Hydrogen Sulfide, Combustible and Toxic Gas Detector SSS-903

Operating Manual

GSKF.413425.003 OM

Revision History: GSKF.413425.003

Date	Revision	Description	Approved
16/04/13	01	Initial Draft	O.Zverev

Table of Content

1. Introduction

This Operating Manual specifies performance characteristics of SSS model (SSS-903) of explosion-proof fixed gas analyzer equipped with plug-in universal sensors (hereinafter referred to as the Gas Analyzer) designed and meant for automatic continuous control monitoring of gas contamination levels with flammable and toxic gases present in the working area environment of oil, gas and chemical industries and provided high alarm protection level and correspondence of gas control methods by state-of-the-art protection requirements.

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- ✓ Drilling and production platforms
- ✓ Refineries, bulk terminals and tank farms
- ✓ Compressor stations and pipeline facility
- ✓ Petrochemical, paint and fertilizer plants
- ✓ Fuel loading facilities
- ✓ Boiler stations
- ✓ Transportation facilities
- ✓ Residential areas

Gas Analyzer has been designed for operation at the temperature range from minus 40 to 75 °C (with activated internal heated) and relative humidity of up to 100 % (non-condensing).

Power supply to Gas Analyzer shall be provided from the DC source with the voltage of 24 V, SSS operates under the power supplying from 18 to 32 VDC.

SSS-903 Gas Analyzer consists of Transmitter SSS (threshold device) and plug-in universal gas transducers PGU with electrochemical (PGU-E), infrared (PGU-IR) and photoionized (PGU-P) sensors. The transmitter can also be connected to TGAES,SGOES and SGOES M11 detectors.

2. Features

- 3-colored status detector indicator (“normal”, “failure” and “alarm” modes);

- 3 LED threshold response diodes for visual control and calibration mode diode;

- Multifunctional display with indication of:

  - Gas type
  - Current gas concentration units in LEL, ppm or vol.;

  - Fixed alarm levels;
  - graphic diagram of detector operation during last 30 minutes.

- Calibration, "zero" set up and maintenance of the device without dismantling in a field conditions (by means of HART-communicator or magnetic switch);

- “Remote sensor” option provides to install the PGU sensor in complicating access zones and execute the remote monitoring of operation.

- Real-time function;

- History records;

- Display illumination function.

- Initializing time after start up is 15 seconds for SSS-903 detector.

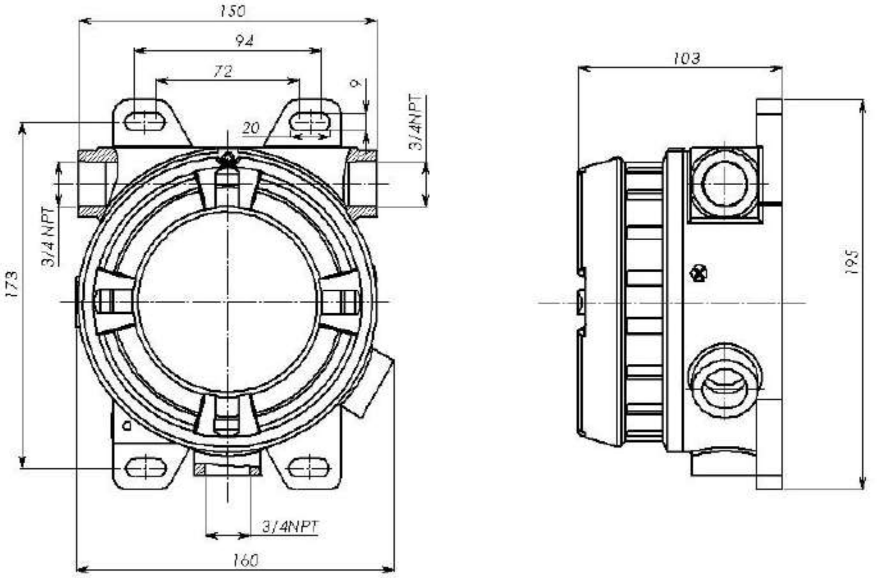
3. Specification

3.1. Electrical, operating, mechanical characteristics

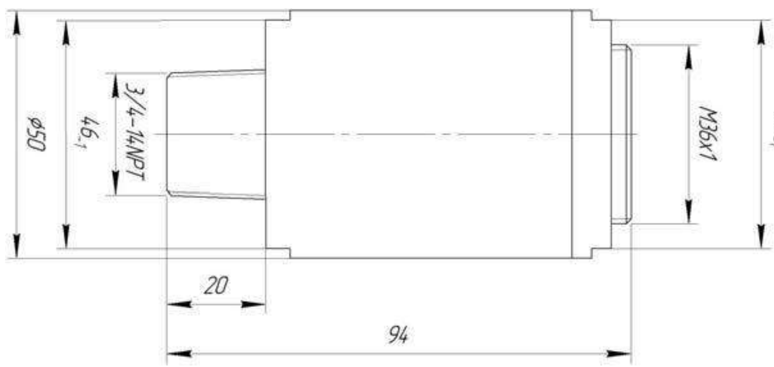
Electrical characteristics	
Voltage supply	24 VDC from 18 to 30 VDC
Power consumption	≤ 6,0W
Outputs	RS-485 MODBUS RTU 4-20 mA, relay “dry ” contact, HART
Sensors types	electrochemical, infrared, photoionized, catalytic
Operation characteristics	
Humidity range	0 to 100%RH (non-condensing)
Operating temperature	-40℃ to +75℃
Ingress protection	IP 66/67
Indicator’s status	-3-colored status detector indicator -3 LED threshold response diodes -Calibrator indicator
Intergral Display:	- gas type - measuring units -32 digit LCD display with backlight illumination - graphic diagram of detector operation during last 30 minutes
Explosion proof marks: Transmitter PGU-E, PGU-P, PGU-IR	 Ex d [ib] IIB+H_2 T6 Gb Ex d ib IIB+H_2 T6 Gb
Dimensions: Transmitter SSS Plug-in universal gas transducers PGU	 270 x 150 x 120 mm 94 x 50 mm
Mechanical characteristics	
Material	Aluminum Alloy Stainless Steel SS316
Cable entry	2 cable entries ¾” NPT
Weight	5,5 kg
Warranty	2 years

Dimensions:

Transmitter SSS (threshold device)



Plug-in universal gas transducer PGU



3.2 Table of sensor types and detecting gases

Transducer's type	Gas	Gas formula	Detected component measuring range	Accuracy	Response time
Plug-in universal gas transducers optic infrared **PGU-IR**	Methane	CH4	(0 ÷100) % LEL	±1% up to 50% scale. ±2% full scale	T50 < 3 seconds T90 < 7 seconds
	Propane	C3H8			
	Ethylene	C2H4			
Plug-in universal gas transducers photoionized **PGU-P**	Isobutylene	C4H8	(0 ÷ 200) ppm	± 2% full scale	T90 < 5 seconds
	All gases with ionization potential <10.6 eV Gas Ionization Potentials see at Annexure 1.				
Plug-in universal gas transducers electrochemical **PGU-E**	Hydrogen	H2	(0 to 4) % vol.(100% LEL) (0 ч 2) %	±1% up to 50% scale. ±2% full scale	T50 < 3 seconds T90 < 7 seconds
	Oxygen	O2	(0 to 25) % vol.	±0,5% vol.	T90 < 7 seconds
	Carbon Monoxide	CO	(0 to 100) ppm	±1% up to 50% scale. ±2% full scale	T20 < 3 seconds T90 < 7 seconds
	Hydrogen Sulfide	H2S	(0 to 100) ppm	±1% up to 50% scale. ±2% full scale	T50 < 3 seconds T90 < 7 seconds
	Sulfur Dioxide	SO2	(0 to 20) ppm	±1% up to 50% scale. ±2% full scale	T50 < 3 seconds T90 < 7 seconds
	Ammonia	NH3	(0 to 100) ppm	±2% full scale	T90 < 90 seconds
PGU-T	Hydrogen	H2	(0 to 4) % vol.(100% LEL) (0 to 2) %	±1% to 50% scale. ±2% full scale	T50 < 3 seconds T90 < 7 seconds
	Methane	CH4	(0 to 100) % LEL	±1% up to 50% scale. ±2% full scale	T50 < 3 seconds T90 < 7 seconds
	Propane	C3H8			

3.3 Table of Gas Ionization Potentials

Chemical name	IP (eV)	Chemical name	IP (eV)
A			
2-Amino pyridine	8.00	Acrolein	10.1
Acetaldehyde	10.21	Acrylamide	9.5
Acetamide	9.77	Acrylonitrile	10.91
Acetic acid	10.69	Allyl alcohol	9.67
Acetic anhydride	10.00	Allyl chloride	9.9
Acetone	9.69	Ammonia	10.2
Acetonitrile	12.2	Aniline	7.7
Acetophenone	9.27	Anisidine	7.44
Acetyl bromide	10.55	Anisole	8.22
Acetyl chloride	11.02	Arsine	9.89
Acetylene	11.41		
B			
1,3-Butadiene (butadiene)	9.07	Boron trifluoride	15.56
1-Bromo-2-chloroethane	10.63	Bromine	10.54
1-Bromo-2-methylpropane	10.09	Bromobenzene	8.98
1-Bromo-4-fluorobenzene	8.99	Bromochloromethane	10.77
1-Bromobutane	10.13	Bromoform	10.48
1-Bromopentane	10.1	Butane	10.63
1-Bromopropane	10.18	Butyl mercaptan	9.15
1-Bromopropene	9.3	cis-2-Butene	9.13
1-Butanethiol	9.14	m-Bromotoluene	8.81
1-Butene	9.58	n-Butyl acetate	10.01
1-Butyne	10.18	n-Butyl alcohol	10.04
2,3-Butadione	9.23	n-Butyl amine	8.71
2-Bromo-2-methylpropane	9.89	n-Butyl benzene	8.69
2-Bromobutane	9.98	n-Butyl formate	10.5
2-Bromopropane	10.08	n-Butyraldehyde	9.86
2-Bromothiophene	8.63	n-Butyric acid	10.16
2-Butanone (MEK)	9.54	n-Butyronitrile	11.67
3-Bromopropene	9.7	o-Bromotoluene	8.79
3-Butene nitrile	10.39	p-Bromotoluene	8.67
Benzaldehyde	9.53	p-tert-Butyltoluene	8.28
Benzene	9.25	s-Butyl amine	8.7
Benzenethiol	8.33	s-Butyl benzene	8.68

