MAC VALVES, INC.

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UI-182

TITLE: Control Manual for MAC Modbus TCP MI/O-67 Manifold

REVISION LEVEL	DATE RELEASED	CHANGE	ECN NUMBER	P.E. APPROVAL	P.D. APPROVAL
A	3/15/19	ENGINEERING RELEASE	31022		GEM
B	1/24/20	ADIs and Configurable Analog Module Added	31656		TRJ
C	4/2/20	CE and 4 Pin Info Added	31797		TRJ

I. Table of Contents

Figures/Tables

Control Manual
For
MAC Valves Modbus TCP
MI/O-67 Serial Manifold

8/1/2019

1. System Overview

Modbus TCP is based on the Modbus messaging protocol originally developed by Modicon in 1979. It is an open protocol used for master-slave communications. It is supported by the Modbus Organization.

The protocol itself is used as an interface between various devices as a transport layer for communications of I/O data. Unlike various other PLC protocols, it does not start with the master but just serves as the interconnection system. It resides in the EtherNet world but it is not an EtherNet protocol per se.

The physical connecting between master (a PC or PLC with its network scanner) and slave devices are connected via a standard D-coded M12 connector on a CAT 5 cable. The valve and electronics 24VDC will have to be supplied to the MI/O-67 manifold via an additional cable.

The MI/O-67 uses IP Addresses for connectivity. It does not use the UnitID.

A. MAC Valves Manifold Stack

A typical valve manifold is shown in **Figure 1**. Note the functional module shown is for reference only. The modules will be discussed later in this document.

The main communications module is call the Comms Module. Its functions is to provide front-end interfacing to the MODBUS protocol, operate 32 valve drivers for the stack valves, route power for the stack valves and electronics, and control the CAN bus backplane which interfaces the functional modules.

The stack will come fully assembled. However, if a need arises to add or subtract modules**, turn off all power and air prior to changing the module configuration.**

The valve stack can operate up to 32 solenoids in any combination of double and single solenoid valves. It is set up for 24VDC valves.

Figure 1 Typical Valve Stack (EtherNet I/P Shown)

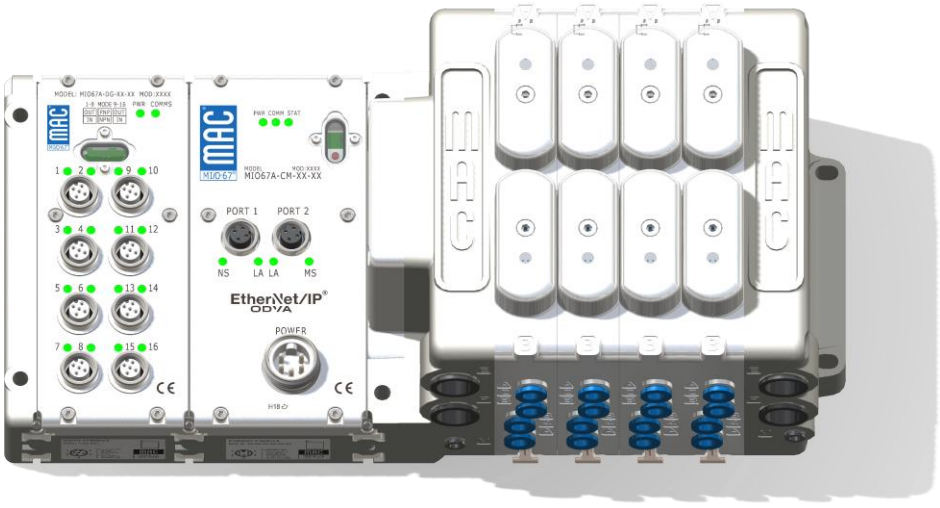


Figure 2 Modbus TCP Comms Module, 5 Pin Power Connector

Figure 3 Modbus TCP Comms Module, 4 Pin Power Connector

B. Process Data Registers

Unlike the other protocols, Modbus TCP does not support cyclic data. The Process Data is mapped into Holding, Input, Coils, and Discrete registers. **Tables 1-5** show the various register mappings.

Table 1 (Holding Registers)

Range	Contents	Notes
0x0000-0x02ff	Read Process Data	Only 210 bytes used of the 1536 bytes
0x0300-0x07ff	Reserved	
0x0800-0x0aff	Write Process Data	Only 210 bytes used of the 1536 bytes
0x1003	Process Active Time-Out	0:disabled >0 Timeout time in milliseconds[1]
0x1004	Enter/Exit Idle Mode	0:Not idle, >0:idle
0x1005-0x100f	Reserved	

Table 1 Continued

0x1010-0x102f	ADI Number 1	Refer to Table 5
0x1030-0x104f	ADI Number 2	
0xffd0-0xffef	ADI Number 1919	

Table 2 (Input Registers)

Range	Contents	Notes
0x0000-0x02ff	Write Process Data	Only 210 bytes used of the 1536 bytes
0x0300-0x07ff	Reserved	
0x0800	Diagnostic Event Count	Number of pending events
0x0801	Diagnostic Event #1	
0x0802	Diagnostic Event #2	
0x0803	Diagnostic Event #3	
0x0804	Diagnostic Event #4	
0x0805	Diagnostic Event #5	
0x0806	Diagnostic Event #6	

Table 3 (Coil Registers)

Range	Contents	Notes
0x0000-0x2fff	Read Process Data	Only 210 bytes used of the 1536 bytes Refer to Section x
0x3000-0x7fff	Reserved	

Table 4 (Discrete Input Registers)

Range	Contents	Notes
0x0000-0x2fff	Write Process Data	Only 210 bytes used of the 1536 bytes
0x3000-0x7fff	Reserved	

C. Application Data Instances (ADIs)

The **Table 5** below defines these ADIs

Table 5 (ADI)

Number	ADI#	Name	Element	Type/Access
1-12	1n0h	Module Inputs	-	-
	-	Entry	1-8	UINT16/RO

Note: Number of entries = 08h, n = 0-12 represents backplane module index
The Module Inputs = 0000h (default) These are the PDO from the modules

Number	ADI#	Name	Element	Type/Access
13-25	2n0h	Module Outputs	-	-
	-	Entry	1-8	UINT16/RW

Note: Number of entries = 08h, n = 0-12 represents backplane module index
The Module Outputs = 0000h (default) These are the PDO to the modules

Number	ADI#	Name	Element	Type/Access
26-38	3n0h	Module Config	0	OCTET_STRING/RW

Note: Module configuration = 00 00 00 00 00 00 00 00h (default)
n = 0-12 represents backplane module index (0 = module 1)
Non-volatile configuration data. The stored parameters object must be used to explicitly tell the device to store the configuration data not non-volatile memory; otherwise changes will be lost after power cycle.

Number	ADI#	Name	Element	Type/Access
39-51	4n0h	Module Info	-	-
		Device Type	4	UINT32/RO

Note: All modules use DS401 devices. Lower 16 bits = 0x0191. For example, the Analog Current Module would be 0x0191 plus 0x820c.

		Vendor ID	5	UINT32/RO

Note: Vendor ID =0 if modules are not used. Otherwise, it is set from which is read from the Module.

		Prod Code	6	UINT32/RO

Note: Produce code = 0 if modules are not used. Otherwise, it is set from which is read from the Module.

		Rev Number	7	UINT32/RO

Note: Revision number = 0 if modules are not used. Otherwise, it is set from which is read from the Module.

		Serial Num	8	UNIT32/RO

Note: Serial number = 0 if modules are not used. Otherwise, it is set from which is read from the Module.

Number	ADI#	Name	Element	Type/Access
52	510h	Store Parameters	-	-
		Save All	1	UNIT32/RW

Note: Save All = 00 00 00 01h, write 65766173h to "save" parameters

		Save Comm	2	UINT32/RO

Note: Save Comm = 00 00 00 02h

		Save App	3	UINT32/RW

Note: Save App = 00 00 00 01h, write 65766173h to "save" parameters.

