PROLON

HARDWARE GUIDE

Boiler Controller M2000 Series

Specifications and Operational Guide

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REV. 7.3.1
PL-HRDW-BLR-M2000-C/F-EN

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PL-M2000 Boiler Controller

Description

The Prolon PL-M2000 Boiler controller is a microprocessor-based controller designed to operate staged or modulating boilers, as well as the associated pumps and valves. It features a variety of control strategies, including outside temperature reset scales, lead-lag sequences, pump exercise intervals and more.

General Behavior

Although fully configurable, the Prolon M2000 Boiler controller monitors dedicated inputs and uses pre-established control sequences to drive dedicated outputs to control standard Boiler equipment. These sequences can be fully optimized to obtain the best results for each type of system. Numerous parameters enable the modification or fine tuning of the pumps, the boilers, the target supply temperature, 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 the lead-lag sequences, conditions for pump activity and the influence of schedules or other data received over the network. All these parameters can be accessed and modified by using the Prolon Focus software.

Operating Sequence

General

The Prolon M2000 Boiler controller receives readings from three different temperature sensors: outside air, supply water and return water. In addition to the temperature sensors, it also has inputs for proof of operation of the pumps. It can receive data from Prolon master controllers such as outside temperature, occupancy, or the average heating request of the building. The controller then analyzes all the data and activates the appropriate outputs to respond accordingly, within parameters set by the temperature sensors and other safety limits.

Parallel Pump Sequence

This sequence is intended for hydronic systems where there is a secondary pump that acts as a backup to the primary pump, with both pumps being installed in parallel. The primary pump is activated based on outside temperature or upon a call for heating, or both. The secondary pump will only be activated when there is no proof of operation of the primary pump after a configurable delay.

The pumps can be setup for various lead-lag sequences wherein they will alternate between primary and secondary roles. The pumps can also be exercised after configurable periods of inactivity.

The target supply temperature can be a fixed setpoint or instead follow a reset scale based on outside temperature. The target supply temperature can also be reduced in unoccupied mode or influenced by a network provided demand, usually representing an average heating request coming from the zones in the building.

Boiler activity is based on a call for heat (supply temperature is below the target), which can be interlocked with the outside temperature. The M2000 boiler controller can be configured to control up to four boiler stages, whether it be a single boiler with four stages or four single stage boilers, or a combination thereof. The M2000 boiler controller can alternately control up to two modulating boilers with an optional backup stage, in which these boilers will modulate to attain target temperature. Boiler outputs (staged or modulating) can also be set up for various lead-lag sequences that will cycle through the position of the lead boiler stage.

The M2000 boiler controller can also be used to control a three-way valve when configured for staged control.

Follower Pump Sequence

This sequence is intended for hydronic systems where there is a primary and secondary loop. The primary pump is activated based on outside temperature or upon a call for heating, or both. The secondary pump will be activated simply when there is proof of operation of the primary pump.

The pumps can be exercised after configurable periods of inactivity.

The target supply temperature can be a fixed setpoint or instead follow a reset scale based on outside temperature. The target supply temperature can also be reduced in unoccupied mode or influenced by a network provided demand, usually representing an average heating request coming from the zones in the building. Boiler activity is based on a call for heat (supply temperature is below the target), which can be interlocked with the outside temperature. The M2000 boiler controller can be configured to control up to four boiler stages, whether it be a single boiler with four stages or four single stage boilers, or a combination thereof. Boiler stages can also be set up for various lead-lag sequences that will cycle through the position of the lead boiler stage.

The M2000 boiler controller can also be used to control a three-way valve.

