ANALYTICAL TECHNOLOGY, INC.

O & M Manual

Dual-Channel H_2O_2 Monitor

Home Office

Analytical Technology
6 Iron Bridge Drive
Collegeville, PA 19426
Phone: 800-959-0299
610-917-0991
Fax: 610-917-0992
Email: sales@analyticaltechnology.com
www.AnalyticalTechnology.com

European Office

Badger Meter UK Limited
Unit 1 & 2 Gatehead Business Park
Delph New Road, Delph
Saddleworth OL3 5DE
Phone: +44 (0)1457-873-318
Fax: + 44 (0)1457-874-468
Email: sales@atiuk.com

Table of Contents

Table of Figures

SPECIFICATIONS

Application	Controlling Hydrogen peroxide sterilization. Not for use in Hazardous Locations.
High Range Channel **Low Range Channel**	0-1000 PPM as shipped (0-200 min, 0-2000 max) 0-20 PPM as shipped (0-10 PPM min, 0-100 max)
Display **Accuracy** **Sensitivity**	Backlighted graphics LCD Sensors are ± 5% full scale range from factory ½ % of operating range
Repeatability	± 20 PPM on high range ± 1 PPM on low range
Memory	15,000 data points per channel
Storage Interval	Programmable 1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30 and 60-minute intervals Typical capacity is 11 Days at 1-minute storage interval.
Alarms	Three adjustable level alarms and one trouble alarm per channel. Level alarm type may be high, low, or disabled (None). 3 SPST relays per channel (one used internally)
Communications	ASCII Protocol (standard) Modbus RTU (option)
Outputs	Two RS-232/485 outputs for stored gas values Two 4-20 mA DC, 500 ohms max. load
Power	120 or 220 VAC, 50/60 Hz, 15 W max. 6’ power cord supplied on units shipped to United States or Canada
Operating Temp.	-5º to +45º C
Humidity	0-95% non-condensing
Enclosure	NEMA 4X (IP-65), ABS with polycarbonate cover
Shipping Weight	10 lbs. (4.5 Kg.)
Warnings	**NOT FOR USE IN HAZARDOUS LOCATIONS**

INTRODUCTION

The Dual Peroxide Monitor (monitor) is well suited for monitoring sterilization cycles in glove boxes, isolators, or other chambers using hydrogen peroxide (peroxide). It features both a high-range channel for monitoring the elevated levels required for sterilization, and a low range channel to know when the air is safe to breathe after dosing. Each channel records readings and provides a 4-20mA current loop output.

The two channels consist of two separate F12/D gas transmitters mounted on the front of the monitor. Each is connected to a separate H10 sensor module inside, the left transmitter is connected to the low range sensor and the right one is connected to the high range sensor.

The monitor features a common pump that pulls a continuous gas stream to both sensors. When the concentration reaches 50 PPM, a bypass valve actuates to divert ambient air to the low range sensor. This helps protect it from over-exposure that might otherwise desensitize it. As peroxide levels subside, the valve restores normal gas flow to the low range sensor at 48 PPM so that a safe level may be determined.

By default, the high range sensor “Range” setting is 1000 PPM, which represents the 20mA level on the analog output. This setting also determines the maximum value that can be recorded by the data logger (values above this are clipped). The display, however, will report readings up to 2400 PPM (120% of the sensor’s maximum range).

Likewise, the low range channel full scale is 20 PPM, which also determines its 20mA level and maximum data logger value. Since the maximum upper range for this sensor is 100 PPM, the display will report readings up to 120 PPM.

Each channel has three “level” alarms. By default, these alarms are disable as shipped, except for the high range Warning alarm, which is set to trip at 50 PPM. Its associated relay is used to control the bypass valve, mentioned earlier, to limit exposure of the low range sensor to high levels of peroxide.

Units are shipped for operation on either 120 or 220 VAC. A power cord is supplied with units delivered within the U.S. or Canada.

The monitor’s sensor modules require time to stabilize after powering on the monitor, and after reinstalling the sensor. During this time, readings are normally high, and the transmitter will inhibit alarms and prevent relay activation for the first 5 minutes. If the sensor has been unpowered for a few days, you should allow a minimum of 1 hour. If the sensor is subsequently used every day, and not removed, they will normally stabilize within 15 minutes.

Note: the F12 transmitter inhibits activation of alarm relays for 5 minutes at power on and whenever the sensor is reinstalled. To protect the low range sensor from over exposure, it is recommended to not switch on the pump motor within the first 5 minutes after startup (unless the incoming gas is known to be less than 50 PPM).

UNPACKING

Upon receipt, inspect the contents for any damage caused by handling.
The package will contain the following items.

1 – Two Channel Hydrogen Peroxide Monitor
1 – Low Range Hydrogen Peroxide Sensor, 10/100 PPM (inside)
1 – High Range Hydrogen Peroxide Sensor, 200/2000 PPM (inside)
1 – 25 ft. (7 m.) length of 1/8" ID Teflon-lined inlet tubing.
1 – 25 ft. (7 m.) length of 1/8" ID PVC vent tubing.
2 – Quick-disconnect fittings for inlet and outlet tubing connection.
1 – Flowmeter
2 – Spare fuse
2 – RS-232 cable assemblies

Sensors are mounted inside the measuring chambers for each channel. Spare sensors and additional items are packaged into a separate parts bag.

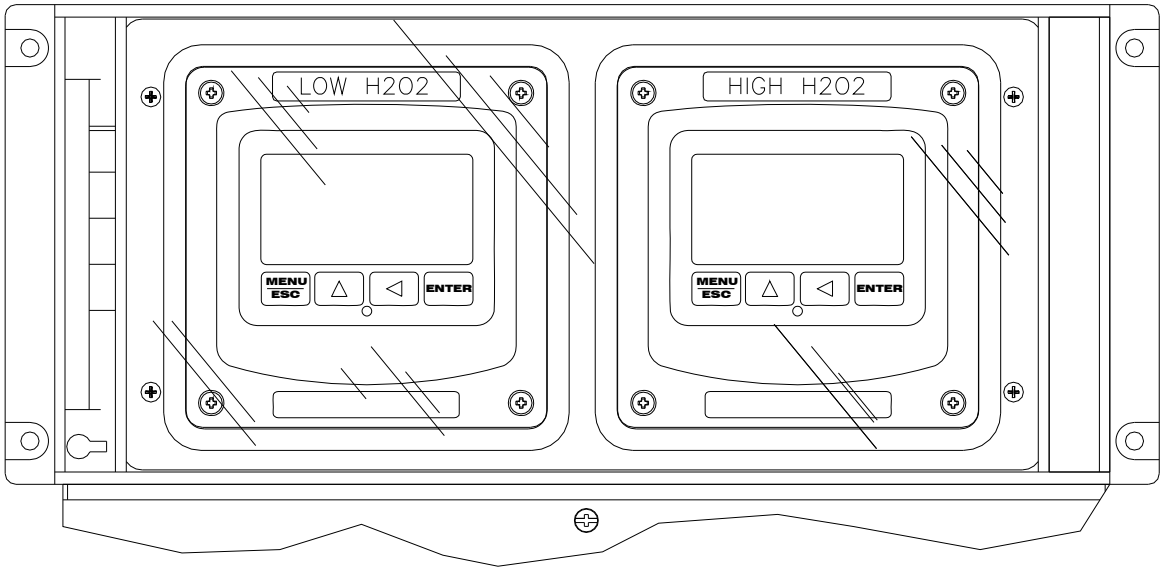


Figure 1 - Front Panel Overview

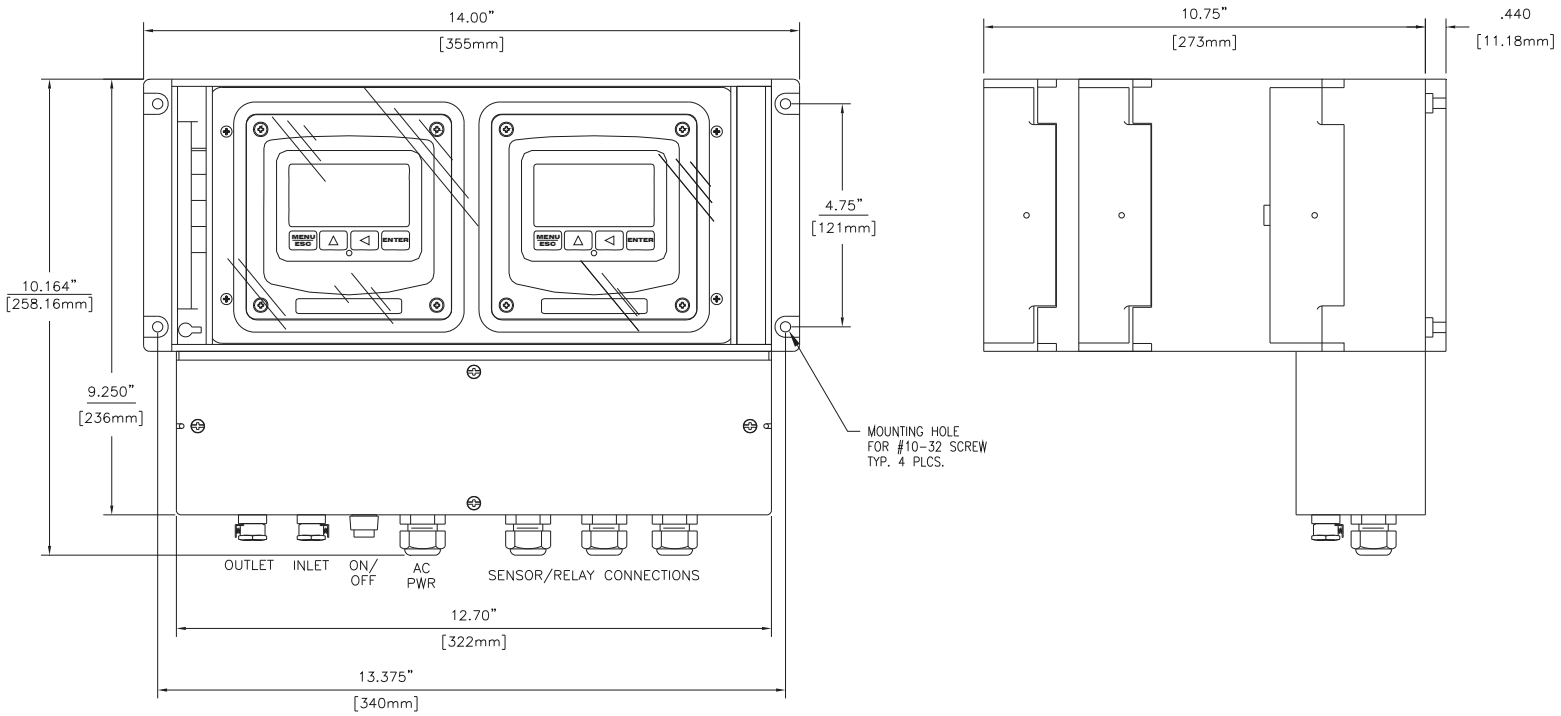


Figure 2 - Overall Dimensional Drawing

ELECTRICAL CONNECTIONS

The monitor features a high range and low range transmitter “channel”. Each channel exposes connections to an RS232/485 port, a 4-20mA output, and 3 SPST relays. Relay 1 on the high range channel controls the bypass valve to the low range sensor and the terminals may be used to monitor the status of that relay. The monitor requires a single A/C line power connection, as shown below.

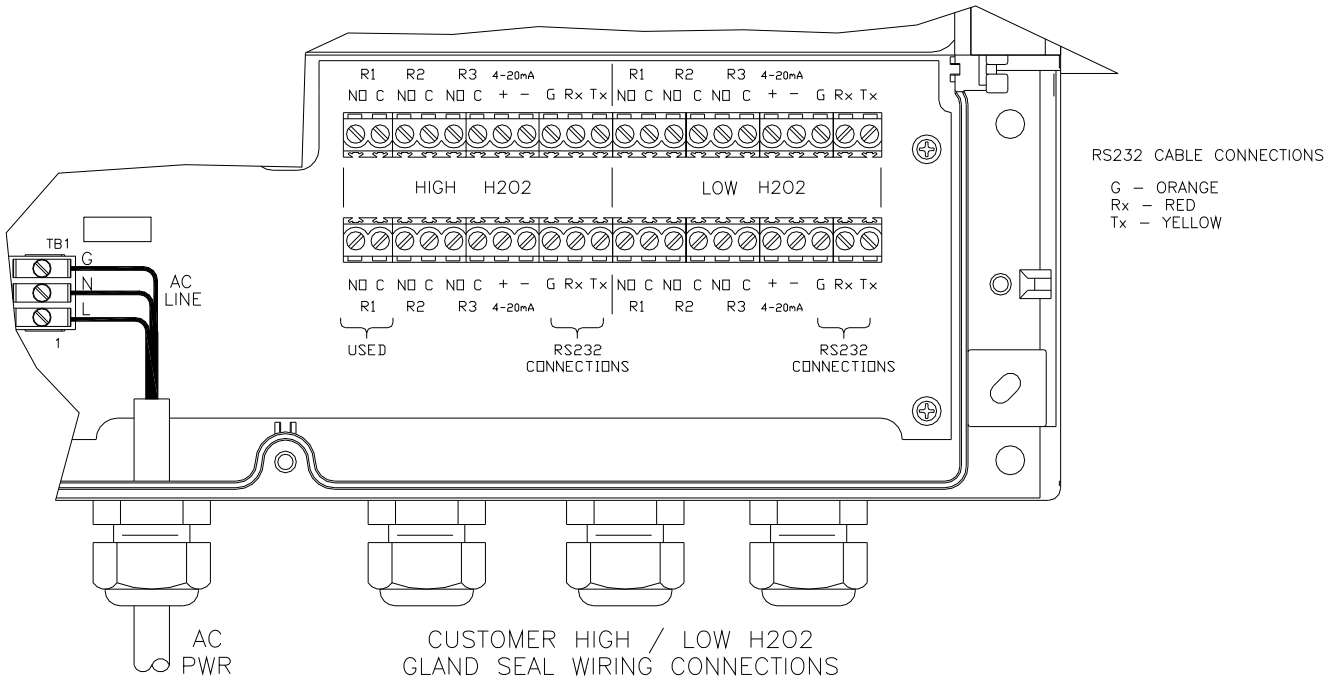


Figure 3 - Electrical Connections

OPERATION

Considerations for the Dual-Channel H_2O_2 Monitor

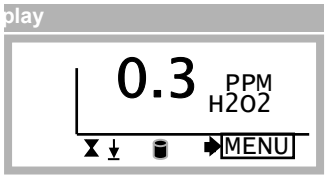
Prior to use, connect inlet and vent tubing as required. The inlet tubing must be inserted into the isolation chamber that is to contain the peroxide. The outlet vent tube can be either inserted into the isolator or vented to another safe location. Once the tubing is connected, activate the pump using the on/off switch next to the inlet connection on the bottom.

NOTE

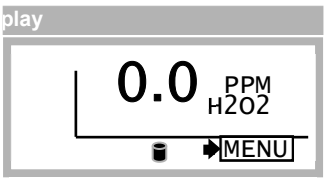
1. Do not block or obstruct the INLET or OUTLET ports.
2. The low range sensor must be installed in the lower holder. Failure to do so may result in damage to the low range sensor from over exposure to high levels of peroxide.

When power is first applied, the transmitter will sequence through the Transmitter Review and Sensor Review (see page 12) and then present the Main Display as shown below. The monitor's sensors are factory calibrated but require time to stabilize after power on.

For the first 5 minutes after startup, or after installing a sensor, alarms (and their assigned relays) are inhibited and the current loop outputs are held at 4.0mA, as indicated on the display shown below in Figure 4a. During this period the readings may be high but fall steadily to zero. The low range reading normally takes longer to completely stabilize. After 5 minutes, the power-on-inhibit and current-loop-fixed indicators disappear from the display, as shown below in Figure 4b.



a) During first 5 minutes after startup install (both displays)



b) 5 minutes after startup or install (both displays)

Figure 4 - Main Channel Display(s)

NOTE

Keep the pump motor off during the first 5 minutes after powering on the monitor.

Sensor Module Exchange

The monitor uses the H10 Series high range and low range H2O2 sensors, which allow users to easily change them. This allows spare sensors to be used when the primary sensors are removed for span calibration. Sensors may be removed and installed with power applied. Make certain to keep two different range sensors in their correct position.

