Honeywell

Honeywell

VAV CONTROLLER

INSTALLATION INSTRUCTIONS

31-00725-01

GENERAL

Trademark Information

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

Product Description

Honeywell VAV controller is a programmable room controller with an integrated actuator and airflow sensor.

As a freely programmable VAV controller with universal inputs and outputs, the Honeywell VAV has configuration flexibility to achieve a variety of specific applications. Smart engineering and commissioning tools with Honeywell Supervisor Workbench and the Honeywell connect mobile application for test and balance make installation cost-effective.

Honeywell VAV offers BACnet™ IP or BACnet™ MS/TP, Sylk™ bus technology, Modbus RTU RS-485, universal inputs and output (UIO), and solid-state relays.

Table 1 Part Numbers

Part Number	Universal IO	Solid State Relay	Total IO	Communication	BLE Integrated
VAA-VA75IB24NMC/D	7	5	12	IP	Yes
VAA-VA75I24NMC/D	7	5	12	IP	No
VAA-VA00IB24NMC/D	0	0	0	IP	Yes
VAA-VA75MB24NMC/D	7	5	12	MS/TP	Yes
VAA-VA75M24NMC/D	7	5	12	MS/TP	No
VAA-VA00MB24NMC/D	0	0	0	MS/TP	Yes
Note: SKUs with C are applicable to all brands except HBS. SKUs with D are applicable to HBS brand only.					

Table 2 Replacement Part

Part Number	Comments
SDPPF500PA	Replacement air flow sensor
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.

Controller Part Numbers

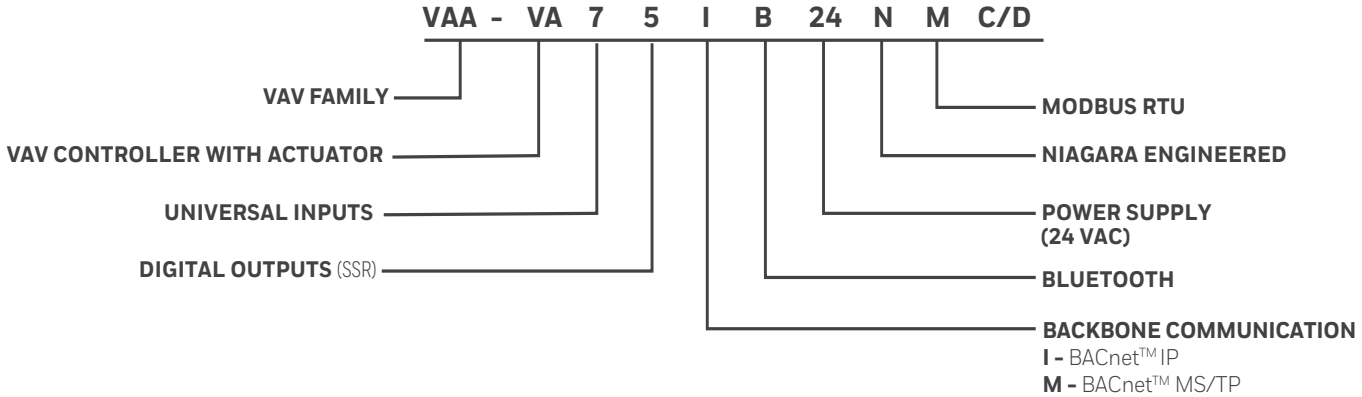


Fig. 1 Controller Part Numbers

Dimensions

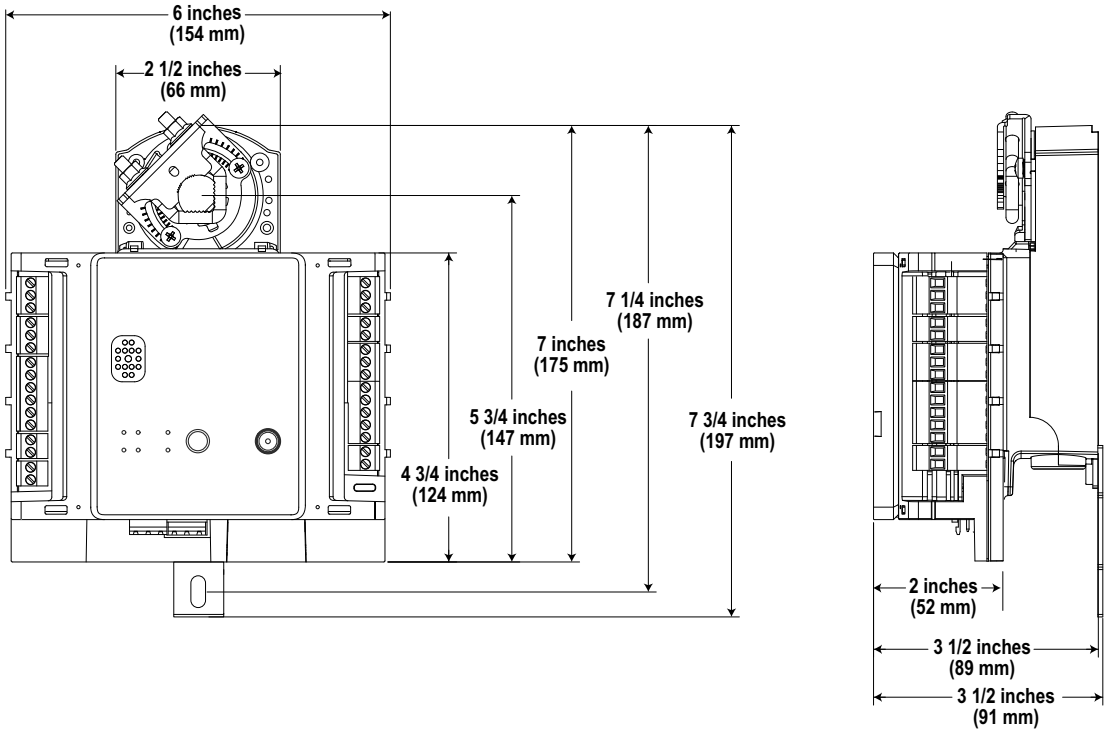


Fig. 2 Honeywell VAV Dimensions

NETWORK SECURITY

⚠ WARNING

Honeywell hereby expressly states that the Honeywell VAV controller are not inherently protected against all cyber security risks from the Internet and are thus intended solely for use in private or protected networks.

Unprotected Internet connections can expose the Honeywell VAV controller to cyber security risks.

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.

GENERAL SAFETY INSTRUCTIONS

Follow the safety instructions provided by Honeywell in this manual while doing any operation such installation, mounting, or starting.

- The Honeywell VAV controllers must be installed and mounted by authorized and trained personnel.
- In the case of any modification, except by Honeywell, the operation and safety warranties become void.
- Observe all applicable local standards and regulations.
- Use only Honeywell supplied or approved accessories.
- Before installing or dismantling the system, disconnect the power supply by either removing the power terminal block from the controller or through local isolation.

⚠ CAUTION

You must disconnect the power before installing, removing, or replacing the Honeywell VAV controller.
Switch off the power before you install any jumpers.

SPECIFICATIONS

Electrical

Table 3 Electrical Specification

Parameter	Specification
Rated input voltage	20 - 30 VAC; Class 2 transformer
Nominal Power Consumption	**IP model:** 14.53 VA; controller and actuator load (nothing connected to IO and COM) **MS/TP model:** 15.33 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). **MS/TP 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

Table 4 Operational Environment

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

Hardware

Table 5 Hardware Specification

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, example, green, yellow, or red

Actuators

Table 6 Integrated and External Actuators

Integrated Actuators	
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 if the actuator is stuck or the potentiometer is damaged.	
External Actuators	
Non-Sylk™ Actuators: MS4103, MS4105, MS7403, MS7405, MS7503, MS7505, MS8103, MS8105	

Communications

Table 7 Communication Specification

Parameter	Specification
Protocol supported	BACnet™ IP, BACnet™ MS/TP, 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

Table 8 Modbus Client Specifications

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 20.
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.

Sylk™ Supported Devices*

Table 9 Sylk™ Supported Devices

Parameter	Specification
Sylk™ wall modules	TR40, TR40-H, TR40-CO2, TR40-H-CO2, TR42, TR42-H, TR42-CO2, TR42-H-CO2, TR71, TR71-H, TR75, TR75-H, TR120, and TR120-H, TR50-3D, TR50-3N, TR50-5D, TR50-5N, TR100-THC-G, TR100-TH-G.
Sylk™ sensor	C7400S Sylk™ sensor
Actuator	**Sylk™:** MS3103, MS3105

NOTE:
"*" mentioned applies to Niagara 4 workbench only. CPO supports only TR50, TR100, TR40 and TR42 wall modules.

Differential Pressure Sensor

Table 10 Differential Pressure Sensor Specification

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

Weight And Dimensions

Table 11 Weight And Dimensions

Parameter	Specification
Dimension (L x W x H)	3 1/2 x 6 x 7 3/4 in. (89 x 154 x 197 mm)
Weight	3.06 lb (1.5 Kg)
Mounting	Fixation with bracket and shaft

Universal IO

Table 12 Universal IO Specification

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 Honeywell VAV controller has a single common terminal for every two UIOs, which protects them against 24 VAC mis-wiring and short circuits.	

NOTE:
Universal signal input/output 4 (Input = Binary input dry contact (Polarity = Normal/reverse) can be configured <"4-20 mA" "0-10 V" NTC20K" PT1000, NI1000TK5000, Setpoint Absolute, Set-point Relative and Bypass Fan >; Output = Binary Output dry contact (Polarity = Normal/reverse) can be configured <"0-10 V" "4-20 mA">. These UIOs are applicable for CPO only.

Solid State Relay (SSR)

Table 13 Solid State Relay (SSR)

Specification
Solid state relay 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. • All SSR on the controller must be the same: either all high side switching or all low side switching. • Keep the jumper in place for high side switching. • Remove the jumper for low side switching.

