MANUFACTURER DOCUMENT PACKAGE

Manufacturer's Manual

Reference package for procurement and maintenance review

ALERTON

VAVI-7U5-IP

PROGRAMMABLE VAV ROOM CONTROLLER

Used with the applicable VAV IP Controllers configuration.

REFERENCE PACKAGE

OFFICIAL DOCUMENT

Selected official manufacturer pages follow this cover.

Source: Alerton VAV IP Controller Installation and Operations Guide 31-00531-02; pages 3, 6-7, 9-10 and 19-23.

GENERAL

Trademark Information

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Product Description

The VAV IP controller with integrated actuator and air flow sensor are designed for use with VAV applications.

The VAV IP controller is a designed for pressure-independent control of any single duct variable air volume (VAV) box; it is ideally suited for critical environment applications such as Laboratory Airflow Tracking, Critical Patient Rooms, Operating Rooms, and other applications requiring precise control of airflows.

The VAV IP controller has a field-replaceable integral airflow sensor. The airflow sensor is factory calibrated at multiple velocity points. Minimum, maximum, and reheat airflows can be entered using a Microset wall unit or compatible operator workstation software.

The integrated Bluetooth® Low Energy (BLE) capability enables easy pairing with mobile apps such as BMS Startup app.

Table 1 Part Numbers

Part Number	Power Supply	Universal IO	Solid State Relay	Integrated Actuators	Communication	Bluetooth
VAVi-7u5-IP	24 VAC	7	5	Yes	IP	No
VAVi-0-IP	24 VAC	0	0	Yes	IP	No
VAVi-7u5-IP-BLE	24 VAC	7	5	Yes	IP	Yes

Table 2 Replacement Part

Part Number	Type	Description
SDPPF500PA	Air flow sensor	Replacement air flow sensor for use if the original sensor is damaged, or becomes inoperable. (Sold in pack of 2)

