MERLIN NX

IP AND MS/TP VAV CONTROLLER

INSTALLATION INSTRUCTIONS

CENTRA LINE by Honeywell

GENERAL

Trademark Information

Sylk™ is a trademark of Honeywell International Inc.
BACnet® is a registered trademark of ASHRAE Inc

Product Description

The CLMEVAxxxx24NM IP and MSTP VAV controller with integrated actuator and air flow sensor are a part of the MERLIN NX family.

The MERLIN NX family of room controllers offers performance-based engineering with ARENA NX (Niagara eXtended) and enables Single-Tool-Engineering throughout the whole Building Management System and allowing cost-effective installation and commissioning and driving new levels of functionality and efficiency in today's buildings.

These scalable and freely programmable BACnet/IP and BACnet MS/TP based unitary controllers utilize smart engineering and commissioning tools. It supports multiple flexible configurations to address specific applications with ARENA NX (Niagara) tool, Modbus, and Sylk™ bus sub-bus integration options.

Table 1. ordering part number

Part Number	UIO	SSR	Sum IO	Backbone Comm.	DIP switch	BLE integrated
CLMEVA75I24NM	7	5	12	IP	No	No
CLMEVA00IB24NM	0	0	0	IP	No	Yes
CLMEVA75IB24NM	7	5	12	IP	No	Yes
CLMEVA75M24NM	7	5	12	MS/TP	Yes	No
CLMEVA00MB24NM	0	0	0	MS/TP	Yes	Yes
CLMEVA75MB24NM	7	5	12	MS/TP	Yes	Yes

Table 2. Replacement Parts

Part Number	Comments
SDPPF500PA	Spare part used in case, original air flow sensor gets damaged.
ANT-REM	Use the remote antenna if the antenna mounted on the controller does not provide reliable communication due to environmental conditions. The packet contains four antennas.

Table 3. Mobile Application

Honeywell Connect Mobile application	Honeywell Connect Mobile application for the VAV balancing can be downloaded from the Google Play Store / Apple App store.

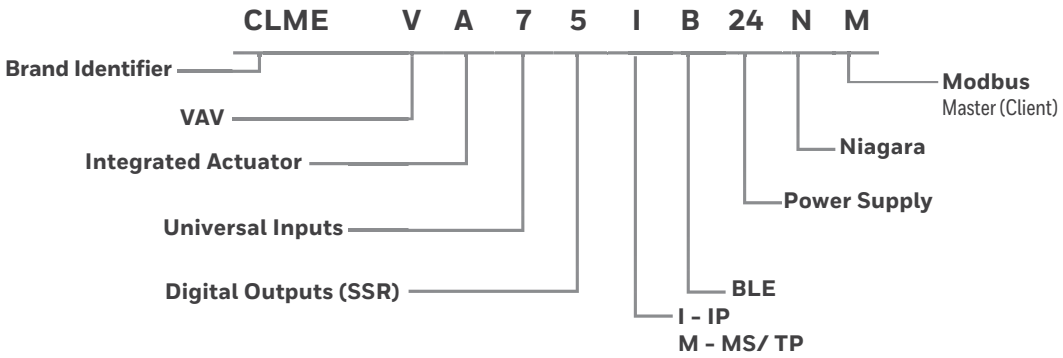


Fig. 1. Controller Part Numbers Description

Dimension

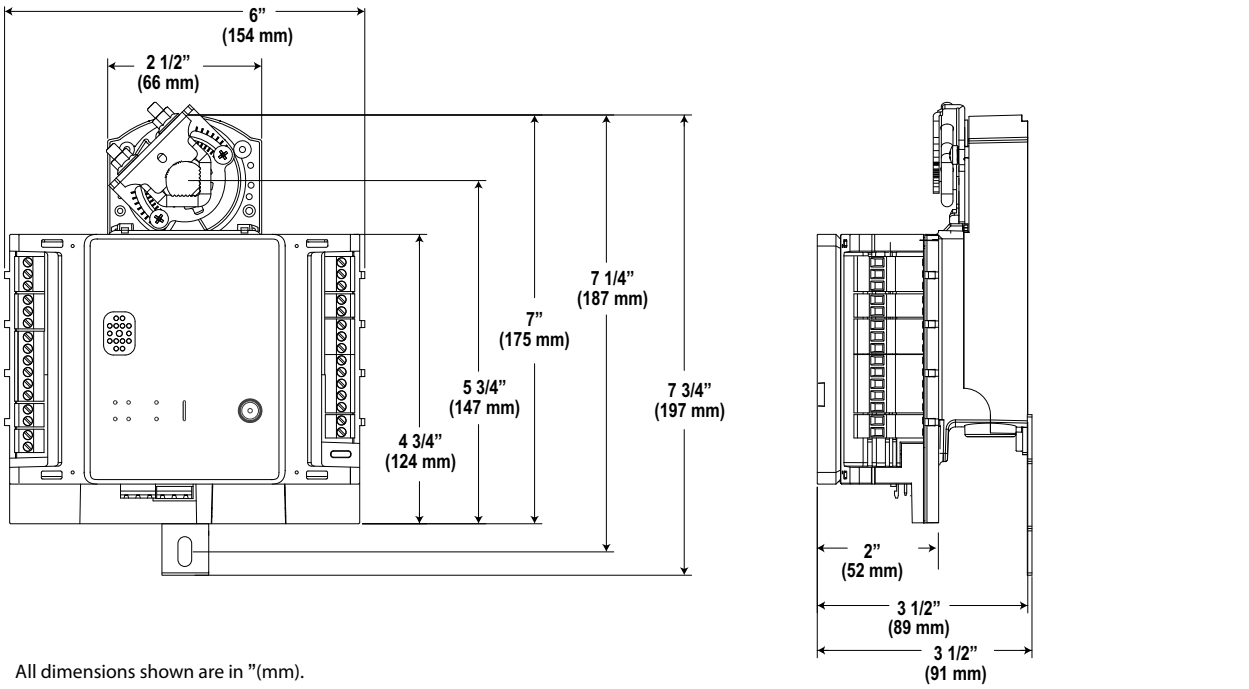


Fig. 2. Dimensions

NETWORK SECURITY

WARNING

CentraLine hereby expressly states that the MERLIN NX IP and MSTP VAV controllers are not inherently protected against cyber-attacks from the Internet and that, it is therefore intended solely for use in private, protected networks.

Unprotected Internet connections can expose the MERLIN NX IP and MSTP VAV controller to cyber-attacks from third-parties who can then damage it and connected facility components or cause them to malfunction or misuse it for illegal purposes for which the operator may then be held liable. When directly connected to the Internet, the MERLIN NX IP and MSTP VAV controllers automatically become a potential target for cyber-attacks.

To ensure a safe and reliable operation, take necessary protective measures, such as locating BMS controls behind a firewall and using a VPN connection for remote maintenance. Numerous third-party manufacturers offer suitable VPN routers.

If it is necessary for the MERLIN NX IP and MSTP VAV controllers to be accessible from the Internet (e.g., to perform remote maintenance), a coded VPN connection is indispensable. Suitable VPN routers are available from numerous third-party manufacturers in various designs for operation at 230 V or 24 V.

GENERAL SAFETY INSTRUCTIONS

While performing any work (installation, mounting, startup), follow all instructions provided by the manufacturer and the safety instructions provided in this document.

— The MERLIN NX IP and MSTP VAV controllers must be installed and mounted by authorized and trained personnel.

— If the unit is modified in any way, except by the manufacturer, all warranties concerning operation and safety become invalid.

— Make sure that applicable local standards and regulations are always observed.

— Use only CentraLine supplied or approved accessories.

— Before dismantling the system, disconnect the power supply by either removing the power terminal block from the controller or using local isolation. Read the following caution note carefully.

CAUTION

You must disconnect the power before installing, removing, or replacing the MERLIN NX IP and MSTP VAV controllers.

Switch off the power before you install any jumpers.

SPECIFICATIONS

Electrical

Parameter	Specification
Rated input voltage	20 - 30 VAC; Class 2 transformer
Nominal Power Consumption	**IP model:** 6.24 VA; controller and actuator load (nothing connected to IO and COM) **MSTP model:** 7.68 VA; controller and actuator load (nothing connected to IO and COM)
Full Load Power Consumption	**IP model:** 30 VA; maximum load including external loads, Sylk™, communication, BLE, universal IO, and 20 VDC output (excluding the load on the solid state relays). **MSTP model:** 22 VA; maximum load including external loads, Sylk™, communication, BLE, universal IO output, and 20 VDC output (excluding the load on the solid state relays). If the solid state relays are used, user needs to determine the full load power consumption (or VA rating) as per the below example. Example for a transformer load (VA); if there is an addition of parallel load from two solid state relays with 24 VAC @ 1.5 A: Total transformer load on a fully loaded controller will be 30 VA + 72 VA = 102 VA.
Frequency Range	50 to 60 Hz
Auxiliary Output	20 VDC @ 75 mA

Operational Environment

Parameter	Specification
Storage Temperature	-40 °C to 66 °C (-40 °F to 150 °F)
Operation	0 °C to 50 °C (32 °F to 122 °F)
Humidity	5 % to 95 % RH, non-condensing
Protection	IP20, NEMA -1
Pollution	Level 2

Sylk™ Supported Devices

Parameter	Specification
Wall Modules Sensors	CLCMTR40, CLCMTR40-H, CLCMTR40-H-CO2, CLCMTR40-CO2, CLCMTR42, CLCMTR42-H, CLCMTR42-H-CO2, CLCMTR42-CO2, CLCMTR71-H, CLCMTR120 (TR75E) and CLCMTR120-H (TR75-HE)

Hardware

Parameter	Specification
CPU	Crossover processor NXP I.MRT, Cortex M7
Memory Capacity	16 MB QSPI Flash, 16 MB SDRAM
Ethernet (IP Model only)	Two each RJ-45 Ethernet ports.
Real Time Clock	• 24-hour backup after power failure. • In case of power failure, the controller includes a super capacitor to retain the time set with the built-in real time clock for 24 hours. After 24 hours, the time will reset to the factory default time until the user performs a BACnet Time Sync.
Small LED	Transmission or reception of BACnet and Modbus communication signal (green)
Large LED	Controller status such as normal operation, firmware download, broken sensor, e.g. green, yellow or red

Integrated Actuator

Parameter	Specification
Torque	44 in-lbs (5 Nm)
Run Time	• Floating 108 s at 50 Hz • Floating 90 s at 60 Hz
Mounting Shaft	• Round 5/16 – 5/8 in (8 - 16 mm) • Square 1/4 – 1/2 in (6 -13 mm)
Shaft Length	≥ 1 5/8 in (41 mm)
Position feedback via integrated potentiometer • Periodic synchronization not required. • Additional diagnostic, for example, the command to change the actuator position does not provide a corresponding sensor reading — actuator stuck or potentiometer damaged.	

Differential Pressure Sensor

Parameter	Specification
Range	±2.0 H_2O (±500 Pa), bi-directional
Accuracy	±3 % of full range
Field replaceable differential pressure sensor.	

BACnet Communications

Parameter	Specification
Protocol supported	BACnet IP, BACnet MSTP, Sylk™, Modbus RTU (Modbus client only), and BLE.
Ethernet Connection Speed	10/100 Mbps
Internet Protocol Version	IPv4
IP Addressing Modes	• Dynamic: DHCP and Link Local • Static
Sylk™ bus	2-wire, polarity-insensitive
Bluetooth	BLE for using mobile balancing application.

Modbus Client

Parameter	Specification
Physical Layer	2-wire serial line (TIA/EIA-485) (with additional common).
Communication rates	9.6, 19.2, 38.4, 57.6, and 76.8 kb/s supported.
Maximum numbers of devices	32, It is recommended to connect a smaller number of devices for better Modbus performance.
Cable and wiring specifications	See *TIA/EIA 485 Cable Specifications on page 19*.
Communication Mode	Modbus client only.
Transmission Mode	RTU (Remote Terminal Unit).
Address Range	Modbus clients can have an address between 1 and 247. Discrete inputs, coils, input registers, and holding registers can have an address between 1 and 65534.

Weight And Dimensions

Parameter	Specification
Dimension (L x W x H)	175.2 x 154.3 x 90.2 mm(7 x 6 x 3 1/2 in.)
Weight	1.5 Kg (3.06 lb)
Mounting	Fixation with bracket and shaft

Universal IO

Parameter	Specification
AO (Analog output)	**Voltage:** 0(2) to 10 VDC direct or reverse with -3 mA to 20 mA **Current:** 0(4) to 20 mA
UI (Universal input)	**Voltage input**: 0(2) to 10 VDC direct or reverse. **Current input**: 0(4) to 20 mA **Sensors**: 10k NTC TYPE II, NTC10K3, 10K3A1, 20k NTC, PT100, PT1000, NI1000 TK5000, Nickel Class B DIN 43760, PT3000, 100 Ohm to 100k Ohm resistive (custom characteristic). **Hardwired wall sensors**: Set point, fan speed, occupancy override. Dry contact binary input with direct or reverse voltage. All UI can be used for pulse input. Maximum frequency 100 Hz, Minimum duty cycle (50 % / 50 %) 5 ms ON / 5 ms OFF.
The MERLIN VAV controller has a single common terminal for every two UIOs, which protects them against 24 VAC mis-wiring and short circuits.	

Solid State Relay (SSR)

Specification
Solid state relays switches supply voltage and works with 24 ± 20% VAC and 41 VDC. VDC switching does not support synchronous motor. • 1.5 A constant; 3.5 A inrush for 0.1 sec. per SSR output • Optional jumper between 24 VAC supply and SSR input shared by all SSRs.

Wireless Connectivity

Parameter	Specification
Connectivity	Bluetooth
Frequency range	2400 MHz - 2483.5 MHz
E.I.R.P for CE (Effective Isotropic Radiated Power)	20 mW
E.I.R.P for FCC/IC (Effective Isotropic Radiated Power)	20 mW

Standards and Compliances

CE, UL916 Energy Management Equipment, UL60730, FCC Part 15; Class A verified, EN 55022; Class A, EN 61000-3-2, 61000

