PROLON

HARDWARE GUIDE

Fan Coil Controller M2000 Series

Specifications and Operational Guide

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Table of Contents

General Information **4**
- PL-M2000 Fan Coil Controller 4
- Description 4
- General Behavior 4

Operating Sequence **5**
- Fan 5
- Two-Pipe System 5
- Four Pipe System 5

Components **6**
- Component Identification 6
- LEDs and Switches 7
- HAND/OFF/AUTO Switches 8
- Jumpers 8
- Input and Output Identification 9
- Addressing Dipswitch Configuration for Network Communication 10

Inputs **11**
- Temperature Sensors 11
- Alarm Input 11
- Proof of Fan 12
- Room Sensors 12
- Analog Room Sensor (PL-RS Series) 12
- Digital Room Sensors 13

Outputs **14**
- Output Specifications 14
- Typical Connection the Digital Outputs 15
- Typical Connection of Analog Outputs 15

Power Source & Network **16**
- Power Source 16
- Network Communication 16

Technical Specifications **17**

Compliance **18**
- FCC User Information 18
- Industry Canada 18

Overall Dimensions **19**

Table of Figures

Figure 1 - Component Identification....6
Figure 2 - LEDs Identification....7
Figure 3 - Location of the EXTERNAL jumpers....8
Figure 4 - Location of the INTERNAL jumpers....8
Figure 5 - INT and NET jumpers....8
Figure 6 - AI jumpers....8
Figure 7 - RJ45 Pinout....9
Figure 8 - Input and Output Identification (Two-Pipe System)....9
Figure 9 - Input and Output Identification (Four Pipe System)....10
Figure 10 - Addressing Dipswitch....10
Figure 11 - Connecting the Temperature Sensors....11
Figure 12 - Connecting the Alarm Input Contacts to the Controller....11
Figure 13 - Connecting the Proof of Fan Contact to the Controller....12
Figure 14 - Typical Wiring of the PL-RS Room Sensor to the Controller....12
Figure 15 - Connecting the Digital Sensor to the Controller....13
Figure 16 - Wiring Example of Digital Outputs 1 and 2....15
Figure 17 - Wiring Example of Analog Output 1....15
Figure 18 - Connecting the 24VAC Power Source....16
Figure 19 - Connecting to the Network....16
Figure 20 - PL-M2000 Size Diagram....19

[IMPORTANT INFORMATION - READ BEFORE YOU BEGIN]

For simplicity and consistency, temperature values shown in this document are displayed in Fahrenheit (°F). Prolon Focus can be configured by the user to display either Fahrenheit (°F) or Celsius (°C) based on preference or regional requirements.

Prolon products also support metric and imperial measurement options, where applicable.

Product availability, features, and specifications may vary by region.

Images and information are provided for reference only and may change without notice.

General Information

PL-M2000 Fan Coil Controller

Description

The Prolon PL-M2000-FCU Fan Coil Controller is a microprocessor-based controller designed to operate Two-Pipe or Four-Pipe hydronic systems. It uses PI (Proportional-Integral) control loops to optimize HVAC management and offers a variety of functions such as Two-Pipe automatic mode-change based on supply water temperature, periodic purge cycles, secondary backup heat control and more.

General Behavior

The Prolon PL-M2000 Fan Coil controller monitors dedicated inputs and uses pre-established control sequences to drive Fan Coil equipment using dedicated outputs. The main goal of this controller is to keep the zone temperature within the user-defined setpoints by driving valves, allowing hot or cold water to flow through heat exchanger coils as required, and then circulating air past these coils into the zone via a fan. The FCU controller supports both On-Off and Modulating valves in either Two-Pipe or Four-Pipe configurations. Additional backup reheat and preheat sequences can activate to heat the air as required. When networked with other Prolon devices, the FCU controller can periodically share its status to a Master controller and help drive the direction of the whole system.



Operating Sequence

Fan

The Fan can operate in Single Speed, Two Speed or Three Speed Mode. The first speed is primarily occupancy based, but can be configured to activate on a call for heat or cool. The user can define how the fan reacts based on various states of occupancy, which can be received via the Prolon Network from a Network or Master controller. If no Prolon Network is present, the PL-M2000-FCU determines its occupancy state from on on-board real-time clock.

The second speed, if enabled, responds to valve activity. When a valve opens past a configurable threshold, the second fan speed is activated.

The third fan speed, if enabled, responds to zone demand. When the prior fan speeds are active and the zone demand reaches a configurable threshold, the third fan speed is activated.

Note that valves require a call for the first fan speed before they can open.

Two-Pipe System

In a Two-Pipe setup, the FCU controller constantly monitors the water supply mode and can then react intelligently to calls for heat or cool by opening the valve only if the water supply is favorable. The water supply temperature can be obtained via a local thermistor input, a dry contact or shared via the Prolon Network. In the case of a local thermistor, a purge cycle is available to periodically flush out stagnant water and update the water supply mode.

