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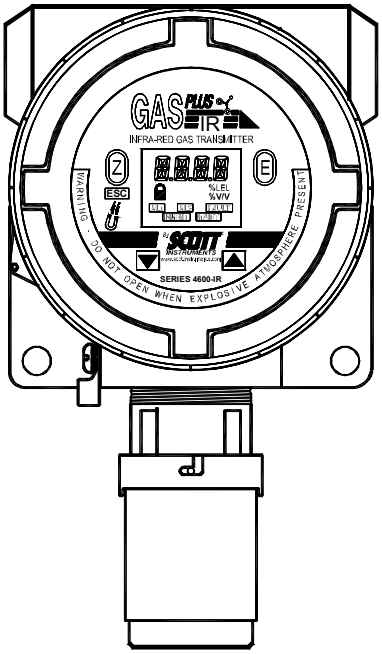
Find the *Scott / Bacharach Series 4600-IR* at our website: *Click HERE*

SCOTT INSTRUMENTS

GAS PLUS IR

Series 4688IR/4679IR

Operation & Maintenance Manual



! SAFETY FIRST !

THREE KEY POINTS TO OPERATIONAL SAFETY

To assure both personnel and facility safety, it is extremely important to observe all transmitter installation and operational safety requirements. The three key points listed below may be found in the contents of this manual.

#1 - Install the system correctly following all local, state, and federal guidelines.

#2 - Perform regular operational tests on the transmitter. This helps ensure the unit is functioning properly.

#3 - Maintain a zero adjustment log for each transmitter and adhere to the schedule. Infrared combustible gas transmitters require periodic zero adjustment in order to continue to operate accurately. Failure to properly operate and maintain this instrument could result in serious injury.

Rev: 4688IR (G)
Date: 10/30/03
CN: 3209
Part #087-0007G

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Transmitter Quick Start

1. **Mount and wire the transmitter (*See "Transmitter Installation"*).**
2. **Apply power to the transmitter.** All segments and indicators on the display will turn on for 2 seconds, then will turn off for 2 seconds. The transmitter will subsequently enter a 30 second warm-up period (countdown shown on the display).
3. **Select the gas to be detected.**





a. Touch the magnet to the up arrow key and observe "USER" on the display.

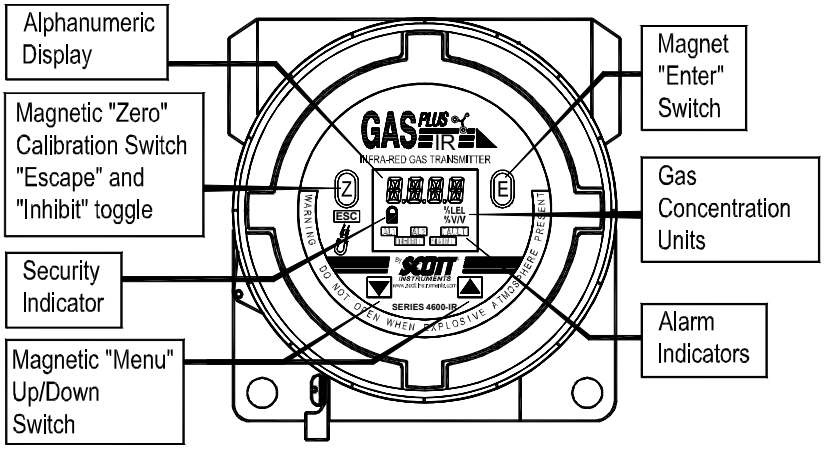
b. Touch the magnet to the E key and observe "A1.SP" is the first parameter to be displayed.

c. Repeatedly touch (or hold to scroll) the magnet to the UP key until the display shows "SR.GN." Touch the E key.

d. The display should read "1". Use the Up or Down arrow keys to change the number to the appropriate gas as shown in the following table below. See Appendix 3 for gas cross-sensitivity tables.

e. When the display has the correct gas, touch the magnet to the E key and observe the display read "SEt". Then, touch the magnet to the Z key 3 times until the display shows "RUN."

The instrument is now ready to operate! Consult the manual for more information on the instrument's many features.



Parameter	SR.GN =	Gas	Notes
Standard Gas Set	1	Methane	
	2	Ethane	
	3	Propane	
	4	Butane	
	5	Pentane	
	6	Hexane	
	10	Propylene	
Extended Gas Set	9	Ethylene	Only ONE "extended" gas can be selected on transmitters ordered with this option. Other standard gases are still selectable.
	11	Acetone	
	12	IPA	
	13	MEK	
	14	Toluene	
	15	Methanol	
	16	Butadiene	
	17	Pure Methane	
	18	20% Hexane	
	19	Ethanol	
	20	Benzene	
	21	Xylene	
	22	Isobutanol	
	23	Rotosolv-1	
	24	Cyclohexane (0-60% LEL)	
Model 4679IR CO2 Gas Detector ONLY	64	Carbon Dioxide	Hydrocarbon settings are ***not*** available

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Start-Up, General Information, & Installation

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Introduction

The GasPlus-IR 24VDC powered INFRA-RED GAS TRANSMITTER uses infrared absorption technology to monitor the level of combustible hydrocarbon gases (Model 4688-IR) or CO_2 (Model 4679-IR) in the surrounding atmosphere and transmits an analog (4-20 mA) or digital (Modbus®) signal that is proportional to the measured concentration. The output signal is linear for the specific gas being measured. Linearization curves for numerous gases are built into the instrument and are user selectable.

The instrument features 2 alarm relays capable of indicating high and high-high alarm conditions, and a separate relay for indicating faults (relays are optional). A local display reports concentration readings in units of either %LEL or %V/V (user selectable), as well as system status. The operator panel interface uses a Scott Instruments magnetic screwdriver for accessing the system parameters and may be password protected. Non-intrusive user setup and calibration permits operation and maintenance from within classified areas.

Principle of Operation

Infrared radiation propagating from an incandescent emitter passes through a volume of gas, then is reflected by a mirror onto 2 fixed detectors. One detector is tuned to a wavelength that is absorbed by hydrocarbons or CO_2, while the other detector is tuned to a nearby wavelength that is not absorbed. The ratio of the output voltages of the 2 detectors is used to compute the concentration of gas. As gas concentration increases, the incremental output produced by the detectors decreases. The instrument then uses a gas-specific algorithm to linearize the signal. Since the amount of infrared absorption differs with each gas, the instrument's cross-sensitivity will vary. For example, an instrument setup to detect methane, which absorbs less infrared radiation than most other hydrocarbons, will produce high readings when exposed to most other combustible gases.

Other Gas Sensitivities - *Model 4688-IR ONLY*

The Model 4688-IR is specifically tuned to detect certain hydrocarbon gases and will not detect non-hydrocarbon combustibles such as NH_3, H_2, etc. Scott Instruments' Model 4600 GasPlus Universal Toxic Gas Transmitter provides an excellent solution for many of these gases. Hydrocarbons not listed as available (see parameter SR.GN) may or may not be detectable by the transmitter. Consult the factory for further information.

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Lower Explosive Limit - *Model 4688-IR ONLY*

Combustible gas mixtures can be ignited only between certain concentration limits. These limits are known as the Lower Explosive Limit (LEL) and the Upper Explosive Limit (UEL). When these terms are used, it is assumed that a normal atmospheric air background (20.9% O_2) is present. For example, the LEL for methane is a concentration of 5.00 %V/V (volume per volume) in air.

Combustible gas sensors are designed to operate at concentrations under the LEL, and typically the readings are calibrated in %LEL. For methane, 100 %LEL is defined as a concentration of 5.00% in air; 50% LEL is defined as a concentration of 2.5%, and so on. If the reading is under 100% LEL, the gas at the sensor cannot ignite. However, even very low readings indicate that there may be a significant gas leak at some distance from the sensor. Readings exceeding 100% LEL are possible.

Suitability For Use in Hazardous Locations

The Models 4688-IR and 4679-IR are designed to be acceptable for use in Class 1, Zones 1 and 2, Groups B, C, and D hazardous (classified) locations (these locations are approximately equivalent to Class 1, Division 1 and 2, Groups B, C, and D, as defined in the pre-1996 NEC). The instrument accomplishes this primarily through the use of the explosion-proof method of protection (Ex d). The 1 exception is the heater which uses the intrinsically-safe (Ex ib) method of protection.

Using a Flowcell

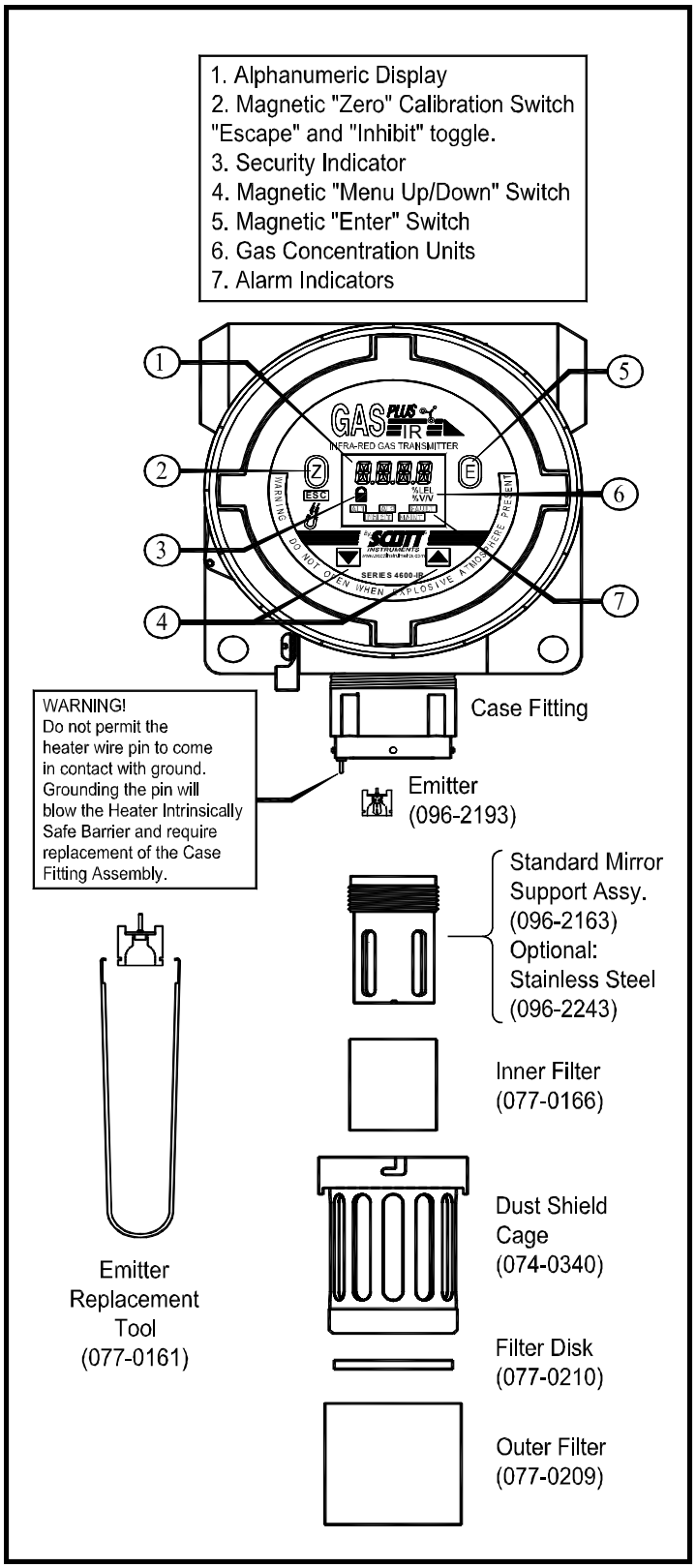
When using the GasPlus-IR with a flowcell, it is important to recognize that output will vary with gas pressure. The Ideal Gas Law establishes a relationship between pressure and the number of molecules. Where P=pressure, V=volume, n=number of molecules, R=gas constant, and T=temperature):

$$P\,V = nRT$$

If temperature is held at a constant, the number of molecules in a given volume of gas (gas density) will vary linearly with pressure. Since the amount of infrared absorption increases with gas density, the higher the pressure in the flowcell with respect to atmospheric, the higher the instrument's concentration output will be (and vice-versa). Note that the flowcell pressure can be either positive (i.e., gas is being pushed into the flowcell) or negative (i.e., gas is being pulled through the flowcell).

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General Instrument Overview Map



Alphanumeric Display - Used for displaying decimal values in the range -999 to -0.00 and 0.000 to 9999, hexadecimal values in the range 0000 to FFFF, and text labels representing parameters during user setup.

Gas Concentration Units - Parameters can be set to display gas concentration in %LEL or in %V/V.

Security Indicator (Lock) - Appears when software security is active, prohibiting parameter editing. When the security parameter is "locked" parameters may be reviewed, but not changed.

Alarm Indicators - Visible when alarm, fault, inhibit, or maintenance conditions exist.

Case Fitting - Stainless steel housing containing emitter**,** detectors, and heater I.S. barrier.

Replacement Emitter Assembly - Provides infrared radiation for detectors. Easily field-replaceable (see "*Troubleshooting & Maintenance: Replacing The Emitter*").

Mirror Support Assembly - Provides the optical path in which gas absorbs infrared radiation from the emitter. An intrinsically safe heater prevents condensation on the mirror. Two versions exist, the standard nickel-plated aluminum and the optional 316 stainless steel.

Filters - Allow gas to diffuse into the mirror support assembly while protecting the optics from dust, oil, and dirt. Filter material (Porex™) is hydrophobic so filters are suitable for all weather conditions. Note that use of filters slows sensor response. Refer to page 10 for information detailing their use.

Dust Shield - Provides protection against indoor dust (See Figure 1).

Rain Guard - Provides protection against rain (See Figure 2).

Deluge Guard- Provides protection in hose-down areas (See Figure 3).

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Transmitter Installation

Installation Considerations

Prior to installing GasPlus-IR, consideration should be given to the following items when choosing its location:

1. ***Orientation*** - In outdoor applications always mount the instrument's optical bench pointing downwards.

2. ***Gas Density*** - For gases with densities greater than air, the Instrument should be installed approximately 18" from floor level. In these applications care should be taken to protect the sensors from physical damage. For gases with densities less than air, the Instrument should be installed at a high level or close to the potential leak source. For gases with densities equal to air, mount as close to potential leak source as practical.

3. ***Potential Gas Sources*** - The location and nature of potential vapor/gas sources (e.g., pressure, amount, source, temperature, and distance) need to be assessed. Locate the transmitter where air currents are most likely to contain the highest concentration of escaping gas.

4. ***Ambient Temperature*** - Ensure that the system is located within an area that complies with the specified operating temperature range.

5. ***Vibration*** - Mount the instrument in a manner that minimizes vibration.

6. ***Accessibility*** - When determining mounting location, consider future maintenance requirements.

Vapor Densities *Relative To Air*	
Methane	0.6
Air	1.0
Ethane	1.0
Ethylene	1.0
Carbon Dioxide	1.5
Propylene	1.5
Propane	1.6
Butadiene	1.9
Acetone	2.0
Butane	2.0
IPA	2.1
MEK	2.5
Pentane	2.5
Hexane	3.0
Toluene	3.1

7. ***Avoid water.*** Water inside the infrared optics will adversely affect performance. Although the optics are heated to prevent condensation on the mirror, the use of a rain shield is still recommended for outdoor installations. NOTE: The rain shield is included with the instrument.

8. ***Avoid strong electromagnetic fields***. Although the instrument is designed to be RFI/EMI resistant, mounting the gas transmitter near power transformers or other strong EM fields may cause undesirable results.

9. Conduit seals and drain loops. Explosion proof conduit and other materials required for electrical wiring in hazardous areas should be installed in accordance with National Electrical Code (NEC) and Canadian Electrical Code (CEC) requirements. All conduit connections should be sealed and contain a drain loop to protect the transmitter electronics from moisture.

10. Direct bold sunlight. Scott Instruments recommends using a sunshade if the instrument will be mounted in direct sunlight.

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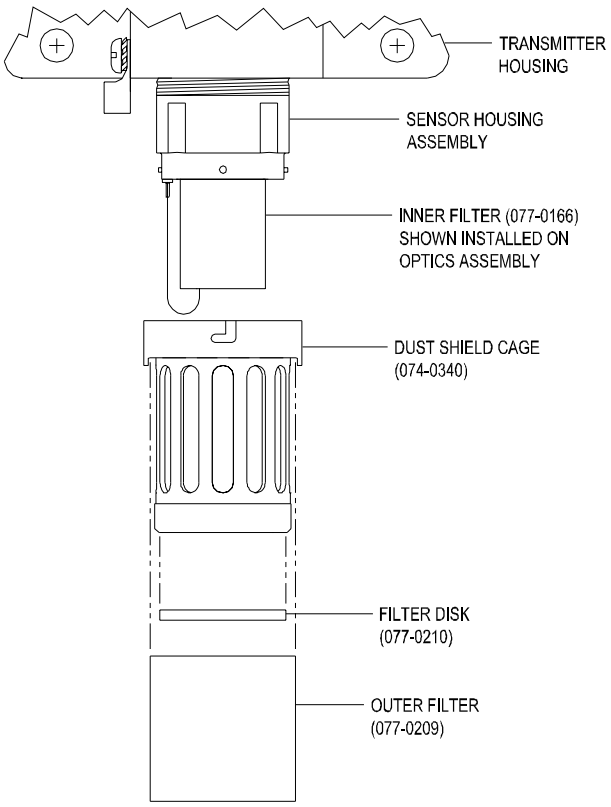


Figure 1 - Dust Filter Assembly

Using the Rain Shield and Filters

Using different combinations of the transmitter's filters optimizes air flow to the detector.

1. For Outdoor Use - Non-Hose Down Enviroments: Use the rain guard (096-2709), but not optics assembly inner filter (077-0166). The transmitter is mounted vertically. See Figure 2 for list of parts and Figure 5 for dimensions.

2. For Outdoor /Indoor Use - Hose Down Environments: Use the deluge guard (096-2727), but not optics assembly inner filter (077-0166). The transmitter is mounted vertically. See Figure 3 for list of parts and Figure 5 for dimensions.

3. For Clean Indoor Use: For use in applications were no wash-downs or liquid spray is expected. Use the optics assembly inner filter (077-0166) and dust shield cage (074-0340), see Figure 1. The transmitter is typically mounted vertically, or should the application require, the transmitter may be mounted horizontally to provide a more unrestricted flow of gas over the detector. ***Mounting the transmitter horizontally is application dependent and should only be done in indoor applications and where there is no potential for the transmitter's optics assembly to be exposed to liquid.***

4. For Dirty Indoor Use: For use in applications were no wash-downs or liquid spray is expected. Use the inner filter (077-0166), dust shield cage (074-0340) outer filter (077-0209) and filter disk (077-0210). The transmitter is typically mounted vertically, or should the application require, the transmitter may be mounted horizontally to provide a more unrestricted flow of gas over the detector. ***Mounting the transmitter horizontally is application dependent and should only be done in indoor applications and where there is no potential for the transmitter's optics assembly to be exposed to liquid.***

5. For Indoor Use - Remote Bump Testing Installation: Typical application is a gas compressor installation where the sensor is mounted in the ceiling. Use deluge guard (096-2727) and attach tubing to the 1/4" FNPT fitting. Use inner filter (077-0166). Apply bump check gas at a minimum flowrate of 2 LPM. THIS IS NOT FOR CALIBRATION PURPOSES NOR ACCURACY VERIFICATION.