Component Identification

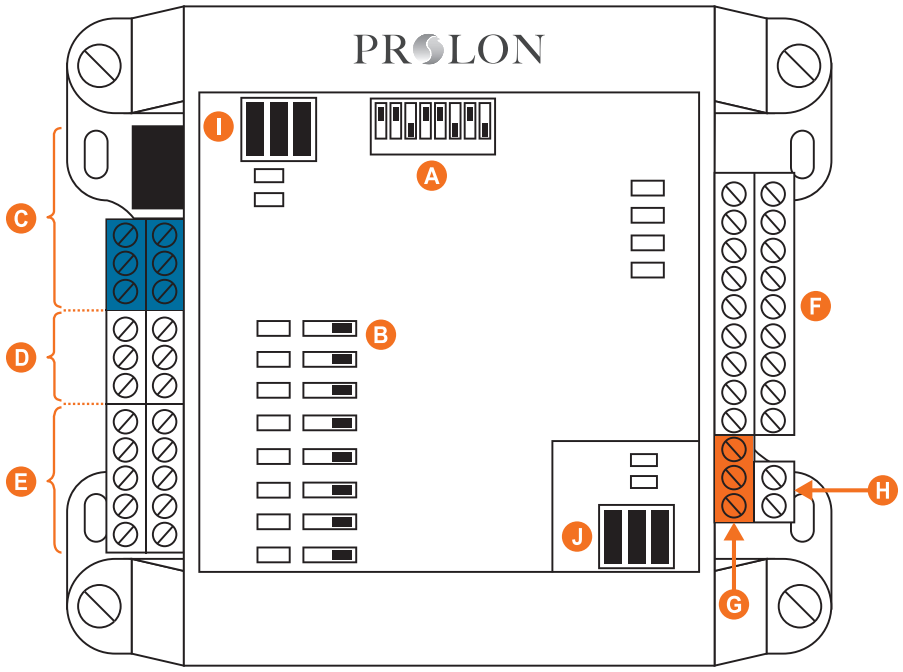

Figure 1 - Component Identification

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 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.

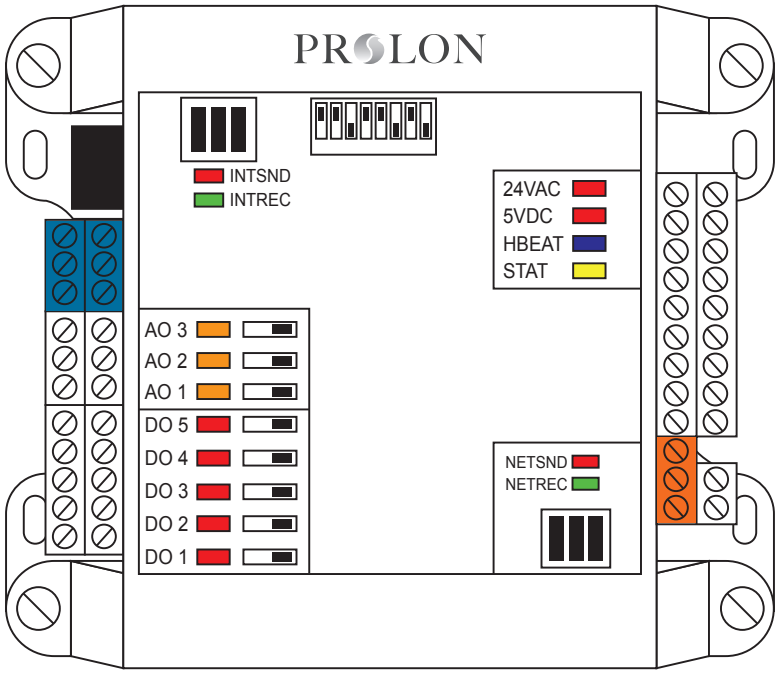

Figure 2 - LEDs Identification

LED Descriptions

- **24 VAC**: The M2000 is receiving 24 VAC from the power source.
- **5V DC**: The microchip and other components on the 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 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 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 M2000’s microchip.

Jumpers

The 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.

