GDX-350 Sensor Transmitter

Instruction 5600-9001

Installation • Operation • Maintenance

Rev. 2 – October 2012

Product Leadership • Training • Service • Reliability

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1. OVERVIEW

1.1. Stand-alone and Wired Networks

The GDX-350 is a fixed-point monitor designed to provide continuous monitoring of hazardous gases in the workplace. Monitored values are displayed in their engineering units as well as graphically such as bar graphs or 30-minute trends (see Figure 1-1).

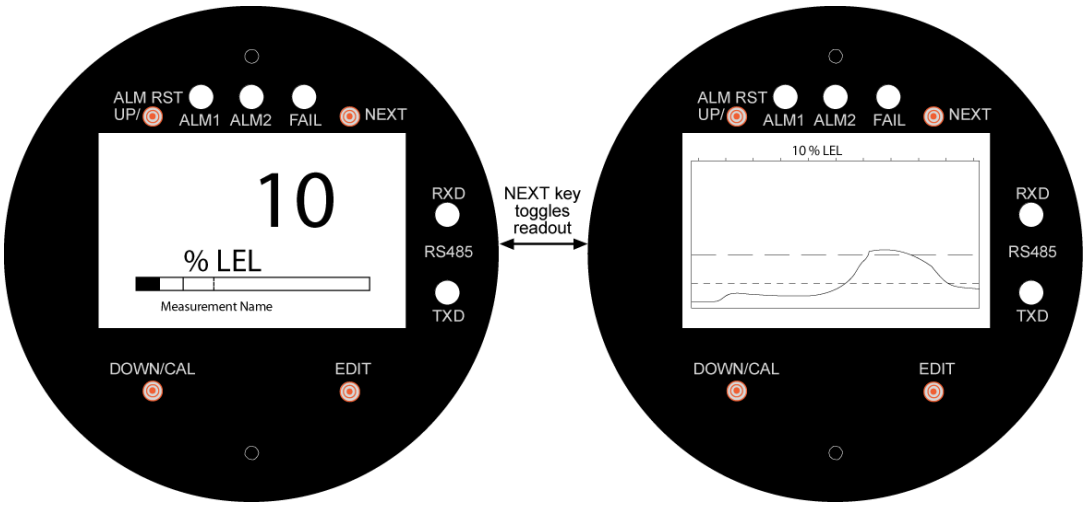

Figure 1-1: Engineering Units Data Displays: Bar Graph (Left), 30-Minute Trend (Right)

Input types include electrochemical toxic and oxygen sensors, catalytic bead combustible sensors, MOS solid-state sensors, as well as various millivolt, volt and 4-20 mA inputs. Sensors supplied by the factory include an 8-wire *Smart Sensor* interface capable of configuring data uploads to the GDX-350. Traditional 3-wire *Simple* sensors, without the smart interface, are also supported by the GDX-350. Its advanced microcontroller electronics and superior graphic LCD operator interface offer enhanced diagnostics and fault analysis not possible in competing products. The GDX-350 provides a standard 4-20 mA output signal for connection to control systems or other alarm instrumentation. Available options include an Alarm Relay/RS-485-Modbus board or an isolated 4-20 mA output. Non-volatile memory retains all configuration data during power interruptions. The magnetic, non-intrusive calibration can be easily performed by a single person without opening the enclosure. A standard *Real Time Clock and Calendar* feature allows data logging of calibrations and alarm events for recall to the LCD readout or over the serial port.

Only periodic calibration checks are needed to assure dependable performance. The operator interface is very intuitive with the LCD displaying data both graphically as bar-graphs/trends as well as in engineering units (Figure 1-1). Additional features include:

- No potentiometer or jumper settings required. All setup is completed through display menus accessed via the LCD/magnetic keypad operator interface without opening the enclosure.
- Field adjustable alarm levels may be high, low, fault, fail-safe, latching and acknowledgeable.
- New alarms cause front LEDs to flash and become steady after acknowledgement.
- CAL MODE advises when to apply gas during calibrations.
- One half-hour trend screen shows rate of change of gas exposures.
- Sensor life bar-graph automatically updates after each SPAN calibration.
- Modular design allows for efficient installation as well as plug in sensors that allow a change in target gas after installation
- New smart sensors are recognized by the GDX-350 and prompt users to either upload new configuration data or continue with data from the previous smart sensor.
- Sensors are industry proven for fast response and long life.

1.2. RF Wireless Networks

IMPORTANT: This section describes GDX-350 RF toxic / oxygen monitors equipped with the RF Wireless Interface and RF firmware. This battery powered device has no external power or signal wiring and is limited to self powered electrochemical sensors for toxic and oxygen measurements. Gas values are displayed in their engineering units as well as graphically as bar graphs or 30-minute trends. Flashing front panel LEDs notify personnel when alarm levels have been reached. Periodic calibration checks are needed to assure dependable performance.

The RF version of the GDX-350 functions on a license free 900MHz or 2.4GHz wireless Client / Server networks and transmits monitored data to GDA-400 and GDA-1600 controllers. Controllers must be equipped with the matching RF wireless modem and appropriate antenna to receive the transmissions. Up to sixteen GDX-350 wireless monitors may communicate to one GDA-1600 and up to four to a GDA-400. Wireless networks requiring more than 16 points may consist of multiple controllers.

Advanced microcontroller electronics and superior graphic LCD operator interface offers enhanced diagnostics and fault analysis not possible in competing products. Non-volatile memory retains all configuration data during power interruptions. The magnetic keypad allows non-intrusive calibrations be performed by one person without opening the enclosure. A “real time clock & calendar” feature allows logging of calibrations, alarm trips, communication faults and other events for review on the LCD readout.

Compatible sensors include an 8-wire *Smart Sensor* interface capable of configuration data uploads to the monitor. Traditional *Simple* sensors without the smart interface are also supported. A separate PC compatible USB Interface device allows *Smart* sensors to be loaded with configuration variables via a PC and upload this data to the GDX-350. This configuration data includes alarm set points, range, target gas, calibration constants and other variables required to match a specific application. For *Simple* sensors without the smart interface, the USB device allows direct GDX-350 configuration from a PC.

Additional features include:

- On screen radio status icons indicate “Server In Range”, “Server Out of Range”, “Server Previously Out of Range” and “Low Battery” conditions.
- No potentiometer or jumper settings required. All setup is with menus accessed via the LCD / magnetic keypad operator interface without opening the enclosure.
- Field adjustable alarm levels flash front panel LED indicators for HIGH, WARN, FAIL conditions. Alarm relays are not available with this low power model.
- CAL MODE provides on-screen prompts when to apply cal gas during calibrations.
- “Sensor life” bar-graph updates after each SPAN calibration indicating when to replace old sensors.
- Half hour trend screen shows rate of change of gas exposures.
- Modular design affords efficient installation and plug in sensors allow changing target gases even after installation.
- New smart sensors are recognized by the GDX-350 which prompts users to either upload new configuration data or continue with data from the previous smart sensor.
- Missing sensors trip the FAIL alarm.
- Compatible sensors are industry proven for fast response and long life.

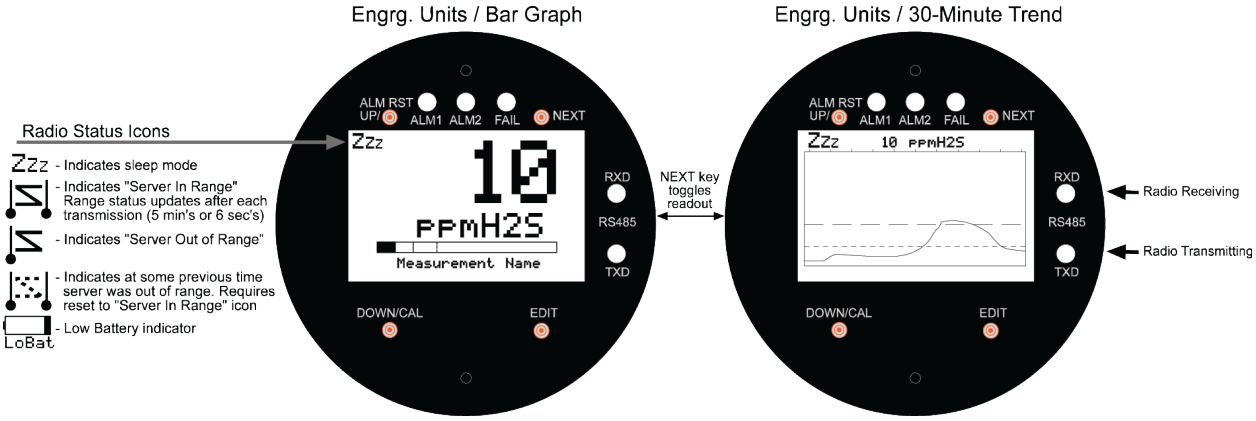

Figure 1-2: Data Displays (RF Version) SHOWING Radio Status

1.3. The RF Transmitter and Client/Server Wireless Networks

Wireless transceivers utilize a FHSS (Frequency Hopping Spread Spectrum) Server-Client network where multiple clients synchronize their frequency hopping to a single server. The Server transmits a beacon at the beginning of every frequency hop (50 times per second). Client transceivers listen for this beacon and upon receiving it synchronize their hopping with the Server. Since RF GDX-350s are powered by a small battery, much care is taken to reduce power consuming RF transmissions to a minimum. For this reason RF-configured GDX-350s are unsuitable for Server operation and are always Clients.

Each GDX-350 wireless "broadcast" includes 10-bit monitored gas value, battery voltage and a status byte. This proprietary wireless protocol interfaces only to GDA-400 and GDA-1600 controllers. Controllers are capable of functioning as Clients or Servers, but only one Server is allowed per wireless network. Multiple controllers may receive the same transmissions from RF-configured GDX-350s, but only one controller per wireless network may be configured as the Server.

Each transceiver on a wireless network must have its **RADIO SETUP** menus configured to share the same **Hop Channel** (0-32) and **System ID** (0-255) in order to communicate. There should never be two servers with the same **Hop Channel** / **System ID** settings in the same coverage area as the interference between the two servers will severely hinder RF communications. The Server must be in a powered location and should be centrally located since all Clients must receive the server's beacon in order to communicate.

Correct planning and design of wireless systems are imperative for ensuring a successful installation. It is highly recommended that a site drawing indicating location of monitors and base station, line of site obstructions, and sources of RF interference be submitted when requesting a quotation.

1.3.1 Radio Status Icons (*Zzz's,* , , ,)

Figure 2-1 shows the data displays and identifies "radio status" (RS) icons which appear on the LCD of RF-configured GDX-350s. RS icons, along with the TXD led (see Figure 1-2), are useful diagnostic tools for evaluating RF communication. Status conditions indicated by the RS icon are **Sleep Mode** - **Zzz**'s, **Server In Range** - (server's beacon received at most recent attempt), **Server Out of Range** - (server's beacon not received at most recent attempt), **Server Previously Out of Range** - and **Low Battery** - . The Server "Previously Out of Range" icon is useful in determining if intermittent communication failures are a result of this monitor having problems receiving the Server's beacon. The duration and frequency of "out of range" conditions are stored in the Event Log table. Low Battery conditions also flash the FAIL LED.

It is important to understand RS icons only update as the TXD LED flashes indicating an RF transmission has occurred. The adjustable (see ***Wakeup Time*** menu) RF transmission rates are typically each 5-minutes, but increase to each 6-seconds during alarm conditions.

1.3.2 RF Comm Cycle and Conserving Battery Life

Most of the GDX-350's battery power is consumed as the radio communicates to the wireless network. Each Comm cycle consists of the following operations: Awake the radio in receive mode; listen for the Server's beacon; synchronize to the Server's hopping frequency to become "In Range"; transmit data packet out the antenna and return to sleep mode. This sequence takes from 0.25 to 1 second to complete. If the radio fails to synchronize hopping upon the initial attempt, it waits 6 seconds and tries again, then waits 6 seconds and tries once more. If the third attempt fails, the "Out of Range" icon appears and the GDX-350 returns to its Comm cycle. Out of Range will also be logged into the Event Log. Transmit power levels are adjustable (900MHx models only) and the lower the power setting the longer the battery will last.

Every 6-seconds, the monitor performs a "sniff test" to detect level of target gas present at the sensor. At each "sniff test", the **Zzz**'s "Sleep Mode" icon is briefly replaced by an RS icon. At this time the readout updates to indicate gas value measured at the "sniff test." The radio stays OFF if the gas value does not trip A1 or A2 alarms. Except when the ***Wakeup Time*** menu expires (maximum of 5-minutes) the radio turns on, receives the Server's beacon, and transmits its data. These routine transmissions allow the controllers to confirm a good wireless comm link even when no alarms exist. If A1 or A2 alarms do exist during the "sniff test", the radio wakes, receives the Server's beacon, and transmits its data immediately.

The following list identifies each of the conditions that cause the radio to transmit:

- Every 5-minutes (or faster depending upon ***Wakeup Time*** menu) when there is no A1 or A2 alarm.

IMPORTANT: The receiving controller reports "Comm Error" if the monitor does not reply for periods of greater than 18-minutes. A3 and FAIL alarms do not increase radio transmission rates.

- Every 6-seconds if there is an A1 or A2 level alarm.
- Upon entry into CAL MODE a 75 counts value (-15.6% FS) is transmitted. Receivers indicate "IN CAL" when 75 counts is the input for a channel (200 to 1000 counts represents 0 to 100% of full scale).
- Upon ENTRY into CAL PURGE a 200 counts value (0% FS) is transmitted.

  NOTE: To prevent A1 & A2 low trip alarms, oxygen ranges transmit 20.9% readings upon entry into CAL PURGE.

- Holding the magnet to the UP key for >8 seconds forces a transmission of the current reading value.

1.3.3 RF BATTERY I/O PCB WITH POWER SWITCH

The RF electronics consists of the lower Battery I/O PCB (Figure 1-3) connected by a cable to the upper Display assembly with RF Module PCB (Figure 1-4). The 3.6 volt lithium 'D' cell battery will continuously power the unit for up to one year and may be replaced by following the procedure in Figure 1-3.

Power switch (SW1), on the Battery PCB, applies battery power to the RF monitor. SW1 should be OFF if the monitor is to be out of service for long periods.

IMPORTANT: Do not turn SW1 ON until the controller designated as Server is fully operational and ready to communicate to the RF-equipped GDX-30s. Battery life is reduced if the RF-equipped GDX-30 is on for long periods while unable to communicate to the Server controller.

IMPORTANT: DO NOT ATTEMPT TO CHARGE THIS BATTERY OR REPLACE WITH ANY OTHER THAN THE APPROPRIATE PART FROM BACHARACH.

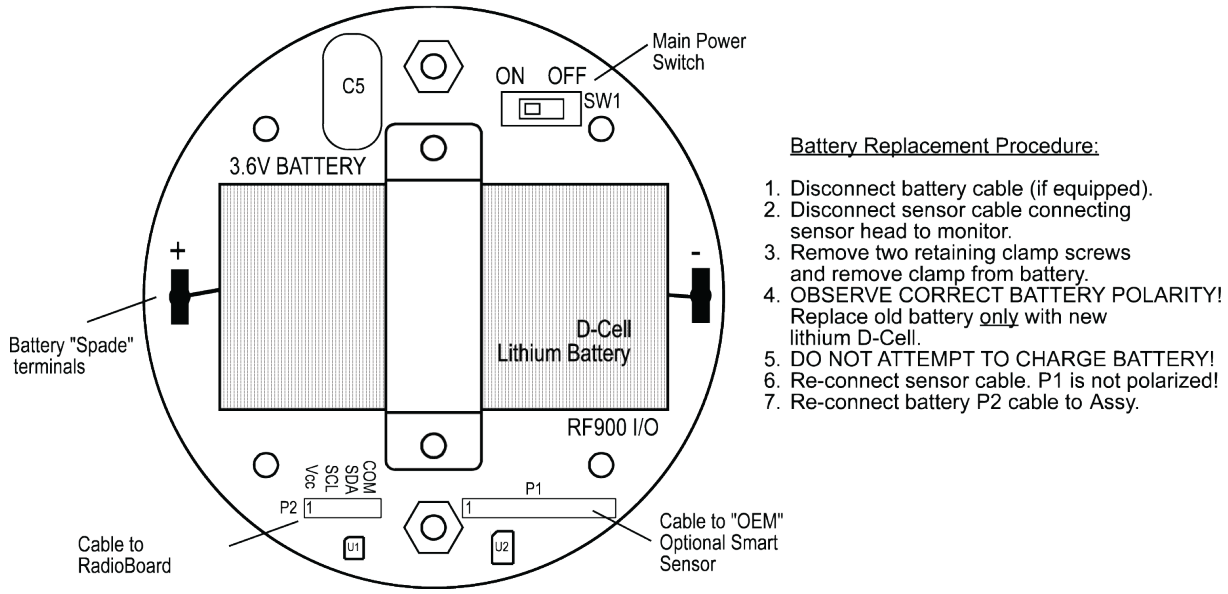

Figure 1-3: Battery I/O PCB

1.3.4 900 MHz RF Module

The RF-equipped GDX-350's RF module mounts "piggy back" to the back of the Display assembly as shown in Figure 1-4. The MMCX RF connector connects to the antenna fitting's pigtail coax cable. There is also a slender 4 conductor cable between the RF Module PCB and the battery I/O PCB bolted to the bottom of the enclosure.

