PROLON

HARDWARE GUIDE

VAV Zone Controller - VC2000 Series

Specifications and Operational Guide

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REV. 7.3.2
PL-HRDW-VC2000-EN

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VC2000: Independent or Networked Intelligent Zone Controller

Description

The Prolon VC2000 series zone controllers are designed for variable air volume zoning systems. The built-in microprocessor offers precise digital control to maximize performance. The outputs and control sequences are all fully configurable, either locally or remotely, using free software or from the digital room sensor. The on-board brushless actuator provides electronic feedback on damper position. When in a network, the VC2000s can share information such as the occupancy state, the demand, the supply temperature and more.

General Behaviour

The Prolon VC2000 controllers are configurable so that every parameter may be tuned to obtain optimal results for each zone. It is possible to modify the action of each output (heating or cooling, ON/OFF or pulsed), the proportional bands, the integration times, the differentials, the operational ranges and the setpoints. The on-board damper actuator is controlled by Belimo's self-configuring Halomo technology, enabling accurate positioning of the damper. The various programming options also allow the user to modify the unoccupied mode set points, the dead bands, the maximum and minimum setpoints for each zone, as well as the minimum damper positions in ventilation mode and heating mode for each zone. All these parameters can be modified using the Prolon Focus software or with the Prolon T1000 advanced digital wall sensor.

Operating Sequence

General

The Prolon controller, located on the VAV box, receives the zone temperature and setpoints from the zone sensor, and optionally the duct temperature from a duct temperature sensor. The controller then analyzes the information and commands the damper actuator and the different outputs to respond accordingly.

Occupied Mode

When there is a cooling demand in the zone and the supply temperature is colder than the zone temperature, the damper opens proportionally to the demand. Once the demand is satisfied, the damper returns to its minimum ventilation position.

When there is a heating demand in the zone, the controller activates the designated auxiliary heating outputs. If the zone has a terminal duct heater, the damper opens first to the minimum heating position and the designated auxiliary heating outputs activate. If the supply temperature is warmer than the zone temperature, the damper is used as the first heating output and opens proportionally to the demand. Once the demand is satisfied, the damper returns to the minimum ventilation position.

When the controller has no cooling or heating demand (deadband), and the supply temperature is also within this deadband, the controller opens the damper to maximum position to allow maximum ventilation of the zone.

The user can modify the setpoints by adjusting the room temperature sensor at all times.

Unoccupied Mode

In unoccupied mode, the damper can be configured to fully open or to operate in a fashion similar to that of occupied mode. The room temperature setpoints in the unoccupied mode are adjustable.

The digital zone sensors offer a method to temporarily bypass the unoccupied mode for a specified length of time.

Selection Table

Model	Description	Inputs / Outputs
PL-VC2000	Zoning Controller, Pressure Dependant (no Flow Sensor)	2 RS485 Communication Ports
		1 Configurable Analog Input (AI)
		1 Configurable Digital Output (DO)
		1 Configurable Analog Output (AO)
PL-VC2000-PI	Zoning Controller, Pressure Independant (with Flow Sensor)	2 RS485 Communication Ports
		1 Configurable Analog Input (AI)
		1 Configurable Digital Output (DO)
		1 Configurable Analog Output (AO)
		Airflow Input

Components

Component Identification

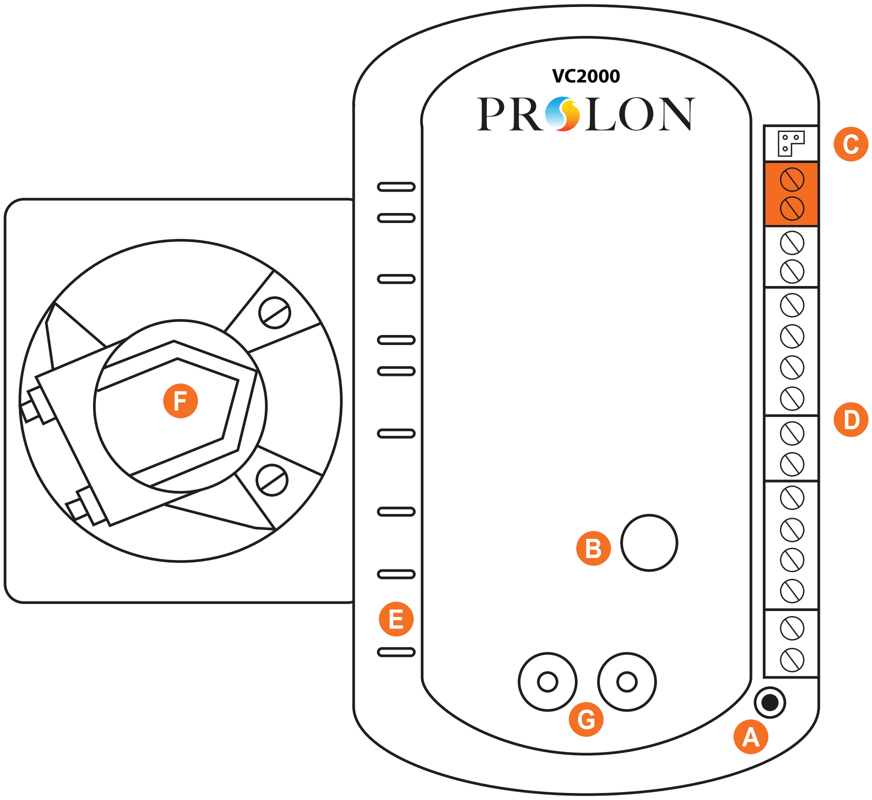


Figure 1 - Component Identification

Legend:

A - Service Button

B - Damper Actuator Clutch Button

C - Jumper for RS485 NET Port Terminating Resistor

D - Terminal Blocks for Inputs and Outputs

E - LEDs

F - Damper Actuator and Grip

G - Airflow Sensor (PL-VC2000-PI models only)

Terminal Block Identification

The inputs and outputs of the VC2000 use "Plug-In" screw type terminal blocks with elevator-style clamping and are numbered for your convenience.