The valve requires a call for fan (but not proof) before it can open.

A reheat sequence is available to heat the air in case the water supply is not in heating mode, or if an alarm condition occurs.

Additionally, a supplemental heat sequence is available even if the water supply is in heating mode. This sequence is activated when the supply air temperature fails to rise following extended use of the valve and no improvement in the zone.

Configurable outside air and supply air temperature limits are also in place to establish safeguards on operation.

Four Pipe System

In a Four-Pipe setup, the FCU controller does not need to track the water supply temperatures since it is assumed that the heating and cooling valves will have continuous access to adequate sources of hot and cold water, and they will simply open respectively on a call for heating or cooling.

The valves require a call for fan (but not proof) before they can open.

A reheat sequence is available to heat the air in case an alarm condition occurs.

Additionally, a supplemental heat sequence is available, which activates when the supply air temperature fails to rise following extended use of the heating valve and no improvement in the zone.

Configurable outside air and supply air temperature limits are also in place to establish safeguards on operation.

Component Identification

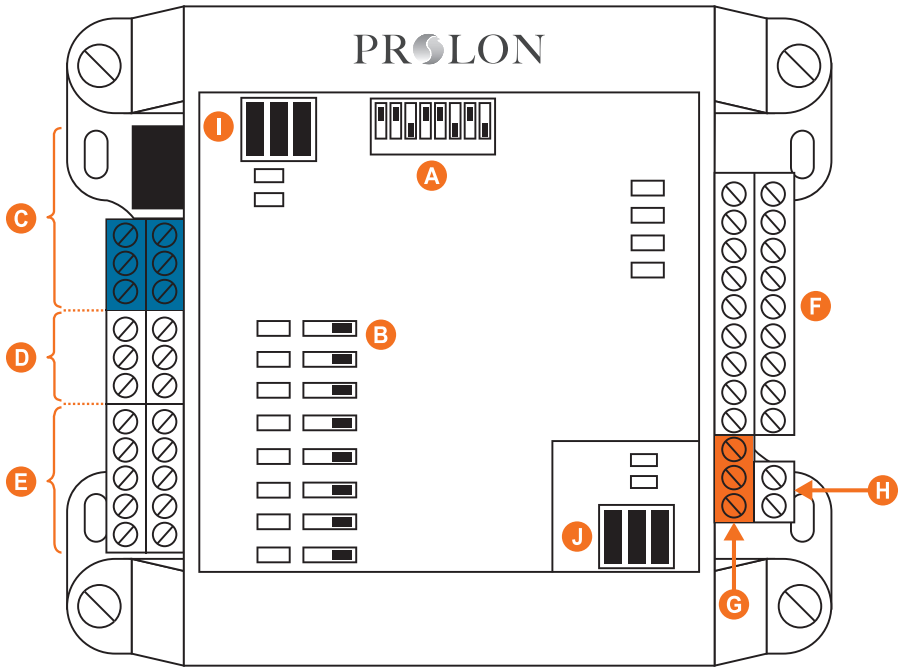


Figure 1 - Component Identification

Legend:

A - Addressing Dipswitch

B - AUTO/OFF/HAND Switches

C - RS485 INT port for interface communication (RJ45 plug and screw connectors are in parallel)

D - Analog outputs (3)

E - Digital outputs (5)

F - Analog inputs (9)

G - RS485 NET port for network communication

H - Terminal block for 24VAC (Class 2 transformer)

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

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

LEDs and Switches

The PL-M2000 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.

