

SGOES Infrared Hydrocarbon Gas Detector Operating Manual

820-0006



ESP SAFETY INC

Technology of the Future...Protection for today

SGOES Infrared Hydrocarbon Gas Detector Operating Manual 820-0006

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It is important that this entire manual be thoroughly read and understood prior to installing or operating the SGOES. Any deviation from this manual may impair system performance and compromise safety.

1.0 Introduction

Product Overview

The SGOES is a combustible gas detector that measures the concentration of hydrocarbon gases present in the monitored environment. The SGOES is configured to report alarms when the gas concentrations in the environment reach two independently programmable levels, expressed as a percentage of the lower explosive limit (LEL) in air. As determined by application requirements, the SGOES is factory calibrated with one of eight hydrocarbon-based gases (typically methane or propane). Conversion factors are used to correct for gases other than the factory calibration gas.

Moreover, SGOES is not sensitive to inadvertent detection of gases, such as nitrogen, oxygen, carbonic acid, ammonia, and hydrogen sulfide. This makes the SGOES an excellent choice for environments where non-hydrocarbon gases are present and precise monitoring of combustible hydrocarbons like methane and propane is required.

Key Features

- Fast response time ($T_{90} \leq 2\text{sec}$ @ 100% LEL methane)
- Broadest operating temperature of detectors in its class (-60°C to 125°C / -76°F to 257°F w optional Extended Temperature package)
- No significant zero drift
- High-performance weather protective cover eliminates water ingress of the gas detection chamber, a common cause of false alarms with most IR detectors
- Simple, non-intrusive zero and span calibration
- Can be used in conjunction with ESPs SSS-903 or VECTOR Field Control Units to provide local display of gas readings, alarm levels and device status.

ESP Safety, Inc. Contact Information

Contact ESP Safety for application assistance or order placement.

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Our Mission

ESP Safety, Inc.'s mission is to provide complete turn-key protection solutions beginning with the design stage, through system installation and commissioning, and on-going field service in hazardous environments. Our line of industry-leading products, services, and systems benefits society, saves lives, and preserves capital resources.

Principles of Operation

Operation is based on selective signal disruption by hydrocarbon molecules. An infrared light source is reflected to a set of optical detectors that simultaneously monitors the infrared power at multiple wavelengths of the infrared spectrum. If no gas is present, the photodetectors will receive all of the power radiated by the IR source. When gas molecules enter the collection chamber the gas selectively absorbs infrared energy at wavelengths specific to the gas. As a result the detector monitoring the wavelength specific to the gas records a drop in infrared signal, and the signal from the detector monitoring a wavelength unaffected by the gas does not change. The ratio of the photodetector signals, when properly calibrated, provides a quantitative measurement of the target gas concentration.

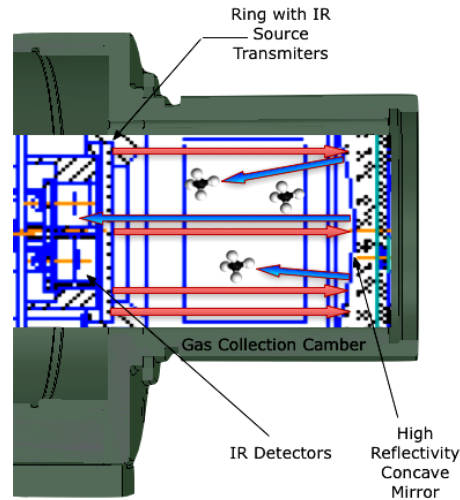


Figure 1-1: Hydrocarbon Gas Detection

SGOES Components

- A. Explosion proof housing
- B. Conduit entry for Field Wiring (3/4" NPT), x2
- C. Tri-color LED Status Indicator
- D. HART communication port (3/4" NPT), x1
- E. Gas detection chamber
- F. Integral mounting lugs
- G. Magnetic Calibration Point