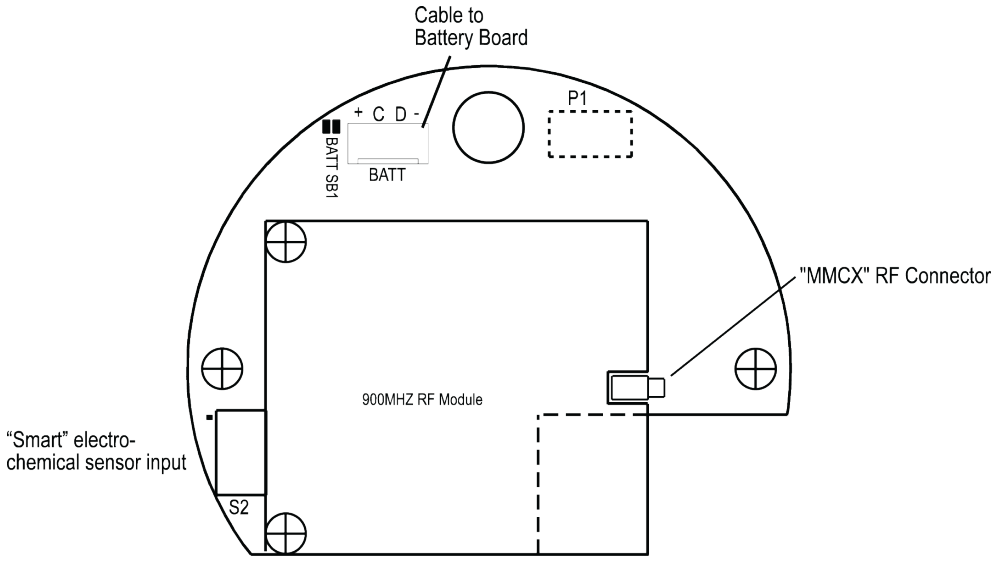

Figure 1-4: RF Module PCB

1.4. Safety Information – Read Before Installation and Applying Power

IMPORTANT: Users should have a detailed understanding of GDX-350 operating and maintenance instructions. Use the GDX-350 only as specified in this manual otherwise the detection of gases and resulting protection provided may be impaired. Read the following **WARNINGS** prior to use.

WARNING: Calibrate with known target gas at start-up and check on a regular schedule, at least every 90 days. More frequent inspections are encouraged to spot problems such as dirt, oil, paint, grease or other foreign materials on the sensor head.

WARNING: Do not use the GDX-350 if its enclosure is damaged or cracked or has missing components.

WARNING: Make sure the cover, internal PCBs, antenna, and field wiring connections are securely in place before operation.

WARNING: Use only a sensor assembly compatible with the GDX-350 and approved by Bacharach, Inc.

WARNING: Periodically test for correct operation of the system's alarm events by exposing the monitor to a targeted gas concentration above the High Alarm set point.

WARNING: Do not expose the GDX-350 to electrical shock or continuous severe mechanical shock.

WARNING: Protect the GDX-350 from dripping liquids and high power sprays.

WARNING: Use only for applications described within this manual.

CAUTION: Do not paint the sensor assembly or the transmitter.

CAUTION: For safety reasons this equipment must be operated and serviced by qualified personnel only. Read and understand instruction manual completely before operating or servicing.

1.5. Ordering Information

Transmitter Description	Part Number	Options	
GDX-350 CO	5600-301x	x=1	3-wire base w/ 4-20 mA output
		x=2	3-wire base w/ 4-20 mA output and Modbus
	5601-301x	x=1	2-wire base
		x=8	2-wire base w/ 900 MHz wireless
		x=9	2-wire base w/ 2.4 GHz wireless
GDX-350 H_2S	5600-302x	x=1	3-wire base w/ 4-20 mA output
		x=2	3-wire base w/ 4-20 mA output and Modbus
	5601-302x	x=1	2-wire base
		x=8	2-wire base w/ 900 MHz wireless
		x=9	2-wire base w/ 2.4 GHz wireless
GDX-350 O_2	5600-303x	x=1	3-wire base w/ 4-20 mA output
		x=2	3-wire base w/ 4-20 mA output and Modbus
	5601-303x	x=1	2-wire base
		x=8	2-wire base w/ 900 MHz wireless
		x=9	2-wire base w/ 2.4 GHz wireless
GDX-350 NO_2	5600-304x	x=1	3-wire base w/ 4-20 mA output
		x=2	3-wire base w/ 4-20 mA output and Modbus
	5601-304x	x=1	2-wire base
		x=8	2-wire base w/ 900 MHz wireless
		x=9	2-wire base w/ 2.4 GHz wireless
GDX-350 NH_3	5600-305x	x=1	3-wire base w/ 4-20 mA output
		x=2	3-wire base w/ 4-20 mA output and Modbus
	5601-305x	x=1	2-wire base
		x=8	2-wire base w/ 900 MHz wireless
		x=9	2-wire base w/ 2.4 GHz wireless
GDX-350 SO_2	5600-306x	x=1	3-wire base w/ 4-20 mA output
		x=2	3-wire base w/ 4-20 mA output and Modbus
	5601-306x	x=1	2-wire base
		x=8	2-wire base w/ 900 MHz wireless
		x=9	2-wire base w/ 2.4 GHz wireless

Transmitter Description	Part Number	Options
GDX-350 PH_3	5600-307x	x=1 3-wire base w/ 4-20 mA output
		x=2 3-wire base w/ 4-20 mA output and Modbus
	5601-307x	x=1 2-wire base
		x=8 2-wire base w/ 900 MHz wireless
		x=9 2-wire base w/ 2.4 GHz wireless
GDX-350 H_2	5600-311x	x=1 3-wire base w/ 4-20 mA output
		x=2 3-wire base w/ 4-20 mA output and Modbus
	5601-311x	x=1 2-wire base
		x=8 2-wire base w/ 900 MHz wireless
		x=9 2-wire base w/ 2.4 GHz wireless
GDX-350 CH_4 (Catalytic)	5600-320x	x=1 3-wire base w/ 4-20 mA output
		x=2 3-wire base w/ 4-20 mA output and Modbus
GDX-350 CH_4 (IR)	5600-321x	x=1 3-wire base w/ 4-20 mA output
		x=2 3-wire base w/ 4-20 mA output and Modbus
GDX-350 CO_2	5600-322x	x=1 3-wire base w/ 4-20 mA output
		x=2 3-wire base w/ 4-20 mA output and Modbus
GDX-350 C_3H_3 (IR)	5600-323x	x=1 3-wire base w/ 4-20 mA output
		x=2 3-wire base w/ 4-20 mA output and Modbus

1.6. Replacement Parts and Accessories

Part Number	Description	
5600-0004	GDX Calibration Cup/Sample Draw Adaptor	
5600-0003	GDX Splash Guard/Remote Cal-Cup	
0024-7059	Calibration Kit – Regulator, Tubing, and Carrying Case (no gas included)	
5600-5010	CO	Uncalibrated Sensor Module
5600-6010	CO	Pre-Calibrated Smart Sensor Module
5600-5020	H_2S	Uncalibrated Sensor Module
5600-6020	H_2S	Pre-Calibrated Smart Sensor Module
5600-5030	O_2	Uncalibrated Sensor Module
5600-6030	O_2	Pre-Calibrated Smart Sensor Module
5600-5040	NO_2	Uncalibrated Sensor Module
5600-6040	NO_2	Pre-Calibrated Smart Sensor Module
5600-5050	NH_3	Uncalibrated Sensor Module
5600-6050	NH_3	Pre-Calibrated Smart Sensor Module
5600-5060	SO_2	Uncalibrated Sensor Module
5600-6060	SO_2	Pre-Calibrated Smart Sensor Module
5600-5070	PH_3	Uncalibrated Sensor Module
5600-6070	PH_3	Pre-Calibrated Smart Sensor Module
5600-5200	CH_4 (CAT)	Uncalibrated Sensor Module
5600-6200	CH_4 (CAT)	Pre-Calibrated Smart Sensor Module
5600-5210	CH_4 (IR)	Uncalibrated Sensor Module
5600-6210	CH_4 (IR)	Pre-Calibrated Smart Sensor Module
5600-5220	CO_2	Uncalibrated Sensor Module
5600-6220	CO_2	Pre-Calibrated Smart Sensor Module
5600-5110	H_2	Uncalibrated Sensor Module
5600-6110	H_2	Pre-Calibrated Smart Sensor Module
5600-5330	C_3H_8	Uncalibrated Sensor Module
5600-6330	C_3H_8	Pre-Calibrated Smart Sensor Module

1.7. Calibration Gas

Part Number	Gas Name	Chemical Formula	Concentration
0051-4000	Ammonia	NH_3	25 PPM
0051-4028	Propane	C_3H_8	25% LEL
0051-4031	Methane	CH_4	25% LEL
0051-4010	Carbon Dioxide	CO_2	2.50%
0051-4052	Phosphine	PH_3	1 PPM
0051-4040	Hydrogen	H_2	100 PPM
0051-4048	Nitrogen Dioxide	NO_2	5 PPM
0051-4075	Sulfur Dioxide	SO_2	5 PPM
0051-4044	Hydrogen Sulfide	H_2S	25 PPM
0051-4049	Oxygen	O_2	20.9%
0051-4025	Carbon Monoxide	CO	100 PPM

1.8. System Design Specifications

Category	System Design Specification
Supply Voltage	10 to 30 volts
Power Consumption	• With a typical 0.5 watt Bridge Sensor: 100 mA @ nominal 24 VDC • Relays/RS-485 Modbus Option Board: 40 mA per relay (120 mA total with all 3 energized); RS-485 use adds 20 mA
Memory	Non-volatile E2 memory retains configuration values on power outages.
Loop Resistance	750 ohms maximum (at nominal 24 VDC power)
Relays (Optional)	Three configurable form C (SPDT) relays rated for 5 amp at 30 VDC or 240 VAC RESISTIVE. Relay 1 and Relay 2 level alarms may be configured for HIGH or LOW trip, for normally energized (Failsafe) or normally de-energized and for latching or non-latching. Relay 3 is always normally energized for failsafe operation; therefore, loss of power to the GDX-350 will be indicated as a “FAULT” condition.

CAUTION: Relays are rated for RESISTIVE loads. Inductive loads, such as contactor coils or motors may cause contact arcing, which emits RFI into the sensor signals. Use appropriate snubbers and MOVs across inductive loads and keep wiring away from signal wires.

1.9. General Specifications

Category	General Specifications	
Product Type	GDX-350 transmitter/monitor for various gases.	
Coverage	Single sensor, 40 foot diameter	
Front Panel	5 Indicator lights; AL1, AL2, Fail, In Cal, and RS-485 TXD and RXD 64 x 128 Pixel LCD graphic display for gas readings, 30 minute trend, bar graphing, engineering units, and backlight	
Housing	Instrument enclosure suitable for Class 1, Div 1 and 2, Gr. B, C, and D	
Security mode	Locks out critical parameters	
Calibration	Non-intrusive calibration	
4-20 output Signal	3-wire, 4-20 mA. Max loop resistance is 750 ohms (@24 VDC)	
Alarm relays	Three configurable form C (SPDT) relays rated for 5 amp at 30 VDC or 240 ~VAC **RESISTIVE**. Relay 1 and Relay 2 level alarms are configurable for HIGH or LOW trip, for normally energized (Failsafe) or normally de-energized and for latching or non-latching. Relay 3 is always normally energized for failsafe operation so loss of power to the unit will be indicated as a “FAULT” condition.	
Communications	RS-485, Modbus optional, 4-20 mA standard	
Power Safety Mode	Fully automatic system reset. All programmed parameters retained	
Operating Temp	-55 to 60 °C (-67 to 140 °F)	
Ambient Humidity	5% to 90% RH (non-condensing)	
Power	10 – 30 VDC, 250 mA (@ 24 VDC)	
Certification	CSA certified for Division 1 and 2 hazardous area installations for explosion proof Class 1 Groups B, C, and D, and intrinsically safe (GDX-350/EC 2-wire loops only) Class 1 Groups A, B, C, and D. Designed to meet CSA C22.2 No.152 for Combustibles Monitors and ISA 92.0.01 Part 1 for Toxic Monitors (excludes ammonia). Ammonia is for use in non-classified areas only. ATEX: CE, EExd IIB + H2, T5	
Warranty	2 years from date of shipment, consumables not included	
RF Specifications	Power Supply:	Integral non-rechargeable 3.6 volt 19AH lithium D cell battery.
	Power Consumption:	<2mA during “sleep” mode, 40mA during “receive beacon” mode, up to 1 amp during 1 watt “transmit” mode. Transmit power may be set from 10mW to 1 watt.
	Transmit (TX) Power:	30dBm at highest 1W power setting. Transmit power may be set from 10mW to 1 watt
	Receive (RX) Sensitivity:	-100 dBm
	Radio Frequency:	Hopping occurs between 902 MHz and 928 MHz.
	Memory:	Non-volatile E^2 memory retains configuration values in the event of power outages.

1.10. Sensor Specifications

Gas Sensor	Measuring Range	Sensor Type	Display Resolution	Default Span Point	Default Low Alarm	Default High Alarm	Response Time (T90)
CO	0-1000 ppm	EC	1 ppm	100 ppm	35 ppm	70 ppm	<50 s
O_2	0-25%	EC	0.1%	20.9%	19.5%	18.5%	<30 s
H_2S	0-500 ppm	EC	1 ppm	25 ppm	10 ppm	20 ppm	<75 s
SO_2	0-99.9 ppm	EC	0.1 ppm	5.0 ppm	2.0 ppm	4.0 ppm	<45 s
NO_2	0-99.9 ppm	EC	0.1 ppm	5.0 ppm	1.0 ppm	2.0 ppm	<75 s
H_2	0-1000 ppm	EC	1 ppm	100 ppm	50 ppm	100 ppm	<180 s
PH_3	0-5 ppm	EC	0.01 ppm	1.00 ppm	0.30 ppm	0.60 ppm	<60 s
CH_4	0-100% LEL	CAT	1%	25% LEL	10% LEL	20% LEL	<45 s
CO_2	0-5%	IR	0.1%	2.5%	1.5%	2.5%	<50 s
CH_4	0-100% LEL	IR	1%	25% LEL	10% LEL	20% LEL	<60 s
C_3H_8	0-100% LEL	IR	1%	25% LEL	10% LEL	20% LEL	<60 s
NH_3	0-500 ppm	EC	1 ppm	25 ppm	25 ppm	50 ppm	<75 s

2. INSTALLATION INSTRUCTIONS

2.1. Sensor Location

Factors such as air movement, gas density in relation to air, emission sources and environmental variables affect correct sensor location. Air movement by fans, prevailing winds and convection should be carefully evaluated to determine if a leak is more likely to raise gas levels in certain areas within the facility. Vapor density of a gas determines if it will rise or fall in air when there are no significant currents. Lighter than air gases should have the monitors mounted 12-18 inches (30-45 centimeters) above the potential gas leak and heavier than air gases should be the same distance below the point of leakage. Even though the GDX-350 is designed for rugged service, sensors should be protected from water, snow, shock, vibration, and dirt.

2.2. Mounting the Enclosure

2.2.1 Stand-alone and Wired Networks

The GDX-350 standard enclosure is a cast aluminum explosion-proof (NEMA 7) enclosure as shown in Figure 2-1.

