Base Load Power Hub (BLPH)

PT, PDT, TT, LT RADAR

INSTALLATION, OPERATION AND MAINTENANCE MANUAL

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ROSETTI MARINO

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OPERATING and MAINTENANCE MANUAL for SST77B DIFFERENTIAL PRESSURE TRANSMITTERS

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Phone: +39 0377 919119 – Fax: +39 0377 855720 - VAT IT07848810151

SST77B DIFFERENTIAL PRESSURE TRANSMITTER



ORIGINAL INSTRUCTIONS

SPRIANO® TECHNOLOGIES

CE 1354

EU Declaration of Conformity

TERRANOVA® Srl

Via Gramsci 1 – 26827 Terranova dei Passerini (LO) – Italy
declares on his sole responsibility that the product:

SPRIANO® Electronic Transmitters series

SST70, SST71, SST72, SST75, SST76, SST77B, SST77BL, SST79B, SST70-REM

(device controlling or regulating the limits of an industrial process, like pressure, level and vacuum)
satisfies the essential requirements and conformity assessment procedures of the following legislation:

Directive 2014/34/EU (ATEX)

EU TYPE CERTIFICATE: TI 17 ATEX 304 X

Equipment for use in potentially explosive atmospheres, suitable for Zones 0, 1, 2 (process side and external side)



II 1/2G Ex db IIC T6 Ga/Gb for use in the ambient temperature range –40°C to 60°C
II 1/2G Ex db IIC T5 Ga/Gb for use in the ambient temperature range –40°C to 80°C

Presumption of conformity provided by the application of the harmonised standards:
EN 60079-0:2012+A11:2013 - EN 60079-1:2014

The Notified Body NB 1354 Technicka inspekcia a.s. performed Module D, Annex IV, Directive 2014/34/EU and issued the Production Quality Assurance Notification. Periodical Surveillance is provided according to Annex IV, Point 4, Directive 2014/34/EU by the same Notified Body.

Directive 2014/68/EU (PED)

EU DESIGN EXAMINATION CERTIFICATE: 1292/1/2017-2÷8

Pressure equipment, up to Category IV, for fluids (gases, liquids and vapours) in Group 1.

Conformity provided by the application of the harmonised standard:
EN 13445-1:2015, EN 13445-2:2015, EN 13445-5:2015

The Notified Body NB 1354 Technicka inspekcia a.s. performed Module H1, Directive 2014/68/EU and issued the Production Examination Certificate. Periodical Surveillance is provided according to Directive 2014/68/EU by the same Notified Body.

Directive 2014/30/EU (EMC)

Equipment with an adequate level of electromagnetic compatibility.

Presumption of conformity provided by the application of the harmonised standard:
EN 61326-1:2006

Terranova dei Passerini, 04/08/2017

Mr Sergio Valletti,
General Manager

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WARNING!
Exclusively follow the instructions indicated in this document. Failure to comply with this document may cause injury to health or may damage the equipment.

SPRIANO® TECHNOLOGIES do not takes any kind of responsibility for damages due to failure to comply with this document.

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1 → INTRODUCTION

1.1 → PRODUCT OVERVIEW

Electronic transmitters series SST7X are apparatus which use a piezoresistive sensor for pressure, level and temperature measurement and transmit a current signal (4 ÷ 20mA) proportional to the variable measured. The series SST7X is composed by the following types:

SST77B	Differential pressure transmitter
SST70	Displacer level transmitter
SST71	Smart Float Level Transmitter
SST72	Electronic temperature transmitter
SST75	Absolute or relative pressure transmitter
SST76	Absolute or relative pressure transmitter with diaphragm
SST77BL	Level transmitter
SST79B	Immersion level transmitter
SST70-REM	4÷20mA loop powered field digital indicators (External local indicator)



MANDATORY!
The accessories used for the cable entries and to close unused shall be certificated according to the standards EN 60079-0 and EN 60079-1 for the gas groups IIC or IIB, according to the type of protection implemented.

1.2 → ATTENTION!

This manual does not contain information concerning all type of Transmitter or all different installation and/or working and mounting solutions. For more information or for particular problems not considered in this manual, please address to our technical office.
The warranty period is the one contemplated in our general servicing conditions. This warranty is neither increased nor restricted by the contents of this manual.
This Transmitter has to be installed and used only by qualified persons who have first checked the correctness of supply voltage so that both in standard working conditions and in presence of damages of the plant or of any part of it, no dangerous voltage can reach the Transmitter. As the Transmitter can be utilized both with high pressure values and with aggressive media it must be considered that an incorrect use of it could bring even serious damages to people and things. A correct and safe working needs an adequate transport, stock and mounting other than an appropriate maintenance service. So it is necessary for the people handling these Transmitter to have knowledge and experience in mounting, servicing and working and to have title to do their job with reference to “Safety Standards“.

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1.3 → DEFINITIONS AND SYMBOLS

In this manual are used the following symbols and labels:

	Equipment for use in potentially explosive atmospheres
II 1/2G	Equipment Group II Category 1/2G, suitable for potentially explosive area (gases, vapours or mists); to be installed in a separation wall between Zone 0 (process side) and Zone 1 (external side)
Ex d	Device with Explosion Proof Enclosure
IIC	Group IIC apparatus, fit for substances of group IIC, IIB and IIA (only when used in the ambient temperature range –40°C to 60°C)
IIB	Group IIB apparatus, fit for substances of group IIB and IIA (when used in the ambient temperature range –40°C to 80°C)
T6, T5	Temperature Class of the transmitter (maximum surface temperature) ➢ only when used in the ambient temperature range –40°C to 60°C ➢ only when used in the ambient temperature range –40°C to 80°C
Ga/Gb	Equipment to be installed in the boundary wall between an area requiring EPL Ga and the less hazardous area



WARNING!
Warning label, used to warn about hazardous materials, locations, or objects, including electric currents, poisons, and other things.



PROHIBITION!
Prohibition label, used to indicate something is not permitted.



MANDATORY!
Mandatory label, used to set obligation tasks to be performed by the user.



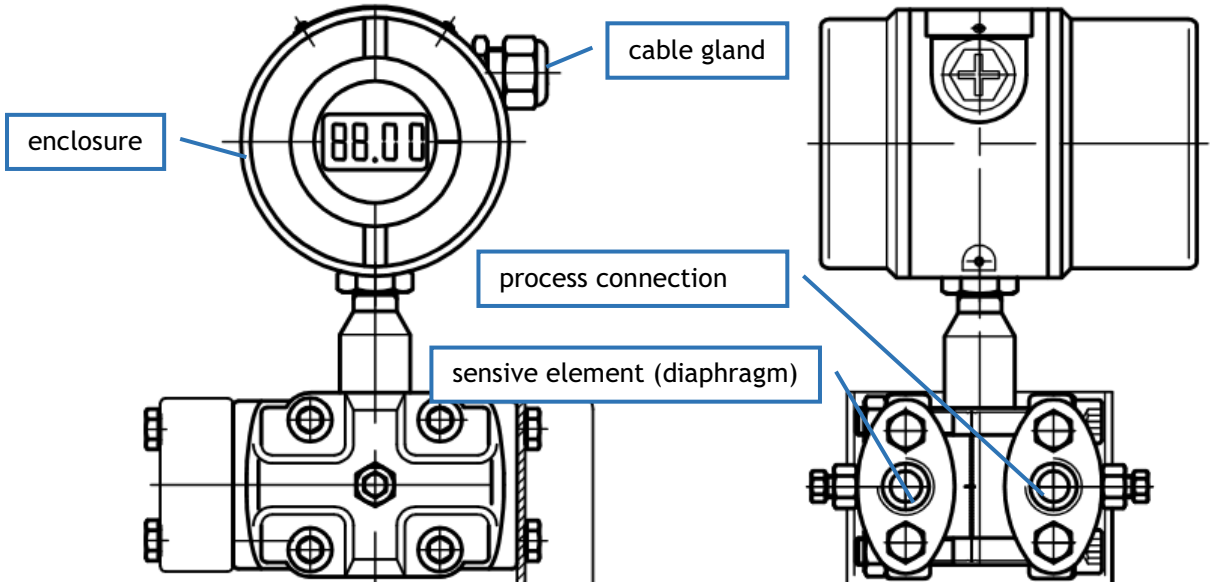
INFORMATION!
Information label, used to set general information for the user or warn about hazards for the equipment.

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2 → DESCRIPTION

SST77B series SMART differential pressure transmitters are microprocessor-based instruments that combine the analog signal advantages (4 - 20mA) together with the flexibility of digital communication using HART® protocol. They can be remotely configured by a universal hand held terminal (HHT) or by a PC with a dedicated interface.
Moreover, it is possible to locally configure the instruments (zero and span) by means of 4 push buttons and to display the data on the wide LCD display. The SST77B transmitters measure differential pressure with spans from 1,2 to 20000 mbar with a static pressure up to 200 bar. The pressure measuring element is a piezoresistive sensor. It is possible to choose a variety of sensors to satisfy all process conditions.
The **SPRIANO®** measuring cell contains the sensor and transmits pressure to the electronics. Thermal drift is compensated using the temperature signal generated by a PTC thermistor integrated in the sensor itself. Based on these readings the microprocessor generates the 4-20 mA analog output two wires system and displays the pressure measurement on the LCD.
Some of the main characteristics of this microprocessor-based transmitter, are:

- Wide rangeability;
- Automatic temperature compensation;
- Digital communication using HART® protocol.



NOM RANGE [mbar]	SPAN MIN/MAX [mbar]	RANGE LIMITS MIN/MAX [mbar]
0/18	1.2 / 36	-18 / +18
0/50	3.3 / 100	-50 / +50
0/350	23.3 / 700	-350 / +350
0/1000	66.7 / 2000	-1000 / +1000
0/2500	166.7 / 5000	-2500 / +2500
0/5000	333.3 / 10000	-5000 / +5000
0/10000	666.7 / 20000	-10000 / +10000
NOTE: Whenever an adjustment <10bar would be necessary, check if it is possible to do and create the atmospheric reference with a dedicated tube passing inside the supply cable.		

Figure 1: differential pressure transmitter SST77B

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3 → INSTALLATION

3.1 → TRANSMITTER IDENTIFICATION

Transmitter data can be found on the nameplate fixed on the top of transmitter enclosure (see 6 → MARKING). The Serial Number must be quoted at the occurrence of a specific request to the manufacturer.

3.2 → GENERAL MOUNTING REQUIREMENTS

Prior installation shall be observed following considerations:

- Check whether Transmitter's operating conditions are within the limits as reported in the nameplate, technical specifications sheets and/or label.
- Make sure that the operating conditions are compatible with the specification given to the manufacturer.



MANDATORY!

- For measurement in the presence of particularly hot liquids (e.g. steam) make sure that the Transmitter is supplied with a suitable finned arm.
- For viscous liquids or those containing solid particles in suspension make sure that the connection to the process is a suitable one in order to avoid clogs.



WARNING!

Direct sunlight may cause serious damages to the instrument.
Never install standard Transmitter under the sun or in any other location which could cause direct overheating through radiation.

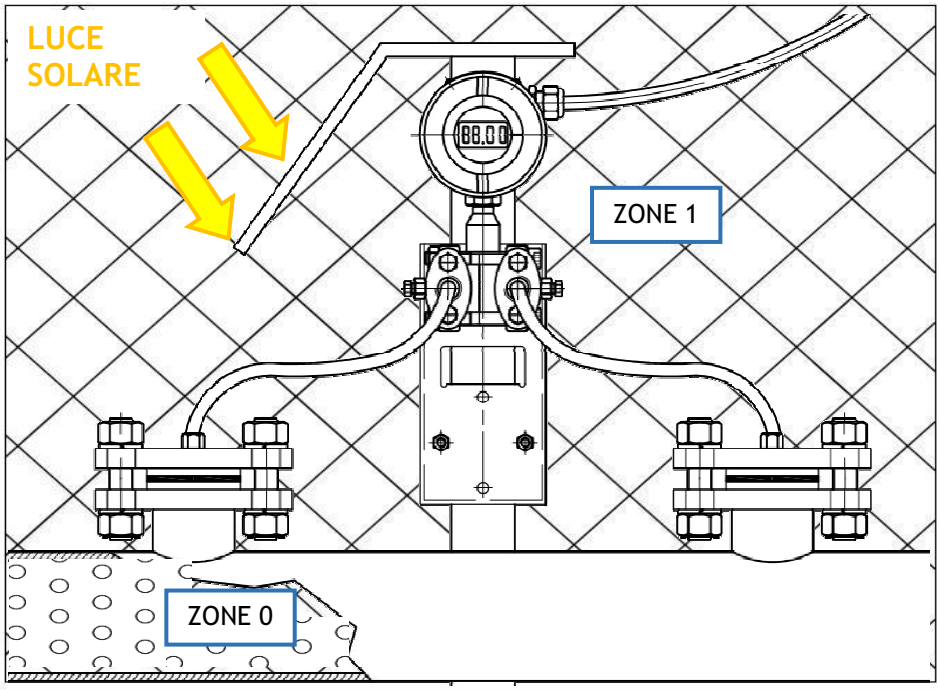


Figure 2: mounting requirements

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3.3 → MECHANICAL INSTALLATION

The Transmitter should be located, if possible, at some easily accessible, well lighted place on the vessel or pipe, in order to allow putting in operations and maintenance work. Location should also be such that ambient temperature at the Transmitter enclosure be not excessive (see 6 → MARKING).

INFORMATION!
- Plant overpressure / over-temperature: observe rating plate
- Installation on seismic areas: inform technical department
- In case of unstable fluids: inform technical department
- In case of damages: inform technical department
- Inspection frequency: consideration should be given to applicable national legislation.

WARNING!
- The process connection must be realized in such a way that guarantees the hold at the maximum working pressure and temperature.
- Do not overcome the maximum pressure and temperatures indicated in the technical data sheet of the selected model.
- When the device is connected to the process it can be submitted to high pressures and temperatures. To avoid accidents subsequent to sudden discharge of pressure and/or to contact with dangerous or flammable fluids it is necessary to take the maximum attention when the Transmitter is taken off, heated or repaired, verifying that it is isolated from the process and is not submitted to pressure and/or temperature.

3.4 → INSTALLATION FOR RELATIVE PRESSURE MEASUREMENT

The transmitters SST77B may be used for relative pressure measurements or level measurements in tanks or piping. In **Figure 3** the simplest mounting, direct on piping, is illustrated.

WARNING!
- Remember to introduce always a security valve in order to put in maintenance operations when necessary.
- When the connections are located on a vertical process line, the flow should be upward.

INFORMATION!
Figure 3, **Figure 4**, **Figure 5** and **Figure 6** show some of the installations recommended by ISO 2186 Standards. Refer to this Standard for more information.

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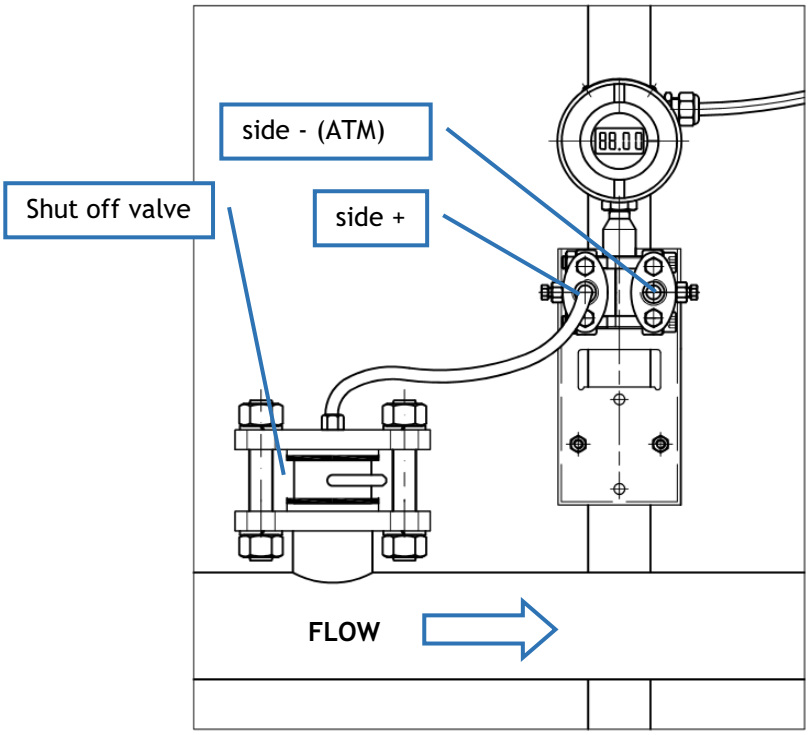


Figure 3: relative pressure measurements in piping lines

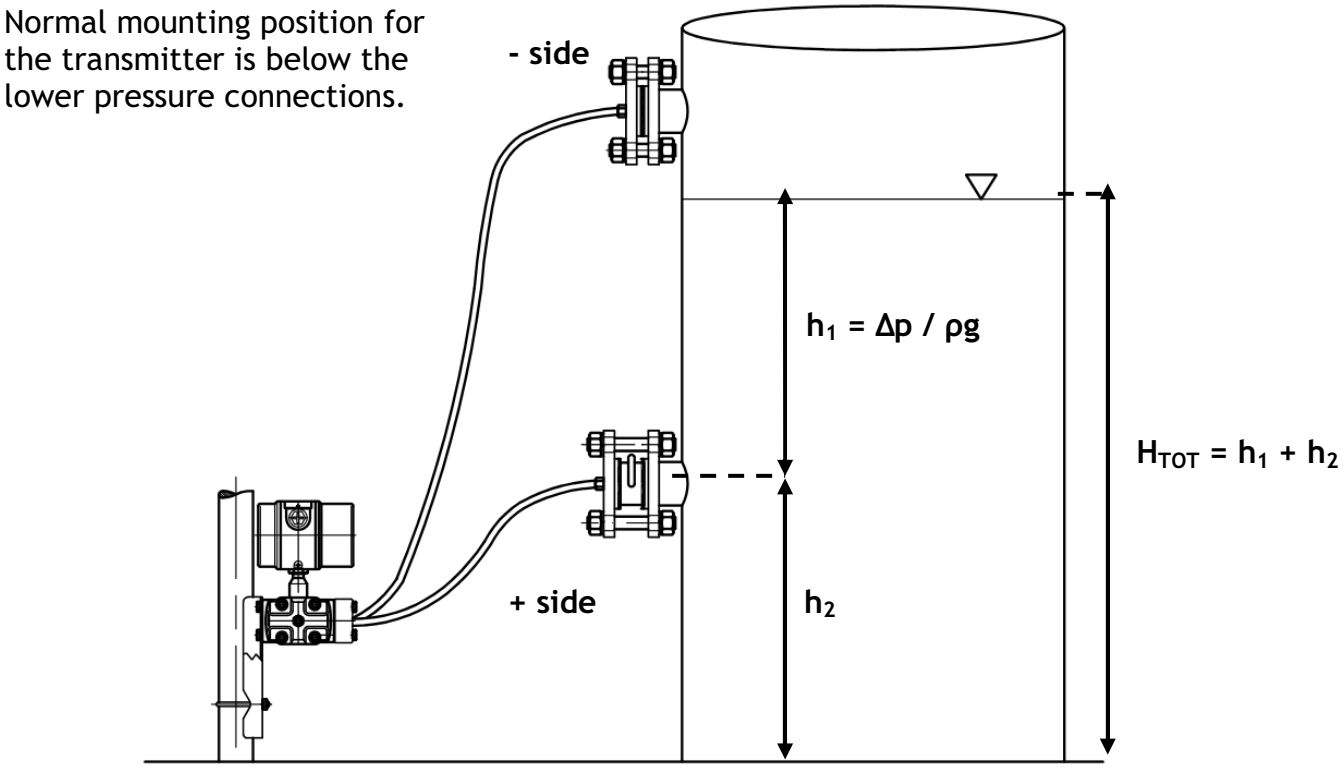


Figure 4: level measurements in open vessels

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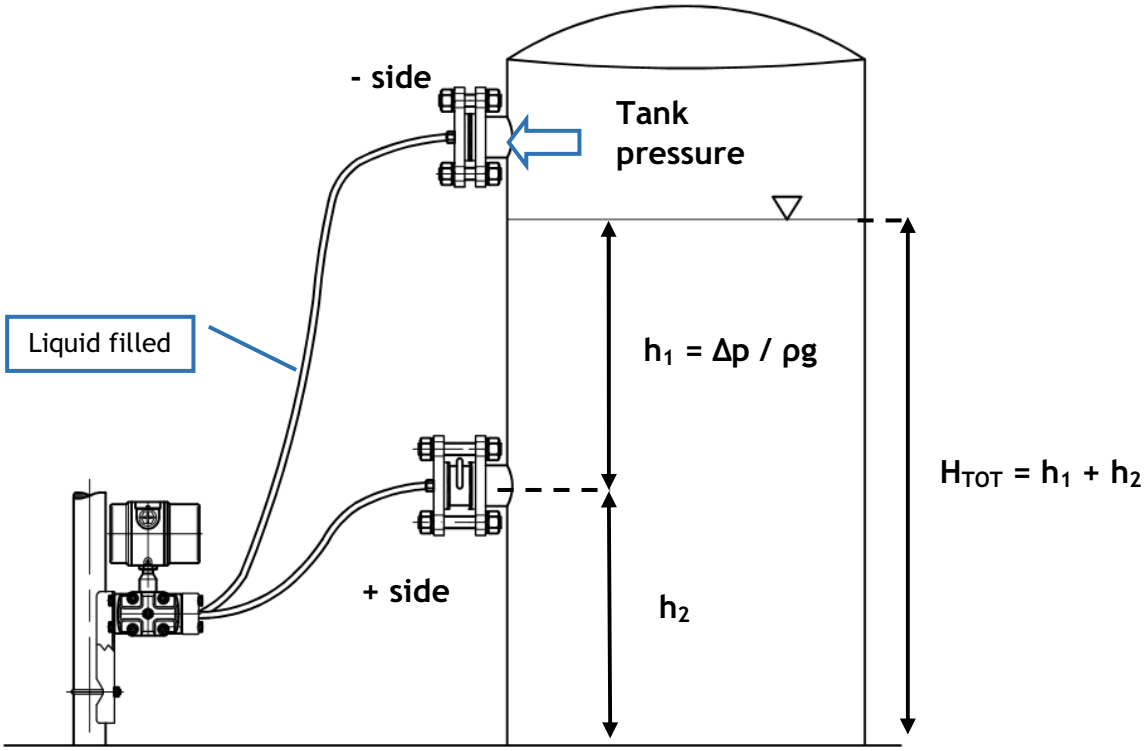


Figure 5: level measurements in closed vessels with corrosive vapors

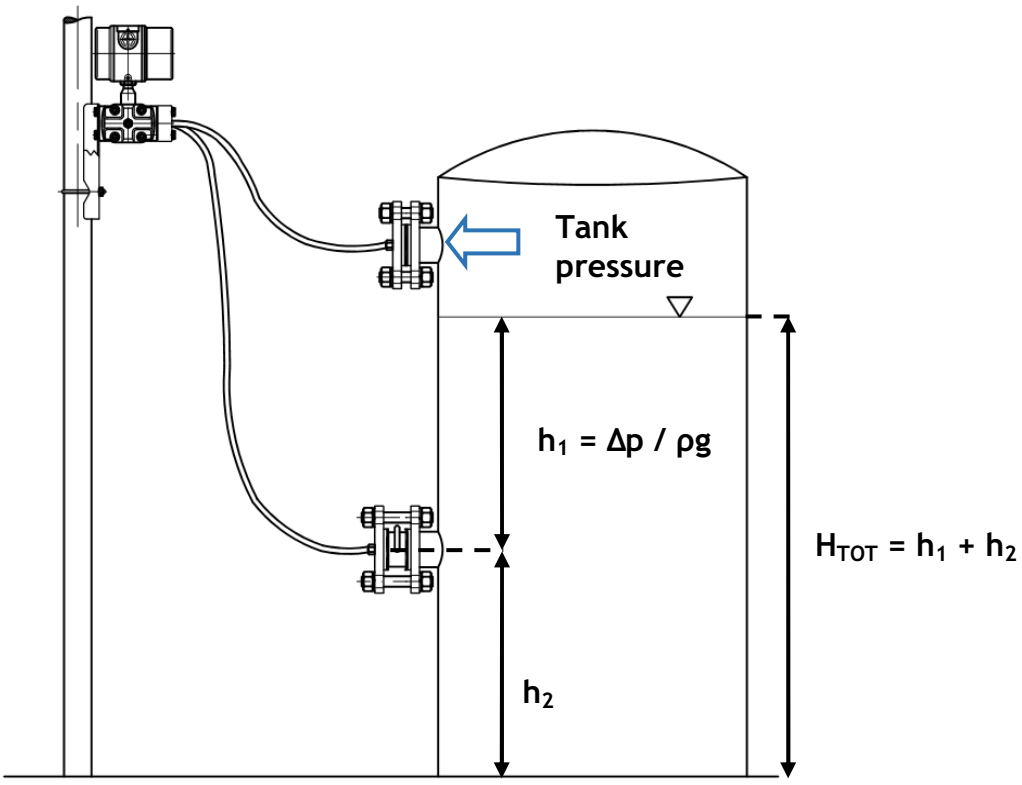


Figure 6: level measurements in closed vessels with dry and clean vapors

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INFORMATION!
- Referring to **Figure 5**: the descending pipes can be filled with condensate vapors of the process fluid or with suitable inert liquid to prevent direct contact with the transmitter diaphragm.
- Referring to **Figure 6**: the transmitter can be mounted above the process connections only when in service with dry and clean gas vapors without seal liquid.