To change a sensor, release the left-side hinge for the center section of the enclosure by sliding a small screwdriver blade into the slot and pry open the hinge. Release the catch and swing the center section open to the right. Inside, you will see two sensor holders with flow cells and tubing and held in place by a large plastic clip.

Remove the flow cell by twisting slightly and sliding it out of the sensor holder. It is held in place by an internal O-ring. If necessary, release the plastic clip to allow the assembly to move more freely. Unscrew the cap on the bottom of the sensor holder and gently pull the sensor out of the holder. Install the new sensor by rotating it as necessary to align the sensor guide pin, then push it onto the connector seated at the base of the holder. Replace the cap and gently work the flow cell back in the opening. Press the entire assembly back into the plastic clip.

If power is on when the sensor is removed, the transmitter will display “Sensor Removed”, along with a digital timer that counts down from 60 seconds. This is normally enough time to install a new sensor, but if not, you may repeatedly select “Reset” to restart the period at 05:00 (5 minutes). When a sensor is reinstalled, the transmitter will sequence the Sensor Review as shown on page 13.

NOTE

The low range sensor must be installed in the lower holder, which is protected from high levels of gas by the bypass valve.

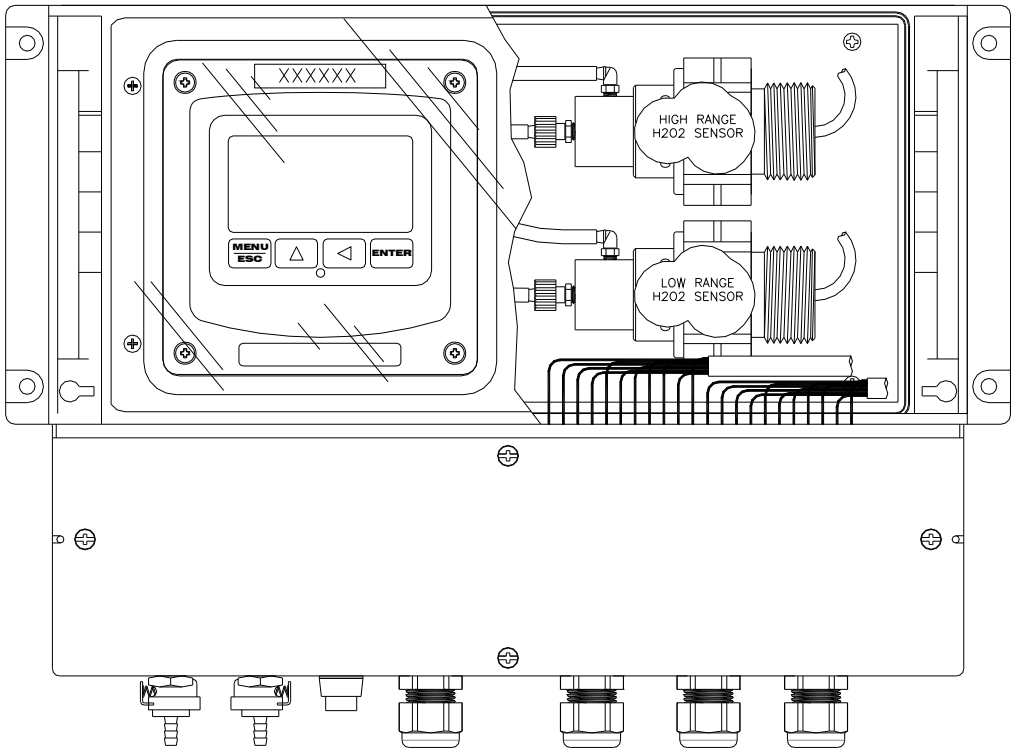


Figure 5 - Sensor Module Location

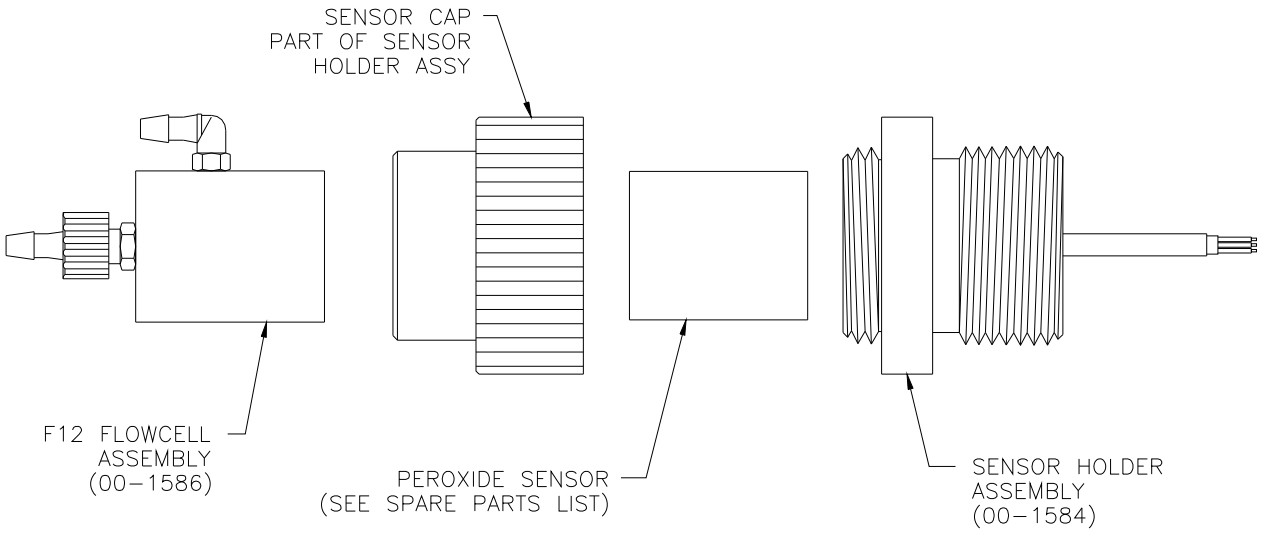


Figure 6 - Sensor Holder Exploded View

Bypass Valve Control

The monitor contains a bypass valve designed to protect the low range sensor from over exposure to peroxide. The valve is actuated when the high range channel's Warning alarm relay reaches 50 PPM, which diverts the sample stream and draws air across the sensor. The low range sensor should not be exposed to peroxide concentrations above 50 PPM, which is the factory default setting.

Display Resolution

The resolution of the displayed gas reading is appropriate for each channel. Full scale ranges of 0-49.9 or below will provide resolution of 0.1. Ranges from 0-50 up to 0-2000 will provide a resolution of 1 PPM.

Response Time

The upscale response time of the hydrogen peroxide sensors is generally about 40 seconds to 66% of final value and 120 seconds to 90% of final value. The downscale response time varies significantly with the duration and concentration of the exposure. A typical high range sensor will recover to 20 PPM after a 1-hour exposure to 1000 PPM in about 10 minutes. A low range sensor will recover to 1 PPM after a 1-hour exposure to 50 PPM in about 10 minutes.

Response Check

Prior to using the peroxide monitoring system, it is useful to perform a quick test to verify that both sensors are operating. To do this, you will need an 8-oz. bottle containing about 25 cc. of 37% hydrogen peroxide. The peroxide is available through laboratory supply houses such as Fisher Scientific.

Connect a piece of 1/8" I.D. tubing to the inlet fitting on the bottom of the monitor. Open the bottle containing the peroxide and insert the other end of the tube about 1" into the bottle so that vapors inside the bottle are drawn into the tube.

DO NOT ALLOW LIQUID PEROXIDE TO ENTER THE TUBE OR SERIOUS DAMAGE MAY RESULT

Both channel displays should show a rapid increase in peroxide values (the low range sensor will be faster). When the concentration exceeds about 50 PPM on the high range display, the solenoid venting the low range sensor will trigger, causing the reading to decrease. This check should be performed prior to commissioning the system.

CAUTION:
Hydrogen peroxide at 37% is an extremely strong oxidizer and must be handled with great care. Follow all safety recommendations provided by the supplier when using this material. Do not use unless you fully understand the hazards and the proper first aid requirements if exposure occurs.

Interferences

Hydrogen peroxide (H2O2) sensors may respond to "interferent" gases or vapors. The table below summarizes the sensor readings to a 1 PPM exposure of interferent gas. Those marked with "---" have no significant effect on sensor readings. Exposure to high concentrations of interferents may cause a persistent high reading.

		H_2O_2 PPM
	NH_3	---
	CO	0.005
	H_2	0.01
I	NO	1.5
N	O_2	---
T	Cl_2	---
E	O_3	---
R	HCl	0.1
F	HCN	0.1
E	HF	---
R	H_2S	4
E	NO_2	0.2
N	SO_2	1
C	Hydride	2
E	SiH_4	2
	CO_2	---
	CH_4	---
	CH_3SH	1.3
	C_2H_2	0.1
	C_2H_4	---
	C_2H_6O	0.02

Level Alarm Functions

Each monitor channel features three adjustable level alarms with visual indicators and relay contacts:

Caution	Low alarm to indicate sensor negative drift (disabled by default)
Warning	High alarm (enabled, automatic reset by default)
Alarm	High-high alarm (disabled by default)

Since the monitor is designed for continuous measurement of peroxide, rather than for leaks, alarms are disabled except for the high range Warning alarm, which is used to control a bypass valve for the low range sensor. However, disabled alarms and their associated relays may be enabled by following the instructions on page 20.

When alarms are enabled, the gas reading is continuously compared to the alarm level. When the reading reaches the alarm level, a corresponding indicator on the front panel will appear (see Main Display on page 14) and the associated relay will activate. There is no audible alarm in the unit. If external alarm devices are connected to the relays, these devices will also activate. See Relay Operation, Menus, and Settings on page 41 for assigning relays to alarms.

RS-232 Computer Interface

Each channel in the monitor is equipped with an on-board data logger, which can be used to store gas readings over time and transfer the data to a PC. See Data-log Menus, Methods, and Settings on page 30 for details on the data logger function. Two RS-232/485 connections are also exposed at terminals inside the monitor. Cables are supplied for connection to the digital outputs

Analog Outputs

One 4-20 mA output is provided for each channel. An output of 4 mA represents a gas reading of 0 PPM, and an output of 20mA represents a full scale reading, which is automatically configured by the sensor 'Range' setting (upper range value). The Range setting is user adjustable within the upper range limits of the sensor (see Sensor Range Menu on page 18). By default, the low range channel 20mA output is equivalent to a gas level of 20 PPM, and the high range 20mA output is equivalent to 1000 PPM.

Startup

When the monitor starts, each display sequences a series of pages to review the configuration of the transmitter and sensor. During this time, alarms and the associated relays are normally inhibited, and the analog outputs are held at 4.0 mA. This state is maintained for 5 minutes to provide time for the sensor readings to stabilize. If the trouble alarm is active, the analog output drops to 3.6mA (default value) and remains there indefinitely. Since the bypass valve will not be controlled during this time, keep the pump motor off until the power on inhibit has expired.

Keep the pump motor off during the first 5 minutes after powering on the monitor.

Operator Interface Panel

The F12/D has an intuitive, non-intrusive operator interface that features a backlighted LCD and four panel keys.

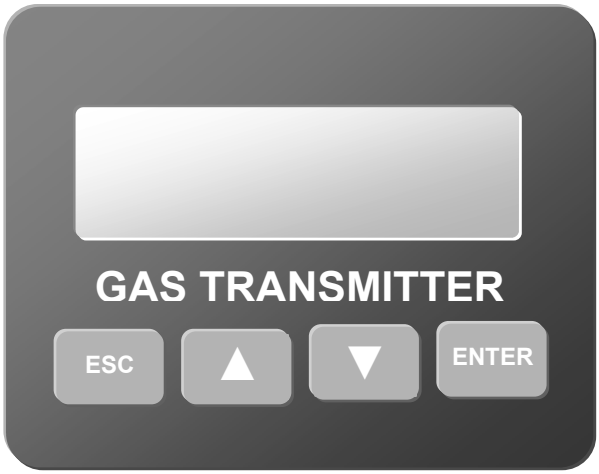


Figure 7. Operator interface panel

Display Items

The display is composed of graphic icons, text labels, numeric values, and a cursor. Graphic icons represent the device status, while menus and settings appear as text and numeric values, like "Menu", and "Range= 50.0".

Moving the Cursor and Selecting

The selection cursor (▶) moves between display items using the up (▲) and down (▼) keys. The down key moves the cursor down or to the right, while the up key moves the cursor up or to the left. Pressing the **Enter** key when pointing at an item selects it, and pressing the **ESC** key cancels the selection.

Editing Settings

A setting is selected for edit by moving the cursor to the left of the label and pressing the **Enter** key, which causes the up-down cursor (▲▼) to appear in front of the value. Pressing the up key (▲) increases the value or list item, while pressing the down key (▼) decreases the value or list item. Once the setting has been adjusted to the desired value, pressing the **Enter** key stores it and exits edit mode. Pressing the **ESC** key restores the original value and exits edit mode.

While editing, the edit cursor changes its shape to provide feedback on which key is activated.

▲▼ Edit Active ▲ Increasing ▼ Decreasing ⧗ Saving Value

▶ Range= 50.0	Move the selection cursor to the left of the setting's label and press the **Enter** key.
Range▲▼ 50.0	The up-down edit cursor appears.
Range▲ 50.1	Pressing the ▲ key increases the value.
Range▼ 49.9	Pressing the ▼ key decreases the value.
Range⧗ 100.0	Pressing the **Enter** key saves the new value and exits edit mode.
▶ Range= 50.0	Pressing the **ESC** key restores the old value and exits edit mode.