Wireless Connectivity

Table 14 Connectivity Frequency Range

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

HARDWARE OVERVIEW

IP Model

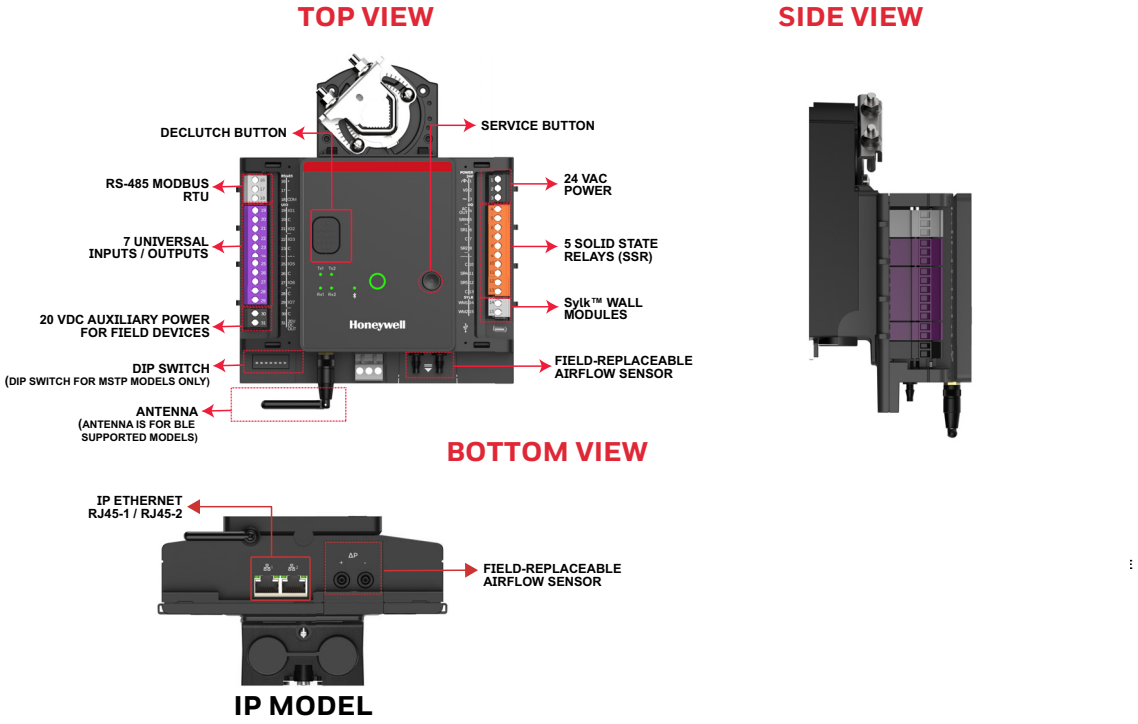


Fig. 3 IP Model Hardware Overview

MS/TP Model

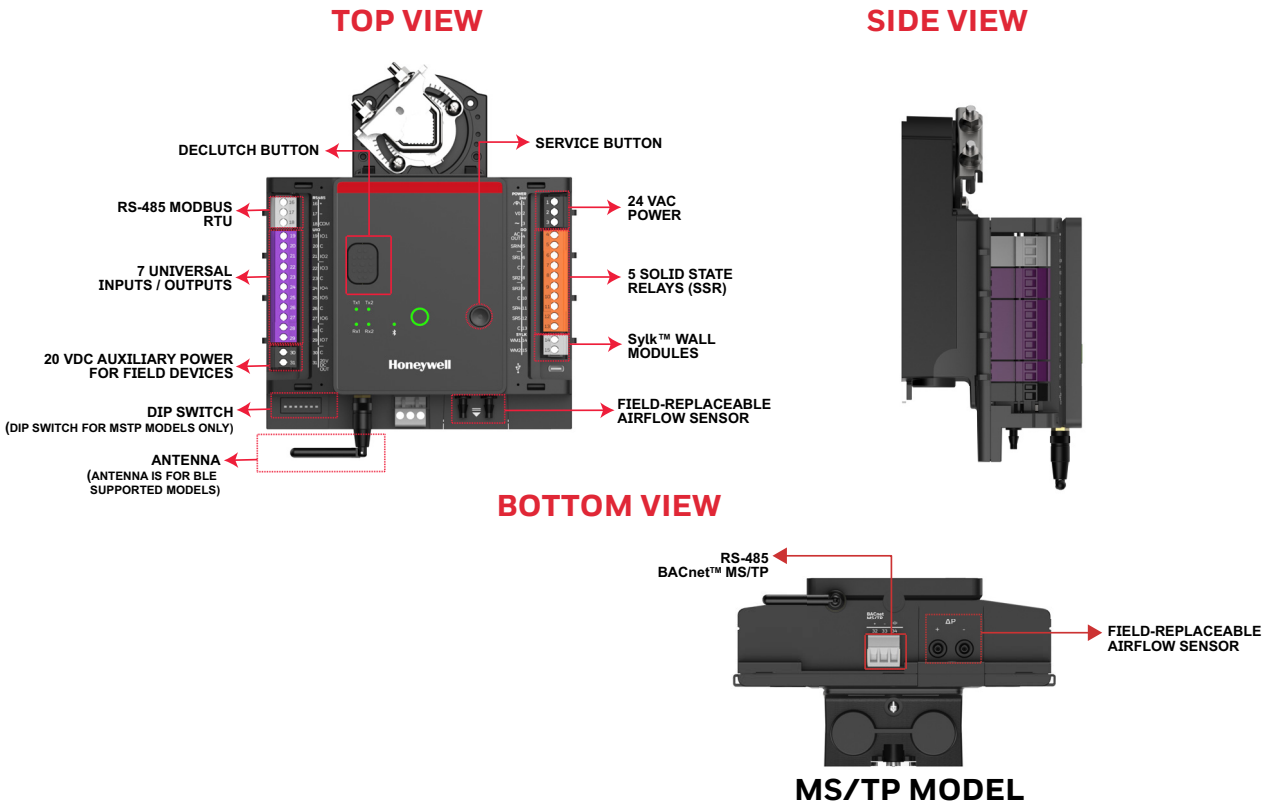


Fig. 4 MS/TP Model Hardware Overview

Service Button

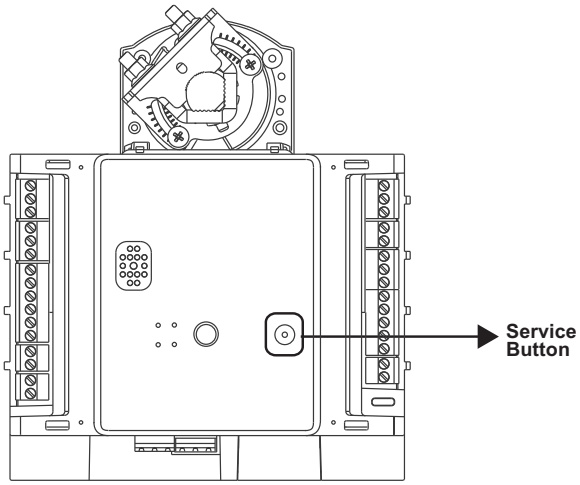


Fig. 5 Service Button Location

The service button is used to trigger dedicated events. It is important to distinguish different controller behaviors which are 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

The controller is reset to factory settings when you press the service button and turn it on (while the service button is pressed). The factory defaults are as follows:

- The application is cleared from the controller.
- The MAC address will be set to 0xFF (255), meaning that the controller will now search for a new MAC address (Auto MAC will be automatically triggered after controller power-up).
- The Max Master setting will revert to its default value. See Automatic MAC Addressing on page 25 for the 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 VAA-VAxxxx.
- The values of Auto MAC, Min MAC, and Max MAC will be reset to default.
- The Modbus, Ethernet, and Bluetooth 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 button message (BACnet™ WhoAmI as a Private Transfer (SerialNo. = 130)) to be sent.

Refer to the Honeywell Compact VAV and Honeywell VAV System Engineering Guide - 31-00282 for more information.

MOUNTING

To mount the Honeywell VAV, 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.

Field devices driven by the analog current outputs must have a maximum resistance of 550 Ohms. The resistor must be installed on the field device.

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

Before Mounting Actuator

Honeywell VAV controller includes a direct-coupled actuator with the declutch mechanism, 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.

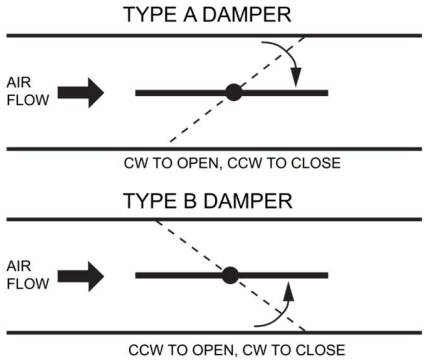


Fig. 6 Determining the Rotation Direction (CW or CCW)

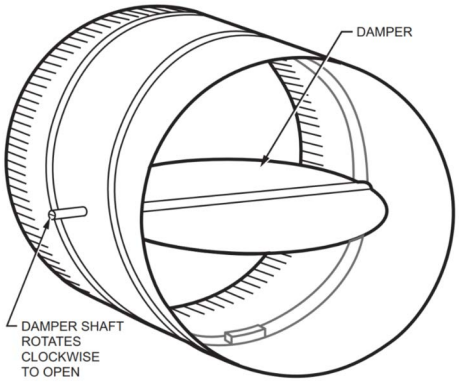


Fig. 7 Damper with 90 Degree CW Rotation to Open

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

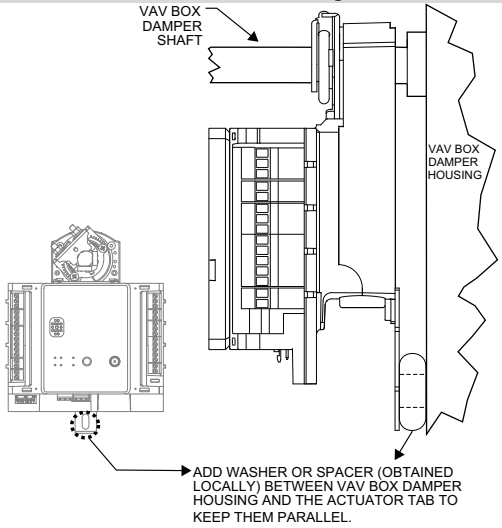


Fig. 8 Mounting Controller to VAV Box Damper Housing when Actuator is not Parallel to VAV Box Damper Housing

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

Mounting Actuator onto Damper Shaft

The Honeywell VAV controllers can be mounted in any orientation. Mount them in a position that allows access to the service button and clearance for wiring, servicing, and removing BACnet™ wiring.

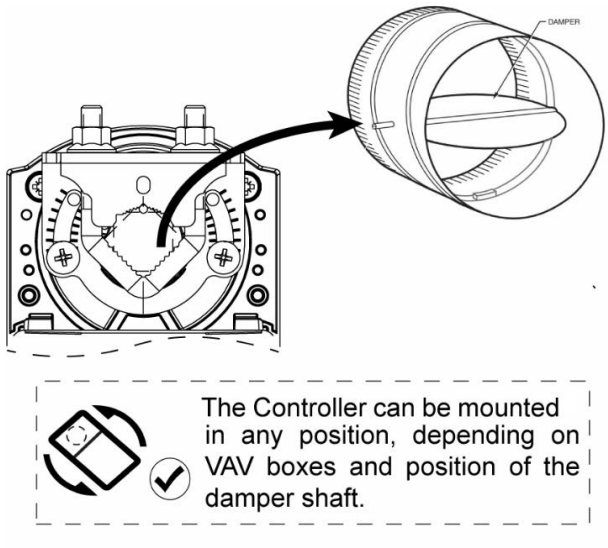


Fig. 9 Mounting Actuator on Damper Shaft

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

The Honeywell 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 damper shafts 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 Honeywell 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.

Screw the anti-rotation bracket using screws on the controller.

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 °.

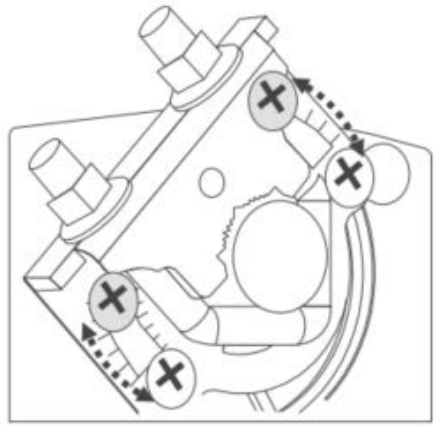


Fig. 10 Setting the Mechanical End Limits

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 90 ° 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 ° to close fully.

2. **If the damper rotates clockwise (CW) to open, and the angle of the damper open-to-closed is 45 or 60 °:**
   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 counterclockwise (CCW) either 45 or 60 ° to fully close.