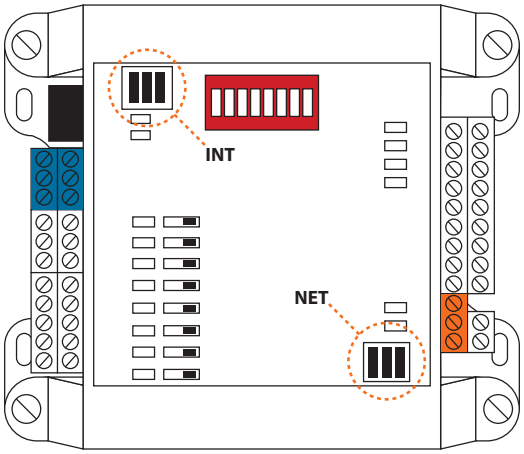

Figure 3 - Location of the EXTERNAL jumpers

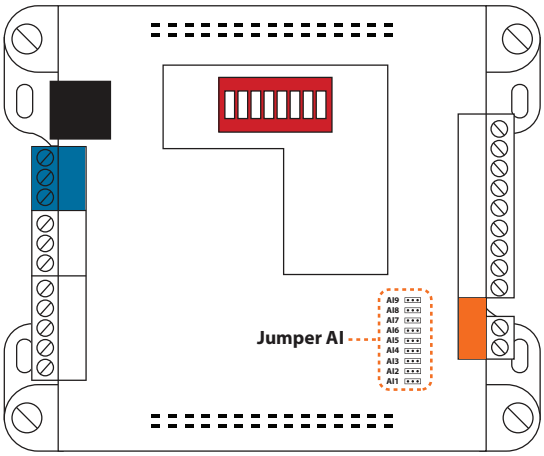

Figure 4 - Location of the INTERNAL jumpers

- **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)

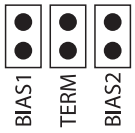

Figure 5 - INT and NET jumpers

Figure 6 - AI jumpers

Input and Output Identification

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

The M2000 Boiler 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.