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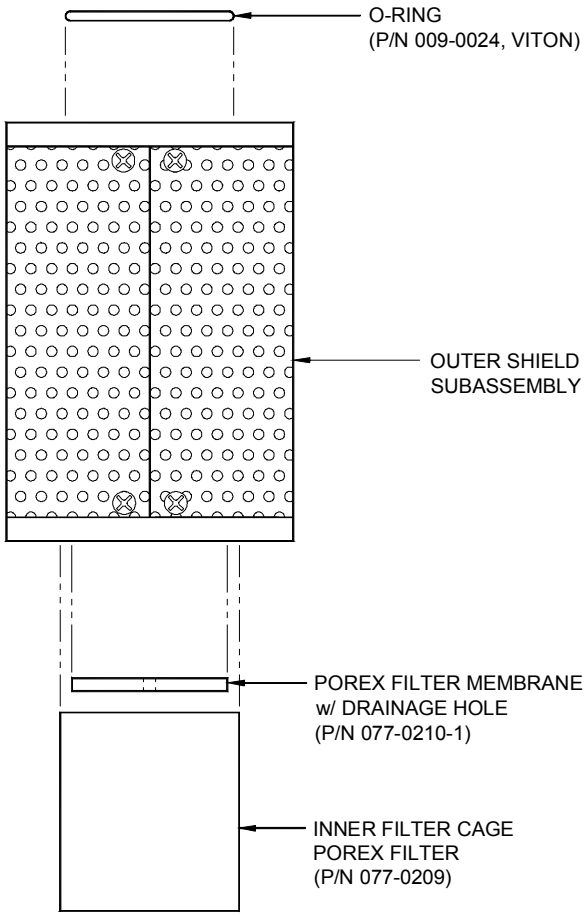


Figure 2 -Rain Guard - P/N 096-2709

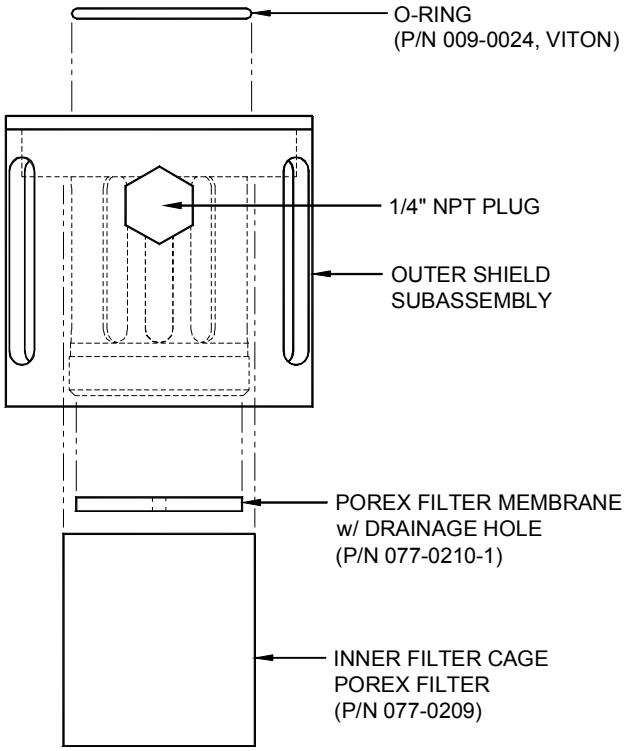


Figure 3 - Deluge Guard - P/N 096-2727

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Wiring and Power

Current Draw

Upon instrument start-up, the GasPlus-IR will experience a 500 mA transient current draw. Immediately thereafter, current draw will drop to the instrument's 250 mA i_{MAX}, eventually "settling" down" to the 130 mA typical current draw.

Maximum Wire Length

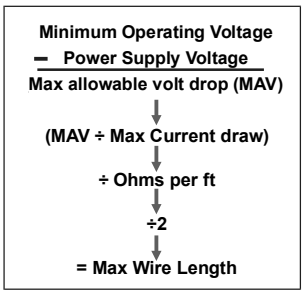
AWG wire size requirements are dependent upon power supply voltage and wire length.

The maximum distance between the transmitter and its power supply is determined by the maximum allowable interconnecting loop-voltage drop. If the voltage drop is exceeded, the transmitter will not operate. To determine the maximum loop-voltage drop, subtract the transmitter's minimum operating voltage (18 VDC) from the power supply's minimum output voltage. For example; if the power supply's minimum output voltage is 24 VDC, then the maximum voltage drop across the power supply is 6 volts.

Figure 4 - Calculating Maximum Wire Length

Stand-Alone 24 VDC Power Supply	
VMIN Source Voltage	24 VDC
VMIN Transmitter	18 VDC
IMAX Transitter	250 mA
RMAX of Wire	24 Ohms

Wire Ohms/ft	Max Length Ft (M)
18 AWG (0.00639 Ohm/ft)	1878 (572)
20 AWG (0.01015 Ohm/ft)	1182 (360)
22 AWG (0.01614 Ohm/ft)	743 (227)



To determine actual maximum wire length, divide the maximum allowable voltage drop by the transmitter's maximum current draw, then by the resistance of the wire (ohms/foot), then divide by 2.

Switches and Circuit Breakers: UL and EN Requirements

EN 61010-1, 1995 edition and UL 3111-1, 1994 edition (Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use-Part 1: General Requirements) contain the following requirement:

> *Except as specified in 6.12.1.1, equipment shall be provided with a means for disconnecting it from each operating energy supply source, whether external or internal to the equipment. The disconnecting means shall disconnect all current-carrying conductors.*

For the GasPlus-IR to comply with EN 61010-1, 1995 edition and UL 3111-1, 1994 edition:

1. A switch or circuit breaker must be included in the GasPlus-IR installation,
2. The switch or circuit breaker must be in close proximity to the equipment and within easy reach of the operator, and
3. The switch or circuit breaker must be marked as the disconnecting device for the GasPlus-IR.

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Current Sourcing and Sinking Modes (see Figure 7)

The GasPlus-IR may be wired in a current sourcing (most typical) or a current sinking mode. As the names suggest, these 2 modes describe the direction of current flow in the 4-20 mA loop connecting the GasPlus-IR transmitter and its receiver. Principally, this is dictated by which end of the loop is connected to the positive supply voltage (the source).

Current sourcing mode (TYPICAL). When the transmitter is wired in current sourcing mode, a positive voltage supply is connected to the transmitter's mA+ terminal [TB1-3]. Note that this may be the same supply powering the instrument or a different one (*see Isolated and Non-Isolated Loop Power*). Current flows into the mA terminal [TB1-3] and out of the mA- terminal [TB1-4], controlled by the virtual resistance of the instrument. From the transmitter's mA- terminal [TB1-4], current flows into the receiver's + terminal, and then out of the receiver's - terminal to the power supply negative (common). Most facilities wire instruments in the current sourcing mode.

Current sinking mode. When the transmitter is wired in the current sinking mode, the positive supply voltage is connected to the receiver's + terminal. Note that this may be the same supply powering the instrument or a different one (see ***Isolated and Non-Isolated Loop Power***). Current flows through the receiver and out of the - terminal to the transmitter's mA+ terminal [TB1-3]. Controlled by the virtual resistance of the instrument, current flows out of the transmitter's mA- terminal [TB1-4] to the supply negative (common).

Isolated and Non-Isolated Loop Power

When the current loop power supply is different than the one used to power the transmitter, the loop is "isolated." When the same power supply is used for both the current supply and the instrument, the loop is "non-isolated." Many PLCs require an isolated loop.

The GasPlus-IR can be wired with either isolated or non-isolated power. Note from **Figure 7** that isolated power requires 4 wires, whereas non-isolated power can use a 3-wire configuration.

Mounting the Transmitter

General

Before installing (or servicing) the transmitter, ground it and follow all appropriate procedures to declassify the area (if necessary). Make all mounting connections (e.g., wiring conduit, mounting bolts, etc.) then mount the transmitter using the plastic spacer block (on wall mount configurations).

Installing the Transmitter

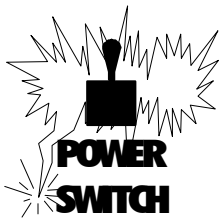
In most applications, the display and controls will be integral to the transmitter. After physically mounting the transmitter:

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1. Unscrew transmitter cover and turn power switch to the "OFF" position.



DO NOT REMOVE OR INSERT THE BOARD STACK while the transmitter is powered ! Place the power switch to the OFF position prior to removing the Display / CPU board stack. See Figure 3. Do not swap CPU and power supply boards between different units. They come from the factory calibrated as a matched set.



Place in the OFF position before removing Display / CPU board stack. Ensure power switch is in the OFF position prior to replacing board stack.

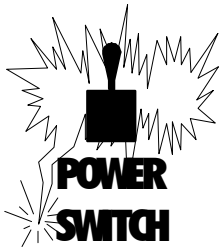
2. Grasp the top display board, and pull outward while gently rocking it from top to bottom. Both the top display board and the center CPU board will remove, exposing the electrical connectors on the Power Supply board in the bottom of the housing. The terminal blocks pull out for easy access.
3. Make wire connections (18 to 22 AWG wire is recommended for electrical connections). Ensure that proper wire gauge is used and that all wire, electrical grounds, and sensor connections are secure and intact.
4. Replace the 2 stacked boards and return the power switch to the ON position.
5. Screw transmitter cover on, ensuring a tight seal.

Installing Transmitters with Remote Display (see Figure 8)

The remote display option enables users to mount the GasPlus-IR's controls and display up the 50 feet away from the sensor. The 50 foot maximum should not be exceeded. After physically mounting the transmitter and remote display enclosures:



1. Unscrew the (master) transmitter cover and turn power switch to the "OFF" position.



Place in the OFF position before removing Display / CPU board stack. Ensure power switch is in the OFF position prior to replacing board stack.

DO NOT REMOVE OR INSERT THE BOARD STACK while the transmitter is powered ! Place the power switch to the OFF position prior to removing the Display / CPU board stack. See Figure 3. Do not swap CPU and power supply boards between different units. They come from the factory calibrated as a matched set.

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2. Disconnect the ribbon cable located on the top (CPU) board in the transmitter enclosure. Grasp the board and pull outward.
3. Make power, loop, and relay wire connections (18 to 22 AWG wire is recommended), then connect the 9 conductor (master-to-remote) cable as shown in Figure 10. Replace the CPU board.



4. Unscrew the (remote display) transmitter cover and remove the display board. Connect the 9 conductor (master-to-remote) cable as shown in Figure 10. Replace the display board and screw the enclosure cover on, ensuring a tight seal.
5. Turn the power switch to the ON position on the (master) transmitter and screw the enclosure cover on, ensuring a tight seal.

Powering The Transmitter

When power is applied to the transmitter, all segments and indicators on the display will turn on for 2 seconds, then will turn off for 2 seconds. The transmitter will subsequently enter a 30 second warm-up period (countdown shown on the display).

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Installation Drawings

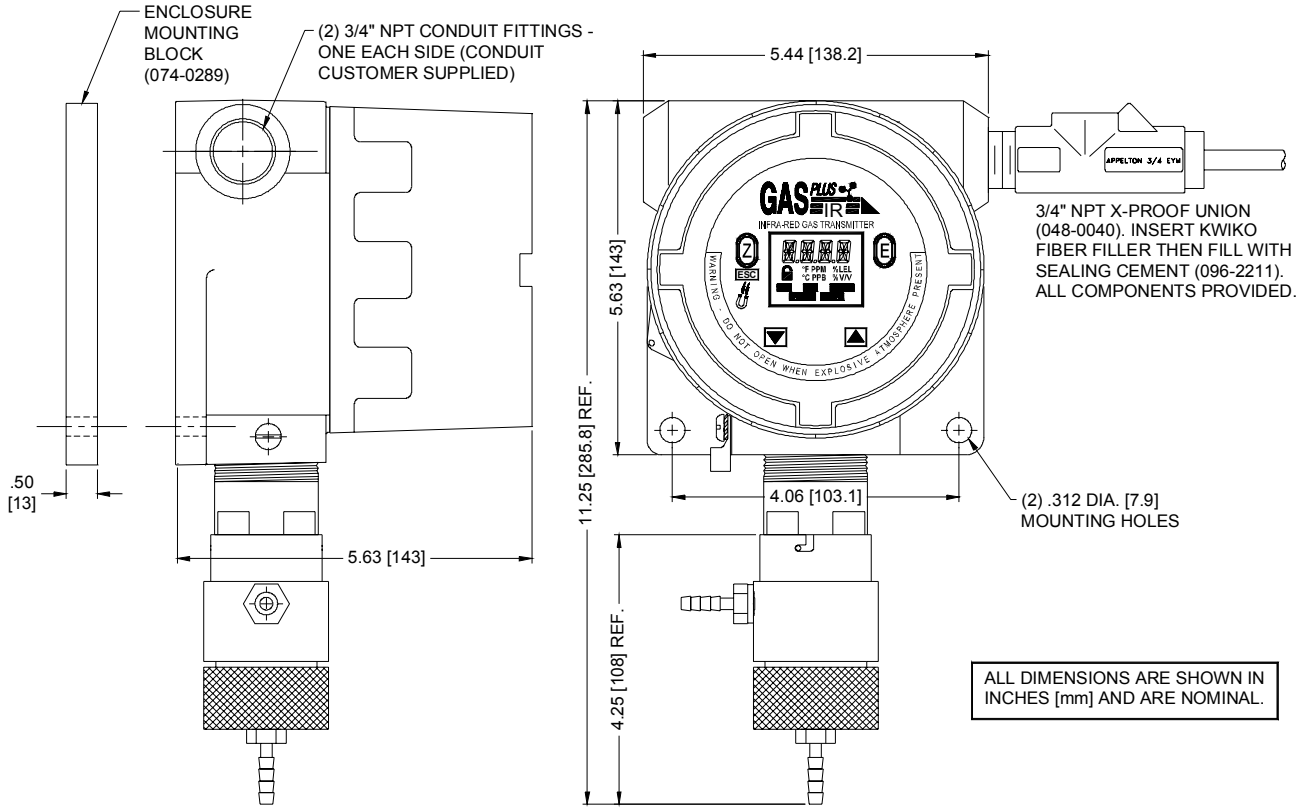
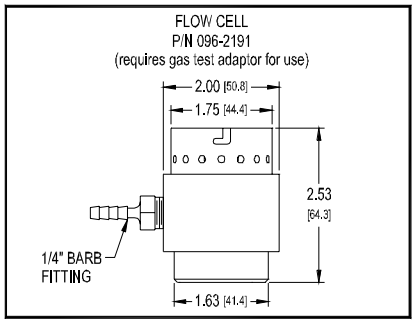
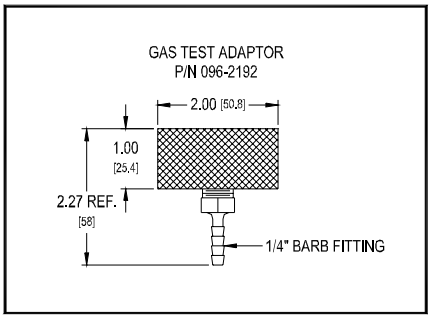
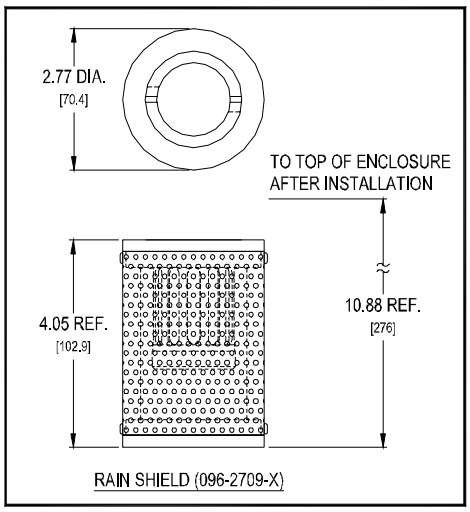
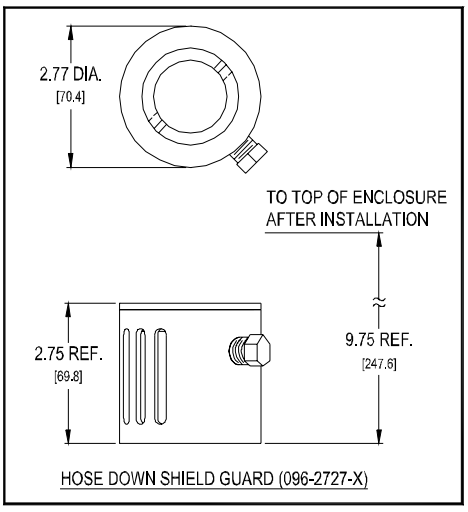


Figure 5 - Instrument Dimensions









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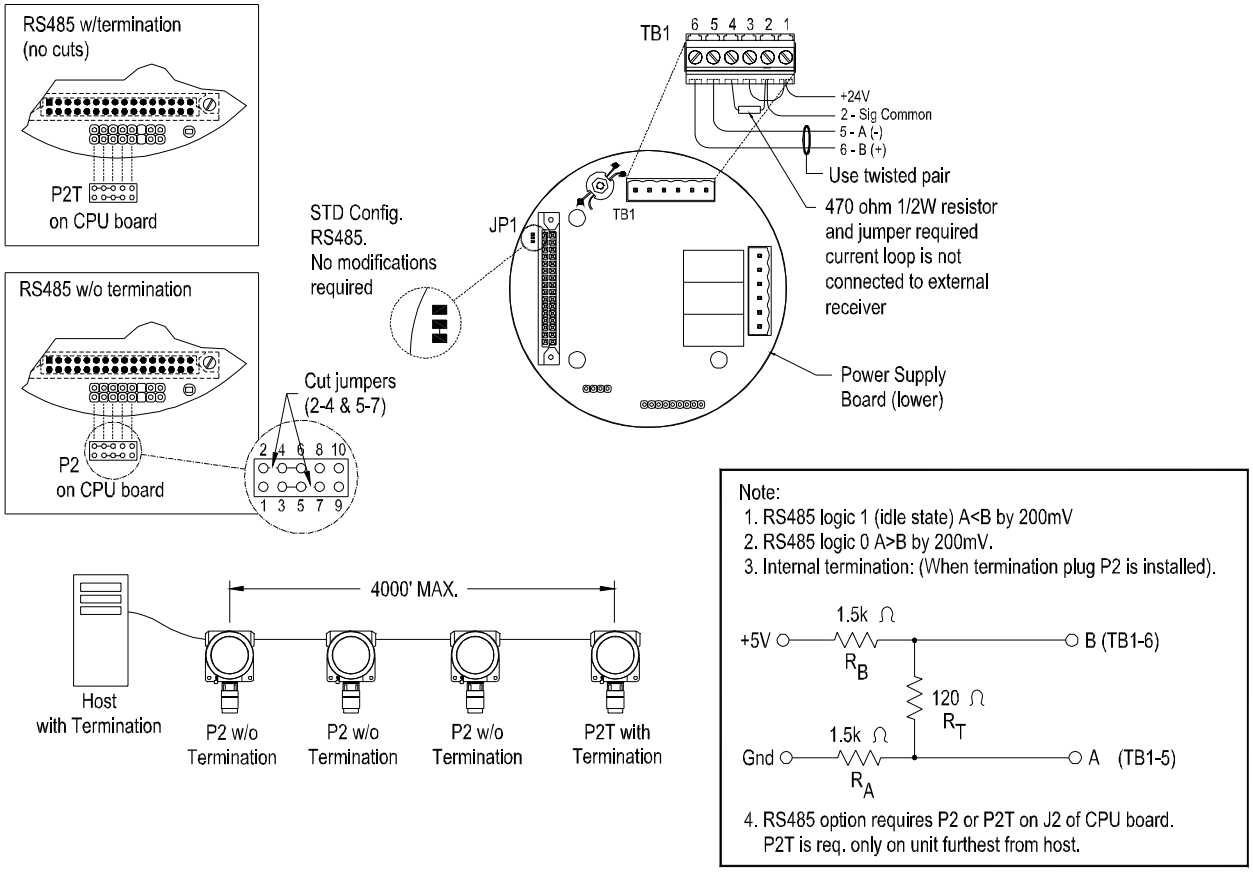


Figure 6 - RS-485 Communications Connections

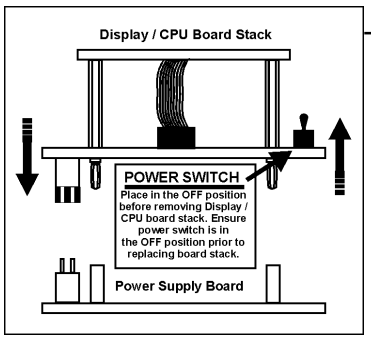
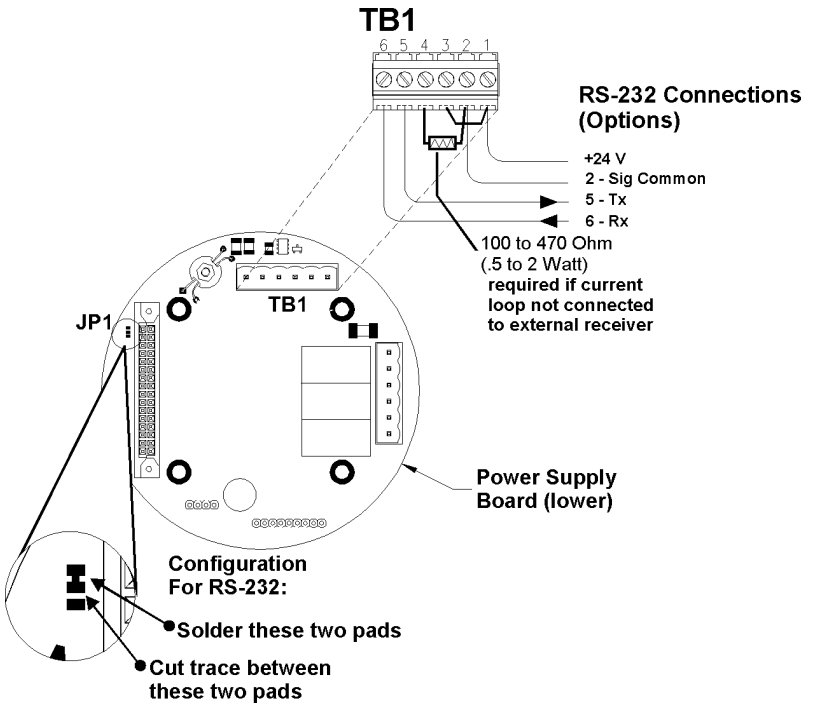


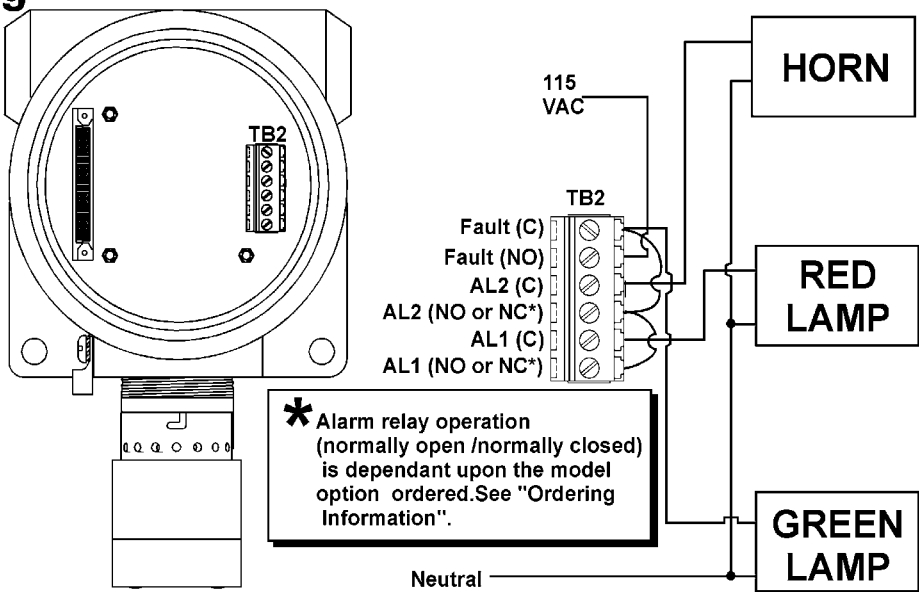
Figure 7 - RS-232 Communications Connections

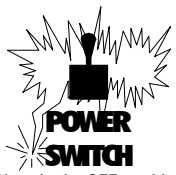


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Alarm Wiring

TYPICAL WIRING
- Horn sounds on high alarm
- Red lamp lights on low alarm
- Green lamp lit under normal conditions, off during fault or power failure, and prevents false alarms. Transmitter keeps fault relay energized under normal conditions.



