FW MURPHY®
PRODUCTION CONTROLS

Interchange™ Comm Control Module
MX5-R2 Series

Installation and Operations Manual

For Models with Date Codes S8 or Higher

00-02-1025
2021-10-18
Section 50

Warranty - A limited warranty on materials and workmanship is given with this FW Murphy product.
A copy of the warranty may be viewed or printed by going to http://www.fwmurphy.com/warranty

BEFORE BEGINNING INSTALLATION OF THIS FW MURPHY PRODUCT:

- Please read the following information before installing the MX5-R2 Module. This installation information is intended for MX5-R2 Module only.
- Visually inspect the product for any damage during shipping.
- Before proceeding please visit our website and review our support documentation including Wiring the Murphy Way www.fwmurphy.com/uploaded/WIR_Murphy_Way.pdf
- Disconnect all power and be sure machine is inoperative before beginning installation.
- Installation is to be done only by a qualified technician of the Responsible Body.
- Observe all Warnings and Cautions at each section in these instructions.
- Device shall be wired in accordance with NEC, CEC or other local code, as applicable.
- Please contact FW Murphy immediately if you have any questions.

For Class I, Division 2:

THIS EQUIPMENT IS AN OPEN-TYPE DEVICE AND IS MEANT TO BE INSTALLED IN AN ENCLOSURE SUITABLE FOR THE ENVIRONMENT SUCH THAT THE EQUIPMENT IS ONLY ACCESSIBLE WITH THE USE OF A TOOL.

THIS EQUIPMENT IS SUITABLE FOR USE IN CLASS I, DIVISION 2, GROUPS A, B, C AND D OR NON-HAZARDOUS LOCATIONS ONLY.

WARNING – EXPLOSION HAZARD – DO NOT DISCONNECT EQUIPMENT UNLESS POWER HAS BEEN REMOVED OR THE AREA IS KNOWN TO BE NON-HAZARDOUS.

WARNING – EXPLOSION HAZARD – DO NOT REPLACE BATTERIES UNLESS THE AREA IS KNOWN TO BE FREE OF IGNITABLE CONCENTRATIONS.

TEMPERATURE CODE OF T4 FOR ALL MODELS.

PROVIDES NONINCENDIVE FIELD WIRING OUTPUTS/INPUTS WHEN WIRED ACCORDING TO DRAWING 50-08-0104 (MX5-R2-X).

For AEX/EX Class I, Zone 2:

THE EQUIPMENT SHALL ONLY BE USED IN AN AREA OF POLLUTION DEGREE 2.

THE EQUIPMENT SHALL BE INSTALLED COMPLETELY WITHIN AN ENCLOSURE THAT PROVIDES A MINIMUM INGRESS PROTECTION OF IP 54 IN ACCORDANCE WITH UL60079-0 AND ONLY ACCESSIBLE BY THE USE OF A TOOL.

THE WIRE SIZE, TORQUE RATING OF 12-24 AWG, 0.37-0.44 ft. lbs.(0.4-0.5 Nm), AND SUITABLE SUPPLY WIRE TEMPERATURE RATING OF 97ºC MINIMUM SHALL BE PROVIDED FOR THE INPUT POWER TERMINAL BLOCK.

ALL MARKING INFORMATION EXCEPT FOR SERIAL NUMBER/DATE CODES SHALL BE REPEATED.

PROVIDES NONINCENDIVE FIELD WIRING OUTPUTS/INPUTS WHEN WIRED ACCORDING TO DRAWING 50-08-0104 (MX5-R2-X).

SPECIAL CONDITIONS FOR USE IECEx/ATEX Zone 2:

THE EQUIPMENT SHALL ONLY BE USED IN AN AREA OF NOT MORE THAN POLLUTION DEGREE 2, AS DEFINED IN IEC/EN 60664-1.

THE EQUIPMENT SHALL BE INSTALLED IN AN ENCLOSURE THAT PROVIDES A DEGREE OF PROTECTION NOT LESS THAN IP 54 IN ACCORDANCE WITH IEC/EN 60079-0 AND ONLY ACCESSIBLE BY THE USE OF A TOOL.

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FW Murphy Interchange Comm Control Module Series

The MX5-R2 expansion module provides input/output capability to the Centurion and future generations of FW Murphy Controllers using CAN proprietary communication with enhanced diagnostics. Two serial RS485 ports, an RS232 port and 2 Ethernet ports also provide other communication methods to work with any Modbus RTU or Modbus TCP/IP client device. MX5-R2 is backward compatible to the MX5, MX5-A and MX5-D.

Accessories

MX5-R2 Plug Kit (00032657) Printed Terminal Plugs for MX5-R2 Expansion I/O Module

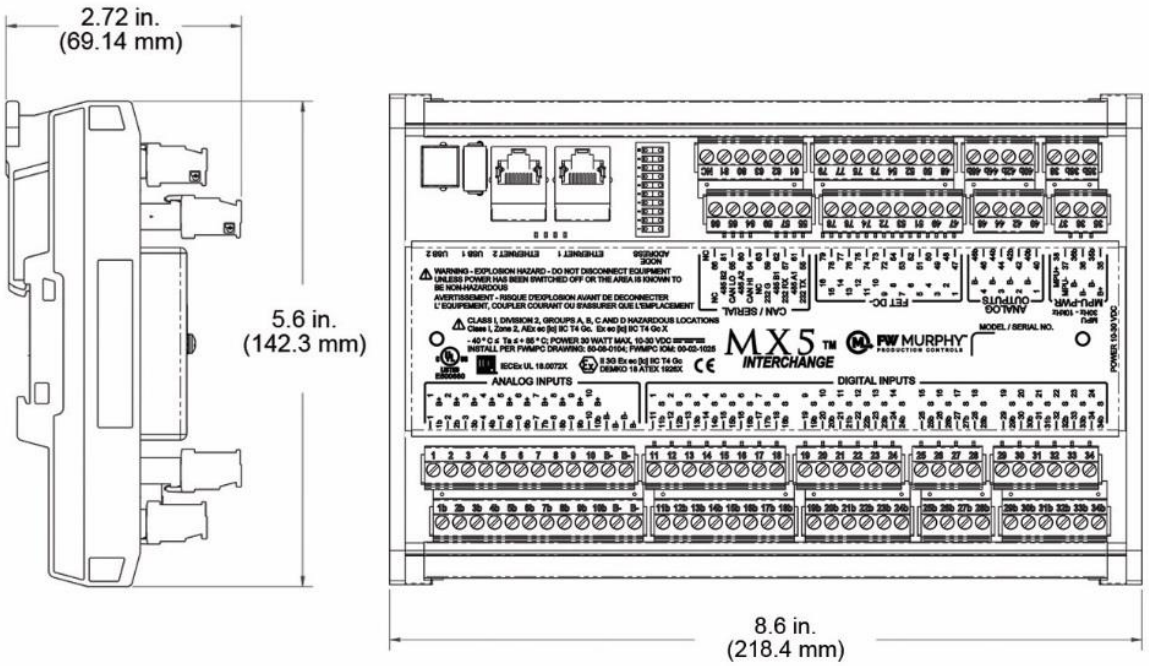
Specifications

- Operating temperature: -40° to 185° F (-40° to 85° C)
- Power input: 16.5 W max 10-30 VDC
- 10* Analog inputs:
  - 0-24 mA or 0 – 5 VDC, 15-bit hardware
  - 4 channels may be selected to read linear resistive sensor (5kΩ max R)
- 24* Digital inputs[++]:
  - NO or NC (active high/active low) intrinsically safe
  - Optically isolated with LED indicators
  - Polarity sense / wire fault detection on normally closed systems
  - Approved for use with general purpose switches in hazardous areas
- One magnetic pickup input*:
  - 30 to 10 kHz
- 16* Digital outputs[++]:
  - LED indicators
  - FET (sink)
- 4 Analog outputs:
  - 4-20 mA, 16-bit hardware
- 6 Communication ports
  - Two SERIAL RS485:
    - Protocol: Modbus RTU (server)
  - One SERIAL RS232:
    - Protocol: Modbus RTU (server)
  - One CAN:
    - Protocol: Proprietary for FW Murphy hardware
  - Two Ethernet 100/100 (DLR):
    - Protocol: Modbus TCP/IP (server) / Ethernet/IP (CIP)
- Third-party approvals for MX5-R2:
  - Class I, Div 2, Grps A, B, C, D Haz. Loc. T4
  - Class I, Zone 2, AEx ec [ic] IIC T4 Gc
    Ex ec [ic] IIC T4 Gc X
  - ATEX Zone 2:
    - ⟨Ex⟩ II 3G Ex ec [ic] IIC T4 Gc
    - DEMKO 18 ATEX 1926X
      - -40°C ≤ Tamb ≤ +85°C
  - IECEx Zone 2:
    - Ex ec [ic] IIC T4 Gc X
    - IECEx UL 18.0072X
      - -40°C ≤ Tamb ≤ +85°C

***** Non-incendive. (Digital Inputs and Analog Inputs are intrinsically safe and non-incendive.)
[++] Applies only to Centurion™ Custom and Rockwell Automation® Processor Configurations.

