Gas Detector SGOES
Operating Manual

413311.002 OM

Revision History:

Date	Revision	Description	Approved by
18.06.2015	01	Operating Manual	Zverev A.

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APPENDICES SCHEDULE:

INTRODUCTION

ESP, designs and manufactures affordable safety products and protection solutions for industrial safety and fire protection. Our company is committed to partner with our customers, contractors, and Architects in their design process to create a system that best meets the specification. After the system is installed, ESP offers customer assistance via telephone, email, or instant message. On site commissioning services and field support are available to ensure and maintain the protection of lives and infrastructure in hazardous environments. Our line of industry leading products, services, and systems benefit society, save lives, and preserve capital resources.

1. PURPOSE

SGOES is used in dangerously explosive areas of indoor and outdoor facilities providing reliable detection for a wide range of applications in accordance with IEC 60079-14-96.

The SGOES is explosion proof, making it the detector of choice for several environments. SGOES has a very low occurrence of false/positive alarms and is ideal for automated warning, control, and suppression system designs used in unmanned and centrally controlled applications.

SGOES is used in unmanned warning and control systems and as standalone device for detecting gases and vapors.

ESP has designed the SGOES to detect and quantify the presence of hydrocarbons by measuring their absorption of infrared light (IR). SGOES is based on dual-compensated multi-channel non-focusing infrared gas absorption technology. Providing continuous monitoring of pre-explosive concentrations of combustible hydrocarbon gasses and vapors, with a rapid response time. SGOES has an explosion proof certified enclosure. SGOES is also certified by international accreditation agencies for SIL-2 rating.

Because SGOES does not depend on the presence of oxygen in a mixture of gases, it can function effectively in environments where other sensor technologies cannot, thus it is the de-facto standard for oil and gas facilities, pharmacies, automobile and other factories where safety is a priority for the company. Moreover, SGOES is not sensitive to inadvertent detection of gases, such as nitrogen, oxygen, carbonic acid, ammonia, and hydrogen sulfide.

2. BASIS PERFORMANCE CHARACTERISTICS

Mechanical Characteristics	
Material	Stainless Steel (SS316)/Aluminum
Conduit Connection	• 2 Cable Entries (1/2 NPT)
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	• 2W (Standby) • 4.5W (Alarm) • 7.9W (Heated Optics)
Output From SGOES	• +4-20mA • HART 7.0 • RS-485 MODBUS RTU • 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
Operational Characteristics	
Gases detected	Methane, Propane, Butane, Pentane, Hexane, (Gases from C1 to C12 are available upon request.)
Gas Detection Range	0-100% LEL
Accuracy	± 1% up to 50% LEL/ ± 2% from 50 to 100% LEL
Response Time (for 100% LEL methane)	50% full scale < 1.9 seconds 90% full scale < 5.0 seconds
Humidity Range	Up to 95% RH, non-condensing (Withstands up to 100% RH for short periods)
Warm-up time	5 minutes
Operating Temperature	-40^{o}C to +85^{o}C
Ingress Protection	IP66
Status Indication	Tri-color status LED indicates operational mode, fault, and gas presence.
Display*	-Indication of %LEL -Alphanumeric Indication of Fault -Alphanumeric Indication of calibration in progress

Notes:

*SGOES analogue and digital output signals variation shall not be in excess 0.5 in quotas of limits of basic error.

* Alteration of SGOES analogue and digital output signals within the set time interval of 24 hours shall not be over 0.5 in quotas of limits of basic error.

* There are the limits of complementary error of thermal variations of environment for each 10°C at minus 60°C to 90°C temperature range not more 0,3 of in quotas of limits of basic error.

* SGOES is tolerated the temperature range from – 50 to 50°C in industrial packaging

* SGOES remains serviceability under the high relative humidity 95% of environment which is up to quality of exploitation and transportation at temperature 35C.

* SGOES remains serviceable under the influence of sinusoidal vibration to quality of exploitation.
* SGOES remains serviceable under the influence of sinusoidal vibration according to quality of transportation.
* SGOES nominal static conversion function is presented at the Appendix A
* Display is provided optionally

Ordering Guide:

For simplifying the ordering process, SGOES is configured for detection of specific gases. For gases or concentrations not indicated in Table 1, please contact ESP.

Table 1

		Scale Range		
SGOES Model to Order	**Detected Hydrocarbon**	**%LEL**	**%vol IEC6007920-2000/BSEN617791:2000**	**%vol ISO 10156**
SGOES-CH4	Methane	0 to 100	0 to 4.4	0 to 5.0
SGOES-C3H8	Propane	0 to 100	0 to 1.7	0 to 2.1
SGOES-C4H10	Butane	0 to 50	0 to 0.7	0 to 0.9
SGOES-iC4H10	Isobutane	0 to 50	0 to 0.65	0 to 0.9
SGOES-C5H12	Pentane	0 to 50	0 to 0.7	0 to 0.75
SGOES-C5H10	Cyclopentane	0 to 50	0 to 0.7	0 to 0.75
SGOES-C6H14	Hexane	0 to 50	0 to 0.5	0 to 0.55
SGOES-C3H6	Propylene/Propene	0 to 50	0 to 0.1	0 to 1.5
SGOES-CH3OH	Methanol Vapor	0 to 50	0 to 2.75	0 to 3.65
SGOES-C2H5OH	Ethanol Vapor	0 to 25 0 to 50	0 to 0.78 0 to 1.55	0 to 1.08 0 to 2.15

2.1. Reliability.

2.1.1. Average error-free running time of SGOES is not less than 55,000 hours.
2.1.2. Average service life of SGOES is not less than 15 years.

2.2. Safety

2.2.1. SGOES is made in an explosion-proof modification; the type of explosion protection is “Explosion-proof enclosure”, the related explosion-protected marking is Class I, Division 1 & 2, Group B, C & D, T4. SGOES is also designed and certified in compliance to EN 50270 for electromagnetic immunity.

SGOES is designed to be explosion-proof thus SGOES units installed and in operation must not be modified in any form. All labeling must be intact and visible.

The enclosure explosion protection marking is: Ex d IICT4 Gb.
For safety application need to use a certified power supply with SELV or $PELV_{ouput}$ (Um=32V).
SGOES Explosion proof means are detailed in Appendix B-1 of this document.

Explosion protection of SGOES is ensured by:

Cabling entering into and out of the SGOES must utilize explosion-proof gland connections. The cable gland should be able to withstand explosion pressure and prevent spread of combustion into the hazardous area. The connection points are marked in the drawings with word “Explosion” and indicate permissible values of the explosion-protection parameters.

- Limit the enclosure outer temperature to no higher than 135 °C.
- All the bolts securing the parts and an enclosure must be sufficiently tightened and prevented from loosening by using spring washers or lock nuts.

