# OPERATING MANUAL
# SSS-903 Toxic Gas Detection System

Model SSS-903 Transmitter and Controller
Model PGU-IR Infrared Optical Gas Sensor
Model PGU-P Photo Ionization Gas Sensor
Model PGU-E Electrochemical Gas Sensor
Model PGU-C Catalytic Bead Gas Sensor




ESP SAFETY INC

**Revision History**

| Date | Revision | Description | Approved |
|---|---|---|---|
| 3/21/13 | 02 | Addition; Appendix II Warranty & Return Policy | A. Burgos |

## *General Information*

This instruction guide details the specification, application and operation of the ESP Safety Inc. SSS-903 with an included sensor. The SSS-903 System consists of two components, a receiver and gas specific sensor that have been factory configured and calibrated to provide detection of toxic, flammable and combustible gases in open or closed environments. The product includes multiple features required to report alarms when the toxic gas concentrations in the environment reach three independently programmed levels. Each alarm also triggers a relay that is provided as a standard feature, which can be used to operate warning devices, sirens, valves or switches.

The SSS-903 receiver is a versatile product that can be used in a specific proximity or in a decoupled mode with the sensor and receiver head located up to 500 feet apart. Furthermore, any SSS-903 can be reconfigured in the field to detect toxic gases using optional sensor replacements.

## *Applications*

The SSS-903 system is recommended for applications that require a gas detector with localized digital readout of detected gas levels. It comes factory standard for with Analog 4-20mA output with embedded HART, an independent HART connector that is conveniently located on the SSS-903 enclosure able, relay contacts, and Modbus RS485. The system is comprised of an SSS-903 Receiver and plug-in universal PGU sensors for electrochemical (PGU-E) , infrared (PGU-IR) ,photo-ionized (PGU-P) and catalytic bead (PGU-C)detection. Power is supplied from an external 24 VDC nominal power source (source can range 18-3VDC). In operation the

SSS-903 system has been designed for operation in temperature ranges from minus 40 to 75 °C (without internal heated option activation) and minus 60 to 75 °C (with activated internal heated option) and relative humidity of up to 100 % (non-condensing)

The SSS-903 receiver includes 5 LED annunciators plus an easily readable LCD display. On the display an operator can determine information of alarm status, gas detected, current level detected and view a Time Weighted Average (TWA) run time graphic showing each event and level detected during a user programmed time from 3 to 30 minutes. The design of the SSS-903 is an approved product for use in control monitoring of gas contamination levels with flammable and toxic gases present in the working area environment of oil, gas and chemical industries All electronics are enclosed in explosion-proof aluminum or stainless steel housings that have been certified by FM-Approvals for use in explosive areas pertinent to classes 1 and 2 with the potential hazard of forming explosive gas mixtures attributed to the subgroup IIC and to explosion hazard categories T1–T6, inclusive of the following zones, premises and facilities:

| | |
|---|---|
| Drilling and production platforms | Petrochemical facilities |
| Refineries | Paint Manufacturing |
| Bulk terminals and tank farms | Fertilizer plants |
| Compressor stations | Fuel loading facilities |
| Pipelines | Residential areas |
| Transportation facilities | Boiler stations |

Non-invasive calibrations can be performed in the field using an included magnetic wand or a HART communicator.

A device descriptor file is available from ESP Safety for use with a HART communicator. Calibration can also be performed with an included Windows PC application, ESP Commander. Both HART and ESP Commander applications can supply real time output of current operational data plus access a non-volatile memory in the SSS-903 for further diagnostic analysis.

# *Specifications of SSS-903 with PGU Sensors*

## *Electrical Characteristics*

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|---|---|
| Input Voltage | +24VDC Nominal (+18 to 32VDC) |
| Power Consumption | 2 W-standby<br>5 W-during alarms |
| Output From SSS-903 | +4-20mA industry standard analog with embedded HART<br>Digital RS-485 Modbus RTU<br>HART interface with easy access dedicated connector<br>4 "Dry Contact" relays (NO/Form-A)<br>All Relays Contact Rating 1Amp@125VAC/30VDC |
| Alarm Relays | 3 User Programmed Alarm Relays<br>1 Fault Condition Relay |
| GT Sensor Interface to SSS-903 Receiver | Digital RS-485 Modbus RTU<br>*Note All ESP Safety gas detector products can be interfaced with the SSS-903 |
| Sensor Types / Model | Electrochemical: PGU-E<br>Infrared: PGU-IR<br>Photo Ionized: PGU-P |

## *Operational Characteristics*

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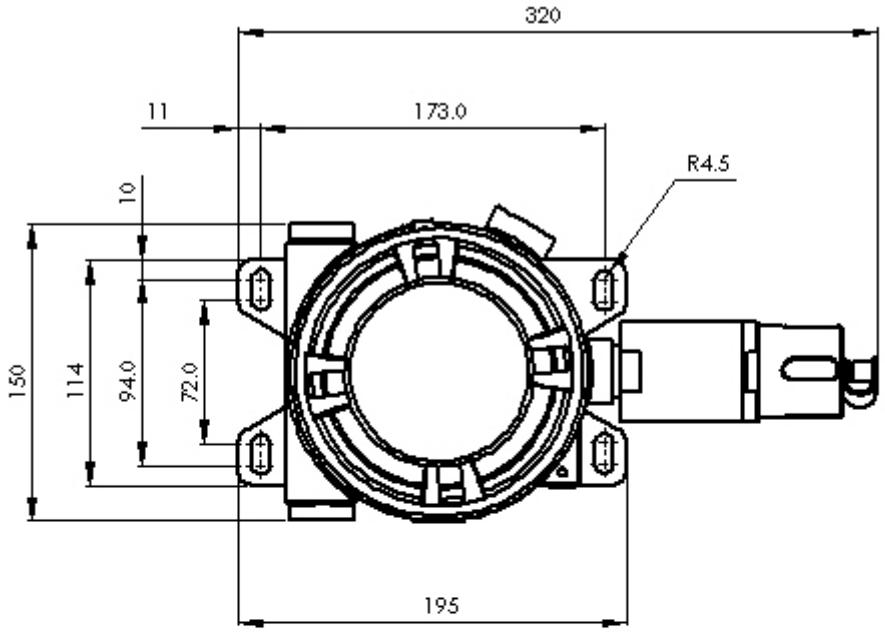
|---|---|
| Humidity Range | Up to 100%, non-condensing<br>(Withstands up to 100% RH for short periods) |
| Operating Temperature | Standard Operation: -40°F to +167°F (-40°C to +75°C)<br>With Optic Heater Enabled: –76°F to +167°F (-60°C to +75°C) |
| Ingress Protection | IP66 |
| RFI/EMI Protection | EN50081-1 / Class B E> 50270<br>*Operates with no interference from a 5 watt walkie talkie keyed (transmitting) at 1 meter |
| Annunciators (LED) | Tri-color status LED indicates operational mode, fault, and gas presence.<br>Three LED indicators for Alarms activation<br>A fourth LED indicates the unit is in calibration mode |
| Displayed Information (Illuminated LCD Display) | Continuous sensor data<br>Gas Type<br>Measuring Units<br>Three Fixed Alarm Thresholds<br>Graphic display of trending data for Peak Readings and Time-Weighted Average (TWA) of gas concentration 3-30 minutes |
| Explosion Proof Labels for SSS-903 & PGU Sensors | Ex d [ia Ga] IIC T6 Gb<br>Ex d ia IIC T6 |
| Dimensions of SSS-903 Receiver | 270x150x120mm<br>10.63"x5.9"x4.73" |
| Dimensions of PGU Sensors | 94x50mm<br>3.7"x1.97" |

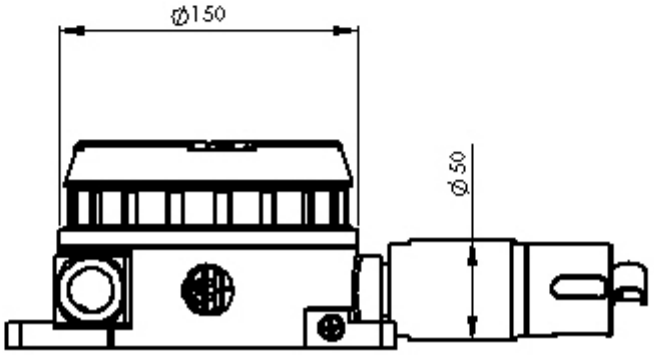
## *Mechanical Characteristics*

| | |
|---|---|
| SSS-903 and PGU | Stainless Steel Grade-316 |
| Cable Entry | 2 Cable Entries ¾" NPT |
| Weight | 5.5kg / 11lbs |

***Dimensions Diagram of SSS-903 Receiver***

All dimensions are in mm



## *Table 1: SSS-903 with PGU-E Electrochemical Gas Sensor Range, Accuracy and Response Times*

Using Gas Specific Electrochemical Detectors
*Response Time is the time to reach a percentage of final reading when gas concentration is equal to full scale of the sensor range of detection. (i.e. T50=50% 0f Range)
**Some sensors have multiple ranges one of which is determined by the user during setup or calibration

| Gas | Formula | Range of Detection** | Accuracy | Response Time* |
|---|---|---|---|---|
| Hydrogen | ($H_2$) | 0 to 4 % vol (100% LEL)<br>0 - 1% vol (0 - 100) ppm | ±2% full scale | T50 < 40 seconds<br>T90 < 60 seconds |
| Carbon Monoxide | (CO) | (0 - 100) ppm<br>(0 - 500) ppm<br>(0 – 1000)ppm | ±2% full scale | T20 < 10 seconds<br>T90 < 25 seconds |
| Ammonia | ($NH_3$) | (0 - 1000) ppm | ±2% full scale | T90 < 90 seconds |
| Hydrogen Fluoride | (HF) | (0 - 10) ppm | ±2% full scale | T50 < 30 seconds<br>T90 < 90 seconds |
| Methanol | ($CH_3OH$) | (0 – 100)ppm | ± 2% full scale | T90 < 90 seconds |
| Oxygen | ($O_2$) | (0 - 30) % vol | ±2% full scale | T90 < 11 seconds |
| Hydrogen Sulfide | ($H_2S$) | (0 - 20) ppm<br>(0 - 50) ppm<br>(0 - 100) ppm | ±2% full scale | T20 < 10 seconds<br>T50 < 12 seconds<br>T90 < 25 seconds |
| Chlorine | (CI2) | (0 - 20) ppm | ±2% full scale | T90 < 25 seconds |
| Formaldehyde | ($CH_2O$) | (0 - 10) ppm | ± 2% full scale | T50 < 20 seconds |
| Nitrogen Dioxide | ($NO_2$) | (0 - 20) ppm | ±2% full scale | T50 < 12 seconds<br>T90 < 25 seconds |
| Sulfur Dioxide | ($SO_2$) | (0 - 20) ppm<br>(0 - 100) ppm | ±2% full scale | T50 < 12 seconds<br>T90 < 25 seconds |
| Hydrogen Chloride | (HCI) | (0 - 30) ppm | ±2% full scale | T50 < 30 seconds<br>T90 < 90 seconds |
| Vinyl Acetate | ($C_4H_6O_2$) | (0 - 100)ppm | ± 2% full scale | T90 < 90 seconds |

## *Table 2: SSS-903 with PGU-P Photo Ionization Gas Sensor: Range, Accuracy and Response Times*

Using Gas Specific Photoionized Detectors
*Response Time is the time to reach a percentage of final reading when gas concentration is equal to full scale of the sensor range of detection. (i.e. T50=50% 0f Range)
**Some sensors have multiple ranges one of which is determined by the user during setup or calibration
Note: All gases with ionization potential <10.6 eV

| Gas | Formula | Range of Detection** | Accuracy | Response Time* |
|---|---|---|---|---|
| Benzene | $C_6H_6$ | (0 - 100) ppm | ± 2% full scale | T50 < 9 seconds<br>T90 <25 seconds |
| | | (0 - 1000) ppm | | |
| | | (0-10000) ppm | | |
| Ethylene | $C_2H_4$ | (0 - 20) ppm | | |
| | | (0 - 2000) ppm | | |
| Isobutylene | $C_4H_8$ | (0 - 20) ppm | | |
| | | (0 - 200) ppm | | |
| | | (0 - 2000) ppm | | |
| Methyl Mercaptan | $CH_3SH$ | (0 - 100) ppm<br>Other ranges per request | ± 2% full scale | T90 <25 seconds |

## *Table 3: SSS-903 with PGU-IR Infrared Optical Detection: Range Accuracy and Response Times*

Using Gas Specific IR Detectors

*Response Time is the time to reach a percentage of final reading when gas concentration is equal to full scale of the sensor range of detection. (i.e. T50=50% 0f Range)

| Gas | Formula | Range of Detection** | Accuracy | Response Time* |
|---|---|---|---|---|
| Methane | $CH_4$ | (0 -100) % LEL | ± 3% to 50% LEL<br>± 5% from 51% to 100% LEL | T20 < 5 seconds<br>T90 < 25 seconds |
| Propane | $C_3H_8$ | | | |
| Ethylene | $C_2H_8$ | | | |
| Hexane | $C_6H_{14}$ | | | |
| Butane | $C_4H_{10}$ | | | |
| Isobutane | $I\text{-}C_4P_{10}$ | | | |
| Ethanol | $C_2H_5OH$ | | | |
| Cyclopentane | $C_5H_{10}$ | | | |
| Propylene | $C_3H_6$ | | | |
| Methanol | $CH_3OH$ | | | |
| Gasoline Vapor | | | | |
| Diesel Vapor | | | | |
| JP4 Fuel Vapor | | | | |
| Carbon Dioxide | CO2 | (0 to 2) % Vol<br>(0 to 5 ) % vol<br>( 1 – 3000) ppm | ± 2% full scale | T90 <25 seconds |

## *Table 4: SSS-903 with PGU-C Catalytic Bead Sensor: Range Accuracy and Response Times*

Using Catalytic Bead (pellisor) sensor specifically for detection of hydrogen
*Response Time is the time to reach a percentage of final reading when gas concentration is equal to full scale of the sensor range of detection. (i.e. T50=50% 0f Range)
** All data refers to catalytic bead sensor as tested with H2 gas from an approved source. The sensor data listed is based on ideal test environment with no interference from other gases

| Gas | Formula | Range of Detection** | Accuracy | Response Time* |
|---|---|---|---|---|
| Hydrogen | H2 | 0-100 % LEL | < ± 10% of measured value | T 90 < 10 seconds |

## *Certifications*

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

## *SSS-903 Receiver Operation*

The SSS-903 is physically designed to perform in a wide range of hazardous environments and harsh weather conditions. Employing a durable enclosure that can withstand these conditions and even explosion is key to the operation and function of the device.

