PROLON

HARDWARE GUIDE

Heatpump Controller C1000 Series

Specifications and Operational Guide

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PL-HRDW-HP-C1000-C/F-EN

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PL-C1000 Heatpump Controller

Description

The Prolon PL-C1000 Heatpump controller is a microprocessor-based controller designed to operate residential or commercial heatpump equipment. It uses PI (Proportional-Integral) control loops and acts as a master when used on a network with Prolon zone controllers.

The Standalone model of this controller will not act as a master to other Prolon zone controllers, relying instead on the demand provided by a local sensor.

General Behaviour

Although fully configurable, the Prolon C1000 Heatpump controller uses pre-established control sequences or ''profiles'' to operate specific HVAC equipment with dedicated output functions. These can be fully optimized to obtain the best results for each type of system. Numerous parameters enable the modification or fine tuning of the fan, the compressor outputs, the action of the heating outputs (On-or-Off / pulsed / modulating), the proportional bands, integration times, differentials, operational ranges, setpoints and a whole range of limits and safeguards. The various programming options also allow the user to modify unoccupied mode settings, morning warm-up and supply air pre-heating sequences as well as the network demand control strategy best suited for the building space it is controlling. All these parameters can be accessed by using the Prolon Focus software.

Operating Sequence

General

The Prolon C1000 Heatpump controller receives readings from three different temperature sensors: outside air, return air and supply air. Also, as a Master device, it receives data from the zone controllers or thermostats sent on the network bus. The controller then analyzes all the data and demands sent by the zones and commands the appropriate outputs to respond accordingly, within parameters set by the temperature sensors and other safety limits. When working as a network Master, it sends back information to its network such as supply air temperature, occupancy status and other relevant data for the zone controllers to use.

Occupied Mode

The controller operates the fan. When there is a cooling demand from the zones, the Heatpump controller will put the reversing valve into cooling mode and activate the compressor outputs as long as all temperature limits, delays and other related parameters are respected. Once the demand is satisfied, the outputs are deactivated within the prescribed minimum on/off time delays.

When there is a heating demand from the zones and the outside temperature is above the low balance point, the Heatpump controller will put the reversing valve into heating mode and activate the compressor outputs as long as all temperature limits, delays and other related parameters are respected. If the outside temperature is below the low balance point, the controller will activate the auxiliary heating outputs. If the heatpump is configured for water-to-air mode, the low balance point is ignored and the use of compressors is permitted all year round. Protection sequences are in place that will activate auxiliary heat upon failure of the compressors. Once the demand is satisfied, the outputs are deactivated within the prescribed minimum on/off time delays.

When there is no cooling or heating demand from the zones, only the fan is enabled. If the heating equipment permits, a supply air pre-heating sequence may be enabled. This allows cold mixed air to be heated to a more comfortable level for subsequent use by the zones for ventilation.

Unoccupied Mode

The fan can be configured to operate in intermittent mode. When there is a cooling or heating demand from any single zone, the Heatpump controller will activate the fan and the necessary cooling or heating outputs as long as all temperature limits, delays and other related parameter are respected. Once the demand is satisfied, the fan and any cooling/heating outputs are deactivated within the minimum on/off time delays set.

During the unoccupied period, the Heatpump controller can be driven by the highest demand on the network and will operate the fan and relevant outputs accordingly.