3. **If the damper rotates counterclockwise (CW) to open, and the angle of the damper open-to-closed is 90 °:**
   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. [8 Nm] torque). When the actuator closes, the damper rotates CW 90 ° to close fully.

4. **If the damper rotates counterclockwise (CW) to open, and the angle of the damper open-to-closed is 45 or 60 °:**
   a. Manually open the damper fully (rotate counterclockwise).
   b. The actuator is shipped with the mechanical end limits set at 95 °. 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 counterclockwise.
   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 Nm] torque).
   g. When the actuator closes, the damper rotates CW, either 45 or 60 °, to close fully.

Airflow Sensor Connection

Connect the airflow 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.

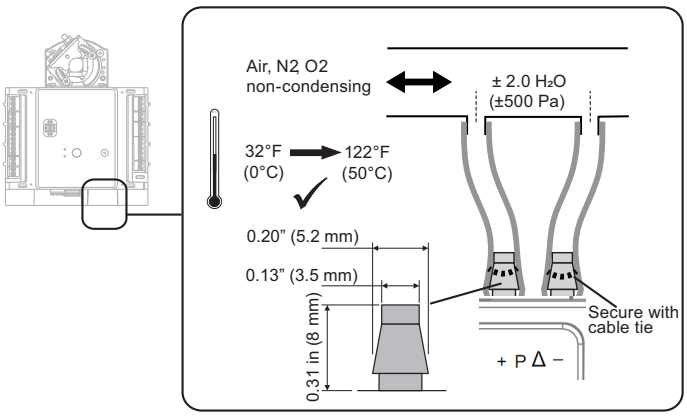


Fig. 11 Airflow Pickup Connections

NOTE:

The sensor is not polarity sensitive for the VAV application. The tubing can be attached to either of the ports since it is bidirectional.

If desired, the application can use it polarity-sensitively based on the + and - markings on the controller.

Differential Pressure Installation Recommendations

The Honeywell VAV must be powered up for a minimum of an hour before performing the zero calibration.

The tubing from the airflow pickup to the controller should not exceed 3 ft (1 m). Any length greater than this will degrade the flow sensing accuracy.

Use caution when removing tubing from the 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.

NOTE:

- Dust particle contamination may be present in some applications. Take appropriate steps to limit particulate contamination.
- The sensing element is parallel to the air stream and tends to direct the dust particles in the airflow stream past the sensing element away from the sensing bridge.
- The sensing element is a micro-structure-based device. Two platinum sensing elements and a heater are used in the bridge part of the sensing element assembly. The heater repels dust particles due to a thermophoretic action. It keeps most of the majority of the dust off the bridge structure. The heat effect, along with a simple filter, can help keep the dust from causing output shifts in the device's output.
- Although the sensor naturally repels dust, some dust and contamination can still collect on the microstructure. 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.

Airflow Sensor Replacement

Procedure to replace the airflow sensor is as follows:

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

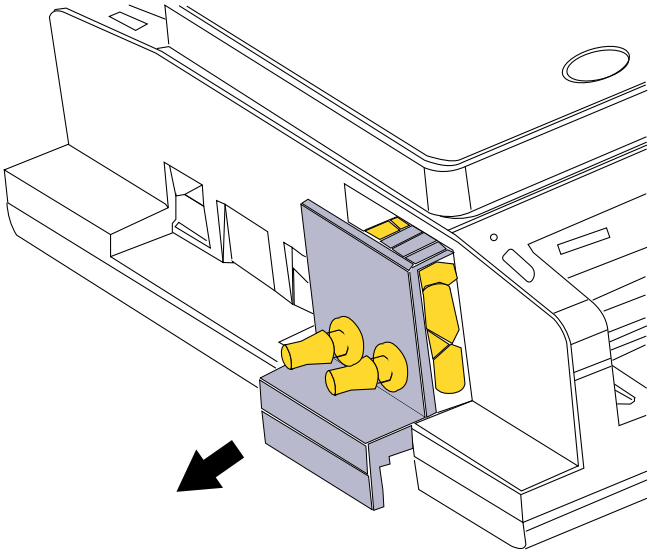


Fig. 12 Removing the Airflow Sensor Cover

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

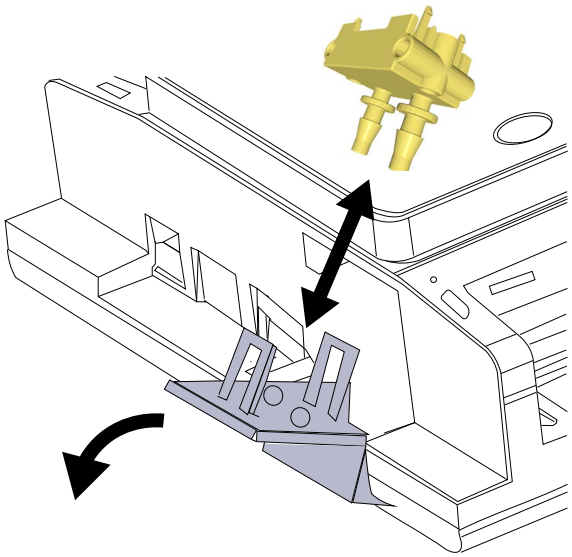


Fig. 13 Replace the Airflow Sensor

4. Attach the electrical connector.
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 Honeywell VAV, do not reverse the polarity of the power connection cables and avoid ground loops (connecting one field device to several 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 provide 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 disconnect incorporated in the fixed wiring. This type of disconnect 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.

The 24 VAC power from an energy limited Class II power source must be provided to the controller. To conform to Class II restrictions (U.S. only), the transformer must not be larger than 100 VA.

NOTE:

A single transformer can power more than one controller. The same side of the transformer secondary must be connected to the same power input terminal on each controller. Fig. 14 on page 15 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 (U.S. only).

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 mm^2), with a minimum of 22 AWG (0.3 mm^2), for all power wiring.

IMPORTANT:

When connecting power, ensure that one leg of the 24 VAC secondary circuit and the grounded terminal on the device are connected 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 ft. (4.5 m and restricted for same room installation).

Power Wiring Examples

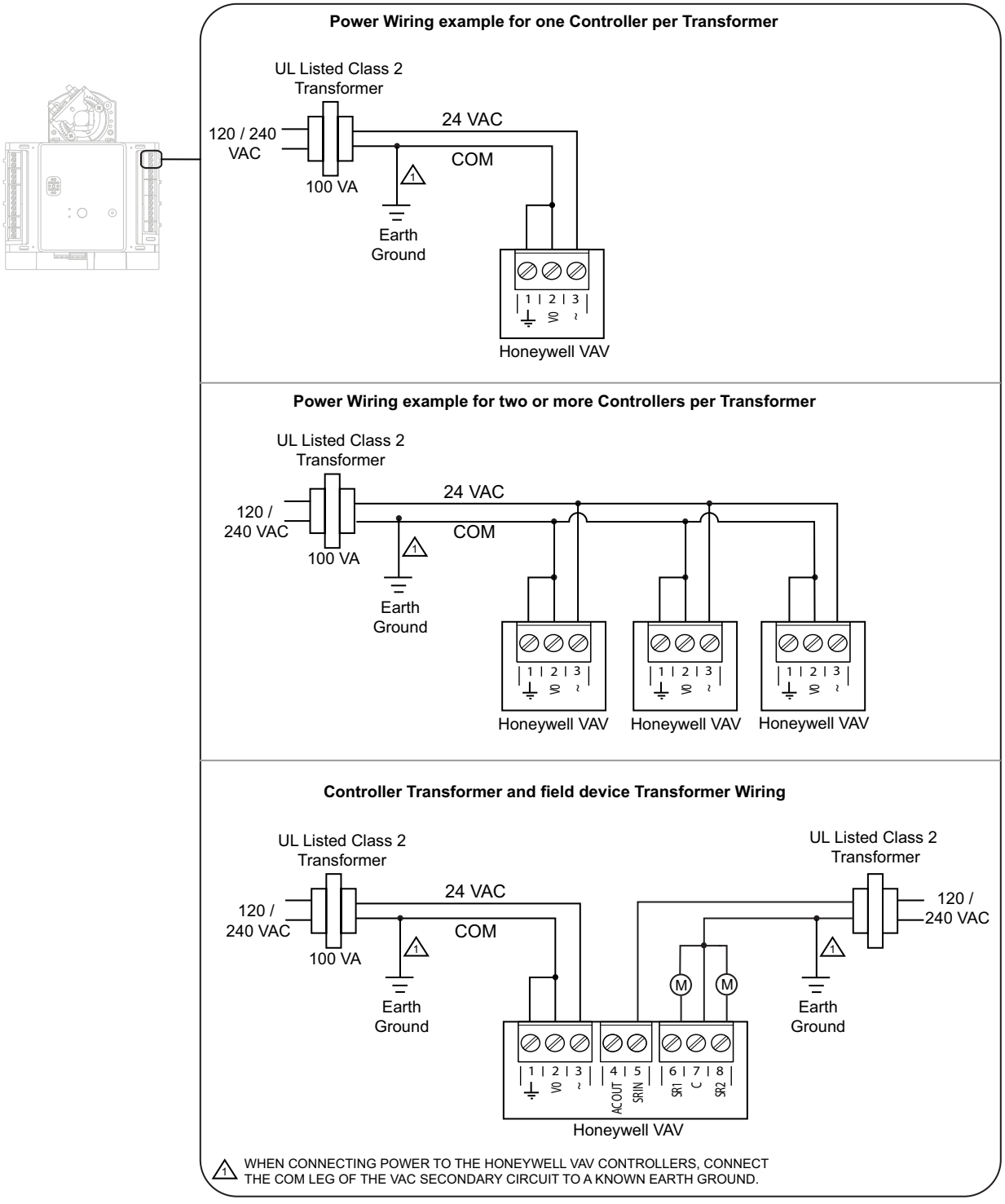


Fig. 14 Power Wiring Examples

INPUT / OUTPUT WIRING

Wiring Requirements

NOTE:
When attaching two or more wires to the same terminal, other than 14 AWG (2.0 mm^2), be sure to twist them together. Deviation from this rule can result in improper electrical contact, see Fig. 15.

Each terminal can accommodate the following gauge of wire:

- **Single wire**: From 22 AWG (0.3 mm^2) to 18 AWG (1 mm^2) solid or stranded
- **Multiple wires**: Up to two 18 AWG (1 mm^2) 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 with a minimum of three turns before inserting them, see Fig. 15.
  - 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 to the terminal block. The maximum torque for the terminal screws is 4.4 in-lb (0.5 Nm).

