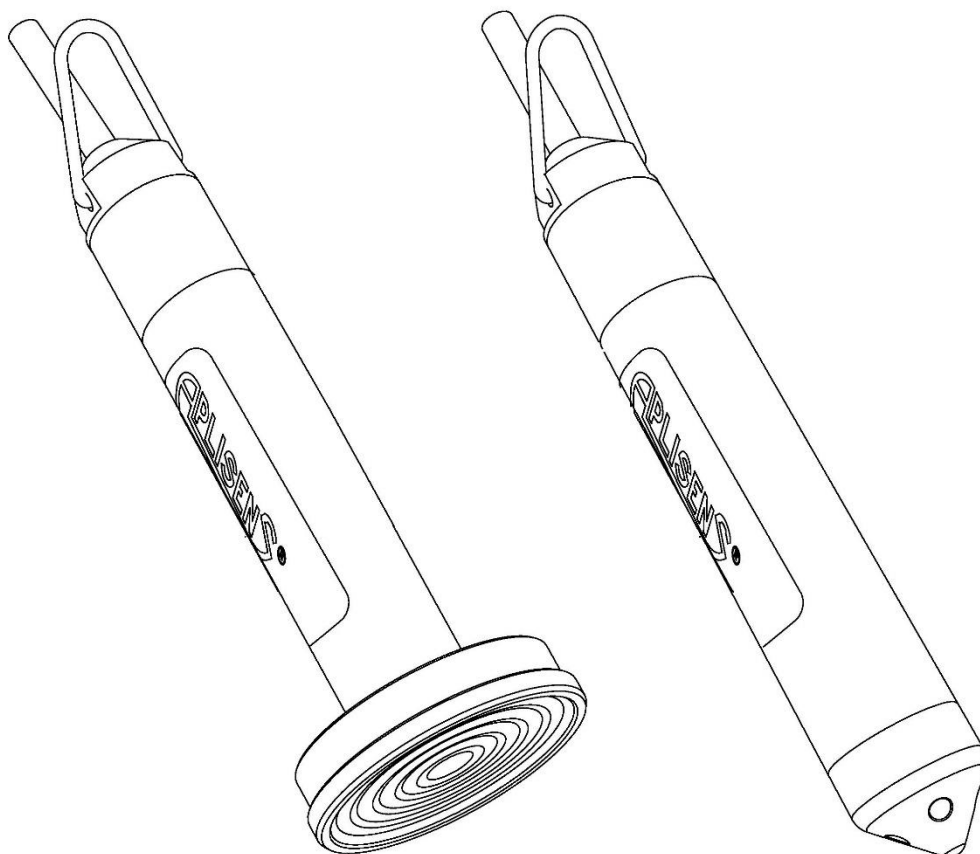


APLISENS[®]

USER'S MANUAL

SMART LEVEL PROBES

SGE-25.Modbus and SGE-25S.Modbus



PRODUCT CODE – see: (→ [Probe identification](#)).

The QR code or ID number identifies the probe and provides quick access to the following documentation on the manufacturer's website: User's Manual, Explosion Proof Device Manual, Modbus Manual, declarations of conformity and copies of certificates.

SGE-25.Modbus

ID: 0044 0001 0001 0000 0000 0000 0001 77

<https://www.aplisens.pl/ID/004400010001000000000000000177/>



SGE-25.Modbus (Exi)

ID: 0044 0002 0001 0000 0000 0001 0001 94

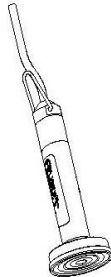
<https://www.aplisens.pl/ID/00440002000100000000000001000194/>



SGE-25S.Modbus

ID: 0045 0001 0001 0000 0000 0000 0001 74

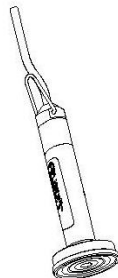
<https://www.aplisens.pl/ID/004500010001000000000000000174/>







SGE-25S.Modbus (Exi)

ID: 0045 0002 0001 0000 0000 0001 0001 91

<https://www.aplisens.pl/ID/00450002000100000000000001000191/>



Symbols used

Symbol	Description
	Warning to proceed strictly in accordance with the information contained in the documentation in order to ensure the safety and full functionality of the device
	Information particularly useful during installation and operation of the device.
	Information particularly useful during installation and operation of an Ex type device.
	Information on disposal of used equipment.

BASIC REQUIREMENTS AND SAFE USE



The manufacturer will not be liable for damage resulting from incorrect installation, failure to maintain a suitable technical condition of the device or use of the device other than for its intended purpose.

Installation should be carried out by qualified staff having the required authorizations to install electrical and I&C equipment. The installer is responsible for performing the installation in accordance with manual as well as with the electromagnetic compatibility and safety regulations and standards applicable to the type of installation.

In systems with I&C equipment, in case of leakage, there is a danger to staff due to the medium under pressure. All safety and protection requirements must be observed during installation, operation and inspections.