MANDATORY!
- Pressure connections on model SST77 are marked with "H" ("+") and "L" ("-"); the higher pressure will be applied to "+" side.
- Always check carefully all manifolds, reducers if any, vents and drain plugs for leaks.

3.5 → INSTALLATION FOR DIFFERENTIAL PRESSURE MEASUREMENT

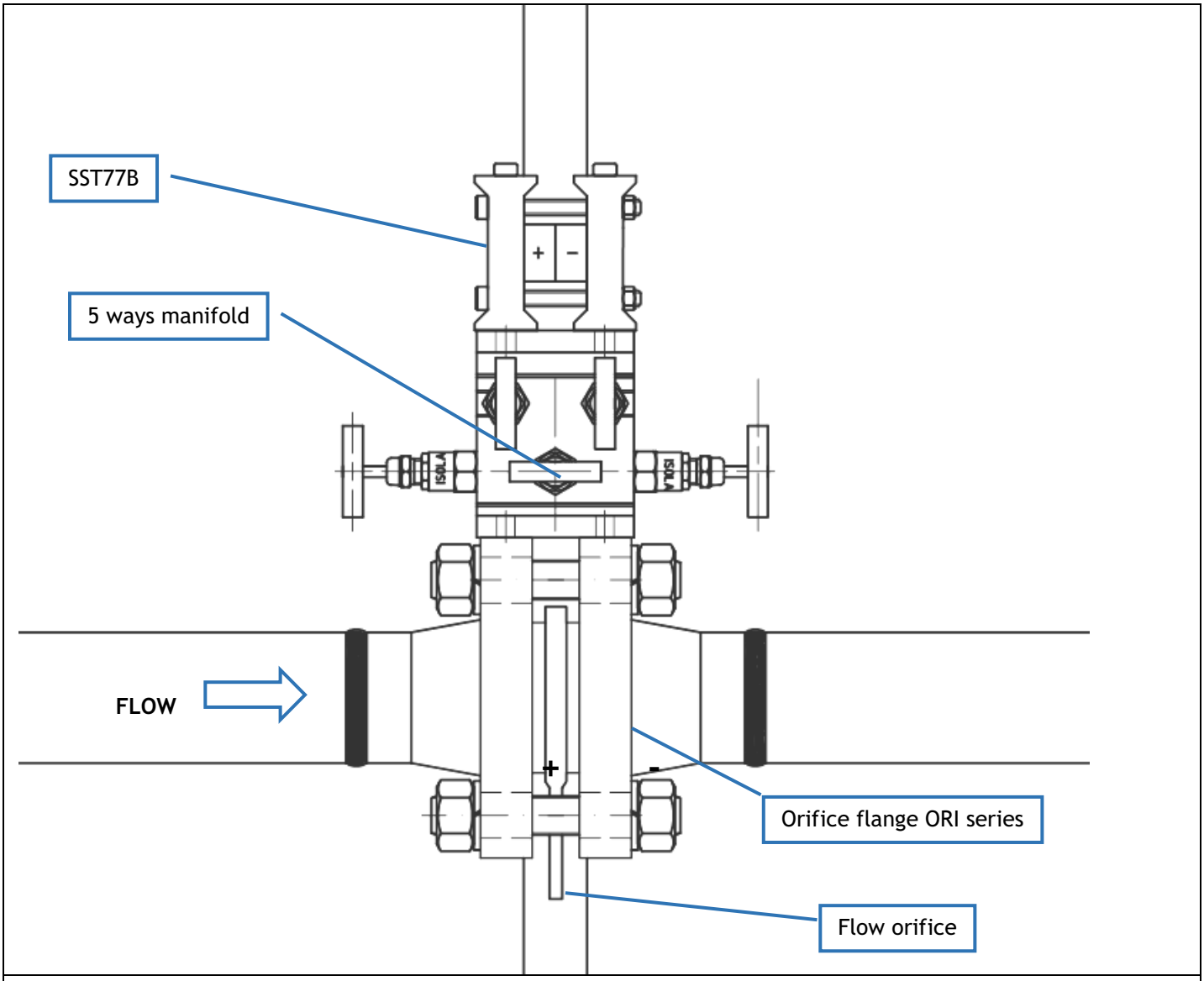


Figure 7: differential pressure measurements in piping

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MANDATORY!
- Always check carefully all manifolds, reducers if any, vents and drain plugs for leaks.

3.6 → ELECTRONIC HEAD ORIENTATION

In order to rotate the electronic head in the desired position you must follow these passages (**Figure 8**):

- unscrew the nut (A) with key CH.24;
- by hand gently rotate the enclosure (B) in the desired position;
- once the desired position is reached fix the nut (A) again with the same key.

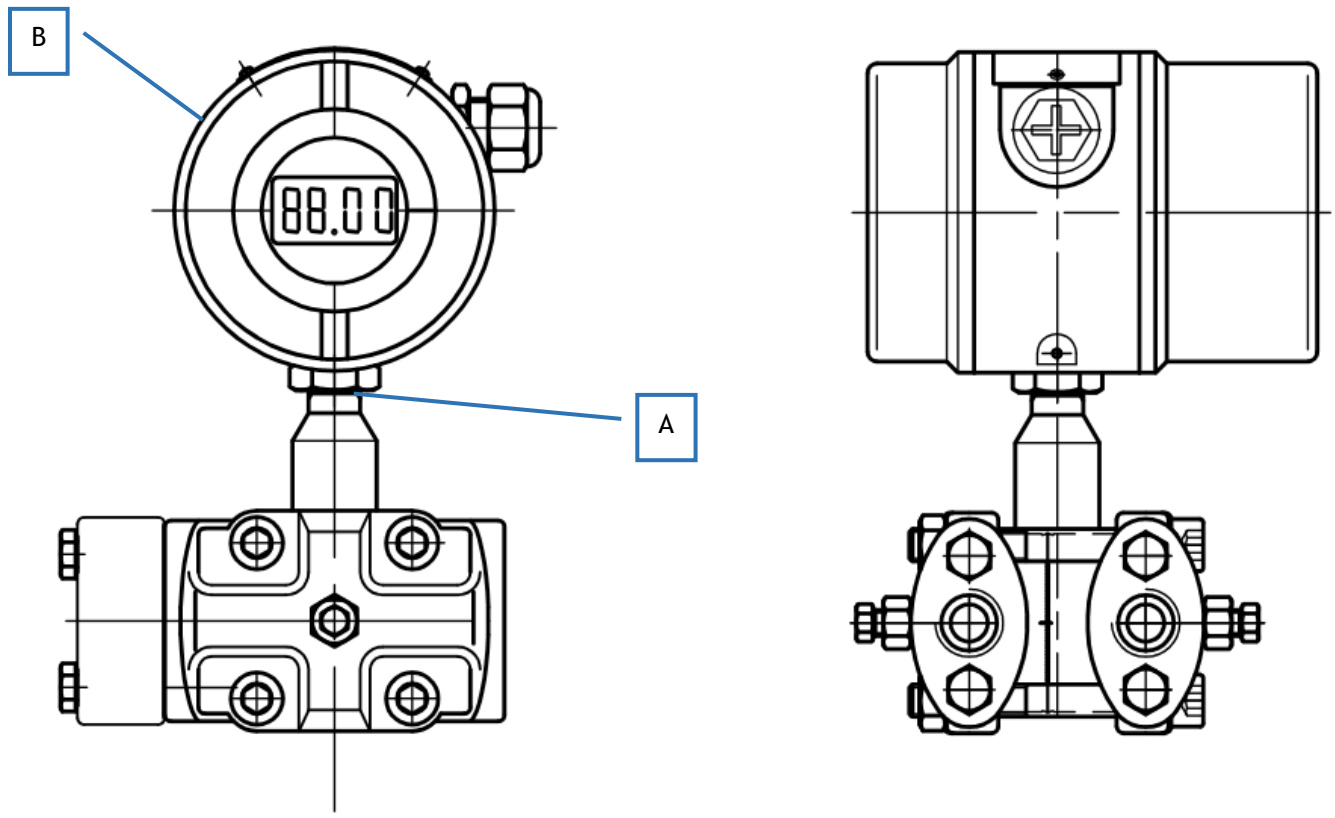


Figure 8: Rotating The Transmitter Head

INFORMATION!
It is not necessary to turn off the supply.

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3.7 → ELECTRICAL CONNECTION

Under the rear cap are placed the terminals reporting the electric polarity (**Figure 9**).
Insert the power supply cable into the enclosure through one of the two threaded openings. Transmitter is protected from accidental inversion of polarity. For a better use is recommended a twisted pair cable (22 AWG min). Avoid placing Transmitter near devices powered in AC or Switching. Connect ground-tap of the Transmitter to the local common earth (PE) as indicated in paragraph → Earthing.

WARNING!
The threaded opening that is not used must be sealed using a suitable cap. The caps included in the delivery are only for protection during transport.

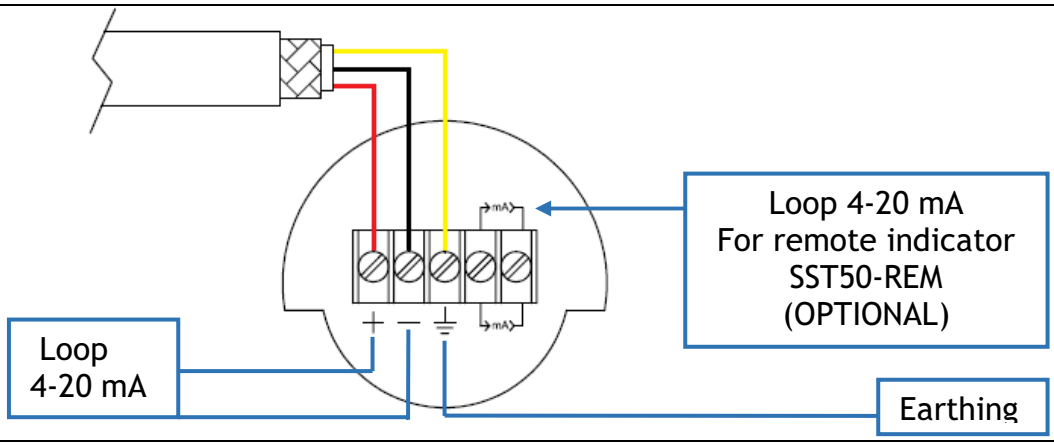


Figure 9: electrical connection of the power cable to the terminal block

INFORMATION!
Impedance of the cables defines the possible maximum length for digital communication. It's recommended using cable with a low impedance. The maximum length of the point to point connection, with a load of 250 ohm and single twisted cable 22 AWG-207 pF/m it's about 1000 meters.
The maximum connection length for the analog signal only is limited by the loads (connected devices and cable) present in the current loop.

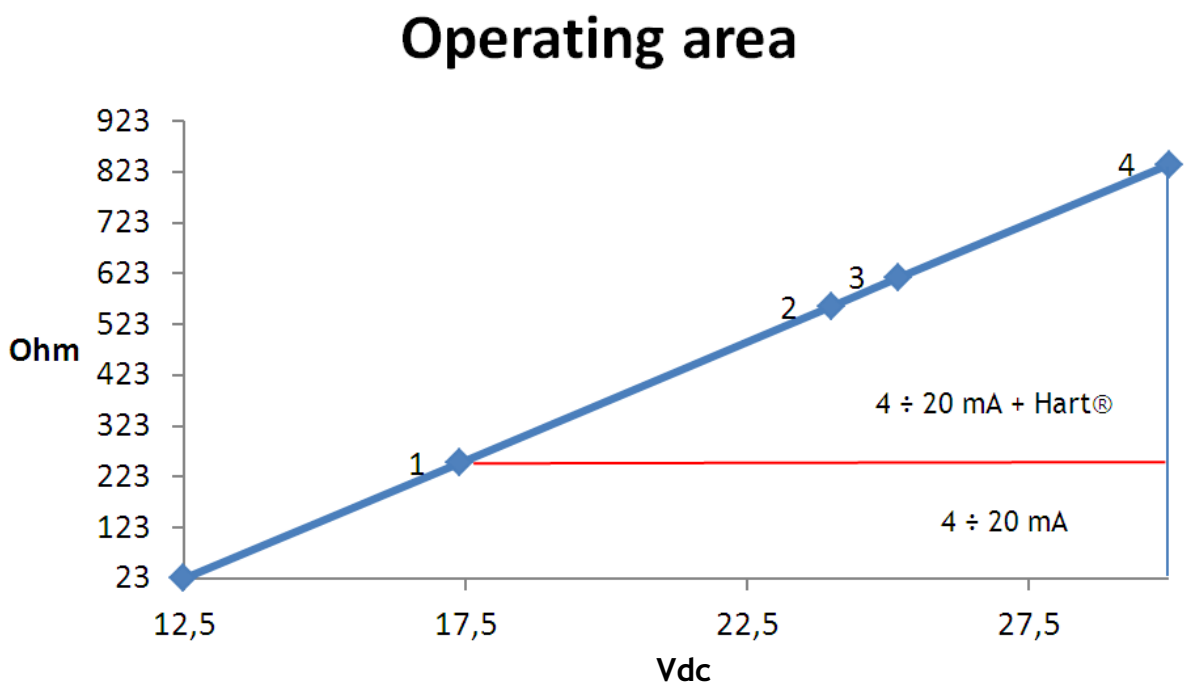
To obtain output signal of 4-20 mA, you have to determine the minimum supply voltage as a function of the load relation: see **Figure 10**. From the following formula you can achieve the right minimum value of supply voltage:

$$V_{dc} = 0.0215 \times R_L + 12$$

Where: R_L = output load [Ohm].
The power supply source must assure a minimum current value of 24 mA.

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MANDATORY!
In order to obtain a 4÷20 mA + Hart® output a minimum load of 250 Ohm is required.



TAG	-	1	2	3	4
Vcc	12.5	17.4	24	25.2	30
Ohm	23	250	558	615	837

Figure 10: operating area for Ex d protection

The electronic transmitters series SST77B are fully comply with the HART® protocol specification Revision 6.0, so they include remote process variable interrogation, parameter setting and diagnostics. The device is a 4÷20mA 2-wire transmitter, with FSK communication.
It is possible to read via HART® the following variables:

- **PV**: transmitter main measure;
- **SV**: % of the span;
- **TV**: analog output;
- **FV**: sensor temperature.

Please refer to **Figure 11** for the Hart® modem connection on transmitter's 4÷20mA loop.
In **Figure 12** the multidrop connection type is shown.
It is possible to purchase the Hart Server as an additional product; this is a software including all the interrogation, configuration and diagnostics functions required by the Hart® specifications.

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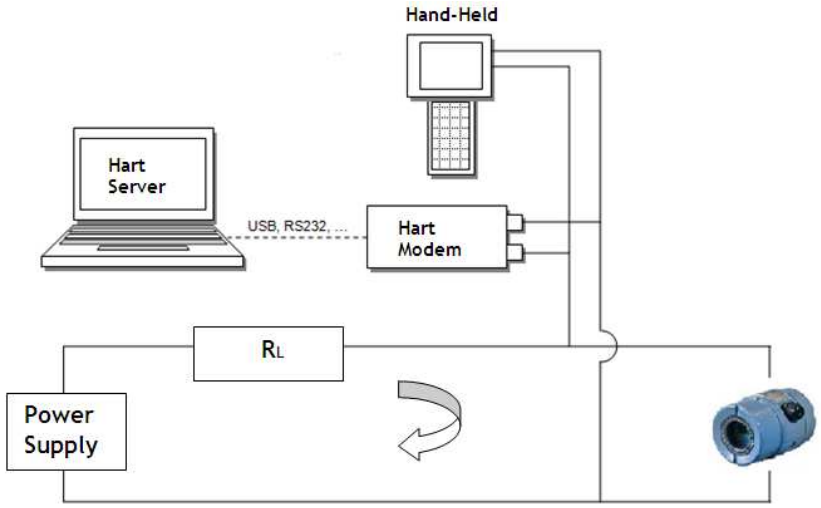


Figure 11: 4÷20 mA + Hart® modem connection

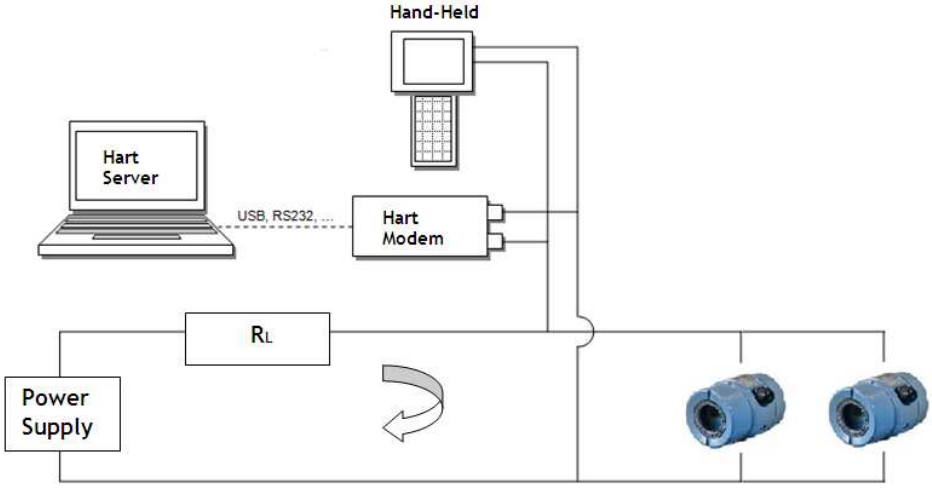


Figure 12: Only HART® multidrop connection

INFORMATION!
At maximum 15 transmitters could be connected in parallel on the same line.
Attention: when more transmitters are connected on the same line the current standing on the resistor (250 Ω) is equal to

4mA x N of connected instruments.

This could cause a high electric potential. Be sure power supply is sufficient.

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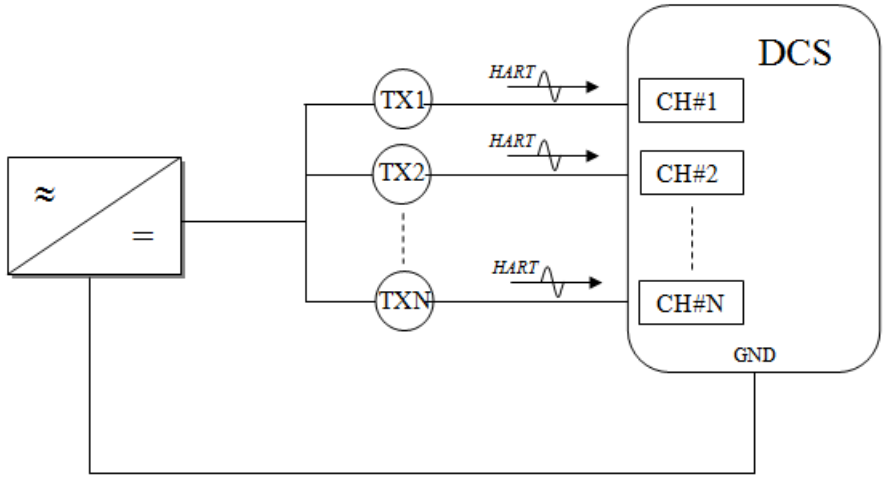


Figure 13: DCS connection

MANDATORY!
Transmitter response time is <256ms.
DCS POLLING time must be set approximately at 800ms in order to avoid updating problems both in analog and digital measurement.
On request the transmitter can be supplied in order to support a Polling time of 500ms but with a minimal consumption of 5 mA.

3.8 → EXPLOSION PROOF PROTECTION

In case of use in areas with danger of explosion, it must be verified that the identified type of transmitter fits for the classification of the zone and for the presence of flammable substances in the plant (see 6 → MARKING).
The safety essential requisite against the risk of explosion in the classified areas are fixed from the European Directives 2014/34/EU of 26 February 2014 (as far as it concerns the 'Equipment') and 1999/92/EC of December 16th 1999 (as far as it concerns the 'Working Environment').

WARNING!
For the electrical connections please follow the instructions brought in this operator manuals taking care that for the use in classified areas it is necessary to foresee the standard EN 60079-14.
The accessories for cable entry (which must be threaded ½" NPT) must be certified following the Standards EN 60079-Series (for Tamb >70°C must be certified for T > 90°C).

PROHIBITION!
Do not open the covers or any part of the device in dangerous area when circuit alive.
For explosion proof safety installation, it is mandatory to disconnect the electric supply before opening the device.

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3.9 → EARTHING

WARNING!
The earth connection is required to prevent damage to people and malfunction of the instrument.

- **Case 1: Installing the instrument in a plant devoid of earthing systems**

In the case where the plant devoid of earthing, it is necessary to connect the earth wire to the terminal block through the cable that carries the signal and the power supply (**Figure 9**).

- **Case 2: Installing the instrument in a plant provided with earthing systems**

Make sure the earthing (GND) of the system has the least resistance possible.
You can add an additional earth wire with section not less than 4 mm^2 to ensure such connection.