Figure 8. Example Edit

Transmitter Review

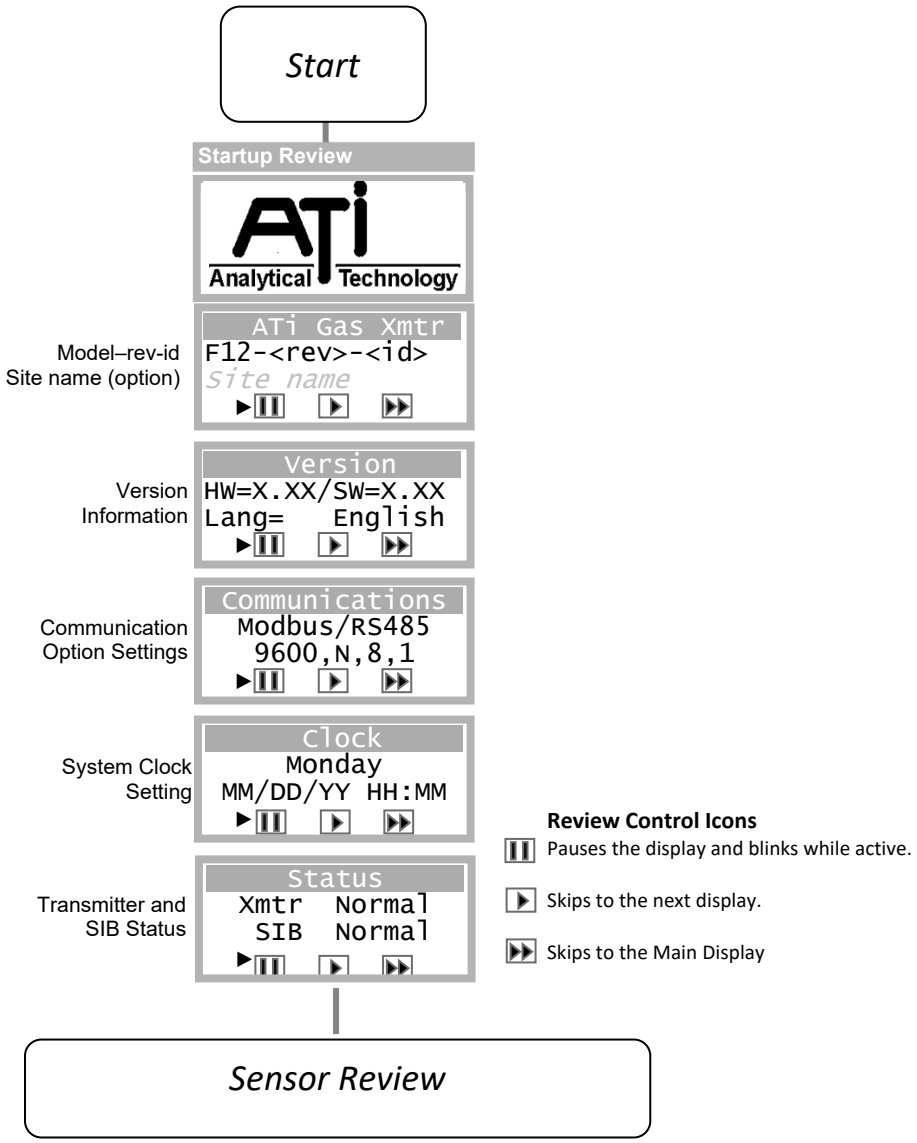
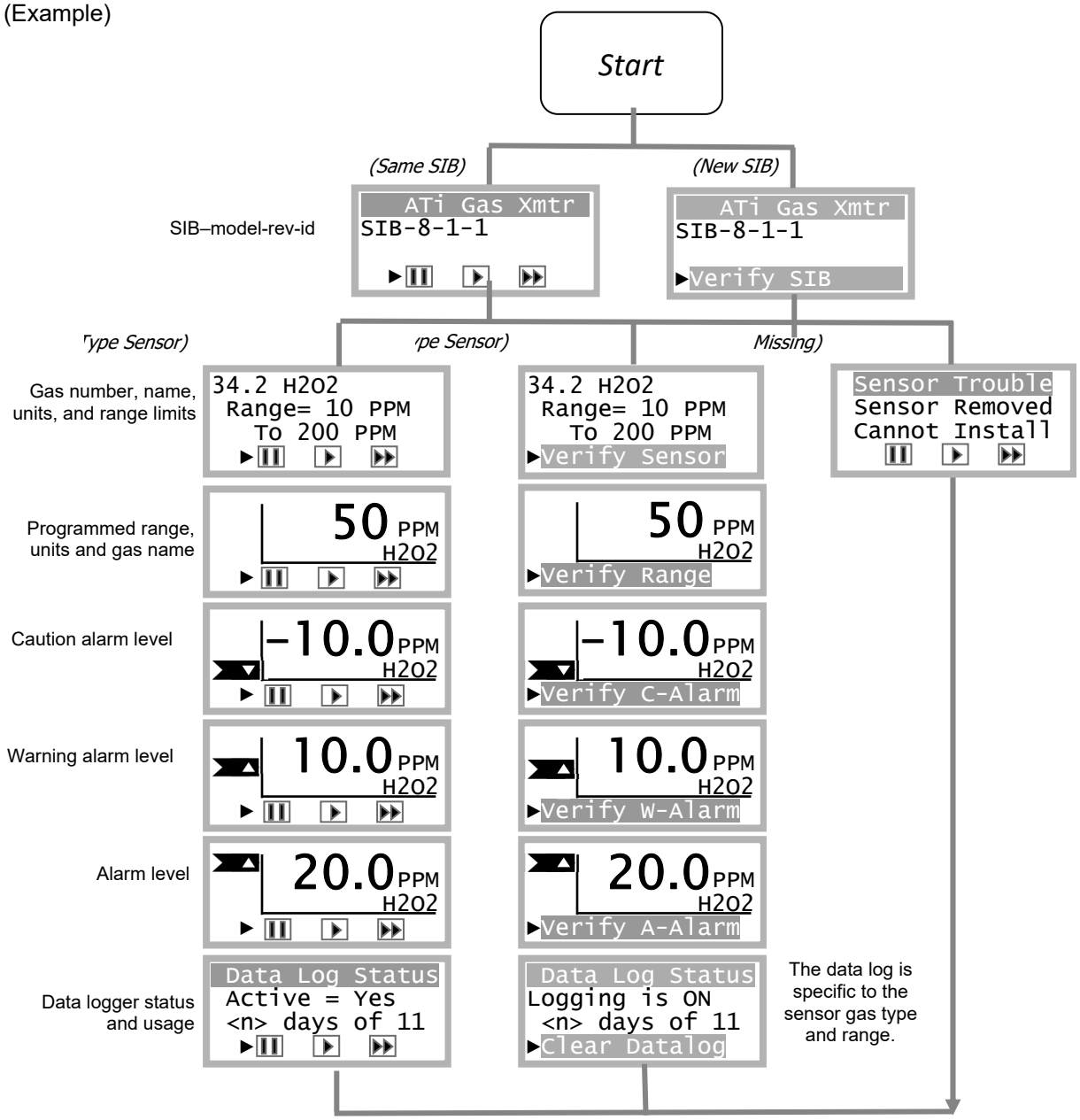


Figure 9 - Transmitter Review Menu

Sensor Review

(Example)



Review Control Icons

- Pauses the display.
- Skips to the next display.
- Skips to the Main Display

Operator Verify

Review pauses indefinitely at: Verify SIB, Verify Sensor, Verify Range, Verify C-Alarm, Verify W-Alarm, Verify A-Alarm, and Clear Datalog, The Trouble alarm is activated after 5 minutes of no keypad activity.

Figure 10 - Sensor Review Menu

Main Display

The Main Display page shows the name and concentration of the target gas, and units of measurement (PPM, PPB, %, etc.). Alarm icons appear on the left, and status icons appear along the bottom.

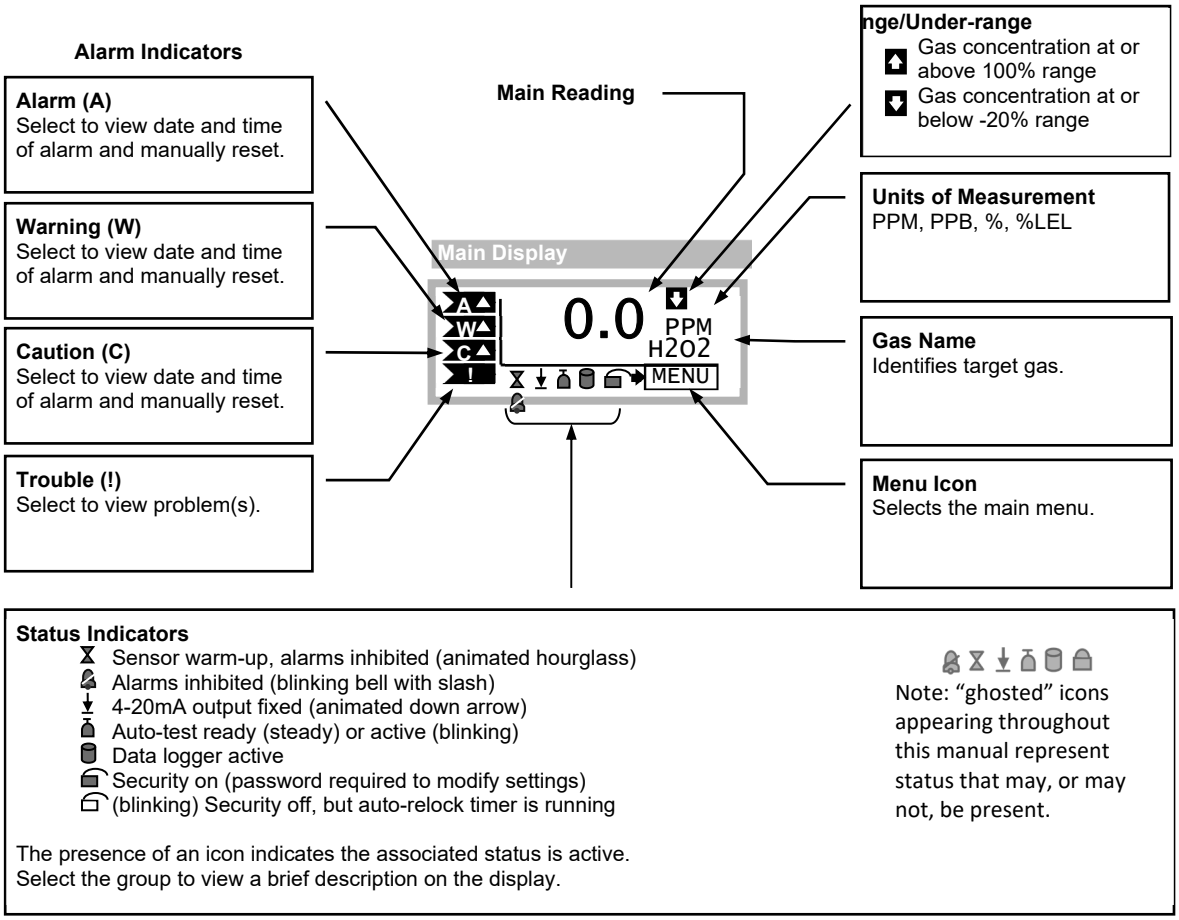


Figure 11 - Main Display

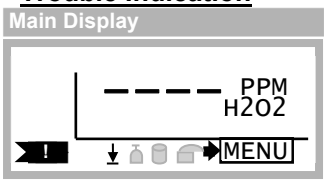
Main Reading

The main reading represents the gas concentration value and appears on the Main Display, along with the gas name and units of concentration. This is also the value reported on the 4-20mA output[1],[2]. By default, negative values are suppressed. A trouble alarm appears if the concentration falls to –20% of the full-scale range. Small positive readings may also be suppressed using the Blanking setting, as a means of stabilizing the reading in the presence of excessive external noise or other environmental factors (see Sensor Settings Menu on page 25). Note: during zero and span calibration, the "un-blanked" gas concentration value is displayed, primarily to assess the amount of positive or negative drift.

[1] The 4-20mA may not match the reading when the status indicator is visible on the Main Display, or when the output is in a physical limit.

[2] Throughout this manual, "ghosted" status icons are used to indicate status that may be present or not present.

Trouble Indication



The Trouble alarm is indicated by four dashes appearing on the Main Display, along with the (!) flag in the lower left corner, and the 4-20mA status icon indicating that the 4-20mA output is fixed (default = 3.6mA).

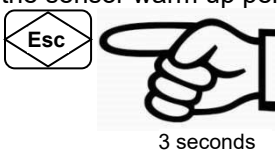
Figure 12 - Main Display Trouble Indication

Timed Return to Main Display

Menus and other pages used for configuring the transmitter and sensor return to the Main Display after 5 minutes of no key activity. Exceptions to this behavior include the zero and span calibration pages.

Inhibiting Alarms from the Main Display

Pressing the **ESC** key for 3 seconds, then releasing, toggles the alarm inhibit mode. If alarm inhibit was off, it is turned on for 15 minutes (default value). If alarm inhibit was on, it is turned off, and in addition, the sensor warm up period is expired immediately (see status indicators above).



3 seconds

Pop-up Displays

Sensor Removed

Removing the gas sensor causes the transmitter to "pop-up" the count-down timer display below. Alarms are inhibited and the current loop output is fixed at 4.0mA (17.4mA for Oxygen sensors). A trouble alarm will occur if a sensor is not installed before the timer expires. This 60 second period is usually long enough to reinstall the sensor, or install a replacement, but if more time is needed, the count may be extended to 5 minutes by selecting "Reset". Selecting "Exit" forces expiration of the timer and exits to the Main Display, which will then indicate the Trouble alarm is active (see Figure 12 - Main Display Trouble Indication

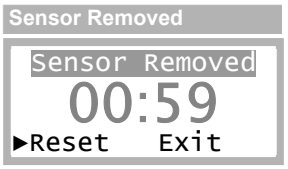


Figure 13 - Sensor Removed Display

Sensor Installed

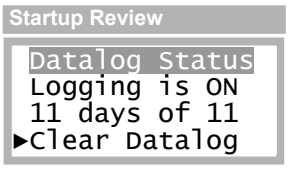
When a sensor is installed, the transmitter compares the type to the previously installed sensor. If they match, the previous sensor's settings are copied to the new sensor, if necessary[3]. The transmitter then starts the sensor review as shown in Figure 6.

[3] The transmitter sets the new sensor's range, blanking, damping, and alarms to match the previously installed sensor, which might cause confusion when transferring sensors from field transmitters to shop transmitters for calibration. During review, the shop transmitter will display the settings of the previously installed sensor, which might not match the field transmitter. Fortunately, this is not a real problem. The sensor may be calibrated as normal, and when it is

When the types do not match, the review halts and waits for the operator to verify the new sensor's full-scale range, and alarm settings. After verifying the sensor, the transmitter copies the sensor settings to its local memory.

Sensor Install Effects on the Data Log

When the sensor is replaced with one of a different gas type (i.e., a different part number), you are also prompted to clear the data log during review.



Once the sensor is installed, the transmitter executes a 5-minute (typical value) warm-up period, during which alarms are inhibited, the 4-20mA output is held at 4mA (17.4mA for Oxygen sensors), and Zero, Span and Auto-test are not permitted. Once the 5 minute warm up period is complete, the monitor is ready for use. No additional adjustments are needed.

Figure 14 - Startup Review Menu

The monitor contains inlet and outlet gas ports on the bottom of the enclosure. Quick-connect plugs are supplied for connection of gas inlet and outlet tubing. Two 25 ft. lengths of Teflon-lined PVC tubing (1/8" I.D.) are supplied. For monitoring hydrogen peroxide levels inside an isolator, the inlet tubing must be connected into the isolator. The outlet tube can either be placed in the isolator so that gas is returned to the source, or it must connect to a safe vent.

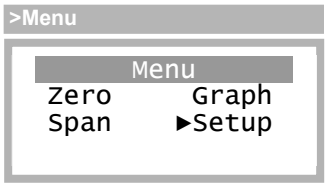
CAUTION: Do not allow high concentrations of hydrogen peroxide vapor to vent into the breathing zones where employees are present. Doing so may create an unsafe condition where H_2O_2 levels exceed those allowed under OSHA and/or other regulatory agency limits.

eventually returned to the field, the field transmitter will restore its original settings. Always verify the settings of field transmitters.

Main Menu

Main Menu

The main menu provides direct access to the sensor calibration methods, data logger graph, and transmitter settings.

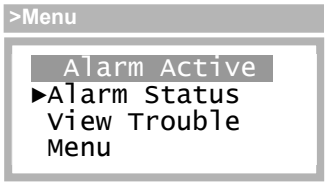


Item	Select to …
Zero	Calibrate the gas sensor zero reading (pg. 20).
Span	Calibrate the gas sensor sensitivity (pg. 20)
Graph	View the contents of the logged data as a graph (pg. 32).
Setup	View and configure transmitter settings (below).

Figure 15. Main Menu

Alarm Active Menu

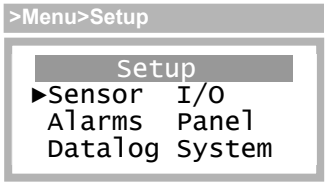
When a gas or trouble alarm is active, the following menu appears in place of the main menu.



Item	Select to …
Alarm Status	View the Alarm Status Menu (pg. 24) and clear manual reset alarms. This item appears only if a gas alarm is active.
View Trouble	View the Trouble Status Display (pg. 27). This item appears only if the trouble alarm is active.
Menu	View the Main Menu (above).

Figure 16. Alarm Active Menu

Setup Menu

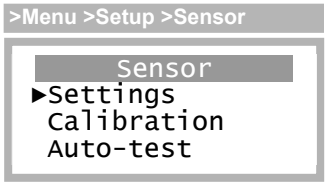


Item	Select to …
Sensor	Configure sensor settings, auto-test, and calibration methods (see Sensor Menus, Methods, and Settings below).
Alarms	Configure the three transmitter alarms (see Alarm Menus, Methods, and Settings on pg. 22)
Datalog	View the data log graph (see Data-log Menus, Methods, and Settings on pg. 30).
I/O	Configure the 4-20mA output, serial communications, and relay operation (see I/O Menus, Methods and Settings on pg. 36).
Panel	Configure the display contrast and backlighting, and panel security (see Panel Menus, Methods, and Settings on pg. 44).
System	Set the real-time-clock, site name, and view version information (see System Menu on pg. 48).

Figure 17. Setup Menu.

Sensor Menus, Methods, and Settings

Sensor Menu

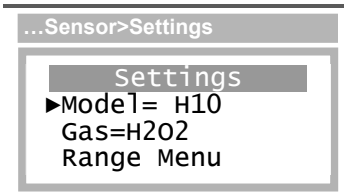


Item	Select to …
Settings	Configure the sensor range, damping, and blanking (see Sensor Settings, below).
Calibration	Maintain the accuracy of the gas sensor (see Sensor Calibration Menu on pg. 20)
Auto-test	Configure automatic gas sensor tests or perform manual tests (not available on this model).

Figure 18. Sensor Menu.

