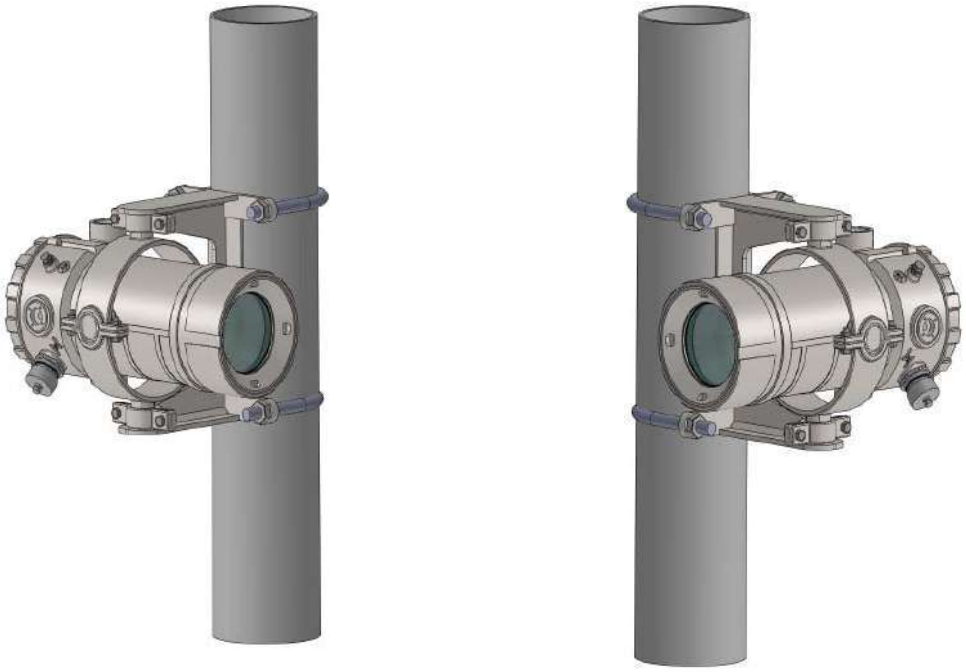

OPEN PATH GAS DETECTOR
TGAES

Operating manual
GSKF.413311.003 OM

Technology of Future…Protection for Today

Orig. Inv. No.	Signature and date	Supersedes Inv. No.	Dupl. Inv. No.	Подпись и дата

TGAES OPEN PATH
GAS DETECTOR
Operating Manual
GSKF.413311.003 R01

ELECTRONSTANDART-PRIBOR
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10/07/13	01	Initial Draft	O. Zverev

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Table of Contents

1 Introduction

Carefully study the Operating Manual before installation and connection of the open path gas detector TGAES (hereinafter the gas detector). Strict observance of the instructions and recommendations ensures instrument's proper functioning under normal conditions.

CAUTION! TGAES shall be used only for the purposes listed below and in the conditions specified herein. Any modification of the system instruments, improper mounting, use in a faulty or incomplete set will void the warranty.

2 Purpose and application

TGAES gas detector is an open path infrared gas detection system for providing continuous monitoring of combustible hydrocarbon gas concentrations in the range of 0 to 5 LEL/m, 0 – 2,5 LEL/m, 0 -1 5 LEL/m over a distance of 5 to 200 m. TGAES is designed for detection and measurement of combustible gas and vapour content in the air by measuring their spectral absorption along the optic path at distances from 5 to 200 m.

The TGAES system consists of an transmitter (TGAES TX) and receiver (TGAES RX), whose housing have similar design and are made of stainless steel. Methods of gas contamination control at the operation facility comply with the contemporary safety and reliability requirements.

TGAES is designed for operation in potential explosion-hazardous zones of premises and outdoor facilities according to the explosion protection marking and normative documents regulating the use of electrical equipment in hazardous locations. Including explosion-hazard zones 1 and 2 where explosive gas mixtures may form under normal operation of electrical equipment and/or in case of emergency.

Features and benefits

- TGAES gas detector replaces from 8 to 12 fixed point gas detectors, since gas contamination monitoring is continuous on the whole length of light emission between TGAES modules
- Continuous gas contamination monitoring of increased range zone
- Receiver and transmitter self-test mode
- Continuous device parameter and characteristics registration/displaying
- 3-color LED indicator of system operating modes ("normal", "alarm", "failure")
- Built-in real-time clock and nonvolatile memory for recording of setting/calibration characteristics of operation during gas detector release from production, as well as current/archive data about device operability directly at the operation facility (gas contamination monitoring trends etc).
- High sensitivity to the main hydrocarbon gases/mixtures; wide range of measured concentrations
- Cross sensitivity
- Heating of optics for protection against condensation and icing on TGAES optical elements during outdoor operation
- The protective shield additionally protects the device against adverse environmental effects and does not affect detection properties
- Zero set up and maintenance of the device without dismantling, in field conditions (by means of HART-communicator or magnetic bangle)

Application:

- Drilling and production platforms, locations of process equipment during oil and gas extraction and processing
- Oil and gas pumping stations of main oil and gas pipelines
- Oil and oil product, as well as liquefied gas storage tanks
- Plants of chemical and metallurgy industry, paint plants, fertilizer and plastic plants
- Plants of the fuel and power sector, boiler houses etc
- Loading racks and marine terminals etc

Note: *TGAES gas detector can be used a standalone facility or as part of integrated protection using other equipment.*

3 Standard output signals and LED indicator

The standard output signals of TGAES (analogue current one in the range 4 – 20 mA, HART-interface, as well as digital output – RS-485, dry relay contact) output real-time data on the concentration of monitored gas within the measuring path.

TGAES has standard output signals:

–Analogue current signal in the range of 4 – 20 mA, depending on concentration of monitored gas (receiver), the transmitter has the output 2 mA (failure) and 4 mA (standard).

–Digital signal (RS-485 communication channel, ModBus RTU protocol);

–HART-interface;

–Wireless (optionally Bluetooth 2.0 EDR)

–Relay: Three built-in, single-pole normally open (*contacts are open if there is no power*)

0-60V 1.0 A

Failure relay

First threshold relay

Second threshold relay

Relay operation modes:

Permitted or prohibited, with or without fixing – for all relays

Besides, each TGAES module has a LED indicator visually showing the current mode of device operation.

a) Normal operation (green)

b) Failure (yellow)

c) Alarm (red)

Gas detector operation mode.

TGAES transmitter and receiver have similar design, but have differences in their operation modes.

The transmitter 5 second after power-on generates, twice a second, light emission pulses, simultaneously monitoring the parameters of power supply, temperature, and pulses themselves.

The transmitter has the following operation modes:

- *warm-up* - state after power-on
- *standard* - pulse parameters are normal
- *failure* – if there are failures:
  - error
  - power disruption
  - disrupted temperature conditions
  - number of misfires is not in norm

The receiver in 5 sec after power-on waits for completion of transitory processes and starts receiving emission pulses from the transmitter. After 10 consecutive emission pulses, provided that adjustment is not disrupted and there are no data on other failures, the device shall pass to the "standard" mode.

The receiver has the following operation modes:

- *warm-up* - state after power-on
- *adjustment* – at establishing optical visibility between TGAES modules
- *zero setup* – at zero setup
- *calibration* – at receiver sensitivity setting

- *standard* – no error, concentration = 0
- *alarm* – in case of exceeded specified concentration thresholds of the determined gas component within the measuring path
- *failure* – if there are failures:
  - error
  - beam blocking
  - power disruption
  - disrupted temperature conditions
  - negative concentration
  - number of misfires is not OK
  - saturation of analog to digital converter (ADC)

Table of transmitter operation modes

Operation mode	**LED indication**	**Relay signal**		**Output current signal, mA**
		Alarm	**Failure**	
warm-up	yellow intermittent	open	open	2 Stop operation
standard	yellow permanent	open	closed	4
Failures:				
Power not OK	Flashing Yellow	open	open	2 Continue operation
Number of misfires exceeds 10 running	Flashing yellow	open	open	2 Stop operation
Number of misfires per 1 hour exceeds 10.	Yellow	open	open	2 Continue operation
Device temperature out of the preset range	Yellow	open	open	2 Continue operation

Note: *Despite the fact that the transmitter uses pulse xenon lamp of extra reliability, and the receiver can work with unstable emission, the transmitter program monitors the number of misfires per hour. Change of this parameter to 10 shows deterioration of one of the elements involved in generating the emission pulse and prevents temporary ageing of device and need to replace it.*

The transmitter continues operation with this failure.

Table of receiver operation modes

Operation mode	LED indication	Relay signal		Output current signal, mA
		Alarm	Failure	
Warm-up	Flashing yellow	Open	Open	2
Standard	Green	Open	Closed	Proportional to measured concentration
Alarm	Red	Closed	Closed	Proportional to measured concentration
Adjustment	Yellow	Open	Open	2,5
Calibration	Green flashing	Open	Closed	3,2
Zero setup	Yellow	Open	Open	3,8
Negative concentration	Yellow	Open	Open	3,6
Number of misfires exceeds 10 running	Flashing Yellow	Open	Open	2
Power not OK	Flashing Yellow	Open	Open	2
Device temperature not OK	Yellow	Open	Open	2
Saturation of ADC	Yellow	Open	Open	2

4 Specifications

- *Model:* TGAES
- *Housing material*:
  - 316 stainless steel
- *Overall dimensions* of each TGAES module (with bracket) maximum, mm:
  − 185 x 265.
- *Weight* of each TGAES module (with bracket) maximum, kg:
  - 7,5
- *Cable entry:* 2 cable entries, 3/4" NPT
- *Diameter of connected armoured cable:*
  - Minimum: inner sealing ring ø12.0 – 13.5 mm
    outer sealing ring - ø 16.0 – 18.0 mm
  - Maximum: inner sealing ring ø 13.5 – 15.0 mm
    outer sealing ring - ø 18.0 – 20.0 mm
- *Ambient temperature range:*
  - from -55 to +70 °C
- *Atmospheric pressure:* from 80 to 120 kPa
- *Relative humidity:* up to 100% non-condensing
- *Power supply voltage:*
  Rated: 24 V DC
  Range: 18 …32 V DC
- *Power consumption* of TGAES max, W:
  - Transmitter: 15
  - Receiver: 15
- *Detected gases:* methane, propane (cross sensitivity to other hydrocarbons)
- *Path length:*
  - 5 - 200 meters;
  - a set of apertures for the transmitter is supplied for operation at small distance.
- *Output signals:*
  - *analogue signal:* 4..20 mA
  - *digital signal* in RS-485 standard with Modbus RTU interface
  - *Three built-in, single-pole normally open relays* (*contacts are open if there is no power*) *0-60V 1.0A:*
    - Failure relay
    - First threshold relay
    -Second threshold relay
- *Measuring range:* 0-5 LEL/m, 0 – 2.5 LEL/m, 0 – 1.0 LEL/m
- *Setting time of TGAES output signals by level T_{90}, : 3 s*

- *Accuracy:* ± 0.25 LEL/m or 10% of applied gas concentration
- *Output signal linearization:* linearization for measuring ranges
- *Warm-up time:* Transmitter – 5 seconds
  Receiver – 15 seconds
- *Warranty: 2* years
- *Mean time between failures*, minimum: 35000 h
- *Average service life*, minimum: 10 years

Note! *The t_{90} response time of the standalone open path gas detector and the stand alone control unit shall be added together and shall not exceed 10 seconds.*

Certification:

FM APPROVED

Performance verified in accordance with FM 6325.
FM certification does not cover Hazardous Location approval, the use of magnetic bangle or use of HART or Bluetooth protocols for gas performance. Modbus may be used for diagnostics and data collection.

ATEX: 94/9/EC

CE 0470 Ex II 2 G
Ex d[ib op is] IIC T4 (T_{amb}70°C) IP 66

IECEx:

Ex d [ib op is] IIC T4 (T_{amb} 70°C) IP 66

ГОСТ Р:

Ex d [ib] IIC T4/T6 Gb
T = - 60°C …. 70°C
IP 66

EN Standards:

EN 60079-0: 2006; EN 60079-1: 2007
EN 60079-11: 2007; EN 60079-29-4: 2010
EN 61779-1: 2000
EN 60529: 1991+A1: 2000
EN 50270:2013

Signature and date | Dupl. Inv. No. | Supersedes Inv. No. | Signature and date | Orig. Inv. No.

5 Important Safety Information

- TGAES may be operated by persons who have studied this OM, passed briefing on safety precautions and have at least III qualification group according to electric safety, as well as documents of the approved form of Gosgortekhnadzor.

- It is not allowed to use gas detectors with mechanical damage of housing.

- Mounting and operation of equipment power supply facilities shall meet the rules and norms of Electrical Installation Regulations (PUE).

- TGAES shall be operated while taking the safety measures in compliance with the Operation Rules for Consumers' Electrical Installations (PEEP), including ch. 3.4 Electrical Installations in Explosive Zones of the Safety Rules for Operation of Consumers' Electrical Installations (PTB).

- TGAES shall have inner and outer grounding devices and grounding signs as per GOST 21130-75.

Attention! *It is not allowed to open the gas detector in explosive medium with power switched on. The gas detector has no components which may be serviced by the user, that's why the gas detector should not be opened even in the conventional ambience. The opening of electronic unit may violate the installation of optical units and calibration parameters and, possibly, serious damages.*

Attention! *Any system modification, improper mounting or use in faulty or incomplete set will void the product warranty.*

6 Operational Description

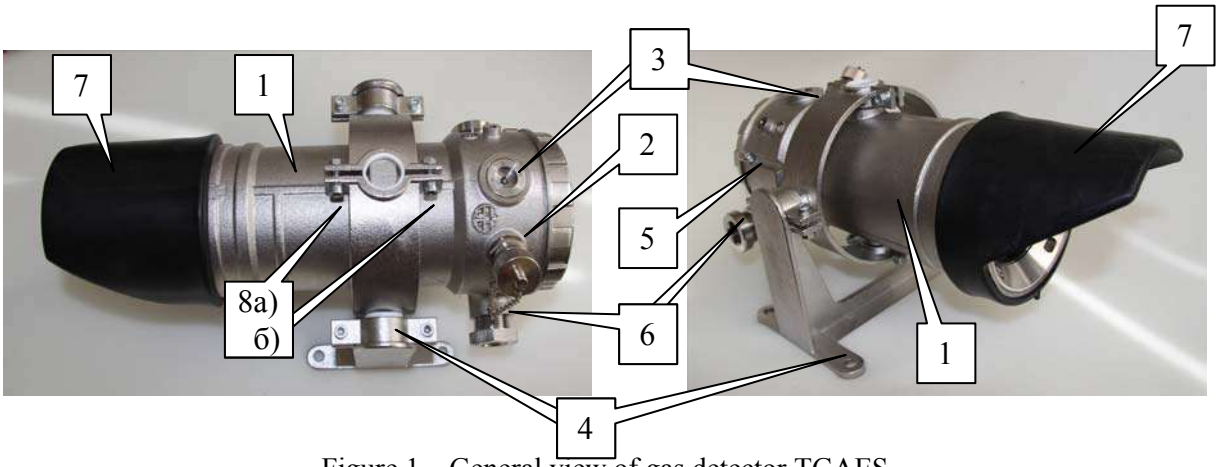


Figure 1 – General view of gas detector TGAES

1 – detector's housing; 2 - HART-communicator connector;
3 - three-colour LED indicator of operation modes; 4 - bracket;
5 – base locking screw; 6 – cable entry; 7 – protective shield;
8 – magnetic bangle location during setting of receiving (a) or transmitting (b) TGAES modules

The TGAES system consists of two optically coupled modules – transmitter and receiver. The receiver and transmitter modules of TGAES are identical to each other. Requirements to mounting of both modules are virtually similar, but there are differences in functional and electric characteristics (electric connections, factory setting, built-in LED indicator).

