# *1600 Gas Controller*

## User's Manual

Version 3.2
September 1, 2006

**Industrial Scientific Corporation**

# 1 Introduction

The 1600 Gas Controller monitors up to 16 gas sensors via the Modbus RTU protocol over an RS-485 serial communication link.

Included in the 1600 are:

- Support for 16 Modbus gas sensors
- 1 physical relay rated at .5A @125VAC
- Support for 16 Modbus relays
- Modbus Slave support via an RS-232 connection
- Automatic 'discover' feature to detect all sensors and setup the 1600
- Optional 24VDC supply to power gas sensors

The physical relay by default is used:

- as a local alarm indicating loss of communication with any of the sensors,
- when any of the sensors goes into a fault condition, and
- when any sensors exceeds a low or high alarm limit.

The user can select any of the available sensors, physical or Modbus-addressable, to be used for any of these conditions.

## *1.1 General Operation*

The 1600 has 2 modes of operation – PROGRAM and RUN.

- During PROGRAM mode the user can change how the 1600 operates.
- During RUN mode the 1600 is monitoring sensors and controlling relays as specified.

The 1600 monitors up to 16 sensors continuously. When any one of the sensors readings changes from the normal condition to the alarm condition, the 1600 turns on the specified relay. There are a total of 16 Modbus-addressable relays that can be configured.

### *1.1.1 Power Up*

On power up, the 1600 does the following:

- Starts in the bootloader looking for a valid application
- Starts the application
- Enters RUN mode if an Access Code is set
- Enters PROGram mode if an Access Code is not set
    - Switches to RUN mode 30 minutes after no activity

### *1.1.2 Viewing Sensors*

Automatic scrolling of all sensor channels starts 60 seconds after the display is returned to the main RUN mode screen. During scrolling, a user can use the NEXT/PREV keys to temporarily stop the scrolling and select a channel for viewing.

### *1.1.3 Acknowledging Alarms*

Alarms are acknowledged by pressing the ACK' key on the keypad while in RUN mode.

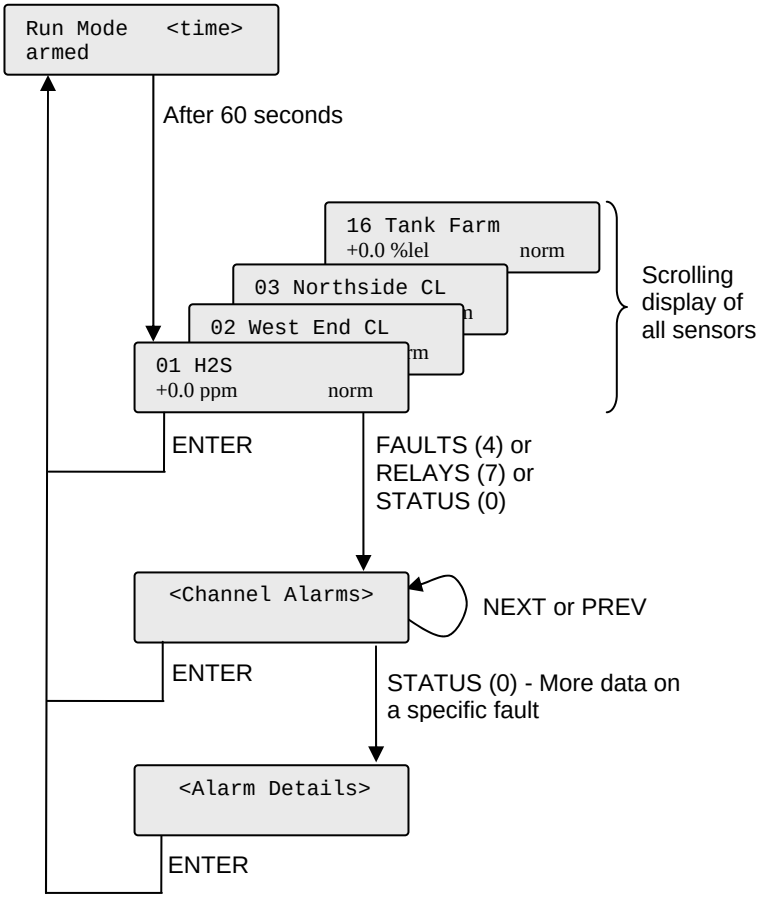



*Figure 1 RUN Mode screens*

# 2 Installation

The 1600 comes in 2 physical configurations, a metal enclosure that can be flush or panel mounted and a NEMA 4X enclosure with a clear door.

The 1600 can be mounted to a panel or it can be flush mounted to a door. The brackets on the either side of the 1600 can be removed and turned around for panel mounting.

