PROLON

HARDWARE GUIDE

VAV Zone Controller C1000 Series

Specifications and Operational Guide

www.proloncontrols.com | info@proloncontrols.com
17 510, rue Charles, Suite 100, Mirabel, QC, J7J 1X9

REV. 7.1.3
PL-HRDW-VAV-C1000-C/F-EN

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General Information

PL-C1000 VAV Zone Controller

Description

The Prolon C1000 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 C1000 requires an external actuator (sold separately) when damper control is needed. When in a network, the C1000s can share information such as the occupancy state, the demand, the supply temperature and more.

General Behaviour

The Prolon C1000 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 various programming options also allow the user to modify the unoccupied mode setpoints, the deadbands, 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 digital sensor (T1000 series).

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.

PL - C1000 - VAV - PI

Flow Sensor

BLANK: No Flow Sensor
PI: With Flow Sensor 0-3000 FPM

Figure 1 - Part Number

Flow Sensor

This option specifies whether or not a flow sensor should be included with the C1000 VAV controller.

In all cases, the C1000 includes:

- 2 Independent Communication Ports
- 3 Analog Inputs
- 1 Binary Input
- 4 Configurable Digital Outputs (24 VAC Source or Sink)
- 1 Configurable Analog Output (0-10VDC)

The external damper actuators can be controlled by either the Analog Output (modulating actuator), by two of the Digital Outputs (floating actuator), or both.

Component Identification

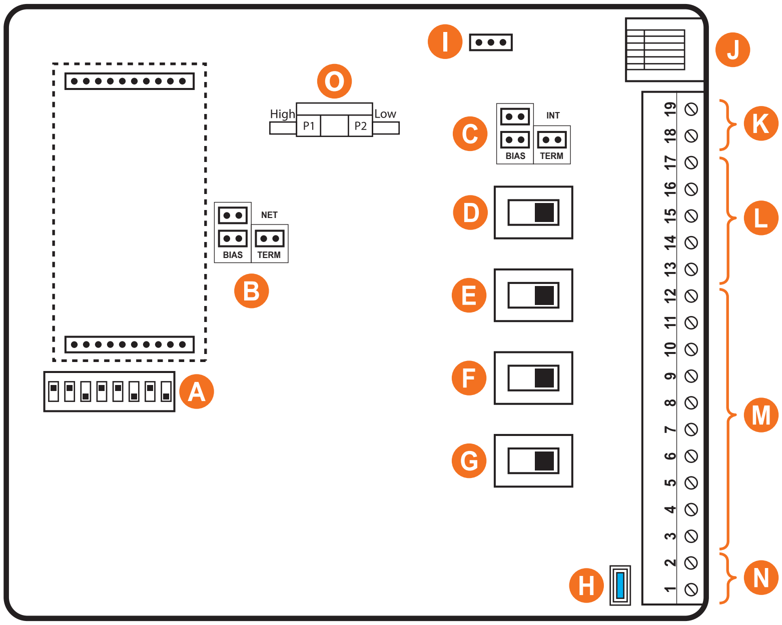

Figure 2 - Component Identification

Legend:

A - Addressing dipswitch

B - Jumpers for RS485 terminating and bias resistors for the NET port (see J)

C - Jumpers for RS485 terminating and bias resistors for the INT port (see K)

D - SOURCE/SINK dipswitch for Output 4

E - SOURCE/SINK dipswitch for Output 3

F - SOURCE/SINK dipswitch for Output 2

G - SOURCE/SINK dipswitch for Output 1

H - Reset Button

I - Jumper to supply voltage to INT port (see J)

J - INT port for RS485 communication (RJ45 jack)

K - NET port for RS485 or Lon communication (terminal block)

L - Inputs (4 total)

M - Terminal Blocks for Outputs 1 to 5

N - Terminal Blocks for 24 VAC

O - Airflow Sensor (optional)

LEDs

The C1000 has various LEDs which are linked to different functions and outputs of the controller. Each LED is individually identified to help the user make a quick visual diagnostic of the controller's activity and status