Components

Component Identification

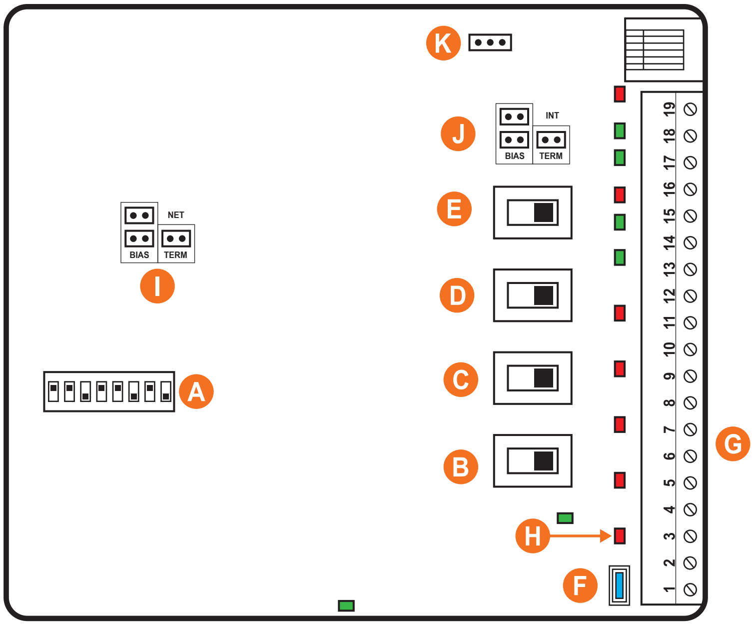

Figure 1 - Component Identification

Legend:

A - Addressing Dipswitch

B - Output 1 Dipswitch

C - Output 2 Dipswitch

D - Output 3 Dipswitch

E - Output 4 Dipswitch

F - Master reset button

G - Terminal Blocks for Inputs and Outputs

H - LEDs

I - Jumpers for terminating and bias resistors for the NET port

J - Jumpers for terminating and bias resistors for the INT port

K - Jumper to supply voltage to INT port (RJ45 jack)

