 2 Select the user and click **Edit**.

The **UserService Property Sheet** opens.

Step 3 Scroll down to **Authentication Scheme Name** and expand the **Authenticator** section.

Step 4 To assign an authentication scheme, select the scheme from the **Authentication Scheme Name** drop-down list.

Once these setup steps are complete, the station is ready for authentication.

Password management

Managing passwords involves configuring the strength of the passwords to be used authentication scheme, establishing the period of time after which the password expires, setting the warning period, and setting up the password for each user.

The system supports three password features designed to strengthen access security:

- Password strength that may be configured for each authentication scheme.
- An expiration interval for a password
- Password history

Setting up password strength

Strong passwords are recommended. Along with the other password features, password strength will frustrate any attempt to breach your system.

Prerequisites: Authentication scheme has been added to the **AuthenticationService**.

Password strength is associated with the selected authentication scheme, for example, Digest or Baisc, but not LDAP, for which password strength is managed by the LDAP server. You can create different strengths for different schemes and apply those schemes to different classes of user. For example, an administrator could have stricter password strength requirements.

Once the New Station wizard completes, you can adjust the scheme's password strength properties as needed. If changed for a scheme, any future password change for any station user (including the `admin` user) requires the minimum values specified in the **`Password Strength`** properties.

NOTE: Although you may reduce password strength by entering zeros for its property values, it is strongly recommended that you retain a level of password strength similar to the default level, if not greater. For example, you may wish to require at least one special and at least two upper case characters.

You configure password strength for each authentication scheme.

Step 1 Right-click the **`AuthenticationService`** in the Nav tree and click **Views→Property Sheet**.

The **AuthenticationService Property Sheet** window appears.

Step 2 Expand the scheme and the **Global Password Configuration→Password Strength** container for the scheme.

Step 3 Configure the minimum character requirements, **`Expiration Interval`**, **`Warning Period`**, and **`Password History Length`** (5 or 10 characters).

Step 4 Do the same for any other scheme you plan to use and click **Save**.

Setting up password options

In most cases, users create their own passwords. You may create a temporary password for each user in the **`UserService`** and require them to change the password at their next login. You may also configure the password expiration date.

Prerequisites: The authentication scheme you need is available in the **`AuthenticationService`**.

Step 1 Right-click **`UserService`** and click **Views→Property Sheet** in the Nav tree.

Step 2 Open the user's **Property Sheet**.

Step 3 Expand the user whose password you want to set.

Step 4 Scroll down and expand the **Authenticator→Password Config** container under the user name.

`Force Reset At Next Login` defaults to `true`.

Step 5 To allow the user to continue using the same password, set **`Force Reset At Next Login`** to `false`.

Step 6 Set the password expiration date, scroll down and click **OK**.

Setting up a user's password

You configure user passwords through the UserService. If you are accessing the UserService from a browser, your connection must be secure (https) or you will be unable to set the password.

Step 1 Double-click **UserServices** in the Nav tree and double-click the user record.

Step 2 To view the password properties, expand the **Authenticator**.

Step 3 Enter and confirm the password, then click **OK**.

Logging on to a station

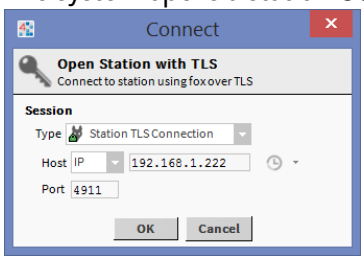
Using TLS, a secure communication session is established before the system asks for your user credentials. When you log on using the station Authentication window, the system confirms your identity, which determines your Nav tree configuration and the components you have permission to access. The system is designed to require minimum interaction while providing a secure connection and ensuring authorized access.

Prerequisites: An authentication scheme has been assigned to each user, and a user name and password created.

This procedure demonstrates user authentication using the default DigestScheme.

Step 1 Open the station.

The system opens a station **Connect** window.



This window initiates the process of verifying the server.

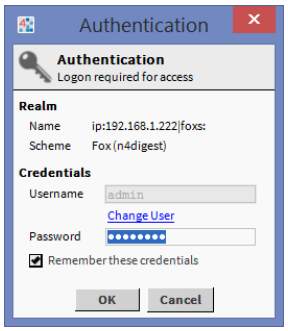
Step 2 Enter the IP address or confirm the default address and click **OK**.

If no matching root CA certificate can be found in the client's System or User Trust Stores, the system presents a default certificate for your approval.

Step 3 If you are presented with a certificate, make sure you recognize the certificate's **`Issued By`** and **`Subject`** properties.

CAUTION: Do not approve a certificate if you do not recognize these properties. The weakest link in the security chain is the user who simply clicks OK without thinking.

The system displays the station **Authentication** window.



Step 4 If you are logging on for the first time, enter your user name.

Stations can have many authentication schemes. The first time you log on to a new station the system allows you to enter the **`Username`**. It uses this information to determine what authentication scheme to use. After that initial logon, you cannot change the user because another user may use a different scheme with different credential requirements. The `Change User` link provides a way for a different user with a different authentication scheme to log on.

Step 5 To change to a different user, click the `Change User` link and enter a different name.

Step 6 Enter your station password, select **`Remember these credentials`** and click **OK**.

When you select the `Remember these credentials` check box, the system saves the last user name and password you entered and defaults to them the next time you log on.

This procedure establishes a secure TLS connection to the station using the Foxs protocol over port 4911 (this is the default port).

The default logon threshold is five attempts. If you make five unsuccessful attempts to log in during a 30-second period the system locks you out for 10 seconds. You may change the logon threshold in the **`UserService`**.

To log off, close Workbench or the browser.

Each authentication scheme supports its own audit log, including saving date, user, and event. This information is written to the AuditHistory in the following location: **Station→History→<station name>→AuditHistory**. Permission must be assigned to this file in the **`RoleService`** to grant a user access to view it.

Station Auto Logoff

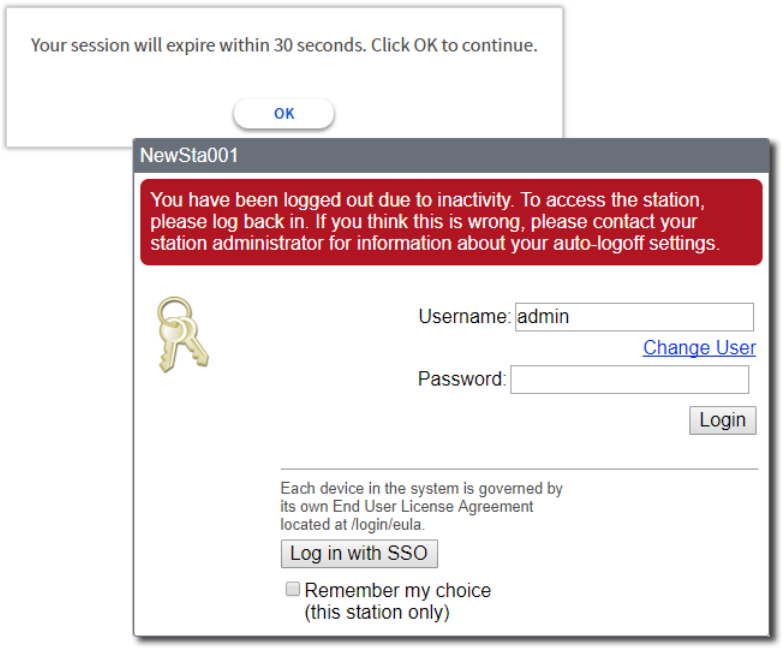
In Niagara 4.4 and later there is added support for the station auto logoff capability. Meaning that any station connection, in a web browser or in Workbench, can log the user off due to inactivity. This is important for security reasons, helping to prevent the opportunity for unauthorized access.

NOTE: The Workbench has separate auto logoff settings (under **Tools→Options**) that apply to only to the Workbench session.

Enabled by default, the station Auto LogOff feature can be configured using the **`Default Auto Logoff Period`** property in the UserService and additional auto logoff properties in the individual User accounts.

When the station does not detect any user activity for a configurable period of time, it first displays a warning popup. Clicking **OK** in the warning allows you to continue working in the station connection, otherwise the station automatically logs you off. Once auto logoff occurs, you are presented with an auto logoff notice in the **Login** window in the browser, as shown. If your station connection is via Workbench, a similar warning and logoff notice displays in the window.

Figure 8 Auto Logoff warning popup and alert notice in browser login



The intended purpose of the station auto logoff properties and separate Workbench auto logoff options is to allow for setting more restrictive (shorter) or less restrictive (longer) auto logoff period times to accommodate different use cases. A security best practice is using these properties to set reasonable limits for periods of inactivity for both the Workbench and station users.

For details on the station auto logoff properties, see baja-UserService, page 100.

Changing your password

Based on the password configuration, the system warns you when your password is about to expire. You can only change your password when required to do so by the system. Follow the login prompts.

User authentication troubleshooting

Once authentication is configured and passwords assigned, very little can go wrong.

I am attempting to set up new users using a browser, and the New button is not available.

This is a security control. Most likely the **Secure Only Password Set** is on (set to `true`), and you have made a regular connection (http) to the platform/station. When a secure connection is required, you must make a secure connection (https) to the platform/station to set the password.

My credentials were working, but they no longer allow me to log in.

- Your password may have expired.
- You may not have permission to access this station. Check with your manager.
- The credentials cache may have become corrupted causing the saved credentials to no longer work. Clear the `Remember these credentials` check box, re-type the password or clear your computer's cache.
- There is a problem with the configuration of the authentication scheme. For example, if you are using the LDAP scheme, the port is blocked by a firewall or the wrong LDAP host name or port has been configured. Refer to the documentation for the LDAP scheme.

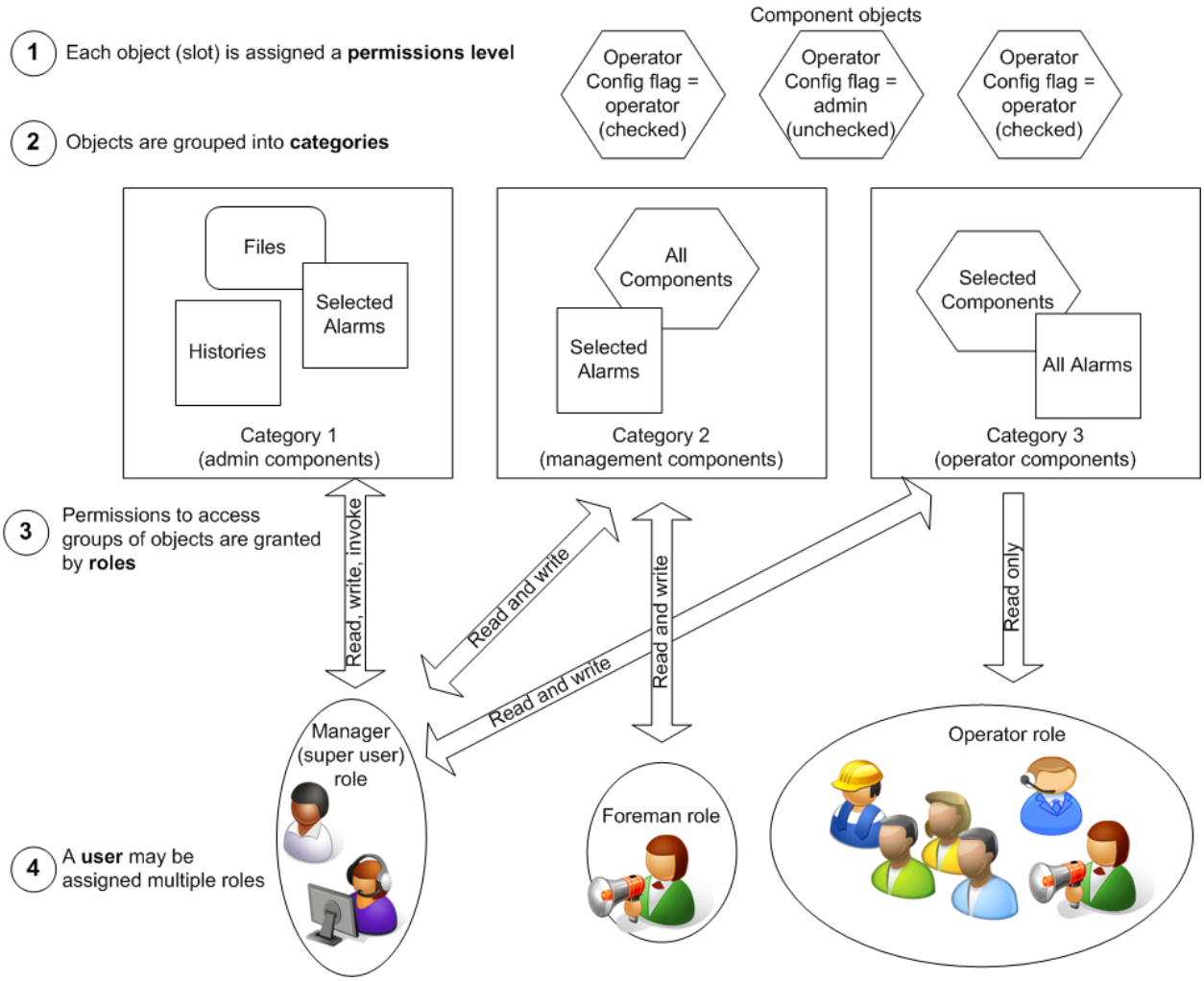
Chapter 4 Authorization management

Topics covered in this chapter

- ♦ Component permissions checklist
- ♦ Component permission level
- ♦ Categories
- ♦ Roles and permissions
- ♦ Component permissions troubleshooting

Once a human or remote station user is authenticated, authorization to access station components is based upon the permission level assigned to each slot, the category(ies) into which components are grouped, and the role assigned to each user. All configuration is stored in the system database, using services, components, and component views.

Figure 9 Station security configuration includes categories, roles and users



1. Beginning at the top of the diagram, the *permission level* may be configured on each component as needed. You change the default permission level for a component by turning the `Operator` config flag for the slot on or off.

2. *Categories* organize components, files and histories into groups. You set up categories using the **Category Manager** view (**CategoryService**).
3. *Roles* associate permissions to read, write, or invoke an action on a category of system components with a generic name, such as *Manager*, *Foreman* or *Maintenance crew*. You set up roles and permissions using the **Role Manager** view (**RoleService**). The **New Station** wizard installs the `Admin` role. This special super user cannot be modified or configured, and does not appear in the **Role Manager**.
4. Human and machine *users* are assigned to roles for the purpose of granting users the right to read, write and invoke actions on components. You assign roles to individual users using the **User Manager** view (**UserService**).

Component permissions checklist

Use this checklist to verify that you completed all required tasks to set up roles and permissions.

- Categories have been set up and basic categories assigned to components.
- System components that require access control have been identified.
- The permission level config flag has been set on component slots.
- Basic categories have been set up.
- Basic categories have been assigned to components.
- Roles have been created and permissions granted.
- Roles have been assigned to users.
- Station security has been tested.

Component permission level

The component permission level is a config flag associated with the slot. The configuration of this flag begins the process of granting permission to access individual component slots.

- If the component slot's `Operator` config flag is cleared (unchecked), the slot is configured for the `admin` *permission level*. A user must be assigned a role with at least the minimum permission set in the **Role Manager** view to `admin`-level Read (R).
- If the slot's `Operator` config flag is set (checked), the slot is configured for the `operator` permission level, and can be accessed by a user who has been assigned a role with the minimum permission set in the **Role Manager** view to `operator`-level read (r). In other words, any user assigned this role may access the slot at least to read it.

With the `admin` permission level, users can see and change slot flags from the slot sheet of any component. By default, most slots are configured for the `admin` permission level (the out slot is typically set to the `operator` permission level).

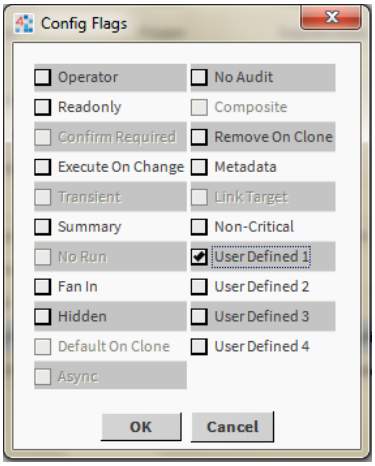
Changing a component Config flag

Config flags set up system features at the component level.

Step 1 Display the component slot sheet.

Step 2 Right-click the slot and click **Config Flags**.

The Config Flags editor appears.



Step 3 Click in the `Operator` check box to set the config flag and click **OK**.

UserService permission levels

By design, the **`UserService`** component enjoys a special permission level scheme—one that varies from the scheme described for other component access.

By default, these user properties appear as slots in the **`UserService`**:

- Email
- Password
- Cell Phone Number
- Facets (time format and unit conversion)

The `Operator` config flag for these slots may be enabled (checked) and disabled (unchecked) just as you would configure the permission level on any other slot. The special scheme that applies only to the **`UserService`** component yields the following results:

- If the `operator` permission level is enabled (`Operator` checked) on the slot, and the role assigned to the user grants read permission (r), the user is allowed read-only access to the user properties (email, password, etc.) on their own user account (all other users are hidden).
- If the `operator` permission level is enabled (`Operator` checked) on the slot, and the role assigned to the user grants write permissions (rw), the user is allowed both read and write access to the user properties on their own user account (all other users are hidden). This is the configuration required to allow a user to change their own password.
- If the `admin` permission level is enabled (`Operator` unchecked) on the slot, and the role assigned to a user grants read permission (rR), the user is allowed read-only access to all user properties for all available users.
- If the `admin` permission level is enabled (`Operator` unchecked) on the slot, and the role assigned to a user grants write permissions (rwRW), the user is allowed both read and write access to all properties for all available non-super users. Moreover, they have access to the **User Manager**, and can add new users and delete selected users. In addition, the **Permissions Browser** view of the **`UserService`** is available to them.

NOTE: A user cannot assign permissions to other users that they do not have themselves. For example, a non-super user cannot make another user a super user.

To allow each user to change their own password, but not have access to other users' passwords, you would set the config flag for the **`Authenticator`** slot to the **`operator`** permission level (checked; this is the default for this slot), and assign a role to the user that grants `operator`-level write (rw) permissions.

All non-super user roles should be configured for `operator`-level write (rw) permissions applied to the category that contains the **`UserService`**. (By default, the **New Station Wizard** assigns the **`UserService`** to the `Admin` named category (category 2), along with the **`CategoryService`**.)

NOTE: Any user granted super user permissions has access to all components, and can add more super users.

Categories

Categories are groups to which each station component may be assigned for the purpose of managing who has permission to access the component.

The system provides two types of categories:

- Basic (or explicit) categories are groups (collections) to which you assign each component.

  Each component maintains a bitmap for basic category membership. The default eight categories consume one byte and each increment of eight categories you add consumes an additional byte (1–8, 9–16, 17–24, and so on) in the component record.

- Inherited categories are passed down from component parent to component child.

All components must be assigned to at least one basic category, either an explicit assignment, or an inherited assignment from a parent component. Beyond this assignment, which type of category to use depends on your needs. You may use explicit and inherited categories at the same time.

Basic categories

The system maintains basic categories as indexes in an array. You individually assign components in the station to each category. Subsequently, you set up roles to grant permission to access components based on the category you associated with each component. Finally, you assign a role to each user.

A new station (created using the New Station wizard) comes with two default basic categories:

- `User` (Category 1)
- `Admin` (Category 2)

As the names imply, regular users may view and modify some station objects. Only administrators should have permission to access other objects. All objects default to the `User` category except for these, which default to the `Admin` category:

- The configuration services: **`UserService`**, **`CategoryService`**, and **`ProgramService`**
- All files (the entire file space)

You may add basic categories as needed. For example, you could group components by equipment type, such as `Lighting`, `Door access`, and `HVAC`. An alternate scheme might group components by geography: `Floor 1`, `Floor 2`, and `Floor 3`. How you group components depends on your overall building model, and specifically on how you plan to set up roles, permissions and users.

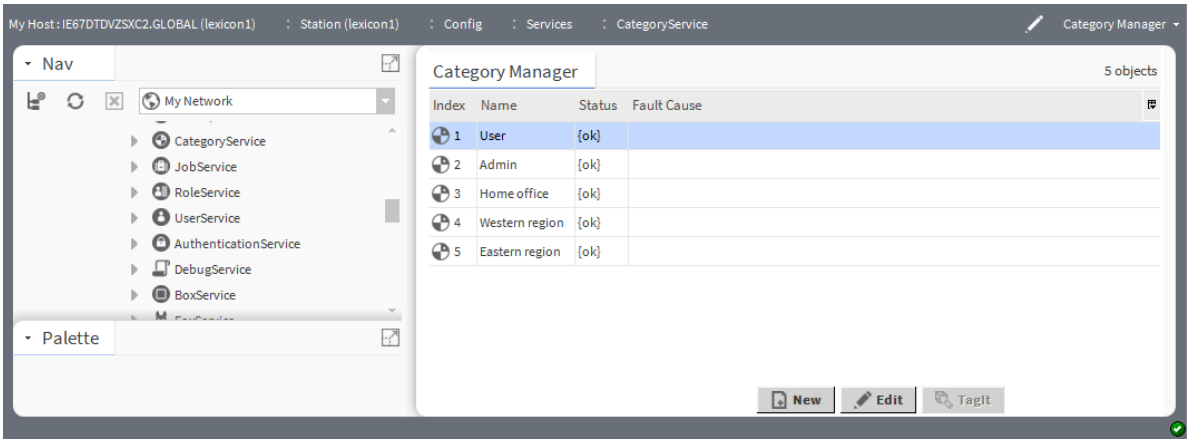
NOTE: Basic categories use station memory. To improve system performance, minimize the number of categories, and keep category indexes contiguous.

Adding and editing a basic category

You add and edit basic categories using the **Category Manager**.

Step 1 Right-click the **CategoryService** and click **Views→Category Manager**.

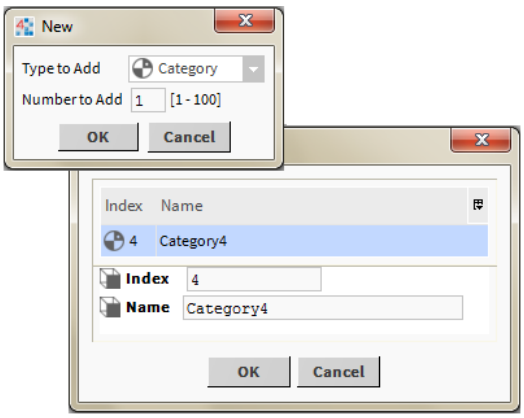
The **Category Manager** view opens.



The rows in the **Category Manager** view represent existing categories.

Step 2 Do one of the following:

- To edit the name or index of an existing category, double-click the category row in the table.
- To create a new category, click the **New** button.



Step 3 In the **New** window, choose `Category` for **`Type`**, select the number of categories to add, and click **OK**.

Selecting `Category` from the **`Type`** list allows you to assign a name to one or more basic categories.

Step 4 Enter a name and an index for each category and click **OK**.

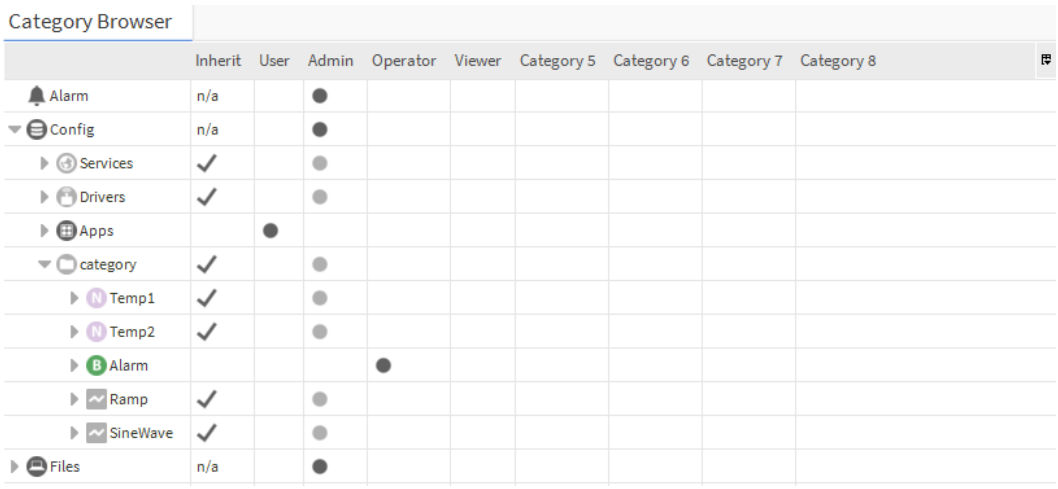
The name(s) replace the default "Category 1," "Category 2", etc. names.

Assigning a component to a basic category

You use the **Category Browser** to assign individual components to basic categories. Components may belong to more than one category at the same time.

Step 1 Right-click Expand **CategoryService** in the Nav tree and click **Views→Category Browser** in the Nav tree.

The **Category Browser** view appears. Use this view to assign components to categories.



By default this view shows the component types collapsed into rows in a tree structure: Alarm, Config (components), Files, and History. The columns represent the categories in the station. The column titles identify the categories.

Step 2 To view all components that have category assignments, click the binocular icon () on the toolbar.

All components appear in the table.

Step 3 Use the expandable tree to navigate to components of interest in the table. To return to the previous collapsed view, select the `Category Browser` from the drop-down list of views.

Step 4 As needed, in any component row, click either:

- In the category column to assign a component to a category or click again (toggle) to remove the component assignment from the category.
- In the Inherit column to assign a component to any of the categories its parent is assigned to.

NOTE: With the exception of the root components, Alarms, Config, Files, and History, each object must belong to at least one basic category or inherit its parent's category assignments. The root objects cannot inherit. They must belong to one or more categories.

NOTE: When an admin user (user with Admin write privilege on the CategoryService and on a particular station component being adjusted) is making a category mask adjustment, the user must also have at least Operator write privilege on the category being adjusted in the category mask for the station object. This includes changes to check marks in the "Inherit" column - the user must have at least Operator write access to any altered categories applied from the Inherit change.

Using the **Category Browser** to assign a component to a basic category updates the component's category bitmap. Copying the component to another station or saving it in a bog for reuse includes the category bitmap.

Deleting a category name

You delete a category name using the **Category Manager**.

Prerequisites: The category has been added. You are viewing the Category Manager.

Step 1 To delete a category name, click the row in the **Category Manager** view and press **Delete** or right-click the row and click **Delete**.

Deleting a category name changes the name back to the generic index name of Category 1, 2, etc. It does not remove the category index from the object(s) with which it is associated.

Roles and permissions

Once a user has been authenticated, the user is granted or denied the right to access each protected object in the system using a permissions map (a category-based matrix), which is defined by the role assigned to the user. Permissions define the rights a user has within each category of station objects.

Roles ease the management of permissions for a large number of users. The permissions for a group of users who are assigned to the same role can be updated by changing the role. This saves having to update each user's permissions individually.

For example, if 40 operators need access to a new component in the station, you may need to update only their shared operator role, and then only if a category has been added or permissions need to be changed. The initial configuration of a station's security, which involves object permission levels, object categories, roles (permissions) and users may take time to design and set up in some configurations, but the trade off is worth the future time saved when updating the permissions of more than one user at a time.

CAUTION: It is important to understand the risk involved in giving any user broad permissions on the Role Service. For example, giving a user **admin write** permissions on the Role Service allows that user to create, edit, rename or delete any role. Best practices recommend that such permissions on the Role Service be limited only to appropriately authorized users.

Adding roles and permissions

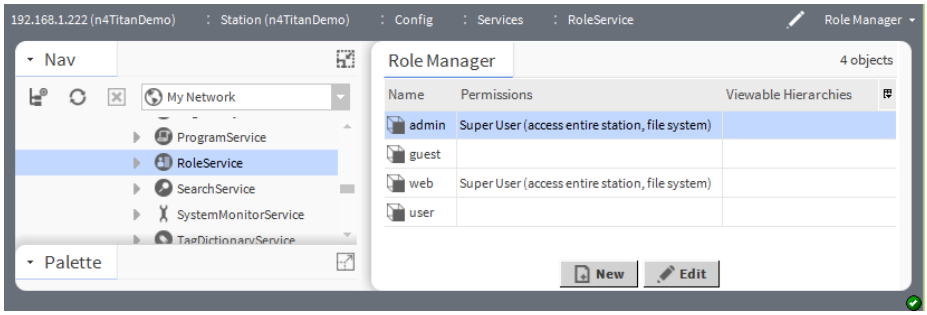
You add roles using the station's **Role Manager** view (**`RoleService`**).

Prerequisites: `Operator` config flag enabled for any restricted components. Categories created and any basic categories assigned to components.

Most companies require as a minimum, an administrator (super user) role, a manager role, and a regular user or operator role.

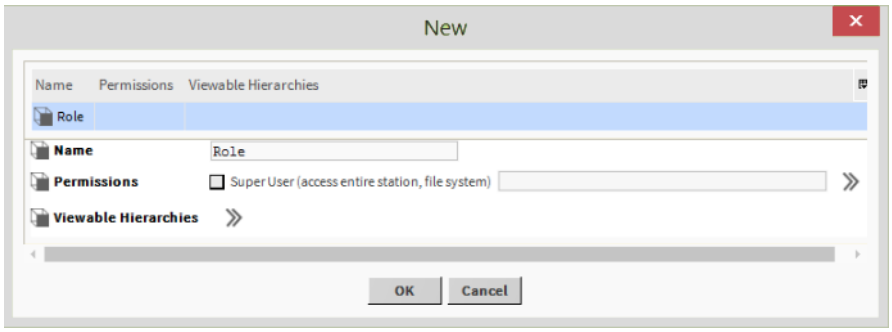
Step 1 Right-click **RoleService** in the Nav tree, click **Views→Roll Manager**.

The **Role Manager** view opens.



Step 2 Click the **New** button, enter the number of roles to create in the pop-up window and click **OK**.

The system displays the **New** window with a row for each role you are creating.



Step 3 Name each role.

Step 4 To configure a role as a super user, click the `Permissions` check box for `Super User`.

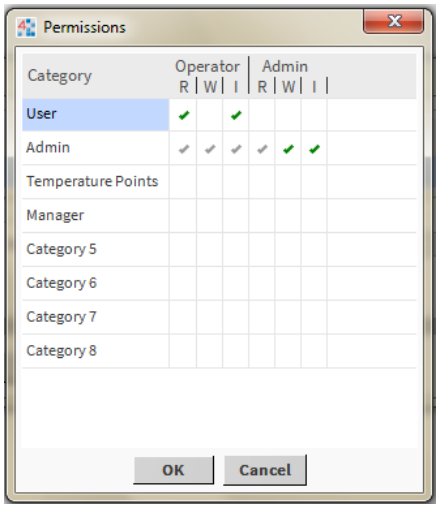
The built-in `Admin` role grants all possible rights for every category (super user). Only when logged in as the `Admin` user, or another super user, can you assign super user rights using the `Super User` check box.

In general, assigning super user rights should be strictly limited and based on special needs. For example, a Supervisor station may need super user rights to connect with other station clients (machine login vs. login by a person) in scenarios where Program objects are exported from stations using ExportTags. Human users may need super user rights to add and edit Program or Robot components.

CAUTION: Do not make it a common practice to give station-to-station users admin privileges. If your network is breached, a station-to-station user could cause significant damage without drawing attention to what is happening.

Step 5 To set up individual permissions, click the chevron at the end of the **`Permissions`** property.

The **Permissions** map appears.



The first column, Category, lists the groups to which you may grant permission. The Operator and Admin columns relate to the permissions level configured on each component. Below these headings are the cells to use for assigning one of three permissions to each category:

- R = Read allows the user to view the object.
- W = Write allows the user to change the object.
- I = Invoke allows the user to initiate an action related to the object.

Depending on how the permission level is set on the slot, six permissions are derived:

- To allow a user to view `operator`-level information, check the `Operator` config flag on the slot and select the Operator R column on the permission map.
- To allow a user to modify `operator`-level information (if it is not read-only), check the `Operator` config flag on the slot and select the Operator W column on the permission map.
- To allow the user to view and invoke `operator`-level operations (actions), check the `Operator` config flag on the slot and select the Operator I column on the permission map
- To allow the user to view `admin`-level information, leave the `Operator` config flag unchecked on the slot and select the Admin R column on the permission map.
- To allow the user to modify `admin`-level information (if it is not read-only), leave the `Operator` config flag unchecked on the slot and select the Admin W column on the permission map.

- To allow the user to view and invoke `admin`-level operations (actions), leave the `Operator` config flag unchecked on the slot and select the Admin I column on the permission map.

When you assign permissions, higher-level permissions (green check marks) automatically include the lower-level ones (gray check marks). For example, if you enable `admin`-level write (W), the system automatically enables `admin`-level read (R), as well as `operator`-level read and write (rw).

Step 6 Click the cell to assign a permission and click **OK**.

The permissions appear in the **`Permissions`** property.

Step 7 To finalize permissions, click **OK**.

Adding a component

Adding a component to your building model involves dragging the component from a palette, possibly setting the **Config Flag** on the component slot, and configuring the component to assign it to a category. A component may be a new network, device or service.

Prerequisites:

- If required, you have a license to add the component to your model.
- Any categories, roles (permissions) to assign to the component have been set up.
- The users who will access the component exist in the system.

Step 1 Open the palette that contains the component module.

Step 2 Expand the Nav tree to view the **Services** or **Drivers** container.

Step 3 Do one of the following:

- Drag the component from the palette to the **Property Sheet** or **Driver Manager**.
- Drag the component to the appropriate **Services** or **Driver** container in the Nav tree

The **Name** window opens.

Step 4 Change the name of the component, or use the default name and click **OK**.

Step 5 If you need to configure the permission level for the new component slot, right-click the component in the Nav tree and click **Slot Sheet**, then right-click the slot and click **Config Flags**.

- Leave the `Operator` config flag unchecked for the `admin` permission level (this level allows read and write access).
- Toggle this flag (checked) for the `operator` permission level (this level restricts user access to a minimum of read-only permission).

Step 6 To assign the component to a category, do one of the following:

- Add the component to the category using the **Category Browser**.
- Add the component to the category using the component's **Category Sheet**.

Step 7 If you created a new basic category, update the role assigned to users of this component to include permissions for the new component, otherwise confirm that the role includes the category.

Step 8 Confirm that component **Status** is `{ok}`.

You are ready to configure the component.

Editing roles and permissions

The primary reason for editing a role is to update permissions.

Prerequisites: The permission level is set appropriately on all components. Categories have been created. Roles have been created.

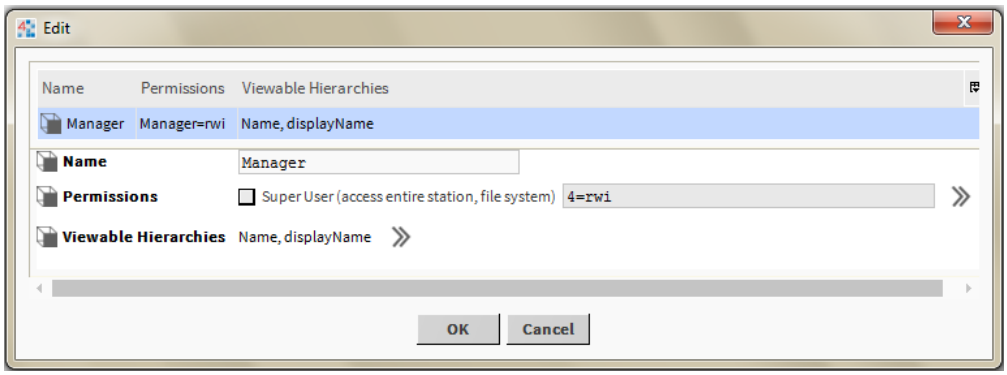
Step 1 Right-click Expand **RoleService** in the Nav tree and click **Views→Roll Manager** .

The **`Role Manager`** view opens.

Step 2 Double-click the row for the role to edit or select the row and click the **Edit** button.

The **Edit** window opens.

Figure 10 Example of an Edit role window



Step 3 To change permissions, click the chevron to the right of the **`Permissions`** property.

The **Permissions** map appears.

Step 4 Update the permissions as needed and click **OK**.

Step 5 To finalize the changes, click **OK**.

Assigning roles to users

This task associates the permissions defined by a specific role with each user.

Prerequisites: Roles and users have already been created.

Step 1 Right-click **UserService** in the Nav tree, click **Views→User Manager** .

Step 2 Double-click the user's row in the **User Manager**.

The user's **Property Sheet** appears.

Step 3 For the **`Roles`** property, select one or more role names by clicking in the check box and click **OK**.

Confirming access security

You should test each user's access rights before allowing users to use the system.

Step 1 Log out of the station.

Step 2 Log back in as a user that represents each role.

Step 3 Confirm that the Nav tree shows only those components to which the user has read, write or invoke action rights.

Reviewing permissions

The **Permissions Browser** view displays the rights granted to each role/user.

Prerequisites: Roles exist with permissions granted.

NOTE: In Niagara 4.8 and later, there is added support for the UserService in the **Permissions Browser** view. Use the **Show Permissions for** dropdown list to switch between permissions for Users, and for Roles. When viewing permissions for **Users**, the view displays a separate column for each user as well as any prototype.

Step 1 Log in to the station as a super user or as the `Admin` user.

Step 2 Right-click RoleService (or UserService) in the Nav tree and click **Views→Permissions Browser** .

Step 3 Expand the Nav tree to view permissions for each role (or User).

For more details on the improvements to the Permissions Browser view for Niagara 4.8 and later, see "wbutil-PermissionsBrowser" in the Components, views and windows section of this document.

NOTE: Although you may double-click any object row in the **Permissions Browser**, view the permissions map and update permissions for an individual user, this method of updating permissions does not change the permissions as configured in the user's role.

Ancestor permissions

Often, you may wish to grant a user the right to access components using categories that are not included in the component's parent, such that, permissions to a component's ancestor tree are not explicitly granted. In this case, the system automatically grants `operator` permission level read-only access to all ancestor components in the component tree. Otherwise, a user would be unable to navigate to target component in the Nav tree.

This automatic ancestor permission level assignment is done by the station periodically, but you can force it at any time with a right-click **Update** action on the **CategoryService** node in the Nav tree.

File permissions

By default, the New Station Wizard assigns the entire station's File space to category 2 (`Admin`). A station's config.bog file and config.bog.backup files are not accessible (even by super users) in the station's file space. If needed, other station files and folders may be hidden from a remote station.

Users typically require that the role assigned to them have `operator`-level read permission on station file folders, such as ^nav, ^px, ^images, ^html, and so on. However, permissions higher than an `operator`-level read on the `Admin` category should only be assigned to selected users on an as-needed basis. In most situations, creating a new category containing *only* the components a user needs to access is a more appropriate solution.

Largely, rights granted to access categories that are used by files and folders are `operator`-level permissions as follows:

- Files require `operator`-level read (r) access to view, and `operator`-level write (rw) access to edit a file (if applicable). For instance, a user with `operator`-level write and write (rw) access to an .html file can modify it using the Text File Editor in Workbench.
- Folders (directories) require `operator`-level read (r) access to list and to copy child files, and `operator`-level write (rw) access to create new (or delete existing) child files.

A few views of files require `admin`-level Write (rwRW) permissions to access, such as the **`Nav File Editor`** for a Nav file. There are also these special case file permissions:

- The system automatically restricts any system module files to `operator`-level read (r) access.
- If a user is not a super user, the system denies all access outside of the station's home directory.
- Users need `admin`-level Read (rwRW) access to see a Supervisor station's `^provisioningNiagara` folder (written to by the Supervisor's provisioning mechanism).
- If you have a developer license, your system includes an additional category called NModuleDevFilePermission. This category grants rwRW permission to access all system modules.

History permissions

Histories require that the `operator` permission level be set and `operator`-level read (r) permission granted by the role to access all available views.

History views include History Chart, Collection Table, and History Table). This includes the ability to rename a history.

Component permissions troubleshooting

To begin troubleshooting component permissions, go back and review your original design and double-check all configuration properties.

I can successfully log in to a station, but I get the message, "User `username` does not have access to the station. Check permissions."

The user name you used to log in with is an authentic user name, but either no role has been associated with the user or the permissions contained in the role configuration do not allow the user to access the station. Log in with a user that has permission to access the station and update the configuration. A role needs permissions on at least one component for a user to be able to access the station.

I set up categories and roles, but my users can still access some components they should not be able to access and cannot access others that they should be able to access.

Confirm that you configured the component permission level correctly for each component.

Open the **Category Browser** and review the categories the user has permission to access. Verify that there are no unexpected components in the categories.

My users cannot change their own passwords.

You need to assign a role to each user that grants write access (rw) to the **`Password`** slot on the **`UserService`**.

Chapter 5 Components, views and windows

Topics covered in this chapter

♦ Components
♦ Plugins (views)
♦ Windows

The user interface includes components, views and windows, which provide the means for communicating with the system.

The Help topics include context sensitive information about each component and view, as well as information about individual windows.

Components

Components include services, folders and other model building blocks associated with a module. You may drag them to a property or wire sheet from a palette.

Descriptions included in the following topics appear as context-sensitive help topics when accessed by:

- Right-clicking on the object and selecting **Views→Guide Help**
- Clicking **Help→Guide On Target**

baja-AuthenticationService

This component manages how users verify their identity to the station, using authentication schemes. Some schemes require password configuration, others do not. The **AuthenticationService** node is located in the **Services** container.

The **New Station** wizard installs two default authentication schemes:

- **`DigestScheme`** provides SCRAM-SHA256 (Salted Challenge Response Authentication Mechanism) technology for connecting Niagara 4 entities. Several messages are passed back and forth to prove the client knows the password.
- **`AXDigestScheme`** provides compatibility with stations running a previous software version.

Schemes available in the **ldap** palette include:

- **`LdapScheme`**
- **`KerberosScheme`**

Additional schemes may reside in other palettes. Developers may also create authentication schemes for special circumstances. You pick the one or two schemes you wish to use, drag them from the palette and drop them directly under the **AuthenticationService** in the Nav tree.

baja-AuthenticationSchemeFolder

This component is a special container designed to store authentication schemes used in the station UserService. Additional authentication schemes and authentication scheme folders may be added. This component is located in the **`baja`** palette.

The AuthenticationSchemes authentication scheme folder is a frozen slot on the AuthenticationService which contains the following default authentication scheme folders and schemes.

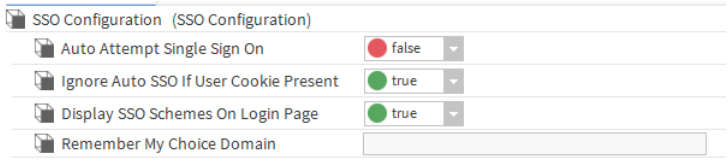
- FoxAndWebSchemes contains the DigestScheme and AXDigestScheme

- WebServicesSchemes contains the HTTPBasicScheme

baja-SSOConfiguration

This component is a frozen slot on the **AuthenticationService**, used to configure Single Sign On (SSO) properties for the station. These properties allow you to enable different aspects of SSO functionality such as whether or not to automatically attempt single sign on when users log on to the station. This component is located in the **baja** palette.

Single Sign On is a method of controlling access to multiple related, but independent software systems. With SSO, a user logs in once and gains access to all networked systems without being prompted to log in again at each of them. Centrally managed credentials eliminate the opportunity for errors and using one point of authentication makes authentication less complicated and more secure.



SSOConfiguration properties

Name	Value	Description
Auto Attempt Single Sign On	true, false (default)	When set to `true`, SSO is automatically attempted when logging you into the station. That is unless the user specifically visits the login or prelogin pages. Typically, when there is just one SSO scheme available you would set auto-SSO to `true`. In order to set this to true, there must be exactly one SSO scheme available. When multiple SSO schemes are present in the station this setting is automatically `false` and read only.
Ignore Auto SSO If User Cookie Present	true (default), false	When set to `true`, the presence of the `niagara_userid` cookie causes the user to always be redirected to the login screen, instead of automatically attempting SSO. When set to `false`, this has no effect. This is useful if you have certain users who need to login as station users rather than SSO users, such as admin users.

Name	Value	Description
Display SSO Schemes On Login Page	true (default), false	When set to `true`, a separate login button for each SSO authentication scheme in the station displays on the login page as well as on the prelogin page. Users logging in select a scheme by clicking one of those buttons. When using multiple SSO schemes, it is a good idea to configure the **`Login Button Text`** for each with a meaninful label. For example, OpenAM SSO Login.
Remember My Choice Domain	text string, null (default)	If no value in this field, logging in with SSO sets a cookie for that domain (i.e. jace1.myDomain.com) on that station only. If a domain name is entered in the field the effect is that a user only has to login to one station to set a cookie for that domain on all networked stations. For example, if stations all follow the pattern jace1.myDomain.com, jace2.myDomain.com, etc..., entering myDomain.com will cause a cookie for this domain to be set on all of the stations. This is especially useful in an environment where **`Auto Attempt Single Sign On`** is set to `false`.

baja-DigestScheme

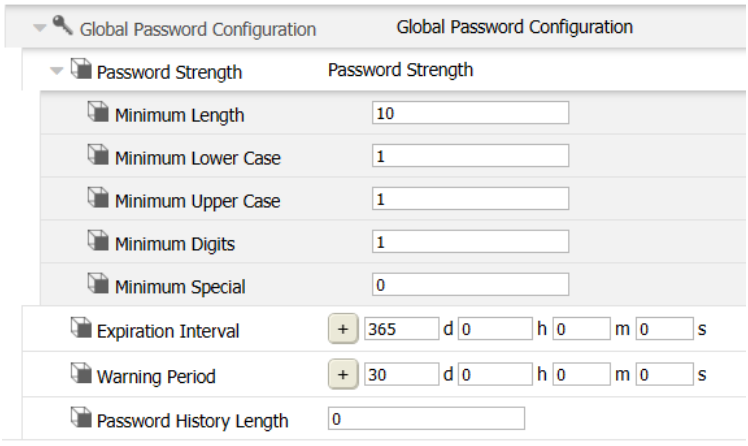
This is an authentication scheme that uses SCRAM-SHA256 (Salted Challenge Response Authentication mechanism). One of the default schemes, this component is located in the **`baja`** palette.

When using the DigestScheme, the password is never sent across the wire. Instead, the client sends proof that they know the password.

baja-GlobalPasswordConfiguration

These properties configure password requirements for a particular authentication scheme. You access them by expanding **Station→Config→Services→Authentication→Authentication Schemes** and double-clicking one of the schemes.

Figure 11 Global Password Configuration properties



Scheme properties

Property	Value	Description
Password Strength	several sub-properties	See "Password strength properties," in the *Niagara Station Security Guide*.
Expiration Interval	number of days, hours, minutes and seconds	Defines the length of time from when the password is created until it is no longer valid. When this period of time expires, the system denies access.
Warning Period	number of days, hours, minutes and seconds	Defines how many days of warning a user receives prior to the expiration of the password.
Password History Length	number	Defines how many previously used passwords the system remembers.

Password strength properties

Property	Value	Description
Minimum Length	number	Indicates the total number of characters required.
Minimum Lower Case	number	Indicates the minimum number of lower case letters required.
Minimum Upper Case	number	Indicates minimum number of upper case letters required.
Minimum Digits	number	Indicates the minimum number of digits (1, 2, 3 etc.)
Minimum Special	number	Indicates the number of special characters required. For example: ! @ # $ % ^ , . ; etc.

baja-AXDigestScheme

This default authentication scheme provides backward compatibility with stations running a previous software version. This component is located in the **baja** palette.

This authentication scheme provides compatibility with these : NiagaraAX versions:

- 3.5u4
- 3.6u4 and up
- 3.7u1 and up
- any 3.8 version

Earlier versions of NiagaraAX do not support the AXDigestScheme.

baja-HTTPBasicAuthenticationScheme

This authentication scheme performs HTTP-Basic authentication using standard HTTP headers. It only works via the web, and is intended for clients that cannot use cookies. In this authentication scheme, the user name and password are sent over the connection. This component is located in the **baja** palette.

This component is located in the **baja** palette.

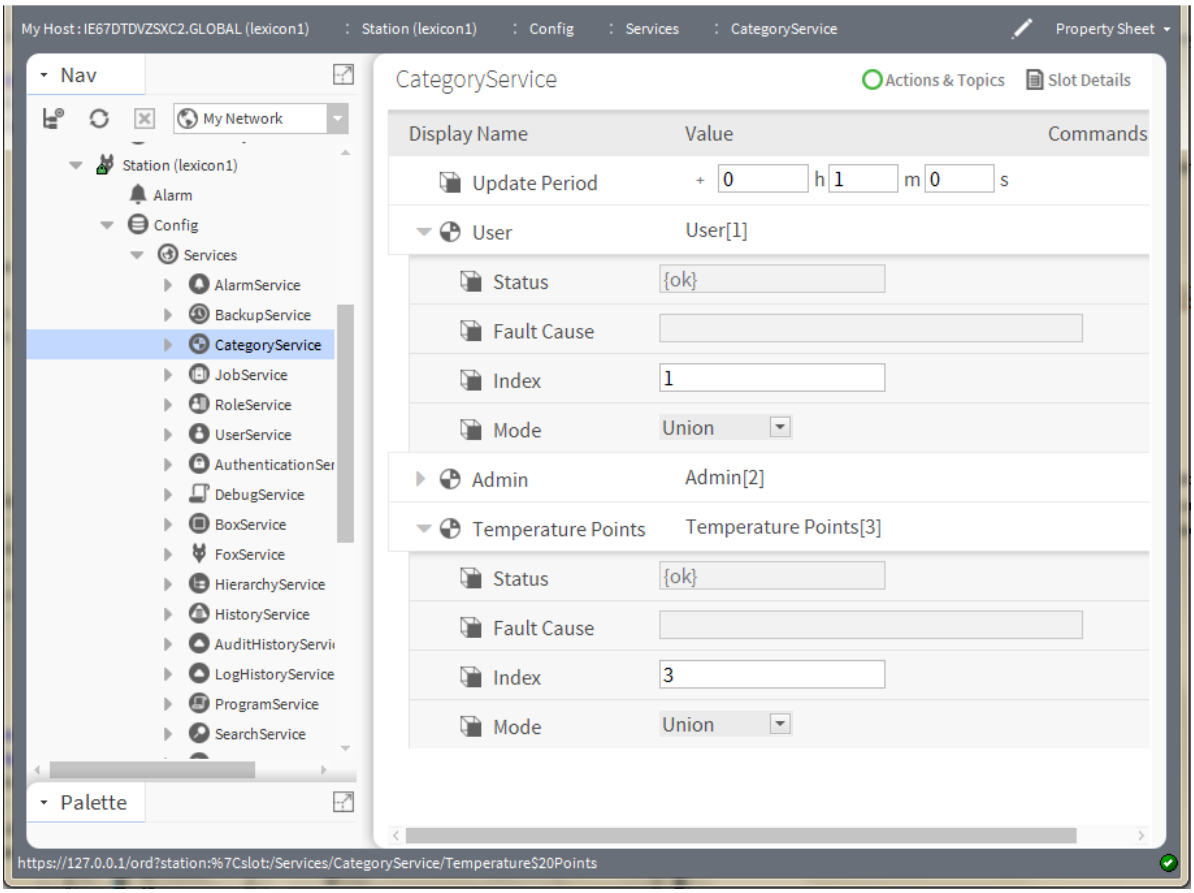
baja-CategoryService

This service is the station container for all categories, which represent logical groupings to which you can assign components, files, and histories. It is located in a station's **Services** container.

The default view of this service, the **Category Browser**, lets you centrally assign different objects to categories, using an expandable tree view of the station. The CategoryService also provides a **Category Manager** view, for you to create, edit and delete categories. Categories play an integral role in station security, where you can give users permissions for some (or all) categories. By default, the CategoryService is included when you create a new station using the **New Station** wizard.

Primary properties

Figure 12 CategoryService property sheet



In addition to being the container for child categories, the **`CategoryService`** has only one slot: **`Update Period`**.

Property	Value	Description
Update Period	hours minutes seconds	Sets the interval at which the system automatically assigns ancestor permissions. The default value is one (1) minute. If you assign a zero value, the system disables this feature.

User, Admin and additional basic category properties

Property	Value	Description
Status	text	Read-only field. Indicates the condition of the component at last polling. • `{ok}` indicates that the component is polling successfully. • `{down}` indicates that polling is unsuccessful, perhaps because of an incorrect property. • `{disabled}` indicates that the **`Enable`** property is set to `false`. • `fault` indicates another problem.
Mode	drop-down list	There are two modes: Union and Intersection.
Fault Cause	text	Read-only field. Indicates why the network, component, or extension is in fault.
Index	integer	Sequential number that identifies the property in the station.

RoleService

This service manages the Role Manager view, which is used to set up user roles in the system.

CAUTION: It is important to understand the risk involved in giving any user broad permissions on the Role Service. For example, giving a user **admin write** permissions on the Role Service allows that user to create, edit, rename or delete any role. Best practices recommend that such permissions on the Role Service be limited only to appropriately authorized users.

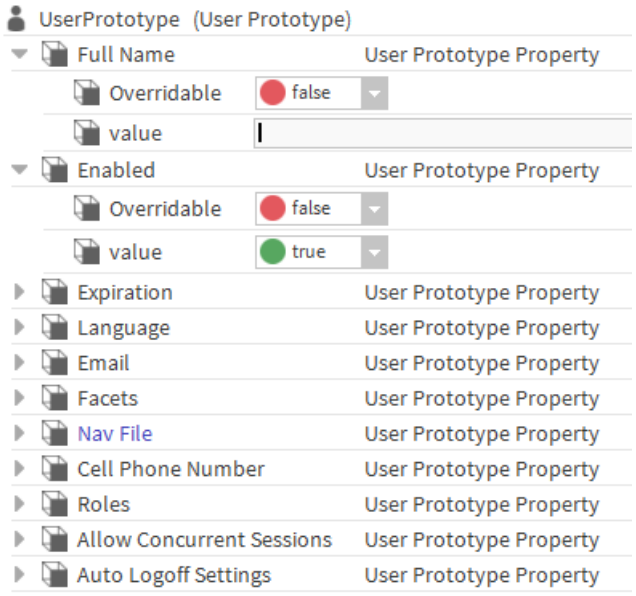
baja-UserPrototype

The baja-UserPrototype (an alternative to the legacy Default Prototype) was created to provide better control over how users are created and where their properties come from. This component is used only for remote authentication schemes (e.g. LDAP, Kerberos, SAML, and etc.). It is implemented with the User Service.

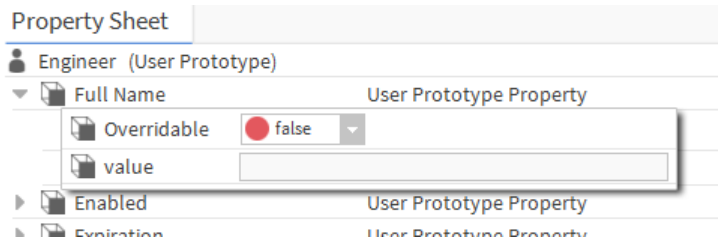
NOTE: The SAML Authentication Scheme only supports this UserPrototype. While LDAP and Kerberos support this user prototype as well the default user prototype.

Although the properties are similar to those of the Default Prototype, UserPrototype has only the relevant properties on it. Also, there is an **Overridable** user property that, when selected to `true`, prevents a value from being overwritten with a default value at next login.

Figure 13 UserPrototype properties



Each of these properties have two sub-properties, as shown:



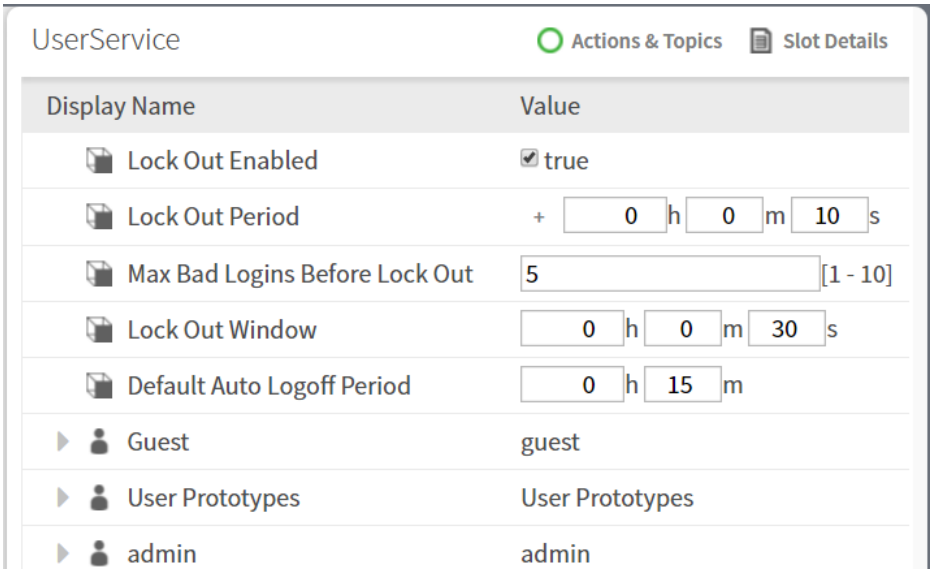
Name	Value	Description
Overridable	`true`, `false` (default)	Determines whether or not the property can be manually overridden on a user that was created from this prototype.
Value	string	Determines what the matching property on the user will be set to when creating or updating from a prototype.

baja-UserService

This service manages all system users: human and machine. You access it by right-clicking **UserService** and clicking **Views→Property Sheet**.

The **User Manager** is the primary view of this service. By default, the UserService is included when you create a new station using the **New Station** wizard. The UserService component is available in the baja module.

Figure 14 User Service property sheet view



Effect of property changes on user session

Starting in Niagara 4.3, any active session associated with a user will be terminated if the following changes are made in UserService propery sheet.

- If you remove the User from the UserService Property Sheet.
- If the **`Enabled`** property is set to `false`.
- If the **`Expiration`** property is changed to a date which has already expired.
- If the **`Authentication Scheme Name`** is changed.
- If the **`Allow Concurrent Sessions`** is set to `false`.

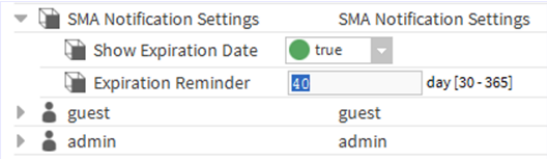
Property	Value	Description
Lock Out Enabled	`true` or `false`	If enabled (`true`), a number of consecutive authentication failures temporarily disables login access to the user account for the duration of the lock out period (next property). Using lock out makes it difficult to automate the guessing of passwords. **NOTE:** Each user has a Clear Lock Out action.
Lock Out Period	hours minutes seconds (default is 10 seconds)	If lock out is enabled, this property defines the period of time a user account is locked out before being reset. While locked out, any login attempt (even a valid one) is unsuccessful. **NOTE:** The default Lock Out value guards against an automated, brute-force password attack, where a computer application issues hundreds of login attempts a second. The 10 second latency thwarts such an attack, as the attacker must wait 10 seconds after each five unsuccessful login attempts. If deemed necessary, you can adjust this value to guard against human attack.
Max Bad Logins Before Lock Out	number from 1 — 10 (default is 5)	If lock out is enabled in conjunction with the **`Lock Out Window`**, this property specifies the number of consecutive failed user login attempts that trigger a lock out after a window of time.

Property	Value	Description
Lock Out Window	hours minutes seconds (default is 30 seconds)	If lock out is enabled, and a user fails to log in successfully before the **Max Bad Logins Before Lock Out** window (period) expires, the user is locked out for the **Lock Out Period** duration. The system enforces changes to lock out properties the next time the user logs in. For example, if **Max Bad Logins Before Lock Out** is set to 5, user ScottF fails to log in four times within the **Lock Out Window**, and an admin-level user changes **Max Bad Logins Before Lock Out** to 3, the change does not lock ScottF out. User ScottF still has one more chance to log in before getting locked out. If ScottF's fifth attempt to log in fails, the system locks him out the next time he attempts to log in because five failed attempts is greater than or equal to the **Max Bad Logins Before Lock Out** of 3.
Default Auto Logoff Period	0000h 15m (default)	Specifies the amount of time that a period of inactivity may last before a station connection is automatically disconnected. The acceptable range of values is two minutes to four hours. This limit is observed only when the User's **Use Default Auto Logoff Period** property is set to true.
SMA Notification Settings	multiple properties	See the next section
User Prototypes	multiple properties	See the next section.

SMA Notification Settings

These are the properties to configure the Software Maintenance Agreement (SMA) expiration reminder. For details, see the *Niagara Platform Guide*.

Figure 15 SMA expiration reminder properties



Type	Value	Description
Show Expiration Date	true (default), false	When set to true, the initial SMA expiration reminder displays in the browser-connected station **Login** window at 45 days prior to expiry. When set to false, the initial SMA expiration reminder is hidden, it does not display. **NOTE:** Once the SMA expires, the SMA expiration reminder cannot be hidden.
Expiration Reminder	45 day (default) [30–365 days]	By default, this is set to 45 days before expiration.

User Prototypes

UserPrototypes is a frozen slot on a station's UserService. It contains a frozen **Default Prototype** (properties shown in the following figure) to support centralized users in the station's NiagaraNetwork, as well as a

frozen Alternate Default Prototype for any additional user prototypes needed to support remote authentication schemes such as LDAP, Kerberos, and SAML.

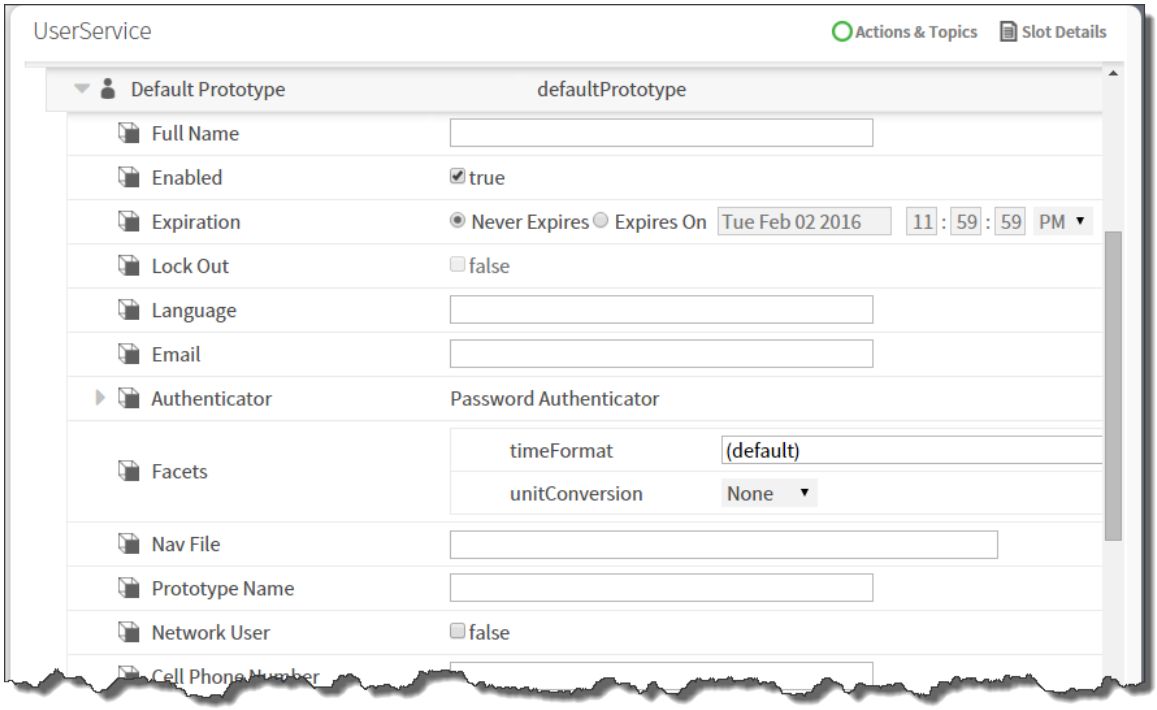
Default Prototype

The User Service and Niagara Network still use the existing default user prototype functionality and there are no current plans to migrate them to the new UserPrototype. Also, LDAP and Kerberos will continue to support the default user prototypes.

Alternate Default Prototype

This property allows you to specify an alternate user prototype to start with when creating a new user (instead of only using defaultPrototype). For example, you would use this to select a prototype (other than default prototype) specifically created to support a remote authentication scheme, such as SAML.

Figure 16 Default Prototype user properties



Property	Value	Description
Full Name	text	The user's name.
Enabled	`true` (default) or (`false`	Unchecked (`false`) disables this user. Disabled users cannot access the system.
Expiration	radio buttons	• `Never Expires` permits this user to always log in. • `Expires On` [date and time] allows this user to log in until the expiration date and time.
Lock Out	`true` or `false` (default)	Checked enables a user to log in. Unchecked (true) prohibits this user from logging in.

Property	Value	Description
Language	two lower-case letters	Defines the ISO 639 language code. For a list of codes, see the following: http://www.loc.gov/standards/iso639-2/langcodes.html.
Email	email address	Defines the user's email address.
Authenticator	additional properties	Manages user password.
Facets	timeFormat and unitConversion	Configures the time format and units to use when this user logs in to the system.
Nav File	`file:^nav/Nav-File.nav`	Identifies the file to use for displaying a customized navigation tree.
Prototype Name	text	Identifies the name of the prototype used to create this user.
Network User	`true` or `false` (default)	When true, this user account can be synchronized to other stations on the network.
Cell Phone Number	number	Defines the user's mobile phone number.
Authentication Scheme Name	drop-down list	Identifies the authentication scheme used to verify this user.
Roles	radio buttons	Identifies the user's role.
Allow Concurrent Sessions	`true` (default) or `false`	When checked, allows multiple sessions. When unchecked, a new session invalidates the old session.
Auto Logoff Settings	additional properties	Refer to the below section in this document.
Default Web Profile	additional properties	Refer to the below section in this document.
Mobile Web Profile	additional properties	Refer to the below section in this document.

Auto Logoff Settings

Property	Value	Description
Auto Logoff Enabled	`true` (default) or `false`	When `true`, a station connection (via Workbench or web browser) automatically disconnects if a period of inactivity exceeds the amount of time specified for the **`Default Auto Logoff Period`** (in the UserService). When `false`, the station does not automatically terminate a user's session due to inactivity. **NOTE:** Separate auto logoff options exist for Workbench which functions independently of these station settings. For details, see the *Getting Started with Niagara*.
Use Default Auto Logoff Period	`true` (default) or `false`	If the property is set to `true`, the **`Default Auto Logoff Period`** (configured in the UserService) displays the specified time. When `false`, the specified **`Default Auto Logoff Period`** is not observed. Instead, use the **`Auto Logoff Period`** property to set a different auto logoff time period.
Auto Logoff Period	0h 15m (default) (2-4 hours)	When **`Use Default Auto Logoff Period`** property is set to `false`, use this property to specify a different time period . The range is 2 minutes to 4 hours. Otherwise, this property is read only, showing the value specified in the UserService's **`Default Auto Logoff Period`**.

Authenticator—Password Config

Property	Value	Description
Force Reset at Next Login	`true` or `false` (default)	Requests that the user create a new password the next time they log in.
Expiration	radio button	Configures a password change for a specific date and time.

Default Web Profile

These properties configure the information available to a specific user who accesses the system through a browser. By default all information is visible.

Property	Value	Description
Type Spec (type of profile)	drop-down list	Identifies the type of profile: • hx (default) • axvelocity • mobile • Workbench
Type Spec (type of profile)	drop-down list	Identifies the type of profile: • BasicHxProfile • DefaultHxProfile • HTML5HxProfile (default) • HandHeldHxProfile

Property	Value	Description
Hx Theme	drop-down list	Selects the look of the user interface: • Zebra • Lucid
Enable Hx Workbench Views	`yes` (default)	Removing the check mark disables the views.
Enable Nav Tree Side Bar	`yes` (default)	Removing the check mark disables the Nav tree.
Enable Search Side Bar	`yes` (default)	Removing the check mark disables the use of the search side bar.
Enable Palette Side Bar	`yes` (default)	Removing the check mark disables the use of the palette side bar.
Enable Nav File Tree	`yes` (default)	Removing the check mark disables the Nav tree.
Enable Config Tree	`yes` (default)	Removing the check mark disables the Config tree.
Enable Files Tree	`yes` (default)	Removing the check mark disables the Files tree.
Enable Histories Tree	`yes` (default)	Removing the check mark disables the Histories tree.
Enable Hierarchies Tree	`yes` (default)	Removing the check mark disables the Hierarchies tree.

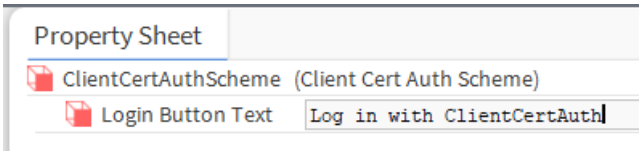
Mobile Web Profile

Property	Value	Description
Type Spec (type of profile)	drop-down list	Identifies the type of profile: • Hx • Mobile
Type Spec (type of profile)	drop-down list	Identifies the type of profile: • BasicHxProfile • DefaultHxProfile • HTML5HxProfile (default) • HandHeldHxProfile
Mobile Nav File	ord	Identifies the location of the file that defines the mobile nav tree for this user.
Hx Theme	drop-down list	Selects the look of the user interface: • Zebra • Lucid

clientCertAuth-ClientCertAuthScheme

In Niagara 4.8 and later, Client Certificate Authentication is one method of verifying that a user is authorized to log in to a station. Provided by the **`clientCertAuth`** palette, the ClientCertAuthScheme is an authentication mechanism requiring that the user enter his or her password as well as a certificate.

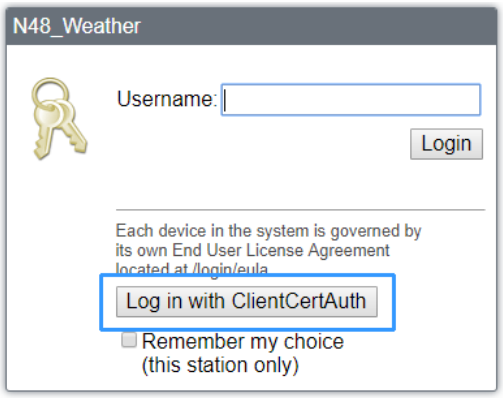
With this scheme, each User object has an authenticator containing a public certificate (which matches the user certificate's private key). Additionally, each certificate must be added to the server socket's **TrustAnchor** list. During a login attempt, the user is prompted to upload the certificate. The server verifies that the certificate matches the certificate stored on the User object.



Adding this component to the station AuthenticationSchemes node adds a button to the **Login** window. The text label on the button is configurable via the **`Login Button Text`** property. By default, the button text label is "Sign in with SSO" but you should change this to your preferred text.

NOTE: In the example shown, the User object is configured to use clientCertAuthScheme authentication, and to reset his/her authentication scheme on login (via the User **`Force Scheme Reset To`** property).

Figure 17 Example configured button visible in login window

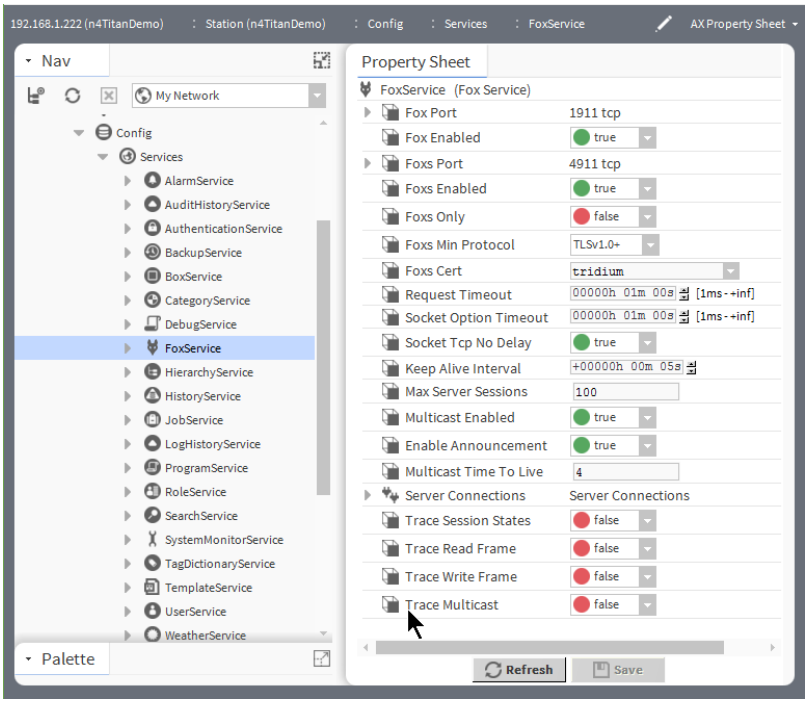


For additional information, see Admin/User workflow for client certificate authentication in the "User Authentication" chapter.

FoxService

To view these properties expand the **Services** folder in the Nav tree, right-click **FoxService→Views→Property Sheet**.

Figure 18 Example of FoxService properties



Type	Value	Description
Fox Port	1911 (default) Tcp (default)	`Public Server Port` specifies the port number for standard Fox communication. `Ip Protocol` specifies the protocol.
Fox Enabled	`true` (default) or `false`	When set to `true`, turns on a standard Fox connection (no communication encryption) using port 1911. When enabled, **`Http Enabled`** in the **`WebService`** must also be set to `true` (for wbapplet use). When set to `false`, turns off the standard Fox connection causing the system to ignore attempts to connect using Fox port 1911. If **`Foxs Only`** is enabled, this setting (`false` for **`Fox Enabled`**) is irrelevant.
Foxs Port	4911 (default) Tcp (default)	`Public Server Port` specifies the port number for standard Fox communication. `Ip Protocol` specifies the protocol.
Foxs Enabled	`true` (default) or `false`	When set to `true`, turns on secure Fox communication using port 4911. When enabled, **`https Enabled`** in the **`WebService`** must also be set to `true` (for webapplet use). When set to `false`, turns off the secure Fox connection causing the system to ignore attempts to connect using Foxs port 4911.
Foxs Only	`true` or `false` (default)	When set to `true` redirects any attempt to connect using a connection that is not secure (Fox alone) to Foxs. When set to `false`, does not redirect attempts to connect using Fox alone.

Type	Value	Description

Foxs Min Protocol	drop-down list
	`TLSv1.0+` (default)
	`TLSv1.1+`
	`TLSv1.2`
		The minimum level of the TLS (Transport Layer Security) protocol to which the server will accept negotiation. The default includes versions 1.0, 1.1 and 1.2. It works with most clients, providing greater flexibility than an individual version.
		During the handshake, the server and client agree on which protocol to use.
		Change **Protocol** from the default if your network requires a specific version or if a future vulnerability is found in one of the versions.

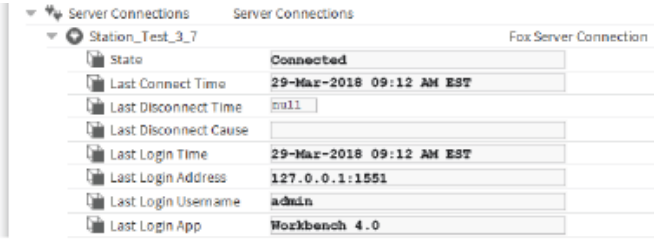
Foxs Cert	drop-down list of server certificates; defaults to `tridium`	Specifies the alias of the host platform's server certificate, which the client uses to validate server authenticity. The default identifies a self-signed certificate that is automatically created when you initially log in to the server. If other certificates are in the host platform's key store, you can select them from the drop-down list.
Request Timeout	hours, minutes, seconds (default: 1 minute)	Specifies the time to wait for a response before assuming a connection is dead.
Socket Option Timeout	hours, minutes, seconds (default: 1 minute)	Specifies the time to wait on a socket read before assuming the connection is dead.
Socket Tcp No Delay	`true` (default) or `false`	Used to disable Nagle's algorithm, which may cause issues with delayed acknowledgements that occur in TCP socket communications between Fox clients and servers. The default disables Nagle's algorithm. In Workbench, you can enter this line in the `system.properties` file to adjust this setting: `niagara.fox.tcpNoDelay=true`.
Keep Alive Interval	hours, minutes, seconds (default: 5 seconds)	Sets the amount of time between messages, which indicate that the connection is alive. This value should be well below the request timeout and socket option timeout.
Max Server Sessions	number (default: 100)	Sets the maximum number of Fox/Foxs server connections before additional client connections error with busy.
Multicast Enabled	`true` (default) or `false`	Allows the station to initiate UDP (User Datagram Protocol) multicasting. This feature is necessary for a discovery from this station. This type of multicasting differs from Workbench UDP mulitcast support, which can be optionally disabled via an entry in the Workbench host's `system.properties` file.
Enable Announcement	`true` (default) or `false`	Turns on support for UDP multicast announcement messages received by the station in support of learn/discover.
Multicast Time to Live	number (default: 4)	Specifies the number of hops to make before a multicast message expires.
Server Connections		See Server Connections, page 105
Trace Session States	`true` or `false` (default)	Debug usage for tracing session state changes.

Type	Value	Description
Trace Read Frame	`true` or `false` (default)	Debug usage for dumping frames being read from the wire.
Trace Write Frame	`true` or `false` (default)	Debug usage for dumping frames being written to the wire.
Trace Multicast	`true` or `false` (default)	Debug usage for tracing multicast messaging.

Server Connections

These properties provide status information about current Workbench client connections to the local station. They do not reflect station-to-station Fox connections. Each connection provides the same set of properties.

Figure 19 Example of Server Connections properties



Property	Value	Description
State	Not connected, Connected	Reports the current status of the connection.
Last Connect Time	hours, minutes, seconds	Reports the last time the client successfully connected to the server.
Last Disconnect Time	hours, minutes, seconds	Reports when the client last disconnected from the server.
Last Disconnect Cause	text	Provides a brief explanation.
Last Login Time	hours, minutes, seconds	Reports the last time a client logged in to the server.
Last Login Address	IP address	Identifies the platform.
Last Login Username	text	Identifies the user who made the connection.
Last Login App	text	Identifies the version of Workbench.

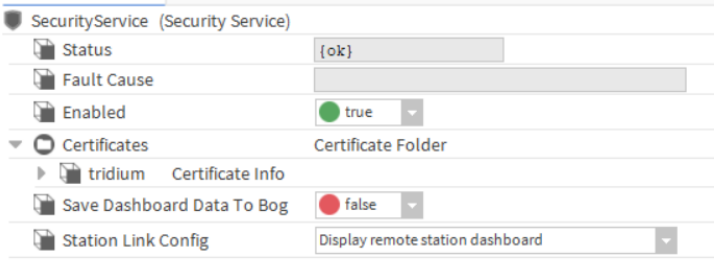
nss-SecurityService

The SecurityService, available in the **nss** palette in Niagara 4.6 and later, provides the ability to monitor certificates and generate alarms for those that are about to expire. Other station services with configurable security settings report to the SecurityService.

NOTE: Manually installing the nss modules (nss-rt, -ux, -wb) requires a station restart. Otherwise, when you click on the added SecurityService component, a "Not Found" error message displays in Workbench. In cases where you restart the station after installing the modules you do not see this error. Also note that uninstalling the nss modules causes an auto restart of the station.

The **Security Dashboard** is the main view for the Security Service. For additional details on the view, see "nss-SecurityDashboardView, page 114" in the "Components and views" chapter of this guide.

Figure 20 SecurityService properties



SecurityService properties

In addition to the standard properties (Status, Fault Cause, and Enabled), the following configuration properties are present.

Name	Value	Description
Certificates	additional properties	Container for certificates in use in the station. For each certificate listed the following read-only data is shown.
Certificate Info		Displays the certificate name/Alias
Expiry		Displays the number of days until/since the certificate expiry date.
Used In		Displays the name and ORD of the Service using the certificate.
Save Dashboard Data to Bog	true, false (default)	In a supervisor (or other station licensed for the system security dashboard), if set to true, the dashboard information is stored in the station's `.bog` file. This makes the information available immediately on station restart, instead of having to fetch it from the remote stations. If set to false (the default), the data will not be saved to the `.bog` file. On station restart, the system dashboard data will not be available until a dashboard refresh is triggered (via the action on the service).
Station Link Config	Display remote station dashboard (default), Display local view of the remote station dashboard view	This property determines if the links on the SYSTEM dashboard link directly to the remote station, or if they link to the NiagaraNetwork station in the supervisor. In most cases, it is a better experience to link directly to the station, unless you know that the user will have access to those stations from the browser, or if you are concerned about the user having to log in to multiple stations. The SSO feature can improve that experience.

Actions

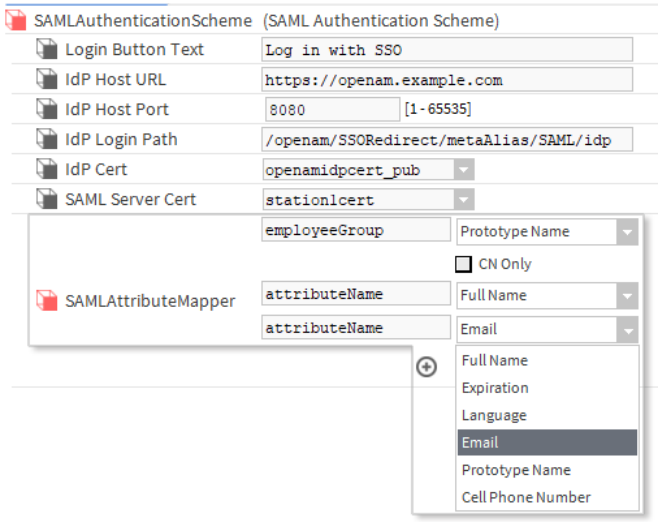
Refresh System Dashboard Data — this action fetches the Security dDashboard data from all remote stations (or all stations matching the provided filter).

saml-SAMLAttributeMapper

During SAML Single Sign On, the SAML Identity Provider (IdP) may send the Service Provider (SP) various attributes. These may contain information about the user, and can be used by the station to build the User

object. Many SAML IdPs can be configured to return the attributes with customized name. However, other IdPs may not be configurable, or IT restrictions may prevent configuring an IdP that supports this feature. In this case, you can configure the SAML Authentication Scheme to map specific SAML attributes to properties in the User Prototype.

This is done by dragging the SAMLAttributeMapper from the **saml** palette to the SAMLAuthenticationScheme.



NOTE: Refer to the IdP-provided documentation to determine which SAML attributes are coming in from the IdP. As an alternative, you can install a SAML add-on to your web browser which lets you view the attributes coming in from the IdP. For example, there is the SAML DevTools extension for Chrome which you can use.

NOTE: In some cases an IdP sends back multiple values for the prototypeName attribute. After the following patches if the IdP sends back multiple prototypeNames, the SAMLAuthenticationScheme considers all returned values and extracts the one that appears highest on the list of UserPrototypes (similar to how LDAP works).

- For Niagara 4.4U1:
  - **saml-rt-4.4.93.40.1**
  - **saml-wb-4.4.93.40.1**
- For Niagara 4.6:
  - **saml-rt-4.6.96.28.2**
  - **saml-wb-4.6.96.28.1**

User properties that can be mapped from SAML attributes

The following User properties can be mapped:

- Full Name
- Expiration
- Language
- Email
- Prototype Name
- Cell PhoneNumber

All other properties will be acquired from the UserPrototype associated with the user.

Default mappings

If no mappings are specified on the SAMLAuthenticationScheme, the following mappings will be used.

SAML Attribute Name	User Property	Extra Information
Full Name	fullName	Not applicable.
Expiration	expiration	Format: "D-MMM-YY h:mm:ss zz"
Language	language	Not applicable.
Email	email	Not applicable.
Prototype Name	prototypeName	Select the **CN Only** checkbox if the IdP returns multiple values for user prototype.
Cell Phone Number	cellPhoneNumber	Not applicable.

How attribute mappings are processed

Attribute mappings are processed as follows when a user logs in to the system.

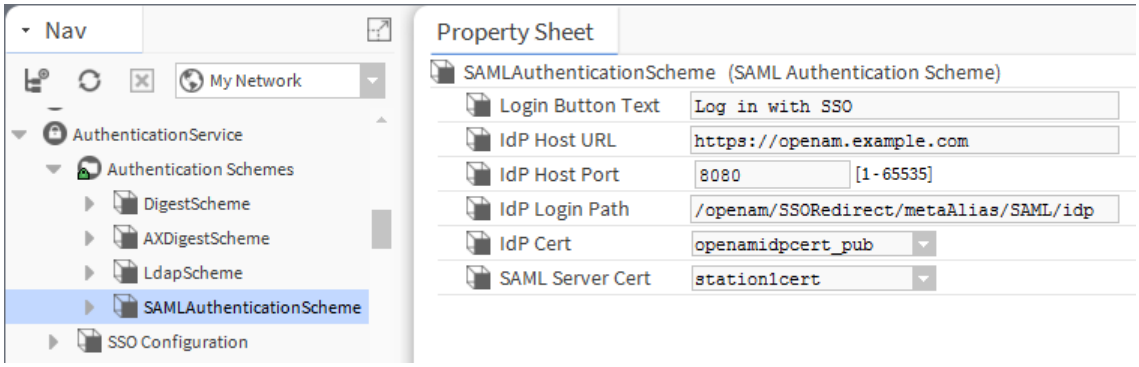
1. Customized mappings are considered first. If there are multiple mappings to the same property, the first successful mapping is used. For example, if there were two mappings to the "expiration" property, and the first mapping failed to parse properly, the second mapping would be attempted. If the first mapping parsed correctly, the second would be ignored.
2. Once all customized mappings are processed, the default mappings will be attempted for any User property not yet mapped.
3. Any property not mapped from a SAML attribute will be pulled from the UserPrototype, if possible.

saml-SAMLAuthenticationScheme

The SAML Authentication Scheme extends the SSO authentication scheme. SAML SSO is enabled by adding a SAML Authentication Scheme to the station. The scheme must be configured with a number of IdP configuration values, typically, these are obtained from the IdP SAML Server administrator.

Additionally, most SAML IdPs require you to provide an XML file with metadata about the Service Provider to add it to the SAML network. In Niagara 4.8 and later, if a station is configured with a SAMLAuthenticationScheme, you can visit the following URL to automatically generate the station's SAML metadata XML: `https://host.domain.com/saml/samlrp/metadata?scheme=<schemeName>` (where you replace `<schemeName>` with the name of the station's SAMLAuthenticationScheme).

Since SAML is an open standard, a number of third-party SAML Servers are available (i.e. OpenAM, Salesforce, etc.). In the example shown here, the authentication scheme is configured for the OpenAm Identity Provider.



SAML Authentication Scheme properties

Type	Value	Description
Login Button Text	text string, "Log in with SSO" (default)	The preferred text label for the SSO login button that appears on the **Login** window. This button always displays if the corresponding scheme is in the authentication schemes folder.
IdP Host URL	text string, https://idp.domain.com (default)	IdP provided data, this is the URL for the host of your Identity Provider.
IdP Host Port	443	IdP provided data, this is the port number of your Identity Provider
IdP Host Login Path	/path/to/login	IdP provided data, this is the location on the Identity Provider that you must navigate to trigger SAML authentication.
IdP Cert	drop-down list	IdP provided data, this is the certificate required to encrypt messages sent to the IdP, and validate messages sent from the IdP.
SAML Server Cert	drop-down list	This is the certificate used by the station to sign messages that are sent back to the IdP. Note that this certificate is also provided to the IdP SAML Server admin so that the IdP can read and validate the messages. It is also used to decrypt messages sent from the IdP to the station.

samlEncryption-SamlXmlDecrypter

In Niagara 4.4U1 and later, there is added support for SAML EncryptedAssertions. If an IdP requires encryption, you can add a SamlXmlDecrypter to the SAMLAuthenticationScheme, and configure it with the encryption certificate from the **User Key Store**.

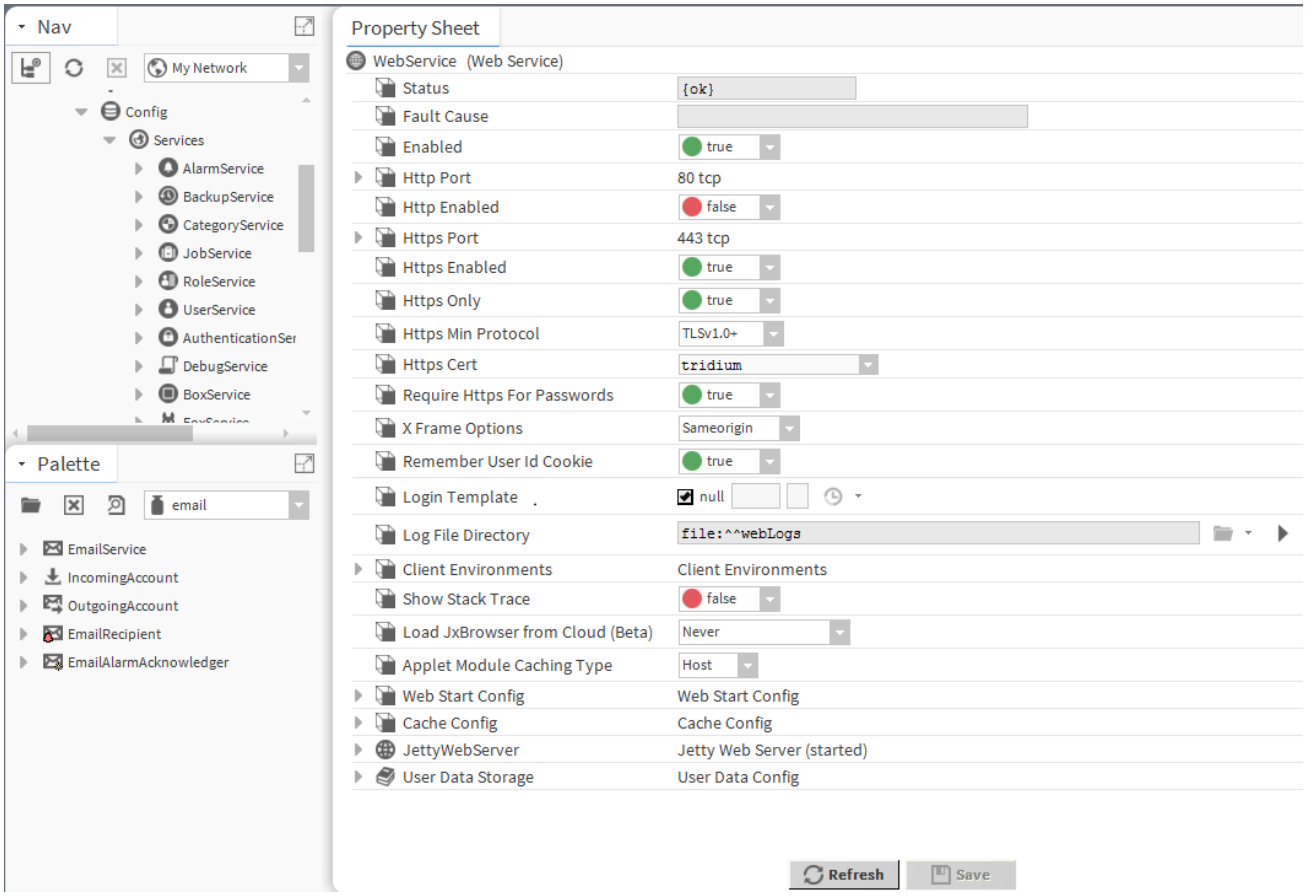
After adding the SamlXmlDecrypter to the SAMLAuthenticationScheme, you configure the decrypter's **SAML Server Encryption Cert** property with the appropriate encryption certificate. In some cases, you may be using the same certificate as the SAML Server (Signing) Cert.

This component is available in the samlEncryption-rt module. You will need the latest saml-rt and samlEncryption-rt patches for Niagara 4.4U1, Niagara 4.4U2, Niagara 4.6, and Niagara 4.7.

web-WebService

This service encapsulates access to the HTTP server as well as the servlet infrastructure used to expose custom applications over HTTP. The WebService is available in the `web` palette. It is also one of the default services in a station created by using the **New Station** tool. Only one WebService is supported in a station.

Figure 21 Example of WebService properties



Name	Value	Description
Status	text	Read-only field. Indicates the condition of the component at last polling. • `{ok}` indicates that the component is polling successfully. • `{down}` indicates that polling is unsuccessful, perhaps because of an incorrect property. • `{disabled}` indicates that the **`Enable`** property is set to `false`. • `fault` indicates another problem.
Fault Cause	text	Read-only field. Indicates why the network, component, or extension is in fault.
Enabled	`true` or `false`	Activates and deactivates use of the function.
Http Port	80 (default)	Specifies the TCP port the service listens on for HTTP client connections, where port 80 is the default.
Http Enabled	`true` (default) or `false`	Determines if HTTP client requests are processed. When set to `true`, turns on a standard Http connection (no communication security) using port 80. When enabled, **`Fox Enabled`** in the **`FoxService`** must also be set to `true` (for wbapplet use).

Name	Value	Description
		When set to `false`, turns off the standard Http connection causing the system to ignore any attempts to connect using Http port 80. If **`Https Only`** is enabled, this setting (`false` for **`Http Enabled`**) is irrelevant.
Https Port	443 (default)	Specifies the TCP port the service listens on for HTTPS (secure) client connections, where port 443 is the default.
Https Enabled	`true` (default) or `false`	Determines if HTTPS client requests are processed. When set to `true`, turns on secure Http communication using port 443. When enabled, **`Foxs Enabled`** in the **`FoxService`** must also be set to `true` (for webapplet use). When set to `false`, turns off the secure Https connection causing the system to ignore any attempts to connect using Https port 443.
Https only	`true` (default) or `false`	When set to `true` redirects any attempt to connect using a connection that is not secure (Http alone) to Https. When set to `false`, does not redirect attempts to connect using Http alone.

Https Min Protocol	drop-down list
	`TLSv1.0+` (default)
	`TLSv1.1+`
	`TLSv1.2`
		The minimum level of the TLS (Transport Layer Security) protocol to which the server will accept negotiation. The default includes versions 1.0, 1.1 and 1.2. It works with most clients, providing greater flexibility than an individual version.
		During the handshake, the server and client agree on which protocol to use.
		Change **Protocol** from the default if your network requires a specific version or if a future vulnerability is found in one of the versions.

Https Cert	drop-down list of server certificates; defaults to `tridium`	Specifies the alias of the host platform's server certificate, which the client uses to validate server authenticity. The default identifies a self-signed certificate that is automatically created when you initially log in to the server. If other certificates are in the host platform's key store, you can select them from the drop-down list.
Require Https For Passwords	`true` (default) or `false`	When set to `true`, the **`HTTPs Enabled`** property also must be is set to `true`, or the system disables the **New** button (for creating a new user in the UserService). This prevents the creation of a password for a new user across a connection that is not secure. When set to `false`, the **New** button (for creating a new user in the UserService) remains enabled even if **`HTTPs Enabled`** is `false`. This combination of settings creates a security vulnerability when creating passwords for new users and is not recommended.
X Frame Options	`Sameorigin` (default) `Deny` or `Any` (least secure)	The X-Frame-Options HTTP response header can be used to indicate whether or not a browser should be allowed to render a page in a <frame> or <iframe>. You can use this to avoid clickjacking attacks, by ensuring that content is not embedded into other sites.

Name	Value	Description
		If you specify `Sameorigin`, the page will load in a frame as long as the site including it in a frame is the same as the one serving the page (same server). If a page specifies `Sameorigin`, browsers will forbid framing only if the top-level origin FQDN (fully-qualified-domain-name) does not exactly match FQDN of the subframe page that demanded the `Sameorigin` restriction. This is considered a safe practice. If you specify the `Deny`, attempts to load the page in a frame will always fail. **NOTE:** The `Deny` option inhibits display of some typical Shell Hx Profile views. **CAUTION:** If you specify the `Any` option then Cross-Frame Scripting (SFS) and Cross-Site Scriptin (XSS) are allowed.
Login Template	`null`	When `Any` is selected, no custom login template is used. When `Any` is not selected, the option list shows available custom login templates that you can select for a station login page.
Log File directory	filepath	Default is `file:^webLogs`. The folder in the station's file space in which log files are stored. Log file names use a YYMMDD.log (date) convention, such as 230501.log for a file created May 1, 2023.
Client Environments	additional properties	This property is a container for Mobile Client Environment (mobile) entries, available if the station's host is licensed with the mobile feature. It is used in detection of a user's browser type (e.g. desktop or mobile) and the selection of the appropriate webProfile for that user. See details below. Also, refer to the *Niagara Mobile Guide*.
Show Stack Trace	`true` or `false` (default)	Shows the stack trace, if set to `true`.
Load JxBrowser from Cloud	drop-down list	Loads the JxBrowser from the cloud.
Applet Module Caching Type	`Host` (default) or `User`	The default option, `Host`, results in a folder and the downloading of installation modules to the `module` folder (`n4applet` for N4, and `wbapplet` for AX). This results in the creation of multiple folders of downloaded modules, which negatively affects platform memory usage. The `User` option results in the creation of a `.sharedModuleCache` folder. The system then downloads to a sub-folder at this location (`n4applet` for N4, and `wbapplet` for AX). This option minimizes the memory required when running in JACE.
Web Start Config	additional properties	Container for several subproperties used to configure aspects of Niagara Java Web Start which provides an applet-like Workbench environment that runs completely outside of a web browser. For more details see, *Niagara Java-based Web Clients Guide*.

Name	Value	Description
Cache Config	additional properties	In Niagara 4.4 and later, contains subproperties used to configure Cache Config, which caches all station home image files in the web browser. See more details below.
JettyWebServer	read-only	Jetty Web Server Started. See more details below.
User Data Storage	`true` (default), or `false`	Enabled by default, this allows web apps to store user-specific data (i.e. user options for the HTML5 Alarm Console) in the `userdata` folder on the station file system. Typically left enabled, a user with admin priviliges can set this to disabled to clear User Data Storage.

Client Environments—Mobile

The Client Environments container slot allows the station to automatically detect the user agent of an incoming client and use the appropriate Web Profile for the user:

- Default Web Profile if using a Java-enabled device, such as a PC
- Mobile Web Profile if using a mobile device, such as a cell phone or tablet

Name	Value	Description
Enabled	`true` or `false`	Activates and deactivates use of the function.
Status	text	Read-only field. Indicates the condition of the component at last polling. • `{ok}` indicates that the component is polling successfully. • `{down}` indicates that polling is unsuccessful, perhaps because of an incorrect property. • `{disabled}` indicates that the **`Enable`** property is set to `false`. • `fault` indicates another problem.
Fault Cause	text	Read-only field. Indicates why the network, component, or extension is in fault.
User Agent Pattern	text separated by the pipe symbol (|)	A list of one or more user agents separated by the pipe symbol that identify the target display types.

Cache Config

In Niagara 4.4 and later the Cache Config property, enabled by default, caches all station home image files in the web browser.

NOTE: When upgrading from Niagara 4.3 to Niagara 4.4, you need to clear the browser cache once manually to take advantage of this change. Additionally, when changes are made to a station home image file, clear the browser cache manually to update the cache. One exception to this is if the changed image file type is not one that is included in the Cached File Extensions property setting.

To revert back to the Niagara 4.3 behavior, set the **`Enabled`** property to `false`.

Type	Value	Description
Enabled	`true` or `false`	Activates and deactivates use of the function.
Cached File extentions	`png,jpg,gif, svg` (default) or `*`	Set the desired file type(s) to cache or set to "`*`" to cache all file types without re-validation.

JettyWebServer

Name	Value	Description
Server State	read-only	Displays the state of the server.
Min Threads	4 - 30 (defaults to 4)	Specifies the minimum number, concurrent connections (threads) that the station makes with the server.
Max Threads	10– max (defaults to 30)	Specifies the maximum number of multiple, concurrent connections (threads) that the station makes with the server.
N C S A Log	NCSA Request Log	Refer the below section..

N C S A Log

This is a common format of a standardized text file that web servers use to keep track of processed requests.

Name	Value	Description
Enabled	`true` or `false`	Activates and deactivates use of the function.
Retain Days	7 (default)	Limits the size of the log by defining how many days to save log information.
Extended Format	`true` (default) or `false`	Extends the format of a standardized text file.
Log Cookies	`true` or `false` (default)	Logs the cookies of processed requests.
Log Time Zone	list of time zones	Identifies the time zone to use for time stamps.

Plugins (views)

Plugins provide views of components and can be accessed in many ways. For example, double-click a component in the Nav tree to see its default view. In addition, you can right-click on a component and select from its **Views** menu.

For summary documentation on any view, select **Help→On View** (**F1**) from the menu or press **F1** while the view is open.

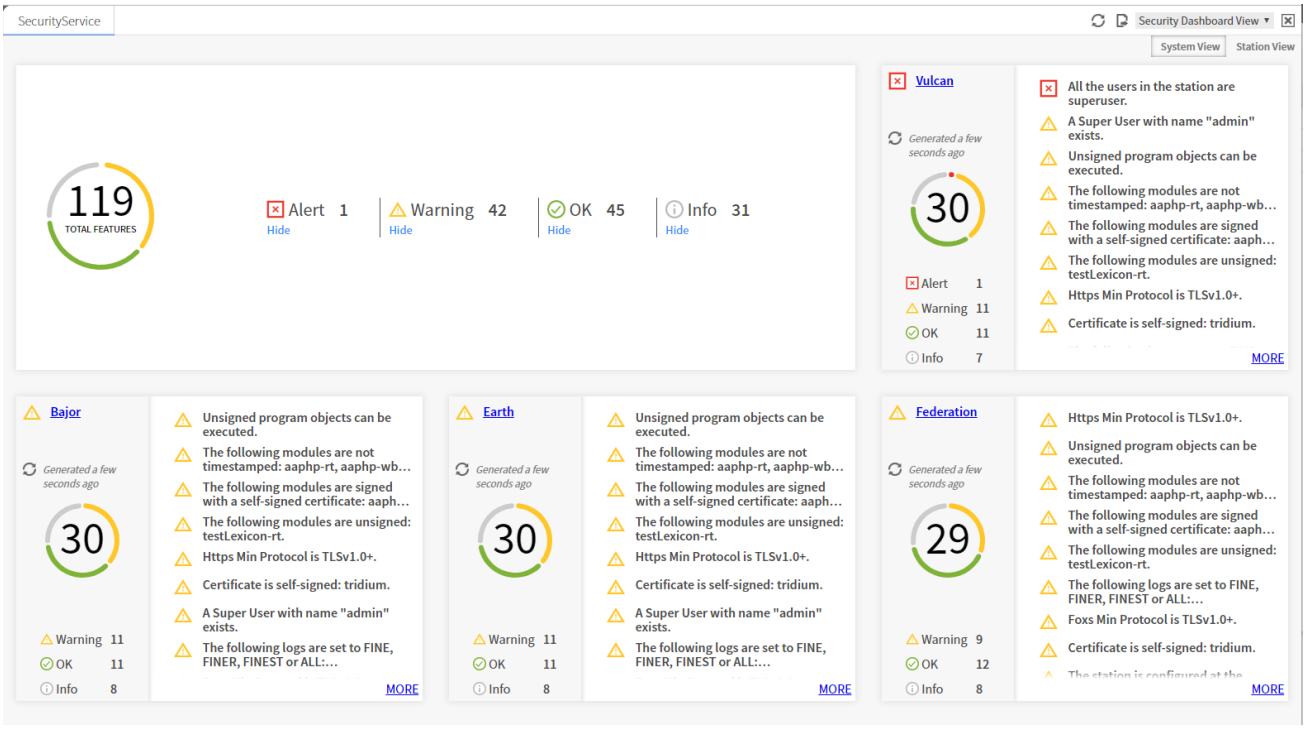
nss-SecurityDashboardView

In Niagara 4.8 and later, there is added support for the Security Dashboard feature. The **Security Dashboard** is the main view for the Security Service. The view provides (for admin and other authorized users) a snapshot of the security configuration of your station.

NOTE: The **Security Dashboard** transmits sensitive information. To minimize security risks, use the Foxs (secure Fox) protocol to manage platform connections. Also, the HTTPS protocol is enforced for secure communication over the network. The **Security Dashboard View** is not accessible over HTTP.

CAUTION: The **Security Dashboard View** presents data of a sensitive nature. Users with access should be made aware of this and take necessary precautions to safe-guard the information. For example, a user should not walk away from the PC while the view is open for others to see. A security best practice recommendation would be that any user who has access to the dashboard should be configured for auto-logoff.

Figure 22 Example Security Dashboard View



CAUTION: The **Security Dashboard View** may not display every possible security setting, and should not be considered as a guarantee that everything is configured securely. In particular, third party modules may have security settings that do not register to the dashboard.
For each "card" included in the view, a number of security-related items (e.g. security settings on the FoxService shown in the FoxService card) are listed. Each card displays a status color which reflects the lowest status of any of its items. That is, if any item is red (alert), the card's status color is red. Similarly, each item listed in a card has a status displayed as a color flag (highest-to-lowest): "Info", OK", "Warning", or "Alert") as gray, green, yellow, or red icons.

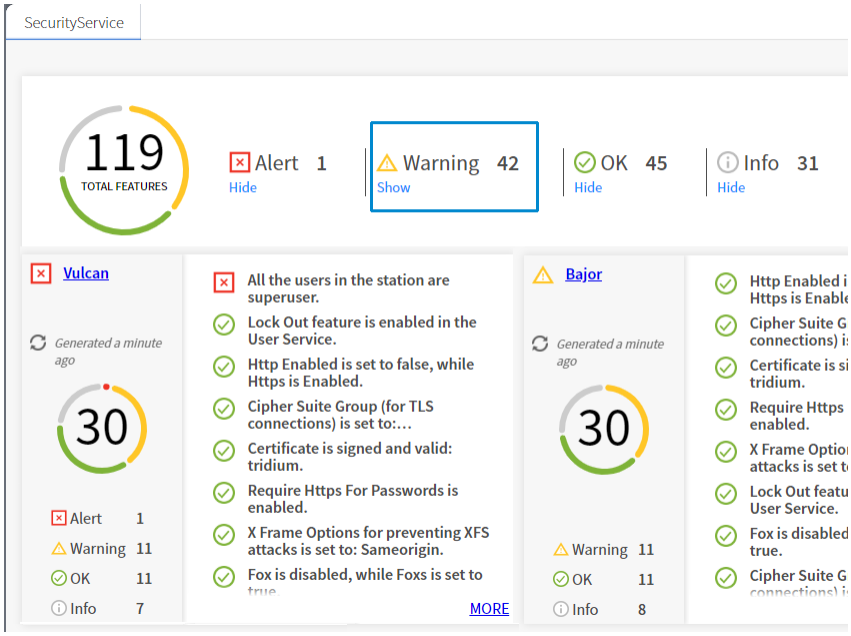
- Gray Info icon ( ) indicates secondary information. For example, there is an info level that states how many users are in the station. There is no particular action to take regarding this, it is just presented for consideration.
- Green OK icon ( ) indicates the item's security status is good.
- Yellow Warning icon ( ) indicates a warning status on the item which means that the setting should be examined and possibly changed.
- Red Alert icon ( ) indicates an alert status on the item which means that the setting is a security concern and should probably be changed.

Each card displays several of the most urgent items. If there are more items than fit on a card, a **More** button at the bottom of the card will popup the full list of items for that Service. Typically, a card provides a hyperlink to that particular Service (or to a component) so that you can easily change the configuration. In cases where there is no component to link to, no hyperlink is provided on the card. By default, the links on the individual cards in the Security Dashboard view link directly to the remote station. However, this is configurable via the **`Station Link Config`** property on the SecurityService component. For details, see nss-SecurityService, page 105.

The Summary card, located in the upper left corner, summarizes the number of security status messages for all Services on the station . The Summary card features **Hide** / **Show** options which allow you to hide, or

show, all messages for one or more security status levels. For example, if you click the **Hide** option under Warning (as shown below) all of the Warning status messages for each card are hidden from view.

Figure 23 Example Summary card set to Hide all Warning status messages



Services reporting to the Security Dashboard include the following:

- Fox Service (e.g. TLS status)
- Web Service (e.g. TLS status)
- Authentication Service (e.g. weak password strength)
- Debug Service (e.g. FINE logs enabled)
- Module Permissions (e.g. SEVERE permissions requested)
- Module Signatures (e.g. modules unsigned)
- Program Objects (e.g. unsigned program objects)
- Platform Settings (e.g. TLS status)
- File System (e.g. users with write access)
- User Service (e.g. super user status

Other services and components may also be reporting to the Security Dashboard.

Additionally, the Dashboard is "pluggable" so that third parties can add their own security warnings for drivers.

Security Dashboard Refresh

In addition to the action available on the SecurityService, there are several ways that you can trigger a data refresh for this view:

- Attempting to retrieve the Dashboard data (e.g. by viewing the Dashboard) when there is no data available yet (possibly because the station has just restarted) triggers a refresh.
- An "Execute" action on the **NiagaraNetwork→Station→SecurityDashboardDeviceExt→Data Importer** refreshes the data for that station.

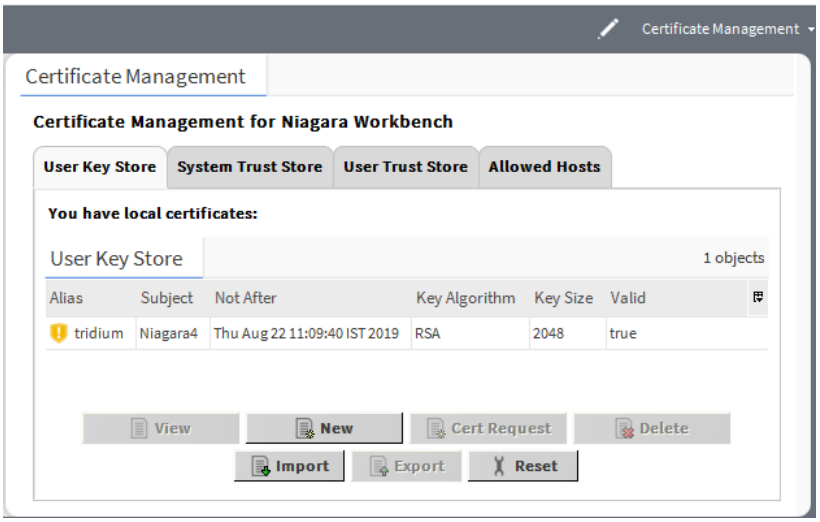
- A time trigger on the **NiagaraNetwork→Station→SecurityDashboardDeviceExt→Data Importer** that allows you to schedule a refresh. The default is to refresh daily.
- The **Refresh System Dashboard Data** action on the SecurityService takes a String argument. It will refresh any station that matches that String. For example, the string, "`Richmond*`", will match any station that starts with Richmond; or "`*`"will match all stations).
- On the **System Dashboard View**, the card for each station has a **Refresh** icon ( ) next to the "Generated x time ago" text. Click on the icon to trigger a refresh for the station.

platCrypto-CertManagerView

This view is a platform view on any Niagara host. It is also the default view of the **CertManagerService** under a station's **PlatformServices**. The **Certificate Management** view allows you to create digital certificates and Certificate Signing Requests (CSRs). You use this view to import and export keys and certificates to and from the Workbench, platform and station stores. You access this view, via **Tools→ Certificate Management**. Also included is a related **Tools Certificate Signer Tool** view.

You use this view to manage PKI (Public Key Infrastructure) and self-signed digital certificates to secure communication within Niagara network. Certificates secure TLS connections to this host.

Figure 24 Example of a Key Store



The Certificate Management view has four tabs:

- User Key Store
- System Trust Store
- User Trust Store
- Allowed Hosts

User Key Store tab

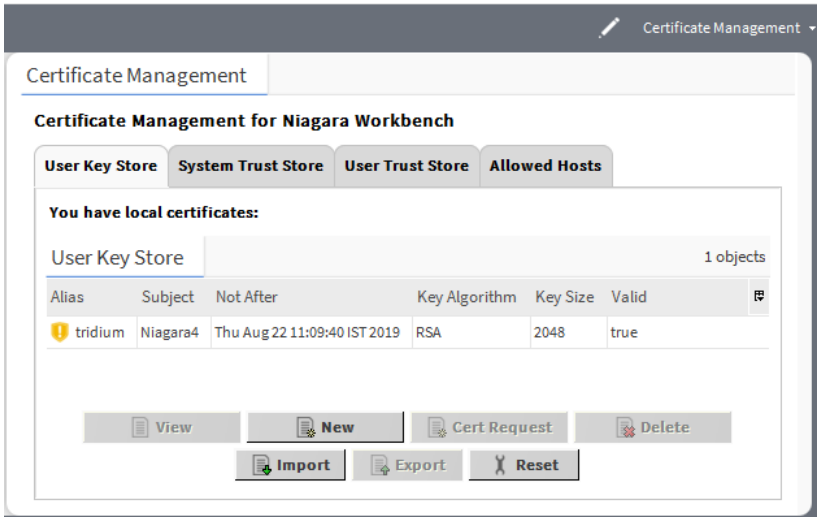
The **User Key Stores** contain server certificates and self-signed certificates with their matching keys. Each certificate has a pair of unique private and public encryption keys for each platform. A **User Key Store** supports the server side of the relationship by sending one of its signed server certificates in response to a client (Workbench, platform or station) request to connect.

If there are no certificates in a **User Key Store** when the server starts, such as when booting a new platform or station, the platform or station creates a default, self-signed certificate. This certificate must be approved as an allowed host. This is why you often see the certificate popup when opening a platform or station.

Default self-signed certificates have the same name in each **User Key Store** (`tridium`), however, each certificate is unique for each instance.

Clicking the **New** and **Import** buttons also adds certificates to the **User Key Store**.

Figure 25 Example of a Key Store



Name	Value	Description
Alias	text	A short name used to distinguish certificates from one another in the **Key Store**. This property is required. It may identify the type of certificate (root, intermediate, server), location or function. This name does not have to match when comparing the server certificate with the CA certificate in the client's Trust Store.
Issued By	text	Identifies the entity that signed the certificate.
Subject	text	Specifies the Distinguished Name, the name of the company that owns the certificate.
Not Before	date	Specifies the date before which the certificate is not valid. This date on a server certificate should not exceed the **Not Before** date on the root CA certificate used to sign it.
Not After	date	Specifies the expiration date for the certificate. This date on a server certificate should not exceed the **Not After** date on the root CA certificate used to sign it.
Key Algorithm	text	Refers to the cryptographic formula used to calculate the certificate keys.
Key Size	number	Specifies the size of the keys in bits. Four key sizes are allowed: 1024 bits, 2048 bits (this is the default), 3072 bits, and 4096 bits. Larger keys take longer to generate but offer greater security.
Signature Algorithm	formula text	Specifies the cryptographic formula used to sign the certificate.
Signature Size	KB	Specifies the size of the signature.

Name	Value	Description
Valid		Specifies certificate dates.
Self Signed	text	Read-only. Indicates that the certificate was signed with its own private key.

User Key Store buttons

Name	Value	Description
View	button	Displays details for the selected item
New	button	Opens the window used to create the entity you are working on.
Cert Request	button	Opens a **Certificate Request** window, which is used to create a Certificate Signing Request (CSR).
Delete	button	Removes the selected record from the database.
Import	button	Adds an imported item to the database.
Export	button	Saves a copy of the selected record to the hard disk. For certificates, the file extension is .pem.
Reset	button	Deletes all certificates in the **User Key Store** and creates a new default certificate. It does not matter which certificate is selected when you click **Reset**. **CAUTION:** Do not reset without considering the consequences. The **Reset** button facilitates creating a new key pair (private and public keys) for the entity, but may disable connections if valid certificates are already in use. Export all certificates before you reset.

Trust Store tabs

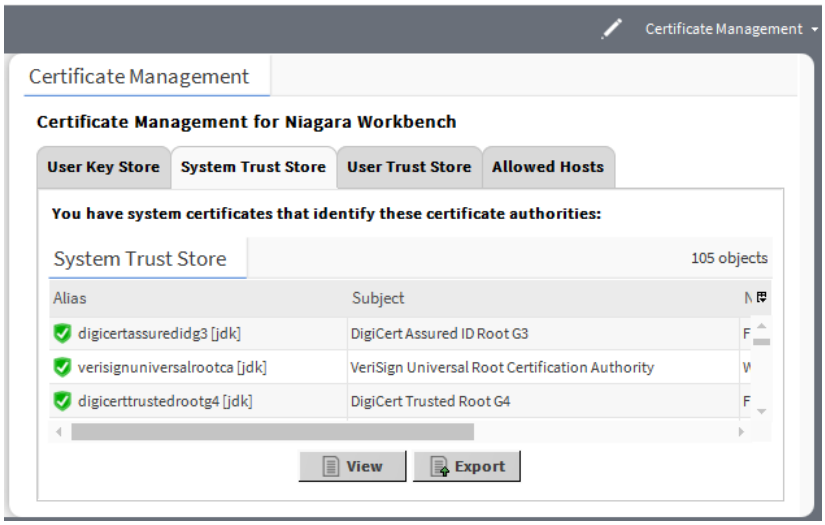
The **Trust Stores** contain signed and trusted root certificates with their public keys. These stores contain no private keys. A **Trust Store** supports the client side of the relationship by using its root CA certificates to verify the signatures of the certificates it receives from each server. If a client cannot validate a server certificate's signature, an error message allows you to approve or reject a security exemption (on the **Allowed Hosts** tab).

The **System Trust Stores** contain installed signed certificates by trusted entities (CA authorities) recognized by the Java Runtime Engine (JRE) of the currently opened platform. A **User Trust Store** contains installed signed certificates by trusted entities that you have imported (your own certificates).

Only certificates with public keys are stored in the **Trust Stores**. The majority of certificates in the **System Trust Store** come from the JRE. You add your own certificates to a **User Trust Store** by importing them.

Feel free to pass out such root certificates to your team; share them with your customers; make sure that any client that needs to connect to one of your servers has the server's root certificate in its client **Trust Store**.

Figure 26 Example of a System Trust Store



Trust Store columns

Name	Value	Description
Alias	text	A short name used to distinguish certificates from one another in the **Key Store**. This property is required. It may identify the type of certificate (root, intermediate, server), location or function. This name does not have to match when comparing the server certificate with the CA certificate in the client's Trust Store.
Issued By	text	Identifies the entity that signed the certificate.
Subject	text	Specifies the Distinguished Name, the name of the company that owns the certificate.
Not Before	date	Specifies the date before which the certificate is not valid. This date on a server certificate should not exceed the **Not Before** date on the root CA certificate used to sign it.
Not After	date	Specifies the expiration date for the certificate. This date on a server certificate should not exceed the **Not After** date on the root CA certificate used to sign it.
Key Algorithm	text	Refers to the cryptographic formula used to calculate the certificate keys.
Key Size	number	Specifies the size of the keys in bits. Four key sizes are allowed: 1024 bits, 2048 bits (this is the default), 3072 bits, and 4096 bits. Larger keys take longer to generate but offer greater security.
Signature Algorithm	formula text	Specifies the cryptographic formula used to sign the certificate.
Signature Size	KB	Specifies the size of the signature.
Valid		Specifies certificate dates.
Self Signed	text	Read-only. Indicates that the certificate was signed with its own private key.

Trust Store buttons

The **Delete** and **Import** buttons are available only in a **User Trust Store**.

Name	Value	Description
View	button	Displays details for the selected item
Delete	button	Removes the selected record from the database.
Import	button	Adds an imported item to the database.
Export	button	Saves a copy of the selected record to the hard disk. For certificates, the file extension is .pem.

Allowed Hosts tab

The **Allowed Hosts** tab contains security exemptions for the currently open platform. These are the certificates (signed or self-signed) received by a client from a server (host) that could not be validated against a root CA certificate in a client **Trust Store**. Whether you approve or reject the certificate, the system lists it in the **Allowed Hosts** list.

To be authentic, a root CA certificate in the client's **System** or **User Trust Store** must be able to validate the server certificate's signature, and the `Subject` of the root CA certificate must be the same as the `Issuer` of the server certificate.

Allowing exemptions makes it possible for a human operator to override the lack of trust between a server and client when the human user knows the server can be trusted.

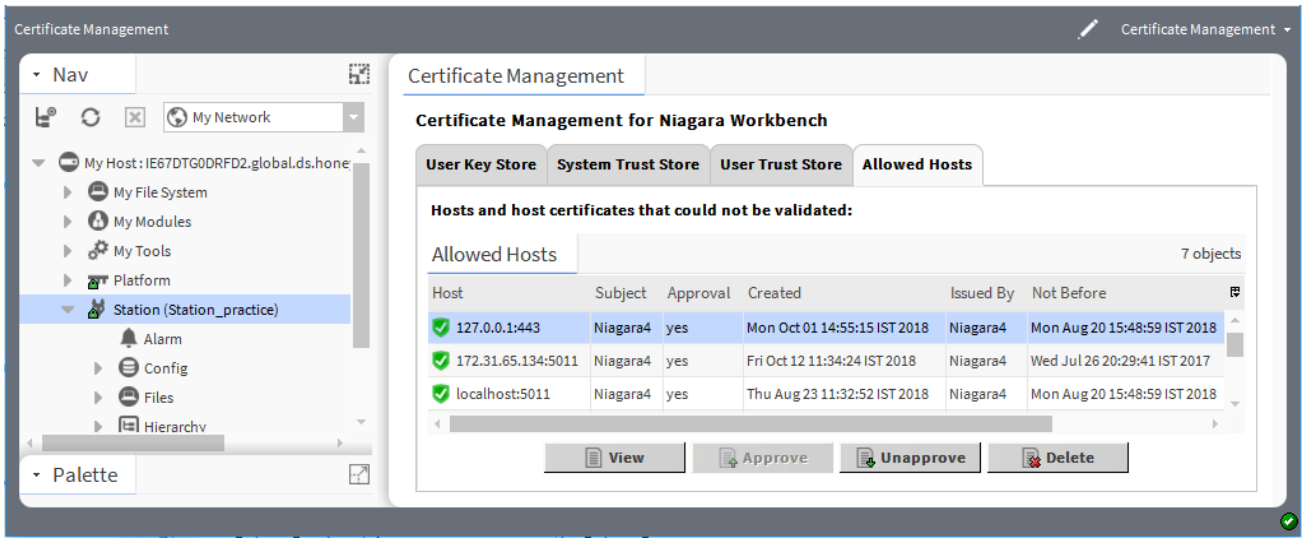
If this is Workbench to station connection, the system prompts you to approve the host exemption. Workbench challenges server identity at connection for unapproved hosts and, unless specific permission is granted, prohibits communication. Once permission is granted, future communication occurs automatically (you still have to log in). Both approved and unapproved hosts remain in this list until deleted.

If this is a station to station connection, and there is a problem with the certificates, the connection fails silently. There is no prompt to approve the host exemption. However, the last failure cause in the station (expand the station **ClientConnection** under **NiagaraNetwork**) reports the problem.

The approved host exemption in the **Allowed Hosts** list is only valid when a client connects to the server using the IP address or domain name that was used when the system originally created the exemption. If you use a different IP address or domain name to connect to the server, you will need to approve an updated exemption. The same is true if a new self-signed certificate is generated on the host.

Allowed Hosts columns

Figure 27 Example of an Allowed Hosts list



Name	Value	Description
Host	text	Specifies the server, usually an IP address.
Subject	text	Specifies the Distinguished Name, the name of the company that owns the certificate.
Approval	`Yes` or `No`	Specifies the servers within the network to which the a client may connect. If approval is set to `no`, the system does not allow the client to connect.
Created	date	Identifies the date the record was created.
Issued By	text	Identifies the entity that signed the certificate.
Not Before	date	Specifies the date before which the certificate is not valid. This date on a server certificate should not exceed the **Not Before** date on the root CA certificate used to sign it.
Not After	date	Specifies the expiration date for the certificate. This date on a server certificate should not exceed the **Not After** date on the root CA certificate used to sign it.
Key Algorithm	text	Refers to the cryptographic formula used to calculate the certificate keys.
Key Size	number	Specifies the size of the keys in bits. Four key sizes are allowed: 1024 bits, 2048 bits (this is the default), 3072 bits, and 4096 bits. Larger keys take longer to generate but offer greater security.
Signature Algorithm	formula text	Specifies the cryptographic formula used to sign the certificate.
Signature Size	KB	Specifies the size of the signature.
Valid		Specifies certificate dates.

Allowed Hosts buttons

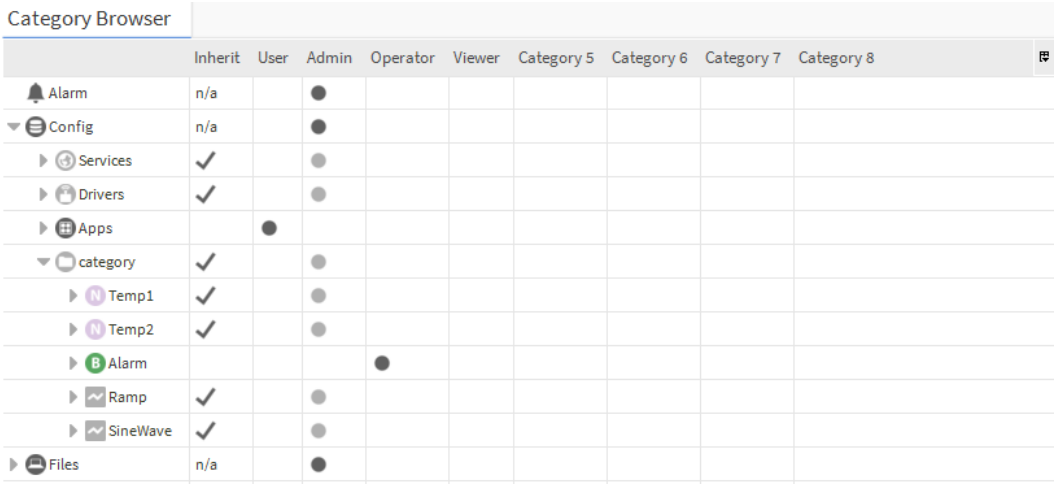
Name	Value	Description
View	button	Displays details for the selected item
Approve	`Yes` or `No`	Designates the server as an allowed host.
Unapprove	`Yes` or `No`	Does not allow connection to this server host. The system terminates any attempted communication.

wbutil-CategoryBrowser

This view is the default view of the station's **`CategoryService`**, and typically where you spend most of your time assigning categories to components after initially creating the categories.

NOTE: When an admin user (user with Admin write privilege on the CategoryService and on a particular station component being adjusted) is making a category mask adjustment, the user must also have at least Operator write privilege on the category being adjusted in the category mask for the station object. This includes changes to check marks in the "Inherit" column - the user must have at least Operator write access to any altered categories applied from the Inherit change.

Figure 28 Category Browser



Columns

Column	Value	Description
Inherit	check mark or blank	A check mark indicates that the object inherits the category from its parent in the table.
User	Category 1	All system objects except for those listed as assigned to `Admin` are assigned to this category.

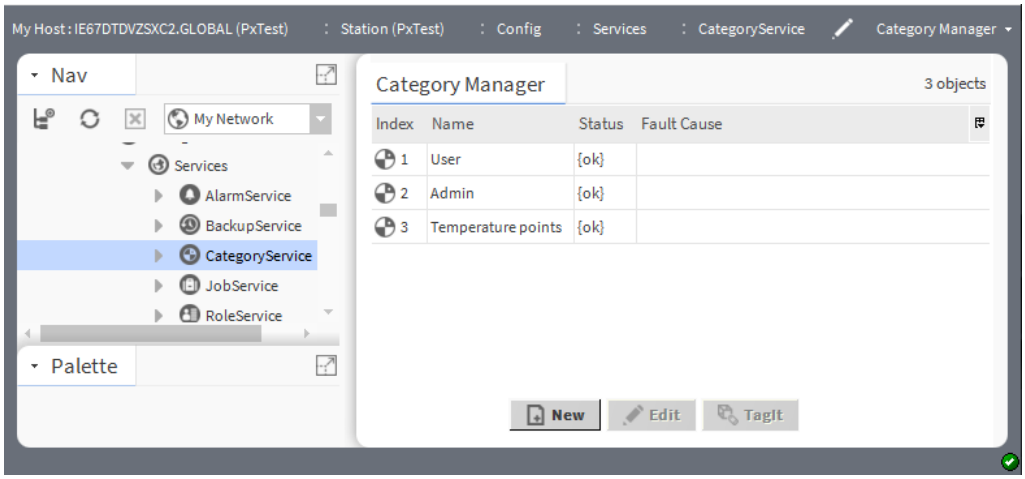
Column	Value	Description
Admin	Category 2	These objects default to the `Admin` category: • The configuration services: **`UserService`**, **`CategoryService`**, and **`ProgramService`** • All files (the entire file space)
Categories 3–8	bold bullet, grayed out bullet, or blank	A bold bullet indicates that the object is assigned to the category. A grayed out bullet indicates inheritance. Blank indicates that the category has not been assigned.

wbutil-CategoryManager

This view of the CategoryService allows you to create, enable and delete the groups that the security model uses to control access to the objects in a station. Once you create categories, you use the **Category Browser** view to centrally assign system objects to categories. Or, at the individual component level, you use a component's **Category Sheet** view to assign the component to one or more categories.

You can assign an object to many categories at the same time. Each object stores its own categories.

Figure 29 Category Manager, Temperature Points as Category 3



Column	Value	Description
Index	number	A unique number for the category, as it is known to the station.
Name	text string	Descriptive text that reflects the purpose of the entity or logical grouping.

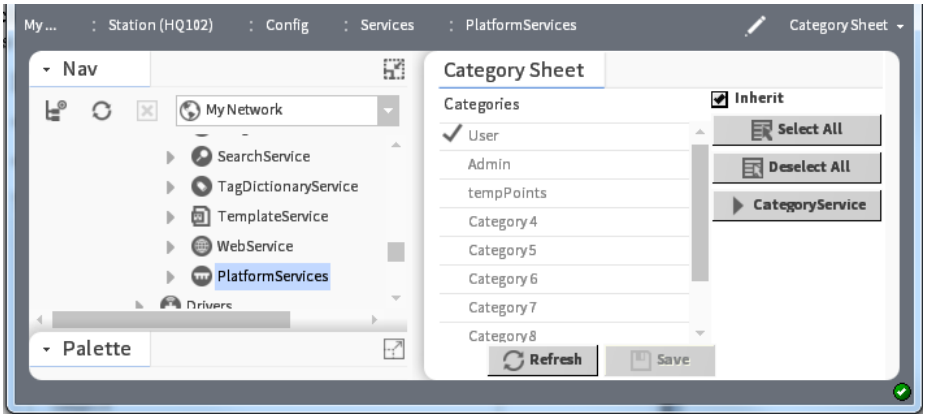
Column	Value	Description
Status	text	Read-only field. Indicates the condition of the component at last polling. • `{ok}` indicates that the component is polling successfully. • `{down}` indicates that polling is unsuccessful, perhaps because of an incorrect property. • `{disabled}` indicates that the **`Enable`** property is set to `false`. • `fault` indicates another problem.
Fault Cause	text	Read-only field. Indicates why the network, component, or extension is in fault.

wbutil-CategorySheet

This view assigns a component to one or more categories (or configures it to inherit categories from its parent. Every component has a **Category Sheet** view.

NOTE: When an admin user (user with Admin write privilege on the CategoryService and on a particular station component being adjusted) is making a category mask adjustment, the user must also have at least Operator write privilege on the category being adjusted in the category mask for the station object. This includes changes to check marks in the "Inherit" column - the user must have at least Operator write access to any altered categories applied from the Inherit change.

Figure 30 Category Sheet



Option/button	Value	Description
Categories	text	Provides one table row for each category name.
Inherit	toggle	A check mark indicates that the component belongs to the same categories as its parent component. No check mark allows you to make explicit category assignments for this component.
Select All	button	Effective if `Inherit` is cleared, clicking this button assigns this component to all categories in this station.
Deselect All	button	Effective if `Inherit` is cleared, clicking this button removes this component from all categories.
CategoryService	button	Opens the **Category Browser**.

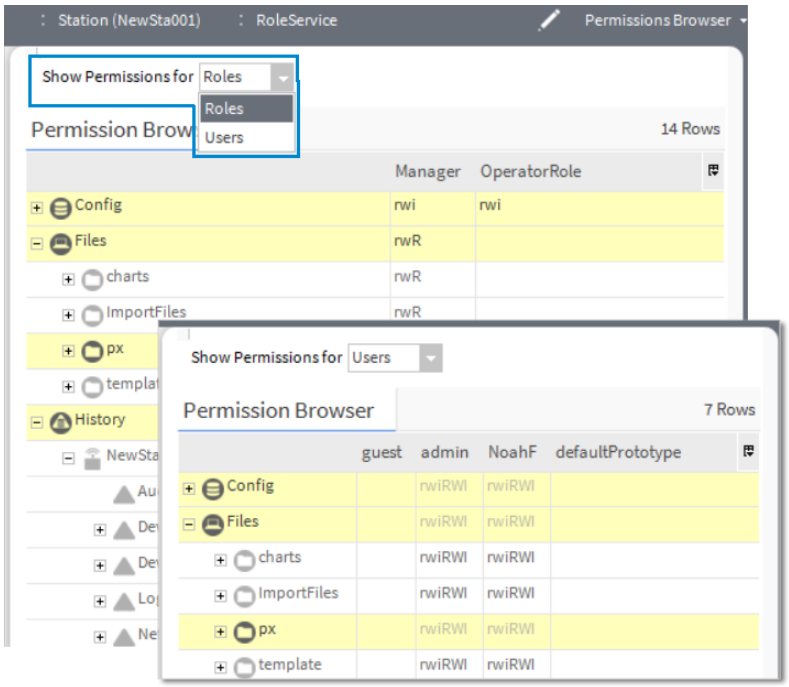
Option/button	Value	Description
Refresh	button	Re-displays the **Category Sheet**.
Save	button	Records the changes made.

wbutil-PermissionsBrowser

This view allows you to quickly review the objects that someone, who has been assigned a given role may access. You access this view by right-clicking **`RoleService`** in the Nav tree and clicking **Views→Permissions Browser**.

NOTE: In Niagara 4.8 and later, there is added support for the UserService in the **Permissions Browser** view. Use the **Show Permissions for** dropdown list to switch between permissions for Users, and for Roles. When viewing permissions for **Users**, the view displays a separate column for each user as well as any prototype.

Figure 31 Permissions Browser view shows permissions for Roles and Users



Columns represent roles or users, and rows identify the objects in the station, with each table cell showing user permissions.

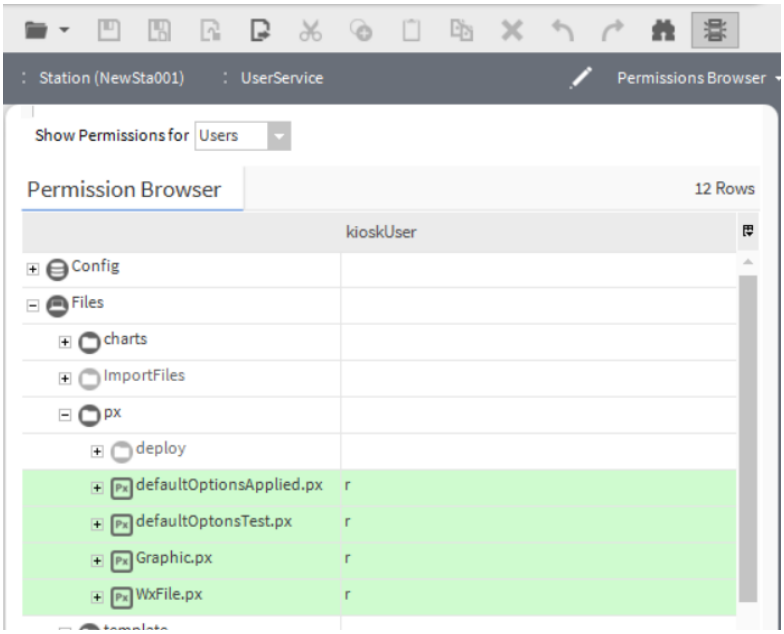
- Yellow rows are objects explicitly assigned with permissions.
- Dimmed rows represent objects that inherit their permissions from their parent object.

Double-click a cell to bring up the permissions window for that role or user depending on which option is selected in the **Show Permissions for** dropdown list. This allows you to globally change a ermission levels for any category in the station.

Additional enhancements to the **Permissions Browser** view include the following:

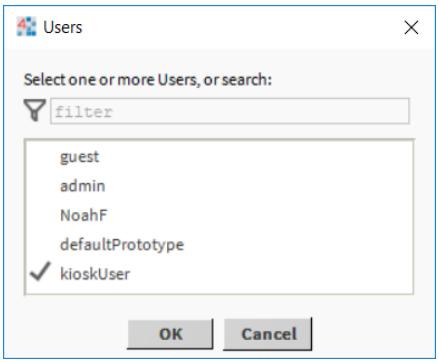
- **Highlight Accessible** – applies green shading to entries that are accessible by at least one displayed column (user or role). Do this by clicking the **Highlight Accessible** icon ( ) in the Workbench toolbar.

Figure 32 Highlight Accessible tool highlights entries accessible by this user



- **Filtering** – filters results in the table for selected users/roles. Do this by clicking the table **Options** icon ( ) at the far right side of the column heading row, to display the options menu, and click on **Show Users...** (or **Show Roles...**) to open a window that lists all users (or roles) which you can filter by search or selection and click **OK**.

Figure 33 Filtering shows persmissions for selected users/roles

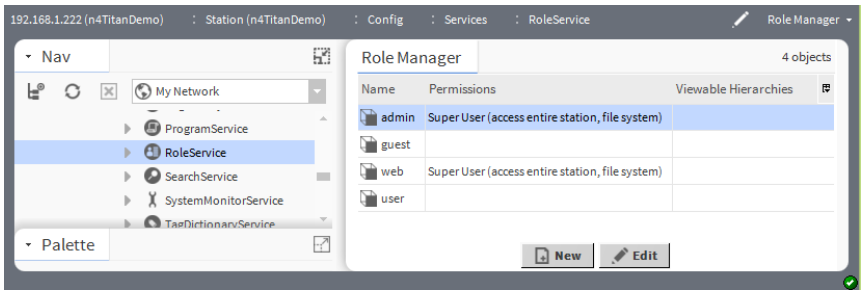


Column	Value	Description
First column	Nav tree for station Config, Files and History	Each Nav tree node occupies a row in the table. This expandable tree lets you navigate to objects of interest to review current permissions.
Admin	permissionsR = readW = writeI = invoke action`admin` level permissions appear in upper case.	Reports the rights assigned to the `admin` role. As this is a super user, `admin` has rights to read, write and invoke an action for all objects.
user	permissionsr = readw = writei = invoke action`operator` permissions appear in lower case.	Reports the rights assigned to the `user` role. The default is no rights assigned.

wbutil-RoleManager

This manager allows you to create, edit and delete roles. It is the default view of the RoleService and is located in the station's **Services** container.

Figure 34 Role Manager view

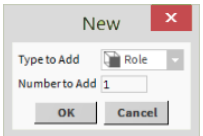


The system creates the `admin` role by default and grants it super user permissions. The `admin` role does not appear in the **Role Manager** view and you may not delete it.

Column or field	Value	Description
Name	text	Identifies the role to be assigned to one or more users. Role names are case sensitive.
Permissions	text	Associates a name with a specific set of permissions.
Viewable Hierarchies	text	Identifies the hierarchies this user may view.
Type	`Role` (default)	Identifies the type of entity being created.
Number to add	number	Allows you to create many rows at once in the **Role Manager** view's table.

New role window

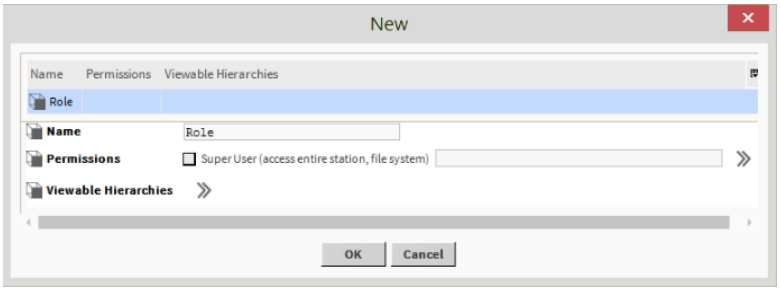
Figure 35 New Role window



Column or field	Value	Description
Type	`Role` (default)	Identifies the type of entity being created.
Number to add	number	Allows you to create many rows at once in the **Role Manager** view's table.

New role properties

Figure 36 New role properties



CAUTION: It is important to understand the risk involved in giving any user broad permissions on the Role Service. For example, giving a user **admin write** permissions on the Role Service allows that user to create, edit, rename or delete any role. Best practices recommend that such permissions on the Role Service be limited only to appropriately authorized users.

Windows

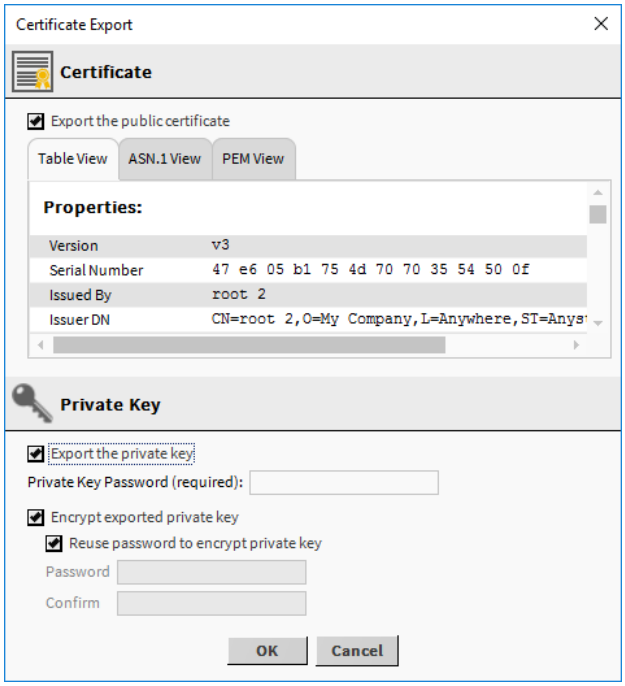
Windows create and edit database records or collect information when accessing a component. You access them by dragging a component from a palette to a nav tree node or by clicking a button.

Windows do not support **On View (F1)** and **Guide on Target** help. To learn about the information each contains, search the help system for key words.

Certificate Export windows

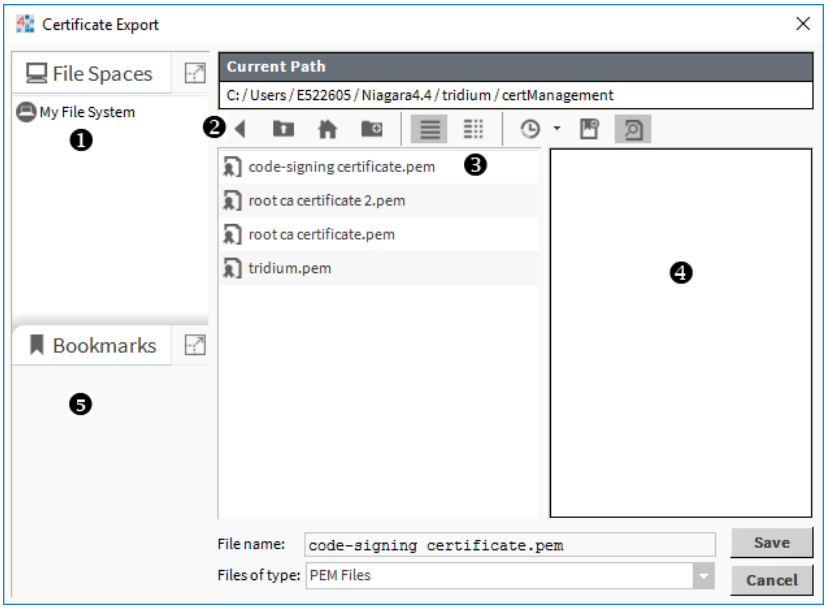
These windows save a copy of the selected certificate to a folder on your hard drive or thumb drive.

Certificate Export chooser



Property	Value	Description
Export the public certificate	check box, defaults to selected	Indicates that the system will export the certificate with only its public key.
Table, ASN.1 View and PEM View	tabs	Shows the contents of the certificate in terms of properties, ASN (Abstract Syntax Notation), and PEM (Privacy Enhanced Mail).
Export the private key	check box, defaults to de-selected	Instructs the system to export the private key with the public key. You would select this option only if you are backing up a root CA or intermediate certificate to a second secure location.
Private Key Password	text	Supplies the password created when the certificate was created.
Encrypt exported private key	check box, defaults to selected	Causes the system to encode the private key for enhanced security.
Reuse password to encrypt private key	check box, defaults to selected	Indicates that no additional password is required to encrypt the private key. Deselecting this option allows you to assign a second password to protect the private key.
Password and Confirm	text	Create and confirm the second password.

Certificate Export, file chooser



❶	Displays the available file spaces. The contraction ( ) and expansion ( ) icons resize the selected pane.
❷	The control icons determine the contents of the file view pane: returns to a previous folder. displays files in the folder above the current folder. displays files in the root of the user home. creates a new folder. configures the chooser to display the file name only. configures the chooser to display the details for each file. provides a drop-down list of available file paths. creates an entry in the Bookmarks pane. turns the display of the details pane on and off.
❸	The file view pane.
❹	This pane displays the details for the selected file.
❺	Bookmarks pane.

Edit history export window

The **Edit** window shows the configuration properties of the history export descriptor, plus **Name**, which is equivalent to the right-click **Rename** command on the descriptor. To access all properties, including all status properties, view the HistoryService property sheet.

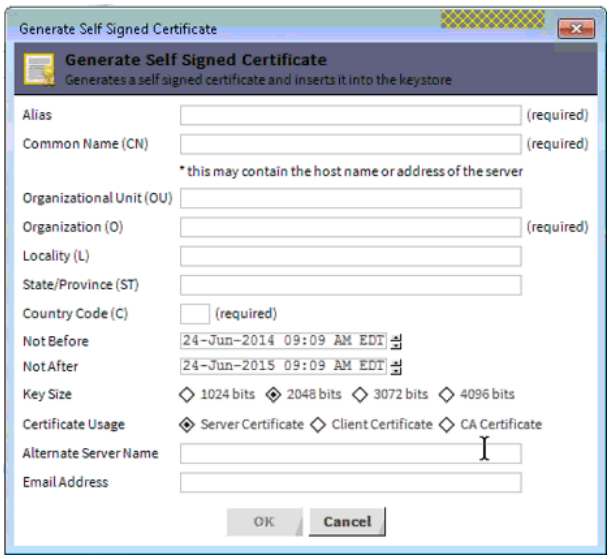
The **NiagaraHistoryExport** line above the properties summarizes the properties.

Property	Value	Description
Name	Text string followed by numbers	For a history originating in the local host station, the name begins with `Local_` . If Discovered for import, typically left at default. For a system history export, originating in the remote station, the name begins with `NiagaraSystemHistoryExport`.
Execution Time — Manual	N/A	Requires human intervention to initiate a history export or import.
HistoryId	Text in two parts: `/stationname/historyname`	Specifies the history name in the local station's History space, using two parts: "`/<stationName>`" and "`/<history-Name>`". If Discovered, station name is "`^`" (a character representing the device name of the parent container) and history name reflects the source history name. Typically, you leave both fields at default values, or edit the second (`<history-Name>`) field only.
Execution Time — Daily (default)	Time Of Day hours:minutes:seconds AM/PM timezone Randomization Days Of Week	Defines when the daily export or import automatically takes place. The hours follow a 24–hour clock.
Execution Time — Interval	Interval hours:minutes:seconds Time Of Day Days Of Week	Defines the amount of time between automatic exports or imports. Hours may number in the thousands.
Enabled	`true` or `false`	Activates and deactivates use of the function.

Generate Self-Signed Certificate window

This window defines the important information required to create a certificate. You use this window to create your own certificates along with a key pair (public and private).

Figure 37 Default view of the Generate Self-Signed Certificate window



This window opens when you click **New** at the bottom of the **User Key Store** tab.

A self-signed certificate provides data encryption only. Since it is not signed by a CA (Certificate Authority) it cannot verify server identify. Generating a self-signed certificate should be a temporary measure until a signed certificate is installed in the browser's and station's trust stores. After installing the signed certificate you should delete any self-signed certificates. See the *Niagara Station Security Guide* for more information about using TLS (Transfer Layer Security) to secure communication among security system components.

There is a limit of 64 characters for each of the following properties. Although blank properties are permitted, it is recommended to correctly fill in all properties, as not doing so may generate errors, or cause third-party CAs to reject your certificate. Spaces and periods are allowed. Enter full legal names.