Number	ADI#	Name	Element	Type/Access
53	530h	Time Stamp (nanoseconds)	0	UINT64/RO

Number	ADI#	Name	Element	Type/Access
54	600h	Config Module Id List	-	- Number of entries =0ch
		Entry	1-12	UINT16/RW

Note: 00 00 00 00h (default) = no module configured. This list will be synchronized to the detected module ID list at startup.

Number	ADI#	Name	Element	Type/Access
55	610h	Detected Module Id List Number of entries = 0ch	-	-
		Entry	1-12	UINT32/RO

Note: Module ID detected on the backplane by the Comms Module.
00 00 00 00h = no module detected.

Number	ADI#	Name	Element	Type/Access
56	620h	Module Device Pro Number of entries =01h	-	-
		Index Dist Index distance = 16	1	UINT16/RO
		Max Num Of Modules Max. number of Modules = 12	2	UINT16/RO

Number	ADI#	Name	Element	Type/Access
57	630h	Device Status	-	UNIT16/RO

Number	ADI#	Name	Element	Type/Access
58	640h	Backplane Status	-	-

		Number of entries = 0ch		
		Entry	1-12	UINT32/RO
Number	ADI#	Name	Element	Type/Access
59	650h	Device Control	0	UINT16/RW
Number	ADI#	Name	Element	Type/Access
60	660h	Device Inputs	-	-
		Number of entries = 08h		
		Entry	1-8	UINT16/RO
Number	ADI#	Name	Element	Type/Access
61	670h	Device Outputs	-	-
		Number of entries = 08h		
		Entry	1-8	UINT16/RW

Number	ADI#	Name	Element	Type/Access
62	680h	Device Config	0	Octet_STRING(8)/RW

Note: First 8 bytes of the configuration for the Comms Module

Number	ADI#	Name	Element	Type/Access
63	681h	Device Config	0	Octet_STRING(8)/RW

Note: Last 8 bytes of the configuration for the Comms Module

Number	ADI#	Name	Element	Type/Access
64	690h	Device Address	0	UINT8/RW

Note: Device Address = 00h, Valid range 0

Number	ADI#	Name	Element	Type/Access
65	6A0h	Vendor Name	0	Visible_STRING(10) /RO

Note: Vendor Name = “MAC Valves”

Number	ADI#	Name	Element	Type/Access
66	6B0h	Command	1	OCTET_STRING(6) /RW
		Id List		

Note: Reset Command = 00 00 00 00 00h.
Device Reset: 74 65 73 65 72 66h
Factory Reset: 74 65 73 65 72 66h

Status	2	UINT8/RO

Note: Status of the written command. Status = 02h if command is invalid or could not Be completed. Otherwise = 00h

Response	3	OCTET_STRING(2) /RO

Note: Response of written command. Response = 02 00h if command is invalid or could not be completed. Otherwise = 00 00h.

2. System Structure

A. Applicable MAC Valves Series for the MI/O-67

Following are the valves, which can be used with the MI/O-67 Valve Manifold:

92 Series	36 Series
42 Series	46 Series

For other valve types, please consult the factory

The maximum wattage per channel is 12.0W, which corresponds to 500mA at 24VDC. The Comms Module uses 400mA from the valve current so the maximum total load is 7.6A. Please refer to the individual valve series and power calculator for further explanation of maximum wattage and current limits.

An example of a valve stack is shown in **Figure 1**. The stack consists of one Digital Module and one Comms Module, and 4 double solenoid valves for reference.

3. Power Wiring and Connectors

A. Connectors - Power

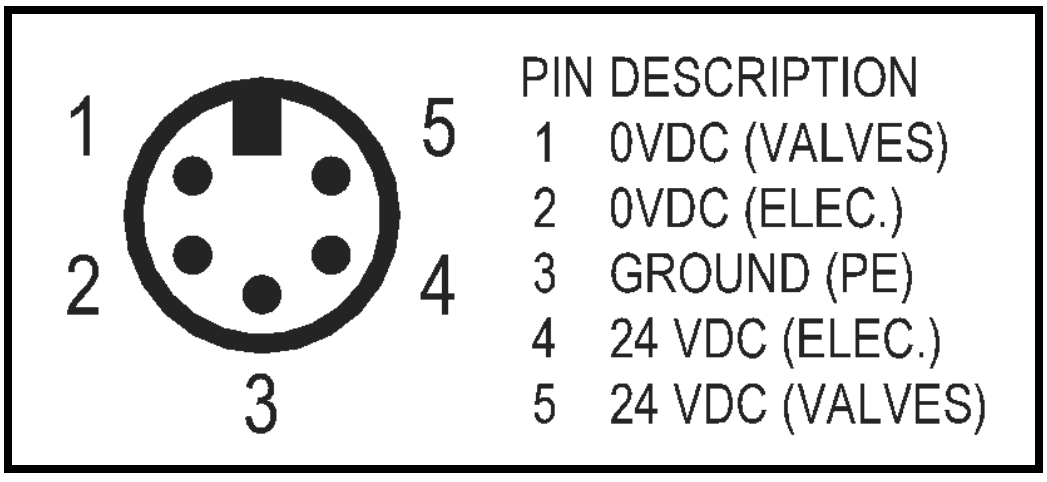
The power connector located on the top of the MI/O-67 is shown in **Figure 1,2, and 3**. The pin-out for the 5 pin option is shown in **Figure 4**. The pin-out for the 4 pin option is shown in **Figure 5**.

If it is desired to add or subtract modules from the stack, it is very important to remove all the power prior to connecting or discounting the modules. Failure to do this could result in module damage.

The power connector has two separate power channels on it. The first is the +24VDC required for the valves. The largest current a single valve can consume is 500mA. If all 32 channels need to be operated simultaneously, each valve is limited to 225mA (8A total – 0.4A Comms Module Consumption = 7.6A….7.6A/32 Valve Channels = 0.238A/Channel….rounding down to 5.4W @24VDC =0.225A). Also, it is possible to run the electronics independent of the valves. If it is desirable to keep the electronics "awake," while the valve power is off, then two separate power supplies will be necessary. By disconnecting the valve power supply and keeping the electronics supply active, the node will stay online but the valves will not operate. Please note that it is also important to make a connection to the Earth (PE).

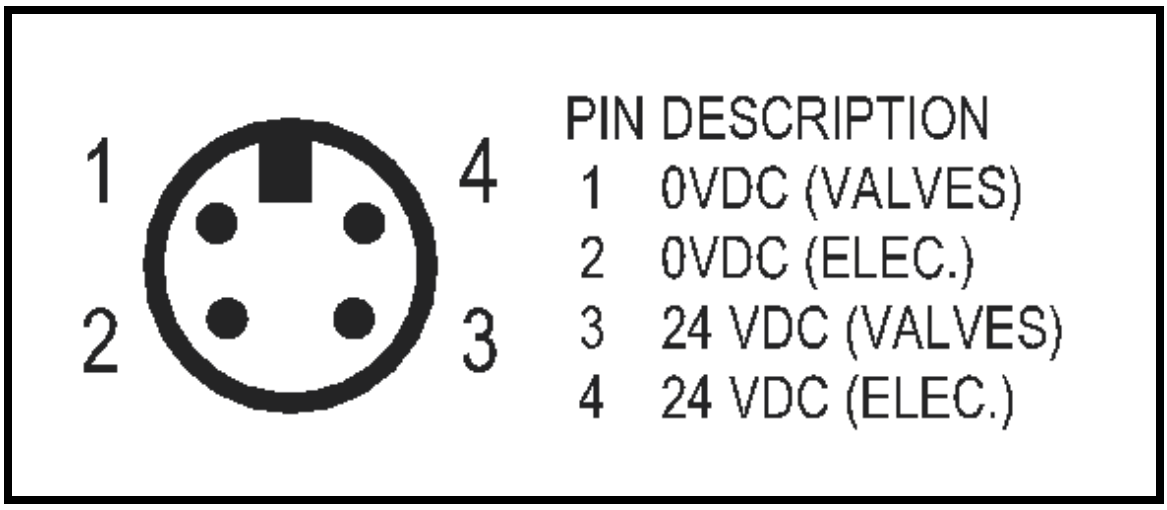
As far as the Electronics and I/O power is concerned; it depends on the number of modules and the load on each module. For starters, each module except the Comms Module will draw about 100mA without a load (sensor, analog load, etc.). The Comms Module (electronics side) draws 140mA. The maximum capacity for this line is also 8.0A. Refer to the **Power Handling Section** (8) for the load calculations.