LEDs

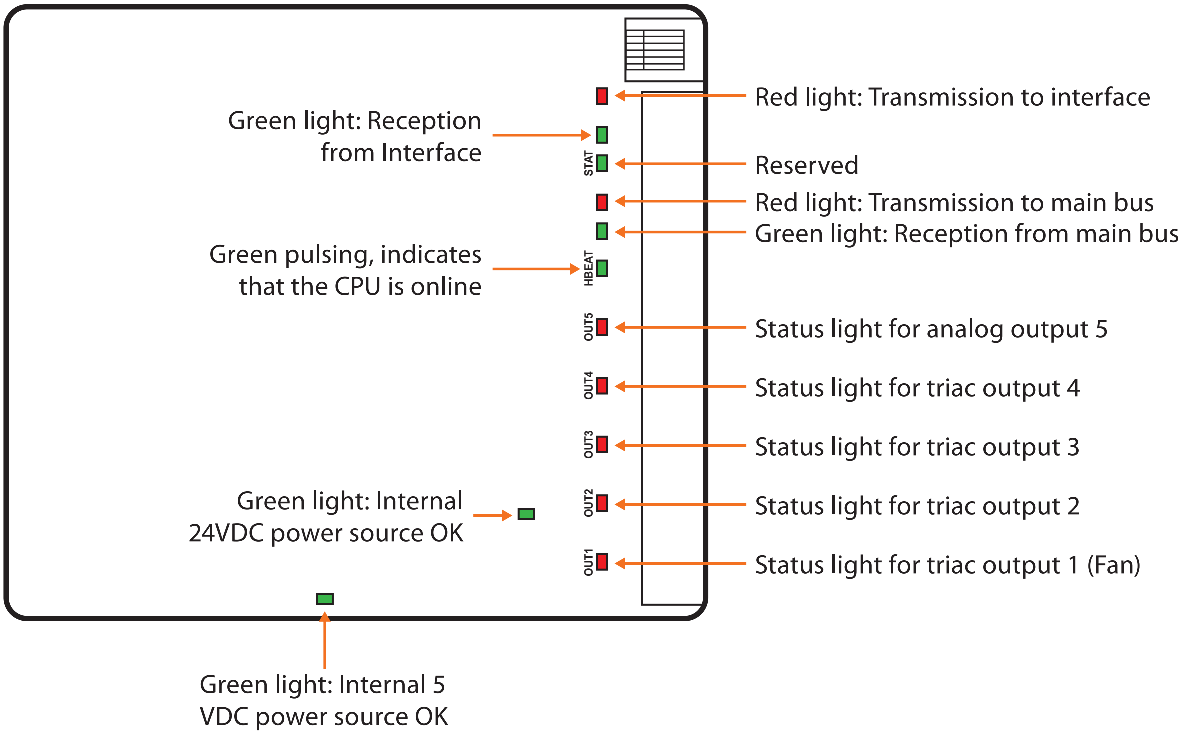

Figure 2 - LEDs Identification

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. Output functionality will vary depending on the number of compressors in use (1 or 2 - see below).

The C1000 Heatpump Controller has 2 separate communication ports offering varying functionality based on whether or it is a heatpump standalone controller (HPS) or not (HP).

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.