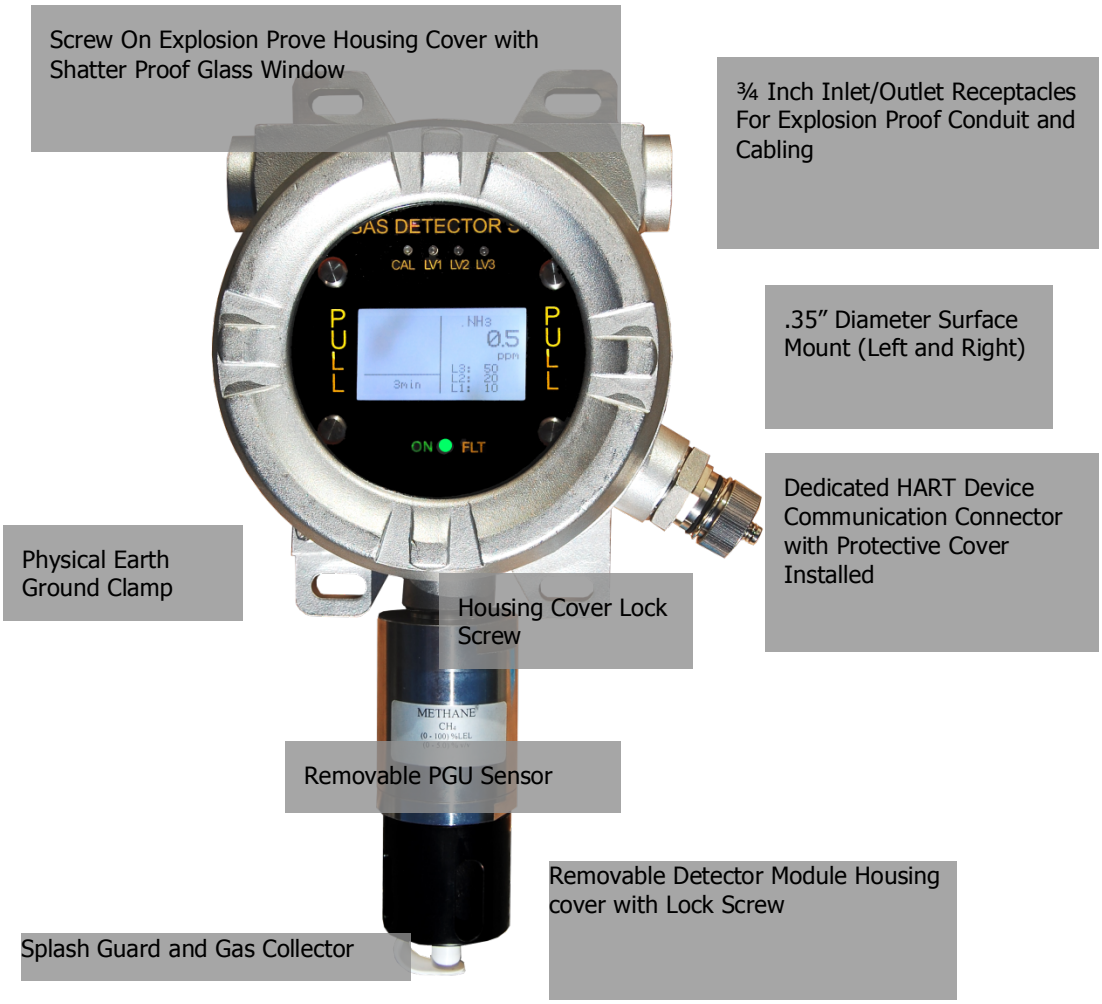
The SSS-903 is an elegant design that uses only two printed circuit board assemblies (PCBA) that have also been designed to resist the effects of environmental challenges. The PCBAs are installed in a layered fashion with a single interconnection for easy removal.

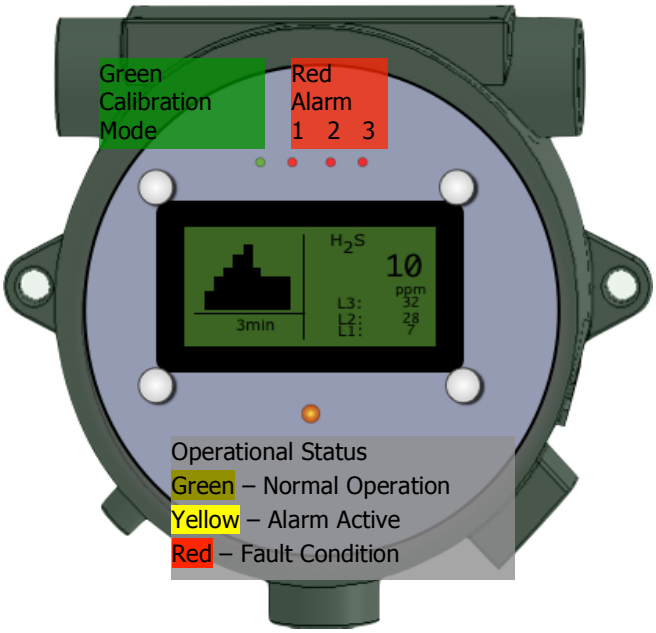
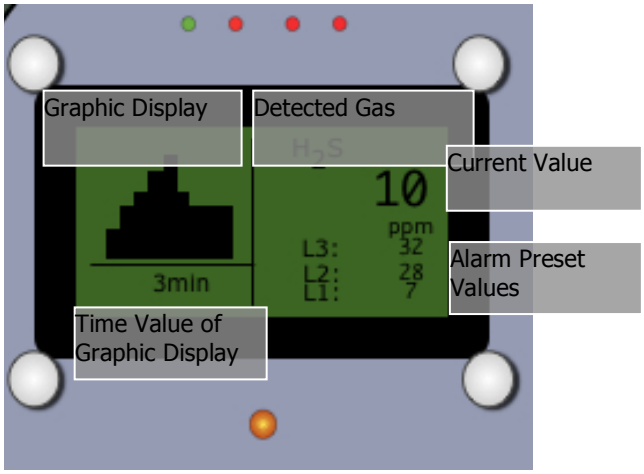
The Controller PCBA provides all information to the user via LED and LCD display. A micro controller with embedded software performs all functions used in communication and control. As noted the controller card also functions as the driver for the LCD display and performs all calculations used for the timed graphic HART. Event information displayed on the graphic cHART is also stored in a Non-Volatile memory within the PGU sensor that can be accessed using ModBus or a HART communicator.

The second module is the Power PCBA. This PCBA accepts and regulates the externally supplied power source in addition to all signal connections. Four solid state-sealed relays are also located on the Power PCBA eliminating the potential of electronic discharge associated with mechanical relays.

All signals enter and exit the enclosure via ¾" threaded female attachments for conduit as required by the user application and local regulations.

## *Figure 1 SSS-903 Receiver with PGU Sensor Installed*



| | |
|---|---|
| ***Figure 2- SSS-903 LED Indicators*** |  |
| ***Figure 3 - SSS-903 LCD Display*** |  |

# PGU-P Photo Ionization Gas Sensor Theory of Operation

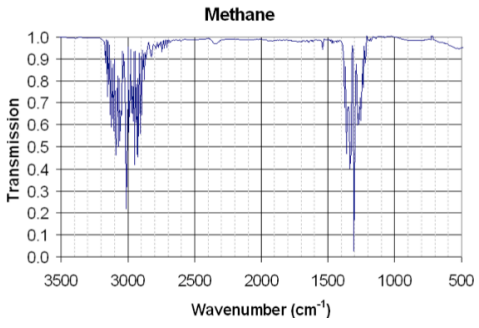

*Figure-4 PGU-P Detector*

The PGU-P performs selective detection of hydrocarbon molecules using infrared light and photo ionization detectors (PID). Air containing molecules of the selected combustible gas passes into a collection chamber that has an IR source and detector. The molecules containing the combustible gas absorb the IR photons and become ionized. Ionized molecules create an electric current that is measured by the detector. The electric current increases as the amount of gas molecules in the chamber increases. The current is measured and processed by the PGU-P sensor, generating the signals that are passed to the SSS-903 receiver via RS-485. Each detector is factor programmed for the gas requested by the customer at the time of purchase.

# PGU-IR Infrared Optical Gas SensorTheory of Operation


*Figure -5 TG-IR Detector*

Operation the PGU-IR is based on selective signal disruption by hydrocarbon molecules when an infrared light source is projected to an optical detector. Measurement for a specific gas is determined by passing the IR energy through a filter placed between the source and a chamber where the gas is collected. If nogas is present, the detector will receive all of the energy radiated by the IR source and generating an electrical current. When gas molecules enter the collection chamber, each molecule of the gas blocks the IR energy reducing the output of the detector, which is then processed by the PGU-IR sensor. Each detector is delivered preset for a specific gas, in the example shown, the gas is Methane (CH4), which ionizes at two points on the light spectrum, one for each Atomic Element, and are measured as wave numbers ($cm^{-1}$).



## PGU-E Electrochemical Gas Sensor Theory of Operation


*Figure6 – TG-E Detector*

The PGU-P sensor contains electrode in contact with an electrolyte. The target gas diffuses into the sensor through a membrane and comes into contact with electrodes where it is oxidized. The electrochemical reaction results in an electric current that passes to PGE-P microcontroller and from there to the SSS-903 receiver. The magnitude of the current is controlled by how much of the target gas is oxidized by the electrode. Output current from the sensor is also linearly proportional to the gas concentration. A linear output allows for more precise measurement of low concentrations and much simpler calibration.

## PGU-C Catalytic Bead Gas Sensor Theory of Operation

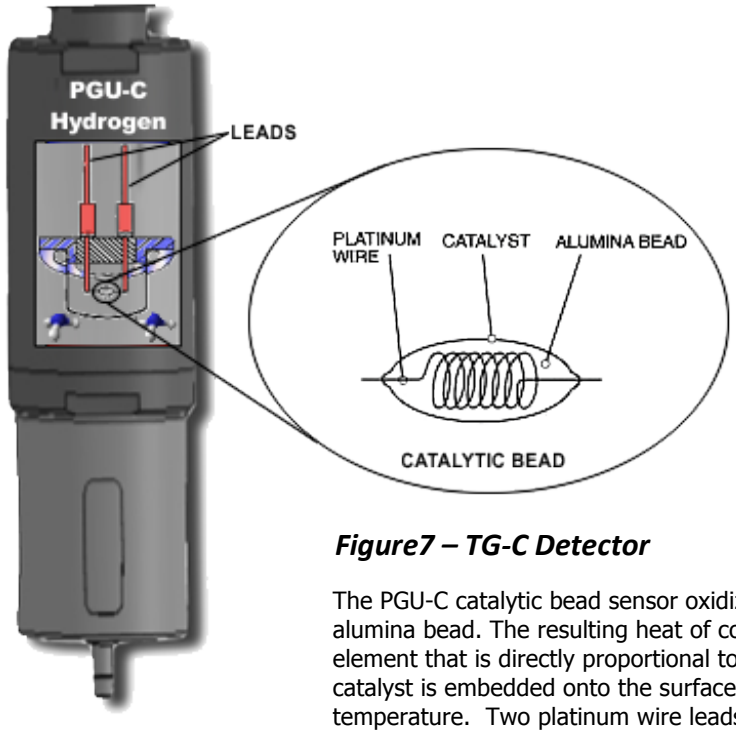



*Figure7 – TG-C Detector*

The PGU-C catalytic bead sensor oxidizes the target gas on the surface of a heated alumina bead. The resulting heat of combustion results in a change in resistivity of the element that is directly proportional to the concentration of the gas. A precious metal catalyst is embedded onto the surface of the alumina bead to lower the oxidation temperature. Two platinum wire leads are embedded in the alumina bead and connected electrically in a Wheatstone bridge circuit. Heat is generated by passing current through the leads.