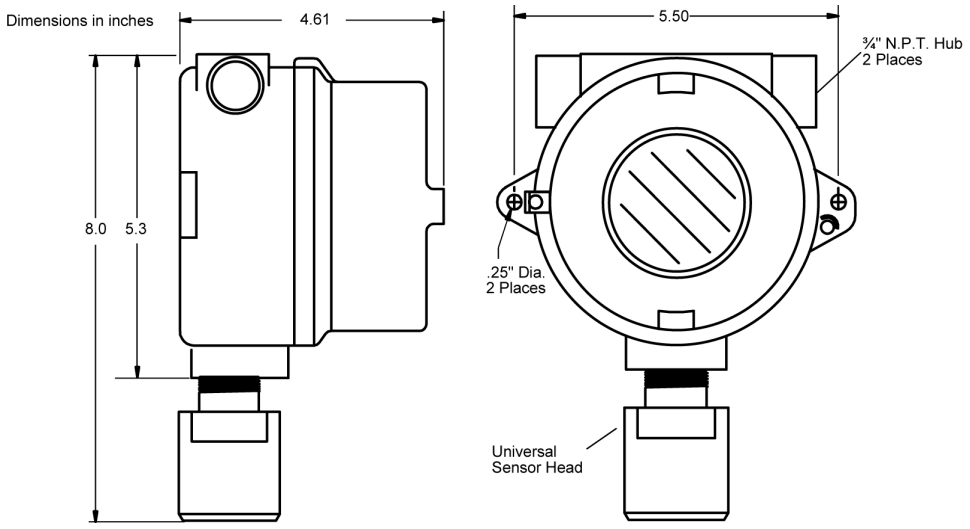

Figure 2-1: GDX-350 Explosion-Proof Housing

Modular design simplifies the installation of the GDX-350. A top Display Assembly is mounted with captive thumbscrews and is easily removed to access field-wiring terminals. An optional Alarms/Modbus board (P/N 5600-0007) mounts *piggyback* to the back of the Display Assembly. The enclosure is equipped with two threaded, 3/4 inch NPT conduit fitting outlet and pre-drilled mounting flanges.

WARNING: Qualified personnel should perform the installation according to applicable electrical codes, regulations and safety standards. Insure that correct cabling and seal fitting practices are implemented. Install the GDX-350 to a wall or bracket using the predrilled mounting flanges with I.D. 0.25 on 5.5 inch centers (Figure 2-1). If conduit is rigid and able to support the weight of the GDX-350, the mounting bolts may be omitted.

WARNING: The sensor should never be installed pointing upwards.

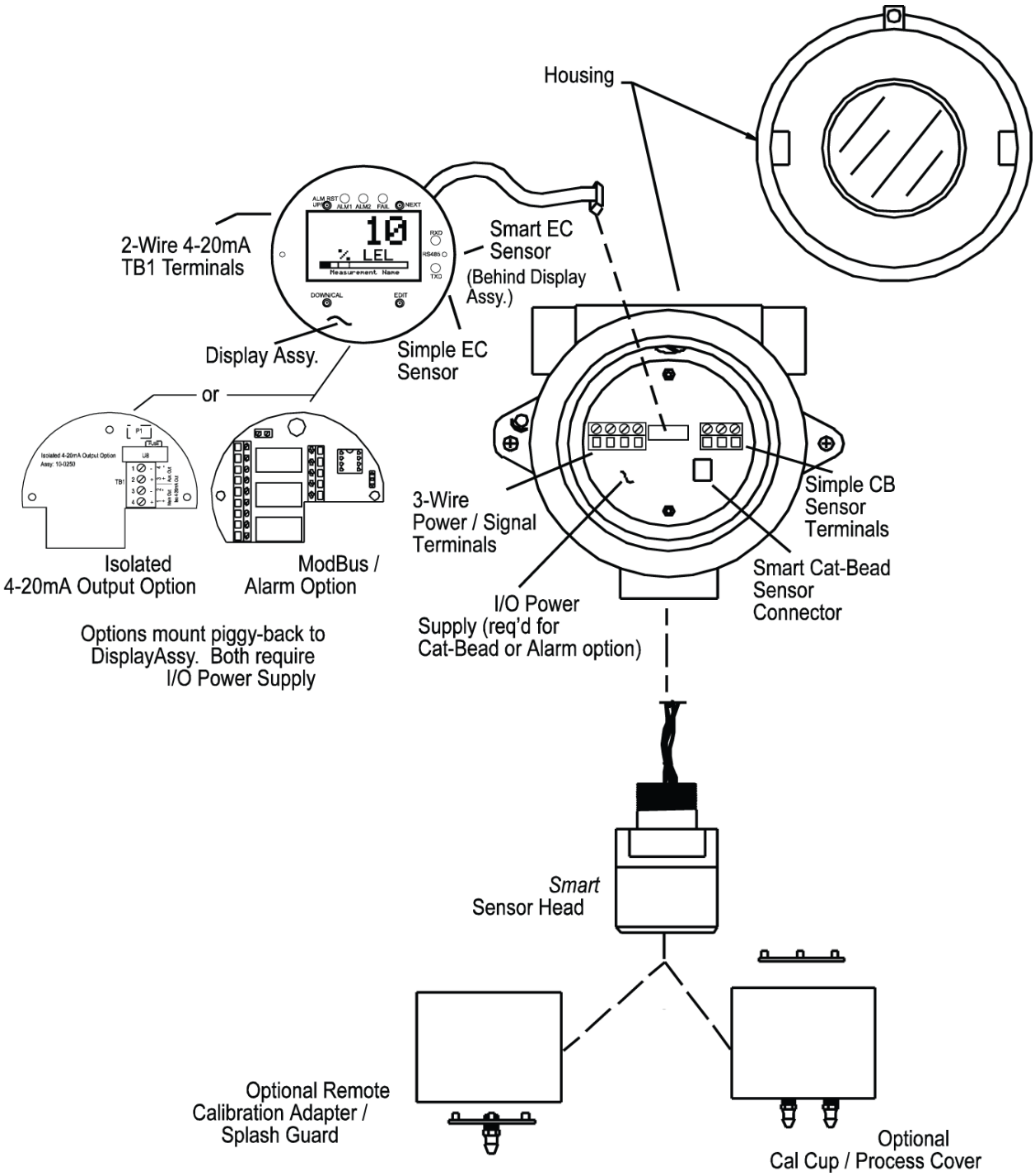

Figure 2-2: Outline Drawing (Stand-alone and Wired Version)

2.2.2 RF Wireless Networks

The standard enclosure for the RF version of the GDX-350 is a cast aluminum explosion-proof (NEMA 7) enclosure as shown in Figure 2-3. Modular design simplifies the installation. The RF antenna should typically be mounted with "line of site" access to the controller's base station antenna. If a good "line of site" angle is not possible the GDX-350s will usually still function properly at ranges up to 1500 feet, but obstructions should be kept to a minimum.

WARNING: Qualified personnel should perform the installation according to applicable electrical codes, regulations and safety standards. Ensure correct cabling and sealing fitting practices are implemented. Install the GDX-350 to a wall or bracket using the predrilled mounting flanges with I.D. 0.25 on 5.0 inch centers (Figure 2-3).

CAUTION: The sensor head (not shown in Figure 2-3) should never be installed pointing upwards.

The RF enclosure is NRTL certified for Division 1 hazardous area installations for explosion-proof Class 1 Groups B,C,D (see Figure 2-3). The RF version of the GDX-350 is designed to meet ISA 92.0.01 Part 1 for Toxic Monitors. The standard RF antenna fitting has an RP-SMA connector and is suitable for Division 2 classified areas. An optional antenna is also available for Division 1 classified areas. Figure 2-4 shows both antenna styles.

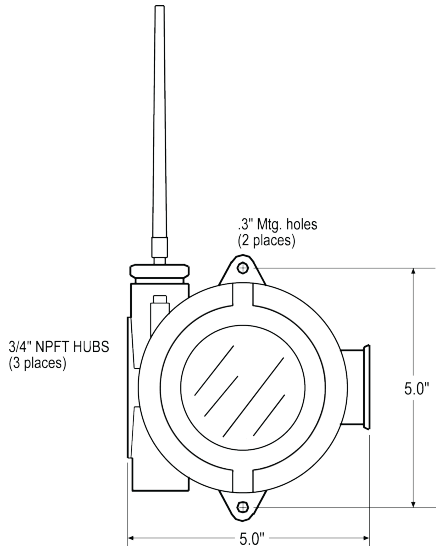

Figure 2-3: GDX-350 (RF Version) with Explosion Proof Housing

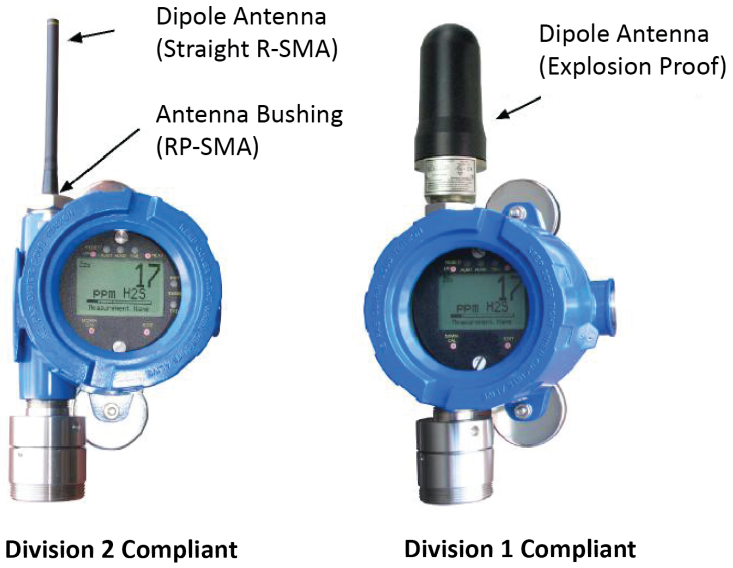

Figure 2-4: Local Antennas (900MHZ Shown)

Bacharach offers a square aluminum plate, with a magnet on each corner, to bolt to the back of the GDX-350's instrument enclosure. The Magnetic Mount securely attaches the assembly to solid steel structure that is at least 6 inches wide.

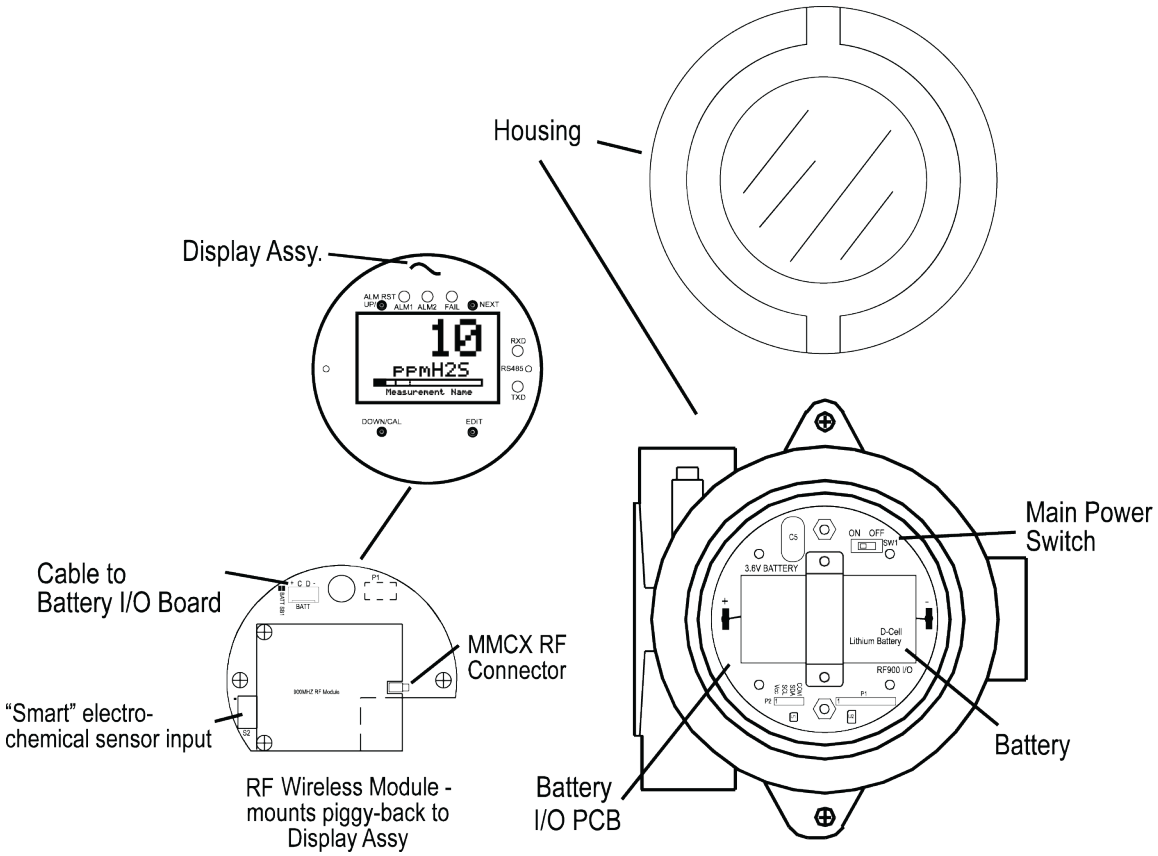

Figure 2-5: Outline Drawing (RF Network Version)

2.3. Transmission Range: 4-20mA Signals

The distance 4-20 mA signals can travel is dependent upon several factors including the cable gauge, DC power supply voltage level and input impedance of the receiving device.

Note: GDX-350 Controllers have 4-20 mA input resistance of 100 ohms.

2.4. Transmission Range: RF Antenna Signals

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

Distance Between Antennas	Fresnel Zone Diameter	Freespace Loss (dB)
1000 ft (300 m)	16 ft (4.9 m)	81
1 Mile (1.6 km)	32 ft (9.7 m)	96
5 miles (8 km)	68 ft (20.7 m)	110
10 miles (16 km)	95 ft (29 m)	116

Example:

The RF radio modem has the following parameters:

- Maximum RF TX power setting = 30 dBm (1 Watt)
- RF RX sensitivity = -100 dBm (this is a constant)
- Antenna gain (standard equipped dipole) = 2.1dBi x 2 = 4.2dBi

So the system operating margin is:**30 - (-100) + 4.2 = 134.2 dBm**

This is enough to transmit 10 miles if freespace was the only loss in the system. For this to be the case, the antennas must be mounted with a combined height greater than 95 ft above all obstructions (including the ground) to keep the Fresnel zone clear. In practice however, there are many losses in the system besides just freespace and it is recommended there be at least 20dB extra system operating margin.

RF "Rules of Thumb":

- Doubling the range with good RF "Line of Site" (LOS) requires an increase of 6 dB.
- Doubling the range without good RF LOS requires an increase of 12 dB.

2.5. Antenna Selection and Location

A site survey using an RF spectrum analyzer and test radios is highly recommended.

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

Most installations utilize locally mounted dipole antennas as shown in Figure 2-6. An option is available for a 6 foot riser to increase the height of the antenna 6 feet above the GDX-350. Extreme cases may require special order of directional antennas mounted in such a way to allow aiming towards the base station antenna. Minimize obstructions between the GDX-350 and the base station antenna.

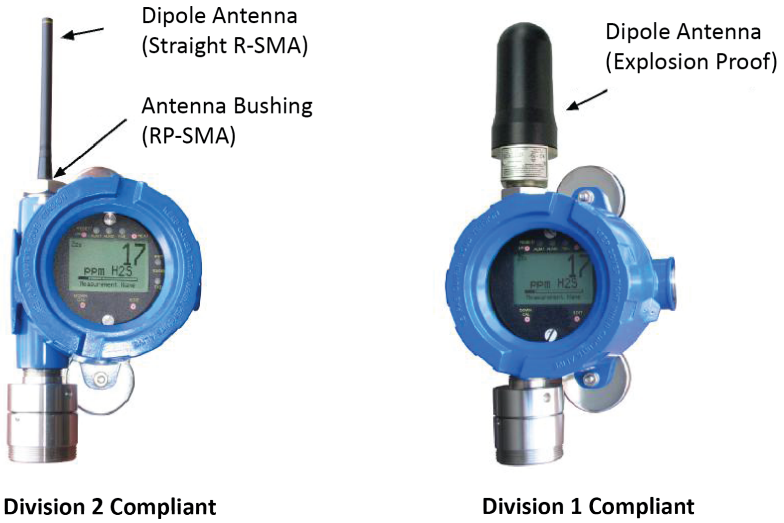

Figure 2-6: Local Antennas (900MHZ Shown)

2.6. Water Proofing Antenna Connection

Waterproof all outdoor coax connectors using a three layer sealing process of initial layer of adhesive PVC tape, followed by a second layer of self-vulcanizing weatherproofing tape such as 3M 23, with a final layer of adhesive PVC tape (see Figure 2-7).