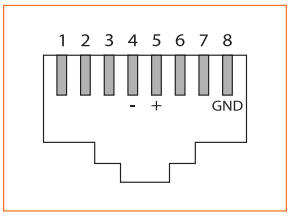

Figure 7 - RJ45 Pinout

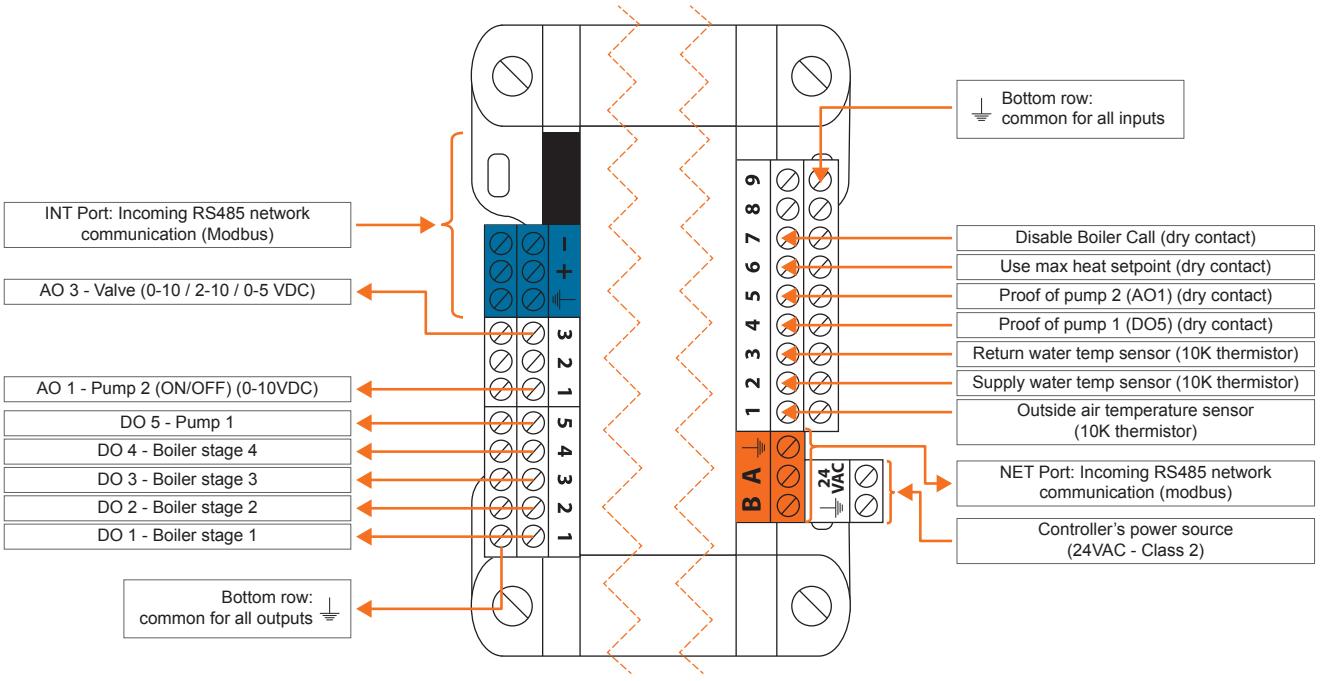

Figure 8 - Input and Output Identification (Staged Boiler)

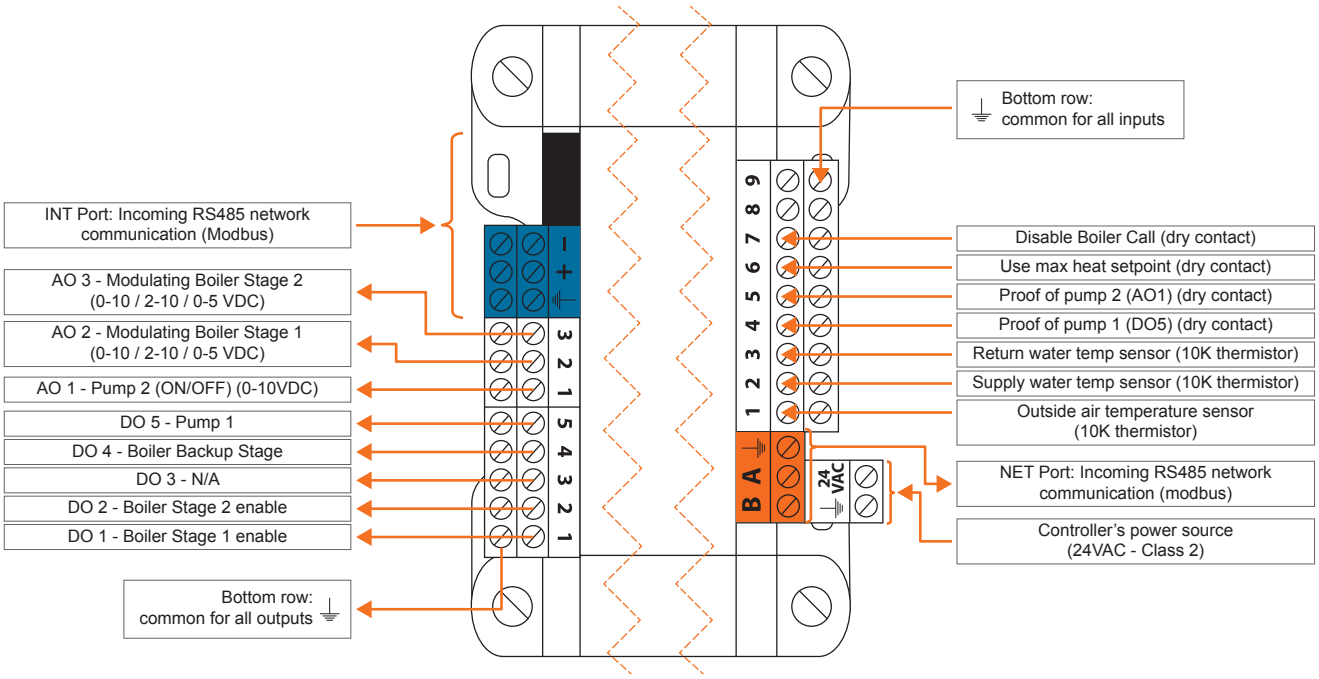

Figure 9 - Input and Output Identification (Modulating Boiler)

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 9 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

Temperature Sensors

The M2000 Boiler controller has three analog inputs that monitor supply, outside and zone air temperatures (see Figure 11) 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 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.