Controller Part Numbers

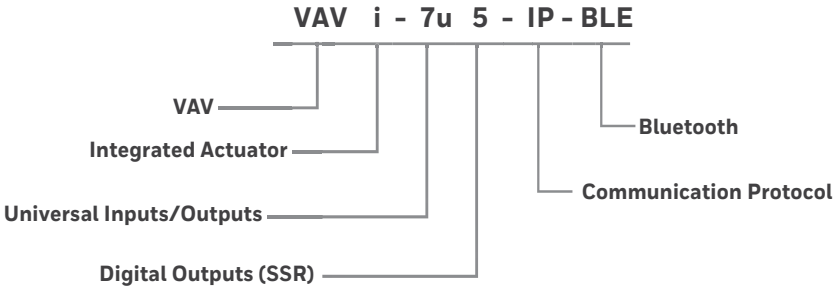


Fig. 1 Controller Part Numbers

Dimensions

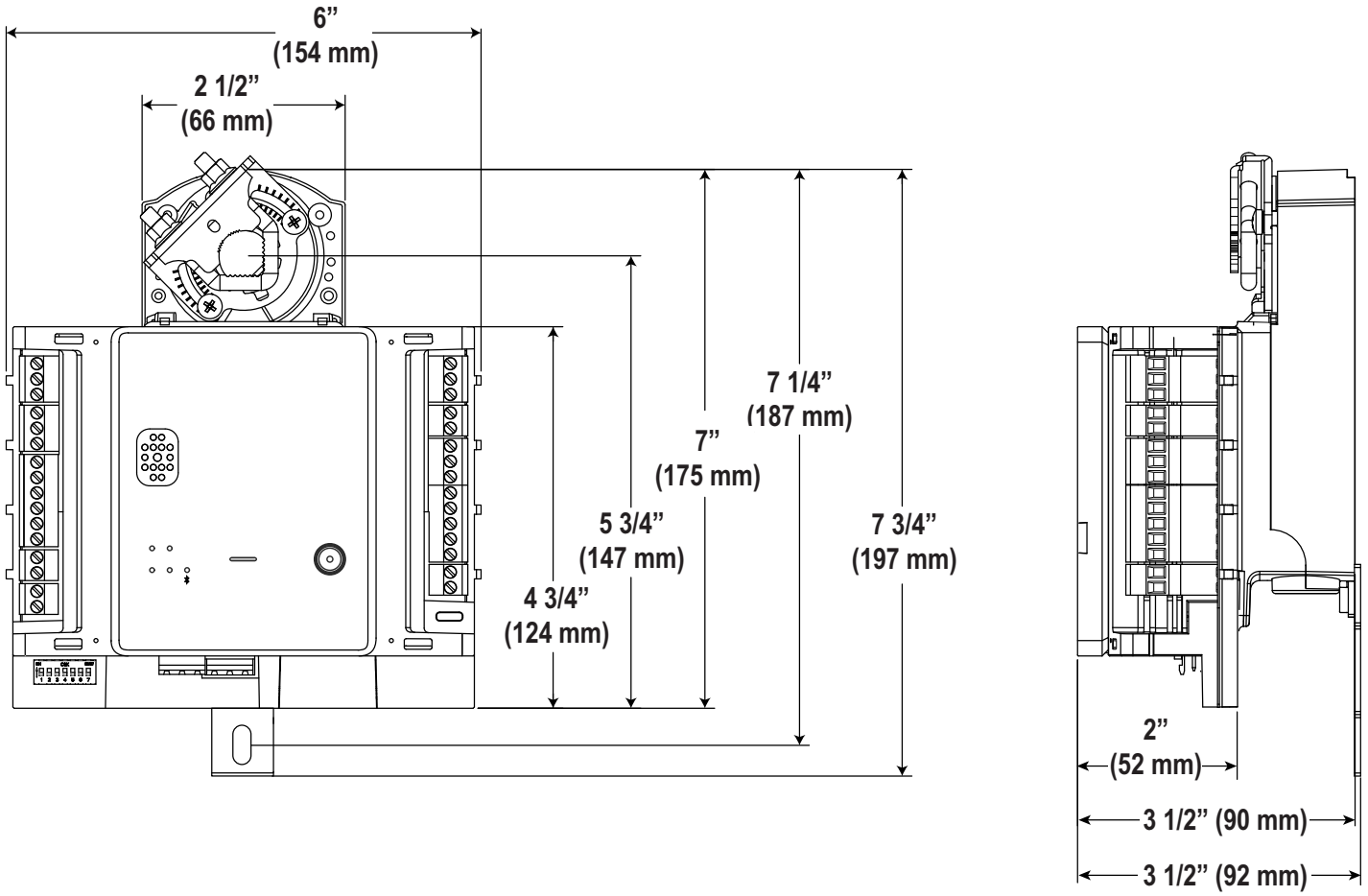


Fig. 2 VAV IP Controller Dimensions

NETWORK SECURITY

⚠ WARNING

Alerton hereby states that the VAV IP controllers 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 Alerton VAV IP 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.

For more details, refer Security Guide (31-0529-01).

GENERAL SAFETY INFORMATION AND INSTALLATION PRECAUTION

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

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

⚠ CAUTION

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

Read all the instructions below

Follow all instructions to avoid equipment damage or hazardous condition. Read all instructions carefully before installing equipment.

High Voltage safety test

Experienced electricians, at first contact, always assume that hazardous voltages may exist in any wiring system. A safety check using a known, reliable voltage measurement or detection device should be made immediately before starting work and when work resumes.

Lightning and high-voltage danger

Most electrical injuries involving low-voltage wiring result from sudden, unexpected high voltages on normally low-voltage wiring. Low voltage wiring can carry hazardous high voltages under unsafe conditions. Never install or connect wiring or equipment during electrical storms. Improperly protected wiring can carry a fatal lightning surge for many miles. All outdoor wiring must be equipped with properly grounded and listed signal circuit protectors, which must be installed in compliance with local, applicable codes. Never install wiring or equipment while standing in water.

Wiring and equipment separations

All wiring and controllers must be installed to minimize the possibility of accidental contact with other potentially hazardous and disruptive power and lighting wiring. Never place 24 VAC or communications wiring near other bare power wires, lightning rods, antennas, transformers, or steam or hot water pipes. Never place the wire in any conduit, box, channel, duct, or other enclosure containing power or lighting circuits of any type. Always provide adequate separation of communications and another electrical wiring according to code. Keep wiring and controllers at least six feet from large inductive loads (power distribution panels, lighting ballasts, motors, etc.)

