Freedom® 6000 User Guide

TOXIC AND COMBUSTIBLE GAS DETECTOR

087-0044

Rev G

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ABOUT THIS GUIDE

Guide Overview

This guide describes the steps required to use the Freedom® 6000. This document is for gas detection personnel to manage their gas monitoring device. This document contains information on installation, configuration, operation, maintenance and troubleshooting.

This user guide assumes a basic knowledge of gas detection procedures.

The user guide is divided into the following topics:

- Introduction
- Installation
- Configuration and Setup
- Operation
- Maintenance
- Specifications
- Sensor Information
- Support

Warning: *Read, understand and follow the entire content of this guide prior to use. Failure to do so may result in serious injury or death.*

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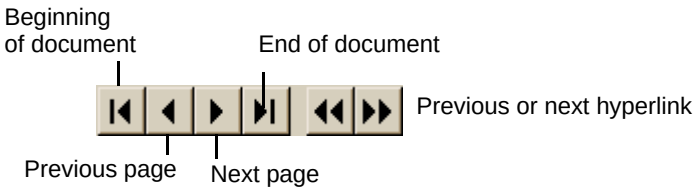

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Table 1 Navigating Within a PDF Document

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Move to an entry in the Table of Contents.	The entry itself
Move to an entry in the Index.	The page number
Move to an entry in the List of Figures or List of Tables.	The Figure or Table number
Follow a cross-reference (highlighted in blue text).	The cross-reference text
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Move backward or forward among a series of hyperlinks you have selected.	The appropriate Acrobat Reader navigation buttons

Guide Conventions

The following visual elements are used throughout this guide, where applicable:

Warning: *This icon and text indicate a potentially hazardous situation, which, if not avoided, could result in death or injury.*

Caution: *This icon and text indicates a potentially dangerous procedure. Instructions contained in the warning must be followed. Failure to do so may result in damage to the device.*

This icon and text indicate the possibility of electrostatic discharge (ESD) in a procedure that requires the reader to take the proper ESD precautions.

This icon and text designates information of special note.

Related Product Documentation

Table 2 lists the Scott Health & Safety, a Division of Scott Technologies, Inc. Family documentation set.

Table 2 Scott Health & Safety Documentation Set

DOCUMENT NAME	PURPOSE	DOCUMENT ID
N/A	N/A	N/A

Revision History

Table 3 shows the revision history for this guide, providing a description of the changes.

Table 3 Freedom 6000 User Guide Revision History

REVISION	CHANGE
A	Initial release
B	Updated technical info and parts list
C	Updated wiring configurations, updated certification page
D	Updated certification page
E	Updated parts list
F/G	Updated content on Span Calibration Gas for IR Sensors. Added content on K-factors for 5.5V Scott Cat-bead Sensors. Added content on K-factors for 6V Detector. Added Gas Interference data for Toxic (E-Chem) Sensors. Added Gas Interference data for Toxic (E-Chem) Rock Solid Sensors. Added Registered Trademark logo. Updated Company name. Added a number of Specifications. Added information on ATEX Sensor Head and System information. Updated Calibration information. Added Troubling Shooting information. Added Maintenance information. Added Index. Added Sensor section. Updated part number list and added 46 pictures to better identify items. Added information on mounting and wiring Remote Sensor Junction Box. Rewrote and revised Installation Chapter completely. Rewrote and revised Introduction Chapter completely. Rewrote and revised Configuration and Setup Chapter completely. Rewrote and revised Operation Chapter completely. Rewrote and revised Maintenance Chapter completely. Rewrote and revised the About This Guide Chapter. Added Support Appendix. Added Specification Appendix. Added Sensor Information Appendix. Updated Certifications and Approvals section. Enhanced Gas Density table for Combustibles and added table for Toxic and included CAS Numbers in Installation chapter. Added Specifications for 53 Toxic Sensors to Specifications Appendix. Added drawings and list of equipment for Zero and Span Calibration. Added information on Duct Mount Adapters. Added information on using the Test Socket Adapter. Updated drawings to include current Aluminium and Stainless Steel housings. Added Warm Up Sec. and Cal Purge Sec. maximum values in the Configuration and Setup Chapter.

Certifications and Approvals

Table 4 shows the device has been tested and complies with the following directives, standards, or standardized documents.

Table 4 Certifications and Approvals

SYMBOL	SPECIFIC DIRECTIVES, STANDARDS	FOR COMBUSTIBLE (LEL) SENSOR HEAD	FOR COMBUSTIBLE (LEL) DETECTION SYSTEM	FOR TOXIC (E-CHEM) DETECTION SYSTEM
CE Ex Ex d IIC T4 Gb DNV 10 ATEX 74945X Ambient temperature: -40°C to +85°C Gas detector must be mounted in an certified Ex d or Ex e enclosure and mounting must ensure grounding of gas detector.	EN 60079-0 EN 60079-1	* Applicable		
CE Ex Ex d IIC T5 Gb DNV 10 ATEX 85337 Ambient temperature: -40°C to +70°C	EN 60079-0 EN 60079-1		* Applicable	
CLASSIFIED c UL us Class I, Groups A-D Ambient temperature: -20°C to +40°C To reduce the risk of ignition of hazardous atmospheres, calibration port shall be tightly closed with plug during operation. Disconnect the device from the supply circuit before opening enclosure. Keep tightly closed when in operation.	UL 1203 CSA C22.2 No. 30-M1986	Applicable		

Table 4 Certifications and Approvals (continued)

SYMBOL	SPECIFIC DIRECTIVES, STANDARDS	FOR COMBUSTIBLE (LEL) SENSOR HEAD	FOR COMBUSTIBLE (LEL) DETECTION SYSTEM	FOR TOXIC (E-CHEM) DETECTION SYSTEM
 Freedom 6000 Class I, Division 1, Groups A-D Ambient temperature: -40°C to +60°C Temperature Code: T5 Freedom 6000S Class I, Division 1, Groups B-D Ambient temperature: -40°C to +60°C Temperature Code: T5	UL 1203, 4th Edition CSA C22.2 No. 30-M1986		Applicable	
 Class I, Division 2, Groups B, C & D Temperature Code: T6	CAN/CSA Standard C22.2 No. 0-M91 CSA Standard C22.2 No. 30-M1986 CSA Standard C22.2 No. 142-M1987 CAN/CSA Standard C22.2 No. 213-M1987 ANSI/ISA-12.12.01-2007 UL 1203, 4th Edition UL 916, 4th Edition			Applicable

* The TYPE EXAMINATION CERTIFICATE relates only to the design and construction of the specified equipment or protective system. The performance characteristics of the product have not been evaluated.

Note: This table indicates all applicable certifications and approvals on a factory basis. However, it does not mean that each individual device has all of the indicated certifications and approvals for that particular factory. Check your particular device for its certifications and approvals.

General Safety Information

Ensure you adhere to the following for your safety.

Warning: *Read and follow the entire content of this guide prior to use. Failure to do so may result in serious injury or death.*

Warning: *All individuals who have or will have responsibility for using or testing this product must read and understand the contents of this manual. The product will perform as designed only if used and tested in accordance with the manufacturer's instructions. failure to follow manufacturer's instructions will render the warranty and approvals null and void. Failure to follow these instructions may also result in serious injury or death.*

Scott Health and Safety, a Division of Scott Technologies, Inc. can take no responsibility for use of its equipment if it is not used in accordance with the instructions. If further operational or maintenance details are required but not provided in this guide, contact Scott Health & Safety, a Division of Scott Technologies, Inc. or their agent. Scott Health & Safety, a Division of Scott Technologies, Inc. shall not be liable for any incidental or consequential damages in connection with any modifications, errors or omissions in this guide.

All pertinent state, regional, and local safety regulations must be observed when installing and using this product. For reasons of safety and to assure compliance with documented system data, repairs to components should be performed only by the manufacturer.

Additionally, industry standards, codes, and legislation are subject to change. Updated copies should be obtained by users to ensure the most recently issued regulations, standards and guidelines are available.

All pertinent state, regional, and local safety regulations must be observed when handling and disposing of hazardous material, Toxic (E-Chem) Sensors, batteries and other similar items that may fall under the classification of hazardous material.

Only use Scott Health and Safety, a Division of Scott Technologies, Inc. approved replacement parts.

Warnings and Cautions – Device Use and Care

Ensure you follow the applicable warnings and cautions indicated here.

Warning: *This equipment must be operated and serviced by qualified personnel only. Read and understand the guide completely before operating or servicing. Qualified personnel as defined according to local, county, state, federal and individual company standards.*

Warning: *When in doubt vacate the area immediately. You should vacate the area immediately should the device indicate a warning or alarm condition. You should know and understand your company's safety protocols.*

Warning: *Ensure the atmosphere is free from combustible and/or toxic gases prior to starting any of the procedures.*

Warning: *When the primary device is off line, ensure you have another online device to actively detect gases. The device may be off line due to such activities, like but not limited to, calibration, installation, maintenance, troubleshooting, configuration, wiring and other activities.*

Warning: *If the device does not function as described herein, remove from service and mark for maintenance. Only use Scott Health & Safety, a Division of Scott Technologies, Inc. replacement parts.*

Warning: *Only use the device to monitor the atmosphere for the gases and concentrations for which it is set-up to detect.*

Warning: *Verify the cover, internal PCB's and field wiring are securely in place before applying power and operation.*

Warning: *Do not expose the device to electrical shock or continuous severe mechanical shock.*

Warning: *Do not use the device if its enclosure is damaged, cracked, or has missing components.*

Warning: *Protect the device from dripping liquids and high power sprays.*

Caution: *Device will not operate without power applied. Thus, it only detects gases while powered.*

Caution: *Use only a sensor assembly compatible with the device and approved by Scott Health & Safety, a Division of Scott Technologies, Inc.*

Caution: *Periodically test for correct operation of the system's alarm events by exposing the device to a targeted gas concentration above the high alarm set point.*

Caution: *Calibration is critical. Calibration should be performed periodically that takes into account device use and environment conditions. Calibrate with known target gas at start-up and check on a regular schedule. The device should always be re-calibrated after exposure to high concentrations of toxic or combustible gases or vapors.*

Warnings and Cautions – Sensor Use and Care

Ensure you follow the applicable warnings and cautions indicated here.

Warning: *Extended exposure of the detector to high concentrations of toxic or combustible gases may result in degraded sensor performance. If an alarm occurs due to high concentration of combustible gases, recalibrate the device or, if needed, replace the sensor.*

Caution: *Do not use any solvents, chemicals, or polishes containing silicon compounds to clean the detector as these can cause damage to the sensor.*

Caution: *Be aware of poisoned combustible sensors. The operation of catalytic type combustible gas sensors may be seriously affected by silicones, free halogens, halogenated hydrocarbons and metallic oxides present in the ambient air being monitored. If the presence of any of these substances is suspected, increased frequency of calibration verification is recommended.*

Caution: *Sensitivity of the combustible gas sensor can be adversely affected by exposure to sulfur compounds, halogens, silicone or lead containing compounds, or phosphorus containing compounds. Avoid exposure to these substances. Should the detector be suspected of being exposed to such substances, perform a gas test to verify its accuracy and that it is calibrated accordingly.*

Acronyms

Table 5 provides a quick reference for acronyms used in this guide that may be unfamiliar.

Table 5 Acronyms

ACRONYM	DEFINITION
AC	Alternating Current
A/D	Analog to Digital
AH	Amp-Hour
ASCII	American Standard Code for Information Interchange
AWG	American Wire Gauge
C	Common or the pole
CEC	Canadian Electrical Code
D/A	Digital to Analog
DC	Direct Current
EM	Electromagnetic
EMI	Electromagnetic Interference
ID	Inside Diameter
I/O	Input/Output
LCD	Liquid Crystal Display
LED	Light Emitting Device
LEL	Lower Explosive Level
mA	Milliamps
MOV	Metal Oxide Varistor
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NIST	National Institute of Standards and Technology
NPT	National Pipe Thread
NV-EEPROM	Non-Volatile Electrical Erasable Programmable Read Only Memory
OD	Outside Diameter
PCB	Printed Circuit Board
PID	Photo Ionization Detector
RMI	Radio Magnetic Interference
RTU	Remote Terminal Unit
SPDT	Single Pole, Double Throw
VAC	Volts Alternating Current
VDC	Volts Direct Current

Chapter 1

INTRODUCTION

Chapter Overview

This chapter covers the following topic:

- Device Overview

Device Overview

The Freedom® 6000 is a single fixed-point device designed to provide continuous monitoring of Combustible (LEL) gases (range: 0 to 100%) or Toxic (E-Chem) gases (range: varies based on the individual Sensor type).

The device receives inputs from an attached Sensor Head that affixes to the bottom and transmits the output to a remote monitoring system. Two (2) types of Sensor Heads can be used with the device:

- To detect Hydrocarbon Combustibles in ambient atmospheres; it accepts either Catalytic Bead (Cat-bead) or miniaturized Infrared (IR) Sensors. Both are referred to as Combustible (LEL) Sensors. This type Sensor Head is available in two (2) different designs; an UL approved version and an ATEX approved version.
- To detect Toxic gases in ambient atmospheres; it uses Electrochemical (E-Chem) Sensors. Referred to as Toxic (E-Chem) Sensors. When using a Toxic Sensor Head, the Toxic (E-Chem) Sensor Head Daughter Board is required.

Except where noted, functionality of the device is not affected by the type of Sensor Head installed.

Standard device features include:

- A Numerical and Graphic Display (LCD) – For quick and easy User Interface (UI) for access to menus.
- Three Alarm LEDs (ALM1, ALM2 and FAIL) – For field equipment alarm levels.
- MODBUS RS-485 RXD and TXD LEDs – Indicates active MODBUS RS-485 Communications (Only functions when the Relays/MODBUS RS-485 Option PCB is installed).
- Multiple Navigation Keys – For device configuration, calibration and fault analysis without opening the enclosure.
- Non-Volatile Memory (NV-EEPROM) – Retains all configuration parameters of the device in the event of a power interruption or loss.
- Real Time Clock (RTC) and Calendar – Provides a time stamp capability. Thus, allows data logging of calibrations and alarm events for recall to the LCD or over the MODBUS RS-485 Serial port.
- CAL MODE – Advises when to apply calibration gas.
- Modular Design – For easy installation, allows multiple Sensor Head Types, easy of maintenance and replacement of individual Sensors.
- Compatible Sensors – Provides a wide variety of Sensors to accommodate your applicable needs.
- Housings – Available in either Aluminium or Stainless Steel.

Additionally, the device may be ordered with either of the following based on your needs:

- An Isolated 4-20mA Option PCB – Allows the separation of the Power Source and Sensor Inputs from the Sensor Output Signals to the Receiver.
- A Relays/MODBUS RS-485 Option PCB – Allows the use of three (3) Discrete Relays and a Remote Reset connection, as well as, MODBUS RS-485 Communication Protocol output. The three (3) Discrete Relays can be wired to notification alarm equipment (such as lights, and audible). The MODBUS RS-485 output supports up to 247 Remote Terminal Units (RTUs) on the MODBUS RS-485 Network.

If a Toxic (E-Chem) Sensor Head is ordered, then the Toxic (E-Chem) Sensor Head Daughter Board is installed at the factory.

The device ships preconfigured using the factory default settings. However, you my want to reconfigure some of the parameters based upon your application. See "Configuration Defaults" on page 69.

Combustible (LEL) Sensors shipped with the device are calibrated at the factory. However, Spare Combustible (LEL) Sensors must be calibrated prior to use.

Toxic (E-Chem) Sensors shipped with the device are calibrated at the factory using a simulator. Verify that Spare Toxic (E-Chem) Sensors are calibrated prior to use.

***Warning:** Periodic Calibration checks are needed to assure dependable performance. Operating the device that has exceeded its calibration date can cause false readings of detected gases. Readings obtained while device is out of calibration are invalid and could lead to death or injury.*

Other accessories are available to aid you in your use of the device. For a complete list, See "Parts List" on page 115. Here are only a few examples:

- Remote Sensor Junction Box – Allows mounting the Sensor at remote locations for better detection since some gases rise and some sink.
- Duct Mount Adaptor – Allows the monitoring of airflow in exhaust or ventilation ducts without drying out the device's sensor.
- Calibration Adaptor – Allows direct calibration flow to the sensor face without dilution from environmental interferences such as wind.

If you have any questions about the device or its operation contact Scott Health and Safety, a Division of Scott Technologies, Inc. See "Assistance" on page 114.

Figure 1 shows the major parts of the device.

Figure 1 Major Parts

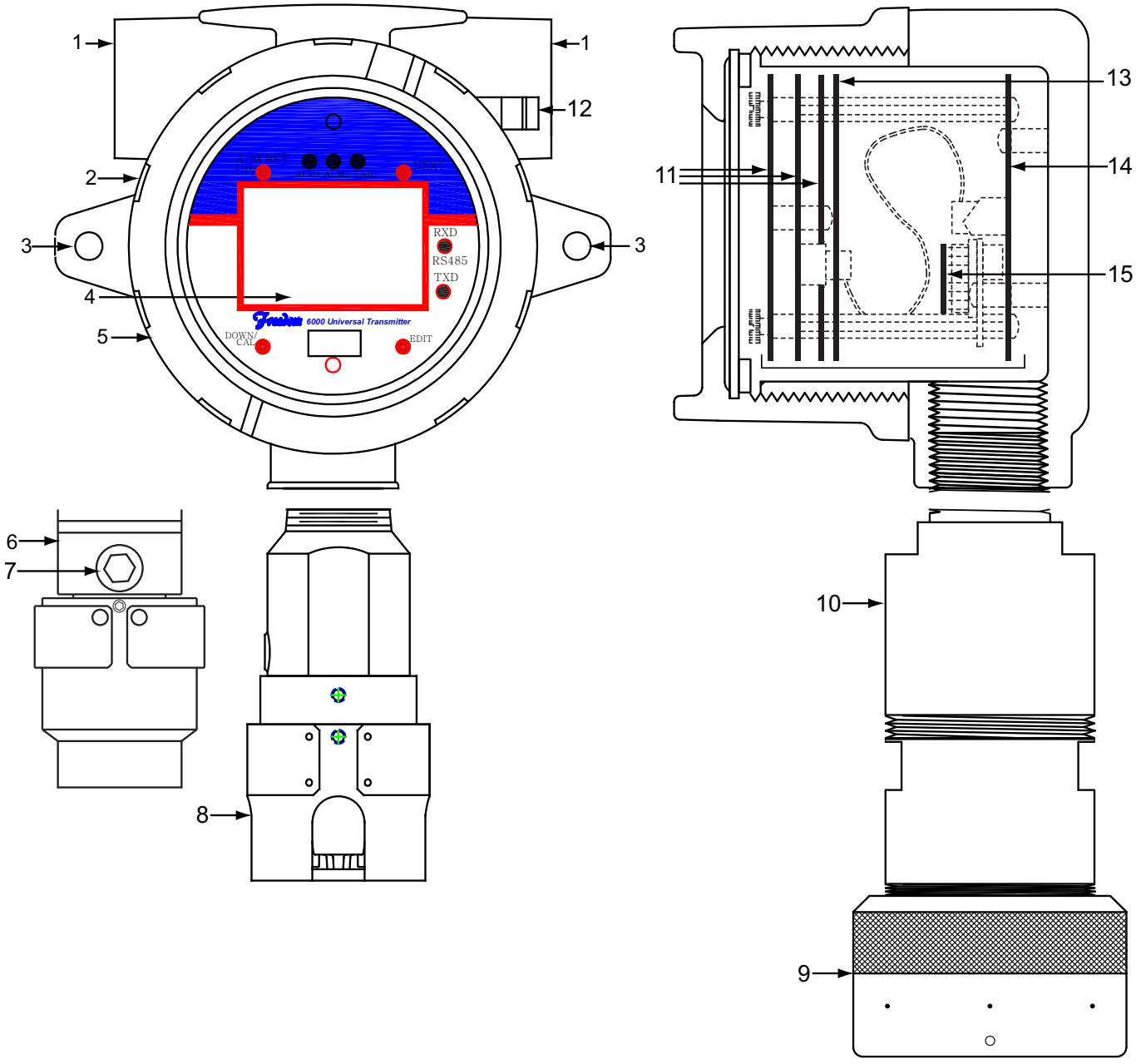


Table 6 lists the major parts of the device.

Table 6 Major Parts

REFERENCE NUMBER	ITEM
1	3/4” Conduit Entries (2)
2	Housing
3	Mounting Flange Holes (2)
4	Text and Numerical Display (LCD)
5	Removable Cover
6	Combustible (LEL) Sensor Head
7	Calibration Port
8	Combustible (LEL) Sensor Head – ATEX Approved
9	End Cap
10	Toxic (E-Chem) Sensor Head – ClassI, Division2 Approved
11	Display/CPU PCB
12	Grounding Screw
13	Either: • Isolated 4-20mA Option PCB • Relays/MODBUS RS-485 Option PCB
14	Power/ I/O PCB
15	Toxic (E-Chem) Sensor Head Daughter Board (Required for Toxic (E-Chem) Sensor Head – Class1, Division2 only)

Chapter 2

INSTALLATION

Chapter Overview

This chapter covers the following topics:

Planning for Installation

This section provides the pre-installation items.

Verifying Items Shipped

This section provides a list of the items that ship with the device. Ensure you have all items, if not See "Assistance" on page 114.

There are two (2) basic versions:

- Device Toxic (E-Chem) version
  - Toxic (E-Chem) Sensor
  - End Cap
  - Screwdriver with magnet
  - Manual
- Device Combustible (Cat-bead or IR version)
  - Allen Wrench
  - Screwdriver with magnet
  - Manual

Mounting Considerations

This section outlines a few variables that should be taken into consideration when selecting a location for mounting the device:

Each application is unique and needs to be assessed. These are only general guidelines.

- Orientation – Always mount the device's sensor pointing downwards.

Caution: *Never mount the detector in a way that causes the sensor to be pointing upwards. Failure to do so can result in poor sensor performance.*

- Gas Density – Some gases raise and some sink depending on their Gas Density relative to air. For gases heavier-than-air, it is recommended that the sensor be installed near the floor. In these applications, care should be taken to protect the sensors from physical damage. For gases that are lighter-than-air, the sensor should be placed near the ceiling, above the potential source of the leak, as well as at the highest point in the room if it is an indoor application. For gases with densities equal-to-air, mount as close to potential leak source as practical, or near or at breathing level. Table 7 provides various gas densities for Combustibles (LEL) and Table 8 provides various gas densities for Toxic (E-Chem).

Ensure you consult the CAS Registry Database (cas.org) for the latest and most current information. These tables are for reference only and not meant to be the most update source of information. The content of these tables were derived from the CAS Registry. Additionally, review the applicable MSDS.

Table 7 Gas Density Relative to Air and CAS No. - Combustibles (LEL)

GAS	SYMBOL	CAS NO.	VALUE
Acetone	CH_3COCH_3	67-64-1	2.0
Ammonia	NH_3	7664-41-7	0.6
Benzene	C_6H_6	71-43-2	2.8
Butadiene	C_4H_6	106-99-0	1.9
Butane	C_4H_{10}	106-97-8	2.0
Carbon Monoxide	CO	630-08-0	1.0 @0°C
Cyclohexane	C_6H_{12}	110-82-7	3.0
Ethane	C_2H_6	74-84-0	1.0
Ethanol	C_2H_5OH	64-17-5	1.6
Ethylene	$CH_2=CH_2$	74-85-1	1.0
Ethylene Oxide	C_2H_4O	75-21-8	1.5
Heptane	C_7H_6	142-82-5	3.5
Hexane	C_6H_{14}	110-54-3	3.0
Hydrogen	H_2	1333-74-0	0.1
Hydrogen Sulfide	H_2S	7783-06-4	1.2
Isobutylene	$CH_2=C_3H_6$	115-11-7	1.9
Isopropyl Alcohol	C_3H_8O	67-63-0	2.1
Methane	CH_4	74-82-8	0.6
Methanol	CH_3OH	67-56-1	1.1
Methyl Ethyl Ketone	$C_2H_5COCH_{13}$	78-93-3	2.5
Methyl Mercaptan	CH_3SH	74-93-1	1.7
Octane	C_8H_{18}	111-65-9	3.9
Pentane	C_5H_{12}	109-66-0	2.5
Propane	C_3H_8	74-98-6	1.6
Propylene	$CH_3CH=CH_2$	115-07-1	1.5
Toluene	$C_6H_5CH_3$	108-88-3	3.1
o-Xylene	$C_6H_4(CH_3)_2$	95-47-6	3.7
Note: Vapor densities (Air= 1.0 atmosphere @25°C). Therefore, values <1 raise and values >1 sink.			

Table 8 Gas Density Relative to Air and CAS No. - Toxic (E-Chem)

GAS	SYMBOL	CAS NO.	VALUE
Ammonia	NH_3	7664-41-7	0.6
Arsine	AsH_3	7784-42-1	2.7 @20°C
Boron Trichloride	BCl_3	10294-34-5	4.1 @0°C
Bromine	Br_2	7726-95-6	N/A
Carbon Dioxide	CO_2	124-38-9	1.5
Carbon Monoxide	CO	630-08-0	1.0 @0°C
Chlorine	Cl_2	7782-50-5	2.5 @20°C
Chlorine Dioxide	ClO_2	10049-04-4	N/A
Diborane	B_2H_6	19287-45-7	1.0 @0°C
Dichlorosilane	SiH_4Cl_2	4109-96-0	3.5
Fluorine	F_2	7782-41-4	1.3
Germane	GeH_4	7782-65-2	2.6 @0°C
Hydrogen	H_2	1333-74-0	0.1
Hydrogen Chloride	HCl	7647-01-0	1.3
Hydrogen Cyanide	HCN	74-90-8	0.9 @31°C
Hydrogen Fluoride	HF	7664-39-3	0.391
Hydrogen Selenide	H_2Se	7783-07-5	2.8
Hydrogen Sulfide	H_2S	7783-06-4	1.2
Methanol	CH_3OH	67-56-1	N/A
Methylene Chloride	CH_2Cl_2	75-09-2	N/A
Methyl Iodide	CH_3l	74-88-4	N/A
Nitric Oxide	NO	10102-43-9	1.0
Nitrogen Dioxide	NO_2	10102-44-0	2.6 @21.1°C
Nitrogen Trifluoride	NF_3	7783-54-2	2.5 @20°C
Oxygen	O_2	7782-44-7	1.1
Ozone	O_3	10028-15-6	1.7
Phosphine	PH_3	7803-51-2	1.2
Silane	SiH_4	7803-62-5	1.1 @20°C
Sulfur Dioxide	SO_2	7446-09-5	2.3
Note: Vapor densities (Air= 1.0 atmosphere @25°C). Therefore, values <1 raise and values >1 sink.			

- 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 device where air currents are most likely to contain the highest concentration of escaping gas.

- Ambient Temperature – Ensure that the device is located within an area that complies with the specified operating temperature range. See “Specifications” on page 93.
- Vibration – Mount the device in a manner that minimizes vibration.
- Gas release temperature – Evaluate the behavior of the gas when it is cooled or heated when released. For example, some heated heavier-than-air gases, such as hydrogen sulfide, rise when first released, but settles as they cool and their density increases above that of air.
- Accessibility – Consider future maintenance and calibration requirements.
- Ingress and Egress – Consider passing traffic areas regarding items like personnel, forklifts, motor vehicles, mobile hoists and the like.
- Avoid water and condensing humidity – Water inside the infrared optics adversely affects performance. Avoid mounting in locations where water can collect or splash on the sensor head. Scott Health & Safety, a Division of Scott Technologies, Inc. recommends a rain shield for outdoor installations.
- Electromagnetic Fields – Although the device is designed to be RFI/EMI resistant, mounting the device near power transformers, walkie-talkies, or other strong EM fields may cause undesirable results. Avoid strong EM fields.
- Use 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 device electronics from moisture.
- Avoid direct bold sunlight – Scott Health & Safety, a Division of Scott Technologies, Inc. recommends using a sunshade if the device is mounted in direct sunlight.
- Environmental damage – Every effort should be made to protect sensors from environmental damage caused by water, snow, shock, vibration, dirt, and debris.
- Air variables – Factors such as air movement, gas density in relation to air, emission sources, gas interferences and environmental variables should be considered when determining the correct device location. Air movement by fans, prevailing winds, exhaust duct, strong air-flow through a room, and convection should be carefully evaluated to determine if a leak is more likely to raise gas levels in certain areas within the facility. High air velocities results in inaccurate measurement and reduce sensor life.
- Distance – All systems that separate the Transmitter from the Sensor have distance limit specifications. Ensure that the application’s distance requirements are within specifications and that the appropriate gauge wiring is used.

Following Electrical Codes

This section provides information about adhering to electrical codes when installing the device.

Warning: *To avoid an explosion or electrical fire, encase the cable connection to the device in conduit. The conduit must meet prevailing electrical codes for hazardous-area installations which specify conduit sealing, explosion-proof fittings, and special wiring methods. Failure to do so could result in injury or death.*

To meet prevailing electrical codes, use conduit and all other materials required for electrical wiring in hazardous areas. Install wiring according to National Electrical Code (NEC) Articles 501-517.

As supplied, the Sensor Head wiring is already sealed and requires no additional sealing to conform to NEC requirements for explosion-proof installations, as long as the detector is mounted no further than 18" (457 mm) from the device [NEC Article 501-5(a)(1)].

Determining Wire Length and Size

This section describes various factors that go into determining wire length and its size.

Each device, receiver have unique ranges of output voltage and must be adjusted accordingly. Refer to their respective manuals.

When the VDC Power Supply is remote in relation to the device or when the device is remote in relation to the Remote Sensor Head you must determine the proper wire length and size so the proper Voltage gets from the source to the destination. If the proper Voltage is not at the destination, then the device or the Remote Sensor Head will not function properly. This is referred to as Voltage Loss and must be planned for when installing.

These methods may be used to determine length and size for both:

- VDC Power Supply to the device
- Device to Remote Sensor

Various methods are provided, because different situations require different methods.