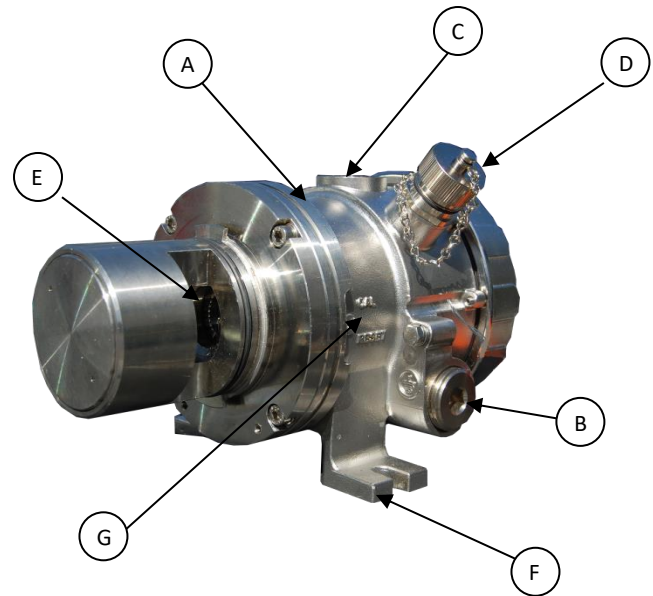


Figure 1-2: SGOES Components

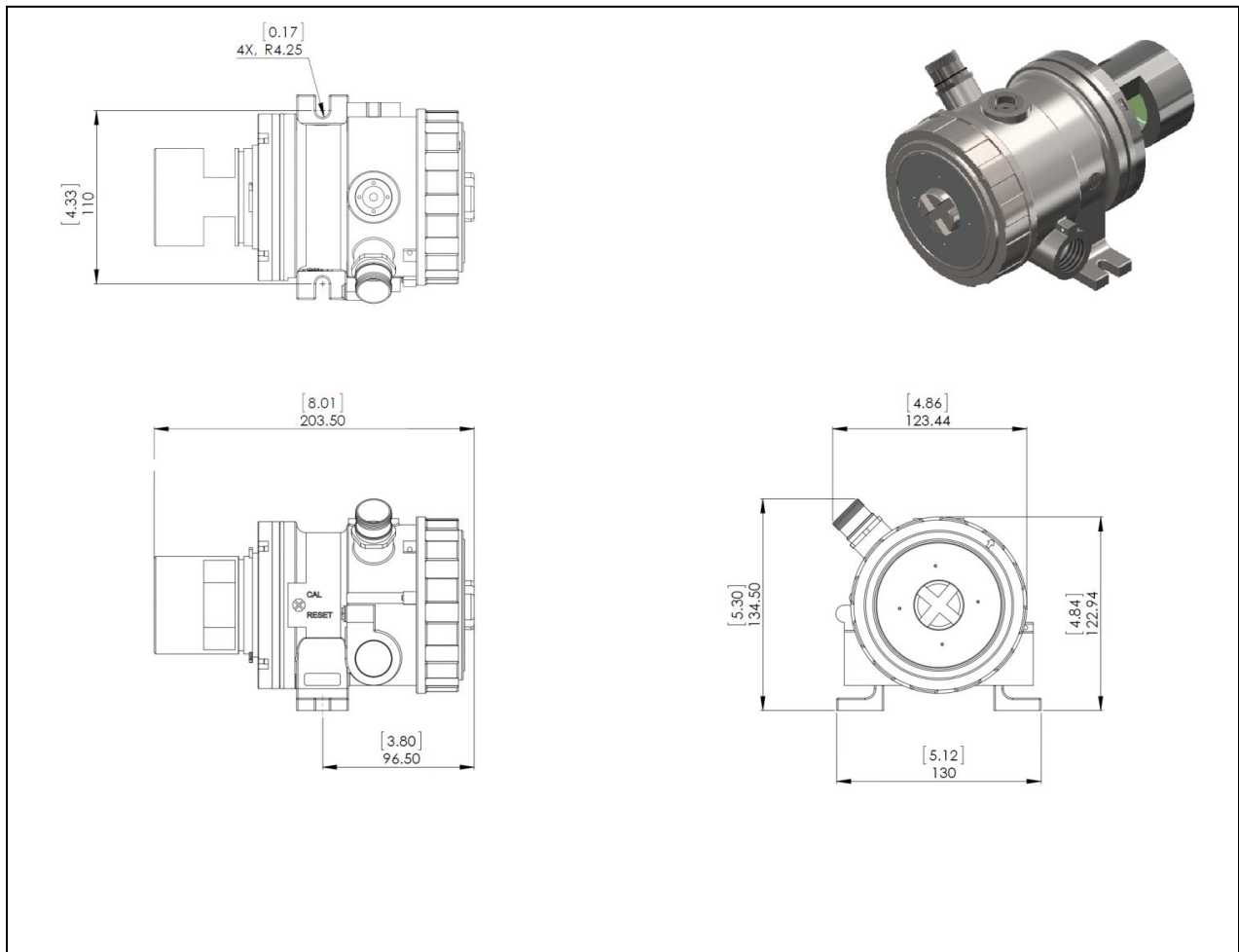


Figure 1-3: SGOES Dimensions

2.0 Specifications and Technical Data







Mechanical Characteristics	
Material	Stainless Steel (Type 316)
Conduit Connection	¾" NPT 2 connections for Field Wiring 1 connection for HART/USB
Dimensions	8.01" x 5.30" x 5.12" (203.5mm x 134.50mm x 130mm)
Weight (no sensors)	14.33lb (6.5 kg)
Optics Protection	Weatherproof Cover
Electrical Characteristics	
Input Voltage	+24VDC Nominal (+18 to 32VDC)
Power Consumption	7.9W Maximum
Output From SGOES	+4-20mA industry standard analog with embedded HART Digital RS-485 MODBUS RTU HART interface with easy access dedicated connector 3 "Dry Contact" relays. Fault relay (NC/Form-B), alarm level 1 (NO/Form-A), alarm level 2 (NO/Form-A). All Relays Contact Rating 1Amp@125VAC/30VDC
Alarm Relays	2 User Programmed Alarm Relays (factory default setting: NO) 1 Fault Condition Programmed Relay (factory default setting: NC)
Operational Characteristics	
Gases detected	Methane, Propane, Butane, Pentane, Hexane, Isobutane, Cyclopentane, Ethanol. (The target gas is factory configured according to customer request.)
Gas Detection Range	0-100% LEL
Accuracy	± 2% of the full-scale gas concentration
Response Time (for 100% LEL methane)	50% full scale < 1.5 seconds 90% full scale < 2.0 seconds
Humidity Range	Up to 95% RH, non-condensing (Withstands up to 100% RH for short periods)
Warm-up time	10 minutes
Operating Temperature	-40° F to + 167° F (-40°C to +75°C), Extended Range -76° F to + 257° F (-60°C to +125°C)
Ingress Protection	IP66
RFI/EMI Protection	EN50081-1 / Class B E> 50270 *Operates with no interference from a 5 watt walkie-talkie keyed (transmitting) at 1 meter
Status Indication	Tri-color status LED indicates operational mode, fault, and gas presence.
Displayed information when used w/ Field Control Unit (SSS-903 or Vector)	Continuous sensor data Gas Type Measuring Units Three Fixed Alarm Thresholds Graphic display of trending data for Peak Readings and Time-Weighted Average (TWA) of gas concentration 3-30 minutes

Ordering Guide

For simplicity of ordering, the SGOES is factory configured for detection specific gases. For gases not included in the table below, please contact ESP Safety.

SGOES Model to Order	Detected Hydrocarbon	Scale Range		
		%LEL	%vol IEC6007920-2000/BSEN617791:2000	%vol ISO 10156
100-0001-M11-C1	Methane	0 to 100	0 to 4.4	0 to 5.0
100-0001-M11-C2	Propane	0 to 100	0 to 1.7	0 to 2.1
100-0001-05	Butane	0 to 50	0 to 0.7	0 to 0.9
100-0001-07	Isobutane	0 to 50	0 to 0.65	0 to 0.9
100-0001-09	Pentane	0 to 50	0 to 0.7	0 to 0.75
100-0001-11	Cyclopentane	0 to 50	0 to 0.7	0 to 0.75
100-0001-13	Hexane	0 to 50	0 to 0.5	0 to 0.55
100-0001-15	Propylene/Propene	0 to 50	0 to 0.1	0 to 1.5
100-0001-17	Methanol Vapor	0 to 50	0 to 2.75	0 to 3.65
100-0001-19	Ethanol Vapor	0 to 25 0 to 50	0 to 0.78 0 to 1.55	0 to 1.08 0 to 2.15

Certifications and Compliance

 <p>FM: APPROVED</p>	<p>Explosion-proof for Class 1, Div.1, Group B, C, D (T4) Hazardous (classified) locations per FM 3615, 6310 Dust ignition-proof for Class II, Div.1, Group E, F, G Hazardous (classified) locations per FM 3615, 6310 Non-incendiary for Class 1, Div.2, Group A, B, C, D (T4), Class 2, Div.2, Group E, F, G (T4) Hazardous (classified) locations per FM 3611 Performance verified up to 100% LEL methane-in-air atmosphere per FM 6320</p>
 <p>CSA:</p>	<p>Explosion-proof for Class 1, Div.1, Group B, C, D (T4) Hazardous (classified) locations per CSA C 22.2 # 30 and Ex d IIC T4 per CSA E 60079-0-1 Dust ignition-proof for Class II, Div.1, Group E, F, G Hazardous (classified) locations per CSA C 22.2 # 25 Non-incendiary for Class 1, Div.2, Group A, B, C, D (T4), Class 2, Div.2, Group E, F, G (T4) Hazardous (classified) locations per CSA C 22.2 # 213 Performance verified up to 100% LEL methane-in-air atmosphere per CSA C 22.2 # 152</p>
 <p>ATEX: 94/9/EC</p>	 <p>CE 0539 II 2 G Ex d[ia] IIC T4 (Tamb 75°C) IP 66</p>
 <p>IECEx:</p>	<p>Ex d [ia] IIC T4 (Tamb 75°C) IP 66</p>
 <p>ГОСТ P:</p>	<p>1 Ex d [ia] IIC T4 X T= -60°C....75°C IP 66</p>
<p>EN Standards</p>	<p>EN 60079-0: 2006 EN 60079-1: 2007 EN 61779-1: 2000 EN 60529: 1991+A1: 2000 EN 50270: 2006.</p>

Protective Weather Cover

The protective weather cover is UV resistant, static-dissipating black plastic. It is designed with internal baffles and hydrophobic filters to eliminate water ingress into the detection chamber without limiting the flow of gases and vapors.

A separate calibration cup is supplied for use during zero and span calibration of the SGOES.

Internal Optics Heater

The SGOES is designed with a heating system that eliminates moisture, condensation and frost from the detector lens.

3.0 Safety Considerations**Guidelines**

Before installing and operating the SGOES, be sure to read this entire manual. Failure to follow these guidelines could result in impaired product performance and safety hazards.

For maximum safety:

- SGOES wiring should comply with all governing electrical codes, standards and regulations.
- Never operate the SGOES if the casing is damaged.
- Do not open the SGOES case when the unit is energized.
- Perform regular testing and maintenance as outlined in the Maintenance section.
- Ensure that alarm notification and control systems associated with the SGOES and its detectors are switched off before any testing or maintenance to avoid unwanted operation of alarms and control equipment.