Name	Value	Description
Alias	text	A short name used to distinguish certificates from one another in the **Key Store**. This property is required. It may identify the type of certificate (root, intermediate, server), location or function. This name does not have to match when comparing the server certificate with the CA certificate in the client's Trust Store.
Common Name (CN)	text, required, alphanumeric; do not use "*" or "?" as part of the name	Also known as the Distinguished Name, this field should be the host name. It appears as the `Subject` in the **User Key Store**.
Organizational Unit (OU)	text	The name of a department within the organization or a Doing-Business-As (DBA entry). Frequently, this entry is listed as "IT", "Web Security," "Secure Services Department" or left blank.
Organization (O)	text	The legally registered name of your company or organization. Do not abbreviate this name. This property is required.
Locality (L)	text	The city in which the organization for which you are creating the certificate is located. This is required only for organizations registered at the local level. If you use it, do not abbreviate.
State/Province (ST)	text	The complete name of the state or province in which your organization is located. This property is optional.
Country Code (C)	two-character ISO-format country code.	If you do not know your country's two-character code, check www.countrycode.org. This property is required.
Not Before	date	Specifies the date before which the certificate is not valid. This date on a server certificate should not exceed the **Not Before** date on the root CA certificate used to sign it.
Not After	date	Specifies the expiration date for the certificate. This date on a server certificate should not exceed the **Not After** date on the root CA certificate used to sign it.
Key Size	number	Specifies the size of the keys in bits. Four key sizes are allowed: 1024 bits, 2048 bits (this is the default), 3072 bits, and 4096 bits. Larger keys take longer to generate but offer greater security.
Certificate Usage:	text	Specifies the purpose of the certificate: server, client or CA certificate. Other certificate management software utilities may allow other usages.

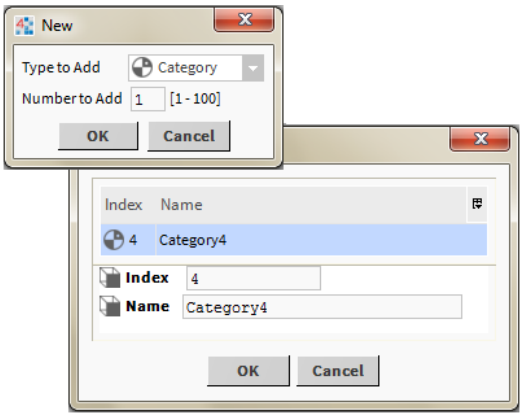
Name	Value	Description
Alternative Server Name	text	This property provides a name other than the Subject (`Common Name`) that the system can use to connect to the server. Like the `Common Name`, the system uses the `Alternative Server Name` to validate the server certificate making it possible to specify both an IP (Internet Protocol) and FQDN (Fully Qualified Domain Name).
Email Address	email address	The contact address for this certificate. It may also be the address to which your signed certificate (.pem file) will be sent.

New category windows

The **New** window appears when you click the **New** button at the bottom of the **Category Manager** view. When you click **OK** a second **New** window displays, allowing you to assign name and index details.

Basic category window

Figure 38 Creating basic categories

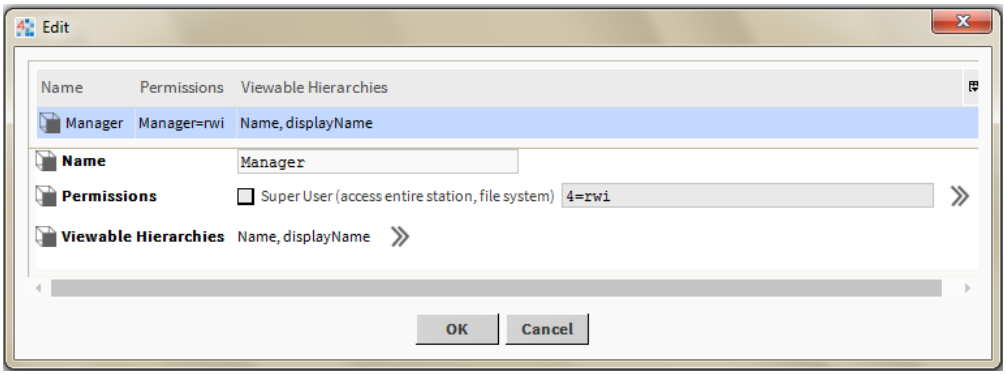


Property	Value	Description
Name	text	A name for the given category. This can be any name that describes how you are using the category.
Index	number	A unique number for the category, as it is known to the station.

New/Edit roles window

This window creates and edits roles and permissions. You access it from the **Role Manager** view (**`RoleService`**).

Figure 39 Example of an Edit role dialog box

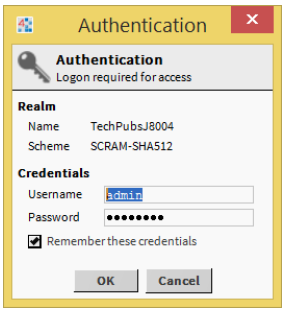


Property	Value	Description
Name	text string	Descriptive text that reflects the purpose of the entity or logical grouping.
Permissions	check box and chevron	Checking the **All Powerful User** (super user) check box sets up a role that allows the user to access the entire station and file system. To set individual permissions for a role, click the chevron. The box between The All Powerful User and the chevron displays all categories. Basic categories display by index number (for example: `3=rwi`).
tags	various	Any tags associated with the object appear at the end of the property sheet. The tag icon identifies them. The systems integrator sets up tags to provide additional, searchable information about the object.

Platform Authentication window

This window opens after a secure platform connection is made. Its purpose is to authenticate the platform user.

Figure 40 Platform authentication window

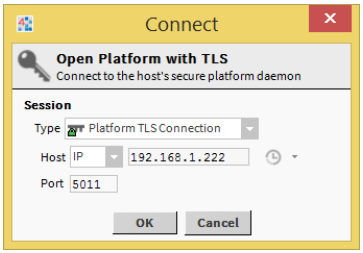


Name	Value	Description
Name	text	The name may include your company network name (when connecting to a Windows-based computer), the IP address of the controller, or host name of the controller.
Scheme	text	This information identifies the authentication scheme used to log on to a platform: HTTP-Basic, HTTP-Digest, or SCRAM-SHA512.
Credentials—Username	text	This is where you enter the platform user name created when the controller was commissioned. Access to this name is through **Platform Administration→User Accounts**.
Credentials—Password	text	This is the password created when the controller was commissioned. Access to this password is through **Platform Administration→User Accounts**.
Remember These Credentials	check box	Select this check box to have the system automatically fill in the user name and password when you log on the next time.

Platform Connect window

This window opens when you open a platform (supervisor PC or controller).

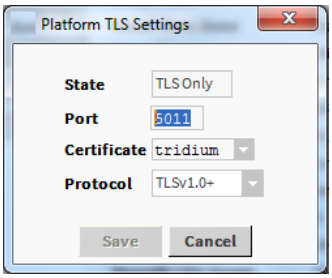
Figure 41 Platform connect window



Name	Value	Description
Type	drop-down list	Defaults to `Platform TLS Connection`.
Host (type)		Defaults to `IP`.
IP address	text	This is where you enter the IP address or URL of the host platform.
Port	number	The port for secure platform communication. Defaults to 5011.

Platform TLS settings

This window sets up the platformtls (niagarad) properties that provide server authentication and encryption. To access it, right-click **Platform→Views→Platform Administration** and double-click **Change TLS Settings**.



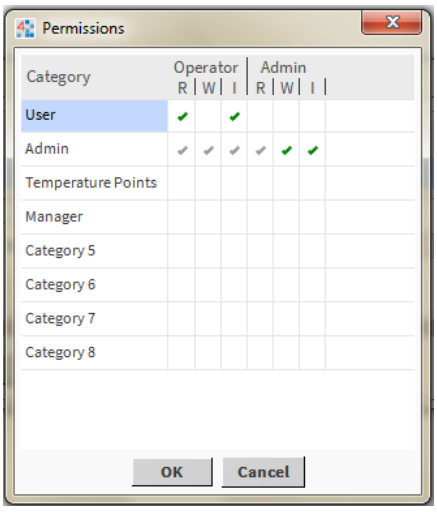
Name	Value	Description
State	TLS	Defaults to TLS only.
Port	number	The port for secure communication. Defaults to 5011
Certificate	drop-down list	Provides a list of available certificate aliases. The `tridium` certificate is the default, self-signed certificate created when you first accessed the platform.

Protocol	drop-down list
	`TLSv1.0+` (default)
	`TLSv1.1+`
	`TLSv1.2`
		The minimum level of the TLS (Transport Layer Security) protocol to which the server will accept negotiation. The default includes versions 1.0, 1.1 and 1.2. It works with most clients, providing greater flexibility than an individual version.
		During the handshake, the server and client agree on which protocol to use.
		Change **Protocol** from the default if your network requires a specific version or if a future vulnerability is found in one of the versions.

Permissions map

This window associates permissions with categories and permission levels. To access it, add or edit a role and click the chevron next to the **`Permissions`** property.

Figure 42 Permissions map

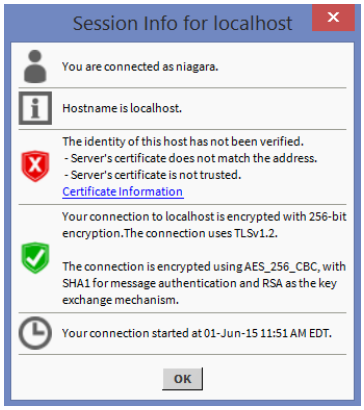


Column	Value	Description
Category	table row	`User` and `Admin` are default categories created by the **New Station** wizard. Each category occupies a single row in the Permissions map.
Operator	permission level	Provides a way to set access rights for components that are configured with the `operator` permission level. Permission level is set by the `Operator` config flag on the component's **Property Sheet**.
Admin	permission level	Indicates that the object may be read, written or an action invoked by only system users that have been granted `admin` rights. The Admin permission level is set by turning off the `Operator` config flag on the component's **Property Sheet**.

Session Info window

The **Session Info** window reports the security status of the current communication session. You view this window by right-clicking the Session Info icon ( ).

Figure 43 Example of Session Info when using a self-signed certificate



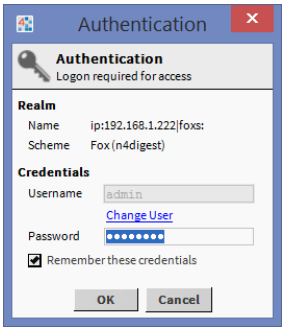
Screen element	Value	Description
	Connection	Identifies the user account that is logged in to the station.
	Hostname	Identifies the host name of the server.
or	Identity verification	Reports on the attempt to verify the authenticity of the server. A green shield indicates that a root CA certificate in the client's Trust Store verified the authenticity of the server certificate. A red shield indicates that the client system found no matching root CA certificate in a **Trust Store** with which to verify the server certificate. Clicking `Certificate Information` displays the certificate.

Screen element	Value	Description
 or	Encryption	Describes the Foxs session encryption strength. A green shield indicates that the transmission is encrypted. A red shield indicates that the transmission is not encrypted.
	Time	Logs when the Foxs session began.

Station Authentication window

This window opens after a secure station connection is made. Its purpose is to authenticate the station user.

Figure 44 Station Authentication window

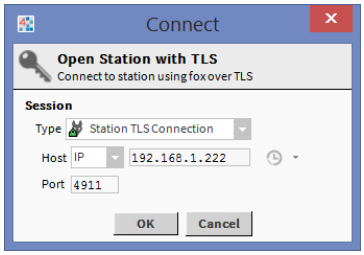


Name	Value	Description
Name	text	The station name, which, for a controller, is usually its IP address.
Scheme	text	This information identifies the authentication scheme used to log on to this station. The scheme used depends upon the user. Configuration is through the UserService.
Credentials—Username	text	This is where you enter your station user name.
Credentials—Password	text	This is your platform password, which is the same as your personal station password.
Remember These Credentials	check box	Select this check box to have the system automatically fill in the user name and password when you log on the next time.

Station Connect window

This window opens when you open a station.

Figure 45 Station Connect window



Name	Value	Description
Type	drop-down list	Defaults to `Station TLS Connection`.
Host (type)		Defaults to `IP`.
IP address	text	This is where you enter the IP address or URL of the host platform.
Port	number	The port for secure station (foxs) communication. Defaults to 4911.

Glossary

certificate	A PKI (Public Key Certificate) or digital certificate is an electronic document used to prove ownership of a public key. The certificate includes information about the key, the identity of its owner, and the digital signature of an entity that verified the validity of the certificate's contents. If the signature is valid, and the client can trust the signer, the client can be confident that it can use the public key contained in the certificate to communicate with the server.
Certificate Authority (CA)	An entity that issues the digital certificates used to certify the ownership of a public key by the named subject of the certificate. This allows system users to rely upon signatures or assertions made by the private key that corresponds to the certified public key. In this relationship model, the party that relies on the certificate trusts that the subject (owner) of the certificate is authentic because of the relationship of both parties to the CA.
chain of trust	Also called a web of trust, certification path, or trusted certificate tree is an approach to server verification that uses a self-signed certificate owned by a CA (Certificate Authority) to begin the authorized relationships. The private key of this root CA certificate signs a company's server certificate(s). Intermediate certificates may be used to further isolate relationships, such as by geographic location or corporate division.
Distinguished Name	A Distinguished Name (DN) is a string that uniquely identifies an entry in the LDAP directory. It's comparable to a path in a file system. The CN portion of the DN is comparable to a file name. As it applies to SAML attribute mapping, an Identity Provider may return a DN (e.g. CN=userGroup, OU=Users, DC=domain, DC=net) for the prototypeName attribute. More details on SAML authentication and attribute mapping are available in the "Single Sign On" section of the *Niagara Station Security Guide*.
key	A digital key is a very large, difficult-to-predict number surrounded by a certificate. Keys serve these purposes: 1) The public key of a root CA certificate in a client's **System** or **User Trust Store** verifies the authenticity of each server. 2) The private key of a trusted root CA certificate may sign other certificates. 3) After server authentication, matching public and private keys encrypt and decrypt data transmission.
NEQL	Niagara Entity Query Language provides a simple mechanism for querying objects with tags. Whereas BQL supports the tree semantics and pathing of Workbench component space (for example parent.parent) and BFormat operations, NEQL queries only for tags using the Niagara 4 tagable and entity APIs.
object	An object is the base class required for all system entities that conform to the baja model. Objects group information used to construct a model that includes building devices, virtual devices, individual points, users, system features and services. Objects appear in the Nav tree as files, modules, installers, administrators, copiers, drivers and apps. Metadata associated with objects, including categories, roles (permissions), and hierarchies, provide access control and configuration options to manage automated buildings efficiently.
permission	The right to access a component slot, folder, file or history. Three rights may be granted: the right to read information provided by the object, the right to write (change) the object, and the right to invoke an action on the object. Rights are granted using the **Role Manager**'s permissions map. Permissions

	are applied to users by assigning each user a role. A super user is automatically granted every permission in every category for every object.
permission level	A slot config flag that indicates who is allowed to access the slot. When unchecked (the default) at least `admin`-Read (R) permission is required (as defined in the **Role Manager**'s permissions map). When checked a user with a minimum of `operator`-read permission (r) may access the slot.
role	A logical grouping that is assigned as metadata to system users (human and machine) for security purposes. For example, roles may be used to group users as administrators (`admin`), regular users (user), and operators (`operator`). Roles speed the management of permissions for a large number of users. The permissions of a group of users that share the same role can be updated by changing the role's permissions instead of updating each user's permissions individually. You manage roles using the **`RoleService`**.
signature	A digital signature combines a unique hash that is created using a cryptographic algorithm (such as SHA-512) with a public key. This is done by using a matching private key to encrypt the hash. The resulting signature is unique to both the certificate and the user. Finally, the signing process embeds the digital signature in the certificate.
user permission	See permission.

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DELL Technologies

PRECISION 3650 TOWER

Ready to build the next big thing.

SPACE-SAVING DESIGN

Get incredible, scalable performance and reliability in a small tower design. A range of easy-to-reach ports on the front and back of the system keep you connected to everything you need while the optional Smart Card reader seamlessly keeps your IP secure.

INTELLIGENT PERFORMANCE

Power through intensive tasks easily with 11th Generation Intel® Core™ or Xeon® processors and get real-time results with up to 128GB of faster 3200Mhz UDIMM memory (ECC memory optional). Dell Optimizer for Precision uses AI to tune your workstation to provide the best performance for the applicationsyou use most, while providing intelligent audio and an optimized WiFi connection.

IMMERSIVE PRODUCTIVITY

Create VR content without limits with Radeon™ Pro or NVIDIA® professional-grade graphics with up to 350W TDP of graphics supports. Scalable, RAID capable storage with SATA® or PCIe NVMe™ SSD options up to 32TB deliver plenty of room for every project.

MISSION-CRITICAL RELIABILITY

All Dell Precision workstations are Independent Software Vendor (ISV) certified to ensure the high-performance applications you rely on every day run smoothly. Also, with Xeon® processors you can get Error Correcting Code (ECC) memory which identifies and corrects single bit memory errors. Our exclusive Reliable Memory Technology Pro works on top of ECC memory to identify and map out bad memory sectors and will alert you when the memory is at a critical level and needs replaced - providing layers of protection against memory related errors and blue screens.

Recommended Accessories

PRECISION 3650 Tower

DELL PREMIER WIRELESS KEYBOARD AND MOUSE | KM5221W

Enhance productivity with a comfortable keyboard and a mouse that can scroll on almost any surface (including glass and high gloss). Dual mode connectivity (Bluetooth and USB receiver) allows you to pair up to 3 devices.

DELL ULTRASHARP 27 4K MONITOR | U2720Q

Experience captivating details and true-to-life color reproduction on this brilliant 27" 4K monitor with the widest color coverage in its class[5].

PRECISION MINI-TOWER DUST FILTER

Custom built for your Precision, the external dust filter keeps your internal components clean and running smoothly. It is easy to install and rinse clean.

DELL PRO STEREO SOUNDBAR | AE515M

Optimize your conference calls, multimedia streaming and gaming with this 5W RMS Microsoft® Skype® for Business certified soundbar.

DELL ULTRASHARP 34 CURVED USB-C HUB MONITOR | U3421WE

Productivity never looked so good. Archieve more with this immersive 34" curved monitor with wide color coverage and extensive connectivity including RJ45, USB-C and quick access front ports.

PRECISION MINI-TOWER CABLE COVER

Reduce clutter and provide secure cable management for your Precision with custom built cable cover.

WIRED MOUSE WITH FINGERPRINT READER

Safeguard your identity and login instantly without needing to remember complex passwords when you use the Dell Wired Mouse with Fingerprint Reader.

JABRA EVOLVE 75

With the ambient noise cancellation feature of this wireless headset you can hear every word clearly on your next call.

3DCONNEXION® SPACEMOUSE WIRELESS

3Dconnexion's patented 6-Degrees-of-Freedom (6DoF) sensor is specifically designed to manipulate digital content or camera positions in the industry leading CAD applications. Simply push, pull, twist or tilt the 3Dconnexion controller cap to intuitively pan, zoom and rotate your 3D drawing.

Features & Technical Specifications

PRECISION 3650 TOWER

Feature	Precision 3650 Tower Technical Specifications
Processor Options[1]	10th Generation Intel® Core™ i3-10100, 6 MB Cache, 4 Core, 3.6 GHz to 4.3 GHz 65W TDP 10th Generation Intel® Core™ i3-10105, 6 MB Cache, 4 Core, 3.7 GHz to 4.4 GHz, 65W TDP 10th Generation Intel® Core™ i5-10505, 12 MB Cache, 6 Core, 3.2 GHz to 4.6 GHz 65W TDP 10th Generation Intel® Core™ i5-10600, 12 MB Cache, 6 Core, 3.3 GHz to 4.8 GHz 65W TDP 10th Generation Intel® Core™ i5-10600K, 12 MB Cache, 6 Core, 4.1 GHz to 4.8 GHz 125W TDP 10th Generation Intel® Core™ i7-10700, 16 MB Cache, 8 Core, 2.9 GHz to 4.8 GHz 65W TDP 10th Generation Intel® Core™ i7-10700K, 16 MB Cache, 8 Core, 3.8 GHz to 5.1 GHz 125W TDP 10th Generation Intel® Core™ i9-10900, 20 MB Cache, 10 Core, 2.8 GHz to 5.2 GHz 65W TDP 10th Generation Intel® Core™ i9-10900K, 20 MB Cache, 10 Core, 3.7 GHz to 5.3 GHz 125W TDP 10th Generation Intel® Xeon® W-1250, 12 MB Cache, 6 Core, 3.3 GHz to 4.7 GHz 80W TDP 10th Generation Intel® Xeon® W-1250P, 12 MB Cache, 6 Core, 4.1 GHz to 4.8 GHz 125W TDP 10th Generation Intel® Xeon® W-1270, 16 MB Cache, 8 Core, 3.4 GHz to 5.0 GHz 80W TDP 10th Generation Intel® Xeon® W-1270P, 16 MB Cache, 8 Core, 3.8 GHz to 5.1 GHz 125W TDP 10th Generation Intel® Xeon® W-1290, 20 MB Cache, 10 Core, 3.2 GHz to 5.2 GHz 80W TDP 10th Generation Intel® Xeon® W-1290P, 20 MB Cache, 10 Core, 3.7 GHz to 5.3 GHz 125W TDP 11th Generation Intel® Core™ i5-11500, 12 MB Cache, 6 Core, 2.7 GHz to 4.6 GHz, 65W TDP 11th Generation Intel® Core™ i5-11600, 12 MB Cache, 6 Core, 2.8 GHz to 4.8 GHz, 65W TDP 11th Generation Intel® Core™ i5-11600K, 12 MB Cache, 6 Core, 3.9 GHz to 4.9 GHz, 125W TDP 11th Generation Intel® Core™ i7-11700, (16 MB Cache, 8 Core, 2.5 GHz to 4.9 GHz, 65W TDP 11th Generation Intel® Core™ i7-11700K, 16 MB Cache, 8 Core, 3.6 GHz to 5.0 GHz, 125W TDP 11th Generation Intel® Core™ i9-11900, 16 MB Cache, 8 Core, 2.5 GHz to 5.2 GHz, 65W TDP 11th Generation Intel® Core™ i9-11900K, 16 MB Cache, 8 Core, 3.5 GHz to 5.3 GHz, 125W TDP 11th Generation Intel® Xeon® W-1350, 12 MB Cache, 6 Core, 3.3 GHz to 5.0 GHz, 80W TDP 11th Generation Intel® Xeon® W-1350P, 12 MB Cache, 6 Core, 4.0 GHz to 5.1 GHz, 125W TDP 11th Generation Intel® Xeon® W-1370, 16 MB Cache, 8 Core, 2.9 GHz to 5.1 GHz, 80W TDP 11th Generation Intel® Xeon® W-1370P, 16 MB Cache, 8 Core, 3.6 GHz to 5.2 GHz, 125W TDP 11th Generation Intel® Xeon® W-1390, 16 MB Cache, 8 Core, 2.8 GHz to 5.2 GHz, 80W TDP 11th Generation Intel® Xeon® W-1390P, 16 MB Cache, 8 Core, 3.5 GHz to 5.3 GHz, 125W TDP
Operating System Options[2]	Windows® 10 Home (64-bit) Windows® 10 Professional (64-bit) Windows® 10 Professional (64-bit) National Academic Windows® CMIT Government Edition (V0-H) Windows® 10 Professional Workstation (64-bit) (for 6 or more cores) Windows® 10 IoT Enterprise LTSC Red Hat® Linux® 8.4 Ubuntu® Linux® 20.04 LTS Kylin Linux® 10.1 (China only)
Chipset	Intel® W580 chipset
Memory Options[3]	4 DIMM slots (dual channel) Up to 128GB or up to 3200MHz Non-ECC & ECC DDR4 Memory 2 DIMMs per channel (2DPC) speed of 3200MHz is supported when channel is populated with the same DIMM part number and available on 11th gen processors only. Symmetrical configurations are required for 2DPC within one channel to achieve 3200MHz memory operating speed, otherwise memory speed may drop to 2666MHz or 2933MHz. There are no restrictions across channels. Please review Setup and Specifications or Owner's Manual document for more detailed explanation.
Graphics Options[3]	One PCI Express® x16 Gen 4 slot supporting graphics card up to 350W (Total power available for discrete graphics cards). (Some cards are available in Dual Config as well Gen 4 slot speed is available on 11th gen processors only.) **High End cards:** NVIDIA® RTX5000, 16GB, GDDR6 AMD Radeon™ Pro W5700, 8GB, GDDR6 **Mid-range 3D cards:** NVIDIA® RTX4000, 8GB, GDDR6 NVIDIA® P2200, 5GB, GDDR5X AMD Radeon™ Pro W5500, 8GB, GDDR6 **Entry 3D cards:** (all single or dual) NVIDIA® P1000, 4GB, GDDR5 NVIDIA® P620, 2GB, GDDR5 NVIDIA® P400, 2GB, GDDR5 AMD Radeon™ Pro WX3200, 4GB, GDDR5X

Features & Technical Specifications

PRECISION 3650 TOWER

Feature	Precision 3650 Tower Technical Specifications
Storage Options[4]	Support for up to (3) 3.5" SATA® or (4) 2.5" SATA® For 11th gen processors, up to (3) M.2 PCIe NVMe SSD on motherboard slots. Boot drive installed on gen 4 slot. For 10th gen processors, up to (2) M.2 PCIe NVMe SSD on motherboard slots. Boot drive installed on gen 3 slot. Support for Intel® Ready Mode™ technology Support for up to (1) additional PCIe SSD on Dell Precision Ultra-Speed drive with active cooling **M.2 PCIe NVMe™ SSD** M.2 2280 256GB NVMe™ gen3 Class 40 M.2 2280 512GB NVMe™ gen4 Class 40 M.2 2280 512GB NVMe™ gen3 Class 50 M.2 2280 1TB NVMe™ gen3 Class 50 M.2 2280 1TB NVMe™ gen4 Class 40 M.2 2280 2TB NVMe™ gen4 Class 40 **SATA® 2.5" 7200 RPM** 2.5" 1TB 5400 RPM HDD (7mm) 2.5" 2TB 5400 RPM HDD (7mm) 2.5" 500GB 7200 RPM HDD (7mm) 2.5" 1TB 7200 RPM HDD (7mm) **SATA® 3.5"** 3.5" 500GB 7200 RPM HDD 3.5" 1TB 7200 RPM HDD 3.5" 2TB 7200 RPM HDD 3.5" 4TB 5400 RPM HDD 3.5" 4TB 7200 RPM Enterprise HDD 3.5" 8TB 7200 RPM Enterprise HDD **Self Encrypting Drives** M.2 2280 256GB NVMe™ gen3 SED M.2 2280 512GB NVMe™ gen3 SED M.2 2280 1TB NVMe™ gen3 SED 2.5" 500GB 7200RPM OPAL SED FIPS (7mm) RAID options 0, 1, 5, 10 available.
Storage Controller	**Integrated:** Intel® Rapid Storage Controller 12.0 supporting SATA 6Gb/s and host based RAID 0/1/5/10
Speakers	Optional Internal Speaker; Optional Dell 2.0 stereo speaker systems available and Dell sound bar for select flat-panel displays, Optional Dell Pro Stereo Headset (wired/wireless).
Communications	**Integrated:** Intel® Ethernet Connection I219-LM 10/100/1000 **Optional:** 2nd Ethernet Connection (RJ-45) up to 2.5Gbps **Optional:** Intel® 10/100/1000 PCIe Gigabit Networking card Aquantia® AQtion™ AQN-108 5/2.5 GbE NIC Adapter **Optional:** WLAN on PCIe Add-in-card with up to Wi-Fi® 6 (802.11ax) wireless module and Bluetooth® 5.2
Audio Controller	Integrated Realtek® ALC3246 High Definition Audio Codec (2 Channel)
Add-in cards	**Ethernet NIC** Aquantia AQtion AQN-108 5/2.5 GbE NIC Adapter (Full Height) Intel® Gigabit Ethernet NIC (1Gbps) PCIe Card (Full Height) Intel® Ethernet 10G Dual Port X550-t Adapter (2X10GbE) **WLAN on PCIe Add-in-card** Qualcomm® QCA6174A 802.11ac Dual Band (2x2) Wireless + Bluetooth 5.0 LE M.2, w/Internal Antenna Intel® Wi-Fi 6 AX210 802.11ax Dual Band (2x2) Wireless Module + Bluetooth 5.2 **Extra Ports** Additional USB Type C™ w/ DisplayPort Alternative Additional VGA Port Additional DisplayPort™ Additional HDMI 2.0 Port Serial and Parallel Port PCIe Card (Full Height) USB 3.2 G2 PCIe Card - 2 Type C™ Ports. 1DP in USB 3.2 Type C™ Gen 2 PCIE add-in card (Full Height) Serial port add-in card (PCIe) Thunderbolt™ 4 PCIe add-in-card (Full Height)

Features & Technical Specifications

PRECISION 3650 TOWER

Feature	Precision 3650 Tower Technical Specifications
I/O Ports	**Front:** Front of the chassis has 2 I/O offerings - Standard and Advanced with following differences in USB and SD card reader. (Availability depends on chassis selection and region) **Standard offering** 2x USB 2.0 Type A 1x USB 3.2 Type A Gen1 (5Gbps), with PowerShare 1x USB 3.2 Type C™ Gen2 (10Gbps), with PowerShare No SD card reader **Advanced offering** 1x USB 3.2 Type A Gen1 (5Gbps) 1x USB 3.2 Type A Gen2 (10Gbps) **Advanced offering** 1x USB 3.2 Type A Gen2 (10Gbps), with PowerShare 1x USB 3.2 Type C™ Gen 2x2 (20Gbps), with PowerShare With SD card reader **Other Front ports** 1x 3.5mm headphone jack with microphone **Rear** Starting from top, going left to right 2x DisplayPort™ 1.4 2x PS2 (Legacy for keyboard and mouse) 2x USB 2.0 Type A (with SmartPower) 1x RJ45 Network Connector 1x USB 3.2 Type A Gen2 (10Gbps) 2x USB 3.2 Type A Gen1 (5Gbps) 1x Audio Line out
Chassis	1x Optional Port (VGA, HDMI 2.0, DP1.4 with 5K display support, Type C w/DP-Alt mode) 1x Optional 2nd RJ45 Network Connector (2.5GHz) Height: 13.19 in. (335.0 mm) Width: 6.95 in. (176.6 mm) Depth: 13.58 in. (345.0 mm) Weight: 18.74 lb (8.5 kg) **Bays:** 4x SATA slots for (4) 2.5 in. / (3) 3.5 in. HDD / (1) ODD / (1) DP27 **Slots:** 3x M.2 2280 PCIe x4 slots for NVMe SSD on RKL-S CPUs (1 slot will be Gen4, 2 slots will be Gen3); 2x M.2 2280 PCIe x4 slots for NVMe SSD on CML-S Refresh Core i3 CPU (2 slots will be Gen3), 1x PCIe x16 Gen4 (full height), 1x PCI (full height), 1x PCIe x4 Gen3 (open ended, full height) **Power Supply:** 300W 90% efficient PSU (80PLUS Gold Certified Certified) Energy Star compliant; 460W 90% efficient PSU (80PLUS Gold Certified Certified) Energy Star compliant; 550W 90% efficient PSU (80PLUS Gold Certified) Energy Star compliant; 1000W 90% efficient PSU (80 PLUS Gold Certified) Energy Star compliant (PSU availability varies by region.)
Storage devices	Optional: 1 optical drive: DVD-ROM; DVD+/-RW (Note: optical drive not available with Smart Card Reader (CAC/PIV)) SD Card Reader (Note: SD card reader is available in Advanced front I/O offering at the time of purchase. Availability for a chassis may differ across regions.)
Security Options[5]	Trusted Platform Module TPM 2.0, Dell Data Guardian, Dell Endpoint Security Suite Enterprise, Dell HW Crypto Accelerator, Microsoft Windows Bitlocker, Local HDD data wipe via BIOS (“Secure Erase”), Encryption - SED HDD (Opal FIPS), Chassis lock slot support, Chassis Intrusion Switch, D-Pedigree (Secure Supply Chain Functionality), Setup/BIOS Password, Optional Smart Card keyboards, Intel® Trusted Execution Technology, Intel® Identity Protection Technology, Dell Secure Works, BIOS support optional Computrace, Intel Software Guard extensions

Features & Technical Specifications

PRECISION 3650 TOWER

Feature	Precision 3650 Tower Technical Specifications
Systems Management[6]	Dell Command | Intel vPro™ Out of Band
Regulatory & Environmental	EPEAT Gold Registered (available worldwide except India. EPEAT Silver available in India.) China CECP ENERGY STAR 8.0 qualified TCO 8.0 Certified Japan Green PC Design for Environment (ENV0425) CEC Compliance Mark plastics parts as per the ISO 11469 standard
Warranty & Support Services[7]	3-Year Limited Hardware Warranty and 3-year NBD On-Site Service after Remote Diagnosis Optional: Dell ProSupport is designed to rapidly respond to your business's needs, help protect your investment and sensitive data and provide enhanced proactive support services to help reduce risk and complexity within your IT environment

Built for business

Dell Technologies Unified Workspace

Dell Technologies Unified Workspace is the most comprehensive solution to deploy, secure, manage and support virtually all devices from the cloud. We designed this revolutionary solution with intelligence and automation providing you with visibility across the entire endpoint environment. We help you save time, improve user experience, optimize resources and strenthen security.

DEPLOY

Our modern deployment solution, ProDeploy in the Unified Workspace allows you to revolutionize the way deployment gets done. By spending just one hour for set up , IT can then hand deployment to Dell and have preconfigured systems shipped directly to the end users--wherever they are.

SECURE

Dell Endpoint Security for the Unified Workspace helps you manage growing cyber risks while embracing workforce transformation. With Dell SafeGuard and Response powered by Secureworks, you gain actionable insight to help you quickly and efficiently prevent, detect and respond to cyber-attacks - keeping your environment free from harm.

MANAGE

We integrated our hardware management solution Dell Client Command Suite with VMware Workspace ONE, allowing you to take advantage of unified endpoint management (UEM) and manage the firmware, operating system and applications for all devices from the Workspace ONE console. UEM simplifies the management of the entire environment saving IT time from having to work between separate consoles for PCs and phones.

SUPPORT

ProSupport Plus continues to be the only predictive and proactive support in the market. When compared to key competitors, ProSupport Plus with SupportAssist reduced time to resolve a failed hard drive with up to 11x faster time to resolution*

*Based on a Principled Technologies test report, "Spend Less Time and Effort Troubleshooting Laptop Hardware Failures" dated April 2018. Testing ommissioned by Dell, conducted in the United States. Actual results will vary. Full report: http://facts.pt/L52XKM

PRECISION 3650 TOWER

Create without limits.

Some options available only in select regions; ISV certification applies to select configurations:
1 Intel Turbo Boost mode only available on Xeon, Core i9, Core i7 and Core i5 processors. Intel Integrated HD graphics only available with select processors.
2 A 64-bit operating system is required to support 4GB or more of system memory.
3 System memory may be used to support graphics, depending on system memory size and other factors.
4 Hard Drive capacity varies with preloaded material and will be less.
5 Computrace is not a Dell offer. Certain conditions apply. For full details, see terms and conditions at www.absolute.com/en/about/legal/agreements.
6 Systems Management Options:Intel® vPro Technology - Fully vPro-capable at point of purchase; the vPro systems management option requires vPro processors. Includes support for Intel Advanced Management Technology (AMT) 9.x. Intel® Standard Manageability - Fully enabled at point of purchase, the Intel Standard Management option is a subset of the AMT features. ISM is not upgradeable to vPro technology post-purchase. No Out-of-Band Systems Management - This option entirely removes Intel out of band systems (OOB) management features. The system can still support in band management. OOB management support through AMT cannot be upgraded post-purchase.
7 Availability and terms of Dell Services vary by region. For more information, visit Dell.com/servicecontracts/global; Limited Hardware Warranty available by writing Dell USA LP, Attn: Warranties, One Dell Way, Round Rock, TX 78682 or see www.dell.com/warranty; Onsite Service after Remote Diagnosis: Remote Diagnosis is determination by online/phone technician of cause of issue; may involve customer access to inside of system and multiple or extended sessions. If issue is covered by Limited Hardware Warranty (www.dell.com/warranty) and not resolved remotely, technician and/or part will be dispatched, usually within 1 business day following completion of Remote Diagnosis. Availability varies. Other conditions apply.
8 With up to 95% coverage of the DCI-P3 color space, based on Dell analysis of publicly available data of competitive monitors, Aug 2019.

Precision 3650 Tower

Description	SKU
11th Generation Intel Core i5-11500, 12 MB Cache, 6 Core, 2.7 GHz to 4.6 GHz	338-BZKD
HEATSINK for 65W CPU	412-AAWJ
Windows 10 Pro English, French, Spanish	619-AHKN
Microsoft(R) Office Professional 2019 - Includes Outlook, Access & Publisher	630-ABGO
Precision 3650 Tower with 300W up to 90% efficient (80 Plus Gold) PSU, Standard Front I/O, no SD card reader	321-BGKR
32GB (2x16GB) DDR4 UDIMM non-ECC Memory	370-AGEH
Intel Integrated Graphics	490-BBBS
C1: M.2 SSD Boot + Optional M.2 SSD (No SATA HDD)	449-BBWL
No RAID	780-BBCJ
512GB PCIe NVMe Class 40 M.2 SSD	400-BLQY
Thermal Pad 3640	412-AATT
No Hard Drive	400-AKZR
No Hard Drive	400-AKZR
No Hard Drive	400-AKZR
No Hard Drive	400-AKZR
No Hard Drive	400-AKZR
No Additional Network Card Selected (Integrated NIC included)	555-BBJO
No Wireless LAN Card (no WiFi enablement)	555-BBFO
Not selected in this configuration	817-BBBC
No Additional Port	492-BCLP
No Optical Drive	429-ABHB
CMS Software not included	632-BBBJ
Intel Management Engine with vPro	631-ACWM
Dell KB216 Wired Keyboard English	580-ADJC
Dell Optical Mouse - MS116 (Black)	570-ABIE
ENERGY STAR Qualified	387-BBLW
EPEAT 2018 Registered (Gold)	379-BDZB
Dell Precision TPM	340-ACBY
No Front Cooling Fan	384-BCGU

No Driver	555-BBNI
US Power Cord	450-AHDU
SERI Guide (ENG/FR/Multi)	340-AGIK
Quick setup guide, Precision 3650	340-CVFC
US Order	332-1286
SHIP,PWS,LNK,NO,NO,AMF	340-CBUU
Ship material - EPEAT Certification	340-COYI
300W Gold PSU label	389-DYML
11th Gen Intel Core i5 vPro label	340-CTSV
Internal Speaker for Precision 3650	520-AASQ
No External ODD	429-ABGY
No AutoPilot	340-CKSZ
No Stand included	575-BBCH
No Additional Cable Requested	379-BBCY
OS-Windows Media Not Included	620-AALW
Not selected in this configuration	817-BBBC
SupportAssist	525-BBCL
Dell(TM) Digital Delivery Cirrus Client	640-BBLW
Dell Optimizer for Precision	640-BBSC
Dell Premier Color 6.0	640-BBSH
Dell Client System Update (Updates latest Dell Recommended BIOS, Drivers, Firmware and Apps)	658-BBMR
Waves Maxx Audio	658-BBRB
Dell SupportAssist OS Recovery Tool	658-BEOK
No Anti-Virus Software	650-AAAM
Custom Configuration	817-BBBB
Precision 3650 Tower CTO BASE	210-AYSV
No UPC Label	389-BCGW
Basic Onsite Service 12 Months	709-BBUK
ProSupport and Next Business Day Onsite Service Extension, 24 Month(s)	199-BDSB
ProSupport and Next Business Day Onsite Service Initial, 12 Month(s)	199-BDSC

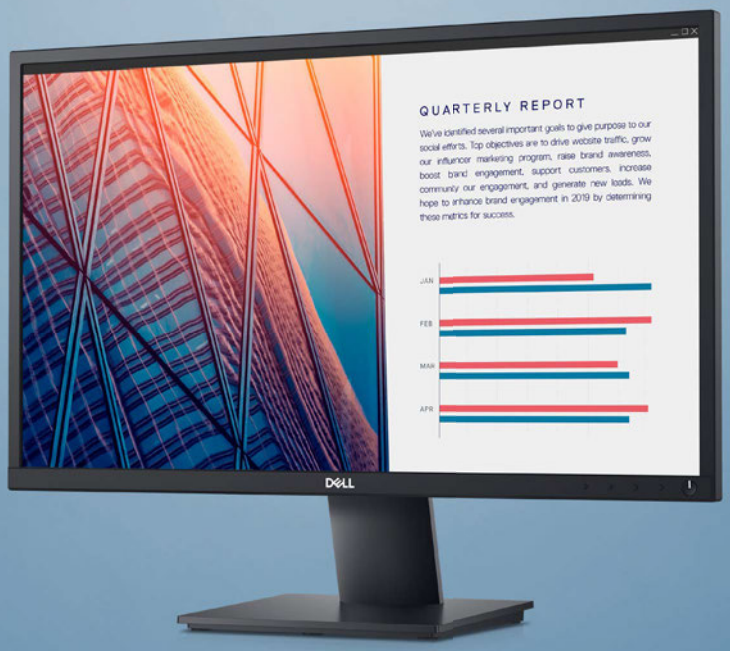
Dell 24 Monitor - E2420H, 60.5cm (23.8")

Description	SKU
Dell 24 Monitor - E2420H, 60.5cm (23.8")	210-AUNE
Dell Limited Hardware Warranty	814-9340
Advanced Exchange Service, 3 Years	814-9341

DELL Technologies

DELL 24 MONITOR | E2420H

Elevate your everyday display.



ALL THE ESSENTIALS

Enhance your everyday workspace with a 1920 x 1080 resolution monitor with improved cable management and a smaller footprint.

DELL DISPLAY MANAGER

Superior productivity and manageability featuring quick access keys, preset layouts, multi-monitor configuration and remote management for IT managers.

AWARDED THE ENERGY STAR® MOST EFFICIENT MARK IN 2020[1]

Delivering cutting-edge energy efficiency that represents the best in energy savings and environmental protection.[1]

TRUSTED RELIABILITY

As the world's #1 monitor company*, we take pride in our unyielding commitment to quality and the utmost satisfaction of our customers.

Reliable, eco-conscious monitors at a great value

ALL THE ESSENTIALS

Screen performance: The 1920 X 1080 FHD resolution is ideal for routine tasks, while ComfortView — a feature that reduces harmful blue light emissions[2] — helps optimize eye comfort over extended viewing periods.

Enhance your workspace: A thinner profile than the previous generation and improved cable management create a smaller footprint, lending itself to a clean, uncluttered desk.

Plug in: Quickly connect legacy or non-legacy PCs with VGA and DP ports.

Adapts to your needs: Make your workspace your own with VESA-compatible mounts and stands.

ECO-CONSCIOUS INSIDE AND OUT

Energy efficient: This monitor meets the latest regulatory and environmental standards such as ENERGY STAR® and TCO, and is registered EPEAT® Gold.[3] Dell E2420H has also been awarded the ENERGY STAR® Most Efficient Mark in 2020.[1]

Reduce energy: Save energy with PowerNap[4], a feature that dims or puts the monitor to sleep when not in use.

Eco-conscious packaging: To reduce our manufacturing impact on the environment, this monitor is shipped in Styrofoam-free packaging with paper based material made of at least 75% recycled cardboard.

DELL DISPLAY MANAGER

Productive at every level: Dell Display Manager's (DDM) Easy Arrange feature lets you quickly tile and view your applications side by side across one or more connected screens for multi-tasking efficiency.

Seamless transitions: The Auto-Restore feature remembers where you left off, so applications will go back to where you left them — even after you've unplugged.

The key to convenience: Shortcut keys can save you time, allowing quick access to commonly used controls that let you work faster.

More ways to manage: Asset management reports allow IT managers to quickly capture and track monitor information as well as configure multiple displays at once through a single setup.

THANK YOU FOR MAKING DELL MONITORS #1 WORLDWIDE*

Uncompromised testing: Rigorous development processes help ensure consistent, reliable performance in busy office environments.

Minimize downtime: Your monitor comes with a 3-year Advanced Exchange Service[5] so that if a replacement becomes necessary, it will be shipped to you the next business day during your 3-year Limited Hardware Warranty.[6]

Get a higher level of support: Upgrade to 24 X 7, in-region technical phone support from qualified engineers with Dell ProSupport option.[7]

Features & Technical Specifications

Monitor	Dell 24 Monitor – E2420H
Diagonal Viewing Size	60.47 cm (23.8 inches)
Horizontal Vertical	527.04 mm (20.75 inches) 296.46 mm (11.67 inches)
Maximum Preset Resolution	1920 x 1080 at 60 Hz
Aspect Ratio	16:9
Pixel Pitch	0.275 mm x 0.275 mm
Pixel Per Inch (PPI)	92
Brightness	250 cd/m² (typical)
Color Support	Color gamut (typical): 83% (CIE1976) 72% (CIE1931) Color depth: 16.7 Million
Contrast Ratio	1000:1 (typical)
Viewing Angle	178°/178°
Response Time	8 ms typical (Normal) 5 ms typical (Fast) (gray to gray)
Panel Type	IPS (In-Plane Switching)
Display Screen Coating	Anti-Glare
Backlight Technology	LED
ComfortView with Flicker-free screen	Yes
Dell Display Manager Compatibility	Yes
Remote Asset Management	Yes, via Dell Command I Monitor
GSA/TAA	No
Optional Soundbar	Dell Stereo Soundbar – AC511M
Connectivity	
Connectors	1 x VGA 1 x DisplayPort 1.2
HDCP Support	DisplayPort HDCP 1.2
Design Features	
Adjustability	Tilt Only (-5° to 21°)
Security	Security lock slot (cable lock sold separately)
Flat Panel Mount Interface	VESA (100 mm)
Power	
AC input voltage/frequency/current	100 VAC to 240 VAC / 50 Hz or 60 Hz ± 3 Hz / 0.8 A (typical)
Power Consumption (Operational)	15W (Typ). 22W (Max). 14.36W (ENERGY STAR®)
Power Consumption Stand by/Sleep	Less than 0.3W
Dimensions (with stand)	
Height	419.70 mm (16.52 inches)
Width	550.60 mm (21.68 inches)
Depth	171.0 mm (6.73 inches)
Weight	
Weight (panel only - for VESA mount/ no cables)	3.25 kg (7.17 lbs)
Weight (monitor and cables with stand)	4.27 kg (9.41 lbs)
Weight (with packaging)	5.95 kg (13.12 lbs)
Standard Service Plan	3-Years Advanced Exchange Service[5] and Limited Hardware Warranty[6]
Optional Service Plan	Dell ProSupport[7]
Environmental Compliance	Awarded the ENERGY STAR® Most Efficient Mark in 2020[1], EPEAT® Gold registered where applicable[3], TCO Certified Display

What's in the box?

Components
- Monitor with stand

Cables
- Power cable
- 1 x DP Cable (DP to DP)
- 1 x VGA Cable (EMEA and Japan only)
- 1 x VESA screw cover

Documentation
- Quick Setup Guide
- Safety and Regulatory Information

Recommended Accessories

DELL 24 MONITOR | E2420H

Easily adjust the panel to your preferred viewing position.

Back view -
Cable management slot

Tilt

Connectivity

1 Power connector
2 DisplayPort 1.2
3 VGA Port

RECOMMENDED ACCESSORIES

DELL SINGLE MONITOR ARM | MSA20

For greater viewing flexibility and a smaller footprint, choose the Dell Single Monitor Arm. Set up is virtually tool-free and its advanced cable management features offer a neat and clutter-free desk.

DELL STEREO SOUNDBAR | AC511M

The Dell Stereo Soundbar AC511M offers clear stereo sound, allowing you to enjoy audio on your favorite games, music and movies, without sacrificing desk space.

DELL PRO WIRELESS KEYBOARD AND MOUSE | KM5221W**

Enhance your everyday productivity with a quiet full size keyboard and mouse combo that offers programmable shortcuts and 36 months*** battery life.

* Dell monitors are #1 Worldwide for 7 consecutive years (2013, Q2 to 2020, Q3)! Source: IDC Worldwide Quarterly PC Monitor Tracker, Q3, 2020.
** Product availability varies by country. Contact your Dell representative or visit Dell.com to learn more.
*** Based on Dell analysis of battery life usage model calculations, Nov 2020. Results vary depending on use, operating conditions and other factors.
1 This monitor is ENERGY STAR® certified and awarded the ENERGY STAR® Most Efficient Mark in 2020. For more information, visit https://www.energystar.gov/most-efficient/me-certified-computer-monitors
2 ComfortView reduces harmful blue light emissions when activated via the OSD (Onscreen Display) menu.
3 EPEAT registered where applicable. EPEAT registration varies by country. See www.epeat.net for registration status by country.
4 PowerNap is available via Dell Display Manager. Download the software at www.dell.com/ddm
5 Advanced Exchange Service: Dell will send you a replacement monitor the next business day in most cases, if deemed necessary after phone/online diagnosis. Shipping times may vary by location and for monitors 55" and above. Fee charged for failure to return defective unit. See dell.com/servicecontracts/global for details.
6 For a copy of the Limited Hardware Warranty, write to Dell USA LP, Attention: Warranties One Dell Way, Round Rock, TX 78682 or see dell.com/warranty for details.
7 Availability varies by region, please visit dell.com/support for details.

Dell.com/monitors Product availability varies by country. Please contact your Dell representative for more information.

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v.4 11/2020

1340 Satellite Blvd.
Suwanee, GA 30024
Tel.: (800) 433-4822

Section 4: DDC Controllers

Job Name:
System Reference: Date:

GENERAL INFORMATION

- Compact, embedded controller/server platform
- Combines integrated control, supervision, data logging, alarming, scheduling and network management functions with Internet connectivity and web serving capabilities in a small, compact platform
- Makes it possible to control and manage external devices over the Internet and present real-time information to users in web-based graphical views

APPLICATION

- Ideal for smaller facilities, remote sites, or distributing control andmonitoring throughout large facilities. Optional I/O modules can be plugged in for applications where local control is required
- Supports a wide range of field busses for connection to remote I/O and stand-alone controllers. Ideal for use in small facilities to provide a complete integration system
- Serves data and rich graphical displays to a standard web browser via an Ethernet LAN or remotely over the Internet or dial-up modem.
  - In larger facilities, multi-building applications and large-scale control system integrations, Diamond Controller Server™ software can be used to aggregate information (real-time data, history, alarms, etc.) from large numbers of DC-8000 into a single unified application
- Manage global control functions, support data passing over multiple networks, connect to enterprise level software applications, and host multiple, simultaneous client workstations connected over the local network, the Internet, or dial-up modem

SPECIFICATION (PRODUCT DESCRIPTION)

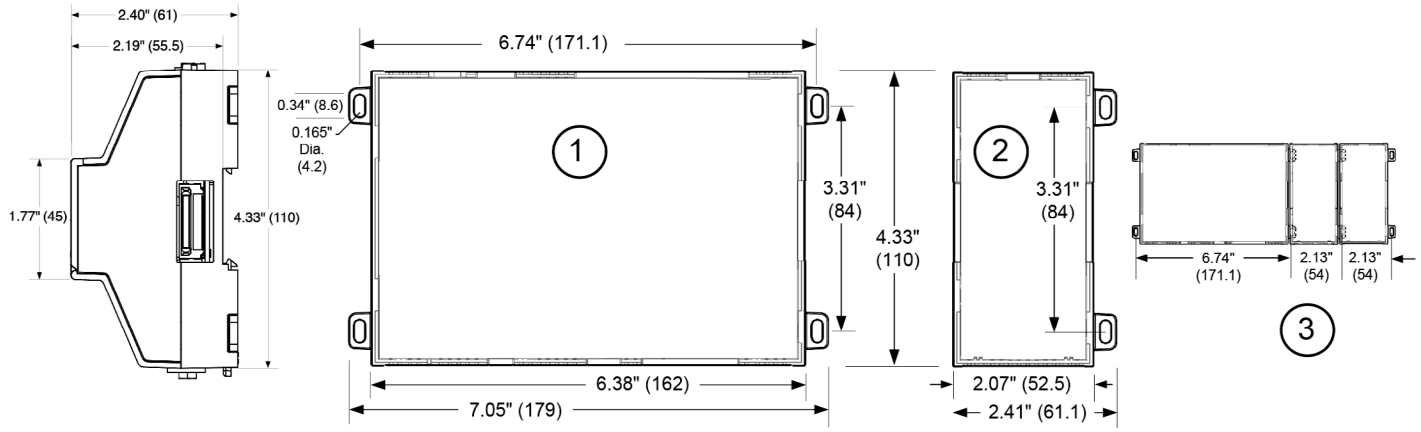
- Base Unit:
  - Two Isolated RS 485 Ports
  - Two 10/100MB
  - USB Backup & Restore
  - Wireless Connectivity
  - Compatible with DC-600E modules
  - Runs Niagara 4.1 and later
  - Batteryless operation
  - Expandable with up to four option modules
  - Real-time Clock
- Platform:
  - Texas Instruments® AM3352 1000MHz ARM® CortexTM-A8
  - 1 GB DDR3 SDRAM
  - USB backup and restore
- Communications:
  - 2 Ethernet Ports: 10/100MB
  - 2 Isolated RS-485 Port
  - Supports IEEE 802.11a/b/g/n networks
  - Configurable radio (Off, WAP, or Client)
  - Mobile phone and Tablet Accessible
  - Optional LON FTT10 & RS232 expansion
  - Optional Antenna with SMA Connector
  - Support WPA-PSK, WPA2-PSK security protocols
  - Secure boot
- Operating System:
  - Runs Niagara AX: 3.8u1 and later
  - Runs Niagara 4: 4.1 or later
- Chassis:
  - Construction: Plastic, din rail or screw mount chassis, plastic cover
    - Compatible with DIN 43880 enclosures
  - Cooling: Internal air convection
- Environmental Specifications:
  - Operational Temperature: -4 to 140°F (-20 to 60°C)
  - Storage Temperature Range: -40 to 185°F (-40 to 85°C)
  - Humidity Rating: 5% to 95% RH, non-condensing
  - Shipping & vibration: ASTM D4169, Assurance Level II
    - MTTF: 10 years+
- Rating Approvals:
  - UL 916
  - CE EN 61326-1
  - FCC Part 15 Subpart B, Class B
  - FCC Part 15 Subpart C
  - C-UL listed to Canadian Standards Association (CSA)C22.2 No. 205-M1983 “Signal Equipment”
  - 1999/5/EC R&TTE Directive
  - CCC
  - SRRC
  - RSS
  - RoHS
  - UL 916
  - C-tick (Australia)
- Dimensions: 7.05 W x 4.33 H x 2.41D In.

OPTIONS AND DIMENSIONS: DC-8000 DIAMOND CONTROLLER™

GENERAL

Part Number	Description
JENE-PC-LON	Single Port LON FTT-10A module
JENE-PC-232	Single Port RS-232 module
JENE-PC-485	Dual Port RS-485 module
DC-8000-WPM	100-240VAC, 50/60 Hz. Wall Adapter, includes US, EU, UK, and AU style plugs.
DC-8000-R-16	16 Point I/O module
DC-8000-R-34	34 Point I/O module

DIMENSIONS



Compatible with (DIN43880) enclosures
Suitable for mounting to a panel or to an EN50022 standard 35mm rail

MOUNTING INSTRUCTIONS

① DC-8000 Controller. Allow at least 1.5” (38 mm) clearance around all sides
② Expansion module. Up to four (4) may be used. See “Expansion Modules and I/O Modules Configurations”
③ Distances between center of tabs from one unit to another unit

MITSUBISHI ELECTRIC
COOLING & HEATING
1340 Satellite Boulevard. Suwanee, GA 30024
Toll Free: 800-433-4822 www.mehvac.com

BACnet® MS/TP Repeater

Overview

The BACnet MS/TP repeater is a designed to extend your network beyond the 4,000 feet range limitation of RS-485.

The repeater also augments the RS-485 signal to allow more devices on a single channel.

Applications

- Extend the range of your RS-485 BACnet MS/TP field bus by 4000 ft.
- Augment an attenuated signal to add extra devices to your channel

Features & Benefits

- Auto switching baud rate, 300 ~ 115200 bps
- DIN-Rail mountable
- ESD Protection for the data line
- Flexible power input, +10 ~ +30 VDC

Product Warranty & Total Quality Commitment

This product is under warranty regarding defective materials for a period of one year from the date of delivery to the original purchaser. Distech Controls and its supplier are ISO 9001 registered companies. Distech Controls' products provide both the contractor and the end user with the flexibility of using “best-of-breed” products in system design.

Available Models

PDIID-BACNETREPX0

BACnet MS/TP repeater
- Extend the range of your BACnet network by 4000 ft
- Augment an attenuated signal to add extra devices to your channel

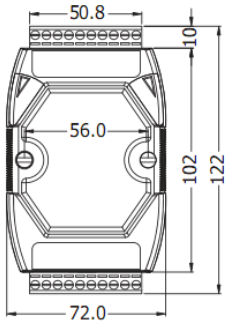
Related Products

Power Supplies

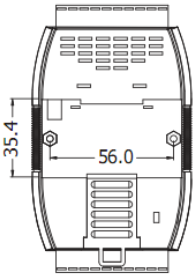
07PWS-DINKA52F — 24 V_{DC}/1.04 A, 25 W Power Supply with Din-Rail Mounting

07PWS-GPSU06U6 — 24 V_{DC}/0.25 A, 6 W Power Supply with wall plug

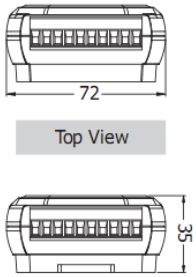
Product Specifications



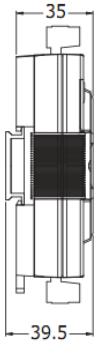
Front View



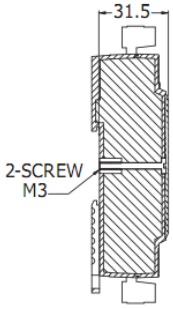
Back View



Top View / Bottom View



Din-Rail Mounting Bracket



Side View

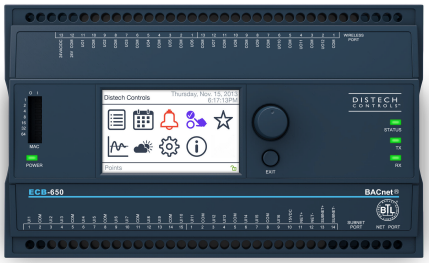
Power	
Voltage:	+10 VDC to +30 VDC (non-isolated)
Power Consumption	2.16 W
Environmental	
Operating Temperature:	-25°C to 75°C; -13°F to 167°F
Storage Temperature:	-30°C to 75°C; -22°F to 167°F
Relative Humidity:	10 to 90%, non-condensing
Enclosure	
Material:	Plastic (Fire Retardant materials UL 94-VO)
Color:	Grey
Dimensions (W x H x D):	2.83" x 4.80" x 1.38" (72mm x 122mm x 35mm)
Installation:	DIN-Rail
Interface	
Input:	1 RS-485 Channel: Data+, Data-
Output:	1 RS-485 Channel: Data+, Data-
Wiring:	07CBL-BACNET
Transfer Distance:	Max. 1,200 m @ 9.6kbps; Max 400 m @ 115.2 kbps
Max. Devices supported:	256
Speed:	300 to 115200 bps (self-tuning)
LED Indicators:	Power/Communication
Electromagnetic Compatibility	
CE:	EN 55022:1998+A1:200 Class A EN 61000-3-2:2000 Class A EN 61000-3-3:1995+A1:2001 EC 55024:1998+A1:2001
FCC:	FCC Part 15 Class A

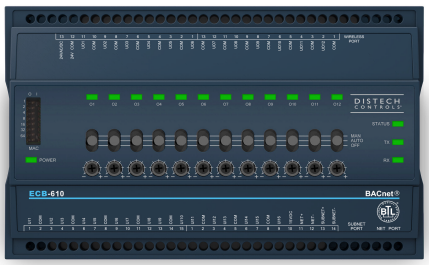
All materials and manufacturing processes comply with the RoHS directive RoHS✓.

Specifications subject to change without notice.

ECB-600 Series

BACnet B-AAC 28-Point Programmable Controllers





Overview

The ECB-600 Series controllers are microprocessor-based programmable controllers designed to control various building automation applications such as air handling units, chillers, boilers, pumps, cooling towers, and central plant applications. This series supports up to two ECx-400 Series I/O extension modules.

This controller uses the BACnet® MS/TP LAN communication protocol and is BTL®-Listed as BACnet Advanced Application Controllers (B-AAC).

Features & Benefits

- Flexible inputs and outputs support all industry-standard HVAC unitary applications
- Rugged hardware inputs and outputs eliminate the need for external protection equipment
- Models available with HOA switches and potentiometers are ideal for equipment testing or commissioning
- An optional full-color backlit display with jog dial provides direct access to a wide range of controller functions
- Supports EC-*gfx*Program, making Building Automation System programming effortless
- Open-to-Wireless™ ready, supporting a wide variety of wireless sensors and switches and helping to reduce installation costs
- Supports the Allure™ Series Communicating Sensors, providing intelligent sensing and environmental zone control

Model Selection

Example: ECB-*600*

Series	Model	Options
ECB-	***600***: 28 Points, 15Vdc Power Supply, 16 UI, 12 UO	***UUKL:*** UL 864, 10th Edition UUKL and California State Fire Marshal Listed[1]
	610: 28 Points, 15Vdc Power Supply, 16 UI, 12 UO, HOA	
	650: 28 Points, 15Vdc Power Supply, 16 UI, 12 UO, Color Display	

1. The UL 864 UUKL Listed Smoke Control Equipment is used only in Distech Controls' UUKL smoke control system. For detailed specifications, requirements and procedures for installing and operating UUKL Listed equipment refer to the Distech Controls' UUKL Smoke Control documentation.

Recommended Applications

Model	ECB-600 / 610 / 650	ECB-600 UUKL
Air Handling Unit	■	■
Multi-Zone Application	■	
Chiller	■	
Boiler	■	
Cooling Tower	■	
Central Plant	■	
Exhaust Fan		■

BACnet Objects List

BACnet Objects

Calendar Objects	2
Events per calendar	45
Schedule Objects	10
Special events per schedule	10
PID Loop Objects	30
Input Objects (AI, BI, MSI)[1]	68[2]
Output Objects (AO, BO)[1]	12[3]
Alarm Notification Classes	5

1. Supports object internally-generated alarms (intrinsic reporting).
2. This consists of Hardware Inputs, Allure Series Communicating Sensor Inputs, and Open-to-Wireless Inputs.
3. This consists of Hardware Outputs.

Commandable Objects[1]

BV Objects	20
MSV Objects	20
AV Objects	35

Non-Commandable Objects

BV Objects	55
MSV Objects	55
AV Objects	115

1. Supports object internally-generated alarms (intrinsic reporting).

Product Specifications

Power Supply Input

Voltage Range	24VAC/DC; ±15%; Class 2
Frequency Range	50/60Hz
Overcurrent Protection	Field replaceable fuse
Fuse Type	3.0A
Power Consumption ECB-600 / ECB-610	22 VA typical plus all external loads[1], 65 VA max.
Power Consumption ECB-650	25 VA typical plus all external loads[1], 68 VA max.

1. External loads must include the power consumption of any connected modules such as an Allure Series Communicating Sensor. Refer to the respective module's datasheet for related power consumption information.

Communications

Communication Bus	BACnet MS/TP
BACnet Profile	B-AAC[1]
EOL Resistor	Built-in, jumper selectable
Baud Rates	9600, 19 200, 38 400, or 76 800 bps
Addressing	Dip switch or with an Allure EC-Smart-Vue Series Communicating Sensor

1. Refer to Distech Controls' Protocol Implementation Conformity Statement for BACnet.

Subnetwork

Communication	RS-485
Cable	Cat 5e, 8 conductor twisted pair
Connector	RJ-45
Connection Topology	Daisy-chain

Room Devices Support

Maximum combined number of devices per controller	12[1]
Allure EC-Smart-Vue Series	Up to 12
Allure EC-Smart-Comfort Series (not supported by UUKL)	Up to 6
Allure EC-Smart-Air Series (not supported by UUKL)	Up to 6

1. A controller can support a maximum of 2 Allure sensor models equipped with a CO_2 sensor. Any remaining connected sensors must be without a CO_2 sensor.

Hardware

Processor	STM32 (ARM Cortex™ M3) MCU, 32 bit
CPU Speed	72 MHz
Applications Memory	1 MB Non-volatile Flash
Storage Memory	2 MB Non-volatile Flash

RAM Memory	96 kB RAM
Real Time Clock (RTC)	Built-in Real Time Clock with rechargeable battery Network time synchronization is initially required
RTC Battery	20 hours charge time, 20 days recharge time Up to 500 charge/discharge cycles
Green LEDs	Power status & LAN Tx
Orange LEDs	Controller status & LAN Rx
Communication Jack	BACnet 1/8" (3.5mm) stereo audio jack

I/O Extension Modules (ECx-400 Series)

Communication	RS-485
Number of I/O extension modules per controller	Up to 2, in daisy-chain configuration

Wireless Receiver

Communication Protocol	EnOcean wireless standard[1]
Number of Wireless Inputs[2]	28
Supported Wireless Receivers	Refer to the Open-to-Wireless Application Guide
Cable	Telephone cord
Connector	4P4C modular jack
Length (maximum)	2m (6.5ft)

1. Available when an optional external Wireless Receiver module is connected to the controller. Refer to the Open-to-Wireless Application Guide for a list of supported EnOcean wireless modules.
2. Some wireless modules may use more than one wireless input from the controller.

Mechanical

Dimensions (H × W × D) ECB-600 / 610	4.7 × 7.7 × 2.03” (119.38 × 195.58 × 51.47 mm)
Dimensions (H × W × D) ECB-650	4.7 × 7.7 × 2.55” (119.38 × 195.58 × 64.68 mm)
Shipping Weight ECB-600 / 610	1.17lbs (0.53 kg)
Shipping Weight ECB-650	1.28lbs (0.58 kg)
Enclosure Material[1]	FR/ABS
Enclosure Rating	Plastic housing, UL94-5VB flammability rating Plenum rating per UL1995
Installation	Direct DIN-rail mounting or wall mounting through mounting holes (see figure above for hole positions)

1. All materials and manufacturing processes comply with the RoHS directive and are marked according to the Waste Electrical and Electronic Equipment (WEEE) directive

Environmental

Operating Temperature	32°F to 122°F (0°C to 50°C)
Storage Temperature	-4°F to 122°F (-20°C to 50°C)
Relative Humidity	0 to 90% Non-condensing

Standards and Regulation

CE Emission	EN61000-6-3: 2007; A1:2011
CE Immunity	EN61000-6-1: 2007
FCC	Compliance with FCC rules part 15, subpart B, class B
UL Listed (CDN & US)	UL916 Energy management equipment
UL 864	UL 864, 10th Edition, UUKL Listed Smoke Control Equipment (ECB-600 UUKL model only)[1]
California State Fire Marshal Listing	CSFM: 7300-2187:0100 (ECB-600 UUKL model only) [1]
CEC Appliance Database	Appliance Efficiency Program[2]

1. For detailed specifications regarding the ECB-600 UUKL model, refer to the Distech Controls UUKL Smoke Control Design Guide.
2. California Energy Commission’s Appliance Efficiency Program: The manufacturer has certified this product to the California Energy Commission in accordance with California law.

ECB-650 Display

Display Type	Backlit-color LCD
Display Resolution	400 W x 240 H pixels (WQVGA)
Effective Viewing Area (W × H)	2.4 × 1.4” (61.2 × 36.7mm) diagonal: 2.8” (71mm)
Menu Navigation	Jog dial turn, select navigation with Exit button

Universal Inputs (UI)

General

Input Type	Universal; software configurable
Input Resolution	16-Bit analog / digital converter
Power Supply Output	15VDC; maximum 320mA

Contact

Type	Dry contact

Counter

UI1 to UI4:

Type	SO output compatible
Maximum Frequency	50Hz maximum
Minimum Duty Cycle	10milliseconds On / 10milliseconds Off

UI5 to UI10:

Type	Dry contact
Maximum Frequency	1Hz maximum
Minimum Duty Cycle	500ms On / 500ms Off

0 to 10VDC

Range	0 to 10VDC (40kΩ input impedance)

0 to 5VDC

Range	0 to 5VDC (high input impedance)

0 to 20mA

Range	0 to 20mA
	249Ω jumper configurable internal resistor

Resistance/Thermistor

Range	0 to 350 KΩ
Supported Thermistor Types	Any that operate in this range

Pre-configured Temperature Sensor Types:

Thermistor	10KΩ Type 2, 3 (10KΩ @ 77ºF; 25ºC)
Platinum	Pt1000 (1KΩ @ 32ºF; 0ºC)
Nickel	RTD Ni1000 (1KΩ @ 32ºF; 0ºC) RTD Ni1000 (1KΩ @ 69.8ºF; 21ºC)

Universal Outputs (UO)

General

Output Type	Universal; software configurable
Output Resolution	10-bit digital to analog converter
Output Protection	Built-in snubbing diode to protect against back-EMF, for example when used with a 12VDC relay Output is internally protected against short circuits
Load Resistance	Minimum 200 Ω for 0-10VDC and 0-12VDC outputs Maximum 500 Ω for 0-20mA output
Auto-reset fuse	Provides 24VAC over voltage protection

0 or 12VAC (On/Off)

Range	0 or 12VDC
Source Current	Maximum 60 mA at 12VDC (minimum load resistance 200Ω)

PWM

Range	Adjustable period from 2 to 65 seconds
Thermal Actuator Management	Adjustable warm up and cool down time

Floating

Minimum Pulse On/Off Time	500 milliseconds
Drive Time Period	Adjustable

0 to 10VDC

Range	0 to 10VDC
Source Current	Maximum 60 mA at 10VDC (minimum load resistance 200Ω)

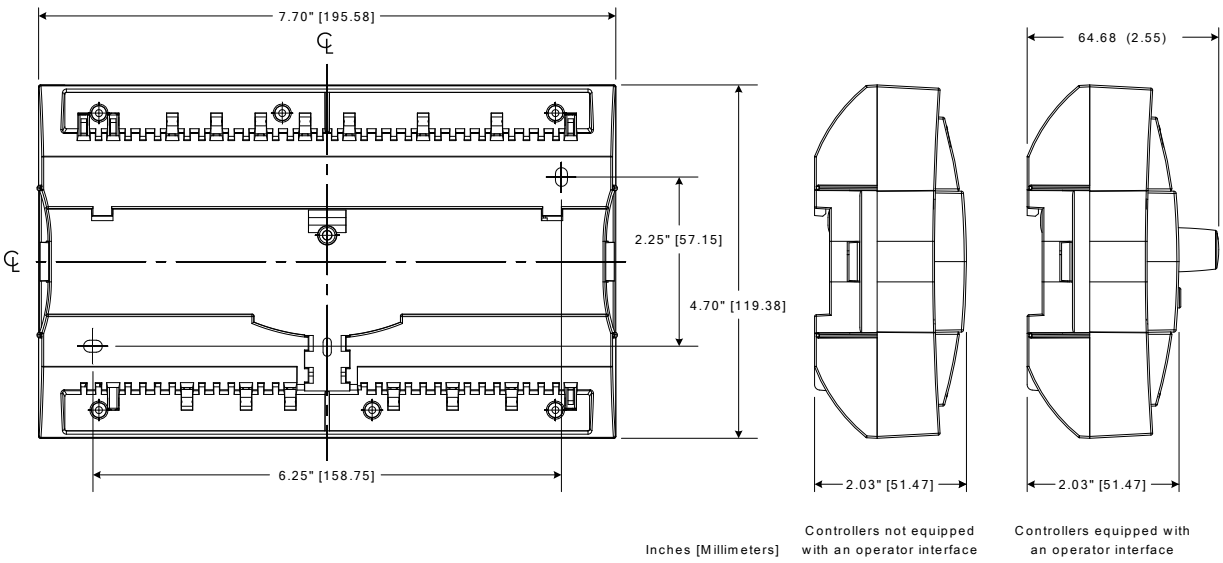
0 to 20mA

Range	0 to 20mA
Type	Current source (jumper configurable)

HOA

Hand-Off-Auto switch	When equipped. Supervision allows control logic to read the current HOA switch and potentiometer settings
Threshold	Configurable
Potentiometer Voltage Range	0 to 12.5VDC

Dimensions



Inches [Millimeters]

Controllers not equipped with an operator interface

Controllers equipped with an operator interface

ECB Series BACnet® Controllers

Figure 1: From left to right: ECB-650 with operator interface, ECB-410 with HOA, ECB-203

Product Description

This document describes the hardware installation procedures for the ECB Series BACnet controllers.

The Distech Controls ECB Series controllers are designed to control and monitor various HVAC equipment such as roof top units, air handling units as well as chillers, boilers, and central plant applications. Moreover, these controllers are suitable for any lighting control and power measurement applications. This product line includes the following controllers: ECB-203, ECB-300, ECB-400 Series, ECB-600 Series.

For controllers equipped with an operator interface (ECB-x50 models), refer to the ECL-x50 and ECB-x50 Series Controller User Guide for how to use the this interface.

The ECB-600 Series are compatible with the IO Extension Module product line, which includes the following modules: ECx-400, ECx-410, and ECx-420 (refer to the ECx-400 series IO Extension Module Hardware Installation Guide).

Each controller uses the BACnet® MS/TP LAN communication protocol.

This document describes the hardware installation procedures for the following controllers: ECB-203, ECB-300, ECB-400 Series, and ECB-600 Series controllers only.

- ☐ These controllers are all built on a similar platform, but have different numbers of inputs and outputs. Moreover, each individual model has different amounts of digital and/or universal outputs. For more information on the specific layout and functionality of each controller, please refer to their individual datasheets.
- ☐ The following controllers are housed in small enclosures: ECB-203 Series and ECB-300 Series.
- ☐ The following controllers are housed in large enclosures: ECB-400 Series and ECB-600 Series.

General Installation Requirements

For proper installation and subsequent operation of the device, pay special attention to the following recommendations:

- ☐ It is recommended that the controller(s) be kept at room temperature for at least 24 hours before installation to allow any condensation that may have accumulated due to low temperature during shipping/storage to evaporate.
- ☐ Upon unpacking, inspect the contents of the carton for shipping damages. **Do not install a damaged device.**
- ☐ The device is designed to operate under environmental conditions that are specified in its datasheet.
- ☐ Ensure proper ventilation of the device and avoid areas where corroding, deteriorating or explosive vapors, fumes or gases may be present.
- ☐ Allow for proper clearance around the device's enclosure and wiring terminals to provide easy access for hardware configuration and maintenance.
- ☐ When installing in an enclosure, select one that provides sufficient surface area to dissipate any heat generated by the device and by any other devices installed in the enclosure. A metal enclosure is preferred. If necessary, provide active cooling for the enclosure.
- ☐ Orient the controller with the ventilation slots and power supply/output terminal block connectors towards the top to permit proper heat dissipation.
- ☐ The device's plastic enclosure has a back plate that is separable from the front plate allowing the back plates (with the connectors) to be shipped directly to the installation site while all the engineering is done in the office.
- ☐ The device's datasheet specifies the power consumption (amount of heat generated), the operating temperature range, and other environmental conditions the device is designed to operate under.
- ☐ Ensure that all equipment is installed according to local, regional, and national regulations.
- ☐ Do not drop the device or subject it to physical shock.
- ☐ If the device is used and/or installed in a manner not specified by Distech Controls, the functionality and the protection provided by the device may be impaired.

Any type of modification to any Distech Controls product will void the product's warranty

Take special care to keep the front and back plate aligned when separating and joining them.

Before installation of the Wireless Receiver, verify that local communication regulations allow the installation of wireless devices and available frequencies to be supported in your area. Refer to the Open-to-Wireless™ Application Guide for more information.

Take reasonable precautions to prevent electrostatic discharge to the device when installing, servicing or during operation. Discharge accumulated static electricity by touching one's hand to a well-grounded object before working with the device.

Device Markings (Symbols)

Certain markings (symbols) can be found on the controller and are defined as follows:

Symbol	Description
	CE marking: the device conforms to the requirements of applicable EC directives.
	Products must be disposed of at the end of their useful life according to local regulations.
	Read the Hardware Installation Guide for more information.
	UL marking: conforms to the requirements of the UL certification.
	FCC marking: This device complies with FCC rules part 15, subpart B, class B.
	Warning Symbol: Significant information required. Refer to the Hardware Installation Guide.
	Alternating Current
	Direct Current

General Wiring Recommendations

Risk of Electric Shock: Turn off power before any kind of servicing to avoid electric shock.

- ☐ All wiring must comply with electrical wiring diagrams as well as national and local electrical codes.
- ☐ To connect the wiring to a device, use the terminal connectors. Use a small flat screwdriver to tighten the terminal connector screws once the wires have been inserted (strip length: 0.25'' (6 mm), maximum tightening torque 0,4 Nm (3.45 in-lb)).
- ☐ Comply with all network and power supply guidelines outlined in the Network Guide.
- ☐ Always use unshielded cabling with a minimum Category 5 (CAT5) cable for ethernet communications.
- ☐ Keep wiring separate according to their function and purpose to avoid any ambient noise transmission to other wires. Use strapping to keep these wires separated. For example, keep power, hazardous voltage, SELV, PELV, network, and input wiring separate from each other.
- ☐ The board connectors accept wires or flat cables ranging from 22 to 14AWG (0.644 to 1.630mm diameter) per pole. However, power cables must be between 18 and 14AWG (1.024 to 1.630mm diameter).
- ☐ Keep all wires away from high speed data transmission cables (for example, Ethernet, etc.).
- ☐ Do not connect the universal inputs, analog/digital outputs or common terminals to earth or chassis ground (unless stated otherwise).
- ☐ Keep input and output wiring in conduits, trays or close to the building frame if possible.

Controller Dimensions & Components

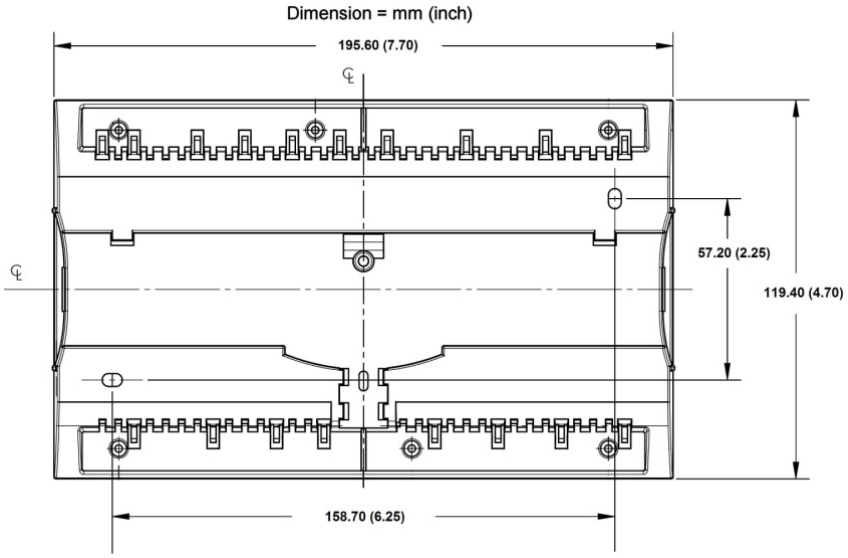


Figure 2: Rear view of large enclosure

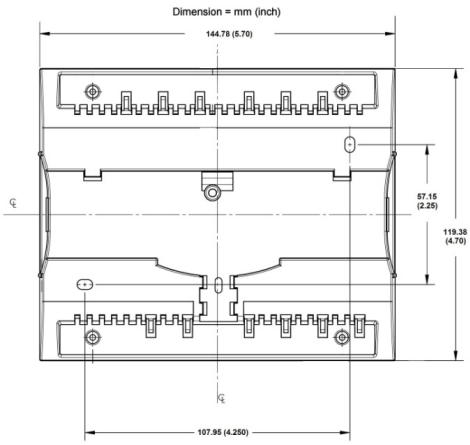


Figure 3: Rear view of small enclosure

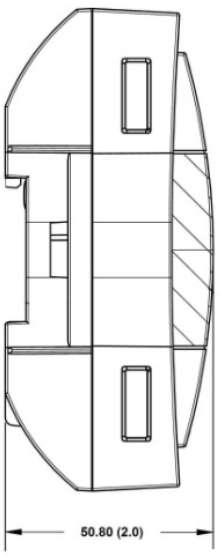
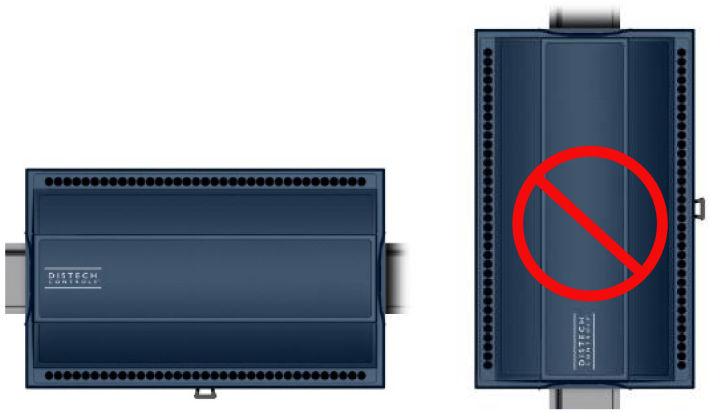


Figure 4: Side view of large and small enclosure

Mounting Instructions

The controllers can be mounted on a DIN rail to speed up the installation procedure. They are also equipped with two mounting holes 0.25” x 0.165” (6.35mm x 4.191mm). The controllers can be mounted in a panel or on a wall by using appropriate screw types (use sheet metal, thread forming, or self-tapping screws accordingly).

The controller’s mounting orientation must be horizontal with controller’s back attached to a vertical wall surface.



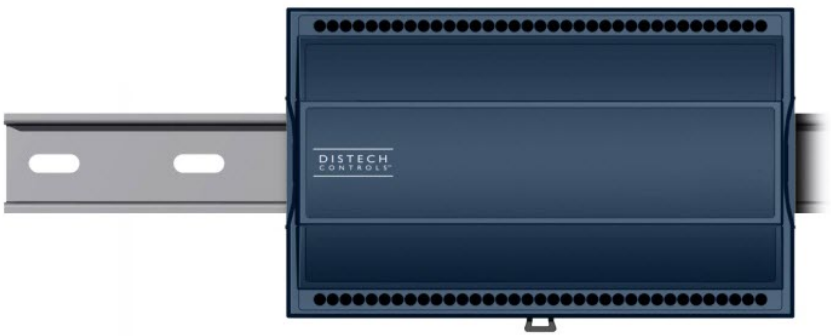
Horizontal Mounting Position:
Required for DIN rail mounting
Required for wall mounting

Vertical Mounting Position:
Is Forbidden

Figure 5: Permitted Mounting Positions

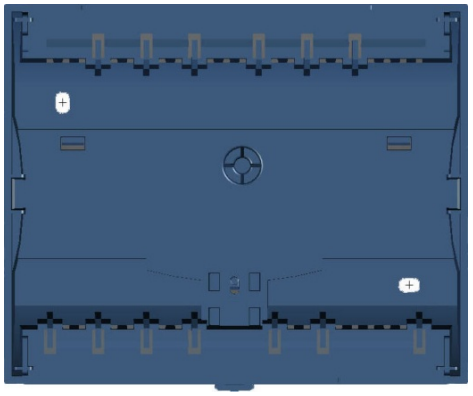
DIN Rail-Mounted Installation

1. Ensure the DIN rail is properly mounted on the wall.
2. Simply clip controller onto the DIN rail.



Wall-Mounted Installation

3. Open the enclosure by separating the front and back plate while pressing on the side clips.
4. Use the back plate’s mounting holes to mark the location of any holes that need to be drilled.
5. Drill the holes.
6. Clean the surface and mount the controller using the appropriate screw types.



Power Wiring

Voltage: 24VAC/DC; ± 15%, Class 2

This is a Class 2 Product. Use a Class 2 transformer only (rated at 100VA or less at 24VAC) to power the controller(s).

The Network Guide provides extensive information and requirements for powering a controller that uses a BACnet network for communications. It can be downloaded from our website.

It is recommended to wire only one controller per 24VAC transformer.

If only one 24VAC transformer is available, determine the maximum number of controllers that can be supplied using the following method to determine the required power transformer capacity:

- ☐ Add up the maximum power consumption of all controllers including external loads and multiply this sum by 1.3.
- ☐ If the resulting number is higher than 100VA, use multiple transformers.

Use an external fuse on the 24VAC side (secondary side) of the transformer, as shown below, to protect all controllers against power line spikes.

Maintain consistent polarity when connecting controllers and devices to the transformer. One terminal on the secondary side of the transformer must be connected to the building's ground. All 24V COM terminals of all controllers and peripherals throughout the BACnet MS/TP network must be connected to the grounded transformer terminal as shown below. This ensures that the 24V COM terminals of all devices connected to any BACnet MS/TP bus in the building are at the same potential.

It is recommended to use a separate transformer for each ECB-600 series controller and for each of its associated IO Extension Module (ECx-400s). Note that the figures below show how controller power wiring can be daisy-chained if the application permits.
One terminal on the secondary side of each of these transformers must be connected to the building's ground and to the respective controller's or IO Extension Modules' 24V COM terminal.

A mechanical ground is unacceptable: Do not use a pipe, conduit, or duct work for a ground. The power supply must have a dedicated ground wire that comes from the main electrical supply panel.

Failure to maintain consistent polarity throughout the entire network will result in a short circuit and/or damage to the controller!
The COM terminals of the controller are internally wired to the 24V COM terminal of the power supply. Connecting a peripheral or another controller to the same transformer without maintaining polarity between these devices will cause a short circuit.

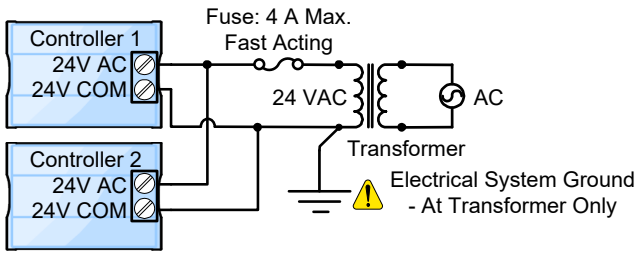


Figure 6: Power wiring – AC

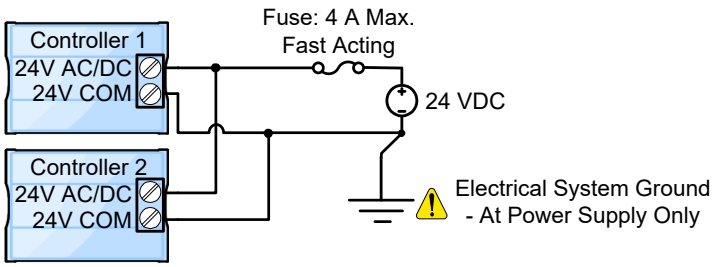


Figure 7: Power wiring – DC

Jumper Identification and Configuration

Controllers have the following onsite configurable jumpers.

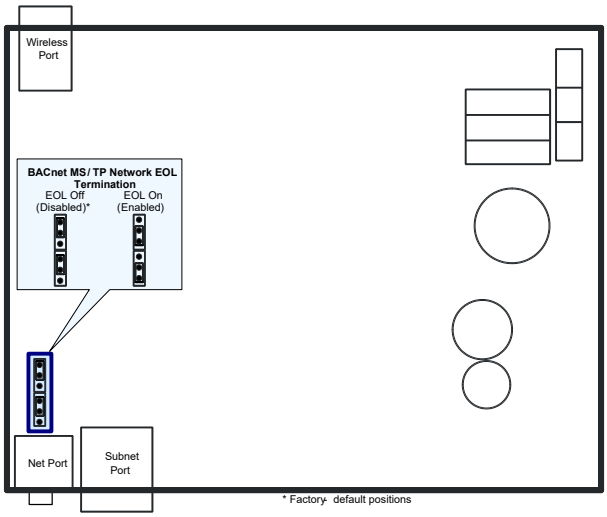


Figure 8: ECB-203 Controller Jumper Locations

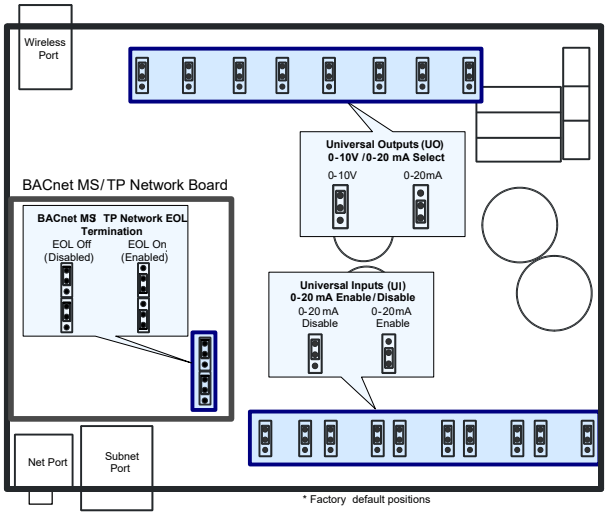


Figure 9: ECB-300 Controller Jumper Locations

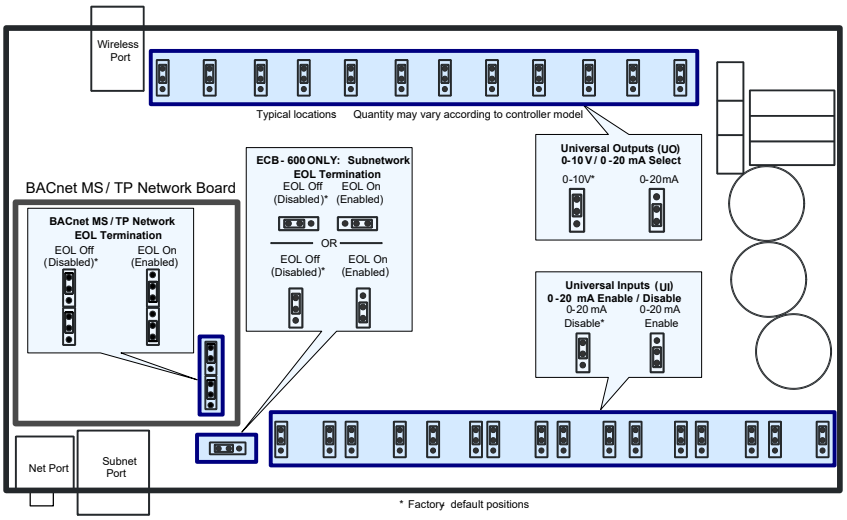


Figure 10: ECB-400 Series and ECB-600 Series Controller Jumper Locations

Input Wiring

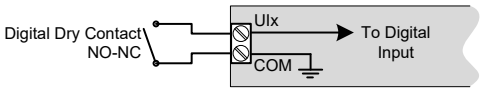
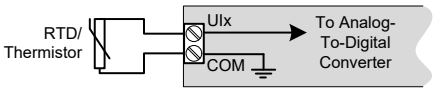
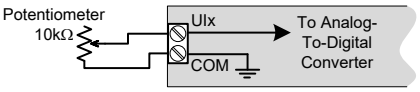
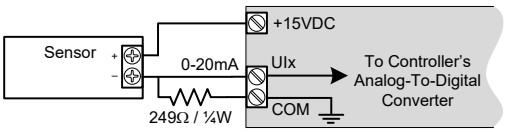
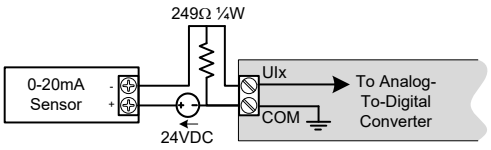
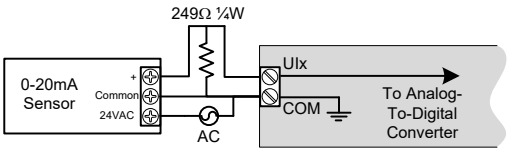
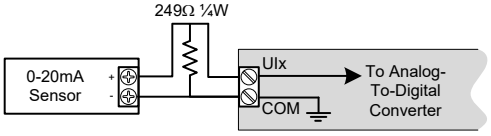
Before connecting a sensor to the controller, refer to the installation guide of the equipment manufacturer.

- ☐ For a wire length less than 75' (23m), either a shielded or unshielded 18AWG wire may be used.
- ☐ For a wire up to 200' (61m) long, a shielded 18AWG wire is recommended.
- ☐ The shield of the wire should be grounded on the controller side only and shield length should be kept as short as possible.

Table 1 shows the ECB-203, ECB-300, ECB-400, and ECB-600 Series controller pulse and current input jumper support. Table 2 shows the available universal input (UIx) wiring methods.

Controller	Fast and Slow Pulse Inputs support		Current Input Jumper support:
	50Hz: 10ms minimum ON/OFF (Fast Pulse)	1Hz: 500ms minimum ON/OFF (Slow Pulse)	0 to 10VDC / 0 to 20mA
ECB-203	None	UI1 to UI6	None
ECB-300	UI1 to UI4	UI5 to UI10	Yes; see *Table 2*
ECB-400 Series	UI1 to UI4	UI5 to UI12	
ECB-600 Series	UI1 to UI4	UI5 to UI16	

Table 1: Controller Input Support

Sensor Input Type	Input Connection Diagram
☐ Dry Contact input.	
☐ RTD input (for example, 1000Ω). ☐ Thermistor Input (for example, 10kΩ type II and III).	
☐ Resistive input, (for example, use with 10kΩ and 100kΩ potentiometers).	
ECB-**203 Series:** ☐ 0 to 20mA input used with a 2-wire, 0 to 20mA sensor powered by the controller's internal 15VDC power supply.	
ECB-**203 Series:** ☐ 0 to 20mA input used with a 2-wire, 0 to 20mA sensor powered by an external 24VDC power supply.	
ECB-**203 Series:** ☐ 0 to 20mA input used with a 3-wire, 0 to 20mA sensor powered by an external 24VAC power supply.	
ECB-**203 Series:** ☐ 0 to 20mA input used with a sensor powered by its own power source.	

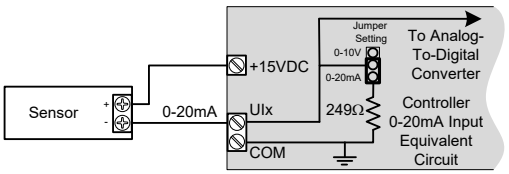
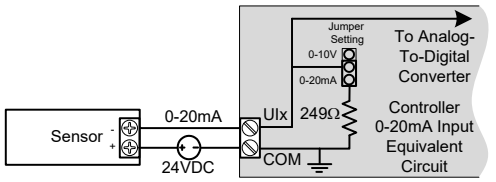
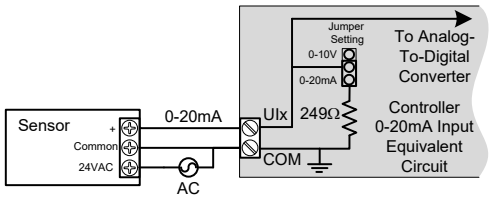
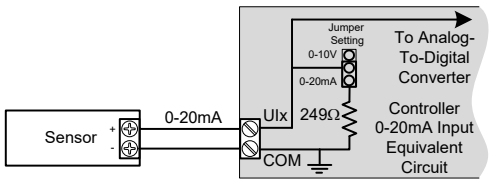
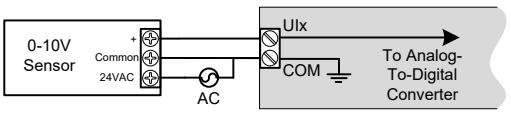
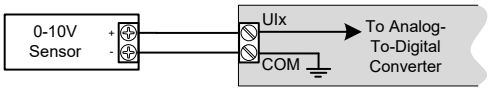
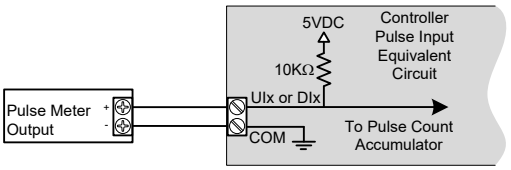
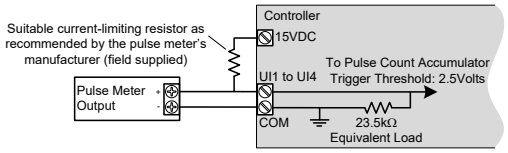
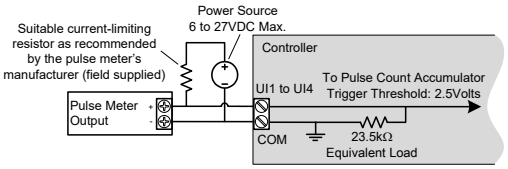
Sensor Input Type	Input Connection Diagram
ECB-**300,** ECB-**400, and** ECB-**600 Series:** ☐ 0 to 20mA input used with a 2-wire, 0 to 20mA sensor powered by the controller's internal 15VDC power supply. ☐ For jumper location, see Jumper Identification and Configuration.	
ECB-**300,** ECB-**400, and** ECB-**600 Series:** ☐ 0 to 20mA input used with a 2-wire, 0 to 20mA sensor powered by an external 24VDC power supply. ☐ For jumper location, see Jumper Identification and Configuration.	
ECB-**300,** ECB-**400, and** ECB-**600 Series:** ☐ 0 to 20mA input used with a 3-wire, 0 to 20mA sensor powered by an external 24VAC power supply. ☐ For jumper location, see Jumper Identification and Configuration.	
ECB-**300,** ECB-**400, and** ECB-**600 Series:** ☐ 0 to 20mA input used with a sensor powered by its own power source. ☐ For jumper location, see Jumper Identification and Configuration.	
☐ Voltage input used with a 3-wire 0 to 10VDC or 0 to 5VDC sensor powered by an external 24VAC power supply.	
☐ Voltage input used with a 0 to 10VDC or 0 to 5VDC sensor powered by its own power source.	
☐ **Slow Pulse – Internal supply**: 2-wire pulse meter for ECB-203, ECB-300, ECB-400, and ECB-600 Series controllers ☐ Connect the pulse input according to the figure for a pulse meter that can pull-down a +5VDC supply with a 10KΩ pull-up resistor (internal supply type). ☐ Refer to Table 1 for more information on Controller Input Support	
☐ **Fast Pulse – Internal supply:** 2-wire pulse meter for ECB-300, ECB-400, and ECB-600 Series controllers ☐ Connect the pulse input according to the figure for a pulse meter that requires more than 5VDC to operate using **built in controller power source** from 6VDC to 15VDC maximum. ☐ Refer to Table 1 for more information on Controller Input Support	
☐ **Fast Pulse – External supply**: 2-wire pulse meter for ECB-300, ECB-400, and ECB-600 Series controllers ☐ Connect the pulse input according to the figure for a pulse meter that requires more than 5VDC to operate using an **external power source** from 6VDC to 27VDC maximum. ☐ Refer to Table 1 for more information on Controller Input Support	

Table 2: Input Wiring

Output Wiring

Before connecting an output device (actuator, relay, etc.) to the controller, refer to the datasheet and installation guide of the equipment manufacturer.

- ☐ For a wire length less than 75' (23m) long, either a shielded or unshielded 18AWG wire may be used.
- ☐ For a wire length up to 200' (61m) long, a shielded 18AWG wire is recommended.
- ☐ The shield of the wire should be grounded on the controller side and the shield length should be kept as short as possible.
- ☐ For relay outputs (DOx); select appropriately-sized wiring suitable to the current load.
- ☐ To measure the state of a triac output, an external load must be connected.

Table 3 shows the ECB-203, ECB-300, ECB-400, and ECB-600 Series controller Output and Jumper support. Table 4 shows the available output wiring methods.

Controller	Digital (Triac) Outputs	Universal Outputs	Jumper 0 to 10VDC/0 to 20mA
ECB-203	5	3	
ECB-300	0	8	■
ECB-4x0 Series	0	12	■
ECB-4x3 Series	8	4	■
ECB-600 Series	0	12	■

Table 3: Controller Output Support

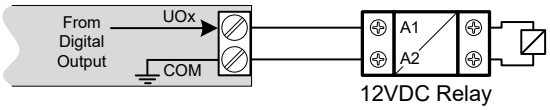
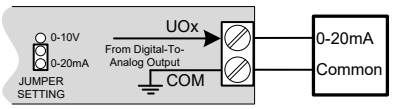
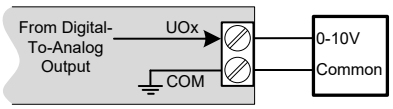
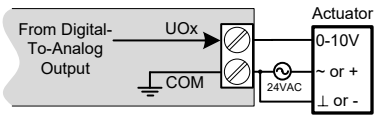
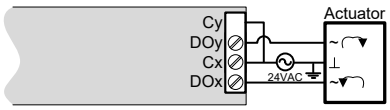
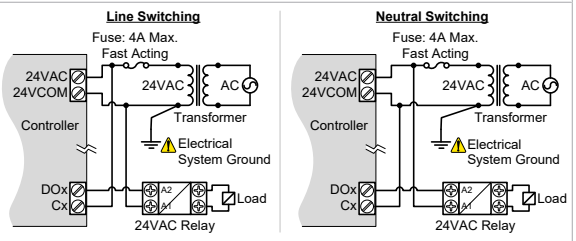
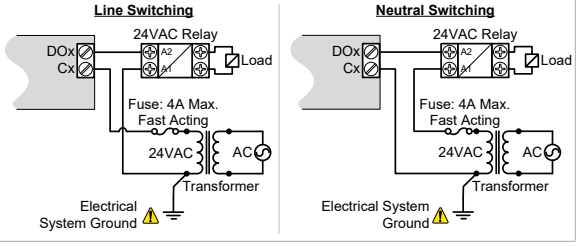
Control Output Type	Output Designation	Output Connection Diagram
☐ Discrete 0 or 12VDC digital, Pulse, or PWM output controlling a 12VDC relay. Maximum 60 mA (minimum load resistance 200Ω).	UOx	
☐ Current 0 to 20mA universal output & jumper configuration ☐ For ECB-300, ECB-400, and ECB-600 Series only ☐ For jumper location, see Jumper Identification and Configuration.	UOx	
☐ Linear 0 to 10VDC digital to analog output.	UOx	
☐ 0 to 10VDC voltage output controlling an analog actuator that is powered by an external 24VAC power source.	UOx	
☐ 24VAC externally-powered triac output controlling a floating actuator[1]. ☐ Ensure that the external power supply is grounded as shown.	DOx	
☐ 24VAC **controller**-powered triac output controlling a relay[1] with line and neutral switching. ☐ Ensure that the transformer's secondary winding is grounded as shown.	DOx	
☐ 24VAC **externally**-powered triac output controlling a relay[1] with line and neutral switching. ☐ Ensure that the transformer's secondary winding is grounded as shown.	DOx	

Table 4: Output Wiring

1. Maximum output current for all digital triac outputs is 0.5A continuous or 1A @ 15% duty cycle for a 10-minute period.

Subnet-Wiring

The subnet is used to connect a range of Allure Series Communicating Sensors:

- The Allure EC-Smart-Vue Series sensor is a communicating room temperature sensor with backlit display graphical menus and VAV balancing capabilities.
- The Allure EC-Smart-Comfort and Allure EC-Smart-Air Communicating Sensors are a range of communicating room temperature sensors.

Connect the Allure Series to the controller's **Subnet Port** with a standard Category 5e Ethernet patch cable fitted with RJ-45 connectors. Refer to the Network Guide for extensive information and requirements for the connection of the Allure Series. It contains information about network topology and length, cable type, setting the Subnet ID, etc. It can be downloaded from the *www.distech-controls.com* website. See also the Hardware Installation Guide supplied with the Allure Series.

If you make your own patch cable, see the Allure Series Hardware Installation Guide.

Protect the controller's connector from being pulled on when a cable to the Allure Series is connected. Create a strain-relief by looping the cable and attaching it to a solid object with a nylon tie so that a tug on the cable will not pull out the connector on the controller.

Subnet Wiring with the ECB-600 Series Controller

ECx-400 series IO Extension Modules are connected to the **SUBNET**– and **SUBNET+** terminals of the ECB-600 series controller. The Network Guide provides extensive information and requirements to implement the subnetwork for the ECx-400 series IO Extension Modules. It contains information about network length, cable type, controller addressing, etc. It can be downloaded from our website. See also the Hardware Installation Guide supplied with the ECx-400 series IO Extension Module.

Communications Wiring

The Network Guide provides extensive information and requirements to implement a BACnet MS/TP network. It contains information about network and sub network length, cable type, device addressing, etc. It can be downloaded at the *www.distech-controls.com* website. For optimal performance, use Distech Controls 24 AWG (0.65 mm) stranded, twisted pair shielded cable or refer to the Network Guide for cable specification. The BACnet MS/TP communication wire is polarity sensitive and the only acceptable topology is to daisy-chain the cable from one controller to the next.

As shown in BACnet MS/TP Communications Wiring:

- The first and last daisy-chained BACnet MS/TP device must have its EOL resistors enabled / installed. All other devices must have their EOL resistor disabled (default factory setting).
- When the BACnet MS/TP data bus is connected to a following device, twist data bus shields together.
- Isolate all shields with electrical tape so there is no exposed metal that can touch ground or other conductors.
- The shield of the data bus must be connected to the electrical system ground at only one point – usually at one end of the bus as shown below.
- Connect no more than 50 devices to a BACnet MS/TP data bus.

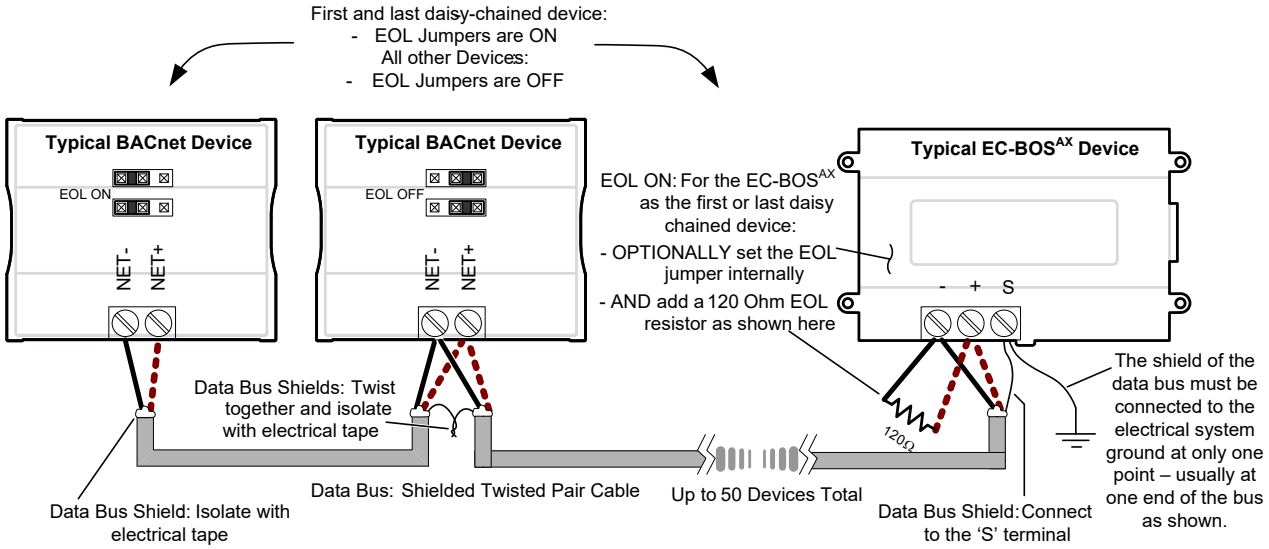


Figure 11: BACnet MS/TP Communications Wiring

If inserting multiple wires in the terminals, ensure to properly twist wires together prior to inserting them into the terminal connectors.

For more information and detailed explanations on network topology and wire length restrictions, refer to the Network Guide, which can be downloaded from our website.

Device Addressing

The Network Guide provides extensive information and requirements to implement a BACnet MS/TP network. It contains information about network planning and MAC Address numbering schemes. It can be downloaded from the *www.distech-controls.com* website.

The MAC Address must be set according to your network planning document by setting the DIP switch located under the cover or when this DIP switch is set to 0 (all off), the MAC address can be set by connecting an Allure EC-Smart-Vue Series Communicating Sensor to the controller as shown in Step 5 of *Setting the Communicating Sensor Subnet ID* in the following section. An example of how to set the device's MAC Address DIP switch is shown below.

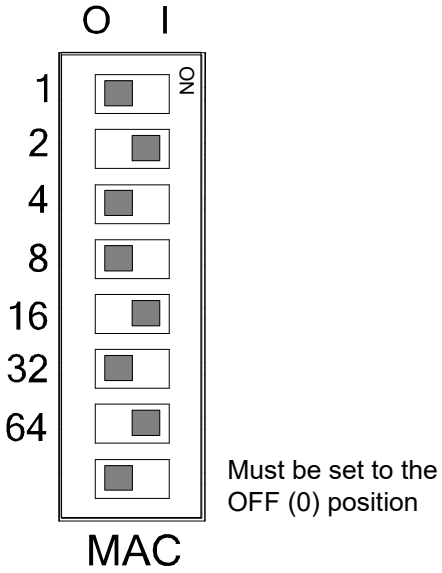


Figure 12: Typical Device MAC Address DIP Switch Set to 82

The address is the sum of the numbers set to ON. For example, if the second (2), fifth (16), and seventh (64) DIP switches are set to ON, the device MAC address is 82 (2 + 16 + 64). Only addresses from 1 to 127 are recommended to be used.

The controller must be power cycled after the MAC address DIP switch has been changed. The device instance (DevID) is automatically configured when setting the MAC Address to prevent network address conflict. The following formula is used to determine the device instance:

```
DevID = 364 * 1000 + MAC
```

For example:

```
MAC: 37
DevID = 364 * 1000 + 37 = 364037
```

The Device Instance can be changed once the controller has been commissioned through the network management software interface.

The Device Instance can be changed once the controller has been commissioned through the network management software interface or through the color LCD screen's Settings menu (when equipped).

Temporary Network Access

To temporarily access the BACnet MS/TP LAN for commissioning and maintenance purposes, connect a BACnet MS/TP Adaptor to the NET PORT audio plug. Wire a standard ⅛" (3.5 mm) three-conductor stereo jack as shown below.

The BACnet MS/TP Adaptor must have an electrically-isolated RS 485 port. Otherwise a ground path from the BACnet network will be made through the computer that will disrupt BACnet network communications.

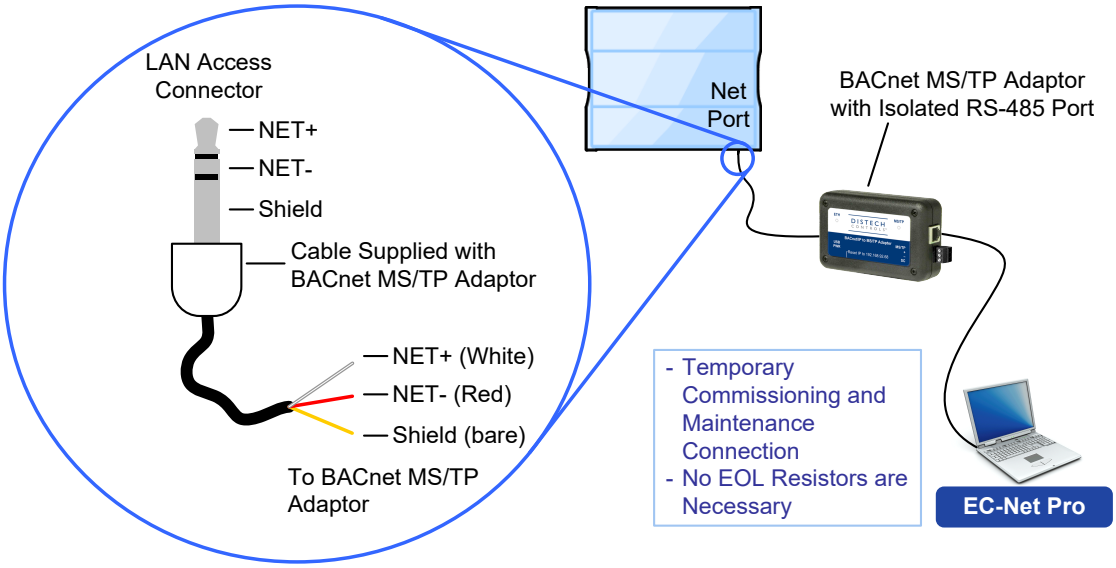


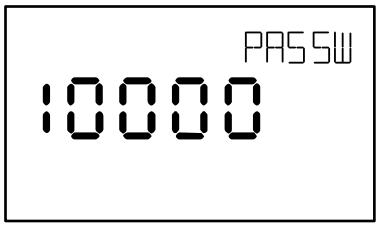
Figure 13: ⅛" (3.5 mm) Stereo Jack Connection for a Portable Router

Setting the Communicating Sensor Subnet ID

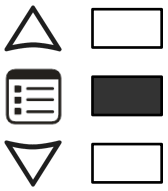
ECB Series controllers can be commissioned with an Allure EC-Smart-Vue Series Communicating Sensor by connecting it to the controller as shown in the wiring diagram at the end of this guide.

The default Subnet ID for an Allure EC-Smart-Vue Series Communicating Sensor is 1. To commission an ECB Series controller, the sensor's Subnet ID must be set to 1. If the sensor's Subnet ID has been set to another value (for example, the display flashes error code 1 with the Bell icon when the sensor is connected to a controller for commissioning), change the Subnet ID to 1 as follows:

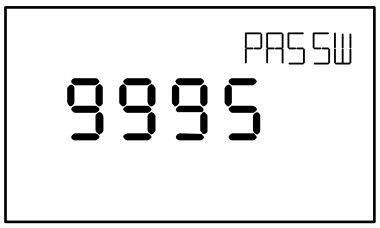
1. Connect an an Allure EC-Smart-Vue Series Communicating Sensor to the controller with a Cat 5e patch cable. Wait for the Bell icon and the number 1 to flash on the display.
2. Press and hold the Menu button for 5 seconds to enter the password menu. 10000 is shown on the display.



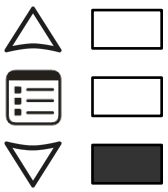
Screen Timeout: 15 seconds



3. Press the down button to set the number to 9995 (this is the default password).

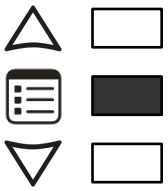


Screen Timeout: 15 seconds

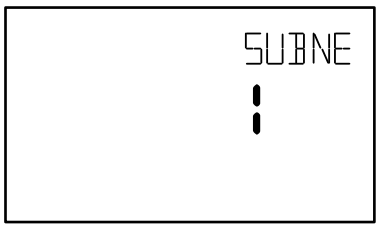


4. Press the Menu button to submit the password. Upon submitting the password, the GEN CFG menu appears on the display.

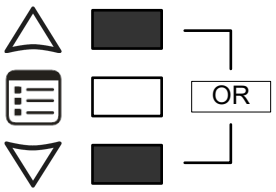
Screen Timeout: 30 seconds



5. Press the down button once to enter the **GEN CFG** submenu.
6. Press the Menu button several times until SUBNET ID appears on the display. The current controller's Subnet ID is shown.



Screen Timeout: 30 seconds



7. Use the up and down buttons to set the controller's Subnet ID to **1**. *Tip*: Hold down either the up or down button to fast-advance the display value.
8. Press the Menu button once.
9. Press and hold the Menu button for 5 seconds to exit the configuration menu.

The an Allure EC-Smart-Vue Series Communicating Sensor can now be used to go from one ECB series controller to the next for commissioning purposes.

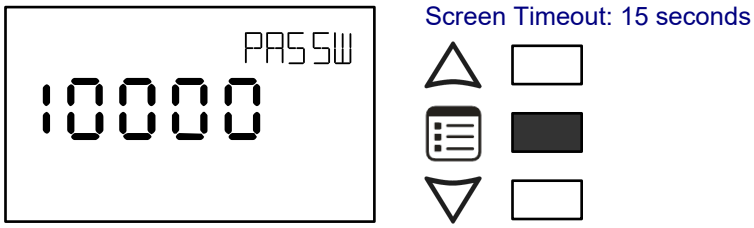
Commissioning ECB-Series Controllers

When using an Allure EC-Smart-Vue Series Communicating Sensor for commissioning ECB Series controllers (the DIP switch located on the faceplate is set to 0 (all off) and before code is downloaded to the controller from EC-*gfx*Program), connect an Allure EC-Smart-Vue Series Communicating Sensor to the controller with its Subnet ID set to 1.

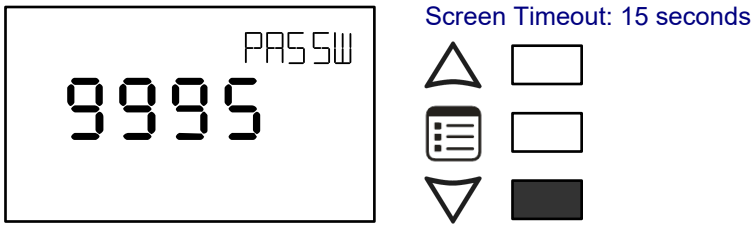
During commissioning, the sensor is used to set the controller's BACnet® MAC Address.

Set the connected controller's MAC Address as follows:

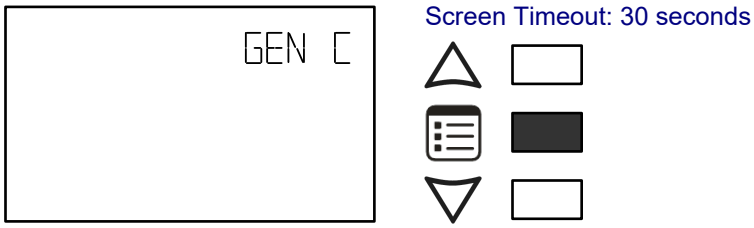
1. Connect an Allure EC-Smart-Vue Series Communicating Sensor to the controller with a Cat 5e patch cable. Wait for the display to show the room temperature.
2. Press and hold the Menu button for 5 seconds to enter the password menu. 10000 is shown on the display.



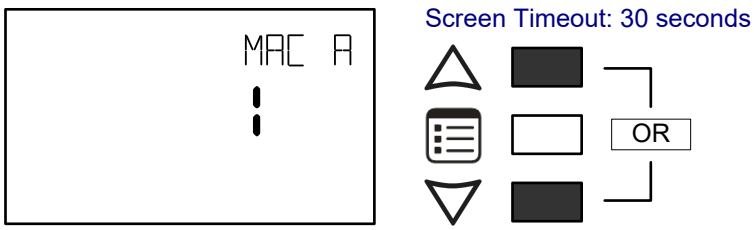
3. Use the down button to set the number to 9995 (this is the default password).



4. Press the **Menu** button to submit the password. Upon submitting the password, the **GEN CFG** menu appears on the display.



5. Press the down button once to enter the **GEN CFG** submenu. The **MAC ADDRESS** menu is shown with the current controller's BACnet MAC Address.



6. Use the up and down buttons to set the controller's MAC Address. Only addresses from 1 to 127 are recommended to be used.
7. Press the Menu button once to apply the value.
8. Press and hold the Menu button for 5 seconds to exit the configuration menu.

Once the controller's network is operational, the controller can be programmed with EC-*gfx*Program. For each Allure EC-Smart-Vue Series Communicating Sensor, set its Subnet ID number to the block number of its associated ComSensor block in EC-*gfx*Program. This is done in the sensor's **GEN CFG** menu under **SUBNET ID**.

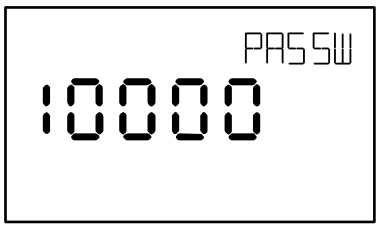
Setting the BAUD Rate (optional – ECB series controllers only)

By default, the BAUD rate for the controller is set to automatically detect the current communication BAUD rate of the connected BACnet MS/TP network (AUTO). This is the preferred setting for a controller. However, at least one controller on the BACnet MS/TP network data bus must have its BAUD rate set. The preference is to set the building controller's BAUD rate (if present). Otherwise, set the BAUD rate on one controller that will set the BAUD rate for all other controllers (to act as the master for setting the BAUD rate).

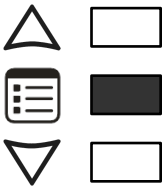
When the BAUD rate is set to AUTO, the controller cannot initiate any communication until it has detected the baud rate of the BACnet MS/TP network. If all controllers on the BACnet MS/TP network are set to AUTO, then all controllers will not communicate.

Set the connected controller's BAUD rate as follows:

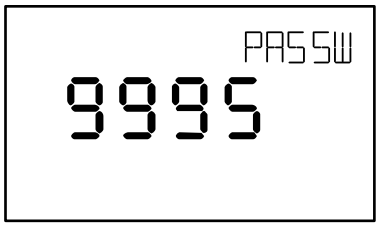
1. Connect an Allure EC-Smart-Vue Series Communicating Sensor sensor to the controller with a Cat 5e patch cable. Wait for the display to show the room temperature.
2. Press and hold the Menu button for 5 seconds to enter the password menu. 10000 is shown on the display.



Screen Timeout: 15 seconds

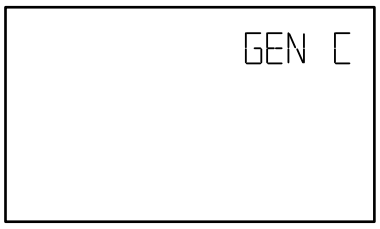


3. Use the down button to set the number to 9995 (this is the default password).

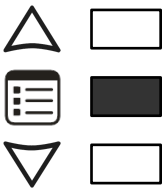


Screen Timeout: 15 seconds

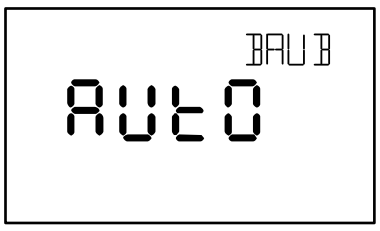
4. Press the **Menu** button to submit the password. Upon submitting the password, the **GEN CFG** menu appears on the display.



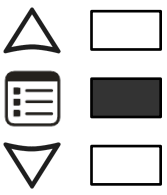
Screen Timeout: 30 seconds



5. Press the down button once to enter the **GEN CFG** submenu.
6. Use the Menu button several times until **BAUD RATE appears on the display**. The current controller's BAUD rate is shown.



Screen Timeout: 30 seconds



7. Use the up and down buttons to set the controller's Baud rate. The **AUTO** setting detects and uses the current baud rate being used by the BACnet MS/TP network.
8. Press the Menu button once to apply the value.
9. Press and hold the Menu button for 5 seconds to exit the configuration menu.

Wireless Installation

When connected to a Wireless Receiver, controllers can receive input signals from a wide selection of wireless devices. Compatible wireless devices include temperature sensors, duct sensors, window/door contacts and light switches. These devices are easy to install, and can be mounted on a wide range of building materials.

Before connecting any wireless equipment to the controller, refer to the Open-to-Wireless Application Guide.

Connecting the Wireless Receiver

The Wireless Receiver is connected to the controller using a 2m (6.5ft) telephone cable with 4P4C modular connectors at both ends. Do not exceed this cable length. The Wireless Receiver's telephone socket is located inside the device. To locate it, open the Wireless Receiver by separating its front and back plates.

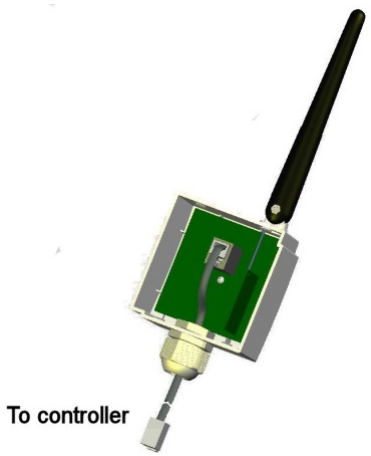


Figure 14: Location of the Wireless Receiver's telephone socket

Connecting to the Controller's Wireless Port

Each controller has a wireless port in which one end of the Wireless Receiver's telephone cable plugs in.

Strain relief and Terminal Block Cover

In certain jurisdictions, terminal block covers are required to meet local safety regulations. Strain reliefs and terminal block covers are available for controllers housed in large enclosures and are used to relieve tension on the wiring and conceal the controllers' wire terminals. Strain reliefs and terminal block covers are optional and are sold as peripherals.

Prior to connecting all wires, it is recommended to install the strain relief. Three screws are provided for its installation under the bottom part of the enclosure. Tie wraps can then be used to group wires together and attach them securely to the strain relief in an effort to relieve undue tension. If necessary, the terminal block cover can then be clipped on to the strain relief as shown below.

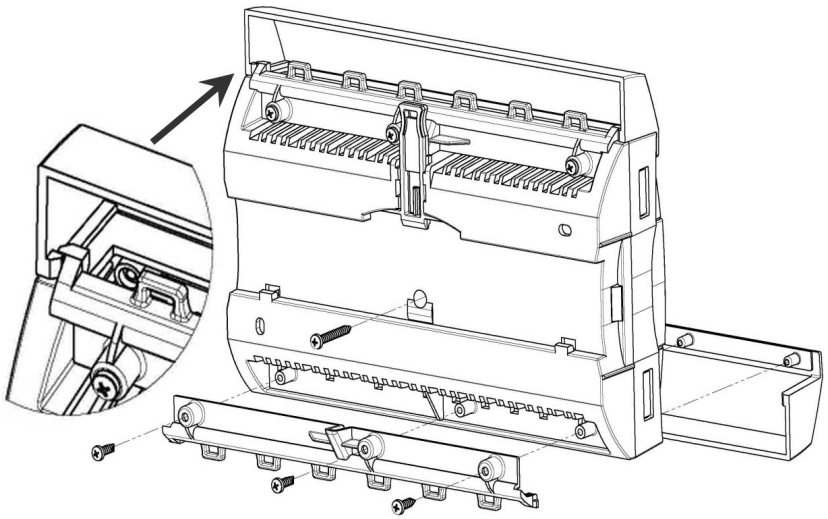


Figure 15: Large enclosure strain relief and terminal block cover installation

Maintenance

Unplug device before any kind of servicing.

The device requires minimal maintenance, but it is important to take note of the following:

- If it is necessary to clean the outside of the device, use a dry cloth.
- Using a torque limited screw driver set to 0.4 Nm (3.54 in-lb), retighten terminal connector screws annually to ensure the wires remain securely attached.

Disposal

The Waste Electrical and Electronic Equipment (WEEE) Directive set out regulations for the recycling and disposal of products. The WEEE2002/96/EG Directive applies to standalone products, for example, products that can function entirely on their own and are not a part of another system or piece of equipment.

For this reason Distech Controls products are exempt from the WEEE Directive. Nevertheless, Distech Controls products are marked with the WEEE symbol  , indicating devices are not to be thrown away in municipal waste.

Products must be disposed of at the end of their useful life according to local regulations and the WEEE Directive.

North American Emissions Compliance

United States

Changes or modifications not expressly approved by Distech Controls could void the user's authority to operate the equipment.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential and commercial installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Canada

This Class (B) digital apparatus meets all the requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la Classe (B) respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

Typical Air Handling Unit Application Wiring Diagram

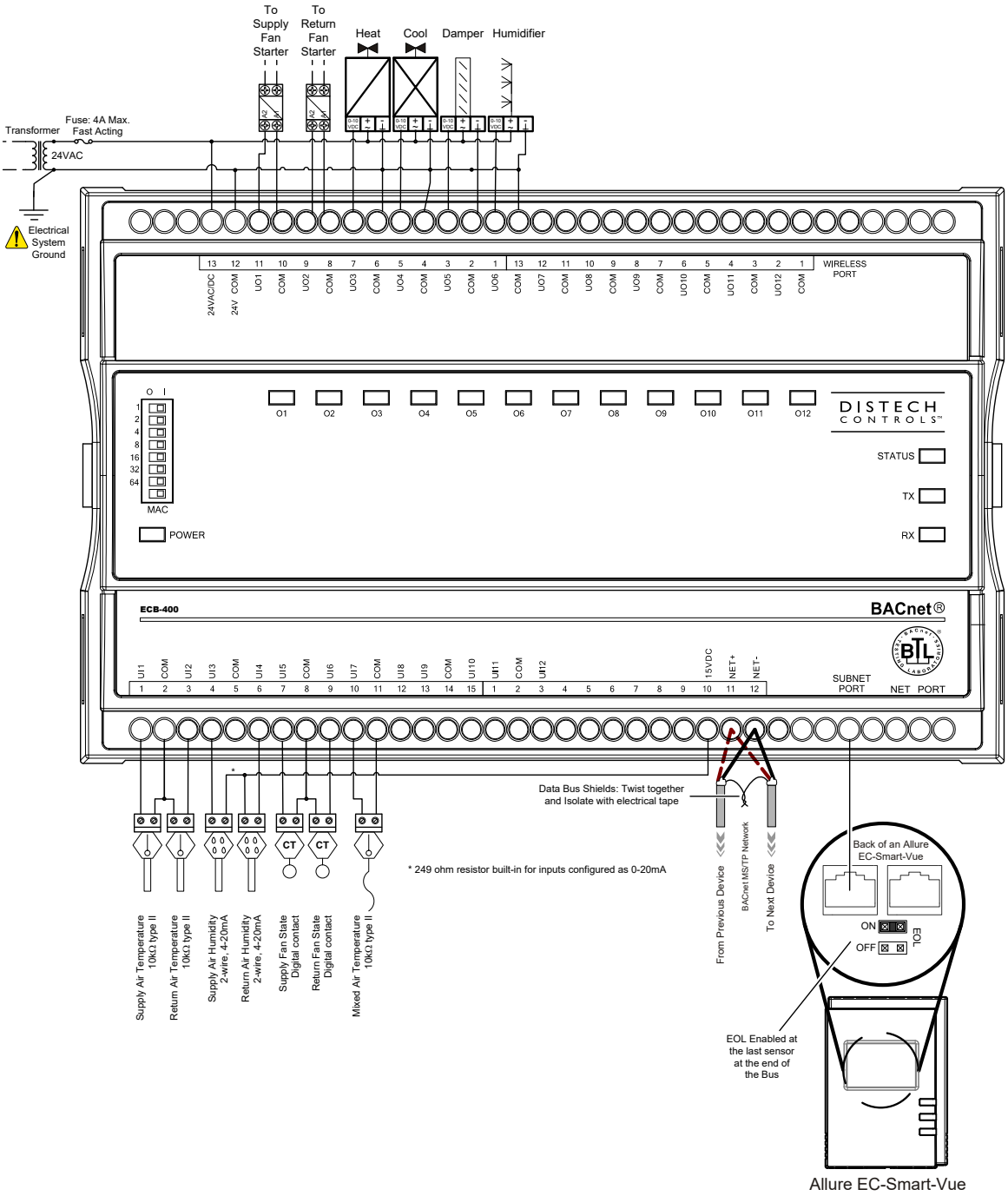


Figure 16: Typical Power and Network Connections with an Allure EC-Smart-Vue sensor

Although only the Allure EC-Smart-Vue is shown here, any other Allure Series Communicating Sensor can be connected to the subnet port in this manner. Refer to the sensor's corresponding Hardware Installation Guide for more details.

Troubleshooting Guide

Controller is powered but does not turn on

Fuse has blown	Disconnect the power. Check the fuse integrity. Reconnect the power.
Power supply polarity	Verify that consistent polarity is maintained between all controllers and the transformer. Ensure that the 24VCOM terminal of each controller is connected to the same terminal on the secondary side of the transformer. See *Power Wiring.*

Controller cannot communicate on a BACnet MS/TP network

Absent or incorrect supply voltage	1. Check power supply voltage between 24VAC ±15% and 24VCOM pins and ensure that it is within acceptable limits. 2. Check for tripped fuse or circuit breaker.
Overloaded power transformer	Verify that the transformer used is powerful enough to supply all controllers.
Network not wired properly	Double check that the wire connections are correct.
Absent or incorrect network termination	Check the network termination(s).
Max Master parameter	Configure the maximum number of master device on the MS/TP network in all devices to the controller's highest MAC address used on the MS/TP trunk.
There is another controller with the same MAC Address on the BACnet MS/TP data bus	Each controller on a BACnet MS/TP data bus must have a unique MAC Address. Look at the MAC Address DIP switch on the faceplate or under the cover of the controller. If it is set to 0 (all off), use an Allure EC-Smart-Vue sensor to check the MAC Address.
There is another controller with the same Device ID on the BACnet intranetwork	Each controller on a BACnet intranetwork (the entire BACnet BAS network) must have a unique Device ID. Use an Allure EC-Smart-Vue sensor to check the Device ID of each controller.

Controller communicates well over a short network, but does not communicate on large network

Network length	Check that the total wire length does not exceed the specifications of the *Network Guide*.
Wire type	Check that the wire type agrees with the specification of the *Network Guide*.
Network wiring problem	Double check that the wire connections are correct.
Absent or incorrect network termination	Check the network termination(s). Incorrect or broken termination(s) will make the communication integrity dependent upon a controller's position on the network.
Number of controllers on network segment exceeded	The number of controllers on a channel should never exceed 50. Use a router or a repeater in accordance to the *Network Guide*.
Max Master parameter	Configure the maximum number of master device on the MS/TP network in all devices to the controller's highest MAC address used on the MS/TP trunk.
There is another controller with the same MAC Address on the BACnet MS/TP data bus	Each controller on a BACnet MS/TP data bus must have a unique MAC Address. Look at the MAC Address DIP switch on the faceplate or under the cover of the controller. If it is set to 0 (all off), use an Allure EC-Smart-Vue sensor to check the MAC Address.
There is another controller with the same Device ID on the BACnet intranetwork	Each controller on a BACnet intranetwork (the entire BACnet BAS network) must have a unique Device ID. Use an Allure EC-Smart-Vue Series Communicating Sensor to check the Device ID of each controller.

I/O Extension Module cannot communicate on the subnetwork

Absent or incorrect supply voltage	1. Check power supply voltage between 24VAC ±15% and 24VCOM pins and ensure that it is within acceptable limits. 2. Check for tripped fuse or circuit breaker.
Overloaded power transformer	Verify that the transformer used is powerful enough to supply all controllers. See *Power Wiring.*
Network not wired properly	Double check that the wire connections are correct.
There is another controller with the same Subnet ID on the subnetwork	Each I/O Extension Module on the subnetwork must have a unique Subnet ID. Look at the Subnet ID DIP switch on the faceplate of each I/O Extension Module.
Network length	Check that the total wire length does not exceed the specifications in the *Network Guide.*
Wire type	Check that the wire type agrees with the specification of the *Network Guide.*
Absent or incorrect network termination	Check the network termination(s). Only the last ECx-400 I/O Extension Module must have its EOL termination set to ON. When one or more Allure EC-Smart-Vue sensors are connected to the controller, only the last sensor must have its EOL termination set to ON. See the *Network Guide*for more information.

Hardware input is not reading the correct value

Input wiring problem	Check that the wiring is correct according to this manual and according to the peripheral device's manufacturer.
Configuration problem	Using EC-gfxProgram, check the configuration of the input. Refer to the EC-gfxProgram user guide for more information.
Over-voltage or over-current at an input	An over-voltage or over-current at one input can affect the reading of other inputs. Respect the allowed voltage / current range limits of all inputs. Consult the appropriate datasheet for the input range limits of this controller.
Open circuit or short circuit	Using a voltmeter, check the voltage on the input terminal. For example, for a digital input, a short circuit shows approximately 0V DC and an open circuit shows approximately 5V DC.

Hardware output is not operating correctly

Fuse has blown (Auto reset fuse)	Disconnect the power and outputs terminals. Then wait a few seconds to allow the auto-reset fuse to cool down. Check the power supply and the output wiring. Reconnect the power.
Output wiring problem	Check that the wiring is correct according to this manual and according to the peripheral device's manufacturer.
Configuration problem	Using EC-gfxProgram, check the configuration of the input. Refer to the EC-gfxProgram user guide for more information.

0 to 10V output, 24VAC powered actuator is not moving.	Check the polarity of the 24VAC power supply connected to the actuator while connected to the controller. Reverse the 24VAC wire if necessary.

Wireless devices not working correctly

Device not associated to controller	Using EC-*gfx*Program, check the configuration of the input. Refer to the *EC-gfxProgram user guide* for more information.
Power discharge	1. Recharge device with light (if solar-powered) or replace battery (if battery-powered), 2. Ensure sufficient light intensity (200lx for 4 hours/day).
Device too far from the Wireless Receiver	Reposition the device to be within the range of the Wireless Receiver. For information on typical transmission ranges, refer to the *Open-to-Wireless Application Guide.*
Configuration problem	Using the device configuration plug-in or wizard, check the configuration of the input. Refer to the Wireless Battery-less *Sensors and Switches Solutions Guide* for more information.

Rx/Tx LEDs

RX LED not blinking	Data is not being received from the BACnet MS/TP data bus.
TX LED not blinking	Data is not being transmitted onto the BACnet MS/TP data bus.

Status LED– Normal Operation

One fast blink ●	Initialization: The device is starting up.
Fast blink continuous: ● ● ● ● ● (150ms On, 150ms Off, continuous)	Firmware upgrade in progress. Controller operation is temporarily unavailable. The new firmware is being loaded into memory. This takes a few seconds. Do not interrupt power to the device during this time.
The Status LED is always OFF	The controller is operating normally.

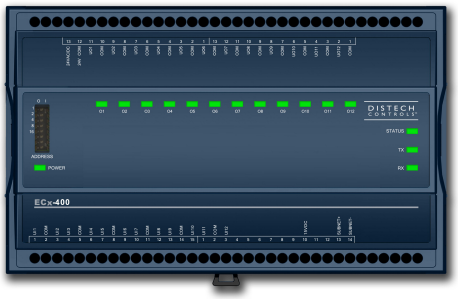
Status LED blink patterns – Repeats every 2 seconds (highest priority shown first)

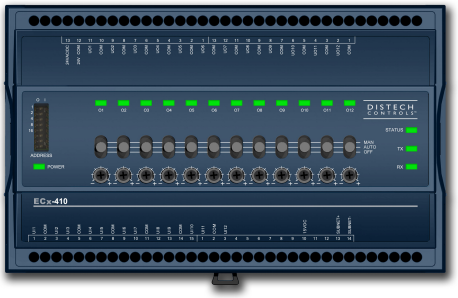
Long Long Long blink ▬ ▬ ▬ (800ms On, 300ms Off, 800ms On, 300ms Off, 800ms On)	The device has not received a BACnet token, and therefore cannot communicate on the network: Verify that the controller's MAC Address is unique on the BACnet MS/TP Data Bus – see Device Addressing. Make sure the controller's BAUD rate is the same as the BACnet MS/TP Data Bus' BAUD rate (see Setting the BAUD Rate (optional)). Verify that the Max Master is set high enough to include this controller's MAC Address (See the Network Guide).
Short Short Long blink ● ● ▬ (150ms On, 300ms Off, 150ms On, 300ms Off, 800 ms On)	Poor-quality power; The device has browned-out: The voltage at the 24VAC and 24VCOM terminals has gone below the device's acceptable limit during power up.
Short Long blink ● ▬ (150ms On, 300ms Off)	Invalid MAC address: The device's MAC address is set to zero (0) or is set to an address higher than the Max Master. See the Network Guide.

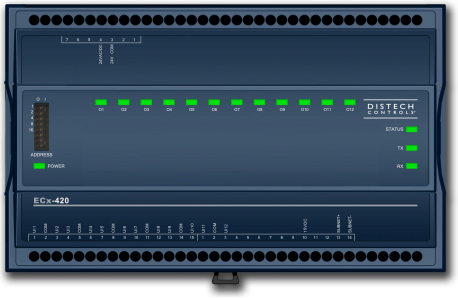
For issues with the Allure EC-Smart-Vue Series Communicating Sensor, refer to the Allure EC-Smart-Vue Series Communicating Sensor Hardware Installation Guide.

ECx-400 Series

24-Point I/O Extension Modules







Overview

The ECx-400 Series I/O Extension Modules are designed to add extra inputs and outputs to any Distech Controls ECB-600 Series controller.

Features & Benefits

- Flexible inputs and outputs support all industry-standard HVAC unitary applications
- Rugged hardware inputs and outputs eliminate the need for external protection equipment
- Models available with HOA switches and potentiometers are ideal for equipment testing or commissioning
- Supports EC-*gfx*Program, making Building Automation System programming effortless
- Supports the Allure™ Series Communicating Sensors, providing intelligent sensing and environmental zone control

Model Selection

Example: ECx-*410*

Series	Model	Options
ECx-	***400***: 24 Points, 15Vdc Power Supply, 12 UI, 12 UO	***UUKL:*** UL 864, 10th Edition UUKL and California State Fire Marshal Listed[1]
	410: 24 Points, 15Vdc Power Supply, 12 UI, 12 UO, HOA	
	420: 24 Points, 15Vdc Power Supply, 12 UI	

1. The UL 864 UUKL Listed Smoke Control Equipment is used only in Distech Controls' UUKL smoke control system. For detailed specifications, requirements and procedures for installing and operating UUKL Listed equipment refer to the Distech Controls' UUKL Smoke Control documentation.

BACnet Objects List

BACnet Objects

Input Objects (AI, BI, MSI)[1]	12[2,3]
Output Objects (AO, BO) [1]	12[4,3] (ECx-400 / 410 models)
Alarm Notification Classes[3]	5

1. Supports object internally-generated alarms (intrinsic reporting).
2. This consists of Hardware Inputs, Allure Series Communicating Sensor Inputs, and Open-to-Wireless Inputs.
3. Objects are in the connected ECB-600, ECB-610, or ECB-650 controller (master)
4. This consists of Hardware Outputs.

Product Specifications

Power Supply Input

Voltage Range	24VAC/DC; ±15%; Class 2
Frequency Range	50/60Hz
Overcurrent Protection	Field replaceable fuse
Fuse Type	3.0A
Power Consumption ECx-400 / ECx-410	22 VA typical plus all external loads[1], 50 VA max.
Power Consumption ECx-420	10 VA typical plus all external loads[1], 16 VA max.

1. External loads must include the power consumption of any connected modules such as an Allure Series Communicating Sensor. Refer to the respective module's datasheet for related power consumption information.

Communications

Communication Bus	RS-485
Baud Rates	38 400
Addressing	Dip switch

Hardware

Processor	STM32 (ARM Cortex™ M3) MCU, 32 bit
CPU Speed	64 MHz
Applications and Storage Memory	64 kB Non-volatile Flash
RAM Memory	20 kB RAM
Green LEDs	Power status & LAN Tx
Orange LEDs	Controller status & LAN Rx
Communication Jack	BACnet 1/8" (3.5mm) stereo audio jack

Mechanical

Dimensions (H × W × D)	4.7 × 7.7 × 2.03" (119.38 × 195.58 × 51.47 mm)
Shipping Weight	1.17lbs (0.53 kg)
Enclosure Material[1]	FR/ABS
Enclosure Rating	Plastic housing, UL94-5VB flammability rating Plenum rating per UL1995
Installation	Direct DIN-rail mounting or wall mounting through mounting holes

1. All materials and manufacturing processes comply with the RoHS directive and are marked according to the Waste Electrical and Electronic Equipment (WEEE) directive

Environmental

Operating Temperature	32°F to 122°F (0°C to 50°C)
Storage Temperature	-4°F to 122°F (-20°C to 50°C)
Relative Humidity	0 to 90% Non-condensing

Standards and Regulation

CE Emission	EN61000-6-3: 2007; A1:2011
CE Immunity	EN61000-6-1: 2007
FCC	Compliance with FCC rules part 15, subpart B, class B
UL Listed (CDN & US)	UL916 Energy management equipment
UL 864	UL 864, 10th Edition, UUKL Listed Smoke Control Equipment (ECx-400 UUKL model only)[1]
California State Fire Marshal Listing	CSFM: 7300-2187:0100 (ECx-400 UUKL model only) [1]
CEC Appliance Database	Appliance Efficiency Program[2]

1. For detailed specifications regarding the ECx-400 UUKL model, refer to the Distech Controls UUKL Smoke Control Design Guide.
2. California Energy Commission's Appliance Efficiency Program: The manufacturer has certified this product to the California Energy Commission in accordance with California law.

Universal Inputs (UI)

General

Input Type	Universal; software configurable
Input Resolution	16-Bit analog / digital converter
Power Supply Output	15VDC; maximum 240mA

Contact

Type	Dry contact

Counter

Type	Dry contact
Maximum Frequency	1Hz maximum
Minimum Duty Cycle	500ms On / 500ms Off

0 to 10VDC

Range	0 to 10VDC (40kΩ input impedance)

0 to 5VDC

Range	0 to 5VDC (high input impedance)

0 to 20mA

Range	0 to 20mA 249Ω external resistor wired in parallel

Resistance/Thermistor

Range	0 to 350 KΩ
Supported Thermistor Types	Any that operate in this range

Pre-configured Temperature Sensor Types:

Thermistor	10KΩ Type 2, 3 (10KΩ @ 77ºF; 25ºC)
Platinum	Pt1000 (1KΩ @ 32ºF; 0ºC)
Nickel	RTD Ni1000 (1KΩ @ 32ºF; 0ºC) RTD Ni1000 (1KΩ @ 69.8ºF; 21ºC)

Universal Outputs (UO)

General

Output Type	Universal; software configurable
Output Resolution	10-bit digital to analog converter
Output Protection	Built-in snubbing diode to protect against back-EMF, for example when used with a 12VDC relay Output is internally protected against short circuits
Load Resistance	Minimum 200 Ω for 0-10VDC and 0-12VDC outputs Maximum 500 Ω for 0-20mA output
Auto-reset fuse	Provides 24VAC over voltage protection

0 or 12VAC (On/Off)

Range	0 or 12VDC
Source Current	Maximum 60 mA at 12VDC (minimum load resistance 200Ω)

PWM

Range	Adjustable period from 2 to 65 seconds
Thermal Actuator Management	Adjustable warm up and cool down time

Floating

Minimum Pulse On/Off Time	500 milliseconds
Drive Time Period	Adjustable

0 to 10VDC

Range	0 to 10VDC
Source Current	Maximum 60 mA at 10VDC (minimum load resistance 200Ω)

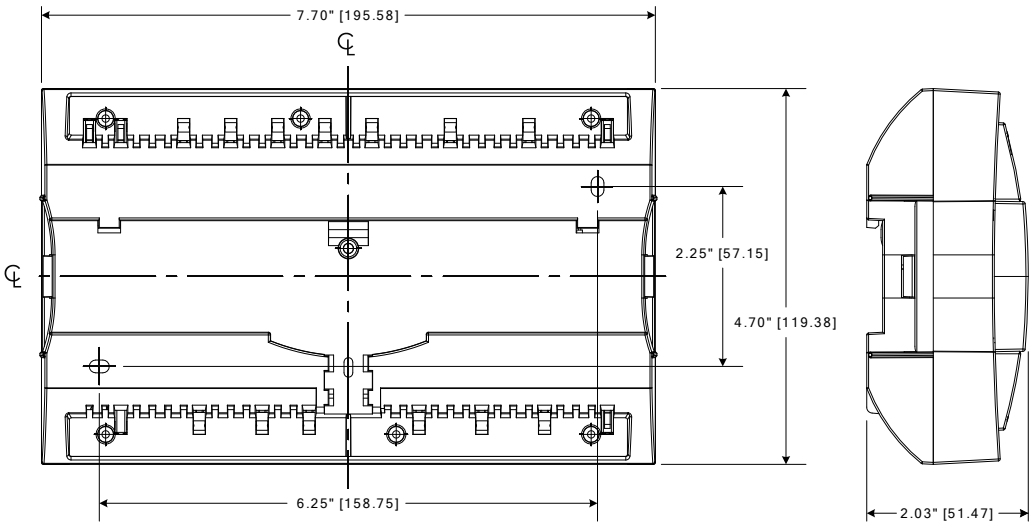
0 to 20mA

Range	0 to 20mA
Type	Current source (jumper configurable)

HOA

Hand-Off-Auto switch	When equipped. Supervision allows control logic to read the current HOA switch and potentiometer settings
Threshold	Configurable
Potentiometer Voltage Range	0 to 12.5VDC

Dimensions



Inches [Millimeters]

ECx-400 Series Extension Modules

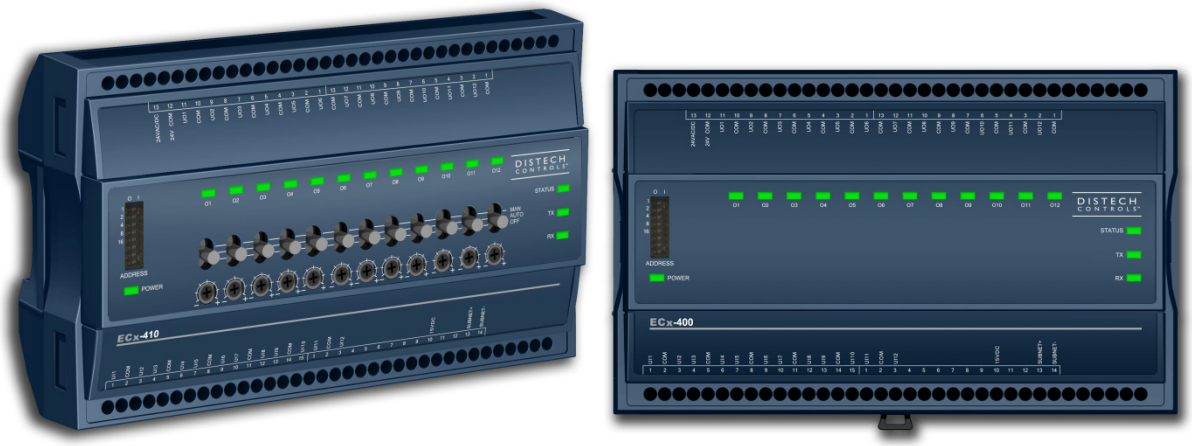


Figure 1: From left to right: enclosure with HOA switches and enclosure without HOA

Product Description

This document describes the hardware installation procedures for the ECx-400 Series I/O Extension Modules.