Sensor Settings Menu

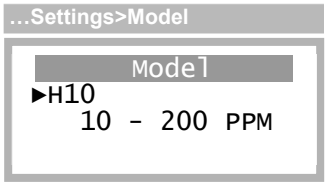
The transmitter accommodates a variety of sensors that automatically configure the transmitter with the gas name, range, units, and other settings, and contain calibration data to convert the sensor analog output to a gas concentration reading. Some of these settings can be changed by the transmitter and it is important to make sure they are configured properly for the site.



Item	Description …
Model	Displays the model name. Select to view sensor specific settings or information about the installed sensor (below).
Gas	Displays the name of the target gas (read only).
Range Menu	Select to view and adjust the sensor's upper range, blanking, and damping settings (below)

Figure 19. Sensor Settings Menu

Sensor Model Menu

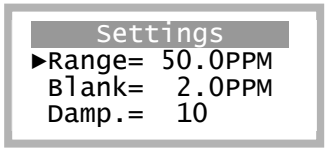


Item	Description …
Line 1	Sensor model name (read only)
Line 2	Sensor upper range limits (read only)

Figure 20. Sensor Model Menu

Sensor Range Menu

…Settings>Range Menu



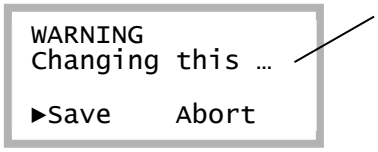
Item	*Select to …*
Range	Set the gas concentration value corresponding to the 20mA output value. Changing this value also changes the Blank (blanking) value, which is maintained as a fraction of the range. Setting limits vary among sensors. Changing this setting invalidates data stored in the data logger (see below), and may result in an Auto-test exception message (also below).
Blank (Blanking)	Force the main reading to zero whenever the gas concentration is below this setting. The limits vary from sensor to sensor but are typically 0 to 5% of Range. Note that the transmitter always reports negative readings as 0 (except on calibration displays), without regard to this setting. The setting is recomputed when the Range setting changes, so that the same fraction of range is maintained. Doubling, or halving the Range setting, doubles or halves the Blanking setting, respectively.
Damp. (Damping)	Helps to stabilize the gas sensor readings. It is a unit-less value from 1 to 100 that controls a s/w lag filter. The setting has an approximate effect on the T90[4] response time, as shown Damping / T90 time: 1 / 6 s; 10 / 10 s; 100 / 50 s

Figure 21. Sensor Range Menu

Effect of the Range Setting on the Data Logger

The data-logger records readings as a fraction of the sensor range. If data-logging is turned on (as indicated on the Main Display), changing the Range setting causes a warning message to appear prior to saving the value. Select "Save" to save the new Range setting, or "Abort" to leave it unchanged.

Data-log Warning Page



" Changing this parameter will clear the datalog."

Figure 22. Data-log Warning Message

Effect of Range on Auto-test

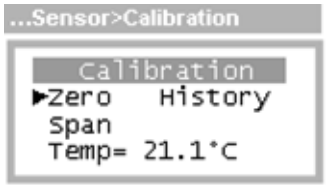
Gas generators used for Auto-test may not be compatible on all sensor ranges. If the Auto-test Status is READY, scrolling to a higher Range may result in the following exception message, "Gas generator incompatible on sensor's range." To overcome this exception, change the Auto-test Status to OFF, then set the desired range.

[4] T90 is the approximate time required for the transmitter to reach 90% of its final value after a step change. The values given in the table do not include gas flow time or the actual response time of the sensor.

Sensor Calibration Menu

Sensor calibration is recommended approx. every 6 months in normal use. If the unit is used very infrequently, yearly calibration should be sufficient. Checking the zero every few months is recommended. Span calibration methods for H2O2 are not detailed in this manual.

Zero and span calibration data is stored in the sensor, and is independent of the transmitter being used. The sensor may be span calibrated remotely and later returned to the unit. More often, the H2O2 sensor is returned to ATI Service for span calibration on specialized gas equipment that might be unavailable to most users. Because stable gas standards for many gases are not readily available or are very expensive, the factory calibration service can be more economical in the long run. Contact ATI or your ATI representative for details on factory calibration service for sensor modules.



Item	*Select to …*
Zero	Calibrate the gas sensor zero reading. Note: a shortcut to this menu item also appears in the Main Menu.
Span	Calibrate the gas sensor sensitivity. Note: a shortcut to this menu item also appears in the Main Menu.
Temp	Sensor temperature – not adjustable. This item may be higher than ambient due to transmitter or enclosure heating.
History	View sensor zero and span calibration records.

Zero Calibration Procedure

To zero the sensor, connect a cylinder of Zero Air to the inlet port and turn on the internal pump. Make certain From the Main Display, use the panel buttons to navigate to the Calibration menu and select Zero. This will clear and inhibit alarms at the transmitter and hold the current loop output at 4mA. Note: a shortcut to this menu item appears on the Main Menu.

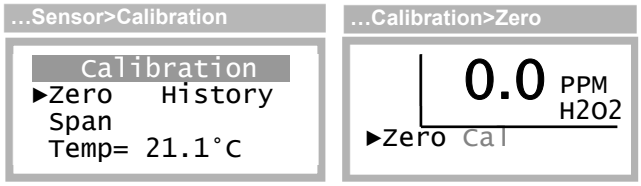


Figure 23 - Zero Sensor Page

After approximately four minutes, select Zero. The “Cal” message will appear briefly at the bottom of the page and the reading will be forced to 0, 0.0, or 0.00. Since the reading is not blanked, it may show a negative sign, like “-0.0”, which is normal.

Press the Escape key twice to leave the Zero page and return to the Main page. By default, alarms will remain inhibited, and the current loop fixed for 15 more minutes (the default value).

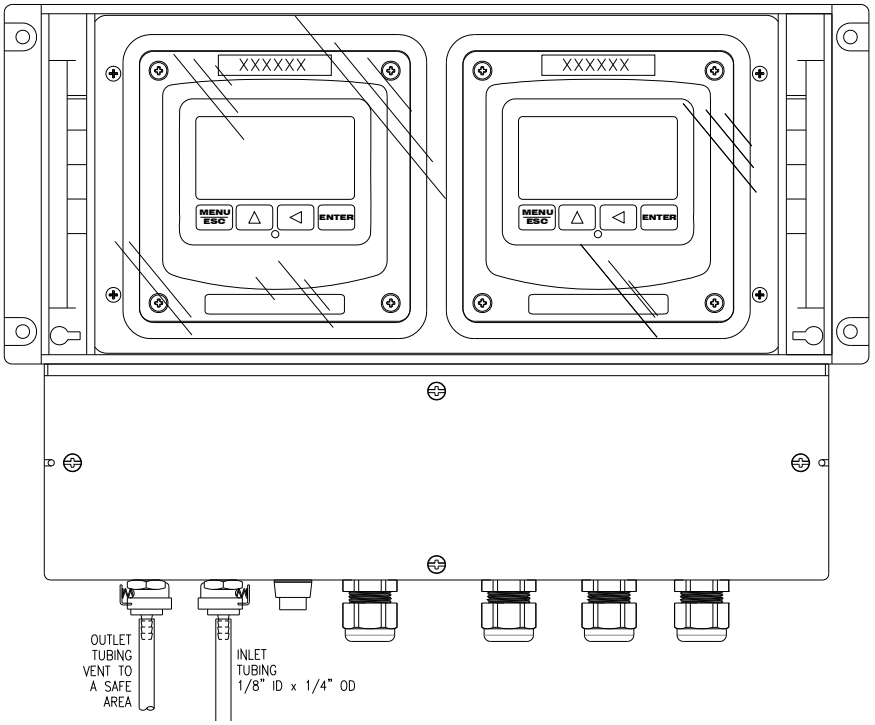


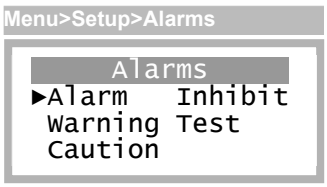
Figure 24 - Flow Schematic using Zero Air

Alarm Menus, Methods, and Settings

The transmitter features three gas level alarms - Alarm, Warning, and Caution, and a Trouble alarm. Gas level alarms are automatically configured when a gas sensor is installed, and are retained between the same type sensors.

Alarms Menu

The Alarms Menu is the main entry point for configuring gas level alarms, and for inhibiting and testing configured alarms.



Item	*Select to …*
Alarm	Configure the Alarm settings to indicate a dangerous condition (see Alarm Setting Menus on pg. 25).
Warning	Configure the Warning settings to indicate an unsafe condition (see Alarm Setting Menus on pg. 25).
Caution	Configure the Caution settings (normally used to indicate excessive sensor drift - see Alarm Setting Menus on pg. 25).
Inhibit	Configure or activate the manual alarm inhibit period (see Alarm Inhibit on pg. 28)
Test	Test operation of the alarm indicators and relays (see Alarm Test Menu on pg. 29)

Figure 25. Alarms Menu

Gas Level Alarms

For toxic gas sensors, Alarm is a high-high alarm and the default setting for Alarm is normally 2 or 3 times higher than the TLV (threshold limit value) of the target gas. The Warning alarm is a high alarm and normally set to the TLV. Caution is a low alarm and set to activate on negative drift of –10% of the sensor range (a trouble alarm occurs if the reading drifts to –20% of the sensor range). Figure 26 depicts the relationships of these alarms.

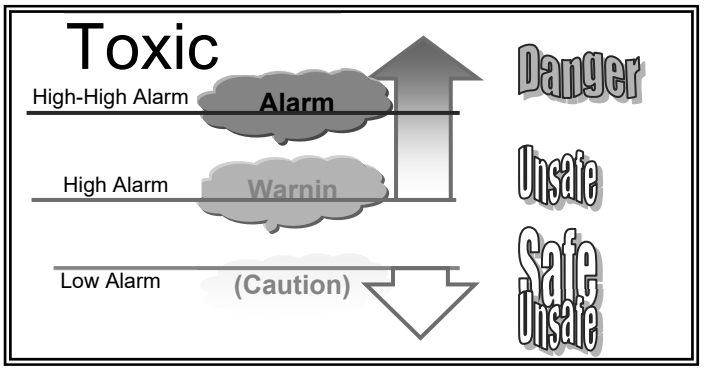


Figure 26. Toxic Gas Alarms.

For oxygen sensors*, Alarm is a low-low alarm set to 16%, Warning is a low alarm set to 19.5%, and Caution is a high alarm set to 23%. Figure 27 depicts the relationships of these alarms.

**Information only. This instrument does not normally contain an oxygen sensor.*

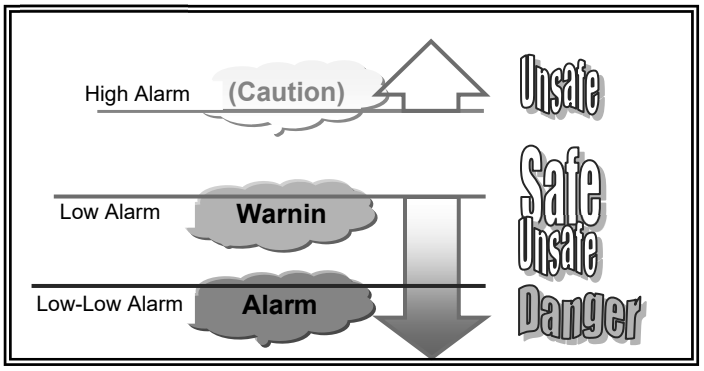


Figure 27. Oxygen Deficiency Alarms

Gas Alarm Operation

Figure 28 illustrates the operation of a high (rising) gas level alarm.

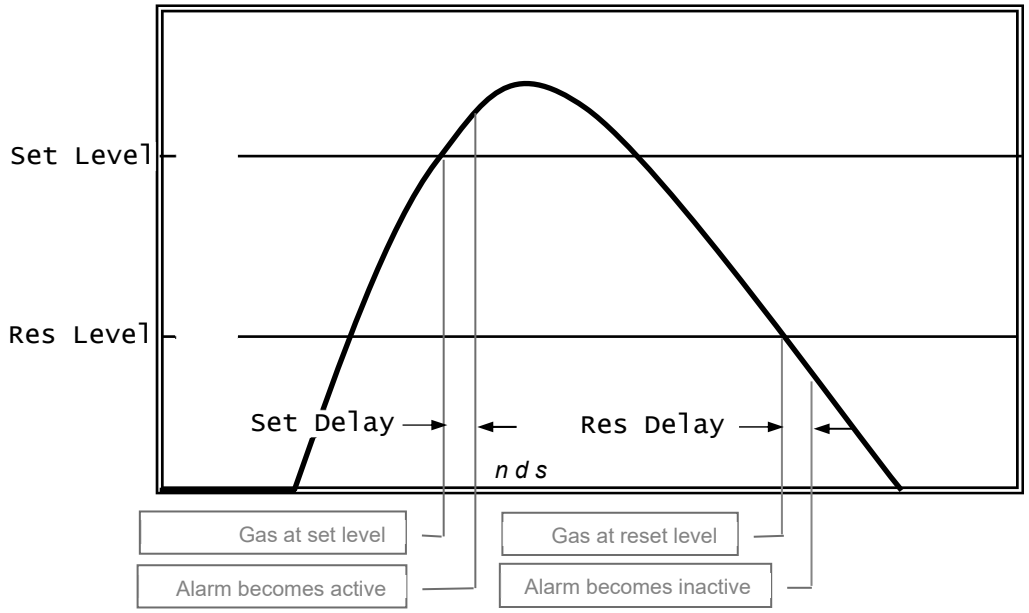


Figure 28. High Alarm Operation

Figure 29 illustrates the operation of a low (falling) gas level alarm (such as for Oxygen deficiency).

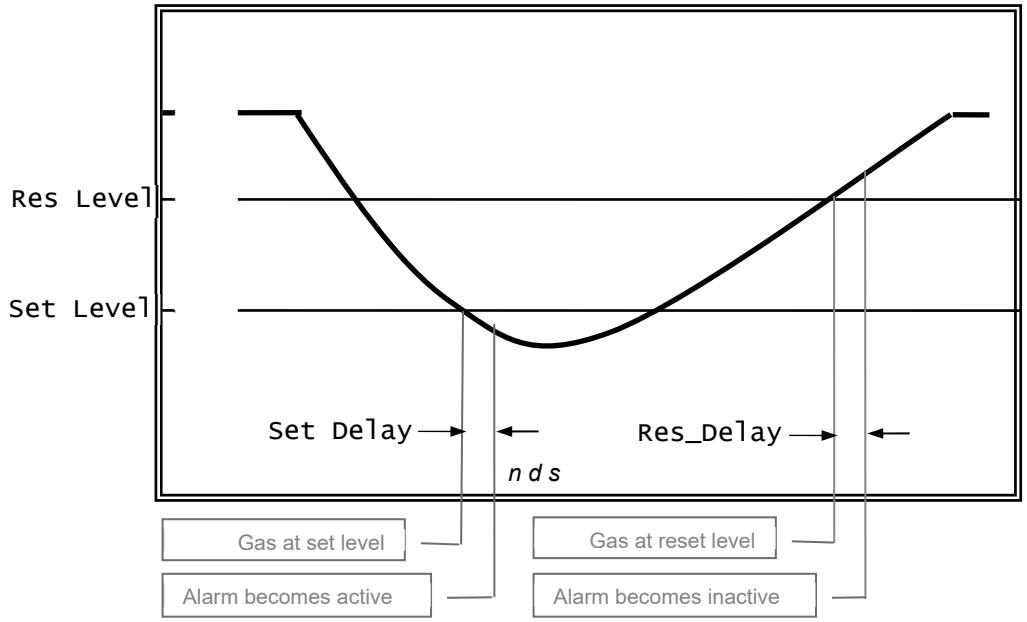
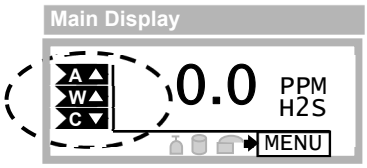


Figure 29. Low Alarm Operation

Alarm Indicators

Gas level alarms are indicated by three flags on the left side of the Main Display, each containing a letter indicating the alarm name, and an arrow indicating the type of alarm - high (rising) alarm, or low (falling) alarm.