Figure 4 5 Pin Power Connector Pin-Out



It is also possible to have a four pin power connector on the Comms Module. The pin-out for this options is shown in **Figure 5.**

Figure 5 4 Pin Power Connector Pin-Out



4. Analog Module (Non-Configurable Type) Connectors

A. Connectors

The four connectors for these modules on the top of the MI/O-67 are shown in **Figure 5**. The pin outs can be found in **Figure 6**.

Each module has four channels on four different connectors. The modules themselves are either 0-10V I/O or 4-20mA I/O. Each connector has one input and one output.

Figure 6 Analog I/O Module, Non-Configurable Type

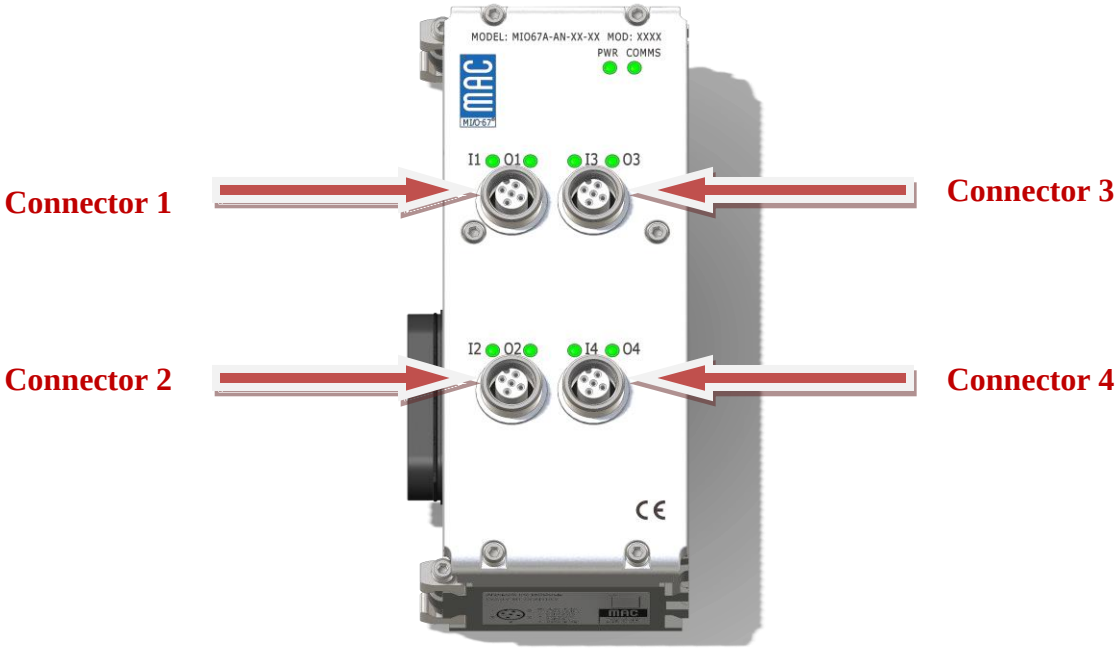
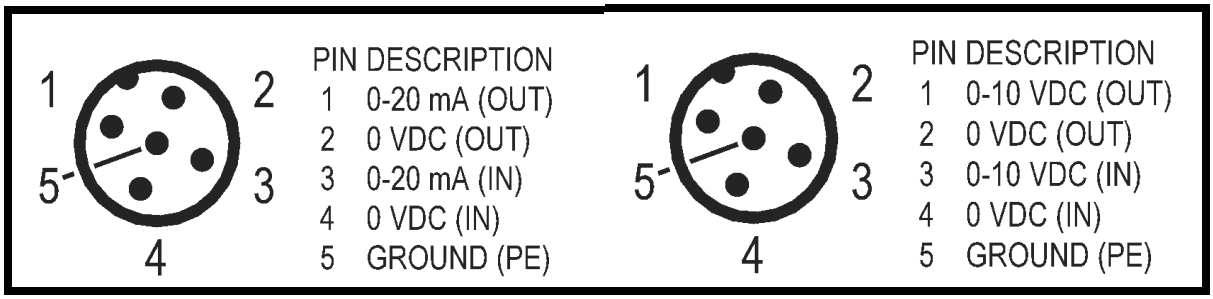


Figure 7 Analog I/O, Non-Configurable Type, Pin-Out



B. Indicator LEDs

Each connector has two LEDs near them. The LEDs are solid green when everything is running normally. They will change to red when there is either an overvoltage (for the current module) or overcurrent (for the voltage module) fault.

5. Analog Module (Configurable Type) Connectors and Configuration

A. Connectors

The four connectors for these modules on the top of the MI/O-67 are shown in **Figure 7**. The pin outs can be found in **Figure 8**.

The pin out for each connector is dependent on whether it is configured as an Output or Input. This is set by the dipswitches located under the window.

Each module has four channels on four different connectors. The modules themselves are either 0-10V I/O or 4-20mA I/O.