Figure 2-7: Water Proofing Antenna Connections

2.7. System Grounding

Direct grounding of the GDX-350 enclosure via a good electrical connection to a well designed grounding system is essential. This will protect your system, reduce the damage that can occur during lightning strikes and reduce noise.

2.8. 3-Wire 4-20 mA Mode Installation

WARNING: GDX-350s equipped with the I/O Power Supply board (P/N 5600-0006) only operate as 3 or 4-wire 4-20 mA transmitters and are not compatible with 2-wire intrinsically-safe installations. Such units should not be combined with IS Sensor Heads without flame arrestors unless the area is classified as non-hazardous.

GDX-350s equipped with the I/O Power Supply (P/N 5600-0006) and Alarms/Modbus option (P/N 5600-0007) are NRTL certified as suitable for Div 1 and 2 Groups B, C, and D explosion proof installations with the IS Sensor Head or with any sensor head with an equivalent CSA certification.

3-wire sourcing transmitters require an additional dedicated 24 VDC wire. The 4-20 mA loop current is then delivered, or sourced, from the transmitter output and the receiver device must not provide 24 VDC from its input terminal. When the GDX-350 is equipped with the bottom I/O Power Supply board (P/N 5600-0006) shown in Figure 2-8, the 2-wire 4-20 mA output is disabled and one of the boards' 3-wire outputs must be used. TB2 terminal 2 is for ECHEM toxic/oxygen 3-wire 4-20 mA output signals while the TB2 terminal 3 is for LEL 3-wire 4-20 mA output signals.

STEP	3-WIRE 4-20 mA MODE INSTALLATION
1.	Unscrew the cover on the GDX-350 explosion-proof enclosure.
2.	Loosen the 2 thumbscrews holding the display assembly in place and remove it (refer to Figure 2-8). A small ribbon cable is attached with sufficient length to allow access to the I/O PCB mounted in the bottom of the enclosure.
3.	Power and signal connections are to TB2 where 24 VDC, Signal and Common wires must be connected. A blocking diode protects the GDX-350 if polarity of the power supply is reversed, but it will not operate.
4.	Reassemble the GDX-350. Follow the procedures and recommendations in the receiver and power supply manuals to complete the installation.
5.	Be sure the GDX-350 enclosure and conduit are properly grounded. Apply power and observe that the GDX-350 functions.

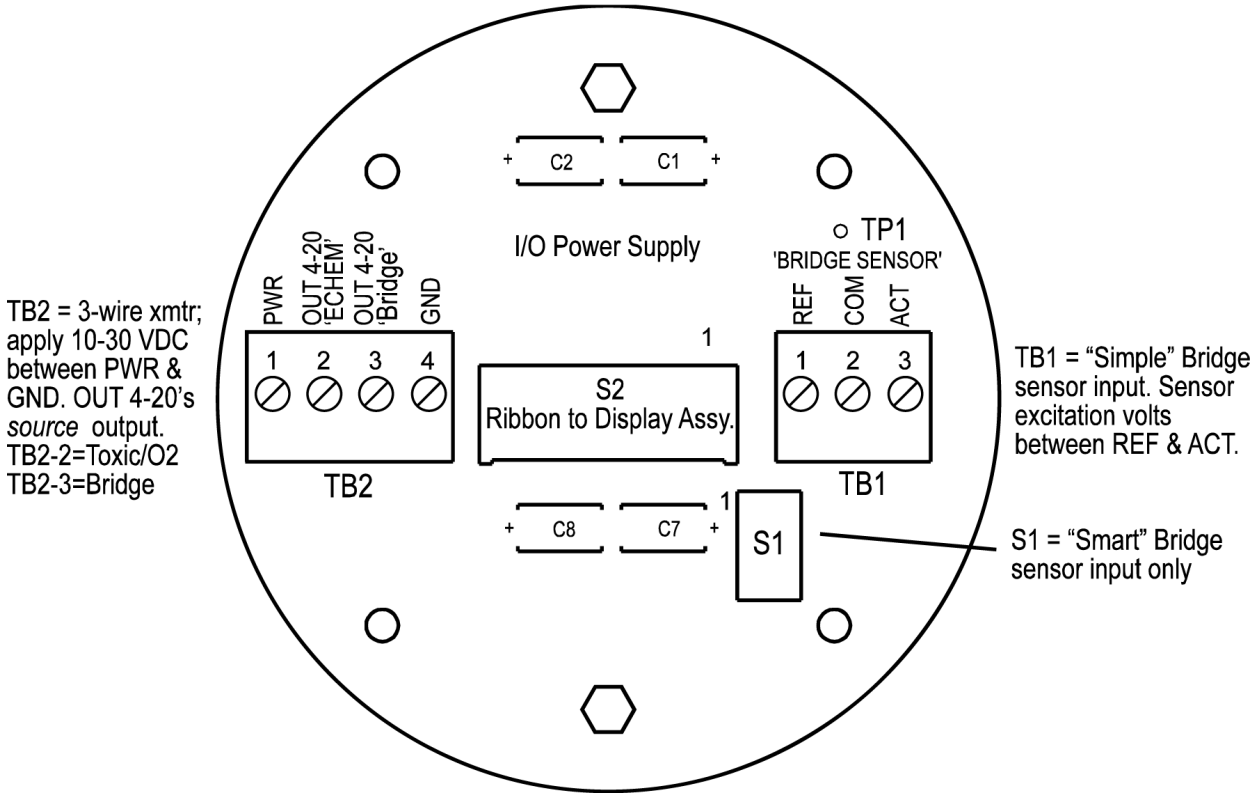

Figure 2-8: 5600-0006 I/O Power Supply/3-Wire 4-20 mA Assembly

2.9. Alarms/RS-485 Modbus Option Installation

The optional Alarms/RS-485 Modbus board (P/N 5600-0007) supplies two level alarm relays: a FAULT relay and an RS-485 Modbus RTU slave port (Figure 2-9). This board is "piggybacked" behind the Display Assembly (P/N 5600-0005) as shown in Figure 2-8. Addition of this option requires 3-wire mode, 4-20 mA operation and thereby requires the I/O Power Supply board (P/N 5600-0006) (Figure 2-8). This is because relays and RS-485 circuits require much more power than 2-wire 4-20 mA loops can deliver.

CAUTION: Alarm relays have dry contacts and power must be supplied from an external source. Contacts are rated for RESISTIVE loads. Inductive loads, such as contactor coils or motors, may cause contact arcing, which shortens life and emits RFI into the sensor signals. Use appropriate arcing snubbers and MOVs across inductive loads and keep wiring away from signal wires. External wiring to TB3 (Remote Alarm Reset) should be shielded and protected from noise spikes to prevent false Alarm Reset.

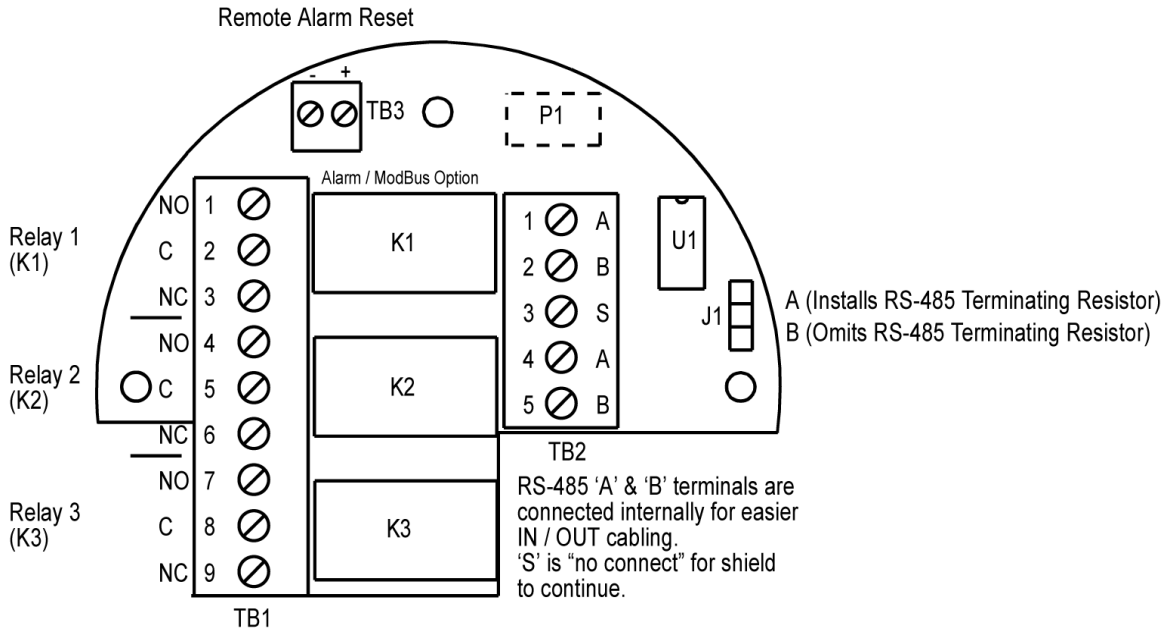

Figure 2-9: Alarm Relays/Modbus Option (P/N 5600-0007)

STEP	Alarms/RS-485 Modbus Option Installation
1.	Unscrew the cover on the GDX-350 explosion-proof enclosure.
2.	Loosen the two thumbscrews holding the display assembly in place and remove.
3.	A small ribbon cable is attached with sufficient length to access the back of the Display assembly where the Alarms/RS-485 Modbus board option is located. It is possible to use only relays, only RS-485, or both. Relay terminals are labeled NO (normally open), NC (normally closed) and C (common, or the pole). These designators correspond to the shelf, or de-energized, state of the relays. The FAULT relay is always failsafe, meaning it is energized when there is not a fault condition and therefore its action is reverse of the designators.
4.	RS-485 Modbus networks should be wired as shown in Figure 2-10. Each GDX-350 connected represents an RTU and must have a unique RTU address. RTU addresses are assigned in the Modbus setup menu described in Section 5.14 on page 44.
5.	Cabling must be a "daisy chain" as opposed to a "star" pattern for reliable operation.
6.	The "end of line" unit should have J1 installed in the 'A' position for terminating resistor installation. All others should have J1 in the 'B' position. **NOTE:** Front panel Rx/Tx LEDs are helpful troubleshooting tools.

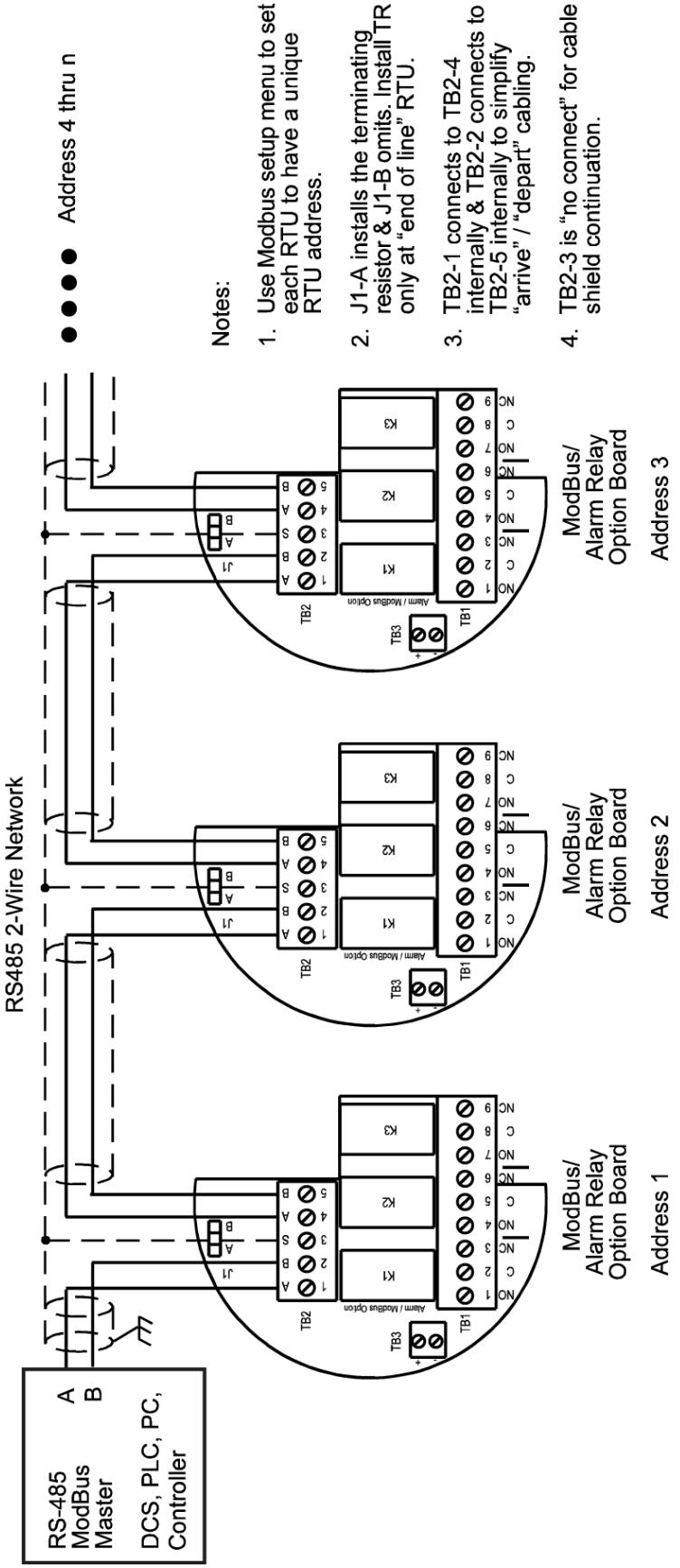

Figure 2-10: RS-485 Modbus Wiring

2.10. Isolated 4-20 mA Output Option

The optional Isolated 4-20 mA option (P/N 5600-0009) as shown in Figure 2-11 provides dual 4-20 mA outputs that are electrically isolated from sensor inputs and the 24 VDC power source. Each 4-20 mA output shares the same common terminal and are not isolated from one another. This board is "piggybacked" behind the Display Assembly (P/N 5600-0005) as seen in Figure 2-2. Addition of this option requires 4-wire mode 4-20 mA operation and thereby requires the use of an I/O Power Supply board (Figure 2-8).

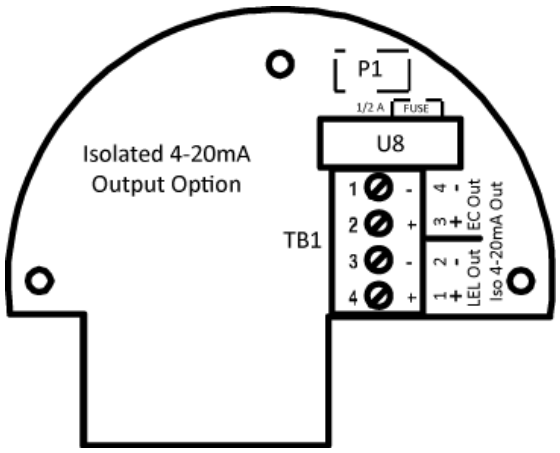

Figure 2-11: Isolated 4-20 mA Output Option (P/N 5600-0009)

2.11. Sensor Installation

The GDX-350 *Smart Sensor* interface uses proven electrochemical technology for toxic/oxygen and catalytic bead for LEL. In addition, a tiny memory IC is incorporated into GDX-350 factory supplied Smart sensors allowing them to contain the entire database of GDX-350 parameters onboard the replaceable Smart Sensor assembly (Figure 2-12).

Electrochemical and catalytic bead smart sensors both plug into the ***Smart Sensor Head*** that connects to GDX-350 electronics with its 8-conductor Smart Sensor Interface cable (Figure 2-12).

