

SENSIDYNE®

Industrial Health & Safety Instrumentation

INSTRUCTION MANUAL

MODEL 7100 Plus – 8/16 CHANNEL CONTROLLER

Document No. 360-0264-01 • Revision A



Warning: Read & understand contents of this manual prior to operation. Failure to do so could result in serious injury or death.

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Chapter 1 Safety Information

1.1 Safety Information – Read Before Installation and Applying Power

The following symbols are used in this manual to alert the user of important instrument operating issues:



This symbol is intended to alert the user to the presence of important operating and maintenance (servicing) instructions.



This symbol is intended to alert the user to the presence of dangerous voltage within the instrument enclosure that may be sufficient magnitude to constitute a risk of electric shock.

WARNINGS:

- **WARNING- EXPLOSION HAZARD** - DO NOT REPLACE FUSE UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS KNOWN TO BE NON-HAZARDOUS.
- **WARNING- EXPLOSION HAZARD** - DO NOT DISCONNECT EQUIPMENT UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS KNOWN TO BE NON-HAZARDOUS.
- **Shock Hazard** - Disconnect or turn off power before servicing this instrument.
- Use a properly rated CERTIFIED AC power (mains) cable installed as per local or national codes
- A certified AC power (mains) disconnect or circuit breaker should be mounted near the controller and installed following applicable local and national codes. If a switch is used instead of a circuit breaker, a properly rate CERTIFIED fuse or current limiter is required to be installed as per local or national codes. Markings for positions of the switch or breaker should state (I) for on and (O) for off.
- Clean only with a damp cloth without solvents.
- Equipment not used as prescribed within this manual may impair overall safety.

1.2 Contacting Sensidyne, LP

To contact Sensidyne LP, call, fax, email or write:

800-451-9444 FAX 727-539-0550 Email: info@Sensidyne.com

1000 112th Circle N., Suite 100 St. Petersburg, FL 33782

Or visit us on the Web at www.sensidyne.com

Chapter 2 General Description

The Sensidyne, LP Model 7100 Plus Controller is designed to display and control alarm events for up to 16 sensor data points. It may also be set as an 8 channel controller for applications needing fewer inputs. Three programmable standard alarms with features such as *ON* and *OFF* delays, *Alarm Acknowledge*, along with dedicated horn and fault relays make the Model 7100 Plus well suited for many multi-point monitoring applications. Data may be input to the Model 7100 Plus by optional analog inputs or via the multiple communication ports. These communication ports are programmable so the controller can be configured with multiple Master or Slave configurations. With a Modbus® RTU *slave* RS-485 port configured, sending data to PCs, PLCs, DCSs, or even other Model 7100 Plus Controllers is available. The Ethernet port allows the unit to be a Modbus®TCP *Master and Slave* and also provides access to the embedded webpage. Options such as analog I/O and discrete relays for each alarm are easily added to the addressable I²C bus. Option boards have 8 channels and therefore require multiple boards for 16 channel applications.

In addition to traditional analog and serial methods of providing monitored values, the Model 7100 Plus is also capable of sending and receiving wireless data.

A color 320 x 240 pixel graphic LCD readout displays monitored data as bar graphs, trends and engineering units. System configuration is through user friendly menus or via the internal webpage that can be accessed through the standard Ethernet connection. All configuration data is retained in non-volatile memory during power interruptions, and can also be backed up and loaded using the SD card located on the display.

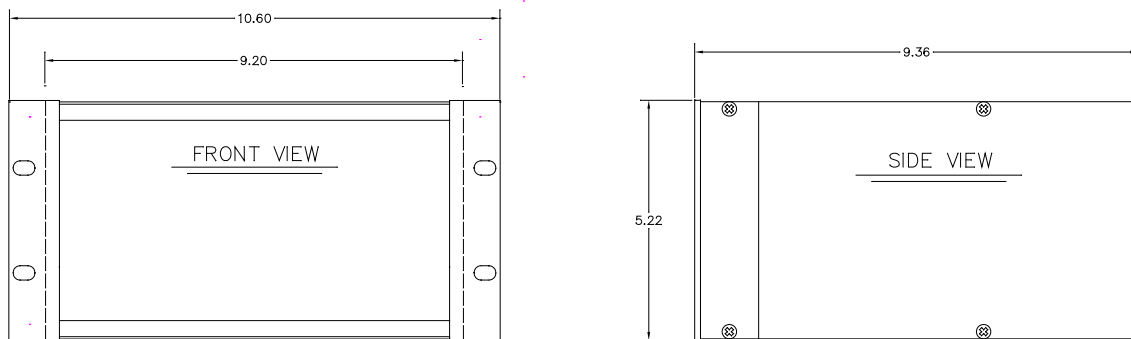


Chapter 3 Installation Instructions

3.1 Mounting the Enclosure

3.1.1 Panel/Rack Mount Enclosure

The 19" Panel/Rack enclosure is supplied with hardware that allows mounting in either a full width 19" rack style cabinet or it may be panel mounted in a rectangular cutout. Only two 8 channel I/O option PCB's such as analog input or discrete relays may be mounted directly to the back of the enclosure. Additional 8 channel I/O option PCB's must be located external from the assembly on another mounting plate. A 3 foot length of I²C cable is also supplied for this purpose. Weight is approximately 7 pounds. Properly ground the enclosure and follow national and local electrical codes.



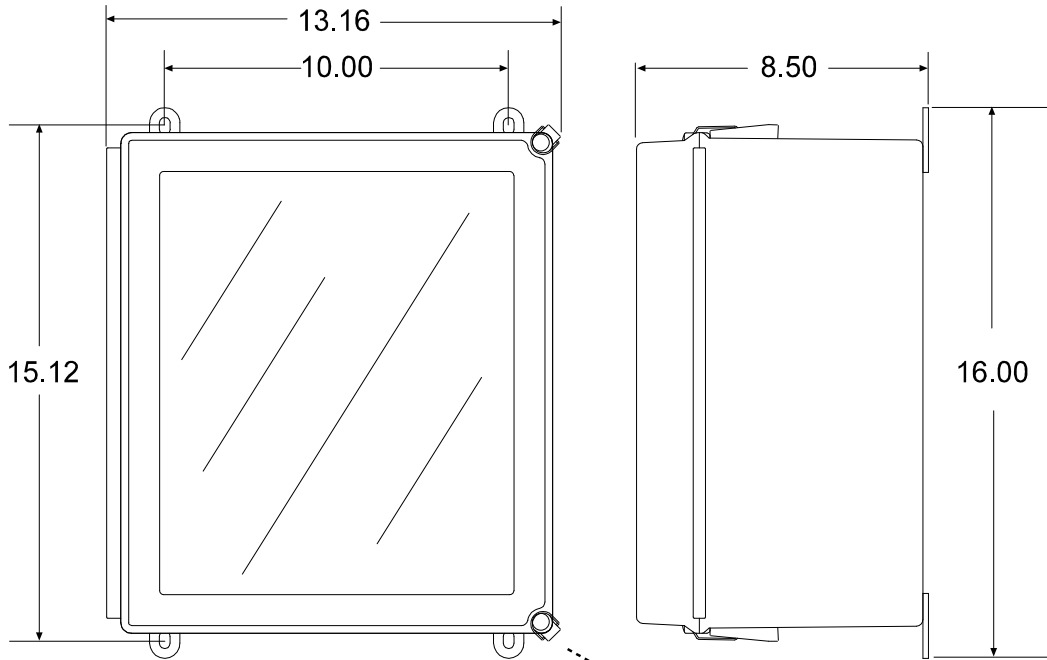
RACK / PANEL MOUNT
(19" rack spreader plates &
panel not shown)

Figure 1 Panel/Rack Mount Dimensions

3.1.2 NEMA 4X Wall Mount Fiberglass Enclosure

The NEMA 4X wall mount fiberglass enclosure is suitable for mounting outdoors but an above mounted weather deflector shield is recommended. Weight is approximately 17 pounds. Important Conduit entries are not provided so installers may place entries as needed. Bottom or lower side areas are recommended. Care must be taken to avoid drilling into circuit boards

mounted inside the enclosure. Properly ground the enclosure and follow national and local electrical codes.



Note: 4 mounting holes are .31 diameter

SHOCK HAZARD

ADD LOCKING DEVICE TO CLASP ON BOTTOM RIGHT SIDE TO PREVENT CONTACT WITH DANGEROUS VOLTAGES. REMOVE AC POWER BEFORE SERVICING EQUIPMENT.



NEMA 4X WALL MOUNT

Figure 2 NEMA 4X Wall Mount Fiberglass Enclosure



GROUNDING OF EQUIPMENT AND CONDUIT

Ground in accordance with the requirements of the National Electrical Code.

Conduit hubs for metallic conduit must have a grounding bushing attached to the hub on the inside of the enclosure. Grounding bushings have provisions for connection of a grounding wire. Non-metallic conduit and hubs require the use of a grounding wire in the conduit. Grounding bushings are not required.

System grounding is provided by connection wires from all conduit entries to the subpanel or to other suitable point which provides continuity. Any device having a metal portion or portions extending out of the enclosure must also be properly grounded.

TYPICAL GROUNDING ILLUSTRATIONS METALLIC CONDUIT NON-METALLIC CONDUIT

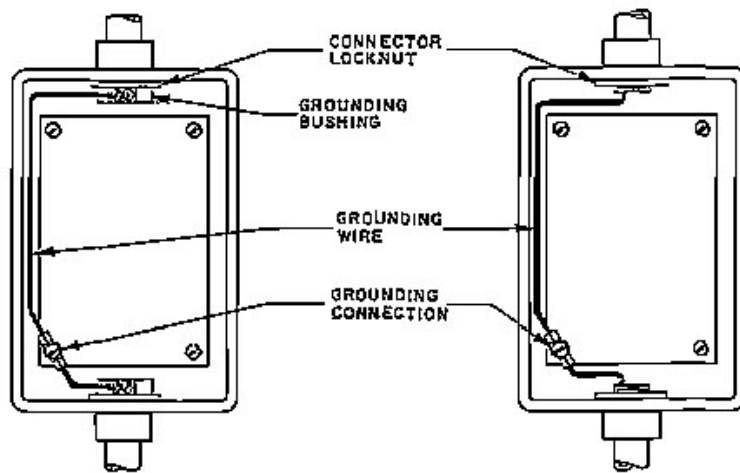


Figure 3 Grounding Instructions for Non-metallic Enclosures

3.1.3 Model 7100 Plus Main I/O and Option Board Enclosure Capacities

- 820-0110-01 Standard NEMA 4X Fiberglass Wall Mount
 - 2 Option Boards
 - Expansion Plate adds up to 4 Option Boards
- 820-0110-02 Standard 316 Stainless Steel Wall Mount
 - 2 Option Boards
 - Expansion Plate adds up to 4 Option Boards
- 820-0110-03 Cast Aluminum Wall Mount
 - 4 Option Boards
 - Expansion Plate adds up to 3 Option Boards
- 820-0110-04 Full 19" Rack Mount (one Model 7100 Plus)

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- 4 Option Boards
- Expansion Plate adds up to 6 Option Boards
- 820-0110-05 Half Width 19" Rack/Panel Mount
 - 1 Option Board

3.2 Power and Analog Outputs Wiring



WARNING: Qualified personnel should perform the installation according to applicable electrical codes, regulations and safety standards. Ensure correct cabling and sealing fitting practices are implemented. Do not aim the sensor pointing upward.

3.2.1 DC Power Supply

Standard Model 7100 Plus power requirements are 10-30VDC @ 12 watts applied to terminals 1 & 3(+) and 5 & 7(-) of TB4 on the standard I/O Board. Optional features increase power consumption as described below:

1. Discrete Relay Board option; add 3.5 watts per board (assumes all 8 relays are energized).
2. Programmable Relay Board option; add 3.5 watts per board (assumes all 8 relays are energized).
3. Analog Input Board option; add 1/2 watts per board plus transmitter power consumption.
4. 4-20mA Output Board option; add 2.5 watts per board.
5. Bridge Sensor Input Board option; add 3 watts max per board with four 10-0192 modules installed (power consumption of the sensors not included).
6. Auxiliary Standard Relay Board option; add 2.5 watts.
7. Isolated Serial Expansion Board; add 1.5 watts.
8. TB4 terminals 2, 4, 6 & 8 of the standard I/O Board provide a maximum of 500mA fused output power for powering of auxiliary external devices such as relays, lamps or transmitters. Power consumed from these terminals should be considered when calculating system power consumption.

3.2.2 AC Power Supply

Optional AC power supplies are available for applications requiring local AC power connections. When installed at the factory, the 24VDC output will be wired to the Main I/O and to any connected optional I/O boards.

3.2.2.1 *Optional 150 Watt 110-240VAC – 24VDC Power Supply*

3.2.2.1.1 299-0203-01 150 Watt Power Supply

The Model 7100 Plus Controller may be powered from 10-30VDC. However, many applications require 24VDC power for the monitors or transmitters providing inputs to the Model 7100 Plus. A 150 watt AC / DC power supply may be included for these applications (115VAC or 230 VAC selected via slide switch). When ordered from the factory, it is pre-wired to provide 24VDC primary power for the Model 7100 Plus controller as well as any transmitters or monitors that may be connected by the end user.

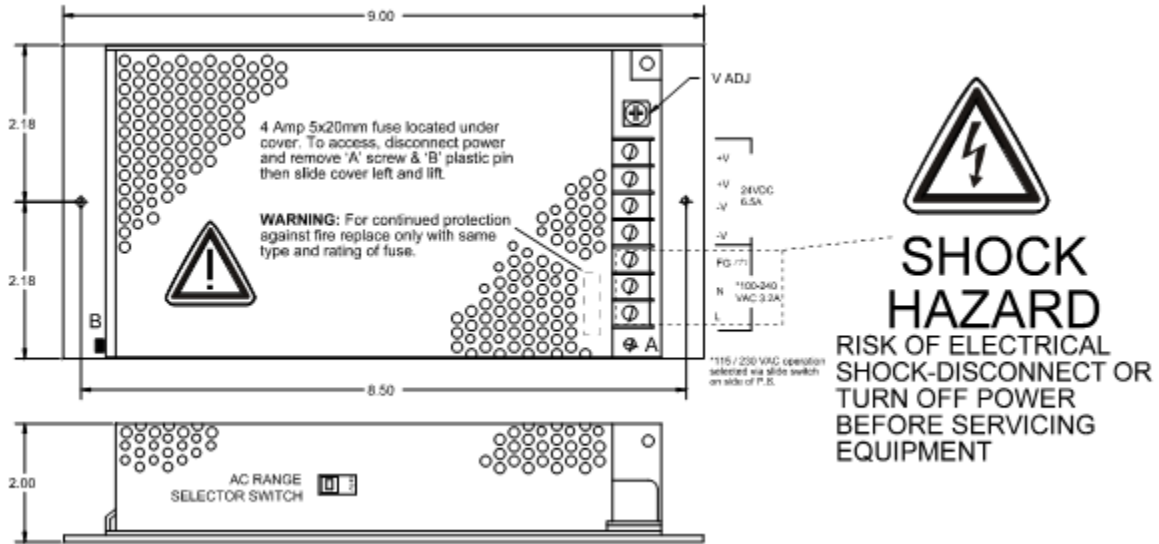


Figure 4 Optional 299-0203-01 150W 24VDC Power Supply Dimensions

3.2.2.1.2 299-0203-01 150 Watt Power Supply

The Model 7100 Plus Controller may be powered from 10-30VDC. However, many applications require 24VDC power for the monitors or transmitters providing inputs to the Model 7100 Plus. A 150 watt AC / DC power supply may be included for these applications (100-240 VAC auto-ranging). When ordered from the factory, it is pre-wired to provide 24VDC primary power for the Model 7100 Plus controller as well as any transmitters or monitors that may be connected by the end user.

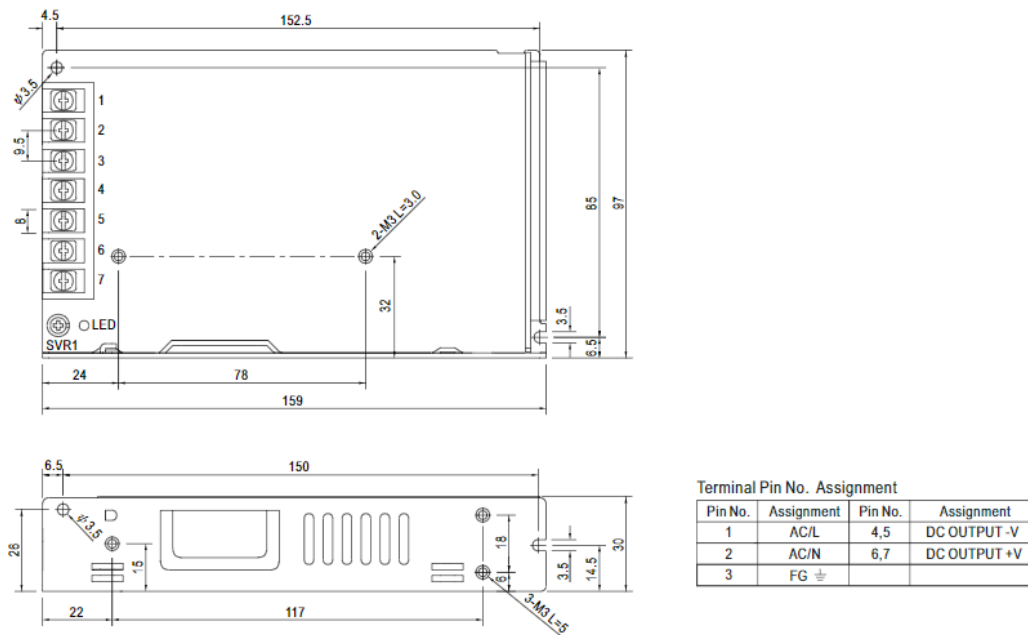


Figure 5 Optional 299-0204-01 150W 24VDC Power Supply Dimensions

3.2.2.2 Optional 600 Watt 110-240VAC – 24VDC Power Supply

The Model 7100 Plus Controller may be powered from 10-30VDC. However, many applications require 24VDC power for the monitors or transmitters providing inputs to the Model 7100 Plus. A 600 watt AC / DC power supply may be included for these applications (115VAC or 230VAC). When ordered from the factory, it is pre-wired to provide 24VDC primary power for the Model 7100 Plus controller as well as any transmitters or monitors that may be connected by the end user.

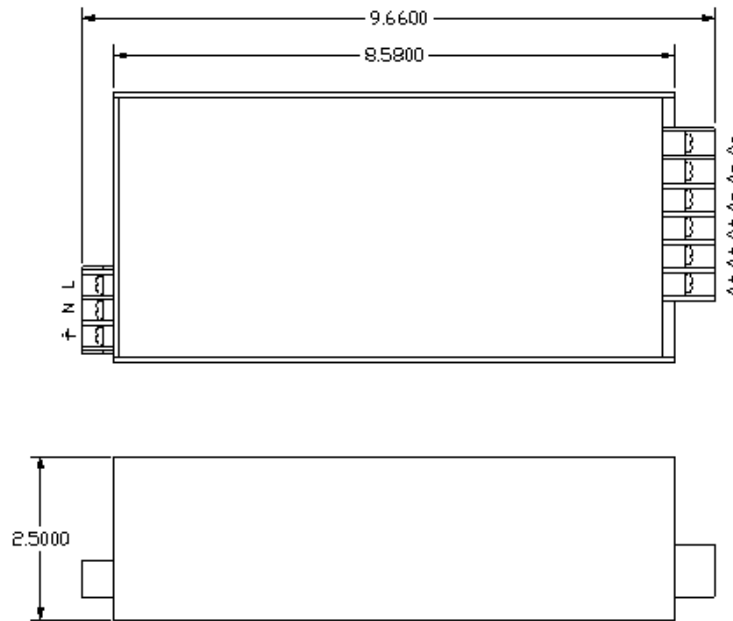


Figure 6 Optional 600W 24VDC Power Supply Dimensions

3.2.3 CPU and Main I/O

Standard Model 7100 Plus power requirements are 10-30VDC @ 12 watts applied to terminals 1 & 3(+) and 5 & 7(-) of TB4 on the standard I/O Board. Recommended cable size is 16AWG.

TB4 terminals 2, 4, 6 & 8 of the standard I/O Board provide a maximum of 500mA fused output power for powering of auxiliary external devices such as relays, lamps or transmitters. Power consumed from these terminals should be considered when calculating system power consumption. The CPU board is powered via a ribbon cable connected to the Main I/O.

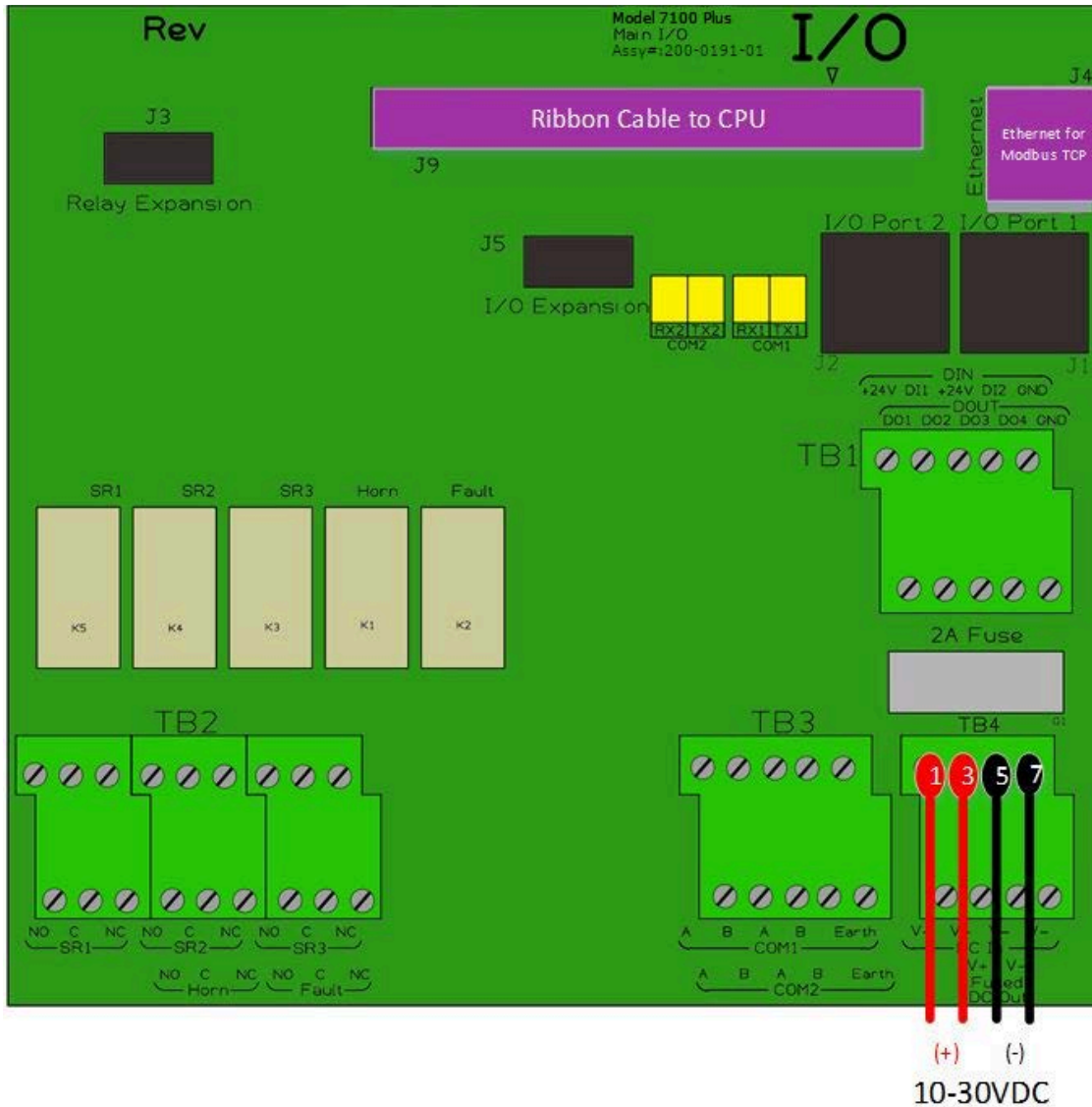


Figure 7 Model 7100 Plus Main I/O Power Wiring Diagram

3.2.4 Option Board Power

Recommended cabling for 24VDC power supply to all option boards is 16AWG. Power must be supplied to each option board on TB3 or TB4, and can either be supplied from the DC out terminals on the Main I/O Board (TB4 terminals 2, 4, 6 and 8), or directly from the optional 150 or 600Watt optional power supply.

The two terminals (TB3 and TB4) are provided on each option board to allow for daisy changing of power from one option board to the next without having to run individual sets of wires for every option board back to the power supply.

3.3 Standard I/O Wiring

Recommended cabling for 24VDC power supply to all option boards is 16AWG. Power must be supplied to each option board on TB3 or TB4, and can either be supplied from the DC out terminals on the Main I/O Board (TB4 terminals 2, 4, 6 and 8), or directly from the optional 150 or 600Watt power supply.

Recommended cabling for RS-485 communications is 24-18AWG (shielded or unshielded) twisted pair. Multiple devices may be connected on a single RS-485 loop using unique remote IDs. When connecting devices in series, be sure that terminating resistors are removed from all but the final device on the communication loop.

Option boards communicate to the CPU is through I²C connection from J3, or J4, back to the Main I/O I²C ports (J1 or J2). Two ports are provided on each board to allow for daisy chaining of board back to the single connector on the Main I/O.

3.3.1 Common Relays

The Common Relays are found on the Main I/O. There are 3 standard relays, a dedicated Horn Relay, and a dedicated Fault relays. All relays are 5 Amp Single Pole Double Throw (SPDT) relays, and are rated at 5 Amps for 28VDC and 250~VAC Resistive Loads.



IMPORTANT: Appropriate diode (DC loads) or MOV (AC loads) snubber devices must be installed with inductive loads to prevent RFI noise spikes. Relay wiring should be kept separate from low level signal wiring.

Terminals for the Common Relays are found on TB2. The upper row of terminals are for the 3 Standard Relays, and the Horn and Fault Relay Terminals can be found on the right side of the bottom terminals.

Relay terminals are labeled NO for the Normally Open terminal, C for the Closed terminal and NC for the Normally Closed Terminal. The NO and NC nomenclature comes from the normal state of the relay (de-energized state). The Fault Relay (and standard relays when placed in Failsafe Mode) is normally in the energized state, and becomes de-energized when the Fault (alarm) condition is reached.

Only two wires are needed for wiring of relays. A typical wiring would have power wired to the C terminal, and the NO and C terminals wired to the alarm device. Under normal operations the circuit between the two terminals is open. When the alarm state is reached, the NO contact closes, and completes the circuit, energizing the alarm device.

When a Standard Relay is configured for Failsafe Mode (or the Fault Relay), the alarm condition is used to de-energize a device such as a Green Steady Light (all clear). In this case, the light is wired to the C and NO terminals, and Power is wired to the C terminal just as described previously. However, since the relay is in Failsafe mode, the circuit is complete, and the device is powered. When the alarm (fault) state is reached, the relay de-energizes, and the light turns off. This is very useful for indicating a loss of power to the Model 7100 Plus.

When powering multiple devices with the same voltage requirements, placing wires across the C terminals of the relays with common load requirements can simplify wiring.

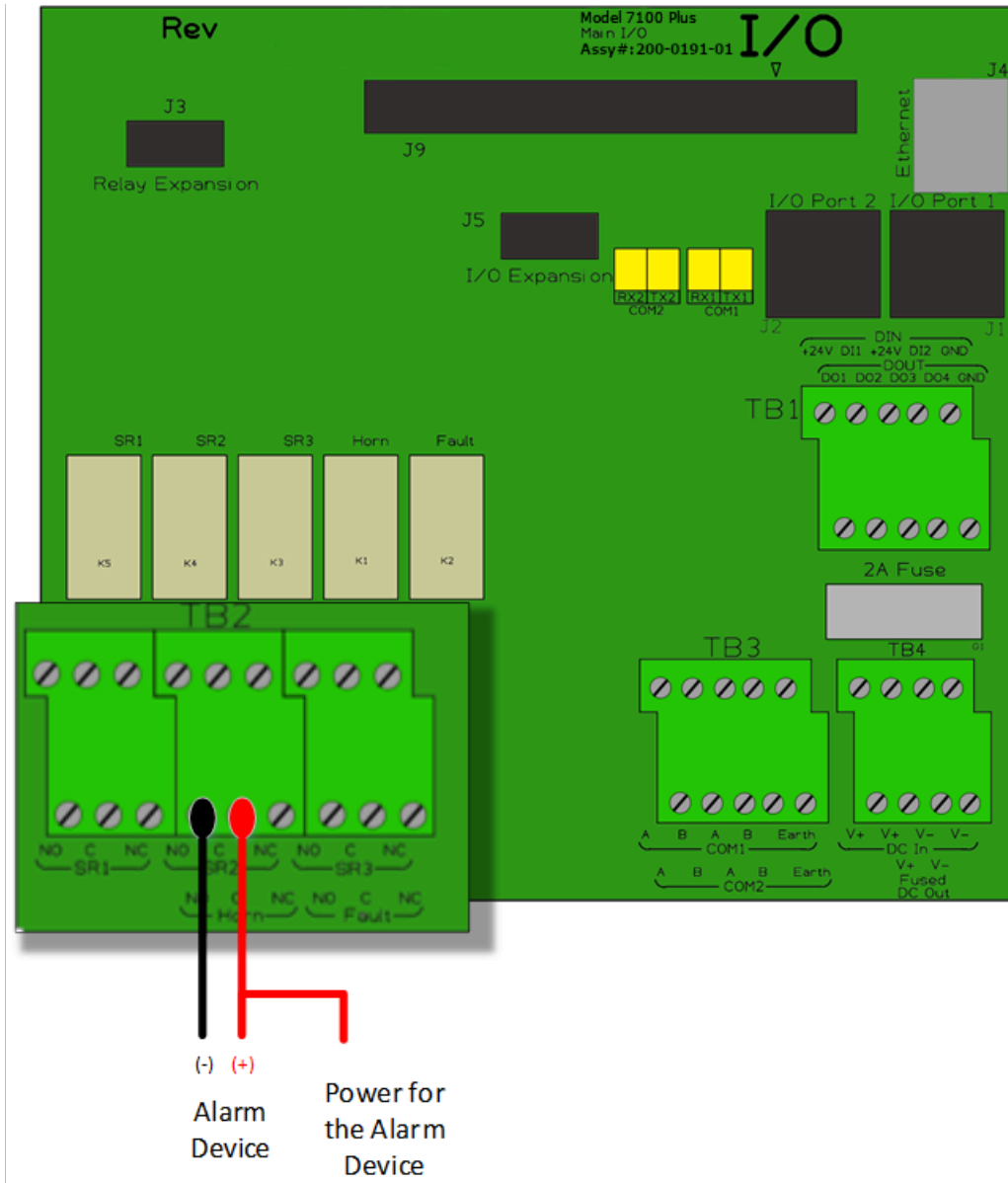


Figure 8 Common Relay Wiring

3.3.2 RS-485 Modbus®

Recommended cabling for RS-485 communications is 24-18AWG shielded twisted pair. Multiple devices may be connected on a single RS-485 loop using unique remote IDs. When connecting devices in series, be sure that terminating resistors are removed from all but the final device on the communication loop.

Power for connected RS-485 may be drawn from TB4 terminals 2, 4, 6 & 8 of the standard I/O Board. These terminals provide a maximum of 500mA fused output power for powering of auxiliary external devices such as relays, lamps or transmitters. Power consumed from these terminals should be considered when calculating system power consumption. The CPU board is powered via a ribbon cable connected to the Main I/O.

Communication Port 1 (COM1) and Communication Port 2 (COM 2) are both found on terminal TB3. To simplify 2-wire daisy chains by providing additional terminals for cable connections, terminals 1 and 5 (2 and 6) are tied together on TB3 as well as terminals 3 and 7 (4 and 8) of COM 1 (COM 2).