Figure 8 Analog I/O Module, Configurable Type

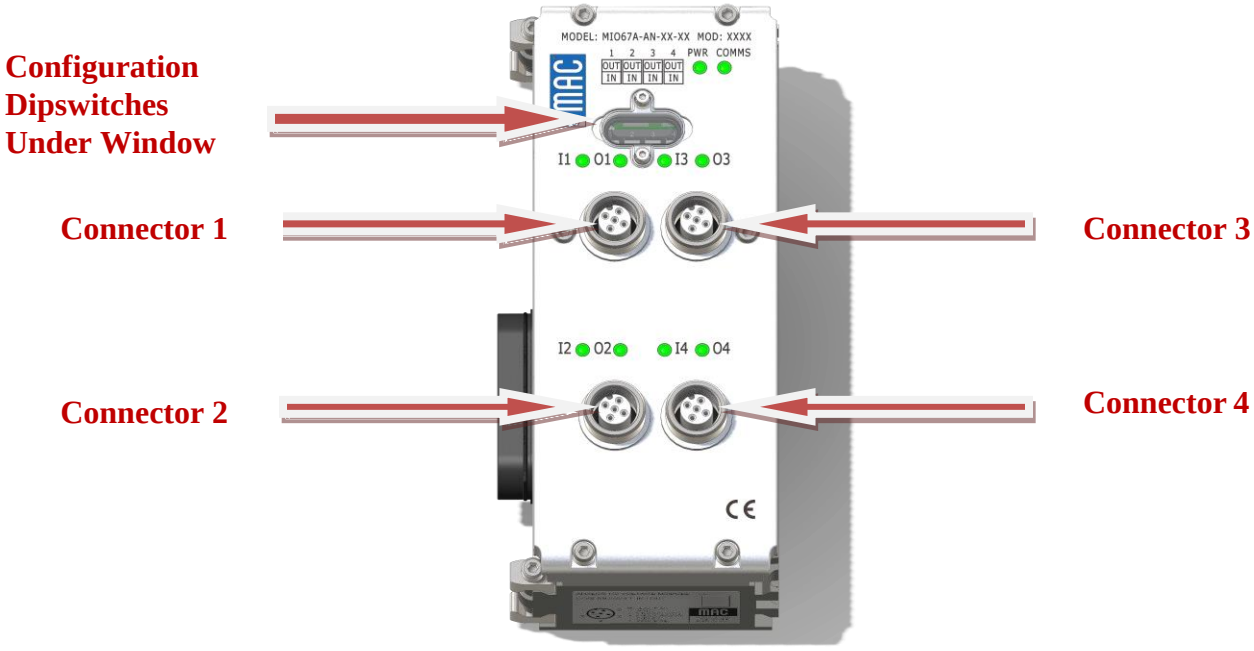
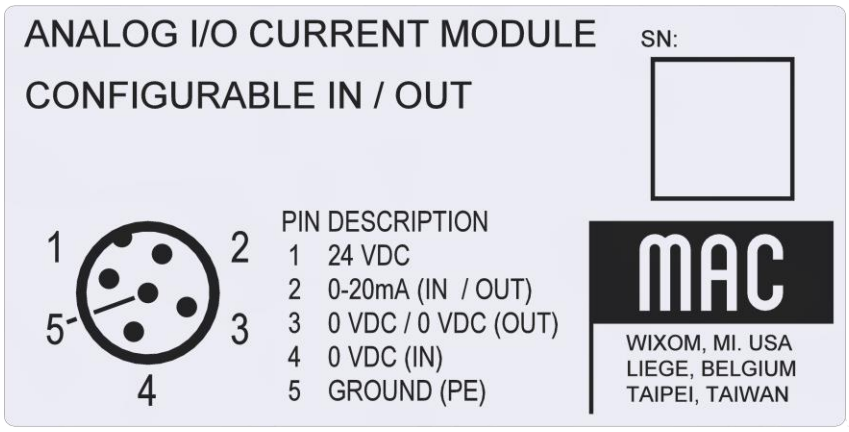
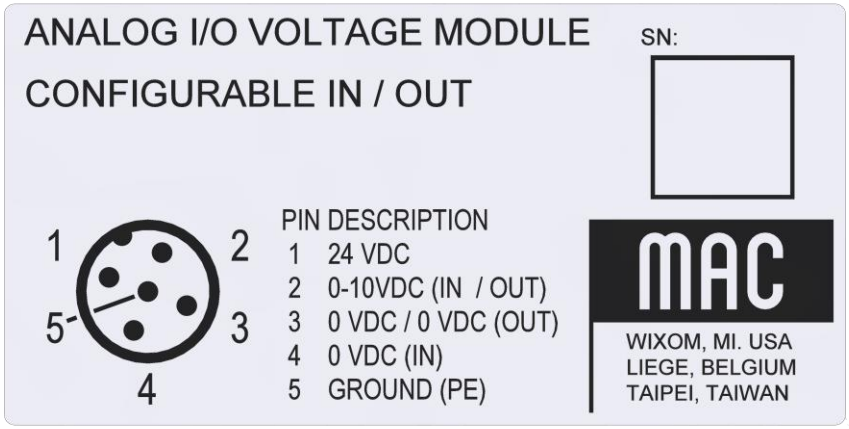


Figure 9 Analog Module (Configurable) Pin-Out





As shown in **Figure 8**, depending on how the connectors are configured sets the pin-out for

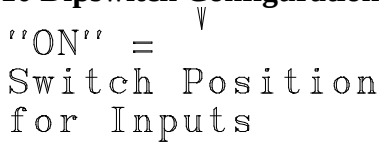
that connector. For example, if you have a 0-10V module and you configure a connector to act as an output, then Pin 2 is the Positive output and Pin 3 is the Negative Output along with the common for the 24VDC. If you have a 4-20mA module and you configure a connector to act as an Input, then Pin 2 is the Positive input and Pin 4 is the Negative Input.

B. Module Configuration

Each connector on the module can be configured as an Analog Output or an Analog Input. The type depends on whether you have an Analog Current Module, an Analog Voltage Module.

The configuration is done by way of the four dipswitches under the window on the module near the top as shown in **Figure 8**.

Figure 10 Dipswitch Configuration



C. Indicator LEDs

Each connector has two LEDs near them. The LEDs are solid green when the everything is running normally. They will change to red when there is either an overvoltage (for the current module) or overcurrent (for the voltage module) fault.

6. Digital I/O Module Connectors and Configuration

A. Connectors

The eight connectors for these modules on the top of the MI/O-67 are shown in **Figure 11**. The pin outs can be found in **Figure 12**.

Each module has sixteen channels on the eight different connectors. The module can be configured for sixteen inputs, sixteen outputs, or eight inputs and eight outputs.

Also shown in **Figure 11** is the window for access to the mode selector dipswitches.