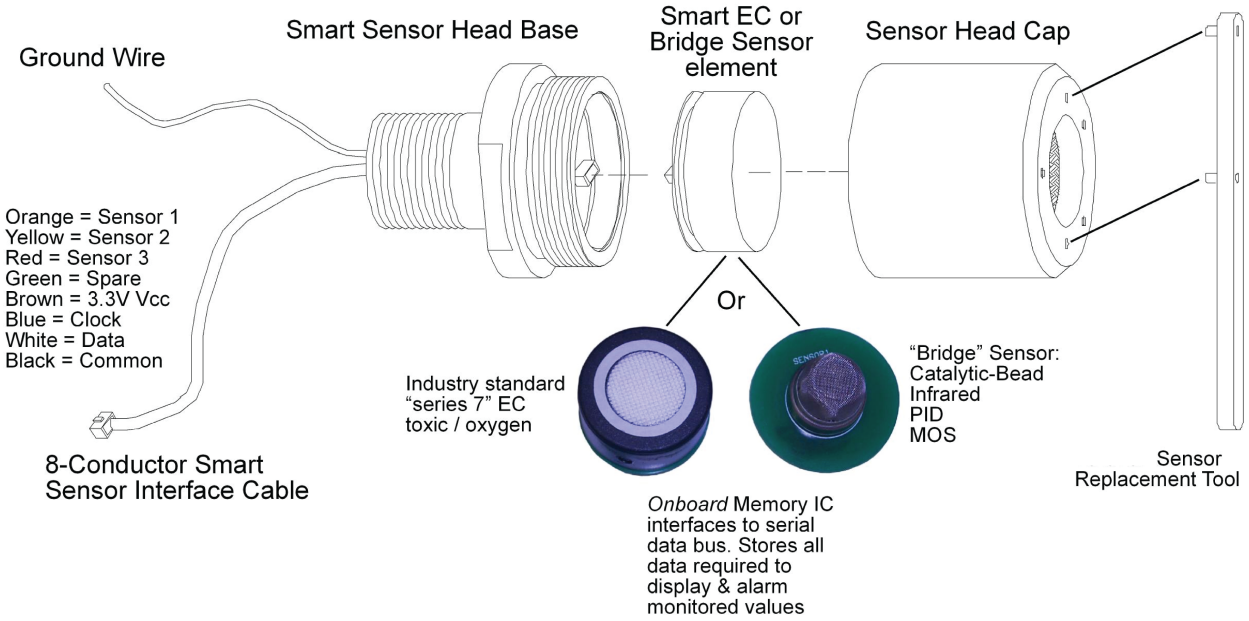

Figure 2-12: Smart Sensor Head Assembly

CAUTION: Smart sensor heads with electrochemical toxic/oxygen sensors must connect to S1 located on the back of the Display Assembly (P/N 5600-0005) as seen in Figure 2-2. Smart sensor heads with catalytic bead combustible sensors must connect to S1 located on the optional I/O PCB assembly (Figure 2-8).

Smart Sensors are automatically recognized by the GDX-350. The Smart Sensor identification screen in Figure 2-13 is shown after power-up, upon installation of a new smart sensor or by viewing INPUT type in the SENSOR SETTINGS/INFO menu in Section 5.6 on page 39.

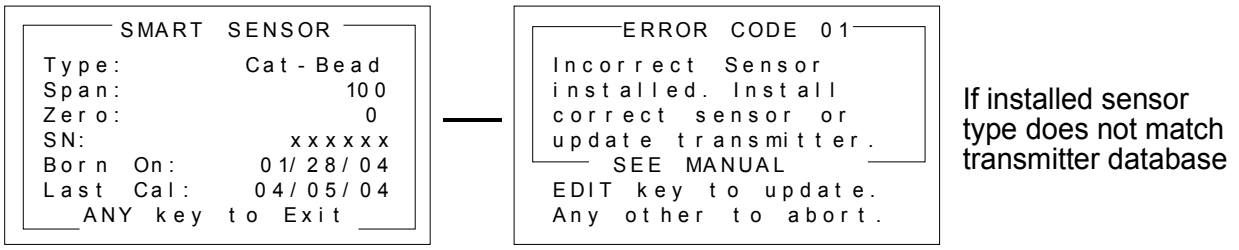

Figure 2-13: Smart Sensor Info/ERROR Screens

3. INITIAL START-UP

3.1. Model Name

When power is applied to the GDX-350 it will briefly show a 10-digit ASCII model and company name during start-up. The name can be edited in the Transmitter Configuration menu by editing the **Model** field.

Figure 3-1 shows how to access the menu for setting the 10-digit ASCII model name which is displayed briefly after power is applied to the GDX-350 (RF shown). To access from any data display, press and hold the NEXT key for 5-seconds until the screen appears requesting a special key sequence (4-UP keystrokes).

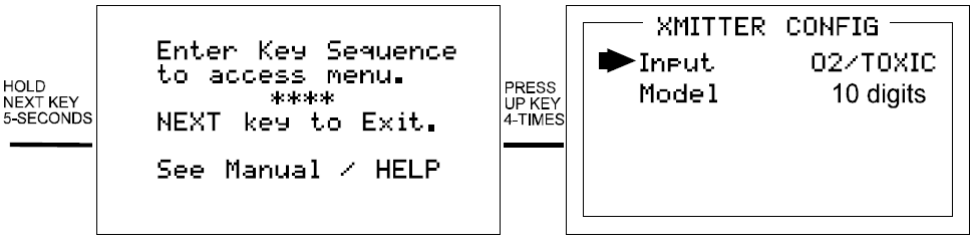

Figure 3-1: Transmitter Configuration Menu

3.2. Initial Toxic/Oxygen Sensor Monitor Start-Up

GDX-350 Toxic/Oxygen Monitors, which are factory equipped with a local Simple or Smart electrochemical sensor, rarely require adjustments (other than routine calibrations) to provide accurate readings. However, after installation the following check should be performed to ensure proper operation. In addition, alarm levels, Measurement Name ASCII fields and other variables may require attention by users in order to best serve their application.

3.3. Initial Toxic/Oxygen Sensor Monitor "Span" Check

Prior to the initial *Routine Sensor Calibration* described in Section 4.1 on page 29, a coarse SPAN gas reading verification (or *bump test*) should be performed after installation. Apply an upscale gas value of at least 25% of full scale to the sensor. For example, if 0-100 ppm H_2S is the measurement range, apply at least 25 ppm, but not more than 100 ppm. Remember that this is only a coarse check and precision calibrations are performed in *Routine Sensor Calibrations* described in the following Section 4.1.

4. OPERATING INSTRUCTIONS

4.1. Routine Sensor Calibrations

Calibration is the most important function for ensuring correct operation of the GDX-350. The CAL MODE (flow chart shown in Figure 4-2) is designed to make calibration quick, easy and error free.

The 4-20 mA output indicates CAL MODE by transmitting 1.5 mA for 3-wire installations. It then transmits 4 mA during the subsequent CAL PURGE delay to prevent external alarms during calibration. Local GDX-350 alarm relays (if equipped) are inhibited during CAL MODE. CAL MODE automatically exits if no keystrokes are detected after 5 minutes.

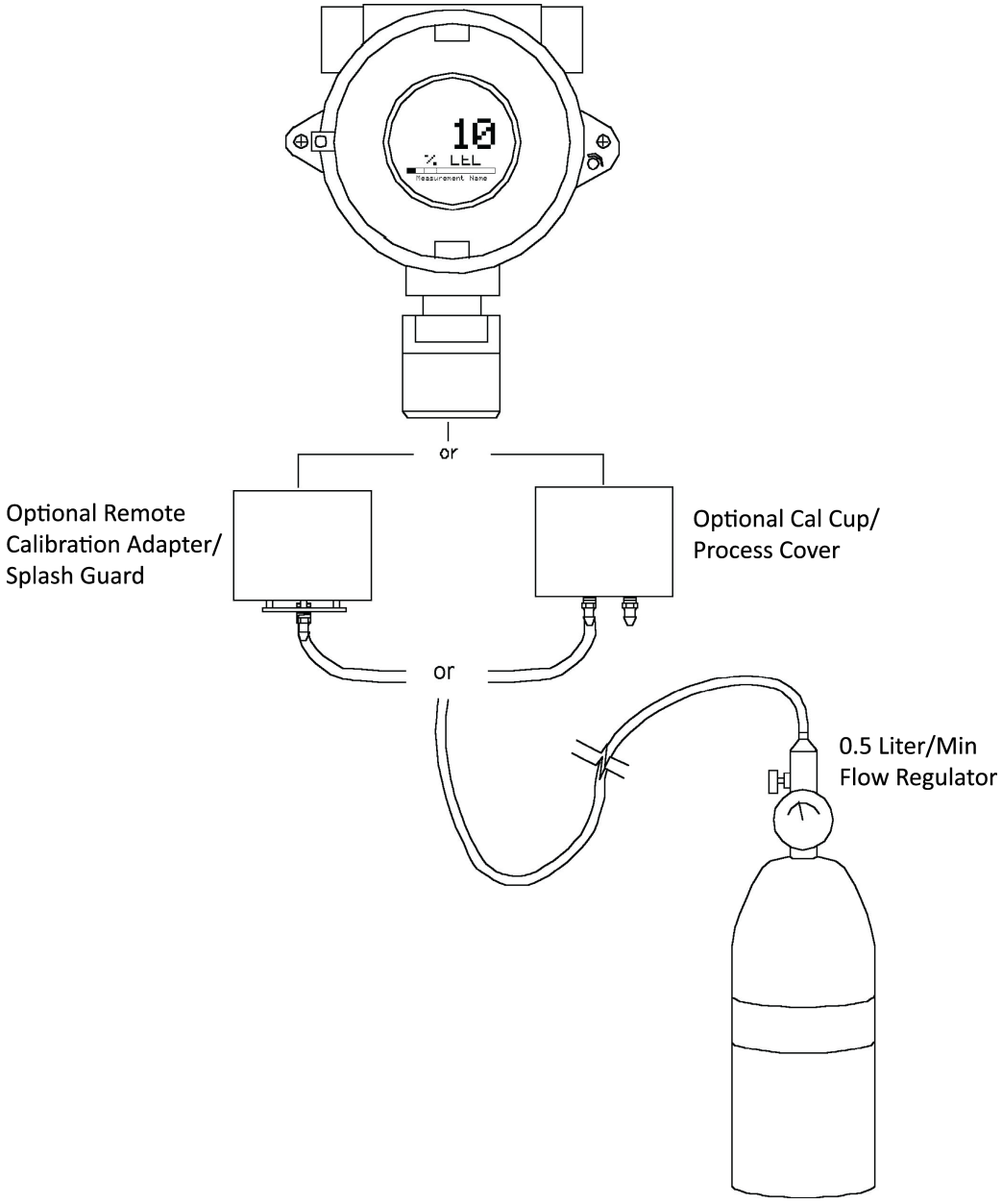

Figure 4-1: Calibration Gas Input

Follow these GDX-350 calibration guidelines:

- Calibration accuracy is only as good as the calibration gas accuracy. Bacharach, Inc. recommends calibration gases with NIST (National Institute of Standards and Technology) traceable accuracy to increase the validity of the calibration.
- Do not use a gas cylinder beyond its expiration date.
- Calibrate a new sensor before use.
- Allow the sensor to stabilize before starting calibration (approximately 5 minutes).
- Calibrate on a regular basis. (Bacharach, Inc. recommends once every 3 months, depending on use and sensor exposure to poisons and contaminants.)
- Calibrate only in a clean atmosphere, which is free of background gas.

Use the following step-by-step procedure to perform ZERO and SPAN calibrations.

The flow chart in Figure 4-2 illustrates the following procedure. UP, CAL, NEXT and EDIT labels indicate keystrokes using the magnetic wand. The CAL MODE information screen (located on the top of the chart) is available for advanced users to see Offset/Gain calibration constants and live analog to digital converter (A/D) counts. Span Gas calibration values may also be edited from this screen. Holding the UP key for 5 seconds during CAL MODE displays this screen.

Calibration history records are logged and may be viewed in the *Sensor Information* menu (see Section 5.6 on page 39).

Step	ZERO and SPAN Calibrations
1.	To enter the CAL MODE from either of the data displays, press the DOWN/CAL key and within 5 seconds press the EDIT key.
2.	Using the Cal-Cup, apply a clean ZERO gas or be sure there is no background target gas in the monitored area. After the reading is stable, (approximately 1 minute) press the EDIT key to perform a ZERO calibration.
3.	If the ZERO calibration is successful, press the NEXT key to proceed to the SPAN check. Once ZERO CAL is successful, the unit automatically proceeds to SPAN CHECK. If NEXT is pressed now, it will exit the CAL routine. However, if NEXT is pressed when first in CAL, it will skip ZERO CAL and go to SPAN CHECK.
4.	Apply the **correct** SPAN gas at 0.5 liters/min. After the reading is stable (approximately 1 minute), press the EDIT key to perform a SPAN calibration. **WARNING:** The SPAN gas used must match the value specified since this is what the GDX-350 will indicate after a successful SPAN calibration. The Cal Span Value may be edited if it becomes necessary to apply a different gas concentration (see Cal Span Value in Section 5.3 on page 35).
5.	Once the SPAN calibration is successful, the display flashes “REMOVE CAL GAS” and starts the CAL PURGE delay.
6.	CAL MODE will be complete after the end of the CAL PURGE delay.

4.2. Alarm Operation

GDX-350s have front panel LED indicators for Alarm 1, Alarm 2 and Alarm 3. An optional Relay/Modbus board (P/N 5600-0007) adds K1, K2, and K3 relays for these alarms.

CAUTION: GDX-350 Alarm LED indicators function even without the presence of the 5600-0007 Relay option. With 3-Wire 4-20 mA operation, alarm LEDs flash when new and becomes steady after the operator selects ACKNOWLEDGE by pressing the UP/RESET key.

4.3. Alarm 3 – Understanding Fault/Level Operation

The "A3" alarm is typically dedicated to FAULT conditions indicating sensor failures or "out of measurement range" conditions. However, some applications require a third level alarm. The A3 menu is identical to A1 and A2 and may be set to trip at an upscale level value. **A3 will also trip with missing or failed sensors regardless of the level value.**

CAUTION: Missing or failed sensors always trip Alarm 3 and relay K3 (if equipped). This is true even with A3 configured as a level alarm and it must be realized that A3 level alarm events might be caused by the monitored level or by a missing or failed sensor.

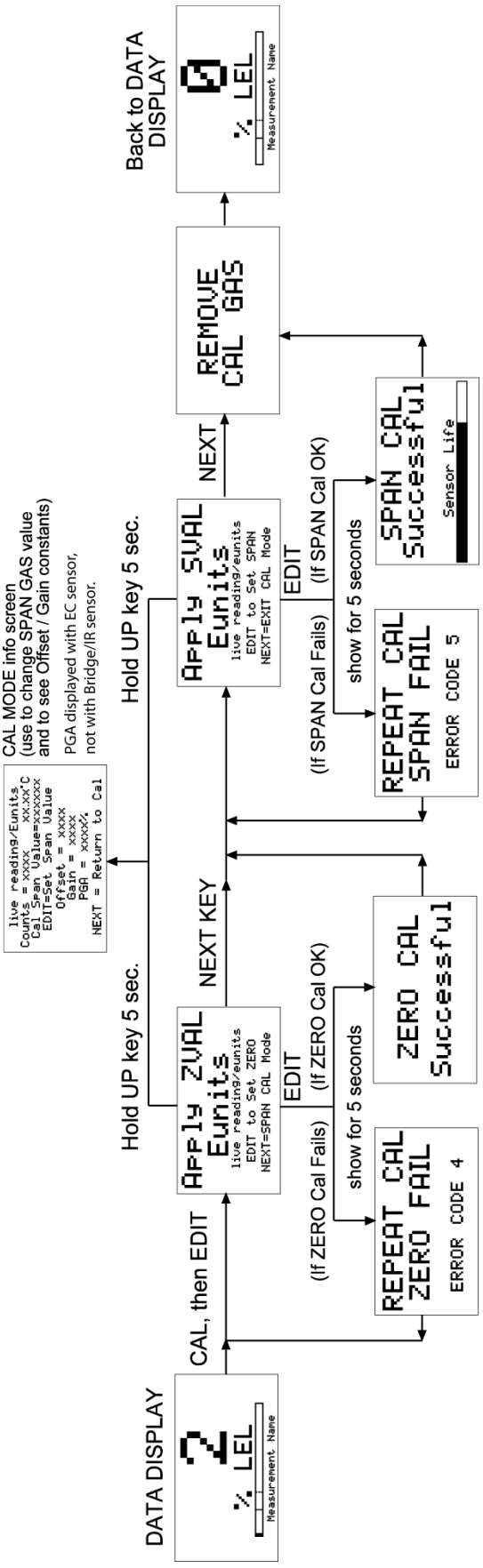

Figure 4-2: Cal-Mode Flow Chart and Menus

5. SETUP MENU CONFIGURATION

5.1. Menus Database Configuration

All GDX-350 configuration variables are stored in its menu database. Many menu items will contain default values from the factory and require changes to better match a user's particular application. GDX-350 menus may be configured from the magnetic keypad.

The GDX-350's configuration menus are shown below.