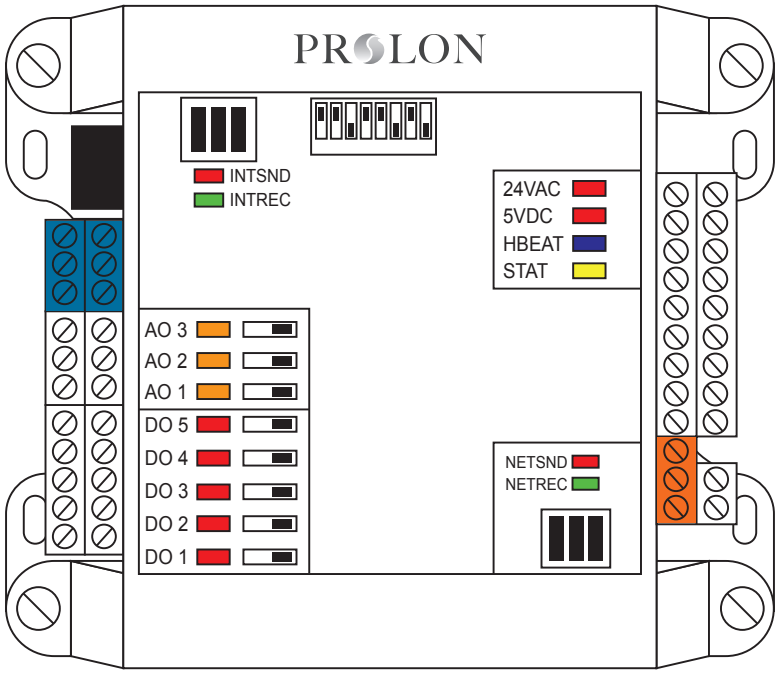


Figure 2 - LEDs Identification

LED Descriptions

- **24 VAC**: The PL-M2000 is receiving 24 VAC from the power source.
- **5V DC**: The microchip and other components on the PL-M2000 are being powered successfully by a 5 VDC source derived from the 24VAC source.
- **HBEAT**: When this LED is blinking, the microchip is active and the controller's program is running (normal). When this LED is ON and steady, the PL-M2000 is inactive and the microchip is awaiting programming (you must use Prolon's Focus software to reprogram the microchip).
- **STAT**: Reserved.
- **NETSND**: Indicates the transmission of data onto the network communication bus.
- **NETREC**: Indicates reception of data from the network communication bus.
- **INTSND**: Indicates the transmission of data onto the interface communication bus.
- **INTREC**: Indicates the reception of data from the interface communication bus.
- **AO3**: The intensity of the LED represents the voltage present on analog output 3.
- **AO2**: The intensity of the LED represents the voltage present on analog output 2.
- **AO1**: The intensity of the LED represents the voltage present on analog output 1.
- **DO5**: Represents the activity of digital output 5.
- **DO4**: Represents the activity of digital output 4.
- **DO3**: Represents the activity of digital output 3.
- **DO2**: Represents the activity of digital output 2.
- **DO1**: Represents the activity of digital output 1.

HAND/OFF/AUTO Switches

Each output on the PL-M2000 has a dedicated switch that lets the user manually override the activity of the output. "HAND" mode (switch at rightmost position) fully activates the output (24 VAC for digital outputs, 10VDC for analog outputs). "OFF" (switch at center) deactivates the output and "AUTO" (switch at left) returns control of the output to the program in the PL-M2000's microchip.

Jumpers

The PL-M2000 has jumpers that are externally accessible (see Figure 3), as well as jumpers that are inside the controller on the top internal board (see Figure 4), that allow for configuration of various hardware elements.

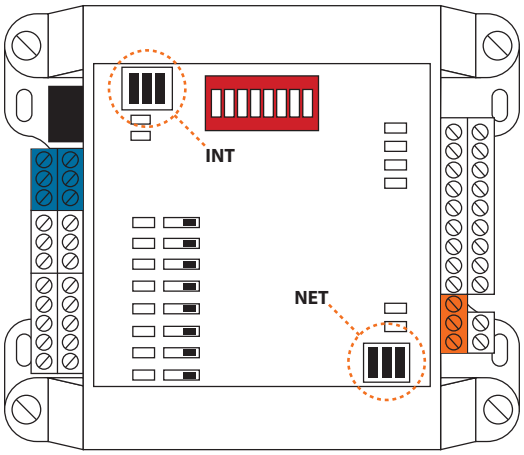


Figure 3 - Location of the EXTERNAL jumpers

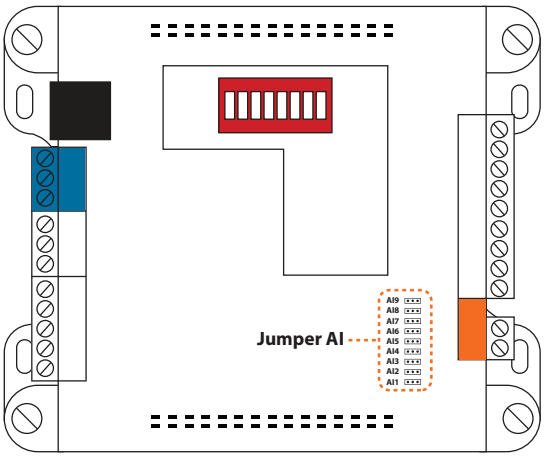


Figure 4 - Location of the INTERNAL jumpers

- **INT**: These are the jumpers for the bias and terminating resistors used for the interface communication bus. See the Prolon network guide for information about bias and terminating resistors. (See Figure 5)
- **NET**: These are the jumpers for the bias and terminating resistors used for the network communication bus. See the Prolon network guide for information about bias and terminating resistors. (See Figure 5)
- **AI 1 - 9**: These jumpers allow the user to select the signal mode of the associated analog input. (See Figure 6)

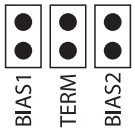


Figure 5 - INT and NET jumpers



Figure 6 - AI jumpers

Input and Output Identification

All the inputs and outputs of the PL-M2000 use pluggable screw type terminal blocks with elevator style clamping, which make connections easier and more secure.