Also see the individual sections in this manual for relevant specific safety guidelines.

Explosion Protection Means

The SGOES is designed to be explosion-proof. Any user modifications to the device will invalidate the explosion proof / flame proof certifications. All labeling must be intact and visible. All Surfaces that are subject to disassembly or removal during installation or maintenance must be installed as detailed in Appendix I and comply with the relevant NEC, IEC and/or ATEX standards when replaced.

Hazardous location safety is ensured by:

- Cabling entering into and out of the SGOES must utilize connections certified for the hazardous location where the SGOES unit is installed. The cable gland should be able to withstand the pressure of an explosion and prevent the spread of combustion into the hazardous area. The connection points are marked in the drawings with word "Explosion" and indicate permissible values. Limit the ambient temperature to no higher than 85 °C.
- Use only with combustible gases with auto-ignition temperatures of 135 °C or higher.
- All the bolts securing the parts and enclosure must be sufficiently tightened and prevented from loosening by using spring washers or lock nuts.

4.0 Installation

Component Parts and Delivery Set

The SGOES parts and delivery set consists of the following:

- One SGOES infrared combustible gas detector
- One Protective Weather Cover
- One SGOES Operating Manual
- Accessory Kit (bolts, nuts, washers, etc.).
- Calibration Magnet (magnetic wand), P/N 611-0005

Compare the contents of the set to the packing list to be sure all items were received. If any items are missing, contact ESP Safety Inc.

Visual Examination

Before installing the SGOES, examine the unit to ensure that:

- The nameplates and warning labels are in place.
- The external surfaces and joined surfaces of the SGOES casing are free of dents or damage.
- Make sure all removable parts are joined to the casing as tightly as possible.

Guidelines for locating the SGOES

There are no standard rules for selection and placement of sensors since the optimum sensor choice location is unique for each application. Before installing the SGOES, check the conditions at the installation site to make a placement determination.

The following guidelines can assist in determining the best possible placement of the SGOES:

- Locate the SGOES detectors near potential gas leak sources and away from excessive heat, light, wind, dust, water, vibration, shock, and radio frequency interference (RFI).
- Ensure the installation location has sufficient space to accommodate the SGOES housing and all necessary cabling.
- Mount the SGOES detector pointing horizontally

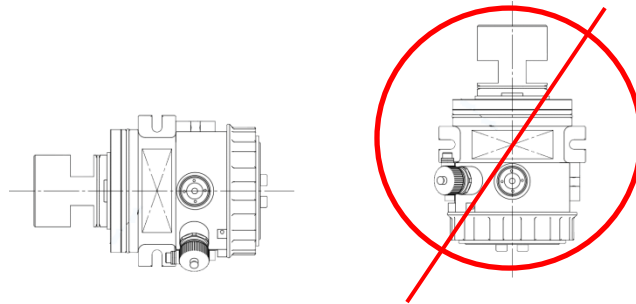
Preparing For Installation

- Before installation, evaluate the gas leak locations and other conditions such as wind or air currents at the test site and configure the unit for that particular need. Also, be sure to consult local installation codes.

Selection of gas sensor location is critical to the overall performance of the SGOES. Five factors play an important role in the selection of sensor locations:

- Density of the gas to be detected
- Most probable leak sources within the industrial process
- Ventilation and prevailing wind conditions
- Personnel exposure
- Maintenance access

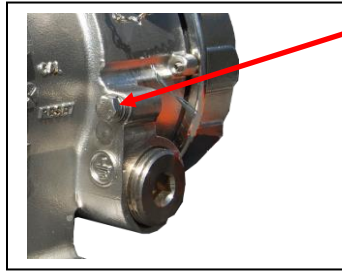
Density of Detected Gas	If the target gas is heavier than air, the sensor should be located within 4 feet of grade. Heavier than air gases will tend to settle in low-lying areas. For gases lighter than air, sensor placement should be 4-8 feet above grade in open areas or in pitched areas of enclosed spaces.
Probable Leak Sources	Leak sources include flanges, valves, tubing and connections of the sealed type where seals may either fail or wear. All potential leak sources and SGOES mounting locations are best determined by facility engineers with experience in similar processes.
Ventilation & Prevailing Winds	Normal ventilation or prevailing wind must be considered for locating SGOES detectors.
Personnel Exposure	Consideration should be given to placement of detectors in areas where personnel may be exposed. Account for ventilation, wind direction and potential gas cloud size when determining the number and location of gas detectors.
Maintenance Access	Consideration should be given to providing easy access for maintenance personnel. SGOES location should also take into account the proximity to contaminants that may foul or obscure the SGOES optics.
Tools Required for Mounting	<ul style="list-style-type: none">• 2.5-MM "Flat Head" screwdriver for protective cover lock screw and wire terminal block clamps• 5/16 wrench for Ground Connector• Allen wrench set• Ferrule crimper (up to 12ga)
Mounting	The SGOES must be mounted such that it is oriented at a horizontal plane.

**FIGURE 4-1: REMOTE CONFIGURATION**

Earth Grounding

The enclosure of the SGOES Field Control Unit must be earth grounded for electrical safety and to limit the effects of radio frequency interference. An earth/ground point is provided on the outside of the VECTOR Field Control Unit Explosion Proof enclosure.

The SGOES must be earth grounded in order to operate properly. The grounding lug is located on the SGOES housing below the HART port.



Ground Point

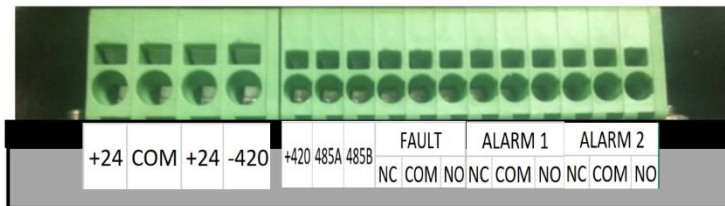
Figure 4-2: Ground Point

General Wiring Requirements

Caution: All cable/conduit entries must be sealed with an appropriate and certified sealing plug and cable gland. The use of industrial grade, armored field cable is recommended. If installing the sensor in a hazardous area using remote configuration, armored cabling is required for the detector connection to the SGOES.

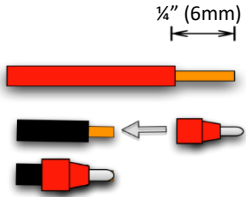
- If installing connection cables in an explosion proof conduit, do not use the same conduit to carry wiring for any other purpose or equipment.
- If installing the SGOES in a hazardous area, armored cabling is required for the connections to the SGOES
- Minimum 14 AWG (2.08 mm²) shielded cable conductors are required for optimal performance.
- When using Modbus, twisted pair wiring is required for both the power and signal wires. Each pair must be shielded to eliminate electromagnetic interference.


For reliable communications between the SGOES and the Host master, connect the Host RS-485 common or signal ground to the SGOES RS-485 common terminal. This is especially important when connecting to an isolated RS-485 port. Failure to do so could result in communications failures and possible damage to either the Host or SGOES RS-485 transceivers.