Each module is a stainless steel instrument equipped with three-colour functioning (status) indicator, holes for cable entry (3/4 '' NPT) for connection of power supply and data signal readout, HART-communicator connector and special hinged brackets (also of stainless steel).

The universal system of TGAES modules' fastening to the bracket (bracket design) allows for detectors' free motion in the horizontal or vertical plane (not less than 45 degrees) and then rigidly fixes their spatial position. Thus, TGAES can be easily oriented in any required position and fixed on any supporting surface/ design in accordance with the installation requirements.

Both modules are installed approximately at the same level and must be optically aimed at each other. Besides direct optical visibility, the installed devices do not require any interconnection.

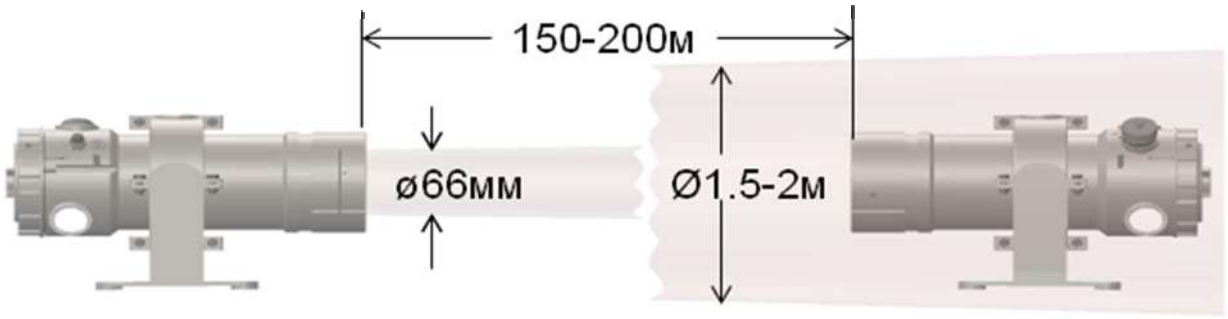
Operating Principle

TGAES operating principle is based on absorption of the light emission energy by the detected gas component in the space between the transmitter and receiver modules of the gas detector. The line of direct optical visibility between TGAES modules is the measuring path, that is the actual area of gas contamination monitoring and control.

Note: *The transmitter is a high-reliable pulse xenon lamp with arc length 3 mm and discharge energy adjustable from 0.5 to 0.85 J. Lamp life is 950000000 flashes or 15 years of continuous operation in the used mode at pulse frequency 2 Hz.*

TGAES-TX transmitter sends an IR-beam to the receiver. The beam power is dissipated when passing through the measuring space where the detected gas component is present. As the flow of light pulses crosses combustible hydrocarbon gases, certain infrared radiation wavelengths are absorbed. The total absorption of infrared radiation is determined by hydrocarbon gas concentration.

Note: *The transmitter generates an IR radiation beam of diameter 66 mm, beam divergence is 1°. At 200 meters from the transmitter, beam diameter reaches 1.5-2 meters. The high power and wide beam ensure very easy system adjustment:*



The transmitter is a wide-range source of light emission pulses of length 40-50 microseconds.

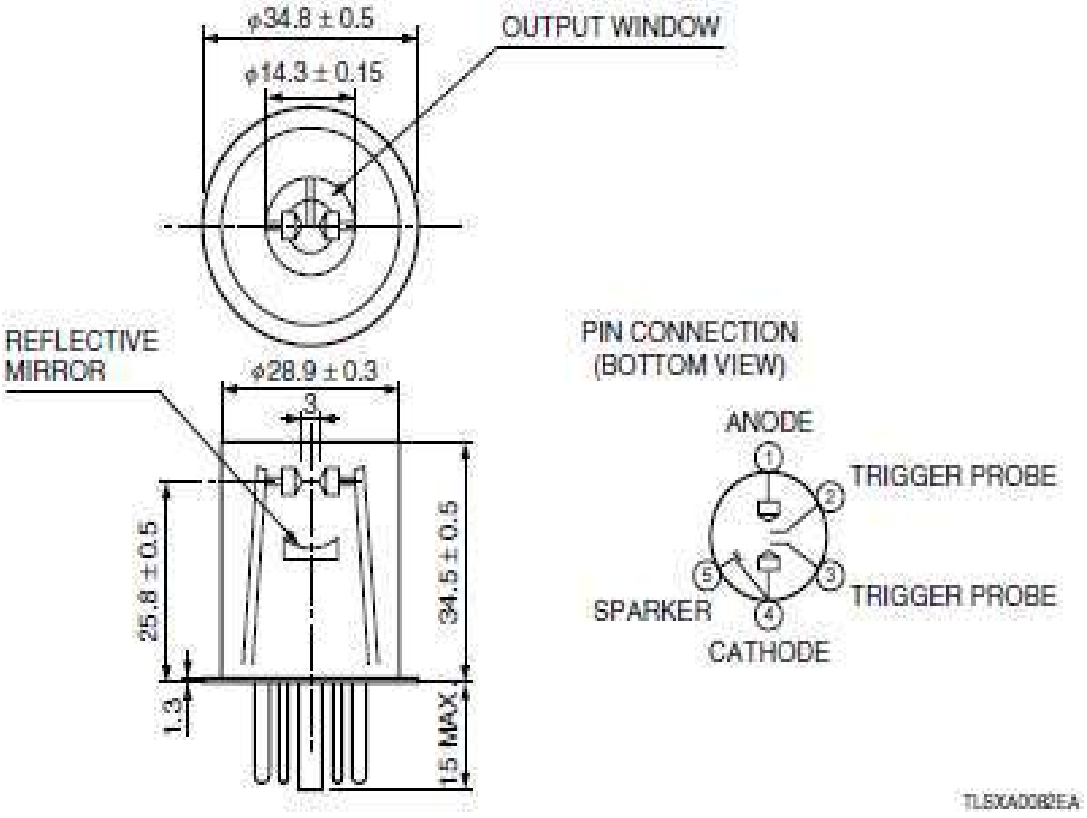
The main transmitter element is a pulse xenon lamp.

Lamp arc length is 3 mm.

Service life at maximum power (1 J with frequency 60 Hz) is 1 000 000 flashes.

The transmitter generates pulses with frequency 2 Hz pulses with energy 0.5 – 0.85 J. Lamp use in the mode of tenths of the manufacturer's stated maximum increases its service life to 950 000 000 flashes or 15 years of continuous operation.

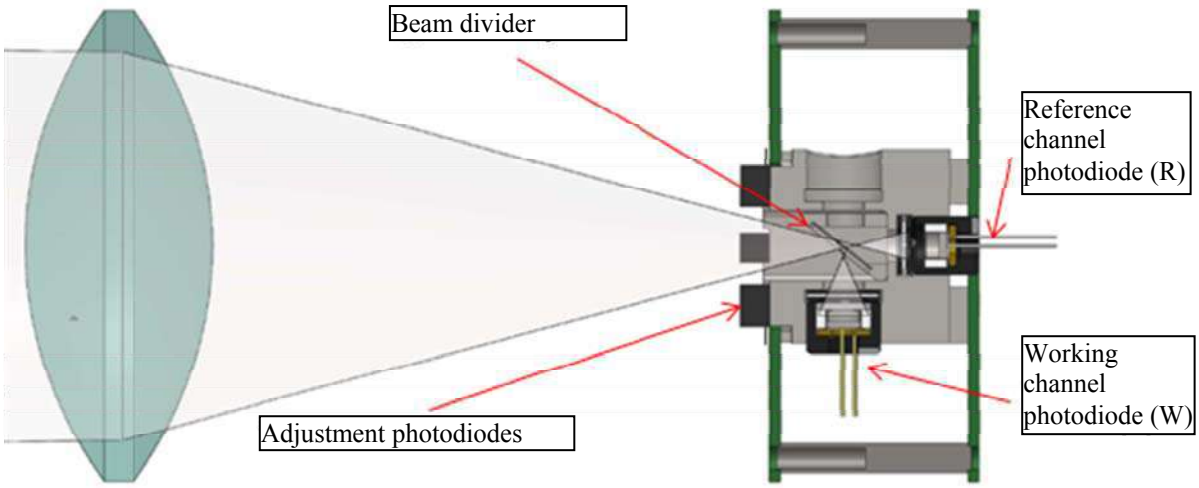
Excess emission power (about 10 times more than when using flash lamps) and the wide beam allow for manifold simplification of system adjustment.



TGAES-RX receiver is built on the basis of photodiodes, its optical arrangement is double-channel, single-axis. Light emission pulses of the transmitter come to the receiver's inlet. IR radiation is gathered by the lens and equally distributed by the beam divider, at rate 50X50. After the divider, the emission beams are collected on the photodiodes of the working (W) and

reference (R) channels. Before the photodiodes there are optical interference filters for the working and reference IR emission wavelengths. Photodiode aperture is completely covered by filters, completely preventing the ingress of visual disturbances.

Note: *To simplify system setting, there are four adjusted photodiodes used to determine the position of IR emission beam in relation to the device's optical axis.*



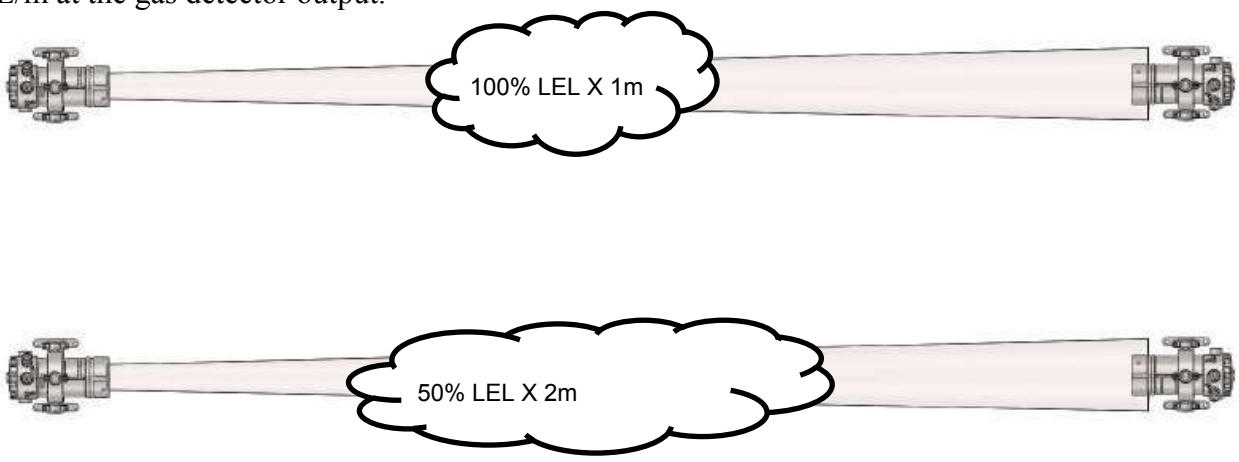
The gas cloud between the source and receiver absorbs IR emission with working (W) wavelength. IR emission with reference (R) wavelength propagates freely. Reference wavelength absorption degree depends on gas concentration in the cloud and its dimensions. The photodiodes of the reference and working channels convert IR emission into photo current which is amplified and converted in digital form.

Absorption degree: **D = W/R .**

Note: *Nonselective absorbers - water vapours, mist, dust, absorb the reference and working channel equally and do not affect the value D.*

Gas concentration is calculated and calibrated in volume fractions of gas content per unit volume (Vol), then is converted in LEL.m in accordance with the lower explosion level (LEL) for the chosen gas type and European or USA standard. LEL.m of digital form is converted to the current signal 4-20 mA proportional to the selected measuring range (Range).

The concept of measurements in units LEL/m is shown in fig.2. The figure shows how three gas clouds of different size and concentration cause the same value of current signal equal to 1LEL/m at the gas detector output.



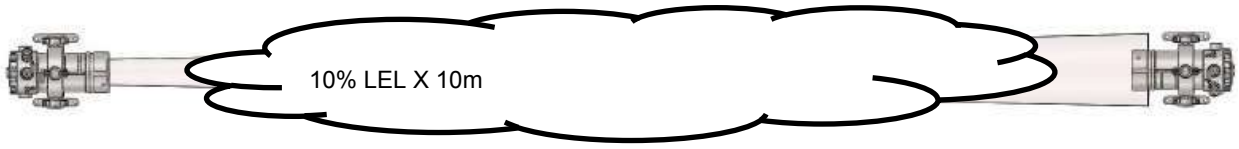


Figure 2 – Concept of measurements in units LEL/m

Detected gases

The TGAES system is able of detecting the majority of hydrocarbons, including methane, ethane, propane, butane, propylene, ethylene etc in the working air. The detected component and other operating parameters can be set using digital communication channels. The device contains the standard concentration and calibrating characteristic (gas image) for each detected component separately in the range of 0-5 LEL·m.

At release from the manufacturing plane, the gas detector sensitivity to methane and propane is calibrated. Calibration of sensitivity to other gases – according to the operating organization's request.

Factory standard setting of the measuring limits of the detected gas concentration, distributed within the measuring path, is 0-5 LEL·m.