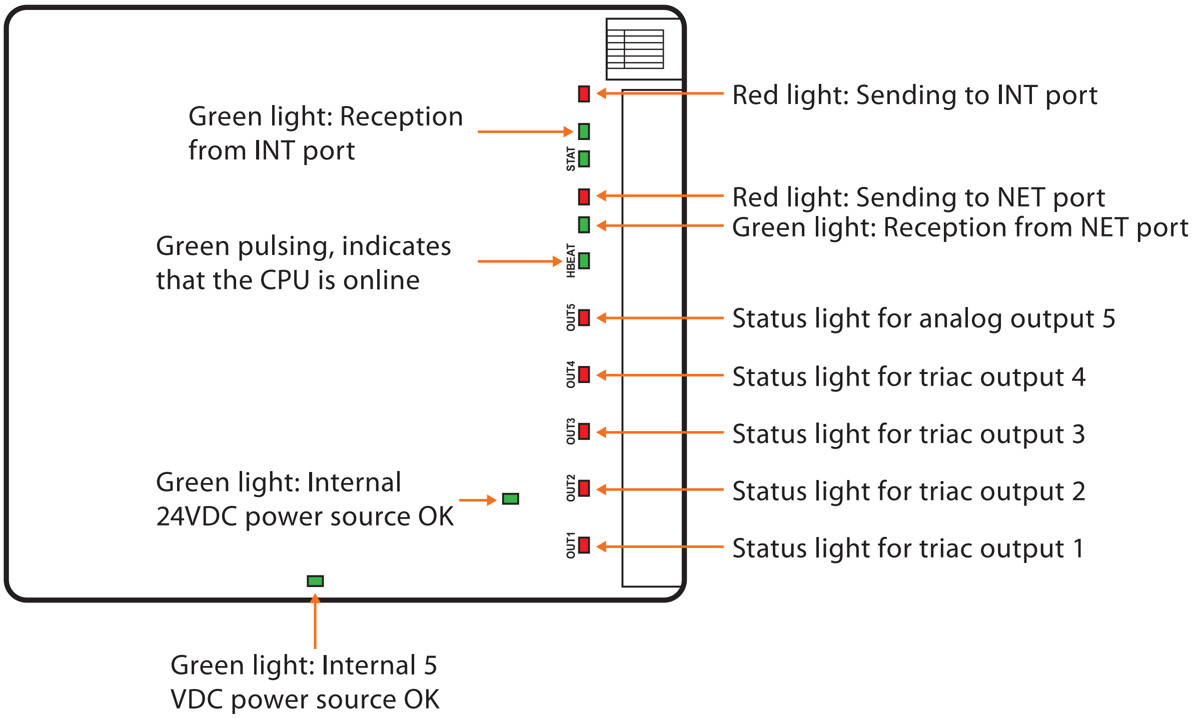

Figure 3 - LEDs Identification

Address Configuration for Networking (Modbus or BACnet)

A unique address on each controller must be configured by setting the first 7 switches of the addressing dipswitch to the desired value.

These switches are numbered from 1 to 7 and represent a binary value from 1 to 64 (1, 2, 4, 8, 16, 32, 64 respectively). The value of each switch that is in the ON position is added together to form the numerical address of the controller.

The example on Figure 4 shows the switches 1, 2 and 4 on the ON position. So the corresponding values are 1, 2 and 8, giving an address sum of 11. (1+2+8=11).

Modbus and BACnet networks over RS485 allow a maximum of 127 addresses, therefore 127 controllers.

To enable BACnet communication, no additional communication card is required! Simply move switch #8 of the addressing dipswitch to the 'ON' position to start BACnet MS/TP (RS485) communication.

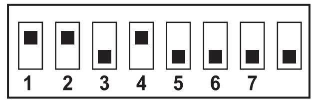

Figure 4 - Addressing Dipswitches

Jumper to Supply Power to the RJ45 Plug

The RJ45 jumper lets the user select the voltage that will appear on pin #7 of the RJ45 plug. This can be used to power a device attached to the RJ45 plug, such as a digital sensor or interface. ***NOTE***: If multiple C1000 controllers are connected together through the RJ45 plug, ***only one*** C1000 should be supplying power onto the RJ45, otherwise you will be mixing your supply sources and possibly cause damage. The jumper setups are as follows:

Figure 5 - Jumper

Airflow Sensor (Optional)

Adding an airflow sensor to the Prolon VAV controller lets it regulate the temperature AND the airflow of a zone, independently of the static pressure variations of the system. Two different airflow sensors are offered (see Figure 6):

- Low velocity sensor (0 - 1100 ft/min)
- High velocity sensor (0 - 3000 ft/min)

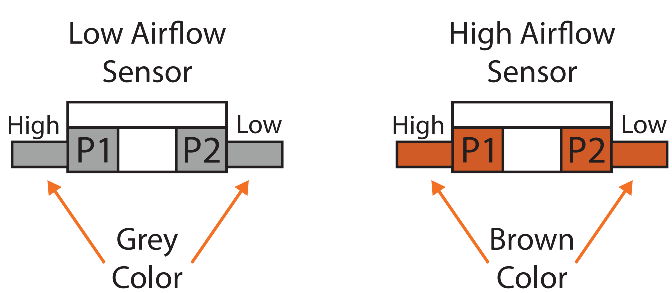

Figure 6 - Airflow Sensors

Damper Direction Configuration

The default damper opening direction of a C1000 VAV controller is counter clockwise (CCW). This parameter can be modified in two different ways. The first is by using a digital interface or Prolon Focus software to manually change the setting. The second is to use the following method:

1. *Reversing the Damper Direction*
Whenever a C1000 resets and a jumper is placed on the last two pins on the far most right of port J11, the damper opening direction will be inverted (see adjacent image).

A C1000 can be ***reset*** in one of the following ways:

- Pressing on the physical RESET button
- Cycling power to the device

Please note that in the event of a device reset, a C1000 VAV controller always performs a damper recalibration first, where 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.

2. *Once you have finished* configuring the damper opening direction to the setting of your choice, ***do not forget to REMOVE the jumper*** from the last two pins, or the damper direction will invert itself again and again upon any subsequent resets of the controller.

To ensure that the damper direction will no longer change, move the jumper one pin to the left, as depicted in this image:

3. *Confirming Damper Direction*
The damper opening direction can be visually confirmed by observing the green "STAT" LED on the VC1000 board after performing a ***reset***:

- "STAT" LED STEADY ON for 3 seconds = COUNTER CLOCKWISE (CCW) OPENING
- "STAT" LED PULSES 3 TIMES (ON/OFF) over 3 seconds = CLOCKWISE (CW) OPENING