SPECIFICATIONS

Electrical

Table 3 Electrical Specification

Parameter	Specification
Rated input voltage	20 - 30 VAC; Class 2 transformer
Power Consumption for VAVi-7u5-IP, VAVi-7u5-IP-BLE and VAVi-0-IP	Nominal 9.3 VA (actuator at nominal load and IP communication active)
Frequency Range	50 to 60 Hz
Auxiliary Output	20 VDC @ 75 mA
Internal Power Supply	Half-wave rectified

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	512 MB QSPI Flash, 128 MB SDRAM
BACnet® IP	2 X RJ-45 Ethernet ports with a protection that allows loop topology to continue the communication with other controllers even if one node fails, when used with an RSTP supporting device.

Table 5 Hardware Specification

Real Time Clock	24-Hours backup after power failure. The controller includes a supercapacitor to power the built-in real time clock for 24-Hours. In case of power failure, the super capacitor retains the time set in controller for 24-Hours. After 24-Hours, the time will reset to default factory time until user perform BACnet Time Sync.
Small LED	Transmission or Reception of communication Signal (green)
Large LED	Controller status (Green, Yellow or Red)

Integrated Modulating Actuator

Table 6 Integrated Actuator Specification

Parameter	Specification
Torque	44 in-lbs (5 Nm) with analog position feedback
Run Time	• 108 seconds at 50 Hz • 90 seconds at 60 Hz
Mounting Shaft	• Round 8-16 mm (5/16 – 5/8”); • Square 6-13 mm (15/64 –33/64”)
Shaft Length	≥ 1 5/8 in (41 mm)

Weight And Dimensions

Table 7 Weight And Dimensions

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

IMPORTANT:
This device is UL listed and limited to 100 VA maximum. Binary output loads are restricted by this maximum VA rating. If all 5 SSR binary outputs are connected and fully loaded (@24 VA each) the total VA of the device will exceed the UL listed and limited maximum rating. DO NOT EXCEED 100 VA MAXIMUM RATING!

Communications

Table 8 Communication Specification

Parameter	Specification
Protocol supported	BACnet/IPv4, BACnet/IPv6, BACnet/Ethernet
Ethernet Connection Speed	10/100 Mbps
Internet Protocol Version	IPv4 and IPv6
IP Addressing Modes	Supports Static, DHCP, SLAAC
Networking Protocol	Rapid Spanning Tree Protocol (RSTP) and Network Time Protocol (NTP4)
Microset Bus	2 wire, polarity sensitive bus for Microtouch, Microset-BT, Microset II and Microset 4 wall modules **Note:** For Microtouch configuration, a hard wire jumper wire from the Microset port terminal 15 to terminal 19 is required.

Air Flow Sensor

Table 9 Air Flow Sensor Specification

Parameter	Specification
Range	0-2 in. w.c. (500 Pa)
Accuracy	0.0004 in.w.c. (0.1 Pa)
Repeatibility	0.5% of span
Connection	1/8-inch x 3/8-inch long barbfitting
Resolution	16 bit input

Universal IO

Table 10 Universal IO Specification

Parameter	Specification
AO (Analog output)	16-bit universal analog outputs support Voltage Mode: 0-10 VDC @ 10 mA maximum (1k ohm minimum); Current Mode: 4-20 mA @ 550 ohms Maximum;
BO (Binary output)	Binary Mode: 11 VDC @ 20 mA maximum relay coil current (for controlling low-coil current 11 VDC relays and solid-state relays).
UI (Universal input)	16-bit universal inputs accept 10 k thermistor (type II and III), dry contact, 1 k platinum RTD, 0-20 mA, 0-10 V, or dry-contact pulse. External resistor required for 0-20 mA. Pulse input maximum frequency of 100 Hz. Pulse input minimum duty cycle 5 ms ON / 5 ms OFF. **Note:** Some 4-20 mA input sensors may need an external resistor to function properly. Please refer to the sensor's documentation.
Common terminal shared by 2 UIO, protected against 24 VAC mis-wiring and short circuit	

Solid State Relay (SSR)

Table 11 Solid State Relay (SSR)

Specification
SSR does switch supply voltage, works with AC and DC, however in case of DC no support for synchronous motor. • 1.5 A constant; 3.5 A inrush for 0.1 sec. per SSR output • Optional bridge provides shared power to all SSRs from 24 VAC powering controller. **Note:** SSRs will not close the contact unless voltage is present, they cannot be used as dry contact.