This section provides a formula and a couple of reference diagrams for determining wiring distance.

Figure 2 provides a formula to calculate the maximum wire length that can be used.

Figure 2 Maximum Wire Length Formula

$$D_{ir} = \frac{V\ PowerSupply - V\ Min}{I_{Max} \times R_{Wire} \times 2}$$

Where:

D_{ir} = Maximum wire length in feet based on the wire's loop voltage

$V_{PowerSupply}$ = Power supply output voltage

V_{Min} = Minimum current voltage of device

I_{Max} = Maximum current in amperes

R_{Wire} = Resistance of wire in Ohms/foot

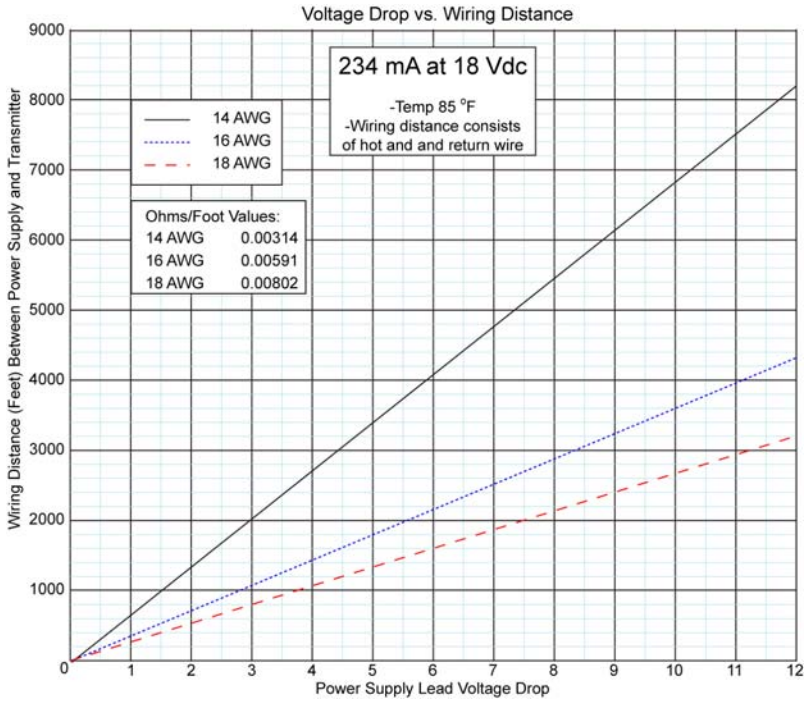
Figure 3 and Figure 4 provide a quick reference to determining maximum wiring distances for various power supply voltages and wire sizes.

To determine the maximum wiring distance, first calculate the wiring's maximum allowable voltage drop by subtracting the device minimum operating voltage from the power supply's output voltage. Then, use the appropriate chart to determine the maximum wiring distance for 18, 16 and 14-AWG wire.

When using MODBUS use 18VDC value for the Minimum Operating Voltage. Otherwise use 10VDC.

Figure 3 and Figure 4 are invalid if the wire being used has a different Ohms/foot value from those listed.

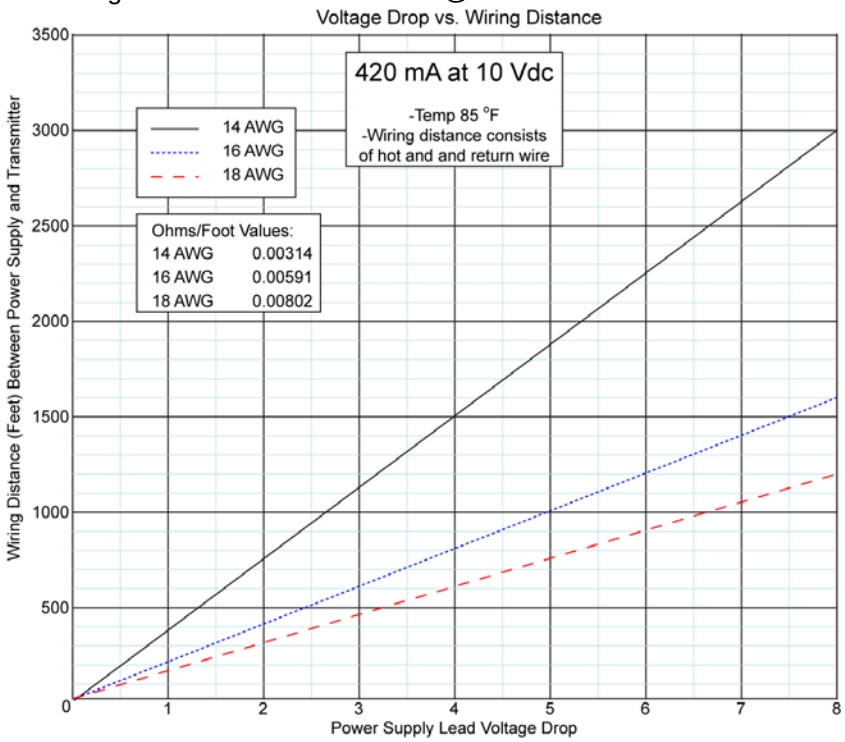
Figure 3 Wiring Distance Reference Chart @ 18VDC



If wiring requirements fall outside the boundaries of the graph, then use the formula provided. See Figure 2.

Figure 3 and Figure 4 show resistance per 1000 feet for several AWG wire gauges. Remember to double these values since the output is a loop.

Figure 4 Wiring Distance Reference Chart @ 10VDC



If wiring requirements fall outside the boundaries of the graph, then use the formula provided. See Figure 2.

Figure 3 and Figure 4 show resistance per 1000 feet for several AWG wire gauges. Remember to double these values since the output is a loop.

This section provides key factors, a couple of formulas, a few tables of information and an example for determining wiring distance.

Key factors that must be known to determine the maximum length of wire that can be used include:

- Nominal Output Voltage for the device.
- Resistance of the Wire being used expressed in Ohms/1000Ft.
- Operating Voltage for the applicable Sensor Type being used.
- Maximum Consumption in mA for the Sensor Type being used.

For example, assume you need to determine the maximum length of wire a Remote Sensor Head with an 4.25V IR Sensor can be mounted from the device using 18AWG solid, uncoated wire.

First, identify the key factors:

- 7.0V is Maximum Output Voltage for the device.
- 7.77Ohms/1000Ft. is the Resistance for 18AWG solid, uncoated wire being used. See Table 9.
- 4.25V is the Operating Voltage for the IR Sensor being used. See Table 10.
- 85mA is the Maximum Consumption for the Sensor Type being used. See Table 11

Table 9 Wire Resistance

AWG SIZE AND TYPE	RESISTANCE/1000FT. (OHMS/1000FT.)
18 solid, coated	8.08
18 solid, uncoated	7.77
18 stranded, coated	8.45
18 stranded, uncoated	7.95
16 solid, coated	5.08
16 solid, uncoated	4.89
16 stranded, coated	5.29
16 stranded, uncoated	4.99
14 solid, coated	3.19
14 solid, uncoated	3.07
14 stranded, coated	3.26
14 stranded, uncoated	3.14
Note: Data obtained from the National Electrical Code, 2008 edition. Resistance values at 167°F (75°C). The values shown are valid only for these parameters. Actual resistance values should be obtained from wire manufacturer specifications.	

Table 10 Operating Voltages for Sensors

SENSOR TYPE	OPERATING VOLTAGE
IR Sensor	4.25V
4.25V Cat-bead	4.25V
5.5V Cat-bead	5.5V
6.0V Cat-bead	6.0V

Table 11 Maximum Consumption for the Sensor Type

SENSOR TYPE	MAXIMUM CONSUMPTION
IR Sensor	85mA
4.25V Cat-bead	60mA
5.5V Cat-bead	60mA
6.0V Cat-bead	220mA

Next, using Ohm's Law, E= I*R (where: E= Voltage, I= Current, and R= Resistance), multiply the Max. Consumption (85ma) and the Resistance/1000Ft. (7.77) to determine the Voltage Loss/1000Ft.

E= .085 * 7.77

E= .66Volts Lost/1000Ft.

Next subtract the Max Voltage Output of the device (7.0V) from the Voltage needed for the Sensor to work (4.25V) to get the amount of Voltage Loss that can occur (2.75V).

Last, multiply the Max Loss that can occur (2.75V) by 1000 and divide the answer by the expected Voltage Loss per 1000Ft. (.66V). See Figure 5.

Figure 5 Maximum Wire Distance Formula

$$\text{Maximum Wire Distance} = \frac{2.75 * 1000}{.66}$$

$$\text{Maximum Wire Distance} = \frac{2750}{.66}$$

$$\text{Maximum Wire Distance} = 4167.67 \text{ Feet}$$

For a Typically distance between the device and a Remote Sensor, See "Device Specifications" on page 94. This value is based on the variations in Resistance of Wires Sizes, Type and Makes.

Caution: *Always measure the Voltage at the Sensor using a Test Socket Adapter to verify the proper voltage. Use the formulas provided only to help plan the installation, do not rely on formulas to verify installation has occurred properly.*

Installation Checklist

This section provides the installation requirements. Table 12 lists the individual items.

Warning: *Only qualified personnel should perform the installation according to applicable electrical codes, local regulations, and safety standards. Failure to do so could result in injury or death. Qualified personnel as defined according to local, county, state, federal and individual company standards.*

Warning: *Ensure the atmosphere is free from combustible and/or toxic gases prior to starting any of the procedures.*

Table 12 Installation Checklist

ITEM	DETAILS
The Aluminium Device	See "Mounting the Aluminum Device" on page 18.
The Stainless Steel Device	See "Mounting the Stainless Steel Device" on page 19.
Remote Sensor Junction Box (with a Combustible (LEL) Sensor Head)	See "Mounting and Wiring the Remote Sensor Junction Box - Combustible" on page 20.
Test Socket Adapter (for Combustible)	See "Using a Test Socket Adapter" on page 21.
Remote Sensor Junction Box (with a Toxic (E-Chem) Sensor Head)	See "Mounting and Wiring the Remote Sensor Junction Box - Toxic" on page 22.
Duct Mount Adapter for Combustible (LEL) Sensor Head	See "Mounting a Combustible (LEL) Sensor Head Using a Duct Mount Adapter" on page 24.
Duct Mount Adapter for Toxic (E-Chem) Sensor Head	See "Mounting a Toxic (E-Chem) Sensor Head Using a Duct Mount Adapter" on page 25.
Connections from the VDC Power Supply and the 4-20mA Receiver to the Device	See "Connecting the Device to the Power Supply and a Receiver" on page 26.
Connections from the Device to Various Scott Receivers (Controllers)	See "Connecting from the Device to Various Scott Receivers" on page 27.
Relays and Remote Alarm on the Relay/MODBUS RS-485 Option PCB	See "Connecting Relays & Remote Alarm Reset - Relays/MODBUS RS-485 Option PCB" on page 29.
Isolated 4-20mA Output Option PCB	See "Connecting the Isolated 4-20mA Output Option PCB" on page 32.
Combustible (LEL) Cat-bead and IR Sensor Heads	See "Connecting a Combustible (LEL) Cat-bead and IR Sensor Heads" on page 34.
Toxic (E-Chem) Sensor Head	See "Connecting a Toxic (E-Chem) Sensor Head" on page 35.
Toxic (E-Chem) Sensor Head	See "Installing/Replacing a Toxic (E-Chem) Sensor" on page 36.
Combustible (LEL) Sensor Head	See "Installing/Replacing a Combustible (LEL) Sensor Head" on page 37.

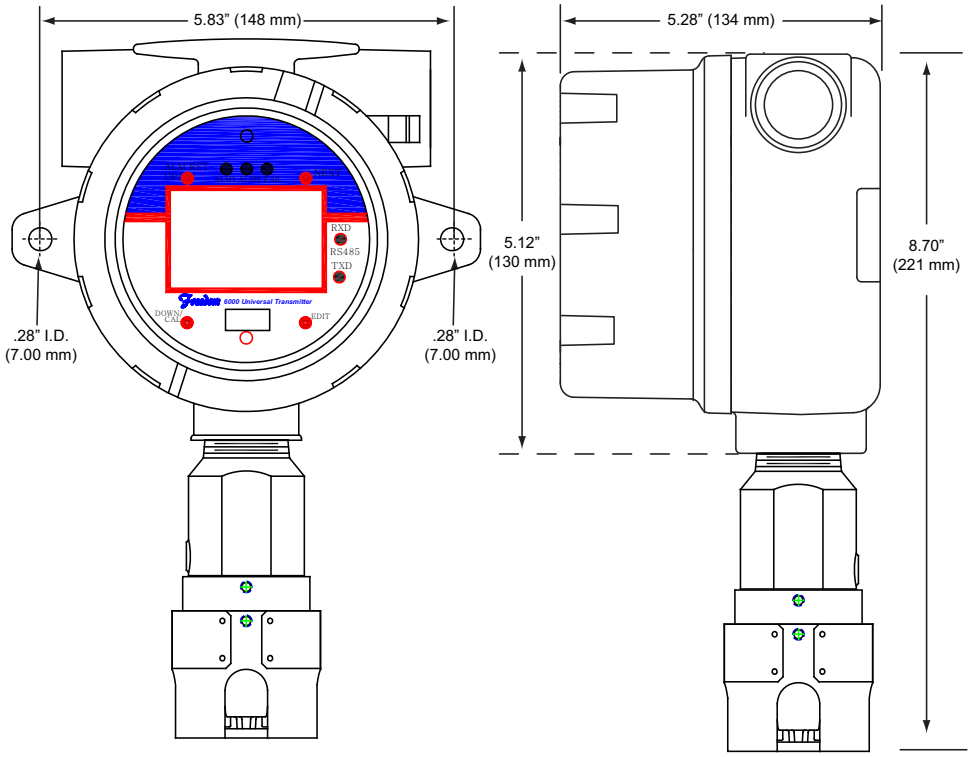
Mounting the Aluminum Device

This section describes how to mount the Aluminum device.

Install the device to a wall or bracket using the Predrilled Mounting Flanges (that is part of the housing). For details on I.D and Center dimensions. See “Device Specifications” on page 94. To facilitate wiring to the device enclosure, two-threaded 3/4” NPT conduit fittings are provided. See Figure 6.

Do not attempt to mount the device using only the conduit.

Figure 6 Device Mounting Dimensions - Aluminum



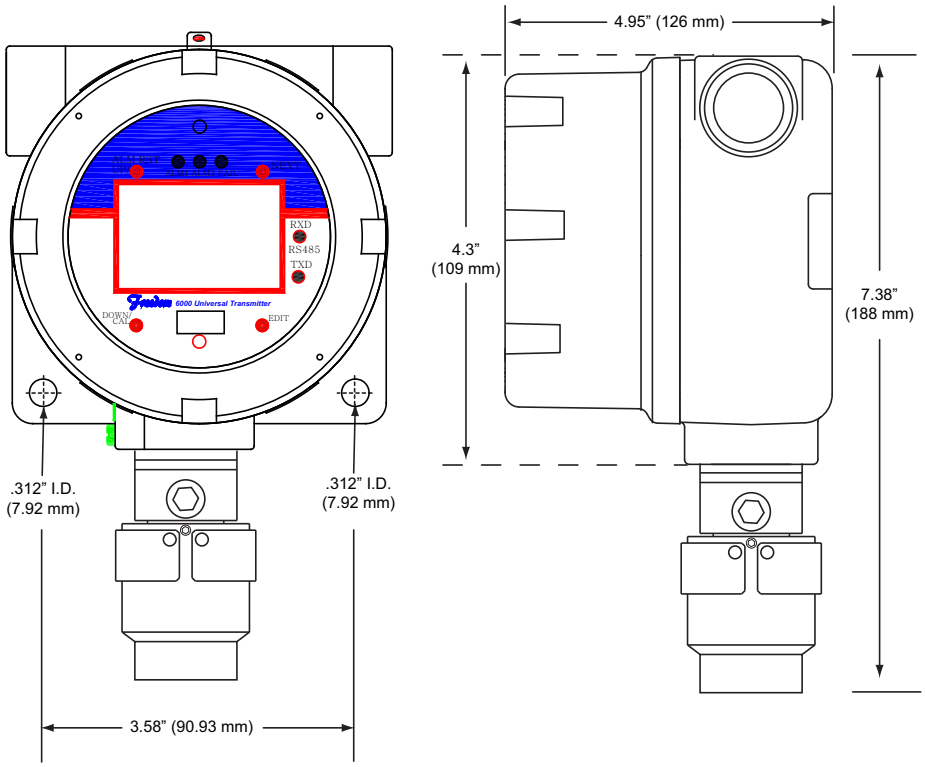
Mounting the Stainless Steel Device

This section describes how to mount the Stainless Steel device.

Install the device to a wall or bracket using the Predrilled Mounting Flanges (that is part of the housing). For details on I.D. and Center dimensions. See “Device Specifications” on page 94. To facilitate wiring to the device enclosure, two-threaded 3/4” NPT conduit fittings are provided. See Figure 7.

Do not attempt to mount the device using only the conduit.

Figure 7 Device Mounting Dimensions Stainless Steel



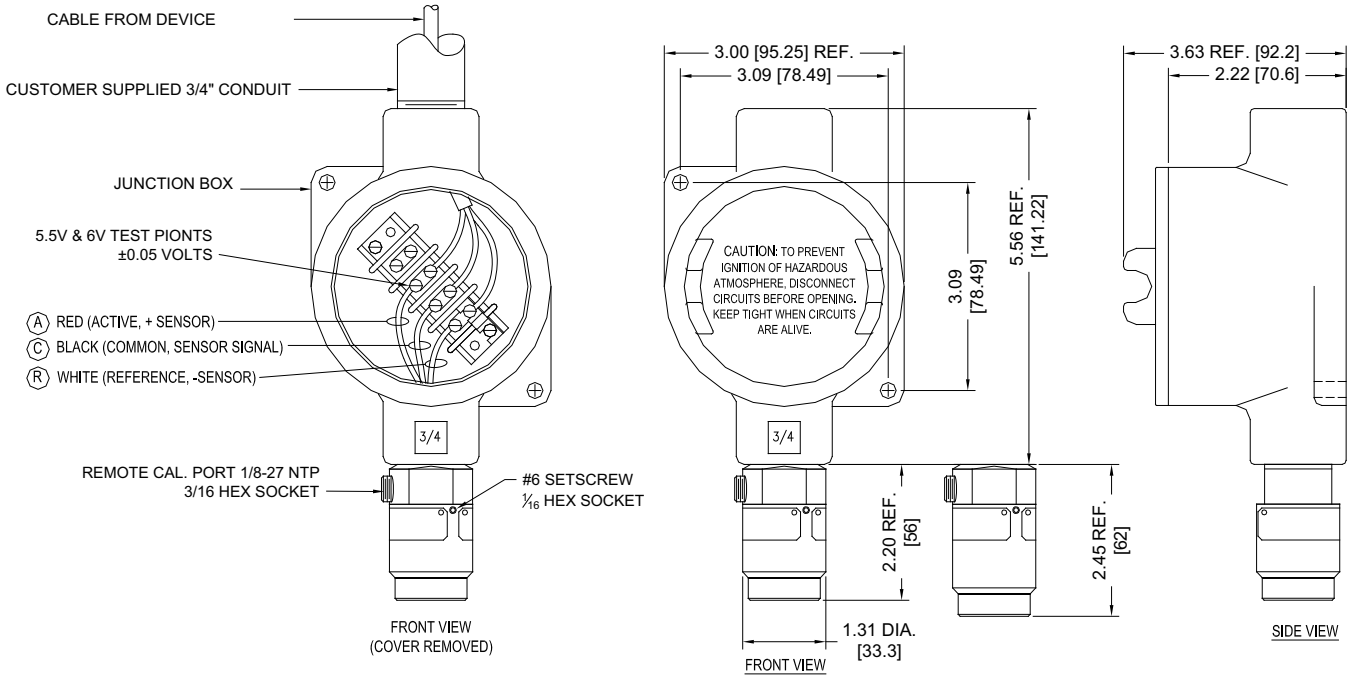
Mounting and Wiring the Remote Sensor Junction Box - Combustible

This section describes how to mount and wire the Remote Sensor Junction Box for a Combustible (LEL) Sensor Head.

If your application requires that the sensor be mounted remotely from the device, ensure you follow all code and regulatory requirements. In a remote application, the wiring distance (the Max. length of the wire) from the sensor to the device must to be determined. The sensor will not function if you go over this distance. The distance is determined based on a few variables. For details, See "Determining Wire Length and Size" on page 12. See "Device Specifications" on page 94. Conduit must be obtained from your local vendor. See Figure 8.

Sensor type does not affect wiring.

Figure 8 Remote Sensor Junction Wiring and Mounting - Combustible



The Remote Sensor Junction Box - Combustible is ClassI, Groups A, B, C, D approved.

Using a Test Socket Adapter

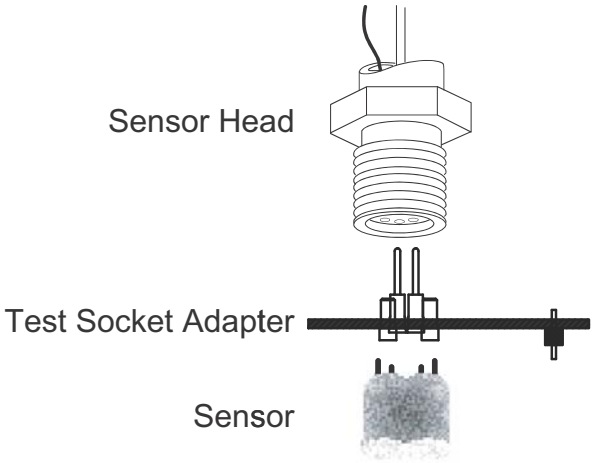
This section describes how to use the Test Socket Adapter to measure the Voltage at the Remote Sensor Combustible (LEL) Head.

Voltage to the Remote Sensor at the Combustible (LEL) Head must be at the correct voltage to work properly. When the device is remote in relation to the Remote Sensor Head you must determine the proper wire length and size so the proper Voltage gets from the source to the destination. If the proper Voltage is not at the destination, then the device or the Remote Sensor Head will not function properly. This is referred to as Voltage Loss. Therefore, you need to measure the Output Voltage at the Remote Sensor.

To measure the Output Voltage at the Remote Sensor, select the applicable Test Socket Adapter (there is one for 4.25V IR, 4.25V and 5.5V Cat-bead Sensors and one for 6.0V Cat-bead Sensor). See "Parts List" on page 115.

Plug the applicable Test Socket Adapter into the Combustible Head Receptacles and then plug the applicable Sensor's Alignment Pins into the Test Socket Adapter. See Figure 9.

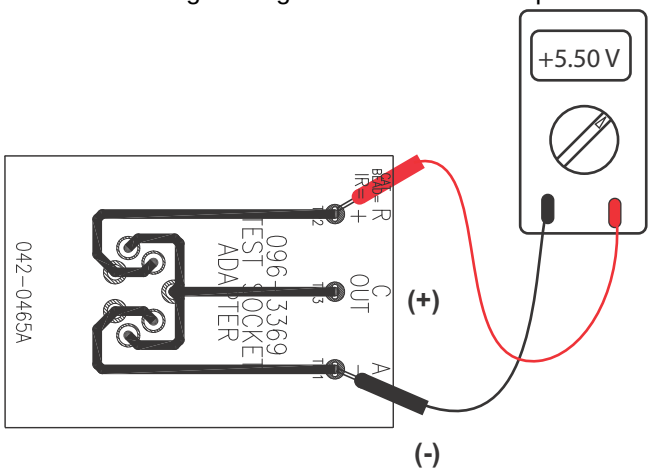
Figure 9 Using a Test Socket Adapter



Measure the Voltage across the R (reference) and A (active) terminals on the Test Socket Adapter using a Digital Multimeter (DMM). See Figure 10.

Ensure that the measured voltage has a tolerance of +/- .05V. This tolerance applies to the 4.25V (IR and Cat-bead), 5.5V and 6.0V sensors.

Figure 10 Measure the Voltage Using the Test Socket Adapter

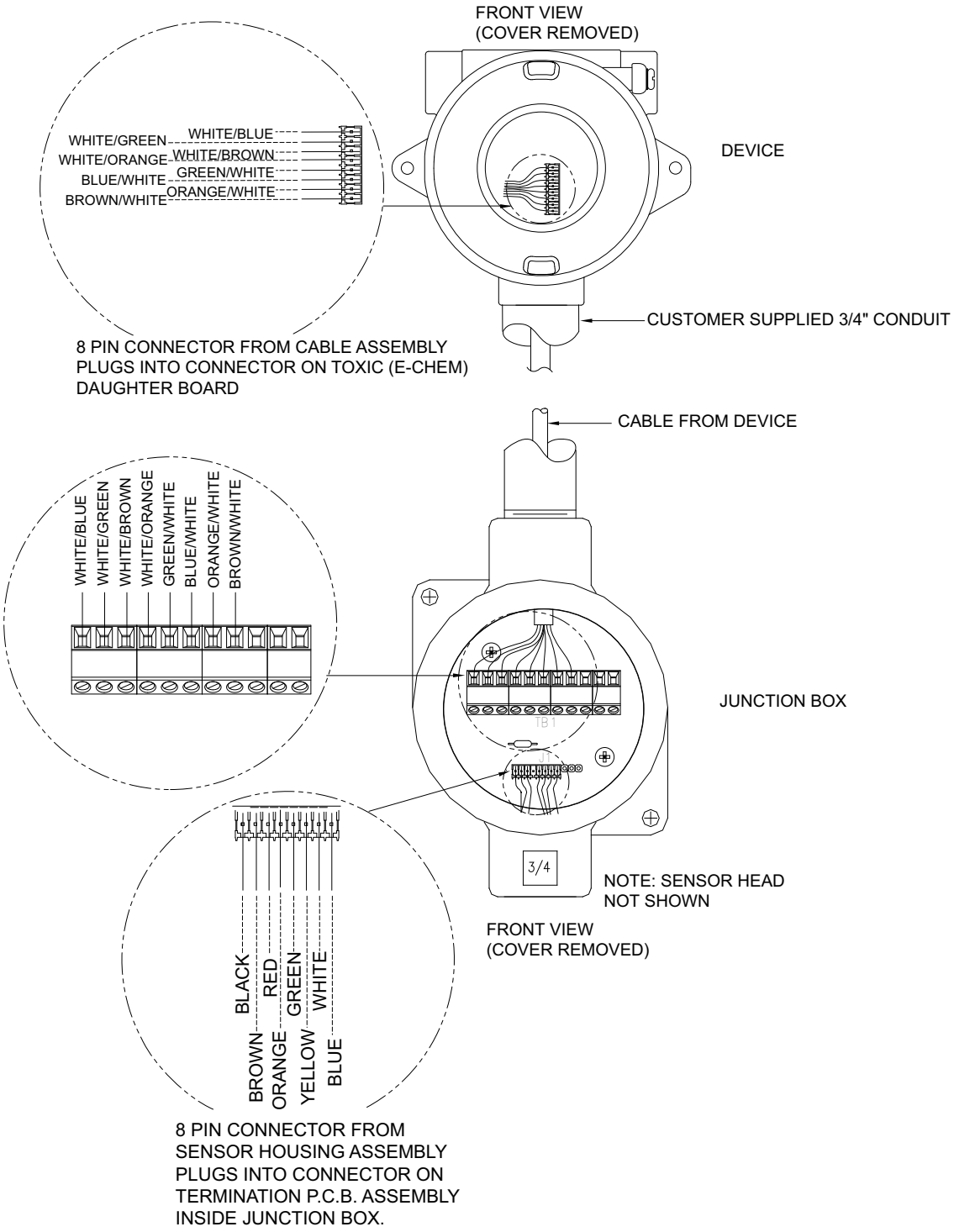


Mounting and Wiring the Remote Sensor Junction Box - Toxic

This section describes how to mount and wire the Remote Sensor Junction Box for a Toxic (E-Chem) Sensor Head.

If your application requires that the sensor be mounted remotely from the device, ensure you follow all code and regulatory requirements. In a remote application, the wiring distance (the Max. length of the wire) from the sensor to the device is a fixed value. The sensor will not function if you go over this distance. See “Device Specifications” on page 94.Conduit must be obtained from your local vendor. See Figure 11.

