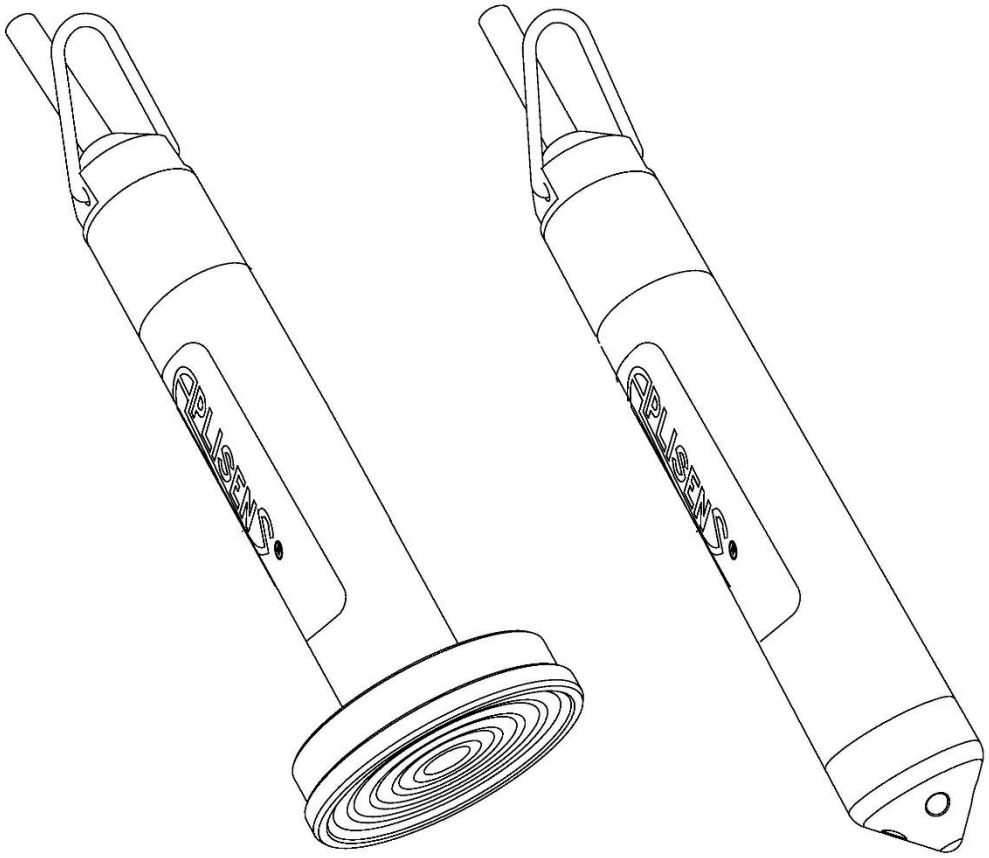
USER'S MANUAL

SMART LEVEL PROBES

SGE-25.Smart, SGE-25S.Smart, SGE-25C.Smart, SGE-25S.Smart/Titan



APLISENS S.A., 03-192 Warsaw, Morelowa 7 St
tel. +48 22 814 07 77; fax +48 22 814 07 78
www.aplisens.com, e-mail: export@aplisens.com

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, declarations of conformity and copies of certificates.

SGE-25.SMART

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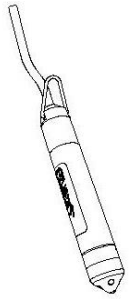

SGE-25.SMART (Exi)

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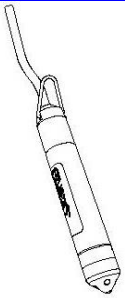

SGE-25S.SMART

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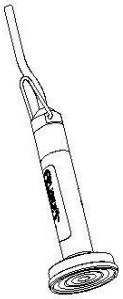

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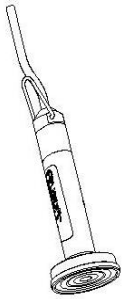

SGE-25C.SMART

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SGE-25C.SMART (Exi)

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SGE-25S.SMART/TITAN

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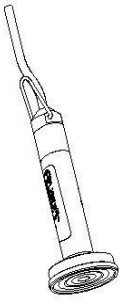

Symbols used

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.