MOUNTING

To mount the Alerton VAV IP controller, 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 6.

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

Alerton VAV IP controller includes a direct-coupled actuator with the declutch mechanism, shipped hard-wired to the controller.

5. 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.

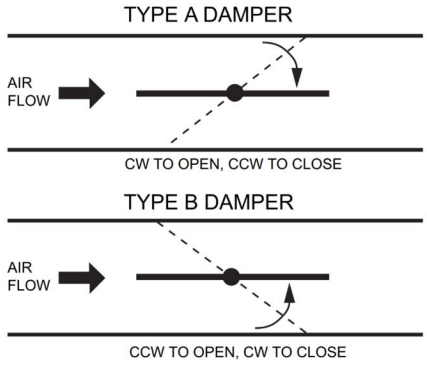


Fig. 5 Determining the Rotation Direction (CW or CCW)

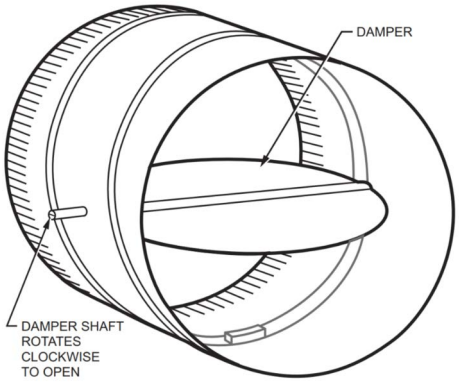


Fig. 6 Damper with 90 Degree CW Rotation to Open

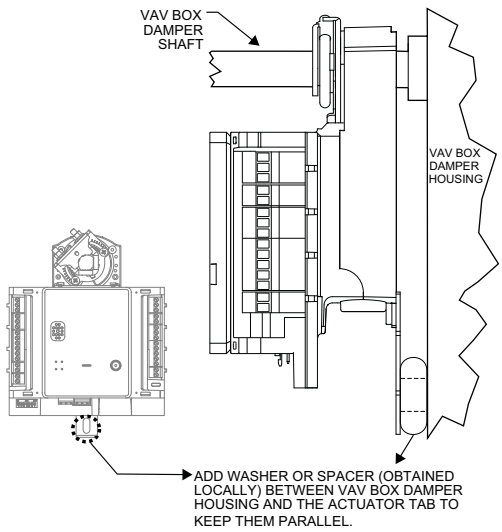


Fig. 7 Mounting Controller to VAV Box Damper Housing when Actuator is not Parallel to VAV Box Damper Housing

6. Determine the damper 'full opening angle' (45, 60, or 90 degrees). The damper is open to its fully open position of 90 degrees.

Mounting Actuator onto Damper Shaft

Alerton VAV IP 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.

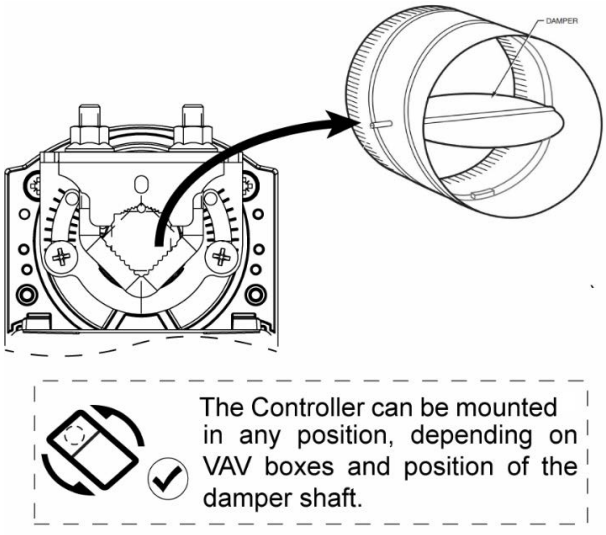


Fig. 8 Mounting Actuator on Damper Shaft

NOTE:

The controller is not position sensitive and can be mounted sideways or upside down.