Figure 11 Remote Sensor Junction Wiring - Toxic



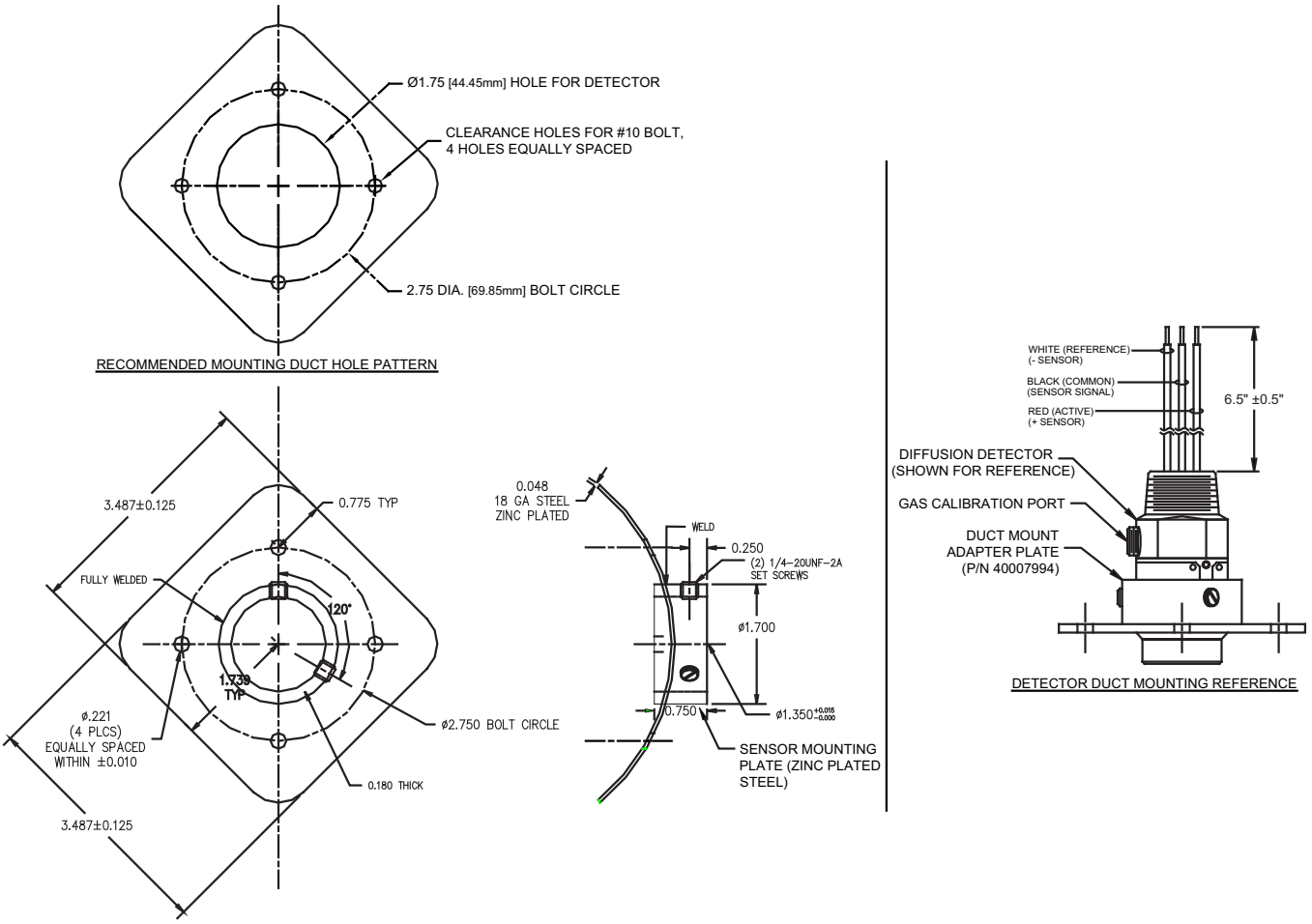
Mounting a Combustible (LEL) Sensor Head Using a Duct Mount Adapter

This section covers the mounting of a Combustible (LEL) Sensor Head using a Duct Mount Adapter.

This mounting method allows the monitoring of airflow in exhaust or ventilation ducts without drying out the device's sensor. For details on Flow Velocities and Duct compatibility. See "Device Specifications" on page 94. The Duct Mount Adapter comes in a Flat and Round version. See Figure 12.

For use only with devices configured for remote sensor and without Remote Junction Box.

Figure 12 Duct Mount Adapter Mounting - Combustible (LEL) Sensor Head



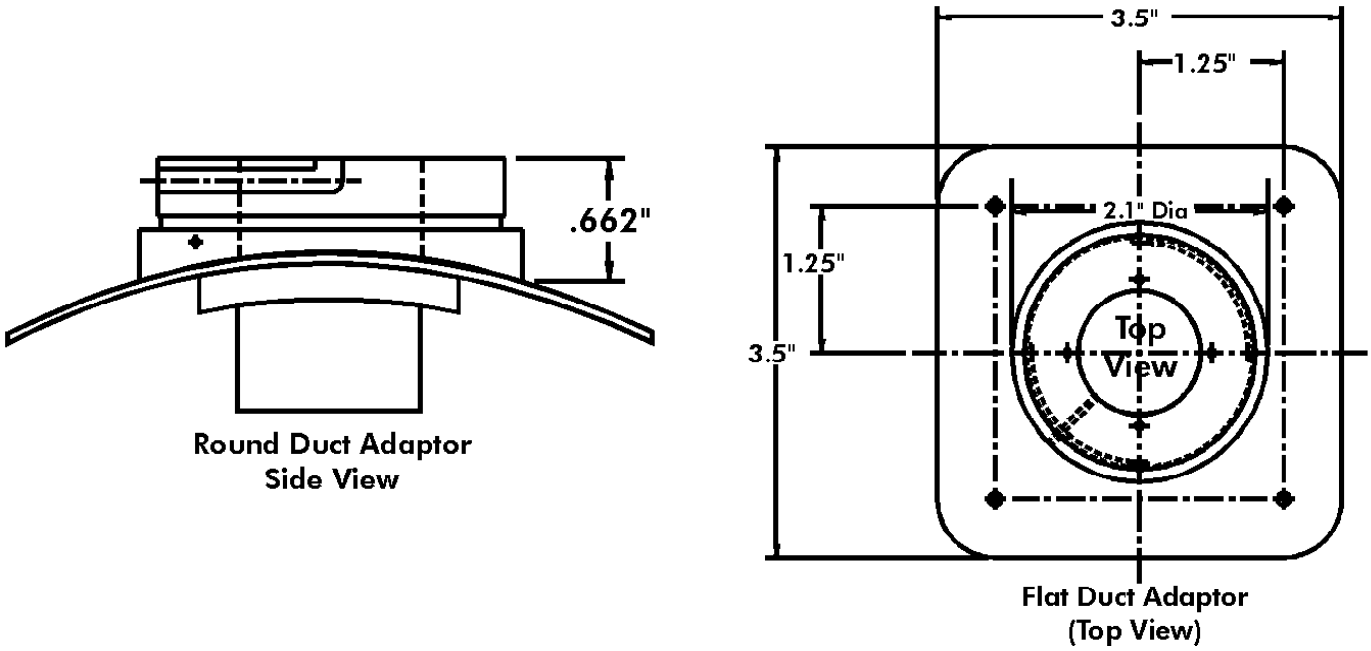
Mounting a Toxic (E-Chem) Sensor Head Using a Duct Mount Adapter

This section covers the mounting of a Toxic (E-Chem) Sensor Head using a Duct Mount Adapter.

This mounting method allows the monitoring of airflow in exhaust or ventilation ducts without drying out the device's sensor. For details on Flow Velocities and Duct compatibility. See "Device Specifications" on page 94. The Duct Mount Adapter comes in a Flat and Round version. See Figure 13.

For use only with devices configured for remote sensor and without Remote Junction Box.

Figure 13 Duct Mount Adapter Mounting - Toxic (E-Chem) Sensor Head



Connecting the Device to the Power Supply and a Receiver

This section describes the installation of the 3-wire connection from the VDC Power Supply and a 4-20mA Receiver (for example, Scott Controllers or other devices capable of measuring 4-20mA inputs) to the device.

For a the 3-wire connection (without any options), an operating voltage of 10-30 VDC is necessary from the power supply to correctly power the device.

Verify that the 14-wire ribbon cable is connected properly. The device ships with a 14-wire ribbon cable connecting the Display/CPU PCB to the Power/ I/O PCB and is made between connectors S3 and S2 respectively.

***Warning:** Ensure Receivers and Power Supplies are not powered when installing wire to the device. Failure to do so could result in injury or death.*

See "Determining Wire Length and Size" on page 12. *For determining appropriate wire length and AWG for each installation.*

1. Route wires of appropriate AWG from source through conduit runs into the device housing.

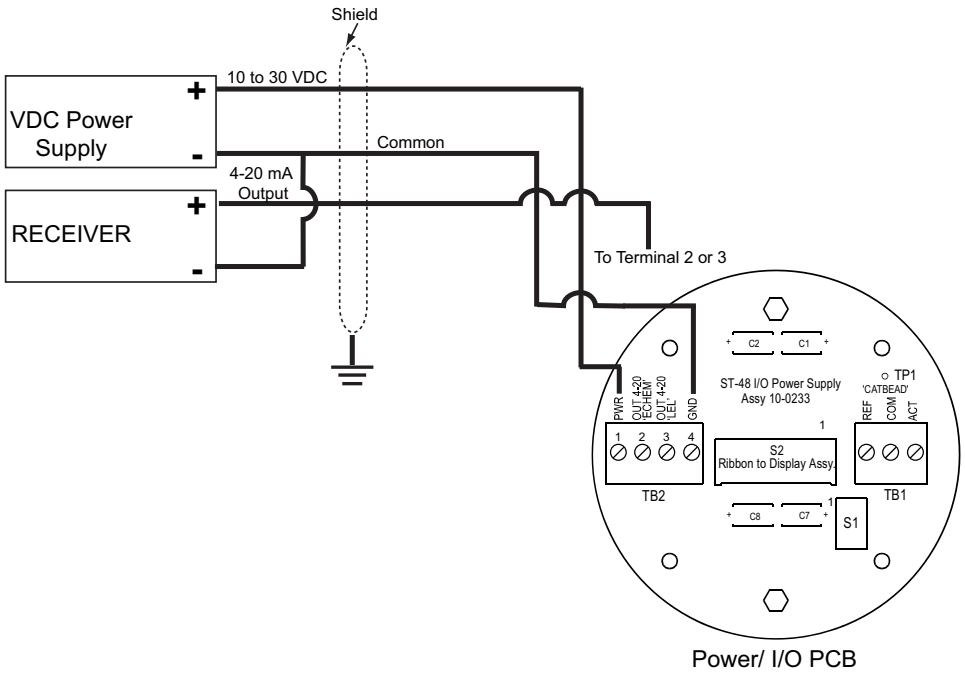
***Caution:** RFI may be generated if wires are not appropriately shielded or share conduit with other AC power conductors. Protect wires with appropriate shielding practices to prevent negative equipment performance.*

2. Connect Ground Wire to device's Grounding Screw on its housing.
3. Unscrew the Housing Cover and then loosen the two (2) Thumbscrews and remove the LCD Board to gain access to the internal PCBs.
4. Connect Positive (+) and Negative (-) leads from the Power Supply wires to TB2 on the Power/ I/O PCB. Specifically, connect the Positive (+) lead to Pin1 (PWR), and the Negative (-) lead to Pin4 (GND).

A blocking diode protects and prevents the device from operating if polarity of the power supply is reversed.

5. Connect Positive (+) and Negative (-) leads from Receiver wires to TB2 on the Power/ I/O PCB. Specifically, the Negative (-) connects to the Power Supply Negative (-) wiring and the Positive (+) connections change based on Sensor type as indicated here:
   - **a** For Combustible (LEL) Sensor: Connect the Positive (+) lead from the Receiver supplying the 4-20mA signal to Pin3 (OUT 4-20 'LEL') on TB2. See Figure 14.
   - **b** For Toxic (E-Chem) Sensor: Connect the Positive (+) lead from the Receiver supplying the 4-20mA signal to Pin2 (OUT 4-20 'ECHEM') on TB2. See Figure 14.

Figure 14 Connection for 3-Wire



6 Secure display assembly in place with two (2) thumbscrews.

7 Install device cover and tighten.

8 Apply power to Receiver.

Connecting from the Device to Various Scott Receivers

This section provides the Pinouts for the 3-wire connection from the device to various Scott Receivers (Controllers).

Details are provided in the following tables:

- Table 13 for 3-Wire Connection – Device to Sentinel 7200 Plus
- Table 14 for 3-Wire Connection – Device to Sentinel 16
- Table 15 for 3-Wire Connection – Device to Sentinel 6
- Table 16 for 3-Wire Connection – Device to Series 7400 QuadScan II
- Table 17 for 3-Wire Connection – Device to Series 7400 Plus

Table 13 3-Wire Connection - Device to Sentinel 7200 Plus

DEVICE	SENTINEL 7200 PLUS
TB2: Pin1 (PWR)	TB2: Pin1 (+) +24VDC PWR OUT
TB2: Pin2 (OUT 4-20 “ECHEM”)	
TB2: Pin3 (OUT 4-20 “LEL”)	TB1: Pin1 (+) CH1
TB2: Pin4 (GND)	TB1: Pin2 (-) CH1

Table 14 3-Wire Connection - Device to Sentinel 16

DEVICE	SENTINEL 16
TB2: Pin1 (PWR)	TB1: (EXC) ANALOG INPUTS
TB2: Pin2 (OUT 4-20 “ECHEM”)	
TB2: Pin3 (OUT 4-20 “LEL”)	TB1: (HI) ANALOG INPUTS
TB2: Pin4 (GND)	TB1: (LO) ANALOG INPUTS

Table 15 3-Wire Connection - Device to Sentinel 6

DEVICE	SENTINEL 6
TB2: Pin1 (PWR)	Pin3 (CH1 EXC-)
TB2: Pin2 (OUT 4-20 “ECHEM”)	
TB2: Pin3 (OUT 4-20 “LEL”)	Pin4 (CH1 IN HI)
TB2: Pin4 (GND)	Pin2 (CH1 IN LO)

Table 16 3-Wire Connection - Device to Series 7400 QuadScan II

DEVICE	SERIES 7400 QUADSCAN II
TB2: Pin1 (PWR)	TB1: (+V) CH1
TB2: Pin2 (OUT 4-20 “ECHEM”)	
TB2: Pin3 (OUT 4-20 “LEL”)	TB1: (+IN) CH1
TB2: Pin4 (GND)	TB1: (-IN) CH1
Note: Ensure Jumper is in place between TB1: (-IN) and (GND)	

Table 17 3-Wire Connection - Device to Series 7400 Plus

DEVICE	SERIES 7400 PLUS
TB2: Pin1 (PWR)	TB2: (24VDC) CH1
TB2: Pin2 (OUT 4-20 “ECHEM”)	
TB2: Pin3 (OUT 4-20 “LEL”)	TB2: (HI) CH1
TB2: Pin4 (GND)	TB2: (LO) CH1

Connecting Relays & Remote Alarm Reset - Relays/MODBUS RS-485 Option PCB

This section describes how to connect the Relays/MODBUS RS-485 Option PCB to use the Relays and the Remote Alarm Reset. Using these features are optional.

The Relays/MODBUS RS-485 Option PCB contains 3 relays (K1, K2, and K3) and a Remote Reset.

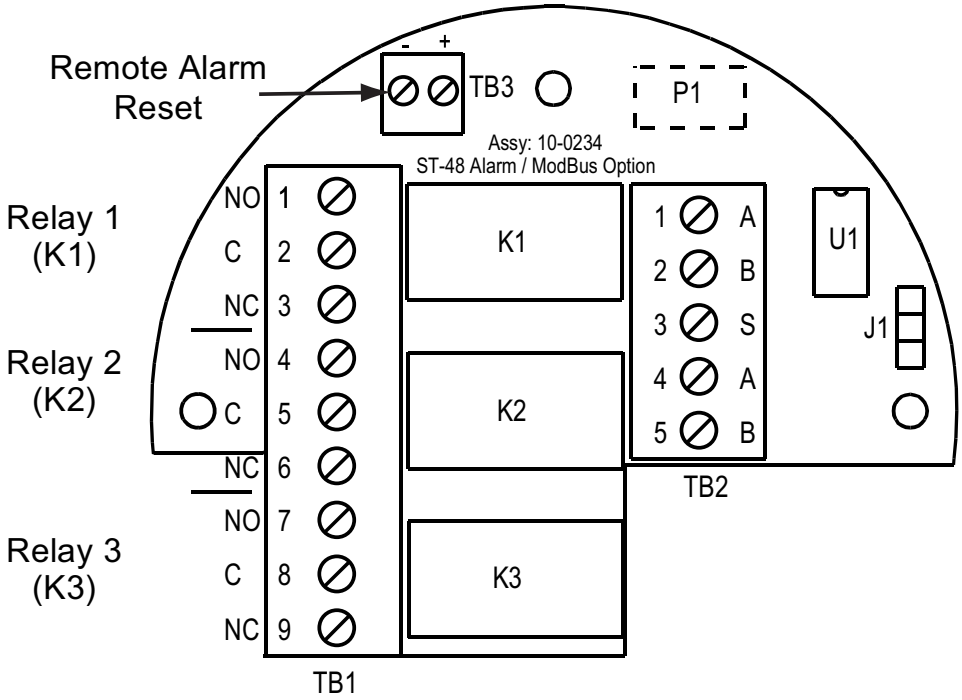
Consult Receiver equipment instructions for amplifying information on wiring in addition to what is provided in this manual as various receivers may have additional specific requirements.

Ensure you have already made the proper connections prior to connecting the Relay/MODBUS RS-485 Option PCB. See "Connecting the Device to the Power Supply and a Receiver" on page 26. *See* "Connecting from the Device to Various Scott Receivers" on page 27.

1 Unscrew the Housing Cover and then loosen the two (2) Thumbscrews and remove the LCD to gain access to the internal PCBs.

2 If desired, connect wiring from Receiver equipment to one or more of the three (3) Relays on TB1 of the Relay/MODBUS RS-485 Option PCB. Relays are designated Relay1 (K1), Relay2 (K2), and Relay3 (K3). Each relay has 3 Pins for wiring; a Normally Open (NO), a Normally Closed (NC), and a Common (C). See Figure 15.

Figure 15 Relays/Remote Alarm Reset Connections - Relays/MODBUS Option PCB



Caution: *Contacts are rated for resistive loads alarm relays have dry contacts and power must be supplied from an external source. Failure to do so could result in failure of alarm relays.*

3 If desired, connect a Remote Switch to TB3 on the Relays/MODBUS RS-485 Option PCB. This feature allows you to shut off and reset a sounding Remote Alarm. See Figure 15.

Warning: *External wiring to TB3 must be shielded and protected from noise spikes to prevent a false alarm reset condition. Failure to do so could result in injury or death if a false alarm reset condition occurs.*

Connecting the Relays/MODBUS RS-485 Option PCB

This section describes how to connect the Relays/MODBUS RS-485 Option PCB to multiple devices to use the MODBUS RS-485 Communication Protocol.

The Relays/MODBUS RS-485 Option PCB contains a MODBUS Network connection that is used to connect several devices to a single Receiver for monitoring purposes. Up to 247 devices can be wired together on a network. Each connected device becomes a Remote Terminal Unit (RTU) and requires a unique RTU address.

Consult receiver equipment instructions for information on wiring in addition to what is provided in this manual as various equipment may have additional specific requirements.

1 Determine if other devices (RTUs) are to be wired or if the current device (RTU) is the last device being wired on the MODBUS Network.

2 Unscrew the Housing Cover and then loosen the two (2) Thumbscrews and remove the LCD to gain access to the internal PCBs.

3 Set or verify J1 on the Relays/MODBUS RS-485 Option PCB as follows:

   a For a device at the end of the network with no other RTUs to be wired, install the Terminating Resistor to J1-A.

   b For device with other RTUs to be wired from the current device, install the Terminating Resistor to J1-B. See Table 18.

Table 18 Jumper (J1) Settings for the Device

DEVICE'S POSITION ON THE MODBUS NETWORK	JUMPER SETTING
Device is the last RTU	J1A
Device is NOT the last RTU	J1B

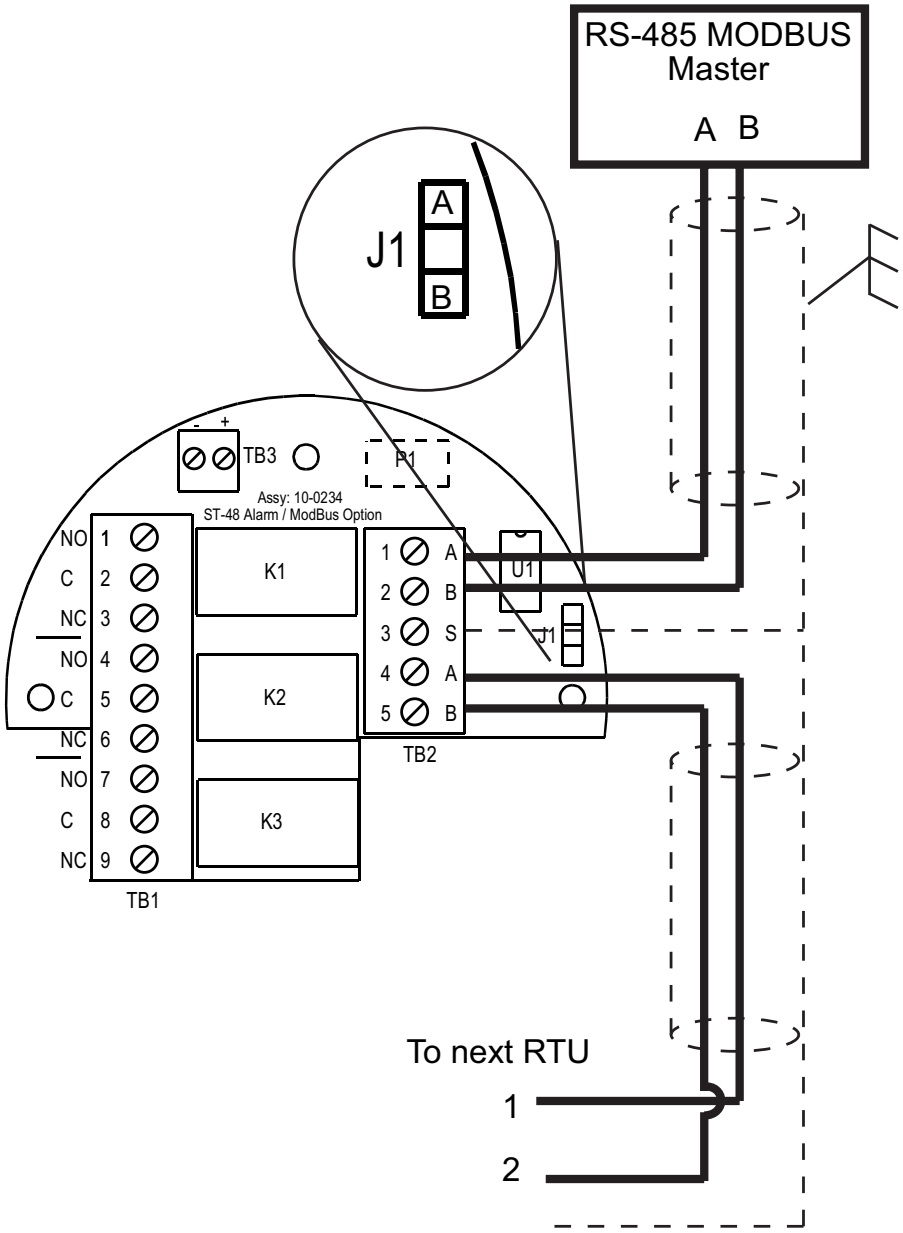
4 Connect your MODBUS Master input wire signals at TB2 Pin1 (A) and TB2 Pin2 (B) on the Relays/MODBUS RS-485 Option PCB.

5 Cable shielding must connect to TB2 Pin3 (S).

6 Route Output Wiring to next RTU from TB2 Pin4 (A) and TB2 Pin5 (B). See Figure 16.

TB2 Pin1 and Pin4 are connected internally as are TB2 Pins2 and Pin5.

Figure 16 MODBUS Connections - Relays/MODBUS RS-485 Option PCB



7 When powered up, assign unique RTU address to each of the devices on the MODBUS Network using the MODBUS Setup menu. See "Configuring the MODBUS RS-485 Port Menu" on page 59.

Connecting the Isolated 4-20mA Output Option PCB

This section describes how to connect the Isolated 4-20mA Option PCB in order to isolate the Power Supply from the Output Loop.

An Operating Voltage of 10-30VDC is necessary from the Power Supply to correctly power the device.

Verify that the 14-wire ribbon cable is connected properly. The device ships with a 14-wire ribbon cable connecting the Display/CPU PCB to the Power/ I/O PCB is made between connectors S3 and S2 respectively.

***Warning:** Ensure there is no power coming from the Receiver when installing wire to the device. Failure to do so could result in injury or death.*

See "Determining Wire Length and Size" on page 12. *For determining appropriate wire length and AWG for each installation.*

1 Route wires of appropriate AWG from source through conduit runs into the device housing.

***Caution:** RFI may be generated if wires are not appropriately shielded. Protect wires with appropriate shielding practices to prevent negative equipment performance.*

2 Connect Ground Wire to device's Grounding Screw on its housing and back to the Receivers Ground.

To prevent Grounding issues, ensure you have a good Ground Wire attached to the housing and back to the Receiver's Ground. Do not Ground to conduit or steel beams as this creates ground issues.

3 Unscrew the Housing Cover and then loosen the two (2) Thumbscrews and remove the LCD to gain access to the internal PCBs.

4 Connect Positive (+) and Negative (-) leads from Power Supply wires to TB2 on the Power/ I/O PCB. Specifically, connect the Positive (+) lead to Pin1 (PWR), and the Negative (-) lead to Pin4 (GND).

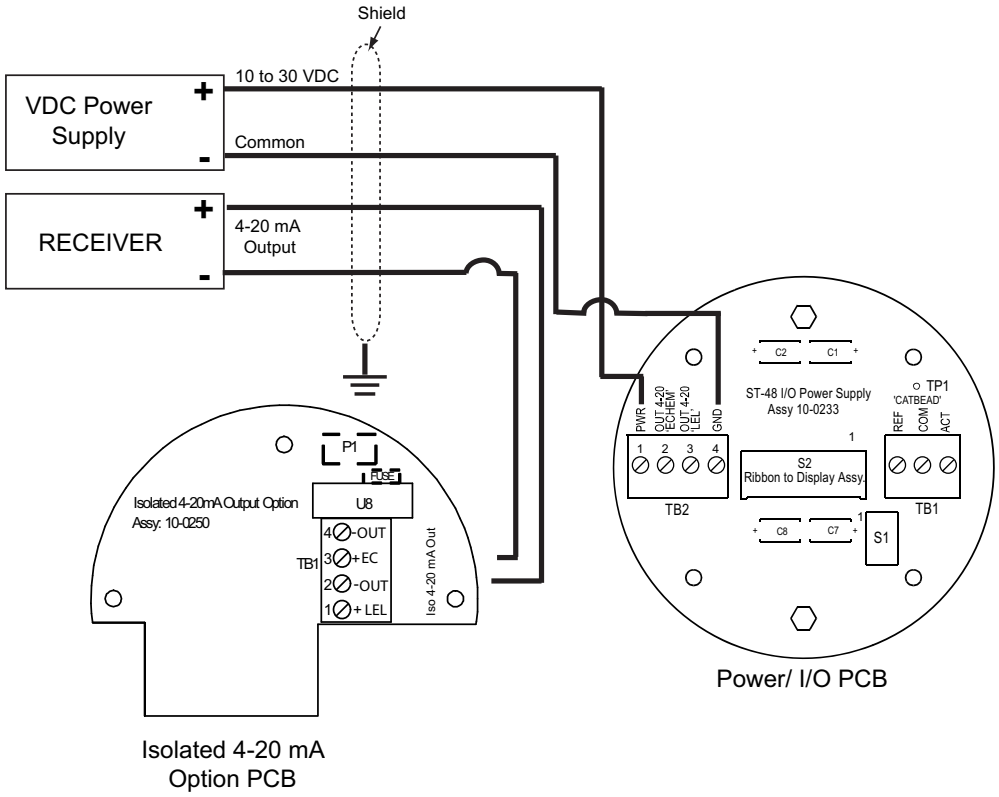
A blocking diode protects and prevents the device from operating if polarity of the power supply is reversed.

5 Connect Positive (+) and Negative (-) leads from Receiver wires to TB1 on the Isolated 4-20mA Option PCB. Specifically, both the Negative (-) and the Positive (+) connections change based on Sensor type as indicated here:

a For Combustible (LEL) Sensor: Connect the Positive (+) lead from the Receiver supplying the 4-20mA signal to Pin1 (+LEL) on TB1 and connect the Negative (-) lead from the Receiver supplying the 4-20mA signal to Pin2 (-OUT) on TB1. See Figure 17.

b For Toxic (E-Chem) Sensor: Connect the Positive (+) lead from the Receiver supplying the 4-20mA signal to Pin3 (+EC) on TB1 and connect the Negative (-) lead from the Receiver supplying the 4-20mA signal to Pin4 (-OUT) on TB1. See Figure 17.

Figure 17 4-20mA Connections - Isolated 4-20mA Option PCB



6 Secure display assembly in place with two (2) thumbscrews.

7 Install device cover and tighten.

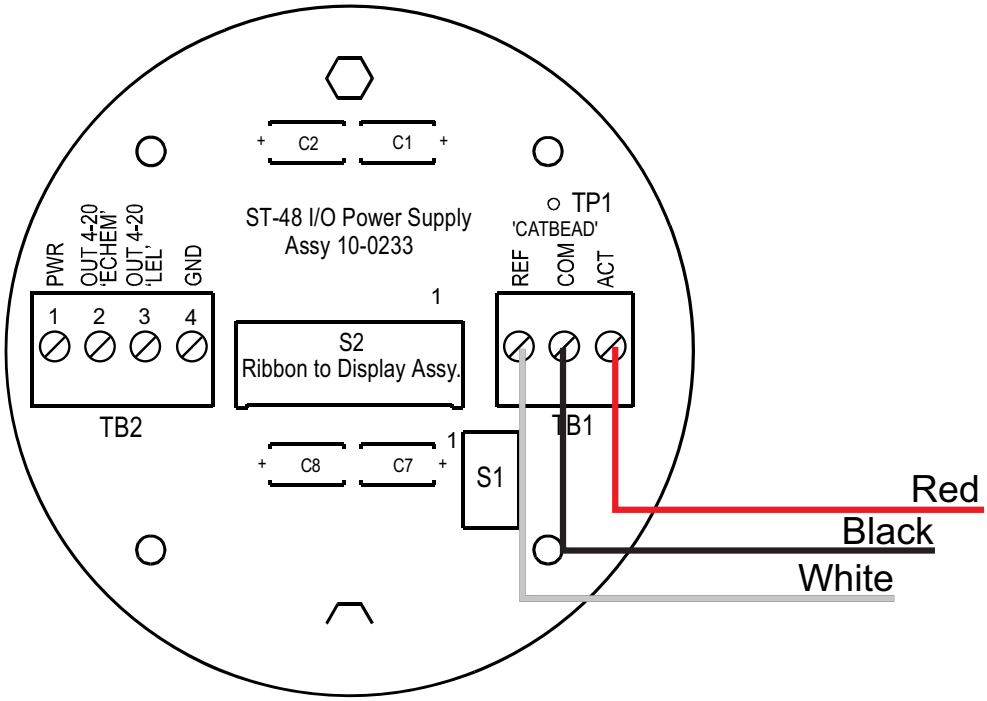
8 Apply power to Receiver.