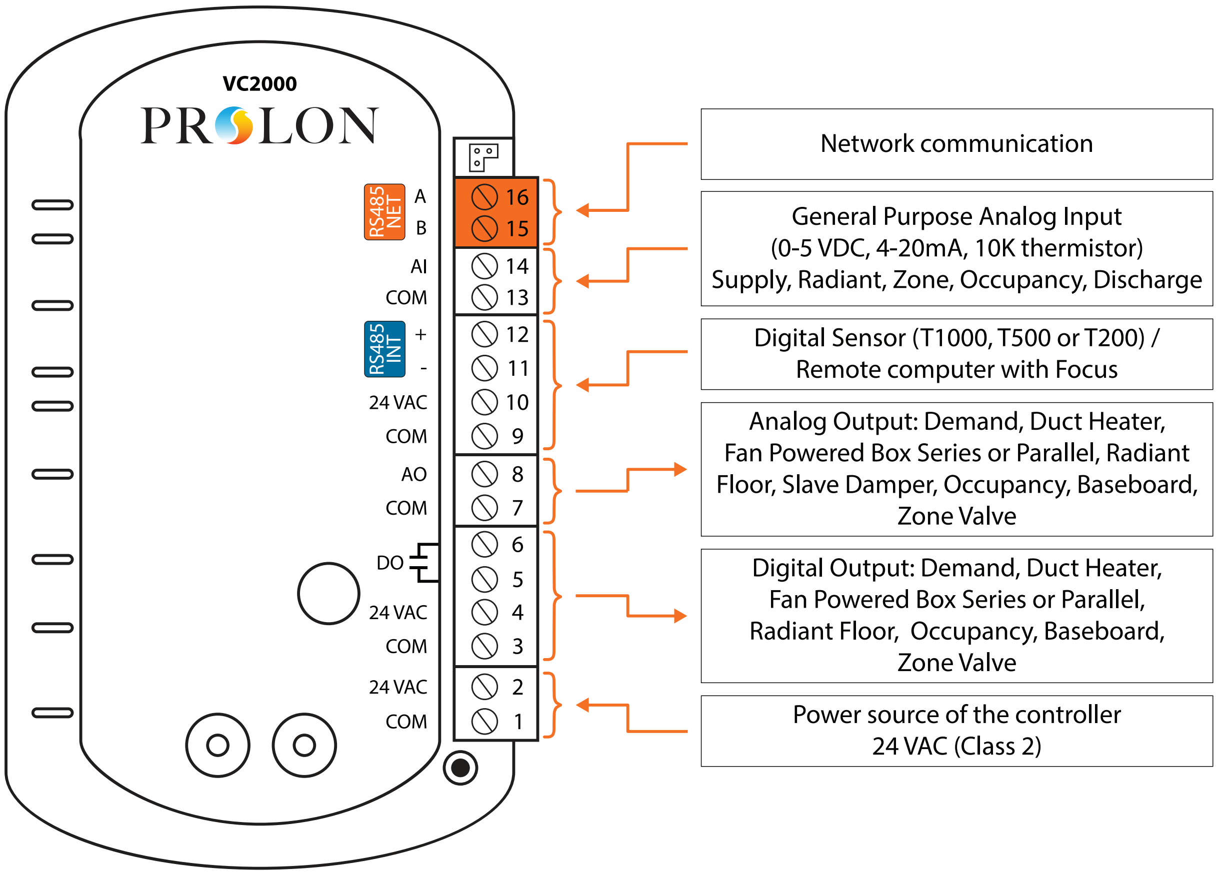


Figure 2 - Terminal Block Identification

LED Identification

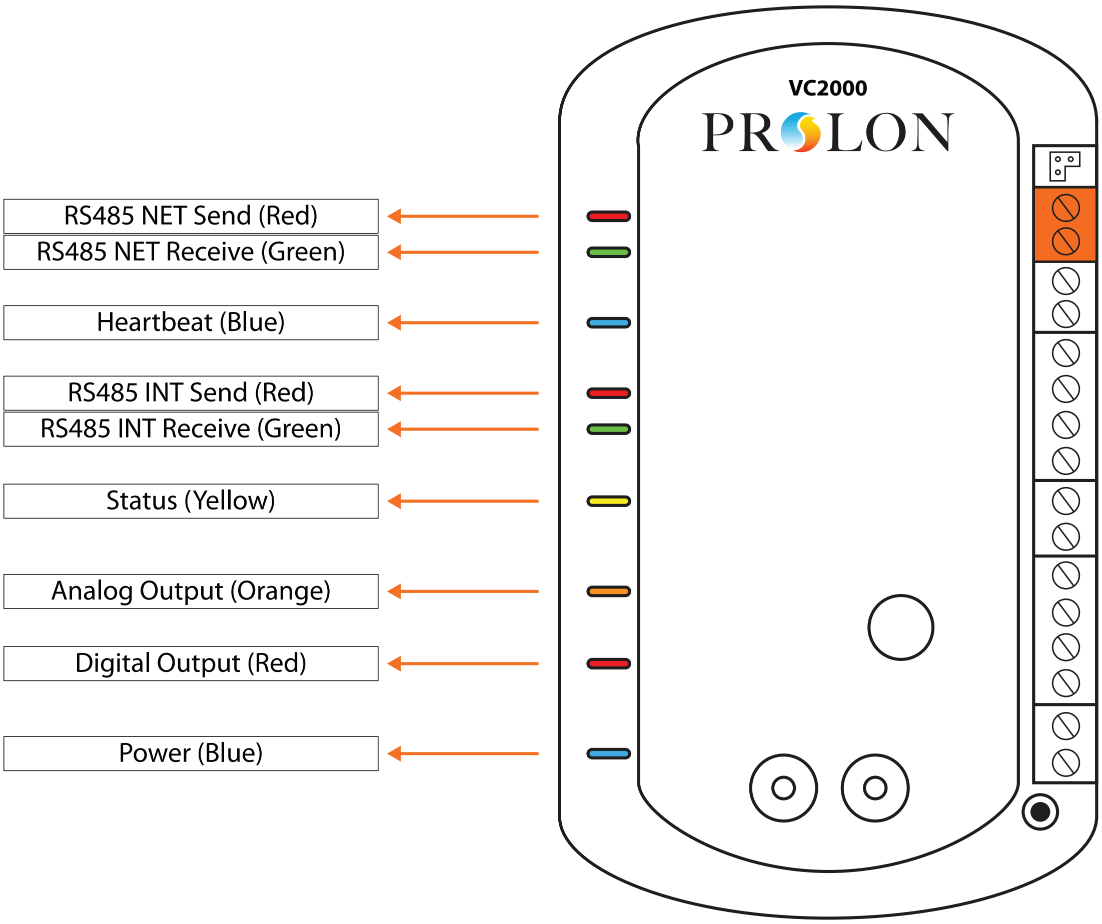


Figure 3 - LED Identification

Power Source

The Prolon VC2000 controller must be powered by a 24 VAC CLASS 2 power source connected using the COM pin (#1) and the 24 VAC pin (#2), as demonstrated in the image below. Note that if a digital sensor is being powered by the VC2000, it is important to take the power requirements of the digital sensor into account when selecting a power source for the VC2000.