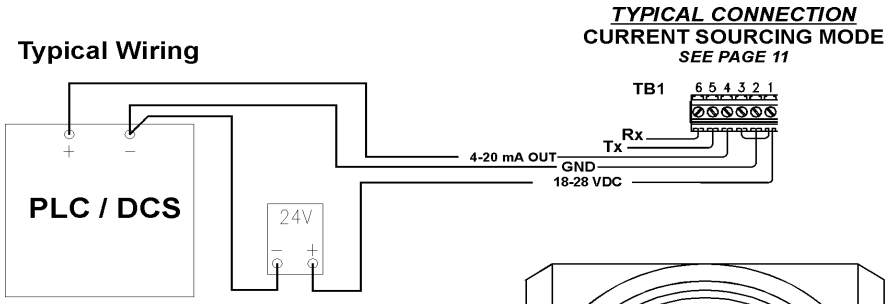


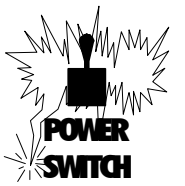
Place in the OFF position before removing Display / CPU board stack. Ensure power switch is in the OFF position prior to replacing board stack.

Note: The AL1 and AL2 relays are assumed to be field programmed as non-fail safe (normally de-energized). Field programming these relays for fail safe (normally energized) operation will reverse the NC/NO status of the relays. See page 25 for additional information.

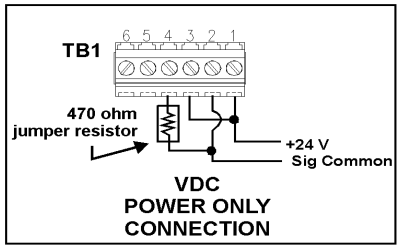
Figure 8 - Alarm Wiring

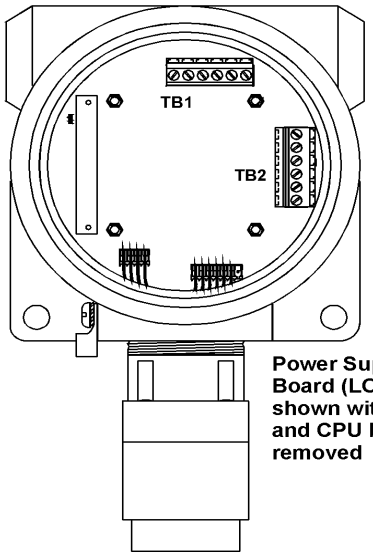
Note: The power and CPU boards are factory calibrated to match the IR detector. Do not exchange with other units.





Place in the OFF position before removing Display / CPU board stack. Ensure power switch is in the OFF position prior to replacing board stack.





Power Supply Board (LOWER) shown with display and CPU boards removed

Figure 9a - Typical 4-20 mA Current Loop Connections (Current Source Mode, Non-isolated Loop Power)

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Current Source Mode, Isolated Loop Power

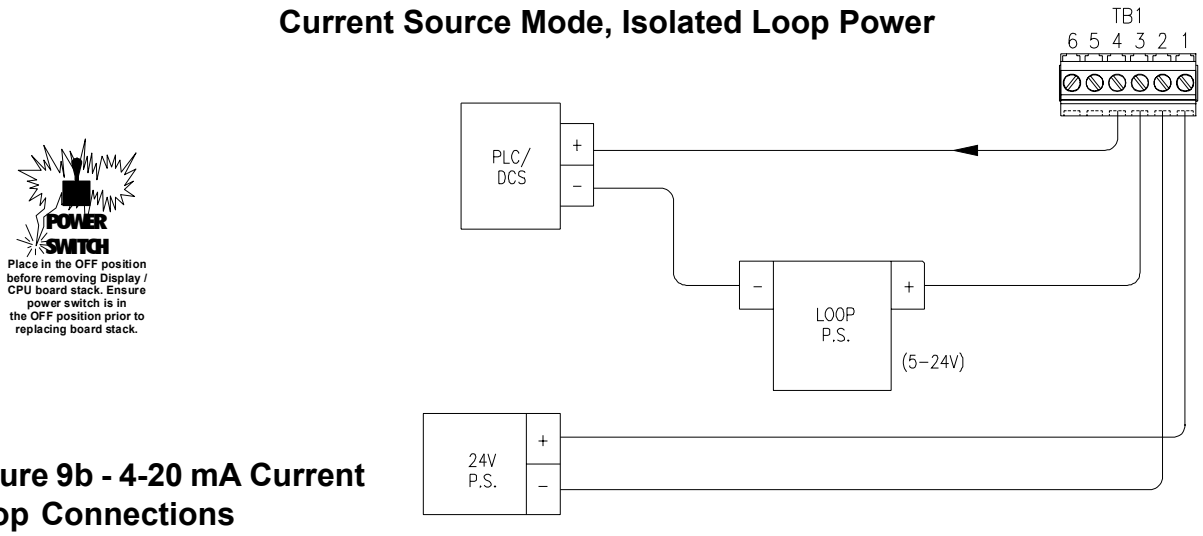


Figure 9b - 4-20 mA Current Loop Connections

Current Sink Mode, Non-Isolated Loop Power

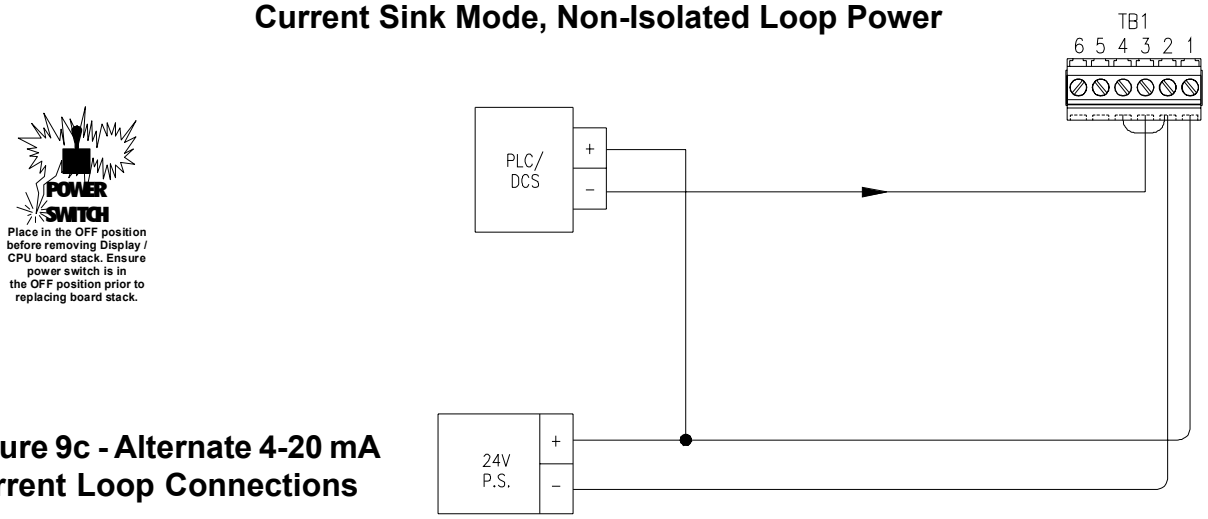


Figure 9c - Alternate 4-20 mA Current Loop Connections

Current Sink Mode, Isolated Loop Power

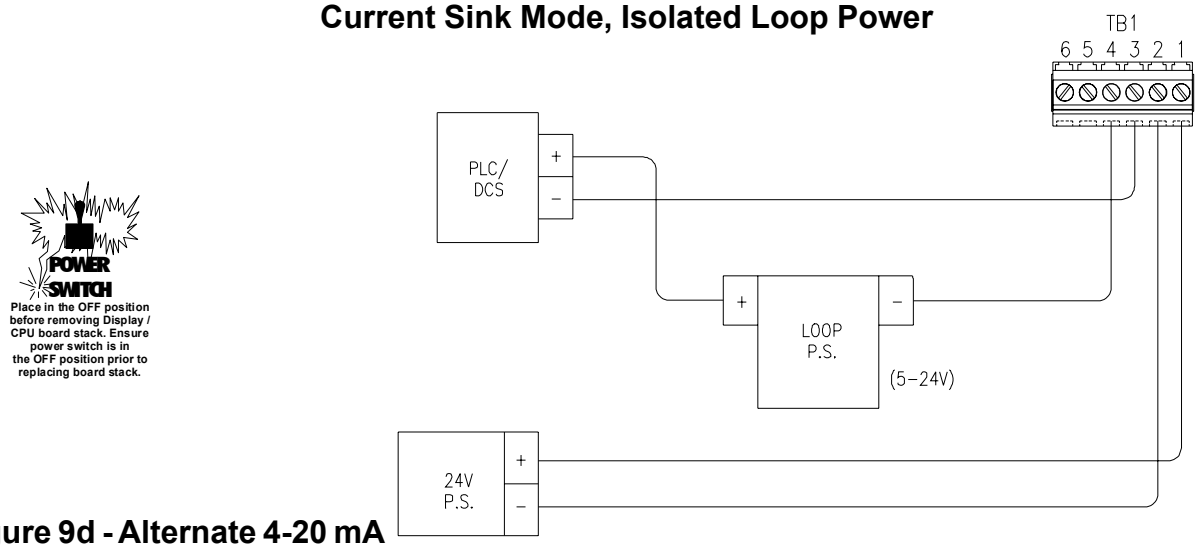


Figure 9d - Alternate 4-20 mA Current Loop Connections

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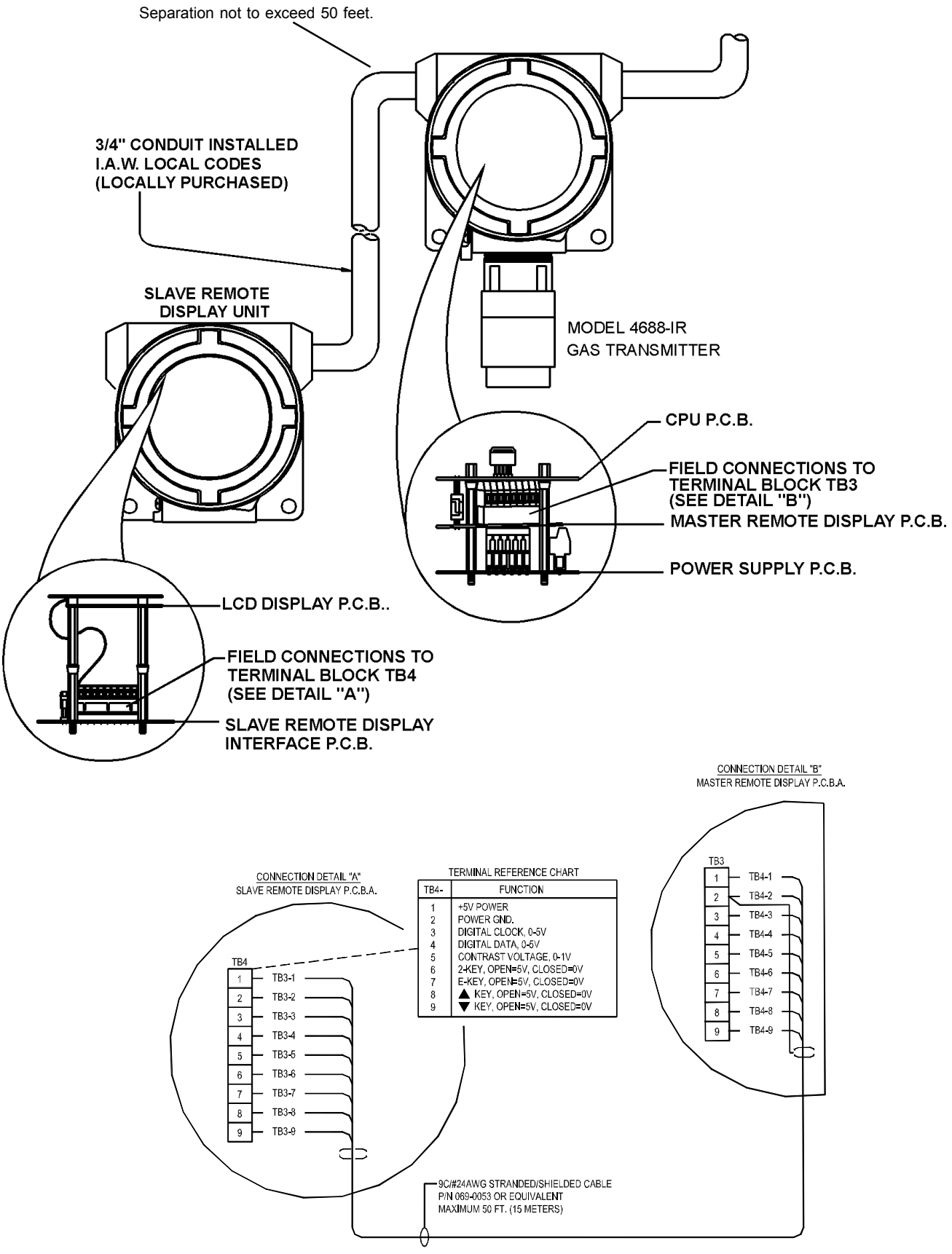


Figure 10 - Optional Remote Display Connections

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Transmitter Operation

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Basic Instrument Adjustments

Navigating the Instrument

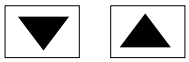
All adjustments on the ***GasPlus-IR*** are made non-intrusively through the front panel of the instrument with a Scott Instruments magnetic screwdriver. A "Parameter Navigation Map" is also provided at the beginning of the "Technical Reference" section. Four keys are used for all settings:



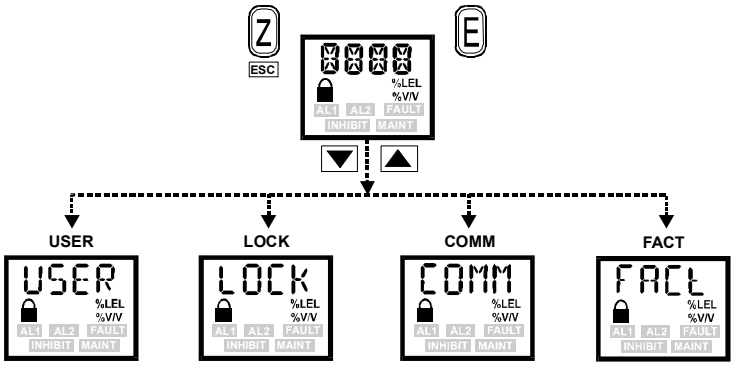
Also referred to as the "Escape" key. Used to zero the instrument and place unit into inhibit. Also used to abort an adjustment and/or back up to the previous menu.



Also referred to as the "Enter" key. Used to select a menu option or to enter a setting.



These keys are referred to as either the "Up" or "Down" keys. Used to move up or down through a menu or to increase/decrease a setting.



RUN Mode

The transmitter's normal operating mode is referred to as "RUN mode". The transmitter will always return to RUN mode if no keys have been activated for 2 minutes. In RUN mode, the LCD's alphanumeric display will show the ambient gas concentrations or a fault code (if a problem exists with the instrument)

How to Adjust Transmitter Parameters

Parameters are located in 4 main menu groups:

- **USER**
- **LOCK (Security)**
- **COMM (Communications)**
- **FACT (Factory)**

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From RUN mode, the user can access the menus by touching the magnet to the ▲ (Up) or ▼ (Down) key then selecting the E (Enter) key. The Z (Esc) key is used to back out of the menu and return to RUN mode.



The instrument continues to sense gas and transmit a signal when it is not in RUN mode.

Each menu contains a set of logically grouped parameters. After a menu has been selected, the first parameter in the menu is displayed on the LCD. For example, if the USER menu is selected, A1.SP (alarm setpoint 1) will be shown on the display. The user can scroll through the parameter list by touching the magnet to either the Up or Down arrow keys.



STEP 1	▼ ▲	Scroll through menus
STEP 2	S ENT	Access the selected menu
STEP 3	▼ ▲	Scroll through the menu's parameters
STEP 4	S ENT	Access the selected parameter
STEP 5	▼ ▲	Scroll to select parameter value
STEP 6	S ENT	Store the selected parameter value. Verify "set" is displayed
STEP 7	ESC	Return to the previous menu level (3x returns to the main display).

A form is provided in the back of this manual to record your transmitter's parameter setup

Touching the magnet to the Enter key while the parameter is displayed (selecting the parameter) causes its value to be displayed for editing. Editing is done by placing the magnet over the Up and Down arrow keys to increment or decrement its value, and then placing the magnet on the Enter key to store the new value. The display changes to “SEt” if successful, or “ERR” if a memory error is detected.

Adjusting LCD Display Contrast

The LCD contrast may be adjusted for better viewing at ambient light levels. To adjust the contrast:

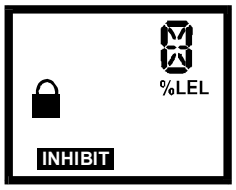
1. From the RUN mode, hold a magnet on the E (Enter) key for 2 seconds. All segments come on and blink.
2. Apply and hold the magnet (for 4 approximately seconds) to the Up (increase) or Down (decrease) arrow keys to adjust contrast. Remove the magnet and allow 5 seconds to view the adjustment results. Reapply the magnet if necessary.
3. Apply the magnet to the E (Enter) key to save the new setting (observe "SEt") or the Esc (Escape) key to abort.

NOTE: Contrast can only be adjusted from the RUN mode.

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Acknowledging Latched Alarms

Latched alarms may be reset only after conditions have returned to normal (concentration is below the alarm reset point). To reset a latched alarm, momentarily apply, then remove, the Scott Instruments magnet to any key. Observe that the specific alarm indication has cleared from the main display.



Inhibiting Output

The ***GasPlus-IR*** transmitter's INHIBIT function prevents activation of alarm relays in addition to holding loop output at the selected inhibit level. *NOTE: Alarms are inhibited automatically at power on (for 30 seconds).* When INHIBIT is toggled ON, it will automatically toggle OFF after 9 minutes. To activate the inhibit function, place the magnet over the Z (Zero) key for 2 seconds, then remove. Observe the LCD displays **INHIBIT**. The inhibit mode can be toggled OFF by again reapplying the magnet over the Z (Zero) key for 2 seconds, then removing. The period may be reprogrammed by changing the value of the **AL.IP** parameter in the **USER** menu.

Zeroing the Transmitter



To ensure the transmitter operates to specifications, power must be applied to the transmitter for at least 20 minutes.

Frequency

Slight changes in the GasPlus-IR 's sensor optics over time will affect its zero point. For this reason, zero adjustment (described below) should be performed periodically. Scott Instruments recommends zeroing the instrument every 6 months. More frequent zeroing may be required in extremely harsh environments containing high concentrations of ambient dust or oil vapor. Zeroing intervals should be independently established through a documented procedure which includes a zeroing log.

Span calibration is only required when the transmitter optics are maintenanced. See "*Maintenance, Troubleshooting, & Product Support: Replacing the Emitter*" for instructions.

Last Zero Date

The date of the transmitter's last zero was performed can be viewed by accessing the SR.Zd parameter in the "User" menu.