Connecting a Combustible (LEL) Cat-bead and IR Sensor Heads

This section describes how to connect a Combustible (LEL) Cat-bead (5.5 and 6.0V) and IR (4.25V) Sensor Head to TB1 on the Power/ I/O PCB.

1. Unscrew the Housing Cover and then loosen the two (2) Thumbscrews and remove the LCD to gain access to the internal PCBs.
2. Insert the three (3) wires (Red, Black and White) that extends from the Combustible (LEL) Cat-bead and IR Sensor Head through the bottom of the threaded hole of the device.
3. Connect the Red wire to TB1 (ACT), the Black wire to TB1 (COM) and the White wire to TB1 (REF). See Figure 18.

Figure 18 Combustible (LEL) Cat-bead and IR Sensor Head Connections



If installing a new Combustible (LEL) Cat-bead and IR Sensor Head. See "Installing/Replacing a Combustible (LEL) Sensor Head" on page 37.

Connecting a Toxic (E-Chem) Sensor Head

This section describes how to connect a Toxic (E-Chem) ClassI, Division2 Sensor Head's 8-Pin Female Straight Line Connector onto the Toxic (E-Chem) Daughter Board that mounts on the Power/ I/O PCB.

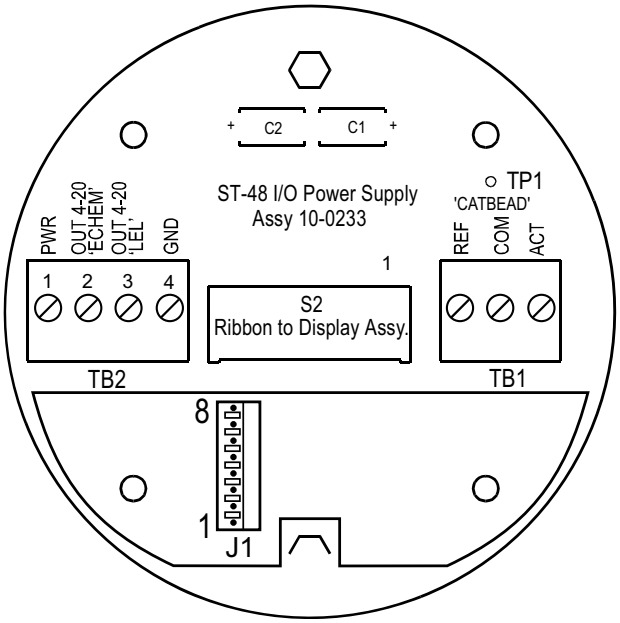
1 Unscrew the Housing Cover and then loosen the two (2) Thumbscrews and remove the LCD to gain access to the internal PCBs.

2 Insert the 8-Pin Female Straight Line Connector that extends from the Toxic (E-Chem) Sensor Head through the bottom of the threaded hole of the device.

3 Connect the 8-Pin Female Straight Line Connector from the Toxic (E-Chem) Sensor Head to the 8-Pin Male Connector located on the Toxic (E-Chem) Daughter Board. See Figure 19.

Ensure you orient the Female 8-Pin Straight Line Connector properly. Pin 8 is identified on it and on the PCB. Figure 11 shows the colored wires for your reference.

Figure 19 Toxic (E-Chem) Sensor Head Connection – ClassI, Division2



Toxic (E-Chem) Daughter Board

If installing a new Toxic (E-Chem) Sensor Head. See "Installing/Replacing a Toxic (E-Chem) Sensor" on page 36.

Installing/Replacing a Toxic (E-Chem) Sensor

This section describes how to install/replace a Toxic (E-Chem) Sensor.

The Toxic (E-Chem) Sensor ships separate from the device and must be installed. Additionally, it should be replaced as the need arises.

Toxic (E-Chem) Sensors do not require Balance or PreAmp adjustments prior to Calibrating them. Sensors installed at the factory have already had these adjustments made and only require calibration.

When installing a previously removed sensor that has already had the Balance and PreAmp Gain set, only perform a Zero and Span Calibration. For example, removing installed sensors for testing or calibration, when reinstalled, do not require Balance or PreAmp Gain adjustments.

Warning: *The device is not actively monitoring target gases when power is removed. Verify atmosphere is safe or monitor atmosphere with another device while installing a new sensor to prevent risk of injury or death.*

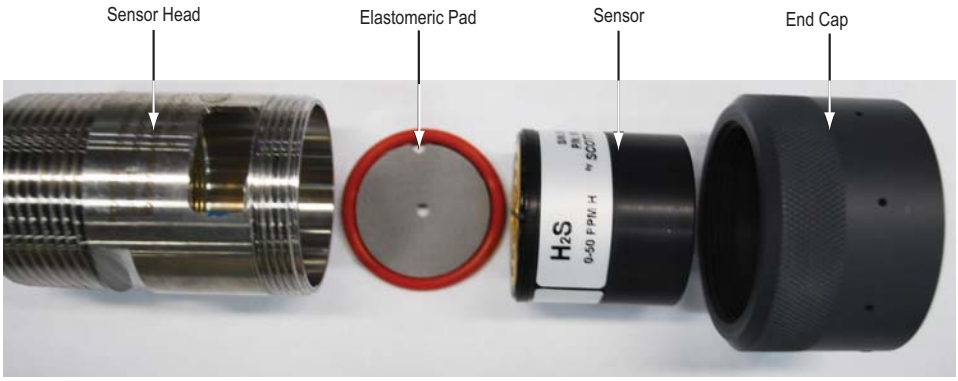
Caution: *Install sensor only in a clean atmosphere, that is free of background gas. If a clean atmosphere is not available, Zero Gas must be used when performing Sensor Balance. Failure to do so can prevent accurate adjustment of Sensor Balance.*

Removing power is not required when installing/replacing a Toxic (E-Chem) Sensor. Follow local procedures and safety regulations.

1 Loosen and remove the End Cap to gain access to Toxic (E-Chem) Sensor.

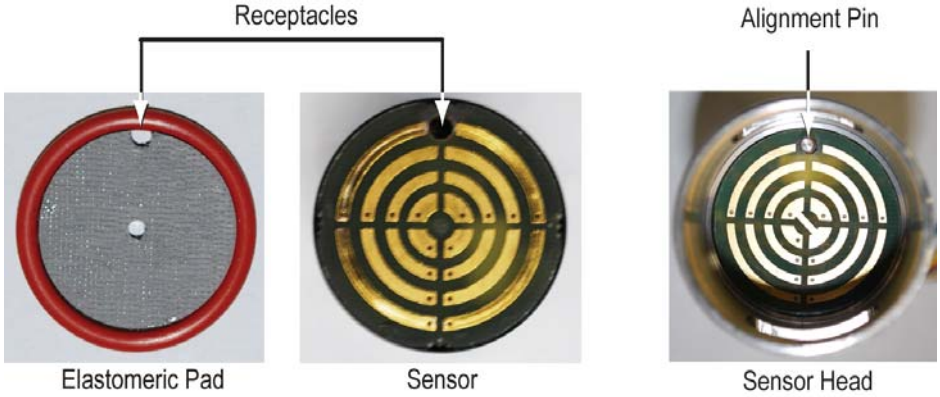
2 Remove the Toxic (E-Chem) Sensor and verify Elastomeric Pad remains seated in place. The Elastomeric Pad should be replaced if damaged, torn, deteriorates or otherwise deemed unusable. See Figure 20

Figure 20 Toxic (E-Chem) Sensor Head Assembly – ClassI, Division2



3 Align Receptacle in both the Toxic (E-Chem) Sensor and Elastomeric Pad with Alignment Pin in Sensor Head and fully insert Toxic (E-Chem) Sensor into Sensor Head. See Figure 21.

Figure 21 Toxic (E-Chem) Sensor Assembly Alignment



4 While ensuring the Toxic (E-Chem) Sensor remains seated and aligned, install the End Cap and hand tighten.

Caution: *Over tightening the End Cap may place excessive pressure on the Elastomeric Pad and creates a Short. Thus, causing the device to generate a flashing FAULT on the LCD.*

5 Allow a minimum of 10 minutes for the Toxic (E-Chem) Sensor to initialize.

Installing/Replacing a Combustible (LEL) Sensor Head

This section describes how to install/replace a Combustible (LEL) Sensor.

The Combustible (LEL) Sensor ships separate from the device and must be installed. Additionally, it should be replaced as the need arises.

When installing a new Combustible (LEL) Sensor (Cat-bead or IR), you must Balance and set the PreAmp Gain prior to Calibrating the Sensor.

When installing a previously removed sensor that has already had the Balance and PreAmp Gain set, only perform a Zero and Span Calibration. For example, removing installed sensors for testing or calibration, when reinstalled, do not require Balance or PreAmp Gain adjustments.

Warning: *The device is not actively monitoring target gases when power is removed. Verify atmosphere is safe or monitor atmosphere with another device while installing a new sensor to prevent risk of injury or death.*

Caution: *Install sensor only in a clean atmosphere, that is free of background gas. If a clean atmosphere is not available, Zero Gas must be used when performing Sensor Balance. Failure to do so can prevent accurate adjustment of Sensor Balance.*

Removing power is not required when installing/replacing a Combustible (LEL) Sensor. Follow local procedures and safety regulations.

1 Loosen setscrew on the Outer Guard/Flame Arrestor.

2 Unscrew and remove Sensor Head to gain access to Combustible (LEL) Sensor.

3 Remove Combustible (LEL) Sensor. See Figure 22, Figure 23 and Figure 24.

Combustible (LEL) Sensors come in different Voltages.

Figure 22 Combustible (LEL) Sensor Assembly – 4.25V

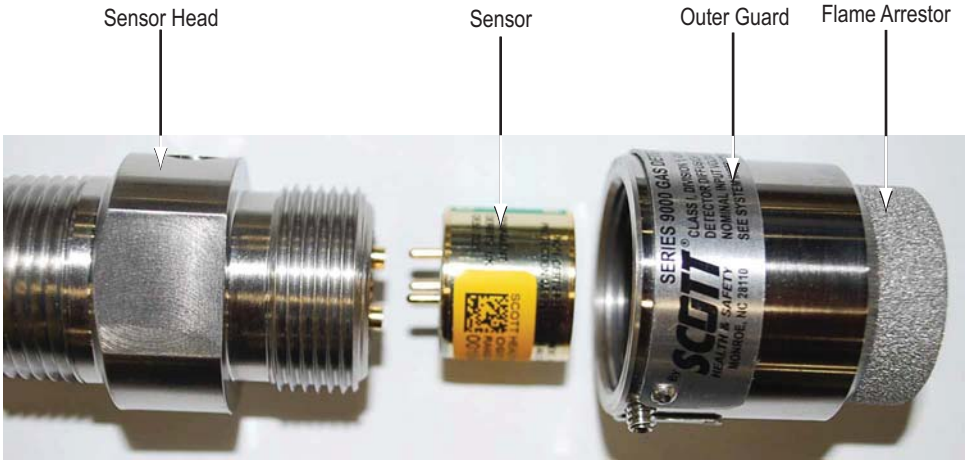
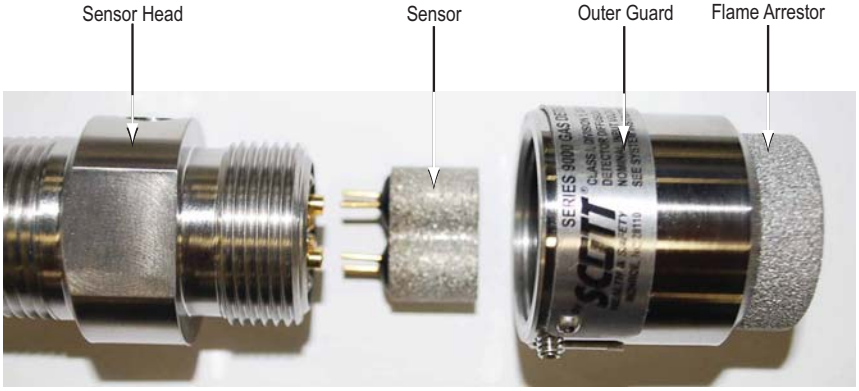


Figure 23 Combustible (LEL) Sensor Assembly – 5.5V



The Outer Guard and Flame Arrestor is actually combined into one item for the Combustible (LEL) Sensor Assembly, as shown in Figure 23.

The 5.5V Sensor may be used with either the UL or ATEX Sensor Head. As shown in Figure 23 *and* Figure 24.

Figure 24 Combustible (LEL) Sensor Assembly – ATEX Approved

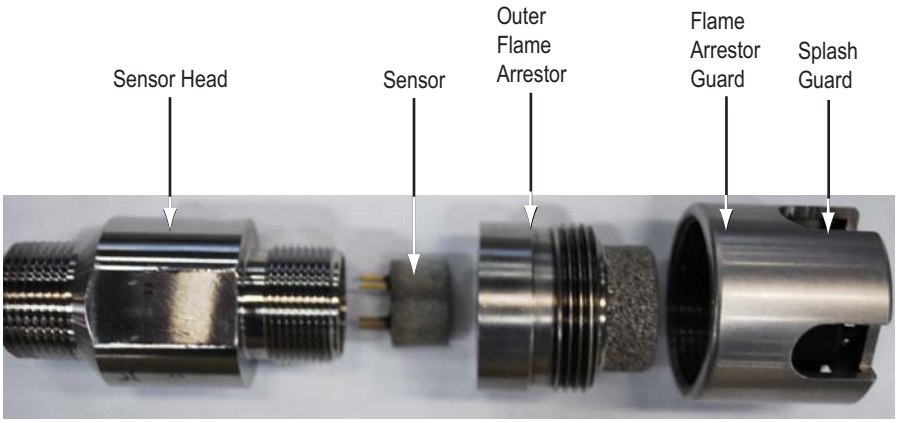


Figure 24 shows the Combustible Sensor Assembly that is ATEX approved. Note, that any Sensor may be used.

4 Install new Combustible (LEL) Sensor in place aligning Pins to Receptacles. See Figure 25, Figure 26 and Figure 27.

Figure 25 Combustible (LEL) Sensor Assembly Alignment - 4.25V IR

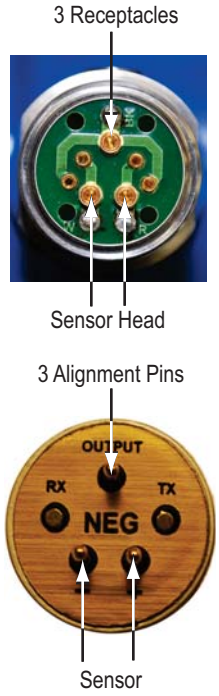


Figure 26 Combustible (LEL) Sensor Assembly Alignment - 5.5V Cat-bead

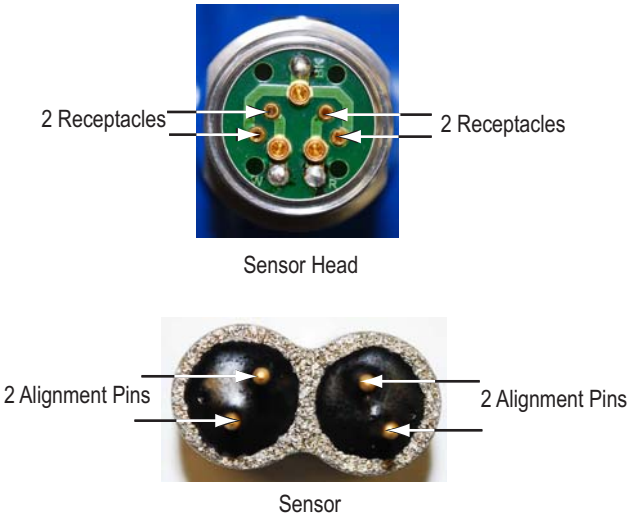
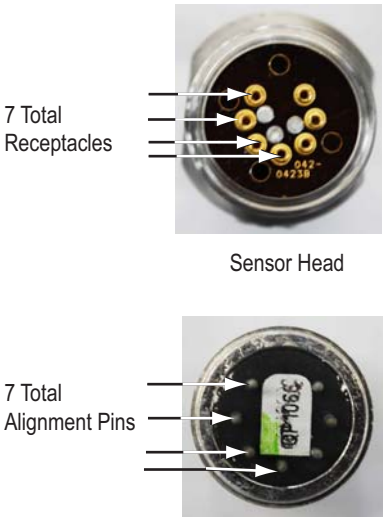


Figure 27 Combustible (LEL) Sensor Assembly Alignment - 6.0V Cat-bead



5 Replace protective Outer Guard/Flame Arrestor.

6 Tighten setscrew on Outer Guard/Flame Arrestor.

7 Apply Power to the device and allow a minimum of 10 minutes for the Combustible (LEL) Sensor to warm-up.

After installing/replacing either a Combustible (LEL), or Toxic (E-Chem) it needs to be Balanced and Calibrated. See "Set Balance Procedure after Installing a New Sensor" on page 64. *See* "Calibrating the Device" on page 80.

CONFIGURATION AND SETUP

Chapter Overview

This chapter covers the following topic:

Configuration and Setup Checklist

This section provides the configuration and setup requirements. Table 19 lists the individual items.

Warning: *Configuration should be performed by trained individuals who have read this manual and understand the calibration procedures. Failure to follow these instructions may result in serious injury or death.*

Warning: *When the primary device is off line, ensure you have another online device to actively detect gases. The device may be off line due to such activities, like but not limited to, calibration, installation, maintenance, troubleshooting, configuration, wiring and other activities.*

Warning: *When settings are changed, ensure those changes are communicated to all affected personnel.*

Warning: *Before you begin, read and understand the MSDS and warning labels for the calibration gases. Failure to do so may result in serious injury or death.*

Table 19 Configuration and Setup Checklist

ITEM	DETAILS
Relays/MODBUS RS-485 Option PCB	See "Configuring the Relays/MODBUS RS-485 Option PCB" on page 42.
Device Configuration	See "Configuring the Device" on page 49.
Combustible IR CO_2 Sensor	See "Configuring the IR CO2 Sensor" on page 66.

Configuring the Relays/MODBUS RS-485 Option PCB

This section describes how to configure the Relays/MODBUS RS-485 Option PCB if installed in the device.

This optional PCB must be configured for use with receiving equipment. Details about Discretes, Coils, Registers, Read/Write function codes, as well as other parameters are provided in the following tables:

- Table 20 for Read Only – Discretes
- Table 21 for Read/Write Coils
- Table 22 for Read Only Registers
- Table 23 for Floating Point Registers
- Table 24 for ASCII String Registers
- Table 25 for Byte Variables
- Table 26 for Firmware Version
- Table 27 for Real Value Registers
- Table 28 for Binary Cal Data

Consult the technical documentation provided with the receiving equipment in conjunction with the table provided herein for configuration.

Table 20 Read (Rd) Only – Discretes

ASSIGNED CODE	ALIAS	RD FUNCTION CODE
Chan 1 Alarm 1	2001	2 (Rd input status)
Chan 1 Alarm 2	2002	
Chan 1 Fault	2003	
Chan 2 Alarm 1	2004	
Chan 2 Alarm 2	2005	
Chan 2 Fault	2006	
Relay (K1)	2007	
Relay (K2)	2008	
Relay (K3)	2009	
Chan 1 Cal Mode	2010	
Chan 2 Cal Mode	2011	

Table 21 Read/Write (Rd/Wr) – Coils

ASSIGNED CODE	COIL ADDRESS	RD FUNCTION CODE	WR FUNCTION CODE
Alarm Ack/Reset	12001	1(Rd coil status)	5 (Force single coil)
Note: After writing a True to this location, it resets back to False automatically.			

Table 22 Read (Rd) Only – Registers

ASSIGNED CODE	INPUT REGISTER ADDRESS	RD FUNCTION CODE
D/A Raw Chan 1	31001 (E-Chem Sensor Type)	4 (Rd input register)
D/A Raw Chan 2	31002 (LEL Sensor Type)	
Calibrated 10bit value representing the D/A value of 0 to 1023 for -25 to 105% Full Scale (200= 0% & 1000= 100%)		
Note: Read Only Registers (31001 to 31002) are configured to capture the values displayed on the device's LCD.		
A/D Raw Chan 1	31003	4
A/D Raw Chan 2	31004	
10bit value representing the A/D value of 0 to 1023 before calibration constants are applied		
Chan 1 Status	31005	4
Chan 2 Status	31006	4
16bit status words; bit assignment for each channel as indicated here:		
Bit Name:		Bit Position:
ALARM1_BELOW		BIT0
ALARM2_BELOW		BIT1
ALARM3_BELOW		BIT2

Table 22 Read (Rd) Only – Registers (continued)

ASSIGNED CODE	INPUT REGISTER ADDRESS	RD FUNCTION CODE
ALARM1_LATCH		BIT3
ALARM2_LATCH		BIT4
ALARM3_LATCH		BIT5
ALARM3_ACTIVE		BIT6
CHANNEL_DISABLED		BIT7
CHANNEL_CAL		BIT8
CHANNEL_LINEARIZE		BIT9
FAULT_RELAY_LATCH		BIT10
DISPLAY_NEGATIVE		BIT11
TRANSMIT_SENSOR_LIFE_ENABLED		BIT12
Alarm Status Word	31007	4
16bit status words; bit assignment for alarm status indicted here:		
Bit Name:		Bit Position:
CH1_ALM1		BIT0
CH1_ALM2		BIT1
CH1_FAULT		BIT2
CH2_ALM1		BIT4
CH2_ALM2		BIT5
CH2_FAULT		BIT6
K1_STATUS		BIT8
K2_STATUS		BIT9
K3_STATUS		BIT10
Device Status Word	31008	4
16bit status words; bit assignment for system status indicted here:		
Bit Name:		Bit Position:
CHAN_1_ACTIVE		BIT0
CHAN_2_ACTIVE		BIT1
SECURE_LEVEL		BIT2
MARKER_TX_LED		BIT3
K1_FAILSAFE		BIT12
K2_FAILSAFE		BIT13
K2_ACK		BIT14
LOCK		BIT15
Chan 1 Sensor Life	31009	4
Chan 2 Sensor Life	31010	
16bit signed integer range from -1 to 100 where -1 indicates Cal required.		

Table 22 Read (Rd) Only – Registers (continued)

ASSIGNED CODE	INPUT REGISTER ADDRESS	RD FUNCTION CODE
Chan 1 Sensor Temperature	31011	4
Chan 2 Sensor Temperature	31012	
16bit integer range from 1 to 4095 scaled for -55 to +125° C.		

Table 23 Floating Point Registers

ASSIGNED CODE	INPUT REGISTER ADDRESS	RD FUNCTION CODE
Note: Returned as 15bit plus sign 2s complement with +/- 5% over/under range applied. Consider over/under range when scaling values for display. The following equation may be used to determine a value for display:		
$\text{Display Val} = \frac{\text{MODBUS Val } [(\text{SpanVal} - \text{ZeroVal}) 1.1}{32767} + \{\text{ZeroVal} - [(\text{SpanVal} - \text{ZeroVal}) .05]\}$		
FP Value Chan 1	3300 (E-Chem Sensor Type)	4 (Rd input register)
FP Value Chan 2	33002 (LEL Sensor Type)	

Table 24 ASCII String Registers

ASSIGNED CODE	HOLDING REGISTER ADDRESS	RD FUNCTION CODE
User Info Chan 1	40401-40408	3 (Rd holding register)
User Info Chan 2	40409-40416	
16 ASCII characters (2 per register) assigned to the unit identifier as bytes.		
Chan 1 ASCII Reading	40417-40416	3
Chan 2 ASCII Reading	40420-40422	
6 ASCII characters (2 per register) reflecting the display readout.		
EUNITS Chan 1	404423-40427	3 (Rd holding register)
EUNITS Chan 2	404428-40432	
10 ASCII characters (2 per register) assigned to the engineering units as read bytes.		

Table 25 Byte Variables

ASSIGNED CODE	HOLDING REGISTER ADDRESS	RD FUNCTION CODE
PreAmp/Gain Ch1	40433	3 (Rd holding register)
PreAmp/Gain Ch2	40434	
2bytes representing PreAmp (HiByte) and PGA (LoByte) Settings.		

Table 26 Firmware Version

ASSIGNED CODE	HOLDING REGISTER ADDRESS	RD FUNCTION CODE
Version	40435-40436	3 (Rd holding register)
4 ASCII characters (2 per register) reflecting the firmware version.		

Table 27 Real Value Registers

ASSIGNED CODE	HOLDING REGISTER ADDRESS	RD FUNCTION CODE
Note: Real values represents float value without the decimal point. For example, 123.4 returns as 1234. Decimal divisor returns as 1, 10, 100 or 1000 for decimal position of 1, 2, 3, or 4, where 123.4 returns the value of 10.		

Table 27 Real Value Registers (continued)

ASSIGNED CODE	HOLDING REGISTER ADDRESS	RD FUNCTION CODE
Chan 1 Cal Zero Real	41001	3 (Rd holding register)
Chan 1 Cal Zero Divisor	41002	
Chan 1 Cal Span Real	41003	
Chan 1 Cal Span Divisor	41004	
Chan 1 Zero Real	41005	
Chan 1 Zero Divisor	41006	
Chan 1 Span Real	41007	
Chan 1 Span Divisor	41008	
Chan 1 Fault Real	41009	
Chan 1 Fault Divisor	41010	
CHan 1 Alarm 1 Real	41011	
Chan 1 Alarm 1 Divisor	41012	
Chan 1 Alarm 2 Real	41013	
Chan 1 Alarm 2 Divisor	41014	
Chan Alarm 3 Real	41015	
Chan 1 Alarm 3 Divisor	41016	
Chan 1 Manual Gain Real	41017	
Chan 1 Manual Gain Divisor	41018	
Chan 1 Manual Offset Real	41019	
Chan 1 Manual Offset	41020	
Chan 2 Cal Zero Real	41021	
Chan 2 Cal Zero Divisor	41022	
Chan 2 Cal Span Real	41023	

Table 27 Real Value Registers (continued)

ASSIGNED CODE	HOLDING REGISTER ADDRESS	RD FUNCTION CODE
Chan 2 Cal Span Divisor	41024	3 (Rd holding register)
Chan 2 Zero Real	41025	
Chan 2 Zero Divisor	41026	
Chan 2 Span Real	41027	
Chan 2 Span Divisor	41028	
Chan 2 Fault Real	41029	
Chan 2 Fault Divisor	41030	
Chan 2 Alarm 1 Real	41031	
Chan 2 Alarm 1 Divisor	41032	
Chan 2 Alarm 2 Real	41033	
Chan 2 Alarm 2 Divisor	41034	
Chan 2 Alarm 3 Real	41035	
Chan 2 Alarm 3 Divisor	41036	
Chan 2 Manual Gain Real	41037	
Chan 2 Manual Gain Divisor	41038	
Chan 2 Manual Offset Real	41039	
Chan 2 Manual Offset Divisor	41040	

Table 28 Binary Cal Data

ASSIGNED CODE	HOLDING REGISTER ADDRESS	RD FUNCTION CODE
Chan 1 A/D MIN	41041	3 (Rd holding register)
Chan 1 A/D MAX	41042	
Chan1 D/A MIN	41043	
Chan 1 D/A MAX	41044	
Chan 2 A/D MIN	41045	
Chan 2 A/D MAX	41046	
Chan 2 D/A MIN	41047	
Chan 2 D/A MAX	41048	
Min and Max calibration points for A/D and D/A converters.		

Configuring the Device

This section covers the various configuration parameters for the device.

All device configuration variables are selected via the menu screens and those variables are stored in its Non-Volatile Memory (NV-EEPROM). Many menu items contain default values from the factory and require changes to better match your applicable application. Although similar, some menu items vary between devices with a Toxic (E-Chem) Sensor Head and those with a Combustible (LEL) Sensor Head.

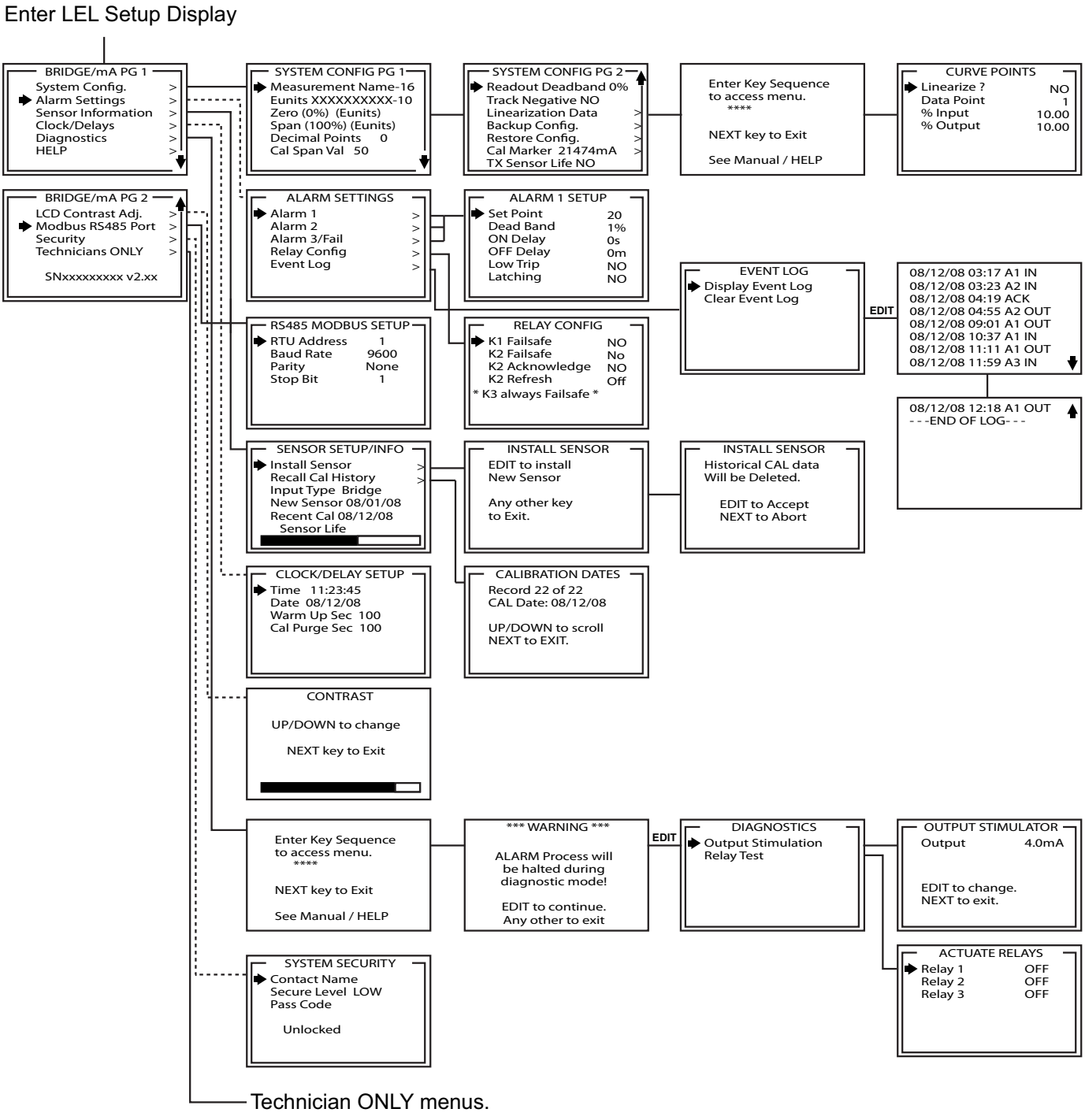
A device may be configured using the supplied pocket magnet screwdriver and the four (4) navigation keys in approximately 5-10 minutes.