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1. INTRODUCTION

1.1. Purpose of the document

The subject of manual are smart level probes: **SGE-25.Smart, SGE-25S.Smart, SGE-25C.Smart** and **SGE-25S.Smart/Titan** 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.SMART**, **SGE-25S.SMART** and **SGE-25C.SMART** in intrinsically safe version according to ATEX are included in the Explosion-proof Device Manual marked as EN.IX.SG.25.SMART.

1.2. Registered trademarks

HART® is registered trademark of FieldComm Group.
Windows® is registered trademark of Microsoft Corporation.
Google Play® is service registered and operated by Google® Inc.

1.3. Set range

The following figure shows the set range of the probe and the limits associated with the allowable set range, the digital conversion range and the saturation limits of the pressure measurement A/D converter. By default, the LRV/URV points are assigned current values of 4 mA/20 mA. For a reversed characteristic it is possible to reverse the assignment so that the LRV/URV points are assigned current values of 20 mA/4 mA.

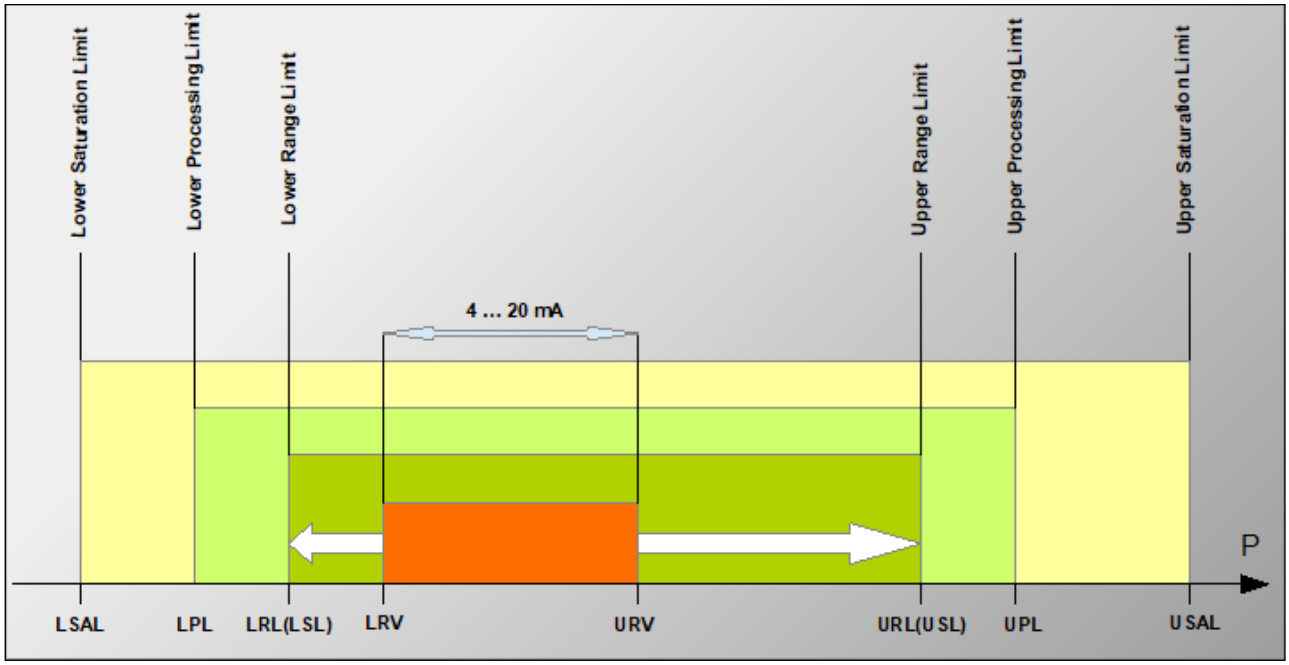

Figure 1. Set range and measurements limits.

1.4. Definition and abbreviations

Table 1. Definition and abbreviations.