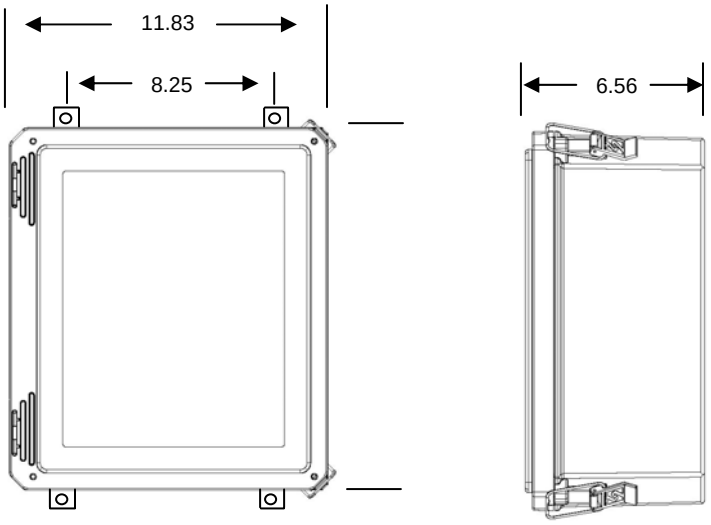



*Figure 2 NEMA 4X enclosure mounting*

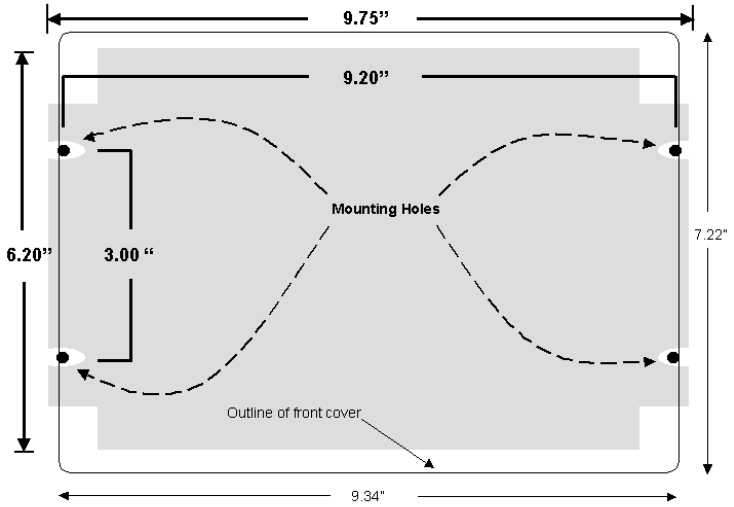



*Figure 3 Panel Mount mounting holes*

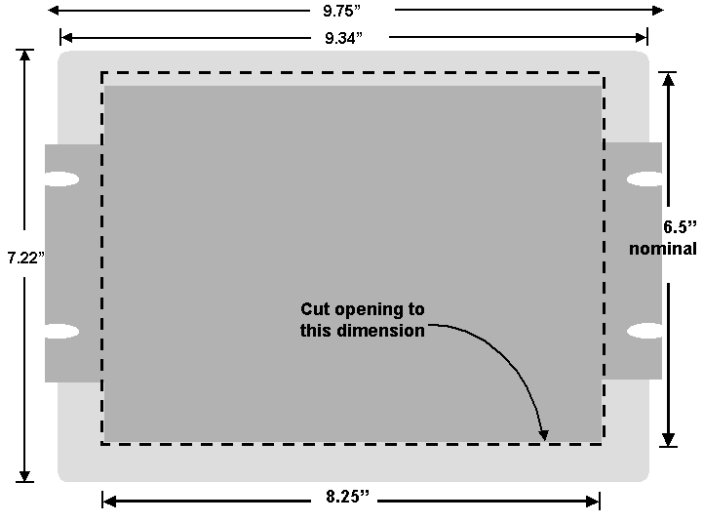



*Figure 4 Flush Mount cut-out dimensions*

## 2.1 Enabling power

For the flush/panel mount configuration, plug in the provided 12VDC power supply to the power connector on the 1600.

The power switch is on the left-hand side just to the right of the power connection.

For the NEMA 4X configuration, connect either 120VAC or 220VAC to the terminal block on the bottom panel.

The power switch is on the inside door on the right-hand side of the circuit board, just to the left of the power connection.

## 2.2 Serial connections – flush/panel mount

The 1600 has two serial cables, Port 1is a 9-pin connector located on the far right-hand side which is usually used as the Modbus Master port to communicate with sensors.

The RS232-to-RS485 converter should be connected either directly or through a straight-through cable to the 9-pin connector. You must provide 12VDC and ground connections to the converter as labeled.

On the RS-485 converter:
Connect the wire leading from the A connections in all sensors to the B terminal.
Connect the wire leading from the B connections in all sensors to the A terminal.
**NOTE:** *RD(A) and TD(A) are jumpered and RD(B) and TD(B) are jumpered.*

Port 2 is an RS-232 cable used for diagnostics (debug) or as a Modbus Slave port.

XMT – pin 2, RCV – pin 3

## 2.3 Serial connections – NEMA enclosure

Port 1, the RS-485 port to communicate with sensors, is mounted on the bottom panel inside the enclosure.

Connect the wire leading from the A connections in all sensors to the B terminal.
Connect the wire leading from the B connections in all sensors to the A terminal.
**NOTE:** *RD(A) and TD(A) are jumpered and RD(B) and TD(B) are jumpered.*

Port 2 is an RS-232 cable used for diagnostics (debug) or as a Modbus Slave port.

## 2.4 Configuring the serial ports

The serial ports are configured from the System Setup (3) function when in the Programming mode.

| | | |
|---|---|---|
| **Mode** | 0 – None, 1 - Debug, 2 – Slave, 3 – Master<br>Comm 1 default = **Master**<br>Comm 2 default = **Slave** | |
| **Baud Rate** | 0 - 1200<br>1 – 2400<br>2 – 4800<br>**3 - 9600**<br>4 – 14400 | 5 – 19200<br>6 - 28800<br>7 – 38400<br>8 – 57600<br>9 - 115200 |
| **Parity** | **0 – None**, 1 – Odd, 2 - Even | |
| **Data Bits** | 7 or **8** | |
| **Stop Bits** | **1** or 2 | |
| **Max Idle** | 5 – 4000 character times (default = **50**) | |
| **Response Timeout** | 20 – 6000 msecs (default = **850**) | |
| **Scan Rate** | 1 – 60 seconds (default = **1**) | |
| **Block Requests** | 0 – off, **1 - on** | |

Serial Port Defaults

- Port 1: MASTER, 9600 baud, 8, 1, NONE
- Port 2: SLAVE, ID=126, 9600 baud, 8, 1, NONE

# 3 Quick Setup

Setting up the 1600 from the factory defaults is very simple. The serial port default settings match the ISC sensor settings, once the RS-485 physical connection is made, the 1600 can automatically find all connected sensors.

## *3.1 Sensor Defaults*

| Default Name | Decimal Position | Low Limit | High Limit | Units | Alarm Mode |
|---|---|---|---|---|---|
| CO | 1 | 35.0 | 70.0 | ppm | Above a Limit |
| H2S | 1 | 10.0 | 20.0 | ppm | Above a Limit |
| NO | 1 | 25.0 | 50.0 | ppm | Above a Limit |
| NH3 | 2 | 22.00 | 50.00 | ppm | Above a Limit |
| NO2 | 1 | 1.0 | 2.0 | ppm | Above a Limit |
| SO2 | 2 | 2.00 | 4.00 | ppm | Above a Limit |
| CL2 | 1 | 0.5 | 1.0 | ppm | Above a Limit |
| HCN | 2 | 5.00 | 10.00 | ppm | Above a Limit |
| HCL | 2 | 5.00 | 10.00 | ppm | Above a Limit |
| PH3 | 2 | 0.30 | 0.60 | ppm | Above a Limit |
| CL02 | 2 | 0.30 | 0.50 | ppm | Above a Limit |
| O2 | 2 | 19.50 | 23.50 | %vol | Outside a Range |
| H2 | 1 | 50.0 | 100.0 | ppm | Outside a Range |
| CH4 | 0 | 10 | 20 | %lel | Above a Limit |
| LEL | 0 | 10 | 20 | %lel | Above a Limit |
| IR LEL | 0 | 10 | 20 | %lel | Above a Limit |
| CO/H2 | 1 | 35.0 | 70.0 | ppm | Above a Limit |
| ETO | 2 | 0.50 | 1.00 | ppm | Above a Limit |
| O3 | 2 | 0.10 | 0.20 | ppm | Above a Limit |
| CO2 | 2 | 0.50 | 1.00 | ppm | Above a Limit |

## *3.2 Systems with only 1 relay*

| | Function being performed | What you do |
|---|---|---|
| **Step 1** | Create network of sensors and 1600. | Connect RS-485 from 1600 to each sensor.<br>A to A and B to B. |
| **Step 2** | Find all sensors and setup all sensor channels. | PROG > DISCOVER<br><br>(wait for it to complete) |
| **Step 3** | Verify all sensors were found correctly.<br><br>**NOTE:** *At this point, each sensor has a Low alarm relay set to Relay1 and a High alarm relay set to Relay 1.* | STATUS > NEXT<br><br>Loop through all channels. |