Installation

Dimensions



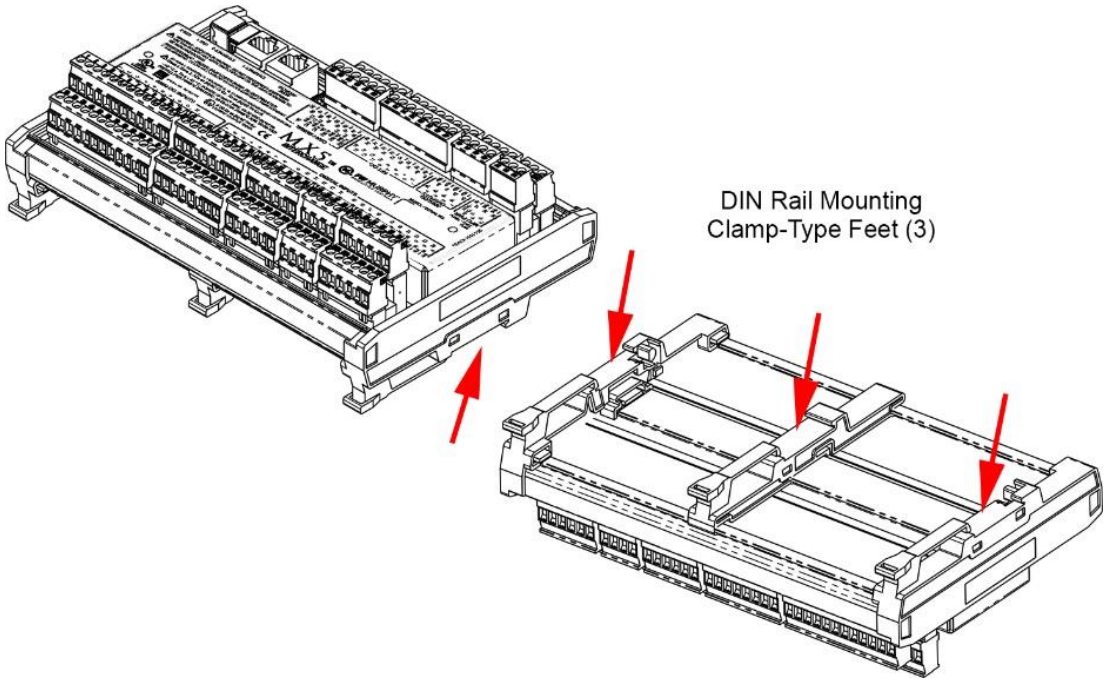
Install MX5-R2 Module

The MX5-R2 must be mounted in an enclosure meeting the requirements of IP54 or greater according to the intended use and environmental conditions in accordance with standard UL and only accessible by use of a tool.

> **NOTE:** IP requirement is ONLY for North America and IECEx/ATEX Zones UL 60079, IEC/EN 60079-0.

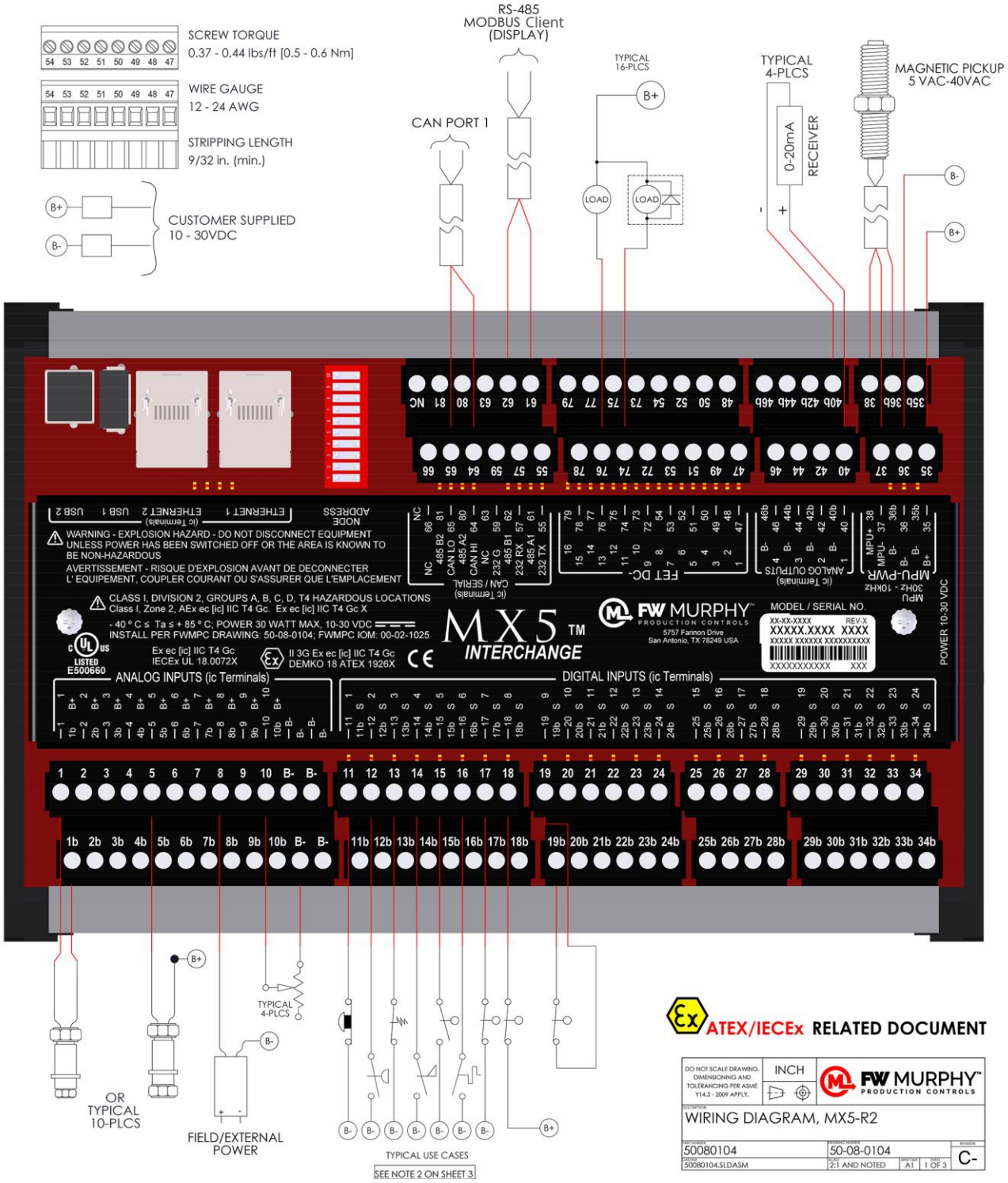
- Operating Temperature -40° to 185° F (-40° C to +85° C)
- Pressure 80 kPa (0,8 bar) to 110 kPa (1,1 bar)
- Air with normal oxygen content, typically 21% v/v
- Temperature Class T4
- “ic”: intrinsic safety (for EPL Gc)
- Increased safety (for EPL Gc)

The MX5-R2 can be mounted vertically or horizontally on a standard DIN rail. Three clamp-type feet along the bottom of the controller attach to the DIN rail; however, rail stops are recommended to prevent sliding.



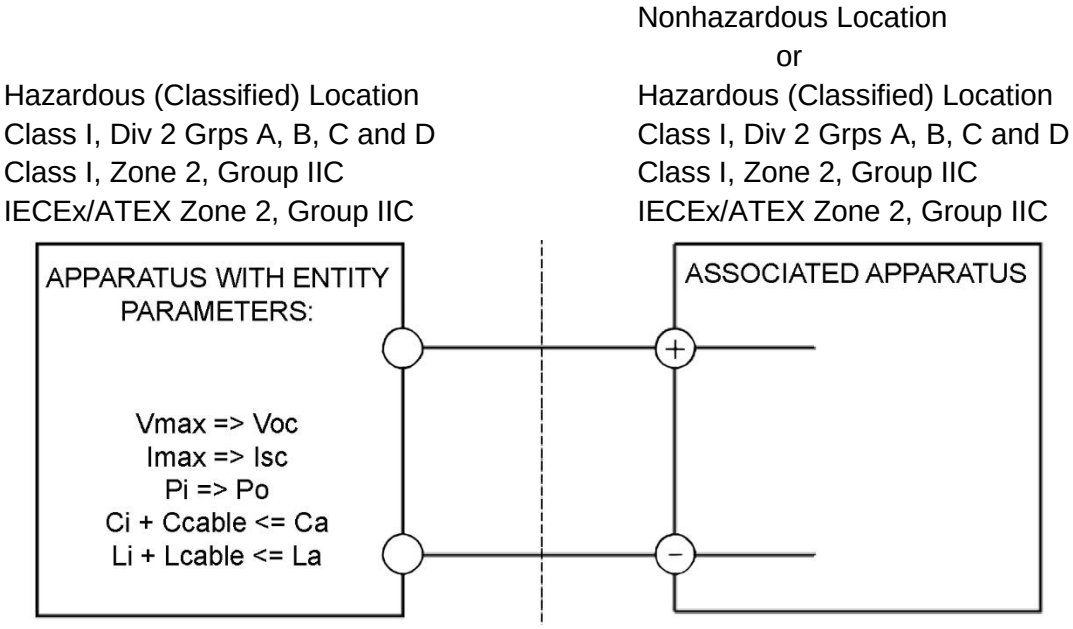
Wire Connections

Wire Diagram — MX5-R2 Module



Entity Parameters

1. The output current of this associated apparatus is limited by a resistor such that the output voltage-current plot is a straight line drawn between open-circuit voltage and short-circuit current. The Entity Concept allows interconnection of intrinsically safe apparatus with associated apparatus not specifically examined in combination as a system when the approved vales of Voc (or Uo) and Isc (or Io) for the associated apparatus are less than or equal to Vmax (Ui) and Imax (Ii) for the intrinsically safe apparatus. Capacitance and inductance of the field wiring from the intrinsically safe equipment to the associated apparatus shall be calculated and must be included in the system calculations. Cable capacitance, Ccable, plus intrinsically safe equipment capacitance, Ci must be less than the marked capacitance, Ca (or Co), shown on any associated apparatus used. The same applies for inductance (Lcable, Li and La or Lo, respectively). Where the cable capacitance and inductance per foot are not known, the following values shall be used: Ccable = 60 pF/ft., Lcable = 0.2 µH/ft.