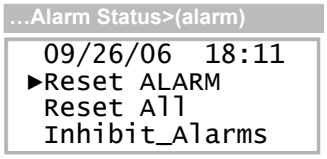


A▲	Alarm – flag with letter 'A' on line 1 (top line)
W▲	Warning – flag with letter 'W' on line 2
C▼	Caution – flag with letter 'C' on line 3

Figure 30. Alarm Indicator Flags

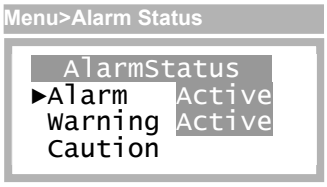
Alarm Status Menu

The Alarm Status Menu appears only when a gas alarm is active. It is displayed by selecting Menu from the Main Display, then selecting "Alarm Status", from the Alarm Active Menu (see page 17). The menu lists the three gas alarms and the word, "Active", if the alarm is currently active. Selecting an active alarm displays the specific Alarm Reset Menu, below.



Item	*Select to …*
(line 1)	Date and time of alarm event.
Reset (alarm)	Manually reset the alarm selected on the Alarm Status Menu above. Reset is performed only if the alarm conditions have subsided, and the alarm is programmed for manual reset (see Figure 33. Alarm Setting on pg. 25),
Reset All	Manually reset all manual-reset alarms, once alarm conditions have subsided.
Inhibit Alarms	Temporarily resets and inhibits gas level and Trouble alarms (default is 15 minutes, see Alarm Inhibit on pg. 28.

Figure 31. Alarm Status Menu



Item	*Select to …*
Alarm	View the time and date of Alarm and manually reset it, if required.
Warning	View the time and date of the Warning alarm and manually reset it, if required.
Caution	View the time and date of the Caution alarm and manually reset it, if required.

Alarm Reset Menu

The Alarm Reset Menu appears by selecting an active alarm from the Alarm Status Menu, or by selecting an alarm indicator flag from the Main Display. The menu presents the date and time of when the alarm became active, and permits manual reset, along with the other options are listed below.

Figure 32. Alarm Reset Menu

Alarm Setting Menus

The Alarm Setting Menus are accessed from the Alarms Menu and are used to configure the three gas level alarms.

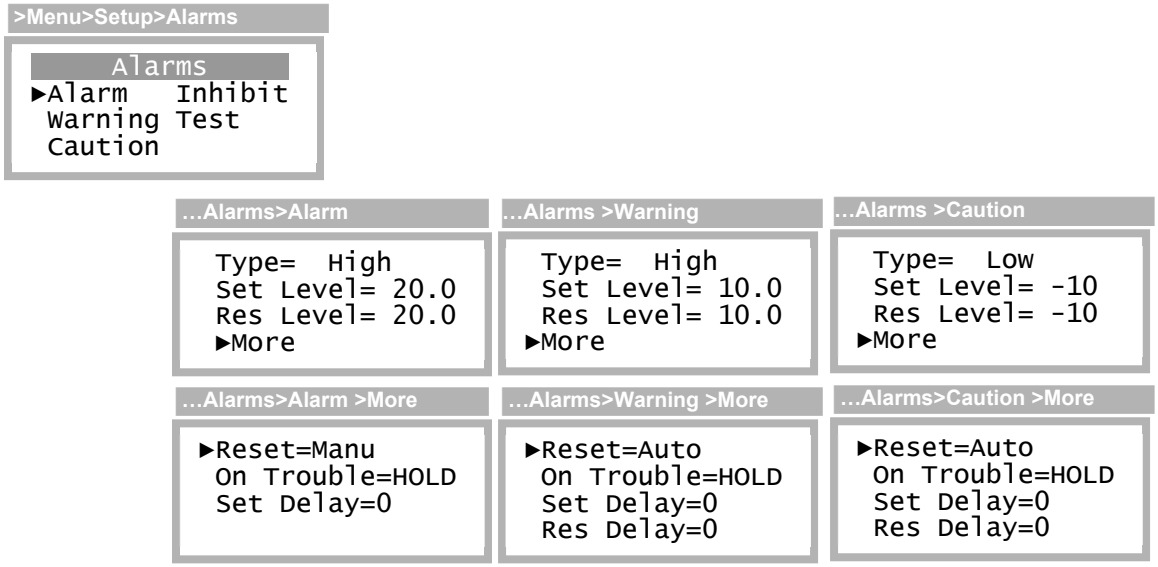


Figure 33. Alarm Setting Menus

Item	***Select to…***
`Type`	Set the type of alarm as `High`, `Low`, or `None`. When set to `High`, the alarm becomes active *at and above* the `Set Level`. When set to `Low`, the alarm becomes active *at and below* the `Set Level`. Setting the value to `None` permanently deactivates the alarm. The setting is stored in the sensor memory.
`Set Level`	Set the gas concentration level at which the alarm becomes active. The alarm then becomes active at the expiration of the `Set Delay` period. Changing `Set Level` changes `Res Level` to the same value. Limits for the `Set Level` are maintained in the gas sensor memory.

`Res Level`	Set the gas concentration level at which the alarm becomes inactive. The alarm then becomes inactive after expiration of the `Res Delay` period, and only if the `Reset` setting is programmed as `Auto` – see below. The limits for the `Res Level` depend on the alarm `Type` setting.
	
	`Type = High`
	Upper limit = `Set Level`
	Lower limit = lowest `Set Level`
	
	`Type = Low`
	Upper limit = highest `Set Level`
	Lower limit = `Set Level`
	
	Changing `Set Level` changes `Res Level` to the same value.

Reset	Select how the alarm is reset as Manu or Auto. When set to Auto, the alarm will reset (clear) without operator intervention, as soon as conditions allow (concentration reaches Res Level, and the Res Delay period expires). When set to Manu, the operator must reset the alarm manually after conditions subside, through the operator interface, the serial interface, or through the remote reset. Note: Res Delay is meaningful only when Reset= Auto. Setting Reset to Manu suppresses display of the Res Delay setting.
On Trouble	Specify the alarm state during Trouble alarms. This setting specifies alarm behavior during transmitter faults and overrides all other alarm settings. If the trouble alarm should become active, you may program the concentration alarm to behave in one of three ways: Hold - the transmitter will attempt to hold the alarm in its current state. If the alarm is active, it will remain active. If the alarm is inactive, it will be inhibited from becoming active until after Trouble is cleared. Set - activates the alarm immediately (the Set Delay period is ignored). This feature permits the alarm to signal both concentration and trouble conditions. Reset – deactivates the alarm immediately (the Res Delay period is ignored).
Set Delay	Configure the amount of time, in seconds, that the gas concentration must be at or above a high alarm set level, or at or below a low alarm set level, before the alarm becomes active. This is used to avoid triggering alarms on relatively short gas exposures. The setting may be programmed between 0 (its default) and 10 seconds.
Res Delay	Configure the amount of time, in seconds, that the gas concentration must be below a high alarm reset level, or above a low alarm reset level, before the alarm becomes inactive. The setting is typically used to keep relays energized to maintain exhaust fans after a gas leak. The setting is displayed only when Reset is set to Auto, and may be programmed between 0 (default) and two hours (7200 seconds).

Trouble Alarm

The trouble alarm is presented on the Main Display as shown below. When active, new alarms are inhibited, and (by default) active alarms are held so that relays controlling lights, sirens, and fans may continue to operate (this behavior may be modified on the Alarms Menu (page 22). Certain Trouble alarm causes, like a temporary bus fault, may clear automatically without operator intervention. Others, such as a missing sensor, will not clear until corrected.

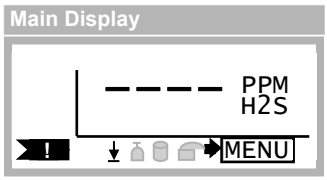


Figure 34. Trouble Indication on Main Display

Trouble Status Display

The Trouble Status Display appears by selecting the Trouble indicator from the Main Display. It may also be viewed by selecting MENU from the Main Display when the Trouble alarm is active, then selecting View Trouble. The 8-digit hex code on line 2 represents all active faults and is useful when obtaining help from the factory. Select Next Problem to view a description of each problem in succession on line 3. Some problems listed in TROUBLESHOOTING on page 51 are cleared after pressing **Esc** to return to the previous display.

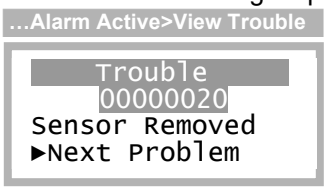


Figure 35. Trouble Status Display

Corrective Actions

- Check the external and internal electrical connections, wiring, and tubing.
- Contact the Badger Meter/ATI Service Desk

REMINDER: After replacing the sensor or transmitter …

- Review, verify, and restore all sensor AND alarm settings.

Alarm Inhibit

Events may inhibit alarms for a time to prevent "false alarms". Alarm inhibit is indicated on the Main Display by the appearance of a bell-shaped icon the amount of time depends on the event. For example, zero and span calibration will inhibit alarms for up to 30 minutes to provide recovery time for the sensor. The table below summarizes the duration of the alarm inhibit periods for each method used to initiate it.

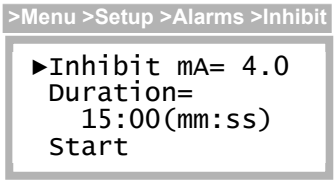
Table 1. Alarm Inhibit Periods

Cause	*Duration*
Start up	(Same as Sensor Install below)
Zero, Span	Set immediately on entering the method. Then for up to 30 minutes after pressing a key while in the method
Sensor Auto-test	5 minutes during gas generation attempt 10 minutes during recovery period
Sensor Removal	60 seconds, then Trouble alarm active
Sensor Install	Alarm Inhibit active during sensor warm-up (usually 5 minutes)
Manual activation from Main Display using Esc key	Duration value in Alarm Inhibit Menu
Manual activation by Start in Alarm Inhibit menu	Duration value in Alarm Inhibit Menu

The most convenient method for activating alarm inhibit is from the Main Display. For more information on that method, see Inhibiting Alarms from the Main Display on page 15. Alarm inhibit may also be started through the Alarm Inhibit Menu, shown below.

Alarm Inhibit Menu

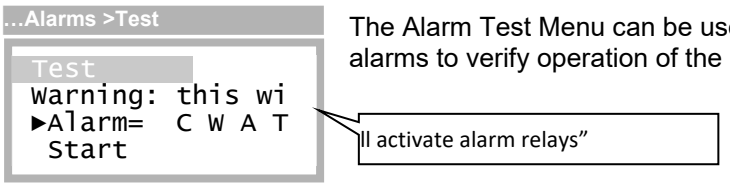
The Alarm Inhibit Menu exposes the manual alarm inhibit start and stop control, and the duration and fixed 4-20mA setting.



Item	*Select to …*
`Inhibit_mA`	Set the fixed value of the 4-20mA output during alarm inhibit (3.5 to 22.0 mA). This is normally 4mA for toxic gas sensors, and 17.4mA for oxygen sensors.
`Duration`	When alarm inhibit is **off**: Set the manual alarm inhibit period (0-60, default=15 minutes). When alarm inhibit is **on**: Adjust the amount of time remaining.
`Start (Stop)`	Start (or stop) alarm inhibit

Figure 36. Alarm Inhibit Menu

Alarm Test Menu



The Alarm Test Menu can be used to test the gas level and Trouble alarms to verify operation of the associated relays.

Note

Devices wired to the relays may activate when “Start” is selected. Inform all personnel before performing the test.

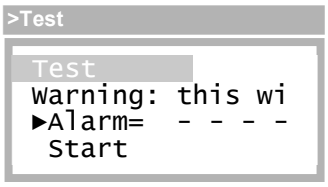
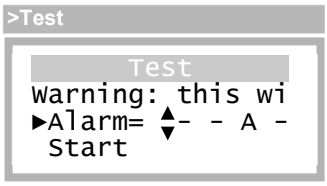
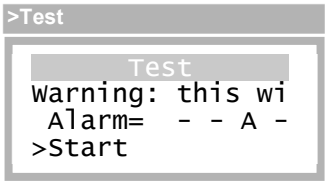
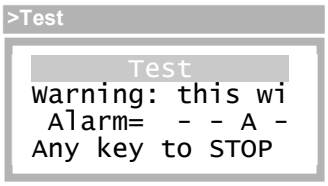
Display	*Instructions*
	1. Select Alarm
	2. Scroll up or down to specify which alarms to test - C, W, A, T, and save the selection by pressing the Enter key. 3. (C=Caution, W=Warning, A=Alarm, T=Trouble)
	4. Select Start to begin the test.
	5. Press any key to end the test. The test stops automatically after 5 minutes.

Figure 37. Alarm Test Menu

Data-log Menus, Methods, and Settings

The transmitter records gas concentrations in one of twelve intervals ranging from 1 to 60 minutes, providing data from 11 to 474 days. Table 2 details the sampling intervals, and the samples/day and totals days for each interval.

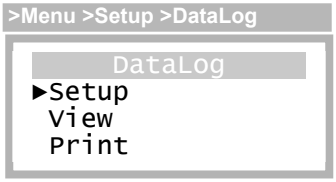
Table 2. Data-log sampling metrics

Sampling (Minutes)	*Samples/Day*	*Total Days*
1	1440	11
2	720	22
3	480	32
4	360	43
5	288	54
6	240	64
10	144	104
12	120	124
15	96	152
20	72	196
30	48	278
60	24	474

The gas concentration reading is recorded as an instantaneous value and is not averaged or filtered in any way. When the data log memory is full, new records overwrite older ones.

Data Log Menu

The Data Log Menu permits access to configuration, review, and print menus.

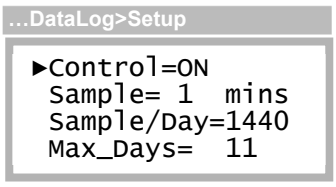


Item	*Select to …*
Setup	Configure the data log settings (see Data Log Setup Menu below).
View	View the logged data as a graph or single text records.
Print	Send a tabular ASCII report to the device connected to the COM port (see Data Log Print on the next page). The data log must not be empty, and the COM protocol must be set to ASCII. Otherwise, the transmitter will display an exception message.

Figure 38. Data Log Menu

Data Log Setup Menu

Settings on the Data Log Setup page select one of the 12 discrete sampling intervals listed in Table 2, and control starting, stopping and clearing of the data-log.

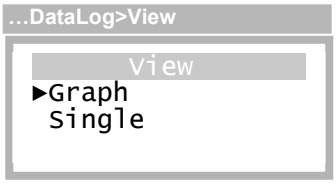


Item	Select to …
Control	Turn data logging on or off, or clear stored data.
Sample Sample/Day Max_Days	Set the sampling interval to one of the 12 values listed in Table 2. Changing one automatically changes the other two. Warning: changing the sampling interval will clear the data-log.

Figure 39. Data Log Setup Menu

Data Log View Menu

Data is presented as a gas concentration reading at a specific date and time and may be viewed collectively as points on a graph (Graph), or individually as a single text record (Single). In Graph view, readings are presented sequentially in time when scrolling the up and down keys. In Single view, both the date and time may be scrolled to provide a pseudo random-access method. Since the two views are connected, it is possible to navigate directly to the date and time of interest using the Single view, and then switch to the Graph view to see more readings around a particular time. Conversely, the view can be switched from Graph to Single to view readings taken around the same time on different days.



Item	Select to …
Graph	View multiple points of data as a graph (sequential selection).
Single	View single records (pseudo random-access selection)

Figure 40. Data Log View Menu

Samples reported are assumed to be in units of PPM, PPB, or %, as determined by the gas concentration units appearing on the Main Display. Sample values outside of printing limits are forced to the following values.

Samples …	*Forced to…*
Less than –999	*-999*
Greater than 9999	*9999*

Readings in both views are displayed in the same units and decimal precision as those on the Main Display, and the date format is consistent[5] with the format selected in the Clock Menu (see pg. 48). Both views also display special codes to indicate samples were unavailable. The table below summarizes the special codes.

[5] Dates presented in the Graph view are shortened to just the month and date, the year is not presented.

Special Code	*Description*
----	Sample unavailable (transmitter powered off, or sample not yet recorded)
FFFF	Trouble alarm active at time of sample.
TEST	Auto-test active at time of sample (Log_Data=NO)
****	Data corrupted.

Table 3. Data Log Special Codes

Data Log Graph View

The Graph view plots a sample as a vertical line, the height of which corresponds to the gas reading as a percentage of the sensor's range (i.e., height = 100*reading/range). Samples are plotted from left (oldest) to right (newest). On entry, a vertical cursor appears over the most recent sample (or sample of interest), and the corresponding date, time, and gas reading or special code (see above) are displayed on the lower line. These values are updated as the cursor is moved left and right by pressing the up and down keys. Note: the gas reading on the lower line is in the same units that appear in the Main Display and Sensor menus.