Figure 28 shows the configuration menu structure of a device equipped with a Combustible (LEL) Sensor Head. The configuration menu structure does vary somewhat for a Toxic (E-Chem) Sensor Head. To enter the Combustible (LEL) Sensor Configuration Setup Display, press the EDIT key from either of the Displays (Text and Numerical Display or the 30 Minute Graphic Display).

The menu screens in this chapter are based on the device's Firmware. Version 2.42. If your device as a different firmware version, then the menu screens will vary somewhat. Additionally, disabled menu items are denote in gray colored text.

Access to ceratin menus are restricted. A special Key Sequence screen appears that requires you to enter four (4) consecutive UP keys to access the menu.

Figure 28 Configuration Menu Structure - Combustible (LEL) Sensor Head



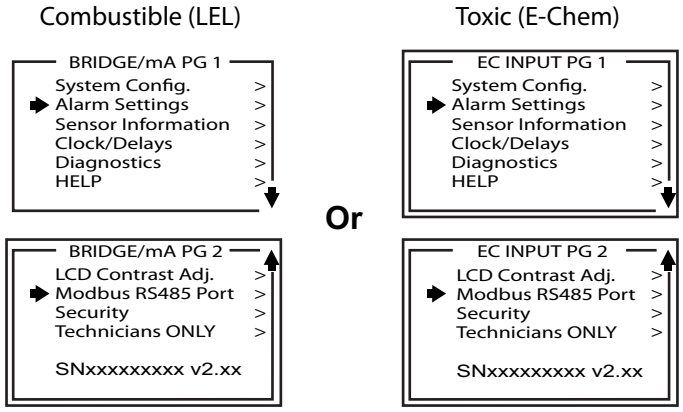
Configuring the Setup Menu

This section covers the Setup Menu.

Press the EDIT key from either of the Displays (Text and Numerical Display or the 30 Minute Graphic Display) to access the Setup Menu.

The Setup Display 1 displays. Use the DOWN key to move the cursor to Setup Display 2 if desired. Use the magnetic keys to navigate through the menu structure as necessary. See Figure 29.

Figure 29 Configuration Menu - Setup Display Combustible (LEL) & Toxic (E-Chem)



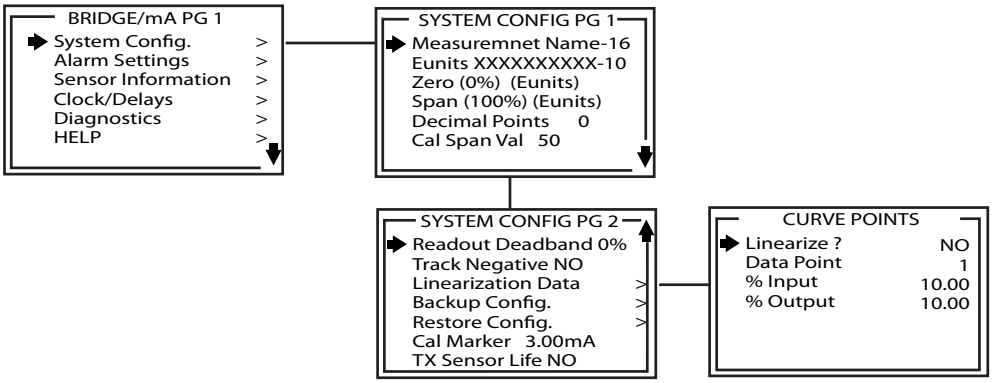
Configuring the System Configuration Menu

This section covers the System Configuration Menu.

Navigate the cursor from the Setup Display Menu to System Config. and press the EDIT key to access the System Configuration Menu. See Figure 30.

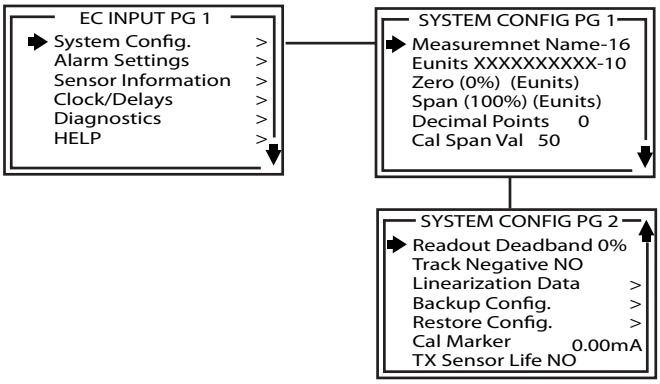
Figure 30 Configuration Menu - System Config. Combustible & Toxic

Combustible (LEL)



Or

Toxic (E-Chem)



The System Configuration Menu is shown on two (2) pages and includes the following:

- SYSTEM CONFIG PG 1
  - Measurement Name – May be edited to contain virtually any 16-character ASCII field. Typically describes the monitored point by your tag # or other familiar terminology. Edit the field by navigating the cursor to the field and pressing the EDIT key. Use the UP and DOWN keys change the selected character. Press the NEXT key to move the cursor to the next character. Press the EDIT key when finished.

- Eunits (Engineering Units) – May have up to a 10 character ASCII field. Many common gases have pre-configured Eunits based upon the sensor type and each may be edited in this menu. Edit the field by navigating the cursor to the field and pressing the EDIT key. Use the UP and DOWN keys change the selected character. Press the NEXT key to move the cursor to the next character. Press the EDIT key when finished.
- Zero (0%) – Defines the reading to be displayed when 4mA (0%) is the device output.
- Span (100%) – Defines the reading to be displayed when 20mA (100%) is the device output. The highest reading allowed is 9999 and includes a negative polarity sign and one decimal point.

Polarity is only indicated for negative readings.

- Decimal Points – Sets the display format of the LCD readings and may be for 0, 1 or 2. ZERO readings for 0, 1 & 2 DP's respectively are 0, 0.0 & 0.00.
- Cal Span Value – Sets what upscale value must be applied when performing Span calibrations, or the calibration concentration of the Cal Gas to be used for Spanning.

• SYSTEM CONFIG PG 2

- Readout Deadband – Allows forcing low values to continue to read zero. This is useful when there are small amounts of background gases that cause fluctuating readouts above zero. The highest amount of deadband allowed is 5%. The 4-20mA output is not affected by this menu item.
- Track Negative – When set to NO, causes negative values to read the (0%) value in data displays. The CAL MODE readout displays negative values regardless of this setting and negative values below the Fault set point still causes the Fault alarm to trip. The 4-20mA output always locks at 4mA when the reading is negative.
- Linearization Data – Allows nonlinear signals to be linearized by entering the correct curve into the device. If Linearize is set for NO, the CURVE POINTS menu data is not used and no linearization is applied. When YES, the CURVE POINT entries are used and a straight-line approximation is calculated between each of the nine entries. 0% input always provides 0% output and 100% input always provides 100% output.

Access to the linearization data menu requires you to input a key sequence. Press the UP key four times when prompted for key sequence.

- Backup Config. – Allows you to store all of the device’s settings into Non-Volatile Memory (NV-EEPROM) for restoration later if incorrect values are accidentally entered or uploaded.
- Restore Config. – Allows you to restore all of the device’s settings from the Non-Volatile Memory (NV-EEPROM) incase incorrect values are accidentally entered.

– TX (Transmitter) Sensor Life – Normal operation has the device transmit a 4mA during the CAL PURGE delay. However, when TX Sensor Life is set for YES, this causes the device's 4-20mA output to transmit a sensor life value after successful calibrations during the CAL PURGE. The device transmits 4mA for the first 10-seconds, then for 5-seconds, transmits a value between 4mA and 5mA, with 4 mA equal to 0% sensor life and 5mA equal to 100% sensor life. The output then returns to 4mA for the remainder of the CAL PURGE delay. For example, if after a calibration, sensor life is 75%, the device transmits 4.75mA during the 5-second interval.

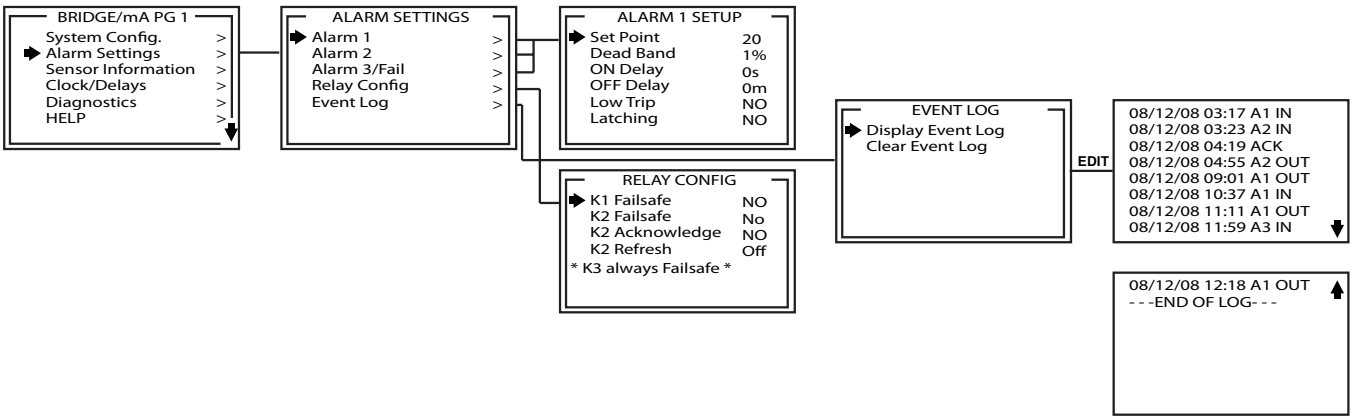
TX Sensor Life should always be set for no unless the 4-20mA receiver is capable of interpreting the sensor life signal. The Scott Health and Safety, a Division of Scott Technologies, Inc. 7800 / Sentinel 16 Controller is capable of this function.

Configuring the Alarm Settings Menu

This section covers the Alarm Setting Menu.

Navigate the cursor from the Setup Display Menu to Alarm Settings and press the EDIT key to access the Alarm Settings Menu. See Figure 31.

Figure 31 Configuration Menu - Alarm Settings



Alarm LEDs and alarm functions are active even if the Relays/MODBUS RS-485 Option PCB is not installed.

- Set Point – Enters the Engineering Unit value where the alarm trips. It may be negative and trip when monitored values fall out of range in this direction. A 3 has a default negative 5% of range Set Point with Low Trip set for YES. This makes it function as a FAULT alarm and trip when the monitored value is more than 5% out of range.
- Dead-Band – Has a minimum value of 1% and a maximum value of 10%. It is useful for preventing alarm cycling when the monitored value is hovering around the set point. For example, with a range of 0-100ppm, if Dead-Band equals 5% and the set point is 20ppm, after tripping at 20ppm the value must drop below 15ppm to reset.

- ON Delay – Allows entering a maximum 10 second delay before this alarm becomes active. This is useful for preventing recurring alarms caused by brief spikes beyond the set point.
- OFF Delay – Allows entering a maximum 120 minute delay before clearing an alarm after the alarm condition is gone. This is useful for continuing an alarm function, such as operation of an exhaust fan, for a period of time after the alarm condition clears.
- Low Trip – Set to YES causes the alarm to trip as the value falls below the set point.
- Latching – Set to YES causes the alarm to remain active even after the condition is gone and only reset when the magnetic screwdriver touches RESET/UP key from a Display.

Configuring the Relay Configuration Menu

This section covers the Relay Configuration Menu.

Navigate the cursor from the Alarm Setting Menu to Relay Config. and press the EDIT key to access the Relay Config. Menu.

This is only available when a Relays/MODBUS RS-485 Option PCB is installed in the device. Otherwise, Hardware Not Present displays.

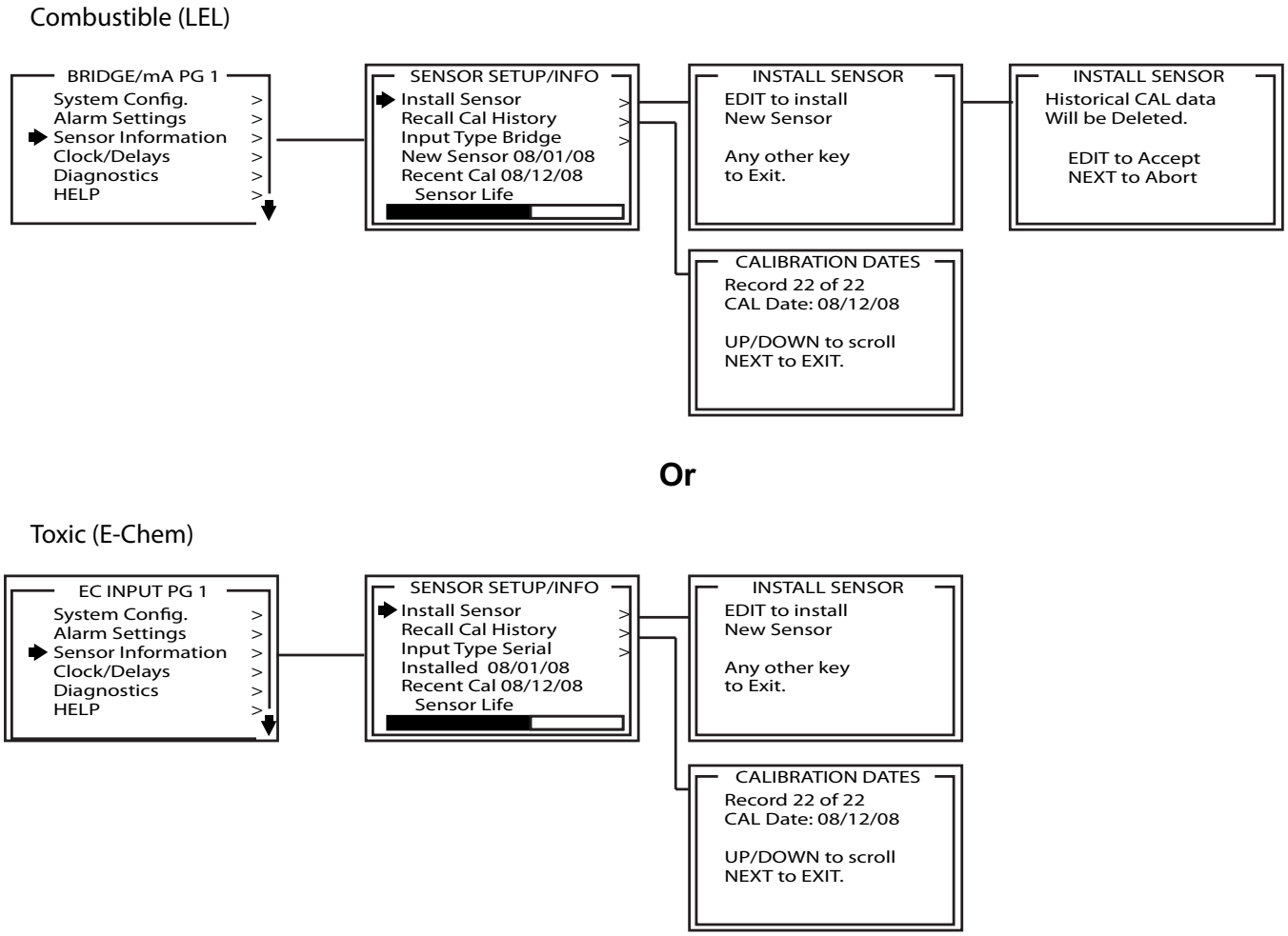
- K1 / K2 Failsafe – Set for YES means the relay de-energizes during alarm and energizes with no alarm. This is useful for signaling alarm when device power is lost. K3 is a FAULT alarm and is always failsafe.
- K2 Acknowledge – Set for YES means the RESET/UP key sets K2 to the normal state EVEN when an Alarm 2 condition exists. This is useful for silencing an audible device, driven from K2, during the alarm condition.
- K2 Refresh – Set for ON causes an acknowledged Alarm 2 condition to reactivate K2 if it continues beyond the designated Refresh interval. This feature ensures against forgotten alarms after an Acknowledge.

Configuring the Sensor Information Menu

This section covers the Sensor Information Menu.

Navigate the cursor from the Setup Display Menu to Sensor Information and press the EDIT key to access the Sensor Information Menu. See Figure 32.

Figure 32 Configuration Menu - Sensor Info. Combustible (LEL) & Toxic (E-Chem)



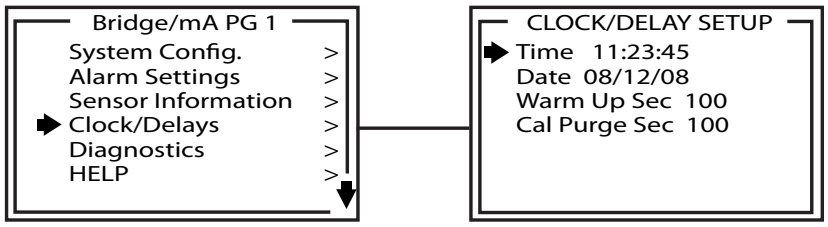
- Install Sensor – Only used when a new type of sensor is installed. This deletes historical CAL data and sets sensor life to 100% after initial calibration.
- Recall Cal History – Recalls each successful calibration. These dates may be reviewed by scrolling with the UP / DOWN keys.
- Input Type – Displays sensor type.
- New Sensor – Displays the date when a new sensor was last installed.
- Recent Cal – Displays the most recent calibration date.

Configuring the Clock/Delays Setup Menu

This section covers the Clock/Delays Setup Menu.

Navigate the cursor from the Setup Display Menu to Clock/Delays and press the EDIT key to access the Clock/Delays Setup Menu. See Figure 33.

Figure 33 Configuration Menu - Clock/Delays Setup



The device comes with a Clock & Calendar. The Time and Date must be set to correctly match its location. They are set at the factory in a 24 hour format but may require adjustment to match the location's time & date after shipment.

The device's NV-EEPROM retains the Date and Time Settings. Therefore, there is no need to adjust these settings if power is interrupted to the device.

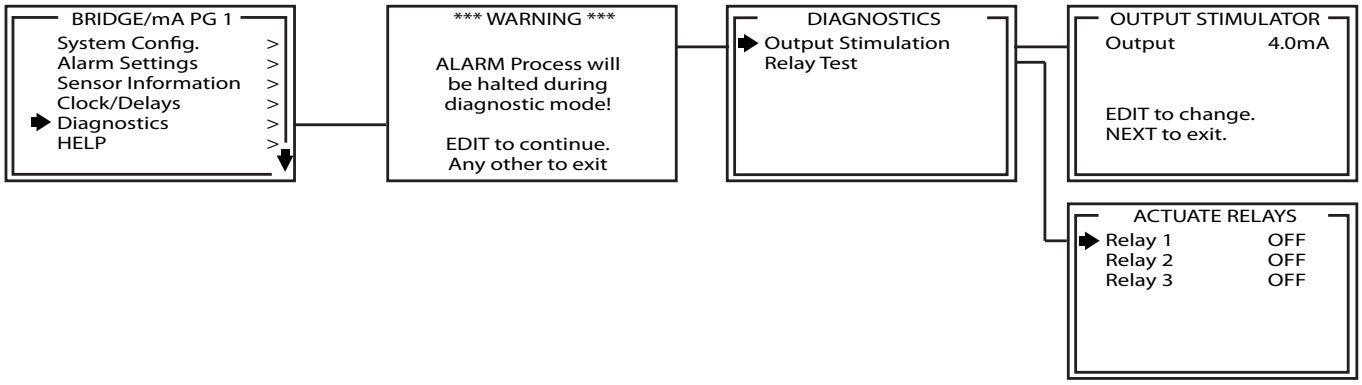
- Time – Edit the field by navigating the cursor to the field and pressing the EDIT key. Use the UP and DOWN keys change the selected character. Press the NEXT key to move the cursor to the next character. Press the EDIT key when finished.
- Date – Edit the field by navigating the cursor to the field and pressing the EDIT key. Use the UP and DOWN keys change the selected character. Press the NEXT key to move the cursor to the next character. Press the EDIT key when finished.
- Warm Up Sec. – Time delay set to prevent unwanted alarm trips. This is also referred to as Inhibit Time. It inhibits all relays and output signals. Based on the application, increasing this value allows the device more time to stabilize before taking live readings. The maximum time is 255Seconds. Edit the field by navigating the cursor to the field and pressing the EDIT key. Use the UP and DOWN keys change the selected character. Press the NEXT key to move the cursor to the next character. Press the EDIT key when finished.
- Cal Purge Sec. – Time delay set to prevent unwanted alarm trips. This is also referred to as Inhibit Time. It inhibits all relays and output signals. Based on the application, increasing this value allows the device to fall below alarm set points, to make sure the device does not set off alarms. Typically used when performing a Zero Calibration or a Span Calibration procedure. The maximum time is 255Seconds. Edit the field by navigating the cursor to the field and pressing the EDIT key. Use the UP and DOWN keys change the selected character. Press the NEXT key to move the cursor to the next character. Press the EDIT key when finished.

Configuring the Diagnostics Menu

This section covers the Diagnostics Menu.

Navigate the cursor from the Setup Display Menu to Diagnostics and press the EDIT key to access the Diagnostics Menu. See Figure 34.

Figure 34 Configuration Menu - Diagnostics



Warning: *When using the Diagnostics Menus the device is not detecting hazardous gases. Thus, gas monitoring and alarm processing are not performed. When the primary device is off line, ensure you have another online device to actively detect hazardous gases. Failure to do so could result in injury or death.*

Access to the Diagnostics Menu requires you to input a key sequence. Press the UP key four (4) times when prompted for key sequence.

- Output Stimulation – Allows you to set the 4-20mA output to a virtual value within the 4-20mA range to verify Receiving Equipment is receiving the correct output from the device.
- Relay Test – Allows you to trip optional installed Relays without setting alarm trip points for the target gas. This can be used to verify operation of optional alarms, lights, or audible devices.

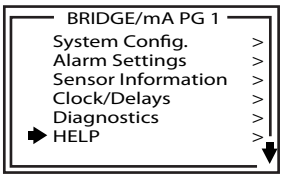
This is only available when a Relays/MODBUS RS-485 Option PCB is installed in the device. Otherwise, Hardware Not Present displays.

Configuring the Help Menu

This section covers the Help Menu.

Navigate the cursor from the Setup Display Menu to Help and press the EDIT key to access the Help Menu. See Figure 35.

Figure 35 Configuration Menu - Help



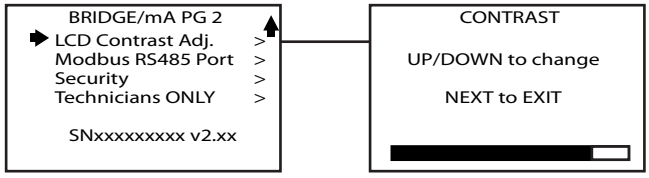
- Help – Contains several pages of information describing how to operate the device. Press the UP and DOWN keys to navigate through the pages.

Configuring the LCD Contrast Adjustment Menu

This section covers the LCD Contrast Adjustment Menu.

Navigate the cursor from the Setup Display Menu to LCD Contrast Adjustment and press the EDIT key to access the LCD Contrast Adjustment Menu. See Figure 36.

Figure 36 Configuration Menu - LCD Contrast Adjustment



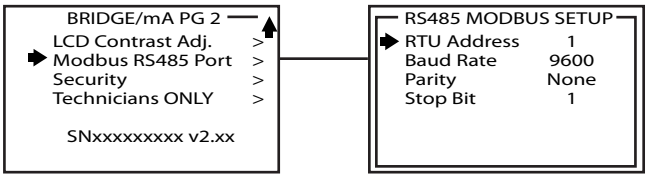
- LCD Contrast Adj. – Allows you to change the contrast of the LCD Display for optimum viewing.

Configuring the MODBUS RS-485 Port Menu

This section covers the MODBUS RS-485 Port Menu.

Navigate the cursor from the Setup Display Menu to MODBUS RS-485 Port and press the EDIT key to access the MODBUS RS-485 Port Menu. See Figure 37.

Figure 37 Configuration Menu - MODBUS RS-485 Port



If the Relays/MODBUS RS-485 Option PCB is installed and the RS-485 port is in use, navigate to the MODBUS RS-485 Port display and assign each device its own RTU address, the legal range is 1 to 247.

Caution: *Each device must have its own RTU Address while communicating on the same two (2) wire cable to prevent bus conflicts with Receiving Equipment.*

Edit the RTU Address by navigating the cursor to the field and pressing the EDIT key. Use the UP and DOWN keys change the selected character. Press the NEXT key to move the cursor to the next character. Press the EDIT key when finished.

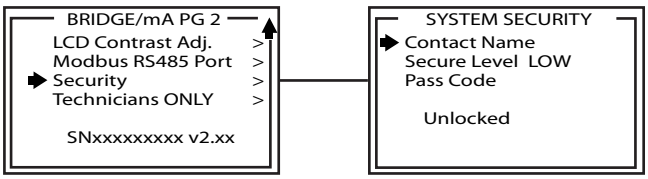
The Baud Rate, Parity, and Stop Bit fields each display a fixed value set to industry standards and are not configurable. Receiving Equipment using the MODBUS RS-485 Communications Protocol need to be configured according to the capabilities of the equipment. See "Configuring the Relays/MODBUS RS-485 Option PCB" on page 42.

Configuring the Security Menu

This section covers the Security Menu.

Navigate the cursor from the Setup Display Menu to Security and press the EDIT key to access the Security Menu. See Figure 38.

Figure 38 Configuration Menu - Security



- Contact Name – A 12 character ASCII field available for displaying a phone number or a point of contact who knows the Pass Code. Edit the field by navigating the cursor to the field and pressing the EDIT key. Use the UP and DOWN keys change the selected character. Press the NEXT key to move the cursor to the next character. Press the EDIT key when finished.
- Secure Level – Two (2) options are available for the security level:
  - LOW allows CAL MODE sensor calibrations but requires the 4-digit Pass Code prior to altering menus.
  - HIGH locks the entire menu database and the CAL Mode until the correct Pass Code is entered. In either LOW or HIGH security level, you may view configuration menus without making changes.
- Pass Code – Is a 4-digit pass code to either lock or unlock the security menu. Edit the field by navigating the cursor to the field and pressing the EDIT key. Use the UP and DOWN keys change the selected character. Press the NEXT key to move the cursor to the next character. Press the EDIT key when finished.

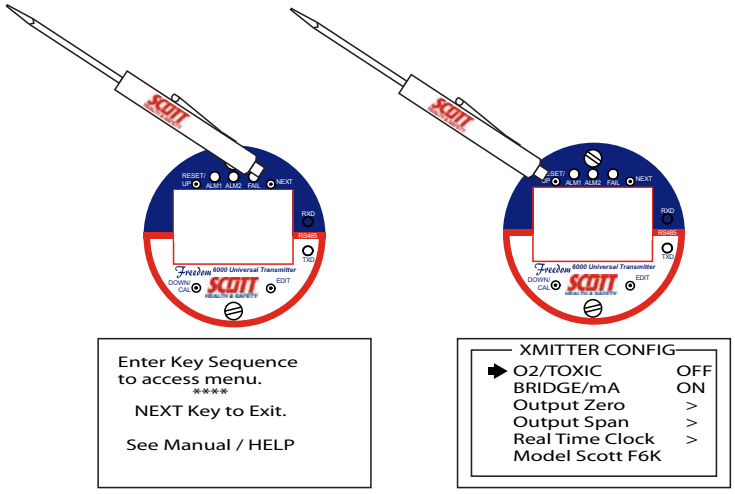
Lost pass codes can be recovered by accessing the Locked Security Menu and pressing the UP key for 5 seconds. The four digit pass code displays at the bottom of the screen.

Configuring the Transmitter Configuration Menu

This section covers the Transmitter Configuration Menu.

Navigate the cursor from the Setup Display Menu hold the magnetic screwdriver over the NEXT key for 5 seconds until the Display requests a special key sequence. Use the magnetic screwdriver to select the UP key four times and the Transmitter Configuration Menu displays. See Figure 39.