L.P.	Abbreviation	Meaning
1	**LRV**	"Lower Range Value" – the value of the set range expressed in physical units corresponding to the current of 4,000 mA, i.e. 0% of the output setpoint. The set range cannot exceed the set range limits. The minimum width of the set range **|(URV-LRV)|** is limited to 10% of the base range **(URL-LRL)**.
2	**URV**	"Upper Range Value" – the value of the set range expressed in physical units corresponding to the current of 20,000 mA, i.e. 100% of the output setpoint. The set range cannot exceed the set range limits. The minimum width of the set range **|(URV-LRV)|** is limited to 10% of the base range **(URL-LRL)**.
3	**LRL** **LSL**	"Lower Range Limit" or "Lower Sensor Limit" - lower limit of set range expressed in physical units. Value **(URL-LRL)** or **(USL-LSL)** is referred to as the base probe range.
4	**URL** **USL**	"Upper Range Limit" or "Upper Sensor Limit" – upper limit of set range expressed in physical units. Value **(URL-LRL)** or **(USL-LSL)** is referred to as the base probe range.
5	**LPL**	"Lower Processing Limit" – lower limit of digital processing of measured value. The probe processes a digital measurement up to 50% of the base range width below the lower limit of set range **LRL (LSL)**. After reaching the **LPL** and when below this value up to **LSAL,** the probe freezes the refreshing of digital value of the measurement.
6	**UPL**	"Upper Processing Limit" – upper limit of digital processing of measured value. The probe processes a digital measurement up to 50% of the base range width above the upper limit of set range **URL (USL)**. After reaching the **UPL** and when above this value up to **USAL**, the probe freezes the refreshing of digital value of the measurement.
7	**LSAL**	"Lower Saturation Limit" - lower limit of the A/D probe processing range. The lower limit of the A/D probe saturation is on the pressure/differential pressure scale below the **LPL** point and is associated with the minimum pressure, at which the analogue-digital pressure measurement probe reaches the lower limit of the processing capacity. The exact determination of this pressure is not possible, however usually the pressure does not exceed the pressure corresponding to 200% of the base range width **(URL-LRL)** below the lower limit of the digital processing of measured **LPL** value.
8	**USAL**	"Upper Saturation Limit" - upper limit of the A/D probe processing range. The upper limit saturation point of A/D probe is on the pressure/differential pressure scale above the **UPL** point and is associated with the maximum pressure at which the analogue-digital pressure measurement probe reaches the upper limit of the processing capacity. The exact determination of this pressure is not possible, however usually the pressure does not exceed the pressure corresponding to 200% of the base range width **(URL-LRL)** above the upper limit of the digital processing of measured **UPL** value.
9	**AL_L**	Low current alarm.
10	**AL_H**	High current alarm.
11	**I_AL**	The alarm current set by the probe controller in the current loop.

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

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.

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 2. Symbols appearing on the probe's.

APLISENS® APLISENS S.A.	Logo and name of manufacturer
CE	CE mark
CE 1453	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
P	Measuring range
U	Power supply voltage
	Output signal
Tamb	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 version

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

Smart level probes are installed where liquid levels are measured in wells, tanks, boreholes, etc. The probe is immersed in the measured medium. The probe is immersed in the measured medium. A special cable extends above the medium level, which can be connected directly to the probe device or to a junction box. The probe may be hung on the supply cable using Aplisens SG cable hanger (item 1 on Fig. 2). In case 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 cable using the carrying eye (item 2 on Fig. 2).

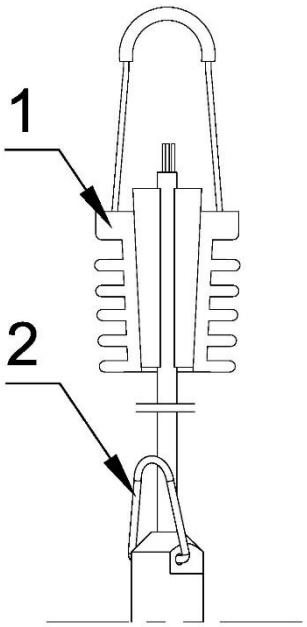

Figure 2. Mounting brackets for probes.