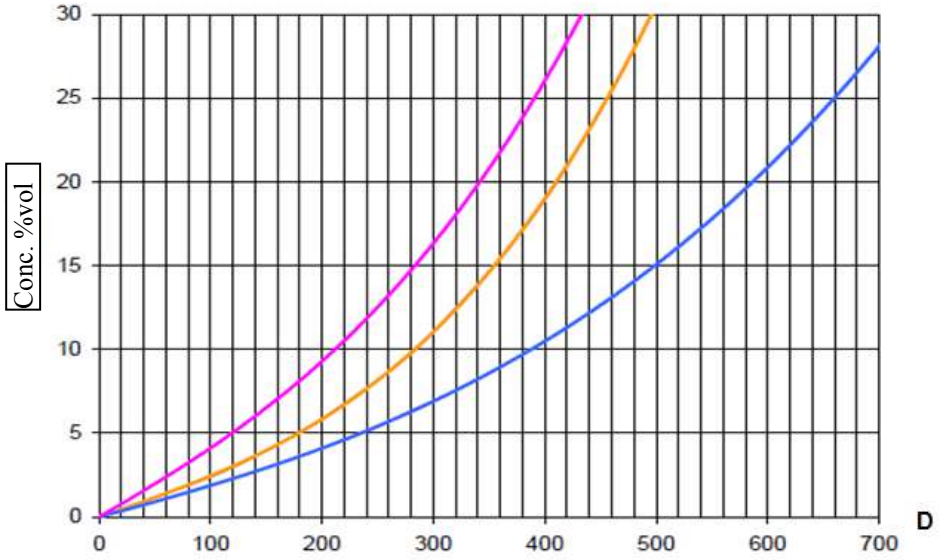
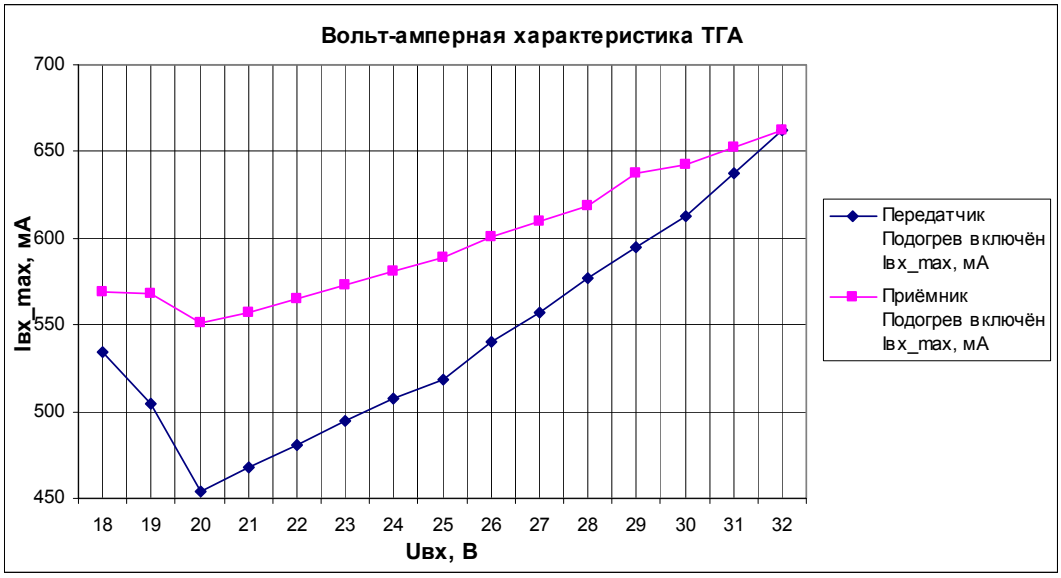


Figure 3 – Example of concentration characteristics for ethylene, methane and propane (from left to right respectively)

Electromagnetic compatibility

The TGAES system is survived under influence of electromagnetic interferences of 5W in frequency range from 150 to 170 MHz and from 450 to 470 MHz.

Inrush and normal operating currents



Current signal 4-20 mA

The current output 4-20 mA, corresponding to the set measuring range RANGE is intended for connection to analogue input devices, such as gas controllers, logical controllers. The following formula is used to convert signals from mA to LEL.m:

$$LEL.m = Range * \frac{Iout - 4}{16}$$

Relay output

The relay output consists of two alarm relays and one failure signal relay. Relays can be permitted or prohibited for power saving. Relays can be set to the mode with or without status fixing. Settings of the operation modes of all relays and setting of alarm thresholds are available via HART and RS485.

Data archive

The devices have real-time clock (RTC) and nonvolatile memory for 16000 pages. Each page saves a single screenshot containing all the current system operation parameters and time for such events as:

- power on
- alarm
-failure
- beam blocking
- disrupted temperature conditions
- power disruption

The data archive is accessible via programs TGAES−RX and TGAES−TX provided by the manufacturer.

For saving data archive the lithium battery is used in TGAES−RX and TGAES−TX. Battery life is not less then 10 years.

Controlled path

TGAES system can operate at distances from 5 to 200 meters.

A set of apertures, mounted on the transmitter, is provided for operation at distances less than 60 m.

The capability of transmitter power level adjustment makes the system more flexible in setting.

Optics heating

Heating is uniform on the lens perimeter. Maintains a temperature 25C higher than ambient temperature. Heating power is approximately 10 W, if operation conditions do not involve condensing or freezing on lens, receiver heating should be switched off. Transmitter heating disconnection will not reduce the peak consumption power.

Transmitter will give signal in case if sensing element(optics) is covered with dirt or other obscuring elements without interrupting the operation of detector. Warning is generated on 50% or more concealment of beam by obscuring elements.

7 Installation

7.1. Installation Locations

When selecting the most correct and optimal area of TGAES system installation, it is recommended to determine the possible sources of gas leak, forecast the behaviour of the gas cloud formed by leakage.

Before installation, it is needed to determine the combustible gases present at the facility for correct calibration of the device. Also, optimal system installation requires determining the gases' physical characteristics (e.g. density and flash point). For volatile compounds and gas mixtures (methane and others) the TGAES modules should be placed above the supposed area of controlled gas occurrence, and for "heavier-than-air" gas mixtures (propane etc) – vice-versa, under the supposed area of gas mixture leakage.

The measuring path and its surroundings shall not have obstacles hindering free air circulation in the protected zone or stopping the optical beam between the system modules.

Avoid installation in areas of:

- Steam valves and steam ejection points
- Smoke stacks, flues and exhaust hoods
- Footpaths and personnel stay areas
- Water spraying areas
- Parking lots, loading areas, building cranes, temporary vehicle parking lots, road intersections
- Abundant vegetation areas
- Surfaces capable of causing snow, ice accumulation etc

TGAES system installation locations should be chosen by the following rules:

- **Ensuring access to system modules.**
  The installation location shall be chosen so as to ensure free access to the device for periodic check, sensitivity setting, regular maintenance, optics cleaning, troubleshooting etc. It is also needed to ensure maintenance personnel's view of the module status indicator within the protected zone. If it is needed to install TGAES modules in hard-to-reach spaces, use the remote SSS transmitter[1] for display of the module status indication.

- **Impact of terrain relief**
  It is needed to avoid system installation in areas subject to soil subsidence, landslides or soil defrosting, capable of shifting the installed gas detection system. If such locations cannot be avoided, engineering measures shall be taken to ensure a secure foundation.

[1] – *the remote SSS transmitter is not included in delivery set, is delivered by special order*

- **Installation of several systems**
  If more than one TGAES system is used, make sure each receiver receives the signal only from its assigned transmitter.

- **Impact of external transmitters**
  TGAES is not sensitive to impact of external emission sources, such as sunlight, artificial lighting, welding, flare burner flame, radiation.

- **Impact of moisture**
  TGAES system has casing protection level IP66, therefore, rain, snow, and high humidity cannot damage the modules.

- **Impact of increased contamination sources**
  It is necessary to avoid such installation locations where the gas detector module lenses will be permanently subject to high contamination level. Potential contamination sources are exhaust systems of generator/turbine plants, drilling units, smoke stacks etc. If the system cannot be mounted without impact of contamination sources, it is recommended to use additional shields and/or provide access for regular cleaning.

- **Installation height**
  The device shall be in all cases installed at a height allowing for correct adjustment and, regardless of weather conditions, ensuring gas detector operability.
  When detecting lighter-than-air gases (density by air is less than 1), the device shall be installed above the supposed gas leakage source. To detect heavier gases (density by air more than 1), the system shall be installed not higher than 0.5 m above the floor level. If the room has the risk of leakage of gases with different density, the device shall be installed at the height depending on the density of the mixture component, for which the value of the LEL ratio is the maximum.

- **Distance between system modules**
  It is reasonable to install TGAES system if the distance between the transmitter and receiver modules (gas contamination monitoring area) is at least 5 m, in other cases it is better to use fixed spot gas detectors (SGOES, SSS-903 etc). The maximum distance between modules not more than 200 m. Displacement tolerance is +/- 1.0 deg. at 200 m

- TGAES modules should be fastened on stable, vibration-free structures, to avoid optical beam displacement in space. Building walls, a massive steel I-beam or almost any masonry usually provide the most rigid structure for system installation. It is needed to avoid using wooden structures or supports subject to skewing or twisting. When using vertical supports, such as poles or racks, such supports shall be fully stable and not experience vibration loads. Supports not higher than 3 m should be used. The mounting support can be placed in the ground or attached to a secure structure. If the support is placed in the ground, the support portion below the ground level shall be placed in a reinforced concrete foundation at least 1 m deep.

  IMPORTANT! *As a rule, it is necessary to use additional braces or supporting fasteners required to ensure stable mounting of the system modules. It should be remembered that accurate adjustment is important for correct functioning of the open path gas detector. Even minor shifts or displacements of supports can exert a negative impact on adjustment results. It occurs particularly in case of great distances between the gas detector modules.*

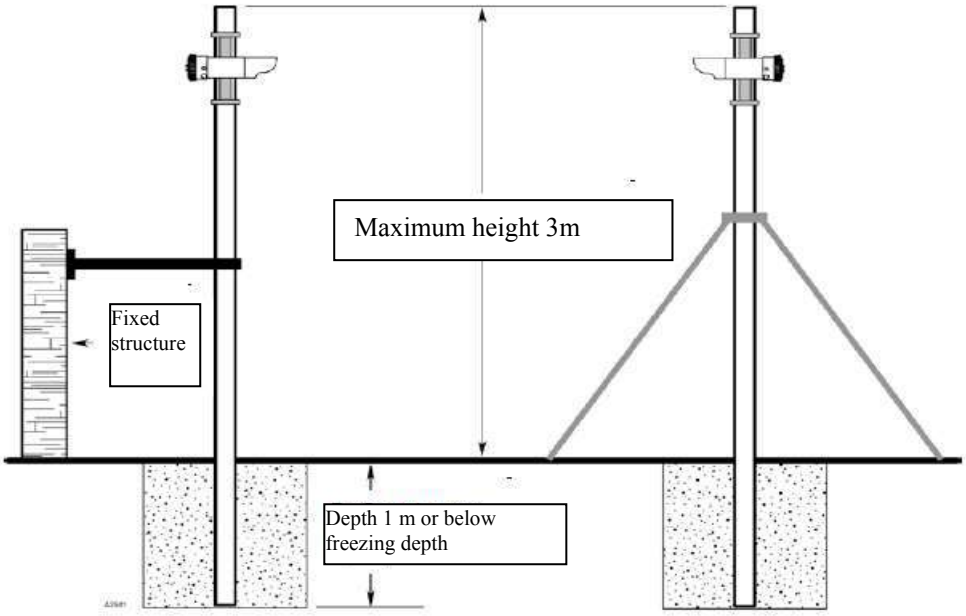


Figure 1 – Installation of gas detectors TGAES

Requirements to power supply unit

Requirements:

- Calculate the total rate of consumed power of the gas detection system in watts, with account of the cold start system.
- Select a power supply unit with relevant power for the calculated load.
- Make sure the selected power supply unit for the whole system ensures adjustable output voltage of 24 V DC with account of the permissible ripple. It is recommended to use a standby power supply unit with storage batteries to enhance system reliability.

Note: *If it is required to disconnect the electric power supply, a separate method of its disconnection shall be provided.*

7.2 Cable Guidelines

The delivery set of TGAES includes [Ex d] explosion-proof cable entries CG 201 (Figure 2) for electric power supply and readout of output information signals of the gas detector.

Figure 2 – Cable entry ¾ NPT (CG 201)

It is necessary at all times to use the corresponding cable type and diameter for electric power voltage supply, as well as for readout of the output signal from TGAES modules.

For connecting gas detectors via the analogue (current) 4-20 mA output, it is recommended to use four-core shielded copper cable with section than 1.5 mm^2 (cable КВБбШнг 5х1.5 should be used).

Connection of a group of devices in the loop via RS-485 is carried out with two independent cables for optimal protection against electromagnetic and radio interference. a shielded cable with core section 1.5 mm^2 – for instrument power supply and shielded twisted pair – for connection via RS-485 (cable Gerda – LS 2x2x1,5 should be used). Grounding of cable shield should be done only from one side (on the side of controller).

It is allowed to connect the devices via RS-485 with joint power cores and information cores in one cable if they are shielded in pairs.

To avoid EMI, low-frequency and high-voltage cables, as well as current supply lines of other equipment should not be placed in the same cable duct with the cable of gas detector connection via RS-485.

Connection of SSS for visualization and control/adjustment of TGAES should be performed by means of multi-cored cable (4 twisted pairs, two of which provide TGAES module power supply, and the other two – information transfer to the "remote" transmitter SSS via RS-485).

Equipment in hazardous locations should be connected by a specific cable (armoured, shielded) of industrial interface and, by means of cable entries, it is necessary to provide explosion-proof connection of TGAES modules to the SSS transmitter.

During making-up of multi-core cable wires, it is needed to account for the location and purpose of the terminals of the connecting board of TGAES module (fig.3).

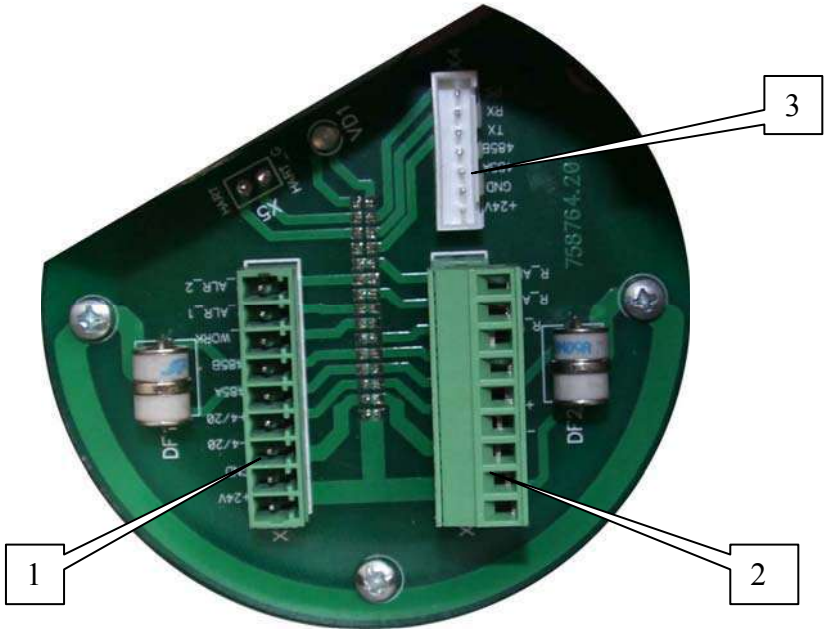


Figure 3 – Connecting board terminals location and designation

Note: *Except the contacts of relay outputs of gas detector, terminal blocks XT1 and XT2 are paralleled*

1 Terminal block XT1

relay contact "2 gas contamination threshold"
relay contact "1 gas contamination threshold"
relay contact "failure"

digital signal RS-485B

2 Terminal block XT2

relay contact "2 gas contamination threshold"
relay contact "1 gas contamination threshold"
relay contact "failure"

digital signal RS-485B

digital signal	RS-485A	digital signal	RS-485A
analogue signal	+ 4-20	analogue signal	+ 4-20
analogue signal	– 4-20	analogue signal	– 4-20
common			common
power	+ 24V	power	+ 24V

3 process connector XT3

Characteristics of threaded connections (cable entry holes) ¾ '' NPT are also designed for retaining the required explosion protection parameters during mounting using pipe connectors ANSI/ASME B1.20.1 (including a metal hose with a relevant threaded coupling).