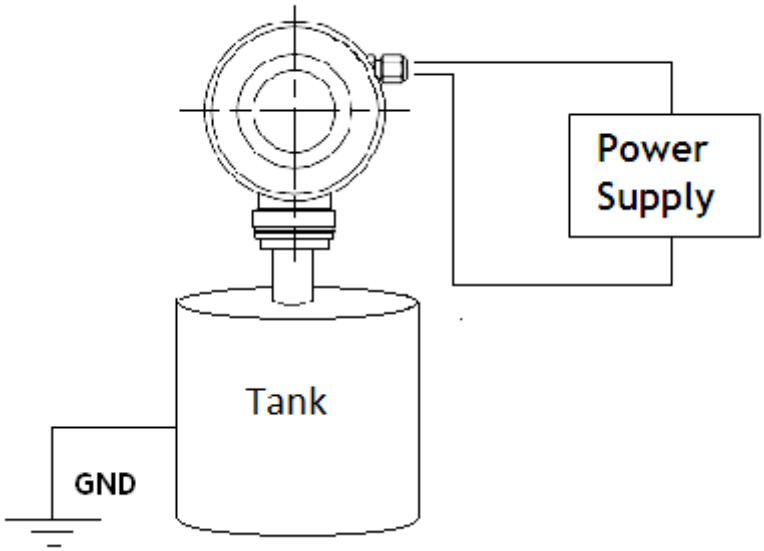


Figure 14: 4 ÷ 20 mA loop connection with plant provided with earthing systems

WARNING!
In the case represented in **Figure 15**, within the earth wire may also scroll through the current protection of other instruments where the earthing of the system (GND) had not been carried out in an optimal manner.

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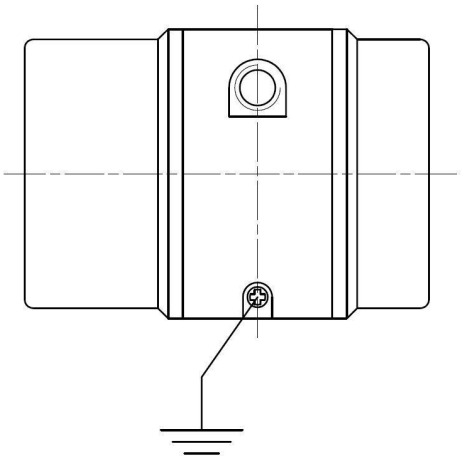


Figure 15: earthing in the housing

WARNING!
The hose must not be considered as a protection against electric shock for the protection of security, but as protection against electromagnetic interference of the instrument. Therefore, in the case of long distance cable (L> 20 m), both ends of the braid must be connected to the chassis or to the connectors. In the case of cables L <20 meters, will be sufficient to connect the braid only from the side "Power Supply".

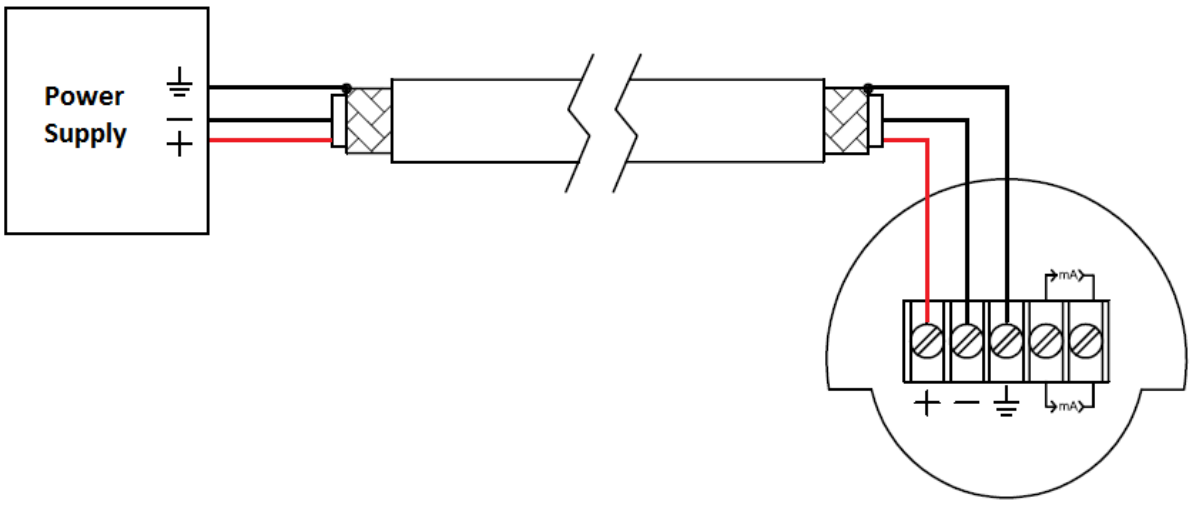


Figure 16: earthing of the sock for cables longer than 20 meters

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4 → OPERATIONS

Each transmitter is calibrated in factory and has on the nameplate the configuration data. If not differently stated in the purchase order the transmitter is configured as follow:

Upper Range Value (Highest pressure value): refer to the data sheet of unit
Lower Range Value (Lower pressure value)**:** refer to the data sheet of unit
Damping **0 sec**.

4.1 → CONFIGURATION

The transmitter shows the status and the measure on the dot matrix LCD (**Figure 17**). The span is from -99999 to 999999.
The input signal to the transmitter can be related to the output signal in the following ways:

Direct mode = 4 ÷ 20mA output
Reverse mode = 20 ÷ 4mA output

The direct mode is obtained by setting the lower range point with the lowest value of the range (e.g. 0.1 bar) and by setting the upper range point with the highest value (e.g. 0.5 bar). The reverse mode is obtained by setting the lower range point with the highest value of the range (e.g. 0.5 bar) and by setting the upper range point with the lowest value (e.g. 0.1 bar).
The instrument can calculate different variables. From the main screen (where the current measure is shown), you can select, using the buttons ⇩ **Next Page** and ⇧ **Previous Page**, the desired variable to keep on the display. There are available the following variables:

- PV;
- Flow Measure (based on PV);
- Percentage;
- Current
- Sensor temperature;

The selected variable is saved and retained even after the instrument is restarted. So, if you want a different variable, then you have to select it again.

SECTION LEAVED INTENTIONALLY BLANK

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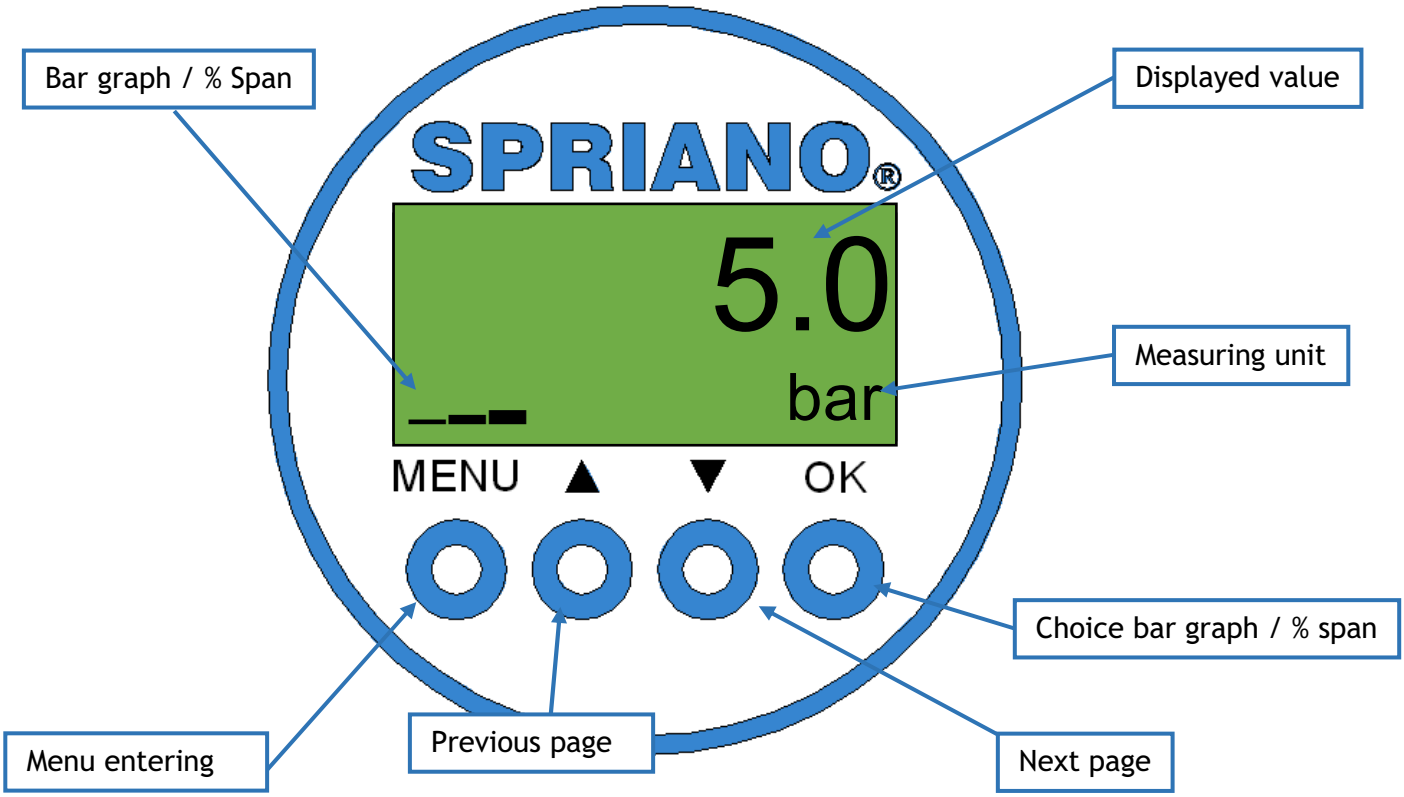


Figure 17: SST77B display

It will be possible to display one of the following variables on the screen:

PRESSURE (PV) 234 mbar	FLOW MEASURE 2.83 m3/h
PERCENTAGE (SV) 74.73 %	CURRENT (TV) 14.290 mA
SENSOR TEMPERATURE (FV) 24.2 °C	

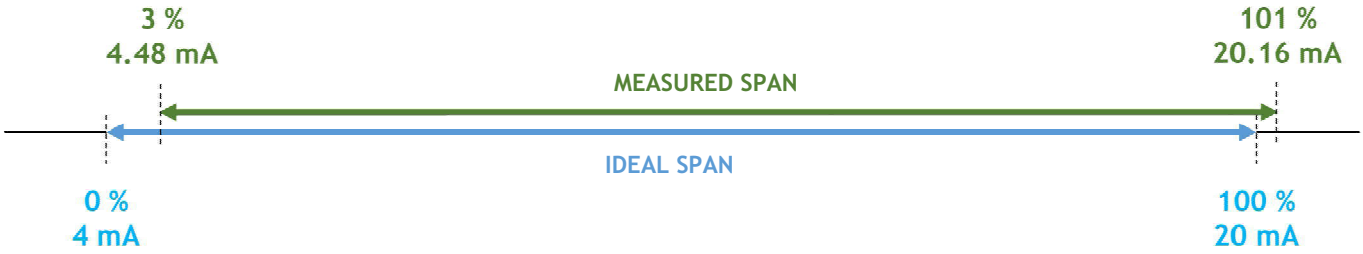
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4.2 → SPAN ADJUSTMENT

It is possible to setup, using the configuration menu (Keyboard Configuration), the zero value. Afterwards, it will be possible to adjust the translated span, by setting the measurement at URV value using SET S. URV command.

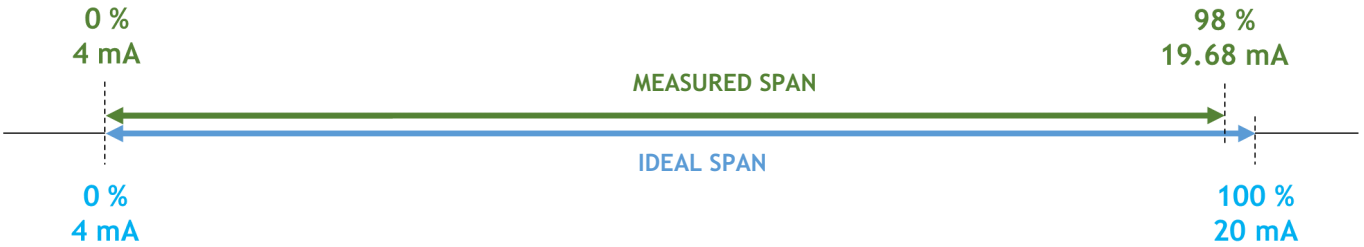
Initial measurement

The entire span is moved and resized.



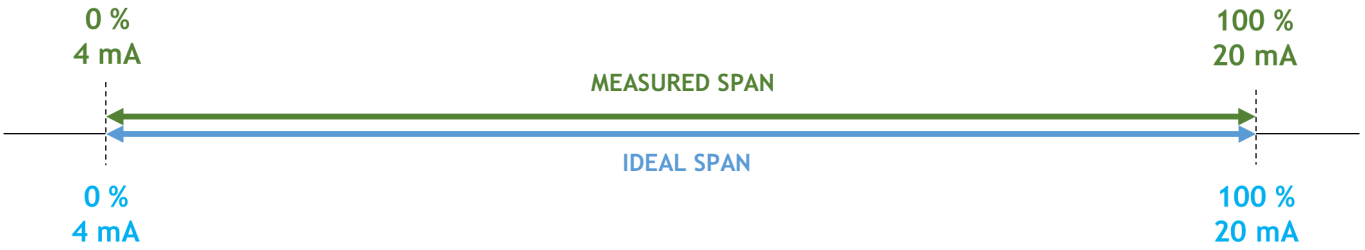
With measure at Zero

Perform an **OFFSET** operation. The zero value is adjusted correctly, but the span must be resized:



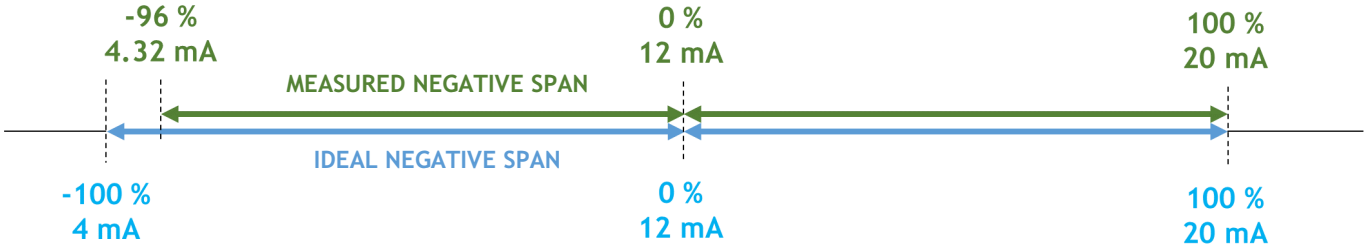
With measure at Maximum

By performing a **SET S. URV** (Set Span URV) operation, you can scale the span so that the current value is resized to be identical to the URV value.



OPTIONAL: Negative side Span Adjustment

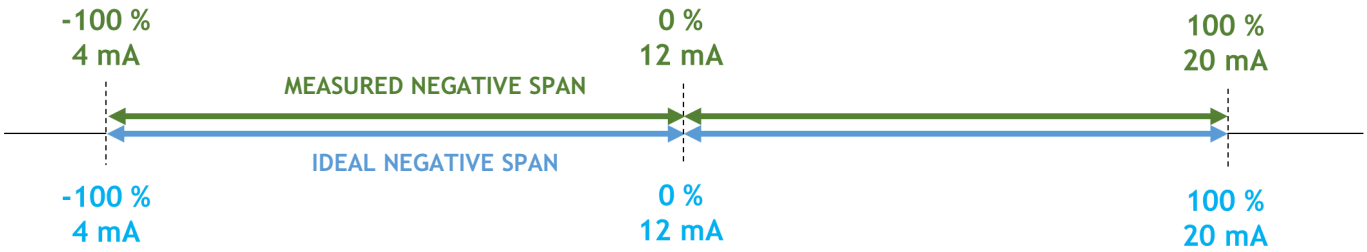
As an advanced feature, it will be possible to adjust the translated span of the negative span (when LRV is below zero). First configure the positive span side, as described above. Then you can experience a negative span side as below:



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With measure at Minimum

It is possible to set the measure at LRV value using the SET S. LRV command:



INFORMATION!
To restore any unwanted change it is possible to select the RESTORE function in the menu or simply reset the SPAN URV and SPAN LRV value to the default value of 1.0.

4.3 → KEYBOARD CONFIGURATION

The electronic transmitters have some configuration functions available via keyboard and LCD display, provided with the transmitters themselves.

- Press the [MENU] button to enter the password entering dialog (the default password is 0000). Confirm by [OK] to enter the configuration menu.
- The display will allow to choose from the different functions described in the table below. Use the ⇧ and ⇩ buttons to show the sequence of the available functions and press [OK] to confirm the selected function.
- When the display is in numerical entering mode, the cursor will blink.
- To move the cursor press the ⇩ button; to raise the value of the digit press the ⇧ button. Press the [OK] button to confirm; use instead the [MENU] button to cancel the modifications and to go back to the standard display.

Function	Display name	Use	Choice span
Maximum FS flow rate	**FMAX**	Represents the maximum flow rate associated with the pressure set by the client in the URV	-
Lower Range Value setting	**LRV**	Indicates and allows you to manually enter the initial value of the interval (the value corresponding to the 4 mA output). The unit of measurement is displayed at the bottom right of the screen.	Between the sensor limits

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Function	Display name	Use	Choice span
Upper Range Value setting	**URV**	Indicates and allows you to manually enter the final value of the interval (the value corresponding to the 20 mA value). The unit of measurement is displayed at the bottom right of the screen.	Between the sensor limits
Measuring unit selection	**PV UNIT** (disabled in volumetric flow meters mode)	Measuring unit selection from the available ones. Press ⇧ o ⇩ to scroll.	**Pressure:** bar, mbar, Pa, hPa, kPa, MPa, mmH_2O, cmH_2O, Kg/cm^2, mmHg, psi, Torr, inHg, Atm, FtH_2O, g/cm^2, inH_2O **Level:** m, mm, cm, in
Sensor Temperature unit	**TEMP UNIT**	Temperature unit selection from the available ones. Press ⇧ o ⇩ to scroll.	°C, °K, °F
Configuration of the measuring unit typology	**XFR FUNC**	Not configurable in this series	LIN SQRT = volumetric flow meter
Fault configuration	**ALARM TYPE**	Fault condition analog output selection.	NONE = no action 21mA 3.85mA LAST = last read value
Damping setting	**DAMP VALUE**	Insert the signal averaging time constant.	0 ÷ 60s

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Function	Display name	Use	Choice span
4mA input automatic setting (zero)	**SET LRV**	At button pushing, the instrument modifies the value of LRV and places it equal to the currently measured value. In this way, the analog output is 4 mA.	-
20mA output Entrant setting (span)	**SET URV**	At button pushing, the instrument modifies the value of URV and places it equal to the currently measured value. In this way, the analog output is 20 mA.	-
Analog output test	**LOOP TEST**	It is possible to fix the analog output of the transmitter to a required mA value.	3.85 ÷ 21mA
Analog output calibration	**CAL 4-20mA**	The transmitter fixes the output to 4mA and asks by display to check the value (OK? YES/NO). Choose NO if the output is incorrect and insert the value read on an external Ammeter. Do it again until necessary. The same procedure for 20mA follows.	-
Hart® polling address	**ADDRESS**	Hart® polling address modification.	0 ÷ 15
Transmitter information	**INFO**	The polling address, the lower sensor limit (LSL), the upper sensor limit (USL) and the firmware revision are shown.	-
Password setting	**PASSWORD**	Allows to insert a new password for the transmitter. To be used with care.	0000 ÷ 9999

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Function	Display name	Use	Choice span
Set Span for URV	**SET S. URV**	Set the current measurement to the URV value, automatically calculating the required Span URV.	-
Expert command: Span Value URV	**SPAN URV**	Indicates and allows the manual entering of linear correction for URV value.	0.500 – 2.000 Three decimal places
Zero re-setting	**OFFSET**	Set the current measurement to zero, automatically calculating the required zero elevation.	-
Expert command: Manual zero elevation	**ZERO ELEV.** (disabled in volumetric flow meters mode)	Indicates and allows manual entry of zero elevation value.	6 digits, including "-" sign and decimal point
Set Span for LRV	**SET S. LRV**	Set the current measurement to the LRV value, automatically calculating the required Span LRV.	-
Expert command: Span Value LRV	**SPAN LRV**	Indicates and allows the manual entering of linear correction for LRV value.	0.500 – 2.000 Three decimal places
Expert command: Specific Gravity	**SPEC.GRAV.**	Indicates and allows manual entry of the specific gravity value.	0.1 ÷ 3.0
Factory setting restore	**RESTORE**	Select and confirm using buttons ⇧ and [OK].	-

INFORMATION!
The password is in 4 digits format and spans from 0000 to 9999. If you can't remember or find the password you set, please contact our technical department.

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5 → MAINTENANCE AND TROUBLESHOOTING

Although transmitters SST7X do not require a maintenance on periodical basis, it is good practice to regularly check the general transmitter status, the possible presence of rust or damage on the case or on the measuring diaphragm and the presence of clogging in the process connection.



PROHIBITION!
Repair, maintenance and/or overhaul of the equipment shall only be conducted by the manufacturer himself, or by a repairer he has qualified or authorized.

Is forbidden during the maintenance operation to use the tool as a handle or step.



Please refer to the following pages scheme for troubleshooting.
In any case contact our technical department for help.

Condition	Potential source	Solution
The transmitter doesn't turn on	Supply	Check the supply voltage to be 12,5Vdc<V_{supply}<30Vdc.
	Polarity	Check the transmitter connection polarity.
	Electrical load	Check that the load is less than the maximum allowed.
Measure is incorrect	Process	Accurately verify the compatibility between the process and the connection type.
	Sensor drift	Apply zero input conditions to the transmitter and use the OFFSET command.
	EMC interference	Accurately verify the possible presence of electromagnetic interference on the supply line. Check the PE connection.

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Condition	Potential source	Solution
Erratic analog output	Wrong span limits	1) Verify that LRV and URV values are the ones you want; 2) In the start-scale process condition, use OFFSET command to correct the measure to zero; 3) In the full scale process condition, use SET S. URV (set span URV) command to correct the URV value; It is possible to correct only the analogical output, by changing the LRV or URV values (alternatively editing SET LRV and SET URV) to set the instrument measure at 4 mA or 20 mA.
	Uncalibrated analog output	Use the LOOP TEST command to verify the analog output calibration. If it is not correct, use the CAL4-20mA command to calibrate the output.
	Incorrect HART® settings	Use the ADDRESS command to verify that the polling address is set to 0.
Analog output <4mA or >20mA	Transmitter in fault mode	Check if the output isn't out of the allowed span or check the presence of a failure (e1, e2, … on display).
	Wrong fault settings	Check the settings using the ALARM TYPE command.
Unstable measure	Measuring disturbs	Set an input average using the DAMP VALUE command (i.e. 10 seconds).
Impossible to access the menu	Wrong / forgotten password	Contact us for help

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5.1 → DISPLAY ERROR CODES

Type of error	Description
ALARM HIGH	OVER RANGE: this message is shown if PV is greater than URV by 10% of the span.
ALARM LOW	UNDER RANGE: this message is shown if PV is lower than LRV by 5% of the span.
LCD OV	LCD OV: this message is shown if PV < -99999 or PV >99999.
EE CHK ERR	This message depends by an error configuration of the EEPROM memory
EE ADC ERR	This message is shown if there are PV calculus error in primary ADC input. If it persist contact Spriano® for help
T EX AD ER	This message is shown if there are on external temperature signal calculus error in secondary ADC input. If it persist contact Spriano® for help
T IN AD ER	This message is shown if there are on internal temperature signal calculus error in secondary ADC input. If it persist contact Spriano® for help
PR ADC ER	This message is shown if there is an error in calculating the input of primary ADC pressure signal. If persist contact Spriano® for help.
NaN	Indicates a sensor damage.