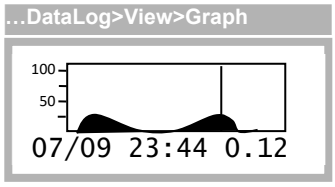
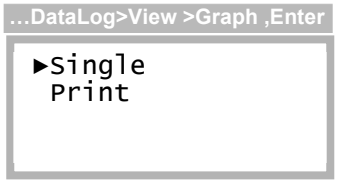


Figure 41. Data Log Graph View

New data is not plotted while viewing the page. Pressing the **Enter** key presents the Data Log Menu shown below, pressing the **Esc** key returns to the previous menu.

Data Log Graph View Menu

The Data Log Graph View Menu is appears by pressing the **Enter** key while viewing the Data Log Graph View (above).

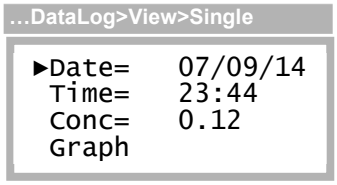


Item	*Select to …*
Single	View single records (pseudo random-access selection) starting at the cursor position.
Print	Send a tabular ASCII report to the device connected to the COM port (see Data Log Print on the next page). The data log must not be empty, and the COM protocol must be set to ASCII. Otherwise, the transmitter will display an exception message.

Figure 42. Data Log Graph View Menu

Data Log Single View

The Data Log Single View Menu allows scrolling to an exact date and time for viewing a single sample. Selecting Graph then presents the Graph view at the selected date and time.



Item	*Select to …*
Date	Scroll to a specific sample date.
Time	Scroll to a specific sample time.
Conc	View the gas reading when sample was recorded (not selectable).
Graph	View the Graph at the specified date and time.

Figure 43. Data Log Single View Menu

Data Log Print Menus, Methods, and Settings

A data log report may be sent to a serial printer, or "captured" to a file using a terminal emulation program over the serial interface using the ASCII protocol. Many terminal emulation programs exist for both Microsoft Windows® and non-Windows platforms. See example on page 54 for a detailed example of how to capture a report using HyperTerminal®, and how to then open it in Microsoft Excel® for charting.

The report consists of a series of lines, each containing a date and time, followed by up to 30 gas readings. All fields on the line are separated by a TAB character (ASCII 9), which serves to keep the fields aligned in columns. This format is suitable for most Epson protocol printers and for import into most spreadsheet programs after capture. The date and time apply to the first gas reading on the line following the time. Readings appearing in subsequent columns to the right were recorded at the programmed sampling interval after the first reading. The format of the gas readings appear as described in Data Log View Menu on page 31. A report example is shown below.

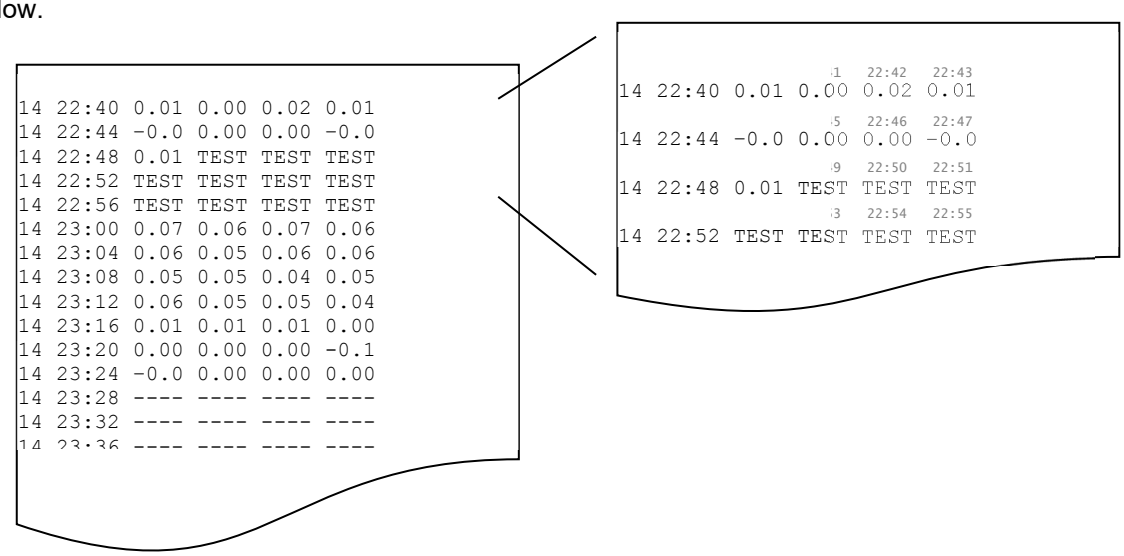
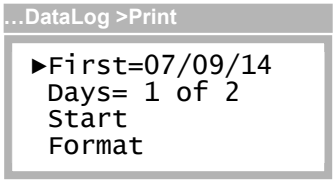


Figure 44. Data Log Print Example

In the example above, the first sample occurred at 22:40. The next sample to the right occurred at 22:41, followed by the next at 22:42, and so on. This pattern is repeated to the end of the line, and then repeats on the line below, and so on.

Data Log Print Menu

The Data Log Print Menu appears by selecting Print from the Data Log Menu (pg. 30). The data log must not be empty, and the communication protocol must be set to ASCII before entry, or an exception message will be displayed. The transmitter's real time clock should also be set to the correct date and time.



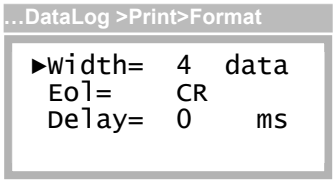
Item	*Select to …*
First	Set the first date to print in the report. Scrolling this date automatically updates the Days field.
Days	Set the number of days of data to include in the report.
Start	Send the report to the device connected to the transmitter's COM port.
Format	Configure the report format for the connected device.

Figure 45. Data Log Print Menu

To send the report, set the start date (First) and number of days to print (Days), and select Start. The line will blink Printing until the report is done. The report always begins at 00:00 on the start date and continues for the number of days specified. If no data has yet been logged, the report will show four dashes (----) in place of samples.

Data Log Print Format Menu

The Data Log Print Format Menu appears by selecting Format from the Data Log Print Menu (above) and is used to control the appearance of the report, and the interaction of the transmitter with the device.



Item	*Select to …*
Width	Change the number of data samples (gas readings) printed on each line.
Eol	Toggle the ASCII control code(s) transmitted at the end of each line from CR to CR/LF (more on this below).
Delay	Add up to a 10 second delay at the end of each line.

Figure 46. Data Log Print Format Menu

The transmitter adds a CR (ASCII 13) or CR/LF (ASCII 13 and 10) at the end of each line. If the lines of the report appear to be printing over each other, choose the CR/LF option. If the lines appear to be double spaced, choose the CR option.

The number of sample data samples (gas readings) appearing across the page is programmable from 1 to 30. This is designed to allow reports to fit on small thermal printers, and on conventional sized printers. A wider report takes less time to print because the date and time fields are printed less frequently.

A delay of up to 10 seconds can be added after each line is transmitted to help prevent buffer overflows on printers without XON/XOFF protocol. This is sometimes required to allow slow printers enough time to perform carriage return. If characters appear to be missing, increase the setting.

Flow Control

The transmitter uses XON/XOFF flow control while sending a report. That is, once the data stream has begun, it will continue until the XOFF character (19) is received. After sitting idle, the report stream will begin again upon reception of the XON character (17).

An RS232 connection can support full duplex communication and is perfectly suited for XON/XOFF flow control. However, an RS485 connection is only half duplex. It cannot receive while it is transmitting and might miss the XOFF character, resulting in a buffer overflow at the receiving device.

A receiving device will send the XOFF character when its buffer is nearly full. Some older dot-matrix printers will send an XOFF because they have a small receive buffer and cannot process characters while the head is returning to start a new line. By comparison, most computers have comparatively large buffers and can easily accept the report stream without sending an XOFF, so an RS485 connection may work in those cases.

The transmitter features an additional method to help avoid losing data due to buffer overflow problems on receiving devices that lack XON/XOFF capability (or have the capability but are using an RS485 connection). A programmable time delay of up to 10s may be inserted at the end of each report line. This permits the receiver time to process more characters in its buffer and avoid an overflow. However, this may be a method of trial and error until the proper delay setting is determined so that no characters are missing from the report.

Report Control

The start date and length of the report may be controlled from the operator interface. The length of the report is limited to the number of days actually stored in the log. The report always begins at 00:00 on the start date and continues forward for the number of days specified. If no data has yet been logged, the report will show four dashes (----) in place of samples.

I/O Menus, Methods and Settings

I/O Menu

The I/O menu is shown below and appears by selecting I/O from the Main Menu on pg. 17.

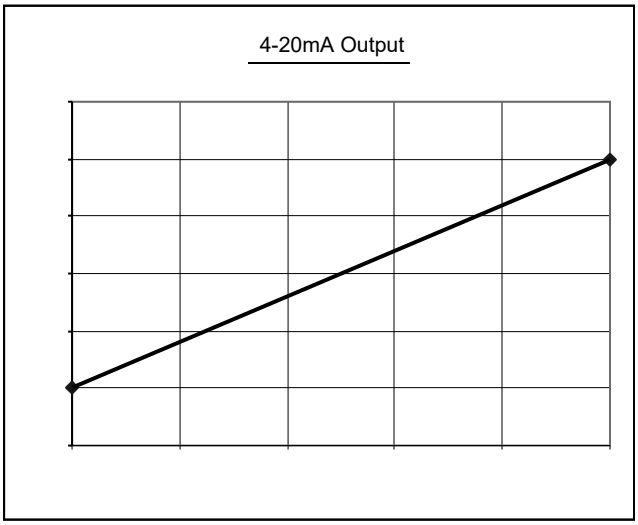
	Item	Select to …
Menu>Setup>I/O I/O ▶4-20mA COM Relays	4-20mA	Configure and adjust the 4-20mA output.
	COM	Configure the RS232/RS485 serial interface (option).
	Relays	Configure the three transmitter relays (option).

Figure 47. I/O Menu

4-20mA Output

The transmitter sources (or sinks) a 4-20mA current that is proportional to the gas reading on the Main Display (see Main Reading on pg. 14) . The current is normally 4 mA at zero and 20mA at the programmed range of the sensor (see Range in Sensor Settings Menu on pg. 18). Since the Main Reading is blanked below zero, the output should never go below 4mA in the course of normal operation. In the event of gas flooding, the current *may* go as high as 25mA (125% Range).

Figure 48. Graph of 4-20mA Output



4-20mA Menu

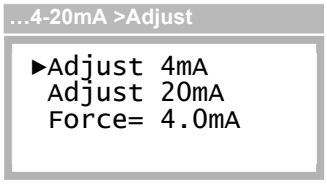
During alarm inhibit and Auto-test, the 4-20mA output is fixed at 4.0mA (17.4mA for oxygen sensors) to prevent false alarms at the receiver. The output is forced to 3.6mA to signal a Trouble alarm to the receiver. These are the default values, which may be changed in the *4-20mA Menu*, below.

	Item	Select to …
…I/O>4-20mA ▶Autotst mA= 4.0 Inhibit mA= 4.0 Trouble mA= 3.6 Adjust	Autotst mA	Set the fixed output level during Auto-test (4.0 to 22.0 mA). This is normally 4.0mA to prevent alarms at the receiver.
	Inhibit mA	Set the output level to indicate alarms are not enabled (4 to 22 mA). This is normally 4.0mA to prevent alarms at the receiver.
	Trouble mA	Set the output level to indicate the Trouble alarm (3.5 to 3.8 mA). Note: 3.5mA not allowed on 2-wire 4-20mA connection.
	Adjust	Adjust the 4mA and 20mA levels or force the output for testing.

Figure 49. 4-20mA Menu

4-20mA Adjust Menu

These methods permit adjustment of the 4-20mA output and provide a way to force it to a fixed value to evaluate receiver alarms. They do not affect the computed gas concentration reading.



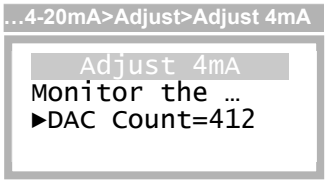
Item	*Select to …*
Adjust 4mA	Adjust the 4mA analog output level.
Adjust 20mA	Adjust the 20mA analog output level.
Force	Force the 4-20mA output to a fixed level between 3.5 and 22.0 mA. Displays the real time value when not selected.

Figure 50. 4-20mA control page

4-20mA Adjustment

Loop adjustment consists of adjusting the 4 and 20 mA levels (order does not matter) by scrolling the corresponding DAC value. This may be accomplished by reading a calibrated current meter connected in series with the transmitter's 4-20mA output, reading a calibrated volt meter across a precision load resistor in series with the transmitter's 4-20mA output, or reading the display of a calibrated, current loop receiver[6].

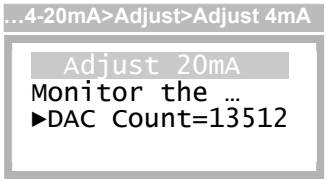
Adjust 4mA Menu



Item	*Select to …*
DAC Count	Scroll the DAC (digital-to-analog converter) count up to increase or down to decrease the analog output to 4.00mA. Note The displayed value is "as left" by the previous adjustment.

Figure 51. Adjust 4mA Menu

Adjust 20mA Menu



Item	*Select to …*
DAC Count	Scroll the DAC (digital-to-analog converter) count up to increase or down to decrease the analog output to 20.0mA. Note The displayed value is "as left" by the previous adjustment. When selected, however, the DAC count changes to the factory calibrated value of 20.0mA. This is to help prevent adjustment errors caused by 4-20mA receivers that limit readings to 20mA.

Figure 52. Adjust 20mA Menu

[6] When using a current loop receiver, make certain the reading is not limited to 20mA by hardware or programming. If so, adjust the reading first to 19.5mA, then slowly increase it to 20.0mA.

COM Menus and Settings

The transmitter supports ASCII, HART, and Modbus communications, which are configured through the COM Menu below.

COM Menu

The is *COM Menu* used to configure the protocol and connection settings of the serial COM interface, and varies slightly, depending on the factory configured protocol.

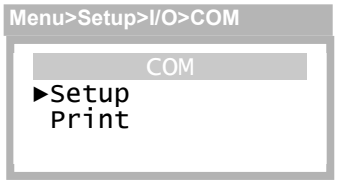
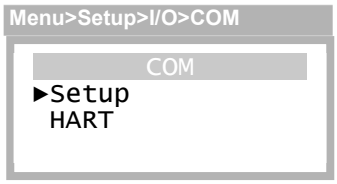
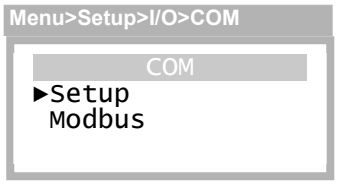
	Item	*Select to …*
	Setup	Configure the connection settings (only selection when Protocol is None).
	Print	Print the data log (appears only when the Protocol is ASCII, see Data Log Print Menu on pg. 34). Note that the transmitter must have an RS232 or RS485 interface.
	HART	Configure the HART protocol settings (appears only when Protocol is HART). Note that the transmitter must have a HART FSK modem interface, and be ordered with the HART FSK stack option.
	Modbus	Configure the Modbus protocol settings (appears only when Protocol is Modbus). Note that the transmitter must have an RS232 or RS485 interface, and be ordered with the optional Modbus protocol stack option.

Figure 53. COM Menu

COM Setup Menu

The COM Setup Menu is used to select the protocol and configure the transmitter's connection settings.