Ui ≥ Uo; Ii ≥ Io; Co ≥ Ci + Ccable; Lo ≥ Li + Lcable

2. This associated apparatus may also be connected to non-incendive or simple apparatus as defined in Article 504.2 and installed and temperature classified in accordance with Article 504.10 (B) of the National Electrical Code (ANSI/NFPA 70) or other local codes, as applicable. Examples of “simple apparatus” are general-purpose contact/switch, thermocouples and RTD.

3. For Intrinsically Safe devices selected associated apparatus must be third-party listed as providing intrinsically safe circuits for the application or have Voc or Vt not exceeding Vmax (or Uo not exceeding Ui), Isc or It not exceeding Imax (or Io not exceeding Ii), and the Po of the associated apparatus must be less than or equal to the Pmax or Pi of the intrinsically safe equipment. Examples of “simple apparatus” are general-purpose contact/switch, thermocouples and RTD.

4. Where multiple circuits extend from the same piece of associated apparatus, they must be installed in separate cables or in one cable having suitable insulation. Refer to Article 504.30 (B) of the National Electrical Code (ANSI/NFPA 70) and Instrument Society of America Recommended Practice ISA RP12.6 for installing intrinsically safe equipment.
5. Intrinsically safe circuits must be wired and separated in accordance with Article 504.20 of the National Electrical Code (ANSI/NFPA 70) or other local codes, as applicable.
6. This associated apparatus has not been evaluated for use in combination with another associated apparatus.
7. Control equipment must not use or generate more than 250 V rms or dc with respect to earth.
8. For installations in which both the Ci and Li of the intrinsically safe apparatus exceeds 1% of the Co and Lo parameters of the associated apparatus (excluding the cable), then 50% of Co and Lo parameters are applicable and shall not be exceeded.

WARNING:

EXPLOSION HAZARD - DO NOT DISCONNECT EQUIPMENT UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS KNOWN TO BE NON-HAZARDOUS.

AVERTISSEMENT - RISQUE D'EXPLOSION - AVANT DE DECONNECTER L'EQUIPEMENT, COUPER LE COURANT OU S'ASSURER QUE L'EMPLACEMENT EST DESIGNE NON DANGEREUX.

Analog Inputs (Per Pin)										
Designation	Uo[V]	Io[mA]	Po[mW]	Lo[H]	Co[uF]	Ui[V]	Ii[mA]	Pi[mW]	Li[mH]	Ci[uF]
J1 AI1-AI6 Pins 1-6	-	-	-	-	-	10.3	51.6	-	0	0.1
J1 AI7-AI10 Pins 7-10	4.4	1.0	-	80	995.1	10.3	51.6	-	0.022	4.9
J1 AB+ Pins 1b-10b	-	-	-	-	-	-	-	-	-	-
DC-	Ground Pin									

Digital Inputs (Per Pin)										
Designation	Uo[V]	Io[mA]	Po[mW]	Lo[H]	Co[uF]	Ui[V]	Ii[mA]	Pi[mW]	Li[mH]	Ci[uF]
J2-J5 DI1-DI24 Pins 11-34	30	5.2	-	2.95	0.120	30	17	-	0	0.1
J2-J5 B+1 to B+32 Pins 11b-34b	30	12.66	-	0.500	0.120	-	-	-	0	0.1

Analog Outputs (Per Pin)										
Designation	Uo[V]	Io[mA]	Po[mW]	Lo[mH]	Co[uF]	Ui[V]	Ii[mA]	Pi[mW]	Li[mH]	Ci[uF]
J7 Pins 40,42,44,46	30	38.5	-	54	0.120	-	-	-	0	0.1
J7 Pins 40b,42b,44b,46b	Analog Output Ground									

RS485/RS232/CAN										
Designation	Uo[V]	Io[mA]	Po[mW]	Lo[mH]	Co[uF]	Ui[V]	Ii[mA]	Pi[mW]	Li[mH]	Ci[uF]
J9 RS485 Pins 61, 62, 80, 81	±5.0	±60	-	22.2	999.9	±12.0	±60	-	0	0.01
J9 RS485 Pin 63	Shield Connection Ground									
J9 RS232 Pin 59	Shield Reference Ground									
J9 RS232 Transmit/Receive Pins 55,57	±15.0	±60	-	22.2	2.99	±30	±60	-	0	0.001
J9 CAN Pins 64, 65	±4.5	±5	-	3.2	999.9	±24	100	-	0	0.000267
J9 CAN Pin 66	Shield Connection Ground									

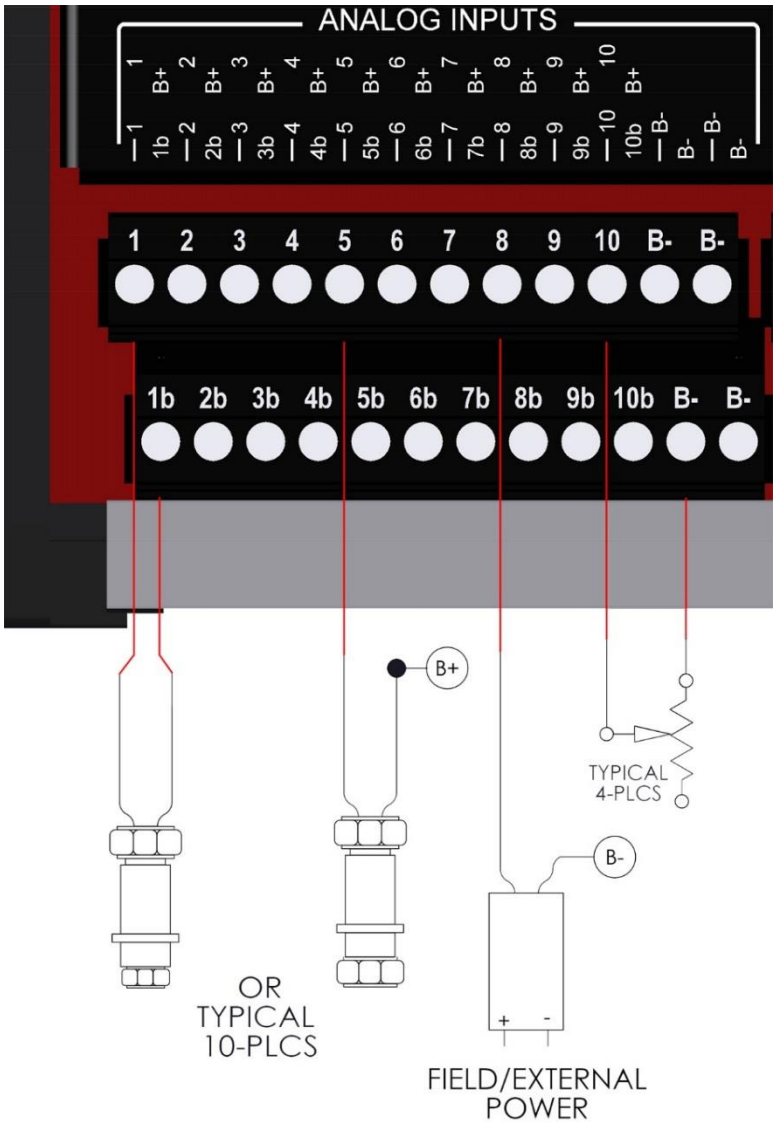
USB										
Designation	Uo[V]	Io[mA]	Po[mW]	Lo[mH]	Co[uF]	Ui[V]	Ii[mA]	Pi[mW]	Li[mH]	Ci[uF]
J10 Type A	±5.19	±25	-	128	889.9	±5	±500	-	0	110.2
J11 Type B	3.3	±25	-	128	999.8	±5	±500	-	0	0.200

Ethernet Per Port										
Designation	Uo[V]	Io[mA]	Po[mW]	Lo[mH]	Co[uF]	Ui[V]	Ii[mA]	Pi[mW]	Li[mH]	Ci[uF]
J12-J13	3.3	±61.5	-	21.2	999.9	3.3	±60	-	0	0.1

Analog Inputs (Pins 1 – 10b)

The MX5-R2 is equipped with 10 analog inputs marked 1 through 10b. Analog inputs 7 through 10 may be optionally set to read a linear resistive device up to 5kΩ.

Important: For Entity Parameters or Power Supply and Grounding, refer to Wire Connections.