The PL-M2000 Fan Coil Controller has 2 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) offers dual RJ45 type connectors ***in parallel*** with screw type terminal blocks. The RJ45 connectors allow the use of premade CAT5 cables for simple plug-and-play RS485 communication. These RJ45 connectors follow the Modbus pinout specification for RS485 communication.

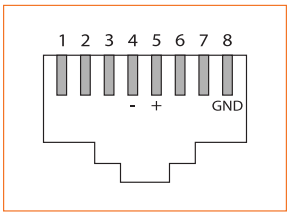


Figure 7 - RJ45 Pinout

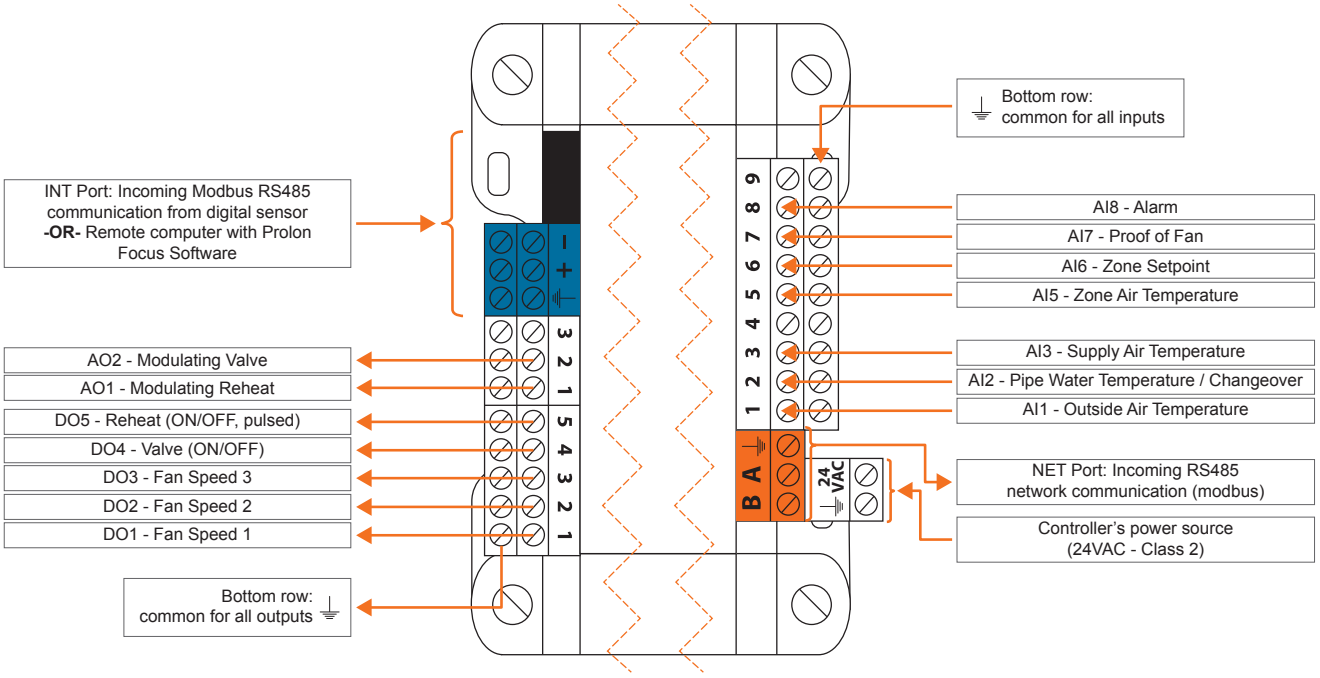


Figure 8 - Input and Output Identification (Two-Pipe System)