HARDWARE OVERVIEW

IP Variant

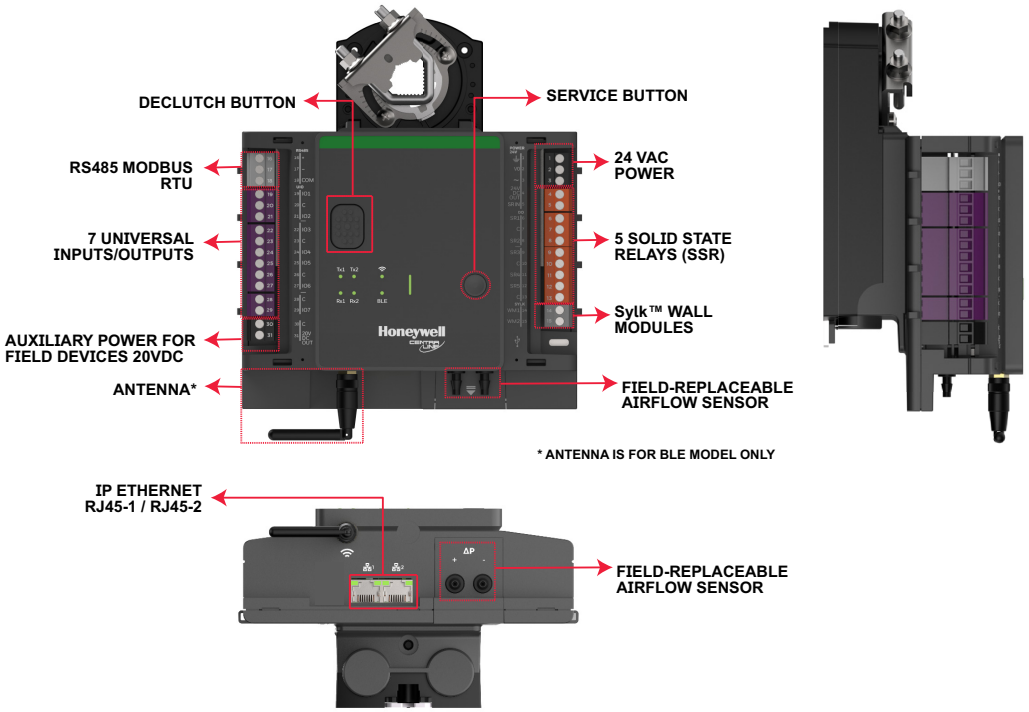


Fig. 3. IP Model Hardware Overview

MS/TP Variant

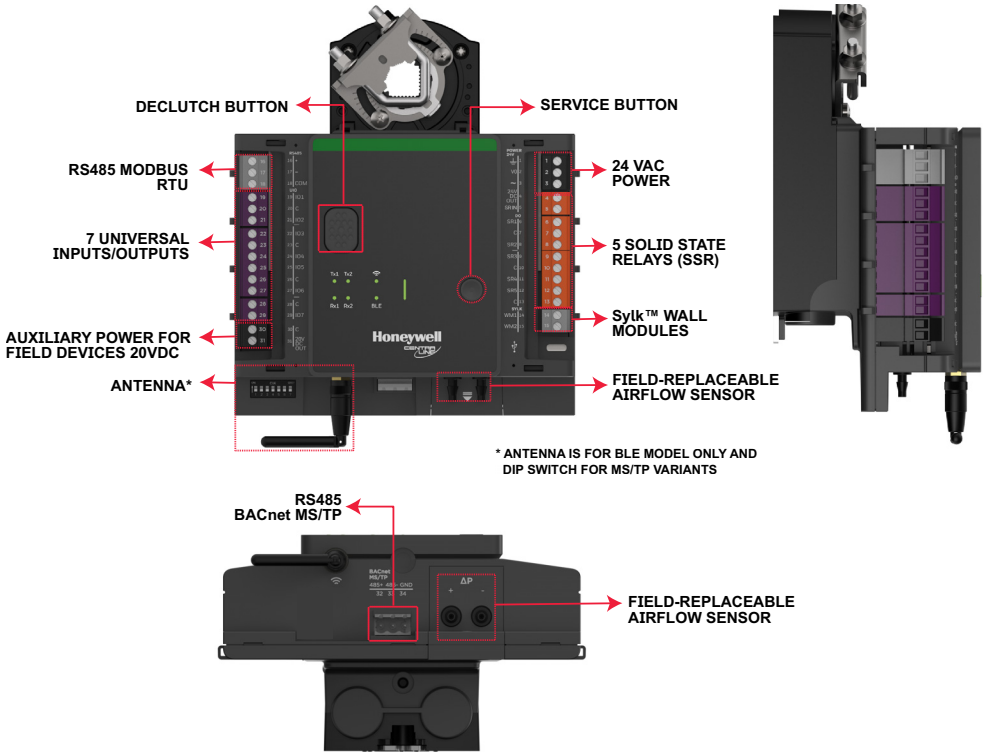


Fig. 4. MSTP Model Hardware Overview

Controller Terminals

Type	Legend	Printing	Description
Power	1	⏚	Earth Ground (Connected to power earth ground)
	2	V0	Ground
	3	~	Power supply voltage (Connected to 24VAC~)
	4	AC OUT	24VAC~ output
	5	SR IN	SSR POWER input (Connected to terminal 4 (AC OUT) by a jumper wire)
SSR	6	SR1	SSR1 output (if SSR1 is on this pin should be 24VAC~)
	7	C	Ground
	8	SR2	SSR2 output (if SSR2 is on this pin should be 24VAC~)
	9	SR3	SSR3 output (if SSR3 is on this pin should be 24VAC~)
	10	C	Ground
	11	SR4	SSR4 output (if SSR4 is on this pin should be 24VAC~)
	12	SR5	SSR5 output (if SSR5 is on this pin should be 24VAC~)
	13	C	Ground
SYLK	14	WM1	Interface for Sylk™ bus
	15	WM2	Interface for Sylk™ bus
RS 485	16	+	RS 485 Modbus interface
	17	-	RS 485 Modbus interface
	18	COM	Ground
UIO	19	IO1	Universal signal input/output1 (Input<"0-20mA" "0-10V" "NTC10K" NTC20K" "RTD" >; Output<"0-10V" "0-20mA">
	20	C	Ground
	21	IO2	Universal signal input/output2 (Input<"0-20mA" "0-10V" "NTC10K" NTC20K" "RTD" >; Output<"0-10V" "0-20mA">
	22	IO3	Universal signal input/output3 (Input<"0-20mA" "0-10V" "NTC10K" NTC20K" "RTD" >; Output<"0-10V" "0-20mA">
	23	C	Ground
	24	IO4	Universal signal input/output4 (Input<"0-20mA" "0-10V" "NTC10K" NTC20K" "RTD" >; Output<"0-10V" "0-20mA">
	25	IO5	Universal signal input/output5 (Input<"0-20mA" "0-10V" "NTC10K" NTC20K" "RTD" >; Output<"0-10V" "0-20mA">
	26	C	Ground (Connected to 24VAC~ground)/System ground
	27	IO6	Universal signal input/output6 (Input<"0-20mA" "0-10V" "NTC10K" NTC20K" "RTD" >; Output<"0-10V" "0-20mA">
	28	C	Ground
	29	IO7	Universal signal input/output7 (Input<"0-20mA" "0-10V" "NTC10K" NTC20K" "RTD" >; Output<"0-10V" "0-20mA">
20 VDC	30	C	Ground
	31	20 VDC OUT	20VDC power output
BACnet MS/TP	32[a]	+	Signal for RS 485 bus +
	33[a]	-	Signal for RS 485 bus -
	34[a]	COM	Ground
		1 2	IP ethernet RJ45-1/RJ45-2[b]

[a] Terminal 32,33, and 34 are available in MSTP variant only.
[b] Terminal for IP variant only.

Service Button

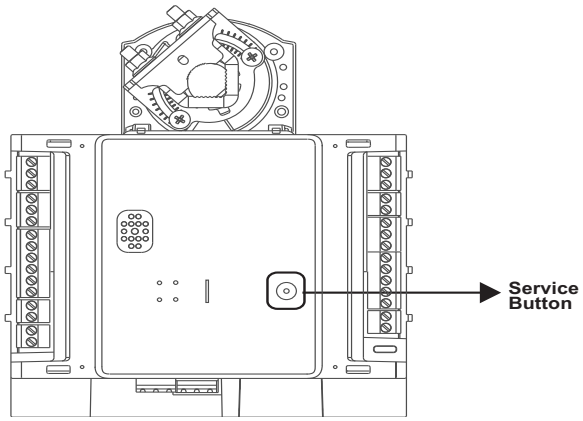


Fig. 5. Service Button

The service button is used to trigger dedicated events. It is important to distinguish different controller behaviors elicited depending upon whether the service button is pressed when the controller is powering up or when it is in normal operation.

See the following dedicated events:

Pressing Service Button during Power-Up

If the service pin is pressed and the controller is switched on (while the service pin is still pressed), a reset to factory delivery is performed.

- The application is cleared from the controller.
- The MAC address will be set to 0xFF, meaning that the controller will now search for a new mac address (Auto-MAC will be automatically triggered after controller power-up).
- The maxMaster setting will revert to its default value (*See "AutoMAC limitation:" on page 24.* for default values).
- The Max info frames will revert to 10.
- The device instance will revert to its default of 4194302.
- The device name will revert to CLMEVA[ModelName].
- The values of Auto MAC, Min MAC and Max MAC will be reset to default (*See "AutoMAC limitation:" on page 24.* for default values).
- The Modbus, Ethernet, and BLE settings will revert to their factory settings. The user settings for Modbus and BLE will be erased, the IP address will be reset to default, and the device will enter DHCP IP configuration.

Pressing Service Button during Normal Operation

During normal operation of the controller, a short press (< 1 sec) of the Service Button will cause a Service Pin Message (BACnet WhoAmI as a Private Transfer (SerialNo. = 130)) to be sent. This can be used in tools to verify devices (Tool can do a ranking of multiple service pin messages received).

MOUNTING

To mount the MERLIN NX IP and MSTP VAV controllers, refer to the mounting instructions provided with the controller.

Before mounting the controller on the damper shaft, review the power, inputs, and output specifications. *See "Specifications" on page 4.*

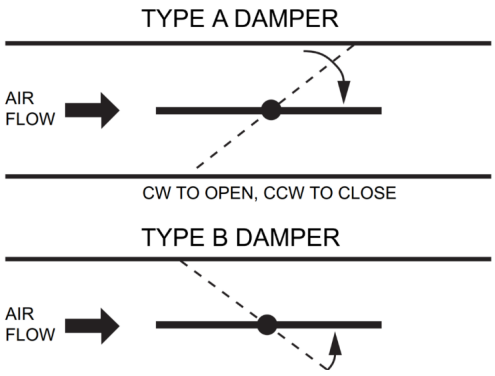
Hardware driven by the analog current outputs must have a maximum resistance of 550 Ohms.

NOTE:
Avoid mounting in areas where acid fumes or other deteriorating vapors can harm the metal parts of the controller or in areas where escaping gas or other explosive vapors are present.

Before Mounting Actuator onto the Damper Shaft

MERLIN NX IP and MSTP VAV controller include a direct-coupled actuator with Declutch mechanism, which is shipped hard-wired to the controller.

1. Determine the direction in which the damper shaft rotates to open the damper. Typically, there is an etched line on the end of the damper shaft that indicates the position of the damper.



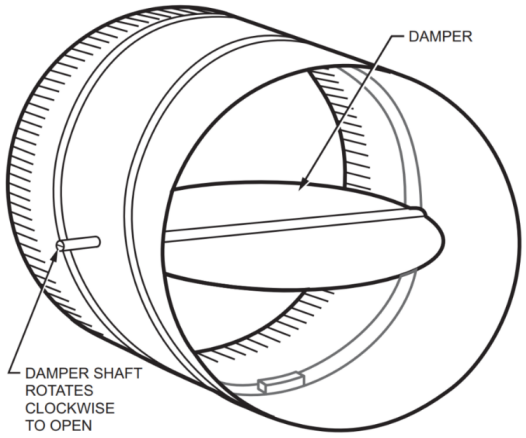


Fig. 7. Damper with 90 degree CW rotation to open

NOTE:
Mount the actuator flush with damper housing or add a spacer between the actuator mounting surface and damper box housing.

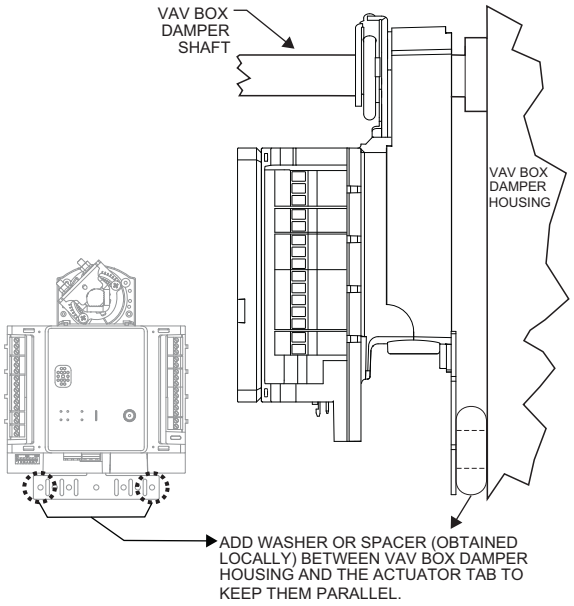


Fig. 8. Mounting Controller to VAV box damper housing when actuator is not parallel to VAV box damper housing

2. Determine the damper 'full opening angle' (45, 60, or 90 degrees). In *Fig. 7* the damper is open to its fully open position of 90 degrees.

Mounting Actuator onto Damper Shaft

MERLIN NX IP and MSTP VAV controllers can be mounted in any orientation. However, ensure that they are mounted in a position that allows clearance for wiring, servicing, removal, connection of the BACnet connector, and access to the service button.

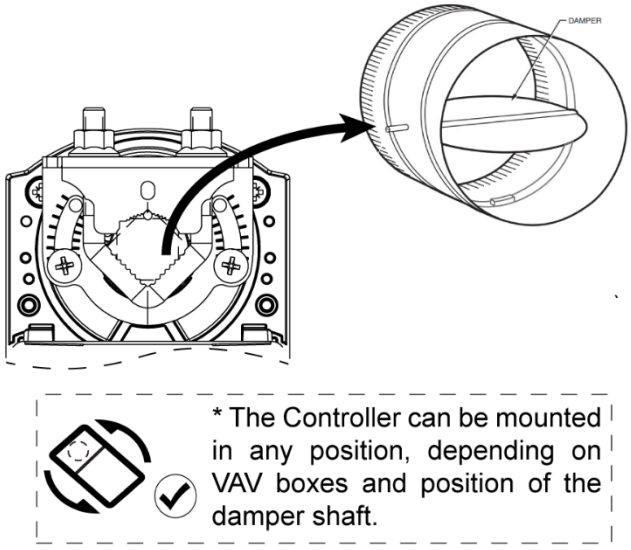


Fig. 9. Mounting Actuator on Damper Shaft

NOTE:
The controller is not position sensitive and can be mounted sideways or upside down. Use the drilling template provided in box.

The MERLIN NX IP and MSTP VAV controller's integral actuator does not float inside the housing therefore it should be installed with a floating mount to allow for non-concentric travel, which can occur with a damper shaft that are out-of-round and/or have asymmetrical damper shaft mounts.

If the actuator does not allow any wobble, it is likely to bind. To prevent this, when installing the MERLIN NX IP and MSTP VAV controllers, install it over the damper shaft and then slide the anti-rotation bracket underneath and into the mounting slot but not at the very end of the slot (leave a little wiggle room).

Screw the anti-rotation bracket using two screws on the sides of the controller. The anti-rotation bracket is designed to be bent as needed (it has built-in bend-it-easy slots) to accommodate difficult installation locations.

Tools Required:

- Phillips #2 screwdriver for end-limit set screw adjustment
- 8 mm wrench for centering clamp

The actuator mounts directly onto the VAV box damper shaft and has up to 44 in-lb. (5 Nm) torque, 90-degree stroke, and 108 second timing at 50 Hz and 90 second timing at 60 Hz.

The actuator is shipped with two mechanical end limit set screws to control the amount of rotation from 12° to 95°. These set screws must be securely fastened in place. To ensure tight closing of the damper, the shaft adapter has a total rotation stroke of 95°.

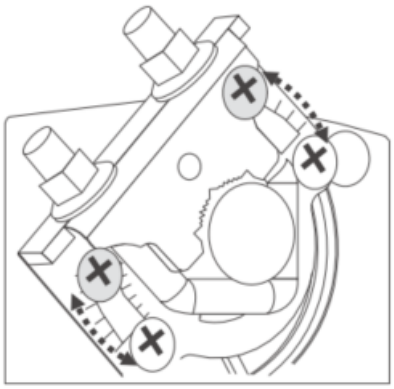


Fig. 10. Setting the mechanical end limits

NOTE: The actuator is shipped with the mechanical end-limit set screws set to 95° of rotation.
Adjust the two set screws closer together to reduce the rotation travel. Each “hash mark” indicator on the bracket represents approximately 6.5° of rotation per side.

The Declutch button, when pressed, allows you to rotate the universal shaft adapter.

The unit is shipped with the actuator set to rotate open in the clockwise (CW) direction to a full 95°. The extra 5° ensures a full opening range for a 90º damper. The installation procedure varies depending on the damper opening direction and angle:

1. **If the damper rotates clockwise (CW) to open, and the angle of the damper open-to-closed is 90°:**
   a. Manually open the damper fully (rotate clockwise).
   b. Using the Declutch button, rotate the universal shaft adapter fully clockwise.
   c. Mount the actuator to the VAV damper box and shaft.
   d. Tighten the two bolts on the centering clamp (8 mm wrench; 70 lb.-in. [8 Nm] torque). When the actuator closes, the damper rotates CCW 90 degrees to fully close.

2. **If the damper rotates clockwise (CW) to open, and the angle of the damper open-to-closed is 45 or 60 degrees:**
   a. Manually open the damper fully (rotate clockwise).
   b. The actuator is shipped with the mechanical end limits set at 95 degrees. Adjust the two mechanical end-limit set screws to provide the desired amount of rotation. Adjust the two set screws closer together to reduce the rotation travel.
   c. Tighten the two mechanical end-limit screws (Phillips #2 screwdriver; (26.5-31 lb.-in. [3.0-3.5 Nm] torque).
   d. Using the Declutch button, rotate the universal shaft adapter fully clockwise.
   e. Mount the actuator to the VAV damper box and shaft.
   f. Tighten the two bolts on the centering clamp (8 mm wrench; 70 lb. in. [8-10 Nm] torque).
   g. When the actuator closes, the damper rotates CCW either 45 or 60 degrees to fully close.

3. **If the damper rotates counterclockwise (CCW) to open, and the angle of the damper open-to-closed is 90 degrees:**
   a. Manually open the damper fully (rotate counterclockwise).
   b. Using the Declutch button, rotate the universal shaft adapter fully counterclockwise.
   c. Mount the actuator to the damper box and shaft.
   d. Tighten the two bolts on the centering clamp (8 mm wrench; 70 lb.-in. [8Nm] torque). When the actuator closes, the damper rotates CW 90 degrees to fully close.

4. **If the damper rotates counterclockwise (CCW) to open, and the angle of the damper open-to-closed is 45 or 60 degrees:**
   a. Manually open the damper fully (rotate counterclockwise).
   b. The actuator is shipped with the mechanical end limits set at 95 degrees. Adjust the two mechanical end-limit set screws to provide the desired amount of rotation. Adjust the two set screws closer together to reduce the rotation travel.
   c. Tighten the two mechanical end-limit screws (Phillips #2 screwdriver; (26.5-31 lb.-in. [3.0-3.5 Nm] torque).
   d. Using the Declutch button, rotate the universal shaft adapter fully counter-clockwise.
   e. Mount the actuator to the VAV damper box and shaft.
   f. Tighten the two bolts on the centering clamp (8 mm wrench; 70 lb.-in. [8Nm] torque).
   g. When the actuator closes, the damper rotates CW either 45 or 60 degrees to fully close.

Airflow Sensor Connection

Connect the air flow pickup to the two restrictor ports on the controller.

NOTE:
Use 1/4 in. (6 mm Outside diameter and 5 mm inner diameter), with a 3/64 in. (1 mm) wall thickness, plenum-rated 1219 FR (94V-2) tubing.

You should always use a fresh cut on the end of the tubing that connects to the air flow pickups and the restrictor ports on the controller. Secure the connection using a zip tie (procured locally).

When twin tubing is used from the pickup, split the pickup tubing a short length to accommodate the connections.

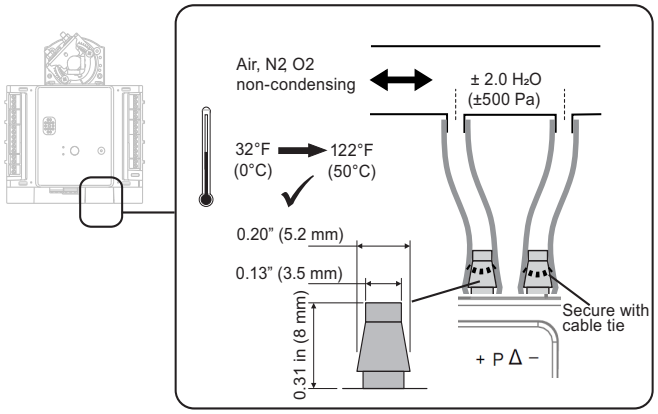


Fig. 11. Airflow pickup connections

Differential Pressure Installation

NOTE: The controller must be powered up for a minimum of 1 hour before performing the zero calibration for the air flow sensor.

If controllers are mounted in unusually dusty or dirty environments, an in-line, 5-micron disposable air filter (use 5-micron filters compatible with pneumatic controls) is recommended for the high-pressure line connected to the air flow pickup.

The tubing from the air flow pickup to the controller should not exceed three feet (1 m). Any length greater than this will degrade the flow sensing accuracy.

Use caution when removing tubing from a connector. Always pull straight away from the connector or use diagonal cutters to cut the edge of the tubing attached to the connector. Never remove by pulling at an angle.

NOTICE

Dust particle contamination may be present in some applications. Ensure appropriate measures are taken to minimize the effect of particulate contamination.