Alerton VAV IP controller 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 wobble, it will likely bind. To prevent this install the VAV controller 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, 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 °.

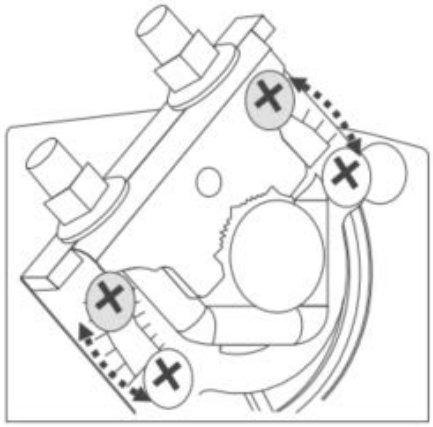


Fig. 9 Setting the Mechanical End Limits

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 (CCW) 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.

Indentifying terminals and terminal wire

Each VAV label identifies wiring terminals by number and function. Terminals are numbered from top to bottom, beginning with one on the upper left side of the controller and continuing top-to-bottom on the right side.

Power supply terminals

Three terminals are used to connect the 24 VAC power supply to the VAV. These are always side-by-side and are usually located on the upper-left or right side of the controller.

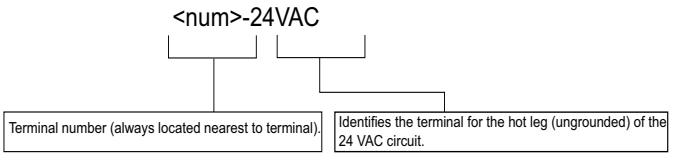


Fig. 29 Power wiring terminals

Grounded terminals

Ground (GND) terminals are used for terminating the grounded leg of the 24 VAC circuit or BO return grounds.

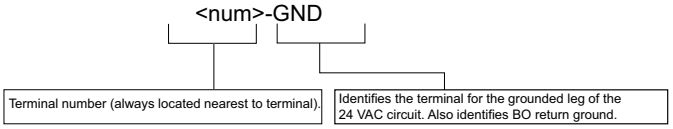


Fig. 30 Grounded terminals

IMPORTANT:
Never terminate input signals to a GND terminal.

Common terminals

Common (COM) terminals (sometimes called VAV ground, common ground, or input signal return ground) provide a low-impedance connection for input circuitry to the VAV reference ground. Use these to terminate the return ground for inputs.

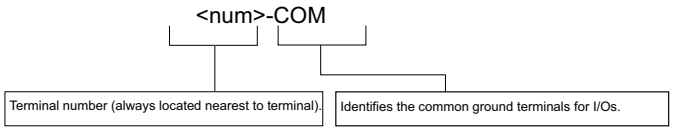


Fig. 31 Common terminals

IMPORTANT:
Input common terminals (those nearest to IN terminals) are internally connected to a separate input ground plane. To maximize input accuracy, always connect input return grounds only to these COM terminals. Do not connect outputs or power grounds to input COM terminals.

Universal inputs and outputs terminals

Use universal input terminals (in conjunction with adjacent COM terminals) to connect universal inputs.

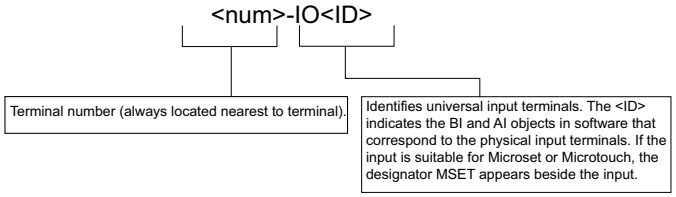


Fig. 32 UIO terminals

20 VDC Source

The 20 VDC source provides low-current 20 VDC to power transducers or other sensors. For non-VAV devices, this terminal provides a maximum 75 ma.