	Item	*Select to …*
…COM>Setup ►Protocol=None	Protocol	Change the slave protocol. • ASCII (default) • Modbus (option) • HART (option) • None Protocol selection is performed at the factory and may not be changed. Settings for the ASCII and Modbus protocols may be changed but are restricted for the HART protocol.
…COM>Setup ►Protocol=ASCII Interface=RS232 Baud Rate=9600 Settings= N,8,1 …COM>Setup ►Protocol=HART Interface=FSK Baud Rate=1200 Settings= O,8,1 …COM>Setup ►Protocol=Modbus Interface=RS485 Baud Rate=9600 Settings= N,8,1	Interface	Change the physical communication interface that the transmitter will control during transmit and receive functions: • RS232 (available for ASCII or Modbus, not for HART) • RS485 (available for ASCII or Modbus, not for HART) • FSK (HART only)
	Baud Rate	Change the baud rate of the transmitter's UART. May be set to: 300, 600,1200, 2400, 4800, 9600, 14.4k, 19.2k, 28.8k, 38.4k, 57.6k, 115.2k, 230.4k, and 460.8k. The value is fixed at 1200 for HART FSK, and defaults to 9600 for Modbus and ASCII.
	Settings	Change the parity, number of data bits, and number of stop bits of the transmitter's UART: N,8,1 …no parity, 8 data bits, 1 stop bits N,8,2 …no parity, 8 data bits, 2 stop bits E,8,1 …even parity, 8 data bits, 1 stop bit O,8,1 …odd parity, 8 data bits, 1 stop bit The value is fixed at O,8,1 for HART protocol, and defaults to N,8,1 for Modbus and ASCII.

Figure 54. COM Setup Menu

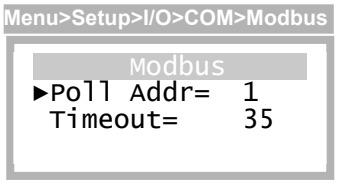
Modbus

The following applies to transmitters that have an RS232 or RS485 COM interface and Modbus firmware options.

Modbus is a master-slave protocol that supports a single master, and up to 255 slave devices on a common bus. The RS485 interface physically limits this number to 32 (1 master, 31 slaves), and RS232 restricts communication to a master and a single slave. Note that the 4-20mA output is fully functional even when using the transmitter's Modbus interface.

Modbus Menu

The *Modbus Menu* appears by selecting Modbus from the *COM Menu* (pg. 38).



Item	*Description*
Poll Addr	This setting controls the address to which the transmitter responds to queries from the host (1-247, default =1).
Timeout	This setting belongs to the data-link layer of the protocol and defines the number of character bits used to frame Modbus RTU messages. The protocol specifies the silent interval as 3.5 characters, which corresponds to 35 bit-times at 10 bits per character. This setting is reserved for future use and changing it is not recommended.

Figure 55. Modbus Menu

Relay Operation, Menus, and Settings

The following applies to F12 transmitters ordered with the Alarm Relay option.

The F12 Alarm Relay option provides three SPST mechanical relays on the Power Supply board. The relays are suitable for switching small loads, such as horns and warning lights, but should not be used to switch motors or other high current, inductive loads.

Each relay coil may be assigned to one of the four alarms and operate as normally energized (`Norm`=1, also called "fail-safe"), or normally de-energized (`Norm`=0). Selecting normally energized (1) allows the relay to indicate an alarm or a power failure. This selection is made in the Relay Setup Menu on page 43.

The table below details the contact states for the two selections in the no-alarm, alarm, and power fail conditions.

Table 4. Relay Coil "Norm" Setting

	No-Alarm	***Alarm***	***Power Failure***
0 (normally de-energized)			
Coil	De-energized	Energized	De-energized
Closed Contacts	C-NC	C-NO	C-NC
1 (normally energized, "fail-safe")			
Coil	Energized	De-energized	De-energized
Closed Contacts	C-NO	C-NC	C-NC

Figure 56 illustrates the alarm and relay operation.

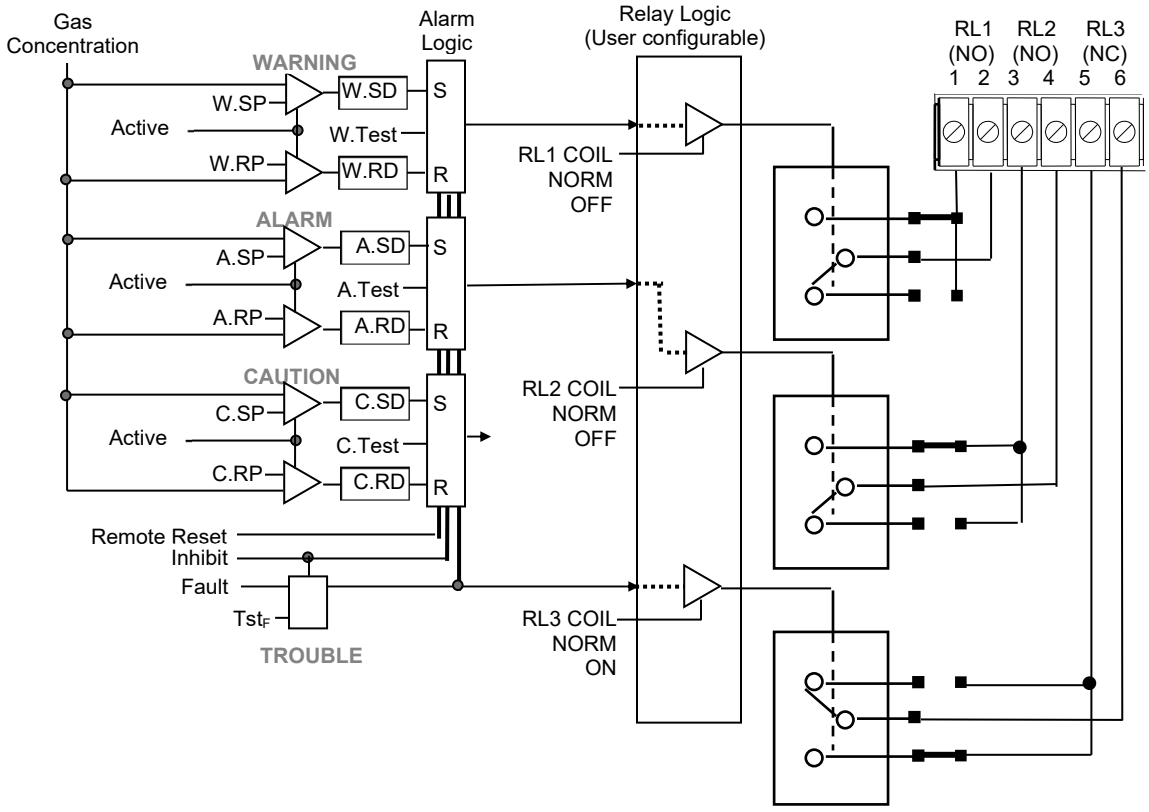


Figure 56 Alarm Relay Diagram

Relays Menu

The **Error! Reference source not found.** appears by selecting Relays from the ***I/O Menu*** (see pg. 36) .

	Item	*Select to …*
Menu>Setup>I/O>Relays Relays ▶Active= No Setup	Active	Permanently enable or disable operation of the relays.
	Setup	Assign each relay to an alarm and select the normal state of its coil.

Figure 57. Relays Menu

Relay Setup Menu

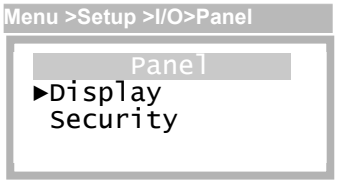
The *Relay Setup Menu* appears by selecting Setup from the Relays Menu above.

	Item	*Select to …*
…Relays>Setup Rly Coil Norm 1 ▶Warning 0 2 Alarm 0 3 Trouble 1	Coil	Change the alarm assigned to the relay coil. Selections are ALARM, WARNING, CAUTION, or TROUBLE.
	Norm	Change the normal (no-alarm) state of the coil to: normally de-energized normally energized (“fail-safe”) See ***Table 4*** on page 41.

Figure 58. Relay Setup Menu

Panel Menus, Methods, and Settings

Panel Menu

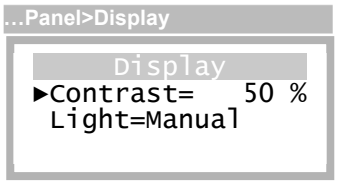


Item	Select to …
Display	Adjust the display contrast or when the backlight comes on. Note: backlight operates only when powered in 3 or 4 wire mode.
Security	Lock or unlock the transmitter panel, or change the password.

Figure 59. Panel Menu

Display Menu

The transmitter features a backlighted, 96w x 32h graphics LCD. The Display menu is used to control the display contrast and manage the backlight.

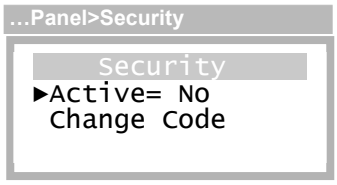


Item	Select to …
Contrast	Adjust the LCD contrast. Scroll the setting up to increase contrast (darker text), or down to decrease it (lighter text). The default value is 50%, and is adjustable between 0 and 100%.
Light*	Control when the LCD backlight is turned on and off* : Manual On when any key is pressed Off when no key pressed for 5 minutes. Auto On when any key is pressed, or alarm is active Off when no key pressed for 5 minutes, and no alarms active Never On Off permanently Always On On permanently (not recommended)

Figure 60. Display Menu

Security Menu

The transmitter prevents changes to the transmitter configuration through the front panel when security is active. Settings may be read, but not modified, and methods will not execute, including sensor verifications during startup. To do so, security must be disabled, either permanently or temporarily, by entering the correct 4-digit code. Panel security status is indicated on the Main Display.



Item	Select to …
Active	Activate or deactivate panel security. You must enter the panel code in either case.
Change Code	Change the panel code.

Figure 61. Security Menu

Activating Security

The following display sequence appears when attempting to activate panel security.

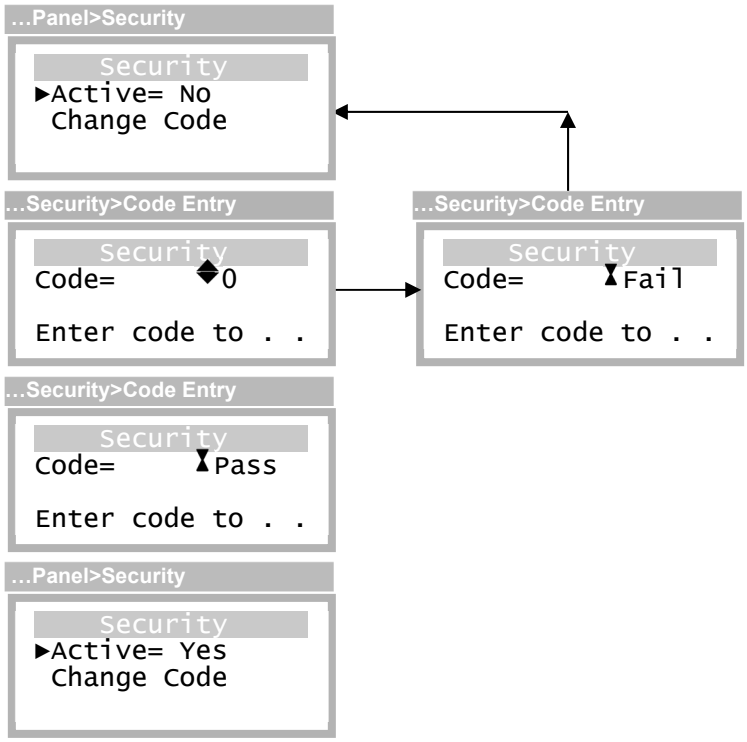
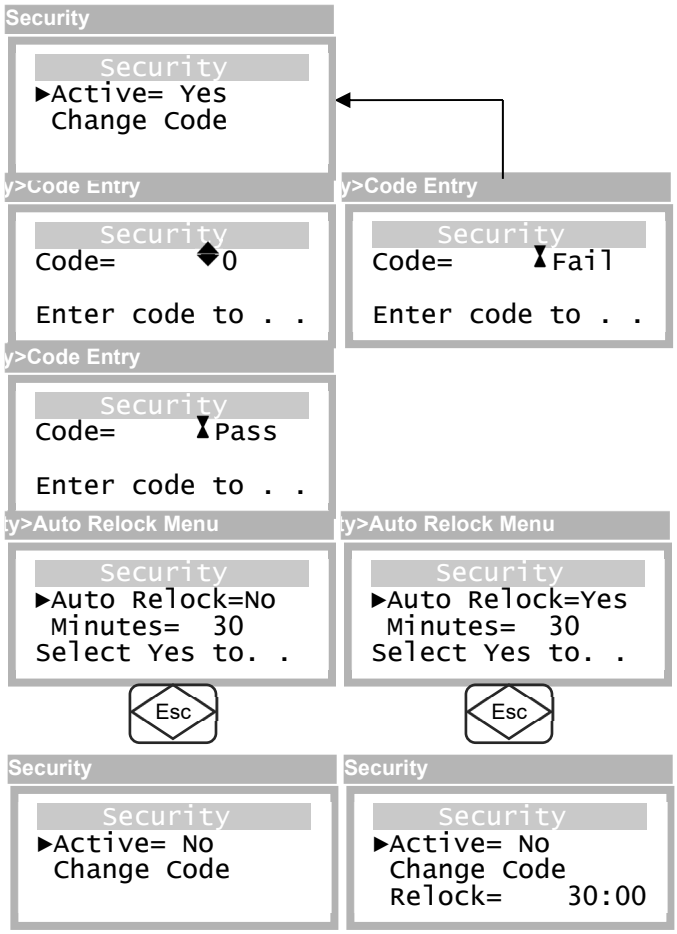


Figure 62 - Activating Security

Deactivating Security

The following display sequence appears when attempting to deactivate panel security. Note the option for automatically relocking the panel after a timed period.



The automatic relock time defaults to 30 minutes, but may be extended up to 60 minutes.

Press the Esc key to exit the Relock display.

The panel re-lock timer is displayed on line 4, but is fixed to prevent relocking while viewing this display. You may select Relock to return to the Auto Relock Menu to extend the period, if necessary.

Figure 63 - Deactivating Security

Changing the Security Code

The security code is changed by selecting Change Code from the Security Menu above.

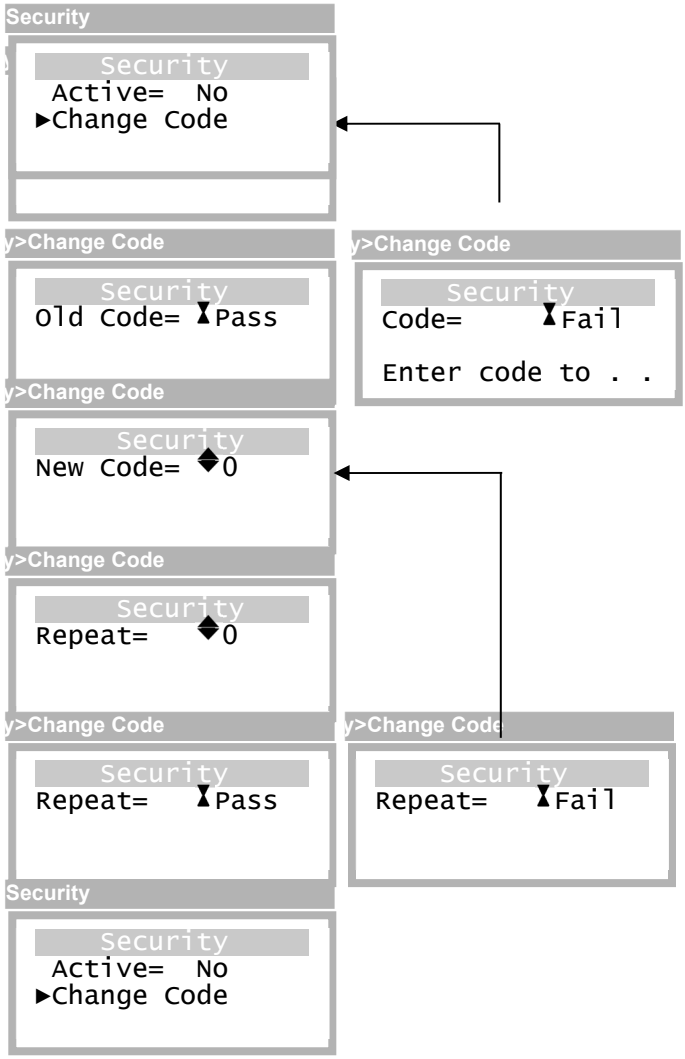
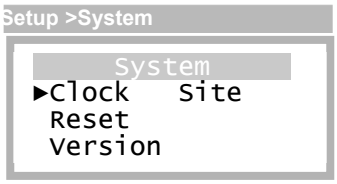


Figure 64. Changing the Security Code

System Menu

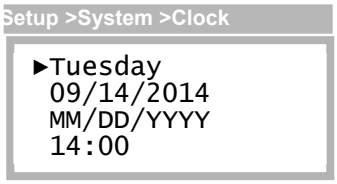


Item	Select to …
Clock	Set or update the transmitter's real-time clock.
Reset	Restart the transmitter or change all user settings to default values.
Version	Display transmitter and sensor version information.
Site	Change the site name displayed during startup review.