Zero Adjustment

When performing zero adjustment on the Model 4688-IR (combustible gas) transmitter, the transmitter's zero may be set while the sensor is exposed to air which is known to be free of hydrocarbons (Scott Instruments recommends the use of a portable zero air cylinder (P/N 077-

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Reminder

Document your adjustment schedule requirements.



Maintain an organized system to prevent confusion between adjusted and unadjusted Instruments.



Properly maintain instruments



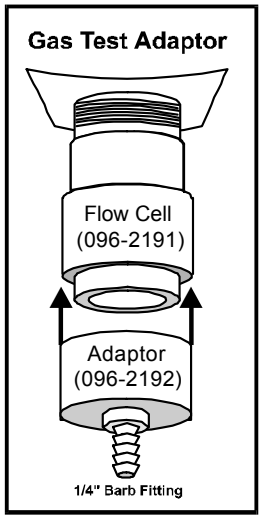
0019). ***When performing zero adjustment on the Model 4679-IR CO2 transmitter, nitrogen must be used.*** After zeroing, the display should read 0 %LEL (or %V/V) and the current loop output will be at 4.00 mA.

Zeroing the transmitter requires a Scott Instruments magnetic screwdriver. This operation can also be performed remotely via the Modbus® interface. The transmitter will not zero if faults are displayed (F. XXX, or dF. XX).

Zero Adjusting Using the Zero Air or N_2 Cylinder

It is important to have the air in the cylinder at the same temperature as the transmitter. A transmitter installed outdoors in direct sunlight is likely to be at a higher temperature than an air-conditioned shop or office. In this case, placing the cylinder outside in direct sunlight for ½ hour before use can help to avoid transient readings caused by flooding the sensor with chilled air. Likewise, when the transmitter is outside during cold months be sure to first equilibrate the cylinder air temperature with the ambient air.

1. Snap the gas test adapter onto the open end of the flowcell (see drawing below). Twist the adapter slightly to help overcome the resistance of the o-ring. Attach the 500 cc/minute regulator to the air cylinder and connect the tubing from the gas barb on the regulator to the gas barb on the gas test adapter. Flow rates up to 2 LPM are permitted.
2. Open the regulator and permit the air to flow for 2 to 3 minutes.
3. Touch the magnet to the Z (Zero) key for 6 seconds until the display shows “SEt”, then remove the magnet. If zeroing the instrument causes a memory error, the display will show “ERR”.
4. For safety, the 4688-IR will not zero when the displayed concentration is at or above 10% LEL. Attempting to zero will result in a display of "ERR" instead of "SEt" (see page 60).



Zero Adjusting to Ambient Air

Only zero the instrument using ambient air after ensuring that it is free of any levels of combustible hydrocarbons. To zero the instrument using the ambient atmosphere follow Step 3 of "*Zero Adjusting Using the Zero Air Cylinder*".

Zero Adjusting the Transmitter Remotely

If the digital communications capabilities of the GasPlus-IR are used, the transmitter can be zeroed from the receiving device. See "*Technical Reference: The COMM Menu*" for instructions.

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Adjusting the Loop Output Parameters

Adjusting the 4-20 mA Output (COMM Menu - MA.04 and MA.20)

Once the transmitter is installed and wired to the current loop, the 4-20 mA levels may be adjusted through the user interface to overcome line or receiver resistance problems. In addition, the current loop may be forced to a level between 1.00 and 20.0 mA for purposes of testing alarms back at the receiver. In order to perform this adjustment, you must be able to monitor the current loop at the receiving device.



1. **This adjustment requires the loop current to be monitored at the receiving device. Refer to the electrical connections drawings in the installation section of this manual.**
2. **To prevent false alarms at the receiver, set the receiver channel to alarm inhibit prior to making these adjustments.**

To adjust the 4 and 20 mA output from RUN mode:

STEP 1 - Touch the magnet to the Up arrow key and observe "USER" in the display.

STEP 2 - Touch the magnet to the Up arrow key until "COMM" appears in the display.

STEP 3 - Touch the magnet to the Enter key and observe "MA.04" in the display.

STEP 4 - Touch the magnet to the Enter key and observe the DAC value (in hexadecimal) corresponding to an output current of 4.00 mA. NOTE: since the current loop has already been calibrated at the factory, this value will be different than the default value. Hold the magnet on the Up arrow key to increase the current loop output (or the Down arrow key to decrease) until the receiver indicates exactly 4.00 mA. Touch the magnet to the Enter key and observe "SEt" on the display. When finished, or if no changes are required, touch the magnet to the Escape key to return to the "MA.04" display.

STEP 5 - Touch the magnet to the Up arrow key and observe the display changes to "MA.20".

STEP 6 - Touch the magnet to the Enter key and observe the DAC value (in hexadecimal) corresponding to an output current of 20.0 mA. Hold the magnet over either the Up or Down arrow keys until the receiver indicates it is receiving exactly 20.0 mA., then touch the magnet to the Enter key and observe "SEt" on the display. When finished, or if no changes are required, touch the magnet to the Escape key 3 times to return to RUN mode.

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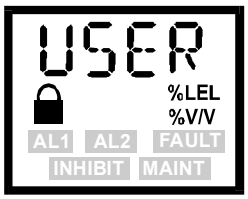
Setting Loop Fault and Inhibit Levels (COMM Menu - MA.F and MA.I)

To indicate abnormal conditions, the transmitter may be programmed to output a current loop level corresponding to either a fault or inhibit state. The "MA.F" and "MA.I" parameters, found in the COMM menu, determine the actual milliampere values which are output during fault and inhibit conditions, respectively.

Testing the 4-20 mA Output (COMM Menu - MA.t)

The MA.t parameter is used to drive loop current to simulated alarm conditions to test a receiver device. Any value between 1.00 and 20.0 mA can be programmed into the transmitter. The "test" output will automatically shut off when exiting the menu. If no keys are pressed the unit will return to Run Mode in 2 minutes.

Setting Alarm and Sensor Parameters



The USER menu accesses the transmitter's alarm and sensor configuration parameters.

STEP 1	▼	Apply the EIT magnet to the Down key once to display the USER menu selection.
STEP 2	E	Enter the USER menu by selecting the E (ENTER) key.
STEP 3	▼ ▲	Scroll to the desired alarm or sensor parameter.
STEP 4	E	Access the selected parameter.
STEP 5	▼ ▲	Scroll to select parameter value (refer toFigure x for parameter options).
STEP 6	E	Store the selected parameter value. Verify “set” is displayed.
STEP 7	ESC	Return to the previous menu level. (3X returns the main display).

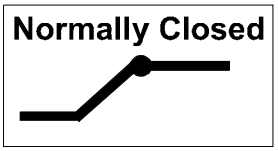


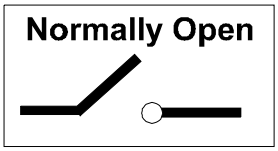
Relay NO/NC Status

The relay's NO or NC configuration *IS SPECIFIED WHEN ORDERING THE TRANSMITTER*.

Position describes the relay’s state when it is inactivated. Normally open (NO) relays represent a break in the circuit; the circuit is completed when the relay is activated. In contrast, with a normally closed (NC) relay the circuit is broken when the relay is activated. Note that a relay’s position (open or closed) is independent of its activation mechanism (energized or de-energized).

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Alarm ***Concentration*** relays assume a non-fail-safe operation and the ***Fault*** relay assumes fail-safe operation. **Changing these modes will reverse the normally open/normally closed status.**

Optional Alarm Relays

Alarm Relay Settings - Model 4688-IR Combustible Gas Transmitter

	Alarm	Set Point	Reset Point	Set Delay	Reset Delay	Failsafe	Latched
Alarm 1	Default	25% LEL	20% LEL	O sec	O sec	NO	NO
	Minimum	0% LEL	0% LEL	O sec	O sec	Operator Selectable	Operator Selectable
	Maximum	60% LEL	60% LEL	5 Sec	600 sec		
Alarm 2	Default	50% LEL	45% LEL	O sec	O sec	NO	YES
	Minimum	0% LEL	0% LEL	O sec	O sec	Operator Selectable	Operator Selectable
	Maximum	60% LEL	60% LEL	O sec	600 sec		
Fault	Default			O sec	O sec	YES	NO
	Options			NO	NO	YES	NO

Pure methane and hexane are provided for monitoring above the UEL and should not be used to monitor below the LEL.

Pure Methane (SR.GN=17) (100% v/v Methane)

	Alarm	Set Point	Reset Point	Set Delay	Reset Delay	Failsafe	Latched
Alarm 1	Default	25% v/v	20% v/v	O sec	O sec	NO	NO
Alarm 2	Default	50% v/v	45% v/v	O sec	O sec	NO	YES
Fault	Default			O sec	O sec	YES	NO

Hexane (SR.GN=18) (20% v/v Hexane)

	Alarm	Set Point	Reset Point	Set Delay	Reset Delay	Failsafe	Latched
Alarm 1	Default	15% v/v	17% v/v	O sec	O sec	NO	NO
Alarm 2	Default	10% v/v	12% v/v	O sec	O sec	NO	YES
Fault	Default			O sec	O sec	YES	NO

Model 4679-IR
CO_2
SR.GN = 64

Alarm Relay Settings - Model 4679-IR CO_2 Gas Transmitter

Alarm		Set Point	Reset Point	Set Delay	Reset Delay	Failsafe	Latched
Alarm 1	Default	0.5% v/v	0.5% v/v	O sec	O sec	NO	NO
	Minimum	0.0% v/v	0.0% v/v	O sec	O sec	Operator Selectable	Operator Selectable
	Maximum	5.0% v/v	5.0% v/v	5 Sec	600 sec		
Alarm 2	Default	1.0% v/v	1.0% LEL	O sec	O sec	NO	YES
	Minimum	0.0% v/v	0.0% v/v	O sec	O sec	Operator Selectable	Operator Selectable
	Maximum	5.0% v/v	5.0% v/v	O sec	600 sec		
Fault	Default			O sec	O sec	YES	NO
	Options			NO	NO	YES	NO

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Alarm 2 should always be configured as a latching alarm. If the A2.OP setting is "0" or "1" (non-latching), the instrument should be connected to an auxiliary system which accomplishes the same purpose as latching.

The GasPlus-IR has 3 optional alarm relays: 2 concentration alarms and 1 fault alarm. Active alarms are displayed on the LCD as shown in the figure to left. ***The appearance of these display indicators does not imply that the associated relay is also active, since the relays are inactive during inhibit.*** When the **INHIBIT** indicator is visible, alarm and fault conditions may be indicated, but their associated relays are held in their normal states (note: fail-safe relays will be held energized during inhibit).

Alarms are inhibited automatically at power on (for 30 seconds), and by touching the Z (Zero) key briefly with the magnet (See *"General Operations: Inhibiting Alarms"*). When the Z (Zero) is used, alarms are inhibited for 9 minutes. The period may be reprogrammed by changing the value of the **AL.IP** parameter in the USER menu.

Changing Alarm Set-Up Parameters

Using the Scott Instruments magnet, access the USER menu and select the desired alarm parameter. Use the Up or Down arrow keys to increment or decrement the value, then touch the magnet to the E (Enter) key to store the reading (observe "SEt" on the display) or the Esc (Escape) key to abort. Use the Z (zero) key to return to the RUN mode.

Set Points and Reset Points

An alarm set point (i.e., A1.SP) is the gas concentration level at which the alarm relay becomes active. A reset point (i.e. A1.RP) is the gas concentration level at which the alarm relay deactivates (note that if the alarm is used in latching mode, the relay will have to be manually reset).

You must always configure both the Set Point and Reset Point for both concentration alarms. Since the Set Point cannot be programmed below the Reset Point, you may be required to first lower the Reset Point. Likewise, the Reset Point cannot be programmed higher than the Set Point, so you may be required to first raise the Set Point.

NOTE: Pure Methane and Hexane transmitters can be programmed with falling alarms.

Set and Reset Delays

A set delay prevents an alarm from activating until the alarm condition has been above the setpoint for a certain amount of time. A reset delay prevents a non-latching alarm from deactivating until the alarm condition has been below the reset point for a certain amount of time.

Reset delays are often used to control ventilation fans (i.e., the fans are kept on past the danger point to ensure that the hazardous condition is absent throughout the area and not just around the transmitter. Set delays are sometimes used to avoid "nuisance trips". No set delay is available on the "high-high" alarm. ***The use of lengthy set delays is strongly discouraged by Scott Instruments .***

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Latching / Non-Latching and Non-Fail-safe / Fail-safe Operation

The relays can be used in latching and non-latching modes, and can be fail-safe or non-fail-safe (per ANSI/ISA standard SP12.13, the high-high alarm can only be used in latching mode). In fail-safe operation, relays are normally energized and de-energized upon alarm activation (in non-fail-safe operation the relays are normally de-energized). In latching mode, alarm indicators must be manually reset by touching any key with the magnet. ***Note that alarm indicators and relays can only be reset if the measured concentration is at or below the reset point.***

Sensor Parameters

The ***USER Menu's*** "SR".xx parameters enables users to change various sensor-related parameters such as engineering units, decimal precision, damping constant, and type gas measured (although the 4688-IR will sense many hydrocarbons, the output will only be linear to a single gas).

For information purposes, the GasPlus-IR also enables users to view certain values held in memory, such as the instrument's full scale (100% LEL or the corresponding %v/v of the gas being measured), the date the transmitter was last zeroed, and ambient temperature.

Report Generation

This Report function would typically be accessed in the field through the RS-232 connection with the output going to a portable printer, datalogger, or PC.

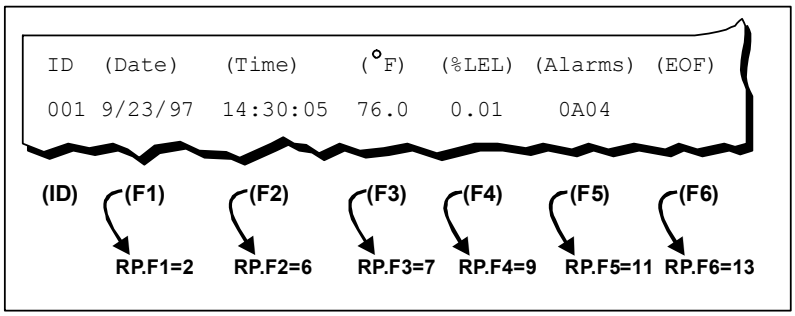
Report generation is accomplished through the ***COMM Menu***. Through the user interface, you may program the 4688-IR to generate one-line reports at intervals ranging from once every second to once every 2 hours (7200 seconds). These reports contain the instrument ID (001-247) and up to 8 fields for data such as date, time, temperature, gas concentration and alarm status. Additionally, the format of the one line report may be controlled for easy import into word processing or spreadsheet programs such as Microsoft® Wordand Microsoft Excel®.

The data that is printed in each of the 8 fields is specified by setting the appropriate code (1-13) in the RP.F1 through RP.F8 parameters. RP" parameters are found in the COMM menu (see "*Instrument Navigation & Parameter Reference*")

In addition to controlling the fields, you also have control over the delimiters appearing between the fields and the termination characters appearing at the end of the line. For these strings, you may specify up to 5 ASCII characters (including spaces, commas, tabs, quotes, etc.) . All you need to know are the hexadecimal ASCII codes for each character in the string. If the delimiter or termination string is less than 5 characters, you must enter 0 after the last character. Characters appearing after the 0 will be ignored.

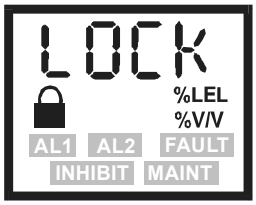
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An example of the default report format is shown.



The report consists of the ID, date, time, temperature in Fahrenheit, gas concentration in %LEL, and the alarm/relay status. The delimiter string is a single space which is defined as hexadecimal 20 (decimal 32), and the termination string is the carriage return and line feed characters represented as hexadecimal 0d (decimal 13), and hexadecimal 0A (decimal 10), respectively.

Setting Transmitter Security



Transmitter password protection is accessed through the **LOCK Menu. The** Gas Plus-IR transmitter employs password protection as means of prohibiting unauthorized access to calibrations and critical parameter settings. When the lock is enabled (lock icon appears on display), parameters may be viewed but not changed until the lock is disabled (no icon visible). The lock is toggled on and off by simply entering the password at the LK.ON parameter (default 000). This 3 digit password may be changed via the LK.PW field. Once unlocked, the transmitter may be programmed to re-lock itself automatically after a specified period.

STEP 1	▼	**Apply the EIT magnet to the Down key 2 times to display the LOCK menu selection.**
STEP 2	E	**Enter the LOCK menu by selecting the E (ENTER) key.**
STEP 3	▼ ▲	**Scroll to the desired parameter.**
STEP 4	E	**Access the selected parameter.**
STEP 5	▼ ▲	**Scroll to select parameter value .**
STEP 6	E	**Store the selected parameter value. Verify "set" is displayed.**
STEP 7	ESC	**Return to the previous menu level. (3X returns the main display).**

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Toggling Parameter Security On/Off (LK.ON)

To toggle the state of the lock, scroll to the LK.ON parameter and touch the magnet to the E (Enter) key. Observe the display changes to 000. Hold the magnet on the Up key ▲ until the display changes to the stored password (000 by default) and touch the Enter key. Observe the display shows "SEt" momentarily, and the lock icon appears (if enabling security) or disappears (if disabling security). If the wrong password is entered, "ERR" will appear on the display.

Changing the Password (LK.PW)

The password is located in the LOCK menu as the LK.PW parameter. When the system is unlocked (no icon visible), the password may be viewed and changed just like any other parameter. However, when the system is locked the password is displayed as 000. Attempting to enter a new password will result in a display of "Err" instead of "SEt".

Auto-Lock Timer (LK.tM)

As an option, parameter security is automatically re-enabled (after being toggled off) by specifying a nonzero value in the LK.tM parameter. The value appearing in the LK.tM parameter is the number of minutes (1 to 90) which the transmitter remains unlocked before automatically re-locking itself (the feature is disabled when LK.tM=0). The time-out period begins at the moment the transmitter is unlocked and will re-lock only after the period has expired and the mode has returned to RUN mode (the transmitter will not self lock during parameter editing). Note that the instrument always returns to RUN mode if no keys have been activated for two minutes. Additionally, if the transmitter experiences a hardware reset (i.e., power cycle) with a nonzero value programmed in the LK.tM parameter, it will immediately enable the security.

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Instrument Parameter Change Example

The example below will permit you to practice using the interface while actually setting the alarm 1 parameters for a transmitter set to monitor a gas requiring *rising alarms*.

Note: The following is to be used as an example only and should not be used as a guideline for your transmitter's parameter(s) setup. Transmitter setup must be determined by the user.

1. With the instrument in RUN mode, place the magnet on the Up arrow key and observe “USER” in the display. This is the user menu selection. Remove the magnet before the next selection scrolls into the display. If another selection does scroll in, repeat touching the Up arrow key until “USER” is finally displayed.
2. Place the magnet on the E (Enter) key and observe “A1.SP” on the display. This is the alarm 1 set point selection. Remove the magnet.
3. Place the magnet on the Enter key again and observe “25.00” (this may be different if already reprogrammed from the factory value). Remove the magnet.
4. Hold the magnet over the Down arrow key to decrement the value, or the up key to increment the value as desired. Note that the alarm set point may not be programmed below the alarm reset point. When the desired value is displayed, remove the magnet.
5. To save the new value, place the magnet over the Enter key and observe “SEt” in the display. The new value is saved in user parameter memory and the user parameter checksums are updated. If a parameter memory error is detected while saving the new value, “ERR” will be displayed (and the appropriate fault code will be displayed upon returning to RUN mode). Place the magnet over the Escape key (ESC) to return to the “A1.SP” selection.
6. To abort changes to the old value, place the magnet over the Escape key (ESC) and observe the display returns to the “A1.SP” selection.
7. Place the magnet momentarily over the up key and observe the display changes to “A1.RP”. This is the alarm 1 reset point. Place the magnet over the Enter key to display the reset point value. Use the magnet over the Up and Down arrow keys to change to the desired value. Remember that the alarm reset point cannot be programmed above the alarm set point. Place the magnet over the Enter key to save the new value and observe “SEt” in the display. If the value cannot be saved in memory, “ERR” will be displayed. Place the magnet over the Escape key (ESC) to return to “A1.RP” selection.
8. Momentarily touch the Up arrow key and observe “A1.Sd”. This is the alarm 1 set delay value in seconds. Use the same procedure detailed in steps 3-7 to set the desired value, and select and set the remaining alarm parameters: “A1.RD” (reset delay), “A1.OP".

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Serial Communications

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Setting Up For Digital Communications

Wiring and configuring the GasPlus-IR for digital communication is fairly straightforward, though more involved than for analog transmission. Slight setup differences exist depending on whether RS-485 and RS-232 data transmission is used.