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5.2 → SPARE PARTS

Below is the list of the spare parts available for SST77B instrument.
Together with the request of spare parts it is required to indicate Serial Number of the Transmitter to control that the correct components will be delivered.

Item	Product Code	Description	Quantity
01	DISPLAY COVER	Cover with display glass	1
02	BLIND COVER	Blind cover terminals side	1
03	COVER O-RINGS	Gaskets for enclosure covers	2

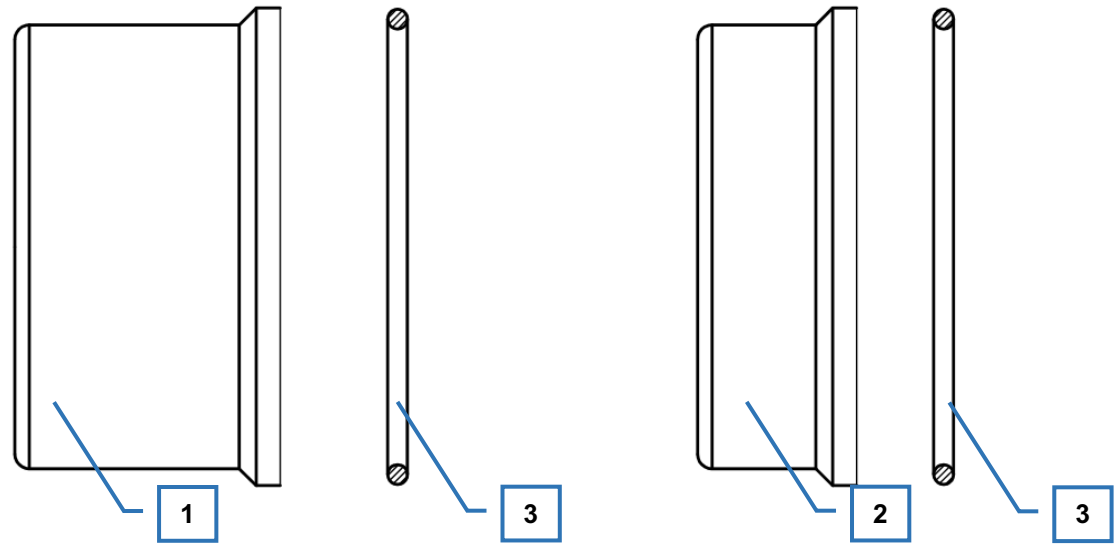


Figure 18: spare parts

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6 → MARKING

On the transmitter enclosure is fixed an identification plate with inscriptions showing the characteristic data of the instrument.
Refer to **Figure 19**, the Transmitter is provided with the following information:

1. Name and address of the manufacturer
2. CE marking followed by the identification number of the notified body involved in the production phase
3. Designation of series or type
4. Serial number (with the Year of construction)
5. ATEX marking for equipment-group II, followed by the specific marking of explosion protection (see 1.3 → Definitions And Symbols)
6. PED essential allowable limits: allowable Fluids, Maximum working pressure (PS), Nominal size (DN), etc.

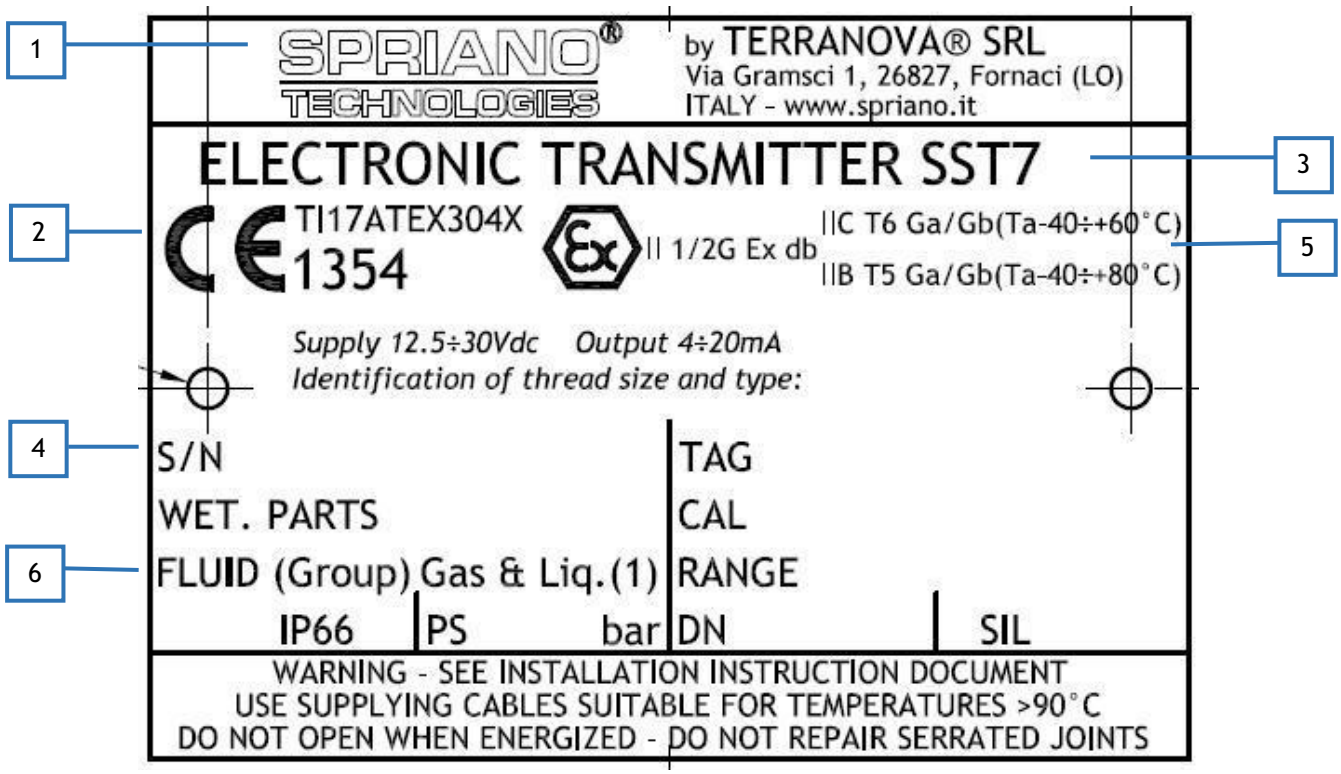


Figure 19: marking plate

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7 → DATA SHEET

FUNCTIONAL DATA
With reference to the following, please note these definitions:
Nominal range: (referred to the sensor mounted in the instrument) the measured pressure range for which the sensor has been designed. Defined as a minimum and maximum value.
Nominal span: the interval between the minimum and maximum values of the sensor nominal range. The span is a single number.
Measuring range: the minimum and maximum range values for which the transmitter is to be calibrated.
Measuring span: the interval between minimum and maximum values of the measuring range.
Input scale initial value or zero input: minimum pressure value within in the measuring range.
Input full scale value: maximum pressure value within in the measuring range.

TRANSMITTER PARAMETERS
The parameters that are available for display and setting are:
Measuring span: possibility to change from 3.33% to 200% of the nominal span.
Zero adjustment: digital calibration ± 15%.
Low/upper range values: they can be set within the nominal range provided that the span > minimum span.
Damping: digitally adjustable from 0 to 60 sec. (minimum response time ~ 0,1 sec.).
Reverse output: automatically obtained via software.
Transfer function: linear/square root via software.
Self-test: in case of malfunction the analog output is forced to the fail-safe state of 3.85mA or 21mA.
Measuring units: 18 different pressure units or % of the measuring span, selectable via software.

PHYSICAL CHARACTERISTICS
Power supply: 12,5 - 30 Vdc
Output signal:
Analog 4-20 mA, 2 wires.
Digital using HART® protocol
Response time: <256 ms (Std Hart®)
Measured value update frequency:
4-20 mA + Hart® output: ~1s
Hart® output only: ~500 ms (on request)
Polling time:
4-20 mA + Hart® output: ~800 ms
Hart® output only: ~500 ms (on request)
Nominal range 18-50 mbar:
Max static pressure: 50bar.
Overpressure limits: 50bar on either side.
Nominal range 350-10000 mbar:
Max static pressure: 100bar.
Overpressure limits: 100bar on either side.

AMBIENT CONDITIONS
Temperature:
Process fluid: -40 ÷ +80°C (with capillary: up to 283°C)
Housing: -40 ÷ +80°C
Handling and storage: -40 ÷ +90°C
Relative Humidity: 0 a 100% R.H.
LCD display reading: -10 ÷ +65°C

PERFORMANCES
Total accuracy[1]**:** <0.1%FS
Dead band: negligible.
Display resolution: 0.1

[1]Including hysteresis, non-linearity, non-conformity and non-repeatability (IEC 60770).
Accuracy and drifts are given for instruments with integral sensor and diaphragm; they may vary according to sensor type and diameter, thickness and material of the diaphragm.

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INFLUENCE OF OPERATING CONDITIONS
Thermal drift: It is referred to -10 ÷ +80°C range.
Zero: ± 0,1%/10°C.
Span: ± 0,1%/10°C at nominal range.

Static pressure effect
Nominal range 18-50 mbar:
Zero: ± 0,4% / 10bar. **Span:** 0,4% / 10bar.
Nominal range 350-2500 mbar:
Zero: ± 0,1% / 10bar. **Span:** 0,1% / 10bar.
Nominal range 5000-10000 mbar:
Zero: ± 0,2% / 10bar. **Span:** 0,2% / 10bar.

Over range effect
Nominal range 18-50 mbar:
Zero: on either side ± 1% at 50bar.
Nominal range 350-2500mbar:
Zero: on either side ± 0,1% at 100bar.
Nominal range 5000-10000mbar:
Zero: on either side ± 1% at 100bar.

Power supply effect:
Negligible between 12.5 and 30 Vdc.

PHYSICAL SPECIFICATIONS
Housing: die cast aluminum alloy EN AW-6082 finished with epoxy resin (RAL 5014). It is dust and sand tight and protected against sea wave effects as defined by IEC IP66. Suitable for tropical climate operation as defined by DIN 50015.
Covers O-ring: EPDM.
Filling fluid: silicone oil.
Nameplate: stainless steel, fixed on housing.
Bracket: for 2 inch pipe mounting.
Calibration
Standard: at nominal range, direct action, linear.
Optional: at the conditions specified with the order.
Electrical connections: two entries on electronic housing, 1/2" NPT and cable gland PG 13,5 for 7 to 12mm diameter cable.
Terminal board: 2 terminals for signal wiring up to 1,5 mm^2 (14 AWG). Connection for ground and cable shield.
Mounting position: any position.
Net weight: 6 kg approx.

PROCESS WETTED PARTS
Process connections: see ordering information table.
Diaphragm: see ordering information table.

OPTIONS
Remote mounting with capillary: for working temperature higher than 80°C up to 283°C.
Static pressure: 200 bar.
Degreasing for oxygen service.
Stainless Steel Housing: AISI 316 (IP66).

7.1 → FUNCTIONAL SAFETY ACCORDING TO IEC 61508 / IEC 61511

According to IEC 61508 / IEC 61511, the assessment of the safety critical and dangerous random errors results, in case of an annual function test and the present safety instructions are observed, in the following parameters:

Transmitter Type	λ_{DD}	λ_{DU}	λ_{S}	λ_{TOT}	SFF	SIL
SST77B	7.5072×10^{-8}	1.0725×10^{-8}	8.0434×10^{-8}	1.6623×10^{-7}	91.67%	2

SPRIANO® TECHNOLOGIES - www.spriano.it – spriano@terranova-instruments.com
a TERRANOVA® Srl brand - www.terranova-instruments.com - VAT IT07848810151
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Head Office: Via Rosso Medardo 16 – 20159 Milano – Italy Ph: +39 0377 919119 – Fax: +39 0377 855720

7.2 → MAIN DIMENSIONS

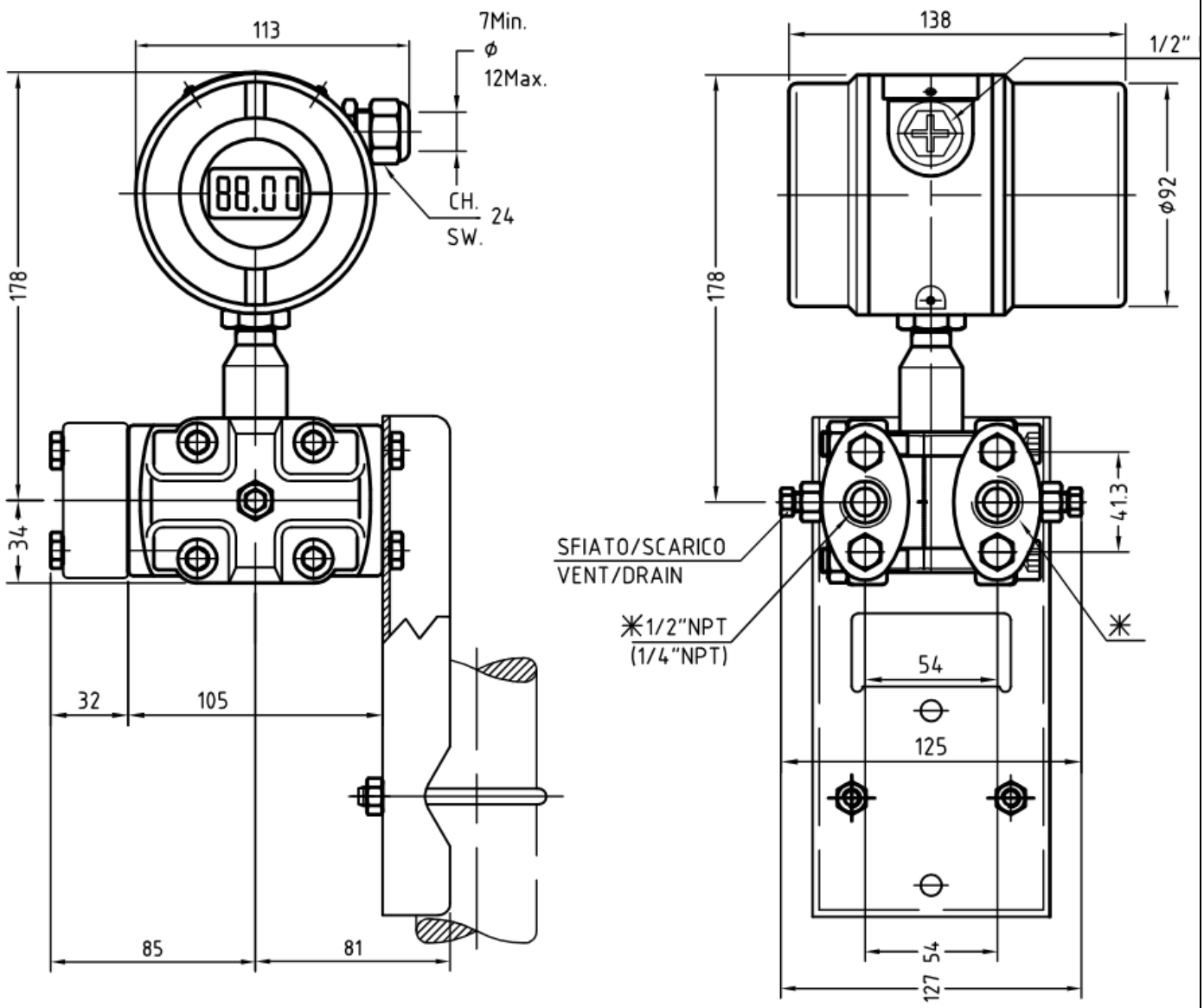


Figure 20: main dimensions (mm)

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OPERATING and MAINTENANCE MANUAL for SST76 PRESSURE TRANSMITTERS

TERRANOVA® Srl - www.terranova-instruments.com
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SST76 PRESSURE TRANSMITTER



PED

SIL
IEC 61508 / IEC 61511

FIELDCOMM GROUP™
MEMBER

HART
COMMUNICATION PROTOCOL

ORIGINAL INSTRUCTIONS

SPRIANO®
TECHNOLOGIES

CE 1354

EU Declaration of Conformity

TERRANOVA® Srl

Via Gramsci 1 – 26827 Terranova dei Passerini (LO) – Italy
declares on his sole responsibility that the product:

SPRIANO® Electronic Transmitters series

SST70, SST71, SST72, SST75, SST76, SST77B, SST77BL, SST79B, SST70-REM

(device controlling or regulating the limits of an industrial process, like pressure, level and vacuum)
satisfies the essential requirements and conformity assessment procedures of the following legislation:

Directive 2014/34/EU (ATEX)

EU TYPE CERTIFICATE: TI 17 ATEX 304 X

Equipment for use in potentially explosive atmospheres, suitable for Zones 0, 1, 2 (process side and external side)



II 1/2G Ex db IIC T6 Ga/Gb for use in the ambient temperature range –40°C to 60°C
II 1/2G Ex db IIC T5 Ga/Gb for use in the ambient temperature range –40°C to 80°C

Presumption of conformity provided by the application of the harmonised standards:
EN 60079-0:2012+A11:2013 - EN 60079-1:2014

The Notified Body NB 1354 Technicka inspekcia a.s. performed Module D, Annex IV, Directive 2014/34/EU and issued the Production Quality Assurance Notification. Periodical Surveillance is provided according to Annex IV, Point 4, Directive 2014/34/EU by the same Notified Body.

Directive 2014/68/EU (PED)

EU DESIGN EXAMINATION CERTIFICATE: 1292/1/2017-2÷8

Pressure equipment, up to Category IV, for fluids (gases, liquids and vapours) in Group 1.

Conformity provided by the application of the harmonised standard:
EN 13445-1:2015, EN 13445-2:2015, EN 13445-5:2015

The Notified Body NB 1354 Technicka inspekcia a.s. performed Module H1, Directive 2014/68/EU and issued the Production Examination Certificate. Periodical Surveillance is provided according to Directive 2014/68/EU by the same Notified Body.

Directive 2014/30/EU (EMC)

Equipment with an adequate level of electromagnetic compatibility.

Presumption of conformity provided by the application of the harmonised standard:
EN 61326-1:2006

Terranova dei Passerini, 04/08/2017

Mr Sergio Valletti,
General Manager

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WARNING!
Exclusively follow the instructions indicated in this document. Failure to comply with this document may cause injury to health or may damage the equipment.

SPRIANO® TECHNOLOGIES do not takes any kind of responsibility for damages due to failure to comply with this document.

1 → INTRODUCTION

1.1 → PRODUCT OVERVIEW

Electronic transmitters series SST7X are apparatus which use a piezoresistive sensor for pressure, level and temperature measurement, and transmit a current signal (4 ÷ 20mA) proportional to the variable measured. The series SST7X is composed by the following types:

SST76	Absolute or relative pressure transmitter with diaphragm
SST70	Displacer level transmitter
SST71	Smart Float Level Transmitter
SST72	Electronic temperature transmitter
SST75	Absolute or relative pressure transmitter
SST77B	Differential pressure transmitter
SST77BL	Level transmitter
SST79B	Immersion level transmitter
SST70-REM	4÷20mA loop powered field digital indicators (External local indicator)



MANDATORY!
The accessories used for the cable entries and to close unused shall be certificated according to the standards EN 60079-0 and EN 60079-1 for the gas groups IIC or IIB, according to the type of protection implemented.

1.2 → ATTENTION!

This manual does not contain information concerning all type of Transmitter or all different installation and/or working and mounting solutions. For more information or for particular problems not considered in this manual, please address to our technical office.
The warranty period is the one contemplated in our general servicing conditions. This warranty is neither increased nor restricted by the contents of this manual.
This Transmitter has to be installed and used only by qualified persons who have first checked the correctness of supply voltage so that both in standard working conditions and in presence of damages of the plant or of any part of it, no dangerous voltage can reach the Transmitter. As the Transmitter can be utilized both with high pressure values and with aggressive media it must be considered that an incorrect use of it could bring even serious damages to people and things. A correct and safe working needs an adequate transport, stock and mounting other than an appropriate maintenance service. So it is necessary for the people handling these Transmitter to have knowledge and experience in mounting, servicing and working and to have title to do their job with reference to “Safety Standards“.

1.3 → DEFINITIONS AND SYMBOLS

In this manual are used the following symbols and labels

	Equipment for use in potentially explosive atmospheres
II 1/2G	Equipment Group II Category 1/2G, suitable for potentially explosive area (gases, vapours or mists); to be installed in a separation wall between Zone 0 (process side) and Zone 1 (external side)
Ex d	Device with Explosion Proof Enclosure
IIC	Group IIC apparatus, fit for substances of group IIC, IIB and IIA (only when used in the ambient temperature range –40°C to 60°C)
IIB	Group IIB apparatus, fit for substances of group IIB and IIA (when used in the ambient temperature range –40°C to 80°C)
T6, **T5**	Temperature Class of the transmitter (maximum surface temperature) ➢ only when used in the ambient temperature range –40°C to 60°C ➢ only when used in the ambient temperature range –40°C to 80°C
Ga/Gb	Equipment to be installed in the boundary wall between an area requiring EPL Ga and the less hazardous area



WARNING!
Warning label, used to warn about hazardous materials, locations, or objects, including electric currents, poisons, and other things.



PROHIBITION!
Prohibition label, used to indicate something is not permitted.



MANDATORY!
Mandatory label, used to set obligation tasks to be performed by the user.