The enclosure of SGOES contains warning nameplate:

“DO NOT SEPARATE WHEN ENERGIZED”

All surfaces labeled with a word “Explosion” are protected with consistent grease.

2.2.2. The SGOES enclosure protection class is IP 66 according to EN/IEC 60529.

3. COMPONENT PARTS AND DELIVERY SET:

Delivery set is consisting of:

- SGOES Gas Detector
- Mounting Bracket
- Sensor Cap
- Nuts and Bolts
- Magnetic Wand*
- Ex d Cable Gland
- Ex d Bling Plug

Available Options:

- Calibration Kit (Zero and Span Gasses)
- Additional Magnetic Calibration Wand
- 2” Pipe Mounting Kit
- Gas Calibration chamber.

*1 Magnetic Wand is shipped per 10 detector F.O.C, any additional quantities will be on a chargeable basis

4. SGOES DESIGN AND PERFORMANCE

Operation is based on selective signal disruption by hydrocarbon molecules when an infrared light source is reflected to an optical detector. If no gas 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 SGOES.

SGOES consists of optical and electronic parts in the explosion-proof enclosure. There are emission sources and radiation receivers.

Output signals of SGOES are taken from terminals mounted inside the explosion-proof compartment

5. INDUSTRIAL SAFETY MEASURES SPECIFICATION

Be sure to read and understand the entire instruction manual before installing or operating the gas detection system.
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.

Installation:

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

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

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

Preparing for installation:

- Before the 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 the consult local installation codes.

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

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

Five factors play and important role in the selection of sensor locations:

Density of the Detected Gas

- If the target gas is heavier than air, the sensors 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 ground in open areas or in pitched areas of enclosed spaces

Probable Leak

- Leak sources include flanges, valves and tubing. Connection of the sealed type where seals may either fail or wear. All potential leak sources and SGOES mounting locations are best determined by facility engineer with experience in similar processes.

Ventilation and Prevailing Winds:

- Normal ventilation or prevailing winds must be considered for location 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 provide easy access for maintenance personnel. SGOES location should take into account proximity for contaminants that may foul or obscure the SGOES optics.

Tools Required for Mounting:

- 5/16 wrench for Ground connector
- Allen Wrench set
- Ferrule Crimper (up to 12ga)

Mounting:

- SGOES should be mounted in a horizontal plane.

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 in- formation 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.**

 **Warning: Take appropriate precautions, including wearing and use of protective clothing and devices when servicing the SGOES as they may have remnants of corrosive solutions.**

 **Caution: ESP recommends use of shielded cable with 16AWG conductors reaching a span no greater than 6500 ft. (2000 meter).**

 **Caution: The SGOES detector has no user serviceable parts. If a problem should develop, refer to the troubleshooting table. If it is determined that the problem is caused by a manufacturing defect, please return the device to the factory for repair or replacement.**

 **Caution: Observe precautions for transport and handling of electrostatic sensitive devices**.

 **Caution: SGOES detectors have been tested and approved for use in hazardous areas. However, it must be properly installed and used only under the conditions specified within this manual and the specific approval certificates. Any device modification, improper installation, or use in a faulty or incomplete configuration will render warranty and product certifications invalid.**

6. PRE-STARTING PROCEDURE

6.1 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. Ensure that all conduit/ cable gland entries have been tightened and sealed.
- Verify that all the signal wires have been installed correctly as per the wiring diagrams provided in the manual.
- Verify connection of earth/ground to the device internally and externally.
- Verify the connections between the SGOES housing and any control room devices and alarm systems.

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

Startup Procedure:

Before the initial power up, remove power from or disconnect all output devices and alarms to prevent actuation. Apply power to the system.
After 15 to 30 seconds the self-test initialization sequence will be completed. At this time the unit will be in the normal operational state. Alarm relays will be (Open) and Status Indicator Green.
Allow the SGOES to warm up for 5 minutes for detection of accurate gas level measurements.

6.2. Assurance of explosion-proof feature in the scope of installation:

6.2.1. Installation of SGOES at the facility to be monitored shall be performed in accordance with the arrangement layout designed for installation of the system incorporating such SGOES as individual components, which lay- out shall be agreed with and approved by the competent authorities pursuant to the prescribed procedure.

Electrical connections shall be arranged in compliance with Appendices B-2 and B-3.

6.2.2. Connection of analogue outputs from SGOES installed within a highly explosive hazardous area with an external appliance installed in a explosion-proof zone shall preferably be executed by means of control armored cable of FRLS 1T 1.5 Sq mm. Such type cable specified above herein shall be allowed for application at highly explosive zones pertinent to any class (category), including use for layouts inside the premises (indoors), at the open sites, inside the cableways, cable ducts, in the soil (along cable trenches) affected by any aggressive media, and at the areas subject to the impact of any vagabond (roaming) currents.

6.2.3. In the scope and in the course of installation of SGOES it shall be imperative to check the condition of explosion-proof surfaces of the components, exposed to any dismantling, for the purpose of verification of the compliance with the requirements specified at the drawing of explosion-proof means (refer to Appendices B-1).

6.2.4. Removable parts shall adjoin the body of SGOES as tightly as the structure on which it will be installed shall permit.

6.2.5. The enclosure of SGOES shall be earthed by means of the external grounding and internal grounding in compliance with requirements specified in Appendix B-4.

6.2.6. External grounding conductor shall be thoroughly cleaned, making sure its connection to the external grounding clip has been properly protected against corrosion by means of consistent lubricant grease application.

6.2.7. Once installation procedures have been accomplished the personnel authorized shall check the resistance of the grounding device, which shall not exceed 4 Ohms.

7. OPERATIONAL PROCEDURE

7.1. Explosion-Proof Feature Assurance Under Operation:

7.1.1. Only experienced staff acquainted with the structure, arrangement layout and operation principles of this equipment, having thoroughly read and fully understood this manual and briefed on the safety rules and regulations applicable to operation of electrical equipment installations, including of specific safety requirements for operation of such equipment's installed within explosion hazardous zones shall be allowed to operate SGOES.

7.1.2. SGOES shall be furnished with internal and external grounding together with the grounding signs.

7.1.3. Connection diagrams recommended for SGOES in the scope of coupling with the threshold device by means of analogue and digital outputs have been given in **Appendix B, C or D**.

7.1.4. In the scope of SGOES analogue output implementation, following feeding of the power voltage, the output current of 4 mA shall appear at the output of SGOES, with the contacts of fault relay in "closed" condition. In 40…60 seconds these readings shall be replaced with actual current values. After the warming up period of 5 minutes the output current magnitude shall conform to the actual concentration of the gas/vapor measured, meaning that the signal value, provided hydrocarbons are absent in the environment analyzed, shall be within the range of 4- 4.4 mA. After initial energizing (first start-up) and warming up of SGOES during 1.5 – 2 hours it recommended (however not necessary) to carry out zero setting and calibration for SGOES in compliance with the procedure and techniques specified in Section 9.2 of the present Manual. Analogue output current value of 1.8 mA shall signify the malfunction/optical path obstruction of SGOES.