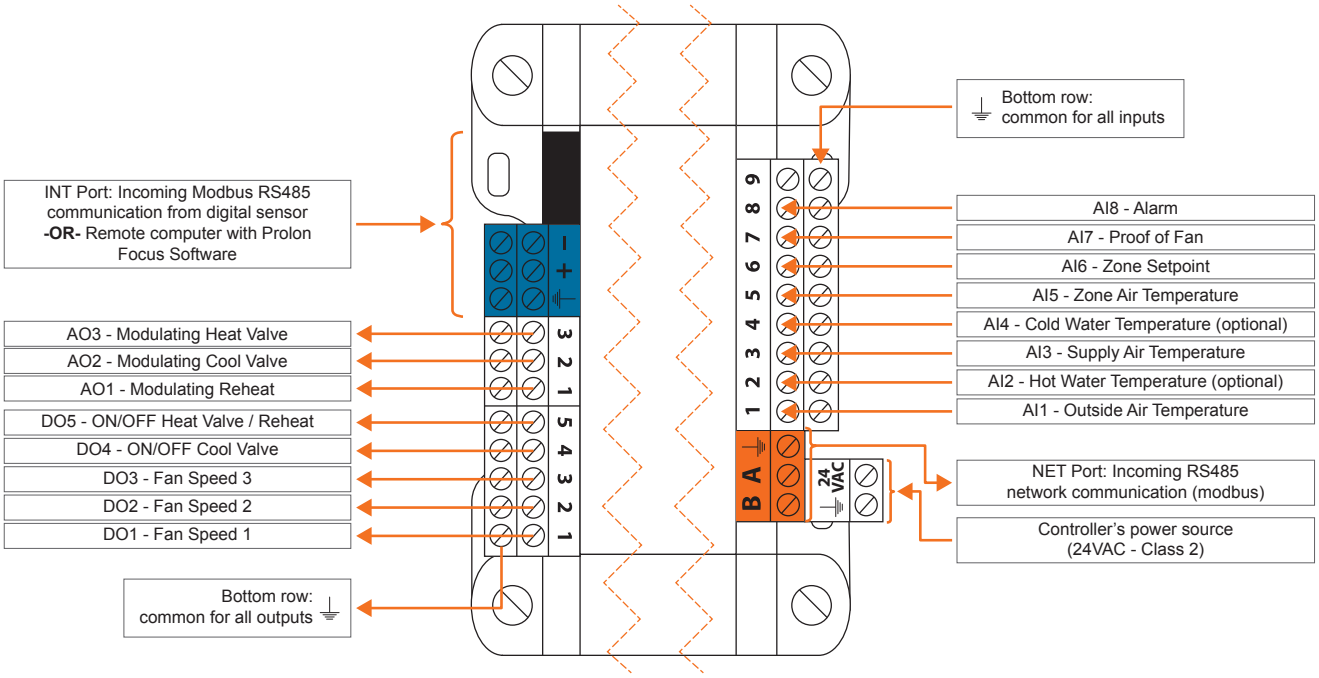


Figure 9 - Input and Output Identification (Four Pipe System)

Addressing Dipswitch Configuration for Network Communication

For proper 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 10 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 10 - Addressing Dipswitch

Inputs

Temperature Sensors

The PL-M2000 Fan Coil has four analog inputs that can monitor outside air, coil water supply (hot & cold) and supply air temperatures and will integrate these readings into its control sequence. The sensors used are standard 10k type 3 thermistors that share a single common connection.

The outside air and two pipe coil water supply temperatures can also be provided by an alternate source on the Prolon network. If a network or master controller is present, they can relay these reading from one controller to another.

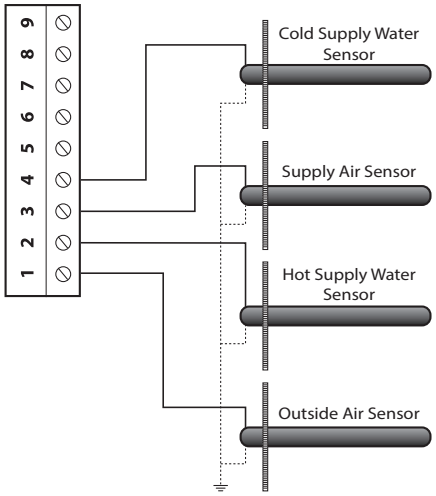


Figure 11 - Connecting the Temperature Sensors

Alarm Input

The PL-M2000 Fan Coil controller can receive an input from an external leak alarm. The alarm can be configured as normally open or normally closed to match the alarm output type. When activated, the alarm input will cause all water valves to close and indicate an active “alarm” when the controller is viewed in the Focus software. If the unit has an auxiliary heat source connected, heating demands will be met using auxiliary heat.

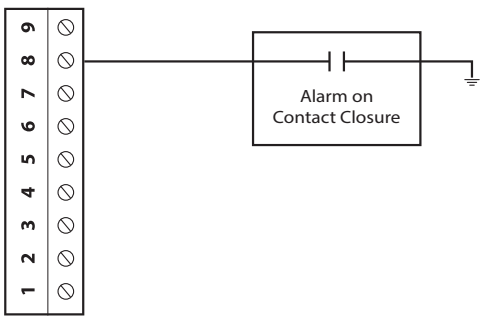


Figure 12 - Connecting the Alarm Input Contacts to the Controller

Proof of Fan

The PL-M2000 Fan Coil has an analog input dedicated to the proof of fan signal. Please refer to Figure 13 to see how to correctly connect it to analog input 7. To indicate proof of fan, the contact must be closed.