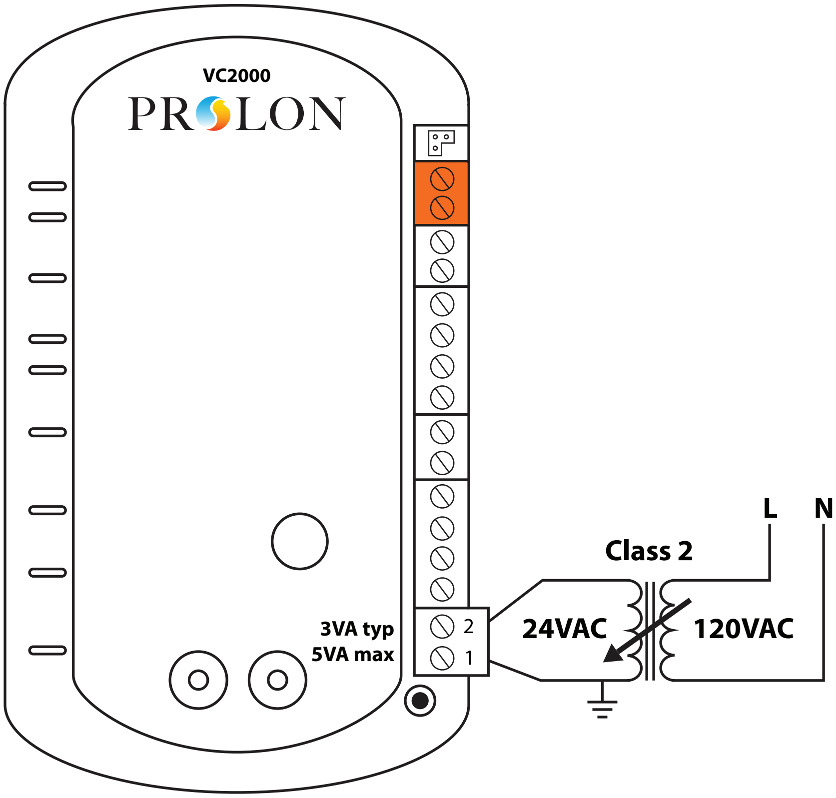


Figure 4 - Power Source

Note that the common for all inputs and outputs on the VC2000 are electrically the same as the power source common (pin #1). The pins of the digital output (pins #5 and #6) are electrically isolated from the rest of the circuit and do not internally touch the common.

Analog Input

The VC2000 series controllers are equipped with a single general purpose analog input. This input can be configured to receive signals of the following types:

- 0-5V
- 4-20mA
- Thermistor (Ω)

When a thermistor is used, the thermistor must be 10KΩ TYPE 3. The thermistor mode is also to be used for when a digital input (dry contact) is required.

The VC2000 analog input is equipped with a fast-switching barrier diode to protect against surges and short circuits.

By default, the VC2000 analog input is set up for thermistor mode, and it functions as a supply air temperature input. The function of the analog input can be changed using the Prolon Focus software or the T1000 digital interface.

The input signal mode can be changed by setting jumper JP4, situated inside the casing, in the desired position:

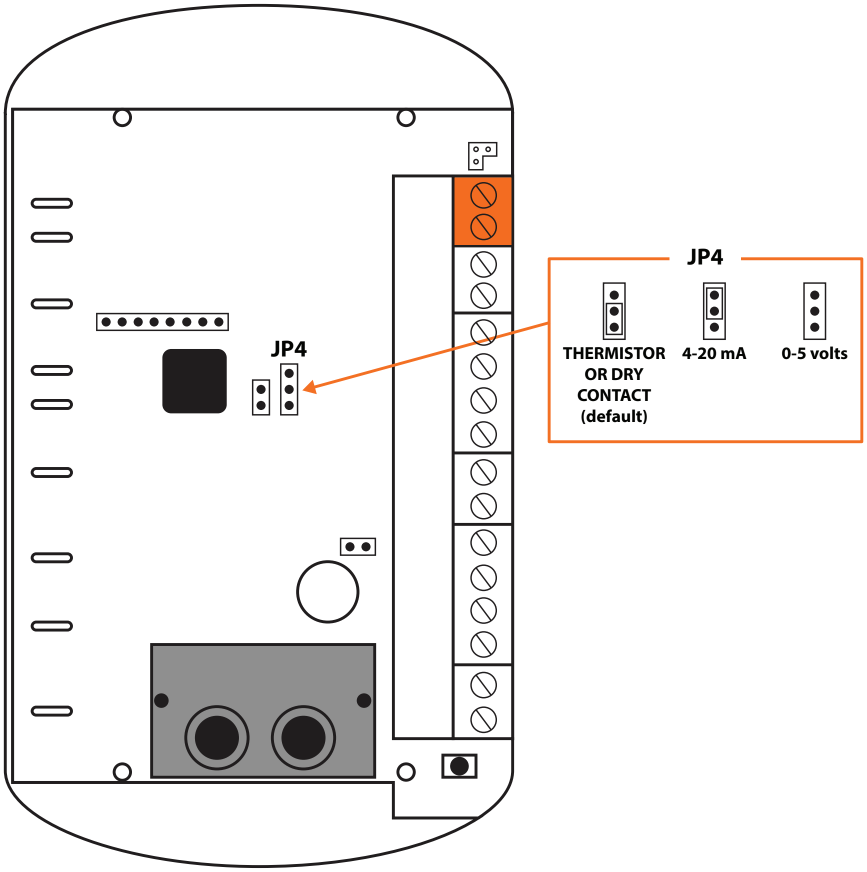


Figure 5 - Analog Input

Typical Wiring of the Analog input (Thermistor Mode)

The following diagram illustrates typical wiring of a thermistor to the analog input. The thermistor is connected to pins #13 and #14 of the VC2000.