Figure 11 Digital I/O Module

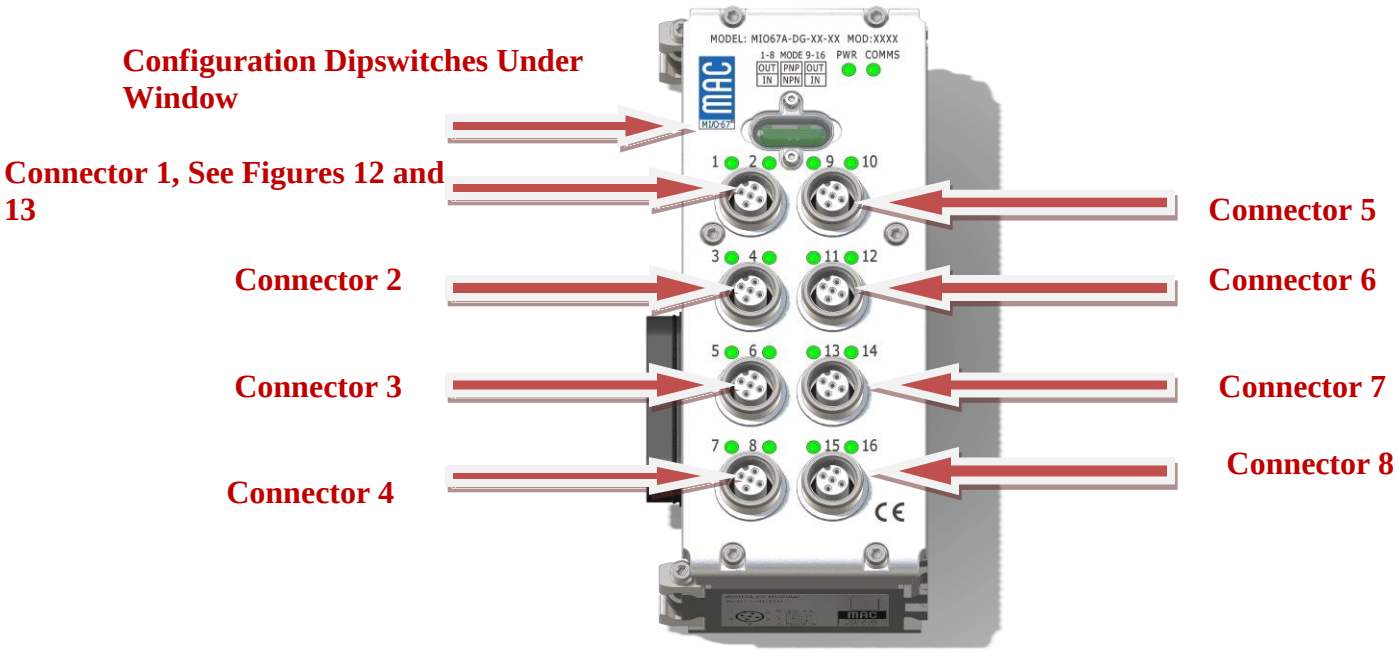


Figure 12 Digital I/O Connector Pin-Out

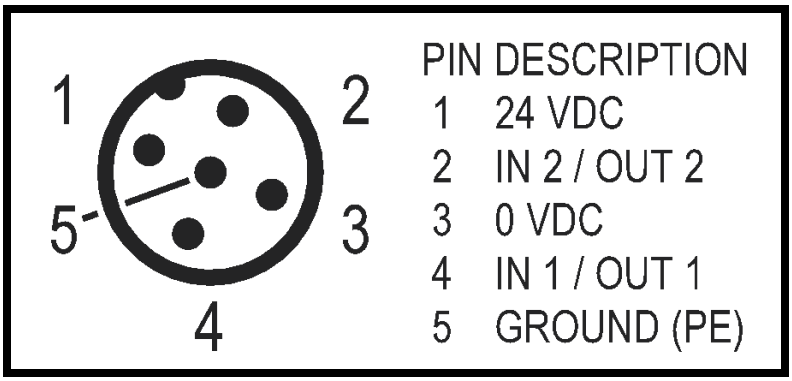
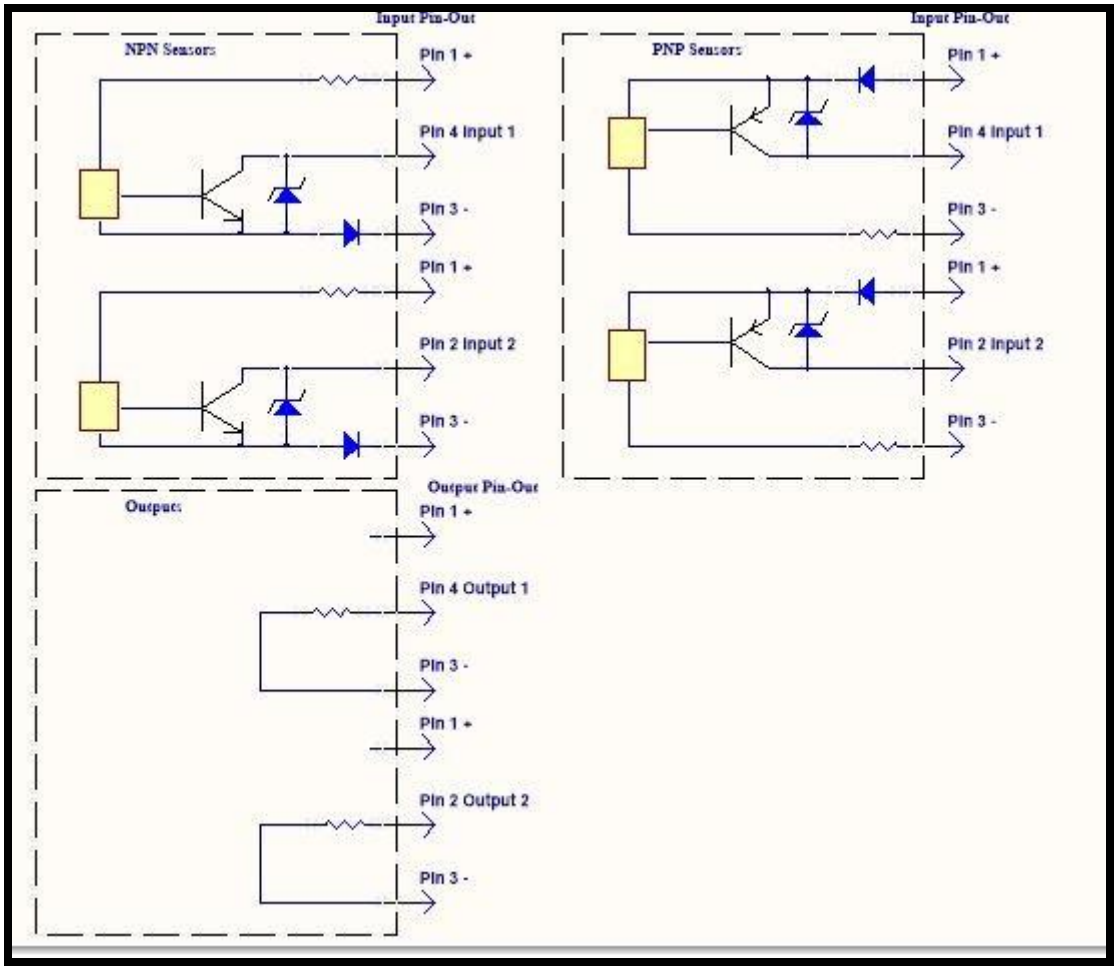


Figure 13 Sensor/Load Wiring



B. Dipswitch Configuration

The module is broken down into two banks of 8 points. The left 4 connectors are considered Bank A and the right 4 connectors are considered Bank B. The dipswitches shown in **Figure 11** will set the bank function of being either input or output connectors for these modules. The pin outs can be found in **Figure 12**. The wiring for each is shown in **Figure 13**.

As stated above, each module has sixteen channels on the eight different connectors. The module can be configured for sixteen inputs, sixteen outputs, or eight inputs and eight outputs. For the inputs, along with setting the banks, you can also set whether they are for npn or pnp sensors. The table below shows the dipswitch settings.

Left to Right as shown in **Figure 14** where 0 = off position (dipswitch position away from top edge of board) and 1 = on position (dipswitch position is closer to top edge of board) for the switches:

Figure 14 Dipswitch Settings

Dipswitch			Bank A	Bank B
A	**B**	**C**		
0	0	0	Input/NPN	Input/NPN
0	0	1	Input/NPN	Output
0	1	0	Input/PNP	Input/PNP
0	1	1	Input/PNP	Output
1	0	0	Output	Input/NPN
1	0	1	Output	Output
1	1	0	Output	Input/PNP
1	1	1	Output	Output

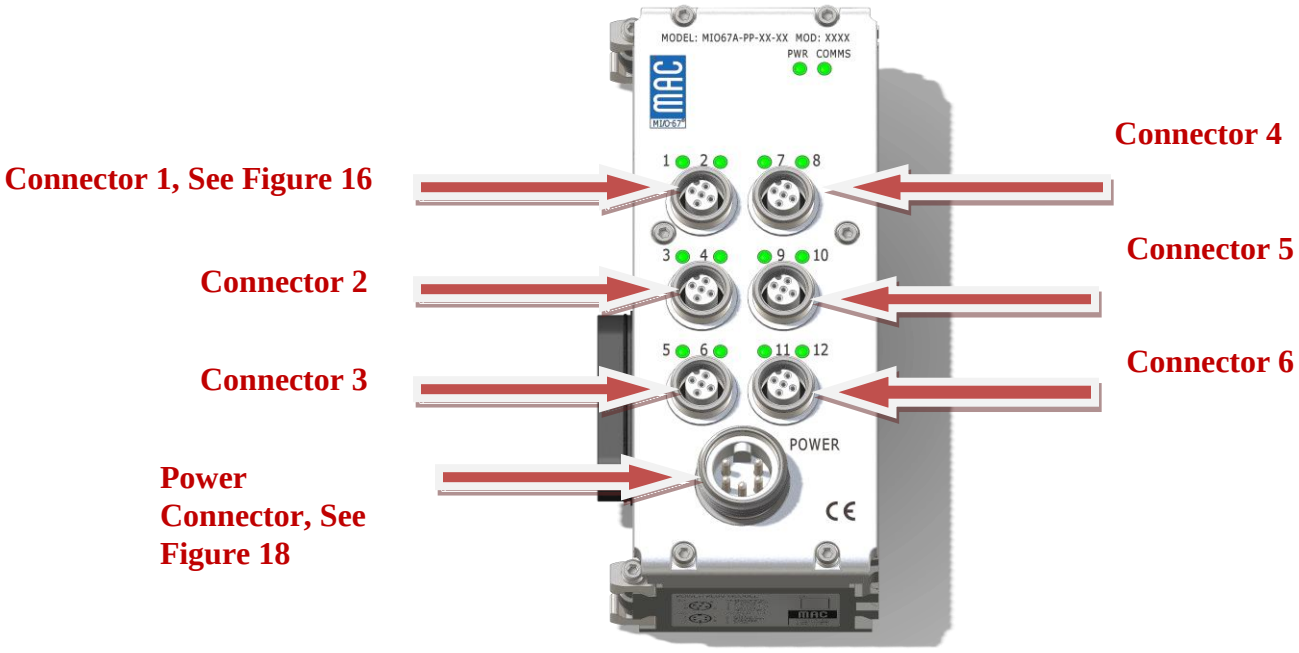
C. Indicator LEDs

Each connector has two LEDs near them. The LEDs are solid green when the change is active (driving an output load or sensing an input). A red LED indicates a short on the connector.