**Terminal No Label Description**

- 1 +24V DC (DC power input)
- 2 0V System Ground
- 3 +24V DC (DC power input)
- 4 0V System Ground (common) -4-20mA
- 5 420 +4-20mA (current output signal)
- 6 485A RS-485 A (Modbus RTU output signal)
- 7 485B RS-485 B (Modbus RTU output signal)
- 8 FLT Fault alarm relay, pin 1(NORMALLY CLOSED when energized)
- 9 FLT Fault alarm relay, pin 2 (COMMON)
- 10 FLT Fault alarm relay, pin 3 (NORMALLY OPEN when energized)
- 11 A1 Alarm Relay 1, pin 1 (NORMALLY CLOSED)
- 12 A1 Alarm Relay 1, pin 2 (COMMON)
- 13 A1 Alarm Relay 1, pin 3 (NORMALLY OPEN)
- 14 A2 Alarm Relay 2, pin 1 (NORMALLY CLOSED)
- 15 A2 Alarm Relay 2, pin 2 (COMMON)
- 16 A2 Alarm Relay 2, pin 3 (NORMALLY OPEN)

<p>Step 1- Remove Conduit Plug</p> <p>Using the supplied M16 hex wrench, loosen and remove one of the threaded conduit plugs</p> 	<p>Step 2- Remove the rear cover</p> 	<p>Step 3- Attach conduit gland (user supplied) to 3/4" threaded opening on detector body. Adapt as necessary to user's conduit size, using standard industry practices.</p> 
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<p>Step 4- Wire Preparation</p> <p>Figure 4-6: Wire Prep</p>	<p>Use a stripping tool for the selected wire gauge to remove ¼-inch (6mm) of the insulating jacket for each conductor to be inserted in the terminal blocks of the Connector PCBA.</p>  <p>Shielded 14 or 16 AWG Stranded wire (Recommended) based on cable length</p> <p>6mm Insulated Crimp On Ferrule</p> <p>ESP safety recommends a ferrule that is crimped onto the wire for better connectivity and ease of insertion into the terminal block.</p>
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Caution: All cable/conduit entries must be sealed with an appropriate and certified sealing plug and cable gland. The use of industrial grade, armored field cable is recommended. If installing the SGOES in a hazardous area, armored cabling is required.

Power up and Stand Alone Operation of SGOES

Installation Review Prior to Startup



Once the mounting, cabling, and alarm relay installation has been completed, the SGOES is ready to begin the power-on sequence.

Before applying power to the system for the first time, review the steps below:

- Verify that the SGOES has been properly mounted.
- Verify that all conduit / cable gland entries have been tightened and sealed if necessary.
- Verify that all wiring has been installed correctly.
- Verify that the enclosure has been connected to an earth/ground.
- If using a SGOES in conjunction with a Field Control Unit such as the SSS-903 or VECTOR, verify that the connections between the SGOES and the Field Control Unit is secure and functional.
- Verify that the SGOES cover is securely installed and locked with the housing cover lock screw.
- Disconnect or power down all output devices and alarms to prevent false actuation.

Once you are ready to begin startup, verify that the power supply is connected properly and verify the power supply voltage with the SGOES is disconnected at the source. The SGOES is powered by 24 VDC (18 to 32 VDC voltage range).

After completing the above, the VECTOR is ready to be powered on.

<p>Startup Procedure</p> <p>Apply power to the system. Upon first power-up, the tri-color status LED will flash green indicating a self-test is being performed.</p>	
<p>After 40-60 seconds, the self-test initialization sequence will be completed, indicated by a solid green status light.</p> <p>At this time, the unit will be in the normal operational state.</p> <p>Allow the SGOES to warm up for 10 minutes prior to functional testing of the unit.</p>	

5.0 Calibration Procedures

The SGOES may be calibrated by one of three methods:

- magnetic wand
- A Windows-based PC using ESP Commander software and the Modbus RTU interface
- HART Communicator

The analog output loops may be calibrated by using a HART communicator

The term SPAN GAS in these calibration procedures refers to a *Full Scale* gas mixture.

The term MID-SPAN GAS in these calibration procedures refers to a gas mixture of intermediate concentration between zero and full scale.

SGOES Calibration using ESP Commander The example shown below is for an SGOES configured for propane.

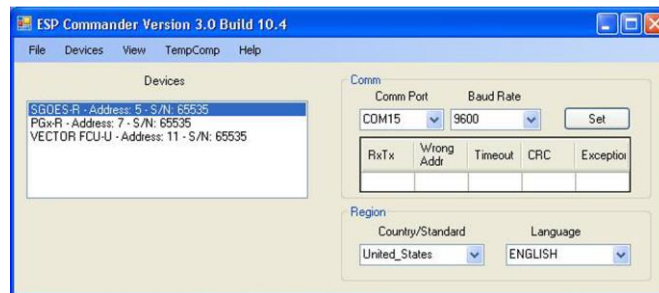


Figure 5-1: Main ESP Commander Form

On the *Devices* list of the main ESP Commander form, double click on the sensor to be calibrated (in this case, the SGOES). This will open the form for the selected sensor.

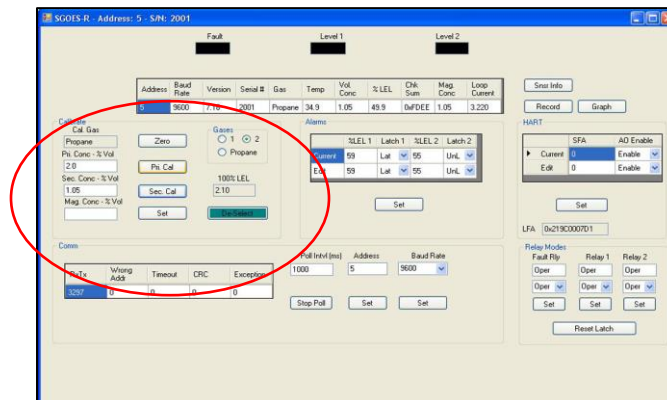


Figure 5-2: SGOES Form

Note the calibrate panel in the upper left quadrant of the form.

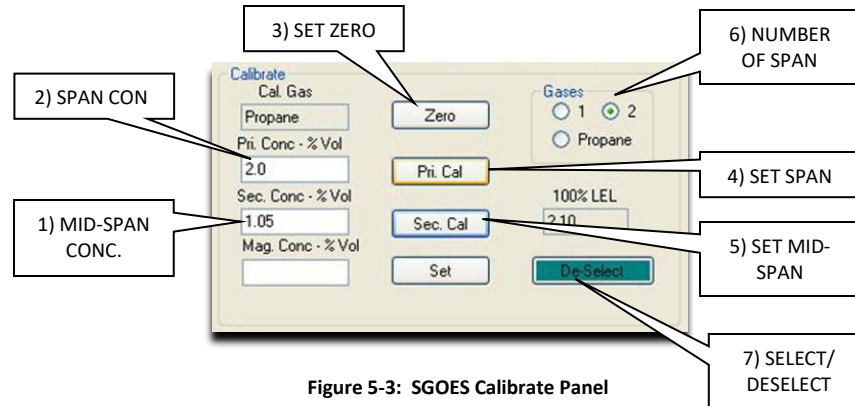


Figure 5-3: SGOES Calibrate Panel

Step 1

Press the (7) Select/DeSelect button to start the calibration sequence. The button will change color to show that the calibration mode is active.

Step 3

Select the (6) Number of Span Gases to be used for calibration using the radio buttons.

Step 5

Apply span gas to the sensor. When the gas concentration stabilizes, press the (4) Set Span button to set the sensor span calibration point.

Step 7

If a two span gas calibration was selected, apply the mid-span gas to the sensor. When the gas concentration stabilizes, press the (5) Set Mid-Span button to set the sensor mid-span calibration point

Step 2

Attach a zero gas to the sensor. When the gas concentration stabilizes, press the (3) Set Zero button to set the sensor zero point.

Step 4

Enter the Span Gas concentration in the units shown in the (2) Span Conc. box.