Benzonitrile	9.71	sec-Butyl acetate	9.91
Benzotrifluoride	9.68	t-Butyl amine	8.64
Biphenyl	8.27	t-Butyl benzene	8.68
Boron oxide	13.5	trans-2-Butene	9.13
C			
1-Chloro-2-methylpropane	10.66	Chlorofluoromethane(Freon 22)	12.45
1-Chloro-3-fluorobenzene	9.21	Chloroform	11.37
1-Chlorobutane	10.67	Chlorotrifluoromethane (Freon 13)	12.91
1-Chloropropane	10.82	Chrysene	7.59
2-Chloro-2-methylpropane	10.61	Cresol	8.14
2-Chlorobutane	10.65	Crotonaldehyde	9.73
2-Chloropropane	10.78	Cumene (isopropyl benzene)	8.75
2-Chlorothiophene	8.68	Cyanogen	13.8
3-Chloropropene	10.04	Cyclohexane	9.8
Camphor	8.76	Cyclohexanol	9.75
Carbon dioxide	13.79	Cyclohexanone	9.14
Carbon disulfide	10.07	Cyclohexene	8.95
Carbon monoxide	14.01	Cyclo-octatetraene	7.99
Carbon tetrachloride	11.47	Cyclopentadiene	8.56
Chlorine	11.48	Cyclopentane	10.53
Chlorine dioxide	10.36	Cyclopentanone	9.26
Chlorine trifluoride	12.65	Cyclopentene	9.01
Chloroacetaldehyde	10.61	Cyclopropane	10.06
á -Chloroacetophenone	9.44	m-Chlorotoluene	8.83
Chlorobenzene	9.07	o-Chlorotoluene	8.83
Chlorobromomethane	10.77	p-Chlorotoluene	8.7
D			
1,1-Dibromoethane	10.19	Diethyl ketone	9.32
1,1-Dichloroethane	11.12	Diethyl sulfide	8.43
1,1-Dimethoxyethane	9.65	Diethyl sulfite	9.68
1,1-Dimethylhydrazine	7.28	Difluorodibromomethane	11.07
1,2-Dibromoethene	9.45	Dihydropyran	8.34
1,2-Dichloro-1,1,2,2-tetrafluoroethane (Freon 114)	12.2	Diiodomethane	9.34
1,2-Dichloroethane	11.12	Diisopropylamine	7.73
1,2-Dichloropropane	10.87	Dimethoxymethane (methylal)	10
1,3-Dibromopropane	10.07	Dimethyl amine	8.24
1,3-Dichloropropane	10.85	Dimethyl ether	10
2,2-Dimethyl butane	10.06	Dimethyl sulfide	8.69

2,2-Dimethyl propane	10.35	Dimethylaniline	7.13
2,3-Dichloropropene	9.82	Dimethylformamide	9.18
2,3-Dimethyl butane	10.02	Dimethylphthalate	9.64
3,3-Dimethyl butanone	9.17	Dinitrobenzene	10.71
cis-Dichloroethene	9.65	Dioxane	9.19
Decaborane	9.88	Diphenyl	7.95
Diazomethane	9	Dipropyl amine	7.84
Diborane	12	Dipropyl sulfide	8.3
Dibromochloromethane	10.59	Durene	8.03
Dibromodifluoromethane	11.07	m-Dichlorobenzene	9.12
Dibromomethane	10.49	N,N-Diethyl acetamide	8.6
Dibutylamine	7.69	N,N-Diethyl formamide	8.89
Dichlorodifluoromethane (Freon 12)	12.31	N,N-Dimethyl acetamide	8.81
Dichlorofluoromethane	12.39	N,N-Dimethyl formamide	9.12
Dichloromethane	11.35	o-Dichlorobenzene	9.06
Diethoxymethane	9.7	p-Dichlorobenzene	8.95
Diethyl amine	8.01	p-Dioxane	9.13
Diethyl ether	9.53	trans-Dichloroethene	9.66
E			
Epichlorohydrin	10.2	Ethyl iodide	9.33
Ethane	11.65	Ethyl isothiocyanate	9.14
Ethanethiol (ethyl mercaptan)	9.29	Ethyl mercaptan	9.29
Ethanolamine	8.96	Ethyl methyl sulfide	8.55
Ethene	10.52	Ethyl nitrate	11.22
Ethyl acetate	10.11	Ethyl propionate	10
Ethyl alcohol	10.48	Ethyl thiocyanate	9.89
Ethyl amine	8.86	Ethylene chlorohydrin	10.52
Ethyl benzene	8.76	Ethylene diamine	8.6
Ethyl bromide	10.29	Ethylene dibromide	10.37
Ethyl chloride (chloroethane)	10.98	Ethylene dichloride	11.05
Ethyl disulfide	8.27	Ethylene oxide	10.57
Ethylene	10.5	Ethylenelmine	9.2
Ethyl ether	9.51	Ethynylbenzene	8.82
Ethyl formate	10.61		
F			
2-Furaldehyde	9.21	Freon 12 (dichlorodifluoromethane)	12.31
Fluorine	15.7	Freon 13 (chlorotrifluoromethane)	12.91

Fluorobenzene	9.2	Freon 22 (chlorofluoromethane)	12.45
Formaldehyde	10.87	Furan	8.89
Formamide	10.25	Furfural	9.21
Formic acid	11.05	m-Fluorotoluene	8.92
Freon 11 (trichlorofluoromethane)	11.77	o-Fluorophenol	8.66
Freon 112 (1,1,2,2-tetrachloro-1,2-difluoroethane)	11.3	o-Fluorotoluene	8.92
Freon 113 (1,1,2-trichloro-1,2,2-trifluororethane)	11.78	p-Fluorotoluene	8.79
Freon 114 (1,2-dichloro-1,1,2,2-tetrafluoroethane)	12.2		
H			
1-Hexene	9.46	Hydrogen chloride	12.74
2-Heptanone	9.33	Hydrogen cyanide	13.91
2-Hexanone	9.35	Hydrogen fluoride	15.77
Heptane	10.08	Hydrogen iodide	10.38
Hexachloroethane	11.1	Hydrogen selenide	9.88
Hexane	10.18	Hydrogen sulfide	10.46
Hydrazine	8.1	Hydrogen telluride	9.14
Hydrogen	15.43	Hydroquinone	7.95
Hydrogen bromide	11.62		
I			
1-Iodo-2-methylpropane	9.18	Iodobenzene	8.73
1-Iodobutane	9.21	Isobutane (Isobutylene)	9.4
1-Iodopentane	9.19	Isobutyl acetate	9.97
1-Iodopropane	9.26	Isobutyl alcohol	10.12
2-Iodobutane	9.09	Isobutyl amine	8.7
2-Iodopropane	9.17	Isobutyl formate	10.46
Iodine	9.28	Isobutyraldehyde	9.74
Isobutyric acid	10.02	Isopropyl benzene	8.69
Isopentane	10.32	Isopropyl ether	9.2
Isophorone	9.07	Isovaleraldehyde	9.71
Isoprene	8.85	m-Iodotoluene	8.61
Isopropyl acetate	9.99	o-Iodotoluene	8.62
Isopropyl alcohol	10.16	p-Iodotoluene	8.5
Isopropyl amine	8.72		
K			
Ketene	9.61		

L			
2,3-Lutidine	8.85	2,6-Lutidine	8.85
2,4-Lutidine	8.85		
M			
2-Methyl furan	8.39	Methyl disulfide	8.46
2-Methyl naphthalene	7.96	Methyl ethyl ketone	9.53
1-Methyl naphthalene	7.96	Methyl formate	10.82
2-Methyl propene	9.23	Methy l iodide	9.54
2-Methyl-1-butene	9.12	Methyl isobutyl ketone	9.3
2-Methylpentane	10.12	Methyl isobutyrate	9.98
3-Methyl-1-butene	9.51	Methyl isocyanate	10.67
3-Methyl-2-butene	8.67	Methyl isopropyl ketone	9.32
3-Methylpentane	10.08	Methyl isothiocyanate	9.25
4-Methylcyclohexene	8.91	Methyl mercaptan	9.44
Maleic anhydride	10.8	Methyl methacrylate	9.7
Mesityl oxide	9.08	Methyl propionate	10.15
Mesitylene	8.4	Methyl propyl ketone	9.39
Methane	12.98	á -Methyl styrene	8.35
Methanethiol (methyl mercaptan)	9.44	Methyl thiocyanate	10.07
Methyl acetate	10.27	Methylal (dimethoxymethane)	10
Methyl acetylene	10.37	Methylcyclohexane	9.85
Methyl acrylate	9.9	Methylene chloride	11.32
Methyl alcohol	10.85	Methyl-n-amyl ketone	9.3
Methyl amine	8.97	Monomethyl aniline	7.32
Methyl bromide	10.54	Monomethyl hydrazine	7.67
Methyl butyl ketone	9.34	Morpholine	8.2
Methyl butyrate	10.07	n-Methyl acetamide	8.9
Methyl cellosolve	9.6	Methyl chloroform (1,1,1-trichloroethane)	11
Methyl chloride	11.28		
N			
1-Nitropropane	10.88	Nitrogen	15.58
2-Nitropropane	10.71	Nitrogen dioxide	9.78
Naphthalene	8.12	Nitrogen trifluoride	12.97
Nickel carbonyl	8.27	Nitromethane	11.08
Nitric oxide, (NO)	9.25	Nitrotoluene	9.45
Nitrobenzene	9.92	p-Nitrochloro benzene	9.96
Nitroethane	10.88		

O			
Octane	9.82	Ozone	12.08
Oxygen	12.08		
P			
1-Pentene	9.5	Phthalic anhydride	10
1-Propanethiol	9.2	Propane	11.07
2,4-Pentanedione	8.87	Propargyl alcohol	10.51
2-Pentanone	9.38	Propiolactone	9.7
2-Picoline	9.02	Propionaldehyde	9.98
3-Picoline	9.02	Propionic acid	10.24
4-Picoline	9.04	Propionitrile	11.84
n-Propyl nitrate	11.07	Propyl acetate	10.04
Pentaborane	10.4	Propyl alcohol	10.2
Pentane	10.35	Propyl amine	8.78
Perchloroethylene	9.32	Propyl benzene	8.72
Pheneloic	8.18	Propyl ether	9.27
Phenol	8.5	Propyl formate	10.54
Phenyl ether (diphenyl oxide)	8.82	Propylene	9.73
Phenyl hydrazine	7.64	Propylene dichloride	10.87
Phenyl isocyanate	8.77	Propylene imine	9
Phenyl isothiocyanate	8.52	Propylene oxide	10.22
Phenylene diamine	6.89	Propyne	10.36
Phosgene	11.77	Pyridine	9.32
Phosphine	9.87	Pyrrole	8.2
Phosphorus trichloride	9.91		
Q			
Quinone	10.04		
S			
Stibine	9.51	Sulfur hexafluoride	15.33
Styrene	8.47	Sulfur monochloride	9.66
Sulfur dioxide	12.3	Sulfuryl fluoride	13
T			
o-Terphenyls	7.78	Toluene	8.82
1,1,2,2-Tetrachloro-1,2-difluoroethane (Freon 112)	11.3	Tribromoethene	9.27
1,1,1-Trichloroethane	11	Tribromofluoromethane	10.67

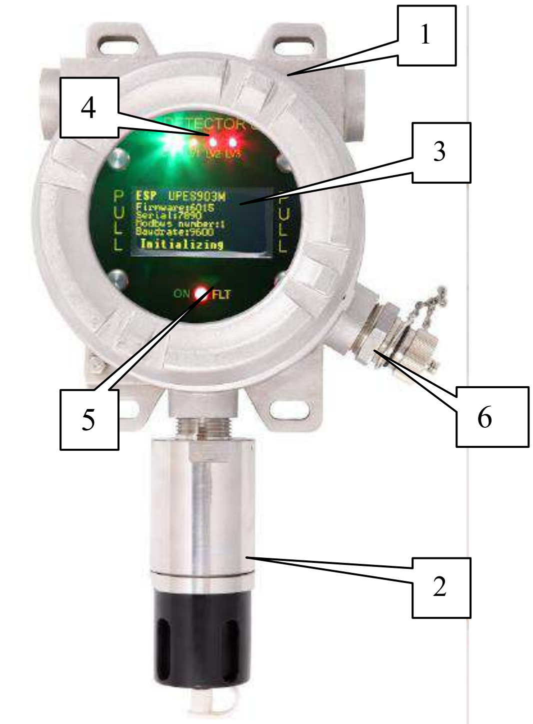
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	11.78	Tribromomethane	10.51
2,2,4-Trimethyl pentane	9.86	Trichloroethene	9.45
o-Toluidine	7.44	Trichloroethylene	9.47
Tetrachloroethane	11.62	Trichlorofluoromethane (Freon 11)	11.77
Tetrachloroethene	9.32	Trichloromethane	11.42
Tetrachloromethane	11.47	Triethylamine	7.5
Tetrahydrofuran	9.54	Trifluoromonobromo-methane	11.4
Tetrahydropyran	9.25	Trimethyl amine	7.82
Thiolacetic acid	10	Tripropyl amine	7.23
Thiophene	8.86		
V			
o-Vinyl toluene	8.2	Vinyl bromide	9.8
Valeraldehyde	9.82	Vinyl chloride	10
Valeric acid	10.12	Vinyl methyl ether	8.93
Vinyl acetate	9.19		
W			
Water 1	2.59		
X			
2,4-Xylidine	7.65	o-Xylene	8.56
m-Xylene	8.56	p-Xylene	8.45