The Distech Controls ECL-600 and ECB-600 Series controllers product line is designed to control and monitor various HVAC equipment such as roof top units, large air handling units as well as central plant applications such as chillers and boilers. These controllers are compatible with the I/O Extension Module product line, which includes the following modules: ECx-400, ECx-410 and ECx-420.

This document describes the hardware installation procedures for the ECx-400, ECx-410 and ECx-420 I/O Extension Modules only.

- These I/O Extension Modules are all built on a similar platform, but have different numbers of inputs and outputs. Moreover, each individual model has different amounts of digital and/or universal outputs. For more information on the specific layout and functionality of each I/O Extension Module, please refer to the ECL-600 or ECB-600 datasheets.

General Installation Requirements

For proper installation and subsequent operation of each controller, pay special attention to the following recommendations:

- It is recommended that the controller(s) be kept at room temperature for at least 24 hours before installation to allow any condensation that may have accumulated due to low temperature during shipping/storage to evaporate.
- Upon unpacking the product, inspect the contents of the carton for shipping damages. **Do not install damaged controllers.**
- Avoid areas where corroding, deteriorating or explosive vapors, fumes or gases may be present.
- Allow for proper clearance around the controller's enclosure, wiring terminals, and Subnet Addressing switches to provide easy access for hardware configuration and maintenance, and to ventilate heat generated by the controller.
- Orient the controller with the ventilation slots and power supply/output terminal block connectors towards the top to permit proper heat dissipation. When installed in an enclosure, select one that provides sufficient surface area to dissipate the heat generated by the controller and by any other devices installed in the enclosure. A metal enclosure is preferred. If necessary, provide active cooling for the enclosure.
- The I/O Extension Module's datasheet specifies the power consumption (amount of heat generated), the operating temperature range, and other environmental conditions the controller is designed to operate under.
- Ensure that all equipment is installed according to local, regional, and national regulations.
- The I/O Extension Module's plastic enclosure has a back plate that is separable from the front plate allowing the back plates (with the connectors) to be shipped directly to the installation site while all the engineering is done in the office.
- Do not drop the I/O Extension Module or subject it to physical shock.
- If the I/O Extension Module is used and/or installed in a manner not specified by Distech Controls, the functionality and the protection provided by the controller may be impaired.

Any type of modification to any Distech Controls product will void the product's warranty

- Take special care to keep the front and back plate aligned when separating and joining them.
- Before installation of the Wireless Receiver, verify that local communication regulations allow the installation of wireless devices and available frequencies to be supported in your area. Refer to the Open-to-Wireless™ Solution Guide for more information.

Take reasonable precautions to prevent electrostatic discharges to the I/O Extension Module when installing, servicing or operating the I/O Extension Module. Discharge accumulated static electricity by touching one's hand to a well-grounded object before working with the I/O Extension Module.

Device Markings (Symbols)

Certain markings (symbols) can be found on the controller and are defined as:

Symbol	Description
CE	CE marking: the device conforms to the requirements of applicable EC directives.
	Double Insulation *marking*: These controllers are built using double insulation.
	Products must be disposed of at the end of their useful life according to local regulations.
	Read the Hardware Installation Guide for more information.
	For indoor use only.
c UL us LISTED	UL marking: conforms to the requirements of the UL certification.
FC	FCC marking: This device complies with FCC rules part 15, subpart B, class B.
	Warning Symbol: Significant information required. Refer to the Hardware Installation Guide.
	HIGH VOLTAGE Symbol: Direct contact will cause electrical shock or burn.
	Alternating Current
	Direct Current
L	Line
N	Neutral

General Wiring Recommendations

Turn off power before any kind of servicing.

- All wiring must comply with electrical wiring diagrams as well as national and local electrical codes.
- To connect the wiring to an I/O Extension Module, use the terminal connectors. It is recommended to remove the front plate from the back plate to facilitate the wiring process, however it is possible to do all wiring with the front and back plates together. Use a small flat screwdriver to tighten the terminal connector screws once the wires have been inserted. Careful use is recommended when tightening the screws. Screw tightening (torqueing) should never exceed 0.5 Nm or 4.4 in-lb.
- Power type cables (i.e. for power, 3-wire voltage and current inputs and outputs) should be kept apart from other types of wiring to avoid any ambient noise transmission to other wires.
- The board connectors accept wires or flat cables ranging from 22 to 14AWG (0.644 to 1.630mm diameter) per pole. However, power cables must be between 18 and 14AWG (1.024 to 1.630mm diameter).
- Do not connect the universal inputs, analog/digital outputs or common terminals to earth or chassis ground (unless stated otherwise).
- Keep all wires away from high speed data transmission cables (for example, Ethernet, etc.).
- Keep input and output wiring in conduits, trays or close to the building frame if possible.

I/O Extension Module Dimensions & Components

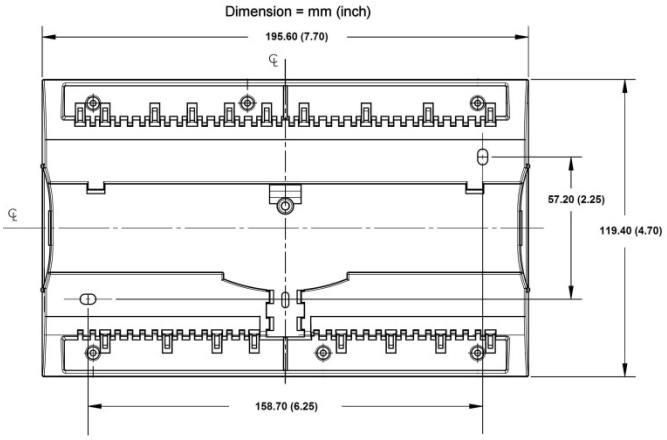


Figure 2: Rear view of large enclosure

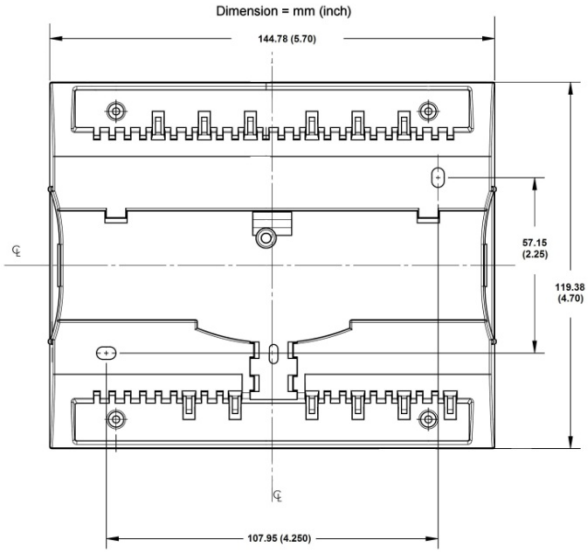


Figure 3: Rear view of small enclosure

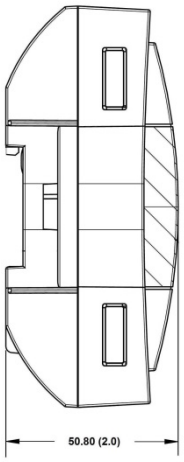


Figure 4: Side view of the large and small enclosure

Mounting Instructions

Each controller can be mounted on a DIN rail to speed up the installation procedure. They are also equipped with two mounting holes 0.25" x 0.165" (6.35mm x 4.191mm). The I/O Extension Module can be mounted in a panel or on a wall by using appropriate screw types (use sheet metal, thread forming, or self-tapping screws accordingly).

DIN Rail-Mounted Installation

1. Ensure the DIN rail is properly mounted on the wall.
2. Simply clip controller onto the DIN rail.

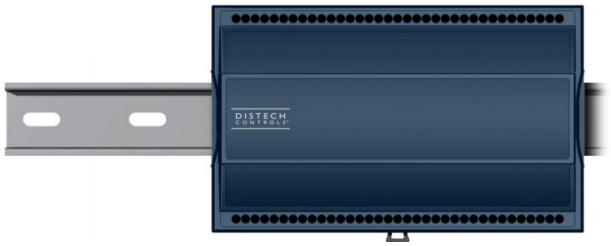


Figure 5: DIN rail-mounted controller

Wall-Mounted Installation

1. Open the I/O Extension Module by separating the front and back plate while pressing on the side clips.
2. Use the back plate's mounting holes to mark the location of any holes that need to be drilled.
3. Drill the holes.
4. Clean the surface and mount the I/O Extension Module using the appropriate screw types.

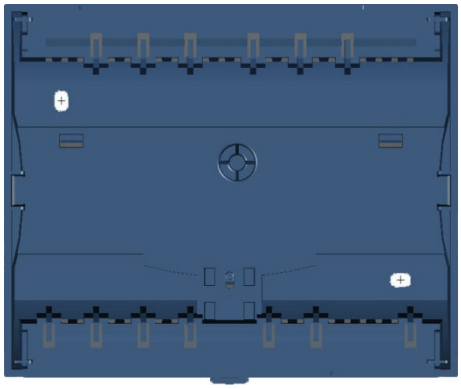


Figure 6: Wall-mounted I/O Extension Module

Power Wiring

Voltage: 24VAC/DC; ± 15%, Class 2

This is a Class 2 Product. Use a Class 2 transformer only (rated at 100VA or less at 24VAC) to power the controller(s).

The Network Guide provides extensive information and requirements for powering a controller. It can be downloaded from the www.distech-controls.com website.

It is recommended to wire only one controller per 24VAC transformer.

If only one 24VAC transformer is available, determine the maximum number of controller that can be supplied using the following method to determine the required power transformer capacity:

- Add up the maximum power consumption of all controller including external loads and multiply this sum by 1.3.
- If the resulting number is higher than 100VA, use multiple transformers.

Use an external fuse on the 24VAC side (secondary side) of the transformer, as shown in *Figure 7* and *Figure 8*, to protect all controllers against power line spikes.

Maintain consistent polarity when connecting controllers and devices to the transformer. One terminal on the secondary side of the transformer must be connected to the building's ground. All 24V COM terminals of all controllers and peripherals throughout the LAN or the Subnetwork must be connected to the grounded transformer terminal as shown in *Figure 7* and *Figure 8*. This ensures that the 24V COM terminals of all devices connected to any LAN or Subnetwork in the building are at the same potential.

A mechanical ground is unacceptable: Do not use a pipe, conduit, or duct work for a ground. The power supply must have a dedicated ground wire that comes from the main electrical supply panel.

Failure to maintain consistent polarity throughout the entire LAN or the Subnetwork will result in a short circuit and/or damage to the controller!

The COM terminals of the controller are internally wired to the 24V COM terminal of the power supply. Connecting a peripheral or another controller to the same transformer without maintaining polarity between these devices will cause a short circuit.

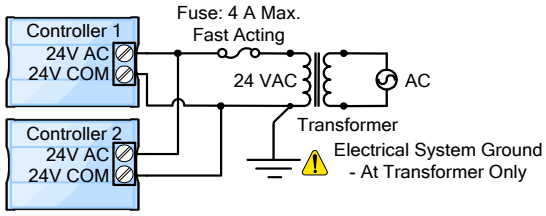


Figure 7: Power wiring – AC

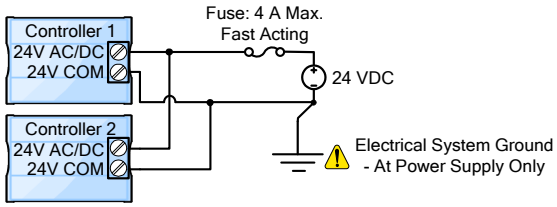


Figure 8: Power wiring – DC

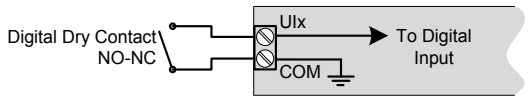
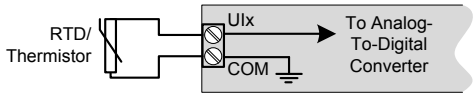
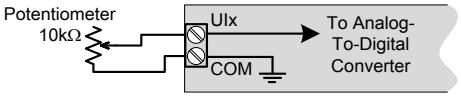
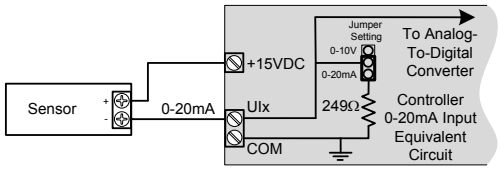
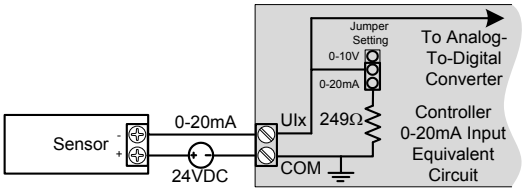
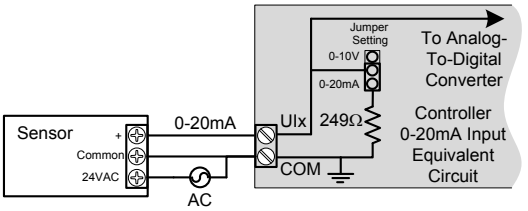
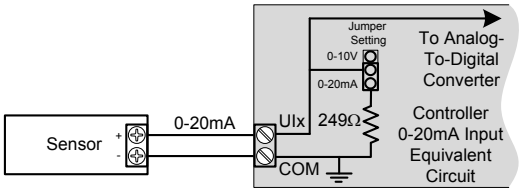
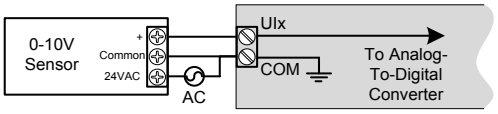
Input Wiring

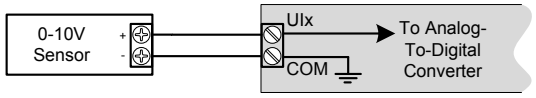
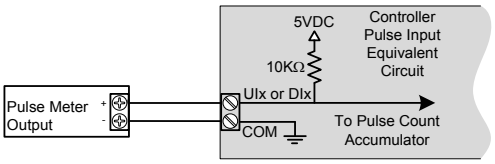
Inputs can be connected as follows. *Table 1* shows the input designation for the ECx-400 Series I/O Extension Module.

Before connecting a sensor to the controller, refer to the installation guide of the equipment manufacturer.

- For a wire length less than 75' (23m), either a shielded or unshielded 18AWG wire may be used.
- For a wire up to 200' (61m) long, a shielded 18AWG wire is recommended.
- The shield of the wire should be grounded on the controller side only and the shield length should be kept as short as possible.

Table 1: ECx IO Module Input Wiring

Sensor Input Type	ECx IO modules' Input Designation	Input Connection Diagram
- Dry Contact input. - Pulsed input.	- UIx - DIx	
- RTD input (for example, 1000Ω). - Thermistor Input (for example, 10kΩ type II and III).	- UIx	
- Resistive input, (for example, use with 10kΩ and 100kΩ potentiometers).	- UIx	
- 0 to 20mA input used with a 2-wire, 0 to 20mA sensor powered by th I/O Extension Module's 15VDC power supply.	- UIx	
- 0 to 20mA input used with a 2-wire, 0 to 20mA sensor powered by an external 24VDC power supply.	- UIx	
- 0 to 20mA input used with a 3-wire, 0 to 20mA sensor powered by an external 24VAC power supply.	- UIx	
- 0 to 20mA input used with a sensor powered by its own power source.	- UIx	
- Voltage input used with a 3-wire 0 to 10VDC or 0 to 5VDC sensor powered by an external 24VAC power supply	- UIx	

Sensor Input Type	ECx IO modules' Input Designation	Input Connection Diagram
- Voltage input used with a 0 to 10VDC or 0 to 5VDC sensor powered by its own power source.	- UIx	
- **Slow Pulse** – **Internal supply**: 2-wire pulse meter, maximum input frequency of 1Hz (500ms minimum ON/OFF) - Connect the pulse input according to the figure for a pulse meter that can pull-down a +5VDC supply with a 10KΩ pull-up resistor (internal supply type).	- UIx	

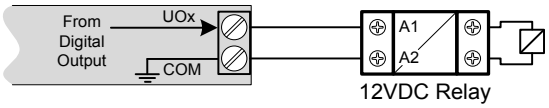
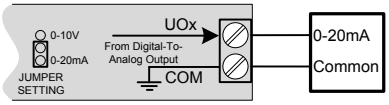
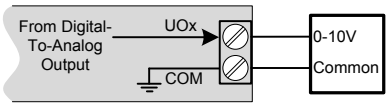
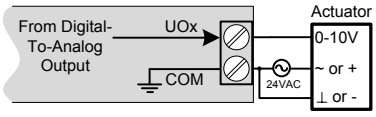
Output Wiring

Outputs can be connected as follows. *Table 2* shows the output designation for the ECx-400 Series I/O Extension Module.

Before connecting an output device (actuator, relay, etc.) to the controller, refer to the datasheet and installation guide of the equipment manufacturer.

- For a wire length less than 75' (23m) long, either a shielded or unshielded 18AWG wire may be used.
- For a wire length up to 200' (61m) long, a shielded 18AWG wire is recommended.
- The shield of the wire should be grounded on the I/O Extension Module side and the shield length should be kept as short as possible.

Table 2: ECB IO Module Output Wiring

Control Output Type	ECx IO modules' Output Designation	Output Connection Diagram
- Discrete 0 or 12VDC digital, Pulse, or PWM output controlling a 12VDC relay.	- UOx	
- Current 0 to 20mA universal output & jumper configuration	- UOx	
- Linear 0 to 10VDC digital to analog output.	- UOx	
- 0 to 10VDC voltage output controlling an analog actuator that is powered by an external 24VAC power source.	- UOx	

Subnet Wiring

The Allure Series Communicating Sensor is a communicating room temperature sensor with backlit display and graphical menus. A dipswitch is needed to identify to the Smart Comfort/Smart Air subnetwork. The Allure EC-Smart-Vue requires a menu to identify to the subnetwork. Connect the Allure Series Communicating Sensor to the controller's **Subnet Port** with a standard Category 5e Ethernet patch cable fitted with RJ-45 connectors. Refer to the Network Guide for extensive information and requirements for the connection of the Allure Series Communicating Sensor. It contains information about network topology and length, cable type, setting the Subnet ID, etc. It can be downloaded from the www.distech-controls.com website. See also the Hardware Installation Guide supplied with the Allure Series Communicating Sensor.

If you make your own patch cable, use Category 5e cable crimped with RJ-45 connectors either as T568A or T568B.

- Do not crimp one connector as T568A and crimp the other connector as T568B on the same cable.
- Protect the controller's connector from being pulled on when a cable to the Allure Series Communicating Sensor is connected. Create a strain-relief by looping the cable and attaching it to a solid object with a nylon tie so that a tug on the cable will not pull out the connector on the controller.

Table 3: T568A and T568B Terminations for an RJ-45 Connector

Pin	T568A (at both cable ends)		T568B (at both cable ends)	
	Pair	Color	Pair	Color
1	3	white/green stripe	2	white/orange stripe
2	3	green solid	2	orange solid
3	2	white/orange stripe	3	white/green stripe
4	1	blue solid	1	blue solid
5	1	white/blue stripe	1	white/blue stripe
6	2	orange solid	3	green solid
7	4	white/brown stripe	4	white/brown stripe
8	4	brown solid	4	brown solid

The final result of a crimped RJ-45 connector is shown graphically below.

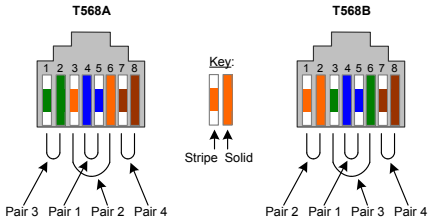


Figure 9: T568A and T568B Crimp Wire Sequence for an RJ-45 Connector

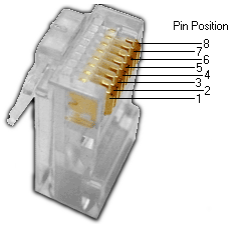


Figure 10: Pins on RJ-45 Jack Face

Patch cables fitted with connectors supplied by Distech Controls are wired as T568B.

Communications Wiring

ECx-400 series IO Extension Modules are connected to the **SUBNET–** and **SUBNET+** terminals of the ECB-600 or ECL-600 series controller. The Network Guide provides extensive information and requirements to implement the subnetwork for the ECx-400 series IO Extension Modules. It contains information about network length, cable type, controller addressing, etc. See the Hardware Installation Guide supplied with the ECx-400 series IO Extension Module. It can also be downloaded from the www.distech-controls.com website.

For optimal performance, use Distech Controls 24 AWG (0.65 mm) stranded, twisted pair shielded cable or refer to the Network Guide for cable specification. The subnetwork communication wire is polarity sensitive and the only acceptable topology is to daisy-chain the cable from one I/O Extension Module to the next.

As shown in *Figure 11* below:

- When the subnetwork data bus is connected to a following device, twist data bus shields together.
- Isolate all shields with electrical tape so there is no exposed metal that can touch ground or other conductors.
- The shield of the data bus must be connected to the electrical system ground at only one point – usually at one end of the bus as shown below.
- The first and last daisy-chained subnetwork device must have its EOL resistors enabled / installed. All other devices must have their EOL resistor disabled.
- The I/O Extension Module and the Allure™ Series Communicating Sensor share the same subnetwork.

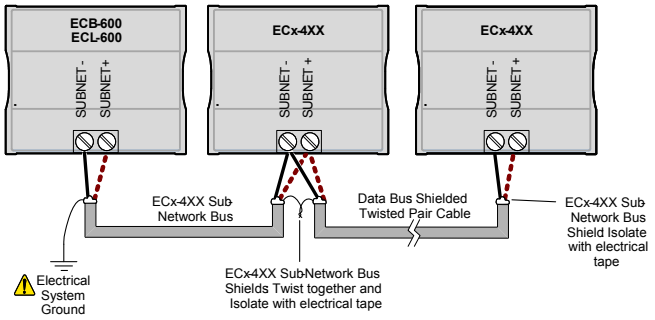


Figure 11: Subnetwork Bus Shielding

About the Subnetwork Bus

The ECB-600 and ECL-600 controllers use the Subnetwork bus to support the ECx-4XX Series I/O Extension Modules through 2-wire shielded cable.

The ECB-600 and ECL-600 controllers also use the Subnetwork bus to support one or more Allure Series Communicating Sensor(s) using standard structural cabling.

Subnetwork Bus Total Length

The total maximum length of all Subnetwork buses, including both the length of the Allure Series Communicating Sensor Subnetwork bus and the ECx-4XX Subnetwork bus is 300 m (1 000 ft). The maximum length of the Allure Series Communicating Sensor Subnetwork bus is 200 m (650 ft). The maximum length of the ECx-4XX Subnetwork bus is 300 m (1 000 ft).

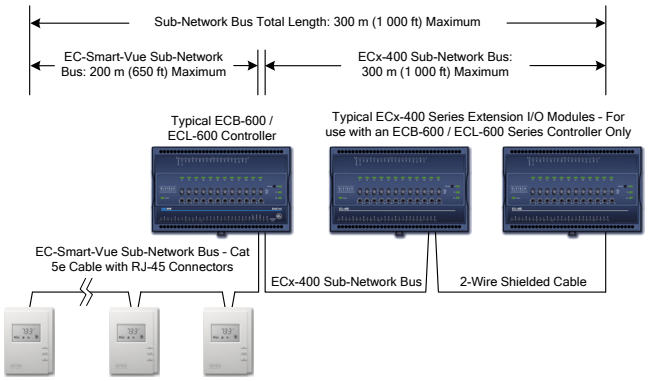


Figure 12: Subnetwork Bus Overview Showing the EC-Smart-Vue Subnetwork Bus and the ECx-4XX Subnetwork Bus

Subnetwork Bus Topology and EOL Terminations with the ECB-600 or ECL-600 Series Controller

When ECx-400 Series I/O Extension Modules are installed with an ECB-600 or ECL-600 Series controller, only the EOL terminations of the ECB-600 / ECL-600 controller and the last I/O Extension Module are set to ON. All other I/O Extension Modules must have their EOL terminations set to OFF.

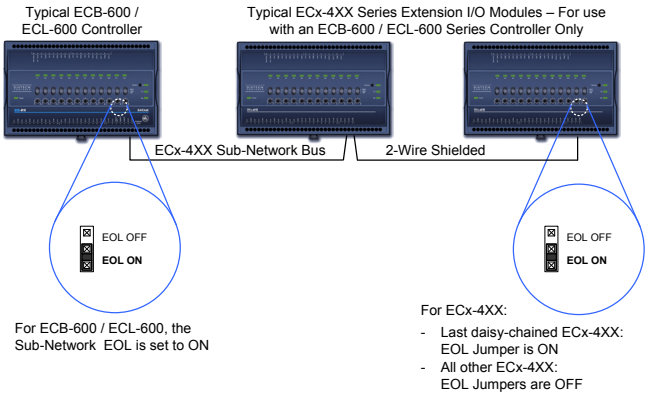


Figure 13: Setting the EOL Terminations on the Subnetwork Bus

When ECx-400 Series I/O Extension Modules are installed with an ECB-600 or ECL-600 Series controller and with Allure Series Communicating Sensor(s) sensor(s), only the EOL terminations on the last I/O Extension Module and the last Allure Series Communicating Sensor are set to ON. The ECB-600 / ECL-600 and all other I/O Extension Modules and Allure Series Communicating Sensor must have their EOL terminations set to OFF.

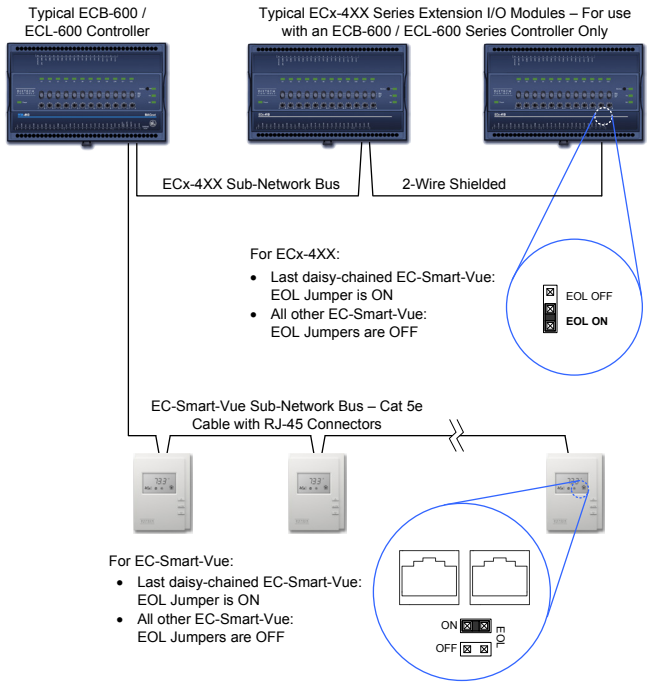


Figure 14: Setting the EOL Terminations on the ECx-400 Series Subnetwork Bus when EC-Smart-Vue Sensors are used

If inserting multiple wires in the terminals, ensure to properly twist wires together prior to inserting them into the terminal connectors.

For more information and detailed explanations on network topology and wire length restrictions, refer to the Network Guide, which can be downloaded from our website www.distech-controls.com.

Device Addressing

The Subnet ID Address must be set to one (1) or two (2) by setting the DIP switch located on the faceplate An example of how to set the device's Subnet ID Address DIP switch is shown below.

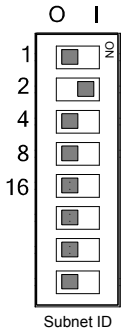


Figure 15: Typical I/O Extension Module DIP Switch Set to 2

The address is the sum of the numbers set to ON. For example, if the second (2) DIP switch is set to ON, the I/O Extension Module address is two (2). Only addresses 1 and 2 are valid.

The I/O Extension Module must be power cycled after the Subnet ID DIP switch has been changed.

Strain Relief and Terminal Block Cover

In certain jurisdictions, terminal block covers are required to meet local safety regulations. Strain reliefs and terminal block covers are available for controllers housed in large enclosures and are used to relieve tension on the wiring and conceal the controllers' wire

terminals. Strain reliefs and terminal block covers are optional and are sold as peripherals.

Prior to connecting all wires, it is recommended to install the strain relief. Three screws are provided for its installation under the bottom part of the enclosure. Tie wraps can then be used to group wires together and attach them securely to the strain relief in an effort to relieve undue tension. If necessary, the terminal block cover can then be clipped on to the strain relief as shown below.

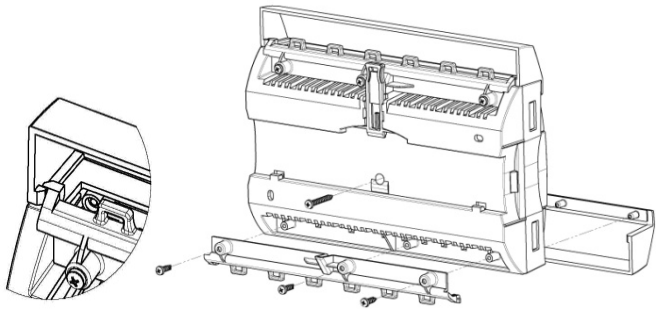


Figure 16: Enclosure strain relief and terminal block cover installation

Maintenance

Turn off power before any kind of servicing.

Each controller requires minimal maintenance, but it is important to take note of the following:

- If it is necessary to clean the outside of the controller, use a dry cloth.
- Retighten terminal connector screws annually to ensure the wires remain securely attached.

Disposal

The Waste Electrical and Electronic Equipment (WEEE) Directive sets out regulations for the recycling and disposal of products. The WEEE2002/96/EG Directive applies to standalone products, for example, products that can function entirely on their own and are not a part of another system or piece of equipment.

For this reason Distech Controls products are exempt from the WEEE Directive. Nevertheless, Distech Controls products are marked with the WEEE symbol  , indicating devices are not to be thrown away in municipal waste.

Products must be disposed of at the end of their useful life according to local regulations and the WEEE Directive.

North American Emissions Compliance

United States

Changes or modifications not expressly approved by Distech Controls could void the user's authority to operate the equipment.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential and commercial installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Canada

This Class (B) digital apparatus meets all the requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la Classe (B) respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

Typical Air Handling Unit Application Wiring Diagram

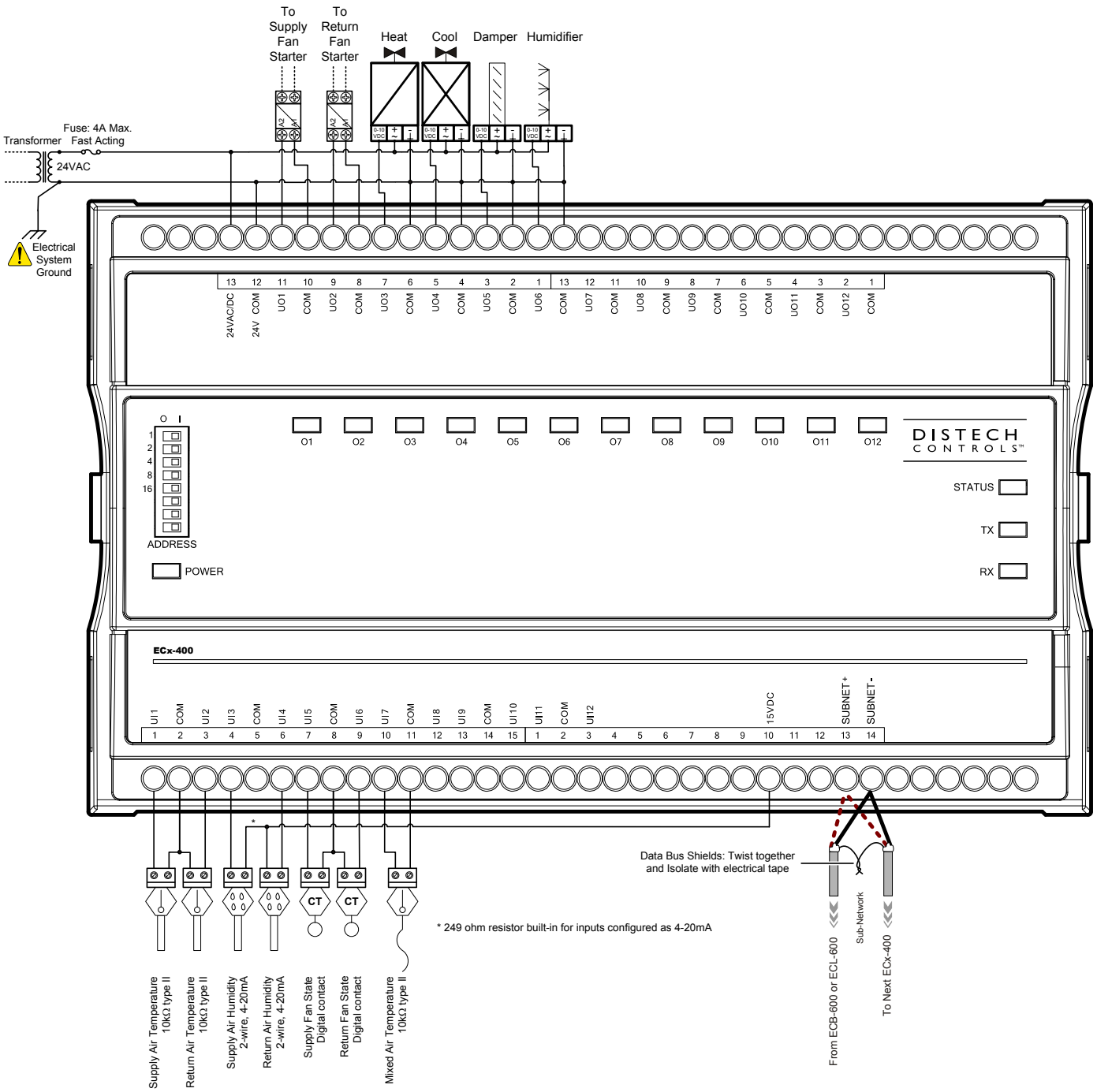


Figure 17: Typical Power and Network Connections

Troubleshooting Guide

Controller is powered but does not turn on	
Fuse has blown	Disconnect power from the controller. Check the fuse integrity. Reconnect power to the controller.
Power supply polarity	Verify that consistent polarity is maintained between all controllers and the transformer. Ensure that the COM terminal of each controller is connected to the same terminal on the secondary side of the transformer. See *Figure 7* and *Figure 8*.
I/O Extension Module cannot communicate on the subnetwork	
Absent or incorrect supply voltage	1. Check power supply voltage between 24VAC ±15% and COM pins and ensure that it is within acceptable limits. 2. Check for tripped fuse or circuit breaker.
Overloaded power transformer	Verify that the transformer used is powerful enough to supply all controllers. See *Power Wiring*.
Network not wired properly	Double check that the wire connections are correct.
Absent or incorrect network termination	Check the network termination(s). Only the last ECx-400 I/O Extension module must have its EOL termination set to ON. See *Figure 13*. When one or more Allure Series Communicating Sensors are connected to the controller, only the last Allure Series Communicating Sensor must have its EOL termination set to ON. See *Figure 14*.
There is another controller with the same Subnet ID on the subnetwork	Each I/O Extension Module on the subnetwork must have a unique Subnet ID. Look at the Subnet ID DIP switch on the faceplate of each I/O Extension Module.
Network length	Check that the total wire length does not exceed the specifications of the *Network Guide*.
Wire type	Check that the wire type agrees with the specification of the Network Guide.
Hardware input is not reading the correct value	
Input wiring problem	Check that the wiring is correct according to this manual and according to the peripheral device's manufacturer.
Open circuit or short circuit	Using a voltmeter, check the voltage on the input terminal. For example, for a digital input, a short circuit shows approximately 0V and an open circuit shows approximately 5V.
Configuration problem	Using EC-*gfx*Program, check the configuration of the input. Refer to the controller's programming user guide for more information.
Over-voltage or over-current at an input	An over-voltage or over-current at one input can affect the reading of other inputs. Respect the allowed voltage / current range limits of all inputs. Consult the appropriate datasheet for the input range limits of this controller.
Hardware output is not operating correctly	
Fuse has blown (Auto reset fuse)	Disconnect the power and outputs terminals. Then wait a few seconds to allow the auto-reset fuse to cool down. Check the power supply and the output wiring. Reconnect the power.
Open circuit or short circuit	Using a voltmeter, check the voltage on the input terminal. For example, for a digital input, a short circuit shows approximately 0V and an open circuit shows approximately 5V.
Configuration problem	Using EC-*gfx*Program, check the configuration of the output. Refer to the controller's programming user guide for more information.
0 to 10V output, 24VAC powered actuator is not moving.	Check the polarity of the 24VAC power supply connected to the actuator while connected to the controller. Reverse the 24VAC wire if necessary.
Rx/Tx LEDs	
RX LED not blinking	Data is not being received from the Subnetwork bus.
TX LED not blinking	Data is not being transmitted onto the Subnetwork bus.

Status LED– Normal Operation	
One fast blink ●	Initialization: The device is starting up.
Fast blink continuous: ● ● ● ● ● (150ms On, 150ms Off, continuous)	Firmware upgrade in progress. Controller operation is temporarily unavailable. The new firmware is being loaded into memory. This takes a few seconds. Do not interrupt power to the device during this time.
The Status LED is always OFF	The controller is operating normally.
Status LED blink patterns – Repeats every 2 seconds (highest priority shown first)	
Long blink continuous: ▬ ▬ ▬ ▬ ▬ ... (1s On, 1s Off, continuous)	The controller is unconfigured. Appropriate action: Commission the controller
Long Long Long blink ▬▬ ▬▬ ▬▬ (800ms On, 300ms Off, 800ms On, 300ms Off, 800ms On)	The controller is offline. Appropriate action: Verify that the: - I/O Extension Module's Subnet ID Address is correctly set. See Device Addressing. - Subnetwork bus cable is not cut, short-circuited, or too long. See Communications Wiring - . - Associated ECB-600 or ECL-600 has power.

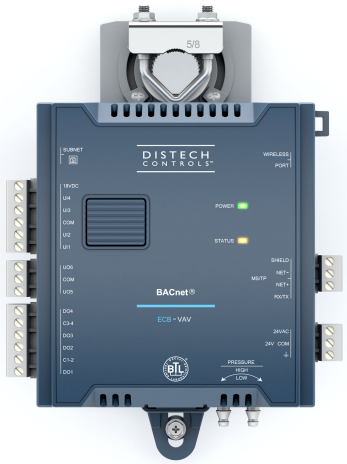
For issues with the Allure Series Communicating Sensor, refer to the Allure Series Communicating Sensor Hardware Installation Guide

12/12

05DI-HIECX40-12

ECB-VAV

BACnet B-ASC 12-Point Programmable VAV Controller



Overview

The ECB-VAV controller is a microprocessor-based programmable variable air volume (VAV) controllers designed to control any variable air volume box. Each controller uses the BACnet® MS/TP LAN communication protocol and is BTL®-Listed as BACnet Application Specific Controllers (B-ASC).

Features & Benefits

- Internal power supply uses power factor correction (PFC) to optimize power usage when multiple controllers are connected at the same power transformer
- Flexible inputs and outputs support all industry-standard VAV unitary applications
- Rugged hardware inputs and outputs eliminate the need for external protection equipment
- Polarity free, on-board airflow sensor for precise airflow monitoring and control at low and high airflow rates
- Built-in actuator with an integrated position feedback system for worry-free operation
- Factory pre-loaded applications allow for out-of-the-box, energy efficient operation of standard VAV equipment
- Optimized air balancing through *my*DC AirBalancing saving time during the commissioning process
- End-to-end solution for support of Smart Room Control of HVAC equipment, lighting and sunblinds
- Supports EC-*gfx*Program, making Building Automation System programming effortless
- Open-to-Wireless™ ready, supporting a wide variety of wireless sensors and switches and helping to reduce installation costs
- Supports the Allure™ Series Communicating Sensors, providing intelligent sensing and environmental zone control

Model Selection

Example: ECB-*VAV (SI)*

ECB-*VAV (IMP) Plenum-rated*

Series	Model	Units	Options
ECB-	***VAV***: 12 points, 18 Vdc power supply output, flow sensor, damper actuator, 4 UI, 4 DO, 2 UO, standard 24VAC/DC power supply	***(IMP)*** : Preloaded Apps in Imperial (US) units ***(SI)*** : Preloaded Apps in SI (Metric) units	***Plenum-rated***: UL2043 plenum-rated (only for North America).
			UUKL: UL 864, 10th Edition UUKL and California State Fire Marshal Listed[1].

1. The UL 864 UUKL Listed Smoke Control Equipment is used only in Distech Controls' UUKL smoke control system. For detailed specifications, requirements and procedures for installing and operating UUKL Listed equipment refer to the Distech Controls' UUKL Smoke Control documentation.

Accessories

Terminal covers	Terminal cover designed to conceal the controller's wire terminals. Required to meet local safety regulations in certain jurisdictions.

Recommended Applications

Model	ECB-VAV
Cooling Only VAV Boxes	■
Dual-Duct VAV Systems	■
Cooling with Reheat VAV Boxes	■
Parallel Fan VAV Boxes	■
Series Fan VAV Boxes	■
Room Pressurization	■
Smart Room Control support for HVAC, light, and shades/sunblinds	■

BACnet Objects List

BACnet Objects

Calendar Objects	1
Special events per calendar	25
Schedule Objects	2
Special events per schedule	5
PID Loop Objects	8

Commandable Objects

BV Objects	10
MSV Objects	10
AV Objects	25

Non-Commandable Objects

BV Objects	40
MSV Objects	40
AV Objects	75

Product Specifications

Power Supply Input

Voltage Range[1]	24VAC/DC; ±15%; Class 2
Frequency Range	50/60Hz
Overcurrent Protection	Field replaceable fuse
Fuse Type	3.0A
Power Consumption	4 VA typical plus all external loads[2], 75 VA max (including powered triac outputs).
Power Factor	>90%

1. 24VDC does not support DO (triac outputs).
2. External loads must include the power consumption of any connected modules such as an Allure Series Communicating Sensor. Refer to the respective module's datasheet for related power consumption information.

Communications

Communication Bus	BACnet MS/TP
BACnet Profile	B-ASC[1]
EOL Resistor	Built-in, selectable
Baud Rates	9600, 19 200, 38 400, or 76 800 bps
Addressing	Dip switch or with an Allure EC-Smart-Vue Series Communicating Sensor

1. Refer to Distech Controls' Protocol Implementation Conformity Statement for BACnet.

Subnetwork

Communication	RS-485
Cable	Cat 5e, 8 conductor twisted pair
Connector	RJ-45
Connection Topology	Daisy-chain
Maximum number of room devices supported per controller combined	4[1]
Allure Series sensor	Up to 4
EC-Multi Sensor	Up to 4
ECx-Light-4 / ECx-Light-4D / ECx-Light-DALI	Up to 2
ECx-Blind-4 / ECx-Blind-4LV	Up to 2

1. A controller can support a maximum of 2 Allure sensor models equipped with a CO_2 sensor. Any remaining connected sensors must be without a CO_2 sensor.

Hardware

Processor	STM32 (ARM Cortex™ M3) MCU, 32 bit
CPU Speed	68 MHz
Applications Memory	384 kB Non-volatile Flash
Storage Memory	1 MB Non-volatile Flash
Memory (RAM)	64 kB RAM
Real Time Clock (RTC)	Built-in Real Time Clock without battery Network time synchronization is required at each power-up cycle before the RTC become available
Green LEDs	Power status & LAN Tx
Orange LEDs	Controller status & LAN Rx

Wireless Receiver

Communication Protocol	EnOcean wireless standard[1]
Number of Wireless Inputs[2]	18
Supported Wireless Receivers	Refer to the Open-to-Wireless Application Guide
Cable	Telephone cord
Connector	4P4C modular jack
Length (maximum)	6.5ft (2m)

1. Available when an optional external Wireless Receiver module is connected to the controller. Refer to the Open-to-Wireless Application Guide for a list of supported EnOcean wireless modules.
2. Some wireless modules may use more than one wireless input from the controller.

Integrated Damper Actuator

Motor	Belimo brushless DC motor
Torque	45 in-lb, 5 Nm
Degrees of Rotation	95º adjustable
Shaft Diameter	5/16 to 3/4"; 8.5 to 18.2mm
Acoustic Noise Level	< 35 dB (A) @ 95º rotation in 95 seconds

Mechanical

Dimensions (H × W × D)	7.90 × 5.51 × 3.70" (200.61 × 139.93 × 94.04 mm)
Dimensions with terminal block covers (H × W × D)	7.90 × 10.84 × 3.70" (200.61 × 275.26 × 94.04 mm)
Shipping Weight (Controller)	1.95lbs (0.89 kg)
Shipping Weight Terminal Cover (one side, bulk packaged)	0.30lbs (0.14 kg)
Enclosure Material[1]	FR/ABS
Enclosure Rating	Plastic housing, UL94-5VB flammability rating Plenum rating per UL1995

1. All materials and manufacturing processes comply with the RoHS directive and are marked according to the Waste Electrical and Electronic Equipment (WEEE) directive

Environmental

Operating Temperature	32°F to 122°F (0°C to 50°C)
Storage Temperature	-4°F to 122°F (-20°C to 50°C)
Relative Humidity	0 to 90% Non-condensing
Nema Rating	1

Standards and Regulation

CE Emission	EN61000-6-3: 2007; A1:2011
CE Immunity	EN61000-6-1: 2007
CE EMC requirements, conditions and test set-up	EN 50491-5-1: 2010
EMC requirements for HBES/ BACS	EN 50491-5-2: 2010
FCC	Compliance with FCC rules part 15, subpart B, class B
UL Listed (CDN & US)	UL916 Energy management equipment UL 864, 10th Edition, UUKL Listed Smoke Control Equipment (ECB-VAV UUKL model only)[1] UL2043 Suitable for use in air handling spaces (for Plenum-rated models only)
CEC Appliance Database	Appliance Efficiency Program[2]

1. For detailed specifications regarding the ECB-VAV UUKL model, refer to the Distech Controls UUKL Smoke Control Design Guide.
2. California Energy Commission's Appliance Efficiency Program: The manufacturer has certified this product to the California Energy Commission in accordance with California law.

On-Board Air-Flow Sensor

Differential Pressure Range	±2.0 in. W.C. (±500 Pa) Polarity-free high-low sensor connection
Input Resolution	0.00007 in. W.C. (0.0167 Pa)
Air Flow Accuracy	±4.0% @ > 0.05 in. W.C. (12.5 Pa) ±1.5% once calibrated through air flow balancing @ > 0.05 in. W.C. (12.5 Pa)
Pressure Sensor Accuracy	±(0.2 Pa +3% of reading)

Universal Inputs (UI)

General

Input Type	Universal; software configurable
Input Resolution	16-Bit analog / digital converter
Power Supply Output	18 VDC; maximum 80mA

Contact

Type	Dry contact

Counter

Type	Dry contact
Maximum Frequency	1Hz maximum
Minimum Duty Cycle	500ms On / 500ms Off

0 to 10VDC

Range	0 to 10VDC (40kΩ input impedance)

0 to 5VDC

Range	0 to 5VDC (high input impedance)

0 to 20mA

Range	0 to 20mA 249Ω external resistor wired in parallel

Resistance/Thermistor

Range	0 to 350 KΩ
Supported Thermistor Types	Any that operate in this range

Pre-configured Temperature Sensor Types:

Thermistor	10KΩ Type 2, 3 (10KΩ @ 77ºF; 25ºC)
Platinum	Pt1000 (1KΩ @ 32ºF; 0ºC)
Nickel	RTD Ni1000 (1KΩ @ 32ºF; 0ºC) RTD Ni1000 (1KΩ @ 69.8ºF; 21ºC)

Universal Outputs (UO)

General

Output Type	Universal; software configurable
Output Resolution	10-bit digital to analog converter
Output Protection	Built-in snubbing diode to protect against back-EMF, for example when used with a 12VDC relay Output is internally protected against short circuits
Auto-reset fuse	Provides 24VAC over voltage protection

0 or 12VAC (On/Off)

Range	0 or 12VDC

PWM

Range	Adjustable period from 2 to 65 seconds
Thermal Actuator Management	Adjustable warm up and cool down time

Floating

Minimum Pulse On/Off Time	500 milliseconds
Drive Time Period	Adjustable

0 to 10VDC

Range	0 to 10VDC linear
Source Current	Maximum 20 mA at 10VDC (minimum load resistance 600Ω)
Sink Current	Maximum 2.5mA at 1 VDC (minimum load resistance 4KΩ)

Digital Outputs (DO)

General

Output Type	24VAC Triac; software configurable
Maximum Current per Output	0.5A continuous 1A @ 15% duty cycle for a 10-minute period
Power Source	External or internal power supply (jumper selectable)

0 or 24VAC (On/Off)

Range	0 or 24VAC

PWM

Range	Adjustable period from 2 to 65 seconds

Floating

Minimum Pulse On/Off Time	500 milliseconds
Drive Time Period	Adjustable
Power Source	Internal power supply

Dimensions

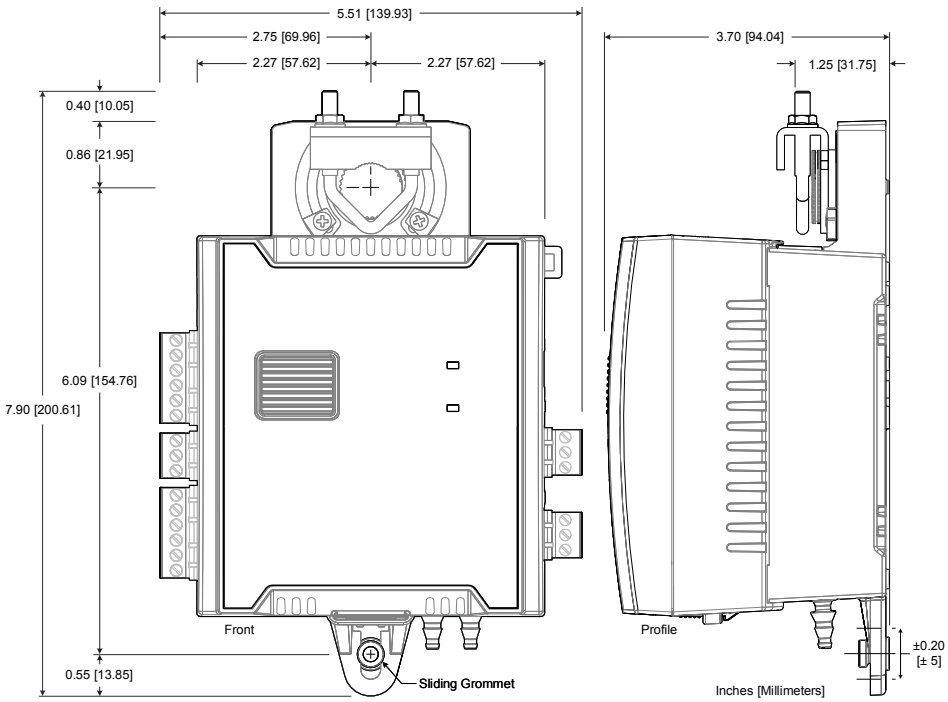


Figure 1: ECB-VAV Controller Dimensions

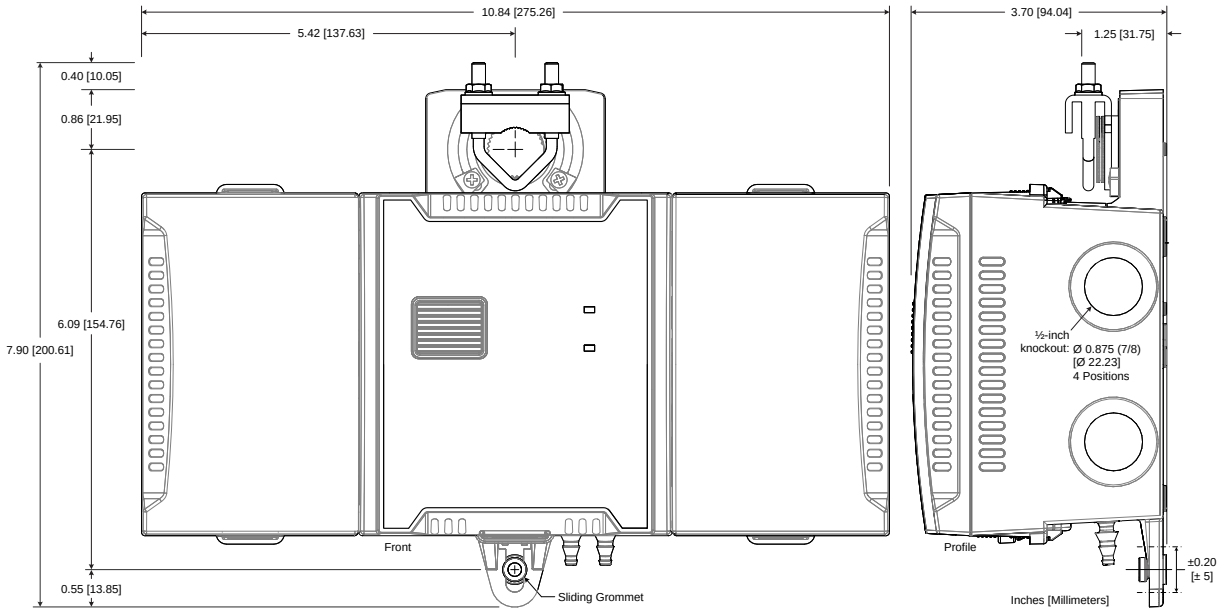


Figure 2: ECB-VAV Controller with Terminal Covers Dimensions

ECB-VAV

Figure 1: ECB-VAV Controller

Product Description

This document describes the hardware installation procedures for the ECB-VAV Single Duct Variable Air Volume Controllers.

The Distech Controls Variable Air Volume product line is designed to control and monitor various types of HVAC equipment such as baseboards, single and multi-stage duct heaters, fans, valves, lights, etc. When connected to a Wireless Receiver, this product line can be used with a variety of wireless battery-less sensors and switches.

The ECB-VAV model supports a range of Smart Room Control modules that expand the controller's range of control to include lighting and shades/sun-blinds with the ECx-Light and ECx-Blind series control modules. This controller also supports the EC-Multi-Sensor ceiling-mounted sensor and its associated EC-Remote remote control.

Each controller uses the BACnet® MS/TP LAN communication protocol and is BTL®-Listed as BACnet Application Specific Controllers (B-ASC).

General Installation Requirements

For proper installation and subsequent operation of the device, pay special attention to the following recommendations:

- ☐ It is recommended that the controller(s) be kept at room temperature for at least 24 hours before installation to allow any condensation that may have accumulated due to low temperature during shipping/storage to evaporate.
- ☐ Upon unpacking, inspect the contents of the carton for shipping damages. **Do not install a damaged device.**
- ☐ The device is designed to operate under environmental conditions that are specified in its datasheet.
- ☐ Ensure proper ventilation of the device and avoid areas where corroding, deteriorating or explosive vapors, fumes or gases may be present.
- ☐ Allow for proper clearance around the device's enclosure and wiring terminals to provide easy access for hardware configuration and maintenance.
- ☐ When installing in an enclosure, select one that provides sufficient surface area to dissipate any heat generated by the device and by any other devices installed in the enclosure. A metal enclosure is preferred. If necessary, provide active cooling for the enclosure.
- ☐ The device's datasheet specifies the power consumption (amount of heat generated), the operating temperature range, and other environmental conditions the device is designed to operate under.
- ☐ Ensure that all equipment is installed according to local, regional, and national regulations.
- ☐ Do not drop the device or subject it to physical shock.

If the device is used and/or installed in a manner not specified by Distech Controls, the functionality and the protection provided by the device may be impaired.

Any type of modification to any Distech Controls product will void the product's warranty

Before installation of the Wireless Receiver, verify that local communication regulations allow the installation of wireless devices and available frequencies to be supported in your area. Refer to the Open-to-Wireless™ Solution Guide for more information.

Take reasonable precautions to prevent electrostatic discharge to the device when installing, servicing or during operation. Discharge accumulated static electricity by touching one's hand to a well-grounded object before working with the device.

Device Markings (Symbols)

Certain markings (symbols) can be found on the controller and are defined as follows:

Symbol	Description
	CE marking: the device conforms to the requirements of applicable EC directives.
	Products must be disposed of at the end of their useful life according to local regulations.
	Read the Hardware Installation Guide for more information.
	UL marking: conforms to the requirements of the UL certification.
	FCC marking: This device complies with FCC rules part 15, subpart B, class B.
	Warning Symbol: Significant information required. Refer to the Hardware Installation Guide.
	Alternating Current
	Direct Current

General Wiring Recommendations

Risk of Electric Shock: Turn off power before any kind of servicing to avoid electric shock.

- ☐ All wiring must comply with electrical wiring diagrams as well as national and local electrical codes.
- ☐ To connect the wiring to a device, use the terminal connectors. Use a small flat screwdriver to tighten the terminal connector screws once the wires have been inserted (strip length: 0.25'' (6 mm), tightening torque 0.5 Nm).
- ☐ Comply with all network and power supply guidelines outlined in the Network Guide.
- ☐ Keep wiring separate according to their function and purpose to avoid any ambient noise transmission to other wires. Use strapping to keep these wires separated. For example, keep power, hazardous voltage, SELV, network, input wiring separate from each other.
- ☐ Power cables must be between 18 and 14 gauge (0.82 to 2.1mm^2 cross-sectional area). When connecting one wire to a controller's terminal block clamping cage (pole), the wire must be between 22 and 14 gauge (0.33 and 2.1mm^2 cross-sectional area). When connecting two wires to a controller's terminal block clamping cage, both wires must be the same thickness, both wires must be between 22 and 16 gauge (0.33 to 1.3mm^2 cross-sectional area), and both wires must be of the same type (solid or stranded). Twist the wires together and insert then into the controller's terminal block clamping cage. For any other wiring combination (mixed wire thickness, mixed solid and stranded conductors, more than three wires, wire thickness is out of range), twist the wires together and use a wire nut and a pig tail to connect to the controller's terminal block connector as show below.

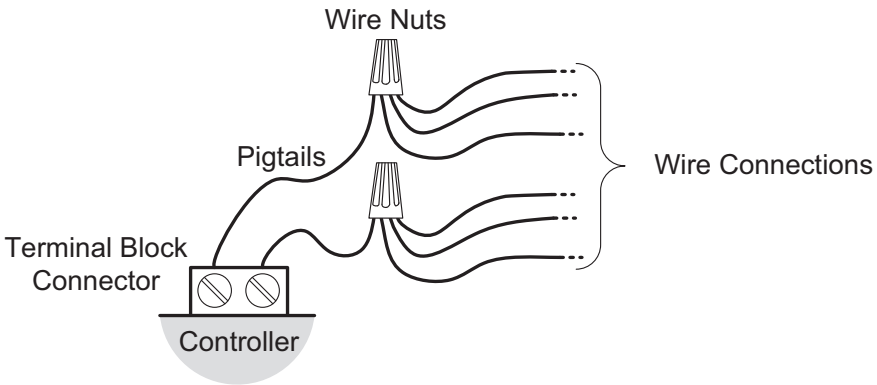


Figure 2: Using a Wire Nut and Pigtail to Wire the Controller

- ☐ The board connectors accept wires or flat cables ranging from 22 to 14AWG (0.644 to 1.630mm diameter) per pole. However, power cables must be between 18 and 14AWG (1.024 to 1.630mm diameter).
- ☐ Keep all wires away from high speed data transmission cables (for example, Ethernet, etc.).
- ☐ Do not connect the universal inputs, analog/digital outputs or common terminals to earth or chassis ground (unless stated otherwise).
- ☐ Keep input and output wiring in conduits, trays or close to the building frame if possible.

Controller Dimensions & Components

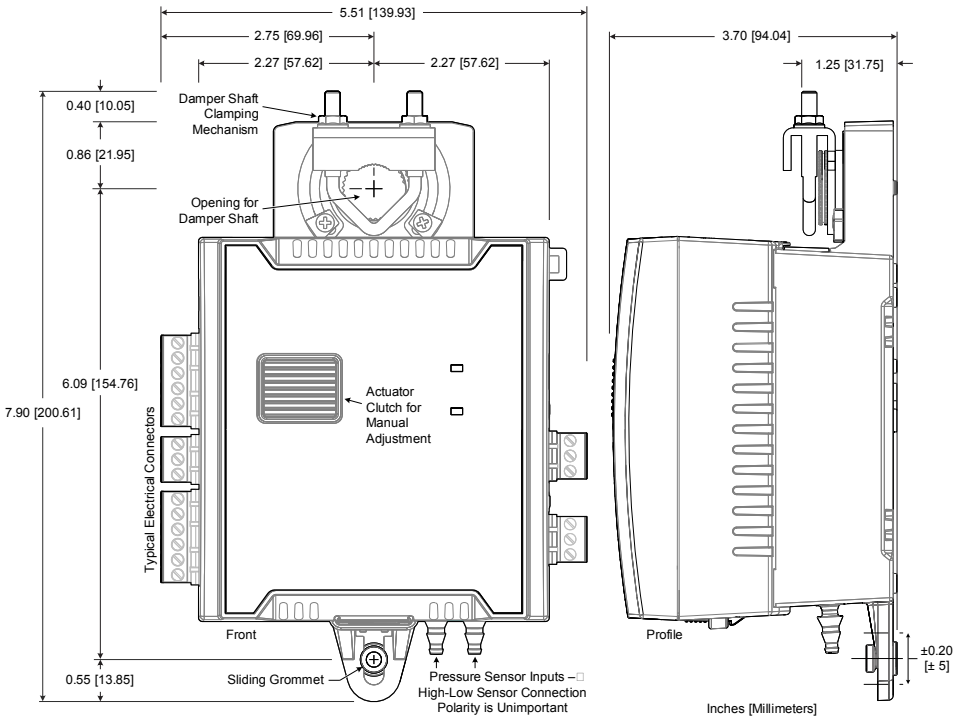


Figure 3: ECB-VAV Dimensions and Components

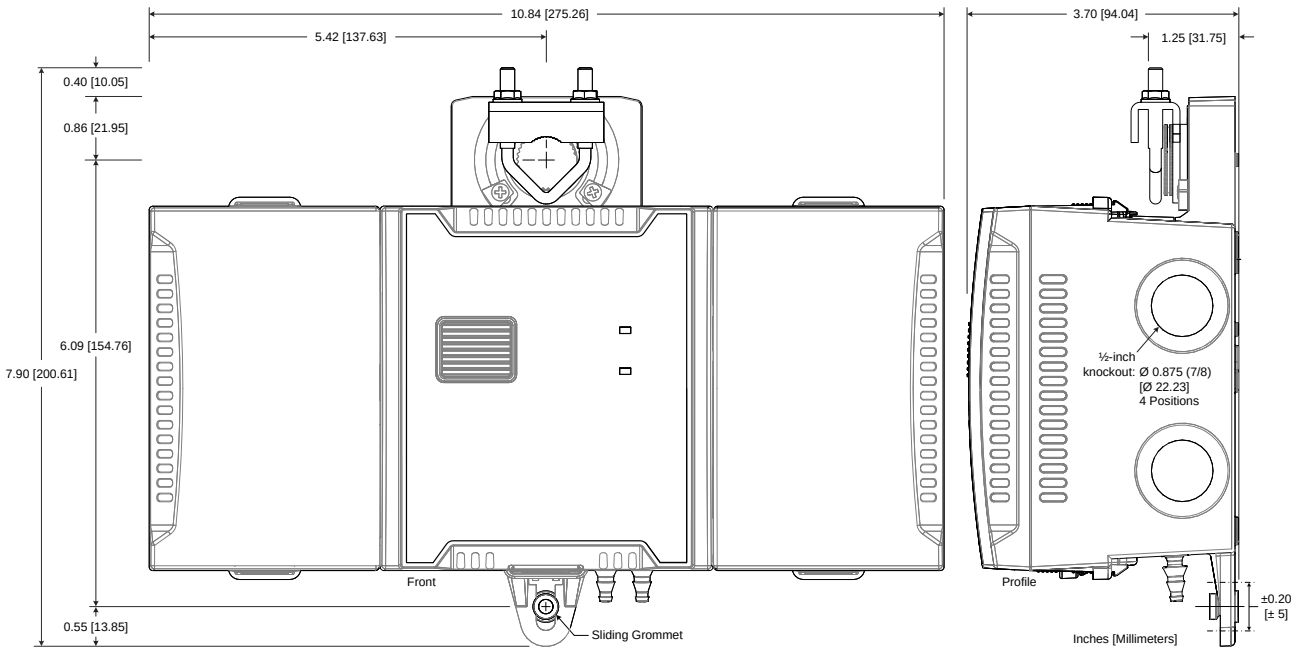


Figure 4: VAV Controller with Terminal Covers Dimensions

DIP Switch Identification and Configuration

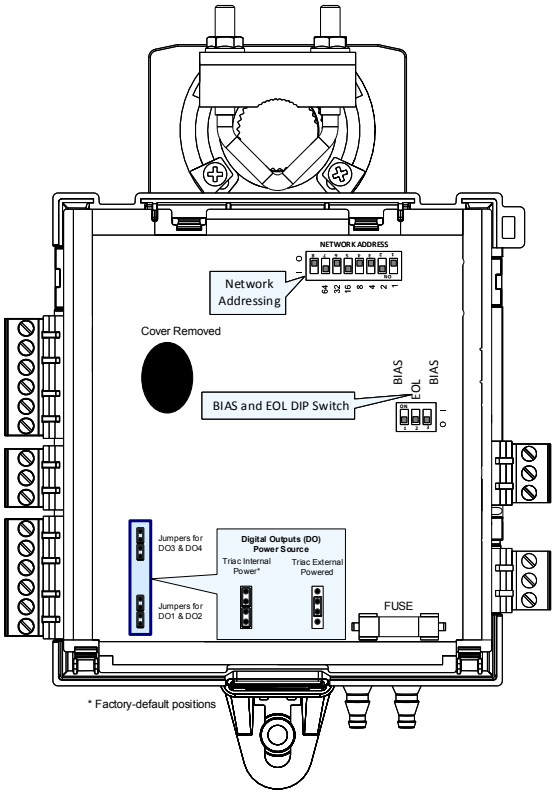


Figure 5: ECB-VAV (cover removed)

Mounting Instructions

Each controller is specially designed for easy installation either directly on an air duct or in a panel by using the integrated mounting collar and the screw that is provided with the controller. This mounting arrangement opposes the torque applied to the damper shaft.

Mounting Position

To prevent condensation on the VAV box's damper shaft from entering the controller's electronics, the controller's mounting orientation should be any position above the damper shaft (between 0 and 180°) so that any condensation from the damper shaft will fall away from the controller's electronics. Further countermeasures may be required in some installations. This is important in hot, humid climates where the VAV box is located near exterior doors or loading bays that may be blocked open or when the VAV box air supply is below 50°F (10°C).

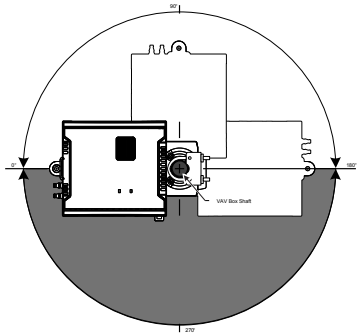


Figure 6: Recommended Mounting Position Angle Range

Mounting Procedure for Terminal Covers

Terminal covers can be added to any VAV controller to protect inadvertent contact with the controller's electrical connections.

- A terminal cover kit can be added to both sides of the controller.

Controllers with terminal block covers can only be mounted on a flat surface that is sufficiently large to provide space around the installation. In this scenario, conductors must be made inaccessible and wiring must comply with local wiring regulations and methods appropriate for fixed equipment installation in a building (the use of cable conduits and trunking for example).

1. Separate the cover from the base of the terminal covers.
2. Attach the base of the terminal cover(s) to the underside of the VAV controller's body with the tabs shown in Figure 7 .
3. Install the VAV controller according to the next procedure, VAV Controller Mounting Procedure.

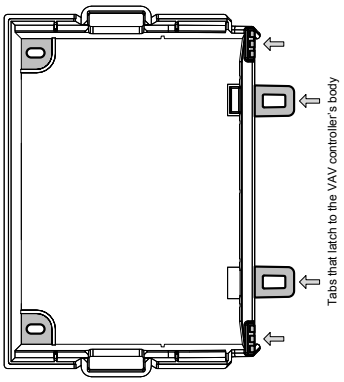


Figure 7: Terminal Cover Attachment Tabs

4. Connect and wire the controller according to the procedures shown later in this document.

VAV Controller Mounting Procedure

Mount the controller as follows:

1. Configure the controller's DIP switches. See Figure 5.
2. The VAV controller comes with the sliding grommet pre-installed.
3. Orient the controller into position on to the damper shaft so that wiring connections are easily accessible. The controller must be fitted onto the shaft such that the base of the controller is parallel to the VAV box (perpendicular to the damper shaft). If the damper shaft has an external bushing that prevents the controller from being mounted flush to the side of the VAV box, use a spacer of the same thickness to compensate and to ensure the controller is at a right-angle to the shaft to prevent binding.
4. Screw the controller onto the VAV box through the controller's Sliding Grommet. The sliding grommet allows the controller to move back and forth when the VAV box's damper shaft is off center. Ensure to center the grommet along its travel range and ensure that the screw enters the VAV box at a right angle. Using a power screwdriver with a 6" extension (Figure 8), attach the controller to the VAV box with the 1" [25mm] screw provided with the controller (Figure 9) through the controller's sliding grommet as shown in Figure 11. Otherwise, mark the positions for the screw on the VAV box with a punch and then drill a hole the into the VAV box. Then attach the controller to the VAV box with the 1" [25mm] screw provided with the controller.

Figure 8: Screwdriver Shaft Extension

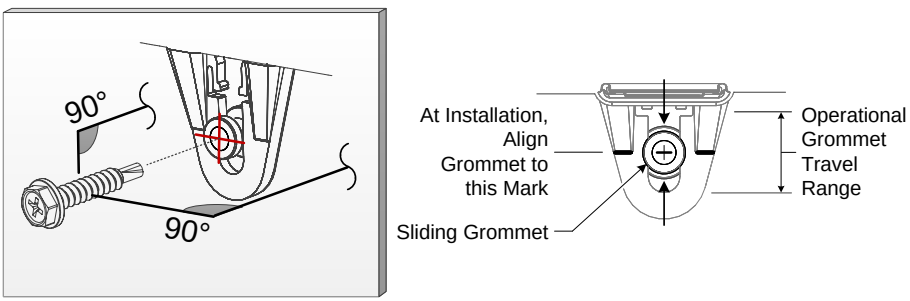


Figure 9: Supplied Mounting Hardware – Drive the screw at a right-angle to the VAV Box

Avoid over-tightening the screw so as to not strip the threads. Make sure the screw does not pierce too far into the VAV box and interfere with damper blade movement.

5. Find the damper position by the marking typically found on the end of the damper shaft.

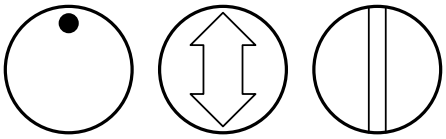


Figure 10: Typical Damper Shaft End Marking

6. Determine the direction required to close the damper: Clockwise (CW) or Counterclockwise (CCW). Turn the damper shaft with a pair of pliers to fully close the damper for 90° boxes or fully open the damper for 45° or 60° boxes
7. Press and hold down the *Actuator Clutch for Manual Adjustment* button (see Figure 3), and turn the controller's shaft coupler until it touches the mechanical end-stop to either the fully closed position (90° boxes) or the fully open position (45° and 60° boxes).
8. For 90° VAV boxes: If the damper closes CCW, turn the coupler to the CCW mechanical stop limit. If the damper closes CW, turn the coupler to the CW mechanical stop limit. The open mechanical stop is factory preset for 90° boxes.
   For 45° and 60° VAV boxes: The mechanical stops must be set for both the fully closed and fully open damper positions. By installing the controller at the fully open position, the controller provides the open mechanical stop for 45° and 60° boxes. The closed damper seal provides the fully closed stop.
9. Tighten the U-Bolt clamp on to the damper shaft using an 5/16 in (8 mm) wrench or socket. Tighten the bolts between 100 and 130 lb-in (11 and 15 N-m).
10. Test for free damper shaft movement: Press and hold down the *Actuator Clutch For Manual Adjustment* button and manually turn the actuator coupling to be certain that the actuator can rotate from full closed to full open positions without binding.

11. Connect the VAV box's flow sensor tubing to the controller's *Pressure Sensor Inputs*. The connection is polarity free (high-low ports are interchangeable). Create a condensation trap in the pneumatic tubing by forming it into a vertical loop.
12. Finalize the installation by rotating the damper to the full open position.

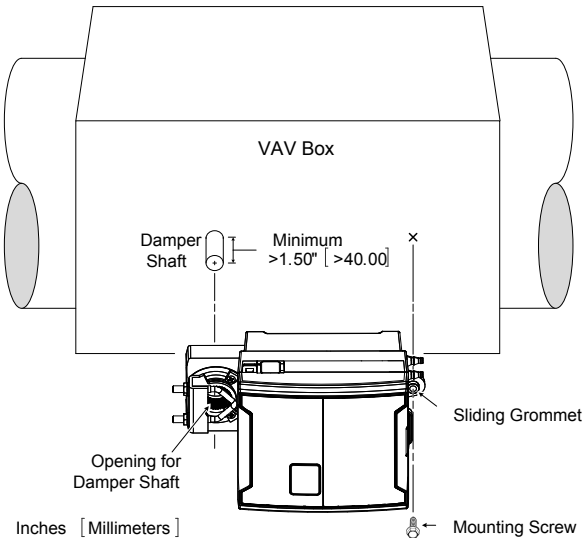


Figure 11: Standard Mounting Method: Mounting a controller on a damper shaft

Power Wiring

Voltage: 24VAC/DC; ± 15%, Class 2

This is a Class 2 Product. Use a Class 2 transformer only (rated at 100VA or less at 24VAC) to power the controller(s).

The Network Guide provides extensive information and requirements for powering a controller that uses a BACnet network for communications. It can be downloaded from our website.

It is recommended to wire only one controller per 24VAC transformer.

When calculating a controller's power consumption to size the 24VAC transformer, you must also add the external loads the controller is going to supply, including the power consumption of any connected subnet module (for example, Allure™ Series Communicating Sensors).

If only one 24VAC transformer is available, determine the maximum number of daisy-chained VAVs that can be supplied on a single power cable supplied by a 100 VA transformer, according to the controller's expected power consumption including external loads, the cable's wire gauge, and the total cable length from the following figure. Any installation condition that is outside of the parameters of the following graph should be avoided.

To maximize daisy-chaining performance, the transformer should be installed as close as possible to the first VAV. If this is not possible, then use 14 AWG wire to power the first VAV which can help reduce a voltage drop at the end of the daisy-chain.

The recommended minimum peak input voltage is 27.2V_p

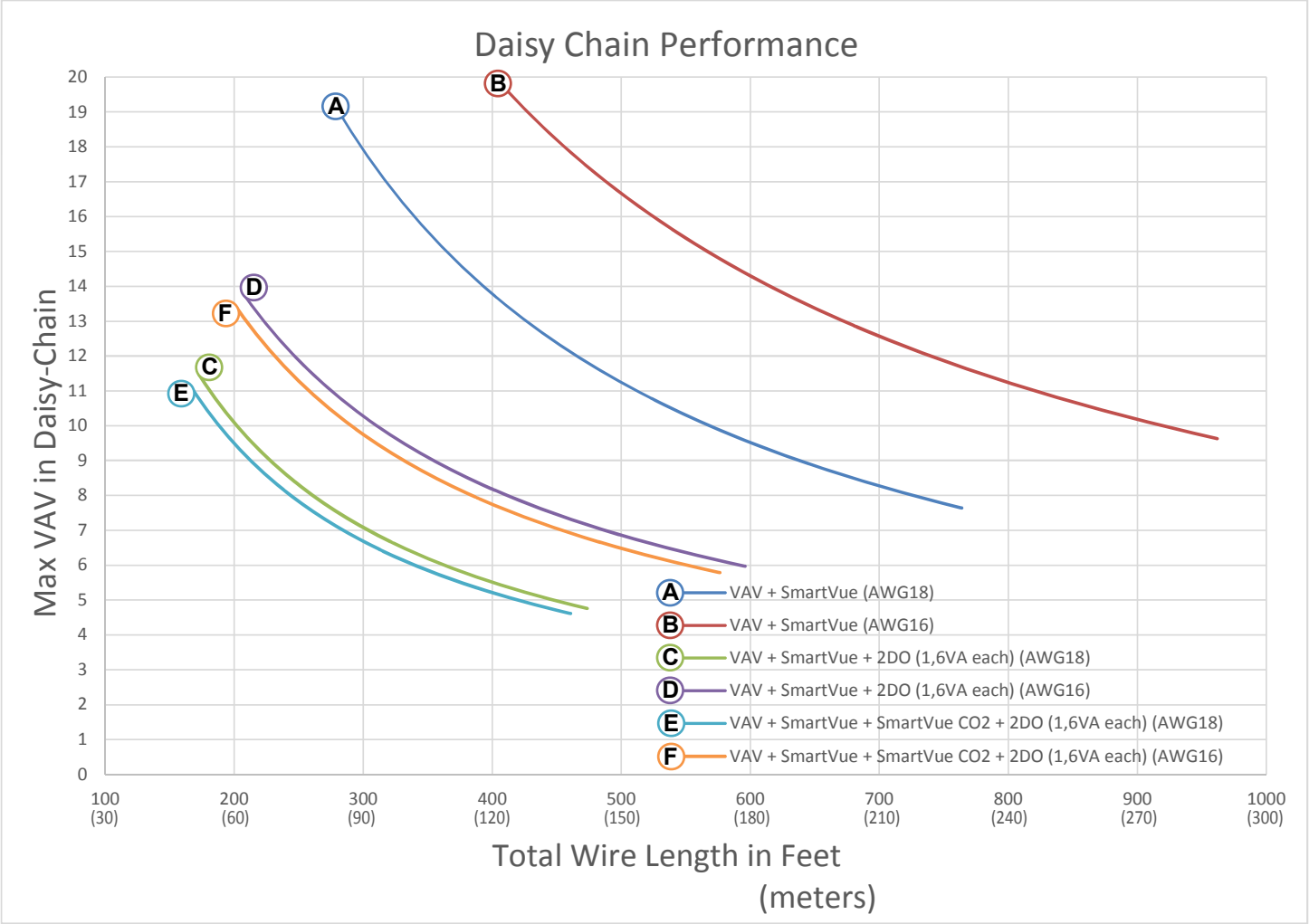


Figure 12: Maximum Number of VAV Devices on a Daisy-Chain at Evenly Spaced Intervals

Laboratory testing conditions for the above graph are as follows:

- ☐ Distance between each VAV is evenly spaced along the entire wire length
- ☐ Transformer specification: 100VA (120/24VAC)
- ☐ Tested at room temperature with low voltage line conditions: 108VAC (50Hz)

Daisy-Chain Wiring

Use an external fuse on the 24VAC side (secondary side) of the transformer, as shown below, to protect all controllers against power line spikes.

Maintain consistent polarity when connecting controllers and devices to the transformer. One terminal on the secondary side of the transformer must be connected to the building's ground. All 24V COM terminals of all controllers and peripherals throughout the BACnet MS/TP network must be connected to the grounded transformer terminal as shown below. This ensures that the 24V COM terminals of all devices connected to any BACnet MS/TP bus in the building are at the same potential.

A mechanical ground is unacceptable: Do not use a pipe, conduit, or duct work for a ground. The power supply must have a dedicated ground wire that comes from the main electrical supply panel.

Failure to maintain consistent polarity throughout the entire network will result in a short circuit and/or damage to the controller!
Connecting a peripheral or another controller to the same transformer without maintaining polarity between these devices will cause a short circuit.

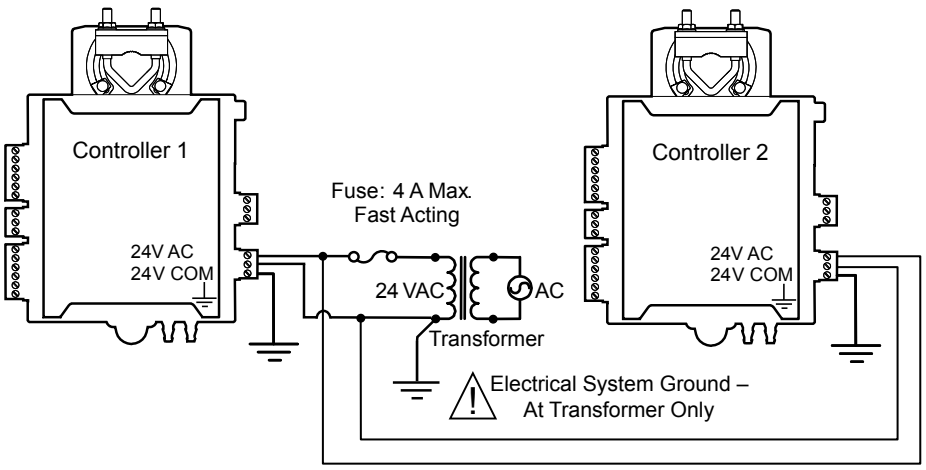


Figure 13: Power Wiring

The following diagram shows the recommended wiring of the ECB-VAV Controller with and without a 3-wire peripheral. This configuration applies either to a daisy-chain configuration or configuration with separate transformers. Note that internally, the COM terminals are no longer connected to the 24VAC COM terminal but rather to the ground terminal.

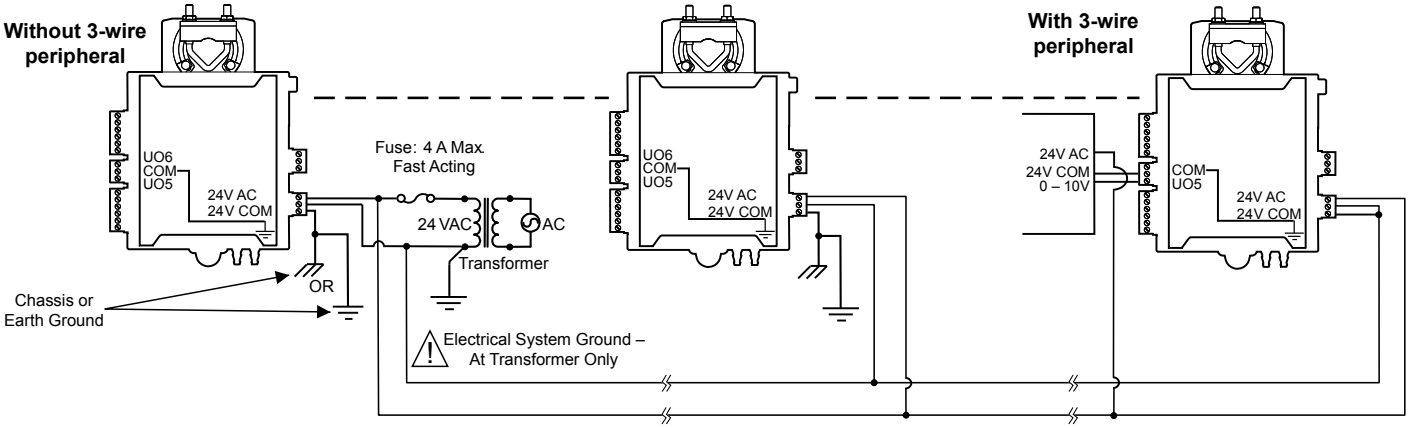


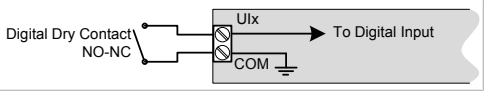
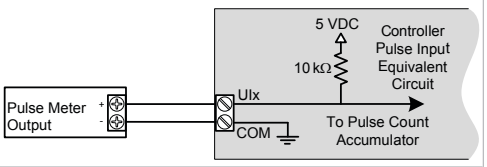
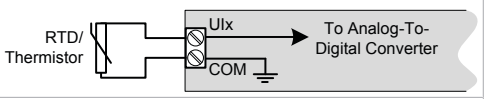
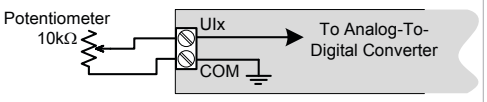
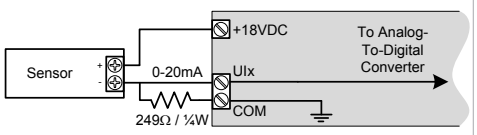
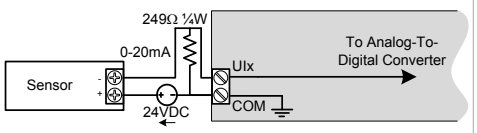
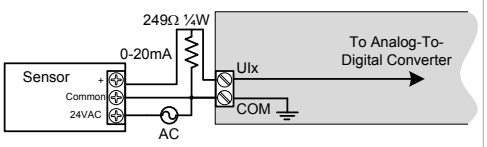
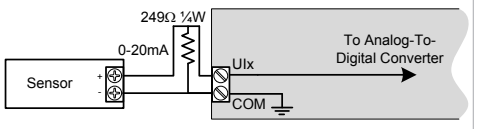
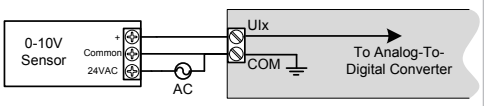
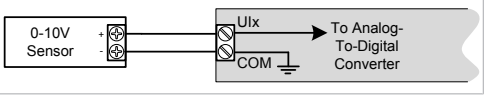
Figure 14: ECB-VAV Power Wiring with and Without 3-Wire Peripherals

Input Wiring

Input options must be properly configured in EC-*gfx*Program to ensure correct input readings. The table below shows the controller's available universal input designation. For terminal block connector wiring best practices, see General Wiring Recommendations [pg. 2]. Inputs can be connected as follows.

Before connecting a sensor to the controller, refer to the installation guide of the equipment manufacturer.

- ☐ For a wire length less than 75' (23m), either a shielded or unshielded 18AWG wire may be used.
- ☐ For a wire up to 200' (61m) long, a shielded 18AWG wire is recommended.
- ☐ The shield of the wire should be grounded on the controller side only and the shield length should be kept as short as possible.

Sensor Input Type	Input Designation	Input Connection Diagram
☐ Dry Contact input. ☐ Pulsed input.	UIx	
☐ Pulse input used with a 2-wire sensor powered by its own power source – this input supports a maximum input frequency of 1Hz (500ms minimum ON/OFF). Connect the pulse input according to the figure for a pulse meter that can pull-down a +5VDC supply with a 10KΩ pull-up resistor (Internal supply type).	UIx	
☐ RTD input (for example, 1000Ω). ☐ Thermistor Input (for example, 10kΩ type II and III).	UIx	
☐ Resistive input, maximum 350kΩ (for example, use with 10kΩ and 100kΩ potentiometers).	UIx	
☐ 0 to 20mA input used with a 2-wire, 0 to 20mA sensor powered by the controller's internal 18VDC power supply. ☐ An on-board 18VDC power supply can provide the necessary power for 20mA current loop sensor operation. ☐ Connect a 249Ω resistor between the UIx and COM terminals.	UIx	
☐ 0 to 20mA input used with a 2-wire, 0 to 20mA sensor powered by an external 24 AC/DC power supply. ☐ Connect a 249Ω resistor between the UIx and COM terminals.	UIx	
☐ 0 to 20mA input used with a 3-wire, 0 to 20mA sensor powered by an external 24 AC/DC power supply. ☐ Connect a 249Ω resistor between the UIx and COM terminals. When daisy-chaining two or more controllers on one transformer, wire the controller according to Figure 14.	UIx	
☐ 0 to 20mA input used with a sensor powered by its own power source. ☐ Connect a 249Ω resistor between the UIx and COM terminals.	UIx	
☐ Voltage input used with a 3-wire 0 to 10VDC or 0 to 5VDC sensor powered by an external 24 AC/DC power supply. When daisy-chaining two or more controllers on one transformer, wire the controller according to Figure 14.	UIx	
☐ Voltage input used with a 0 to 10VDC or 0 to 5VDC sensor powered by its own power source.	UIx	

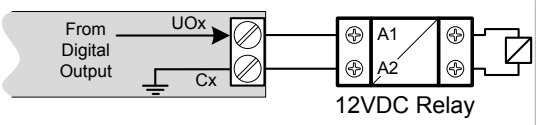
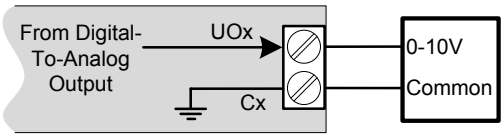
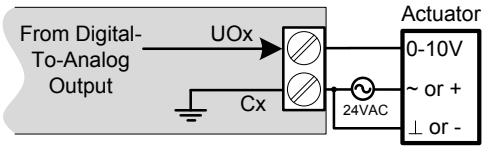
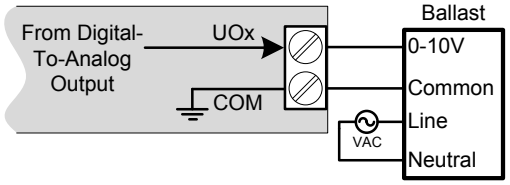
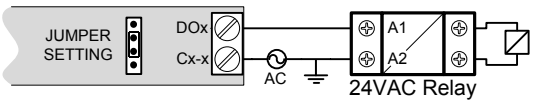
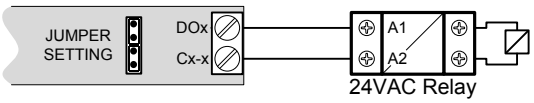
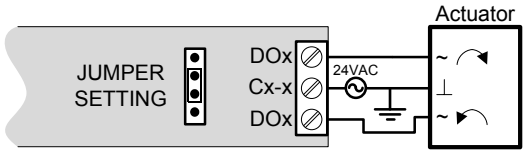
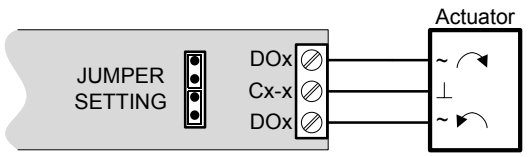
Output Wiring

Output options must be properly configured in EC-*gfx*Program to ensure correct output values. For terminal block connector wiring best practices, see General Wiring Recommendations [pg. 2] and Figure 2.

Outputs can be connected as follows.

Before connecting an output device (actuator, relay, etc.) to the controller, refer to the datasheet and installation guide of the equipment manufacturer.

- ☐ For a wire length less than 75' (23m) long, either a shielded or unshielded 18AWG wire may be used.
- ☐ For a wire length up to 200' (61m) long, a shielded 18AWG wire is recommended.
- ☐ The shield of the wire should be grounded on the controller side and the shield length should be kept as short as possible.

Control Output Type	Output Designation	Output Connection Diagram
☐ Discrete 0 or 12VDC digital, Pulse, or PWM output controlling a 12VDC relay.	UOx	
☐ 0 to 10VDC voltage output.	UOx	
☐ 0 to 10VDC voltage output controlling an analog actuator that is powered by an external 24VAC power source. ☐ This output can source up to 20 mA	UOx	
☐ 1 to 10VDC voltage output controlling dimmable lighting ballasts that require a current sink output (pull-down). ☐ This output can sink up to 2.5mA.	UOx	
☐ Discrete digital, Pulse, or PWM output: 24VAC externally-powered triac controlling a relay[1]. ☐ Set the jumper according to Figure 5.	DOx	
☐ Discrete digital, Pulse, or PWM output: 24VAC internally-powered triac controlling a relay[1,2] Set the jumper according to Figure 5.	DOx	
☐ 24VAC externally-powered triac output controlling a floating actuator[1]. ☐ Set the jumper according to Figure 5.	DOx	
☐ 24VAC internally-powered triac output controlling a floating actuator[1]. ☐ Set the jumper according to Figure 5.	DOx	

1. Maximum output current for all triac outputs is 0.5A continuous or 1A @ 15% duty cycle for a 10-minute period.

Subnet-Wiring

The subnet is used to connect a range of Allure Series Communicating Sensors:

- The Allure EC-Smart-Vue Series sensor is a communicating room temperature sensor with backlit display graphical menus and VAV balancing capabilities.
- The Allure EC-Smart-Comfort and Allure EC-Smart-Air Communicating Sensors are a range of communicating room temperature sensors.

Connect the Allure Series to the controller's **Subnet Port** with a standard Category 5e Ethernet patch cable fitted with RJ-45 connectors. Refer to the Network Guide for extensive information and requirements for the connection of the Allure Series. It contains information about network topology and length, cable type, setting the Subnet ID, etc. It can be downloaded from the *www.distech-controls.com* website. See also the Hardware Installation Guide supplied with the Allure Series.

These controller models support the connection of EC-Multi-Sensor series, ECx-Light series, and ECx-Blind series to the **Subnet Port** as part of the Smart Room Control solution (see the controller's datasheet for more information). See the room device calculator spreadsheet available for download from our website to know the permitted quantities: **VAV-Smart Room Control Device Calculator.xlsm**

If you make your own patch cable, see the Allure Series Hardware Installation Guide.

Protect the controller's connector from being pulled on when a cable to the Allure Series is connected. Create a strain-relief by looping the cable and attaching it to a solid object with a nylon tie so that a tug on the cable will not pull out the connector on the controller.

Communications Wiring

The Network Guide provides extensive information and requirements to implement a BACnet MS/TP network. It contains information about network and sub network length, cable type, device addressing, etc. It can be downloaded at the *www.distech-controls.com* website. For optimal performance, use Distech Controls 24 AWG (0.65 mm) stranded, twisted pair shielded cable or refer to the Network Guide for cable specification. The BACnet MS/TP communication wire is polarity sensitive and the only acceptable topology is to daisy-chain the cable from one controller to the next.

- The first and last daisy-chained BACnet MS/TP device must have its EOL resistors enabled / installed. All other devices must have their EOL resistor disabled (default factory setting).
- When the BACnet MS/TP data bus is connected to a following device, twist data bus shields together or connect directly to the shield terminal.
- Isolate all shields with electrical tape so there is no exposed metal that can touch ground or other conductors.
- The shield of the data bus must be connected to the electrical system ground at only one point – usually at one end of the bus as shown below.
- Connect no more than 50 devices to a BACnet MS/TP data bus.

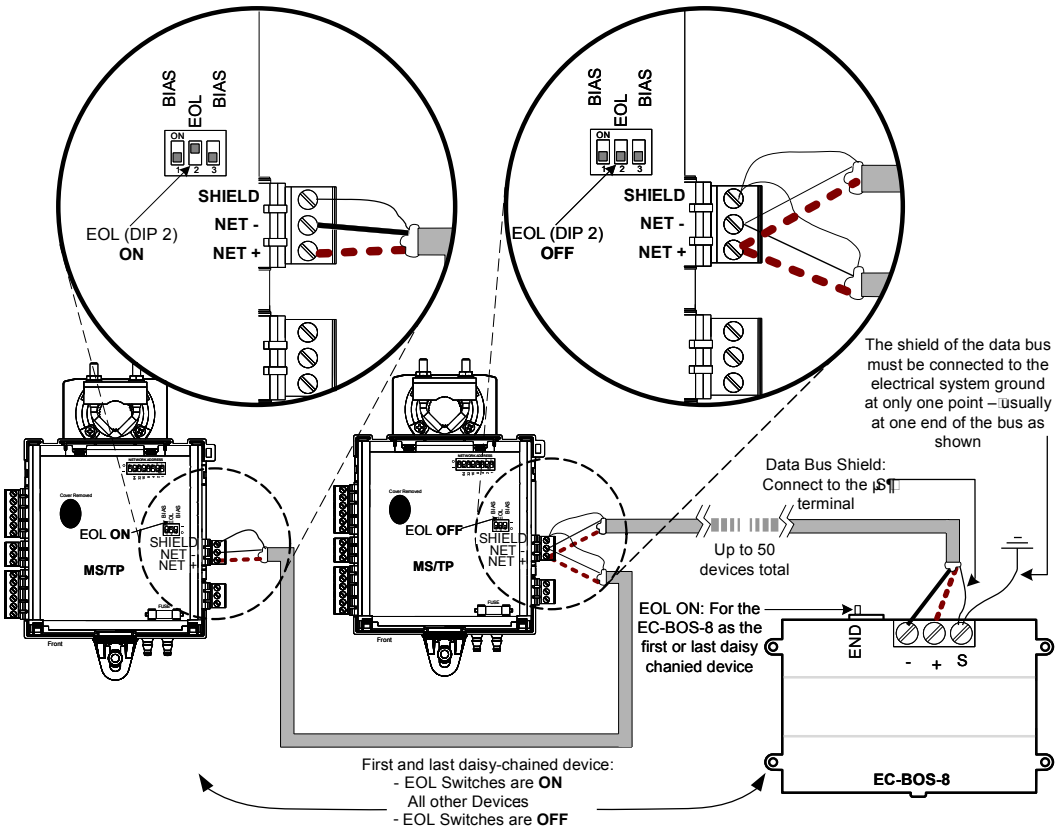


Figure 15: BACnet MS/TP Communications Wiring

BIAS DIP switches must be off unless they are required by another controller other than an ECB-VAV that is on the same daisy-chain. In the case where there is another device other than a ECB-VAV on the same daisy-chain, then both BIAS DIP switches must be in the ON position on no more than ONE controller on the line. Typically the most easily accessible controller will have its BIAS DIP switches in the ON position such as the first VAV, last VAV, or the supervisor (if equipped).

If inserting multiple wires in the terminals, ensure to properly twist wires together prior to inserting them into the terminal connectors.

For more information and detailed explanations on network topology and wire length restrictions, refer to the Network Guide, which can be downloaded from our website.

Device Addressing

The Network Guide provides extensive information and requirements to implement a BACnet MS/TP network. It contains information about network planning and MAC Address numbering schemes. It can be downloaded from the *www.distech-controls.com* website.

The MAC Address must be set according to your network planning document by setting the DIP switch located under the cover or when this DIP switch is set to 0 (all off), the MAC address can be set by connecting an Allure EC-Smart-Vue Series Communicating Sensor to the controller as shown in Step 5 of *Setting the Communicating Sensor Subnet ID* in the following section. An example of how to set the device's MAC Address DIP switch is shown below.

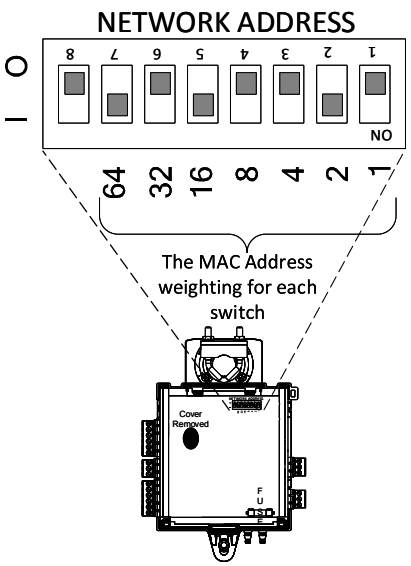


Figure 16: MAC Address DIP Switch Set to 82

DIP Switch number 8 must be set to OFF at all times.

The address is the sum of the numbers set to ON. For example, if the second (2), fifth (16), and seventh (64) DIP switches are set to ON, the device MAC address is 82 (2 + 16 + 64). Only addresses from 1 to 127 are recommended to be used.

The controller must be power cycled after the MAC address DIP switch has been changed. The device instance (DevID) is automatically configured when setting the MAC Address to prevent network address conflict. The following formula is used to determine the device instance:

```
DevID = 364 * 1000 + MAC
```

For example:

```
MAC: 37
DevID = 364 * 1000 + 37 = 364037
```

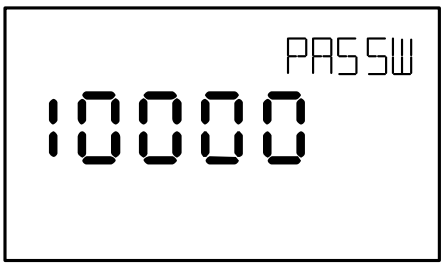
The Device Instance can be changed once the controller has been commissioned through the network management software interface.

Setting the Communicating Sensor Subnet ID

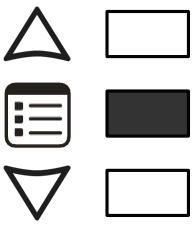
ECB Series controllers can be commissioned with an Allure EC-Smart-Vue Series Communicating Sensor by connecting it to the controller as shown in Figure 14.

The default Subnet ID for an Allure EC-Smart-Vue Series Communicating Sensor is 1. To commission an ECB Series controller, the sensor's Subnet ID must be set to 1. If the sensor's Subnet ID has been set to another value (for example, the display flashes error code 1 with the Bell icon when the sensor is connected to a controller for commissioning), change the Subnet ID to 1 as follows:

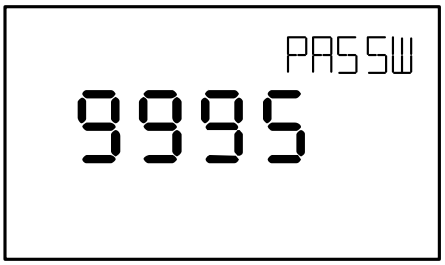
1. Connect an an Allure EC-Smart-Vue Series Communicating Sensor to the controller with a Cat 5e patch cable. Wait for the Bell icon and the number 1 to flash on the display.
2. Press and hold the Menu button for 5 seconds to enter the password menu. 10000 is shown on the display.



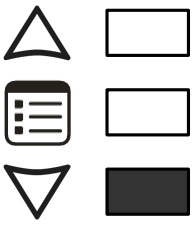
Screen Timeout: 15 seconds



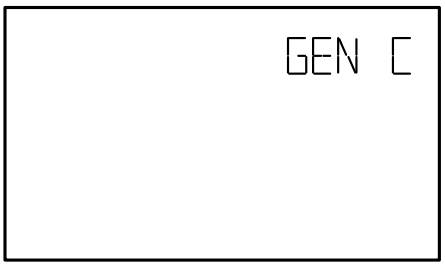
3. Press the down button to set the number to 9995 (this is the default password).



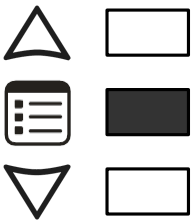
Screen Timeout: 15 seconds



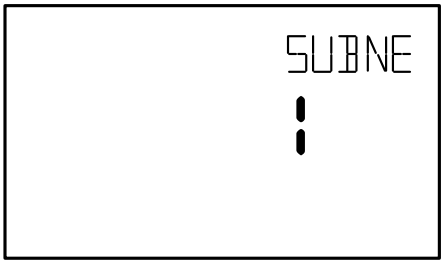
4. Press the Menu button to submit the password. Upon submitting the password, the GEN CFG menu appears on the display.



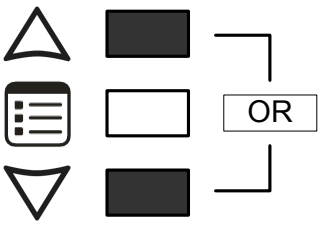
Screen Timeout: 30 seconds



5. Press the down button once to enter the **GEN CFG** submenu.
6. Press the Menu button several times until SUBNET ID appears on the display. The current controller's Subnet ID is shown.



Screen Timeout: 30 seconds



7. Use the up and down buttons to set the controller's Subnet ID to **1**. *Tip*: Hold down either the up or down button to fast-advance the display value.
8. Press the Menu button once.
9. Press and hold the Menu button for 5 seconds to exit the configuration menu.

The an Allure EC-Smart-Vue Series Communicating Sensor can now be used to go from one ECB series controller to the next for commissioning purposes.

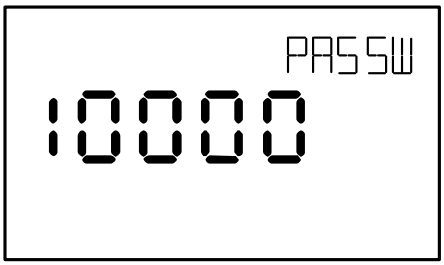
Commissioning ECB-Series Controllers

When using an Allure EC-Smart-Vue Series Communicating Sensor for commissioning ECB Series controllers (the DIP switch located on the faceplate is set to 0 (all off) and before code is downloaded to the controller from EC-*gfx*Program), connect an Allure EC-Smart-Vue Series Communicating Sensor to the controller with its Subnet ID set to 1.

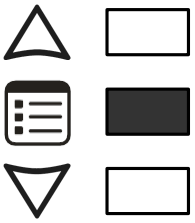
During commissioning, the sensor is used to set the controller's BACnet® MAC Address and to perform application selection if needed. Applications are pre-loaded programs that enable the ECB-VAV to control a typical VAV box.

Set the connected controller's MAC Address as follows:

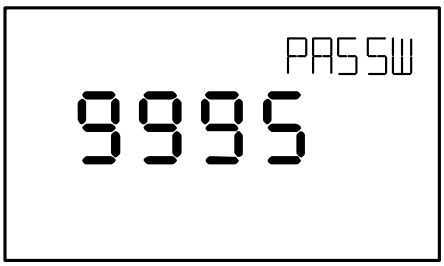
1. Connect an Allure EC-Smart-Vue Series Communicating Sensor to the controller with a Cat 5e patch cable. Wait for the display to show the room temperature.
2. Press and hold the Menu button for 5 seconds to enter the password menu. 10000 is shown on the display.



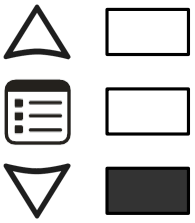
Screen Timeout: 15 seconds



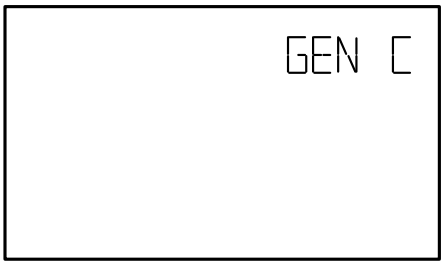
3. Use the down button to set the number to 9995 (this is the default password).



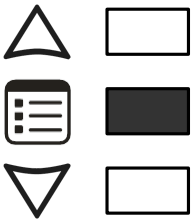
Screen Timeout: 15 seconds



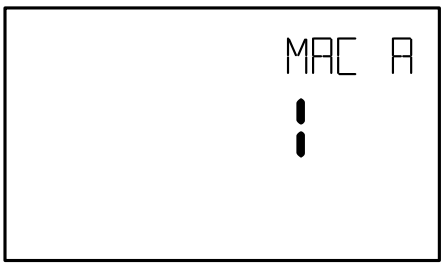
4. Press the **Menu** button to submit the password. Upon submitting the password, the **GEN CFG** menu appears on the display.



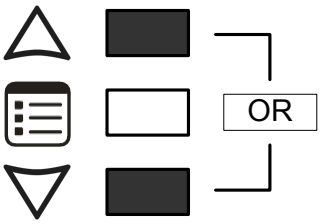
Screen Timeout: 30 seconds



5. Press the down button once to enter the **GEN CFG** submenu. The **MAC ADDRESS** menu is shown with the current controller's BACnet MAC Address.



Screen Timeout: 30 seconds



6. Use the up and down buttons to set the controller's MAC Address. Only addresses from 1 to 127 are recommended to be used.
7. Press the Menu button once to apply the value.
8. Press and hold the Menu button for 5 seconds to exit the configuration menu.

Once the controller's network is operational, the controller can be programmed with EC-*gfx*Program. For each Allure EC-Smart-Vue Series Communicating Sensor, set its Subnet ID number to the block number of its associated ComSensor block in EC-*gfx*Program. This is done in the sensor's **GEN CFG** menu under **SUBNET ID**.

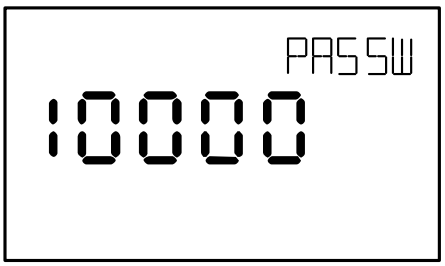
Setting the BAUD Rate (optional – ECB series controllers only)

By default, the BAUD rate for the controller is set to automatically detect the current communication BAUD rate of the connected BACnet MS/TP network (AUTO). This is the preferred setting for a controller. However, at least one controller on the BACnet MS/TP network data bus must have its BAUD rate set. The preference is to set the building controller's BAUD rate (if present). Otherwise, set the BAUD rate on one controller that will set the BAUD rate for all other controllers (to act as the master for setting the BAUD rate).

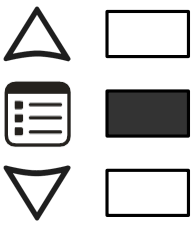
When the Baud rate is set to AUTO, the controller cannot initiate any communication until it has detected the baud rate of the BACnet MS/TP network. If all controllers on the BACnet MS/TP network are set to AUTO, then all controllers will not communicate.

Set the connected controller's BAUD rate as follows:

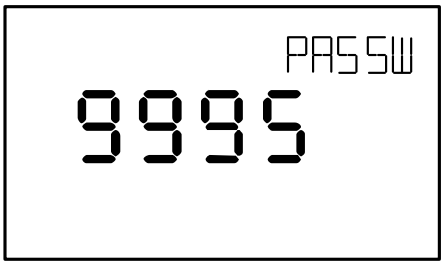
1. Connect an Allure EC-Smart-Vue Series Communicating Sensor sensor to the controller with a Cat 5e patch cable. Wait for the display to show the room temperature.
2. Press and hold the Menu button for 5 seconds to enter the password menu. 10000 is shown on the display.



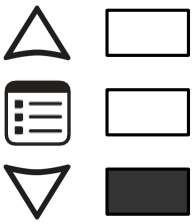
Screen Timeout: 15 seconds



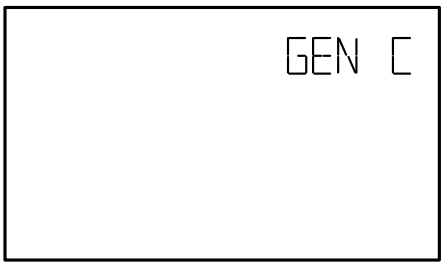
3. Use the down button to set the number to 9995 (this is the default password).



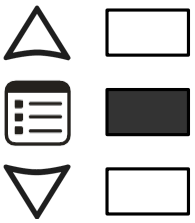
Screen Timeout: 15 seconds



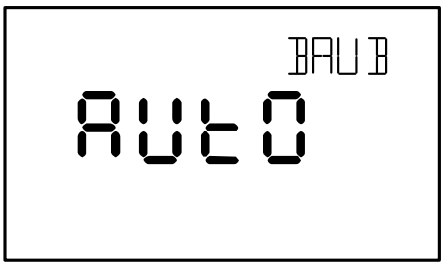
4. Press the **Menu** button to submit the password. Upon submitting the password, the **GEN CFG** menu appears on the display.



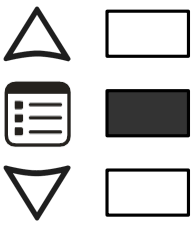
Screen Timeout: 30 seconds



5. Press the down button once to enter the **GEN CFG** submenu.
6. Use the Menu button several times until **BAUD RATE appears on the display**. The current controller's BAUD rate is shown.



Screen Timeout: 30 seconds



7. Use the up and down buttons to set the controller's Baud rate. The **AUTO** setting detects and uses the current baud rate being used by the BACnet MS/TP network.
8. Press the Menu button once to apply the value.
9. Press and hold the Menu button for 5 seconds to exit the configuration menu.

Wireless Installation

When connected to a Wireless Receiver, controllers can receive input signals from a wide selection of wireless devices. Compatible wireless devices include temperature sensors, duct sensors, window/door contacts and light switches. These devices are easy to install, and can be mounted on a wide range of building materials.

Before connecting any wireless equipment to the controller, refer to the Open-to-Wireless Solution Guide.

Connecting the Wireless Receiver

The Wireless Receiver is connected to the controller using a 2m (6.5ft) telephone cable with 4P4C modular connectors at both ends. Do not exceed this cable length. The Wireless Receiver's telephone socket is located inside the device. To locate it, open the Wireless Receiver by separating its front and back plates.

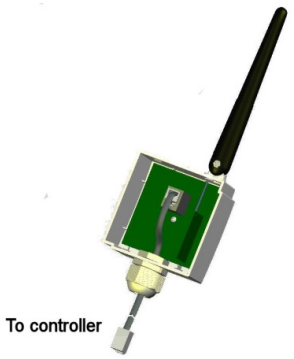


Figure 17: Location of the Wireless Receiver's telephone socket

Connecting to the Controller's Wireless Port

Each controller has a wireless port in which one end of the Wireless Receiver's telephone cable plugs in.

Uncover the controller to locate the wireless port on the PCB board (marked as *Wireless Module*).

Terminal Block Cover

In certain jurisdictions, terminal block covers are required to meet local safety regulations. Terminal block covers are available for all controllers and are used to conceal the controllers' wire terminals. Terminal block covers are optional and are sold as peripherals.

The terminal block cover can be clipped on to the controller as shown below.

Figure 18: Terminal Block Covers

Maintenance

Unplug device before any kind of servicing.

The device requires minimal maintenance, but it is important to take note of the following:

- ☐ If it is necessary to clean the outside of the device, use a dry cloth.
- ☐ Retighten terminal connector screws annually to ensure the wires remain securely attached.

Disposal

The Waste Electrical and Electronic Equipment (WEEE) Directive set out regulations for the recycling and disposal of products. The WEEE2002/96/EG Directive applies to standalone products, for example, products that can function entirely on their own and are not a part of another system or piece of equipment.

For this reason Distech Controls products are exempt from the WEEE Directive. Nevertheless, Distech Controls products are marked with the WEEE symbol, indicating devices are not to be thrown away in municipal waste.

Products must be disposed of at the end of their useful life according to local regulations and the WEEE Directive.

North American Emissions Compliance

United States

Changes or modifications not expressly approved by Distech Controls could void the user's authority to operate the equipment.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential and commercial installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- ☐ Reorient or relocate the receiving antenna.
- ☐ Increase the separation between the equipment and receiver.
- ☐ Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- ☐ Consult the dealer or an experienced radio/TV technician for help.

Canada

This Class (B) digital apparatus meets all the requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la Classe (B) respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

Troubleshooting Guide

Controller is powered but does not turn on

Fuse has blown	Disconnect the power. Check the fuse integrity. Reconnect the power.
Power supply polarity	Verify that consistent polarity is maintained between all controllers and the transformer. Ensure that the 24VCOM terminal of each controller is connected to the same terminal on the secondary side of the transformer. See *Power Wiring.*

Controller cannot communicate on a BACnet MS/TP network

Absent or incorrect supply voltage	1. Check power supply voltage between 24VAC ±15% and 24VCOM pins and ensure that it is within acceptable limits. 2. Check for tripped fuse or circuit breaker.
Overloaded power transformer	Verify that the transformer used is powerful enough to supply all controllers.
Network not wired properly	Double check that the wire connections are correct.
Absent or incorrect network termination	Check the network termination(s).
Max Master parameter	Configure the maximum number of master device on the MS/TP network in all devices to the controller's highest MAC address used on the MS/TP trunk.
There is another controller with the same MAC Address on the BACnet MS/TP data bus	Each controller on a BACnet MS/TP data bus must have a unique MAC Address. Look at the MAC Address DIP switch on the faceplate or under the cover of the controller. If it is set to 0 (all off), use an Allure EC-Smart-Vue sensor to check the MAC Address.
There is another controller with the same Device ID on the BACnet intranetwork	Each controller on a BACnet intranetwork (the entire BACnet BAS network) must have a unique Device ID. Use an Allure EC-Smart-Vue sensor to check the Device ID of each controller.

Controller communicates well over a short network, but does not communicate on large network

Network length	Check that the total wire length does not exceed the specifications of the *Network Guide*.
Wire type	Check that the wire type agrees with the specification of the *Network Guide*.
Network wiring problem	Double check that the wire connections are correct.
Absent or incorrect network termination	Check the network termination(s). Incorrect or broken termination(s) will make the communication integrity dependent upon a controller's position on the network.
Number of controllers on network segment exceeded	The number of controllers on a channel should never exceed 50. Use a router or a repeater in accordance to the *Network Guide*.
Max Master parameter	Configure the maximum number of master device on the MS/TP network in all devices to the controller's highest MAC address used on the MS/TP trunk.
There is another controller with the same MAC Address on the BACnet MS/TP data bus	Each controller on a BACnet MS/TP data bus must have a unique MAC Address. Look at the MAC Address DIP switch on the faceplate or under the cover of the controller. If it is set to 0 (all off), use an Allure EC-Smart-Vue sensor to check the MAC Address.
There is another controller with the same Device ID on the BACnet intranetwork	Each controller on a BACnet intranetwork (the entire BACnet BAS network) must have a unique Device ID. Use an Allure EC-Smart-Vue Series Communicating Sensor to check the Device ID of each controller.

Hardware input is not reading the correct value

Input wiring problem	Check that the wiring is correct according to this manual and according to the peripheral device's manufacturer.
Configuration problem	Using EC-gfxProgram, check the configuration of the input. Refer to the EC-gfxProgram user guide for more information.
Over-voltage or over-current at an input	An over-voltage or over-current at one input can affect the reading of other inputs. Respect the allowed voltage / current range limits of all inputs. Consult the appropriate datasheet for the input range limits of this controller.
Open circuit or short circuit	Using a voltmeter, check the voltage on the input terminal. For example, for a digital input, a short circuit shows approximately 0V DC and an open circuit shows approximately 5V DC.

Hardware output is not operating correctly

Fuse has blown (Auto reset fuse)	Disconnect the power and outputs terminals. Then wait a few seconds to allow the auto-reset fuse to cool down. Check the power supply and the output wiring. Reconnect the power.
Output wiring problem	Check that the wiring is correct according to this manual and according to the peripheral device's manufacturer.
Configuration problem	Using EC-gfxProgram, check the configuration of the input. Refer to the EC-gfxProgram user guide for more information.
0 to 10V output, 24VAC powered actuator is not moving.	Check the polarity of the 24VAC power supply connected to the actuator while connected to the controller. Reverse the 24VAC wire if necessary.

Wireless devices not working correctly

Device not associated to controller	Using EC-*gfx*Program, check the configuration of the input. Refer to the *EC-gfxProgram user guide* for more information.
Power discharge	1. Recharge device with light (if solar-powered) or replace battery (if battery-powered), 2. Ensure sufficient light intensity (200lx for 4 hours/day).
Device too far from the Wireless Receiver	Reposition the device to be within the range of the Wireless Receiver. For information on typical transmission ranges, refer to the *Open-to-Wireless Solution Guide.*
Configuration problem	Using the device configuration plug-in or wizard, check the configuration of the input. Refer to the Wireless Battery-less *Sensors and Switches Solutions Guide* for more information.

Flow sensor is not giving proper readings

Tubing connection problem	1. Ensure the tubing is installed properly and that the tubing is not bent.
Controller is not calibrated properly	Recalibrate the controller. Refer to the controller's user guide for more information.

Damper is not opening or closing properly

Mechanical stops not in proper position	The two mechanical stops must be positioned to stop the damper motion when it is completely closed and completely opened. The mechanical stops can be moved by increments of 5°.
Controller in Override	Set the Override to OFF in the wizard.

Rx/Tx LEDs

RX LED not blinking	Data is not being received from the BACnet MS/TP data bus.
TX LED not blinking	Data is not being transmitted onto the BACnet MS/TP data bus.

Status LED– Normal Operation

One fast blink 	Initialization: The device is starting up.
Fast blink continuous:  (150ms On, 150ms Off, continuous)	Firmware upgrade in progress. Controller operation is temporarily unavailable. The new firmware is being loaded into memory. This takes a few seconds. Do not interrupt power to the device during this time.
The Status LED is always OFF	The controller is operating normally.

Status LED blink patterns – Repeats every 2 seconds (highest priority shown first)

Long Long Long blink  (800ms On, 300ms Off, 800ms On, 300ms Off, 800ms On)	The device has not received a BACnet token, and therefore cannot communicate on the network: Verify that the controller's MAC Address is unique on the BACnet MS/TP Data Bus – see Device Addressing. Make sure the controller's BAUD rate is the same as the BACnet MS/TP Data Bus' BAUD rate (see Setting the BAUD Rate (optional)). Verify that the Max Master is set high enough to include this controller's MAC Address (See the Network Guide).
Short Short Long blink  (150ms On, 300ms Off, 150ms On, 300ms Off, 800 ms On)	Poor-quality power; The device has browned-out: The voltage at the 24VAC and 24VCOM terminals has gone below the device's acceptable limit during power up.
Short Long blink  (150ms On, 300ms Off)	Invalid MAC address: The device's MAC address is set to zero (0) or is set to an address higher than the Max Master. See the Network Guide.

For issues with the Allure EC-Smart-Vue Series Communicating Sensor, refer to the Allure EC-Smart-Vue Series Communicating Sensor Hardware Installation Guide.

Allure™ EC-Smart-Vue Sensor Series

Line of communicating sensors with backlit display and graphical menus

Overview

The Allure EC-Smart-Vue Series is designed to interface with Distech Controls' ECLYPSE™ series BACnet/IP and Wi-Fi Controllers, ECB series BACnet® Controllers and ECL series LonWorks® Controllers.

This line of communicating sensors with backlit display consists of eight models that provide precise environmental zone control. Models are available with any combination of the following: temperature, humidity, CO_2, and motion sensor.

Features & Benefits

- Multi-sensing capabilities (temperature, humidity, CO_2, and motion) using one wire and one connection
- Optional CO_2 sensor facilitates demand-controlled ventilation strategies
- Optional motion sensor helps achieve energy efficiency through occupancy-based control
- ABC Logic Self-Calibration system guarantees lifetime CO_2 calibration
- The ECO-Vue leaf pattern graphically indicates energy consumption in real time to promote an occupant's energy-conscious behavior
- Password protected technician mode allows an installer to perform commissioning and troubleshooting
- Can be used as a hand-held tool for HVAC equipment configuration and system troubleshooting
- When associated to VAV controllers, the Allure EC-Smart-Vue Series sensors can also perform air balancing of the system without requiring an onsite controls engineer.
- Programmability with Distech Controls' EC-*gfx*Program, which makes Building Automation System programming effortless
- Quick and easy installation: Both power and communications pass through a single Cat 5e cable for reduced installation costs and easier installation
- Two RJ-45 ports facilitate the daisy-chain connections of room devices.

Model Selection Table

Example: Allure EC-Smart-Vue***-M***

Series	Functionality
Allure EC-Smart-Vue	**[blank]:** Temperature only
	-C: CO_2[1], Temperature
	-H: Humidity, Temperature
	-M: Motion, Temperature
	-CH: CO_2[1], Humidity, Temperature
	-CM: CO_2[1], Motion, Temperature
	-HM: Humidity, Motion, Temperature
	-CHM: CO_2[1], Humidity, Motion, Temperature

1. The Allure EC-Smart-Vue CO_2 models must be used in spaces that are periodically unoccupied (e.g. during evening or nighttime hours). A controller can support a maximum of two communicating sensors equipped with a CO_2 sensor. Any remaining connected communicating sensors must be without a CO_2 sensor.

Product Specifications

Power Supply Input

Voltage	16 VDC maximum, Class 2
Power Consumption	At the connected controller, an additional 5.25 VA per CO_2 sensor model and 1.0 VA per non-CO_2 sensor model.

Communications

Rate	38 400 bps
Communications	RS-485
Wiring	Cable length: 600 ft (180 m) maximum
Cable Type	T568B Cat 5e network cable, 4 twisted pairs
Input Connector	RJ-45
Output Connector	RJ-45 (pass-through for daisy chain connection to other room devices)
Network Access Jack[1]	⅛" (3.5 mm) stereo plug connector
Daisy-chaining	Up to 12 Allure EC-Smart-Vue sensors or room devices depending on the controller model – see the controller's datasheet

1. Not available with ECLYPSE Series, PTU Series, ECB-VAVS, or ECL-VAVS

Temperature Sensor

Type	10 kΩ NTC Thermistor
Range	41°F to 104°F (5°C to 40°C)
Sensing Component Typical Accuracy	±0.5°F (±0.28°C)
Overall Accuracy	± 0.9°F (± 0.5°C)
Resolution	0.18°F (0.1°C)

Humidity Sensor

Accuracy	±3%
Resolution	1%

Motion Sensor

Type	Passive Infrared (PIR) sensor with Fresnel lens. See Figure 2.

CO_2 Sensor

Measurement Range	0 to 2000 ppm
Operating Elevation	0 to 16000 ft (0 to 4877 m)
Warm-up Time	< 2 minutes (operational), 10 minutes (maximum accuracy)
CO_2 Accuracy	400-1250 ppm ± 30 ppm or 3% of reading, whichever is greater [1]
	1250-2000 ppm ±5% of reading + 30ppm [1]
Temperature Dependence	±0.11% FS per°F (0.2% FS per °C)
Stability	<2% of FS over life of sensor (15 years)
Pressure Dependence	0.135% of reading per mm Hg; software adjustable
Sensing Method	Non-dispersive infrared (NDIR) absorption
	Gold-plated optics
Calibration Method	Patented ABC Logic self-calibration algorithm

1. Tolerance based on span gas of ±2% and ABC Logic enabled.

Mechanical

Dimensions with motion sensor (H×W×D)	4.62 × 3.29 × 1.15" (117.27 × 83.57 × 28.84 mm)
Dimensions without motion sensor (H×W×D)	4.62 × 3.29 × 1.06" (117.27 × 83.57 × 26.81 mm)
Shipping weight with motion sensor	0.20 kg (0.44lbs)
Shipping weight without motion sensor	0.18 kg (0.40lbs)
Enclosure Material	ABS
Enclosure Rating	Plastic housing, UL94-V1
Color	white
Installation	wall mounting through mounting holes (see Figure 1 for hole positions)

Environmental

Operating Temperature	32°F to 122°F (0°C to 50°C)
Storage Temperature	-4°F to 122°F (-20°C to 50°C)
Relative Humidity	0 to 90% Non-condensing

Standards and Regulations

CE Emission	EN 61000-6-3: 2007 + A1: ed.2011
CE Immunity	EN 61000-6-1: 2007
FCC	FCC rules part 15, subpart B class B
UL Listed (CDN & US)	UL916 Energy management equipment
WEEE	All products are marked according to the Waste Electrical and Electronic Equipment (WEEE) directive
RoHS	All materials and manufacturing processes comply with the RoHS directive

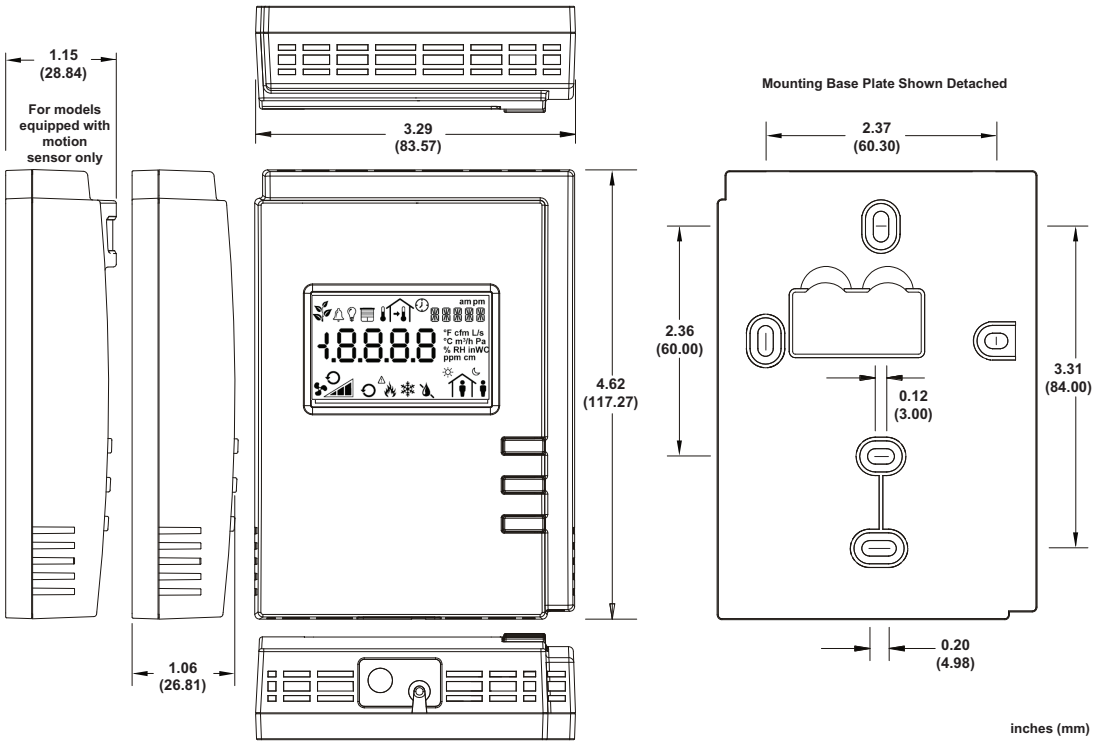


Figure 1: EC-Smart-Vue Dimensions

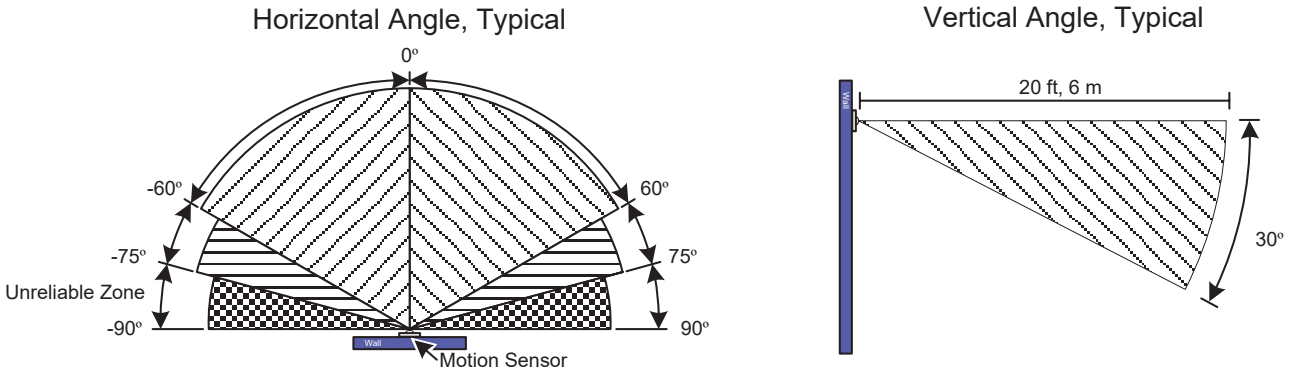


Figure 2: Motion Sensor

Allure™ EC-Smart-Vue Sensor Series

Figure 1: (Left image) Allure EC Smart Vue, Allure EC Smart Vue-H/-C/-CH sensors. (Right image) Models equipped with a motion sensing window in the upper left corner: Allure EC Smart Vue-M/-CM/-HM/-CHM sensors

Product Description

The Allure EC-Smart-Vue Series is designed to interface with Distech Controls' ECLYPSE™ series BACnet/IP and Wi-Fi Controllers, ECB series BACnet® Controllers and ECL series LonWorks® Controllers.

This line of communicating sensors with backlit display consists of eight models that provide precise environmental zone control. Models are available with any combination of the following: temperature, humidity, CO_2, and motion sensor.

General Installation Requirements

For proper installation and subsequent operation of the device, pay special attention to the following recommendations:

- ☐ Upon unpacking, inspect the contents of the carton for shipping damages. **Do not install a damaged device.**
- ☐ Allow for proper clearance around the device's enclosure and wiring terminals to provide easy access for hardware configuration and maintenance.
- ☐ Orient the device with the ventilation slots towards the top to permit proper heat dissipation.
- ☐ Ensure proper ventilation of the device and avoid areas where corroding, deteriorating or explosive vapors, fumes or gases may be present.

Any type of modification to any Distech Controls product will void the product's warranty

Take reasonable precautions to prevent electrostatic discharge to the device when installing, servicing or during operation. Discharge accumulated static electricity by touching one's hand to a well-grounded object before working with the device.

General Wiring Recommendations

Risk of Electric Shock: Turn off power before any kind of servicing to avoid electric shock.

- ☐ All wiring must comply with electrical wiring diagrams as well as national and local electrical codes.
- ☐ Comply with all network and power supply guidelines outlined in the Network Guide.
- ☐ Use the screws, wall anchors, and wire nuts included for wall mounting and wiring.

Maintenance and Cleaning

Gently clean the device with a soft, lint-free cloth slightly moistened with a solution of mild liquid dish soap and warm water or disinfect the device with a soft cloth slightly moistened with a 70% isopropyl alcohol.

Do not directly spray any liquid or disinfecting solution on the device. Do not clean with any other chemicals products.

Mounting Instructions

The Allure EC-Smart-Vue has been specially designed for easy installation. However, certain conditions apply when choosing a suitable location for the device:

- ☐ Install the device in a location of average temperature approximately 5 ft (1.5 m) above the floor
- ☐ The device should not be installed on an exterior wall.
- ☐ The device should not be installed near a heat source.
- ☐ The device should not be installed near an air discharge grill.
- ☐ The device should not be installed in a place where it can be affected by the sun.
- ☐ Install the device in an area that provides proper device ventilation. Nothing must restrain air circulation to the device.

The Allure EC-Smart-Vue has not been designed for outdoor use.

Mounting hardware with a separate sub-base is provided with the device for installation on dry wall or on an electrical junction box.

Wall Mounting Installation Procedure

The Allure EC-Smart-Vue can be mounted on a dry wall using supplied screws.

1. Remove the security screw from the device (See Device Mounting [pg. 3]).
2. Open the device by pressing in the two (2) tabs on the bottom of the device and pulling the bottom side of the front plate out.
3. Set any jumpers (see Connector and Jumper Location, Identification and Configuration [pg. 4]).
4. Pull all cables 6” (15cm) out of the wall, and insert them through the central hole of the back plate.
5. Align the back plate with the wall and mark the location of the mounting holes on the wall. Make sure to orient the proper side of the back plate facing upwards.
6. Remove the back plate and drill holes in the wall if necessary.
7. Install anchors in the wall if necessary.
8. Make sure that the mounting surface is flat and clean.
9. Screw the back plate onto the wall. Do not over tighten.
10. Plug the wire(s) into the connector(s).Gently push excess wiring back into the wall.
11. Reattach the front plate and make sure it clips tightly into place.
12. Install security screw.

Device Dimensions

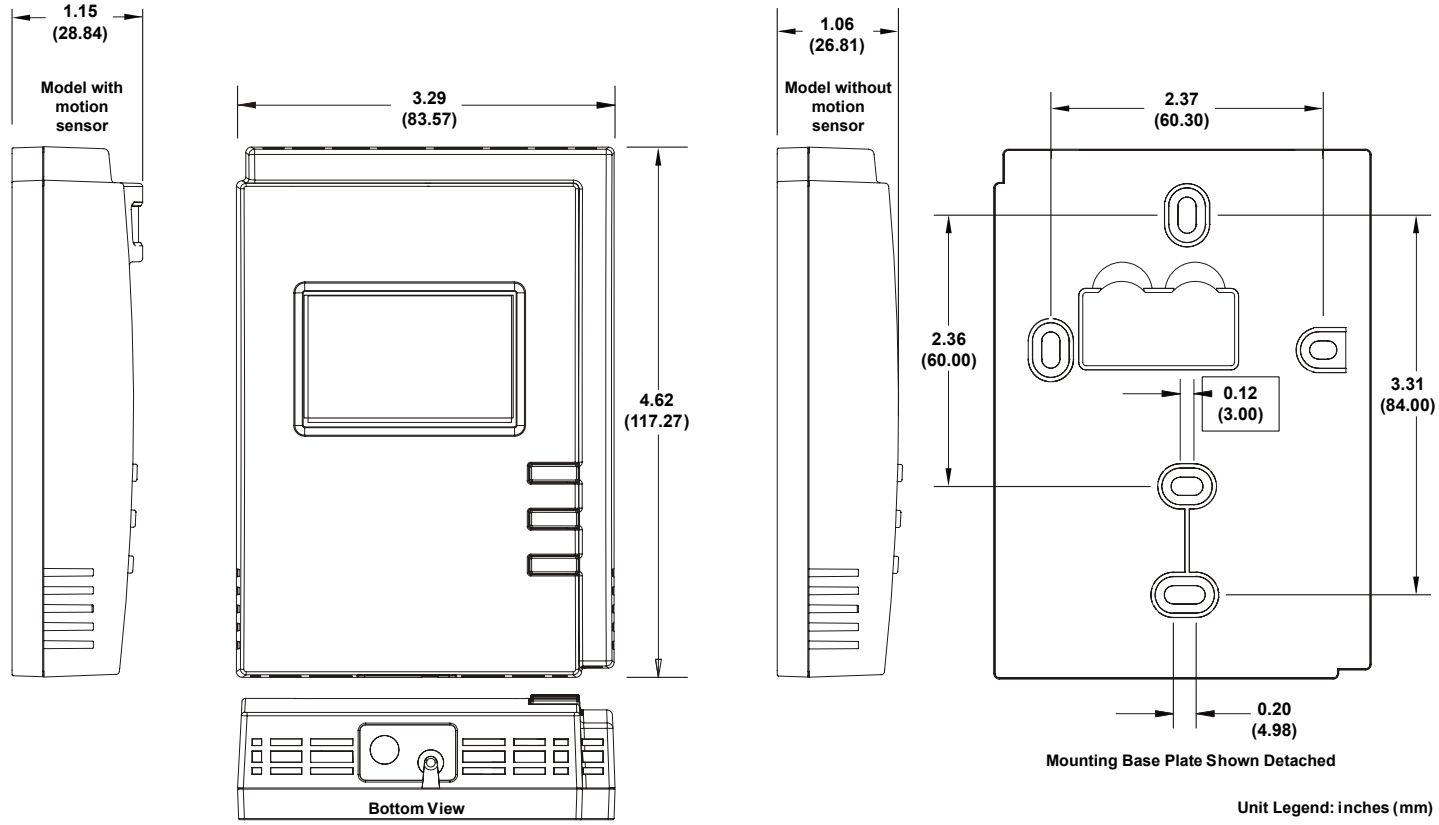


Figure 2: Front view, bottom view, back plate, and side view for models with and without motion sensor.

Device Mounting

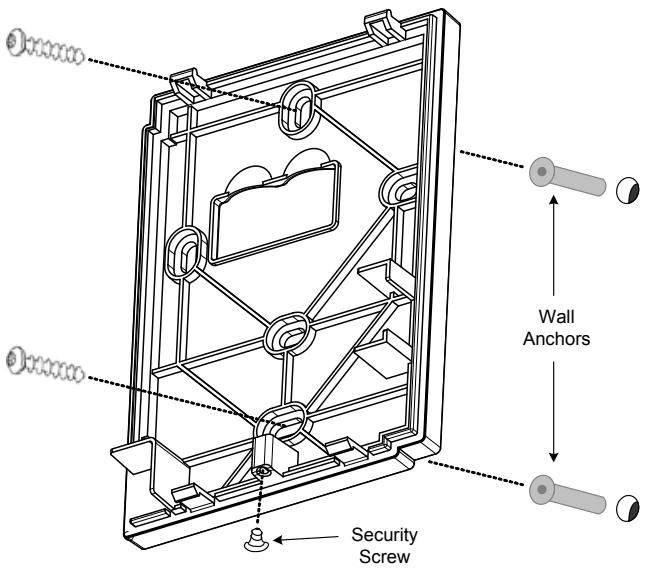


Figure 3: Mounting an Allure EC-Smart-Vue Sensor

Connector and Jumper Location, Identification and Configuration

Allure EC-Smart-Vue sensors have the following onsite configurable jumpers.

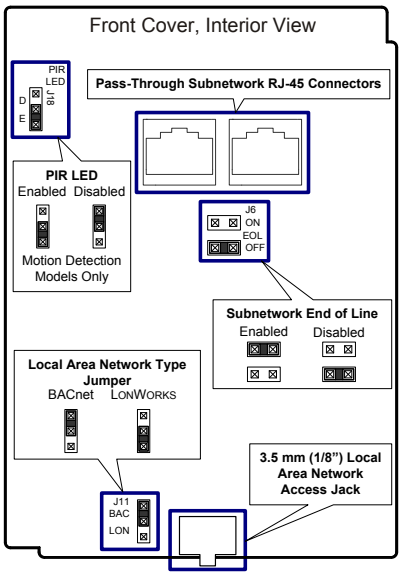


Figure 4: Connector and Jumper Locations

About an Allure EC-Smart-Vue Sensor Equipped with a CO_2 Sensor

The Allure EC-Smart-Vue C/-CM/-CH/-CHM sensors are factory calibrated to accurately read CO_2 concentration levels at sea level. When these Allure EC-Smart-Vue sensors are used in locations where the elevation is greater than 500ft (152m) above sea level, you must set the **Elevation** input of the corresponding **ComSensor** block in EC-*gfx*Program to the current location's elevation to obtain the most accurate readings.

For more information, refer to the **ComSensor** block section in the EC-*gfx*Program User Guide

Under normal conditions, an Allure EC-Smart-Vue sensor with CO_2 sensor will typically reach its operational accuracy after 25 hours of continuous operation on the condition that it was exposed to ambient air reference levels of 400 ppm ±10 ppm CO_2.

Supported Quantity

The Allure EC-Smart Vue sensor connects to the controller's **Subnet Port**. Other expansion modules may also be connected to this port in a daisy-chained fashion (see the controller's datasheet for compatibility information and supported quantities).

Each controller supports a maximum number of Allure EC-Smart Vue sensors. The Subnet ID of all Allure EC-Smart Vue sensors must be set to be within the shown addressing range.

Series	Maximum Number of Allure EC-Smart-Vue sensors[1]	Permitted Subnet ID Addressing Range
ECB-VAV ECL-VAV ECY-VAV ECY-VAV-PoE ECY-303	Up to 4[2]	1 to 4
ECB-VAV-O ECL-VAV-O ECB-VAVS ECL-VAVS ECB-VVTS ECL-VVTS ECB-VAV-N ECL-VAV-N ECB-PTU Series ECL-PTU Series ECB-103 ECL-103 ECB-203 ECL-203 ECY-TU/PTU	4	1 to 4
ECB-300 ECL-300 ECB-400 Series ECL-400 Series ECB-600 Series ECL-600 Series ECY-S1000 Series	12	1 to 12

Table 1: Number of Allure EC-Smart-Vue sensors supported by controller model

1. A controller can support a maximum of two (2) Allure EC-Smart Vue sensor models equipped with a CO_2 sensor. Any remaining connected Allure EC-Smart Vue sensor models must be without a CO_2 sensor.
2. See the room device calculator spreadsheet available for download from our website to know the permitted quantities according to the controller model: VAV Smart Room Control Device Calculator.xlsm.

About the Subnetwork Bus

The ECB-600 and ECL-600 controllers use the Subnetwork bus to support the ECx-400 Series I/O Extension Modules through the controllers **Subnet+** and **Subnet-** terminals with 2-wire shielded cable.

The ECB-600 and ECL-600 controllers also use the Subnetwork bus to support one or more Allure Series(s) using standard structural (Cat 5e) cabling.

Subnetwork Bus Total Length

The total maximum length of all Subnetwork buses, including both the length of the Allure Series Communicating Sensor Subnetwork bus and the ECx-400 Series Subnetwork bus is 300 m (1 000 ft). The maximum length of the Allure Series Communicating Sensor Subnetwork bus is 200 m (650 ft). The maximum length of the ECx-400 Series Subnetwork bus is 300 m (1 000 ft).

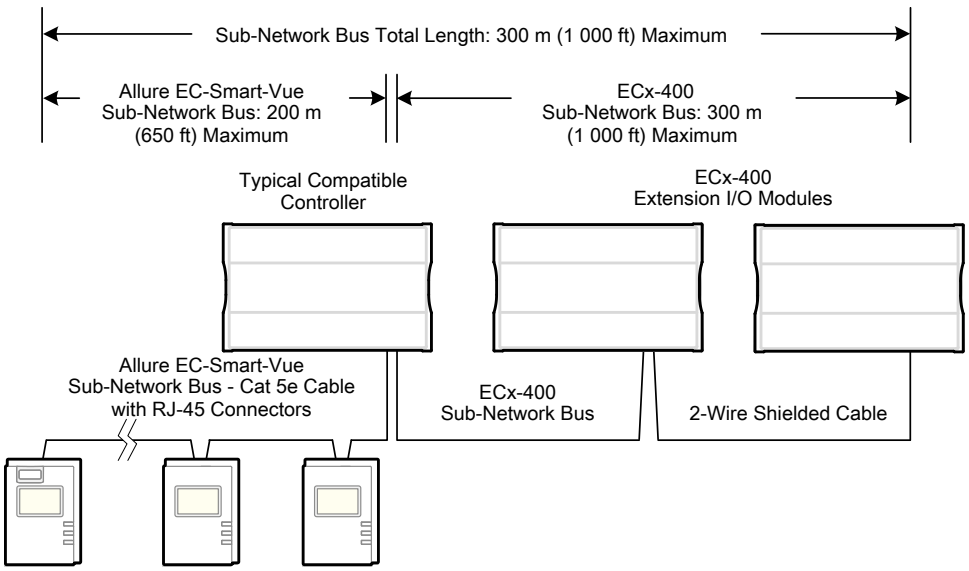


Figure 5: Subnetwork Bus Overview Showing the Allure EC-Smart-Vue Subnetwork Bus and the ECx-400 Series Subnetwork Bus.

A controller can support a maximum of two Allure EC-Smart-Vue sensor models equipped with a CO_2 sensor; the remaining connected models must be without a CO_2 sensor. See Table 1 for the quantity of room devices supported by each controller model.

For instance, if the controller model supports a subnetwork with 12 Allure EC-Smart-Vue sensors in total, then 10 sensor models must be without a CO2 sensor and the other two can be equipped with a CO2 sensor. To ensure proper operation, it is recommended to distribute the sensors throughout the length of the subnetwork.

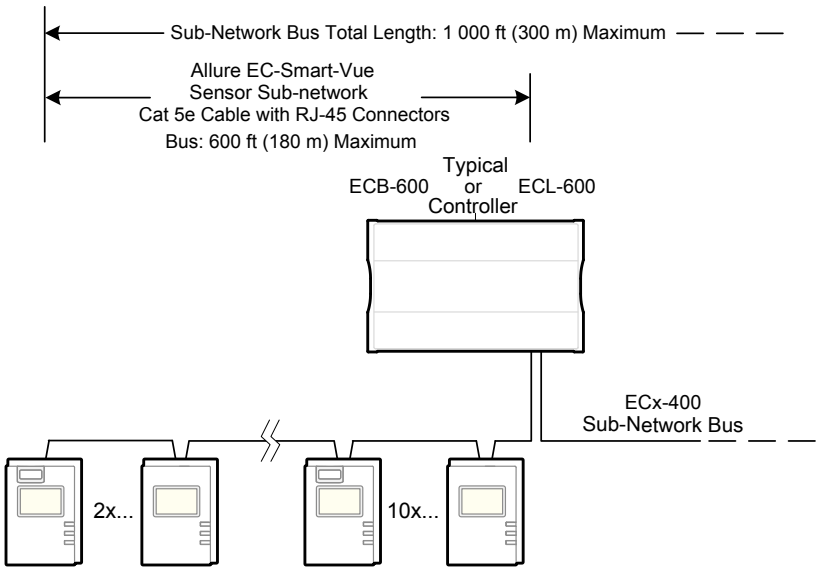


Figure 6: Allure EC-Smart-Vue Sensor Subnetwork Length and Distribution

For ECB/ECL-PTU Series controllers, the maximum length between two consecutive devices on the sub-network bus is 100 feet (30 m).

Subnetwork Bus Topology and EOL Terminations

Only a daisy chain topology is acceptable for the room device subnetwork bus. T connections are not allowed.

Some controller models support the connection of other devices to the **Subnet Port** as part of the Smart Room Control solution (see the controller's datasheet for more information).

For non ECB-600 or ECL-600 Series controllers, only the EOL terminations of the last subnetwork bus device are set to ON. All other subnetwork bus devices must have their EOL terminations set to OFF. The controller must be the first device on the Cat 5e Cable Subnetwork bus as its internal EOL termination is permanently enabled.

See Table 1 for the number of Allure EC-Smart-Vue sensors that a given controller model can support.