7.1.5. In appendix D hereto is given a description of SGOES protocol in the margin of digital communication link application.

7.1.6. For following the recommendation set out in point 7.2.2, please refer chapter 8 for calibration and zeroing procedure

8. MAINTENANCE REQUIREMENTS

8.1. Routine maintenance shall be brought down to regular visual inspections, zero setting and calibration for SGOES, as required. However the SGOES device is designed with keeping the maintenance requirements of it to a minimum.

8.2. Periodic calibration shall be performed as the timeline indicated in the SGOES safety manual, or as per country/international norms, whichever is earlier. Calibration procedure is set out in **"Appendix C"**

8.3. The interval for implementation of visual examinations shall be defined by the consumer depending on specific operational conditions which applicable to SGOES.

8.4. In case if the optical components have been highly contaminated rendering normal operation of SGOES impossible, a 2mA output current shall be set at the analogue output of SGOES.

8.5. Relevant data shall emerge in the signal transmitted via digital channel and the fault relay contacts shall open. Upon the repeated start-up for 1 minute the output current shall reach the value of 4 mA.

8.6. If this is the case, its shall be required to switch of the power and to clean the optical components by means of cotton fabric damped with alcohol so that to remove any and all stains and spots of deposited contaminants, and to turn the power of SGOES back on.

8.7. Should the device appear to be non-operable after carrying of the procedure as specified above herein, it shall be dispatched to the workshop for repairs.

8.8 Zero setting is advised for SGOES upon their initial energizing and there after installation as required, should the reading deviate from the zero in excess of 2-3% of the LEL value. Provided the zero drift of the device exceeds by 2-3% of the LEL value, such SGOES shall be subject to repeating procedure of zero setting. If the issue persists it is advisable to send the device back to the manufacturing facility for repairs.

8.9 In the scope of preparation of SGOES it shall be ensured for proper zero setting, and if so required, for adjustment of the sensitivity in accordance with the procedures and techniques described in Appendix C.

8.10 Field zero setting shall be carried out at the specific location of normal installation of the equipment with the SGOES in operation without performing of any dismantling or de-energizing. So that to proceed as required, it shall be necessary to accomplish the following steps (refer to **Appendix C** hereunder:

9. TRANSPORTATION AND STORAGE REGULATIONS

9.1. SGOES packed by the manufacturer can be transported to any distances by any transportation means. While in transit, the shipping containers with packed SGOES inside shall be adequately protected against atmospheric precipitates. Arrangement and fastening of cargoes within the transportation means shall positively provide for steady position of the load in course of the carriage. Cargo shifting under transportation shall not be allowed at all times.

9.2. Railroad cars, containers, bodies of the trucks used to transport SGOES shall be free and clear from any traces or remains of transportation of cement, coal, chemical agents, etc.

9.3. Storage premises (warehousing facilities) shall be free and clear from dust, fumes of acids and alkalis, corrosive gases and other harmful or aggressive admixture

10. MARKING AND SEALING SPECIFICATIONS

10.1. The marking shall contain as under:

a) Manufacturing enterprise trademark.
b) Conventional designation of the gas detector, being the SGOES abbreviation and gas type (manufacturing version) as specified in Chart 1 of this Manual.
c) Name of the gas and rated range of conversion.
d) Symbol of verification of the measuring means (instrument) type.
e) Sign pertinent to the concerned and competent certification authority.
f) Explosion-proof marking, being **Ex d IIC T4 Gb**.
g) Allowable temperature range for the operating environment, varying from minus -40 to +85 °C.
h) Manufacturer's serial number.
i) Year of manufacture.

10.2. SGOES shall be supplied sealed by means of the manufacturing enterprise seals.

11. WARRANTY POLICY

11.1. The manufacturer, JSC "Electronstandart-pribor", located at the address as follows: Russian Federation, 192286, Saint Petersburg, Slavy Avenue, building 35, block 2, hereby warrants the compliance of SGOES to the requirements stipulated for in the Technical Specifications, provided however the consumer (user) has strictly observed operational conditions, along with the terms prescribed for transportation and storage, as outlined in this Manual.

11.2. Manufacturing enterprise hereby commits within the entire warranty period to make good and rectify on the free of charge basis any and all defects encountered or to replace SGOES falling non-operation

Non-compliance to terms indicated below nullify the warranty entirely:

11.3. Non provision of earthing to the SGOES internally and externally of the device.

11.4. Sensor cap is not utilized during operations of the device.

11.5. Any unauthorized opening of the device front cover and breaking the seal.

11.6. Any tampering with the devices original state internally/externally.

11.7. Non use of lugs, during connection of the device.

Appendix A

NOMINAL STATIC CONVERSION FUNCTION

The nominal static conversion function for SGOES shall be represented by the following formula:

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

Where:

$\mathbf{I_i}$ means the output current value, in mA;

$\mathbf{C_i}$ means the concentration value for the gas analyzed, % LEL;