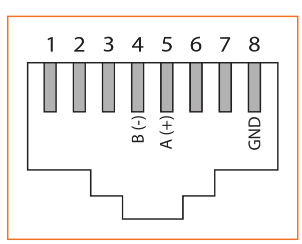

Figure 3 - RJ45 Pinout

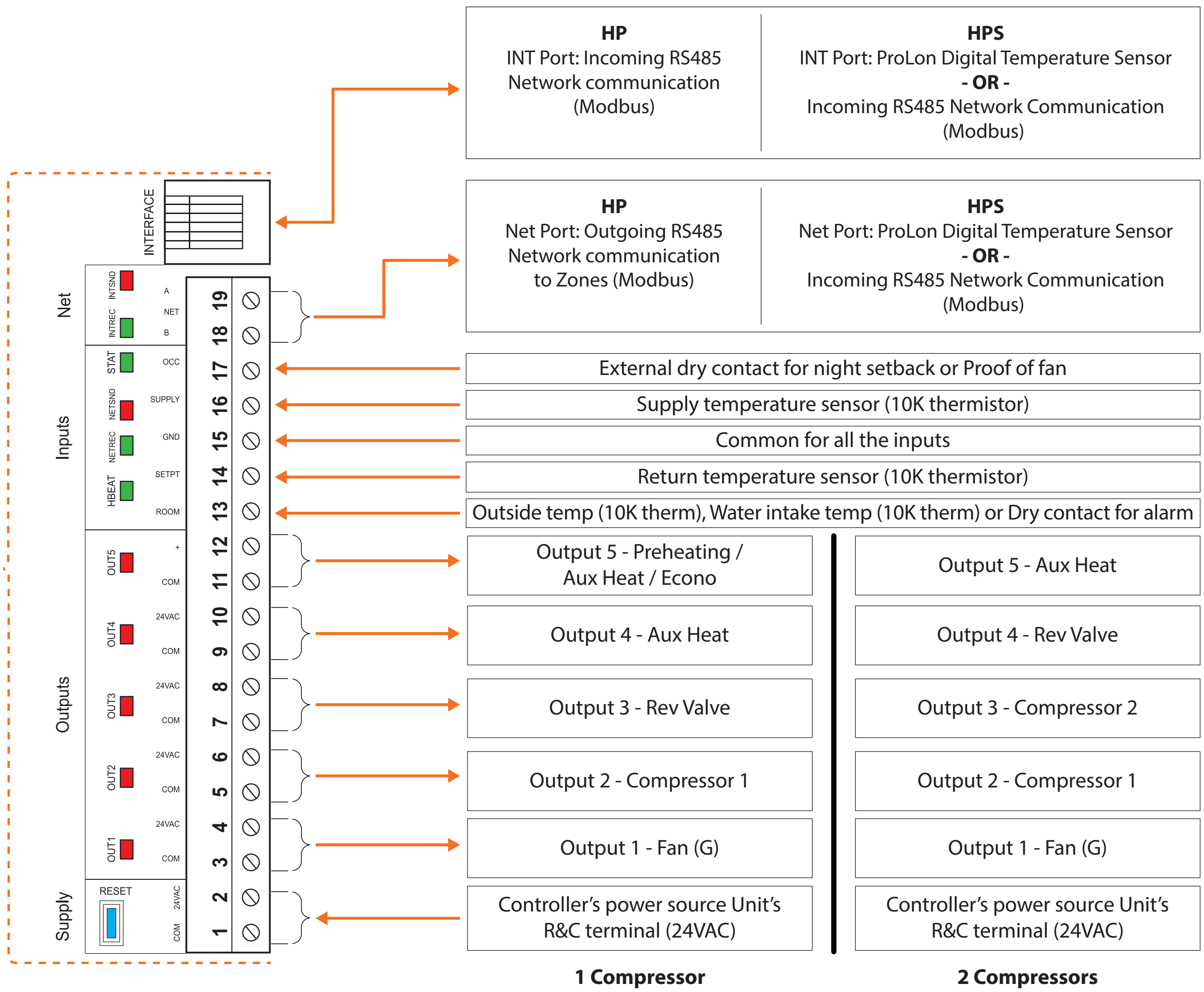

Figure 4 - Input and Output Identification

Addressing Dipswitch Configuration for Network Communication

A unique address must be configured on each controller by setting the first 7 switches on 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, and 64 respectively). The last switch (#8) is reserved. The value of each switch that is in the ON position is added together to form the numerical address of the controller.

The example in Figure 1 shows the switches 1, 2 and 4 in the ON position. Therefore, the corresponding values are 1, 2 and 8, giving an address sum of 11.

The Prolon network allows a maximum of 127 addresses, therefore 127 controllers.

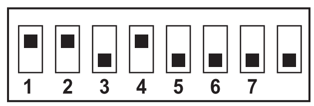

Figure 5 - Addressing Dipswitches

Jumper to Supply Power to the RJ45 Plug

The RJ45 jumper lets the user select if 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 6 - Jumper

Temperature Sensors

he C1000 Heatpump controller has three analog inputs that monitor outside air, return air and supply air temperatures (see Figure 2) and will integrate these readings into its control sequence. The sensors used are standard 10k type 3 thermistors that share a single common connection.

Alternatively, the supply air temperature can be retrieved from a zone controller that has its own supply sensor and belongs to the C1000's network.

The outside air temperature can be also be provided by an alternate source. If a network controller is present on the network, it can retrieve the outside temperature reading from one controller and distribute it to any other controllers on the network.

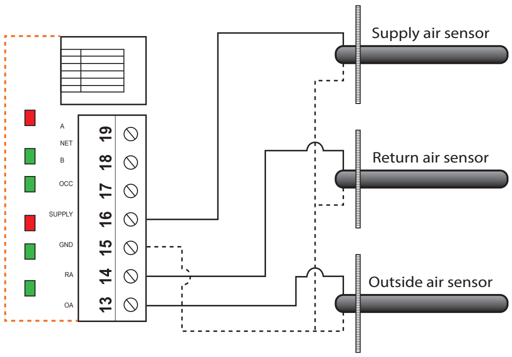

Figure 7 - Connecting the Temperature Sensors

Occupancy Mode (Night Setback)

Temperature setback savings can be obtained by using a dry contact originating from an external timer to switch the controller from occupied to unoccupied mode. The timer contact used must be connected to the "OCC" and the "GND" terminals (see Figure 8). To indicate occupied mode, the contact must be open. To indicate unoccupied mode, the contact must be closed. If operating as a network Master, the Heatpump controller will then send the occupancy status to all known slaves on his network. ***NOTE***: This input can instead be used as a prof of fan input, depending on the software configuration. Alternatively, occupancy can be supplied by the NC2000 network controller.