If a malfunction occurs, the device should be disconnected and handed over to the manufacturer for repair.



In order to minimize the risk of malfunction and associated risks to staff, the device is not to be installed or used in particularly unfavourable conditions, where the following hazards occur:

- possible mechanical impacts, excessive shocks and vibration;
- excessive temperature fluctuation;
- freezing of the medium.

Changes made to the manufacturing of products may be introduced before the paper version of the manual is updated. The up-to-date manuals are available on the manufacturer's website: www.aplisens.com.

TABLE OF CONTENTS

1. INTRODUCTION	6
1.1. Purpose of the document	6
2. SAFETY	6
3. TRANSPORT AND STORAGE	7
3.1. Delivery check.....	7
3.2. Transport.....	7
3.3. Storage and use.....	7
4. GUARANTEE	7
5. IDENTIFICATION	8
5.1. Manufacturer address	8
5.2. Probe identification.....	8
5.3. CE mark, declaration of conformity.....	8
6. INSTALLATION	9
6.1. General recommendation	9
7. ELECTRICAL CONNECTION	10
7.1. Connection, signal output	10
7.2. Power supply.....	10
7.2.1. Power supply voltage.....	10
7.2.2. Shielding, equipotential bonding	10
7.3. Operation mode in MODBUS network.....	11
7.4. Overvoltage protection	13
7.5. Final Inspection of cabling	13
8. START-UP	13
9. OPERATION	14
9.1. MODBUS register layout in the address space.....	14
9.2. Pressure unit codes.....	15
9.3. Modbus status register description	15
9.4. Error codes supported by Modbus.....	15
10. MAINTENANCE	16
10.1. Periodic inspections	16
10.1.1. External overview	16
10.1.2. „Zero” check	16
10.2. Non periodic inspections	16
10.3. Cleaning/Washing	16
10.4. Diaphragm cleaning	16
10.5. Spare parts.....	16
10.6. Repair	16
10.7. Return	16
11. SCRAPPING, DISPOSAL	17
12. HISTORY OF REVISIONS	17
Explosion-proof device manual EN.IX.SGE.25.MODBUS	18

LIST OF DRAWINGS

Figure 1. Mounting brackets for probes.....9
Figure 2. Diaphragm cover for SGE-25S.Modbus probe.....9
Figure 3. Connection in Modbus network..... 12

LIST OF TABLES

Table 1. Symbols appearing on the probe’s nameplate.....8
Table 2. Probe connection..... 10
Table 3. Permissible power supply voltage for probes.10
Table 4. A binary value assigned to the corresponding pressure unit. 15

1. INTRODUCTION

1.1. Purpose of the document

The subject of manual are smart level probes: **SGE-25.Modbus** and **SGE-25S.Modbus** hereinafter referred to as probes in the manual. The manual applies to the following versions: standard and intrinsically safe Exi.

The manual contains data, guidelines and general recommendations for the safe installation and operation of the probes, as well as procedures in the event of a possible failure.



It is forbidden to use devices in hazardous areas without appropriate permits.



Data on the hydrostatic level probes **SGE-25.Modbus**, **SG-25S.Modbus** and **SGE-25C.Modbus** in intrinsically safe version according to IECEx and ATEX are included in the Explosion-proof Device Manual marked as EN.IX.SGE.25.MOVBUS.

2. SAFETY



- The installation and start-up of the device and any activities related to operation shall be carried out after thorough examination of the contents of user's manual and the instructions related thereto;
- installation and maintenance should be carried out by qualified staff having the required authorizations to install electrical and measuring devices;
- the device shall be used according to its intended purpose in line with the permissible parameters specified on the nameplate (→ [Probe identification](#));
- the protection elements used by the manufacturer to ensure probes safety may be less effective if the device is operated in a manner not consistent with its intended purpose;
- before installing or disassembling the device, it is absolutely necessary to disconnect it from the power source;
- no repairs or alterations to the probes electronic system are permitted. Assessment of damages and possible repair may only be performed by the manufacturer or authorized representative;
- do not use instruments if damaged. In case of malfunction, the device must be put out of operation.

3. TRANSPORT AND STORAGE

3.1. Delivery check

After receiving the delivery, please refer to the general terms and conditions of contracts available on the manufacturer website: https://aplisens.com/ogolne_warunki_umow.html.

3.2. Transport

Transport of probes shall be carried out with the use of covered means of transport, in original packages with diaphragm provided with protection. The packaging shall be protected against movement and direct impact of atmospheric factors.

3.3. Storage and use

Probes shall be stored in a factory packaging, in a room without vapours and aggressive substances, protected against mechanical impact. The cable should be coiled into a circle with a diameter of ≥ 30 cm, the coils of the coil should be fixed in relation to each other and the whole should be fixed in the package. Avoid kinking the cable at the point where it exits the gland.