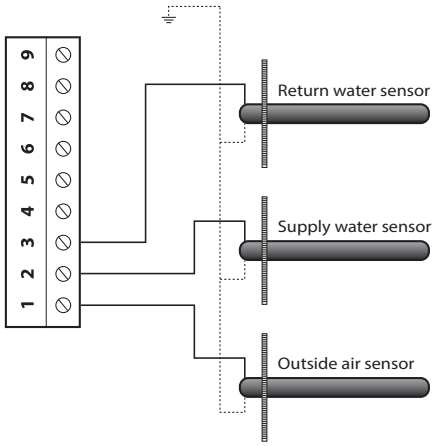

Figure 11 - Connecting the Temperature Sensors

Proof of Pumps

The M2000 has two analog inputs dedicated to the proof of pump signals. Please refer to Figure 12 to see how to correctly connect them. To indicate proof of pump, the contact must be closed. If no proof of pump signal is available, you must short the corresponding input, or else the controller will interpret the absence of signal as a pump malfunction and no heating action will be taken.

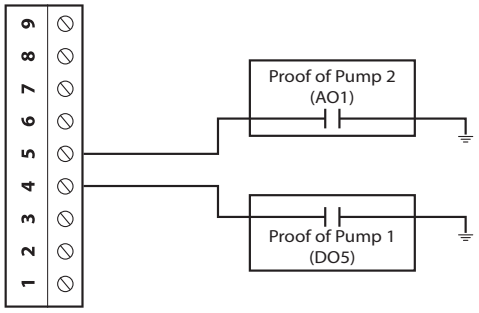

Figure 12 - Connecting the Proof of Pump Contacts to the Controller

Max Heat Setpoint

The M2000 has one analog input dedicated to enabling the maximum heating setpoint. By shorting the input to ground, the M2000 Boiler controller will use its highest hot water setpoint when using the setpoint reset feature. If the M2000 Boiler controller is using a fixed setpoint, then this input has no effect on the operation of the controller.

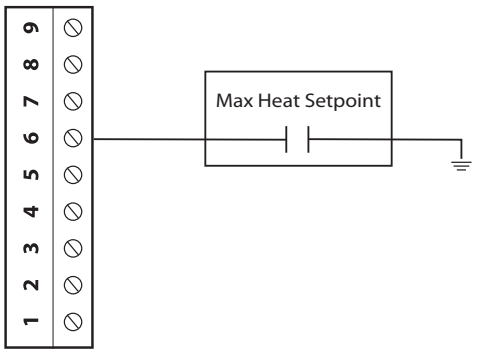

Figure 13 - Connecting Max Heat Setpoint Contact to the Controller

Disable Boiler Call

The M2000 has one analog input dedicated to disabling the boiler outputs. By shorting the input to ground, the M2000 Boiler controller will disable all boiler outputs (digital and analog). Note that the pump operation is not affected by this input.

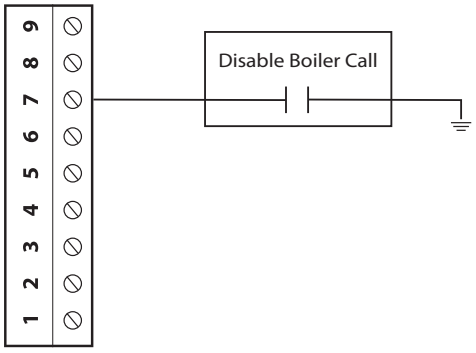

Figure 14 - Connecting Disable Boiler Call Contacts to the Controller

Outputs

The M2000 Boiler controller contains 8 customizable outputs; five triac ON/OFF outputs (24VAC) and three analog outputs (0-10VDC). Output configuration is performed via the Prolon Focus software.

An integrated resettable fuse protects each of the outputs of the 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 a round, yellow-coloured PTC that will change to orange and heat up on an overload condition. Once power has been removed from the M2000, the fuse will cool down and automatically reset. Fix the faulty wiring and you will be able to activate the output once again.