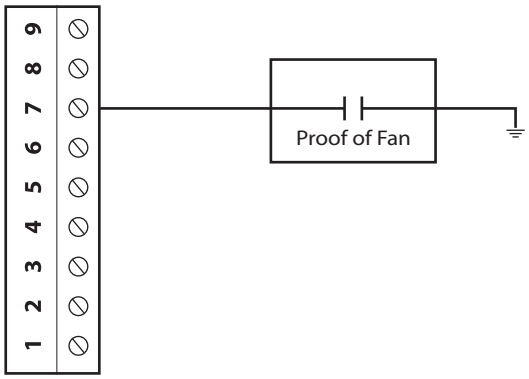


Figure 13 - Connecting the Proof of Fan Contact to the Controller

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 PL-M2000

Analog Room Sensor (PL-RS Series)

The PL-RS series room sensors provide the PL-M2000-FCU 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. Note that if a shielded cable is used to connect the PL-RS, the shield must be grounded at the GND of the PL-M2000 to which it is connected. To activate the schedule override from the PL-RS, hold the override button for 3 seconds.

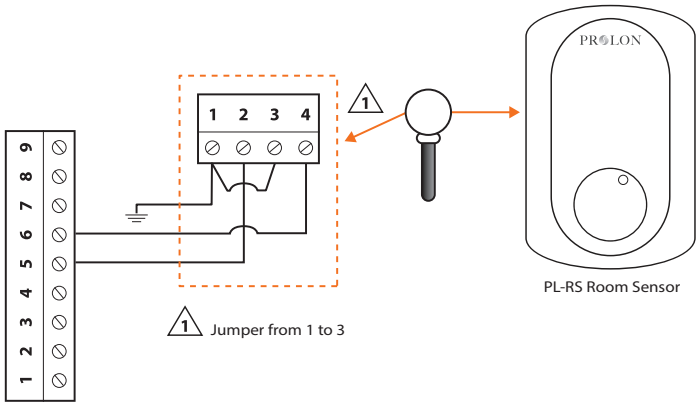


Figure 14 - Typical Wiring of the PL-RS Room Sensor to the Controller

Digital Room Sensors

Prolon offers various digital communicating sensors that can provide the PL-M2000 with room temperature, room setpoint, and schedule override (T1000, T500, T200 sensors).

Typical wiring is as follows:

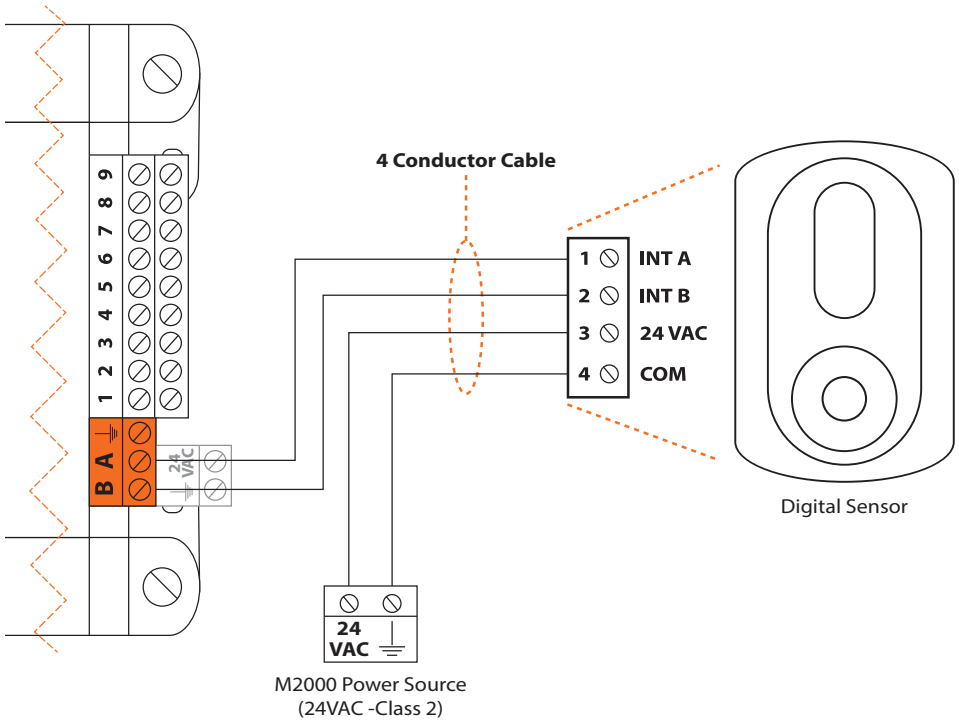


Figure 15 - Connecting the Digital Sensor to the Controller

Outputs

The PL-M2000 Fan Coil controller has 8 configurable outputs: 5 Triac type 24VAC outputs and 3 analog outputs (0-10VDC, voltage or pulse width modulation, On-or-Off). Output configuration is performed via the Prolon Focus software.