## *3.3 Systems with 3 relays – Fault, Low and High*

| | Function being performed | What you do |
|---|---|---|
| **Step 1** | Create network of sensors and 1600. | Connect RS-485 from 1600 to each sensor.<br>A to B and B to A. |
| **Step 2** | Find all sensors and setup all sensor channels. | PROG > DISCOVER<br><br>(wait for it to complete) |
| **Step 3** | Verify all sensors were found correctly.<br><br>**NOTE:** *At this point, each sensor has a Low alarm relay set to Relay1 and a High alarm relay set to Relay 1.* | STATUS > NEXT<br><br>Loop through all channels. |
| **Step 4** | Setup relays by knowing the Modbus ID and Register # of the relays being used.<br><br>Relay # \| Modbus ID \| Register #<br>2 \| \| \|<br>3 \| \| \| | PROG > RELAYS<br><br>enter relay numbers 2 & 3 |
| **Step 5** | For all sensors, set the Low relay to 2 and the High relay to 3. | PROG > RELAYS > NEXT |

## *3.4 Systems with independent relays per sensor*

<table>
<tr><th></th><th>Function being performed</th><th>What you do</th></tr>
<tr><td>Step 1</td><td>Create network of sensors and 1600.</td><td>Connect RS-485 from 1600 to each sensor.<br>A to B and B to A.</td></tr>
<tr><td>Step 2</td><td>Find all sensors and setup all sensor channels.</td><td>PROG > DISCOVER<br><br>(wait for it to complete)</td></tr>
<tr><td>Step 3</td><td>Verify all sensors were found correctly.<br><br>NOTE: At this point, each sensor has a Low alarm relay set to Relay1 and a High alarm relay set to Relay 1.</td><td>STATUS > NEXT<br><br>Loop through all channels.</td></tr>
<tr><td>Step 4</td><td>Setup relays by knowing the Modbus ID and Register # of the relays being used.<br><br>For example,<br><table><tr><th>Relay #</th><th>Modbus ID</th><th>Register #</th></tr><tr><td>2</td><td>21</td><td>401</td></tr><tr><td>3</td><td>22</td><td>401</td></tr><tr><td>4</td><td>120</td><td>750</td></tr><tr><td>5</td><td>120</td><td>760</td></tr><tr><td>…</td><td>…</td><td>…</td></tr></table></td><td>PROG > RELAYS<br><br>enter relay numbers</td></tr>
<tr><td>Step 5</td><td>Set the Low and High relays for each sensor as desired.<br><br>For example,<br><table><tr><th>Sensor #</th><th>Low Relay</th><th>High Relay</th></tr><tr><td>1</td><td>2</td><td>3</td></tr><tr><td>2</td><td>4</td><td>5</td></tr><tr><td>3</td><td>6</td><td>7</td></tr><tr><td>…</td><td>…</td><td>…</td></tr></table></td><td>PROG > SENSORS<br><br>set each low and high relay</td></tr>
</table>

# 4 Programming

The 1600 is programmed from the front panel by pressing the keypad to access the various portions of the system. For the most basic application, you can simply program DISCOVER sensors and view the readings from those sensors.

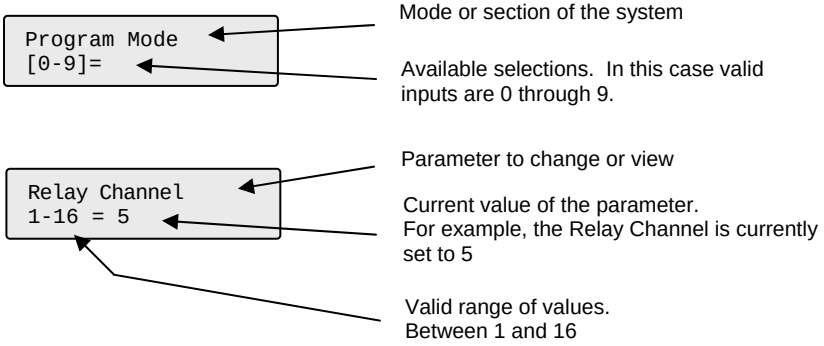
In more complex applications, you can program individual channels to control different relays based on high and/or low limits.

When programming, all prompts are displayed. You can enter a value or press the # key to keep the current value and move to the next option.

**NOTE:** *When you have finished programming, return the 1600 to the RUN mode by pressing the 1 key. If the 1600 is not in RUN mode, it will not perform any alarm operations.*

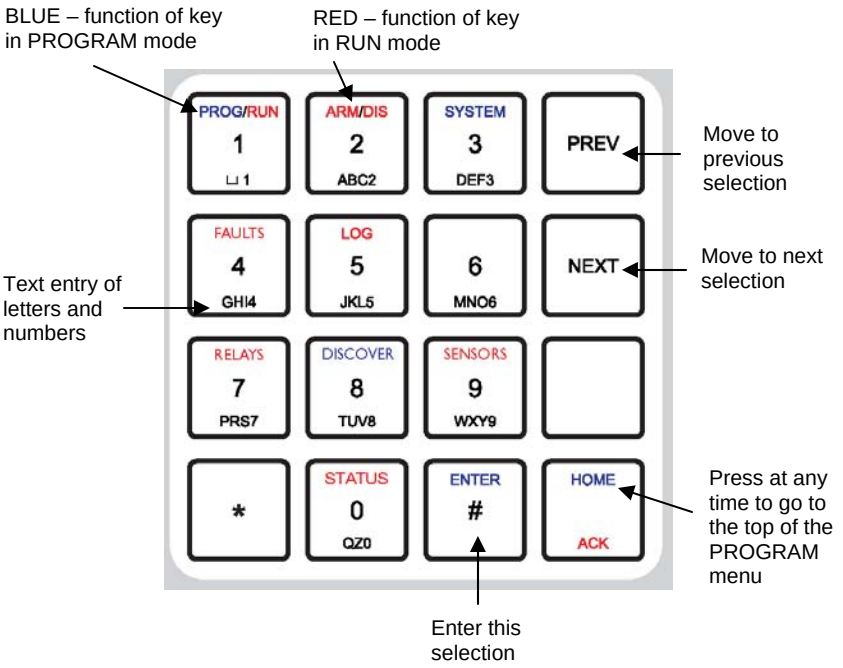
*If you forget to return the 1600 to RUN mode, it will automatically return to RUN mode after 30 minutes.*

## *4.1 How to Read the Menus*



## 4.2 How to use the Keypad

The 1600 keypad is designed to make programming easy. At the bottom of the front panel is a legend to assist in programming the most common functions.




| Key | Function in PROGRAM mode |
|---|---|
| 1 | Toggles the unit between PROGRAM and RUN mode. |
| 3 | Enter SYSTEM wide parameters |
| 4 | Program System channels for FAULT detection |
| 7 | Program RELAY channels |
| 8 | DISCOVER all sensors and automatically program channels |
| 9 | Enter individual SENSOR parameters |
| 0 | View STATUS of each sensor |
| <blank> | To toggle between Upper and Lower case for text entry |
| ** | To toggle between Positive (+) and Negative (-) for numbers |
| ENTER | Enter or keep the current setting or Exit view screens |
| PREV | Go to the PREVious selection |
| NEXT | Go to the NEXT selection |
| HOME | Go to the top of the PROGRAM mode menu |

## 4.3 How to Enter Text for Names

The DiaLog Scout allows the user to enter names for the Site (Unit) and for each channel. Entering names is very similar to entering names on most cell-phones that are used today.