Step 6

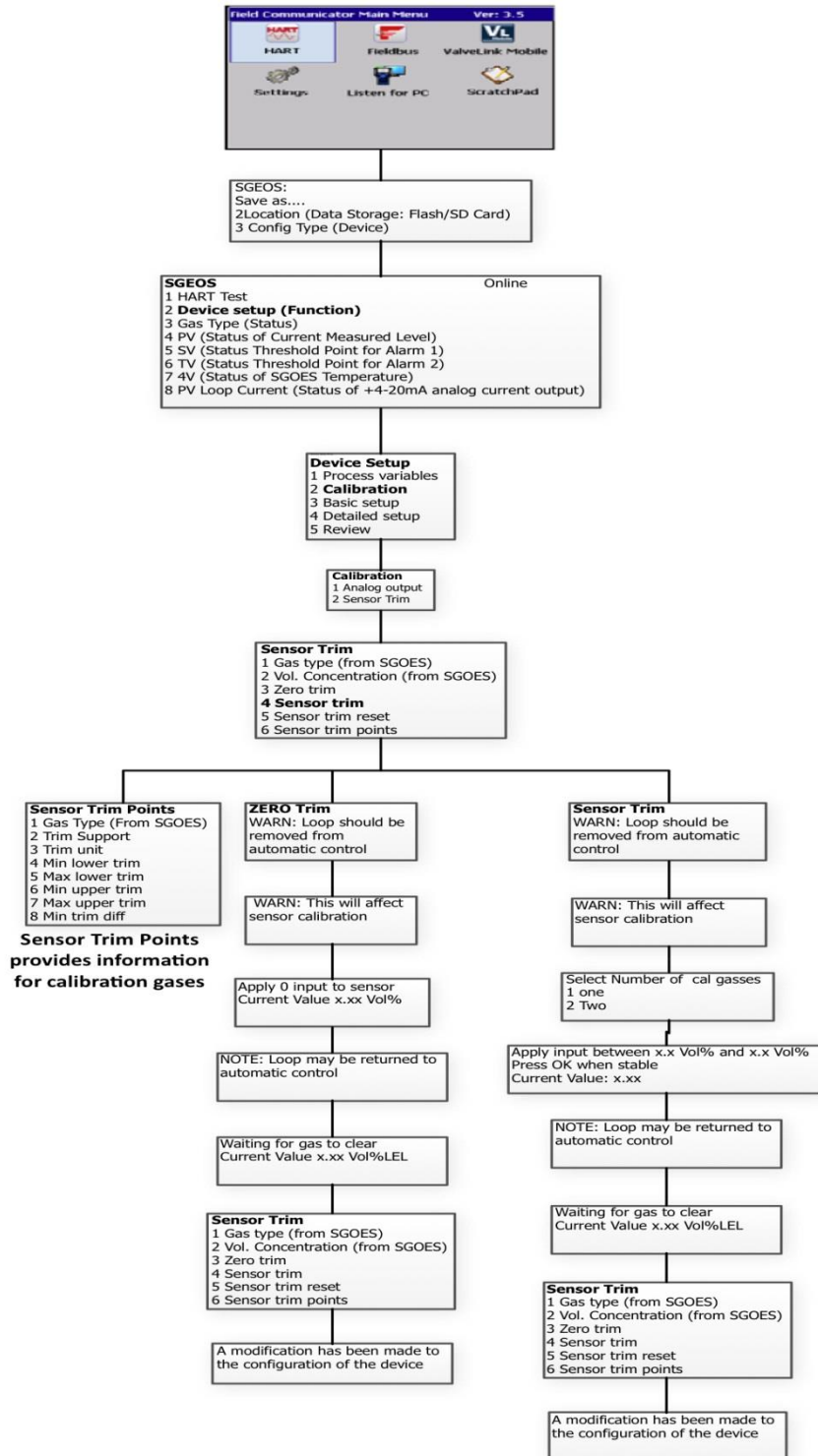
If a two span gas calibration was selected, enter the Mid-Span Gas concentration in the units shown in the (1) Mid-Span Conc. box.

Step 8

Remove the calibration gas and allow the sensor gas concentration to return to zero. When the concentration has returned to zero, press the (7) Select/DeSelect button to end the calibration sequence

**SGOES Calibration using a
HART Communicator**




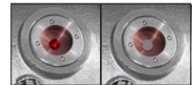

The following table shows the display menu tree for HART calibration of the SGOES





Menu Tree for SGOES HART Device Descriptor

SGOES Calibration using Magnetic Wand

Magnetic field calibration can only be performed with the same calibration gas (type and concentration) used to establish the factory settings for the detector. Standard gases used to establish factory setting for the SGOES detectors are methane and propane. Prior to magnetic field calibration, determine the proper calibration gas and concentration.

<p>Required Equipment for Magnetic Wand Calibration</p> <ul style="list-style-type: none"> • ¼" Clear Tubing • ESP Safety zero gas and span gas • ESP Safety magnetic wand • Regulator • Flowmeter • Calibration Cup 	 <p>Span Gas Zero Gas</p> <p>Figure 5-1: Equipment for Magnetic Wand Calibration</p>
<p>Step 1: Replace the standard weatherproof protective cover with the calibration cup. Secure one end of the flexible tubing to the calibration cup and the other to the ZERO gas canister.</p>	
<p>Step 2: Apply the ESP supplied magnetic calibration wand to the ESP Safety logo on the detector housing until the LED status light appears FLASHING GREEN. This indicates that the detector is in calibration mode and that all output signals are blocked. Remove calibration wand. Open the valve and apply the zero gas at a rate no more than 0.5 l/min. Apply gas for a minimum of 1 minute.</p>	
<p>Step 3: Apply the magnetic wand to the ESP logo. The LED status light will appear FLASHING RED. This indicates that zero calibration is completed. Close zero gas valve. Remove calibration wand.</p>	
<p>Step 4: Replace ZERO gas with CALIBRATION GAS (span gas). Open valve and apply the calibration gas for 2 MINUTES at a rate of no more than 0.5 l/min. Apply the magnetic wand to the ESP logo. The LED status light will appear SOLID RED. This indicates that span calibration is completed. Close calibration gas valve. Remove calibration wand.</p>	

<p>Step 5: Remove the calibration cup from the SGOES detector. After approximately 1 minute, the status LED light will appear FLASHING GREEN</p>	
<p>Step 6: Apply the magnetic wand to the ESP logo and remove.</p> <p>The LED status light will appear SOLID GREEN. This indicates that the SGOES detector is now in operational mode and that the output signals are enabled. Replace the weatherproof protective cover on the detector.</p>	

6.0 Troubleshooting

Table 6.1—Troubleshooting Guide - Display Faults

Fault Condition	Description	Solution
No Status LED	No power supply	Detach the base with the cable entry from the SGOES enclosure and make sure that the terminals are supplied with a voltage of 24 ± 6 VDC.
Constant fault alarm	The space between the receiver and the mirror is blocked or dirty	Turn off the power and clean the optical components with alcohol and a scratch resistant cloth or chamois
Constant GAS alarm when there are no gas in the air	Calibration error	Perform calibration procedure



The SGOES does not contain any user-serviceable parts. Any repair of the SGOES should be performed by ESP Safety personnel. Any attempt to repair or service the SGOES by unauthorized personnel will void the product warranty.

7.0 Maintenance



Before testing, be sure to switch off all output loads normally activated by the gas detection system. This prevents inappropriate activation.

Periodic Maintenance

This section describes maintenance activities to be performed on the SGOES

- Visual examination
- Cleaning
- Checking the grounding and explosion-protection systems
- Performance test.

Maintenance Activities

The SGOES needs very little routine maintenance; but periodic checks for proper system function and calibration are strongly advised. The frequency of these checks should be determined by the specific installation.

Although the fault-detection circuitry continuously monitors for various problems, it does not monitor external response equipment or wiring. These devices must be checked periodically in the Normal mode to ensure proper functioning.