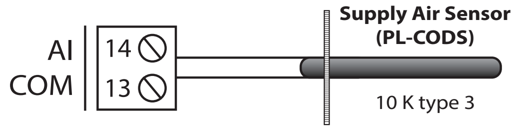


Figure 6 - Thermistor Mode

Note that individual supply air sensors may be unnecessary if the VC2000 is networked, since the supply temperature value is shared between all networked controllers when a network master is present.

When no air supply reading is available, the VC2000 assumes there is COLD air in the supply and operates accordingly. Alternatively, by shorting the analog input with a jumper, the VC2000 will instead assume there is HOT air in the supply.

Depending on the configuration of the VC2000, the function of the analog input will vary (zone temperature, radiant floor slab temperature, etc.). The presence and setup of a digital sensor may also affect the function of the analog input. See the Prolon Focus Guide of the VC2000 for more information.

Typical Wiring of the Analog input (CO_2 Sensor)

The following diagram illustrates typical wiring of a CO_2 sensor to the analog input. The sensor is connected to pins #13 and #14 of the VC2000.

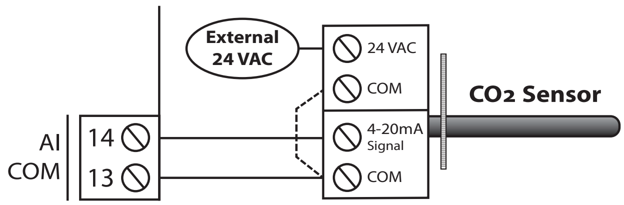


Figure 7 - CO_2 Sensor

The VC2000 is expecting a 4-20mA or 1-5VDC signal (0-2000 ppm) for CO_2 readings. Ensure that jumper JP4 (see p.10) is in the correct mode. When no sensor reading is available (sensor disconnected), the VC2000 will detect 0 ppm at the input.

When the CO_2 reading rises past a configurable setpoint, the VC2000 will use an alternate damper minimum position, one that allows more fresh air into the space. Once the CO_2 reading drops, the default minimum position is used again.

Airflow Sensor (PL-VC2000-PI)

Airflow sensors are only included in the PL-VC2000-PI models only. Adding an airflow sensor to the Prolon VC2000 lets it regulate the airflow as well as temperature in a zone, independently of the static pressure variations of the system.

The default flow sensor has a range of 0 to 2 in H20 (0 to 500 Pa). Depending on the flow cross used, this translates to roughly 0-3500 ft/min.

It is important to connect the airflow tubing in the correct direction, as illustrated in the following diagram:

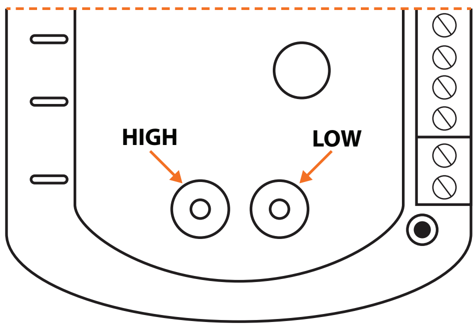


Figure 8 - Airflow Sensor Inlets

Outputs

The VC2000 series controllers are equipped with a 24VAC dry contact triac digital output and an analog 0-10VDC output to control a wide variety of equipment. Both outputs are fully configurable in either heating or cooling mode, can function in pulsed or ON/OFF mode, and much more. The entire setup for each output is fully customizable via the Prolon Focus software or the Prolon T1000 digital interface.

An integrated resettable fuse protects ***each*** of the outputs of the VC2000 against current surges and short circuits. This protection will cut the current to the output as soon as an overload condition is detected. The fuse is round and yellow-colored which, upon a short circuit condition, will heat up and change to orange. When the faulty wiring or circuit is fixed, the fuse will automatically reset and allow current to flow through the output again.

The analog output is equipped with a diode so that it can be wired in parallel with the analog outputs of other VC2000s to obtain a "highest voltage" signal.

Output Specifications

Output	Type	Heating	Cooling
Digital	Passive Triac (dry contact) On-or-Off Pulsed (PWM) Max Current: 300 mA	On-Off Valve Relay Triac	On-Off Valve Relay
Analog	Modulating Output On-or-Off Max Current 40 mA Configurable signal: - 0 to 10 VDC - 2 to 10 VDC - 0 to 5 VDC	Modulating Damper Modulating Valve SCR Relay Triac	Modulating Damper Modulating Valve Relay

Typical Wiring of the Triac Digital Output

The digital output is a passive dry contact triac output. The VC2000 opens and closes a contact to allow a source to power the load. There are two typical wiring setups for the VC2000.

1) The first setup is by using an external power source. The VC2000 opens and closes a contact to allow the external source to power the load (see Figure 9). Pins #3 and #4 are not used.

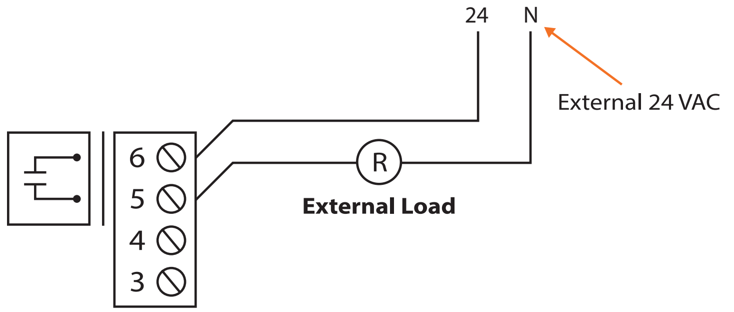


Figure 9 - Digital output wiring using an external power source

2) Alternatively, if an external power source is not available, an additional set of 24 VAC and COM pins (#4 and #3) are provided for your convenience. These pins are internally connected to the VC2000s power source (pins #2 and #1). By using a jumper to connect the internal power source to the digital output, the load can be powered (see Figure 10).