On the bottom of each key, there are letters and numbers. To select a specific letter or number, press that key the designated number of times. For example, to enter the letter 'L', press the 5 key 3 times.

| Key to Press | Number of times to press the key | | | | |
|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** |
| 1 | space | 1 | | | + |
| 2 | A | B | C | 2 | . |
| 3 | D | E | F | 3 | , |
| 4 | G | H | I | 4 | - |
| 5 | J | K | L | 5 | * |
| 6 | M | N | O | 6 | # |
| 7 | P | R | S | 7 | / |
| 8 | T | U | V | 8 | _ |
| 9 | W | X | Y | 9 | |
| 0 | Q | Z | 0 | 0 | @ |
| * | Erases previous letter | | | | |

## 4.4 Programming System Settings

System settings are generally programmed once during the initial setup of the 1600.

| | What you do: | What the display shows: |
|---|---|---|
| **Step 1** | Press the 1 key to enter PROGRAM mode.<br>You can now enter options 0 – 9. | `Program Mode`<br>`[0-9]=` |
| **Step 2** | Press 3<br><br>*Enter Access Code if requested.* | **NOTE:** *If an Access Code has been programmed, the 1600 will show a screen to enter it.* |
| **Step 3** | A 20 character name that is displayed on the screen.<br>To enter the name, press the key that corresponds to the letter or number that you want. | `Site Name`<br>`nnnnnnnnnnnnnnnnn` |
| **Step 4** | The Access Code is displayed. Press # if OK or enter a new 4-digit Access Code.<br><br>**NOTE:** *If an Access Code is entered, then on power up, the 1600 starts in RUN mode instead of PROGram mode.* | `Access Code`<br>`nnnn` |
| **Step 5** | Scan Rate defines how often the 1600 reads all sensors.<br>Press # if OK or enter a new value as nn *(e.g. 03 for 3)* | `Scan Rate`<br>`1-60 secs = 1` |
| **Step 6** | The 1600 communication can be more efficient if data is requested in blocks instead of a each register one at a time.<br>For example, if the 1600 is reading registers 100, 103 and 120 it can read all those values in a single block. | `Block Mode`<br>`0-1 = 1 (on)` |
| **Step 7** | Communication port setup.<br>1 for Comm1 - DB9, RS-232 port<br>2 for Comm2 - header | `Comm Setup`<br>`1-2 = 1` |

| | What you do: | What the display shows: |
|---|---|---|
| **If not changing Comm port settings, skip to Step 15** | | |
| **Step 8** | 0 – none (port not used)<br>1 – debug (programming)<br>2 – Modbus RTU Slave<br>3 – Modbus RTU Master | CommX Mode<br>0-3 = 0 (none) |
| **Step 9** | Set the baud rate for the serial port.<br>0 = 1200 to 9 = 115200. | CommX Baud Rate<br>0-9 = 3 (9600) |
| **Step 10** | Set the parity<br>0 – none, 1 – odd, 2 – even | CommX Parity<br>0-2 = 0 (none) |
| **Step 11** | Set the data bits<br>7 or 8 | CommX Data Bits<br>7-8 = 8 |
| **Step 12** | Set the stop bits<br>1 or 2 | CommX Stop Bits<br>1-2 = 1 |
| **Step 13** | The number of characters the 1600 waits between characters being received. | CommX Max Idle<br>5-4000 chars = 20 |
| **Step 14** | Response Timeout is the maximum time the 1600 waits for a response from the sensors after a request is sent. | CommX Resp Timeout<br>20-6000 = 850 |
| **Step 15** | To set the Date and Time, press 1. Otherwise, press # or NEXT. | Set Date/Time<br>1-set = |
| **Step 16** | Set the time and date as needed. Press the # key if the value is correct already.<br>**NOTE:** *The 1600 uses a 24-hour clock.* | Set Hour<br>00:11:22<br><br>Set Month<br>11/22/06 |

| | What you do: | What the display shows: |
|---|---|---|
| **Step 17** | Reset Config back to the factory default values. Press 0 or # to keep your programming or 1 to reset back to the factory defaults.<br><br>**NOTE:** *Press 9 to store or retrieve a configuration. The 1600 has a separate area that is protected by a separate access code that allows the user to save or restore a configuration.* | `Reset Config`<br>`1-rst =`<br><br>`Enter Access Code`<br><br>`Backup=1 Restore=2`<br>`05/15/06 09:22:04` |
| **Step 18** | Reset Events log erases the Log. Press 0 or # to keep the log or 1 to erase. | `Reset Events`<br>`1-rst =` |

## 4.5 Programming System Fault Channels

This section allows you to configure how a System Fault is detected and what action is taken when a fault is detected.

There are 2 System Fault channels:

- **Communication channel** – indicates loss of communication with 1 or more sensors or relays
- **Sensor Fault channel** – indicates a sensor has a fault condition

If either of these system fault channels goes into alarm, then relay channel 1 is activated. Relay channel 1 is the physical relay on the 1600 board.

| | What you do: | What the display shows: |
|---|---|---|
| **Step 1** | Press the 1 key to enter PROGRAM mode.<br>You can now enter options 0 – 9. | `Program Mode`<br>`[0-9]=` |
| **Step 2** | Press 4<br><br>*Enter Access Code if requested.* | **NOTE:** *If an Access Code has been programmed, the 1600 will show a screen to enter it.* |
| **Step 3** | Enter 1 for the Communication channel<br>or<br>2 for the Sensor Fault channel | `Enter System Chan`<br>`1-2 =` |
| **Step 4** | Enter the Alarm Mode<br>1 – Status Only – monitor only, do not generate alarms<br>2 – Outside a Range – generate alarms and control relays | `Comm  Alm Mode`<br>`1-2=2 OutsideRange` |
| **Step 5** | The Alarm Delay specifies the number of seconds there must be no communication to a device until the alarm is generated. | `Comm  Alm Delay`<br>`0-65535 secs = 10` |
| **Step 6** | The Re-Alarm Delay specifies the number of minutes the channel will automatically go back into alarm if the alarm was acknowledged AND the alarm condition still exists. | `Comm   Re-Alm Mode`<br>`1-1440 mins = 60` |

| | What you do: | What the display shows: |
|---|---|---|
| **Step 7** | Specify which Relay to turn on when the channel goes into alarm. | `Comm  Alm Relay`<br>`Relay 1-17 = 1` |
| **Step 8** | Alarm State specifies the state of the relay when in the alarm condition.<br>1 = turn relay on when in alarm<br>2 – none (nothing is done with the relay) | `Comm  Alm State`<br>`1-2 = 1  On` |
| **Step 9** | Normal State specifies the state of the relay when in the normal (not alarm) condition.<br>0 = turn relay off when in normal<br>2 – none (nothing is done with the relay) | `Comm  Norm State`<br>`0,2 = 0  Off` |
| **Step 10** | Off On Acknowledge specifies whether to turn the relay when the channel alarm is acknowledged.<br>0 = No (leave relay alone)<br>1 – Yes (turn it off) | `Comm  Off On Ack`<br>`0-1 = 0 No` |