Each PGU sensor consists of PGU module with imbedded processing and a single gas specific plug-in electrochemical, infrared (optical) or photo-ionized detector. There is a filter located between the collection chamber and the detector to minimize potential contamination from dust or moisture. The collection chamber is covered by a splashguard, which also serves as the gas collector. The splashguard also has an inlet nipple for calibration purposes.

Each PGU detector internally stores the data reported to the SSS-903, HART, or Modbus. All calibration information is also stored in the PGU module processor, thus any PGU module can be moved to another SSS-903 receiver and resume data collection from the time of removal.
The detector module may be replaced in the field with a one that is intended for use to detect the same gas. If a different gas is required a replacement PGU module must be ordered from ESP Safety or their representative. Aside from detector or filter replacement there are no user serviceable parts in the PGU sensor.

***Figure 7 – PGU Detector Module***

# Digital Data Communication

The SSS-903 provides three digital communication methods:
HART (Highway Addressable Remote Transducer) accessible via a dedicated connector that
Digital RS-485 ModBus-RTU (Remote Terminal Unit)
HART over +4 to 20 mA output

## *HART Dedicated Connector*

HART is a bi-directional communication protocol that provides data access between Intelligent field instruments and host systems. In most applications for the SSS-903 the host is an ESP-Safety specific software application available from the HART Foundation for use on a technician's hand-held HART communicator device.A HART system in considered non-invasive in that the SSS-903 does not have to be opened or removed from a field installed location.
HART communicators and RS-485 devices can access:
Information detected gas type
The measuring range in PPM or LEL%
Value of current gas concentration
State and programming of fixed alarm thresholds
Calibration Zero Cal Address of the SSS-903 as used by RS-485
Download of Non-Volatile Memory of event occurrence from a 60 day history

Emerson 475 Shown

***Figure 8 - SSS-903 with HART Communicator***

## *Digital RS-485 Modbus*

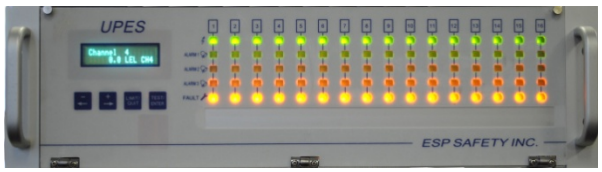
Modbus is an interface structure that is used for communication to control devices (PLC) or computers. Modbus is a similar to HART but has been adapted as the industry standard for communication to multiple devices with a single cable run. (Series or "Daisy Chain" connection) Unlike HART, RS-485 must be considered and designed into the installation of the SSS-903. All of the same functions available with HART can also be accessed remotely with this system.
Modbus is available for use as a dedicated communication system with High Speed data communication.

ESP-Safety provides a Windows compatible computer application, ESP Commander, that provides all access to the SSS-903 functions, and is often used for bench calibration of units removed from the field or prior to new installations. ESP-Commander may require a customer provided translation device. All ESP Safety gas detector models have the ability to interface with ESP Commander in RS-485 "daisy chain" networked installations. Modbus is also available in a single point to point interface (one SSS-903 to One port of a control system as a data signal that is imbedded in the +4 to 20mA analog output. In this application the data rate is significantly slower at 1200kb/s.

## *UPES Controller*

ESP-Safety has an available rack mounted control system that can be used with all ESP devices along with those of other manufacturers.

***Figure 9 - UPES Controller***




## *Explosion Proof Integrity*

Explosion proof integrity of SSS-903 units installed and in operation it is must not be modified in any form. 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 (Explosion Proof Diagram)

Caution: The installation of SSS-903 must comply with relevant requirements of the latest edition of the national Electri Code (ANSI/NFPA 70)
Caution: Connection Conduit, Barrier Glands, and Epoxy Sealants are to meet EN-50018/IEC 60079-1 Standards
Caution: ESP Safety Inc. Recommends use of shielded cable with 14AWG conductors reaching a span no greater than 3,900 ft. (1200 meter)

# IMPORTANT SAFETY INFORMATION

Be sure to read and understand the entire instruction manual before installing or operating the gas detection system. The products described in this document can be used with a variety of ESP-Safety gas detector models to provide earlywarning of the presence of a toxic or explosive gas mixture. Proper device installation, operation, and maintenance is required to ensure safe and effective operation. If this equipment is used in a manner not specified in this manual, safety protection may be impaired.

## *Cautions and Warnings*

This user guide includes numerous cautions and warnings that are specifically included to prevent injury to personnel and prevent damage to equipment. Care is also taken to include notation of all applicable standards and best practices as appropriate information that may apply to any use or procedure associated with the product.

WARNING: TOXIC, COMBUSTIBLE, AND FLAMMABLE GASES OR VAPORS ARE VERY DANGEROUS. USE EXTREME CAUTION WHEN THESE HAZARDS ARE PRESENT.

Caution: The installation of SSS-903 must comply with relevant requirements of the latest edition of the national Electric Code (ANSI/NFPA 70)
Caution: Connection Conduit, Barrier Glands, and Epoxy Sealants are to meet EN-50018/IEC 60079-1 Standards
Caution: ESP Safety Inc. Recommends use of shielded cable with 14AWG conductors reaching a span no greater than 3,900 ft. (1200 meter)

WARNING: Take appropriate precautions, including wearing and use of protective clothing and devices when servicing the SSS-903 as they may have remnants of corrosive solutions.

# Physical Installation Procedure

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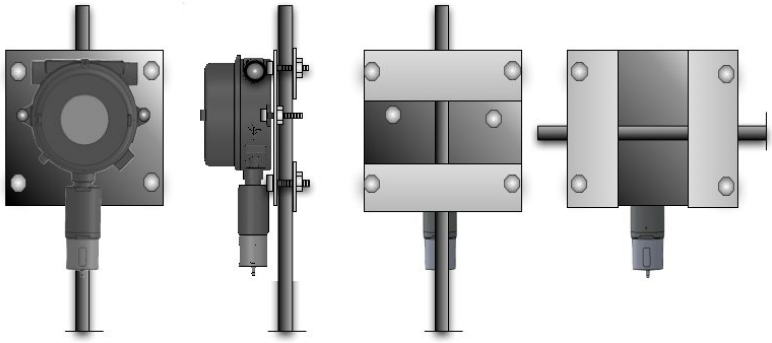
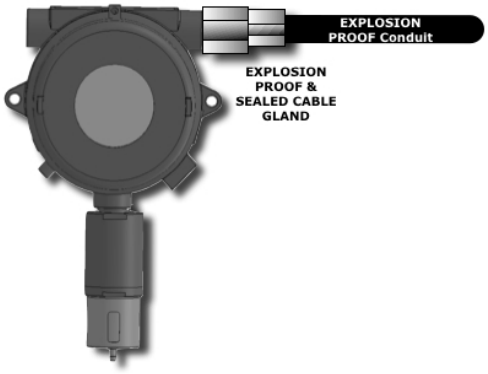
|---|---|
| ***Preparing For Installation*** | The SSS-903 has unique installation procedures for either local or remote hardware configurations. Before installation, evaluate the gas leak locations and other conditions at the test site and configure the unit for that particular need. |
| ***PGU sensor Location*** | Selection of PGU sensor location is critical to the overall performance of the product. Five factors play an important role in the selection of PGU sensor locations:<br>Density of the gas to be detected<br>Most probable leak sources within the industrial process<br>Ventilation and prevailing wind conditions<br>Personnel exposure<br>Maintenance access<br>*Note the PGU Sensor must be pointed down. |
| ***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, PGU 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, and tubing. Connections of the sealed type where seals may either fail or wear. All potential leak sources and SSS-903 mounting locations are best determined by facility engineers with experience in similar processes. |
| ***Ventilation and Prevailing Winds*** | Normal ventilation or prevailing wind conditions can dictate efficient location of gas PGU sensors so that migration of potential gas clouds is quickly detected. |
| ***Personnel exposure*** | If an undetected migration of gas clouds should approach concentrated personnel areas such as control rooms, maintenance or warehouse buildings. Selection of PGU sensor location should include the potential leak source and perimeter of personnel. Use of ESP Safety PGUAES open field detectors should be considered for these areas. |
| ***Maintenance Access*** | Consideration should be given to providing easy access for maintenance personnel. PGU sensor location should also take into account the proximity to contaminants that may foul the PGU sensor prematurely. |
| ***SSS-903 Receiver and PGU Sensor Location Guidelines*** | There are no standard rules for placement since the optimum PGU sensor location is unique for each application. Before installing the SSS-903, 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 SSS-903:<br>Locate the SSS-903 near potential gas leak sources and away from excessive heat, light, wind, dust, water, vibration, shock, and radio frequency interference (RFI).<br>Ensure the installation location has sufficient space to accommodate the SSS-903 housing, PGU sensor, and all necessary cabling.<br>Mount the SSS-903 with the PGU sensor pointing down.<br>Mount the SSS-903 housing in an easily accessible location for reading the digital display and calibration checks |

# Physical Installation Quick Guide

| | |
|---|---|
| ***Tools Required*** | 18-Inch Adjustable Crescent (Spanner Wrench) with 2-inch or greater span for installation and removal of PGU sensor/Sensors<br>2-MM "Flat Head" screwdriver for protective cover lock screw and wire terminal block clamps<br>#2 Phillips Head Screwdriver for Ground Connector |
| ***Physical Installation/ mounting*** | The SSS-903 can be physically mounted in a number of ways.<br>The surface mount "ears" can be used for a wall mount.<br>  <br>Caution: The SSS-903 with TG Sensor installed must always be installed in a vertical orientation with the TG Sensor pointing down. This will minimize collection of contaminates in the TG sensor.<br>***Figure 10 – Mounting To Pole (Local Configuration)***<br>  |
| ***Figure 11- Mounting with PGU Sensor in local configuration*** |  <br>Local configuration refers to the configuration where the SSS-903 housing and the pre-calibrated PGU PGU sensor are attached and placed in the same location. This is also commonly referred to as a stand-alone configuration.<br>Install explosion proof conduit or cable or conveying appropriate cabling using into a ¾" Male NPT fitting using an explosion proof cable gland.<br>Mount the SSS-903 vertically with the Smart PGU sensor pointing down to reduce the possibility of dirt and dust building up on the window.<br>Ensure that the open slots of the gas passage are straight up and down to enable the gas to rise up and through the PGU sensor's cell.<br>Using the two surface mounting holes, attach the SSS-903 to a pole bracket or a surface mount to a wall. |

## *Mounting in Remote configuration*

***Figure 13 – Sensor removal***

In addition to the standard local configuration, the SSS-903 also supports remote placement of the PGU sensor up to 500 feet away from the housing.

Mount the SSS-903 housing vertically to reduce the possibility of dirt and dust building up on the window.

Using an optional bracket or the two surface mounting holes, attach the SSS-903 to a stable surface or wall.

Mount the PGU sensor to a stable surface or wall with user supplied clamps.

Connect the explosion proof conduit or cable to the SSS-903 housing.

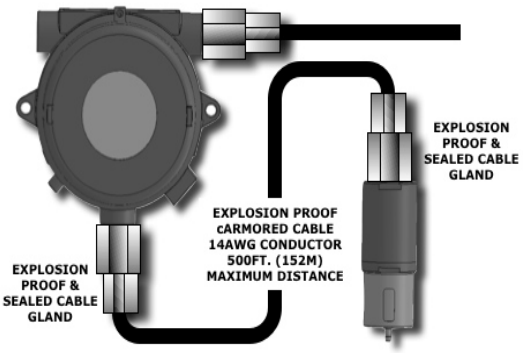
Connect the explosion proof conduit or cable to the PGU sensor.

Ensure that the PGU sensor is pointing down for maximum exposure.

All connections require explosion proof and sealed cable glands.

### *FIGURE 12 - REMOTE CONFIGURATION*

Note: The SSS-903 remote configuration option can be utilized with any gas analyzer equipped with the standard RS-485 (Modbus RTU) output and a power consumption of 24 VDC. This includes all of ESP Safety's toxic gas PGU sensors and ESP's SGOES Combustible Gas Detector.




## *Earth Grounding*

The enclosure of the SSS-903 Reciever must be earthed/grounded for for electrical safety and to limit the effects of radio frequency interference. An earth/ground point is provided on the outside of the SSS-903 Explosion Proof enclosure

Use 14 AWG copper, (Stranded or Solid), wire.

Loosen the screw sufficiently to enable wrapping the wire around the screw in a "U" shape. Raise the flat and lock washers and place the wire between the flat washer and ground base.

Tighten the screw to10.4lb-in torque.