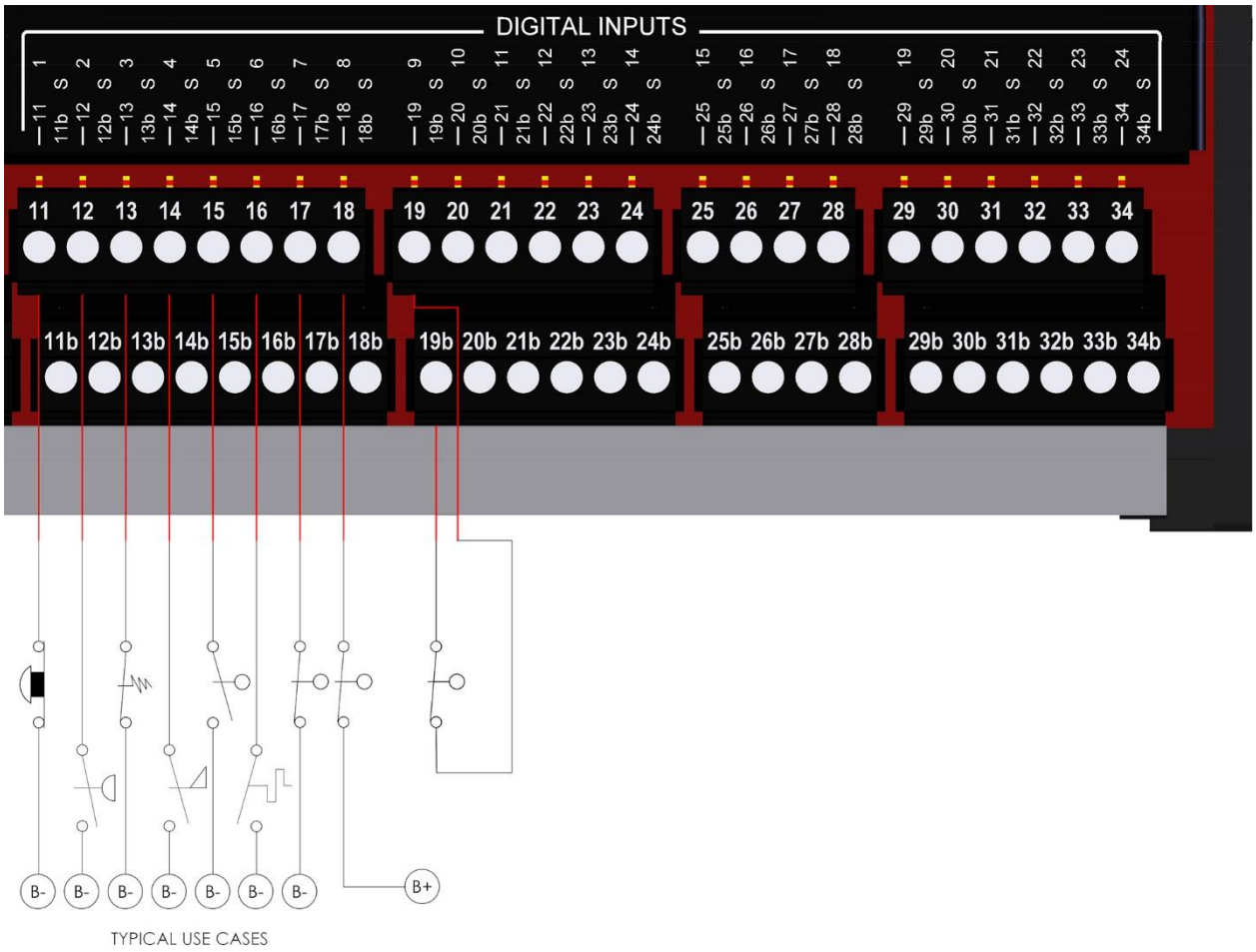
NOTE: These circuits are not required to be in conduit if all the requirements for ic protection are met and Authority Having Jurisdiction (AHJ) allows.

Devices that are self-powered 4-wire devices, such as flowmeters and VFD drives, do not receive power from the panel and offer a pure current loop.

Digital Inputs (Pins 11 – 34b)

The MX5-R2 is equipped with 24 digital inputs marked 11 through 34 for the input and 11b through 34b for ic protected power to loop through the external switch back to the input. Alternately the external switch may use B+ or B- to activate the digital input. An LED lights when the digital input is active.

Important: For Entity Parameters or Power Supply and Grounding, refer to Wire Connections.



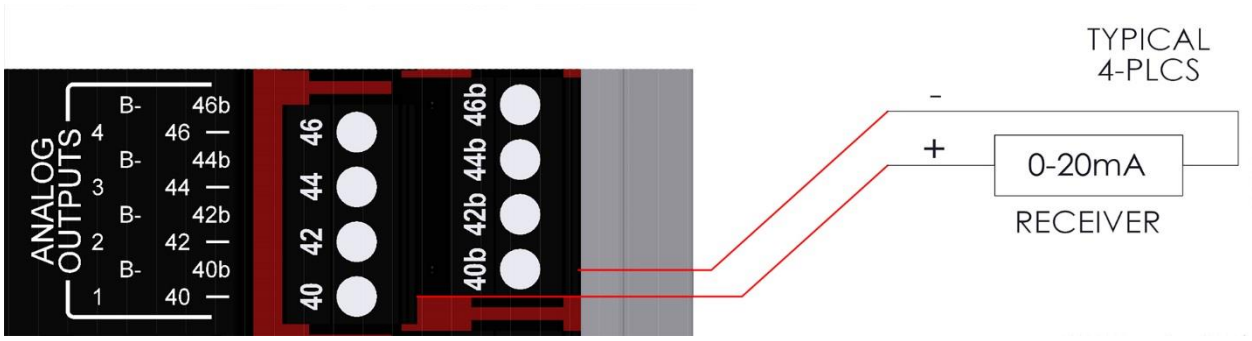
TYPICAL USE CASES

NOTE: These circuits are not required to be in conduit if all the requirements for ic protection are met and Authority Having Jurisdiction (AHJ) allows.

Analog Outputs (Pins 40 – 46b)

The MX5-R2 is equipped with four 2-wire current transmitters for controlling various processes. The supply voltage and measuring currents are supplied by the MX5-R2 over the same two wires. These transmitters are used to convert various process signals representing flow, speed, position, level, temperature, pressure, etc., to 4-20mA DC for the purpose of transmitting the signal over some distance with little or no loss of signal.

Important: For Entity Parameters or Power Supply and Grounding, refer to Wire Connections.



NOTE: The MX5-R2 provides all operating power (~B+) to the transmitter and receiver and any other loop components.

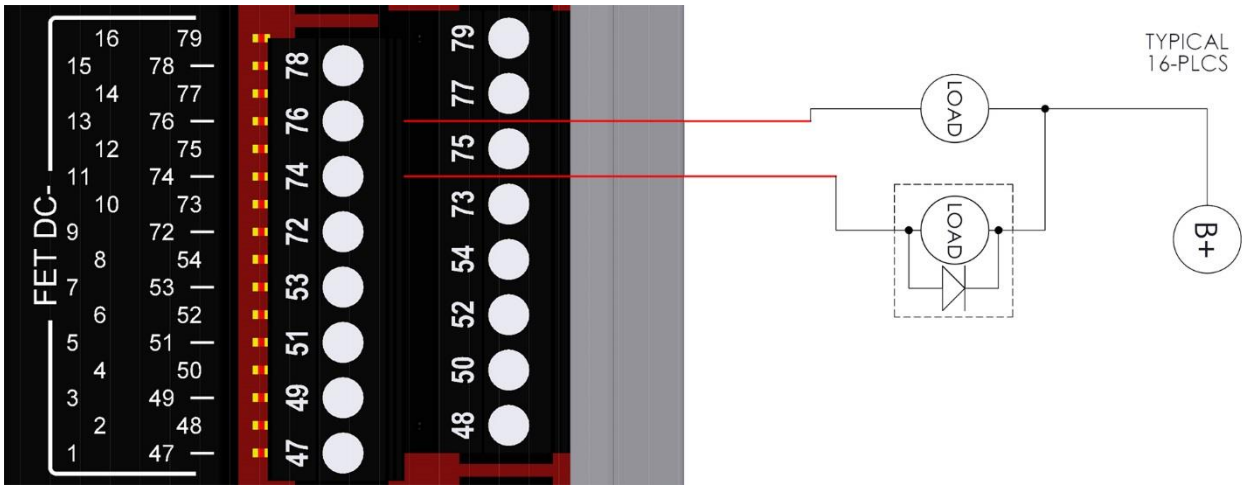
An important aspect of building a current loop system is avoiding ground loops by wiring the return signal to the associate B- terminal.

These circuits are not required to be in conduit if all the requirements for ic protection are met and Authority Having Jurisdiction (AHJ) allows.

FET DC– (Pins 47 – 79b)

The MX5-R2 is equipped with 16 Low Side 250 mA max Switches. The LED lights when the switch is active.

Important: For Entity Parameters or Power Supply and Grounding, refer to Wire Connections.