## 4.6 Programming Relay Channels

This section allows you to configure the relays that are going to be controlled when sensors or system channels go into and out of alarm.

| | What you do: | What the display shows: |
|---|---|---|
| **Step 1** | Press the 1 key to enter PROGRAM mode.<br>You can now enter options 0 – 9. | `Program Mode`<br>`0-9 =` |
| **Step 2** | Press 7<br><br>*Enter Access Code if requested.* | **NOTE:** *If an Access Code has been programmed, the 1600 will show a screen to enter it.* |
| **Step 3** | Enter the Relay Number that you wish to examine or program.<br>**NOTE:** *1 is the physical relay on the 1600 unit and 2-17 are Modbus addressable relays* | `Enter Relay Num`<br>`1-17 =` |
| **Step 4** | Enter a name for this relay.<br>For example, CL Warning | `Rlynn Name`<br>`Relay nn` |
| **Step 5** | The Mode specifies whether this relay is disabled or in the operational mode.<br>0 – disabled<br>1 – Status Only (operational) | `Rlynn Mode`<br>`0-1 = 1 StatusOnly` |
| **Step 6** | Enter the Modbus Slave ID for the relay. The 1600 assumes it is reading a coil.<br><br>**NOTE:** *Physical relay 1 has a Slave Address of 0.* | `Rlynn Slave Addr`<br>`0-247 =` |
| **Step 7** | Enter the Register Number for the relay.<br><br>NOTE: Physical relay 1 has a Register Number of 1. | `Rlynn Reg Number`<br>`0-9999 = 1` |

## 4.7 Discovering Sensor Channels

This section describes how to automatically find and program sensor channels.

Auto discovery of all sensor heads attached to the serial network can be initiated from DISCOVER (8).

'Discover ALL' clears all current sensor configurations before starting,
'Discover NEW' looks for new sensor ID's and looks for mismatches between existing sensor ID's.

The discovery process includes the following:

1. For each ID possible in a network (1-247), the 1600 attempts to read registers the define the type of sensor and the type of gas.
2. If a sensor responds, a channel is allocated to that sensor. If no response, the 1600 increments to the next ID.
3. If a sensor is present, then the alarm set points for that sensor are read.
4. Once this new found sensor channel is setup, the 1600 reads to determine if this is a dual-head installation. If a second sensor is found, then the next channel is allocated for that sensor.
5. This process continues until either the user interrupts the discovery process or all ID's have been tried.
6. The user has the option to manually modify the configuration of any channel using the Sensor configuration (9) function.

**NOTE:** *The DISCOVER process can be stopped at anytime by pressing the ENTER or (#) key.*

| | What you do: | What the display shows: |
|---|---|---|
| **Step 1** | Press the 1 key to enter PROGRAM mode.<br>You can now enter options 0 – 9. | `Program Mode`<br>`0-9 =` |
| **Step 2** | Press 8<br><br>*Enter Access Code if requested.* | **NOTE:** *If an Access Code has been programmed, the 1600 will show a screen to enter it.* |
| **Step 3** | Press 1 to erase the current sensors and find ALL sensors attached to the Modbus Master network.<br>Press 2 to only find NEW or different sensors on the Modbus Master network. | `Auto Discovery`<br>`1=ALL 2=NEW` |

| | What you do: | What the display shows: |
|---|---|---|
| **Step 4** | Press # to execute the ALL or NEW operation.<br>Press 0 to exit this step. | `Discover ---`<br>`#-accept 0-exit =` |
| **Step 5** | The 1600 scans through all IDs from 1 to 247, or until IDs are used.<br>As each ID is scanned, the <status> will indicate if a sensor was found and what type was found. | `ID:nn  <status>` |
| **Step 5** | The 1600 scans through all IDs from 1 to 247, or until IDs are used.<br>As each ID is scanned, the <status> will indicate if a sensor was found and what type was found. | `ID:nn  <status>` |

**NOTE:** *By default, when a sensor channel is configured, the alarm relays are set to Relay 1 and Relay 1. Any other **Relay** channels have to be configured manually by the user through PROG> RELAYS (7).*

## 4.8 Programming Sensor Channels

This section allows the user to configure or modify the sensors individually. There are a total of 16 available sensor channels, numbered 1-16.

| | What you do: | What the display shows: |
|---|---|---|
| **Step 1** | Press the 1 key to enter PROGRAM mode.<br>You can now enter options 0 – 9. | `Program Mode`<br>`0-9 =` |
| **Step 2** | Press 9<br><br>*Enter Access Code if requested.* | **NOTE:** *If an Access Code has been programmed, the 1600 will show a screen to enter it.* |
| **Step 3** | Enter the SensornNumber that you wish to examine or program. | `Enter Sensor Chan`<br>`1-16 =` |
| **Step 4** | The Sensor Type is the gas sensor that is being modified or configured.<br><br>1 = CO 2 = H2S<br>3 = NO 4 = NH3<br>5 = NO2 6 = SO2<br>7 = CL2 8 = HCN<br>9 = HCL 10 = PH3<br>11 = CLO2 12 = O2<br>13 = H2 14 = CH4<br>15 = LEL 16 = IP LEL<br>17 = CO/H2 18 = ETO<br>19 = O3 20 = CO2<br><br>**NOTE:** *When the Sensor Type is selected, the limits are automatically defaulted for that type of sensor.* | `Sensnn Sensor Type`<br>`0-20 = 0 None` |
| **Step 5** | Enter the Modbus Slave ID of the sensor. | `Sensnn Slave Addr`<br>`1-247 =` |
| **Step 6** | The Register Type specifies the Modbus Function code.<br><br>**NOTE:** *All ISC sensors use 3 for Read* | `Sensnn Reg Type`<br>`1-4 = 3 RdHold` |