Certifications

FM:	Explosion-proof for Class 1, Div.1, Group B, C, D (T4) Hazardous (classified) locations per FM 3615, 6310; Dust ignition-proof for Class II, Div.1, Group E, F, G Hazardous (classified) locations per FM 3615, 6310; Non-incendive for Class 1, Div.2, Group A, B, C, D (T4), Class 2, Div.2, Group E, F, G (T4) Hazardous (classified) locations per FM 3611; Performance verified up to 100% LEL methane-in-air atmosphere per FM 6320;
CSA:	Explosion-proof for Class 1, Div.1, Group B, C, D (T6) Hazardous (classified) locations per CSA C 22.2 # 30 and Ex d IIB+H2 T6 per CSA E 60079-0-1; Dust ignition-proof for Class II, Div.1, Group E, F, G Hazardous (classified) locations per CSA C 22.2 # 25; Non-incentive for Class 1, Div.2, Group A, B, C, D (T4), Class 2, Div.2, Group E, F, G (T4) Hazardous (classified) locations per CSA C 22.2 # 213; Performance verified up to 100% LEL methane-in-air atmosphere per CSA C 22.2 # 152;
ATEX: 94/9/EC	CE 0539 II 2 G Ex d [ib] IIC T4 (T_{amb} 75°C) IP 66
IECEx:	Ex d [ia] IIC T4 X (T_{amb} 75°C) IP 66
ГОСТ Р:	1 Ex d [ia] IIC T4 X T = - 60°C …. 75°C IP 66
EN Standards:	EN 60079-0: 2006 EN 60079-1: 2007 EN 61779-1: 2000 EN 60529: 1991+A1: 2000 EN 50270: 2006.

4. Design and Performance

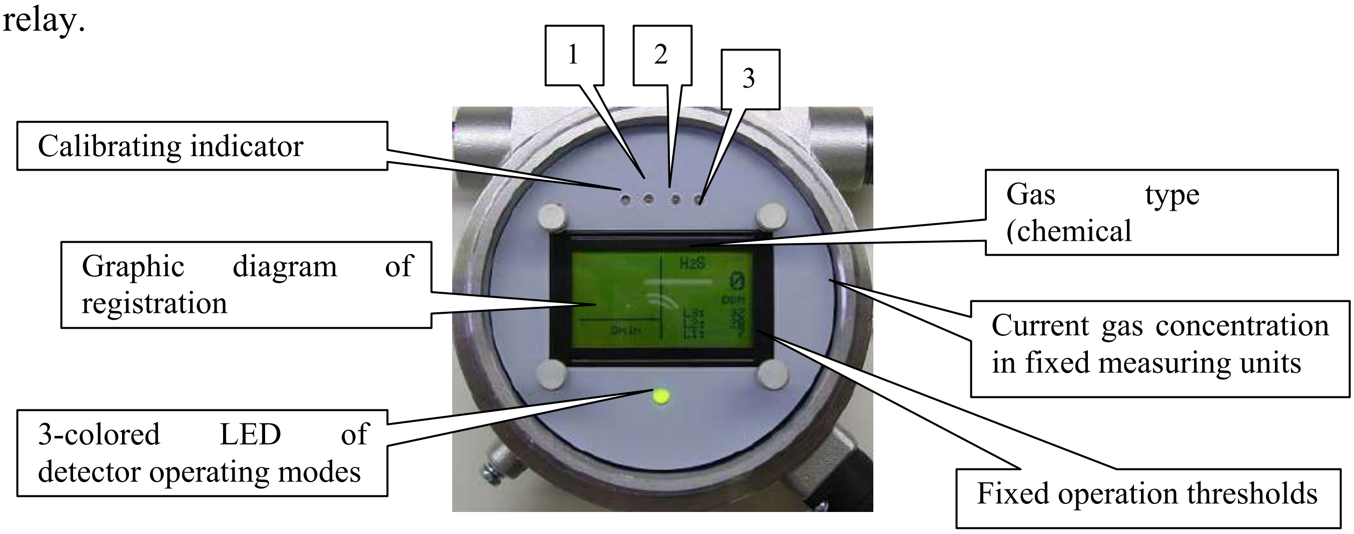
SSS Gas Analyzer consists of Transmitter SSS (threshold device) and plug-in universal gas transducers PGU with electrochemical (PGU-E) , infrared (PGU-IR) and photoionized (PGU-P) sensors.



1. Transmitter SSS body
2. Transducer (PGU-E, PGU-P, PGU-IR)
3. Display
4. LED-diodes of alarm and calibration
5. 3-colored status detector indicator
6. HART-communicator socket

SSS Transmitter body is explosionproof enclosure with integrated HART-communicator socket, PGU plug-in sensor socket and cable entries.

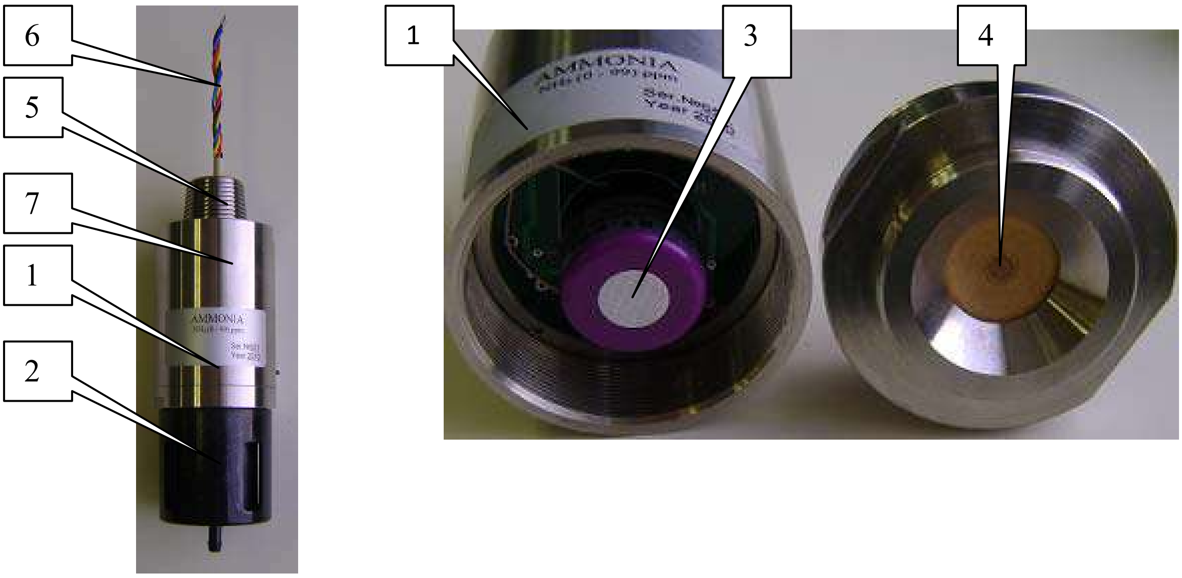
SSS Transmitter is the universal threshold device intended for visualization of gas content indication receiving from gas plug-in sensors (and/or gas analyzers connected as “remote” sensor mode) and passing the signals to the peripheral automatic control and signaling equipment. Measurement results of gas concentration are readout from standard transmitter outputs in analog current output 4-20mA, digital output RS-485, and via HART-interface. “Dry contact” relay are operated automatically during increasing of specified gas alarms (separately for each of tree alarms); failure mode is identified by actuation of “failure” contacts relay.



SSS Transmitter is designed for connecting in loop up to eight PGU transducers or/and stand alone gas analyzers (SGOES type) under RS-485.

PGU universal gas transducer consists of PGU module and plug-in electrochemical, infrared (optical) and photoionized sensors; specific protection filter provides the protection from dust and high humidity. Optional protective cover preserves from mechanical damages and serves as calibrating chamber.

Fig. 3. PGU universal gas transducer.



1 - Transducer's body; 2- Protective cover/ calibration chamber; 3 – sensor; 4- protective filter; 5 – pipe thread; 6 – connecting cables; 7 – place of C-type magnetic key

Electrical connections of sensitive element (sensor) inside of PGU transducer's body are made as "intrinsically safety barrier".

SSS transmitter provides power supply to the PGU transducer and connection under the digital output RS-485. PGU module can be connected to the SSS transmitter body directly via explosionproof threaded connection or by means of insulated multicore cable (two cores –power supply, other two cores- RS-485 connection, shield) – "remote sensor" option.

PGU transducer has integrated flash-memory with adjusting/calibrating settings of the sensors using composed of SSS; The present parameters are recorded to the PGU memory during adjusting procedure of manufacturing of gas analyzer and read-out during connection PGU (specific sensor) to the SSS transmitter. The specific calibration of PGU does not require under connection.

Sensitive adjustment of PGU (zero setup) on-site of SSS is carried out by means of magnetic key which is available with SSS gas analyzer. Magnetic key shall be placed on the body of PGU directly (or on the SSS transmitter body), for providing the reset of characteristics of integrated adjusting element (magnetically operated sealed switch) and wait 3 seconds.

Visual indication of SSS operation is displayed on multifunctional LCD display of SSS transmitter, as well as with integrated LED calibration, alarms indicators and 3-colored LED of detector operating modes.

Fig.5 Visual indication of SSS operating modes.

a) normal operation (green)

b) threshold crossing (red)

c) failure (yellow)

Real time function allows to control visually the current parameters of gas control (gas type, measuring units, concentration, thresholds settings) and to observe the changes of current concentration during the time (last 30 min.) on data registration graphic diagram.

In addition, the current gas control data, adjustment/checking information of detector operation and others are recorded in nonvolatile flash-memory of SSS. History record includes the registered in time the gas concentration measuring data, gas thresholds crossing, failure confirmations and other information about SSS gas analyzer operation. Information from history record of flash-memory can be read-out with HART-communicator (via HART-interface) or by means of request from controller of alarm and control system (via RS-485 interface, Modbus protocol). Transmitter will give a notification in case optical sensor element is covered with dirt or other obstructing elements without interrupting the work of the detector. Warning will be generated on 50% or more concealment by obscuring elements of optical path.Provisions are in place to avoid condensataion on the sensor optics. *(for IR model).

5 SSS Outputs.

SSS has the standard outputs:

- analog current output 4—20 mA, in depending of measuring gas concentration;
- digital output (RS-485, Modbus RTU protocol);
- HART-interface ;
- Digital signal of « dry contact » relays :

  Three “Alarm” signals

  “Failure” signal

“Dry contact” relay provides current communication from 1A 125 V AC/DC supply voltage

5.1. HART-communicator

Universal HART-socket of SSS transmitter allows to connect any HART-communicator model in the field conditions for read-out the concentration values, thresholds changing, zero setup, sensitivity calibration and adjustment of the SSS main operation characteristics (modification of configuration device parameters – net address, speed, etc.).