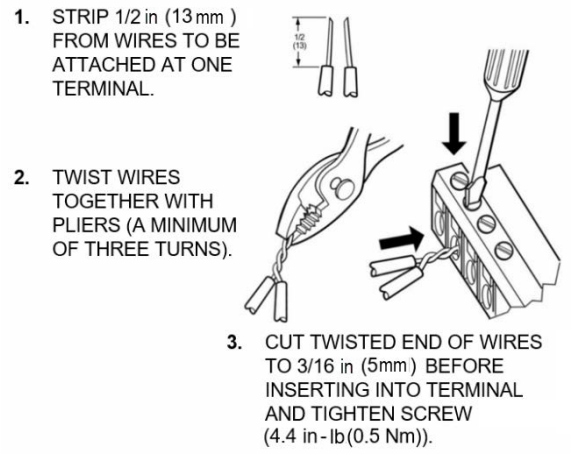


Fig. 15 Attaching Two or More Wires at Terminal Block

Internal Wiring Examples

IP Model Internal Wiring

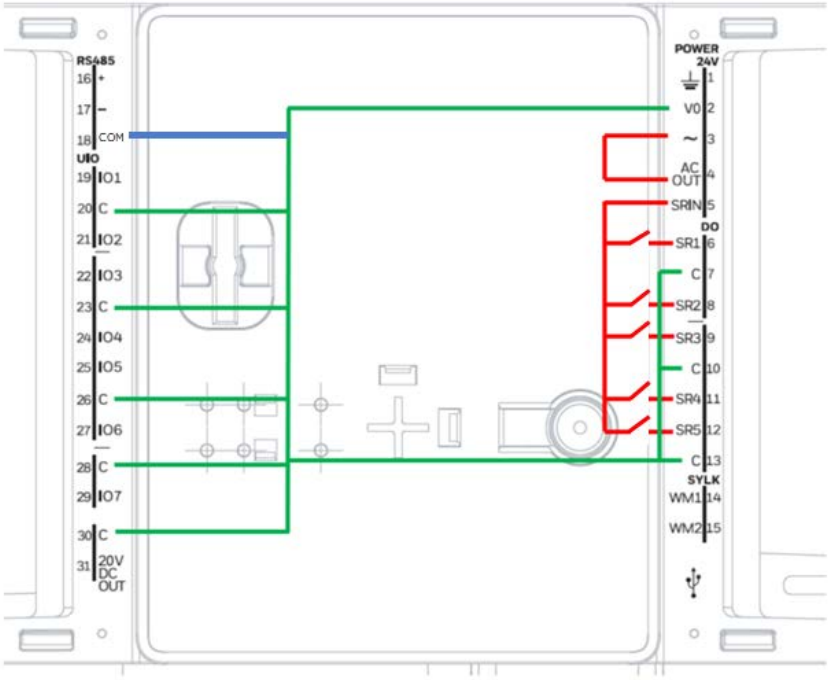


Fig. 16 IP Model Internal Wiring

MS/TP Model Internal Wiring

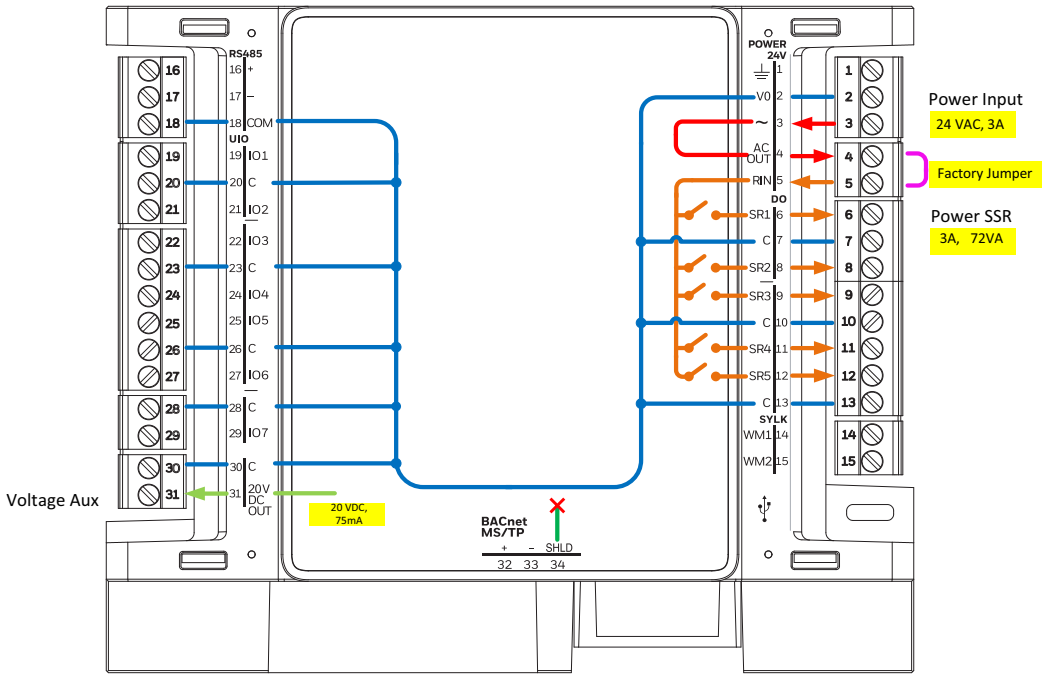


Fig. 17 MS/TP Model Internal Wiring

Terminal Connections

All the terminals for this controller are removable.

Table 15 Terminal Connections

Terminal	Label	Description
Power 24 VAC		
1	⏚	Earth ground (connected to building earth ground)
2	V0	Power supply voltage (connected to 24 V0)
3	~	Power supply voltage (connected to 24 VAC~)
4	AC OUT	24 VAC~ output
5	SRIN	SSR power input ((connected to AC OUT with a factory jumper)
DO		
6	SR1	SSR1 output
7	C	Common
8	SR2	SSR2 output
9	SR3	SSR3 output
10	C	Common
11	SR4	SSR4 output
12	SR5	SSR5 output
13	C	Common
Sylk ™		
14	WM1	Sylk™ bus
15	WM2	Sylk™ bus
RS485		
16	+	RS-485 bus + (for Modbus only)
17	-	RS-485 bus - (for Modbus only)
18	COM	Common
UIO		
19	IO1	Universal signal input / output 1
20	C	Common
21	IO2	Universal signal input / output 2
22	IO3	Universal signal input / output 3
23	C	Common
24	IO4	Universal signal input / output 4
25	IO5	Universal signal input / output 5
26	C	Common
27	IO6	Universal signal input / output 6
28	C	Common
29	IO7	Universal signal input / output 7
20 VDC OUT		
30	C	Common
31	20 VDC OUT	20 VDC power output
BACnet™ MS/TP		
32	+	BACnet™ MS/TP +
33	-	BACnet™ MS/TP -
34	COM	BACnet™ MS/TP common

UIO Wiring Examples

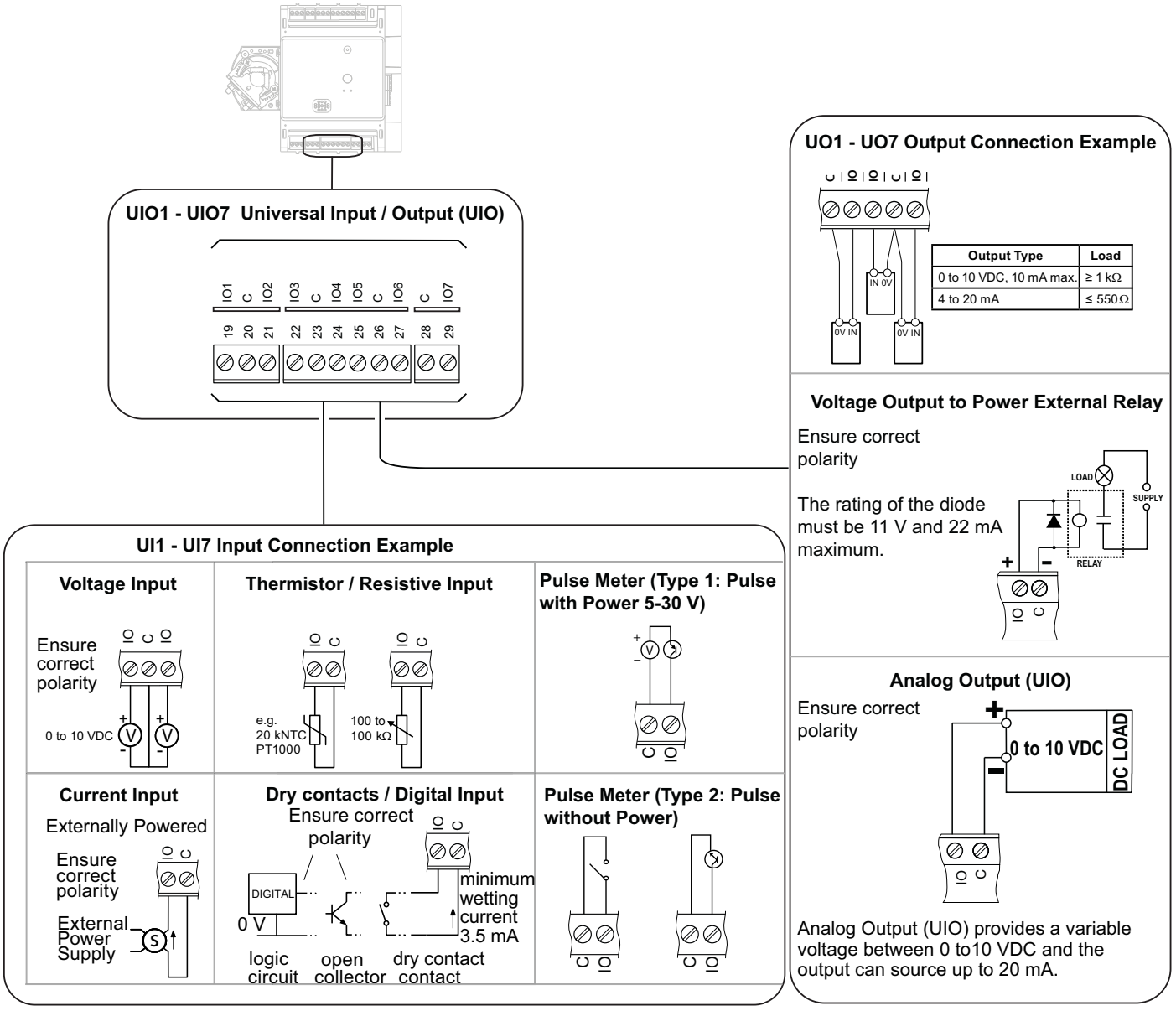


Fig. 18 Universal IO Wiring Examples

NOTE:
A protective diode is recommended, such as 1N4001, to protect the controller from the relay's voltage EMF. The rating of the diode must be 11 V and 22 mA maximum.