If there is a possibility of turbulence, the probe should be installed in a casing pipe (e.g. PVC).
Do not clean or touch the diaphragm with hard or sharp objects. Hang the probe with the additional Teflon shielding on the cable on the suspension cable or on the inner cable (do not grab the Teflon shield).

Immediately before inserting the probe into the medium to be measured, remove the protective cover from the front membrane (not applicable SGE-25.Smart).

During installation protect the probe from mechanical impacts.

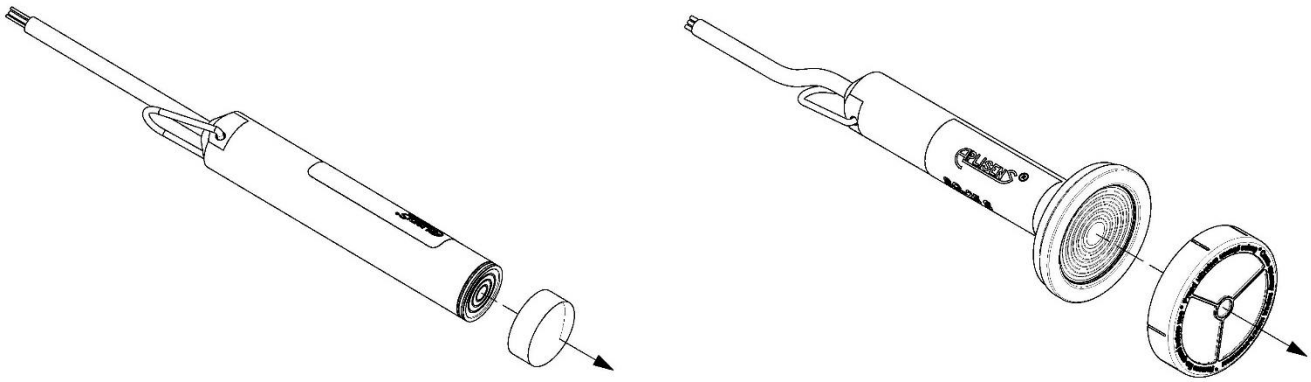

Figure 3. Diaphragm cover for SGE-25C.Smart and SGE-25S.Smart probes.

7. ELECTRICAL CONNECTION

7.1. Cable connection with possibility of local HART communication

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.

Make the electrical connection according to the diagram below. If the transmission line is led in the open air, to distant rooms, it is recommended to assemble a junction box, e.g. PP type manufactured by Aplisens S.A., to connect the probe cable with the further part of the transmission line. The junction box should have IP65 protection grade and at the same time it should be unsealed enough to ensure "breathing" of the probe's measuring element through the capillary tube which is a part of the cable.
Do not allow the outlet of the capillary to get dirty or water to get inside it.
In case of a long transmission line, it is recommended to lead the cable from the end of the probe cable through a "twisted pair", and the input to the cooperating devices should also be equipped with an overvoltage protection device, e.g. Aplisens UZ-2 system.