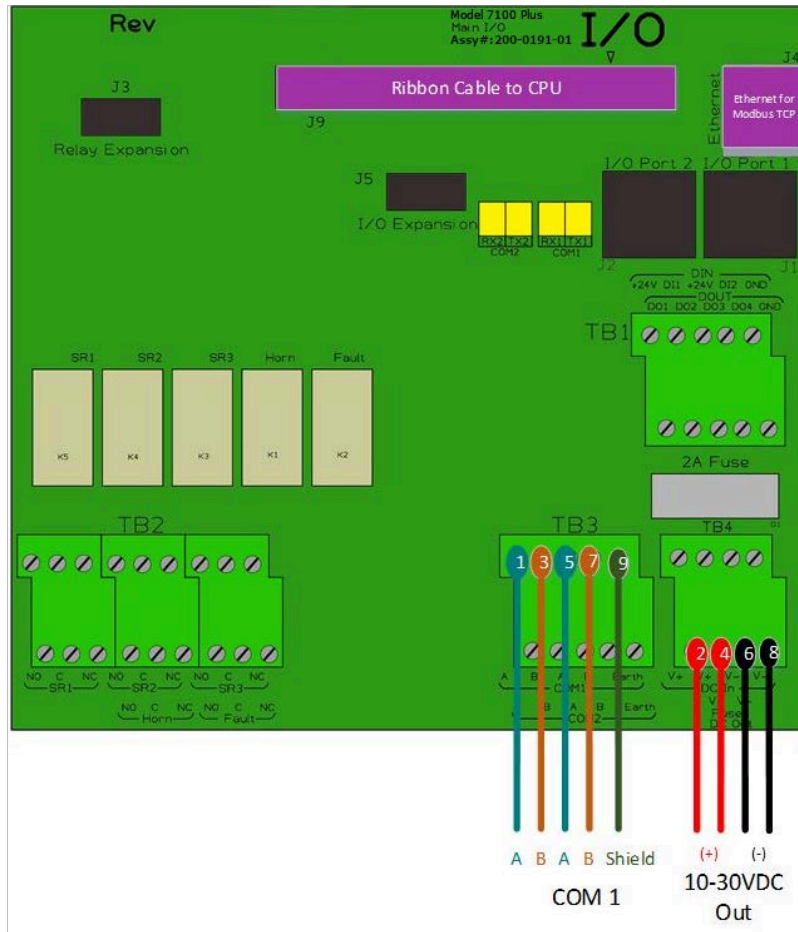


Figure 9 RS-485 Modbus® Wiring Diagram

3.3.3 Modbus® TCP

A shielded Ethernet Cable should be used to connect the Model 7100 Plus to the network as described below through the Ethernet port on the Main I/O (J4 Ethernet Port).

3.3.3.1 Direct Connection with Crossover Cable or Hub/Switch

If a network is not available, or if it is desired to keep the Model 7100 Plus and PC(s) completely separated from other computers, a simple network can be created.

The simplest network can be created by connecting the Model 7100 Plus to a PC directly using an Ethernet crossover cable. Many modern computers have automatic detection/switching on the port. In most cases a normal patch cable can directly connect the Model 7100 Plus to a PC.

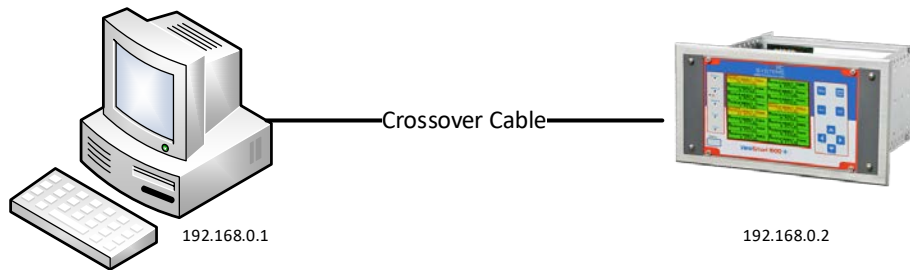


Figure 10 Modbus® TCP Direct Connection using a Crossover Cable

If a crossover cable is not available, or if multiple computers need access to the Model 7100 Plus, a switch can be connected to the Model 7100 Plus and one or more computers using standard patch cables.

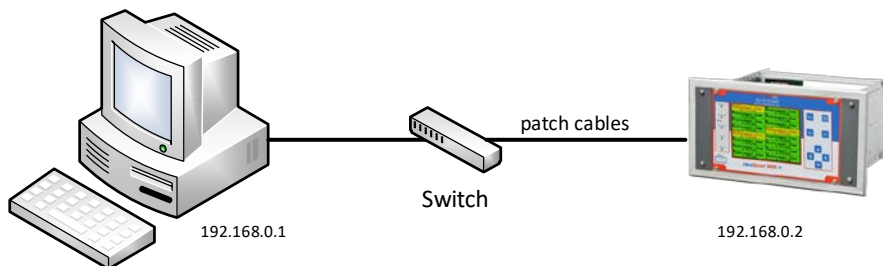


Figure 11 Modbus® TCP Direct Connection using a Hub or Switch

These simple networks will not likely have access to a DHCP server. In this case, if the Model 7100 Plus is configured for DHCP, it will automatically select an IP address on the subnet 169.254.x.x. This subnet uses a netmask of 255.255.0.0 and is compatible with the default IP addresses chosen by Microsoft Windows. If connecting to a new Model 7100 Plus with firmware version 2.12 or later, no configuration changes will be needed to connect a PC. Simply connect the PC with a patch cable. Then view the Model 7100 Plus 'Communication Settings'-'>'Network Settings' menu. The IP address field will show a value which can be entered into the web browser to view the webpage.

The recommended option for a permanent network is to setup a static IP on the Model 7100 Plus and any other devices (or computers) on the network. [See section 10.4.](#)

3.3.3.2 Connecting to an Existing Local Area Network (LAN)

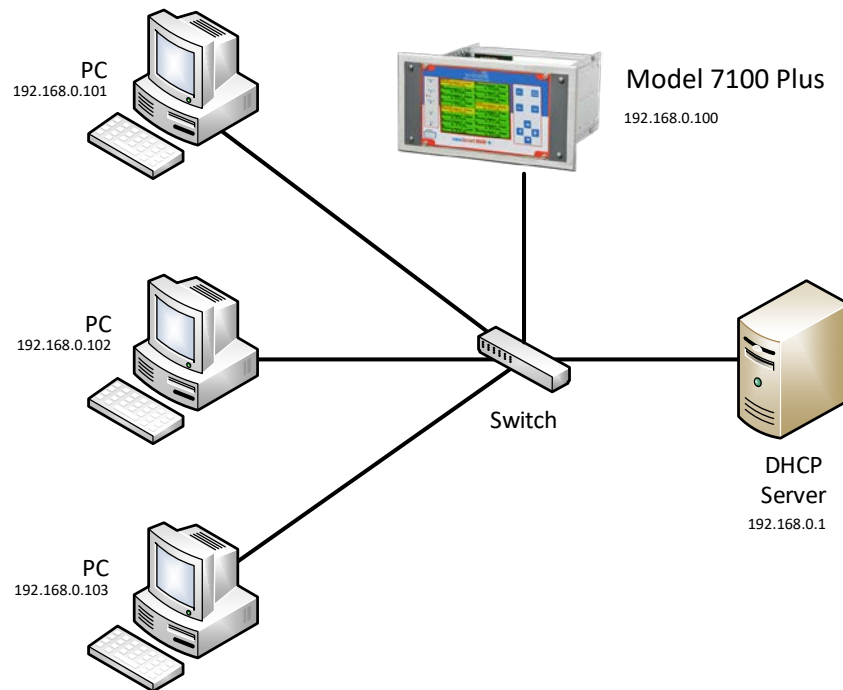


Figure 12 Modbus® TCP Connection over a Local Area Network

A typical network will have a DHCP server, a switch (sometimes combined) and several devices connected to that switch. A Model 7100 Plus can normally be added to such a network simply by connecting the Ethernet port to the switch using an Ethernet patch cable. The Model 7100 Plus's default settings will allow it obtain an IP address from the DHCP server. Once this happens, the Model 7100 Plus can be accessed from computers and other devices on the network. Computers access the Model 7100 Plus by hostname, or by IP address.

If more than one Model 7100 Plus is on the network, and if they need to communicate with each other, it is recommended to use a static IP configuration ([see section 10.4](#)). This is because there is a possibility that a dynamic address will be changed by the DHCP server. If the IP address is changed, communication will fail. Static configuration is necessary when using Modbus® TCP master or Mimic mode over TCP/IP.

If accessing the Model 7100 Plus from a computer or other device that can resolve its hostname, dynamic configuration is fine.

3.3.3.3 Connecting to an Isolated Network

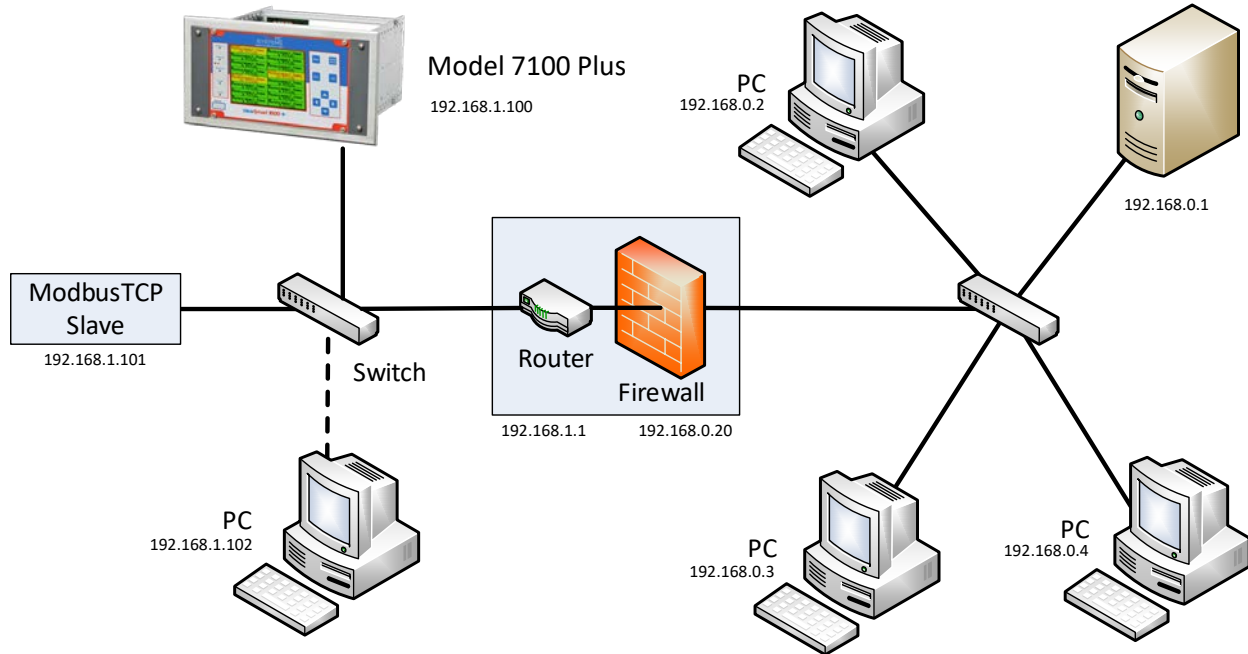


Figure 13 Modbus® TCP Connection over an Isolate Network

Another possible network configuration for the Model 7100 Plus involves connecting the controller, with Modbus®TCP slave devices, and possibly computers on a network. This network can then be isolated from a larger company network using a router/firewall. The isolated network will not see any traffic from the company network unless port forwarding rules are setup in the router. This configuration offers greater security and improved network performance when the company network has a large amount of traffic.

When creating an isolated network, make sure to use a different private IP address range than the outside network. For example; if the main network uses 192.168.0.0 – 192.168.0.255 with a netmask of 255.255.255.0, the isolated network could use 192.168.1.0 – 192.168.1.255 with the same netmask.

Port forwarding rules can usually be configured to only allow certain computers outside the firewall access to the Model 7100 Plus. The method for creating forwarding rules is heavily dependent on the router/firewall being used. See router documentation. The IP address or MAC address of the source (outside computer), Incoming port, destination (Model 7100 Plus) IP address, destination port, and protocol will need to be set. The source IP address should be set to allow a range or single IP Address. Some firewalls can restrict access by MAC address. This can be used instead of or in addition to the source IP address. The protocols for forwarding rules should be TCP/IP. The destination ports should be 80 for access to the web server, and 502 for access to Modbus®TCP.

In most cases, a router and firewall will separate the network from the internet. It is not recommended to forward ports from the internet to a Model 7100 Plus. In cases where offsite access is needed, a VPN or tunnel connection could be used to get inside the network.

3.4 Option Board Wiring

10-30VDC must be applied to TB3 or TB4 of all optional I/O boards.

Option boards are powered from 10-30VDC. TB4 terminals 2, 4, 6 & 8 of the standard I/O Board provide a maximum of 500mA fused output power for powering of auxiliary external devices such as relays, lamps or transmitters. If additional power is required, option boards may be powered directly from the optional 150W or 600W power supply.

3.4.1 Analog Input Option



In compliance with CSA C22.2 No. 152 certification, the 4-20mA input does not include or imply approval of the LEL gas detection apparatus such as sensors, transmitters, or devices connected to the system. In order to maintain CSA Certification of the system, all the 4-20mA gas detection instruments connected to the input must also be CSA Certified.

Many transmitters or sensors have analog output signals and the 12 bit *Analog Input* Board, shown below, is available to accept these. TB1 and TB2, 12 positions each, offer 3 terminals per channel for distributing power and receiving analog inputs. These are EXC and HI / LO inputs.

When the transmitters are hi power three wire units it is recommended this power be supplied to each option board with its own pair of wires connected directly to the DC power supply.

Precision 150 ohm 5 watt resistors (R1 – R16) between each channel's IN LO and IN HI terminals are termination resistors for 4-20mA inputs.

EXC and LO terminals are bussed together internally. EXC terminals are tied directly to TB3 and TB4 +24 VDC and LO terminals are tied to TB3 and TB4 power supply common. Bussing allows transmitter power to be brought into the system at a single point (TB3 or TB4) and distributed back out at each channel's EXC/LO terminals to simplify field wiring. The below figure includes typical wiring to 2 and 3 wire 4-20mA transmitters.

For configuration and setup instructions refer to Chapter 4.3.1.

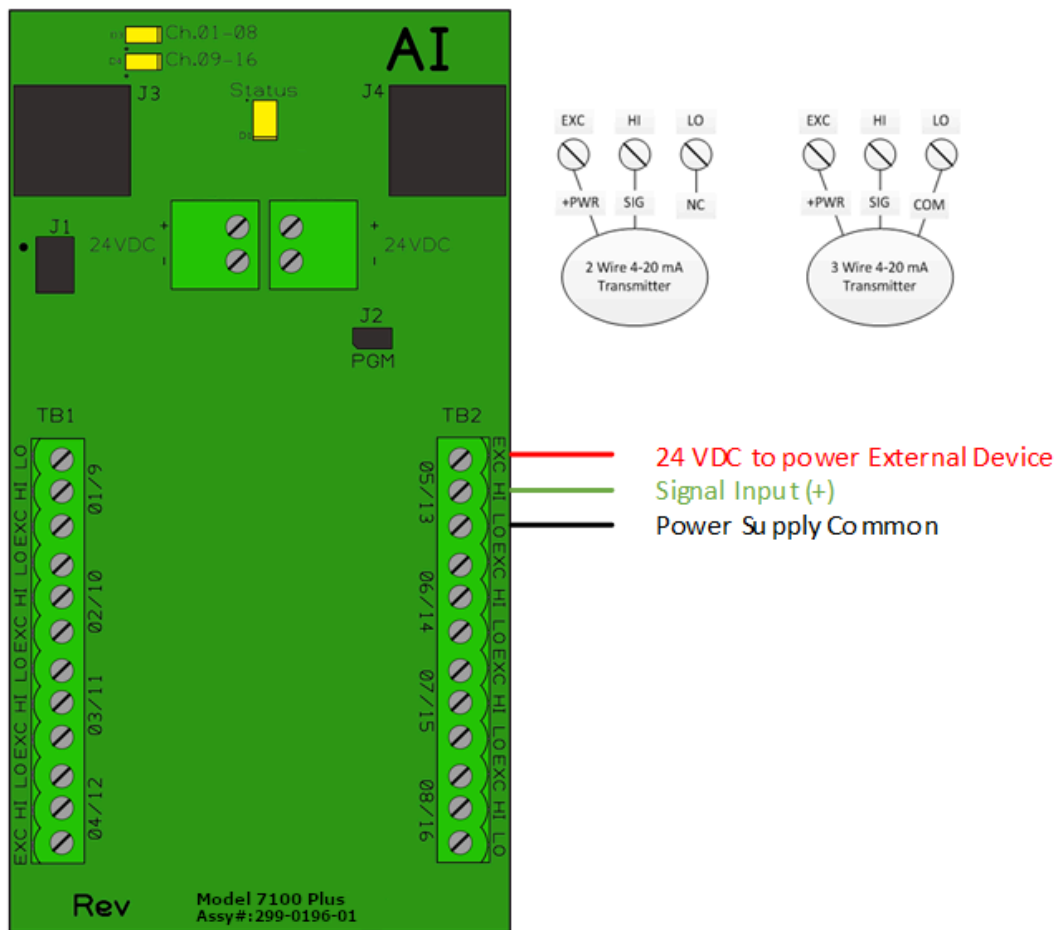


Figure 14 Analog Input Option Wiring Diagram

This option may also be configured to accept 4-20mA inputs for mixing bridge sensors and current loops into the same board. Placing any channel's 2 position Bridge/4-20mA jumper into 4-20mA position and installing the associated precision 100 ohm socketed resistor allows 4-20mA signals to be applied to its C & A terminals. The 10-0192 sensor modules are not required for channels accepting 4-20mA.

After performing the one time only *Bridge Sensor Input Board Initial Setup* as described below, all subsequent calibrations are by the Model 7100 Plus's electronic Cal Mode menus.

After initial setup, configuration setting of a channel for a bridge input can be found in Chapter 4.3.2.

*Catalytic sensors connected directly to the Model 7100 Plus should be limited to ranges of 0-1000ppm.

3.4.1.1 Bridge Sensor Input Board Initial Setup

Catalytic bead sensors vary widely in power requirements and sensitivity. It is therefore important to configure each channel to match the sensor with which it will operate.

Prior to connecting sensors:

1. Apply power to the system.
2. Measure the voltage between each channel's A and R terminals
3. Set the *Voltage Adjust* potentiometers for the correct sensor excitation voltage. This may range from 1.5 volts to 7.5 volts depending upon sensor specifications.



Sensors may be damaged by accidental over voltage conditions. It is recommended the *Voltage Adjust* potentiometer screws be covered by a dollop of RTV or similar material after completion of this procedure to avoid accidental over voltage conditions.

4. Remove system power
5. Connect sensor wires to the R-C-A terminals as described in the previous section.
6. Apply system power
7. Confirm correct voltage across each sensor's A & R terminals.



Note: If sensor wires are long, it may be necessary to measure the excitation voltage at the sensor end to compensate for power losses in the wiring.

8. Measure voltage at the channel's red test point, TB3 common as your common.
9. Adjust the *Balance* potentiometer for .4 volts at the test point, with zero air on that sensor.
10. Apply 50% span gas to the sensor and allow the test point voltage to stabilize.



Note: Two volts = 100% input to the A – D Converter and .4 volts = 0%. Therefore, 1.2 volts = 50%.

11. Place the 3 position *Coarse Gain* jumper into the position which reads between .8 volts and 1.2 volts on the test point with 50% gas on the sensor.



Note: Gain settings for each jumper position are as follows: no jumper = 1, LOW = 7, MED = 21, HI = 41. Multiple jumpers have an additive affect upon gain, so the LOW and MED jumpers together provide a gain of 28.

Initial setup is now complete, and normally only requires repeating if a sensor is replaced.

Final calibration of this channel may now be performed using the Model 7100 Plus's electronic Cal Mode feature described in Chapter 5.

3.4.2 Isolated RS-485 Modbus® Option

The Isolated RS-485 Modbus® Option plugs in to the I/O Expansion Connector (J5) on the Main I/O board. Adding this option provides two additional communication ports, which are wired in a similar fashion to the Standard Communication Ports as described in Chapter 3.3.3. Setup for these Comm Ports (Comm Port 3 and 4) is identical to the Standard Communication Ports, which can be found in Chapter 4.2.1.

3.4.3 Relay Options

The Programmable and Discrete relay options add 8 relays per board. The Auxiliary Relay Option adds 5 relays to the Main I/O, which mimic the common relays. All relays are 5 Amp Single Pole Double Throw (SPDT) relays, and are rated at 5 Amps for 28VDC and 250~VAC Resistive Loads.

3.4.3.1 Auxiliary Relay Option

The Auxiliary Relay Option plugs in to the Relay Expansion Connector (J3) on the Main I/O board. Adding this option provides five additional standard relays, which are wired in the same fashion as the Common Relays (described in Chapter 3.3.1). Setup for these relays is completed when setting up the Common Relays as described in Chapter 4.2.4.

3.4.3.2 Programmable Relay Option

The Model 7100 Plus supports up to two Programmable Relay Option Boards for a total of 16 fully programmable relays.



IMPORTANT: Appropriate diode (DC loads) or MOV (AC loads) snubber devices must be installed with inductive loads to prevent RFI noise spikes. Relay wiring should be kept separate from low level signal wiring.

Terminals for the Programmable Relays are found on TB1 and TB2.

Relay terminals are labeled NO for the Normally Open terminal, C for the Closed Terminal and NC for the Normally Closed Terminal. The NO and NC nomenclature comes from the normal state of the relay (de-energized state). The Fault Relay (or relays when placed in Failsafe Mode) is normally in the energized state, and becomes de-energized when the Fault (alarm) condition is reached.

Only two wires are needed for wiring of relays. A typical wiring would have power wired to the C terminal, and the NO and C terminals wired to the alarm device. Under normal operations the circuit between the two terminals is open. When the alarm state is reached, the NO contact closes, and completes the circuit, energizing the alarm device.

When a Standard Relay is configured for Failsafe Mode (or the Fault Relay), the alarm condition is used to de-energize a device such as a Green Steady Light (all clear). In this case, the light is wired to the C and NO terminals, and Power is wired to the C terminal just as described previously. However, since the relay is in Failsafe mode, the circuit is complete, and the device is powered. When the alarm (fault) state is

reached, the relay de-energizes, and the light turns off. This is very useful for indicating a loss of power to a device.

When powering multiple devices with the same voltage requirements, placing wires across the C terminals of the relays with common load requirements can simplify wiring.

TB5 provides an open collector failure detection output. If communication is lost with the CPU board or if the relay board's processor fails, the positive terminal of TB5 is pulled low.

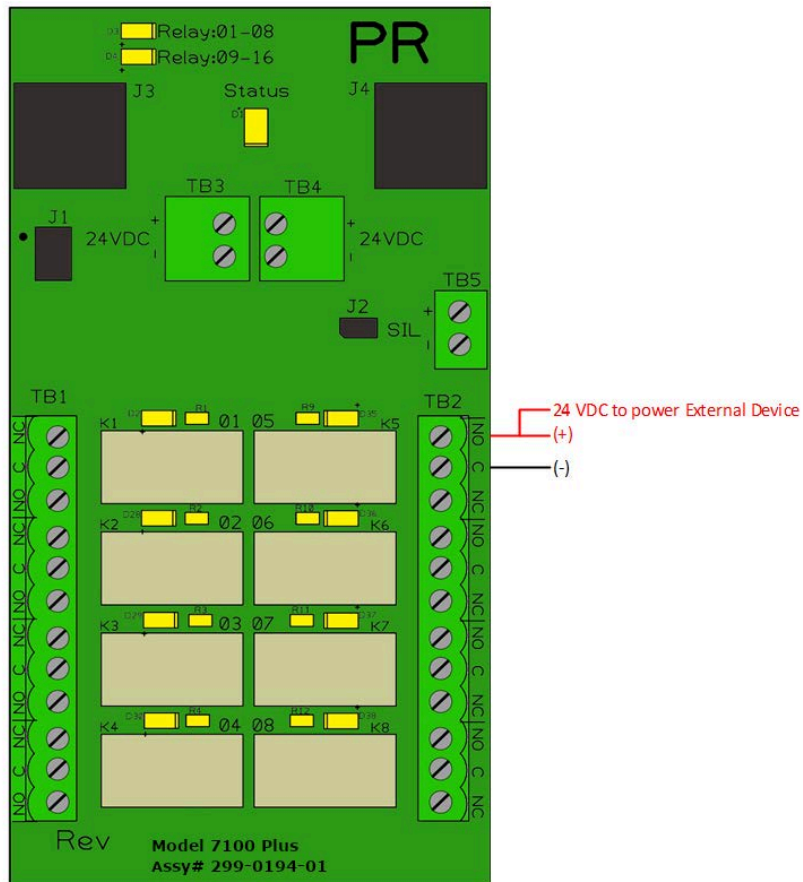


Figure 15 Programmable Relay Option Wiring Diagram

3.4.3.3 Discrete Relay Option

Each Discrete Relay Option board provides 8 addressable relays for the Model 7100 Plus.



IMPORTANT: Appropriate diode (DC loads) or MOV (AC loads) snubber devices must be installed with inductive loads to prevent RFI noise spikes. Relay wiring should be kept separate from low level signal wiring.

Terminals for the Discrete Relays are found on TB1 for channels 1/9, 3/11, 5/13, 7/15 and TB2 for channels 2/10, 4/12, 6/14, 8/16 (channels depend on the channel group assigned to the board).

Rev A

Relay terminals are labeled NO for the Normally Open terminal, C for the Closed Terminal and NC for the Normally Closed Terminal. The NO and NC nomenclature comes from the normal state of the relay (de-energized state). The Fault Relay (or relays when placed in Failsafe Mode) is normally in the energized state, and becomes de-energized when the Fault (alarm) condition is reached.

Only two wires are needed for wiring of relays. A typical wiring would have power wired to the C terminal, and the NO and C terminals wired to the alarm device. Under normal operations the circuit between the two terminals is open. When the alarm state is reached, the NO contact closes, and completes the circuit, energizing the alarm device.

When a Standard Relay is configured for Failsafe Mode (or the Fault Relay), the alarm condition is used to de-energize a device such as a Green Steady Light (all clear). In this case, the light is wired to the C and NO terminals, and Power is wired to the C terminal just as described previously. However, since the relay is in Failsafe mode, the circuit is complete, and the device is powered. When the alarm (fault) state is reached, the relay de-energizes, and the light turns off. This is very useful for indicating a loss of power to a device.

When powering multiple devices with the same voltage requirements, placing wires across the C terminals of the relays with common load requirements can simplify wiring.

TB5 provides an open collector failure detection output. If communication is lost with the CPU board or if the relay board's processor fails, the positive terminal of TB5 is pulled low.

After wiring is complete, the boards can be configured as described in Chapter 4.3.1.2.

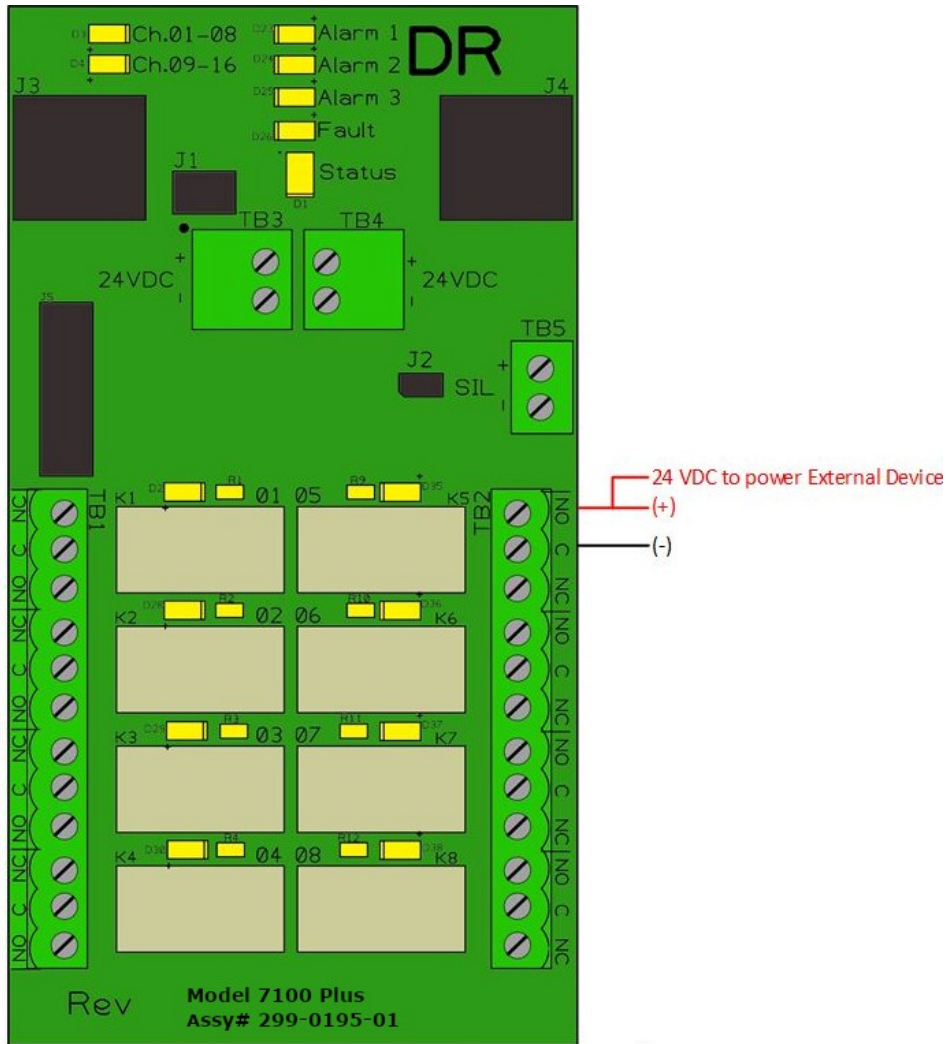


Figure 16 Discrete Relay Option Wiring Diagram

3.4.4 Analog Output Option

The optional 16 bit 4-20mA Analog Output Board transmits each channel's output, and is scaled from 4mA for 0% readings and 20mA for 100% readings. Loop drive capability depends upon the level of the Model 7100 Plus's primary DC power supply. With at least 20 volts DC primary power they are capable of driving 20mA through a 750 ohm load. Outputs are self-powered, and DC power should not be provided by the receiving device. Each board has 8 channels, two are required for 16 channel applications.

Terminals for the Analog Outputs are found on TB1 for channels 1/9, 3/11, 5/13, 7/15 and TB2 for channels 2/10, 4/12, 6/14, 8/16 (channels depend on the channel group assigned to the board).

The analog output board has a failure detection circuit. If the output board's processor fails, or if communication is lost with the CPU board, then the outputs of all channels go to 0mA.

Chapter 4 General Operating Instructions

4.1 Introduction

Swiping a magnetic wand past or pressing the *Menu* key, from any of the **Data Display** screens, displays the **Main Menu**. In the **Main Data Screen** *Up, Down, Left and Right* keys maneuver the selection bar between the channels and *Edit* selects the highlighted Channel to enter the Channel Configuration menus.

The *Up* and *Down* keys maneuver the selection bar up and down menu items and *Edit* selects the highlighted item to enter the sub-menus. All items with a sub-menu are indicated by a right facing arrow at the end of the line. To edit menu item values, swipe or press the *Edit* key, and use the *Up* and *Down* keys to edit the value. Once the desired value is entered, swipe the *Edit* key again to save the value. Swipe the *Next* key to reverse out of a sub-menu.



Important: Some values require a **Technician Sequence** to be entered to change their values. This is to prevent the operator from inadvertently changing the values. When prompted to “Enter technician sequence:” simply swipe the *Up* key four times to unlock the value for editing.

All system and channel configuration menu items are also editable from the embedded webpage (Chapter 4.5).

4.2 Security Menu

A password entered in the Security Menu allows locking all menus. Viewing menus is not denied, however, attempts to edit variables flashes the Locked message on the LCD.