SSR (DO) Wiring Examples

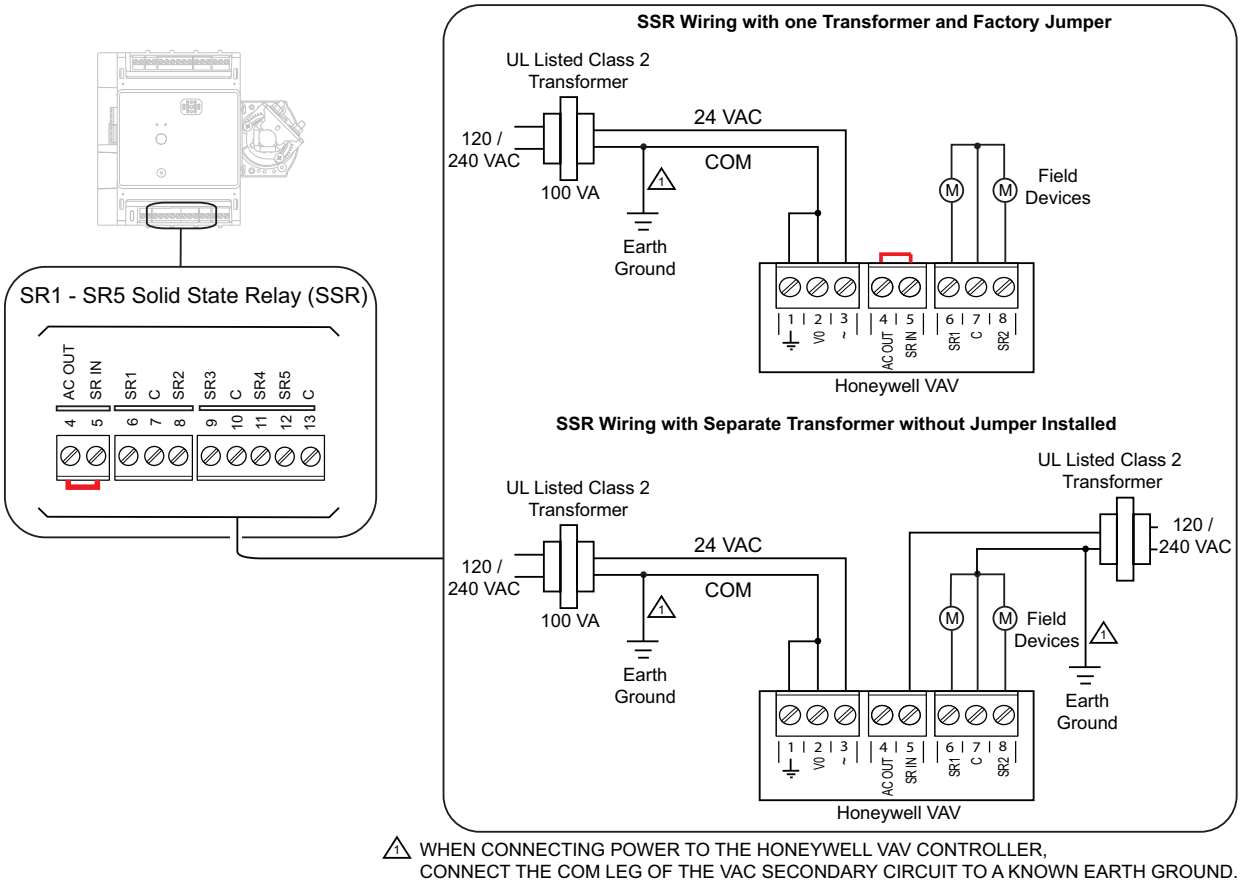


Fig. 19 SSR (DO) Wiring Examples

NOTE:

- SR IN (terminal 5, SSR power input) is connected to AC OUT (terminal 4, 24 VAC~ output) by a jumper wire provided by the factory.
- Remove the jumper if you want to power field devices with their own 24 VAC/ VDC transformer or 20 VDC.
- All terminals are protected against short circuit and 24 VAC.

20 VDC Auxiliary Wiring Examples

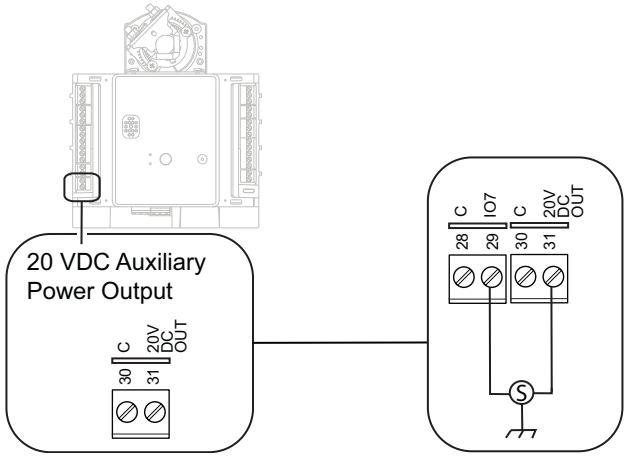


Fig. 20 20 VDC Auxiliary Wiring

NETWORK CONCEPTS

The RS-485 Standard

According to the RS-485 standard (TIA/EIA 485: “Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems”), only one driver communicating via an RS-485 interface may transmit data at a time. Further, according to U.L. requirements, each RS-485 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 RS-485 interfaces must comply with the RS-485 standard. Thus, it is recommended that each end of every bus be equipped with a termination resistor (not included in shipment) with a resistance equal to the cable impedance (120 Ω; the wattage should be in the range of 0.25 – 0.5 W).

RS-485 systems frequently lack a separate signal ground wire. However, the laws of physics still require that a solid ground connection be provided to ensure error-free communication between drivers and receivers unless all of the devices are electrically isolated, and no earth grounding exists.

CAUTION

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 16. TIA/EIA 485 Cable Specifications

Maximum Length	4000 ft (9.6–76.8 kbps)
Cable Type	Twisted shielded pair (foil or braided shields are acceptable)
Characteristic Impedance	100-130 Ω
Distributed Capacitance Between Conductors	Less than 30 pF per foot (100 pF per meter)
Distributed Cap. Between Conductors and Shield	Less than 200 pF per foot (60 pF per meter)

The Honeywell tested and recommended MS/TP cable is Honeywell Cable 3322 (18 AWG, 1-Pair, Shielded, Plenum cable). Alternatively, Honeywell Cable 3251 (22 AWG, 1-Pair, Shielded, Plenum cable) is available and meets the BACnet™ Standard requirements.

IP Network Topologies

- Recommended cable: CAT5, CAT6.
- Maximum distance between two controllers or controller and switch should be less than 328 ft (100 m).

Daisy Chain

In the daisy chain connection type, if any of the devices in the network fails, the devices beyond 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.

In a daisy chain configuration, 100 Honeywell VAV BACnet™ IP VAV and 40 Honeywell VAV BACnet™ MS/TP VAV controllers are recommended.

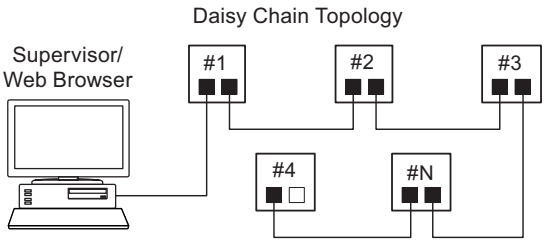


Fig. 21 Daisy Chain Topology

Ring Topology

If the Honeywell VAV BACnet™ IP VAV controllers are connected in a ring, you must have one rapid spanning tree protocol supported Ethernet switch as part of the ring. Honeywell VAV BACnet™ IP VAV supports Ethernet switch for 10/100 Mbps IP connection.

The ring topology eliminates broadcast storms and duplicate frame transmissions. The loop supports 39 Honeywell VAV BACnet™ IP VAV controllers with 1 RSTP switch. The switch manages the connection of the loop.

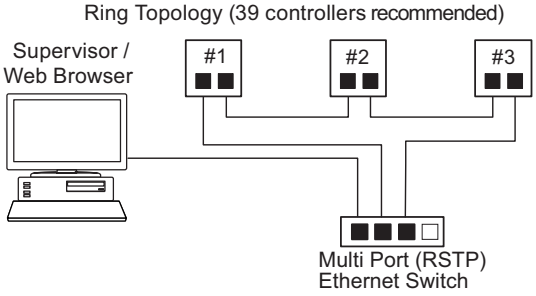


Fig. 22 Ring Topology

BACNET™ IP CONTROLLER

DHCP IP Configuration

A new controller from the factory has DHCP enabled by default.

- 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 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.

Static IP Configuration

Static IP address can be configured using Honeywell Supervisor 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**.

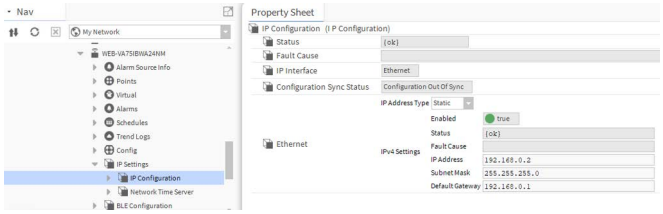


Fig. 23 Static IP Configuration

Refer to the Honeywell Compact VAV and Honeywell VAV System Engineering Guide - 31-00282 for more information on configuring the IP address.

NOTE:
The controller support the BACnet communication only via the default UDP port 47808 (0xBAC0).

Connect to an IP Network

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

Install the Local Antenna

1. Insert local antenna terminal nut into the SMA (SubMiniature version A) connector.
2. Tighten by turning the base of the antenna clockwise.

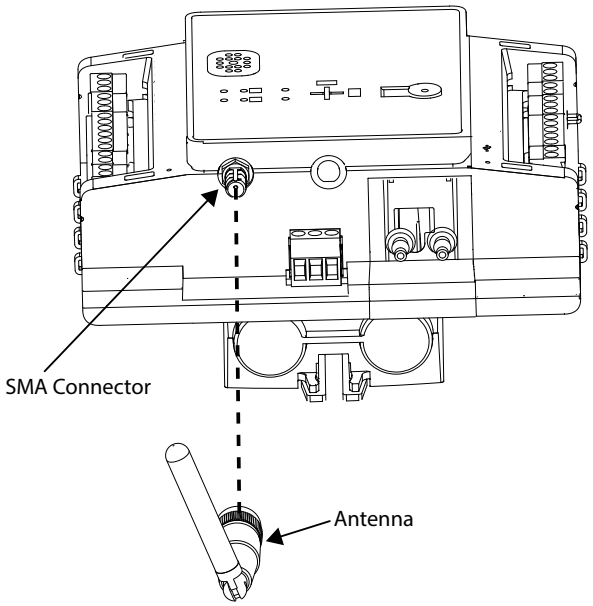


Fig. 24 Installing a Local Antenna

Install the Remote Antenna

1. Uninstall the local antenna by turning the base of the antenna counterclockwise.
2. Place the remote antenna where the signal reception is good.
3. Safely route the remote antenna wire terminal nut to the Honeywell VAV controller.
4. Insert the wire terminal nut into the SMA (SubMiniature version A) connector.

5. Tighten the wire terminal nut by turning the nut clockwise. Do not over-tighten.

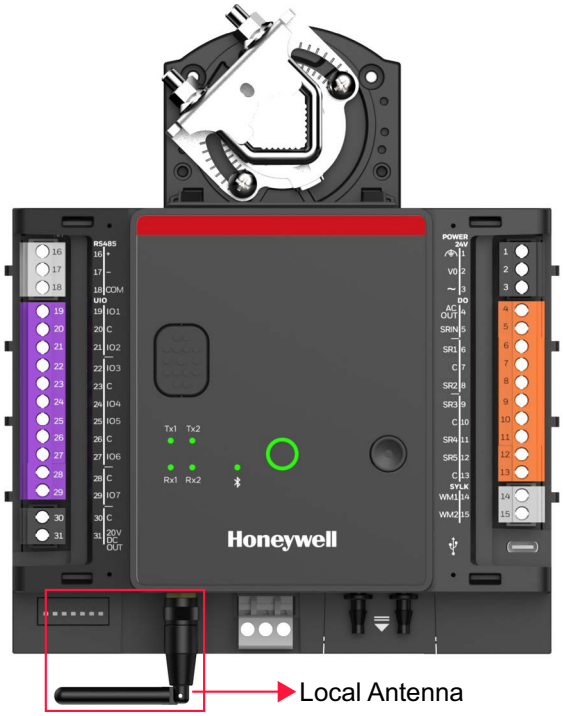


Fig. 25 Controller with local antenna

Remote Antenna Placement

Place and align the antenna in a way that the BLE signal does not interfere with any obstacles.