Output Specifications

Output	Type	Action	Application
DO 1	Triac source 24VAC, Max Current: 300 mA	On-or-Off	Boiler Stage 1
DO 2	Triac source 24VAC, Max Current: 300 mA	On-or-Off	Boiler Stage 2
DO 3	Triac source 24VAC, Max Current: 300 mA	On-or-Off	Boiler Stage 3
DO 4	Triac source 24VAC, Max Current: 300 mA	On-or-Off	Boiler Stage 4
DO 5	Triac source 24VAC, Max Current: 300 mA	On-or-Off	Pump 1
AO 1	Configurable Analog Output: - 0 to 10 VDC Max Current: 40 mA	On-or-Off	Pump 2
AO 2	Configurable Analog Output: - 0 to 10 VDC - 2 to 10 VDC - 0 to 5 VDC Max Current: 40 mA	Modulating Proportional	Modulating Boiler
AO 3	Configurable Analog Output: - 0 to 10 VDC - 2 to 10 VDC - 0 to 5 VDC Max Current: 40 mA	Modulating Proportional	Three way valve / Modulating Boiler (Backup)

Typical Connection of Triac Outputs 1 to 5

On the M2000 Boiler 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 (see Figure 15). The bottom row is the common (GND).

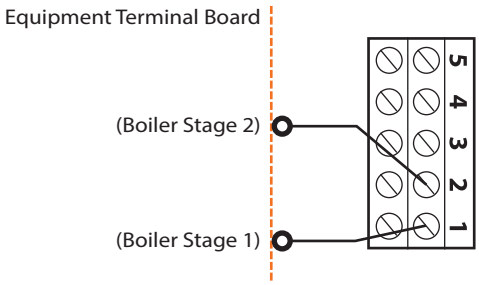

Figure 15 - Wiring Example of Digital Outputs 1 and 2

Typical Connection of Analog Outputs 1 to 3

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 (see Figure 16). Analog output 1 is configured to control a 10 VDC On/Off relay. Analog outputs 2 and 3 can only modulate a DC load (0-10 VDC, 2-10 VDC, 0-5 VDC).

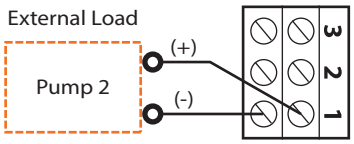

Figure 16 - Wiring Example of Analog Output 1

Power Source

The 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 (see Figure 17). 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).

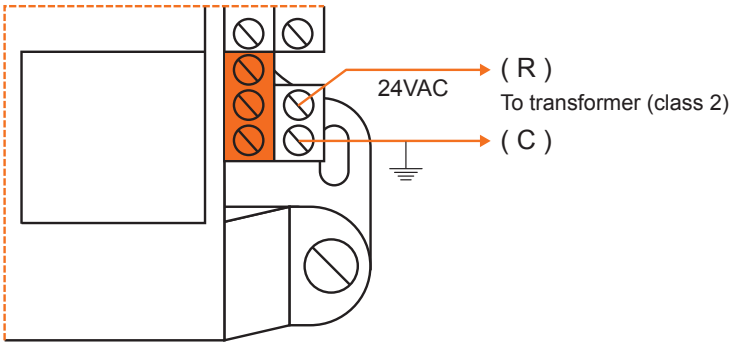

Figure 17 - Connecting the 24VAC Power Source

Network Communication

The Prolon M2000 Boiler 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 M2000 controller (see Figure 18).

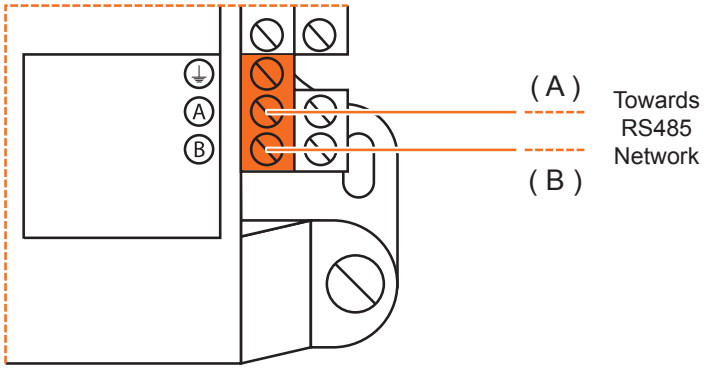

Figure 18 - Connecting to the Network

Technical Specifications

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

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

Inputs: 7 configurable analog inputs (outside temp / supply temp / return temp / dry contacts for proof of pumps, max heat request and boiler disable). Input signals (thermistor / dry contact / 4-20mA / 0-5 VDC) individually configurable for each input

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.