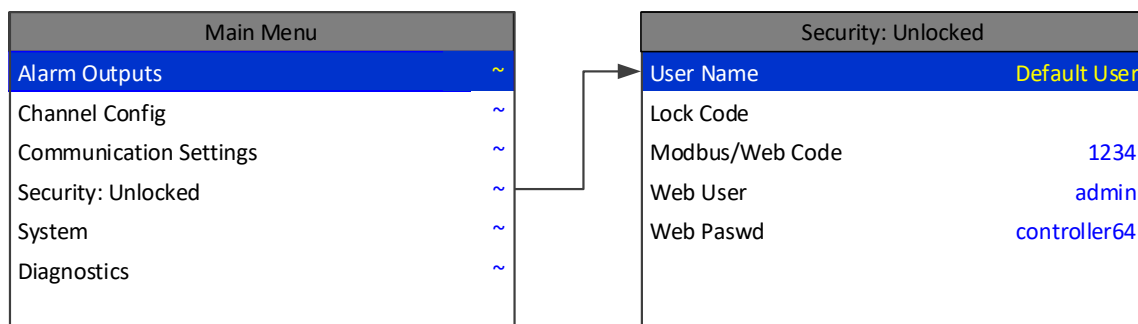


Figure 17 Security Menu

4.2.1 User Name

Authorized individuals locking the system should first enter a name, phone number, or other contact information into the 10 digit field so they can be contacted to unlock the unit at a later date.

4.2.2 Lock Code

To lock or unlock the system the correct 4 digit authorization number must be entered into the Lock Code field. The Model 7100 Plus will ask this 4 digit code to be re-entered and then it will be locked. Once locked, re-entering the code will unlock the unit.

It is very important to record the 4 digit code. However, if lost the controller may be unlocked by entering the override code: 8621

4.2.3 Modbus®/Web Code

The Modbus® database is normally locked. The register 40099 is used to unlock the unit and allow writes. When written with the unlock code (found in the security menu). The database unlocks and stays unlocked while writes occur and for 10 minutes of being idle. The default Modbus® lock code is “1234”.

4.2.4 Web User

Web User allows the user to change the Username for use when logging in to the Embedded Webpage.

4.2.5 Web Paswd

Web Paswd allows the user to change the password for use when logging in to the Embedded Webpage.

4.3 System Configuration Setup

4.3.1 Version

The **Version** line in the System menu displays the version of firmware that is programmed in the controller.

System	
Version	v1.00
Configure	~
Zone Names	~
Mimic Mode	~
SD Card	~
View Event Log	~
Clear Event Log	~
View Sensor Life	~
Inhibit Mode	~

Figure 18 System Menu

4.3.2 System Configure Menu

Some items needing configuration are not specific to a channel but affect the entire Model 7100 Plus system. These are located in the **Configure** entry menu shown on the right side of the figure below. **Reference source not found.** System Configuration menus are accessed by pointing to the desired item and pressing Edit.

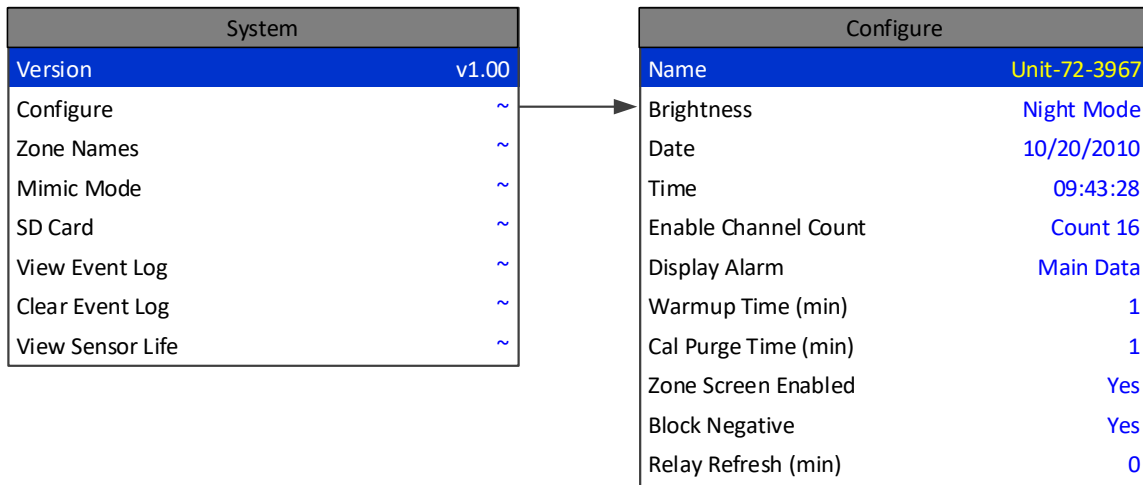


Figure 19 System Configuration Menu

4.3.2.1 Name

Assign the controller a name for use in the backup configuration file name on the SD card. The controller name is limited to 16 characters.

4.3.2.2 Brightness

The Configure menu item identified as **Brightness** allows users to adjust the LCD brightness based on three levels, Normal, High and Night Mode. To adjust the brightness level suitable to the ambient lighting, highlight **Brightness** and press Edit to cycle through the available settings, and press Next to accept the desired setting.

4.3.2.3 Date and Time

Adjust the date and time here for use in Data and Event Logging. This is a factory setting but may need to be adjusted to reflect the end user's location.

4.3.2.4 Enabled Channel Count

For applications that do not need 16 channels, the Model 7100 Plus can be configured to display channels. With fewer channels to be displayed in Main Data screen the cells expand for better resolution.

4.3.2.5 Display Alarm

Utilizing the display alarm feature in the System menu allows the Model 7100 Plus controller to force the LCD to the Main Data or Zone screens when an alarm level is reached. This proves to be useful if a channel or zone must be displayed when in alarm. The Main Data screen is the default alarm screen from the factory. Turning this setting off means the display will not change screens when an alarm level is reached.

4.3.2.6 Warmup and Cal Purge Time

Warmup and Cal Purge Time are available to prevent unwanted alarm trips during these times. This time can be adjusted up to five minutes for sensors that take a long time to warmup or drift back down after a calibration.

4.3.2.7 Zone Screen Enabled

In some applications, all points are linked together in one large ZONE. In these applications the ZONE screen does not need to be displayed. Turning Zone Screen Enabled to No causes scrolling through the screens to skip the Zone screen.

4.3.2.8 Block Negative

This setting prevents negative channel values from being displayed, and applies to all channels.

4.3.2.9 Relay Refresh

The Relay Refresh selection allows reactivation of Acknowledged alarms after the time period expires. This feature is used primarily to restart audible alarm devices after having been silenced by an acknowledge function (via serial port or pressing the Alarm Reset button). An entry of 0 seconds effectively disables the Alarm Refresh function. Maximum of 60 minutes is allowed.

4.3.3 Zone Names

Zones 1-8 names can be edited for a quick reference while in the zone screen. These 16 character names show up in the title bar of each zone.

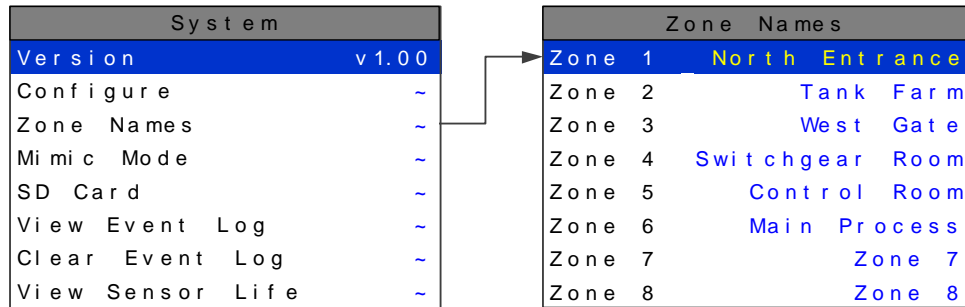


Figure 20 Zone Names System Menu

4.3.4 Mimic Mode

When Mimic Mode is enabled, the Model 7100 Plus will duplicate the data and alarms of another Model 7100 Plus which can be connected by either RS-485 Modbus® or Modbus® TCP/IP. Entering the communications port and slave ID allows the Model 7100 Plus to automatically retrieve programmed configuration parameters from the Main controller. The Mimic controller's communication port must be configured as the Modbus® Master and the Main controller's communication port is set to Modbus® Slave. Once connected, the Mimic controller will update automatically one minute after any parameter is changed in the Main controller. Alarm Reset from either controller will acknowledge any relay with Acknowledge set to Yes

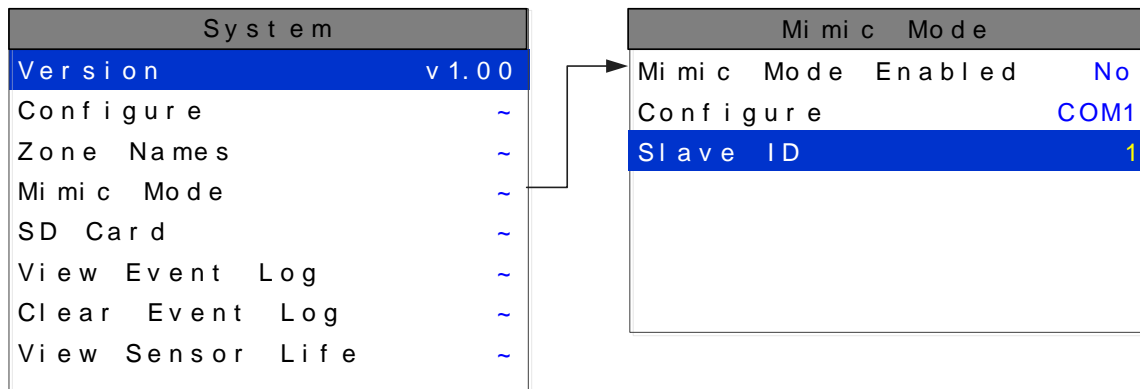


Figure 21 Mimic Mode System Menu

4.3.5 SD Card

A 4 gigabyte SD card comes standard with each Model 7100 Plus. This SD card is not needed for normal operation, but is useful for data logging and backing up configuration settings.

When the data logger is enabled, every ten minutes the Min, Max, Average, Alarm 1/2/3 status, Fault status, Calibration status, and Alarm Reset for each active channel is written to the SD card in one minute intervals. The log files are stored on the SD card by date. Each day a new file is created and stored in a directory structure as follows: **UNIT_NAME\YEAR\MONTH\DAY.csv**. The files are comma delimited text files and work with MS Excel, which can be used to create historical plots of the data.

The first line in the file contains a date stamp. The next line is the header. The header shows the name of each column. The AVG fields in the header list the zero and span values for that channel. The zero and span can be used when creating plots. Another line exists for each minute of the day. Those lines are time stamped with the hour and minute.

The numeric format of the MIN, MAX, and AVG values are based on channel settings. The decimal precision is the same that is viewed from the unit. This can be adjusted with the decimal points parameter in each channel's Configure menu.

The SD Card can store more than 10 years of historical data, but backups of the card should be performed periodically. Backing up logs requires removing the SD card and inserting it in a PC that has a card reader interface. The standard 4GB SD card can be replaced with SD cards up to 32GB if desired.

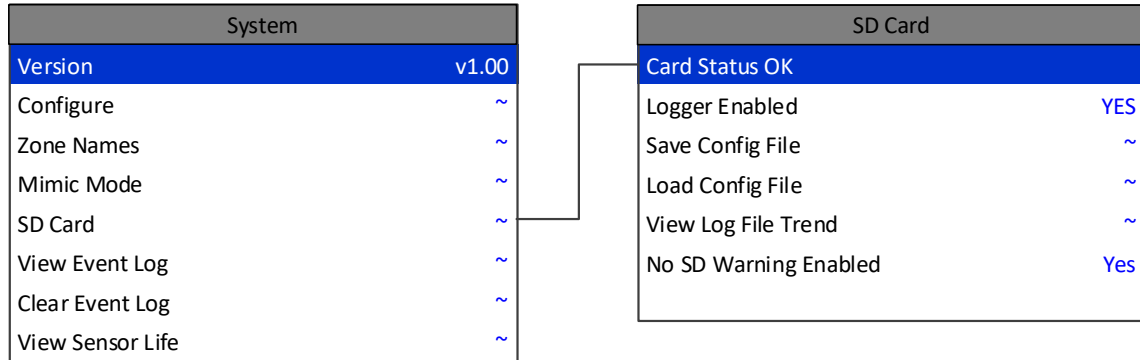


Figure 22 SD Card System Menu

4.3.5.1 Card Status

When the SD card is properly inserted into the card slot Card Status will display OK. If the No SD Warning Enabled setting is set to Yes, and the SD card is removed or becomes corrupt the green LED on the display panel will blink continuously and Card Status will say Card Not Found.

4.3.5.2 Logger Enabled

Enabling the Data Logger allows the Model 7100 Plus to record the channel data for all active channels.

4.3.5.3 Save Config File

By selecting Save Config File the current configuration file will be backed up on the SD card. This can be beneficial in the event of a board failure or if multiple Model 7100 Plus must be programmed the same. The filename of the save will be **UniteNameDDMMYY.cfg** where DDMMYY is the current date. Saving configuration will overwrite previous saves from the same date. It is recommended to backup configuration once a unit has been fully configured and tested.

4.3.5.4 Load Config File

Once a file is backed up on the SD card it can be loaded back into the Model 7100 Plus to change the current configuration to a previous configuration, or the SD card can be moved to another unit and the configuration can be copied to the second unit. This is done by selecting Load Config File, selecting the file with the name and date of the configuration file that is to be copied.

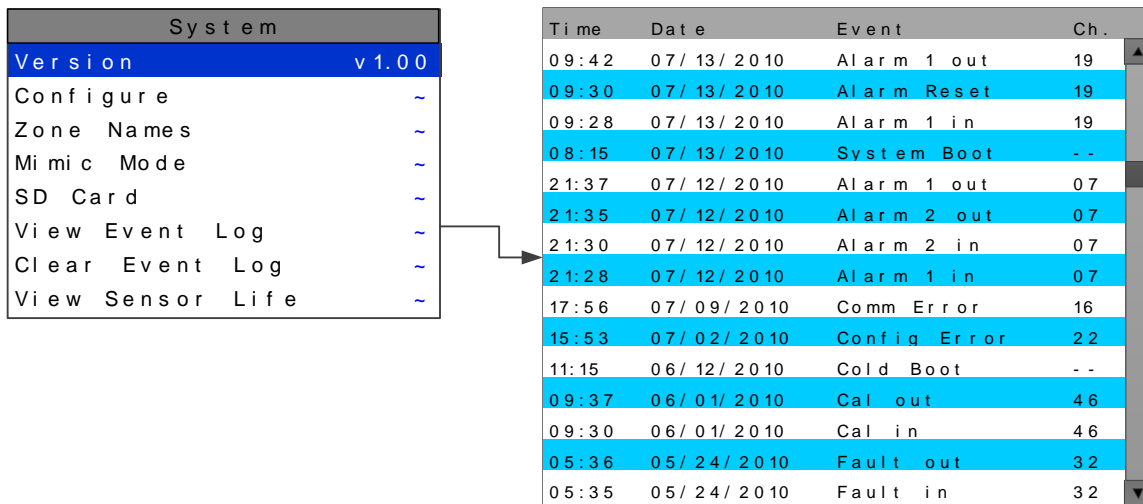
4.3.5.5 View Log File Trend

View Log File Trend displays historic 24 hours of data using the 24 Hour Trend screen format. The user selects the date to be displayed and all active channels for that day are loaded into the Model 7100 Plus. Use the Up and Down buttons to scroll through the 16 channels of Historic data. The Model 7100 Plus 24 Hour Historic Trend data screen is identified by the cyan background color in the graph area. All alarm processing is active during viewing of historic trend and if a new alarm becomes present a prompt will ask the user if they would like to continue viewing the historic data or exit this mode and view real time readings.

4.3.6 View Event Log

The Model 7100 Plus logs the last 2000 events, first in first out, in non-volatile memory so an SD card is NOT necessary to view the event log. The events are time and date stamped and if channel specific the number is shown in the right column. Use the Up and Down buttons to scroll through the events.

Logged Events include: Alarm 1 In, Alarm 1 Out, Alarm 2 In, Alarm 2 Out, Alarm 3 In, Alarm 3 Out, Fault In, Fault Out, Comm Error, Config Error, IO Error, Cal In, Cal Out, System Boot, Cold Boot, Alarm Reset, Remote Alarm Reset, Alarm Refresh, Marker, Configuration Change, and Event Log Cleared.



System		Time	Date	Event	Ch.
Version	v 1.00	09:42	07/13/2010	Alarm 1 out	19
Configure	~	09:30	07/13/2010	Alarm Reset	19
Zone Names	~	09:28	07/13/2010	Alarm 1 in	19
Mimic Mode	~	08:15	07/13/2010	System Boot	--
SD Card	~	21:37	07/12/2010	Alarm 1 out	07
View Event Log	~	21:35	07/12/2010	Alarm 2 out	07
Clear Event Log	~	21:30	07/12/2010	Alarm 2 in	07
View Sensor Life	~	21:28	07/12/2010	Alarm 1 in	07
		17:56	07/09/2010	Comm Error	16
		15:53	07/02/2010	Config Error	22
		11:15	06/12/2010	Cold Boot	--
		09:37	06/01/2010	Cal out	46
		09:30	06/01/2010	Cal in	46
		05:36	05/24/2010	Fault out	32
		05:35	05/24/2010	Fault in	32

Figure 23 View Event Log System Menu

4.3.7 Clear Event Log

After initial setup and testing of the controller, **CLEAR EVENT LOG** is used to manually clear all events in the log file. If the event log is not cleared the older events will be pushed out as new ones occur.

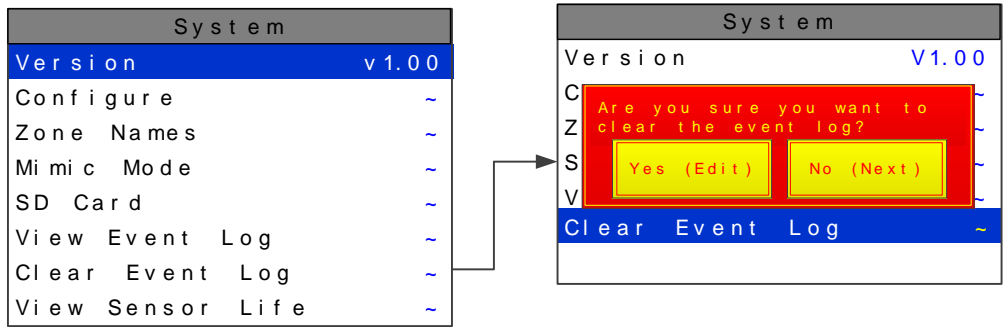


Figure 24 Clear Event Log System Menu

4.3.8 View Sensor Life

Sensor Life is available when at least one channel has Sensor Life activated in the Marker menu (See Chapter 4.12). The Sensor Info screen displays each channel's sensor status as illustrated below. Channels with Sensor Life disabled are indicated by Ch. # Disabled below the bar. Cal Required indicates no Calibration Marker value has been received by the Model 7100 Plus.

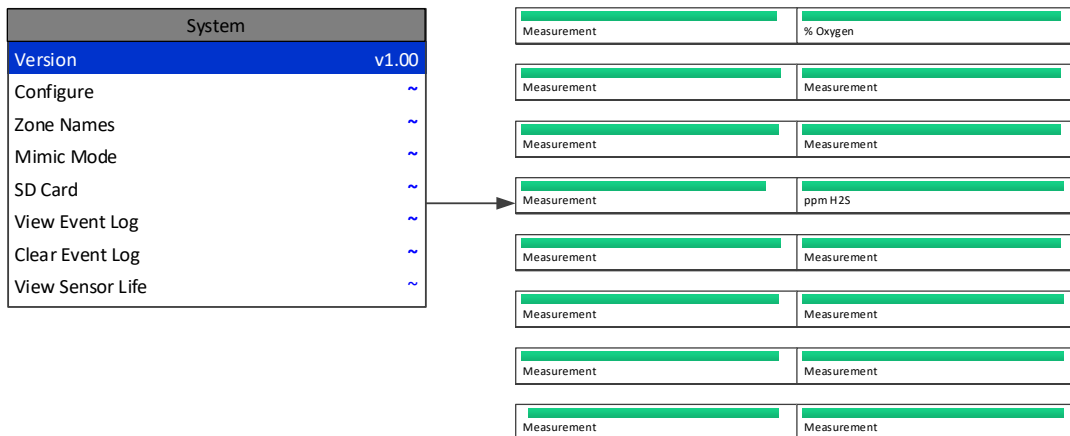


Figure 25 View Sensor Life System Menu

4.4 Basic Channel Configuration

From the entry level setup menu below, the Channel Configure menu may be entered for setting variables defining how the controller presents monitored data to the various graphic displays.

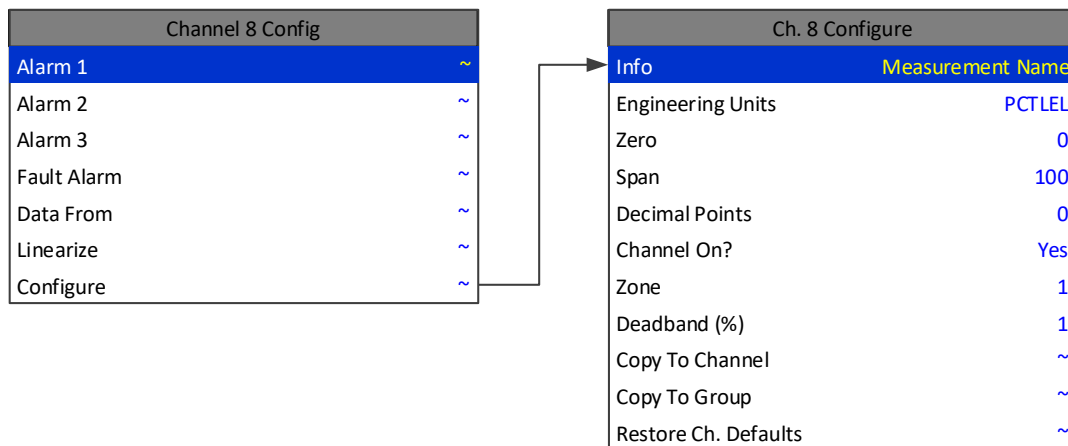


Figure 26 Channel Configuration Menu

4.4.1 Info and Engineering Units

The first two items in this menu are for entering the 16 character Measurement Name and 6 character engineering unit (Eunits) ASCII fields. Eunits should define the units of measure for what this channel is to display. Measurement Name should describe the source of this data in the user’s terminology.

4.4.2 Zero/Span

The Zero/Span entries allow configuration of the measurement range displayed by this channel. Measurement Range works along with A/D Counts menus to define the range of the input signal’s engineering units. For example, if a channel’s input is 4-20mA from a transmitter monitoring 0 to 10ppm chlorine, then the Zero value should equal 0.000 and the Span value equal 10.00. The six ASCII engineering units previously entered are automatically displayed at the top of each menu as a reminder. Four digits must appear in this entry so trailing 0’s may appear here that are not displayed on other data screens.

4.4.3 Decimal Points

Resolution of displayed channel values is configured in this menu by setting the number digits trailing the decimal point. Values are limited to a maximum of four digits, and a polarity sign. An auto-ranging feature displays the highest resolution allowed by this menu’s decimal point entry.

For example, if three decimal points are entered, and the range is 0 to 100ppm, the reading will be 0.000 at 0ppm and 100.0 at 100ppm. However, this may be undesirable due to the high resolution at zero unless the sensor’s output is extremely stable. If decimal points are limited to one, the 0ppm reading becomes 0.0 and the 100ppm reading remains 100.0. Resolution may be limited further by setting decimal points to 0. In the above example, this would cause 0ppm to display 0 and 100ppm to display 100.

4.4.4 Channel On?

The Channel On? entry determines if this channel is to be utilized. Turning it off will cause the controller to never process inputs applied to this channel and no alarms will be tripped or data displayed. Inactive channels will be grayed out on the Main Data screen and skipped when scrolling through the 30 Minute Trend screens. Channels may be turned off in groups of 8. This is done in the System Setup menu.

4.4.5 Zone

The ZONE feature allows assigning of channels into up to eight possible Zones. This is useful for applications that may need all like gases or inputs from a certain area to be grouped together. Once the channels are assigned to a certain group, relays can be configured to respond to only the channels in this Zone.

4.4.6 Deadband

Deadband allows forcing low values to continue to read zero. This is useful when there are small amounts of background gases that cause fluctuating readouts above zero. The highest amount of deadband allowed is 5%. The 4-20mA output is affected by this menu item and will remain at 4mA until the input gets above the programmed deadband level.

4.4.7 Copy to Channel

This menu simplifies the Setup procedure by allowing similar channels to be copied from one to another. For example, if some channels are identical except for the Measurement Name entry, one channel could be configured and copied to the other channels that are the same. Only Measurement Name then must be configured on the copied channels. Use Edit, Up and Down to select channel numbers and Edit once more to copy.

4.4.8 Copy to Group

This menu simplifies the Setup procedure by allowing one channel to be copied to a whole group of channels. For example, if some groups of 4 channels are identical except for the Measurement Name entry; one channel could be configured and copied to the whole group at one time. Only Measurement Name then must be configured on the copied channels. Use Edit, Up and Down to select the group to be copied then point to Copy Now? Press Edit once more to copy.

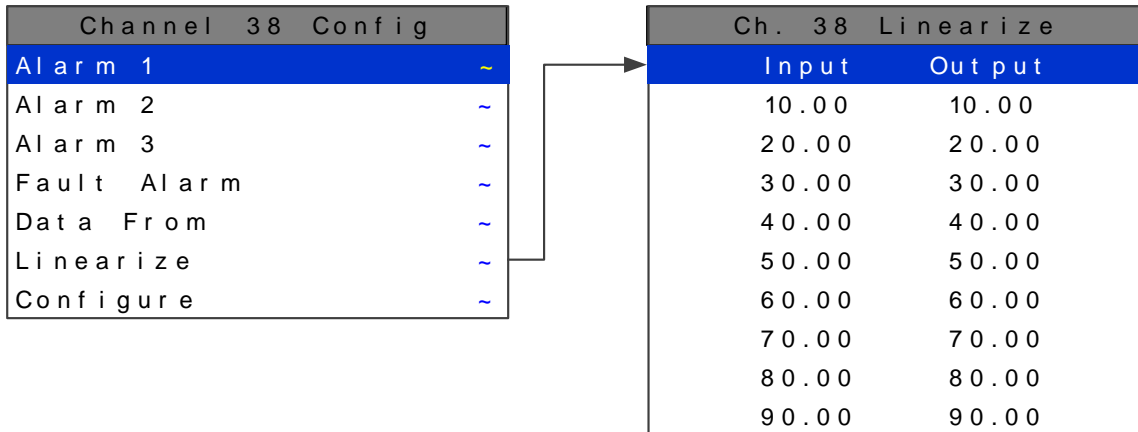
4.4.9 Restore Ch. Defaults

This menu allows the user to reset a specific channel to factory defaults without affecting any other channels. This is useful if a channel must be changed to a different input. All channel configuration will be reset and the user can configure the new parameters from the factory defaults. A confirming dialog box will appear before the channel is reset protecting against an accidental restore.

4.4.10 Linearize

The Linearization menu allows each channel to have its own linearization curve stored in the controller's non-volatile memory. Input versus output points must be entered in percent of full scale values. This means if the range is 0-200 ppmH₂S then 100 ppm is 50% of full scale. Zero input will provide a zero output and 100% input a 100% output. Nine intermediate points may be entered to define the curve.

This is particularly useful in applications such as measuring tank levels in a spherical tank.



4.5 Standard Features Setup

Standard Features are those features which are present in all configurations of the Model 7100 Plus. The only necessary hardware for a Model 7100 Plus is the Main CPU assembly and the Main I/O assembly.

4.5.1 Alarm Settings

Each Channel has its own set of Alarm 1, 2 and 3 settings. To edit a channel's alarm settings, use the Up, Down, Left and Right buttons to highlight the desired channel and press the Edit key.

4.5.1.1 Alarm 1, Alarm 2 and Alarm 3 Menus

Alarms 1, 2, and 3 are identical except A1 does not have the option to change the color, it is always yellow, and only A3 can be turned off if not needed. The following parameters can be accessed while in the Alarm Menus.

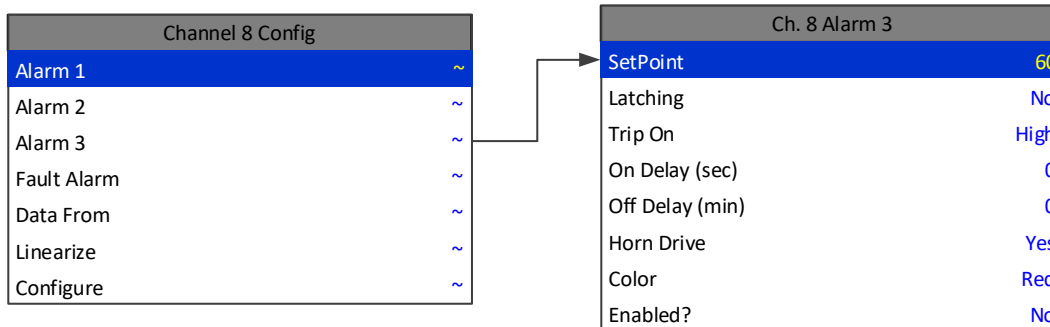


Figure 27 Channel Settings Alarm Menu

4.5.1.1.1 Setpoint

Setpoint is the value where the alarm trips. It is entered in engineering units. For example, if a channel monitors 0-50 ppmH₂S, and the alarm must trip at 10 ppm, the correct Setpoint is 10.00.

If the desired setpoint is unknown, Sensidyne, LP recommends setting Alarm 1 to 20% of full scale, Alarm 2 to 40% of full scale and Alarm 3 to 60% of full scale.

4.5.1.1.2 Latching

Latching determines either manual or automatic alarm reset operation. When set to Yes, the channel requires a manual Alarm Reset to unlatch the alarm even though an alarm condition no longer exists, and alarm group's common relay, front panel LED, and optional discrete relay to latch. When set to No, the all alarm outputs for this channel are allowed to automatically reset as soon as the alarm condition clears.

4.5.1.1.3 Trip On

Trip On should be set to High for increasing alarms and Low for decreasing alarms to determine if the alarm activates upon exceeding or falling below the setpoint.

4.5.1.1.4 On and Off Delays

The On Delay and Off Delay entries allow time delays affecting how long the setpoint must be surpassed before an alarm event transition occurs. On delays are limited to 10 seconds while Off delays may be as long as 120 minutes.

On Delays are useful in many applications to prevent nuisance alarms and unwanted cycling into and out of alarm conditions.

Off Delays are useful for allowing alarm events to continue even after the alarm has cleared. An example of this is when the Alarm state is reached and a relay is activated that energizes a ventilation fan. The Off Delay will allow the ventilation fan to continue to run up to two hours after the alarm condition has cleared.

4.5.1.1.5 Horn On

The Horn On entry allows linking this alarm to the common horn relay. When set to No the alarm has no effect on the horn relay. Entering Yes causes this alarm to turn the horn relay on steady, or, to pulse it depending upon horn relay configuration (Chapter 4.3.2.2).

4.5.1.1.6 Color

The Color menu selection gives the option of assigning Alarm 2 and Alarm 3 different colors besides the default, red. The options are red, blue and orange.

4.5.1.1.7 Enabled

Most applications require only two alarm levels, the default configuration has the Alarm 3 Enabled menu option set to No. Setting Enabled to Yes activates the Alarm 3 alarm level if needed.

4.5.1.2 Fault Alarm

The Fault Alarm activates when the input is out of range in the negative direction. The fault level is always low trip and the dedicated common fault relay is always failsafe. The minimum setting is -10% of full scale. The factory default setting is -10; which is -10% of 100, or default full scale value. If the full scale value is changed the fault value is automatically updated to reflect the new value. For example, if the fault level is -10 and the full scale value is changed from 100 to 50 the fault level will automatically change to -5 which is -10% of the new full scale value. If the fault level is -5 (-5% of full scale) and the full scale value is changed from 100 to 50 the fault level will automatically change to -2.5 which is -5% of the new full scale value.