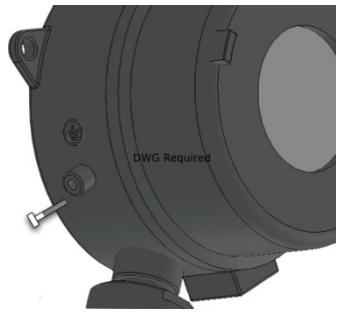



***Figure 14 – Ground***

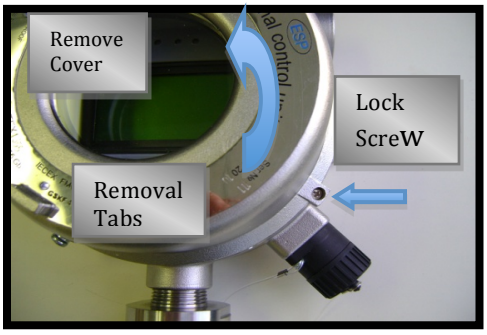
### Step 1- Remove Protective Cover

**Figure 15 - Cover Removal**

Loosen the Protective Cover Lock Screw approx. one turn.

Remove the explosion proof protective cover by turning counter clockwise. The handle of a Crescent Spanner Wrench can be used as a lever with the cover removal tabs.

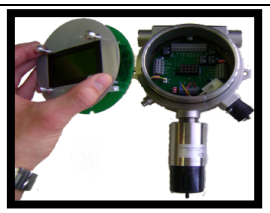
or




### Step 2- Remove Control PCBA Module

**Figure 16 - Remove Module**

Un-plug the control circuit by grasping two of the thumbscrews surrounding the display and pulling outwards.



### Step 3- Wire Preparation

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.

**Figure 17 –Wire Prep**

¼" (6mm)

Shielded 14 AWG Stranded wire (Recommended)

Paladin Model GripP – 1117 Multi-gauge wire stripper shown above

ESP safety recommends a Ferrule that is crimped onto the wire for better connectivity and ease of insertion into the terminal block.

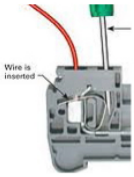
6mm Insulated Crimp On Ferrule

### Step 4- Electrical Connections

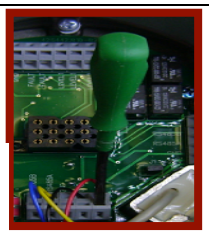
**Figure 18 - Spring Clamp Terminal Block**

Use a 2MM Flathead screwdriver or Spring Actuation Tool to engage spring connector slots when installing or removing wires.

Insert wire



Use tool to lever the spring open



### Step 5- Re-assemble the SSS-903

After wiring is completed insert the control module with the 4 LED lights at the top then attach the Explosion Proof protective cover onto the SSS-903 and secure by tightening the housing cover lock screw.

# 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 PGU sensor in a hazardous area using remote configuration, armored cabling is required for the Probe/Sensor connection to the SSS-903 receiver.

Cabling Guidelines

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 PGU sensor in a hazardous area using remote configuration armored cabling is required for the PGU Sensor connection to the SSS-903 Receiver

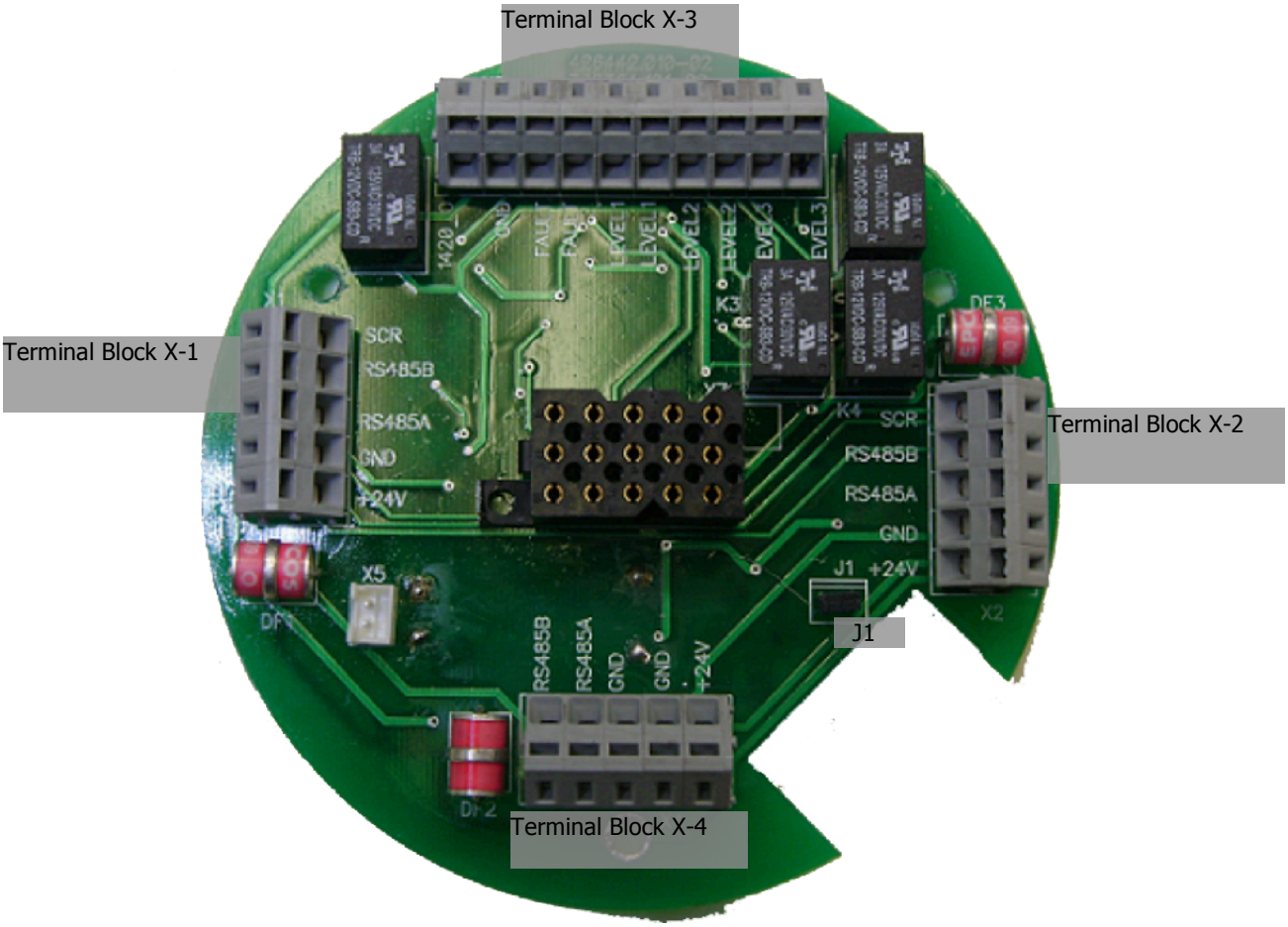
Minimum 14 AWG (2.08 $mm^2$) shielded cable conductors are required for optimal performance. The gauge of the wire used determines the maximum distance between the controller and the PGU SENSOR.

When using Modbus power and signal must be separate shielded twisted pair conductors

CAUTION: ***System Power / Digital Ground***

***System ground must be provided at the point of origination for 24VDC. Failure to do this may result in loss of range and/or signal integrity.***

***Figure 19 - Power Board Connecting Terminal Block Locations***



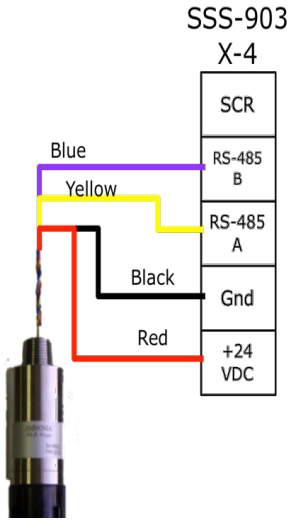
## *Table 6 SSS-903 Connections*

| Connection | Label | Function |
|---|---|---|
| Terminal Block X1 | SCR | Not Used |
| | RS485B | ModBus RTU Interface |
| | RS485A | ModBus RTU Interface |
| | GND | Digital Ground |
| | +24V | +24 VDC Power (From External Source) |
| | | |
| Terminal Block X2 | SCR | Bridge from X1 SCR for Daisy Chain configuration |
| | RS485B | Bridge from X1 RS-485B for Daisy Chain configuration |
| | RS485A | Bridge from X1 RS-485A for Daisy Chain configuration |
| | GND | Bridge from X1 GND |
| | +24V | Bridge from X1 +24 VDC |
| | | |
| Terminal Block X3 | +4 to 20 mA | Analog status system with embedded HART communication data |
| | GND | Digital Ground |
| | Fault Relay In | Normally Open Relay closes when the SS-903 detects a fault condition. |
| | Fault Relay Out | Closed condition output of Fault Relay |
| | Level 1 Relay In | Normally Open Relay closes when the SS-903 detects a pre-programmed level condition determined by +4 to 20 mA. |
| | Level 1 Relay Out | Closed condition output of Level 1 Relay |
| | Level 2 Relay In | Normally Open Relay closes when the SS-903 detects a pre-programmed level condition determined by +4 to 20 mA. |
| | Level 2 Relay Out | Closed condition output of Level 1 Relay |
| | Level 3 Relay In | Normally Open Relay closes when the SS-903 detects a pre-programmed level condition determined by +4 to 20 mA. |
| | Level 3 Relay Out | Closed condition output of Level 1 Relay |
| | | |
| Terminal Block X4 | SCR | |
| | RS-485B | Probe |
| | RS-485a | |
| | GND | |
| | +24V | |
| | | |
| Jumper 1 | J1 | Termination Jumper For "Daisy Chain" RS-485 configuration of Multiple SSS-903 Units. |
| | | |

# *Remote PGU Sensor Wiring to SSS-903*

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 TG sensor in a hazardous area using remote configuration, armored cabling is required for the Sensor connection to the SSS-903 receiver.

## *Figure 20 –PGU Connection to Terminal Block X-4*




# *Installation Wiring*

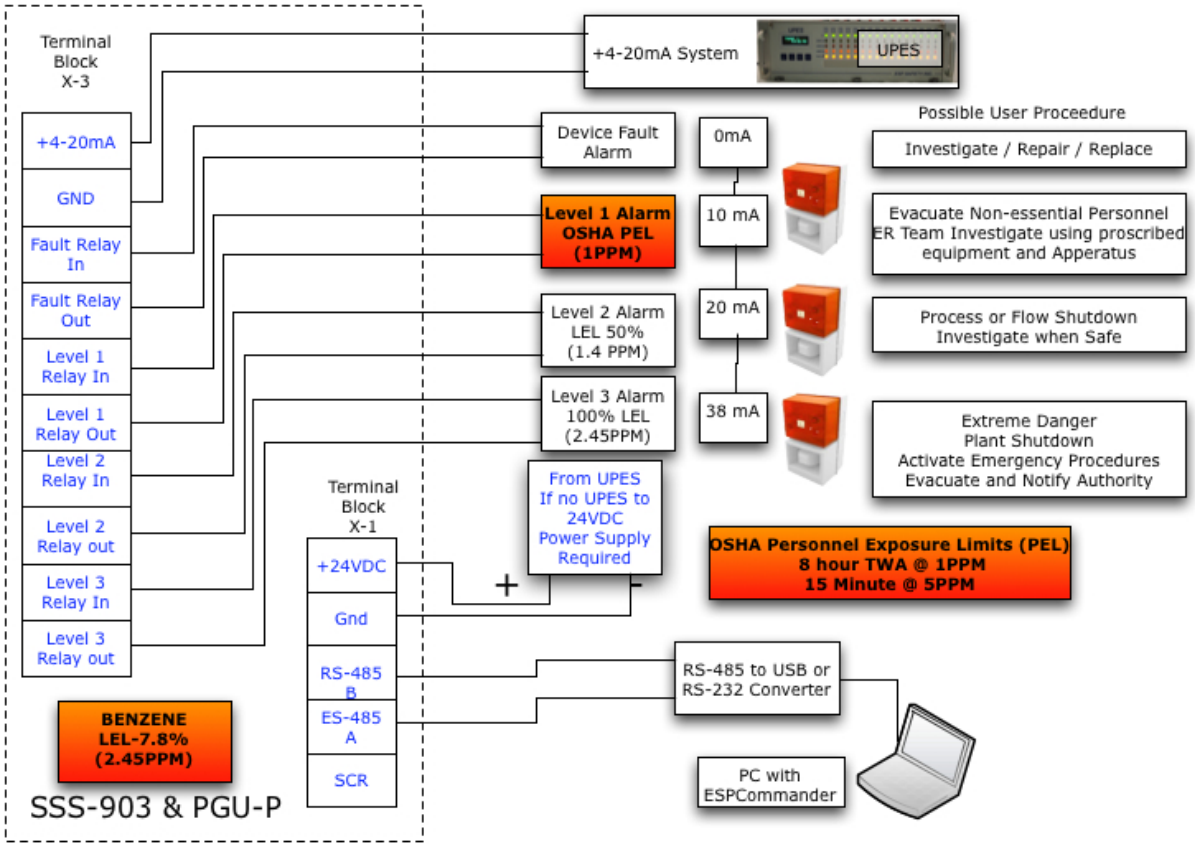
There are several methods of wiring connections for the SSS-903 Receiver. To accommodate this variety and provide ease of installation, the SSS-903 includes all hardware and connections for any configuration determined by the user making it well suited for new and replacement applications.