An integrated resettable fuse protects ***each*** of the outputs of the PL-M2000 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.

Output Specifications

Output	Type	Action
DO 1	Triac source 24VAC, Max Current: 300 mA	On-or-Off
DO 2	Triac source 24VAC, Max Current: 300 mA	On-or-Off
DO 3	Triac source 24VAC, Max Current: 300 mA	On-or-Off
DO 4	Triac source 24VAC, Max Current: 300 mA	On-or-Off / Pulse Width Modulation
DO 5	Triac source 24VAC, Max Current: 300 mA	On-or-Off / Pulse Width Modulation
AO 1	Configurable Analog Output: - 0 to 10 VDC - 2 to 10 VDC - 0 to 5 VDC Max Current: 40 mA	On-or-Off / Pulse Width Modulation / Voltage Modulation
AO 2	Configurable Analog Output: - 0 to 10 VDC - 2 to 10 VDC - 0 to 5 VDC Max Current: 40 mA	Voltage Modulation
AO 3	Configurable Analog Output: - 0 to 10 VDC - 2 to 10 VDC - 0 to 5 VDC Max Current: 40 mA	Voltage Modulation

Typical Connection the Digital Outputs

On the PL-M2000 Fan Coil controller, all triac outputs produce a 24 VAC live voltage when activated. Note that all output voltages originate from a single voltage supply: the equipment's transformer. Consequentially, only the live side of the output connections are usually needed; these are on the top row. The bottom row is the common (GND).

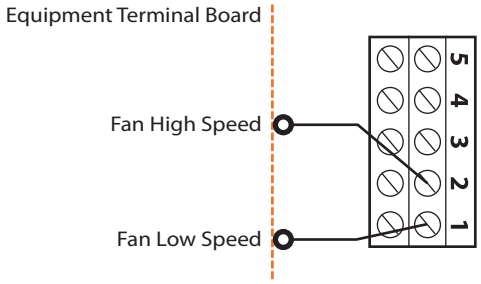


Figure 16 - Wiring Example of Digital Outputs 1 and 2

Typical Connection of Analog Outputs

For all analog outputs, the common is found on the bottom row terminal block, and the active signals are found on the top row terminal block.

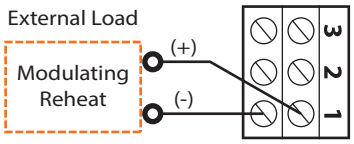


Figure 17 - Wiring Example of Analog Output 1

Power Source

The PL-M2000 controller is powered by a 24 VAC power supply (class 2) by connecting the common (''C'' wire) to the "COM" terminal and the live (''R'' wire) to the "24 VAC" terminal. The common for all inputs and outputs is the same as the power source's common. All output power sources also originate from the source transformer (class 2).

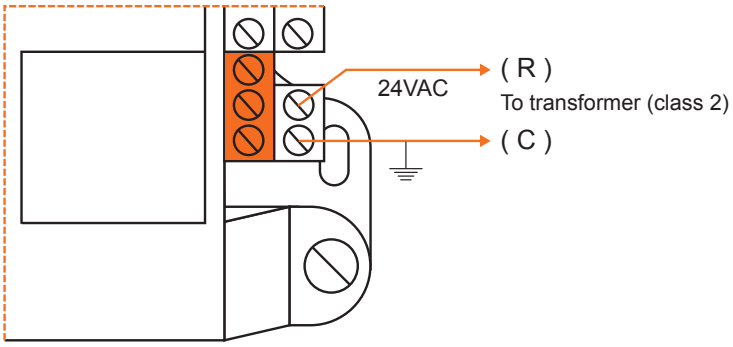


Figure 18 - Connecting the 24VAC Power Source

Network Communication

The Prolon PL-M2000 Fan Coil controller is designed to work standalone or networked with Prolon master controllers. When networked, the master transmits the occupancy status, outside temperature and math demand in real-time. The network connections are made using the network terminal block located on the PL-M2000 controller.

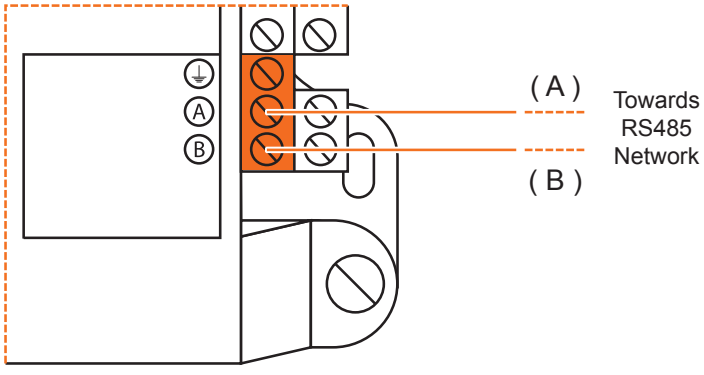


Figure 19 - Connecting to the Network

Technical Specifications

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

Power: 5 VA (consumption), 40 VA (input)