Figure 39 Configuration Menu - Transmitter Configuration



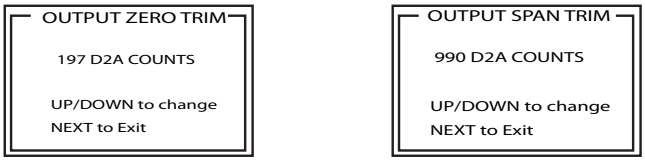
Warning: *Access to the following configuration menus should only occur when you have a complete understanding of the functions contained within. Monitoring of target gases, processing of alarms, 4-20mA output values, and MODBUS RS-485 communications are not reliable while editing these menus. Verify atmosphere is free using an independent monitor while menus are used. Failure to do so could result in injury or death.*

Caution: *See* "Configuring the System Configuration Menu" on page 52. *And perform a backup of configuration data prior to changing any configuration item in the following configuration menus. Failure to perform a backup may result in the loss of critical data affecting device performance.*

Factory defaults are configurable on the device. However, changes to these particular configuration parameters are typically not needed.

- O_2/Toxic and Bridge/mA – These fields allow you to activate what type of sensor is used by the device.
- Output Zero Trim and Output Span Trim – Selections are entries for D/A values that determine the device's final 4-20mA output. These entries are for precise output measurements. Using a mA meter attached to the output being used, you are able to define values at 4.00mA (Output Zero Trim) and 20.00mA (Output Span Trim). These newly defined D/A values are stored by the device as 0 &100% full scale endpoints. Once entered, select the NEXT key to exit this menu. See Figure 40.

Figure 40 Configuration Menu - Output Zero Trim and Output Span Trim



- Real Time Clock (RTC) – Adjusts date and time settings. This supplies the date and time stamp for data logging of events.

The device comes with Non-Volatile Memory (NV-EEPROM) that retains Date and Time Settings. There is no need to adjust Date and Time Settings if power is interrupted to the device.

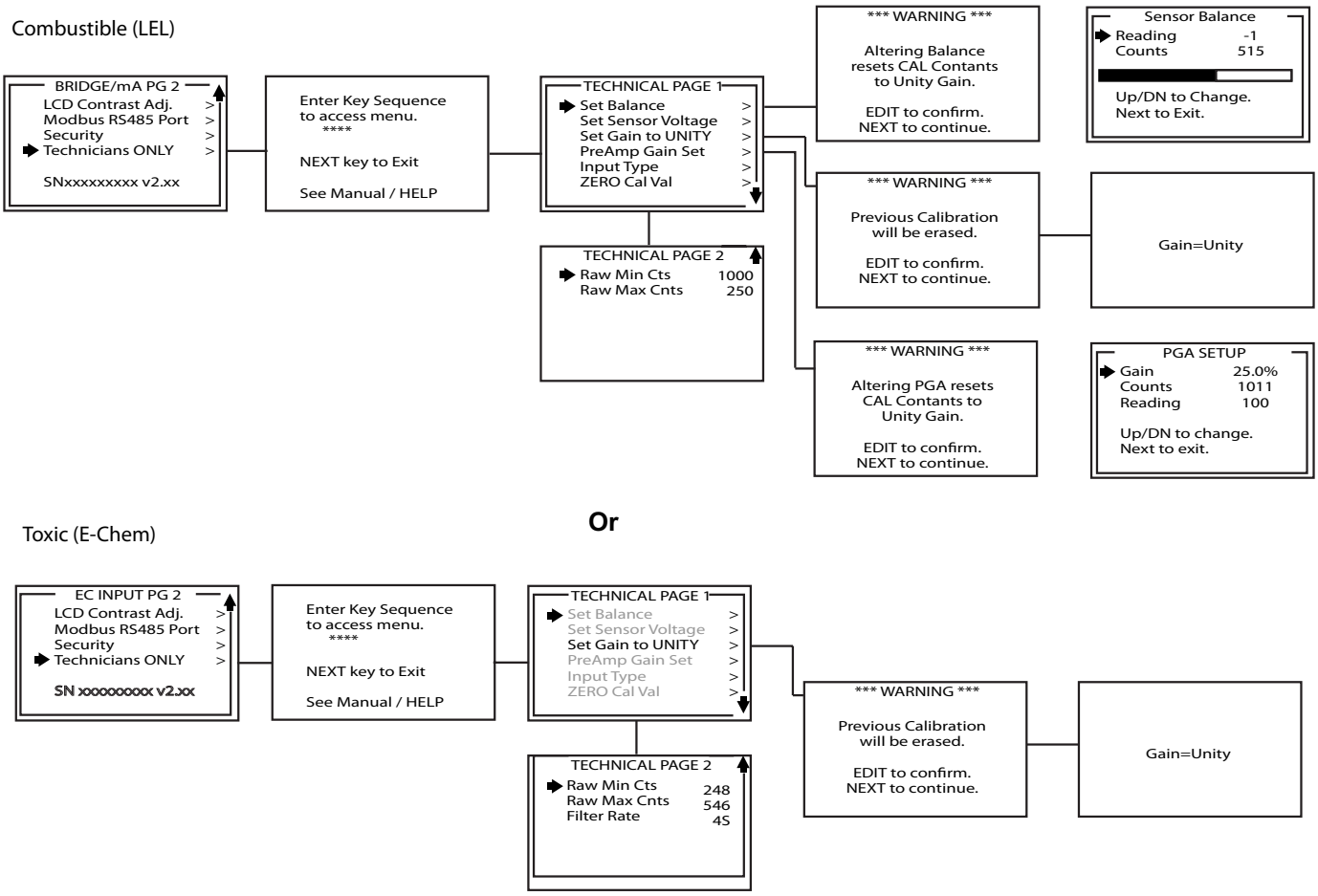
- Model – Allows you to edit the name of the device. Displays Scott F6K. Enter the device name using the 10 ASCII character format.

Configuring the Technicians Only Menu

This section covers the Technicians Only Menu.

Navigate the cursor from the Setup Display Menu to Technicians Only and press the EDIT key to access the Technicians Only Menu. See Figure 41.

Figure 41 Configuration Menu - Technicians Only



- Set Balance – Adjusts sensor balance upon new installation. This adjustment should only be made with a free atmosphere or Zero Gas applied to the Sensor and requires the Sensor to have power applied for sufficient warm up.

Not available for Toxic (E-Chem) Sensors.

Caution: *Do not use Sensor Balance to calibrate Sensors. Use only when a new Sensor has been installed. Failure to do this can result in poor sensor performance.*

Set Balance Procedure after Installing a New Sensor

This section covers the steps to Set Balance after a New Sensor is installed.

1 Press EDIT key to enter configuration screen menus.

2 Press the DOWN key to navigate to the Technician Only option and press EDIT.

3 Enter the Key Sequence asked for on the screen to access the menu by pressing the UP key four (4) times.

4 Verify the cursor is pointing to the Set Balance option and press EDIT.

A brief warning screen flashes on the LCD then displays the Sensor Balance screen.

5 If a clean atmosphere is not available, use the Calibration Adapter to apply Zero gas at a rate of 0.5 liters per minute (LPM) and wait approximately 5 minutes for stabilized readings. See "Calibrating the Device" on page 80.

6 Use the UP and DOWN keys to adjust the Sensor Balance to a reading of zero.

7 Press the NEXT key.

8 If installed, remove the Zero gas supply.

9 Navigate to PreAmp Gain and press EDIT.

A brief warning screen flashes on the LCD then displays the PGA Setup screen.

10 Using the Calibration Adapter, apply calibration gas to the Sensor at a rate of 0.5LPM and wait approximately 5 minutes for stabilized readings.

11 Use the UP and DOWN keys to adjust the gain to achieve a reading equal to the concentration of the calibration gas +/- 2%.

12 Remove the calibration gas.

13 Press the NEXT key three (3) times to return to the Text and Numerical Display.

- Set Sensor Voltage – Adjusts sensor based on the type of Sensor installed. Some voltages are 5.5V, 6.0V and 4.25V. Use the UP and DOWN keys to change. Press NEXT to exit.

Warning: *A voltage setting higher than the voltage of the Sensor damages the Sensor. Therefore, ensure you match the Sensor Voltage configuration parameter to that of the installed Sensor.*

Not available for Toxic (E-Chem) Sensors.

- Set Gain to UNITY – By recording the new Sensor readings, it may be possible to monitor a Sensor's signal response degradation over time. This allows a prediction of Sensor life expectancy for preventative maintenance purposes. Set Gain to UNITY resets previous calibration OFFSET to zero and GAIN to one. This is the definition of UNITY. A calibration should be performed after setting UNITY. EDIT to confirm, NEXT to exit.

Warning: *After changing this configuration parameter you must recalibrate the device. Failure to do so may result in serious injury or death.*

- PreAmp Gain Set – Depending upon Input Type, the device inputs range from a few Micro Amps to hundreds of Micro Amps. PreAmp Gain Set is the adjustment that matches the input signal range to the device's input signal conditioning circuits. Altering the PreAmp Gain setting automatically resets previous calibration OFFSET & GAIN values to UNITY. If it is determined the PreAmp Gain value is incorrect, apply the desired up-scale input and use the UP and DOWN keys to obtain the correct Reading value. Counts are the 10-bit binary A/D value with an active range value of 0 - 1023.

Warning: *Altering the PreAmp Gain setting automatically resets previous calibration OFFSET & GAIN values to UNITY. Therefore, after changing the PreAmp Gain Set configuration parameter, you must recalibrate the device. Failure to do so may result in serious injury or death.*

Not available for Toxic (E-Chem) Sensors.

Caution: *Do not use PreAmp Gain Set to calibrate Sensors. Use only when a new measurement gas or input range is required. Failure to do so could result in poor sensor performance.*

- Input Type – Allows selection between Bridge (3-wire) or 4-20mA (3-wire). As well as, selection between POS or NEG Coefficient.

Not available for Toxic (E-Chem) Sensors.

- ZERO Cal Val – Menu entry allows the Zero Calibration value to be set for something other than a zero reading. For example, a device 4-20mA input may represent a BTU Analyzer range of 500 - 1000 BTU's. In this case, 0% of full-scale equals 500 BTU's and may be the desired zero calibration point. Other upscale values may also be used for the Zero Calibration point by setting this menu item to the desired Engineering Unit value.

Not available for Toxic (E-Chem) Sensors.

Caution: *Do not exceed 25% of full scale when adjusting Zero Calibration value. Failure to do so could result in poor sensor performance.*

- Raw Min. Cnts and Raw Max. Cnts – Menus determine the range of 10-bit A/D converter counts that define 0 & 100% of full scale. Raw Min A/D counts create 0% readings and Raw Max A/D counts create 100% readings. These menus are for use with non-standard input ranges, such as an input of 8-18mA. Set RAW MIN COUNTS to match the 8mA input counts value and RAW MAX COUNTS to match the 18mA input counts value. The corresponding Zero 0% and Span 100% readings are entered in the Configuration Menu. Live A/D count values may be viewed from the CAL MODE Information screen.The values that appear in the menu screen are sensor dependent.

Both Raw Min. and Raw Max. Cnts are available for both Combustible (LEL) and Toxic (E-Chem) Sensors.

- Filter Rate – Allows selection of the rate of gas detection. The range is 4 to 44Seconds (4S= Faster Time and 44S= Slower Time).

Filter Rate is not available for Combustible (LEL) Sensors.

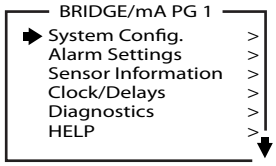
Configuring the IR CO_2 Sensor

This section covers the configuration for a IR CO_2 Sensor.

1 Press the EDIT key.

2 Press System Config. menu option. See Figure 42.

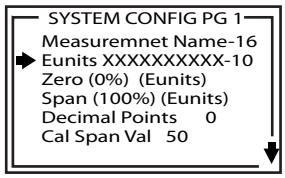
Figure 42 System Configuration Screen



3 Press EIDT key.

4 Navigate the cursor to the EUNIT menu option using the DOWN/CAL key. See Figure 43.

Figure 43 Eunits Menu



5 Press EDIT key.

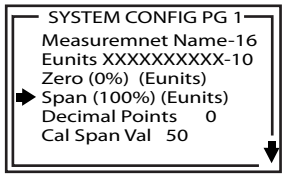
6 Press NEXT key to scroll to the LEL menu option.

7 Change LEL to V/V (volume) using either the UP or DOWN keys.

8 When finished press the EDIT key.

9 Press the DOWN/CAL key to select the Span menu option. See Figure 44.

Figure 44 Span Menu



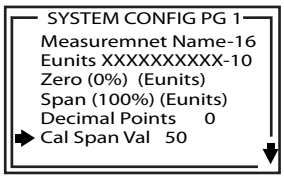
10 Press the EDIT key.

11 Change the Span value from 100% to 5% using the UP and DOWN keys.

12 When finished press the EDIT key.

13 Select the Cal Span Val menu option using the UP and DOWN keys. See Figure 45.

Figure 45 Cal Span Val Menu

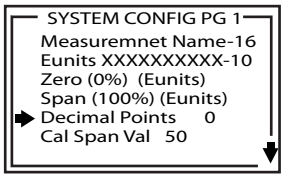


14 Change 50 to 1 using the EDIT key.

15 When finished press the EDIT key.

16 Press UP and DOWN keys to select the Decimal Points menu option. See Figure 46.

Figure 46 Decimal Points Menu



17 Change the Decimal Points value from 0 to 1 using the EDIT key.

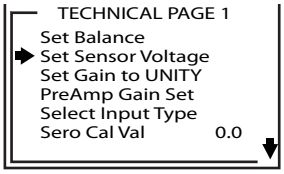
18 Press the NEXT key to save data.

19 Press the NEXT key to exit System Config. menu.

If you are changing from a Scott Combustible Cat-bead to a Combustible IR Sensor, you must change the sensor's voltage from 5.5V (factory preset) to 4.25V. Access the Technician Only Menus from the Setup Display Menu, navigate the cursor to Technician Only and press the EDIT key.

20 Navigate to Set Sensor Voltage menu option using the UP and Down keys. See Figure 47.

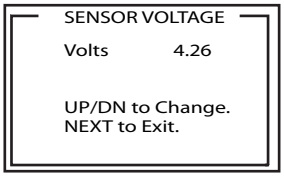
Figure 47 Set Sensor Voltage Menu



21 Press the EDIT key.

22 Change the voltage to 4.25 using the DOWN/CAL key. See Figure 48.

Figure 48 Sensor Voltage Screen



23 Press NEXT key to save data.

24 When finished press the NEXT key twice to return to the main menu.

25 The Sensor needs to Balanced and Calibrated. See "Configuring the Technicians Only Menu" on page 63. *See* "Set Balance Procedure after Installing a New Sensor" on page 64. *See* "Calibrating the Device" on page 80.

Configuration Defaults

Table 29 and Table 30 provides the default settings and ranges for the device based on whether you have a Combustible (LEL) or Toxic (E-Chem) Sensor installed.

Table 29 Key Device Configuration Defaults with a Combustible (LEL) Sensor

ITEM	SUB-ITEM 1*	SUB-ITEM 2*	FACTORY DEFAULT
EUNIT			%LEL
Zero			(0%) 0
Span			(100%)
Decimal Point			0
Cal Span Val			50
Readout Deadband			0%
Track Negative			NO
Linearization Data	Linearize		NO
TX Sensor Life			NO
Alarm Settings	Alarm1	Set point	20
		Dead Band	1%
		ON Delay	0s
		OFF Delay	0m
		Low Trip	NO
		Latching	NO
	Alarm2	Set point	40
		Dead Band	1%
		ON Delay	0s
		OFF Delay	0m
		Low Trip	NO
		Latching	NO
	Alarm3/Fail	Set point	-10
		Dead Band	1%
		ON Delay	0s
		OFF Delay	0m
		Low Trip	YES
		Latching	NO
	Relay Config	K1 Failsafe	NO
		K2 Failsafe	NO
		K2 Acknowledge	NO
		K2 Refresh	NO
		K3 Always	Failsafe

Table 29 Key Device Configuration Defaults with a Combustible (LEL) Sensor

ITEM	SUB-ITEM 1*	SUB-ITEM 2*	FACTORY DEFAULT
Clock/Delays		Time	xx:xx:xx
		Date	xx/xx/xx
		Warm Up Sec.	60S
		Cal Purge Sec.	60S
MODBUS RS-485Port	RTU Address		1
	Baud Rate		9600
	Parity		None
	Stop Bit		1
System Security	Secure Level	LOW	LOW
	Pass Code		Blank
Technicians ONLY	Set Balance	Reading	Varies
		Counts	Varies
	Set Sensor Voltage	Volts	Varies (based on specific Sensor Type installed. 4.25V for IR, 5.5V or 6.0V for Cat-bead).
	Set Gain to UNITY		OFF
	PreAmp Gain Set	Gain	Varies
		Counts	Varies
		Reading	Varies
	Select Input Type		Bridge (3-wire)
			NEG Coefficient
	Zero Cal Val		0
	Raw Min Cnts		511**
	Raw Max Cnts		1000**
Xmitter Config	O_2/Toxic		OFF
	Bridge/mA		ON
	Output Zero	O_2/Toxic	195 D2A counts
		Bridge/mA	201 D2A counts
	Output Span	O_2/Toxic	996 D2A counts
		Bridge/mA	1001 D2A counts
	Real Time Clock	Set Time	xx:xx:xx
		Set Date	xx/xx/xx

*Note: Blank cells indicate no corresponding Sub-Item.
**These values are sensor dependent.

Table 30 Key Device Configuration Defaults with a Toxic (E-Chem) Sensor

ITEM	SUB-ITEM 1*	SUB-ITEM 2*	FACTORY DEFAULT
EUNIT			ppm H_2S
Zero			(0%) 0
Span			(100%) 100
Decimal Point			0
Cal Span Val			50**
Readout Deadband			0%
Track Negative			NO
Linearization Data	Linearize		NO
TX Sensor Life			NO
Alarm Settings	Alarm1	Set point	20**
		Dead Band	1%
		ON Delay	0s
		OFF Delay	0m
		Low Trip	NO
		Latching	NO
	Alarm2	Set point	40**
		Dead Band	1%
		ON Delay	0s
		OFF Delay	0m
		Low Trip	NO
		Latching	NO
	Alarm3/Fail	Set point	-10
		Dead Band	1%
		ON Delay	0s
		OFF Delay	0m
		Low Trip	YES
		Latching	NO
	Relay Config	K1 Failsafe	NO
		K2 Failsafe	NO
		K2 Acknowledge	NO
		K2 Refresh	NO
		K3 Always	Failsafe
Clock/Delays		Time	xx:xx:xx
		Date	xx/xx/xx
		Warm Up Sec.	60S
		Cal Purge Sec.	60S

Table 30 Key Device Configuration Defaults with a Toxic (E-Chem) Sensor

ITEM	SUB-ITEM 1*	SUB-ITEM 2*	FACTORY DEFAULT
MODBUS RS-485Port	RTU Address		1
	Baud Rate		9600
	Parity		None
	Stop Bit		1
System Security	Secure Level	LOW	LOW
	Pass Code		Blank
Technicians ONLY	Set Balance		Disabled
	Set Sensor Voltage		Disabled
	Set Gain to UNITY		OFF
	PreAmp Gain Set	Gain	Disabled
		Counts	Disabled
		Reading	Disabled
	Select Input Type		Disabled
	Zero Cal Val		Disabled
	Raw Min Cnts		511**
	Raw Max Cnts		1000**
	Filter Rate		4Seconds
Xmitter Config	O_2/Toxic		ON
	Bridge/mA		OFF
	Output Zero	O_2/Toxic	195 D2A counts
		Bridge/mA	201 D2A counts
	Output Span	O_2/Toxic	996 D2A counts
		Bridge/mA	1001 D2A counts
	Real Time Clock	Set Time	xx:xx:xx
		Set Date	xx/xx/xx

*Note: Blank cells indicate no corresponding Sub-Item.
**These values are sensor dependent.

OPERATION

Chapter Overview

This chapter covers the following topic:

Operating the Device

This section describes the operational modes of the device. Primary User Interface (UI) of the device is via the LCD. During operation, the LCD displays continuous data on gas concentrations and alarm conditions. Additionally, you can monitor peak values of gas concentrations.

Warning: *When settings are changed, ensure those changes are communicated to all affected personnel.*

The device name can be changed (Measurement Name). See "Configuring the System Configuration Menu" on page 52.

The device defaults to the Text and Numerical Display upon power up. This display shows real time data to you. Specifically, the current numerical value of sensor information shown as a percentage.

Navigation of the LCD displays is done by using the supplied pocket magnetic screwdriver with the four (4) navigation keys (RESET/UP, NEXT, DOWN/CAL, and EDIT). You do not need to remove the removable cover of the housing to activate these keys. The magnetic screwdriver works in close proximity to the four (4) keys. Additionally, the magnetic screwdriver must be removed and replaced to perform sequential key routines. See Figure 49 shows the Text and Numerical Display, as well as the navigation keys and the devices' LEDs. Additionally, Table 31 lists these items along with their descriptions.

Figure 49 Text and Numerical Display

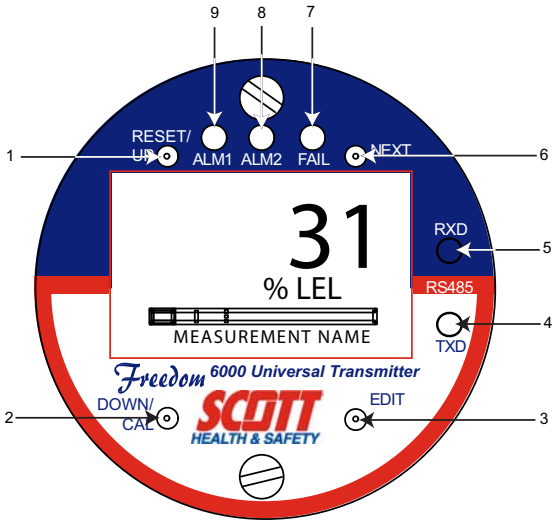


Table 31 LCD Items and Descriptions

REFERENCE NUMBER	ITEM	DESCRIPTION
1	RESET/UP	Key is used to navigate between LCD configuration screens with the magnetic pocket screwdriver. UP key maneuvers the Arrow/Cursor. Individual items, such as a numerical value or ASCII characters are changed using the UP key to change the character. Where applicable, display menus and display information is continued on a second display. This is indicated by the up or down Arrow along the right side. Navigate between displays by pressing UP to navigate the Arrow to the next display. RESET key is pressed to acknowledge an alarm and the LED changes from flashing to solid. It is used in conjunction with ALM1, ALM2 and FAIL LEDs.
2	DOWN/CAL	Key is used to navigate between LCD configuration screens with the magnetic pocket screwdriver. DOWN key maneuvers the Arrow/Cursor. Individual items, such as a numerical value or ASCII characters are changed using the DOWN key to change the character. Where applicable, display menus and display information is continued on a second display. This is indicated by the up or down Arrow along the right side. Navigate between displays by pressing DOWN to navigate the arrow to the next display. CAL key is used to enter Calibration Mode. You have 5 seconds to press EDIT to continue or the device times out and returns to the Text and Numerical Display. Once in Calibration Mode you select either Set Zero or Span Cal Mode.
3	EDIT	Key is used to navigate between LCD configuration screens and to display the Combustible (LEL) or Toxic (E-Chem) Setup Display using the magnetic pocket screwdriver. Enables sub-levels of menu items. Items with sub-menus are indicated by the Arrow (>) at the end of each line. Edit menu items by navigating the cursor to the desired selection and press EDIT. Pressing EDIT key displays the Combustible (LEL) or Toxic (E-Chem) Setup Display. The Combustible (LEL) or Toxic (E-Chem) Setup Display features a Cursor/Arrow for navigation and an Arrow indicator denoting Continued Menus. See Figure 50.
4	MODBUS RS-485 TXD	Green LED indicates MODBUS RS-485 communication transmission activity.
5	MODBUS RS-485 RXD	Green LED indicates receiving MODBUS RS-485 communication activity.

Table 31 LCD Items and Descriptions (continued)

REFERENCE NUMBER	ITEM	DESCRIPTION
6	NEXT	Key used to navigate between LCD configuration screens and displays the 30 Minute Graphic Display using the magnetic pocket screwdriver. Reverses out of a menu or sub menu to a previous configuration screen. Pressing NEXT toggles between the Text and Numerical Display and the 30 Minute Graphic Display. The 30 Minute Graphic Display features a dotted line to indicate Alarm Setpoints and a solid line to indicate the 30 Minute History. See Figure 51.
7	FAIL (See Caution below)	Indicates an new alarm condition when Red LED Flashes. This LED functions in tandem with equipment configured to Relay (K3). To acknowledge this alarm, press RESET/UP key and this LED changes from flashing to solid. Note: This LED functions regardless of whether the Relays/MODBUS RS-485 Option PCB is installed.
8	ALM2	Indicates an new alarm condition when Red LED Flashes. This LED functions in tandem with equipment configured to Relay (K2). To acknowledge this alarm, press RESET/UP key and this LED changes from flashing to solid. Note: This LED functions regardless of whether the Relays/MODBUS RS-485 Option PCB is installed.
9	ALM1	Indicates an new alarm condition when Amber LED Flashes. This LED functions in tandem with equipment configured to Relay (K1). To acknowledge this alarm, press RESET/UP key and this LED changes from flashing to solid. Note: This LED functions regardless of whether the Relays/MODBUS RS-485 Option PCB is installed.

Caution: *Though fully configurable to the same alarm levels available to Alarm1 and Alarm2, Alarm3 always trip with missing or failed sensors. An alarm from Alarm3 or Relay (K3) can be caused by level set points or by a missing or failed sensor. Always verify the reason for alarms.*

Figure 50 Combustible (LEL) or Toxic (E-Chem) Setup Display

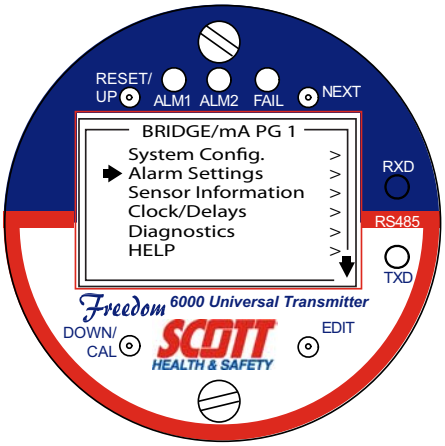
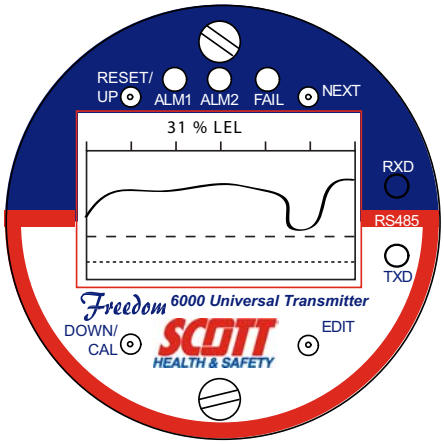


Figure 51 30 Minute Graphical Display



The device ships preconfigured for standard operation. However, if a Relays/MODBUS RS-485 Option PCB is installed in the device, you may need to change some of the configuration parameters. See “Configuration and Setup Checklist” on page 42. The configuration structure is divided into two (2) parts: Basic Configuration parameters and Advanced Configuration parameters. Most applications do not typically require making changes to the Advanced Configuration parameters and are not recommended. However, there may be occasions when changes are needed. See “Configuring the Transmitter Configuration Menu” on page 61. See “Configuring the Technicians Only Menu” on page 63.

Upon initial completion of the power up sequence, the device needs to be Calibrated to ensure proper operation of the Sensor. See “Calibrating the Device” on page 80.

Powering Up

This section covers the power up sequence.

Once power is applied to the device, the five (5) LEDs emit solid, the LCD displays BUSY, the LCD displays SCOTT F6K along with Firmware Version and Serial Number briefly as it powers up. The boot up process takes about eight (8) seconds to complete.

The Warm Up Time (Inhibit Time) is adjustable using the Warm Up Second parameter. See "Configuring the Clock/Delays Setup Menu" on page 57.

Powering Down

This section covers the power down sequence.

Powering down the device is not required to perform routine operations.

Caution: *If you change from a 5.5V Combustible Cat-bead Sensor to a 4.25V IR Combustible Sensor, ensure you change the Sensor Voltage parameter via the configuration menu. Failure to do so damages the 4.25V IR Sensor.*

Chapter 5

MAINTENANCE

Chapter Overview

This chapter covers the following topics:

Calibrating the Device

This section covers calibration of the device.

Warning: *Operating the device that has exceeded its calibration date can cause false readings of detected gases. Readings obtained while device is out of calibration are invalid and could lead to death or injury.*

Warning: *During Calibration, the device is not detecting hazardous gases. Ensure you notify affected personnel working in the area or otherwise depending on its detection that it will be out of service and ensure other gas detection protection is in place.*

Warning: *Before you begin, read and understand the MSDS and warning labels for the calibration gases. Failure to do so may result in serious injury or death.*

Warning: *Local alarms are Inhibited in the device while in Calibration Mode (that is, a time delay set to prevent unwanted alarm trips). Verify the environment is clean and free of hazardous gases and toxins or have monitoring performed by another device prior to calibrating. Failure to do so could lead to injury or death. Inhibit Time is adjustable using the Cal Purge Second parameter. See* "Configuring the Clock/Delays Setup Menu" on page 57.

Combustible (LEL) Sensors shipped with the device are calibrated at the factory. However, Spare Combustible (LEL) Sensors must be calibrated prior to use.

Toxic (E-Chem) Sensors shipped with the device are calibrated at the factory using a simulator. Verify that Spare Toxic (E-Chem) Sensors are calibrated prior to use.

Calibration Hookup Options

This section describes the various calibration Hookup Options.

There are two (2) Hookup options for Calibrating Combustibles (LEL) for both Zero Calibration and Span Calibration. They are:

- Using the Combustible (LEL) Calibration Adapter
- Using the Calibration Port on the Sensor Head

Figure 52 shows the required equipment for both Hookup options.