Permissible medium temperature range:

- SGE-25.MODBUS/ SGE-25S.MODBUS -25 ... 40°C (-13 ... 104°F);
- Special version - Teflon 0 ... 75°C (32 ... 167°F);



The medium must not be allowed to freeze in the immediate vicinity of the probe.

4. GUARANTEE

General terms and conditions of guarantee are available on the manufacturer's website: www.aplisens.com/ogolne_warunki_gwarancji



The guarantee shall be repealed if the device is used against its intended use, failure to comply with user's manual or interference with the structure of the device.

5. IDENTIFICATION









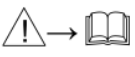
5.1. Manufacturer address

APLISENS S.A.
03-192 Warsaw
Morelowa 7 St.
Poland

5.2. Probe identification

Depending on the version of the probe, the nameplates may differ in the amount of information and parameters.

Table 1. Symbols appearing on the probe's nameplate.

	Logo and name of manufacturer
	CE mark
	CE mark with number notified body
03-192 WARSZAWA Morelowa 7 Poland tel.: +48 22 814 07 77	Manufacturer address
	QR code
TYPE:	Probe type
ID	Probe model ID
# S/N	Probe serial number
	Measuring range
	Power supply voltage
	Output signal
	Permissible range of ambient temperature
IP	IP protection rating
Year of production	Year of production
	Note about the obligation of read the manual
//Lower part of the nameplate//	Special versions

5.3. CE mark, declaration of conformity

The device has been designed to meet the highest safety standards, has been tested and has left the factory in a condition that is safe for operation. The device complies with the applicable standards and regulations listed in the EU Declaration of Conformity and has CE marking on nameplate.

6. INSTALLATION

6.1. General recommendation

The probe can be hung on the power cable, e.g. by using from the Aplisens SG cable hanger (item 1 in fig. 1). In the event of frequent removal of the probe or when there is a risk of catching on protruding elements during pulling up, it is recommended to hang the probe on a steel cord using the carrying eye (item 2 in Fig. 1.). The probes are immersed in the medium to be measured. A special cable extends above the level of the medium and can be connected directly to probe or to a junction box. If the probe is to be placed in the current or in an area of turbulence, it should be installed in a protective tube.

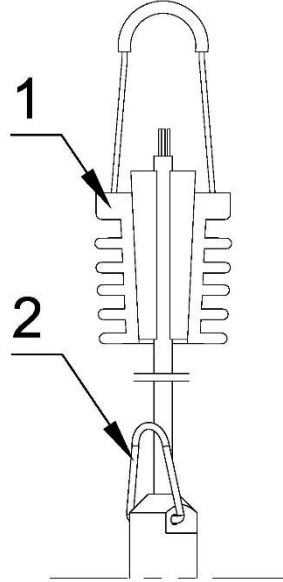


Figure 1. Mounting brackets for probes.

Do not clean or touch the diaphragm with hard or sharp objects. Hang the probe with the additional Teflon coating on the cable on the suspension cable or on the inner cable (do not grab the Teflon).



Remove the protective cap from the probe's separator immediately before the SGE-25S.Modbus type probe is inserted into the medium to be measured.

During installation protect the probe from mechanical impacts

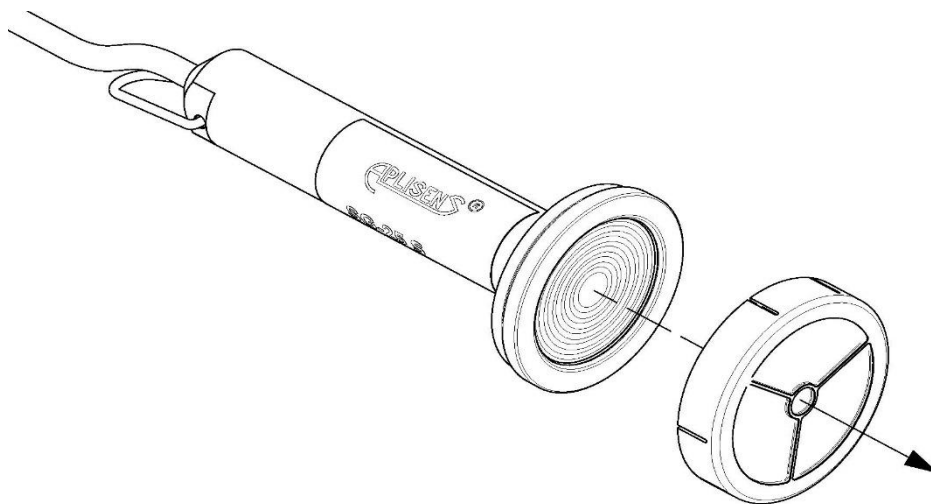


Figure 2. Diaphragm cover for SGE-25S.Modbus probe.

7. ELECTRICAL CONNECTION

7.1. Connection, signal output



All connection and assembly activities must be performed with the power supply disconnected and other external voltages, if used.