8.0 Warranties

ESP Safety, Inc. ("ESP") warrants the SGOES to be free from defects in material and workmanship under normal use and service for a period of five (5) years, beginning on the date of shipment to the buyer. This warranty extends only to the sale of new and unused products to the original buyer. ESP's warranty obligation is limited, at ESP's option, to refund of the purchase price, repair, or replacement of a defective product or a component thereof, to the extent that the product is properly returned to ESP within the warranty period.

This warranty does not include:

- a) fuses, disposable batteries or the routine replacement of parts due to the normal wear and tear of the product arising from use;
- b) any product or component which in ESP's opinion, has been misused, altered, abused, tampered with, improperly maintained or used, neglected or otherwise damaged by accident or abnormal conditions of operation, handling or use, or to have deteriorated due to aging of any component made of rubber or any other elastomer; or
- c) any damage or defect attributable to repair of the product by any person other than an authorized dealer, or the installation of unapproved parts on the product.

The obligations set forth in this warranty are conditional on:

- a) proper storage, installation, calibration, use, maintenance and compliance with the product manual instructions and any other applicable recommendations of ESP;
- b) the buyer promptly notifying ESP of any defect and, if required, promptly making the product available for correction. No goods shall be returned to ESP until receipt by buyer of shipping instructions from ESP. A return authorization number must be obtained from ESP prior to shipment; and
- c) all warranty returns being shipped directly to ESP Safety, Inc.;
- d) the right of ESP to require that the buyer provide proof of purchase such as the original invoice, bill of sale or packing slip to establish that the product is within the warranty period.

THE BUYER AGREES THAT THIS WARRANTY IS THE BUYER'S SOLE AND EXCLUSIVE REMEDY AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. ESP SHALL NOT BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES OR LOSSES. ESP WILL NOT BE LIABLE FOR LOSS OR DAMAGE OF ANY KIND CONNECTED TO THE USE OF ITS PRODUCTS OR FAILURE OF ITS PRODUCTS TO FUNCTION OR OPERATE PROPERLY. IN NO EVENT SHALL ESP'S LIABILITY HEREUNDER EXCEED THE PURCHASE PRICE ACTUALLY PAID BY THE BUYER FOR THE PRODUCT.

To the extent any provision of this warranty is held invalid or unenforceable by a court of competent jurisdiction, such holding will not affect the validity or enforceability of any other provision.

9.0 Repair and Return

Field Repair

The SGOES is not intended to be repaired in the field. If a problem should develop, refer to Section 8.0 Troubleshooting of this manual. Please return the device to the factory for repair or replacement.

Return Material Authorization (RMA) Number

Contact ESP Safety Inc. at +1-408-886-9746 to obtain a Return Material Authorization (RMA) number. Please provide the following information during your call:

- Your Company Name
- Product Type
- Serial Number
- Date of Shipment
- Brief explanation of malfunction

Pack the unit properly to ensure that no shipping damage occurs and ship to:

ESP Safety, Inc.
555 North First Street
San Jose, CA 95112 USA

Write the RMA number on the front of the shipping carton



ESP Safety, Inc. recommends that an inventory of spare detectors be kept on hand to enable rapid field replacement and minimize downtime.

10.0 Parts Ordering Information

The following items for the SGOES may be ordered:

Accessories:

Calibration Magnet (magnetic wand), P/N 611-0005
Calibration Cup
Replacement Weather Protective Cover
HART connection cable
RS-485 converter

For items not listed above, please contact ESP Safety.

Order from:

ESP Safety Inc
555 North First Street
San Jose, CA 95112
USA
Ph: 408-886-9746
Fax: 408-886-9757
Website: www.espsafetyinc.com
Email: info@espsafetyinc.com

Please note that shipping charges will be added to your order.

Appendix 1 – Calculating Values**SGOES Nominal Static Conversion Formula**

Nominal conversion of the SGOES employs the following formula:

$$I_i = 16C_i / C_{MAX} + 4$$

I_i is the output current value, in mA;

C_i is the concentration value for the gas analyzed, % LEL

C_{MAX} is the maximum value of converted concentration, % LEL).

To determine the concentration of the detected gas in %LEL, calculate by the formula:

$$C_i = 6.25(I_i - 4)$$

Under calibration with standard gas mixture, the measuring concentration of the detected component (in %LEL) is calculated by the formula:

$$C_i = 100 C_{pasp} / C_p$$

C_{pasp} is the value of the converted range of the detecting component concentration labeled on the cylinder of a specific control gas mixture.

C_p is the upper value of the converted gas range of the detecting component equaling 100% LEL.

Calculation of absolute error

The absolute error is calculated using the formula:

$$Ca = C_i - Ct$$

C_i – indicated concentration—value reported by SGOES in %vol or %LEL.

C_t – known true concentration of gas used for calibration in %vol or % LEL

Example

Using a calibration gas mixture labeled 61.7 LEL.

The measured value %LEL resulted 60% LEL.

Calculate the measurement error of absolute error:

$$Ca = 60 \text{ LEL} - 61.7\% \text{LEL} = -1.7\% \text{LEL}$$

Thus the absolute error of this gas mixture is equal to -1.7% LEL.

Relative error estimate of gas analyzer is calculated by formula:

$$\delta = (C_i - C_t / C_t) \times 100$$

using the above to determine absolute error.

$$\delta = (60 - 61.7 / 61.7) \times 100 = -2.8\%$$

The calibration results are considered accurate if the basic error of gas analyzer calculated by the formulas given above in all calibrating points does not exceed limits of Table 1-A

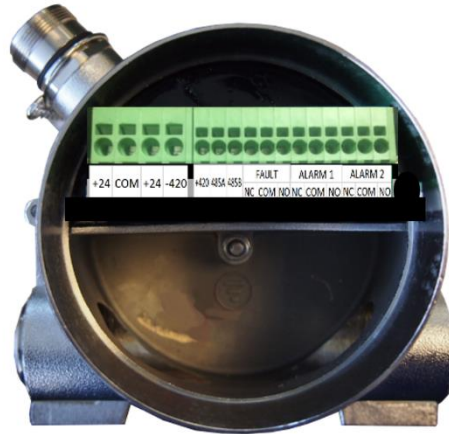
Appendix 2 – Gas Measurement Scale Range

SGOES Model	Detected Hydrocarbon	Scale Range			Limits of Basic Absolute Error	
		%LEL	%vol ISO	%vol IEC	Absolute	Relative
100-0001-M11-C1	Methane	0 to 100	0 to 5	0 to 4.4	± 3% (0 to 50%LEL)	± 5% (50 to 100%LEL)
100-0001-M11-C2	Propane	0 to 100	0 to 2.1	0 to 1.7	± 3% (0 to 50%LEL)	± 5% (50 to 100%LEL)
100-0001-05	Butane	0 to 50	0 to 0.7	0 to 0.7	± 3% LEL	
100-0001-07	Isobutane	0 to 50	0 to 0.65	0 to 0.65	± 3% LEL	
100-0001-09	Pentane	0 to 50	0 to 0.7	0 to 0.7	± 3% LEL	
100-0001-11	Cyclopentane	0 to 50	0 to 0.7	0 to 0.7	± 3% LEL	
100-0001-13	Hexane	0 to 50	0 to 0.5	0 to 0.5	± 3% LEL	
100-0001-15	Propylene/Propene	0 to 50	0 to 0.1	0 to 0.1	± 3% LEL	
100-0001-17	Methanol Vapor	0 to 50	0 to 0.1	0 to 2.75	± 3% LEL	
100-0001-19	Ethanol Vapor	0 to 25 0 to 50	0 to 0.78 0 to 1.55	0 to 0.78 0 to 1.55	± 3% LEL ± 3% LEL	