Table 17 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 BLE signal.
- The antenna has a strong signal transmission and reception from the side. Position the sides of the antenna towards the device it is communicating with.

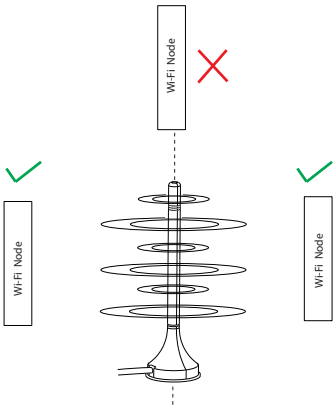


Fig. 26 Remote Antenna Placement

- Keep the antenna away from devices that cause wireless interference, such as other WiFi networks and telecommunications equipment.
- Do not install the antenna close to the floor.

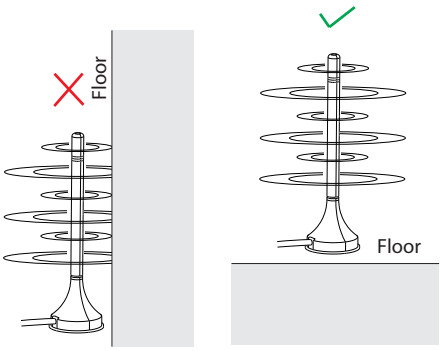


Fig. 27 Remote Antenna Placement

- The local antenna can be used when the Honeywell VAV controller is installed in a cabinet or enclosure.

BACNET™ MS/TP WIRING

The MS/TP variants of the Honeywell VAV controller use the BACnet™ MS/TP communication protocol. The controller's data is presented to other controllers over a twisted-pair MS/TP 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 Honeywell VAV BACnet™ MS/TP controllers are server devices on the MS/TP network. Each Honeywell VAV BACnet™ controller uses a high-quality TIA/EIA 485 transceiver and exerts 1/8-unit load on the MS/TP 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™ MS/TP devices per network is recommended. It is recommended to have less than 40 controllers on a single MS/TP network.

The controller features a 2-wire non-isolated RS-485 interface (terminals 32, 33, and 34) suitable for BACnet™ MS/TP communication. The terminal block containing it is gray. The cable length affects the baud rate. See Table 18.

Table 18 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 length of a BACnet™ MS/TP network bus segment with recommended wiring is 4,000 ft (1200 m). Repeaters must be used when making runs longer than 4,000 ft (1200 m). Between any two devices, a maximum of three repeaters can be used.

Auto Baud Rate Functionality

The MS/TP network is listened up to 4 minutes each time the supply voltage to the controller is turned on to establish a baud rate. Once the proper baud rate has been identified, the auto baud detection is stopped, and the new baud rate is used and saved in the controller as a successful baud rate.

If no baud rate is determined after 4 minutes, the controller will switch to the baud rate successfully used before the controller was powered up. However, if the controller is new from the factory and has yet to communicate successfully, then a default baud rate is used but not stored as a successful baud rate in the controller. This causes the same process to start again next time the supply voltage is switched on.

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 MS/TP cable has a listed characteristic impedance of 120 Ω, install a 120 Ω resistor.

RS-485 Bias Switches

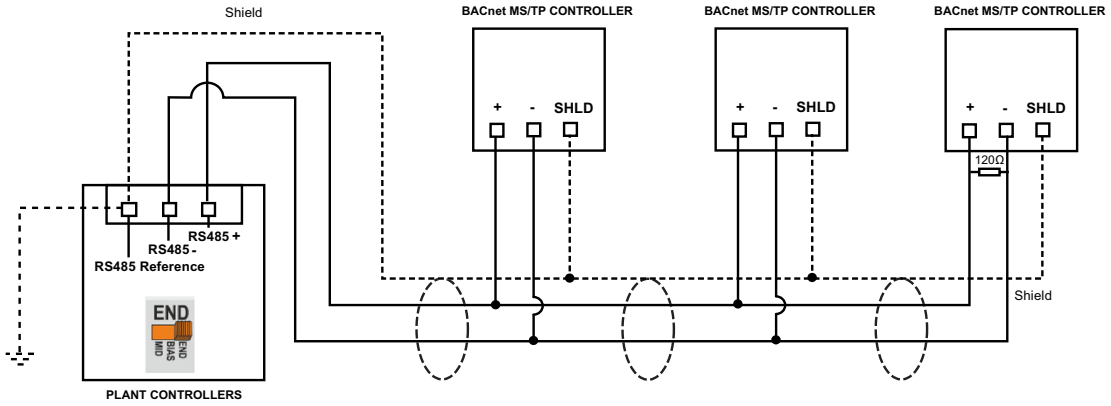
Each RS-485 port has an adjacent 3-position biasing switch, with these settings:

- **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™ MS/TP Wiring Example

Following proper MS/TP 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 MS/TP cabling close to lines carrying higher voltage. The shield should be grounded on only one end of the MS/TP segment, for example, on the earth ground terminal on the WEB-8000 and to earth ground.



NOTE: Connect the shield to earth ground from the RS485 reference terminal as shown above.

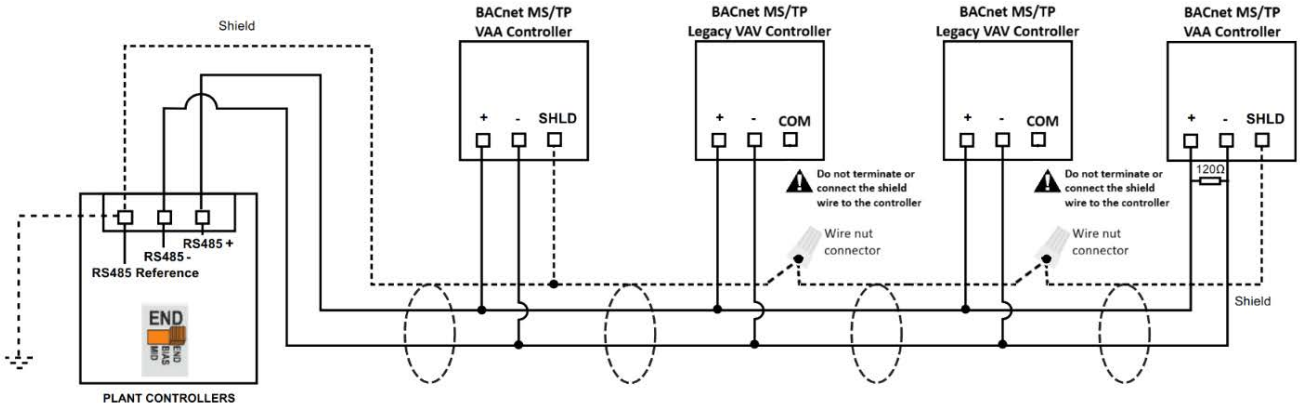
Fig. 28 BACnet™ MS/TP Wiring Example with Plant or Advanced Controller

NOTE:
The 120 Ω termination resistor must be inserted directly into the terminals of both end devices.

NOTE:
The controller is insensitive to bias voltages due to the failsafe chipset inside, and it can share the BACnet™ bus with other devices with or without bias voltages.

BACnet™ MS/TP wiring between Honeywell VAV VAA controllers and Honeywell legacy VAV controllers

For current installations where the BACnet™ MS/TP network has existing Honeywell legacy VAV controllers (e.g. WEB-VA75M24NM, WEB-VA75MB24NM, WEB-VA00MB24NM, CPO-VA75M24NM, etc.) and new Honeywell VAV VAA controllers need to be added to the network; ensure that the shield is connected on the "SHLD" terminal of the Honeywell VAV VAA controller and for the Honeywell legacy VAV controllers the shield has not been connected to the "COM" terminal only to the wire nuts as depicted in Fig. 28a.



NOTE: Connect the shield to earth ground from the RS485 reference terminal as shown above.

Fig. 28a BACnet™ MS/TP wiring example between Honeywell VAV VAA controllers and Honeywell legacy VAV controllers

BACNET™ MS/TP CONTROLLER

Automatic MAC Addressing

In contrast to other controllers, the Honeywell VAV MS/TP controllers feature automatic MAC addressing.

NOTE:
When the dip switches are set to all-ON or all-OFF, the controller will run in Auto MAC mode. Do not attempt to program a MAC address outside of Min MAC and Max MAC (0 to 127).

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

In the scenario depicted in Fig. 29, some of the controllers in the BACnet™ MS/TP network do not feature automatic MAC addressing; therefore, their MAC addresses are assigned manually. Thus, when a new Honeywell VAV BACnet™ MS/TP 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.

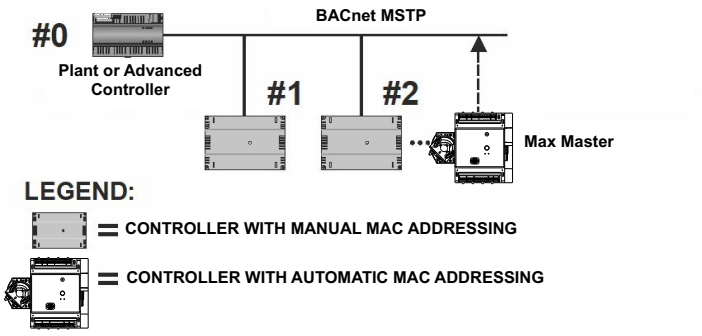


Fig. 29 Automatic MAC Addressing

All Honeywell VAV BACnet™ MS/TP VAV controllers are BACnet™ MS/TP 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™ MS/TP 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 Max Master specifies the highest-allowable address for client nodes. Max Master is set to 126 by default, which means that it can support up to 124 BACnet™ MS/TP VAV controllers, one supervisor, and one BACnet™ client (tool) per BACnet™ MS/TP network.

The following properties are writable and can be changed:

- Max Master
- Min MAC
- Max MAC
- MAC address.

Table 19 Default Values

Default Max Master	Default MinMAC	Default MaxMAC	Default Baud Rate
126	1	126	38400

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 1-126 on an MS/TP network segment. Seven DIP switches on the Honeywell VAV BACnet™ MS/TP controller is used to set the controller's MAC address.

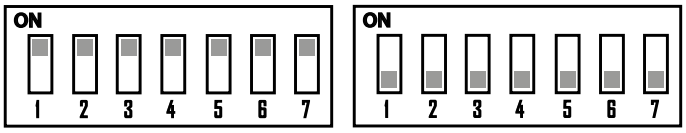


Fig. 30 MS/TP MAC Address Details

To set the MAC address of a Honeywell VAV BACnet™ MS/TP VAV controller:

1. Find an unused MAC address on the BACnet™ MS/TP network to which the Honeywell VAV BACnet™ MS/TP VAV controller connects.
2. Locate the DIP switch bank on the Honeywell VAV BACnet™ MS/TP VAV for addressing.
3. Power off the Honeywell VAV BACnet™ MS/TP and set the DIP switches for the MAC address you want.
4. Add the value of DIP switches set to ON to determine the MAC address. See Table 20.

Table 20 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 ON, the MAC address would be 85 (1 + 4 + 16 + 64 = 85).