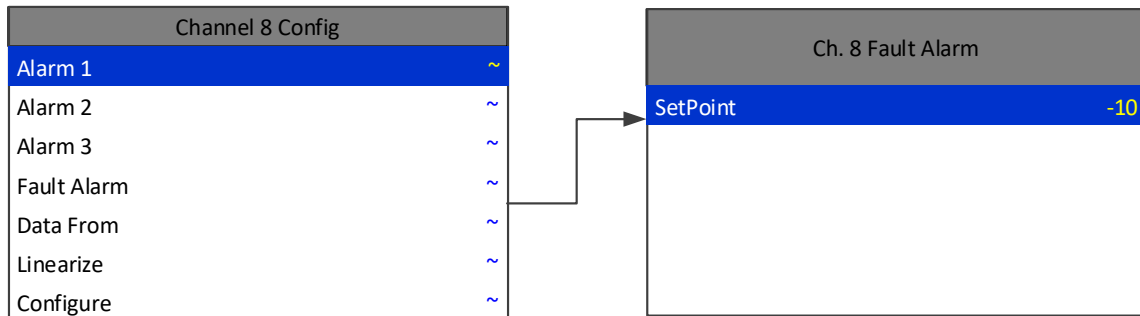


Figure 28 Fault Alarm Channel Config Menu

4.5.2 Common Relays

The Common Relays are found on the Main I/O. There are 3 standard relays, a dedicated Horn Relay, and a dedicated Fault relays. All relays are 5 Amp Single Pole Double Throw (SPDT) relays, and are rated at 5 Amps for 28VDC and 250~VAC Resistive Loads.

4.5.2.1 Standard Relays

Every Model 7100 Plus comes standard with three programmable relays that the user can individually program to suit their needs. This is achieved through the Standard Relay menus accessed from the ALARM OUTPUTS menu. Only one Standard Relay menu screen is shown in **Error! Reference source not found.** because all the standard relay's menus are identical. Under the Standard Relay menu the user can configure the following.

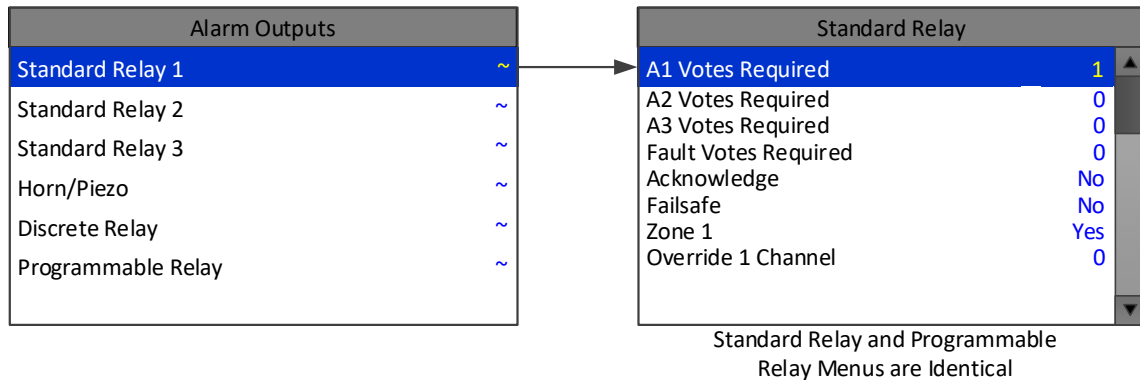


Figure 29 Standard Relay Configuration Menu

4.5.2.2 A1 A2, A3 and Fault Votes Required

A1 Votes Required, A2 Votes Required, A3 Votes Required and Fault Votes Required are the number of A1, A2, A3 and Fault level alarms that must be present for the relay to activate. This allows creation of logical AND function equations that control standard relays. Default settings for standard relay 1 are A1 Votes = 01 A2 Votes = 00 & A3 Votes = 00 which causes relay 1 to trip if any channel has an A1 level alarm active. Default settings for standard relay 2 are A1 Votes = 00 A2 Votes = 01 & A3 Votes = 00 which causes relay 2 to trip if any channel has an A2 level alarm active. Example: If either default setting is modified such that A1 Votes = 02 and A2 Votes = 01, then any two channels must have an A1 level alarm active and any one channel must have an A2 level alarm active to trip that relay.

REMEMBER! One of the A1s and the A2 could be on the same channel. These level alarms must come from a channel included in the Zone entry described below.

4.5.2.3 Acknowledge

Turning Acknowledge Yes allows the standard relay to be deactivated during alarm conditions by an Alarm Reset. This is useful if an audible device is being driven by the relay

4.5.2.4 Failsafe

Failsafe controls relay activation for this standard relay. Failsafe Yes causes the relay to de-energize during alarm conditions and energize when there is no alarm. Thereby, a power failure forces the relay contact to the alarm position. Note the standard Fault relay is always failsafe and may be monitored separately to indicate loss of power conditions in many applications.

4.5.2.5 Zone 1-8

Zones offer additional flexibility by controlling which channel zones trip this menu's standard alarm relay. There are eight possible zones that can be assigned to the relays individually. Some applications have different types of sensors, or sensors in different areas connected to the same Model 7100 Plus Controller. In these cases, it may be undesirable for a sensor in one area to trip the same relay as a sensor in another area. The Zone menus may restrict this. For example, channels 1-3 might be set to trip standard relay 1 while channels 4-6 trip standard relay 2. This is done by assigning channels 1-3 to zone 1 and channels 4-6 to zone 2 and turning only zone 1 to YES for Standard relay 1 and only zone 2 to YES for standard relay 2. Another possibility is channels 1-3 be set to trip standard relay 1 while channels 4-6 trip relays on an optional discrete relay PCB configured for Alarm 1.

4.5.2.6 Override Channels 1-8

Override allows entering one of the 256 different alarms that will trip this relay regardless of the Votes or Zone entries. There are four alarms per channel and 16 channels and any one of these alarms may be used as the Override. This feature is useful when one channel's alarm has more significance than the others. Up to eight override alarms may be entered per relay.

4.5.2.7 Horn/Piezo Relay

The Model 7100 Plus is equipped with a dedicated Horn Relay and a low decibel audible piezo which chirps when keys are pressed and may be configured to audibly indicate alarm conditions.

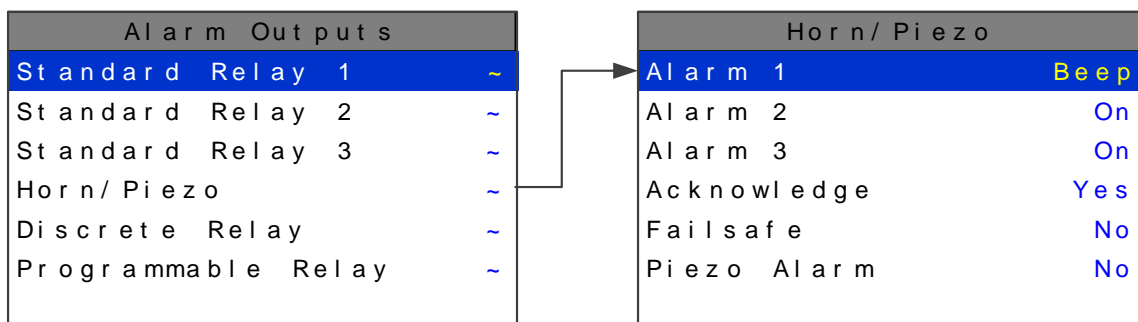


Figure 30 Horn/Piezo Relay Configuration Menu

4.5.2.8 Alarm 1, Alarm 2 and Alarm 3

Alarm 1, Alarm 2 and Alarm 3 menus control how this alarm level from each channel will affect the standard horn relay. Choices are OFF, ON or BEEP (one Hz. Pulsating). As an example, A1 conditions might pulse the horn (BEEP) and A2 conditions to cause a steady horn (ON). Any other combination of these 3 choices is possible for A1, A2, and A3 levels affecting the horn relay. This feature is very useful since it allows the horn relay to serve as another level A1, level A2, level A3 or both. Individual channel alarms may also be configured to not affect the Horn relay on a channel by channel basis.

4.5.2.9 Acknowledge

Turning Acknowledge set to Yes allows the Horn relay to be deactivated during alarm conditions by an Alarm Reset. This is useful if an audible device is being driven by the relay

4.5.2.10 Failsafe

Failsafe controls relay activation for this relay. Failsafe set to Yes causes the horn relay to de-energize during alarm conditions and energize when there is no alarm. Thereby, a power failure forces the relay contact to the alarm position.

4.5.2.11 Piezo Alarm

Piezo Alarm On causes the audible piezo to duplicate the action of the horn relay. This feature may be used to provide a low decibel indication of the status of the system's horn.

4.5.3 Standard RS-485 Modbus® and Optional RS-485 Modbus® Isolated I/O

4.5.3.1 Communication Setting Menu

Communication Settings menu is accessed through the Main Menu. This menu is used to configure the four possible communication ports. Once in the Communication Settings entry menu, use Up and Down to scroll up or down to select the communication port that is to be configured. Once the correct com port is selected pressing Edit brings you to that com port's configuration menu. Com ports 1-4 have identical menus and are shown only once.

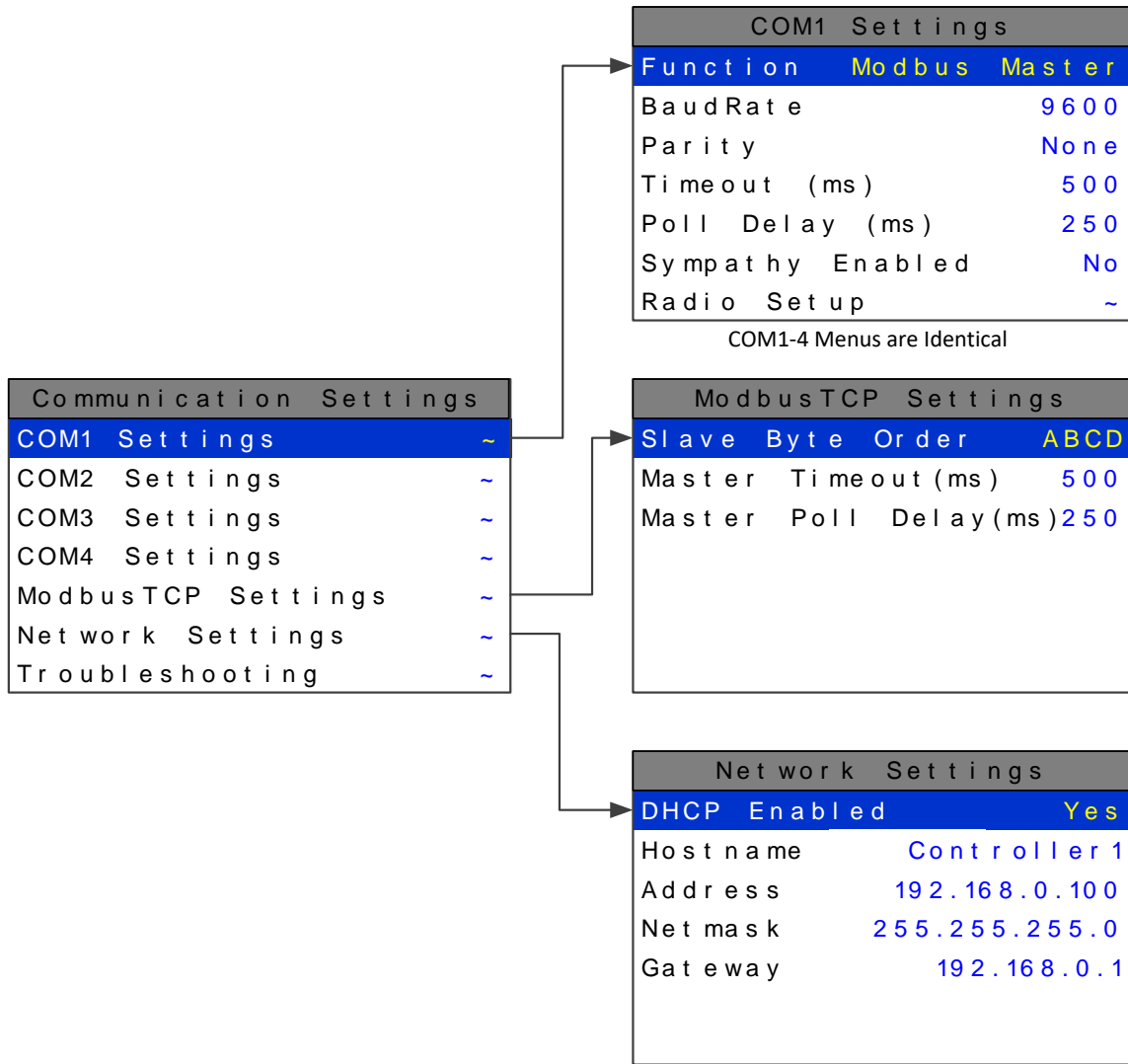



Figure 31 Communication Settings Menus

4.5.3.1.1 COM 1-4 Settings

The four Modbus® RS-485 ports can be individually configured multiple ways using the following menus.

Communication Settings	
COM1 Settings	~
COM2 Settings	~
COM3 Settings	~
COM4 Settings	~
ModbusTCP Settings	~
Network Settings	~
Troubleshooting	~



COM1 Settings		
Function	Modbus	Master
BaudRate		9600
Parity		None
Timeout (ms)		500
Poll Delay (ms)		250
Sympathy Enabled		No
Radio Setup		~

COM1-4 Menus are Identical

Figure 32 Comm Settings Menu

4.5.3.1.1.1 Function

The Function parameter allows the communication ports to be set as Modbus® Master, Modbus® Slave, Wireless Monitor, Redundant Port, or Disabled.

4.5.3.1.1.1.1 Modbus® Master

Master mode allows the communication port to poll any device using the Modbus® RTU protocol. This setting is also utilized for Wireless Modbus® Master.

4.5.3.1.1.1.2 Modbus® Slave

Slave mode allows the communication port to be polled by any Modbus® Master device using the Modbus® RTU protocol. This setting is also utilized for Wireless Modbus® Slave.

4.5.3.1.1.1.3 Wireless Monitor

This mode is exclusively for wireless communication to our SensCast Series wireless gas detectors.

4.5.3.1.1.1.4 Redundant Port

This setting allows the user to create a redundant port which uses the settings from another port that is already configured. Redundant mode works with ports configured as Modbus® Master. When configured as a redundant port, the Primary port communicates until it gets a communication error. The Model 7100 Plus then switches to the redundant port and continues to poll the slave nodes. When communication has switched to the redundant port the Model 7100 Plus trips the Fault relay, beeps, and displays a warning telling the user there has been a communication error. The user is able to ignore the warning for 12 hours or Test the Primary port. Ignoring the problem gives technicians time to trouble shoot and fix the problem. If the problem is not going to be fixed, the warning message can be cleared permanently by disabling the redundant port. If the user chooses to test the port and it passes, a success message will appear and the error message will be cleared.

Before a Primary port switches to its redundant port, a scan must fail 3 times. All channels setup to use the primary port are polled. At the end of the scan, if an error has occurred on any channel, the error

count is incremented. After 3 scans fail, the redundant port takes over communication. If the redundant port also fails 3 times, communication is switched back to the primary port. When both ports fail, the Model 7100 Plus will continuously switch between primary and redundant port.

Individual channels do not enter Comm Error mode unless both primary and redundant port failures occur.

Manual tests can be performed on the redundant or primary port by going into the redundant port's com setting menu and selecting Test Redundant Port or Test Primary Port. While in this menu, the Model 7100 Plus also gives the active port on the screen.

4.5.3.1.1.1.5 Disabled

Select Disable to turn the port off if not needed.

4.5.3.1.1.2 Baud rate

This setting allows user to set the data rate of the communication port. The options include 9600, 19200, 38400, 57600, and 115200.

4.5.3.1.1.3 Parity

A Parity bit is a bit that is added to ensure the number of bits with the value of 1 in a set of bits is even or odd. Parity bits are used as the simplest form of error detecting code. Default is None.

4.5.3.1.1.4 Timeout

The Master Timeout menu item affects the Model 7100 Plus's *master* Modbus® ports. Timeout is the length of time in milliseconds the controller waits before a Modbus® request fails. Three consecutive failed requests must occur before a communication error is indicated. This item is useful for optimizing throughput to the Model 7100 Plus from other slave RTUs.

4.5.3.1.1.5 Poll Delay

The time in milliseconds the unit will delay between Modbus® master requests.

4.5.3.1.1.6 Sympathy Enabled

The sympathy feature allows multiple Model 7100 Plus controllers, communicating on the same communication port, to go into an alarm condition simultaneously when any one Model 7100 Plus controller detects an alarm condition. If Sympathy Enabled is set to YES then the Model 7100 Plus controller, which is the master in the network, broadcasts alarm flags to all Model 7100 Plus controllers in the network. Model 7100 Plus controllers that are configured to react to these flags then energize their relays configured to trip for that alarm. The following sympathy parameters only show up if sympathy is set to Yes.

4.5.3.1.1.6.1 *FAULT Transmit*

When set to Yes the Model 7100 Plus broadcasts the Fault alarm flag out of the communication port. This option is only available if Sympathy Enabled is set to Yes.

4.5.3.1.1.6.2 *A1 Transmit*

When set to Yes the Model 7100 Plus broadcasts the alarm 1 alarm flag out of the communication port. This option is only available if Sympathy Enabled is set to Yes.

4.5.3.1.1.6.3 *A2 Transmit*

When set to Yes the Model 7100 Plus broadcasts the alarm 2 alarm flag out of the communication port. This option is only available if Sympathy Enabled is set to Yes.

4.5.3.1.1.6.4 *Sympathy A2 Ack*

When set to Yes the Model 7100 Plus broadcasts the alarm acknowledge flag to acknowledge all ST-90 relays on the network configured to be acknowledgeable. This option is only available if Sympathy Enabled is set to Yes.

4.5.3.1.1.6.5 *A3 Transmit*

When set to Yes the Model 7100 Plus broadcasts the alarm 3 alarm flag out of the communication port. This option is only available if Sympathy Enabled is set to Yes.

4.5.3.1.1.7 *Radio Setup*

Radio Setup is used to configure radio kits that are connected directly to the Model 7100 Plus (Chapter 4.5.6).

4.5.3.1.1.8 *Slave Byte Order*

If Modbus® Slave is selected, a BYTE ORDER entry appears in the menu. Slave Byte Order determines Word and Byte alignment of data at the remote Modbus® transmitter when sending its 4 byte IEEE Floating Point values. With the select bar on this entry, Edit toggles between the 4 possible modes. Min / Max Raw values are not used in this mode.

4.5.3.1.1.9 *Wireless Timeout*

If Wireless Monitor is selected, a Wireless Timeout entry appears in the menu. The Edit button toggles between 1m, 6m, 12m, and 18m. These represent the number of minutes the Model 7100 Plus will wait before going into Comm Error.

4.5.3.1.2 Troubleshooting

The Troubleshooting option in the communication settings menu can prove to be very helpful when setting up communications through the Model 7100 Plus's numerous communication ports. This feature allows the user to see how many messages were either corrupt when received or not received at all.

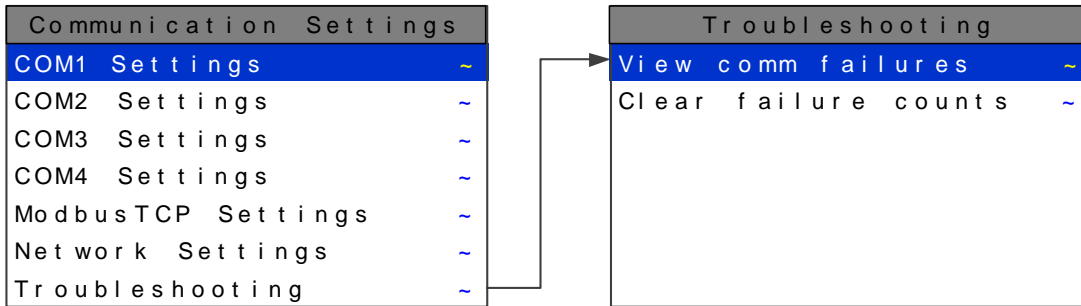


Figure 33 Communication Troubleshooting Menu

4.5.3.1.2.1 View Comm Failures

When View Comm Failures is selected the screen below is shown. Each individual channel is shown and it is color coded by the communication port that it is configured for in its own Data From menu. If the channel is not configured to receive data from a communication port it is shown in grey.

Communication port 1 is shown in cyan, communication port 2 in orange, communication port 3 in magenta, communication port 4 in blue, and the Ethernet port in yellow.

The number that is shown after the channel number represents the number of times a query was sent out and either a corrupt message was received or no message was received at all. When trouble shooting a specific channel or communication port a simple test can be performed by resetting this number, and recording the number of communication failures received after a known amount of time has passed. Make a change to the system, and repeat the test for the same duration. Compare the results to see if the change has helped the problem.

Ch.01:4	Ch.09:0
Ch.02:6	Ch.10:0
Ch.03:7	Ch.11:0
Ch.04:2	Ch.12:0
Ch.05:4	Ch.13:213
Ch.06:3	Ch.14:200
Ch.07:6	Ch.153:215
Ch.08:7	Ch.16:204

Comm Port 1	Cyan	Comm Port 4	Blue
Comm Port 2	Orange	Ethernet Port	Yellow
Comm Port 3	Magenta	Channel Off	Grey

Figure 34 View Comm Failures Menu

4.5.3.1.2.2 Clear Failure Counts

Selecting this option clears the communication failure counter so test can be run or old data can be cleared after communication ports are configured.

4.5.3.2 Channel Configuration

To configure a channel for Modbus® input use the Up, Down, Left and Right buttons to highlight the desired channel, and press Edit. Use the Down button to highlight the Data From menu, and press Edit. Pressing Edit on the Src menu item choose between Modbus® 16 Bit, Modbus® 16 Bit Signed and Modbus® 32 Bit.

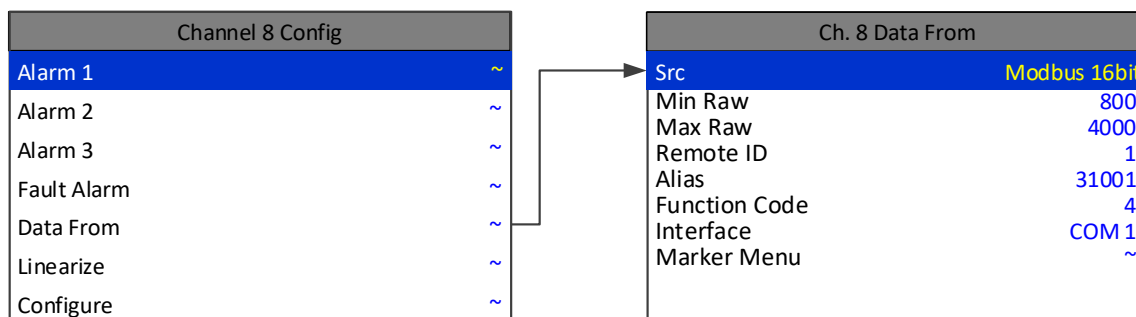


Figure 35 Channel Data From Menu

4.5.3.2.1 Min an Max Raw

Min Raw and Max Raw counts entries included in Input Data From: menus define the range of input counts that provide Measurement Range read-out values. This menu entry is determined by the A/D converter resolution of the channel's input. For example, if the input is a 10 bit Modbus® device with zero at 200 counts and 100% at 1000 counts, then this menu's MIN should be set at 200 and MAX at 1000. If communicating with the Model 7100 Plus's optional 12 bit Analog Input PCB the MIN should be 800 and the MAX 4000.

If the input device's resolution is unknown, the live counts variable on the Combination screen displays actual raw A/D counts currently being read by this channel. This reading may be used to test the input device for what A/D counts are provided for zero and 100% if these values are unknown. Forcing the input device to read zero should provide the A/D counts value needed to make this channel's display also read zero. Likewise, forcing the input device to read 100% should provide the A/D counts value needed to make the Model 7100 Plus channel's display also read 100%.

Note: Each *Data From:* item has a matching default Min/Max counts value of 20% to 100% with $\pm 5\%$ over/under range applied. If the default value is incorrect for the input device it should be edited.

4.5.3.2.2 Remote ID

When the Data From is set to receive input through the Communications ports, this is where the slave's unique ID number is entered. Remote ID numbers up to 247 are valid.

4.5.3.2.3 Alias

The Alias register numbers define the location of the variable representing the input value of the Modbus® data received through the Communications ports. This number must be obtained from the manufacturer of the Modbus® RTU device.

4.5.3.2.4 Function Code

The Function Code is the code used to write configuration parameters to the Modbus® registers. Modbus registers and write codes are discussed in detail in Appendix 3.

4.5.3.2.5 Interface

The Interface assigns what communication port the Modbus® slave or Wireless radio is connected to and the channel will get its data from. The communication port that is assigned here must be configured as a Modbus® Master or Wireless Monitor in the Communications Menu (see section 2.5.1).

4.5.3.2.6 Slave Byte Order

If Modbus® 32 BIT is selected, a Byte Order entry appears at the bottom of the menu. This determines WORD and BYTE alignment of data at the remote Modbus® transmitter when sending its 4 byte IEEE Floating Point values. With the select bar on this entry, the Edit toggles between the 4 possible modes.

4.5.3.2.7 Marker Menu

Marker Menu setup is discussed in Chapter 4.13.

4.5.4 Modbus® TCP

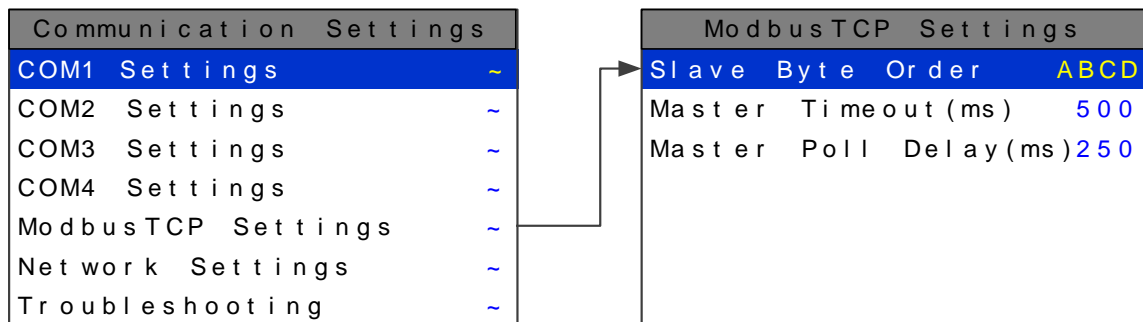


Figure 36 Modbus® TCP Settings Menu

4.5.4.1 Slave Byte Order

Slave Byte Order determines Word and Byte alignment of data at the remote Modbus® transmitter when sending its 4 byte IEEE Floating Point values. With the select bar on this entry, Edit toggles between the 4 possible modes. Min / Max Raw values are not used in this mode.

4.5.4.2 Master Timeout

The time in milliseconds before the unit gives up on a Modbus® request and moves on to the next channel. After three consecutive timeouts, the channel enters the Comm Error state.

4.5.4.3 Master Poll Delay

The time in milliseconds the unit will delay between Modbus® master requests.

Typical installation utilize Dynamic IP Configuration as described below. In installations which require Static IP configuration refer to your operating systems instructions to complete the connection after completing the steps in Chapter 4.4.2.

4.5.4.4 Dynamic IP Configuration

The Model 7100 Plus defaults to use a dynamic IP address. This setting may be used if a DHCP server is available on the network. It is recommended for Model 7100 Plus unless there are multiple Model 7100 Plus that need to communicate with each other.

Network Settings	
DHCP Enabled	Yes
Host name	Unit - 72 - 1000
Address	192.168.0.100
Net mask	255.255.255.0
Gateway	192.168.0.1

Figure 37 Dynamic IP Network Settings Menu

To enable dynamic IP, set DHCP to Yes in the network settings menu. Power must be cycled before this change takes effect. Make sure to exit the menu so the settings are saved before cycling power.

A PC will normally have DHCP enabled by default. If not, consult your operating system's instructions to determine how to change this setting.

4.5.4.5 Static IP Configuration

If you are setting up static IPs on a larger company network, make sure to consult your IT administrator to obtain an IP address. The IT administrator can also provide the correct netmask, and gateway. In this case, do not choose your own addresses or you could cause an address conflict with other devices on the network.

On the Model 7100 Plus, in the network settings menu, disable DHCP. The IP address should be set to 192.168.0.x where 'x' is any number from 0-255. A typical address would be 192.168.0.2. The netmask should be set to 255.255.255.0. The gateway can be left as 0.0.0.0 unless the Model 7100 Plus will be accessing Modbus®TCP devices outside a router/firewall. If the Model 7100 Plus needs to poll outside devices, the gateway IP should be set. This is typically the IP address of a router.

Network Settings	
DHCP Enabled	No
Host name	Unit - 72 - 1000
Address	192.168.0.2
Net mask	255.255.255.0
Gateway	0.0.0.0

Figure 38 Network Setting Menu



After making changes to the network settings menu a power cycle is required. Make sure to exit the menu before cycling power so that the changes are saved.

4.5.4.6 Testing Connections

To verify that a Model 7100 Plus is accessible, bring up a command prompt. In windows, this can be found by going to 'start' -> 'run'. Then type 'cmd' and press ok. From the command prompt, type ping and then the IP address of the unit. Verify that 4 reply lines are printed.

```
C:\>ping 192.168.0.2

Pinging 192.168.0.2 with 32 bytes of data:

Reply from 192.168.0.2: bytes=32 time<1ms TTL=128
Reply from 192.168.0.2: bytes=32 time<1ms TTL=128
Reply from 192.168.0.2: bytes=32 time<1ms TTL=128
Reply from 192.168.0.2: bytes=32 time<1ms TTL=128

Ping statistics for 192.168.0.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

To test access by hostname: Type ping and then the hostname of the unit.

```
C:\>ping unit-72-1000

Pinging unit-72-1000 [192.168.0.2] with 32 bytes of data:

Reply from 192.168.0.2: bytes=32 time<1ms TTL=128
Reply from 192.168.0.2: bytes=32 time<1ms TTL=128
Reply from 192.168.0.2: bytes=32 time<1ms TTL=128
Reply from 192.168.0.2: bytes=32 time<1ms TTL=128

Ping statistics for 192.168.0.2:

    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

If pinging the hostname fails, but pinging the IP address does not, it may indicate a DNS problem. The command 'ipconfig /flushdns' may help if network settings have been changed recently on the Model 7100 Plus. Otherwise, the webpage can be accessed by IP address rather than hostname.

The web links for the Model 7100 Plus when using the configuration as shown above are <http://192.168.0.2/> or <http://unit-72-1000/>.

4.6 Optional I/O Setup

Each Optional I/O board must be assigned to a channel group (either 1-8 or 9-16). The current channel group the board is assigned to be is indicated at the top of the option board by a green LED. To change the assigned channel group perform the following:

1. Enter the Diagnostics Menu
 - a) Press the Main Menu button
 - b) Press the Up button to highlight Diagnostics
 - c) Press Edit three times to enter the Diagnostics Menu
2. Press Up to highlight I/O Board Config
3. Press Edit
4. Remove the PGM Jumper (J2) on the option board you wish to configure

5. Press Edit until the desired channel group is displayed
6. Replace the PGM Jumper (J2)
7. Press Next twice
8. Press Edit to accept the changes, and reboot the controller

The Channel group LED should now be illuminated next to the desired channel group.

4.6.1 Optional Relays

4.6.1.1 Programmable Relays

Each Optional I/O board must be assigned to a channel group (either 1-8 or 9-16). The current channel group a board is assigned to will be indicated at the top of the option board by a green LED. To change the assigned channel group perform the following:

1. Enter the Diagnostics Menu
 - a) Press the Main Menu button
 - b) Press the Up button to highlight Diagnostics
 - c) Press Edit three times to enter the Diagnostics Menu
2. Press Up to highlight I/O Board Config
3. Press Edit
4. Remove the PGM Jumper (J2) on the option board you wish to configure
5. Press Edit until the desired channel group is displayed
6. Replace the PGM Jumper (J2)
7. Press Next twice
8. Press Edit to accept the changes, and reboot the controller

The Channel group LED should now be illuminated next to the desired channel group.

4.6.1.2 A1 A2, A3 and Fault Votes Required

A1 Votes Required, A2 Votes Required, A3 Votes Required and Fault Votes Required are the number of A1, A2, A3 and Fault level alarms that must be present for the relay to activate. This allows creation of logical AND function equations that control standard relays. Default settings for standard relay 1 are A1 Votes = 01 A2 Votes = 00 & A3 Votes = 00 which causes relay 1 to trip if any channel has an A1 level alarm active. Default settings for standard relay 2 are A1 Votes = 00 A2 Votes = 01 & A3 Votes = 00 which causes relay 2 to trip if any channel has an A2 level alarm active. Example: If either default setting is modified such that A1 Votes = 02 and A2 Votes = 01, then any two channels must have an A1 level alarm active and any one channel must have an A2 level alarm active to trip that relay.

REMEMBER! One of the A1s and the A2 could be on the same channel. These level alarms must come from a channel included in the Zone entry described below.