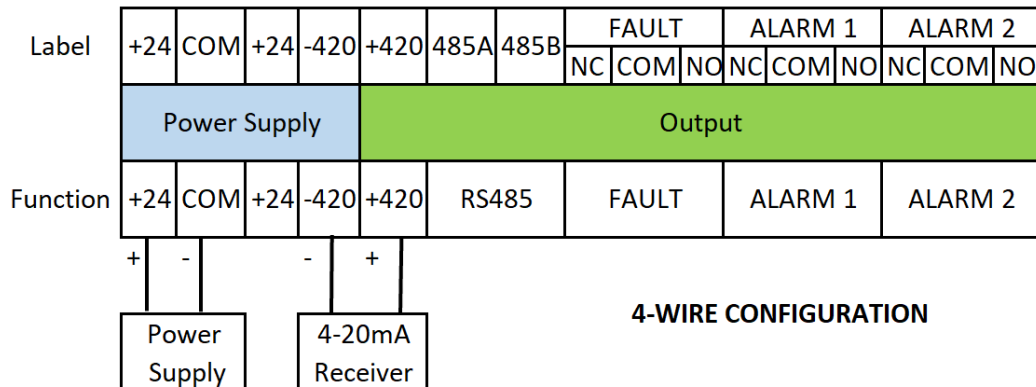
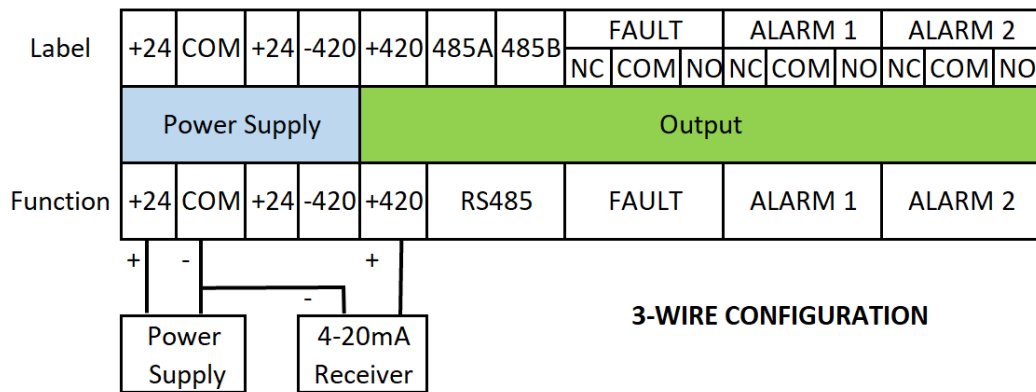
Appendix 3 – Gas Flash Point Temperatures

Detected Hydrocarbon	Boiling/Vapor Point at 1 atmosphere	Flash Point
Methane	-165 °C	gas
Propane	-42 °C	gas
Butane	-0.5 °C	-108 °C
Isobutane	-11 °C	Gas
Pentane	36 °C	-49 °C
Cyclopentane	49 °C	-37 °C
n-Hexane	69 °C	-23 °C
Propylene/Propene	-48 °C	gas
Methanol	-64 °C	11 °C
Ethanol	78 °C	13 °C

Appendix 4 – SGOES Terminal Block & Wiring for 3-Wire and 4-Wire Systems



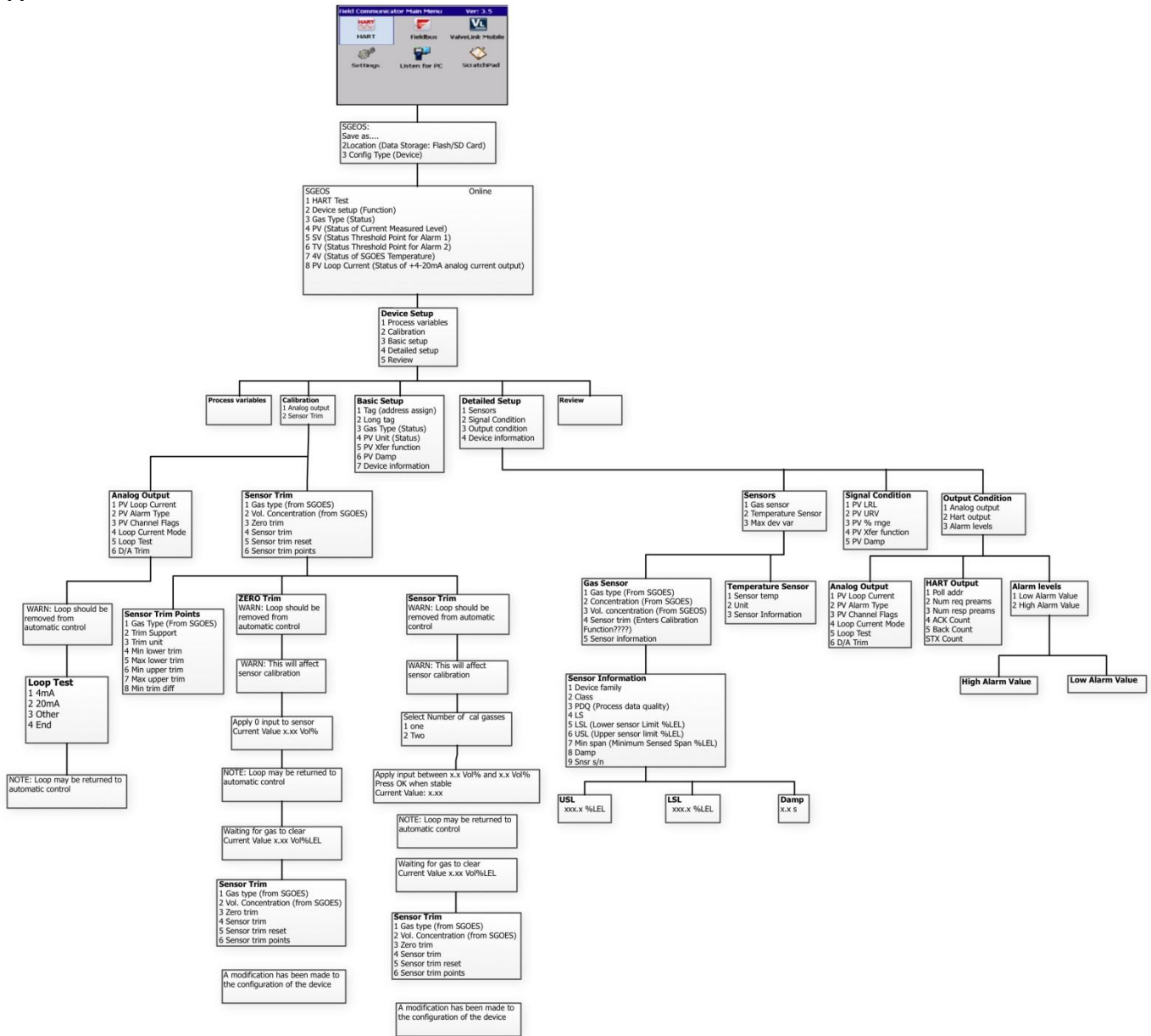
SGOES Terminal Block



Appendix 5 – Maximum Cable Lengths for Analog Connection (using 24VDC Supply)