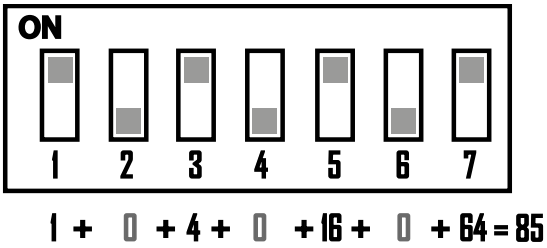


Fig. 31 Calculating the MAC Address

Configure the Device Instance Number

The Device Instance number must be unique across the entire BACnet™ network because it uniquely identifies the BACnet™ devices. It may be used to distinguish the BACnet™ device from other devices during installation. The Honeywell VAV BACnet™ MS/TP device instance number is automatically set when it is added to a Honeywell Supervisor station. The user can change the device instance number.

Connect to the BACnet™ MS/TP Network

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). Consider the following factors before connecting.

- Maximum BACnet™ MS/TP bus length. See Table 18 on page 23.
- Daisy chain topology.
- Must conform to TIA/EIA RS-485 cabling guidelines and ANSI/ASHRAE Standard 135-2010.

Use the Honeywell tested and recommended MS/TP cable - Honeywell Cable 3322 (18 AWG, 1-Pair, Shielded, Plenum cable). Alternatively, Honeywell Cable 3251 (22 AWG, 1-Pair, Shielded, Plenum cable) is available and meets the BACnet™ standard requirements.

MODBUS RTU

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

The Honeywell VAA controller is conditionally compliant with the “regular” Modbus device standard. The controller differs from an unconditionally compliant “regular” Modbus device standard in that it does not support communication rates of 1.2, 2.4, and 4.8 kb/s (because these communication rates are not market-relevant).

NOTE:
The recommended number of Modbus servers is 8, with a maximum of 155 read / write data points.

Modbus Considerations

The RS-485 interface suitable for Modbus communication is 2-wire with shield non-isolated hence the following considerations apply:

- Maximum Modbus length (“L”): 4000 ft (9.6 – 78.8 kbps) or 2600 ft (115.2 kbps). 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 20.
- It Should not extend beyond a single building.

Default Modbus values

Table 21 Default Modbus Details

Specification	Description
Baud rate	76800
Parity	Even parity
Byte size	8 bit
Stop bits	1 stop bit

Cables and Shielding

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 network).

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, CAT 5 cable may also be used.

Modbus RS-485 Repeaters

RS-485 repeaters are possible but have not been tested by Honeywell; therefore, it is the installing or commissioning person's responsibility to ensure proper operation.

NOTE:
Each Modbus segment will require its own line polarization and line termination (120 Ω; the wattage should be in the range of 0.25 – 0.5 W).

Wiring Topology

Only daisy chain wiring topology is allowed.

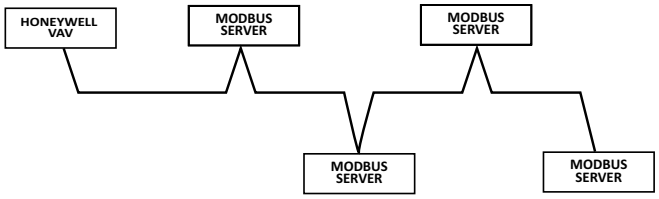


Fig. 32 Modbus Wiring Topology

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

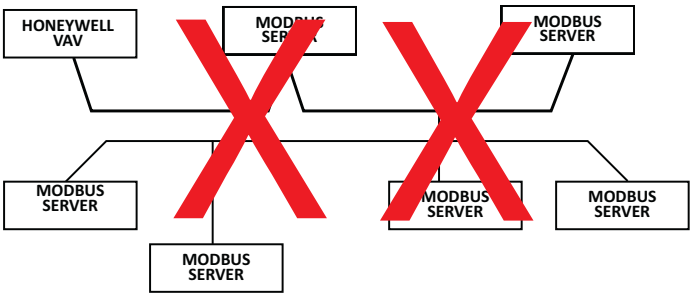


Fig. 33 Prohibited Wiring Topology (example)

SYLK™ BUS

Sylk™ Bus compatible wall modules such as TR120 can be connected to the controller's Sylk™ (terminals 14 and 15).

- Sylk™ is a two wire, polarity insensitive bus.
- The maximum current provided at the Sylk™ bus interface is 96 mA.
- The Honeywell Supervisor software has a built-in resource calculator to calculate the number of Sylk™ wall modules can be connected.
  The Honeywell Supervisor calculates the maximum number of modules based on the following information for each wall module:
  - Sylk™ bus power consumption.
  - Number of parameters used.
  - Total config file size.

Supported Sylk bus devices

The Honeywell VAV supports the following Sylk™ devices and actuators.

- **Sylk™ bus wall modules:** TR40, TR40-H, TR40-CO2, TR40-H-CO2, TR42, TR42-H, TR42-CO2, TR42-H-CO2, TR71, TR71-H, TR75, TR75-H, TR120, TR120-H TR50-3D, TR50-3N, TR50-5D, TR50-5N, TR100-THC-G, TR100-TH-G, and TC300.
- **Sylk™ actuator:** MS3103, MS3105, MS4103, MS4105, MS7403, MS7405, MS7503, MS7505, MS8103.

NOTE:
- The firmware version for TR42x wall modules must be 1.00.3 or higher.
- TR70 wall modules are not supported.

Table 22. Recommended maximum distances

Single Twisted Pair, Non-shielded, Stranded or Solid[a]		Standard Non-twisted Thermostat Wire Shielded or Non-shielded, Stranded or Solid[b]
18 - 22 AWG (0.048 - 0.028 in) (0.3 to 1 mm^2)	24 AWG (0.022 in) (0.2 mm^2)	18 - 24 AWG (0.048 - 0.022 in) (0.2 to 1 mm^2)
500 ft (150 m)	400 ft (120 m)	100 ft (30 m)

[a] 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.

Table 22. Recommended maximum distances

Single Twisted Pair, Non-shielded, Stranded or Solid[a]	Standard Non-twisted Thermostat Wire Shielded or Non-shielded, Stranded or Solid[b]

[b] 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.).

NOTE:
- Shielded cable is recommended if there is a need to reduce the effect of electrical noise.

Sylk bus Wiring Example

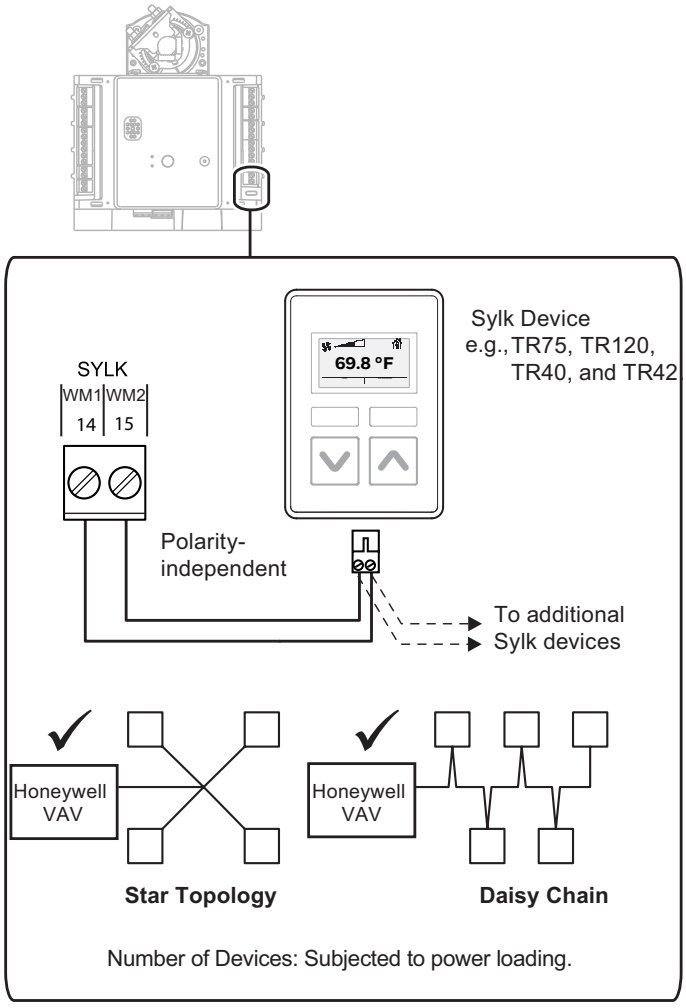


Fig. 34 Sylk™ Wiring

BLUETOOTH BALANCING

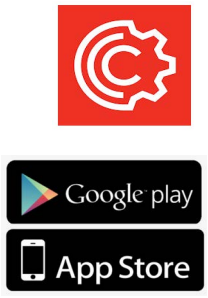
The Honeywell VAV controllers have a local rubber antenna included in the packaging.
The antenna facilitates wireless communication via Bluetooth with other devices.

Overview

The Honeywell Connect Mobile (HCM) is a mobile application used for VAV balancing. The HCM app provides easy access to the Honeywell VAV controller via integrated Bluetooth. Make sure that the Honeywell VAV controller has a strong Bluetooth signal before connecting to the Honeywell Connect Mobile VAV Balancing app. The BACnet™ MS/TP instance ID range allows the discovery of additional controllers on the BACnet™ MS/TP network.

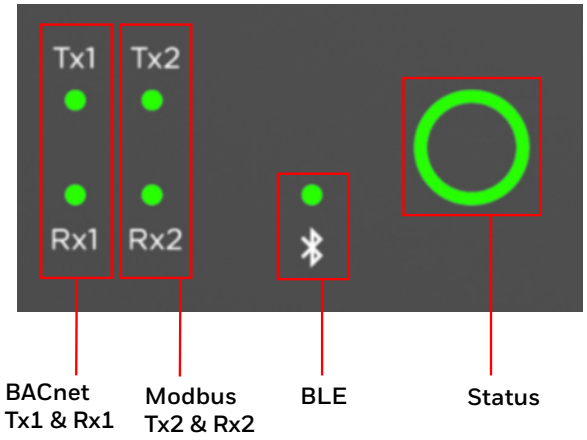
For more information about VAV balancing with the HCM mobile app, refer to Honeywell VAV Balancing Tools User Guide - 31-00472.

Table 23 Mobile Application for Balancing

	Honeywell Connect Mobile (HCM) is a mobile VAV balancing application that connects to the Honeywell VAV controller through integrated Bluetooth. The mobile application should be linked to a Honeywell 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.



See Table "LED light status", "Bluetooth LED Status", and "BACnet and Modbus LED Status" below.

Fig. 35 LED Interface

BACnet™ and Modbus LED Status

Table 24 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 25 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 26 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 A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

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

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 or TV technician for help.

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.

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 is listed in Table 2 on page 2.
- This device requires significant technology engineering expertise to understand the tools and relevant technology, which is not readily available to the average consumer. Only a person professionally trained in the technology is competent.
- This device is not directly marketed or sold to general public.

Detachable Antenna Warning (IC)

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

This radio transmitter See Table 27 on page 33 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 27 BLE Certification Numbers

	FCC ID	IC ID
VAA-VA75MB24NMC/D	2ARTN-00005	24552-00005
VAA-VA00MB24NMC/D		
VAA-VA00IB24NMC/D		
VAA-VA75IB24NMC/D		

Standards and Compliance

- CE
- UL916 Energy Management Equipment
- UL60730
- FCC Part 15; Class A verified
- EN 55022; Class A
- EN 61000-3-2
- 61000
- UL2043

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
- BACnet™™ BTL®-Listed; IP, T1L and MS/TP Unitary models as BACnet™™ Advanced Application Controller (B-AAC).
- CE-approved
- FCC part 15B-compliant.
- RoHS conformity

NOTE:

• 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.