4.6.1.3 Acknowledge

Turning Acknowledge Yes allows the standard relay to be deactivated during alarm conditions by an Alarm Reset. This is useful if an audible device is being driven by the relay

4.6.1.4 Failsafe

Failsafe controls relay activation for this standard relay. Failsafe Yes causes the relay to de-energize during alarm conditions and energize when there is no alarm. Thereby, a power failure forces the relay contact to the alarm position. Note the standard Fault relay is always failsafe and may be monitored separately to indicate loss of power conditions in many applications.

4.6.1.5 Zone 1-8

Zones offer additional flexibility by controlling which channel zones trip this menu's standard alarm relay. There are eight possible zones that can be assigned to the relays individually. Some applications have different types of sensors, or sensors in different areas connected to the same Model 7100 Plus Controller. In these cases, it may be undesirable for a sensor in one area to trip the same relay as a sensor in another area. The Zone menus may restrict this. For example, channels 1-3 might be set to trip standard relay 1 while channels 4-6 trip standard relay 2. This is done by assigning channels 1-3 to zone 1 and channels 4-6 to zone 2 and turning only zone 1 to YES for Standard relay 1 and only zone 2 to YES for standard relay 2. Another possibility is channels 1-3 be set to trip standard relay 1 while channels 4-6 trip relays on an optional discrete relay PCB configured for Alarm 1.

4.6.1.6 Override Channels 1-8

Override allows entering one of the 256 different alarms that will trip this relay regardless of the Votes or Zone entries. There are four alarms per channel and 16 channels and any one of these alarms may be used as the Override. This feature is useful when one channel's alarm has more significance than the others. Up to eight override alarms may be entered per relay.

4.6.1.7 Discrete Relays

Each Optional Discrete Relay board must be assigned to a channel group (either 1-8 or 9-16) and an alarm level. The current channel group and alarm level the board is assigned to be is indicated at the top of the option board by green LEDs. To change the assigned channel group or alarm level perform the following:

1. Enter the Diagnostics Menu
 - a) Press the Main Menu button
 - b) Press the Up button to highlight Diagnostics
 - c) Press Edit three times to enter the Diagnostics Menu
2. Press Up to highlight I/O Board Config
3. Press Edit
4. Remove the PGM Jumper (J2) on the option board you wish to configure

5. Highlight the channel range menu item
6. Press Edit until the desired channel range is displayed
7. Press Down to highlight the Alarm
8. Press Edit to change the Alarm setting to the desired alarm
9. Replace the PGM Jumper (J2)
10. Press Next twice
11. Press Edit to accept the changes, and reboot the controller

The Channel Range and Alarm LED should now be illuminated next to the desired settings.

If it is desired to have Alarm 1, 2 or 3 be failsafe, this setting can be changed in the Discrete Relay Settings Menu. To reach this menu, enter the Main Menu, highlight the Alarm Outputs Menu Item and press Edit. Highlight Discrete Relay, and Press Edit.

Setup of the Discrete Relays is now complete.

4.6.2 Analog 4-20mA and Bridge Input

Each Optional I/O board must be assigned to a channel group (either 1-8 or 9-16). The current channel group the board is assigned to be is indicated at the top of the option board by a green LED. To change the assigned channel group perform the following:

1. Enter the Diagnostics Menu
 - a) Press the Main Menu button
 - b) Press the Up button to highlight Diagnostics
 - c) Press Edit three times to enter the Diagnostics Menu
2. Press Up to highlight I/O Board Config
3. Press Edit
4. Remove the PGM Jumper (J2) on the option board you wish to configure
5. Press Edit until the desired channel group is displayed
6. Replace the PGM Jumper (J2)
7. Press Next twice
8. Press Edit to accept the changes, and reboot the controller

The Channel group LED should now be illuminated next to the desired channel group.

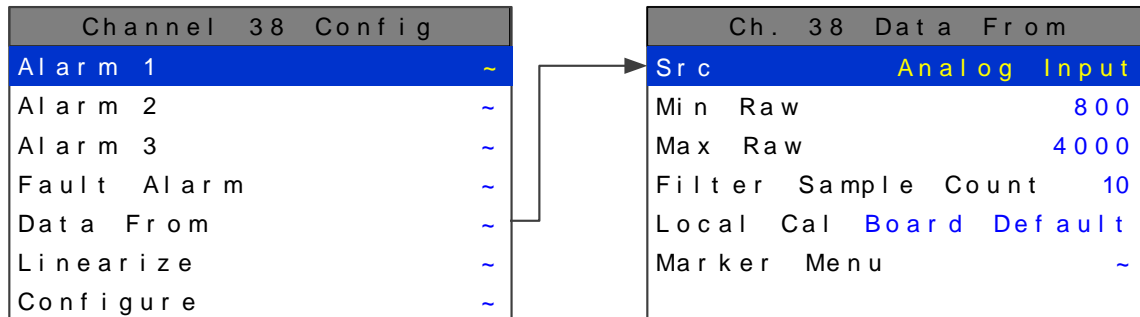


Figure 39 Analog Input Data From Menu

To Configure a channel for an Analog 4-20mA or Bridge Input, highlight the Src menu item and press Edit until Analog Input is selected.

4.6.2.1.1 Min an Max Raw

Min Raw and Max Raw counts entries included in Input Data From: menus define the range of input counts that provide Measurement Range read-out values. This menu entry is determined by the A/D converter resolution of the channel's input. For example, if the input is a 10 bit Modbus® device with zero at 200 counts and 100% at 1000 counts, then this menu's MIN should be set at 200 and MAX at 1000. If communicating with the Model 7100 Plus's optional 12 bit Analog Input PCB the MIN should be 800 and the MAX 4000.

If the input device's resolution is unknown, the live counts variable on the Combination screen displays actual raw A/D counts currently being read by this channel. This reading may be used to test the input device for what A/D counts are provided for zero and 100% if these values are unknown. Forcing the input device to read zero should provide the A/D counts value needed to make this channel's display also read zero. Likewise, forcing the input device to read 100% should provide the A/D counts value needed to make the Model 7100 Plus channel's display also read 100%.

Note: Each *Data From:* item has a matching default Min/Max counts value of 20% to 100% with $\pm 5\%$ over/under range applied. If the default value is incorrect for the input device it should be edited.

4.6.2.2 Filter Sample Count

The Filter Sample Count is the number of samples from an Analog Input channel that are averaged together before displayed. The valid range is 1-40 with the default value of 10. If a channel has a noisy input the sample rate can be increased causing the noise to average itself out. This higher number of samples causes the channel to react slower to input.

If an input is reacting to exposure of target gas too slowly, the Filter Sample Count can be reduced as long as the additional noise is permissible.

4.6.2.3 Local Cal

Local Cal is available with the Analog Input option. There are three choices Board Default, On, and Off. With the Analog Input option used for both the Analog and Bridge input boards, Board Default automatically turns the local calibration feature On for the Bridge input and Off for the Analog Input. If there is a need to calibrate a channel locally and the board default is Off it can be manually changed.

Calibration is discussed in detail in Chapter 5.

4.6.2.4 Marker Menu

Marker Menu setup is discussed in Chapter 4.13.

4.6.3 Analog Output

Each Optional I/O board must be assigned to a channel group (either 1-8 or 9-16). The current channel group the board is assigned to be is indicated at the top of the option board by a green LED. To change the assigned channel group perform the following:

1. Enter the Diagnostics Menu
 - a) Press the Main Menu button
 - b) Press the Up button to highlight Diagnostics
 - c) Press Edit three times to enter the Diagnostics Menu
2. Press Up to highlight I/O Board Config
3. Press Edit
4. Remove the PGM Jumper (J2) on the option board you wish to configure
5. Press Edit until the desired channel group is displayed
6. Replace the PGM Jumper (J2)
7. Press Next twice
8. Press Edit to accept the changes, and reboot the controller

The Channel group LED should now be illuminated next to the desired channel group.

Once the Channel Range has been assigned the Terminal Pair on the Analog Output board will transmit the associated channel's reading on a 4-20mA signal. For instructions on how to test the Analog Outputs refer to Chapter 7.5.

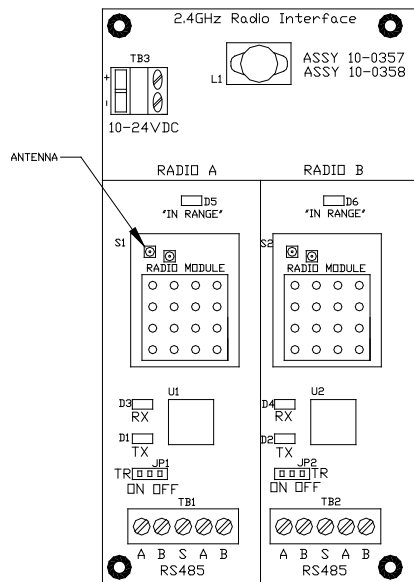
4.6.4 Wireless Communications

For details on wiring the wireless option board, refer to Chapter 3.4.

The Model 7100 Plus's communication ports may be connected to a FHSS (Frequency Hopping Spread Spectrum) wireless radio modem shown in the figure below. There are two different frequency options offered, 900 MHz and 2.4 GHz. 900 MHz is available in a single port modem (299-0207-01) or dual port modem (299-0208-01). 2.4 GHz is also available in a single port (299-0209-01) or dual port modem (299-0210-01). The dual port radio modems have two radio modules installed and can be used to receive and

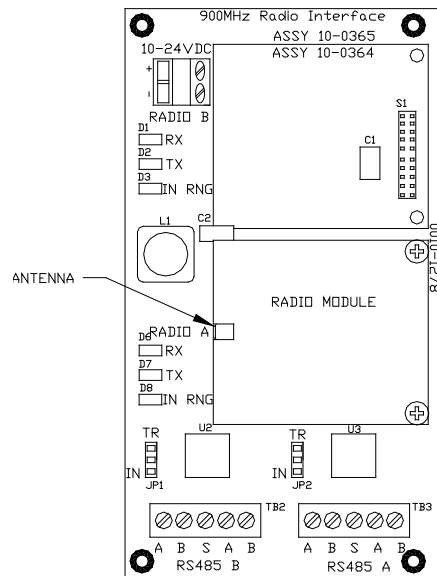
transmit data simultaneously. The radio kit options allow Wireless Modbus® Slave operations, providing data to a Modbus® *master* (*master* side of network requires additional radio), and Wireless Modbus® Master accepting wireless data from Modbus® *slaves* (*slaves* side of network requires additional radio).

- ✓ When used in the Wireless Modbus® Master mode, the radio must be connected to the Model 7100 Plus's RS-485 port configured for Modbus® Master.
- ✓ When used in the Wireless Modbus® Slave mode, the radio must be connected to the Model 7100 Plus's RS-485 port configured for Modbus® Master
- ✓ Each transceiver on a wireless network must have their Radio Setup menus configured to share the same hopping channel (0-32) and System ID (0-255) to communicate.
- ✓ All Sensidyne, LP wireless transceivers utilize a Server-Client network where Clients synchronize their hopping to the Server.
 - The Server transmits a beacon at the beginning of every hop (50 times per second).
 - Client transceivers listen for this beacon and upon hearing it will indicate InRange with the LED on the radio modem board and synchronize their hopping with the Server.
 - Each network should consist of only one Server.
 - There should never be two servers on the same RF Channel number in the same coverage area as the interference between the two servers will severely hinder RF communications.
 - The Server must be in a powered location
 - Servers typically should be centrally located since all Clients must receive the beacon in order to communicate.



2.4 GHz Radio Modem

Note: 299-0209-01 Has One Radio Module Installed
 299-0210-01 Has Two Radio Modules Installed



900 MHz Radio Modem

Note: 299-0207-01 Has One Radio Module Installed
 299-0208-01 Has Two Radio Modules Installed

4.6.4.1 WaveNet Wireless

The Model 7100 Plus utilizes Sensidyne, LP's wireless technology to make setup simplified with three easy steps.

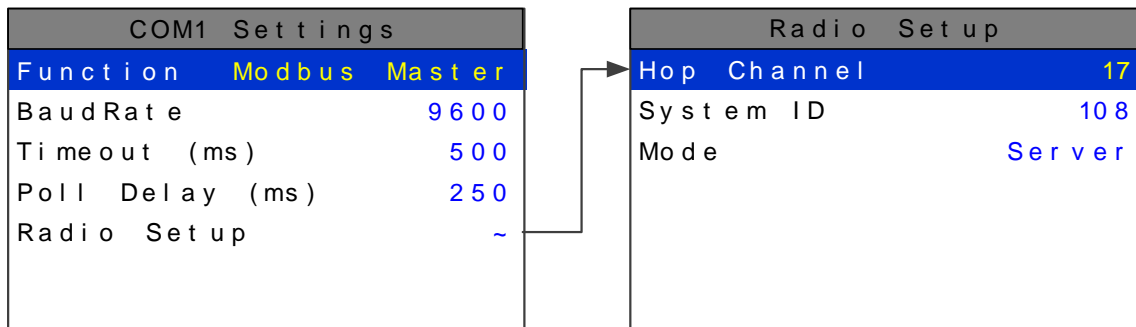
1. Power on the SensCast 7000/7000X (for the SensCast 7000 hold a magnet over the *Up* key, for the SensCast 7000X apply 10-30VDC to the power terminals).

Note: Once the detector is on the data screen, you may notice high or low values out of the full-scale range. These values should quickly return to the zero-gas value if no gas is present. No false alarms should be indicated at this time as the zero-gas value will be transmitted by the detector during the user-defined warmup delay period (up to 5 minutes).

2. Using the magnetic interface, navigate the menus to:
 - a. Ensure the Network ID matches the Network ID of the controller.
 - b. Set the RTU number to the desired number.
3. Verify proper operation by ensuring readings on gas detector and controller match.

4.6.4.2 Wireless Modbus®

Radio modules connected to the Model 7100 Plus's communication port may be configured through the Radio Setup menu. Enter the Radio Setup Menu by moving the selection bar over Radio Setup and press Edit.



COM1-4 Menus are Identical

Hop Channel may be set from 1-32 using the Model 7100 Plus keypad and assigns the pseudo-random radio frequency hopping pattern. A transceiver will not go **InRange** of, or communicate with, a transceiver operating on a different **Hop Channel**.

System ID may be set from 1-255 using the Model 7100 Plus keypad, and is similar to a password character or network number and makes network eavesdropping more difficult. A transceiver will not go in range of or communicate with a transceiver operating on a different **System ID**.

Mode may be set for **CLIENT** or **SERVER**. For a single Model 7100 Plus communicating to up to 16 wireless transceivers, Mode must = Server. If an application calls for multiple Model 7100 Plus locations, only one

may be set for Server and all others must be Clients. This single Server transmits a beacon which all of the network's Clients synchronize to. ONLY ONE SERVER PER NETWORK.

4.6.4.2.1 Wireless Modbus® Slave Mode

Wireless Modbus® allows one or many Model 7100 Plus(s) to function as wireless Modbus® slaves by connecting their RS-485 Modbus® slave ports to a radio modem. These wireless networks require a Modbus® master such as a DCS, HMI or another Sensidyne, LP Controller; also equipped with a radio modem. As in all Sensidyne, LP wireless networks, one transceiver must be designated as Server and all others as Clients. No special configuration is required by the *master* or *slave* since this is a standard Modbus® RTU network. However, radios must have the same Hop Channel and System ID settings to communicate.

The entire Model 7100 Plus Modbus® database, including registers and supported Function Codes, is documented in Appendix 3.

4.6.4.2.2 Wireless Modbus® Master Mode

Each Channel's Data From menu must be configured with the correct Modbus® values to match the slave device. Wired and wireless inputs may be mixed between the Model 7100 Plus's channels so it is also possible to accept wired signals from analog input option PCB's described in Chapter 4.3.1.

This is a popular application when the Modbus® slave is another remote Model 7100 Plus, Model 7100 or our Model 9000/Quad Four Channel controller available with built in radio modem compatible with the Model 7100 Plus Radio Kit. Other Modbus® slave devices may also be converted to wireless by addition of another Radio Kit at the slave's location.

4.7 Embedded Webpage

All Model 7100 Plus controllers come standard with an embedded webpage. The webpage gives remote access to view and configure parameters inside the controller. There are two levels of security clearance. The first level allows the user to view channel status and configuration while the second level allows the user to change configuration parameters directly from the computer.

The webpage requires a modern web browser. Supported browsers include Internet Explorer 8*, Google Chrome, or Mozilla Firefox 2+. Viewing pages in an outdated browser will result in improperly drawn pages.

In order to view the webpage first the user must know the IP address or, if DHCP enabled, the controller's hostname. This information can be viewed from the Network Settings Menu. Once the name or address is entered into a browser a pop up box ask the user for the username and password. The name and password are fixed. The default **NAME: admin** and the **PASSWORD: controller64**. After access is gained the user will be able to see channel data, event logs and configuration. If a parameter needs to be changed the user must enter the Modbus®/Web Code before the controller will accept the change. The default Modbus® Lock Code is **1234**. The login username, password and Modbus®/Web Code can be changed in the Security menu found in the Main Menu under Modbus® Lock Code.

* Internet Explorer does not allow access to hostnames that contain a '_' character.

4.7.1 System Screen

The System screen shown below displays all active channels at once. It is capable of displaying 8 or 16 channels depending on the controller's configuration. This screen, very similar to the Main Data screen, displays measurement name and uses colored cells that flash with new alarms to indicate alarm conditions. Once the alarms have been acknowledged by an operator the cell will remain the appropriate color but will stop flashing, showing the alarm has been acknowledged.

The five standard relays states are shown at the bottom of the screen. The boxes duplicate the LED behavior as seen when looking at the unit. A flashing box indicates an unacknowledged relay, a red box indicates an energized (de-energized for failsafe) relay.

While in the System screen, use the mouse to click on any cell to go directly to that channel's individual data screens. The unused channels are grayed out when turned off.

Viewing only channels belonging to a certain zone can be enabled using the zone drop down box. Selecting a zone will cause channels belonging to other zones to dim.

The System screen is updated automatically every 15 seconds.

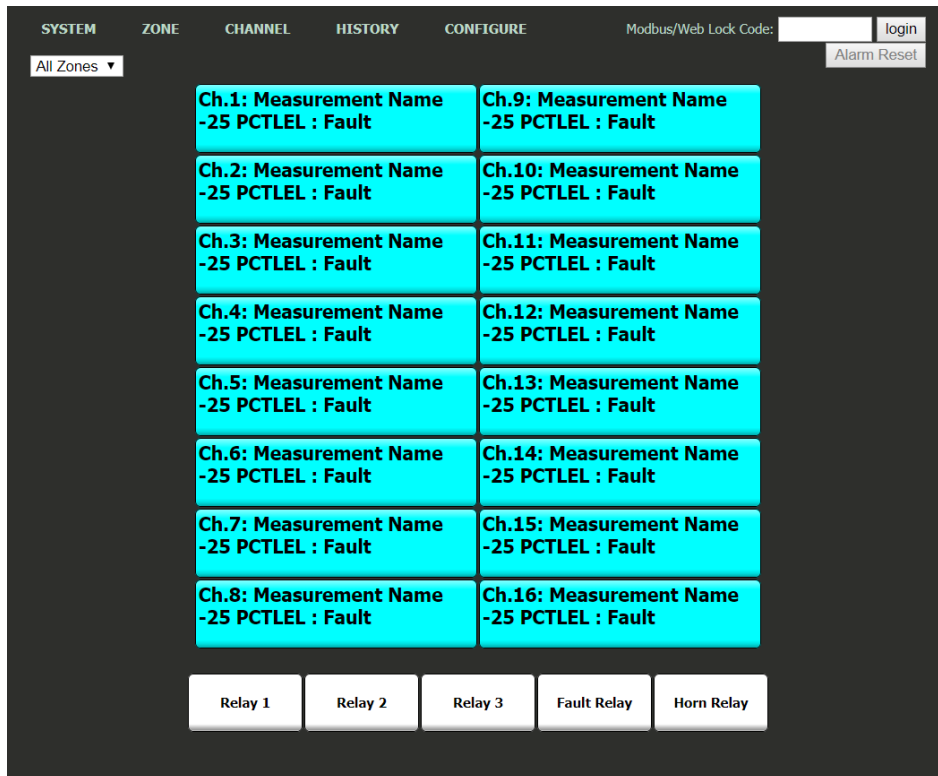


Figure 40 Webpage System Screen

4.7.2 Zone Screen

The webpage's Zone screen (below) displays the eight possible zones simultaneously. If an alarm condition occurs the user will be able to quickly see in what zone the situation is occurring. Each active zone is divided into alarm levels which are green until an alarm is present. Inactive zones and alarm levels are grayed out. If an alarm should occur, the zone name field will flash and the corresponding box in the assigned zone will turn the color of the alarm that is present or alternate if two different colors are present. Once the alarm has been acknowledged the name field will stop flashing.

To display all the channels included in any zone, use the mouse to click that zone box. The System screen will appear with all the channels that are included in the selected zone displayed in color and the channels that are not in the selected zone dimmed.

The zone screen is updated automatically every 15 seconds.

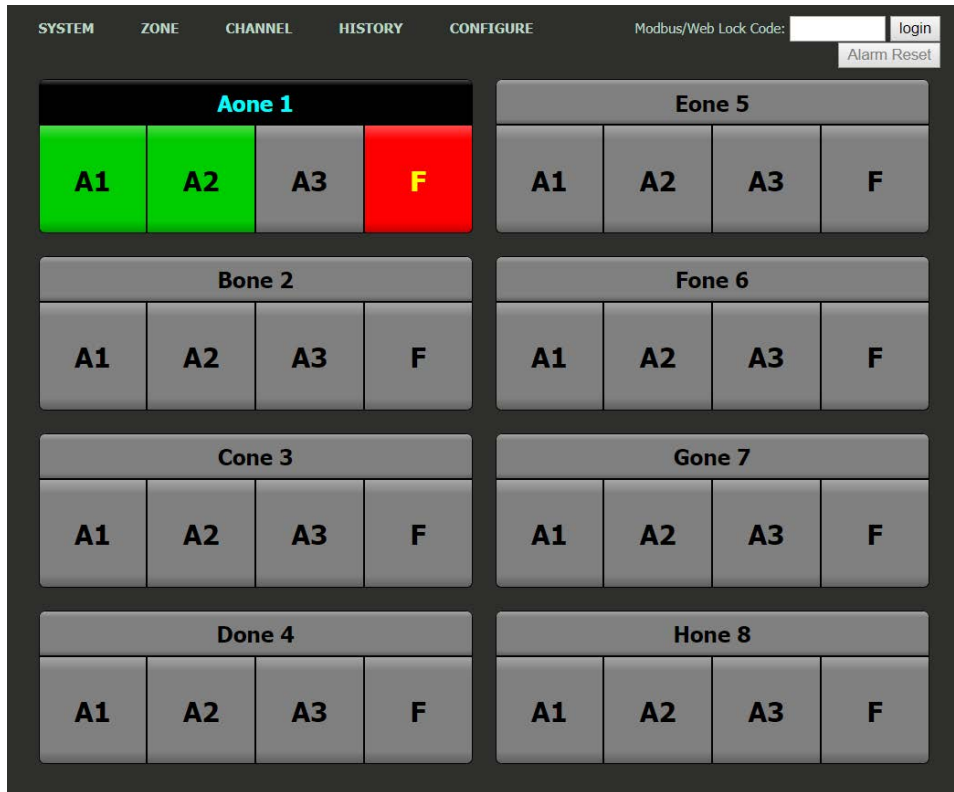


Figure 41 Webpage Zone Screen

4.7.3 Channel Screen

The Channel screen shown below displays a 24 hour trend of input data for the channel selected. Vertical tic marks are each hour and horizontal tic marks are each 10% of full scale. Colored lines indicate alarm levels. Since each data point must be collected for several minutes before it may be displayed, it is likely input values will fluctuate during this interval. Therefore, MAX, MIN and AVERAGE values are stored in the controller for each subinterval. Checking the Min, Max and Avg box in the lower left corner turns the respective lines on and off. If there is no trend data available, the corresponding section of the graph will be grayed out. This will occur on power interruptions.

The top portion of each trend screen indicates channel number, real time reading in engineering units, and measurement name. When a channel reaches alarm state, the colored bar changes to the color that represents that alarm level and flashes. Once the alarm is acknowledged the bar stops flashing.

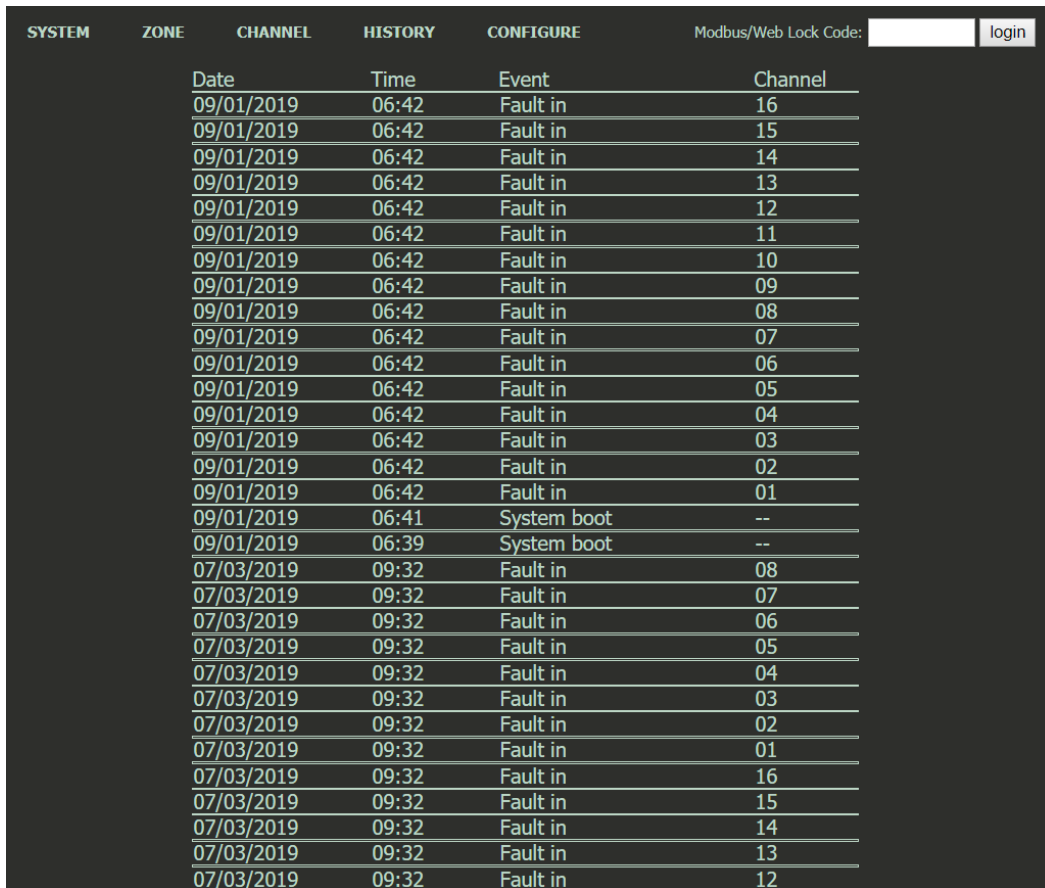
The top portion of the page updates automatically every 15 seconds. The trend is updated when a channel is changed or the 'Refresh Trend' button is pressed.



Figure 42 Webpage Channel Screen

4.7.4 Event Log Screen

The Event Log Screen displays the last 2000 events logged in the Model 7100 Plus. The events are logged in a first in first out format, in non-volatile memory so an SD card is not necessary to view the event log. These events include Alarms In and Out, Alarm Resets, Calibrations, System and Cold Boots, and Communication and Configuration Errors. The events are time and date stamped and if channel specific the number is shown in the right column in the figure below **Error! Reference source not found..**



SYSTEM	ZONE	CHANNEL	HISTORY	CONFIGURE	Modbus/Web Lock Code: <input type="text"/>	login
Date	Time	Event	Channel			
09/01/2019	06:42	Fault in	16			
09/01/2019	06:42	Fault in	15			
09/01/2019	06:42	Fault in	14			
09/01/2019	06:42	Fault in	13			
09/01/2019	06:42	Fault in	12			
09/01/2019	06:42	Fault in	11			
09/01/2019	06:42	Fault in	10			
09/01/2019	06:42	Fault in	09			
09/01/2019	06:42	Fault in	08			
09/01/2019	06:42	Fault in	07			
09/01/2019	06:42	Fault in	06			
09/01/2019	06:42	Fault in	05			
09/01/2019	06:42	Fault in	04			
09/01/2019	06:42	Fault in	03			
09/01/2019	06:42	Fault in	02			
09/01/2019	06:42	Fault in	01			
09/01/2019	06:41	System boot	--			
09/01/2019	06:39	System boot	--			
07/03/2019	09:32	Fault in	08			
07/03/2019	09:32	Fault in	07			
07/03/2019	09:32	Fault in	06			
07/03/2019	09:32	Fault in	05			
07/03/2019	09:32	Fault in	04			
07/03/2019	09:32	Fault in	03			
07/03/2019	09:32	Fault in	02			
07/03/2019	09:32	Fault in	01			
07/03/2019	09:32	Fault in	16			
07/03/2019	09:32	Fault in	15			
07/03/2019	09:32	Fault in	14			
07/03/2019	09:32	Fault in	13			
07/03/2019	09:32	Fault in	12			

Figure 43 Webpage Event Log

4.7.5 Configure

The configuration pages allow viewing and editing of most system parameters. The exceptions are communication and security settings which must be set from the unit's keypad interface. All changes made to the configuration parameters will not be saved until the user has entered the correct login password and the Save Button is clicked. For more information on how to configure the Model 7100 Plus refer to Chapters 4.2 and 4.3.

4.7.5.1 Alarm Outputs

Figure 44 Webpage Alarm Outputs Menu

4.7.5.2 Channel Configuration

SYSTEM ZONE CHANNEL HISTORY CONFIGURE Modbus/Web Lock Code:

Channel: **1**

Alarm 1	
Setpoint	<input type="text" value="20.000"/>
Latching	<input type="checkbox"/>
Trip On	<input type="text" value="High"/>
On Delay (seconds)	<input type="text" value="0"/>
Off Delay (minutes)	<input type="text" value="0"/>
Horn Drive	<input checked="" type="checkbox"/>

Alarm 2	
Setpoint	<input type="text" value="40.000"/>
Latching	<input type="checkbox"/>
Trip On	<input type="text" value="High"/>
On Delay (seconds)	<input type="text" value="0"/>
Off Delay (minutes)	<input type="text" value="0"/>
Horn Drive	<input checked="" type="checkbox"/>
Color	<input type="text" value="Red"/>

Alarm 3	
Enabled	<input type="checkbox"/>
Setpoint	<input type="text" value="60.000"/>
Latching	<input type="checkbox"/>
Trip On	<input type="text" value="High"/>
On Delay (seconds)	<input type="text" value="0"/>
Off Delay (minutes)	<input type="text" value="0"/>
Horn Drive	<input checked="" type="checkbox"/>
Color	<input type="text" value="Red"/>

Linearize	
Input	Output
<input type="text" value="10.000"/>	<input type="text" value="10.000"/>
<input type="text" value="20.000"/>	<input type="text" value="20.000"/>
<input type="text" value="30.000"/>	<input type="text" value="30.000"/>
<input type="text" value="40.000"/>	<input type="text" value="40.000"/>
<input type="text" value="50.000"/>	<input type="text" value="50.000"/>
<input type="text" value="60.000"/>	<input type="text" value="60.000"/>
<input type="text" value="70.000"/>	<input type="text" value="70.000"/>
<input type="text" value="80.000"/>	<input type="text" value="80.000"/>
<input type="text" value="90.000"/>	<input type="text" value="90.000"/>

Configure	
Channel Enabled	<input checked="" type="checkbox"/>
Tag	<input type="text" value="Measurement Name"/>
Engineering Units	<input type="text" value="PCTLEL"/>
Zero	<input type="text" value="0.000"/>
Span	<input type="text" value="100.000"/>
Decimal Places	<input type="text" value="0"/>
Zone	<input type="text" value="Aone 1"/>
Deadband (%)	<input type="text" value="1.000"/>

Data From	
Source	<input type="text" value="Analog Input"/>
Min Raw	<input type="text" value="800"/>
Max Raw	<input type="text" value="4000"/>
Filter Sample Count	<input type="text" value="10"/>
Local Cal	<input type="text" value="Board Default"/>

Marker	
Marker Enabled	<input type="checkbox"/>
Marker Setpoint (%)	<input type="text" value="-15.625"/>
Mark as	<input type="text" value="IN CAL"/>
Sensor Life Enabled	<input type="checkbox"/>

Fault	
Fault Level	<input type="text" value="-10.000"/>

Figure 45 Webpage Channel Configuration Menu

4.7.5.3 Copy Channels

The Copy Channels function allows the user to configure a single channel, and copy those configuration settings to multiple other channels. This can significantly reduce setup time by allowing the user to quickly enter channel data of inputs with similar parameters.