While RS-232 buses require no termination resistors, multi-drop RS-485 buses must be terminated on both ends by a resistor that matches the characteristic impedance of the transmission line, which is typically between 100 W and 200 W (the characteristic impedance should be provided in the cable's technical specifications). The standard configuration of the GasPlus-IR includes a 120 W termination resistor, which is adequate for most buses and saves the user from having to provide any termination. This resistor should be removed for all instruments except the one farthest from the master. (See *Figures 4 and 5* on page 15.)

Note that RS-485 and RS-232 connections are the same in both current sinking and sourcing configurations (although ground and 4-20 mA connections differ).

Once a device is powered and connected to the bus (see Electrical Installation drawings), it needs to be configured for use with the master. All communications parameters are contained within the COMM menu. Note that these settings (except for SC.Ad instrument address parameter) ***must be the same for all devices on the network*** (including the master).

Note that all COMM parameters settings (except for SC.Ad) *must be the same for all devices on the network <u>including the master</u>*.

Three data transmission methods are available on the GasPlus-IR: RS-232C, RS-485, and 4-20 mA These methods have quite different characteristics.

Comparison of Data Transmission Methods

	4-20mA	RS-232C	RS-485
Data Format	**Analog**	**Digital**	**Digital**
Transmission type	Current loop	Referred to ground	Differential
Max. transmitting devices	1	1	32 *
Max. receiving devices	1	1	32 *
Max. line length	n/a	15m	1,000m
Max. transmission rate**	n/a	38.4 kB/s	90-500 kB/s

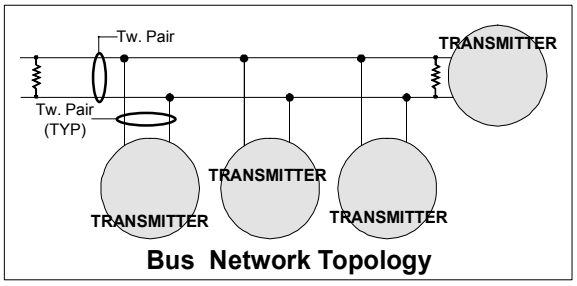
The number of transmitting and receiving devices on an RS-485 bus can be increased by the use of repeaters.

****4688/79-IR maximum transmission rate = 9600 bps.***

Since RS-232C can only be used for point-to-point communication while RS-485 can be used for multi-drop systems, the GasPlus-IR will typically use RS-485 for digital communications (unless it is connected directly to a PC, in which case RS-232C would generally be used). Digital communication on the GasPlus-IR follows the Modbus® protocol.

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RS-485 data transmission requires a bus topology, as does Modbus™.



RS-485/232 Topology

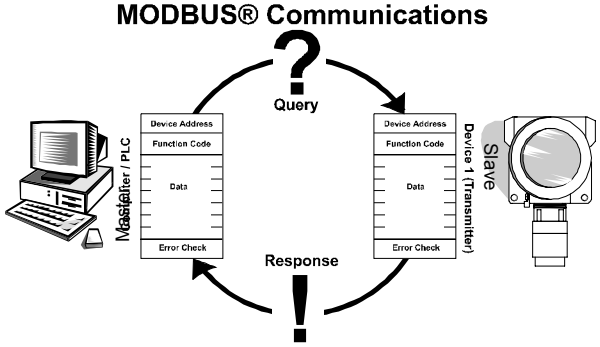
Because RS-485 (and RS-232) transmission uses two wires for communications, instruments using this method are 4-wire devices (2 wires for power, 2 wires for communications). Note that RS-485 cable, such as Belden 9841 and Manhattan 3993, should be used instead of standard 18 AWG instrumentation cable.

RS-485 limits the number of slave devices to 32. This limit is driven by power considerations and can be overcome through the use of repeaters (also called extenders), each of which allows another 32 devices and 1,000 m to be added to the bus. Modbus® protocol limits the number of slave devices to 247. The 4688-IR limits the transmission rate to 9600 baud.

MODBUS Protocol (or Network)

In the Modbus® protocol, up to 247 transmitting and receiving devices can be used on a single bus (not including the DCS or PLC).

Modbus® uses master/slave (centralized) bus access. The master (a PLC, PC-based MMI, or DCS) continuously sends queries to the devices connected to the bus. Upon receiving a request, a slave device sends a response to the master. Note that all devices constantly monitor the bus for instructions but only transmit information upon receipt of a query - in other words, a slave can never initiate a dialog. This is in contrast to 4-20 mA devices, which continuously transmit data back to the receiver.



Modbus® has two data transmission modes, ASCII and RTU, which define how information is packed into message fields and decoded. The GasPlus-IR supports only the RTU mode.

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Using MODBUS® Serial Communications

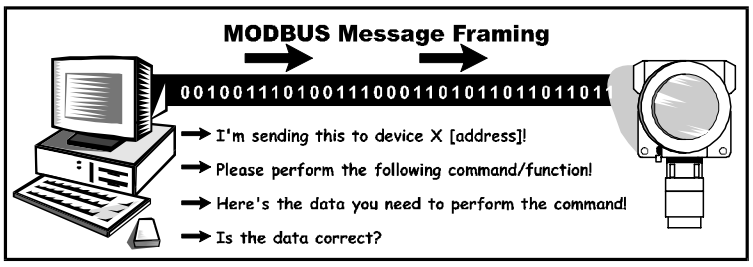
Serial communication parameters are accessed through the **COMM menu**.



Using the transmitter on Modbus®-based systems requires a proficient knowledge of the "master" (application layer) device (i.e., Scitec, PLC, etc.) to be used. Scott Instruments can only provide troubleshooting assistance on the use of MODBUS with its transmitter. Requests for assistance regarding the application layer application must be directed toward the manufacturer.

Modbus® Protocol Message Framing

As mentioned previously, the Modbus® protocol uses master/slave (centralized) bus access. The protocol provides frames for the transmission of messages between the master and slaves. The information in the message is the address of the intended receiver, what the receiver must do, the data needed to perform the action, and a means of checking errors.



Messages (both queries and responses) in Modbus® RTU are 'framed' by silent intervals. If a silent interval of over 1.5 characters occurs within a message, the receiving device times out and flushes the incomplete message. A silent interval of 3.5 or more characters marks the "official" end of a message; messages that begin within this interval will result in errors.

Configuring the Master Device and Tagging Data Elements

To simplify programming of the master (Wonderware®, Citect®, PLC, etc.), it is generally desirable to assign names to, or "tag," the data elements that will be used in an instrument. In a PC-based application such a Wonderware® this is accomplished by generating a "tag" database which assigns values to each transmitter's various parameters that are to be used. Each parameter is given a unique "tag" name. Since more than one transmitter will typically exist in a Modbus® configuration, parameter tags will also reflect the device (unit) assignment (SC.Ad =1, SC.Ad =2, etc.). A tag database may look like the following example:

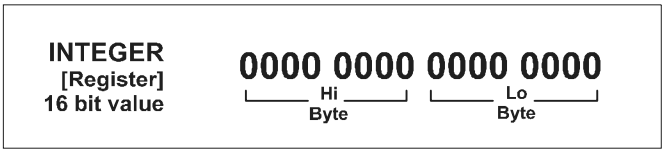
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TAG DATABASE EXAMPLE

NAME	TYPE	UNIT	ADDR	RAW_ZERO	RAW_FULL	ENG_ZERO	ENG_FULL	ENG_UNITS	FORMAT
GAS_1	REAL	IODev1	40019	0	100.0	0	100.0	PCT	### EU
TEMP_1	REAL	IODev1	40021	0	100.0	0	100.0	DEG	### EU
GAS_2	REAL	IODev2	40019	0	100.0	0	100.0	PCT	### EU
TEMP_2	REAL	IODev2	40021	0	100.0	0	100.0	DEG	### EU
A2_SP_1	REAL	IODev1	40259						
A2_RP_1	REAL	IODev1	40263						

In general, it will be necessary to configure the master to communicate with the GasPlus-IR. Modbus® drivers are available for most master devices (DCSs, PLCs, and PC-based MMIs); if a master requires drivers for Modicon® PLCs rather than the Modbus™ protocol, users should select the Model 884 driver.

Note: Some parameter addresses may specify "Hi byte" or "Low Byte". This refers to the area used to store the value within the 16 bit register:



Registers, Coils, and Addresses

The Modbus® protocol allows the master device to read from, or write data to the transmitter using two data types: coils (1 bit) and registers (16 bits). However, consecutive groups of coils and registers can be combined to form other logical and real data types.

Organizing parameter data within transmitter memory improves communications efficiency. The GasPlus-IR's first 25 registers and commonly used coil addresses have been organized for just this purpose:

Register Address	Description	Suggested Tag	
40001	Function select register	FSR	
40002	Parameter select register	PSR	
40003-40006	Character data registers	CDR1 - CDR4	
40007-40010	Integer data registers	IDR1 - IDR4	
40011-40014	Long data registers	LDR1 - LDR2	
40015-40018	Real data registers	RDR1 - RDR2	
40019	Gas concentration (read only)	GAS	READ ONLY
40021	Temperature (read only)	TMP	
40023	Transmitter status (read only)	STS	
40024	General fault status (read only)	GFS	
40025	Sensor faults status (read only)	SFS	

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Refer to Appendix 1 for a complete description of MODBUS™ Registers & Coil Addressing

Coil address	Description	Suggested Tag
353	STS, relay 1 (1 = energized)	RL1
354	STS, relay 2 (1 = energized)	RL2
355	STS, fault relay (1 = energized)	RLF
356	STS, alarm indicator 1 (1 = active)	AL1
357	STS, alarm indicator 2 (1 = active)	AL2
358	STS, fault alarm indicator (1 = active)	ALF
359	STS, maint indicator (1 = active)	MNT
360	STS, inhibit indicator (1 = active)	IHB
361	STS, concentration units (1 = %v/v)	VOL
362	STS, temperature units (1 = °C)	DGC
363	STS, lock indicator (1 = active)	LCK
364	STS, remote function failure (1 = fail)	RFF

READ ONLY

Likewise, how parameter data is accessed also improves efficiency. The use of coils to read/write data to the instrument increases the quantity of transactions required to obtain parameter data (Coil addressing is typically used in applications where PLCs are used). For instance, to obtain data for 3 parameters a separate 8-bit transaction is required to occur (even though the coil is only 1 bit) for each transaction [query]. However, when using a register a "*range"* of data *(data high/data low)* can be specified within the query. This allows the master device to request data for more than one parameter in a single transaction rather than the high overhead required by accessing individual coils.

Accessing Parameter Data - The ABC's of Reading & Writing

To write a parameter into the instrument's nonvolatile memory, the data element within the application layer must specify the appropriate instructions by directing values to the appropriate address registers. ***Each parameter's data type, address, and parameter number are specified within the tables provided in the "Instrument Navigation & Parameter Reference". Appendix 1 provides Modbus® Register Address locations and Appendix 2 Command Function descriptions.***

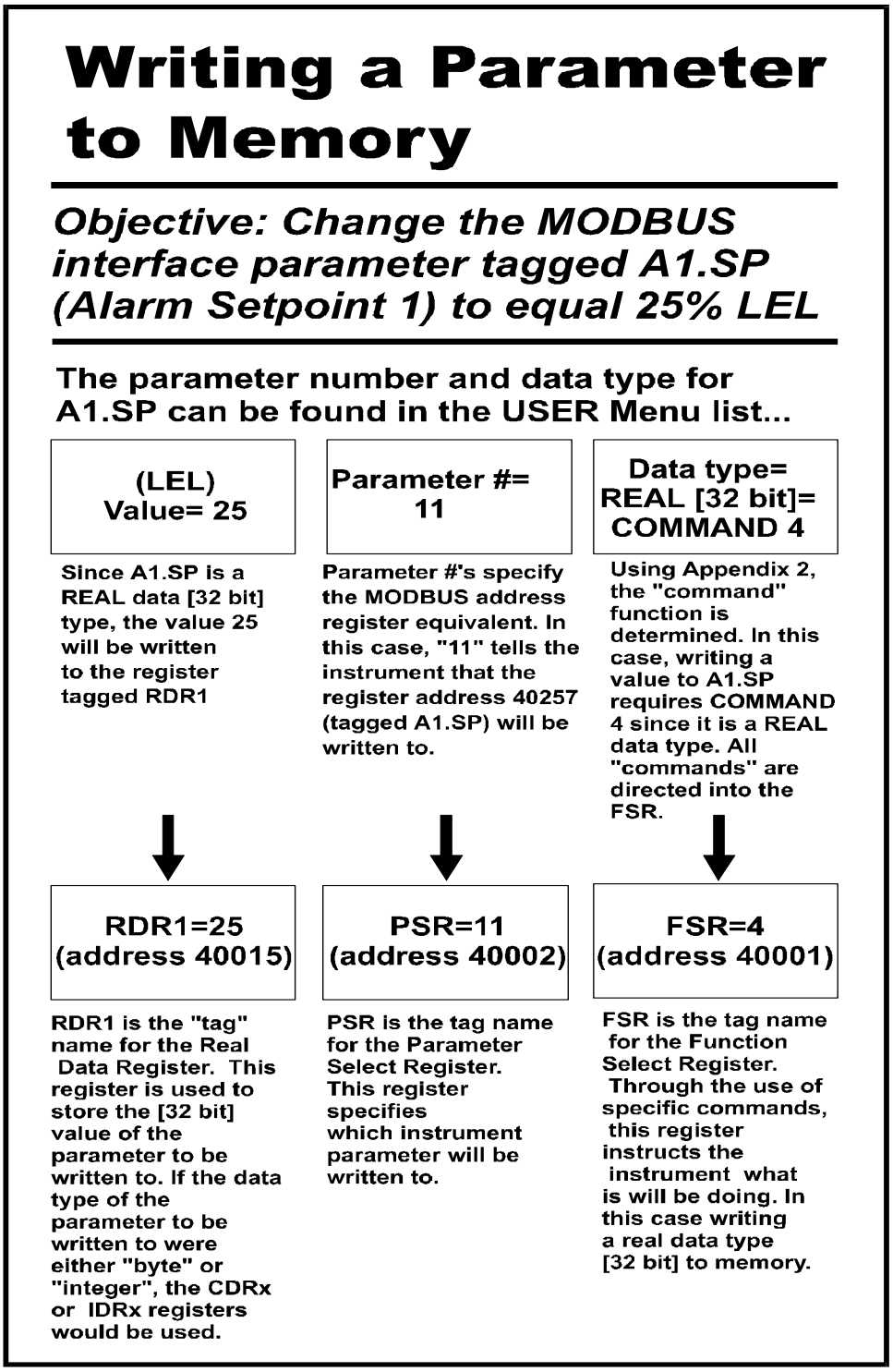
The basics of writing a value to a parameter is summed up in 4 steps:

1. Write the input data to the appropriate data registers according to its data type (i.e. write an alarm setpoint [32-bit] value to RDR1 [register 40015]).
2. Write the Parameter Number to the parameter select register (PSR). *Note: This step is only required for command functions 1, 2, and 4.*
3. Write the "command" function code to the FSR (see Appendix 2 for command function code descriptions).
4. Read the Transmitter Status Register (STS) RFF bit register to verify success: a 1 indicates the command/adjustment has failed (note: this step is not required, but is recommended).

The instrument continuously scans the FSR and, upon finding non-0 value, uses the data in the PSR and the data registers to perform the appropriate function (afterwards resetting the FSR to 0). This process enables the instrument to check the validity of data sent and provide real-time feedback.

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The other data access registers provide continuously-updated READ ONLY data for transmitter gas concentration, temperature, and status (see Appendix 1). All parameters defined in the USER, LOCK, COMM, and FACT menus are also available to users on a READ ONLY basis.



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Instrument Navigation & Parameter Reference

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Parameter Navigation Map



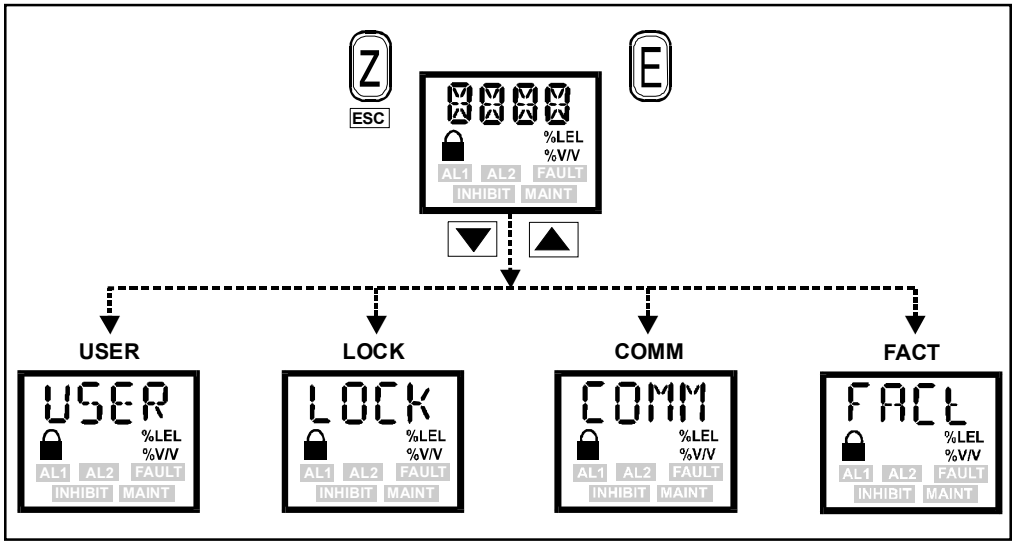


Figure 11 - Parameter Navigation Map

Alarm and Sensor Parameters.

Adjusts alarm setpoints, relay operation and various sensor parameters such as gas type and display engineering units.

Alarm Parameters:

A1.SP	A2.Sd
A1.RP	A2.Rd
A1.Sd	A2.OP
A1.Rd	AF.NL
A1.OP	AF.OP
A2.SP	AL.IP
A2.RP	AL.tO

Sensor Parameters:

SR.CU	SR.tP
SR.dC	SR.tU
SR.dP	SR.ZM
SR.FS	SR.Zd
SR.GN	SR.ZY

Lock Functions

Used to secure system parameters from tampering.

- LK.ON
- LK.PW
- LK.tM

Communications Functions

Adjusts transmitter 4-20 mA out, serial comm, and report generator parameters.

Current Loop
- MA.04
- MA.20
- MA.F
- MA.I
- MA.t

Report Generator
- RP.ON
- RP.D1 thru RP.d5
- RP.E1 thru RP.E5
- RP.F1 thru RP.F6

Real Time Clock
- RT.MO
- RT.Dt
- RT.YR
- RT.HR
- RT.MN

Serial Comm

SC.Ad	SC.Md
SC.bR	SC.OP
SC.dL	SC.P
SC.Id	SC.RS
	SC.Rt
	SC.Sb
	SC.VF

Factory Functions

Used to adjust sensor parameters after transmitter maintenance. Typically not used except after sensor bulb maintenance and replacement.

F.PWD	
F.tMR	SR.G2
F.AGC	SR.Ht
F.NOP	SR.H1
F.CAL	SR.H2
F.HtZ	SR.L1
F.RES	SR.L2
GW.W0	SR.R1
GS.W1	SR.R2
SR.FA	SR.SN
SR.D1	Sr.tY
SR.D2	SR.ZC
SR.G1	SR.ZR
	SW.ID

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The USER Menu

Adjusts alarm setpoints, relay operation, and various sensor parameters such as gas type, display engineering units.