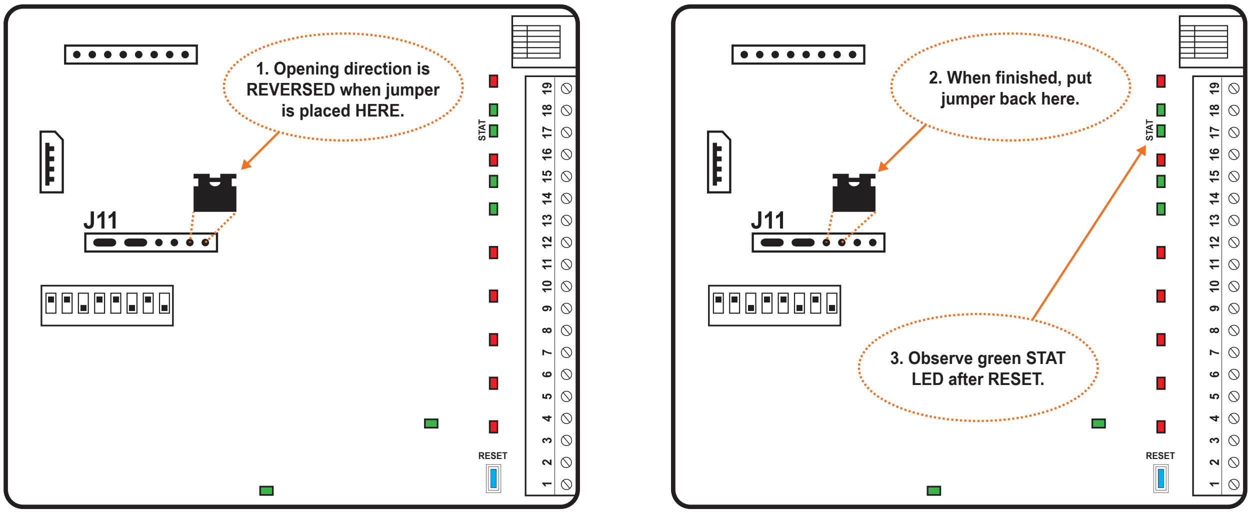

Figure 7 - Damper Configuration

Input and Output Identification

All the inputs and outputs of the C1000 use pluggable screw type terminal blocks with elevator style clamping, which make connections easier and more secure. The C1000 VAVController has two separate communication ports offering the same functionality on each. Both act as ports for incoming Modbus communications from other ProLon devices or interfaces,such as a Network Controller or remote computer with Prolon Focus software.

The "INT" Port (see below) uses an RJ45 type connector. The RJ45 connector allows the use of premade CAT5 cables for simple plug-and-play RS485 communication. This RJ45 connector follows the Modbus pinout specification for RS485 communication.

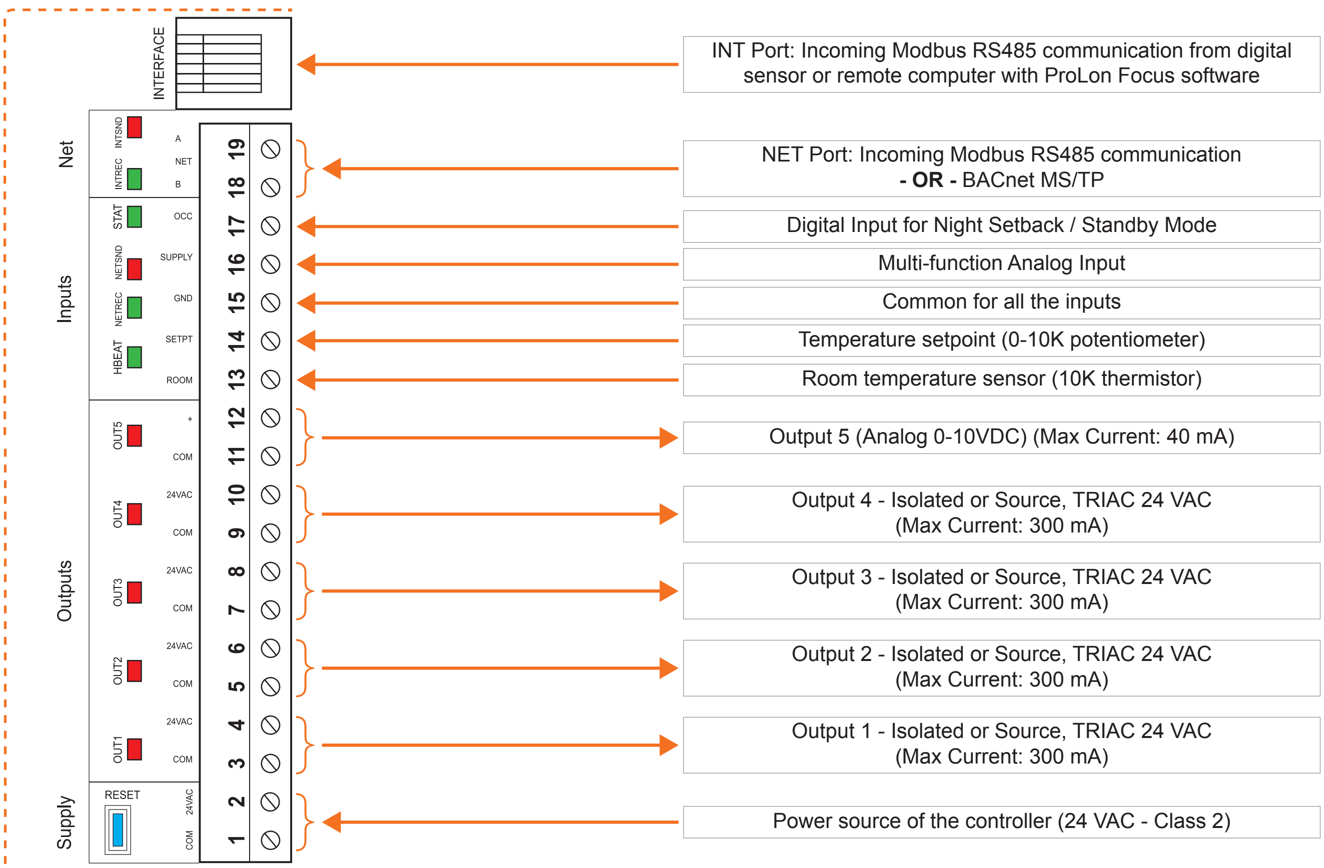

Figure 8 - Input and Output Identification

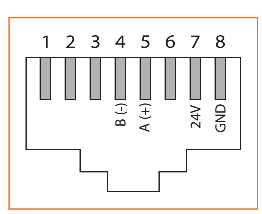

Figure 9 - RJ45 Pinout

Room Sensors

Two types of room temperature sensors are available:

- ***Analog***: Analog room temperature sensor (thermistor) with setpoint knob and override button
- ***Digital***: Digital sensor, communicating over RS485 to the C1000

Analog Room Sensor (PL-RS Series)

The PL-RS series room sensors provide the C1000 with a room temperature and setpoint. A push-button is also present to override the schedule. The PL-RS series are connected using a 3-conductor cable (see Figure 10). Note that if a shielded cable is used to connect the PL-RS, the shield must be grounded at the GND (pin 1) of the C1000 to which it is connected. To activate the schedule override from the PL-RS, hold the override button for 3 seconds.

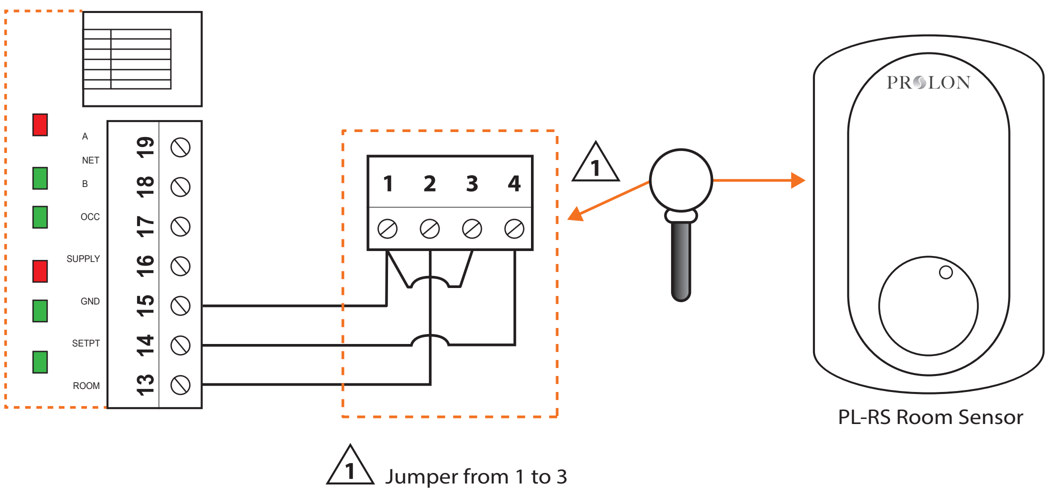

Figure 10 - Typical Wiring of the PL-RSC Room Sensor to the Controller

Digital Room Sensors

Prolon offers various digital communicating sensors that can provide the C1000 with room temperature, room setpoint, and schedule override (T1000, T500, T200 sensors), as well as giving you access to all configuration parameters of the C1000 (T1000 only).

The digital room sensors are connected to the INT communication port on the C1000, either directly using a standard CAT5 Ethernet network cable (see Figure 11), or by using an RJ45 adapter (PL-T1000-ADAPT) to allow the use of a 4-conductor cable (see Figure 12).

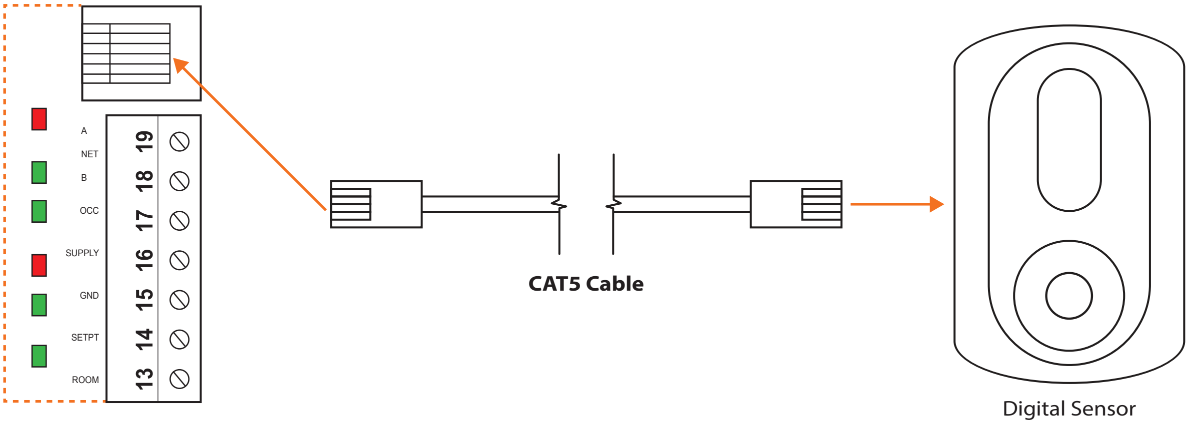

Figure 11 - Connecting the Digital Sensor to the Controller (CAT5 Cable)