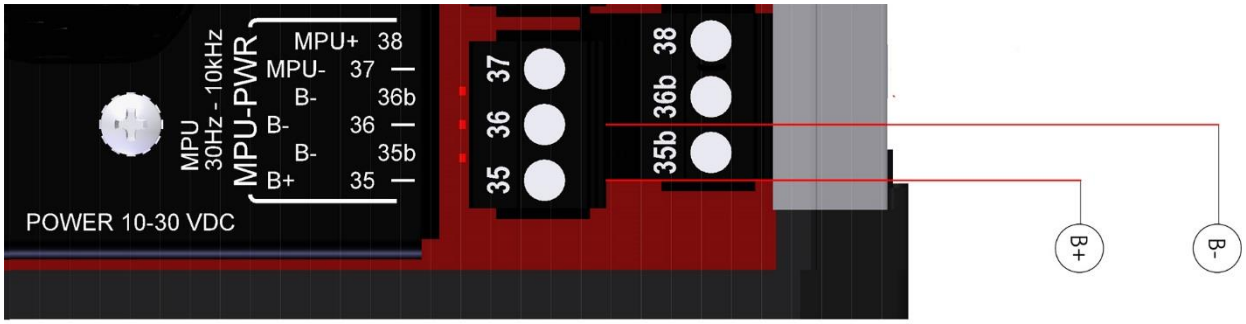
NOTE: If an inductive load does not have an internal flyback diode, it is recommend you install a 1A 600V PIV diode in parallel with the load. (1N4005 – EC P/N 36-16-1002)
To ground ignition, use pilot relay with 25 Ω 3 W series resistor to ground.

Interposing relays are recommended to interface with end devices that require high current ratings or alternative voltage supplies.
Consult General Cautions for Solid-State Devices for best practices when connecting to external inductive load devices such as relays or solenoids.
www.fwmurphy.com/other-support-resources/general-cautions-solid-state-devices

Power (Pins 35 – 36)

The 10-30 VDC power for the MX5-R2 is applied to the power supply terminals marked 35 B+ and 36 B−. An external 10 amp replaceable fuse protects the system from over-currents. The power LED lights when power is applied to the system.

Important: For Entity Parameters or Power Supply and Grounding, refer to Wire Connections.



NOTE: Run power directly from battery posts to controller power terminals when battery is the power supply.

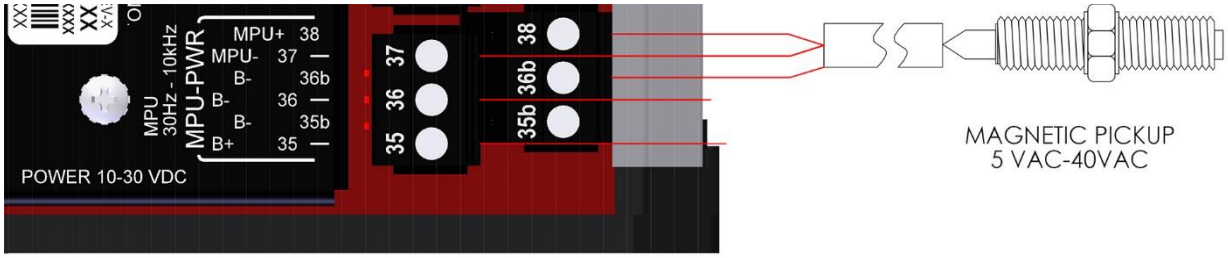
Maximum power ratings based on all I/O operating in the ON position with 10V supply. Typical based on 24V supply.

Magnetic Pickup, MPU (Pins 36 – 38)

The MPU for the MX5-R2 is applied to the magnetic pickup terminals marked 37 MPU- and 38 MPU+, MPU 5-40 Vrms 30-10 kHZ. If used, the foil shield and drain wire of the cable assembly may be terminated at 35b- or 36b-. The MPU sends the pulses to the controller, which calculates the engine speed.

FW Murphy recommends using 00031022 Magnetic Pickup 4 in. Length and 00031023 Magnetic Pickup Cable 50 ft.

Important: For Entity Parameters or Power Supply and Grounding, refer to Wire Connections.



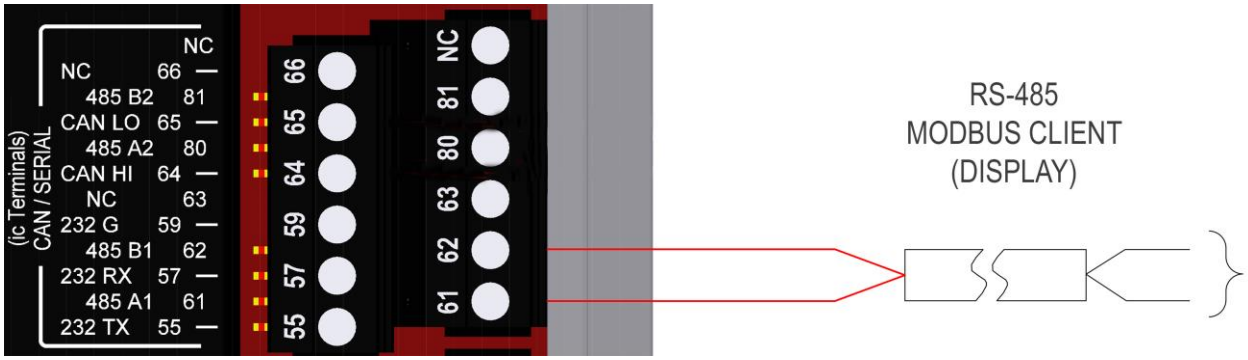
NOTE: The MPU input requires a minimum signal of 2 Vrms when connected.

RS485 (Pins 60 – 62, 80 – 81)

The MX5-R2 is equipped with two RS485 communications ports.
RS485 1 uses 61 A1 / 62 B1.
RS485 2 used 80 A2 / 81 B2.

The TX LED lights when the port is transmitting. The RX LED lights when the port is receiving.

Important: For Entity Parameters or Power Supply and Grounding, refer to Wire Connections.

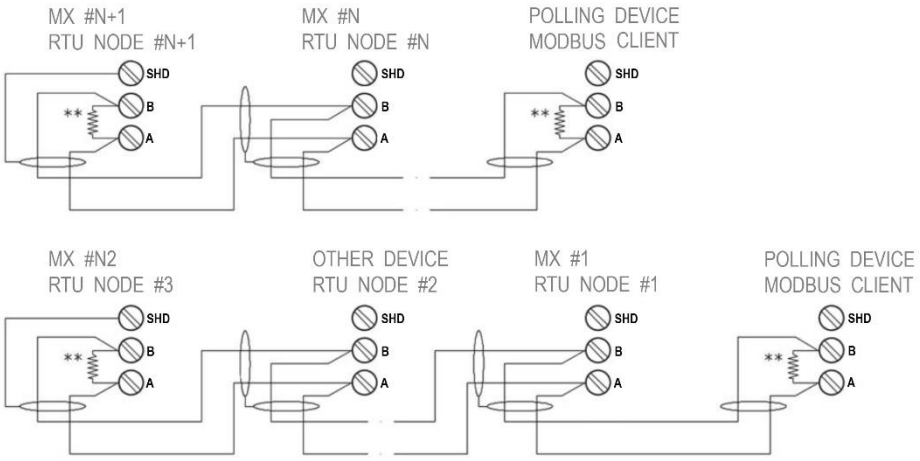


NOTE: A is the non-inverting pin and should have a single pull-up physically placed anywhere on the network. B is the inverting pin and should have a single pull-down physically placed anywhere on the network.
These circuits are not required to be in conduit if all the requirements for ic protection are met and Authority Having Jurisdiction (AHJ) allows.

Consult RS-485 the Murphy Way for information on best practices for connecting and communicating on RS-485.
www.fwmurphy.com/uploaded/documents/pdfs/rs-485murphyway.pdf

The recommended arrangement of the wires is as a connected series of point-to-point (multidropped) nodes, i.e. a line or bus, not a star, ring or multiply connected network.

RS-485 Typical Connections



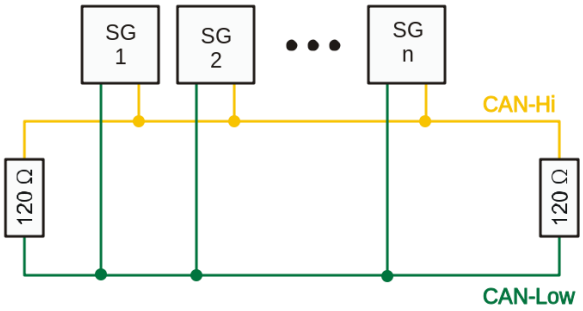
** USE EIA RS485 SHIELDED, TWISTED PAIR, 120 OHMS CHARACTERISTIC IMPEDANCE.
INSTALL 120 OHMS TERMINATING RESISTOR ON FIRST AND LAST NODE ON RS-485 NETWORK.
ALL RS-485 DEVICES MUST SHARE DC COMMON GROUND.

CAN (Pins 64 – 65)

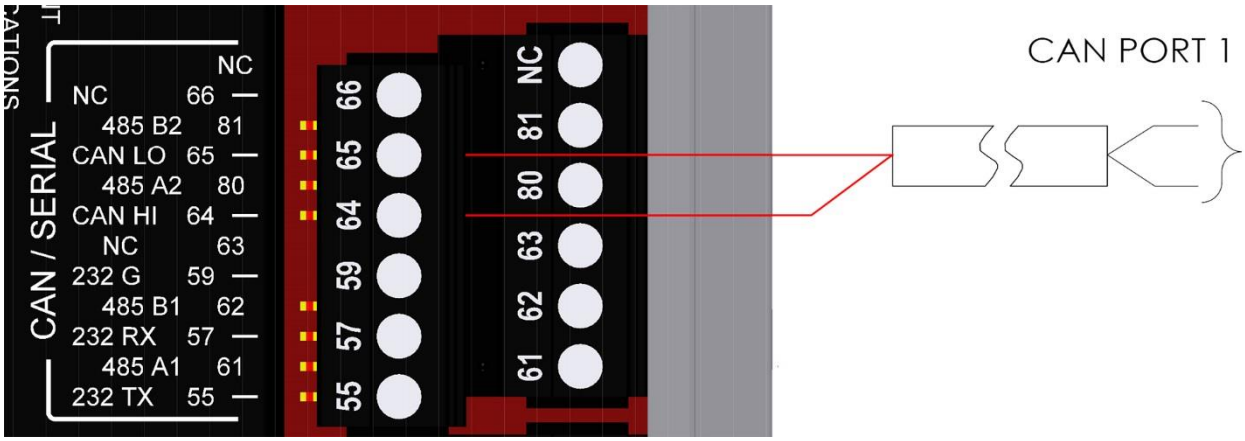
The MX5-R2 is equipped with one CAN communication port. The port is marked pin 64 CAN HI and pin 65 CAN LOW.