Figure 65. System Menu

Clock Menu

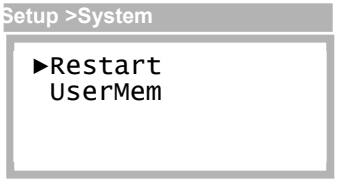
The Clock Menu is used to set the transmitter's real-time clock, which is recorded during sensor calibration and data logging, and is used to trigger Auto-test starts.



Item	Select to …
Line 1	Change the day of the week: Monday, Tuesday, Wednesday, Thursday, Friday, Saturday, and Sunday
Line 2	Configure the month, date, and year, in the format specified by the Format setting (below). Built-in support for leap year. Note: you may select and adjust the year separately.
Line 3	Change the date format: MM/DD/YYYY, example: 09/14/2014 DDMMM/YYYY, example: 09Sep/2014
Line 4	Change the time of day (24-hour format, 00:00 to 23:59)

Figure 66 Clock Menu

Reset Menu

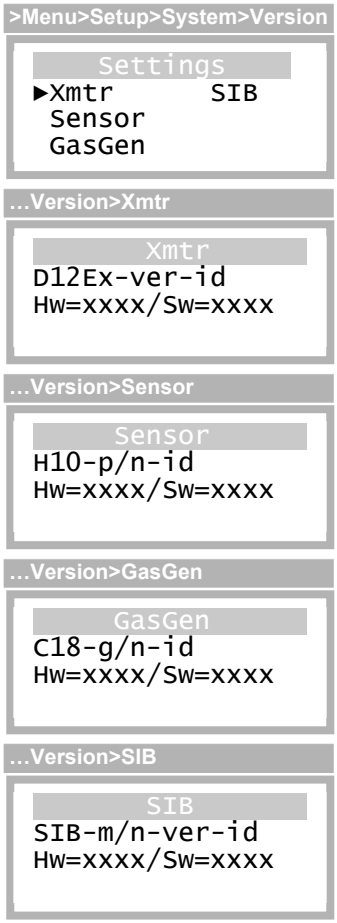


Item	Select to …
Restart	Restart the transmitter without cycling power.
UserMem	**Reset all user settings to default values**. **NOTE**: this method is provided to recover from a corrupted user memory. It does not affect calibration of the sensor or transmitter analog inputs or outputs. After running this method, you will be required to manually restore all of the transmitter alarm, data logger, i/o (communications, relays, and 4-20mA), panel (display and security), settings, as well as the transmitter's real-time clock.

Figure 67 Reset Menu

Version Menu

The Version Menu appears by selecting Version from the System Menu above and lists the major components of the transmitter as menu entries.



Item	*Select to …*
Xmtr	View the transmitter version information.
Sensor	View the sensor version information.
GasGen	View the gas generator version information.
SIB	View the SIB (board) version information.
g/n	Gas number – identifies a gas species.
m/n	Model number – identifies a series model type.
p/n	Part number – identifies a specific assembly.
id	Identity – uniquely identifies a CPU board assembly*
ver	Version number – indexes a specific assembly (shorter text)
Hw	Hardware revision – revision level of the electronics
Sw	Software revision – revision level of the software
	* Id numbers displayed here are used to identify board level components and are not intended to identify the complete device. These numbers will not match serial numbers printed on labels physically attached to the device.

Figure 68. Version Menu

Site Menu

The Site name appears by selecting Site from the System Menu. The name allows the user to assign a meaningful name to the location of the transmitter.

	Item	*Select to …*
Setup >System Site ►(unnamed site) Save	<name>	The name of the site
	Save	Saves the new name

Figure 69. Site Menu

To change the site name:

1. Press the Enter key. A block cursor will appear over the first character.
2. Press the up or down key to scroll to the desired character, and press Enter to advance to the next character. Repeat this for each character.
3. When finished, press the Esc key, move the arrow cursor to Save, and press Enter. Otherwise, press the Esc key to exit without saving changes.

TROUBLESHOOTING

Most electronic faults result in an error message on the display. The following lists transmitter faults and corrective actions.

Trouble	*Description*	*Corrective Action(s)*
Gas Signal Err	The analog-to-digital converter channel assigned to the sensor's gas concentration output signal has failed or is out of range.	1-3,4,6,8
LCD Busy Error	The LCD driver chip cannot recover from an internal error.	1-3,9,7,8
SPI/I2C Bus Error	An internal CPU bus has faulted.	1-3,7,9
Tmp. Signal Err	The analog-to-digital converter channel assigned to the sensor's temperature output signal has failed or is out of range.	1-3,4,6,8
Sensor (-) Range	The sensor has drifted -20% range (below zero).	Zero calibrate the sensor. 4,6,8
Sensor Removed	The sensor cannot be detected.	2-4,6,8
Sensor NVM Err	One or more configuration settings in the sensor memory do not pass checksum test.	4,6,8
Sensor Config	One or more sensor configuration settings are outside of their expected range.	4
Generator NVM	The generator's non-volatile memory is corrupt.	5,6,8
Auto-test Fail With Gen. Config Err	Auto-test is enabled (Status=READY) and a problem has been detected with the gas generator, or the gas generator is not compatible with the sensor's type or range. This problem is reported on the display during startup, when a sensor is installed, and when a generator is removed or installed.	4,5, or disable Auto-test (set Status to OFF)
NVM1 User CRC	An error has been detected in the user settings stored in the transmitter's primary non-volatile memory.	2,3, otherwise, reset the user memory defaults (see Reset Menu on pg. 48) If the problem persists, replace the CPU board.
NVM1 Fact CRC	An error has been detected in the factory settings stored in the transmitter's primary non-volatile memory.	2,3,7
NVM2 User CRC	An error has been detected in the transmitter's secondary non-volatile memory.	Not applicable on this transmitter
NVM2 Fact CRC	An error has been detected in the transmitter's secondary non-volatile memory.	Not applicable on this transmitter
Auto-test Fail Without Gen. Config Err	Auto-test failed after three attempts (and the Auto-test Trouble is set to YES).	5,4,6

Trouble	*Description*	*Corrective Action(s)*
3W Pwr Required	Relays or RS232/485 communication is enabled, but transmitter does not have 3-wire power applied.	If relays are not being used, disable them
Xmtr Uncal	The transmitter's factory calibration data has become corrupted.	2,3,7
CPU Trouble	A stack overflow or other internal error occurred in the CPU.	2,3,7
Fault Test	Trouble alarm is being tested, not an actual fault.	
Gas Sensor Uncal	The gas sensor appears to be uncalibrated, which occurs after resetting its memory.	Zero and Span calibrate the sensor.
No User Verify	A setting was not verified at the panel within 5 minutes.	Restart the transmitter (2) and verify all settings.
Hardware Fault	The real-time-clock, a non-volatile memory, or some other component has been faulted or been corrupted. The transmitter will restart upon exit from the Trouble Status Display (pg. 27), or automatically from the Main Display after 5 minutes.	1,3,7,8
Sensor COM TmOut	The SIB is not responding.	2,3,6,7,8
Sensor COM Error	The SIB is responding with physical communication errors.	2,3,6,7,8
Sensor Proto Err	The SIB is responding with protocol errors (i.e., bad CRC). This could be caused by physical communication errors.	2,3,6,7,8
Sensor Reply Err	The SIB is responding with bad information.	2,3,6,7,8
Sensor CPU Trble	The SIB is reporting a stack overflow or other internal error occurred in its CPU.	2,3,6,7,8
Sensor H/W Error	The SIB is reporting a non-volatile memory or other hardware component has faulted.	2,3,6,7,8
Sensor NVM1 CRC	The SIB is reporting an error has been detected in the user or factory settings stored in its primary non-volatile memory.	2,3,6,7,8
Sensor NVM2 CRC	The SIB is reporting an error has been detected in the user or factory settings stored in its secondary non-volatile memory.	Not applicable on this transmitter.

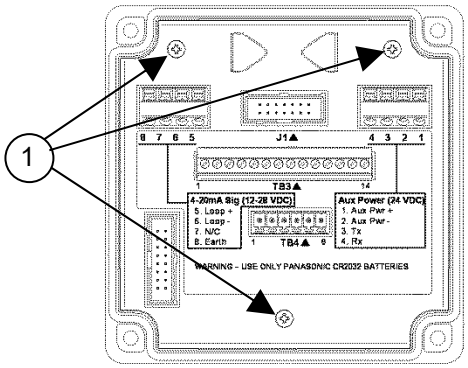
Corrective Action Codes

1. Select View Trouble (status is cleared on exit, see Trouble Status Display on page 27
2. Restart the transmitter (Menu>Setup>System>Reset>Restart)
3. Toggle power off and on
4. Replace the sensor
5. Replace the generator
6. Replace the SIB
7. Replace the CPU Board
8. Replace the Power Supply Board
9. Replace the Display Board

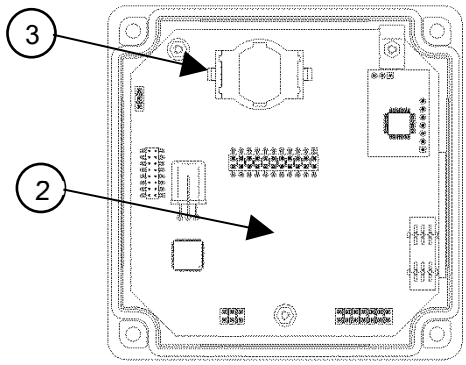
Maintenance

Real Time Clock Battery Replacement

1. Loosen the four screws securing the front enclosure.
2. Remove the front enclosure from the rear enclosure, by squeezing the hinge pin.
3. Remove the Internal Shield by removing the three screws (1)



4. Remove the Terminal Board by gently prying evenly along the top edge to loosen it from the board below, then pull straight up, to expose the CPU PCB (2).



5. Remove the Battery (3), and replace with same kind.
6. Reverse steps 4 through 1 to re-assemble the unit.
7. After powering up the unit, set the data and time.

SPARE PARTS LIST

Part No.	Description
00-1042	Hydrogen peroxide, 0-10/100 PPM (20 PPM Standard)
00-1169	Hydrogen peroxide, 200/2000 PPM (500 PPM Standard)
03-0477	F12/D Transmitter Front Lid Assembly (Not rated for Hazardous Locations)
00-1584	F12 Sensor Holder Assembly
03-0118	Sensor Cap
01-0413	AC Relay Board Assy, 115 or 230V (specify when ordering)
01-0420	Power Supply Circuit Protection Cover
31-0192	Ribbon Cable, P/S to Front Lid, 16 conductors
00-1251	Flow Cell Assembly * requires the 03-0118 Flow cell Sensor Cap
36-0044	Solenoid Valve, 3 way, 12 VDC
36-0045	Sample Pump, twin-head, 12 VDC
29-0013	Battery
44-0124	Tubing, FEP lined PVC, 1/8” I.D.
00-1592	RS232 cable

PRODUCT WARRANTY

ANALYTICAL TECHNOLOGY, INC. (MANUFACTURER) WARRANTS TO THE CUSTOMER THAT IF ANY PART(S) OF THE MANUFACTURER'S PRODUCTS PROVES TO BE DEFECTIVE IN MATERIALS OR WORKMANSHIP WITHIN THE EARLIER OF 18 MONTHS OF THE DATE OF SHIPMENT OR 12 MONTHS OF THE DATE OF START-UP, SUCH DEFECTIVE PARTS WILL BE REPAIRED OR REPLACED FREE OF CHARGE. INSPECTION AND REPAIRS TO PRODUCTS THOUGHT TO BE DEFECTIVE WITHIN THE WARRANTY PERIOD WILL BE COMPLETED AT THE MANUFACTURER'S FACILITIES IN COLLEGEVILLE, PA. PRODUCTS ON WHICH WARRANTY REPAIRS ARE REQUIRED SHALL BE SHIPPED FREIGHT PREPAID TO THE MANUFACTURER. THE PRODUCT(S) WILL BE RETURNED FREIGHT PREPAID AND ALLOWED IF THE MANUFACTURER DETERMINES THAT THE PART(S) FAILED DUE TO DEFECTIVE MATERIALS OR WORKMANSHIP.

THIS WARRANTY DOES NOT COVER CONSUMABLE ITEMS, BATTERIES, OR WEAR ITEMS SUBJECT TO PERIODIC REPLACEMENT INCLUDING LAMPS AND FUSES.

GAS SENSORS, EXCEPT OXYGEN SENSORS, ARE COVERED BY THIS WARRANTY, BUT ARE SUBJECT TO INSPECTION FOR EVIDENCE OF EXTENDED EXPOSURE TO EXCESSIVE GAS CONCENTRATIONS. SHOULD INSPECTION INDICATE THAT SENSORS HAVE BEEN EXPENDED RATHER THAN FAILED PREMATURELY, THE WARRANTY SHALL NOT APPLY.

THE MANUFACTURER ASSUMES NO LIABILITY FOR CONSEQUENTIAL DAMAGES OF ANY KIND, AND THE BUYER BY ACCEPTANCE OF THIS EQUIPMENT WILL ASSUME ALL LIABILITY FOR THE CONSEQUENCES OF ITS USE OR MISUSE BY THE CUSTOMER, HIS EMPLOYEES, OR OTHERS. A DEFECT WITHIN THE MEANING OF THIS WARRANTY IS ANY PART OF ANY PIECE OF A MANUFACTURER'S PRODUCT WHICH SHALL, WHEN SUCH PART IS CAPABLE OF BEING RENEWED, REPAIRED, OR REPLACED, OPERATE TO CONDEMN SUCH PIECE OF EQUIPMENT.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES (INCLUDING WITHOUT LIMITING THE GENERALITY OF THE FOREGOING WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE), GUARANTEES, OBLIGATIONS OR LIABILITIES EXPRESSED OR IMPLIED BY THE MANUFACTURER OR ITS REPRESENTATIVES AND BY STATUTE OR RULE OF LAW.

THIS WARRANTY IS VOID IF THE MANUFACTURER'S PRODUCT(S) HAS BEEN SUBJECT TO MISUSE OR ABUSE, OR HAS NOT BEEN OPERATED OR STORED IN ACCORDANCE WITH INSTRUCTIONS OR IF THE SERIAL NUMBER HAS BEEN REMOVED.

ANALYTICAL TECHNOLOGY, INC. MAKES NO OTHER WARRANTY EXPRESSED OR IMPLIED EXCEPT AS STATED ABOVE.

This product is not for use in hazardous locations.

WATER QUALITY MONITORS

Dissolved Oxygen
Free Chlorine
Combined Chlorine
Total Chlorine
Residual Chlorine Dioxide
Potassium Permanganate
Dissolved Ozone
pH/ORP
Conductivity
Hydrogen Peroxide
Peracetic Acid
Dissolved Sulfide
Residual Sulfite
Fluoride
Dissolved Ammonia
Turbidity
Suspended Solids
Sludge Blanket Level
MetriNet Distribution Monitor

GAS DETECTION PRODUCTS

NH_3	Ammonia
CO	Carbon Monoxide
H_2	Hydrogen
NO	Nitric Oxide
O_2	Oxygen
CO	Cl2 Phosgene
Br_2	Bromine
Cl_2	Chlorine
ClO_2	Chlorine Dioxide
F_2	Fluorine
I_2	Iodine
H_X	Acid Gases
C_2H_4O	Ethylene Oxide
C_2H_6O	Alcohol
O_3	Ozone
CH_4	Methane (Combustible Gas)
H_2O_2	Hydrogen Peroxide
HCl	Hydrogen Chloride
HCN	Hydrogen Cyanide
HF	Hydrogen Fluoride
H_2S	Hydrogen Sulfide
NO_2	Nitrogen Dioxide
NO_x	Oxides of Nitrogen
SO_2	Sulfur Dioxide
H_2Se	Hydrogen Selenide
B_2H_6	Diborane
GeH_4	Germane
AsH_3	Arsine
PH_3	Phosphine
SiH_4	Silane
HCHO	Formaldehyde
$C_2H_4O_3$	Peracetic Acid
DMA	Dimethylamine