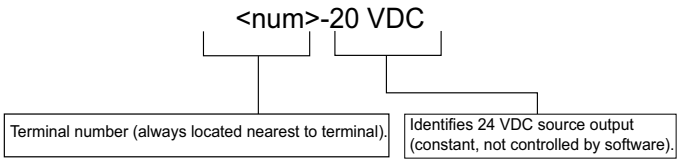


Fig. 33 20 VAC Source terminals

For more details refer Terminal Connections on page 20.

Terminal Connections

All the terminals for this controller are removable.

Table 12 Terminal Connections

Terminal	Label	Description
Power 24 VAC		
1	⏚	Functional 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	Solid State Relay Output 1 (BO-11)
7	C	Common
8	SR2	Solid State Relay Output 2 (BO-12)
9	SR3	Solid State Relay Output 3 (BO-13)
10	C	Common
11	SR4	Solid State Relay Output 4 (BO-14)
12	SR5	Solid State Relay Output 5 (BO-15)
13	C	Common
Microset Bus (For Microset II and Microset 4)		
14	COM	Common
15	MSET	Microset/Microtouch (AI-0). For wiring details, refer MS4,MS2 / Microtouch Wiring Examples on page 25.
RS485		
16	+	RS-485 bus + (for Modbus (future release) only)
17	-	RS-485 bus - (for Modbus (future release) only)
18	COM	Common
UIO		
19	IO1	Universal Input / Output 1 (AI-1/BI-1/AO-1/BO-1)
20	C	Common
21	IO2	Universal Input / Output 2 (AI-2/BI-2/AO-2/BO-2)
22	IO3	Universal Input / Output 3 (AI-3/BI-3/AO-3/BO-3)
23	C	Common
24	IO4	Universal Input / Output 4 (AI-4/BI-4/AO-4/BO-4)
25	IO5	Universal Input / Output 5 (AI-5/BI-5/AO-5/BO-5)
26	C	Common
27	IO6	Universal Input / Output 6 (AI-6/BI-6/AO-6/BO-6)
28	C	Common
29	IO7	Universal Input / Output 7 (AI-7/BI-7/AO-7/BO-7)
20 VDC OUT		
30	C	Common
31	20 VDC OUT	Supplies 20 VDC, 75 mA of current

UIO Wiring

The VAV IP controller supports universal inputs and outputs (UIO) configured as UIs, AOs, or BOs.

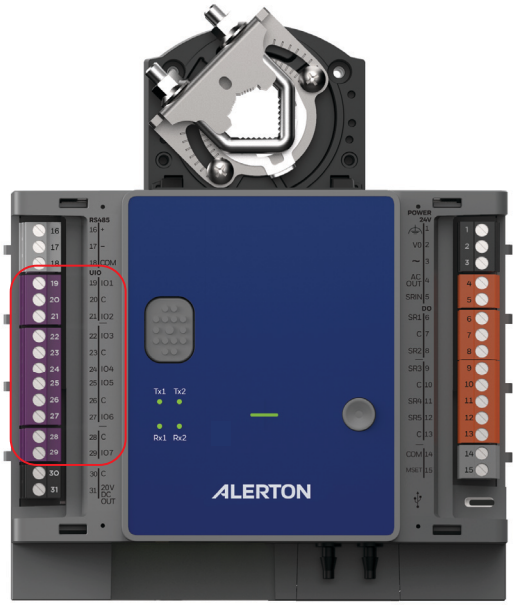


Fig. 34 UIO terminals

Universal inputs

Universal inputs on the VAV IP controller can accept a variety of input types. Typically, a sensor, transducer, or other device producing an output signal that is wired to an input terminal on the VAV controller.

Inputs can be configured to accept any of the following:

- Resistance (10 kΩ thermistor type II and type III, 1 kΩ Platinum RTD, and potentiometers).
- Voltage (0 to 10 VDC).
- Current (0 to 20 mA).
- Dry contact.
- Solid-state (transistor) switch.
- Pulse-type inputs.

The VAV IP controller has BACnet objects for only those inputs that exist.

The VAV IP controller set up of all Inputs and Outputs is software configurable.