The sense element is in parallel to the air stream and tends to direct the dust particles in the airflow stream past the sense element away from the sense bridge. The sense element is a micro-structure-based device and the bridge portion of the sense element structure is made up of two platinum sense elements and a heater. The heater tends to repel dust particles via a thermophoretic effect past the heater and tends to keep most dust off the bridge structure. The heat affect, along with a simple filter, can help to keep the dust from causing output shifts in the output of the device. Although the sensor naturally repels dust, some dust and contamination can still collect on the micro-structure. Dust adherence to chip edges and channel surfaces can be prevented by using a simple filter. A disposable five micron filter used in series on the upstream side of the airflow divide will provide adequate filtering in most applications. See *Table 4, "Recommended Filter Suppliers," on page 11* below for recommended filter suppliers.

Table 4. Recommended Filter Suppliers

Pall Corporation www.pall.com	
Acro 50	The filter may be used at a common mode pressure of 0.17 MPa (24.6 psi) at a temperature of 80 °C [176 °F] May be used with swag lock compression fittings Approximate pressure drop is 5 kPA at 1 SLPM of flow.
Acro cap	May be used at an operating temperature of 55 °C [131 °F] and common mode pressure of 30 psi Sensors connections are1/4 barb fittings General Gas filter Pressure drop is 1 psi with a flow of 15 SLPM Fittings are 1/8 barbed tubing.
Parker Balston www.balstonfilters.com	
Model 9933-05	US and EMEA only sales offices. May be used at common mode pressures up to 125 psi and operating temperature to 135 °C [275] °F Sensor connections are 1/4 tube.
MAHLE: https://catalog.mahleaftermarket.com/eu/product.xhtml?eid=184	
MAHLE KL13	Automotive filter

Airflow Sensor Replacement

Procedure to replace the airflow sensor is as follows:

1. Gently pull the sensor cover outward and rotate it by 75 degree.

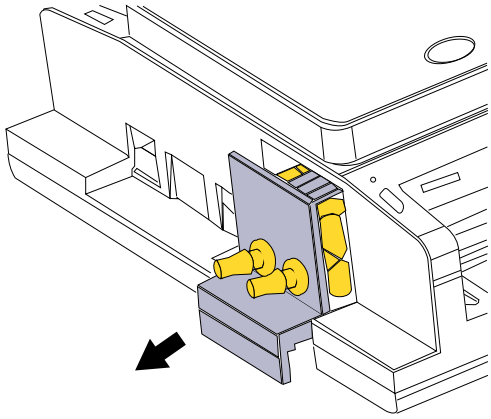


Fig. 12. Removing the sensor cover

2. Disconnect the electrical connector by gently pulling it away from the differential pressure sensor.
3. Replace the airflow sensor.

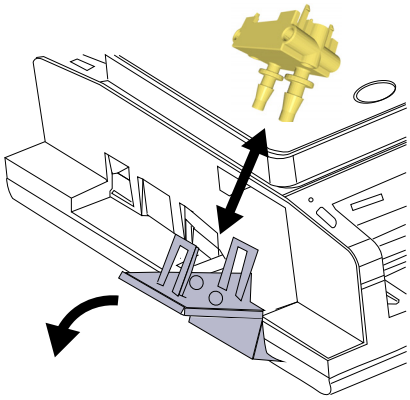


Fig. 13. Replace the sensor

4. Attach the electrical connector.

NOTE: Before closing the sensor cover, make sure to push the excess cable into the controller cavity. The sensor cover will not snap into the controller if the cable is not tucked correctly.

5. Close the cover.

POWER SUPPLY

General Information

To prevent a risk of injury due to electrical shock and/or damage to the device due to short-circuiting, low-voltage and high-voltage lines must be kept physically separate. To prevent a risk of short-circuiting and damage to your MERLIN controller, do not reverse the polarity of the power connection cables and avoid ground loops (connecting one field device to several controllers).

Before wiring the controller, determine the input and output device requirements for each controller used in the system. Select input and output devices compatible with the controller and the application. Consider the operating range, wiring requirements, and environmental conditions while selecting input and output devices.

Determine the location of controllers, sensors, actuators, and other input and output devices and create wiring diagrams for illustrations of typical controller wiring for various configurations.

The application engineer must review the control job requirements. This includes the sequences of operation for the controller and the system as a whole. Usually, some variables must be passed between the controllers that are required for optimum system-wide operation. Typical examples are the TOD, occupied, unoccupied, outdoor air temperature, demand limit control signal, and the smoke control mode signal. Understanding these interrelationships early in the job engineering process is vital for proper implementation while configuring the controllers.

NOTE:
All wiring must comply with applicable electrical codes and ordinances. Refer to job or manufacturers' drawings for details. Local wiring guidelines (for example, IEC 364-6-61 or VDE 0100) may take precedence over recommendations provided in these installation instructions.

To comply with CE requirements, devices having a voltage of 50-1000 VAC or 75-1500 VDC but lacking a supply cord, plug, or other means for disconnecting from the power supply must have the means of disconnection incorporated in the fixed wiring. This type of disconnection must have a contact separation of at least 1/8 in. (3 mm) at all poles.

Power Wiring

All wiring must comply with applicable electrical codes and ordinances, or as specified on installation wiring diagrams. Controller wiring is terminated to the screw terminal blocks located on the device.

NOTE:
For multiple controllers operating from a single transformer, the same side of the transformer secondary must be connected to the same power input terminal in each controller.

NOTE:
Power must be off prior to connecting or removing connections from the 24 VAC power (24 V~ / 24 V0), and 20 VDC power terminals.

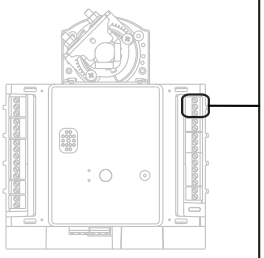
Use the heaviest gauge wire available, up to 18 AWG (1 mm2), with a minimum of 22 AWG (0.3 mm2), for all power wiring.

NOTE:
When connecting power, ensure that one leg of the 24 VAC secondary circuit and the grounded terminal on the device are connect to a known earth ground at the panel or enclosure. Limit the distance of the power wire run between the device and the transformer to 15 feet (4.5 meters and restricted for same room installation).

The transformer must be UL Listed for smoke control. The transformer also needs to be mounted and installed in an enclosure.

CAUTION
A single transformer can power more than one controller. *Fig. 14 on page 14* shows the power wiring details for multiple controllers. Controller and configuration are not necessarily limited to three devices, but the total power draw, including accessories, cannot exceed 100 VA when powered by the same transformer (the U.S. only).

Power Wiring Examples



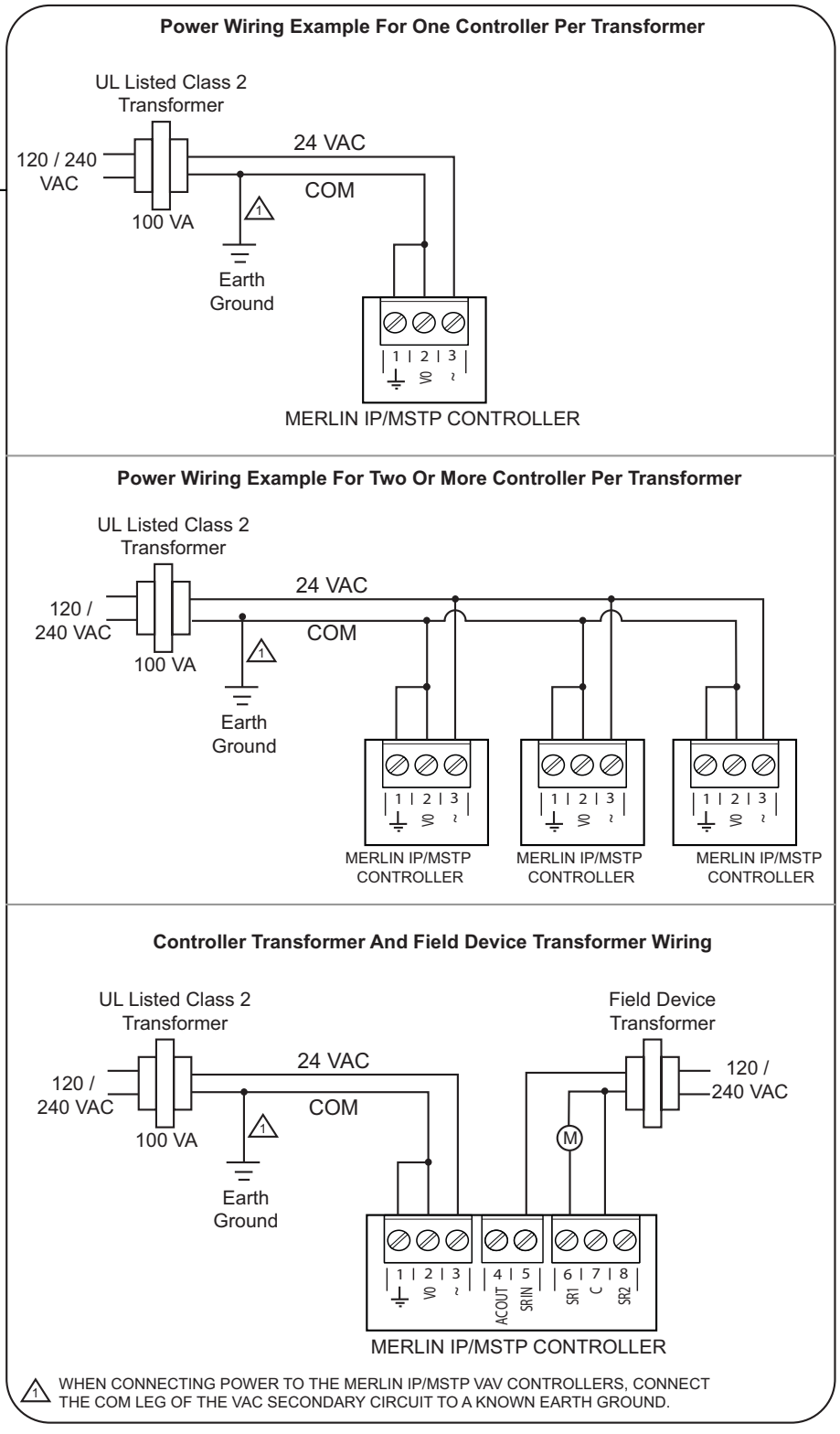


Fig. 14 Power Wiring Examples

INPUT / OUTPUT WIRING

Wiring Requirements

NOTE:
When attaching two or more wires to the same terminal, other than 14 AWG (2.0 mm2), be sure to twist them together. Deviation from this rule can result in improper electrical contact, see *Fig. 15* below.

Each terminal can accommodate the following gauge of wire:

- **Single wire**: From 22 AWG (0.3 mm2) to 18 AWG (1 mm2) solid or stranded
- **Multiple wires**: Up to two 18 AWG (1 mm2) stranded, with 1/4 watt wire-wound resistor
  - Prepare wiring for the terminal blocks, as follows:
  - Strip 1/2 in. (13 mm) insulation from the conductor.
  - Cut a single wire to 3/16 in. (5 mm). Insert the wire in the required terminal location and tighten the screw.
  - If two or more wires are being inserted into one terminal location, twist the wires together a minimum of three turns before inserting them, see *Fig. 15* below.
  - Cut the twisted end of the wires to 3/16 in. (5 mm) before inserting them into the terminal and tightening the screw.
  - Pull on each wire in all terminals to check for good mechanical connection.

NOTE:
Do not over-tighten the terminal screws to avoid deformation and damage of the terminal block. The maximum torque for the terminal screws 4.4 lb.-in. (0.5 Nm).

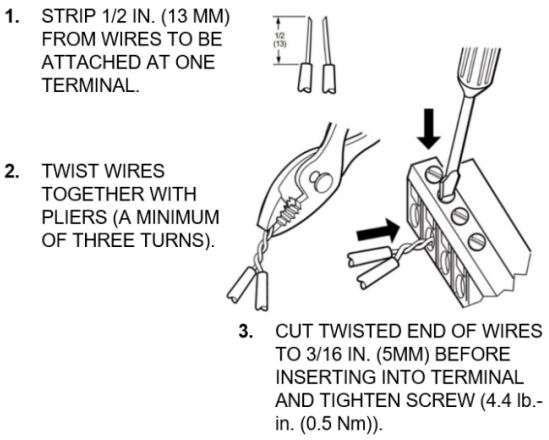


Fig. 15. Attaching two or more wires at terminal block

Internal Wiring Examples

IP MODEL INTERNAL WIRING

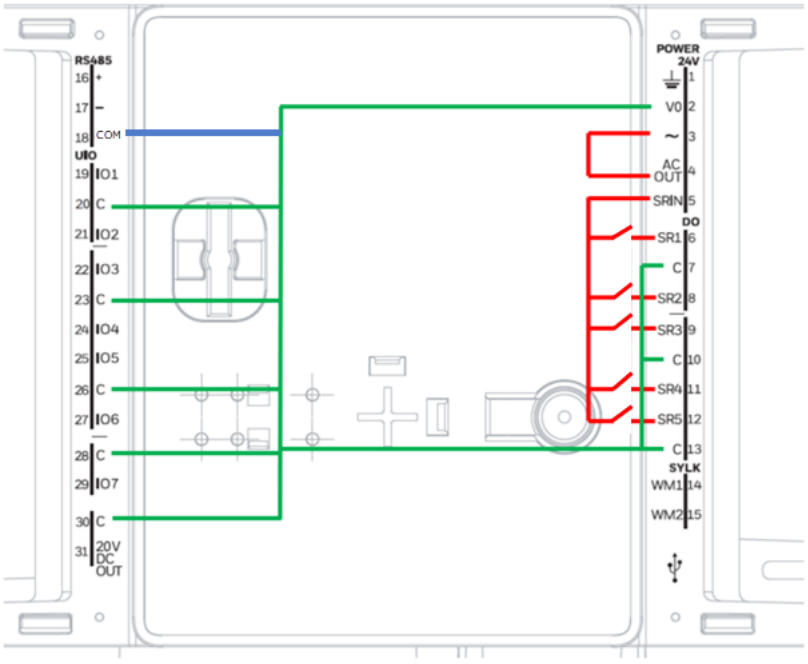


Fig. 16. IP Model Internal Wiring

MSTP MODEL INTERNAL WIRING

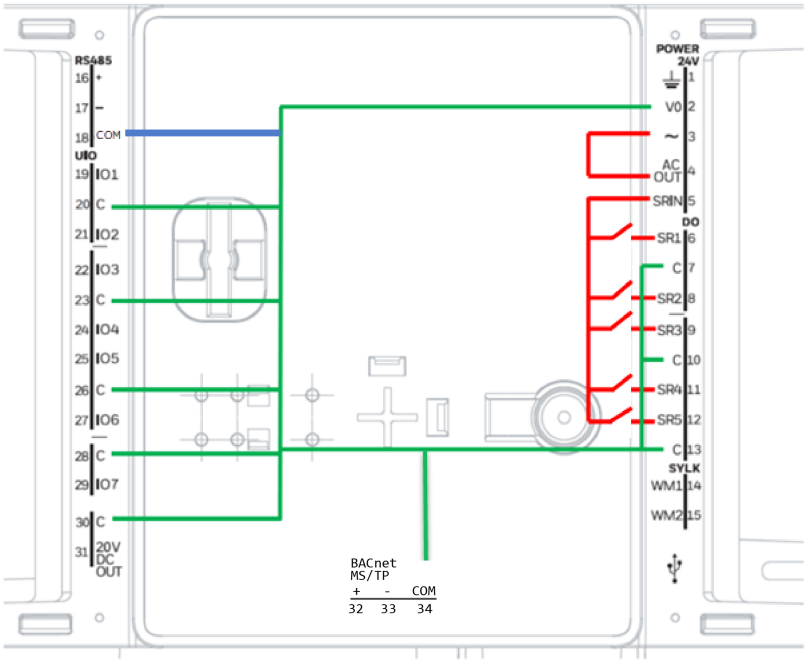


Fig. 17. MSTP Model Internal Wiring

UIO Wiring Examples

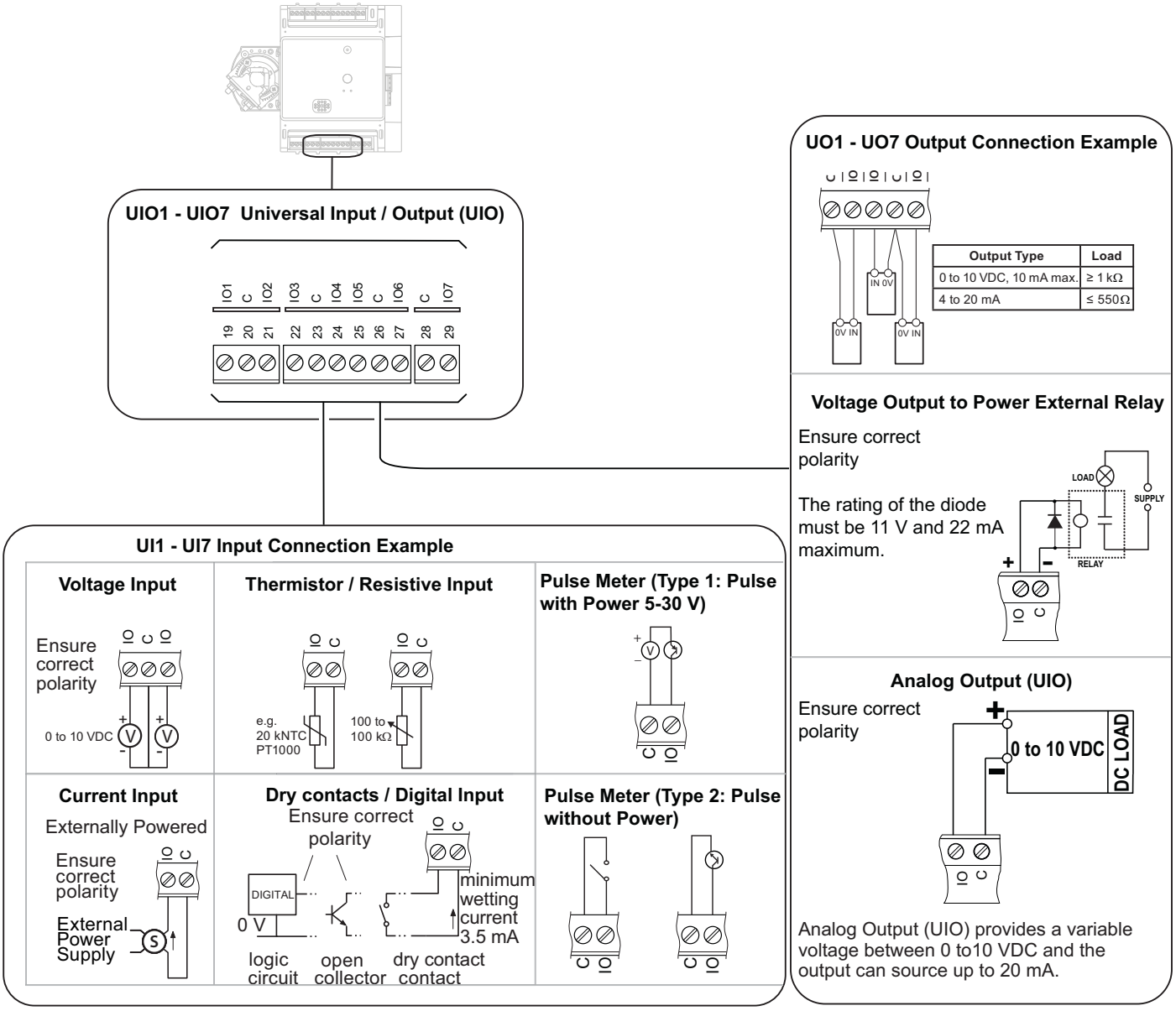


Fig. 18 Universal IO Wiring Examples

NOTE:
- The UL Standards recommends that all wiring connections for the IO, DO (SSR), 24 VAC, and 20 VDC circuits must be restricted to the same room.
- A protective diode is recommended in any circuit that allows the flow of current in the forward direction because the current will not flow in the reverse direction. The diode protects components sensitive to a flow of current in the wrong direction.