| | What you do: | What the display shows: |
|---|---|---|
| | *Holding.*<br><br>Others supported are:<br>1 – Read Coil (digital value)<br>2 – Read Status (digital value)<br>4 – Read Input (analog value) | |
| **Step 7** | The Register Number is the Modbus register that contains the sensor reading.<br><br>**NOTE:** *All ISC sensors use 102 for single head and 102 and 202 for dual head.* | `Sensnn Reg Number`<br>`1-9999 = 102` |
| **Step 8** | Enter a 20 character name for this sensor.<br><br>**NOTE:** *Refer to 4.3*How to Enter Text for Names. | `Sensnn Name`<br>`AIN Chan 1` |
| **Step 9** | Enter the type of Engineering Units for this sensor.<br><br>0 none 1 **pct**<br>2 **ppm** 3 gals<br>4 gpm 5 gph<br>6 ft 7 rpm<br>8 psi 9 degC<br>10 degF 11 in<br>12 meters 13 km<br>14 liters 15 kliters<br>16 grams 17 kg<br>18 lbs 19 **%vol**<br>20 **%lel** | `Sensnn Engr Units`<br>`0-20 =` |
| **Step 10** | The Decimal Position specifies the number of digits to the right of the decimal point. | `Sensnn Dec Pos`<br>`0-5 = 1` |
| **Step11** | Signed Register indicates if the value being read is signed or unsigned. | `Sensnn Signed Reg`<br>`0-1 = 1 yes` |

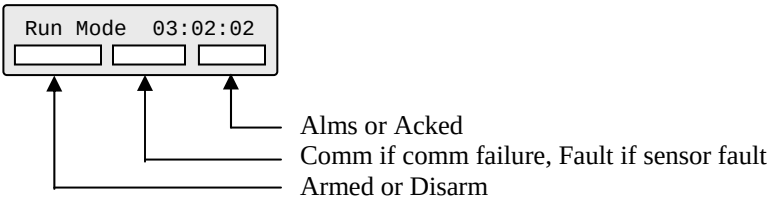
| | What you do: | What the display shows: |
|---|---|---|
| **Step12** | Scaled Input indicates if the value read is already in engineering units or needs to be scaled into engineering units.<br><br>**NOTE:** *If Scaling is required, the user is asked to enter:*<br>*Min Counts – minimum value in counts*<br>*Max Counts – maximum value in counts*<br>*Zero – minimum value in eng. units*<br>*Full – maximum value in eng. units*<br><br>*For example,* the reading from a gas sensor has 2 significant decimal places (xx.xx) in the register value and the user only wants to display 1 (xx.x). Set the number of decimal places to 1, min counts = 0, max counts = 10000, zero scale =0.0, full scale =100.0.<br><br>**NOTE:** *Any time the decimal point is changed, it affects the zero scale, full scale, low limit, and the high limit.* | `Sensnn ScaleInput`<br>`0-1 = 0 No` |
| **Step13** | Enter the type of Alarm Mode that will be used.<br><br>0 – disabled (channel not read)<br>1 – Status only (no alarming)<br>2 – Outside a Range<br>3 – Below a Limit<br>4 – Above a Limit<br>5 – Inside a Range | `Sensnn Alm Mode`<br>`0-5 = 4 AboveLimit` |
| **Step 14** | The Alarm Delay specifies the number of seconds there must be no communication to a device until the alarm is generated. | `Sensnn  Alm Delay`<br>`0-65535 secs = 10` |
| **Step 15** | The Re-Alarm Delay specifies the number of minutes the channel will automatically go back into alarm if the alarm was acknowledged AND the alarm condition still exists. | `Sensnn Re-Alm Mode`<br>`1-1440 mins = 60` |
| **Step 16** | The Low Limit alarm for the sensor. | `Sensnn Low Limit`<br>`+/-99999 = +10.0` |

| | What you do: | What the display shows: |
|---|---|---|
| **Step 17** | The High Limit alarm for the sensor. | `Sensnn High Limit`<br>`+/-99999 = +50.0` |
| **Step 18** | The Relay to activate on Low Alarm | `Sensnn Lo ALm Rly`<br>`Relay 1-17 = 2` |
| **Step 19** | The state the relay should be in the Alarm condition:<br>1 = On, 2 = no change | `Sensnn Lo Alm State`<br>`1-2 = 1 On` |
| **Step 20** | The state the relay should be in the non-Alarm or Normal condition:<br>0 = Off, 2 = no change | `Sensnn Lo Norm State`<br>`0,2 = 0 Off` |
| **Step 21** | The Relay to activate on High Alarm. | `Sensnn Hi ALm Rly`<br>`Relay 1-17 = 3` |
| **Step 22** | The state the relay should be in the Alarm condition:<br>1 = On, 2 = no change | `Sensnn Hi Alm State`<br>`1-2 = 1 On` |
| **Step 23** | The state the relay should be in the non-Alarm or Normal condition:<br>0 = Off, 2 = no change | `Sensnn Hi Norm State`<br>`0,2 = 0 Off` |
| **Step 24** | Off On Acknowledge specifies whether to turn the relay when the channel alarm is acknowledged.<br>0 = No (leave relay alone)<br>1 – Yes (turn it off) | `Sensnn  Off On Ack`<br>`0-1 = 0 No` |

# 5 RUN Mode functions

While the Scout is in RUN mode it is scanning all inputs, evaluating them for transitions into and out of alarm conditions, performing alarm calls and updating the display.

The default RUN mode display looks like this:




There are 6 functions that can be performed while in RUN mode.

| Function | Capability |
|---|---|
| Keypad 0 | Get system status |
| Keypad 1 | Enter Program mode |
| Keypad 2 | Toggle Arm/Disarm |
| Keypad 5 | View Event Log |
| Keypad 7 | Activate Relay |
| Keypad 9 | Acknowledge alarms |

The only difference between the armed state and the disarmed state is that in the disarmed state, no relays are allowed to be set/reset by an alarm condition.

However, the user can perform manual control over the relays via the keypad while in the disarmed state. The timeout in going back to the armed state automatically is fixed at 30 minutes.