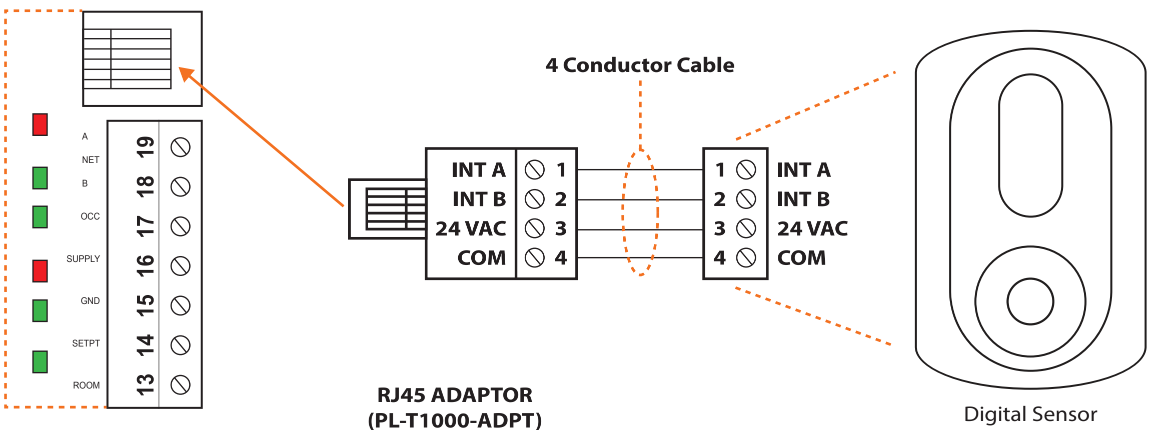

Figure 12 - Connecting the Digital Sensor to the Controller (RJ45 Adapter)

Multi-Function Analog Input

The C1000 has a multi-function analog input. The function of this input varies depending on the configuration that is setup using the Prolon Focus software. By default, this input is used as a supply air temperature input.

Supply Air Temperature Sensor (PL-CODS)

When a zone controller works autonomously, a supply air temperature sensor (10K Type 3) can be connected to it in order to invert the damper control method upon detection of hot or cold air (see Figure 13).

However, if that controller is part of a network that includes a Prolon Master controller (RTU, HP or other), individual sensors for each C1000 may be unnecessary since the Master controller will distribute its own supply air temperature reading to all controllers it is associated with.

NOTE: A supply temperature reading received from a physically attached thermistor will take precedence over a reading received over the network.

If no Master is present and no sensor is available, the controller will then work under the assumption that there is cold air in the supply. Alternatively, by shorting the supply temperature input (terminals 15 and 16), the controller will instead assume there is hot air in the supply.

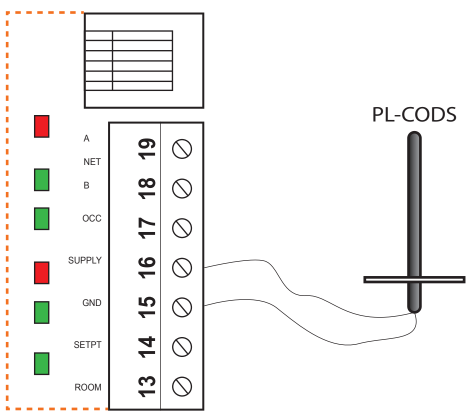

Figure 13 - Connecting the Supply Air Sensor to the Controller

Radiant Floor Slab Temperature Sensor

When the C1000 is configured to work as a radiant floor controller, the function of the supply temperature input changes to become a slab temperature input. Therefore, a radiant floor slab thermistor (10K type 3) can then be connected to the C1000 on terminals 15 and 16 (see Figure 14).

Note that if a T1000 digital sensor is connected to the C1000, the slab thermistor can instead be wired directly to the T1000, and the T1000 will then send the slab temperature to the C1000, cutting down wiring costs. The supply temperature input can then again be used for a supply air sensor or other.

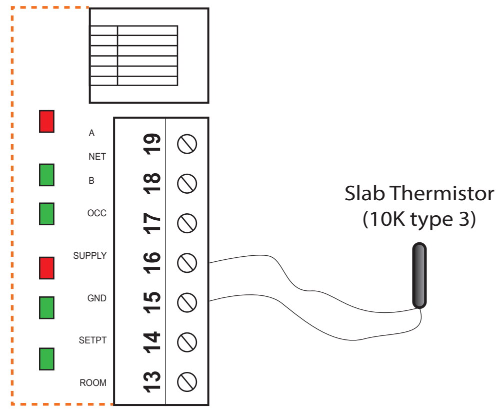

Figure 14 - Connecting the Slab Temperature Sensor to the Controller

Discharge Air Temperature Sensor

The multi-function analog input can be configured to monitor a discharge air temperature sensor (10K type 3). Discharge air temperature is not used in any sequence and is for display purposes only.

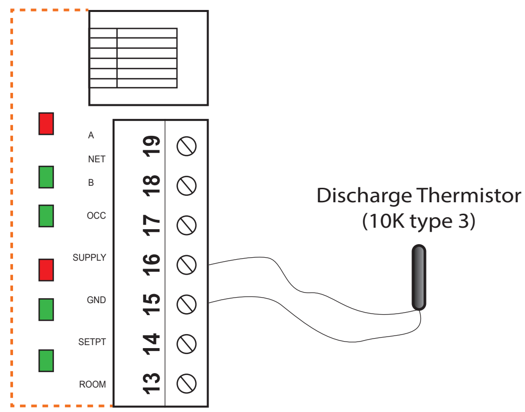

Figure 15 - Connecting the Discharge Temperature Sensor to the Controller

Digital Input

Occupancy originating from an External Timer

An external timer can be used to switch the C1000 between occupied and unoccupied modes. The dry contact originating from the external timer must be connected to the "Setback" and the "GND" terminals (17 and 15). Refer to Figure 16 to see how to correctly connect the timer.

To indicate occupied mode, the contact must be open. To indicate unoccupied mode, the contact must be closed.