Displayed As:	Description		Min	Max	Default Value	MEM Region	MODBUS Register Address	Data Type [BITS]	Assigned Parameter #
USER MENU - Alarm Relay Parameters									
A1.SP	**Alarm 1 Set Point** (High* Alarm) At or above this concentration the unit will turn on the alarm's display indicator and activate the associated alarm relay. Units are the same as the displayed reading in RUN mode (%LEL or equivalent %V/V). Value must be equal or greater than the alarms reset point.		0 %LEL	60 %LEL (or equiv. %V/V)	25 %LEL	PMEM	40257	REAL [32]	11
		CO_2	0.0 %v/v	5.0 %v/v	0.5%v/v				
A1.RP	**Alarm 1 Reset Point** - At or below this concentration the unit will turn off the AL1 display indicator and deactivate the alarm's relay. Units are the same as the displayed reading in RUN mode (%LEL or equivalent %V/V).		0 %LEL	60 %LEL E14(or equiv. %V/V)	20 %LEL	PMEM	40261	REAL [32]	12
		CO_2	0.0 %v/v	5.0 %v/v	0.5%v/v				
A1.Sd	**Alarm 1 Set Delay** in seconds. Delays activation of the alarm's display indicator and the alarm's relay after the concentration rises to (or above) the alarm's set point value.		0s	5 s	0 s	PMEM	40265	Unsigned Integer [16]	13
A1.Rd	**Alarm 1 Reset Delay** in seconds. Delays de activation of the alarm's display indicator and the alarm's relay after the concentration to (or below) the alarm's reset point value.		0 s	600 s	0 s	PMEM	40268	Unsigned Integer [16]	14
A1.OP	**Alarm 1 Options** - Specifies options for the alarm 1 indicator and relay. 0 = Non-latching, non-failsafe 1 = Non-latching, failsafe 2 = Latching, non-failsafe 3 = Latching, failsafe The failsafe option keeps the relay energized in the non-alarm state and de-energizes it on alarm (and power) failure. The latching option requires that the alarm indicator be manually reset and re-latched, once the concentration has fallen to (or below) the alarm's set point value.		0	3	0	PMEM	40272 [Low byte]	Unsigned Byte [8]	15
A2.SP	**Alarm 2 Set Point** (High/High* Alarm) - See A1.SP for details.		0 %LEL	60%LEL (or equiv. %V/V)	50%LEL	PMEM	40259	REAL [32]	16
		CO2	0.0 %v/v	5.0 %v/v	1.0 %v/v				
A2.RP	**Alarm 2 Reset Point** - See A1.SP for details. ***IMPORTANT!*** Alarm 2 should always be configured as a latching alarm.		0 %LEL	60% LEL (or equiv. %V/V)	45% LEL	PMEM	40263	REAL [32]	17
		CO2	0.0 %v/v	5.0 %v/v	1.0 %v/v				
A2.Sd	**Alarm 2 Set Delay** in seconds. See A1.Sd for details.		0 s	0 s	0 s	PMEM	40266	Unsigned Integer [16]	18
A2.Rd	**Alarm 2 Reset Delay** in seconds. See A1.Rd for details.		0 s	600 s	0 s	PMEM	40269	Unsigned Integer [16]	19
A2.OP	**Alarm 2 Options** - Specifies options for the alarm 2 indicator and relay. See A1.OP for details.		2	3	2	PMEM	40272 [hi byte]	Unsigned Byte [8]	20

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Displayed As:	Description		Min	Max	Default Value	MEM Region	MODBUS Register Address	Data Type [BITS]	Assigned Parameter #
USER MENU - Alarm Relay Parameters *(continued...)*									
AF.NL	**Maximum Negative Drift Fault Alarm** - At or below this concentration the unit will display the fault indicator, open the fault relay, and output the programmed milliamp fault level. Units are the same as the displayed reading in RUN mode.		-10 %LEL(or equiv. %V/V)	0 %LEL	-5 %LEL	PMEM	40331	REAL [32]	21
		CO2	-2.0% v/v	0.0 %v/v	-2.0% v/v				
AF.OP	**Fault Alarm Options.** ***This parameter should never be set to "0" on the Model 4688I-R.*** 0= non-latching,non-failsafe 1=non-latching, failsafe The failsafe option keeps the relay energized in the non-alarm state and de-energizes it in alarm (and power failure). The latching option requires you to manually reset the alarm indicator and relatch after an alarm, once concentration has fallen to (or below) the alarm's setpoint value.		0	1	1	PMEM	40273	Unsigned Byte [8]	22
AL.IP	**Alarm Inhibit Period** - Specifies the number of minutes which the alarm inhibit period will remain on before automatically timing out and re-enabling alarm relays.		9 min.	120 min.	9 min.	PMEM	40271	Unsigned Integer [16]	23
AL.tO	**Alarm Test Over-Ride** - Used to test each alarm indicator and relay individually, or in groups (regardless of the alarm inhibit state). Activates alarm indicators and energizes non failsafe relays (de-energizes failsafe relays). Note that this test has no affect if the alarm is currently active and cannot be used to turn off an alarm. The state is reset to 0 at startup and is defined below: 0 - None 4 - Fault 1 - AL1 5 - AL1, Fault 2 - AL2 6 - AL2, Fault 3 - AL1, AL2 7 - AL1, AL2, Fault NOTE: To prevent false alarms at the receiver, set the receiver channel to alarm inhibit prior to making these adjustments.		0	7	0	VMEM			
USER MENU - Sensor Parameters									
SR.CU	**Sensor Concentration Units** - Specifies the units in which to display the measured concentration, full scale value, alarm set points, alarm reset points, and negative concentration limit: 0=%LEL 1=%V/V. The transmitter will automatically change the display will automatically change the displayed decimal precision based on this setting. When %LEL is chosen, the decimal precision is automatically changed to 0 (no decimal point). When %v/v is chosen, the decimal precision is changed to 1 (0.1). The decimal precision precision may be overridden using the SR.dP parameter.		0	1	0 (%LEL)	PMEM	40336	Unsigned Byte [8]	25
		CO2	1	1	1(% v/v)				

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Displayed As:	Description		Min	Max	Default Value	MEM Region	MODBUS Register Address	Data Type [BITS]	Assigned Parameter #
USER MENU - Sensor Parameters *(continued...)*									
SR.dC	**Sensor Damping Constant** - Specifies the damping time constant in seconds. This is the amount of time that it will take the unit to reach 63% of its final value when suddenly exposed to a known concentration of gas. The time to reach 95% of final value may be estimated by multiplying this setting by 3. This period is only valid for an immersion test without membrane filters and does not include the time required to transport the gas or fill the sensor chamber. Note that the lower the damping time constant, the more unstable the reading will be.		0 s	2 s	2 s	PMEM	40337 [hi byte]	Unsigned Byte [8]	26
SR.dP	**Sensor Decimal Precision** - Specifies the maximum precision of the displayed concentration. 0=No Decimal Point 1=0.1 2=0.01 3=0.001		0	3	0 (No Decimal Point)	PMEM	40337 [low byte]	Unsigned Byte [8]	27
SR.FS	**Sensor Full Scale (Read Only)** - This value represents the concentration level (in %LEL or %V/V) corresponding to 20 mA on the 4-20 mA current loop output. It is assigned according to gas selection and displayed engineering units. When displaying the measured concentration in %LEL, the value is always 100. When measuring the concentration in units of %V/V, the value is the % mix of gas to air (at STP) known as the Lower Explosive Limit (or Lower Flammable Limit).		1	100	100	PMEM	40329	REAL [32]	28
		CO_2	0.00% v/v	5% v/v	5(% v/v)				
SR.GN	**Sensor Gas Number** - Specifies the particular hydrocarbon gas for which the transmitter will produce a reading and output signal which is linear to the measured concentration. **NOTE**: *changing this parameter RESETS the alarm setpoints and reset points, the negative drift limit, the display units, and decimal precision parameters. See the parameter description for default values.* 1. Methane 2. Ethane 3. Propane 4. Butane 5. Pentane 6. Hexane 9. Ethylene* 10. Propylene 11. Acetone* 12 . IPA* 13. MEK* 14. Toluene* 15. Methanol* 16. Butadiene* 17. Pure Methane* 18. 20% V/V Hexane* 19. Ethanol* 20. Benzene 21. Xylene 22. Isobutanol Isobuty Alcohol 23. Rotosolv-1 24. Cyclohexane 64. Carbon Dioxide ** *Only the "extended" gas(es) specifically ordered can be selected. "Extended" gases are only included in transmitters ordered with this option and are not found in units equipped with only the "standard" gas set. **The Carbon Dioxide (SR.GN-64) setting is available.		1	6	1 (Methane)	PMEM	40335	Unsigned Byte [8]	29
SR.tP	**Sensor Temperature (Read Only)** - This is the temperature in either °F or °C, according to the value current set by SR.tU (below).		-99.0°F	500°F	Current	VMEM	40405	REAL [32]	30

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Displayed As:	Description		Min	Max	Default Value	MEM Region	Address	Data Type [BITS]	Assigned Parameter #
USER MENU - Sensor Parameters *(continued...)*									
SR.tU	**Sensor Temperature Units** - Determines the units of measure for the temperature reported under SR.TP: 0=°F / 1=°C		0	1	0 (°F)	PMEM	40336	Unsigned Byte [8]	31
SR.ZM	**Sensor Zero Month (Read Only)** - When the unit is zero calibrated, it stores the month under this parameter. Since the unit is zero calibrated during manufacture, the month will be set at that time. The value is reset to 1 when default parameters are restored. 1=January 2=February, etc.		1	12	12 (updated during mfg.)	PMEM	40313	Signed Byte [8]	32
SR.ZD	**Sensor Zero Date (Read Only)** - When the unit is zero calibrated, it stores the date under this parameter. Since the unit is zero calibrated during manufacture, the date will be set at that time. The value is reset to 1 when default parameters are restored.		1	31	31 (updated during mfg.)	PMEM	40314	Signed Byte [8]	33
SR.ZY	**Sensor Zero Year (Read Only)** - When the unit is zero calibrated, it stores the last 2 digits of the year under this parameter. Since the unit is zero calibrated during manufacture, the year will be set at that time. The value is reset to 97 when default parameters are restored.		0	99	97 (updated during mfg.)	PMEM	40313	Signed Byte [8]	34

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The LOCK Menu

Accesses the transmitter's security features.

Displayed As:	Description		Min	Max	Default Value	MEM Region	MODBUS Register Address	Data Type [BITS]	Assigned Parameter #
LK.ON	**Lock On/Off (Password Entry Required)** - Entering the current password in this field toggles the lock status from On to Off, or from Off to On. The LCD lock icon is visible to indicate the transmitter is locked. Note that the transmitter can automatically re-lock when a non-zero value is entered under the LK.TM parameter.		0	999	000 NOT LOCKED	PMEM	40312 [low byte]	Unsigned Byte [8]	40
LK.PW	**Lock Password** - The lock password is visible for changing only when the lock icon is not present on the LCD. The master password is 251 and will open the lock at any time.		0	999	0	PMEM	40311	Integer [16]	41
LK.TM	**Auto-Lock Time-Out** - Specifies the number of minutes after which the transmitter will automatically re-lock. The period begins from the moment of toggling the lock off, and will not re-lock until resuming operation in RUN mode (will not auto-lock while reviewing or editing parameters). The feature is completely disabled by setting the parameter to 0.		0 min	90 min	0 min	PMEM	40312 [hi byte]	Unsigned Byte [8]	42

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The COMM Menu

Accesses the transmitter's loop current, report generator, and serial communication parameters.

Displayed As:	Description		Min	Max	Default Value	MEM Region	MODBUS Register Address	Data Type [BITS]	Assigned Parameter #
COMM MENU - Loop Current Parameters									
MA.04	**4.00 mA Loop Cal Point** - This value can be adjusted to drive precisely 4.00mA to calibrate the 0% concentration level, which can help overcome excessive wire/receiver loading. The value presented is the hexadecimal value that is written to the digital-to-analog converter (DAC). NOTE: There is a 5 second delay between the time the parameter is set and the time the output is seen by the receiving device.		The loop adjustment parameters are typically not used in serial communications. In applications using 4-20 loop these adjustments are adjusted at the transmitter while observing the receiver's zero or full scale readings.			LMEM			
MA.20	**20.0 mA Loop Cal Point** - This value can be adjusted to drive precisely 20.0 mA at the full scale concentration level, which can help overcome excessive wire/receiver loading. The value presented is the hexadecimal value that is written to the digital-to-analog converter.					LMEM			
MA.F	**4-20 mA Fault Level** - Specifies the output in milliamps when the transmitter detects a fault condition.		2.4 mA	4.0 mA	3.2 mA	PMEM	40345	REAL [32]	45
MA.I	**4-20 mA Inhibit Level** - Specifies the output in milliamps when the transmitter is placed into an alarm inhibit condition.		1.5 mA	20.0 mA	1.5 mA	PMEM	40343	REAL [32]	46
MA.t	**4-20 mA Test Level** - Specifies the output in milliamps which is forced onto the current loop for test purposes (checking alarms at the receiver, etc.).		1.0 mA	20.0 mA	4.0 mA	PMEM	40341	REAL [32]	47
COMM MENU - Report Generator Parameters									
RP.ON	**Report On/Off** - When set to 1, a report line is transmitted on the serial communication interface which may be sent to a printer, or to a host computer for data capture. Since the reports are not synchronized by a master, the communication must occur on dedicated serial port (cannot be shared by more than one transmitter). The report rate is determined by the RP.Pd parameter and the format of the report line is controlled by the RP.F1 through RP.F8 parameters. Field delimiters and line termination strings are specified by the RP.d1 through RP.d5 and RP.E1 through RP.F5 parameters.		0	1	0 (Off)	PMEM	40310	Unsigned Byte [8]	48

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Displayed As:	Description	Min	Max	Default Value	MEM Region	MODBUS Register Address	Data Type [BITS]	Assigned Parameter #
COMM MENU - Report Generator Parameters								
RP.d1 thru RP.d5	**Report Delimiter String -** These parameters contain each character of the null terminated delimiter string which is printed between fields of the report line. The parameter value is the hexadecimal ASCII code representing a single character. RP.d1 contains the first character, followed by RP.d2, RP.d3, etc. The null terminated string may be up to 5 characters in length; the last character must be 0. Examples: (space): RP.d1=20, RP.d2 thru RP.d5=0 (comma): RP.d1=2C, RP.d2 thru RP.d5=0 (tab): RP.d1=09, RP.d2 thru RP.d5=0 (comma+space): RP.d1=20, RP.d2=2C, RP.d3 thru RP.d5=0	0	FF (hex)	RP.d1=20 RP.d2=0 RP.d3=0 RP.d4=0 RP.d5=00 (space)	PMEM	40303	Byte [40]	50 thru 54
RP.E1 thru RP.E5	**Report Line Termination String -** These parameters contain each character of the null terminated delimiter string which is printed between fields of the report line. The parameter value is the hexadecimal ASCII code representing a single character. RP.E1 contains the first character, followed by RP.E2, RP.E3, etc. The null terminated string may be up to 5 characters in length. The last character must be 0. Examples: (carriage return): RP.E1=0d, RP.E2 thru RP.E5=0 (carriage return+line feed): RP.E1=0d, RP.E2=0A, RP.E3 thru RP.E5=0	0	FF (hex)	RP.E1=0d RP.E2=0A RP.E3=00	PMEM	40306	Byte [40]	55 thru 59
RP.F1 thru RP.F8	**Report Fields -** Data may be printed in up to 8 fields in the form of a 1 line report. The data that is printed in each of the 8 fields is specified by setting an appro. code (1-13) in the RP.F1 thru RP.F8 parameters. The table below lists each code and the data that is printed when the code is used. Note that the first field printed is always the device ID (SC.Id). 0 (blank). Prints empty field 1 Date (mm/dd) US format (w/o year). Ex: 11/22 2 Date (mm/dd/yy) US format (w/year). Ex: 11/22/97 3 Date (dd/mm) Euro. format (w/o year). Ex: 22/11 4 Date (dd/mm/yy) Euro. format (w/year). Ex:22/11/975 5 Time 12 hr. format with AM/PM. Ex: 2:15:05-PM 6 Time 24 hr. Military format. (Ex: 14:05:05) 7 Temperature (°C) 0.1° resolution. (Ex: 25.0) 8 Temperature (°F) 0.1° resolution (Ex: 77.0)	0	13	RP.F1=2 RP.F2=6 RP.F3=7 RP.F4=9 RP.F5=11 RP.F6= RP.F7= RP.F8=	PMEM	40293	Integer [128]	60 thru 67
	9 Gas (%LEL). (Ex: 0.0, 5.0, 18.3, 50.6) 10 Gas (%v/v). (Ex: 0.00, 0.25, 0.92) 11 Alarms (4 digit hex).							

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Displayed As:	Description	Min	Max	Default Value	MEM Region	MODBUS Register Address	Data Type [BITS]	Assigned Parameter #
COMM MENU - Report Generator Parameters								
Rt.MO	**Real Time Clock (Month) -** Used to set the internal real time clock month. 1=January 2=February, etc.	1	12	12	###### #			
Rt.dt	**Real Time Clock (Date) -** Used to set the intermal real time clock date.	1	31	31	CMEM			
Rt.YR	**Real Time Clock (Year) -** Used to set the intermal real time clock year. A Note About Year 2000 Roll Over…The transmitter's is not controlled in any way by the internal clock which is used only for date recording during zero adjustment and reports. Since only two digits are maintained for the year dates, there will be no effects from the year 2000 roll-over.	0	99	96	PMEM			
RT.HR	**Real Time Clock (Hour) -** Used to set the intermal real time clock hour.	0	23	8	CMEM			
RT.MN	**Real Time Clock (Minutes) -** Used to set the intermal real time clock minutes.	0	59	0	CMEM			
COMM MENU - Serial Communication Parameters								
SC.Ad	**(Modbus™ Address)** - Specifies the address to which the instrument will respond to Modbus™ queries (when SC.Md=2). This field also shows up in the first column printed by the report generator.	1	247	1	PMEM	40287	Unsigned Byte [8]	73
SC.bR	**Serial Communication Baud Rate -** Specifies the data communication baud rate: 0 ... 110 6 ... 4800 1 ... 150 7...9600 2 ... 300 8 ... 19.2 k 3 ... 600 9 … 31.2 k+B30 4 ... 1200 10 … 38.4 k 5 ... 2400	0	10	7 (9600)	PMEM	40288	Unsigned Byte [8]	74
SC.dL	**Serial Communication Data Length -** Specifies the number of data bits transmitted in each byte. 0=7 bits 1=8 bits	0	1	1 (8 bits)	PMEM	40289	Unsigned Byte [8]	75
SC.Id	**Serial Communication Idle** - Specifies the number of idle characters (silent interval) that must be seen before recognition of the end of message (Modbus™ = 4). This can be used to adjust query/response synchronization on noisy data lines.	0	9999	4(Modbus ™ ready)	PMEM	40285	Unsigned Integer [16]	76

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Displayed As:	Description	Min	Max	Default Value	MEM Region	MODBUS Register Address	Data Type [BITS]	Assigned Parameter #
COMM MENU - Serial Communication *(continued...)*								
SC.Md	**Serial Communication Mode -** This parameter specifies which communication protocol to use: 0=None 1=Modbus™ ASCII 2=Modbus™ RTU	0	2	2(Modbus ™ RTU)	PMEM	40290 [hi byte]	Unsigned Byte [8]	78
SC.OP	**Serial Communication Options** - Primarily used in ASCII mode, this parameter controls whether the transmitter echoes every character sent, and if it expands outbound carriage returns to carriage return + line feed. This parameter should be set to 0 for Modbus communication. 0 = no echo, no CR expansion 1 = echo, no CR expansion 2 = no echo, expand CR to CR/LF 3 = echo, expand CR to CR/LF	0	3	0	PMEM	40290 [lo byte]	Unsigned Byte [8]	79
SC.P	**Serial Communication Parity Checking** - Specifies whether parity checking is performed and generated. 0=None 1=Odd 2=Even	0	2	0	PMEM	41288 [hi byte]	Unsigned Byte [8]	80
SC.RS	**Serial Communication RS-232/ 485 Selection** - Specifies either RS-232 or RS-485 communication. When choosing RS-232, verify the jumpers at JP1 on the power supply board are cut and jumpered as shown in the electrical connections. Since RS-485 is the default, no modifications to JP1 are required. 0 = RS-232 1 = RS-485	0	1	1 (RS-485)	PMEM	40287 [hi byte]	Unsigned Byte [8]	81
SC.Rt	**Serial Communication Retries -** This parameter is not currently used.	0	9999	0	PMEM	na	na	na
SC.Sb	**Serial Communication Stop Bits** -Specifies either 1 or 2 stop bits 0=1 bit 1=2 bits	0	1	0 (1 bit)	PMEM	40289 [hi byte]	Unsigned Byte [8]	83
SC.VF	**Serial Communication Verify** - When set to 1, turns off LRC checking in Modbus™ ASCII protocol.	0	1	0	PMEM	40291 [hi byte]	Unsigned Byte [8]	84
SC.LO	**Serial Communication Listen Only**- Setting this parameter to 1 forces the transmitter to listen for and process Modbus™ queries (including broadcast), but without generating a response. 0=listen and respond 1=listen only This parameter should normally be set to 0.	0	1	0	PMEM	40291	Unsigned Byte [8]	77

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The FACT Menu

FACT parameters are rarely used under "field" conditions. Typically these parameters are only used for troubleshooting and service issues. Refer to the "*Troubleshooting & Maintenance*" section for assistance in malfunction diagnosis.

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Maintenance, Troubleshooting, & Product Support

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Maintenance

Maintenance Safety

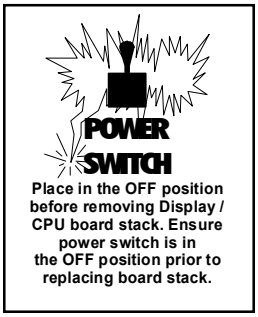
The GasPlus-IR transmitter should be properly grounded before any maintenance is performed. Appropriate procedures to declassify the area (if necessary) should be followed.

Routine Maintenance

Inspecting Dust Filters

Dust filters should be visually checked on a routine basis and replaced, if necessary. Use past maintenance records and good judgement to determine when dust filters should be inspected. For example, transmitters located in dirty or dusty environments should be checked more often than transmitters in relatively clean areas. Keep a maintenance log for each transmitter and note the condition of the transmitter when inspected.

First examine the dust shield filters, looking for evidence of clogging or coating. Then, remove the dust shield cage by gently turning it to the left until the twist-lock fitting unlocks, then pull downward. Inspect the mirror assembly filter, again looking for clogging or coating. Replace the dust shield cage, taking care to align the twist-lock pins with the corresponding slots on the dust shield cage. Gently turn the dust shield to the right until the twist-lock fitting locks in place.