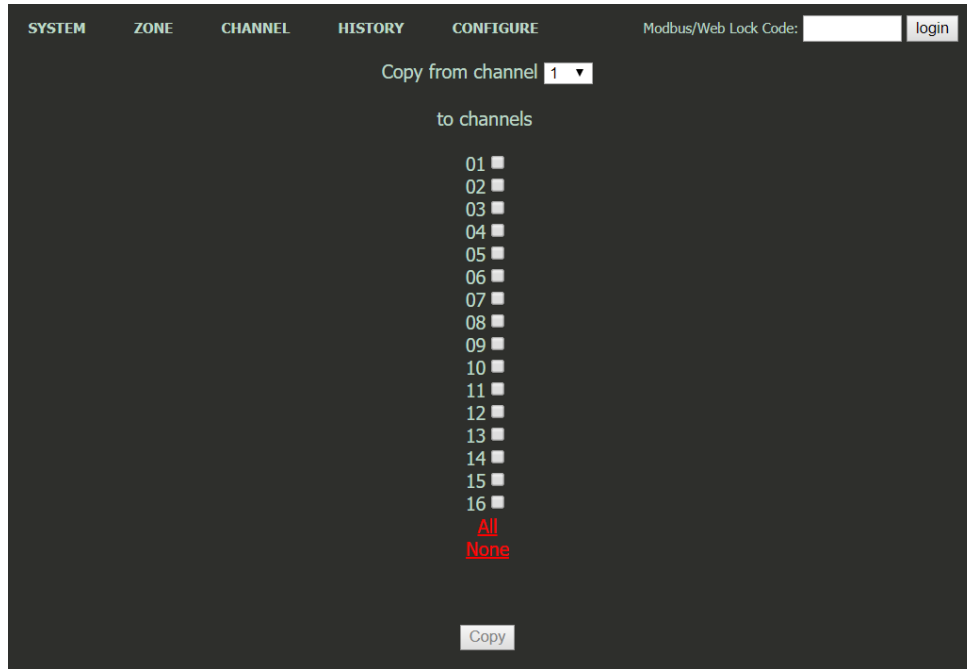


Figure 46 Webpage Copy Channels Menu

4.7.5.4 Programmable Relays

SYSTEM ZONE CHANNEL HISTORY CONFIGURE Modbus/Web Lock Code:

Programmable Relay 1 ▼ Relay Down Relay Up

Programmable Relay board not found.

A1 Votes	<input type="text" value="1"/>
A2 Votes	<input type="text" value="0"/>
A3 Votes	<input type="text" value="0"/>
Fault Votes	<input type="text" value="0"/>
Acknowledge	<input type="checkbox"/>
Failsafe	<input type="checkbox"/>
Zone 1	<input checked="" type="checkbox"/>
Zone 2	<input checked="" type="checkbox"/>
Zone 3	<input checked="" type="checkbox"/>
Zone 4	<input checked="" type="checkbox"/>
Zone 5	<input checked="" type="checkbox"/>
Zone 6	<input checked="" type="checkbox"/>
Zone 7	<input checked="" type="checkbox"/>
Zone 8	<input checked="" type="checkbox"/>

Email Enable	User 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/>
Email Subject (19)	<input type="text"/>
Email Body (129)	<input type="text"/>

Override 1	Type: <input type="text" value="None"/>
Override 2	Type: <input type="text" value="None"/>
Override 3	Type: <input type="text" value="None"/>
Override 4	Type: <input type="text" value="None"/>
Override 5	Type: <input type="text" value="None"/>
Override 6	Type: <input type="text" value="None"/>
Override 7	Type: <input type="text" value="None"/>
Override 8	Type: <input type="text" value="None"/>

Figure 47 Webpage Programmable Relays Menu

4.7.5.5 System Configuration

SYSTEM	ZONE	CHANNEL	HISTORY	CONFIGURE	Modbus/Web Lock Code: <input type="text"/>	login
System Config:						
Name	<input type="text" value="Unit-72-1000"/>					
Date	<input type="text" value="9"/>	/	<input type="text" value="1"/>	/	<input type="text" value="2019"/>	
Time	<input type="text" value="7"/>	:	<input type="text" value="27"/>	:	<input type="text" value="5"/>	
Channel Count	<input type="text" value="16"/>					
Display Alarm	<input type="text" value="Main Data"/>					
Cal Purge Time (min)	<input type="text" value="1"/>					
Warmup Time (min)	<input type="text" value="1"/>					
Alarm Refresh Time (min)	<input type="text" value="0"/>					
Zone Screen Enabled	<input checked="" type="checkbox"/>					
Block Negative	<input checked="" type="checkbox"/>					
<input type="button" value="Save"/>						
Zone Names:						
Zone 1 Name	<input type="text" value="Aone 1"/>					
Zone 2 Name	<input type="text" value="Bone 2"/>					
Zone 3 Name	<input type="text" value="Cone 3"/>					
Zone 4 Name	<input type="text" value="Done 4"/>					
Zone 5 Name	<input type="text" value="Eone 5"/>					
Zone 6 Name	<input type="text" value="Fone 6"/>					
Zone 7 Name	<input type="text" value="Gone 7"/>					
Zone 8 Name	<input type="text" value="Hone 8"/>					

Figure 48 Webpage System Configuration Menu

4.7.5.6 Email Configuration

Figure 49 Webpage Email Configuration Menu

4.7.5.6.1 Email Capabilities

4.7.5.6.1.1 Connection Capabilities

The email client uses ESMTP protocol to connect to a mail server. The user must provide their own mail server and sending account.

4.7.5.6.1.2 TLS (Transport Layer Security) Certificates

Implicit TLS (SSL) can be selected if the server expects a TLS connection to be opened. The default certificate processing does not validate server certificates with a certificate authority.

The email client will connect to the server using Implicit TLS (SSL). This is typically port 465. The email client will not connect to an unencrypted port (port 25) or send a STARTTLS command.

4.7.5.6.1.3 Users

- Up to 4 destination email users may be configured.
- Each email trigger can be programmed to send to any of all of the 4 users.
- Email addresses are limited to 40 characters

4.7.5.6.1.4 Events

Any system event can trigger an email. These are the same events that are entered into the event log. Event emails provide a predefined set of information relating to the event. For events such as alarms which have an in/out state event, the subscription will trigger both in and out type event emails.

4.7.5.6.1.5 Relay States

Changes to any standard or programmable relay can trigger an email. Emails are sent when the state of the relay changes. Programmable relay emails can be configured even if the relay option is not installed in the system. These settings are configured on the relay configuration web pages.

The subject and body are both customizable

Subject length is limited to 19 characters in addition to 16 characters for system name

Body length is limited to 129 characters

4.7.5.6.1.6 Summaries

Summary emails combine up to 50 system events into a single email. If more than 50 events occur in this period, only the last 50 are sent.

Daily summary sends at midnight.

Weekly summary sends at midnight on Saturday

4.7.5.6.1.7 Combined Messages

This option will merge emails per user if multiple events or relays trigger rapidly. Combining messages will reduce the number of emails a user receives in these situations. This option is recommended unless the emails are forwarding to a SMS text messaging address. Up to 20 events may be merged into a single email

4.7.5.6.1.8 Text Messaging

Emails can typically be forwarded to a SMS text message. This is accomplished by using the cellular provider's email forwarding address for an email user. An example for a Verizon customer is 4095550100@vtext.com

4.7.5.6.1.9 Discarded Messages

In some situations, emails will be discarded. The following cases may cause an email to not be sent.

- **Rapid email triggers:** If emails are being triggered more rapidly than they can be sent, only 50 messages may be queued at once. Once 50 messages are queued, the oldest messages will be replaced by newer messages. The messages will be sent from the queue in the order they occurred. This is only likely if the connection to the server is very slow.
- **Combined email limits:** If the combined email option is selected and the total length of the combined email is more than 2048 characters, the message will be truncated.
- **Email Server Connection Error:** If the email server connection is giving errors then all pending messages will be discarded. This only applies to server or authentication errors. Errors such as DNS timeout or SMTP timeout will result in a retry and the messages will not be discarded

4.7.5.6.2 Email Server Setup

To configure the email function included with the Model 7100 Plus it is first required to enter information about the outbound email server you will be using.

Hostname is the name of the host server of the outgoing email server you will be using (e.g. smtp.gmail.com for Gmail's SMTP server). Check with your email service provider for more details. The Port is the server port that will be used.

Username and Password are the Username and Password associated with the email address that will be sending the emails (e.g. Username: outgoingemail@gmail.com password: Password).

Once these settings are entered, click Save.

Click Test to ensure the configuration is working properly.

4.7.5.6.3 Email Setup

1. Check the Email Enabled checkbox to enable the email function
2. Check the Combine Messages checkbox to combine multiple emails into a single email
3. Assign up to four email recipients by entering their email addresses in the Email Users fields
4. Check the Event Message Box associated with the users who need to receive email notifications for the associated events
5. Check the Summary Message Box associated with the users who need to receive email summaries of events daily and/or weekly
6. Configure emails for relay states on the Alarm Outputs configuration page and the Programmable Relay configuration page

4.7.5.7 Configuration Upload/Download

The configuration upload/download page allows transferring system configuration to or from the unit via the webpage. When the download link is clicked, the unit saves the current configuration into a file and

transfers it to the user. It should be saved as a .cfg file. When uploading configuration, select a .cfg file and press upload. Note that the maximum length of a filename for an uploaded file is 28 characters. After a successful upload, the unit will restart and the webpage will attempt to refresh after 30 seconds.

Sensidyne, LP recommends downloading the Config File once the system is successfully setup and tested to be functioning as desired. This will allow the user quickly reconfigure a replacement unit in the event of a catastrophic failure of the Model 7100 Plus, or provide a reliable configuration setup for similar applications in different areas.

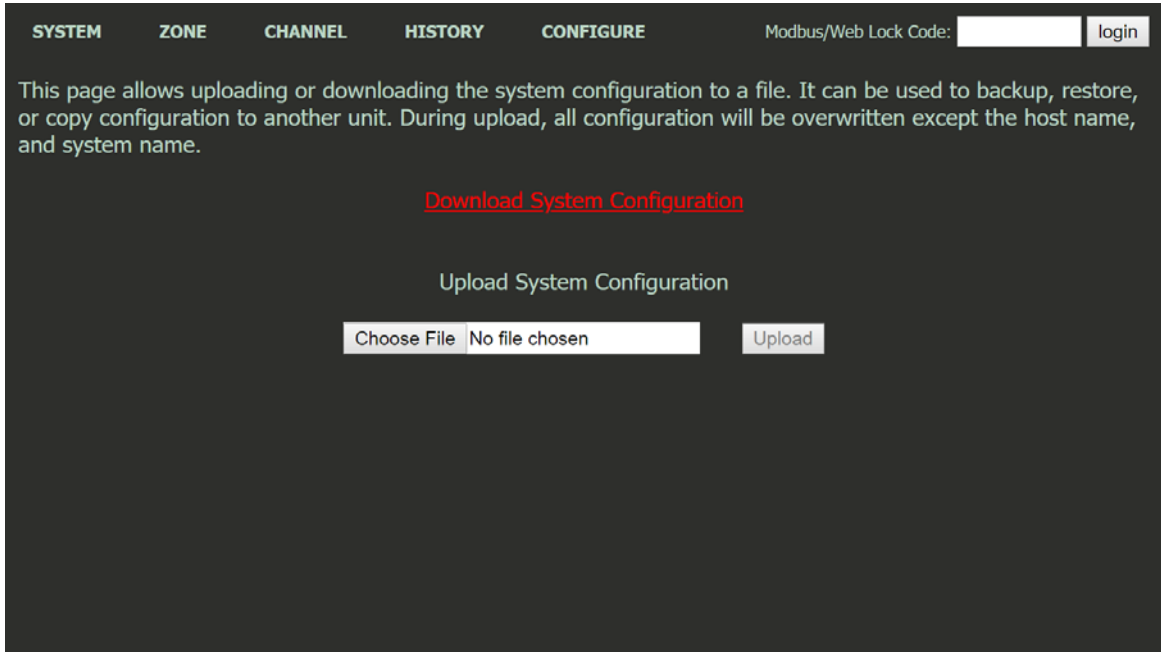
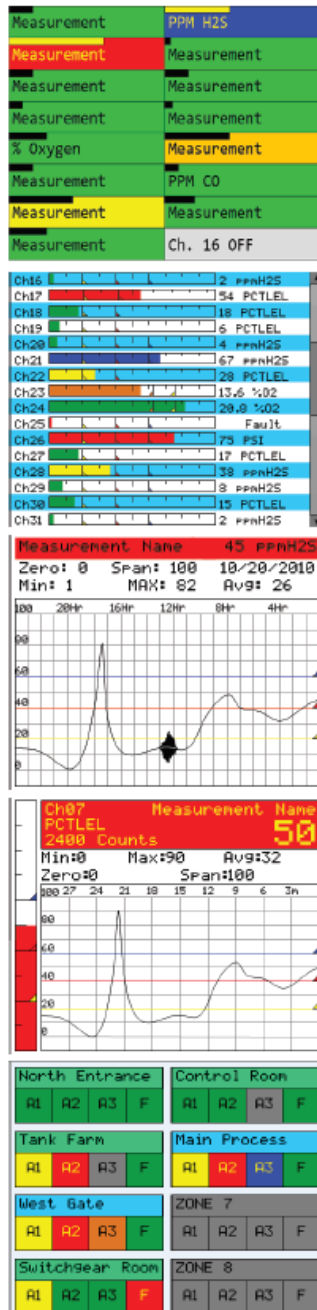


Figure 50 Webpage Configuration Upload/Download Menu

4.8 Normal Operation

During normal operation the input data is displayed on one of five data display screens as shown below. To cycle through the data display screens, use a press or use a magnet to swipe the *Next* key until the desired screen is reached.



MAIN DATA SCREEN

Displays all active channels on the same screen. Channel configurations include 16, active channels. Cells indicate alarm status by color.

BAR GRAPH SCREEN

Displays 16 channels at a time. Bar graphs change colors to indicate alarm status.

24 HOUR TREND SCREEN

Displays 1 channel at a time as most recent 24 hour trend. Top data fields include current reading, max - min - average readings over the 24 hours, range, channel ID and engineering units.

COMBINATION SCREEN

Displays 1 channel at a time as most recent 30-minute trend, bar graph and large engineering units. Top data fields include current reading, max - min - average readings over the 30-minutes, range, channel ID, and engineering units. Readings change color and flash on alarms. Flashing color becomes steady after acknowledge.

ZONE SCREEN

Displays all eight possible active zones. Alarm cells change colors and name field flashes indicating alarms. Allows user direct access to screen that shows which channels belong to each zone.

Figure 51 Model 7100 Plus Data Display Screens

4.9 Fault Condition

The Fault alarm is used to indicate a condition when there is a failure from the sensor or an out of range state has been reached. It is recommended to set the fault alarm level to -10% of the span value. For example, if an H₂S sensor is installed with a span value of 100, the fault should be set at -10, or if an oxygen sensor is installed with a span value of 25, the fault setting should be -2.5.

The Fault relay is always Failsafe. This is necessary for the relay to de-energize in the event there is a loss of power, so that a Fault will be indicated by the display color changing to red and the red Fault LED flashing.

4.10 Alarm Conditions

The Model 7100 Plus allows the user to select the color associated with a certain alarm level. Options include yellow, orange, red, blue and purple. Alarm 1 is always set to yellow, and the Fault alarm is always set to Red.

When an alarm level is reached, the display will change the channel's color to the user defined color and the alarm level will flash on the display. If Latching is turned on, the alarm will stay enabled until the user acknowledges the alarm, even if the alarm condition has cleared.

4.11 Communication Errors

The Master Timeout menu item, found in the Comm Port Settings Menus affects the Model 7100 Plus's *master* Modbus® ports. Timeout is the length of time in milliseconds the controller waits before a Modbus® request fails. Three consecutive failed requests must occur before a communication error is indicated. This item is useful for optimizing throughput to the Model 7100 Plus from other slave RTUs.

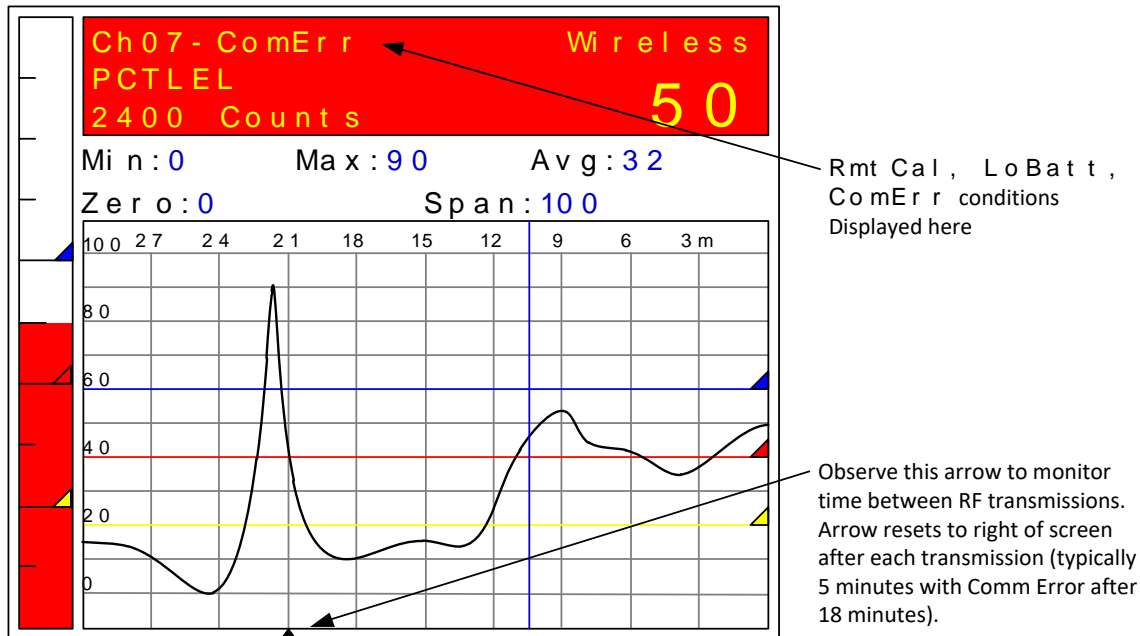


Figure 52 Error Indications

Each channel's 30-minute trend screen (above) is useful for diagnosing wireless problems since it indicates amount of time since the most recent transmission was received. The arrow on the bottom of the trend screen resets to far right each time a transmission is received by that channel. When not in alarm, ST-48/RFs transmit every 5-minutes so the arrow should never progress past the 5-minute interval. The Model 7100 Plus activates the channel's FAULT alarm and indicates ComErr if no transmission has been received in 18 consecutive minutes. This interval can be adjusted in the communication settings menu for transmitters that are configured to communicate more often.

4.12 Low Battery

When using one of Sensidyne, LP's SensCast series of gas detectors, and the voltage of the integral 3.6V Lithium battery drops below 3.3V, a Low Battery alarm will be displayed on the Model 7100 Plus's display on the corresponding channel. When this alarm is received, the battery should be replaced very soon.

LoBatt is indicated on the Model 7100 Plus's LCD readout and the background color turns red. Relays are not energized by low battery conditions. The actual battery voltage of each detector may be seen in the Data From menu.

4.13 Calibrations

Calibrations force a transmission of 75 counts (negative 15.62%) which is indicated on the Model 7100 Plus's LCD readout by In Cal by using the Marker Menu described in the next section. Alarms are inhibited while the Marker Value of -15.62% is activated.

4.14 Markers

Some monitoring devices providing the Model 7100 Plus inputs also indicate special modes of operation, such as *Calibration*, *Maintenance* or *Fault*, by transmitting a special <4mA or negative “Marker” value. The Model 7100 Plus offers channel Marker menus for detecting and indicating such events (below). While active, the Model 7100 Plus displays a 6-digit ASCII message to indicate the special event.

If equipped with 299-0193-01 4-20mA output option, the Model 7100 Plus also transmits the same <4mA value.

4.14.1 Marker Menu

The diagram shows two terminal screens. The left screen is titled 'Ch. 38 Data From' and has 'Src Wireless Monitor' highlighted. The right screen is titled 'Ch. 38 Marker Menu' and has 'Marker Enabled Yes' highlighted. An arrow points from the 'Marker Menu' option in the left screen to the 'Marker Enabled' option in the right screen.

Ch. 38 Data From		
Src	Wireless Monitor	
Min Raw		200
Max Raw		1000
Remote ID		10
Interface		COM1
Marker Menu		~

Ch. 38 Marker Menu		
Marker Enabled		Yes
Marker %		-16
Mark as		IN CAL
Sensor Life		Yes

Figure 53 Marker Menu

4.14.2 Marker Enabled

Turns the marker feature ON and OFF

4.14.3 Marker %

The negative Marker value is entered into the **Marker %** field as a negative percent of full scale. For example, -15.62% of full scale detects a marker value of 1.5mA (1.5mA is -15.62% of full scale when 4-20mA is the range). Marker mode is active when the input value reads the Marker % +/- 1% of full scale.

4.14.4 Mark As

The **Mark As** menu allows user entry of the 6-digit ASCII message to be displayed when the marker is detected.

4.14.5 Sensor Life

Note: This feature is exclusive to Sensidyne, LP Gas Detectors. Sensor Life should only be activated when the Marker event is *Calibration*, and when used with an Sensidyne, LP gas detector, where sensor life value is transmitted after each calibration.

For Sensor Life to record properly the monitor must perform as follows: After the *Calibration* Marker interval, 4.0mA transmits for 10 seconds to indicate its *calibration mode* is complete. The monitor then

transmits between 4.0mA and 5.0mA for five seconds depending on remaining sensor life where 4.0mA = 0% and 5.0mA = 100% remaining sensor life. The Model 7100 Plus reads this value and records it as the channel's Sensor Life. Sensor Life is stored in the Model 7100 Plus Modbus® database and displayed as a bar-graph in the Sensor Info screen. This is a useful tool for planning sensor replacement schedules.

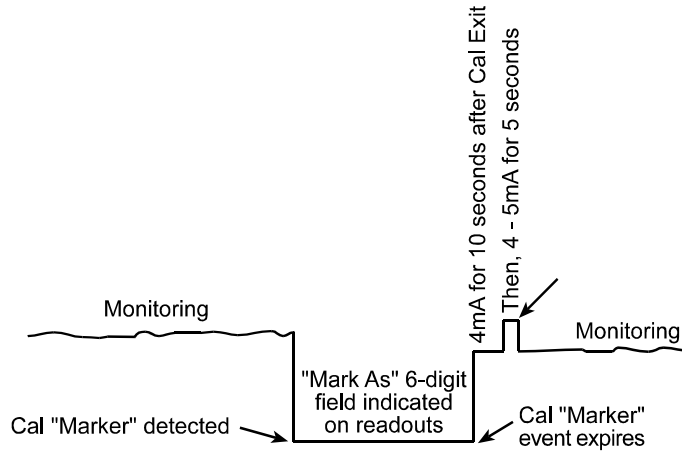


Figure 54 Sensor Life Transmission Diagram

Chapter 5 Calibration Procedure

5.1 Preparation

Caution: Calibration of inputs should only be performed at the Model 7100 Plus when the sensor has no zero and span controls within the sensor itself.

Calibration is the most important function for ensuring correct operation of the Model 7100 Plus. The CAL MODE is designed to make calibration quick, easy and error free, and a successful Zero and Span calibration requires only four keystrokes. The 4-20mA output transmits 3mA during the calibration, and 4mA during calibration purge to prevent alarms. After 5 minutes of inactivity the controller will exit calibration mode automatically.

- Sensidyne, LP recommends performing calibrations
 - ✓ Immediately prior to placing a gas detector in service
 - ✓ Any time a new sensor is installed
 - ✓ Every six months for routine calibrations (more often if sensor is known to have been exposed to gas for extended periods of time)
 - ✓ Periodic bump tests are recommended if detector has potentially been exposed to incompatible gases to ensure correct operation
- Follow these calibration guidelines to ensure proper operation of your Sensidyne, LP, Inc. gas detector:
 - ✓ Calibration accuracy is only as good as the calibration gas accuracy. Sensidyne, LP recommends calibration gases with National Institute of Standards and Technology (NIST) traceable accuracy to increase the validity of the calibration.
 - ✓ Do not use gas cylinders beyond their expiration date.
 - ✓ Calibrate a new sensor before it is put in use.
 - ✓ Allow the sensor to stabilize before starting calibration.
 - ✓ Calibrate on a regular schedule. Sensidyne, LP recommends once every 6 months, depending on use and sensor exposure to poisons and contaminants.
 - ✓ Calibrate only in a clean atmosphere, free of background gas.

Prior to beginning your calibration make sure you have the following items:

1. A cylinder of calibration gas with concentration equal to the SPAN GAS VALUE setting (Sensidyne, LP typically recommends choosing a value at 50% of full scale.)
2. A cylinder of Zero Air (unless you are confident there is no target gas potentially present in the area)
3. A flow regulator, a fixed flow of 0.5LPM is recommended for most applications, but some instances may require a 1.0LPM fixed flow regulator.
4. A Calibration Cup or Calibration Adaptor
5. Sufficient length of flexible tubing to connect the regulator to the calibration adaptor

5.2 Menu Settings for Calibration

5.2.1 Local Cal

Local Cal is a setting available for both the Analog Input and Bridge Input options, and is configurable in the channel's Data From Menu.

There are three choices Board Default, On, and Off. With the Analog Input option used for both the Analog and Bridge input boards, Board Default automatically turns the local calibration feature On for the Bridge input and Off for the Analog Input. If there is a need to calibrate a channel locally and the board default is Off it can be manually changed.

Model 7100 Plus Cal Mode features allow pushbutton calibration of zero and span values. This feature should be utilized only when there are no other zero/span controls within the monitoring system since it is inappropriate to calibrate a signal at more than one point. Therefore, if calibration is to be performed at another transmitter or monitoring device, the Model 7100 Plus Cal Mode feature should not be used.

The Calibration Menu allows entering the correct Cal Zero & Cal Span set-point values needed to calibrate the sensor. These are entered in the same engineering units as input range.

Cal Purge Time Found in the channel setting menu, Cal Purge Time is a setting that can be adjusted up to 5 minutes. This setting is used to provide sufficient time for the calibration gas to purge from the detector and reading to return to normal levels prior to re-enabling outputs and alarm settings.

5.3 Routine Calibration Procedure

Set Zero & Set Span controls in the Local Cal menu allow pushbutton calibration by moving the highlight bar to each and pressing the Edit button.

Unintentional calibrations are reset by the **Set Unity Gain** menu item. **Set Unity Gain** resets zero offset to 0 and span gain to 1. It is useful for returning the calibration to a known starting place. Sensor aging may be monitored by recording zero and span readings at Unity Gain when it is new, and again at later dates when degradation may have occurred.

Use the following procedure to perform Zero and Span calibrations.

1. Apply the ZERO calibration value to the sensor and observe the live reading
2. If the zero reading differs from the zero setpoint, a calibration is needed
3. To calibrate zero, move the highlight bar to Set Zero and press Edit
4. A warning message explains that pressing Edit again will change the zero calibration and any other key will exit

Note: For span calibration, if a gas sensor is to be spanned with 50% span gas, the span set-point must be 50%. If 45% is to be used later, the span set-point must be changed to 45% to match the span calibration gas.

5. Apply the SPAN calibration value to the sensor and observe the live reading and allow the reading to stabilize
6. If the reading differs from the gas applied, a span calibration is needed
7. Move the pointer to the Set Span entry and press Edit twice

Note: Unity Gain may be used at any time to cancel incorrect calibrations and start again.

Calibration history records are logged and may be viewed in the Even Log.

5.4 Bump Test Procedure



Note: A bump test, when performed correctly, is meant to check both sensor and alarm functionality. This results in expected alarms, and proper precautions should be taken.

Also known as a functionality test, a bump test is not meant to test the accuracy of the detector, and no calibration settings are changed during the test.

To perform a bump test, briefly expose the sensor to a gas of known concentration (above the Low Alarm set point), and check to ensure the display reading increases to a value within tolerance of the concentration applied and check for alarm actuation. If the sensor does not perform as expected, Sensidyne LP recommends performing a routine calibration and/or replacing the sensor. If the alarm does not perform as expected check the detector's alarm settings.

Chapter 6 Maintenance Procedure

Sensidyne LP recommends performing visual inspections at regular intervals to ensure proper functionality of the Model 7100 Plus. Visual inspection of enclosure and conduit entries should be performed to check for cleanliness and physical integrity. Cleaning the Model 7100 Plus is recommended when necessary, but be aware that some cleaning compounds may be detected by an operational gas detector depending on the sensor type. So, proper precautions should be taken.

Sensidyne, LP recommends calibrations:

- ✓ Immediately prior to placing a gas detector in service
- ✓ Any time a new sensor is installed
- ✓ Every six months for routine calibrations (more often if sensor is known to have been exposed to gas for extended periods of time)
- ✓ Periodic bump tests are recommended if detector has potentially been exposed to incompatible gases to ensure correct operation

Chapter 7 Diagnostics and Troubleshooting

A *System Diagnostic Mode* may be entered during normal operation from the Main menu. The entry menu, shown below, offers useful routines for testing front panel LED's, relays, serial ports and analog I/O. It is exited manually by pressing Next and automatically if no keys are pressed for 5 minutes. The unit will reboot when diagnostics is exited. It is very important to understand that



CHANNEL INPUT DATA IS NOT PROCESSED WHILE IN DIAGNOSTICS MODE. It is possible to miss important input values while utilizing this mode and appropriate safeguards should be in place. However, the Diagnostics Mode can prove invaluable when testing I/O since relays and analog outputs may be stimulated without driving inputs to precise levels.

7.1 Standard Relays

Standard Relays allows manual actuation of the Standard Relays, Horn Relay and Fault Relay while in the Diagnostic mode. Highlight the relay to be actuated and press Edit. LEDs on the Main I/O board confirm relay actuation.

Standard Relay	
Standard Relay 1	Off
Standard Relay 2	Off
Standard Relay 3	Off
Fault Relay	Off
Horn Relay	Off

Figure 55 Standard Relay Diagnostics Menu

7.2 Discrete Relays

Discrete Relays allows manual actuation of the connected Discrete Relays while in the Diagnostic mode. Highlight the channel group to be actuated and press Edit. Then select the alarm group and press Edit. These steps allow the actuation of each relay in the group to be activated individually. LEDs on the Discrete Relay board confirm relay actuation.

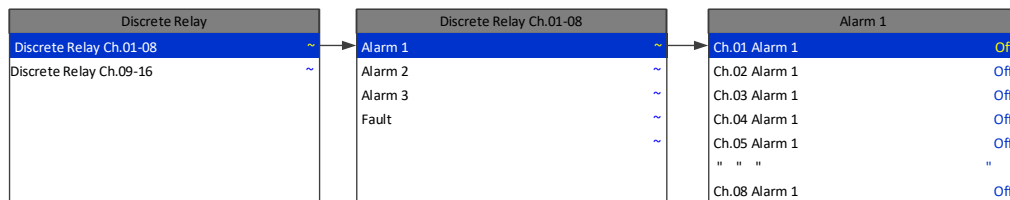


Figure 56 Discrete Relay Diagnostics Menu

7.3 Programmable Relays

Programmable Relays allows manual actuation of the Programmable Relays while in the Diagnostic mode. Highlight the relay to be actuated and press Edit. LEDs on the Programmable Relay board confirm relay actuation.

Programmable	
Programmable Rly.01	Off
Programmable Rly.02	Off
Programmable Rly.03	Off
Programmable Rly.04	Off
Programmable Rly.05	Off
" " "	"
Programmable Rly.08	Off

Figure 57 Programmable Relay Diagnostics Menu

7.4 Analog Inputs

By selecting a channel group you can View Inputs or Calibrate Board.