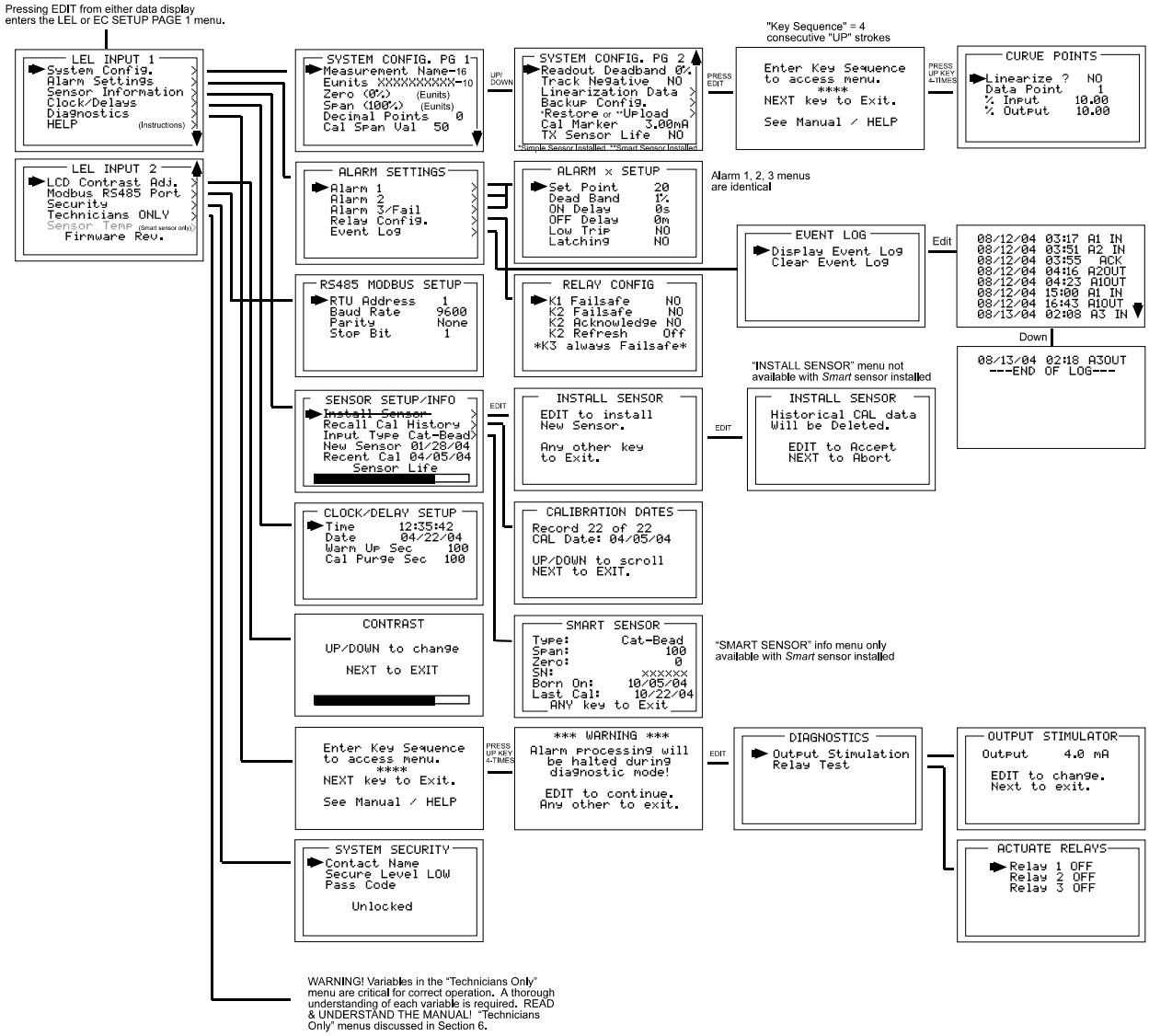

Figure 5-1: Configuration Menu Tree

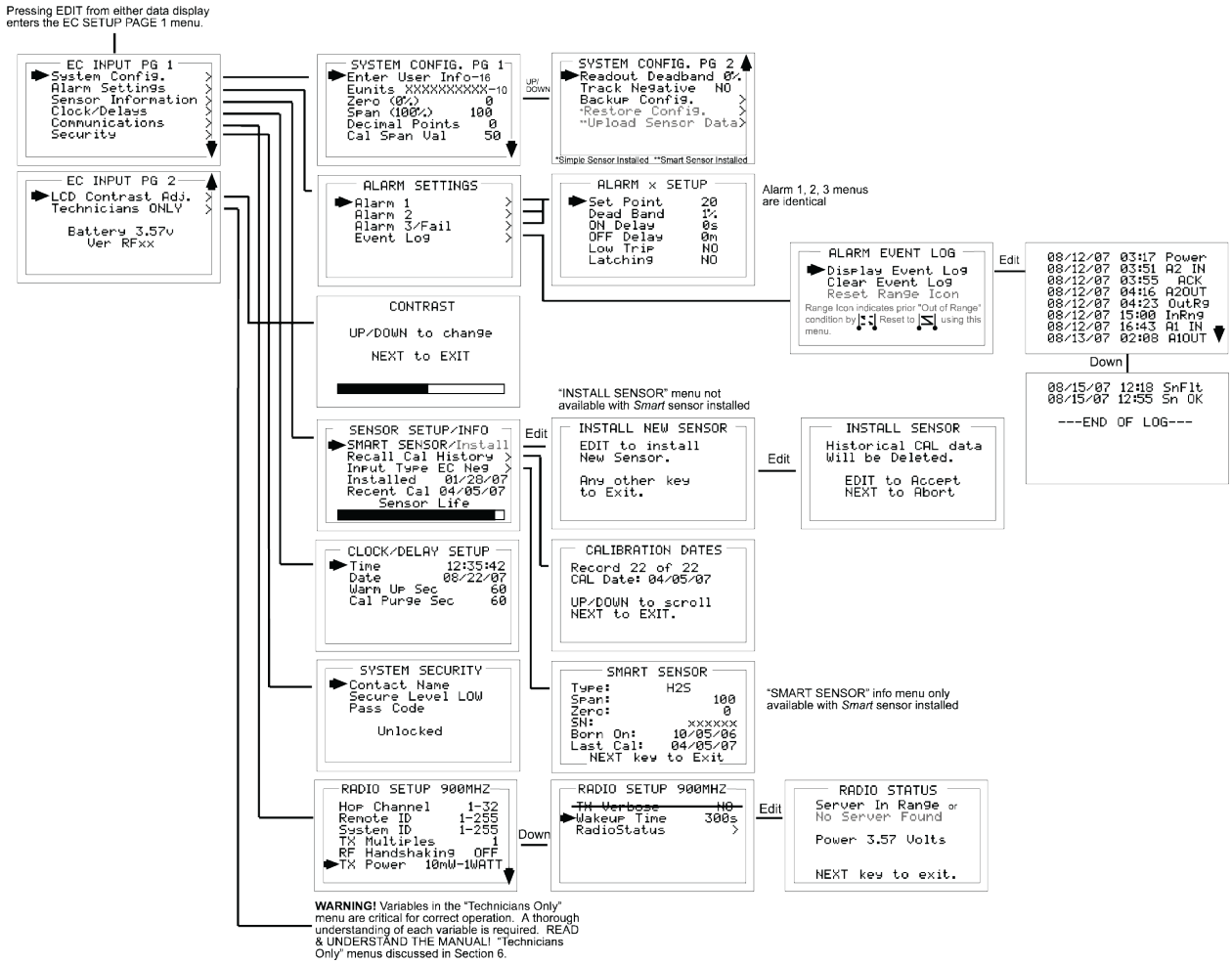

Figure 5-2: Configuration Menu Tree (RF Model)

5.2. Configuration Using the Magnetic Wand

Passing the magnetic wand past the EDIT key from either data display screen displays SETUP PAGE 1 as shown in Figure 5-3. The UP/DOWN keys maneuver the pointer while EDIT enters sub-levels of menu items. All SETUP menu items have at least one page of sub-menus. Items with sub-menus are indicated by the > symbol (right arrow) at the end of each line. Edit menu items by:

- pointing to them
- pressing the EDIT key to display the cursor
- pressing UP/DOWN to change that character
- pressing NEXT to move the cursor
- pressing EDIT again to load the new item and remove the cursor.

Press NEXT to exit the sub-menu. To view **SETUP PAGE 2**, press the DOWN key with the pointer aimed at the bottom item on PAGE 1.

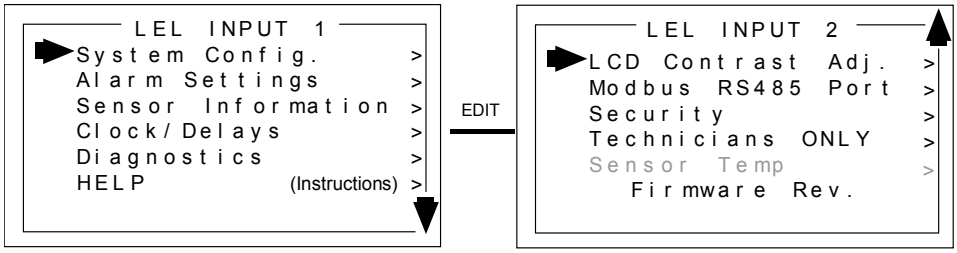

Figure 5-3: Setup Menu Entry

5.3. System Configuration Menus

The **System Config**. group consists of two pages of menus as shown in Figure 5-4. Each item's description follows in this section.

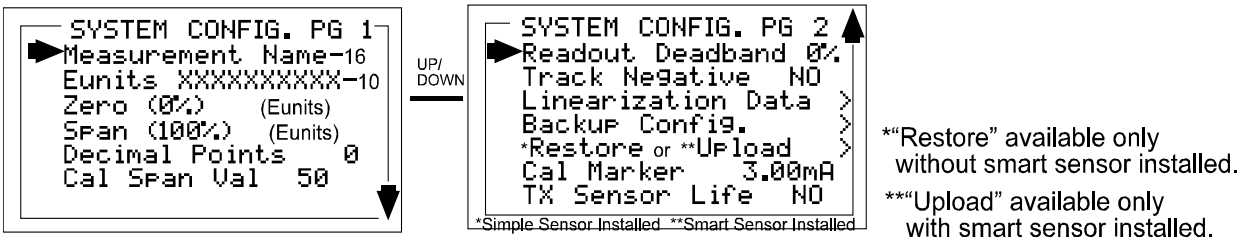

Figure 5-4: System Configuration Menus

Menu Item	Description
Measurement Name	May be edited to contain virtually any 16-character ASCII field. It is typically used to describe the monitored point by user tag # or other familiar terminology.
Eunits	Engineering Units - May have up to a 10 character ASCII field. Many common gases have pre-configured Eunits based upon the sensor type. Each may be edited in this menu as described in Configuration Using the Magnetic Wand in Section 5.2 on page 35.
***Zero* (0%)**	Defines the reading to be displayed when 4 mA (0%) is the GDX-350 output.

Menu Item	Description
***Span* (100%)**	Defines the reading to be displayed when 20 mA (100%) is the GDX-350 output. The highest reading allowed is 9999. Included is a negative polarity sign and one decimal point. Polarity is only indicated for negative readings.
Decimal Points	Sets the resolution of the LCD readings and may be for 0, 1 or 2. Example: ZERO readings for 0, 1, and 2 DPs respectively are 0, 0.0, and 0.00.
Cal Span Value	Sets which upscale value must be applied when performing Span calibrations.
Readout Deadband	Allows for forcing of low values to continue to read zero. This is useful when there are small amounts of background gases that cause fluctuating readouts above zero. The highest amount of deadband allowed is 5%. The 4-20 mA output is not affected by this menu item.
Track Negative	(Default set to NO) Causes negative values to read the **Zero (0%)** value in data displays. The CAL MODE readout displays negative values regardless of this setting and negative values below the Fault set point will still cause the Fault alarm to trip. The 4-20 mA output always locks at 4 mA when the reading is negative.
Linearization Data	Allows nonlinear signals to be linearized by entering the correct curve into the GDX-350 (Figure 5-5). If Linearize is set for NO, the CURVE POINTS menu data is not used and no linearization is applied. When YES, the CURVE POINT entries are used and a straight-line approximation is calculated between each of the 9 entries. 0% input always provides 0% output and 100% input always provides 100% output. To prevent accidental data entry a special keystroke sequence of 4 consecutive UP keys is required to enter this menu.

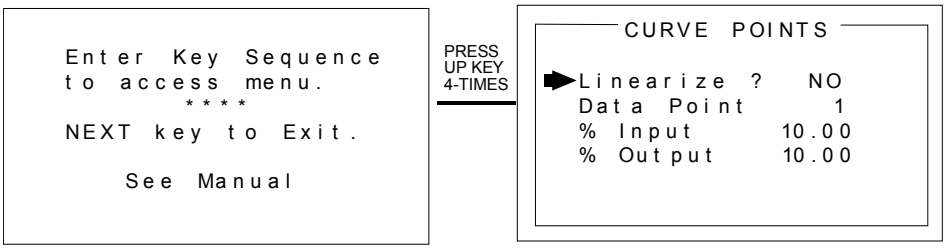

Figure 5-5: Linearization Menu

Menu Item	Description
Backup Config.	Allows users to store the entire, current GDX-350 menu database into non-volatile memory for restoration later, in the case that incorrect values are accidentally entered or uploaded.
Restore Config.	Restores the GDX-350 menu database to the values from the most recent Backup Configuration. This menu item is only available if a smart sensor is not installed. The special keystroke sequence of 4 consecutive UP keys is also required to perform backup and restore operations.
Upload Sensor Data	Allows manual uploading of the entire smart sensor database to the GDX-350 from the smart sensor.
Cal Marker	Allows setting of the 4-20 mA output value during ZERO and SPAN calibrations at a level to prevent alarm trips by calibration values. Three-wire models may be set from 0 to 20 mA.

Menu Item	Description
TX Sensor Life	(Default is set for YES) Causes the GDX-350 4-20 mA output to transmit a sensor life value after successful calibrations during the CAL PURGE delay (see Section 4.1 on page 29). Normal operation is such that the GDX-350 transmits 4 mA during the CAL PURGE delay. But with **TX Sensor Life = YES** it transmits 4 mA for the first 10-seconds, then for 5-seconds transmits a value between 4 mA and 5 mA, with 4 mA equal to 0% sensor life and 5 mA equal to 100% sensor life (see Figure 5-6). The output then returns to 4 mA for the remainder of the CAL PURGE delay. For example, if after a calibration the sensor life is 75%, the GDX-350 transmits 4.75 mA during the 5-second interval.

NOTE: **TX Sensor Life** should always be set for NO unless the 4-20 mA receiver is capable of interpreting the sensor life signal. The Bacharach, Inc. GDX-1600 Controller is capable of this function.

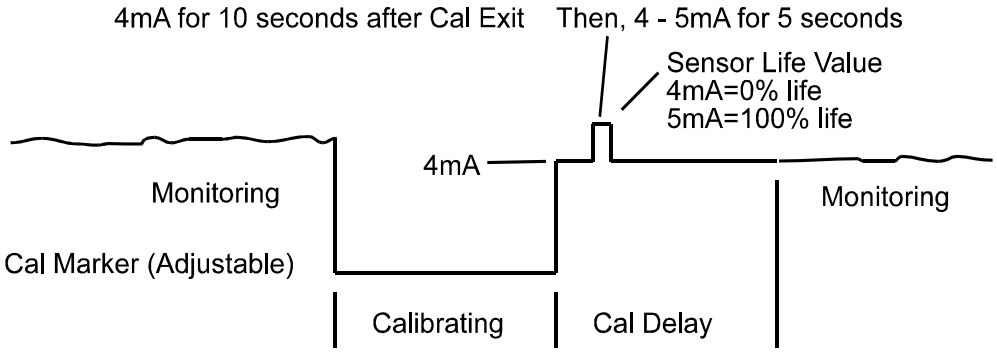

Figure 5-6: Transmit Sensor Life Timing Diagram

5.4. Alarm Settings

The **Alarm Settings** page has the **Alarm 1, 2, 3 Setups, Relays** and **Event Log** submenus shown in Figure 5-7. Alarm 1, Alarm 2 and Alarm 3/Fail menus are identical and therefore described only once in this section.

IMPORTANT: Alarm functions and their associated LEDs are active without the Relay/Modbus (P/N 5600-0007) option installed.