The LED lights when the port is active transmitting and when the port is active receiving.

The recommended arrangement of the wires is as a connected series of point-to-point (multidropped) nodes, i.e. a line or bus, not a star, ring or multiply connected network. It is recommended to use CAN-Bus Cable J1939/11 SAE Shielded, twisted pair with 120 Ω characteristic impedance. Install a 120 Ω terminating resistor (software selectable on the Centurion) on the physical first and last node of the CAN network. All nodes must share a common DC ground



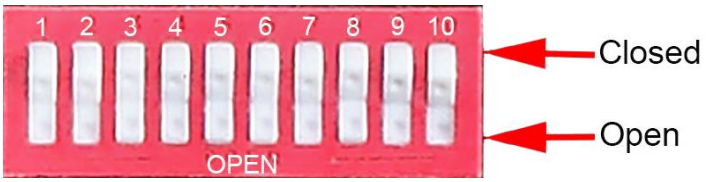
Important: For Entity Parameters or Power Supply and Grounding, refer to Wire Connections.



NOTE: These circuits are not required to be in conduit if all the requirements for ic protection are met and Authority Having Jurisdiction (AHJ) allows.

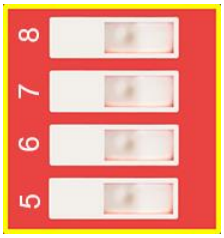
DIP Switch Configuration

Set these switches to the open or closed position for your application.



Node Address:

- **DIP1-8:** These switches allow you to assign a unique address to each MX5-R2 that may be in the system using either Modbus or CAN communication. This allows the client controller to differentiate between the modules. Addressing is done in binary format, with each switch increasing value by factor of 2. For example, to name the controller address 5, set switch DIP1 and DIP4 to the CLOSED position. Valid settings are from 1 to 239. Addresses 240 thru 255 are for power-up functions only as detailed below.
- **DIP Power-up Functions:** There is a special feature for switching module operation mode that is activated by setting specific switch positions at power up. Change will only occur if the following switches are set CLOSED at power up. All other times, these switches behave as address selections.
    - DIP switches 5-8 CLOSED at power up activates special mode to change the module behavior based on switches 1-4 position.



5-8 CLOSED

        - 1-4 CLOSED: Load factory defaults to non-volatile settings – restores serial baud rate, Ethernet address and channel configurations to default values.
        - 1 OPEN, 2-4 CLOSED: Load Rockwell IO Application.
        - 2 OPEN, 1, 3, 4 CLOSED: Load Standard IO Application.

1-4 CLOSED 1 OPEN, 2-4 CLOSED 2 OPEN,1, 3, 4 CLOSED

- **Stop Bits:** For addresses < 31, the RS485 port will use 1 stop bit. For addresses > 31, the RS485 port will use 2 stop bits.

Can Termination:

- **DIP9:** This switch provides a 120Ω termination resistor for the CAN communication chain. CAN must be wired in a daisy chain configuration. Set this switch to CLOSED only when the module is the end of the network. See control panel drawings for designation.

RS485-1 Termination:

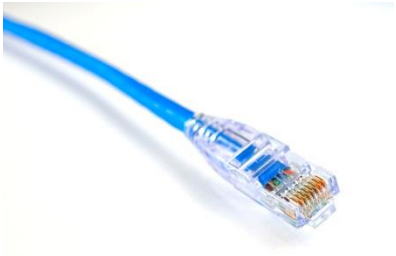
- **DIP10:** This switch provides a 120Ω termination resistor for the RS485-1 communication chain. RS485 must be wired in a daisy chain configuration. Set this switch to CLOSED only when the module is the end of the network. See control panel drawings for designation.

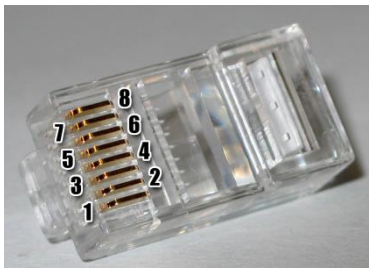
Ethernet

The MX5-R2 is equipped with two Ethernet communication ports. The ports are marked ETHERNET 1 and ETHERNET 2. An LED flashes when the port is active — transmitting or receiving a message, and an LED lights to indicate the link is active when connected to another device. LED closest to the DIP switch illuminates for 100Mbit connections. LED furthest from the DIP switch illuminates for 10Mbit connections.

WARNING: Explosion hazard – Do not disconnect the Ethernet port unless the power has been switched off or the area is known to be non-hazardous.

Below is an 8P8C modular connector (often called RJ45) commonly used on Cat 5 cables in Ethernet networks.





Twisted-pair Ethernet standards are such that the majority of cables can be wired "straight-through" (pin 1 to pin 1, pin 2 to pin 2 and so on), but others may need to be wired in the "crossover" form (receive to transmit and transmit to receive). The MX5-R2 can automatically detect another computer connected with a straight-through cable and then automatically introduce the required crossover, if needed with no intervention by the installer. 10BASE-T and 100BASE-TX only require two pairs (pins 1-2, 3-6) to operate. Since Category 5 cable has four pairs, the spare pairs (pins 4–5, 7–8) in 10- and 100-Mbit/s configurations are not used.

TIA/EIA-568 T568A termination

Pin	Pair	Wire	Color
1	3	tip	white/green
2	3	ring	green
3	2	tip	white/orange
4	1	ring	blue
5	1	tip	white/blue
6	2	ring	orange
7	4	tip	white/brown
8	4	ring	brown

TIA/EIA-568 T568B termination

Pin	Pair	Wire	Color
1	2	tip	white/orange
2	2	ring	orange
3	3	tip	white/green
4	1	ring	blue
5	1	tip	white/blue
6	3	ring	green
7	4	tip	white/brown
8	4	ring	brown

The MX5-R2 uses autonegotiation, an Ethernet procedure by which two connected devices choose common transmission parameters, such as speed, duplex mode and flow control. In this process, the connected devices first share their capabilities regarding these parameters and then choose the highest performance transmission mode they both support. The MX5-R2 supports 10 and 100 Mbit/s over two-pair Cat5 or better cable.

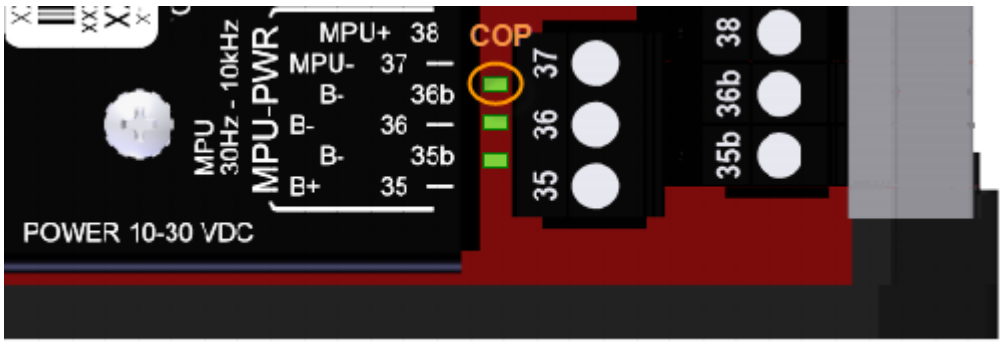
Important: For Entity Parameters or Power Supply and Grounding, refer to Wire Connections.

> **NOTE**: These circuits are not required to be in conduit if all the requirements for ic protection are met and Authority Having Jurisdiction (AHJ) allows.

Controller Operating Properly (COP) LED Codes

Blink codes will be 2 digits separated by pauses with each blink code further separated by a rapid blink event.

- Blink codes will be ¼ second ON and ¼ second OFF.
- Pauses will be ¾ second OFF.
- The separator will be a 2 1/2 seconds pause.



Blink Codes *	Code Description
1, 1	Startup Error
4, 1	Rockwell Automation IO Application Mode
4, 2	Standard IO Application Mode
4, 3	Custom Application Mode
* There will be a ¾ second pause between the digits.	

NOTE: A fast flash (100ms on/off) = Running in bootloader mode. Bootloader is the mode used for switching applications or module reprogramming via external CAN tools.

Communications For Standard IO Applications (default)

Physical Layer: The MX5-R2 module features two Ethernet ports, two RS485 serial communication ports, one RS232 serial port, and one CAN bus 2.0B communication port.

Ethernet Interconnect: Two RJ45 jacks. This connection may require setting the IP address of the module to the desired network configuration. Ethernet port settings can be changed by modifying Modbus registers. Default setting is 192.168.0.100 IP, 255.255.255.0 network mask, 0.0.0.0 Gateway.