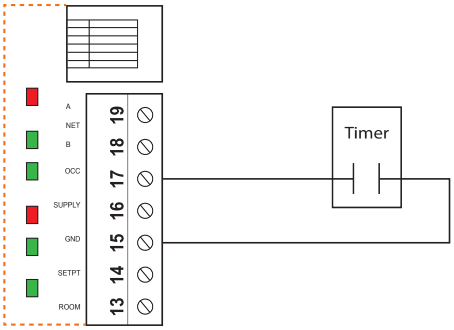

Figure 8 - Night Setback Contact Connection

Proof of Fan

The C1000 has a digital input that can be used to receive the proof of fan signal. Please refer to Figure 9 to see how to correctly connect it. To indicate proof of fan, the contact must be closed. ***NOTE***: This input can instead be used as an occupancy contact input, depending on the software configuration.

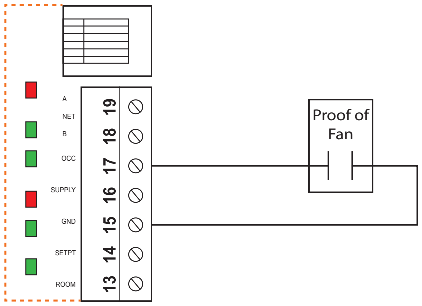

Figure 9 - Connecting the Proof of Fan Contact to the Controller

Dry Contact for Alarm Signal

The C1000 has an analog input which can be designated as an alarm signal input. Please refer to Figure 10 to see how to correctly connect it. To signal an alarm, the contact must be closed. Closing this contact will prevent the use of the compressors, either in heating or cooling. Auxiliary heating will still activate as required.

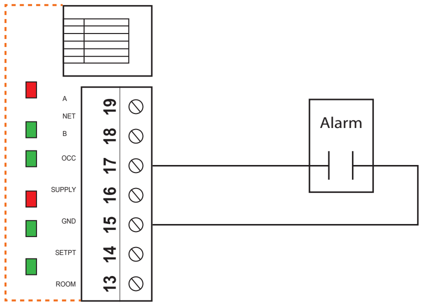

Figure 10 - Connecting the Alarm Contact to the Controller

Outputs

The C1000 Heatpump controller contains 5 customizable outputs, 4 being Triac type switch outputs and one being 0-10Vdc analog modulating / pulsed / On-or-Off output. Some outputs are configurable and follow a proportional and integral algorithm (PI) to ensure precise adjustment of the device. Output configuration is performed via the Prolon Focus software.

An integrated resettable fuse protects each of the four Triac 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. It consists of a round yellow-coloured thermal fuse that will change to orange and heat up on a short circuit condition. When the faulty wiring or circuit is fixed, the breaker will automatically reset and activate the output again.

Output Specifications

Output	Type	Action	Applications (1 Compressor)	Application (2 Compressors)
1	Triac Source: 24VAC Max Current: 300 mA	On-or-Off	Fan	Fan
2	Triac Source: 24VAC Max Current: 300 mA	On-or-Off	Compressor	Compressor (1st Stage)
3	Triac Source: 24VAC Max Current: 300 mA	On-or-Off	Reversing Valve	Compressor (2nd Stage)
4	Triac Source: 24VAC Max Current: 300 mA	On-or-Off	Auxiliary Heat	Reversing Valve
5	Configurable Analog Output: - 0 to 10 VDC - 2 to 10 VDC - 0 to 5 VDC Max Current: 40mA	Modulating Proportional / Pulsed / On-or-Off	Preheating / Auxiliary Heat (2nd Stage)/ Economizer	Auxiliary Heat

Typical Connection of the Triac Outputs 1 Through 4

On the C1000 Heatpump controller, all triac outputs must be set to SOURCE mode because they all share a single source supply: the equipment's transformer. All triac outputs have a SOURCE / SINK configuration switch; they must be set to "SWITCH" (move switch towards terminal blocks). Only the terminal blocks marked 24 VAC are used for each output.