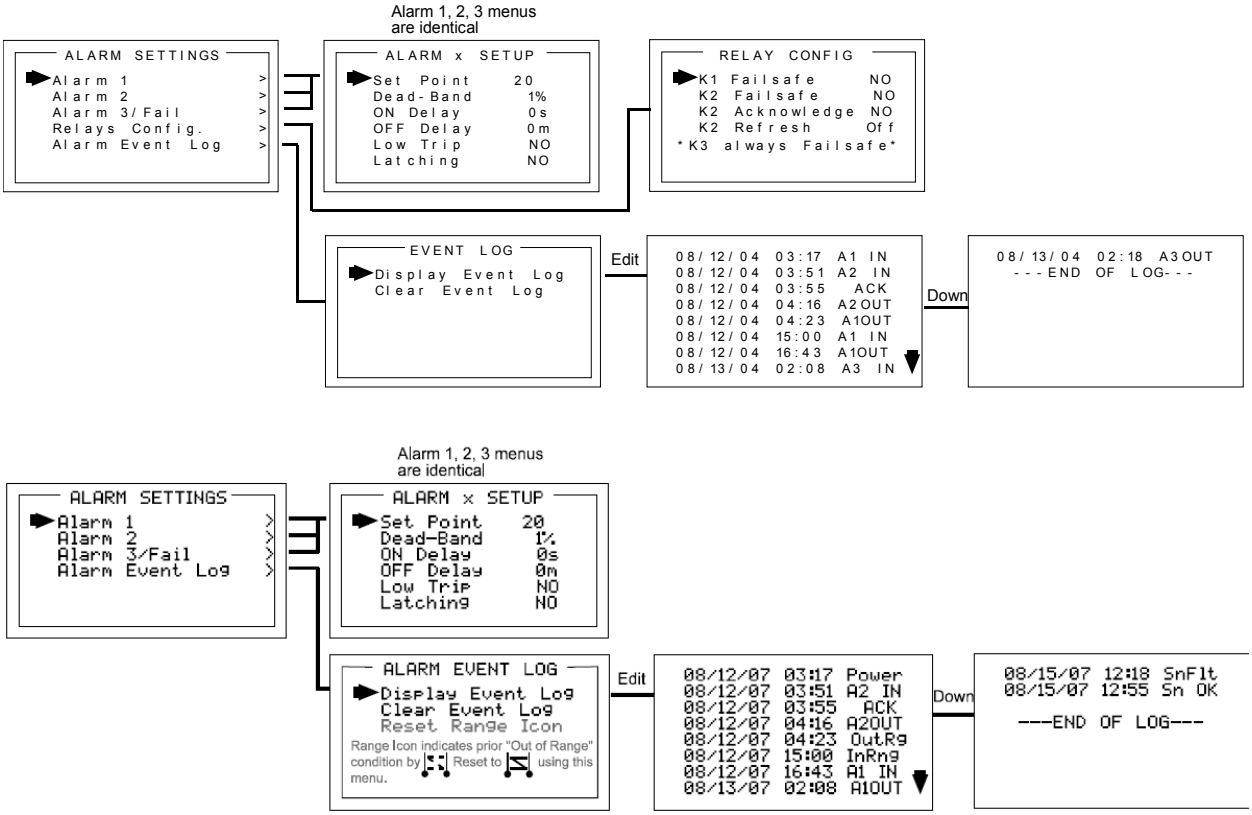

Figure 5-7: Alarm Settings Menus

Menu Item	Description
Set Point	Enters the engineering unit value where the alarm trips. It may be negative and trip when monitored values fall out of range in this direction. A3 has a default negative 5% of range Set Point with Low Trip set for YES. This makes it function as a FAULT alarm and trip when the monitored value is more than 5% "out of range".
Dead-Band	Has a minimum value of 1% and a maximum value of 10%. It is useful for preventing alarm cycling of 0-100 ppm, if Dead-Band equals 5% and the set point is 20 ppm, after tripping at 20 ppm the value must drop below 15 ppm to reset.
ON Delay	Allows entering a maximum 10 second delay before this alarm becomes active. This is useful for preventing nuisance alarms caused by brief spikes beyond the set point.
OFF Delay	Allows entering a maximum 120 minute delay before clearing an alarm after the alarm condition is gone. This is useful for continuing an alarm function, such as operation of an exhaust fan, for a period of time after the alarm condition clears.
Low Trip	(Default set to YES) Causes the alarm to trip as the value falls below the set point.
Latching	(Default set to YES) Causes the alarm to remain active even after the condition is gone and only reset when the UP/RESET key is pressed from a data display.

5.5. Relay Configuration (If Equipped)

Relay Config has the submenu shown in Figure 5-8. The optional relay PCB must be installed to access this menu or a "HARDWARE NOT PRESENT" message appears.

Figure 5-8: Relay Configuration Menu

Menu Item	Description
K1/K2 Failsafe	(Default set for YES) Means that the relay de-energizes during alarm and energizes with no alarm. This is useful for signaling alarm when GDX-350 power is lost. K3 is a FAULT alarm and is always failsafe.
K2 Acknowledge	(Default set for YES) Means that the UP/RESET key (RESET key during either data display) will set K2 to the normal state EVEN when an Alarm 2 condition exists. This is useful for silencing an audible device, driven from K2, during the alarm condition.
K2 Refresh	(Default set for ON) Causes an acknowledged Alarm 2 condition to reactivate K2 if it continues beyond the designated Refresh interval (0-99 minutes). This feature insures against forgotten alarms after an Acknowledge.

5.6. Sensor Information

Sensor Information has the **SENSOR SETUP/INFO** menus shown in Figure 5-9.

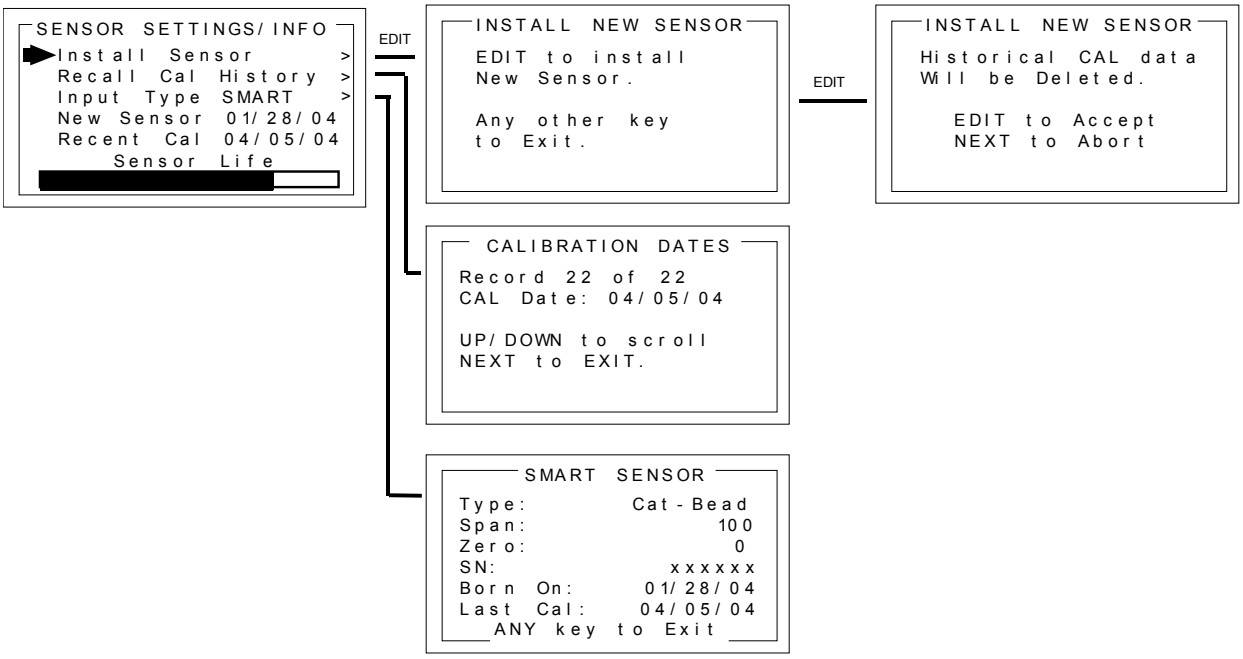

Figure 5-9: Sensor Information Menus

Menu Item	Description
Install New Sensor	Should always be performed when a new *simple* sensor is installed. This deletes historical CAL data and sets sensor life to 100% after initial calibration of the new *simple* sensor. The GDX-350 *Smart* sensor interface will automatically detect new smart sensors and this menu is therefore not available with a smart sensor connected.
Recall Cal History	Recalls each successful calibration. These dates may be reviewed by scrolling with the UP/DOWN keys.
Input Type	Indicates which type of input or sensor the GDX-350 is configured to accept and is pre-configured at the factory. There are four Input Type possibilities consisting of bridge, EC negative, EC positive, and 4-20 mA (all are Smart Sensors). Smart Sensors upload sensor type and other data to the GDX-350 and may be viewed on the SMART SENSOR information screen.
New Sensor	Displays the date when a new sensor was last installed.
Recent Cal	Displays the most recent calibration date.

5.7. Clock/Delay Setup

The GDX-350 is equipped with a Real Time Clock and Calendar **Time** and **Date** and must be set to correctly match its location. They are set at the factory in a 24 hour format but may require adjustment to match the location's time and date after shipment. Follow the procedure in *Configuration Using the Magnetic Wand* in Section 5.2 on page 35.

Warm Up and **Cal Purge** time delays are also available to prevent unwanted alarm trips. Figure 5-10 shows the menu for these items.

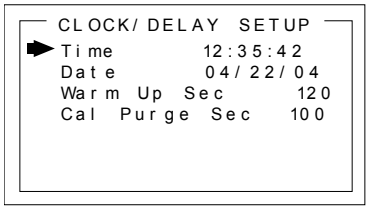

Figure 5-10: Clock and Calendar/Delay Timer Menu

5.8. Communications Setup (RF Communications)

The **Communications** menu provides access to **RADIO SETUP** menus described below. **Hop Channel** and **System ID** settings must match these settings in the Server. **Remote ID** must be unique to each GDX-350. Items tagged with an asterisk affect power consumption and may have significant affects upon battery life.

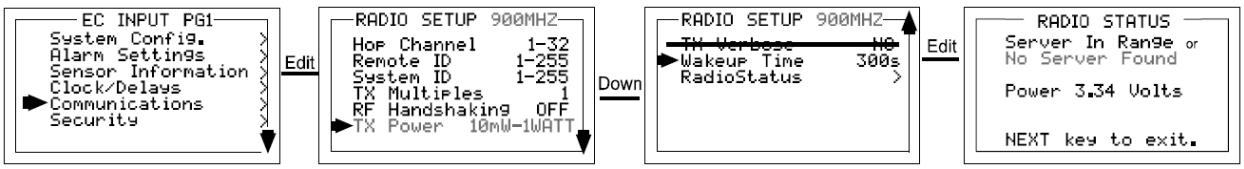

Figure 5-11: Radio Setup Menu

Menu Item	Description
Hop Channel	May be set from 1-32 and assigns the pseudo-random radio frequency hopping pattern. A transceiver will not go In Range of or communicate with a transceiver operating on a different Hop Channel. Different hop channels can be used to prevent radios in one network from listening to transmissions of another. Installations having more than one Server network should also have different hop channels for each network. **2.4GHZ variation: Hop channels on 2.4 GHZ models may be set between 0 and 39. Hop channels 0-19 includes EU "low band" frequencies 2406 – 2435MHZ. Hop channels 20-39 includes EU "high band" frequencies 2444 – 2472MHZ.** **IMPORTANT!! EXPLORE WHAT FREQUENCIES ARE APPROPRIATE FOR THE FINAL LOCATION OF ANY WIRELESS SYSTEM.**
Remote ID	May be set from 1-255 and acts as the "RTU" address for this particular GDX-350. Controller channels receiving this monitor's data must also be configured with this matching Remote ID address.
System ID	May be set from 1-255 and is similar to a password character or network number and makes network eavesdropping more difficult. A transceiver will not go In Range of or communicate with a transceiver operating on a different System ID.
TX Multiples	Allows up to 5 consecutive repeats of EVERY transmission. The default setting of 1 should only be increased if there is no other way to improve communications success. Power consumption increases with radio transmissions and battery life will be affected by raising the TX Multiples setting.
***RF Handshaking**	Affects the way RF transmissions are made by the GDX-350. This menu may be set for **OFF** (default) or **ON**. **OFF** requires no acknowledge from the receiving server. **ON** should be used only when transmitting to a single receiving server (such as a GDA-400 or GDA-1600 Controller). Since **ON** creates an "acknowledge" hand shake returned from the receiver, only one receiver is allowed to avoid data collisions of the "acknowledge" signal. If an "acknowledge" is not received by the GDX-350 it transmits repeatedly up to 16 times. RF HANDSHAKING = **OFF** may be used for any application but is required when transmitting to a Server and other receiver Client radios. RF HANDSHAKING = **ON** always transmits the packet 4 times and does not require any "acknowledge" returned by the receivers.
TX Power	(900MHZ models only) May be set for 10 mW, 200mW, 400mW and 1 watt. Since GDX-350s are battery powered the TX Power setting should be as low as possible to sustain reliable communication. The maximum TX Power setting is 30db (1 watt) and each time TX power is reduced by half, antenna transmit power is reduced by 3dB. **2.4GHZ variation: The TX Power menu is not available in 2.4GHZ models and is fixed at 50mW**.
TX Verbose	Unavailable for firmware revisions 3.09 and earlier.
Wakeup Time	Menu is new to firmware revision 3.09 and determines how often the radio is activated WHEN THERE IS NOT AN A1 or A2 LEVEL ALARM. The default value is 300 seconds (5 minutes) but this may be reduced to as low as 6 seconds. Intervals are rounded up to the nearest 6 seconds regardless of the menu entry (example: 50 second entry transmits every 54 seconds).  **IMPORTANT:** More frequent RF transmissions deplete the battery faster!

Menu Item	Description
Radio Status	Opens another screen that shows if the RF GDX-350 is In Range of the Server and what the battery voltage is. Battery voltage is also displayed on the "EC INPUT PG. 2" screen.
*** TX Multiples**	Menu settings are available to improve communications reliability by increasing the quantity and power of wireless transmissions.
RF Handshaking	
TX Power	**IMPORTANT:** Ensure proper selection and location of antennas before increasing ***TX Multiples*** and ***TX Power*** settings! Battery life will be reduced by increasing these settings. Proper selection and location of antennas contributes much more to successful communications, without sacrificing battery life, than these settings.

5.9. Base Stations

Figure 5-12 shows correct settings for the GDA-1600 base station's "Data From" menu to receive data from RF GDX-350s. Each controller channel's Remote ID must match the GDX-350's Remote ID setting in order for its VALUE to appear on the desired controller channel. The GDX-350 counts value equals 75 counts, or -15.6%, during CAL MODE. Enabling the GDX-350's "INPUT MARKER" menu as shown on the right menu in Figure 5-12 causes the GDA-1600 controller to indicate IN CAL when the GDX-350 has its CAL MODE activated.

Input Req set for VALUE means this GDA-1600 channel reads the GDX-350's monitored gas value. If the **Input Req** menu is set for BATT this GDA-1600 channel reads the battery voltage from the GDX-350 with the same Remote ID. To properly display battery voltage, the GDA-1600's engineering unit range should be 0-5.00 VDC. Even if this channel reads VALUE from the GDX-350, the battery voltage is displayed at the bottom of this GDA-1600 menu as shown in Figure 5-12.

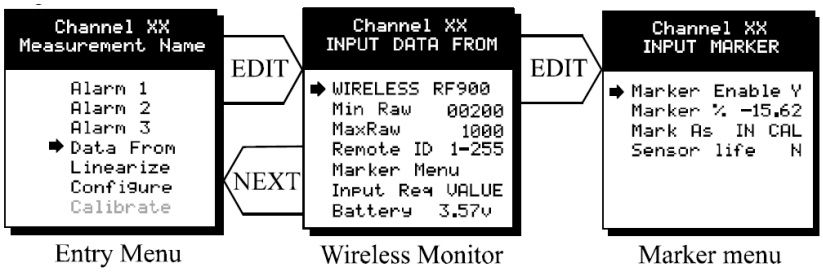

Figure 5-12: GDA-1600 Base Station "Data From" Menu

FIGURES 5-13 and 5-14 show correct settings for a GDA-400 base station to receive data from RF GDX-350s.

Figure 5-13

GDA-400 base stations must have their Communications menus set for Wireless Receiver mode as shown in Figure 5-12. In Receiver mode the GDA-400 may have 1-4 channels configured to receive input data from 1-4 GDX-350 sensor transmitters.