Figure 52 Combustible (LEL) Calibration Hookup Methods

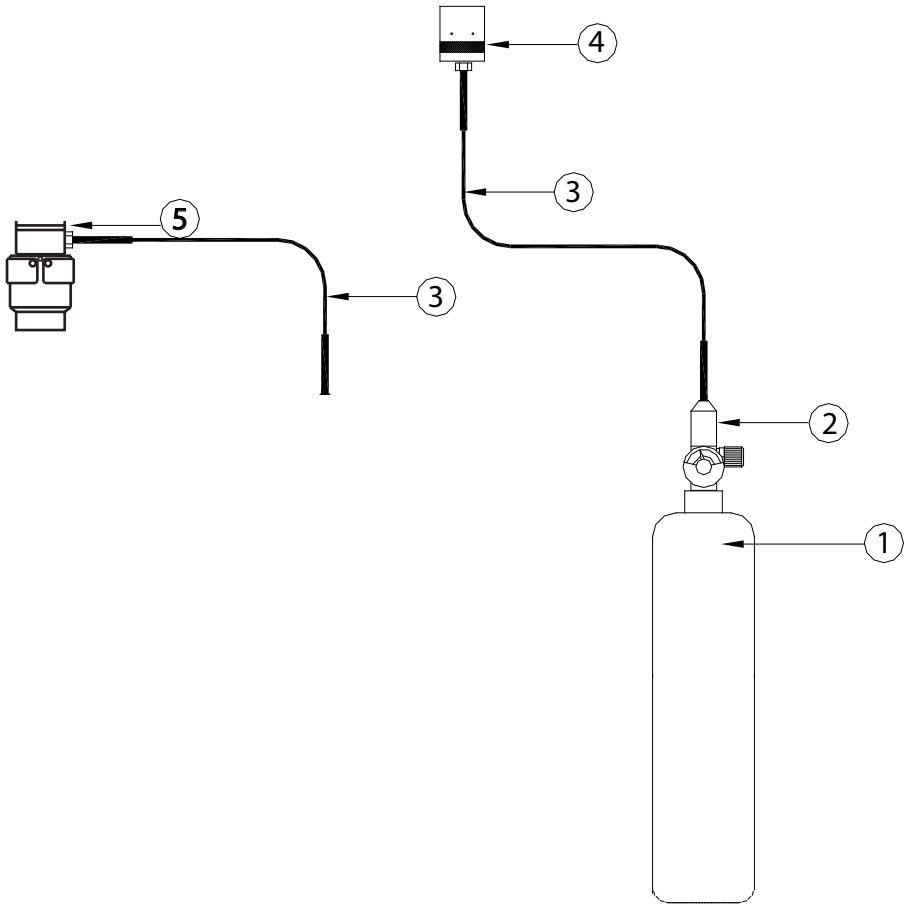


Table 32 lists the required equipment for both Hookup options.

Table 32 Combustible (LEL) Calibration Equipment - Both Hookup Options

REFERENCE NUMBER	ITEM	USING CALIBRATION ADAPTER	USING CALIBRATION PORT ON SENSOR HEAD
1	Gas Cylinder • For Zero Gas Calibration: Zero Gas Cylinder • For Span Gas Calibration: See Table 35.	Same	Same
2	Regulator (P/N 077-0018)	Same	Same
3	Tygon Tubing, 3/16” ID (P/N 077-0021) Note: Barb fitting not supplied.	Same	Same
4	1/4” Turn Calibration Adapter (P/N 096-3242, For Combustible (LEL) only)	N/A	Applicable
5	Combustible (LEL) Sensor Head (Cal Port)	Applicable	N/A

There is one (1) Hookup option for Toxic (E-Chem) for both Zero Calibration and Span Calibration. It is:

- Using the Toxic (E-Chem) Calibration Adapter

Figure 53 shows the required equipment for the Hookup.

Figure 53 Toxic (E-Chem) Calibration Hookup Method

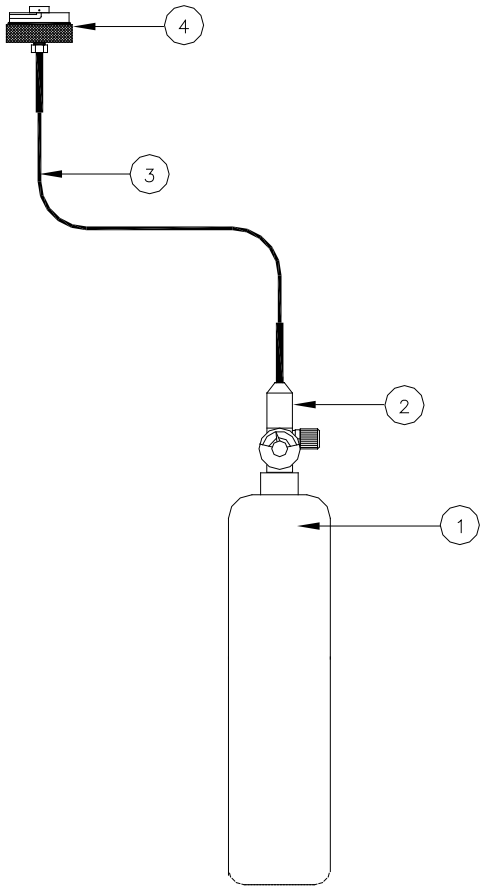


Table 33 lists the required equipment for the Hookup.

Table 33 Toxic (E-Chem) Calibration Equipment

REFERENCE NUMBER	ITEM
1	Gas Cylinder • For Zero Gas Calibration: Zero Gas Cylinder • For Span Gas Calibration: Contact your Scott sales representative or Scott Health & Safety, A Division of Scott Technologies, Inc. See “Assistance” on page 114.
2	Regulator (P/N 077-0018)
3	Tygon Tubing, 3/16” ID (P/N 077-0021)
4	1/4” Turn Calibration Adapter (P/N 096-2101, For Toxic (E-Chem) only)

Table 33 Toxic (E-Chem) Calibration Equipment (continued)

REFERENCE NUMBER	ITEM
Note: A Generic (Toxic) Calibration Kit (P/N 096-2748) is available. See "Parts List" on page 115.	

Calibration Methods

This section describes the various calibration methods.

Scott Health & Safety, a Division of Scott Technologies, Inc. recognizes the potential of the device as a life saving device when operated and maintained correctly. As such, verifying proper operation of the device in the form of Span Calibration and Zero Calibration is essential to ensure the device performs as intended in a potentially hazardous environment.

The frequency at which Span Calibration and Zero Calibration occur is best determined based on local regulatory standards, company policies, and industry best practices. Scott Health & Safety, a Division of Scott Technologies, Inc. is not responsible for setting policies or practices.

Calibration methods include the following:

- Zero Calibration — Is performed to establish baseline readings of atmospheres that are known to be free of toxic or combustible gases.
- Span Calibration — Is performed to ensure the device detects target gases within specified operating parameters. Span Calibration is the adjustment of the device's response to match a known concentration of gas. Sensors can lose sensitivity through normal degradation, exposure to high gas concentrations, or sensor poisoning. Accurate calibration can be achieved only if specific concentrations of the correct gases are used. Span Calibration should be performed when a new sensor is installed. Span Calibration must be performed anytime a Bump Test fails.

Warning: *During Calibration, the device is not detecting hazardous gases. Thus, gas monitoring and alarm processing are not performed. When the primary device is off line, ensure you have another online device to actively detect hazardous gases. Failure to do so could result in injury or death.*

If the Relays/MODBUS RS-485 Option PCB is installed. Local Alarm Relays are Inhibited during the Calibration Mode. Inhibit Time is adjustable using the Cal Purge Second parameter. See "Configuring the Clock/Delays Setup Menu" on page 57.

Table 34 details the recommended calibration and test items for the device.

Table 34 Recommended Calibration Matrix

ITEM	FREQUENCY	DETAILS
Zero Calibration	• When baseline readings are incorrect or suspect • Prior to a Span Calibration	See "Zero Calibration" on page 84.
Span Calibration	• After installing new sensors	See "Span Calibration" on page 84.

Zero Calibration

This section describes how to perform Zero Calibration.

Prior to starting the Zero Calibration procedure, you may need to adjust the Inhibit Time on the device. This prevents unwanted alarm trips. Likewise remember to reset it after calibration. Inhibit Time is adjustable using the Cal Purge Second parameter. See "Configuring the Clock/Delays Setup Menu" on page 57.

1. From either Data Display, enter the Cal Mode by pressing the DOWN/CAL key. EDIT To Enter Cal Mode, Time out in 5 Seconds displays. Ensure the EDIT key is pressed within 5 seconds.
2. Using the Calibration Adapter, apply Zero Air or Nitrogen at a flow of 0.5LPM.

Only use Zero Air for Cat-bead Sensors.

3. Wait approximately 2 minutes for stabilized readings.
4. Press the EDIT key to perform a Zero Calibration.
5. If Zero Calibration is successful the SET SPAN displays. If Zero Calibration fails, repeat procedure.

If 5 minutes elapses before Zeroing the device, the device times out and returns to the Data Display. If this happens just reenter the Cal Mode. To keep the time out from occurring activate either the UP or DOWN keys. The 5 minute time out starts over after a key is activated.

Baseline readings for a Zero Calibration is 20.9% for O_2.

6. If Span calibration is desired, continue to See "Span Calibration" on page 84.

Span Calibration

This section describes how to perform Span Calibration.

Prior to starting the Zero Calibration procedure, you may need to adjust the Inhibit Time on the device. This prevents unwanted alarm trips. Likewise remember to reset it after calibration. Inhibit Time is adjustable using the Cal Purge Second parameter. See "Configuring the Clock/Delays Setup Menu" on page 57.

The Span gas used must match the Cal Span Value specified since this is what the device indicates after a successful Span Calibration. See "Configuring the System Configuration Menu" on page 52.

For precise K-Factors when performing a Span Calibration of a combustible sensor. See "Sensor K-Factors" on page 102.

Verify concentration level matches detection at points of the device and the expiration date of the cylinder has not passed.

Caution: *Gas must be applied at a flow rate of 0.5LPM to perform Span Calibration. A flow rate either above or below results in a failed or inaccurate calibration.*

The device can be Span Calibrated using either individual calibration gas cylinders that contain one specific target gas for the sensor being calibrated or a gas mixture cylinder that contains a mixture of each of the target gases required to calibrate each of the sensors the device is presently configured to detect. If using individual gas cylinders to Span Calibrate, the Span Calibration procedure must be completed for each sensor.

1 Determine the target calibration gas. See Table 35.

Different Sensors target different gases. Ensure the Span Gas being used is applicable to the Sensor installed.

Only use Zero Air for Cat-bead Sensors.

Table 35 Span Calibration Gas for IR Sensors

TARGET GAS	INSTALLED SENSOR	CALIBRATION GAS TO BE USED**
Methane	Methane	50%LEL (2.5%V/V) Methane. Span to 50%LEL
Propane	Propane	41%LEL Propane. Span to 41%LEL
Ethane	Ethane*	41%LEL Propane. Span to 41%LEL
Butane	Propane	41%LEL Propane. Span to 43%LEL
Pentane	Propane	41%LEL Propane. Span to 53%LEL
Hexane	Propane	41%LEL Propane. Span to 69%LEL
Propylene	Propylene*	41%LEL Propane. Span to 70%LEL
Isopropanol	Propane	41%LEL Propane. Span to 65%LEL
Methanol	Methanol*	41%LEL Propane. Span to 31%LEL
Ethanol	Propane	41%LEL Propane. Span to 48%LEL
Toluene	Propane	25%LEL Propane. Span to 59%LEL
Ethylene	Propane	25%LEL Propane. Span to 67%LEL
Acetone	Acetone	25%LEL Propane. Span to 71%LEL
* Propane Sensor programmed for specific type gas. ** When not specifically stated otherwise, 41% concentration is preferred. However, any percentage between 25 to 75% may be used.		

2 From the Data Display, enter Cal Mode by pressing the DOWN/CAL key and within 5 seconds activating the EDIT key.

3 Attach the Calibration Adapter to the device and apply gas from the regulator.

4 Apply the applicable Calibration Gas using Table 35 at 0.5LPM.

5 Wait approximately 3 minutes for stabilized readings.

6 Activate the Edit key to perform a Span calibration.

7 Remove Calibration Gas.

8 If successful, SPAN CAL SECCESSFUL displays momentarily, then displays REMOVE CAL GAS momentarily. The device then displays the Data Display with the 1 minute CAL PURGE delay at the bottom of the LCD. If Span Calibration fails, repeat procedure.

If 5 minutes elapses before Zeroing the device, the device times out and returns to the Data Display. If this happens just reenter the Cal Mode. To keep the time out from occurring activate either the UP or DOWN keys. The 5 minute time out starts over after a key is activated.

Maintaining the Device

This section covers maintenance of the device.Table 36 details the recommend maintenance item for the device.

Table 36 Recommended Maintenance Matrix

ITEM	ACTIVITY	FREQUENCY	DETAILS
Sensor	Replace	Periodic	See “Replacing the Sensor” on page 87.

Replacing the Sensor

This section provides information on how to replace Sensors.

The device ships without the Sensor installed and must be installed prior to use. The procedure to install your Sensor is the same to replace your Sensor.

1 To replace a Toxic (E-Chem) Sensor, *See* “Installing/Replacing a Toxic (E-Chem) Sensor” on page 36.

2 To replace a Combustible (LEL) Sensor, *See* “Installing/Replacing a Combustible (LEL) Sensor Head” on page 37.

3 Perform Zero and Span Calibrations of the device in accordance with Zero Calibration. See “Zero Calibration” on page 84. See “Span Calibration” on page 84.

Error Codes

Table 37 provides a list of error codes with cause and solutions. Errors display on the bottom of the LCD.

Table 37 Error Codes

ERROR CODES	CAUSE	SOLUTION
01- EUNIT_ERR	A newly installed sensor was read and the gas type does not match that of the device's data.	Verify correct sensor has been installed. Accepting this error by pressing EDIT causes the device to auto configure using the data stored in the sensor.
02- SCALE_ERR	The sensor was read and the gas range does not match that of the device's data.	Verify correct sensor has been installed. Accepting this error by pressing EDIT causes the device to auto configure using the data stored in the sensor.
03- CAL_ERR	Sensor has a calibration error recorded.	Perform a full calibration. See "Calibrating the Device" on page 80.
04- ZERO_CAL_FAIL	The cal zero sequence failed due to high offset i.e. >±25%.	Check balance on Cat-bead sensors. See "Configuring the Technicians Only Menu" on page 63. And then calibrate. See "Calibrating the Device" on page 80. Digital sensors may be corrected by putting unit back to unity gain. See "Configuring the Technicians Only Menu" on page 63. And then calibrate. See "Calibrating the Device" on page 80.
05- SPAN_CAL_FAIL	The cal span sequence failed due to being either under or over range i.e. gain <0.5 or >2.0.	Check preamp adjustment on analog sensors. See "Configuring the Technicians Only Menu" on page 63. And then calibrate. See "Calibrating the Device" on page 80. Digital sensors may be corrected by putting unit back to unity gain. See "Configuring the Technicians Only Menu" on page 63. And then calibrate. See "Calibrating the Device" on page 80.
06- HIST_DATA_FULL_ERR	The history log is full and no further records can be added.	Purge the Event Log. Event Log Menu is found under the Alarm Settings Menu. See "Configuring the Alarm Settings Menu" on page 54.

Table 37 Error Codes (continued)

ERROR CODES	CAUSE	SOLUTION
07-SENSOR_CHAN_CRC_ERR 08-SENSOR_SYS_CRC_ERR 09-SENSOR_CUST_CRC_ERR 10-SENSOR_LIN_CRC_ERR	Errors 7-10 indicate an error is detected in the non-volatile data during a read cycle.	If error persists, attempt to reboot device by removing and reapplying power. If error code will not clear, contact Scott Health & Safety, a Division of Scott Technologies, Inc. for repair. See “Assistance” on page 114.

Troubleshooting the Device

Refer to Table 38 for troubleshooting assistance.

Warning: *If the device does not function properly, remove from service and mark for maintenance. Only use Scott Health & Safety, a Division of Scott Technologies, Inc. replacement parts.*

Table 38 Troubleshooting Matrix

SYMPTOM	CAUSE	SOLUTION
LCD indicates FAULT and FAIL LED Flashes.	**1** Alarm3 setting incorrect. **2** Device is seeing a Negative Value but is not configured to display a Negative Value. **3** Xmitter configuration does not match the actual Sensor Type installed. **4** Sensor Type configuration does not match actual Sensor Type installed. **5** Sensor Voltage configuration does not match required Voltage of the Sensor installed. **6** Sensor Pins not properly seated into Receptacles, or the Power/ I/O PCB is faulty. **7** To much pressure causes the Elastomeric Pad to create a short. **8** Elastomeric Pad has degraded. **9** Incorrect Endcap.	**1** Check the Alarm3 configuration. Ensure that both the Set Point level and the Low Trip are set appropriately. **2** Change Track Negative configuration to YES. **3** Change the Xmitter configuration. Ensure it matches the Sensor Type installed. Select either O_2/Toxic or Bridge/mA (Cat-bead in devices with firmware lower than V2.39) using ON. **4** Change Input Type configuration. Ensure it matches the Sensor Type installed. Select either O_2/Toxic or Bridge/mA (Cat-bead in devices with firmware lower than V2.39) using ON. **5** Use a DMM to measure the voltage on the Power/ I/O PCB TB1 (REF) to (ACT). The common probe should connect to (ACT) and the positive probe to (REF). If the voltage is incorrect, change the Set Sensor Voltage configuration. Ensure it matches the Voltage specified for the Sensor installed. The options are: • For IR Sensors: 4.25V • For Cat-bead Sensors: Either 5.5V, 4.25V or 6.0V based on the Sensor installed. **6** Ensure the Sensor's Pins are properly seated into the Sensor's Receptacles. • Use a DMM to measure the voltage on the Power/ I/O PCB TB1 (COM) to (ACT). The common probe should connect to (ACT) and the positive probe to (COM). This should be approximately half the Sensor Voltage. If seating is correct, then replace the Sensor. If the voltage measurement is correct, then replace the Power/ I/O PCB. **7** Loosen the Outer Guard to reduce the amount of pressure on the Elastomeric Pad. **8** Change out the Elastomeric Pad. **9** Ensure correct Endcap is used (two different sizes exist).

Table 38 Troubleshooting Matrix (continued)

SYMPTOM	CAUSE	SOLUTION
Device does not respond to Span Gas.	**1** Damaged Stainless Steel Sensor Housing. **2** Bad Elastomeric Pad. **3** Bad Sensor. **4** Bad or weak Calibration Gas **5** Poor gas delivery - wind **6** Incorrect Calibration Gas. **7** Incorrect Calibration Gas concentration.	**1** Replace Sensor Housing. **2** Replace Elastomeric Pad. **3** Replace Sensor. **4** Replace Gas Source. **5** Cover holes on Endcap except for one. • Check Tubing for cuts. • For CL_2 applications, confirm Regulator/Tubing was not used with H_2S. • For sticky gases (HF, HCl Cl_2, SO_2, BCl_3 etc.), confirm that Teflon Tubing is being used. • Check Calibration Adapter is not plugged. **6** Replace Gas Source. **7** Replace Gas Source.
Device Zero Drifts.	**1** Needs Calibration. **2** Interfering gas present. **3** Rapid temperature changes.	**1** Zero Calibrate the device. **2** Place Zero Air on Sensor to determine if outside gas is present. **3** If possible, shield Sensor from source of temperature changes.
Device's output is continuously negative.	**1** It was probably Zero Calibrated with Hydrocarbons present.	**1** Apply a source of clean air to Sensor and Zero Calibrate.
LCD is blank although the device is producing an output signal.	**1** LCD contrast too low.	**1** Adjust LCD contrast.
LCD indicates OVERRANGE and Both ALM1 and ALM2 LEDs flashes.	**1** Device reads an Overrange, but is < 250% Full Scale. Reading does not indicate correct concentration.	**1** Zero Calibrate.
LCD indicates FAULT and FAIL LED flashes.	**1** Device reads an Overrange, that is >250% Full Scale. Reading does not indicate correct concentration.	**1** Zero Calibrate.

Appendix A

SPECIFICATIONS

Appendix Overview

This appendix covers the following topics:

- Device Specifications
- Combustible (LEL) IR and Cat-bead Sensor Specifications
- Toxic (E-Chem) Sensor Specifications

Device Specifications

Table 39 lists the device's specifications.

Table 39 Device Specifications

DEVICE SPECIFICATIONS		
Supply Voltage	10 to 30VDC	
Power Consumption	240mA @ 24VDC Max with the Relays/MODBUS RS-485 Option PCB and typical.5W Combustible (LEL) (Bridge) Sensor	
	5.76W @ 24VDC	
	Relays/MODBUS RS-485 Option PCB	• 40mA per Relay (120mA total with all 3 energized) • 20mA used by MODBUS
Scott Controllers Input Resistance	100Ω	
Communications	• MODBUS RS-485 • RTU legal address range is 1 to 247	
Memory	• Non-Volatile Memory (NV-EEPROM) • Rated for 10 years • Ensures configuration parameters retained during power loss.	
Loop Load Resistance at nominal 24VDC	3-Wire	750Ω Max.
	4-Wire	750Ω Max.
Remote Sensor Mounting Distance	Toxic (E-Chem) Sensor	Up to 50' (15.25cm) Max.
	Combustible (LEL) Sensors	3500' (1067m) Typical (Varies based on several factors, See "Determining Wire Length and Size" on page 12.
Duct Mount Adapters	Flow Velocities	350 to 1000 Ft./Minute
	Compatibility	• Flat • Round; for 6" to 8" Diameter Ducts
Relays (Optional)	Three configurable form C (SPDT) relays rated for 5A @ 30VDC or 240VAC resistive	
	Relay1 and Realy2 level alarms are configurable for High or Low trip, for normally energized (Failsafe) or normally de-energized and for latching or non-latching	
	Relay3 is always normally energized for failsafe operation so loss of power to the device indicates a Fault condition.	
Calibration	Both Zero and Span supported	
Housing	Combustible (Cat-bead)	Aluminium 3/4"NPT Stainless Steel 3/4" NPT
	Combustible (IR)	Aluminium 3/4"NPT Stainless Steel 3/4" NPT Groups B, C, D
	Toxic	Aluminium 3/4"NPT Aluminium 3/4"NPT Condensing Humidity Sensor Head
	Toxic (Carbon Dioxide)	Aluminium 3/4"NPT Stainless Steel 3/4" NPT

Table 39 Device Specifications (continued)

DEVICE SPECIFICATIONS		
Dimensions	Aluminium Device	5.0Hx5.75Wx5.0”D (12.7Hx14.6Wx12.7Dcm)
	Stainless Steel Device	5.0Hx5.75Wx5.0”D (12.7Hx14.6Wx12.7Dcm)
Mounting Flanges Holes	Aluminium Device	ID 0.28” on 5.83” centers (7.00 on 148mm)
	Stainless Steel Device	ID 0.312” on 3.58” centers (7.92 on 90.93mm)
Weight	Aluminium Device	3.59Lbs. (1.63Kg)
	Stainless Steel Device	5.79Lbs. (2.63Kg)
Operating Temperature	-40.0 to +140°F (-40 to 60°C)	
Operating Humidity	0 to 90% RH, Non-Condensing	

Caution: *Relays are rated for Resistive Loads. Inductive Loads, such as coils or motors may cause contact arcing, which emits RFI into the sensor signals. Use appropriate snubbers and MOV’s across inductive loads and keep wiring away from signal wires. Failure to do so could result in RFI and negatively effect device performance.*

Combustible (LEL) IR and Cat-bead Sensor Specifications

Table 40 lists Combustible (LEL), IR and Cat-bead sensor specifications.

Table 40 Combustible (LEL) IR and Cat-bead Sensors Specifications

COMBUSTIBLE (LEL), IR AND CAT-BEAD SENSOR SPECIFICATIONS	
IR - Methane Sensor	
Operating Voltage	4.25VDC
Operating Current	Constant current operation, current range 75 to 85mA
Methane Measuring Range	0 to 5% volume up to 0 to 100% volume
Hydrocarbon Measuring Range	0 to 100% LEL equivalent
Warm Up Time	To final zero +/- 2% FSD: 1 minute @20°C (68°F) ambient
Response Time	T90 <30sec @68°F (20°C) ambient
Zero Repeatability	+/- 1% FSD @20°C (68°F) ambient
Span Repeatability	+/- 2% FSD @20°C (68°F) ambient
Long Term Zero Drift	+/- 1% FSD per month @20°C (68°F) ambient, (max +/- 3% FSD per year)
Operating Temp.	-4.0 to +122°F (-20 to +50°C)
Humidity	0 to 90% RH, Non-Condensing
Storage Temp.	-4.0 to +122°F (-20 to +50°C)
MTBF	> 5 years
IR - Carbon Dioxide Sensor	
Operating Voltage	4.25VDC
Operating Current	Constant current operation, current range 75 to 85mA
Measuring Range	0 to 5%, 0 to 4%, 0 to 3%, 0 to 2%, 0 to 1% volume CO_2
Accuracy	+/- 2% FSD @20°C (68°F). 1 bar pressure. applied gas 2.5% volume CO_2
Warm Up Time	To final zero +/- 100ppm: 1 minute @20°C (68°F) ambient
Response Time	T90 <30sec @68°F (20°C) ambient
Zero Repeatability	+/- 500ppm @20°C (68°F) ambient
Span Repeatability	+/- 500ppm @20°C (68°F) ambient
Long Term Zero Drift	+/- 500ppm per month @20°C (68°F) ambient
Operating Temp.	-4.0 to +122°F (-20 to +50°C)
Humidity	0 to 90% RH, Non-Condensing
Storage Temp.	4.0 to +122°F (-20 to +50°C)
MTBF	> 5 years
IR - Propane Sensor	
Operating Voltage Range	3.0 to 5.0VDC
Operating Current	Constant current operation, current range 75 to 85mA

Table 40 Combustible (LEL) IR and Cat-bead Sensors Specifications (continued)

COMBUSTIBLE (LEL), IR AND CAT-BEAD SENSOR SPECIFICATIONS		
Methane Measuring Range	0 to 5% volume up to 0 to 100% volume	
Hydrocarbon Measuring Range	0 to 100% LEL equivalent	
Warm Up Time	To final zero +/- =- 2% FSD: 1 minute @20°C (68°F) ambient	
Response Time	T90 <30sec @68°F (20°C) ambient	
Zero Repeatability	+/- 1% FSD @20°C (68°F) ambient	
Span Repeatability	+/- 2% FSD @20°C (68°F) ambient	
Long Term Zero Drift	+/- 1% FSD per month @20°C (68°F) ambient, (max +/- 3% FSD per year	
Operating Temp.	-4.0 to +122°F (-20 to +50°C)	
Humidity	0 to 90% RH, Non-Condensing	
Storage Temp.	-4.0 to +122°F (-20 to +50°C)	
MTBF	> 5 years	
5.5V and 5.5V Poison Resistant - Combustible (LEL) Sensor		
Voltage	5.5VDC	
Current	60mA Max.	
Range	0 to 100% Lower Flammable Limit (LFL) Combustible Gas	
Response Time	3Seconds to 63% of Step Change with 50% LFL Hydrogen Applied 6.5Seconds to 63% of Step Change with 50% LFL Methane Applied	
Accuracy	+3% of Full Scale	
Operating Temp.	-40 to +392°F (-40 to +200°C)	
Humidity Variation	<3% Full Scale; 10 to 0 to 90% RH	
4.25V - Combustible (LEL) Sensor		
Operating Voltage Range	4.25VDC, +/-0.1	
Operating Current	50 to 60mA	
Sensitivity	30mV/% vol. Minimum (1% Methane)	
Offset	+/-20mV	
Poison Resistance	Silicones and H_2S	
Response Time	T50 <10Sec	
Linearity	Linear up to 3% vol. Methane/Balance Air	
Drift	Long-Term Signal Drift	<5% LEL/Month
	Long-Term Zero Drift	<5% LEL/Month
Operating Temp.	-40 to +131°F (-40 to +55°C)	
Humidity	0 to 80% RH, Non-Condensing	

Table 40 Combustible (LEL) IR and Cat-bead Sensors Specifications (continued)

COMBUSTIBLE (LEL), IR AND CAT-BEAD SENSOR SPECIFICATIONS	
Storage Temp.	-40 to +131°F (-40 to +55°C)
6.0V - Combustible (LEL) Sensor	
Current	220mA Nominal
Response Time	<10Seconds to 50% Full Scale <30 Seconds to 90% Full Scale
Operating Temp.	-40 to +200°F (-40 to +93°C)
Humidity	0 to 99% RH, Non-Condensing
3.3V - Combustible (LEL) Sensor	
Bridge Supply Voltage	2.9 to 3.1VDC
Sensor Current (at 3.0 +/- 0.1V)	67 to 80mA
Minimum Sensitivity (Measured with 1% Methane, 20% LEL, at 3.0 +/- 0.1V)	20mV/% Methane
Zero Offset Range in Clean Air (at 3.0 +/- 0.1V)	+/- 20mV Max.
Zero Offset with Temperature	<0.2% Methane Variation from Reading at 20°C to -10 and +40°C
Linearity	10S Max
Maximum Gastration	5% Methane in Air
Long-Term Zero Drift	<0.75mV/Month
Long-Term Sensitivity Drift	<2.5% Full Scale/Month

Toxic (E-Chem) Sensor Specifications

Table 41 lists some of the Toxic (E-Chem) sensor specifications.