Table 28 Honeywell VAA Containing Lead (Pb)

Product / Part Name	Substance Name
VAA-VA00IB24NMC/D	Lead (Pb)
VAA-VA00MB24NMC/D	
VAA-VA75I24NMC/D	
VAA-VA75IB24NMC/D	
VAA-VA75M24NMC/D	
VAA-VA75MB24NMC/D	

- 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 10 K NTC Ω and 20 K NTC Ω sensors. The following table lists the typical minimum accuracies of the hardware and software for these temperature sensors.

Table 29 Sensor Accuracies

Range	Measurement Error (Excluding Sensor Characteristics)			
	10 kΩ NTC [a)]	**20 k NTC**	**PT3000**	**NI1000TK5000 [b)]**
-58 °F to -4 °F (-50 °C to -20 °C)	≤ 5.0 K	≤ 5.0 K	≤ 1.2 K	≤ 1.2 K
-4 °F to +32 °F (-20 °C to 0 °C)	≤ 1.0 K	≤ 1.0 K	≤ 0.7 K	≤ 0.7 K
32 °F to 86 °F (0 °C to 30 °C)	≤ 0.5 K	≤ 0.3 K	≤ 0.5 K	≤ 0.5 K
86 °F to 158 °F (30 °C to 70 °C)	≤ 0.5 K	≤ 0.5 K	≤ 0.7 K	≤ 0.7 K
158 °F to 212 °F (70 °C to 100 °C)	≤ 1.0 K	≤ 1.0 K	≤ 1.2 K	≤ 1.2 K
212 °F to 266 °F (100 °C to 130 °C)	--	≤ 3.0 K	≤ 1.2 K	≤ 1.2 K
266 °F to 302 °F (130 °C to 150 °C)	--	≤ 5.5 K	≤ 1.2 K	--
302 °F to 752 °F (150 °C to 400 °C)	--	--	--	--

a) 10 k NTC Ω specified for -22 °F to 212 °F (-30 °C to +100 °C) only.

b) NI1000TK5000 specified for -22 °F to +266 °F (-30 °C to +130 °C) 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 Sensor Characteristics on page 36.

Recognition of Sensor Failure of Sensor Inputs

The thresholds at which the sensor fails, that is, sensor breaks (SB) and short-circuits (SC), are recognized, depending upon the given sensor type. In the event of a recognized sensor failure, the sensor assumes the safety values configured in Table 29 on page 34. It lists the measurement ranges and the corresponding thresholds for the recognized sensor failure for the various types of sensor:

Table 30 Thresholds for Short-circuit (SC) and Sensor-break (SB) Recognition

I/O Configuration	Measurement Range	Recognition Thresholds
2 to 10 V	2 to 10 VDC 4 to 20 mA (without pull-up)	SC: < 1.5 VDC 3 mA; SB: no recognition
10 k NTC Ω (Type II)	-22 °F to +212 °F (-30 °C to +100 °C)	SC: < 20 Ω; SB: < -94 °F (-70 °C)
20 k NTC Ω	-58 °F to +302 °F (-50 °C to +150 °C)	SC: < 20 Ω; SB: < -94 °F (-70 °C)
PT1000	-58 °F to +752 °F (-50 °C to + 400 °C)	SC: < 775 Ω; SB: < -58 °F (-50 °C)
NI1000TK5000	-22 °F to +266 °F (-30 °C to +130 °C)	SC: < 850 Ω; SB: < -58 °F (-30 °C)
PT100	-58 °F to +752 °F (-50 °C to +400 °C)	-
PT3000	-58 °F to +302 °F (-50 °C to +150 °C)	-
10K3A1	-40 °F to +257 °F (-40 °C to +125 °C)	-
Nickel Class B DIN 43760 sensors	-76 °F to +752 °F (-60 °C to +169 °C)	-

NOTE:
In the case of temperatures lying outside the ranges, the lowest and highest value within the range, 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, mis readings due to a meter connected to measure resistance or voltage at the input.

10 K NTC TYPE II Characteristics

Table 31 10 K NTC TYPE II Characteristics

Temp. [°F]	Temp. [°C]	Resistance [KΩ]	Terminal Voltage [V]	Temp. [°F]	Temp. [°C]	Resistance [KΩ]	Terminal Voltage [V]
-22	-30	177	7.904	35.6	2	29.494	5.079
-20.2	-29	166.35	7.848	37.4	3	28.047	4.969
-18.4	-28	156.41	7.79	39.2	4	26.68	4.859
-16.6	-27	147.14	7.73	41	5	25.388	4.75
-14.8	-26	138.47	7.666	42.8	6	24.166	4.641
-13	-25	130.37	7.601	44.6	7	23.01	4.532
-11.2	-24	122.8	7.534	46.4	8	21.916	4.423
-9.4	-23	115.72	7.464	48.2	9	20.88	4.316
-7.6	-22	109.09	7.392	50	10	19.898	4.209
-5.8	-21	102.88	7.318	51.8	11	18.968	4.103
-4	-20	97.073	7.241	53.6	12	18.087	3.998
-2.2	-19	91.597	7.161	55.4	13	17.252	3.894
-0.4	-18	86.471	7.08	57.2	14	16.46	3.792
1.4	-17	81.667	6.996	59	15	15.708	3.69
3.2	-16	77.161	6.91	60.8	16	14.995	3.591
5	-15	72.932	6.821	62.6	17	14.319	3.492
6.8	-14	68.962	6.731	64.4	18	13.678	3.396
8.6	-13	65.231	6.639	66.2	19	13.068	3.3
10.4	-12	61.723	6.545	68	20	12.49	3.207
12.2	-11	58.424	6.448	69.8	21	11.94	3.115
14	-10	55.321	6.351	71.6	22	11.418	3.025
15.8	-9	52.399	6.251	73.4	23	10.921	2.937
17.6	-8	49.648	6.15	75.2	24	10.449	2.85
19.4	-7	47.058	6.047	77	25	10	2.767
21.2	-6	44.617	5.943	78.8	26	9.572	2.684
23	-5	42.317	5.838	80.6	27	9.165	2.603
24.8	-4	40.15	5.732	82.4	28	8.777	2.524
26.6	-3	38.106	5.624	84.2	29	8.408	2.447
28.4	-2	36.18	5.516	86	30	8.057	2.372
30.2	-1	34.363	5.408	87.8	31	7.722	2.299
32	0	32.65	5.299	89.6	32	7.402	2.228

Table 31 10 K NTC TYPE II Characteristics (Continued)

Temp. [°F]	Temp. [°C]	Resistance [KΩ]	Terminal Voltage [V]
33.8	1	31.027	5.189
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
156.2	69	1.813	0.673
158	70	1.752	0.652
91.4	33	7.098	2.159
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

10 K NTC TYPE III Characteristics

Table 32 10 K NTC TYPE III Characteristics

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

Temp. [°F]	Temp. [°C]	Resistance [Ω]
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

10 K3A1 Characteristics

Table 33 10 K3A1 Characteristics

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
26.6	-3	38110
28.4	-2	36184
30.2	-1	34366
32	0	32651
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

Table 33 10 K3A1 Characteristics (Continued)

Temp. [°F]	Temp. [°C]	Resistance [Ω]
23	-5	42317
24.8	-4	40151
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
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

Temp. [°F]	Temp. [°C]	Resistance [Ω]
89.6	32	7402
91.4	33	7097
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
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

Table 33 10 K3A1 Characteristics (Continued)

Temp. [°F]	Temp. [°C]	Resistance [Ω]
156.2	69	1813
158	70	1752
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

Temp. [°F]	Temp. [°C]	Resistance [Ω]
222.8	106	571
224.6	107	555
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

20 K NTC Characteristics

Table 34 20 K NTC Characteristics

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
44.4	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

Table 34 20 K NTC Characteristics (Continued)

Temp. [°F]	Temp. [°C]	Resistance [KΩ]	Terminal voltage [V]
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
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

Table 34 20 K NTC Characteristics (Continued)

Temp. [°F]	Temp. [°C]	Resistance [KΩ]	Terminal voltage [V]
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
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

Temp. [°F]	Temp. [°C]	Resistance [KΩ]	Terminal Voltage [V]
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

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)

Table 35 Characteristic of the Nickel Temperature Sensor is Specified as per DIN 43760

Temp. [°F]	Temp. [°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

NI1000 TK5000 DIN B

R-T Characteristics of Ni1000 TK5000 DIN B.

Table 36 NI1000 TK5000 Sensor Specification

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

Table 37 R-T Characteristics (according to supplier's specifications and based on DIN 43760, resistance values in Ω)

Temp. [°F]	Temp. [°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
Temp. [°F]	**Temp. [°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									

PT100 Characteristics

Table 38 PT100 Characteristics

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

PT1000 Characteristics

Table 39 PT1000 Characteristics

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

Table 39 PT1000 Characteristics (Continued)

Temp. [°F]	Temp. [°C]	Resistance [KΩ]	Terminal Voltage [V]
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

Temp. [°F]	Temp. [°C]	Resistance [KΩ]	Terminal Voltage [V]
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

Table 39 PT1000 Characteristics (Continued)

Temp. [°F]	Temp. [°C]	Resistance [KΩ]	Terminal Voltage [V]
143.6	62	1240	0.474
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
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

Temp. [°F]	Temp. [°C]	Resistance [KΩ]	Terminal Voltage [V]
213.8	101	1389	0.528
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

Table 39 PT1000 Characteristics (Continued)

Temp. [°F]	Temp. [°C]	Resistance [KΩ]	Terminal Voltage [V]
282.2	139	1532	0.58
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

Temp. [°F]	Temp. [°C]	Resistance [KΩ]	Terminal Voltage [V]
350.6	177	1674	0.63
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

Table 39 PT1000 Characteristics (Continued)

Temp. [°F]	Temp. [°C]	Resistance [KΩ]	Terminal Voltage [V]
419	215	1813	0.679
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
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

Temp. [°F]	Temp. [°C]	Resistance [KΩ]	Terminal Voltage [V]
487.4	253	1952	0.727
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
618.8	326	2212	0.816
620.6	327	2216	0.817
622.4	328	2219	0.818

Table 39 PT1000 Characteristics (Continued)

Temp. [°F]	Temp. [°C]	Resistance [KΩ]	Terminal Voltage [V]
555.8	291	2088	0.774
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
624.2	329	2223	0.82
690.8	366	2353	0.863
692.6	367	2356	0.864
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 Characteristics

Table 40 PT3000 Characteristics

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

Temp. [°F]	Temp. [°C]	Resistance [KΩ]	Terminal Voltage [V]
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

ABBREVIATIONS

Table 41 Abbreviations

Abbreviation	Definition
SSR	Solid State Relay
MSTP	Multiple Spanning Tree Protocol
IP	Internet Protocol
RTU	Remote Terminal Unit
BMS	Building Management Solutions
VAV	Variable air volume
UIO	Universal IO
NEMA	National Electrical Manufacturers Association
SDRAM	Synchronous dynamic random-access memory
QSPI	Quad Serial Peripheral Interface
DHCP	Dynamic Host Configuration Protocol
EIRP	Effective Isotropic Radiated Power
SMA	Sub miniature push
CMOS	Complementary Metal Oxide Semiconductor
TTL	Transistor - Transistor Logic

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