Caution: The installation of SSS-903 must comply with relevant requirements of the latest edition of the national Electric Code (ANSI/NFPA 70)

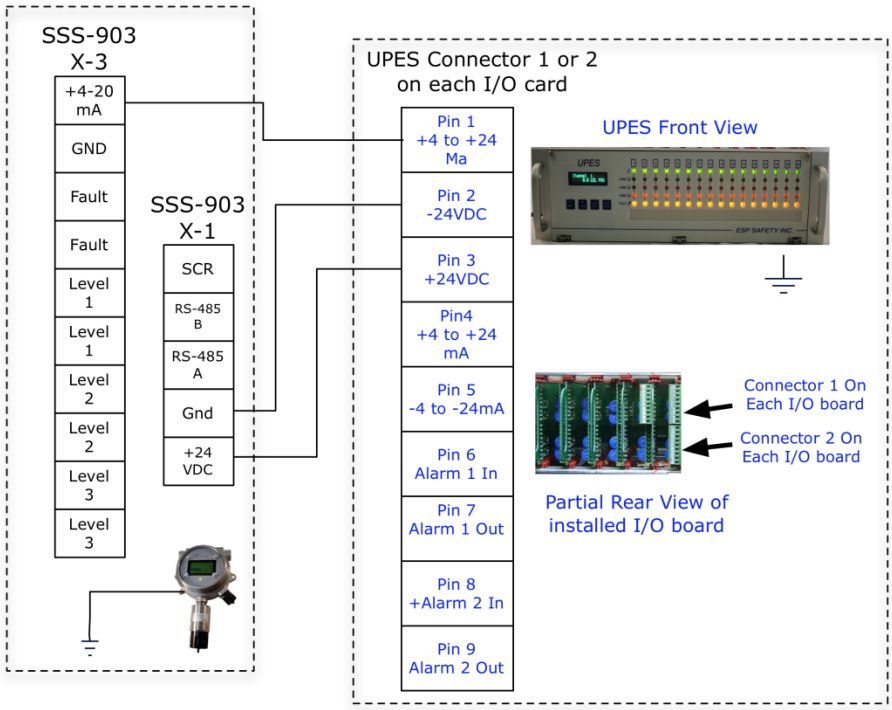
Caution: Connection Conduit, Barrier Glands, and Epoxy Sealants are to meet EN-50018/IEC 60079-1 Standards

Caution: ESP Safety Inc. Recommends use of shielded cable with 14AWG conductors reaching a span no greater than 3,900 ft. (1200 meter)

## *Figure 21 - Comprehensive Wiring Diagram for Multiple use Configuration*



## *Figure 22 - Connecting the SSS-903 to ESP Safety UPES Multichannel Controller*




## *Figure 23 - Connecting the SSS-903 Using 3 Wire Analog Interface Method*

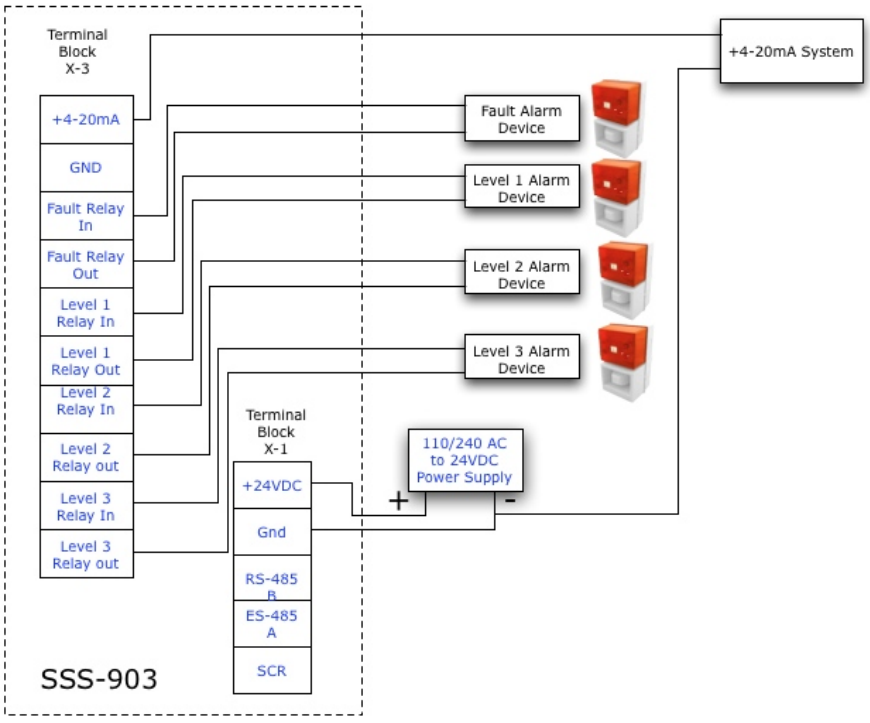
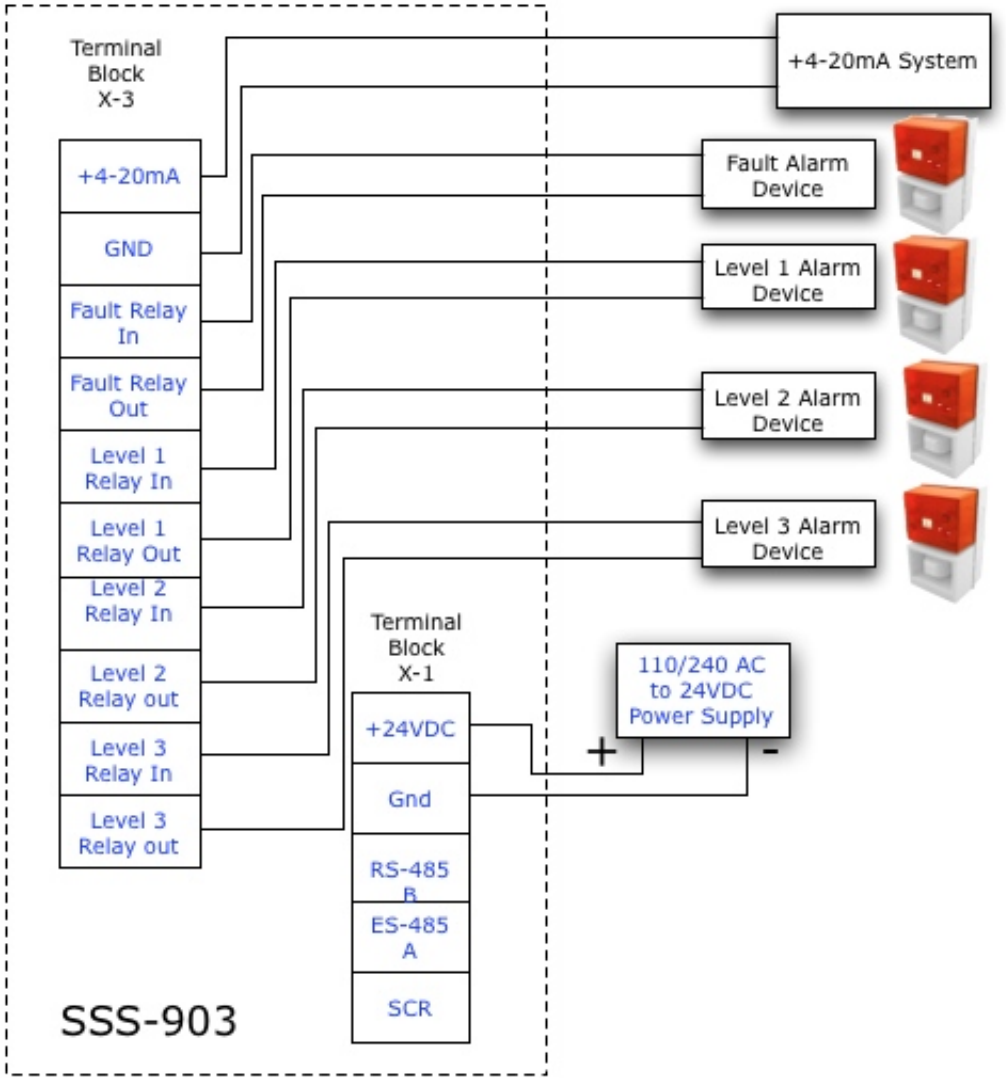
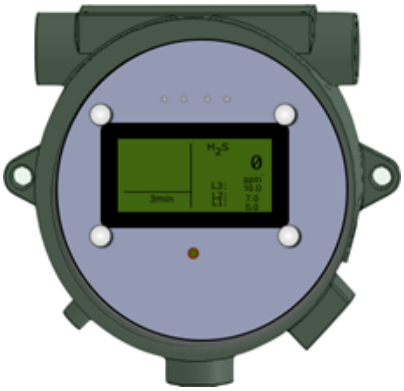
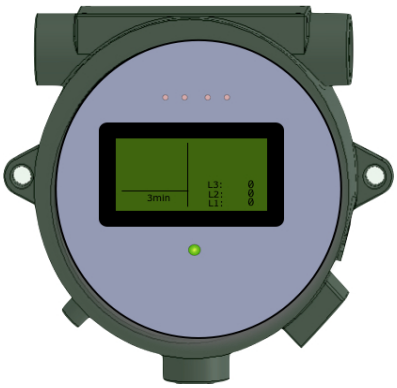


***Figure 24 - Connecting the SSS-903 Using 4 Wire Analog Interface Method***



# Power up and Stand Alone Operation of the SSS-903

| | |
|---|---|
| ***Installation Review Prior to Startup*** | Once the mounting, cabling, and alarm relay installation has been completed, the SSS-903 is ready to begin the power-on sequence.<br>Before applying power to the system for the first time, review the steps below:<br>Verify that the SSS-903 has been properly mounted. Ensure that all conduit / cable gland entries have been tightened and sealed if necessary.<br>Verify that all of the signal wires have been installed correctly.<br>Verify connection or earth/ground to the enclosure.<br>Verify connections between the SSS-903 housing and the PGU sensor if in remote configuration.<br>Verify the connections between the SSS-903 housing and any control room devices and alarm systems.<br>Make sure that the SSS-903 cover is securely installed and locked with the housing cover lock screw.<br>Make sure to turn off or disconnect any external devices, such as Trip Amplifiers, PLC devices or DCS systems, until after the startup sequence has been completed.<br>Once you are ready to begin startup, verify that the power supply is connected properly and verify input voltage with the SSS-903 disconnected at the source. The SSS-903 is powered by 24 VDC (12 to 36 VDC voltage range).<br>After completing the above, the SSS-903 is ready to be powered on. |
| ***Startup Procedure***<br>Before the initial power up, remove power from or disconnect all output devices and alarms to prevent actuation.<br>Apply power to the system. Upon first power-up, the SSS-903 should be allowed to stabilize and allow the sensor to initialize | ***Figure 25 - Initialization Screen***<br>  |
| After 15 seconds, the Operational Status indicator diode will glow green and all information will be available on the display. | ***Figure 26 - Operation Screen***<br>  |

# RS-485 Modbus Digital Communication and Operation

The Modbus interface is used for communication to all ESP Safety Detector models. Up to 480 devices can be connected in a Daisy Chain method. Modbus® RTU protocol uses ASCII/Hex data for communication and allows all SSS-903 functions to be transmitted using this method.Modbus protocol is a Master-Slaves protocol. ESP-Safety provides a communication program, ESP Commander that uses a PC as a Master Device controlling all connected Detectors as Slave devices.

The ESP Commander master initiates all communication to the devices. The slave detectors cannot transmit data without receiving a request from the master. The slave detectors cannot communicate with each other. MODBUS® is a registered trademark of Schneider Automation Inc.ESP Commander can perform real time monitoring, control operations, adjustment of function, and download of the non-volatile flash memory on the SSS-903.