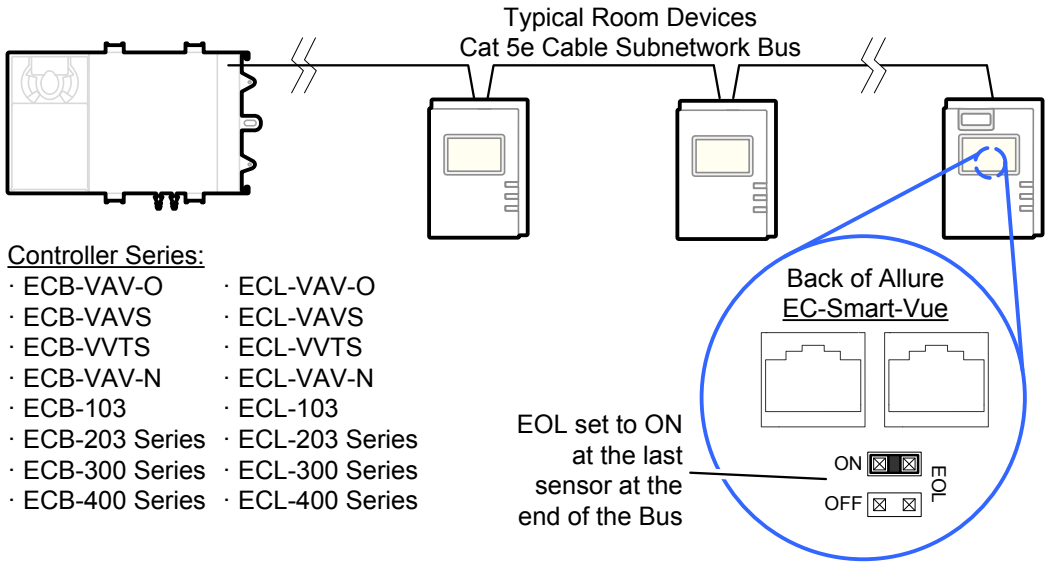


Figure 7: Setting the EOL Terminations on the Allure EC-Smart-Vue Sensor for non ECB-600 or ECL-600 series, non-Smart Room Control controllers

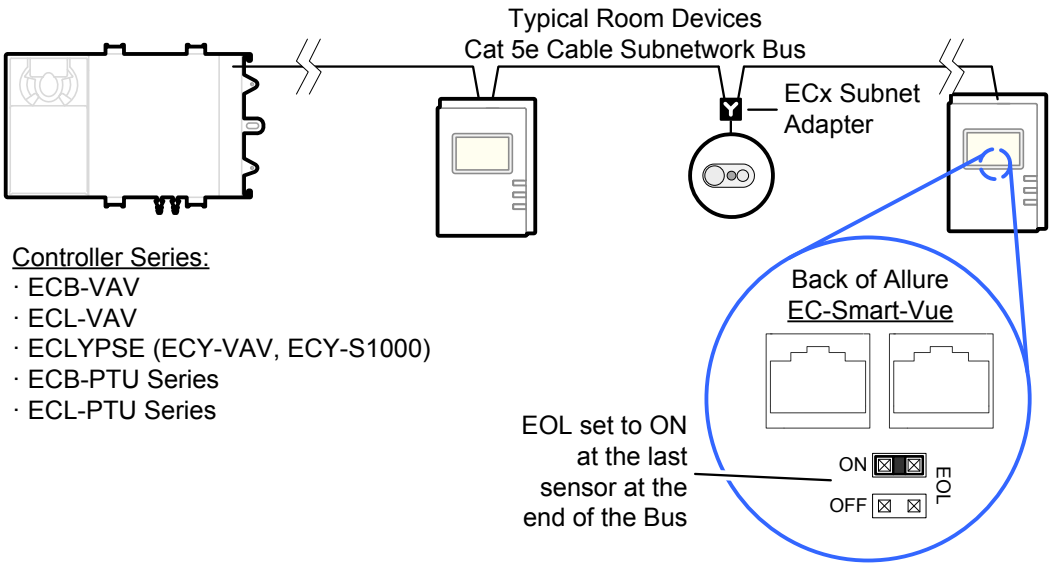


Figure 8: Setting the EOL Terminations on the Allure EC-Smart-Vue Sensor for Smart Room Control-compatible controllers

When one or more Allure EC-Smart-Vue sensors are installed with an ECB-600 or ECL-600 (without an ECx-4xx IO Extension Module), only the EOL terminations on the ECB-600 / ECL-600 and the last Allure EC-Smart-Vue sensor are set to ON. All other Allure EC-Smart-Vue sensors must have their EOL terminations set to OFF.

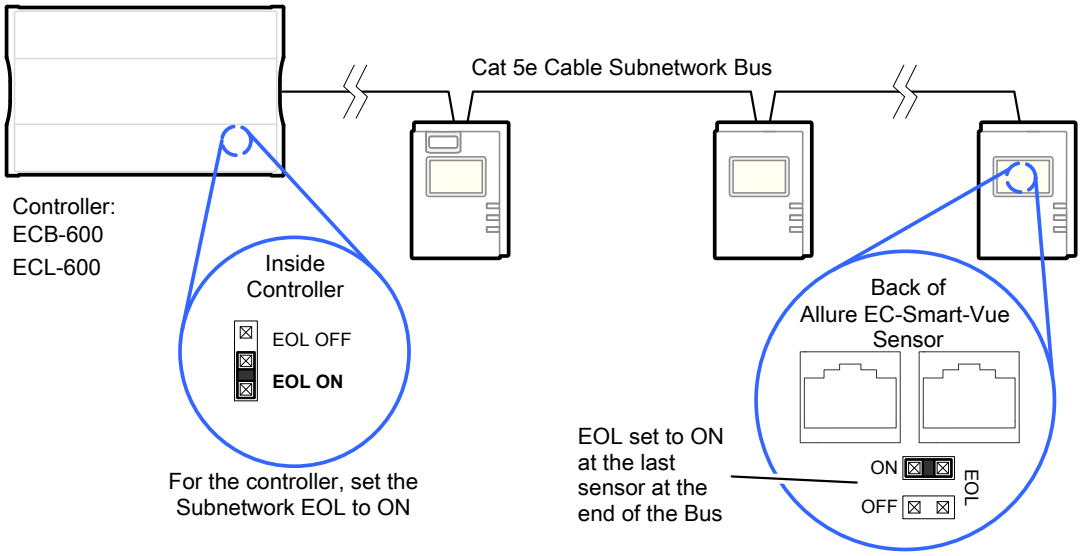


Figure 9: Setting the EOL Terminations on the Allure EC-Smart-Vue Sensor for ECB-600 or ECL-600 Series controllers

When ECx-400 Series I/O Extension Modules are installed with an ECB-600 or ECL-600 Series controller and with Allure Series Communicating Sensors, only the EOL terminations on the last I/O Extension Module and the last Allure Series Communicating Sensor are set to ON. The ECB-600 / ECL-600 and all other I/O Extension Modules and Allure Series Communicating Sensor s must have their EOL terminations set to OFF.

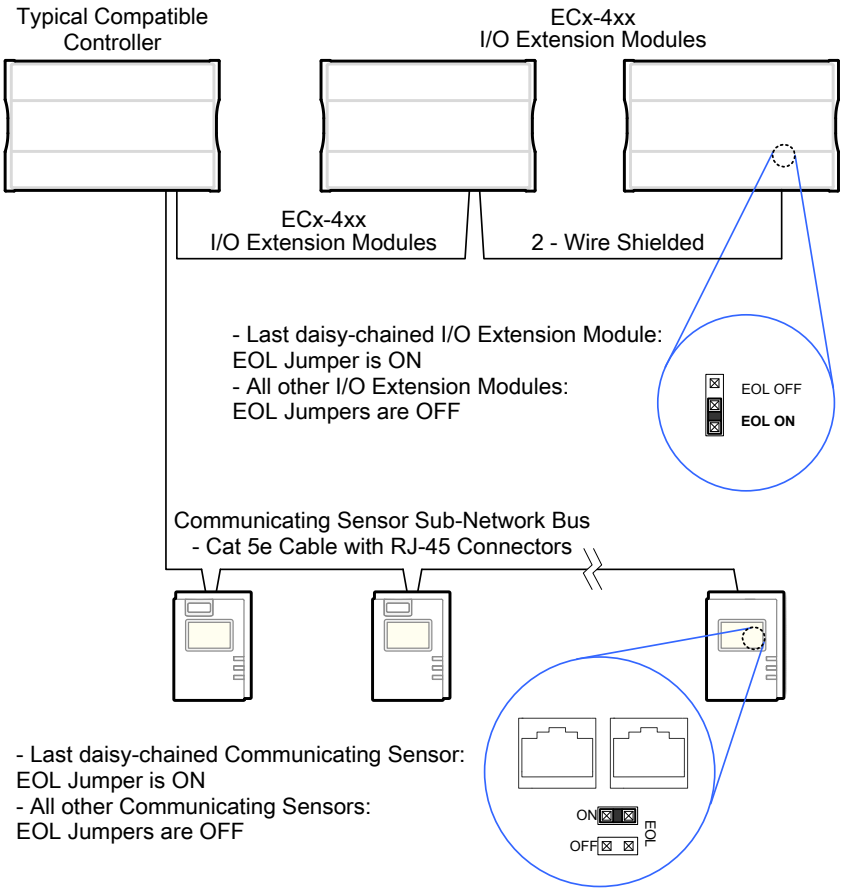


Figure 10: Setting the EOL Terminations on the ECx-400 Series Subnetwork Bus when Allure EC-Smart-Vue Sensors are used

ECx-400 Series devices and Allure EC-Smart-Vue sensors are factory-set with the EOL set to OFF by default.

If inserting multiple wires in the terminals, ensure to properly twist wires together prior to inserting them into the terminal connectors.

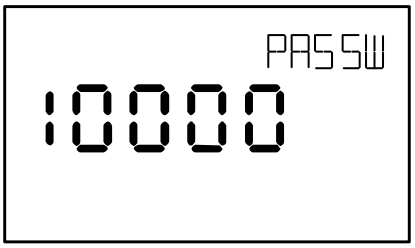
For more information and detailed explanations on network topology and wire length restrictions, refer to the Network Guide, which can be downloaded from our website *www.distech-controls.com*.

Setting the Communicating Sensor Subnet ID

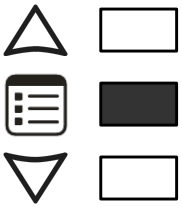
Controllers can be commissioned with an Allure EC-Smart-Vue sensor.

The default Subnet ID for an Allure EC-Smart-Vue Series Communicating Sensor is 1. To commission an ECB Series controller, the sensor's Subnet ID must be set to 1. If the sensor's Subnet ID has been set to another value (for example, the display flashes error code 1 with the Bell icon when the sensor is connected to a controller for commissioning), change the Subnet ID to 1 as follows:

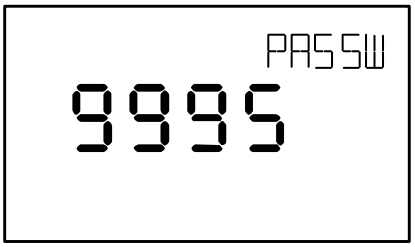
1. Connect an an Allure EC-Smart-Vue Series Communicating Sensor to the controller with a Cat 5e patch cable. Wait for the Bell icon and the number 1 to flash on the display.
2. Press and hold the Menu button for 5 seconds to enter the password menu. 10000 is shown on the display.



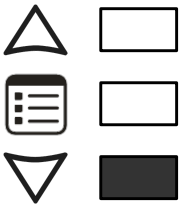
Screen Timeout: 15 seconds



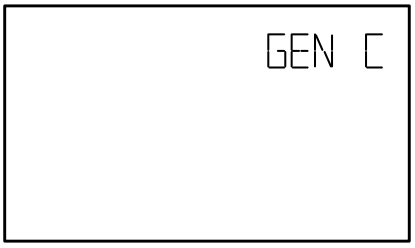
3. Press the down button to set the number to 9995 (this is the default password).



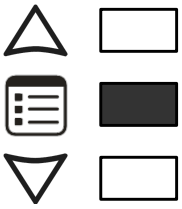
Screen Timeout: 15 seconds



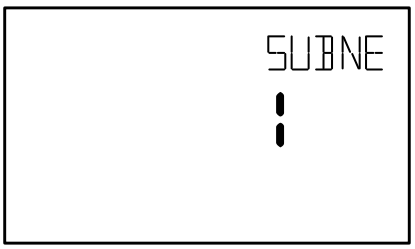
4. Press the Menu button to submit the password. Upon submitting the password, the GEN CFG menu appears on the display.



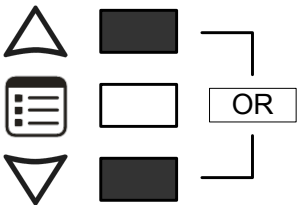
Screen Timeout: 30 seconds



5. Press the down button once to enter the **GEN CFG** submenu.
6. Press the Menu button several times until SUBNET ID appears on the display. The current controller's Subnet ID is shown.



Screen Timeout: 30 seconds



7. Use the up and down buttons to set the controller's Subnet ID to **1**. *Tip*: Hold down either the up or down button to fast-advance the display value.
8. Press the Menu button once.
9. Press and hold the Menu button for 5 seconds to exit the configuration menu.

The an Allure EC-Smart-Vue Series Communicating Sensor can now be used to go from one ECB series controller to the next for commissioning purposes.

Commissioning Controllers

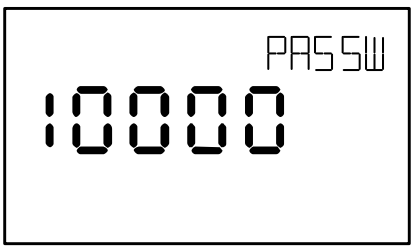
For ECB series controllers: to commission a controller with a MAC Address DIP switch located on the faceplate or under the cover in the case of an ECB-VAV Series controller, first set the DIP switch to 0 (all off). When using an Allure EC-Smart-Vue sensor for commissioning a controller (before code is downloaded to the controller from EC-*gfx*Program), connect an Allure EC-Smart-Vue sensor to the controller with its Subnet ID set to 1. (see Setting the Allure EC-Smart-Vue Sensor Subnet ID).

For controllers embedding a pre-loaded application, commissioning can be used to perform application selection if needed. Pre-loaded applications are factory-loaded programs that enable the controller to control a typical equipment. See the Pre-Loaded Application User Guide for more information.

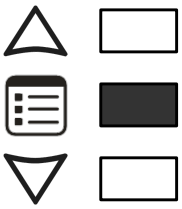
For ECB Series controllers only, during commissioning, the Allure EC-Smart-Vue sensor is used to set the controller's BACnet® MAC Address. Set the connected ECB Series controller's MAC Address as follows:

Set the connected controller's MAC Address as follows:

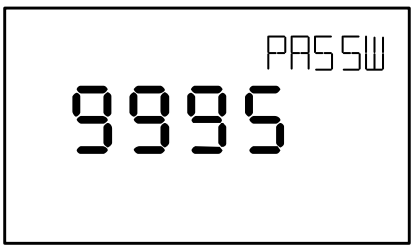
1. Connect an Allure EC-Smart-Vue Series Communicating Sensor to the controller with a Cat 5e patch cable. Wait for the display to show the room temperature.
2. Press and hold the Menu button for 5 seconds to enter the password menu. 10000 is shown on the display.



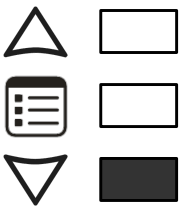
Screen Timeout: 15 seconds



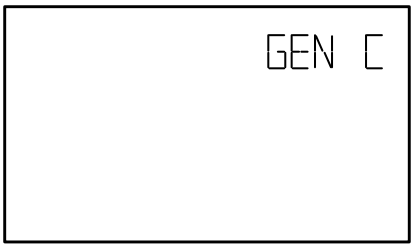
3. Use the down button to set the number to 9995 (this is the default password).



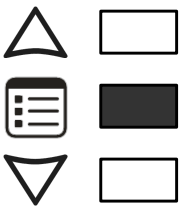
Screen Timeout: 15 seconds



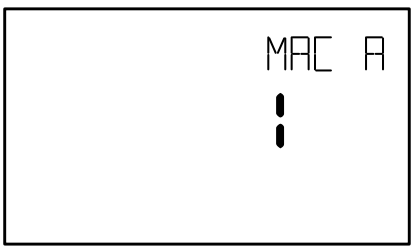
4. Press the **Menu** button to submit the password. Upon submitting the password, the **GEN CFG** menu appears on the display.



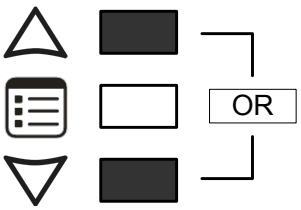
Screen Timeout: 30 seconds



5. Press the down button once to enter the **GEN CFG** submenu. The **MAC ADDRESS** menu is shown with the current controller's BACnet MAC Address.



Screen Timeout: 30 seconds



6. Use the up and down buttons to set the controller's MAC Address. Only addresses from 1 to 127 are recommended to be used.
7. Press the Menu button once to apply the value.
8. Press and hold the Menu button for 5 seconds to exit the configuration menu.

Once the controller's network is operational, the controller can be programmed with EC-*gfx*Program. For each Allure EC-Smart-Vue Series Communicating Sensor, set its Subnet ID number to the block number of its associated ComSensor block in EC-*gfx*Program. This is done in the sensor's **GEN CFG** menu under **SUBNET ID**.

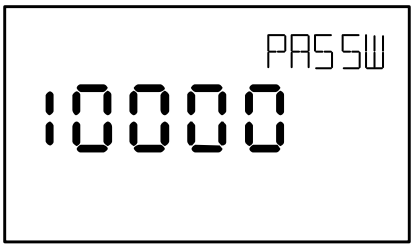
Setting the BAUD Rate (optional – ECB series controllers only)

By default, the BAUD rate for the controller is set to automatically detect the current communication BAUD rate of the connected BACnet MS/TP network (AUTO). This is the preferred setting for a controller. However, at least one controller on the BACnet MS/TP network data bus must have its BAUD rate set. The preference is to set the building controller's BAUD rate (if present). Otherwise, set the BAUD rate on one controller that will set the BAUD rate for all other controllers (to act as the master for setting the BAUD rate).

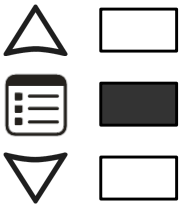
When the BAUD rate is set to AUTO, the controller cannot initiate any communication until it has detected the baud rate of the BACnet MS/TP network. If all controllers on the BACnet MS/TP network are set to AUTO, then all controllers will not communicate.

Set the connected controller's BAUD rate as follows:

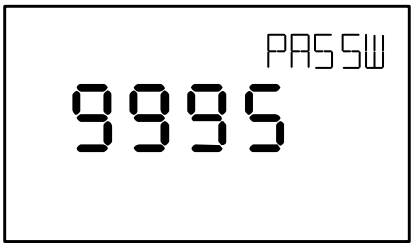
1. Connect an Allure EC-Smart-Vue Series Communicating Sensor sensor to the controller with a Cat 5e patch cable. Wait for the display to show the room temperature.
2. Press and hold the Menu button for 5 seconds to enter the password menu. 10000 is shown on the display.



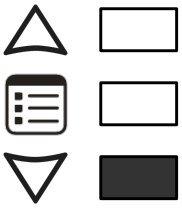
Screen Timeout: 15 seconds



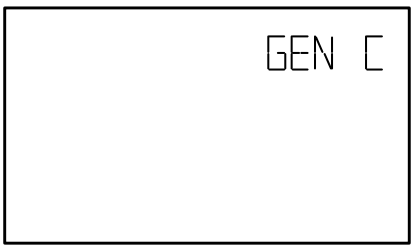
3. Use the down button to set the number to 9995 (this is the default password).



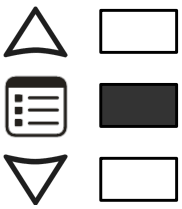
Screen Timeout: 15 seconds



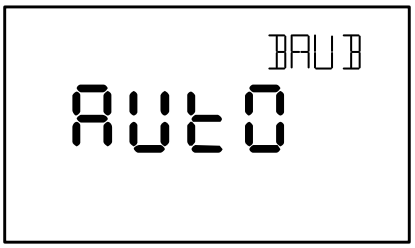
4. Press the **Menu** button to submit the password. Upon submitting the password, the **GEN CFG** menu appears on the display.



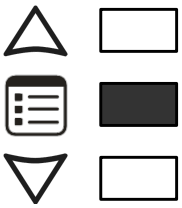
Screen Timeout: 30 seconds



5. Press the down button once to enter the **GEN CFG** submenu.
6. Use the Menu button several times until **BAUD RATE appears on the display**. The current controller's BAUD rate is shown.



Screen Timeout: 30 seconds



7. Use the up and down buttons to set the controller's Baud rate. The **AUTO** setting detects and uses the current baud rate being used by the BACnet MS/TP network.
8. Press the Menu button once to apply the value.
9. Press and hold the Menu button for 5 seconds to exit the configuration menu.

Set the LAN Type

Set the BAC/LON jumper for the type LAN in use: BAC for a BACnet network, LON for a LonWorks network.

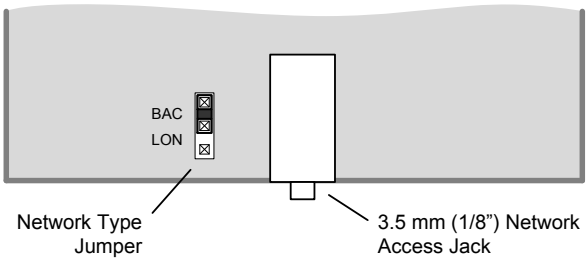


Figure 11: BAC/LON Jumper Set to the BAC (BACnet) Position when used with ECBSeries Controllers

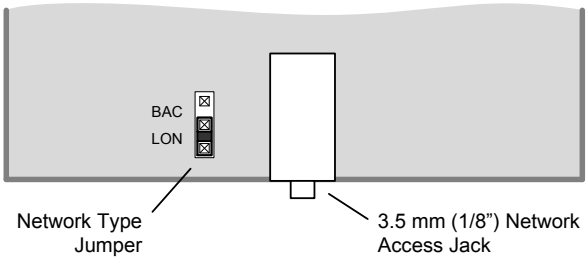
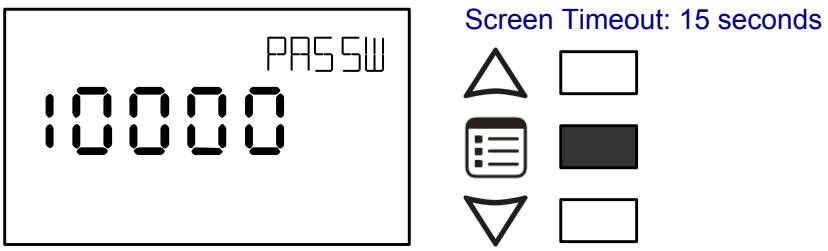


Figure 12: BAC/LON Jumper: Set to the LON (LonWorks) Position when used with ECL Series Controllers

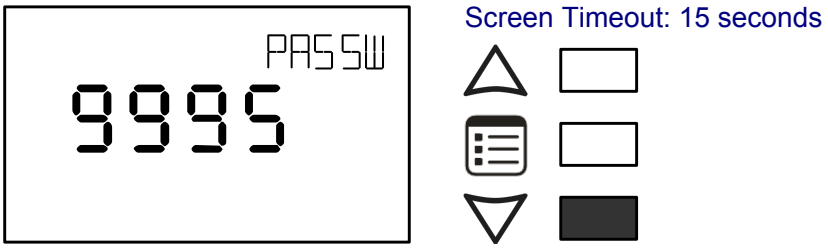
Setting Up an Allure EC-Smart-Vue Sensor Equipped with a Motion Sensor

The following procedure describes how to commission and test an Allure EC-Smart-Vue sensor equipped with a motion sensor as well as adjust the motion sensitivity (Allure EC-Smart-Vue M/-CM/-HM/-CHM sensors).

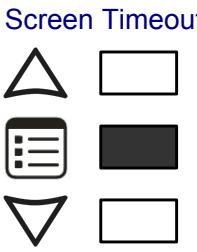
1. Connect an Allure EC-Smart-Vue sensor equipped with a motion sensor to the controller with a Cat 5e patch cable.
2. After a 30-second warm-up period, if movement is detected, the motion sensor light will turn on.
3. To test the sensor functionality, aim the sensor in the direction you want to detect motion and walk at a normal pace across the typical detection zone and verify that the sensor light turns on. The light will turn on and after 2 seconds of non-movement, the motion sensor light will turn off.
4. Now to set the motion sensitivity, on the Allure EC-Smart-Vue sensor, press and hold the **Menu** button for 5 seconds to enter the password menu. 10000 is shown on the display.



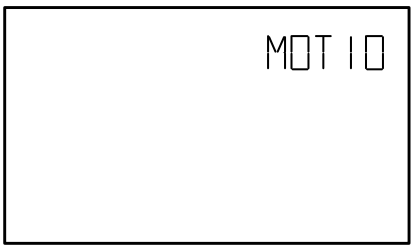
5. Press the down button to set the number to 9995 (this is the default password).

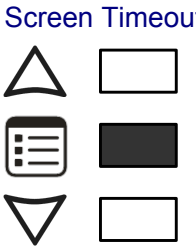


6. Press the **Menu** button to submit the password. Upon submitting the password, the **GEN CFG** menu appears on the display.



7. To enter the **GEN CFG** submenu, press the down button ▽ once.
8. Press the **Menu** button ☰ several times until **MOTION SENSITIVITY** appears on the display. The current motion sensitivity level is shown.





9. Use the up and down buttons △ ▽ to set the motion sensitivity level to 0 (low), 1 (medium - typical default setting), or 2 (high). The default and recommended level of sensitivity is medium (1) and should typically work with all installations. This setting should not be changed unless for some reason you are experiencing false detections, then a low sensitivity (0) setting may be used, or if working with larger room installations a high sensitivity (2) setting can be used.
10. Press the Menu button ☰ once to apply the value.
11. Press and hold the Menu button ☰ for 5 seconds to exit the configuration menu.

The motion indicator LED provides a visual confirmation of motion detection. By default, the indicator (PIR LED jumper) is enabled. If you wish to disable it, set jumper J18 to Disabled. See Connector and Jumper Location, Identification and Configuration [pg. 4].

BACnet Network Access from the Sensor

To temporarily access the BACnet MS/TP LAN for commissioning and maintenance purposes (not available with either the ECB-PTU series controllers, the ECLYPSE series controllers, or the ECB-VAVS), connect a BACnet MS/TP Adaptor to the audio plug port located on the lower edge of the Allure EC Smart Vue sensor. Wire a standard ⅛" (3.5 mm) three-conductor stereo jack as shown below.

The BACnet MS/TP Adaptor must have an electrically-isolated RS-485 port. Otherwise a ground path from the BACnet network will be made through the computer that will disrupt BACnet network communications.

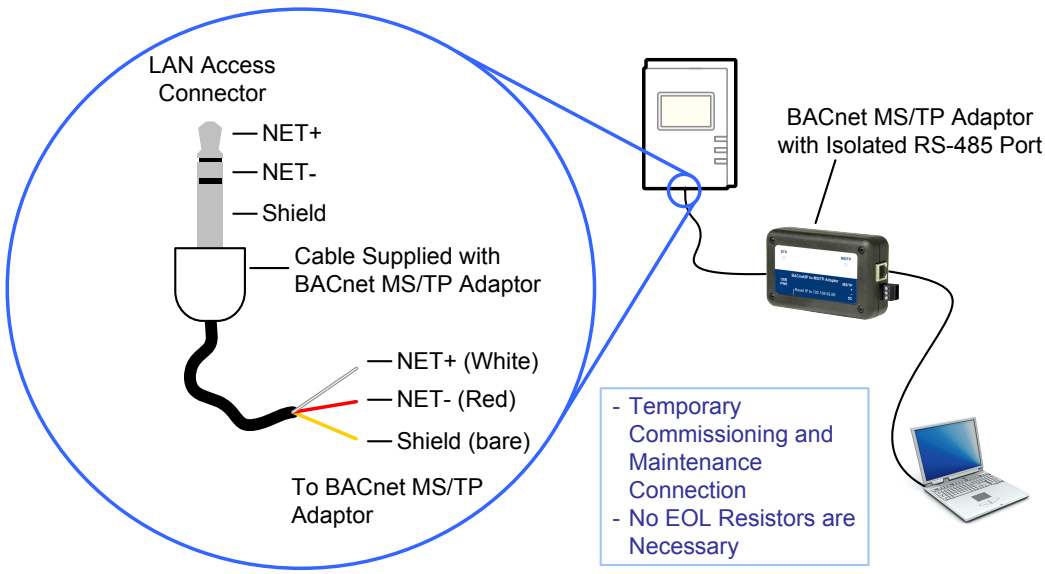


Figure 13: ⅛" (3.5 mm) Stereo Jack Connection for a Portable Router

LonWorks Network Access from the Sensor

For commissioning and maintenance purposes, the LonWorks network is optionally available from the Allure EC-Smart-Vue sensor audio plug port (not available with ECL-PTU series controllers, or the ECL-VAVS).

Setting the two (2) Net to Subnet Port Settings jumpers inside the ECL Series controller to Enable will connect the main LonWorks network to the Allure EC-Smart-Vue sensor subnetwork Cat 5e cable.

Recommendation: Only a limited number of controllers on a LonWorks network segment should have their **Net to Subnet Port Settings** jumpers enabled. Enabling too many Allure EC-Smart-Vue sensors with network access may cause network communication issues. If there are any network communication problems, see the *Troubleshooting* section in this document.

The Cat 5e cable length is restricted by the maximum allowable subnetwork bus length (see Subnetwork Bus Total Length [pg. 6]). The standard **Net to Subnet Port Settings** jumper setting is **Disable**.

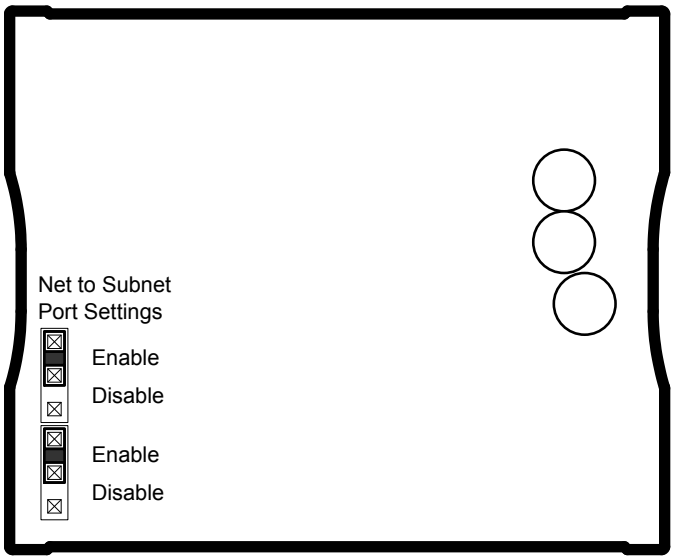


Figure 14: ECL Series controller: Net to Subnet Port Settings Jumpers

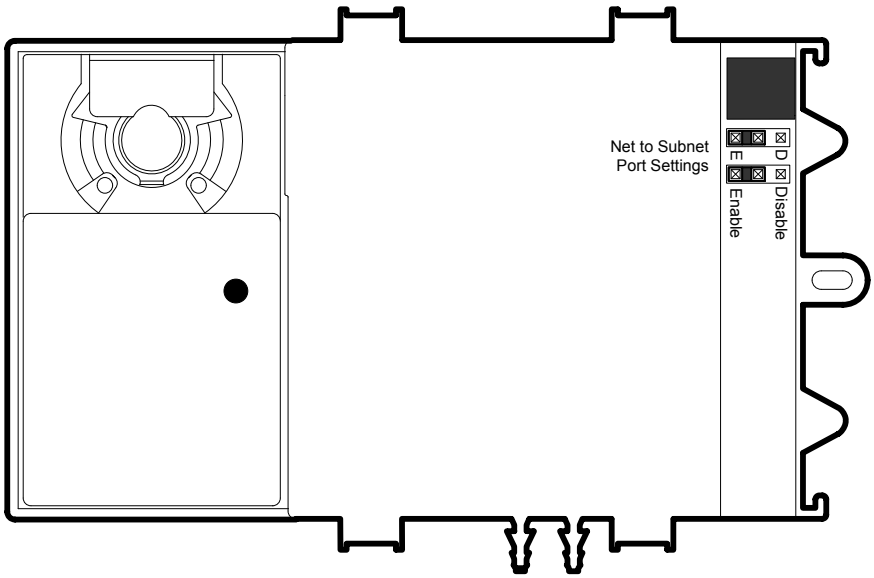


Figure 15: ECL-VAV Series controller: Net to Subnet Port Settings Jumpers

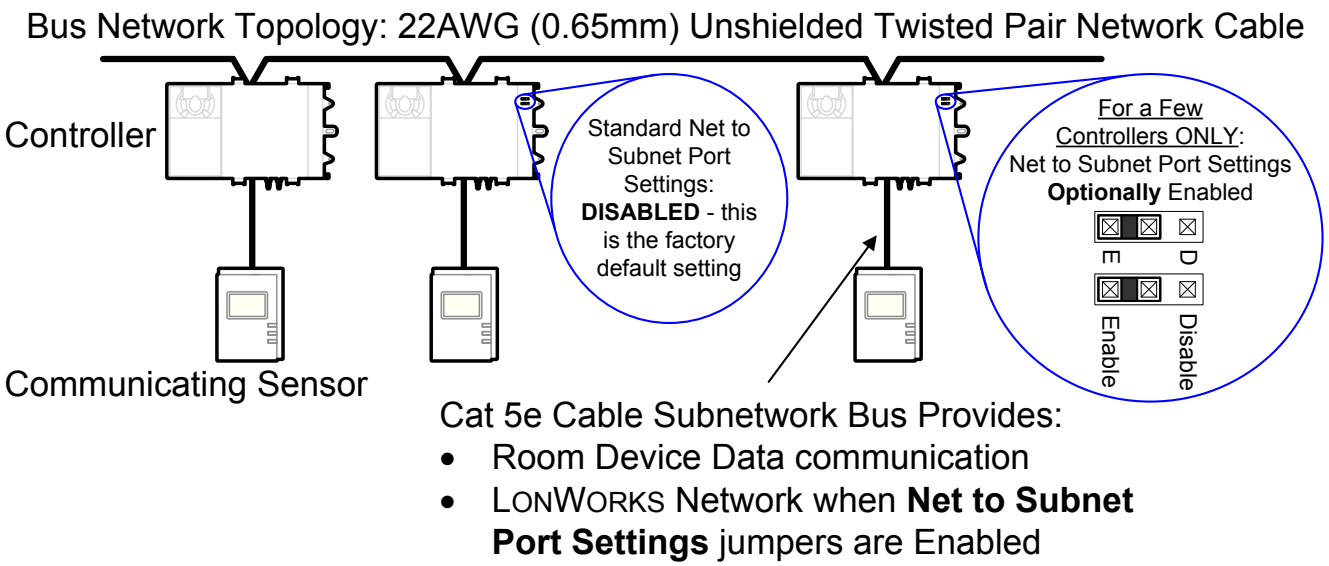


Figure 16: LONWORKS Network: Bus Topology

To temporarily access the LONWORKS LAN for commissioning and maintenance purposes, connect a LONWORKS USB network interface to the audio plug port located on the lower edge of the Allure EC-Smart-Vue sensor. Wire a standard ⅛" (3.5 mm) three-conductor (stereo jack) or two-conductor (mono jack) as shown below.

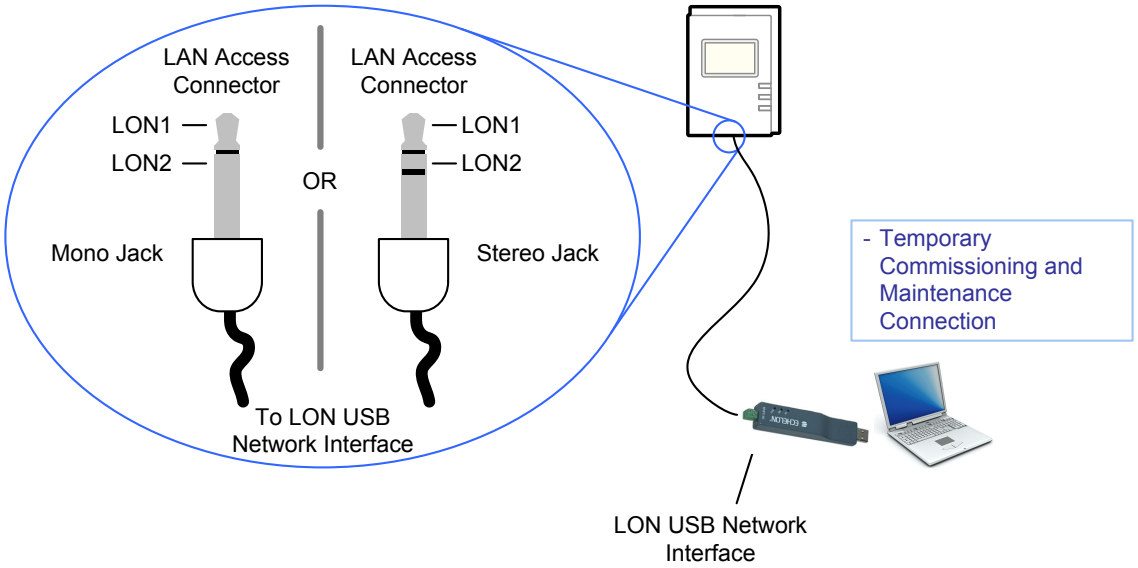


Figure 17: ⅛" (3.5 mm) Stereo or Mono Jack Connection for a LONWORKS Network Interface

Troubleshooting

Allure EC-Smart-Vue sensor's screen is blank & back light is on for about 30 to 45 seconds – Normal Operation		
Firmware upgrade in progress	Wait for the upgrade to complete. Do not disconnect the sensor from the controller as the upgrade will restart once it is reconnected.	
Allure EC-Smart-Vue sensor's screen is blank & back light is off.		
Is the Allure EC-Smart-Vue sensor connected to the controller?	Verify that the Allure EC-Smart-Vue sensor is connected to the controller and that the patch cables are plugged into the connectors. Refer to Wall Mounting Installation Procedure for more information.	
Is power being supplied to the controller?	There may be no power being supplied from the controller. Check if the controller has power or if the controller's internal fuses have blown or tripped.	
Is the cable connected to the controller and Allure EC-Smart-Vue sensor?	Verify wiring.	
Was the patch cable made onsite?	Verify that the RJ-45 crimp connectors were installed on the cable correctly.	
Device not communicating with controller		
Is the address correctly set to a unique address?	Each Allure EC-Smart-Vue sensor must be set to a unique address for each controller. See Setting the Communicating Sensor Subnet ID [pg. 9].	
Is the device too far from controller?	Verify the distance between the device and the controller. See Subnetwork Bus Total Length [pg. 6].	
Is there a configuration problem?	With EC-*gfx*Program, check the configuration of the sensor; for example, is it enabled? Refer to the EC-*gfx*Program User Guide for more information.	
Have the subnetwork EOL settings been correctly set?	Only the last Allure EC-Smart-Vue sensor must have its EOL termination set to ON. See Figure 10 and Figure 12. When one or more ECx-400 Series IO Extension modules are connected to the controller, only the last ECx-400 must have its EOL termination set to ON. See Figure 13.	
Controller cannot communicate on the LonWorks network		
Too many Allure EC-Smart-Vue sensors are providing network access	Disable the **Net to Subnet Port Settings** jumpers on all controllers (for jumper location, see Connector and Jumper Location, Identification and Configuration [pg. 4]). If communications are re-established, re-enable only a few Allure EC-Smart-Vue sensors to have network access.	
Allure EC-Smart-Vue sensor's motion detector window indicator is always ON and the Motion output of the associated ComSensor block always reads NULL in EC-*gfx*Program		
Does the connected controller have Allure EC-Smart-Vue sensor firmware that supports the motion sensor?	When the Allure EC-Smart-Vue sensor is connected to a controller, its firmware is loaded from the controller. In this case, the controller has an earlier version of Allure EC-Smart-Vue sensor firmware that does not support the motion sensor. To upgrade to the latest Allure EC-Smart-Vue sensor firmware, download the firmware from Software Center and refer to the firmware upgrade procedure in the EC-*gfx*Program User Guide.	
The CO_2 output of the associated ComSensor block always reads NULL in EC-*gfx*Program		
Does the connected controller have Allure EC-Smart-Vue sensor firmware that supports the CO_2 sensor?	When the Allure EC-Smart-Vue sensor is connected to a controller, its firmware is loaded from the controller. In this case, the controller has an earlier version of Allure EC-Smart-Vue sensor firmware that does not support the CO_2 sensor. To upgrade to the latest Allure EC-Smart-Vue sensor firmware, download the firmware from Software Center and refer to the firmware upgrade procedure in the EC-*gfx*Program User Guide.	
The CO_2 sensor readings are too high, too low, or inconsistent between sensors		
Immediately after installing the Allure EC-Smart-Vue sensor with CO_2 sensors, are the CO_2 sensor readings incoherent?	If the CO_2 sensor readings seem unusual or show inconsistencies between sensors in the same building right after installation, the following reasons should be taken into consideration: ☐ Concentration levels in each space may be different ☐ The installer may have unintentionally blown into the sensor while installing it. ☐ The sensor may have been dropped or mishandled during shipment causing a minor shift in the original factory calibration. Allow up to 14 days of operation (without power interruptions) for the sensor to calibrate itself according to its new environment.	
Error Code Interpretation		
Clock icon flashing for 15 seconds	Cannot communicate with controller.	Wait for the communication link to the controller to be established.
After 15 seconds: Flashing error code 1 with Bell icon		Verify wiring
		Verify that all Allure EC-Smart-Vue sensor's Subnet IDs are unique for this controller. See Setting the Communicating Sensor Subnet ID [pg. 9].
Flashing error code 2 with Bell icon	Invalid configuration.	In EC-*gfx*Program, resynchronize the code with the controller. Contact Distech Controls Customer Support.

Flashing error code 3 with Bell icon	Allure EC-Smart-Vue sensor is not properly configured in the controller	With EC-*gfx*Program, check the configuration of the sensor, for example, is the ComSensor block enabled? Refer to the EC-*gfx*Program User Guide for more information.

1340 Satellite Blvd.
Suwanee, GA 30024
Tel.: (800) 433-4822

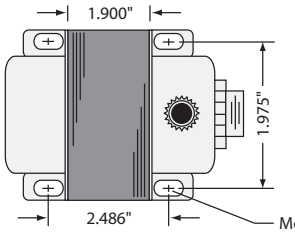
Section 5: Enclosures & Devices

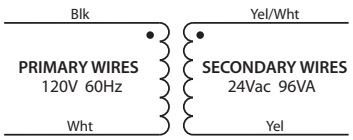
TRANSFORMER

TR100VA001

Transformer 96 VA, 120 to 24 Vac, Circuit Breaker, Foot and Single Threaded Hub Mount

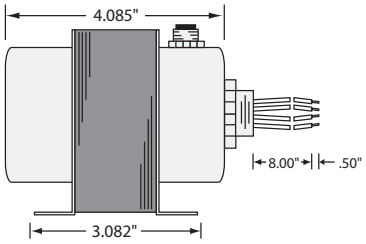
c UL us LISTED Class 2

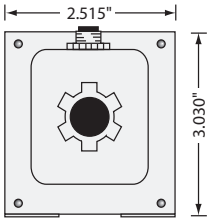




Secondary Yel/Wht wire in phase with Primary Blk wire.

Mounting Hole = .350" x .175"





SPECIFICATIONS

VA Rating: 96
Frequency: 50/60 Hz
Mounting: Foot & Single Threaded Hub
Over Current Protection: Circuit Breaker
Dimensions: 4.085˝ x 2.515˝ x 3.030˝ (w/ .500˝ NPT Hub)
Wire Length: 8˝ Typical w/ .5˝ Strip
Operating Temperature: -30 to 140° F
MTBF: 100,000 Hours @ 77° F
Construction: Split-Bobbin
Approvals: Class 2 UL5085-3 Listed, C-UL, CE, RoHS

20191017

Functional Devices, Inc.
101 Commerce Drive
Sharpsville, IN 46068

Toll-free: (800) 888-5538
Office: (765) 883-5538
Fax: (765) 883-7505

Email: sales@functionaldevices.com
Website: www.functionaldevices.com

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3. TERMS OF PAYMENT: Buyer will pay the fees specified in each invoice provided by Seller in United States Dollars within thirty (30) calendar days after the invoice date unless otherwise agreed to in writing by an authorized representative of Seller. Any amount due under this Agreement that remains unpaid after its due date will bear interest from the date that such payment became delinquent until the date it is paid in full at the lower of 1.5% per month, which equals an annual percentage rate of 18%, or the maximum rate permitted by law. Seller reserves the right to establish, revoke or modify credit terms for Buyer at any time. No discounts are allowed unless otherwise agreed to in writing by an authorized representative of Seller. Buyer will pay any collection fees, legal fees, or court costs incurred by Seller to collect past due amounts. No offsets or setoffs of payments due to Seller hereunder are allowed with respect to any other agreement between the parties. Seller hereby retains a lien on the goods sold for unpaid purchase money as herein provided.

4. TAXES AND OTHER CHARGES: In addition to the prices quoted or invoiced, Buyer will pay any sales tax, excise tax, use tax, value added or consumption tax, customs duty (that is assessed on the delivery of Product(s) to a destination outside of the U.S.A.), fee or charge of any nature whatsoever imposed by any governmental authority on or measured by the transaction between Seller and Buyer. In the event Seller is required to pay any amount, Buyer will reimburse Seller therefore; or provide Seller, at the time the order is submitted, an exemption certificate or other document acceptable to the authority imposing the same. Seller does not accept and will not pay any fines, penalties or chargebacks from Buyer for any reason.

5. DELIVERY, RISK OF LOSS, CLAIMS AND FORCE MAJEURE:

A. All prices quoted for products are Ex-Works (Incoterms 2010) at a shipping facility determined by Seller, unless otherwise noted by Seller ("**Seller's Shipping Facility**"). Risk of loss or damage, and beneficial ownership, of the Products are transferred to Buyer when the Products are made available to Buyer at Seller's Shipping Facility. All delivery dates are approximate.

B. Buyer will only make written claims to Seller for damages, shortages or other delivery errors within seven (7) calendar days after receipt of shipment. All Products received by Buyer, or Buyer's clients, customers, or agents, that are not rejected within such time will be deemed accepted. Failure to provide such written notice constitutes a waiver of all such claims regarding such shipment by Buyer. Buyer will not revoke acceptance.

C. Seller is not liable for any damage as a result of any delay or failure to deliver due to any act of God, act of Buyer, embargo or other governmental act, regulation or request, fire, accident, power outage, strike, civil unrest, weather, slowdown or other labor difficulties, war, riot, act of terrorism, delay in transportation, defaults of common carriers, inability to obtain necessary labor, materials or manufacturing facilities or, without limiting the foregoing, any other delays beyond Seller's control. Buyer's sole and exclusive remedy for any delays or for Seller's inability to deliver Products for any reason, in each case, that persists for more than ninety (90) days, is to cancel the order pursuant to Seller's Order Policies and Guidelines available upon request.

6. WARRANTY; DISCLAIMER. Products are warranted to be free from manufacturing defects under normal use and conditions for five (5) years (the "**Warranty Period**").

The warranty does not apply to: (a) Damage caused by accident, abuse, mishandling, or dropping; (b) Products which have been subjected to unauthorized repair, opened, or taken apart; (c) Products not used in accordance with directions; (d) Damages exceeding the cost of such Product; and (e) Damages caused by lightning, water, or condensation. If warranty service is required during the Warranty Period, and if examination shall disclose to Seller's satisfaction that such Product was originally defective, then Seller will at its option repair or replace the product without charge upon prepaid delivery of such Product to Seller's facility with proof of date of purchase. Corrections of such defects by repair to or supplying of replacements for defective parts shall constitute fulfillment of all obligations of Seller.

Seller shall not be liable for loss, damage, or expense directly or indirectly caused from the failure of Products to perform as expected.

EXCEPT AS SET FORTH HEREIN, SELLER DISCLAIMS ALL REPRESENTATIONS OR WARRANTIES OF ANY KIND WHATSOEVER, WHETHER EXPRESS, IMPLIED OR STATUTORY, INCLUDING, WITHOUT LIMITATION, ANY IMPLIED WARRANTIES OF MERCHANTABILITY, NON-INFRINGEMENT, FITNESS FOR A PARTICULAR PURPOSE OR ANY WARRANTY ARISING FROM A COURSE OF DEALING OR USAGE OF TRADE. NO PERSON (INCLUDING ANY AGENT, DEALER OR REPRESENTATIVE OF SELLER) IS AUTHORIZED TO MAKE ANY REPRESENTATION OR WARRANTY CONCERNING PRODUCTS EXCEPT TO REFER BUYER TO THIS AGREEMENT. BUYER WARRANTS THAT BUYER HAS NOT RELIED ON ANY OTHER WARRANTIES OR REPRESENTATIONS CONCERNING THE PRODUCTS OR THIS AGREEMENT.
For warranty service, call factory for RA number and send such Product prepared with sales receipt to: FUNCTIONAL DEVICES, INC., 101 COMMERCE DRIVE, SHARPSVILLE, IN 46068.

7. LIMITATION OF LIABILITY: SELLER WILL NOT BE LIABLE FOR ANY LOSS OF PROFIT, INTERRUPTION OF BUSINESS OR ANY OTHER SPECIAL, CONSEQUENTIAL OR INCIDENTAL DAMAGES SUFFERED OR SUSTAINED BY BUYER FOR ANY REASON. EXCEPT FOR CLAIMS OF DEATH OR PERSONAL INJURY, IN NO EVENT WILL SELLER'S AGGREGATE LIABILITY TO BUYER ARISING UNDER OR IN ANY WAY RELATED TO THIS AGREEMENT FOR ANY REASON (INCLUDING, BUT NOT LIMITED TO, LIABILITY ARISING FROM NEGLIGENCE OR ON THE BASIS OF STRICT LIABILITY, OR OTHERWISE) EXCEED THE TOTAL AMOUNT PAID BY BUYER TO SELLER HEREUNDER FOR ANY PRODUCT GIVING RISE TO A CLAIM UNDER THIS AGREEMENT.

8. RETURNS: Unless otherwise approved by Seller in writing in its sole discretion, except in the case of a non-conforming shipment or a warranty issue, Buyer may not return Products. If Seller approves the return of Products pursuant to the preceding sentence, such returned Products must be returned within ninety (90) days from date of invoice and will be subject to a 25% restocking fee. In the event of a non-conforming shipment or a warranty issue, Buyer may return Products, but only if Buyer first: (a) provides notice to Seller as required in this Agreement, (b) obtains prior authorization from Seller, and (c) all Products or containers for which return is properly authorized have been marked with a return authorization number supplied by Seller. Buyer will make all returns via a traceable form such as Federal Express, UPS or insured mail and in resalable condition. Buyer will pay all return shipping charges and any other charges associated therewith.

9. CANCELLATIONS: Cancellation or deferment of all or part of an order is subject to acceptance by the Seller. If accepted, any reduction in quantity of any item to less than 85% of the original item quantity is subject to a 15% cancellation charge. If an order cancellation is accepted, the Buyer will make delivery and pay for all material manufactured and in stock or in process at time of notice for such order, and for any special materials on orders for which the Seller must take delivery.

10. EXPORTS. Buyer agrees that it will comply with any and all U.S. Export Controls and will not pay for, resell, transfer or knowingly sell Products in violation of U.S. Export Controls. If Buyer resells Products within or exports Products to a country or region which imposes upon Seller and/or Buyer an obligation to fund or undertake reuse, recycling, composting, recovery of Products, or any similar obligation (e.g., the European Union's Waste Electrical and Electronic Equipment Directive, EC 2002/96/EC) (the "**Obligations**"), Buyer shall wholly undertake the Obligations or duties and shall be entirely responsible for all associated costs therewith. Seller shall have no obligation to reimburse Buyer for execution of the Obligations. In the event that Seller is named in a proceeding based upon the Obligations, Buyer shall indemnify, defend and hold Seller harmless from all actions related thereto, including all civil and governmental actions.

11. MISCELLANEOUS. This Agreement is governed by the laws of the State of Indiana, without giving effect to its conflict of laws principles. Buyer hereby irrevocably consents and submits to the exclusive jurisdiction and venue of the state and federal courts in Marion County, Indiana. The United Nations Convention for Contracts for the International Sale of Goods is explicitly excluded. Each provision contained in this Agreement constitutes a separate and distinct provision severable from all other provisions. If any provision (or any part thereof) is unenforceable under or prohibited by any present or future law, then such provision (or part thereof) will be amended, and is hereby amended, so as to be in compliance with such law, while preserving to the maximum extent possible the intent of the original provision. Any provision (or part thereof) that cannot be so amended will be severed from this Agreement; and, all the remaining provisions of this Agreement will remain unimpaired. No modification, addition or deletion, or waiver of any rights under this Agreement is binding on a party unless made in a non-preprinted agreement clearly understood by the parties to be a modification or waiver, and signed by a duly authorized representative of each party.

HOFFMAN ENCLOSURES AND PANELS

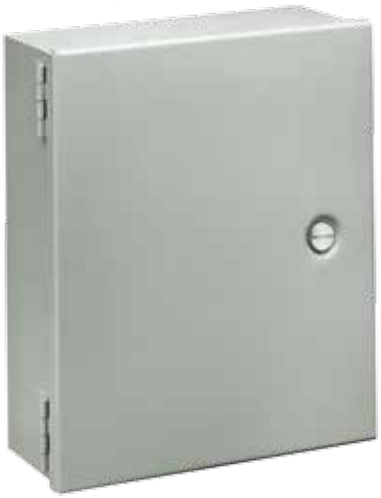
NEMA 1 MEDIUM

DESCRIPTION

The **Hoffman A Series Medium NEMA 1 enclosures** house controls and instruments in areas which do not require oil tight and dust tight ratings.

FEATURES

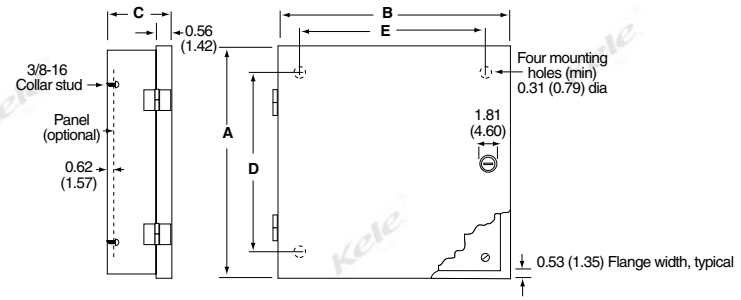
- ***Removable doors with butt hinges***
- ***Mounting holes on back of enclosure***
- ***Easy operation of flush latch with a screwdriver or coin***
- ***Collar studs provided for mounting optional panels***
- ***ANSI 61 gray polyester-powder coating inside and out over phosphatized surfaces***
- ***Optional steel panels with white finish***
- ***UL File #E27567***
- ***CSA File #LL42184, RoHs***
- ***One-year warranty***



NEMA 1 Medium

DIMENSIONS

in
(cm)



ORDERING INFORMATION

ENCLOSURE MODEL†	DIMENSIONS A x B x C in (cm)	DIMENSIONS MOUNTING D x E in (cm)	BODY GAUGE	WEIGHT lb (Kg)	SOLID PANEL* MODEL	SIZE H x W in (cm)	GAUGE	WEIGHT lb (Kg)
A-16N12ALP	16 x 12 x 6.62 (41 x 31 x 17)	13.88 x 7 (35 x 18)	16	15.0 (6.8)	A-16N12MP	13 x 10.5 (33 x 27)	14	3.0 (1.4)
A-16N16ALP	16 x 16 x 6.62 (41 x 41 x 17)	13.88 x 11 (35 x 28)	16	22.5 (10.2)	A-16N16MP	13 x 14.5 (33 x 37)	14	5.0 (2.3)
A-16N20ALP	16 x 20 x 6.62 (41 x 51 x 17)	13.88 x 15 (35 x 38)	16	21.5 (9.8)	A-16N20MP	13 x 18.5 (33 x 47)	14	6.0 (2.7)
A-20N16ALP	20 x 16 x 6.62 (51 x 41 x 17)	17.88 x 11 (45 x 28)	16	21.5 (9.8)	A-20N16MP	17 x 14.5 (43 x 37)	14	6.0 (2.7)
A-20N20ALP	20 x 20 x 6.62 (51 x 51 x 17)	17.88 x 15 (45 x 38)	16	26.0 (11.8)	A-20N20MP	17 x 18.5 (43 x 47)	14	7.0 (3.2)
A-24N16ALP	24 x 16 x 6.62 (61 x 41 x 17)	21.88 x 11 (56 x 28)	16	26.0 (11.8)	A-24N16MP	21 x 14.5 (53 x 37)	14	7.0 (3.2)
A-24N20ALP	24 x 20 x 6.62 (61 x 51 x 17)	21.88 x 15 (56 x 38)	16	30.0 (13.6)	A-24N20MP	21 x 18.5 (53 x 47)	14	9.0 (4.1)
A-24N24ALP	24 x 24 x 6.62 (61 x 61 x 17)	21.88 x 19 (56 x 48)	14	40.0 (18.1)	A-24N24MP	21 x 22.5 (53 x 57)	12	15.0 (6.8)
A-30N24ALP	30 x 24 x 6.62 (76 x 61 x 17)	27.5 x 16.75 (70 x 43)	14	49.5 (22.5)	A-30N24MP	26 x 22.5 (66 x 57)	12	18.5 (8.4)
A-36N24ALP	36 x 24 x 6.62 (91 x 61 x 17)	33.5 x 16.75 (85 x 43)	14	52.2 (23.7)	A-36N24MP	32 x 22.5 (81 x 57)	12	23.0 (10.4)
A-36N30ALP	36 x 30 x 6.62 (91 x 76 x 17)	33.5 x 22.75 (85 x 58)	14	69.0 (31.3)	A-36N30MP	32 x 28.5 (81 x 72)	12	29.0 (13.2)
A-16N12BLP	16 x 12 x 8.62 (41 x 31 x 22)	13.88 x 7 (35 x 18)	16	17.0 (7.7)	A-16N12MP	13 x 10.5 (33 x 27)	14	6.0 (2.7)
A-20N16BLP	20 x 16 x 8.62 (51 x 41 x 22)	17.88 x 11 (45 x 28)	16	25.5 (11.6)	A-20N16MP	17 x 14.5 (43 x 37)	14	6.0 (2.7)
A-20N20BLP	20 x 20 x 8.62 (51 x 51 x 22)	17.88 x 15 (45 x 38)	16	30.5 (13.8)	A-20N20MP	17 x 18.5 (43 x 47)	14	7.0 (3.2)
A-24N20BLP	24 x 20 x 8.62 (61 x 51 x 22)	21.88 x 15 (56 x 38)	16	33.0 (15.0)	A-24N20MP	21 x 18.5 (53 x 47)	14	9.0 (4.1)
A-24N24BLP	24 x 24 x 8.62 (61 x 61 x 22)	21.88 x 19 (56 x 48)	14	42.0 (19.1)	A-24N24MP	21 x 22.5 (53 x 57)	12	15.0 (6.8)
A-30N24BLP	30 x 24 x 8.62 (76 x 61 x 22)	27.5 x 16.75 (70 x 43)	14	50.5 (22.9)	A-30N24MP	26 x 22.5 (66 x 57)	12	18.5 (8.4)
A-30N30BLP	30 x 30 x 8.62 (76 x 76 x 22)	27.5 x 22.75 (70 x 58)	14	61.5 (27.9)	A-30N30MP	26 x 28.5 (66 x 72)	12	23.5 (10.7)
A-36N24BLP	36 x 24 x 8.62 (91 x 61 x 22)	33.5 x 16.75 (85 x 43)	14	54.2 (24.6)	A-36N24MP	32 x 22.5 (81 x 57)	12	23.0 (10.4)
A-36N30BLP	36 x 30 x 8.62 (91 x 76 x 22)	33.5 x 22.75 (85 x 58)	14	68.0 (30.8)	A-36N30MP	32 x 28.5 (81 x 72)	12	29.0 (13.2)
A-24N20CLP	24 x 20 x 10.62 (61 x 51 x 27)	21.88 x 15 (56 x 38)	16	36.0 (16.3)	A-24N20MP	21 x 18.5 (81 x 47)	14	9.0 (4.1)
A-24N24DLP	24 x 24 x 12.62 (61 x 61 x 27)	21.88 x 19 (56 x 48)	14	51.0 (23.1)	A-24N24MP	21 x 22.5 (53 x 57)	12	15.0 (6.8)
A-30N24DLP	30 x 24 x 12.62 (76 x 61 x 27)	27.5 x 16.75 (70 x 43)	14	62.5 (28.4)	A-30N24MP	26 x 22.5 (66 x 57)	12	18.5 (8.4)
A-36N30DLP	36 x 30 x 12.62 (91 x 76 x 27)	33.5 x 22.75 (85 x 58)	14	81.0 (36.7)	A-36N30MP	32 x 28.5 (81 x 72)	12	29.0 (13.2)

* Order panels separately
† Add **P** to the end of the part number to order optional perf panel.
See Accessories page for locks, latches, louvers, fans and heaters.

MEDIUM, TYPE 1

APPLICATION

These enclosures have a size range of 16 x 12 x 6-in. to 36 x 30 x 12-in. and meet basic functionality requirements for applications that do not require oil- or dust-tight enclosures.

FEATURES

- Doors have butt hinges
- Collar studs provided for mounting optional panel
- Slotted flush latches; optional latches available
- Mounting holes on back of enclosure

SPECIFICATIONS

- 14 or 12 gauge steel

FINISH

ANSI 61 gray polyester powder paint finish inside and out over pretreated surfaces. Optional solid panels are white and optional perforated panels are gray.

ACCESSORIES

See also Accessories.
T-Handle Latch and Keyed Cylinder Lock Kits
Electric Heater
Electrical Interlocks
Grounding Device
Panels for Medium Type 1 Enclosures
Rack Mounting Angles - U Style (Type RA)
T-Handle Latch and Keyed Cylinder Lock Kits
Touch-Up Paint
Steel and Stainless Steel Window Kits

BULLETIN: A1M

INDUSTRY STANDARDS

UL 50, 50E Listed; Type 1; File No. E27567
cUL Listed per CSA C22.2 No 40; Type 1; File No. E27567

NEMA/EEMAC Type 1
CSA, File 42184: Type 1
IEC 60529, IP30

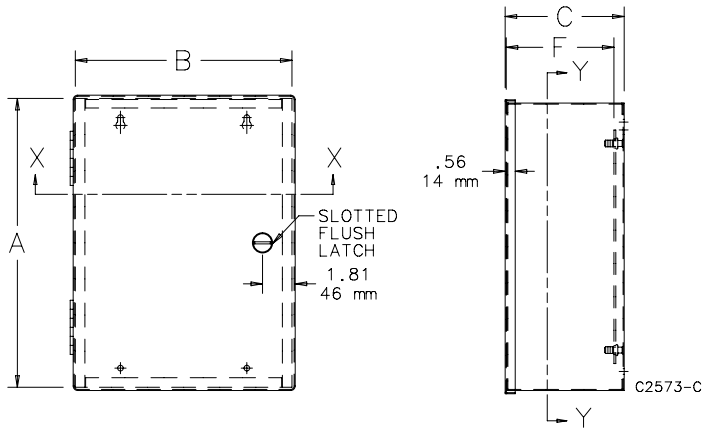
Standard Product

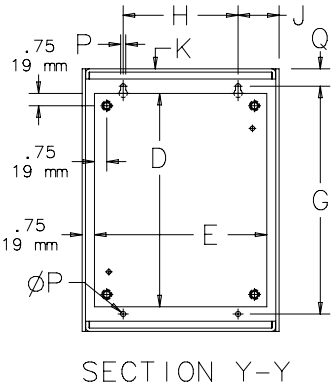
Catalog Number	AxBxC in./mm	Panel	Perforated Panel	Panel Size D x E in./mm	Panel Gauge	G in./mm	H in./mm	J in./mm	Q in./mm	P in./mm	F in./mm	K in./mm
A16N12ALP	16.00 x 12.00 x 6.62 406 x 305 x 168	A16N12MP	A16N12MPP	13.00 x 10.50 330 x 267	14	13.88 353	7.00 178	2.50 64	1.06 27	0.31 8	6.00 152	1.50 38
A16N16ALP	16.00 x 16.00 x 6.62 406 x 406 x 168	A16N16MP	A16N16MPP	13.00 x 14.50 330 x 368	14	13.88 353	11.00 279	2.50 64	1.06 27	0.31 8	6.00 152	1.50 38
A16N20ALP	16.00 x 20.00 x 6.62 406 x 508 x 168	A16N20MP	A16N20MPP	13.00 x 18.50 330 x 470	14	13.88 353	15.00 381	2.50 64	1.06 27	0.31 8	6.00 152	1.50 38
A20N16ALP	20.00 x 16.00 x 6.62 508 x 406 x 168	A20N16MP	A20N16MPP	17.00 x 14.50 432 x 368	14	17.88 454	11.00 279	2.50 64	1.06 27	0.31 8	6.00 152	1.50 38
A20N20ALP	20.00 x 20.00 x 6.62 508 x 508 x 168	A20N20MP	A20N20MPP	17.00 x 18.50 432 x 470	14	17.88 454	15.00 381	2.50 64	1.06 27	0.31 8	6.00 152	1.50 38
A24N16ALP	24.00 x 16.00 x 6.62 610 x 406 x 168	A24N16MP	A24N16MPP	21.00 x 14.50 533 x 368	14	21.88 556	11.00 279	2.50 64	1.06 27	0.31 8	6.00 152	1.50 38
A24N20ALP	24.00 x 20.00 x 6.62 610 x 508 x 168	A24N20MP	A24N20MPP	21.00 x 18.50 533 x 470	14	21.88 556	15.00 381	2.50 64	1.06 27	0.31 8	6.00 152	1.50 38
A24N24ALP	24.00 x 24.00 x 6.62 610 x 610 x 168	A24N24MP	A24N24MPP[a]	21.00 x 22.50 533 x 572	12	21.88 556	19.00 483	2.50 64	1.06 27	0.31 8	6.00 152	1.50 38
A30N24ALP	30.00 x 24.00 x 6.62 762 x 610 x 168	A30N24MP	A30N24MPP[a]	26.00 x 22.50 660 x 572	12	27.50 699	16.75 425	3.62 92	1.25 32	0.44 11	6.00 152	2.00 51
A36N24ALP	36.00 x 24.00 x 6.62 914 x 610 x 168	A36N24MP	A36N24MPP[a]	32.00 x 22.50 813 x 572	12	33.50 851	16.75 425	3.62 92	1.25 32	0.44 11	6.00 152	2.00 51
A36N30ALP	36.00 x 30.00 x 6.62 914 x 762 x 168	A36N30MP	A36N30MPP[a]	32.00 x 28.50 813 x 724	12	33.50 851	22.75 578	3.62 92	1.25 32	0.44 11	6.00 152	2.00 51
A16N12BLP	16.00 x 12.00 x 8.62 406 x 305 x 219	A16N12MP	A16N12MPP	13.00 x 10.50 330 x 267	14	13.88 353	7.00 178	2.50 64	1.06 27	0.31 8	8.00 203	1.50 38
A20N12BLP	20.00 x 12.00 x 8.62 508 x 305 x 219	A20N12MP	A20N12MPP	17.00 x 10.50 432 x 267	14	17.88 454	7.00 178	2.50 64	1.06 27	0.31 8	8.00 203	1.50 38
A20N16BLP	20.00 x 16.00 x 8.62 508 x 406 x 219	A20N16MP	A20N16MPP	17.00 x 14.50 432 x 368	14	17.88 454	11.00 279	2.50 64	1.06 27	0.31 8	8.00 203	1.50 38
A20N20BLP	20.00 x 20.00 x 8.62 508 x 508 x 219	A20N20MP	A20N20MPP	17.00 x 18.50 432 x 470	14	17.88 454	15.00 381	2.50 64	1.06 27	0.31 8	8.00 203	1.50 38
A24N20BLP	24.00 x 20.00 x 8.62 610 x 508 x 219	A24N20MP	A24N20MPP	21.00 x 18.50 533 x 470	14	21.88 556	15.00 381	2.50 64	1.06 27	0.31 8	8.00 203	1.50 38
A24N24BLP	24.00 x 24.00 x 8.62 610 x 610 x 219	A24N24MP	A24N24MPP[a]	21.00 x 22.50 533 x 572	12	21.88 556	19.00 483	2.50 64	1.06 27	0.31 8	8.00 203	1.50 38
A30N20BLP	30.00 x 20.00 x 8.62 762 x 508 x 219	A30N20MP	A30N20MPP[a]	26.00 x 18.50 660 x 470	12	27.50 699	15.00 381	2.50 64	1.25 32	0.44 11	8.00 203	2.00 51
A30N24BLP	30.00 x 24.00 x 8.62 762 x 610 x 219	A30N24MP	A30N24MPP[a]	26.00 x 22.50 660 x 572	12	27.50 699	16.75 425	3.62 92	1.25 32	0.44 11	8.00 203	2.00 51
A30N30BLP	30.00 x 30.00 x 8.62 762 x 762 x 219	A30N30MP	A30N30MPP[a]	26.00 x 28.50 660 x 724	12	27.50 699	22.75 578	3.62 92	1.25 32	0.44 11	8.00 203	2.00 51

Catalog Number	AxBxC in./mm	Panel	Perforated Panel	Panel Size D x E in./mm	Panel Gauge	G in./mm	H in./mm	J in./mm	Q in./mm	P in./mm	F in./mm	K in./mm
A36N24BLP	36.00 x 24.00 x 8.62 914 x 610 x 219	A36N24MP	A36N24MPP[a]	32.00 x 22.50 813 x 572	12	33.50 851	16.75 425	3.62 92	1.25 32	0.44 11	8.00 203	2.00 51
A36N30BLP	36.00 x 30.00 x 8.62 914 x 762 x 219	A36N30MP	A36N30MPP[a]	32.00 x 28.50 813 x 724	12	33.50 851	22.75 578	3.62 92	1.25 32	0.44 11	8.00 203	2.00 51
A18N18CLP	18.00 x 18.00 x 10.62 457 x 457 x 270	A18N18MP	A18N18MPP	15.00 x 16.50 381 x 419	14	15.88 403	13.00 330	2.50 64	1.06 27	0.31 8	10.00 254	1.50 38
A24N20CLP	24.00 x 20.00 x 10.62 610 x 508 x 270	A24N20MP	A24N20MPP	21.00 x 18.50 533 x 470	14	21.88 556	15.00 381	2.50 64	1.06 27	0.31 8	10.00 254	1.50 38
A30N24CLP	30.00 x 24.00 x 10.62 762 x 610 x 270	A30N24MP	A30N24MPP[a]	21.00 x 22.50 533 x 572	12	27.50 699	16.75 425	3.62 92	1.25 32	0.44 11	10.00 254	2.00 51
A24N24DLP	24.00 x 24.00 x 12.62 610 x 610 x 321	A24N24MP	A24N24MPP[a]	21.00 x 22.50 533 x 572	12	21.88 556	19.00 483	2.50 64	1.06 27	0.31 8	12.00 305	1.50 38
A30N24DLP	30.00 x 24.00 x 12.62 762 x 610 x 321	A30N24MP	A30N24MPP[a]	26.00 x 22.50 660 x 724	12	27.50 699	16.75 425	3.62 92	1.25 32	0.44 11	12.00 305	2.00 51
A36N30DLP	36.00 x 30.00 x 12.62 914 x 762 x 321	A36N30MP	A36N30MPP[a]	32.00 x 28.50 813 x 724	12	33.50 851	22.75 578	3.62 92	1.25 32	0.44 11	12.00 305	2.00 51

Purchase panels separately.

[a]Flanged on all four sides





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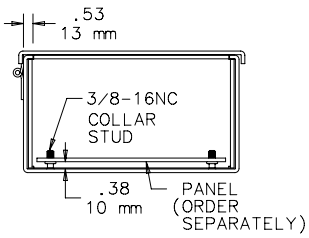
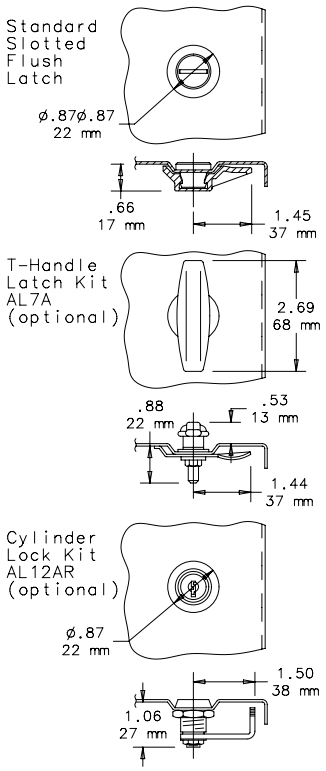


SECTION X-X



DESCRIPTION

The **Iboco P Series Spiralite** universal spiral wrapping is great for fast and economical grouping of wire bundles.

FEATURES

- ***Polyethylene construction***
- ***Provides flexible connection between panel and door***
- ***Strong, yet simple to install and remove***

ORDERING INFORMATION

MODEL	FOR WIRE BUNDLES in (cm)	FT (m) (per carton*)
P2	1/4 to 1 (0.64 to 2.54)	80 (24)
P3	3/8 to 2 (0.95 to 5.08)	80 (24)
P4	1/2 to 3 (1.27 to 7.62)	65 (20)

* Available in carton quantities only – order quantity 1 = 1 carton

P Series

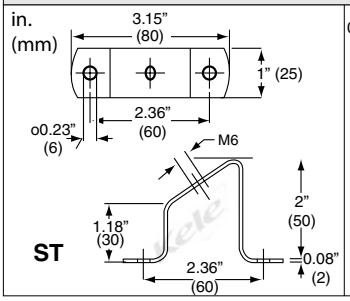
DESCRIPTION

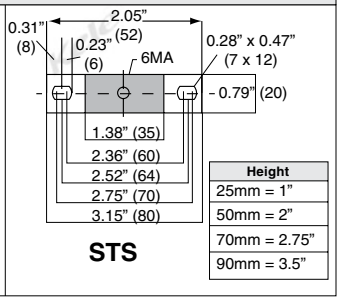
The **Iboco ST, STS support brackets** give you options in mounting your DIN rail. These are made of cold-rolled steel treated with galvanic zinc plating and passivation.

FEATURES

- ***Includes 6mm screws***

DIMENSIONS





STS Series **ST Series**

ORDERING INFORMATION

MODEL	DESCRIPTION
ST	DIN Rail support bracket
STS-25	1" din rail support bracket
STS-50	2" din rail support bracket
STS-70	2.75" din rail support bracket
STS-90	3.5" din rail support bracket

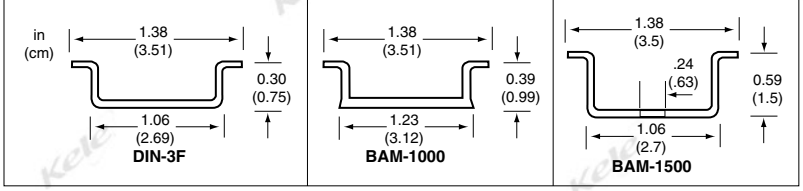
DESCRIPTION

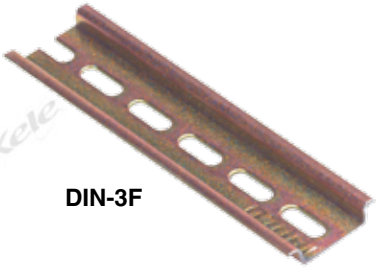
DIN rail is the standard method for mounting relays and terminal blocks. Kele offers five models with different features.

FEATURES

- ***One meter length (39.4")***
- ***Steel or aluminum***
- ***Perforated***

DIMENSIONS





DIN-3F

RoHS

ORDERING INFORMATION

MODEL	DESCRIPTION
BAM-1000	35 mm aluminum DIN mounting rail 39.4" (1m)
BAM-1500	35 mm aluminum DIN mounting rail 39.4" (1m) 15mm height
DIN-3F	35 mm DIN rail, steel, 39.4" (1m), RoHS compliant
DINRALU	DIN rail, aluminum, 39.4" (1m)
DINRSTL	DIN rail, steel, 39.4" (1m)

RELATED PRODUCTS

DINCLIC-FM4 Mounting clips, 4 mm screw size

PANEL FABRICATION

WIRING DUCT
VD SERIES

DESCRIPTION

The **Kele VD Series wiring duct** allows the simplification and acceleration of panel-building operations such as wire retention, identification of equipment and circuits, and wire separation.

FEATURES

- ***High impact PVC, self extinguishing***
- ***UL recognized, file E97527***
- ***One year warranty***
- ***Gray or white***

VD Series

ORDERING INFORMATION

MODEL	DESCRIPTION
VD1-15G	1.5"H x 1"W x 6.5'L (3.81 cm x 2.54 cm x 2m), includes cover (**56)
VD1-15W	1.5"H x 1"W x 6.5'L (3.81 cm x 2.54 cm x 2m), includes cover (**56)
VD1-3G	3"H x 1"W x 6.5'L (7.62 cm x 2.54 cm x 2m), includes cover (**28)
VD1-3W	3"H x 1"W x 6.5'L (7.62 cm x 2.54 cm x 2m), includes cover (**28)
VD15-15G	1.5"H x 1.5"W x 6.5'L (3.81 cm x 3.81 cm x 2m), includes cover (**38)
VD15-15W	1.5"H x 1.5"W x 6.5'L (3.81 cm x 3.81 cm x 2m), includes cover (**38)
VD15-3G	3"H x 1.5"W x 6.5'L (7.62 cm x 3.81 cm x 2m), includes cover (**28)
VD15-3W	3"H x 1.5"W x 6.5'L (7.62 cm x 3.81 cm x 2m), includes cover (**28)
VD22-22G	2.25"H x 2.25"W x 6.5'L (5.72 cm x 5.72 cm x 2m), includes cover (**18)
VD22-22W	2.25"H x 2.25"W x 6.5'L (5.72 cm x 5.72 cm x 2m), includes cover (**18)
VD22-3G	3"H x 2.25"W x 6.5'L (7.62 cm x 5.72 cm x 2m), includes cover (**20)
VD22-3W	3"H x 2.25"W x 6.5'L (7.62 cm x 5.72 cm x 2m), includes cover (**20)
VD3-3G	3"H x 3"W x 6.5'L (7.62 cm x 7.62 cm x 2m), includes cover (**16)
VD3-3W	3"H x 3"W x 6.5'L (7.62 cm x 7.62 cm x 2m), includes cover (**16)

** Carton quantity, order per piece

1340 Satellite Blvd.
Suwanee, GA 30024
Tel.: (800) 433-4822

Section 6: Field Devices

RH DUCT

Relative Humidity, Duct

The ACI Relative Humidity Duct utilizes a thermoset polymer capacitive sensing element with a factory fitted hydrophobic filter to improve its moisture resistance. The sensing elements multilayer construction also provides excellent resistance in applications where dust, dirt, oils and common environmental chemicals are found. The RH duct sensors include on board DIP switches which allow the user to select the desired output signal and can be powered by AC or DC power sources. Each unit also contains 0%, 50%, and 100% test options to verify that the transmitter is both working and wired properly. Field calibration can be performed by using the increment and decrement calibration DIP switches without the need to replace the sensing element. These enhancements provide increased flexibility and outstanding long-term reliability without the need to replace the sensors in the field. Duct configurations feature a weatherproof Euro style enclosure with a gasketed cover and conformally coated circuit boards for increased moisture resistance in high humidity environments. The sensor is protected by a stainless-steel sintered filter. Three point NIST Calibration Certificates are available.

Applications: Humidification, Dehumidification, Supply / Discharge / Return Air, Economizers, Clean Rooms, Data Centers, Process Control, Schools, Hospitals, Office Buildings

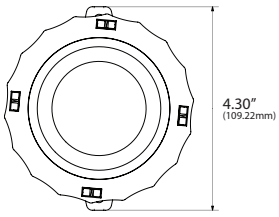
The ACI RH Duct is covered by ACI's Five (5) Year Limited Warranty. The warranty can be found in the front of ACI's Sensors & Transmitters catalog, as well as on ACI's website, www.workaci.com.

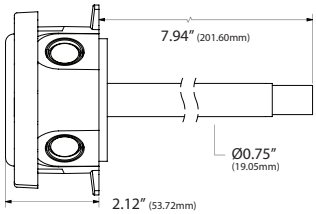
PRODUCT SPECIFICATIONS

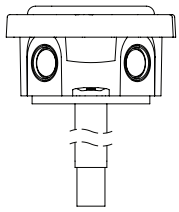
RH Supply Voltage (Reverse Polarity Protected):	**4-20 mA:** 250 Ohm Load: 15 - 40 VDC / 18 - 28 VAC | **500 Ohm Load:** 18 - 40 VDC / 18 - 28 VAC **0-5 VDC:** 12 - 40 VDC / 18 - 28 VAC | **0-10 VDC:** 18 - 40 VDC / 18 - 28 VAC
RH Supply Current (VA):	**Voltage Output:** 8 mA maximum (0.32 VA) | **Current Output:** 24 mA maximum (0.83 VA)
RH Output Load Resistance:	**4-20 mA:** 700 Ohms maximum | **0-5 VDC or 0-10 VDC:** 4K Ohms Minimum
RH Output Signal:	**2-wire:** 4 - 20 mA (Factory Default) | **3-wire:** 0-5 or 0-10 VDC and 4 - 20 mA (Field Selectable)
RH Accuracy @ 77°F (25°C):	+/- 1% over 20% RH Range between 20 to 90% | +/- 2%, 3%, or 5% from 10 to 95%
RH Measurement Range:	0-100%
Operating RH Range:	0 to 95% RH, non-condensing (Conformally Coated PCB's)
OperatingTemperature Range:	-40 to 140°F (-40 to 60°C)
Storage Temperature Range:	-40 to 149°F (-40 to 65°C)
RH Stability | Repeatability | Sensitivity:	Less than 2% drift / 5 years | 0.5% RH | 0.1% RH
RH Response Time (T63):	20 Seconds Typical
RH Sensor Type:	Capacitive with Hydrophobic Filter
RH Transmitter Stabilization Time:	30 Minutes (Recommended time before doing accuracy verification)
RH Connections | Wire Size:	Screw Terminal Blocks (Polarity Sensitive) | 16 (1.31 mm^2) to 26 AWG (0.129 mm^2)
RH Terminal Block Torque Rating:	4.43 to 5.31 lb-in (0.5 to 0.6 Nm)
RH NIST Test Points:	**Default Test Points:** 3 Points (20%, 50% & 80%) **1% NIST Test Points:** 5 Points within selected 20% Range (ie. 30%-50% are 30, 35, 40, 45 & 50)
Enclosure Specifications (Material, Flammability, Temperature, NEMA/IP Rating):	**"-EH" Enclosure:** ABS Plastic; UL94-V0; -40 to 140°F (-40 to 60°C) **"-4X" Enclosure:** Polystyrene Plastic; UL94-V2; -40 to 158°F (-40 to 70°C); NEMA 4X (IP 66)
Sensing Tube Material | Filter Material:	**"EH" Enclosure:** 304 Series Stainless Steel | 304 Series Stainless Steel **"-4X" Enclosure:** Schedule 40 PVC (White) | Slotted PVC without filter
Sensing Tube Dimensions (Length x Diameter):	**"-EH" Models with Sintered Filters:** 7.75" (196.85 mm) x 0.75" (19.05 mm) **"-4X" Models:** 7.20" (182.88 mm) x 0.840" (21.34 mm)
Product Dimensions (L x W x D):	See drawings on back of data sheet
Product Weight:	**A/RHx-D Series:** 1.22 lbs. (0.55 kg) | **A/RHx-D-4X Series:** 0.50 lbs. (0.227 kg)
Agency Approvals:	CE, RoHS2, WEEE

DIMENSIONAL DRAWING

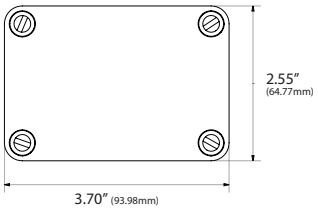
Euro Enclosure [EH]

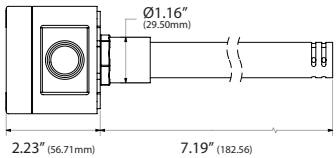


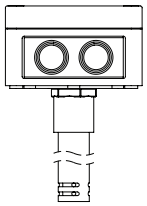




NEMA 4X Enclosure [4X]







Front View	Right View	Top View

STANDARD ORDERING

Model # Example: A/RH1-D -OR- 122531

Model #	Item #	Description
A/RH1-D	122531	RH Duct, +/- 1%, 4-20 mA Output (default), 0-5 VDC or 0-10 VDC (selectable), Euro Enclosure
A/RH1-D-NIST	148178	RH Duct, +/- 1%, 4-20 mA Output (default), 0-5 VDC or 0-10 VDC (selectable), Euro Enclosure, NIST Certificate
A/RH2-D	122687	RH Duct, +/- 2%, 4-20 mA Output (default), 0-5 VDC or 0-10 VDC (selectable), Euro Enclosure
A/RH2-D-4X	122689	RH Duct, +/- 2%, 4-20 mA Output (default), 0-5 VDC or 0-10 VDC (selectable), NEMA 4X Enclosure
A/RH2-D-NIST	148181	RH Duct, +/- 2%, 4-20 mA Output (default), 0-5 VDC or 0-10 VDC (selectable), Euro Enclosure, NIST Certificate
A/RH2-D-4X-NIST	148183	RH Duct, +/- 2%, 4-20 mA Output (default), 0-5 VDC or 0-10 VDC (selectable), NEMA 4X Enclosure, NIST Certificate
A/RH3-D	122931	RH Duct, +/- 3%, 4-20 mA Output (default), 0-5 VDC or 0-10 VDC (selectable), Euro Enclosure
A/RH3-D-4X	122924	RH Duct, +/- 3%, 4-20 mA Output (default), 0-5 VDC or 0-10 VDC (selectable), NEMA 4X Enclosure
A/RH3-D-NIST	148182	RH Duct, +/- 3%, 4-20 mA Output (default), 0-5 VDC or 0-10 VDC (selectable), Euro Enclosure, NIST Certificate
A/RH3-D-4X-NIST	148184	RH Duct, +/- 3%, 4-20 mA Output (default), 0-5 VDC or 0-10 VDC (selectable), NEMA 4X Enclosure, NIST Certificate
A/RH5-D	123085	RH Duct, +/- 5%, 4-20 mA Output (default), 0-5 VDC or 0-10 VDC (selectable), Euro Enclosure

CUSTOM ORDERING

Model # Example: A/ (A.) RH1 (B.) D (C.) (D.)

		MODEL #
A. Sensor Series *No Selection Required*	**A/** →	**A/**
B. Accuracy *Select One (1)*	**RH1** = +/-1% (Specify a 20% Range between 20 to 90% RH) **RH2** = +/-2% | **RH3** = +/-3% | **RH5** = +/-5%	
C. Configuration *Select One (1)*	**D** = Duct (Euro Enclosure) | **D-4X** (NEMA 4X Enclosure)	
D. Output Signal *Select One (1)*	**----** = 4 to 20 mA (Default) | 0 to 10 VDC (Field Selectable) | 0 to 5 VDC (Field Selectable)	
E. NIST *Select One (1)*	**----** = No NIST Certificate | **NIST** = NIST Certificate (3 Points)	

Note: Outputs are field selectable between 4-20 mA, 0-5 VDC & 0-10 VDC

ACCESSORIES ORDERING

Model # Example: A/SINTERED FILTER

Model #	Item #	Description
A/SINTERED FILTER	143433	3/8" Sintered Filter for RH Duct/Stainless Plate/Remote Probe

DUCT HUMIDITY SERIES

Installation & Operation Instructions

Phone: 1-888-967-5224
Website: workaci.com

GENERAL INFORMATION

The A/RH Duct Series Sensor is a Relative Humidity transmitter that can be powered with either an AC or DC supply voltage. The RH Duct transmitter is field selectable with a 4-20 mA, 0-5 VDC, or 0-10 VDC output signal that is equivalent to 0 to 100% RH. This sensor is designed for use with electronic controllers in commercial heating and cooling building management systems. All units are shipped from the factory set up for a 4-20 mA output. The transmitter can also include an optional temperature sensor for monitoring the space temperature.

For optimal readings, follow these tips:

- The sensor should be mounted in the middle of the duct where air circulation is well mixed (no stratification), and not blocked by obstructions. Stratification and obstructions can cause sensing errors. An example is downstream from a heating or cooling coil.
- Duct probe should be placed (3) to (4) duct segments down from any bend or obstructions and away from 90° bends.
- Mount the sensor on the top or sides of duct work; mounting on the bottom risks damage due to moisture.

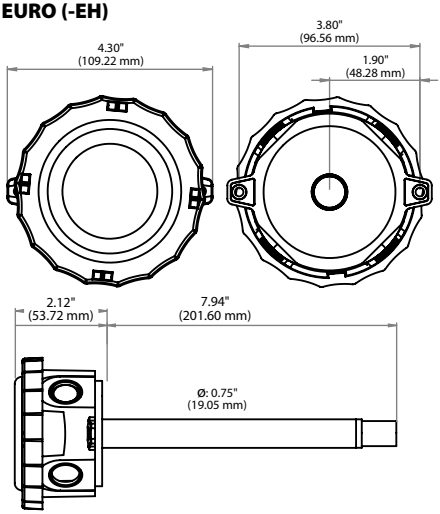
MOUNTING INSTRUCTIONS

The Euro enclosure (-EH) requires a 0.875" (22.23 mm) hole in the duct, and the Nema 4X enclosure (-4X) requires a 1.25" (31.75 mm) hole - see **FIGURE 1**. After drilling, insert the probe through the hole until the foam pad is tight to the duct. Drill pilot holes for the mounting screws. Use the enclosure as a guide, or use the dimensions listed on the right to measure out.

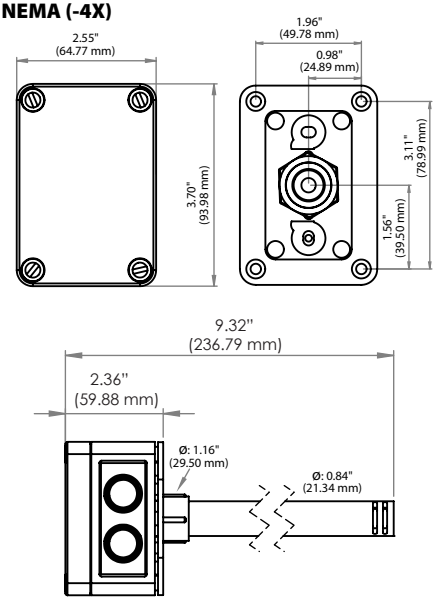
Now fasten and insert mounting screws through the mounting holes and tighten until the unit is held firmly to the duct. Refer to **Wiring Instructions** (p. 2-4) to make necessary connections.

FIGURE 1: ENCLOSURE DIMENSIONS

EURO (-EH)



NEMA (-4X)



Automation Components, Inc.
2305 Pleasant View Road | Middleton, WI 53562
Phone: 1-888-967-5224 | **Website:** workaci.com

Version: 10.0
I0000546

FIGURE 2: TEMPERATURE WIRING

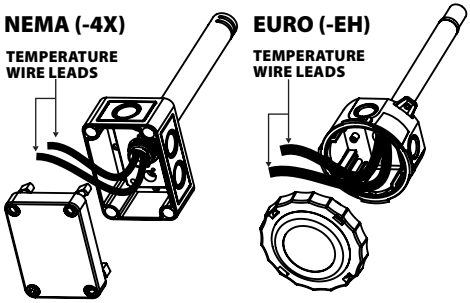
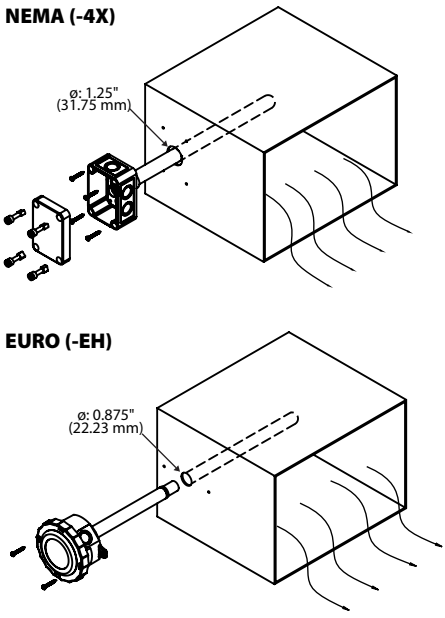


FIGURE 3: MOUNTING DIMENSIONS



WIRING INSTRUCTIONS

PRECAUTIONS

- **Do not run the temperature sensor wiring in any conduit with line voltage (24/120/230 VAC) if utilizing resistance temperature signal.**
- **Remove power before wiring. Never connect or disconnect wiring with power applied.**
- **When using a shielded cable, ground the shield only at the controller end. Grounding both ends can cause a ground loop.**
- **It is recommended you use an isolated UL-listed class 2 transformer when powering the unit with 24 VAC. Failure to wire the devices with the correct polarity when sharing transformers may result in damage to any device powered by the shared transformer.**
- **If the 24 VDC or 24VAC power is shared with devices that have coils such as relays, solenoids, or other inductors, each coil must have an MOV, DC/AC Transorb, Transient Voltage Suppressor (ACI Part: 142583), or diode placed across the coil or inductor. The cathode, or banded side of the DC Transorb or diode, connects to the positive side of the power supply. Without these snubbers, coils produce very large voltage spikes when de-energizing that can cause malfunction or destruction of electronic circuits.**

RELATIVE HUMIDITY WIRING INSTRUCTIONS

Open the cover of the enclosure. ACI recommends 16 to 26 AWG twisted pair wires or shielded cable for all transmitters. Twisted pair may be used for 2-wire current output transmitters or 3-wire for voltage output. Refer to **FIGURE 5** (p. 3) for wiring diagrams.

TEMPERATURE WIRING INSTRUCTIONS

ACI recommends 16 to 26 AWG twisted pair wires or shielded cable for all temperature sensors. ACI recommends a separate cable be pulled for Temperature signal only. Temperature Signal wiring must be run separate from low and high voltage wires (24/120/230VAC). All ACI thermistors and RTD temperature sensors are both non-polarity and non-position sensitive. All thermistor type units are supplied with (2) flying lead wires, and all RTD's are supplied with (2) or (3) flying lead wires – see **FIGURE 6** (p. 3). The number of wires needed depends on the application. Connect thermistor/RTD wire leads to controller analog input wires using wire nuts, terminal blocks, or crimp style connectors. All wiring must comply with local and National Electric Codes. After wiring, attach the cover to the enclosure.

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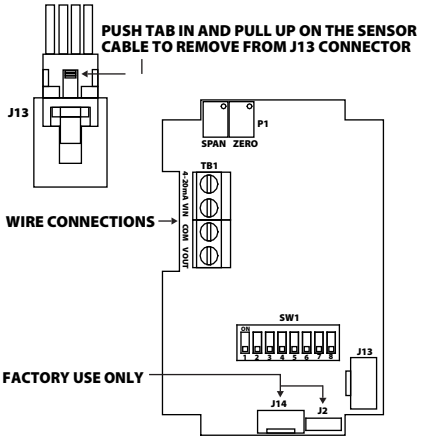
FIGURE 4: PRINTED CIRCUIT BOARD

SQUARE PCB (-4X ENCLOSURE)



ROUND PCB (-EH ENCLOSURE)

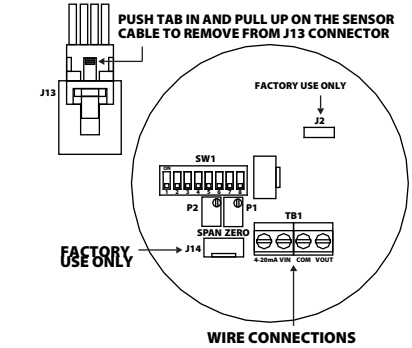
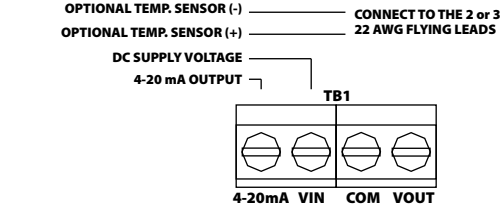
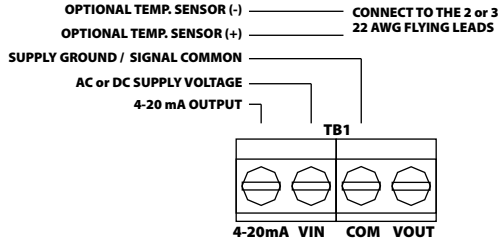


FIGURE 5: OUTPUT SIGNALS

2 WIRE CURRENT OUTPUT SIGNAL



3 WIRE CURRENT OUTPUT SIGNAL



VOLTAGE OUTPUT SIGNAL

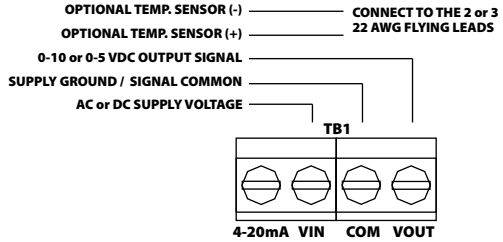
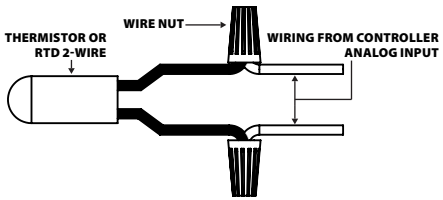
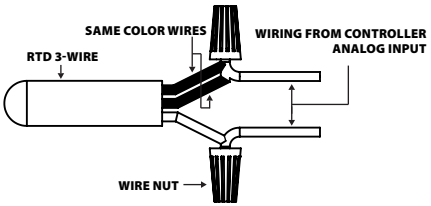


FIGURE 6: TEMPERATURE WIRING

2-WIRE THERMISTOR or RTD WIRING



3-WIRE RTD WIRING



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WIRING INSTRUCTIONS *(Continued)*

TEMPERATURE WIRING INSTRUCTIONS

(Continued)

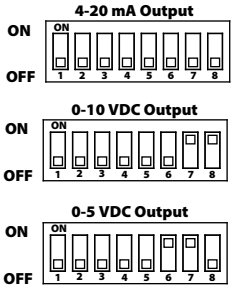
Note: When using a shielded cable, be sure to connect only (1) end of the shield to ground at the controller. Connecting both ends of the shield to ground may cause a ground loop. When removing the shield from the sensor end, make sure to properly trim the shield to prevent any chance of shorting.

Note: If the controller requires a (2) wire input for a RTD, connect the (2) common wires (same color) together. If the controller requires (3) wires, use (3) individual wires - see **FIGURE 6** (p. 3).

OUTPUT SIGNALS

Switches 6, 7, and 8 are used to set the RH output signal. Refer to **FIGURE 7** for switch settings.

FIGURE 7: OUTPUT SELECTION SWICHES



HUMIDITY REVERSE ACTING OUTPUT

The output is direct acting and can be changed to reverse acting mode. The output range stays the same but the corresponding RH value is opposite.

Example:

Direct Acting (DA)

0-10 V output mode,

0 V = 0% RH and 10 V = 100% RH

Reverse Acting (RA)

0-10 V output mode,

0 V = 100% and 10 V = 0%

REVERSE ACTING OUTPUT *(Continued)*

To change the transmitter to reverse acting or back to direct acting, set switch 4 to ON to put the unit in setup mode. After switch 4 is on, turning switch 2 to ON will put the unit in direct/reverse acting mode. When switch 2 is set to ON, the output can be used to show if the unit is in direct or reverse acting mode. For direct acting, the output will be 1 V for 0-5 V, 2 V for 0-10 V, and 7.2 mA for 4-20 mA. For reverse acting the output will be 4 V for 0-5 V, 8 V for 0-10 V, and 16.8 mA for 4-20 mA.

With switches 2 and 4 ON, each time switch 5 is set to ON the output will change to reverse acting or direct acting.

To reset the unit to the default setting, toggle both switches 5 and 6 ON then OFF while both switches 2 and 4 are ON.

When all calibration is completed, remember to place the switches back into the positions that correspond to the output needed as shown in **FIGURE 7**.

RH CALIBRATION INSTRUCTIONS

Note: This is only a single point calibration. All transmitters are factory calibrated to meet/exceed published specifications. Field adjustment should not be necessary.

The dipswitch allows the user to calibrate the sensor through the software. Setting switch 4 ON will put the transmitter into setup mode allowing the increment and decrement to work.

Once in setup mode, the output will change to 50% (2.5 V for 0-5 V, 5 V for 0-10 V, 12 mA for 4-20 mA). Each increment or decrement step will cause the output to change by 0.1 V for 0-5 V, 0.2 V for 0-10 V, and 0.32 mA for 4-20 mA in setup mode. This can be used to show the user how far offset the transmitter is. To see the starting point again set switch 1 ON. This will show the 50% output again. When the unit is out of setup mode the output will go back to RH output. The maximum offset is 10%. There can be a total of 20 increments.

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RH CALIBRATION INSTRUCTIONS *(Continued)*

Increment RH Output

This will shift the RH output linearly up in 0.5% steps. Switch 4 must be set to ON first. After switch 4 is on, each time switch 5 is set ON the RH output will increase by 0.5%. The increase goes into effect each time switch 5 is set to ON.

Decrement RH Output

This will shift the RH output linearly down in 0.5% steps. Switch 4 must be set to ON first. After switch 4 is on, each time switch 6 is set ON the RH output will decrease by 0.5%. The decrease goes into effect each time switch 6 is set to ON.

Reset RH Output

This will reset the RH output back to the original calibration. Switch 4 must be set to ON first. After switch 4 is on, toggle switches 5 and 6 ON then OFF. After 5 and 6 are OFF, slide switch 4 OFF.

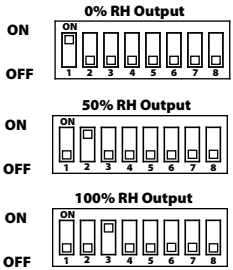
When all calibration is completed, remember to place the switches back into the positions that correspond to the output needed as shown in **FIGURE 7**.

TEST INSTRUCTIONS

Test mode will make the transmitter output a fixed 0%, 50%, or 100% value. The sensor will not affect the transmitter output. This is used for trouble-shooting or testing only.

Switches 1, 2, and 3 are used for test mode. The output will be a fixed 0%, 50%, or 100% signal that corresponds to the output selected with switches 6, 7, and 8. Refer to **FIGURE 8** for switch settings.

FIGURE 8: TEST SELECTION SWITCHES



RH CONVERSION FORMULAS

	4-20 mA	0-5 VDC	0-10 VDC
Formula:	([mA signal] -4) / 0.16 = percent RH	[VDC signal] / 0.05 = percent RH	[VDC signal] / 0.10 = percent RH
Example:	12 mA output signal (12 - 4) / 0.16 = 50% RH	1.25 vdc output signal 1.25 / 0.05 = 25% RH	7.50 vdc output signal 7.50 / 0.10 = 75% RH

WARRANTY

The ACI Duct Series RH sensors are covered by ACI's Five (5) Year Limited Warranty, which is located in the front of ACI'S SENSORS & TRANSMITTERS CATALOG or can be found on ACI's website: www.workaci.com.

W.E.E.E. DIRECTIVE

At the end of their useful life the packaging and product should be disposed of via a suitable recycling centre. Do not dispose of with household waste. Do not burn.

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PRODUCT SPECIFICATIONS

RELATIVE HUMIDITY SPECIFICATIONS

SENSOR SPECIFIC	
RH Supply Voltage:	**4-20 mA:** 250 Ω Load: 15 - 40 VDC / 18 - 28 VAC | **500 Ω Load:** 18 - 40 VDC / 18 - 28 VAC
(Reverse Polarity Protected)	**0-5 VDC:** 12 - 40 VDC / 18 - 28 VAC | **0-10 VDC:** 18 - 40 VDC / 18 - 28 VAC
RH Supply Current (VA):	**Voltage Output:** 8 mA max (0.32 VA) | **Current Output:** 24 mA max (0.83 VA)
RH Output Load Resistance:	**4-20 mA:** 700 Ω maximum | **0-5 VDC or 0-10 VDC:** 4K Ω Minimum
RH Output Signal:	**2-wire:** 4 - 20 mA (Default) | **3-wire:** 0-5 or 0-10 VDC and 4 - 20 mA (Field Selectable)
RH Accuracy @ 77°F (25°C):	+/- 1% over 20% RH Range between 20 to 90% | +/- 2%, 3%, or 5% from 10 to 95%
RH Measurement Range:	0-100%
Operating RH Range:	0 to 95% RH, non-condensing (Conformally Coated PCB's)
Operating Temperature Range:	-40 to 140 °F (-40 to 60 °C)
Storage Temperature Range:	-40 to 149 °F (-40 to 65 °C)
RH Stability | Repeatability | Sensitivity:	Less than 2% drift / 5 years | 0.5% RH | 0.1% RH
RH Response Time (T63):	20 Seconds Typical
RH Sensor Type:	Capacitive with Hydrophobic Filter
RH Transmitter Stabilization Time:	30 Minutes (Recommended time before doing accuracy verification)
RH Connections | Wire Size:	Screw Terminal Blocks (Polarity Sensitive) | 16 (1.31 mm^2) to 26 AWG (0.129 mm^2)
RH Terminal Block Torque Rating:	4.43 to 5.31 lb-in (0.5 to 0.6 Nm)
Enclosure Specifications (Flammability,	**"-4X" Enclosure:** Polystyrene Plastic, UL94-V2, NEMA 4X (IP 66)
Temperature, NEMA/IP Rating):	**"-EH" Enclosure:** ABS Plastic with UV Protectant, UL94-VO
Sensing Tube Material | Filter Material:	**"-EH" Enclosure:** 304 Series Stainless Steel | 304 Series Stainless Steel
	"-4X" Enclosure: Schedule 40 PVC (White) | Slotted PVC without filter

TEMPERATURE SENSOR SPECIFICATIONS (OPTIONAL)

SENSOR NON-SPECIFIC		
Lead Wire Length	14" (35.6 cm) | 22 AWG (0.65 mm)	
Insulation Rating	Etched Teflon (PTFE) Colored Leads | Mil Spec 1678/4 Type E	
THERMISTOR		
Sensor Output @ 25 °C (77 °F): (Lead Wire Colors)	**A/1.8K:** 1.8 KΩ nominal (Red/Yellow) **A/3K:** 3 KΩ nominal (White/Brown) **A/AN (Type III):** 10 KΩ nominal (White/White) **A/AN-BC:** 5.238 KΩ nominal (White/Yellow) **A/CP (Type II):** 10 KΩ nominal (White/Green) **A/50K:** 50KΩ nominal (Brown/Yellow)	**A/CSI:** 10 KΩ nominal (Green/Yellow) **A/10KS:** 10 KΩ nominal (White/Blue) **A/10K-E1:** 10 KΩ nominal (Gray/Orange) **A/20K:** 20 KΩ nominal (Brown/Blue) **A/100KS:** 100 KΩ nominal (Black/Yellow)
Accuracy @ 0-70 °C (32 - 158 °F):	**A/1.8K Series:** +/- 0.5 °C @ 25 °C (77 °F) and (+/-1.0 °C) (+/-1.8 °F)	**A/10K-E1 Series:** +/- 0.3 °C (+/- 0.54 °F) **All Else:** +/- 0.2 °C (+/- 0.36 °F)
PLATINUM		
Sensor Output @ 0 °C (32 °F):	**A/100:** 100 Ω nominal	**A/1K:** 1 KΩ nominal
Accuracy:	+/- 0.06% Class A (Tolerance Formula: +/- °C = (0.15 °C + (0.002 * |t|)) where |t| is the absolute value of Temperature above or below 0 °C in °C)	
	@ -40 °C (-40 °F): +/- 0.23°C (+/- 0.414°F) **@ 0 °C (32 °F):** +/- 0.15 °C (+/- 0.27 °F)	**@ 60 °C (140 °F):** +/- 0.27 °C (+/- 0.49 °F)
NICKEL		
Sensor Output @ 21.1 °C (70 °F):	1 KΩ nominal (Red/Red)	
Accuracy:	**@ -40 °C (-40 °F):** +/- 1.52 °C (+/- 2.73 °F) **@ 0 °C (32 °F):** +/- 0.4 °C (+/- 0.72 °F)	**@ 21.1 °C (70 °F):** +/- 0.17 °C (+/- 0.34 °F) **@ 54.4 °C (130 °F):** +/- 0.56 °C (+/- 1.00°F)
BALCO		
Sensor Output @ 21.1 °C (70 °F):	1 KΩ nominal (Orange/Yellow)	
Accuracy:	**@ 21.1 °C (70 °F):** +/- 1%	

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TROUBLESHOOTING

HUMIDITY READING PROBLEM	SOLUTION(S)
No Reading	• Check that you have the correct supply voltage at the power terminal blocks. • Check that wiring configurations and all DIP switch settings are as in **FIGURE 5** and **7**. • Verify that the terminal screws are all connected tightly and that all of the wires are firmly in place.
Erratic readings	• Verify that all of the wires are terminated properly. • Make sure that there is no condensation on the board. • Check that the input power is clean. In areas of high RF interference or noise, shielded cable may be necessary to stabilize signal.
Inaccurate readings	• Verify proper mounting location to confirm no external factors (see mounting locations above). • Check the output (voltage or current) against a highly accurate recently calibrated secondary reference. Measue RH at the location of the sensor using the secondary reference, then calculate the RH percentage using the **RH CONVERSION FORMULAS** (p. 5). Compare the calculated output to reference. • If the sensor is brand new, leave the sensor powered for at least 30 minutes to stabilize. • If you suspect that the transmitter is not reading within the specified tolerance, please contact ACI for further assistance.
TEMPERATURE (Optional) PROBLEM	**SOLUTION(S)**
Sensor reading is incorrect	• Verify sensor wiring to controller is not damaged and has continuity • Verify sensor or wires are not shorted together • Verify controller is setup for correct sensor curve • Disconnect sensor wires, and take a resistance (ohm) reading with a multimeter • Compare the resistance reading to the Temperature Vs Resistance Curves online: *http://www.workaci.com/content/thermistor-curves-0* • Verify proper mounting location to confirm no external factors
Sensor reads infinity/very high resistance	• Sensor or wires are open
Sensor reads low resistance	• Sensor or wires are shorted together
Erratic readings	• Bad wire connections

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NOTES

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RH OUTSIDE AIR

Relative Humidity, Outside Air, Thermistors

The ACI Relative Humidity with Thermistor Outside Air Series utilizes a thermoset polymer capacitive sensing element with factory applied hygroscopic filter to deliver a proportional analog current or voltage output signal. The hygroscopic filter provides added resistance to moisture, dust, and other chemicals for greater long term reliability. The RH Outside Air transmitter features integral DIP switches for field selection of the proper output signal and supply voltage to meet your applications requirements. Each unit also contains 0%, 50%, and 100% test options to verify that the transmitter is both working and wired properly. Field calibration also can be performed by using the increment and decrement calibration DIP switches without the need to replace the sensing element. These enhancements provide increased flexibility and outstanding long-term reliability. Outside Air configurations feature a weatherproof Euro style enclosure with gasketed cover and conformally coated circuit boards for added moisture and chemical resistance. Three and Five-point NIST Calibration Certificates are available upon request but they must be ordered separately.

Applications: Monitor Outdoor Air Humidity, Economizer Control, Psychrometric calculations such as Enthalpy and Dew point, Wash down Applications

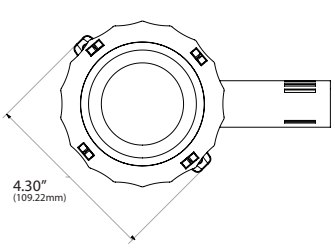
The ACI RH Thermistor Outside Air is covered by ACI's Five (5) Year Limited Warranty. The warranty can be found in the front of ACI's Sensors & Transmitters catalog, as well as on ACI's website, www.workaci.com.

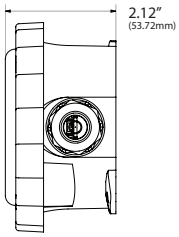
PRODUCT SPECIFICATIONS

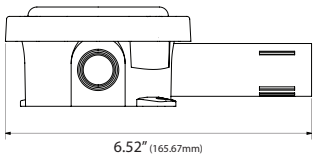
RH Supply Voltage (Reverse Polarity Protected):	**4-20 mA:** 250 Ohm Load: 15 - 40 VDC / 18 - 28 VAC | **500 Ohm Load:** 18 - 40 VDC / 18 - 28 VAC **0-5 VDC:** 12 - 40 VDC / 18 - 28 VAC | **0-10 VDC:** 18 - 40 VDC / 18 - 28 VAC
RH Supply Current (VA):	**Voltage Output:** 8 mA maximum (0.32 VA) | **Current Output:** 24 mA maximum (0.83 VA)
RH Output Load Resistance:	**4-20 mA:** 700 Ohms maximum | **0-5 VDC or 0-10 VDC:** 4K Ohms Minimum
RH Output Signal:	**2-wire:** 4 - 20 mA (Factory Default) | **3-wire:** 0-5 or 0-10 VDC and 4 - 20 mA (Field Selectable)
RH Accuracy @ 77°F (25°C):	+/- 1% over 20% RH Range between 20 to 90% | +/- 2%, 3%, or 5% from 10 to 95%
RH Measurement Range	0-100%
Operating RH Range:	0 to 95% RH, non-condensing (Conformally Coated PCB's)
Operating Temperature Range:	-40 to 140°F (-40 to 60°C)
Storage Temperature Range:	-40 to 149°F (-40 to 65°C)
RH Stability | Repeatability | Sensitivity:	Less than 2% drift / 5 years | 0.5% RH | 0.1% RH
RH Response Time (T63):	20 Seconds Typical
RH Sensor Type:	Capacitive with Hydrophobic Filter
RH Transmitter Stabilization Time:	30 Minutes (Recommended time before doing accuracy verification)
RH Connections | Wire Size:	Screw Terminal Blocks (Polarity Sensitive) | 16 (1.31 mm^2) to 26 AWG (0.129 mm^2)
RH Terminal Block Torque Rating:	4.43 to 5.31 lb-in (0.5 to 0.6 Nm)
RH NIST Test Points:	**Default Test Points:** 3 Points (20%, 50% & 80%) or 5 Points (20%, 35%, 50%, 65% & 80%) **1% NIST Test Points:** 5 Points within selected 20% Range (ie. 30%-50% are 30, 35, 40, 45 & 50)
Nominal Thermistor Resistive Output @ 77°F (25°C) (Lead Wire Colors):	**RHx-1.8K Series:** 1.8KΩ (Red/Yellow) — **RHx-10KS Series:** 10KΩ (White/Blue) **RHx-3K Series:** 3KΩ (White/Brown) — **RHx-10K-E1 Series:** 10KΩ (Gray/Orange) **RHx-AN Series (Type III):** 10KΩ (White/White) — **RHx-20K Series:** 20KΩ (Brown/Blue) **RHx-AN-BC Series:** 5.238KΩ (White/Yellow) — **RHx-50K Series:** 50KΩ nominal (Brown/Yellow) **RHx-CP Series (Type II):** 10KΩ (White/Green) — **RHx-100KS Series:** 100KΩ (Black/Yellow) **RHx-CSI Series:** 10KΩ (Green/Yellow)
Thermistor Accuracy 32-158°F (0-70°C):	+/- 0.36°F (0.2°C) except 10K-E1 Series: +/- 0.54°F (0.3°C) 1.8K Series: +/- 0.9°F (0.5°C) @ 77°F (25°C) & +/- 1.8°F (1.0°C) from 32 to 158°F (0 to 70°C)
Thermistor Power Dissipation Constant:	3 mW/°C except 1.8K Series: 1 mW/°C; 10K-E1 Series: 2 mW/°C
Thermistor Sensor Response Time (T63):	10 Seconds nominal
Lead Wire Length | Conductor Size:	14" (35.6 cm) | 22 AWG (0.65 mm)
Insulation | Rating:	Etched Teflon (PTFE) Colored Leads | Mil Spec 16878/4 Type E
Enclosure Specifications (Material, Flammability, Temperature, NEMA/IP Rating):	**"-EH" Enclosure:** ABS Plastic; UL94-V0; -40 to 140°F (-40 to 60°C) **"-4X" Enclosure:** Polystyrene Plastic; UL94-V2; -40 to 158°F (-40 to 70°C); NEMA 4X (IP 66)
Sensing Tube Dimensions (Length x Diameter):	**"-EH" Models:** 3.00" (76.20 mm) x 1.125" (28.75 mm) **"-4X" Models:** 4.73" (120.14 mm) x 0.845" (21.46mm)
Product Dimensions (L x W x D):	See drawings on back of data sheet
Product Weight:	**A/RHx-xx-O Series:** 0.59 lbs. (0.27 kg) | **A/RHx-xx-O-4X Series:** 0.45 lbs. (0.204 kg)
Agency Approvals:	CE, RoHS2, WEEE

DIMENSIONAL DRAWING

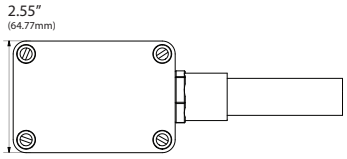
Euro Enclosure [EH]

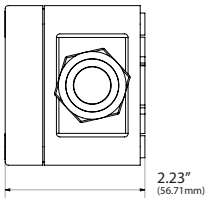


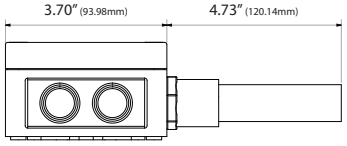




NEMA 4X Enclosure [4X]







Front View | **Right View** | **Top View**

CUSTOM ORDERING

Model # Example: A/ (A.) | RH2 (B.) | CP (C.) | O (D.) | (E.) | NIST (F.)

		MODEL #
A. Sensor Series *No Selection Required*	**A/** →	**A/**
B. Accuracy *Select One (1)*	**RH1** = +/-1% (Specify a 20% Range between 20 to 90% RH) **RH2** = +/-2% | **RH3** = +/-3% | **RH5** = +/-5%	
C. Temperature Sensor *Select One (1)*	**1.8K** | **3K** | **10KS** | **AN** (Type III) | **AN-BC** | **CP** (Type II) | **CSI** | **10K-E1** | **20K** | **50K** | **100KS**	
D. Configuration *Select One (1)*	**O** = Outside Air (Euro Enclosure) | **O-4X** = Outside Air (NEMA 4X Enclosure)	
E. Output Signal *Select One (1)*	**----** = 4 to 20 mA (Default) | 0 to 10 VDC (Field Selectable) | 0 to 5 VDC (Field Selectable)	
F. NIST (Temperature) *Select One (1)*	**----** = No NIST Certificate | **NIST** = NIST Certificate (Must Specify 1, 3 or 5 Points)	

Note: Outputs are field selectable between 4-20 mA, 0-5 VDC & 0-10 VDC

ACCESSORIES ORDERING [NIST]

Model # Example: NIST RH CERT

Model #	Description
NIST RH CERT	RH Calibration Certificate (Specify 3 Point or 5 Point NIST)

Note: When ordering NIST certificates, please add an additional line item under the corresponding A/RHx-XX-O Model Number

OUTSIDE HUMIDITY SERIES

Installation & Operation Instructions

Phone: 1-888-967-5224
Website: workaci.com

GENERAL INFORMATION

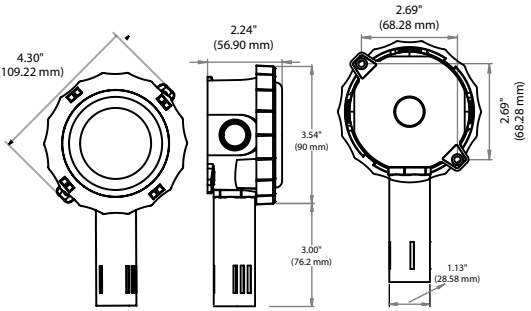
The A/RH Outside Series Sensor is a Relative Humidity transmitter that can be powered with either an AC or DC supply voltage. The RH outside transmitter is field selectable with a 4-20 mA, 0-5 VDC, or 0-10 VDC output signal that is equivalent to 0 to 100% RH. This sensor is designed for use with electronic controllers in commercial heating and cooling building management systems. All units are shipped from the factory set up for a 4-20 mA output. The transmitter can also include an optional temperature sensor for monitoring the space temperature.

For optimal readings, follow these tips:

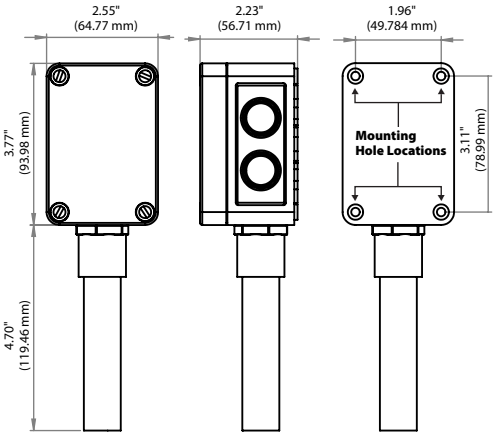
- Mount in shade on North side of the structure to minimize sun exposure. In the Southern hemisphere the South side of the building is where the sensor should be mounted.
- Mount at least 1'-2' (0.3-0.6 m) below eave to prevent thermal radiation from affecting performance – see **FIGURE 2** (p. 2).
- Mount at least 4' (1.22 m) above ground to prevent thermal radiation rising up affecting performance.
- The plastic tube that houses the sensor must be pointed down to avoid debris, water, or ice potentially affecting sensor performance.
- Avoid mounting to chimney walls, above windows, above vents, near doors, or dampers.

FIGURE 1: ENCLOSURE DIMENSIONS

EURO (-EH)



NEMA 4X (-4X)



MOUNTING INSTRUCTIONS

Take care when mounting. Sensors should not be placed in direct sunlight, or any other potential heating or cooling sources that could affect temperature being sensed. Remove the cover from the housing by loosening the screws located in corners of the housing. Attach the base directly to the wall. Mounting holes are located at the corners of the housing – see **FIGURE 1**. Drill pilot holes for the mounting screws. Use the enclosure mounting holes as a guide.

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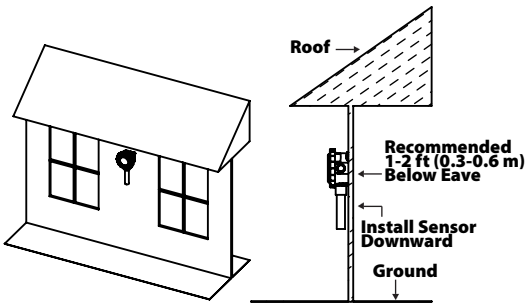
MOUNTING INSTRUCTIONS
(Continued)

Install the PG11 watertight fitting supplied with the sensor if not using conduit. The outer knockout ring (PG 11/16) on housing should not be removed when using a ½" NPT conduit fitting. The 4X enclosure has (4) screws while the -EH has none and instead must be tightened clockwise. Confirm gasketed cover is fastened securely in order to prevent any moisture being introduced into housing.

Refer to **Wiring Instructions** (p. 2-4) to make necessary connections.

FIGURE 2: MOUNTED ASSEMBLY



WIRING INSTRUCTIONS

PRECAUTIONS

- **Remove power before wiring. Never connect or disconnect wiring with power applied.**
- **When using a shielded cable, ground the shield only at the controller end. Grounding both ends can cause a ground loop.**
- **Do not run the temperature sensor wiring in any conduit with line voltage (24/120/230 VAC) if utilizing resistance temperature signal.**
- **It is recommended you use an isolated UL-listed class 2 transformer when powering the unit with 24 VAC. Failure to wire the devices with the correct polarity when sharing transformers may result in damage to any device powered by the shared transformer.**
- **If the 24 VDC or 24VAC power is shared with devices that have coils such as relays, solenoids, or other inductors, each coil must have an MOV, DC/AC Transorb, Transient Voltage Suppressor (ACI Part: 142583), or diode placed across the coil or inductor. The cathode, or banded side of the DC Transorb or diode, connects to the positive side of the power supply. Without these snubbers, coils produce very large voltage spikes when de-energizing that can cause malfunction or destruction of electronic circuits.**

RELATIVE HUMIDITY WIRING INSTRUCTIONS

Open the cover of the enclosure. ACI recommends 16 to 26 AWG twisted pair wires or shielded cable for all transmitters. Twisted pair may be used for 2-wire current output transmitters or 3-wire for voltage output. Refer to **FIGURE 4** (p. 3) or wiring diagrams.

TEMPERATURE WIRING INSTRUCTIONS

ACI recommends 16 to 26 AWG twisted pair wires or shielded cable for all temperature sensors. ACI recommends a separate cable be pulled for Temperature signal only. Temperature Signal wiring must be run separate from low and high voltage wires (24/120/230VAC). All ACI thermistors and RTD temperature sensors are both non-polarity and non-position sensitive.

FIGURE 3: TEMPERATURE LEAD WIRES

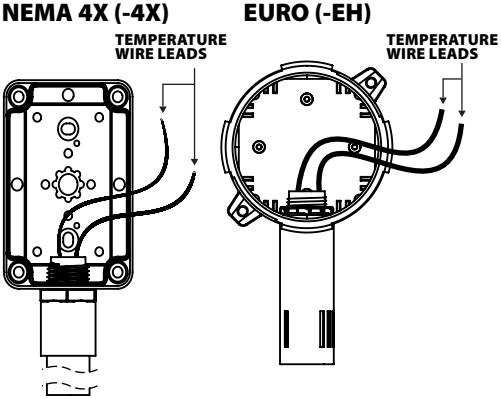


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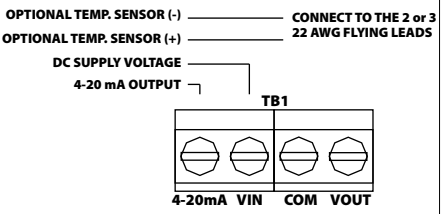
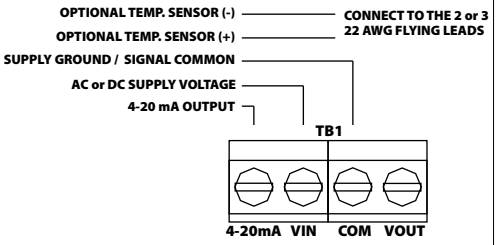
FIGURE 4: OUTPUT SIGNALS

2 WIRE CURRENT OUTPUT SIGNAL



3 WIRE CURRENT OUTPUT SIGNAL



VOLTAGE OUTPUT SIGNAL

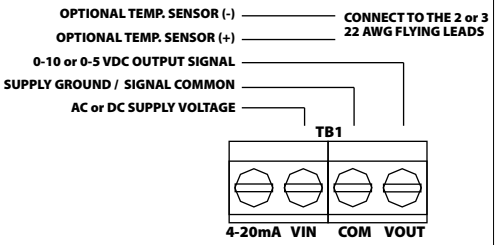
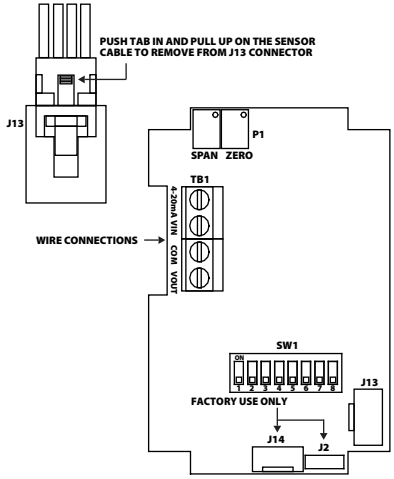


FIGURE 5: PRINTED CIRCUIT BOARD

SQUARE PCB (-BB and -4X ENCLOSURES)



ROUND PCB (-EH ENCLOSURE)

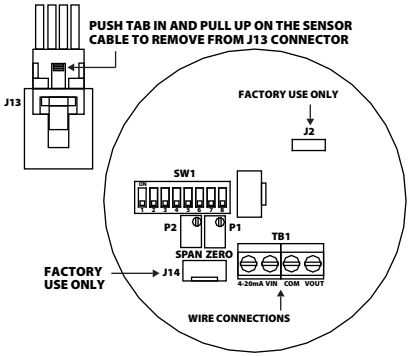
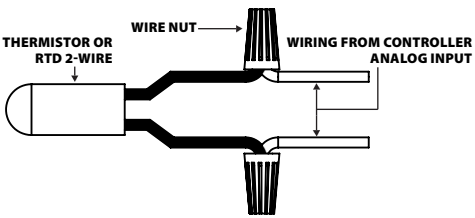
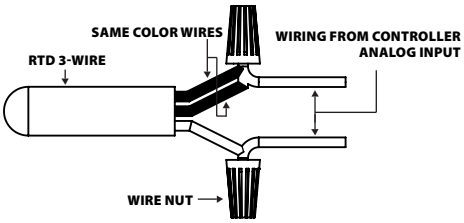


FIGURE 6: TEMPERATURE WIRING

2-WIRE THERMISTOR or RTD WIRING



3-WIRE RTD WIRING



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WIRING INSTRUCTIONS
(Continued)

TEMPERATURE WIRING INSTRUCTIONS
(Continued)

All thermistor type units are supplied with (2) flying lead wires, and all RTD's are supplied with (2) or (3) flying lead wires – see **FIGURE 6** (p. 3). The number of wires needed depends on the application.

Connect thermistor/RTD wire leads to controller analog input wires using wire nuts, terminal blocks, or crimp style connectors. All wiring must comply with local and National Electric Codes. After wiring, attach the cover to the enclosure.

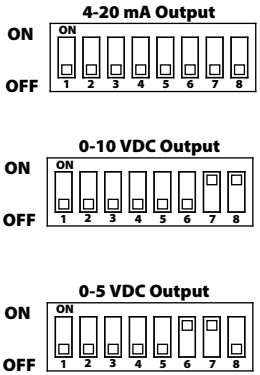
Note: When using a shielded cable, be sure to connect only (1) end of the shield to ground at the controller. Connecting both ends of the shield to ground may cause a ground loop. When removing the shield from the sensor end, make sure to properly trim the shield to prevent any chance of shorting.

Note: If the controller requires a (2) wire input for a RTD, connect the (2) common wires (same color) together. If the controller requires (3) wires, use (3) individual wires - see **FIGURE 6** (p. 3).

OUTPUT SIGNALS

Switches 6, 7, and 8 are used to set the RH output signal. Refer to **FIGURE 7** for switch settings.

FIGURE 7: OUTPUT SELECTION SWICHES



HUMIDITY REVERSE ACTING OUTPUT

The output is direct acting and can be changed to reverse acting mode. The output range stays the same but the corresponding RH value is opposite.

Example:

Direct Acting (DA)
0-10 V output mode,
0 V = 0% RH and 10 V = 100% RH

Reverse Acting (RA)
0-10 V output mode,
0 V = 100% and 10 V = 0%

To change the transmitter to reverse acting or back to direct acting, set switch 4 to ON to put the unit in setup mode. After switch 4 is on, turning switch 2 to ON will put the unit in direct/reverse acting mode. When switch 2 is set to ON, the output can be used to show if the unit is in direct or reverse acting mode. For direct acting, the output will be 1 V for 0-5 V, 2 V for 0-10 V, and 7.2 mA for 4-20 mA. For reverse acting the output will be 4 V for 0-5 V, 8 V for 0-10 V, and 16.8 mA for 4-20 mA.

With switches 2 and 4 ON, each time switch 5 is set to ON the output will change to reverse acting or direct acting.

To reset the unit to the default setting, toggle both switches 5 and 6 ON then OFF while both switches 2 and 4 are ON.

When all calibration is completed, remember to place the switches back into the positions that correspond to the output needed as shown in **FIGURE 7**.

RH CALIBRATION INSTRUCTIONS

Note: This is only a single point calibration. All transmitters are factory calibrated to meet/exceed published specifications. Field adjustment should not be necessary.

The dipswitch allows the user to calibrate the sensor through the software. Setting switch 4 ON will put the transmitter into setup mode allowing the increment and decrement to work.

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RH CALIBRATION *(Continued)*

Once in setup mode, the output will change to 50% (2.5 V for 0-5 V, 5 V for 0-10 V, 12 mA for 4-20 mA). Each increment or decrement step will cause the output to change by 0.1 V for 0-5 V, 0.2 V for 0-10 V, and 0.32 mA for 4-20 mA in setup mode. This can be used to show the user how far offset the transmitter is. To see the starting point again set switch 1 ON. This will show the 50% output again. When the unit is out of setup mode the output will go back to RH output. The maximum offset is 10%. There can be a total of 20 increments.

Increment RH Output

This will shift the RH output linearly up in 0.5% steps. Switch 4 must be set to ON first. After switch 4 is on, each time switch 5 is set ON the RH output will increase by 0.5%. The increase goes into effect each time switch 5 is set to ON.

Decrement RH Output

This will shift the RH output linearly down in 0.5% steps. Switch 4 must be set to ON first. After switch 4 is on, each time switch 6 is set ON the RH output will decrease by 0.5%. The decrease goes into effect each time switch 6 is set to ON.

Reset RH Output

This will reset the RH output back to the original calibration. Switch 4 must be set to ON first. After switch 4 is on, toggle switches 5 and 6 ON then OFF. After 5 and 6 are OFF slide switch 4 OFF.

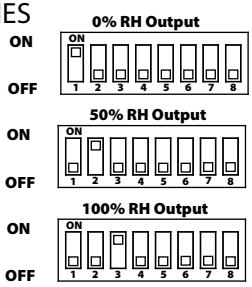
When all calibration is completed, remember to place the switches back into the positions that correspond to the output needed as shown in **FIGURE 8**.

TEST INSTRUCTIONS

Test mode will make the transmitter output a fixed 0%, 50%, or 100% value. The sensor will not affect the transmitter output. This is used for troubleshooting or testing only.

Switches 1, 2, and 3 are used for test mode. The output will be a fixed 0%, 50%, or 100% signal that corresponds to the output selected with switches 6, 7, and 8. Refer to **FIGURE 8** for switch settings.

FIGURE 8: TEST SELECTION SWITCHES



RH CONVERSION FORMULAS

	4-20 mA	0-5 VDC	0-10 VDC
Formula:	([mA signal] -4) / 0.16 = percent RH	[VDC signal] / 0.05 = percent RH	[VDC signal] / 0.10 = percent RH
Example:	12 mA output signal (12 - 4) / 0.16 = 50% RH	1.25 vdc output signal 1.25 / 0.05 = 25% RH	7.50 vdc output signal 7.50 / 0.10 = 75% RH

WARRANTY

The ACI Outside Series RH sensors are covered by ACI's Five (5) Year Limited Warranty, which is located in the front of ACI'S SENSORS & TRANSMITTERS CATALOG or can be found on ACI's website: www.workaci.com.

W.E.E.E. DIRECTIVE

At the end of their useful life the packaging and product should be disposed of via a suitable recycling centre. Do not dispose of with household waste. Do not burn.

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PRODUCT SPECIFICATIONS

RELATIVE HUMIDITY SPECIFICATIONS

SENSOR SPECIFIC	
RH Supply Voltage:	**4-20 mA:** 250 Ω Load: 15 - 40 VDC / 18 - 28 VAC | **500 Ω Load:** 18 - 40 VDC / 18 - 28 VAC
(Reverse Polarity Protected)	**0-5 VDC:** 12 - 40 VDC / 18 - 28 VAC | **0-10 VDC:** 18 - 40 VDC / 18 - 28 VAC
RH Supply Current (VA):	**Voltage Output:** 8 mA max (0.32 VA) | **Current Output:** 24 mA max (0.83 VA)
RH Output Load Resistance:	**4-20 mA:** 700 Ω maximum | **0-5 VDC or 0-10 VDC:** 4K Ω Minimum
RH Output Signal:	**2-wire:** 4 - 20 mA (Default) | **3-wire:** 0-5 or 0-10 VDC and 4 - 20 mA (Field Selectable)
RH Accuracy @ 77°F (25°C):	+/- 1% over 20% RH Range between 20 to 90% | +/- 2%, 3%, or 5% from 10 to 95%
RH Measurement Range:	0-100%
Operating RH Range:	0 to 95% RH, non-condensing (Conformally Coated PCB's)
Operating Temperature Range:	-40 to 140 °F (-40 to 60 °C)
Storage Temperature Range:	-40 to 149 °F (-40 to 65 °C)
RH Stability | Repeatability | Sensitivity:	Less than 2% drift / 5 years | 0.5% RH | 0.1% RH
RH Response Time (T63):	20 Seconds Typical
RH Sensor Type:	Capacitive with Hydrophobic Filter
RH Transmitter Stabilization Time:	30 Minutes (Recommended time before doing accuracy verification)
RH Connections | Wire Size:	Screw Terminal Blocks (Polarity Sensitive) | 16 (1.31 mm^2) to 26 AWG (0.129 mm^2)
RH Terminal Block Torque Rating:	4.43 to 5.31 lb-in (0.5 to 0.6 Nm)
Enclosure Specifications (Flammability, Temperature, NEMA/IP Rating):	**"-4X" Enclosure:** Polystyrene Plastic, UL94-V2, NEMA 4X (IP 66) **"-EH" Enclosure:** ABS Plastic with UV Protectant, UL94-VO
Sensing Tube Material | Filter Material:	**"-EH" Enclosure:** 304 Series Stainless Steel | 304 Series Stainless Steel
	"-4X" Enclosure: Schedule 40 PVC (White) | Slotted PVC without filter

TEMPERATURE SENSOR SPECIFICATIONS (OPTIONAL)

SENSOR NON-SPECIFIC		
Lead Wire Length	14" (35.6 cm) | 22 AWG (0.65 mm)	
Insulation Rating	Etched Teflon (PTFE) Colored Leads | Mil Spec 1678/4 Type E	
THERMISTOR		
Sensor Output @ 25 °C (77 °F): (Lead Wire Colors)	**A/1.8K:** 1.8 KΩ nominal (Red/Yellow) **A/3K:** 3 KΩ nominal (White/Brown) **A/AN (Type III):** 10 KΩ nominal (White/White) **A/AN-BC:** 5.238 KΩ nominal (White/Yellow) **A/CP (Type II):** 10 KΩ nominal (White/Green) **A/50K:** 50KΩ nominal (Brown/Yellow)	**A/CSI:** 10 KΩ nominal (Green/Yellow) **A/10KS:** 10 KΩ nominal (White/Blue) **A/10K-E1:** 10 KΩ nominal (Gray/Orange) **A/20K:** 20 KΩ nominal (Brown/Blue) **A/100KS:** 100 KΩ nominal (Black/Yellow)
Accuracy @ 0-70 °C (32 - 158 °F):	**A/1.8K Series:** +/- 0.5 °C @ 25 °C (77 °F) and (+/-1.0 °C) (+/-1.8 °F)	**A/10K-E1 Series:** +/- 0.3 °C (+/- 0.54 °F) **All Else:** +/- 0.2 °C (+/- 0.36 °F)
PLATINUM		
Sensor Output @ 0 °C (32 °F):	**A/100:** 100 Ω nominal	**A/1K:** 1 KΩ nominal
Accuracy:	+/- 0.06% Class A (Tolerance Formula: +/- °C = (0.15 °C + (0.002 * |t|)) where |t| is the absolute value of Temperature above or below 0 °C in °C)	
	@ -40 °C (-40 °F): +/- 0.23°C (+/- 0.414°F)	**@ 60 °C (140 °F):** +/- 0.27 °C (+/- 0.49 °F)
	@ 0 °C (32 °F): +/- 0.15 °C (+/- 0.27 °F)	
NICKEL		
Sensor Output @ 21.1 °C (70 °F):	1 KΩ nominal (Red/Red)	
Accuracy:	**@ -40 °C (-40 °F):** +/- 1.52 °C (+/- 2.73 °F) **@ 0 °C (32 °F):** +/- 0.4 °C (+/- 0.72 °F)	**@ 21.1 °C (70 °F):** +/- 0.17 °C (+/- 0.34 °F) **@ 54.4 °C (130 °F):** +/- 0.56 °C (+/- 1.00°F)
BALCO		
Sensor Output @ 21.1 °C (70 °F):	1 KΩ nominal (Orange/Yellow)	
Accuracy:	**@ 21.1 °C (70 °F):** +/- 1%	

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TROUBLESHOOTING

HUMIDITY READING PROBLEM	SOLUTION(S)
No Reading	• Check that you have the correct supply voltage at the power terminal blocks. • Check that wiring configurations and all DIP switch settings are as in **FIGURE 4** and **7**. • Verify that the terminal screws are all connected tightly and that all of the wires are firmly in place.
Erratic readings	• Verify that all of the wires are terminated properly. • Make sure that there is no condensation on the board. • Check that the input power is clean. In areas of high RF interference or noise, shielded cable may be necessary to stabilize signal.
Inaccurate readings	• Verify proper mounting location to confirm no external factors (see mounting locations above). • Check the output (voltage or current) against a highly accurate recently calibrated secondary reference. Measue RH at the location of the sensor using the secondary reference, then calculate the RH percentage using the **RH CONVERSION FORMULAS** (p. 5). Compare the calculated output to reference. • If the sensor is brand new, leave the sensor powered for at least 30 minutes to stabilize. • If you suspect that the transmitter is not reading within the specified tolerance, please contact ACI for further assistance.
TEMPERATURE (Optional) PROBLEM	**SOLUTION(S)**
Sensor reading is incorrect	• Verify sensor wiring to controller is not damaged and has continuity • Verify sensor or wires are not shorted together • Verify controller is setup for correct sensor curve • Disconnect sensor wires, and take a resistance (ohm) reading with a multimeter • Compare the resistance reading to the Temperature Vs Resistance Curves online: *http://www.workaci.com/content/thermistor-curves-0* • Verify proper mounting location to confirm no external factors
Sensor reads infinity/very high resistance	• Sensor or wires are open
Sensor reads low resistance	• Sensor or wires are shorted together
Erratic readings	• Bad wire connections

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NOTES

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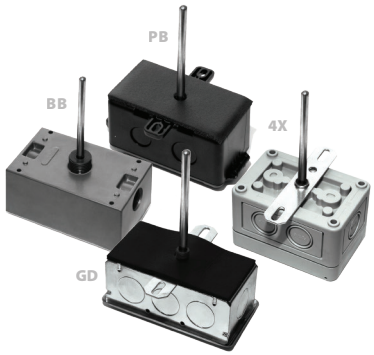


DUCT

Duct Sensor, Thermistor

The ACI Thermistor Duct Series features a stainless steel probe with two, 22 AWG Etched Teflon colored lead wires to differentiate the different sensor types. The sensors in this series are manufactured using ACI's proved double encapsulation process to eliminate the effects of moisture on the sensors and increased response times from our high quality, thermally conductive epoxy. The duct sensor is designed to be used in smaller duct applications and includes an insulation pad for sealing your duct and dampening vibration. The sensor length should be determined by the width or diameter of your duct such that the tip of the probe reaches the approximate center of the duct. Our standard enclosure options are the galvanized enclosure "-GD" or plastic duct enclosure with hinged cover "-PB". On larger ducts, you may want to refer to our Rigid or Bendable Copper Averaging sensor for increased sensing points and better temperature control. This series can be ordered with optional NEMA/IP rated weather proof enclosures and NIST certificates as referenced on the back of the product data sheet.

Applications: Roof Top Units, Air Handlers, Supply/Discharge/Return/Mixed Air Temperatures

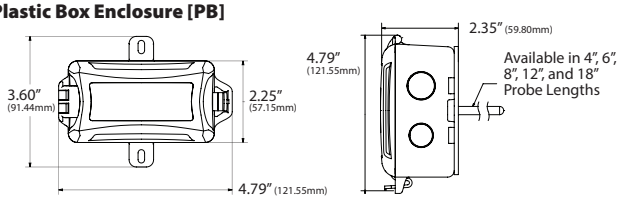
The ACI Thermistor Duct Series is covered by ACI's Five (5) Year Limited Warranty. The warranty can be found in the front of ACI's Sensors & Transmitters catalog, as well as on ACI's website, www.workaci.com.

PRODUCT SPECIFICATIONS

Sensor Type | Sensor Curve:	Thermistor | Non-Linear, NTC (Negative Temperature Coefficient)
Number Sensing Points | Number Wires:	One | Two (Non-Polarity Sensitive)
Sensor Output @ 25°C (77°F) | (Lead Wire Colors):	**A/1.8K:** 1.8KΩ nominal | (Red/Yellow) **A/3K:** 3KΩ nominal | (White/Brown) **A/AN (Type III):** 10KΩ nominal | (White/White) **A/AN-BC:** 5.238KΩ nominal | (White/Yellow) **A/CP (Type II):** 10KΩ nominal | (White/Green) **A/CSI:** 10KΩ nominal | (Green/Yellow) **A/10KS:** 10KΩ nominal | (White/Blue) **A/10K-E1:** 10KΩ nominal | (Gray/Orange) **A/20K:** 20KΩ nominal | (Brown/Blue) **A/50K:** 50KΩ nominal | (Brown/Yellow) **A/100KS:** 100KΩ nominal | (Black/Yellow)
Sensor Accuracy 0-70°C (32-158°F):	+/-0.2°C (+/-0.36°F) except **A/10K-E1 Series:** +/-0.3°C (+/-0.54°F) **A/1.8K Series:** +/- 0.5°C @ 25°C (77°F) and (+/-1.0°C) (+/-1.8°F)
Power Dissipation Constant:	3 mW/°C except **A/1.8K Series:** 1 mW/°C | **A/10K-E1 Series:** 2 mW/°C
Stability:	Sensor Dependent; Contact ACI for more information on specific sensor
Response Time (63% Step Change):	10 Seconds nominal
Sensor Operating Temperature Range:	-40°C (-40°F) to 150°C (302°F)
Enclosure Specifications (Temperature, Material, Flammability, NEMA/IP Ratings):	**"-GD" Enclosure:** Galvanized Steel, -40 to 115°C (-40 to 239°F), NEMA 1 (IP10) **"-PB" Enclosure:** ABS Plastic, UL94-HB, -30 to 90°C (-22 to 194°F), Plenum Rated **"-BB" Enclosure:** Aluminum, -40 to 121°C (-40 to 250°F), Plenum Rated, NEMA 3R **"-4X" Enclosure:** Polystyrene Plastic, UL94-V2, -40 to 70°C (-40 to 158°F), NEMA 4X (IP 66)
Storage Temperature Range:	-40 to 85°C (-40 to 185°F)
Operating Humidity Range:	10 to 95% RH, non-condensing
Probe Material | Probe Diameter:	304 Stainless Steel | 0.250" (6.35mm)
Fitting Material | Flammability Rating:	Polyamide 66 (High Performance Nylon) | UL94-HB
Foam Pad Material | Flammability Rating:	Neoprene/EPDM/SBR Polymer | UL94-HBF; FMVSS-302; MIL-R-6130C
Lead Length | Conductor Size:	4", 6" and 8" Probes: 14" (35.6 cm) | 12" and 18" Probes: 24" (61 cm) | 22 AWG (0.65 mm)
Lead Wire Insulation | Wire Rating:	Etched Teflon (PTFE) Colored Leads | Mil Spec 16878/4 Type E)
Conductor Material:	Silver Plated Copper
Product Dimensions | Product Weight:	See table on back of Product Data sheet
Agency Approvals:	CE, RoHS2, WEEE

DIMENSIONAL DRAWING, WEIGHTS

Plastic Box Enclosure [PB]



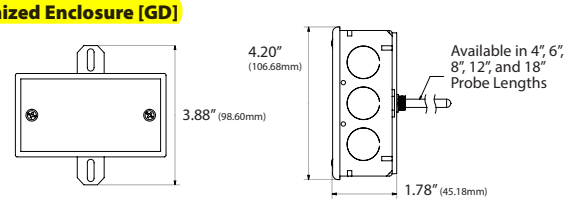
xx = Sensor Type | **yy** = Insertion Length

Plastic Box Enclosure [PB] Weights

ACI Model #	4" (Probe Length)	6" (Probe Length)	8" (Insertion Length)
A/xx-D-yy-PB	0.24 lbs. (0.109 kg)	0.25 lbs. (0.113 kg)	0.26 lbs. (0.117 kg)

ACI Model #	12" (Probe Length)	18" (Probe Length)
A/xx-D-yy-PB	0.28 lbs. (0.127 kg)	0.30 lbs. (0.136 kg)

Galvanized Enclosure [GD]

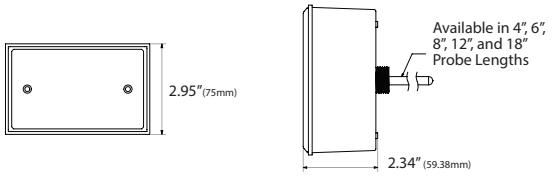


Galvanized Enclosure [GD] Weights

ACI Model #	4" (Probe Length)	6" (Probe Length)	8" (Insertion Length)
A/xx-D-yy-GD	0.66 lbs. (0.299 kg)	0.67 lbs. (0.303 kg)	0.68 lbs. (0.308 kg)

ACI Model #	12" (Probe Length)	18" (Probe Length)
A/xx-D-yy-GD	0.70 lbs. (0.317 kg)	0.74 lbs. (0.336 kg)

Bell Box Enclosure [BB]

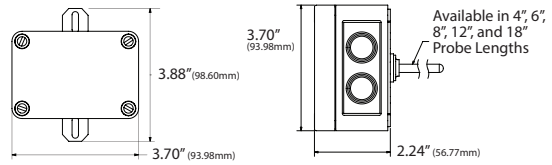


Bell Box Enclosure [BB] Weights

ACI Model #	4" (Probe Length)	6" (Probe Length)	8" (Insertion Length)
A/xx-D-yy-BB	0.70 lbs. (0.317 kg)	0.71 lbs. (0.322 kg)	0.72 lbs. (0.326 kg)

ACI Model #	12" (Probe Length)	18" (Probe Length)
A/xx-D-yy-BB	0.74 lbs. (0.336 kg)	0.78 lbs. (0.354 kg)

NEMA 4X Enclosure [4X]



NEMA 4X Enclosure [4X] Weights

ACI Model #	4" (Probe Length)	6" (Probe Length)	8" (Insertion Length)
A/xx-D-yy-4X	0.34 lbs. (0.154 kg)	0.35 lbs. (0.159 kg)	0.36 lbs. (0.163 kg)

ACI Model #	12" (Probe Length)	18" (Probe Length)
A/xx-D-yy-4X	0.38 lbs. (0.172 kg)	0.40 lbs. (0.181 kg)

Standard Views | **Product Weights**

CUSTOM ORDERING

Model # Example: A/ (A.) | 1.8K (B.) | D (C.) | 8" (D.) | GD (E.) | NIST (F.)