Cable section and maximum length

It is necessary at all times to determine possible voltage drop in the supply cable to guarantee supply of 24 V DC to the gas detector. The minimum voltage required for correct device functioning is 18 V.

Power to the gas detector should be supplied by wires of section not less than 1 mm^2 depending on distance.

Requirements to cable size depend on the value of supplied voltage and cable length. The maximum distance between the gas detector and power supply is determined according to the maximum permissible voltage drop for the electric wiring loop. If electric power supply voltage drop is more than 6 V of the recommended rated supply voltage 24V, the device will stop functioning. To determine the maximum voltage drop in the loop, it is necessary to deduce the minimum device operating voltage (18 V) from the minimum output voltage of the power supply.

Limitations of the signal cable length are not given, but it should be borne in mind that 4-20 mA circuit impedance does not exceed 500 Ohm.

The actual cable length is determined by the following formula:

$$L = \frac{\Delta U \times S}{2 \times \mathrm{Im}\,ax \times \rho}$$

where ΔU(B) – acceptable line voltage drop;
(ΔU(B) = 6 V at Urat. = 24 V; ΔU(B) = 14 V at Urat. = 32 V)
S (mm^2) – cable section;
Imax(mA) – maximum current consumed by the device
for devices connected in loop (Imax(mA)*N(pcs)) – where N(pcs) – number of the devices in loop;
p - resistivity constant.

Example: *Let us consider installation of a device connected by 1.5 mm^2 copper cable*
Power supply voltage Upwr = 24V.
Minimal supply voltage on gas detector = 18V.
Maximum power consumption Pmax = 15 W
Permissible line voltage drop ΔU =24-18 = 6V

Imax = Pmax / Upwr = 15 / 24 = 0.625 A.

$$L = \frac{6 \times 1.5}{2 \times 0.625 \times 0.0178} = 405$$

The maximum cable length in this case shall not exceed 405 m.

7.3 Mounting Procedure:

1. Pull the gas detector from the transportation package and perform external examination of the device to check the delivery package contents and presence of visible damages.

2. Prepare the required tools and accessories for fastening of TGAES module brackets in their locations (according to the optimal trajectory of measuring path).

Note: *The measuring path trajectory and areas of measuring module location/fastening are designed at the preliminary stage of design of the gas contamination control system so as to ensure the proper layout of power supply cables and cables of TGAES data signal readout at the operation facility.*

3. Place the TGAES modules in the direction from the transmitter to receiver.

4. Fix the fastening of module brackets.

For this (Figure 4):

4.1 The fastening bolts of one of the opposite bracket sides (e.g. upper and right) should be left tightened with a force ensuring free movement of the module housing in two planes. The fastening bolts (lower and left) on the other bracket site should be loosened.

4.2 Turning the module housing by hand in two planes, perform system adjustment.

4.3 Fasten the remaining bracket fastening bolts.

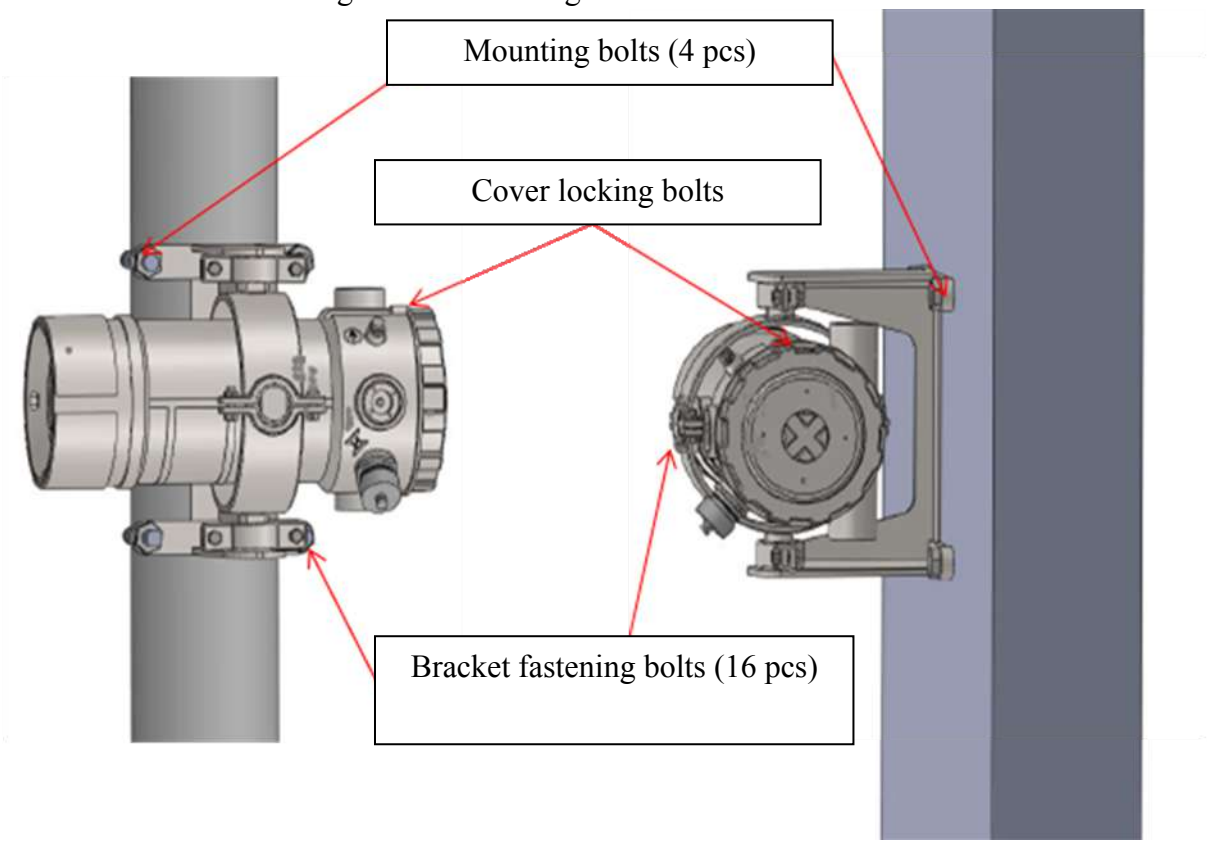


Figure 4

Note: *To avoid thread galling, lubricate the thread of U-shaped bolts during installation.*

7.4 Connection:

1. Loosen the lock screw of the device base and unscrew it counterclockwise using a spanner/screwdriver as lever (Figure 5).

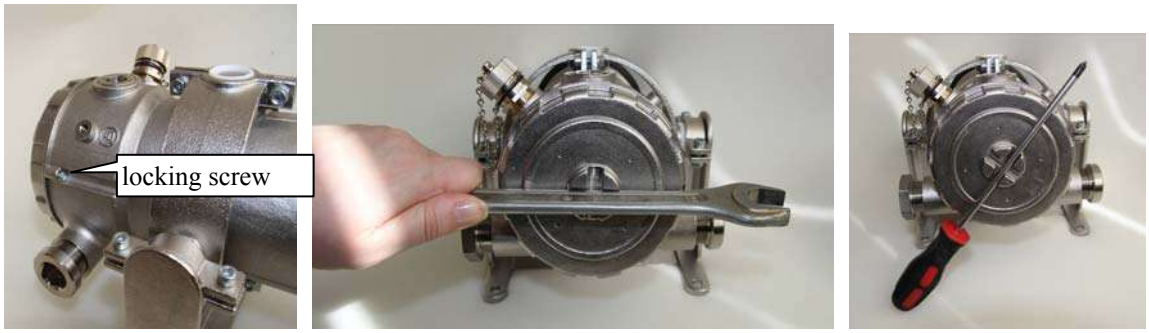


Figure 5

2. When connecting TGAES modules, take into account the location and assignment of connecting board terminals shown in figure 6.

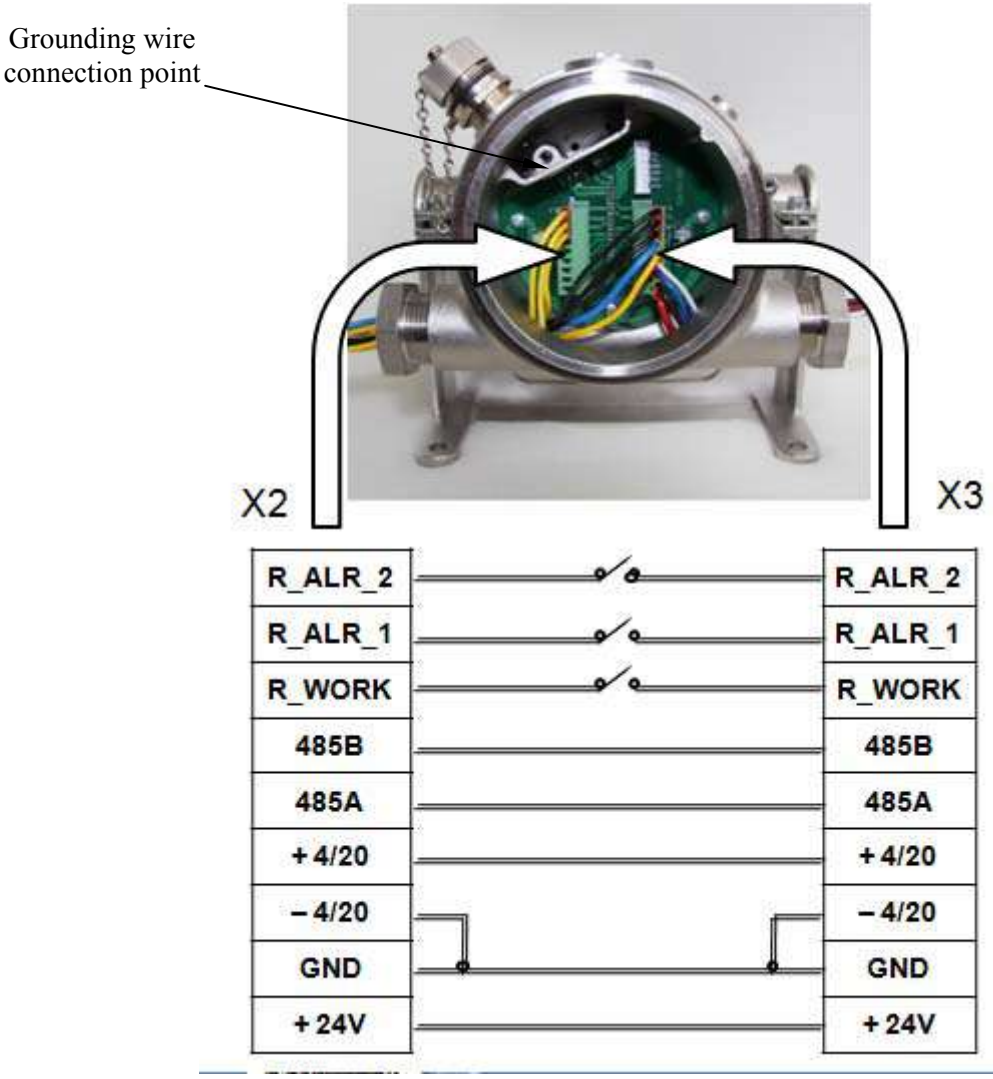


Figure 6 – Contact assignment and layout of inner connections

Table of assignment of contacts of terminal compartment
of TGAES receiver and transmitter

X2

R_ALR_2	Contact 1 alarm relay 2
R_ALR_1	Contact 1 alarm relay 1
R_WORK	Contact 1 failure relay
485B	RS485-
485A	RS485+
+ 4/20	Current output +
– 4/20	Current output –
GND	Power minus
+ 24V	Power plus 24V

X3

R_ALR_2	Contact 2 alarm relay 2
R_ALR_1	Contact 2 alarm relay 1
R_WORK	Contact 2 failure relay
485B	Backup
485A	Backup
+ 4/20	Backup
– 4/20	Backup
GND	Backup
+ 24V	Backup

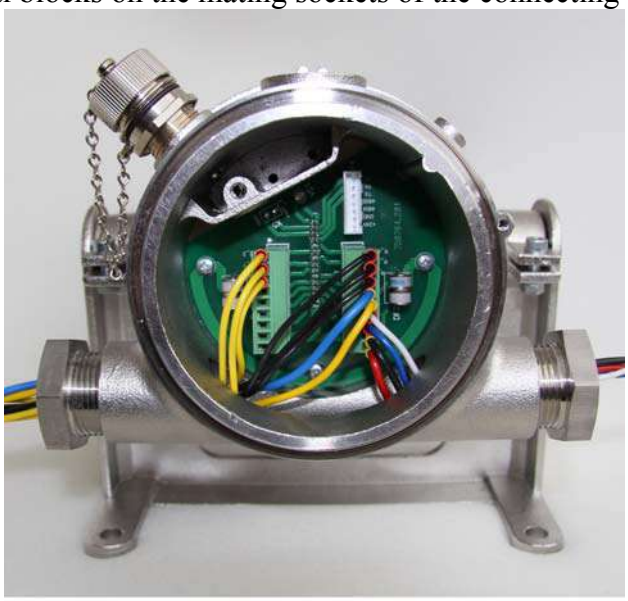
Attention! *The outputs marked GND are not designed for grounding connection.*

2.1. Unscrew the corresponding contacts of sockets on the terminal block using a screwdriver and connect the power supply cables and readout of the digital (RS-485) signal of TGAES via the explosion-proof cable entry.

To connect the TGAES module to the remote SSS transmitter, similarly connect the mounting cable by the opposite end to the transmitter board.

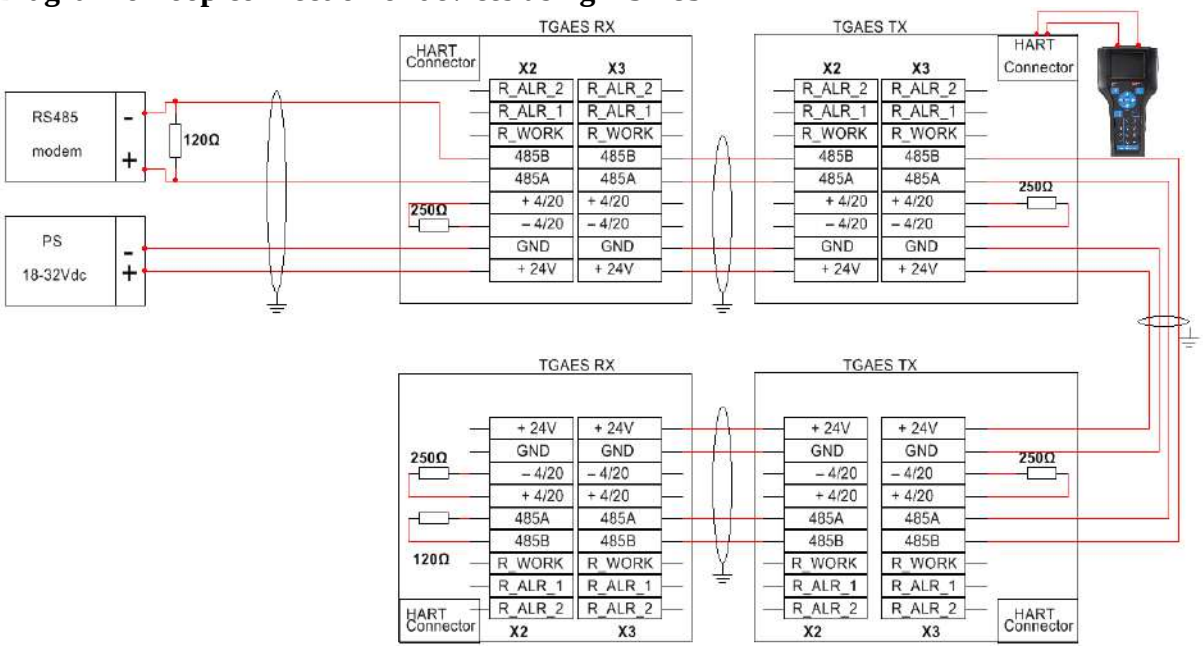
2.2. For connecting TGAES module using analog and relay outputs, unscrew the contacts of correspondent sockets of the detachable terminal blocks using a screwdriver. Via the explosion-proof cable entry, connect the wires of readout of the gas detector analogue (4-20 mA) and relay outputs.