Note that if a C1000 controller is part of a network that includes a Prolon Master controller (RTU, HP or other), an individual contact per C1000 may be unnecessary because all zone controllers share the occupancy status sent on the network by that Master.

NOTE: The occupancy state received from a physically attached dry contact will take precedence over the occupancy state received over the network. Applies only to closed contact (unoccupied mode).

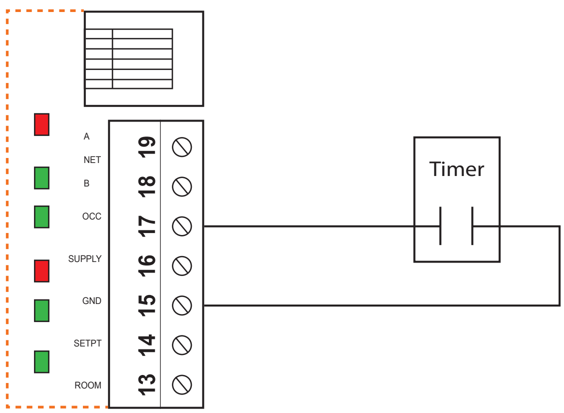

Figure 16 - Connecting an External Timer to the Controller

Standby mode originating from a Motion Detector

A motion detector is typically used to enable the standby mode sequence. The dry contact originating from the motion detector must be connected to the "Setback" and the "GND" terminals (17 and 15). Refer to Figure 16 to see how to correctly connect the motion detector.

To indicate occupancy in the space (motion detected), the contact must be closed. Standby mode occurs when the C1000 is receiving an occupancy signal from the network, but no motion is detected in the space (contact open).

When in standby mode, the controller uses an alternate, smaller damper minimum position, and will also stop influencing the master controller in regards to building demand (zone demand and weight sent to the master are 0). The C1000 will still control its own space to the best of its ability.

Outputs

The C1000 series controllers are equipped with four configurable 24VAC triac digital output and an analog 0-10VDC output to control a wide variety of equipment. All 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 sensor.

An integrated resettable fuse protects ***each*** of the outputs of the C1000 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
1	Triac Source 24VAC Passive Triac (dry contact) On-or-Off Pulsed Max Current: 300mA	Damper Valve Relay Triac	Damper Valve Relay
2	Triac Source 24VAC Passive Triac (dry contact) On-or-Off Pulsed Max Current: 300mA	Damper Valve Relay Triac	Damper Valve Relay
3	Triac Source 24VAC Passive Triac (dry contact) On-or-Off Pulsed Max Current: 300mA	Valve relay Triac	Valve Relay
4	Triac Source 24VAC Passive Triac (dry contact) On-or-Off Pulsed Max Current: 300mA	Valve Relay Triac	Valve Relay
5	Modulating Output On-or-Off Pulsed Max Current: 40mA Configurable Signal: - 0 to 10 VDC - 2 to 10 VDC - 0 to 5 VDC	Modulating Damper Modulating Valve SCR Relay Triac	Modulating Damper Modulting Valve Relay

Configuration of Digital Outputs 1 to 4

Outputs 1 to 4 are configurable via switches located on the C1000 board. Simply move the switch to obtain either an active output (1) or a passive output (2).

1) Switch position to obtain an ***active output*** (see Figure 17):

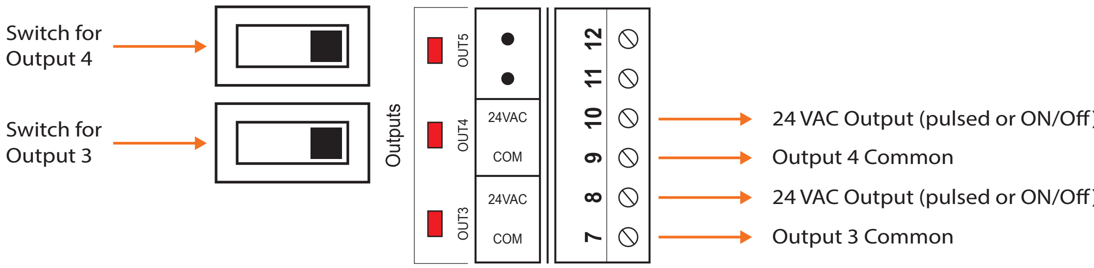

Figure 17 - Outputs 3 and 4 Active

2) Switch position to obtain a ***passive output*** (see Figure 18):

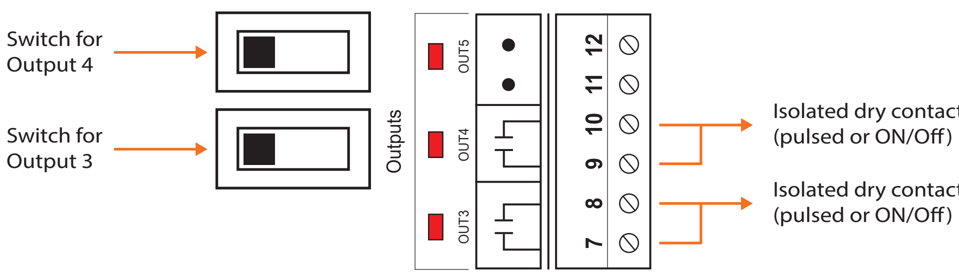

Figure 18 - Output in SINK mode

Typical Connection of the Triac Outputs 1 to 4

Two types of configurations are possible:

1) Active outputs. The C1000 is actively powering the load (see Figure 19).