Incorrect connection of the probe may endanger safety.
Risk of electric shock and / or ignition in hazardous areas.

The electrical connection should be made according to Table. 2. It is recommended to install the PP-Modbus connection box manufactured by Aplisens S.A. to connect the probe cable with the rest of the transmission line. The PP-Modbus junction box is non-hermetic (pressure inside is equal to atmospheric pressure) due to the use of an air filter, which is required for the probe to operate correctly. Do not allow the capillary outlet to become contaminated or any liquid to enter the capillary.

Table 2. Probe connection.

Signal output	
Type of connector	Wire colour
SHIELD	Green
+	Red
- (GND)	Black
RS-485 A +	Blue
RS-485 B -	Yellow

7.2. Power supply

7.2.1. Power supply voltage



Supply cables may be live.
There is a risk of electric shock and/or explosion.



Installation in potentially explosive atmospheres must comply with local standards and regulations.

Table 3. Permissible power supply voltage for probes.

Mode	Output signal	MIN. Power supply voltage	MAX Power supply voltage
MODBUS mode - standard version*	MODBUS RTU	4 V DC	28 V DC
MODBUS mode Exi version	MODBUS RTU	4 V DC	10 V DC
Configuration mode – standard version	4...20 mA	5 V DC	28 V DC

*- power consumption in Modbus mode <3,6 mA.

7.2.2. Shielding, equipotential bonding

A cable shield (green cable) is led out of the probe power supply and measurement cable. Connect the shield on one side at the probe supply point.

7.3. Operation mode in MODBUS network

The SGE-25.Modbus and SGE-25S.Modbus probes have two modes of operation:

- configuration mode;
- Modbus mode.

The configuration mode is used to change the settings and for accurate diagnostics of the probe. In this mode, in devices with software version at least 14 and electronics version at least 48, the current loop is also activated, allowing operation with current output 4...20 mA.



The SGE-25.Modbus and SGE-25S.Modbus probes in Exi version have a Modbus RTU interface without current regulator 4...20 mA.

If the user intends to use the 4...20 mA operating mode, the probe must be left in the configuration mode after the parameters have been configured with the "Modbus Configurator" program.

Additional settings for the 4...20 mA operating mode beyond the scope of the "Modbus Configurator" option are possible using the Report 2 program. If the user intends to use the Modbus mode of operation, the probe must be switched to Modbus mode after the parameters have been configured with the "Modbus Configurator" program.

The measuring range for 1/100th of an integer unit with sign is between -32767 and 32767 units. Exceeding this range results in a skewed reading.

In case of pressure readings in binary format "Signed 16-bit int", the basic unit must be selected so that 100 times the pressure value expressed in it does not exceed the above range.

At all transmission speeds (especially at 115200 bps), a 120 Ω matching resistor should be used, which by default is included via a jumper in the transmission circuit between the "Digital" A and B outputs (Aplisens PP-Modbus boxes are factory equipped with a 120 Ω resistor).