2.3 Fasten the terminal blocks on the mating sockets of the connecting board of TGAES.



3. Screw back the removable part (base) of TGAES module using (if needed) a spanner/screwdriver for thread adjustment. Fix the lock screw of the TGAES base by a screwdriver.

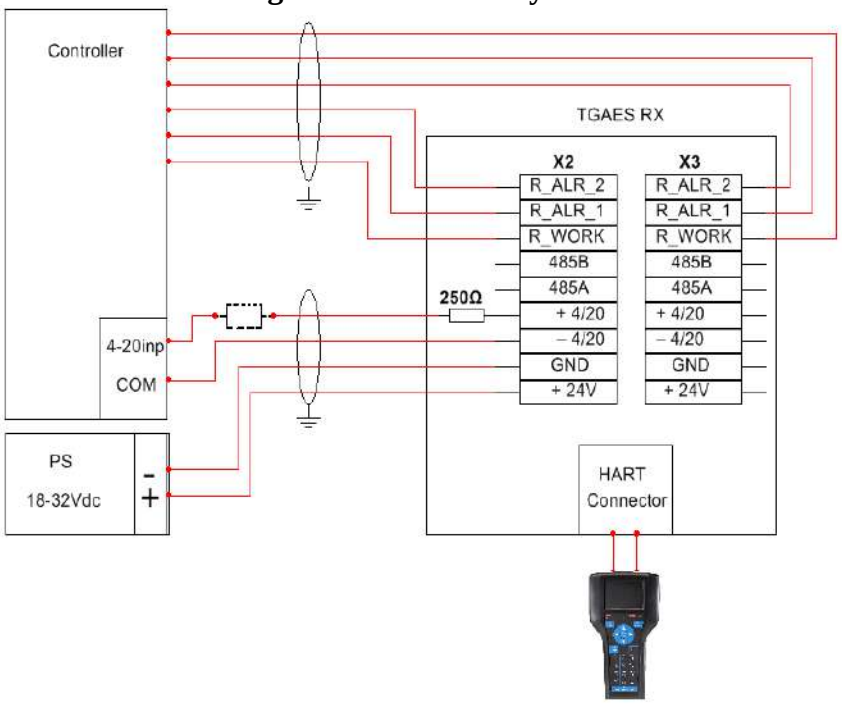
Diagram of loop connection of devices using RS-485



Note: *If the 4-20 mA output is not used and the HART-communicator is planned to be connected to the device, 250 Ohm resistors shall be installed.*

Attention! *When using RS-485, the devices shall not be connected by the star pattern or similar one. Figure 6 shows the worst option of networking by RS-485*

Layout of device connection using 4-20 mA and relay:



Note: *250 Ohm is required to ensure correct operation of HART interface, in case of low resistance 4-20 mA of the controller, it is not needed to install the resistance at the output TGAES-RX, it can be installed on the controller input.*

8 Start up Procedure

The system is ready for commissioning after gas detector installation and completion of electric wiring. If the specific application requires specific changes in the factory setting, they shall be performed using the communication protocols stated in the specification.

Attention! *Before start-up procedure, make sure all the alarm devices are off.*

8. 1 Adjustment

The adjustment procedure is performed at the first device installation and at any movement of the emitter and receiver.

The receiver and source shall be oriented as accurately as possible with the unaided eye. It will save time, reducing the number of steps required to detect the heavy central peak during device adjustment. Emitter or receiver deviation from the correct axis can cause weaker, false peaks, e.g. when the emitter light is reflected from the adjacent surface. Adjustment is performed by the visible portion of transmitter emission (rough adjustment) and using software TGAES RX (accurate adjustment).

To access the suspensions of emitter and receiver, do as follows:

- Unscrew the casing fastening screws;
- Loosen the eight clamping screws on the suspension assembly;
- Retighten the clamping bolts so that the device is able to move freely in all directions.
-

General adjustment algorithm:

- Installation and approximate aiming of receiver and transmitter one to the other.
- Rough adjustment – transmitter aiming by the visible emission or by receiver signals.
- Accurate adjustment – receiver aiming by adjustment channels. During this process, the received signal will increase, use apertures to reduce it, see “Signal level and apertures”
- Zero setup
-

Options of connection to TGAES for adjustment and calibration

Communication method used	Required equipment	Note
RS485	PC with Windows Modem USB-RS485 Programs TGAES-RX TGAES-TX (v.130122)	Cannot be used during connection in explosion-hazardous area. Baudrate 19200 max High functionality
HART	EX PC with Windows Modem USB-HART EX Programs TGAES-RX TGAES-TX (v.130122)	Intrinsically safe connection Baudrate 1200 max High functionality
HART	HART-communicator EX	Intrinsically safe connection Baudrate 1200 max Low functionality
Bluetooth	EX PC with Windows and Bluetooth Programs TGAES-RX TGAES-TX (v.130122)	option

Rough adjustment

Rough adjustment is performed by the visible spectrum of TGAES emission. This adjustment kind is aimed at approximate orienting of the receiver and transmitter one to the other.

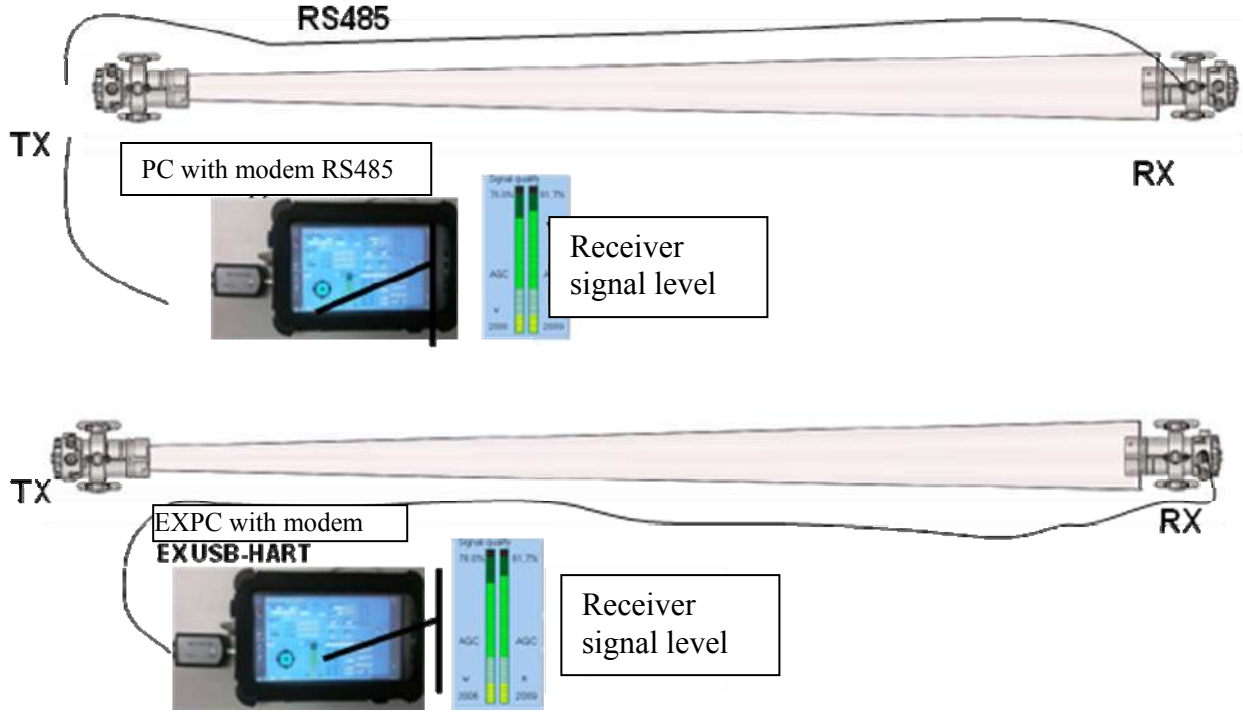
Do the following for rough adjustment:

- Visually orient the modules in the direction one from the other as it is possible by the unaided eye.
- Turn the transmitter so as to obtain visible emission of maximum brightness when viewing along the receiver axis towards the transmitter;
- Fix the transmitter suspension. Additional transmitter adjustment is not required.

Recommendation: *As a rule, even in sunny weather and from 200 meters the peak of transmitter flash brightness is well distinguishable, having very high contrast to lateral emission. Nevertheless, if it is possible to establish communication, e.g. via RS-485, if the transmitter and receiver are on the same loop or HART, with a receiver from the point of transmitter location, it can be used for remarkably faster and more accurate transmitter adjustment by a single person (Figure 1).*

For this:

- Staying by the transmitter, establish communication with the relevant receiver and observe the optic signal level at its input;
- Turning the transmitter, attain the maximum signal value, after which fix the transmitter.



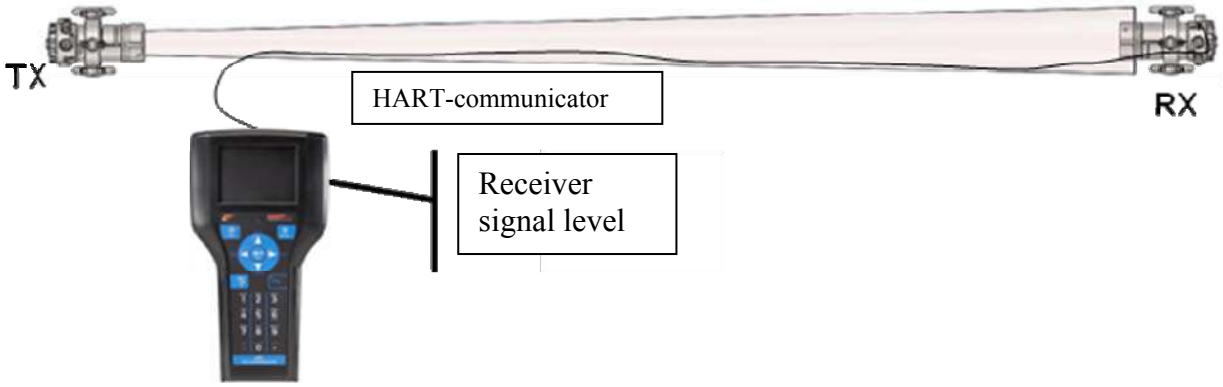


Figure 1 – Kinds of communication establishment

Accurate adjustment

Accurate adjustment is aimed at additional turning of the receiver casing so as to align the axis of the device direction pattern with the axis of transmitter IR-beam.

To facilitate this task, the receiver has four adjustment photodiodes installed equispaced from the receiver axis.

Using the ratio between the signals of the opposite photodiodes, the receiver program determines the receiver housing position in relation to the transmitter.

Do the following:

- Start the PC program TGAES-RX from the equipment delivery set (CD-disc) to establish connection with the receiver;
- Switch on adjustment – press the Start button on the adjustment panel, the adjustment indicator will blink from yellow to black. The analogue output will be set at 3.6 mA.
- For correct program behaviour, specify the receiver housing position in relation to the operator. For this, the adjustment panel has four marks of the grounding bolt position on the housing, if the operator is behind the receiver (Figure 2).

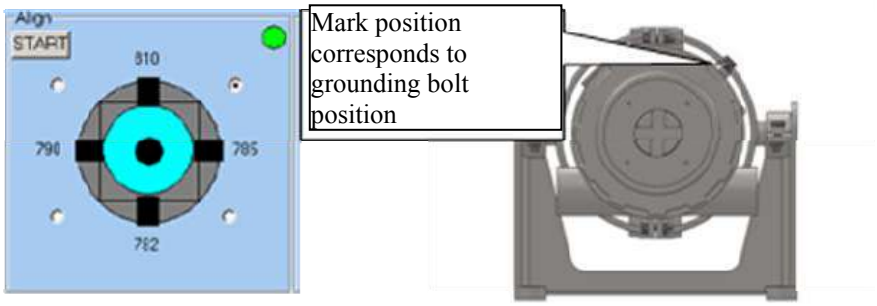


Figure 2 – Marks of grounding bolt position on the housing, if the operator is behind the receiver

- Slowly moving the receiver in the horizontal and vertical directions, attain equalization of the adjustment channel levels (Figure 3).

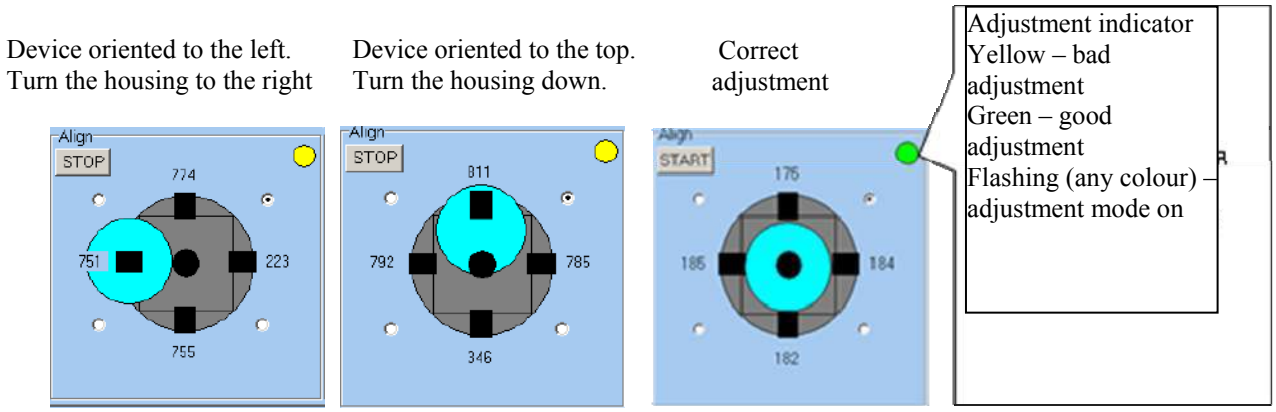


Figure 3 – Equalization of adjustment channel levels

- Upon adjustment completion, press the Stop button, if the receiver program accepts the adjustment, the adjustment indicator will become green.