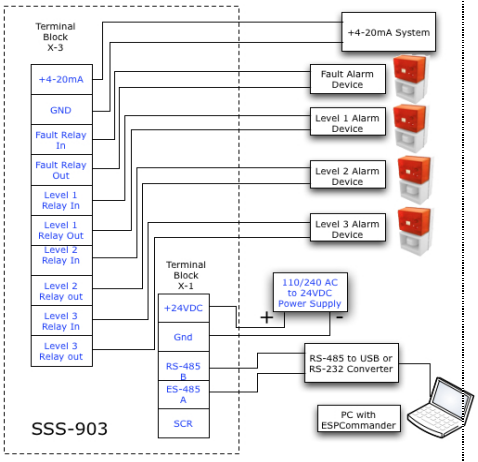
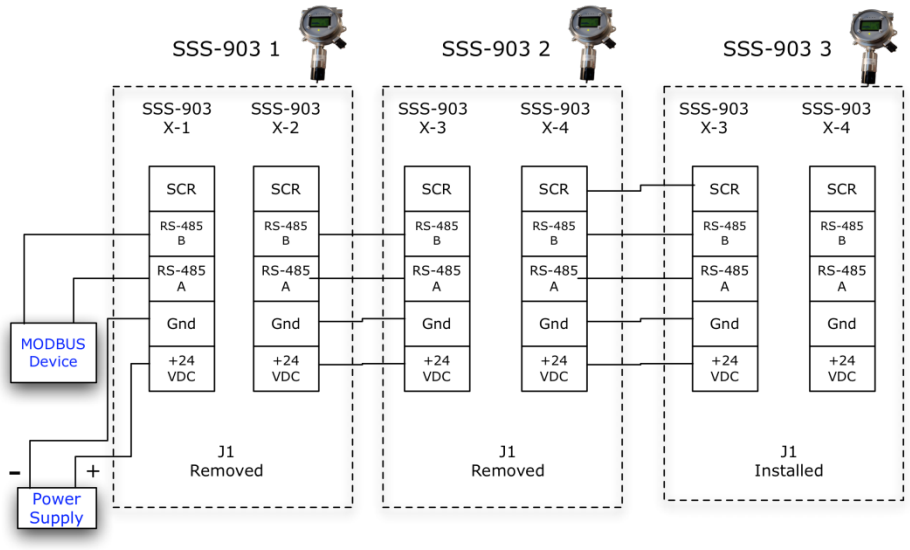



***Figure 27 - Modbus Connection with Analog and Alarm***

## *RS-485 Modbus Daisy Chain Digital Data Loop*

ESP Safety manufactures a variety of detection devices for fire, explosive and toxic gas detection. Up to eight detectors, of any mix, can be connected in a string, or daisy chain. When using this configuration, Jumper J-1 must be used for the last unit in the chain, providing signal termination. All other units must have J1 removed.

***Figure 28 - Modbus Daisy Chain***



# Calibration Procedures

Warning: Trained staff must perform all calibration procedures.
The calibration procedure work area must be located a safe distance from any hazardous zone.
Follow all site safety operating procedures before removing any detector from service.

Warning: All alarms must be disconnected to eliminate the possibility of erroneous alarm activation when performing this procedure.

## *Methods of Performing Calibration*

There are three methods available to perform calibration of the SSS-903 with Smart Probe:
Using RS-485 Modbus with the ESPCommander control Program (Bench Test Method A)
Using a HART Communicator (Non-invasive In Field or Bench Test Method B) HART Communicator required
Using a Magnetic "Wand" (Non-invasive In Field or Bench Test Method C) No Instrument or tools required

Non-Invasive Zero set up can be performed on SSS-903 detectors when installed in the permanent location by using a magnetic Wand that is included with every SSS-903 unit.

***Required Equipment For Non-Invasive Calibration***.

¼" PVC Tubing

ESP Safety Zero Gas and Span Gas disposable canister for the appropriate gas.

ESP Safety Magnetic Wands

***Figure 29 - Equipment for Magnetic Wand Calibration***

# Non-Invasive Magnetic Wand Calibration Procedure

## *Purging*

The working area must be free of any Gas or contaminants.

Connect the nipple of Sensor's collection chamber to the Zero Gas Cylinder with PVC tubing.

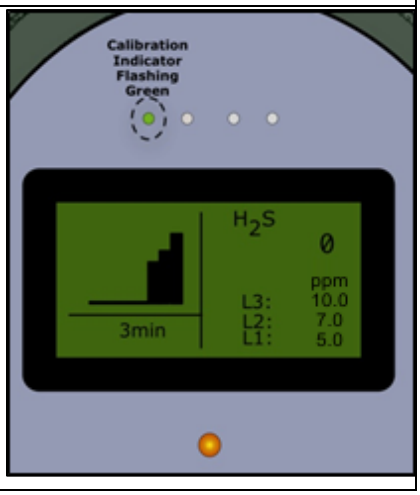
1. Apply magnetic wand to SSS-903 calibration point. CAL LED will turn solid green and 'CALIBRATION' message is displayed
2. Apply zero gas for at least 1 minute at 0.3 LPM flow rate. Ensure reading displayed on SSS-903 is a stable value (should be zero).


*Figure 30 – Purge for Wand Calibration*

## *Wand Zero Cal*

Apply magnetic wand to SSS-903 calibration point. CAL LED will start to flash green. Displayed value should be zero (zero calibration is now complete).

*Figure 31 - Zero Cal with Wand*

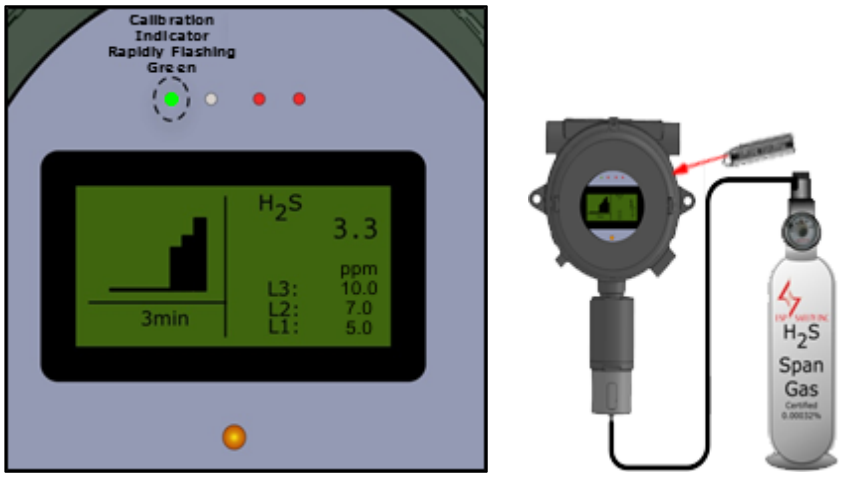
## *Wand Span Cal*

1. Apply calibration gas for 1 minute at 0.3 LPM flow rate. Reading displayed should increase to near calibration gas value. Ensure reading is stable value.

2. Apply magnetic wand to SSS-903 calibration point. The CAL LED will start rapidly flashing green. The magnetic calibration gas value is now set, displayed value should equal magnetic calibration gas value.

3. Remove the calibration cup, once calibration gas is clear of the sensor (readings approach zero) CAL LED will turn off and 'CALIBRATION' message turns off indicating calibration is complete.

## *Figure 32 – Span Cal with Wand*

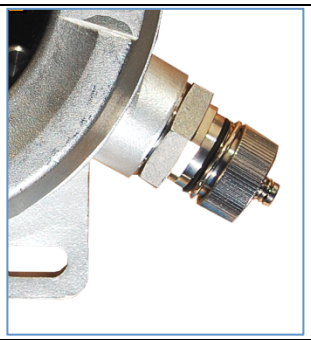



Caution: Factory calibration of the PGU sensor is performed using a gas flow rate of 0.3 LPM (Litres Per Minute). ESP Safety recommends that field calibration of PGU sensors is performed at the same flow rate. Using non-recommended flow rates may result in calibration errors.

# Non-Invasive Calibration Procedure w HART Communicator

Non-Invasive field calibration can be performed on SSS-903 detectors with a HART communicator.

Establish communication between the HART Communicator and the SSS-903 by attaching the ESP Safety-supplied cable to the HART connection port of the SSS-903



***Zero Calibration using a HART Communicator***

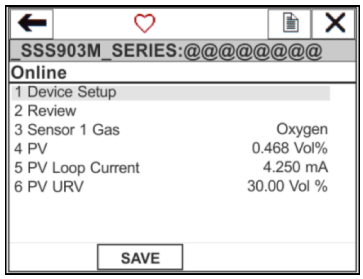



**Figure x-xx: Online Display**

**Step 1:**

From the Online Display, select *1 Device Setup*

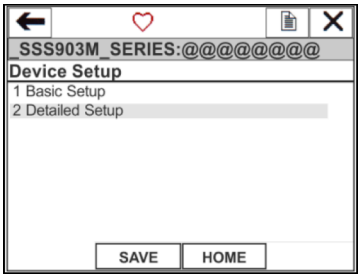



**Figure x-xx: Device Setup**

**Step 2:**

Highlight and select the *2 Detailed Setup* item.

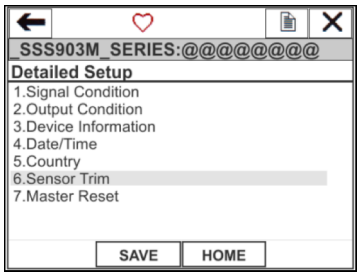



**Figure x-xx: Detailed Setup**

**Step 3:**
Highlight and select the *6 Sensor Trim* item.

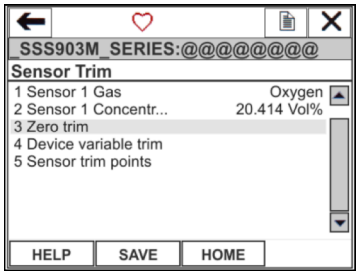



**Figure x-xx: Sensor Trim Select**

**Step 4:**
From the Sensor Trim Display, highlight and select *3 Zero Trim*

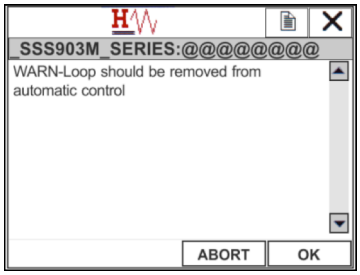



**Figure x-xx: Warning Message**

**Warning Message 1:**
Note the warning message. As a safety precaution, any alarms or devices controlled by the gas sensor output should be disabled at this time.

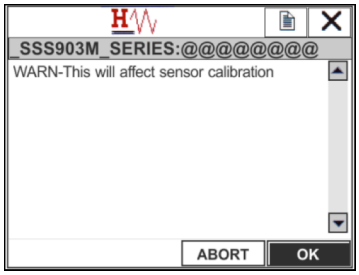



**Figure x-xx: Warning Message 2**

**Warning Message 2:**
Note the warning message. The user may abort the calibration sequence at this point if calibration is not desired at this time.

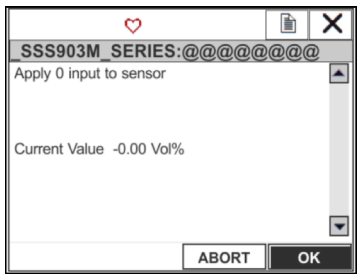



**Figure X-XX: Sensor Zero Calibration**

**Step 5:**
Apply the zero gas to the sensor and wait for the reading to stabilize. Press "OK" to complete the sensor zero calibration. Press "ABORT" to cancel the calibration sequence. Remove the zero gas from the sensor.

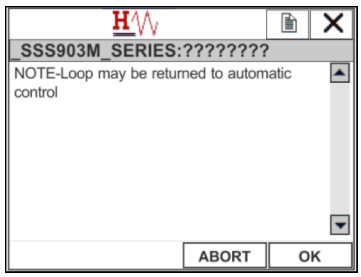



**Figure x-xx: Warning Message**

**Warning Message 3:**

***Span Calibration using a HART Communicator***

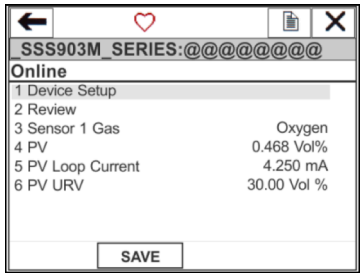



**Figure x-xx: Online Display**

**Step 1:**

From the Online Display, select *1 Device Setup*

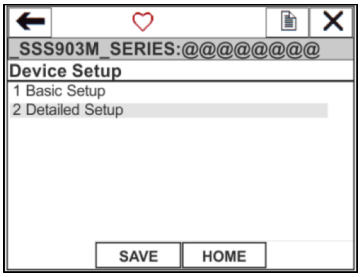



**Figure x-xx: Device Setup**

**Step 2:**

Highlight and select the *2 Detailed Setup* item.

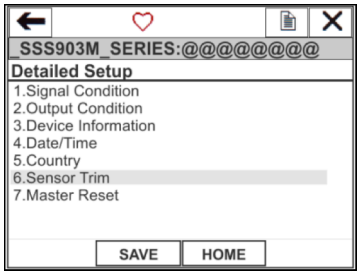



**Figure x-xx: Detailed Setup**

**Step 3:**

Highlight and select the *6 Sensor Trim* item.

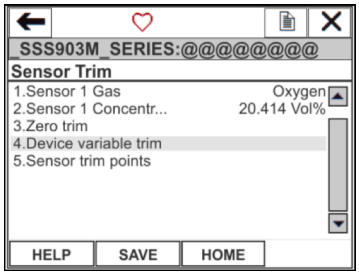



**Figure x-xx: Sensor Trim Select**

**Step 4:**

From the Sensor Trim Display, highlight and select *4 Device Variable Trim*

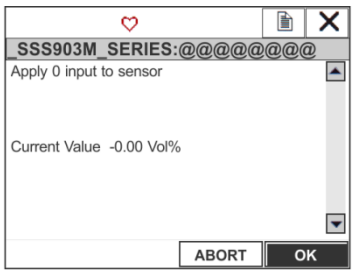
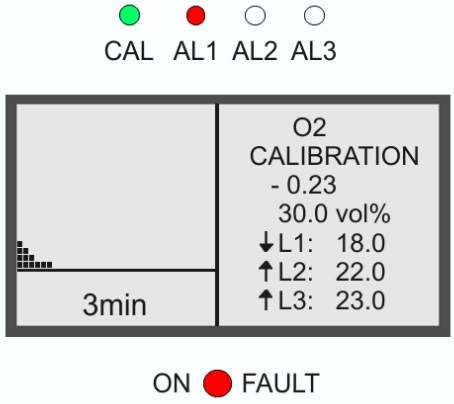



**Figure X-XX: Sensor Zero Calibration**

**Step 5:**

Apply zero gas to sensor. When the displayed gas is stable, select OK




**Step 5a:**

The SSS-903 display will show 'Calibration' message and green CAL LED will flash.