Electrical characteristics of the VAV input circuits

The VAV IP controller has an on board input filter and a 16-bit analog-to-digital (A/D) converter that converts the electrical input signal to counts. Counts refer to the number in software that results from the A/D conversion.

Input wiring and configuration tips

This section provides tips, wiring diagrams, and application notes for the most commonly encountered input types.

Resistive inputs (thermistors and potentiometers)

When measuring resistive input values, an infinitely great resistance (an open circuit) results in a count near the top of the full range, while an infinitely small resistance (a short circuit) results in a count of 0.

Wire the potentiometer leads across the desired IN terminal and the adjacent COM terminal (no polarity).

Thermistors

The Alerton sensors utilize a thermistor that has specific characteristics. They are commonly referred to as Type 2 unicurve 10 kΩ at 77°F.

The most common resistive input types are 10 kΩ thermistors They are recommended for all temperature-sensing applications. BACtalk wall, duct, and immersion sensors, Microset, Microset II, Microset 4, and Microtouch sensors use 10 kΩ thermistors. Both 10 kΩ and 1 kΩ thermistors have a software setup in the VAV controllers that eliminates the need for custom scaling. Simply specify the type of thermistor and the input reports degrees in Fahrenheit or degrees Celsius as appropriate.

Potentiometers

Alerton highly recommends 10 kΩ potentiometers for all applications because they yield the best resolution. As the potentiometer moves from 0 to 10 kΩ, raw counts move through half of the full range.

Application conditions and the precision rating of the potentiometer can cause variations. Always confirm the raw count reading when the potentiometer is at minimum and at maximum. Then scale the input in software with appropriate values.

Counts vs resistance

Use the following equation to calculate the counts from a given resistance and vice-versa:

Counts = (4095 x R)/(4095 + R)

Resistance = (4095 x counts)/(4095 - counts)

Dry Contact inputs

Dry contact inputs are electrically identical to resistive inputs: an open contact (OFF) ideally results in a count of 4095, and a closed contact (ON) results in a count of 0. In software, built-in trigger and restore values determine when the BI transitions ON and OFF:

- BI = ON when raw counts less than or equal to 448.
- BI = OFF when raw counts greater than or equal to 512.
- BI is unchanged when raw counts are in the range 449 to 511

Test to ensure that the contact produces appropriate count values as wired to produce ON and OFF signals.

Wire the input leads across the desired IN terminal and the adjacent COM terminal (no polarity).

4 mA to 20 mA inputs

The VAV IP controller inputs can be configured in software to accept 0-20 mA inputs.

NOTE:
Some 4-20 mA input sensors may need an external resistor to function properly. Please refer to the sensor's documentation.

0 VDC to 10 VDC inputs

The VAV IP inputs can be configured in software to accept 0-10 VDC inputs. A 0-5 VDC input can be attached but will only use half the available range and will need to be scaled appropriately.

Solid-state switch inputs

Solid-state (transistor) switches can be wired to the VAV IP controller input terminals. The switch should be listed as acceptable for switching DC currents or for direct connection to programmable logic controllers (PLCs) or DDC controllers. The DC switch should use a transistor on the output.

When wiring these types of switches to the VAV controller input, be careful to maintain polarity. Also ensure that the switch's ON and OFF states produce input counts appropriate to switch the BI in software. Off-state leakage (if present) or other factors can result in inappropriate software counts.

Pulse-type inputs

Pulse-type inputs can be wired to any universal input.

Three types of pulse-type inputs can be used: consumption rate, totalizer, or frequency. To use two or all pulse information types per meter, wire the meter to a physical input for each type of pulse data used: for example, consumption rate on IN-1, totalizer on IN-2, and frequency on IN-3 as shown below.

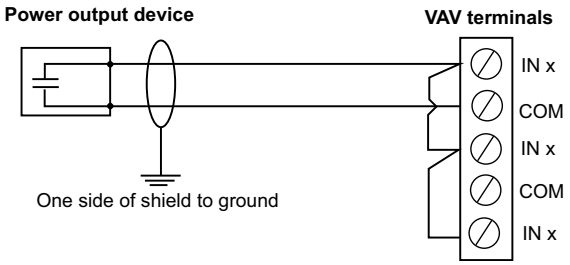


Fig. 35 Pulse type input wiring terminals

Analog outputs (AOs)

AOs provide an electrical output signal in response to a software control signal of 0 to 100.