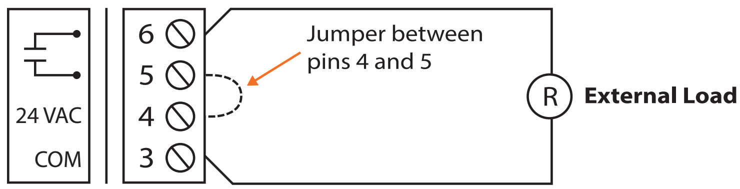


Figure 10 - Digital output wiring using the internal power source

Typical Wiring of the Analog Output

Tree types of configurations are possible:

1) The VC2000 only provides a control signal (see Figure 11).

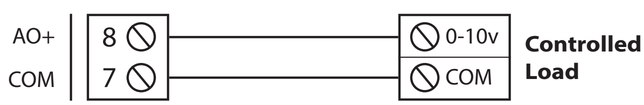


Figure 11 - Connecting the analog output (controller powered)

2) The VC2000 powers the load and provides a control signal (see figure 12).

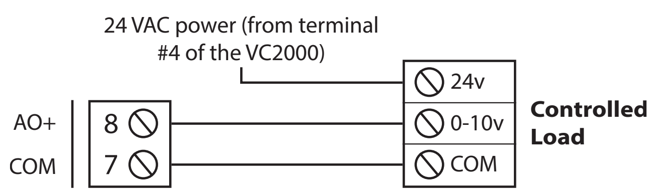


Figure 12 - Connecting the analog output (controller powered)

3) The VC2000 only provides the control signal to the load, which is powered by an external source (see figure 13). The common of the external source must be connected to the common of the VC2000.

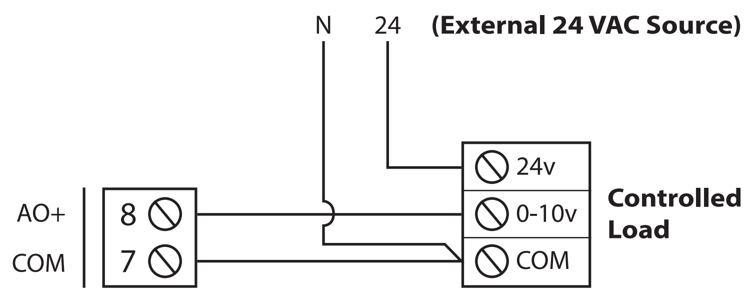


Figure 13 - Connecting the analog output (external power)

Damper Directing Configuration

The default damper opening direction of a VC2000 is counter clockwise (CCW). This setting can be modified by using either the Prolon Focus software, the T1000 digital interface, or with the following method:

Reversing the Damper Direction

- Remove power from the VC2000
- Press and hold the Service Pin
- Re-apply power to the VC2000
- Release the Service Pin

Whenever the VC2000 powers up while the Service Pin is pressed down, the damper opening direction setting will be reversed.

Please note that anytime the VC2000 powers up, it always starts by performing a damper calibration, where in it moves the damper completely to one side and then completely to the other side. Even if you invert the damper opening direction, the change will not take effect until after the calibration period.

Be careful not to hold down the service pin for more than 10 seconds after power-up, or this will cause the VC2000 to reset its network address.

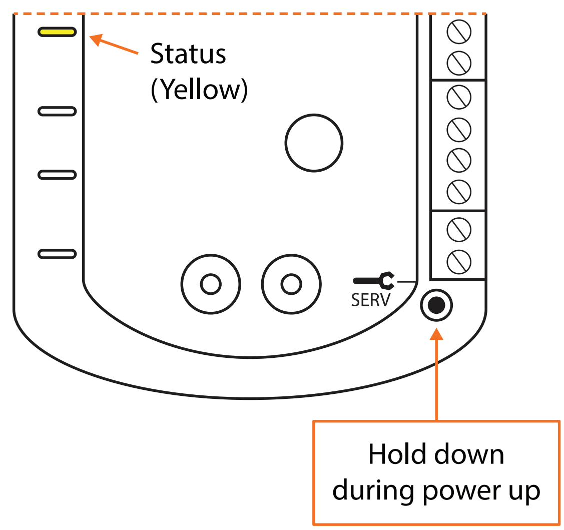


Figure 14 - Reversing the Damper Direction

Confirming Damper Direction

The damper opening direction can be visually confirmed after ***power up*** by observing the YELLOW STATUS LED:

- STEADY ON for 3 seconds → Opens COUNTER-CLOCKWISE (CCW)
- PULSES 3 TIMES (ON/OFF) over 3 seconds → Opens CLOCKWISE (CW)

Network Port (NET)

The Prolon VC2000 controller works either autonomously or networked. When networked, it will communicate in real-time with other controllers through its RS485 NET port. The VC2000 can communicate using two different communication protocols:

- Modbus RTU
- BACnet MS/TP

The network profiles for the VC2000 under both these protocols can be found on the Prolon website.

Regardless of the chosen communication protocol, the network wiring connections are made via the NET terminal block (#15 and #16) of the VC2000:

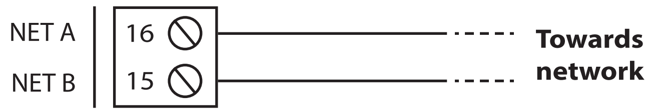


Figure 15 - Network port (NET)

The VC2000 controller's default communication protocol is Modbus RTU over RS485. The default baud rate is 57600 bps, with a single stop bit and no parity.

Changing the Communication Protocol of the NET Port

The communication protocol for the NET port can be modified using jumper JP1, situated inside the casing, as demonstrated in the following diagram.

Note that the communication protocol for the Interface Port (INT) cannot be changed, and is always Modbus RTU.