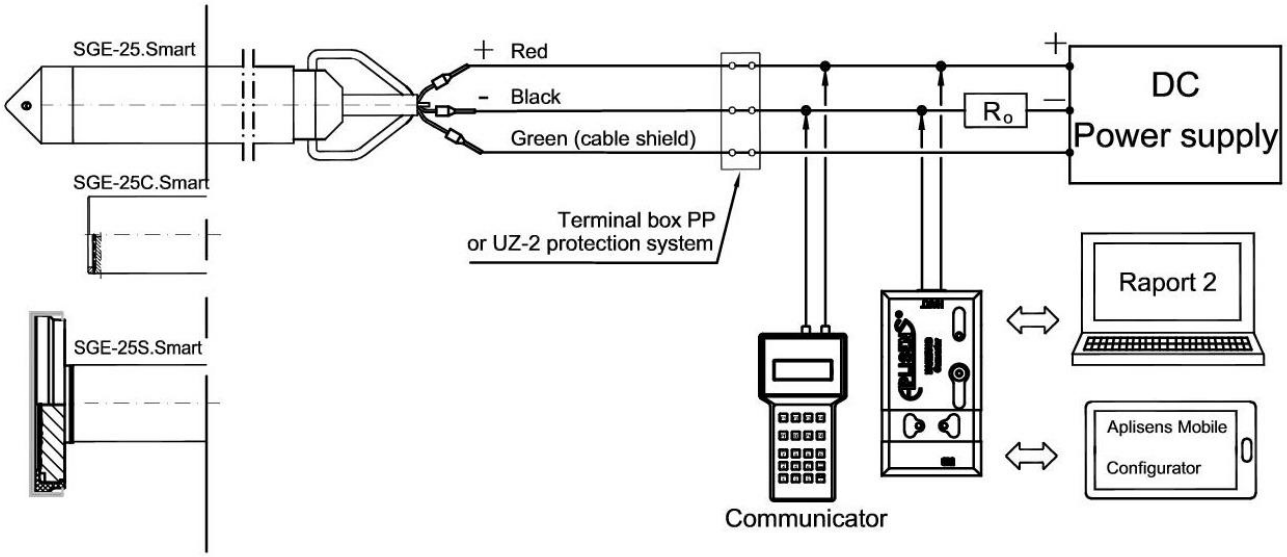

Figure 4. Electrical connection 4…20 mA of probes with HART communication.

The probe enables the use of local HART communication. You can use a communicator or a HART modem that works with a computer or smartphone. Resistance necessary for communication Ro ≥ 240 Ω.

The scheme for connecting the communicator or modem to the power supply and measurement installation is shown in Figure 4.

The Aplisens HART/USB converter can also be supported by the Aplisens Mobile Configurator software installed on an Android smartphone using wireless communication. The software is available on Google Play®:https://play.google.com/store/apps/details?id=com.aplisens.mobile.amc

7.1.1. Level probe with internal temperature sensor PT

Electrical connections and wire colours in the level probe cable with 4...20 mA output signal with resistance temperature sensors:

Level probe:

- red: „+" power supply;
- black: „–„ power supply;
- green: wire shield (if it led out);

Resistance sensor:

- white
- white
- brown
- brown

Sensor in four wire connection;

- white
- brown
- brown

Sensor in three wire connection;

7.2. 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.

Probe type	Output signal	Minimum power supply voltage	Maximum power supply voltage
SGE-25.Smart, SGE-25S.Smart, SGE-25C.Smart, SGE-25S.Smart/Titan	4…20 mA	7,5 V DC	55 V DC 30 V DC*
*For probes in intrinsically safe version Exi (not applicable SGE-25S.Smart/Titan).			

7.2.1. Resistive load in the supply line

Power line resistance, power source resistance and additional series resistances increase the voltage drops between the power source and the probe. The maximum current of the device in normal operation is 20,500 mA, but in high alarm condition the current I_max is 22,000 mA.
The maximum value of resistance in the supply circuit (together with the resistances of the supply wires) is given by the formula:

$$R_{Lmax} = \frac{(U_{zas} - U_{min})}{0{,}0225\ A}$$

Where:
U_{zas} - voltage on terminals of current loop power supply 4…20 mA in [V].
U_{min} – minimum power supply voltage of probe (➔ **Table 3**. Permissible power supply voltage.)
R_{L_MAX} – maximum supply line resistance w [Ω].

Installation in hazardous areas must comply with local standards and regulations.

7.2.2. Shielding

The cable shield (green wire) is led out from the probe's power supply and measurement cable. The manufacturer recommends connecting the probe cable shield to the measuring system grounding point. The earthing of the cable screen is especially justified in the environment of high EMC disturbances. In a battery-assisted piezometric stand, the cable screen may or may not be grounded.

7.3. Overvoltage protection

Probes can be exposed to switching surges, or those resulting from lightning discharges. Protection against surges between the wires of the transmission line is provided by surge diodes.
For protection against overvoltage between the transmission line and the ground or the enclosure (which are not protected by diodes connected between the line conductors), the probes in standard versions and Exi in SA version are equipped with additional protection in the form of surge arresters. For systems with long signal transmission lines, it is recommended the using of an additional Aplisens UZ-2 overvoltage protection circuit.