Principle of operation with HART-communicator is given in paragraph "Calibration" and Appendix D.

Information about controlled gas type (measuring range), measured value of current gas concentration, crossing of fixed alarm thresholds and other can be received in field conditions by connecting the HART-communicator to the SSS transmitter socket. HART-interface allows to carried out the functioning settings of SSS (including sensitive calibration, zero setup, change of alarm threshold, net address, etc.). History records readout (trends) from nonvolatile flash-memory of the device is carried out by the request from external gas control system unit (controller) of the object.

Real-time function allows to display the current gas control on the object, history record allows to the customer receive the data about gas concentration on the object for previous period (duration of record/volume period is determined by the specific conditions of the object, maximum -2 months). The gas content data can be passed to upper level of automatic control system via RS-485, HART-interface as in real time as in trends records.

5.2. RS-485

RS-485 output allows to provide the SSS functional control distantly by means of standard connection (ModBus RTU protocol). For SSS control and adjusting procedure by means of digital channel it is need to connect the detector to PC (placing in safety area) and use the specific software which available with the detector delivery set. Information about SSS operation will be displayed on the display of the computer, including sensitivity calibration, zero setup, changing of alarm thresholds values, device net address, etc.)

RS-485 output allows to readout the history records from nonvolatile flash-memory of the device over a period of time set by user.

Principle of operation with RS-485 is given in paragraph "Calibration" and Appendix E.

6. Important Safety Notes

Warning! Do not apply power to the system with enclosure cover removed unless the area has been de-classified. Do not open the enclosure in hazardous area when power is applied.

The wiring procedure in this manual are intended to ensure proper functioning of the device under normal conditions. However, because of the many variations in wiring codes and regulations, total compliance to these ordinances cannot be guaranteed. Be certain that all wiring complies with applicable regulations that relate to the installation of the electrical equipment in hazardous area.

7. Explosionproof Features

For the purpose of providing the explosionproof during SSS installation and operation it is need to comply with following regulations:

- all explosionproof surfaces which are subjected to dismounting during installation on-site must corresponding to drawing requirements of explosionproof (see Appendix A);

Warning! It is exclude the present of mechanical damages, nicks and lacquer coating on the detail surfaces marked by word “Explosion"!

- demountable parts must adjoin to the device body as much as possible;
- cable sealing at the cable entry must be done carefully for providing explosionproof of the gas analyzer. Unused detachable unions have to be closed by screw plugs that preserve the explosionproof of the body.

8. Installation

During installation of SSS gas analyzer the following factors should be taken into consideration - the present of explosion or toxic detectable gas concentration in working area and the most possible sources of gas content appearance.

Installation guideline of SSS gas analyzer is given in Appendix B.

8.1. Wiring Requirements

Types of cables for connecting SSS gas analyzer are given in Appendix B.

It is need to avoid low-frequency and high-voltage cables layout, as well as current supply lines of other equipment in the immediate locality of the cable for connection SSS on RS-485 to avoid the EMI and spurious pickups.

For connecting SSS on analog output 4-20 mA it is recommended to use the forth-core screened copper cable with section not less 1.5 mm^2.

Connection of a group of devices to the controller in a loop on RS-485 is carried out with two independent screened cables – one for power supplying other for connection in a loop RS-485. Grounding of core screen should be done only from one side (on the side of controller).

Allow to connect the devices on RS-485 with joint power cores and information cores in one cable in case if they are screened in pairs. Unscreened twisted pairs can be used for connection in loop with additional terminal box, when the cable length from gas analyzer to terminal box does not exceed 1m.

Gas analyzers are needed to install on-site in closed to the possible places of gas appearance. For volatile compounds and gas mixtures (for example – methane, hydrogen, ammonia and others) the sensitive element PGU is placed above the supposed area of control gas appearing, and for “heavy-than-air” gas mixtures (carbon dioxide, oxygen, hydrogen sulfide and others) – vice-versa, under the supposed area of control gas leakage.

For comfortable visual controlling of information on the display of the transmitter SSS and for environmental immunity of sensitive element the gas analyzer should be installed in vertical position – the PGU transducer should be directed perpendicular to the ground. Maintenance staff should have the free access to the gas analyzer for checking/ adjusting operations on-site.

Mechanical mounting of SSS transmitter with PGU, as well as alone transducer PGU (“remote sensor” option) is recommended to provide with U-type bolts.

The universal gas transducer PGU is connected to the transmitter with forth-core cable (4 twisted pairs, two of the provide PGU power supply and others transferring the information on RS-485). For connecting the divece with "remote sensor" option in explosion area it is need to use the specific (armored, screened) cable of industrial interface and provide the explosion safety of SSS connection with cable entries.

Any gas analyzer compatible with SSS can be using as "remote sensor" (for example—SGOES), which has the standard output on RS-485 (Modbus RTU) and power consumption (24 VDC) from SSS transmitter. The scheme of connection SGOES to the SSS transmitter wit "remote sensor" option is given in Appendix B.

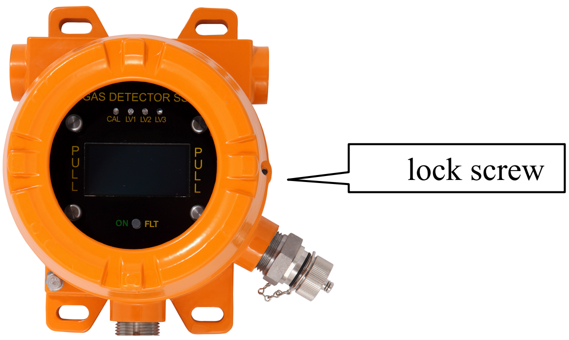
SSS transmitter is connected to the periphery equipment of gas control on digital output (RS-485) and/or analog (4-20 mA) output. Schemes of SSS transmitter connection on analog and digital outputs (including the connection to threshold device UPES) are given in Appendix B.

8.2. Installation procedure

1. Pull the gas analyzer from transportation package and make the external examination of the device to ensure of delivery package contents and presence of visible damages.

Warning! SSS gas analyzer with mechanical body, detachable unions and other damages are prohibited for operation.

2. Unscrew the lock screw of top cover transmitter SSS by cross-point screwdriver.



3. Unscrew counterclockwise the top cover of the transmitter SSS by means of spanner.

4. Pull up at the handles of false panel. Take out the controller circuit board with display.

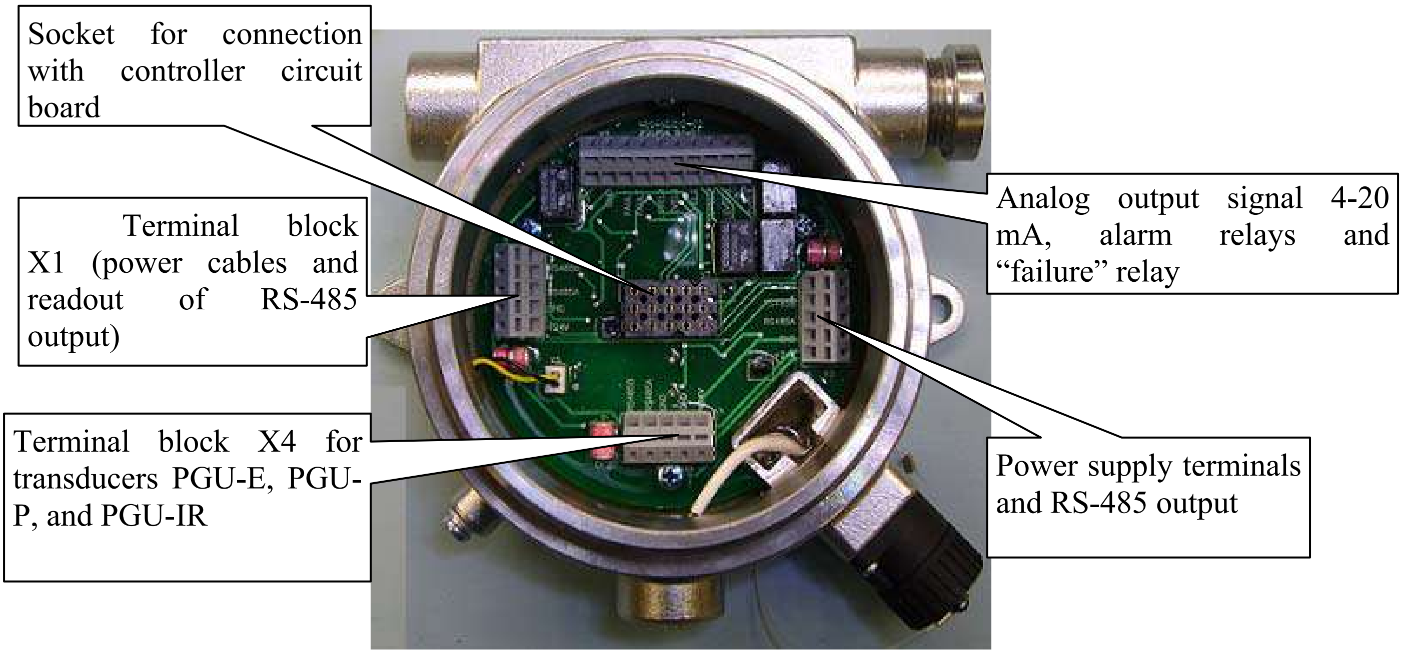
5. For SSS connection with “remote sensor” option - release the spring terminals of socket X4 with screwdriver and disconnect four wires of reducer

Twist off the reducer from transmitter SSS-903 body with screw key and connect to the transmitter the corresponding cable via explosionproof cable entry. At harness of multicore cable is need to consider position and setting of terminals of connection transmitter board., see fig.7. Similarly, with following of harness of mounting cables, connect the other cable end (via explosion cable entry) to the SSS transducer or SGOES gas analyzer which installed in remote area.

Fig. 6 – Cable marking of transducer PGU

Red	+24 V DC
Black	- 24 V DC
Yellow	RS-485 A
Blue	RS-485 B

Fig.7 – Terminals location and designation on the SSS transmitter connecting board.



6. Release the spring terminals of sockets (X1, X2) with screwdriver on the transmitter connecting board and connect (via explosionproof entry) the power supply cables to the corresponding contacts, as well as analog (4-20 mA), digital (RS-485) and relays outputs of the gas analyzer.

Warning! The contacts of terminals X1 and X2 are multiple contacts, that allow to avoid twisting and mechanical jamming of mounting wires under connection and assembly of electronic part of the device.

7. Put the controller circuit board with display into transmitter SSS body and twist the top cover of transmitter.

8. Fix the lock screw

9. Operation checkout

Be certain that all installation and connection procedures have done with the requirements of the present operating manual before the SSS operation checkout. Following key points should be check additionally:

- transmitter’s body is fixed reliable in-site in vertical position, and gas transducer is placed perpendicularly down to the ground;

correctly

incorrectly

incorrectly

power supply cabling and gas analyzer outputs reading is carried out in according with terminals layout of the transmitter connecting board; connecting layout is given in Appendix C;

- continious monitoring and self checking of all internal components and sensors for failures
- additional accessories for PGU protection and sensitive adjustments of gas analyzer (protection cover/ calibration kit) are installed properly and in operational condition.