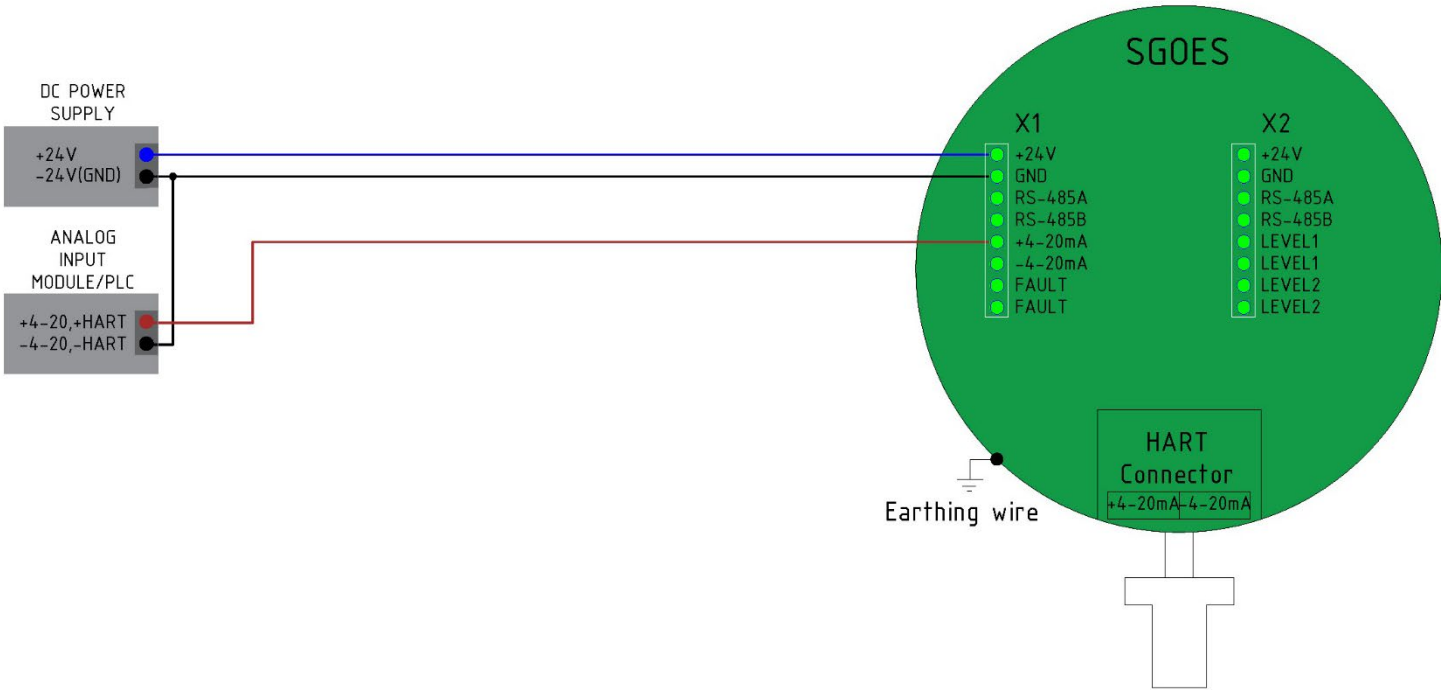
$\mathbf{C_{MAX}}$ means the maximum value of converted concentration, % LEL.

The concentration of metered gas in % LEL shall be calculated in accordance with the following formula:

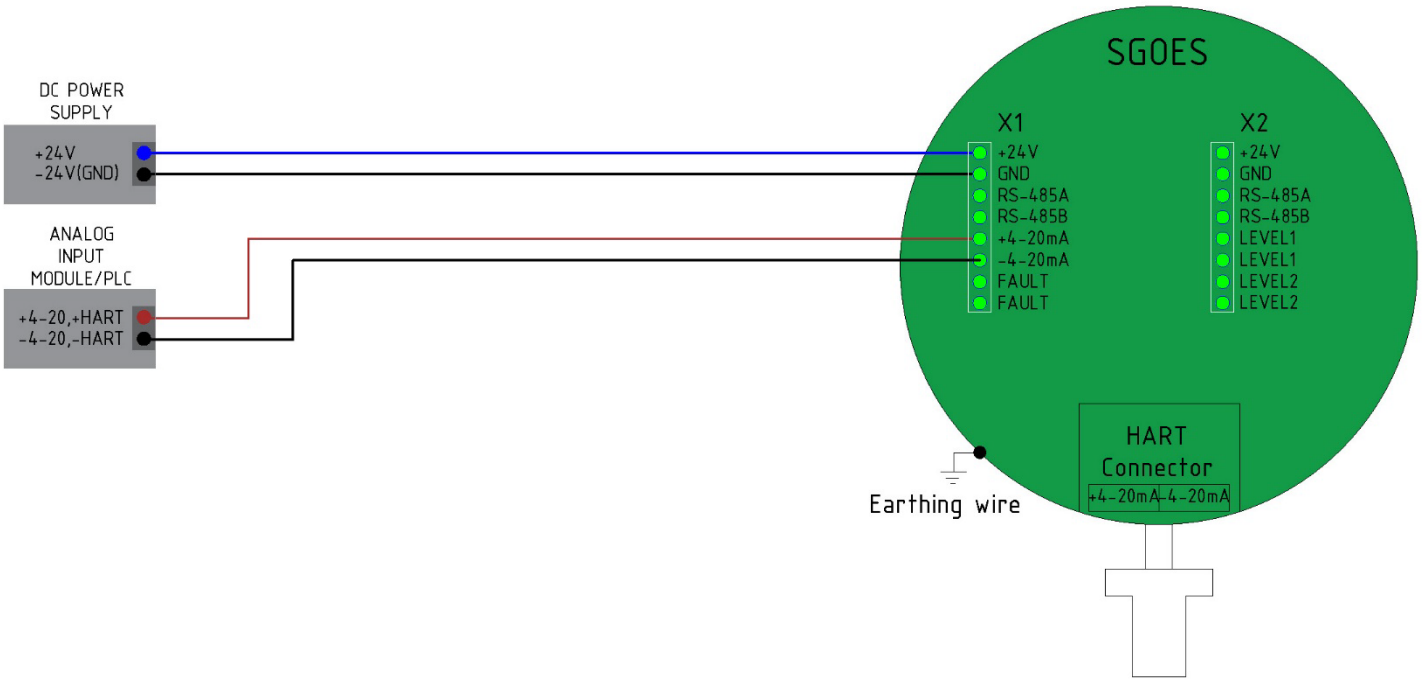
$$\mathbf{C_i = 6.25 \times (I_i - 4)}$$

Appendix B

a) SGOES 3 Wire Connection Diagram (4-20mA/HART)