SSR (DO) Wiring Examples

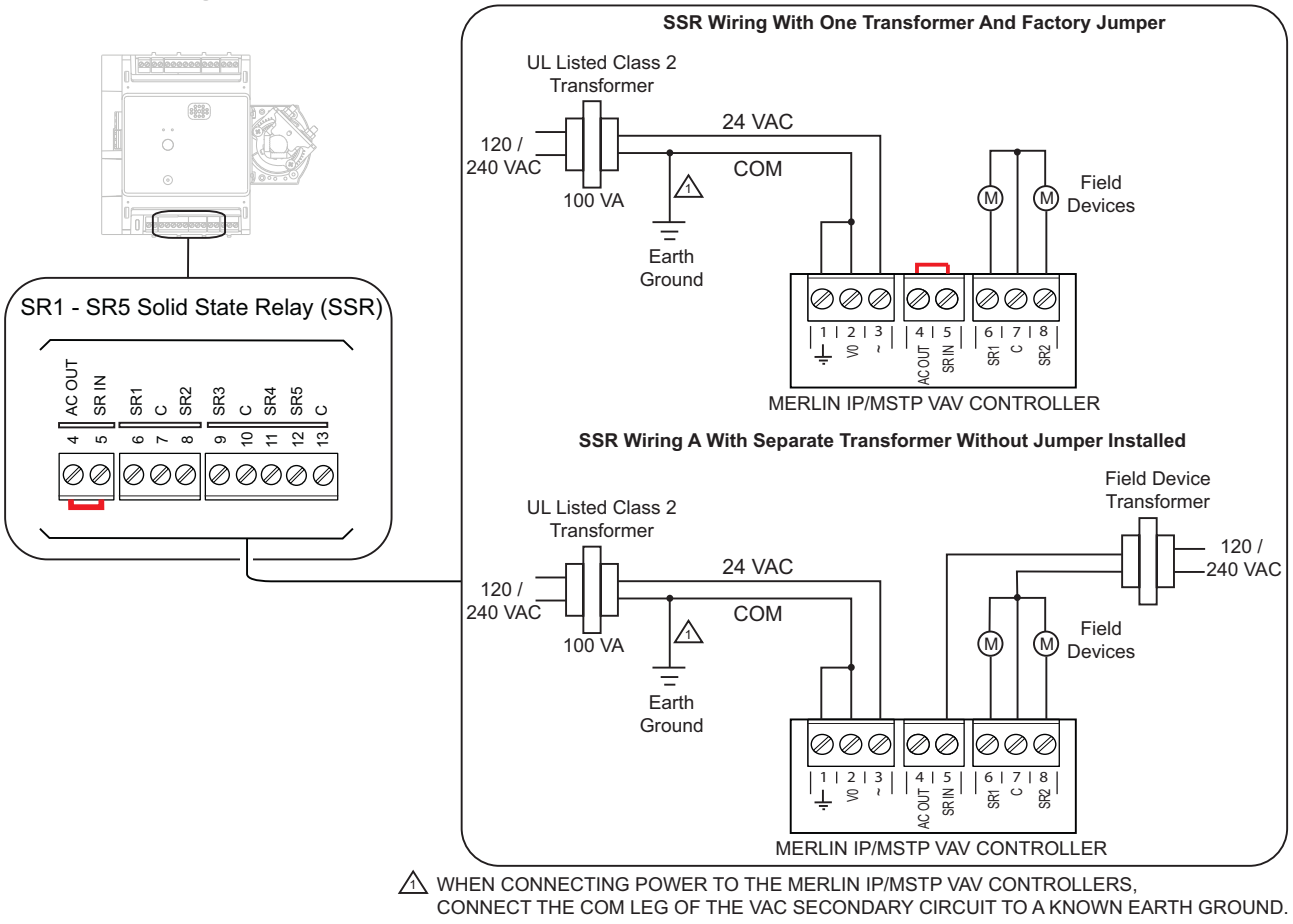


Fig. 19 SSR (DO) Wiring Examples

NOTE:
- SR IN (terminal 5, SSR power input) is connected to AC OUT (terminal 4, 24VAC~ output) by a jumper wire at factory.
- Remove the jumper if different voltages need to be used for SSRs.
- All terminals are protected against short circuit and 24VAC.

20 VDC Auxiliary Wiring Examples

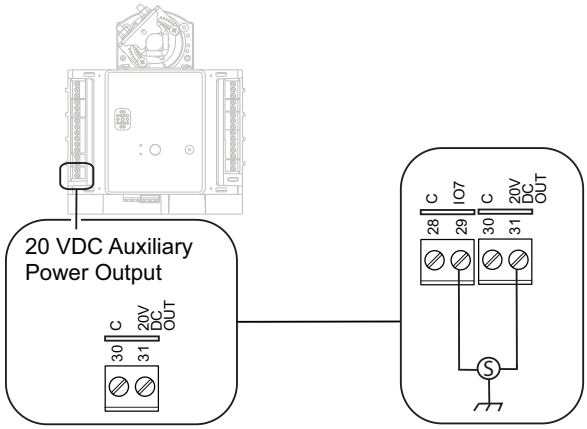


Fig. 20. 20 VDC Auxiliary Wiring

NETWORKING CONCEPTS

The RS485 Standard

According to the RS485 standard (TIA/EIA 485: “Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems”), only one driver communicating via an RS485 interface may transmit data at a time. Further, according to U.L. requirements, each RS485 interface may be loaded with a max. of 32 unit loads. For example, if a controller utilizes as little as 1/8 unit load each, up to 256 devices can be connected.

BACnet connections to the RS485 interfaces must comply with the RS485 standard. Thus, it is recommended that each end of every bus should be equipped with a termination resistor (not included in shipment) having a resistance equal to the cable impedance (120 Ω; the wattage should be in the range of 0.25 – 0.5 W).

RS485 systems frequently lack a separate signal ground wire. However, the laws of physics still require that a solid ground connection be provided in order to ensure error-free communication between drivers and receivers – unless all of the devices are electrically isolated, and no earth grounding exists.

NOTE:
A separate signal ground wire must be used. Failing to obey this requirement can lead to unpredictable behavior if other electrically non-isolated devices are connected and the potential difference is too high.

TIA/EIA 485 Cable Specifications

The following cable specification is valid for BACnet MS/TP EIA 485 buses.

Table 5. TIA/EIA 485 cable specifications

Maximum length	4000 ft (9.6–76.8 kbps)
Cable type	Twisted pair shielded (foil or braided shields are acceptable)
Characteristic impedance	100-130 Ω
Distributed capacitance between conductors	Less than 100 pF per meter (30 pF per foot)
Distributed cap. between conductors and shield	Less than 200 pF per meter (60 pF per foot)

The following cables fulfill this requirement:

— AWG 18 (1 mm2)
— Shielded, twisted pair cable J-Y-(St)-Y 4 x 2 x 0.8 mm2.
— CAT 5,6,7 cable - use only one single pair for one bus
— Belden 9842 or 9842NH.

Network Topologies

— Recommended cable: Cat5/Cat6
— Maximum distance between 2 controllers or controller and switch should be less than 328 ft. (100 meters)

Daisy Chain

In the daisy chain connection type, if any of the device in the network fails, the devices next to the failed device also fail.

Suppose there are 10 devices in a network, and device number 1 is the client, connected to device number 2, and device number 2 is connected to device number 3, and so on. If device 5 fails to function, device 6, 7, 8, 9, and 10 also fails to communicate with the client device.

Maximum number of controller that can be connected in a daisy chain is 100.

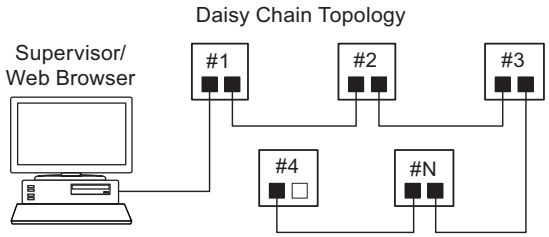


Fig. 21. Daisy chain topology

Spanning Tree Protocol (RSTP)

If the MERLIN NX IP VAV controllers are to be connected in a redundant ring, then you must have one spanning tree protocol supported Ethernet switch as a part of the ring. MERLIN NX IPVAV supports Ethernet switch for 10/100 Mbps IP connection.

The switch will connect MERLIN NX IP VAV ring with the backbone network.The loop-free topology ensures that there is no broadcast storms and duplicate frame transmission. Maximum number of controllers that can be connected in STP loop is 39. A switch manages the connection of a loop.

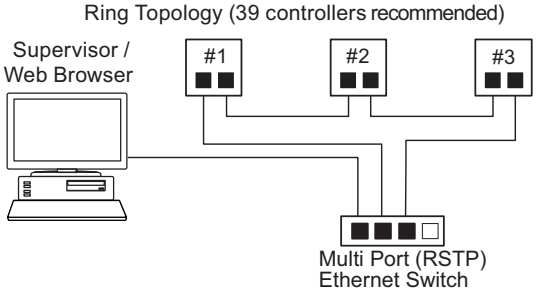


Fig. 22. RSTP wiring

BACNET IP

DHCP IP Configuration

A new, from the factory controller has DHCP enabled. For the first 15 seconds after powering the controller, a search for a DHCP server will be performed to acquire an IP address.

Link-local addressing

- If a DHCP server (switch) is not found, the controller will switch to Auto IP mode, in which it follows link-local addressing for address resolution.
- It will acquire an IP address in the range 169.254.1.0 - 169.254.254.254. The controller will use the last two characters of its serial number as the last octet for starting address search. For example, if the serial number ends with 36 (Conversion HexToDec = 54), the IP address is set to 169.254.1.54).
- If the controller has link-local addressing, the controller will periodically (every 1 minute) search for the DHCP server. If a server is found, the controller will acquire a new IP address from the server and start using it immediately.

NOTE:
From the firmware version 0.0.0.50 onwards, if a controller has the Link Local Addressing, it will periodically search for DHCP server (every 1 minute). If server is found, controller acquires the new IP address from server and start using it immediately.

Static IP Configuration

Static IP address can be configured using Niagara workbench.

1. Navigate to IP configuration under IP settings.
2. Select the IP address as **Static.**
3. Select **Enabled** as True.
4. Configure a valid **IP address**.

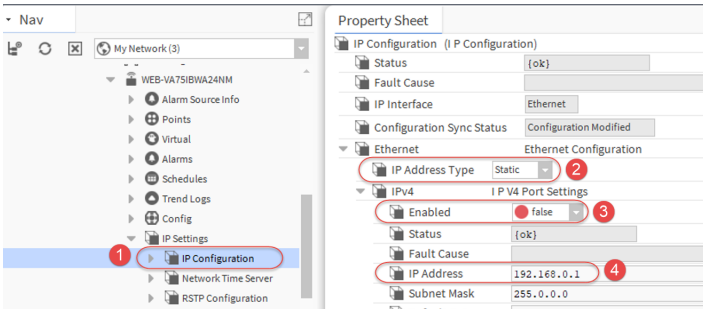


Fig. 23. Static IP Configuration

Refer *IRM Engineering Tool User Guide* for more information on how to do this.

Connect to a IP network

MERLIN NX BACnet IP VAV controller communicates over wired IPV4 network using Ethernet connection via one of two RJ45 ports.

ANTENNA

The MERLIN NX IP and MSTP VAV controllers have a local rubber antenna included in the packaging. If the MERLIN NX IP and MSTP VAV controllers are mounted inside a cabinet or enclosure, and you are using the local antenna, use an enclosure made of a non-metallic material to achieve a reliable wireless signal.
Replace the local antenna with the remote antenna when an extended range is needed or when the MERLIN NX IP and MSTP VAV controller is mounted in a metal cabinet or enclosure. The remote antenna has a cable that connects to the MERLIN NX IP and MSTP VAV controller, and the antenna is mounted outside the cabinet or closure. When the MERLIN NX IP and MSTP VAV controller is mounted inside a metal enclosure, the remote antenna helps achieve a strong wireless signal.

Installing the Local Antenna

1. Insert local antenna terminal nut into the SMA connector.
2. Tighten by turning the base of the antenna clockwise.

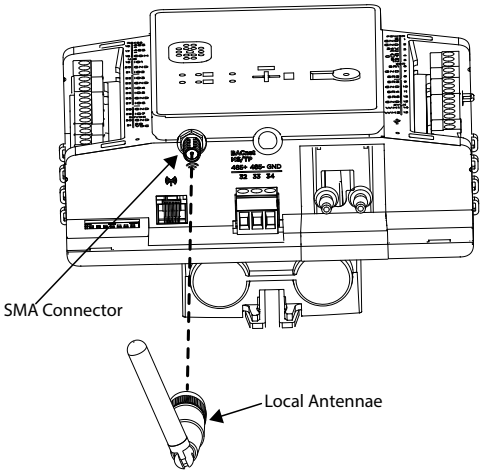


Fig. 24. Installing a Local Antenna

Installing the Remote Antenna

1. Uninstall the Local antenna by turning the base of the antenna counter-clockwise.
2. Place the Remote antenna where the signal reception is good.
3. Safely route the Remote antenna wire terminal nut to the MERLIN NX IP and MSTP VAVcontroller.
4. Insert the wire terminal nut into the SMA connector.
5. Tighten the wire terminal nut by turning the nut clockwise. Do not over-tighten.

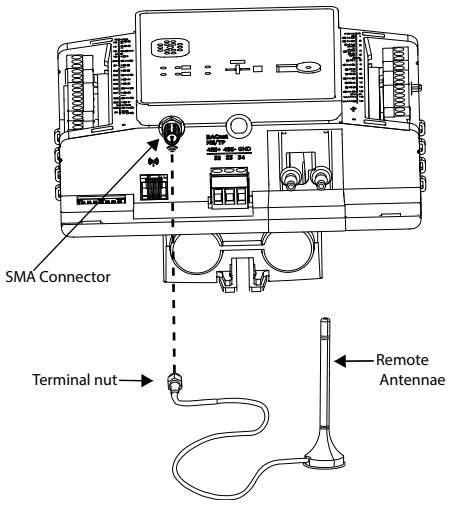


Fig. 25. Installing a Remote Antenna

Remote Antenna Placement

- Place and align the antenna in a way that the Wi-Fi signal does not interfere with many obstacles.

Table 6. types of building materials and range reduction

Wall Material	Range Reduction
Wood, drywall, glass	0-10%
Brick, Particle board	5-25%
metal, steel-reinforced concrete wall	10-90%

- Make sure that the antenna is installed perpendicular to the surface for a good Wi-Fi signal.
- The antenna has a strong signal transmission and reception from the side. See figure below. Position the sides of the antenna towards the device it is communicating with (e.g WiFi Node).

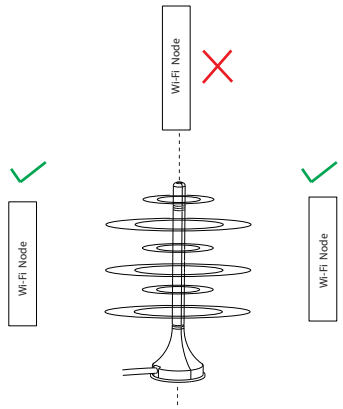


Fig. 26. Remote Antennae Placement

- Do not install the antenna close to the floor.

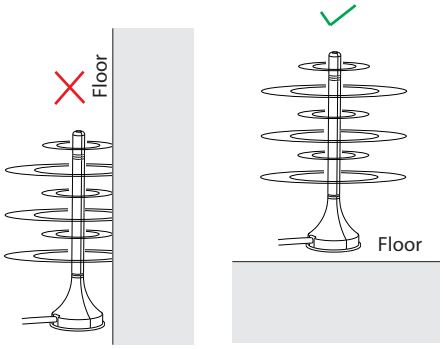


Fig. 27. Remote Antennae Placement

- Keep the antenna away from devices that cause wireless interference such as other Wi-Fi network and telecommunications equipment.
- The Local antenna can be used when the IP and MSTP VAV controller is installed in a plastic cabinet/enclosure.

BACNET MS/TP VARIANT

Each MERLIN NX IP and MSTP VAV controller uses the BACnet MSTP communications. The controller's data is presented to other controllers over a twisted-pair MSTP network, using the TIA/EIA 485 signaling standard capable of the following baud rates: 9.6, 19.2, 38.4, 57.6, and 76.8 kb/s. The MERLIN NX BACnet MSTP controllers are server devices on the MSTP network. Each MERLIN NX BACnet controller uses a high-quality TIA/EIA 485 transceiver and exerts 1/8 unit load on the MSTP network.