To apply power to SSS, the tree-colored LED indicator on the front panel of transmitter is lighted. The following signals are appeared on the transmitter's output:

1. "failure" relay contacts are latching.
2. after 15 seconds, which is need for initialization of PGU, the following information will be displayed on the transmitter:
   - gas type (chemical formula)
   - current gas concentration in LEL, ppm, vol.
   - thresholds values of alarm;
   - registration graphic diagram of gas concentration changes in time (during 30 minutes).
3. LED indicator of SSS operation modes will be glowing by green color.
4. the unified current signal in range of 4-20 mA is appeared on the analog output in depends of the measuring gas concentration. In case of absent the gas content in working area the current output of the SSS is equal 4 mA.

In case of incorrect connection of PGU reducer or gas analyzer defect the following signals are appeared on the SSS transmitter output after 15 seconds:

1. "failure" relay contacts are unlatching.
2. LED indicator of SSS operation mode will be glowing by yellow color(break, failure)
3. SSS gas analyzer adjustment information is not displayed on the transmitter.
4. Current output is equal 0 mA.

When the operation checkout of SSS gas analyzer is made successfully and for prevention of unauthorized opening of SSS transmitter body in hazardous area it is recommended to seal the body in place of lock screw by the representative of exploitation organization.

10. Calibration procedure

For calibration procedure of SSS gas analyzer is need to:

- ensure that the devise is in normal operation mode (absence of mechanical damages of the body and optical elements, LED indication is green);
- check the availability of control gas mixtures for calibration.

Warning! It is need at least one standard CGM for SSS calibration with gas concentration of the detecting gas component in the detection range of gas analyzer. Sensitivity calibration is carried out either low (up to 75% LEL) or high (more then 75% LEL) gas concentration of the detecting gas component in depending of present CGM.

Important! If the SSS calibration is carried out by one CGM only the detecting gas component concentration in the present gas mixture should be at level of 50% LEL or higher, if the concentration is low it can have an adverse effect on measuring of high level concentrations of gas analyzer (in measuring range).

10.1. Magnetic bangle.

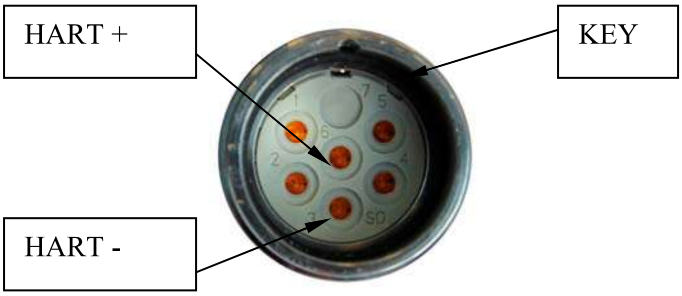
Zero set up can be carried out in the field conditions at the place of installation without dismounting of the device by means of specific magnetic bangle.

- ensure in absence of gas content in the working area of SSS gas analyzer. Connect the nipple of transducer’s calibration chamber with cylinder (contained the clean air/nitrogen) by means of PVC tube and blow off the PGU by 1 liter of gas mixture.
- Place the magnetic bangle on the transmitter body for providing reset of characteristics of integrated adjustment element (magnetically operated sealed switch);
- Wait 3 seconds for reset the indication.

Similarly in the field conditions is carried out the rest of characteristics of SSS operation (configuration parameters, data exchange) set by the user to the factory adjustments of manufacturer.

10.2. HART-communicator.

Connect the communicator to the HART-interface output of the SSS transmitter in accordance with basing socket given below for providing the operational adjustments in the field conditions via HART-interface.



The user can adjust the required configuration of gas analyzing system with help of HART-communicator, to set the net addresses of connected devices, rate of exchange of informational data and other by following:

- ensure that communication between HART-communicator and device is settled
- pass to the "Direct connection" and set the required characteristics(rate of exchange, net address etc.)

Zero setup up can be carried out in the field conditions at the place of installation without dismounting of the device by means of HART-communicator.

- ensure in absence of gas content in the working area of SSS gas analyzer. Connect the nipple of transducer's calibration chamber with cylinder (contained the clean air/nitrogen) by means of PVC tube and blow off the PGU by 1 liter of gas mixture.
- When the communication between communicator and device will be installed pass to the adjustment menu of SSS and set zero concentration value of analyzed control gas mixture;
- Verified the reset of device sensitivity, and ensure that value of analog signal is equal 4 mA.

Detailed description of supported commands, communication protocol with controller of higher level on HART-interface, and operation with HART-communicator with 691 HT ABB model is given in Appendix E.

Zero setup (sensitivity calibration and others adjustments of SSS gas analyzer in the field conditions) by means of HART-communicator is given in Appendix E.

Calibration with HART-communicator.

1. Switch on the communicator, beforehand to learn the operating manual of specific model of HATR-communicator, wait the communication installation with gas analyzer (in additional pass to the connection adjustment division from the main menu of communicator).
2. The following main options (modes) are available after connection with device was setup: zero setup and SSS sensitivity calibration, value of detectable gas concentration readout (in set measuring values) and current output signal (mA) of corresponding gas concentration, as well as alarms thresholds changing.
3. To supply CGM #2 (low concentration of the detected component) to the input of Gas analyzer or CGM #3 (high concentration of the detected component) used for sensitivity calibration of the device. Using the key board of the communicator key board to set assign value of supplied CGM, wait the fixing of the gas concentration indication on the SSS transmitter and verified with concentration with supplied CGM;
4. Equivalent of the SSS transmitter indication to the supplied gas concentration can be controlled with analog output signal readout. Calculation of equivalent current signal which is equivalent to the concentration of CGM supplied to the device should be carried out in accordance with SSS nominal conversion function (Appendix D);
5. Additionally, in the field condition, the user can change the manufacturer thresholds alarm values of SSS in accordance with demand settings of specific exploitation object. Chose the setting/changing threshold values of the device in HART-communicator's menu using the key board (program menu), enter requested thresholds values. (%LEL).

10.3. RS-485.

Zero setup and sensitivity adjustments of SSS via digital channel RS-485 is carried out by means of the PC with Windows (98,2000, XP) operation systems, convertor RS-232/ RS-485 and specific calibration program (available with documentation on CD). Communication scheme of SSS to the computer is given in Annexure C.

For zero setup of SSS on RS-485 is need:

- ensure in absence of gas content in the working area of SSS gas analyzer. Connect the nipple of transducer's calibration chamber with cylinder (contained the clean air/nitrogen) by means of PVC tube and blow off the PGU by 1 liter of gas mixture.
- To chose the "sensitivity calibration" division in software menu and using the program interface to set the zero concentration value of analyzing

CGM.

- Verified the reset of device sensitivity, and ensure that zero value of current gas concentration is indicated on the computer's monitor and analog signal is equal 4 mA.

Specific software is allowed to make the adjustment of informational network parameters and configuration of the device (rate of exchange, net address, etc.) Detailed description of software operation, including zero setup and sensitivity calibration is given in Annexure F.

Calibration with RS-485.

1. After connecting the SSS gas analyzer to PC ensure that digital interface is operated properly by checking the current operation settings of the device on the computer monitor;
2. Choose the calibration mode of the gas analyzer in accordance with program menu of sensitivity adjustment of SSS;
3. To supply CGM #2 (low concentration of the detected component) to the input of Gas analyzer or CGM #3 (high concentration of the detected component) used for sensitivity calibration of the device. Using the program interface to set the specific concentration value of supplied CGM, wait the fixing of the gas concentration indication on the SSS transmitter and verified with concentration with supplied CGM;
4. Equivalent of the SSS transmitter indication to the supplied gas concentration can be controlled with analog output signal readout. Calculation of equivalent current signal which is equivalent to the concentration of CGM supplied to the device should be carried out in accordance with SSS nominal conversion function (Appendix D);
5. Additionally, in the field condition, the user can change the manufacturer thresholds alarm values of SSS in accordance with demand settings of specific exploitation object. Detailed description of setting/ changing threshold value on RS-485 is given in Appendix F.

11.Maintenance

Gas Analyzer has been designed for long-term continuous operation and shall not require fulfillment of any specific routine maintenance in the scope of such operation.

The technical maintenance consists of periodical external examination and zero setup. The inspection interval is set by user in depending of operating conditions. In case of fault conditions appearing, when the operation of the detector is impossible, the zero current output is set on the analog output of the SSS and the corresponding data is appearing on information transferring on digital channel, the contacts "Fault" relay are unlatching. At reset condition the output current will be equal 4 mA during one minute, and the become zero.

11.1 Malfunction and troubleshooting

Possible malfunctions along with troubleshooting techniques for the same have been listed below:

Malfunction / Problem	**Possible Cause**	**Troubleshooting Method**
No testing mode is activated after energizing of Gas Analyzer.	Communication lines' rupture along the power supply circuits. Malfunction in the processor's program.	Check availability of power voltage of 24V at the contacts of terminal connectors of SSS transmitter and within data input device. If required voltage is absent, restore the communication line. Reprogram the processor.
Following power-up of Gas Analyzer the testing mode is activated and is running OK, but certain functions of the Detector fail to perform.	Malfunction in the processor's program.	Reprogram the processor.
The keyboard installed at the Control and Display Unit is inoperative.	Damage of the contact or contact loss in the socket connecting the keyboard with Control and Display Unit. Malfunction in the processor's program.	Restore the contact in the socket. Reprogram the processor.

12. PGU sensor replacement

In case of need the user can make the replacement of PGU transducer or sensitive element (sensor).

Warning! In the field conditions on-site the PGU transducer or sensor replacement can be carried out in case of assured absence of explosion (toxic) gas content in control area only, with observance of all safety standards!

For replacement of gas transducer it is need to de-energize the detector, disconnect the transducer form the transmitter in accordance with regulations given in division “Installation”.

Replacement of sensitive element (sensor) on the analogue type (in case of life-time expiry of electrochemical sensor) can be carried out without detector demounting in the field conditions:

PGU-E (Electrochemical) shown above for reference

- remove the protection cover from PGU reducer (calibration chamber)
- unscrew (anticlockwise) the nut (and hydrophobic filter) to have the access to sensor element;
- take out the sensor from terminal and change the it on analogue type sensor element.
- to fix the sensor by nut (with protective filter);
- place the protective cover to the PGU reducer(calibration chamber)
- ensure in operability of the detector.

13. Transportation and storage

Gas Analyzers packed by the manufacturer in compliance with requirements stipulated for in Technical Specifications can be transported to any distances by any transportation means.

While in transit, the shipping containers with packed Gas Analyzers inside shall be adequately protected against atmospheric precipitates.

Arrangement and fastening of Gas Analyzers in transit by air shall positively provide for steady position of the load in course of the carriage; the equipment shall be loaded inside heated and tightly sealed compartments. Cargo shifting under transportation shall not be allowed at all times.

14. Warranty Policy

The manufacturer hereby warrants the compliance of Gas Analyzer with the requirements stipulated for in the Technical Specifications (TU), provided however the consumer (user) has strictly observed operational conditions, along with the terms prescribed for transportation and storage, as outlined in this Manual.

Warranty operation lifespan shall be set as 18 months following the date of the equipment commissioning but in any case not longer than 18 months from the manufacturing date.

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 Analyzer falling non-operational.

The manufacturing enterprise hereby confirms rendering of the post-warranty repair service.

Appendix A . ***SSS explosionproof overview drawing***

Appendix B.1 ***Installation, location and mounting recommendations***

Installation and location of explosive gas concentration analyzers at industrial facilities.

1. At compressor house every compressor unit is need to be provided by gas analyzer of combustible gases and vapour in the area of the most probable leakage sources of pumping agent (glands, seals, valves, coupling, etc)

2. At pumping houses of condense hydrocarbons is need to install one gas analyzer near the pump or group of pumps if the distance between the detector and the most probable leakage source of the present group of pumps does not exceed three meters (in horizontal).