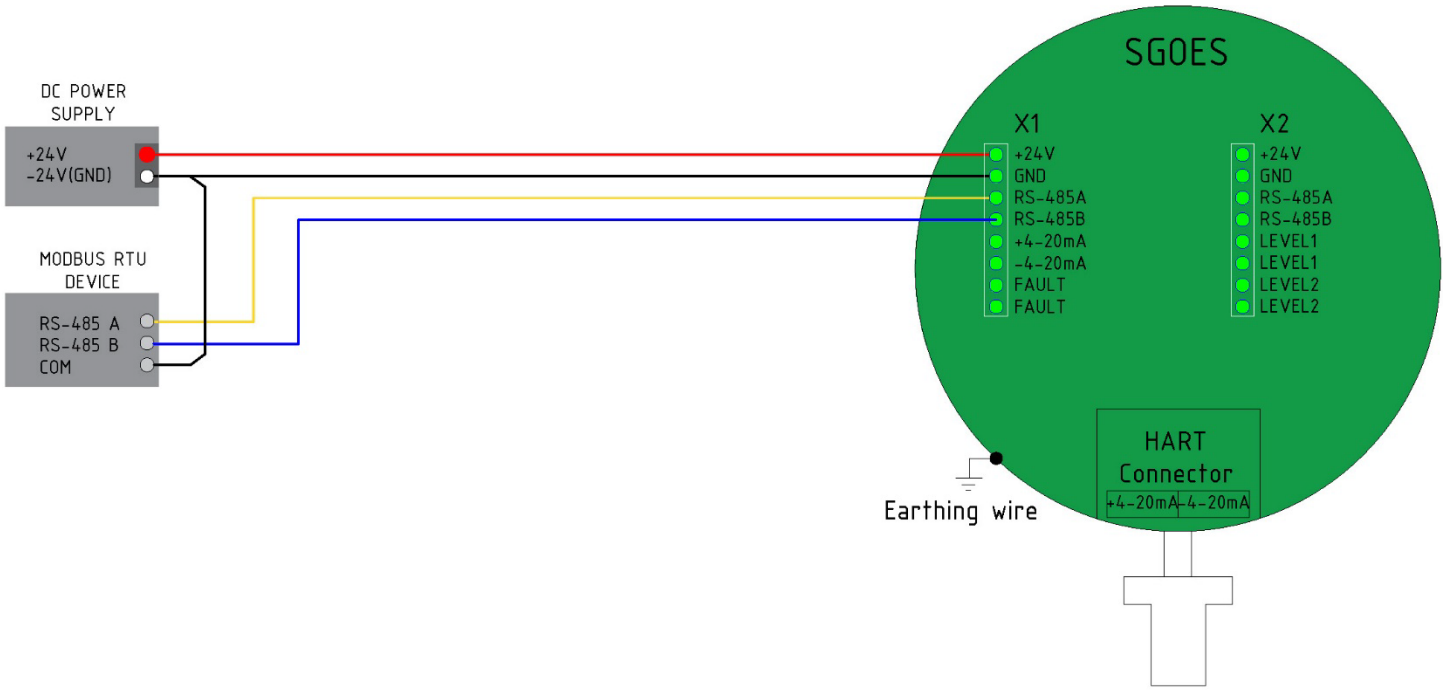
b) SGOES 4 Wire Connection Diagram (4-20mA/HART)



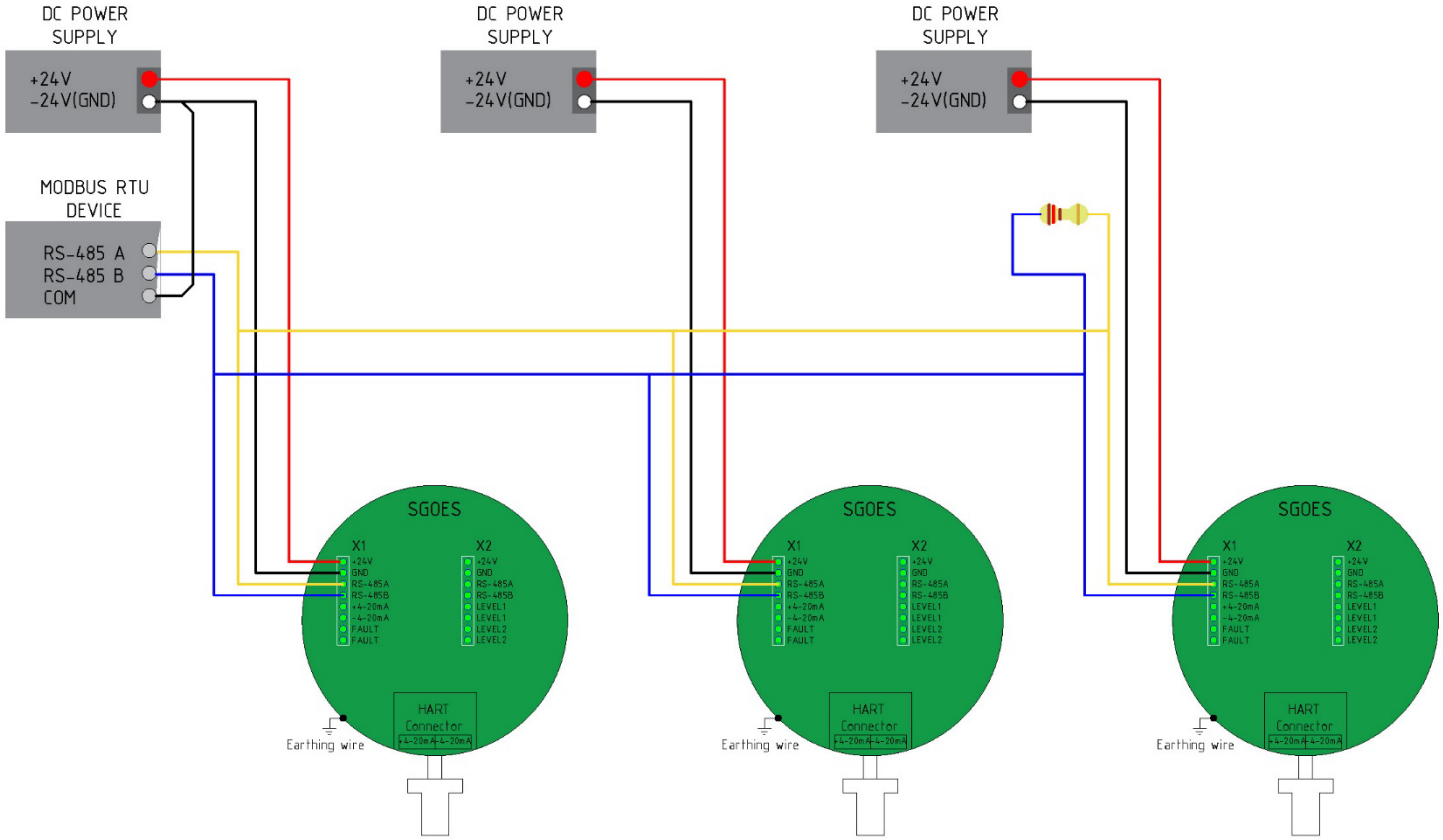
Note: Connection diagram for SGOES linking with the Threshold Device by means of the analogue output. In the scope of operation with the analogue output it shall be advised to make use of 1Tx1.5 sq mm cable.