Place in the OFF position before removing Display / CPU board stack. Ensure power switch is in the OFF position prior to replacing board stack.

Replacing Dust Shield Filters

Remove the dust shield cage by gently turning it to the left until the twist-lock fitting unlocks, then pull downward. Remove and replace the ring filter and the disk filter. Replace the dust shield cage, taking care to align the twist-lock pins with the corresponding slots on the dust shield cage. Gently turn the dust shield cage to the right until the twist-lock fitting locks in place.

Replacing Mirror Assembly Dust Filters

Remove the dust shield cage by gently turning it to the left until the twist-lock fitting unlocks, then pull downward. Grasp the base of the heater wire and gently pull downward to unplug it from the heater wire connection pin.

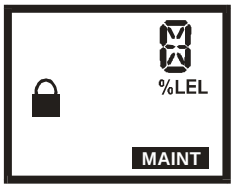


Do not allow the heater wire connection pin to make contact with foreign metal objects when the instrument is powered, as this will blow the fuses in the protective intrinsic safety barrier and will require replacement of the case fitting assembly.

Remove and replace the mirror assembly dust filter (part number 077-0166). Grasp the base of the heater wire and gently plug it into the heater wire connection pin. Replace the dust shield cage, taking care to align the twist-lock pins with the corresponding slots on the dust shield cage. Gently turn the dust shield cage to the right until the twist-lock fitting locks in place.

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Periodic Maintenance



The mirror assembly may require periodic cleaning. The need for this is indicated by the MAINT flag on the display. Although the emitter has an expected lifetime of more than 2 years, it may eventually need to be replaced. The need for this is indicated by sensor fault code dF.XX (where X is any number between 0 and 4).

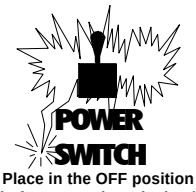
Resolving High Zero-Offset Issues

High zero offsets may be the result of either one of two issues with the transmitter:

1. Contaminant buildup within the mirror assembly; or
2. Faulty emitter.

If the transmitter is exhibiting a high zero offset the first step should be to address the possibility of a significant buildup of dirt, etc., within the mirror assembly. A buildup of contaminants within the mirror assembly will dull the reflective mirror surfaces causing unintended absorption of the infrared light. Refer to "Cleaning the Mirror Assembly" to resolve dirt buildup issues.

If it is unlikely that a dirt buildup is responsible OR the cleaning procedure has been performed with no results, contact the Scott Instruments Service department for further troubleshooting assistance (see "Contacting Scott Instruments").



Place in the OFF position before removing Display / CPU board stack. Ensure power switch is in the OFF position prior to replacing board stack.

Cleaning the Mirror Assembly

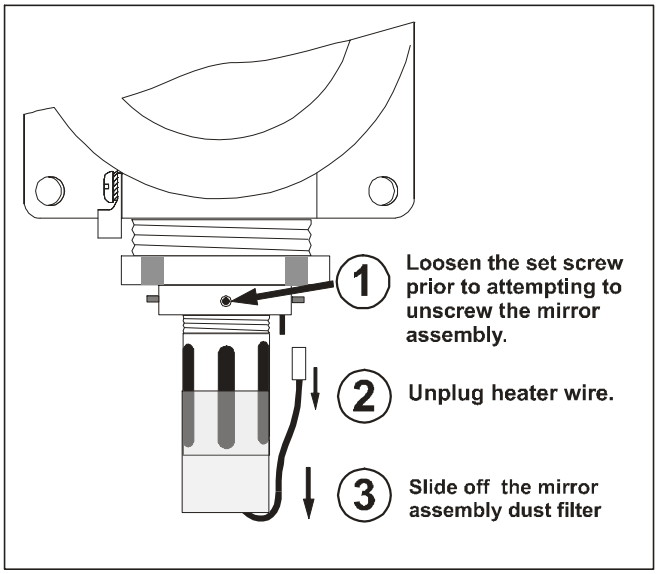
Cleaning the mirror assembly will help remove most accumulations of dirt, etc., within the transmitter's mirror assembly. The necessity and frequency of this procedure is dependant on the environment in which the transmitter is operating. *Alternately, the assembly can be returned to the factory for cleaning.*

STEP 1 - **Remove power from the transmitter** before cleaning the mirror assembly ***(removing the mirror assembly will expose the emitter, which is not an intrinsically-safe component)***.



Acetone is extremely flammable and harmful if inhaled or swallowed. Handle with care and wear eye and hand protection while handling!

STEP 2 - Remove the dust shield by gently turning it to the left until the twist-lock fitting unlocks, then pull downward. Grasp the base of the heater wire and gently pull downward to unplug it from the heater wire connection pin. Loosen the set screw then remove the mirror assembly dust filter. Unscrew the mirror assembly.



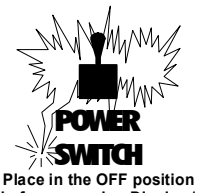
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STEP 3 - Without touching the sapphire window at the top of the mirror assembly (oil can absorb infrared radiation), dip the mirror assembly in a small quantity of *fresh* reagent grade isopropanol (e.g., Fisher Scientific #A416-20). Agitate thoroughly and repeat as necessary.

STEP 4 - Using a source of *dry* compressed air, clean away any accumulations. Ensure that the assembly is dried thoroughly.

STEP 5 - When the mirror assembly is clean, replace its dust filter and gently screw it back into the case fitting taking care not to overtighten (mirror assembly should be finger-tight). Retighten the set screw. Grasp the base of the heater wire and gently plug it into the heater wire connection pin. Replace the dust shield, taking care to align the twist-lock pins with the corresponding slots on the dust shield cage. Gently turn the dust shield cage to the right until the twist-lock fitting locks in place.

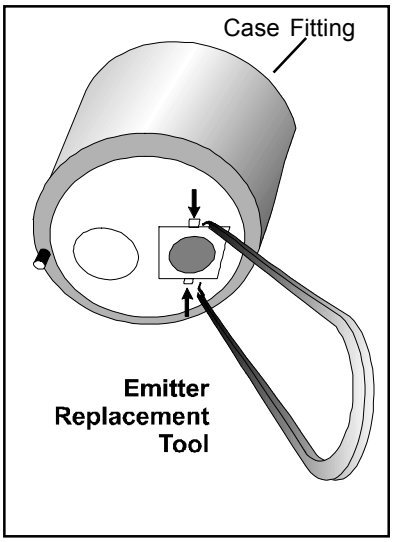
When the transmitter has been repowered and warmed up for 1/2 hour, use the Up or Down arrow key to scroll to the F.AGC parameter in the FACT menu and touch the magnet to the Enter key. See the next page for gaining access to F.AGC. The transmitter will analyze the reflectivity of the mirror support assembly and adjust the gain applied to the detectors. This function will take about 2 minutes to run. If successful, the LCD will read “SEt”. If "ERR" appears, perform steps under "Performing F.AGC Function" Step 3 on page 59. If "ERR" appears again you will need to replace the mirror assembly. Apply a source of clean air to the sensor (p/n 077-0019) and zero the unit after 5 minutes. Use the "Z" key to return to the main screen.



Place in the OFF position before removing Display / CPU board stack. Ensure power switch is in the OFF position prior to replacing board stack.

Replacing the Emitter

Although the emitter has been selected for performance and reliability, it may eventually fail and need to be replaced (estimated life is greater than 2 years). The need for emitter replacement will be indicated by a fault output from the transmitter (factory default = 3.2 mA) and the fault code dF.XX (where X is any number between 0 and 4) on the LCD display. On transmitters with optional relays, the fault relay will also be triggered.



STEP 1 - Before replacing the emitter, cycle the transmitter power off and on. If this clears the fault indication, there is no need to replace the emitter.

STEP 2 - **Remove power from the transmitter** and remove the dust shield by gently turning it to the left until the twist-lock fitting unlocks, and then pulling downward.

STEP 3 - Grasp the base of the heater wire and gently pull downward to unplug it from the heater wire connection pin. Loosen the set screw and remove the mirror assembly dust filter and gently unscrew the mirror assembly taking care not to touch the sapphire window.

STEP 4 - Two components will be visible inside the case fitting. One, the



Make sure the lamp assembly is flush, or slightly below the case fitting surface after reinserting. There must be no contact with the sapphire window when the mirror assembly is screwed in! Otherwise:
- Will zero drift greatly
- Might fracture window

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detector "T-can", is circular; the other, the emitter, is square. Carefully insert the emitter extraction tool (provided with the replacement emitter) in the slots on either side of the emitter and gently pull out. Insert replacement emitter (096-2193) into the slots and gently plug in. Since the lamp is not polarized, it doesn't matter which way it is reinserted.

STEP 5 - Replace the mirror assembly dust filter and gently screw it back into the case fitting taking care not to overtighten (mirror assembly should be finger-tight). Retighten the set screw. Grasp the base of the heater wire and gently plug it into the heater wire connection pin. Replace the dust shield cage, taking care to align the twist-lock pins with the corresponding slots on the dust shield cage. Gently turn the dust shield cage to the right until the twist-lock fitting locks in place.

After replacing the emitter, the F.AGC function must be run and span calibration is recommended.

Performing F.AGC Function

Consider that the unit is now uncalibrated and may power on reporting a high gas concentration. Therefore, inhibit alarms at the loop receiver and remove power from local alarms connected to the transmitter. Power on the unit and allow it to warm up for 2 hours.

To run the F.AGC function:



NOTE: Do not enter any menus other than whats specified without approval from an authorized Scott Instrument Service technician. Damage to the unit is possible.

1. Apply a source of clean air to the sensor to purge hydrocarbons that may be present. CO_2 units will require nitrogen.
2. Enter the FACT menu, use the Up or Down arrow key to scroll to the F.PWD parameter and enter the factory password (251). Select Enter then scroll to the F.AGC parameter and touch the magnet to the Enter key. This function will take about 2 minutes to run. If successful, the LCD will read “SEt”. Use the Z key to return to the main screen.

NOTE, If "ERR" appears on the display, do the following:

3. Reset the gain pots back to the factory defaults:
   - A. Use the "Z" key to return to the main screen.
   - B. Touch the magnet to the down key, 2 times (USER, FACT)
   - C. Touch the magnet to the enter key (F.PWD)
   - D. Touch the magnet to the down key (SR.G1)
   - E. Touch the magnet to the enter key (00XX)
   - F. Touch the magnet to the up or down key until 0040 is displayed (0040) then touch the magnet to the enter key
   - G. Touch the magnet to the escape (ESC) key once (SR.G1)
   - H. Touch the magnet to the up key once (SR.G2)
   - I. Touch the magnet to the enter key once (00XX)
   - J. Touch the magnet to the up or down key until 0040 is displayed (0040) then touch the magnet to the enter key
   - K. Touch the magnet to the escape (ESC) key three times to return to the run mode

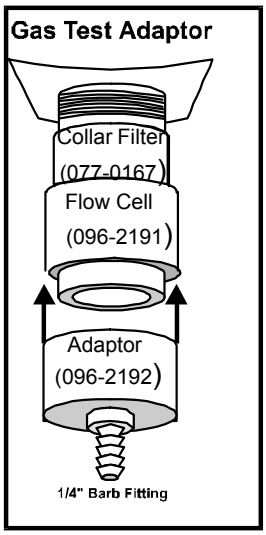
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L. Turn the toggle switch (S5) on the cpu board to the off position for at least 15 seconds then turn the toggle switch to the on position. (The transmitter will display all segments and indicators on just like the initial power up.)

4. Re-enter the factory password (page 59 of the manual).
5. Run the factory automatic gain control.
6. Use the "Z" key to return to the main menu.
7. Wait (1) one hour after running F.AGC, then apply a source of clean air to the sensor to purge hydrocarbons that may be present. Zero the transmitter.

IMPORTANT

Used for Accuracy Test Flow



Accuracy Test

An accuracy test can be performed periodically. The interval of the test is application specific and is determined by the user. The transmitter must be zeroed (see "*Transmitter Operation: Zeroing the Transmitter*") prior to performing the test. To perform the accuracy test perform Steps 1 through 3 of the "Span calibration" procedure (below).

Span Calibration

Span calibration of the transmitter is only required after replacing either the emitter assembly or the mirror assembly. If after performing an accuracy test and the transmitter is found to be inaccurate, (error greater than + 5% LEL) please contact factory service.

It is important to ensure that the zero and span gas being used for this procedure is the same temperature as the transmitter.

IMPORTANT

A span calibration should only be used after the emitter bulb or mirror assembly is replaced. If the unit is found to have an error in accuracy (greater than ±5% LEL, ±.1% CO_2) contact factory service

To perform span calibration:

STEP 1 - Zero the transmitter (see "*Transmitter Operation: Zeroing the Transmitter*") using zero grade air source or if zeroing a carbon dioxide transmitter use nitrogen.

STEP 2 - Obtain a calibration gas cylinder containing the target gas in a concentration of 50% LEL or greater (the transmitter can be spanned using a gas concentration as low as 10% LEL but for accuracy purposes this is not recommended). Verify that the span gas being used has not exceeded its expiration date. Old or improperly stored calibration gases can degrade causing inaccurate calibration.

STEP 3 - From RUN mode, inhibit the instrument by touching the magnet to the Z key for 2 seconds and then removing it (the INHIBIT flag will appear in the display).

STEP 4 - Assemble the calibration accessories and attach gas test adaptor and tubing. On transmitters equipped with a flow cell, detach the intake tubing from the flowcell so that the tubing from the calibration cylinder can be attached. Apply the target (span) gas at 500 cc/min for 5 minutes.

STEP 5 - Prior to performing span calibration it is important to note that the %LEL values indicated on calibration gas standards may differ from that used

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NOTE: Do not enter any menus other than specified without approval from an authorized Scott Instruments Service technician. Damage to the unit is possible.

by the instrument. To ensure span accuracy the instrument's gas concentration units (USER menu: SR.CU parameter) may be changed to %v/v prior to beginning the span procedure. The F.CAL parameter is then changed during the span procedure to match the %v/v value indicated on the calibration cylinder (see Step 6).

STEP 6 - Initiate gas flow at 500 cc/min and allow gas to flow for 5 minutes or until transmitter concentration reading is stable. Once stable, go to the "**FACT**" menu, select the F.PWD (password) parameter and enter "251". Upon reading "SEt" in the display, touch the magnet to the ESC key. Then touch the magnet to the Up arrow key repeatedly until observing F.CAL. Touch the magnet to the Enter key and adjust the reading to match the known concentration of span gas applied to the sensor, then touch the magnet to the Enter key and verify the display shows "SEt" Touch the ESC key 3 times to return to "RUN" mode. Verify that the reading in the display matches the span value within the stated accuracy of the instrument. Remaining in the "FACT" menu, select and enter the "F.CAL" parameter. Using the Up/Down arrow keys, select the concentration value of the calibration gas being used. Select "Enter" to store the value and exit.

Note:

If span calibration for Methane(SR.GN = 1) or Butane (SR.GN = 4) is performed, the cross calibration factors from Methane and Butane must be copied to the other standard gases by using the "UP/DOWN" arrow keys. To select F.WCF, touch the magnet to the ENTER key (1 or 4 will be displayed). Touch the magnet to the ENTER key again and SET will be displayed when successful. Touch the magnet to the "ESC" key 3 times until the display shows "RUN".

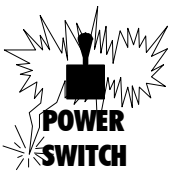
STEP 7 - Turn off the span gas and reconfigure the instrument for on-line service (remove cal cap and test adapter, etc.).

STEP 8 - Once the gas concentration reading has subsided to 0, restore thealarms (local and remote) to their proper function (remove the inhibits).

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Troubleshooting

General Difficulties



Place in the OFF position before removing Display / CPU board stack. Ensure power switch is in the OFF position prior to replacing board stack.

Problem	Solution
Transmitter output is continuously negative.	Transmitter was probably zero calibrated with hydrocarbons present. Apply a source of clean air to the sensor (p/n 077-0019) and zero instrument.
Response to gas is sluggish.	Check dust filters and replace, if necessary (see "*Maintenance: Replacing Dust Filters*").
Display is blank, although transmitter is producing an output signal.	Adjust display contrast (see *"General Operation: Adjusting LCD Display Contrast"*).
Alarm set point cannot be lowered.	Lower alarm reset point, then try lowering set point.
"MAINT" Indicator displayed	The MAINT indicator appears when the reference detector (IR1) signal drops below 1.5 volts, peak-to-peak. This will occur when enough dirt/dust contamination has collected in the sensor body to reduce the amount of reflection below 30% of its original value. If this occurs, the mirror assembly will likely require cleaning. See "*Periodic Maintenance: Cleaning the Mirror Assembly*".
High Zero Reading	Follow the periodic maintenance procedures detailed at the beginning of

Note: DO NOT change out CPU or power supply boards. These boards are factory calibrated as a matched set.

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this section.

Fault Codes

The GasPlus-IR continuously performs self-diagnostics (memory, software integrity, sensor performance, power, and loop output are checked two or more times a second). The fault indicator will appear under any of three conditions:

1. Negative concentration in excess of 5.0% LEL
2. System fault (4-20 mA loop open, memory fault, internal bus fault, etc.).
3. Sensor fault (sensor signals too high or too low).

When a system or sensor fault is present, a hexadecimal fault code is also shown on the alphanumeric display. System fault codes use the form F.XXX (where X is any alphanumeric value), while sensor fault codes use the form dF.XX.

Following is list of GasPlus-IR fault codes and corrective actions. Before performing any corrective action, cycle the transmitter power off and on. If this clears the fault indication, there is no need to perform further corrective action.

DO NOT REMOVE OR INSERT THE BOARD STACK while the transmitter is powered !

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IMPORTANT

More than one fault code indicates that BOTH the associated "clear" procedures must be performed.

Table 2 - Fault Code Table

DISPLAYED AS				ASSOCIATED FAULT(s)	
F.	1	x	x	EE	See following page for fault code description and possible solutions to clear fault codes.
F.	2	x	x	LOOP	
F.	3	x	x	LOOP + EE	
F.	4	x	x	TEST	
F.	5	x	x	TEST + EE	
F.	6	x	x	LOOP + TEST	
F.	7	x	x	TEST + LOOP + EE	
F.	8	x	x	HTR	
F.	9	x	x	HTR + EE	
F.	A	x	x	HTR + LOOP	
F.	B	x	x	HTR + LOOP + EE	
F.	C	x	x	HTR + TEST	
F.	D	x	x	HTR + TEST + EE	
F.	E	x	x	HTR + TEST + LOOP	
F.	F	x	x	HTR + TEST + LOOP + EE	
F.	x	1	x	EMEM	
F.	x	2	x	PWR	
F.	x	3	x	EMEM + PWR	
F.	x	4	x	LCD	
F.	x	5	x	LCD + EMEM	
F.	x	6	x	LCD + PWR	
F.	x	7	x	LCD + PWR + EMEM	
F.	x	8	x	CLK	
F.	x	9	x	CLK + EMEM	
F.	x	A	x	CLK + PWR	
F.	x	B	x	CLK + PWR + EMEM	
F.	x	C	x	CLK + LCD	
F.	x	D	x	CLK + LCD + EMEM	
F.	x	E	x	CLK + LCD + PWR	
F.	x	F	x	CLK + LCD + PWR + EMEM	
F.	x	x	4	PMEM	
F.	x	x	8	LMEM	
F.	x	x	C	PMEM + LMEM	
SENSOR FAULT CODES					
dF.	1	x		IR1 Peak Too High.	
dF.	2	x		IR1 Peak Too Low.	
dF.	3	x		IR1 Peak-Peak Too High.	
dF.	4	x		IR1 Peak-Peak Too Low.	
dF.	x	1		IR2 Peak Too High.	
dF.	x	2		IR2 Peak Too Low.	
dF.	x	3		IR2 Peak-Peak Too High.	
dF.	x	4		IR2 Peak-Peak Too Low.	

NOTE: "x" means any other value may be shown.

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Table 2.1 - Fault Code Descriptions

FAULT	SET BY	CLEARED BY
PMEM	Parameter memory checksum failure.	Cleared by re-entering the correct SR.GN value and then verifying all other parameters in the USER COMM menus. Operator should verify the A1.SP and A2.SP (alarm setpoints) at a minimum.
LMEM	Loop calibration data checksum failure.	Cleared by adjusting either the MA.04 and MA.20 in COMM menu. Operator should adjust both settings if current loop output is being used.
EMEM	Sensor EEPROM checksum fault.	Cleared by returning the entire transmitter to the factory.
PWR	Supply voltage drops to critical level.	Self-cleared after 4 seconds of adequate supply voltage.
LCD	LCD display bus fault.	Shop/factory repair.
CLK	Real Time Clock I2C bus fault.	Shop/factory repair.
EE	Sensor EEPROM I2C bus fault.	Remove power to unit. Open housing and check sensor connections to power supply board. Replace entire sensor if necessary.
LOOP	4-20mA current loop output open.	Repair connection.
TEST	Used for testing fault relay operation. AL.TO (alarm test override) see Alarm Relay parameters	Clear by returning AL.TA to 0.
HTR	Heater current to sensor below 50mA.	Remove rainshield (or flowcell) and check wires to heater. If fault condition persists, contact factory for repair.
SENSOR FAULT CODES		
dF.x.1 OR dF.1.x	Signal peak too high.	Could be caused by a condensation on the mirror. Dry the mirror using compressed air. If fault condition persists, contact factory for repair.
dF.x.2 OR dF.2.x	Signal peak too low.	
dF.x.3 OR dF.3.x	Signal peak-peak too high.	
dF.x.4 OR dF.4.x	Signal peak-peak too low.	May be due to a dirty mirror. Perform cleaning procedure (see "*Periodic Maintenance:Cleaning mirror assy*") If fault condition persists, contact factory for repair.