- 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

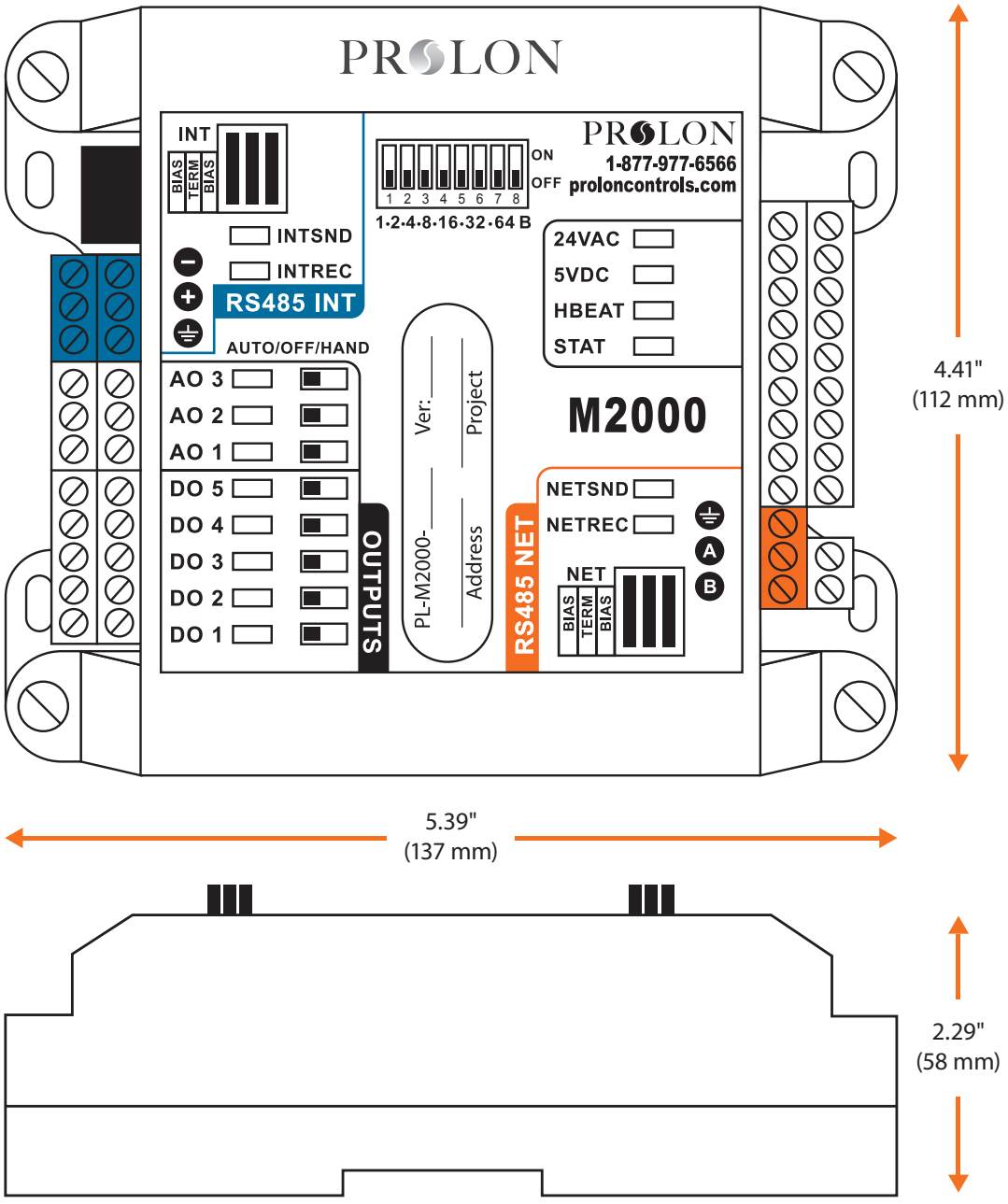

Figure 19 - M2000 Size Diagram

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