Appendix C

a) SGOES RS-485 Connection Diagram

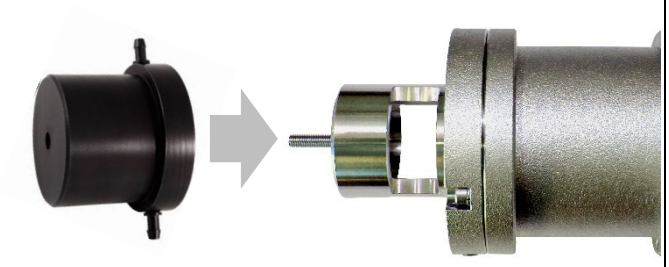
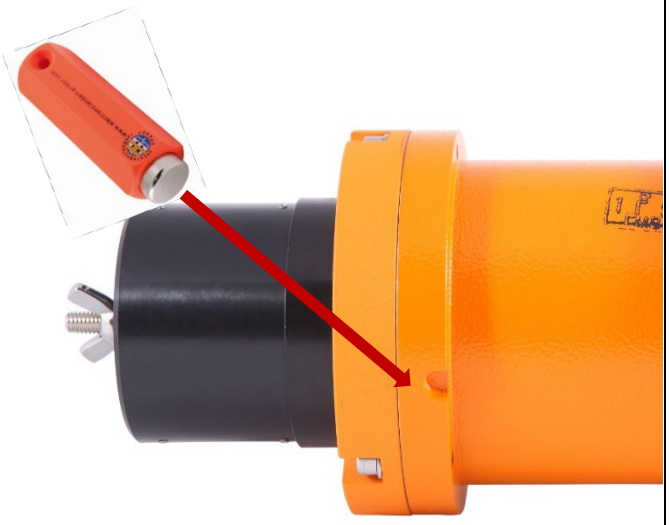


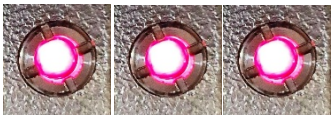
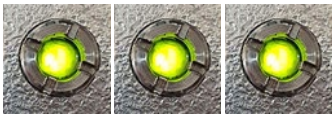
b) SGOES RS-485 Daisy Chain Connection Diagram



Appendix D

SGOES Calibration (via Magnetic Key)

Calibration Procedure of SGOES	
Required Equipment for Magnetic Wand Calibration • ¼" Clear Tubing • ESP Safety zero gas and span gas • ESP Safety magnetic wand • Regulator • Flowmeter • Calibration Cup	
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.	
Step 2: Apply the ESP supplied magnetic calibration wand to the magnetic control point.	
Step 3: 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.	

Step 4: 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.	
Step 5: 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.	
Step 6: Remove the calibration cup from the SGOES detector. After approximately 1 minute, the status LED light will appear FLASHING GREEN	
Step 7: Apply the magnetic wand to the ESP logo and remove. 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.	

Appendix E

ZERO SETTING TECHNIQUES AND GAS DETECTOR SENSITIVITY ADJUSTMENT THROUGH THE USE OF PC

Zero setting and sensitivity adjustment of SGOES shall be performed in the scope of preparation for accomplishment of the calibration check, should the conversion error be inconsistent with the requirements stipulated for in this Manual.

In the margin of checking procedures the concerned personnel shall make use of the means specified in Chart 1 of Appendix E hereto. In addition to them, the following gear shall be used:

a) A personal computer with installed Windows 98, 2000 or XP operating system, equipped with a free COM port (hereinafter referred to as the PC);
b) Test cable (field service cable) and calibration chamber;
c) Executable program TestSGO (included to the SPTA kit on a CD-disk).

Zero setting and sensitivity adjustment of SGOES shall be performed under normal operating conditions of the equipment.

Works focused on zeroing and adjusting of sensitivity of SGOES on the basis of the PC application shall be carried out by the instrumentation and automated control systems engineering staff beyond the explosive hazard zone. Operations prescribed shall be executed in the following order:

1) SGOES shall be disconnected from the data input device and further transferred to an inexplosive area;
2) By means of the test cable and by means of bonding wires the optical-electronic compartment of SGOES shall be linked to the PC and to a power supply unit in compliance with connection diagram shown in the Figure below;

   Warning! Incorrect power supply connection might result in a breakdown of the critical elements of SGOES securing connection with the PC and it shall become impossible henceforth to establish the link and therefore to perform the calibration!

3) The protecting cover shall be removed from SGOES and replaced with calibration chamber, outfitted with the nipples (chokes) meant to procure gas delivery;
4) By means of the switches of the power supply unit, output voltage shall be set to +24V and the current value to >0.3 A; once the parameters have been adjusted the power source shall be turned on;
5) The PC shall be powered up; following loading of the operating system the executable module designed for zero setting and sensitivity adjustment TestSGO shall be run (the program has been saved on the CD-disk included to the SPTA kit supplied);
6) After loading the monitor screen shall provide the menus of the calibration program together with the message windows with current information selected by the user: ID number of the Detector (SGOES), operation mode, concentration value for the calibration gas mixture; such data shall be imported from the console;
   Using the prompts of the menus the user shall define the parameters for the link between the PC and the device. Afterwards the Search mode shall be activated for a while. In a few moments the monitor shall display a message window with actual parameters of SGOES, such as the current concentration value, relays status, etc.
7) At this step the gas type and control gas mixture concentration sued in the scope of calibration shall be introduced to the program. In the margin of device verification CGM listed in Chart 2 of Appendix E hereto shall be used;
8) In about 20…30 minutes following feeding of the supply voltage to SGOES, the rotameter input shall be connected with the cylinder containing control gas mixture No. 1 and the output of the rotameter shall be connected with the nipple (choke) of the calibrating hood of the optical-electronic transducer; such connection shall be executed by means of a hose

section. The device shall be purged for 2.5…3 minutes with the gas flow at the rate of 0.4…0.6 l/minute (making sure that the total volume of the gas mixture passing through the device is not less than 1.2…1.5 liters);

9) After stable readings of SGOES have been established by clicking the mouse button Zero Setting key shall be activated; the user shall make sure that after activation SGOES readings match 0% LEL;
10) So that to enable calibration with CGM No. 2 the input hose shall be connected to the cylinder containing control gas mixture No. 3 and SGOES shall be further purged for another 2.5-3 minutes by means of the gas flow at the rate of 0.4…0.6 l/minute (making sure that the total volume of the gas mixture passing through the device is not less than 1.2…1.5 liters);
11) After stable readings of SGOES have been established by clicking the mouse button Calibration with Higher Concentrations key shall be activated;
12) In order to carry out additional calibration with CGM No. 2, the input hose shall be connected to the cylinder containing this gas mixture and SGOES shall be further purged for another 2.5…3 minutes by means of the gas flow at the rate of 0.4…0.6 l/minute (making sure that the total volume of the gas mixture passing through the device is not less than 1.2…1.5 liters). Please refer to paragraph 16 of this instruction, should the second gas mixture be unavailable;
13) After stable readings of SGOES have been established by clicking the mouse button Calibration with Lower Concentrations key shall be activated;
14) To finalize the procedure SGOES shall be checked for compliance with technical characteristics specified in this Manual, for which purpose the following operations shall be accomplished:
    - ✓ Control gas mixtures 1 – 2 – 3 shall be delivered to the device in sequential order, measuring the values of the output currents of SGOES apparatuses (in mA);
    - ✓ Pursuant to the nominal static conversion function design values for the output cur- rents (refer to Appendix A-1 for details) shall be defined for every control gas mixture supplied;
    - ✓ Measured current values of SGOES gas detectors shall not deviate from the design values by more than ± 0.8 mA for the gas mixture No. 2 and by more than ± 1.5 mA for the gas mixture No. 3;
    - ✓ Should the current value difference exceed ± 0.8 mA and ± 1.5 mA, respectively for the two control gas mixtures delivered, a repeated sensitivity adjustment shall be per- formed.