According to U.L. requirements, each RS-485 interface may be loaded with a maximum of 32 unit loads. Depending on the actual performance and connection speed, connecting fewer BACnet MSTP devices per network is recommended. It is recommended to have less than 62 controllers on a single MSTP network.

The controller features a 2-wire non-isolated RS-485 interface (terminals 32, 33, and 34) suitable for BACnet MSTP communication. The terminal block containing it is gray. The cable length affects the baud rate. See *Table 7* below.

Table 7. Baud rate vs. Maximum cable length

Baud rate	Maximum cable length (L)
9.6, 19.2, 38.4, 57.6, and 76.8 kbps	4000 ft (1200 m)

NOTE:
The maximum BACnet MS/TP network Bus segment length is 4,000 ft. (1200 m) using recommended wiring. Repeaters must be used when making runs longer than 4,000 ft. (1200 m). A maximum of three repeaters can be used between any two devices.

Termination Resistors

Matched terminating resistors are required at each end of a segment bus wired across (+) and (-). Use matched precision resistors rated ¼ W ±1 % / 80 = 130 Ω.

Ideally, the value of the terminating resistors should match the rated characteristic impedance of the installed cable. For example, if the installed MSTP cable has a listed characteristic impedance of 120 Ω, install a 120 Ω resistor.

RS-485 Bias Switches

Each RS-485 port has an adjacent 3-position biasing switch, with these settings:

- BIA - (Default, middle) Controller provides RS-485 biasing, but without a termination resistor.
- END - Both RS-485 biasing and a termination resistor are provided by the controller.
- MID - No RS-485 biasing or termination resistor is provided by the controller.

Often, adding RS-485 biasing can improve communications by eliminating indeterminate idle states.

BACnet MSTP Wiring Example

Following proper MSTP cabling shield grounding procedures is important to minimize the risk of communication problems and equipment damage caused by capacitive coupling. Capacitive coupling is caused by placing MSTP cabling close to lines carrying higher voltage.

The shield should be grounded on only one end of the MSTP segment, for example, on the earth ground terminal on the HAWK 8000 and to earth ground.

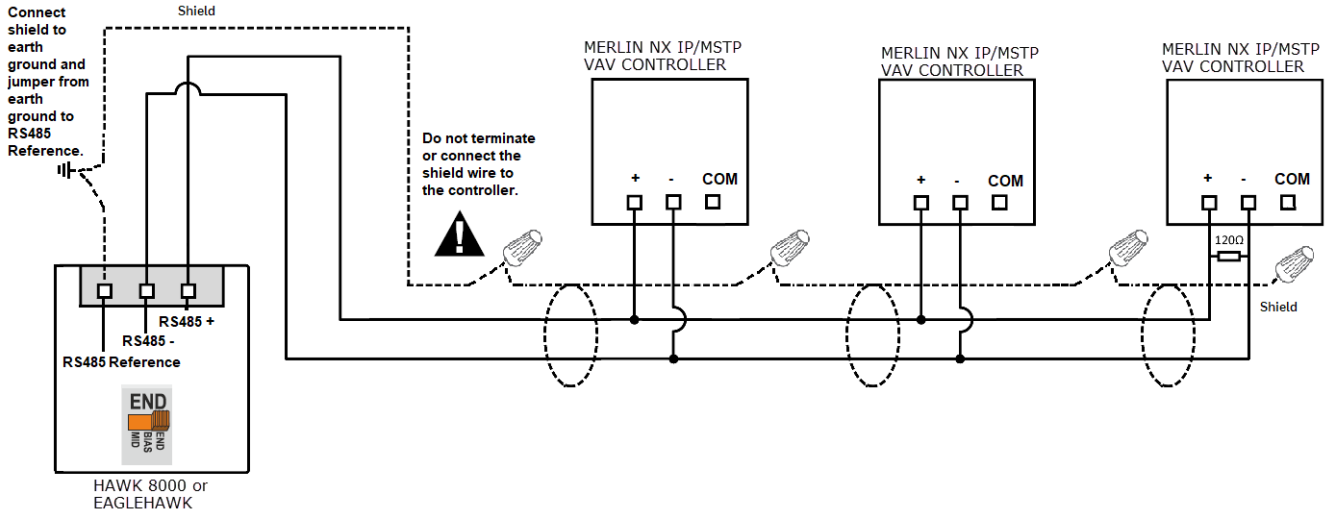


Fig. 28. BACnet MSTP Wiring Example with WEB-8000 or CIPer Model 50

BACNET MSTP CONTROLLER

Automatic MAC Addressing

In contrast to other controllers, the MERLIN NX MSTP controllers feature automatic MAC addressing.

NOTE:
Automatic MAC addressing will be enabled only if dip switches are all-on or all-off.

The MAC addresses are not assigned in sequential order. Controllers are assigned MAC addresses that are not already in use by another BACnet MSTP device in the range of Min MAC to Max MAC.

In the scenario depicted in *Fig. 29*, some of the controllers in the BACnet MSTP network do not feature automatic MAC addressing; therefore, their MAC addresses are assigned manually. Thus, when a new MERLIN NX BACnet MSTP VAV is added to the network and its automatic MAC addressing function is triggered, it will assign itself an available (unused) MAC address within the range of Min MAC and Max MAC values.

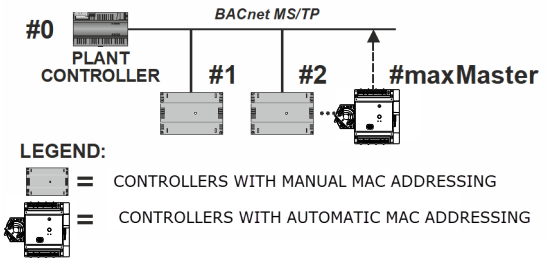


Fig. 29. Automatic MAC addressing

All MERLIN NX MSTP VAV controllers are BACnet MSTP clients. Every client performs periodic polling for the possible appearance of new clients. Each client knows the identity of the next client on the BACnet MSTP bus and to which it must pass the token. The polling process includes searching for new clients with MAC addresses lying between their own MAC address and that of the next client.

The property maxMaster specifies the highest-allowable address for master nodes. The maxMaster is set to 64 by default, thus guaranteeing that, on a BACnet MS/TP bus with, for example, 35 BACnet MSTP VAV controllers, all of the other BACnet MSTP VAV controllers will be found. Following properties are writable and can be changed:

- maxMaster
- min MAC
- max MAC
- MAC address

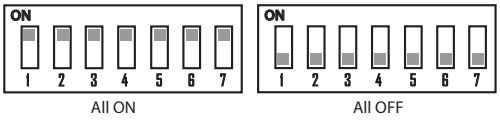
Default maxmaster	Default MinMAC	Default MaxMAC	Default Baud rate
64	1	60	38400

NOTE:
You should not attempt to program a MAC Address outside the range of min MAC and max MAC (1 to 64)

Manual configuration of the MAC Address

The MS/TP MAC address for each device must be set to a unique value in the range of 1-64 on an MS/TP network segment (address 0, 1, 2, & 3 should be avoided as they are commonly used for the router, diagnostic tools, and as spare addresses). A seven position DIP switch on the MERLIN NX MS/TP BACnet controller is used to set the controller's MAC address.

NOTE:
DIP setting of all-ON or all-OFF will enable the Auto MAC mode in controller and the dip switches will not be used for MAC addressing. *See "Automatic MAC Addressing" on page 24.*



To set the MS/TP MAC address of a MERLIN NX BACnet MSTP VAV controller:

1. Find an unused MAC address on the MS/TP network to which the MERLIN NX MS/TP VAV controller connects.
2. Locate the DIP switch bank on the MERLIN NX MS/TP VAV controller BACnet for addressing.
3. Powered off the MERLIN NX MS/TP BACnet Controller and set the DIP switches for the MAC Address you want. Add the value of DIP switches set to ON to determine the MAC address. See *Table 8, "DIP Switch Values For MS/TP MAC Address," on page 24* below.

Table 8. DIP Switch Values For MS/TP MAC Address

DIP	1	2	3	4	5	6	7
VALUE	1	2	4	8	16	32	64

For example, if only DIP switches 1, 3, 5, and 7 are enabled the MAC address would be 85 (1 + 4 + 16 + 64 = 85).

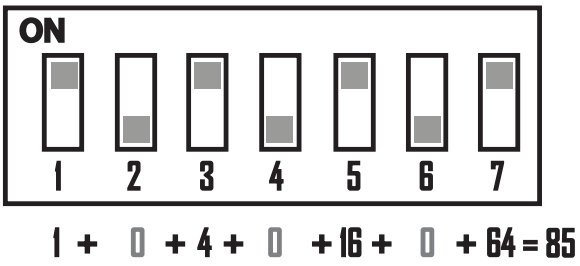


Fig. 30. Calculating the MAC address

Setting the Device Instance Number

The Device Instance Number must be unique across the entire BACnet system network because it is used to uniquely identify the BACnet devices. It may be used to conveniently identify the BACnet device from other devices during installation. The MERLIN NX MS/TP BACnet Controllers Device Instance Number is automatically set when it is added to a ARENA-NX project. The Device Instance Number can be changed by the user, which may be necessary when integrating with a third party or when attempting to replace an existing controller and it is desired to maintain the existing Device Instance Number.

NOTE:
This controller is insensitive to bias voltages because of failsafe chip-set inside and can share the BACnet bus with other devices with or without bias voltages.

Connecting to BACnet MS/TP Buses

The controller communicates via its BACnet MS/TP interface with other BACnet MS/TP-capable devices (for example, other room controllers or MS/TP controllers). In doing so, the following considerations should be taken into account.

— Maximum BACnet MS/TP bus length = "L" on Fig. 18 See Table 7, "Baud rate vs. Maximum cable length," on page 22.
— Twisted-pair cable, for example,
- AWG 18 (1 mm2)
- J-Y(ST)Y 4 x 2 x 0.8 mm2 or a special RS485 cable.
- CAT 5,6,7 cable – use only one single pair for one bus
- Belden 9842 or 9842NH and
- Daisy-chain topology.
- Must conform to TIA/EIA RS485 cabling guidelines and ANSI/ASHRAE Standard 135-2010.

BACnet MS/TP Limitataions

There are two limitations regarding the number of controllers per BACnet MS/TP channel:

PHYSICAL LIMITATION:
32 loads as per TIA/EIA-485 standard. One MERLIN NX MSTP VAV controller represents 1/8 load. The physical limitation is important in case 3rd party devices representing a full load are connected.

AUTOMAC LIMITATION:
See Table 7, "Baud rate vs. Maximum cable length," on page 22 for default maxmaster value. It can be modified by the user. Refer *IRM Engineering Tool User Guide* for more information on how to do this?

A maxMaster of 64 means we can support a maximum of 62 BACnet MSTP VAV controllers, one supervisor, and one BACnet client (tool) per BACnet MS/TP channel.

Thus, depending upon the actual performance needs and required communication rates, it is recommended to connect a smaller number of BACnet MS/TP devices per channel.

NOTE:
It is recommended not to have more than 62 controllers on single MSTP channel.

MODBUS RTU

The controller features a removable 2-wire non-isolated RS485 interface suitable for Modbus communication (terminal 16, 17, and 18). The terminal block containing it is grey. The controller can function only as a Modbus Master. In general, the TIA/EIA 485 wiring rules must be followed.

Modbus Defaults

Baudrate	19200
Parity	Even parity
Bytesize	8 bit
Stopbits	1 stop bit

Wiring Topology

Only daisy-chain wiring topology is allowed.

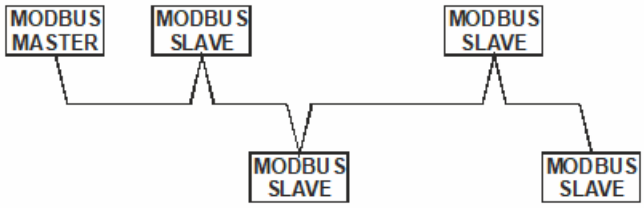


Fig. 31. Allowed Wiring Topology

Other wiring topologies (such as, star wiring, mixed star wiring, and daisy chain wiring) are prohibited. This is to avoid communication problems of the physical layer.

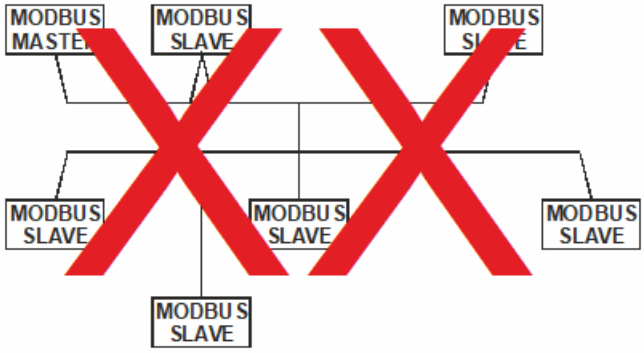


Fig. 32. Prohibited Wiring Topology (example)

Cables and Shielding

See "TIA/EIA 485 Cable Specifications" on page 19.

Use shielded twisted pair cable J-Y-(St)-Y 4 x 2 x 0.8 and connect the Modbus shield to a noise-free earth ground - only once per Modbus connection.

Shielding is especially recommended when the Modbus cable is installed in areas with expected or actual electromagnetic noise. Avoiding such areas is to be preferred.

You must use three wires:

- One wire for Modbus +
- One wire for Modbus –
- One wire for the signal common

When using one pair for Modbus (+) and Modbus (-) and one wire of another pair for the signal common, CAT5 cable may also be used.

RS485 Repeaters

RS485 repeaters are possible but have not been tested by Honeywell. Therefore it is the responsibility of the installing / commissioning person to ensure proper function.

NOTE: Each Modbus segment will require its own line polarization and line termination.

Modbus Master Specifications

Physical Layer	2-wire serial line (TIA/EIA-485) (with additional common)
Communication rates:	9.6, 19.2, 38.4, 57.6, and 76.8 kbps supported.
Maximum number of devices:	32, It is recommended to connect a smaller number of devices for better Modbus performance.
Cable and wiring specifications:	See section TIA-EIA 485 Cable Specifications on pg. 13
Communication Mode	Always Modbus Master.
Transmission Mode	RTU (Remote Terminal Unit).
Address Range	Modbus master can have an address between 1 and 247. Discrete Inputs, Coils, Input Registers and Holding Registers can have an address between 1 and 65534.

Modbus Compliance

As per the Modbus standard, the controller is a conditionally compliant "regular" Modbus device.

The controller differs from an unconditionally compliant "regular" Modbus device in that, it does not support communication rates of 1.2, 2.4, and 4.8 kbps (because these communication rates are not market-relevant).
Modbus Considerations

The RS485 interface suitable for Modbus communication is 2-wire non-isolated, hence the following considerations apply:

- Maximum Modbus length ("L"): 4000 ft (9.6 – 78.8 kbps) or 2600 ft (115.2 kbps) *See "TIA/EIA 485 Cable Specifications" on page 19.* It is recommended that you select a low baud rate (for example, 19.2 kbps) for reliable operation.
- Use only shielded, twisted-pair of cables and daisy-chain topology.

— Ground noise should not exceed the EIA-485 common mode voltage limit.
— Must conform to TIA/EIA 485 cabling guidelines. *See "TIA/EIA 485 Cable Specifications" on page 19.*
— Should not extend beyond a single building.
— It is recommended that you select a low baud rate (for example, 19.2 kbps) for reliable operation

.

SYLK BUS™

Sylk™ Bus capable wall modules such as CLCMTR40x / CLCMTR42x can be connected to the controller's Sylk™ Interface (terminals 14 and 15).

- The Sylk™ Bus is single pair, and polarity-insensitive.
- Maximum current provided at the Sylk™ Bus interface: 96 mA.
- The maximum number of wall modules depends on the following wall module specific information:
  — Sylk™ bus power consumption
  — Number of parameters used
  — Total config file size

The Niagara tool has an inbuilt resource calculator to calculate the number of Sylk™ wall modules.The Sylk™ devices supported by the MERLIN NX IP and MSTP VAV are;

Supported wall modules

CLCMTR40, CLCMTR40-H, CLCMTR40-H-CO2, CLCMTR40-CO2, CLCMTR42, CLCMTR42-H, CLCMTR42-H-CO2, CLCMTR42-CO2, CLCMTR71-H, CLCMTR120 (TR75E) and CLCMTR120-H (TR75-HE)

NOTE:
The CLCMTR42x Wall Module must be version 1.00.3 or higher.

NOTE:
CLCMTR70 Wall Modules are not supported.

Table 9. Recommended max. distances from controller to CLCMTR40x/CLCMT42x wall modules

Single twisted pair, Non-Shielded, Stranded or Solid[c]		Standard non-twisted thermostat wire shielded or Non-Shielded, Stranded or Solid[d]
18 - 22 AWG (0.33 to 1mm2)	24 AWG (0.20 mm2)	18 - 24 AWG (0.20 to 1 mm2)

Table 9. Recommended max. distances from controller to CLCMTR40x/CLCMT42x wall modules (Continued)

Single twisted pair, Non-Shielded, Stranded or Solid[c]		Standard non-twisted thermostat wire shielded or Non-Shielded, Stranded or Solid[d]
500 ft (150 m)	400 ft (120 m)	100 ft (30 m)

[c] As a rule of thumb, single twisted pair (two wires per cable, only), thicker gauge, non-shielded cable yields the best results for longer runs.

[d] The 100 ft (30 m) distance for standard thermostat wire is conservative but is meant to reduce the impact of any sources of electrical noise (incl. but not limited to VFDs, electronic ballasts, etc.). Shielded cable recommended only if there is a need to reduce the effect of electrical noise.
These distances apply also for shielded twisted pair.