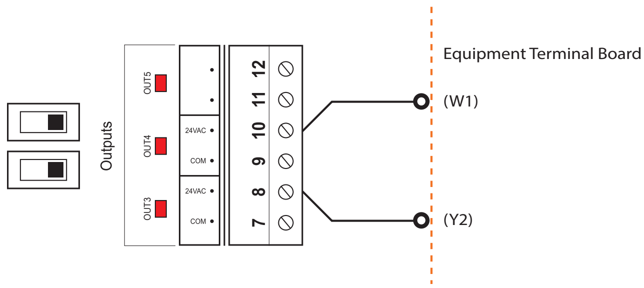

Figure 11 - Connection of Outputs 3 and 4

Typical Connection of Output #5

Output 5 is an analog output 0-10 VDC. It can be configured to modulate a 0@10 VDC load, to pulse a 0 or 10 VDC Triac relay or to control a 10 VDC On/Off relay.

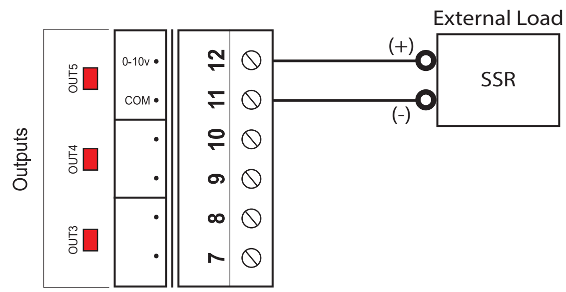

Figure 12 - Connecting the Analog Output (External Power)

Power Source / Network

Power Source

The Prolon controller is powered by the HVAC equipment's 24 VAC supply by connecting the common or ''C'' wire to the "COM" terminal and the live or ''R'' wire to the "24 VAC" terminal (see Figure 13). The common for all inputs and outputs is the same as the power source's common. All output power sources also originate from the controller's power source.

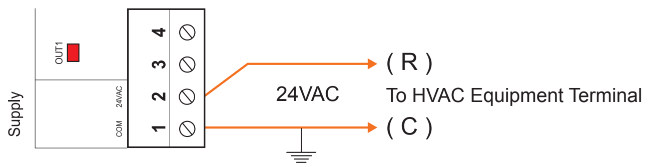

Figure 13 - Connecting the 24VAC Power Source

Network Communication

The Prolon C1000 Heatpump controller is primarily designed to work with Prolon zone controllers. When they are net-worked, the Heatpump and zones all communicate in real-time using Modbus RTU protocol over RS485. The network connections are made using the NET terminal block located on the Prolon controller.

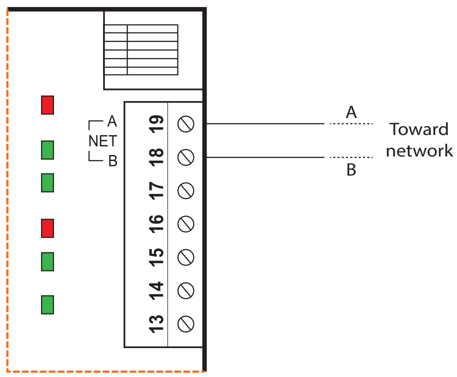

Figure 14 - Connecting to the Network

Technical Specifications

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

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

Inputs: 4 configurable inputs with selectable functions (outside temp / return temp / supply temp / water intake temp / night setback / proof of fan / alarm)

Digital outputs: 4 triac outputs, 10-30 VAC source or dry contact, 300 mA max (resettable fuse)

Analog output: 1 output 0-10 VDC / 2-10 VDC / 0-5 VDC, 40 mA max (resettable fuse)

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 (HP): Modbus RTU (RS485) or BACnet MS/TP (RS485), up to 127 nodes

Communication (HPS): Modbus RTU (RS485), up to 127 nodes

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.