Table 41 Toxic (E-Chem) Sensors Specifications

GAS	SYMBOL	TYPE	RH RATING**	OPERATING TEMP RANGE (°C)	TYPICAL RESPONSE TIME***	STANDARD SENSOR FULL RANGE (PPM)****
Ammonia	NH_3	Standard	G	-5 to 50	<45	100
Arsine	AsH_3	Rock Solid*	L	10 to 40	<45	1
Arsine	AsH_3	Standard	G	-25 to 50	<45	1000
Boron Trichloride	BCl_3	Rock Solid	H	-25 to 50	<45	10
Boron Trichloride	BCl_3	Rock Solid	H	-40 to 50	<45	10
Bromine	Br_2	Rock Solid	H	-40 to 50	<20	10
Carbon Monoxide	CO	Standard	G	-40 to 50	<20	100
Chlorine	Cl_2	Rock Solid	L	-40 to 50	<20	5
Chlorine	Cl_2	Rock Solid*	H	-40 to 50	<20	5
Chlorine	Cl_2	Standard	G	-40 to 50	<20	5
Chlorine Dioxide	ClO_2	Rock Solid	H	-40 to 50	<20	1
Diborane	B_2H_6	Rock Solid	L	-10 to 50	<60	500ppb
Ethylene Oxide (ETO)	C_2H_4O	Standard	G	-20 to 50	<140	10
Fluorine	F_2	Rock Solid	L	-40 to 50	<20	1
Fluorine	F_2	Rock Solid*	H	-40 to 50	<20	10
Fluorine	F_2	Standard	G	-40 to 50	<15	10
Germane	GeH_4	Standard	G	-40 to 50	<20	1000ppb
Hydrogen	H_2	Standard	H	-40 to 50	<10	4%
Hydrogen	H_2	Standard*	L	-40 to 50	<10	4%
Hydrogen Bromide	HBr	Rock Solid*	L	-40 to 50	<60	5
Hydrogen Bromide	HBr	Rock Solid	H	-40 to 50	<60	10
Hydrogen Chloride	HCl	Standard	L	-25 to 50	<60	25
Hydrogen Chloride	HCl	Standard	H	-25 to 50	<60	25
Hydrogen Chloride	HCl	Rock Solid	L	-40 to 50	<60	10
Hydrogen Chloride	HCl	Rock Solid*	H	-40 to 50	<60	10
Hydrogen Cyanide	HCN	Rock Solid	H	-10 to 50	<60	10
Hydrogen Cyanide	HCN	Standard*	G	-10 to 50	<60	10
Hydrogen Fluoride	HF	Standard	L	-25 to 50	<60	10
Hydrogen Fluoride	HF	Standard	H	-25 to 50	<60	10
Hydrogen Fluoride	HF	Rock Solid	L	-40 to 50	<45	10
Hydrogen Fluoride	HF	Rock Solid*	H	-40 to 50	<45	10
Hydrogen Sulfide	H_2S	Standard	G	-40 to 50	<30	50

Table 41 Toxic (E-Chem) Sensors Specifications (continued)

GAS	SYMBOL	TYPE	RH RATING**	OPERATING TEMP RANGE (°C)	TYPICAL RESPONSE TIME***	STANDARD SENSOR FULL RANGE (PPM)****
Hydrogen Sulfide	H_2S	Standard	L	-40 to 50	<15	50
Hydrogen Sulfide (Low Methanol cross sensitivity)	H_2S	Standard	G	-40 to 50	<15	50
Hydrogen Sulfide	H_2S	Standard*	H	-40 to 50	<15	50
Methanol	CH_3OH	Standard	G	-40 to 50	<40	500
Methyl Iodide	CH_3I	Standard	G	-40 to 50	<30	25
Methyl Mercaptan	CH_3SH	Standard	G	-40 to 50	<20	3
Monomethylhydrazine	$CH_3(NH)NH_2$	Standard	G	-5 to 50	<45	50
Nitric Oxide	NO	Standard	G	-40 to 50	<10	50
Nitrogen Dioxide	NO_2	Standard	G	-5 to 50	<10	10
Oxygen	O	Standard	G	-10 to 50	<15	25%
Ozone	O_3	Standard	G	-40 to 50	<20	1
Ozone	O_3	Rock Solid	L	10 to 50	<20	1
Ozone	O_3	Rock Solid*	H	-40 to 50	<20	1
Phosphine	PH_3	Rock Solid	L	10 to 40	<45	500
Silane	SiH_4	Standard	G	-25 to 50	<20	5
Silicon Tetrafluoride	SiF_4	Rock Solid	L	-40 to 50	<45	5
Sulfur Dioxide	SO_2	Standard	H	-40 to 50	<20	50
Sulfur Dioxide	SO_2	Rock Solid	L	-40 to 50	<20	10
Sulfur Dioxide	SO_2	Rock Solid*	H	-40 to 50	<20	10
Tetraethyl Orthosilicate (TEOS)	$Si(OC_2H_5)_4$	Standard	G	-40 to 50	<60	50
Tungsten Hexafluoride	WF_6	Rock Solid	G	-40 to 50	<45	1

* Denotes the most common sensor used to monitor the gas when several options are available. Sensor Type - Rock Solid sensors have extremely low noise allowing for lower alarm set points with less false alarms.

** The typical Humidity Range the sensor will be exposed to. (G) denotes General indoor or outdoor use, (H) denotes High humidity (70%RH, +/-15%RH) areas or outdoor use, (L) Low humidity (50%RH, +/-15%RH) for indoor use.

*** Sensor Response Time – Represented as T_{50}

**** Standard Full Range – This is the range of Scott's most popular sensor.

Note: Toxic (E-Chem) Sensor specifications vary from sensor to sensor. We provide a large number to select from. This list is not in-conclusive. For specific Part Numbers, please contact your Scott sales representative or Scott Health & Safety, A Division of Scott Technologies, Inc. See "Assistance" on page 114.

Appendix B

SENSOR INFORMATION

Appendix Overview

This appendix covers the following topics:

- Sensor K-Factors
- Gas Interferences

Sensor K-Factors

Table 42, Table 43 provide the K-Factors referenced to propane calibration. The factors are the typical ratios of the response to the listed gases relative to the response to propane. The values are typical, but will vary from sensor to sensor and over the lifetime of a given sensor. When a gas other than the calibration gas is detected, divide the reading by the corresponding factor to estimate the actual gas concentration. For example, propane may be detected by the device calibrated with methane.

Note the concentration in %LEL on the label of the Propane tank. Apply gas to the device and span to value derived by multiplying this number with the given K-Factor. For example, for Isobutylene, the Propane tank's label indicates 50% LEL, then you would multiply that by 1.3 to get 0.65 to span. (50% x 1.3 = 0.65)

Table 42 K-Factors for 5.5V Combustible Cat-bead Sensors

GAS/VAPOR*	P/N 40011528(SENSOR 4888-2)	P/N 40012111 (SENSOR 4888-3)
Acetaldehyde	0.9	
Acetone	1.4	1.4
Acrylonitrile	0.9	
Acetylene	1.0	
Ammonia	1.0	
Benzene	1.5	2.1
1,3-Butadiene	1.1	1.3
n-Butane	1.3	
Isobutane	1.4	
Isobutylene	1.3	
Butyl Acetate	2.4	
n-Butyl Alcohol	1.7	
Chlorobenzene	1.4	1.4
Cyclohexane	1.5	
Cyclohexanone	1.9	
Dimethylformamide	1.4	
Diethyl ether	1.5	
n-Decane	2.4	
Ethane	0.9	
Ethyl Acetate	1.4	
Ethyl Acrylate	1.7	
Ethyl Alcohol	1.2	1.8
Ethylbenzene	1.7	
Ethylene	1.0	
Ethylene Oxide	1.1	1.2

Table 42 K-Factors for 5.5V Combustible Cat-bead Sensors (continued)

GAS/VAPOR*	P/N 40011528(SENSOR 4888-2)	P/N 40012111 (SENSOR 4888-3)
Heptane	1.5	
n-Hexane	1.5	2.4
Hexane	1.3	
Isopropyl Alcohol	1.4	
Methyl Ethyl Ketone	1.4	1.8
Methyl Isobutyl Ketone	1.5	
N-Methyl 2-Pyrrolidone	1.6	No Span
Methanol	1.1	1.1
Methyl Styrene	1.1	
Mineral Spirits	2.6	
Naphta V.M. & P	1.9	
Nitropropane	1.4	
Iso-octane	1.7	2.6
n-Octene	2.4	
Octene	2.0	
Pentane	1.4	
Isopentane	1.4	
Isoprene	1.1	
Propane	1.0	
Propylene	1.2	
Styrene	1.8	2.6
Tetrahydrofuran	1.2	2.1
Toluene	1.5	2.5
Vinyl Acetate	1.3	
Vinyl Chloride	1.7	
O-Xylene	1.9	2.9
Note: K-Factors based on Propane.		

Table 43 K-Factors for 6.0V Combustible Cat-bead Sensor

GAS/VAPOR*	P/N 8000-8050
Acetone (C_3H_6O)	1.3
Acetylene (C_2H_2)	1.4
Acrylonitrile (C_3H_3N)	0.97
Ammonia	0.7
Benzene (C_6H_6)	1.5
1,3-Butadiene (C_4H_6)	1.5
Butane (C_4H_{10})	1.1
Cyclohexane (C_6H_{12})	1.5
Dichloromethane (CH_2Cl_2)	1.5
1,2 Dichloropropane ($C_3H_6Cl_2$)	1.5
Difuoromethane (CH_2F_2)	0.9
Ethane (C_2H_6)	0.8
Ethyl Alcohol (C_2H_6O)	1.1
Ethylene (C_2H_4)	0.9
Ethylene Oxide (C_2H_4O)	1.1
Heptane (C_7H_{16}), JP-4, gasoline	1.9
Hexane (C_6H_{14})	1.7
Hydrogen (H_2)	0.8
Isopropyl Alcohol (C_3H_8O)	1.5
Methane (CH_4)	0.6
Methyl Alcohol (CH_4O)	1.1
Methyl Chloride (CH_3CL)	0.7
Methylene Chloride (CH_2Cl_2)	1.5
Methyl Ethyl Ketone (C_4H_8O)	1.8
Methyl Fluoride (CH_3F)	1.1
Pentane (C_5H_{12})	1.3
Propane (C_3H_8)	1.0
Propylene (C_3H_6)	1.2
Propylene Dichloride ($C_3H_6Cl_2$)	1.5
Propylene Oxide (C_3H_6O)	1.4
Styrene (C_8H_8)	3.95
Toluene (C_7H_8)	1.7
Vinyl Chloride (C_2H_3Cl)	1.2
O-Xylene (C_8H_{10})	3.0
Note: K-Factors based on Propane.	

Gas Interferences

There are known gas interferences to a limited number of chemical compounds. Scott Health & Safety, a Division of Scott Technologies, Inc. attempts to identify possible gas interferences to which gas sensors may be exposed; however, not all chemical compounds that presently exist have been tested. Table 44, Table 45, Table 46 for Toxic (E-Chem) Sensors and Table 47, Table 48, Table 49 for Toxic (E-Chem) Rock Solid Sensors provides known toxic gas interferences.

Table 44, Table 45, Table 46, and Table 47, Table 48, Table 49 *does not show, nor should it be implied, that no additional interferences may occur. These selectivity ratios are used as guides only. they are not to be used as calibration factors. The gas species' actual cross-sensitivities may vary from the values shown.*

Table 44 Gas Interferences For Toxic (E-Chem) Sensors (1 of 3)

	INTERFERENCE GAS:	NH_3	ASH_3	BR_2	BCL_3	CO	CL_2	CLO_2	B_2H_6	CLCH:CHCL	SIH_2CL_2	SI_2H_6
Sensor Type	NH_3	1				(-.03) +.02	(1.0) -0.5					
	AsH_3	0	1			0.0004	0.003		0			0.4
	Br_2	-0.0003	-.9	1		NEG	1.1					
	BCl_3	0	0.7	0.02	1	-0.0001	0.1				1.3	
	CO	-0.01				1	-0.25					
	Cl_2	Zero		0.1		0.003	1	1.2				
	ClO_2	-.001	-3			NEG	0.3	1				
	B_2H_6		2						1			
	SiH_2Cl_2	0	0.5	0.015	0.75	-0.0001	0.075				1	
	Si_2H_6	0	2.5			.001	.0075		0			1
	F_2	-.0004	-1	1.1		NEG	1.2					
	H_2					0.1						
	HCl	Zero	2	0.06	3	-0.0004	0.05				4	
	HCN	0.004	1.9			0.001	NEG					
	HF	-0.02					2.5					
	H_2S	-0.001	Zero			0.1	(-0.02 0.1					
	CH_3OH					0.5						
	CH_3l	-.0025	Zero			0.25	(-.5) .25					
	CH_3SH	Zero	0.9	0.03	1.3	-0.0002	0.02				2	
	CH_2Cl_2									2.6		
	NO	-0.009	1.6			-0.01	0.2					

Table 44 Gas Interferences For Toxic (E-Chem) Sensors (1 of 3) (continued)

	INTERFERENCE GAS:	NH_3	ASH_3	BR_2	BCL_3	CO	CL_2	CLO_2	B_2H_6	CLCH:CHCL	SIH_2CL_2	SI_2H_6
Sensor Type	NO_2	-0.001	-5			(-0.04) +.02	0.4					
	NF_3											
	Oxidants	-0.0003	-0.8	0.9		NEG	1	3.0				
	O_3	-.0003	-.8	0.9		NEG	1.0	3.0				
	PH_3	0	0.9			.00035	.0025		0			0.35
	SiH_4	0	1.7			.0007	.005		0			0.7
	SO_2						0.035					
	TEOS					1.2						
	Trimethylsilane (3MS)		6						0			2
For each sensor type, the table shows how 1ppm of an Interference Gas appears on that specific sensor type. For example, 1ppm CO appears as less than 0.02ppm on a H_2S sensor.												

Table 45 Gas Interferences For Toxic (E-Chem) Sensors (2 of 3)

	INTERFERENCE GAS:	F_2	H_2	HCL	HCN	HF	H_2S	$(CH_3)_2CHOH$	CH_3OH	CH_3SH	CH_2CL_2	CH_3L
Sensor Type	NH_3		0.6		(0.1) -0.05	0.4	(0.3) -0.08			2.5		
	AsH_3		0.001	0.0001	0.015	-0.001	0.01			0.9		
	Br_2	0.9	0.00002	0.06	-0.06	-.004	NEG					
	BCl_3		0.0007	0.33	0.003	0.01	1					
	CO		0.5	-0.01		0.0035	0.3					
	Cl_2	0.4	0.02	<0.1	Zero	-0.001	NEG					
	ClO_2		.0001	0.2	-0.2	-0.01	NEG					
	B_2H_6											
	SiH_2Cl_2		0.0005	0.25	0.0025	0.0075	0.07					
	Si_2H_6		.0025	.00025	.038	-.0025	.025					
	F_2	1	.00002	.06	-.06	-.005	NEG					
	H_2		1				20					
	HCl		0.002	1	0.01	0.03	3			2.5		
	HCN			0.004	1	-0.001	0.02					
	HF	2	-0.0001	1	-0.15	1	-0.6					
	H_2S		0.1	0.2	0.2	-0.001	1			0.6		0.4
	CH_3OH						3	0.35	1	2		
	CH_3l		.25	.5	.5	-.0025	2.5					1
	CH_3SH		0.001	0.44	0.005	0.02	1.3			1		
	CH_2Cl_2			16							1	
	NO		-0.05	-0.04	0.25	0.045	0.01					
	NO_2		0.05	-0.1	-0.1	-0.01	-5					
	NF_3						1.7					
	Oxidants	0.8	0.00002	0.05	-0.05	-0.004	NEG					
	O_2		-.02									
	O_3	0.8	.00002	.05	-.05	-.004	NEG					
	PH_3		.001	.0001	.015	-.001	.009					
	SiH_4		.0017	.00017	.025	-.0017	.017					
	SO_2		0.002		0.2	Zero	0.8					
	TEOS						8	0.9	2.5			
	3MS											

For each sensor type, the table shows how 1ppm of an Interference Gas appears on that specific sensor type. For example, 1ppm CO appears as less than 0.02ppm on a H_2S sensor.

Table 46 Gas Interferences For Toxic (E-Chem) Sensors (3 of 3)

	INTERFERENCE GAS:	NO	NO_2	O_3	PH_3	SIH_4	SO_2	TEOS	3MS
Sensor Type	NH_3	(0.05) -0.2	-0.5	-0.5			(0.1) -0.06		
	AsH_3	(0.02) 0.008	-0.2	-0.2	1.1	0.5	0.03		0.17
	Br_2	.01	0.6	1.1	-1.0		NEG		
	BCl_3	0.02			0.23		0.013		
	CO	0.4			0.2		-0.06		
	Cl_2	0.35	0.5	0.6	Zero		-0.01		
	ClO_2	.03	2	0.3	-3		NEG		
	B_2H_6								
	SiH_2Cl_2	0.015			0.2		0.01		
	Si_2H_6	(.05) .02	-.5	-.5	2.8	1.5	.075		0.5
	F_2	.01	.6	1.2	-1.1		NEG		
	H_2	2.2							
	HCl	0.06			0.7		0.04		
	HCN	-0.01	-0.3	-0.5	4				
	HF		0.02	0.05			1.5		
	H_2S	(.6) .4	(0.2) 0.1		0.4		0.2		
	CH_3OH							0.4	
	CH_3l	(1.5) 1.0	(.5) .25		1.0		.5		
	CH_3SH	0.03			0.3		0.02		
	CH_2Cl_2								
	NO	1	0.15		2		0.05		
	NO_2	0.04	1	0.4	-5		-1.1		
	NF_3		0.08	0.02					
	Oxidants	0.01	0.5	1.0	-0.9		NEG		
	O_2			1					
	O_3	.01	.5	1	-0.9		NEG		
	PH_3	(.02)	(.02) 0.007	-.2	1	0.55	.025		0.2

Table 46 Gas Interferences For Toxic (E-Chem) Sensors (3 of 3) (continued)

	INTERFERENCE GAS:	NO	NO_2	O_3	PH_3	SIH_4	SO_2	TEOS	3MS
Sensor Type	SiH_4	(.034) .014	-.34	-.34	1.9	1	.05		0.3
	SO_2	0.04	-0.7		2		1		
	TEOS								
	3MS				6.5	3			1
For each sensor type, the table shows how 1ppm of an Interference Gas appears on that specific sensor type. For example, 1ppm CO appears as less than 0.02ppm on a H_2S sensor.									

Table 47 Gas Interferences For Toxic (E-Chem) Rock Solid Sensors (1 of 3)

	INTERFERENCE GAS:	NH_3	ASH_3	BR_2	BCL_3	BF_3	CO	CO_2	CL_2	CLO_2	B_2H_6	SIH_2CL_2	SI_2H_6
Sensor Type	AsH_3	0	1		0.01		0	0	-0.02		0.02		0.01
	BCl_3				1	0.8			2.8			2	
	BF_3				1.3	1			3.5			2.5	
	Br_2	0							1	0.4			
	Cl_2	0							1	0.4			
	ClO_2	0					0	0	0.5	1			
	B_2H_6	0	0.03						-0.3		1		0.02
	HBr				0.8	0.7			2.0			1.6	
	HCl				0.5	0.4			1.4			1	
	HCN	0	0.06						-0.6		1.9		0.04
	HF				0.7	0.5			1.9			1.3	
	O_3			0.3					0.5	0.4			
	PH_3	0	1		0.01		0	0	-0.02		0.02		0.009
	SiF_4				0.2	0.2			0.5			0.4	
	SO_2				0.5	0.4			1.1			0.9	
	WF_6				0.2	0.1			0.4			0.3	
For each sensor type, the table shows how 1ppm of an Interference Gas appears on that specific sensor type. For example, 1ppm CO appears as less than 0.02ppm on a H_2S sensor.													

Table 48 Gas Interferences For Toxic (E-Chem) Rock Solid Sensors (2 of 3)

	INTERFERENCE GAS:	F_2	GE_2H_4	H_2	HBR	HCL	HCN	HF	H_2S	L_2	$(CH_3)_2CHOH$	CH_3OH
Sensor Type	AsH_3		0.03	0	0.07	0.1	0	0.03	0.09		irr.	
	BCl_3	3.2		0	1.2	2		1.6				
	BF_3	4		0	1.5	2.5		2				
	Br_2	0.9		0		0.05			0	0.2		
	Cl_2	0.9		0		0.05			0	0.2		
	ClO_2			0		0	0		0			
	B_2H_6		0	0		0	0.5	0	1.4		0	0
	HBr	2.7		0	1	1.6		1.3				
	HCl	1.6		0	0.6	1		0.8				
	HCN		0	0		0	1	0	2.7		0	0
	HF	2		0	0.8	1.3		1				
	O_3			0		0	0					
	PH_3		0.03	0	0.06	0.1	0	0.03	0.09		irr.	
	SiF_4	0.6		0	0.6	0.4		0.3				
	SO_2	1.5		0	0.6	0.9		0.8				
	WF_6	0.5		0	0.2	0.3		0.2				

For each sensor type, the table shows how 1ppm of an Interference Gas appears on that specific sensor type. For example, 1ppm CO appears as less than 0.02ppm on a H_2S sensor.

Table 49 Gas Interferences For Toxic (E-Chem) Rock Solid Sensors (3 of 3)

	INTERFERENCE GAS:	NO	NO_2	O_3	PH_3	SIH_4	SIF_4	SO_2	WF_6
Sensor Type	AsH_3	0	-0.005		1	0.01		0	
	BCl_3						5	2	7
	BF_3						6.8	2.8	8.5
	Br_2	0.004	0.02	0.1				0.003	
	Cl_2	0.004	0.02	0.1				0.003	
	ClO_2	0.006	0.09	0.2				0	
	B_2H_6	0	-0.02		0.05	0.008			
	HBr						6.2	1.7	5.7
	HCl						2.7	1.1	3.4
	HCN	0	-0.05		0.09	0.015			
	HF						3.4	1.4	4.3
	O_3	0.003	0.1	1				0	
	PH_3	0	-0.005		1	0.01		0	
	SiF_4						1	0.4	1.3
	SO_2						2.5	1	3
	WF_6						0.8	0.3	1
For each sensor type, the table shows how 1ppm of an Interference Gas appears on that specific sensor type. For example, 1ppm CO appears as less than 0.02ppm on a H_2S sensor.									

SUPPORT

Appendix Overview

This appendix covers the following topics:

Assistance

Congratulations on your purchase of a Scott Health & Safety, a Division of Scott Technologies, Inc. product. It is designed to provide you with years of reliable trouble-free service.

- If you have technical questions or need support.
- If you are missing an item that should have shipped with the device.
- If you need to return a product.

Contact us using the options provided:

  – By E-mail: techsupport.scotths.us@tycoint.com

  – By Telephone: 1- 800-247-7257

When returning a product, contact Technical Support to obtain a Return Maintenance Authorization (RMA) number prior to shipping for service repairs using the contact options.

Parts List

Table 50 provides a parts list. Some of these items are orderable, others are not.

Table 50 Applicable Parts List

CATEGORY	ITEM	DESCRIPTION	PART NUMBER
Common		Power/ I/O PCB (Bottom PCB)	093-0498
		Display/CPU PCB (Top PCB)	093-0499
		Relays/MODBUS RS-485 Option PCB (Attaches to back of Display/CPU PCB)	093-0504
		Isolated 4-20mA Output Option PCB (Attaches to back of Display/CPU PCB)	093-0505
		14-Wire Ribbon Cable (Between S2 and S3)	093-0513
		0.5LPM Regulator	077-0018

Table 50 Applicable Parts List (continued)

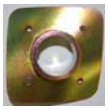
CATEGORY	ITEM	DESCRIPTION	PART NUMBER
Combustible (LEL)		Diffusion Sensor Head	096-3349
		6.0V Diffusion Detector (UL approved)	096-2932
		Filament Detector Guard	096-3363
		Weather Shield Assembly	40012041
		Duct Mount Adapter – Flat	40007994
		Duct Mount Adapter – Round (for 6” to 8” Diameter Ducts)	40007994-1
		5.5V Combustible Cat-bead Sensor	40011528
		5.5V Combustible Cat-bead Sensor – Poison Resistant	40011211

Table 50 Applicable Parts List (continued)

CATEGORY	ITEM	DESCRIPTION	PART NUMBER
Combustible (LEL) (continued)		6.0V Combustible Cat-bead Sensor	8000-8050
		4.25V e2V Combustible Cat-bead Sensor	093-0524
		4.25V IR Methane Combustible Sensor	093-0500
		4.25V IR Propane Combustible Sensor	093-0515
		4.25V IR CO_2 Combustible Sensor	093-0536
		Combustible Head Assembly (ATEX approved)	096-3376
		Outer Flame Arrestor (ATEX)	073-0336
		Splash Guard (ATEX) Black Nylon Only	074-0515
		Flame Arrestor Guard (ATEX)	073-0332

Table 50 Applicable Parts List (continued)

CATEGORY	ITEM	DESCRIPTION	PART NUMBER
Combustible (LEL) (continued)		Outer Guard Assembly (ATEX)	096-3379-01
		O-Ring, EPDM 3/16”IDx7/16” W (ATEX)	009-0052
		Remote Sensor Junction Box (ClassI, Groups A, B, C, D), (Cat-bead & IR)	40012040
		Test Socket Adapter Measures the output voltage received at the sensor (6.0V Cat-bead Only) installed in a remote location.	096-3345
		Test Socket Adapter Measures the output voltage received at the sensor (4.25V IR, 4.25V and 5.5V Cat-bead) installed in a remote location.	096-3369
		Calibration Adapter For Combustible (LEL) Calibrations only. (Cat-bead & IR)	096-3242

Table 50 Applicable Parts List (continued)

CATEGORY	ITEM	DESCRIPTION	PART NUMBER
Toxic (E-Chem)		Duct Mount Adapter – Flat	096-2118-F
		Duct Mount Adapter – Round (for 6” to 8” Diameter Ducts)	096-2118-6/8
		Duct Mount Adapter – Sensor Housing 6’	096-2149
		Thread Adaptor	096-0328
		1/4 Turn Sensor End Cap Assembly	096-2105
		Rock Solid 1/4 Turn Sensor End Cap Assembly (Longer)	096-2273
		Remote Sensor Junction Box (With PCB for Toxic Sensor Head Connection)	096-2794
		Calibration Adapter For Toxic (E-Chem) Calibration only. Delivers calibration gas directly to the sensor face without dilution from environmental interferences such as wind. Barb fitting provided for tube connection to the calibration gas source (gas cylinder, permeation device or generator).	096-2101

Table 50 Applicable Parts List (continued)

CATEGORY	ITEM	DESCRIPTION	PART NUMBER
Toxic (E-Chem) (continued)		1/4 Turn Rain Shield Provides protection from wet weather and hose-downs. Teflon© construction permits use with both reactive (such as Hydrogen Fluoride, Hydrogen Chloride and Ammonia) and non-reactive gases. Lab tested hole geometry protects sensors from stray water droplets.	074-0305
		1/4 Turn Flowcell Assembly Used in sample draw configurations. The Teflon baffle prolongs sensor life by reducing air velocity past the sensor face.	096-2102
		Sensor Head (ClassI, Division2) with Window	096-2466
		Condensing Humidity Sensor Housing without Window	096-3197
		Elastomeric Connector This gray foam-like pad provides an electrical pathway between the sensor and the sensor housing.	093-0097

Table 50 Applicable Parts List (continued)

CATEGORY	ITEM	DESCRIPTION	PART NUMBER
Toxic (E-Chem) (continued)		Toxic (E-Chem) Sensors	We offer a very large selection of Toxic (E-Chem) Sensor. For specific Part Numbers, please contact your Scott sales representative or Scott Health & Safety, A Division of Scott Technologies, Inc. See “Assistance” on page 114.
		Generic (Toxic) Calibration Kit (Includes Carrying Case, 0.5LPM Regulator, 3/16” ID Tygon Tubing and 1/4” Turn Cal Adapter) Note; Does not include any Gas Cylinders. That must be determined at time of order.	096-2748
		Toxic (E-Chem) Daughter Board (Mounts on the Power/ I/O PCB)	096-3354
		2 Screws for Toxic (E-Chem) Daughter Board	076-0204
Note: For calibration equipment, contact your Scott sales representative. Note: When placing an order for Toxic (E-Chem) Sensors, please specify Part Number to ensure compatibility.			

Warranty Statement

Scott Health & Safety (SCOTT), a division of Scott Technologies Inc. warrants the Freedom® 6000 TOXIC AND COMBUSTIBLE GAS DETECTOR (THE PRODUCTS) to be free from defects in workmanship and materials for a period of two (2) years from the date of original manufacture by SCOTT.

This warranty applies to all components of THE PRODUCTS supplied at the time of original sale of THE PRODUCTS, EXCEPT pump and consumable filters. SCOTT warrants pump supplied with THE PRODUCTS to be free from defects in workmanship and materials for one (1) year from the date of original manufacture by SCOTT.

SCOTT's obligation under this warranty is limited to replacing or repairing (at SCOTT's option) THE PRODUCTS or components shown to be defective in either workmanship or materials.

Only personnel of SCOTT or, when directed by SCOTT, authorized SCOTT agents are permitted to perform warranty obligations. This warranty does not apply to defects or damage caused by any repairs of or alterations to THE PRODUCTS made by owner or any third party unless expressly permitted by SCOTT product manuals or by written authorization from SCOTT.

To obtain performance under this warranty, and as a condition precedent to any duty of SCOTT, the purchaser must return such products to SCOTT, a SCOTT authorized distributor or a SCOTT authorized service center. See “Assistance” on page 114.

This warranty does not apply to any malfunction of or damage to THE PRODUCTS resulting from accident, alteration, misuse, or abuse.

THIS WARRANTY IS MADE IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIEDINCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. IN ADDITION, SCOTT EXPRESSLY DISCLAIMS ANY LIABILITY FOR SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES IN ANY WAY CONNECTED WITH THE SALE OR USE OF SCOTT PRODUCTS, AND NO OTHER FIRM OR PERSON IS AUTHORIZED TO ASSUME ANY SUCH LIABILITY.

Product Information

For general information on our products, refer to our Web site:

- http://www.scotthealthsafety.com/

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