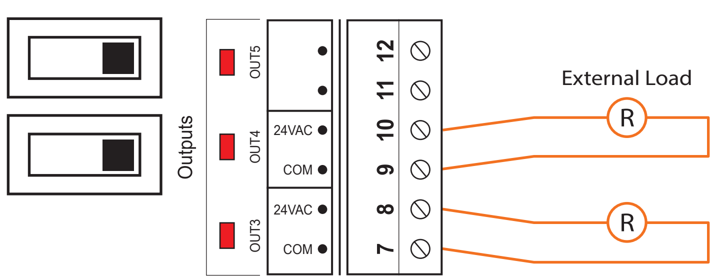

Figure 19 - Connection of Active Outputs 3 and 4

2) Passive outputs. The C1000 opens and closes a contact to allow an external source to power the load (see Figure 20).

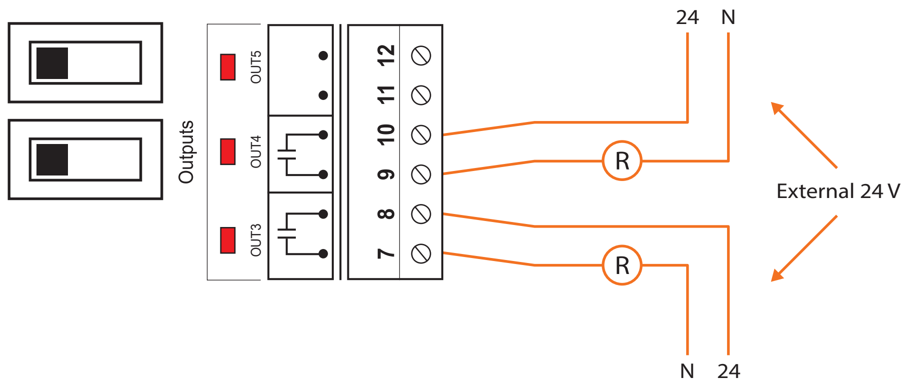

Figure 20 - Connection of Passive Outputs 3 and 4

Typical Connection of the Analog Output

Two types of configuration are possible:

1) The C1000 powers the load and provides a control signal (see Figure 20)

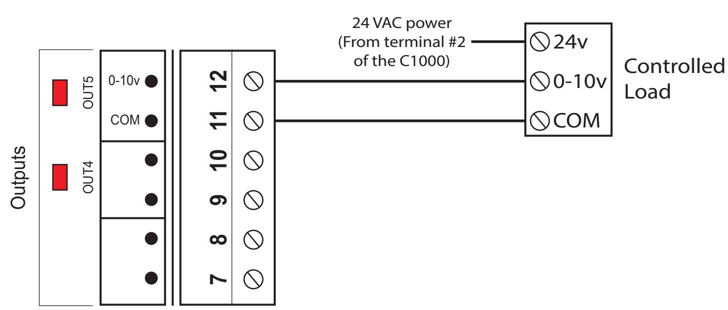

Figure 21 - Connecting the Analog Output (Controller Powered)

2) The C1000 only provides the control signal to the load, which is powered by an external source (see Figure 21).

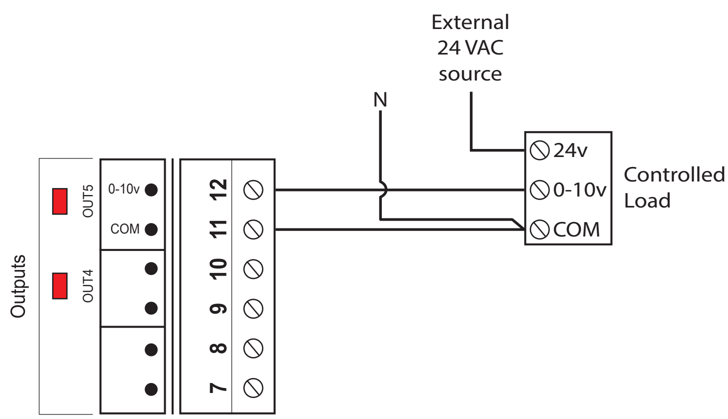

Figure 22 - Connecting the Analog Output (External Power)

Power Source / Network

Power Source

The Prolon C1000 controller is powered by a 24 VAC power source (Class 2) connected using the "COM" terminal and the "24 VAC" terminal (see Figure 16). The common for all inputs and outputs are the same as the power source's common (exception: when an output is set to passive, the common for this output will not correspond to the power source common). All output power sources also originate from the controller's power source. Note that if a digital sensor is being powered by the C1000, it is important to take the power requirements of the digital sensor into account when selecting a power source for the C1000.

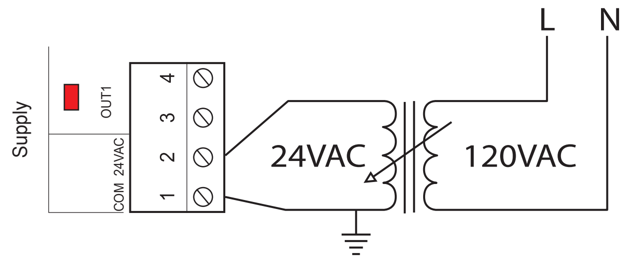

Figure 23 - Connecting the 24VAC Power Source

Network Communication

The Prolon C1000 controller works autonomously or networked. When networked, it will communicate in real-time with other controllers. The C1000 controller's default communication protocol is Modbus RTU over RS485. The addressing is done with the addressing dipswitch located on the C1000 card (see Figure 4). The network connections are made using the NET terminal block located on the Prolon C1000 controller (see Figure 23). If the optional Lon communication card is connected to the C1000 board, the controller will automatically switch to the Lon protocol, with a unique address found on the communication card itself.