		MODEL #
A. Sensor Series *No Selection Required*	**A/**	A/
B. Model Series *Select One (1)*	**1.8K** | **3K** | **AN** | **AN-BC** | **CP** | **CSI** | **10KS** | **10K-E1** | **20K** | **50K** | **100KS**	
C. Configuration *No Selection Required*	**D** = Duct	D
D. Probe Length *Select One (1)*	**4"** = 4" Probe | **6"** = 6" Probe | **8"** = 8" Probe | **12"** = 12" Probe | **18"** = 18" Probe	
E. Enclosure *Select One (1)*	**GD** = Galvanized | **PB** = Plastic | **BB** = Aluminum, NEMA 3R | **4X** = NEMA 4X	
F. NIST *Select One (1)*	**----** = No NIST Certificate | **NIST** = NIST Certificate (3 Points)	

DUCT SERIES

Installation & Operation Instructions

Phone: 1-888-967-5224
Website: workaci.com

PRECAUTIONS

- **DO NOT RUN THE WIRING IN ANY CONDUIT WITH LINE VOLTAGE (24/120/230 VAC).**

GENERAL INFORMATION

The Duct sensor is a single point temperature sensor that is designed for use with electronic controllers in commercial heating and cooling building management systems. It is available with multiple thermistor or RTD options.

For optimal temperature readings, follow these tips:

- Duct probe should be placed (3) to (4) duct segments down from any bend or obstructions and away from 90° bends.
- Mount the sensor on the top or sides of duct work; mounting on the bottom risks damage due to moisture.
- The sensor should be mounted in the middle of the duct where air circulation is well mixed (no stratification), and not blocked by obstructions. Stratification and obstructions can cause sensing errors. An example is downstream from a heating or cooling coil.

MOUNTING INSTRUCTIONS

Drill a 3/8" hole in the duct and insert the probe through the hole until the foam pad is tight to the duct. Drill pilot holes for the (2) mounting screws. Use the enclosure flange as a guide, or use the dimensions listed below to measure out.

WITHOUT BOX (-DO)

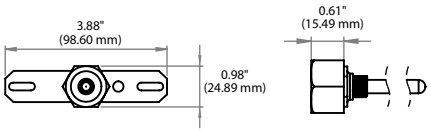
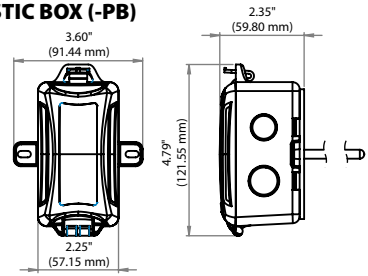
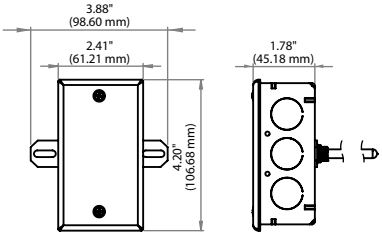


FIGURE 1: ENCLOSURE DIMENSIONS

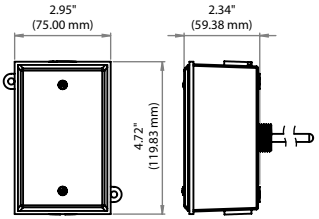
PLASTIC BOX (-PB)



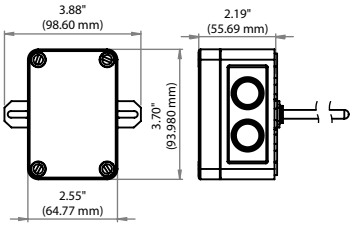
GALVANIZED ENCLOSURE (-GD)



BELL BOX (-BB)



NEMA -4X (-4X)



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Phone: 1-888-967-5224 | **Website:** workaci.com

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MOUNTING *(Continued)*

Now fasten and insert (2) screws #8 x 3/4" TEK (provided and recommended) through the mounting holes in the flange and tighten until the unit is held firmly to the duct. Make sure the foam pad is tight to the duct to eliminate any possible air leaks. Refer to the **Wiring Instructions** (p. 2-3) to make necessary connections.

Note: All enclosures have the foam pad attached. For the "DO" (no enclosure), the foam pad is included, but not installed. The foam pad must be installed prior to mounting.

FIGURE 2: DUCT MOUNTING

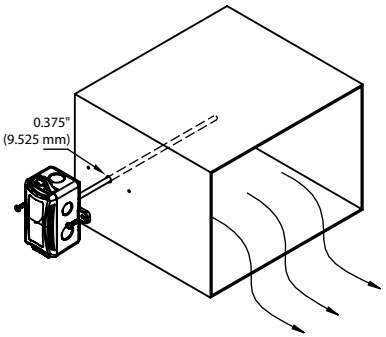
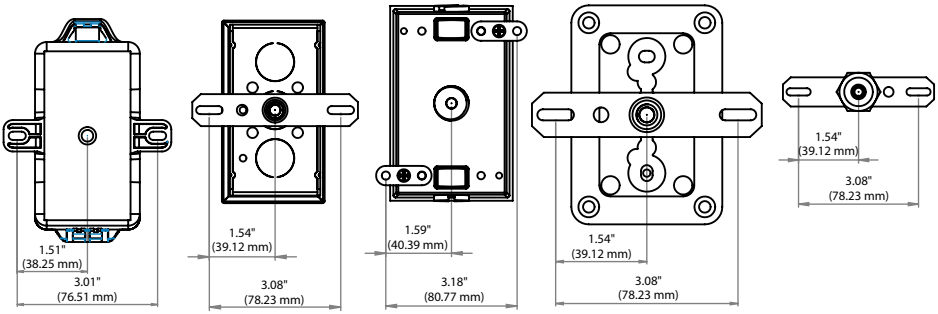


FIGURE 3: MOUNTING FOR DIFFERENT CONFIGURATIONS

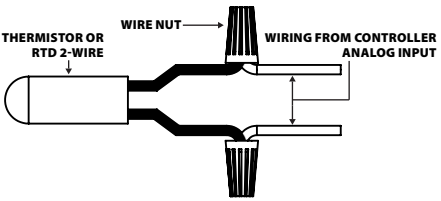


WIRING INSTRUCTIONS

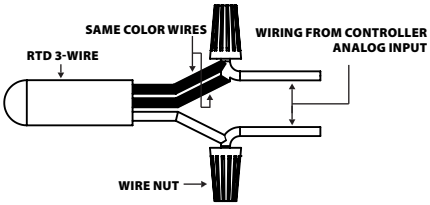
Open the cover of the enclosure. ACI recommends 16 to 26 AWG twisted pair wires or shielded cable for all sensors. Signal wiring must be run separate from low and high voltage wires (24/120/230VAC). All ACI thermistors and RTD temperature sensors are both non-polarity and non-position sensitive. All thermistor type units are supplied with (2) flying lead wires, and all RTD's are supplied with (2) or (3) flying lead wires – see **FIGURE 4** (below). The number of wires needed depends on the application.

FIGURE 4: TEMPERATURE WIRING

2-WIRE THERMISTOR or RTD WIRING



3-WIRE RTD WIRING



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WIRING INSTRUCTIONS *(Continued)*

Connect thermistor/RTD wire leads to controller analog input wires using wire nuts, terminal blocks, or crimp style connectors. All wiring must comply with all local and National Electric Codes. After wiring, attach the cover to the enclosure.

Note: When using a shielded cable, be sure to connect only (1) end of the shield to ground at the controller. Connecting both ends of the shield to ground may cause a ground loop. When removing the shield from the sensor end, make sure to properly trim the shield to prevent any chance of shorting.

Note: If the controller requires a (2) wire input for a RTD, connect the (2) common wires (same color) together. If the controller requires (3) wires, use (3) individual wires.

TROUBLESHOOTING

PROBLEM	SOLUTION(S)
Sensor reading is incorrect	• Verify sensor wiring to controller is not damaged and has continuity. • Verify sensor or wires are not shorted together. • Verify controller is setup for correct sensor curve. • Disconnect wires from sensor terminal block, tighten terminal block screws down, and take a resistance (ohm) reading with a multimeter. • Compare the resistance reading to the Temperature Vs Resistance Curves online: *http://www.workaci.com/content/thermistor-curves-0* • Verify proper mounting location to confirm no external factors are affecting reading.
Sensor reads infinity/very high resistance	• Sensor or wires are open.
Sensor reads low resistance	• Sensor or wires are shorted together.
Erratic readings	• Condensation on PCB board • Bad wire connections.

WARRANTY

The ACI Duct Series temperature sensors are covered by ACI's Five (5) Year Limited Warranty, which is located in the front of ACI'S SENSORS & TRANSMITTERS CATALOG or can be found on ACI's website: www.workaci.com.

W.E.E.E. DIRECTIVE

At the end of their useful life the packaging and product should be disposed of via a suitable recycling centre. Do not dispose of with household waste. Do not burn.

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PRODUCT SPECIFICATIONS

SENSOR NON-SPECIFIC INFORMATION		
Number Sensing Points:	One	
Storage Temperature Range:	-40 to 80 °C (-40 to 185 °F)	
Operating Humidity Range:	10 to 95% RH, non-condensing	
Probe Material | Diameter:	304 Stainless Steel | 0.250" (6.35 mm)	
Wire Size	22 AWG (0.65 mm)	
Enclosure Specifications: (Temperature, Material, Flammability, NEMA/IP Ratings)	**"-GD" Enclosure:** Galvanized Steel, -40 to 115 °C (-40 to 239 °F), NEMA 1 (IP10) **"-PB" Enclosure:** ABS Plastic, UL94-HB, -30 to 90 °C (-22 to 194 °F), Plenum Rated **"-BB" Enclosure:** Aluminum, -40 to 115 °C (-40 to 239 °F), NEMA 3R (IP 14) **"-4X" Enclosure:** Polystyrene Plastic, UL94-V2, -40 to 70°C (-40 to 158°F), NEMA 4X (IP 66) **"-DO" No Enclosure:** Polyamide 66 (High Performance Nylon), -40 to 115 °C (-40 to 239 °F), UL94-HB	
THERMISTOR		
Sensor Output @ 25 °C (77 °F): (Lead Wire Colors) *Does not include CL2P	**A/1.8K:** 1.8 KΩ nominal (Red/Yellow) **A/3K:** 3 KΩ nominal (White/Brown) **A/AN (Type III):** 10 KΩ nominal (White/White) **A/AN-BC:** 5.238 KΩ nominal (White/Yellow) **A/CP (Type II):** 10 KΩ nominal (White/Green) **A/50K:** 50 KΩ nominal (Brown/Yellow)	**A/CSI:** 10 KΩ nominal (Green/Yellow) **A/10KS:** 10 KΩ nominal (White/Blue) **A/10K-E1:** 10 KΩ nominal (Gray/Orange) **A/20K:** 20 KΩ nominal (Brown/Blue) **A/100KS:** 100 KΩ nominal (Black/Yellow)
Accuracy @ 0-70 °C (32 - 158 °F):	**A/1.8K Series:** +/- 0.5 °C @ 25 °C (77 °F) and (+/-1.0 °C) (+/-1.8 °F)	**A/10K-E1 Series:** +/- 0.3 °C (+/- 0.54 °F) **All Else:** +/- 0.2 °C (+/- 0.36 °F)
PLATINUM		
Sensor Output @ 0 °C (32 °F):	**A/100:** 100 Ω nominal	**A/1K:** 1 KΩ nominal
Accuracy:	+/- 0.06% Class A (Tolerance Formula: +/- °C = (0.15 °C + (0.002 * |t|)) where |t| is the absolute value of Temperature above or below 0 °C in °C)	
	@ -40 °C (-40 °F): +/- 0.23ºC (+/- 0.414ºF)	**@ 115 °C (239 °F):** +/- 0.38 °C (+/- 0.69 °F)
	@ 0 °C (32 °F): +/- 0.15 °C (+/- 0.27 °F)	
BALCO		
Sensor Output @ 21.1 °C (70 °F): (Lead Wire Colors)	1 KΩ nominal (Orange/Yellow)	
Accuracy:	**@ 21.1 °C (70 °F):** +/- 1%	
NICKEL		
Sensor Output @ 21.1 °C (70 °F): (Lead Wire Colors)	1 KΩ nominal (Red/Red)	
Accuracy:	**@ -40 °C (-40 °F):** +/- 1.52 °C (+/- 2.73 °F)	**@ 54.4 °C (130 °F):** +/- 0.56 °C (+/- 1.00°F)
	@ 0 °C (32 °F): +/- 0.4 °C (+/- 0.72 °F)	**@ 121 °C (250 °F):** +/- 1.25 °C (2.25 °F)
	@ 21.1 °C (70 °F): +/- 0.17 °C (+/- 0.34 °F)	

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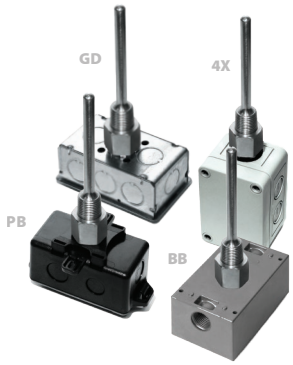


IMMERSION

Stainless Steel Immersion, Thermistor

The ACI Thermistor Immersion Series features a ¼" diameter stainless steel probe with two, 14 inch 22 AWG Etched Teflon colored lead wires depending on the probe length ordered to differentiate the different sensor types. The sensors in this series are manufactured using ACI's proven double encapsulation process to eliminate the effects of moisture and to increase the response times using our high quality, thermally conductive epoxy. The immersion sensors include a welded thermowell "-I" version but can be ordered without the welded thermowell "-INW" version. The "INW" version includes a standard ½" NPS Male process thread to be used with an optional machined thermowell or in an existing thermowell application. Optional NEMA/IP rated enclosures and NIST certificates are available the back of the product data sheet.

Applications: Chilled Water Systems, Hot Water Systems, Boilers, Pumps, Compressor, Chillers

The ACI Thermistor Immersion Series is covered by ACI's Five (5) Year Limited Warranty. The warranty can be found in the front of ACI's Sensors & Transmitters catalog, as well as on ACI's website, www.workaci.com.

PRODUCT SPECIFICATIONS

Sensor Type | Sensor Curve:	Thermistor | Non-Linear, NTC (Negative Temperature Coefficient)
Number Sensing Points | Number Wires:	One | Two (Non-Polarity Sensitive)
Sensor Output @ 25°C (77°F) | Lead Wire Colors:	**A/1.8K:** 1.8KΩ nominal | Red/Yellow **A/3K:** 3KΩ nominal | White/Brown **A/AN (Type III):** 10KΩ nominal | White/White **A/AN-BC:** 5.238KΩ nominal | White/Yellow **A/CP (Type II):** 10KΩ nominal | White/Green **A/CSI:** 10KΩ nominal | (Green/Yellow) **A/10KS:** 10KΩ nominal | (White/Blue) **A/10K-E1:** 10KΩ nominal | (Gray/Orange) **A/20K:** 20KΩ nominal | (Brown/Blue) **A/50K:** 50KΩ nominal | (Brown/Yellow) **A/100KS:** 100KΩ nominal | (Black/Yellow)
Accuracy 0-70°C (32-158°F):	+/-0.2°C (+/-0.36°F) except **A/10K-E1 Series:** +/- 0.3°C (+/-0.54°F) **A/1.8K Series**: +/-0.5°C @ 25°C (77°F) and (+/-1.0°C) (+/-1.8°F)
Stability:	Sensor Dependent; Contact ACI for more information on specific sensor
Response Time (63% Step Change):	10 Seconds nominal
Power Dissipation Constant:	3 mW/°C except **A/1.8K Series:** 1 mW/°C | **A/10K-E1 Series:** 2 mW/°C
Sensor Operating Temperature Range:	-40 to 150°C (-40 to 302°F)
Enclosure Specifications (Temperature, Flammability, NEMA/IP Ratings):	**"-GD" Enclosure:** Galvanized Steel, -40 to 121°C (-40 to 250°F), NEMA 1 (IP10) **"-PB" Enclosure:** ABS Plastic, -30 to 90°C (-22 to 194°F), UL94-HB, Plenum Rated **"-BB" Enclosure:** Aluminum, -40 to 121°C (-40 to 250°F), NEMA 3R **"-4X" Enclosure:** Polystyrene Plastic, -40 to 70°C (-40 to 158°F), UL94-V2, NEMA 4X (IP 66)
Storage Temperature Range:	-40 to 85°C (-40 to 185°F)
Operating Humidity Range:	10 to 95% RH, non-condensing
Probe Diameter | Thermowell Bore Diameter:	0.250" (6.35mm) | 0.260"
Probe Material | Thermowell Material:	304 Stainless Steel | 304 Series Stainless Steel
Thermowell Instrument | Process Thread Size:	½" NPS (National Pipe Straight) Female Thread | ½" NPT (National Pipe Tapered) Male Thread
Fitting Material | Flammability Rating:	Polyamide 66 (High Performance Nylon 66) | UL94-HB
Foam Pad Material | Flammability Rating:	Neoprene/EPDM/SBR Polymer | UL94-HBF; FMVSS-302; MIL-R-6130C
Lead Length | Conductor Size:	14" (35.6 cm) | 22 AWG (0.65mm)
Lead Wire Insulation | Wire Rating:	Etched Teflon (PTFE) Colored Leads | Mil Spec 16878/4 Type E)
Conductor Material:	Silver Plated Copper
Product Dimensions | Product Weight:	See table on back of Product Data sheet
Agency Approvals:	CE, RoHS2, WEEE

MAXIMUM VELOCITY VS THERMOWELL INSERTION LENGTH Machined Thermowell

Straight Shank Insertion Length "U"					Stepped Shank Insertion Length "U"	
Material:	**Media Type:**	**1.0"** (25.4 mm)	**2.5"** (63.5 mm)	**8.0"** (203.2 mm)	**4.0"** (101.6 mm)	**6.0"** (152.4 mm)
304/316 SS	Air/Gas/Steam [1]	349 ft/s (106.3 m/s)	349 ft/s (106.3 m/s)	71.9 ft/s (21.9 m/s)	109 ft/s (33.2 m/s)	39.5 ft/s (12.0 m/s)
304/316 SS	Water	360 ft/s (109.7 m/s)	360 ft/s (109.7 m/s)	71.9 ft/s (21.9 m/s)	82.2 ft/s (25.1 m/s)	39.5 ft/s (12.0 m/s)

Note 1: Values are for Air/Gas/Steam and similar density media | All velocity ratings are based upon an operating temperature of 1000ºF (537.8ºC)

MAXIMUM PRESSURE VS TEMPERATURE RATINGS Two-Part Fabricated / Welded Thermowell

Material:	**70ºF** (21.1ºC)	**200ºF** (93.3ºC)	**400ºF** (204.4ºC)	**600ºF** (315.6ºC)	**800ºF** (426.7ºC)	**1000ºF** (537.8ºC)	**1200ºF** (648.9ºC)
304/316 SS	982 PSI (67.7 Bar)	820 PSI (56.5 Bar)	675 PSI (46.5 Bar)	604 PSI (41.6 Bar)	550 PSI (37.9 Bar)	510 PSI (35.1 Bar)	290 PSI (20.0 Bar)

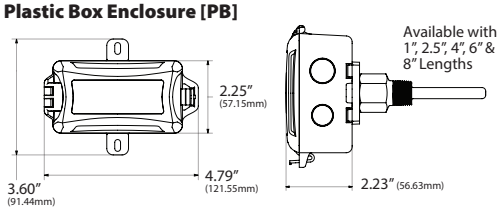
MAXIMUM FLUID VELOCITY RATINGS Two-Part Fabricated / Welded Thermowell

Straight Shank Insertion Length "U"				
Material:	**Media Type:**	**2.5"** (63.5 mm)	**4.0"** (101.6 mm)	**6.0"** (152.4 mm)
304/316 SS	Air/Gas/Steam [2]	169 ft/s (51.5 m/s)	61 ft/s (18.6 m/s)	20 ft/s (6.1 m/s)
304/316 SS	Water	88 ft/s (26.8 m/s)	20 ft/s (6.1 m/s)	10 ft/s (3.05 m/s)

Note 2: Values are for Air/Gas/Steam and similar density media

DIMENSIONAL DRAWING. WEIGHTS

Plastic Box Enclosure [PB]



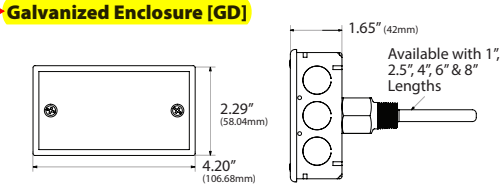
xx = Sensor Type | **yy** = Insertion Length

Plastic Box Enclosure [PB] Weights

ACI Model #	1.0"	2.5"	4.0"	6.0"	8.0"
A/xx-INW-yy-PB	0.20 lbs. (0.091 kg)	0.24 lbs. (0.109 kg)	0.28 lbs. (0.127 kg)	0.32 lbs. (0.145 kg)	0.36 lbs (0.163 kg)
A/xx-I-yy-PB	N/A	0.56 lbs. (0.254 kg)	0.60 lbs. (0.272 kg)	0.64 lbs. (0.290 kg)	N/A
A/xx-IM-yy-PB	0.40 lbs. (0.182 kg)	0.58 lbs. (0.263 kg)	0.74 lbs. (0.336 kg)	0.92 lbs. (0.417 kg)	1.15 lbs (0.522 kg)

N/A = Not Available

Galvanized Enclosure [GD]



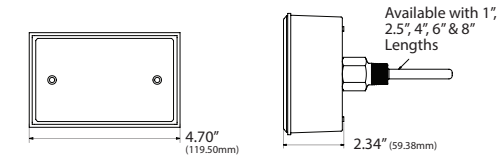
xx = Sensor Type | **yy** = Insertion Length

Galvanized Enclosure [GD] Weights

ACI Model #	1.0"	2.5"	4.0"	6.0"	8.0"
A/xx-INW-yy-GD	0.62 lbs. (0.281 kg)	0.66 lbs. (0.299 kg)	0.70 lbs. (0.318 kg)	0.74 lbs. (0.336 kg)	0.78 lbs (0.354 kg)
A/xx-I-yy-GD	N/A	0.88 lbs. (0.399 kg)	1.00 lbs. (0.454 kg)	1.04 lbs. (0.472 kg)	N/A
A/xx-IM-yy-GD	0.81 lbs. (0.367 kg)	1.00 lbs. (0.454 kg)	1.16 lbs. (0.526 kg)	1.32 lbs. (0.599 kg)	1.55 lbs (0.703 kg)

N/A = Not Available

Bell Box Enclosure [BB]



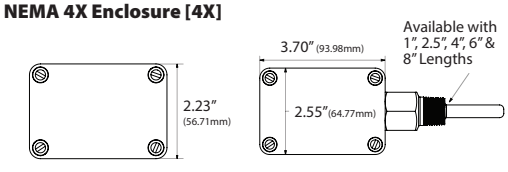
xx = Sensor Type | **yy** = Insertion Length

Bell Box Enclosure [GD] Weights

ACI Model #	1.0"	2.5"	4.0"	6.0"	8.0"
A/xx-INW-yy-BB	0.64 lbs. (0.290 kg)	0.68 lbs. (0.308 kg)	0.70 lbs. (0.318 kg)	0.74 lbs. (0.336 kg)	0.80 lbs (0.363 kg)
A/xx-I-yy-BB	N/A	1.02 lbs. (0.463 kg)	1.00 lbs. (0.454 kg)	1.04 lbs. (0.472 kg)	N/A
A/xx-IM-yy-BB	0.83 lbs. (0.376 kg)	1.02 lbs. (0.463 kg)	1.16 lbs. (0.526 kg)	1.32 lbs. (0.599 kg)	1.59 lbs (0.721 kg)

N/A = Not Available

NEMA 4X Enclosure [4X]



xx = Sensor Type | **yy** = Insertion Length

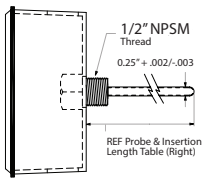
NEMA 4X Enclosure [4X] Weights

ACI Model #	1.0"	2.5"	4.0"	6.0"	8.0"
A/xx-INW-yy-4X	0.28 lbs. (0.127 kg)	0.32 lbs. (0.145 kg)	0.36 lbs. (0.163 kg)	0.40 lbs. (0.181 kg)	0.44 lbs (0.200 kg)
A/xx-I-yy-4X	N/A	0.64 lbs. (0.290 kg)	0.68 lbs. (0.308 kg)	0.72 lbs. (0.327 kg)	N/A
A/xx-IM-yy-4X	0.48 lbs. (0.218 kg)	0.66 lbs. (0.299 kg)	0.82 lbs. (0.372 kg)	1.00 lbs. (0.454 kg)	1.27 lbs (0.576 kg)

N/A = Not Available

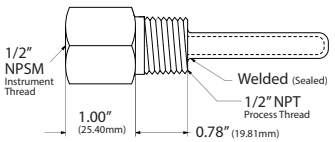
Standard Views | **Product Weights**

PROBE AND INSERTION LENGTH IMMERSION NO WELL



Pictured Above: immersion no well (INW) sensor in Bell Box Enclosure (BB).

Pictured Below: welded two piece thermowell to show connection and depth reference. Thermowell not included with immersion no well (INW).



Probe & Insertion Length

Probe Length	Insertion Length	ACI Part #	Thermowell Part #
3"	2.81 +/- 0.13"	A/xx-INW-1"-yy-zz	A/M1"
4.5"	4.31" +/- 0.13"	A/xx-INW-2.5"-yy-zz	A/2.5" or A/M2.5"
6"	5.81" +/- 0.13"	A/xx-INW-4"-yy-zz	A/4" or A/M4"
8"	7.81" +/- 0.13"	A/xx-INW-6"-yy-zz	A/6" or A/M6"
10"	9.81" +/- 0.13"	A/xx-INW-8"-yy-zz	A/M8"

ORDERING Welded Thermowell or No Thermowell

Model # Example: A/ (A.) | 1.8K (B.) | I (C.) | 4" (D.) | GD (E.) | NIST (F.)

		MODEL #
A. Sensor Series *No Selection Required*	**A/** →	A/
B. Model Series *Select One (1)*	**1.8K** | **3K** | **AN** | **AN-BC** | **CP** | **CSI** | **10KS** | **10K-E1** | **20K** | **100KS**	
C. Configuration *Select One (1)*	**I** = Immersion with Welded Thermowell | **INW** = Immersion without Welded Thermowell	
D. Insertion Length *Select One (1)*	**2.5"** = 2.5" Insertion | **4"** = 4" Insertion | **6"** = 6" Insertion	
E. Enclosure *Select One (1)*	**GD** = Galvanized | **PB** = Plastic | **BB** = Aluminum, NEMA 3R | **4X** = NEMA 4X	
F. NIST *Select One (1)*	**----** = No NIST Certificate | **NIST** = NIST Certificate (3 Points)	

ORDERING Machined Thermowells or No Thermowell

Model # Example: A/ (A.) | 1.8K (B.) | IM (C.) | 4" (D.) | GD (E.) | NIST (F.)

		MODEL #
A. Sensor Series *No Selection Required*	**A/** →	A/
B. Model Series *Select One (1)*	**1.8K** | **3K** | **AN** | **AN-BC** | **CP** | **CSI** | **10KS** | **10K-E1** | **20K** | **50K** | **100KS**	
C. Configuration *Select One (1)*	**IM** = Immersion with Machined Well | **INW** = Immersion without Thermowell	
D. Insertion Length *Select One (1)*	**1"** = 1" Insertion | **2.5"** = 2.5" Insertion | **4"** = 4" Insertion | **6"** = 6" Insertion **8"** = 8" Insertion	
E. Enclosure *Select One (1)*	**GD** = Galvanized | **PB** = Plastic | **BB** = Aluminum, NEMA 3R | **4X** = NEMA 4X	
F. NIST *Select One (1)*	**----** = No NIST Certificate | **NIST** = NIST Certificate (3 Points)	

Note : Thermowells with lengths of 12", 18", and 24" are available and must be ordered separately | See the Machined Thermowells Data Sheet (Accessories)

ACCESSORIES ORDERING

Model # Example: NSG HEAT TRANSFER PASTE 2OZ -OR- 102595

Model #	Item #	Description
NSG HEAT TRANSFER PASTE 2OZ	102595	Thermal Grease, 2 oz. Tube, Silicone Free, -40 to 320ºF (-40 to 160ºC)
NSG HEAT TRANSFER PASTE 16OZ	140574	Thermal Grease, 16 oz. Jar, Silicone Free, -40 to 390ºF (-40 to 198ºC)
A/2.5"	128349	2.5" (63.5mm) Insertion, 304 Stainless, Welded, ½" NPT Thermowell
A/4"	128350	4" (101.6mm) Insertion, 304 Stainless, Welded, ½" NPT Thermowell
A/6"	128351	6" (152.4mm) Insertion, 304 Stainless, Welded, ½"NPT Thermowell
A/M1"	128337	1" (25.4mm) Insertion, 304 Stainless, Machined, ½" NPT Thermowell
A/M2.5"	128338	2.5" (63.5mm) Insertion, 304 Stainless, Machined, ½" NPT Thermowell
A/M4"	128343	4" (101.6mm) Insertion, 304 Stainless, Machined, ½" NPT Thermowell
A/M6"	128344	6" (152.4mm) Insertion, 304 Stainless, Machined, ½"NPT Thermowell
A/M8"	138725	8" (203.2mm) Insertion, 304 Stainless, Machined, ½" NPT Thermowell
A/M2.5"-316SS	128352	2.5" (63.5mm) Insertion, 316 Stainless, Machined, ½" NPT Thermowell
A/M4"-316SS	128353	4" (101.6mm) Insertion, 316 Stainless, Machined, ½" NPT Thermowell
A/M6"-316SS	128354	6" (152.4mm) Insertion, 316 Stainless, Machined, ½" NPT Thermowell

IMMERSION SERIES

Installation & Operation Instructions

Phone: 1-888-967-5224
Website: workaci.com

PRECAUTIONS

- **DO NOT RUN THE WIRING IN ANY CONDUIT WITH LINE VOLTAGE (24/120/230 VAC).**

GENERAL INFORMATION

The Immersion sensor is a single point temperature sensor that is designed for use with electronic controllers in commercial heating and cooling building management systems. It is available with multiple thermistor or RTD options.

For optimal temperature readings, follow these tips:

- Apply thermal grease to the end of the probe before installation into thermowell (ACI Item #102595).
- The tip of the thermowell should be located in the middle of the pipe.
- The sensor thermowell should be installed against the flow of the water, where water temperature is well mixed (no stratification).
- Make sure the entire thermowell is immersed. If the thermowell is longer than the pipe diameter, the thermowell should be installed in an elbow or Tee.

THERMOWELL INSTALLATION

ACI's standard Immersion sensors are made to install into a ½" NPT female thread. Typically a Threadolet or Tee is installed into the pipe, but a hole can also be drilled and tapped.

FIGURE 1: THREADOLET ASSEMBLY

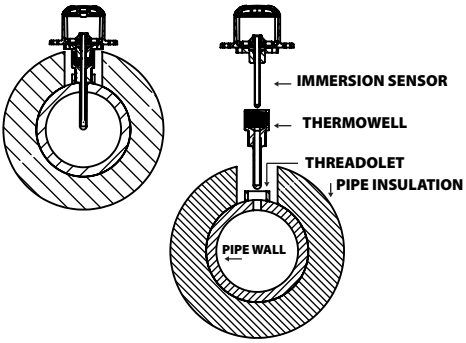
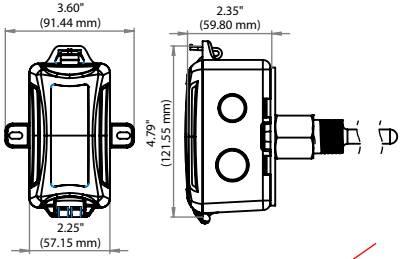
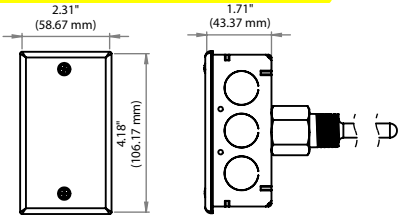


FIGURE 1: ENCLOSURE DIMENSIONS

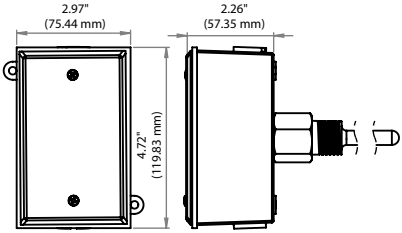
PLASTIC BOX (-PB)



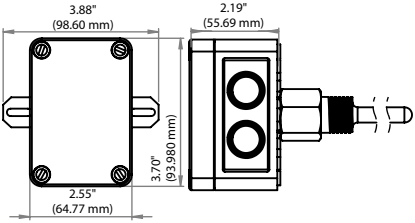
GALVANIZED ENCLOSURE (-GD)



BELL BOX (-BB)



NEMA -4X (-4X)



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Version: 3.0
I0000811

THERMOWELL INSTALLATION

The pipe/system will need to be drained, unless a Hot Tap is being used. The recommend drill size is 23/32 in. (18 mm). Drill the hole, and tap the hole with ½"-14NPT.

Always use proper thread sealants on tapered pipe threads of the thermowell. Screw the thermowell into the Threadolet, Tee, or tapped hole, using a wrench to tighten it firmly. Refill the system and check for leaks.

Best practice is to apply thermal grease to the end of the probe, but not required. Insert and push the sensor probe into the thermowell. Turn the sensor probe assembly clockwise to tighten down completely. Refer to the **Wiring Instructions** (p. 2-3) to make necessary connections.

PROBE INSERTION

The immersion sensors "-I" include a welded thermowell but can be ordered without the thermowell "-INW" version. The "-INW" includes a standard ½" NPS process thread to be used with a machined thermowell or previously installed thermowell. Verify the existing thermowell insertion length of the pipe is suitable for your selected Immersion.

If the length of the probe is too large, the probe may be pressed into its enclosure - up to an inch of clearance.

Note: *Fabricated (welded) thermowells (-I) are not intended for moving water or high pressure service. Fluid velocity and wake frequency are primary factors in well failure. Machined thermowells (-IM) should be used in these types of applications. Fabricated thermowells are intended for tank, or low to no flow, applications.

FIGURE 3: ELBOW ASSEMBLY

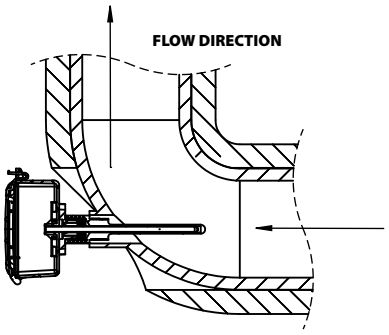

FIGURE 4: TEE MOUNT ASSEMBLY

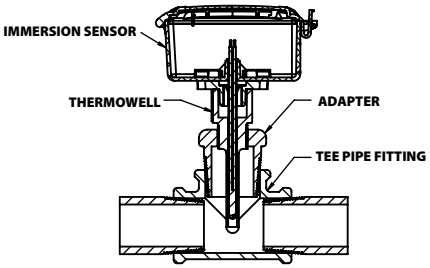

FIGURE 5: PROBE and IMMERSION

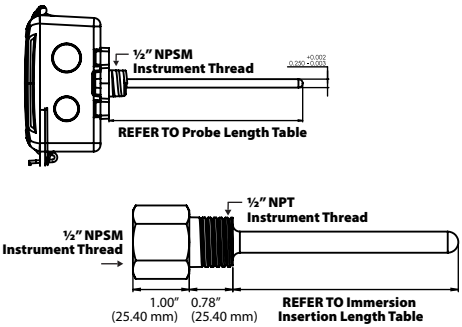

TABLE 1: PROBE LENGTH and INSERTION LENGTH

ACI PART #	IMMERSION LENGTH	PROBE LENGTH
A/xx-I-2.5"-yy-zz	2.5" (63.50 mm)	4.31" (109.47 mm) +/- 0.13" (3.30 mm)
A/xx-I-4"-yy-zz	4.0" (101.60 mm)	5.81" (147.57 mm) +/- 0.13" (3.30 mm)
A/xx-I-6"-yy-zz	6.25" (158.75 mm)	7.81" (198.37 mm) +/- 0.13" (3.30 mm)

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WIRING INSTRUCTIONS

Open the cover of the enclosure. ACI recommends 16 to 26 AWG twisted pair wires or shielded cable for all sensors. Signal wiring must be run separate from low and high voltage wires (24/120/230VAC). All ACI thermistors and RTD temperature sensors are both non-polarity and non-position sensitive. All thermistor type units are supplied with (2) flying lead wires, and all RTD's are supplied with (2) or (3) flying lead wires – see **FIGURE 6** (below). The number of wires needed depends on the application.

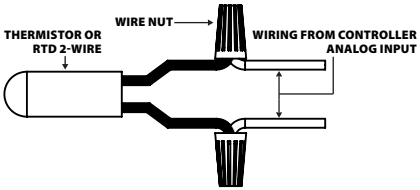
Connect thermistor/RTD wire leads to controller analog input wires using wire nuts, terminal blocks, or crimp style connectors. All wiring must comply with all local and National Electric Codes. After wiring, attach the cover to the enclosure.

Note: When using a shielded cable, be sure to connect only (1) end of the shield to ground at the controller. Connecting both ends of the shield to ground may cause a ground loop. When removing the shield from the sensor end, make sure to properly trim the shield to prevent any chance of shorting.

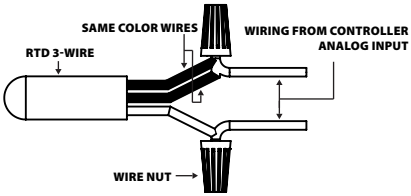
Note: If the controller requires a (2) wire input for a RTD, connect the (2) common wires(same color) together. If the controller requires (3) wires, use (3) individual wires.

FIGURE 7: TEMPERATURE WIRING

2-WIRE THERMISTOR or RTD WIRING



3-WIRE RTD WIRING



TROUBLESHOOTING

PROBLEM	SOLUTION(S)
Sensor reading is incorrect	• Verify sensor wiring to controller is not damaged and has continuity. • Verify sensor or wires are not shorted together. • Verify controller is setup for correct sensor curve. • Disconnect wires from sensor terminal block, tighten terminal block screws down, and take a resistance (ohm) reading with a multimeter. • Compare the resistance reading to the Temperature Vs Resistance Curves online: *http://www.workaci.com/content/thermistor-curves-0* • Verify proper mounting location to confirm no external factors are affecting reading.
Sensor reads infinity/very high resistance	• Sensor or wires are open.
Sensor reads low resistance	• Sensor or wires are shorted together.
Erratic readings	• Condensation on PCB board • Bad wire connections.

WARRANTY

The ACI Immersion Series temperature sensors are covered by ACI's Five (5) Year Limited Warranty, which is located in the front of ACI'S SENSORS & TRANSMITTERS CATALOG or can be found on ACI's website: www.workaci.com.

Automation Components, Inc.
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PRODUCT SPECIFICATIONS

SENSOR NON-SPECIFIC INFORMATION	
Number Sensing Points:	One
Storage Temperature Range:	-40 to 85 °C (-40 to 185 °F)
Operating Humidity Range:	0 to 90% RH, non-condensing
Probe Diameter | Thermowell Bore Diameter:	0.250" (6.35mm) | 0.260"
Probe Material | Thermowell Material:	304 Stainless Steel | 304 Series Stainless Steel
Wire Size	22 AWG (0.65 mm)
Thermowell Instrument | Process Thread Size:	½" NPS (National Pipe Straight) Female Thread | ½" NPT (National Pipe Tapered) Male Thread

Enclosure Specifications (Temperature, Material, Flammability, NEMA/IP Ratings)	**"-GD" Enclosure:** Galvanized Steel, -40 to 121 °C (-40 to 250 °F), NEMA 1 (IP10) **"-PB" Enclosure:** ABS Plastic, UL94-HB, -30 to 90 °C (-22 to 194 °F), Plenum Rated **"-BB" Enclosure:** Aluminum, -40 to 121°C (-40 to 250 °F), Plenum Rated, NEMA 3R (IP 14) **"-4X" Enclosure:** Polystyrene Plastic, UL94-V2, -40 to 70°C (-40 to 158°F), NEMA 4X (IP 66)

THERMISTOR		
Sensor Output @ 25 °C (77 °F): (Lead Wire Colors) *Does not include CL2P	**A/1.8K:** 1.8 KΩ nominal (Red/Yellow) **A/3K:** 3 KΩ nominal (White/Brown) **A/AN (Type III):** 10 KΩ nominal (White/White) **A/AN-BC:** 5.238 KΩ nominal (White/Yellow) **A/CP (Type II):** 10 KΩ nominal (White/Green) **A/50K:** 50KΩ nominal (Brown/Yellow)	**A/CSI:** 10 KΩ nominal (Green/Yellow) **A/10KS:** 10 KΩ nominal (White/Blue) **A/10K-E1:** 10 KΩ nominal (Gray/Orange) **A/20K:** 20 KΩ nominal (Brown/Blue) **A/100KS:** 100 KΩ nominal (Black/Yellow)
Accuracy @ 0-70 °C (32 - 158 °F):	**A/1.8K Series:** +/- 0.5 °C @ 25 °C (77 °F) and (+/-1.0 °C) (+/-1.8 °F)	**A/10K-E1 Series:** +/- 0.3 °C (+/- 0.54 °F) **All Else:** +/- 0.2 °C (+/- 0.36 °F)

PLATINUM		
Sensor Output @ 0 °C (32 °F):	**A/100:** 100 Ω nominal	**A/1K:** 1 KΩ nominal
Accuracy:	+/- 0.06% Class A (Tolerance Formula: +/- °C = (0.15 °C + (0.002 * |t|)) where |t| is the absolute value of Temperature above or below 0 °C in °C)	
	@ -40 °C (-40 °F): +/- 0.23ºC (+/- 0.414ºF) **@ 0 °C (32 °F):** +/- 0.15 °C (+/- 0.27 °F)	**@ 200 °C (392 °F):** +/- 0.55 °C (+/- 1.00 °F)

BALCO	
Sensor Output @ 21.1 °C (70 °F): (Lead Wire Colors)	1 KΩ nominal (Orange/Yellow)
Accuracy:	**@ 21.1 °C (70 °F):** +/- 1%

NICKEL		
Sensor Output @ 21.1 °C (70 °F): (Lead Wire Colors)	1 KΩ nominal (Red/Red)	
Accuracy:	**@ -40 °C (-40 °F):** +/- 1.52 °C (+/- 2.73 °F) **@ 0 °C (32 °F):** +/- 0.4 °C (+/- 0.72 °F) **@ 21.1 °C (70 °F):** +/- 0.17 °C (+/- 0.34 °F)	**@ 54.4 °C (130 °F):** +/- 0.56 °C (+/- 1. 00°F) **@ 121 °C (250 °F):** +/- 1.25 °C (2.25 °F)

W.E.E.E. DIRECTIVE

At the end of their useful life the packaging and product should be disposed of via a suitable recycling centre. Do not dispose of with household waste. Do not burn.

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Phone: 1-888-967-5224 | **Website:** workaci.com

Version: 3.0
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BELIMO

On/Off, Spring Return, AC/DC 24 V

Technical data sheet AFB24

5-year warranty

Technical data

Electrical data	Nominal voltage	AC/DC 24 V
	Nominal voltage frequency	50/60 Hz
	Power consumption in operation	5 W
	Power consumption in rest position	2.5 W
	Transformer sizing	7.5 VA (class 2 power source)
	Electrical Connection	18 GA appliance cable, 3 ft [1 m], with 1/2" conduit connector
	Overload Protection	electronic throughout 0...95° rotation
	Electrical Protection	actuators are double insulated
Functional data	Torque motor	180 in-lb [20 Nm]
	Direction of motion motor	selectable by ccw/cw mounting
	Direction of motion fail-safe	reversible with cw/ccw mounting
	Manual override	5 mm hex crank (3/16" Allen), supplied
	Angle of rotation	95°, adjustable with mechanical end stop, 35...95°
	Angle of rotation note	adjustable with mechanical end stop, 35...95°
	Running Time (Motor)	75 s
	Running time fail-safe	<20 s @ -4...122°F [-20...50°C], <60 s @ -22°F [-30°C]
	Running time fail-safe note	@ -4...122°F [-20...50°C], <60 s @ -22°F [-30°C]
	Noise level, motor	50 dB(A)
	Noise level, fail-safe	62 dB(A)
	Shaft Diameter	1/2...1.05" round, centers on 1/2" and 3/4" with insert, 1.05" without insert
	Position indication	Mechanical
Safety data	Degree of protection IEC/EN	IP54
	Degree of protection NEMA/UL	NEMA 2
	Enclosure	UL Enclosure Type 2
	Agency Listing	cULus listed to UL60730-1A:02; UL 60730-2-14:02 and CAN/CSA-E60730-1:02; Listed to UL 2043 - suitable for use in air plenums per Section 300.22(c) of the NEC and Section 602.2 of the IMC
	Quality Standard	ISO 9001
	Ambient temperature	-22...122°F [-30...50°C]
	Storage temperature	-40...176°F [-40...80°C]
	Ambient humidity	max. 95% r.H., non-condensing
	Servicing	maintenance-free
Weight	Weight	2.4 lb [2.4 kg]
Materials	Housing material	Galvanized steel and plastic housing

Product features

Application

For On/Off, fail-safe control of dampers in HVAC systems. Actuator sizing should be done in accordance with the damper manufacturer's specifications. Control is On/Off from an auxiliary contact or a manual switch. The actuator is mounted directly to a damper shaft up to 1.05" in diameter by means of its universal clamp. A crank arm and several mounting brackets are available for applications where the actuator cannot be direct coupled to the damper shaft. Maximum of two AF's can be piggybacked for torque loads of up to 266 in-lbs. Minimum 3/4" diameter shaft and parallel wiring.

Operation

The AF..24 series actuators provide true spring return operation for reliable failsafe application and positive close off on air tight dampers. The spring return system provides constant torque to the damper with, and without, power applied to the actuator. The AF..24 series provides 95° of rotation and is provided with a graduated position indicator showing 0° to 95°. The actuator may be stalled anywhere in its normal rotation without the need of mechanical end switches. The AF..24 actuator is shipped at 5° (5° from full fail-safe) to provide automatic compression against damper gaskets for tight shut-off.

Typical specification

On/Off spring return damper actuators shall be direct coupled type which require no crank arm and linkage and be capable of direct mounting to a jackshaft up to a 1.05” diameter. The actuators must be designed so that they may be used for either clockwise or counter clockwise fail-safe operation. Actuators shall be protected from overload at all angles of rotation. If required, two SPDT auxiliary switch shall be provided having the capability of one being adjustable. Actuators with auxiliary switches must be constructed to meet the requirements for Double Insulation so an electrical ground is not required to meet agency listings. Actuators shall be cULus listed and have a 5 year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo.

Accessories

Electrical accessories

Description	Type
Auxiliary switch, mercury-free	P475
Auxiliary switch, mercury-free	P475-1
Signal Siumlator, Power supply AC 230 V	PS-100
Cable Conduit Connector 1/2"	TF-CC US
Transformer, AC 120 V to AC 24 V, 40 VA	ZG-X40

Mechanical accessories

Description	Type
Anti-rotation bracket AF/NF.	AF-P
Shaft extension 240 mm Ø20 mm for damper shaft Ø 8...22.7 mm	AV8-25
End stop indicator	IND-AFB
Shaft clamp reversible, for central mounting, for damper shafts Ø12.7 / 19.0 / 25.4 mm	K7-2
Ball joint suitable for damper crank arm KH8 / KH10	KG10A
Ball joint suitable for damper crank arm KH8	KG8
Actuator arm, for 3/4" shafts, clamping range Ø10...22 mm, Slot width 8.2 mm	KH-AFB
Damper crank arm Slot width 8.2 mm, clamping range Ø14...25 mm	KH10
Damper crank arm Slot width 8.2 mm, for Ø1.05"	KH12
Damper crank arm Slot width 8.2 mm, clamping range Ø10...18 mm	KH8
Push rod for KG10A ball joint (36” L, 3/8” diameter).	SH10
Push rod for KG6 & KG8 ball joints (36” L, 5/16” diameter).	SH8
TOOL-06 8mm-10mm Wrench	TOOL-06
Retrofit clip	Z-AF
Base plate extension	Z-SF
Univ. right angle bracket 17"x11-1/8"x6" (HxWxbase).	ZG-100
Univ. right angle bracket 13x11x7-7/16" (HxWxbase).	ZG-101
Dual actuator mounting bracket.	ZG-102
Right angle bracket for ZS-260.	ZG-109
Stand-off bracket for ZS-260.	ZG-110
AFB(X)/NFB(X) U bracket 5-7/8x5-1/2x2-19/32" (HxWxD).	ZG-118
Jackshaft mounting bracket.	ZG-120
Mounting kit for linkage operation for flat and side installation	ZG-AFB
Mounting kit for foot mount installation	ZG-AFB118
Damper clip for damper blade, 3.5” width.	ZG-DC1
Damper clip for damper blade, 6” width.	ZG-DC2
1" diameter jackshaft adaptor (11" L).	ZG-JSA-1
1-5/16" diameter jackshaft adaptor (12" L).	ZG-JSA-2
1.05" diameter jackshaft adaptor (12" L).	ZG-JSA-3

Weather shield 13x8x6" [330x203x152 mm] (LxWxH)	ZS-100
Base Plate, for ZS-100	ZS-101
Weather shield 16x8-3/8x4" [406x213x102 mm] (LxWxH)	ZS-150
Explosion Proof Housing 16x10x6.435" [406x254x164 mm] (LxWxH), UL and CSA, Class I, Zone 1&2, Groups B, C, D, (NEMA 7), Class III, Hazardous (classified) Locations, outdoor application NEMA 4	ZS-260
Weather shield 17-1/4x8-3/4x5-1/2" [438x222x140 mm] (LxWxH), NEMA 4X, with mounting brackets	ZS-300
Weather shield 17-1/4x8-3/4x5-1/2" [438x222x140 mm] (LxWxH), NEMA 4X, with mounting brackets	ZS-300-5
Shaft extension 1/2"	ZS-300-C1
Shaft extension 3/4"	ZS-300-C2
Shaft extension 1"	ZS-300-C3

Electrical installation

Warning! Live Electrical Components!
During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

Meets cULus requirements without the need of an electrical ground connection.

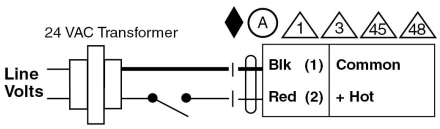
A Actuators with appliance cables are numbered.

1 Provide overload protection and disconnect as required.

3 Actuators may also be powered by 24 VDC.

45 Actuators may be powered in parallel. Power consumption must be observed.

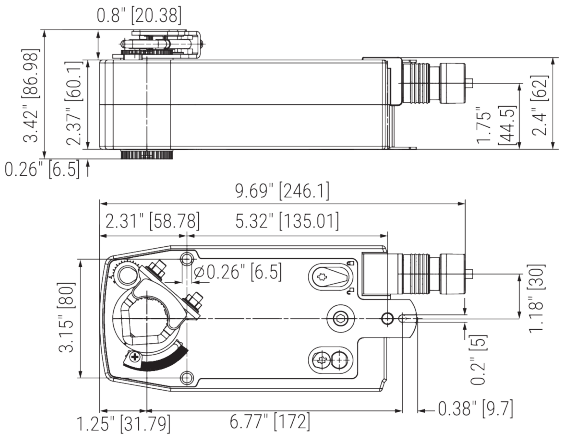
48 Parallel wiring required for piggy-back applications.



On/Off

Dimensions

Dimensional drawings

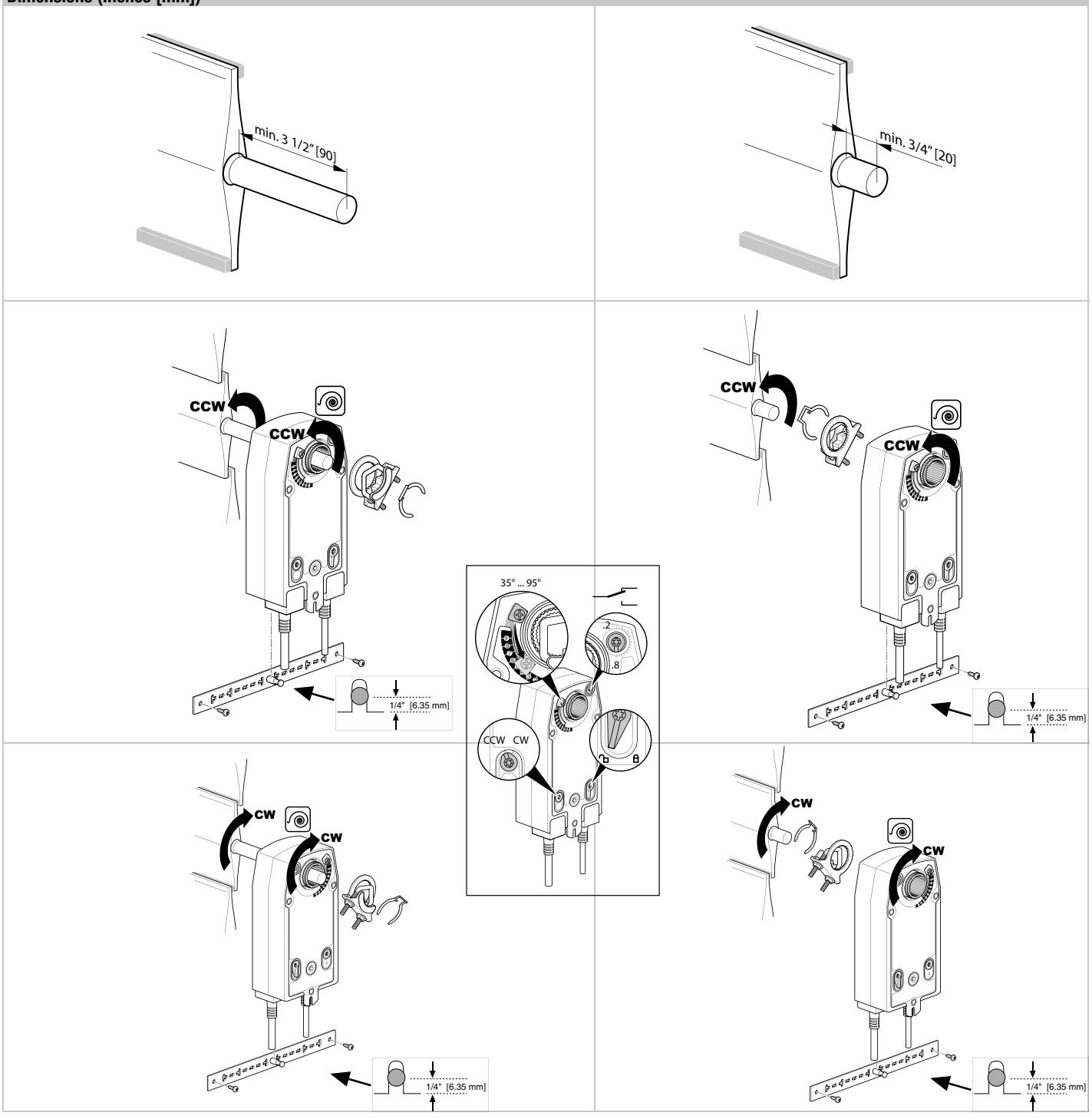


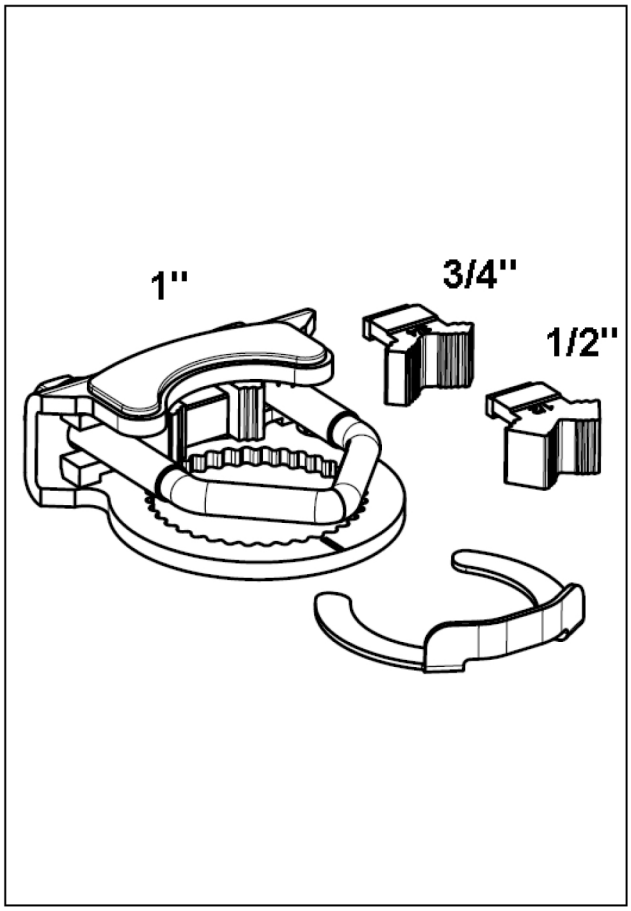
Quick-Mount Visual Instructions

1. Rotate the damper to its fail-safe position.
   If the shaft rotates counterclockwise, mount the “CCW” side of the actuator out.
   If it rotates clockwise, mount the actuator with the “CW” side out.
2. If the universal clamp is not on the correct side of the actuator, mount it onto the correct side.
3. Slide the actuator onto the shaft and tighten the nuts on the V-bolt with a 10mm wrench to 6-8 ft-lb of torque.
4. Slide the anti-rotation strap under the actuator so that it engages the slot at the base of the actuator. Secure the strap to the duct work with #8 self-tapping screws.

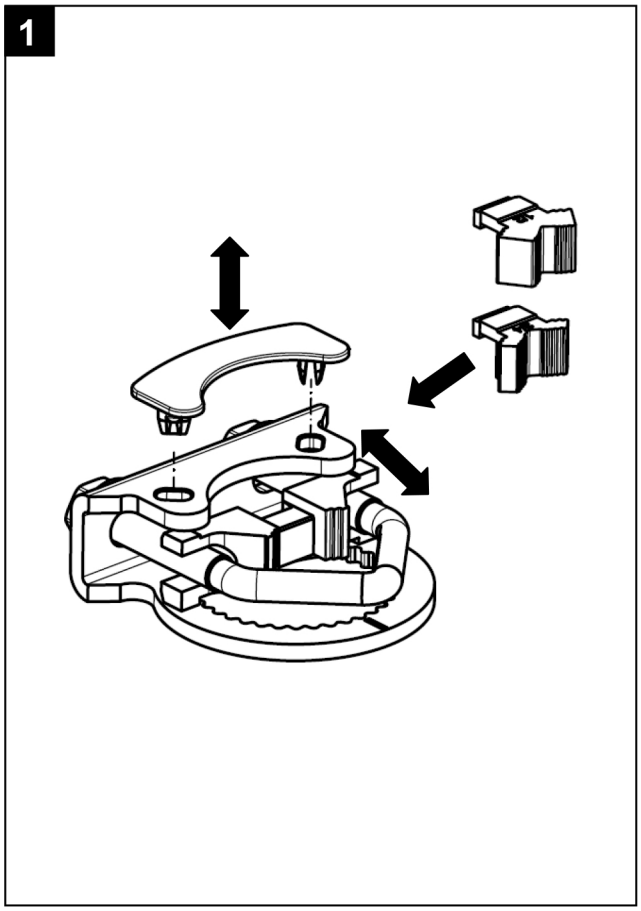
NOTE: Read the “Standard Mounting” instructions, on the next page, for more detailed information.

Dimensions (Inches [mm])





1



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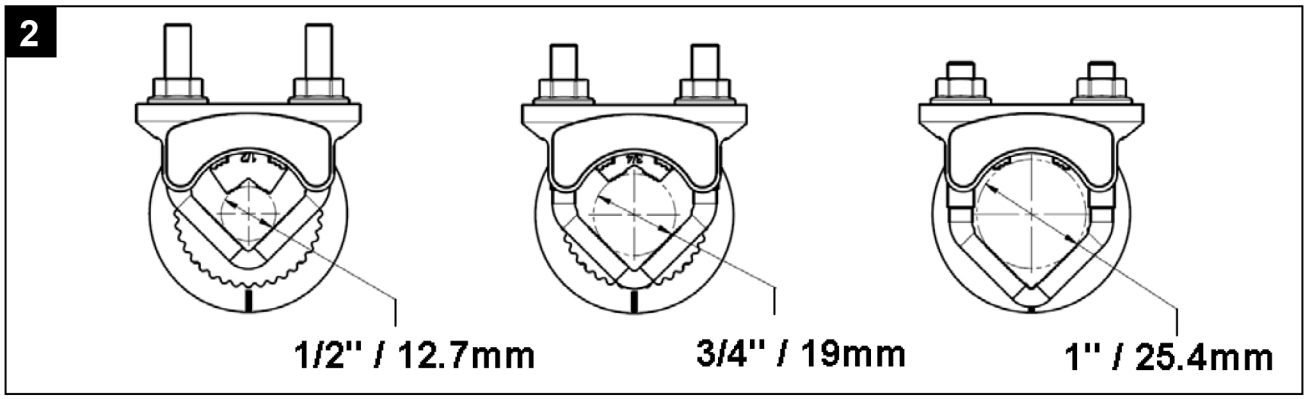
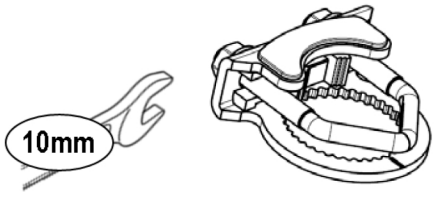


1/2"	mm	12.7	10 … 19	---	14 … 20
	inch	1/2	3/8 … 3/4	---	9/16 … 3/4
3/4"	mm	19	10 … 22	10	14 … 25.4
	inch	3/4	3/8 … 3/4	3/8	9/16 … 1
1"	mm	25.4	19 … 26.7	12 …18	---
	inch	1	3/4 … 1.05	1/2 …11/16	---



9 Nm / 80 in- lb

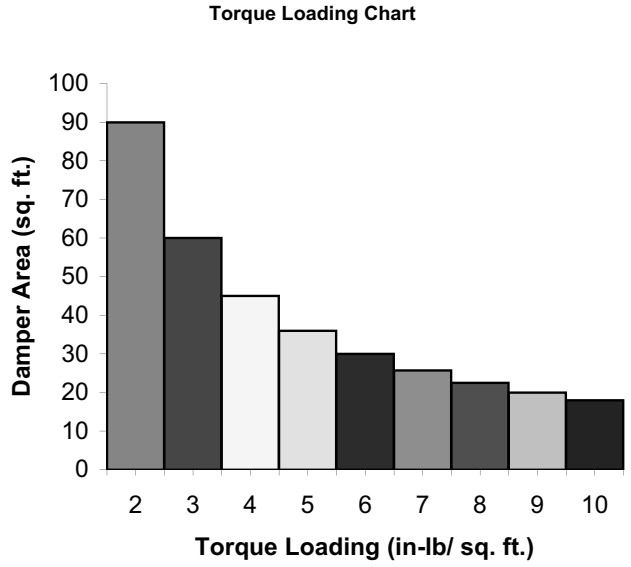
Determining Torque Loading and Actuator Sizing

Damper torque loadings, used in selecting the correct size actuator, should be provided by the damper manufacturer. If this information is not available, the following general selection guidelines can be used.

Damper Type	Torque Loading
Opposed blade, without edge seals, for non-tight close-off applications	3 in-lb/sq. ft.
Parallel blade, without edge seals, for non-tight close-off applications	4 in-lb/sq. ft.
Opposed blade, with edge seals, for tight close-off applications	5 in-lb/sq. ft.
Parallel blade, with edge seals, for tight close-off applications	7 in-lb/sq. ft.

The above torque loadings will work for most applications with 1000 FPM face velocity. For applications between this criteria and 2500 FPM, the torque loading should be increased by a multiplier of 1.5. If the application calls for higher criteria up to 3000 FPM, use a multiplier of 2.0.

Torque Loading Chart



General Information

Belimo actuators should be mounted indoors in a dry, relatively clean environment free from corrosive fumes. If the actuator is to be mounted outdoors, a protective enclosure must be used to shield the actuator.

For new construction work, **order dampers with extended shafts**. Instruct the installing contractor to allow space for mounting and service of the Belimo actuator on the shaft. The damper shaft must extend at least 3 1/2" from the duct. If the shaft extends less than 3-1/2" or if an obstruction blocks access, the shaft can be extended with the AV 8-25 shaft extension accessory or the actuator may be mounted in its short shaft configuration.

Mechanical Operation

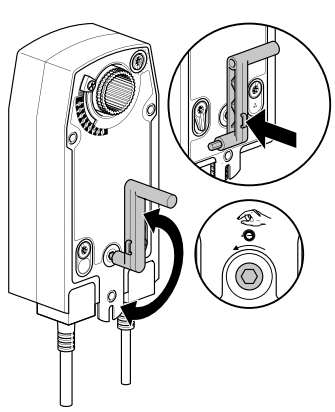
The actuator is mounted directly to a damper shaft up to 1.05" in diameter by means of its universal clamp. A crank arm and several mounting brackets are available for applications where the actuator cannot be direct coupled to the damper shaft. The AFB, AFX series actuators provide true spring return operation for reliable fail-safe application and positive close-off on air tight dampers. The spring return system provides constant torque to the damper with, and without, power applied to the actuator. The AFB…-S, AFX…-S versions are provided with two built-in auxiliary switches. These SPDT switches are provided for safety interfacing or signaling, for example, for fan start-up. The switching function at the fail-safe position is fixed at +10°, the other switch function is adjustable between +10° to +90°.

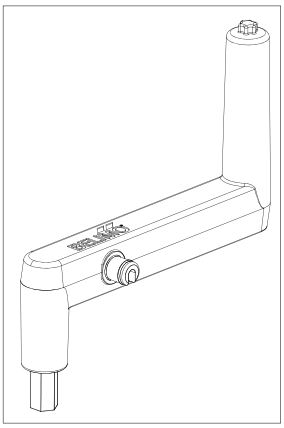
Automatic Airtight Dampers/Manual Override

The AFB, AFX series provides 95° of rotation and is provided with a graduated position indicator showing 0° to 95°.

The AFB, AFX has a unique built in manual positioning mechanism which allows the setting of any damper position within its 95° of rotation. A pre-tensioned spring automatically tightens the damper when power is applied to the actuator, compensating for damper seal deterioration..

The actuator is shipped at +5° (5° from full fail-safe) to provide automatic compression against damper gaskets for tight shut-off. When power is applied, the manual mechanism is released and the actuator drives toward the full fail-safe position.





Standard Mounting

NOTE: The AFB, AFX…series actuator is shipped with the manual override adjusted for a +5° position at the universal clamp (not at full fail-safe, 0°). This allows for automatic compression of damper blade seals when the actuator is in use, providing tight shut-off. This assumes that the damper is to have tight shut-off at the fail-safe position. If tight close-off is desired at the opposite direction from fail-safe, the manual override should be released so the actuator can go to the full fail-safe position. See the manual override instructions.

1. Manually move the damper to the fail-safe position (usually closed). If the shaft rotated counterclockwise ( ), this is a CCW installation. If the shaft rotated clockwise ( ), this is a CW installation. In a CCW installation, the actuator side marked "CCW" faces out, while in a CW installation, the side marked "CW" faces out. All other steps are identical.
2. The actuator is usually shipped with the universal clamp mounted to the "CCW" side of the actuator. To test for adequate shaft length, slide the actuator over the shaft with the side marked "CCW" (or the "CW" side if this is the side with the clamp). If the shaft extends at least 1/8" through the clamp, mount the actuator as follows. If not, go to the *Short Shaft Installation* section.
3. If the clamp is not on the correct side as determined in step #1, re-mount the clamp as follows. If it is on the correct side, proceed to step #5. Look at the universal clamp. If you are mounting the actuator with the "CCW" side out,

position the clamp so that the pointer section of the tab is pointing to 0° (see Figure C) and the spline pattern of the clamp mates with spline of the actuator. Slip the clamp over the spline. (Use the same procedure if the "CW" side is out.) If your application requires a mechanical minimum position, read the *Rotation Limiting, Mechanical Minimum Damper Position* section.
4. Lock the clamp to the actuator using the retaining clip.
5. Verify that the damper is still in its full fail-safe position.
6. Slide the actuator over the shaft.
7. Position the actuator in the desired location.
8. Tighten the two nuts on the clamp using a 10mm wrench or socket using 6-8 ft-lb of torque.
9. Slip the stud of the anti rotation strap into the slot at the base of the actuator. The stud should be positioned approximately 1/16 of an inch from the closed end of the slot. Bend the strap as needed to reach the duct. Attach the strap to the duct with #8 self tapping screws.

Short Shaft Installation

If the shaft extends at least 3/4" from the duct, follow these steps:
1. Determine the best orientation for the universal clamp on the back of the actuator. The best location would be where you have the easiest access to the V bolt nuts on the clamp.
2. Engage the clamp to the actuator as close as possible to the determined location.
3. Lock the clamp in place using the remaining retainer clip.
4. Verify that the damper is still in its full fail-safe position.
5. Slide the actuator over the shaft.
6. Position the actuator in the desired location.
7. Tighten the two nuts on the clamp using a 10mm wrench or socket using 6-8 ft-lb of torque.
8. Slip the stud of the anti-rotation strap into the slot at the base of the actuator. The stud should be positioned approximately 1/16 of an inch from the closed end of the slot. Bend the strap as needed to reach the duct. Attach the strap to the duct with #8 self tapping screws.
9. If damper position indication is required, use the optional IND-AFB pointer. See **Figure A**.

Jackshaft Installation

The AFB, AFX… series actuator is designed for use with jackshafts up to 1.05" in diameter. In most applications, the AFB, AFX actuator may be mounted in the same manner as a standard damper shaft application. If more torque is required than one AFB, AFX actuator can provide, a second AFB, AFX actuator may be mounted to the jackshaft using the ZG-102 multiple actuator mounting bracket. ***See wiring guide for wiring details.***

AF ACTUATORS WHICH MAY BE USED ON ONE SHAFT

Model	Maximum Quantity Per Shaft
AFB24-MFT(-S), AFX24-MFT (-S)	3
AFBUP(-S), AFXUP(-S)	2

MOUNTING: If the actuators are mounted on the opposed ends of the shaft, the actuator direction must be selected carefully. Usually, the direction of rotation is reversed.

Multiple Actuator Mounting

If more torque is required than one AFB, AFX actuator can provide, a second AFB, AFX actuator may be mounted to the shaft using the ZG-102 multiple mounting bracket.

NOTE: The manual positioning mechanism cannot be used in multiple actuator applications.

Special Wiring and Additional Information: See wiring guide

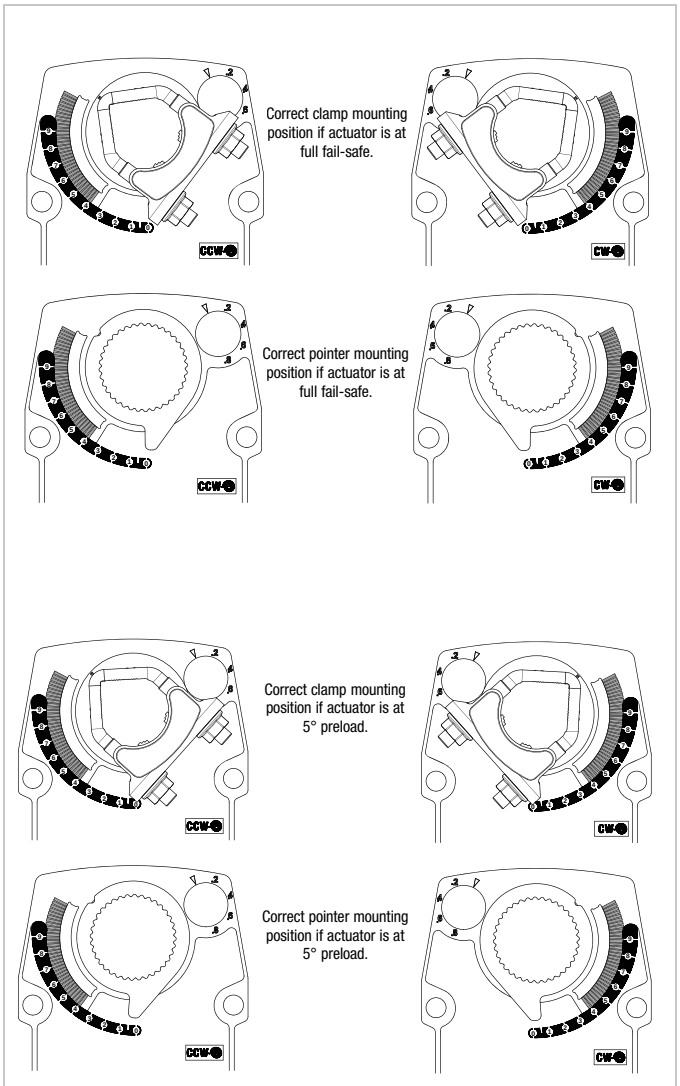


Figure A

Rotation Limitation

The angle of rotation limiter, which is built into the actuator, is used in conjunction with the tab on the universal clamp or IND-AFB position indicator. In order to function properly, the clamp or indicator must be mounted correctly.

See **Figure A**.

The rotation limiter may not work in certain mounting orientations using the ZG-118 mounting bracket. Limiting the damper rotation must be accomplished by adjusting the crank arm linkage.

The built-in rotation limiter may be used in 2 ways to control the rotational output of the AFB, AFX series actuator. One use is in the application where a damper has a designed rotation less than 90°. An example would be a 45° or 60° rotating damper. The other application would be to set a minimum damper position which can be easily set or changed without having to remove the actuator from the damper.

Damper Rotation Limiting

1. Determine the amount of damper rotation required.
2. Locate the Angle of Rotation Limiter on the actuator **Figure B**.
3. Position the limiter to the desired position, making sure the locating “teeth” on the limiter are engaged into the locating holes on the actuator.
4. Fasten the limiter by screwing the attached screw.
5. Test the damper rotation either manually with the manual crank or apply power and if required, a control signal. Re-adjust i**f** necessary.

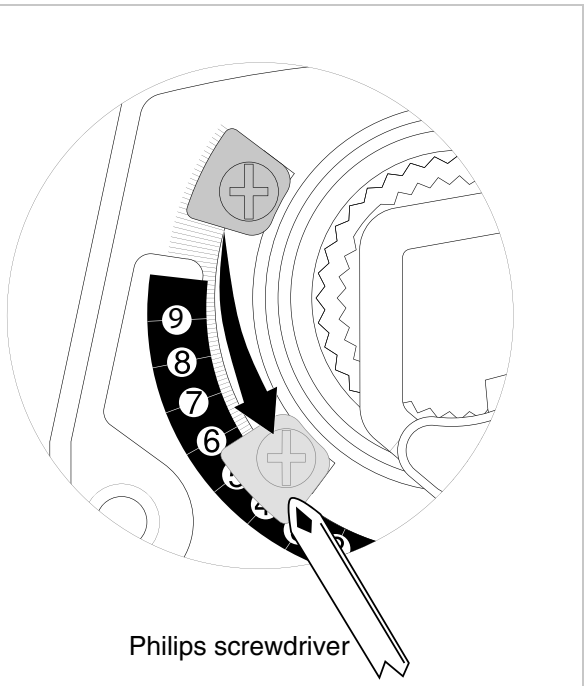
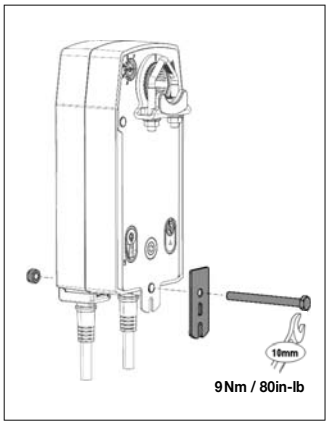
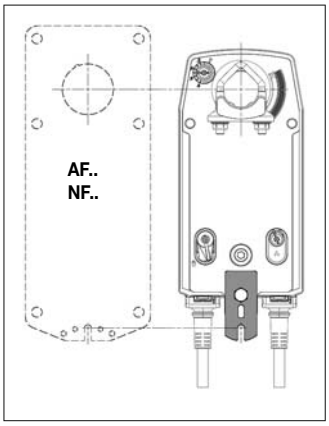


FIGURE B

Z-AF For Replacing AF and NF Actuators



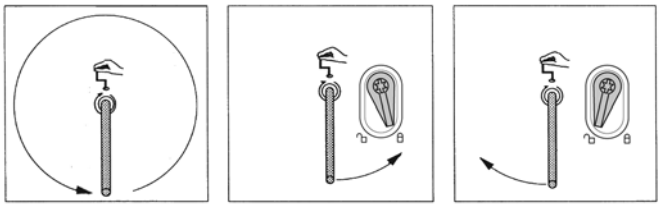


Manual Override

The AFB, AFX series actuators can be manually positioned to ease installation or for emergency positioning.

1. The manual override will only work if no power is available to the actuator.
2. Insert the manual crank (shipped with the actuator) into the hexagon hole located on either side of the actuator. An illustration, located on the label, shows the location.
3. Turn the crank in the direction shown on the label (clockwise on the “CW” side, counterclockwise on the “CCW” side). It will take approximately 23 revolutions to rotate the full 95° of rotation.
4. To lock the actuator in the required position, flip the switch to the locked position that is located to the right of the crank on the CCW side of the actuator (left of the crank on the CW side).
5. The manual override may be disengaged in 2 ways.
   - Flip the switch to the unlocked position and the actuator will go to its fail-safe position.
   - Apply power to wire 1 and 2. The actuator will automatically disengage the override function and will go to the “on” position in the case of the On/Off versions. Or, in the case of the proportional versions, go to the 0 signal position and then go to the position corresponding to the control signal. The actuator will now work normally.

CCW Side Example:



Winding the damper actuator	Locking the damper actuator	Unlocking the damper actuator (2 options)
- insert crank handle - turn handle in direction of arrow	- Flip the lock switch to the position pointing to the “locked” symbol	- Flip the lock switch to the position pointing to the “unlocked” symbol. - Remote control by supplying power to the unit for > than 3 sec.

Testing the installation Without Power

The actuator/damper installation may be tested without power at the actuator. Refer to the manual positioning section of the instructions. Move the damper to its full non-fail-safe position using the manual crank. Disengage the manual position mechanism and have the damper go to full fail-safe position. Correct any mechanical problems and retest.

Auxiliary Switches

The AFB, AFX series actuators may be ordered with two built-in SPDT auxiliary switches used for safety interfacing or signaling, for example, for fan start-up. The switch position near the fail-safe position is fixed at 10°. The other is adjustable between 10° and 90° of rotation. The crank that is supplied with the actuator is used to change the switch position.

SWITCH RATING

Voltage	Resistive Load	Inductive Load
120 VAC	3A	1.03A
250 VAC	3A	0.5A

Two methods may be used to adjust the switching point of the adjustable switch.

Method 1 - See **Figure F**
1 The actuator must be in its fail-safe position.
2. Insert the crank handle into the torx shaped hole located in the center of the adjustable switch pointer.
3. Gently rotate the crank until the switch pointer is at the desired switch point in degrees as shown.

AFB, AFX... Series

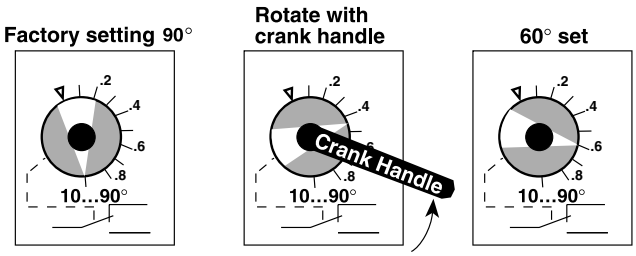


FIGURE F

Method 2 - See **Figure G**
1. Position the damper to the point at which you want the switch to activate. This may be done by using the manual override or by providing the appropriate proportional signal to AFB24, AFX24… modulating type actuator. The position of the switch pointer is not important during this step
2. Insert the crank into the hexagon shaped hole located in the center of the adjustable switch pointer.
3. Gently rotate the switch pointer to just past the switch point indicating arrow as shown.

AFB, AFX... Series

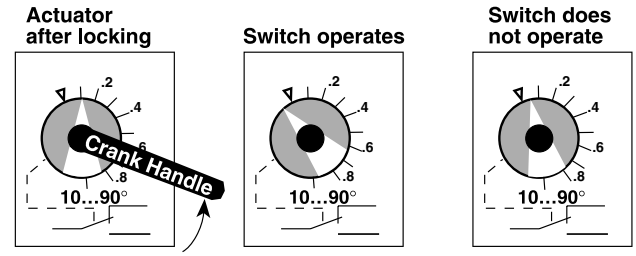
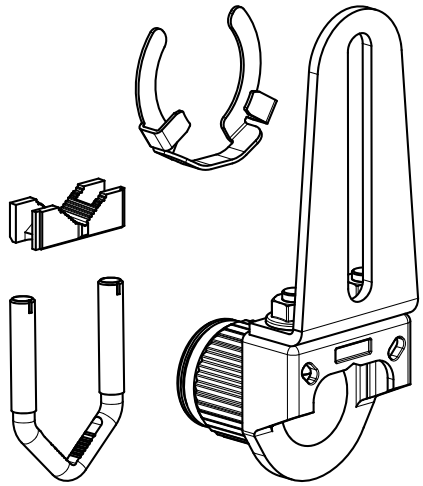
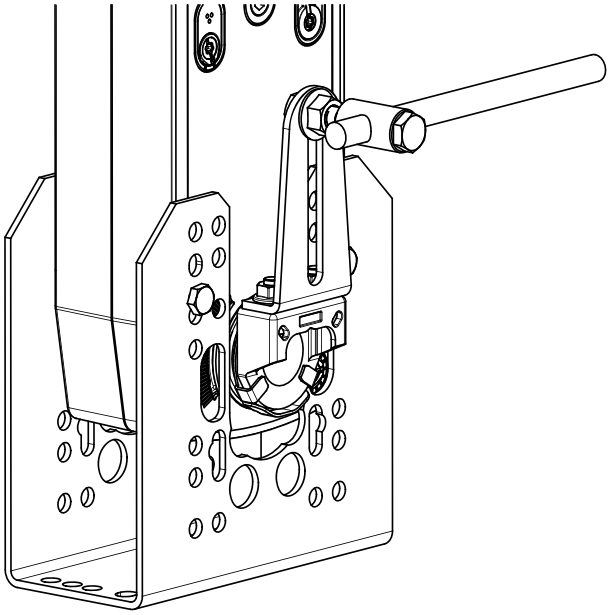


FIGURE G





KH-AFB non-direct mounting with ZG-118 mounting bracket

KH-AFB Crank arm

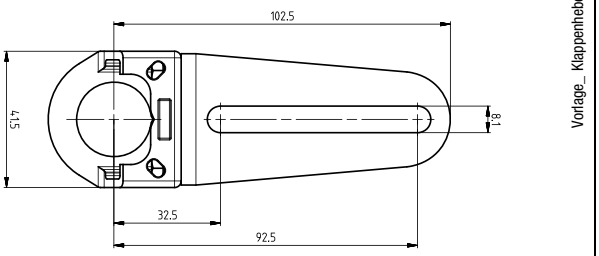
Including Retaining Ring

CAUTION: *The retaining clip supplied with the clamp is* ***not*** *used to mount the KH-AFB crank arm.*

The KH-AFB crank arm is used in non-direct coupled mounting applications. The KH-AFB may also be used to simultaneously direct couple to a damper shaft and provide an additional crank arm connection to a second damper.

KH-AFB	For round shafts up to 3/4" or square shafts up to 5/8"

Dimensions (Inches [mm])



General

The AFB, AFX series actuators utilize both DC Motors and brushless DC motor technology. The AFB, AFX uses this motor in conjunction with an Application Specific Integrated Circuit (ASIC). In the On/Off versions of the AFB and AFX, the ASIC monitors and controls the actuator's rotation and a digital rotation sensing function to prevent damage to the actuator. The AFB24, AFX24… modulates type actuators incorporate a built in microprocessor. The microprocessor provides the intelligence to the ASIC to provide a constant rotation rate and knows the actuator's exact zero position.

Brushless DC Motor Operation

Belimo's brushless DC motor spins by reversing the poles of stationary electromagnets housed inside of a rotating permanent magnet. The electromagnetic poles are switched by a special ASIC circuit developed by Belimo. Unlike the conventional DC motor, there are no brushes to wear or commutators to foul.

Overload Protection

The AFB, AFX series actuators are protected from overload at all angles of rotation. The ASIC circuit constantly monitors the rotation of the DC motor inside the actuator and stops the pulses to the motor when it senses a stall condition. The DC motor remains energized and produces full rated torque to the load. This helps ensure that dampers are fully closed and that edge and blade seals are always properly compressed.

Motor Position Detection

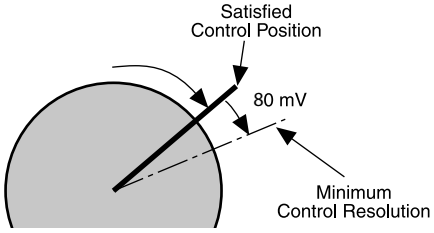
Belimo brushless DC motors eliminate the need for potentiometers for positioning in modulating type actuators. Inside the motor are three "Hall Effect" sensors. These sensors detect the spinning rotor and send pulses to the microprocessor which counts the pulses and calculates the position to within 1/3 of a revolution of the motor.

Control Accuracy and Stability

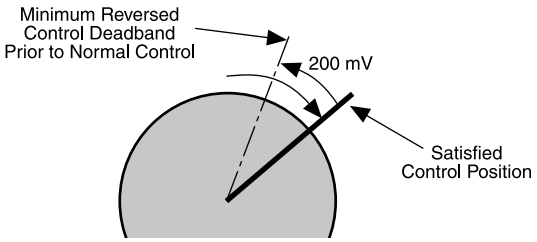
AFB24-MFT, AFX24-MFT actuators have built-in brushless DC motors which provide better accuracy and longer service life.

The AFB24-MFT, AFX24-MFT actuators are designed with a unique non-symmetrical deadband. The actuator follows an increasing or decreasing control signal with a 80 mV resolution. If the signal changes in the opposite direction, the actuator will not respond until the control signal changes by 200 mV. This allows these actuators to track even the slightest deviation very accurately, yet allowing the actuator to "wait" for a much larger change in control signal due to control signal instability.

AF Actuator responds to an 80 mV signal when not changing direction from stop



AF Actuator responds to a 200 mV signal when reversing direction from stop position.



Note: Resolution is a percentage of operating range. 1% in one direction, 2.5% when changing direction. 2-10 VDC control example shown above.

WARNING The wiring technician must be trained and experienced with electronic circuits. Disconnect power supply before attempting any wiring connections or changes. Make all connections in accordance with wiring diagrams and follow all applicable local and national codes. Provide disconnect and overload protection as required. Use copper, twisted pair, conductors only. If using electrical conduit, the attachment to the actuator must be made with flexible conduit.

Always read the controller manufacturer's installation literature carefully before making any connections. Follow all instructions in this literature. If you have any questions, contact the controller manufacturer and/or Belimo.

Transformers

The AFB24, AFX24…actuators require a 24 VAC class 2 transformer and draws a maximum of 10 VA per actuator. The actuator enclosure cannot be opened in the field, there are no parts or components to be replaced or repaired.

– EMC directive: 89/336/EEC
– Software class A: Mode of operation type 1
– Low voltage directive: 73/23/EEC

CAUTION: It is good practice to power electronic or digital controllers from a separate power transformer than that used for actuators or other end devices. The power supply design in our actuators and other end devices use half wave rectification. Some controllers use full wave rectification. When these two different types of power supplies are connected to the same power transformer and the DC commons are connected together, a short circuit is created across one of the diodes in the full wave power supply, damaging the controller. Only use a single power transformer to power the controller and actuator if you know the controller power supply uses half wave rectification.

Multiple Actuators, One Transformer

Multiple actuators may be powered from one transformer provided the following rules are followed:

1. The TOTAL current draw of the actuators (VA rating) is less than or equal to the rating of the transformer.
2. Polarity on the secondary of the transformer is strictly followed. *This means that all No. 1 wires from all actuators are connected to the common leg on the transformer and all No. 2 wires from all actuators are connected to the hotleg.* Mixing wire No. 1 & 2 on one leg of the transformer will result in erratic operation or failure of the actuator and/or controls.

Multiple Actuators, Multiple Transformers

Multiple actuators positioned by the same control signal may be powered from multiple transformers provided the following rules are followed:

1. The transformers are properly sized.
2. All No. 1 wires from all actuators are tied together and tied to the negative leg of the control signal. See wiring diagram.

Wire Length for AFB..., AFX... Actuators

Keep power wire runs below the lengths listed in the **Figure H**. If more than one actuator is powered from the same wire run, divide the allowable wire length by the number of actuators to determine the maximum run to any single actuator.

Example: 3 actuators, 16 Ga wire
350 Ft ÷ 3 Actuators = 117 Ft. Maximum wire run

MAXIMUM WIRE LENGTH FOR 10VA

Wire Size	Max. Feet.	Wire Size	Max. Feet
12 Ga	900 Ft.	18 Ga	220 Ft.
14 Ga	550 Ft.	20 Ga	120 Ft.
16 Ga	350 Ft.	22 Ga	60 Ft.

FIGURE H

Wire Type and Wire Installation Tips

For most installations, 18 or 16 Ga. cable works well with the AFB24, AFX24... actuators. Use code-approved wire nuts, terminal strips or solderless connectors where wires are joined. It is good practice to run control wires unspliced from the actuator to the controller. If splices are unavoidable, make sure the splice can be reached for possible maintenance. Tape and/or wire-tie the splice to reduce the possibility of the splice being inadvertently pulled apart.

The AFB24, AFX24... proportional actuators have a digital circuit that is designed to ignore most unwanted input signals (pickup). In some situations the pickup may be severe enough to cause erratic running of the actuator. For example, a large inductive load (high voltage AC wires, motors, etc.) running near the power or control wiring may cause excessive pickup. To solve this problem, make one or more of the following changes:

1. Run the wire in metallic conduit.
2. Re-route the wiring away from the source of pickup.
3. Use shielded wire (Belden 8760 or equal). Ground the shield to an earth ground. **Do not** connect it to the actuator common.

Initialization of the AFB24-MFT, AFX24-MFT

When power is initially applied, the actuator will first release its manual preload position (This assumes a manual position has been set). The actuator will then rotate to the full fail-safe position. At this point the microprocessor recognizes that the actuator is at full fail-safe and uses this position as the base for all of its position calculations. The microprocessor will retain the initialized zero during short power failures of up to 20 seconds. The AFB24-MFT and AFX24-MFT will also return to its position prior to the 20-second-or-less power loss. For power failures greater than 20 seconds, the actuator would naturally return to its full fail-safe position prior to the microprocessor losing its memory. The actuator will also re-initialize if the manual position mechanism is used.

AFB24-MFT, AFX24-MFT + P-100… Electrical Check-Out Procedure

STEP	Procedure	Expected Response	Gives Expected Response Go To Step…	Does Not Give Expected Response Go To Step…
1.	Control signal is applied to actuator.	Actuator will move to its "Control Signal" position.	Actuator operates properly **Step 7.**	No response at all **Step 2.** Operation is reversed **Step 3.** Does not drive toward "Control Signal Position" **Step 4.**
2.	Check power wiring. Correct any problems. **See Note 1.**	Power supply rating should be the total power requirement of the actuator(s). Minimum voltage of 19.2 VAC or 21.6 VDC.	Power wiring corrected, actuator begins to drive **Step 1.**	Power wiring corrected, actuator still does not drive **Step 4.**
3.	Turn reversing switch to the correct position. Make sure the switch is turned all the way left or right.	Actuator will move to its "Control Signal" position.	Actuator operates properly **Step 7.**	Does not drive toward "Control Signal Position" **Step 4.**
4.	Make sure the control signal positive (+) is connected to Wire No. 3 and control signal negative (-) is connected to wire No. 1. Most control problems are caused by reversing these two wires. Verify that the reversing switch is all the way CCW or CW.	Drives to "Control Signal" position.	Actuator operates properly **Step 7.**	**Step 5.**
5.	Check input signal with a digital volt meter (DVM). Make sure the input is within the range of the actuator. **NOTE:** The input signal must be above the 2 VDC or 4 mA to have the actuator move.	Input voltage or current should be ±1% of what controller's adjustment or programming indicates.	Controller output (actuator input) is correct. Input Polarity Correct **Step 6.**	Reprogram, adjust repair or replace controller as needed **Step 1.**
6.	Check damper torque requirement.	Torque requirement is actuator's minimum torque.	Defective Actuator. Replace Actuator - **See Note 2.**	Recalculate actuator requirement and correct installation.
7.	Actuator works properly. Test controller by following controller manufacturer's instructions.			

NOTE 1 Check that the transformer(s) are sized properly.

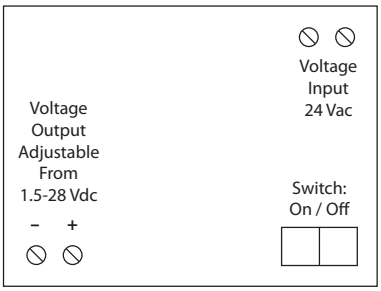
- If a common transformer is used, make sure that polarity is observed on the secondary. This means connect all No. 1 wires to one leg of the transformer and all No. 2 wires to the other leg of the transformer.
- If multiple transformers are used with one control signal, make sure all No. 1 wires are tied together and tied to control signal negative (-).
- Controllers and actuators must have separate 24 VAC/VDC power sources.

NOTE 2 If failure occurs within 5 years from original purchase date, notify Belimo and give details of the application.

DC POWER SUPPLY: 24 VAC TO 1.5 - 28 VDC

PSM24A24DAS

4.00˝ & 2.75˝ Track Mount Isolated Linear DC Power Supply, 24 Vac to 1.5-28 Vdc, 300 mA Adjustable Output



SPECIFICATIONS

Voltage Input: 24 Vac
Voltage Output: 1.5 - 28 Vdc Isolated
Frequency: 50/60 Hz
Overload Protection: Electrical and Thermal, Auto-Reset
Operating Temperature: -30 to 140° F
Humidity Range: 5 to 95% (noncondensing)
Power Status: LED On = Activated
Dimensions: 1.625˝ x 2.750˝ x 4.000˝
Track Mount: 4.000˝ and 2.750˝
MT212-4 Mounting Track Supplied
ON/OFF Switch: 2 Position
Approvals: UL916, C-UL, CE, RoHS

Output Current Ratings:
116 mA @ 10 Vdc
125 mA @ 12 Vdc
300 mA @ 24 Vdc

Input Current Rating:
950 mA Maximum

Percent Ripple:
0.0016%, 24 Vdc @ 300 mA

Regulation:
Load: 0.04% No Load to Full Load
Line: 0.0080 mV/V

20191127

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101 Commerce Drive
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Email: sales@functionaldevices.com
Website: www.functionaldevices.com

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C. Seller is not liable for any damage as a result of any delay or failure to deliver due to any act of God, act of Buyer, embargo or other governmental act, regulation or request, fire, accident, power outage, strike, civil unrest, weather, slowdown or other labor difficulties, war, riot, act of terrorism, delay in transportation, defaults of common carriers, inability to obtain necessary labor, materials or manufacturing facilities or, without limiting the foregoing, any other delays beyond Seller's control. Buyer's sole and exclusive remedy for any delays or for Seller's inability to deliver Products for any reason, in each case, that persists for more than ninety (90) days, is to cancel the order pursuant to Seller's Order Policies and Guidelines available upon request.

6. WARRANTY; DISCLAIMER. Products are warranted to be free from manufacturing defects under normal use and conditions for five (5) years (the "**Warranty Period**").

The warranty does not apply to: (a) Damage caused by accident, abuse, mishandling, or dropping; (b) Products which have been subjected to unauthorized repair, opened, or taken apart; (c) Products not used in accordance with directions; (d) Damages exceeding the cost of such Product; and (e) Damages caused by lightning, water, or condensation. If warranty service is required during the Warranty Period, and if examination shall disclose to Seller's satisfaction that such Product was originally defective, then Seller will at its option repair or replace the product without charge upon prepaid delivery of such Product to Seller's facility with proof of date of purchase. Corrections of such defects by repair to or supplying of replacements for defective parts shall constitute fulfillment of all obligations of Seller.

Seller shall not be liable for loss, damage, or expense directly or indirectly caused from the failure of Products to perform as expected.

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9. CANCELLATIONS: Cancellation or deferment of all or part of an order is subject to acceptance by the Seller. If accepted, any reduction in quantity of any item to less than 85% of the original item quantity is subject to a 15% cancellation charge. If an order cancellation is accepted, the Buyer will make delivery and pay for all material manufactured and in stock or in process at time of notice for such order, and for any special materials on orders for which the Seller must take delivery.

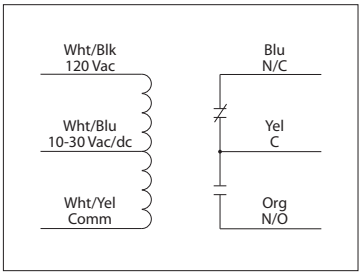
10. EXPORTS. Buyer agrees that it will comply with any and all U.S. Export Controls and will not pay for, resell, transfer or knowingly sell Products in violation of U.S. Export Controls. If Buyer resells Products within or exports Products to a country or region which imposes upon Seller and/or Buyer an obligation to fund or undertake reuse, recycling, composting, recovery of Products, or any similar obligation (e.g., the European Union's Waste Electrical and Electronic Equipment Directive, EC 2002/96/EC) (the "**Obligations**"), Buyer shall wholly undertake the Obligations or duties and shall be entirely responsible for all associated costs therewith. Seller shall have no obligation to reimburse Buyer for execution of the Obligations. In the event that Seller is named in a proceeding based upon the Obligations, Buyer shall indemnify, defend and hold Seller harmless from all actions related thereto, including all civil and governmental actions.

11. MISCELLANEOUS. This Agreement is governed by the laws of the State of Indiana, without giving effect to its conflict of laws principles. Buyer hereby irrevocably consents and submits to the exclusive jurisdiction and venue of the state and federal courts in Marion County, Indiana. The United Nations Convention for Contracts for the International Sale of Goods is explicitly excluded. Each provision contained in this Agreement constitutes a separate and distinct provision severable from all other provisions. If any provision (or any part thereof) is unenforceable under or prohibited by any present or future law, then such provision (or part thereof) will be amended, and is hereby amended, so as to be in compliance with such law, while preserving to the maximum extent possible the intent of the original provision. Any provision (or part thereof) that cannot be so amended will be severed from this Agreement; and, all the remaining provisions of this Agreement will remain unimpaired. No modification, addition or deletion, or waiver of any rights under this Agreement is binding on a party unless made in a non-preprinted agreement clearly understood by the parties to be a modification or waiver, and signed by a duly authorized representative of each party.

10 AMP PILOT CONTROL RELAY

RIBU1C

Enclosed Relay 10 Amp SPDT with
10-30 Vac/dc/120 Vac Coil



RIBU1C-RD
- Red housing

RIBU1C-N4
- NEMA 4X housing, UL508 only

SPECIFICATIONS

 # Relays & Contact Type: One (1) SPDT Continuous Duty Coil
Expected Relay Life: 10 million cycles minimum mechanical
Operating Temperature: -30 to 140° F
Humidity Range: 5 to 95% (noncondensing)
Operate Time: 20ms
Relay Status: LED On = Activated
Dimensions: 1.70˝ x 2.80˝ x 1.50˝ with .50˝ NPT nipple
Wires: 16˝, 600V Rated
Approvals: UL Listed, UL916, UL864, C-UL
California State Fire Marshal, CE, RoHS
Housing Rating: UL Accepted for Use in Plenum, NEMA 1
Gold Flash: Yes
Override Switch: No

Contact Ratings:
10 Amp Resistive @ 277 Vac
10 Amp Resistive @ 28 Vdc
480 VA Pilot Duty @ 240-277 Vac
480 VA Ballast @ 277 Vac
Not rated for Electronic Ballast
600 Watt Tungsten @ 120 Vac (N/O)
240 Watt Tungsten @ 120 Vac (N/C)
1/3 HP @ 120-240 Vac (N/O)
1/6 HP @ 120-240 Vac (N/C)
1/4 HP @ 277 Vac (N/O)
1/8 HP @ 277 Vac (N/C)

Coil Current:

33 mA @ 10 Vac	13 mA @ 10 Vdc
35 mA @ 12 Vac	15 mA @ 12 Vdc
46 mA @ 24 Vac	18 mA @ 24 Vdc
55 mA @ 30 Vac	20 mA @ 30 Vdc
28 mA @ 120 Vac	

Coil Voltage Input:
10-30 Vac/dc ; 120 Vac ; 50-60 Hz
Drop Out = 2.1 Vac / 2.8 Vdc
Pull In = 9 Vac / 10 Vdc

20191025

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Sharpsville, IN 46068

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B. Buyer will only make written claims to Seller for damages, shortages or other delivery errors within seven (7) calendar days after receipt of shipment. All Products received by Buyer, or Buyer's clients, customers, or agents, that are not rejected within such time will be deemed accepted. Failure to provide such written notice constitutes a waiver of all such claims regarding such shipment by Buyer. Buyer will not revoke acceptance.

C. Seller is not liable for any damage as a result of any delay or failure to deliver due to any act of God, act of Buyer, embargo or other governmental act, regulation or request, fire, accident, power outage, strike, civil unrest, weather, slowdown or other labor difficulties, war, riot, act of terrorism, delay in transportation, defaults of common carriers, inability to obtain necessary labor, materials or manufacturing facilities or, without limiting the foregoing, any other delays beyond Seller's control. Buyer's sole and exclusive remedy for any delays or for Seller's inability to deliver Products for any reason, in each case, that persists for more than ninety (90) days, is to cancel the order pursuant to Seller's Order Policies and Guidelines available upon request.

6. WARRANTY; DISCLAIMER. Products are warranted to be free from manufacturing defects under normal use and conditions for five (5) years (the "**Warranty Period**").

The warranty does not apply to: (a) Damage caused by accident, abuse, mishandling, or dropping; (b) Products which have been subjected to unauthorized repair, opened, or taken apart; (c) Products not used in accordance with directions; (d) Damages exceeding the cost of such Product; and (e) Damages caused by lightning, water, or condensation. If warranty service is required during the Warranty Period, and if examination shall disclose to Seller's satisfaction that such Product was originally defective, then Seller will at its option repair or replace the product without charge upon prepaid delivery of such Product to Seller's facility with proof of date of purchase. Corrections of such defects by repair to or supplying of replacements for defective parts shall constitute fulfillment of all obligations of Seller.

Seller shall not be liable for loss, damage, or expense directly or indirectly caused from the failure of Products to perform as expected.

EXCEPT AS SET FORTH HEREIN, SELLER DISCLAIMS ALL REPRESENTATIONS OR WARRANTIES OF ANY KIND WHATSOEVER, WHETHER EXPRESS, IMPLIED OR STATUTORY, INCLUDING, WITHOUT LIMITATION, ANY IMPLIED WARRANTIES OF MERCHANTABILITY, NON-INFRINGEMENT, FITNESS FOR A PARTICULAR PURPOSE OR ANY WARRANTY ARISING FROM A COURSE OF DEALING OR USAGE OF TRADE. NO PERSON (INCLUDING ANY AGENT, DEALER OR REPRESENTATIVE OF SELLER) IS AUTHORIZED TO MAKE ANY REPRESENTATION OR WARRANTY CONCERNING PRODUCTS EXCEPT TO REFER BUYER TO THIS AGREEMENT. BUYER WARRANTS THAT BUYER HAS NOT RELIED ON ANY OTHER WARRANTIES OR REPRESENTATIONS CONCERNING THE PRODUCTS OR THIS AGREEMENT.
For warranty service, call factory for RA number and send such Product prepared with sales receipt to: FUNCTIONAL DEVICES, INC., 101 COMMERCE DRIVE, SHARPSVILLE, IN 46068.

7. LIMITATION OF LIABILITY: SELLER WILL NOT BE LIABLE FOR ANY LOSS OF PROFIT, INTERRUPTION OF BUSINESS OR ANY OTHER SPECIAL, CONSEQUENTIAL OR INCIDENTAL DAMAGES SUFFERED OR SUSTAINED BY BUYER FOR ANY REASON. EXCEPT FOR CLAIMS OF DEATH OR PERSONAL INJURY, IN NO EVENT WILL SELLER'S AGGREGATE LIABILITY TO BUYER ARISING UNDER OR IN ANY WAY RELATED TO THIS AGREEMENT FOR ANY REASON (INCLUDING, BUT NOT LIMITED TO, LIABILITY ARISING FROM NEGLIGENCE OR ON THE BASIS OF STRICT LIABILITY, OR OTHERWISE) EXCEED THE TOTAL AMOUNT PAID BY BUYER TO SELLER HEREUNDER FOR ANY PRODUCT GIVING RISE TO A CLAIM UNDER THIS AGREEMENT.

8. RETURNS: Unless otherwise approved by Seller in writing in its sole discretion, except in the case of a non-conforming shipment or a warranty issue, Buyer may not return Products. If Seller approves the return of Products pursuant to the preceding sentence, such returned Products must be returned within ninety (90) days from date of invoice and will be subject to a 25% restocking fee. In the event of a non-conforming shipment or a warranty issue, Buyer may return Products, but only if Buyer first: (a) provides notice to Seller as required in this Agreement, (b) obtains prior authorization from Seller, and (c) all Products or containers for which return is properly authorized have been marked with a return authorization number supplied by Seller. Buyer will make all returns via a traceable form such as Federal Express, UPS or insured mail and in resalable condition. Buyer will pay all return shipping charges and any other charges associated therewith.

9. CANCELLATIONS: Cancellation or deferment of all or part of an order is subject to acceptance by the Seller. If accepted, any reduction in quantity of any item to less than 85% of the original item quantity is subject to a 15% cancellation charge. If an order cancellation is accepted, the Buyer will make delivery and pay for all material manufactured and in stock or in process at time of notice for such order, and for any special materials on orders for which the Seller must take delivery.

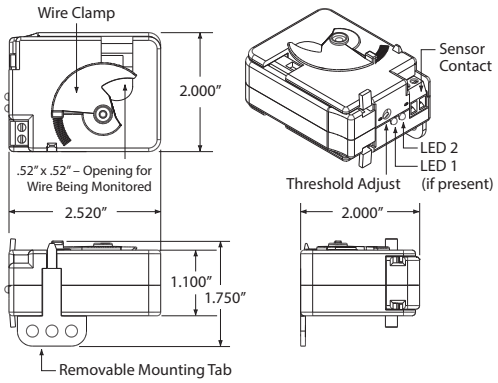
10. EXPORTS. Buyer agrees that it will comply with any and all U.S. Export Controls and will not pay for, resell, transfer or knowingly sell Products in violation of U.S. Export Controls. If Buyer resells Products within or exports Products to a country or region which imposes upon Seller and/or Buyer an obligation to fund or undertake reuse, recycling, composting, recovery of Products, or any similar obligation (e.g., the European Union's Waste Electrical and Electronic Equipment Directive, EC 2002/96/EC) (the "**Obligations**"), Buyer shall wholly undertake the Obligations or duties and shall be entirely responsible for all associated costs therewith. Seller shall have no obligation to reimburse Buyer for execution of the Obligations. In the event that Seller is named in a proceeding based upon the Obligations, Buyer shall indemnify, defend and hold Seller harmless from all actions related thereto, including all civil and governmental actions.

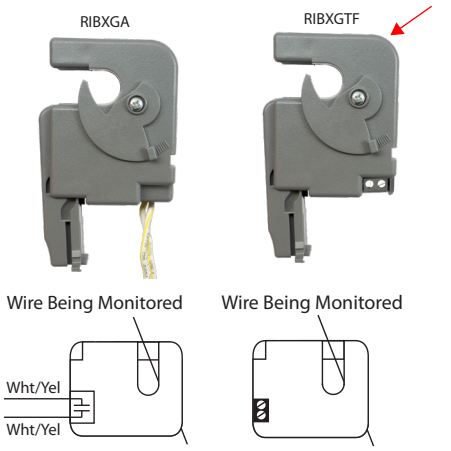
11. MISCELLANEOUS. This Agreement is governed by the laws of the State of Indiana, without giving effect to its conflict of laws principles. Buyer hereby irrevocably consents and submits to the exclusive jurisdiction and venue of the state and federal courts in Marion County, Indiana. The United Nations Convention for Contracts for the International Sale of Goods is explicitly excluded. Each provision contained in this Agreement constitutes a separate and distinct provision severable from all other provisions. If any provision (or any part thereof) is unenforceable under or prohibited by any present or future law, then such provision (or part thereof) will be amended, and is hereby amended, so as to be in compliance with such law, while preserving to the maximum extent possible the intent of the original provision. Any provision (or part thereof) that cannot be so amended will be severed from this Agreement; and, all the remaining provisions of this Agreement will remain unimpaired. No modification, addition or deletion, or waiver of any rights under this Agreement is binding on a party unless made in a non-preprinted agreement clearly understood by the parties to be a modification or waiver, and signed by a duly authorized representative of each party.

AC CURRENT SWITCHES

RIBXG Series

Enclosed Self-Powered Split Core AC Sensors





c UL us LISTED

CE

RoHS

MADE IN THE U.S.A.

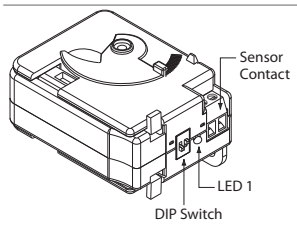
SPECIFICATIONS

FUNCTIONAL DEVICES CERTIFIED FOR USE WITH **ECMs**

Operating Temperature: -30 to 140° F
Humidity Range: 5 to 95% (noncondensing)
Max Sense Voltage: 600 Vac
Approvals: UL Listed, UL916, UL864, C-UL, California State Fire Marshal, CE, RoHS
Mounting/Installation: Removable mounting tab provided. The wire clamp locks against the wire being monitored, securing the unit in place.
Sensor Contact Status: Current below threshold: Open
Current above threshold: Closed

Sensor Contact:
- Solid State Contact
- When sensor contact is off (open), leakage <30 uA @ 30Vac/dc
- When sensor contact is on (closed), voltage drop
  < .3 Vac/dc @ .1 Amp
  < 1.6 Vac/dc @ .4 Amp

SELF-CALIBRATING AC SWITCHES (Models with -SCAL Suffix)



-SCAL LED TABLE	
LED Off	No Current
Two Winks	Current Below Range
Three Winks	Current In Range
Four Winks	Current Above Range
Continuous Winks	Calibration in Progress

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The SCAL unit begins the 30 second self-calibration process the first time current is applied in the operating range. The threshold is then set. Subsequent calibrations may be performed by moving SW1 to the position opposite of its current position with or without current applied (hands can be safely away from live voltage). Once current begins flowing, or if it already is, the calibration process will begin. At the end of the 30 seconds, amperage will be read and set as the threshold. SW2 in the ON position provides a 15% (+/-3%) differential. In the OFF position, it provides a 25% (+/-3%) differential. SW2 can be selected at anytime and does not affect the threshold setting. Current in-range closes the sensor contact. Current above or below range opens the sensor contact.

Example: With a current of 10 amps set as the threshold and a 15% differential, sensor contact will be closed between 8.5 amps and 11.5 amps and open outside of this range. A small amount of hysteresis is provided to prevent dithering near the differential limits.

RIBXG SERIES SELECTION GUIDE

Model#	Sensing Range	Type	Threshold	Sensor Contact Type	Switching Voltage Range	Maximum Switching Current	Sensor Contact Termination	LED 1	LED 2
RIBXGF	.35-150 Amp	Split Core	Fixed, .35 Amp	Solid State Switch SPST	30 Vac/dc	.4 Amps Max	Wht/Yel 16″ 18 AWG Wire Leads		
RIBXGFL*	.75-150 Amp	Split Core	Fixed, .75 Amp	Solid State Switch SPST	30 Vac/dc	.4 Amps Max	Wht/Yel 16″ 18 AWG Wire Leads	Over Trip Point	
RIBXGTF	.35-150 Amp	Split Core	Fixed, .35 Amp	Solid State Switch SPST	30 Vac/dc	.4 Amps Max	Terminal Strip, Accepts #14-22 AWG Wire		
RIBXGTFL*	.75-150 Amp	Split Core	Fixed, .75 Amp	Solid State Switch SPST	30 Vac/dc	.4 Amps Max	Terminal Strip, Accepts #14-22 AWG Wire	Over Trip Point	
RIBXGA	.75-150 Amp	Split Core	Adjustable	Solid State Switch SPST	30 Vac/dc	.4 Amps Max	Wht/Yel 16″ 18 AWG Wire Leads	Over Trip Point	Under Trip Point
RIBXGTA	.75-150 Amp	Split Core	Adjustable	Solid State Switch SPST	30 Vac/dc	.4 Amps Max	Terminal Strip, Accepts #14-22 AWG Wire	Over Trip Point	Under Trip Point
RIBXGA-SCAL	3-150 Amp	Split Core	Self-Cal.	Solid State Switch SPST	30 Vac/dc	.4 Amps Max	Wht/Yel 16″ 18 AWG Wire Leads	See -SCAL Table	
RIBXGTA-SCAL	3-150 Amp	Split Core	Self-Cal.	Solid State Switch SPST	30 Vac/dc	.4 Amps Max	Terminal Strip, Accepts #14-22 AWG Wire	See -SCAL Table	
RIBXGTA-ECM	.25-150 Amp	Split Core	Adjustable	Solid State Switch SPST	30 Vac/dc	.4 Amps Max	Terminal Strip, Accepts #14-22 AWG Wire	Over Trip Point	Load Current Detcted

* = Not approved by California State Fire Marshal

20191018

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Sharpsville, IN 46068

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Office: (765) 883-5538
Fax: (765) 883-7505

Email: sales@functionaldevices.com
Website: www.functionaldevices.com

TERMS AND CONDITIONS OF SALE

1. OFFER, GOVERNING PROVISIONS AND CANCELLATIONS: This document constitutes an offer or counter-offer by Functional Devices, Inc. or any of its affiliates ("**Seller**") to sell various products as agreed by Seller ("**Products**") to the buyer named on the reverse side of this document or in other applicable print or electronic documentation ("**Buyer**") in accordance with these terms and conditions. This writing is not an acceptance of any offer made by Buyer. This offer or counter-offer is expressly conditioned upon Buyer's assent to these terms and conditions and no others. Buyer is deemed to have assented to these terms and conditions (including Seller's warranty) when the first of the following occurs: A. Buyer signs and delivers to Seller an acknowledgement copy of any of Seller's quotation, order acknowledgement or invoice forms; B. Buyer gives to Seller (orally or in writing) specifications of quantity and/or type, assortments thereof, delivery dates, shipping instructions, instructions to bill, or the like as to all or any part of the Products; C. Buyer receives delivery of any of the Products; or, D. Buyer has otherwise assented to the terms and conditions hereof.

Where an attachment to this Agreement or separate document referencing this Agreement consists of a quotation, the quotation remains open for acceptance for a period of thirty (30) days or such other period as specified in the quotation. Seller hereby rejects any additional or different terms or provisions contained in any purchase order, acknowledgment or other communication heretofore or hereafter received from Buyer. Seller's delivery of Products does not constitute an assent to any terms proposed by Buyer. Except for an officer of Seller, no representative of Seller has any authority to waive, alter, vary, amend, or add to the terms hereof. **THESE TERMS AND CONDITIONS OF SALE CONSTITUTE THE ENTIRE AGREEMENT ("AGREEMENT") BETWEEN SELLER AND BUYER WITH RESPECT TO THE MATTERS ADDRESSED HEREIN.**

2. PRICES: The prices for the Products are based on the terms and conditions herein, including the limitations of liability and warranties, and all such terms and conditions are material to the sale of the Products. In the event Seller fails to provide a price quote and/or terms prior to the acceptance of the order, Buyer will pay Seller's then-current list price for such Products. All quotations and invoices show the net selling price of each item quoted. In the event of a mathematical error, the quoted price per Product governs.

3. TERMS OF PAYMENT: Buyer will pay the fees specified in each invoice provided by Seller in United States Dollars within thirty (30) calendar days after the invoice date unless otherwise agreed to in writing by an authorized representative of Seller. Any amount due under this Agreement that remains unpaid after its due date will bear interest from the date that such payment became delinquent until the date it is paid in full at the lower of 1.5% per month, which equals an annual percentage rate of 18%, or the maximum rate permitted by law. Seller reserves the right to establish, revoke or modify credit terms for Buyer at any time. No discounts are allowed unless otherwise agreed to in writing by an authorized representative of Seller. Buyer will pay any collection fees, legal fees, or court costs incurred by Seller to collect past due amounts. No offsets or setoffs of payments due to Seller hereunder are allowed with respect to any other agreement between the parties. Seller hereby retains a lien on the goods sold for unpaid purchase money as herein provided.

4. TAXES AND OTHER CHARGES: In addition to the prices quoted or invoiced, Buyer will pay any sales tax, excise tax, use tax, value added or consumption tax, customs duty (that is assessed on the delivery of Product(s) to a destination outside of the U.S.A.), fee or charge of any nature whatsoever imposed by any governmental authority on or measured by the transaction between Seller and Buyer. In the event Seller is required to pay any amount, Buyer will reimburse Seller therefore; or provide Seller, at the time the order is submitted, an exemption certificate or other document acceptable to the authority imposing the same. Seller does not accept and will not pay any fines, penalties or chargebacks from Buyer for any reason.

5. DELIVERY, RISK OF LOSS, CLAIMS AND FORCE MAJEURE:

A. All prices quoted for products are Ex-Works (Incoterms 2010) at a shipping facility determined by Seller, unless otherwise noted by Seller ("**Seller's Shipping Facility**"). Risk of loss or damage, and beneficial ownership, of the Products are transferred to Buyer when the Products are made available to Buyer at Seller's Shipping Facility. All delivery dates are approximate.

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C. Seller is not liable for any damage as a result of any delay or failure to deliver due to any act of God, act of Buyer, embargo or other governmental act, regulation or request, fire, accident, power outage, strike, civil unrest, weather, slowdown or other labor difficulties, war, riot, act of terrorism, delay in transportation, defaults of common carriers, inability to obtain necessary labor, materials or manufacturing facilities or, without limiting the foregoing, any other delays beyond Seller's control. Buyer's sole and exclusive remedy for any delays or for Seller's inability to deliver Products for any reason, in each case, that persists for more than ninety (90) days, is to cancel the order pursuant to Seller's Order Policies and Guidelines available upon request.

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For warranty service, call factory for RA number and send such Product prepared with sales receipt to: FUNCTIONAL DEVICES, INC., 101 COMMERCE DRIVE, SHARPSVILLE, IN 46068.

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10. EXPORTS. Buyer agrees that it will comply with any and all U.S. Export Controls and will not pay for, resell, transfer or knowingly sell Products in violation of U.S. Export Controls. If Buyer resells Products within or exports Products to a country or region which imposes upon Seller and/or Buyer an obligation to fund or undertake reuse, recycling, composting, recovery of Products, or any similar obligation (e.g., the European Union's Waste Electrical and Electronic Equipment Directive, EC 2002/96/EC) (the "**Obligations**"), Buyer shall wholly undertake the Obligations or duties and shall be entirely responsible for all associated costs therewith. Seller shall have no obligation to reimburse Buyer for execution of the Obligations. In the event that Seller is named in a proceeding based upon the Obligations, Buyer shall indemnify, defend and hold Seller harmless from all actions related thereto, including all civil and governmental actions.

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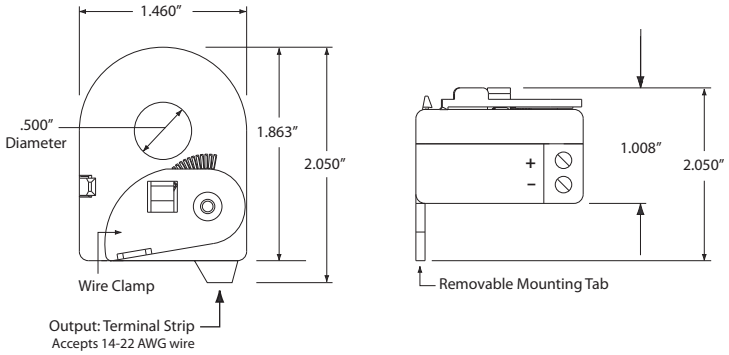
AC TRANSDUCERS

RIBXKTV Series

Enclosed Self-Powered Solid Core Current to DC Transducers



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MADE IN THE U.S.A.

SPECIFICATIONS

Operating Temperature: -30 to 140° F
Humidity Range: 5 to 95% (noncondensing)
Accuracy: 96.8% Full Scale
Loading: RIBXKTV5-10, 1% Error @ 180 kΩ
RIBXKTV5-20, 1% Error @ 90 kΩ
RIBXKTV5-50, 1% Error @ 40 kΩ
RIBXKTV5-100, 1% Error @ 15 kΩ
Max Sense Voltage: 600 Vac
Approvals: UL Listed, UL916, UL864, California State Fire Marshal, C-UL, CE, RoHS
Mounting/Installation: Removable mounting tab provided. The wire clamp locks against the wire being monitored, securing the unit in place.
Sensor Type: Solid core with voltage output

RIBXKTV SERIES SELECTION GUIDE

Model#	Sensing Range	Sensor Output
RIBXKTV5-10	0-10 Amp	0-5 Vdc (Terminal Strip, Accepts #14-22 AWG Wire)
RIBXKTV5-20	0-20 Amp	0-5 Vdc (Terminal Strip, Accepts #14-22 AWG Wire)
RIBXKTV5-50	0-50 Amp	0-5 Vdc (Terminal Strip, Accepts #14-22 AWG Wire)
RIBXKTV5-100	0-100 Amp	0-5 Vdc (Terminal Strip, Accepts #14-22 AWG Wire)

20191018

TRANSFORMER

TR40VA001

Transformer 40 VA, 120 to 24 Vac, Foot and Single Threaded Hub Mount

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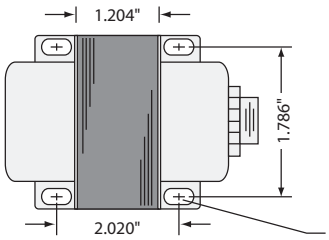
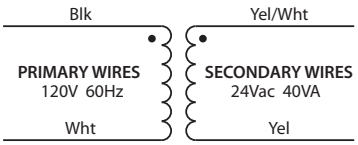
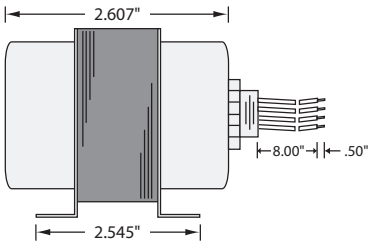
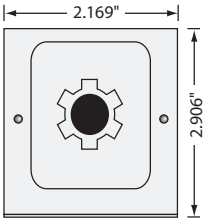


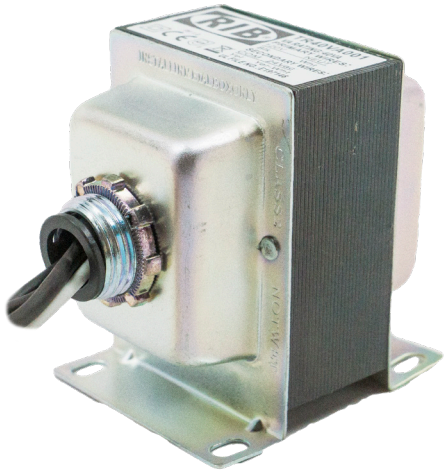


Secondary Yel/Wht wire in phase with Primary Blk wire.

Mounting Hole = .320" x .175"







SPECIFICATIONS

VA Rating: 40
Frequency: 50/60 Hz
Mounting: Foot & Single Threaded Hub
Over Current Protection: Inherently Limited
Dimensions: 2.607˝ x 2.169˝ x 2.906˝ (w/ .500˝ NPT Hub)
Wire Length: 8˝ Typical w/ .5˝ Strip
Operating Temperature: -30 to 140° F
MTBF: 100,000 Hours @ 77° F
Construction:: Split-Bobbin
Approvals: Class 2 UL5085-3 Listed, C-UL, CE, RoHS

20191017

Functional Devices, Inc.
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Sharpsville, IN 46068

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Website: www.functionaldevices.com

TERMS AND CONDITIONS OF SALE

1. OFFER, GOVERNING PROVISIONS AND CANCELLATIONS: This document constitutes an offer or counter-offer by Functional Devices, Inc. or any of its affiliates ("**Seller**") to sell various products as agreed by Seller ("**Products**") to the buyer named on the reverse side of this document or in other applicable print or electronic documentation ("**Buyer**") in accordance with these terms and conditions. This writing is not an acceptance of any offer made by Buyer. This offer or counter-offer is expressly conditioned upon Buyer's assent to these terms and conditions and no others. Buyer is deemed to have assented to these terms and conditions (including Seller's warranty) when the first of the following occurs: A. Buyer signs and delivers to Seller an acknowledgement copy of any of Seller's quotation, order acknowledgement or invoice forms; B. Buyer gives to Seller (orally or in writing) specifications of quantity and/or type, assortments thereof, delivery dates, shipping instructions, instructions to bill, or the like as to all or any part of the Products; C. Buyer receives delivery of any of the Products; or, D. Buyer has otherwise assented to the terms and conditions hereof.

Where an attachment to this Agreement or separate document referencing this Agreement consists of a quotation, the quotation remains open for acceptance for a period of thirty (30) days or such other period as specified in the quotation. Seller hereby rejects any additional or different terms or provisions contained in any purchase order, acknowledgment or other communication heretofore or hereafter received from Buyer. Seller's delivery of Products does not constitute an assent to any terms proposed by Buyer. Except for an officer of Seller, no representative of Seller has any authority to waive, alter, vary, amend, or add to the terms hereof. **THESE TERMS AND CONDITIONS OF SALE CONSTITUTE THE ENTIRE AGREEMENT ("AGREEMENT") BETWEEN SELLER AND BUYER WITH RESPECT TO THE MATTERS ADDRESSED HEREIN.**

2. PRICES: The prices for the Products are based on the terms and conditions herein, including the limitations of liability and warranties, and all such terms and conditions are material to the sale of the Products. In the event Seller fails to provide a price quote and/or terms prior to the acceptance of the order, Buyer will pay Seller's then-current list price for such Products. All quotations and invoices show the net selling price of each item quoted. In the event of a mathematical error, the quoted price per Product governs.

3. TERMS OF PAYMENT: Buyer will pay the fees specified in each invoice provided by Seller in United States Dollars within thirty (30) calendar days after the invoice date unless otherwise agreed to in writing by an authorized representative of Seller. Any amount due under this Agreement that remains unpaid after its due date will bear interest from the date that such payment became delinquent until the date it is paid in full at the lower of 1.5% per month, which equals an annual percentage rate of 18%, or the maximum rate permitted by law. Seller reserves the right to establish, revoke or modify credit terms for Buyer at any time. No discounts are allowed unless otherwise agreed to in writing by an authorized representative of Seller. Buyer will pay any collection fees, legal fees, or court costs incurred by Seller to collect past due amounts. No offsets or setoffs of payments due to Seller hereunder are allowed with respect to any other agreement between the parties. Seller hereby retains a lien on the goods sold for unpaid purchase money as herein provided.

4. TAXES AND OTHER CHARGES: In addition to the prices quoted or invoiced, Buyer will pay any sales tax, excise tax, use tax, value added or consumption tax, customs duty (that is assessed on the delivery of Product(s) to a destination outside of the U.S.A.), fee or charge of any nature whatsoever imposed by any governmental authority on or measured by the transaction between Seller and Buyer. In the event Seller is required to pay any amount, Buyer will reimburse Seller therefore; or provide Seller, at the time the order is submitted, an exemption certificate or other document acceptable to the authority imposing the same. Seller does not accept and will not pay any fines, penalties or chargebacks from Buyer for any reason.

5. DELIVERY, RISK OF LOSS, CLAIMS AND FORCE MAJEURE:

A. All prices quoted for products are Ex-Works (Incoterms 2010) at a shipping facility determined by Seller, unless otherwise noted by Seller ("**Seller's Shipping Facility**"). Risk of loss or damage, and beneficial ownership, of the Products are transferred to Buyer when the Products are made available to Buyer at Seller's Shipping Facility. All delivery dates are approximate.

B. Buyer will only make written claims to Seller for damages, shortages or other delivery errors within seven (7) calendar days after receipt of shipment. All Products received by Buyer, or Buyer's clients, customers, or agents, that are not rejected within such time will be deemed accepted. Failure to provide such written notice constitutes a waiver of all such claims regarding such shipment by Buyer. Buyer will not revoke acceptance.

C. Seller is not liable for any damage as a result of any delay or failure to deliver due to any act of God, act of Buyer, embargo or other governmental act, regulation or request, fire, accident, power outage, strike, civil unrest, weather, slowdown or other labor difficulties, war, riot, act of terrorism, delay in transportation, defaults of common carriers, inability to obtain necessary labor, materials or manufacturing facilities or, without limiting the foregoing, any other delays beyond Seller's control. Buyer's sole and exclusive remedy for any delays or for Seller's inability to deliver Products for any reason, in each case, that persists for more than ninety (90) days, is to cancel the order pursuant to Seller's Order Policies and Guidelines available upon request.

6. WARRANTY; DISCLAIMER. Products are warranted to be free from manufacturing defects under normal use and conditions for five (5) years (the "**Warranty Period**").

The warranty does not apply to: (a) Damage caused by accident, abuse, mishandling, or dropping; (b) Products which have been subjected to unauthorized repair, opened, or taken apart; (c) Products not used in accordance with directions; (d) Damages exceeding the cost of such Product; and (e) Damages caused by lightning, water, or condensation. If warranty service is required during the Warranty Period, and if examination shall disclose to Seller's satisfaction that such Product was originally defective, then Seller will at its option repair or replace the product without charge upon prepaid delivery of such Product to Seller's facility with proof of date of purchase. Corrections of such defects by repair to or supplying of replacements for defective parts shall constitute fulfillment of all obligations of Seller.

Seller shall not be liable for loss, damage, or expense directly or indirectly caused from the failure of Products to perform as expected.

EXCEPT AS SET FORTH HEREIN, SELLER DISCLAIMS ALL REPRESENTATIONS OR WARRANTIES OF ANY KIND WHATSOEVER, WHETHER EXPRESS, IMPLIED OR STATUTORY, INCLUDING, WITHOUT LIMITATION, ANY IMPLIED WARRANTIES OF MERCHANTABILITY, NON-INFRINGEMENT, FITNESS FOR A PARTICULAR PURPOSE OR ANY WARRANTY ARISING FROM A COURSE OF DEALING OR USAGE OF TRADE. NO PERSON (INCLUDING ANY AGENT, DEALER OR REPRESENTATIVE OF SELLER) IS AUTHORIZED TO MAKE ANY REPRESENTATION OR WARRANTY CONCERNING PRODUCTS EXCEPT TO REFER BUYER TO THIS AGREEMENT. BUYER WARRANTS THAT BUYER HAS NOT RELIED ON ANY OTHER WARRANTIES OR REPRESENTATIONS CONCERNING THE PRODUCTS OR THIS AGREEMENT.
For warranty service, call factory for RA number and send such Product prepared with sales receipt to: FUNCTIONAL DEVICES, INC., 101 COMMERCE DRIVE, SHARPSVILLE, IN 46068.

7. LIMITATION OF LIABILITY: SELLER WILL NOT BE LIABLE FOR ANY LOSS OF PROFIT, INTERRUPTION OF BUSINESS OR ANY OTHER SPECIAL, CONSEQUENTIAL OR INCIDENTAL DAMAGES SUFFERED OR SUSTAINED BY BUYER FOR ANY REASON. EXCEPT FOR CLAIMS OF DEATH OR PERSONAL INJURY, IN NO EVENT WILL SELLER'S AGGREGATE LIABILITY TO BUYER ARISING UNDER OR IN ANY WAY RELATED TO THIS AGREEMENT FOR ANY REASON (INCLUDING, BUT NOT LIMITED TO, LIABILITY ARISING FROM NEGLIGENCE OR ON THE BASIS OF STRICT LIABILITY, OR OTHERWISE) EXCEED THE TOTAL AMOUNT PAID BY BUYER TO SELLER HEREUNDER FOR ANY PRODUCT GIVING RISE TO A CLAIM UNDER THIS AGREEMENT.

8. RETURNS: Unless otherwise approved by Seller in writing in its sole discretion, except in the case of a non-conforming shipment or a warranty issue, Buyer may not return Products. If Seller approves the return of Products pursuant to the preceding sentence, such returned Products must be returned within ninety (90) days from date of invoice and will be subject to a 25% restocking fee. In the event of a non-conforming shipment or a warranty issue, Buyer may return Products, but only if Buyer first: (a) provides notice to Seller as required in this Agreement, (b) obtains prior authorization from Seller, and (c) all Products or containers for which return is properly authorized have been marked with a return authorization number supplied by Seller. Buyer will make all returns via a traceable form such as Federal Express, UPS or insured mail and in resalable condition. Buyer will pay all return shipping charges and any other charges associated therewith.

9. CANCELLATIONS: Cancellation or deferment of all or part of an order is subject to acceptance by the Seller. If accepted, any reduction in quantity of any item to less than 85% of the original item quantity is subject to a 15% cancellation charge. If an order cancellation is accepted, the Buyer will make delivery and pay for all material manufactured and in stock or in process at time of notice for such order, and for any special materials on orders for which the Seller must take delivery.

10. EXPORTS. Buyer agrees that it will comply with any and all U.S. Export Controls and will not pay for, resell, transfer or knowingly sell Products in violation of U.S. Export Controls. If Buyer resells Products within or exports Products to a country or region which imposes upon Seller and/or Buyer an obligation to fund or undertake reuse, recycling, composting, recovery of Products, or any similar obligation (e.g., the European Union's Waste Electrical and Electronic Equipment Directive, EC 2002/96/EC) (the "**Obligations**"), Buyer shall wholly undertake the Obligations or duties and shall be entirely responsible for all associated costs therewith. Seller shall have no obligation to reimburse Buyer for execution of the Obligations. In the event that Seller is named in a proceeding based upon the Obligations, Buyer shall indemnify, defend and hold Seller harmless from all actions related thereto, including all civil and governmental actions.

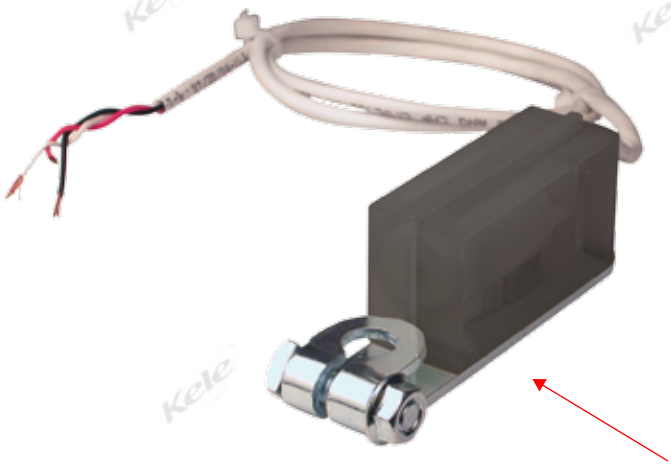
11. MISCELLANEOUS. This Agreement is governed by the laws of the State of Indiana, without giving effect to its conflict of laws principles. Buyer hereby irrevocably consents and submits to the exclusive jurisdiction and venue of the state and federal courts in Marion County, Indiana. The United Nations Convention for Contracts for the International Sale of Goods is explicitly excluded. Each provision contained in this Agreement constitutes a separate and distinct provision severable from all other provisions. If any provision (or any part thereof) is unenforceable under or prohibited by any present or future law, then such provision (or part thereof) will be amended, and is hereby amended, so as to be in compliance with such law, while preserving to the maximum extent possible the intent of the original provision. Any provision (or part thereof) that cannot be so amended will be severed from this Agreement; and, all the remaining provisions of this Agreement will remain unimpaired. No modification, addition or deletion, or waiver of any rights under this Agreement is binding on a party unless made in a non-preprinted agreement clearly understood by the parties to be a modification or waiver, and signed by a duly authorized representative of each party.

NON-MERCURY DAMPER POSITION SWITCH

TS-475 SERIES

DESCRIPTION

The **TS-475 Series** damper position switches use a roller ball and mechanical switch to provide open/closed damper position status. The **TS-475 Series** offers a non-mercury alternative for applications and for projects which do not allow mercury.



TS-475

SPECIFICATIONS

Wiring	3' (0.9 m) length, AWG 18, 3-conductor plenum-rated cable; black = common, white = N.C., red = N.O.
Switch Type	Mechanical roller ball, SPDT
Contact Rating	5A @ 120/250 VAC
Switch Angle	N.O. makes at 10° above horizontal, breaks at 5° below horizontal
Operating Temperature	-30° to 130°F (-34° to 54°C)
Dimensions	
TS-	1.5"H x 1.5"W x 4.4"L (3.8 x 3.8 x 11.1 cm)
TS1-	1.8"H x 1.5"W x 5.5"L (4.5 x 3.8 x 14.0 cm)
Weight	
TS-	0.4 lb (0.2 Kg)
TS1-	0.7 lb (0.3 Kg)
Mounting	
TS-	1/2" (1.3 cm) damper shaft
TS1-	1" (2.5 cm) damper shaft
Enclosure Rating	UL 94V-0 flammability rating
Warranty	1 year

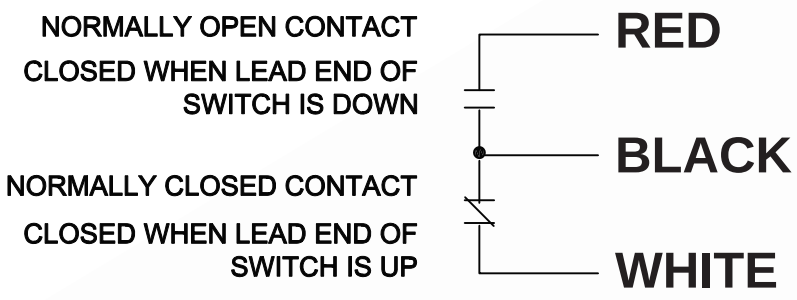
ORDERING INFORMATION

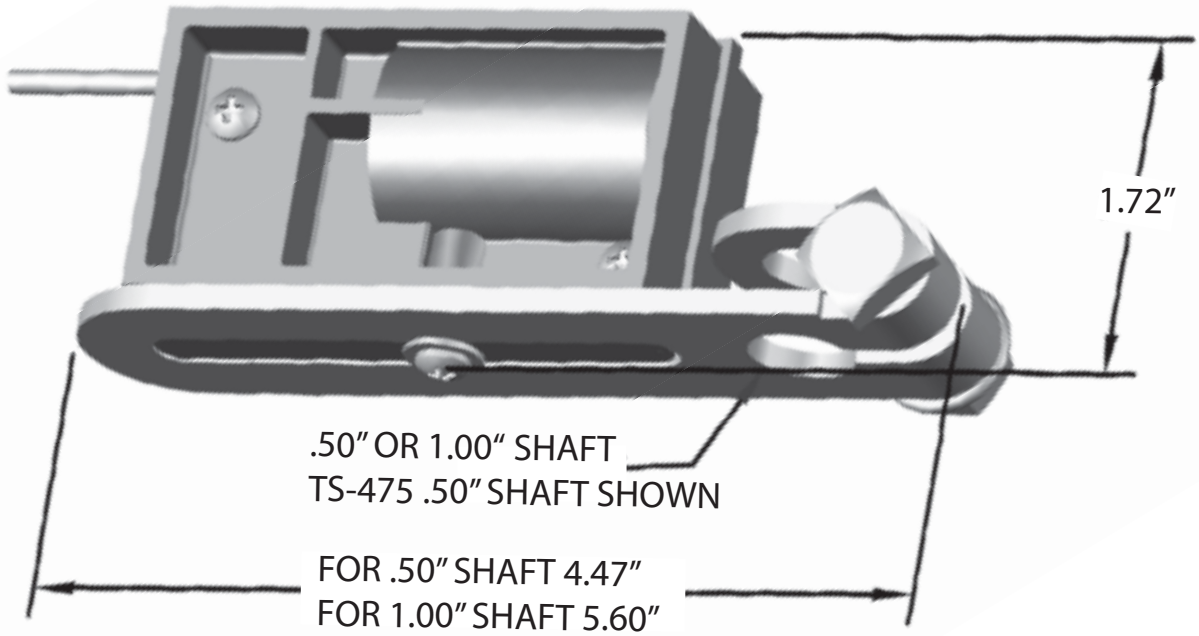
MODEL	DESCRIPTION
TS-475	Non-mercury damper position switch, SPDT, for 1/2" damper shaft
TS1-475	Non-mercury damper position switch, SPDT, for 1" damper shaft

MERCURY DISPLACEMENT INDUSTRIES, INC.
Post Office Box 710 - U.S. 12 East - Edwardsburg, Michigan 49112-0710
Phone (269) 663-8574 - Fax (269) 663-2924
(800) 634-4077

MECHANICAL DAMPER ARM SWITCH

TS-475 & TS1-475





WIRE: 18/3 CMP/CL39 PLENUM WIRE

HOUSING MAT'L: GLASS FILLED PBT

BRACKET MAT'L: PLATED STEEL

OPERATION: STEEL BALL ACTUATED SUBMINITURE SNAP ACTION SWITCH

RATINGS: 5 AMPS @ 120/240 VAC
5 AMPS @ 30 VDC

OPERATING ANGLE 15°: CONTACTS CLOSE @ 10° ABOVE HORIZONTAL
CONTACTS OPEN @ 5° BELOW HORIZONTAL

Low Pressure Sensor

Model PR-274/275

RoHS

- 100% solid-state, micro-machined glass-on-silicon, ultra-stable capacitance sensor
- As low as ±0.05"wc (±12.5 pa)
- Can resolve less than 0.00001"wc (0.00025 pa)
- Up to 10 PSID overpressure without zero shift
- Up to 6 field selectable ranges in one unit
- Wide 12-40 VDC/12-35 VAC unregulated supply voltage
- Two temperature compensated output versions, 4-20 mA 2-wire or field selectable 0-5 VDC/0-10 VDC
- Non-interacting zero and span trimmers
- NIST traceable calibration
- Two rugged steel enclosure types NEMA 4 (IP-65) or panel mount for ease of installation
- Conforms to EMC and RoHS standards

The PR-274/275 incorporates a new micro-machined glass-on-silicon (Gl-Si) capacitance sensor. This technology revolutionizes very low pressure measurement. Temperature related zero drift, calibration shift due to overpressure, non-repeatability, non-linearity, and extremely low pressure sensitivity have been some of the problems which have plagued the controls industry. The PR-274/275 with the new Gl-Si technology not only addresses all of the above shortcomings, but for the first time offers a reliable, accurate means to measure and control building/room pressure, air flow, duct pressure, filter pressure drop, or any other extremely low pressure application. Up to six field selectable direct or compound ranges, two enclosure types, field selectable outputs, fully temperature compensated NIST traceable accuracy, non-interacting zero and span adjustments, short circuit and reverse polarity protected output, and a liberal five year warranty are some of the features which make the PR-274/275 the industry's highest performance, ultra-stable, low pressure sensor.

MAMAC SYSTEMS®

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1 Fullerton Road #02-01
One Fullerton
Singapore • 049213
65-31581826 • Fax 65-31581826

4 Armiger Court, Unit 2
Adelaide • S.A.
5088 • Australia
08-8395-4333 • Fax 08-8395-4433

675 Cochrane Drive
East Tower • 6th Floor
Toronto • Ontario
L3R 0B8 • Canada
905-474-9215 • Fax 905-474-0876

The PR-274/275 incorporates sophisticated integrated circuits to not only provide a high level, fully-conditioned and temperature compensated output, but also to offer field selectable flexibility which was unheard of in the industry. The PR-274/275 offers up to six field selectable pressure ranges in one unit. In this way, a customer does not need to know the exact pressure range prior to selection. By merely knowing the application, a unit may be selected and then later field-configured for the desired pressure range. With fixed range units, in case of engineering error or incorrect selection, the only solution is expensive field recalibration or time consuming product exchange or replacement. Similarly, numerous units have to be kept in stock as spares to cover all ranges in case of field failure. The PR-274/275 with the field selectable pressure range feature, eliminates above mentioned costly inefficiencies. A single unit can be configured to cover all the pressure ranges in a particular application thereby eliminating any possibility of incorrect range selection. Additionally, one unit can be kept in stock and, in the event of failure, it can be field-configured thereby eliminating the need to stock numerous fixed range units. (For a complete listing of all ranges available, please see the ordering information section on page three.)

On VDC output units, two additional field-selectable options are available: dual outputs 0-5 or 0-10 VDC, and dual unregulated supply voltages 12-35 VAC or 12-40 VDC. By merely setting a dip switch, one can select the desired output for the specific application. As far as supply voltage is concerned, the unit automatically configures for AC or DC, and no field selection is necessary. Another feature is that the output is fully protected from short circuit to ground, or if the supply voltage is applied by mistake to the output. Past experience demonstrates that field-related wiring problems do occur. Instead of denying this fact, the protection circuit is designed in to ensure trouble-free start-up. The VDC output unit is also designed to handle low impedance circuits. In fact, the unit can drive up to 1k ohms minimum. In this way, multiple controllers, indicators, or other devices can be paralleled to the output without performance degradation.

The mA output units can function over a wide unregulated supply voltage range: 12-40 VDC without any effect on calibration or performance. The unit has built-in reverse polarity protection. As a result, it is next to impossible to damage the unit by miswiring. By using sophisticated low drop-out voltage regulators and CMOS integrated circuits, the mA output unit can drive very high output impedance.

In fact, with only 12 VDC supply, the unit can drive 200 ohms. At 40 VDC, the unit is capable of handling up to 1600 ohms load. In this way, the output loop can be tied in series to multiple controllers, indicators, and other devices without degrading the performance.

Due to the low mass of the micro-machined capacitance Gl-Si sensor, the mounting orientation error for ranges higher than 1.0"wc (250 pa) is negligible. For extremely low ranges, if the unit is installed as indicated on the label, there should be no orientation error. However, due to space limitation, if the unit cannot be installed in the indicated position, the error can be easily removed by merely adjusting the zero trimmer. Since the zero and span trimmers are non-interactive, adjustment to the zero should under no circumstance affect the calibration integrity of the unit including linearity and repeatability specifications across the range.

The PR-274/275 is available with two packaging options: a NEMA 4 (IP-65) fully gasketed, dust proof and splash proof enclosure, or a lightweight but rugged panel mount chassis for ease of installation with minimum space requirement in a control panel. The NEMA 4 (IP-65) enclosure has an external mounting bracket to facilitate field installation. A ½" (.875"/22.25mm dia.) knock-out for conduit connection is also provided. A liquid tight cable connector is also supplied if the unit is not being hard wired. Once installed, the enclosure maintains its environmental rating and protects the electronics and the sensing element from condensation, corrosive contaminants and other environmental pollutants. Both packaging options also have additional features for ease of installation, including upluggable terminal blocks, rugged brass hose barbs, easily accessible zero and span trimmers, and conveniently located dip switches for field selection.