Attention! *The receiver program is protected against significant device displacement to any side, blocking all measurements and alarms, activates the failure.*
Nevertheless, do the following before switching on non-adjusted receiver: Switch off all actuating devices and alarm devices. On the switched on receiver, switch on the adjustment mode before the operator starts additionally turning the device housing. Switching on of the adjustment mode guarantees that the device will not give false alarms.

Signal level and aperture

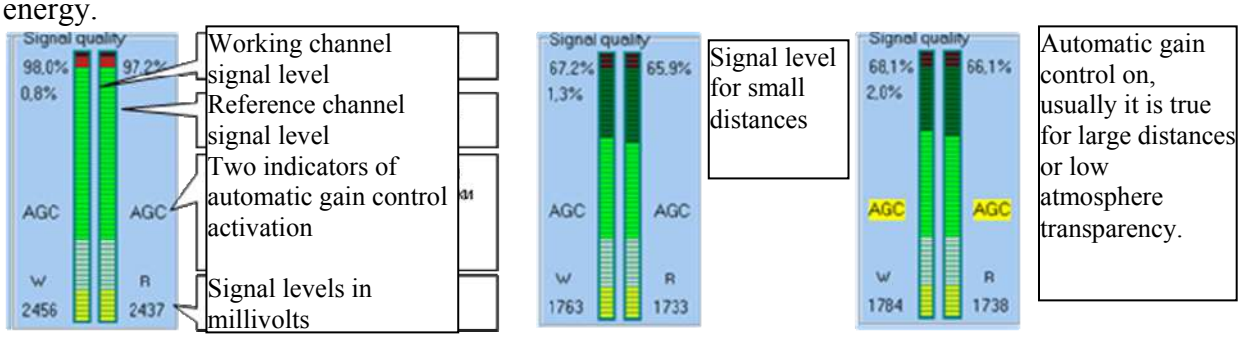
Checking and adjustment of the optical signal level consists in adjusting the transmitter emission power to the level ensuring normal receiver operation under any conditions and with any environment changes, such as temperature and atmosphere transparency.

It is needed at all times to have the signal levels located in the "green" area at the level of 30-95% of the maximum.

At distances less than 60 meters, apertures are used to reduce a very intense signal; they are stainless steel plates with holes of different diameter in the centre. Apertures are mounted on the transmitter, thus reducing the signal level.

The aperture is not required at the distances of 150 meters, adjustment can be performed using electronic control of transmitter power.

It is needed at all times to attain the maximum accurate setting to the emission maximum and transmitter power reduction. This will prolong the equipment service life and save electric energy.



Zone	Level, %	Level, mV	Description
Yellow	0 – 10%	0 – 250 mV	Very low signal Operation is impossible
Grey	10 – 30%	250 – 750 mV	If the signal is below the green area, AGC activates, the AGC sign is lit yellow. Operation is impossible in case of further signal decrease and entering the yellow area
Green	30 – 95%	750 – 250 mV	Signal level guaranteeing the maintenance of all device properties. The best case – signal level is in the green area middle, 60-70%
Red	95 – 100 %	2375 – 2550 mV	ADC saturation level Operation is impossible.

Signal level setting

During setting, to find out the true maximum of the transmitter signal, it may be needed to place apertures on the transmitter, if the signal is too high, reaching the ADC saturation level (red zone).

The signal shall be in the green area after aperture installation.

If the signal is at the upper edge of the green area, reduce the transmitter power.

If the signal is at the lower edge of the green area, or even lower, use an aperture with a larger hole and reduce the transmitter power.

To adjust the transmitter power, use RS-485 or HART and manufacturer's program TGAES−TX.

At large distances, when the aperture is not used, simply set the required signal level.

Transmitter with aperture
For installation, align the axes of receiver and aperture. Press on the aperture edges until it clicks.

Hole diameter mm	Use distance m
1	5 -10
5	10-20
10	20-30
20	30-40
40	50-60

8.2 Operation Checkout

Checkout is performed using special test plates (figure 4) simulating a known concentration of the detected gas component between the gas detector's transmitter and receiver modules.

At TGAES release from production, the response of each article to the specific test plate type shall be recorded, while the output signals of receiver module during measurement of the preset gas concentration are recorded in the calibration certificate of this specific equipment.

Comparison of the results of sensitivity check by test plates during release from production and in real operation conditions allows for gas detector assessment on the whole.

Before operation checkout, make sure there is no gas contamination within the measuring path. Install the selected test plate in close vicinity to the receiver glass and monitor the measured concentration.

Figure 4 – Test plates

Test plate designation	Range of rated values of integral concentration for test plate, LEL·m					
	The detected component is methane, in measurement range, LEL·m			The detected component is propane, in measurement range, LEL·m		
	0 to 1.0	0 to 2.5	0 to 5.0	0 to 1.0	0 to 2.5	0 to 5.0
PT – 1 GSKF.711111.022	0,25 – 0,65	-	-	0,65 – 1,00	-	-
PT – 2 GSKF.711111.023	-	0,85 – 1,55	-	-	1,50 – 2,50	-
PT – 3 GSKF.711111.024	-	-	1,55 – 2,40	-	-	2,35 – 3,55

Real value of integral concentration of detecting component in application of Ist Gas Mixture, C_o ,LEL/m, is calculated by formula

$$C_o = L \cdot \frac{C}{C_{LEL}}$$

Where L – length of cell,

C – volume fraction of detecting component, specified in passport of Ist Gas mixture, %;

C_{LEL} – volume fraction of detecting component, corresponded to low concentration level (LEL)

Value of integral concentration of detecting component under the value of current output 4-20 mA is calculated by formula:

$$C_i = \frac{1}{k} \cdot (I_i - 4)$$

Where I_i – steady-state value of output current under applicalion of Ist Gas Mixture, mA;

k – coefficient of conversion function (see table)

Table – Values of conversion function coefficients.

Detecting component	Measurement range of integral concentration	Values of coefficient k of conversion function
Methane (CH_4)	from 0 to 1 LEL/m	16 mA / (LEL/m)
	from 0 to 2,5 LEL/m	6,4 mA / (LEL/m)
	from 0 to 5 LEL/m	3,2 mA / (LEL/m)
Propane (C_3H_8)	from 0 to 1 LEL/m	16 mA / (LEL/m)
	from 0 to 2,5 LEL/m	6,4 mA / (LEL/m)
	from 0 to 5 LEL/m	3,2 mA / (LEL/m)

8. 3 Zero setup

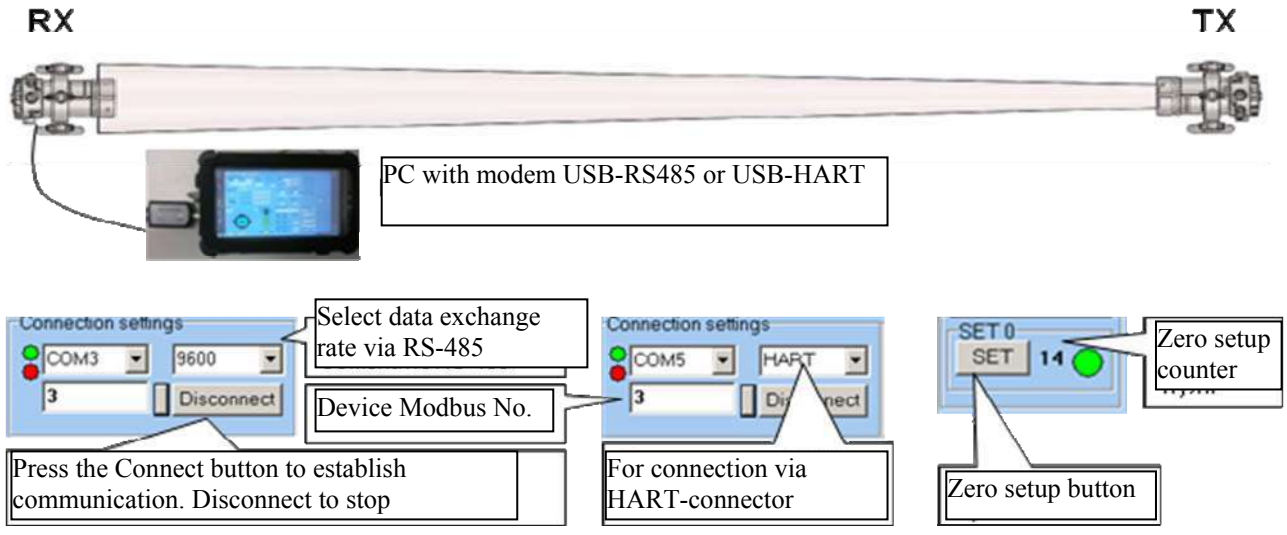
As a rule, periodic calibration of TGAES gas detector is not required, nevertheless, the device has the capability of zero setup in field conditions.

Note: *Before zero setup, make sure (using portable gas detector) there is no gas contamination throughout the measuring path length between TGAES modules and no obstacles stopping the beam.*

Repeated zero setup shall be performed each time the device is moved to a new location, as well as after cleaning and repeated adjustment.

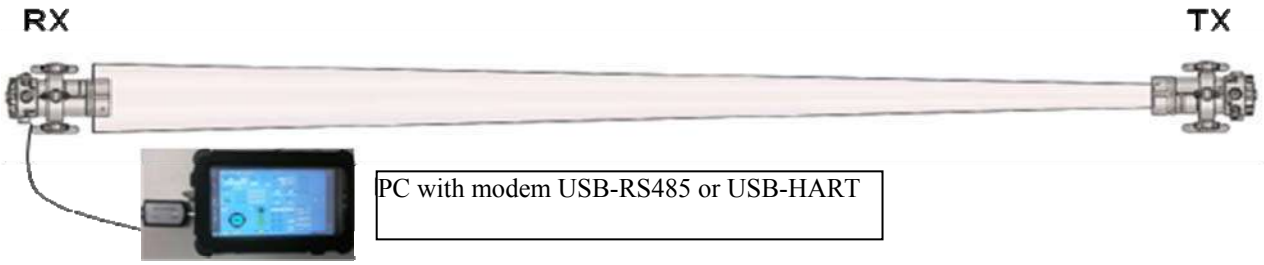
Zero setup and sensitivity calibration of TGAES is carried out during preparation for calibration in case of nonconformance of conversion accuracy to the requirements of the present Operating Manual.

8.3.1 Zero setup by service program via RS-485 or HART



- Connect the PC via modem USB – RS485 to the preliminarily installed and adjusted receiver.
- Make sure there are no hydrocarbons in the path.
- Open the program TGAES-RX, establish connection with the device. See program user's manual.
- Make sure the device is operable and signals are OK.
- Press the SET button on the SET 0 panel
- If the zero setup indicator is yellow, the zero setup process was started. During zero setup, the device accumulates and averages the concentration data.
- The zero setup counter depends on application conditions, noises, interference etc. After zero setup start, it starts decreasing, showing the remaining time in seconds.
- After counter expiry, the device sets the zero and passes to standby mode.

8.3.2 Zero Setup and Sensitivity Adjustment via RS-485



Before gas detector sensitivity adjustment, make sure (using portable gas metering instrument / gas detector) there is no gas contamination throughout the measuring path length between TGAES modules and no obstacles stopping the beam.

Repeated zero setup shall be performed each time the device is moved to a new location, as well as after cleaning and repeated adjustment.

Zero setup and sensitivity calibration of TGAES is carried out during preparation for calibration in case of nonconformance of conversion accuracy to the requirements of the present Operating Manual.

The following means are used during zero setup and sensitivity adjustment:

a) explosion-proof PC – IBM-compatible personal computer with operating system Windows XP, 2000 and free COM-port (hereinafter the PC);

b) Calibration cuvette, converter RS-232 / RS-485 ADAM (if needed);

c) Power supply source, milliammeter (multimeter);

d) PVC-tubes, rotameter, fine adjustment valve;

e) software (from accessories set on CD disk).

Ensure absence of mechanical damages of the body and optical elements of TGAES before works.

During adjustment of device sensitivity to calibration gas mixtures (CGM) of the set concentration, use CGM with the inner pressure of the detected mixture in the cylinder not less than 1000 kPa. Drop of pressure in the cylinder below the given value can cause non-uniformity of CGM supply and has an adverse effect on reliability of TGAES readings.

Device zero set up and sensitivity adjustment from the personal computer should be carried out outside the explosion-hazardous area.

Requirements:

- Install a special calibration cuvette (from the gas detector delivery set) between the TGAES transmitter and receiver modules so as to ensure passage of optic IR-radiation through the cuvette containing the calibration gas mixture.
- Using wires, connect the gas detector to the computer and power source according to figure 4.

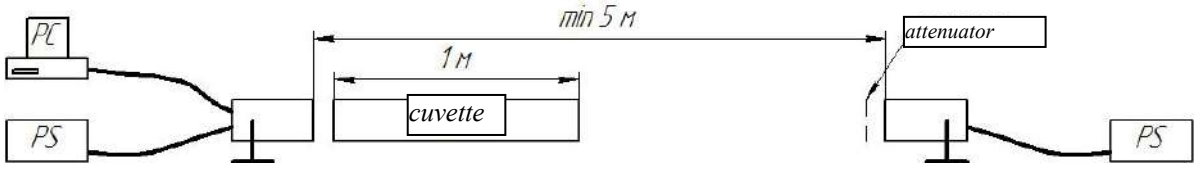


Figure 4 – Gas detector connection with computer and power source

- set the output voltage +24V and current > 0.3 A by the power source switches and switch it on;
- power the PC and after operating system load start the program TGAES RX for zero set up and sensitivity adjustment from the equipment set of delivery (CD);
- To establish communication with the device, select the COM-port number from the program menu (fig.5 pos.1). Enter the device network address (fig.5 pos.2) and press the Connect key.