Sylk Bus Wiring Examples

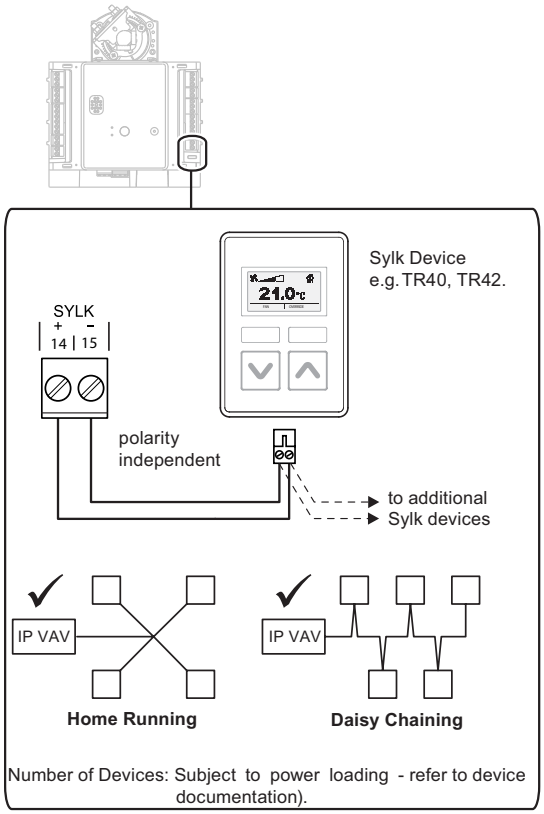


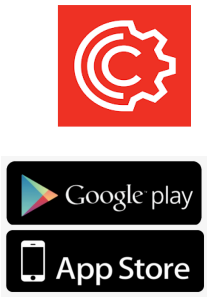
Fig. 33. Sylk™ Wiring Topologies

BLUETOOTH BALANCING

The antenna facilitates wireless communication via Bluetooth with other devices.

Overview

The Honeywell Connect Mobile (HCM) is a mobile application used for VAV balancing. The HCM app provides easy access to the MERLIN NX VAV controller via integrated Bluetooth. Make sure that the MERLIN NX VAV controller has a strong Bluetooth signal before connecting to the Honeywell Connect Mobile VAV Balancing app. The BACnet instance ID range allows the discovery of additional controllers on the BACnet network.
For more information about VAV balancing with the HCM mobile app, refer to Honeywell Connect Mobile VAV Balancing application User Guide - EN2Z1086-IE67.

	Honeywell Connect Mobile (HCM) is a mobile VAV balancing application that connects to the MERLIN NX VAV controller through integrated Bluetooth. The mobile application should be linked to a MERLIN NX VAV controller via Bluetooth with strong signal strength. You can download the Honeywell Connect Mobile application for the VAV balancing from the Google Play Store or Apple App Store.

TROUBLESHOOTING

The controller features the following LEDs:

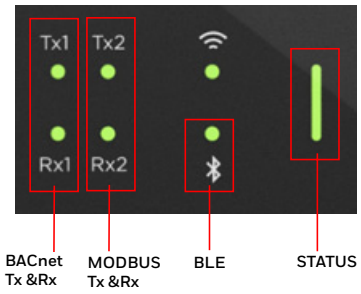


Fig. 34. LED interface

BACnet and Modbus LED Status

Table 10. BACnet and Modbus LED Status

Mode	Status	Tx and Rx LED Status	Visual
BACnet Tx1	Fail	OFF	
BACnet Tx1	Success	Blinking	
BACnet Rx1	Fail	OFF	
BACnet Rx1	Success	Blinking	
Modbus Tx2	Fail	OFF	
Modbus Tx2	Success	Blinking	
Modbus Rx2	Fail	OFF	
Modbus Rx2	Success	Blinking	

Bluetooth LED Status

Table 11. Bluetooth LED Status

Mode	LED Status	Visual
BLE disabled by user	OFF	
BLE normal operation and connected	Green, permanently ON.	
BLE enabled but not connected	Green, 2 blinks in 1 s followed by 2 s pause, and repeat.	
BLE failure	Red, permanently ON.	

Controller LED Status

Table 12. Controller LED Status

Mode	LED Status	Visual
Firmware download	Green blinks every 200 ms.	
No application [a)]	Red, Green, Yellow blinks every 1 s.	
Broken sensor Short circuit	Red permanent ON [b)].	
AutoMac	Green blinks every 2 s.	
No Valid Mac	Yellow permanent ON.	
Un Ack Alarm	Yellow blinks every 2 s.	
Normal operation	Green LED permanent ON.	
Communication error	Red LED blinks every 200 ms.	

[a)] While performing setpoint balancing using the VAV mobile application, the LED pattern changes from static green to red, green, yellow cycles (which indicates the controller is empty).

b) For troubleshooting a permanent red LED, navigate to IRM Program > On Board IO and check the UIO function block OutCase status. A permanent red LED will be illuminated when the OutCase status is SensorOpen (broken sensor) or SensorClose (short circuit).

REGULATORY INFORMATION

FCC Regulation

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) this device may not cause harmful interference, and
(2) this device must accept any interference received, including interference that may cause undesired operation.

NOTE:
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 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.

NOTE:
Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Canadian Regulatory Statement

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions:
(1) this device may not cause interference, and
(2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le present appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisee aux deux conditions suivantes :

(1) l'appareil ne doit pas produire de brouillage, et
(2) l'utilisateur de l'appareil doit accepter tout brouillage radioelectrique subi, meme si le brouillage est susceptible d'en compromettre le fonctionnement.

CE Statement: The WLAN function for this device is restricted to indoor use only when operating in the 5150 to 5350 MHz frequency range.

EMF Statement: To maintain compliance with the RF exposure requirement, a separation distance of 20 cm between the device and the human should be maintained.

Déclaration d'exposition Attention: Cet émetteur doit être installé pour fournir une distance de separation d'au moins 20 cm de toute personne.

RESTRICTIONS IN THE 5 GHZ BAND
Within the 5.15 to 5.25 GHz band, UNII devices will be restricted to indoor operations to reduce any potential for harmful interference to co-channel Mobile Satellite System (MSS) operations.

RESTRICTIONS DANS LA BANDE DE 5 GHZ
Dans la bande de 5,15 à 5,25 GHz, les appareils UNII seront restreints aux opérations intérieures pour réduire toute possibilité d'interférence pouvant nuire aux opérations du Système satellite mobile dans le même canal(MSS).

Professional Installation Warning

- This device must be professionally installed, this should be noted on grantee.
- To maintain compliance, only the antenna types that have been tested shall be used, which listed in *Table 2, "Replacement Parts," on page 2*.
- This device requires a significant technology engineering expertise towards understanding of the tools and relevant technology, not readily available to average consumer. Only a person professionally trained in the technology is competent.
  This device is not directly marketed or sold to general public.

Detachable Antennae Warning (IC)

Transmitter Antenna (From Section 6.8 RSS-GEN, Issue 5, April 2018):

— This radio transmitter [See *Table 13, "Certification Numbers," on page 31*] has been approved by Innovation, Science and Economic Development Canada to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in

this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

Table 13. Certification Numbers

	FCC ID	IC ID
CLMEVA75MB24NM	2ARTN-00005	24552-00005
CLMEVA00MB24NM		
CLMEVA00IB24NM		
CLMEVA75IB24NM		

Approvals and Certifications

— UL 60730-1, Standard for Automatic Electric Controls for Household and Similar Use, Part 1: General Requirements;
— CAN/CSA-E60730-1:02, Standard for Automatic
— Electrical Controls for Household and Similar Use, Part 1: General Requirements;
— Complementary listing for UL916, CSA C22.2 No. 205;
— BTL-listed, BACnet AAC profile;
— CE-approved;
— FCC part 15B-compliant.
— RoHS Conformity

WEEE DIRECTIVE

At the end of the product life, dispose of the packaging and product in an appropriate recycling center.

Do not dispose of the device with the usual domestic refuse.

Do not burn the device.

Article 33 Communication

REGULATION (EC) No 1907/2006 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 18 December 2006

Concerning the Registration, Evaluation, Authorization and Restriction of Chemicals (REACH)

Honeywell takes compliance with REACH very seriously.

According to Article 33 “Duty to communicate information on substances in articles”:

— Any supplier of an article containing a substance meeting the criteria in Article 57 and identified in accordance with Article 59(1) in a concentration above 0,1% weight by weight (w/w) shall provide the recipient of the article with sufficient information, available to the supplier, to allow safe use of the article including, as a minimum, the name of that substance.
— On request by a consumer any supplier of an article containing a substance meeting the criteria in Article 57 and identified in accordance with Article 59(1) in a concentration above 0,1% weight by weight (w/w) shall provide the consumer with sufficient information, available to the supplier, to allow safe use of the article including, as a minimum, the name of that substance. Our duty is to inform you that the substance(s) listed below may be contained in these products above the threshold level of 0.1% by weight of the listed article.

Product / Part Name	Substance Name
CLMEVA00IB24NM CLMEVA00MB24NM CLMEVA75IB24NM CLMEVA75MB24NM CLMEVA75I24NM CLMEVA75M24NM	Lead (Pb)

— We confirm that our products do not use any other REACH restricted materials during the manufacturing, storage or handling process.

APPENDIX

Sensor Input Accuracy

The controller's internal sensor inputs support both NTC10K Ω and NTC20k Ω sensors. The following table lists the typical minimum accuracies of the hardware and software for these temperature sensors.

Table 14. Accuracies of internal NTC10k Ω and NTC20k Ω sensor inputs of the controller

Range	Measurement error (excluding sensor characteristics)				
	NTC10kΩ[a]	NTC20k	Johnson A99[b]	PT3000	NI1000TK5000[b]
-50 °C to -20 °C (-58 °F to -4 °F)	≤ 5.0 K	≤ 5.0 K	≤ 1.2 K	≤ 1.2 K	≤ 1.2 K
-20 °C to 0 °C (-4 °F to +32 °F)	≤ 1.0 K	≤ 1.0 K	≤ 0.7 K	≤ 0.7 K	≤ 0.7 K
0 °C to 30 °C (32 °F to 86 °F)	≤ 0.5 K	≤ 0.3 K	≤ 0.5 K	≤ 0.5 K	≤ 0.5 K
30 °C to 70 °C (86 °F to 158 °F)	≤ 0.5 K	≤ 0.5 K	≤ 0.7 K	≤ 0.7 K	≤ 0.7 K
70 °C to 100 °C (158 °F to 212 °F)	≤ 1.0 K	≤ 1.0 K	≤ 1.2 K	≤ 1.2 K	≤ 1.2 K
100 °C to 130 °C (212 °F to 266 °F)	--	≤ 3.0 K	≤ 1.2 K	≤ 1.2 K	≤ 1.2 K
130 °C to 150 °C (266 °F to 302 °F)	--	≤ 5.5 K	≤ 1.2 K	≤ 1.2 K	--
150 °C to 400 °C (302 °F to 752 °F)	--	--	--	--	--

[a] NTC10kΩ specified for -30 °C to +100 °C (-22 °F to 212 °F) only.
[b] Johnson A99 specified for -40 °C to +120 °C (-40 °F to +248 °F) only.
[c] NI1000TK5000 specified for -30 °C to+130 °C (-22 °F to +266 °F) only.

NOTE:
This is the accuracy of the internal sensor input (hardware + software [linearization]), only. This table does not include the characteristics of the sensors, themselves (see section “Sensor Characteristics below). If a different sensor or sensor accuracy is required, one may instead use the inputs of, such as a connected Panel I/O module.

Recognition of Sensor Failure of Sensor Inputs

The thresholds at which sensor failures – i.e., sensor breaks (SB) and short-circuits (SC) – are recognized depends upon the given sensor type. In the event of a recognized sensor failure, the sensor assume the safety values configured in CARE. *Table 14, “Accuracies of internal NTC10k Ω and NTC20k Ω sensor inputs of the controller,” on page 32* lists the measurement ranges and the corresponding thresholds for the recognition of sensor failure for the various different sensor types:

Table 15. Thresholds for short-circuit (SC) and sensor-break (SB) recognition

I/O configuration	Measurement range	Recognition thresholds
2 to 10 V	2to10 V / 4to20 mA (without pull-up)	SC: < 1.5 V / 3 mA; SB: no recognition
NTC10kΩ (Type II)	-30 °C to +100 °C (-22 °F to +212 °F)	SC: < 20 Ω; SB: < -94 °F (-70 °C)
NTC20kΩ	-50 °C to +150 °C (-58 °F to +302 °F)	SC: < 20 Ω; SB: < -94 °F (-70 °C)
PT1000	-50 °C to + 400 °C (-58 °F to +752 °F)	SC: < 775 Ω; SB: < -58 °F (-50 °C)
Ni1000TK5000	-30 °C to +130 °C (-22 °F to +266 °F)	SC: < 850 Ω; SB: < -58 °F (-30 °C)
PT100	-50 °C to +400 °C (-58 °F to +752 °F)	-
PT3000	-50 °C to +150 °C (-58 °F to +302 °F)	-
10K3A1	-40 °C to +125 °C (-40 °F to +257 °F)	-
Nickel Class B DIN 43760 sensors	-60 °C to +169 °C (-76 °F to +752 °F)	-
JOHNSON A99	-40 °C to +120 °C (-40 °F to +248 °F)	-

NOTE:
In the case of temperatures lying outside the afore-mentioned ranges, the lowest/highest value within the range, instead, will be communicated. Thus, a temperature of -51 °F will be communicated as “-50 °F.”

SENSOR CHARACTERISTICS

The characteristics (resistance in relation to temperature) of the sensors and the resultant voltage are listed on the following pages. The stated values do not include failures due to sensor failures; wiring resistance or wiring failures; misreadings due to a meter connected to measure resistance or voltage at the input.

PT1000

Temp. [°F]	Temp. [°C]	Resistance [KΩ]	Terminal voltage [V]
-58	-50	803	0.312
-56.2	-49	807	0.314
-54.4	-48	811	0.315
-52.6	-47	815	0.317
-50.8	-46	819	0.318
-49	-45	823	0.32
-47.2	-44	827	0.321
-45.4	-43	831	0.323
-43.6	-42	835	0.324
-41.8	-41	839	0.326
-40	-40	843	0.327
-38.2	-39	847	0.329
-36.4	-38	851	0.33
-34.6	-37	855	0.332
-32.8	-36	859	0.333
-31	-35	862	0.335
-29.2	-34	866	0.336
-27.4	-33	870	0.338
-25.6	-32	874	0.339
-23.8	-31	878	0.341
-22	-30	882	0.342
-20.2	-29	886	0.344
-18.4	-28	890	0.345
-16.6	-27	894	0.347
-14.8	-26	898	0.348
-13	-25	902	0.35
-11.2	-24	906	0.351
-9.4	-23	910	0.353
-7.6	-22	914	0.354
-5.8	-21	918	0.356
-4	-20	922	0.357
-2.2	-19	926	0.359
-0.4	-18	929	0.36
1.4	-17	933	0.361
3.2	-16	937	0.363
5	-15	941	0.364
6.8	-14	945	0.366
8.6	-13	949	0.367
10.4	-12	953	0.369
12.2	-11	957	0.37
14	-10	961	0.372
15.8	-9	965	0.373
17.6	-8	969	0.375
19.4	-7	973	0.376
21.2	-6	977	0.378
23	-5	980	0.379
24.8	-4	984	0.38
26.6	-3	988	0.382
28.4	-2	992	0.383
30.2	-1	996	0.385
32	0	1000	0.386
33.8	1	1004	0.388
35.6	2	1008	0.389
37.4	3	1012	0.391
39.2	4	1016	0.392
41	5	1020	0.394
42.8	6	1023	0.395
44.6	7	1027	0.396
46.4	8	1031	0.398
48.2	9	1035	0.399
50	10	1039	0.401
51.8	11	1043	0.402
53.6	12	1047	0.404
55.4	13	1051	0.405
57.2	14	1055	0.406
59	15	1058	0.408
60.8	16	1062	0.409
62.6	17	1066	0.411
64.4	18	1070	0.412
66.2	19	1074	0.413
68	20	1078	0.415
69.8	21	1082	0.416
71.6	22	1086	0.418
73.4	23	1090	0.419
75.2	24	1093	0.42
77	25	1097	0.422
78.8	26	1101	0.423
80.6	27	1105	0.425
82.4	28	1109	0.426
84.2	29	1113	0.428
86	30	1117	0.429
87.8	31	1121	0.431
89.6	32	1124	0.432
91.4	33	1128	0.433
93.2	34	1132	0.435
95	35	1136	0.436
96.8	36	1140	0.438
98.6	37	1144	0.439
100.4	38	1148	0.441
102.2	39	1152	0.442
104	40	1155	0.443
105.8	41	1159	0.445
107.6	42	1163	0.446
109.4	43	1167	0.448
111.2	44	1171	0.449
113	45	1175	0.451
114.8	46	1179	0.452
116.6	47	1182	0.453
118.4	48	1186	0.455
120.2	49	1190	0.456
122	50	1194	0.458
123.8	51	1198	0.459
125.6	52	1202	0.461
127.4	53	1205	0.462
129.2	54	1209	0.463
131	55	1213	0.465
132.8	56	1217	0.466
134.6	57	1221	0.467
136.4	58	1225	0.469
138.2	59	1229	0.47
140	60	1232	0.471
141.8	61	1236	0.473
143.6	62	1240	0.474
145.4	63	1244	0.476
147.2	64	1248	0.477
149	65	1252	0.479
150.8	66	1255	0.48
152.6	67	1259	0.481
154.4	68	1263	0.483
156.2	69	1267	0.484
158	70	1271	0.486
159.8	71	1275	0.487
161.6	72	1278	0.488
163.4	73	1282	0.49
165.2	74	1286	0.491
167	75	1290	0.493
168.8	76	1294	0.494
170.6	77	1297	0.495
172.4	78	1301	0.497
174.2	79	1305	0.498
176	80	1309	0.499
177.8	81	1313	0.501
179.6	82	1317	0.502
181.4	83	1320	0.503
183.2	84	1324	0.505
185	85	1328	0.506
186.8	86	1332	0.508
188.6	87	1336	0.509
190.4	88	1339	0.51
192.2	89	1343	0.512
194	90	1347	0.513
195.8	91	1351	0.515
197.6	92	1355	0.516
199.4	93	1358	0.517
201.2	94	1362	0.519
203	95	1366	0.52
204.8	96	1370	0.522
206.6	97	1374	0.523
208.4	98	1377	0.524
210.2	99	1381	0.525
212	100	1385	0.527
213.8	101	1389	0.528
215.6	102	1393	0.53
217.4	103	1396	0.531
219.2	104	1400	0.532
221	105	1404	0.534
222.8	106	1408	0.535
224.6	107	1412	0.537
226.4	108	1415	0.538
228.2	109	1419	0.539
230	110	1423	0.541
231.8	111	1427	0.542
233.6	112	1430	0.543
235.4	113	1434	0.545
237.2	114	1438	0.546
239	115	1442	0.547