Ethernet Protocol: Modbus TCP/IP server. Refer to the Modbus RTU map provided in this manual for a detailed mapping of the available data and data scaling.

Serial RS485 Interconnects: Screw terminals. Typically this connection uses twisted shielded pair cable with 120 ohm impedance. RS485 networks are 2-wire, half-duplex, and feature an "A" terminal 61/62, and "B" terminal 80/81. The A terminal is the + or non-inverting signal, and the B terminal is the – or inverting signal. These signal lines will take turns transmitting and receiving depending on the device using the RS485 network at any given instant.

Serial Baud Rate: default 9600, adjustable up to 115.2k

Serial Stop Bits: The module will respond with 1 stop bit for Modbus RTU addresses 1 through 31 and 2 stop bits for addresses 32 through 239. This maintains flexibility for systems requiring 2 stop bits.

Serial Protocol: Modbus RTU server. The module may be polled by the Modbus RTU Client at without any additional timing delays and response times will be < 100mS. This may vary depending on the amount of data requested. Modbus RTU timeout settings should be set to >= 400mS.

Refer to the Modbus RTU map provided in this manual for a detailed mapping of the available data and data scaling.

CAN bus Interconnect: Screw terminals. Typically this connection uses twisted pair cable with 120 ohm impedance to connect to a FW Murphy Controller. CAN bus networks are 2-wire, with a "HI" terminal 64, and "LOW" terminal 65.

CAN bus Baud Rate: 250k / 1Mb auto sense.

CAN bus Protocol: Proprietary for FW Murphy Controllers.

PC Connection: Reading data from the module into a PC may be done with an Ethernet connection and Modbus TCP/IP client software or serial RS485 or RS232 connection and Modbus RTU client software. A serial interface converter that can convert USB to RS485 would be needed for a RS485 serial connection. (FW Murphy MConfig™ Software and P/N 53702325 may be used for this purpose)

Communications For Rockwell Automation IO Mode (optional)

Physical Layer: The MX5-R2 module features two Ethernet ports.

Ethernet Interconnect: Two RJ45 jacks. This connection may require setting the IP address of the module to the desired network configuration. Ethernet port settings can be changed by modifying Modbus registers. Default setting is 192.168.0.100 IP, 255.255.255.0 network mask, 0.0.0.0 Gateway.

Ethernet Protocol: CIP for use with Rockwell Automation IO.

Modbus Holding Register Description (Standard IO Application Mode)

All data will be contained in 16-bit Modbus Holding Registers. Following the Modbus RTU and Modbus TCP/IP specification, the Most Significant Byte in a 16-bit word is broadcast first, followed by the Least Significant Byte. The module responds to Modbus Function Code 03 (Read Holding Registers), Function Code 06 (Preset Single Holding Register), and Function Code 16 (Preset Multiple Holding Register). Polling invalid/non-existent data will result in Modbus Exception Code response from the module.

Modbus Holding Register Description Used With Standard IO Application Mode					
Modbus Register	**Description**	**Read/ Write**	**Data Range**	**Data Units**	**Definitions / Sample Data**
400001	Hardware Type	R	33	ID	Module name
400002 – 400004	Factory Use	R			
400005	Bootloader Build Version	R	0 – 65535		Version number
400006	Not Used	R			
400007	Firmware Number	R	0 – 65535		Version number
400008	Firmware Build Version	R	0 – 65535		Version number
400009	Firmware Checksum MSW	R	0 – 65535		
400010	Firmware Checksum LSW	R	0 – 65535		
400011	Firmware Major Version	R	0 – 65535		Version number
400012	Firmware Minor Version	R	0 – 65535		Version number
400013	Bootloader Major Version	R	0 – 65535		Version number
400014	Bootloader Minor Version	R	0 – 65535		Version number
400021	Digital Input 1-16 Boolean Status	R	0 - 65535	Bitmap	0=Open, 1=Closed Bit 0 = DI1, Bit 15= DI16
400022	Digital Input 17-24 Boolean Status	R	0 – 255	Bitmap	0=Open, 1=Closed Bit 0 = DI17, Bit 7= DI24
400023	System Voltage	R	0 - 65535	Vdc x10	0 = 0.0 VDC, 320 = 32.0 VDC
400024	Analog input 1	R	0 – 32768	A/D count	0 = 0Vdc, 32768 = 5Vdc 0 = 0mA, 32768 = 25mA
400025	Analog input 2	R	0 – 32768	A/D count	0 = 0Vdc, 32768 = 5Vdc 0 = 0mA, 32768 = 25mA
400026	Analog input 3	R	0 – 32768	A/D count	0 = 0Vdc, 32768 = 5Vdc 0 = 0mA, 32768 = 25mA
400027	Analog input 4	R	0 – 32768	A/D count	0 = 0Vdc, 32768 = 5Vdc 0 = 0mA, 32768 = 25mA
400028	Analog input 5	R	0 – 32768	A/D count	0 = 0Vdc, 32768 = 5Vdc 0 = 0mA, 32768 = 25mA
400029	Analog input 6	R	0 – 32768	A/D count	0 = 0Vdc, 32768 = 5Vdc 0 = 0mA, 32768 = 25mA
400030	Analog input 7	R	0 – 32768	A/D count	0 = 0Vdc, 32768 = 5Vdc 0 = 0mA, 32768 = 25mA
400031	Analog input 8	R	0 – 32768	A/D count	0 = 0Vdc, 32768 = 5Vdc 0 = 0mA, 32768 = 25mA
400032	Analog input 9	R	0 – 32768	A/D count	0 = 0Vdc, 32768 = 5Vdc 0 = 0mA, 32768 = 25mA
400033	Analog input 10	R	0 – 32768	A/D count	0 = 0Vdc, 32768 = 5Vdc 0 = 0mA, 32768 = 25mA

Modbus Holding Register Description Used With Standard IO Application Mode					
Modbus Register	**Description**	**Read/ Write**	**Data Range**	**Data Units**	**Definitions / Sample Data**
400034-400037	Not used				
400038	Frequency input	R	0 – 10,000	Hz	
400039-400046	Not used				
400047	Analog output 1 signal	R/W	0 - 65535	D/A count	0=0mA, 65535=24mA 4mA=10485 20mA=52428
400048	Analog output 2 signal	R/W	0 - 65535	D/A count	0=0mA, 65535=24mA 4mA=10485 20mA=52428
400049	Analog output 3 signal	R/W	0 - 65535	D/A count	0=0mA, 65535=24mA 4mA=10485 20mA=52428
400050	Analog output 4 signal	R/W	0 - 65535	D/A count	0=0mA, 65535=24mA 4mA=10485 20mA=52428
400051-400052	Factory Use-Legacy AO range	R/W			
400053	RTC Time - seconds	R/W	0 - 59	Seconds	
400054	RTC Time - minutes	R/W	0 - 59	Minutes	
400055	RTC Time - hours	R/W	0 - 23	Hours	
400056	RTC Day of week	R/W	1 - 7	Day Of Week	
400057	RTC Date - day	R/W	1 - 31	Day	
400058	RTC Date - month	R/W	1 - 12	Month	
400059	RTC Date - year	R/W	2000 - 3000	Year	
400060	Clock set enable	R/W	0 - 1	Enable/Disable	1 = set above values into the real-time clock
400061	Digital outputs 1-16	R/W	0 - 65535	Bitmap	Bit 0 = DO1, Bit 15 = DO16
400062	Not Used	R			
400063	Digital output 1-16 status on power-up	R/W	0 - 65535	Bitmap	Bit 0 = DO1, Bit 15 = DO16
400064	Digital output 1-16 status on comm. failure	R/W	0 - 65535	Bitmap	Bit 0 = DO1, Bit 15 = DO16
400065	Analog output 1 status on power-up	R/W	0 - 65535	D/A count	0=0mA, 65535=24mA 4mA=10485 20mA=52428
400066	Analog output 2 status on power-up	R/W	0 - 65535	D/A count	0=0mA, 65535=24mA 4mA=10485 20mA=52428
400067	Analog output 3 status on power-up	R/W	0 - 65535	D/A count	0=0mA, 65535=24mA 4mA=10485 20mA=52428
400068	Analog output 4 status on power-up	R/W	0 - 65535	D/A count	0=0mA, 65535=24mA 4mA=10485 20mA=52428
400069	Analog output 1 status on comm. failure	R/W	0 - 65535	D/A count	0=0mA, 65535=24mA 4mA=10485 20mA=52428
400070	Analog output 2 status on comm. failure	R/W	0 - 65535	D/A count	0=0mA, 65535=24mA 4mA=10485 20mA=52428
400071	Analog output 3 status on comm. failure	R/W	0 - 65535	D/A count	0=0mA, 65535=24mA 4mA=10485 20mA=52428
400072	Analog output 4 status on comm. failure	R/W	0 - 65535	D/A count	0=0mA, 65535=24mA 4mA=10485 20mA=52428
400073	Communication timeout	R/W	0 – 65535	Seconds	Lost comm for this duration will revert outputs to comm fail configuration
400074	Analog input 1 type	R/W	0 -1	mA enable	0 = 0-5VDC , 1=0-25mA
400075	Analog input 2 type	R/W	0 -1	mA enable	0 = 0-5VDC , 1=0-25mA
400076	Analog input 3 type	R/W	0 -1	mA enable	0 = 0-5VDC , 1=0-25mA
400077	Analog input 4 type	R/W	0 -1	mA enable	0 = 0-5VDC , 1=0-25mA
400078	Analog input 5 type	R/W	0 -1	mA enable	0 = 0-5VDC , 1=0-25mA
400079	Analog input 6 type	R/W	0 -1	mA enable	0 = 0-5VDC , 1=0-25mA,