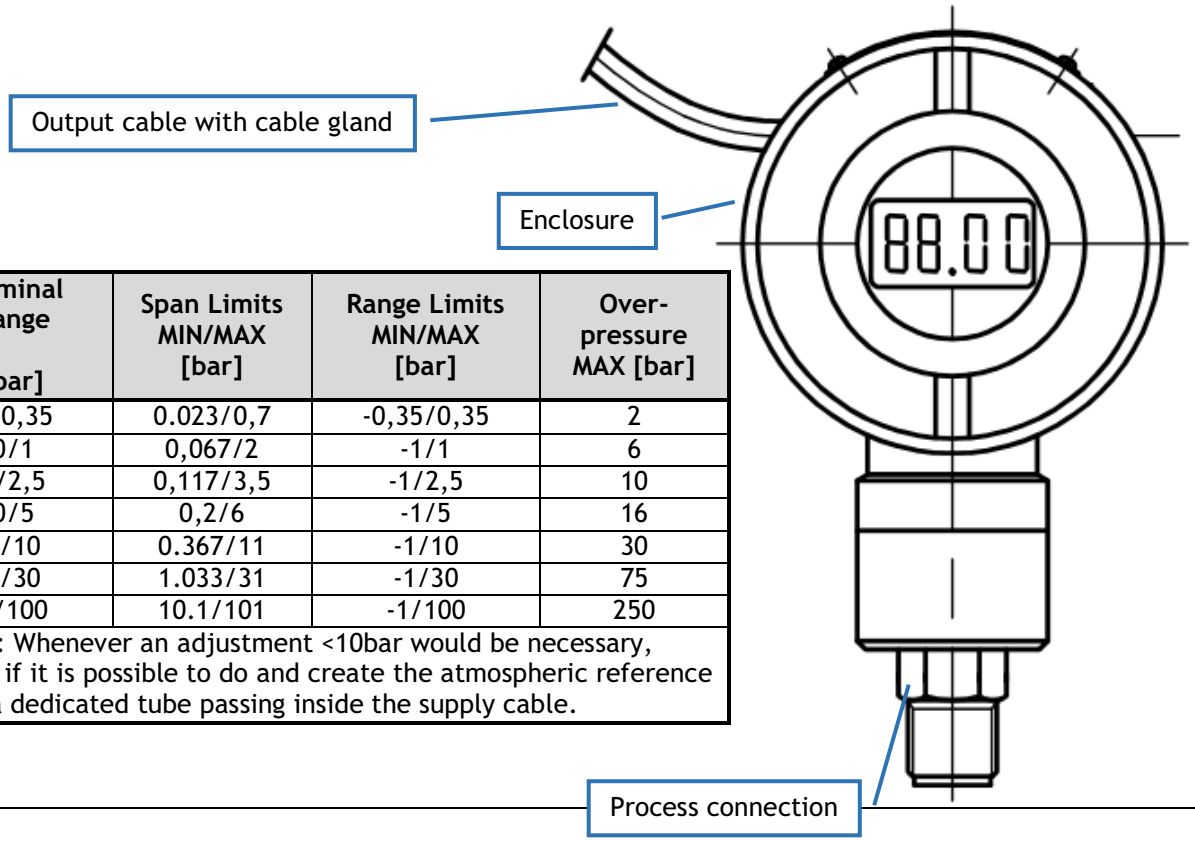


INFORMATION!
Information label, used to set general information for the user or warn about hazards for the equipment.

2 → DESCRIPTION

The SST76 series SMART pressure transmitters are microprocessor based instruments that combine the analog signal advantages (4-20mA) together with the flexibility of digital communication using HART® protocol. They can be remotely configured by a universal hand held terminal (HHT) or by a PC with a dedicated interface.
Moreover, it is possible to locally configure the instruments (zero and span) by means of push buttons and to display the data on the wide LCD display. The SST76 transmitters, complete with AISI 316 diaphragm, measure relative pressure with spans from 0,023 to 101 bar. The pressure measuring element is a piezoresistive sensor. It is possible to choose a variety of sensors to satisfy all process conditions.
The **SPRIANO®** measuring cell contains the sensor and transmits pressure to the electronics. Thermal drift is compensated using the temperature signal generated by a PTC thermistor integrated in the sensor itself. Based on these readings the microprocessor generates the 4-20mA analog output "two wires system" and displays the pressure measurement on the LCD.
Some of the main characteristics of this microprocessor-based transmitter, are:

- Wide rangeability;
- Automatic temperature compensation;
- Digital communication using HART® protocol.



Nominal Range [bar]	Span Limits MIN/MAX [bar]	Range Limits MIN/MAX [bar]	Over-pressure MAX [bar]
0/0,35	0.023/0,7	-0,35/0,35	2
0/1	0,067/2	-1/1	6
0/2,5	0,117/3,5	-1/2,5	10
0/5	0,2/6	-1/5	16
0/10	0.367/11	-1/10	30
0/30	1.033/31	-1/30	75
0/100	10.1/101	-1/100	250

NOTE: Whenever an adjustment <10bar would be necessary, check if it is possible to do and create the atmospheric reference with a dedicated tube passing inside the supply cable.

Figure 1: SST76 electronic pressure transmitter

3 → INSTALLATION

3.1 → TRANSMITTER IDENTIFICATION

Transmitter data can be found on the nameplate fixed on the top of transmitter enclosure (see MARKING). The Serial Number must be quoted at the occurrence of a specific request to the manufacturer.

3.2 → GENERAL MOUNTING REQUIREMENTS

Prior installation shall be observed following considerations:

- Check whether Transmitter's operating conditions are within the limits as reported in the nameplate, technical specifications sheets and/or label.
- Make sure that the operating conditions are compatible with the specification given to the manufacturer.



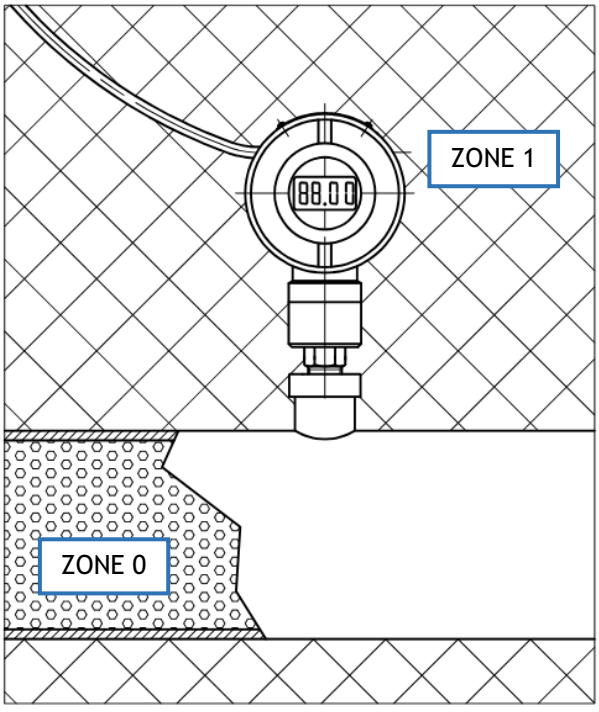
MANDATORY!

- For measurement in the presence of particularly hot liquids (e.g. steam) make sure that the Transmitter is supplied with a suitable finned arm.
- For viscous liquids or those containing solid particles in suspension make sure that the connection to the process is a suitable one in order to avoid clogs.



WARNING!

Direct sunlight may cause serious damages to the instrument.
Never install standard Transmitter under the sun or in any other location which could cause direct overheating through radiation.



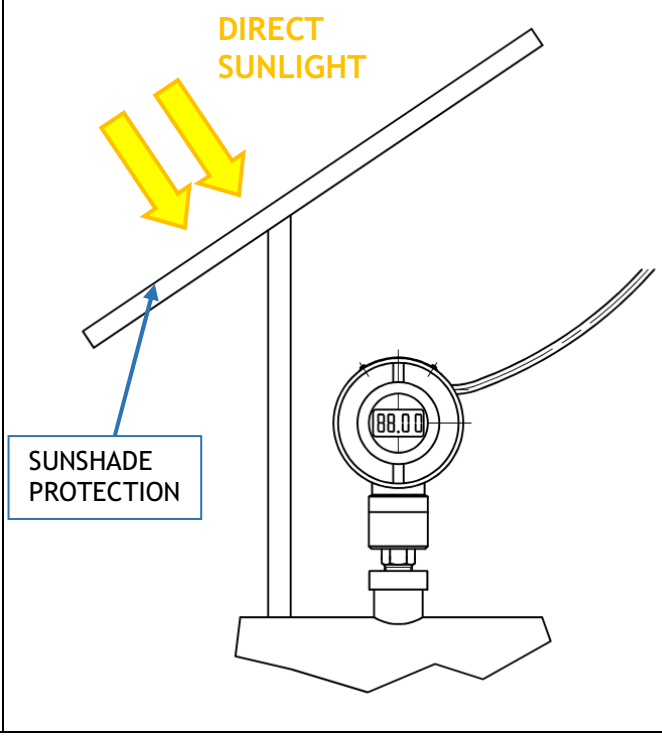


Figure 2: mounting requirements

3.3 → MECHANICAL INSTALLATION

The Transmitter should be located, if possible, at some easily accessible, well lighted place on the vessel or pipe, in order to allow putting in operations and maintenance work. Location should also be such that ambient temperature at the Transmitter enclosure be not excessive (see MARKING).



INFORMATION!
- Plant overpressure / over-temperature: observe rating plate
- Installation on seismic areas: inform technical department
- In case of unstable fluids: inform technical department
- In case of damages: inform technical department
- Inspection frequency: consideration should be given to applicable national legislation.



WARNING!
- The process connection must be realized in such a way that guarantees the hold at the maximum working pressure and temperature.
- Do not overcome the maximum pressure and temperatures indicated in the technical data sheet of the selected model.
- When the device is connected to the process it can be submitted to high pressures and temperatures. To avoid accidents subsequent to sudden discharge of pressure and/or to contact with dangerous or flammable fluids it is necessary to take the maximum attention when the Transmitter is taken off, heated or repaired, verifying that it is isolated from the process and is not submitted to pressure and/or temperature.

3.4 → ELECTRICAL CONNECTION

Under the rear cap is placed the terminal block reporting the electric polarity (**Figure 3**).
Insert the power supply cable into the enclosure through one of the two screwed openings. Transmitter is protected from accidental inversion of polarity. For a better use is recommended a twisted pair cable (22 AWG min). Avoid placing Transmitter near devices powered in AC or Switching. Connect ground-tap of the Transmitter to the local common earth (PE) as indicated in paragraph 3.6 → Earthing.

WARNING!
The threaded opening that is not used must be sealed using a suitable cap.
The caps included in the delivery are only for protection during transport.

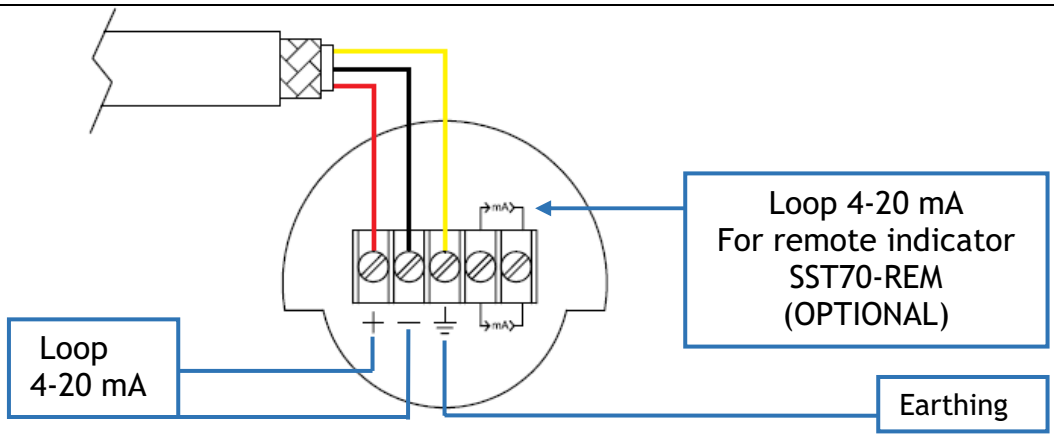


Figure 3: electrical connection of the power cable to the terminal block

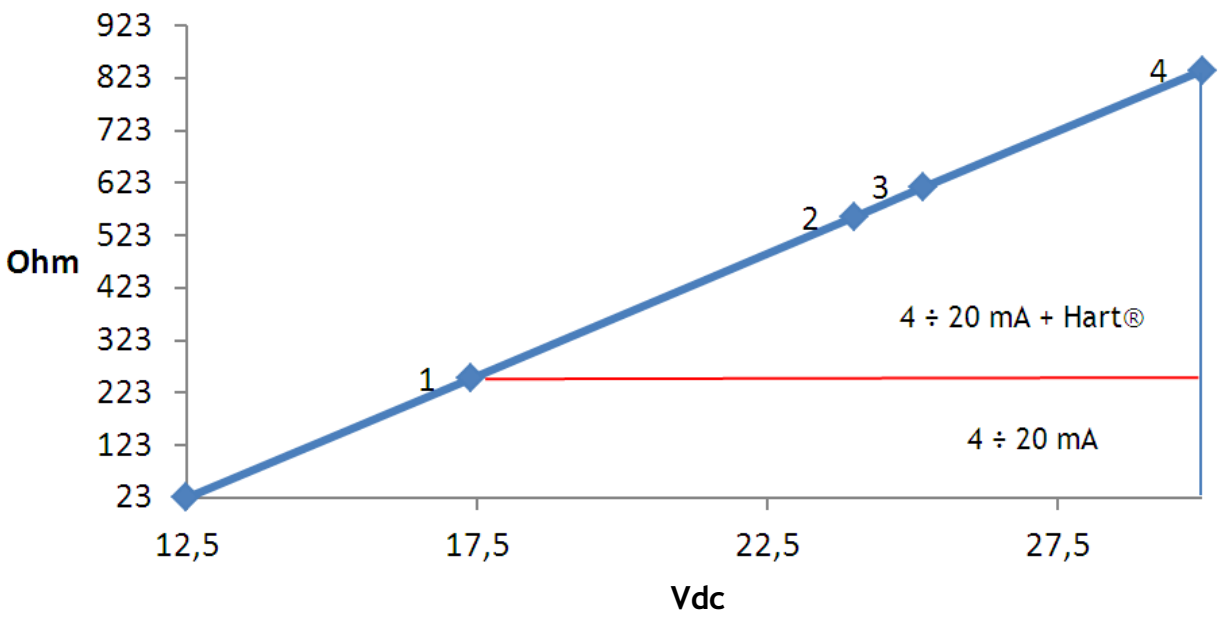
INFORMATION!
Impedance of the cables defines the possible maximum length for digital communication. It's recommended using cable with a low impedance. The maximum length of the point to point connection, with a load of 250 ohm and single twisted cable 22 AWG-207 pF/m it's about 1000 meters.
The maximum connection length for the analog signal only is limited by the loads (connected devices and cable) present in the current loop.

To obtain output signal of 4-20 mA, you have to determine the minimum supply voltage as a function of the load relation: see **Figure 4**. From the following formula you can achieve the right minimum value of supply voltage:

$$V_{dc} = 0.0215 \times R_L + 12$$

Where: R_L = output load [Ohm].
The power supply source must assure a minimum current value of 24 mA.

MANDATORY!
In order to obtain a 4÷20 mA + Hart® output a minimum load of 250 Ohm is required.



TAG	-	1	2	3	4
Vcc	12.5	17.4	24	25.2	30
Ohm	23	250	558	615	837

Figure 4: operating area for Ex d protection

The electronic transmitters series SST76 are fully comply with the HART® protocol specification Revision 6.0, so they include remote process variable interrogation, parameter setting and diagnostics. The device is a 4÷20mA 2-wire transmitter, with FSK communication.
It is possible to read via HART® the following variables:

- **PV**: transmitter main measure;
- **SV**: % of the span;
- **TV**: analog output;
- **FV**: sensor temperature.

Please refer to **Figure 5** for the Hart® modem connection on transmitter's 4÷20mA loop.
In **Figure 6** the Hart® connection type is shown. It is possible to purchase the Hart Server as an additional product; this is a software including all the interrogation, configuration and diagnostics functions required by the Hart® 6.0 specifications.

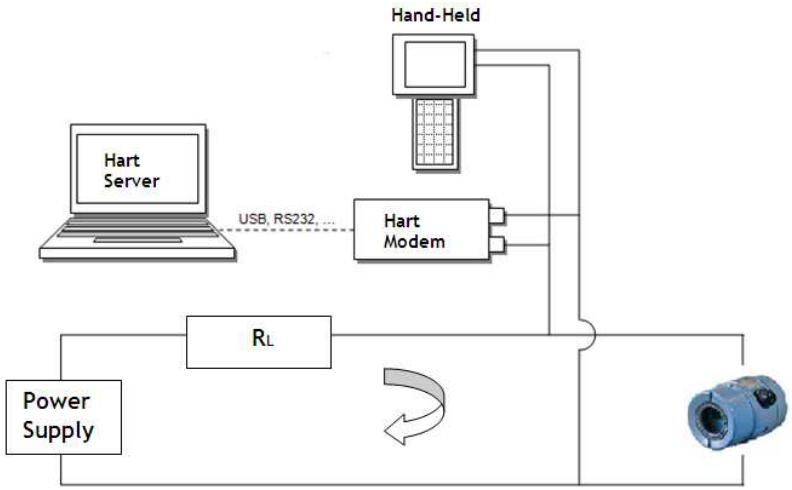


Figure 5: 4÷20 mA + Hart® modem connection

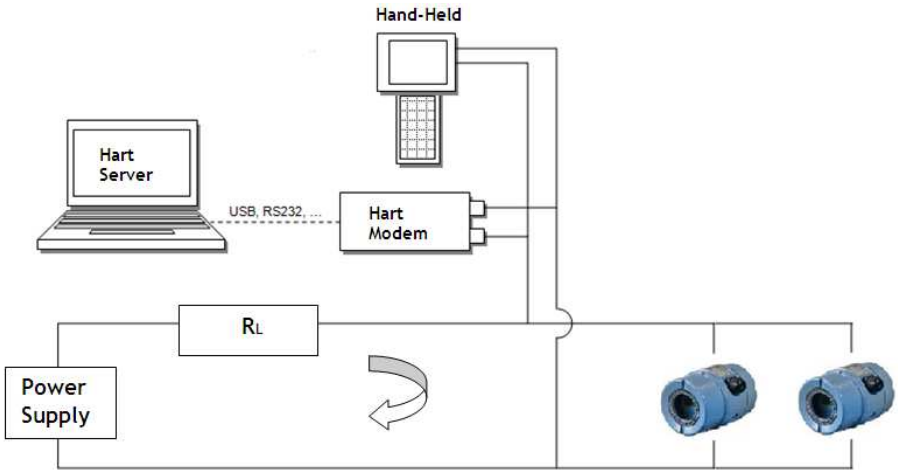


Figure 6: only Hart® multidrop connection

INFORMATION!
At maximum 15 transmitters could be connected in parallel on the same line.
Attention: when more transmitters are connected on the same line the current standing on the resistor (250-ohm) is equal to

4mA x N of connected instruments.

This could cause a high electric potential. Be sure power supply is sufficient.

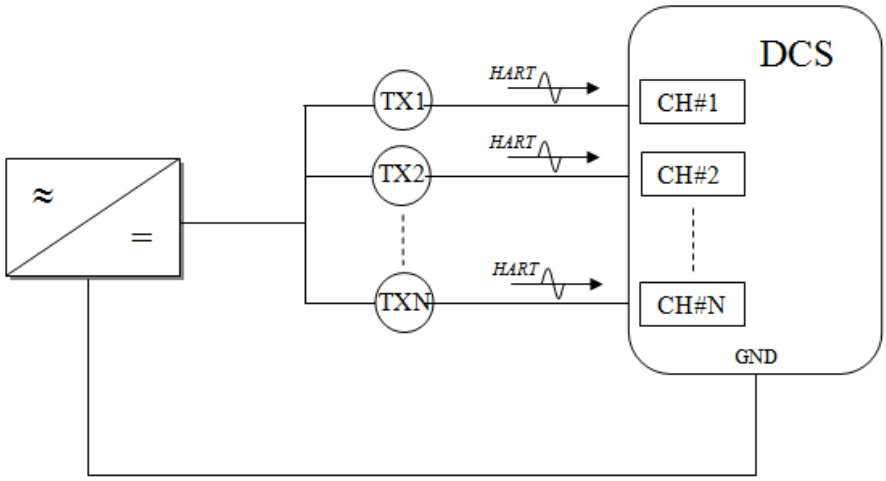


Figure 7: DCS connection

MANDATORY!
Transmitter response time is <256ms.
DCS POLLING time must be set approximately at 800ms in order to avoid updating problems both in analog and digital measurement.
On request the transmitter can be supplied in order to support a Polling time of 500ms but with a minimal consumption of 5 mA.

3.5 → EXPLOSION PROOF PROTECTION

In case of use in areas with danger of explosion, it must be verified that the identified type of transmitter fits for the classification of the zone and for the presence of flammable substances in the plant (see MARKING).
The safety essential requisite against the risk of explosion in the classified areas are fixed from the European Directives 2014/34/EU of 26 February 2014 (as far as it concerns the 'Equipment') and 1999/92/EC of December 16th 1999 (as far as it concerns the 'Working Environment').

WARNING!
For the electrical connections please follow the instructions brought in this operator manuals taking care that for the use in classified areas it is necessary to foresee the standard EN 60079-14.
The accessories for cable entry (which must be threaded ½" NPT) must be certified following the Standards EN 60079-Series (for Tamb >70°C must be certified for T > 90°C).

PROHIBITION!
Do not open the covers or any part of the device in dangerous area when circuit alive.
For explosion proof safety installation, it is mandatory to disconnect the electric supply before opening the device.

3.6 → EARTHING

WARNING!
The earth connection is required to prevent damage to people and malfunction of the instrument.

- **Case 1: Installing the instrument in a plant devoid of earthing systems**

In the case where the plant devoid of earthing, it is necessary to connect the earth wire to the terminal block through the cable that carries the signal and the power supply (**Figure 3**).

- **Case 2: Installing the instrument in a plant provided with earthing systems**

Make sure the earthing (GND) of the system has the least resistance possible.
You can add an additional earth wire with section not less than 4 mm^2 to ensure such connection.

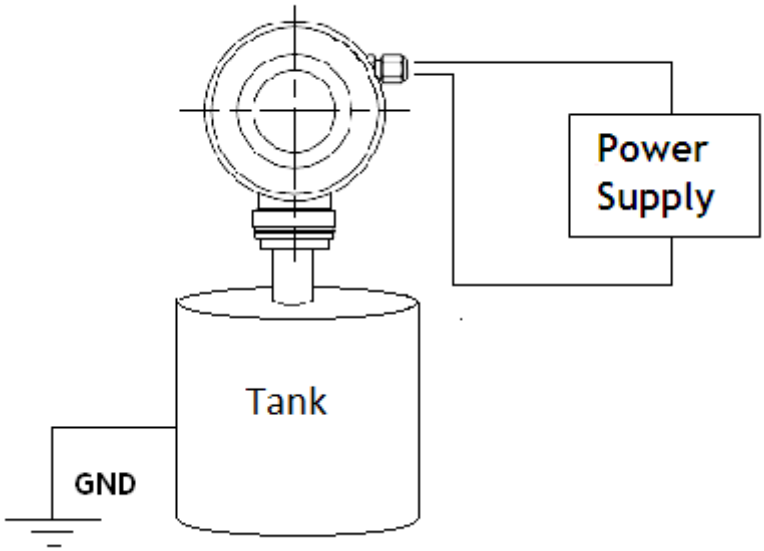


Figure 8: 4 ÷ 20 mA loop connection with plant provided with earthing systems

WARNING!
In the case represented in **Figure 9**, within the earth wire may also scroll through the current protection of other instruments where the earthing of the system (GND) had not been carried out in an optimal manner.