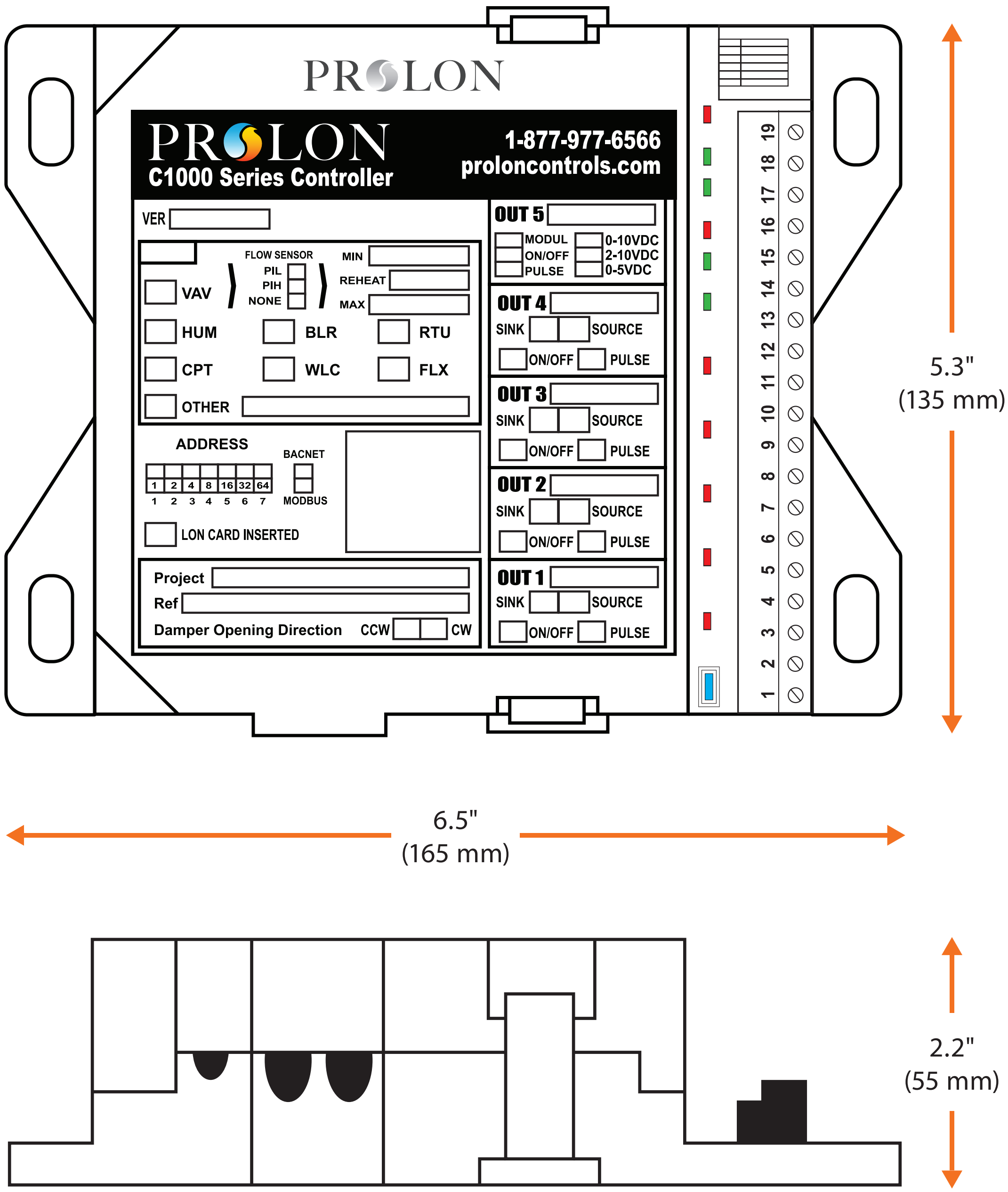

Figure 15 - C1000 Size Diagram