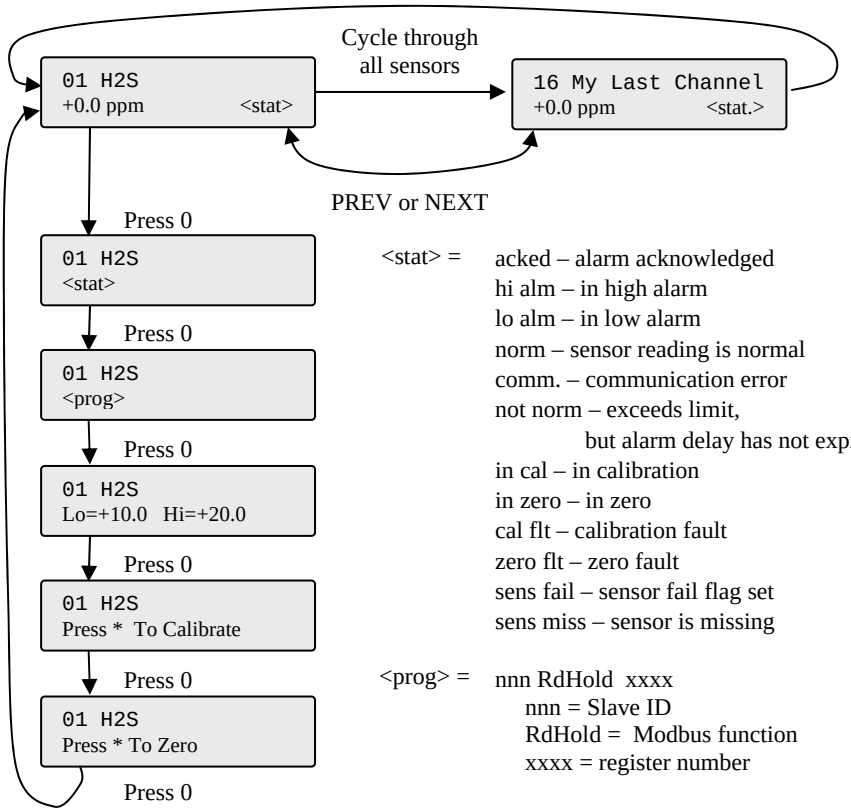
# 6 Getting System Status

Status reports the current conditions of the 1600. It will report the current condition of system channels, relays and sensors.

## 6.1 Sensor Status

To review the current sensor status from either RUN or PROGram mode, press the STATUS (0) key.

The 1600 displays the first sensor channel. To view the other sensors **press the PREV key to move backward** or the **NEXT key to move forward**.



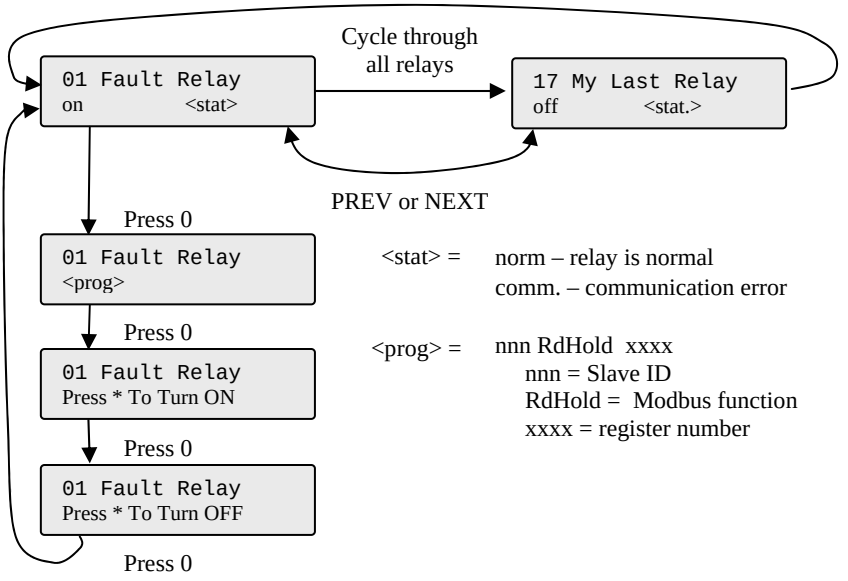

<stat> = acked – alarm acknowledged
hi alm – in high alarm
lo alm – in low alarm
norm – sensor reading is normal
comm. – communication error
not norm – exceeds limit,
but alarm delay has not expired
in cal – in calibration
in zero – in zero
cal flt – calibration fault
zero flt – zero fault
sens fail – sensor fail flag set
sens miss – sensor is missing

<prog> = nnn RdHold xxxx
nnn = Slave ID
RdHold = Modbus function
xxxx = register number

## 6.2 Relay Status

To review the relay status from either RUN or PROGram mode, press the RELAYS (7) key.

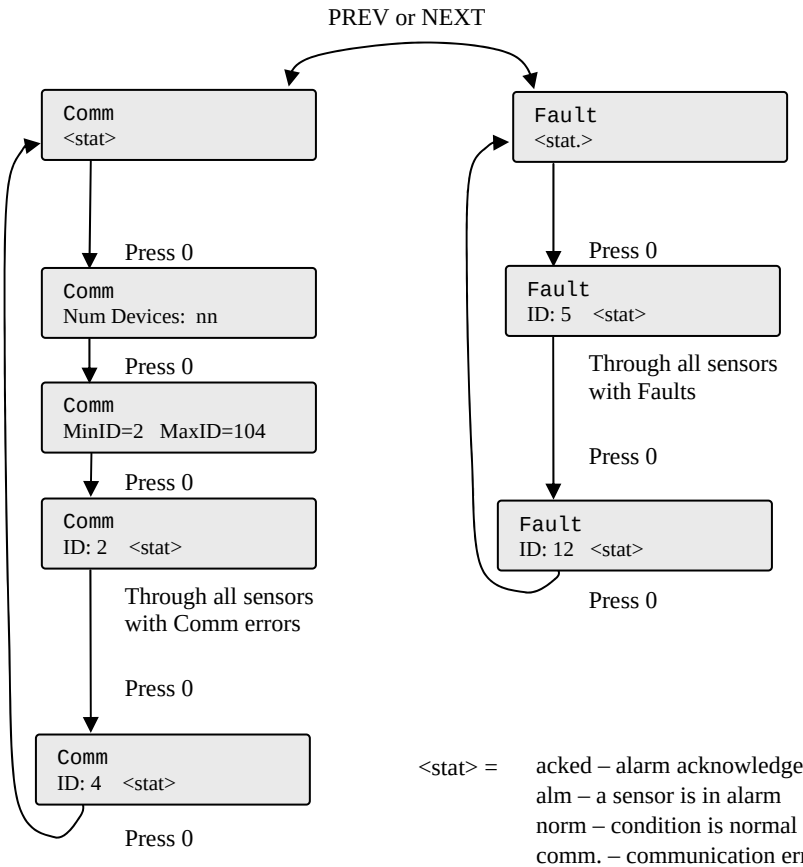
The 1600 displays the first relay channel. To view the other relays **press the PREV key to move backward** or the **NEXT key to move forward**.



## 6.3 Fault Status

To review the fault status from either RUN or PROGram mode, press the FAULTS (4) key.

The 1600 displays the first system fault channel. To view the other fault channels **press the PREV key to move backward** or the **NEXT key to move forward**.




<stat> =
acked – alarm acknowledged
alm – a sensor is in alarm
norm – condition is normal
comm. – communication error
in cal – in calibration
in zero – in zero
cal flt – calibration fault
zero flt – zero fault
sens fail – sensor fail flag set
sens miss – sensor is missing

Num Devices shows the total number of sensors configured.

MinID and MaxID are the lowest and highest Slave IDs for sensors that are configured.

# 7 Verifying Communication

The Communication channel, viewed by pressing FAULTS from RUN mode, indicates whether all sensors and relays are being read without error or not.