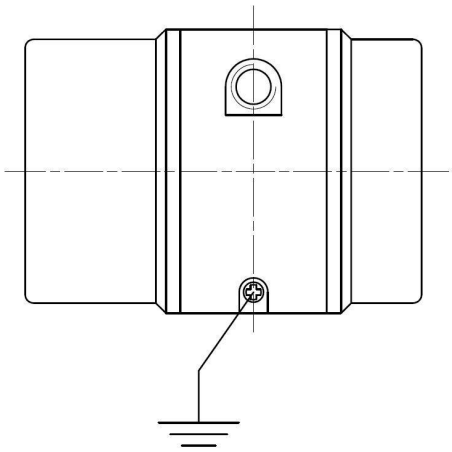


Figure 9: earthing in the housing

WARNING!
The hose must not be considered as a protection against electric shock for the protection of security, but as protection against electromagnetic interference of the instrument. Therefore, in the case of long distance cable (L> 20 m), both ends of the braid must be connected to the chassis or to the connectors. In the case of cables L <20 meters, will be sufficient to connect the braid only from the side "Power Supply".

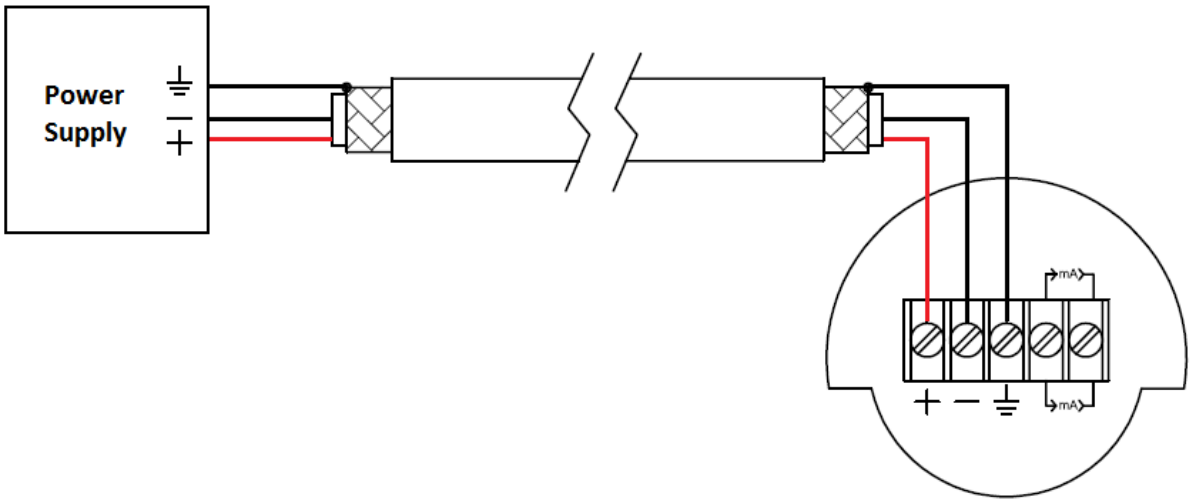


Figure 10: earthing of the sock for cables longer than 20 meters

4 → OPERATIONS

Each transmitter is calibrated in factory and has on the nameplate the configuration data. If not differently stated in the purchase order the transmitter is configured as follow:

Upper Range Value (Highest pressure value): refer to the data sheet of unit
Lower Range Value (Lower pressure value)**:** refer to the data sheet of unit
Damping **0 sec**.

4.1 → CONFIGURATION

The transmitter shows the status and the measure on the dot matrix LCD (**Figure 11**). The span is from -99999 to 999999.
The input signal to the transmitter can be related to the output signal in the following ways:

- **Direct mode** = 4 ÷ 20mA output
- **Reverse mode** = 20 ÷ 4mA output

The direct mode is obtained by setting the lower range point with the lowest value of the range (e.g. 0 bar) and by setting the upper range point with the highest value (e.g. 5 bar). The reverse mode is obtained by setting the lower range point with the highest value of the range (e.g. 5 bar) and by setting the upper range point with the lowest value (e.g. 0 bar).
The instrument can calculate different variables. From the main screen (where the current measure is shown), you can select, using the buttons ⇩ **Next Page** and ⇧ **Previous Page**, the desired variable to keep on the display. There are available the following variables:

- PV;
- Percentage;
- Current
- Sensor temperature;

The selected variable is saved and retained even after the instrument is restarted. So, if you want a different variable, then you have to select it again.

SECTION LEAVED INTENTIONALLY BLANK

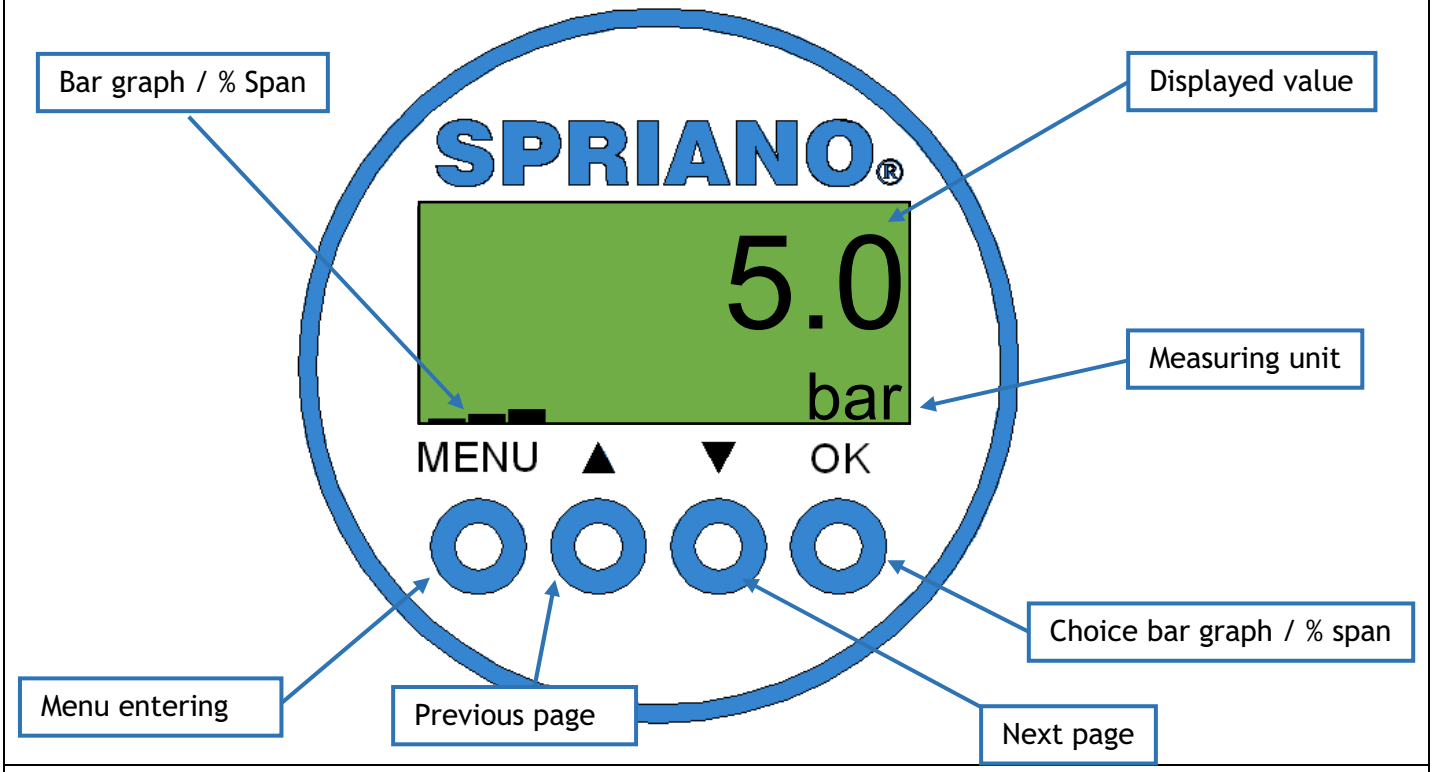


Figure 11: SST76 display

It will be possible to display one of the following variables on the screen:

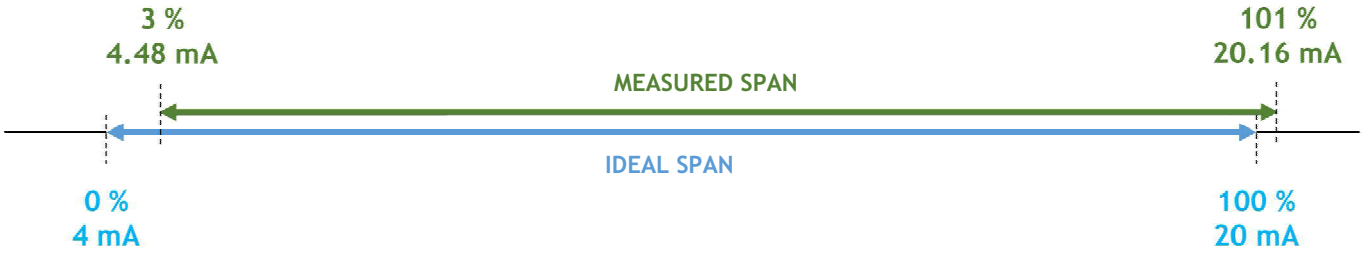
PRESSURE (PV) 1.270 bar	CURRENT (TV) 4.220 mA
PERCENTAGE (SV) 34.73 %	SENSOR TEMPERATURE (FV) 24.2 °C

4.2 → SPAN ADJUSTMENT

It is possible to setup, using the configuration menu (Keyboard Configuration), the zero value. Afterwards, it will be possible to adjust the translated span, by setting the measurement at URV value using SET S. URV command:

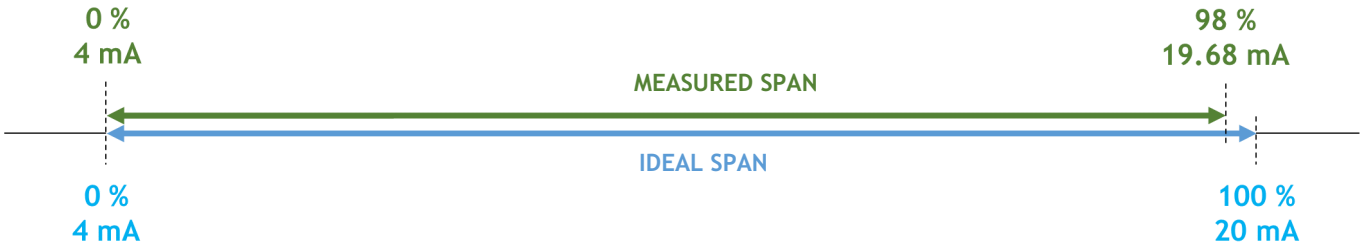
Initial measurement

The entire span is moved and resized.



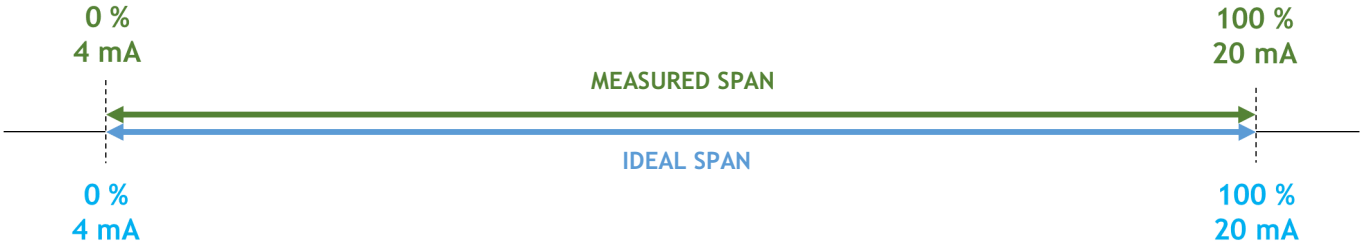
With measure at Zero

Perform an **OFFSET** operation. The zero value is adjusted correctly, but the span must be resized:



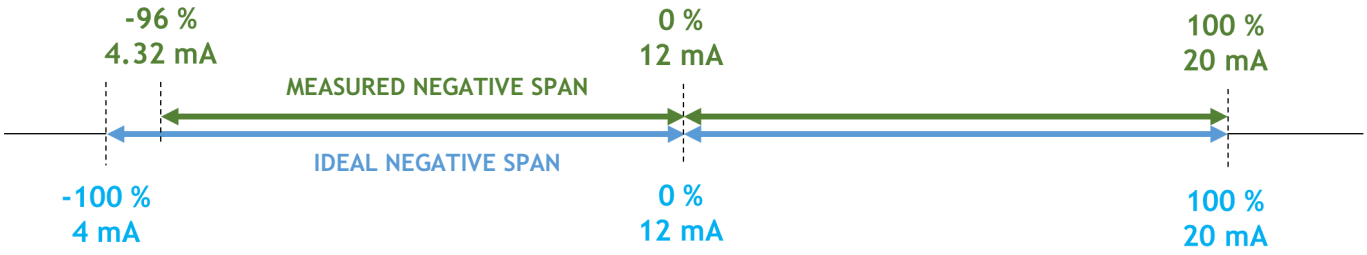
With measure at Maximum

By performing a **SET S. URV** (Set Span URV) operation, you can scale the span so that the current value is resized to be identical to the URV value.



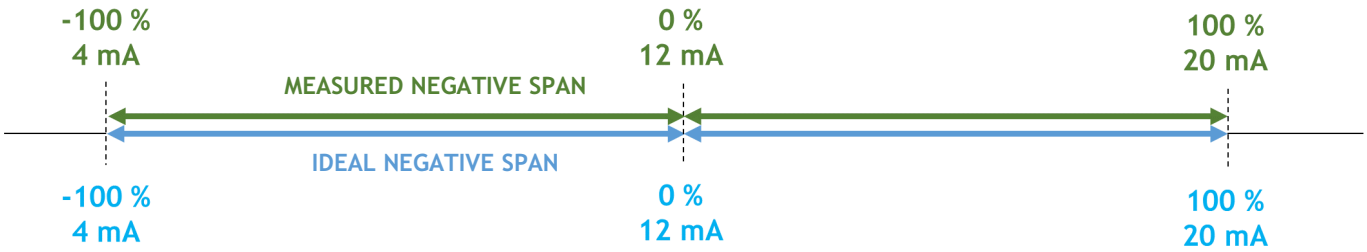
OPTIONAL: Negative side Span Adjustment

As an advanced feature, it will be possible to adjust the translated span of the negative span (when LRV is below zero). First configure the positive span side, as described above. Then you can experience a negative span side as below:



With measure at Minimum

It is possible to set the measure at LRV value using the SET S. LRV command:



INFORMATION!
To restore any unwanted change it is possible to select the RESTORE function in the menu or simply reset the SPAN URV and SPAN LRV value to the default value of 1.0.

4.3 → KEYBOARD CONFIGURATION

The electronic transmitters have some configuration functions available via keyboard and LCD display, provided with the transmitters themselves.

- Press the [MENU] button to enter the password entering dialog (the default password is 0000). Confirm by [OK] to enter the configuration menu.
- The display will allow to choose from the different functions described in the table below. Use the ⇧ and ⇩ buttons to show the sequence of the available functions and press [OK] to confirm the selected function.
- When the display is in numerical entering mode, the cursor will blink.
- To move the cursor press the ⇩ button; to raise the value of the digit press the ⇧ button. Press the [OK] button to confirm; use instead the [MENU] button to cancel the modifications and to go back to the standard display.

Function	Display name	Use	Choice span
Lower Range Value setting	**LRV**	Indicates and allows you to manually enter the initial value of the interval (the value corresponding to the 4 mA output). The unit of measurement is displayed at the bottom right of the screen.	Between the sensor limits
Upper Range Value setting	**URV**	Indicates and allows you to manually enter the final value of the interval (the value corresponding to the 20 mA value). The unit of measurement is displayed at the bottom right of the screen.	Between the sensor limits

Function	Display name	Use	Choice span
Measuring unit selection	**PV UNIT** (disabled in volumetric flow meters mode)	Measuring unit selection from the available ones. Press ⇧ o ⇩ to scroll.	**Pressure:** bar, mbar, Pa, hPa, kPa, MPa, mmH_2O, cmH_2O, Kg/cm^2, mmHg, psi, Torr, inHg, Atm, FtH_2O, g/cm^2, inH_2O **Level:** m, mm, cm, in
Sensor Temperature unit	**TEMP UNIT**	Temperature unit selection from the available ones. Press ⇧ o ⇩ to scroll.	°C, °K, °F
Configuration of the measuring unit typology	**XFR FUNC**	Not configurable in this series	LIN
Fault configuration	**ALARM TYPE**	Fault condition analog output selection.	NONE = no action 21mA 3.85mA LAST = last read value
Damping setting	**DAMP VALUE**	Insert the signal averaging time constant.	0 ÷ 60s
4mA input automatic setting (zero)	**SET LRV**	At button pushing, the instrument modifies the value of LRV and places it equal to the currently measured value. In this way, the analog output is 4 mA.	-

Function	Display name	Use	Choice span
20mA output Entrant setting (span)	**SET URV**	At button pushing, the instrument modifies the value of URV and places it equal to the currently measured value. In this way, the analog output is 20 mA.	-
Analog output test	**LOOP TEST**	It is possible to fix the analog output of the transmitter to a required mA value.	3.85 ÷ 21mA
Analog output calibration	**CAL 4-20mA**	The transmitter fixes the output to 4mA and asks by display to check the value (OK? YES/NO). Choose NO if the output is incorrect and insert the value read on an external Ammeter. Do it again until necessary. The same procedure for 20mA follows.	-
Hart® polling address	**ADDRESS**	Hart® polling address modification.	0 ÷ 15
Transmitter information	**INFO**	The polling address, the lower sensor limit (LSL), the upper sensor limit (USL) and the firmware revision are shown.	-
Password setting	**PASSWORD**	Allows to insert a new password for the transmitter. To be used with care.	0000 ÷ 9999
Set Span for URV	**SET S. URV**	Set the current measurement to the URV value, automatically calculating the required Span URV.	-
Expert command: Span Value URV	**SPAN URV**	Indicates and allows the manual entering of linear correction for URV value.	0.500 – 2.000 Three decimal places

Function	Display name	Use	Choice span
Zero re-setting	**OFFSET**	Set the current measurement to zero, automatically calculating the required zero elevation.	-
Expert command: Manual zero elevation	**ZERO ELEV.** (disabled in volumetric flow meters mode)	Indicates and allows manual entry of zero elevation value.	6 digits, including "-" sign and decimal point
Set Span for LRV	**SET S. LRV**	Set the current measurement to the LRV value, automatically calculating the required Span LRV.	-
Expert command: Span Value LRV	**SPAN LRV**	Indicates and allows the manual entering of linear correction for LRV value.	0.500 – 2.000 Three decimal places
Expert command: Specific Gravity	**SPEC.GRAV.**	Indicates and allows manual entry of the specific gravity value.	0.1 ÷ 3.0
Factory setting restore	**RESTORE**	Select and confirm using buttons ⇧ and [OK].	-

INFORMATION!
The password is in 4 digits format and spans from 0000 to 9999. If you can't remember or find the password you set, please contact our technical department.

5 → MAINTENANCE AND TROUBLESHOOTING

Although transmitters SST7X do not require a maintenance on periodical basis, it is good practice to regularly check the general transmitter status, the possible presence of rust or damage on the case or on the measuring diaphragm and the presence of clogging in the process connection.



PROHIBITION!
Repair, maintenance and/or overhaul of the equipment shall only be conducted by the manufacturer himself, or by a repairer he has qualified or authorized.

Is forbidden during the maintenance operation to use the tool as a handle or step.



Please refer to the following pages scheme for troubleshooting.
In any case contact our technical department for help.

Condition	Potential source	Solution
The transmitter doesn't turn on	Supply	Check the supply voltage to be 12,5Vdc<V_{supply}<30Vdc.
	Polarity	Check the transmitter connection polarity.
	Electrical load	Check that the load is less than the maximum allowed.
Measure is incorrect	Process	Accurately verify the compatibility between the process and the connection type.
	Sensor drift	Apply zero input conditions to the transmitter and use the OFFSET command.
	EMC interference	Accurately verify the possible presence of electromagnetic interference on the supply line. Check the PE connection.

Condition	Potential source	Solution
Wrong Analog Output	Wrong span limits	1) Verify that LRV and URV values are the ones you want; 2) In the start-scale process condition, use OFFSET command to correct the measure to zero; 3) In the full scale process condition, use SET S. URV (set span URV) command to correct the URV value; It is possible to correct only the analogical output, by changing the LRV or URV values (alternatively editing SET LRV and SET URV) to set the instrument measure at 4 mA or 20 mA.
	Uncalibrated analog output	Use the LOOP TEST command to verify the analog output calibration. If it is not correct, use the CAL4 - 20mA command to calibrate the output.
	Incorrect HART® settings	Use the ADDRESS command to verify that the polling address is set to 0.
Analog output <4mA or >20mA	Transmitter in fault mode	Check if the output isn't out of the allowed span or check the presence of a failure (e1, e2, … on display).
	Wrong fault settings	Check the settings using the ALARM TYPE command.
Unstable measure	Measuring disturbs	Set an input average using the DAMP VALUE command (i.e. 10 seconds).
Impossible to access the menu	Wrong / forgotten password	Contact us for help

5.1 → DISPLAY ERROR CODES

Type of error	Description
ALARM HIGH	OVER RANGE: this message is shown if PV is greater than URV by 10% of the span.
ALARM LOW	UNDER RANGE: this message is shown if PV is lower than LRV by 5% of the span.
LCD OV	LCD OV: this message is shown if PV < -99999 or PV >99999.
EE CHK ERR	This message depends by an error configuration of the EEPROM memory
EE ADC ERR	This message is shown if there are PV calculus error in primary ADC input. If it persist contact Spriano® for help
T EX AD ER	This message is shown if there are on external temperature signal calculus error in secondary ADC input. If it persist contact Spriano® for help
T IN AD ER	This message is shown if there are on internal temperature signal calculus error in secondary ADC input. If it persist contact Spriano® for help
PR ADC ER	This message is shown if there is an error in calculating the input of primary ADC pressure signal. If persist contact Spriano® for help.
NaN	Indicates a sensor damage.

5.2 → SPARE PARTS

Below is the list of spare parts available for SST76 instrument.
Together with the request of spare parts it is required to indicate Serial Number of the Transmitter to control that the correct components will be delivered.