3. In the embed houses of waste-water of pump stations, water recycling and other places where the flowing of combustible gases and vapour is possible, as well as warehouses with combustible gases is need to install not less then one gas analyzer in the room.

4. Combustible gas analyzers should be installed in the rooms in accordance with density of gases and vapour with a glance of temperature:

- for light gas emission with density to air less then 1 – under the source;

- for gas emission with density to air from 1 to 1,5 – at height of source or lower;

- for gas emission with density to air more the 1,5 – up to 0,5 m above the floor.

5. In case of installation the gas analyzers in the industrial rooms with combustible gases and vapour mixtures of different densities the transducers of gas analyzers is need to install at height proceeding from the density of the mixture component with maximum ratio value of LEL.

6. In case of equipment installation, with the probable leakage sources of gas and vapour emission, in multistory industrial facilities with non-blind and latticed floors every floor is need to allowed as individual housing.

Installation and location of explosive gas concentration analyzers at open areas.

1. Combustible gas analyzers are installed at the facility open area near the equipment with explosive combustible products. The gas analyzers are placed on the height of 0,5 m from zero point.
2. At the open areas of pumping compressor stations, tank farms, oil and gas treating utility, gas processing equipment the gas analyzers is need to install along the perimeter of the zone at the distance does not exceed 20 m from each other.
3. The combustible gas analyzers are provided for installation at the open areas of technological stoves of gas processing plants, proceeding from gas emission from explosion and combustible utilities.
4. At loading racks is need to install one gas analyzer on two loading stands at the distance does not exceed 20 m from each other along the rack.
5. At open compressor stations of combustible gases, pump stations and the pumps the gas detectors are installed with recommendations for industrial facilities.

Important: the place for installation of the gas analyzer is determined with a glance of visibility of the LED indicator and display for staff, placed at the limits of protective area, and with free access for detector maintenance.

Appendix B2.

Installation and location of maximum permissible concentration (MPC) gas analyzers (of toxic gases and hazardous substances)

1. The MPC gas analyzer of hazardous substances is need to install in working area of permanent or temporary stay of the service staff at height of 1..1,5 m. For each 200m2 is need to install not less then one transducer, but not less the one detector for each room.
2. The MPC gas analyzer is need to install at the open areas of drilling objects, technological utilities of field preparation of oil and gas delivery, gas conversion process, in place of probable toxic gas emission sources for service staff.
3. The MPC gas analyzers is recommended to install near air supply utilities of forced ventilation, not less 1 m from probable gas emission sources.
4. Under simultaneous emission of several hazardous substances to the air of working area should be provided the MPC control of the substance with ratio of component concentration in gas mixture to MPC has the maximum value.

Appendix B3.

Wiring requirements

For power supply and output signal readout use the correspondence type and diameter of cables. For connecting the gas detector on analog (current) output 4…20 mA is recommended to use screened froth-(multi-cored) cored copper cable with cross section of 1.5 mm^2.

Connection of a group of devices to the controller in a loop on RS-485 is carried out with two independent screened cables: screened cable with section core of 1.5 mm2 – one for power supplying and screened twisted pair for connection in a loop RS-485. Grounding of core screen should be done only from one side (on the side of controller).

Allow to connect the devices on RS-485 with joint power cores and information cores in one cable in case if they are screened in pairs. Unscreened twisted pairs can be used for connection in loop with additional terminal box, when the cable length from gas analyzer to terminal box does not exceed 1m.

It is need to avoid low-frequency and high-voltage cables layout, as well as current supply lines of other equipment in the immediate locality of the cable for connection SSS on RS-485 to avoid the EMI and spurious pickups.

Requirements for size and maximum length of electric wiring for power supply.

Be ensure that the gas analyzer is powered by 24 VDC with glance that minimum power supply is 18 VDC. For this purpose is needed to define the possible voltage drop at supply cable. If the voltage drop is more the 6V from nominal 24 VDC the normal operation of gas analyzer is not guaranteed.

For power supply is need to use the cables with 1 mm^2 section in depending of the distance.

It is recommended to use the cables with wire section 1 mm^2 in dependence of the distance.

The requirements to the cable size are depended from the power supply and cable length. The maximum distance between gas analyzer and power source is determined with maximum allowable voltage drop for electric wiring circuit. If the limits of voltage drop are exceeded the device is not operate. For determination of maximum voltage drop is need to deduct the operation voltage of the device (18V) from minimum output voltage of power source.

Cable length is determined by following formula:

$$L=\Delta U(B) *S\ (мм^2)\ /Imax(мА),*p*2$$

Where ΔU(B) – acceptable voltage drop;

(ΔU(B) = 6 V at Urat. = 24 V; ΔU(B) = 14 V at Urat. = 32 V)

S (mm^2) – cable wire section;

Imax(mA) – maximum current consumed by the detector

For devices connected in loop (Imax(mA)*N(pcs)) – where N(pcs) – number of the devices in loop;

P – resistivity constant.

Example: The device is connected by copper cable with wiring section of 1.5 mm^2 with current supply voltage of 24 V.

Supply voltage = 24 V.

Minimal supply voltage on gas analyzer = 18 V.

The voltage drop will be equal

$$\Delta U(B) = 24-18 = 6V$$

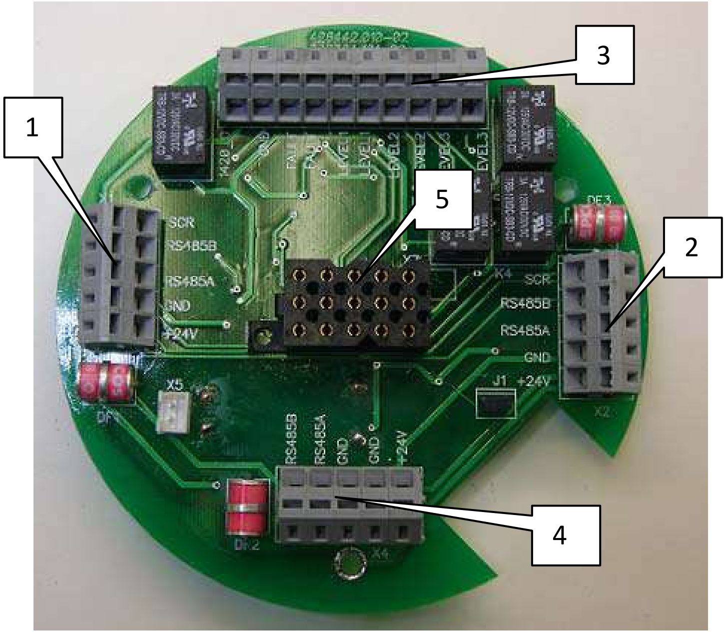
Maximum power consumption – 7.9 VA, current consumption 312 mA.

P – copper resistivity 0,0175...0,0182 Ohm*mm^2/m at 20°C.

L= 6*1.5/0.312*0.0175*2=800 m.

The maximum cable length in this case does not exceed 800m.

Appendix C. ***Wiring layout connection***



1. Terminal block X1 (power cables and readout of RS-485 output)
+24V
- 24V
RS-485A
RS-485B
CSR

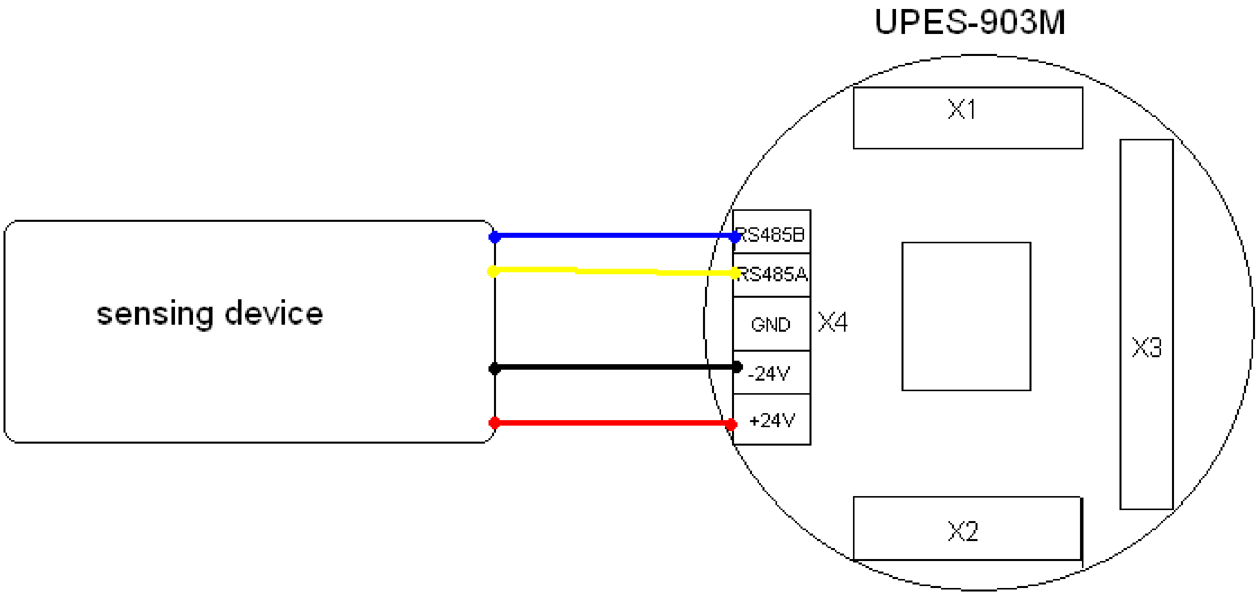
2 Terminal block X2 (power cables and readout of RS-485 output)
+24V
-24V
RS-485A
RS-485B
CSR
Terminal blocks X1 and X2 are bridged.