If the status is ‘norm’, then all sensors and relays are being read correctly.

If the status is ‘comm’, then at least 1 sensor or relay is not being read correctly.

**NOTE:** *If communication with a sensor is lost, the Communication channel will not go into alarm until the Alarm Delay period, which is defaulted to 10 seconds.*

The most common causes for a Comm Fault are:

1. The serial cable is disconnected.
   (all sensors and relays would have comm. fault)
2. The ID is not correct.
   (generally a single sensor or relay is incorrect)
3. The Baud Bate is not correct.
   (all sensors and relays would have comm. fault)
4. The Register Type or Register Number are not correct.
   (generally a single sensor or relay is incorrect)
5. The Max Idle it too low.
   (some sensors and relays would have comm. fault)
6. The Response Timeout is too low
   (some sensors and relays would have comm. fault)

# 8 Acknowledging alarms

A channel, Fault or Sensor, goes into alarm when it transitions out of the normal condition specified in the Alarm State.

When a channel for into alarm, any configured relays activate and the display automatically shows all channels in alarm in a scrolling mode.

The alarms can be acknowledged by pressing the ACK key while the 1600 is in RUN mode.

If configured, relays can be turned off when an alarm is acknowledged.

# 9 Arming and Disarming

At times it may be beneficial to Disarm the 1600 to prevent it from turning relays on/off. This is generally done when you are performing maintenance on equipment being monitored and do not want unnecessary alarms generated.

**NOTE:** *The 1600 must be in the RUN mode*

| | What you do: | What the display shows: |
|---|---|---|
| **Step 1** | Press the 2 key to toggle between Armed and Disarmed. | Run Mode 03:04:07<br>armed |
| | **NOTE:** *If the 1600 is Disarmed, it will automatically become Armed after 30 minutes.* | |

# 10 Modbus Slave

Use Communication Port 2 for Modbus Slave communication.

| Channel | Modbus Function | Register |
|---|---|---|
| COMM | Read Status | 1 |
| FAULT | Read Status | 2 |
| COMM Alarm status | Read Status | 101 |
| FAULT Alarm status | Read Status | 102 |
| Sensor Alarm Status | Read Status | 201 – 216 |
| Sensor channel data | Read Holding | 1 – 16 |
| Relay state | Read Coil | 1 – 17 |
| Set relay state | Write Coil | 1 - 17 |

# 11 Using Diagnostics on Port 2

Port 2 is defaulted to be a Modbus Slave connection, however, it can be used as a diagnostics port to perform some basic functions.

The most common use of this port is to monitor all Modbus traffic on Port 1 to help diagnose network issues.

To use Port 2 as a diagnostics port, set the Mode to 1 (Debug). Connect a laptop or PC to Port 2 and run Hyperterminal or another terminal emulation package.

The following menu will be displayed when you press the Enter key from Hyperterminal.

```
ISC 1600 GC - S16R16 (v3.2)

0) System Config
1) Channel Config
2) System State
3) Timers
4) Chan Data
5) Event Log
6) System Maint
7) Status Report

Cmd =>
```

**NOTE:** *To monitor the Modbus traffic on Port 1, press the '?' key from the top menu. The '?' key toggles the traffic viewing on and off.*

# 12 Retrieving the Event Log

The 1600 keeps the last 300 events that occurred in a local non-volatile log. The Event Log can be viewed locally on the display.

The **PREV moves backwards** and the **NEXT moves forwards** through the logs.

## *12.1 To view the Event Log locally*

| | What you do: | What the display shows: |
|---|---|---|
| **Step 1** | Press the 1 key to enter Program Mode | Program Mode<br>0-9 = |
| **Step 2** | Press the LOG (5) key | View Log<br>0-Evt 1-Data = |
| **Step 2** | Press 0 to view the Event Log | 1) PROG Mode<br>date time |
| **Step 3** | Press the NEXT key to advance forward through the Event Log or the PREV key to move backward.<br><br>Press the # key when you are finished. | 2) Relay On 2<br>date time |

**Press # when finished**

| Event # | Event Description | Event # | Event Description |
|---|---|---|---|
| 0 | NULL Event | 42 | GSM unsolicited reg event |
| 1 | Power On | 43 | GSM result of +CFUN cmd |
| 2 | Dead Task with task number | 44 | GSM attach to network |
| 3 | System Armed | 45 | GSM has reset |
| 4 | Armed | 46 | Pager call |
| 5 | RUN Mode | 47 | Phone check Telco/GSM |
| 6 | PROGram Mode | 48 | Sending SMS msg |
| 7 | Configuration Change | 49 | Sending e-mail msg |
| 8 | Reset to System Defaults | 50 | Sending GPRS UDP/PAD msg |
| 9 | Call Answered | 51 | Receiving SMS msg with cmd |
| 10 | No Dial Tone | 52 | Railed to execute SMS cmd |
| 11 | Call Busy | 53 | Automatic update call out |
| 12 | Call Error | 54 | Reset DIN run limit |
| 13 | Call Aborted | 55 | Reset DIN starts |
| 14 | Call Timeout | 56 | Reset AIN totals |
| 15 | Call No Answer | 57 | Write Holding |
| 16 | Call Incoming | 58 | Receive DTMF tone |
| 17 | Call Complete | 59 | Comm OK |
| 18 | Voice Call | 60 | Comm Fail |
| 19 | Data Call | 61 | Set notified |
| 20 | Alarms acknowledged locally | 62 | Clear notified |
| 21 | Alarms acknowledged remotely | 63 | Normal call |
| 22 | Alarm call / phone position | 64 | Between calls timer |
| 23 | Open alarm / digital channel number | 65 | Time was set |
| 24 | Closed alarm / digital channel number | 66 | GPS fix (1=valid, 0=not) |
| 25 | Run time alarm / digital channel number | 67 | midnite posting to Web |
| 26 | Starts alarm / digital channel number | 68 | GSM modem lockout states |
| 27 | Low alarm / analog channel number | 69 | GSM lockout active |
| 28 | High alarm / analog channel number | 70 | GSM lockout end |
| 29 | Totalization alarm / analog channel number | | |
| 30 | Channel is normal / channel number | | |
| 31 | Channel acknowledged / channel number | | |
| 32 | Relay channel on / channel number | | |
| 33 | Relay channel off / channel number | | |
| 34 | Normal data value for channel | | |
| 35 | Starts data for digital channel | | |
| 36 | Run time data for digital channel | | |
| 37 | Totalizer data for analog channel | | |
| 38 | Maximum value for analog channel | | |
| 39 | Minimum value for analog channel | | |
| 40 | Send status report | | |
| 41 | Send events report | | |

# 13 Index

## Industrial Scientific Corporation

***1001 Oakdale Road***
***Oakdale, PA***
***15071-1500***
***Phone:(412)788-4353***
***1-800-DETECTS***
***Fax:(412)788-8353***

*www.indsci.com*