Item	Product Code	Description	Quantity
01	DISPLAY COVER	Cover with display glass	1
02	BLIND COVER	Blind cover terminals side	1
03	COVER O-RINGS	Gaskets for enclosure covers	2

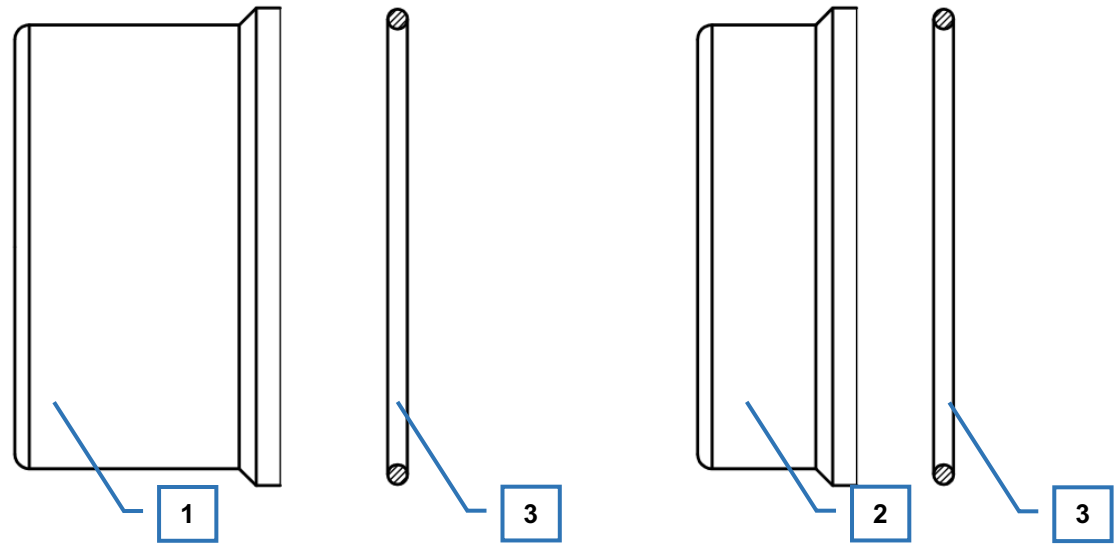


Figure 12: spare parts

6 → MARKING

On the transmitter enclosure is fixed an identification plate with inscriptions showing the characteristic data of the instrument.
Refer to **Figure 13**, the Transmitter is provided with the following information:

1. Name and address of the manufacturer
2. CE marking followed by the identification number of the notified body involved in the production phase
3. Designation of series or type
4. Serial number (with the Year of construction)
5. ATEX marking for equipment-group II, followed by the specific marking of explosion protection (see 1.3 → Definitions And Symbols)
6. PED essential allowable limits: allowable Fluids, Maximum working pressure (PS), Nominal size (DN), etc.

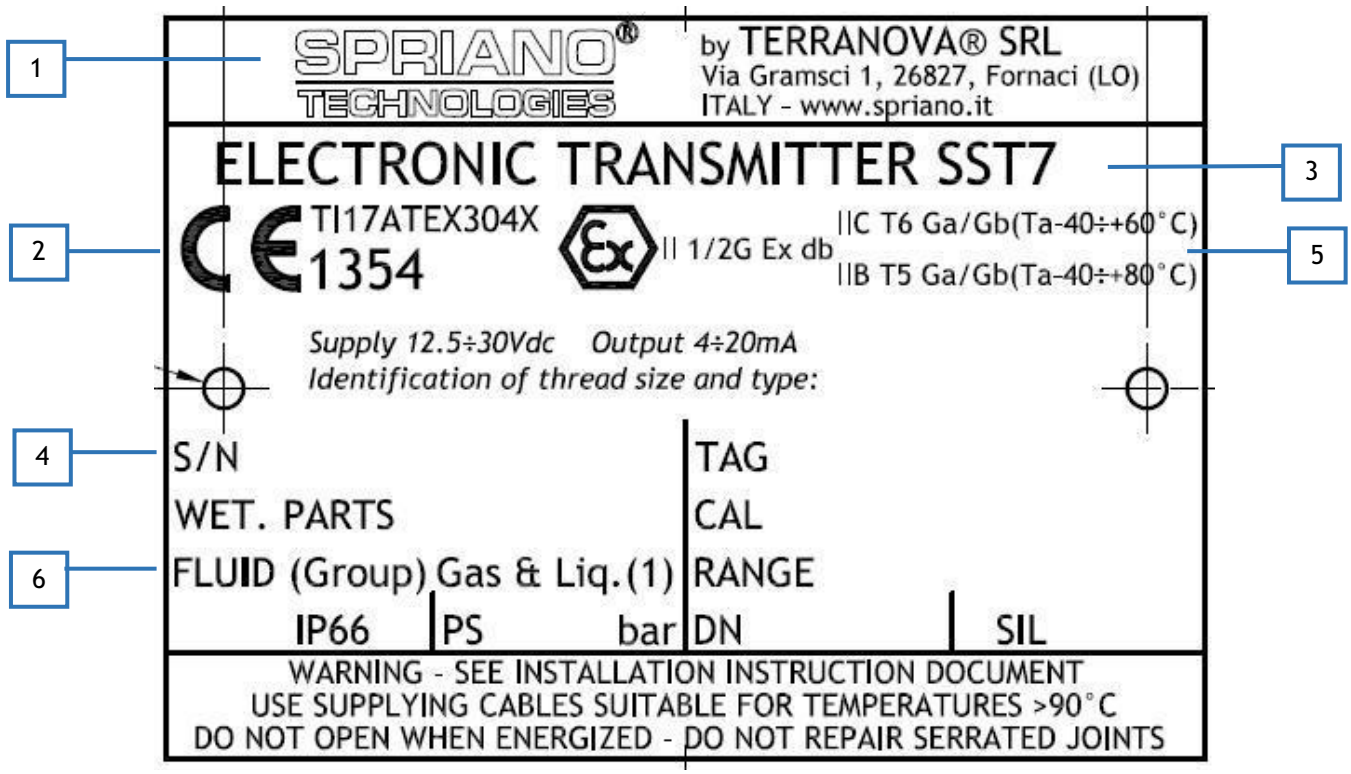


Figure 13: marking plate

7 → DATA SHEET

FUNCTIONAL DATA
With reference to the following, please note these definitions:
Nominal range: (referred to the sensor mounted in the
instrument) the measured pressure range for which the sensor has been designed. Defined as a minimum and maximum value.
Nominal span: the interval between the minimum and maximum values of the sensor nominal range. The span is a single number.
Measuring range: the minimum and maximum range values for which the transmitter is to be calibrated.
Measuring span: the interval between minimum and maximum values of the measuring range.
Input scale initial value or zero input: minimum pressure value within in the measuring range.
Input full scale value: maximum pressure value within in the measuring range.

TRANSMITTER PARAMETERS
The parameters that are available for display and setting are:
Measuring span: possibility to change from 3,3% to 100% of the nominal span.
Zero adjustment: digital calibration ± 15%.
Low/upper range values: they can be set within the nominal range provided that the span > minimum span.
Damping: digitally adjustable from 0 to 60 sec. (minimum response time ~ 0,1 sec.).
Reverse output: automatically obtained via software.
Transfer function: linear/square root via software.
Self-test: in case of malfunction the analog output is forced to the fail-safe state 3.85 mA or 21 mA.
Measuring units: 18 different pressure units or % of the
measuring span, selectable via software.

PHYSICAL CHARACTERISTICS
Power supply: 12,5-30 Vdc
Output signal:
Analog 4-20mA, 2 wires.
Digital using HART® protocol
Response time: <256 ms (Std Hart®)
Measured value update frequency:
4-20 mA + Hart® output: ~1s
Hart® output only: ~500 ms (on request)
Polling time:
4-20 mA + Hart® output: ~800 ms
Hart® output only: ~500 ms (on request)

AMBIENT CONDITIONS
Temperature:
Process fluid: -40 ÷ +80°C (with finned arm: up to 150°C; with syphon: up to 235°C; with capillary: up to 283°C)
Housing: -40 ÷ +80°C
Handling and storage: -40 ÷ +90°C
Relative Humidity: 0 a 100% R.H.
LCD display reading: -10 ÷ +65°C

PERFORMANCES
Output resolution: < 0,01% nominal range (at 20°C)
Total accuracy[1]: up to <0.07%FS (0 ÷ 80°C)
<0.2%FS (0 ÷ -40°C)
Dead band: negligible
Display resolution: 0.1

INFLUENCE OF OPERATING CONDITIONS
Thermal drift: referred to -10 ÷ +80°C range.
- **Zero:** ± 0,1%/10°C.
- **Span:** ± 0,1%/10°C at nominal range.

Long term stability: <0.1%FS/year
Power supply effect:
Negligible between 12.5 and 30 Vdc.

[1] Including hysteresis, non-linearity and repeatability (IEC 60770)

PHYSICAL SPECIFICATIONS
Housing: die cast aluminum alloy EN AW-6082 finished with epoxy resin (RAL 5014). It is dust and sand tight and protected against sea wave effects as defined by IEC IP66. Suitable for tropical climate operation as defined by DIN 50015.
Covers O-ring: EPDM.
Filling fluid: silicone oil.
Nameplate: stainless steel, fixed on housing.
Calibration
Standard: at nominal range, direct action, linear.
Optional: at the conditions specified with the order.
Electrical connections: two cable entries on electronic housing: 1/2" NPT and cable gland PG 13.5 for 7 to 12mm diameter cable.
Terminal board: 2 terminals for signal wiring up to 1.5mm^2 (14 AWG). Connection for ground and cable shield.
Mounting position: any position.
Net weight: 2.4kg approx.

PROCESS WETTED PARTS
Process connections: AISI 316.
Diaphragm: see ordering information table.

OPTIONS
Finned extension, siphon or remote mounting with capillary: for working temperature higher than 80°C up to 283°C.
Bracket: for 2 inch pipe mounting.
Degreasing for oxygen service.
Stainless Steel Housing: AISI 316 (IP66).

7.1 → FUNCTIONAL SAFETY ACCORDING TO IEC 61508 / IEC 61511

The assessment of the safety critical and dangerous random errors results, provided that the attached safety instructions are observed and an annual function test is performed, in the following parameters:

Transmitter Type	λ_{DD}	λ_{DU}	λ_S	λ_{TOT}	SFF	SIL
SST76	7.5072×10^{-8}	1.0725×10^{-8}	8.0434×10^{-8}	1.6623×10^{-7}	91.67%	2

7.2 → MAIN DIMENSIONS

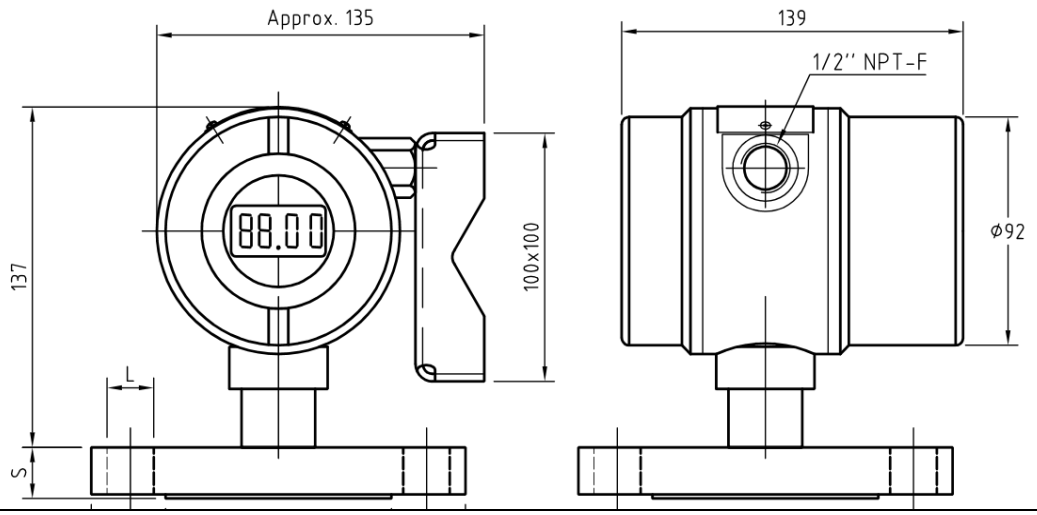


Figure 14 – flanged connections UNI, ASME etc.

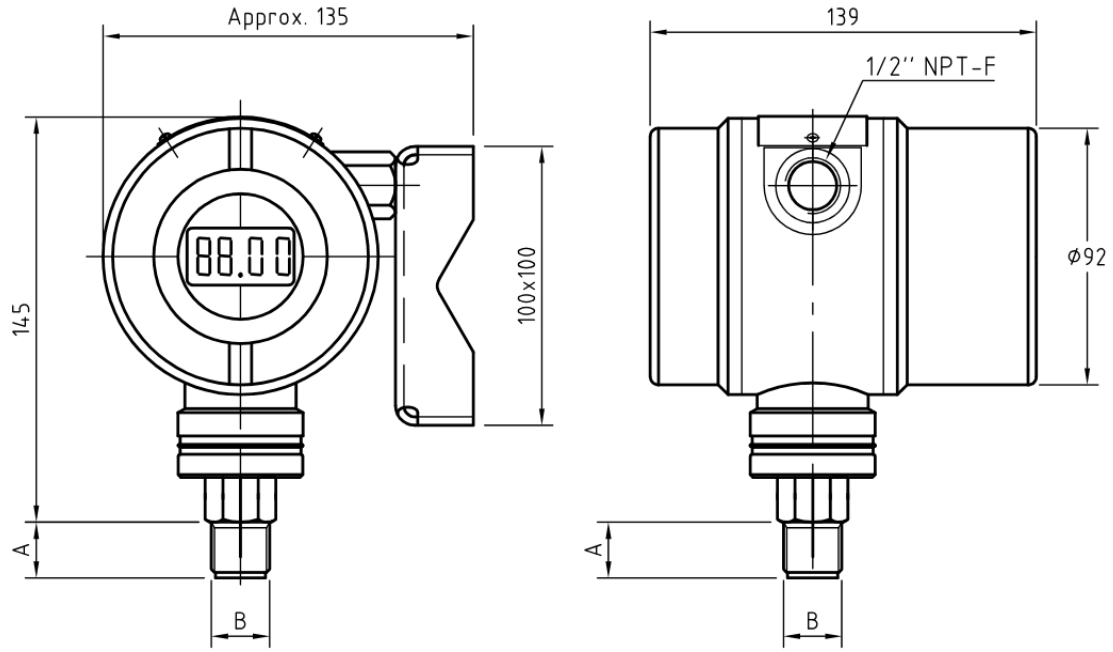


Figure 15 – male screwed connections for Nominal Range up to 30 bar

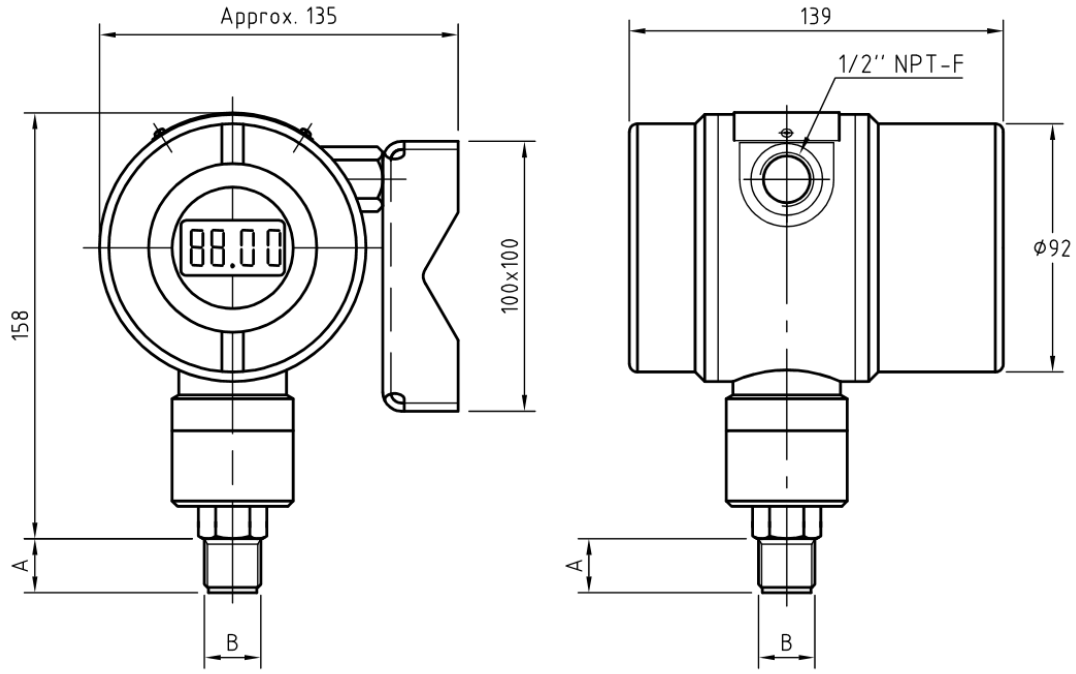


Figure 16 – male screwed connections for Nominal Range up to 100 bar

	1/4''		3/8''		1/2''		3/4''	
A	13	13	16	-	20	18	20	14
B	G	NPT	G	NPT	G	NPT	G	NPT

Note: 1/4'', 3/8'' and 1/2'' follows standard UNI EN 837

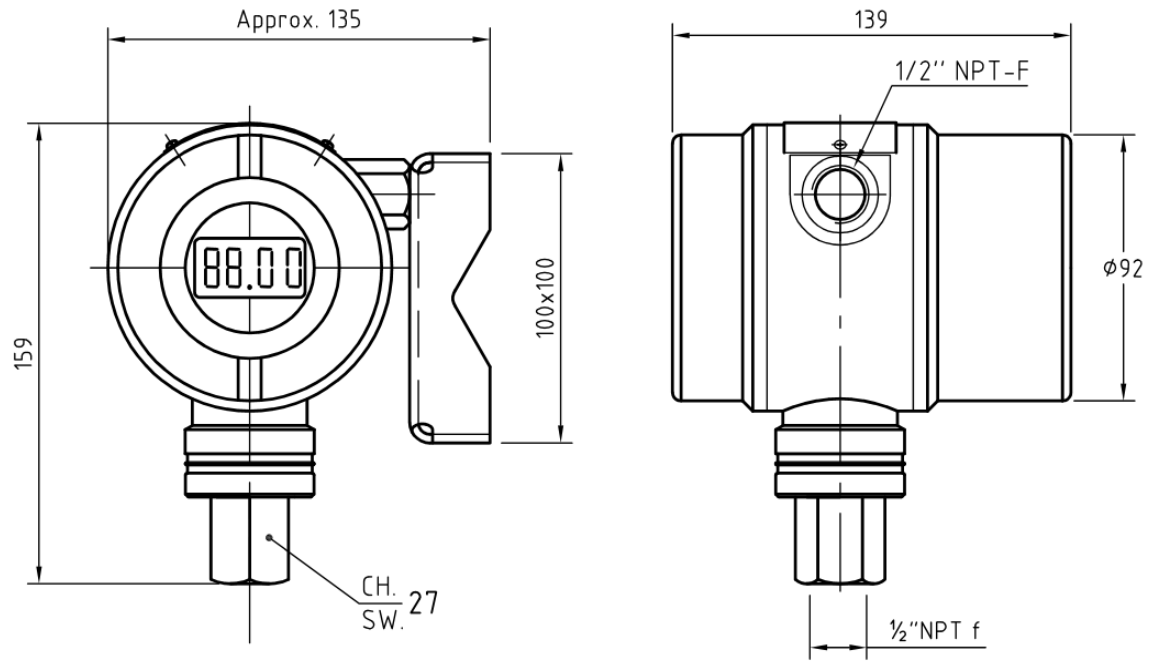


Figure 17 – female screwed connections for Nominal Range up to 30 bar

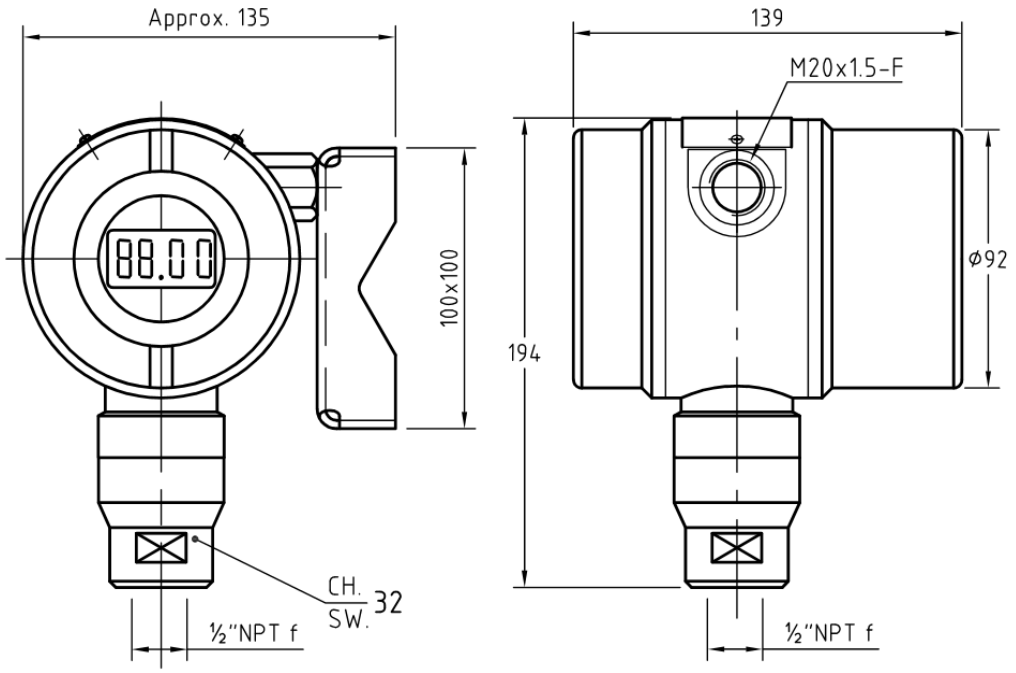


Figure 18 – female screwed connections for Nominal Range up to 100 bar

	1/4''		3/8''		1/2''		3/4''	
A	13	13	16	-	20	18	20	14
B	G	NPT	G	NPT	G	NPT	G	NPT

Note: 1/4'', 3/8'' and 1/2'' follows standard UNI EN 837

NOTES



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OPERATING and MAINTENANCE MANUAL for SST72 TEMPERATURE TRANSMITTERS

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SST72 TEMPERATURE TRANSMITTER



PED

SIL
IEC 61508 / IEC 61511

FIELDCOMM GROUP
MEMBER

HART
COMMUNICATION PROTOCOL

ORIGINAL INSTRUCTIONS

SPRIANO®
TECHNOLOGIES

CE 1354

EU Declaration of Conformity

TERRANOVA® Srl

Via Gramsci 1 – 26827 Terranova dei Passerini (LO) – Italy
declares on his sole responsibility that the product:

SPRIANO® Electronic Transmitters series

SST70, SST71, SST72, SST75, SST76, SST77B, SST77BL, SST79B, SST70-REM

(device controlling or regulating the limits of an industrial process, like pressure, level and vacuum)
satisfies the essential requirements and conformity assessment procedures of the following legislation:

Directive 2014/34/EU (ATEX)

EU TYPE CERTIFICATE: TI 17 ATEX 304 X

Equipment for use in potentially explosive atmospheres, suitable for Zones 0, 1, 2 (process side and external side)

II 1/2G Ex db IIC T6 Ga/Gb for use in the ambient temperature range –40°C to 60°C
II 1/2G Ex db IIC T5 Ga/Gb for use in the ambient temperature range –40°C to 80°C

Presumption of conformity provided by the application of the harmonised standards:
EN 60079-0:2012+A11:2013 - EN 60079-1:2014

The Notified Body NB 1354 Technicka inspekcia a.s. performed Module D, Annex IV, Directive 2014/34/EU and issued the Production Quality Assurance Notification. Periodical Surveillance is provided according to Annex IV, Point 4, Directive 2014/34/EU by the same Notified Body.

Directive 2014/68/EU (PED)

EU DESIGN EXAMINATION CERTIFICATE: 1292/1/2017-2÷8

Pressure equipment, up to Category IV, for fluids (gases, liquids and vapours) in Group 1.