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Resetting Factory Defaults

The transmitter stores parameters into memory. This means that under certain circumstances such as internal battery failure, power surges, etc., the transmitter may require the parameters to be reset to factory default values. Contact the factory for the proper procedure.

Extremely Important

Do not enter a value of 2 (in F. RES). This will corrupt the sensor memory.

Contacting SCOTT INSTRUMENTS

251 Welsh Pool Rd.
Exton, PA 19341
SCOTT INSTRUMENTS may be contacted Monday through Friday
8:30 am to 5:00 PM EST.
Phone 1-610-363-5450 • FAX 1-610-363-0167
e-mail • service@scottinstruments.com

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Technical Specifications

GENERAL

Sensor Type	Non-dispersive infrared
Detection Range	**See "Ordering Information"**
Linearity	± 2% below 40% full scale ± 5% from 40% to 110% full scale
Repeatability	± 2% below 40% full scale ± 5% from 40% to 110% full scale
Response Time	T90 < 5 seconds (without rain shield)
Start Up Time	30 seconds
Self-Diagnostic Test	2x per second
Calibration	Span: none (factory set) Zero: every 6 months
User Interface	Non-intrusive via magnet
Display	4 digit LCD with user-adjustable contrast. Numeric display of gas concentration and faults; icons for alarms, lock, and inhibit
Weight	6.5 lbs (3.0 kg)
Warranty	2 years

OUTPUTS

Analog	Isolated, 4-20 mA, max loop load 900 ohms at 24 VDC. (source or sink)
Programmable Fault	2.4 to 4.0 mA
Programmable Inhibit	1.5 to 20.0 mA
Programmable Loop Test	1.0 to 20.0 mA
Digital	RS-485 or RS-232 using Modbus® RTU or Modbus® ASCII protocol
Relay (optional)	3 SPST relays (2 concentration, 1 fault), 5 A at 30 VDC. User-selectable latching/non-latching, energized/de-energized, set/reset delay, and set/reset point

ELECTRICAL

Input Voltage	18-28 VDC
Power Consumption	3.1 W, nominal / 6.0 W, max
Connections	3 wires or 4 wires (with RS-485 or RS-232 configuration); 18-22 AWG nominal

ENVIRONMENTAL

Operating Temp	-40°F to 140°F (-40°C to 60°C)
Operating Humidity	0 to 100% RH

ENCLOSURE

Enclosure Material	Copper-free cast aluminum, baked epoxy finish
Optical Bench Material	Stainless steel and nickel-plated aluminum

Enclosure Rating/Approvals

Explosion proof; Class 1, Zone 1, Group IIC
UL2279 (1996) and UL3111-1 (1994)
ETL9700793
DEMKO 98D.123942
CENELEC EEx d [ib] IIC T6

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Appendix 1

MODBUS® Registers & Coil Addressing

READ ONLY

Register Address	Description	Suggested Tag
40001	Function select register	FSR
40002	Parameter select register	PSR
40003-40006	Character data registers	CDR1 - CDR4
40007-40010	Integer data registers	IDR1 - IDR4
40011-40014	Long data registers	LDR1 - LDR2
40015-40018	Real data registers	RDR1 - RDR2
40019	Gas concentration (read only)	GAS
40021	Temperature (read only)	TMP
40023	Transmitter status (read only)	STS
40024	General fault status (read only)	GFS
40025	Sensor faults status (read only)	SFS

READ ONLY

Coil address	Description	Suggested Tag	
00353	STS, relay 1 (1 = energized)	RL1	
00354	STS, relay 2 (1 = energized)	RL2	
00355	STS, fault relay (1 = energized)	RLF	
00356	STS, alarm indicator 1 (1 = active)	AL1	
00357	STS, alarm indicator 2 (1 = active)	AL2	
00358	STS, fault alarm indicator (1 = active)	ALF	
00359	STS, maint indicator (1 = active)	MNT	
00360	STS, inhibit indicator (1 = active)	IHB	
00361	STS, concentration units (1 = %v/v)	VOL	(0 = %LEL)
00362	STS, temperature units (1 = ºC)	DGC	(0 = ºF)
00363	STS, lock indicator (1 = active)	LCK	
00364	STS, remote function failure (1 = fail)	RFF	

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MODBUS® READ-ONLY Register Descriptions

The READ ONLY registers contain most of the status data typically required from most application using MODBUS® serial communications.

GAS: Gas concentration

Provides gas concentration reading in %LEL or %V/V. Concentration units are indicated in the VOL bit of the transmitter status register, and are changed through the SR.CU parameter in the USER menu.

Type	Real
Range	Programmed negative limit (AF.NL) to 9999
Access	Read-only

STS: Transmitter status

Provides information on status of various transmitter parameters and indicators. AL1, AL2, and ALF are set when the corresponding display indicator is active, while RL1, RL2, and RLF are set when the corresponding relay is energized. MNT, IHB, and LCK are set when the MAINT, INHIB, and LOCK flags are active. VOL and DGC is set when gas concentration units and temperature are in %V/V and ºC, respectively. RFF is set when a data access function has failed.

Type	Unsigned Integer								
Range	0 to 4095 (12 bits)								
	Data high	0	0	0	0	RFF	LCK	DGC	VOL
	Data low	IHB	MNT	ALF	AL2	AL1	RLF	RL2	RL1
Access	Read-only								

Note that in some circumstances relays may be energized even if indicators are not displayed on the LCD - when alarm relays are programmed as fail-safe.

TMP: Temperature

Provides temperature reading in °F or °C. Concentration units are indicated in the DGC bit of the transmitter status register, and are changed through the SR.TU parameter in the USER menu.

Type	Real
Range	-50°C (-58°F) to +448°C (838°F)
Access	Read-only

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GFS: General Fault Status

Provides detail on general instrument faults, as listed in Table 2 (see "*Maintenance, Troubleshooting, & Product Support*").

Type

Range	See Table 2
Access	Read-only

SFS: Sensor Fault Status

Provides detail on sensor faults, as listed in Table 2 (see "*Maintenance, Troubleshooting, & Product Support*").

Type

Range	See Table 2
Access	Read-only

T_Type: Transmitter Type

16 bit value (4688 dec, 1250 hex)

Lp_Pwm: Pwm Drive to 4-20 Loop Control

16 bit unsigned value represting 16 bit pulse width modulation control to the 4-20 mA loop control circuit. Nominally 24mA + 65535 counts, but is factory or user calibrated. 0ma = 0 counts.

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Appendix 2
(FSR) Command Functions

Command functions are required whenever a value is to be *written* to the instrument. All command values are direct to the Function Select Register (FSR), located in address 40001. The FSR register recognizes 11 commands:

Command (1): Write 8-Bit byte parameter
Validates and writes 8-bit byte parameters into nonvolatile parameter memory. Updates the RFF bit in the STS register.

Sequence: CDR1={new value}, PSR={parameter#}, FSR=1

Command (2): Write 16-Bit integer parameter
Validates and writes 16-bit integer parameters into nonvolatile parameter memory. Updates the RFF bit in the STS register.

Sequence: IDR1={new value}, PSR={parameter#}, FSR=2

Command (4): Write 32-Bit real parameter
Validates and writes 32-bit real parameters into nonvolatile parameter memory. Updates the RFF bit in the STS register.

Sequence: RDR1={new value}, PSR={parameter#}, FSR=4

Command (10): Alarm Test Override
Turns on the alarm override mode and forces alarms to a specified state. Note that the alarm relays programmed as FAIL-SAFE will be energized when the alarm is OFF, and de-energized when the alarm is ON. Alarm override mode is disabled by using command function 11 (Reset Alarms). This command does not affect the RFF bit in the STS register.

Register sequence (for forcing on/off more than one alarm at a time):

1. CDR1={0-7 [see table below]}
2. PSR=not used
3. FSR=10

Coil sequence (for forcing on/off one alarm only)

1. CDR1B0 (or CDR1B1, CDR1B2)={0-7 [see table below]}
2. PSR=not used
3. FSR=10

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CDR1	AL1	AL2	FAULT
0	OFF	OFF	OFF
1	ON	OFF	OFF
2	OFF	ON	OFF
3	ON	ON	OFF
4	OFF	OFF	ON
5	ON	OFF	ON
6	OFF	ON	ON
7	ON	ON	ON

ALARM	CDRBx
AL1 ON	CDRB0=1
AL1 OFF	CDRB0=0
AL2 ON	CDRB1=1
AL2 OFF	CDRB1=0
FAULT ON	CDRB2=1
FAULT OFF	CDRB2=0

Application Note:

When implementing the Alarm Test command (10), be sure to include the Alarm Reset command (11). For example, in a graphical user interface this might mean creating a "test" and "reset" button for each alarm (i.e., pushing alarm 1 "test" button executes CDR1B0=1, FSR=10).

Command (11): Reset Alarms

Turns off the alarm override mode and clears the specified latched alarms. Any alarms currently forced on or off by command 10 will return to normal program control. This command may also be used in normal operation to manually reset latched alarm 1 or alarm 2, but only after alarm conditions have subsided. This function does not affect the RFF bit in the STS register.

Register sequence:

1. CDR1=0-4 (see table below)
2. PSR=not used
3. FSR=11

Coil sequence (for resetting one alarm only

1. CDR1B0 (or CDR1B1) = 1 (see table below)
2. PSR=not used
3. FSR=11

CDR1	AL1	AL2
0	No Change	No Change
1	Reset	No Change
2	No Change	Reset
3	Reset	Reset

ALARM	CDRBx
Alarm1 Reset	CDRB0=1
Alarm2 Reset	CDRB1=1

See application note in Command 10.

Command (12): Set alarm inhibit timer

Updates the alarm inhibit countdown timer. The timer value is written into the IDR1 register in units of 1 minute. Does not use PSR register. A timer value is an unsigned integer therefore its maximum value is 65535 (1092.25 hours).

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Since there is no associated error checking, Scott Instruments strongly recommends that this parameter not be set above 9 minutes. Setting the IDR1 register to 0 cancels alarm inhibit. The set alarm inhibit timer function does not affect the RFF bit in the STS register.

Sequence: IDR1={# of minutes}; FSR=12

Command (13): Zero-calibrate sensor

Sets the transmitter's zero point. Does not use PSR or data registers. Care must be taken to ensure that clean, zero-grade air is present at the sensor. Updates the RFF bit in the STS register.

FSR=20

Command (30): Update real-time clock date

Synchronizes instrument date to host date. Does not use PSR register. Updates the RFF bit in the STS register.

Sequence:

CDR1=0-99 (2 digit year)

CDR2= 1-12 (month)

CDR3=1-31 (day)

FSR=30

Command (31): Update real-time clock time

Synchronizes instrument time (military time) to host time. Does not use the PSR register. Updates the RFF bit in the STS register.

Sequence:

CDR1=0-23 (hours)

CDR2= 1-59 (minutes)

CDR3=1-59 (seconds)

FSR=31

Command (40): Toggle password security on/off

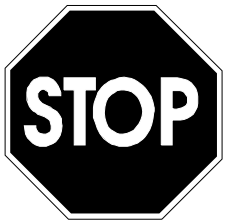
Uses the password stored in IDR1 to toggle security on/off. Note that if the password is incorrect, this function will not be successful. Updates both the RFF and LCK bits in the STS register.

Sequence: FSR=40

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Appendix 3
Instrument Cross-Sensitivity





READ THIS!

In some applications the Model 4688-IR may be used to detect more than one combustible gas present in the atmosphere. Cross-sensitivity is defined as the reading produced by a one gas when the instrument is set to detect another (different) gas. Under these circumstances it is ***EXTREMELY IMPORTANT TO ADHERE TO THE FOLLOWING GUIDELINES:***

1. ***The instrument can only detect those gases available in its software.*** To determine which gases the instrument is capable of detecting, observe the instrument's SR.GN values and refer to the USER Menu.
2. ***The instrument MUST be set to detect the gas which, using the appropriate chart below, is determined to be the least visible (absorbed) by the instrument. Failure to do so could result in the undetected presence of a combustible at or above its 100% LEL !***

Cross-Sensitivity Programming Examples - These examples only apply to units with a sensor type 2. This can be viewed by SR.tY.

Suppose the instrument may be exposed to either METHANE/AIR or ETHANE/AIR separately, or in a mixture. We are free to set the instrument to monitor any one of the gases so long as we adjust the alarm set points safely. ***In this case, we want to trigger ALARM 1 when the least sensitive gas reaches 30% LEL, and ALARM 2 when the least sensitive gas reaches 50% LEL.***

*When the instrument is set to detect **METHANE** (SR.GN=1):*

Alarm 1 [
Alarm 2 [

- 30% LEL of METHANE (1.50%V/V) produces a METHANE reading of **30% LEL**
- 30% LEL of ETHANE (0.90%V/V) produces a METHANE reading of **117% LEL,** which is an approximate value.
- 50% LEL of METHANE (2.50%V/V) produces a METHANE reading of **50% LEL**
- 50% LEL of ETHANE (1.50%V/V) produces a METHANE reading of **303% LEL,** which is an approximate value.

Solution:

> Set alarm 1 (A1.SP) to the lowest value, 30 %LEL.

Alarm 1 [> Set alarm 2 (A2.SP) to the lowest value, 50 %LEL.

*When the instrument is set to detect **ETHANE** (SR.GN=2):*

Alarm 2 [

- 30% LEL of METHANE (1.50%V/V) produces an ETHANE reading of **14% LEL,** which is an approximate value.
- 30% LEL of ETHANE (0.90%V/V) produces an ETHANE reading of **30% LEL**
- 50% LEL of METHANE (2.50%V/V) produces an ETHANE reading of **19% LEL,** which is an approximate value.
- 50% LEL of ETHANE (1.50%V/V) produces an ETHANE reading of **50% LEL**

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Solution:

> Set alarm 1 (A1.SP) to the lowest value, 14 %LEL.

> Set alarm 2 (A2.SP) to the lowest value, 19% LEL

For Cross Sensitivity information information, please contact Scott Instruments.

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Record Your Parameters !

Parameter Label	Transmitter #
A1.SP	
A1.RP	
A1.Sd	
A1.Rd	
A1.OP	
A2.SP	
A2.RP	
A2.Sd	
A2.Rd	
A2.OP	
AF.NL	
AF.OP	
AL.IP	
SR.CU	
SR.dC	
SR.dP	
SR.FS	
SR.GN	
SR.tU	
SR.ZM	
SR.Zd	
SR.ZY	
LK.ON	
LK.PW	
LK.tM	
MA.04	
MA.20	
MA.F	
MA.I	
MA.t	
RP.ON	
RP.d1-RP.d5	
RP.E1-RP.E5	
RP.F1-RP.F8	
Rt.MO	
Rt.dT	
Rt.YR	
Rt.HR	
Rt.MN	

NOTES:

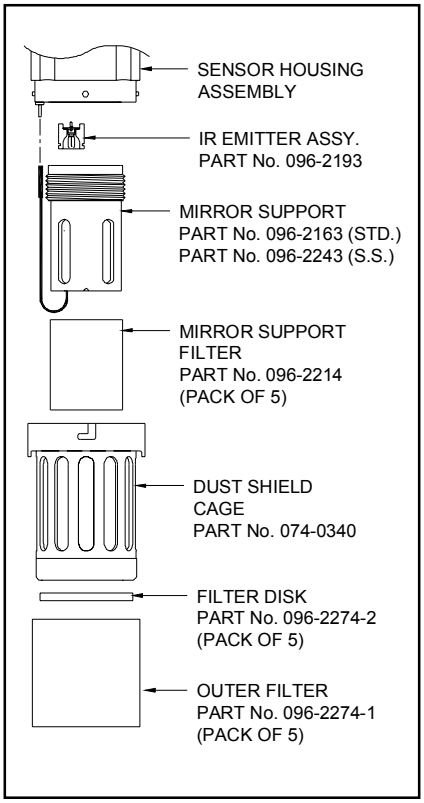
Parameter Label	Transmitter #
SC.Ad	
SC.bR	
SC.dL	
SC.Id	
SC.Md	
SC.OP	
SC.P	
SC.RS	
SC.Rt	
SC.Sb	
SC.VF	
SR.LO	

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Spare Parts & Accessories

Scott Instruments may be contacted Monday through Friday 8:30 AM to 5:00 PM EST.

Toll Free 800-634-4046 • Phone 1-610-363-5450 • FAX 1-610-363-0167



ADAPTORS

Part #	Description
096-2727	Deluge guard (see Figure 3 for replacement parts)
096-2709	Rain guard (see Figure 2 for replacement parts)
074-0340	Dust shield cage
096-2274-1	(5) #077-0209 Dust Filter Cage Outer-Filters (*see drawing*)
096-2274-2	(5) #077-0210 Disk Filters - (*see drawing*)
096-2947	(5) #077-0210-1 Disk Filters with drainage hole - (*for use with 096-2709 Rain Guard & 096-2727* Deluge Guard)
096-2214	(5) #077-0166 Mirror Support Inner Filters - (*see drawing*)
096-2191-X	Flowcell (X= [1] Nitrile [2]Viton [3]ethylene propylene) (REQUIRES GAS TEST ADAPTOR 096-2192 FOR USE)
096-2289	Bump Test Adaptor - unit supplied after 1/99
096-2192	Gas test adaptor

OTHER

069-0053	9-C cable 24 AWG (used between remote display and sensor)
087-0007	Spare O&M Manual
077-0120	Scott Instruments magnetic screwdriver
096-2201	RS-485 Termination Board
096-2187	Combustible Zero Adjustment Kit (includes regulator, tubing, and carrying case - does NOT include methane "bump gas")
096-2190	Combustible Gas test kit (2 feet tubing, zero air and methane “bump” gas”, cal adaptor, regulator, and carrying case)
096-2159	SS emitter bench assembly (screw-in)
096-2193	IR emitter bulb assembly (plug-in)
077-0161	Emitter bulb replacement tool
096-2163	Standard Mirror housing assembly
096-2243	SS Mirror housing assembly

SPARE BOARDS

NOTE: The CPU & Power Supply boards listed below cannot be replaced without recalibration of the complete unit. Contact Scott Instruments Service to arrange for this calibration.

096-2151	Display board
096-2152	CPU board (specify RS-232 or RS-485). ***MUST specify gas.***
096-2153	Power supply board (no relays)
096-2153-1	Power supply board (w/ all relays normally open)
096-2153-2	Power supply board (w/ all relays normally closed)
096-2153-3	Power supply board (w/ alarm relay NO and fail relay NC)
096-2153-4	Power supply board (w/ alarm relay NC and fail relay NO)
096-2194-1	Spare transmitter (board stack) No relays ***RS-485. MUST specify gas set.***
096-2194-2	Spare transmitter (board stack) No relays ***RS-232. MUST specify gas set.***
096-2194-C-D	Spare transmitter (board stack) with relays. ***See Options C and D*** and specify corresponding option numbers for protocol and relay operation (i.e. 096-2194-1-2 = RS-485/all relays NO)

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The manufacturer, SCOTT INSTRUMENTS, LLC, warrants to the original purchaser and/or ultimate customer of the manufacturer's products, that if any part(s) thereof (except for those listed below) proves to be defective in material or workmanship within 30 months from the date of shipment or 24 months from the date of start-up, whichever comes first, such defective part(s) will be repaired or replaced free of charge if shipped prepaid to the factory in a package equal to (or) original container.

All products will be returned freight prepaid to user when determined by the manufacturer that the part(s) failed due to defective materials or workmanship.

The seller 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 buyer, its employees or others. A defect within the meaning of this warranty in any part of any piece of equipment shall not, when such part is capable of being renewed, repaired or replaced, operate to condemn such piece of equipment.

This warranty does not cover consumable items, batteries, or wear items subject to periodic replacement.

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 seller or its representatives and by the statute or rule of law.

This warranty is void if the instrument has been subject to misuse or abuse, or has not been operated in accordance with instructions, or if the serial number has been removed.

SCOTT INSTRUMENTS MAKES NO OTHER WARRANTY EXPRESSED OR IMPLIED EXCEPT AS STATED ABOVE.

Statement of Year 2000 Compliance

This Model GasPlus-IR accepts all dates in the years after 1999 as valid dates. Its functionality, performance, and accuracy will not be affected as a result of the run date or the dates being processed, irrespective of the century. When maintenance is performed on the product and/or the product is restarted after power has been removed, the system dates will remain correct to the actual date even if this date is on or later than the 1 January 2000.

Caution: This instrument stores its year data as a value from 00 to 99 (2 digits). It is recommended that this data is not accessed via the digital interface.

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