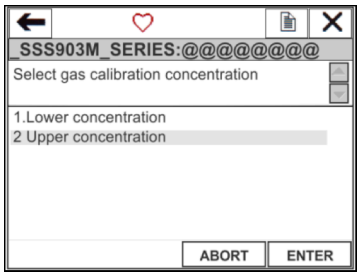



**Figure x-xx: Warning Message**

**Step 6:**

Select gas calibration.

1. Lower Concentration (choose for mid-span)
2. Upper Concentration (choose for full-scale)

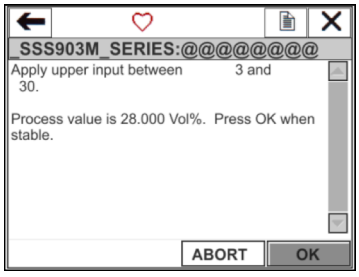



**Figure x-xx: Warning Message 2**

**Step 7:**

Apply concentration gas. When the displayed gas value is stable, select 'OK'.

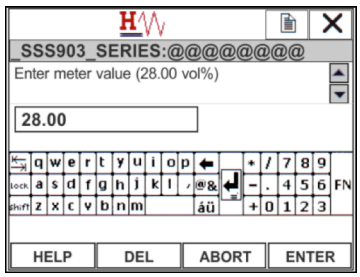
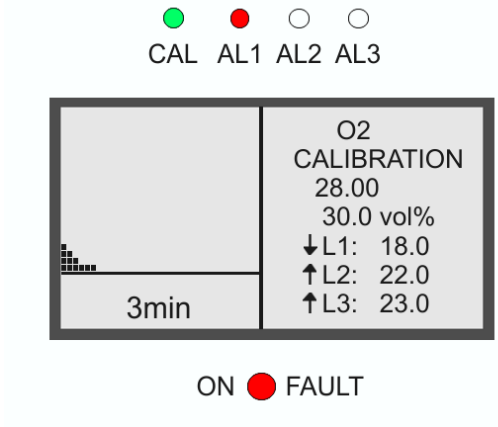



**Figure X-XX: Sensor Zero Calibration**

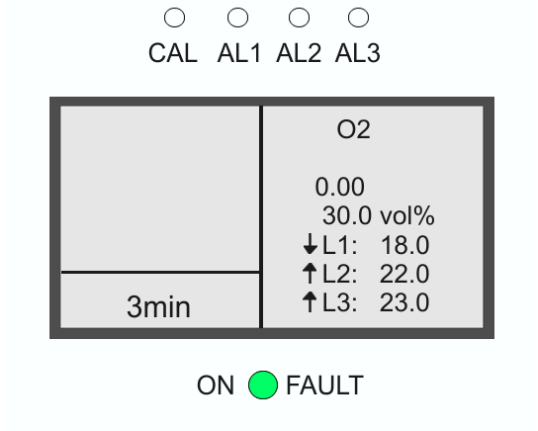
**Step 8:**

Enter the span gas concentration in the units specified. Press 'ENTER' to complete




**Step 8a:**

The value of the gas displayed on the SSS-903 should now equal the reference gas concentration.




**Step 9:**

Reapply zero gas. The green 'CAL' LED on the SSS-903 will flash for approximately three minutes as the readings stabilize. When calibration is complete, the green 'CAL' LED will turn off and the 'ON/FAULT' LED will display solid green, indicating normal function.

# Bench Test Calibration Procedure with ESP Commander

The bench test procedure requires the SSS-903 and PGU sensor to be removed from a field installation for testing in an area designated by the user. Site safety procedures should designate the location, configuration, and safety requirements.
The user may also choose to perform a bench calibration as part of a commissioning procedure for a new (out of the box) unit prior to installation.

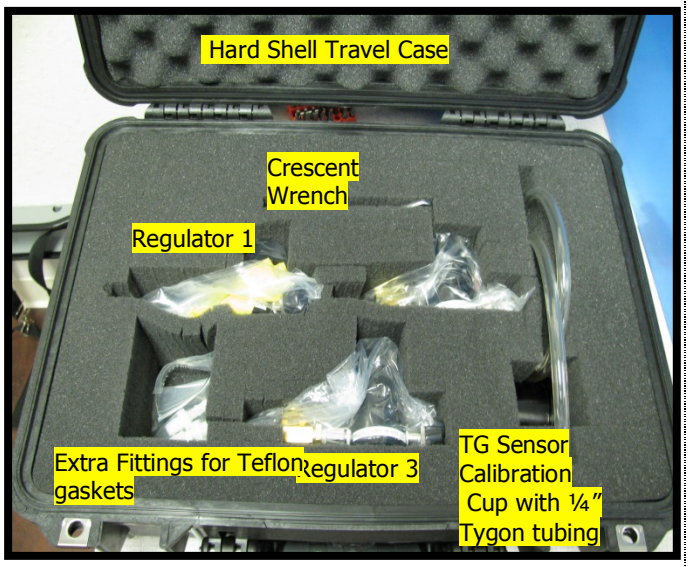
Warning: SSS-903 Receivers and PGU Sensors may be used in conditions where Toxic gasses may have been present. The customer must follow their defined and regulatory procedures, including protective clothing and or breathing apparatus for safe handling of these toxic substances, as residual of amounts of the toxic substance may be present in the Detector units being calibrated.

Caution: Before the calibration and verification procedure, inspect the SSS-903 for any mechanical damages to the enclosure and/or sensor elements. Please contact the ESP Safety Inc. service department for further information

## *The following equipment is required for ESP Commander calibration of the SSS-903:*

ESP Safety Inc. SSS-903 Calibration Kit for Methane Gas (Part Number 24011-xxx)
Power supply: output voltage 0-30VDC with adjustable current limit (no less than .05mA)
Digital Multimeter (Optional)
Plastic or vinyl tube – 3 pieces of 59.06 inches (1.5M) in lenPGUh
Four control lamps (24VDC) for relay operation verification (Optional)
PC With Windows operating System
Convertor RS232/485 (Or USB to RS-485 Adapter Cable)
ESP Safety Inc. "ESP Commander Program"

Figure 39- ESP Safety Inc. calibration Kit Methane Gas



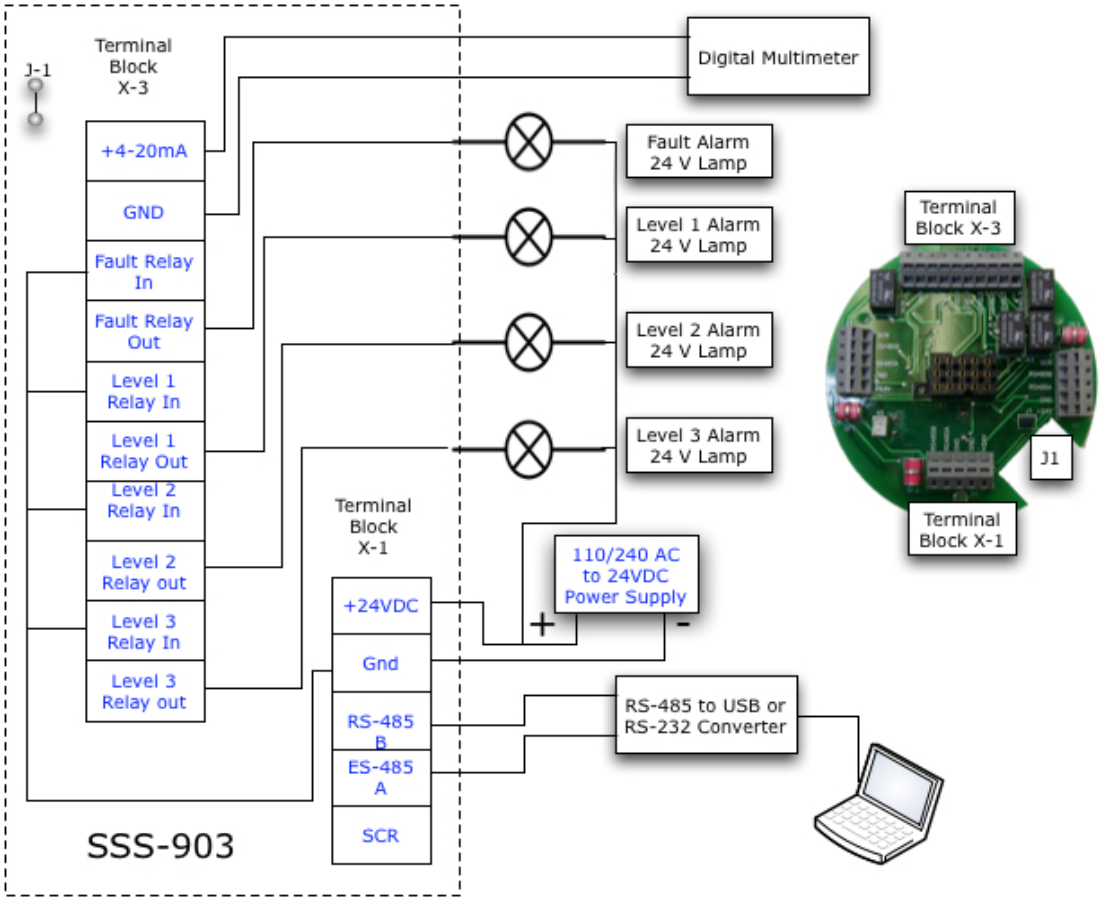

Calibration Gas Cylinders
Zero Gas (0% LEL)
Mid Span Gas (typically 50%LEL)
Span Gas (typically 90% LEL)
Cylinders are supplied with 1 cubic liter of gas at 1600-1800 PSIG. Replace cylinders when the internal pressure is lower than 200PSIG

## *Calibration Kit Components*

| ITEM | PART NUMBER | DESCRIPTION | QTY |
|---|---|---|---|
| 1 | 50016-xxx | ZERO GAS CALIBRATION CYLINDER | 1 |
| 2 | 50021-xxx | MID-SPAN CALIBRATION GAS CYLINDER (50% LEL) | 1 |
| 3 | 50022-xxx | SPAN GAS CALIBRATION CYLINDER (50% LEL) | 1 |
| 4 | 40072-xxx | REGULATOR, SINGLE STAGE, FIXED ORIFICE, 500 SCCM | 3 |
| 5 | 40074-xxx | CUP, CALIBRATION, SSS-903 | 1 |
| 6 | 40076-xxx | CASE, TRAVEL, CALIBRATION KIT | 1 |

***Note: User supplied tanks and regulators may be employed. Flow rates must be limited to 10 LPM as measured on a rotameter.***