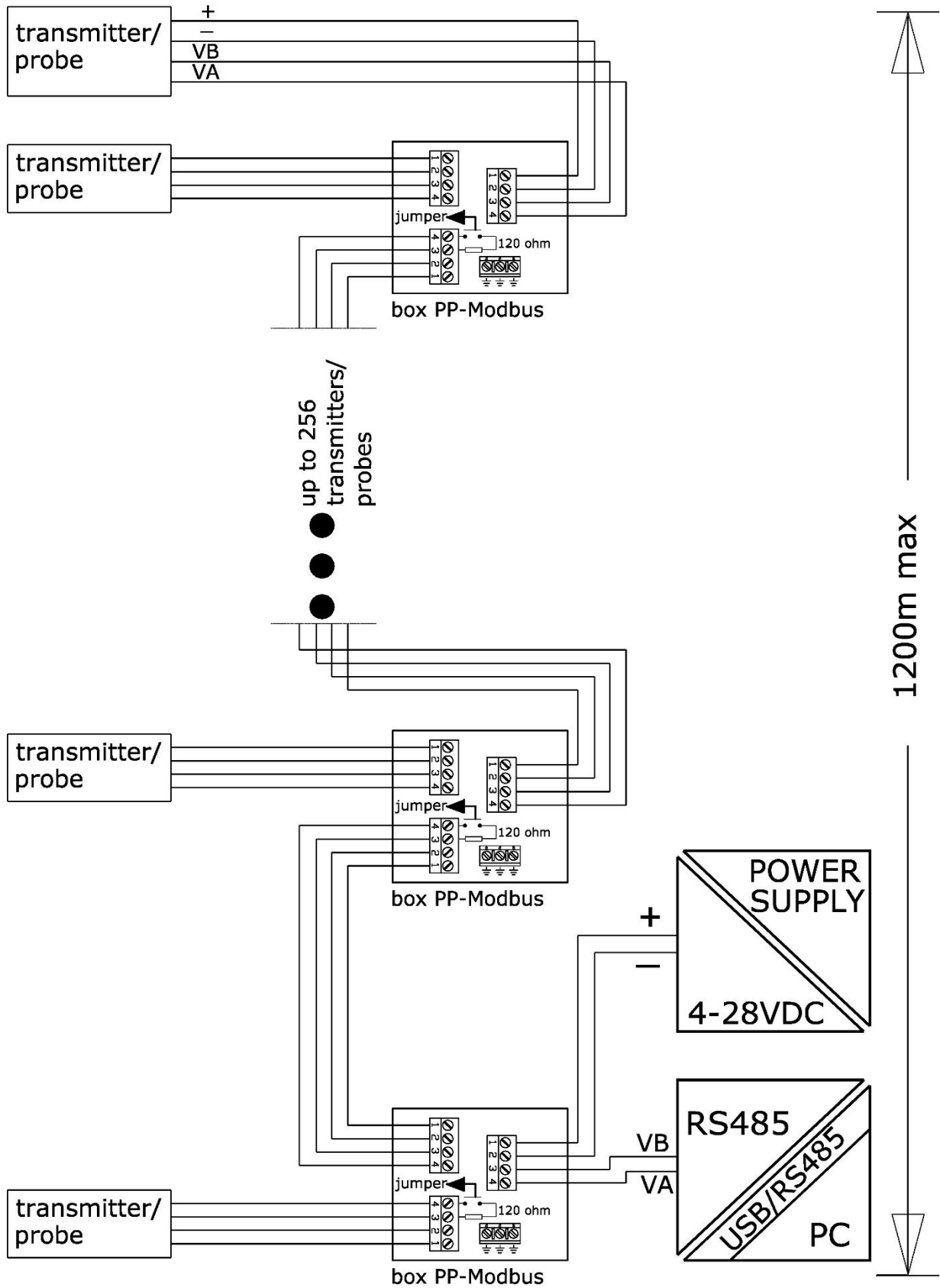


Figure 3. Connection in Modbus network.

7.4. Overvoltage protection

Probes can be exposed to switching surges, or other surges, such as those resulting from lightning. Protection against surges between the wires of the transmission line is provided by surge diodes. For protection against surges between the transmission line and earth or housing (which are not protected by diodes connected between the line conductors), the probes are equipped with additional protection in the form of surge arrestors.

7.5. Final Inspection of cabling

After completing the electrical installation of the probe, it is necessary to check the following:

- that the supply voltage measured at the power supply terminals of the cable connection at the maximum current is in accordance with the supply voltage range specified on the rating plate;
- is the probe connected according to the information given in section → [ELECTRICAL CONNECTION](#);
- when using a junction box, that the glands are tightened.

8. START-UP

The probe's basic data can be read from the device's rating plate (→ [Probe identification](#)).

Description of the communication protocol used in probes with Modbus digital output is available on the manufacturer's website in "Modbus Configurator" manual.

9. OPERATION

9.1. MODBUS register layout in the address space

Read-only data

Register	Address (hex)	Purpose	Comments	Format	Number of bytes (2 byte per register)
1	0x0000	User value	% of the set range	IEEE754	4 bytes (2 registers)
3	0x0002	Pressure of sensor 1	Pressure or level process variable	IEEE754	4 bytes (2 registers)
5	0x0004	Pressure of sensor 2	Constant value 0 °C	IEEE754	4 bytes (2 registers)
7	0x0006	Temperature of sensor 1	Sensor 1 temperature process variable in °C	IEEE754	4 bytes (2 registers)
9	0x0008	Temperature of processor	Processor temperature process variable in °C	IEEE754	4 bytes (2 registers)
11	0x000A	Temperature of sensor 2	Constant value 0 °C	IEEE754	4 bytes (2 registers)
13	0x000C	-----	-----	-----	4 bytes (2 registers)
15	0x000E	-----	-----	-----	4 bytes (2 registers)
17	0x0010	User value	1/100% controlled of the set range	Signed 16-bit int	2 bytes (1 register)
18	0x0011	Pressure of sensor 1	Integer, 1/100 of pressure or level unit	Signed 16-bit int	2 bytes (1 register)
19	0x0012	Pressure of sensor 2	Value 0 1/100 of the selected unit.	Signed 16-bit int	2 bytes (1 register)
20	0x0013	Temperature of sensor 1	Integer, 1/100 °C	Signed 16-bit int	2 bytes (1 register)
21	0x0014	Temperature of processor	Integer, 1/100 °C	Signed 16-bit int	2 bytes (1 register)
22	0x0015	Temperature sensor 2	Value 0 1/100 w °C	Signed 16-bit int	2 bytes (1 register)
23	0x0016	Pressure unit	Pressure or level unit	Unsigned 16-bit int	2 bytes (1 register) → Table 4
24	0x0017	-----	-----	-----	2 bytes (1 register)
25	0x0018	Upper sensor range	Upper limit of the standard range	IEEE754	4 bytes (2 registers)
27	0x001A	Lower sensor range	Lower limit of the standard range	IEEE754	4 bytes (2 registers)
29	0x001C	Damping time constant [s] second		IEEE754	4 bytes (2 registers)
31	0x001E	Response delay Millisecond [ms]		Unsigned 16-bit int	2 bytes (1 register)
32	0x001F	Address Modbus	1...247	Unsigned 8-bit int	2 bytes (1 register)
33	0x0020	Identification register		Unsigned 8-bit int	6 bytes (3 registers)
36	0x0023	Status Register		8-bit flags	2 bytes (1 register)