7.4. Final wiring inspection

After completing the electrical installation of the probe, 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 nameplate;
- that the probe is connected in accordance with the information given in section (➔ Cable connection with possibility of local HART communication)
- if a junction box is used, that the glands are tightened.

8. START-UP

The basic data of the probe can be read from the nameplate of the device (➔ Probe identification).

8.1. Alarm configuration

Smart level probes have developed internal diagnostics that watch over the operation of their electronic circuits, process and environmental parameters. Diagnosed hazardous conditions or internal circuit malfunctions result in an alarm current setting depending on the configuration of I_AL<3,650 mA (nominally 3,600 mA) or I_AL>21,500 mA (nominally 22,000 mA). The user has the option to enable/disable current alarms. By default the current alarms are disabled.
The following figure shows the normal operation ranges of the process output and the saturation and alarm current ranges.

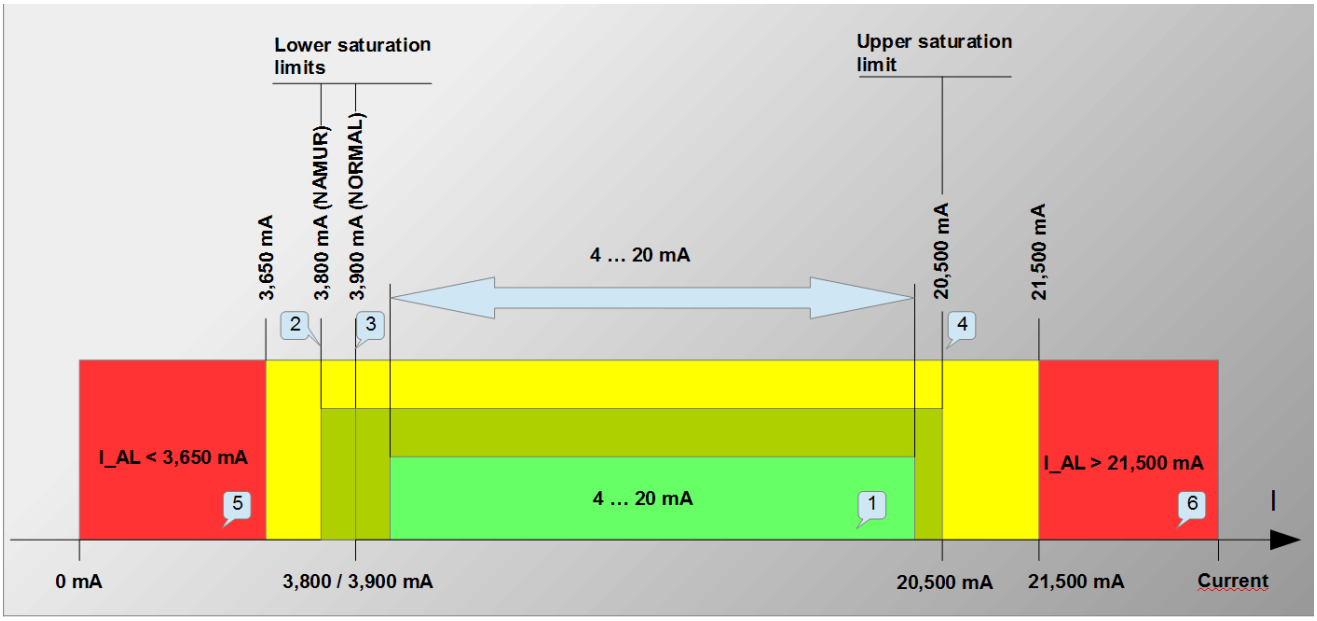

Figure 5. Set range current, saturation currents, alarm currents.

1 – Set current area 4...20 mA corresponding to the 0...100% of the process output.
2 – Lower saturation current 3,800 mA for NAMUR mode.
3 – Lower saturation current 3,900 mA for NORMAL mode.
4 – Upper saturation current 20,500 mA for NAMUR i NORMAL modes.
5 – Alarm current area AL_L<3,650 mA for internal diagnostic alarms.
6 – Alarm current area AL_H>21,500 mA for internal diagnostic alarms.