Channel input type is configured in the ANALOG SETUP menu located within the Input/Output Setup menus as shown in Figure 5-13. GDX-350s transmit 200 counts for 0% and 1000 counts for 100% full scale readings so Input Min/Max menu values should be 200 & 1000. The Rmt. Xmitter ID menu entry must match the Remote Id address setting in the GDX-350 providing data to this GDA-400 channel. Voltage level of the 3.6 volt lithium battery in this GDX-350 is also displayed on this screen. The most recent A/D Counts value is displayed at bottom of the screen.

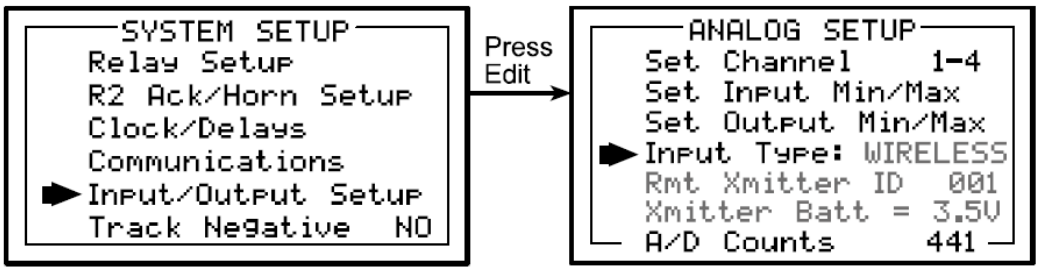

Figure 5-14

5.10. System Security

The **SYSTEM SECURITY** menu in Figure 5-14 offers two levels of protection. A **LOW** level allows CAL MODE sensor calibrations but requires the 4-digit **Pass Code** prior to altering menus. **HIGH** level locks the entire menu database and CAL Mode until the correct **Pass Code** is entered. **LOW** and **HIGH** security levels always allow viewing of configuration menus but they may not be changed. **Contact Name** is a 12 character ASCII field available for displaying a phone # or name of personal who know the **Pass Code**. Lost **Pass Codes** may be recovered by entering the locked security menu and holding the UP key for 5 seconds. The 4-digit code appears near the bottom of the screen.

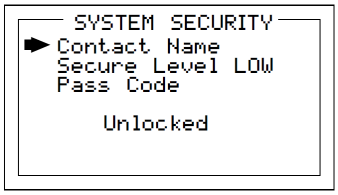

Figure 5-15: System Security Menu

5.11. LCD Contrast Adjustment

LCD Contrast Adj. May be set for optimum viewing using the menu shown in Figure 5-16.

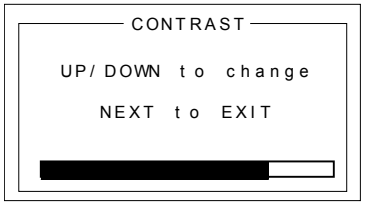

Figure 5-16: LCD Contrast Adjust Menu

5.12. HELP Screen

The **HELP** screen contains several pages of information describing how to operate the GDX-350. This is the bottom menu on page 1 of the **SETUP** screen.

5.13. Diagnostics

IMPORTANT: Gas monitoring and alarm processing are not performed while using the Diagnostics menus. **Access requires a special key sequence of four consecutive UP keystrokes**.

There are two **Diagnostics** menus useful for driving outputs without exposing the sensor to the target gas. The **OUTPUT SIMULATION** menu allows for setting of the 4-20 mA output to virtually any desired value. This is useful for checking responses of devices receiving the GDX-350's 4-20 mA output. The **ACTIVATE RELAYS** menu allows for tripping of the alarm relays (if equipped) without tripping alarm set-points with the target gas.

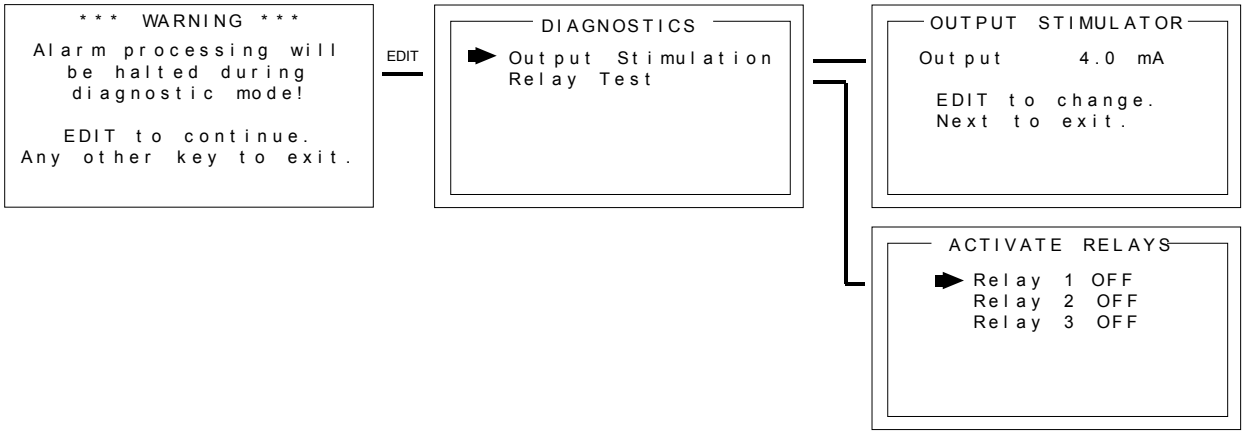

Figure 5-17: Diagnostics Menus

5.14. RS-485/Modbus Setup

The **RS-485 MODBUS SETUP** menu allows setting the RTU address (if RS-485 equipped) for each GDX-350 on the RS-485 network. Each GDX-350 must have a different RTU address when communicating on the same 2-wire cable. Baud rate, parity and stop bits are fixed at industry standard values of:

- Baud Rate: 9600
- Parity: None
- Stop Bits: 1.

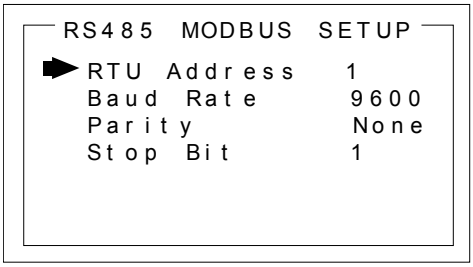

Figure 5-18: Modbus RS-485 Setup Menu

5.15. Modbus Register and Function Code Summary

The following tables identify GDX-350 Modbus register locations and function codes. "Chan 1" designations represent the EC channel while "Chan 2" represents the LEL/4-20 mA Input channel.

Read Only Discretes

VARIABLE	ALIAS	READ FUNCTION CODE	WRITE FUNCTION CODE
Chan 1 Alarm 1	2001	2	NA
Chan 1 Alarm 2	2002	2	NA
Chan 1 Fault	2003	2	NA
Chan 2 Alarm 1	2004	2	NA
Chan 2 Alarm 2	2005	2	NA
Chan 2 Fault	2006	2	NA
K1	2007	2	NA
K2	2008	2	NA
K3	2009	2	NA
Chan 1 Cal Mode	2010	2	NA
Chan 2 Cal Mode	2011	2	NA

Read/Write Coils

VARIABLE	ALIAS	READ FUNCTION CODE	WRITE FUNCTION CODE
Alarm Ack/Reset	12001	1	5

Note: After writing a TRUE to this register, it resets back to FALSE automatically.

Read Only Registers

VARIABLE	ALIAS	READ FUNCTION CODE	WRITE FUNCTION CODE
D2A Raw Chan 1[1]	31001	4	NA
D2A Raw Chan 2[1]	31002	4	NA
A2D Raw Chan 1[2]	31003	4	NA
A2D Raw Chan 2[2]	31004	4	NA
Chan 1 Status[3]	31005	4	NA
Chan 2 Status[3]	31006	4	NA
Alarm Status Word[4]	31007	4	NA
Transmitter Status Word[5]	31008	4	NA
Chan 1 Sensor Life[6]	31009	4	NA
Chan 2 Sensor Life[6]	31010	4	NA
Chan 1 Sensor Temperature[7]	31011	4	NA
Chan 2 Sensor Temperature[7]	31012	4	NA

1 Calibrated 10-bit value representing the D2A value of 0 to 1023 for -25 to 105 %FS (200=0% and 1000=100%). IMPORTANT: Read registers 31001/31002 to create readings that match GDX-350 display values! These should also be read by GDX-1600 Modbus masters.

2 10-bit value representing the A2D value of 0 to 1023 before calibration constants are applied.

3 16-bit status words; bit assignment for each channel. See below.

ALARM1_BELOW	BIT0
ALARM2_BELOW	BIT1
ALARM3_BELOW	BIT2
ALARM1_LATCH	BIT3
ALARM2_LATCH	BIT4
ALARM3_LATCH	BIT5
ALARM3_ACTIVE	BIT6
CHANNEL_DISABLED	BIT7
CHANNEL_CAL	BIT8
CHANNEL_LINEARIZE	BIT9
FAULT_RELAY_LATCH	BIT10
DISPLAY_NEGATIVE	BIT11
TRANSMIT SENSOR LIFE ENABLED	BIT12

4 16-bit status word; bit assignment for system status. See below.

CH1_ALM1	BIT0
CH1_ALM2	BIT1
CH1_FAULT	BIT2
CH2_ALAM1	BIT4
CH2_ALM2	BIT5
CH2_FAULT	BIT6
K1_STATUS	BIT8
K2_STATUS	BIT9
K3_STATUS	BIT10

5 16-bit status word; bit assignment for system status. See below.

CHAN_1_ACTIVE	BIT0
CHAN_2_ACTIVE	BIT1
SECURE_LEVEL	BIT2
MARKER Tx LED	BIT3
K1_FAILSAFE	BIT12
K2_FAILSAFE	BIT13
K2_ACK	BIT14
LOCK	BIT15

6 16-bit signed integer ranging from –1 to 100 where -1 indicates Cal Required.
7 16-bit integer ranging from 1 to 4095 scaled for –55 to +125 degrees C.

Memory Floating Point

VARIABLE	ALIAS	READ FUNCTION CODE	WRITE FUNCTION CODE
FP Value Chan 1	33001	4	NA
FP Value Chan 2	33002	4	NA

NOTE: Returned as 15-bit plus sign 2's complement with ±5% over/underrange applied. Consider over/underrange when scaling values to be displayed at the workstation. The following equation may be used to determine a value for display.

$$\text{Display Value} = \frac{\text{MODBUS Value [(Span Value -Zero Value) 1.1]}}{32767} + \{\text{Zero Value - [(Span Value - Zero Value) .05]}\}$$

Memory ASCII Strings

VARIABLE	ALIAS	READ FUNCTION CODE	WRITE FUNCTION CODE
User Info Chan 1[1]	40401-40408	3	NA
User Info Chan 2[1]	40409-40416	3	NA
Chan 1 ASCII Reading[2]	40417-40419	3	NA
Chan 2 ASCII Reading[2]	40420-40422	3	NA
EUNITS Chan 1[3]	40423-40427	3	NA
EUNITS Chan 2[3]	40428-40432	3	NA

1 16 ASCII characters (2 per register) assigned to the unit identifier read as bytes.
2 6 ASCII characters (2 per register) reflecting the display readout.
3 10 ASCII characters (2 per register) assigned to the engineering units read as bytes.

Byte Variables

VARIABLE	ALIAS	READ FUNCTION CODE	WRITE FUNCTION CODE
PreAmp/Gain Ch1[1]	40433	3	NA
PreAmp/Gain Ch2[1]	40434	3	NA

1 2 bytes representing Pre Amp (HiByte) and PGA (LoByte) settings.

Firmware Version

2	ALIAS	READ FUNCTION CODE	WRITE FUNCTION CODE
Version[1]	40435-40436	3	NA

1 4 ASCII characters (2 per register) reflecting the firmware version.

Memory Reals

NOTE: Real value represents float value without the decimal point such as 123.4 is returned as 1234. Decimal divisor is returned as 1, 10, 100, or 1000 for decimal position of 1, 2, 3, or 4, where 123.4 would return the value 10.

VARIABLE	ALIAS	READ FUNCTION CODE	WRITE FUNCTION CODE
Chan 1 Cal Zero Real	41001	4	NA
Chan 1 Cal Zero Divisor	41002	4	NA
Chan 1 Cal Span Real	41003	4	NA
Chan 1 Cal Span Divisor	41004	4	NA
Chan 1 Zero Real	41005	4	NA
Chan 1 Zero Divisor	41006	4	NA
Chan 1 Span Real	41007	4	NA
Chan 1 Span Divisor	41008	4	NA
Chan 1 Fault Real	41009	4	NA
Chan 1 Fault Divisor	41010	4	NA
Chan 1 Alarm 1 Real	41011	4	NA
Chan 1 Alarm 1 Divisor	41012	4	NA

VARIABLE	ALIAS	READ FUNCTION CODE	WRITE FUNCTION CODE
Chan 1 Alarm 2 Real	41013	4	NA
Chan 1 Alarm 2 Divisor	41014	4	NA
Chan 1 Alarm 3 Real	41015	4	NA
Chan 1 Alarm 3 Divisor	41016	4	NA
Chan 1 Manual Gain Real	41017	4	NA
Chan 1 Manual Gain Divisor	41018	4	NA
Chan 1 Manual Offset Real	41019	4	NA
Chan 1 Manual Offset Divisor	41020	4	NA
Chan 2 Cal Zero Real	41021	4	NA
Chan 2 Cal Zero Divisor	41022	4	NA
Chan 2 Cal Span Real	41023	4	NA
Chan 2 Cal Span Divisor	41024	4	NA
Chan 2 Zero Real	41025	4	NA
Chan 2 Zero Divisor	41026	4	NA
Chan 2 Span Real	41027	4	NA
Chan 2 Span Divisor	41028	4	NA
Chan 2 Fault Real	41029	4	NA
Chan 2 Fault Divisor	41030	4	NA
Chan 2 Alarm 1 Real	41031	4	NA
Chan 2 Alarm 1 Divisor	41032	4	NA
Chan 2 Alarm 2 Real	41033	4	NA
Chan 2 Alarm 2 Divisor	41034	4	NA
Chan 2 Alarm 3 Real	41035	4	NA
Chan 2 Alarm 3 Divisor	41036	4	NA
Chan 2 Manual Gain Real	41037	4	NA
Chan 2 Manual Gain Divisor	41038	4	NA
Chan 2 Manual Offset Real	41039	4	NA
Chan 2 Manual Offset Divisor	41040	4	NA

Binary Cal Data

VARIABLE	ALIAS	READ FUNCTION CODE	WRITE FUNCTION CODE
Chan 1 A2D MIN	41041	4	NA
Chan 1 A2D MAX	41042	4	NA
Chan 1 D2A MIN	41043	4	NA
Chan 1 D2A MAX	41044	4	NA
Chan 2 A2D MIN	41045	4	NA
Chan 2 A2D MAX	41046	4	NA
Chan 2 D2A MIN	41047	4	NA
Chan 2 D2A MAX	41048	4	NA

1 Min and Max calibration points for the A/D and D/A converters.

5.16. System Security

The **SYSTEM SECURITY** menu offers two levels of protection. A **LOW** level allows CAL MODE sensor calibrations but requires the 4-digit **Pass Code** prior to altering menus. **HIG2H** level locks the entire menu database and the CAL Mode until the correct **Pass Code** is entered. **LOW** and **HIGH** security levels always allow viewing of configuration menus but they may not be changed. **Contact Name** is a 12 character ASCII field available for displaying a phone # or name of personnel who know the **Pass Code**. Lost **Pass Codes** may be recovered by entering the locked security menu and holding the UP key for 5 seconds. The 4-digit code appears near the bottom of the screen.

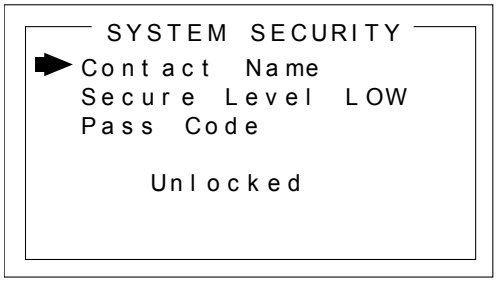

Figure 5-19: System Security Menu

6. SERVICE CENTER

United States
Bacharach, Inc.
621 Hunt Valley Circle
New Kensington, PA 15068
Phone: 724-334-5000
Fax: 724-334-5764
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Printed in U.S.A.