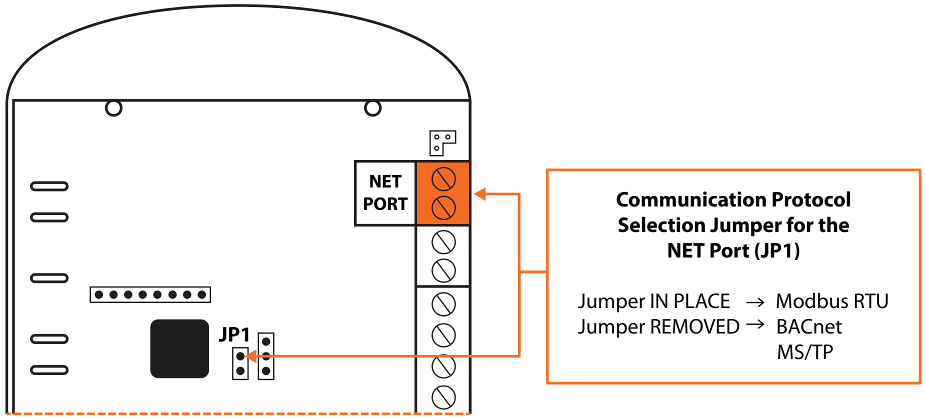


Figure 16 - Communication Protocol of the NET Port

Assigning a network address

The VC2000 requires a network address in order to communicate with other controllers and be seen on a network. When the YELLOW STATUS LED is ON, the VC2000 does not yet have a valid network address (this is the factory default setting). There are two main methods to assign a network address to a VC2000.

1) The first method is by using the Prolon Focus software. When prompted by Focus, press the service button on the VC2000 and hold it until the STATUS LED goes OFF. See the Prolon Focus User guide for more information.

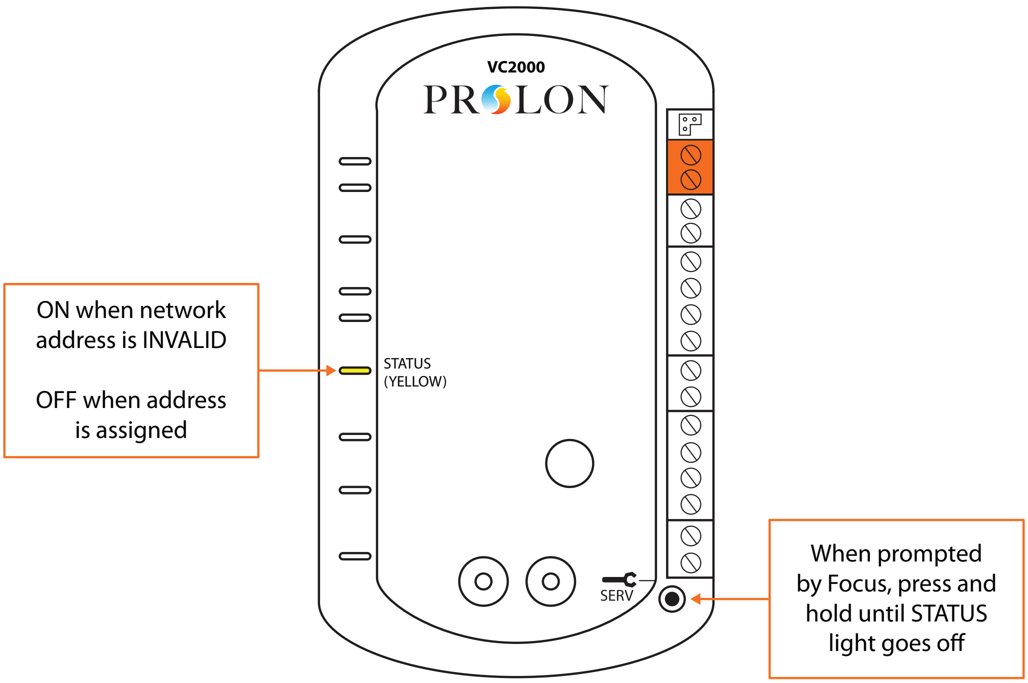


Figure 17 - Assigning a network address

2) The second method is using a Prolon digital interface such as the T1000 digital sensor. Upon power up, the digital interface will detect if the VC2000 does not yet have a valid address and will then prompt the user to assign one using the touchpad or knob on the sensor. The STATUS LED will go OFF once this procedure is complete.

Once assigned, the network address can be modified at any time using the Prolon Focus software or the T1000 digital sensor.

The network address can also be ***erased*** by holding down the service pin continuously for 10 seconds. The STATUS LED will go ON once the address has been erased.

Interface Port (INT)

The Interface RS485 port is intended to function specifically with a Prolon digital interface or sensor such as a T1000, T500 or T200. It is through this port that a digital sensor will send temperature and setpoint information to the VC2000.

For your convenience, an additional set of 24 VAC and COM pins are provided to simplify the wiring and powering of a digital sensor. Please note that since the digital sensor pulls its power from the VC2000, it is important to take the power requirements of the digital sensor into account when selecting a power source for the VC2000.

The communication protocol for this port is exclusively Modbus RTU. Typical wiring is as follows:

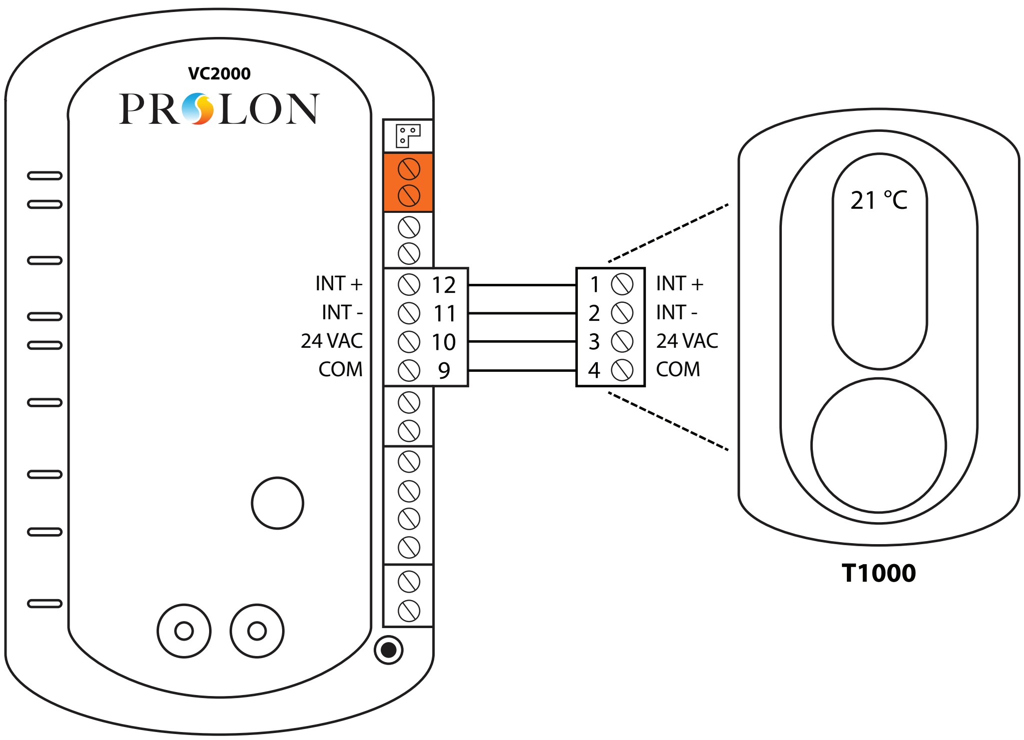


Figure 18 - Interface Port

The Interface port can also be used as a 'backdoor' through which communication can be established with the VC2000 if ever the network address is forgotten or invalid. All Modbus messages will be responded to through this port, regardless of the network address used in the message. The default baud rate is 57600 bps, with a single stop bit and no parity.

Terminating Resistors

Terminating resistors, as specified by the RS485 protocol, are used to improve network communication in long networks. Terminating resistors must be enabled on both End-of-line nodes of an RS485 bus (daisy-chain). End-of-line nodes are the devices that are at BOTH extremities of the RS485 bus. In the following example, device #1 and device # 5 are the End-of-line nodes:

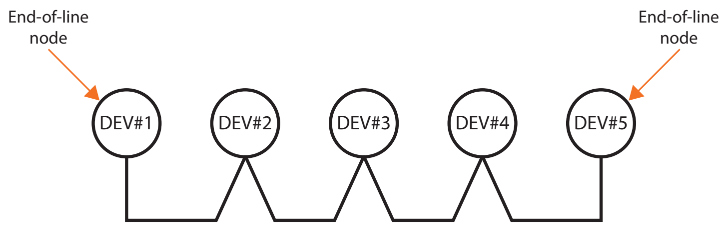


Figure 19 - RS485 Bus

The VC2000 comes equipped with jumpers allowing the user to enable or disable the terminating resistor as required. When a VC2000 is the End-of-line node of a bus, the resistor should be ENABLED. When a VC2000 is not the End-of-line node, it should be DISABLED (factory default).

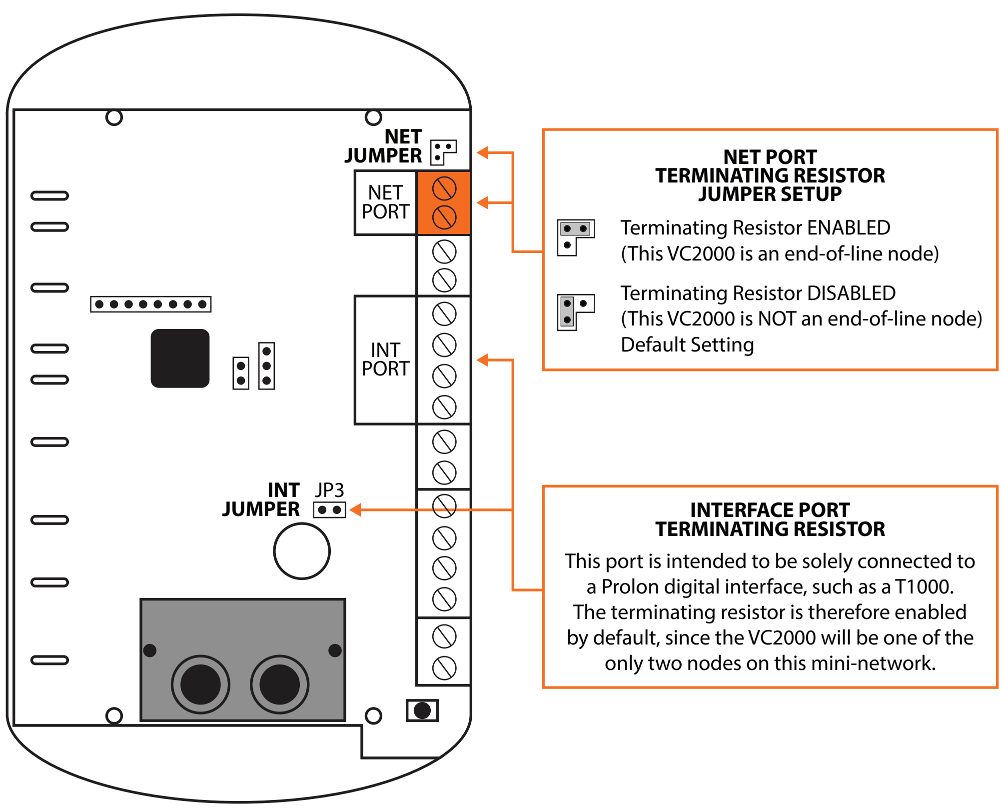


Figure 20 - Terminating Resistors

Note that the VC2000 does not include BIAS resistors, and as such the BIAS resistors must be enabled on another device on the network (such as an M2000) or added manually.

Technical Specifications

Supply: 24 VAC ±10%, 50/60 Hz, Class 2

Consumption: 3 VA (Typ Consumption), 5 VA (Max Consumption), 24 VA (Input)

Inputs: 1 general purpose analog input supporting 3 types of input signals (0-5V, 4-20mA and thermistor), as well as an RS485 communication port for a digital zone temperature sensor

Flow sensor: 0-2 inches of H20 (optional)

Digital output: 1 triac 10-30 VAC dry contact, 300 mA max (resettable fuse), ON/OFF or pulsed, heating or cooling

Analog output: 0-10 VDC, 40 mA max (resettable fuse), modulating, ON/OFF or pulsed, heating or cooling

Indication lights (LED): State of each output / Communication / Power / State of microprocessor

Casing: Molded ABS, UL94-HB

Microprocessor: PIC18F6722, 8 bits, 40 MHz, 128KB FLASH memory

Communication: 1 RS485 network port (Modbus RTU or BACnet MS/TP - up to 127 nodes), and 1 RS485 port for digital sensor or computer interface.