8.2. Operating mode configuration

The following parameters must be set up before working with the probe:

- Basic unit;
- Processing characteristic;
- Beginning of the LRV set range;
- End of the URV set range URV;
- Damping time constant;
- NORMAL/NAMUR analog operating mode;
- Operation mode of the analog mode in the AL_L/AL_H alarm state;
- Alerting mode of the environmental event and defects;
- Label (TAG/LONG_TAG);
- Setting a lock password to change settings.

8.3. Correction of the impact of working position on the object – reset (zeroing)

It is possible to "zero" the probe, which is used, for example, to compensate for deviations arising from the influence of initial immersion at a level assumed to be "zero".
Probes can also be calibrated by relating their readings to an input pressure controlled by a reference instrument. Zeroing and calibration are collectively called "CALIBRATION".
CONFIGURATION AND CALIBRATION of the probe is performed using the Aplisens KAP communicator, or a PC with HART/RS232 converter and Aplisens "Raport 2" software.
Catalogue cards and operating manuals for HART communication tools (i.e. KAP-03 communicator, KAP-03Ex; HART/USB Converter; "Raport 2" software) are available on the manufacturer's website at www.aplisens.com

9. OPERATION

9.1. Remote configuration of settings (HART)

The probe allows to read and configure parameters via HART communication using a 4...20 mA loop as physical layer for FSK BELL 202 modulation.

9.1.1. Compatible devices

The following devices can cooperate with the probe:

- communicator of Aplisens S.A. company. KAP-03, KAP-03Ex (HART only);
- communicators of other companies using DDL and DTM libraries;
- PC equipped with HART modem (e.g. Aplisens HART/USB converter) with Windows 7 or Windows 10 operating system with installed “Raport 2” software;
- PCs with HART modem using third party software accepting DDL and DTM libraries;
- smartphones with Android system cooperating with a converter enabling wireless communication (e.g. Aplisens HART/USB converter) using Aplisens Mobile Configurator software. The software is available on Google Play under the following link: https://play.google.com/store/apps/details?id=com.aplisens.mobile.amc

9.1.2. Compatible configuration software

- Raport 2 Aplisens compatible with Windows 7 or Windows 10;
- Aplisens Mobile Configurator compatible with Android;
- any third-party software that accepts DDL and DTM libraries.

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.

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.

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 or „zero” calibration;
- replacement of improperly selected/shipped probe.

11. SCRAPING, 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 REVISION

No.	Revision	Changing description
-	E5/01.2020	Updating electrical parameters.
1	E6/05.2020	Editorial changes
2	01.A.001/2021.09	New version of the document. Prepared by DBFD.

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

SMART LEVEL PROBES type:
SGE–25.Smart, SGE–25S.Smart, SGE–25C.Smart
INTRINSICALLY SAFE VERSION

1. Introduction

Explosion-proof Device Manual EN.IX.SGE.25.SMART only applies to smart level probes: SGE–25.Smart, SGE–25S.Smart, SGE–25C.Smart in intrinsically safe version with marking as a point 2 on the nameplate and the Ex version in the Product Certificate. When installing and using probes in Ex version, User's Manual EN.IO.SGE.25.SMART and Explosion-proof Device Manual EN.IX.SGE.25.SMART must be used.

2. Using probes in hazardous area

The probes are produced in accordance with the requirements of the following standards:
EN IEC 60079-0:2018-03+A11:2014-03; EN 50303:2004; EN 60079-11:2012.
The probes may operate in areas where there is a risk of explosion , in accordance with the rating of the explosion protection design:

II 1G Ex ia IIC T4/T5/T6 Ga
II 1G Ex ia IIB T4/T5/T6 Ga (For probe with cable in Teflon shielding or cable with additional Teflon shield)
I M1 Ex ia I Ma
KDB 11ATEX 140X