7. Power Plus Module

Figure 15 shows a Power Plus Module.

Figure 15 Power Plus Module



A. Connectors

This module will have six connectors (twelve outputs total, two outputs per connectors) for external valve operation plus an external power connection.

B. Wiring

Shown below in **Figure 16** are the load connections to drive a valve or other 12W or less loads on the Power Plus Module. Note; each connector has two outputs. The wiring for these connectors is show in **Figure 17**.

The power to operate the electronics of the module comes from the Comms Module Electronics power. The load power comes from the mini connector on the module and is wired according to **Figure 18**. The outputs cannot be operated without power from the mini connector. If this power is absent, the channel leds will be solid red and an error message will be sent to the PLC.

Figure 16 Pin-Outs, Power Plus Module

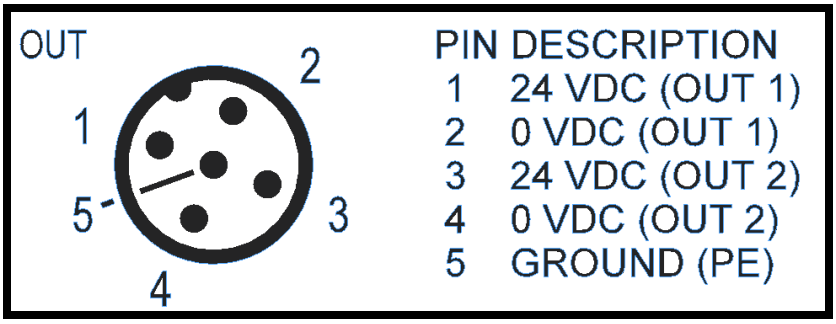


Figure 17 M12 Load Connections

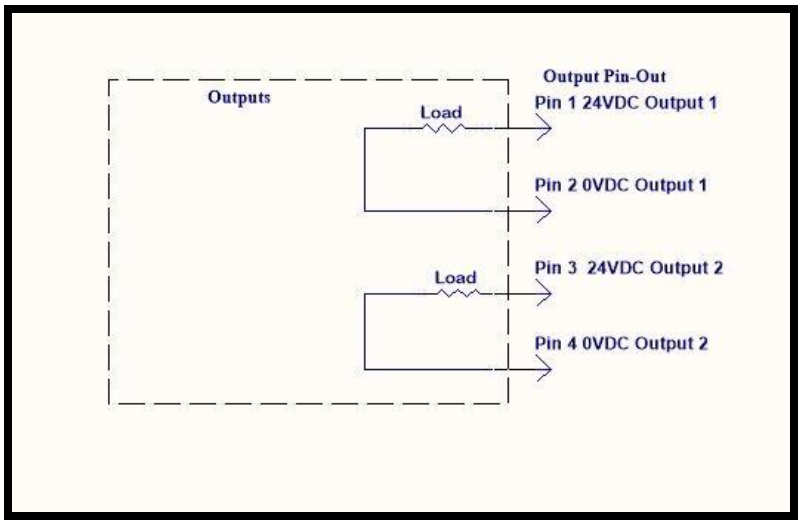
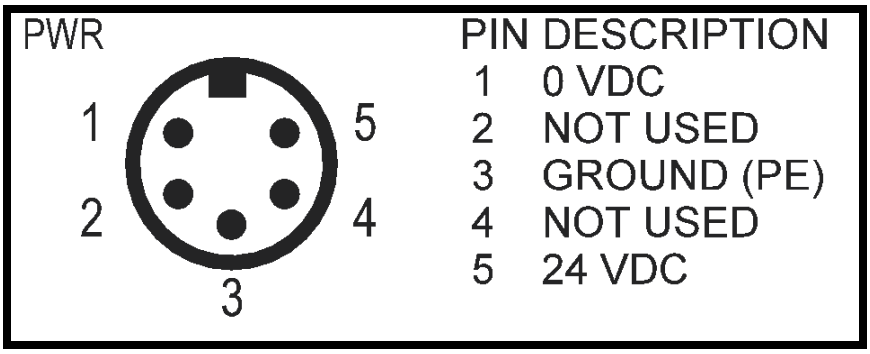


Figure 18 Mini Power Connector



C. Indicator LEDs

Each connector has two LEDs near them. The LEDs are solid green when the change is active (driving an output load). If there is no output power to the module, the LEDs will be solid red.

8. Network Connection

A. Connectors

There are two M12 connectors shown in **Figure 1 and Figure 2**. They use a standard CAT5 Ethernet type cable for communications. Because Modbus TCP resides on a number of network types (EtherNet I/P, ProfiNet, EtherCat, PowerLink), the set-up of these ports will depend on the protocol used. Please refer to the protocol software used for configuration specifics.

9. Power Handling

The MI/O-67 system has two power paths for the valves and the modules as shown in **Figure 1** in Section 3.1. In addition to that, the Power Plus Module uses an external power connector to operate the valves connected to that module.

A. Valve Power

The first power system is for the valves on the stack. It is isolated from the electronics power and thus can be separately disconnected of desired. It can pass up to 8A at 24VDC maximum. To calculate the total power for the valve line, use the following formula:

Total Current (Amps) = Number of Valves x (Valve Wattage/24) +0.4A $\leq$ 8 Amps.

If there are valves of different wattages on the stack then each group of wattages must be added up separately. Thus:

Total Current (Amps) = [Number of Valves (Wattage1) x (Valve Wattage1/24)] + [Number of Valves (Wattage2) x (Valve Wattage2/24] + [Number of Valves (Wattage3) x (Valve Wattage3/24] + [Number of Valves (Wattage4) x (Valve Wattage4/24)] …..etc.

Note: Valve wattage must be $\leq$ 12 watts per channel at 24VDC.

B. Electronics Power

There is an isolated power line which also can handle up to 8 Amps at 24VDC. This line is used for the EtherNet electronics, module electronics, and the electronics (but not the outputs) of the Power Plus Module.

In general, the power consumed by the modules by themselves (excluding the Comms Module) will be between 50-130mA depending on the module type. This number does not include the loads on the module from sensors, analog outputs, and outputs from the Digital I/O Module.

C. Comms Module

The Comms Module will consume 140mA from the 8A total. Thus, for additional modules, and assuming there is 8A available at the connector, the first module will have 7.86A maximum to work with.

D. Analog Module, Current

The Analog Module can operate 4 channels of 4-20mA outputs at the same time. If all the channels are running at maximum output the module will consume 130mA

from the electronics power allotment per module.

E. Analog Module, Voltage

Like the Analog Current Module above, the Analog Voltage Module has four channels which can output 10V at a maximum of 16mA per channel. This module will consume, at maximum output, 50mA per module from the electronics power allotment.

F. Digital I/O Module

The modes of the Digital I/O Module must be considered when calculating the module's current draw.