Inputs: 8 analog inputs (outside temp / hot supply water temp / supply air temp / cold supply water / zone air temp / zone setpoint / fan proof / alarm). Input signals (thermistor / dry contact)

Digital Outputs: 5 triac outputs, 10-30 VAC source, 300 mA max (resettable fuse)

Analog Outputs: 3 x 0-10 VDC outputs, 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: Modbus RTU (RS485) up to 127 nodes

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

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

Dimensions: 5.39" x 4.41" x 2.25" (137 mm x 112 mm x 57 mm)

Weights: 1.05 lbs (0.48 kg)

Environment: -4 to 122 °F (-20 to 50 °C) 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

- 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.

Overall Dimensions

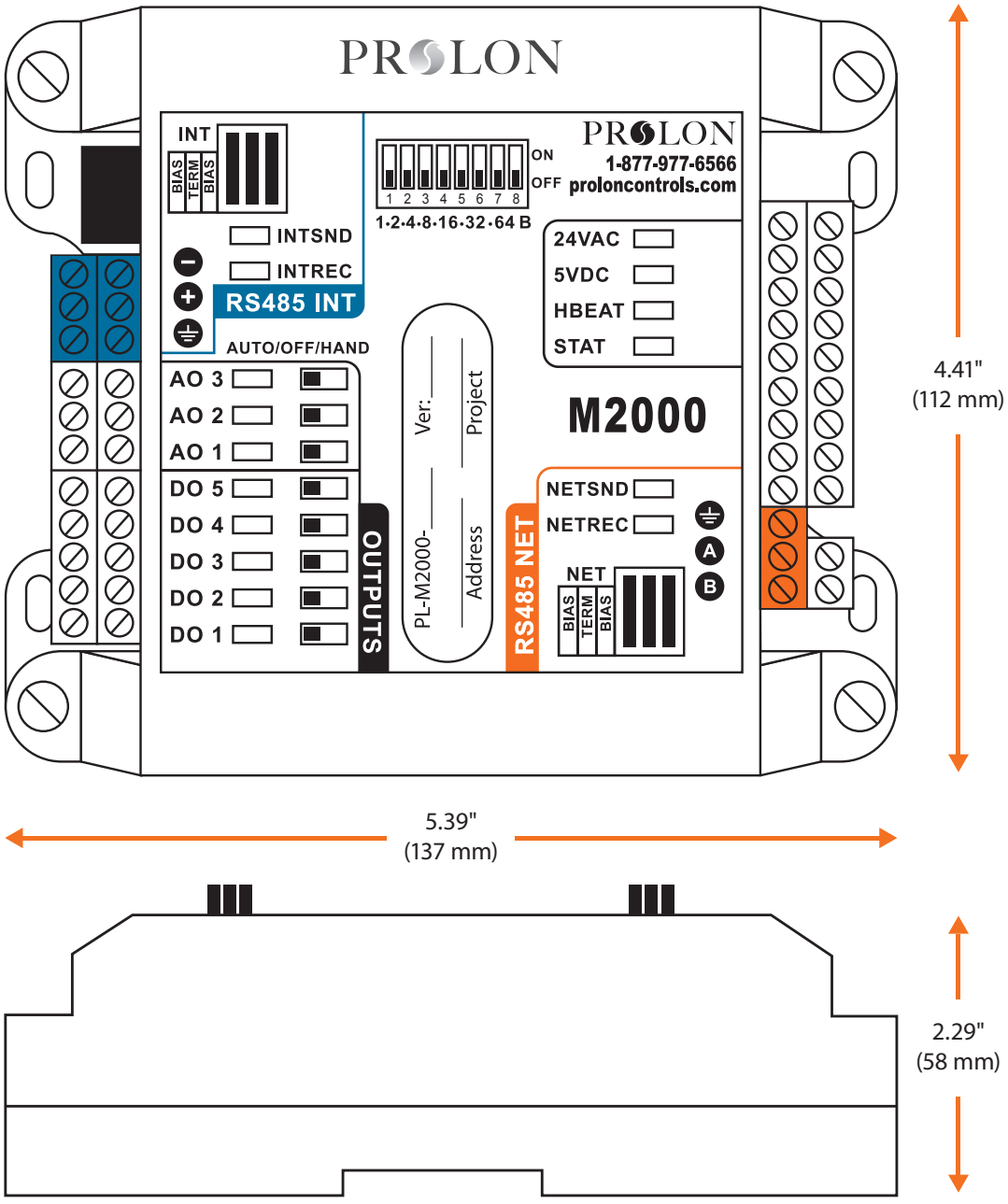


Figure 20 - PL-M2000 Size Diagram

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