Baud rates: 9600, 19200, 38400, 57600, 76800, 115200

Connection: Removable screw-type terminal blocks (16 AWG max)

Dimensions: 5" x 5" x 3" (127 mm x 127 mm x 77 mm)

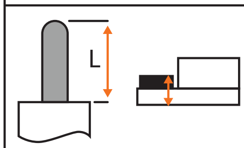
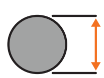
Weight: 1.15 lbs (0.5 kg)

Environment: -4 to 122 ºF (-20 to 50 ºC) Non-Condensing

Certification: UL916 Energy Management Equipment, CAN /CSA-C22.2, FCC part 15: 2012 class B, RoHS

Actuator:

- Belimo® with Halomo® technology, 45 in-lb
- Minimum Spindle Length: 37 mm / 1.5 in (Belimo LM)
- Spindle Diameter Range: 6-20 mm / 0.25-0.75 in (Belimo LM)

Spindle length		Spindle diameter	
	min. 1.5 inch.		1/4...3/4 inch.

The performance specifications are nominal and conform to acceptable industry standards. Prolon Inc. will not be liable for damages resulting from misapplication or misuse of its products.

Compliance

- cULus Listed; UL 916 Energy Management Equipment, File E364757, Vol.1
- CAN/CSA-C22.2 No. 2015-12, Signal Equipment
- FCC Compliant to CFR47, Part 15, Subpart B, Class B
- Industry Canada (IC) Compliant to ICES-003, Issue 5: CAN ICES-3 (B)/NMB-3(B)
- RoHS Directive (2002/95/EC)

FCC User Information

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.

Caution: Any changes or modifications not approved by Prolon can void the user's authority to operate the equipment.

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Industry Canada

This Class (B) digital apparatus meets all the requirements of the Canadian Interference-Causing Equipment regulations.

Cet appareil numérique de la Classe (B) respecte toutes les exigences du Réglement sur le matériel brouilleur du Canada.

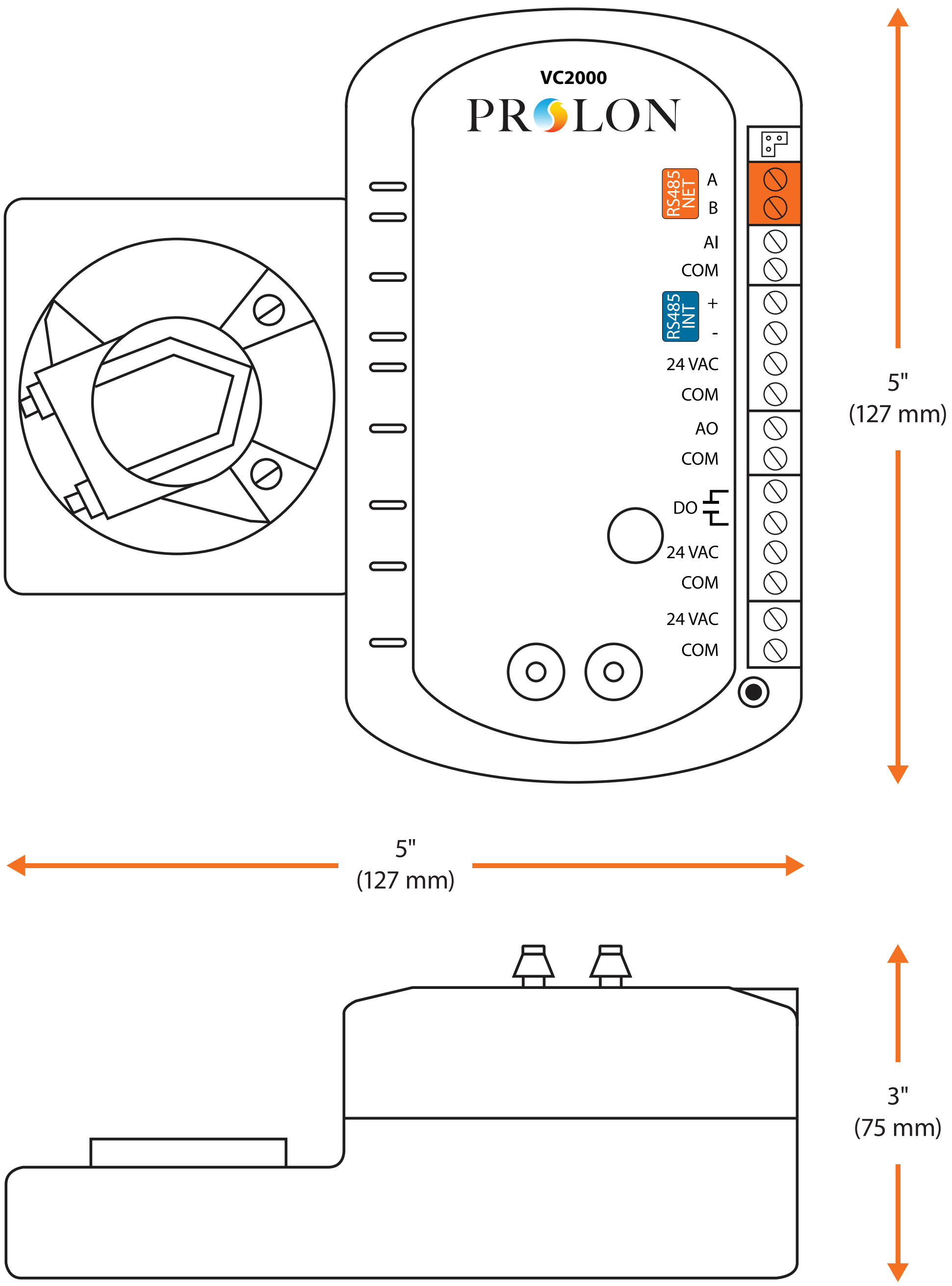


Figure 21 - VC2000 Size Diagram

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