If the module is run completely as an output unit, then the total current draw will be 60mA (for the module) + (number of channels used up to 16 x current load of the outputs). For example, if there are 16 250mA loads on the device, then the current draw will be 60mA + (16 x 250mA) = 4.04A. Care must be taken with this module because the individual channel maximum outputs are 0.5A and if the unit is loaded down to the maximum (16 x 0.5A) it is possible to completely load the entire stack and take MODBUS TCP off line.

If the module is used only as an input unit, then the draw of the sensors must be taken into account. This works out as 60mA for the module and then the current draw of each sensor x the number of sensors on the module. For example, if there are 16 Hall Effect proximity sensors on the module and each sensor draws 2mA, then the total current draw for the module will be 60mA + (16 x 2mA) = 92mA total.

Using the module as a combination input/output module will require using input and output current calculations plus the module current draw (60mA).

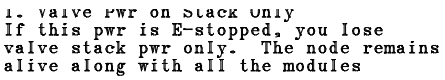
G. Power Plus Module

The Power Plus Module can operate up to 12 0.5A loads (valves, outputs, etc.). However, this power does not come from the electronics total. The module itself draws 50mA.

10. Power Distribution

The stack's power distribution is shown in **Figure 18**. Note, the Electronics power handles all the module electronics plus the I/O electronics for the Digital and Analog I/O Modules. This is routed through the backplane along with the CAN control signals. The stack valve power comes from the Comms Module power. The Power Plus Module has a separate source for its loads.

Figure 19 Stack Power Distributions

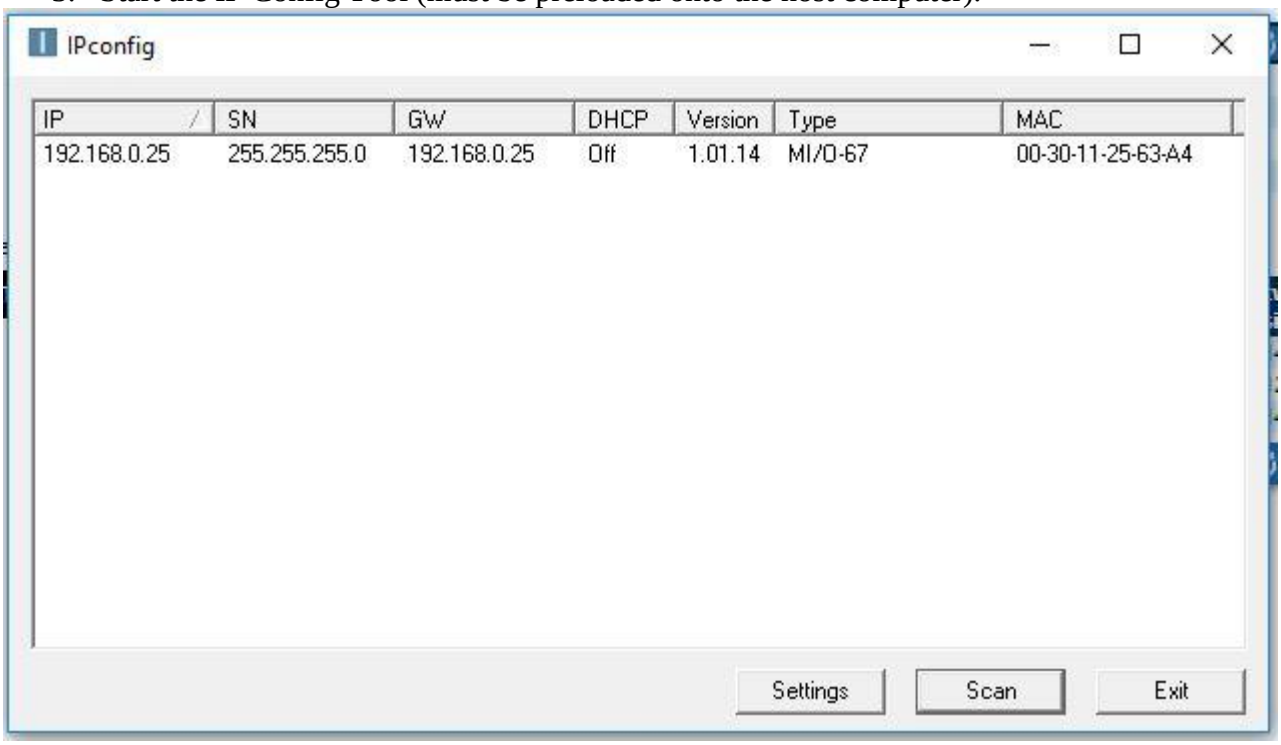


11. Configuration Using the IP Config and Web Config Tools (See UI-174 for more detailed instructions)

The IP Address comes as the factory default as 192-168.1.25. However, if the address is not known or needs to be verified, then the IP Config tool is the easiest way to accomplish this.

The steps are:

1. Connect the unit to a M12 to RJ45 cable and host computer.
2. Connect power to the stack.
3. Start the IP Config Tool (must be preloaded onto the host computer).



4. A screen will appear showing the stack, IP Address, MAC ID, etc.
5. To re-set the IP Address, select the stack on the list (double click). A second menu will appear, load the desired IP Address, Subnet Mask…etc. Exit menu.
6. The first menu will appear. Scan the network and the new information regarding the stack will appear.

To use the Web Config Tool:

1. Connect the unit to a RJ45 to M12 cable and host computer.
2. Connect power to the stack.
3. Launch the web browser (i.e. Google Chrome, Mozilla Firefox, etc.)
4. Browse to http://192.168.1.25 (or whatever the IP Address has been set into the Comms Module)
5. A screen will appear that looks like below.
6. On the left-hand menu bar, go to “1. Network”.

7. Type in the desired IP Address in the space and hit “Save Settings”.
8. Power cycle the Comms Module for the new address to take effect.
9. Also using this tool, you can see the complete device using the various menu items.

Figure 20 WebConfig Main Page

12. Specifications

General Specifications

Item	Specifications
Operating ambient temperature	0~+50°C (consult the factory for higher temperature operation)
Operating ambient humidity	10~90% RH (no condensation)
Vibrating resistance	5G (10~55 Hz, 0.5mm)
Impact resistance	10G
Dielectric strength	500VAC 60 Hz for 1 sec. (between external terminal and case)
Insulation resistance	10Mohm
Operating atmosphere	No corrosive gases

Protocol Performance Specifications

Item	Specification
Transmission Speed	10Mbit
Transmission Distance	100m
Transmission Media	CAT-5 Cable
Protocols	Modbus TCP

CE EMC Directive Certification

Item	Specification
Radiated Emissions	CISPR 16-2-3 Ed 4.1(2019-09)
AC Mains Conducted Emissions	CISPR 16-2-1 Ed 3.1(2017-06)
Electro-Static discharge Immunity	IEC61000-4-2 Ed 2.0(2008-12)
Radiated, Radio Frequency Electromagnetic Immunity	IEC61000-4-3 Ed 3.2(2010-04)
Electrical Fast Transcient/Burst Immunity	IEC61000-4-4 Ed 3.0(2012-04)
Immunity to Surges	IEC61000-4-5 Ed 3.1(2017-08)
Conducted, Radio Frequency Electromagnetic Immunity	IEC61000-4-6 Ed 4.0(2013-10)
Power Frequency Magnetic Field Immunity	IEC61000-4-8 Ed 2.0(2009-09)

2. MODBUS TCP Register Layout

The Process data registers are listed here in a simplified mapping format. This is meant as an additional reference to the Process Data Register section of the manual.