* The shaded fields are not active in the described version of the devices.

9.2. Pressure unit codes

Table 4. A binary value assigned to the corresponding pressure unit.

Unit	Value (decimal)	Unit	Value (decimal)
atm	14	mbar	8
bar	7	mmH ₂ O (w 4°C)	239
FtH ₂ O	3	mmH ₂ O	4
g/cm ²	9	mH ₂ O (w 4°C)	171
InH ₂ O (w 4°C)	238	mmHg	5
InHg	1	MPa	237
kg/cm ²	2	Pa	11
kPa	10	psi	6
mbar	12	torr	13

9.3. Modbus status register description

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	0	0	SV,TV,FV out of limit	PV out of limit	0	0	0	0	0

9.4. Error codes supported by Modbus

Error code	Designation	Description
1	Disallowed function code	The error occurs when the function code is unsupported by the device. Currently the function code with number 3 is implemented - Read Holding Registers.
2	Disallowed data address	Error occurs for addresses out of the range 0x00 ÷ 0x23.
3	Incorrect data quantity	Invalid number of read registers declared in frame.
4	Probe failure	Hardware fault detected.
8	Memory error	A RAM or FLASH error has been detected.

10. MAINTENANCE

10.1. Periodic inspections

Periodic inspections should be carried out in accordance with the standards applicable to the user. Check the processing characteristics by following the steps appropriate to the calibration and configuration procedure described in the EN.IM.PCE.PRE.SGE.MOVBUS document available on the manufacturer's website.

10.1.1. External overview

During the inspection, check the condition of the separating membranes (tarnish, corrosion) and the electrical connection (check the condition of the cable), as well as the stability of the handle (if used). Check for signs of mechanical damage in the form of impact marks or dents.

10.1.2. „Zero” check

Every 2 years or in accordance with the user's standards, check the probe's "zero" by pulling the probe above the liquid mirror and reading the output signal. Make any adjustments using the "Modbus Configurator" software".

10.2. Non periodic inspections

If the probe has been subjected to mechanical damage, pressure overload, hydraulic impulses, electrical surges, deposits, crystallization of the medium, etching of the diaphragm, or if the probe is found to be working incorrectly, the device should be inspected. Check the condition of the diaphragm, clean it, check the electrical functionality and processing characteristics.



If the signal is missing in the transmission line or its value is incorrect, check the power supply line, the state of connections on terminal strips, connections, etc. Check the correct value of the supply voltage and the resistance of the load.

10.3. Cleaning/Washing

To remove impurities from the external surfaces of the probe wipe it with a cloth dampened in water.

10.4. Diaphragm cleaning

The only possible method of cleaning the probe diaphragms is to dissolve the sludge produced.



Do not remove deposits and impurities from the probe diaphragms, which are formed during operation, mechanically using tools, since the diaphragms and the probes can be damaged.

10.5. Spare parts

Parts of the probe that may be worn or damaged and must be replaced: cable and gland seals. The cable and seals can only be replaced by the manufacturer.

10.6. Repair

Faulty or non-operational probe shall be provided to the manufacturer or an authorized representative.

10.7. Return

In the following cases the, probe should be returned directly to the manufacturer:

- Need for repair;
- Need for factory calibration;
- Replacement of improperly selected/shipped probe.

11. SCRAPPING, DISPOSAL



Worn or damaged devices shall be scrapped in accordance with WEEE Directive (2012/19/EU) on waste electrical and electronic equipment or returned to the manufacturer.

12. HISTORY OF REVISIONS

Revision No.	Document revision	Description of changes
1	D1/2018.12	The electrical parameters in point 2.3 of Part 1 have been completed.
2	D2/2019.05	The content of the comment in point 1 of Part 1 has been changed.
3	01.D.011/2020.06	The figure in point 5 and figure 1.5 in appendix Ex.04 has been changed.
4	01.A.001/2021.09	New version of the document. Replaces the revision 01_01.D.011_2020-01. Change of software, power supply, figures. Editorial changes. Prepared by DBFD.