15) In the scope of verification of SGOES compliance with technical characteristics specified in this Manual by means of the digital communication channel, all operations shall be accomplished pursuant to the preceding paragraph 14 of the instruction along with constant monitoring and control of SGOES readings as shown on the PC monitor. In the meanwhile deviation of SGOES readings from the values stated on cylinders containing CGM shall not be in excess of ± 5% LEL in respect to CGM No. 2 and ± 8% LEL in respect to CGM No. 3;
16) Should only one control gas mixture be available, the concentration of such shall be specified as the CGM No. 3 and calibration procedure shall be carried out in compliance with paragraph 11 of this instruction. If this is the case, calibration with additional concentration shall not be executed.

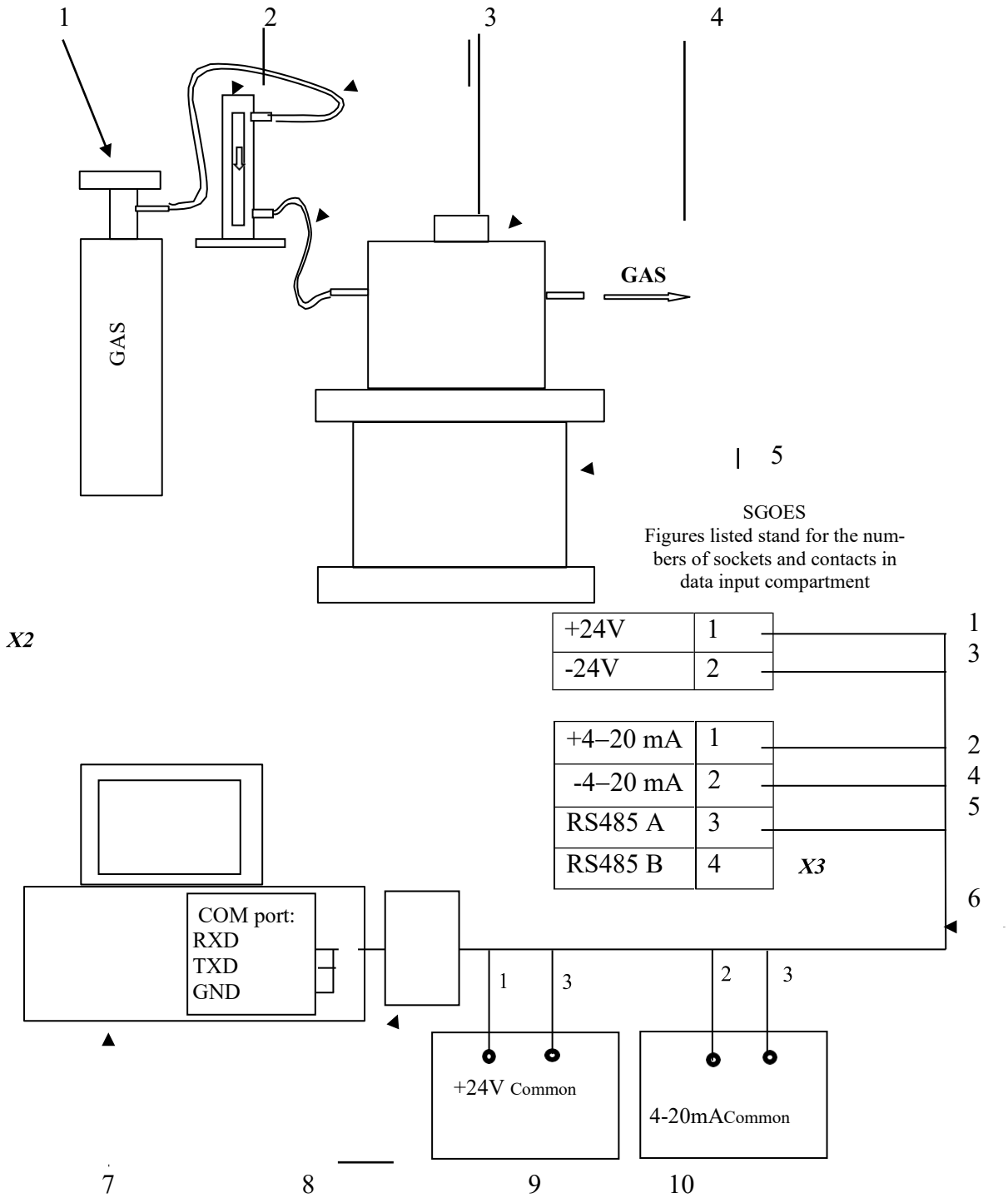


Figure C-1: Connection diagram for computer aided zero setting and sensitivity adjustment procedures for SGOES.

1 – cylinder containing control gas mixture; 2 – the rotameter; 3 – pipes for gas delivery; 4 – calibration chamber; 5 – SGOES; 6 – test cable; 7 – personal computer; 8 – RS232↔RS485 converter; 9 – power supply unit; 10 – milliammeter.

Appendix F

RS-485 Interface Data Communication Protocol for Upper Level Controller, Designed for SGOES – Stationary Optical (Point Type) Gas Detector

SGOES Stationary Optical (Point Type) Gas Detector (hereinafter referred to as SGOES) has been designed for measuring of the concentration of controlled gas and activating of alarm signal upon crossing of pre set threshold level. Alarm signal is delivered to the designated controller/operator station and other warning or actuating instrumentation as required

Communication with control systems and indicating equipment shall be secured by means of analogue channels within the current range values of 4...20 mA, dry contact relays (Threshold 1, Threshold 2, Fault) as well as by means of a digital communication that contains any and all information available over outputs mentioned above.

The presence or absence of the gas along with service supporting parameters shall be transmitted to the upper level controller by means of RS-485 interface with assistance of specific MODBUS Protocol. SGOES shall support the following types of commands:

- reading from the device; command code is 04; and
- recording of a word to the device; command code is 06.

Map of addresses carrying data on the device condition

Address 0×01 – upper byte shall contain the number (address) of the device (unsigned number);
– lower byte shall determine data rate by means of RS-485 channel:
0×01 – 1200 baud;
0×02 – 2400 baud;
0×04 – 4800 baud;
0×08 – 9600 baud;
0×10 – 19200 baud.