Temp. [°F]	Temp .[°C]	Resistance [KΩ]	Terminal voltage [V]
240.8	116	1446	0.549
242.6	117	1449	0.55
244.4	118	1453	0.551
246.2	119	1457	0.553
248	120	1461	0.554
249.8	121	1464	0.555
251.6	122	1468	0.557
253.4	123	1472	0.558
255.2	124	1476	0.56
257	125	1479	0.561
258.8	126	1483	0.562
260.6	127	1487	0.564
262.4	128	1491	0.565
264.2	129	1494	0.566
266	130	1498	0.567
267.8	131	1502	0.569
269.6	132	1506	0.57
271.4	133	1510	0.572
273.2	134	1513	0.573
275	135	1517	0.574
276.8	136	1521	0.576
278.6	137	1525	0.577
280.4	138	1528	0.578
282.2	139	1532	0.58
284	140	1536	0.581
285.8	141	1539	0.582
287.6	142	1543	0.584
289.4	143	1547	0.585
291.2	144	1551	0.586
293	145	1554	0.587
294.8	146	1558	0.589
296.6	147	1562	0.59
298.4	148	1566	0.592
300.2	149	1569	0.593
302	150	1573	0.594
303.8	151	1577	0.596
305.6	152	1581	0.597
307.4	153	1584	0.598
309.2	154	1588	0.6
311	155	1592	0.601
312.8	156	1596	0.602
314.6	157	1599	0.603
316.4	158	1603	0.605
318.2	159	1607	0.606
320	160	1610	0.607
321.8	161	1614	0.609
323.6	162	1618	0.61
325.4	163	1622	0.612
327.2	164	1625	0.613
329	165	1629	0.614
330.8	166	1633	0.615
332.6	167	1636	0.617
334.4	168	1640	0.618
336.2	169	1644	0.619
338	170	1648	0.621
339.8	171	1651	0.622
341.6	172	1655	0.623
343.4	173	1659	0.625
345.2	174	1662	0.626
347	175	1666	0.627
348.8	176	1670	0.629
350.6	177	1674	0.63
352.4	178	1677	0.631
354.2	179	1681	0.632
356	180	1685	0.634
357.8	181	1688	0.635
359.6	182	1692	0.636
361.4	183	1696	0.638
363.2	184	1699	0.639
365	185	1703	0.64
366.8	186	1707	0.642
368.6	187	1711	0.643
370.4	188	1714	0.644
372.2	189	1718	0.645
374	190	1722	0.647
375.8	191	1725	0.648
377.6	192	1729	0.649
379.4	193	1733	0.651
381.2	194	1736	0.652
383	195	1740	0.653
384.8	196	1744	0.655
386.6	197	1747	0.656
388.4	198	1751	0.657
390.2	199	1755	0.658
392	200	1758	0.659
393.8	201	1762	0.661
395.6	202	1766	0.662
397.4	203	1769	0.663
399.2	204	1773	0.665
401	205	1777	0.666
402.8	206	1780	0.667
404.6	207	1784	0.669
406.4	208	1788	0.67
408.2	209	1791	0.671
410	210	1795	0.672
411.8	211	1799	0.674
413.6	212	1802	0.675
415.4	213	1806	0.676
417.2	214	1810	0.678
419	215	1813	0.679
420.8	216	1817	0.68
422.6	217	1821	0.681
424.4	218	1824	0.683
426.2	219	1828	0.684
428	220	1832	0.685
429.8	221	1835	0.686
431.6	222	1839	0.688
433.4	223	1843	0.689
435.2	224	1846	0.69
437	225	1850	0.692
438.8	226	1854	0.693
440.6	227	1857	0.694
442.4	228	1861	0.695
444.2	229	1865	0.697
446	230	1868	0.698
447.8	231	1872	0.699
449.6	232	1875	0.7
451.4	233	1879	0.702
453.2	234	1883	0.703
455	235	1886	0.704
456.8	236	1890	0.705
458.6	237	1894	0.707
460.4	238	1897	0.708
462.2	239	1901	0.709
464	240	1905	0.711
465.8	241	1908	0.712
467.6	242	1912	0.713
469.4	243	1915	0.714
471.2	244	1919	0.716
473	245	1923	0.717
474.8	246	1926	0.718
476.6	247	1930	0.719
478.4	248	1934	0.721
480.2	249	1937	0.722
482	250	1941	0.723
483.8	251	1944	0.724
485.6	252	1948	0.726
487.4	253	1952	0.727
489.2	254	1955	0.728
491	255	1959	0.729
492.8	256	1962	0.73
494.6	257	1966	0.732
496.4	258	1970	0.733
498.2	259	1973	0.734
500	260	1977	0.736
501.8	261	1980	0.737
503.6	262	1984	0.738
505.4	263	1988	0.739
507.2	264	1991	0.74
509	265	1995	0.742
510.8	266	1998	0.743
512.6	267	2002	0.744
514.4	268	2006	0.746
516.2	269	2009	0.747
518	270	2013	0.748
519.8	271	2016	0.749
521.6	272	2020	0.75
523.4	273	2024	0.752
525.2	274	2027	0.753
527	275	2031	0.754
528.8	276	2034	0.755
530.6	277	2038	0.757
532.4	278	2042	0.758
534.2	279	2045	0.759
536	280	2049	0.76
537.8	281	2052	0.761
539.6	282	2056	0.763
541.4	283	2060	0.764

Temp. [°F]	Temp .[°C]	Resistance [KΩ]	Terminal voltage [V]
543.2	284	2063	0.765
545	285	2067	0.766
546.8	286	2070	0.768
548.6	287	2074	0.769
550.4	288	2077	0.77
552.2	289	2081	0.771
554	290	2085	0.773
555.8	291	2088	0.774
557.6	292	2092	0.775
559.4	293	2095	0.776
561.2	294	2099	0.777
563	295	2102	0.778
564.8	296	2106	0.78
566.6	297	2110	0.781
568.4	298	2113	0.782
570.2	299	2117	0.784
572	300	2120	0.785
573.8	301	2124	0.786
575.6	302	2127	0.787
577.4	303	2131	0.788
579.2	304	2134	0.789
581	305	2138	0.791
582.8	306	2142	0.792
584.6	307	2145	0.793
586.4	308	2149	0.794
588.2	309	2152	0.796
590	310	2156	0.797
591.8	311	2159	0.798
593.6	312	2163	0.799
595.4	313	2166	0.8
597.2	314	2170	0.802
599	315	2173	0.803
600.8	316	2177	0.804
602.6	317	2181	0.805
604.4	318	2184	0.806
606.2	319	2188	0.808
608	320	2191	0.809
609.8	321	2195	0.81
611.6	322	2198	0.811
613.4	323	2202	0.812
615.2	324	2205	0.814
617	325	2209	0.815

Temp. [°F]	Temp .[°C]	Resistance [KΩ]	Terminal voltage [V]
618.8	326	2212	0.816
620.6	327	2216	0.817
622.4	328	2219	0.818
624.2	329	2223	0.82
626	330	2226	0.821
627.8	331	2230	0.822
629.6	332	2234	0.823
631.4	333	2237	0.824
633.2	334	2241	0.826
635	335	2244	0.827
636.8	336	2248	0.828
638.6	337	2251	0.829
640.4	338	2255	0.83
642.2	339	2258	0.831
644	340	2262	0.833
645.8	341	2265	0.834
647.6	342	2269	0.835
649.4	343	2272	0.836
651.2	344	2276	0.838
653	345	2279	0.839
654.8	346	2283	0.84
656.6	347	2286	0.841
658.4	348	2290	0.842
660.2	349	2293	0.843
662	350	2297	0.845
663.8	351	2300	0.846
665.6	352	2304	0.847
667.4	353	2307	0.848
669.2	354	2311	0.849
671	355	2314	0.85
672.8	356	2318	0.852
674.6	357	2321	0.853
676.4	358	2325	0.854
678.2	359	2328	0.855
680	360	2332	0.856
681.8	361	2335	0.857
683.6	362	2339	0.859
685.4	363	2342	0.86
687.2	364	2346	0.861
689	365	2349	0.862
690.8	366	2353	0.863
692.6	367	2356	0.864

Temp. [°F]	Temp .[°C]	Resistance [KΩ]	Terminal voltage [V]
694.4	368	2360	0.866
696.2	369	2363	0.867
698	370	2367	0.868
699.8	371	2370	0.869
701.6	372	2373	0.87
703.4	373	2377	0.871
705.2	374	2380	0.872
707	375	2384	0.874
708.8	376	2387	0.875
710.6	377	2391	0.876
712.4	378	2394	0.877
714.2	379	2398	0.878
716	380	2401	0.879
717.8	381	2405	0.881
719.6	382	2408	0.882
721.4	383	2412	0.883
723.2	384	2415	0.884
725	385	2419	0.885
726.8	386	2422	0.886
728.6	387	2426	0.888
730.4	388	2429	0.889
732.2	389	2432	0.89
734	390	2436	0.891
735.8	391	2439	0.892
737.6	392	2443	0.893
739.4	393	2446	0.894
741.2	394	2450	0.896
743	395	2453	0.897
744.8	396	2457	0.898
746.6	397	2460	0.899
748.4	398	2463	0.9
750.2	399	2467	0.901
752	400	2470	0.902

PT3000

Temp. [°F]	Temp. [°C]	Resistance [KΩ]	Terminal voltage [V]
-58	-50	2.82	1.02
-49	-45	2.87	1.03
-40	-40	2.91	1.05
-31	-35	2.96	1.06
-22	-30	3	1.08
-13	-25	3.05	1.09
-4	-20	3.09	1.1
5	-15	3.13	1.12
14	-10	3.18	1.13
23	-5	3.22	1.15
32	0	3.27	1.16
41	5	3.31	1.17
50	10	3.35	1.19
59	15	3.4	1.2
68	20	3.44	1.21
77	25	3.48	1.23
86	30	3.53	1.24
95	35	3.57	1.25
104	40	3.61	1.27
113	45	3.66	1.28
122	50	3.7	1.29
131	55	3.74	1.31
140	60	3.78	1.32
149	65	3.83	1.33
158	70	3.87	1.35
167	75	3.91	1.36
176	80	3.95	1.37
185	85	4	1.38
194	90	4.04	1.4
203	95	4.08	1.41
212	100	4.12	1.42
221	105	4.16	1.43
230	110	4.21	1.45
239	115	4.25	1.46
248	120	4.29	1.47
257	125	4.33	1.48
266	130	4.37	1.49
275	135	4.41	1.51
284	140	4.45	1.52
293	145	4.5	1.53
302	150	4.54	1.54

NTC10K TYPE II

Temp. [°F]	Temp. [°C]	Resistance [KΩ]	Terminal voltage [V]
-22	-30	177	7.904
-20.2	-29	166.35	7.848
-18.4	-28	156.413	7.79
-16.6	-27	147.136	7.73
-14.8	-26	138.47	7.666
-13	-25	130.372	7.601
-11.2	-24	122.8	7.534
-9.4	-23	115.718	7.464
-7.6	-22	109.089	7.392
-5.8	-21	102.883	7.318
-4	-20	97.073	7.241
-2.2	-19	91.597	7.161
-0.4	-18	86.471	7.08
1.4	-17	81.667	6.996
3.2	-16	77.161	6.91
5	-15	72.932	6.821
6.8	-14	68.962	6.731
8.6	-13	65.231	6.639
10.4	-12	61.723	6.545
12.2	-11	58.424	6.448
14	-10	55.321	6.351
15.8	-9	52.399	6.251
17.6	-8	49.648	6.15
19.4	-7	47.058	6.047
21.2	-6	44.617	5.943
23	-5	42.317	5.838
24.8	-4	40.15	5.732
26.6	-3	38.106	5.624
28.4	-2	36.18	5.516
30.2	-1	34.363	5.408
32	0	32.65	5.299
33.8	1	31.027	5.189
35.6	2	29.494	5.079
37.4	3	28.047	4.969
39.2	4	26.68	4.859
41	5	25.388	4.75
42.8	6	24.166	4.641
44.6	7	23.01	4.532
46.4	8	21.916	4.423
48.2	9	20.88	4.316
50	10	19.898	4.209
51.8	11	18.968	4.103
53.6	12	18.087	3.998
55.4	13	17.252	3.894
57.2	14	16.46	3.792
59	15	15.708	3.69
60.8	16	14.995	3.591
62.6	17	14.319	3.492
64.4	18	13.678	3.396
66.2	19	13.068	3.3
68	20	12.49	3.207
69.8	21	11.94	3.115
71.6	22	11.418	3.025
73.4	23	10.921	2.937
75.2	24	10.449	2.85
77	25	10	2.767
78.8	26	9.572	2.684
80.6	27	9.165	2.603
82.4	28	8.777	2.524
84.2	29	8.408	2.447
86	30	8.057	2.372
87.8	31	7.722	2.299
89.6	32	7.402	2.228
91.4	33	7.098	2.159
93.2	34	6.808	2.091
95	35	6.531	2.025
96.8	36	6.267	1.962
98.6	37	6.015	1.9
100.4	38	5.775	1.84
102.2	39	5.546	1.781
104	40	5.327	1.724
105.8	41	5.117	1.669
107.6	42	4.917	1.616
109.4	43	4.726	1.564
111.2	44	4.543	1.514
113	45	4.369	1.465
114.8	46	4.202	1.418
116.6	47	4.042	1.373
118.4	48	3.889	1.329
120.2	49	3.743	1.286
122	50	3.603	1.244
123.8	51	3.469	1.204
125.6	52	3.34	1.166
127.4	53	3.217	1.128
129.2	54	3.099	1.092
131	55	2.986	1.057
132.8	56	2.878	1.023
134.6	57	2.774	0.99
136.4	58	2.675	0.959
138.2	59	2.579	0.928
140	60	2.488	0.898
141.8	61	2.4	0.87
143.6	62	2.316	0.842
145.4	63	2.235	0.815
147.2	64	2.158	0.79
149	65	2.083	0.765
150.8	66	2.011	0.74
152.6	67	1.943	0.718
154.4	68	1.877	0.695
156.2	69	1.813	0.673
158	70	1.752	0.652
159.8	71	1.694	0.632
161.6	72	1.637	0.612
163.4	73	1.583	0.593
165.2	74	1.531	0.575
167	75	1.481	0.557
168.8	76	1.433	0.541
170.6	77	1.387	0.524
172.4	78	1.342	0.508
174.2	79	1.299	0.493
176	80	1.258	0.478
177.8	81	1.218	0.464
179.6	82	1.179	0.45
181.4	83	1.142	0.436
183.2	84	1.107	0.423
185	85	1.072	0.411
186.8	86	1.039	0.399
188.6	87	1.007	0.387
190.4	88	0.976	0.375
192.2	89	0.947	0.365
194	90	0.918	0.354
195.8	91	0.89	0.344
197.6	92	0.863	0.334
199.4	93	0.838	0.324
201.2	94	0.813	0.315
203	95	0.789	0.306
204.8	96	0.765	0.297
206.6	97	0.743	0.289
208.4	98	0.721	0.28
210.2	99	0.7	0.276
212	100	0.68	0.265

NTC10K TYPE III

Temp. [°F]	Temp.[°C]	Resistance [Ω]
-35	-37.2	203.6K
-30	-34.4	173.6K
-25	-31.7	148.3K
-20	-28.9	127.1K
-15	-26.1	109.2K
-10	-23.3	94.07K
-5	-20.6	81.23K
0	-17.8	70.32K
5	-15.0	61.02K
10	-12.2	53.07K
15	-9.4	46.27K
20	-6.7	40.42K
25	-3.9	35.39K
30	-1.1	31.06K
35	1.7	27.31K
40	4.4	24.06K
45	7.2	21.24K
50	10.0	18.79K
55	12.8	16.65K
60	15.6	14.78K
65	18.3	13.15K
70	21.1	11.72K
75	23.9	10.46K
80	26.7	9354
85	29.4	8378
90	32.2	7516
95	35.0	6754
100	37.8	6078
105	40.6	5479
110	43.3	4947
115	46.1	4472
120	48.9	4049
125	51.7	3671
130	54.4	3333
135	57.2	3031
140	60.0	2759
145	62.8	2515
150	65.6	2296
155	68.3	2098
160	71.1	1920
165	73.9	1759
170	76.7	1614
175	79.4	1482
180	82.2	1362
185	85.0	1254
190	87.8	1156
195	90.6	1066
200	93.3	984
205	96.1	909.8
210	98.9	841.9
215	101.7	779.8
220	104.4	723
225	107.2	671
230	110.0	623.3
235	112.8	579.5
240	115.6	539.4

PT100

Temp. [°F]	Temp.[°C]	Resistance [Ω]
-30	-34.44	86
-20	-28.89	89
-10	-23.33	91
0	-17.78	93
10	-12.22	95
20	-6.67	97
30	-1.11	100
32	0.00	100
40	4.44	102
50	10.00	104
60	15.56	106
70	21.11	108
77	25.00	110
80	26.67	110
90	32.22	113
100	37.78	115
110	43.33	117
120	48.89	119
130	54.44	121
140	60.00	123
150	65.56	125
160	71.11	127
170	76.67	130
180	82.22	132
190	87.78	134
200	93.33	136
210	98.89	138
220	104.44	140

JOHNSON A99

Temp. [°F]	Temp.[°C]	Resistance [Ω]
-40	(-40)	613
-31	(-35)	640
-22	(-30)	668
-13	(-25)	697
-4	(-20)	727
5	(-15)	758
14	(-10)	789
23	(-5)	822
32	0	855
41	5	889
50	10	924
59	15	960
68	20	997
77	25	1035
86	30	1074
95	35	1113
104	40	1153
113	45	1195
122	50	1237
131	55	1279
140	60	1323
149	65	1368
158	70	1413
167	75	1459
176	80	1506
185	85	1554
194	90	1602
203	95	1652
212	100	1702
221	105	1753
230	110	1804
239	115	1856
248	120	1908