Explosion-proof Device Manual EN.IX.SGE.25.MODBUS

LEVEL PROBES:

SGE-25.Modbus, SGE-25C.Modbus, SGE-25S.Modbus
INTRINSICALLY SAFE acc. to ATEX

1. Introduction

Explosion-proof Device Manual EN.IX.SGE.25.MODBUS only applies to probes SGE-25.Modbus, SGE-25S.Modbus, SGE-25C.Modbus in intrinsically safe version acc. to ATEX marked as in point 2 and the Ex information in the Product Certificate. During installation and use of Ex probes it is necessary to use User's Manual EN.IO.SGE.25.MODBUS with „Explosion-proof Device Manual EN.IX.SGE.25.MODBUS”.

2. Using probes in hazardous area.

The probes are produced in accordance with the requirements of the following standards:
EN 60079-0:2018-09, EN 60079-11:2012, EN 50303:2004

The probes may operate in areas where there is a risk of explosion, in accordance with the rating of the explosion protection design:



I M1 Ex ia I Ma
II 1G Ex ia IIB T4/T5/T6 Ga
FTZÚ 18 ATEX 0077X

3. Permissible input parameters (based on data from the FTZÚ 18 ATEX 0077X)



For the connection of the power supply line and the RS485 data transmission signal line, use devices that have the relevant intrinsic safety certificates, whose parameters must not exceed the permissible input-output parameters given in points a) and b).



The probes should be powered from devices with galvanically separated power supply.
Minimum probe supply voltage 4 V DC.

The probe is an intrinsically safe device with protection level "ia" when the power supply circuit has protection level "ia"

a) Permissible input parameters for power supply (red "+", black "-")

- for power supply with linear characteristics:

$$U_i \leq 10 \text{ V}, I_i \leq 0.4 \text{ A},$$

- for power supply with rectangular and trapezoidal characteristics:

$$U_i \leq 5 \text{ V}, I_i \leq 0.4 \text{ A}$$

b) Permissible input and output parameters for RS485 transmission (blue VA, yellow VB):

$$U_i \leq 10 \text{ V}, I_i \leq 0.2 \text{ A}, U_o \leq 10 \text{ V}^*, I_o \leq 0.4 \text{ A}^*$$

* the output parameters of the probes U_o, I_o are equal to the output parameters U_o, I_o of the power supply used. Dependence of temperature class of probes on ambient temperature (including temperature of measured medium) T_a [°C] and sum of power P_i [W] in power supply circuit and in RS485 transmission circuit is given in **Table Z1**.

Min. ambient temperature $T_a = -40^\circ\text{C}$ (special version from -50°C).

c) The internal capacitance and inductance of the probe in the power supply circuit and in the RS485 transmission circuit is:

$$L_i = 0 \text{ } \mu\text{H}, C_i \approx 2.5 \text{ } \mu\text{F}^{**}$$

d) The maximum capacitance and inductance that can be connected to the probe in the transmission circuit is for the subgroup:

- IIC $L_o = 0.2 \text{ mH}, C_o = 0.5 \text{ } \mu\text{F};$

- IIB $L_o = 0.7 \text{ mH}, C_o = 15 \text{ } \mu\text{F};$

- IIA and group I $L_o = 1.7 \text{ mH}, C_o = 80 \text{ } \mu\text{F}.$

** Consider the cable capacitance and inductance, which for a permanently connected cable are:

$$C_k = 0,2 \text{ nF/m } i \text{ } L_k = 1 \text{ } \mu\text{H/m}$$

Table Z1. Temperature class dependence on ambient temperature T_a and total amount of input power P_i .

P_i [W] Total input power of 485 power and transmission circuits	T_a [°C]	Class temp.	P_i [W] Total input power of 485 power and transmission circuits	T_a [°C]	Class temp.	P_i [W] Total input power of 485 power and transmission circuits	T_a [°C]	Class temp.
0.25	65	T6	0.75	55	T6	1.5	65	T5
	80	T5		80	T5		80	T4
0.5	60	T6	1.2	70	T5	1.75	60	T5
	80	T5		80	T4		80	T4

4. Connection of probes in Ex version

Connections of the probe and devices in the probe measuring loop must be made in accordance with intrinsic safety and explosion protection standards and conditions of use in hazardous areas. Failure to observe the intrinsic safety rules may result in an explosion and resultant danger to people.