Register Type - Operation

400002 Control - First 16 solenoids (bitwise control)
400003 Control - Second 16 solenoids (bitwise control)
400010 Control - First Additional Module Location

300002 State - First 16 solenoids (bitwise control)
300003 State - Second 16 solenoids (bitwise control)
300010 State - First Additional Module Location

000001 Restart Comms Module (after fault reset)
000016 Reset Comms Module (clears faults)
000017 Control - Solenoid 1
000018 Control - Solenoid 2
000019 Control - Solenoid 3
000020 Control - Solenoid 4
000021 Control - Solenoid 5
000022 Control - Solenoid 6
000023 Control - Solenoid 7
000024 Control - Solenoid 8
000025 Control - Solenoid 9
000026 Control - Solenoid 10
000027 Control - Solenoid 11
000028 Control - Solenoid 12
000029 Control - Solenoid 13
000030 Control - Solenoid 14
000031 Control - Solenoid 15
000032 Control - Solenoid 16
000033 Control - Solenoid 17
000034 Control - Solenoid 18
000035 Control - Solenoid 19
000036 Control - Solenoid 20
000037 Control - Solenoid 21
000038 Control - Solenoid 22
000039 Control - Solenoid 23
000040 Control - Solenoid 24
000041 Control - Solenoid 25
000042 Control - Solenoid 26
000043 Control - Solenoid 27
000044 Control - Solenoid 28
000045 Control - Solenoid 29

000046 Control - Solenoid 30
000047 Control - Solenoid 31
000048 Control - Solenoid 32

100017 State - Solenoid 1
100018 State - Solenoid 2
100019 State - Solenoid 3
100020 State - Solenoid 4
100021 State - Solenoid 5
100022 State - Solenoid 6
100023 State - Solenoid 7
100024 State - Solenoid 8
100025 State - Solenoid 9
100026 State - Solenoid 10
100027 State - Solenoid 11
100028 State - Solenoid 12
100029 State - Solenoid 13
100030 State - Solenoid 14
100031 State - Solenoid 15
100032 State - Solenoid 16
100033 State - Solenoid 17
100034 State - Solenoid 18
100035 State - Solenoid 19
100036 State - Solenoid 20
100037 State - Solenoid 21
100038 State - Solenoid 22
100039 State - Solenoid 23
100040 State - Solenoid 24
100041 State - Solenoid 25
100042 State - Solenoid 26
100043 State - Solenoid 27
100044 State - Solenoid 28
100045 State - Solenoid 29
100046 State - Solenoid 30
100047 State - Solenoid 31
100048 State - Solenoid 32

3. Troubleshooting Guide

In the event of difficulties in either operation or installation of the MI/O-67, there are number of fault detection tools available. Along with the short/open detection mentioned above, each module has groups of LEDs which can help to get the manifold online in the event of problems.

A. Comms Module

Below the ports, there are four LEDs. In addition to the four LEDs near the communications connectors, there are three more LEDs along the top of the Comms Module for further diagnostics.

For NS (Network Status):

State	Description
Off	No Power, No controller connection
Green	Online, 1 or more connections established
Green 1 Flash	Online, controller in STOP state
Green 3 Flashes	Identify flashing with slave
Green, Con Flashes	Connection established, controller in STOP state
Red	Fatal Error
Red 1 Flash	Station name error
Red 2 Flashes	IP address error, address not set
Red 3 Flashes	Configuration error, expected ID differs from Real ID

For MS (Module Status):

State	Description
Off	No power or module in SETUP or INIT state
Green	Controlled by a scanner in run mode
Green 1 Flash	Diagnostic event present
Green Con Flashes	Slave ID
Red	Fatal Error

For LS (Link/Activity)

State	Description
Off	No Link/No Activity
Green	Link established, 100mb
Green Flickering	Activity, 100mb
Yellow	Link established, 10mb
Yellow Flickering	Activity, 10mb

For Power:

State	Description
Off	No Power
Green	Power OK

For Comm (Backplane Communications):

State	Description
Off	No power
Green	OK
Green Flashing	Not configured or scanner in idle mode
Red	Fatal Error
Red Flashing	Recoverable fault

For Stat (Backplane Status)

State	Description
Off	No Link/No Activity
Green	Run Mode
Green Flashing	Standby Mode

B. Digital I/O Module

Leds on top right of module

Com Led-- Red: (CANopen Status, Error Led)

State	Description
Off	No error
Single Flash	Warning limit reached (error passive)
Flickering	LSS Config Mode
On	Bus Off/fatal error
Double Flash	Heartbeat timeout error

Com Led-- Green: (CANopen Status, Run Led)

State	Description
Single Flash	CANopen stopped state
Flickering	LSS Config Mode
On	CANopen operational state
Blinking	CANopen pre-operational state

PWR Led:

State	Description
Green	Power/Application loaded
Green w/Red Single Flash	IO Comm failure
Flickering between Green and Red	Dip switch state changed
Red	Fatal error in application

IO Led near each M12 connector, 2 ea.:

Input Mode

State	Description

Green	NPN-connection is sinking current, PNP-connection is sourcing current.
Red	Fault on channel
Off	Channel off

Output Mode

Green	Output on
Red	Fault on channel
Off	Channel off

During start up, PWR, IO, and Com Leds will be 0.25sec Green, 0.25sec Red.

C. Power Plus Module

Leds on top right of module

Com Led-- Red: (CANopen Status, Error Led)

State	Description
Off	No error
Single Flash	Warning limit reached (error passive)
Flickering	LSS Config Mode
On	Bus Off/fatal error
Double Flash	Heartbeat timeout error

Com Led-- Green: (CANopen Status, Run Led)

State	Description
Single Flash	CANopen stopped state
Flickering	LSS Config Mode
On	CANopen operational state
Blinking	CANopen pre-operational state

PWR Led:

State	Description
Green	Power/Application loaded
Green w/Red	
Single Flash	IO Comm failure
Flickering between	
Green and Red	Dip switch state changed
Red	Fatal error in application

Output Led near each M12 connector, 2 ea:

State	Description
Green	Output on
Red	Fault (output power not present)
Off	Output off

During start up, PWR, Output, and Com Leds will be 0.25sec Green, 0.25sec Red.

D. Analog I/O Module (Voltage and Current)

Leds on top right of module

Com Led-- Red: (CANopen Status, Error Led)

State	Description
Off	No error
Single Flash	Warning limit reached (error passive)
Flickering	LSS Config Mode
On	Bus Off/fatal error
Double Flash	Heartbeat timeout error

Com Led-- Green: (CANopen Status, Run Led)

State	Description
Single Flash	CANopen stopped state
Flickering	LSS Config Mode
On	CANopen operational state
Blinking	CANopen pre-operational state

PWR Led:

State	Description
Green	Power/Application loaded
Green w/Red Single Flash	IO Comm failure
Flickering between Green and Red	Dip switch state changed
Red	Fatal error in application

During start up, PWR, IO, and Com Leds will be 0.25sec Green, 0.25sec Red.

4. Troubleshooting Chart

Fault	**Description**
Do valves operate?	
No	Check power to Comms Module
	Check network wiring
	Check network indicator LEDs on Comms Module
	Check network IP Address and Configuration
	Check for correct Bytes to operate valves in PLC Output Table
Do modules operate?	
No	Check configuration in PLC
	If using a Digital I/O Module, check dipswitches on module
	If using a Power Plus Module, check external power
	Check all module for wiring (sensors, loads, etc)
Are you getting faults on Comms Module?	Check the Open Load Diagnostics in PLC and valve set up
Is unit coming online in the PLC network?	
No	Check the IP address and whether the EDS file is loaded

Warning:

Under no circumstances are MAC Valves to be used in any application or system where failure of the valves or related components to operate as intended could result in injury to the operator or any other person.

- Do not operate outside of prescribed pressure or temperature ranges.
- Air supply must be clean. Contamination of valve can affect proper operation.
- Before attempting to perform any service on valve, consult catalog, P & O sheet, or factory for proper maintenance procedures. Never attempt service with air pressure to valve.
- If air line lubrication is used, consult catalog, P & O sheet, or factory for recommended lubricants.
- Before interfacing the product to any bus or serial system, consult the controller and bus manuals for proper usage.