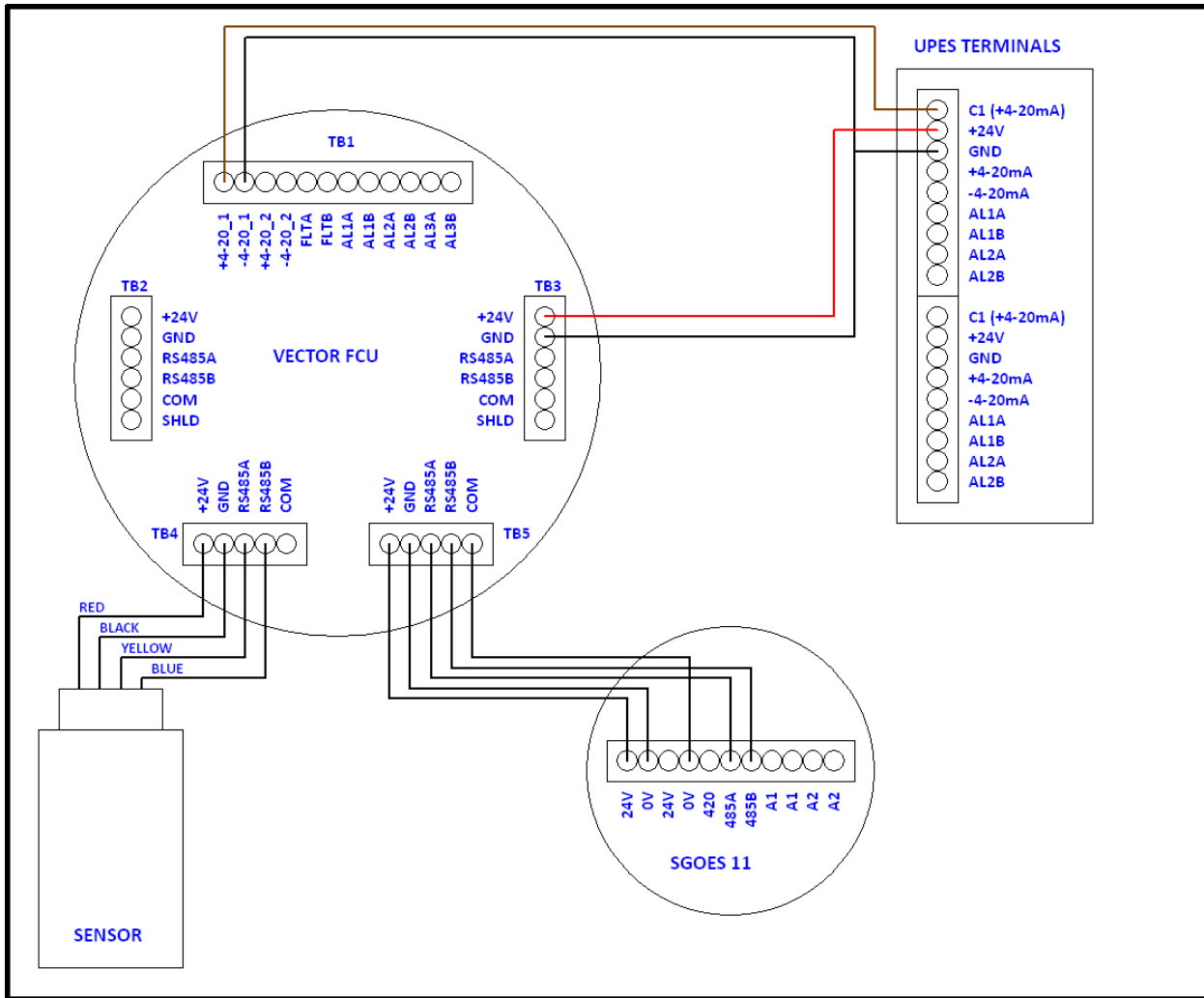
Wire Gauge	Ohms Per Foot	Max Feet	Ohms Per Meter	Max Meters
22AWG .33mm ²	.016	2460	.053	750
20AWG .52mm ²	.010	3936	.033	1200
18AWG .82mm ²	.006	6232	.021	1900
16AWG 1.3mm ²	.003	9840	.013	3000

Appendix 6: HART Menu Tree

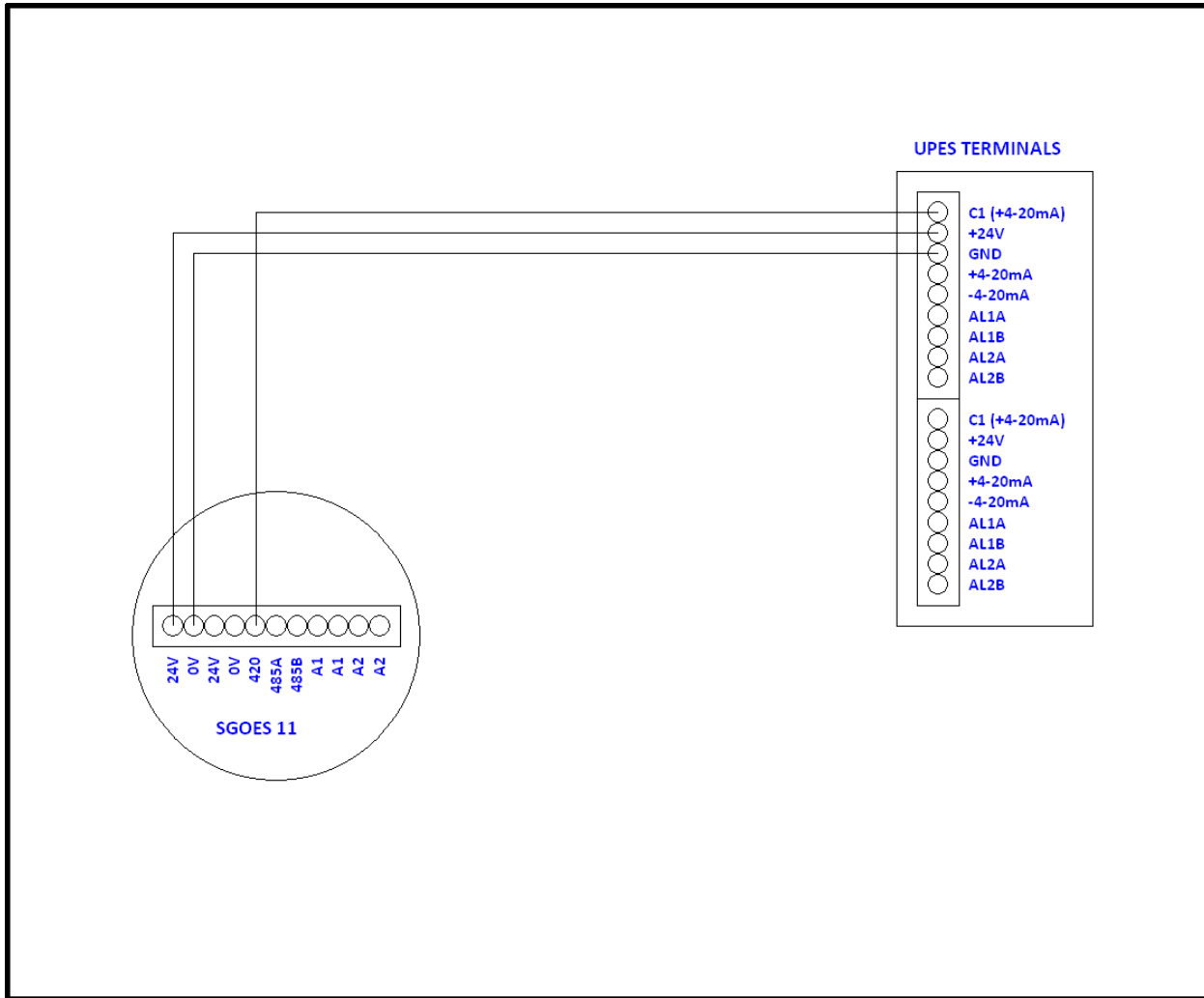


Menu Tree for SGOES HART Device Descriptor

Appendix 7: SGOES to VECTOR FCU



Appendix 8: SGOES to UPES



Appendix 9: SGOES to Analog Input Module