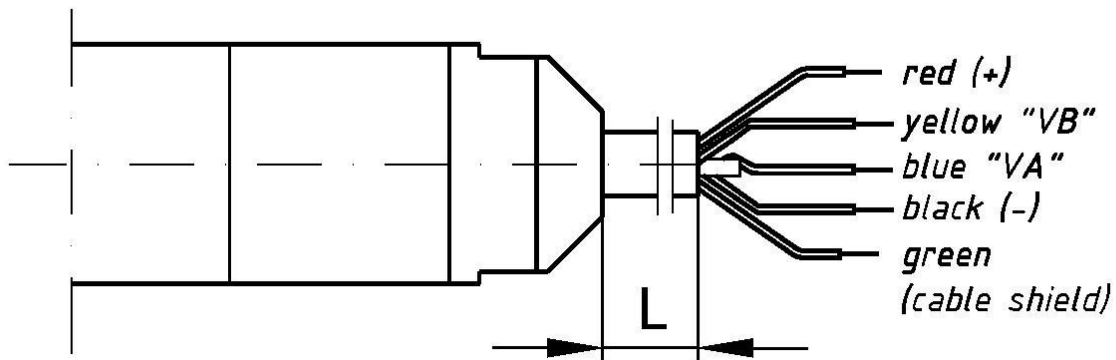


Fig. I.1

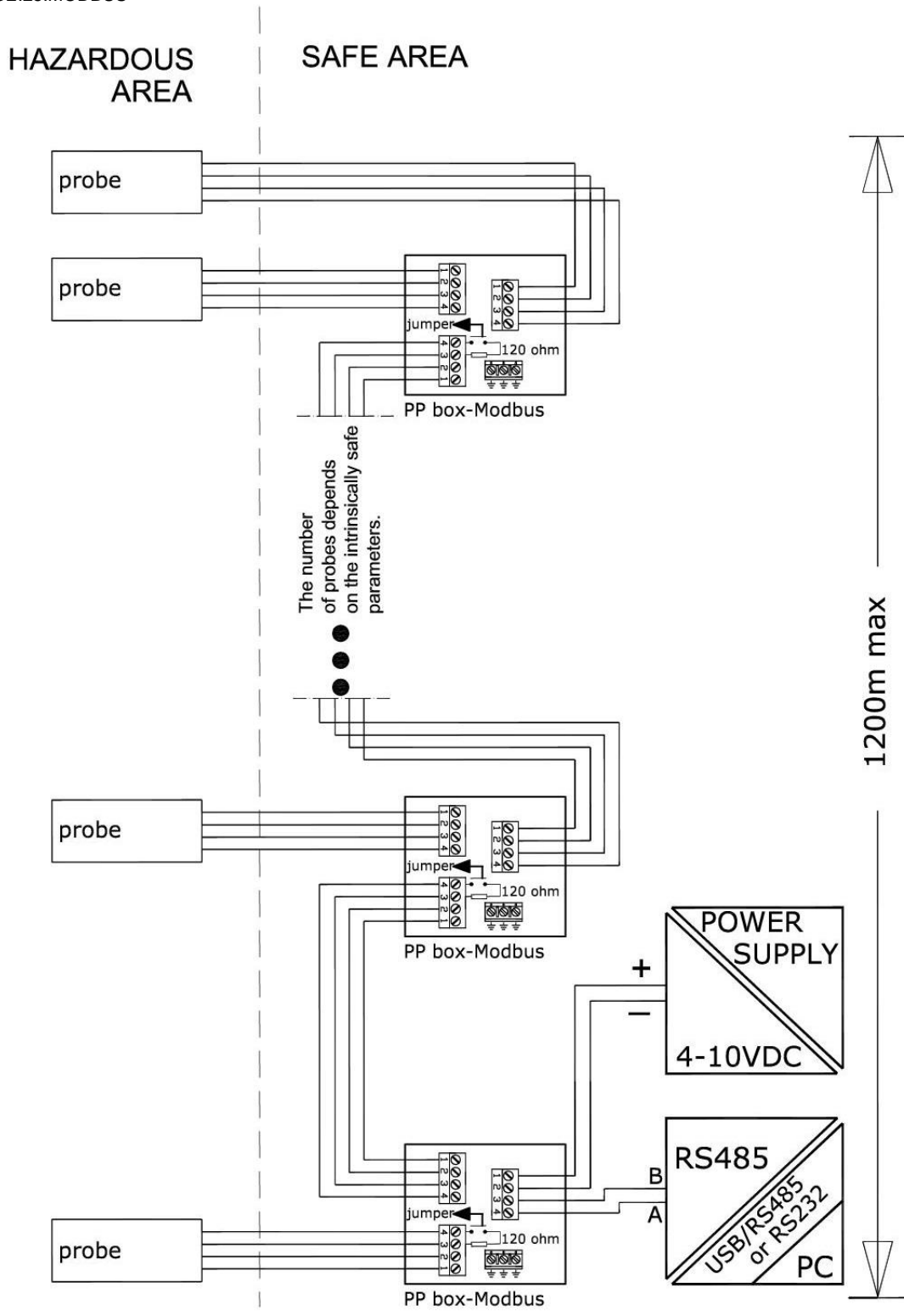


Fig. I.2

5. Special conditions for safe use

1. The probes do not meet the insulation test (500 V rms) required by EN 60079 11:2012. This must be taken into account during installation of the device.
2. For the ambient temperature range – see Table Z1 as well as the information on the probe's rating plate.
3. The process (medium) temperature at the diaphragm must be within the ambient temperature range.