SPECIFICATIONS:

Accuracy*: ±1% FS
Overpressure: 10 PSID
Supply Voltage: 12-40 VDC
12-35 VAC (VDC output units only)
Supply Current: VDC Units – 10 mA max.
mA Units – 20 mA max.
Compensated Temp Range: 25°F - 150°F
(-4° C - 65°C)
T.C. Error: ±0.0125%/°F (.02%/°C)
Load Impedance: 1.6K ohms max. at 40 VDC
(mA output units)
1K ohms min.
(VDC output units)
Enclosure: 18 Ga. C. R. Steel NEMA 4 (IP-65)
or Panel Mount Chassis
Finish: Baked-on enamel – PMS2GR88B
**Includes non-linearity, hysteresis, and non-repeatability*

Operating Temp Range: 0°F – 175°F
(-18°C – 80°C)
Media Compatibility: Clean dry air or any inert gas
Environmental: 10–90%RH Non-Condensing
Termination: Unpluggable screw terminal block
Wire Size: 12 Ga. max
Weight: Enclosure - 1.0 lbs. (.45 kg)
Panel Mount - 0.5 lbs. (.25 kg)

CONFORMANCE & TESTING:

RoHS Compliant
EMC Testing:
BS EN 55022:1998, BS EN 55024:1998,
EN 61000-3-3, EN 61000-4-2,
EN 61000-4-3, EN 61000-4-4,
EN 61000-4-5, EN 61000-4-6,
EN 61000-4-11

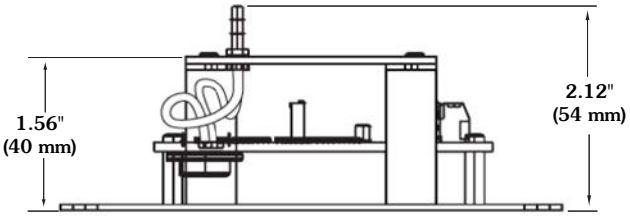
ORDERING INFORMATION: PR-

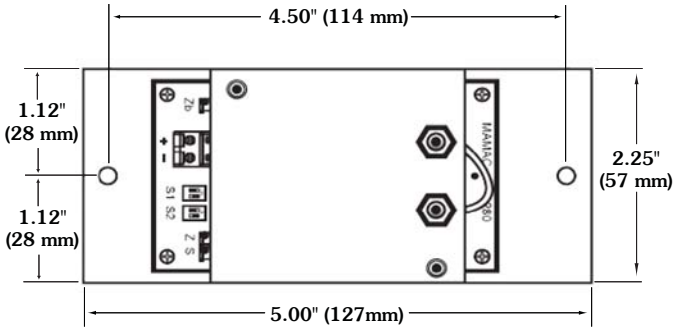
Packaging	Range		Output	
274 (enclosure)	**R1** ("wc)	0 to 0.10 / -0.05 to +0.05	**mA**	(4-20 mA 2-wire)
275 (panel mount)	**R2** ("wc)	0 to 1.0 / 0 to 0.5 / 0 to 0.25 / -0.5 to +0.5 / -0.25 to +0.25 / -0.125 to +0.125	**VDC**	(0-5 VDC or 0-10 VDC field selectable)
	R3 ("wc)	0 to 5.0 / 0 to 2.5 / 0 to 1.25 / -2.5 to +2.5 / -1.25 to +1.25 / -0.625 to +0.625		
	R4 ("wc)	0 to 30 / 0 to 15 / 0 to 7.5 / -15.0 to +15.0 / -7.5 to +7.5 / -3.75 to +3.75		
	R5* (pa)	0 to 25 / -12.5 to +12.5		
	R6* (pa)	0 to 250 / 0 to 125 / 0 to 62.5 / -125 to +125 / -62.5 to +62.5 / -31.25 to +31.25		
	R7* (pa)	0 to 1250 / 0 to 625 / 0 to 312.5 / -625 to +625 / -312.5 to +312.5 / -156.25 to +156.25		
	R8* (pa)	0 to 7500 / 0 to 3750 / 0 to 1875 / -3750 to +3750 / -1875 to +1875 / -937.5 to +937.5		

Example: PR-274-R2-mA: *Enclosure unit with R2 Range which has six (6) field selectable range options and 4-20 mA output.*

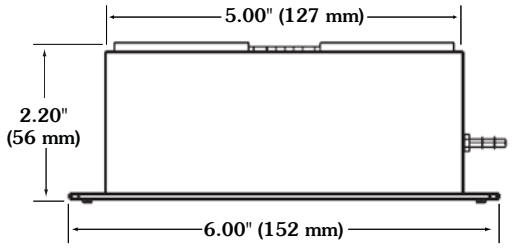
CAUTION: Do not use in explosive/hazardous environment or with flammable/combustible media.

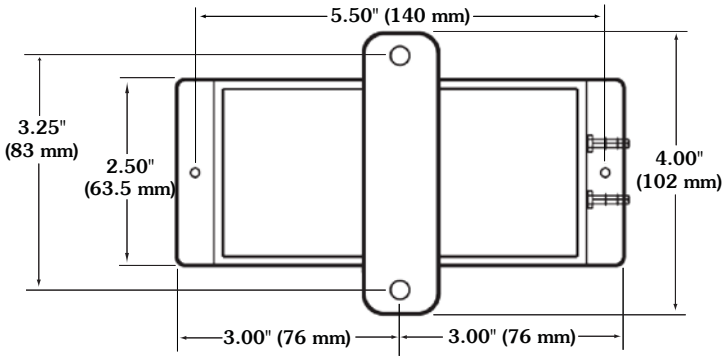
Panel Mount





Enclosure





PR-274/275

MAMAC Systems is the leading global manufacturer of sensors, transducers, control peripherals and web browser based IP appliances. MAMAC products are used for HVAC and environmental controls, remote monitoring, alarming, energy metering and industrial automation.

All MAMAC products are manufactured in the USA.

WARRANTY: MAMAC Systems, Inc. and its subsidiaries (hereinafter referred to as MAMAC Systems) warrants its products to be free of defects in material and workmanship for a period of five (5) years from date of shipment. If a unit is malfunctioning, it must be returned to the factory for evaluation. A return authorization number (RMA) will be issued by the customer service department and this number must be written or prominently displayed on the shipping boxes and all related documents. The defective part should be shipped freight pre-paid to the factory. Upon examination by MAMAC Systems, if the unit is found to be defective, it will be repaired or replaced at no charge to the customer. However, this warranty is void if the unit shows evidence of being tampered with, damaged during installation, misapplied, misused, or used in any other operating condition outside of the unit's published specifications.

MAMAC Systems makes no other warranties or representations of any kind whatsoever, expressed or implied, except that of title. All implied warranties including any warranty of merchantability and fitness for a particular purpose are hereby disclaimed. User is responsible to determine suitability for intended use.

LIMITATIONS OF LIABILITY: The remedies of buyer set forth herein are exclusive and the total liability of MAMAC Systems with respect to this order, whether based on contract, warranty, negligence, indemnification, strict liability or otherwise, shall not exceed the purchase price of the product upon which liability is based. **In no event shall MAMAC Systems be liable for consequential, incidental or special damages.** MAMAC Systems reserves the right to change any specifications without notice to improve performance, reliability, or function of our products.

Every precaution for accuracy has been taken in the preparation of this manual, however, MAMAC Systems neither assumes responsibility for any omissions or errors that may appear nor assumes liability for any damages that result from the use of the product in accordance with the information contained in the manual.

MAMAC SYSTEMS®

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5088 • Australia
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Toronto • Ontario
L3R 0B8 • Canada
905-474-9215 • Fax 905-474-0876

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CE
RoHS

Model PR-274/275
Technical Information
TI.274/275-06

LOW PRESSURE SENSOR

For Additional Information See PR-274/275 Data Sheet

SPECIFICATIONS

Accuracy*: ±1% FS

Overpressure: 10 PSID

Supply Voltage: 12-40 VDC
12-35 VAC (VDC output units only)

Supply Current: VDC Units - 10 mA max.
mA Units - 20 mA max.

Enclosure: 18 Ga C. R. Steel NEMA 4 (IP-65) or Panel Mount Chassis

Finish: Baked on enamel-PMS2GR88B

EMC Conformance: EN 55022, 55024, 61000-3-3, 61000-4-2, 3, 4, 5, 6 & 11

Compensated Temp Range: 25°F-150°F (-4°C-65°C)

T. C. Error: ±0.0125%/°F (.02%/°C)

Operating Temp Range: 0°F-175°F (-18°C-80°C)

Media Compatibility: Clean dry air or any inert gas

Environmental: 10-90%RH Non-Condensing

Termination: Unpluggable screw terminal block

Wire Size: 12 Ga max.

Load Impedance: 1.6K ohms max. at 40 VDC (mA output units)
1K ohms min. (VDC output units)

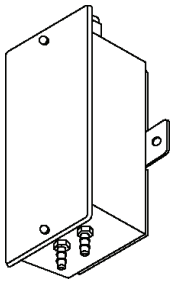
Weight: **Enclosure -** 1.0 lbs. (.45 kg)
Panel Mount - 0.5 lbs. (.25 kg)

ORDERING INFORMATION

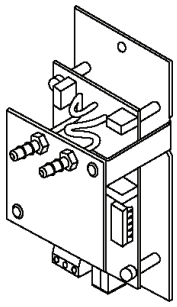
PACKAGING	RANGE		OUTPUT
274 (enclosure)	**R1** ("wc)	0 TO 0.10 / -0.05 TO +0.05	**mA** (4-20 mA 2-wire)
275 (panel mount)	**R2** ("wc)	0 TO 1.0 / 0 TO 0.5 / 0 TO 0.25 / -0.5 TO +0.5 / -0.25 TO +0.25 / -0.125 TO +0.125	**VDC** (0-5 VDC or 0-10 VDC field selectable)
	R3 ("wc)	0 TO 5.0 / 0 TO 2.5 / 0 TO 1.25 / -2.5 TO +2.5 / -1.25 TO +1.25 / -0.625 TO +0.625	
	R4 ("wc)	0 TO 30 / 0 TO 15 / 0 TO 7.5 / -15.0 TO +15.0 / -7.5 TO +7.5 / -3.75 TO + 3.75	
	R5 (pa)	0 TO 25 / -12.5 TO +12.5	
	R6 (pa)	0 TO 250 / 0 TO 125 / 0 TO 62.5 / -125 TO +125 / -62.5 TO +62.5 / -31.25 TO +31.25	
	R7 (pa)	0 TO 1250 / 0 TO 625 / 0 TO 312.5 / -625 TO +625 / -312.5 TO +312.5 / -156.25 TO +156.25	
	R8 (pa)	0 TO 7500 / 0 TO 3750 / 0 TO 1875 / -3750 TO +3750 / -1875 TO +1875 / -937.5 TO +937.5	

INSTALLATION

Inspection - Inspect the package for damage. If damaged, notify the appropriate carrier immediately. If undamaged, open the package and inspect the device for obvious damage. Return damaged products.



Enclosure Mount Transducer



Panel Mount Transducer

Requirements
- Tools (not provided)
  - Digital Volt-ohm Meter (DVM)
  - Appropriate screwdriver for mounting screws
  - Appropriate drill and drill bit for mounting screws
- Appropriate accessories
- Two #8 self-tapping mounting screws (*not provided*)
- Training: **Installer must be a qualified, experienced technician**

Warning:
- Disconnect power supply before installation to prevent electrical shock and equipment damage.
- Make all connections in accordance with the job wiring diagram and in accordance with national and local electrical codes. Use copper conductors only.

Caution:
- Use electrostatic discharge precautions (e.g., use of wrist straps) during installation and wiring to prevent equipment damage.
- Avoid locations where severe shock or vibration, excessive moisture or corrosive fumes are present. NEMA Type 4 housings are intended for outdoor use primarily to provide a degree of protection against wind-blown dust, rain, and hose-directed water.
- Do not exceed ratings of the device.

Caution:
- Condensate or moisture must not enter pressure sensor ports

Mounting

The PR-274/275 must be mounted as indicated by the arrows on the enclosure. Refer to **Figure 7** for mounting dimensions.

1. Remove the transducer cover using a Phillips head screwdriver.
2. Select the mounting location.
3. Mount transducer on a vertical surface with two #8 self-tapping screws (not provided).
4. Transducer must be mounted above the pressure pick-up or a J-Loop must be incorporated in the tubing to function as a condensate trap.
5. Pull wires through bottom of enclosure and make necessary connections.
6. Replace cover and make pneumatic connections.

Wiring

Use maximum 12 AWG wire for wiring terminals. Use flexible 1/4" O.D. 5/32" I.D. tubing for the high and low pressure connections. Refer to **Figures 1, 2, 3**, & **4** for wiring information and **Figures 5** & **6** for switch designations.

(Wiring Instructions continued on pages 2 and 3.)

CE

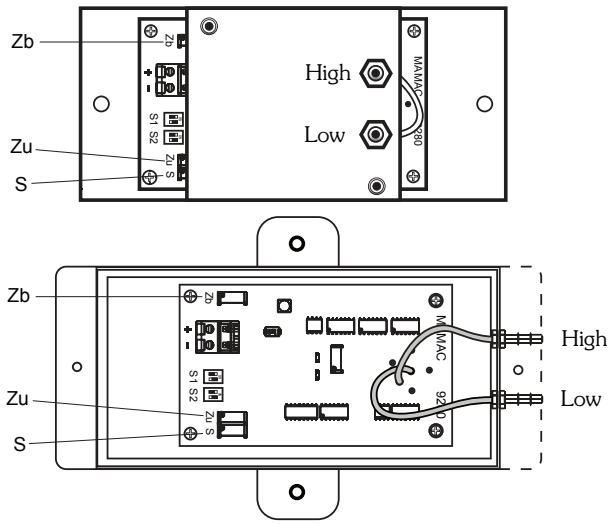
RoHS

Model PR-274/275
Technical Information
TI.274/275-06

LOW PRESSURE SENSOR

Wiring PR-274/275 Units with mA Output

PR-274/275 Low Pressure Transducer with mA Output



PR-274/275 pressure transducers with 4-20 mA output are powered with a 12-40 VDC supply.

The following describes the proper wiring of these pressure transducers with mA output:

1. Remove the terminal block by carefully pulling it off the circuit board.
2. Locate the [+] and [-] terminal markings on the board.
3. Attach the supply voltage to the [+] lead.
4. Connect the 4-20 mA output ([-] terminal) to the controller's input terminal.
5. Ensure that the power supply common is attached to the common bus of the controller.
6. Re-insert the terminal block to the circuit board and apply power to the unit.
7. Check for the appropriate output signal using a DVM set on DC milliamps connected in series with the [-] terminal.

TYPICAL APPLICATIONS (wiring diagrams)

Figure 1 and **Figure 2** illustrate typical wiring diagrams for the mA output low pressure transducer.

Figure 1 - *Wiring for mA Low Pressure Transducers with an External DC Power Supply*

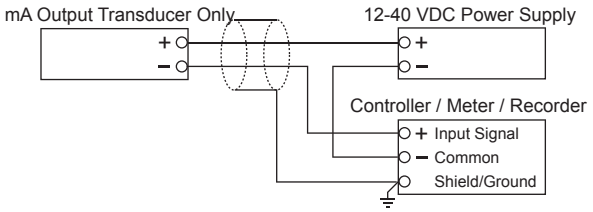
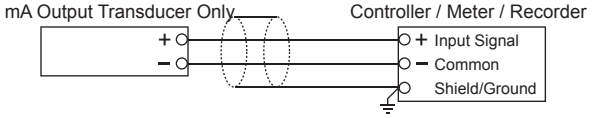
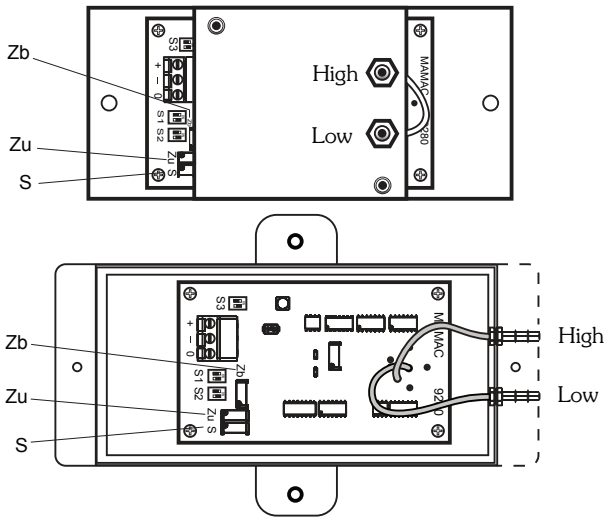


Figure 2 - *Wiring for mA Output Transducers where the Controller or Meter has an Internal DC Power Supply*



Wiring PR-274/275 Units with VDC Output

PR-274/275 Low Pressure Transducer with VDC Output



PR-274/275 pressure transducers with VDC output are field selectable 0-5 VDC or 0-10 VDC output and can be powered with either a 12-40 VDC or 12-35 VAC.

The following describes the proper wiring of these pressure transducers with VDC output:

1. Remove the terminal block by carefully pulling it off the circuit board.
2. Locate the [+], [-] and [O] terminal markings on the board.
3. Attach the power wires to the [+] and [-] terminals. The [-] terminal is also the negative terminal.
4. Connect the [O] terminal, which is the positive VDC output terminal, to the controller's input terminal.
5. Re-insert the terminal block to the circuit board and apply power to the unit.
6. Check the appropriate VDC output using a voltmeter set on DC volts across the [O] and [-] terminals.

TYPICAL APPLICATIONS (wiring diagrams)

Figure 3 and **Figure 4** illustrate typical wiring diagrams for the VDC output low pressure transducer.

Figure 3 *- Wiring for VDC Low Pressure Transducers When Applied with External AC Supply*

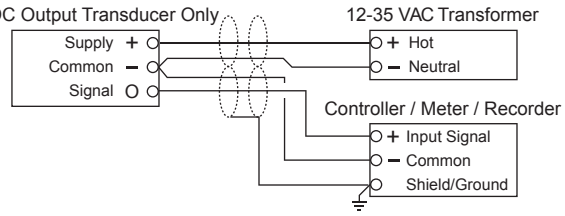
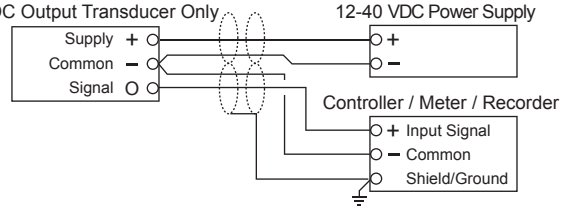


Figure 4 *- Wiring for VDC Low Pressure Transducers When Applied with External DC Power Supply*



Caution: If you are using grounded AC, the hot wire must be on the [+] terminal. Also, if you are using a controller without built-in isolation, use an isolation transformer to supply the PR-274/275.
Caution: This product contains a half-wave rectifier power supply and must not be powered off transformers used to power other devices utilizing non-isolated full-wave rectifier power supplies.
Caution: When multiple PR-274/275 units are powered from the same transformer, damage will result unless all 24G power leads are connected to the same power lead on all devices. It is mandatory that correct phasing be maintained when powering more than one device from a single transducer.

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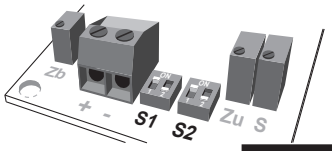
Model PR-274/275

Technical Information

TI.274/275-06

LOW PRESSURE SENSOR

Figure 5 *- Switch Selections for Low Pressure Transducers with mA Outputs*



mA Output

Range Configuration: Uni-Directional **Switch 1 (S1)**

		Factory Sealed
R1/R5	0 - 0.10 "wc / 25 pa	
R2/R6	0 - 1.0 "wc / 250 pa (default)	
	0 - 0.5 "wc / 125 pa	
	0 - 0.25 "wc / 62.5 pa	
R3/R7	0 - 5.0 "wc / 1250 pa (default)	
	0 - 2.5 "wc / 625 pa	
	0 - 1.25 "wc / 312.5 pa	
R4/R8	0 - 30.0 "wc / 7500 pa (default)	
	0 - 15.0 "wc / 3750 pa	
	0 - 7.5 "wc / 1875 pa	

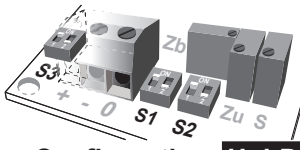
Range Configuration: Bi-Directional **Switch 1 (S1)**

		Factory Sealed
R1/R5	+/- 0.05 "wc / 12.5 pa	
R2/R6	+/- 0.5 "wc / 125 pa (default)	
	+/- 0.25 "wc / 62.5 pa	
	+/- 0.125 "wc / 31.25 pa	
R3/R7	+/- 2.5 "wc / 625 pa (default)	
	+/- 1.25 "wc / 312.5 pa	
	+/- .625 "wc / 156.25 pa	
R4/R8	+/- 15.0 "wc / 3750 pa (default)	
	+/- 7.5 "wc / 1875 pa	
	+/- 3.75 "wc / 937.5 pa	

Output Configuration: **Switch 2 (S2)**

Uni-directional (default)
Bi-directional

Figure 6 *- Switch Selections for Low Pressure Transducers with VDC Outputs*



VDC Output

Range Configuration: Uni-Directional **Switch 1 (S1)**

		Factory Sealed
R1/R5	0 - 0.10 "wc / 25 pa	
R2/R6	0 - 1.0 "wc / 250 pa (default)	
	0 - 0.5 "wc / 125 pa	
	0 - 0.25 "wc / 62.5 pa	
R3/R7	0 - 5.0 "wc / 1250 pa (default)	
	0 - 2.5 "wc / 625 pa	
	0 - 1.25 "wc / 312.5 pa	
R4/R8	0 - 30.0 "wc / 7500 pa (default)	
	0 - 15.0 "wc / 3750 pa	
	0 - 7.5 "wc / 1875 pa	

Output Configuration: **Switch 2 (S2)**

Uni-directional (default)
Bi-directional

Range Configuration: Bi-Directional **Switch 1 (S1)**

		Factory Sealed
R1/R5	+/- 0.05 "wc / 12.5 pa	
R2/R6	+/- 0.5 "wc / 125 pa (default)	
	+/- 0.25 "wc / 62.5 pa	
	+/- 0.125 "wc / 31.25 pa	
R3/R7	+/- 2.5 "wc / 625 pa (default)	
	+/- 1.25 "wc / 312.5 pa	
	+/- .625 "wc / 156.25 pa	
R4/R8	+/- 15.0 "wc / 3750 pa (default)	
	+/- 7.5 "wc / 1875 pa	
	+/- 3.75 "wc / 937.5 pa	

Output Configuration: **Switch 3 (S3)**

0 - 10 (default)
0 - 5 VDC

CE
RoHS

Model PR-274/275
Technical Information
TI.274/275-06

LOW PRESSURE SENSOR

CHECKOUT

1. Verify that the unit is mounted in the correct position.
2. Verify appropriate input signal and supply voltage.

⚠ ***Caution:*** Never connect 120 VAC to these transducers. Never connect AC voltage to a unit intended for DC supply.

3. Verify appropriate configuration range.

Transducer Operation

This is a rough functional check only.

1. Adjust the pressure to obtain maximum output signal for appropriate range.
2. Output should be 20 mA or 5 or 10 VDC.
3. Adjust the pressure to obtain minimum output signal.
4. Output should be 4 mA or 0 VDC.

NOTE: *The PR-274/275 is a highly accurate device. For applications requiring a high degree of accuracy, the use of laboratory quality meters and gauges are recommended.*

CALIBRATION All units are factory calibrated to meet or exceed published specifications. If field adjustment is necessary, follow the instructions below.

Calibration of PR-274/275 mA Units

1. Connect terminals [+] and [-] to the appropriate power source.
2. Connect the DVM in series on the [-] terminal.
3. Apply low pressure to the unit. If configured for uni-direction, adjust Zu trimmer to achieve desired low output. If configured for bi-direction, adjust Zb trimmer to achieve desired low output.
4. Apply high pressure to the unit and adjust span trimmer [S] to obtain the desired high output pressure.
5. Repeat steps 3 and 4 until desired calibration is achieved.

Calibration of PR-274/275 VDC Units

1. Connect terminals [+] and [-] to the appropriate power source. The [-] terminal is also the negative output terminal.
2. Connect the DVM on DC volts across [O] and [-] terminal.
3. Apply low pressure to the unit. If configured for uni-direction, adjust Zu trimmer to achieve desired low output. If configured for bi-direction, adjust Zb trimmer to achieve desired low output.
4. Apply high pressure to the unit and adjust span trimmer [S] to obtain the desired high output pressure.
5. Repeat steps 3 and 4 until desired calibration is achieved.

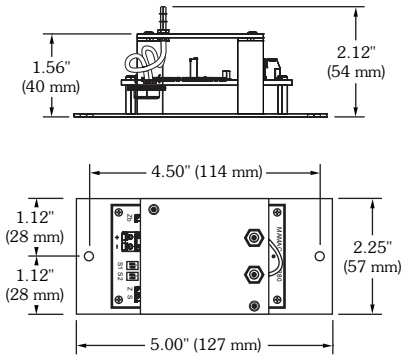
MAINTENANCE Regular maintenance of the total system is recommended to assure sustained optimum performance.

FIELD REPAIR None. Replace with a functional unit.

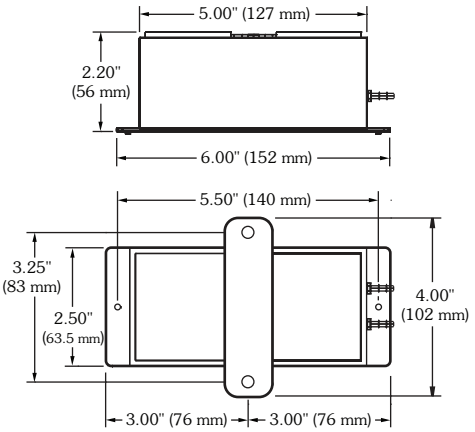
WARRANTY See Data Sheet for additional information.

Figure 7 *- PR-274/275 Low Pressure Transducer Dimensions shown in inches and millimeters (mm).*

Panel Mount



Enclosure



For Technical / Application Assistance call your nearest office

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1340 Satellite Blvd.
Suwanee, GA 30024
Tel.: (800) 433-4822

Section 7: Smoke Control

data sheet

niagara 4 supervisor

PRODUCT DEFINITION

The Niagara Supervisor is part of the portfolio of Java-based controller/server products, software applications and tools powered by the Niagara Framework®. It provides server-level functions for a network of JACE, Niagara Edge and other field devices. The Niagara Supervisor serves real-time graphical information to standard web-browser clients and performs essential functions such as analytics, centralized data logging/trending, archiving to external databases, alarming, dashboarding, system navigation, master scheduling, database management and integration with other enterprise software applications. Additionally, the Niagara Supervisor provides a comprehensive graphical engineering toolset for application development and configuration.

The Niagara Supervisor allows the networking of multiple Niagara-based JACE® and Niagara Edge™ controllers, along with other IP-based controllers and field devices. It enables the design, configuration and maintenance of a unified, real-time controls network.

key features

- Centralized system management
- Utilize tags to quickly navigate to buildings, systems and equipment when diagnosing operational problems or emergencies
- Compare data between buildings
- Export system data to external databases
- Integrate a Building Automation System (BAS) with other enterprise applications
- Integrate with other applications, such as work order management, analytics, etc.
- Single tool used to program JACE, Niagara Edge controllers and Supervisor
- Remotely back up JACE and Edge applications to Supervisor
- Batch provisioning of JACE and Edge firmware upgrades, security credentials, applications and commissioning options from Supervisor
- Robust built-in analytic capabilities supported by standard Niagara components and visualizations
- Includes Niagara Analytics, which features data source, functional and mathematical programming blocks that enable sophisticated analytic algorithms
- Compatibility with Niagara Enterprise Security access control and security application. Allows integration of BAS and access control to save energy and optimize operations
- Eligible for accreditation under the Federal Risk Management Framework (RMF)
- FIPS 140-2 Level 1 conformance available

powered by niagara framework®

SPECIFICATIONS

Features a HTML5 and Java-enabled user interface (UI), and includes a JavaScript data interface library (BajaScript)

Supports an unlimited number of users over the internet/intranet with a standard web browser (depending on the host PC resources)

Optional enterprise-level data archival using SQL, MySQL or Oracle databases, and HTTP/HTML/XML, CSV or text formats

"Audit Trail" of database changes, database storage and backup, global time functions, calendar, central scheduling, control and energy management routines

Sophisticated alarm processing and routing, including email alarm acknowledging

Access to alarms, logs, graphics, schedules and configuration data with a standard web browser

Niagara follows industry best practices for cyber security, with support for features such as strong, hashed passwords, TLS for secure communications and certificate management tools for authentication. A built-in Security Dashboard provides a comprehensive and actionable view of the security posture of your Niagara deployment

HTML-based help system that includes comprehensive online system documentation

Supports multiple Niagara-based stations connected to a local Ethernet network or the internet

Provides online/offline use of the Niagara Framework® Workbench graphical configuration tool and a comprehensive Java Object Library

Optional direct Ethernet-based driver support for most Open IP field bus protocols (see supported drivers document)

SOFTWARE & DRIVERS

Every Niagara Supervisor comes with a Niagara 4 software license, along with multiple open-protocol IP drivers that are compatible with standard control networks. If required, other drivers can be purchase separately. For an up-to-date list of supported drivers, visit the resource library on tridium.com.

SOFTWARE MAINTENANCE

Purchase of a software maintenance agreement (SMA) is required with initial Niagara Supervisor licensing. The initial SMA is for 18 months, with extended agreements of 3 years and 5 years available for discounted rates.

If a Software Maintenance Agreement is not in effect for any period, the price of maintenance for the next period for which it is purchased will be priced at a cost equal to the maintenance fee for the period(s) for which maintenance was not purchased, up to a maximum of 5 years, plus the maintenance fee for the next year.

For an up-to-date list of supported drivers, visit the resource library on tridium.com.

ORDERING INFORMATION

Part number	Description
SUP-0	No Niagara network – Devices only. 18mo SMA required
SUP-0-SMA-INIT	18mo initial SMA required (3YR or 5YR can be substituted)
SUP-1	1 Niagara network connection (18mo SMA req)
SUP-1-SMA-INIT	18mo initial SMA required (3YR or 5YR can be substituted)
SUP-2	2 Niagara network connections (18mo SMA req)
SUP-2-SMA-INIT	18mo initial SMA required (3YR or 5YR can be substituted)
SUP-3	3 Niagara network connections (18mo SMA req)
SUP-3-SMA-INIT	18mo initial SMA required (3YR or 5YR can be substituted)
SUP-10	10 Niagara network connections (18mo SMA req)
SUP-10-SMA-INIT	18mo initial SMA required (3YR or 5YR can be substituted)
SUP-100	100 Niagara network connections (18mo SMA req)
SUP-100-SMA-INIT	18mo initial SMA required (3YR or 5YR can be substituted)
SUP-UNL	Unlimited Niagara network connections (18mo SMA req)
SUP-UNL-SMA-INIT	18mo initial SMA required (3YR or 5YR can be substituted)
SUP-UP-1	Adds 1 additional Niagara connection to Supervisor
SUP-STATION-5UP	Adds 5 additional Niagara connections to Supervisor
SUP-UP-100	Upgrades small Supervisor to 100 Niagara connections
SUP-UP-UNL	Upgrades Supervisor 100 to unlimited Niagara connections
SUP-DEVICE-10	10 device upgrade (standard drivers included)
SUP-DEVICE-25	25 device upgrade (standard drivers included)
SUP-DEVICE-50	50 device upgrade (standard drivers included)
SUP-DEVICE-100	100 device upgrade (standard drivers included)
SUP-DEVICE-200	200 device upgrade (standard drivers included)
SUP-DEVICE-500	500 device upgrade (standard drivers included)
SUP-DEVICE-1000	1000 device upgrade (standard drivers included)
SP-S-FIPS	Provides FIPS 140-2 Level 1 conformance for 4.6 and later
SUP-AX	Enables Supervisor to run Niagara AX (v3.8)
SUP-[0-UNL]-SMA-[1,3,5]YR	Supervisor [0-UNL] Maintenance – [1,3,5] YR extensions

ML100G-53

Industrial Fanless Intel® 11th Gen Tiger Lake NUC

The ML100G-53 industrial Intel Tiger Lake NUC offers quad-display support, Intel Iris® Xe graphics and the protection of OnLogic Hardshell™ Technology.

onlogic.com/ml100g-53

Powerful Processing Built For AI

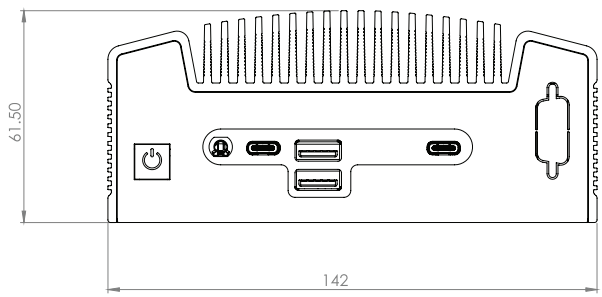
The ML100G-53 is powered by your choice of the Dual-Core Intel® Celeron® 6305E or Core™ i3-1115G4 processors, or the Quad-Core i5-1135G7 or i7-1165G7 processors (all formerly known as Tiger Lake). Built for high performance computing, AI applications and flexible multitasking, the M100G-53 also boasts impressive graphics capabilities thanks to Intel's new Iris® Xe Graphics engine (available on the i5 and i7), and up to 32GB of dual channel DDR4 memory. Meanwhile, onboard TPM helps to ensure your data is secure.

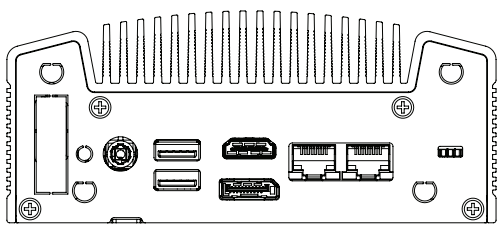
Engineered To Survive At The Edge

Solid-state industrial components and the removal of moving parts significantly extend the lifespan of the system while versatile mounting options allow the ML100G-51 to fit into space-constrained applications. Our Hardshell™ Fanless Technology is optimized for reliable passive cooling and protects the system from dust, debris, chemical and moisture ingress. Power input of 12-19 VDC, a wide operating temperature range, and a variety of installation options, mean you can install the ML100G-53 wherever you need it.

Quad-Display Capable

The ML100G-53 is designed to power your project with versatile connectivity and impressive networking capabilities. 4 x USB 3.2 Gen 2 (Type-A), 2 x USB 3.2 Gen 2 (Type-C), HDMI and DisplayPort support up to 4 simultaneous 4k displays. One Gigabit LAN port and one 2.5 Gigabit LAN port provide blazing fast data transfer to your network or the cloud, while onboard COM lets you connect legacy equipment.





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System

Processor	Intel 11 Gen (Tiger Lake-UP3)
Processor Speed	1.8 GHz 4.10 GHz 4.20 GHz 4.70 GHz
Processor Socket	Onboard (BGA)
Processor Generation	Tiger Lake
Processor Cores	4 8
Chipset	Intel MCP
Graphics/GPU	Intel UHD Graphics Intel Iris XE Graphics
Memory Type	DDR4
Memory Capacity	64 GB
Memory Speed	3200 MHz
Memory Slot Count	2
Number of Displays Supported	4

Rear I/O

USB	2 USB 3.2 Gen 2 (Type A) ports
Video	1 DisplayPort connectors 1 HDMI port
Other	1x1 Gb LAN ports 1x 2.5 Gb LAN ports 1 DC jack
Power Input	DC jack

Front I/O

USB	2 x USB 3.2 Gen2 (Type-A) 2 x USB 3.2 Gen2 (Type-C, Supports DP1.4 display output)
Port Punchouts	2 Antenna holes

Expansion & Features

Expansion Options	1x M.2 E Key 2230 slot 1 PCIe x4 slots
Storage Options	1 M.2 2280 M-key slot (PCIe Gen3 x4) for NVMe SSD 1 SATA M.2 M Key 2242/2260/2280 slot
LAN Controller	Intel I219LM with 10/100/1000 Mbps Intel I225LM with 10/100/1000/2500 Mbps
System Monitoring	Infinion SLB9670VQ2.0
Input Voltage	12 - 19 VDC
Power Input	DC jack

Mechanical

Dimensions (WxHxD)	142 x 62 x 107 mm 5.6” x 2.4” x 4.2”
Mounting Options	DIN-mount (included) VESA-mount Wall-mount
Case Type	Compact Fanless
Case Material	Aluminum Extrusion Steel

Environmental & Regulatory

Operating Temperature	0 - 50°C

Other

Warranty	2 Year Limited Warranty on parts and services

US Office
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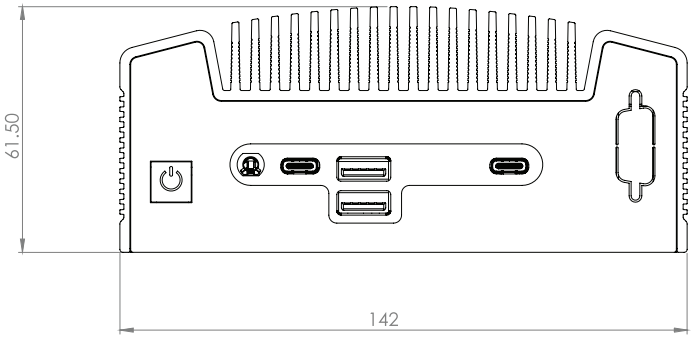
ML100G-53 Dimensional Drawings

Industrial Fanless Intel 11th Gen Tiger Lake NUC

All measurements in mm



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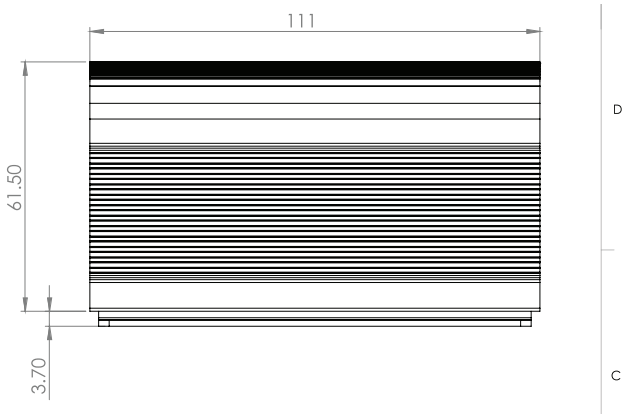

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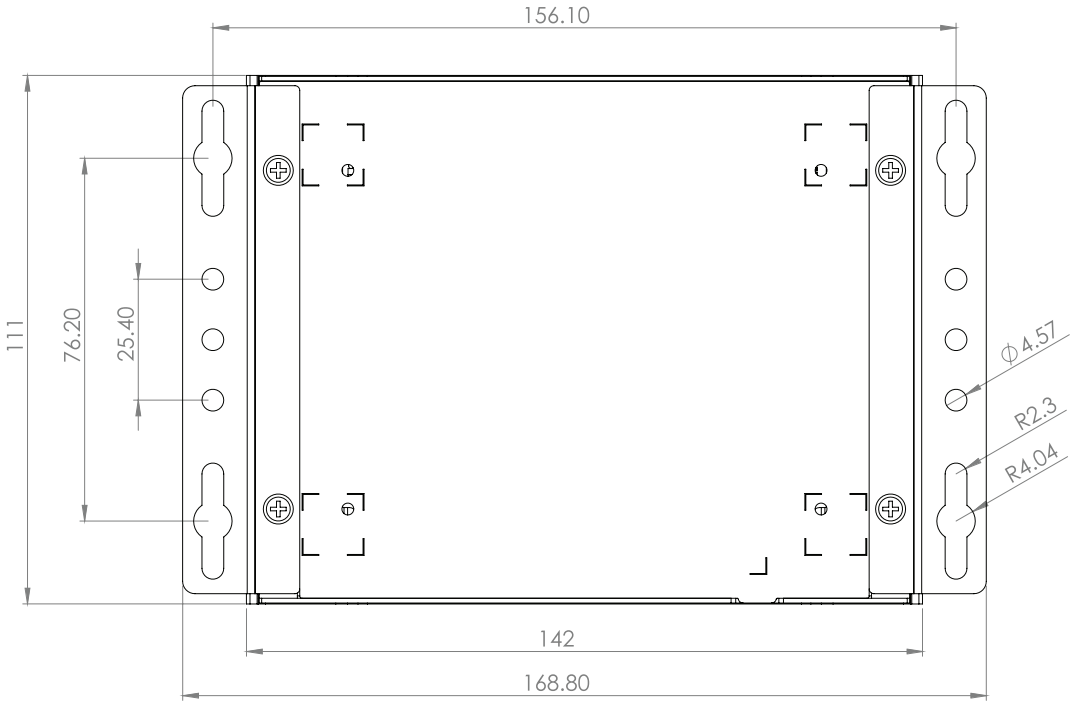

BOTTOM

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BELIMO

On/Off, Spring Return, AC/DC 24 V

Technical data sheet AFB24

5-year warranty

Technical data

Electrical data	Nominal voltage	AC/DC 24 V
	Nominal voltage frequency	50/60 Hz
	Power consumption in operation	5 W
	Power consumption in rest position	2.5 W
	Transformer sizing	7.5 VA (class 2 power source)
	Electrical Connection	18 GA appliance cable, 3 ft [1 m], with 1/2" conduit connector
	Overload Protection	electronic throughout 0...95° rotation
	Electrical Protection	actuators are double insulated
Functional data	Torque motor	180 in-lb [20 Nm]
	Direction of motion motor	selectable by ccw/cw mounting
	Direction of motion fail-safe	reversible with cw/ccw mounting
	Manual override	5 mm hex crank (3/16" Allen), supplied
	Angle of rotation	95°, adjustable with mechanical end stop, 35...95°
	Angle of rotation note	adjustable with mechanical end stop, 35...95°
	Running Time (Motor)	75 s
	Running time fail-safe	<20 s @ -4...122°F [-20...50°C], <60 s @ -22°F [-30°C]
	Running time fail-safe note	@ -4...122°F [-20...50°C], <60 s @ -22°F [-30°C]
	Noise level, motor	50 dB(A)
	Noise level, fail-safe	62 dB(A)
	Shaft Diameter	1/2...1.05" round, centers on 1/2" and 3/4" with insert, 1.05" without insert
	Position indication	Mechanical
Safety data	Degree of protection IEC/EN	IP54
	Degree of protection NEMA/UL	NEMA 2
	Enclosure	UL Enclosure Type 2
	Agency Listing	cULus listed to UL60730-1A:02; UL 60730-2-14:02 and CAN/CSA-E60730-1:02; Listed to UL 2043 - suitable for use in air plenums per Section 300.22(c) of the NEC and Section 602.2 of the IMC
	Quality Standard	ISO 9001
	Ambient temperature	-22...122°F [-30...50°C]
	Storage temperature	-40...176°F [-40...80°C]
	Ambient humidity	max. 95% r.H., non-condensing
	Servicing	maintenance-free
Weight	Weight	2.4 lb [2.4 kg]
Materials	Housing material	Galvanized steel and plastic housing

Product features

Application

For On/Off, fail-safe control of dampers in HVAC systems. Actuator sizing should be done in accordance with the damper manufacturer's specifications. Control is On/Off from an auxiliary contact or a manual switch. The actuator is mounted directly to a damper shaft up to 1.05" in diameter by means of its universal clamp. A crank arm and several mounting brackets are available for applications where the actuator cannot be direct coupled to the damper shaft. Maximum of two AF's can be piggybacked for torque loads of up to 266 in-lbs. Minimum 3/4" diameter shaft and parallel wiring.

Operation

The AF..24 series actuators provide true spring return operation for reliable failsafe application and positive close off on air tight dampers. The spring return system provides constant torque to the damper with, and without, power applied to the actuator. The AF..24 series provides 95° of rotation and is provided with a graduated position indicator showing 0° to 95°. The actuator may be stalled anywhere in its normal rotation without the need of mechanical end switches. The AF..24 actuator is shipped at 5° (5° from full fail-safe) to provide automatic compression against damper gaskets for tight shut-off.

Typical specification

On/Off spring return damper actuators shall be direct coupled type which require no crank arm and linkage and be capable of direct mounting to a jackshaft up to a 1.05” diameter. The actuators must be designed so that they may be used for either clockwise or counter clockwise fail-safe operation. Actuators shall be protected from overload at all angles of rotation. If required, two SPDT auxiliary switch shall be provided having the capability of one being adjustable. Actuators with auxiliary switches must be constructed to meet the requirements for Double Insulation so an electrical ground is not required to meet agency listings. Actuators shall be cULus listed and have a 5 year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo.

Accessories

Electrical accessories

Description	Type
Auxiliary switch, mercury-free	P475
Auxiliary switch, mercury-free	P475-1
Signal Siumlator, Power supply AC 230 V	PS-100
Cable Conduit Connector 1/2"	TF-CC US
Transformer, AC 120 V to AC 24 V, 40 VA	ZG-X40

Mechanical accessories

Description	Type
Anti-rotation bracket AF/NF.	AF-P
Shaft extension 240 mm Ø20 mm for damper shaft Ø 8...22.7 mm	AV8-25
End stop indicator	IND-AFB
Shaft clamp reversible, for central mounting, for damper shafts Ø12.7 / 19.0 / 25.4 mm	K7-2
Ball joint suitable for damper crank arm KH8 / KH10	KG10A
Ball joint suitable for damper crank arm KH8	KG8
Actuator arm, for 3/4" shafts, clamping range Ø10...22 mm, Slot width 8.2 mm	KH-AFB
Damper crank arm Slot width 8.2 mm, clamping range Ø14...25 mm	KH10
Damper crank arm Slot width 8.2 mm, for Ø1.05"	KH12
Damper crank arm Slot width 8.2 mm, clamping range Ø10...18 mm	KH8
Push rod for KG10A ball joint (36” L, 3/8” diameter).	SH10
Push rod for KG6 & KG8 ball joints (36” L, 5/16” diameter).	SH8
TOOL-06 8mm-10mm Wrench	TOOL-06
Retrofit clip	Z-AF
Base plate extension	Z-SF
Univ. right angle bracket 17"x11-1/8"x6" (HxWxbase).	ZG-100
Univ. right angle bracket 13x11x7-7/16" (HxWxbase).	ZG-101
Dual actuator mounting bracket.	ZG-102
Right angle bracket for ZS-260.	ZG-109
Stand-off bracket for ZS-260.	ZG-110
AFB(X)/NFB(X) U bracket 5-7/8x5-1/2x2-19/32" (HxWxD).	ZG-118
Jackshaft mounting bracket.	ZG-120
Mounting kit for linkage operation for flat and side installation	ZG-AFB
Mounting kit for foot mount installation	ZG-AFB118
Damper clip for damper blade, 3.5” width.	ZG-DC1
Damper clip for damper blade, 6” width.	ZG-DC2
1" diameter jackshaft adaptor (11" L).	ZG-JSA-1
1-5/16" diameter jackshaft adaptor (12" L).	ZG-JSA-2
1.05" diameter jackshaft adaptor (12" L).	ZG-JSA-3

Weather shield 13x8x6" [330x203x152 mm] (LxWxH)	ZS-100
Base Plate, for ZS-100	ZS-101
Weather shield 16x8-3/8x4" [406x213x102 mm] (LxWxH)	ZS-150
Explosion Proof Housing 16x10x6.435" [406x254x164 mm] (LxWxH), UL and CSA, Class I, Zone 1&2, Groups B, C, D, (NEMA 7), Class III, Hazardous (classified) Locations, outdoor application NEMA 4	ZS-260
Weather shield 17-1/4x8-3/4x5-1/2" [438x222x140 mm] (LxWxH), NEMA 4X, with mounting brackets	ZS-300
Weather shield 17-1/4x8-3/4x5-1/2" [438x222x140 mm] (LxWxH), NEMA 4X, with mounting brackets	ZS-300-5
Shaft extension 1/2"	ZS-300-C1
Shaft extension 3/4"	ZS-300-C2
Shaft extension 1"	ZS-300-C3

Electrical installation

Warning! Live Electrical Components!
During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

Meets cULus requirements without the need of an electrical ground connection.

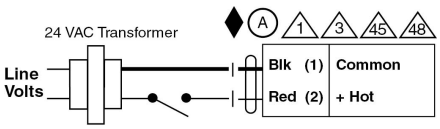
A Actuators with appliance cables are numbered.

1 Provide overload protection and disconnect as required.

3 Actuators may also be powered by 24 VDC.

45 Actuators may be powered in parallel. Power consumption must be observed.

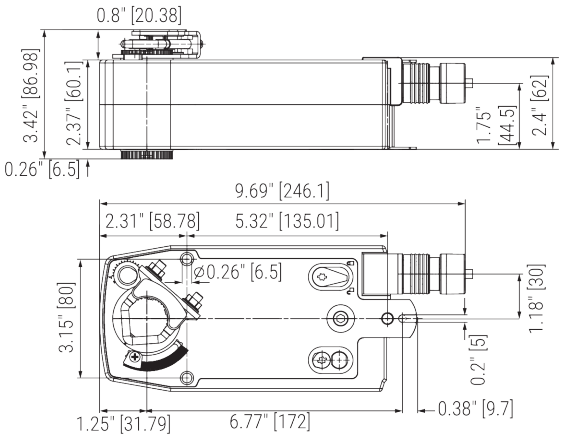
48 Parallel wiring required for piggy-back applications.



On/Off

Dimensions

Dimensional drawings

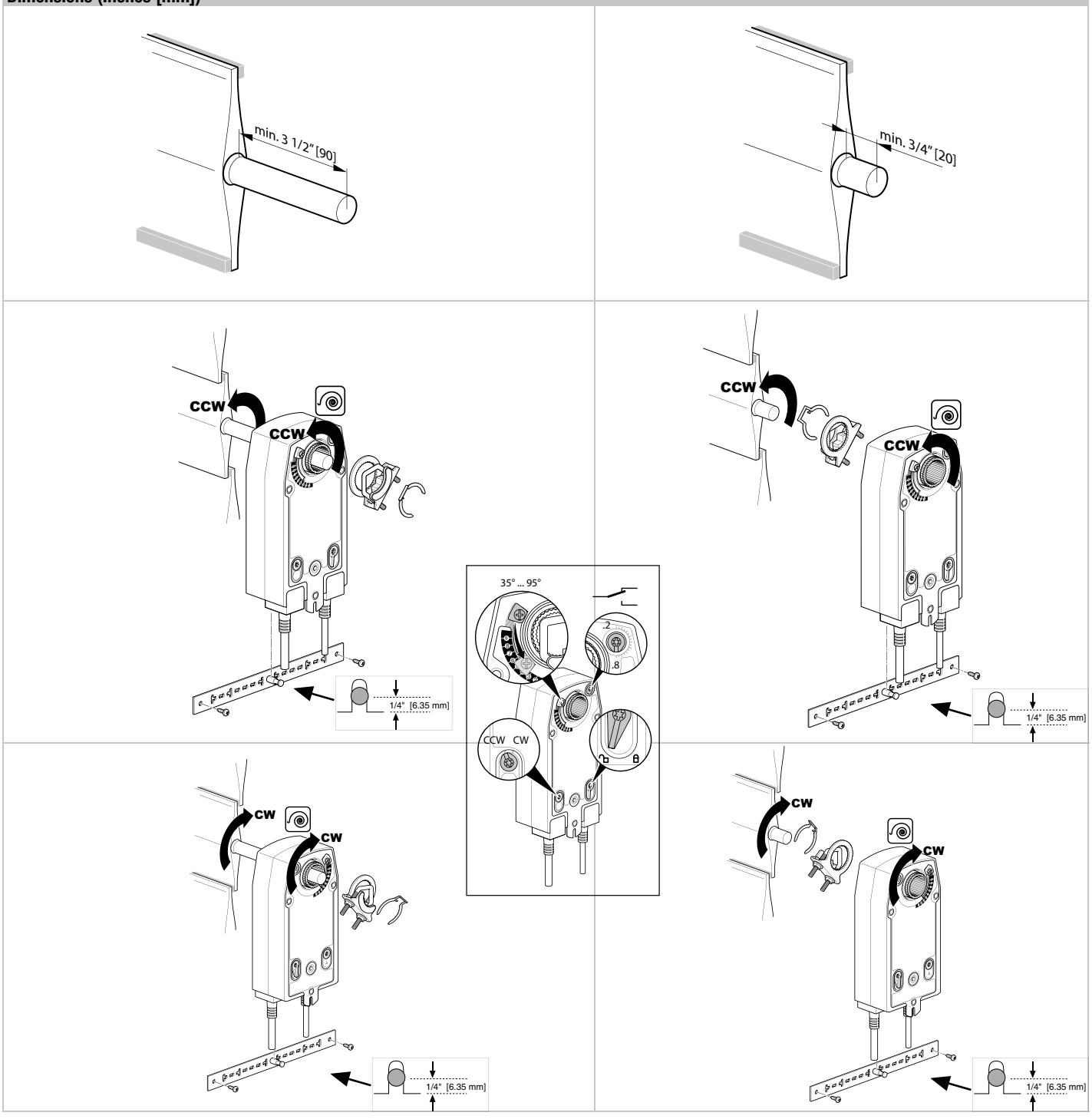


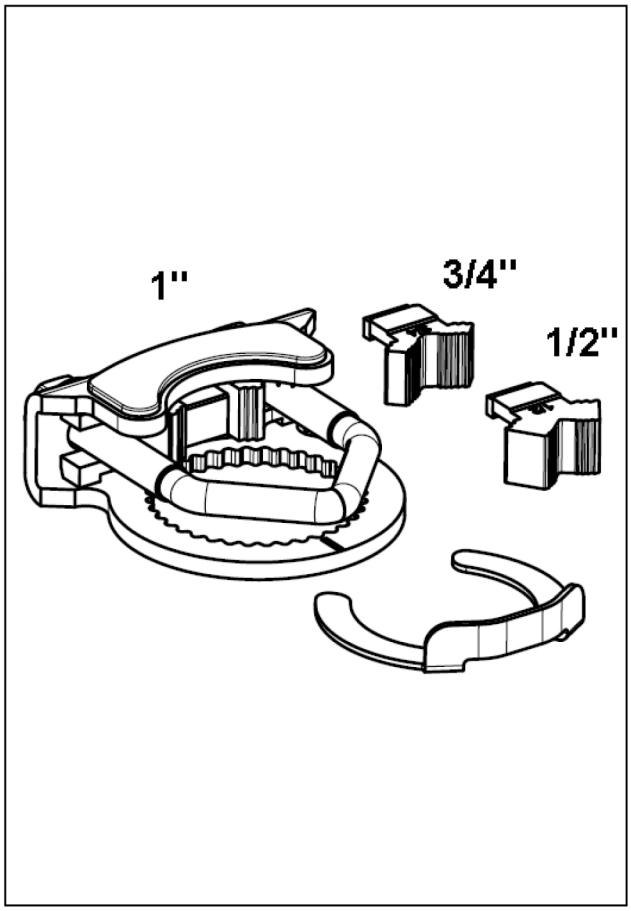
Quick-Mount Visual Instructions

1. Rotate the damper to its fail-safe position.
   If the shaft rotates counterclockwise, mount the “CCW” side of the actuator out.
   If it rotates clockwise, mount the actuator with the “CW” side out.
2. If the universal clamp is not on the correct side of the actuator, mount it onto the correct side.
3. Slide the actuator onto the shaft and tighten the nuts on the V-bolt with a 10mm wrench to 6-8 ft-lb of torque.
4. Slide the anti-rotation strap under the actuator so that it engages the slot at the base of the actuator. Secure the strap to the duct work with #8 self-tapping screws.

NOTE: Read the “Standard Mounting” instructions, on the next page, for more detailed information.

Dimensions (Inches [mm])





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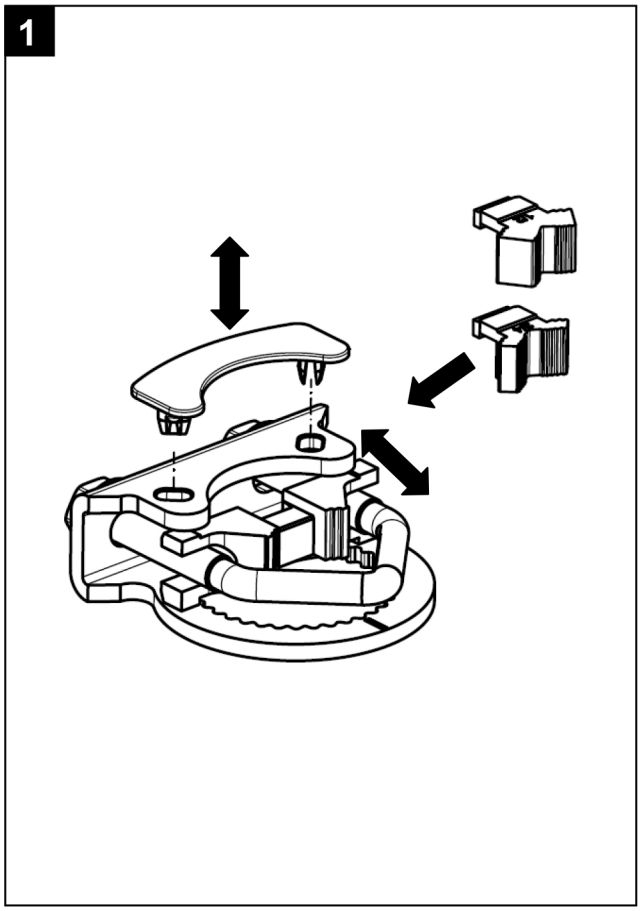

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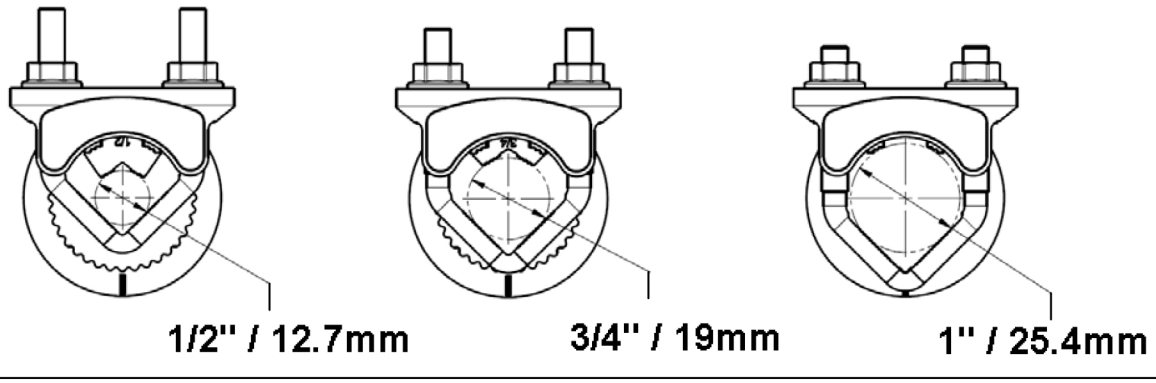
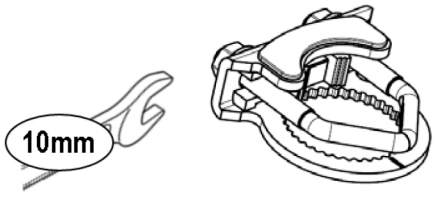


1/2"	mm	12.7	10 … 19	---	14 … 20
	inch	1/2	3/8 … 3/4	---	9/16 … 3/4
3/4"	mm	19	10 … 22	10	14 … 25.4
	inch	3/4	3/8 … 3/4	3/8	9/16 … 1
1"	mm	25.4	19 … 26.7	12 …18	---
	inch	1	3/4 … 1.05	1/2 …11/16	---



9 Nm / 80 in- lb

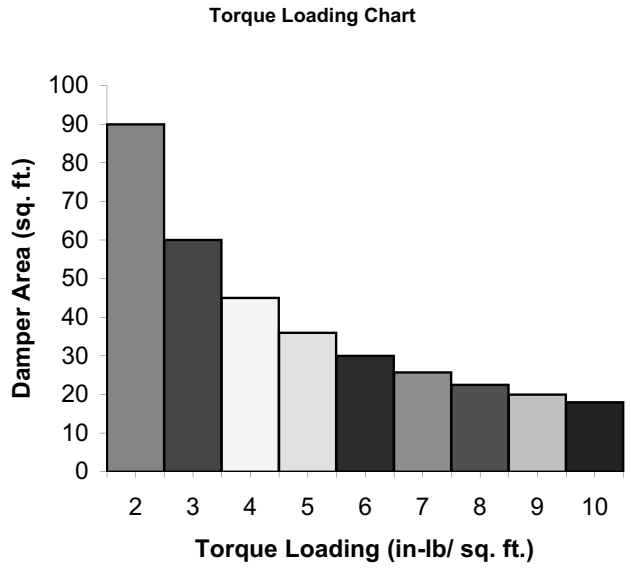
Determining Torque Loading and Actuator Sizing

Damper torque loadings, used in selecting the correct size actuator, should be provided by the damper manufacturer. If this information is not available, the following general selection guidelines can be used.

Damper Type	Torque Loading
Opposed blade, without edge seals, for non-tight close-off applications	3 in-lb/sq. ft.
Parallel blade, without edge seals, for non-tight close-off applications	4 in-lb/sq. ft.
Opposed blade, with edge seals, for tight close-off applications	5 in-lb/sq. ft.
Parallel blade, with edge seals, for tight close-off applications	7 in-lb/sq. ft.

The above torque loadings will work for most applications with 1000 FPM face velocity. For applications between this criteria and 2500 FPM, the torque loading should be increased by a multiplier of 1.5. If the application calls for higher criteria up to 3000 FPM, use a multiplier of 2.0.

Torque Loading Chart



General Information

Belimo actuators should be mounted indoors in a dry, relatively clean environment free from corrosive fumes. If the actuator is to be mounted outdoors, a protective enclosure must be used to shield the actuator.

For new construction work, **order dampers with extended shafts**. Instruct the installing contractor to allow space for mounting and service of the Belimo actuator on the shaft. The damper shaft must extend at least 3 1/2" from the duct. If the shaft extends less than 3-1/2" or if an obstruction blocks access, the shaft can be extended with the AV 8-25 shaft extension accessory or the actuator may be mounted in its short shaft configuration.

Mechanical Operation

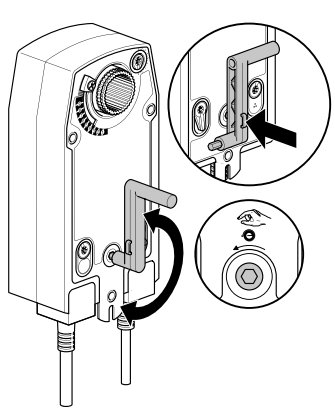
The actuator is mounted directly to a damper shaft up to 1.05" in diameter by means of its universal clamp. A crank arm and several mounting brackets are available for applications where the actuator cannot be direct coupled to the damper shaft. The AFB, AFX series actuators provide true spring return operation for reliable fail-safe application and positive close-off on air tight dampers. The spring return system provides constant torque to the damper with, and without, power applied to the actuator. The AFB…-S, AFX…-S versions are provided with two built-in auxiliary switches. These SPDT switches are provided for safety interfacing or signaling, for example, for fan start-up. The switching function at the fail-safe position is fixed at +10°, the other switch function is adjustable between +10° to +90°.

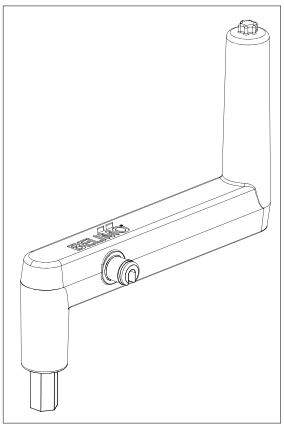
Automatic Airtight Dampers/Manual Override

The AFB, AFX series provides 95° of rotation and is provided with a graduated position indicator showing 0° to 95°.

The AFB, AFX has a unique built in manual positioning mechanism which allows the setting of any damper position within its 95° of rotation. A pre-tensioned spring automatically tightens the damper when power is applied to the actuator, compensating for damper seal deterioration..

The actuator is shipped at +5° (5° from full fail-safe) to provide automatic compression against damper gaskets for tight shut-off. When power is applied, the manual mechanism is released and the actuator drives toward the full fail-safe position.





Standard Mounting

NOTE: The AFB, AFX…series actuator is shipped with the manual override adjusted for a +5° position at the universal clamp (not at full fail-safe, 0°). This allows for automatic compression of damper blade seals when the actuator is in use, providing tight shut-off. This assumes that the damper is to have tight shut-off at the fail-safe position. If tight close-off is desired at the opposite direction from fail-safe, the manual override should be released so the actuator can go to the full fail-safe position. See the manual override instructions.

1. Manually move the damper to the fail-safe position (usually closed). If the shaft rotated counterclockwise ( ), this is a CCW installation. If the shaft rotated clockwise ( ), this is a CW installation. In a CCW installation, the actuator side marked "CCW" faces out, while in a CW installation, the side marked "CW" faces out. All other steps are identical.
2. The actuator is usually shipped with the universal clamp mounted to the "CCW" side of the actuator. To test for adequate shaft length, slide the actuator over the shaft with the side marked "CCW" (or the "CW" side if this is the side with the clamp). If the shaft extends at least 1/8" through the clamp, mount the actuator as follows. If not, go to the *Short Shaft Installation* section.
3. If the clamp is not on the correct side as determined in step #1, re-mount the clamp as follows. If it is on the correct side, proceed to step #5. Look at the universal clamp. If you are mounting the actuator with the "CCW" side out,

position the clamp so that the pointer section of the tab is pointing to 0° (see Figure C) and the spline pattern of the clamp mates with spline of the actuator. Slip the clamp over the spline. (Use the same procedure if the "CW" side is out.) If your application requires a mechanical minimum position, read the *Rotation Limiting, Mechanical Minimum Damper Position* section.

4. Lock the clamp to the actuator using the retaining clip.
5. Verify that the damper is still in its full fail-safe position.
6. Slide the actuator over the shaft.
7. Position the actuator in the desired location.
8. Tighten the two nuts on the clamp using a 10mm wrench or socket using 6-8 ft-lb of torque.
9. Slip the stud of the anti rotation strap into the slot at the base of the actuator. The stud should be positioned approximately 1/16 of an inch from the closed end of the slot. Bend the strap as needed to reach the duct. Attach the strap to the duct with #8 self tapping screws.

Short Shaft Installation

If the shaft extends at least 3/4" from the duct, follow these steps:

1. Determine the best orientation for the universal clamp on the back of the actuator. The best location would be where you have the easiest access to the V bolt nuts on the clamp.
2. Engage the clamp to the actuator as close as possible to the determined location.
3. Lock the clamp in place using the remaining retainer clip.
4. Verify that the damper is still in its full fail-safe position.
5. Slide the actuator over the shaft.
6. Position the actuator in the desired location.
7. Tighten the two nuts on the clamp using a 10mm wrench or socket using 6-8 ft-lb of torque.
8. Slip the stud of the anti-rotation strap into the slot at the base of the actuator. The stud should be positioned approximately 1/16 of an inch from the closed end of the slot. Bend the strap as needed to reach the duct. Attach the strap to the duct with #8 self tapping screws.
9. If damper position indication is required, use the optional IND-AFB pointer. See **Figure A**.

Jackshaft Installation

The AFB, AFX… series actuator is designed for use with jackshafts up to 1.05" in diameter. In most applications, the AFB, AFX actuator may be mounted in the same manner as a standard damper shaft application. If more torque is required than one AFB, AFX actuator can provide, a second AFB, AFX actuator may be mounted to the jackshaft using the ZG-102 multiple actuator mounting bracket. ***See wiring guide for wiring details.***

AF ACTUATORS WHICH MAY BE USED ON ONE SHAFT

Model	Maximum Quantity Per Shaft
AFB24-MFT(-S), AFX24-MFT (-S)	3
AFBUP(-S), AFXUP(-S)	2

MOUNTING: If the actuators are mounted on the opposed ends of the shaft, the actuator direction must be selected carefully. Usually, the direction of rotation is reversed.

Multiple Actuator Mounting

If more torque is required than one AFB, AFX actuator can provide, a second AFB, AFX actuator may be mounted to the shaft using the ZG-102 multiple mounting bracket.

NOTE: The manual positioning mechanism cannot be used in multiple actuator applications.

Special Wiring and Additional Information: See wiring guide

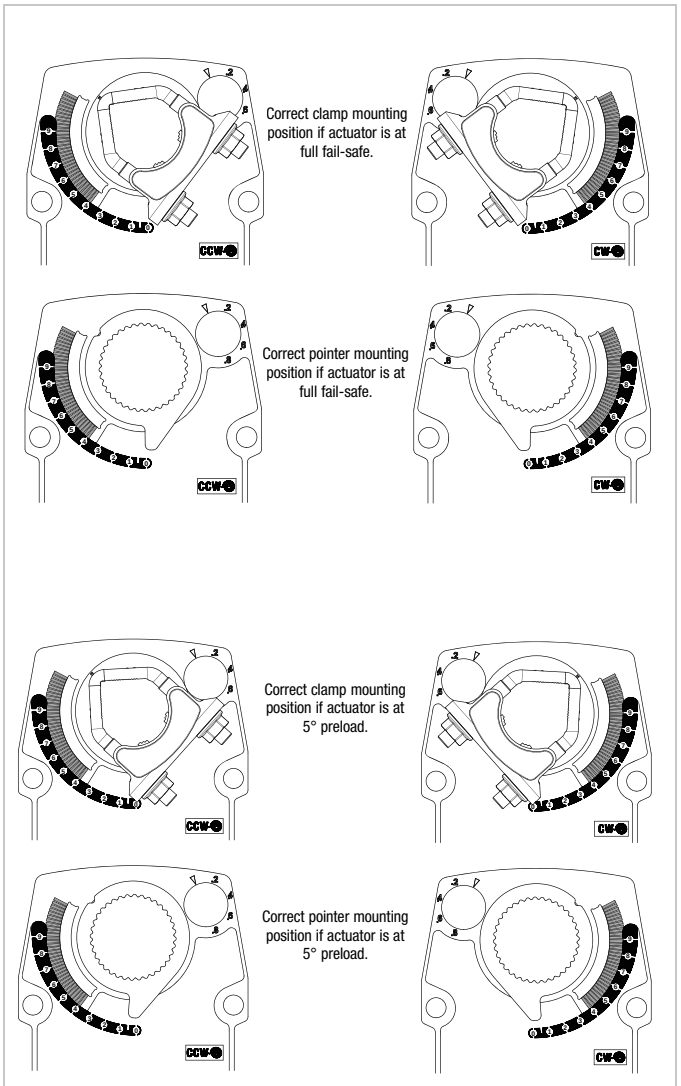


Figure A

Rotation Limitation

The angle of rotation limiter, which is built into the actuator, is used in conjunction with the tab on the universal clamp or IND-AFB position indicator. In order to function properly, the clamp or indicator must be mounted correctly.

See **Figure A**.

The rotation limiter may not work in certain mounting orientations using the ZG-118 mounting bracket. Limiting the damper rotation must be accomplished by adjusting the crank arm linkage.

The built-in rotation limiter may be used in 2 ways to control the rotational output of the AFB, AFX series actuator. One use is in the application where a damper has a designed rotation less than 90°. An example would be a 45° or 60° rotating damper. The other application would be to set a minimum damper position which can be easily set or changed without having to remove the actuator from the damper.

Damper Rotation Limiting

1. Determine the amount of damper rotation required.
2. Locate the Angle of Rotation Limiter on the actuator **Figure B**.
3. Position the limiter to the desired position, making sure the locating “teeth” on the limiter are engaged into the locating holes on the actuator.
4. Fasten the limiter by screwing the attached screw.
5. Test the damper rotation either manually with the manual crank or apply power and if required, a control signal. Re-adjust i**f** necessary.

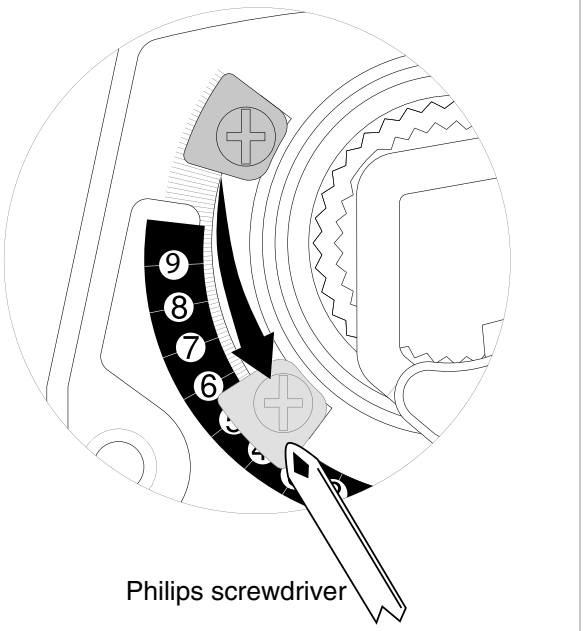
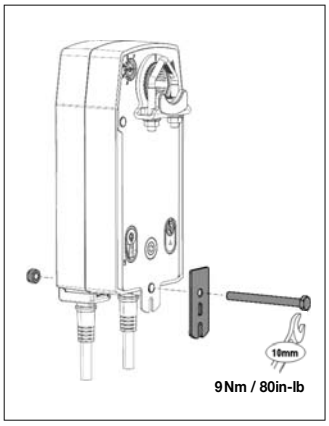
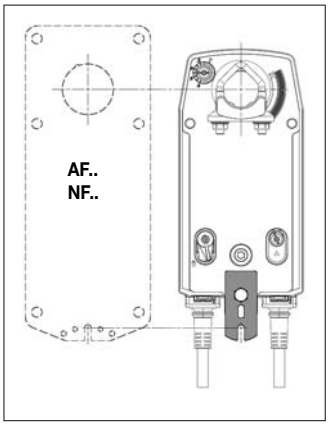


FIGURE B

Z-AF For Replacing AF and NF Actuators



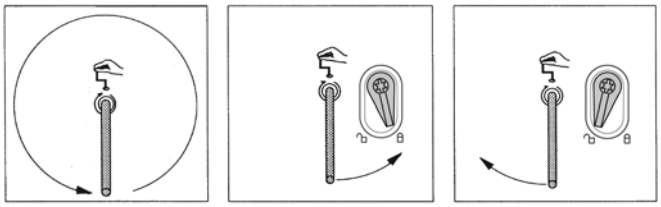


Manual Override

The AFB, AFX series actuators can be manually positioned to ease installation or for emergency positioning.

1. The manual override will only work if no power is available to the actuator.
2. Insert the manual crank (shipped with the actuator) into the hexagon hole located on either side of the actuator. An illustration, located on the label, shows the location.
3. Turn the crank in the direction shown on the label (clockwise on the “CW” side, counterclockwise on the “CCW” side). It will take approximately 23 revolutions to rotate the full 95° of rotation.
4. To lock the actuator in the required position, flip the switch to the locked position that is located to the right of the crank on the CCW side of the actuator (left of the crank on the CW side).
5. The manual override may be disengaged in 2 ways.
   - Flip the switch to the unlocked position and the actuator will go to its fail-safe position.
   - Apply power to wire 1 and 2. The actuator will automatically disengage the override function and will go to the “on” position in the case of the On/Off versions. Or, in the case of the proportional versions, go to the 0 signal position and then go to the position corresponding to the control signal. The actuator will now work normally.

CCW Side Example:



Winding the damper actuator
- insert crank handle
- turn handle in direction of arrow

Locking the damper actuator
- Flip the lock switch to the position pointing to the “locked” symbol

Unlocking the damper actuator (2 options)
- Flip the lock switch to the position pointing to the “unlocked” symbol.
- Remote control by supplying power to the unit for > than 3 sec.

Testing the installation Without Power

The actuator/damper installation may be tested without power at the actuator. Refer to the manual positioning section of the instructions. Move the damper to its full non-fail-safe position using the manual crank. Disengage the manual position mechanism and have the damper go to full fail-safe position. Correct any mechanical problems and retest.

Auxiliary Switches

The AFB, AFX series actuators may be ordered with two built-in SPDT auxiliary switches used for safety interfacing or signaling, for example, for fan start-up. The switch position near the fail-safe position is fixed at 10°. The other is adjustable between 10° and 90° of rotation. The crank that is supplied with the actuator is used to change the switch position.

SWITCH RATING		
Voltage	Resistive Load	Inductive Load
120 VAC	3A	1.03A
250 VAC	3A	0.5A

Two methods may be used to adjust the switching point of the adjustable switch.

Method 1 - See **Figure F**
1 The actuator must be in its fail-safe position.
2. Insert the crank handle into the torx shaped hole located in the center of the adjustable switch pointer.
3. Gently rotate the crank until the switch pointer is at the desired switch point in degrees as shown.

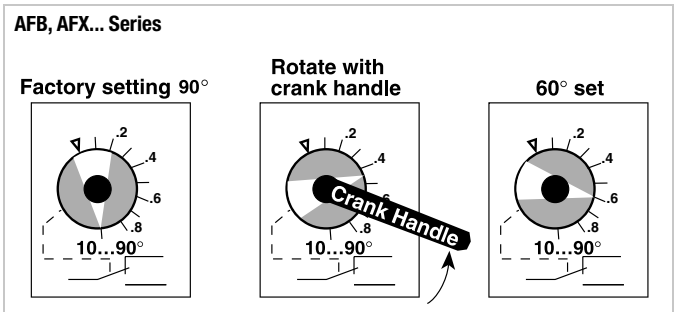


FIGURE F

Method 2 - See **Figure G**
1. Position the damper to the point at which you want the switch to activate. This may be done by using the manual override or by providing the appropriate proportional signal to AFB24, AFX24… modulating type actuator. The position of the switch pointer is not important during this step
2. Insert the crank into the hexagon shaped hole located in the center of the adjustable switch pointer.
3. Gently rotate the switch pointer to just past the switch point indicating arrow as shown.

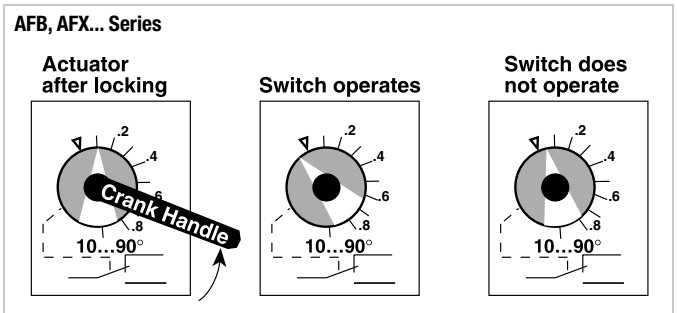
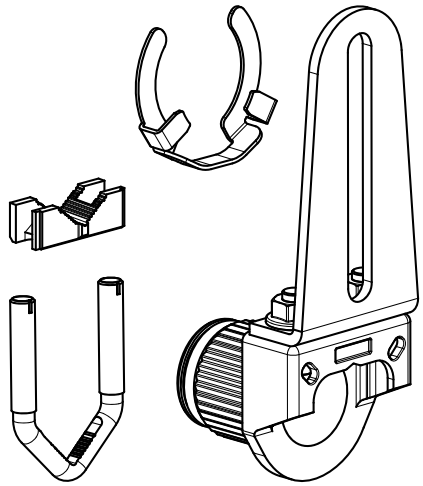
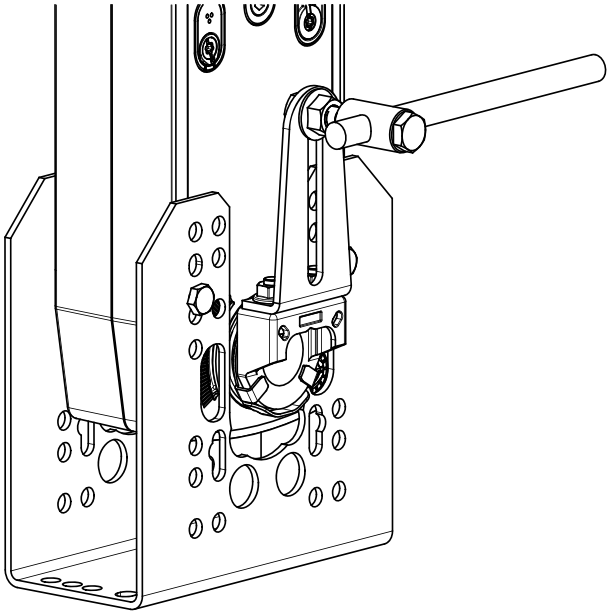


FIGURE G





KH-AFB non-direct mounting with ZG-118 mounting bracket

KH-AFB Crank arm

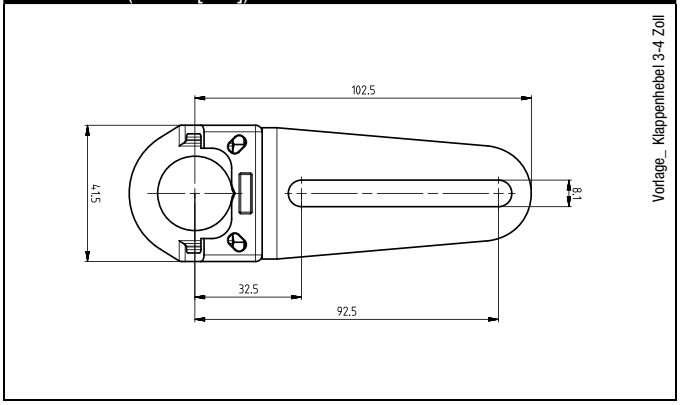
Including Retaining Ring

CAUTION: *The retaining clip supplied with the clamp is* ***not*** *used to mount the KH-AFB crank arm.*

The KH-AFB crank arm is used in non-direct coupled mounting applications. The KH-AFB may also be used to simultaneously direct couple to a damper shaft and provide an additional crank arm connection to a second damper.

KH-AFB	For round shafts up to 3/4" or square shafts up to 5/8"

Dimensions (Inches [mm])



General

The AFB, AFX series actuators utilize both DC Motors and brushless DC motor technology. The AFB, AFX uses this motor in conjunction with an Application Specific Integrated Circuit (ASIC). In the On/Off versions of the AFB and AFX, the ASIC monitors and controls the actuator's rotation and a digital rotation sensing function to prevent damage to the actuator. The AFB24, AFX24… modulates type actuators incorporate a built in microprocessor. The microprocessor provides the intelligence to the ASIC to provide a constant rotation rate and knows the actuator's exact zero position.

Brushless DC Motor Operation

Belimo's brushless DC motor spins by reversing the poles of stationary electromagnets housed inside of a rotating permanent magnet. The electromagnetic poles are switched by a special ASIC circuit developed by Belimo. Unlike the conventional DC motor, there are no brushes to wear or commutators to foul.

Overload Protection

The AFB, AFX series actuators are protected from overload at all angles of rotation. The ASIC circuit constantly monitors the rotation of the DC motor inside the actuator and stops the pulses to the motor when it senses a stall condition. The DC motor remains energized and produces full rated torque to the load. This helps ensure that dampers are fully closed and that edge and blade seals are always properly compressed.

Motor Position Detection

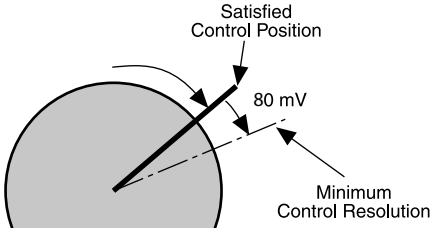
Belimo brushless DC motors eliminate the need for potentiometers for positioning in modulating type actuators. Inside the motor are three "Hall Effect" sensors. These sensors detect the spinning rotor and send pulses to the microprocessor which counts the pulses and calculates the position to within 1/3 of a revolution of the motor.

Control Accuracy and Stability

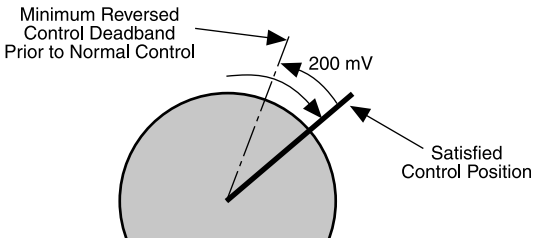
AFB24-MFT, AFX24-MFT actuators have built-in brushless DC motors which provide better accuracy and longer service life.

The AFB24-MFT, AFX24-MFT actuators are designed with a unique non-symmetrical deadband. The actuator follows an increasing or decreasing control signal with a 80 mV resolution. If the signal changes in the opposite direction, the actuator will not respond until the control signal changes by 200 mV. This allows these actuators to track even the slightest deviation very accurately, yet allowing the actuator to "wait" for a much larger change in control signal due to control signal instability.

AF Actuator responds to an 80 mV signal when not changing direction from stop



AF Actuator responds to a 200 mV signal when reversing direction from stop position.



Note: Resolution is a percentage of operating range. 1% in one direction, 2.5% when changing direction. 2-10 VDC control example shown above.

WARNING The wiring technician must be trained and experienced with electronic circuits. Disconnect power supply before attempting any wiring connections or changes. Make all connections in accordance with wiring diagrams and follow all applicable local and national codes. Provide disconnect and overload protection as required. Use copper, twisted pair, conductors only. If using electrical conduit, the attachment to the actuator must be made with flexible conduit.

Always read the controller manufacturer's installation literature carefully before making any connections. Follow all instructions in this literature. If you have any questions, contact the controller manufacturer and/or Belimo.

Transformers

The AFB24, AFX24…actuators require a 24 VAC class 2 transformer and draws a maximum of 10 VA per actuator. The actuator enclosure cannot be opened in the field, there are no parts or components to be replaced or repaired.

– EMC directive: 89/336/EEC
– Software class A: Mode of operation type 1
– Low voltage directive: 73/23/EEC

CAUTION: It is good practice to power electronic or digital controllers from a separate power transformer than that used for actuators or other end devices. The power supply design in our actuators and other end devices use half wave rectification. Some controllers use full wave rectification. When these two different types of power supplies are connected to the same power transformer and the DC commons are connected together, a short circuit is created across one of the diodes in the full wave power supply, damaging the controller. Only use a single power transformer to power the controller and actuator if you know the controller power supply uses half wave rectification.

Multiple Actuators, One Transformer

Multiple actuators may be powered from one transformer provided the following rules are followed:

1. The TOTAL current draw of the actuators (VA rating) is less than or equal to the rating of the transformer.
2. Polarity on the secondary of the transformer is strictly followed. *This means that all No. 1 wires from all actuators are connected to the common leg on the transformer and all No. 2 wires from all actuators are connected to the hotleg.* Mixing wire No. 1 & 2 on one leg of the transformer will result in erratic operation or failure of the actuator and/or controls.

Multiple Actuators, Multiple Transformers

Multiple actuators positioned by the same control signal may be powered from multiple transformers provided the following rules are followed:

1. The transformers are properly sized.
2. All No. 1 wires from all actuators are tied together and tied to the negative leg of the control signal. See wiring diagram.

Wire Length for AFB..., AFX... Actuators

Keep power wire runs below the lengths listed in the **Figure H**. If more than one actuator is powered from the same wire run, divide the allowable wire length by the number of actuators to determine the maximum run to any single actuator.

Example: 3 actuators, 16 Ga wire
350 Ft ÷ 3 Actuators = 117 Ft. Maximum wire run

MAXIMUM WIRE LENGTH FOR 10VA

Wire Size	Max. Feet.	Wire Size	Max. Feet
12 Ga	900 Ft.	18 Ga	220 Ft.
14 Ga	550 Ft.	20 Ga	120 Ft.
16 Ga	350 Ft.	22 Ga	60 Ft.

FIGURE H

Wire Type and Wire Installation Tips

For most installations, 18 or 16 Ga. cable works well with the AFB24, AFX24... actuators. Use code-approved wire nuts, terminal strips or solderless connectors where wires are joined. It is good practice to run control wires unspliced from the actuator to the controller. If splices are unavoidable, make sure the splice can be reached for possible maintenance. Tape and/or wire-tie the splice to reduce the possibility of the splice being inadvertently pulled apart.

The AFB24, AFX24... proportional actuators have a digital circuit that is designed to ignore most unwanted input signals (pickup). In some situations the pickup may be severe enough to cause erratic running of the actuator. For example, a large inductive load (high voltage AC wires, motors, etc.) running near the power or control wiring may cause excessive pickup. To solve this problem, make one or more of the following changes:

1. Run the wire in metallic conduit.
2. Re-route the wiring away from the source of pickup.
3. Use shielded wire (Belden 8760 or equal). Ground the shield to an earth ground. **Do not** connect it to the actuator common.

Initialization of the AFB24-MFT, AFX24-MFT

When power is initially applied, the actuator will first release its manual preload position (This assumes a manual position has been set). The actuator will then rotate to the full fail-safe position. At this point the microprocessor recognizes that the actuator is at full fail-safe and uses this position as the base for all of its position calculations. The microprocessor will retain the initialized zero during short power failures of up to 20 seconds. The AFB24-MFT and AFX24-MFT will also return to its position prior to the 20-second-or-less power loss. For power failures greater than 20 seconds, the actuator would naturally return to its full fail-safe position prior to the microprocessor losing its memory. The actuator will also re-initialize if the manual position mechanism is used.

AFB24-MFT, AFX24-MFT + P-100… Electrical Check-Out Procedure

STEP	Procedure	Expected Response	Gives Expected Response Go To Step…	Does Not Give Expected Response Go To Step…
1.	Control signal is applied to actuator.	Actuator will move to its "Control Signal" position.	Actuator operates properly **Step 7.**	No response at all **Step 2.** Operation is reversed **Step 3.** Does not drive toward "Control Signal Position" **Step 4.**
2.	Check power wiring. Correct any problems. **See Note 1.**	Power supply rating should be the total power requirement of the actuator(s). Minimum voltage of 19.2 VAC or 21.6 VDC.	Power wiring corrected, actuator begins to drive **Step 1.**	Power wiring corrected, actuator still does not drive **Step 4.**
3.	Turn reversing switch to the correct position. Make sure the switch is turned all the way left or right.	Actuator will move to its "Control Signal" position.	Actuator operates properly **Step 7.**	Does not drive toward "Control Signal Position" **Step 4.**
4.	Make sure the control signal positive (+) is connected to Wire No. 3 and control signal negative (-) is connected to wire No. 1. Most control problems are caused by reversing these two wires. Verify that the reversing switch is all the way CCW or CW.	Drives to "Control Signal" position.	Actuator operates properly **Step 7.**	**Step 5.**
5.	Check input signal with a digital volt meter (DVM). Make sure the input is within the range of the actuator. **NOTE:** The input signal must be above the 2 VDC or 4 mA to have the actuator move.	Input voltage or current should be ±1% of what controller's adjustment or programming indicates.	Controller output (actuator input) is correct. Input Polarity Correct **Step 6.**	Reprogram, adjust repair or replace controller as needed **Step 1.**
6.	Check damper torque requirement.	Torque requirement is actuator's minimum torque.	Defective Actuator. Replace Actuator - **See Note 2.**	Recalculate actuator requirement and correct installation.
7.	Actuator works properly. Test controller by following controller manufacturer's instructions.			

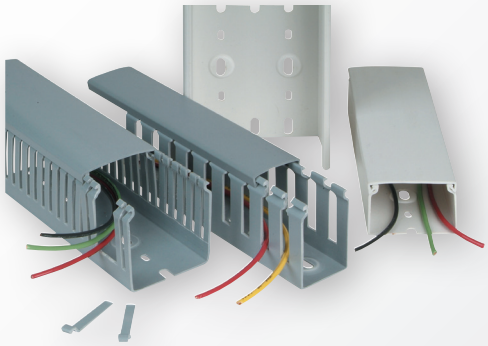
NOTE 1 Check that the transformer(s) are sized properly.

- If a common transformer is used, make sure that polarity is observed on the secondary. This means connect all No. 1 wires to one leg of the transformer and all No. 2 wires to the other leg of the transformer.
- If multiple transformers are used with one control signal, make sure all No. 1 wires are tied together and tied to control signal negative (-).
- Controllers and actuators must have separate 24 VAC/VDC power sources.

NOTE 2 If failure occurs within 5 years from original purchase date, notify Belimo and give details of the application.

WIRING DUCT

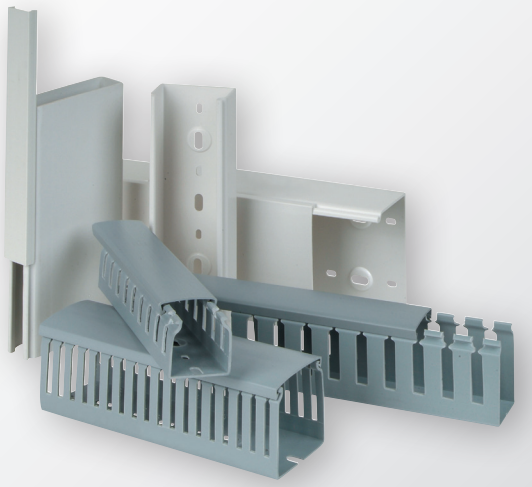
SERIES WD PRODUCT PROFILE



c3controls **Wiring Duct** includes a variety of styles, options, and accessories to simplify and increase the speed of your wiring and cable management, bringing you more control over your wiring productivity, reducing your installation costs, and providing you with the most attractive and organized control panels in the industry.

FEATURES AND BENEFITS

- Wide variety of sizes to meet your wiring capacity needs:
  - Widths from 25mm (0.98") to 150mm (5.90")
  - Heights from 30mm (1.18") to 100mm (3.94")
  - Up to 21 width/height combinations in each slot type
- Non-flammable (UL94 V-0), rigid PVC won't warp, peel, chip, crack, or become brittle, and resists oil, salt solutions, and fungus for superior performance in even the most demanding industrial environments.
- Flush side-wall and duct provide increased wire capacity and a pleasing, finished look.
- Restricted slot design ensures that wires are held in place, even when the cover is not installed.
- Embossed mounting holes accept mounting inserts for installing smaller wiring duct inside larger wiring duct. Mounting inserts can be installed even after the wiring duct is secured to the panel, making it easy and saving you installation time.
- Mounting hole patterns with elongated slots comply with DIN 43659 for global installation flexibility.



ADVANTAGES

Fast Wiring

- The V-shaped slot lead-in makes wire insertion fast and easy.

Convenience

- Snap-off, side wall fingers are scored to easily enlarge slots for any size wire or wire bundle. No tool is required to "snap off" fingers, and scoring ensures clean break-offs, eliminating sharp edges.
- Optional adhesive backing allows you to *temporarily* stick your wiring duct where you want it on the panel before you *permanently* mount it. Just position, press, *then* drill and tap.

Customization

- Three slot types are available to meet your capacity and flexibility needs:
  - Narrow slot – smaller fingers for more precise wiring
  - Wide slot – larger slots for bigger wires and bundles
  - Unslotted – to restrict wire access for extra security

Durability

- Interlocking, non-slip cover prevents sliding, even in high vibration applications.

Reduced Inventory

- Smaller standard package quantities, bringing you more control over your inventory.

Easy Identification

- Complete catalog number and dimensions printed on the side of the duct for quick identification and utilization.

series WD WIRING DUCT

SPECIFICATIONS

GENERAL		
	UNITS	
Materials		
Wiring Duct		Rigid, Self-Extinguishing PVC
Wiring Duct Covers		Rigid, Self-Extinguishing PVC
Mounting Inserts		Nylon 66
Cable Tie Attachments		Nylon 6 - Glass Filled
Nylon Rivets		Nylon 66
Wire Retainers		Nylon 6
Name Plates		Nylon 6
Mounting Clips		Nylon 6
Continuous Use Temperature		+5° F to +140° F (-15° C to +60° C)
Flammability		UL94 V-0
Standard Wiring Duct & Cover Length		2 meters (6' - 6.75')
Standard Unit		Wiring duct complete with cover

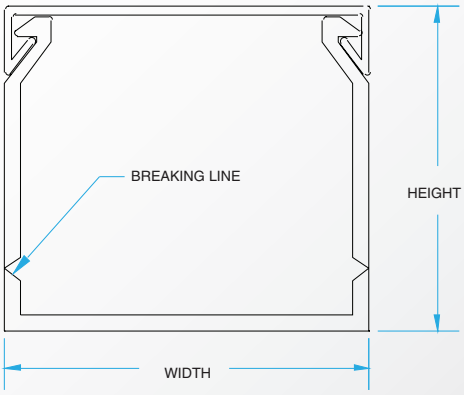
MATERIAL PROPERTY			
	UNITS	**STANDARD**	**VALUE**
Tensile Strength at Break	kg/cm²	ASTM D838	> 390
Tensile Modulus	kg/cm²	ASTM D638	13,500
Flexural Strength	kg/cm²	ASTM D790	550
Compressive Strength	kg/cm²	ASTM D695	1190
Izod Impact Strength	kg-cm/cm	ASTM D256	7.0
Hardness - Shore D	—	ASTM D2240	75 - 80
HDT at 4.6 kg/cm²	°C	ASTM D648	85
Vicat Softening Point at 5 kg Load	°C	ASTM D1525	85
Co-efficient of Linear Thermal Expansion	°C	ASTM D696	4.6×10^{-5}
Flammability	—	UL94	V-0
Glow Wire Test (2mm)	°C	IEC 695-2-1	960
Limiting Oxygen Index	%	ASTM D2863	48.0
Specific Gravity	—	ASTM D792	1.48
Water Absorption	%	ASTM D570	0.05
Power Factor	—	ASTM D150	0.018
Dielectric Constant	—	ASTM D150	2.5
Dielectric Strength	kV/mm	ASTM D149	13
Surface Resistivity	Ohm	ASTM D257	1.29×10^{15}
Volume Resistivity	Ohm-cm	ASTM D257	3.21×10^{16}
Lead Content	ppm	Directive 2002/95/EC (IEC 61321)	< 500
Cadmium Content	ppm	Directive 2002/95/EC (IEC 61321)	< 50

ROHS COMPLIANCE For RoHS compliance documentation by product, refer to www.c3controls.com.

For wire fill capacity of electrical conductors and data cables, refer to www.c3controls.com.

DIMENSIONS

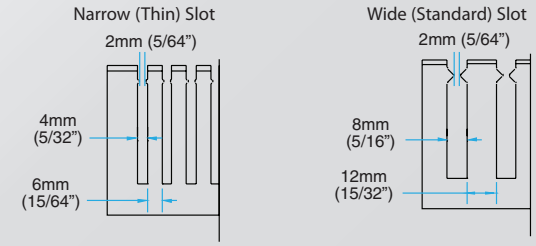
Wiring Duct and Cover



WIRING DUCT AND COVER DIMENSIONS

DIMENSION CODE	WIDTH (MM)	HEIGHT (MM)	WIDTH (INCHES)	HEIGHT (INCHES)
25X30	25	30	0.98	1.18
25X40	25	40	0.98	1.57
25X60	25	60	0.98	2.36
25X80	25	80	0.98	3.15
25X100	25	100	0.98	3.94
40X40	40	40	1.57	1.57
40X60	40	60	1.57	2.36
40X80	40	80	1.57	3.15
40X100	40	100	1.57	3.94
60X40	60	40	2.36	1.57
60X60	60	60	2.36	2.36
60X80	60	80	2.36	3.15
60X100	60	100	2.36	3.94
80X40	80	40	3.15	1.57
80X60	80	60	3.15	2.36
80X80	80	80	3.15	3.15
80X100	80	100	3.15	3.94
100X60	100	60	3.94	2.36
100X80	100	80	3.94	3.15
100X100	100	100	3.94	3.94
150X100	150	100	5.90	3.94

Slots



CERTIFICATIONS

Conformity to Standards:
UL 1565
CSA C22.2 No. 18.5-02
IEC 61084-2-1

Certifications:
UL File #: E330184 (Guide Z0DZ2, ZODZ8)

CE Marked (per EU Low Voltage Directive 2006/95/EC and RoHS Directive 2011/65/EU)

Visit c3controls.com to download product certifications.

REVISION 03.03.2014

QL–Series Miniature Circuit Breakers

Features

- AC Circuit Breaker
- Hydraulic-Magnetic Technology
- 100% Rating Capability Independent of Ambient Temperature
- Up to Three Poles
- CSA, VDE, CE and CCC approved
- UL Listed (UL 489)
- Ratings up to 25A
- Optional Auxiliary / Trip Alarm Switch
- Wide Range of Time Delays and Operating Currents
- Precision tripping
- Current Limiting Capabilities
- Ultra Compact – 13mm width Module
- Trip Indication with Mid-Trip Handle
- Reset Immediately After Overload
- DIN and Dual Rail Mounting

Applications

- UPS Equipment
- Mobile Power-Generation Equipment
- Power Conditioning Equipment
- Alternative Energy Equipment
- Lighting Control
- AC Branch Circuit Installations

Technical Details

Approvals / Marks	**UL 489 / CSA**	**IEC / EN 60947-2, VDE, CE, CCC[a]**
Number of Poles	1, 2, 3	1, 2
Interrupting Capacity @ Operating Voltage	10kA @ 120VAC (1-pole) [1] 5kA @ 240VAC (1-pole) [2] 10kA @ 120/240VAC (2-pole) [3] 5kA @ 240VAC (3-pole) [4]	6kA @ 240VAC
Current Ratings	0.1 – 25A[1, 3 & 4] 0.1-20A[2]	0.1 – 25A
Mounting Options	DIN Rail	
Tripping Curves	1, 9, KM	
Notes	[a]GB 14048.2	

Circuit Breaker Industries Ltd.
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Telephone: + 27 928 2000 • Telefax: + 27 11 392 2354 • e-mail: cbi@cbi.co.za • Reg. No. 05/15747/06
Established 1949

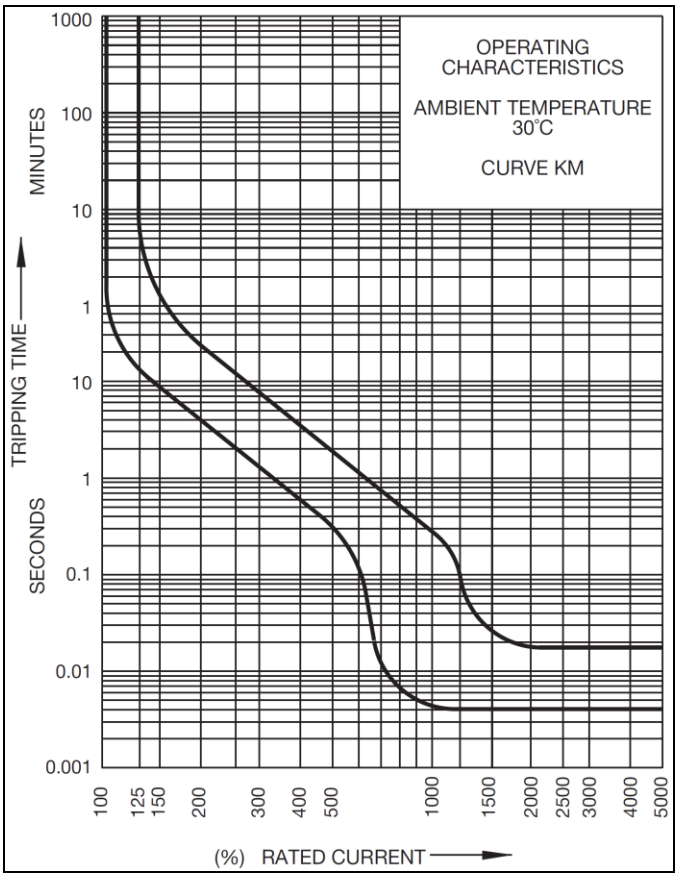
Optional Accessories

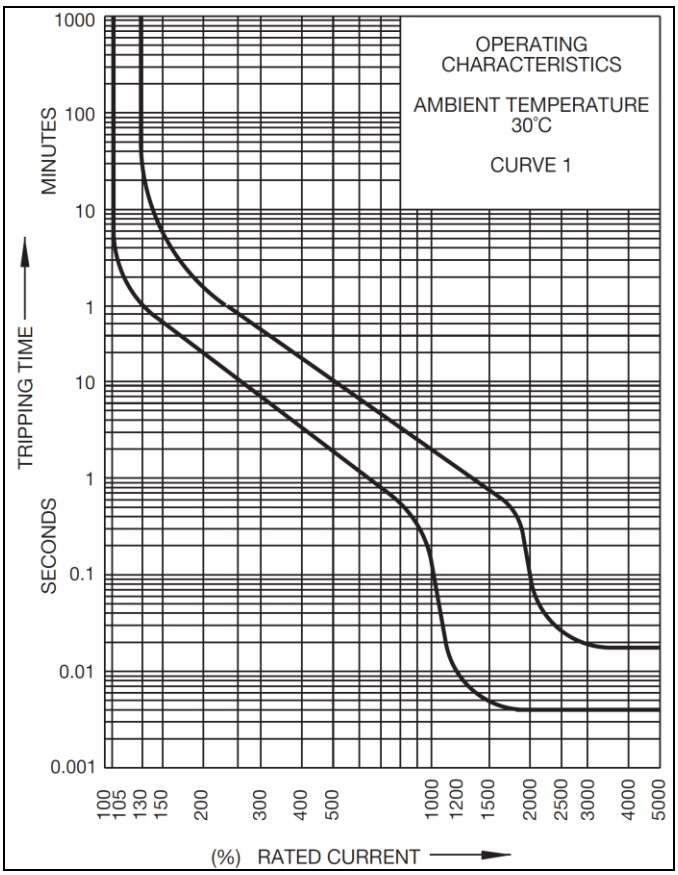
- Auxiliary Switch
- Auxiliary Switch + Trip Alarm
- Trip Alarm

Auxiliary Switch, Trip Alarm & Combo: Features

- AC and DC Voltages
- UL 489 Listed (Auxiliary switch: 6A 250V AC, 0.5A 80V DC; Trip alarm: 5A 250V AC, 0.5A 125V DC)
- IEC 60947-5-1 Approved (Auxiliary switch: 6A 250V AC, 0.5A 80V DC; Trip alarm: 5A 250V AC, 0.5A 125V DC)
- Factory Fitted
- Attached to Right Hand Side of Circuit Breaker
- Compact 6.5mm Width
- Available in Dual and DIN Rail Mounting

Standard Time Delay Curves





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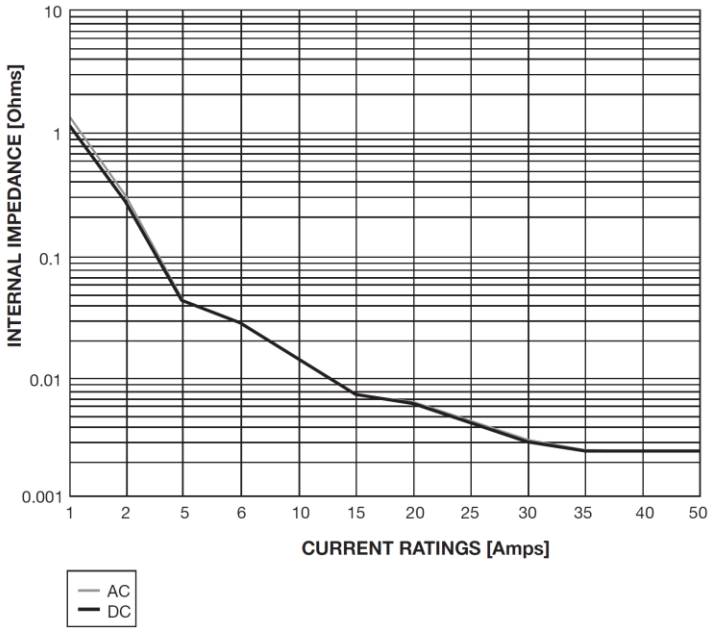
Established 1949

Internal Impedance vs Current Rating



Ordering Code

Group 1: Frame Type	**Code**	**Description**	**Comments**	
	QL	13mm width miniature circuit breaker	UL 489, IEC / EN 60947-2, VDE, CE, CCC	
Group 2: Auxiliary Switch	**Code**	**Description**	**Comments**	
	A	Auxiliary switch	Leave blank if not applicable.	
	T	Trip alarm		
	AT	Auxiliary switch + trip alarm combo		
Group 3: Number of Poles	**Code**	**Description**	**Comments**	
	1	Single pole		
	2	Double pole		
Group 4: Module Width	**Code**	**Description**	**Comments**	
	(13)	13mm module width	13mm per pole	
Group 5: Mounting	**Code**	**Description**	**Comments**	
	D	DIN rail mount	45mm Escutcheon, Grey body	
	DM	Dual mount	57mm Escutcheon, Black body	
Group 6: Time Delay	**Code**	**Description**	**Inst. Trip Point (x In)**	**Comments**
	1	Long, high instantaneous trip	10 - 20	Orange handle
	9	Long	7 - 12	White handle
	KM	Medium	6 – 12	White handle
	OP	Instantaneous	None	White handle
Group 7: Current Ratings	**Code**	**Description**	**Comments**	
	0.1A	0.1A	Examples only. Any rating possible, from 0.1 – 25A.	
	01A	1A		
	1.5A	1.5A		
	05A	5A		
	10A	10A		
	25A	25A		

03

For options not listed, please contact CBI for assistance

Example code: QL – 1(13)-DM-KM-20A

Group	1	2	3	4	5	6	7
Requirement	QL Frame	No auxiliary	Single pole	13mm	Dual mount	Medium delay	20A
Long code	QL	-	- 1	- (13)	- DM	- KM	- 20A

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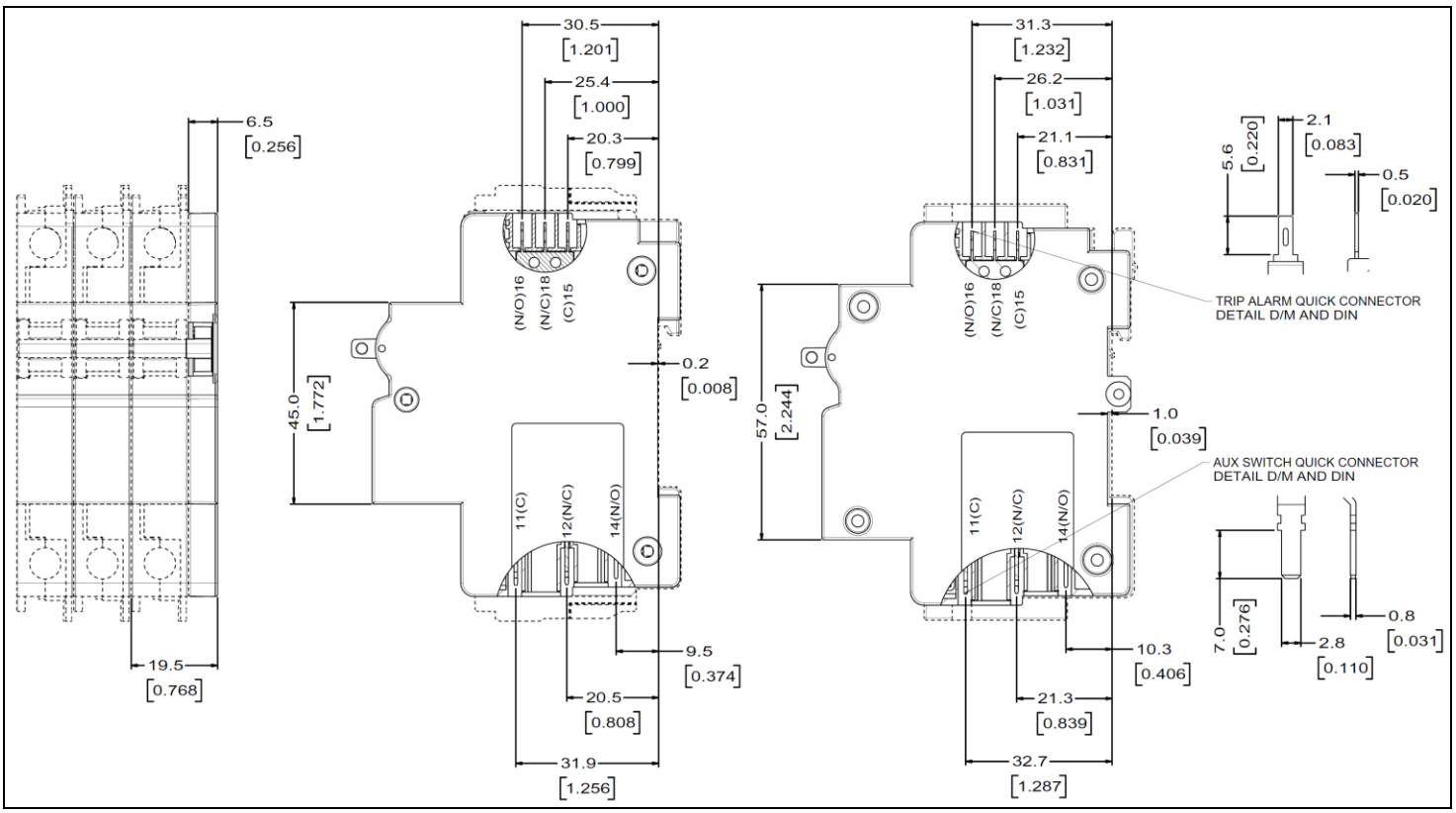
Established 1949

Auxiliary Outline Dimensions: DIN & Dual Mount



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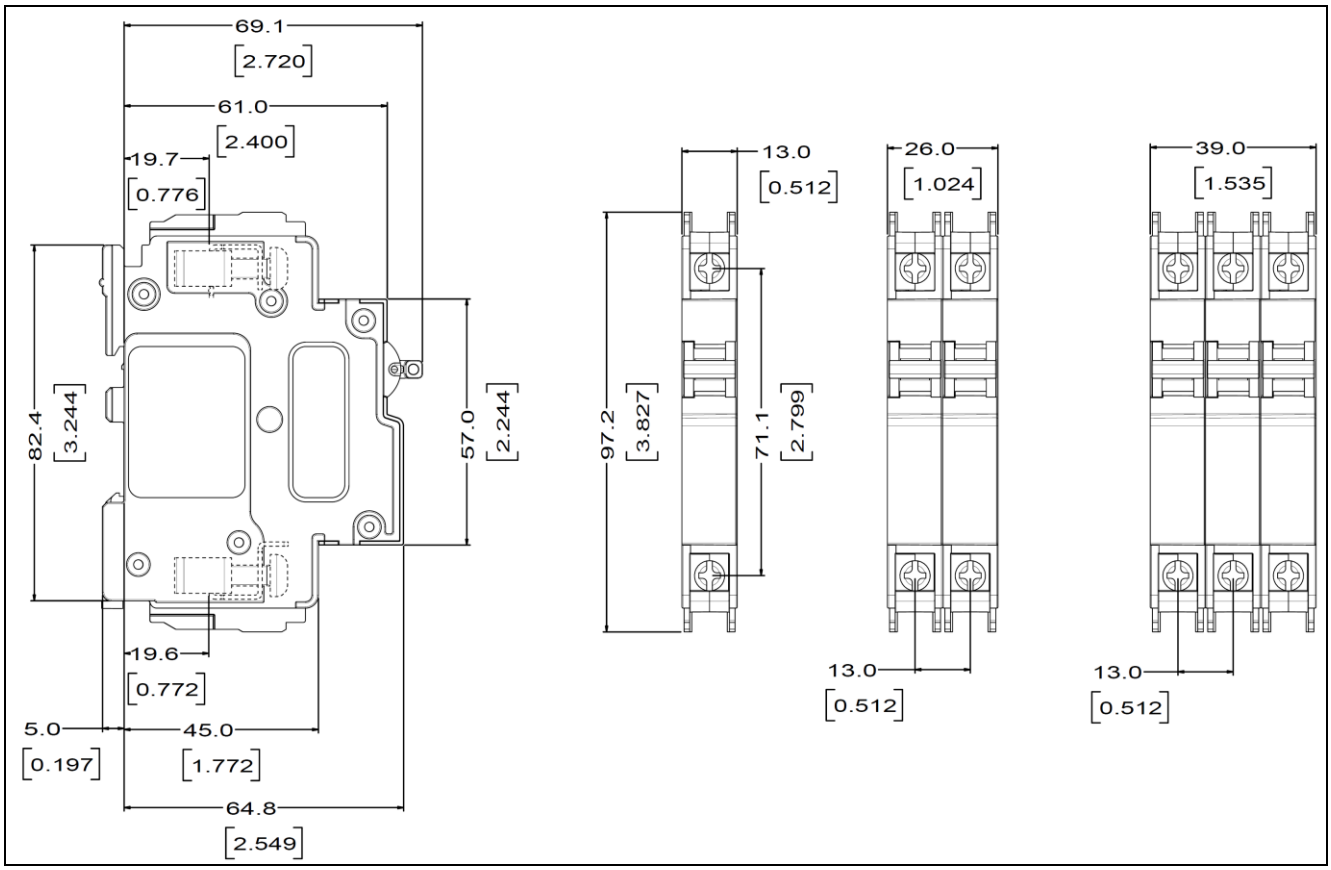
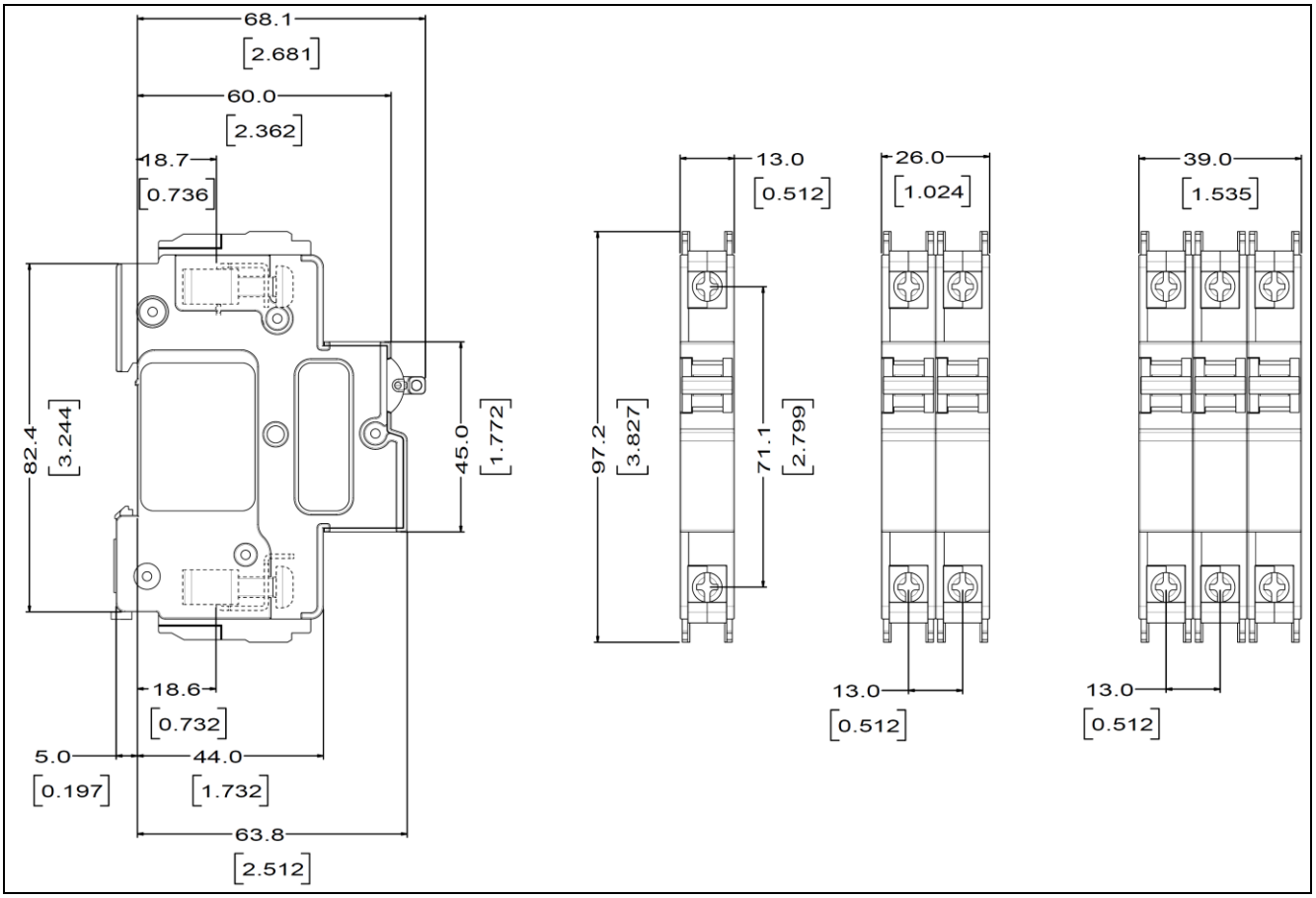
Established 1949

Outline Dimensions: Dual Mount



Outline Dimensions: DIN Mount



Circuit Breaker Industries Ltd.
Private Bag 2016, Isando 1600 • Tripswitch Drive, Elandsfontein, Gauteng, South Africa
Telephone: + 27 928 2000 • Telefax: + 27 11 392 2354 • e-mail: cbi@cbi.co.za • Reg. No. 05/15747/06
Established 1949

BASrouter — BACnet® Multi-Network Router (3.0 Version)

The BASrouter is a compact BACnet multi-network router which provides versatile stand-alone routing between BACnet/IP, BACnet Ethernet (ISO 8802-3), and BACnet MS/TP networks. The BACnet router is web page configurable and it is powered by 24 VAC/VDC. The BASrouter has a number of troubleshooting/ diagnostic capabilities. The BACnet MS/TP *"Status"* webpage contains a graphical table of all of the MS/TP devices on the network and their status. Also provided are network statistics, in addition to a BACnet/IP "Routing" webpage with a discoverable routing table which is useful when setting up or troubleshooting a BACnet network.

Versatile Routing Between …

- BACnet/IP and BACnet MS/TP
- BACnet Ethernet and BACnet MS/TP
- BACnet/IP and BACnet Ethernet
- BACnet/IP and BACnet Ethernet and BACnet MS/TP
- Two BACnet/IP Networks (between two UDP ports)

IP Network Support

- Web server for commissioning and troubleshooting
- DHCP option to automatically acquire IP address
- BACnet/IP Broadcast Management Device (BBMD)
- Foreign Device Registration (FDR)

Flexible Communications

- 10/100 Mbps Ethernet with auto-negotiation and Auto-MDIX
- Optically isolated MS/TP port
- MS/TP baud rates range from 9.6–76.8 kbps

Convenient Installation

- 24 VAC/VDC (± 10%), 47–63Hz input voltage
- Din-rail mounted
- Outdoor temperature operation -40°C to +75°C

Network diagnostics

- Webpage with graphical network map of all 128 MS/TP master devices and their status
- MS/TP error count
- BACnet network traffic statistics
- Discover and View current BACnet routing table

BACnet is a registered trademark of ASHRAE. ASHRAE does not endorse, approve or test products for compliance with ASHRAE standards. Compliance of listed products to the requirements of ASHRAE Standard 135 is the responsibility of BACnet International (BI). BTL is a registered trademark of BACnet International.

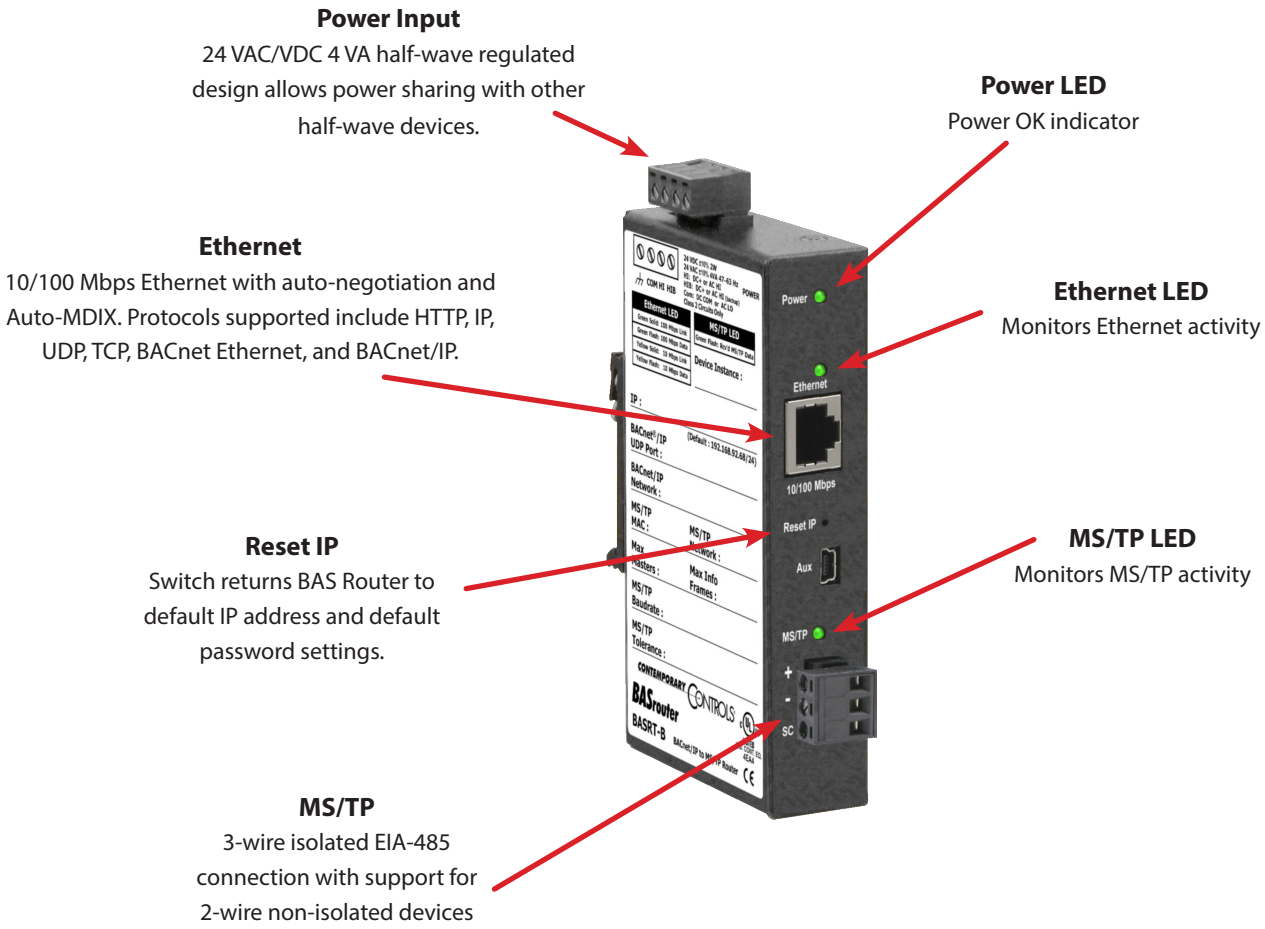
BASrouter — BACnet® Multi-Network Router

The BAS Router is housed in a metal case that mounts on 35-mm DIN-rail and is powered from a 24 VAC/VDC (± 10%) source. There is one MS/TP port and one 10/100 Mbps Ethernet port.

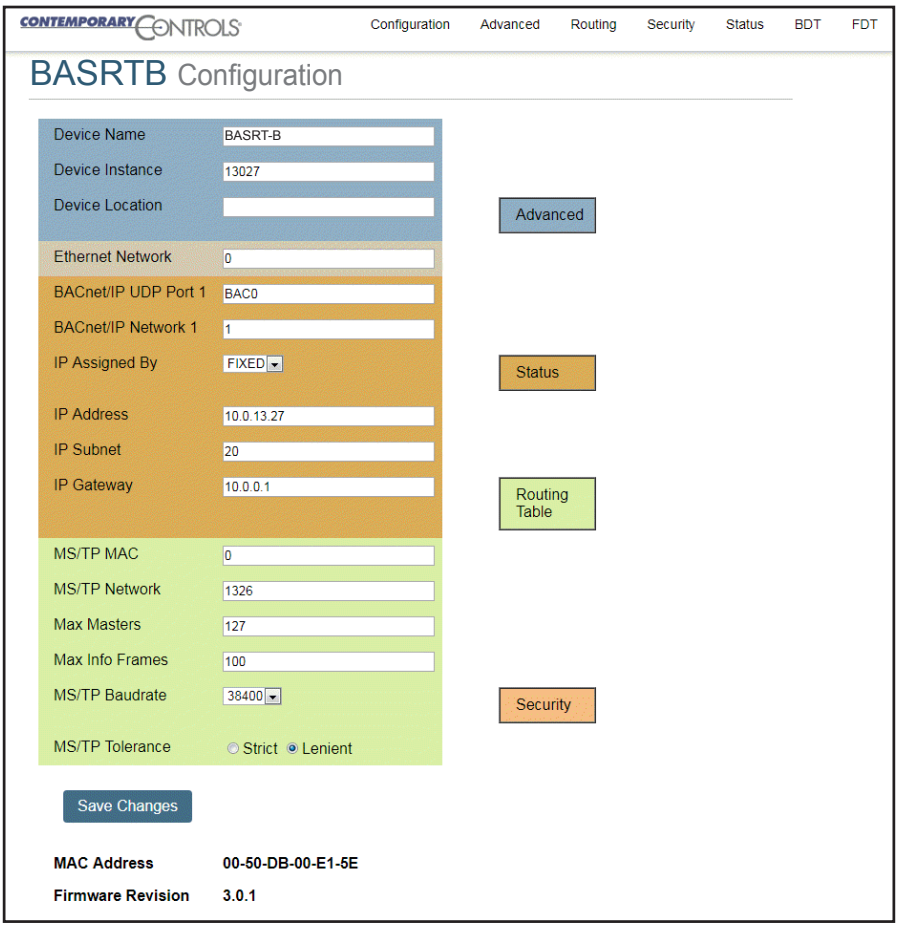
The MS/TP port offers an optically-isolated transceiver. It has a removable 3-pin terminal block for the EIA-485 connection. The Ethernet port offers a shielded RJ-45 connector. Auto-negotiation and Auto-MDIX allow this port to automatically match connections to the attached equipment. Therefore, either straight-through or crossover CAT5/6 cable can be used for hook-up.

A resident web server allows for commissioning, and troubleshooting using a standard web browser. A reset switch is provided on the router to return the unit to the factory default IP address of 192.168.92.68 (/24). Three LEDs are provided: The power LED glows green when proper power is provided. A bicolour Ethernet LED glows green for 100 Mbps, and yellow for 10 Mbps, and indicates activity by flashing. MS/TP LED flashes green when valid MS/TP traffic is received. When flashing continuously and without long interruptions, the MS/TP receive LED is a good indicator that the MS/TP network is operational.

Internal MS/TP bias and termination jumpers allow flexible bias and termination options. They can be removed for mid-span installations.

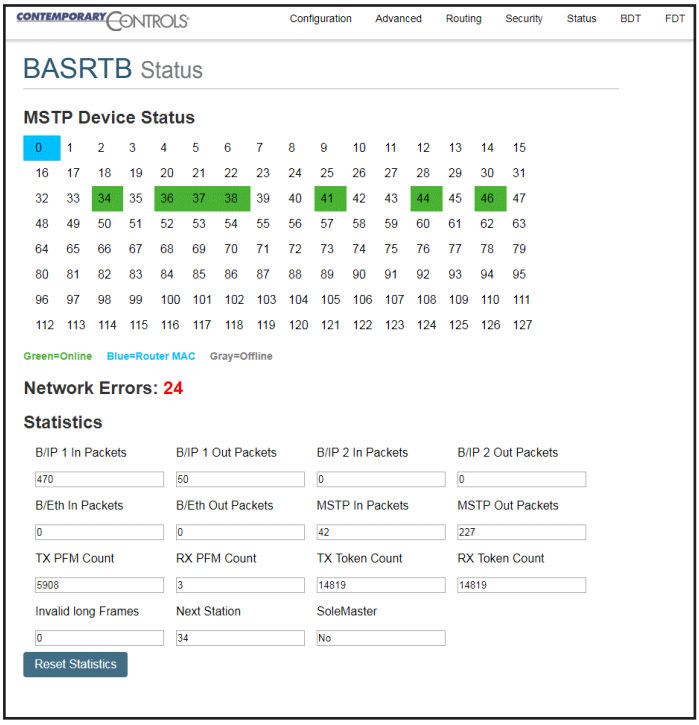


Web Page Configuration



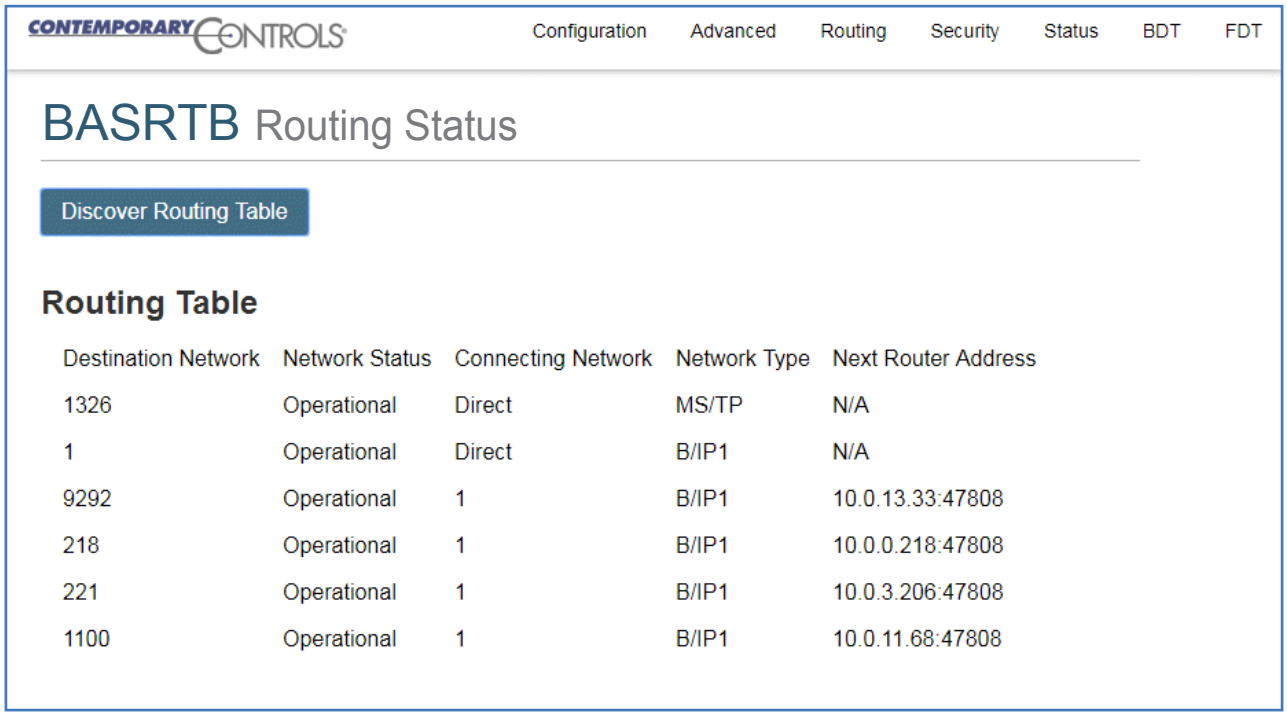
Status Screen

The Status screen is always operational as long as the BASrouter is powered. It consists of *MS/TP Device Status* table, *Network Errors* count, and *Statistics* on BACnet networks to which the BASrouter is connected. The *Status* page will automatically refresh every 5 seconds with the updated status on networks and devices — so you can observe the network state changes and gain insight into the condition of the BACnet network (as seen by the BASrouter). These statistics are retained over time, unless the BASrouter is powered off or rebooted from the main web page using the *"Save Changes"* button, then all Status page parameters are reset. The *"Reset Statistics"* button on Status page will reset Network Errors count, and Statistics, but retain the MSTP Device Status table history. For more information on the Status page refer to the BASrouter User Manual.



Routing Table

Multiple networks, possibly employing different physical layer technologies, may be interconnected by BACnet routers to form a BACnet internetwork. The Routing table web page provides a routing table which contains information about the network topology of the surrounding BACnet internetwork such as *Destination Network, Network Type, Connecting Network,* and *Network Status*. This table will be blank upon powering the BASrouter. Click the *"Discover Routing Table"* button to discover other routers on the BACnet network which will send a *"Who-Is-Router-To-Network"* message and fill the table with the discovered BACnet routers.



BAS Router Parameters Main Settings

Device Parameters	*Default Value*	*Description*
Device Name	BASRT-Bxxxxxx	The unique default value ends with the last 6 characters of the unit's Ethernet MAC address. You can edit it to be up to 20 characters.
Device Instance	0	The router device instance is a 22-bit decimal value (0–4,194,303). Each BACnet device has a unique device instance.
BACnet Ethernet Parameter	***Default Value***	***Description***
BACnet Ethernet Network	0	16-bit decimal value (1–65534). Each BACnet network, regardless of technology, must have a unique network number. By retaining the default value of 0, BACnet Ethernet routing is disabled.
BACnet/IP Parameters	***Default Value***	***Description***
BACnet/IP UDP Port	BAC0	16-bit hex value (0–FFFF) is set to BAC0 as the default value and should be used. All BACnet/IP devices on the same BACnet network must have the same UDP port assignment. For other assignments choose ports in the range from BAC1 to BACF while verifying that these ports are available.
BACnet/IP Network	1	16-bit decimal value (1–65534). Each BACnet network, regardless of technology, must have a unique network number. It is recommended that all subnets of the same BACnet/IP network be given the same BACnet network number as well.
IP Address	192.168.92.68	IP address in dotted decimal format. Select a valid address in the range from 0.0.0.1 through 255.255.255.254.
IP Subnet	24	Decimal value (0–30) in the "slash" notation is the number of bits with a "1" in the mask. The default value of 24 corresponds to 255.255.255.0 in the dotted decimal format. All devices on the same subnet which communicate via BACnet/IP should use the same subnet mask.
IP Gateway	192.168.92.1	IP Gateway address in dotted decimal format. Select a valid address in the range from 0.0.0.1 through 255.255.255.254.
MS/TP Parameters	***Default Value***	***Description***
MS/TP MAC Address	0	Decimal value (0–127) represents the MAC address of the router's MS/TP port. Lower MAC address numbers are preferred.
MS/TP Network	2001	16-bit decimal value (1–65535). Each BACnet network, regardless of technology, must have a unique network number.
Max Masters	127	This 8-bit decimal value (1–127) represents the highest master MAC address in the MS/TP network. If the highest value MAC address is unknown or if additional devices are to be added in the future above the current highest MAC address, use the default setting of 127.
Max Info Frames	100	This is the maximum number of messages (1–100) that can be routed onto the MS/TP network by the router per token pass. Values above 20 are typical.
MS/TP Baud Rate	38400	The baud rate of the MS/TP network can be 9600, 19200, 38400 or 76800 bps. All MS/TP devices on the same MS/TP network must use the same baud rate. Auto-bauding devices will set their baud rates to that of the BAS Router.
MS/TP Tolerance	Lenient	Affects the degree to which interoperability with devices is successful. Lenient option causes less efficient traffic but optimises interoperability.

BAS Router Parameters Advanced Settings — BBMD

BBMD Parameters	*Default Value*	*Description*
BBMD Enable	Unchecked	Check to enable BACnet/IP Broadcast Management Device (BBMD).
BBMD UDP Port	Primary	Normally the primary port is selected. The secondary port is used in very special applications.
Accept FDR	Checked	Uncheck to disable foreign devices from registering with this router.
Secondary BACnet/IP UDP Port	0000	Enter secondary UDP port as a 16-bit hex value (0-FFFF) when operating with two BACnet/IP BACnet networks. In this case use BAC1 if it is available.
Secondary BACnet/IP Net	0	Assign a unique network number from all other BACnet networks.
Public IP Address	0.0.0.0	Enter the public IP address in dotted decimal format of the IP router in the system.

BAS Router Additional Tables and Screens

Table or Screen Name	*Description*
Broadcast Distribution Table (BDT)	This table must contain the entries of any other BBMDs located on the network. The IP address and subnet mask of the BBMDs must be listed.
Foreign Device Table (FDT)	This table is automatically lists all the foreign devices that have registered with this router. Information includes IP address, port number, time-to-live, and remaining time on its lease.
Status Screen	Displays a log of events (automatically refreshed each second) to facilitate troubleshooting. Use this information when discussing any routing issues with Contemporary Controls' technical support.
Security Screen	Authentication menu. Allows the user to change user name and password. Depressing the Reset IP button restores user name and password to default settings.

BACnet Protocol Implementation Conformance (PIC) Statement

CONTEMPORARY CONTROLS

BASrouter

BACnet Multi-Network Router

BACnet Protocol Implementation Conformance Statement (Annex A)

Date: 15 February 2018
Vendor Name: Contemporary Controls
Product Name: BASrouter
Product Model Number: BASRT-B
Applications Software Version: 3.0.3 **Firmware Revision:** 3.0.3 **BACnet Protocol Revision:** 13
Product Description: The BASrouter from Contemporary Controls provides BACnet routing between BACnet/IP, MS/TP and ISO 8802-3 networks. It also supports BACnet Broadcast Management Device (BBMD) and Foreign Device Registration (FDR). By supporting two BACnet/IP UDP ports it can also assist BACnet messages in traversing NAT routers.

BACnet Standardized Device Profile (Annex L):
☒ **BACnet Router (B-RTR)**
☒ **BACnet Broadcast Management Device (B-BBMD)**

List all BACnet Interoperability Building Block Supported (Annex K):
DS-RP-B Data Sharing — ReadProperty – B
DS-RPM-B Data Sharing – ReadPropertyMultiple – B
DM-DOB-B Device Management — Dynamic Object Binding – B
DM-DDB-B Device Management — Dynamic Device Binding – B
NM-RC-B Network Management — Router Configuration – B
NM-BBMDC-B Network Management — BBMD Configuration – B

Segmentation Capability:
Segmentation is not supported.

Standard Object Types Supported:

Object Type Supported	Can Be Created Dynamically	Can Be Deleted Dynamically
Device	No	No

No optional properties are supported. **NOTE:** The above object is directed supported on the router. The router will pass to the appropriate network all BACnet communications not directed to the router.

Data Link Layer Options:
☒ BACnet IP, (Annex J) BACnet Broadcast Management Device (BBMD)
☒ BACnet IP, (Annex J), Network Address Translation (NAT Traversal)
☒ ISO 8802-3, Ethernet (Clause 7)
☐ ANSI/ATA 878.1, EIA-485 ARCNET (Clause 8), baud rate(s):
☒ MS/TP master (Clause 9), baud rate(s): 9600; 19,200; 38,400; 76,800
☐ MS/TP slave (Clause 9), baud rate(s):
☐ Point-To-Point, EIA 232 (Clause 10), baud rate(s):
☐ Point-To-Point, modem, (Clause 10), baud rate(s):
☐ LonTalk, (Clause 11, medium:

Device Address Binding:
Is static device binding supported? (This is currently necessary for two-way communication with MS/TP slaves and certain other devices.) ☐ Yes ☒ No

Networking Options:
☒ Router, Clause 6 — routing between BACnet/IP, ISO 8802-3, and MS/TP

Character Sets Supported:
Indicating support for multiple character sets does not imply that they can all be supported simultaneously.
☒ ISO 10646 UTF-8

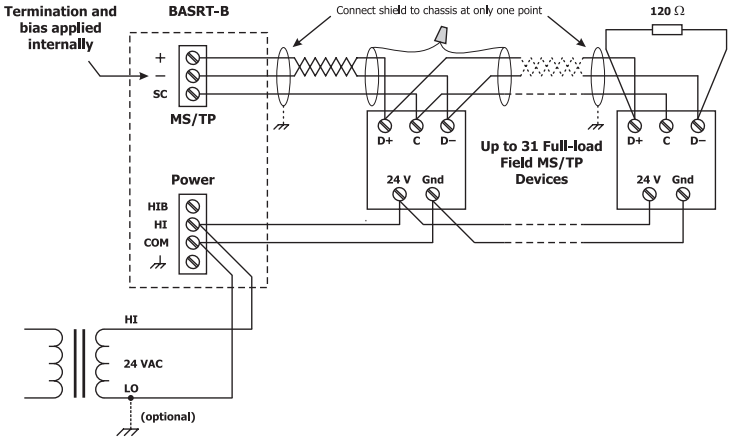
If this product is a communication gateway, describe the types of non-BACnet equipment/network(s) that the gateway supports:
No gateway support.

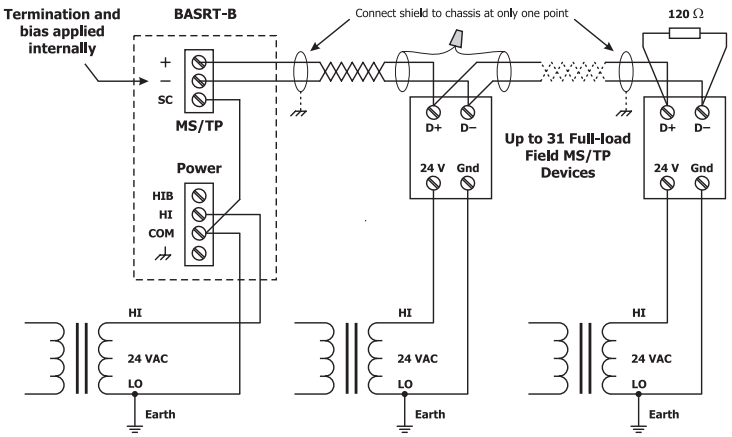
15 February 2018 PI-BASRTB00-AA1

Wiring Diagrams

Since the BAS Router incorporates a half-wave rectifier circuit, it can share the same 24 VAC power with other half-wave rectified devices. It can also be powered from a 24 VDC source. A redundant power connection exists for back-up power schemes.

The BAS Router incorporates a 3-wire optically-isolated EIA-485 interface for the MS/TP connection, allowing better circuit protection and noise immunity. To connect to other 3-wire devices simply make a one-to-one connection to the other devices. But when connecting to 2-wire non-isolated devices, the signal common (SC) on the BAS Router must share the reference used by the 2-wire devices. This is accomplished by tying the SC pin to COM on the BAS Router and by grounding the low-side of each power supply on all connected devices. In this way all EIA-485 transceivers share the same earth reference. Notice that the SC pin is signal common and not a shield pin.

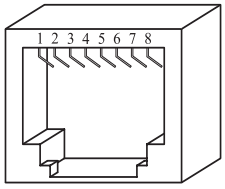




Connector Pin Assignments

Ethernet

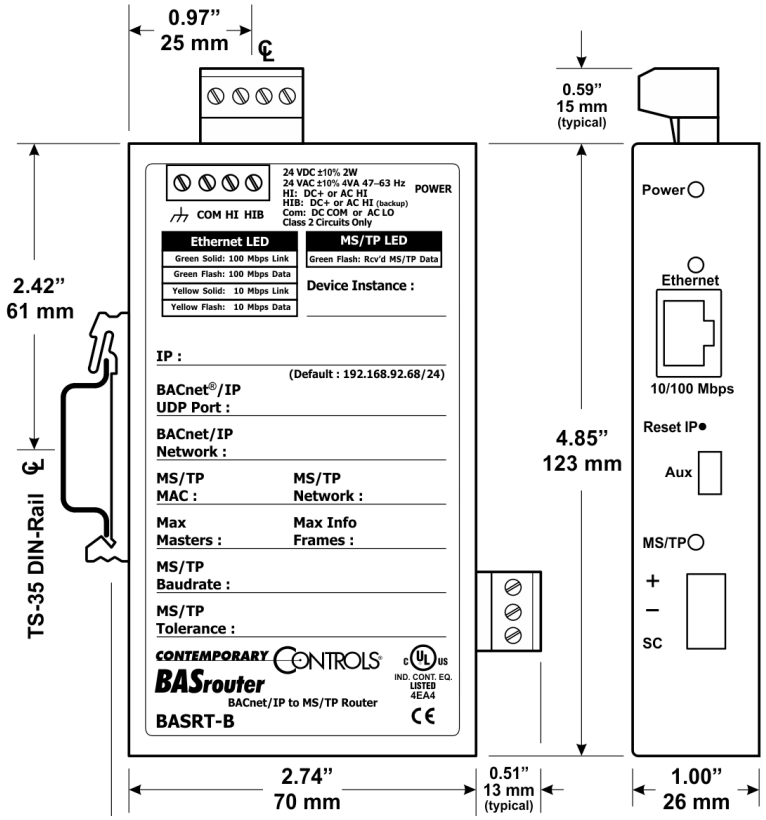
Pin	Function
1	Signal 1
2	Signal 2
3	Signal 3
4	N/C
5	N/C
6	Signal 4
7	N/C
8	N/C



MS/TP

Pin	Function
+	Signal High
–	Signal Low
SC	Signal Common

Mechanical Drawing



Specifications

Power Requirements	24 VDC ±10% 2 W or 24 VAC ±10% 4 VA 47–63 Hz	
Operating Temperature	–40°C to +75°C	
Storage Temperature	–40°C to +85°C	
Relative Humidity	10–95%, non-condensing	
Protection	IP30	
Ethernet Communications	IEEE 802.3 10/100 Mbps data rate 10BASE-T, 100BASE-TX physical layer 100 m (max) CAT5 cable length	
MS/TP Communications	ANSI/ASHRAE 135 (ISO 16484-5) 9600, 19200, 38400, 76800 bps data rate EIA-485 physical layer 1200 m (max) cable length	
LEDs	Power	Green = power OK
	Ethernet	Green = 100 Mbps Yellow = 10 Mbps Flash = activity
	MS/TP	Flashing Green = receive activity
Regulatory Compliance	CE Mark; CFR 47, Part 15 Class A; RoHS UL 508, C22.2 No. 142-M1987	

c UL us LISTED IND. CONT. EQ. 4EA4

Ordering Information

Model	***RoHS***	***Description***
BASRT-B	✔	BASrouter BACnet/IP to MS/TP to Ethernet DIN-Rail Mount

United States
Contemporary Control Systems, Inc.
Tel: +1 630 963 7070
Fax:+1 630 963 0109
info@ccontrols.com

China
Contemporary Controls (Suzhou) Co. Ltd
Tel: +86 512 68095866
Fax: +86 512 68093760
info@ccontrols.com.cn

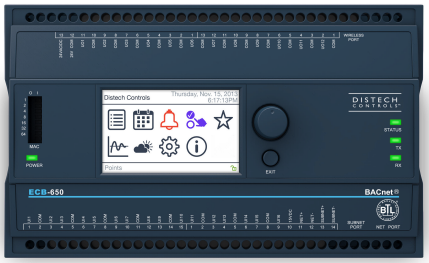
United Kingdom
Contemporary Controls Ltd
Tel: +44 (0)24 7641 3786
Fax:+44 (0)24 7641 3923
info@ccontrols.co.uk

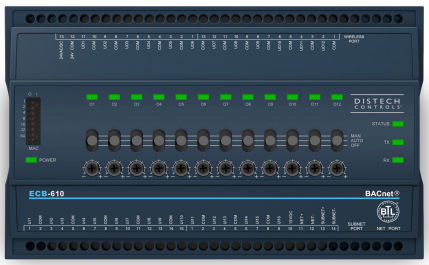
Germany
Contemporary Controls GmbH
Tel: +49 341 520359 0
Fax: +49 341 520359 16
info@ccontrols.de

www.ccontrols.com

ECB-600 Series

BACnet B-AAC 28-Point Programmable Controllers





Overview

The ECB-600 Series controllers are microprocessor-based programmable controllers designed to control various building automation applications such as air handling units, chillers, boilers, pumps, cooling towers, and central plant applications. This series supports up to two ECx-400 Series I/O extension modules.