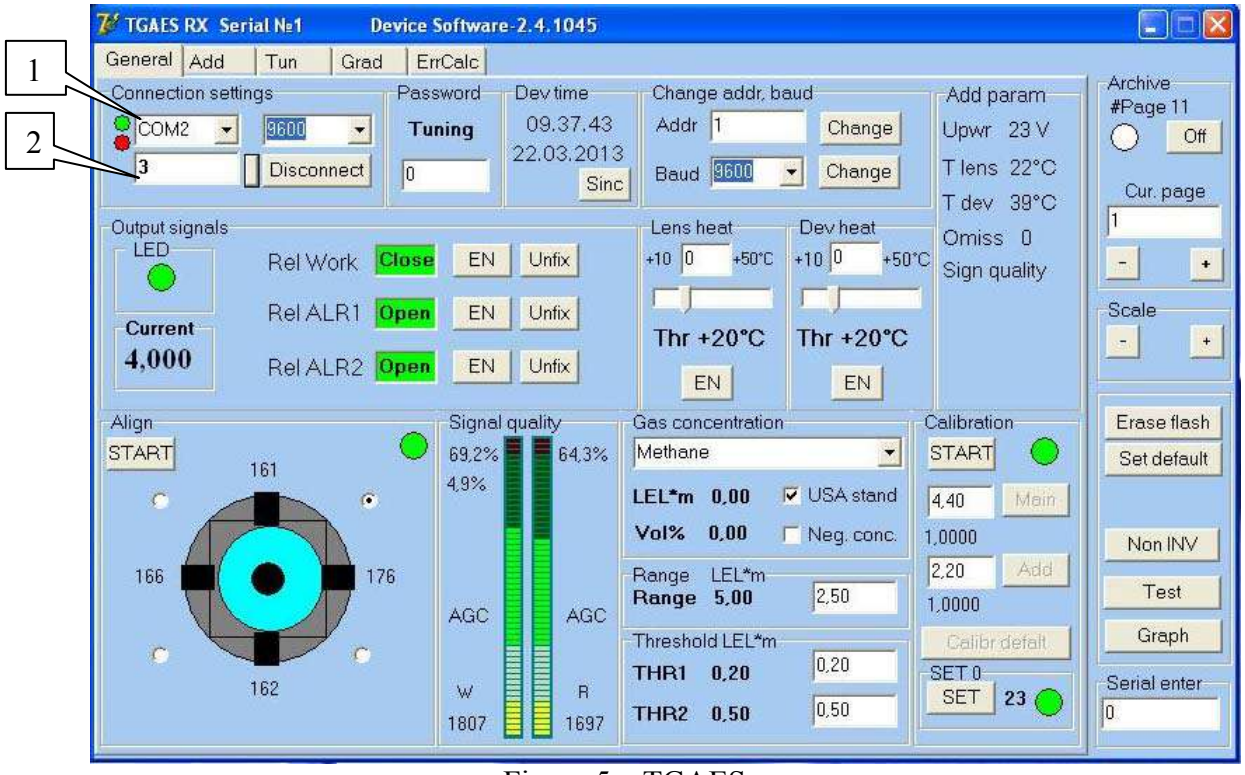


Figure 5 – TGAES program menu

- In case of successful connection, the program interface will show the parameters read out from the device
- Before zero setup and calibration, perform device adjustment (par.8.1).
- If needed, using the attenuator, attain signal level decrease about 80% by the working and reference channels.

- Select a calibration gas, connect the inlet of the cylinder, containing the zero calibration gas mixture (nitrogen) with the connection of the calibration cuvette using a PVC tube and blow it for 5…7 min. by a flow rate of 2….4 l/min.
- Press the SET 0 button.

If the device adjustment is correct, while signal levels by the working and reference channels are OK (no 100% saturation or signal decay less than 20%), in 10 s the message log (Add tab) will show the text “Set Zero” (Zero was set up), the analogue output will stay at 4 mA, relay status indicator Work (operability) will switch to Close (closed) and the colour device status indicator will change from yellow (failure) to green (operability).

Calibration via RS-485

For device switchover to the calibration mode, press the START button (fig.6 pos.1), after which the light indicator of calibration mode will change from green to black (fig.6 pos.2), while the analogue output will stay at 3.2 mA.

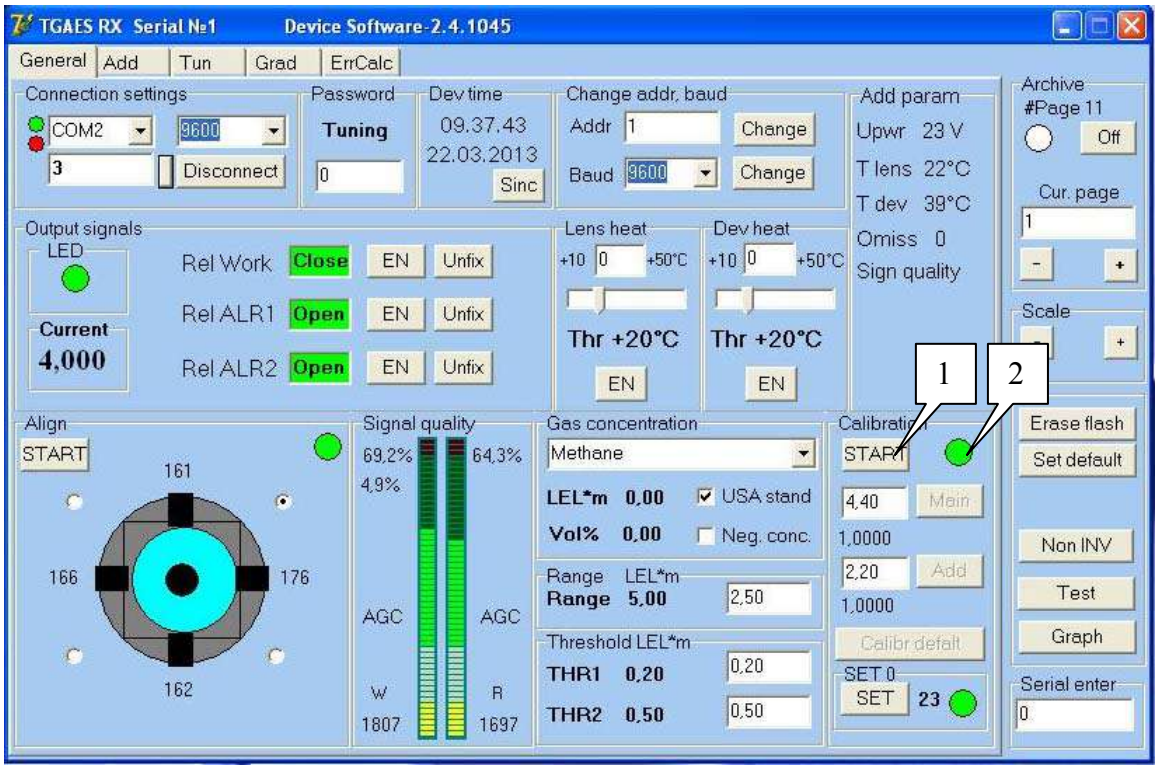


Figure 6 – TGAES program menu

Do the following **during calibration by large mixture**:

- connect the inlet of the cylinder, containing the calibration gas mixture, with the connection of the calibration cuvette using a PVC tube and blow it for 5…7 min. by a flow rate of 2….4 l/min until stabilization of the gas detector readings at a concentration close to 90% of the measuring range.
- Enter the concentration of the target component in volume fractions, given in the calibration gas mixture certificate, in the large concentration input line
- Press the Main key. The message log (“Add” tab) will show the entry “Cal. Main points”.

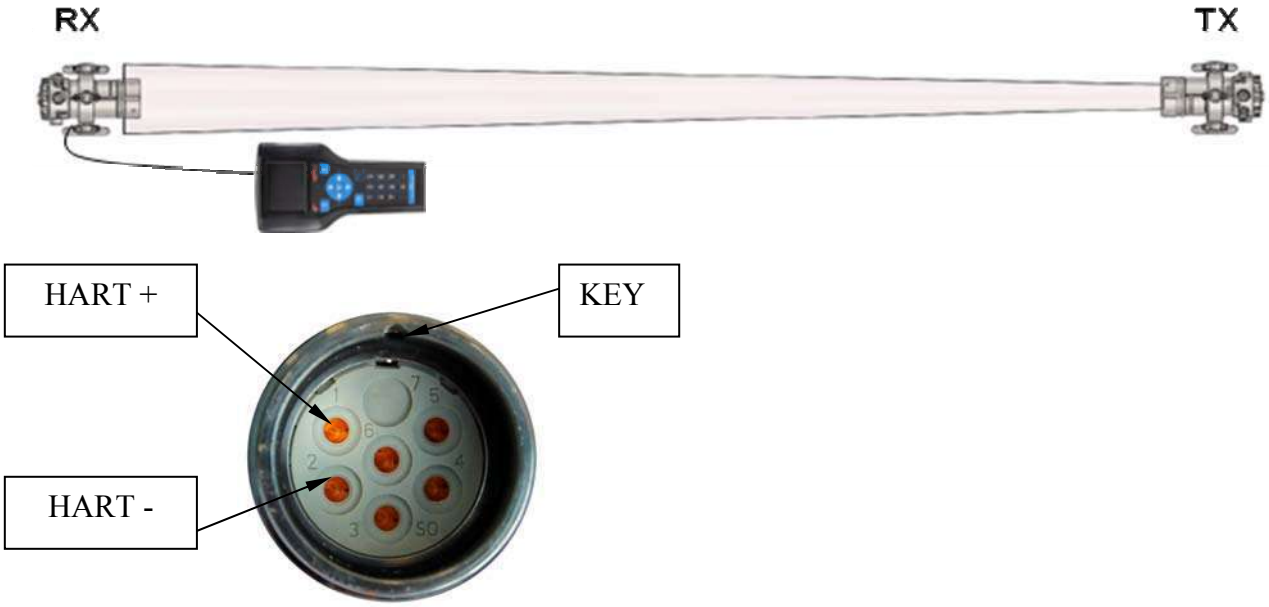
Do the following **during calibration by medium mixture**:

- connect the inlet of the cylinder, containing the calibration gas mixture, with the connection of the calibration cuvette using a PVC tube and blow it for 5…7 min. by a flow

rate of 2….4 l/min until stabilization of the gas detector readings at a concentration close to 50% of the measuring range.

- Enter the concentration of the target component in volume fractions, given in the calibration gas mixture certificate, in the medium concentration input line and press the Add button. The message log will show the entry “Cal. Add points”.
- Connect the inlet of the cylinder, containing the zero calibration gas mixture (nitrogen), with the connection of the calibration cuvette using a PVC tube and blow it for 5…7 min. by a flow rate of 2….4 l/min until stabilization of gas detector zero readings.
- Press the Stop button to stop the calibration mode and for device exit to the standby mode.

8.3.3 Zero setup by HART-communicator



Base diagram of HART-connector

In most cases, when using an isolated intrinsically-safe communicator, connection polarity makes no difference. Use the wire for communicator connection available in the delivery set.

To set zero and adjust sensitivity using HART-communicator, do the following:

- Install the calibration cuvette between the gas detector transmitter and receiver modules so as to ensure free passage of the measuring beam within the measuring path. Observing the given connector base diagram, connect the HART-communicator directly to the HART-interface output of the TGAES receiver module or to the HART-interface output of the remote SSS transmitter.
- Perform general operability check of the gas detector using test filter plates, as well as TGAES reading zero setup (par.8.2 hereof).
- Use the HART-communicator to select concentration calibration using GSO-CGM in the menu of TGAES operability check. The 3.2 mA current blocks the actuation of alarm thresholds and the devices passes to the calibration mode (the LED indicator intermittently glows green).
- Fill the calibration cuvette with a gas mixture containing the specified concentration of the detected gas component. During filling, blow the cuvette by at least fivefold volume of the supplied mixture – to ensure uniform distribution of the detected gas concentration.
- wait (2-3 min.) till steadying of TGAES readings, corresponding to the actual gas mixture concentration in the cuvette and use the HART-communicator menu to record to the gas

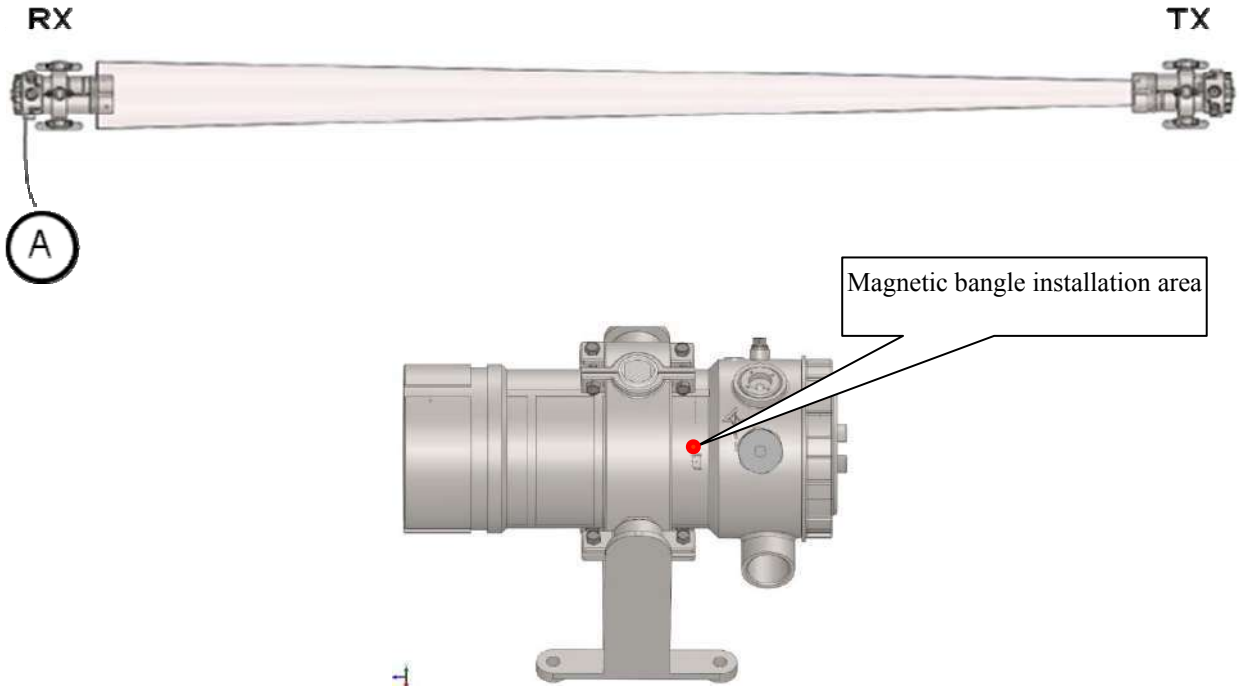
detector memory the value of distributed detected gas concentration, corresponding to the actual gas mixture content in equivalent of the measuring path length.

Note: *In case of concentration calibration using GSO-CGM of higher (more than 75% LEL) concentration, the value of distributed gas concentration of the given mixture recorded in the TGAES flash-memory (in equivalent of the measuring path length) becomes later the reference value of concentration calibration.*

- Wait for TGAES reply (via HART-interface) of the successful device calibration (data record in the gas detector memory).
- Reset the detected gas concentration (blowing the calibration chamber with fivefold volume of pure air). After establishing of the gas concentration near the zero mark, the TGAES current output automatically unlocks, and the device returns to the standby mode, while the indicator permanently glows green.

The process of device sensitivity setting can be remotely controlled by the RS-485 interface output, while the process of sensitivity adjustment is displayed on the personal computer screen installed outside the explosion-hazardous area (using the TGAES software in the delivery set and, if needed RS-232/RS-485 converter).

8.3.4 Zero setup using magnetic bangle



Before gas detector sensitivity adjustment, make sure (using portable gas metering instrument / gas detector) there is no gas contamination throughout the measuring path length between TGAES modules.

Then do the following:

- Set the calibration cuvette (from the gas detector delivery set) on the line between the transmitter and receiver modules to provide free measuring beam passing through the inner cuvette volume.
- To switch TGAES to the calibration mode, place the magnetic bangle to the gas detector receiver module and wait for intermittent (flash frequency about 1 s) green illumination of the LED status indicator.