These can be rescaled to fit almost any application. For example, with a BACnet setting of 0-100 the output can provide 0 to 10 V.

WARNING
Do not ground shield to any terminal on the VAV controller because any signal on the shield is routed through the VAV circuit board to earth ground.

For current outputs, there are multiple ways to scale the output; either via provided AVs on the Alerton standard template or with DDC. A 4-to-20 mA signal is achieved by scaling the 0-to-100 output signal in software to a 20-to-100 signal with Function 45: Two-point Linear Converter. The same method can be used to obtain a 2 to 10 VDC signal.

Wire the AO common to the nearest output COM terminal on the VAV controller.

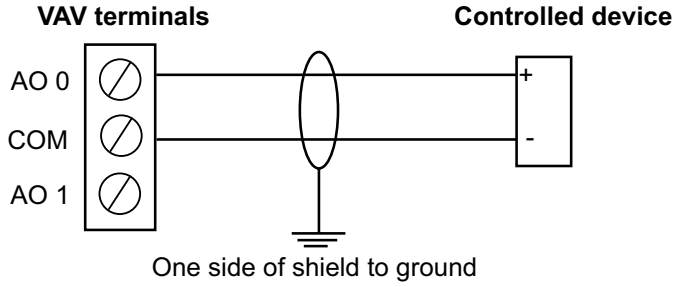


Fig. 36 Analog output COM terminal

Current/Voltage settings

The VAV IP controller AOs can be configured to provide either a current (0 to 20 mA) or voltage (0 to 10 VDC) output.

Binary Outputs (BOs)

UIOs - Universal Input / Outputs can be configured as a 11 VDC BO. The BO switches between minimum and maximum output values which is 0 and 11 VDC.

The 11 VDC for the BO is supplied by the controller itself. Unlike the 24 VAC BOs, there is no way to provide external power for the 11 VDC BOs on the VAV.

Typical usage for both type of BOs (11 VDC and 24 VAC) is controlling pilot relays, though the 24 VAC BOs could power some sort of load elsewhere.

SSR Wiring

SSR wiring with one transformer and factory jumper

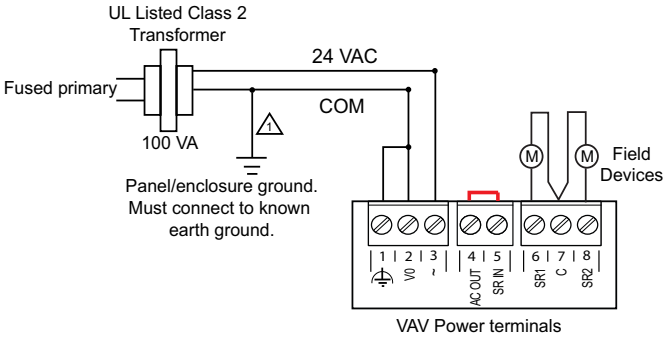


Fig. 37 SSR wiring with one transformer and factory jumper

SSR wiring with separate transformer without factory jumper

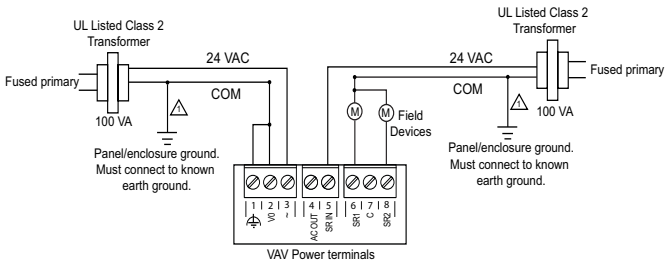


Fig. 38 SSR wiring with separate transformer without factory jumper

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.

IMPORTANT:

This device is UL listed and limited to 100 VA maximum. This maximum VA rating restricts binary output loads. If all 5 SSR binary outputs are connected and fully loaded (@24 VA each), the total VA of the device will exceed the UL listed and limited maximum rating. DO NOT EXCEED 100 VA MAXIMUM RATING!