Address 0×02 – 16-bit register of the Gas Detector state with the following data bytes:
– upper byte – SGOES apparatus type;
1 – methane;
2 – propane;
3 – hexane.
– lower byte – current state of SGOES in XXXXD3D2D1D0 format,
Where:
D3 0 – shall mean the device is non-operational; 1 – shall mean normal state;
D2 1 – shall mean Threshold II has been exceeded; 0 – shall mean normal state;
D1 1 – shall mean Threshold I has been exceeded; 0 – shall mean normal state;
D0 0 – shall mean a breakdown; 1 – shall mean normal state.

Address 0×03 – 16-bit register of the Gas Detector state:
Concentration of the gas measured in % LEL (integer signed value);

Address 0×04 – 16-bit register of the Gas Detector state with the following data bytes:
– upper byte – Threshold I;
– lower byte – Threshold II;

Address 0×05 – 16-bit register of the Gas Detector state:
D – reduced value;

Address 0×06 – 16-bit register of the Gas Detector state:
Reference channel stress;

Address 0×07 – 16-bit register of the Gas Detector state:
Working channel stress;

Address 0×08 – 16-bit register of the Gas Detector state:
D – instrument value;

Address 0×09 – 16-bit register of the Gas Detector state:

Temperature; integrated thermistor readings;

Address 0×0A – 16-bit register of the Gas Detector state:

Device Service Number.

Information available at addresses from 5 through 10 shall be interpreted as tooling data and therefore shall be used in the scope of calibration at the manufacturing enterprise facility or at the repair workshop centers.

So that to change the address of the device it shall be required to write to the register holding address of 0×01 particular number of that device in the range from 0×01 to 0×F7, mapping the same over at the upper byte of the register.

In order to change the data rate via RS-485 channel it shall be required to write to the register with the address of 0×01 the code corresponding to specific data exchange rate, mapping it over at the lower byte of the register (meaning at the upper byte of the device).

0×NN01 – 1200;
0×NN02 – 2400;
0×NN04 – 4800;
0×NN08 – 9600;
0×NN10 – 19200.

It is however imperative to remember that any attempt to change the number of the device shall lead to alteration of the data rate (and vice versa); therefore, should the number of the device ever be altered, it has to be monitored for the contents of the byte responsible for the data rate (and vice versa).

Upon changing of the data rate and (or) the device number the upper level controller shall receive a respond to the command at the same rate and only afterwards SGOES device shall implement changing of the data rate and device number.

Remote setting of zero (“0”) shall be executed by means of writing of any code to the address of 0×02: (command – 06; data – any; address – 02).

Remote calibration (“1”) shall be executed by means of writing of actual concentration value to the address of 0×03: (command – 06; data – gas concentration; address – 03). Where gas concentration value shall mean gas concentration expressed in volumetric fraction (%) multiplied by 100.

Remote calibration (“2”) shall be executed by means of writing of actual concentration value to the address of 0×04: (command – 06; data – gas concentration; address – 04). Where gas concentration value shall mean gas concentration expressed in volumetric fraction (%) multiplied by 100.

Remote setting of factory defaults shall be executed by means of writing of 1 to the address of 0×05: (command – 06; data – 1; address – 05).

Remote setting of “Threshold 1” shall be executed by means of writing of the threshold value in % LEL to the address of 0×06: (command – 06; data – % LEL; address – 06).

Remote setting of “Threshold 2” shall be executed by means of writing of the threshold value in % LEL to the address of 0×07: (command – 06; data – % LEL; address – 07).

Any attempt to write to the registers with different addresses shall result in receiving a respond with the code of addressing error.

WARNING! In the scope of software package debugging and checkout it shall not be allowed for cyclic use of the command carrying 06 code, as the registers meant for writing possess a limited number of write cycles (10,000).

WARNING!In the scope of data readout from the device there shall be a limitation of the length of the mark transmitted (with a maximum = 10).

Appendix G

VERIFICATION MEANS

Table 1

Verification Technique	Description of reference measurement instrumentation or that of auxiliary equipment and gear Reference number of the document regulating applicable technical requirements Basic technical properties
Visual Inspection	a) Aspiration psychrometer (hydrometer) M34; Technical Specifications 25-2607.054-8 TU; metering range from 30 to 80% at the temperature of (5…50) °C; Error ± 7%. b) Thermometer; GOST 215-73; metering range from 0 to 50 °C; Error ± 0.2 °C. c) Aneroid BAMM-1; Technical Specifications; metering range from 80 to 100 kPa; Error ± 0.2 kPa.
Metrological Performance Properties	a) Pipe TC-T6; GOST 25336-82. b) Fine adjustment valve VTR-1; API.4.463.008. c) Rotameter RM-A-0.063 GUZ; GOST 13045-81; KT4. d) Calibrating chamber to supply control gas mixture to SGOES; e) Power supply unit B5-47; Technical Specifications. f) Multimeter combined instrument C4311; Technical Specifications 25-04-3300-77 TU KT0.5. g) National standard samples for gas control mixture composition (NSS-CGM) in pressurized cylinders; Technical Specifications 6-16-2956-92 TU (see Appendix C for details).

CONTROL GAS MIXTURES REQUIRED FOR VERIFICATION PERFORMANCE

Table 2

Verified Device, Component	Range of Converted Concentrations, % LEL (Volume Fraction %)	Contents of specific component in the CGM; allowed deviation from rating value, % LEL (Volume Fraction %)			Receiving Source or NSS-CGM Pub lic Register No.
		CGM No. 1	CGM No. 2	CGM No. 3	
SGOES Methane (CH_4)	0 – 100 (0 – 4.4)	CZG	50 ± 5 (2.20 ± 0.25)	90 ± 10 (4.00 ± 0.40)	National Standard Sample as per the Public Register No. 3883-87
SGOES Propane (C_3H_8)	0 – 100 (0 – 1.7)	CZG	50 ± 5 (0.85 ± 0.05)	90 ± 10 (1.53 ± 0.15)	National Standard Sample as per the Public Register No. 3970-87 CGM1.53±0.15 Error ±0.02

CGM technical characteristics, used during SGOES primary calibration

SGOES version	*Testing component*	*Nominal value of inclusion volume fraction of CGM testing component, allowance limits*			*The limits of allowable basic error*	*Register number NSS*) or CGM source receiver*
		CGM № 1	CGM№ 2	CGM№ 3		
SGOES methane	methane (CH_4)	nitrogen				CZG
			2,20±0,25		±0,04	3883-87
				4,15±0,25	±0,04	3883-87
SGOES propane	propane (C_3H_8)	nitrogen				CZG
			0,85±0,05		±0,015	5328-90
				1,6±0,1	±0,004	EM 06.01.648
			0,39±0,04	0,70 ± 0,08	±5 % (отн)	IM EMVNIIM

Note:

1) recount of concentration values of testing component marked in inclusion volume fractions,%, into % of LEL is made according to GOST R 52136-2003;
2) control zero gas (CZG) -compressed air is produced according TU 6-21-5-82.
3) *) - National Standard Sample