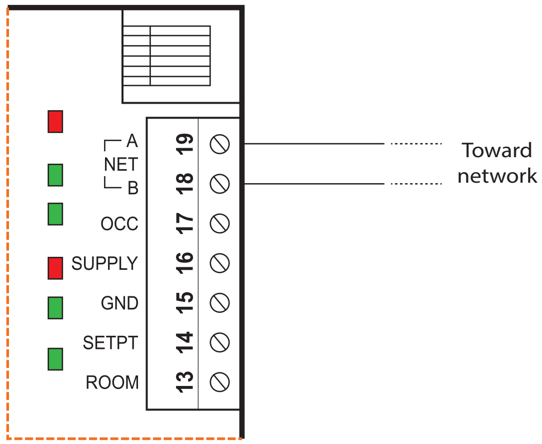

Figure 24 - Connecting to the Network

Technical Specifications

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

Consumption: 2 VA (Consumption), 32 VA (Input)

Inputs:
- Room – thermistor 10K
- Duct – thermistor 10K
- Setpoint – potentiometer 0-10K
- Optional flow sensor
- External clock – dry contact
- Override – dry contact
- Digital room sensor

Flow sensor: 0-3000 ft/min

Digital outputs: 4 triac outputs, 10-30 VAC source or sink, 300 mA max (resettable fuse), ON/OFF or pulsed, heating/cooling

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

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

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

Casing: Molded ABS, UL94-HB

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

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

Connection: Removable screw-type terminal blocks (16 AWG max) and RJ45 modular jack

Dimensions: 6.2" x 5.2" x 2.5" (157 mm x 132 mm x 64 mm)

Weight: 0.85 lbs (0.39 kg)

Environment: 32-122 ºF (0-50 ºC) Non-Condensing

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

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

- 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.

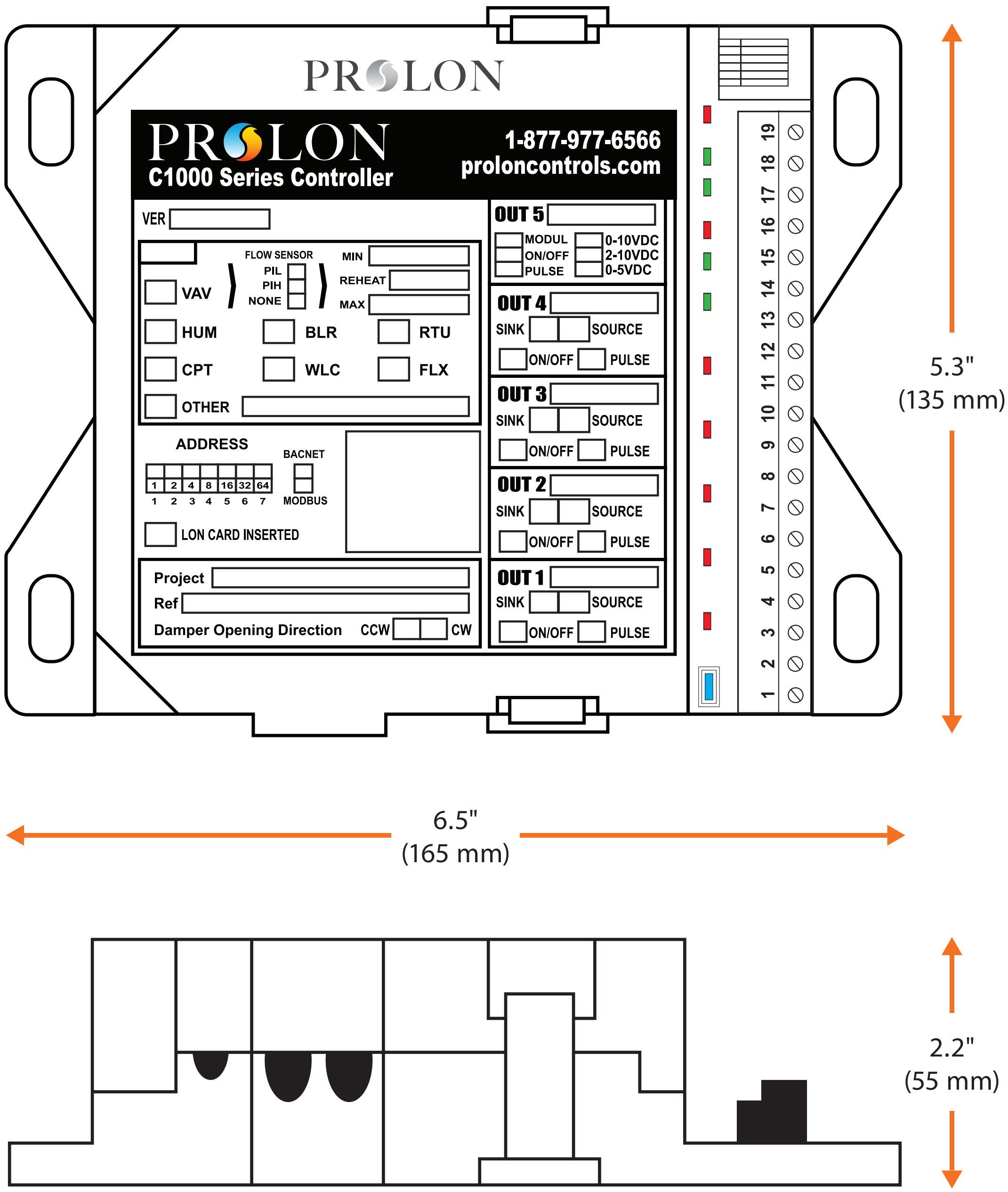

Figure 25 - C1000 Size Diagram

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