Note: *If needed, perform TGAES (reading) zero setup, for which place the magnetic bangle again to the gas detector receiver module when there is no detected gas component.*

- Fill the calibration cuvette with a gas mixture containing the specified concentration of the detected gas component. During filling, blow the cuvette by at least fivefold volume of the supplied mixture – to ensure uniform distribution of the detected gas concentration.

For successful TGAES calibration using magnetic bangle, the concentration of the used GSO-CGM of high concentration corresponds to the reference value of concentration calibration (the data recorded in the device flash-memory).

- Having filled the calibration cuvette with calibration gas mixture, wait (2-3 min.) till steadying of gas detector readings, corresponding to the actual gas mixture concentration in the cuvette.
- Calibrate the device by placing the magnetic bangle to TGAES receiver, after which the LED indicator will start intermittently glowing red.
- Bring the bangle two more times, to exit the zero setup mode.
- Check output current = 4.00 mA
- Reset the detected gas concentration (blowing the calibration chamber with fivefold volume of pure air). After establishing of the gas concentration near the zero mark, the TGAES current output automatically unlocks, and the device returns to the standby mode, while the indicator permanently glows green.

9 Maintenance

Gas Detector TGAES has been designed for long-term continuous operation and requires minimum maintenance during operation. The maintenance interval is set by user depending on operating conditions.

In the general case, maintenance consists in the following:

- Gas detector operability check
- Cleaning of optical elements, if needed. The optical elements need cleaning if there is a failure signal. Clean the optical elements carefully in order to avoid damaging the lens coating. Wipe them with a soft cloth moistened in clean water or alcohol.

Note! TGAES repair is carried out on manufacturer facility only.

10 Malfunctions and Troubleshooting

Malfunction	Possible cause	Troubleshooting method
After power-on, TGAES does not pass to the normal operation mode (there is no indication of built-in LED)	Communication lines' rupture along the power supply circuits Malfunction in the processor's program	Check availability of power voltage 24V at the contacts of terminal connectors of TGAES modules. If power voltage is absent, restore the communication line Reprogram the processor
Absence (blocking) of output signal of TGAES receiver, transmitter module operates properly	Contamination of optical elements A barrier on the path of IR-radiation Incorrect installation of TGAES modules	Clean the optical elements Adjust the receiver and transmitter modules of TGAES in relation to each other. Remove the barrier blocking the optical visibility of

Malfunction	Possible cause	Troubleshooting method
		TGAES modules
Flashes are present Flashing yellow LED Current 2 mA	Power disruption Disrupted temperature conditions	Check supply voltage Check temperature
Flashes are absent Flashing yellow LED Current 2 mA	Transmitter failure	Check supply voltage Switch power supply off and again on, if flashes did not renew or stopped after some time, send the faulty device for repair
Other failures		Consult the manufacturer

11 Delivery Set

TGAES delivery set includes:

- Receiver and transmitter modules (complete with mounting brackets),
- Test plates – for TGAES operability check in the mode of simulation of the known gas contamination level within the measuring path;
- Calibration cuvette – for gas detector calibration and determining its metrological performance using certified calibration gas mixtures;

***Note*:** cuvettes not included in the delivery set can be used only if there is technical justification of their capability of ensuring the required concentration level during TGAES calibration (not less than half the measuring range).

- Shaped rubber protective shield resistant to temperature and to corrosive environmental impact (precipitation, dirt deposits etc);
- Magnetic bangle – for zero setup and calibration;
- Set of tools and accessories for gas detector mounting, including – [Ex d] explosion-proof cable entry (blank), as well as magnetic bangle (zero setup and calibration);
- Software
- Operating documentation set – on CD.

12 Transportation and storage conditions

Gas Detectors packed in compliance with this OM can be transported to any distance by any transportation means. While in transit, the shipping containers with packed Gas Detectors inside shall be adequately protected against atmospheric precipitation.

Gas Detectors transported by air shall be placed in heated leak-tight compartments. Cargo arrangement and fastening in transport vehicles shall ensure its stable position during transportation. Cargo displacement during transportation is not allowed. Railway cars, containers, truck bodies for gas detector transportation shall not have traces of carriage of cement, coal, chemicals etc.

Gas detectors packed in compliance with TU shall be stored during the warranty period according to group 1L as per GOST 15150-69. Storage conditions of TGAES in package of manufacture are corresponding of temperature range from -40 … +50 °C, and relative humidity up to 95% at temperature +25°C. Storage rooms shall be free from dust, acid and alkali vapours,

corrosive gases and other harmful admixtures. The materials should be place on storage shelves not mere then 5 sections.

The anticipated (mean) service life of gas detectors TGAES is 10 years (mean time between failures Tf is not less than 30 000 h).

13 Marking

1. The manufacturer's trademark
2. Conventional designation of TGAES gas detector
3. Certification agency's sign
4. Permissible in-service ambient temperature
5. Electric power supply voltage range from 18 V to 32 V, maximum power consumption
6. Housing degree of protection IP66
7. Serial number
8. Year of manufacture

14 Acceptance, Preservation, and Packing Certificate

Acceptance Certificate

Gas detector TGAES _____

serial No. _____ meets specifications GSKF.413311.003 TU, passed run-in for 72 hrs and is serviceable.

Date of issue: "___"_____

L.S.

QCD representative's signature (surname)

According to initial calibration results, the article is considered serviceable.

State verification officer (surname, stamp)

Preservation Certificate

Gas detector TGAES _____

serial No. _____ passed preservation as required by the packing and preservation instruction.

Preservation date: "___"_____

Preservation period:

Preserved by: (signature)

Article after preservation accepted by: (signature)

L.S.

Packing Certificate

Gas detector TGAES _____

serial No. _____ was packed by the manufacturer as required by the packing and preservation instruction.

Packing date: "___"_____

Packed by: (signature)

Article after packing accepted by: (signature)

Preservation and depreservation data

Table 2

Code, index or designation	Device name	Serial number	Preservation date	Preservation method	Depreservation date	Name or designation of preserving enterprise	Date, Position and signature of person in charge

15 Warranty Service

The manufacturer JSC “Electronstandard-pribor” hereby warrants the compliance of Gas Detectors with the requirements of Technical Specifications (TU), provided that the consumer strictly observes the operation, transportation and storage conditions as outlined in this Manual.

Warranty period is 18 months after gas detector commissioning, with account of the components.

Warranty shelf life with the customer is 12 months subject to observance of the OM storage requirements.

Manufacturer's mailing address - 188301, Gatchina, Leningrad Region, 120-y Gatchinskoy divizii Str.

Legal address - 192286, St. Petersburg, 35/2 Slavy Avenue,

Telephone +7-(812)- 3478834, +7-(81371)-91825

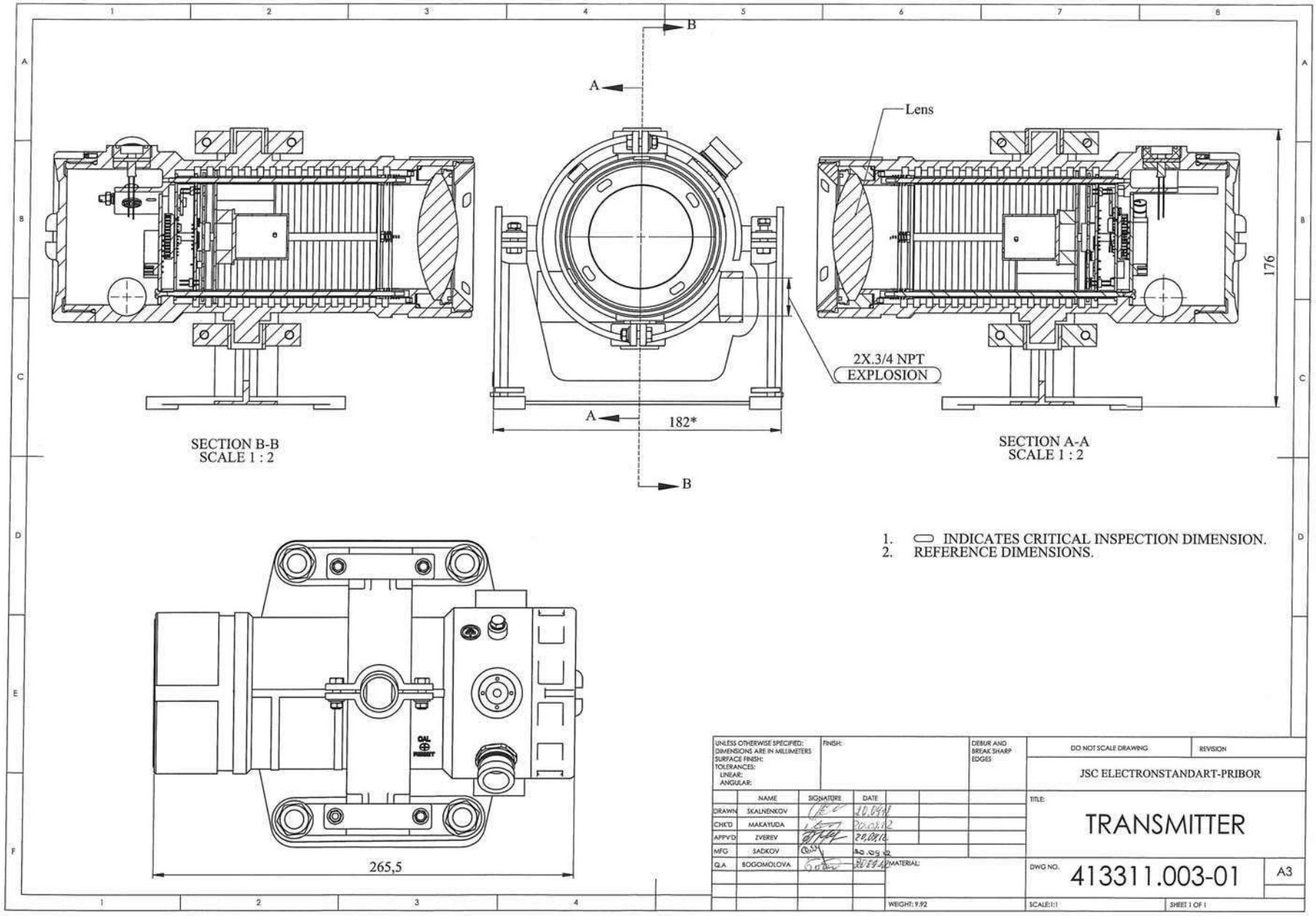
Fax +7-(81371)-21407, e-mail: info@esp.com.ru, сайт: www.electronstandart-pribor.com

The 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 any parts or components of Gas Detector falling non-operational.

Orig. Inv. No.	Sign. and date	Supers. Inv. No.	Dupl.Inv.No.	Signature and date

Изм.	Sheet	Document No.	Signature	Date

Drawing of explosion protections of transmitter module TGAES



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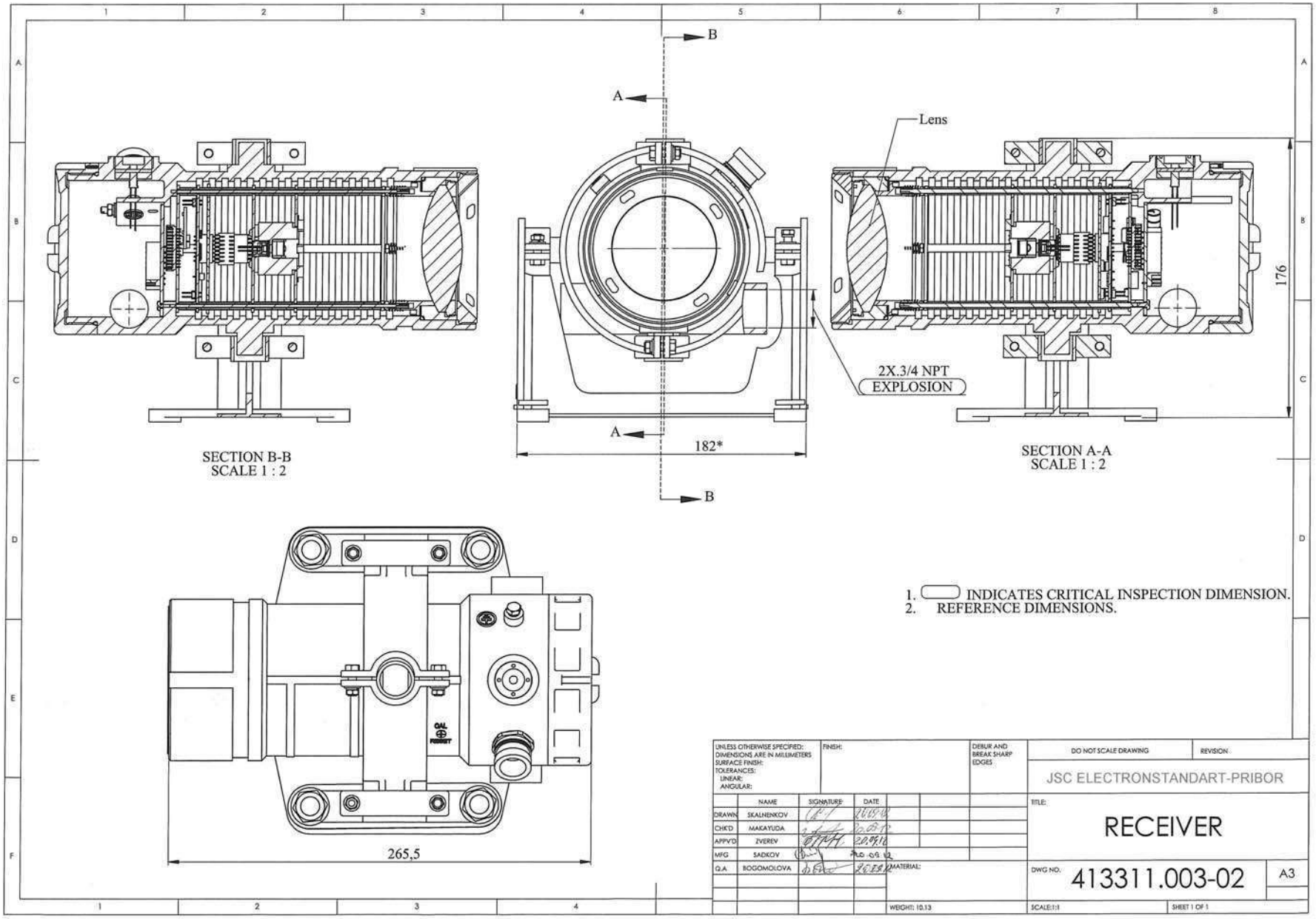
Изм.	Sheet	Document No.	Signature	Date

Drawing of explosion protections of receiver module TGAES



GSKF.413311.003 OM

Sheet
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Appendix A

Record of revisions

Rev.	Sheet (page) numbers				Total sheets (pages)	Docum. No.	Ref. No. of accomp. doc. and date	Signature	Date
	revised	replaced	new	cancelled					

Signature and date

Dupl. Inv. No.

Supersedes Inv. No.

Signature and date

Orig. Inv. No.