Modbus Holding Register Description Used With Standard IO Application Mode					
Modbus Register	**Description**	**Read/ Write**	**Data Range**	**Data Units**	**Definitions / Sample Data**
400080	Analog input 7 type	R/W	0 -2	mA enable	0 = 0-5VDC , 1=0-25mA, 2=Resistive
400081	Analog input 8 type	R/W	0 -2	mA enable	0 = 0-5VDC , 1=0-25mA, 2=Resistive
400082	Analog input 9 type	R/W	0 -2	mA enable	0 = 0-5VDC , 1=0-25mA, 2=Resistive
400083	Analog input 10 type	R/W	0 -2	mA enable	0 = 0-5VDC , 1=0-25mA, 2=Resistive
400084	Factory use	R/W	1/3		
400085	Serial port baud rate	R/W	1-5	Enumeration	1=9600, 2=19.2k, 3=38.4k, 4=57.6k, 5=115.2k
400086	Digital Input 1-2 Polarity	R	0 - 65565	2 bytes	MSB = DI1,LSB =DI2 0 = Closed DC- 1 = Closed DC+ 2 = Open
400087	Digital Input 3-4 Polarity	R	0 - 65565	2 bytes	MSB = DI3,LSB =DI4 0 = Closed DC- 1 = Closed DC+ 2 = Open
400088	Digital Input 5-6 Polarity	R	0 - 65565	2 bytes	MSB = DI5,LSB =DI6 0 = Closed DC- 1 = Closed DC+ 2 = Open
400089	Digital Input 7-8 Polarity	R	0 - 65565	2 bytes	MSB = DI7,LSB =DI8 0 = Closed DC- 1 = Closed DC+ 2 = Open
400090	Digital Input 9-10 Polarity	R	0 - 65565	2 bytes	MSB = DI1,LSB =DI2 0 = Closed DC- 1 = Closed DC+ 2 = Open
400091	Digital Input 11-12 Polarity	R	0 - 65565	2 bytes	MSB = DI3,LSB =DI4 0 = Closed DC- 1 = Closed DC+ 2 = Open
400092	Digital Input 13-14 Polarity	R	0 - 65565	2 bytes	MSB = DI5,LSB =DI6 0 = Closed DC- 1 = Closed DC+ 2 = Open
400093	Digital Input 15-16 Polarity	R	0 - 65565	2 bytes	MSB = DI7,LSB =DI8 0 = Closed DC- 1 = Closed DC+ 2 = Open
400094	Digital Input 17-18 Polarity	R	0 - 65565	2 bytes	MSB = DI1,LSB =DI2 0 = Closed DC- 1 = Closed DC+ 2 = Open
400095	Digital Input 19-20 Polarity	R	0 - 65565	2 bytes	MSB = DI3,LSB =DI4 0 = Closed DC- 1 = Closed DC+ 2 = Open

Modbus Holding Register Description Used With Standard IO Application Mode					
Modbus Register	**Description**	**Read/ Write**	**Data Range**	**Data Units**	**Definitions / Sample Data**
400096	Digital Input 21-22 Polarity	R	0 - 65565	2 bytes	MSB = DI5,LSB =DI6 0 = Closed DC- 1 = Closed DC+ 2 = Open
400097	Digital Input 23-24 Polarity	R	0 - 65565	2 bytes	MSB = DI7,LSB =DI8 0 = Closed DC- 1 = Closed DC+ 2 = Open
465197	IP Address Part 1	R/W	0-255	octet	Ethernet setting
465198	IP Address Part 2	R/W	0-255	octet	Ethernet setting
465199	IP Address Part 3	R/W	0-255	octet	Ethernet setting
465200	IP Address Part 4	R/W	0-255	octet	Ethernet setting
465201	Network Mask Part 1	R/W	0-255	octet	Ethernet setting
465202	Network Mask Part 2	R/W	0-255	octet	Ethernet setting
465203	Network Mask Part 3	R/W	0-255	octet	Ethernet setting
465204	Network Mask Part 4	R/W	0-255	octet	Ethernet setting
465205	Gateway Address Part 1	R/W	0-255	octet	Ethernet setting
465206	Gateway Address Part 2	R/W	0-255	octet	Ethernet setting
465207	Gateway Address Part 3	R/W	0-255	octet	Ethernet setting
465208	Gateway Address Part 4	R/W	0-255	octet	Ethernet setting
465209	DNS1 Address Part 1	R/W	0-255	octet	Ethernet setting
465210	DNS1 Address Part 2	R/W	0-255	octet	Ethernet setting
465211	DNS1 Address Part 3	R/W	0-255	octet	Ethernet setting
465212	DNS1 Address Part 4	R/W	0-255	octet	Ethernet setting
465213	DNS2 Address Part 1	R/W	0-255	octet	Ethernet setting
465214	DNS2 Address Part 2	R/W	0-255	octet	Ethernet setting
465215	DNS2 Address Part 3	R/W	0-255	octet	Ethernet setting
465216	DNS2 Address Part 4	R/W	0-255	octet	Ethernet setting
465217	Ethernet IP Options	R/W	0-4	Bitmap	0=static ip / no auto IP 1= DHCP enabled / no auto IP 2 = static ip / use Auto IP if no DHCP or IP 3 = DHCP enabled / use Auto IP if no DCHP or IP
465218	MAC Address word 1	R	0 – 65535		
465219	MAC Address word 2	R	0 – 65535		
465220	MAC Address word 3	R	0 – 65535		

Register 400001 Value Description

Register 400001 is a read-only register. This register holds the model number of the hardware. If you are using multiple Comm modules, it is sometimes helpful to confirm that you are communicating with the expected module type. In this case, it will return 33.

Digital Input 1-16 Status (400021)

Register 400021 is a read-only register. The value returned in this register is unsigned 16-bit data, assigned to digital inputs 1-16. The channel's bit position is 1 input bitmapped where bit 0 = digital input 1.

Digital Input 17-32 Status (400022)

Register 400022 is a read-only register. The value returned in this register is unsigned 8-bit data, assigned to digital inputs 17-24. The channel's bit position is 1 input bitmapped where bit 0 = digital input 1. The additional upper bits for digital inputs 17-24 will remain at 0 and serve as padding to make a proper 16-bit word to comply with Modbus RTU specifications.

Analog Input Status (400024 - 400033)

Registers 400024 – 400033 are read-only registers. The values returned in these registers are signed 16-bit raw data counts for analog inputs from 0 - 32768 for a full 0VDC to 5VDC input reading. Enabling the mA option (Registers 400074-400083) converts the input to a 0-24mA range where 0 = 0mA, and 32767 = 24mA. Typical expected counts for 4-20mA input would be 4mA=5243 counts and 20mA=26214 counts.

Analog Output (400047 - 400050)

Registers 400047 – 400050 are read/write registers. The values returned in these registers are unsigned 16-bit data, assigned to analog outputs driver. The output can drive from 0-24mA where 0=0mA and 65535=24mA. For example to set the output at 4mA, write 10485. For 20mA, write 52428.

Digital Output (400061)

Register 400061 is a read/write register. The values returned in these registers are unsigned 16-bit data, assigned to digital outputs 1 through 16. The channel's bit position is 1 input bitmapped where bit 0 = digital output 1.

Digital Outputs at Powerup (400063)

Register 400063 is a read/write register. Set the digital outputs, 1-16 state as on or off on initial powerup of the module — before it receives any communication from the client controller. This setting is stored on the module and retained on power loss.

Digital Outputs at Communication Failure (400064)

Register 400064 is a read/write register. Set the digital outputs 1-16 state as on or off if communication to the client controller is lost based on the communication timeout setting in register 400073. This setting is stored on the module and retained on power loss.

Analog Outputs at Powerup (400065 - 400068)

Registers 400065 – 400068 are read/write registers. Set the analog output values on initial powerup of the module, before it has received any communication from the client controller. This setting is stored on the module and retained on power loss.

Analog Outputs at Communication Failure (400069 - 400072)

Registers 400069 – 400072 are read/write registers. Set the analog output values on if communication to the client controller is lost based on the communication timeout setting in register 400073. This setting is stored on the module and retained on power loss.

Communication Timeout (400073)

Registers 400073 is a read/write register. Set the timeout to signal communication lost from the client controller, and this will set the outputs to their communication failure state. All ports are sensed for communication timeout. So any client talking on any port will reset the communication timer and keep normal operation.

Analog Input mA enable (400074 - 400083)

Registers 400074 – 400083 are read/write registers. Choose the input type as 4-20mA if this setting is written to “1”. If it is left at “0”, the input will be a 0-5VDC input. This setting is stored on the module and retained on power loss.

Digital Input 1-24 Polarity Status (400086 - 400097)

Registers 400086 – 400097 are read-only registers. Each register contains a pair of digital input polarity status information stored as 2 bytes of information. The status can be DC-, DC+, or OPEN for each digital input. The most significant byte in each register is the odd-numbered channel. The least significant is the even-numbered channel.

Notes

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