This controller uses the BACnet® MS/TP LAN communication protocol and is BTL®-Listed as BACnet Advanced Application Controllers (B-AAC).

Features & Benefits

- Flexible inputs and outputs support all industry-standard HVAC unitary applications
- Rugged hardware inputs and outputs eliminate the need for external protection equipment
- Models available with HOA switches and potentiometers are ideal for equipment testing or commissioning
- An optional full-color backlit display with jog dial provides direct access to a wide range of controller functions
- Supports EC-*gfx*Program, making Building Automation System programming effortless
- Open-to-Wireless™ ready, supporting a wide variety of wireless sensors and switches and helping to reduce installation costs
- Supports the Allure™ Series Communicating Sensors, providing intelligent sensing and environmental zone control

Model Selection

Example: ECB-*600*

Series	Model	Options
ECB-	***600***: 28 Points, 15Vdc Power Supply, 16 UI, 12 UO	***UUKL:*** UL 864, 10th Edition UUKL and California State Fire Marshal Listed[1]
	610: 28 Points, 15Vdc Power Supply, 16 UI, 12 UO, HOA	
	650: 28 Points, 15Vdc Power Supply, 16 UI, 12 UO, Color Display	

1. The UL 864 UUKL Listed Smoke Control Equipment is used only in Distech Controls' UUKL smoke control system. For detailed specifications, requirements and procedures for installing and operating UUKL Listed equipment refer to the Distech Controls' UUKL Smoke Control documentation.

Recommended Applications

Model	ECB-600 / 610 / 650	ECB-600 UUKL
Air Handling Unit	■	■
Multi-Zone Application	■	
Chiller	■	
Boiler	■	
Cooling Tower	■	
Central Plant	■	
Exhaust Fan		■

BACnet Objects List

BACnet Objects

Calendar Objects	2
Events per calendar	45
Schedule Objects	10
Special events per schedule	10
PID Loop Objects	30
Input Objects (AI, BI, MSI)[1]	68[2]
Output Objects (AO, BO)[1]	12[3]
Alarm Notification Classes	5

1. Supports object internally-generated alarms (intrinsic reporting).
2. This consists of Hardware Inputs, Allure Series Communicating Sensor Inputs, and Open-to-Wireless Inputs.
3. This consists of Hardware Outputs.

Commandable Objects[1]

BV Objects	20
MSV Objects	20
AV Objects	35

Non-Commandable Objects

BV Objects	55
MSV Objects	55
AV Objects	115

1. Supports object internally-generated alarms (intrinsic reporting).

Product Specifications

Power Supply Input

Voltage Range	24VAC/DC; ±15%; Class 2
Frequency Range	50/60Hz
Overcurrent Protection	Field replaceable fuse
Fuse Type	3.0A
Power Consumption ECB-600 / ECB-610	22 VA typical plus all external loads[1], 65 VA max.
Power Consumption ECB-650	25 VA typical plus all external loads[1], 68 VA max.

1. External loads must include the power consumption of any connected modules such as an Allure Series Communicating Sensor. Refer to the respective module's datasheet for related power consumption information.

Communications

Communication Bus	BACnet MS/TP
BACnet Profile	B-AAC[1]
EOL Resistor	Built-in, jumper selectable
Baud Rates	9600, 19 200, 38 400, or 76 800 bps
Addressing	Dip switch or with an Allure EC-Smart-Vue Series Communicating Sensor

1. Refer to Distech Controls' Protocol Implementation Conformity Statement for BACnet.

Subnetwork

Communication	RS-485
Cable	Cat 5e, 8 conductor twisted pair
Connector	RJ-45
Connection Topology	Daisy-chain

Room Devices Support

Maximum combined number of devices per controller	12[1]
Allure EC-Smart-Vue Series	Up to 12
Allure EC-Smart-Comfort Series (not supported by UUKL)	Up to 6
Allure EC-Smart-Air Series (not supported by UUKL)	Up to 6

1. A controller can support a maximum of 2 Allure sensor models equipped with a CO_2 sensor. Any remaining connected sensors must be without a CO_2 sensor.

Hardware

Processor	STM32 (ARM Cortex™ M3) MCU, 32 bit
CPU Speed	72 MHz
Applications Memory	1 MB Non-volatile Flash
Storage Memory	2 MB Non-volatile Flash

RAM Memory	96 kB RAM
Real Time Clock (RTC)	Built-in Real Time Clock with rechargeable battery Network time synchronization is initially required
RTC Battery	20 hours charge time, 20 days recharge time Up to 500 charge/discharge cycles
Green LEDs	Power status & LAN Tx
Orange LEDs	Controller status & LAN Rx
Communication Jack	BACnet 1/8" (3.5mm) stereo audio jack

I/O Extension Modules (ECx-400 Series)

Communication	RS-485
Number of I/O extension modules per controller	Up to 2, in daisy-chain configuration

Wireless Receiver

Communication Protocol	EnOcean wireless standard[1]
Number of Wireless Inputs[2]	28
Supported Wireless Receivers	Refer to the Open-to-Wireless Application Guide
Cable	Telephone cord
Connector	4P4C modular jack
Length (maximum)	2m (6.5ft)

1. Available when an optional external Wireless Receiver module is connected to the controller. Refer to the Open-to-Wireless Application Guide for a list of supported EnOcean wireless modules.
2. Some wireless modules may use more than one wireless input from the controller.

Mechanical

Dimensions (H × W × D) ECB-600 / 610	4.7 × 7.7 × 2.03” (119.38 × 195.58 × 51.47 mm)
Dimensions (H × W × D) ECB-650	4.7 × 7.7 × 2.55” (119.38 × 195.58 × 64.68 mm)
Shipping Weight ECB-600 / 610	1.17lbs (0.53 kg)
Shipping Weight ECB-650	1.28lbs (0.58 kg)
Enclosure Material[1]	FR/ABS
Enclosure Rating	Plastic housing, UL94-5VB flammability rating Plenum rating per UL1995
Installation	Direct DIN-rail mounting or wall mounting through mounting holes (see figure above for hole positions)

1. All materials and manufacturing processes comply with the RoHS directive and are marked according to the Waste Electrical and Electronic Equipment (WEEE) directive

Environmental

Operating Temperature	32°F to 122°F (0°C to 50°C)
Storage Temperature	-4°F to 122°F (-20°C to 50°C)
Relative Humidity	0 to 90% Non-condensing

Standards and Regulation

CE Emission	EN61000-6-3: 2007; A1:2011
CE Immunity	EN61000-6-1: 2007
FCC	Compliance with FCC rules part 15, subpart B, class B
UL Listed (CDN & US)	UL916 Energy management equipment
UL 864	UL 864, 10th Edition, UUKL Listed Smoke Control Equipment (ECB-600 UUKL model only)[1]
California State Fire Marshal Listing	CSFM: 7300-2187:0100 (ECB-600 UUKL model only) [1]
CEC Appliance Database	Appliance Efficiency Program[2]

1. For detailed specifications regarding the ECB-600 UUKL model, refer to the Distech Controls UUKL Smoke Control Design Guide.
2. California Energy Commission’s Appliance Efficiency Program: The manufacturer has certified this product to the California Energy Commission in accordance with California law.

ECB-650 Display

Display Type	Backlit-color LCD
Display Resolution	400 W x 240 H pixels (WQVGA)
Effective Viewing Area (W × H)	2.4 × 1.4” (61.2 × 36.7mm) diagonal: 2.8” (71mm)
Menu Navigation	Jog dial turn, select navigation with Exit button

Universal Inputs (UI)

General

Input Type	Universal; software configurable
Input Resolution	16-Bit analog / digital converter
Power Supply Output	15VDC; maximum 320mA

Contact

Type	Dry contact

Counter

UI1 to UI4:

Type	SO output compatible
Maximum Frequency	50Hz maximum
Minimum Duty Cycle	10milliseconds On / 10milliseconds Off

UI5 to UI10:

Type	Dry contact
Maximum Frequency	1Hz maximum
Minimum Duty Cycle	500ms On / 500ms Off

0 to 10VDC

Range	0 to 10VDC (40kΩ input impedance)

0 to 5VDC

Range	0 to 5VDC (high input impedance)

0 to 20mA

Range	0 to 20mA
	249Ω jumper configurable internal resistor

Resistance/Thermistor

Range	0 to 350 KΩ
Supported Thermistor Types	Any that operate in this range

Pre-configured Temperature Sensor Types:

Thermistor	10KΩ Type 2, 3 (10KΩ @ 77ºF; 25ºC)
Platinum	Pt1000 (1KΩ @ 32ºF; 0ºC)
Nickel	RTD Ni1000 (1KΩ @ 32ºF; 0ºC) RTD Ni1000 (1KΩ @ 69.8ºF; 21ºC)

Universal Outputs (UO)

General

Output Type	Universal; software configurable
Output Resolution	10-bit digital to analog converter
Output Protection	Built-in snubbing diode to protect against back-EMF, for example when used with a 12VDC relay Output is internally protected against short circuits
Load Resistance	Minimum 200 Ω for 0-10VDC and 0-12VDC outputs Maximum 500 Ω for 0-20mA output
Auto-reset fuse	Provides 24VAC over voltage protection

0 or 12VAC (On/Off)

Range	0 or 12VDC
Source Current	Maximum 60 mA at 12VDC (minimum load resistance 200Ω)

PWM

Range	Adjustable period from 2 to 65 seconds
Thermal Actuator Management	Adjustable warm up and cool down time

Floating

Minimum Pulse On/Off Time	500 milliseconds
Drive Time Period	Adjustable

0 to 10VDC

Range	0 to 10VDC
Source Current	Maximum 60 mA at 10VDC (minimum load resistance 200Ω)

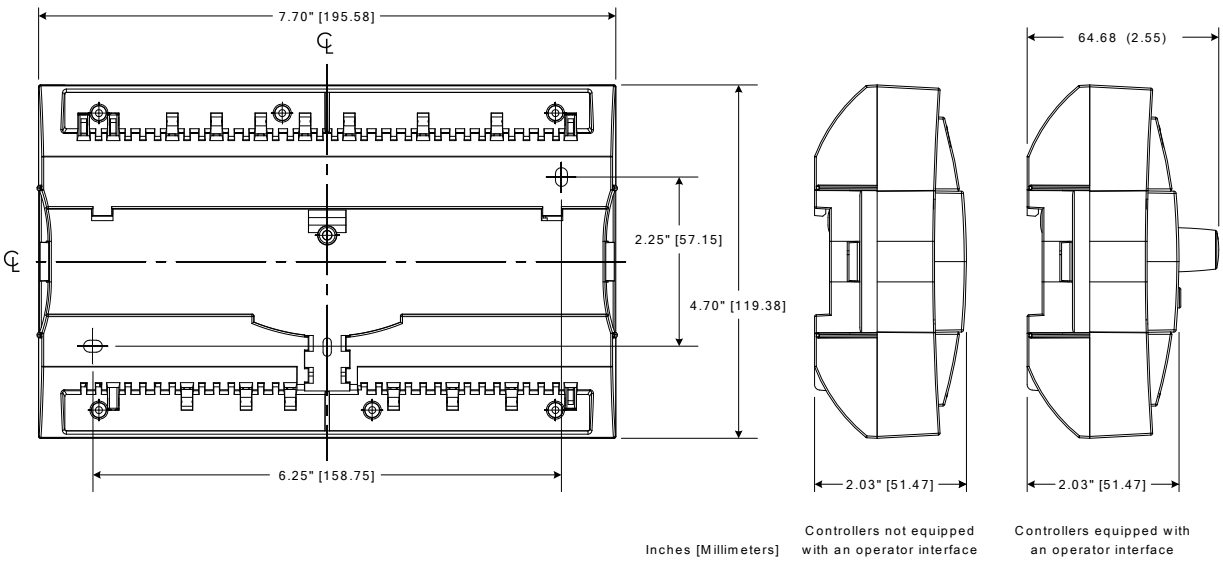
0 to 20mA

Range	0 to 20mA
Type	Current source (jumper configurable)

HOA

Hand-Off-Auto switch	When equipped. Supervision allows control logic to read the current HOA switch and potentiometer settings
Threshold	Configurable
Potentiometer Voltage Range	0 to 12.5VDC

Dimensions



Inches [Millimeters]

Controllers not equipped with an operator interface

Controllers equipped with an operator interface

ECB Series BACnet® Controllers

Figure 1: From left to right: ECB-650 with operator interface, ECB-410 with HOA, ECB-203

Product Description

This document describes the hardware installation procedures for the ECB Series BACnet controllers.

The Distech Controls ECB Series controllers are designed to control and monitor various HVAC equipment such as roof top units, air handling units as well as chillers, boilers, and central plant applications. Moreover, these controllers are suitable for any lighting control and power measurement applications. This product line includes the following controllers: ECB-203, ECB-300, ECB-400 Series, ECB-600 Series.

For controllers equipped with an operator interface (ECB-x50 models), refer to the ECL-x50 and ECB-x50 Series Controller User Guide for how to use the this interface.

The ECB-600 Series are compatible with the IO Extension Module product line, which includes the following modules: ECx-400, ECx-410, and ECx-420 (refer to the ECx-400 series IO Extension Module Hardware Installation Guide).

Each controller uses the BACnet® MS/TP LAN communication protocol.

This document describes the hardware installation procedures for the following controllers: ECB-203, ECB-300, ECB-400 Series, and ECB-600 Series controllers only.

- ☐ These controllers are all built on a similar platform, but have different numbers of inputs and outputs. Moreover, each individual model has different amounts of digital and/or universal outputs. For more information on the specific layout and functionality of each controller, please refer to their individual datasheets.
- ☐ The following controllers are housed in small enclosures: ECB-203 Series and ECB-300 Series.
- ☐ The following controllers are housed in large enclosures: ECB-400 Series and ECB-600 Series.

General Installation Requirements

For proper installation and subsequent operation of the device, pay special attention to the following recommendations:

- ☐ It is recommended that the controller(s) be kept at room temperature for at least 24 hours before installation to allow any condensation that may have accumulated due to low temperature during shipping/storage to evaporate.
- ☐ Upon unpacking, inspect the contents of the carton for shipping damages. **Do not install a damaged device.**
- ☐ The device is designed to operate under environmental conditions that are specified in its datasheet.
- ☐ Ensure proper ventilation of the device and avoid areas where corroding, deteriorating or explosive vapors, fumes or gases may be present.
- ☐ Allow for proper clearance around the device's enclosure and wiring terminals to provide easy access for hardware configuration and maintenance.
- ☐ When installing in an enclosure, select one that provides sufficient surface area to dissipate any heat generated by the device and by any other devices installed in the enclosure. A metal enclosure is preferred. If necessary, provide active cooling for the enclosure.
- ☐ Orient the controller with the ventilation slots and power supply/output terminal block connectors towards the top to permit proper heat dissipation.
- ☐ The device's plastic enclosure has a back plate that is separable from the front plate allowing the back plates (with the connectors) to be shipped directly to the installation site while all the engineering is done in the office.
- ☐ The device's datasheet specifies the power consumption (amount of heat generated), the operating temperature range, and other environmental conditions the device is designed to operate under.
- ☐ Ensure that all equipment is installed according to local, regional, and national regulations.
- ☐ Do not drop the device or subject it to physical shock.
- ☐ If the device is used and/or installed in a manner not specified by Distech Controls, the functionality and the protection provided by the device may be impaired.

Any type of modification to any Distech Controls product will void the product's warranty

Take special care to keep the front and back plate aligned when separating and joining them.

Before installation of the Wireless Receiver, verify that local communication regulations allow the installation of wireless devices and available frequencies to be supported in your area. Refer to the Open-to-Wireless™ Application Guide for more information.

Take reasonable precautions to prevent electrostatic discharge to the device when installing, servicing or during operation. Discharge accumulated static electricity by touching one's hand to a well-grounded object before working with the device.

Device Markings (Symbols)

Certain markings (symbols) can be found on the controller and are defined as follows:

Symbol	Description
CE	CE marking: the device conforms to the requirements of applicable EC directives.
	Products must be disposed of at the end of their useful life according to local regulations.
	Read the Hardware Installation Guide for more information.
c UL us LISTED	UL marking: conforms to the requirements of the UL certification.
FC	FCC marking: This device complies with FCC rules part 15, subpart B, class B.
	Warning Symbol: Significant information required. Refer to the Hardware Installation Guide.
	Alternating Current
	Direct Current

General Wiring Recommendations

Risk of Electric Shock: Turn off power before any kind of servicing to avoid electric shock.

- ☐ All wiring must comply with electrical wiring diagrams as well as national and local electrical codes.
- ☐ To connect the wiring to a device, use the terminal connectors. Use a small flat screwdriver to tighten the terminal connector screws once the wires have been inserted (strip length: 0.25'' (6 mm), maximum tightening torque 0,4 Nm (3.45 in-lb)).
- ☐ Comply with all network and power supply guidelines outlined in the Network Guide.
- ☐ Always use unshielded cabling with a minimum Category 5 (CAT5) cable for ethernet communications.
- ☐ Keep wiring separate according to their function and purpose to avoid any ambient noise transmission to other wires. Use strapping to keep these wires separated. For example, keep power, hazardous voltage, SELV, PELV, network, and input wiring separate from each other.
- ☐ The board connectors accept wires or flat cables ranging from 22 to 14AWG (0.644 to 1.630mm diameter) per pole. However, power cables must be between 18 and 14AWG (1.024 to 1.630mm diameter).
- ☐ Keep all wires away from high speed data transmission cables (for example, Ethernet, etc.).
- ☐ Do not connect the universal inputs, analog/digital outputs or common terminals to earth or chassis ground (unless stated otherwise).
- ☐ Keep input and output wiring in conduits, trays or close to the building frame if possible.

Controller Dimensions & Components

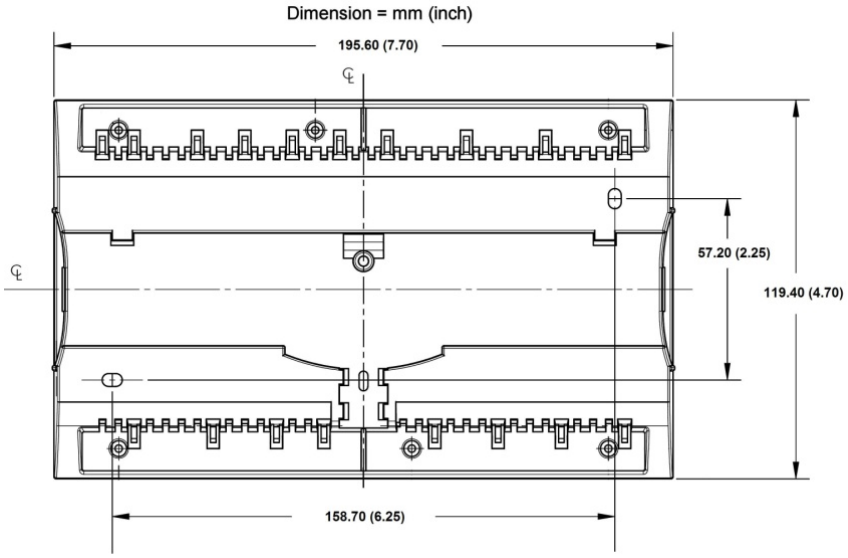


Figure 2: Rear view of large enclosure

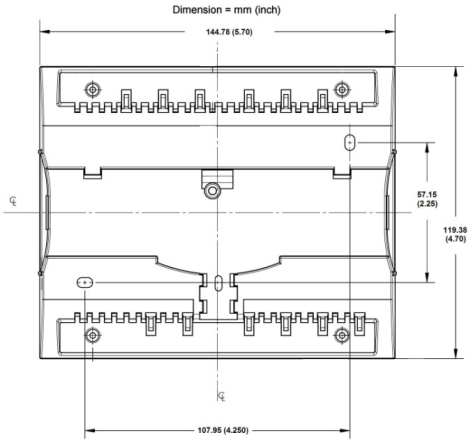


Figure 3: Rear view of small enclosure

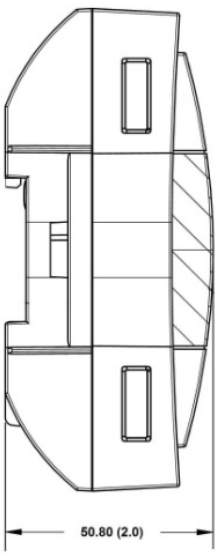
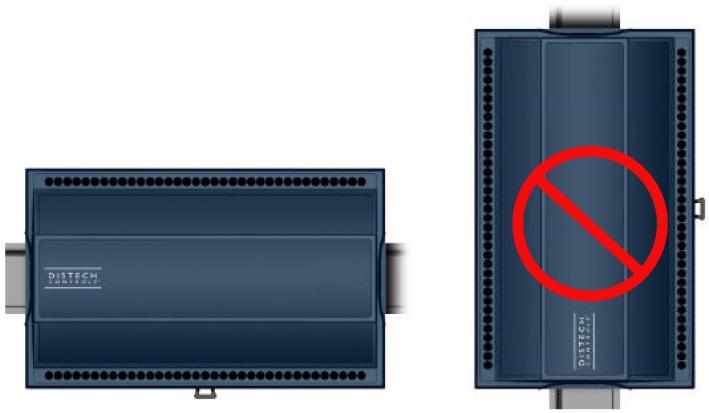


Figure 4: Side view of large and small enclosure

Mounting Instructions

The controllers can be mounted on a DIN rail to speed up the installation procedure. They are also equipped with two mounting holes 0.25” x 0.165” (6.35mm x 4.191mm). The controllers can be mounted in a panel or on a wall by using appropriate screw types (use sheet metal, thread forming, or self-tapping screws accordingly).

The controller’s mounting orientation must be horizontal with controller’s back attached to a vertical wall surface.



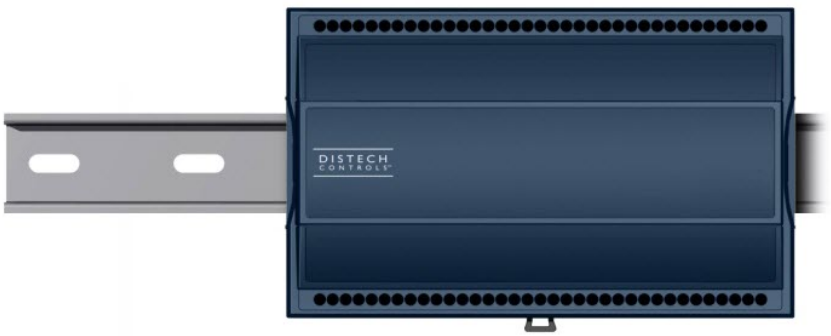
Horizontal Mounting Position:
Required for DIN rail mounting
Required for wall mounting

Vertical Mounting Position:
Is Forbidden

Figure 5: Permitted Mounting Positions

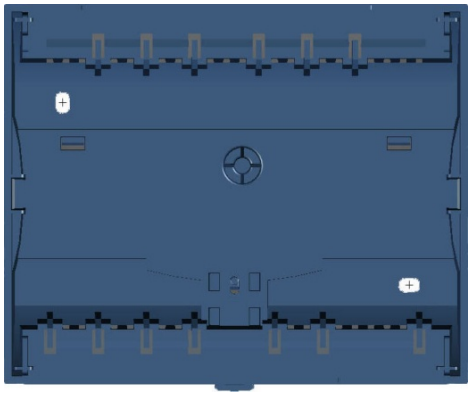
DIN Rail-Mounted Installation

1. Ensure the DIN rail is properly mounted on the wall.
2. Simply clip controller onto the DIN rail.



Wall-Mounted Installation

3. Open the enclosure by separating the front and back plate while pressing on the side clips.
4. Use the back plate’s mounting holes to mark the location of any holes that need to be drilled.
5. Drill the holes.
6. Clean the surface and mount the controller using the appropriate screw types.



Power Wiring

Voltage: 24VAC/DC; ± 15%, Class 2

This is a Class 2 Product. Use a Class 2 transformer only (rated at 100VA or less at 24VAC) to power the controller(s).

The Network Guide provides extensive information and requirements for powering a controller that uses a BACnet network for communications. It can be downloaded from our website.

It is recommended to wire only one controller per 24VAC transformer.

If only one 24VAC transformer is available, determine the maximum number of controllers that can be supplied using the following method to determine the required power transformer capacity:

- ☐ Add up the maximum power consumption of all controllers including external loads and multiply this sum by 1.3.
- ☐ If the resulting number is higher than 100VA, use multiple transformers.

Use an external fuse on the 24VAC side (secondary side) of the transformer, as shown below, to protect all controllers against power line spikes.

Maintain consistent polarity when connecting controllers and devices to the transformer. One terminal on the secondary side of the transformer must be connected to the building's ground. All 24V COM terminals of all controllers and peripherals throughout the BACnet MS/TP network must be connected to the grounded transformer terminal as shown below. This ensures that the 24V COM terminals of all devices connected to any BACnet MS/TP bus in the building are at the same potential.

It is recommended to use a separate transformer for each ECB-600 series controller and for each of its associated IO Extension Module (ECx-400s). Note that the figures below show how controller power wiring can be daisy-chained if the application permits.
One terminal on the secondary side of each of these transformers must be connected to the building's ground and to the respective controller's or IO Extension Modules' 24V COM terminal.

A mechanical ground is unacceptable: Do not use a pipe, conduit, or duct work for a ground. The power supply must have a dedicated ground wire that comes from the main electrical supply panel.

Failure to maintain consistent polarity throughout the entire network will result in a short circuit and/or damage to the controller!
The COM terminals of the controller are internally wired to the 24V COM terminal of the power supply. Connecting a peripheral or another controller to the same transformer without maintaining polarity between these devices will cause a short circuit.

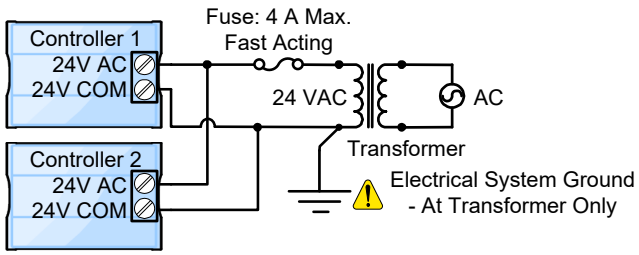


Figure 6: Power wiring – AC

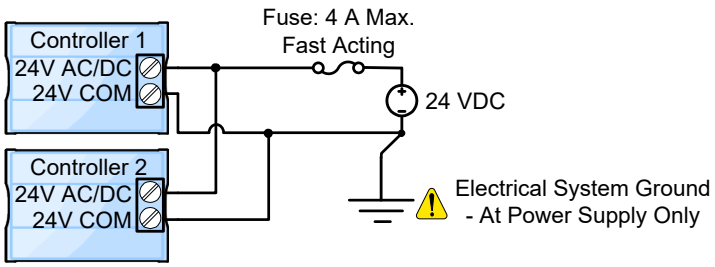


Figure 7: Power wiring – DC

Jumper Identification and Configuration

Controllers have the following onsite configurable jumpers.

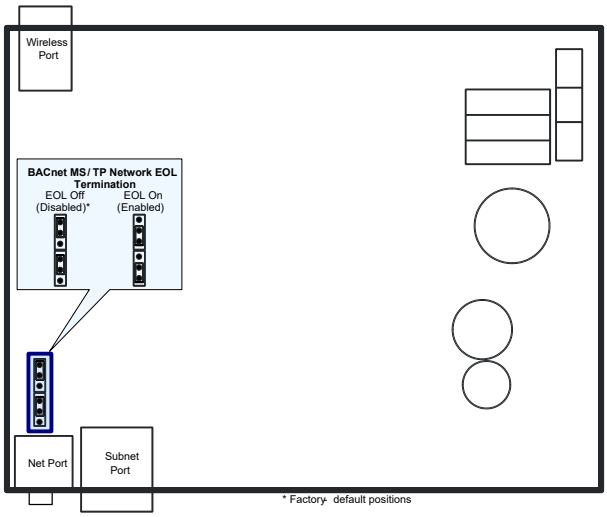


Figure 8: ECB-203 Controller Jumper Locations

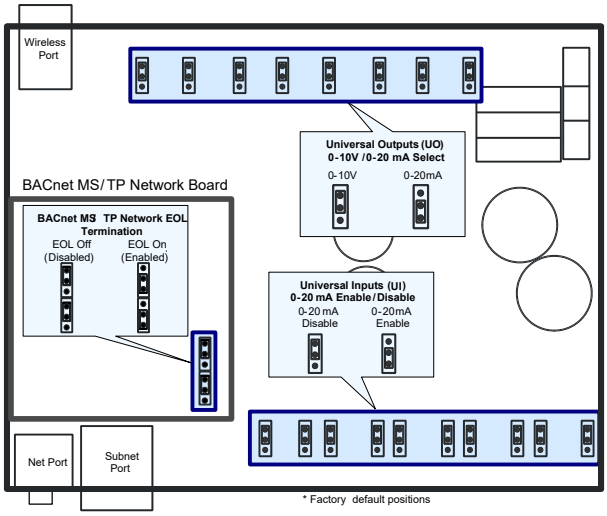


Figure 9: ECB-300 Controller Jumper Locations

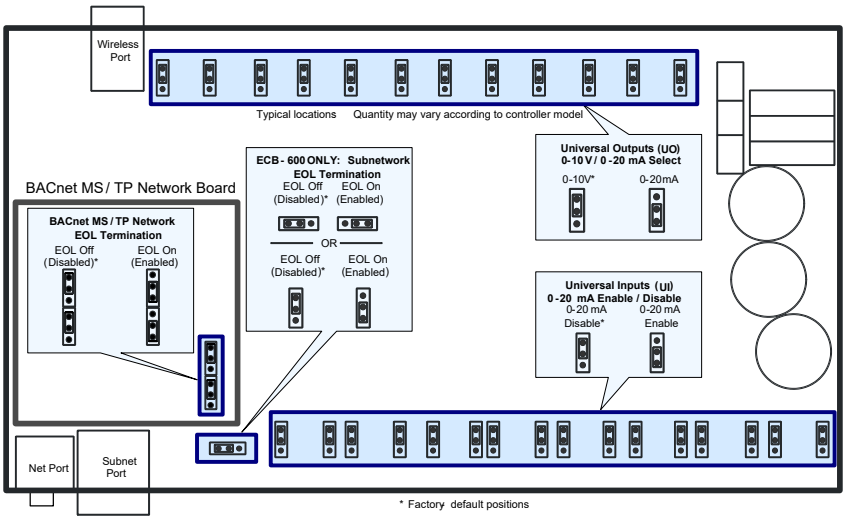


Figure 10: ECB-400 Series and ECB-600 Series Controller Jumper Locations

Input Wiring

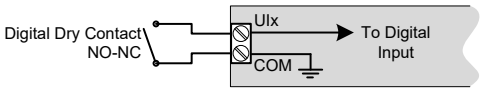
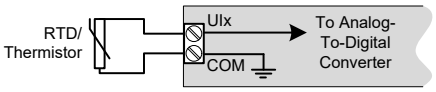
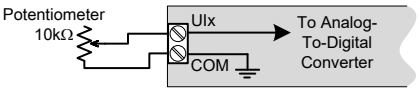
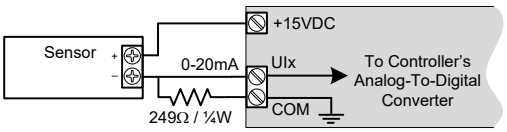
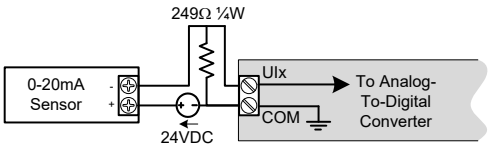
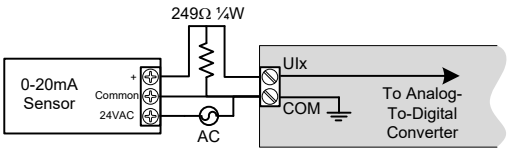
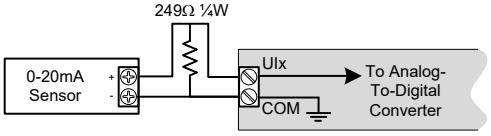
Before connecting a sensor to the controller, refer to the installation guide of the equipment manufacturer.

- For a wire length less than 75' (23m), either a shielded or unshielded 18AWG wire may be used.
- For a wire up to 200' (61m) long, a shielded 18AWG wire is recommended.
- The shield of the wire should be grounded on the controller side only and shield length should be kept as short as possible.

Table 1 shows the ECB-203, ECB-300, ECB-400, and ECB-600 Series controller pulse and current input jumper support. Table 2 shows the available universal input (UIx) wiring methods.

Controller	Fast and Slow Pulse Inputs support		Current Input Jumper support:
	50Hz: 10ms minimum ON/OFF (Fast Pulse)	1Hz: 500ms minimum ON/OFF (Slow Pulse)	0 to 10VDC / 0 to 20mA
ECB-203	None	UI1 to UI6	None
ECB-300	UI1 to UI4	UI5 to UI10	Yes; see *Table 2*
ECB-400 Series	UI1 to UI4	UI5 to UI12	
ECB-600 Series	UI1 to UI4	UI5 to UI16	

Table 1: Controller Input Support

Sensor Input Type	Input Connection Diagram
☐ Dry Contact input.	
☐ RTD input (for example, 1000Ω). ☐ Thermistor Input (for example, 10kΩ type II and III).	
☐ Resistive input, (for example, use with 10kΩ and 100kΩ potentiometers).	
ECB-**203 Series:** ☐ 0 to 20mA input used with a 2-wire, 0 to 20mA sensor powered by the controller's internal 15VDC power supply.	
ECB-**203 Series:** ☐ 0 to 20mA input used with a 2-wire, 0 to 20mA sensor powered by an external 24VDC power supply.	
ECB-**203 Series:** ☐ 0 to 20mA input used with a 3-wire, 0 to 20mA sensor powered by an external 24VAC power supply.	
ECB-**203 Series:** ☐ 0 to 20mA input used with a sensor powered by its own power source.	

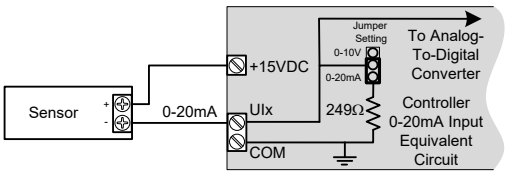
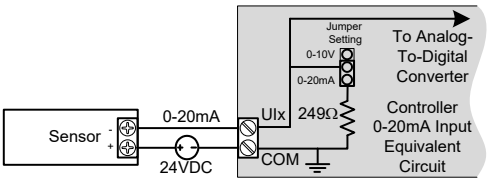
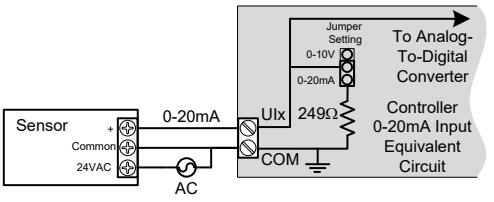
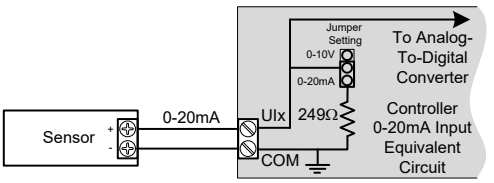
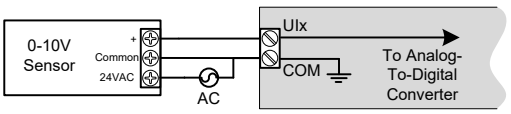
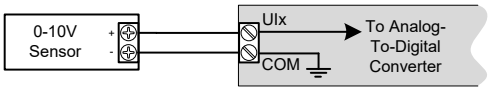
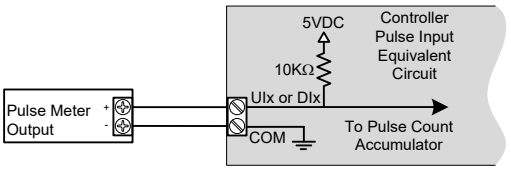
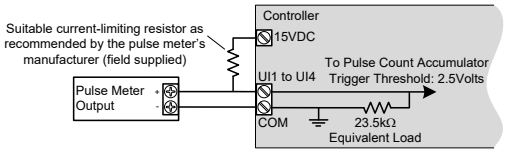
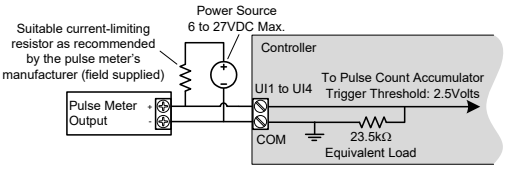
Sensor Input Type	Input Connection Diagram
ECB-**300,** ECB-**400, and** ECB-**600 Series:** ☐ 0 to 20mA input used with a 2-wire, 0 to 20mA sensor powered by the controller's internal 15VDC power supply. ☐ For jumper location, see Jumper Identification and Configuration.	
ECB-**300,** ECB-**400, and** ECB-**600 Series:** ☐ 0 to 20mA input used with a 2-wire, 0 to 20mA sensor powered by an external 24VDC power supply. ☐ For jumper location, see Jumper Identification and Configuration.	
ECB-**300,** ECB-**400, and** ECB-**600 Series:** ☐ 0 to 20mA input used with a 3-wire, 0 to 20mA sensor powered by an external 24VAC power supply. ☐ For jumper location, see Jumper Identification and Configuration.	
ECB-**300,** ECB-**400, and** ECB-**600 Series:** ☐ 0 to 20mA input used with a sensor powered by its own power source. ☐ For jumper location, see Jumper Identification and Configuration.	
☐ Voltage input used with a 3-wire 0 to 10VDC or 0 to 5VDC sensor powered by an external 24VAC power supply.	
☐ Voltage input used with a 0 to 10VDC or 0 to 5VDC sensor powered by its own power source.	
☐ **Slow Pulse – Internal supply**: 2-wire pulse meter for ECB-203, ECB-300, ECB-400, and ECB-600 Series controllers ☐ Connect the pulse input according to the figure for a pulse meter that can pull-down a +5VDC supply with a 10KΩ pull-up resistor (internal supply type). ☐ Refer to Table 1 for more information on Controller Input Support	
☐ **Fast Pulse – Internal supply:** 2-wire pulse meter for ECB-300, ECB-400, and ECB-600 Series controllers ☐ Connect the pulse input according to the figure for a pulse meter that requires more than 5VDC to operate using **built in controller power source** from 6VDC to 15VDC maximum. ☐ Refer to Table 1 for more information on Controller Input Support	
☐ **Fast Pulse – External supply**: 2-wire pulse meter for ECB-300, ECB-400, and ECB-600 Series controllers ☐ Connect the pulse input according to the figure for a pulse meter that requires more than 5VDC to operate using an **external power source** from 6VDC to 27VDC maximum. ☐ Refer to Table 1 for more information on Controller Input Support	

Table 2: Input Wiring

Output Wiring

Before connecting an output device (actuator, relay, etc.) to the controller, refer to the datasheet and installation guide of the equipment manufacturer.

- ☐ For a wire length less than 75' (23m) long, either a shielded or unshielded 18AWG wire may be used.
- ☐ For a wire length up to 200' (61m) long, a shielded 18AWG wire is recommended.
- ☐ The shield of the wire should be grounded on the controller side and the shield length should be kept as short as possible.
- ☐ For relay outputs (DOx); select appropriately-sized wiring suitable to the current load.
- ☐ To measure the state of a triac output, an external load must be connected.

Table 3 shows the ECB-203, ECB-300, ECB-400, and ECB-600 Series controller Output and Jumper support. Table 4 shows the available output wiring methods.

Controller	Digital (Triac) Outputs	Universal Outputs	Jumper 0 to 10VDC/0 to 20mA
ECB-203	5	3	
ECB-300	0	8	■
ECB-4x0 Series	0	12	■
ECB-4x3 Series	8	4	■
ECB-600 Series	0	12	■

Table 3: Controller Output Support

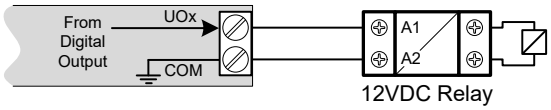
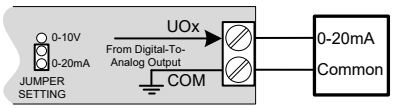
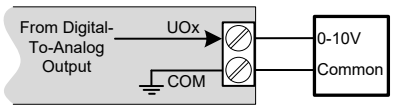
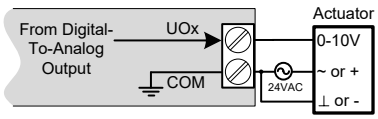
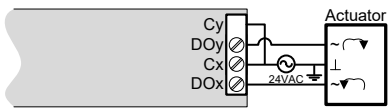
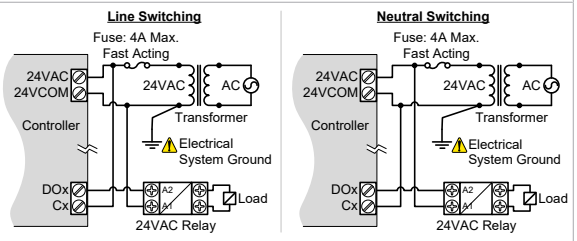
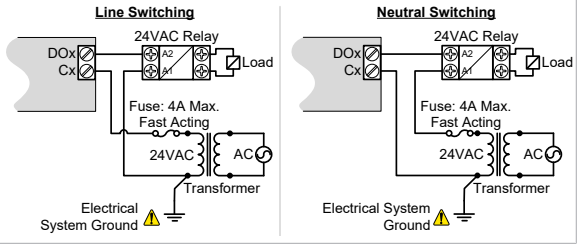
Control Output Type	Output Designation	Output Connection Diagram
☐ Discrete 0 or 12VDC digital, Pulse, or PWM output controlling a 12VDC relay. Maximum 60 mA (minimum load resistance 200Ω).	UOx	
☐ Current 0 to 20mA universal output & jumper configuration ☐ For ECB-300, ECB-400, and ECB-600 Series only ☐ For jumper location, see Jumper Identification and Configuration.	UOx	
☐ Linear 0 to 10VDC digital to analog output.	UOx	
☐ 0 to 10VDC voltage output controlling an analog actuator that is powered by an external 24VAC power source.	UOx	
☐ 24VAC externally-powered triac output controlling a floating actuator[1]. ☐ Ensure that the external power supply is grounded as shown.	DOx	
☐ 24VAC **controller**-powered triac output controlling a relay[1] with line and neutral switching. ☐ Ensure that the transformer's secondary winding is grounded as shown.	DOx	
☐ 24VAC **externally**-powered triac output controlling a relay[1] with line and neutral switching. ☐ Ensure that the transformer's secondary winding is grounded as shown.	DOx	

Table 4: Output Wiring

1. Maximum output current for all digital triac outputs is 0.5A continuous or 1A @ 15% duty cycle for a 10-minute period.

Subnet-Wiring

The subnet is used to connect a range of Allure Series Communicating Sensors:

- The Allure EC-Smart-Vue Series sensor is a communicating room temperature sensor with backlit display graphical menus and VAV balancing capabilities.
- The Allure EC-Smart-Comfort and Allure EC-Smart-Air Communicating Sensors are a range of communicating room temperature sensors.

Connect the Allure Series to the controller's **Subnet Port** with a standard Category 5e Ethernet patch cable fitted with RJ-45 connectors. Refer to the Network Guide for extensive information and requirements for the connection of the Allure Series. It contains information about network topology and length, cable type, setting the Subnet ID, etc. It can be downloaded from the *www.distech-controls.com* website. See also the Hardware Installation Guide supplied with the Allure Series.

If you make your own patch cable, see the Allure Series Hardware Installation Guide.

Protect the controller's connector from being pulled on when a cable to the Allure Series is connected. Create a strain-relief by looping the cable and attaching it to a solid object with a nylon tie so that a tug on the cable will not pull out the connector on the controller.

Subnet Wiring with the ECB-600 Series Controller

ECx-400 series IO Extension Modules are connected to the **SUBNET**– and **SUBNET+** terminals of the ECB-600 series controller. The Network Guide provides extensive information and requirements to implement the subnetwork for the ECx-400 series IO Extension Modules. It contains information about network length, cable type, controller addressing, etc. It can be downloaded from our website. See also the Hardware Installation Guide supplied with the ECx-400 series IO Extension Module.

Communications Wiring

The Network Guide provides extensive information and requirements to implement a BACnet MS/TP network. It contains information about network and sub network length, cable type, device addressing, etc. It can be downloaded at the *www.distech-controls.com* website. For optimal performance, use Distech Controls 24 AWG (0.65 mm) stranded, twisted pair shielded cable or refer to the Network Guide for cable specification. The BACnet MS/TP communication wire is polarity sensitive and the only acceptable topology is to daisy-chain the cable from one controller to the next.

As shown in BACnet MS/TP Communications Wiring:

- The first and last daisy-chained BACnet MS/TP device must have its EOL resistors enabled / installed. All other devices must have their EOL resistor disabled (default factory setting).
- When the BACnet MS/TP data bus is connected to a following device, twist data bus shields together.
- Isolate all shields with electrical tape so there is no exposed metal that can touch ground or other conductors.
- The shield of the data bus must be connected to the electrical system ground at only one point – usually at one end of the bus as shown below.
- Connect no more than 50 devices to a BACnet MS/TP data bus.

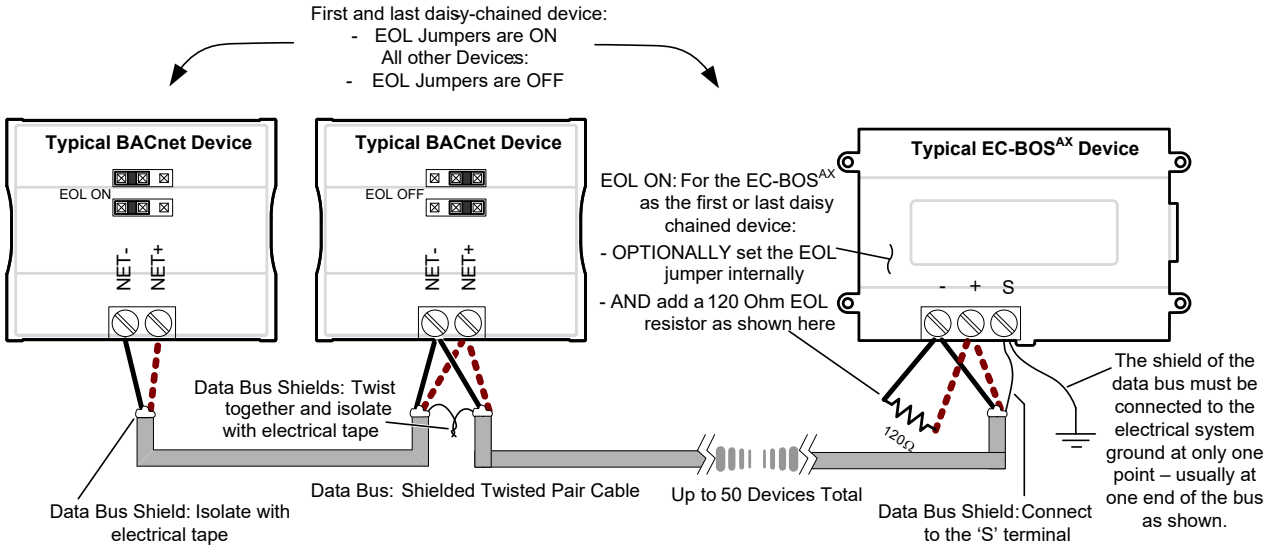


Figure 11: BACnet MS/TP Communications Wiring

If inserting multiple wires in the terminals, ensure to properly twist wires together prior to inserting them into the terminal connectors.

For more information and detailed explanations on network topology and wire length restrictions, refer to the Network Guide, which can be downloaded from our website.

Device Addressing

The Network Guide provides extensive information and requirements to implement a BACnet MS/TP network. It contains information about network planning and MAC Address numbering schemes. It can be downloaded from the *www.distech-controls.com* website.

The MAC Address must be set according to your network planning document by setting the DIP switch located under the cover or when this DIP switch is set to 0 (all off), the MAC address can be set by connecting an Allure EC-Smart-Vue Series Communicating Sensor to the controller as shown in Step 5 of *Setting the Communicating Sensor Subnet ID* in the following section. An example of how to set the device's MAC Address DIP switch is shown below.

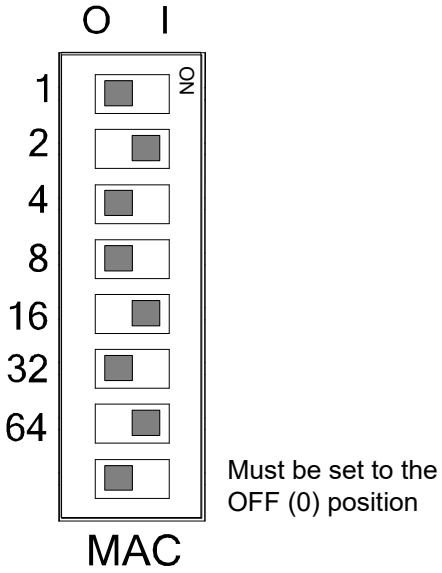


Figure 12: Typical Device MAC Address DIP Switch Set to 82

The address is the sum of the numbers set to ON. For example, if the second (2), fifth (16), and seventh (64) DIP switches are set to ON, the device MAC address is 82 (2 + 16 + 64). Only addresses from 1 to 127 are recommended to be used.

The controller must be power cycled after the MAC address DIP switch has been changed. The device instance (DevID) is automatically configured when setting the MAC Address to prevent network address conflict. The following formula is used to determine the device instance:

```
DevID = 364 * 1000 + MAC
```

For example:

```
MAC: 37
DevID = 364 * 1000 + 37 = 364037
```

The Device Instance can be changed once the controller has been commissioned through the network management software interface.

The Device Instance can be changed once the controller has been commissioned through the network management software interface or through the color LCD screen's Settings menu (when equipped).

Temporary Network Access

To temporarily access the BACnet MS/TP LAN for commissioning and maintenance purposes, connect a BACnet MS/TP Adaptor to the NET PORT audio plug. Wire a standard ⅛" (3.5 mm) three-conductor stereo jack as shown below.

The BACnet MS/TP Adaptor must have an electrically-isolated RS 485 port. Otherwise a ground path from the BACnet network will be made through the computer that will disrupt BACnet network communications.

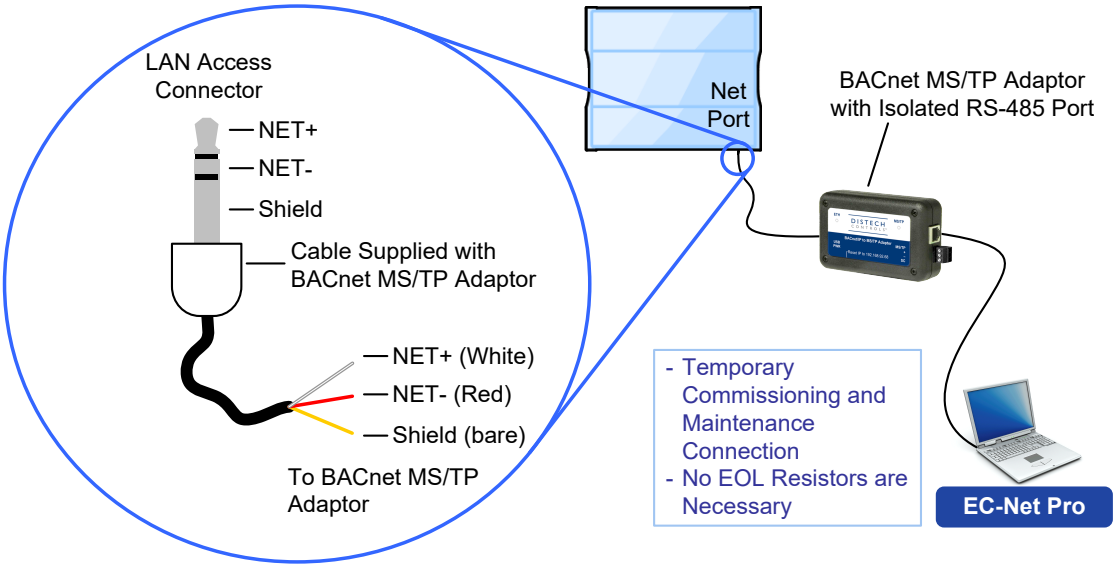


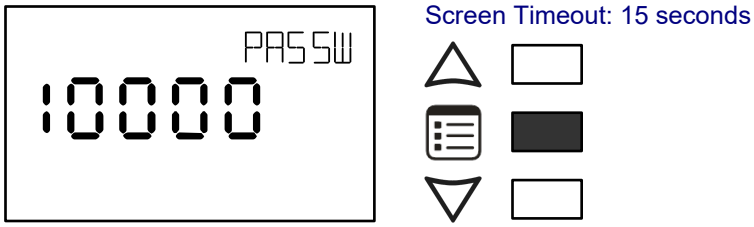
Figure 13: ⅛" (3.5 mm) Stereo Jack Connection for a Portable Router

Setting the Communicating Sensor Subnet ID

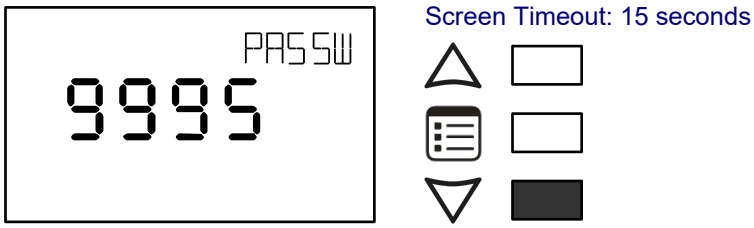
ECB Series controllers can be commissioned with an Allure EC-Smart-Vue Series Communicating Sensor by connecting it to the controller as shown in the wiring diagram at the end of this guide.

The default Subnet ID for an Allure EC-Smart-Vue Series Communicating Sensor is 1. To commission an ECB Series controller, the sensor's Subnet ID must be set to 1. If the sensor's Subnet ID has been set to another value (for example, the display flashes error code 1 with the Bell icon when the sensor is connected to a controller for commissioning), change the Subnet ID to 1 as follows:

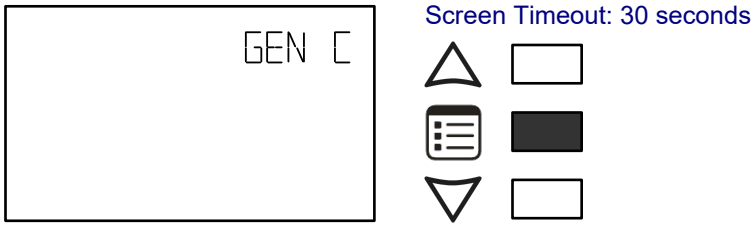
1. Connect an an Allure EC-Smart-Vue Series Communicating Sensor to the controller with a Cat 5e patch cable. Wait for the Bell icon and the number 1 to flash on the display.
2. Press and hold the Menu button for 5 seconds to enter the password menu. 10000 is shown on the display.



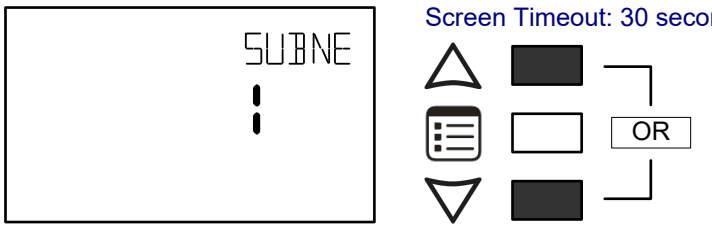
3. Press the down button to set the number to 9995 (this is the default password).



4. Press the Menu button to submit the password. Upon submitting the password, the GEN CFG menu appears on the display.



5. Press the down button once to enter the **GEN CFG** submenu.
6. Press the Menu button several times until SUBNET ID appears on the display. The current controller's Subnet ID is shown.



7. Use the up and down buttons to set the controller's Subnet ID to **1**. *Tip*: Hold down either the up or down button to fast-advance the display value.
8. Press the Menu button once.
9. Press and hold the Menu button for 5 seconds to exit the configuration menu.

The an Allure EC-Smart-Vue Series Communicating Sensor can now be used to go from one ECB series controller to the next for commissioning purposes.

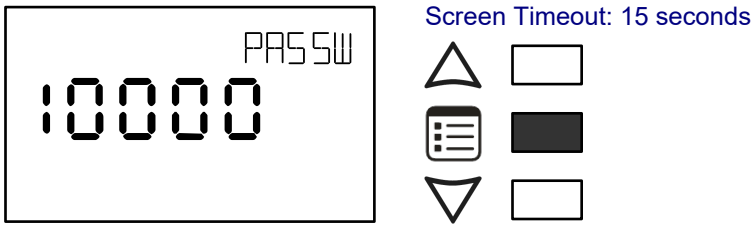
Commissioning ECB-Series Controllers

When using an Allure EC-Smart-Vue Series Communicating Sensor for commissioning ECB Series controllers (the DIP switch located on the faceplate is set to 0 (all off) and before code is downloaded to the controller from EC-*gfx*Program), connect an Allure EC-Smart-Vue Series Communicating Sensor to the controller with its Subnet ID set to 1.

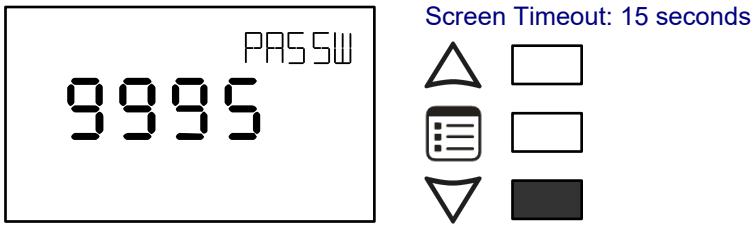
During commissioning, the sensor is used to set the controller's BACnet® MAC Address.

Set the connected controller's MAC Address as follows:

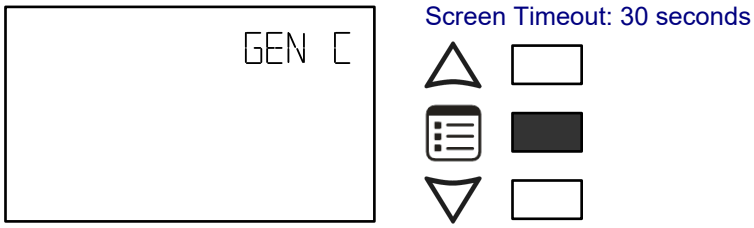
1. Connect an Allure EC-Smart-Vue Series Communicating Sensor to the controller with a Cat 5e patch cable. Wait for the display to show the room temperature.
2. Press and hold the Menu button for 5 seconds to enter the password menu. 10000 is shown on the display.



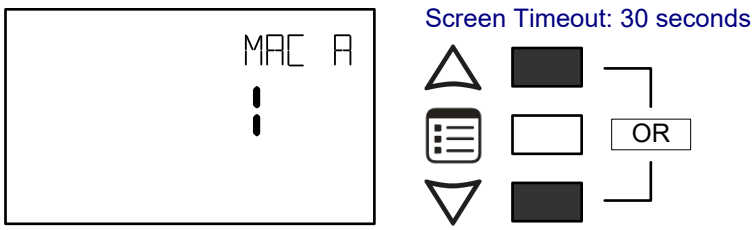
3. Use the down button to set the number to 9995 (this is the default password).



4. Press the **Menu** button to submit the password. Upon submitting the password, the **GEN CFG** menu appears on the display.



5. Press the down button once to enter the **GEN CFG** submenu. The **MAC ADDRESS** menu is shown with the current controller's BACnet MAC Address.



6. Use the up and down buttons to set the controller's MAC Address. Only addresses from 1 to 127 are recommended to be used.
7. Press the Menu button once to apply the value.
8. Press and hold the Menu button for 5 seconds to exit the configuration menu.

Once the controller's network is operational, the controller can be programmed with EC-*gfx*Program. For each Allure EC-Smart-Vue Series Communicating Sensor, set its Subnet ID number to the block number of its associated ComSensor block in EC-*gfx*Program. This is done in the sensor's **GEN CFG** menu under **SUBNET ID**.

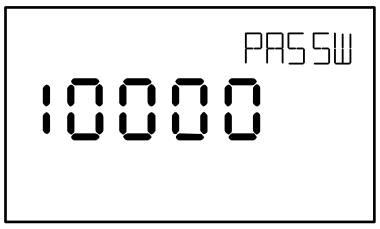
Setting the BAUD Rate (optional – ECB series controllers only)

By default, the BAUD rate for the controller is set to automatically detect the current communication BAUD rate of the connected BACnet MS/TP network (AUTO). This is the preferred setting for a controller. However, at least one controller on the BACnet MS/TP network data bus must have its BAUD rate set. The preference is to set the building controller's BAUD rate (if present). Otherwise, set the BAUD rate on one controller that will set the BAUD rate for all other controllers (to act as the master for setting the BAUD rate).

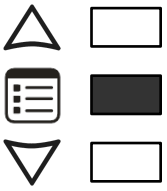
When the BAUD rate is set to AUTO, the controller cannot initiate any communication until it has detected the baud rate of the BACnet MS/TP network. If all controllers on the BACnet MS/TP network are set to AUTO, then all controllers will not communicate.

Set the connected controller's BAUD rate as follows:

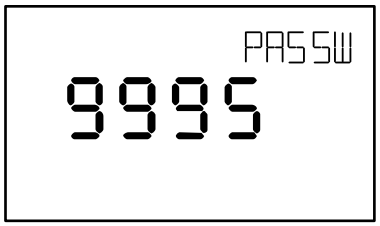
1. Connect an Allure EC-Smart-Vue Series Communicating Sensor sensor to the controller with a Cat 5e patch cable. Wait for the display to show the room temperature.
2. Press and hold the Menu button for 5 seconds to enter the password menu. 10000 is shown on the display.



Screen Timeout: 15 seconds

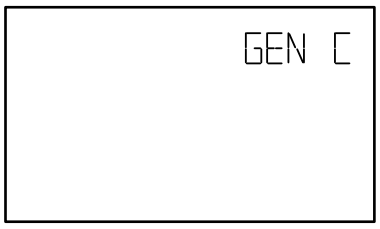


3. Use the down button to set the number to 9995 (this is the default password).

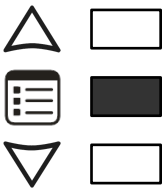


Screen Timeout: 15 seconds

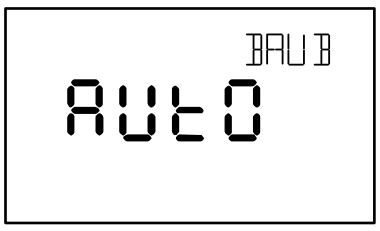
4. Press the **Menu** button to submit the password. Upon submitting the password, the **GEN CFG** menu appears on the display.



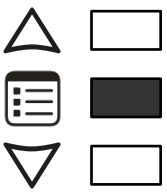
Screen Timeout: 30 seconds



5. Press the down button once to enter the **GEN CFG** submenu.
6. Use the Menu button several times until **BAUD RATE appears on the display**. The current controller's BAUD rate is shown.



Screen Timeout: 30 seconds



7. Use the up and down buttons to set the controller's Baud rate. The **AUTO** setting detects and uses the current baud rate being used by the BACnet MS/TP network.
8. Press the Menu button once to apply the value.
9. Press and hold the Menu button for 5 seconds to exit the configuration menu.

Wireless Installation

When connected to a Wireless Receiver, controllers can receive input signals from a wide selection of wireless devices. Compatible wireless devices include temperature sensors, duct sensors, window/door contacts and light switches. These devices are easy to install, and can be mounted on a wide range of building materials.

Before connecting any wireless equipment to the controller, refer to the Open-to-Wireless Application Guide.

Connecting the Wireless Receiver

The Wireless Receiver is connected to the controller using a 2m (6.5ft) telephone cable with 4P4C modular connectors at both ends. Do not exceed this cable length. The Wireless Receiver's telephone socket is located inside the device. To locate it, open the Wireless Receiver by separating its front and back plates.

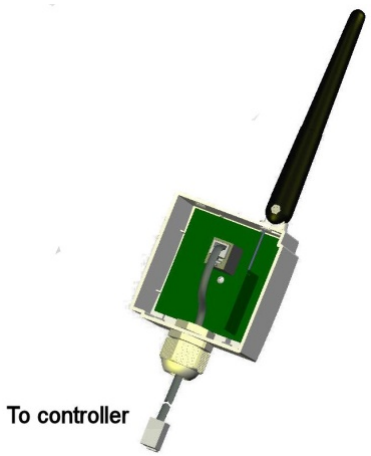


Figure 14: Location of the Wireless Receiver's telephone socket

Connecting to the Controller's Wireless Port

Each controller has a wireless port in which one end of the Wireless Receiver's telephone cable plugs in.

Strain relief and Terminal Block Cover

In certain jurisdictions, terminal block covers are required to meet local safety regulations. Strain reliefs and terminal block covers are available for controllers housed in large enclosures and are used to relieve tension on the wiring and conceal the controllers' wire terminals. Strain reliefs and terminal block covers are optional and are sold as peripherals.

Prior to connecting all wires, it is recommended to install the strain relief. Three screws are provided for its installation under the bottom part of the enclosure. Tie wraps can then be used to group wires together and attach them securely to the strain relief in an effort to relieve undue tension. If necessary, the terminal block cover can then be clipped on to the strain relief as shown below.

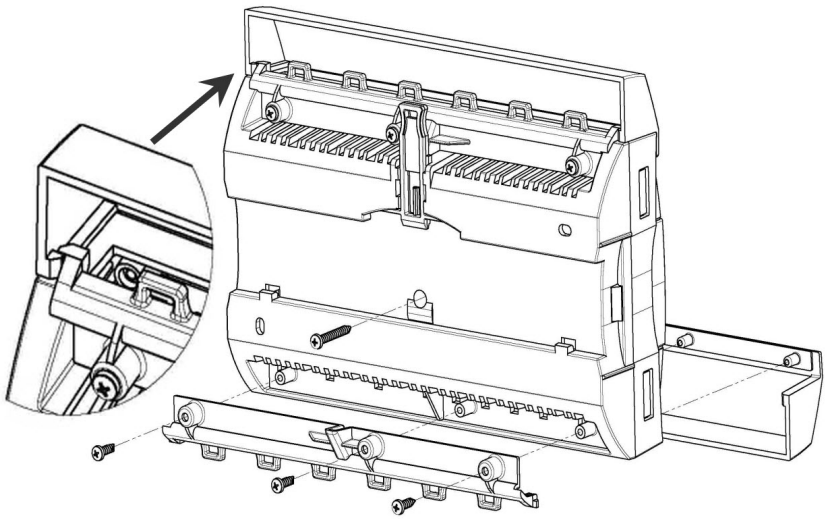


Figure 15: Large enclosure strain relief and terminal block cover installation

Maintenance

Unplug device before any kind of servicing.

The device requires minimal maintenance, but it is important to take note of the following:

- If it is necessary to clean the outside of the device, use a dry cloth.
- Using a torque limited screw driver set to 0.4 Nm (3.54 in-lb), retighten terminal connector screws annually to ensure the wires remain securely attached.

Disposal

The Waste Electrical and Electronic Equipment (WEEE) Directive set out regulations for the recycling and disposal of products. The WEEE2002/96/EG Directive applies to standalone products, for example, products that can function entirely on their own and are not a part of another system or piece of equipment.

For this reason Distech Controls products are exempt from the WEEE Directive. Nevertheless, Distech Controls products are marked with the WEEE symbol  , indicating devices are not to be thrown away in municipal waste.

Products must be disposed of at the end of their useful life according to local regulations and the WEEE Directive.

North American Emissions Compliance

United States

Changes or modifications not expressly approved by Distech Controls could void the user's authority to operate the equipment.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential and commercial installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Canada

This Class (B) digital apparatus meets all the requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la Classe (B) respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

Typical Air Handling Unit Application Wiring Diagram

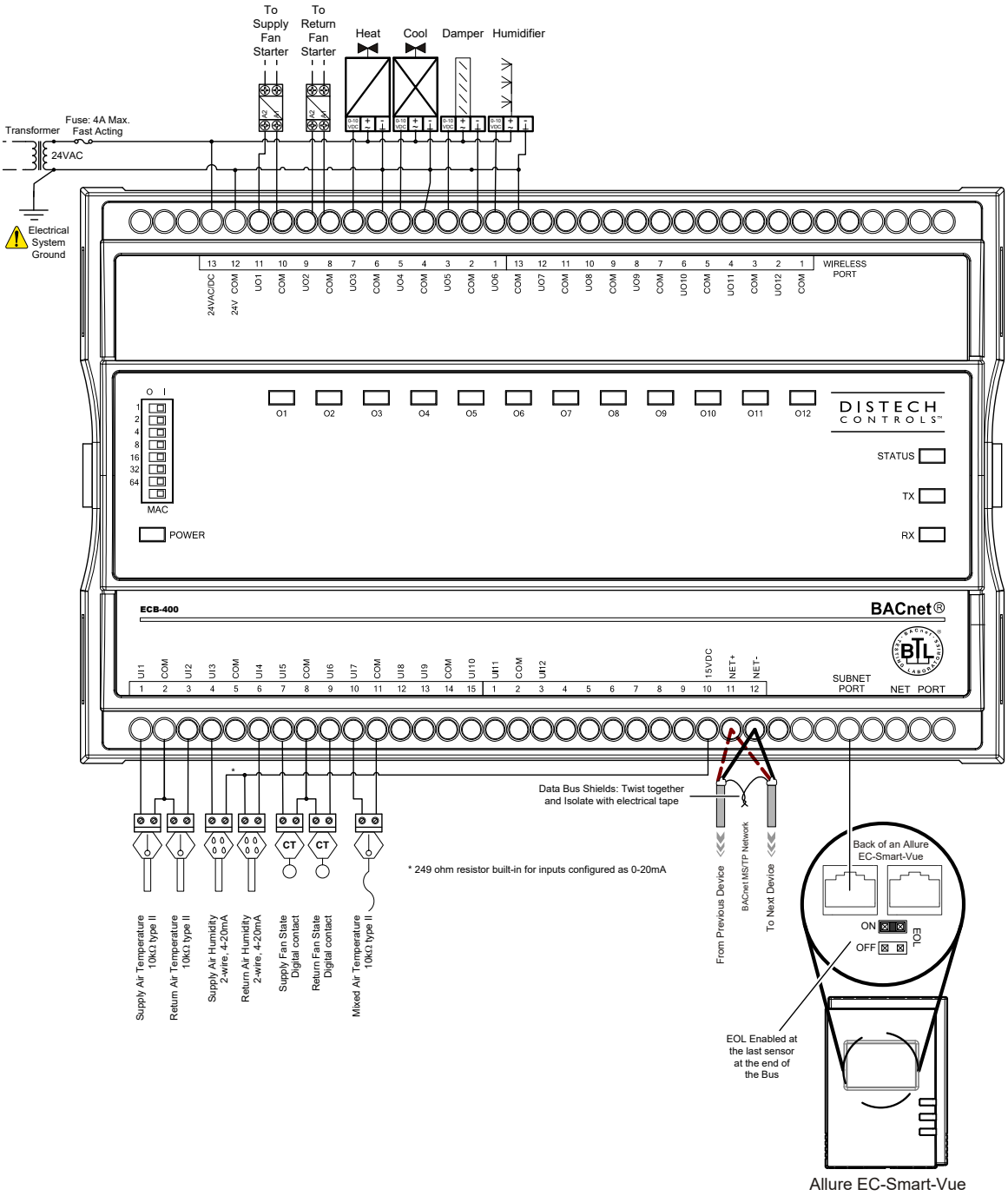


Figure 16: Typical Power and Network Connections with an Allure EC-Smart-Vue sensor

Although only the Allure EC-Smart-Vue is shown here, any other Allure Series Communicating Sensor can be connected to the subnet port in this manner. Refer to the sensor's corresponding Hardware Installation Guide for more details.

Troubleshooting Guide

Controller is powered but does not turn on

Fuse has blown	Disconnect the power. Check the fuse integrity. Reconnect the power.
Power supply polarity	Verify that consistent polarity is maintained between all controllers and the transformer. Ensure that the 24VCOM terminal of each controller is connected to the same terminal on the secondary side of the transformer. See *Power Wiring.*

Controller cannot communicate on a BACnet MS/TP network

Absent or incorrect supply voltage	1. Check power supply voltage between 24VAC ±15% and 24VCOM pins and ensure that it is within acceptable limits. 2. Check for tripped fuse or circuit breaker.
Overloaded power transformer	Verify that the transformer used is powerful enough to supply all controllers.
Network not wired properly	Double check that the wire connections are correct.
Absent or incorrect network termination	Check the network termination(s).
Max Master parameter	Configure the maximum number of master device on the MS/TP network in all devices to the controller's highest MAC address used on the MS/TP trunk.
There is another controller with the same MAC Address on the BACnet MS/TP data bus	Each controller on a BACnet MS/TP data bus must have a unique MAC Address. Look at the MAC Address DIP switch on the faceplate or under the cover of the controller. If it is set to 0 (all off), use an Allure EC-Smart-Vue sensor to check the MAC Address.
There is another controller with the same Device ID on the BACnet intranetwork	Each controller on a BACnet intranetwork (the entire BACnet BAS network) must have a unique Device ID. Use an Allure EC-Smart-Vue sensor to check the Device ID of each controller.

Controller communicates well over a short network, but does not communicate on large network

Network length	Check that the total wire length does not exceed the specifications of the *Network Guide*.
Wire type	Check that the wire type agrees with the specification of the *Network Guide*.
Network wiring problem	Double check that the wire connections are correct.
Absent or incorrect network termination	Check the network termination(s). Incorrect or broken termination(s) will make the communication integrity dependent upon a controller's position on the network.
Number of controllers on network segment exceeded	The number of controllers on a channel should never exceed 50. Use a router or a repeater in accordance to the *Network Guide*.
Max Master parameter	Configure the maximum number of master device on the MS/TP network in all devices to the controller's highest MAC address used on the MS/TP trunk.
There is another controller with the same MAC Address on the BACnet MS/TP data bus	Each controller on a BACnet MS/TP data bus must have a unique MAC Address. Look at the MAC Address DIP switch on the faceplate or under the cover of the controller. If it is set to 0 (all off), use an Allure EC-Smart-Vue sensor to check the MAC Address.
There is another controller with the same Device ID on the BACnet intranetwork	Each controller on a BACnet intranetwork (the entire BACnet BAS network) must have a unique Device ID. Use an Allure EC-Smart-Vue Series Communicating Sensor to check the Device ID of each controller.

I/O Extension Module cannot communicate on the subnetwork

Absent or incorrect supply voltage	1. Check power supply voltage between 24VAC ±15% and 24VCOM pins and ensure that it is within acceptable limits. 2. Check for tripped fuse or circuit breaker.
Overloaded power transformer	Verify that the transformer used is powerful enough to supply all controllers. See *Power Wiring.*
Network not wired properly	Double check that the wire connections are correct.
There is another controller with the same Subnet ID on the subnetwork	Each I/O Extension Module on the subnetwork must have a unique Subnet ID. Look at the Subnet ID DIP switch on the faceplate of each I/O Extension Module.
Network length	Check that the total wire length does not exceed the specifications in the *Network Guide.*
Wire type	Check that the wire type agrees with the specification of the *Network Guide.*
Absent or incorrect network termination	Check the network termination(s). Only the last ECx-400 I/O Extension Module must have its EOL termination set to ON. When one or more Allure EC-Smart-Vue sensors are connected to the controller, only the last sensor must have its EOL termination set to ON. See the *Network Guide*for more information.

Hardware input is not reading the correct value

Input wiring problem	Check that the wiring is correct according to this manual and according to the peripheral device's manufacturer.
Configuration problem	Using EC-gfxProgram, check the configuration of the input. Refer to the EC-gfxProgram user guide for more information.
Over-voltage or over-current at an input	An over-voltage or over-current at one input can affect the reading of other inputs. Respect the allowed voltage / current range limits of all inputs. Consult the appropriate datasheet for the input range limits of this controller.
Open circuit or short circuit	Using a voltmeter, check the voltage on the input terminal. For example, for a digital input, a short circuit shows approximately 0V DC and an open circuit shows approximately 5V DC.

Hardware output is not operating correctly

Fuse has blown (Auto reset fuse)	Disconnect the power and outputs terminals. Then wait a few seconds to allow the auto-reset fuse to cool down. Check the power supply and the output wiring. Reconnect the power.
Output wiring problem	Check that the wiring is correct according to this manual and according to the peripheral device's manufacturer.
Configuration problem	Using EC-gfxProgram, check the configuration of the input. Refer to the EC-gfxProgram user guide for more information.

0 to 10V output, 24VAC powered actuator is not moving.	Check the polarity of the 24VAC power supply connected to the actuator while connected to the controller. Reverse the 24VAC wire if necessary.

Wireless devices not working correctly

Device not associated to controller	Using EC-*gfx*Program, check the configuration of the input. Refer to the *EC-gfxProgram user guide* for more information.
Power discharge	1. Recharge device with light (if solar-powered) or replace battery (if battery-powered), 2. Ensure sufficient light intensity (200lx for 4 hours/day).
Device too far from the Wireless Receiver	Reposition the device to be within the range of the Wireless Receiver. For information on typical transmission ranges, refer to the *Open-to-Wireless Application Guide.*
Configuration problem	Using the device configuration plug-in or wizard, check the configuration of the input. Refer to the Wireless Battery-less *Sensors and Switches Solutions Guide* for more information.

Rx/Tx LEDs

RX LED not blinking	Data is not being received from the BACnet MS/TP data bus.
TX LED not blinking	Data is not being transmitted onto the BACnet MS/TP data bus.

Status LED– Normal Operation

One fast blink ●	Initialization: The device is starting up.
Fast blink continuous: ● ● ● ● ● (150ms On, 150ms Off, continuous)	Firmware upgrade in progress. Controller operation is temporarily unavailable. The new firmware is being loaded into memory. This takes a few seconds. Do not interrupt power to the device during this time.
The Status LED is always OFF	The controller is operating normally.

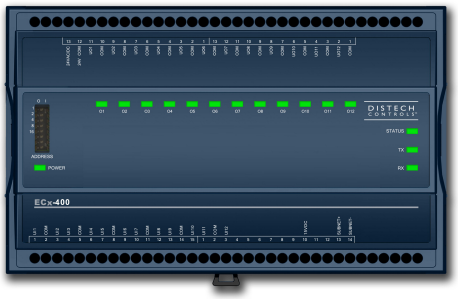
Status LED blink patterns – Repeats every 2 seconds (highest priority shown first)

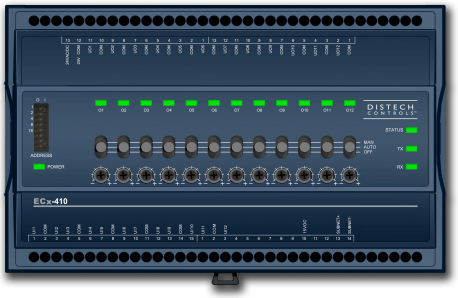
Long Long Long blink ▬ ▬ ▬ (800ms On, 300ms Off, 800ms On, 300ms Off, 800ms On)	The device has not received a BACnet token, and therefore cannot communicate on the network: Verify that the controller's MAC Address is unique on the BACnet MS/TP Data Bus – see Device Addressing. Make sure the controller's BAUD rate is the same as the BACnet MS/TP Data Bus' BAUD rate (see Setting the BAUD Rate (optional)). Verify that the Max Master is set high enough to include this controller's MAC Address (See the Network Guide).
Short Short Long blink ● ● ▬ (150ms On, 300ms Off, 150ms On, 300ms Off, 800 ms On)	Poor-quality power; The device has browned-out: The voltage at the 24VAC and 24VCOM terminals has gone below the device's acceptable limit during power up.
Short Long blink ● ▬ (150ms On, 300ms Off)	Invalid MAC address: The device's MAC address is set to zero (0) or is set to an address higher than the Max Master. See the Network Guide.

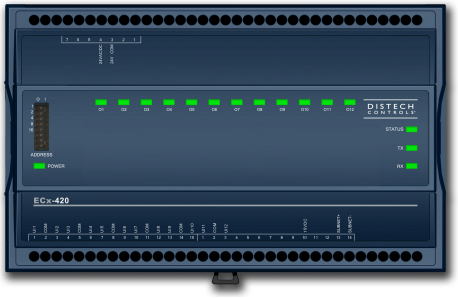
For issues with the Allure EC-Smart-Vue Series Communicating Sensor, refer to the Allure EC-Smart-Vue Series Communicating Sensor Hardware Installation Guide.

ECx-400 Series

24-Point I/O Extension Modules







Overview

The ECx-400 Series I/O Extension Modules are designed to add extra inputs and outputs to any Distech Controls ECB-600 Series controller.

Features & Benefits

- Flexible inputs and outputs support all industry-standard HVAC unitary applications
- Rugged hardware inputs and outputs eliminate the need for external protection equipment
- Models available with HOA switches and potentiometers are ideal for equipment testing or commissioning
- Supports EC-*gfx*Program, making Building Automation System programming effortless
- Supports the Allure™ Series Communicating Sensors, providing intelligent sensing and environmental zone control

Model Selection

Example: ECx-*410*

Series	Model	Options
ECx-	***400***: 24 Points, 15Vdc Power Supply, 12 UI, 12 UO	***UUKL:*** UL 864, 10th Edition UUKL and California State Fire Marshal Listed[1]
	410: 24 Points, 15Vdc Power Supply, 12 UI, 12 UO, HOA	
	420: 24 Points, 15Vdc Power Supply, 12 UI	

1. The UL 864 UUKL Listed Smoke Control Equipment is used only in Distech Controls' UUKL smoke control system. For detailed specifications, requirements and procedures for installing and operating UUKL Listed equipment refer to the Distech Controls' UUKL Smoke Control documentation.

BACnet Objects List

BACnet Objects

Input Objects (AI, BI, MSI)[1]	12[2,3]
Output Objects (AO, BO) [1]	12[4,3] (ECx-400 / 410 models)
Alarm Notification Classes[3]	5

1. Supports object internally-generated alarms (intrinsic reporting).
2. This consists of Hardware Inputs, Allure Series Communicating Sensor Inputs, and Open-to-Wireless Inputs.
3. Objects are in the connected ECB-600, ECB-610, or ECB-650 controller (master)
4. This consists of Hardware Outputs.

Product Specifications

Power Supply Input

Voltage Range	24VAC/DC; ±15%; Class 2
Frequency Range	50/60Hz
Overcurrent Protection	Field replaceable fuse
Fuse Type	3.0A
Power Consumption ECx-400 / ECx-410	22 VA typical plus all external loads[1], 50 VA max.
Power Consumption ECx-420	10 VA typical plus all external loads[1], 16 VA max.

1. External loads must include the power consumption of any connected modules such as an Allure Series Communicating Sensor. Refer to the respective module's datasheet for related power consumption information.

Communications

Communication Bus	RS-485
Baud Rates	38 400
Addressing	Dip switch

Hardware

Processor	STM32 (ARM Cortex™ M3) MCU, 32 bit
CPU Speed	64 MHz
Applications and Storage Memory	64 kB Non-volatile Flash
RAM Memory	20 kB RAM
Green LEDs	Power status & LAN Tx
Orange LEDs	Controller status & LAN Rx
Communication Jack	BACnet 1/8" (3.5mm) stereo audio jack

Mechanical

Dimensions (H × W × D)	4.7 × 7.7 × 2.03" (119.38 × 195.58 × 51.47 mm)
Shipping Weight	1.17lbs (0.53 kg)
Enclosure Material[1]	FR/ABS
Enclosure Rating	Plastic housing, UL94-5VB flammability rating Plenum rating per UL1995
Installation	Direct DIN-rail mounting or wall mounting through mounting holes

1. All materials and manufacturing processes comply with the RoHS directive and are marked according to the Waste Electrical and Electronic Equipment (WEEE) directive

Environmental

Operating Temperature	32°F to 122°F (0°C to 50°C)
Storage Temperature	-4°F to 122°F (-20°C to 50°C)
Relative Humidity	0 to 90% Non-condensing

Standards and Regulation

CE Emission	EN61000-6-3: 2007; A1:2011
CE Immunity	EN61000-6-1: 2007
FCC	Compliance with FCC rules part 15, subpart B, class B
UL Listed (CDN & US)	UL916 Energy management equipment
UL 864	UL 864, 10th Edition, UUKL Listed Smoke Control Equipment (ECx-400 UUKL model only)[1]
California State Fire Marshal Listing	CSFM: 7300-2187:0100 (ECx-400 UUKL model only) [1]
CEC Appliance Database	Appliance Efficiency Program[2]

1. For detailed specifications regarding the ECx-400 UUKL model, refer to the Distech Controls UUKL Smoke Control Design Guide.
2. California Energy Commission's Appliance Efficiency Program: The manufacturer has certified this product to the California Energy Commission in accordance with California law.

Universal Inputs (UI)

General

Input Type	Universal; software configurable
Input Resolution	16-Bit analog / digital converter
Power Supply Output	15VDC; maximum 240mA

Contact

Type	Dry contact

Counter

Type	Dry contact
Maximum Frequency	1Hz maximum
Minimum Duty Cycle	500ms On / 500ms Off

0 to 10VDC

Range	0 to 10VDC (40kΩ input impedance)

0 to 5VDC

Range	0 to 5VDC (high input impedance)

0 to 20mA

Range	0 to 20mA 249Ω external resistor wired in parallel

Resistance/Thermistor

Range	0 to 350 KΩ
Supported Thermistor Types	Any that operate in this range

Pre-configured Temperature Sensor Types:

Thermistor	10KΩ Type 2, 3 (10KΩ @ 77ºF; 25ºC)
Platinum	Pt1000 (1KΩ @ 32ºF; 0ºC)
Nickel	RTD Ni1000 (1KΩ @ 32ºF; 0ºC) RTD Ni1000 (1KΩ @ 69.8ºF; 21ºC)

Universal Outputs (UO)

General

Output Type	Universal; software configurable
Output Resolution	10-bit digital to analog converter
Output Protection	Built-in snubbing diode to protect against back-EMF, for example when used with a 12VDC relay Output is internally protected against short circuits
Load Resistance	Minimum 200 Ω for 0-10VDC and 0-12VDC outputs Maximum 500 Ω for 0-20mA output
Auto-reset fuse	Provides 24VAC over voltage protection

0 or 12VAC (On/Off)

Range	0 or 12VDC
Source Current	Maximum 60 mA at 12VDC (minimum load resistance 200Ω)

PWM

Range	Adjustable period from 2 to 65 seconds
Thermal Actuator Management	Adjustable warm up and cool down time

Floating

Minimum Pulse On/Off Time	500 milliseconds
Drive Time Period	Adjustable

0 to 10VDC

Range	0 to 10VDC
Source Current	Maximum 60 mA at 10VDC (minimum load resistance 200Ω)

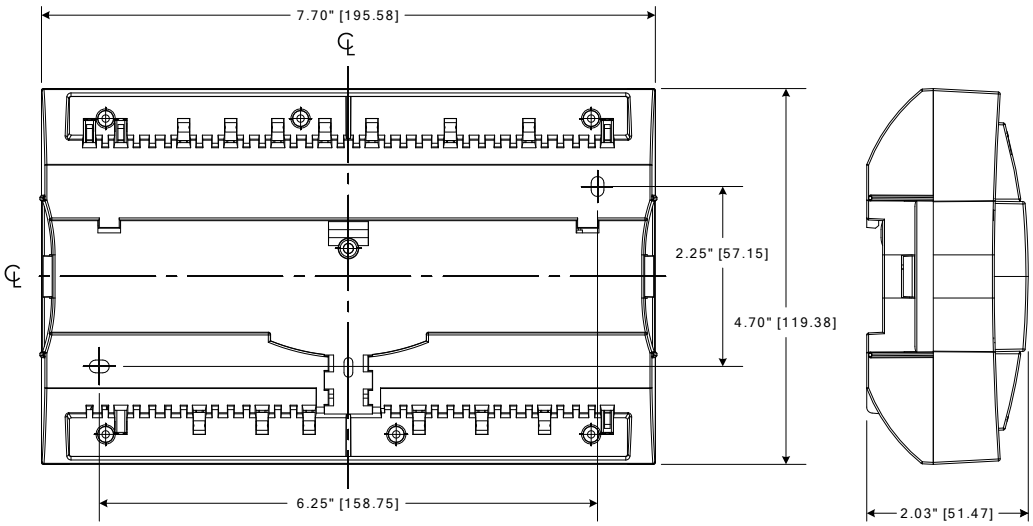
0 to 20mA

Range	0 to 20mA
Type	Current source (jumper configurable)

HOA

Hand-Off-Auto switch	When equipped. Supervision allows control logic to read the current HOA switch and potentiometer settings
Threshold	Configurable
Potentiometer Voltage Range	0 to 12.5VDC

Dimensions



Inches [Millimeters]

ECx-400 Series Extension Modules

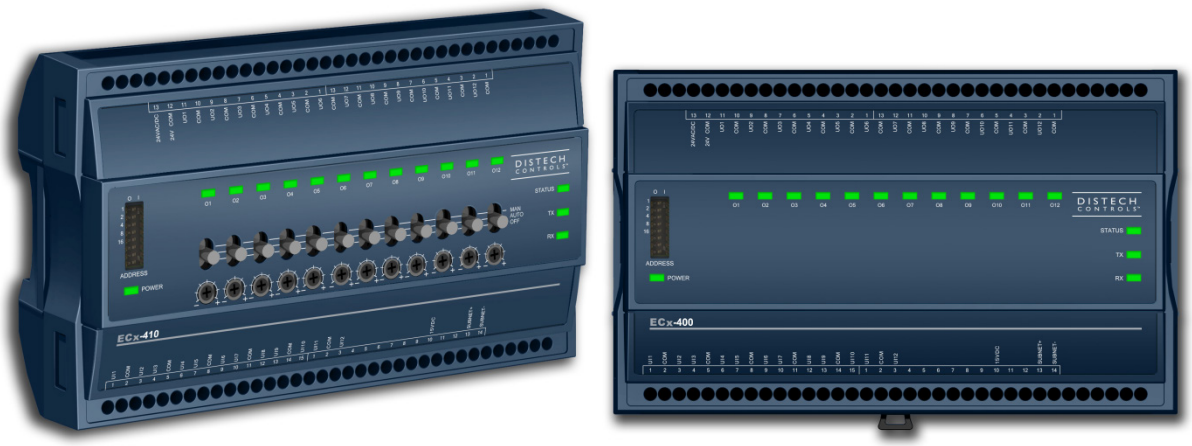


Figure 1: From left to right: enclosure with HOA switches and enclosure without HOA

Product Description

This document describes the hardware installation procedures for the ECx-400 Series I/O Extension Modules.

The Distech Controls ECL-600 and ECB-600 Series controllers product line is designed to control and monitor various HVAC equipment such as roof top units, large air handling units as well as central plant applications such as chillers and boilers. These controllers are compatible with the I/O Extension Module product line, which includes the following modules: ECx-400, ECx-410 and ECx-420.

This document describes the hardware installation procedures for the ECx-400, ECx-410 and ECx-420 I/O Extension Modules only.

- These I/O Extension Modules are all built on a similar platform, but have different numbers of inputs and outputs. Moreover, each individual model has different amounts of digital and/or universal outputs. For more information on the specific layout and functionality of each I/O Extension Module, please refer to the ECL-600 or ECB-600 datasheets.

General Installation Requirements

For proper installation and subsequent operation of each controller, pay special attention to the following recommendations:

- It is recommended that the controller(s) be kept at room temperature for at least 24 hours before installation to allow any condensation that may have accumulated due to low temperature during shipping/storage to evaporate.
- Upon unpacking the product, inspect the contents of the carton for shipping damages. **Do not install damaged controllers.**
- Avoid areas where corroding, deteriorating or explosive vapors, fumes or gases may be present.
- Allow for proper clearance around the controller's enclosure, wiring terminals, and Subnet Addressing switches to provide easy access for hardware configuration and maintenance, and to ventilate heat generated by the controller.
- Orient the controller with the ventilation slots and power supply/output terminal block connectors towards the top to permit proper heat dissipation. When installed in an enclosure, select one that provides sufficient surface area to dissipate the heat generated by the controller and by any other devices installed in the enclosure. A metal enclosure is preferred. If necessary, provide active cooling for the enclosure.
- The I/O Extension Module's datasheet specifies the power consumption (amount of heat generated), the operating temperature range, and other environmental conditions the controller is designed to operate under.
- Ensure that all equipment is installed according to local, regional, and national regulations.
- The I/O Extension Module's plastic enclosure has a back plate that is separable from the front plate allowing the back plates (with the connectors) to be shipped directly to the installation site while all the engineering is done in the office.
- Do not drop the I/O Extension Module or subject it to physical shock.
- If the I/O Extension Module is used and/or installed in a manner not specified by Distech Controls, the functionality and the protection provided by the controller may be impaired.

Any type of modification to any Distech Controls product will void the product's warranty

- Take special care to keep the front and back plate aligned when separating and joining them.
- Before installation of the Wireless Receiver, verify that local communication regulations allow the installation of wireless devices and available frequencies to be supported in your area. Refer to the Open-to-Wireless™ Solution Guide for more information.

Take reasonable precautions to prevent electrostatic discharges to the I/O Extension Module when installing, servicing or operating the I/O Extension Module. Discharge accumulated static electricity by touching one's hand to a well-grounded object before working with the I/O Extension Module.

Device Markings (Symbols)

Certain markings (symbols) can be found on the controller and are defined as:

Symbol	Description
CE	CE marking: the device conforms to the requirements of applicable EC directives.
	Double Insulation *marking*: These controllers are built using double insulation.
	Products must be disposed of at the end of their useful life according to local regulations.
	Read the Hardware Installation Guide for more information.
	For indoor use only.
c UL us LISTED	UL marking: conforms to the requirements of the UL certification.
FC	FCC marking: This device complies with FCC rules part 15, subpart B, class B.
	Warning Symbol: Significant information required. Refer to the Hardware Installation Guide.
	HIGH VOLTAGE Symbol: Direct contact will cause electrical shock or burn.
	Alternating Current
	Direct Current
L	Line
N	Neutral

General Wiring Recommendations

Turn off power before any kind of servicing.

- All wiring must comply with electrical wiring diagrams as well as national and local electrical codes.
- To connect the wiring to an I/O Extension Module, use the terminal connectors. It is recommended to remove the front plate from the back plate to facilitate the wiring process, however it is possible to do all wiring with the front and back plates together. Use a small flat screwdriver to tighten the terminal connector screws once the wires have been inserted. Careful use is recommended when tightening the screws. Screw tightening (torqueing) should never exceed 0.5 Nm or 4.4 in-lb.
- Power type cables (i.e. for power, 3-wire voltage and current inputs and outputs) should be kept apart from other types of wiring to avoid any ambient noise transmission to other wires.
- The board connectors accept wires or flat cables ranging from 22 to 14AWG (0.644 to 1.630mm diameter) per pole. However, power cables must be between 18 and 14AWG (1.024 to 1.630mm diameter).
- Do not connect the universal inputs, analog/digital outputs or common terminals to earth or chassis ground (unless stated otherwise).
- Keep all wires away from high speed data transmission cables (for example, Ethernet, etc.).
- Keep input and output wiring in conduits, trays or close to the building frame if possible.

I/O Extension Module Dimensions & Components

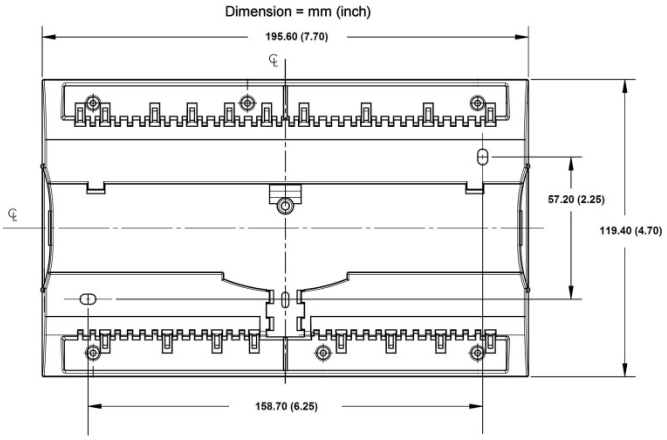


Figure 2: Rear view of large enclosure

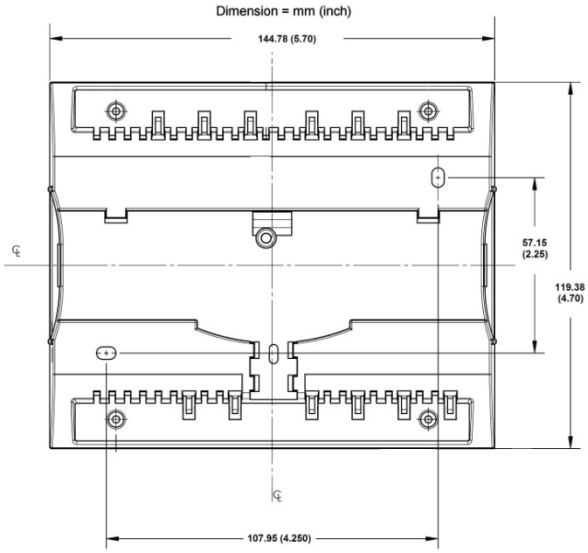


Figure 3: Rear view of small enclosure

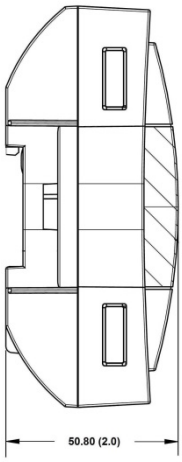


Figure 4: Side view of the large and small enclosure

Mounting Instructions

Each controller can be mounted on a DIN rail to speed up the installation procedure. They are also equipped with two mounting holes 0.25" x 0.165" (6.35mm x 4.191mm). The I/O Extension Module can be mounted in a panel or on a wall by using appropriate screw types (use sheet metal, thread forming, or self-tapping screws accordingly).

DIN Rail-Mounted Installation

1. Ensure the DIN rail is properly mounted on the wall.
2. Simply clip controller onto the DIN rail.

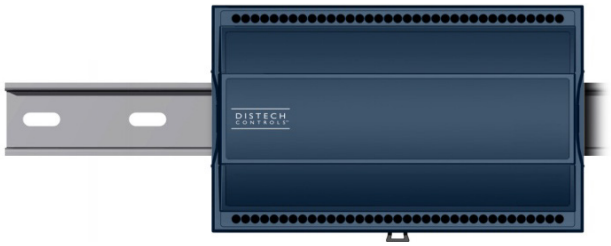


Figure 5: DIN rail-mounted controller

Wall-Mounted Installation

1. Open the I/O Extension Module by separating the front and back plate while pressing on the side clips.
2. Use the back plate's mounting holes to mark the location of any holes that need to be drilled.
3. Drill the holes.
4. Clean the surface and mount the I/O Extension Module using the appropriate screw types.

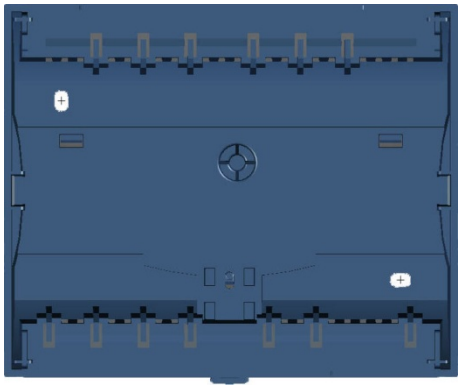


Figure 6: Wall-mounted I/O Extension Module

Power Wiring

Voltage: 24VAC/DC; ± 15%, Class 2

This is a Class 2 Product. Use a Class 2 transformer only (rated at 100VA or less at 24VAC) to power the controller(s).

The Network Guide provides extensive information and requirements for powering a controller. It can be downloaded from the www.distech-controls.com website.

It is recommended to wire only one controller per 24VAC transformer.

If only one 24VAC transformer is available, determine the maximum number of controller that can be supplied using the following method to determine the required power transformer capacity:

- Add up the maximum power consumption of all controller including external loads and multiply this sum by 1.3.
- If the resulting number is higher than 100VA, use multiple transformers.

Use an external fuse on the 24VAC side (secondary side) of the transformer, as shown in *Figure 7* and *Figure 8*, to protect all controllers against power line spikes.

Maintain consistent polarity when connecting controllers and devices to the transformer. One terminal on the secondary side of the transformer must be connected to the building's ground. All 24V COM terminals of all controllers and peripherals throughout the LAN or the Subnetwork must be connected to the grounded transformer terminal as shown in *Figure 7* and *Figure 8*. This ensures that the 24V COM terminals of all devices connected to any LAN or Subnetwork in the building are at the same potential.

A mechanical ground is unacceptable: Do not use a pipe, conduit, or duct work for a ground. The power supply must have a dedicated ground wire that comes from the main electrical supply panel.

Failure to maintain consistent polarity throughout the entire LAN or the Subnetwork will result in a short circuit and/or damage to the controller!

The COM terminals of the controller are internally wired to the 24V COM terminal of the power supply. Connecting a peripheral or another controller to the same transformer without maintaining polarity between these devices will cause a short circuit.

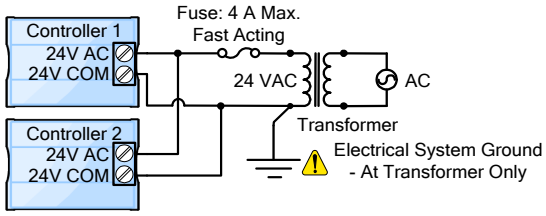


Figure 7: Power wiring – AC

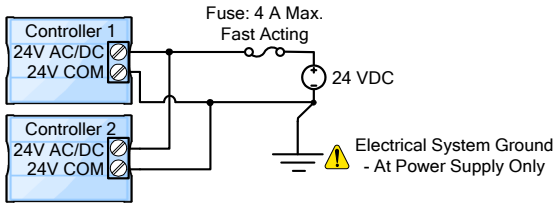


Figure 8: Power wiring – DC

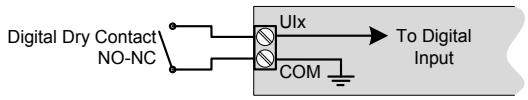
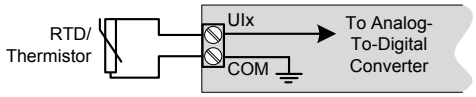
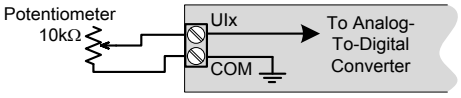
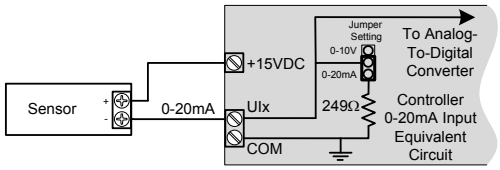
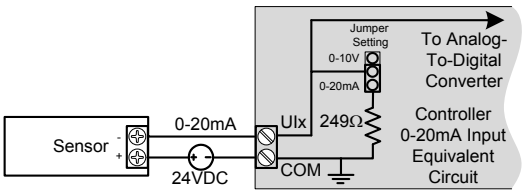
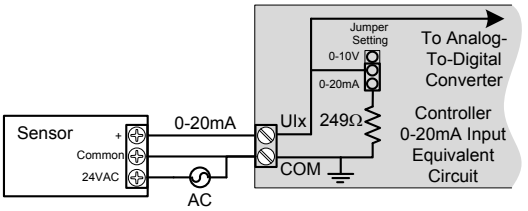
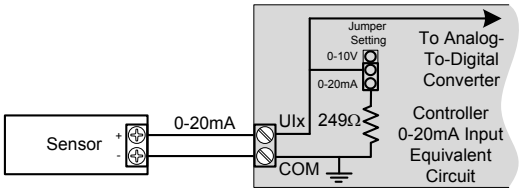
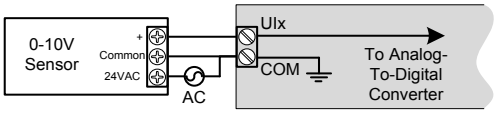
Input Wiring

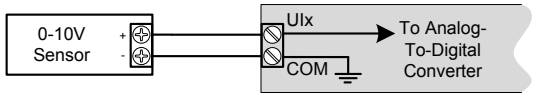
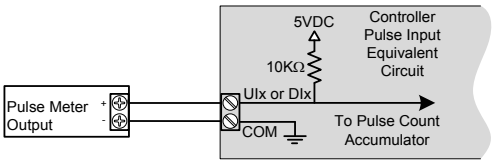
Inputs can be connected as follows. *Table 1* shows the input designation for the ECx-400 Series I/O Extension Module.

Before connecting a sensor to the controller, refer to the installation guide of the equipment manufacturer.

- For a wire length less than 75' (23m), either a shielded or unshielded 18AWG wire may be used.
- For a wire up to 200' (61m) long, a shielded 18AWG wire is recommended.
- The shield of the wire should be grounded on the controller side only and the shield length should be kept as short as possible.

Table 1: ECx IO Module Input Wiring

Sensor Input Type	ECx IO modules' Input Designation	Input Connection Diagram
- Dry Contact input. - Pulsed input.	- UIx - DIx	
- RTD input (for example, 1000Ω). - Thermistor Input (for example, 10kΩ type II and III).	- UIx	
- Resistive input, (for example, use with 10kΩ and 100kΩ potentiometers).	- UIx	
- 0 to 20mA input used with a 2-wire, 0 to 20mA sensor powered by th I/O Extension Module's 15VDC power supply.	- UIx	
- 0 to 20mA input used with a 2-wire, 0 to 20mA sensor powered by an external 24VDC power supply.	- UIx	
- 0 to 20mA input used with a 3-wire, 0 to 20mA sensor powered by an external 24VAC power supply.	- UIx	
- 0 to 20mA input used with a sensor powered by its own power source.	- UIx	
- Voltage input used with a 3-wire 0 to 10VDC or 0 to 5VDC sensor powered by an external 24VAC power supply	- UIx	

Sensor Input Type	ECx IO modules' Input Designation	Input Connection Diagram
- Voltage input used with a 0 to 10VDC or 0 to 5VDC sensor powered by its own power source.	- UIx	
- **Slow Pulse** – **Internal supply**: 2-wire pulse meter, maximum input frequency of 1Hz (500ms minimum ON/OFF) - Connect the pulse input according to the figure for a pulse meter that can pull-down a +5VDC supply with a 10KΩ pull-up resistor (internal supply type).	- UIx	

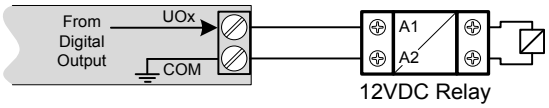
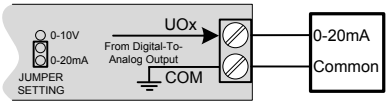
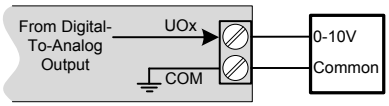
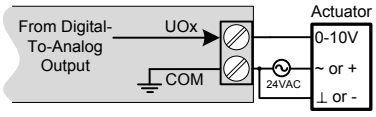
Output Wiring

Outputs can be connected as follows. *Table 2* shows the output designation for the ECx-400 Series I/O Extension Module.

Before connecting an output device (actuator, relay, etc.) to the controller, refer to the datasheet and installation guide of the equipment manufacturer.

- For a wire length less than 75' (23m) long, either a shielded or unshielded 18AWG wire may be used.
- For a wire length up to 200' (61m) long, a shielded 18AWG wire is recommended.
- The shield of the wire should be grounded on the I/O Extension Module side and the shield length should be kept as short as possible.

Table 2: ECB IO Module Output Wiring

Control Output Type	ECx IO modules' Output Designation	Output Connection Diagram
- Discrete 0 or 12VDC digital, Pulse, or PWM output controlling a 12VDC relay.	- UOx	
- Current 0 to 20mA universal output & jumper configuration	- UOx	
- Linear 0 to 10VDC digital to analog output.	- UOx	
- 0 to 10VDC voltage output controlling an analog actuator that is powered by an external 24VAC power source.	- UOx	

Subnet Wiring

The Allure Series Communicating Sensor is a communicating room temperature sensor with backlit display and graphical menus. A dipswitch is needed to identify to the Smart Comfort/Smart Air subnetwork. The Allure EC-Smart-Vue requires a menu to identify to the subnetwork. Connect the Allure Series Communicating Sensor to the controller's **Subnet Port** with a standard Category 5e Ethernet patch cable fitted with RJ-45 connectors. Refer to the Network Guide for extensive information and requirements for the connection of the Allure Series Communicating Sensor. It contains information about network topology and length, cable type, setting the Subnet ID, etc. It can be downloaded from the www.distech-controls.com website. See also the Hardware Installation Guide supplied with the Allure Series Communicating Sensor.

If you make your own patch cable, use Category 5e cable crimped with RJ-45 connectors either as T568A or T568B.

- Do not crimp one connector as T568A and crimp the other connector as T568B on the same cable.
- Protect the controller's connector from being pulled on when a cable to the Allure Series Communicating Sensor is connected. Create a strain-relief by looping the cable and attaching it to a solid object with a nylon tie so that a tug on the cable will not pull out the connector on the controller.

Table 3: T568A and T568B Terminations for an RJ-45 Connector

Pin	T568A (at both cable ends)		T568B (at both cable ends)	
	Pair	Color	Pair	Color
1	3	white/green stripe	2	white/orange stripe
2	3	green solid	2	orange solid
3	2	white/orange stripe	3	white/green stripe
4	1	blue solid	1	blue solid
5	1	white/blue stripe	1	white/blue stripe
6	2	orange solid	3	green solid
7	4	white/brown stripe	4	white/brown stripe
8	4	brown solid	4	brown solid

The final result of a crimped RJ-45 connector is shown graphically below.

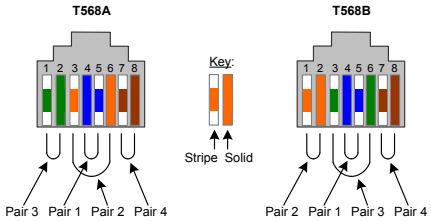


Figure 9: T568A and T568B Crimp Wire Sequence for an RJ-45 Connector

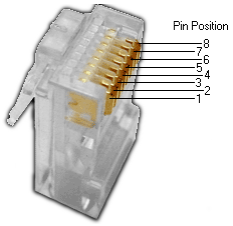


Figure 10: Pins on RJ-45 Jack Face

Patch cables fitted with connectors supplied by Distech Controls are wired as T568B.

Communications Wiring

ECx-400 series IO Extension Modules are connected to the **SUBNET–** and **SUBNET+** terminals of the ECB-600 or ECL-600 series controller. The Network Guide provides extensive information and requirements to implement the subnetwork for the ECx-400 series IO Extension Modules. It contains information about network length, cable type, controller addressing, etc. See the Hardware Installation Guide supplied with the ECx-400 series IO Extension Module. It can also be downloaded from the www.distech-controls.com website.

For optimal performance, use Distech Controls 24 AWG (0.65 mm) stranded, twisted pair shielded cable or refer to the Network Guide for cable specification. The subnetwork communication wire is polarity sensitive and the only acceptable topology is to daisy-chain the cable from one I/O Extension Module to the next.

As shown in *Figure 11* below:

- When the subnetwork data bus is connected to a following device, twist data bus shields together.
- Isolate all shields with electrical tape so there is no exposed metal that can touch ground or other conductors.
- The shield of the data bus must be connected to the electrical system ground at only one point – usually at one end of the bus as shown below.
- The first and last daisy-chained subnetwork device must have its EOL resistors enabled / installed. All other devices must have their EOL resistor disabled.
- The I/O Extension Module and the Allure™ Series Communicating Sensor share the same subnetwork.

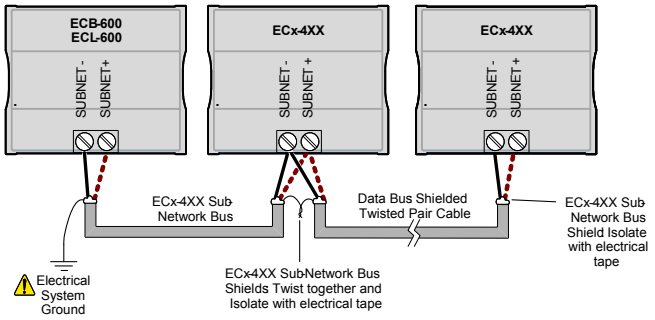


Figure 11: Subnetwork Bus Shielding

About the Subnetwork Bus

The ECB-600 and ECL-600 controllers use the Subnetwork bus to support the ECx-4XX Series I/O Extension Modules through 2-wire shielded cable.

The ECB-600 and ECL-600 controllers also use the Subnetwork bus to support one or more Allure Series Communicating Sensor(s) using standard structural cabling.

Subnetwork Bus Total Length

The total maximum length of all Subnetwork buses, including both the length of the Allure Series Communicating Sensor Subnetwork bus and the ECx-4XX Subnetwork bus is 300 m (1 000 ft). The maximum length of the Allure Series Communicating Sensor Subnetwork bus is 200 m (650 ft). The maximum length of the ECx-4XX Subnetwork bus is 300 m (1 000 ft).

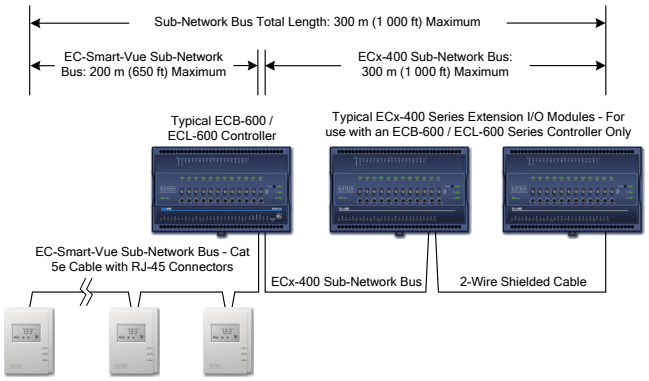


Figure 12: Subnetwork Bus Overview Showing the EC-Smart-Vue Subnetwork Bus and the ECx-4XX Subnetwork Bus

Subnetwork Bus Topology and EOL Terminations with the ECB-600 or ECL-600 Series Controller

When ECx-400 Series I/O Extension Modules are installed with an ECB-600 or ECL-600 Series controller, only the EOL terminations of the ECB-600 / ECL-600 controller and the last I/O Extension Module are set to ON. All other I/O Extension Modules must have their EOL terminations set to OFF.

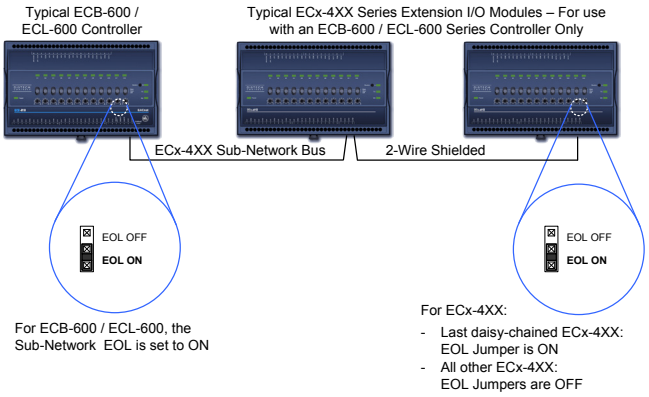


Figure 13: Setting the EOL Terminations on the Subnetwork Bus

When ECx-400 Series I/O Extension Modules are installed with an ECB-600 or ECL-600 Series controller and with Allure Series Communicating Sensor(s) sensor(s), only the EOL terminations on the last I/O Extension Module and the last Allure Series Communicating Sensor are set to ON. The ECB-600 / ECL-600 and all other I/O Extension Modules and Allure Series Communicating Sensor must have their EOL terminations set to OFF.

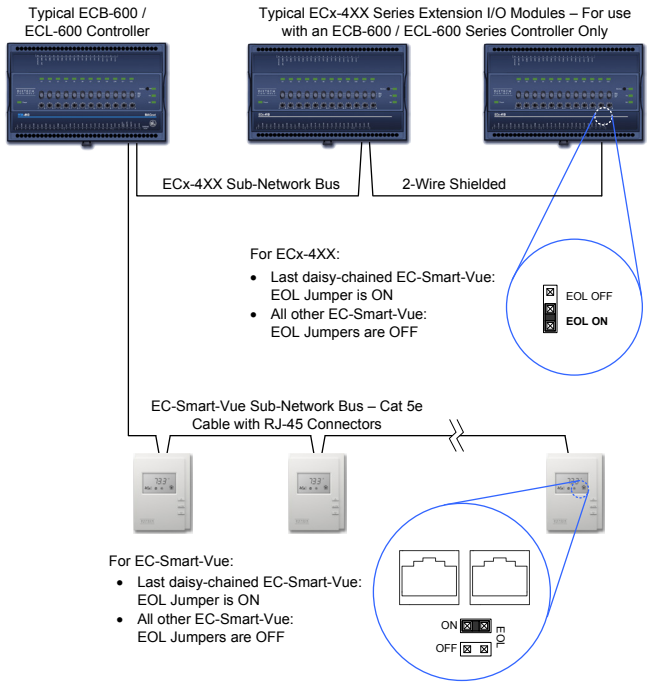


Figure 14: Setting the EOL Terminations on the ECx-400 Series Subnetwork Bus when EC-Smart-Vue Sensors are used

If inserting multiple wires in the terminals, ensure to properly twist wires together prior to inserting them into the terminal connectors.

For more information and detailed explanations on network topology and wire length restrictions, refer to the Network Guide, which can be downloaded from our website www.distech-controls.com.

Device Addressing

The Subnet ID Address must be set to one (1) or two (2) by setting the DIP switch located on the faceplate An example of how to set the device's Subnet ID Address DIP switch is shown below.

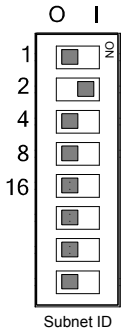


Figure 15: Typical I/O Extension Module DIP Switch Set to 2

The address is the sum of the numbers set to ON. For example, if the second (2) DIP switch is set to ON, the I/O Extension Module address is two (2). Only addresses 1 and 2 are valid.

The I/O Extension Module must be power cycled after the Subnet ID DIP switch has been changed.

Strain Relief and Terminal Block Cover

In certain jurisdictions, terminal block covers are required to meet local safety regulations. Strain reliefs and terminal block covers are available for controllers housed in large enclosures and are used to relieve tension on the wiring and conceal the controllers' wire

terminals. Strain reliefs and terminal block covers are optional and are sold as peripherals.

Prior to connecting all wires, it is recommended to install the strain relief. Three screws are provided for its installation under the bottom part of the enclosure. Tie wraps can then be used to group wires together and attach them securely to the strain relief in an effort to relieve undue tension. If necessary, the terminal block cover can then be clipped on to the strain relief as shown below.

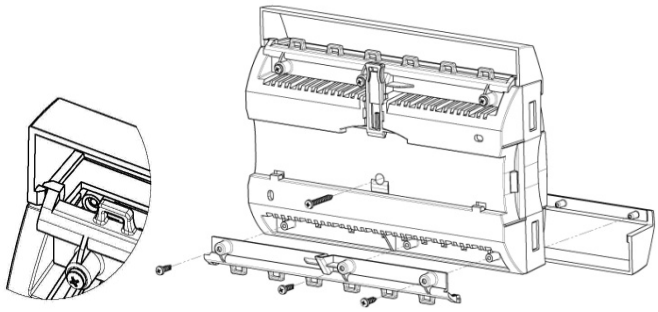


Figure 16: Enclosure strain relief and terminal block cover installation

Maintenance

Turn off power before any kind of servicing.

Each controller requires minimal maintenance, but it is important to take note of the following:

- If it is necessary to clean the outside of the controller, use a dry cloth.
- Retighten terminal connector screws annually to ensure the wires remain securely attached.

Disposal

The Waste Electrical and Electronic Equipment (WEEE) Directive sets out regulations for the recycling and disposal of products. The WEEE2002/96/EG Directive applies to standalone products, for example, products that can function entirely on their own and are not a part of another system or piece of equipment.

For this reason Distech Controls products are exempt from the WEEE Directive. Nevertheless, Distech Controls products are marked with the WEEE symbol  , indicating devices are not to be thrown away in municipal waste.

Products must be disposed of at the end of their useful life according to local regulations and the WEEE Directive.

North American Emissions Compliance

United States

Changes or modifications not expressly approved by Distech Controls could void the user's authority to operate the equipment.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential and commercial installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Canada

This Class (B) digital apparatus meets all the requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la Classe (B) respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

Typical Air Handling Unit Application Wiring Diagram

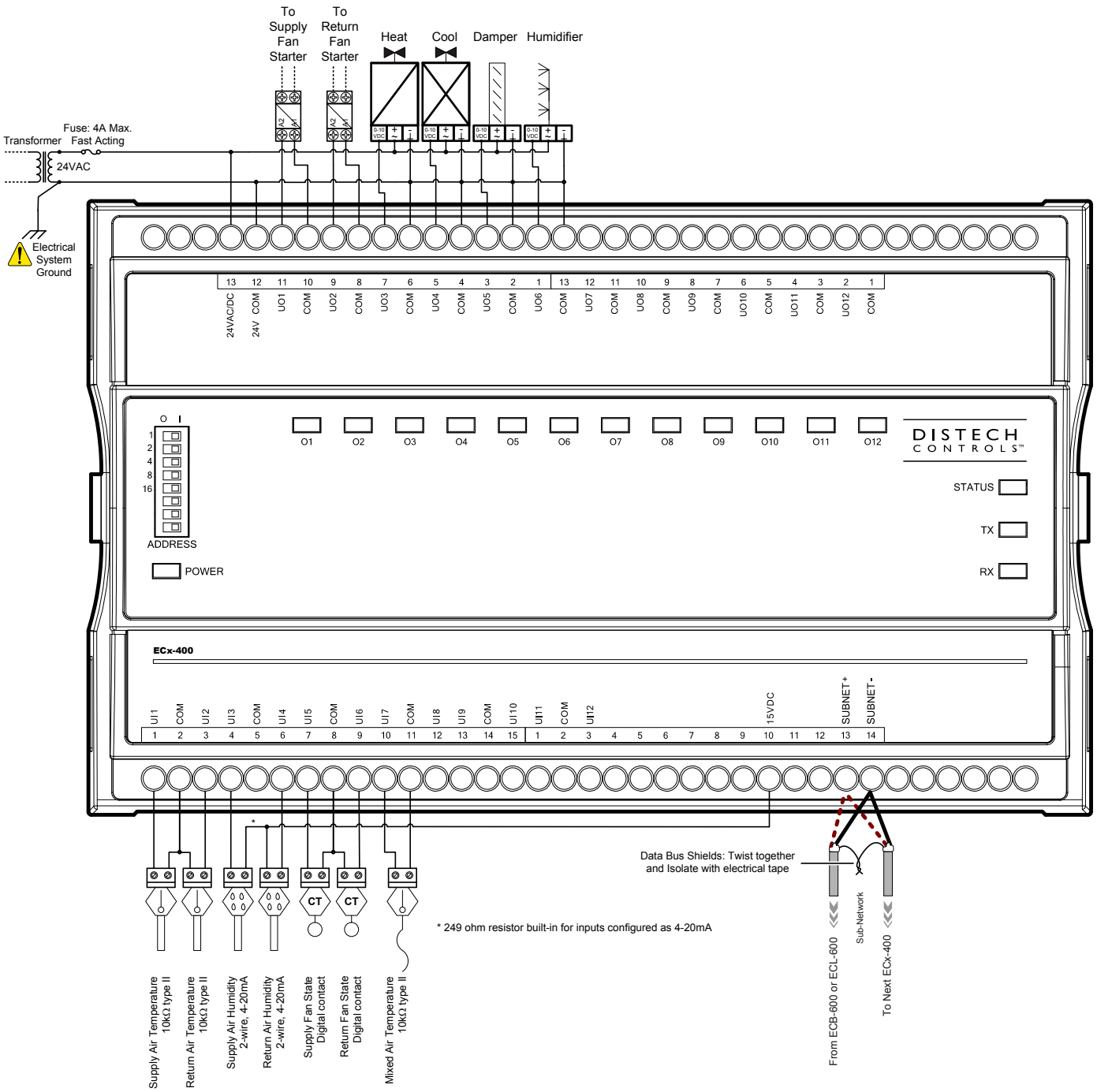


Figure 17: Typical Power and Network Connections

Troubleshooting Guide

Controller is powered but does not turn on	
Fuse has blown	Disconnect power from the controller. Check the fuse integrity. Reconnect power to the controller.
Power supply polarity	Verify that consistent polarity is maintained between all controllers and the transformer. Ensure that the COM terminal of each controller is connected to the same terminal on the secondary side of the transformer. See *Figure 7* and *Figure 8*.
I/O Extension Module cannot communicate on the subnetwork	
Absent or incorrect supply voltage	1. Check power supply voltage between 24VAC ±15% and COM pins and ensure that it is within acceptable limits. 2. Check for tripped fuse or circuit breaker.
Overloaded power transformer	Verify that the transformer used is powerful enough to supply all controllers. See *Power Wiring*.
Network not wired properly	Double check that the wire connections are correct.
Absent or incorrect network termination	Check the network termination(s). Only the last ECx-400 I/O Extension module must have its EOL termination set to ON. See *Figure 13*. When one or more Allure Series Communicating Sensors are connected to the controller, only the last Allure Series Communicating Sensor must have its EOL termination set to ON. See *Figure 14*.
There is another controller with the same Subnet ID on the subnetwork	Each I/O Extension Module on the subnetwork must have a unique Subnet ID. Look at the Subnet ID DIP switch on the faceplate of each I/O Extension Module.
Network length	Check that the total wire length does not exceed the specifications of the *Network Guide*.
Wire type	Check that the wire type agrees with the specification of the Network Guide.
Hardware input is not reading the correct value	
Input wiring problem	Check that the wiring is correct according to this manual and according to the peripheral device's manufacturer.
Open circuit or short circuit	Using a voltmeter, check the voltage on the input terminal. For example, for a digital input, a short circuit shows approximately 0V and an open circuit shows approximately 5V.
Configuration problem	Using EC-*gfx*Program, check the configuration of the input. Refer to the controller's programming user guide for more information.
Over-voltage or over-current at an input	An over-voltage or over-current at one input can affect the reading of other inputs. Respect the allowed voltage / current range limits of all inputs. Consult the appropriate datasheet for the input range limits of this controller.
Hardware output is not operating correctly	
Fuse has blown (Auto reset fuse)	Disconnect the power and outputs terminals. Then wait a few seconds to allow the auto-reset fuse to cool down. Check the power supply and the output wiring. Reconnect the power.
Open circuit or short circuit	Using a voltmeter, check the voltage on the input terminal. For example, for a digital input, a short circuit shows approximately 0V and an open circuit shows approximately 5V.
Configuration problem	Using EC-*gfx*Program, check the configuration of the output. Refer to the controller's programming user guide for more information.
0 to 10V output, 24VAC powered actuator is not moving.	Check the polarity of the 24VAC power supply connected to the actuator while connected to the controller. Reverse the 24VAC wire if necessary.
Rx/Tx LEDs	
RX LED not blinking	Data is not being received from the Subnetwork bus.
TX LED not blinking	Data is not being transmitted onto the Subnetwork bus.

Status LED– Normal Operation	
One fast blink ●	Initialization: The device is starting up.
Fast blink continuous: ● ● ● ● ● (150ms On, 150ms Off, continuous)	Firmware upgrade in progress. Controller operation is temporarily unavailable. The new firmware is being loaded into memory. This takes a few seconds. Do not interrupt power to the device during this time.
The Status LED is always OFF	The controller is operating normally.
Status LED blink patterns – Repeats every 2 seconds (highest priority shown first)	
Long blink continuous: ▬ ▬ ▬ ▬ ▬ ... (1s On, 1s Off, continuous)	The controller is unconfigured. Appropriate action: Commission the controller
Long Long Long blink ▬▬ ▬▬ ▬▬ (800ms On, 300ms Off, 800ms On, 300ms Off, 800ms On)	The controller is offline. Appropriate action: Verify that the: - I/O Extension Module's Subnet ID Address is correctly set. See Device Addressing. - Subnetwork bus cable is not cut, short-circuited, or too long. See Communications Wiring - . - Associated ECB-600 or ECL-600 has power.

For issues with the Allure Series Communicating Sensor, refer to the Allure Series Communicating Sensor Hardware Installation Guide

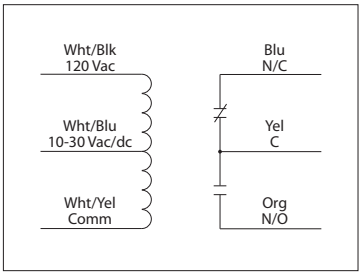
12/12

05DI-HIECX40-12

10 AMP PILOT CONTROL RELAY

RIBU1C

Enclosed Relay 10 Amp SPDT with
10-30 Vac/dc/120 Vac Coil



RIBU1C-RD
- Red housing

RIBU1C-N4
- NEMA 4X housing, UL508 only

SPECIFICATIONS

 # Relays & Contact Type: One (1) SPDT Continuous Duty Coil
Expected Relay Life: 10 million cycles minimum mechanical
Operating Temperature: -30 to 140° F
Humidity Range: 5 to 95% (noncondensing)
Operate Time: 20ms
Relay Status: LED On = Activated
Dimensions: 1.70˝ x 2.80˝ x 1.50˝ with .50˝ NPT nipple
Wires: 16˝, 600V Rated
Approvals: UL Listed, UL916, UL864, C-UL
California State Fire Marshal, CE, RoHS
Housing Rating: UL Accepted for Use in Plenum, NEMA 1
Gold Flash: Yes
Override Switch: No

Contact Ratings:
10 Amp Resistive @ 277 Vac
10 Amp Resistive @ 28 Vdc
480 VA Pilot Duty @ 240-277 Vac
480 VA Ballast @ 277 Vac
Not rated for Electronic Ballast
600 Watt Tungsten @ 120 Vac (N/O)
240 Watt Tungsten @ 120 Vac (N/C)
1/3 HP @ 120-240 Vac (N/O)
1/6 HP @ 120-240 Vac (N/C)
1/4 HP @ 277 Vac (N/O)
1/8 HP @ 277 Vac (N/C)

Coil Current:

33 mA @ 10 Vac	13 mA @ 10 Vdc
35 mA @ 12 Vac	15 mA @ 12 Vdc
46 mA @ 24 Vac	18 mA @ 24 Vdc
55 mA @ 30 Vac	20 mA @ 30 Vdc
28 mA @ 120 Vac	

Coil Voltage Input:
10-30 Vac/dc ; 120 Vac ; 50-60 Hz
Drop Out = 2.1 Vac / 2.8 Vdc
Pull In = 9 Vac / 10 Vdc

20191025

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Where an attachment to this Agreement or separate document referencing this Agreement consists of a quotation, the quotation remains open for acceptance for a period of thirty (30) days or such other period as specified in the quotation. Seller hereby rejects any additional or different terms or provisions contained in any purchase order, acknowledgment or other communication heretofore or hereafter received from Buyer. Seller's delivery of Products does not constitute an assent to any terms proposed by Buyer. Except for an officer of Seller, no representative of Seller has any authority to waive, alter, vary, amend, or add to the terms hereof. **THESE TERMS AND CONDITIONS OF SALE CONSTITUTE THE ENTIRE AGREEMENT ("AGREEMENT") BETWEEN SELLER AND BUYER WITH RESPECT TO THE MATTERS ADDRESSED HEREIN.**

2. PRICES: The prices for the Products are based on the terms and conditions herein, including the limitations of liability and warranties, and all such terms and conditions are material to the sale of the Products. In the event Seller fails to provide a price quote and/or terms prior to the acceptance of the order, Buyer will pay Seller's then-current list price for such Products. All quotations and invoices show the net selling price of each item quoted. In the event of a mathematical error, the quoted price per Product governs.

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4. TAXES AND OTHER CHARGES: In addition to the prices quoted or invoiced, Buyer will pay any sales tax, excise tax, use tax, value added or consumption tax, customs duty (that is assessed on the delivery of Product(s) to a destination outside of the U.S.A.), fee or charge of any nature whatsoever imposed by any governmental authority on or measured by the transaction between Seller and Buyer. In the event Seller is required to pay any amount, Buyer will reimburse Seller therefore; or provide Seller, at the time the order is submitted, an exemption certificate or other document acceptable to the authority imposing the same. Seller does not accept and will not pay any fines, penalties or chargebacks from Buyer for any reason.

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B. Buyer will only make written claims to Seller for damages, shortages or other delivery errors within seven (7) calendar days after receipt of shipment. All Products received by Buyer, or Buyer's clients, customers, or agents, that are not rejected within such time will be deemed accepted. Failure to provide such written notice constitutes a waiver of all such claims regarding such shipment by Buyer. Buyer will not revoke acceptance.

C. Seller is not liable for any damage as a result of any delay or failure to deliver due to any act of God, act of Buyer, embargo or other governmental act, regulation or request, fire, accident, power outage, strike, civil unrest, weather, slowdown or other labor difficulties, war, riot, act of terrorism, delay in transportation, defaults of common carriers, inability to obtain necessary labor, materials or manufacturing facilities or, without limiting the foregoing, any other delays beyond Seller's control. Buyer's sole and exclusive remedy for any delays or for Seller's inability to deliver Products for any reason, in each case, that persists for more than ninety (90) days, is to cancel the order pursuant to Seller's Order Policies and Guidelines available upon request.

6. WARRANTY; DISCLAIMER. Products are warranted to be free from manufacturing defects under normal use and conditions for five (5) years (the "**Warranty Period**").

The warranty does not apply to: (a) Damage caused by accident, abuse, mishandling, or dropping; (b) Products which have been subjected to unauthorized repair, opened, or taken apart; (c) Products not used in accordance with directions; (d) Damages exceeding the cost of such Product; and (e) Damages caused by lightning, water, or condensation. If warranty service is required during the Warranty Period, and if examination shall disclose to Seller's satisfaction that such Product was originally defective, then Seller will at its option repair or replace the product without charge upon prepaid delivery of such Product to Seller's facility with proof of date of purchase. Corrections of such defects by repair to or supplying of replacements for defective parts shall constitute fulfillment of all obligations of Seller.

Seller shall not be liable for loss, damage, or expense directly or indirectly caused from the failure of Products to perform as expected.

EXCEPT AS SET FORTH HEREIN, SELLER DISCLAIMS ALL REPRESENTATIONS OR WARRANTIES OF ANY KIND WHATSOEVER, WHETHER EXPRESS, IMPLIED OR STATUTORY, INCLUDING, WITHOUT LIMITATION, ANY IMPLIED WARRANTIES OF MERCHANTABILITY, NON-INFRINGEMENT, FITNESS FOR A PARTICULAR PURPOSE OR ANY WARRANTY ARISING FROM A COURSE OF DEALING OR USAGE OF TRADE. NO PERSON (INCLUDING ANY AGENT, DEALER OR REPRESENTATIVE OF SELLER) IS AUTHORIZED TO MAKE ANY REPRESENTATION OR WARRANTY CONCERNING PRODUCTS EXCEPT TO REFER BUYER TO THIS AGREEMENT. BUYER WARRANTS THAT BUYER HAS NOT RELIED ON ANY OTHER WARRANTIES OR REPRESENTATIONS CONCERNING THE PRODUCTS OR THIS AGREEMENT.
For warranty service, call factory for RA number and send such Product prepared with sales receipt to: FUNCTIONAL DEVICES, INC., 101 COMMERCE DRIVE, SHARPSVILLE, IN 46068.

7. LIMITATION OF LIABILITY: SELLER WILL NOT BE LIABLE FOR ANY LOSS OF PROFIT, INTERRUPTION OF BUSINESS OR ANY OTHER SPECIAL, CONSEQUENTIAL OR INCIDENTAL DAMAGES SUFFERED OR SUSTAINED BY BUYER FOR ANY REASON. EXCEPT FOR CLAIMS OF DEATH OR PERSONAL INJURY, IN NO EVENT WILL SELLER'S AGGREGATE LIABILITY TO BUYER ARISING UNDER OR IN ANY WAY RELATED TO THIS AGREEMENT FOR ANY REASON (INCLUDING, BUT NOT LIMITED TO, LIABILITY ARISING FROM NEGLIGENCE OR ON THE BASIS OF STRICT LIABILITY, OR OTHERWISE) EXCEED THE TOTAL AMOUNT PAID BY BUYER TO SELLER HEREUNDER FOR ANY PRODUCT GIVING RISE TO A CLAIM UNDER THIS AGREEMENT.

8. RETURNS: Unless otherwise approved by Seller in writing in its sole discretion, except in the case of a non-conforming shipment or a warranty issue, Buyer may not return Products. If Seller approves the return of Products pursuant to the preceding sentence, such returned Products must be returned within ninety (90) days from date of invoice and will be subject to a 25% restocking fee. In the event of a non-conforming shipment or a warranty issue, Buyer may return Products, but only if Buyer first: (a) provides notice to Seller as required in this Agreement, (b) obtains prior authorization from Seller, and (c) all Products or containers for which return is properly authorized have been marked with a return authorization number supplied by Seller. Buyer will make all returns via a traceable form such as Federal Express, UPS or insured mail and in resalable condition. Buyer will pay all return shipping charges and any other charges associated therewith.

9. CANCELLATIONS: Cancellation or deferment of all or part of an order is subject to acceptance by the Seller. If accepted, any reduction in quantity of any item to less than 85% of the original item quantity is subject to a 15% cancellation charge. If an order cancellation is accepted, the Buyer will make delivery and pay for all material manufactured and in stock or in process at time of notice for such order, and for any special materials on orders for which the Seller must take delivery.

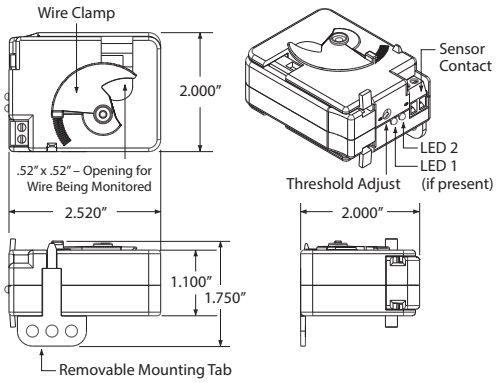
10. EXPORTS. Buyer agrees that it will comply with any and all U.S. Export Controls and will not pay for, resell, transfer or knowingly sell Products in violation of U.S. Export Controls. If Buyer resells Products within or exports Products to a country or region which imposes upon Seller and/or Buyer an obligation to fund or undertake reuse, recycling, composting, recovery of Products, or any similar obligation (e.g., the European Union's Waste Electrical and Electronic Equipment Directive, EC 2002/96/EC) (the "**Obligations**"), Buyer shall wholly undertake the Obligations or duties and shall be entirely responsible for all associated costs therewith. Seller shall have no obligation to reimburse Buyer for execution of the Obligations. In the event that Seller is named in a proceeding based upon the Obligations, Buyer shall indemnify, defend and hold Seller harmless from all actions related thereto, including all civil and governmental actions.

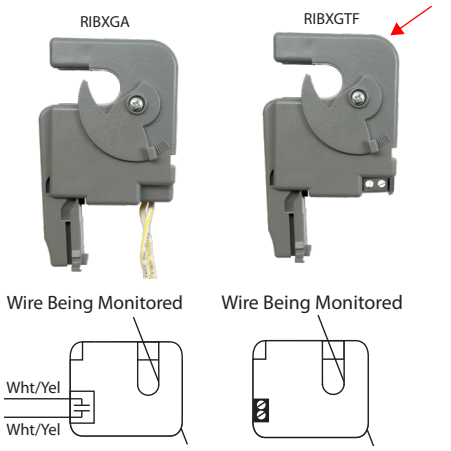
11. MISCELLANEOUS. This Agreement is governed by the laws of the State of Indiana, without giving effect to its conflict of laws principles. Buyer hereby irrevocably consents and submits to the exclusive jurisdiction and venue of the state and federal courts in Marion County, Indiana. The United Nations Convention for Contracts for the International Sale of Goods is explicitly excluded. Each provision contained in this Agreement constitutes a separate and distinct provision severable from all other provisions. If any provision (or any part thereof) is unenforceable under or prohibited by any present or future law, then such provision (or part thereof) will be amended, and is hereby amended, so as to be in compliance with such law, while preserving to the maximum extent possible the intent of the original provision. Any provision (or part thereof) that cannot be so amended will be severed from this Agreement; and, all the remaining provisions of this Agreement will remain unimpaired. No modification, addition or deletion, or waiver of any rights under this Agreement is binding on a party unless made in a non-preprinted agreement clearly understood by the parties to be a modification or waiver, and signed by a duly authorized representative of each party.

AC CURRENT SWITCHES

RIBXG Series

Enclosed Self-Powered Split Core AC Sensors





c UL us LISTED

CE

RoHS

MADE IN THE U.S.A.

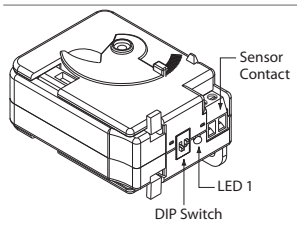
SPECIFICATIONS

FUNCTIONAL DEVICES CERTIFIED FOR USE WITH **ECMs**

Operating Temperature: -30 to 140° F
Humidity Range: 5 to 95% (noncondensing)
Max Sense Voltage: 600 Vac
Approvals: UL Listed, UL916, UL864, C-UL, California State Fire Marshal, CE, RoHS
Mounting/Installation: Removable mounting tab provided. The wire clamp locks against the wire being monitored, securing the unit in place.
Sensor Contact Status: Current below threshold: Open
Current above threshold: Closed

Sensor Contact:
- Solid State Contact
- When sensor contact is off (open), leakage <30 uA @ 30Vac/dc
- When sensor contact is on (closed), voltage drop
  < .3 Vac/dc @ .1 Amp
  < 1.6 Vac/dc @ .4 Amp

SELF-CALIBRATING AC SWITCHES (Models with -SCAL Suffix)



-SCAL LED TABLE	
LED Off	No Current
Two Winks	Current Below Range
Three Winks	Current In Range
Four Winks	Current Above Range
Continuous Winks	Calibration in Progress

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CE

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MADE IN THE U.S.A.

The SCAL unit begins the 30 second self-calibration process the first time current is applied in the operating range. The threshold is then set. Subsequent calibrations may be performed by moving SW1 to the position opposite of its current position with or without current applied (hands can be safely away from live voltage). Once current begins flowing, or if it already is, the calibration process will begin. At the end of the 30 seconds, amperage will be read and set as the threshold. SW2 in the ON position provides a 15% (+/-3%) differential. In the OFF position, it provides a 25% (+/-3%) differential. SW2 can be selected at anytime and does not affect the threshold setting. Current in-range closes the sensor contact. Current above or below range opens the sensor contact.

Example: With a current of 10 amps set as the threshold and a 15% differential, sensor contact will be closed between 8.5 amps and 11.5 amps and open outside of this range. A small amount of hysteresis is provided to prevent dithering near the differential limits.

RIBXG SERIES SELECTION GUIDE

Model#	Sensing Range	Type	Threshold	Sensor Contact Type	Switching Voltage Range	Maximum Switching Current	Sensor Contact Termination	LED 1	LED 2
RIBXGF	.35-150 Amp	Split Core	Fixed, .35 Amp	Solid State Switch SPST	30 Vac/dc	.4 Amps Max	Wht/Yel 16″ 18 AWG Wire Leads		
RIBXGFL*	.75-150 Amp	Split Core	Fixed, .75 Amp	Solid State Switch SPST	30 Vac/dc	.4 Amps Max	Wht/Yel 16″ 18 AWG Wire Leads	Over Trip Point	
RIBXGTF	.35-150 Amp	Split Core	Fixed, .35 Amp	Solid State Switch SPST	30 Vac/dc	.4 Amps Max	Terminal Strip, Accepts #14-22 AWG Wire		
RIBXGTFL*	.75-150 Amp	Split Core	Fixed, .75 Amp	Solid State Switch SPST	30 Vac/dc	.4 Amps Max	Terminal Strip, Accepts #14-22 AWG Wire	Over Trip Point	
RIBXGA	.75-150 Amp	Split Core	Adjustable	Solid State Switch SPST	30 Vac/dc	.4 Amps Max	Wht/Yel 16″ 18 AWG Wire Leads	Over Trip Point	Under Trip Point
RIBXGTA	.75-150 Amp	Split Core	Adjustable	Solid State Switch SPST	30 Vac/dc	.4 Amps Max	Terminal Strip, Accepts #14-22 AWG Wire	Over Trip Point	Under Trip Point
RIBXGA-SCAL	3-150 Amp	Split Core	Self-Cal.	Solid State Switch SPST	30 Vac/dc	.4 Amps Max	Wht/Yel 16″ 18 AWG Wire Leads	See -SCAL Table	
RIBXGTA-SCAL	3-150 Amp	Split Core	Self-Cal.	Solid State Switch SPST	30 Vac/dc	.4 Amps Max	Terminal Strip, Accepts #14-22 AWG Wire	See -SCAL Table	
RIBXGTA-ECM	.25-150 Amp	Split Core	Adjustable	Solid State Switch SPST	30 Vac/dc	.4 Amps Max	Terminal Strip, Accepts #14-22 AWG Wire	Over Trip Point	Load Current Detcted

* = Not approved by California State Fire Marshal

20191018

Functional Devices, Inc.
101 Commerce Drive
Sharpsville, IN 46068

Toll-free: (800) 888-5538
Office: (765) 883-5538
Fax: (765) 883-7505

Email: sales@functionaldevices.com
Website: www.functionaldevices.com

TERMS AND CONDITIONS OF SALE

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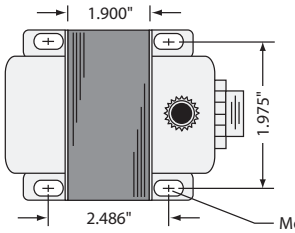
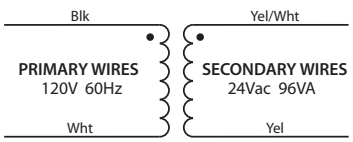
TRANSFORMER

TR100VA001

Transformer 96 VA, 120 to 24 Vac, Circuit Breaker, Foot and Single Threaded Hub Mount

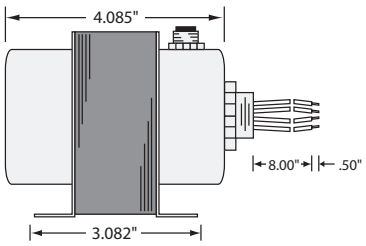
c UL us LISTED
Class 2

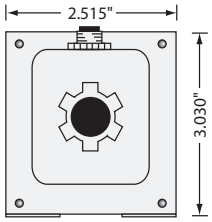




Secondary Yel/Wht wire in phase with Primary Blk wire.

Mounting Hole = .350" x .175"





SPECIFICATIONS

VA Rating: 96
Frequency: 50/60 Hz
Mounting: Foot & Single Threaded Hub
Over Current Protection: Circuit Breaker
Dimensions: 4.085˝ x 2.515˝ x 3.030˝ (w/ .500˝ NPT Hub)
Wire Length: 8˝ Typical w/ .5˝ Strip
Operating Temperature: -30 to 140° F
MTBF: 100,000 Hours @ 77° F
Construction: Split-Bobbin
Approvals: Class 2 UL5085-3 Listed, C-UL, CE, RoHS

20191017

Functional Devices, Inc.
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TERMS AND CONDITIONS OF SALE

1. OFFER, GOVERNING PROVISIONS AND CANCELLATIONS: This document constitutes an offer or counter-offer by Functional Devices, Inc. or any of its affiliates ("**Seller**") to sell various products as agreed by Seller ("**Products**") to the buyer named on the reverse side of this document or in other applicable print or electronic documentation ("**Buyer**") in accordance with these terms and conditions. This writing is not an acceptance of any offer made by Buyer. This offer or counter-offer is expressly conditioned upon Buyer's assent to these terms and conditions and no others. Buyer is deemed to have assented to these terms and conditions (including Seller's warranty) when the first of the following occurs: A. Buyer signs and delivers to Seller an acknowledgement copy of any of Seller's quotation, order acknowledgement or invoice forms; B. Buyer gives to Seller (orally or in writing) specifications of quantity and/or type, assortments thereof, delivery dates, shipping instructions, instructions to bill, or the like as to all or any part of the Products; C. Buyer receives delivery of any of the Products; or, D. Buyer has otherwise assented to the terms and conditions hereof.