NTC20K

Temp. [°F]	Temp. [°C]	Resistance [KΩ]	Terminal voltage [V]
-58	-50	1659	8.78
-56.2	-49	1541	8.77
-54.4	-48	1432	8.76
-52.6	-47	1331	8.75
-50.8	-46	1239	8.74
-49	-45	1153	8.72
-47.2	-44	1073	8.71
-45.4	-43	1000	8.7
-43.6	-42	932	8.69
-41.8	-41	869	8.67
-40	-40	811	8.66
-38.2	-39	757	8.64
-36.4	-38	706	8.62
-34.6	-37	660	8.6
-32.8	-36	617	8.58
-31	-35	577	8.56
-29.2	-34	539	8.54
-27.4	-33	505	8.52
-25.6	-32	473	8.49
-23.8	-31	443	8.47
-22	-30	415	8.44
-20.2	-29	389	8.41
-18.4	-28	364	8.38
-16.6	-27	342	8.35
-14.8	-26	321	8.32
-13	-25	301	8.28
-11.2	-24	283	8.25
-9.4	-23	266	8.21
-7.6	-22	250	8.17
-5.8	-21	235	8.13
-4	-20	221	8.08
-2.2	-19	208	8.04
-0.4	-18	196	7.99
1.4	-17	184	7.94
3.2	-16	174	7.89
5	-15	164	7.83
6.8	-14	154	7.78
8.6	-13	146	7.72
10.4	-12	137	7.66
12.2	-11	130	7.6
14	-10	122	7.53
15.8	-9	116	7.46
17.6	-8	109	7.39
19.4	-7	103	7.32
21.2	-6	97.6	7.25
23	-5	92.3	7.17
24.8	-4	87.3	7.09
26.6	-3	82.6	7.01
28.4	-2	78.2	6.93
30.2	-1	74.1	6.85
32	0	70.2	6.76
33.8	1	66.5	6.67
35.6	2	63	6.58
37.4	3	59.8	6.49
39.2	4	56.7	6.4
41	5	53.8	6.3
42.8	6	51.1	6.2
44.6	7	48.5	6.1
46.4	8	46	6
48.2	9	43.7	5.9
50	10	41.6	5.8
51.8	11	39.5	5.7
53.6	12	37.6	5.59
55.4	13	35.7	5.49
57.2	14	34	5.38
59	15	32.3	5.28
60.8	16	30.8	5.17
62.6	17	29.3	5.07
64.4	18	27.9	4.96
66.2	19	26.6	4.85
68	20	25.3	4.75
69.8	21	24.2	4.64
71.6	22	23	4.53
73.4	23	22	4.43
75.2	24	21	4.32
77	25	20	4.22
78.8	26	19.1	4.12
80.6	27	18.2	4.01
82.4	28	17.4	3.91
84.2	29	16.6	3.81
86	30	15.9	3.71
87.8	31	15.2	3.62
89.6	32	14.5	3.52
91.4	33	13.9	3.43
93.2	34	13.3	3.33
95	35	12.7	3.24
96.8	36	12.1	3.15
98.6	37	11.6	3.06
100.4	38	11.1	2.97
102.2	39	10.7	2.89
104	40	10.2	2.81
105.8	41	9.78	2.72
107.6	42	9.37	2.64
109.4	43	8.98	2.57
111.2	44	8.61	2.49
113	45	8.26	2.42
114.8	46	7.92	2.34
116.6	47	7.6	2.27
118.4	48	7.29	2.2
120.2	49	7	2.14
122	50	6.72	2.07
123.8	51	6.45	2.01
125.6	52	6.19	1.94
127.4	53	5.95	1.88
129.2	54	5.72	1.82
131	55	5.49	1.77
132.8	56	5.28	1.71
134.6	57	5.08	1.66
136.4	58	4.88	1.61
138.2	59	4.69	1.56
140	60	4.52	1.51
141.8	61	4.35	1.46
143.6	62	4.18	1.41
145.4	63	4.03	1.37
147.2	64	3.88	1.32
149	65	3.73	1.28
150.8	66	3.59	1.24
152.6	67	3.46	1.2
154.4	68	3.34	1.16
156.2	69	3.21	1.13
158	70	3.1	1.09
159.8	71	2.99	1.06
161.6	72	2.88	1.02
163.4	73	2.78	0.991
165.2	74	2.68	0.96
167	75	2.58	0.929
168.8	76	2.49	0.9
170.6	77	2.41	0.872
172.4	78	2.32	0.844
174.2	79	2.24	0.818
176	80	2.17	0.792
177.8	81	2.09	0.767
179.6	82	2.02	0.744
181.4	83	1.95	0.72
183.2	84	1.89	0.698
185	85	1.82	0.676
186.8	86	1.76	0.655
188.6	87	1.7	0.635
190.4	88	1.65	0.616
192.2	89	1.59	0.597
194	90	1.54	0.578
195.8	91	1.49	0.561
197.6	92	1.44	0.544
199.4	93	1.4	0.527
201.2	94	1.35	0.511
203	95	1.31	0.496
204.8	96	1.27	0.481
206.6	97	1.23	0.466
208.4	98	1.19	0.452
210.2	99	1.15	0.439
212	100	1.11	0.425
213.8	101	1.08	0.413
215.6	102	1.05	0.401
217.4	103	1.01	0.389
219.2	104	0.98	0.378
221	105	0.95	0.367
222.8	106	0.92	0.356
224.6	107	0.9	0.346
226.4	108	0.87	0.336
228.2	109	0.84	0.326
230	110	0.82	0.317
231.8	111	0.79	0.308
233.6	112	0.77	0.299
235.4	113	0.75	0.29
237.2	114	0.73	0.282
239	115	0.7	0.274

Temp. [°F]	Temp. [°C]	Resistance [KΩ]	Terminal voltage [V]
240.8	116	0.68	0.266
242.6	117	0.66	0.259
244.4	118	0.64	0.252
246.2	119	0.63	0.245
248	120	0.61	0.238
249.8	121	0.59	0.231
251.6	122	0.57	0.225
253.4	123	0.56	0.219
255.2	124	0.54	0.213
257	125	0.53	0.207
258.8	126	0.51	0.201
260.6	127	0.5	0.196
262.4	128	0.49	0.191
264.2	129	0.47	0.186
266	130	0.46	0.181
267.8	131	0.45	0.176
269.6	132	0.43	0.171
271.4	133	0.42	0.167
273.2	134	0.41	0.162
275	135	0.4	0.158
276.8	136	0.39	0.154
278.6	137	0.38	0.15
280.4	138	0.37	0.146
282.2	139	0.36	0.142
284	140	0.35	0.139
285.8	141	0.34	0.135
287.6	142	0.33	0.132
289.4	143	0.32	0.128
291.2	144	0.32	0.125
293	145	0.31	0.122
294.8	146	0.3	0.119
296.6	147	0.29	0.116
298.4	148	0.29	0.113
300.2	149	0.28	0.11
302	150	0.27	0.107

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Temp. [°F]	Temp.[°C]	Resistance [Ω]
-40	-40	336098
-38.2	-39	314553
-36.4	-38	294524
-34.6	-37	275897
-32.8	-36	258563
-31	-35	242427
-29.2	-34	227398
-27.4	-33	213394
-25.6	-32	200339
-23.8	-31	188163
-22	-30	176803
-20.2	-29	166198
-18.4	-28	156294
-16.6	-27	147042
-14.8	-26	138393
-13	-25	130306
-11.2	-24	122741
-9.4	-23	115661
-7.6	-22	109032
-5.8	-21	102824
-4	-20	97006
-2.2	-19	91553
-0.4	-18	86439
1.4	-17	81641
3.2	-16	77138
5	-15	72911
6.8	-14	68940
8.6	-13	65209
10.4	-12	61703
12.2	-11	58405
14	-10	55304
15.8	-9	52385
17.6	-8	49638
19.4	-7	47050
21.2	-6	44613
23	-5	42317
24.8	-4	40151
26.6	-3	38110
28.4	-2	36184
30.2	-1	34366
32	0	32651

Temp. [°F]	Temp.[°C]	Resistance [Ω]
33.8	1	31031
35.6	2	29500
37.4	3	28054
39.2	4	26687
41	5	25395
42.8	6	24172
44.6	7	23016
46.4	8	21921
48.2	9	20885
50	10	19903
51.8	11	18973
53.6	12	18092
55.4	13	17257
57.2	14	16465
59	15	15714
60.8	16	15001
62.6	17	14324
64.4	18	13682
66.2	19	13073
68	20	12493
69.8	21	11943
71.6	22	11420
73.4	23	10923
75.2	24	10450
77	25	10000
78.8	26	9572
80.6	27	9165
82.4	28	8777
84.2	29	8408
86	30	8056
87.8	31	7721
89.6	32	7402
91.4	33	7097
93.2	34	6807
95	35	6530
96.8	36	6266
98.6	37	6014
100.4	38	5774
102.2	39	5544
104	40	5325
105.8	41	5116
107.6	42	4916
109.4	43	4724

Temp. [°F]	Temp.[°C]	Resistance [Ω]
111.2	44	4542
113	45	4367
114.8	46	4200
116.6	47	4040
118.4	48	3887
120.2	49	3741
122	50	3601
123.8	51	3467
125.6	52	3339
127.4	53	3216
129.2	54	3098
131	55	2985
132.8	56	2877
134.6	57	2773
136.4	58	2674
138.2	59	2579
140	60	2487
141.8	61	2399
143.6	62	2315
145.4	63	2234
147.2	64	2157
149	65	2082
150.8	66	2011
152.6	67	1942
154.4	68	1876
156.2	69	1813
158	70	1752
159.8	71	1693
161.6	72	1637
163.4	73	1582
165.2	74	1530
167	75	1480
168.8	76	1432
170.6	77	1385
172.4	78	1341
174.2	79	1298
176	80	1256
177.8	81	1216
179.6	82	1178
181.4	83	1141
183.2	84	1105
185	85	1070
186.8	86	1037

Temp. [°F]	Temp.[°C]	Resistance [Ω]
188.6	87	1005
190.4	88	974
192.2	89	945
194	90	916
195.8	91	888
197.6	92	862
199.4	93	836
201.2	94	811
203	95	787
204.8	96	764
206.6	97	741
208.4	98	720
210.2	99	699
212	100	678
213.8	101	659
215.6	102	640
217.4	103	622
219.2	104	604
221	105	587
222.8	106	571
224.6	107	555
226.4	108	539
228.2	109	524
230	110	510
231.8	111	496
233.6	112	482
235.4	113	469
237.2	114	457
239	115	444
240.8	116	432
242.6	117	421
244.4	118	410
246.2	119	399
248	120	388
249.8	121	378
251.6	122	368
253.4	123	359
255.2	124	350
257	125	341

Nickel Class B DIN 43760 sensors

The characteristic of the nickel temperature sensor is specified as per DIN 43760. The large Temperature Coefficient of Resistance (TCR) of the Ni-RTD, 6178 ppm/K, offers greater sensitivity than other types of RTD's. The electrical characteristic can be described by the following equation:

R(T) = R0 (1+aT+bT2+cT4+dT6)

Coefficients:

- a = 5.485 x 10-3
- b = 6.650 x 10-6
- c = 2.805 x 10-11
- d =-2.000 x 10-17

T(R) = a´+b´(1+c´R)½ +d´R5+e´R7 dT < 0.12 K (higher order equations on request)

Coefficients:

- a´= - 412.6
- b´= 140.41
- c´= 0.00764
- d´= - 6.25 x 10-17
- e´= -1.25 x 10-24

Tolerances:

- Class B (0.4+0.007 x |T|) in range from 32 °F (0 °C) to 320 °F (+160 °C)

(0.4+0.028 x |T|) in range from -67 °F (-55 °C) to 32 °F (0 °C)

T/°F	T/°C	0	1	2	3	4	5	6	7	8	9
-76	-60	695.2	699.9	704.6	709.3	714	718.7	723.4	728.2	733	737.8
-58	-50	742.6	747.4	752.2	757	761.9	766.8	771.6	776.5	781.4	786.4
-40	-40	791.3	796.3	801.2	806.2	811.2	816.2	821.2	826.3	831.3	836.4
-22	-30	841.5	846.5	851.7	856.8	861.9	867	872.2	877.4	882.6	887.8
-4	-20	893	898.2	903.4	908.7	913.9	919.2	924.5	929.8	935.1	940.5
14	-10	945.8	951.2	956.5	961.9	967.3	972.7	978.2	983.6	989.1	994.5
32	0	1000	1005.5	1011	1016.5	1022	1027.6	1033.1	1038.7	1044.3	1049.9
50	10	1055.5	1061.1	1066.8	1072.4	1078.1	1083.8	1089.5	1095.2	1100.9	1106.6
68	20	1112.4	1118.1	1123.9	1129.7	1135.5	1141.3	1147.1	1153	1158.8	1164.7
86	30	1170.6	1176.5	1182.4	1188.3	1194.2	1200.2	1206.1	1212.1	1218.1	1224.1
104	40	1230.1	1236.1	1242.2	1248.2	1254.3	1260.4	1266.5	1272.6	1278.8	1284.9
122	50	1291.1	1297.2	1303.4	1309.6	1315.8	1322	1328.3	1334.5	1340.8	1347.1
140	60	1353.4	1359.7	1366	1372.4	1378.7	1385.1	1391.5	1397.9	1404.3	1410.8
158	70	1417.2	1423.7	1430.1	1436.6	1443.1	1449.7	1456.2	1462.8	1469.3	1475.9
176	80	1482.5	1489.1	1495.7	1502.4	1509.1	1515.7	1522.4	1529.1	1535.9	1542.6
194	90	1549.3	1556.1	1562.9	1569.7	1576.5	1583.4	1590.2	1597.1	1604	1610.9
212	100	1617.8	1624.7	1631.7	1638.6	1645.6	1652.6	1659.6	1666.7	1673.7	1680.8
230	110	1687.9	1695	1702.1	1709.3	1716.4	1723.6	1730.8	1738	1745.2	1752.5
248	120	1759.7	1767	1774.3	1781.6	1788.9	1796.3	1803.7	1811.1	1818.5	1825.9
266	130	1833.3	1840.8	1848.3	1855.8	1863.3	1870.9	1878.4	1886	1893.6	1901.2
284	140	1908.9	1916.5	1924.2	1931.9	1939.6	1947.4	1955.1	1962.9	1970.7	1978.5
302	150	1986.3	1994.2	2002.1	2010	2017.9	2025.9	2033.8	2041.8	2049.8	2057.8
320	160	2065.9	2074	2082.1	2090.2	2098.3	2106.5	2114.6	2122.8	2131.1	2139.3

NI1000TK5000

Sensor Type	Nominal Resistance	Sensitivity
Ni1000 TK5000 DIN B	R_0: 1000 Ω	TC: 5000 ppm/K

°F	°C	0	-1	-2	-3	-4	-5	-6	-7	-8	-9
-58	**-50**	790.88									
-40	**-40**	830.84	826.8	822.78	818.76	814.75	810.75	806.76	802.78	798.8	794.84
-22	**-30**	871.69	867.57	863.45	859.34	855.24	851.15	847.07	843	838.94	834.88
-4	**-20**	913.48	909.26	905.05	900.85	896.65	892.47	888.3	884.13	879.98	875.83
14	**-10**	956.24	951.92	947.61	943.31	939.02	934.74	930.47	926.21	921.96	917.72
32	**0**	1000	995.58	991.17	986.77	982.37	977.99	973.62	969.26	964.91	960.57
°F	**°C**	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
32	**0**	1000	1004.4	1008.9	1013.3	1017.8	1022.3	1026.8	1031.2	1035.8	1040.3
50	**10**	1044.8	1049.3	1053.9	1058.4	1063	1067.6	1072.2	1076.8	1081.4	1086
68	**20**	1090.7	1095.3	1100	1104.6	1109.3	1114	1118.7	1123.4	1128.1	1132.9
86	**30**	1137.6	1142.4	1147.1	1151.9	1156.7	1161.5	1166.3	1171.2	1176	1180.9
104	**40**	1185.7	1190.6	1195.5	1200.4	1205.3	1210.2	1215.1	1220.1	1225	1230
122	**50**	1235	1240	1245	1250	1255	1260.1	1265.1	1270.2	1275.3	1280.3
140	**60**	1285.5	1290.6	1295.7	1300.8	1306	1311.1	1316.3	1321.5	1326.7	1331.9
158	**70**	1337.2	1342.4	1347.6	1352.9	1358.2	1363.5	1368.8	1374.1	1379.4	1384.8
176	**80**	1390.1	1395.5	1400.9	1406.3	1411.7	1417.1	1422.5	1428	1433.4	1438.9
194	**90**	1444.4	1449.9	1455.4	1460.9	1466.5	1472	1477.6	1483.2	1488.8	1494.4
212	**100**	1500	1505.6	1511.3	1517	1522.6	1528.3	1534	1539.8	1545.5	1551.2
230	**110**	1557	1562.8	1568.6	1574.4	1580.2	1586	1591.8	1597.7	1603.6	1609.5
248	**120**	1615.4	1621.3	1627.2	1633.2	1639.1	1645.1	1651.1	1657.1	1663.1	1669.1
266	**130**	1675.2	1681.3	1687.3	1693.4	1699.5	1705.7	1711.8	1717.9	1724.1	1730.3
284	**140**	1736.5	1742.7	1748.9	1755.2	1761.4	1767.7	1774	1780.3	1786.6	1792.9
302	**150**	1799.3									

RELATED TECHNICAL LITERATURE

Table 16. Related Technical Literature

Title	Reference
MERLIN NX IP Product Datasheet	EN0Z1073-GE51
MERLIN NX MSTP Product Datasheet	EN0Z1072-GE51
MERLIN NX IP and MSTP Mounting instructions	EN1Z1074GE51
MERLIN NX Migration Guide	EN2Z1061-GE51
Honeywell Connect Mobile VAV Balancing application User Guide	EN2Z1086-IE67
IRM Engineering Guide	EN2B0414-GE51
IRM Function Blocks User Guide	EN2B0415-GE51
CLCMTR40x/CLCMTR42x – Installation Instructions	EN1Z0990-GE51
CLCMTR40x/CLCMTR42x – Operating Guide	EN2Z0990-GE51

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