3. Terminal block X3 for readout the analog output +4-20mA -4-20mA, failure relay, digital outputs of the first, second and third gas levels.
+4...20mA
-4…20mA
Fault
Level 1
Level 2
Level 3

4. Terminal block X4 for transducers PGU-E, PGU-P, and PGU-IR.
+24V
-24V
GND
RS-485A
RS-485B

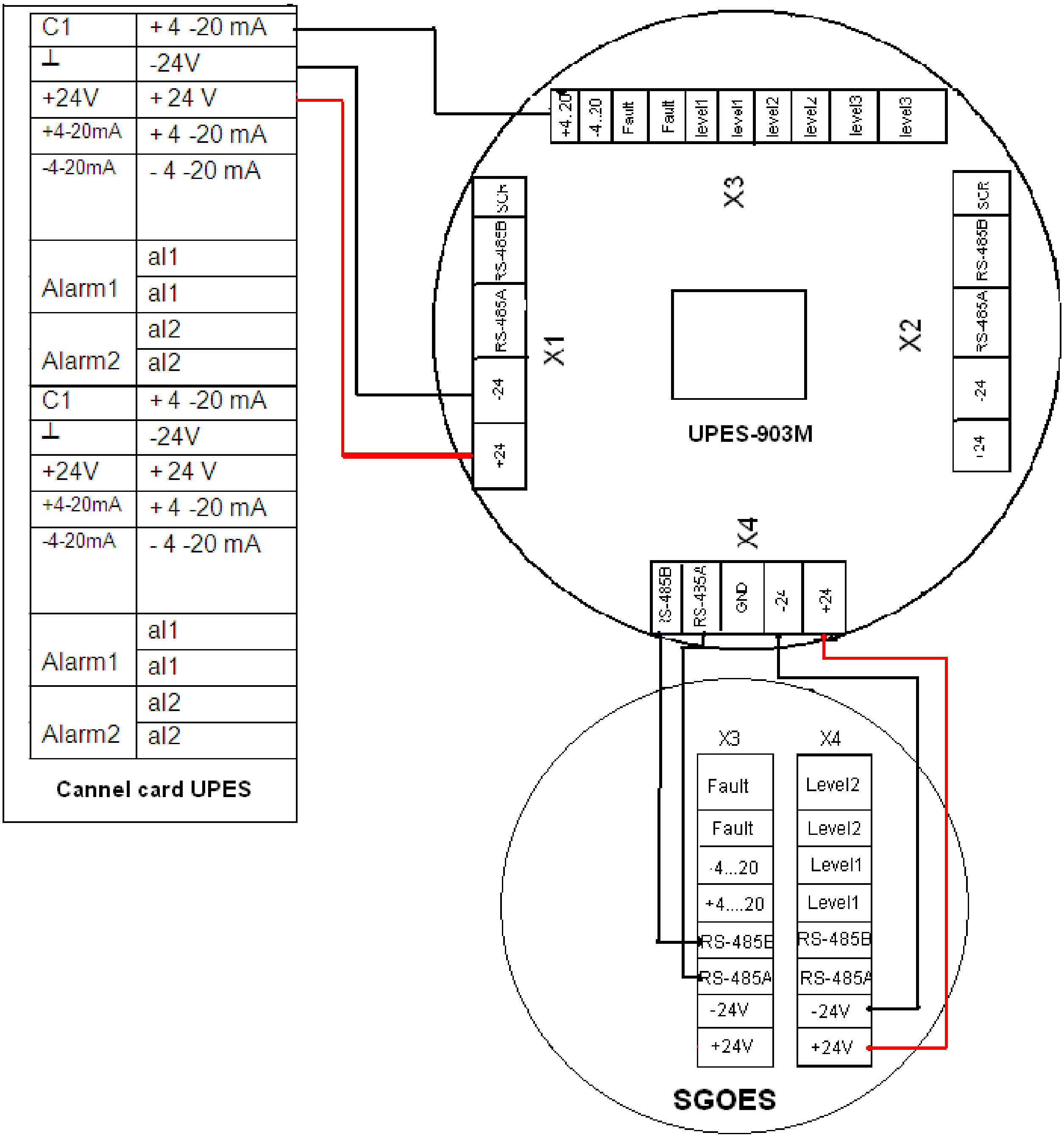
5 Socket for connection with controller circuit board.

Appendix C.1. ***Scheme of transducer connection to the transmitter***



Red	+ 24V DC
Black	-24V DC
Yellow	RS-485 A
Blue	RS-485 B

Appendix C.2. ***Scheme of SSS transmitter connection to the threshold device UPES on analog output (SGOES in “remote sensor” option)***



Appendix D. SSS Nominal conversion function

Nominal conversion function of Gas Analyzer shall be presented by means of the following formula:

$$I_{out} = 16\ C_x/C_p + 4, \qquad (1)$$

where, Iout – gas analyzer output current, mA;

C_x – converted concentration of detecting component: volume fraction, %LEL for combustible gases, ppm for toxic gases.

C_p – upper value of converted range of detecting component is equal 100% LEL (corresponding to current output of 4-20 mA)

Measuring concentration of detecting component in %LEL is calculated by formula:

$$C_i=6,25(I_i – 4). \qquad (2)$$

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

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

where, C_{pasp} – value of detecting gas component concentration pointed in passport of specific CGM.

C_p - upper value of converted range of detecting component is equal 100% LEL (corresponding to current output of 4-20 mA).

For example, SSS gas analyzer on methane,

In detection measuring range from 0 to 100% LEL (from 0 to 4,4 vol.):

In case of using the CGM No.2 (passport value = 2,2 vol)

Measuring concentration is equal $C_{i\ i}$= 100*2,2/ 4,4 = 50 % LEL,

Calculating value of current output I_{out} = 16*50/100 + 4=16 mA

In case of using CGM No.3 (passport value = 4,15 vol.)

Measuring concentration is equal $C_{i\ i}$= 100*4,15/ 4,4 = 94,3 % LEL

Calculating value of current output I_{out} = 16*94,3/100 + 4=19,1 mA

Appendix E. Communication protocol with upper level controller on HART-interface for SSS Gas Analyzer

SSS gas analyzer has the additional HART interface output for connecting the communicator and providing the maintenance operation in the field conditions (concentration value readout, zero setup, calibration, thresholds changes).

For digital data communication is used the low-level modulation, overlay to the analog signal 4…20 mA. Digital signal modulation is carried out with BELL-202 standard, communication speed 1200 baud, “odd” parity, from 2 to 20 “empty” byte 0xFF are sending before the begging of batch sending, which is need for modems synchronization.

SSS gas analyzer supports following commands:

Universal commands in total.

General commands (original setting/ alternative setting):

#35 To record the range value/ two threshold alarm setting:
0 byte – measuring unit (Unsigned-8);
1-4 byte – second alarm threshold, in mA of 4..20 mA signal (Float-32);
5-8 byte – first alarm threshold, in mA of 4..20 mA signal (Float-32);

#38 reset flag “Configuration changed”.

#40 enter/escape from fix current mode.

#43 Zero set up of primary var.

#45 To adjust zero B to A convertor/ Calibration of primary var.
0-3 byte - supply concentration value, in mA of 4..20 mA signal (Float-32);

#46 To adjust the gain factor of B to A convertor / Calibration of primary var.

0-3 byte - supply concentration value, in mA of 4..20 mA signal (Float-32);

Any HART-communicator with command support mentioned in the present

Appendix can be used for operation.

Changing of communication protocol is carried out with the help of factory settings.

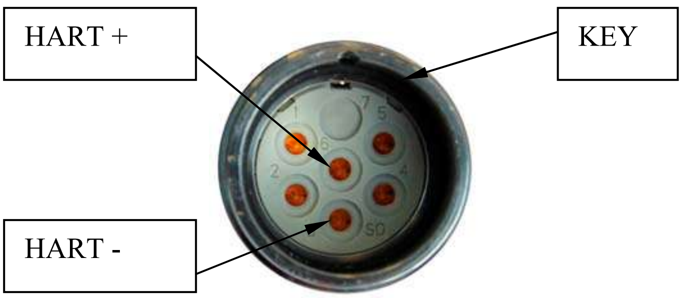
It is need to put the magnetic bangle on the gas analyzer body for providing reset of magnetically operated sealed switch characteristics, then drop and supply voltage. After that the device will be operate on RS-485 interface, Modbus-RTU protocol, net address 3, rate of exchange 9600 baud, shot frame address of HART-protocol – 0.

Attention! Cyclical usage of seek command during adjustment of software is prohibited, because the registers has the limited quantity of recording cycles (10000).

Appendix E.1. Operation with HART-communicator

Gas analyzer SSS-903 has the additional output of HART interface for connecting the communicator and providing necessary service operations in the field (concentration value readout, zero setup, calibration, changing of thresholds values.

Operation with HART-communicator of 691HT ABB model.



1. To learn the HART-communicator operating manual.
2. Connect the communicator to the transmitter in accordance with basing socket. Pic.18
3. Switch on the communicator by pressing “POWER” bottom during 1 second.
4. Pass to the «DIRECT CONNECTION». In main menu press “F1” bottom <->«DIRECT», the connection with detector begins to install. After communication installation «SELECT GREEN KEY» message is appeared.

Note. If the message «XMTR NOT IN COMMUNICATION» was appeared, check power supply and connection of communicator.

5. In menu «DIRECT CONNECTION» following options are available:

5.1.Readout the concentration values in %LEL and corresponding current value 4-20 mA. It is need to press green bottom «PV».

Following 3 parameter will be available for readout:

- «SV» – first threshold value in % LEL;
- «TV» – second threshold value in % LEL;
- «QV» – voltage value on the temperature sensor on mV;

Note. Exit from any divisions of menu making with «ABORT» bottom.

5.2.Changing of threshold values is made by press green bottom «CONF», then «F1»<->«CHNG I/O»,

then «F1»<->«NEXT OPTN»,

then «F3»<->«CHNG»,

enter the values of thresholds in %LEL,

press bottom «F4»<->«ENTER» after each input of data.

5.3. Zero setting.

Press green bottom «TRIM»,

then «F1»<->«SNSR TRIM»,

then «F1»<->«ZERO ALIGN»,

then press twice «F4»<->«PROCEED»,

then «F4»<->«SEND DATA».

5.4. Sensitivity calibration.

To supply the control gas mixture to the detector with flow of 0.5 l/min. during 2 minutes;

Press green bottom «TRIM»,

then «F2»<->«4-20 TRIM»,

then «F2»<->«4 TO 20mA»,

then press twice «F4»<->«PROCEED»,

input the concentration value in mA of the signal 4-20 which corresponding with concentration calculated by formula:

Analog output 4…20 mA calculation:

$$Iout = 16\ Ci/Cmax + 4,$$

where Iout - gas analyzer output current, mA;;

Ci – measuring concentration of detecting component, % LEL

Cmax – maximum value of converting concentration of the detecting component, is equal 100% LEL (corresponding to output current 20mA.

$$Ci = Cx/Cmax * 100$$

where Cx –measuring concentration of detecting component in %vol. (indicated in passport or on cylinder)

Cmax – maximum value of converting concentration of detecting component in % vol. is equal 100% LEL (corresponding to output current 20 mA).

press «F4»<->«ENTER» bottom,

then «F4»<->«YES»,

then «F4»<->«PROCEED», the current value of analog output is appeared on the display in mA..

then «ABORT».

5.3.Note. Calibration on high gas mixture (concentration is approximately equal 100% LEL for combustible gases and MAC concentration for toxic gases) is changed from calibration on average gas mixture (concentration is corresponding to 50% LEL for combustible gases and 1 MAC for toxic gases) by value of specified gas mixture. In case of high gas mixture concentration setting more the 75%, the calibration on high concentration is going automatically, in other case on average gas mixture.

Appendix F. Operating with RS-485

Zero setup and sensitivity calibration via RS-485.

1. Zero setup and sensitivity calibration is carried out in the case of nonconformance of accuracy of conversion to the requirements of the present Operating Manual.
2. The resources pointed in the Table 1 given below are used for execution of work of present operating manual, including:

- PC with Windows 98, XP, 2000 operating system and free COM-port;

- Calibration chamber, technological cable, converter RS-232 / RS-485 ADAM;

- Power supply source, milliammeter;

- Plastic-vinyl tube, rotameter, general regulator;

- Program software (on CD).

3. Zero setup and sensitivity calibration is carried out in normal operation condition. Ensure in absence of mechanical damages of the body and sensitive element (transducer) of SSS gas analyzer before the work execution.

It is not recommended to perform the calibration if the balloon pressure is less then 1000 kPa, through unevenness of gas flow output.

Drop of pressure in the balloon can cause inequality of gas supplying and has an adverse effect on reliability of indicated value of gas analyzer SSS.

4. Zero set up and sensitivity regulation procedures are carried our by Electrical equipment engineer out of hazardous area by following method:

1) To install the calibration chamber on the reducer for gas mixture supplying, connecting the gas analyzer with computer and power source by means of technological cables in accordance with drawing.

Attention! Incorrect power supply connection can course the fail of elements provided the communication with PC and impossibility to set the communication with PC further, therefore to make the calibration!