## *Figure 40 - Wiring Diagram for Bench Calibration*

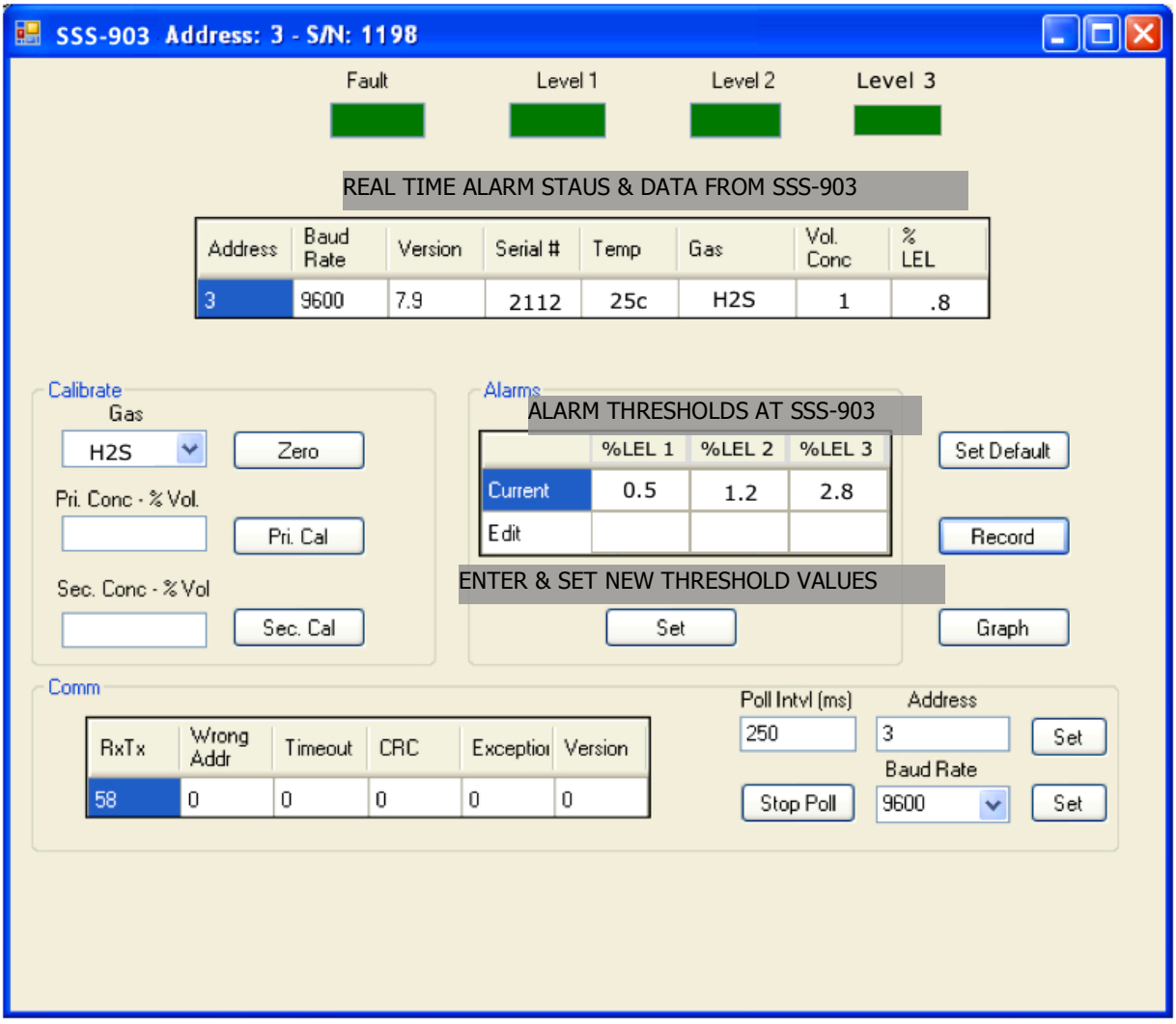


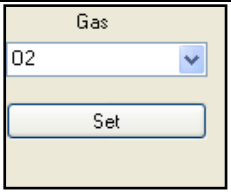
| | |
|---|---|
| Figure 41 -Launch ESP Commander<br>Software Program on the user supplied PC interfaced to the user supplied RS-485 to USB converter.<br>Select The COM port for the link between the PC and converter<br>ESP Commander will scan for all devices connected (via MODBUS communication protocol)<br>Select the device to be calibrated by "double clicking" |  |

***Figure 42 -ESP Commander Operating Screen Display and Function:***

Device Model
Device relay state
Device Address
Version
Serial Number
Device Address Assignment

Detection Gas
Calibration Values
Alarm Values
Graph of Alarm events
Recording of Real Time Data
Polling Interval




| | |
|---|---|
| After connecting the SSS gas analyzer to the PC, ensure that the digital interface is functional by comparing the SSS-903 settings with those display by ESP Commander. | |
| ***Figure 43 –Cal Gas Selection***<br>Use the pull down to select the gas to match the labeling on the sensor.<br>The gas pull down is pre-programmed with the required LEL/ppm for the selected gas. |  |

Connect tubing between the gas cylinder and PGU sensor inlet nipple.

Using the Zero Gas Cylinder, purge the the cup and PGU sensor by inserting the tubing from the Zero Gas Cylinder and passing approximatly one Liter of Gas into the sensor.

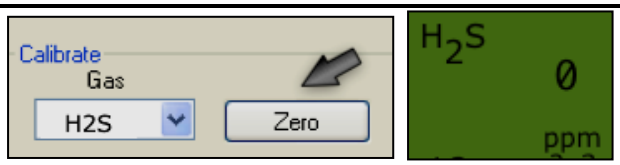

***Figure 44- Zero Cal Purge using ESP Commander***

***Figure 45- Zero Cal***

When measured gas level has stopped changing, Zero or close to it, Click on Zero.

Current loop out put will equal 4.0mA

The SSS-903-903 will show Zero



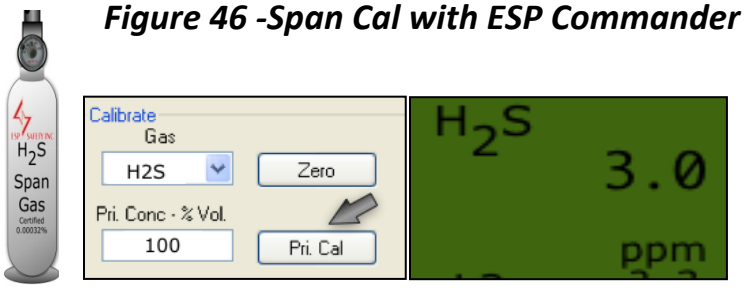
Attached the Span Gas Cylinder with the mixture value as required.

Start a flow into the Calibration cup. After about 60 seconds, the count will top out. Set this as Span or the user selected Max % of the LEL.

Current loop output will equal 20ma.

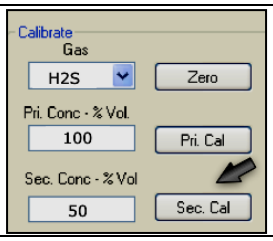
Hydrogen Sulfide is measured as ppm the setting for 100%LEL is equal to the screen value.

***Figure 46 -Span Cal with ESP Commander***




A second gas with a mixture equal to 50% LEL may be used for calibration of span or mid span.

***Figure 47 – 50% Span***




Level 1,2,3 Alarm levels can now be entered to the SSS-903 by entering the value and clicking set.

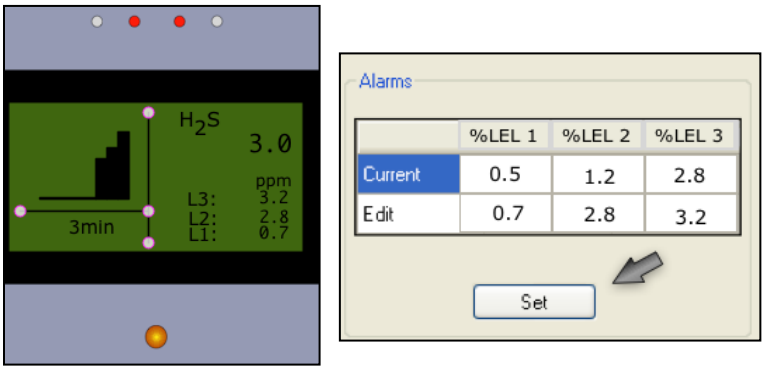
Stop the flow and remove the Span gas hose and Cal Cup at this point.

The SSS-903 can now be reassembled and returned to service.

Note that in the SSS-903 Screen (left) the Alarm 1, Alarm 2, are RED and the Tri Color LED Alarm Status is YELLOW.

When the Span gas is removed, the ppm value will drop to zero and alarms will turn off when thresholds are crossed.

***Figure 48- Setting Alarm Thresholds***




# Unpack A New SSS-903

The contents should be carefully removed and verified against the packing list. If any damage has occurred or there is any discrepancy in the order, please notify ESP Safety Inc. customer service department as soon as possible at (408) 886-9746 or via Email mailto:info@espsafetyinc.com

***Warranty***: ESP Safety Inc, 555 North First Street San Jose, CA 95112 USA, guarantees the SSS-903 will be free of manufacturing defects
for 5 years after date of commissioning, provided the customer follows all guidelines pertaining to installation, operation, and maintenance detailed in this Operating Manual.During this warranty period, the manufacturer will correct any failures detected in the SSS-903 or replace any damaged unit
free of charge.

***Field Repair***

The SSS-903 detector has no user serviceable parts. If a problem should develop, refer to the Troubleshooting information. If it is determined that the problem is caused by a manufacturing defect, please return the device to the factory for repair or replacement.

***Return Material Authorization (RMA)***

Contact ESP Safety Inc at 408-886-9746 to obtain a Return Material Authorization (RMA) number. In the call, provide the following information:

- Company Name
- Serial Number
- Date of Commissioning
- A brief explanation of malfunction

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

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

Write the RMA number on the front of the shipping carton.

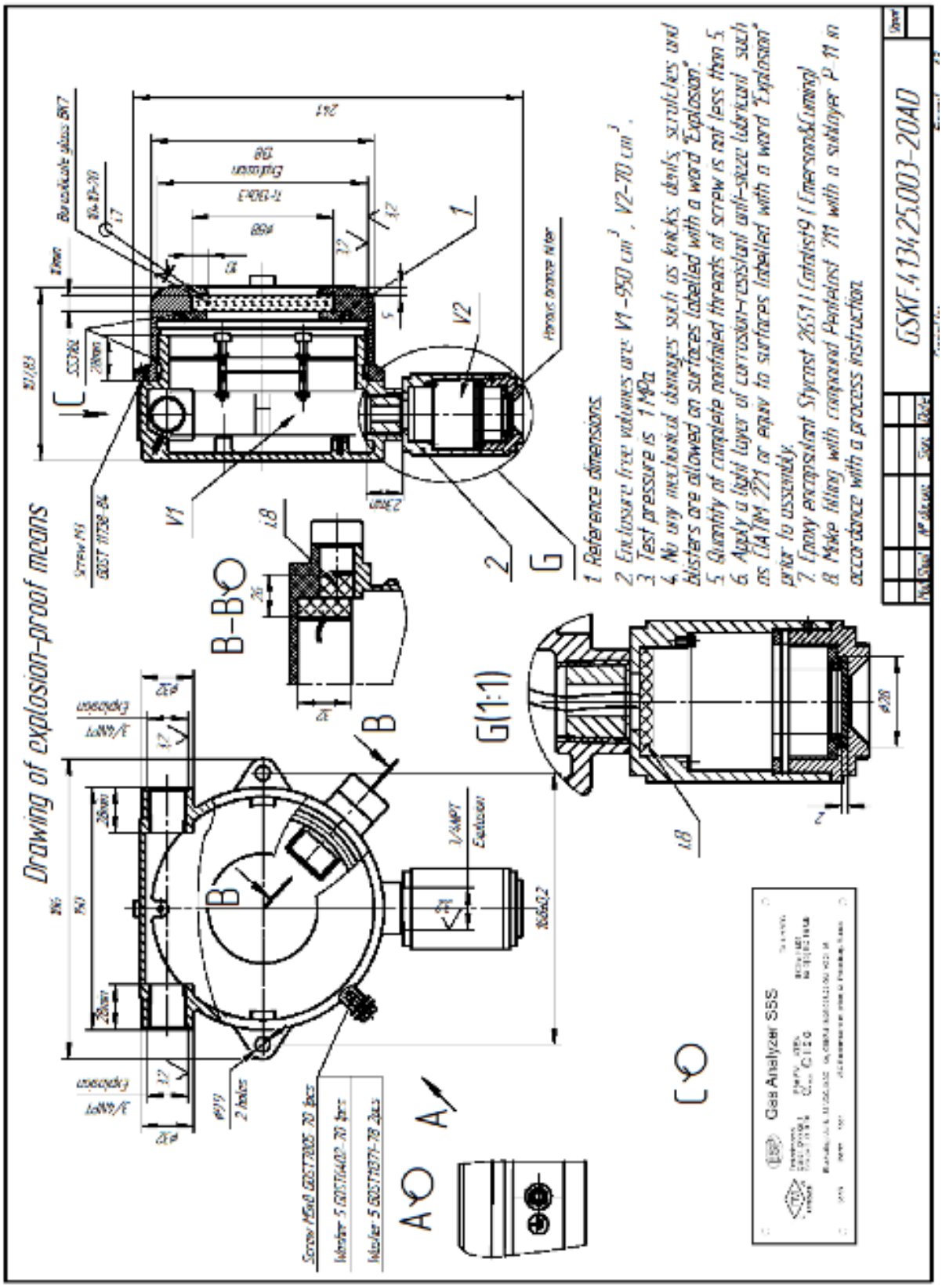
## *Maintenance*

The technical maintenance for the SSS-903 systems consists of periodical external examination and zero setup. The inspection interval is set by the based upon their operating procedures. Physical inspections of the detector installation should be performed at regular intervals as determined by customer procedure.Detectors used in corrosive environments should be replaced at regular intervals. Contact ESP Safety to order replacement
PGU Sensors.

## *Troubleshooting*

| Malfunction / Problem | Possible Cause | Troubleshooting Method |
|---|---|---|
| Unit does not perform self test on power up | Low Power supplied. | Check input voltage to be 18 to 36 VDC range |
| Following power-up of and self testing mode completion some functions fail | Microprocessor error | Return to ESP Safety for repair |

# Appendix I: Explosion Proof Design



# Appendix II: Warranty & Return Policy

ESP Safety, Inc. ("ESP") warrants the SSS-903 Gas Detector 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 defects 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 to be shipped pre-paid by buyer.

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.

***Field Repair***

The SSS-903 Gas Detector is not intended to be repaired in the field. If a problem should develop, refer to the troubleshooting section of this manual. If it is determined that the problem falls within this warranty, please return the product to ESP as instructed hereunder.

***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:

-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 pre-paid to:

ESP Safety Inc.

555 North First Street

San Jose, CA 95112 USA

Write the RMA number on the front of the shipping carton.