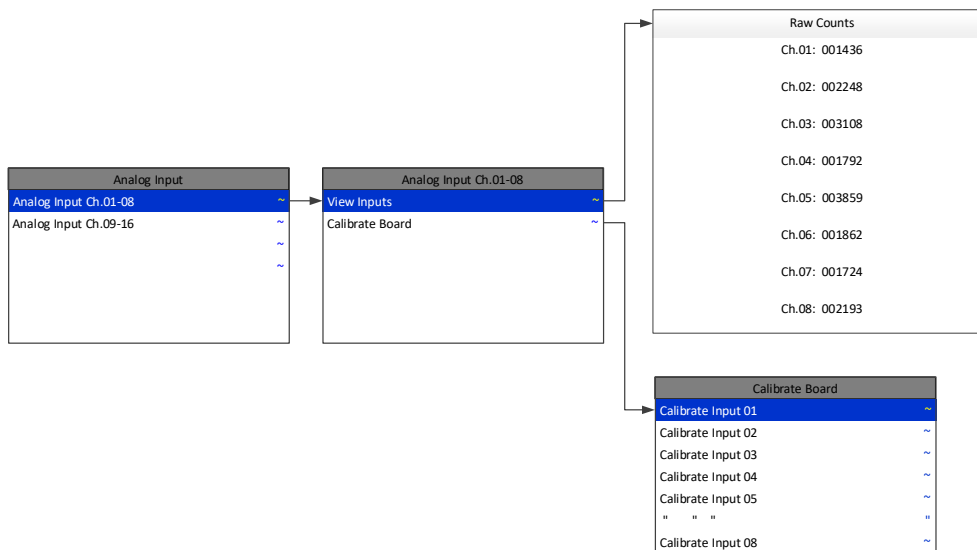


Figure 58 Analog Inputs Diagnostics Menu

7.4.1 View Inputs

The channel inputs are displayed as raw counts. This can be useful for trouble shooting. These counts have no calibration applied to them so the user can see if a particular channel's Analog to Digital counts correspond to the expected values.

7.4.2 Calibrate Board

Initial calibrating of each analog input channel is done at the factory by selecting each channel, one at a time, and applying 20mA. The analog input board self-adjusts its output, and stores this value in non-volatile memory.

7.5 Analog Outputs

If the Model 7100 Plus is equipped with an analog output option board the output can be manually stimulated by selecting the channel group, then the channel, to be ramped up. Pressing the Edit increases the output value in 4mA increments from 0mA to 20mA.

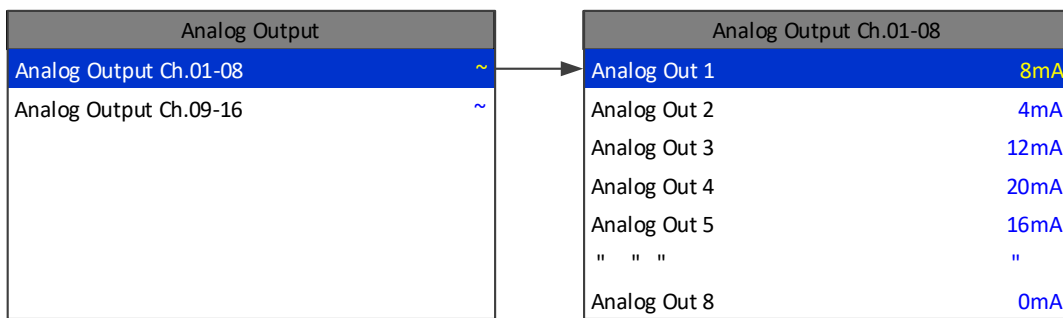


Figure 59 Analog Output Diagnostics Menu

7.6 Piezo

Selecting Piezo pulses the controller's local Piezo buzzer.

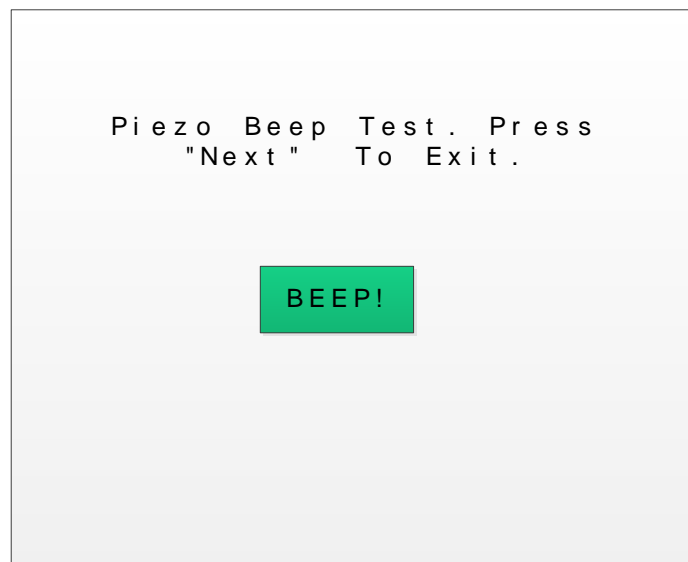


Figure 60 Piezo Beep Test Menu

7.7 LEDs

Selecting LEDs from the diagnostics menu causes the six LEDs on the front panel to blink without affecting their corresponding relays. All six relay will cycle individually as indicated on the screen.

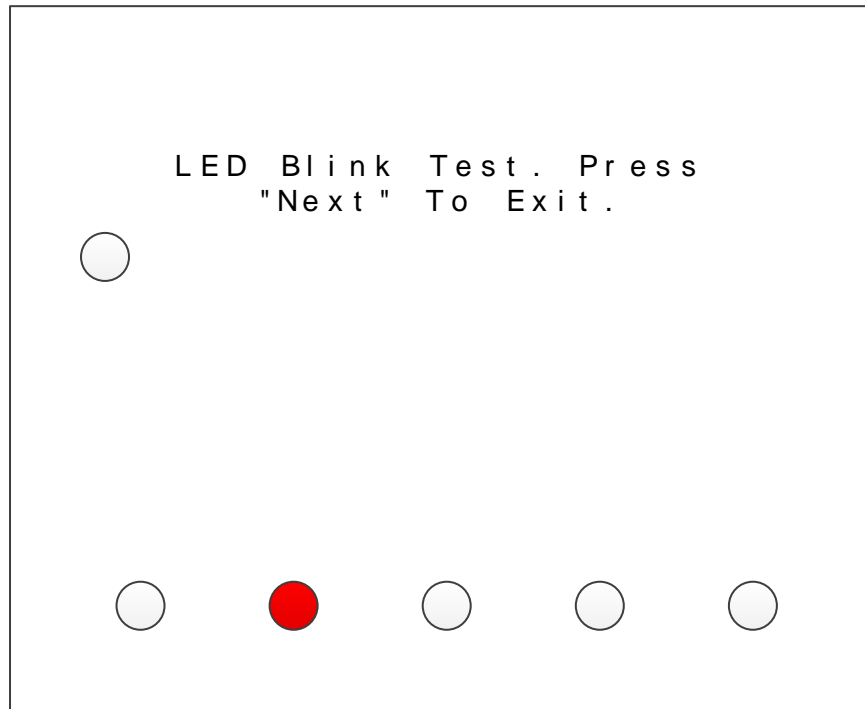


Figure 61 LED Blink Test Menu

7.8 Serial Ports

Testing the controller's standard and optional communication ports is made easy by connecting the ports together as shown below, and selecting Serial Ports in the diagnostic menu. The controller does a self-diagnostic by polling one communication port with the other to ensure correct operation. It gives a Success or Failure report. If the optional communication ports 3 and 4 are not installed they will show a failure as illustrated in below.

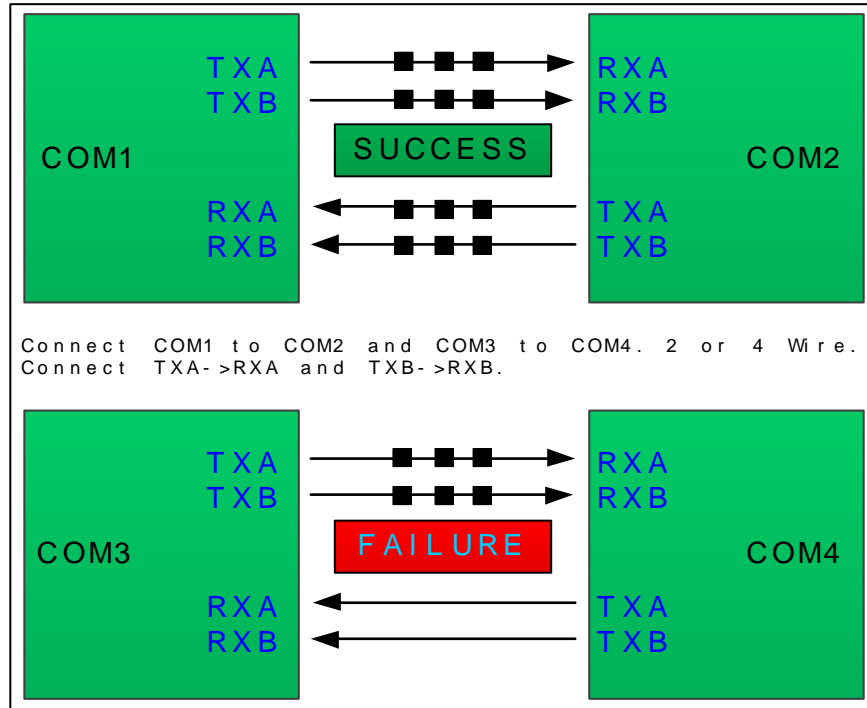


Figure 62 Serial Port Loop Back Test Menu

7.9 I/O Board Configuration

The board configuration screen shows all connected I/O options. This is also the menu where the user must go if they want to change the configuration or channel group of an option board. To change the configuration of an option board

1. Highlight I/O Board Config
2. Press Edit
3. Remove the PGM Jumper (J2) on the option board you wish to configure
4. Press Up, Down and Edit until the desired channel group is displayed
5. Replace the PGM Jumper (J2)
6. Press Next twice
7. Press Edit to accept the changes, and reboot the controller

The Channel group LED should now be illuminated next to the desired channel group.

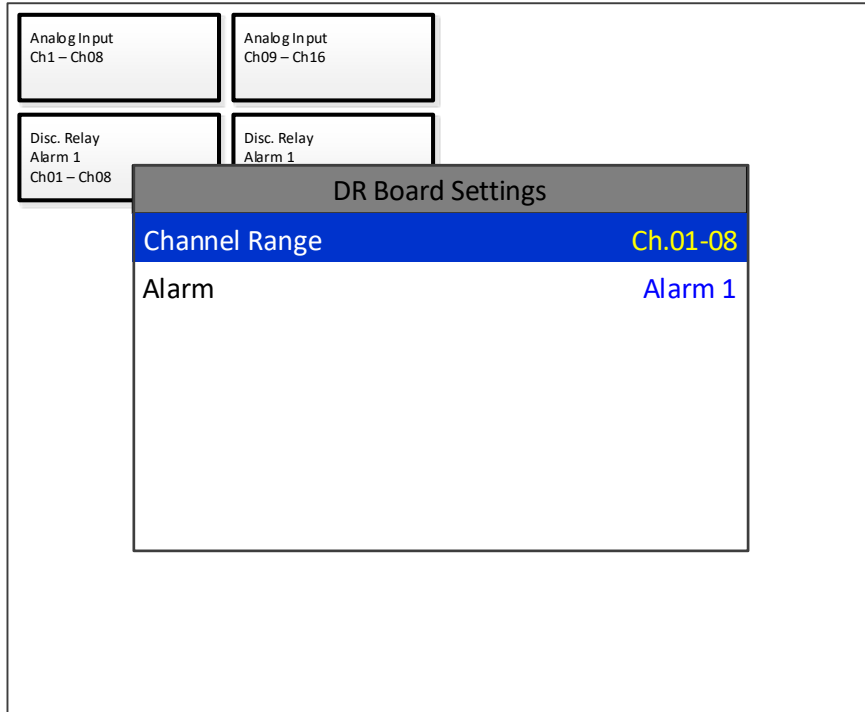


Figure 63 I/O Board Configuration Menu

Appendix 1 Model 7100 Plus Specifications

7.9.1 DC Power Supply Requirements

Standard Model 7100 Plus power requirements are 10-30VDC @ 12 watts applied to terminals 1 & 3(+) and 5 & 7(-) of TB4 on the standard I/O Board ([see section 3.0](#)). Optional features increase power consumption as described below:

- Discrete Relay Board option; add 6.5 watts per board (assumes all 16 relays are energized).
- Programmable Relay Board option; add 6.5 watts per board (assumes all 16 relays are energized).
- Analog Input Board option; add 1/2 watts per board plus transmitter power consumption.
- 4-20mA Output Board option; add 2.5 watts per board.
- Auxiliary Standard Relay Board option; add 2.5 watts.
- Isolated Serial Expansion Board; add 1.5 watts.
- TB4 terminals 2, 4, 6 & 8 of the standard I/O Board provide a maximum of 500mA fused output power for powering of auxiliary external devices such as relays, lamps or transmitters. Power consumed from these terminals should be considered when calculating system power consumption.

7.9.1.1 150 Watt AC – 24VDC Power Supply

7.9.1.1.1 299-0203-01 150 W Power Supply

100-240V~, 50/60Hz, 1.1A Auto switching power supply

Note: When equipped with 299-0203-01 power supply, the current consumption of the external devices powered by the equipment at 24V dc shall not exceed 2A

7.9.1.1.2 10-0172 150 W Power Supply

*110-120 VAC @3.2A max

*220-240VAC @ 1.6A max

* A slide switch on the front of the power supply selects AC input range.

The 299-0203-01 150 watt power supply is for powering the Model 7100 Plus and up to 16 detectors.

7.9.1.2 Relays

The Model 7100 Plus comes standard with five Standard SPDT 5A relays, consisting of one dedicated HORN and one dedicated FAULT relay plus 3 programmable alarm relays. Programmable relays provide voting logic for ALARM 1, ALARM 2, and ALARM 3. Discrete relays and additional Programmable relays are optional. All relays are rated at 5 Amp for 28 VDC and 250 ~VAC RESISTIVE loads.



IMPORTANT: Appropriate diode (DC loads) or MOV (AC loads) snubber devices must be installed with inductive loads to prevent RFI noise spikes. Relay wiring should be kept separate from low level signal wiring.

7.9.2 Ambient Temperature Range

-25 to 60 degrees C

7.9.3 Humidity Range

0 TO 90% R. H. Non-Condensing.

7.9.4 Altitude

Recommended up to 2000 meters





7.9.5 Housings

*General purpose panel mount weighing 7 lbs. and including hardware for 19" rack mounting.

*NEMA 4X wall mount in fiberglass enclosure weighing 54 lbs.

*Includes non-intrusive magnetic keypad.

7.9.6 Non-intrusive Magnetic Keypad

The Model 7100 Plus operator interface includes eight front panel *touch* keys  /  /  /  /



. A magnetic keypad offers these eight keys with adjacent magnetic keys. It is useful in applications where it may be inconvenient to open the enclosure's door to access the *touch* keypad.

7.9.7 Approvals

- CE Mark
- C22.2 No. 142-M1987 - Process Control Equipment
- CAN/CSA-C22.2 No.152-M1984 - Combustible Gas Detection Instruments
- ANSI/ISA-12.13.01-2000 - Performance Requirements for Combustible Gas Detectors
- CSA-C22.2 No. 213-M1987 - Non-Incendive Electrical Equipment for Use in Class I, Division 2 Hazardous Locations
- UL Std No. 1604, Third Ed. - 1994 - Electrical Equipment for Use in Class I and II, Division 2; Class III Hazardous (Classified) Locations
- ANSI/ISA-12.12.01-2010 - Non-Incendive Electrical Equipment for Use in Class I and II, Division 2 and Class III, Divisions 1 and 2 Hazardous (Classified) Locations

- CSA File # = 219995 and may be seen at: CSA-International.org.

Notes:

- 1) The equipment is intended to be connected to supply mains with a suitable conduit according to the applicable local and national (CEC & NEC) regulations. Power supply cord and its entry inside the enclosure was not part of the investigation.
- 2) The suitability of the combination for rack mounting must be determined during the end usage.
- 3) Performance verified using Analog input board #10-0344 or Analog input PCB # 10-0158, 4-20mA input and configured in LEL mode.
- 4) When equipped with 299-0203-01 power supply, the current consumption of the external devices powered by the equipment at 24V dc shall not exceed 2A

Appendix 3 Modbus® Table and Operations

The Model 7100 Plus is equipped with two standard programmable Modbus® RS-485 Master/Slave ports, and has the ability to add two addition isolated Modbus® RS-485 Master/Slave ports (base 1).

The Modbus® slave ports allow function code 5 (write coil), as well as function code 6, and 16 (write holding registers). By default, all Modbus® writes are disabled except the unlock parameter 40099. The Modbus® lock code can be written to register 40099 to enable writes to other registers. The unit will be unlocked for 10 minutes after the last write occurs. After the 10 minute timeout, the unit will automatically save any parameters that have been written. All written parameters can be saved manually by writing a value of 1 to coil 95 or register 40095. These function codes can be used to write configuration parameters to the Model 7100 Plus. Writing parameters that span multiple register (such as 32bit floating points) requires function code 16. All registers must be written at once.

The following table describes the Model 7100 Plus Modbus® slave database. Any portion of this data may be read by a Modbus® master device such as a PC, PLC or DCS. Since the Modbus® port is RS-485, multiple Model 7100 Plus controllers may be multi-dropped onto the same cable.

Coils

All coils are duplicated in the holding register table. These values can be read or written using either the coil register or the holding register.

Actions							
Alarm Reset	N/A	1	1	N/A	1	5	Write 1 to simulate pressing the alarm reset button
Save Config	N/A	95	95	N/A	1	5	Saves configuration now
Config Changed	N/A	96	96	N/A	1	5	This register is set to 1 when a configuration parameter has changed. The user can clear it by writing 0.

Discrete Inputs

All discrete inputs are duplicated in the input register table. These values can be read using either discrete register or the holding register.

Type	Channel	First	Last	Block Size	Read FC	Write FC	Notes
Lock Status	N/A	112005	112005	N/A	2	N/A	Indicates the lock state for Modbus® writes. Locked = 1 Unlocked = 0
Standard Relay 1 State	N/A	112020	112020	N/A	2	N/A	Off = 0, On = 1, doesn't take into account failsafe
Standard Relay 2 State	N/A	112021	112021	N/A	2	N/A	Off = 0, On = 1, doesn't take into account failsafe

Standard Relay 3 State	N/A	112022	112022	N/A	2	N/A	Off = 0, On = 1, doesn't take into account failsafe
Fault Relay State	N/A	112023	112023	N/A	2	N/A	Off = 0, On = 1, doesn't take into account failsafe
Horn Relay State	N/A	112024	112024	N/A	2	N/A	Off = 0, On = 1, doesn't take into account failsafe
Warmup	N/A	112025	112025	N/A	2	N/A	Not in warmup = 0 In warmup = 1
Standard Relay 1 Flashing	N/A	112026	112026	N/A	4	N/A	False = 0, True = 1. Indicates whether standard relay 1 has been acknowledged.
Standard Relay 2 Flashing	N/A	112027	112027	N/A	4	N/A	False = 0, True = 1. Indicates whether standard relay 2 has been acknowledged.
Standard Relay 3 Flashing	N/A	112028	112028	N/A	4	N/A	False = 0, True = 1. Indicates whether standard relay 3 has been acknowledged.
Fault Relay Flashing	N/A	112029	112029	N/A	4	N/A	False = 0, True = 1. Indicates whether the fault has been acknowledged.
Horn Relay Flashing	N/A	112034	112034	N/A	4	N/A	False = 0, True = 1. Indicates whether the horn relay has been acknowledged.

Channel Data

Alarm Status	1	1-16	113449	113464	1	2	N/A	Off = 0, On = 1
Alarm Flashing	1	1-16	113513	113528	1	2	N/A	Off = 0, On = 1
Alarm Status	2	1-16	113577	113592	1	2	N/A	Off = 0, On = 1
Alarm Flashing	2	1-16	113641	113656	1	2	N/A	Off = 0, On = 1
Alarm Status	3	1-16	113705	113720	1	2	N/A	Off = 0, On = 1
Alarm Flashing	3	1-16	113769	113784	1	2	N/A	Off = 0, On = 1
Fault Status		1-16	113833	113848	1	2	N/A	Off = 0, On = 1
Comm Error		1-16	113897	113912	1	2	N/A	Off = 0, On = 1
Config Error		1-16	113961	114976	1	2	N/A	Off = 0, On = 1
IO Error		1-16	114025	114040	1	2	N/A	Off = 0, On = 1
Cal Flag		1-16	114089	114114	1	2	N/A	Off = 0, On = 1
Marker Detected		1-16	114153	114168	1	2	N/A	Off = 0, On = 1
Linearizing		1-16	114217	114232	1	2	N/A	Set if the channel's linearize map is non default. Off = 0, On = 1

Error Flashing	1-16	114281	114296	1	2	N/A	Unacknowledged error. Off = 0, On = 1
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Input Registers

Type	Channel	First	Last	Block Size	Read FC	Write FC	Notes
Product ID	N/A	32001	32001	N/A	4	N/A	Reads value 72
Version	N/A	32002	32002	N/A	4	N/A	Reads version * 100
Custom Feature	N/A	32003	32003	N/A	4	N/A	N/A
Customer ID	N/A	32004	32004	N/A	4	N/A	N/A
Lock Status	N/A	32005	32005	N/A	4	N/A	Indicates the lock state for Modbus® writes. Locked = 1 Unlocked = 0
Boot Date, Year	N/A	32006	32006	N/A	4	N/A	System boot timestamp 0000 - 9999
Boot Date, Mon	N/A	32007	32007	N/A	4	N/A	System boot timestamp 0 – 12
Boot Date, Day	N/A	32008	32008	N/A	4	N/A	System boot timestamp 0 – 31

Boot Time, Hour	N/A	32009	32009	N/A	4	N/A	System boot timestamp 0 – 23
Boot Time, Min	N/A	32010	32010	N/A	4	N/A	System boot timestamp 0 – 59
Boot Time, Sec	N/A	32011	32011	N/A	4	N/A	System boot timestamp 0 – 59
Standard Relay 1 State	N/A	32020	32020	N/A	4	N/A	Off = 0, On = 1, doesn't take into account failsafe
Standard Relay 2 State	N/A	32021	32021	N/A	4	N/A	Off = 0, On = 1, doesn't take into account failsafe
Standard Relay 3 State	N/A	32022	32022	N/A	4	N/A	Off = 0, On = 1, doesn't take into account failsafe
Fault Relay State	N/A	32023	32023	N/A	4	N/A	Off = 0, On = 1, doesn't take into account failsafe
Horn Relay State	N/A	32024	32024	N/A	4	N/A	Off = 0, On = 1, doesn't take into account failsafe
Warmup	N/A	32025	32025	N/A	4	N/A	Not in warmup = 0 In warmup = 1
Standard Relay 1 Flashing	N/A	32026	32020	N/A	4	N/A	False = 0, True = 1. Indicates whether standard relay 1 has been acknowledged.

Standard Relay 2 Flashing	N/A	32027	32027	N/A	4	N/A	False = 0, True = 1. Indicates whether standard relay 2 has been acknowledged.
Standard Relay 3 Flashing	N/A	32028	32028	N/A	4	N/A	False = 0, True = 1. Indicates whether standard relay 3 has been acknowledged.
Fault Relay Flashing	N/A	32029	32029	N/A	4	N/A	False = 0, True = 1. Indicates whether the fault has been acknowledged.
Horn Relay Flashing	N/A	32034	32034	N/A	4	N/A	False = 0, True = 1. Indicates whether the horn relay has been acknowledged.
Active Port for COM1	N/A	32030	32030	N/A	4	N/A	When a redundant port is enabled, this value indicates which port is in use. (0) or the port number of the redundant port (1-3). (PortNumber – 1)
Active Port for COM2	N/A	32031	32031	N/A	4	N/A	See active port for COM1. (1) or the port number of the redundant port (0,2,3). (PortNumber – 1)
Active Port for COM3	N/A	32032	32032	N/A	4	N/A	See active port for COM1. (2) or the port number of the redundant port (0,1,3). (PortNumber – 1)
Active Port for COM4	N/A	32033	32033	N/A	4	N/A	See active port for COM1. (3) or the port number of the redundant port (0-2). (PortNumber – 1)

Channel Data							
Analog Output	1-16	31001	31016	1	4	N/A	16bit integer value tracking analog output. Uses a range of 800 – 4000 to represent 4-20mA.
Channel Value	1-16	33001	33032	1	4	N/A	16bit representation of float w/ +-5% over/under range. * see formula
Channel Value	1-16	33065	33096	2	4	N/A	32bit IEEE Floating point
Channel Value	1-16	33193	33224	3	4	N/A	Character string representation of value. 2 ASCII characters per register
Alarm Status 1	1-16	33449	33480	1	4	N/A	Off = 0, On = 1
Alarm Flashing 1	1-16	33513	33529	1	4	N/A	Off = 0, On = 1
Alarm Status 2	1-16	33577	33593	1	4	N/A	Off = 0, On = 1
Alarm Flashing 2	1-16	33641	33656	1	4	N/A	Off = 0, On = 1
Alarm Status 3	1-16	33705	33720	1	4	N/A	Off = 0, On = 1
Alarm Flashing 3	1-16	33769	33784	1	4	N/A	Off = 0, On = 1

Fault Status	1-16	33833	33848	1	4	N/A	Off = 0, On = 1
Comm Error	1-16	33897	33912	1	4	N/A	Off = 0, On = 1
Config Error	1-16	33961	33976	1	4	N/A	Off = 0, On = 1
IO Error	1-16	34025	34040	1	4	N/A	Off = 0, On = 1
Cal Flag	1-16	34089	34104	1	4	N/A	Off = 0, On = 1
Marker Detected	1-16	34153	34168	1	2	N/A	Off = 0, On = 1
Linearizing	1-16	34217	34232	1	2	N/A	Set if the channel's linearize map is non default. Off = 0, On = 1
Error Flashing	1-16	34281	34296	1	2	N/A	Unacknowledged error. Off = 0, On = 1
Sensor Life	1-16	34401	34416	1	4	N/A	-2 = Disabled, -1 = Cal Required, 0 – 100 = Sensor life

* 16bit representation of float w/ +/-5% over/under range is calculated as follows:

$$DisplayValue = ModbusValue * \frac{(SpanValue - ZeroValue) * 1.1}{32767} + ZeroValue - (SpanValue - ZeroValue) * .5$$

Holding Registers

Type	Channel	First	Last	Block Size	Read FC	Write FC	Notes
Alarm Reset	N/A	40001	40001	N/A	3	6, 16	Simulates the alarm reset button. Write a value of 1 to activate.
System Name	N/A	40010	40017	N/A	3	6, 16	Character string, 2 characters per register
Date, Year	N/A	40020	40020	N/A	3	6, 16	0000 - 9999
Date, Mon	N/A	40021	40021	N/A	3	6, 16	0 – 12
Date, Day	N/A	40022	40022	N/A	3	6, 16	0 – 31
Time, Hour	N/A	40023	40023	N/A	3	6, 16	0 – 23
Time, Min	N/A	40024	40024	N/A	3	6, 16	0 – 59
Time, Sec	N/A	40025	40025	N/A	3	6, 16	0 – 59
Warmup Time	N/A	40027	40027	N/A	3	6, 16	Time in minutes. 0 – 5
Cal Purge Time	N/A	40028	40028	N/A	3	6, 16	Time in minutes. 0 – 5
Block Negative	N/A	40029	40029	N/A	3	6, 16	No = 0, Yes = 1
Zone Names							

Zone Name	1	N/A	40030	40037	N/A	3	6, 16	Character string, 2 characters per register
Zone Name	2	N/A	40038	40045	N/A	3	6, 16	Character string, 2 characters per register
Zone Name	3	N/A	40046	40053	N/A	3	6, 16	Character string, 2 characters per register
Zone Name	4	N/A	40054	40062	N/A	3	6, 16	Character string, 2 characters per register
Zone Name	5	N/A	40062	40069	N/A	3	6, 16	Character string, 2 characters per register
Zone Name	6	N/A	40070	40077	N/A	3	6, 16	Character string, 2 characters per register
Zone Name	7	N/A	40078	40085	N/A	3	6, 16	Character string, 2 characters per register
Zone Name	8	N/A	40086	40093	N/A	3	6, 16	Character string, 2 characters per register
Actions								
Save Config		N/A	40095	40095	N/A	3	6	Saves configuration now
Config Changed		N/A	40096	40096	N/A	3	6	This register is set to 1 when a configuration parameter has changed. The user can clear it by writing 0.