2) To set the output voltage of power source +24V and switch on;
3) Powered PC and after operating system load start the program for zero set up and sensitivity adjustment from set of delivery (CD);
4) Calibration program menr and informational windows will be displayed on monitor – the current information about device operation (see fig. F1)

Set the communication parameters between the PC and device and initiate "Search" mode. Beforehand it is need to set COM-port number (pos.1) and start up the "Sensor search"(pos.2) . The data about connecting SSS gas analyzers should appear on display – device net address, serial number, gas type, concentration, relay status etc.

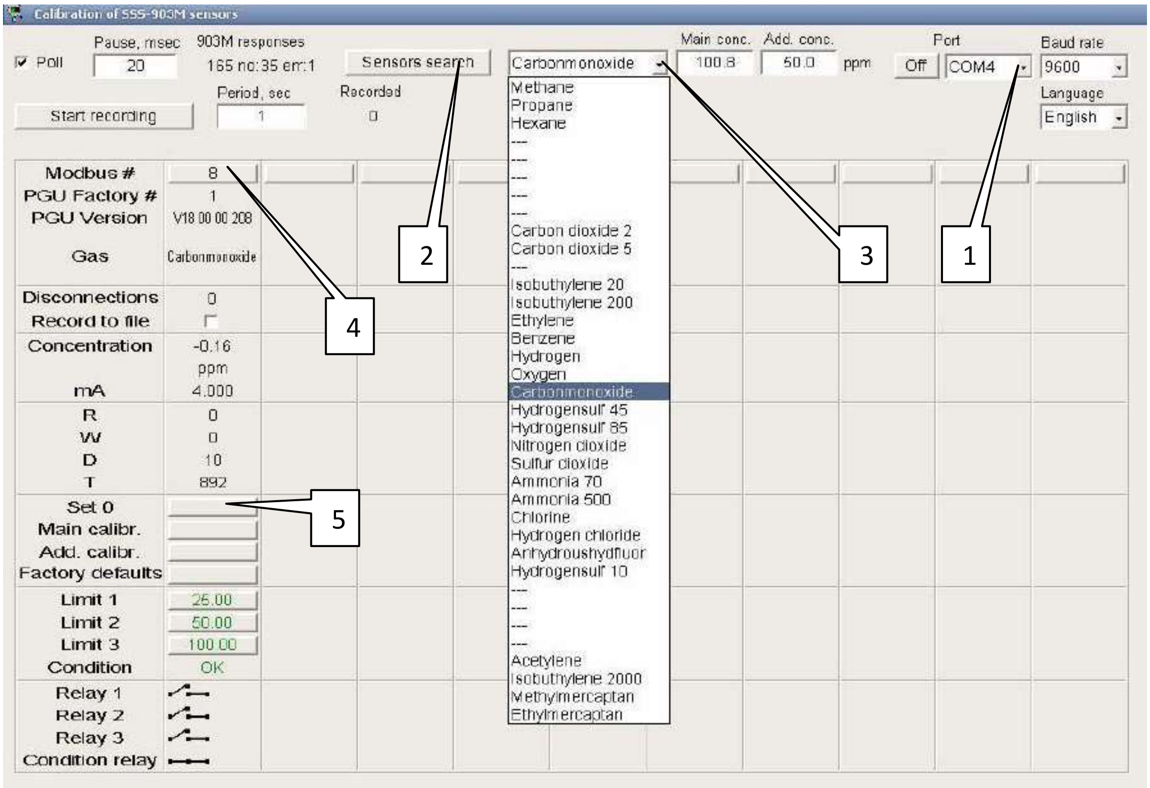
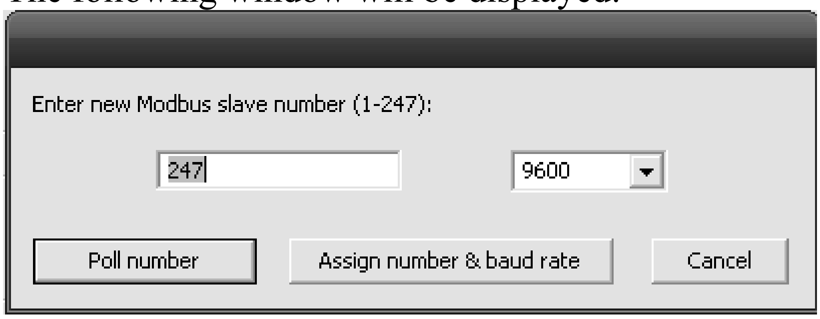


Fig F.1 – program window for SSS gas analyzer adjustment

Type of gas component for gas analyzer adjusting is choose from drop menu (pos.3)

To set the SSS net address (as well as rate of speed with COM-port) user can make manually by press the key of corresponded device in the column (pos.4).

The following window will be displayed:



Changing of device net address and/or rate of data exchange with computer is made by entering of new net address and/ or by choosing the required rate of speed from drop menu. To record the changes in SSS operation by press "Assign number and baud rate" button or cancel by press "Cancel". Press "Connect communication" button for displaying the current characteristics of specific gas analyzer in accordance with required net address.

5. SSS zero set up is making after fixing of stable indication of gas analyzer , and press "Set 0" button in adjustment program (fig. F1, pos.5). Reset of the sensitivity is need to control with current output signal of SSS by value of 4 mA; in corresponding column of detecting component concentration is "Set 0".
6. Set the type (F1, pos.4) and control gas mixture concentration for calibration.

FM Approval is only for single gas calibration.

Attention! If the SSS calibration is carried out by one CGM only the detecting gas component concentration in the present gas mixture should be of full scale (for ppm) or higher, if the concentration is low it can have an adverse effect on measuring of high level concentrations of gas analyzer (in measuring range).

7. after heated gas detector during 2 hours, connect the input of rotameter with CGM cylinder, and its output with fitting of calibration chamber by PVC-tube and blow during 2,5...3 minutes by flow of 0,8...1,2 l/min (total gas mixture volume should be not less 1,2...1,5 l);

8. for calibration with CGM of high concentration detecting component (more then 75% LEL) to set the corresponding "high concentration value" in column "High concentration" (fig.F2,pos.1). For low concentration CGM of detecting component (50…75% LEL) set "low concentration" in column "Low concentration" (Fig.2, pos.3)

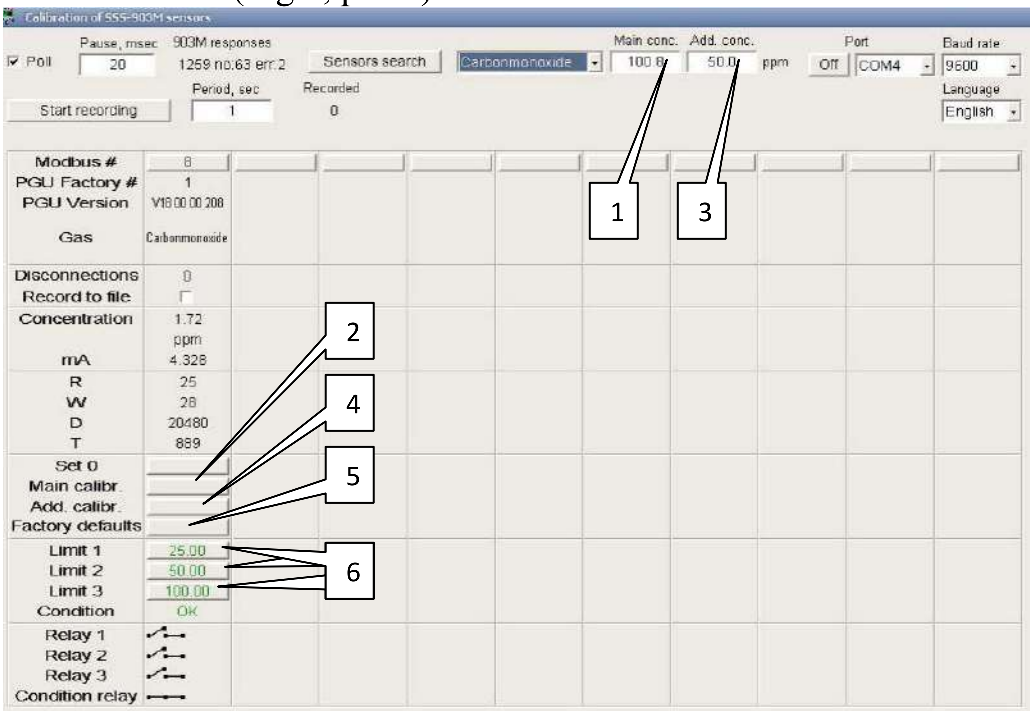


Fig. F2 –programming calibration of gas analyzer

9. after fixing the stable indication values of SSS, press "Calibration with high concentration" button(Fig.F2, pos.2) or "Calibration with low concentration" button (Fig 2, pos.4), and control the settings in corresponding column of concentration of detecting component of the CGM concentration value.

First/second/third thresholds crossing is controlled by integrated red LED indicators; the current analog output should corresponded to calculated current at output of gas analyzer (the formula for nominal static function is given in Appendix A)

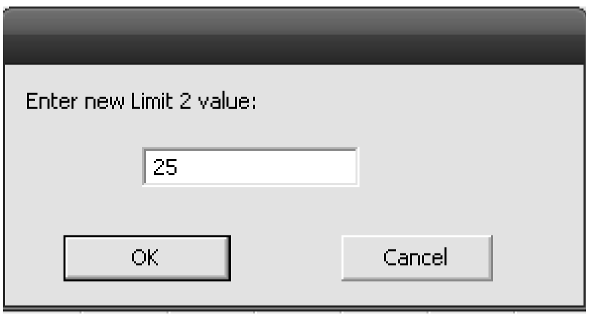
10. Compliance of SSS gas analyzer to technical requirements, specified in the present OM under CGM supplying is controlled by conversion accuracy of gas concentration into output analog (current) signal. The controlled current value of PGU transducer during the calibration have not to differ from calculated more then ±0,8 mA for CGM of «low concentration" and ±1,5 mA for CGM of "high concentration".

If the current values are exceeded the set parameters it is need to readjustment the gas analyzer sensitivity.

11. SSS operability on the digital channel is carried out during the calibration procedure of sensitivity with control the indication on display. Deviation of SSS gas analyzer indication form set of detecting component concentration values for each gas mixture should not exceed the limits of basic error indicated in specification of the device.

In the case of uncorrected calibration of gas analyzer the user can reset the factory settings of SSS gas analyzer – by pressing "Factory defaults" button (Fig. F2, pos.5)

The user can set the required alarms thresholds by pressing "Limit 1", "limit 2", "Limit 3" (Fig. F2, pos.6). In the following window



It is need to input the new value of alarm and confirmed it by pressing "OK" button.

The absolute error is calculated by formula:

$$C_a = C_i - C_d$$

Where

C_i – gas analyzed displayed indication under i control gas mixture supplying, %vol., % LEL for explosive gases and ppm for toxic gases.

C_d – real concentration of detecting component under i control gas mixture supplying, % vol. % LEL for explosive gases, and ppm for toxic gases.

Example 3. Under the supplying control gas mixture the indication on transmitter SSS is equal 7ppm. %vol. of determining component H_2S in accordance passport on the cylinder is 7 ppm.

Calculate the measurement error of absolute error:

Ca=7ppm-7ppm=0 ppm

That is the absolute measurement error of gas mixture is equal zero.

Relative error estimate of gas analyzer is calculated by formula:

б= Ci-Cd/ Cdx100

Example:

б=7-7/7x100=0%

The calibration results are considered as positive if the basic error of gas analyzer calculated by the formulas given above in all calibrating points does not exceed the limits mentioned in specification.