3. Permissible input parameters (based on data from certificate KDB 11ATEX140X)

- The probes should be powered from co-operating power supply and measuring equipment with relevant intrinsic-safety certificates, whose parameters for output to the danger zone should not exceed the permissible power supply parameters for the probes given in points a) and b).
- Probes in "SA version" should be powered from devices with galvanically separated power supply.
- The probe is an intrinsically safe device with protection level "ia" when the supply circuit has protection level "ia" or an intrinsically safe device with protection level "ib" when the supply circuit has protection level "ib".

a) Permissible input parameters for power supply with linear characteristic:
Ui = 30 V DC; Ii = 0,1 A
b) Permissible input parameters for power supply with trapezoidal and rectangular characteristic:
Ui = 24 V DC; Ii = 0,1 A
Input capacitance and inductance: Ci = 11 nF*; Li = 0,611 mH*
*) Consider the cable capacitance and inductance, which for a permanently connected cable are: Ck= 0.2 nF/m i Lk=1 µH/m.
Input capacity Cw and inductance Lw taking into account the parameters of a permanently connected cable is: Cw = Ci + a x Ck = 11nF + a x 0.2 nF/m; Lw= Li + a x Lk = 0,61 mH + a x 1 µH/m
where: - a - length of the wire permanently installed in the probe in metres.

“Pi” for all types of power supply: see table Z1 below.

Table Z1. Temperature class dependence on ambient temperature Ta and total amount of input power Pi.

Pi [W]	Ta [ºC]	Temperature class
0,75	50	T6
	70	T5
	80	T4, group I
1,2	40	T6
	65	T5
	80	T4, group I
Ta- ambient temperature (measured medium)		

4. Connection of probes in Ex version

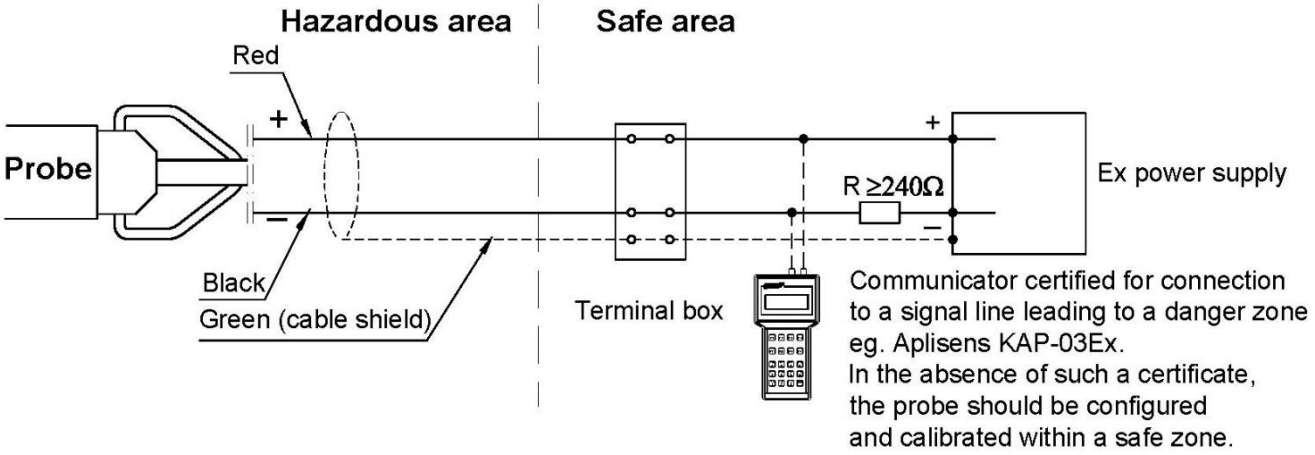

Figure 1.Ex. Connection for SGE-25.Smart, SGE-25S.Smart, SGE-25C.Smart probes in Ex version.

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 follow these rules can lead to an explosion and danger to people.

No repairs or other interference with the electrical system of the probe are allowed.
Damage assessment and possible repair can be done only by the manufacturer or a unit authorized by him.

5. Special conditions for safe use

Probes in the surge arrester version that are labelled as "SA version", do not meet the insulation test (500 V rms) required by EN 60079-11:2012. This must be taken into account when installing the device.