Security Unlock	N/A	40099	40099	N/A	3	6	This register must be written with the Modbus® unlock code before any parameter can be written using function codes 6 or 16. 0000 – 9999, 1234
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Standard Relay 1

Type	Channel	First	Last	Block Size	Read FC	Write FC	Notes	
A1 Votes	N/A	40100	40100	N/A	3	6, 16	Alarm 1 channels required. 0 - 16	
A2 Votes	N/A	40101	40101	N/A	3	6, 16	Alarm 2 channels required. 0 – 16	
A3 Votes	N/A	40102	40102	N/A	3	6, 16	Alarm 3 channels required. 0 - 16	
Acknowledge	N/A	40103	40103	N/A	3	6, 16	Relay is acknowledgeable. No = 0, Yes = 1	
Failsafe	N/A	40104	40104	N/A	3	6, 16	Relay is failsafe. No = 0, Yes = 1	
Zone Enable	1	N/A	40105	40105	N/A	3	6, 16	Use zone 1 channels for voting. No = 0, Yes = 1
Zone Enable	2	N/A	40106	40106	N/A	3	6, 16	Use zone 2 channels for voting. No = 0, Yes = 1
Zone Enable	3	N/A	40107	40107	N/A	3	6, 16	Use zone 3 channels for voting. No = 0, Yes = 1

Zone Enable	4	N/A	40108	40108	N/A	3	6, 16	Use zone 4 channels for voting. No = 0, Yes = 1
Zone Enable	5	N/A	40109	40109	N/A	3	6, 16	Use zone 5 channels for voting. No = 0, Yes = 1
Zone Enable	6	N/A	40110	40110	N/A	3	6, 16	Use zone 6 channels for voting. No = 0, Yes = 1
Zone Enable	7	N/A	40111	40111	N/A	3	6, 16	Use zone 7 channels for voting. No = 0, Yes = 1
Zone Enable	8	N/A	40112	40112	N/A	3	6, 16	Use zone 8 channels for voting. No = 0, Yes = 1
Override Channel	1	N/A	40113	40113	N/A	3	6, 16	Create an override channel. 0 is disabled. 0 - 16
Override Alarm	1	N/A	40114	40114	N/A	3	6, 16	Alarm for this override channel to use. Alarm 1 = 0, Alarm 2 = 1, Alarm 3 = 2
Override Channel	2	N/A	40115	40115	N/A	3	6, 16	Create an override channel. 0 is disabled. 0 - 16
Override Alarm	2	N/A	40116	40116	N/A	3	6, 16	Alarm for this override channel to use. Alarm 1 = 0, Alarm 2 = 1, Alarm 3 = 2

Override Channel	3	N/A	40117	40117	N/A	3	6, 16	Create an override channel. 0 is disabled. 0 - 16
Override Alarm	3	N/A	40118	40118	N/A	3	6, 16	Alarm for this override channel to use. Alarm 1 = 0, Alarm 2 = 1, Alarm 3 = 2
Override Channel	4	N/A	40119	40119	N/A	3	6, 16	Create an override channel. 0 is disabled. 0 - 16
Override Alarm	4	N/A	40120	40120	N/A	3	6, 16	Alarm for this override channel to use. Alarm 1 = 0, Alarm 2 = 1, Alarm 3 = 2
Override Channel	5	N/A	40121	40121	N/A	3	6, 16	Create an override channel. 0 is disabled. 0 - 16
Override Alarm	5	N/A	40122	40122	N/A	3	6, 16	Alarm for this override channel to use. Alarm 1 = 0, Alarm 2 = 1, Alarm 3 = 2
Override Channel	6	N/A	40123	40123	N/A	3	6, 16	Create an override channel. 0 is disabled. 0 - 16

Override Alarm	6	N/A	40124	40124	N/A	3	6, 16	Alarm for this override channel to use. Alarm 1 = 0, Alarm 2 = 1, Alarm 3 = 2
Override Channel	7	N/A	40125	40125	N/A	3	6, 16	Create an override channel. 0 is disabled. 0 - 16
Override Alarm	7	N/A	40126	40126	N/A	3	6, 16	Alarm for this override channel to use. Alarm 1 = 0, Alarm 2 = 1, Alarm 3 = 2
Override Channel	8	N/A	40127	40127	N/A	3	6, 16	Create an override channel. 0 is disabled. 0 - 16
Override Alarm	8	N/A	40128	40128	N/A	3	6, 16	Alarm for this override channel to use. Alarm 1 = 0, Alarm 2 = 1, Alarm 3 = 2

Standard Relay 2

Type	Chan nel	First	Last	Block Size	Rea d FC	Write FC	Notes
A1 Votes	N/A	40140	40140	N/A	3	6, 16	Alarm 1 channels required. 0 - 16
A2 Votes	N/A	40141	40141	N/A	3	6, 16	Alarm 2 channels required. 0 – 16
A3 Votes	N/A	40142	40142	N/A	3	6, 16	Alarm 3 channels required. 0 - 16
Acknowledge	N/A	40143	40143	N/A	3	6, 16	Relay is acknowledgeable. No = 0, Yes = 1
Failsafe	N/A	40144	40144	N/A	3	6, 16	Relay is failsafe. No = 0, Yes = 1
Zone Enable	1 N/A	40145	40145	N/A	3	6, 16	Use zone 1 channels for voting. No = 0, Yes = 1
Zone Enable	2 N/A	40146	40146	N/A	3	6, 16	Use zone 2 channels for voting. No = 0, Yes = 1
Zone Enable	3 N/A	40147	40147	N/A	3	6, 16	Use zone 3 channels for voting. No = 0, Yes = 1
Zone Enable	4 N/A	40148	40148	N/A	3	6, 16	Use zone 4 channels for voting. No = 0, Yes = 1
Zone Enable	5 N/A	40149	40149	N/A	3	6, 16	Use zone 5 channels for voting. No = 0, Yes = 1
Zone Enable	6 N/A	40150	40150	N/A	3	6, 16	Use zone 6 channels for voting. No = 0, Yes = 1
Zone Enable	7 N/A	40151	40151	N/A	3	6, 16	Use zone 7 channels for voting. No = 0, Yes = 1

Zone Enable	8	N/A	40152	40152	N/A	3	6, 16	Use zone 8 channels for voting. No = 0, Yes = 1
Override Channel	1	N/A	40153	40153	N/A	3	6, 16	Create an override channel. 0 is disabled. 0 - 16
Override Alarm	1	N/A	40154	40154	N/A	3	6, 16	Alarm for this override channel to use. Alarm 1 = 0, Alarm 2 = 1, Alarm 3 = 2
Override Channel	2	N/A	40155	40155	N/A	3	6, 16	Create an override channel. 0 is disabled. 0 - 16
Override Alarm	2	N/A	40156	40156	N/A	3	6, 16	Alarm for this override channel to use. Alarm 1 = 0, Alarm 2 = 1, Alarm 3 = 2
Override Channel	3	N/A	40157	40157	N/A	3	6, 16	Create an override channel. 0 is disabled. 0 - 16
Override Alarm	3	N/A	40158	40158	N/A	3	6, 16	Alarm for this override channel to use. Alarm 1 = 0, Alarm 2 = 1, Alarm 3 = 2

Override Channel	4	N/A	40159	40159	N/A	3	6, 16	Create an override channel. 0 is disabled. 0 - 16
Override Alarm	4	N/A	40160	40160	N/A	3	6, 16	Alarm for this override channel to use. Alarm 1 = 0, Alarm 2 = 1, Alarm 3 = 2
Override Channel	5	N/A	40161	40161	N/A	3	6, 16	Create an override channel. 0 is disabled. 0 - 16
Override Alarm	5	N/A	40162	40162	N/A	3	6, 16	Alarm for this override channel to use. Alarm 1 = 0, Alarm 2 = 1, Alarm 3 = 2
Override Channel	6	N/A	40163	40163	N/A	3	6, 16	Create an override channel. 0 is disabled. 0 - 16
Override Alarm	6	N/A	40164	40164	N/A	3	6, 16	Alarm for this override channel to use. Alarm 1 = 0, Alarm 2 = 1, Alarm 3 = 2
Override Channel	7	N/A	40165	40165	N/A	3	6, 16	Create an override channel. 0 is disabled. 0 - 16

Override Alarm	7	N/A	40166	40166	N/A	3	6, 16	Alarm for this override channel to use. Alarm 1 = 0, Alarm 2 = 1, Alarm 3 = 2
Override Channel	8	N/A	40167	40167	N/A	3	6, 16	Create an override channel. 0 is disabled. 0 - 16
Override Alarm	8	N/A	40168	40168	N/A	3	6, 16	Alarm for this override channel to use. Alarm 1 = 0, Alarm 2 = 1, Alarm 3 = 2

Standard Relay 3

Type	Channel	First	Last	Block Size	Read FC	Write FC	Notes
A1 Votes	N/A	40180	40180	N/A	3	6, 16	Alarm 1 channels required. 0 - 16
A2 Votes	N/A	40181	40181	N/A	3	6, 16	Alarm 2 channels required. 0 - 16
A3 Votes	N/A	40182	40182	N/A	3	6, 16	Alarm 3 channels required. 0 - 16
Acknowledge	N/A	40183	40183	N/A	3	6, 16	Relay is acknowledgeable. No = 0, Yes = 1

Failsafe		N/A	40184	40184	N/A	3	6, 16	Relay is failsafe. No = 0, Yes = 1
Zone Enable	1	N/A	40185	40185	N/A	3	6, 16	Use zone 1 channels for voting. No = 0, Yes = 1
Zone Enable	2	N/A	40186	40186	N/A	3	6, 16	Use zone 2 channels for voting. No = 0, Yes = 1
Zone Enable	3	N/A	40187	40187	N/A	3	6, 16	Use zone 3 channels for voting. No = 0, Yes = 1
Zone Enable	4	N/A	40188	40188	N/A	3	6, 16	Use zone 4 channels for voting. No = 0, Yes = 1
Zone Enable	5	N/A	40189	40189	N/A	3	6, 16	Use zone 5 channels for voting. No = 0, Yes = 1
Zone Enable	6	N/A	40190	40190	N/A	3	6, 16	Use zone 6 channels for voting. No = 0, Yes = 1
Zone Enable	7	N/A	40191	40191	N/A	3	6, 16	Use zone 7 channels for voting. No = 0, Yes = 1
Zone Enable	8	N/A	40192	40192	N/A	3	6, 16	Use zone 8 channels for voting. No = 0, Yes = 1
Override Channel	1	N/A	40193	40193	N/A	3	6, 16	Create an override channel. 0 is disabled. 0 - 16
Override Alarm	1	N/A	40194	40194	N/A	3	6, 16	Alarm for this override channel to use. Alarm 1 = 0, Alarm 2 = 1, Alarm 3 = 2

Override Channel	2	N/A	40195	40195	N/A	3	6, 16	Create an override channel. 0 is disabled. 0 - 16
Override Alarm	2	N/A	40196	40196	N/A	3	6, 16	Alarm for this override channel to use. Alarm 1 = 0, Alarm 2 = 1, Alarm 3 = 2
Override Channel	3	N/A	40197	40197	N/A	3	6, 16	Create an override channel. 0 is disabled. 0 - 16
Override Alarm	3	N/A	40198	40198	N/A	3	6, 16	Alarm for this override channel to use. Alarm 1 = 0, Alarm 2 = 1, Alarm 3 = 2
Override Channel	4	N/A	40199	40199	N/A	3	6, 16	Create an override channel. 0 is disabled. 0 - 16
Override Alarm	4	N/A	40200	40200	N/A	3	6, 16	Alarm for this override channel to use. Alarm 1 = 0, Alarm 2 = 1, Alarm 3 = 2
Override Channel	5	N/A	40201	40201	N/A	3	6, 16	Create an override channel. 0 is disabled. 0 - 16

Override Alarm	5	N/A	40202	40202	N/A	3	6, 16	Alarm for this override channel to use. Alarm 1 = 0, Alarm 2 = 1, Alarm 3 = 2
Override Channel	6	N/A	40203	40203	N/A	3	6, 16	Create an override channel. 0 is disabled. 0 - 16
Override Alarm	6	N/A	40204	40204	N/A	3	6, 16	Alarm for this override channel to use. Alarm 1 = 0, Alarm 2 = 1, Alarm 3 = 2
Override Channel	7	N/A	40205	40205	N/A	3	6, 16	Create an override channel. 0 is disabled. 0 - 16
Override Alarm	7	N/A	40206	40206	N/A	3	6, 16	Alarm for this override channel to use. Alarm 1 = 0, Alarm 2 = 1, Alarm 3 = 2
Override Channel	8	N/A	40207	40207	N/A	3	6, 16	Create an override channel. 0 is disabled. 0 - 16

Override Alarm	8	N/A	40208	40208	N/A	3	6, 16	Alarm for this override channel to use. Alarm 1 = 0, Alarm 2 = 1, Alarm 3 = 2
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Discrete Relays

Type	Channel	First	Last	Block Size	Read FC	Write FC	Notes
A1 Failsafe	N/A	40220	40220	N/A	3	6, 16	Makes discrete relays boards that use alarm 1 failsafe. No = 0, Yes = 1
A2 Failsafe	N/A	40221	40221	N/A	3	6, 16	Makes discrete relays boards that use alarm 2 failsafe. No = 0, Yes = 1
A3 Failsafe	N/A	40222	40222	N/A	3	6, 16	Makes discrete relays boards that use alarm 3 failsafe. No = 0, Yes = 1

Horn/Piezo

Type	Channel	First	Last	Block Size	Read FC	Write FC	Notes
Alarm Mode	1	N/A	40230	40230	N/A	3	6, 16 Off = 0, On = 1, Beep = 2

Alarm Mode	2	N/A	40231	40231	N/A	3	6, 16	Off = 0, On = 1, Beep = 2
Alarm Mode	3	N/A	40232	40232	N/A	3	6, 16	Off = 0, On = 1, Beep = 2
Acknowledge		N/A	40233	40233	N/A	3	6, 16	Off = 0, On = 1
Failsafe		N/A	40234	40234	N/A	3	6, 16	No = 0, Yes = 1
Piezo Alarm		N/A	40235	40235	N/A	3	6, 16	No = 0, Yes = 1

Channel Configuration

Type	Channel	First	Last	Block Size	Read FC	Write FC	Notes
Tag	1-16	40401	40528	8	3	16	2 characters per register
Eng. Units	1-16	40913	40960	3	3	16	2 characters per register
Zero Value	1-16	41297	41328	2	3	16	Integer and divisor
Zero Value	1-16	41425	41456	2	3	16	32bit IEEE Float
Span Value	1-16	41553	41584	2	3	16	Integer and divisor
Span Value	1-16	41681	41712	2	3	16	32bit IEEE Float
Alarm 1							

Setpoint	1-16	41809	41840	2	3	16	Integer and divisor
Setpoint	1-16	41937	41968	2	3	16	32bit IEEE Float
Latching	1-16	42065	42080	1	3	6, 16	No = 0, Yes = 1
Trip	1-16	42129	42144	1	3	6, 16	Low = 0, high = 1
On Delay	1-16	42193	42208	1	3	6, 16	Time in seconds. 0 – 10
Off Delay	1-16	42257	42272	1	3	6, 16	Time in minutes. 0 - 120
Horn Drive	1-16	42321	42336	1	3	6, 16	No = 0, Yes = 1
Alarm 2							
Setpoint	1-16	42449	42480	2	3	16	Integer and divisor
Setpoint	1-16	42577	42608	2	3	16	32bit IEEE Float
Latching	1-16	42705	42720	1	3	6, 16	No = 0, Yes = 1
Trip	1-16	42769	42784	1	3	6, 16	Low = 0, high = 1
On Delay	1-16	42833	42848	1	3	6, 16	Time in seconds. 0 – 10
Off Delay	1-16	42897	42912	1	3	6, 16	Time in minutes. 0 - 120
Horn Drive	1-16	42961	42976	1	3	6, 16	No = 0, Yes = 1

Color	1-16	43025	43040	1	3	6, 16	Alarm color displayed on the unit Red = 0, Blue = 1, Orange = 2
Alarm 3							
Setpoint	1-16	43089	43120	2	3	16	Integer and divisor
Setpoint	1-16	43217	43248	2	3	16	32bit IEEE Float
Latching	1-16	43345	43360	1	3	6, 16	No = 0, Yes = 1
Trip	1-16	43409	43424	1	3	6, 16	Low = 0, high = 1
On Delay	1-16	43473	43488	1	3	6, 16	Time in seconds. 0 – 10
Off Delay	1-16	43537	43552	1	3	6, 16	Time in minutes. 0 - 120
Horn Drive	1-16	43601	43616	1	3	6, 16	No = 0, Yes = 1
Color	1-16	43665	43680	1	3	6, 16	Alarm color displayed on the unit Red = 0, Blue = 1, Orange = 2
Enable	1-16	43729	43744	1	3	6, 16	No = 0, Yes = 1
Fault							

Setpoint	1-16	43793	43824	2	3	16	Integer and divisor
Setpoint	1-16	43921	43952	2	3	16	32bit IEEE Float
Data From							
Source	1-16	44369	44384	1	3	6, 16	Analog In = 0, Modbus® 16bit = 1, Signed Modbus® 16bit = 2, Modbus® 32bit = 3, Wireless Monitor = 4, Digital In = 5
Min Raw	1-16	44433	44448	1	3	6, 16	Integer
Max Raw	1-16	44497	44512	1	3	6, 16	Integer
Remote ID	1-16	44561	44576	1	3	6, 16	0 – 247
Interface	1-16	44625	44640	1	3	6, 16	COM1 = 0 COM2 = 1 COM3 = 2 COM4 = 3 TCP/IP = 4
Filter Count	1-16	44689	44704	1	3	6,16	1 – 40

Local Cal	1-16	44753	44768	1	3	6,16	No = 0, Yes = 1, Board Default = 2
Byte Order	1-16	44881	44896	1	3	6,16	ABCD = 0 CDAB = 1 BADC = 2 DCBA = 3
Alias	1-16	44945	44976	2	3	16	Modbus® alias. 0 – 65535
IP Address	1-16	45073	45104	2	3	16	Target address for Modbus®TCP
TCP/IP Port	1-16	45201	45216	1	3	6, 16	TCP/IP port for Modbus®TCP. 0 - 65535
Linearize Map							
Point 1	1-16	45329	45392	4	3	16	2x 32bit IEEE Floats, Input and Output
Point 2	1-16	45585	45648	4	3	16	2x 32bit IEEE Floats, Input and Output
Point 3	1-16	45841	46904	4	3	16	2x 32bit IEEE Floats, Input and Output
Point 4	1-16	46097	46160	4	3	16	2x 32bit IEEE Floats, Input and Output

Point 5	1-16	46353	46414	4	3	16	2x 32bit IEEE Floats, Input and Output
Point 6	1-16	46609	46672	4	3	16	2x 32bit IEEE Floats, Input and Output
Point 7	1-16	46865	46926	4	3	16	2x 32bit IEEE Floats, Input and Output
Point 8	1-16	47121	47184	4	3	16	2x 32bit IEEE Floats, Input and Output
Point 9	1-16	47377	47450	4	3	16	2x 32bit IEEE Floats, Input and Output
Configure							
Decimal Points	1-16	47633	47648	1	3	6, 16	0 = 0, 1 = 1, 2 = 2, 3 = 3,
Channel Enable	1-16	47697	47712	1	3	6, 16	No = 0, Yes = 1

Zone	1-16	47761	47776	1	3	6, 16	Zone 1 = 0, Zone 2 = 1, Zone 3 = 2, Zone 4 = 3, Zone 5 = 4, Zone 6 = 5, Zone 7 = 6, Zone 8 = 7,
Deadband%	1-16	47825	47856	2	3	16	32bit IEEE Float (0.0 – 5.0)

Programmable Relays

The programmable relay option allows 16 relays to be configured. The configuration parameters are the same for all 16 relays. The following table shows the base address of each programmable relay.

Programmable Relay Number	Base Modbus® Address
Relay 1	49000
Relay 2	49040
Relay 3	49080
Relay 4	49120
Relay 5	49160
Relay 6	49200

Relay 7	49240
Relay 8	49280
Relay 9	49320
Relay 10	49360
Relay 11	49400
Relay 12	49440
Relay 13	49480
Relay 14	49520
Relay 15	49560
Relay 16	49600

The register for each relay parameter is determined by adding the offset to that relay's base address.

Type	Channel	Address Offset	Block Size	Read FC	Write FC	Notes
A1 Votes	N/A	0	N/A	3	6, 16	Alarm 1 channels required. 0 - 16
A2 Votes	N/A	1	N/A	3	6, 16	Alarm 2 channels required. 0 - 16
A3 Votes	N/A	2	N/A	3	6, 16	Alarm 3 channels required. 0 - 16
Acknowledge	N/A	3	N/A	3	6, 16	Relay is acknowledgeable. No = 0, Yes = 1

Failsafe		N/A	4	N/A	3	6, 16	Relay is failsafe. No = 0, Yes = 1
Zone Enable	1	N/A	5	N/A	3	6, 16	Use zone 1 channels for voting. No = 0, Yes = 1
Zone Enable	2	N/A	6	N/A	3	6, 16	Use zone 2 channels for voting. No = 0, Yes = 1
Zone Enable	3	N/A	7	N/A	3	6, 16	Use zone 3 channels for voting. No = 0, Yes = 1
Zone Enable	4	N/A	8	N/A	3	6, 16	Use zone 4 channels for voting. No = 0, Yes = 1
Zone Enable	5	N/A	9	N/A	3	6, 16	Use zone 5 channels for voting. No = 0, Yes = 1
Zone Enable	6	N/A	10	N/A	3	6, 16	Use zone 6 channels for voting. No = 0, Yes = 1
Zone Enable	7	N/A	11	N/A	3	6, 16	Use zone 7 channels for voting. No = 0, Yes = 1
Zone Enable	8	N/A	12	N/A	3	6, 16	Use zone 8 channels for voting. No = 0, Yes = 1
Override Channel	1	N/A	13	N/A	3	6, 16	Create an override channel. 0 is disabled. 0 - 16
Override Alarm	1	N/A	14	N/A	3	6, 16	Alarm for this override channel to use. Alarm 1 = 0, Alarm 2 = 1, Alarm 3 = 2

Override Channel	2	N/A	15	N/A	3	6, 16	Create an override channel. 0 is disabled. 0 - 16
Override Alarm	2	N/A	16	N/A	3	6, 16	Alarm for this override channel to use. Alarm 1 = 0, Alarm 2 = 1, Alarm 3 = 2
Override Channel	3	N/A	17	N/A	3	6, 16	Create an override channel. 0 is disabled. 0 - 16
Override Alarm	3	N/A	18	N/A	3	6, 16	Alarm for this override channel to use. Alarm 1 = 0, Alarm 2 = 1, Alarm 3 = 2
Override Channel	4	N/A	19	N/A	3	6, 16	Create an override channel. 0 is disabled. 0 - 16
Override Alarm	4	N/A	20	N/A	3	6, 16	Alarm for this override channel to use. Alarm 1 = 0, Alarm 2 = 1, Alarm 3 = 2
Override Channel	5	N/A	21	N/A	3	6, 16	Create an override channel. 0 is disabled. 0 - 16

Override Alarm	5	N/A	22	N/A	3	6, 16	Alarm for this override channel to use. Alarm 1 = 0, Alarm 2 = 1, Alarm 3 = 2
Override Channel	6	N/A	23	N/A	3	6, 16	Create an override channel. 0 is disabled. 0 - 16
Override Alarm	6	N/A	24	N/A	3	6, 16	Alarm for this override channel to use. Alarm 1 = 0, Alarm 2 = 1, Alarm 3 = 2
Override Channel	7	N/A	25	N/A	3	6, 16	Create an override channel. 0 is disabled. 0 - 16
Override Alarm	7	N/A	26	N/A	3	6, 16	Alarm for this override channel to use. Alarm 1 = 0, Alarm 2 = 1, Alarm 3 = 2
Override Channel	8	N/A	27	N/A	3	6, 16	Create an override channel. 0 is disabled. 0 - 16

Override Alarm	8	N/A	28	N/A	3	6, 16	Alarm for this override channel to use. Alarm 1 = 0, Alarm 2 = 1, Alarm 3 = 2
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Appendix 4 Menu Navigation

Appendix 5 Antenna Selection

Antenna Transmission Range

The distance radio signals can travel is dependent upon several factors including antenna design, transmitter power and free-space losses. In order for a wireless link to work, the available system operating margin (**TX power - RX Sensitivity + Antenna gains**) must exceed the free-space loss and all other losses in the system. For best RF line-of-site, the combined height of both antennas must exceed the Fresnel zone diameter.

Distance Between antennas	Fresnel Zone Diameter	Freespace Loss (dB)
1000ft (300m)	16ft (4.9m)	81
1 mile (1.6km)	32ft (9.7m)	96
5 miles (8km)	68ft (20.7m)	110

Example:

A 2.4GHz WaveNet system has following parameters:

- RF TX power setting = 21 dBm (125 mW)
- RF RX sensitivity = -95 dBm (this is a constant)
- Antenna gain (standard equipped rubber collinear) = 7dBi x 2 = 14dBi

So, the system operating margin is $21 - (-95) + 14 = 130$ dBm. This is enough to transmit 5 miles if free-space was the only loss in the system. For this to be the case, the antennas must be mounted with a combined height greater than 68ft above all obstructions (including the ground) to keep the Fresnel recommended there be at least 20dB extra system operating margin.

RF “Rules of Thumb”:

- Doubling the range with good RF “Line of Sight” (LOS) requires an increase of 6 dB.
- Doubling the range without good RF LOS requires an increase of 12 dB.
- Doubling the power increases dBm by 3.

Antenna Selection and Location

The location of the antenna is very important. Ensure the area surrounding the proposed location is clear of objects such as other antennas, trees or power lines which may affect the antenna’s performance and efficiency. It is also vital that you ensure the support structure and mounting arrangement is adequate to support the antenna under all anticipated environmental conditions. The choice of appropriate mounting hardware is also important for both minimizing corrosion and maintaining site intermodulation performance.

Most installations with ranges under 1000 feet require only the standard equipped rubber antennas. Distances up to 2 miles may be achieved by using YAGI directional antennas aimed towards a mast

mounted fiberglass omnidirectional antenna at the base station. Always minimize obstructions between the gas detector and the base station antenna.

Water-proofing Antenna Connections

Waterproof all outdoor coax connectors using a three-layer sealing process of initial layer of adhesive PVC tape, followed by a second layer of self-vulcanizing weatherproofing tape, with a final layer of adhesive PVC tape.

1. Attach antenna to RP-SMA fitting
2. Wrap 20-24" strip PVC electrical tape onto hub, nut & base of antenna
3. Wrap 20-24" strip 3M 23 tape (order # 1000-2314) onto PVC tape
4. Wrap 24-28" strip PVC electrical tape over all



Figure 64 Water-proofing Antenna Connections

Dipole and Collinear Antennas

These antennas are connected to the Radio via a length of coax cable. If the cable is larger than 6mm diameter (1/4 inch), be aware of sideways tension on the connection. Thick cables have large bending radii and sideways force on the connector can cause a poor connection.

The polarity of these antennas is the same as the main axis, and they are normally installed vertically. They can be mounted horizontally (horizontal polarity), however the antenna at the other end of the wireless link would need to be mounted perfectly parallel for optimum performance. This is very difficult to achieve over distance. If the antenna is mounted vertically, it is only necessary to mount the other antennas vertically for optimum “coupling” – this is easy to achieve.

Dipole and collinear antennas provide best performance when installed with at least 1 to 2 wavelengths clearance of walls or steelwork. The wavelength is based on the frequency:

Wavelength in meters = $300 / \text{frequency in MHz}$

Wavelength in feet = $1000 / \text{frequency in MHz}$

Therefore, 900 MHz antennas require at least 2/3 meter (2 feet) and 2.4GHz 15 cm (6 inches). Antennas may be mounted with less clearance but radiation will be reduced. If the radio path is short this won't matter. It is important the antenna mounting bracket to well connected to “earth” or “ground” for good lightning surge protection.

Yagi Antennas

Yagi antennas are directional along the central beam of the antenna. The folded element is towards the back and the antenna should be pointed in the direction of the transmission. Yagis should also be mounted with at least 1 to 2 wavelengths of clearance from other objects. The polarity of the antenna is the same as the direction of the orthogonal elements. For example, if the elements are vertical the Yagi transmits with vertical polarity.

In networks spread over wide areas, it is common for a central unit to have an omni-directional antenna and the remote units to have Yagi antennas. In this case, as the omni-directional antenna will be mounted with vertical polarity, then the Yagi's must also have vertical polarity. Care needs to be taken to ensure the Yagi is aligned correctly to achieve optimum performance.

Two Yagi's can be used for a point-to-point link. In this case they can be mounted with the elements horizontally to give horizontal polarity. There is a large degree of RF isolation between horizontal and vertical polarity (approx. -30dB) so this installation method is a good idea if there is a large amount of interference from another system close by transmitting vertical polarity.

An important mounting tip – if a Yagi has drainage holes in the dipole element, do not mount the antenna with the drainage.

Mounting Near other Antennas

Avoid mounting your network's antenna near any other antenna even when the other antenna is transmitting on a different radio band. High RF energy of the transmission from a close antenna can deafen a receiver. This is a common cause of problems with wireless systems.

Because antennas are designed to transmit parallel to the ground rather than up or down, vertical separation between antennas is a lot more effective than horizontal separation. If mounting near another antenna cannot be avoided, mounting it beneath or above the other antenna is better than mounting beside it. Using different polarity to the other antenna (if possible) will also help to isolate the RF coupling.

Coax Cables

If a coax cable connects to the antenna via connectors, it is very important to weatherproof the connection using our 1000-2314 or equivalent sealing tape. Moisture ingress into a coax cable connection is the most common cause of problems with antenna installations. A three-layer sealing process is recommended – an initial layer of electrical PVC tape, followed by a second layer of self-vulcanizing weatherproofing tape (1000-2314), with a final layer of electrical PVC tape (see [Section 4.5.2](#)).

Allowing a drip “U loop” of cable before the connection is also a good idea. The loop allows water to drip off the bottom of the U instead of into the connection, reduces installation strain and provides spare cable length in case later the original connectors need to be removed, the cable can be cut back and new connectors fitted.

Avoid installing coax cables together in long parallel paths. Leakage from one cable to another has a similar effect as mounting an antenna near another antenna.

Surge Protection and Grounding

Voltage surges can enter the WaveNet System via the antenna connections, power supply connections, connections to other equipment and even the earth or ground connection. Surges are electrical energy following a path to earth and the best protection is achieved by draining the surge energy to earth via an alternate path. Wireless devices need to have a solid connection to earth via a ground stake or ground grid if the soil has poor conductivity. Solid connection means a large capacity conductor (not a small wire) with no coils or sharp bends. All other devices connected to the WLR need to be grounded to the same ground point. There can be significant resistance between different ground points leading to very large voltage differences during lightning activity. As many wireless units are damaged by earth potential surges due to incorrect grounding as direct surge voltage.

It is very difficult to protect against direct lightning strikes but the probability of a direct strike at any one location is very small. Unfortunately, power line surges and electromagnetic energy in the air can induce high voltage surges from lightning activity several miles away.

Antenna Grounding

Electromagnetic energy in the air will be drained to ground via any and every earth path. An earth path exists between the antenna and the WaveNet, and to protect against damage this earth path current must be kept as small as possible. This is achieved by providing better alternate earth paths. It is important to ground the antenna to the same ground point as the WaveNet. Antennas are normally mounted to a metal bracket which should be grounded to the WaveNet earth connection. Surge energy induced into the antenna will be drained first by the mount's ground connection, second by the outside shield of the coax cable to the ground connection on the radio and third by the internal conductor of the coax cable via the radio electronics. This third earth path causes damage unless the other two paths provide a better earth connection allowing surge energy to bypass the electronics.

When an antenna is located outside of a building and outside of an industrial plant environment, external coax surge diverters are recommended to further minimize the effect of surge current in the inner conductor of the coax cable.

Coax surge diverters have gas-discharge element which breaks down in the presence of high surge voltage and diverts any current directly to a ground connection. A surge diverter is not normally required when the antenna is within a plant or factory environment, as the plant steelwork provides multiple parallel ground paths and good earth grounding will provide adequate protection without a surge diverter.

Connections to other Equipment

Surges can enter the wireless unit from connected devices, via I/O, serial or Ethernet connections. Other data devices connected to the wireless unit should be well grounded to the same ground point as the wireless unit.

Special care needs to be taken where the connected data device is remote from the wireless unit requiring a long data cable. As the data device and the wireless unit cannot be connected to the same ground point, different earth potentials can exist during surge conditions.

There is also the possibility of surge voltages being induced on long lengths of wire from nearby power cables. Surge diverters can be fitted to the data cable to protect against surges entering the wireless unit.

The same principle applies to I/O device is not close to the wireless unit, the risk of surge increases. Surge diverters for I/O wiring are available to protect the wireless unit.

Appendix 6 Ordering Information

Main Assemblies

Part Number	Part Description
820-0110-01	Standard Fiberglass Enclosure w/ RS485 Modbus Master/Slave
820-0110-02	Standard 316 Stainless Steel Enclosure w/ RS485 Modbus Master/Slave
820-0110-03	Cast Aluminum Enclosure w/ RS485 Modbus Master/Slave
820-0110-04	Full Width 19" Rack w/ RS485 Modbus Master/Slave
820-0110-05	Half Width 19" Rack/Panel Mount w/ RS485 Modbus Master/Slave

Option and Replacement Boards

Part Number	Part Description
299-0203-01	85-240VAC Universal Input 150w 24VDC Power Supply (6.2a)
299-0204-01	100-240vac Universal Input 600w 24VDC Power Supply (27.0a)
299-0205-01	Aux Relay Option Board
299-0206-01	Dual Isolated RS-485 Option Board
299-0190-01	CPU/Display Board
299-0191-01	Main I/O 3U Board
299-0192-01	Bridge Input Option Board (accepts up to 4 10-00192 modules)
299-0193-01	Analog Output Option Board
299-0194-01	Programmable Relay Option Board
299-0195-01	Discrete Relay Option Board
299-0196-01	Analog Input Option Board
299-0197-01	Button Board

Wireless Options and Accessories

Part Number	Part Description
299-0207-01	900Mhz Single Wireless Option
299-0208-01	900Mhz Dual Wireless Option
299-0209-01	2.4Ghz Single Wireless Option
299-0210-01	2.4Ghz Dual Wireless Option
299-0211-01	Antenna Base Station 900Mhz, Collinear 8dbi
299-0212-01	Antenna Base Station 2.4Ghz, Collinear 9dbi
299-0213-01	Antenna 900Mhz 2.5dBi Dipole, Rubber, DIV 2
299-0214-01	Antenna 2.4Ghz 7dBi Collinear, Rubber, DIV 2
299-0215-01	Yagi Antenna 900Mhz 9dbi
299-0216-01	Yagi Antenna with Tilt Mount, 2.4ghz 12dbi
299-0217-01	Antenna 900Mhz Spring Base 2dbi Dipole Omni
299-0218-01	Antenna 2.4Ghz Spring Base 4dbi Dipole Omni
299-0219-01	Antenna Lightning Protector
299-0220-01	Converter for Converting "N" Connector to "RP-TNC" Connector
299-0221-01	15' LMR-195 N-Type Male TP RP-SMA Male Cable
299-0222-01	75' Long RP-TNC Low Loss Coax Antenna Cable
299-0223-01	50' Long RP-TNC Low Loss Coax Antenna Cable
299-0224-01	25' Long 2RP-TNC Low Loss Coax Antenna Cable
299-0225-01	15' Long 2RP-TNC Low Loss Coax Antenna Cable
299-0226-01	125' Long 2RP-TNC Low Loss Coax Antenna Cable
299-0227-01	30 Watt Solar Power Supply with 55ah Battery, DIV 2

Expansion Options

Part Number	Part Description
299-0198-01	Nema 4X Expansion Enclosure for up to 8 option PCBs
299-0199-01	Nema 4X Expansion Kit (adds up to 4 option positions)
299-0200-01	19" Rack Position Expansion Plate (adds up to 6 option positions)
299-0201-01	Nema 7 Expansion Kit (adds up to 3 option positions)

NOTES

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