Where an attachment to this Agreement or separate document referencing this Agreement consists of a quotation, the quotation remains open for acceptance for a period of thirty (30) days or such other period as specified in the quotation. Seller hereby rejects any additional or different terms or provisions contained in any purchase order, acknowledgment or other communication heretofore or hereafter received from Buyer. Seller's delivery of Products does not constitute an assent to any terms proposed by Buyer. Except for an officer of Seller, no representative of Seller has any authority to waive, alter, vary, amend, or add to the terms hereof. **THESE TERMS AND CONDITIONS OF SALE CONSTITUTE THE ENTIRE AGREEMENT ("AGREEMENT") BETWEEN SELLER AND BUYER WITH RESPECT TO THE MATTERS ADDRESSED HEREIN.**

2. PRICES: The prices for the Products are based on the terms and conditions herein, including the limitations of liability and warranties, and all such terms and conditions are material to the sale of the Products. In the event Seller fails to provide a price quote and/or terms prior to the acceptance of the order, Buyer will pay Seller's then-current list price for such Products. All quotations and invoices show the net selling price of each item quoted. In the event of a mathematical error, the quoted price per Product governs.

3. TERMS OF PAYMENT: Buyer will pay the fees specified in each invoice provided by Seller in United States Dollars within thirty (30) calendar days after the invoice date unless otherwise agreed to in writing by an authorized representative of Seller. Any amount due under this Agreement that remains unpaid after its due date will bear interest from the date that such payment became delinquent until the date it is paid in full at the lower of 1.5% per month, which equals an annual percentage rate of 18%, or the maximum rate permitted by law. Seller reserves the right to establish, revoke or modify credit terms for Buyer at any time. No discounts are allowed unless otherwise agreed to in writing by an authorized representative of Seller. Buyer will pay any collection fees, legal fees, or court costs incurred by Seller to collect past due amounts. No offsets or setoffs of payments due to Seller hereunder are allowed with respect to any other agreement between the parties. Seller hereby retains a lien on the goods sold for unpaid purchase money as herein provided.

4. TAXES AND OTHER CHARGES: In addition to the prices quoted or invoiced, Buyer will pay any sales tax, excise tax, use tax, value added or consumption tax, customs duty (that is assessed on the delivery of Product(s) to a destination outside of the U.S.A.), fee or charge of any nature whatsoever imposed by any governmental authority on or measured by the transaction between Seller and Buyer. In the event Seller is required to pay any amount, Buyer will reimburse Seller therefore; or provide Seller, at the time the order is submitted, an exemption certificate or other document acceptable to the authority imposing the same. Seller does not accept and will not pay any fines, penalties or chargebacks from Buyer for any reason.

5. DELIVERY, RISK OF LOSS, CLAIMS AND FORCE MAJEURE:

A. All prices quoted for products are Ex-Works (Incoterms 2010) at a shipping facility determined by Seller, unless otherwise noted by Seller ("**Seller's Shipping Facility**"). Risk of loss or damage, and beneficial ownership, of the Products are transferred to Buyer when the Products are made available to Buyer at Seller's Shipping Facility. All delivery dates are approximate.

B. Buyer will only make written claims to Seller for damages, shortages or other delivery errors within seven (7) calendar days after receipt of shipment. All Products received by Buyer, or Buyer's clients, customers, or agents, that are not rejected within such time will be deemed accepted. Failure to provide such written notice constitutes a waiver of all such claims regarding such shipment by Buyer. Buyer will not revoke acceptance.

C. Seller is not liable for any damage as a result of any delay or failure to deliver due to any act of God, act of Buyer, embargo or other governmental act, regulation or request, fire, accident, power outage, strike, civil unrest, weather, slowdown or other labor difficulties, war, riot, act of terrorism, delay in transportation, defaults of common carriers, inability to obtain necessary labor, materials or manufacturing facilities or, without limiting the foregoing, any other delays beyond Seller's control. Buyer's sole and exclusive remedy for any delays or for Seller's inability to deliver Products for any reason, in each case, that persists for more than ninety (90) days, is to cancel the order pursuant to Seller's Order Policies and Guidelines available upon request.

6. WARRANTY; DISCLAIMER. Products are warranted to be free from manufacturing defects under normal use and conditions for five (5) years (the "**Warranty Period**").

The warranty does not apply to: (a) Damage caused by accident, abuse, mishandling, or dropping; (b) Products which have been subjected to unauthorized repair, opened, or taken apart; (c) Products not used in accordance with directions; (d) Damages exceeding the cost of such Product; and (e) Damages caused by lightning, water, or condensation. If warranty service is required during the Warranty Period, and if examination shall disclose to Seller's satisfaction that such Product was originally defective, then Seller will at its option repair or replace the product without charge upon prepaid delivery of such Product to Seller's facility with proof of date of purchase. Corrections of such defects by repair to or supplying of replacements for defective parts shall constitute fulfillment of all obligations of Seller.

Seller shall not be liable for loss, damage, or expense directly or indirectly caused from the failure of Products to perform as expected.

EXCEPT AS SET FORTH HEREIN, SELLER DISCLAIMS ALL REPRESENTATIONS OR WARRANTIES OF ANY KIND WHATSOEVER, WHETHER EXPRESS, IMPLIED OR STATUTORY, INCLUDING, WITHOUT LIMITATION, ANY IMPLIED WARRANTIES OF MERCHANTABILITY, NON-INFRINGEMENT, FITNESS FOR A PARTICULAR PURPOSE OR ANY WARRANTY ARISING FROM A COURSE OF DEALING OR USAGE OF TRADE. NO PERSON (INCLUDING ANY AGENT, DEALER OR REPRESENTATIVE OF SELLER) IS AUTHORIZED TO MAKE ANY REPRESENTATION OR WARRANTY CONCERNING PRODUCTS EXCEPT TO REFER BUYER TO THIS AGREEMENT. BUYER WARRANTS THAT BUYER HAS NOT RELIED ON ANY OTHER WARRANTIES OR REPRESENTATIONS CONCERNING THE PRODUCTS OR THIS AGREEMENT.
For warranty service, call factory for RA number and send such Product prepared with sales receipt to: FUNCTIONAL DEVICES, INC., 101 COMMERCE DRIVE, SHARPSVILLE, IN 46068.

7. LIMITATION OF LIABILITY: SELLER WILL NOT BE LIABLE FOR ANY LOSS OF PROFIT, INTERRUPTION OF BUSINESS OR ANY OTHER SPECIAL, CONSEQUENTIAL OR INCIDENTAL DAMAGES SUFFERED OR SUSTAINED BY BUYER FOR ANY REASON. EXCEPT FOR CLAIMS OF DEATH OR PERSONAL INJURY, IN NO EVENT WILL SELLER'S AGGREGATE LIABILITY TO BUYER ARISING UNDER OR IN ANY WAY RELATED TO THIS AGREEMENT FOR ANY REASON (INCLUDING, BUT NOT LIMITED TO, LIABILITY ARISING FROM NEGLIGENCE OR ON THE BASIS OF STRICT LIABILITY, OR OTHERWISE) EXCEED THE TOTAL AMOUNT PAID BY BUYER TO SELLER HEREUNDER FOR ANY PRODUCT GIVING RISE TO A CLAIM UNDER THIS AGREEMENT.

8. RETURNS: Unless otherwise approved by Seller in writing in its sole discretion, except in the case of a non-conforming shipment or a warranty issue, Buyer may not return Products. If Seller approves the return of Products pursuant to the preceding sentence, such returned Products must be returned within ninety (90) days from date of invoice and will be subject to a 25% restocking fee. In the event of a non-conforming shipment or a warranty issue, Buyer may return Products, but only if Buyer first: (a) provides notice to Seller as required in this Agreement, (b) obtains prior authorization from Seller, and (c) all Products or containers for which return is properly authorized have been marked with a return authorization number supplied by Seller. Buyer will make all returns via a traceable form such as Federal Express, UPS or insured mail and in resalable condition. Buyer will pay all return shipping charges and any other charges associated therewith.

9. CANCELLATIONS: Cancellation or deferment of all or part of an order is subject to acceptance by the Seller. If accepted, any reduction in quantity of any item to less than 85% of the original item quantity is subject to a 15% cancellation charge. If an order cancellation is accepted, the Buyer will make delivery and pay for all material manufactured and in stock or in process at time of notice for such order, and for any special materials on orders for which the Seller must take delivery.

10. EXPORTS. Buyer agrees that it will comply with any and all U.S. Export Controls and will not pay for, resell, transfer or knowingly sell Products in violation of U.S. Export Controls. If Buyer resells Products within or exports Products to a country or region which imposes upon Seller and/or Buyer an obligation to fund or undertake reuse, recycling, composting, recovery of Products, or any similar obligation (e.g., the European Union's Waste Electrical and Electronic Equipment Directive, EC 2002/96/EC) (the "**Obligations**"), Buyer shall wholly undertake the Obligations or duties and shall be entirely responsible for all associated costs therewith. Seller shall have no obligation to reimburse Buyer for execution of the Obligations. In the event that Seller is named in a proceeding based upon the Obligations, Buyer shall indemnify, defend and hold Seller harmless from all actions related thereto, including all civil and governmental actions.

11. MISCELLANEOUS. This Agreement is governed by the laws of the State of Indiana, without giving effect to its conflict of laws principles. Buyer hereby irrevocably consents and submits to the exclusive jurisdiction and venue of the state and federal courts in Marion County, Indiana. The United Nations Convention for Contracts for the International Sale of Goods is explicitly excluded. Each provision contained in this Agreement constitutes a separate and distinct provision severable from all other provisions. If any provision (or any part thereof) is unenforceable under or prohibited by any present or future law, then such provision (or part thereof) will be amended, and is hereby amended, so as to be in compliance with such law, while preserving to the maximum extent possible the intent of the original provision. Any provision (or part thereof) that cannot be so amended will be severed from this Agreement; and, all the remaining provisions of this Agreement will remain unimpaired. No modification, addition or deletion, or waiver of any rights under this Agreement is binding on a party unless made in a non-preprinted agreement clearly understood by the parties to be a modification or waiver, and signed by a duly authorized representative of each party.

Pilot Lights (Assembled)

Assembled Pilot Lights

A P (Q) W 1 (B) (99) (D) – R – (24V)

Function
P: Pilot Light

Bezel Shape
Blank: Octagonal (round lenses)
Q: Square

Series Designation
W: TW Series

Lens Shape
1: Flat
2: Dome

Lens Type
Blank: Standard (ribbed)
B: Engravable (smooth with insert included)

Illumination Circuit
99: Full Voltage (lamp determines voltage)
126: 120V AC Step Down Transformer
246: 240V AC Step Down Transformer
486: 480V AC Step Down Transformer

Lamp Voltage
(Full Voltage Units Only)
6V: 6V AC/DC
12V: 12V AC/DC
24V: 24V AC/DC
120V: 120V AC
240V: 240V AC

Lens Color Code
A: Amber
G: Green
R: Red
S: Blue
W: White
Y: Yellow

Lamp
D: LED

1. Use only when interpreting part numbers. Do not use for developing part numbers.
2. All transformers step down to 6V.

Pilot Lights (Assembled) continued

Assembled Pilot Lights

Style		Type	Voltage	Part Number
Round Flat		Transformer	120VAC 240VAC 480VAC	APW1126D-② APW1246D-② APW1486D-②
		Full Voltage	—	APW199D-②-③
Dome		Transformer	120VAC 240VAC 480VAC	APW2126D-② APW2246D-② APW2486D-②
		Full Voltage	—	APW299D-②-③
Square Flat		Transformer	120VAC 240VAC 480VAC	APQW1B126D-② APQW1B246D-② APQW1B486D-②
		Full Voltage	—	APQW1B99D-②-③

1. In place of ②, specify the Lens Color Code from table below.
2. In place of ③, specify the Full Voltage Code from table below.
3. For accessories, see page 728.
4. For dimensions, see page 730.
5. For sub-assembly part numbers, see next page.
6. Yellow pilot light comes with white LED.

② Lens Color Codes

Color	Code
Amber	A
Green	G
Red	R
Blue	S
White	W
Yellow	Y

③ Full Voltage Codes

Voltage	Code
6V AC/DC	6V
12V AC/DC	12V
24V AC/DC	24V
120V AC	120V
240V AC	240V

Pilot Lights (Sub-Assembled)

Transformer	+	Operator	+	Lamp	+	Lens	=	Complete Part

* Transformer not required for full voltage units.

Operators

Style	Part Number
Round Dome/Flat 	APW-199
Square 	UPQW-199

Same operator is used for full voltage as for transformer completed units.

Lenses

Style	Part Number	
	Standard	Engravable
Dome 	APW2LU-②	—
Round Flat 	APW1LU-②	APW1BLU-②
Square Flat 	—	APQW1BLU-②

1. In place of ②, specify the Lens Color Code from table.
2. Standard lenses have a ribbed lens to enhance light dispersion. Marking lenses are smooth and include an engravable insert.

Lamps

Style	Voltage	Part Number
LED 	6V AC/DC	LSTD-6②
	12V AC/DC	LSTD-1②
	24V AC/DC	LSTD-2②
	120V AC	LSTD-H2②
	240V AC	LSTD-M4②

1. In place of ②, specify the LED color code.
2. The LED contains a current-limiting resistor and a protection diode.
3. Yellow LED not available. Use white LED.

Transformers

Style	Description		Part Number
	Finger-Safe	120V AC	TW-F126B
		240V AC	TW-F246B
		480V AC	TW-F486B

All Transformers step down to 6V (use 6V LED).

② LED/Lens Color Codes

Color	Code
Amber	A
Green	G
Red	R
Blue	S
White	W
Yellow	Y

If clear lens is desired, use white marking lens and remove engraving insert

Non-Illuminated Selector Switches (Assembled)

Assembled Selector Switches

A S W 3 (1) (L) 20 – 304

Function
S: Selector Switch

Series Designation
W: TW Series

Number of Positions
2: 2-Position
3: 3-Position
4: 4-Position
5: 5-Position

Spring Return Action
Blank: Maintained
1: Spring return from Right (2 or 3 position)
2: Spring return from Left (2 or 3 position)
3: 2-Way spring return from Left and Right (3 position only)

Circuit Number
(Standard circuits shown on following pages and 720.)

Contact Arrangement Code

10: 1NO	01: 1NC
20: 2NO	02: 2NC
40: 4NO	04: 4NC
11: 1NO-1NC	22: 2NO-2NC

Operator Style Code
Blank: Knob Operator
L: Lever Operator
K: Key Operator

1. Use only when interpreting part numbers. Do not use for developing part numbers.
2. Custom contact configurations available.
3. Custom key removable codes available.
4. Portions of part number inside ( ) are optional.

Non-Illuminated Selector Switches (Assembled) continued

2-Position Selector Switches

Style					Part Number		
Contact	Mounting	Operator Position L	Operator Position R		Maintained	Spring Return from Right	Spring Return from Left
		↖	↗		L R	L R	L R
1NO	1 2	O O	X O	Knob Lever Key	ASW210 ASW2L10 ASW2K10	ASW2110 ASW21L10 ASW21K10	ASW2210 ASW22L10 ASW22K10
1NC	1 2	X O	O O	Knob Lever Key	ASW201-116 ASW2L01-116 ASW2K01-116	ASW2101-116 ASW21L01-116 ASW21K01-116	ASW2201-116 ASW22L01-116 ASW22K01-116
1NO 1NC	1 2	X O	O X	Knob Lever Key	ASW211 ASW2L11 ASW2K11	ASW2111 ASW21L11 ASW21K11	ASW2211 ASW22L11 ASW22K11
2NO	1 2	O O	X X	Knob Lever Key	ASW220 ASW2L20 ASW2K20	ASW2120 ASW21L20 ASW21K20	ASW2220 ASW22L20 ASW22K20
2NC	1 2	X X	O O	Knob Lever Key	ASW202-104 ASW2L02-104 ASW2K02-104	ASW2102-104 ASW21L02-104 ASW21K02-104	ASW2202-104 ASW22L02-104 ASW22K02-104
2NO 2NC	1 2 3 4	O X O X	X O X O	Knob Lever Key	ASW222 ASW2L22 ASW2K22	ASW2122 ASW21L22 ASW21K22	ASW2222 ASW22L22 ASW22K22
2NO 2NC	1 2 3 4	O O X X	X X O O	Knob Lever Key	ASW222-111 ASW2L22-111 ASW2K22-111	ASW2122-111 ASW21L22-111 ASW21K22-111	ASW2222-111 ASW22L22-111 ASW22K22-111

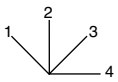
Non-Illuminated Selector Switches (Assembled) continued

3-Position Selector Switches

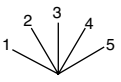
Style						Part Number			
Contact	Mounting	Operator Position L	Operator Position C	Operator Position R		Maintained 	Spring Return from Right 	Spring Return from Left 	Spring Return Two-Way 
2NO	1 2	X 0	0 0	0 X	Knob Lever Key	ASW320 ASW3L20 ASW3K20	ASW3120 ASW31L20 ASW31K20	ASW3220 ASW32L20 ASW32K20	ASW3320 ASW33L20 ASW33K20
2NC	1 2	0 X—X	X—X X—X	X—X 0	Knob Lever Key	ASW302 ASW3L02 ASW3K02	ASW3102 ASW31L02 ASW31K02	ASW3202 ASW32L02 ASW32K02	ASW3302 ASW33L02 ASW33K02
2NO 2NC	1 2 3 4	X 0 0 X—X	0 0 X—X X—X	0 X X—X 0	Knob Lever Key	ASW322 ASW3L22 ASW3K22	ASW3122 ASW31L22 ASW31K22	ASW3222 ASW32L22 ASW32K22	ASW3322 ASW33L22 ASW33K22
2NO 2NC	1 2 3 4	X X—X 0 0	0 X—X X 0	X 0 0 X	Knob Lever Key	ASW322-309 ASW3L22-309 ASW3K22-309	ASW3122-309 ASW31L22-309 ASW31K22-309	ASW3222-309 ASW32L22-309 ASW32K22-309	ASW3322-309 ASW33L22-309 ASW33K22-309
2NO 2NC	1 2 3 4	0 0 0 0	X 0 X 0	0 X 0 X	Knob Lever Key	ASW322-310 ASW3L22-310 ASW3K22-310	ASW3122-310 ASW31L22-310 ASW31K22-310	ASW3222-310 ASW32L22-310 ASW32K22-310	ASW3322-310 ASW33L22-310 ASW33K22-310
4NO	1 2 3 4	X 0 X 0	0 0 0 0	0 X 0 X	Knob Lever Key	ASW340 ASW3L40 ASW3K40	ASW3140 ASW31L40 ASW31K40	ASW3240 ASW32L40 ASW32K40	ASW3340 ASW33L40 ASW33K40
4NC	1 2 3 4	0 X—X 0 X—X	X—X X—X X—X X—X	X—X 0 X—X 0	Knob Lever Key	ASW304 ASW3L04 ASW3K04	ASW3104 ASW31L04 ASW31K04	ASW3204 ASW32L04 ASW32K04	ASW3304 ASW33L04 ASW33K04

1. The truth table indicates the operating position of contact block when the operator is switched to that position.
   X = On (closed contacts)
   0 = Off (open contacts)
   X—X = Overlapping Contacts: Remain on (closed contacts) when switch is moved between these two positions.
2. All knob and lever selector switches come in black. Other colors are available by ordering the knob or lever separately.
3. Every key selector switch uses an identical key. The key is removable in any maintained position.
4. Custom contact configurations are available, see page 720.

4-Position Selector Switch

Style							Maintained	
Contact	Mounting	Operator Position 1	Operator Position 2	Operator Position 3	Operator Position 4		Part Number 	
2NO 2NC	1 2 3 4	X 0 0 0	0 X 0 0	0 0 X 0	0 0 0 X	Knob Lever	ASW422-411 ASW4L22-411	

5-Position Selector Switch

Style								Maintained	
Contact	Mounting	Operator Position 1	Operator Position 2	Operator Position 3	Operator Position 4	Operator Position 5		Part Number 	
2NO 2NC	1 2 3 4	X 0 0 0	0 X 0 0	0 0 0 0	0 0 X 0	0 0 0 X	Knob Lever	ASW522-501 ASW5L22-501	

Non-Illuminated Selector Switches (Sub-Assembled)

Contact Blocks	+	Operator	+	Knob or Lever*	+	Color Insert*	=	Complete Part†

1. *Not needed with key type switches.
2. †Knob type shown.

Operators

Style	Positions	Description	Part Number
Knob/Lever 	2	Maintained	ASW200
		Spring return from right	ASW2100
		Spring return from left	ASW2200
	3	Maintained, Cam 1 Maintained, Cam 2 Maintained, Cam 3	ASW300-1 ASW300-2 ASW300-3
		Spring return from right, Cam 1 Spring return from right, Cam 2	ASW3100-1 ASW3100-2
		Spring return from left, Cam 1 Spring return from left, Cam 2	ASW3200-1 ASW3200-2
		Spring return from left/right, Cam 1 Spring return from left/right, Cam 2	ASW3300-1 ASW3300-2
	4	Maintained, Standard Cam Maintained, Cam 1	ASW400 ASW400-1
	5	Maintained, Standard cam Maintained, Cam 1	ASW500 ASW500-1
Key 	2	Maintained	ASW2K00
		Spring return from right	ASW21K00
		Spring return from left	ASW22K00
	3	Maintained, Cam 1 Maintained, Cam 2 Maintained, Cam 3	ASW3K00-1 ASW3K00-2 ASW3K00-3
		Spring return from right, Cam 1 Spring return from right, Cam 2	ASW31K00-1 ASW31K00-2
		Spring return from left, Cam 1 Spring return from left, Cam 2	ASW32K00-1 ASW32K00-2
		Spring return from left/right, Cam 1 Spring return from left/right, Cam 2	ASW33K00-1 ASW33K00-2

1. Two keys are supplied with every key switch, all are keyed alike, and removable from any maintained position.
2. Locking rings are included with all operators. Order knobs, levers, and color inserts separately.
3. Different cams produce different contact actions. For details, see page 720.
4. Key switch operator supplied with black sleeve.

Handles and Inserts

Style		Part Number
Knob		ASWHHY-①
Lever		ASWHHL-①
Color Insert		TW-HC1-①

Contact Blocks

Style	Contacts	1NO	1NC
	Finger-Safe Spring-Up Terminal	HW-U10-F	HW-U01-F
		HW-U10R-F (early make)	HW-U01R-F (late break)
	Dummy Block	HW-DB	

1. Push rod color code:
   Green = NO contact block
   Red = NC contact block.
2. Dummy blocks (no contacts) are used with an odd number of contact blocks.

① Handle/Insert Color Codes

Color	Code
Black*	B
Blue	S
Green	G
Red	R
Yellow	Y
White†	W

*Color inserts not available in black.
†Knob and lever not available in white.

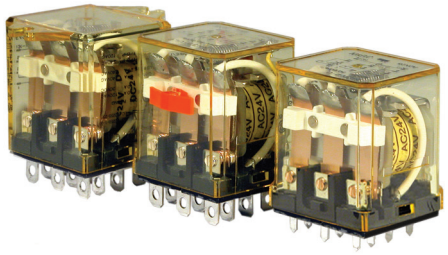
Replacement Parts

Key Switch Black Sleeve	AKW2B-B

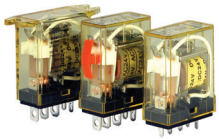
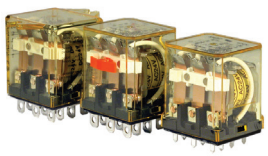
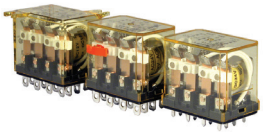
RH Series Compact Power Relays

Key features

- SPDT through 4PDT, 10A contacts
- Compact power type relays
- Miniature power relays with a large capacity
- 10A contact capacity
- Compact size saves space



Part Number Selection

Contact	Model	Part Number: Blade Terminal	Part Number: PCB Terminal	Coil Voltage Code (Standard Stock in bold)
SPDT 	Standard	RH1B-U ☐	RH1V2-U ☐	AC6V, AC12V, **AC24V**, AC110V, **AC120V**, AC220V, **AC240V** DC6V, **DC12V**, **DC24V**, DC48V, DC110V
	With Indicator	RH1B-UL ☐	—	
	With Check Button	RH1B-UC ☐	—	
	With Indicator and Check Button	RH1B-ULC ☐	—	
	Top Bracket Mounting	RH1B-UT ☐	—	
	With Diode (DC coil only)	RH1B-UD ☐	RH1V2-UD ☐	DC6V, **DC12V**, **DC24V**, DC48V, DC110V
	With Indicator and Diode (DC coil only)	RH1B-ULD ☐	—	**DC12V**, **DC24V**, DC48V, DC110V
DPDT 	Standard	RH2B-U ☐	RH2V2-U ☐	AC6V, AC12V, **AC24V**, **AC110-120V**, **AC220-240V** DC6V, **DC12V**, **DC24V**, DC48V, DC100-110V
	With Indicator	RH2B-UL ☐	RH2V2-UL ☐	
	With Check Button	RH2B-UC ☐	—	
	With Indicator and Check Button	RH2B-ULC ☐	—	
	Top Bracket Mounting	RH2B-UT ☐	—	
	With Diode (DC coil only)	RH2B-UD ☐	RH2V2-UD ☐	DC6V, **DC12V**, **DC24V**, DC48V, DC100-110V
	With Indicator and Diode (DC coil only)	RH2B-ULD ☐	RH2V2-ULD ☐	
3PDT 	Standard	RH3B-U ☐	RH3V2-U ☐	AC6V, AC12V, **AC24V**, AC110V, **AC120V**, AC220V, **AC240V** DC6V, **DC12V**, **DC24V**, DC48V, DC110V
	With Indicator	RH3B-UL ☐	RH3V2-UL ☐	
	With Check Button	RH3B-UC ☐	—	
	With Indicator and Check Button	RH3B-ULC ☐	—	
	Top Bracket Mounting	RH3B-UT ☐	—	
	With Diode (DC coil only)	RH3B-UD ☐	—	DC6V, DC12V, DC24V, DC48V, DC110V
	With Indicator and Diode (DC coil only)	RH3B-ULD ☐	—	
4PDT 	Standard	RH4B-U ☐	RH4V2-U ☐	AC6V, AC12V, **AC24V**, AC110V, **AC120V**, AC220V, **AC240V** DC6V, **DC12V**, **DC24V**, DC48V, DC110V
	With Indicator	RH4B-UL ☐	RH4V2-UL ☐	
	With Check Button	RH4B-UC ☐	—	
	With Indicator and Check Button	RH4B-ULC ☐	—	
	Top Bracket Mounting	RH4B-UT ☐	—	
	With Diode (DC coil only)	RH4B-UD ☐	RH4V2-UD ☐	DC6V, DC12V, DC24V, DC48V, DC110V
	With Indicator and Diode (DC coil only)	RH4B-ULD ☐	—	

PCB terminal relays are designed to mount directly to a circuit board without any socket.

Ordering Information
When ordering, specify the Part No. and coil voltage code:

(example) **RH3B-U** **AC120V**
Part No. — Coil Voltage Code

Sockets (for Blade Terminal Models)

Relays	Standard DIN Rail Mount [1]	Finger-safe DIN Rail Mount [1]	Through Panel Mount	PCB Mount
RH1B	SH1B-05	SH1B-05C	SH1B-51	SH1B-62
RH2B	SH2B-05	SH2B-05C	SH2B-51	SH2B-62
RH3B	SH3B-05	SH3B-05C	SH3B-51	SH3B-62
RH4B	SH4B-05	SH4B-05C	SH4B-51	SH4B-62
				

1. DIN Rail mount socket comes with two horseshoe clips. Do not use unless you plan to insert pullover wire spring. Replacement horseshoe clip part number is Y778-011.

Hold Down Springs & Clips

Appearance	Item	Relay	For DIN Mount Socket	For Through Panel & PCB Mount Socket
	Pullover Wire Spring	RH1B	SY2S-02F1 [2]	SY4S-51F1
		RH2B	SY4S-02F1 [2]	
		RH3B	SH3B-05F1 [2]	
		RH4B	SH4B-02F1 [2]	
	Leaf Spring (side latch)	RH1B, RH2B, RH3B, RH4B	SFA-202 [3]	SFA-302 [3]
	Leaf Spring (top latch)	RH1B, RH2B, RH3B, RH4B	SFA-101 [3]	SFA-301 [3]

2. Must use horseshoe clip when mounting in DIN mount socket. Replacement horseshoe clip part number is Y778-011.
3. Two required per relay.

AC Coil Ratings

Voltage (V)	Rated Current (mA) ±15% at 20°C								Coil Resistance (Ω) ±10% at 20°C				Operation Characteristics (against rated values at 20°C)		
	AC 50Hz				AC 60Hz										
	SPDT	DPDT	3PDT	4PDT	SPDT	DPDT	3PDT	4PDT	SPDT	DPDT	3PDT	4PDT	Max. Continuous Applied Voltage	Pickup Voltage	Dropout Voltage
6	170	240	330	387	150	200	280	330	18.8	9.4	6.4	5.4	110%	80% maximum	30% minimum
12	86	121	165	196	75	100	140	165	76.8	39.3	25.3	21.2			
24	42	60.5	81	98	37	50	70	83	300	153	103	84.5			
110	9.6	—	18.1	21.6	8.4	—	15.5	18.2	6,950	—	2,200	1,800			
110-120	—	9.4-10.8	—	—	—	8.0-9.2	—	—	—	—	—	—			
120	8.6	—	16.4	19.5	7.5	—	14.2	16.5	8,100	—	10,800	7,360			
220	4.7	—	8.8	10.7	4.1	—	7.7	9.1	25,892	—	10,800	7,360			
220-240	—	4.7-5.4	—	—	—	4.0-4.6	—		—	18,820	—	—			
240	4.9	—	8.2	9.8	4.3	—	7.1	8.3	26,710	—	12,100	9,120			

DC Coil Ratings

Voltage (V)	Rated Current (mA) ±15% at 20°C				Coil Resistance (Ω) ±10% at 20°C				Operation Characteristics (against rated values at 20°C)		
	SPDT	DPDT	3PDT	4PDT	SPDT	DPDT	3PDT	4PDT	Max. Continuous Applied Voltage	Pickup Voltage	Dropout Voltage
6	128	150	240	250	47	40	25	24	110%	80% maximum	10% minimum
12	64	75	120	125	188	160	100	96			
24	32	36.9	60	62	750	650	400	388			
48	18	18.5	30	31	2,660	2,600	1,600	1,550			
100-110	—	8.2-9.0	—	—	—	12,250	—	—			
110	8	—	12.8	15	13,800	—	8,600	7,340			

Standard coil voltages are in **BOLD**.

Contact Ratings

Model	Continuous Current	Maximum Contact Capacity: Allowable Contact Power: Resistive Load	Allowable Contact Power: Inductive Load	Rated Load: Voltage (V)	Rated Load: Res. Load	Rated Load: Ind. Load
SPDT	10A	1540VA 300W	990VA 210W	110 AC	10A	7A
				220 AC	7A	4.5A
				30 DC	10A	7A
DPDT 3PDT 4PDT	10A	1650VA 300W	1100VA 225W	110 AC	10A	7.5A
				220 AC	7.5A	5A
				30 DC	10A	7.5A

Note: Inductive load for the rated load — cos ø = 0.3, L/R = 7 ms

TÜV Ratings

Voltage	RH1	RH2	RH3	RH4
240V AC	10A	10A	7.5A	7.5A
30V DC	10A	10A	10A	10A

AC: cos ø = 1.0, DC: L/R = 0 ms

UL Ratings

Voltage	Resistive			General Use			Horsepower Rating		
	RH1 RH2	RH3	RH4	RH1 RH2	RH3	RH4	RH1 RH2	RH3	RH4
240V AC	10A	7.5A	7.5A	7A	6.5A	5A	1/3 HP	1/3 HP	—
120V AC	—	10A	10A	—	7.5A	7.5A	1/6 HP	1/6 HP	—
30V DC	10A	10A	—	7A	—	—	—	—	—
28V DC	—	—	10A	—	—	—	—	—	—

CSA Ratings

Voltage	Resistive				General Use				Horse-power Rating
	RH1	RH2	RH3	RH4	RH1	RH2	RH3	RH4	RH1, 2, 3
240V AC	10A	10A	—	7.5A	7A	7A	7A	5A	1/3 HP
120V AC	10A	10A	10A	10A	7.5A	7.5A	—	7.5A	1/6 HP
30V DC	10A	10A	10A	10A	7A	7.5A	—	—	—

Socket Specifications

	Sockets	Terminal	Electrical Rating	Wire Size	Torque
DIN Rail Mount Sockets	SH1B-05	(Coil) M3 screws (contact) M3.5 screws with captive wire clamp	250V, 10A	Maximum up to 2–#12AWG	5.5 - 9 in•lbs 9 - 11.5 in•lbs
	SH2B-05 SH3B-05 SH4B-05	M3.5 screws with captive wire clamp	300V, 10A	Maximum up to 2–#12AWG	9 - 11.5 in•lbs
Finger-safe DIN Rail Mount	SH1B-05C	(coil) M3 screws (contact) M3.5 screws with captive wire clamp, fingersafe	250V, 10A	Maximum up to 2–#12AWG	5.5 - 9 in•lbs 9 - 11.5 in•lbs
	SH2B-05C SH3B-05C SH4B-05C	M3.5 screws with captive wire clamp, fingersafe	300V, 10A	Maximum up to 2–#12AWG	9 - 11.5 in•lbs
Through Panel Mount Socket	SH1B-51 SH2B-51 SH3B-51 SH4B-51	Solder	300V, 10A	—	—
PCB Mount Socket	SH1B-62	PCB mount	250V, 10A	—	—
	SH2B-62 SH3B-62 SH4B-62	PCB mount	300V, 10A	—	—

Accessories

Item	Appearance	Use with	Part No.	Remarks
Aluminum DIN Rail (1 meter length)		All DIN rail sockets	BNDN1000	The BNDN1000 is designed to accommodate DIN mount sockets. Made of durable extruded aluminum, the BNDN1000 measures 0.413 (10.5mm) in height and 1.37 (35mm) in width (DIN standard). Standard length is 39" (1,000mm).
DIN Rail End Stop		DIN rail	BNL5	9.1 mm wide.
Replacement Hold-Down Spring Anchor		DIN mount sockets and hold down springs.	Y778-011	For use on DIN rail mount socket when using pullover wire hold down spring. 2 pieces included with each socket.

Specifications

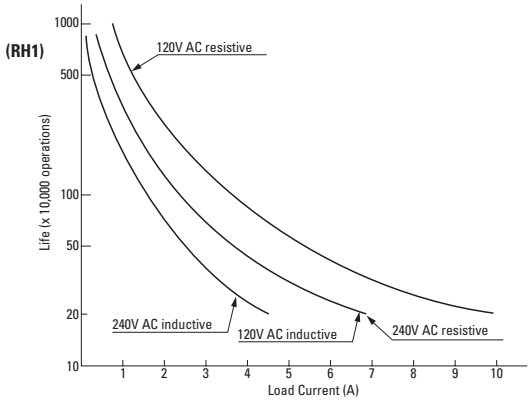
Contact Material		Silver cadmium oxide	
Contact Resistance [1]		50mΩ maximum	
Minimum Applicable Load		24V DC, 30 mA; 5V DC, 100 mA (reference value)	
Operating Time [2]	SPDT DPDT	20ms maximum	
	3PDT 4PDT	25ms maximum	
Release Time [2]	SPDT DPDT	20ms maximum	
	3PDT 4PDT	25ms maximum	
Power Consumption (approx.)	SPDT	AC: 1.1VA (50Hz), 1VA (60Hz)	DC: 0.8W
	DPDT	AC: 1.4VA (50Hz), 1.2VA (60Hz)	DC: 0.9W
	3PDT	AC: 2VA (50Hz), 1.7VA (60Hz)	DC: 1.5W
	4PDT	AC: 2.5VA (50Hz), 2VA (60Hz)	DC: 1.5W
Insulation Resistance		100MΩ minimum (500V DC megger)	
Dielectric Strength [3]	SPDT	Between live and dead parts: Between contact and coil: Between contacts of the same pole:	2,000V AC, 1 minute 2,000V AC, 1 minute 1,000V AC, 1 minute
	DPDT 3PDT 4PDT	Between live and dead parts: Between contact and coil: Between contacts of different poles: Between contacts of the same pole:	2,000V AC, 1 minute 2,000V AC, 1 minute 2,000V AC, 1 minute 1,000V AC, 1 minute
Operating Frequency		Electrical: Mechanical:	1,800 operations/hour maximum 18,000 operations/hour maximum
Vibration Resistance		Damage limits: Operating extremes:	10 to 55Hz, amplitude 0.5 mm 10 to 55Hz, amplitude 0.5 mm
Shock Resistance		Damage limits: Operating extremes:	1,000m/s^2 (100G) 200m/s^2 (20G - SPDT, DPDT) 100m/s^2 (10G - 3PDT, 4PDT)
Mechanical Life		50,000,000 operations minimum	
Electrical Life	DPDT	500,000 operations minimum (120V AC, 10A)	
	SPDT 3PDT 4PDT	200,000 operations minimum (120V AC, 10A)	
Operating Temperature [4]	SPDT DPDT 3PDT 4PDT	–25 to +70°C (no freezing)	
Operating Humidity		45 to 85% RH (no condensation)	
Weight (approx.)		SPDT: 24g, DPDT: 37g, 3PDT: 50g, 4PDT: 74g	

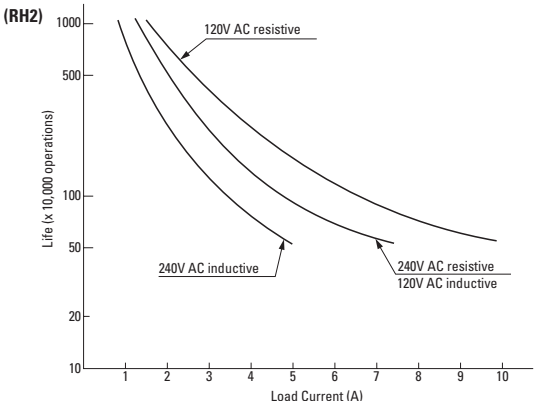
Note: Above values are initial values.
1. Measured using 5V DC, 1A voltage drop method
2. Measured at the rated voltage (at 20°C), excluding contact bouncing
   Release time of relays with diode: 40 ms maximum
3. Relays with indicator or diode: 1000V AC, 1 minute
4. For use under different temperature conditions, refer to Continuous Load Current vs. Operating Temperature Curve. The operating temperature range of relays with indicator or diode is –25 to +40°C.

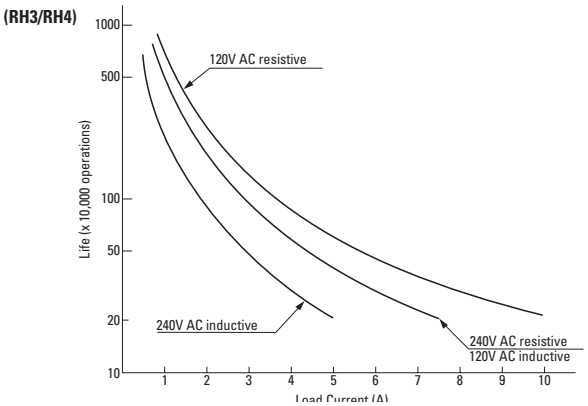
Characteristics (Reference Data)

Electrical Life Curves

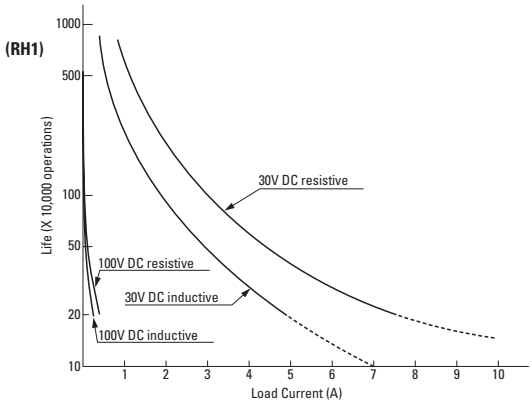
AC Load

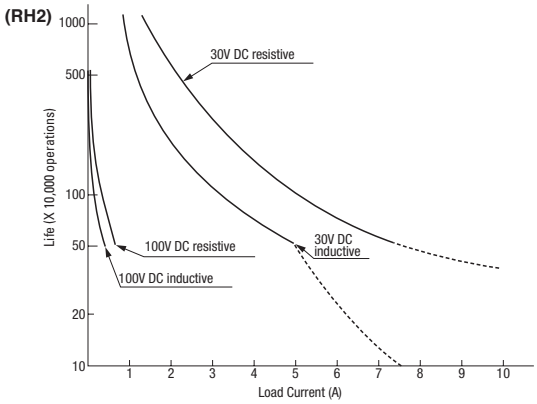


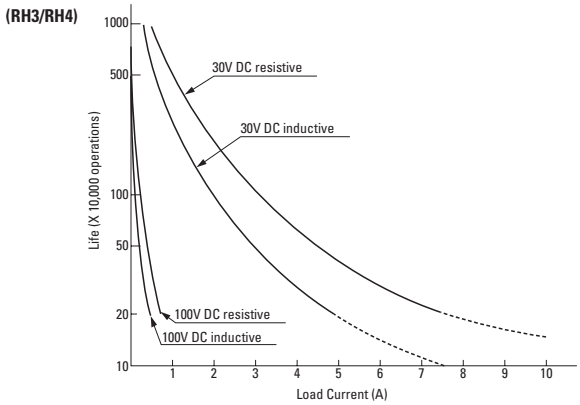




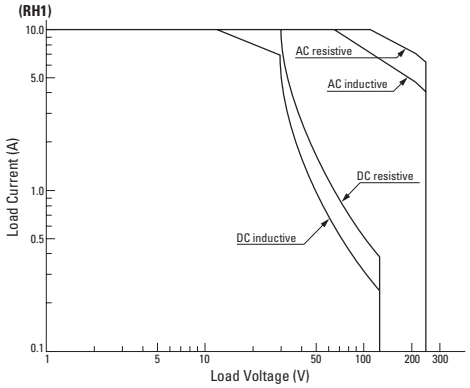
DC Load

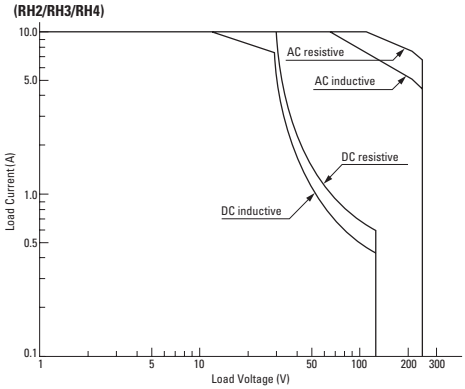






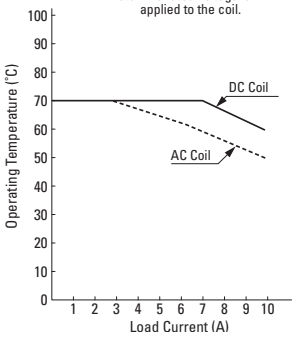
Maximum Switching Capacity



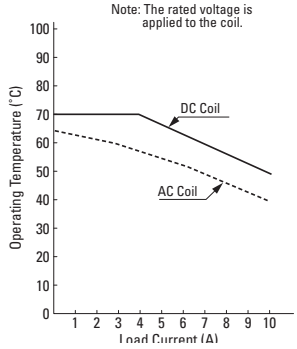


Continuous Load Current vs. Operating Temperature Curve (Basic Type, With Check Button, and Top Bracket Mounting Type)

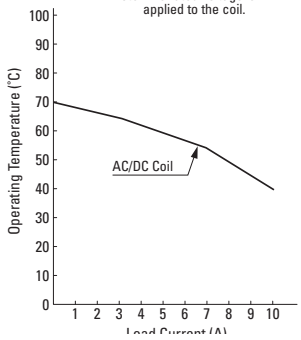
(RH1)



(RH2)



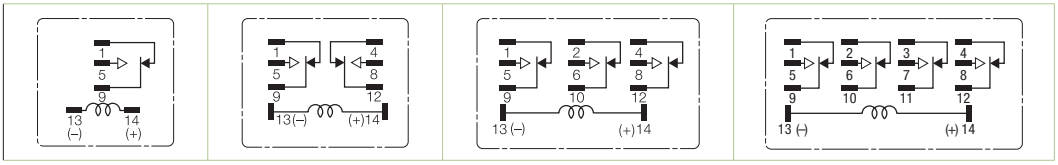
(RH3/RH4)



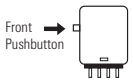
Internal Connection (View from Bottom)

Basic Type

SPDT | DPDT | 3PDT | 4PDT



With Check Button

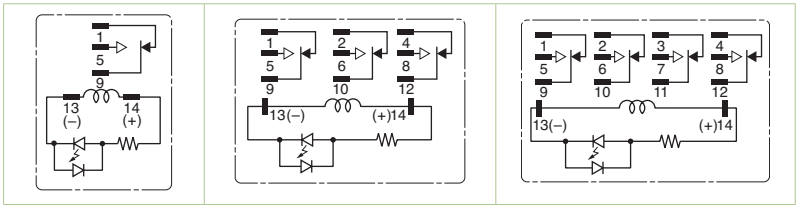


Contacts can be operated by pressing the check button.

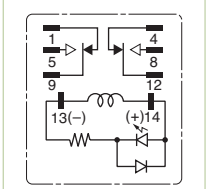
With Indicator (-L type)

SPDT | 3PDT | 4PDT | DPDT

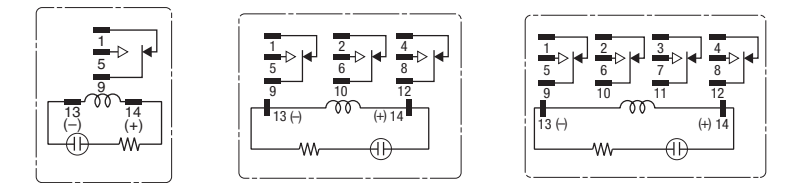
Below 100V AC/DC



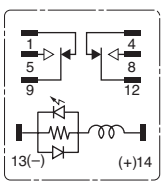
Below 24V AC/DC



100V AC/DC and over



24V AC/DC and over

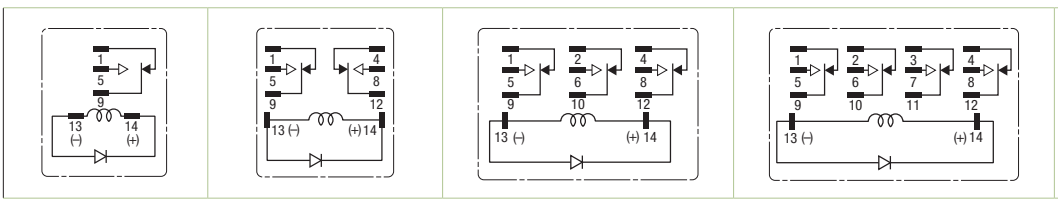


When the relay is energized, the indicator goes on.

- Relay coils less than 100V DC do not contain a protection diode (except DPDT).
- Relay coils below 100V use LED indicator, coils above 100V use neon lamp indicator.
- LED color of DPDT model is green

With Diode (-D type)

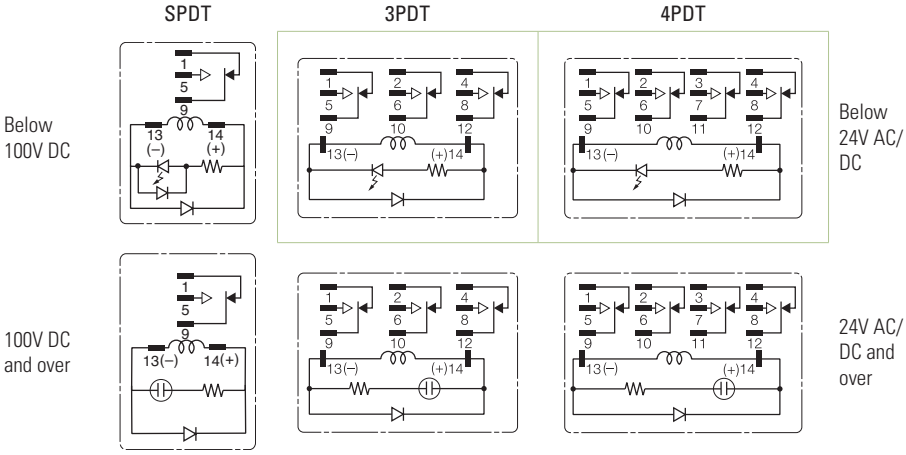
SPDT | DPDT | 3PDT | 4PDT



Contains a diode to absorb the back emf generated when the coil is de-energized. The release time is slightly longer. Available for DC coil only.

- Diode Characteristics
  Reverse withstand voltage: 1,000V
  Forward current: 1A

With Indicator LED & Diode (-LD type)

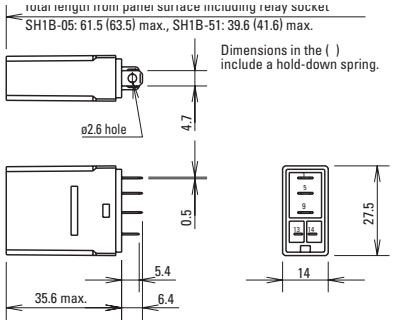


Contains an LED indicator and a surge absorber, and has the same height as the basic type.

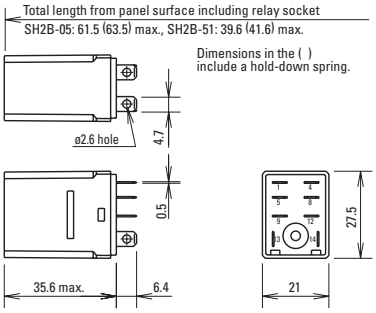
LED color of DPDT model is green.

Dimensions (mm)

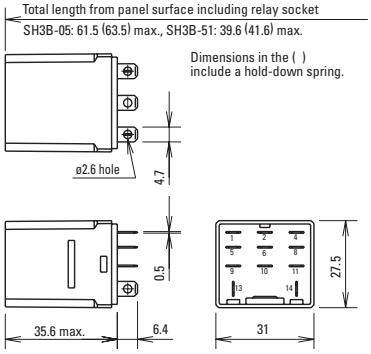
RH1B-U/RH1B-UL/RH1B-UD/RH1B-ULD



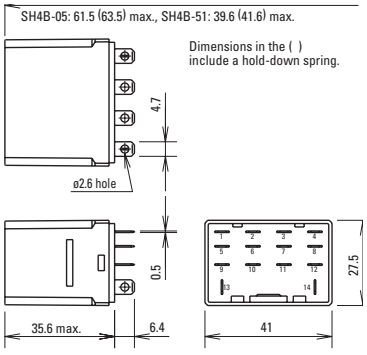
RH2B-U/RH2B-UL/RH2B-UD/RH2B-ULD



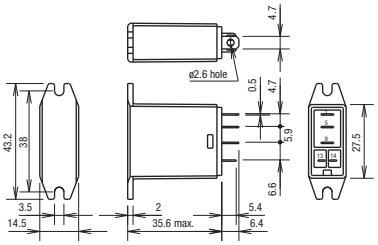
RH3B-U/RH3B-UL/RH3B-UD/RH3B-ULD



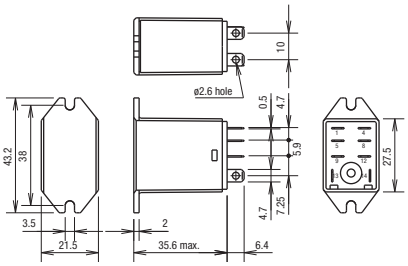
RH4B-U/RH4B-UL/RH4B-UD/RH4B-ULD



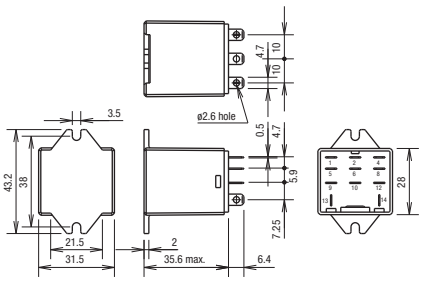
RH1B-UT



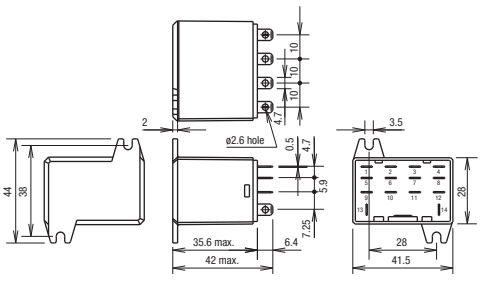
RH2B-UT



RH3B-UT

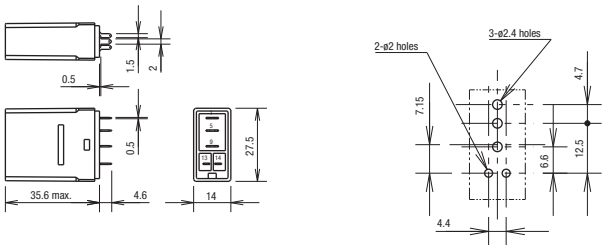


RH4B-UT



Dimensions con't (mm)

RH1V2-U/RH1V2-UD



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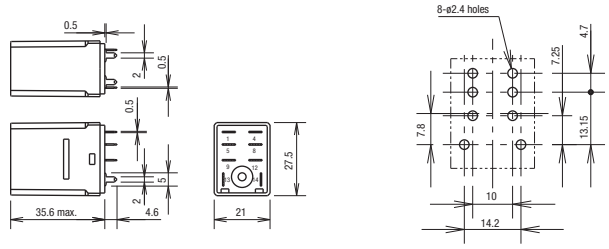
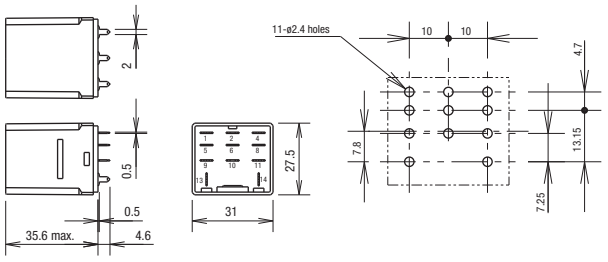
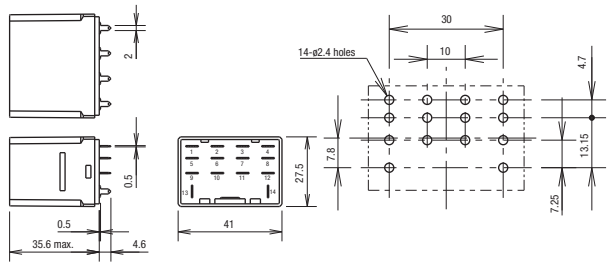


RH3V2-U/RH3V2-UL/RH3V2-D

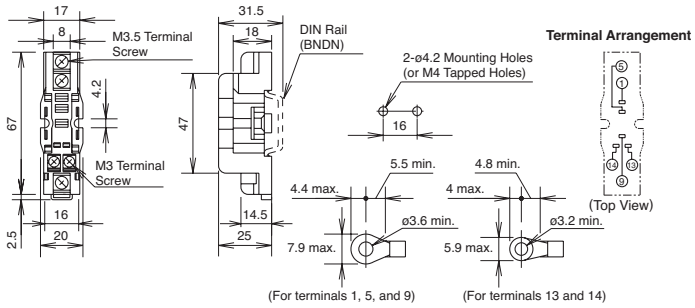


RH4V2-U/RH4V2-UL/RH4V2-UD

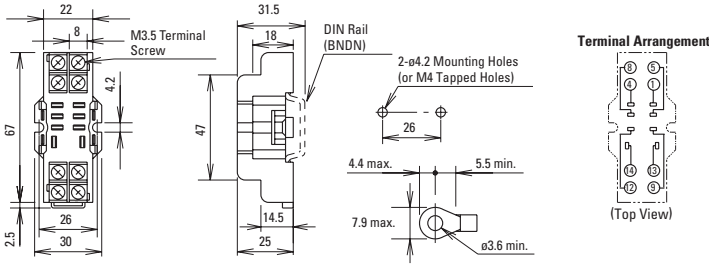


Standard DIN Rail Mount Sockets

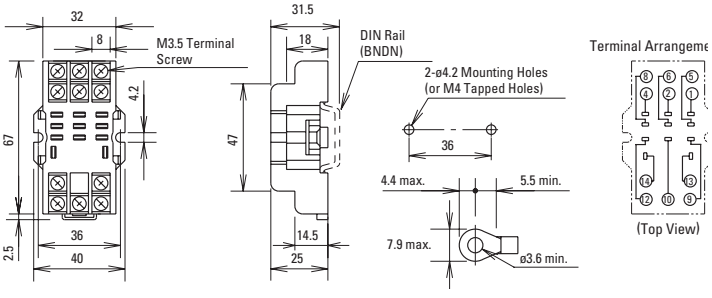
SH1B-05



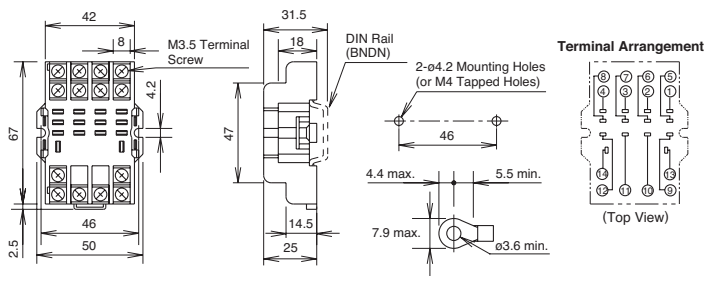
SH2B-05



SH3B-05



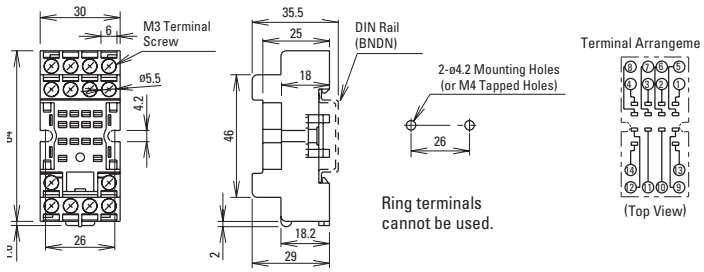
SH4B-05



Dimensions con't (mm)

Finger-safe DIN Rail Mount Sockets

SH1B-05C



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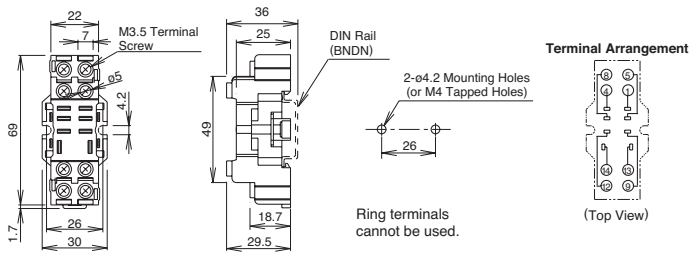

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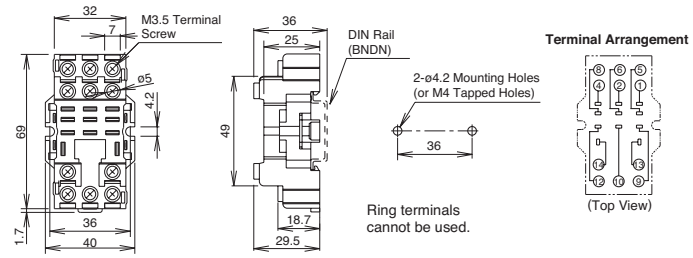
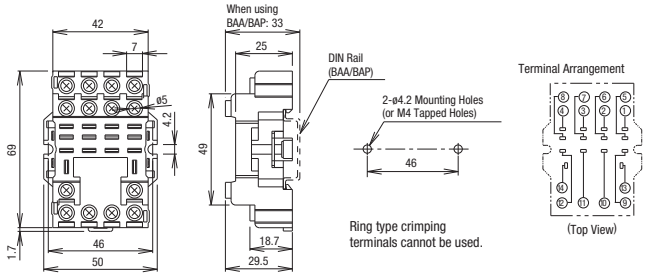
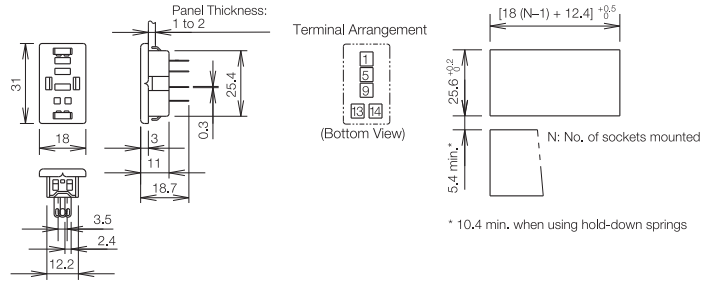


SH4B-05C

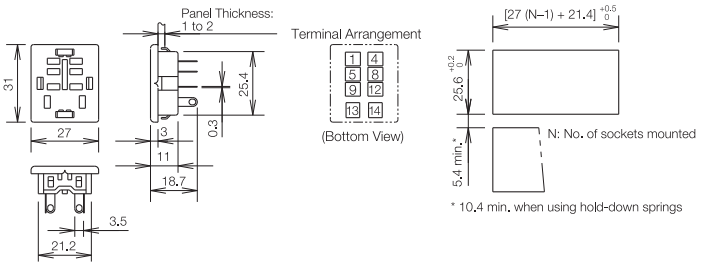


Through Panel Mount Socket

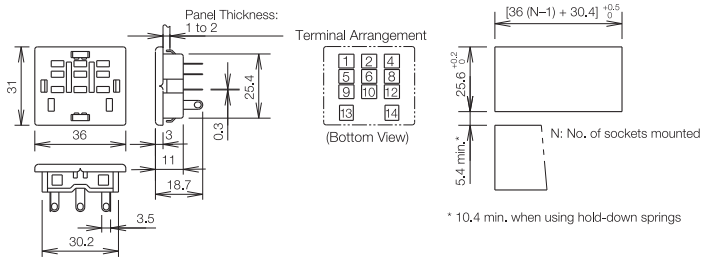
SH1B-51



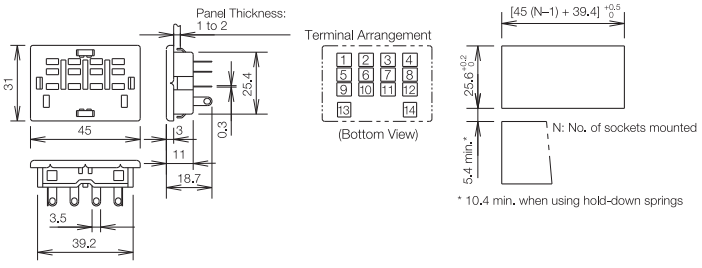
SH2B-51



SH3B-51



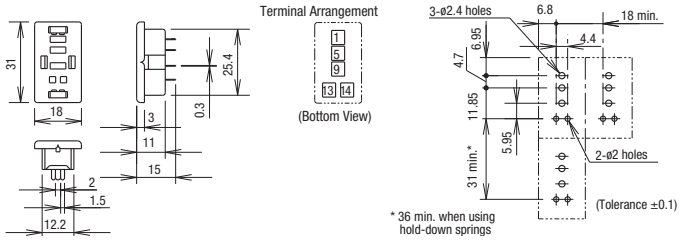
SH4B-51



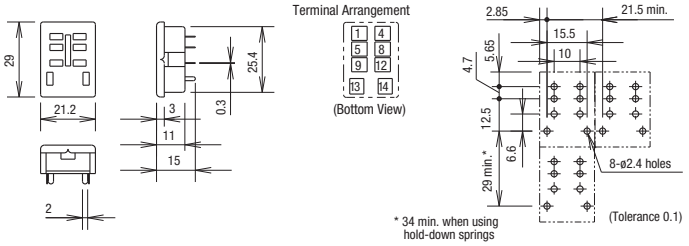
Dimensions con't (mm)

PCB Mount Sockets

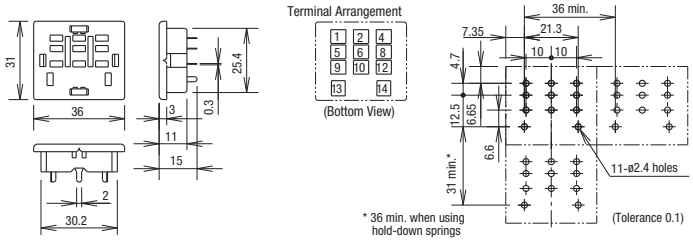
SH1B-62



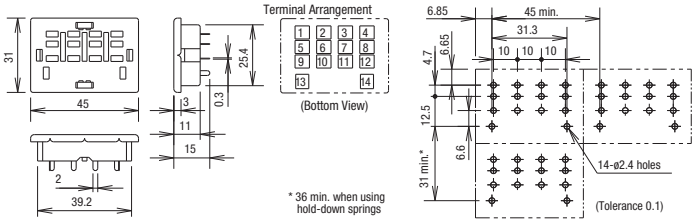
SH2B-62



SH3B-62



SH4B-62



DESCRIPTION

Static Pressure Sensors
The **A-300-K Series** sensors are used with pressure transmitters and pressure switches to sense duct pressures. Two sensors are required to monitor pressure across coils, filters, blowers, etc. **A-301-K** and **A-302-K** have four radial sensing holes and 4" (10.2 cm) insertion depth. The **A-308-K** should be used only where accuracy is not critical. All mount in a 3/8" hole in the duct. If the interior of the duct is not accessible, an optional **A-345-K** flange mounting kit may be used.

Room Static Pressure or Total Pressure Sensor Kit
The versatile **Model 60681** Pressure Sensing Kit is used for monitoring static pressure (aspiration) or total pressure (impact). The kit includes a 7" (17.8 cm) universal sensing probe, adjustable mounting flange, 1/4" adapter, and 3' (0.9 m) length of tubing (1/4" ID x 3/8" OD). For total (impact) pressure applications, install the curved tip opening facing into the air stream or away from the air stream for vacuum applications.

Total Pressure Sensor
The **Model 21122 (4")** and **21123 (8")** sensors are used primarily for proving air flow in ducts. The opening in the tip of the 4" (10.2 cm) aluminum tube faces upstream and senses impact (total) pressure. The "-112" models accept 1/8" to 1/4" ID flexible tubing.

Outdoor Static Pressure Sensor
The **A-306-K** Outdoor Static Pressure Sensor provides an outdoor pressure signal for reference in building pressurization applications. The **A-306-K** includes the sensor, 50' (15.24m) of vinyl tubing, mounting bracket, and hardware.

Room Static Pressure Sensor
The **Model RPS** is a stainless steel, wall-mounted room static pressure sensor. It mounts directly to the wall or to a standard electrical box. The **Model RPS-W** is a white plastic, wall-mounted room static pressure sensor, and the **Model RPS-I** is ivory. The RPS sensors have a 100 micron stainless steel breather vent.

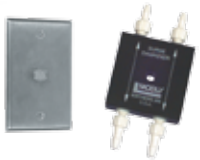
Filter Kit
The Model **A-605** Filter Kit includes an aluminum surface mounting bracket and screws, two 5 ft lengths of 1/4" aluminum tubing, two static pressure tips, and two plastic vent valves.

Surge Dampener
Surge Dampener **Model SD-01** absorbs rapid pressure fluctuations to provide steady pressure outputs. The dampener has two independent channels - one for the low pressure tubing and one for the high pressure tubing. Surge dampeners are typically used with outdoor pressure sensors, which are subject to wind gusts, and isolation rooms, clean rooms, or operating rooms where opening or closing doors creates sudden pressure changes.

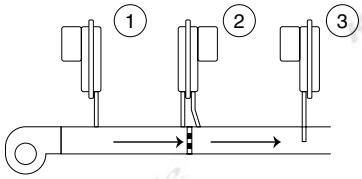

RPS-W


60681

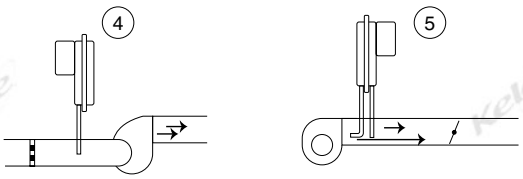

A-300 Series


RPS & SD-01

APPLICATION



1. Positive static pressure increases as the filter gets dirty.
2. Differential across filter changes as filter gets dirty.
3. Flow is reduced as filter gets dirty.



4. Negative pressure increases as the filter gets dirty.
5. Fan operation and true air flow: varying amounts of static pressure. Probes must be perpendicular to air flow.

ORDERING INFORMATION

MODEL	DESCRIPTION
60681	Static or total pressure sensing kit
A-301-K	Duct static pressure tip, 1/4" compression
A-302-K	Duct static pressure tip, 1/4" barb
A-308-K	Duct static pressure fitting, 1/4" barb
A-345-K	Flange mounting kit (1 required for each A-301-K or A-302-K)
A-3145K	A-301-K duct static pressure tip, 1/4" compression with A-345-K mounting flange
A-3245K	A-302-K duct static pressure tip, 1/4" barb with A-345-K mounting flange
A-3845K	A-308-K duct static pressure fitting, 1/4" barb with A-345-K mounting flange
21122	4" aluminum impact tube, 1/4" OD connection
21122-112	6" aluminum impact tube for 1/8" thru 1/4" ID flexible plastic tubing
21123	8" aluminum impact tube, 1/4" OD connection
21123-112	8" aluminum impact tube for 1/8" thru 1/4" ID flexible plastic tubing
A-306-K	Outdoor air static pressure kit
A-605	Mounting kit for air filter application. Includes aluminum surface mounting brackets with screws, two 5 ft. lengths of 1/4" aluminum tubing, two static pressure tips and two plastic vent valves.
RPS	Stainless steel room pressure sensor, 1/4" barb
RPS-I	Ivory plastic room pressure sensor, 1/4" barb
RPS-W	White plastic room pressure sensor, 1/4" barb
SD-01	Surge dampener
B-137	1/4" barb adapter for #21122 and #21123 (standard pack-50)

DESCRIPTION

The **Iboco P Series Spiralite** universal spiral wrapping is great for fast and economical grouping of wire bundles.

FEATURES

- ***Polyethylene construction***
- ***Provides flexible connection between panel and door***
- ***Strong, yet simple to install and remove***

ORDERING INFORMATION

MODEL	FOR WIRE BUNDLES in (cm)	FT (m) (per carton*)
P2	1/4 to 1 (0.64 to 2.54)	80 (24)
P3	3/8 to 2 (0.95 to 5.08)	80 (24)
P4	1/2 to 3 (1.27 to 7.62)	65 (20)

* Available in carton quantities only – order quantity 1 = 1 carton

P Series

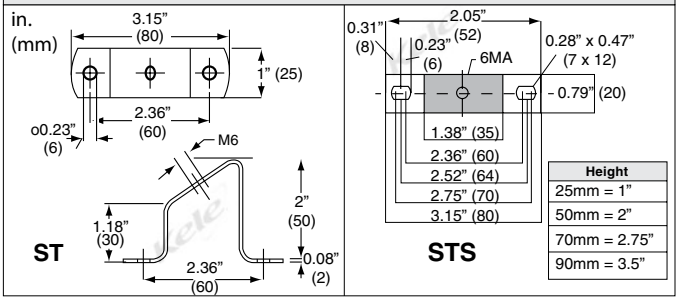
DESCRIPTION

The **Iboco ST, STS support brackets** give you options in mounting your DIN rail. These are made of cold-rolled steel treated with galvanic zinc plating and passivation.

FEATURES

- ***Includes 6mm screws***

DIMENSIONS



STS Series **ST Series**

ORDERING INFORMATION

MODEL	DESCRIPTION
ST	DIN Rail support bracket
STS-25	1" din rail support bracket
STS-50	2" din rail support bracket
STS-70	2.75" din rail support bracket
STS-90	3.5" din rail support bracket

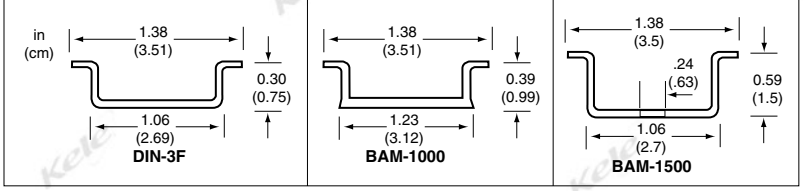
DESCRIPTION

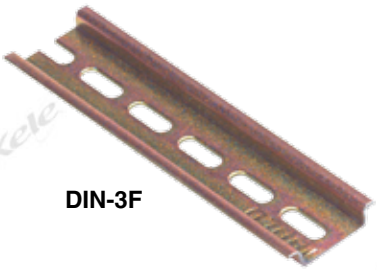
DIN rail is the standard method for mounting relays and terminal blocks. Kele offers five models with different features.

FEATURES

- ***One meter length (39.4")***
- ***Steel or aluminum***
- ***Perforated***

DIMENSIONS





DIN-3F

ORDERING INFORMATION

MODEL	DESCRIPTION
BAM-1000	35 mm aluminum DIN mounting rail 39.4" (1m)
BAM-1500	35 mm aluminum DIN mounting rail 39.4" (1m) 15mm height
DIN-3F	35 mm DIN rail, steel, 39.4" (1m), RoHS compliant
DINRALU	DIN rail, aluminum, 39.4" (1m)
DINRSTL	DIN rail, steel, 39.4" (1m)

RELATED PRODUCTS

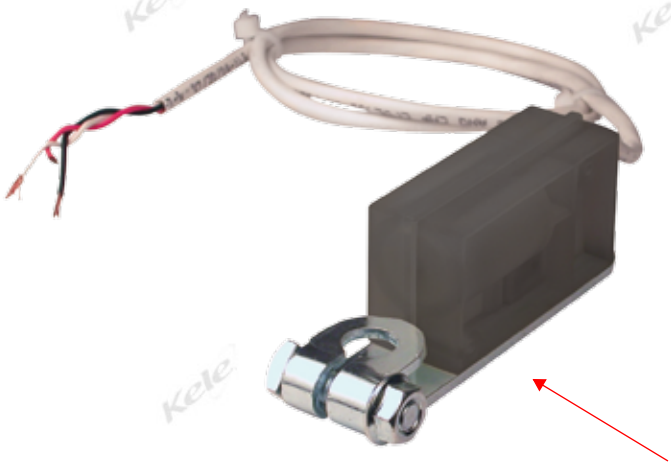
DINCLIC-FM4 Mounting clips, 4 mm screw size

NON-MERCURY DAMPER POSITION SWITCH

TS-475 SERIES

DESCRIPTION

The **TS-475 Series** damper position switches use a roller ball and mechanical switch to provide open/closed damper position status. The **TS-475 Series** offers a non-mercury alternative for applications and for projects which do not allow mercury.



TS-475

SPECIFICATIONS

Wiring	3' (0.9 m) length, AWG 18, 3-conductor plenum-rated cable; black = common, white = N.C., red = N.O.
Switch Type	Mechanical roller ball, SPDT
Contact Rating	5A @ 120/250 VAC
Switch Angle	N.O. makes at 10° above horizontal, breaks at 5° below horizontal
Operating Temperature	-30° to 130°F (-34° to 54°C)
Dimensions	
TS-	1.5"H x 1.5"W x 4.4"L (3.8 x 3.8 x 11.1 cm)
TS1-	1.8"H x 1.5"W x 5.5"L (4.5 x 3.8 x 14.0 cm)
Weight	
TS-	0.4 lb (0.2 Kg)
TS1-	0.7 lb (0.3 Kg)
Mounting	
TS-	1/2" (1.3 cm) damper shaft
TS1-	1" (2.5 cm) damper shaft
Enclosure Rating	UL 94V-0 flammability rating
Warranty	1 year

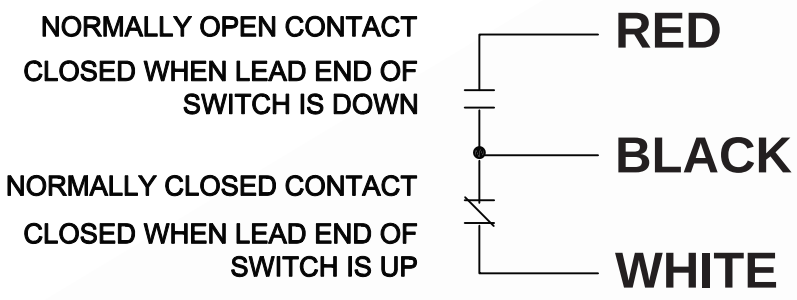
ORDERING INFORMATION

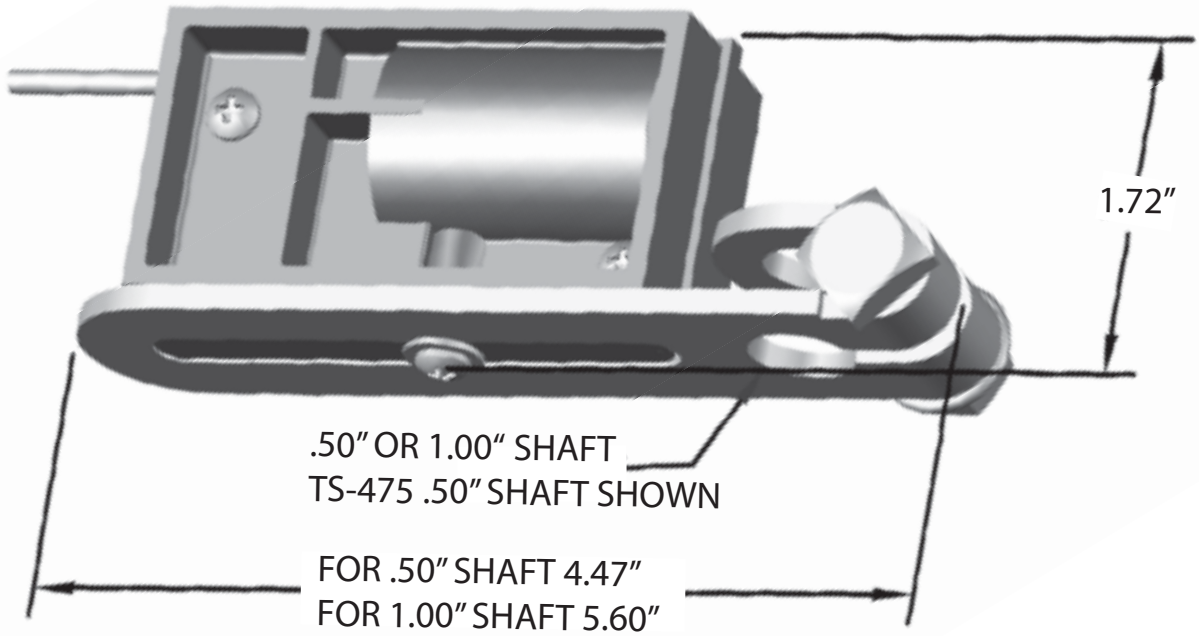
MODEL	DESCRIPTION
TS-475	Non-mercury damper position switch, SPDT, for 1/2" damper shaft
TS1-475	Non-mercury damper position switch, SPDT, for 1" damper shaft

MERCURY DISPLACEMENT INDUSTRIES, INC.
Post Office Box 710 - U.S. 12 East - Edwardsburg, Michigan 49112-0710
Phone (269) 663-8574 - Fax (269) 663-2924
(800) 634-4077

MECHANICAL DAMPER ARM SWITCH

TS-475 & TS1-475





WIRE: 18/3 CMP/CL39 PLENUM WIRE

HOUSING MAT'L: GLASS FILLED PBT

BRACKET MAT'L: PLATED STEEL

OPERATION: STEEL BALL ACTUATED SUBMINITURE SNAP ACTION SWITCH

RATINGS: 5 AMPS @ 120/240 VAC
5 AMPS @ 30 VDC

OPERATING ANGLE 15°: CONTACTS CLOSE @ 10° ABOVE HORIZONTAL
CONTACTS OPEN @ 5° BELOW HORIZONTAL

DESCRIPTION

The **Vynckier VJ and RVJ Series NEMA 4X Enclosures** are constructed from hot compression-molded fiberglass-reinforced polyester. These enclosures offer excellent impact resistance, thermal insulation, and corrosion resistance. Smooth-surfaced, lightweight, nonconductive, and flame-retardant, they can be easily drilled. The gray color is molded in. The **VJ and RVJ Series** has captive stainless cover screws with fiberglass encapsulated heads. **VJ and RVJ Series** are UL listed, File #E192121. All types use a stainless steel piano hinge.

NEW!

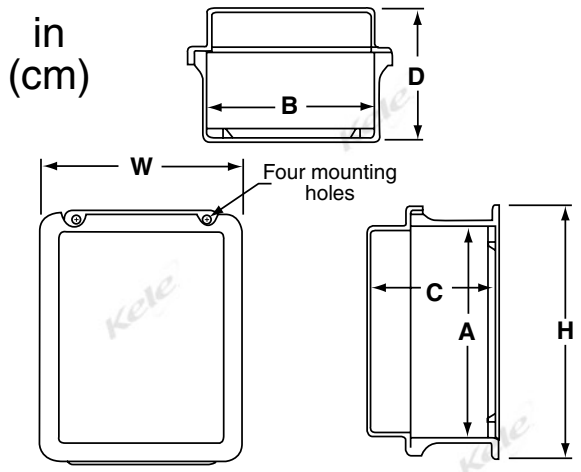
vynckier ENCLOSURE SYSTEMS INC.

FEATURES

- ***Useful outdoor life exceeds 25 years***
- ***Over 20 various global approvals***
- ***Temperature ranges from -58°F to 302°F***

VJ and RVJ Series

DIMENSIONS



VJ, RVJ Series

ORDERING INFORMATION

VJ, RVJ Series

MODEL	ENCLOSURE DIMENSIONS in (cm)			ALUMINUM BACK PANEL	
	INSIDE A x B x C	OVERALL H x W x D	NO. OF SCREWS	MODEL	DIMENSIONS in (cm) H x W
VJ806HW	8 x 6 x 4.6 (20.3 x 15.2 x 11.8)	9.3 x 7.3 x 4.9 (23.6 x 18.6 x 12.5)	2	**MP806A**	6.75 x 4.88 (17.1 x 12.4)
RVJ1008HW	10 x 8 x 6.7 (25.4 x 20.3 x 16.9)	11.3 x 9.3 x 7 (28.7 x 23.6 x 17.8)	2	**MP1008A**	8.75 x 6.88 (22.2 x 17.5)
RVJ1210HW	12 x 10 x 6.8 (30.5 x 25.4 x 17.4)	13.3 x 11.3 x 7.1 (33.8 x 28.7 x 18.1)	2	**MP1210A**	10.5 x 8.88 (26.7 x 22.6)
RVJ1412HW	14 x 12 x 8 (35.6 x 30.5 x 20.2)	15.3 x 13.3 x 8.3 (38.9 x 33.8 x 21.0)	2	**MP1412A**	12.75 x 10.88 (32.4 x 27.6)
RVJ1614HW	16 x 14 x 8 (40.6 x 35.6 x 20.2)	17.3 x 15.3 x 8.3 (44.0 x 38.9 x 20.9)	2	**MP1614A**	14.75 x 12.88 (37.5 x 32.7)
RVJ1816HW	18 x 16 x 10.8 (45.7 x 40.6 x 27.5)	19.3 x 17.3 x 11.1 (49.0 x 44.0 x 28.1)	2	**MP1816A**	16.75 x 14.88 (42.6 x 37.8)

Low Pressure Sensor

Model PR-274/275

RoHS

- 100% solid-state, micro-machined glass-on-silicon, ultra-stable capacitance sensor
- As low as ±0.05"wc (±12.5 pa)
- Can resolve less than 0.00001"wc (0.00025 pa)
- Up to 10 PSID overpressure without zero shift
- Up to 6 field selectable ranges in one unit
- Wide 12-40 VDC/12-35 VAC unregulated supply voltage
- Two temperature compensated output versions, 4-20 mA 2-wire or field selectable 0-5 VDC/0-10 VDC
- Non-interacting zero and span trimmers
- NIST traceable calibration
- Two rugged steel enclosure types NEMA 4 (IP-65) or panel mount for ease of installation
- Conforms to EMC and RoHS standards

The PR-274/275 incorporates a new micro-machined glass-on-silicon (Gl-Si) capacitance sensor. This technology revolutionizes very low pressure measurement. Temperature related zero drift, calibration shift due to overpressure, non-repeatability, non-linearity, and extremely low pressure sensitivity have been some of the problems which have plagued the controls industry. The PR-274/275 with the new Gl-Si technology not only addresses all of the above shortcomings, but for the first time offers a reliable, accurate means to measure and control building/room pressure, air flow, duct pressure, filter pressure drop, or any other extremely low pressure application. Up to six field selectable direct or compound ranges, two enclosure types, field selectable outputs, fully temperature compensated NIST traceable accuracy, non-interacting zero and span adjustments, short circuit and reverse polarity protected output, and a liberal five year warranty are some of the features which make the PR-274/275 the industry's highest performance, ultra-stable, low pressure sensor.

MAMAC SYSTEMS®

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The PR-274/275 incorporates sophisticated integrated circuits to not only provide a high level, fully-conditioned and temperature compensated output, but also to offer field selectable flexibility which was unheard of in the industry. The PR-274/275 offers up to six field selectable pressure ranges in one unit. In this way, a customer does not need to know the exact pressure range prior to selection. By merely knowing the application, a unit may be selected and then later field-configured for the desired pressure range. With fixed range units, in case of engineering error or incorrect selection, the only solution is expensive field recalibration or time consuming product exchange or replacement. Similarly, numerous units have to be kept in stock as spares to cover all ranges in case of field failure. The PR-274/275 with the field selectable pressure range feature, eliminates above mentioned costly inefficiencies. A single unit can be configured to cover all the pressure ranges in a particular application thereby eliminating any possibility of incorrect range selection. Additionally, one unit can be kept in stock and, in the event of failure, it can be field-configured thereby eliminating the need to stock numerous fixed range units. (For a complete listing of all ranges available, please see the ordering information section on page three.)

On VDC output units, two additional field-selectable options are available: dual outputs 0-5 or 0-10 VDC, and dual unregulated supply voltages 12-35 VAC or 12-40 VDC. By merely setting a dip switch, one can select the desired output for the specific application. As far as supply voltage is concerned, the unit automatically configures for AC or DC, and no field selection is necessary. Another feature is that the output is fully protected from short circuit to ground, or if the supply voltage is applied by mistake to the output. Past experience demonstrates that field-related wiring problems do occur. Instead of denying this fact, the protection circuit is designed in to ensure trouble-free start-up. The VDC output unit is also designed to handle low impedance circuits. In fact, the unit can drive up to 1k ohms minimum. In this way, multiple controllers, indicators, or other devices can be paralleled to the output without performance degradation.

The mA output units can function over a wide unregulated supply voltage range: 12-40 VDC without any effect on calibration or performance. The unit has built-in reverse polarity protection. As a result, it is next to impossible to damage the unit by miswiring. By using sophisticated low drop-out voltage regulators and CMOS integrated circuits, the mA output unit can drive very high output impedance.

In fact, with only 12 VDC supply, the unit can drive 200 ohms. At 40 VDC, the unit is capable of handling up to 1600 ohms load. In this way, the output loop can be tied in series to multiple controllers, indicators, and other devices without degrading the performance.

Due to the low mass of the micro-machined capacitance Gl-Si sensor, the mounting orientation error for ranges higher than 1.0"wc (250 pa) is negligible. For extremely low ranges, if the unit is installed as indicated on the label, there should be no orientation error. However, due to space limitation, if the unit cannot be installed in the indicated position, the error can be easily removed by merely adjusting the zero trimmer. Since the zero and span trimmers are non-interactive, adjustment to the zero should under no circumstance affect the calibration integrity of the unit including linearity and repeatability specifications across the range.

The PR-274/275 is available with two packaging options: a NEMA 4 (IP-65) fully gasketed, dust proof and splash proof enclosure, or a lightweight but rugged panel mount chassis for ease of installation with minimum space requirement in a control panel. The NEMA 4 (IP-65) enclosure has an external mounting bracket to facilitate field installation. A ½" (.875"/22.25mm dia.) knock-out for conduit connection is also provided. A liquid tight cable connector is also supplied if the unit is not being hard wired. Once installed, the enclosure maintains its environmental rating and protects the electronics and the sensing element from condensation, corrosive contaminants and other environmental pollutants. Both packaging options also have additional features for ease of installation, including upluggable terminal blocks, rugged brass hose barbs, easily accessible zero and span trimmers, and conveniently located dip switches for field selection.

SPECIFICATIONS:

Accuracy*: ±1% FS
Overpressure: 10 PSID
Supply Voltage: 12-40 VDC
12-35 VAC (VDC output units only)
Supply Current: VDC Units – 10 mA max.
mA Units – 20 mA max.
Compensated Temp Range: 25°F - 150°F
(-4° C - 65°C)
T.C. Error: ±0.0125%/°F (.02%/°C)
Load Impedance: 1.6K ohms max. at 40 VDC
(mA output units)
1K ohms min.
(VDC output units)
Enclosure: 18 Ga. C. R. Steel NEMA 4 (IP-65)
or Panel Mount Chassis
Finish: Baked-on enamel – PMS2GR88B
**Includes non-linearity, hysteresis, and non-repeatability*

Operating Temp Range: 0°F – 175°F
(-18°C – 80°C)
Media Compatibility: Clean dry air or any inert gas
Environmental: 10–90%RH Non-Condensing
Termination: Unpluggable screw terminal block
Wire Size: 12 Ga. max
Weight: Enclosure - 1.0 lbs. (.45 kg)
Panel Mount - 0.5 lbs. (.25 kg)

CONFORMANCE & TESTING:

RoHS Compliant
EMC Testing:
BS EN 55022:1998, BS EN 55024:1998,
EN 61000-3-3, EN 61000-4-2,
EN 61000-4-3, EN 61000-4-4,
EN 61000-4-5, EN 61000-4-6,
EN 61000-4-11

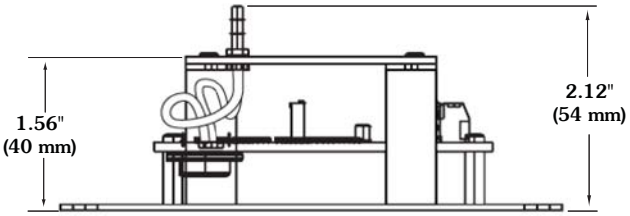
ORDERING INFORMATION: PR-

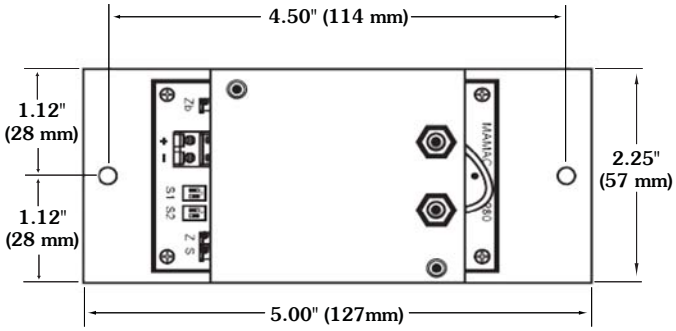
Packaging	Range		Output	
274 (enclosure)	**R1** ("wc)	0 to 0.10 / -0.05 to +0.05	**mA**	(4-20 mA 2-wire)
275 (panel mount)	**R2** ("wc)	0 to 1.0 / 0 to 0.5 / 0 to 0.25 / -0.5 to +0.5 / -0.25 to +0.25 / -0.125 to +0.125	**VDC**	(0-5 VDC or 0-10 VDC field selectable)
	R3 ("wc)	0 to 5.0 / 0 to 2.5 / 0 to 1.25 / -2.5 to +2.5 / -1.25 to +1.25 / -0.625 to +0.625		
	R4 ("wc)	0 to 30 / 0 to 15 / 0 to 7.5 / -15.0 to +15.0 / -7.5 to +7.5 / -3.75 to +3.75		
	R5* (pa)	0 to 25 / -12.5 to +12.5		
	R6* (pa)	0 to 250 / 0 to 125 / 0 to 62.5 / -125 to +125 / -62.5 to +62.5 / -31.25 to +31.25		
	R7* (pa)	0 to 1250 / 0 to 625 / 0 to 312.5 / -625 to +625 / -312.5 to +312.5 / -156.25 to +156.25		
	R8* (pa)	0 to 7500 / 0 to 3750 / 0 to 1875 / -3750 to +3750 / -1875 to +1875 / -937.5 to +937.5		

Example: PR-274-R2-mA: *Enclosure unit with R2 Range which has six (6) field selectable range options and 4-20 mA output.*

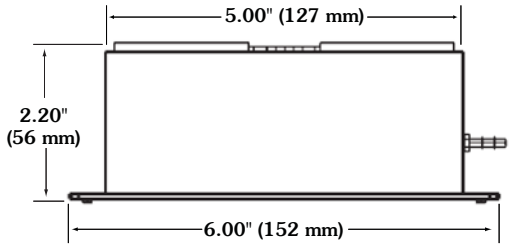
CAUTION: Do not use in explosive/hazardous environment or with flammable/combustible media.

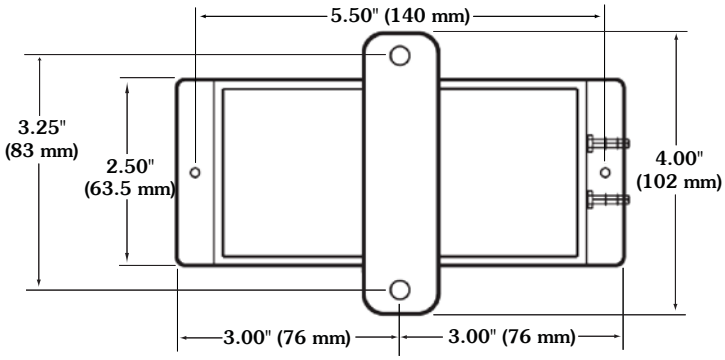
Panel Mount





Enclosure





PR-274/275

MAMAC Systems is the leading global manufacturer of sensors, transducers, control peripherals and web browser based IP appliances. MAMAC products are used for HVAC and environmental controls, remote monitoring, alarming, energy metering and industrial automation.

All MAMAC products are manufactured in the USA.

WARRANTY: MAMAC Systems, Inc. and its subsidiaries (hereinafter referred to as MAMAC Systems) warrants its products to be free of defects in material and workmanship for a period of five (5) years from date of shipment. If a unit is malfunctioning, it must be returned to the factory for evaluation. A return authorization number (RMA) will be issued by the customer service department and this number must be written or prominently displayed on the shipping boxes and all related documents. The defective part should be shipped freight pre-paid to the factory. Upon examination by MAMAC Systems, if the unit is found to be defective, it will be repaired or replaced at no charge to the customer. However, this warranty is void if the unit shows evidence of being tampered with, damaged during installation, misapplied, misused, or used in any other operating condition outside of the unit's published specifications.

MAMAC Systems makes no other warranties or representations of any kind whatsoever, expressed or implied, except that of title. All implied warranties including any warranty of merchantability and fitness for a particular purpose are hereby disclaimed. User is responsible to determine suitability for intended use.

LIMITATIONS OF LIABILITY: The remedies of buyer set forth herein are exclusive and the total liability of MAMAC Systems with respect to this order, whether based on contract, warranty, negligence, indemnification, strict liability or otherwise, shall not exceed the purchase price of the product upon which liability is based. **In no event shall MAMAC Systems be liable for consequential, incidental or special damages.** MAMAC Systems reserves the right to change any specifications without notice to improve performance, reliability, or function of our products.

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Model PR-274/275
Technical Information
TI.274/275-06

LOW PRESSURE SENSOR

For Additional Information See PR-274/275 Data Sheet

SPECIFICATIONS

Accuracy*: ±1% FS

Overpressure: 10 PSID

Supply Voltage: 12-40 VDC
12-35 VAC (VDC output units only)

Supply Current: VDC Units - 10 mA max.
mA Units - 20 mA max.

Enclosure: 18 Ga C. R. Steel NEMA 4 (IP-65) or Panel Mount Chassis

Finish: Baked on enamel-PMS2GR88B

EMC Conformance: EN 55022, 55024, 61000-3-3, 61000-4-2, 3, 4, 5, 6 & 11

Compensated Temp Range: 25°F-150°F (-4°C-65°C)

T. C. Error: ±0.0125%/°F (.02%/°C)

Operating Temp Range: 0°F-175°F (-18°C-80°C)

Media Compatibility: Clean dry air or any inert gas

Environmental: 10-90%RH Non-Condensing

Termination: Unpluggable screw terminal block

Wire Size: 12 Ga max.

Load Impedance: 1.6K ohms max. at 40 VDC (mA output units)
1K ohms min. (VDC output units)

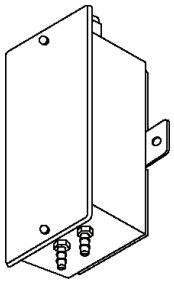
Weight: **Enclosure -** 1.0 lbs. (.45 kg)
Panel Mount - 0.5 lbs. (.25 kg)

ORDERING INFORMATION

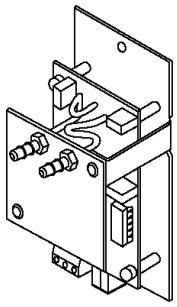
PACKAGING	RANGE		OUTPUT
274 (enclosure)	**R1** ("wc)	0 TO 0.10 / -0.05 TO +0.05	**mA** (4-20 mA 2-wire)
275 (panel mount)	**R2** ("wc)	0 TO 1.0 / 0 TO 0.5 / 0 TO 0.25 / -0.5 TO +0.5 / -0.25 TO +0.25 / -0.125 TO +0.125	**VDC** (0-5 VDC or 0-10 VDC field selectable)
	R3 ("wc)	0 TO 5.0 / 0 TO 2.5 / 0 TO 1.25 / -2.5 TO +2.5 / -1.25 TO +1.25 / -0.625 TO +0.625	
	R4 ("wc)	0 TO 30 / 0 TO 15 / 0 TO 7.5 / -15.0 TO +15.0 / -7.5 TO +7.5 / -3.75 TO + 3.75	
	R5 (pa)	0 TO 25 / -12.5 TO +12.5	
	R6 (pa)	0 TO 250 / 0 TO 125 / 0 TO 62.5 / -125 TO +125 / -62.5 TO +62.5 / -31.25 TO +31.25	
	R7 (pa)	0 TO 1250 / 0 TO 625 / 0 TO 312.5 / -625 TO +625 / -312.5 TO +312.5 / -156.25 TO +156.25	
	R8 (pa)	0 TO 7500 / 0 TO 3750 / 0 TO 1875 / -3750 TO +3750 / -1875 TO +1875 / -937.5 TO +937.5	

INSTALLATION

Inspection - Inspect the package for damage. If damaged, notify the appropriate carrier immediately. If undamaged, open the package and inspect the device for obvious damage. Return damaged products.



Enclosure Mount Transducer



Panel Mount Transducer

Requirements
- Tools (not provided)
  - Digital Volt-ohm Meter (DVM)
  - Appropriate screwdriver for mounting screws
  - Appropriate drill and drill bit for mounting screws
- Appropriate accessories
- Two #8 self-tapping mounting screws (*not provided*)
- Training: **Installer must be a qualified, experienced technician**

Warning:
- Disconnect power supply before installation to prevent electrical shock and equipment damage.
- Make all connections in accordance with the job wiring diagram and in accordance with national and local electrical codes. Use copper conductors only.

Caution:
- Use electrostatic discharge precautions (e.g., use of wrist straps) during installation and wiring to prevent equipment damage.
- Avoid locations where severe shock or vibration, excessive moisture or corrosive fumes are present. NEMA Type 4 housings are intended for outdoor use primarily to provide a degree of protection against wind-blown dust, rain, and hose-directed water.
- Do not exceed ratings of the device.

Caution:
- Condensate or moisture must not enter pressure sensor ports

Mounting

The PR-274/275 must be mounted as indicated by the arrows on the enclosure. Refer to **Figure 7** for mounting dimensions.

1. Remove the transducer cover using a Phillips head screwdriver.
2. Select the mounting location.
3. Mount transducer on a vertical surface with two #8 self-tapping screws (not provided).
4. Transducer must be mounted above the pressure pick-up or a J-Loop must be incorporated in the tubing to function as a condensate trap.
5. Pull wires through bottom of enclosure and make necessary connections.
6. Replace cover and make pneumatic connections.

Wiring

Use maximum 12 AWG wire for wiring terminals. Use flexible 1/4" O.D. 5/32" I.D. tubing for the high and low pressure connections. Refer to **Figures 1, 2, 3**, & **4** for wiring information and **Figures 5** & **6** for switch designations.

(Wiring Instructions continued on pages 2 and 3.)

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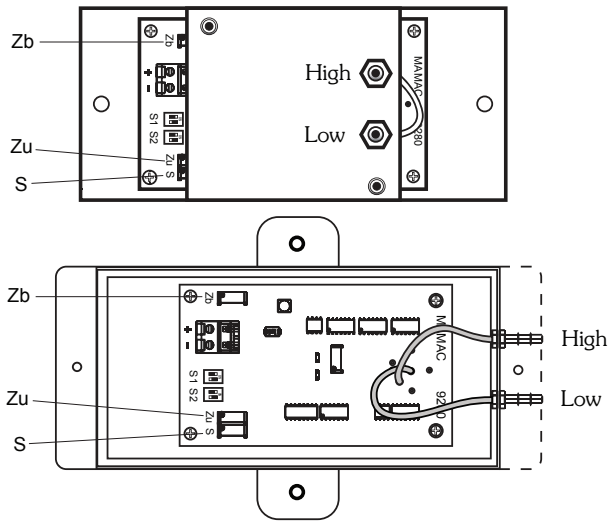
LOW PRESSURE SENSOR

Wiring PR-274/275 Units with mA Output

PR-274/275 Low Pressure Transducer with mA Output



PR-274/275 pressure transducers with 4-20 mA output are powered with a 12-40 VDC supply.

The following describes the proper wiring of these pressure transducers with mA output:

1. Remove the terminal block by carefully pulling it off the circuit board.
2. Locate the [+] and [-] terminal markings on the board.
3. Attach the supply voltage to the [+] lead.
4. Connect the 4-20 mA output ([-] terminal) to the controller's input terminal.
5. Ensure that the power supply common is attached to the common bus of the controller.
6. Re-insert the terminal block to the circuit board and apply power to the unit.
7. Check for the appropriate output signal using a DVM set on DC milliamps connected in series with the [-] terminal.

TYPICAL APPLICATIONS (wiring diagrams)

Figure 1 and **Figure 2** illustrate typical wiring diagrams for the mA output low pressure transducer.

Figure 1 - *Wiring for mA Low Pressure Transducers with an External DC Power Supply*

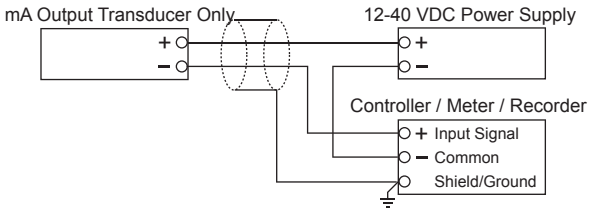
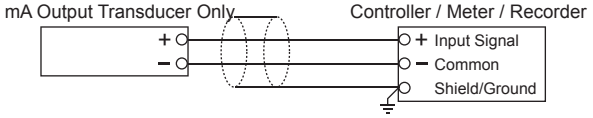
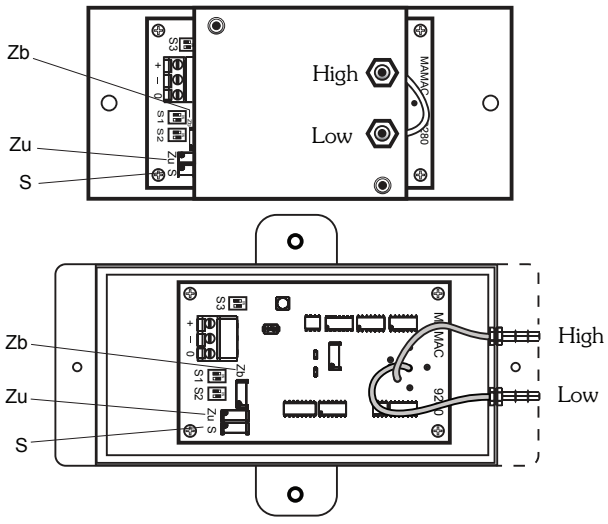


Figure 2 - *Wiring for mA Output Transducers where the Controller or Meter has an Internal DC Power Supply*



Wiring PR-274/275 Units with VDC Output

PR-274/275 Low Pressure Transducer with VDC Output



PR-274/275 pressure transducers with VDC output are field selectable 0-5 VDC or 0-10 VDC output and can be powered with either a 12-40 VDC or 12-35 VAC.

The following describes the proper wiring of these pressure transducers with VDC output:

1. Remove the terminal block by carefully pulling it off the circuit board.
2. Locate the [+], [-] and [O] terminal markings on the board.
3. Attach the power wires to the [+] and [-] terminals. The [-] terminal is also the negative terminal.
4. Connect the [O] terminal, which is the positive VDC output terminal, to the controller's input terminal.
5. Re-insert the terminal block to the circuit board and apply power to the unit.
6. Check the appropriate VDC output using a voltmeter set on DC volts across the [O] and [-] terminals.

TYPICAL APPLICATIONS (wiring diagrams)

Figure 3 and **Figure 4** illustrate typical wiring diagrams for the VDC output low pressure transducer.

Figure 3 *- Wiring for VDC Low Pressure Transducers When Applied with External AC Supply*

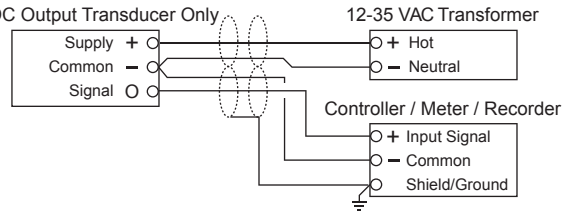
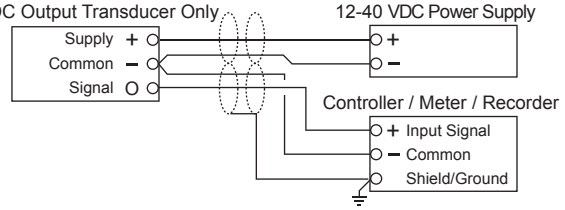


Figure 4 *- Wiring for VDC Low Pressure Transducers When Applied with External DC Power Supply*



Caution: If you are using grounded AC, the hot wire must be on the [+] terminal. Also, if you are using a controller without built-in isolation, use an isolation transformer to supply the PR-274/275.
Caution: This product contains a half-wave rectifier power supply and must not be powered off transformers used to power other devices utilizing non-isolated full-wave rectifier power supplies.
Caution: When multiple PR-274/275 units are powered from the same transformer, damage will result unless all 24G power leads are connected to the same power lead on all devices. It is mandatory that correct phasing be maintained when powering more than one device from a single transducer.

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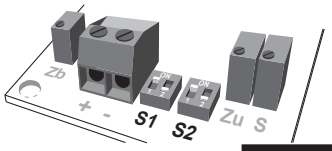
LOW PRESSURE SENSOR

Figure 5 *- Switch Selections for Low Pressure Transducers with mA Outputs*



mA Output

Range Configuration: Uni-Directional **Switch 1 (S1)**

		Factory Sealed
R1/R5	0 - 0.10 "wc / 25 pa	
R2/R6	0 - 1.0 "wc / 250 pa (default)	
	0 - 0.5 "wc / 125 pa	
	0 - 0.25 "wc / 62.5 pa	
R3/R7	0 - 5.0 "wc / 1250 pa (default)	
	0 - 2.5 "wc / 625 pa	
	0 - 1.25 "wc / 312.5 pa	
R4/R8	0 - 30.0 "wc / 7500 pa (default)	
	0 - 15.0 "wc / 3750 pa	
	0 - 7.5 "wc / 1875 pa	

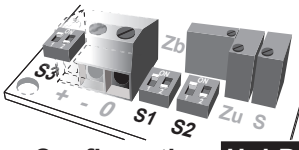
Range Configuration: Bi-Directional **Switch 1 (S1)**

		Factory Sealed
R1/R5	+/- 0.05 "wc / 12.5 pa	
R2/R6	+/- 0.5 "wc / 125 pa (default)	
	+/- 0.25 "wc / 62.5 pa	
	+/- 0.125 "wc / 31.25 pa	
R3/R7	+/- 2.5 "wc / 625 pa (default)	
	+/- 1.25 "wc / 312.5 pa	
	+/- .625 "wc / 156.25 pa	
R4/R8	+/- 15.0 "wc / 3750 pa (default)	
	+/- 7.5 "wc / 1875 pa	
	+/- 3.75 "wc / 937.5 pa	

Output Configuration: **Switch 2 (S2)**

Uni-directional (default)
Bi-directional

Figure 6 *- Switch Selections for Low Pressure Transducers with VDC Outputs*



VDC Output

Range Configuration: Uni-Directional **Switch 1 (S1)**

		Factory Sealed
R1/R5	0 - 0.10 "wc / 25 pa	
R2/R6	0 - 1.0 "wc / 250 pa (default)	
	0 - 0.5 "wc / 125 pa	
	0 - 0.25 "wc / 62.5 pa	
R3/R7	0 - 5.0 "wc / 1250 pa (default)	
	0 - 2.5 "wc / 625 pa	
	0 - 1.25 "wc / 312.5 pa	
R4/R8	0 - 30.0 "wc / 7500 pa (default)	
	0 - 15.0 "wc / 3750 pa	
	0 - 7.5 "wc / 1875 pa	

Output Configuration: **Switch 2 (S2)**

Uni-directional (default)
Bi-directional

Range Configuration: Bi-Directional **Switch 1 (S1)**

		Factory Sealed
R1/R5	+/- 0.05 "wc / 12.5 pa	
R2/R6	+/- 0.5 "wc / 125 pa (default)	
	+/- 0.25 "wc / 62.5 pa	
	+/- 0.125 "wc / 31.25 pa	
R3/R7	+/- 2.5 "wc / 625 pa (default)	
	+/- 1.25 "wc / 312.5 pa	
	+/- .625 "wc / 156.25 pa	
R4/R8	+/- 15.0 "wc / 3750 pa (default)	
	+/- 7.5 "wc / 1875 pa	
	+/- 3.75 "wc / 937.5 pa	

Output Configuration: **Switch 3 (S3)**

0 - 10 (default)
0 - 5 VDC

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LOW PRESSURE SENSOR

CHECKOUT

1. Verify that the unit is mounted in the correct position.
2. Verify appropriate input signal and supply voltage.

⚠ ***Caution:*** Never connect 120 VAC to these transducers. Never connect AC voltage to a unit intended for DC supply.

3. Verify appropriate configuration range.

Transducer Operation

This is a rough functional check only.

1. Adjust the pressure to obtain maximum output signal for appropriate range.
2. Output should be 20 mA or 5 or 10 VDC.
3. Adjust the pressure to obtain minimum output signal.
4. Output should be 4 mA or 0 VDC.

NOTE: *The PR-274/275 is a highly accurate device. For applications requiring a high degree of accuracy, the use of laboratory quality meters and gauges are recommended.*

CALIBRATION All units are factory calibrated to meet or exceed published specifications. If field adjustment is necessary, follow the instructions below.

Calibration of PR-274/275 mA Units

1. Connect terminals [+] and [-] to the appropriate power source.
2. Connect the DVM in series on the [-] terminal.
3. Apply low pressure to the unit. If configured for uni-direction, adjust Zu trimmer to achieve desired low output. If configured for bi-direction, adjust Zb trimmer to achieve desired low output.
4. Apply high pressure to the unit and adjust span trimmer [S] to obtain the desired high output pressure.
5. Repeat steps 3 and 4 until desired calibration is achieved.

Calibration of PR-274/275 VDC Units

1. Connect terminals [+] and [-] to the appropriate power source. The [-] terminal is also the negative output terminal.
2. Connect the DVM on DC volts across [O] and [-] terminal.
3. Apply low pressure to the unit. If configured for uni-direction, adjust Zu trimmer to achieve desired low output. If configured for bi-direction, adjust Zb trimmer to achieve desired low output.
4. Apply high pressure to the unit and adjust span trimmer [S] to obtain the desired high output pressure.
5. Repeat steps 3 and 4 until desired calibration is achieved.

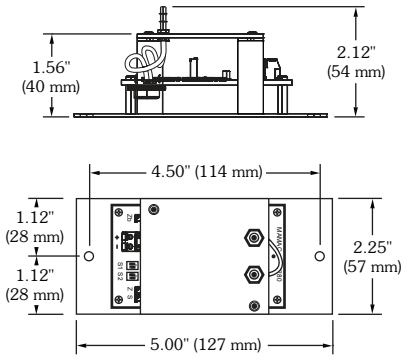
MAINTENANCE Regular maintenance of the total system is recommended to assure sustained optimum performance.

FIELD REPAIR None. Replace with a functional unit.

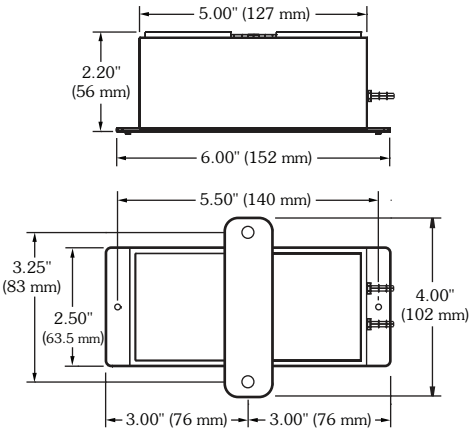
WARRANTY See Data Sheet for additional information.

Figure 7 *- PR-274/275 Low Pressure Transducer Dimensions shown in inches and millimeters (mm).*

Panel Mount



Enclosure



For Technical / Application Assistance call your nearest office

MAMAC SYSTEMS®

8189 Century Boulevard • Minneapolis, MN 55317-8002 • USA
800-843-5116 • 952-556-4900 • Fax 952-556-4997
sales@mamacsys.com • www.mamacsys.com

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Solihull Parkway
Birmingham • West Midlands
B37 7YN • United Kingdom
01384-271113 • Fax 01384-271114

CANADA
675 Cochrane Drive
East Tower • 6th Floor
Toronto • Ontario
L3R 0B8 • Canada
905-474-9215 • Fax 905-474-0876

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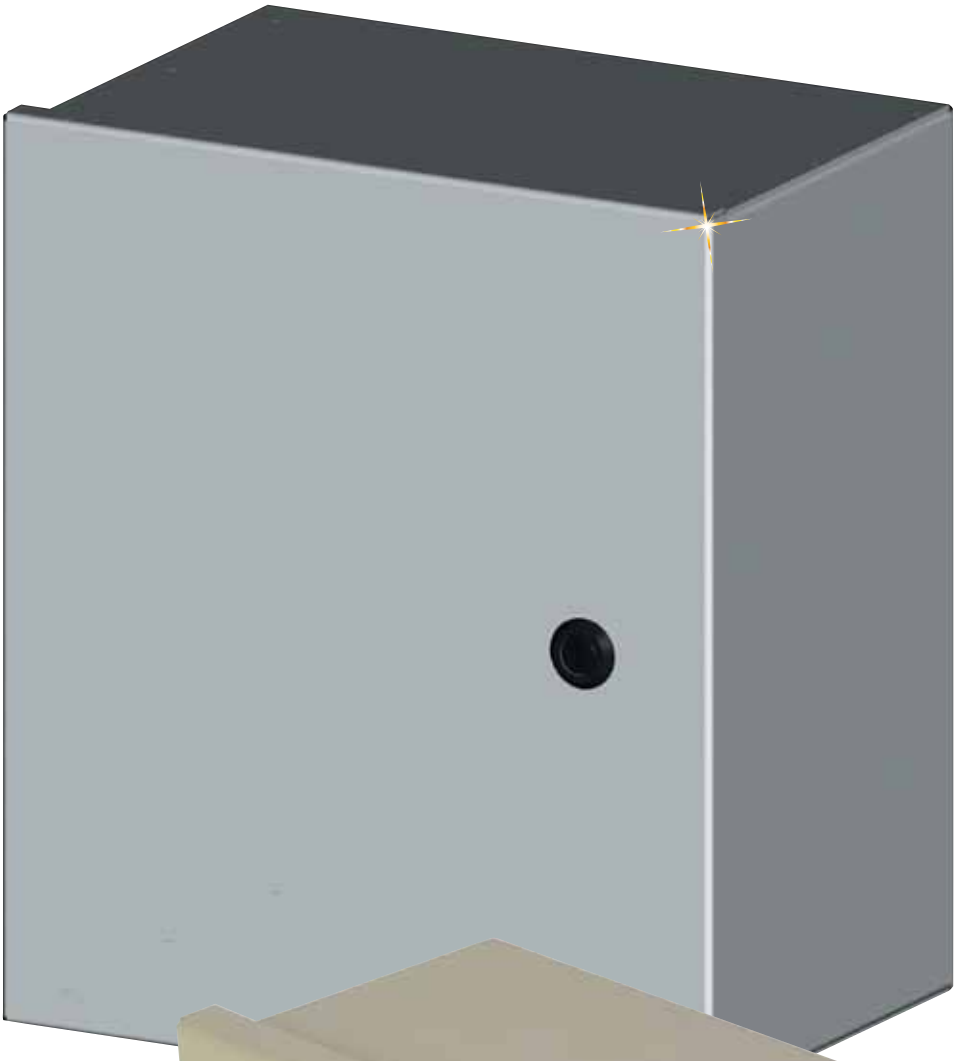
One Fullerton
Singapore • 049213
65-31581826 • Fax 65-31581826

AUSTRALIA
4 Armiger Court, Unit 2
Adelaide • S.A.
5088 • Australia
08-8395-4333 • Fax 08-8395-4433

NEMA TYPE 1 SINGLE-DOOR ENCLOSURES

SCE-LP Series

1 YEAR WARRANTY



SCE-10N804LP shown smaller than actual size.

- 0.060 and 0.075" Carbon Steel Depending on its Size
- Spot Weld Construction
- Standoffs Provided for Mounting Optional Panels
- Doors Open 180°
- Black Quarter Turn Latches
- Latches Are Opened or Closed with a Screwdriver
- Ground Stud On Door
- Mounting Holes in Back of Enclosure
- Subpanel Mounting Hardware

SCE-6N604LP shown smaller than actual size.

Application

Designed to house electrical controls, instruments and components in areas that do not require oil, water and dust tight protection.

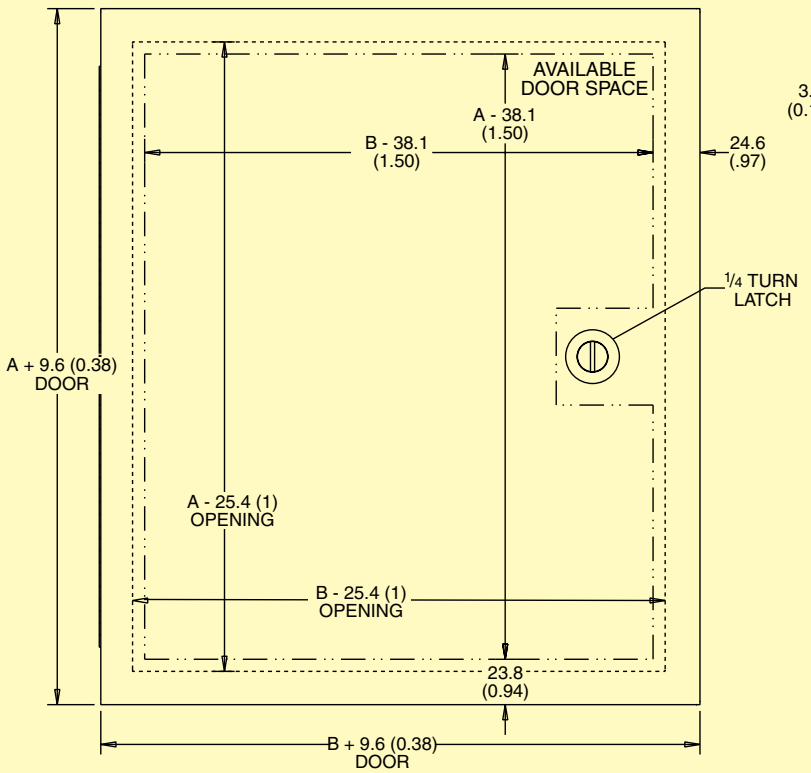
Finish

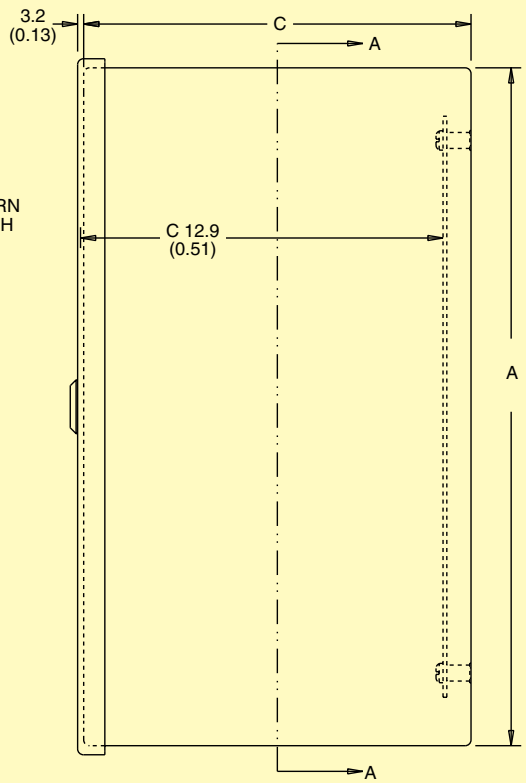
ANSI-61 gray powder coat inside and out over phosphatized surface. Optional panels are powder coated white.

Industry Standards

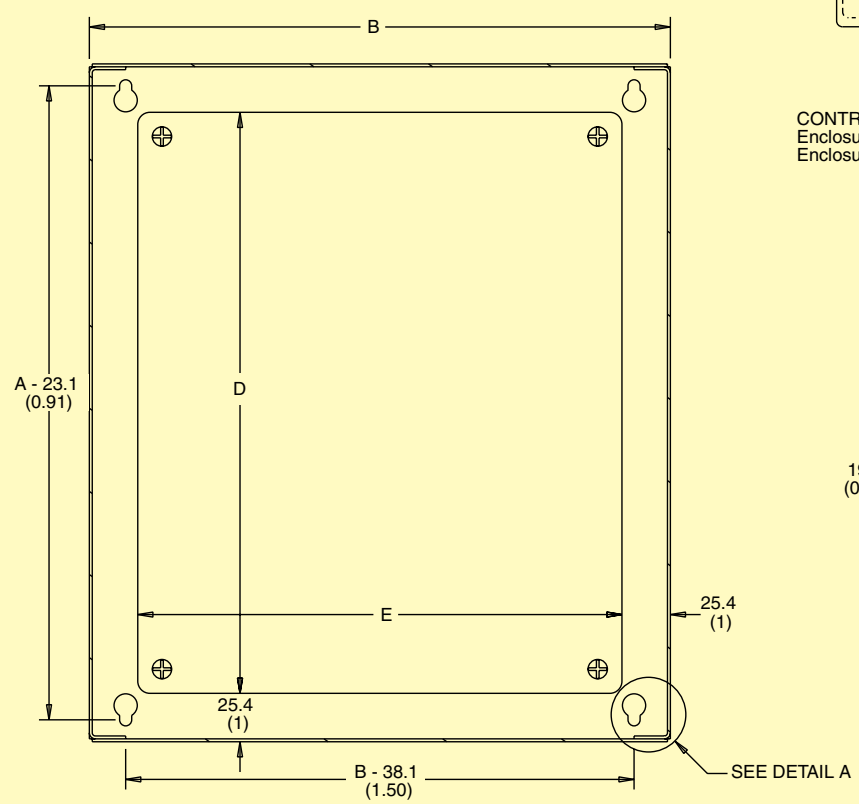
NEMA Type 1
UL Listed Type 1
CSA Type 1
IEC 60529 IP 30

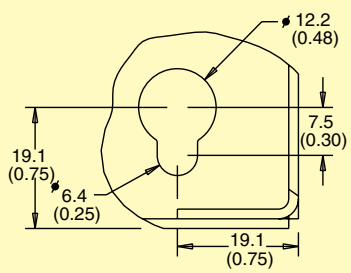
Dimensions: mm (inch)





CONTRUCTION NOTES:
Enclosures < 610 (24) wide are made of 1.5 (0.060) material.
Enclosures 610 (24) wide are made of 1.9 (0.075) material.





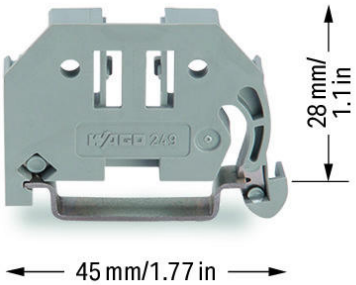
N-41

To Order

TYPE 1 SINGLE-DOOR ENCLOSURES

ENCLOSURES (inch)				SUB-PANEL (inch)		
MODEL NO.	HEIGHT (A)	WIDTH (B)	DEPTH (C)	MODEL NO.	HEIGHT (D)	WIDTH (E)
SCE-6N604LP	6.00	6.00	4.00	SCE-6N6MP	4.00	4.00
SCE-8N604LP	8.00	6.00	4.00	SCE-8N6MP	6.00	4.00
SCE-8N804LP	8.00	8.00	4.00	SCE-8N8MP	6.00	6.00
SCE-8N806LP	8.00	8.00	6.00	SCE-8N8MP	6.00	6.00
SCE-10N804LP	10.00	8.00	4.00	SCE-10N8MP	8.00	6.00
SCE-10N806LP	10.00	8.00	6.00	SCE-10N8MP	8.00	6.00
SCE-10N1004LP	10.00	10.00	4.00	SCE-10N10MP	8.00	8.00
SCE-10N1006LP	10.00	10.00	6.00	SCE-10N10MP	8.00	8.00
SCE-12N1004LP	12.00	10.00	4.00	SCE-12N10MP	10.00	8.00
SCE-12N1006LP	12.00	10.00	6.00	SCE-12N10MP	10.00	8.00
SCE-12N1204LP	12.00	12.00	4.00	SCE-12N12MP	10.00	10.00
SCE-12N1206LP	12.00	12.00	6.00	SCE-12N12MP	10.00	10.00
SCE-12N1208LP	12.00	12.00	8.00	SCE-12N12MP	10.00	10.00
SCE-14N1204LP	14.00	12.00	4.00	SCE-14N12MP	12.00	10.00
SCE-14N1206LP	14.00	12.00	6.00	SCE-14N12MP	12.00	10.00
SCE-14N1208LP	14.00	12.00	8.00	SCE-14N12MP	12.00	10.00
SCE-16N1206LP	16.00	12.00	6.00	SCE-16N12MP	14.00	10.00
SCE-16N1208LP	16.00	12.00	8.00	SCE-16N12MP	14.00	10.00
SCE-16N1606LP	16.00	16.00	6.00	SCE-16N16MP	14.00	14.00
SCE-16N1608LP	16.00	16.00	8.00	SCE-16N16MP	14.00	14.00
SCE-16N2006LP	16.00	20.00	6.00	SCE-20N16MP	18.00	14.00
SCE-20N1606LP	20.00	16.00	6.00	SCE-20N16MP	18.00	14.00
SCE-20N1608LP	20.00	16.00	8.00	SCE-20N16MP	18.00	14.00
SCE-20N2006LP	20.00	20.00	6.00	SCE-20N20MP	18.00	18.00
SCE-20N2008LP	20.00	20.00	8.00	SCE-20N20MP	18.00	18.00
SCE-20N2010LP	20.00	20.00	10.00	SCE-20N20MP	18.00	18.00
SCE-24N1606LP	24.00	16.00	6.00	SCE-24N16MP	22.00	14.00
SCE-24N2006LP	24.00	20.00	6.00	SCE-24N20MP	22.00	18.00
SCE-24N2008LP	24.00	20.00	8.00	SCE-24N20MP	22.00	18.00
SCE-24N2010LP	24.00	20.00	10.00	SCE-24N20MP	22.00	18.00
SCE-24N2406LP	24.00	24.00	6.00	SCE-24N24MP	22.00	22.00
SCE-24N2408LP	24.00	24.00	8.00	SCE-24N24MP	22.00	22.00
SCE-24N2412LP	24.00	24.00	12.00	SCE-24N24MP	22.00	22.00
SCE-30N2406LP	30.00	24.00	6.00	SCE-30N24MP	28.00	22.00
SCE-30N2408LP	30.00	24.00	8.00	SCE-30N24MP	28.00	22.00
SCE-30N2412LP	30.00	24.00	12.00	SCE-30N24MP	28.00	22.00
SCE-30N3008LP	30.00	30.00	8.00	SCE-30N30MP	28.00	28.00
SCE-36N2406LP	36.00	24.00	6.00	SCE-36N24MP	34.00	22.00
SCE-36N2408LP	36.00	24.00	8.00	SCE-36N24MP	34.00	22.00
SCE-36N2412LP	36.00	24.00	12.00	SCE-36N24MP	34.00	22.00
SCE-36N3006LP	36.00	30.00	6.00	SCE-36N30MP	34.00	28.00
SCE-36N3008LP	36.00	30.00	8.00	SCE-36N30MP	34.00	28.00
SCE-36N3012LP	36.00	30.00	12.00	SCE-36N30MP	34.00	28.00

Ordering Examples: SCE-6N604LP, *Type 1 single-door enclosure.*
SCE-16N2006LP, *Type 1 single-door enclosure,* ***SCE-20N16MP,*** *sub-panel.*



Item description

Note:
 Fit – and forget! Assembling the new WAGO screwless end stop is as simple and quick as snapping a WAGO rail-mount terminal block onto the rail. Without any tools! This allows rail-mount terminal blocks to be safely secured, at low cost, against any movement on all DIN-35 rails per DIN EN 60715 (35 x 7.5 mm; 35 x 15 mm). Entirely without screws! The “secret” of the excellent tight fit lies in the two small clamping plates which keep the end stop in position, even if the rails are mounted vertically. Simply snap on and forget! In addition, costs are considerably reduced when using large numbers of end stops. A further advantage is that three marker slots for all WAGO marker systems for rail-mount terminal blocks and a snap-in hole for WAGO adjustable height group marker carriers offer individual marking possibilities.

Data

Technical Data

Main product function	Mounting Accessories
Type of mounting	Carrier rail 35 x 15

Geometrical Data

Width	6 mm / 0.236 Inch
Depth	45 mm / 1.772 Inch
Height from upper-edge of DIN-35 rail	28.2 mm / 1.11 Inch

Material Data

Color	gray
Fire load	0.104 MJ
Weight	3.46 g

Commercial data

Packaging type	BOX
Country of rigin	CN
GTIN	4017332270823
Product Group	2 (Terminal Block Accessories)

Ex-Approvals

Logo	Approval	Certificate name
	ATEX DEKRA EXAM GmbH	BVS 15 ATEX E 049 U
	IECEx DEKRA EXAM GmbH	IECEx PTB 16.0001U

WAGO Kontakttechnik GmbH & Co. KG
Hansastr. 27
32423 Minden
Phone: +49571 887-0 | Fax: +49571 887-169
Email: info.de@wago.com | Web: www.wago.com

WAGO online catalog / eShop

2-conductor through terminal block; suitable for Ex e II applications

Item No.: 2002-1201

2-conductor through terminal block; suitable for Ex e II applications

Marking

RoHS ✓
Compliant

Business data

Supplier	*WAGO*
Item no.	*2002-1201*
GTIN / EAN	*4017332999168*
Content	*1*
Order amount	*100*
Customer item number	

Notes

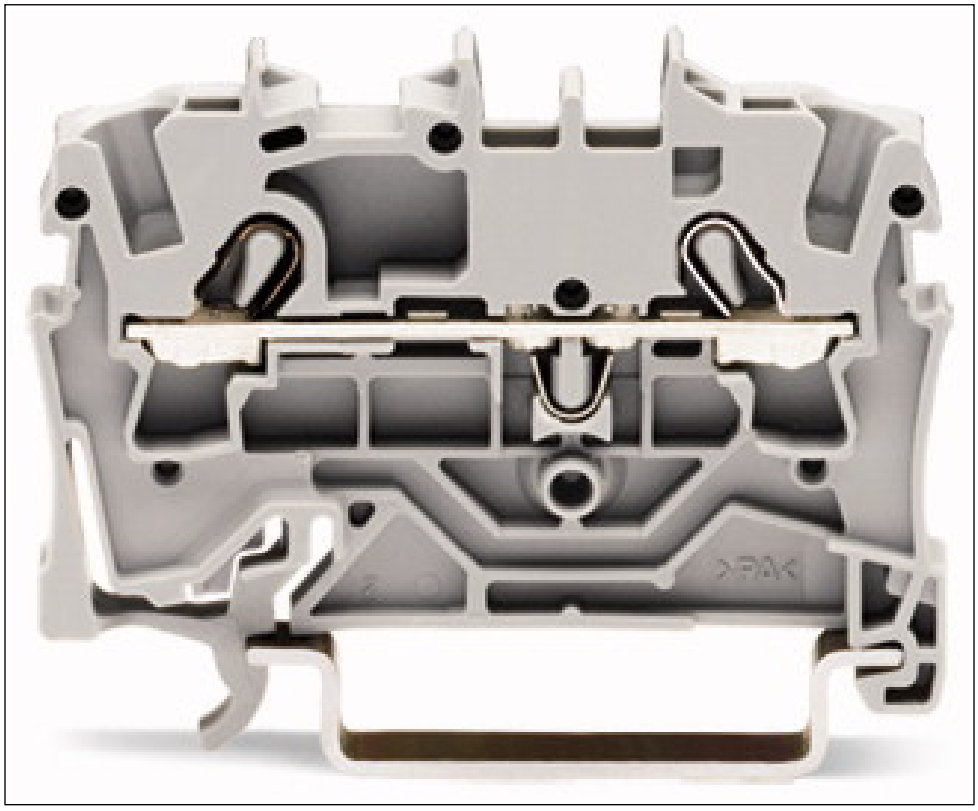
Technical data

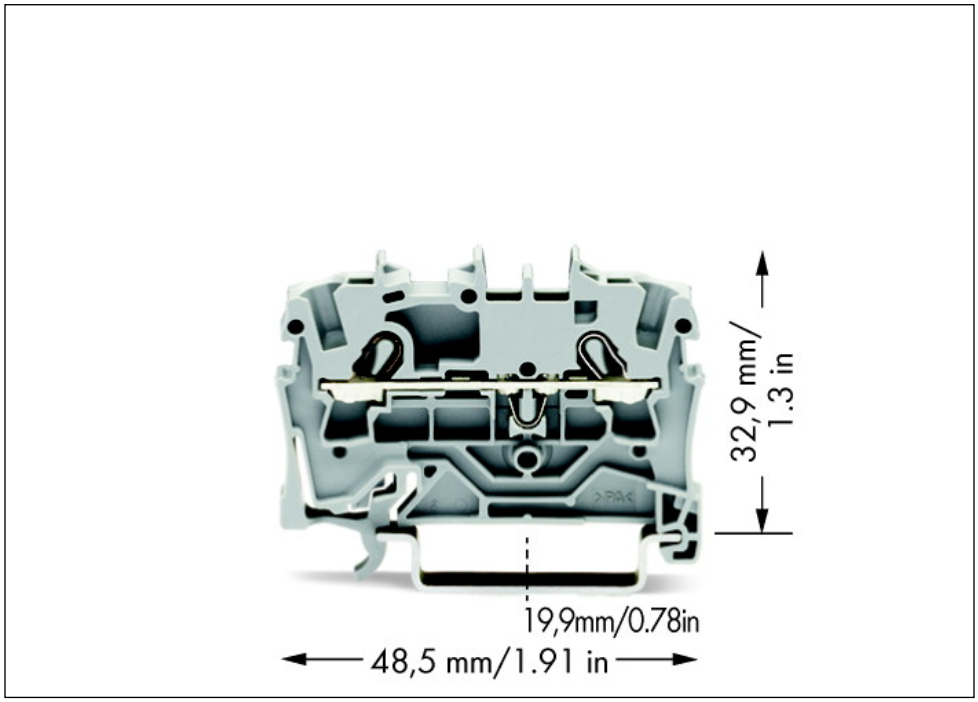
Miscellaneous

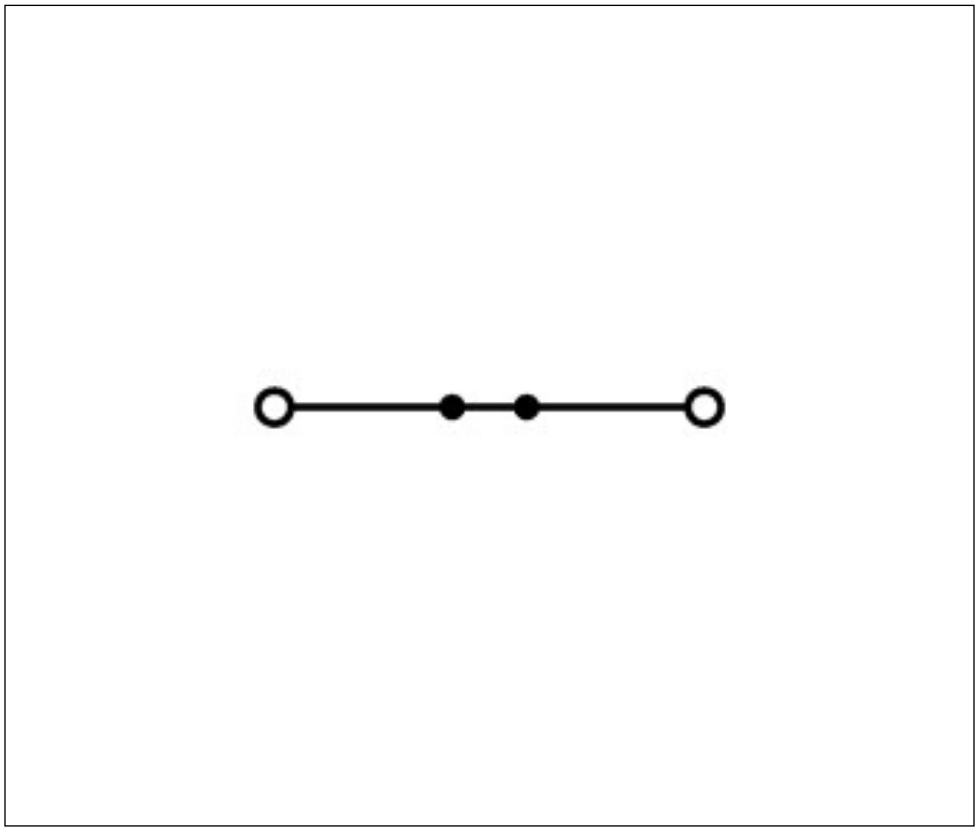
Total number of connection points	*2*
Total number of potentials	*1*
Color	*gray*
Ratings according to 1	*IEC/EN 60947-7-1*
Pollution degree (1)	*3*
Rated voltage EN (1) [V]	*800 [V]*
Rated surge voltage (1) [kV]	*8 [kV]*
Nominal current [A]	*24 [A]*
Nominal current (2) [A]	*32 [A]*
Rated voltage EN (Ex e II) [V]	*550 [V]*

Technical data	
Nominal current (Ex e II) [A]	*22 [A]*
Nominal current (Ex e II) with jumper [A]	*20 [A]*
Connection technology (1)	*Push-in CAGE CLAMP®*
Nominal cross section 1	*2.5 mm²*
Solid sizes 1	*0.25 … 4 mm² / 22 … 12 AWG*
solid, directly pluggable 1	*0.75 … 4 mm² / 18 … 12 AWG*
Fine-stranded wires 1	*0.25 … 4 mm² / 22 … 12 AWG*
min. fine-stranded with insulated ferrule, push-in terminati	*0.75 mm² / 18 AWG*
Strip length 1	*10 … 12 mm / 0.39 … 0.47 in*
Type of wiring	*Front-entry wiring*
Design	*horizontal*
Marking level	*Center/Side marking*
Insulating material	*Polyamide 66 (PA 66)*
Fire load [MJ]	*0.109 [MJ]*
Weight [g]	*5.079 [g]*
Width	*5.2 mm / 0.205 in*
Height from upper-edge of DIN-rail [mm]	*32.9 [mm]*
Height from upper-edge of DIN-rail	*32.9 mm / 1.295 in*
Length	*48.5 mm / 1.909 in*
Type of mounting	*DIN 35 rail*

Images & drawings







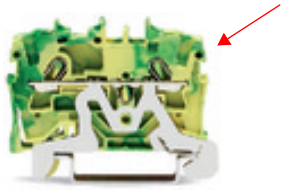
Address

WAGO Kontakttechnik GmbH & Co. KG
Hansastr. 27
32423 Minden
Telefon: 0571/887-0
Fax: 0571/887-169
http://www.wago.com

WAGO online catalog / eShop

2-conductor ground terminal block; suitable for Ex e II applications

Item No.: 2002-1207



2-conductor ground terminal block; suitable for Ex e II applications

Marking

RoHS ✓
Compliant

Business data

Supplier	*WAGO*
Item no.	*2002-1207*
GTIN / EAN	*4017332999212*
Content	*1*
Order amount	*100*
Customer item number	

Notes

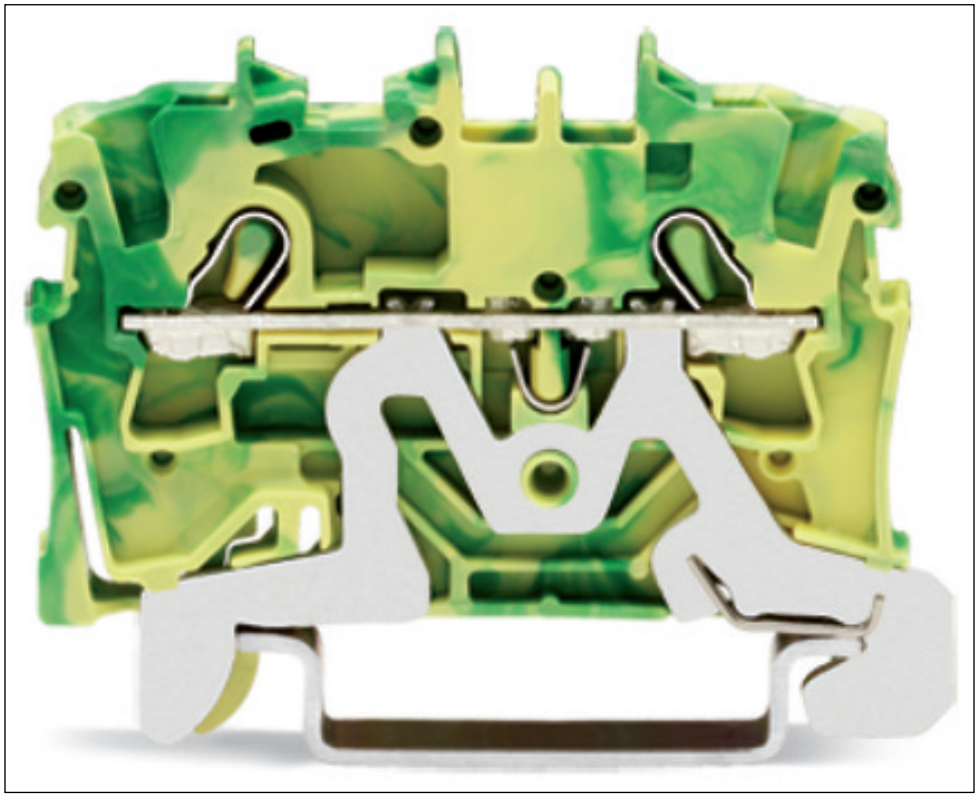
Technical data

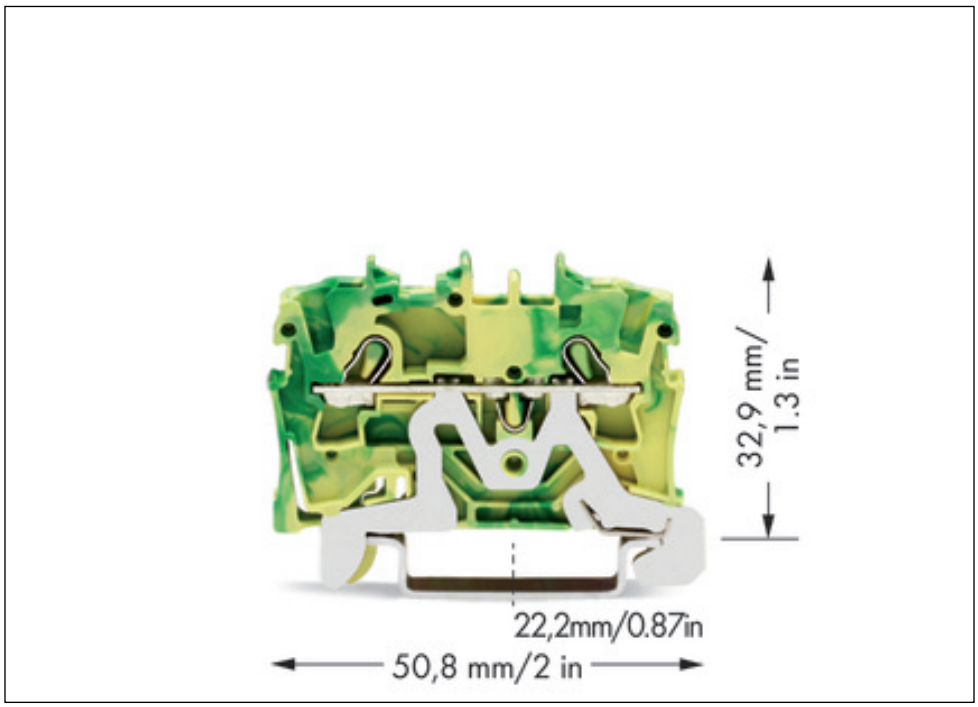
Miscellaneous

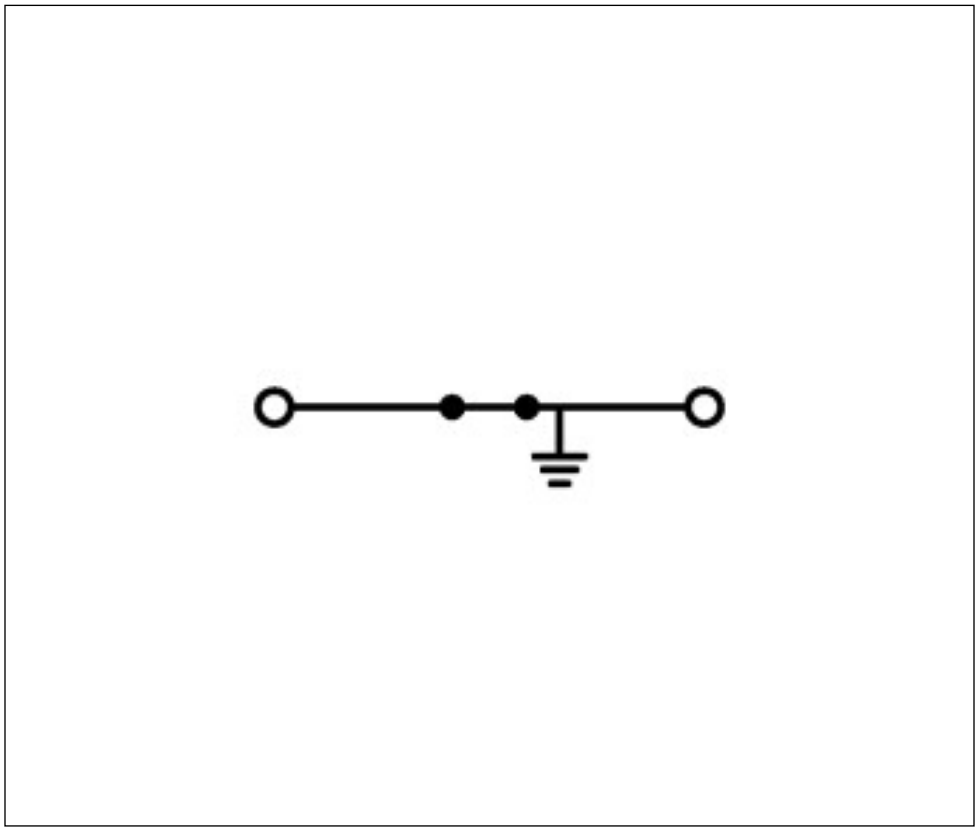
Total number of connection points	*2*
Total number of potentials	*1*
Color	*green-yellow*
Ratings according to 1	*IEC/EN 60947-7-2*
Connection technology (1)	*Push-in CAGE CLAMP®*
Nominal cross section 1	*2.5 mm²*
Solid sizes 1	*0.25 … 4 mm² / 22 … 12 AWG*
solid, directly pluggable 1	*0.75 … 4 mm² / 18 … 12 AWG*
Fine-stranded wires 1	*0.25 … 4 mm² / 22 … 12 AWG*
min. fine-stranded with insulated ferrule, push-in terminati	*0.75 mm² / 18 AWG*

Technical data	
Strip length 1	*10 … 12 mm / 0.39 … 0.47 in*
Type of wiring	*Front-entry wiring*
Design	*horizontal*
Marking level	*Center/Side marking*
Insulating material	*Polyamide 66 (PA 66)*
Fire load [MJ]	*0.087 [MJ]*
Weight [g]	*7.706 [g]*
Width	*5.2 mm / 0.205 in*
Height from upper-edge of DIN-rail [mm]	*32.9 [mm]*
Height from upper-edge of DIN-rail	*32.9 mm / 1.295 in*
Length	*50.8 mm / 2 in*
Type of mounting	*DIN 35 rail*

Images & drawings







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