Conformity provided by the application of the harmonised standard:
EN 13445-1:2015, EN 13445-2:2015, EN 13445-5:2015

The Notified Body NB 1354 Technicka inspekcia a.s. performed Module H1, Directive 2014/68/EU and issued the Production Examination Certificate. Periodical Surveillance is provided according to Directive 2014/68/EU by the same Notified Body.

Directive 2014/30/EU (EMC)

Equipment with an adequate level of electromagnetic compatibility.

Presumption of conformity provided by the application of the harmonised standard:
EN 61326-1:2006

Terranova dei Passerini, 04/08/2017

Mr Sergio Valletti,
General Manager

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WARNING!
Exclusively follow the instructions indicated in this document. Failure to comply with this document may cause injury to health or may damage the equipment.

SPRIANO® TECHNOLOGIES do not takes any kind of responsibility for damages due to failure to comply with this document.

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1 → INTRODUCTION

1.1 → PRODUCT OVERVIEW

Electronic transmitters series SST7X are apparatus which use a piezoresistive sensor for pressure, level and temperature measurement, and transmit a current signal (4 ÷ 20mA) proportional to the variable measured. The series SST7X is composed by the following types:

SST70	Displacer level transmitter
SST71	Smart Float Level Transmitter
SST72	Electronic temperature transmitter
SST75	Absolute or relative pressure transmitter
SST76	Absolute or relative pressure transmitter with diaphragm
SST77B	Differential pressure transmitter
SST77BL	Level transmitter
SST79B	Immersion level transmitter
SST70-REM	4÷20mA loop powered field digital indicators (External local indicator)



MANDATORY!
The accessories used for the cable entries and to close unused shall be certificated according to the standards EN 60079-0 and EN 60079-1 for the gas groups IIC or IIB, according to the type of protection implemented.

1.2 → ATTENTION!

This manual does not contain information concerning all type of Transmitter or all different installation and/or working and mounting solutions. For more information or for particular problems not considered in this manual, please address to our technical office.
The warranty period is the one contemplated in our general servicing conditions. This warranty is neither increased nor restricted by the contents of this manual.
This Transmitter has to be installed and used only by qualified persons who have first checked the correctness of supply voltage so that both in standard working conditions and in presence of damages of the plant or of any part of it, no dangerous voltage can reach the Transmitter. As the Transmitter can be utilized both with high pressure values and with aggressive media it must be considered that an incorrect use of it could bring even serious damages to people and things. A correct and safe working needs an adequate transport, stock and mounting other than an appropriate maintenance service. So it is necessary for the people handling these Transmitter to have knowledge and experience in mounting, servicing and working and to have title to do their job with reference to “Safety Standards”.

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1.3 → DEFINITIONS AND SYMBOLS

In this manual are used the following symbols and labels

	Equipment for use in potentially explosive atmospheres
II 1/2G	Equipment Group II Category 1/2G, suitable for potentially explosive area (gases, vapours or mists); to be installed in a separation wall between Zone 0 (process side) and Zone 1 (external side)
Ex d	Device with Explosion Proof Enclosure
IIC	Group IIC apparatus, fit for substances of group IIC, IIB and IIA (only when used in the ambient temperature range –40°C to 60°C)
IIB	Group IIB apparatus, fit for substances of group IIB and IIA (when used in the ambient temperature range –40°C to 80°C)
T6, T5	Temperature Class of the transmitter (maximum surface temperature) ➢ only when used in the ambient temperature range –40°C to 60°C ➢ only when used in the ambient temperature range –40°C to 80°C
Ga/Gb	Equipment to be installed in the boundary wall between an area requiring EPL Ga and the less hazardous area



WARNING!
Warning label, used to warn about hazardous materials, locations, or objects, including electric currents, poisons, and other things.



PROHIBITION!
Prohibition label, used to indicate something is not permitted.



MANDATORY!
Mandatory label, used to set obligation tasks to be performed by the user.



INFORMATION!
Information label, used to set general information for the user or warn about hazards for the equipment.

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2 → DESCRIPTION

The SST72 series SMART temperature transmitters are microprocessor based instruments that combine the analog signal advantages (4 - 20mA) together with the flexibility of digital communication using HART® protocol. They can be remotely configured by a universal hand held terminal (HHT) or by a PC with a dedicated interface.
Moreover, it is possible to configure locally the instruments (zero and span) by means of push buttons and to display the data on the wide LCD display. The SST72 transmitters are able to accept 3 wires PT 100 Ohm resistance thermometers and total accuracy is depending on class of the sensors utilized such as DIN A, DIN B, 1/3 DIN, 1/5 DIN,1/10 DIN etc.
Based on these readings the microprocessor generates the 4-20mA analog output "two wires system" and displays the measurement on the LCD. Some of the main characteristics of this microprocessor based transmitter are:

- Wide Rangeability;
- Automatic temperature compensation;
- Digital communication using HART® protocol.

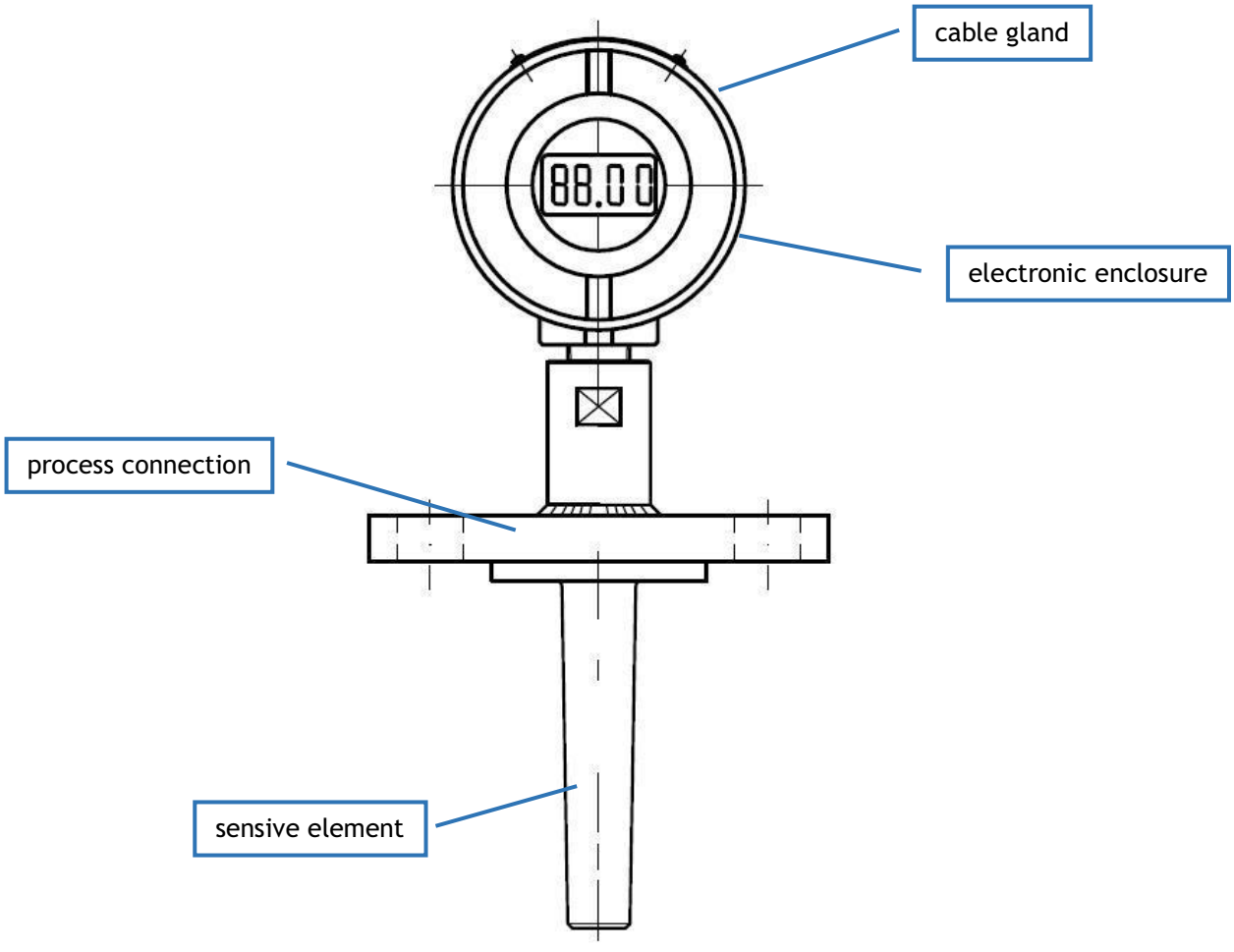


Figure 1: SST72 electronic temperature transmitter

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3 → INSTALLATION

3.1 → TRANSMITTER IDENTIFICATION

Transmitter data can be found on the nameplate fixed on the top of transmitter enclosure (see 6 → MARKING). The Serial Number must be quoted at the occurrence of a specific request to the manufacturer.

3.2 → GENERAL MOUNTING REQUIREMENTS

Prior installation shall be observed following considerations:

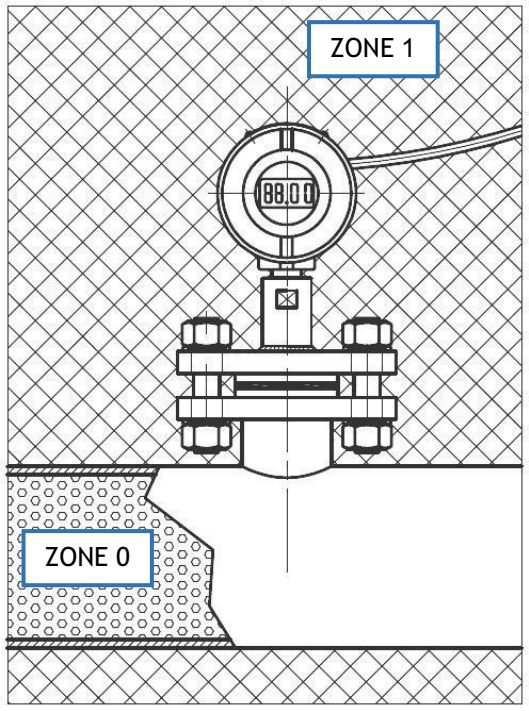
- Check whether Transmitter's operating conditions are within the limits as reported in the nameplate, technical specifications sheets and/or label.
- Make sure that the operating conditions are compatible with the specification given to the manufacturer.

MANDATORY!

- For measurement in the presence of particularly hot liquids (e.g. steam) make sure that the Transmitter is supplied with a suitable finned arm or siphon.
- For viscous liquids or those containing solid particles in suspension make sure that the connection to the process is a suitable one in order to avoid clogs.

WARNING!

Direct sunlight may cause serious damages to the instrument.
Never install standard Transmitter under the sun or in any other location which could cause direct overheating through radiation.



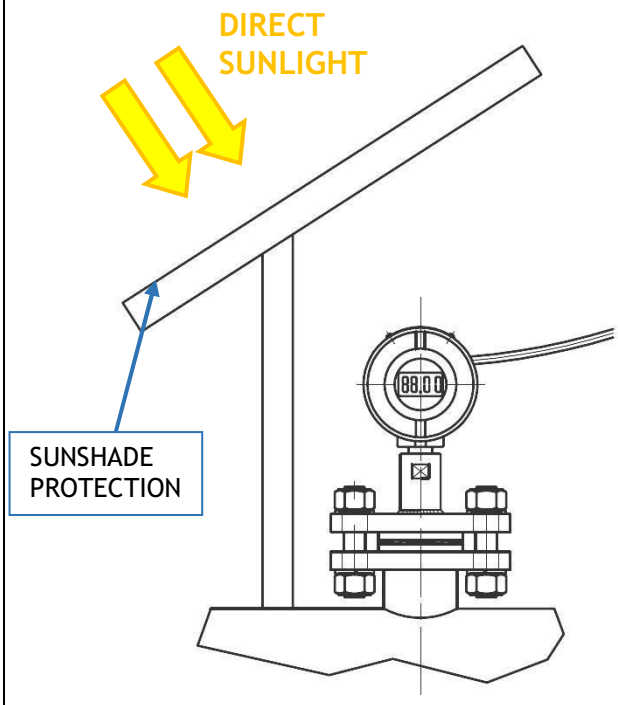


Figure 2: mounting requirements

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3.3 → MECHANICAL INSTALLATION

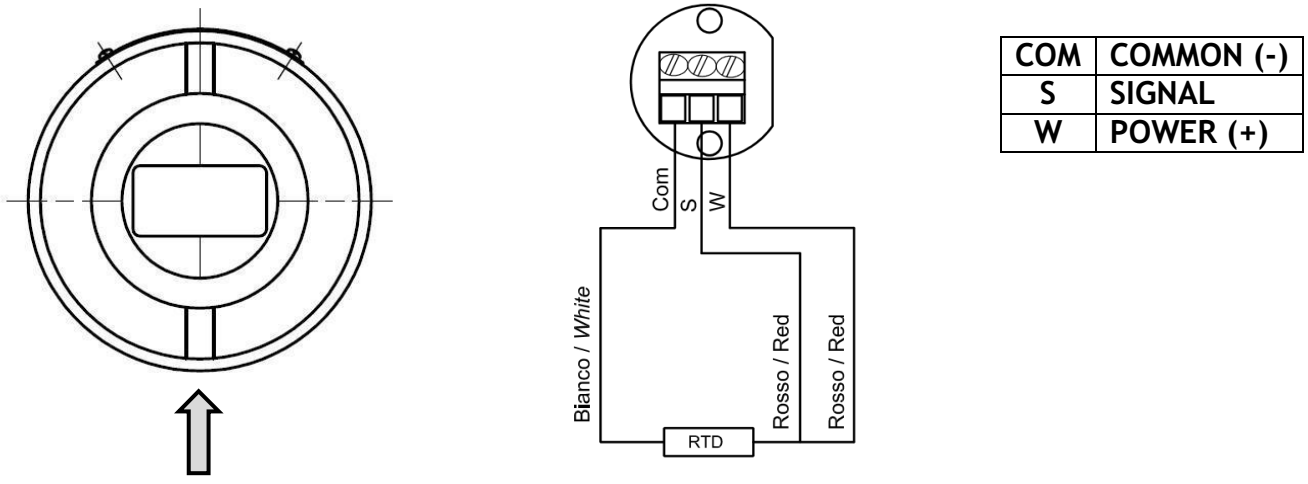
The Transmitter should be located, if possible, at some easily accessible, well lighted place on the vessel or pipe, in order to allow putting in operations and maintenance work. Location should also be such that ambient temperature at the Transmitter enclosure be not excessive (see 6 → MARKING).

INFORMATION!
- Plant overpressure / over-temperature: observe rating plate
- Installation on seismic areas: inform technical department
- In case of unstable fluids: inform technical department
- In case of damages: inform technical department
- Inspection frequency: consideration should be given to applicable national legislation.

WARNING!
- The process connection must be realized in such a way that guarantees the hold at the maximum working pressure and temperature.
- Do not overcome the maximum pressure and temperatures indicated in the technical data sheet of the selected model.
- When the device is connected to the process it can be submitted to high pressures and temperatures. To avoid accidents subsequent to sudden discharge of pressure and/or to contact with dangerous or flammable fluids it is necessary to take the maximum attention when the Transmitter is taken off, heated or repaired, verifying that it is isolated from the process and is not submitted to pressure and/or temperature.

3.4 → SENSIVE ELEMENT CONNECTION

The transmitters SST72 allow to measure the temperature by means of PT100 (3 wire), within industrial processes and in different operating conditions.



COM	COMMON (-)
S	SIGNAL
W	POWER (+)

Figure 3: connection PT100 head transmitter

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3.5 → ELECTRICAL CONNECTION

Under the rear cap is placed the terminal block reporting the electric polarity (**Figure 4**).
Insert the power supply cable into the enclosure through one of the two threaded openings. Transmitter is protected from accidental inversion of polarity. For a better use is recommended a twisted pair cable (22 AWG min). Avoid placing Transmitter near devices powered in AC or Switching. Connect ground-tap of the Transmitter to the local common earth (PE) as indicated in paragraph 3.7 → Earthing.

WARNING!
The threaded opening that is not used must be sealed using a suitable cap. The caps included in the delivery are only for protection during transport.

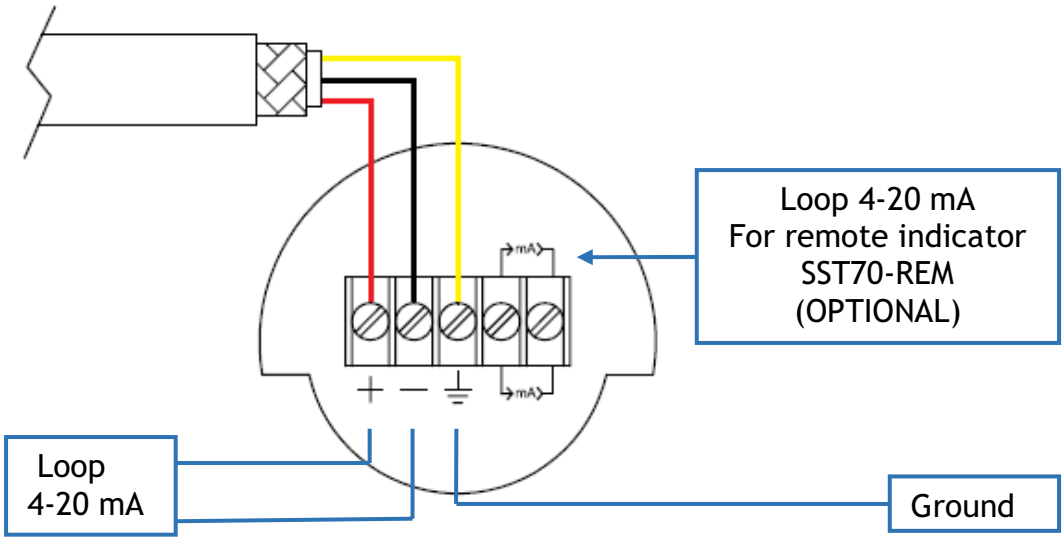


Figure 4: electrical connection of the power cable to the terminal block

INFORMATION!
Impedance of the cables defines the possible maximum length for digital communication. It's recommended using cable with a low impedance. The maximum length of the point to point connection, with a load of 250 ohm and single twisted cable 22 AWG-207 pF/m it's about 1000 meters.
The maximum connection length for the analog signal only is limited by the loads (connected devices and cable) present in the current loop.

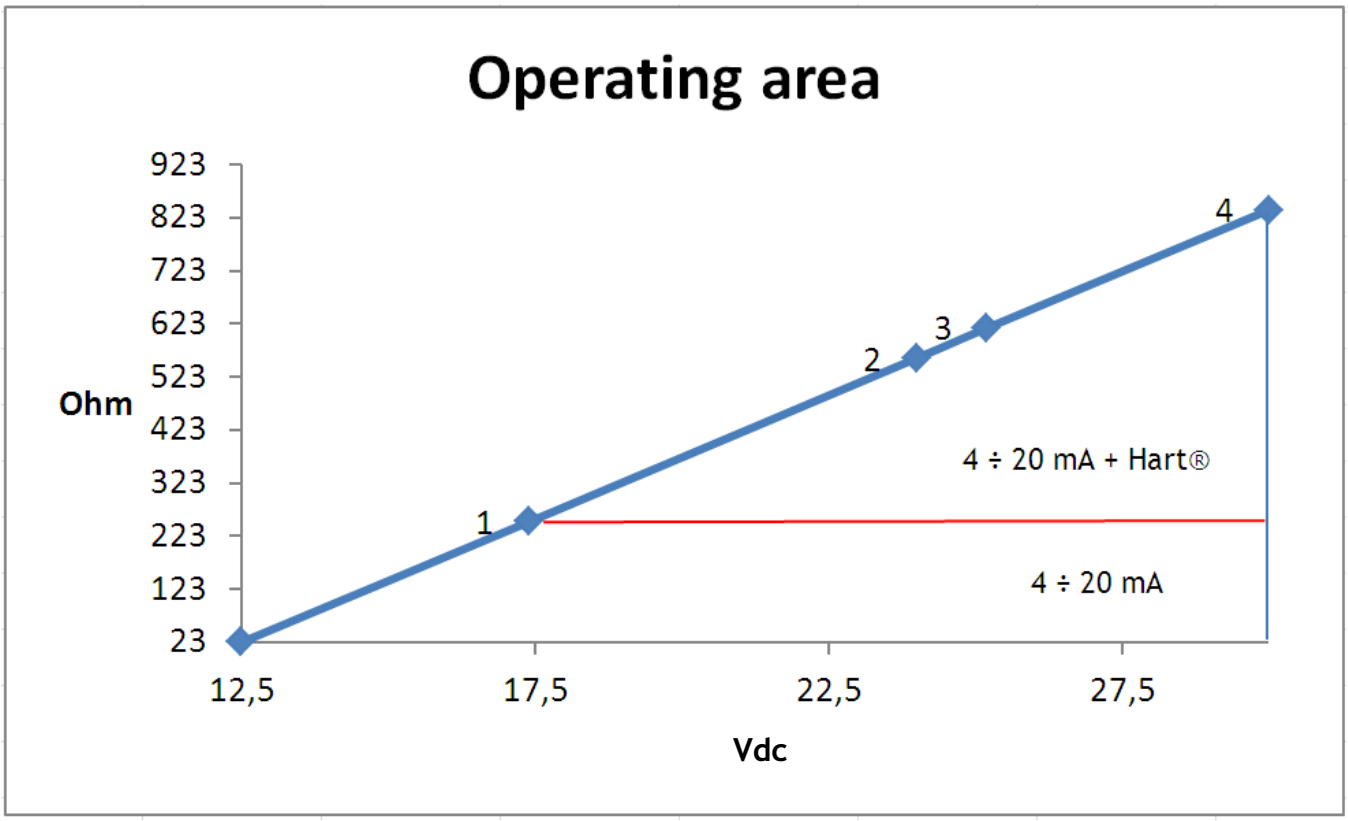
To obtain output signal of 4-20 mA, you have to determine the minimum supply voltage as a function of the load relation: see **Figure 5**. From the following formula you can achieve the right minimum value of supply voltage:

$$V_{dc} = 0.0215 \times R_L + 12$$

Where: R_L = output load [Ohm].
The power supply source must assure a minimum current value of 24 mA.

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MANDATORY!
In order to obtain a 4÷20 mA + Hart® output a minimum load of 250 Ohm is required.



TAG	-	1	2	3	4
Vdc	12.5	17.4	24	25.2	30
Ohm	23	250	558	615	837

Figure 5: operating area for Ex ia protection

The electronic transmitters totally comply with the HART® protocol specification Revision 6.0, so they include remote process variable interrogation, parameter setting and diagnostics.
The device is a 4÷20mA 2-wire transmitter, with FSK communication.
It is possible to read via HART® the following variables:

- **PV**: transmitter main measure;
- **SV**: % of the span;
- **TV**: analog output;
- **QV:** electronic board temperature.

Please refer to **Figure 6** for the Hart® modem connection on transmitter's 4÷20mA loop.
In **Figure 7** the multidrop connection type is shown.

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It is possible to purchase the Hart Server as an additional product; this is a software including all the interrogation, configuration and diagnostics functions required by the Hart® specifications.

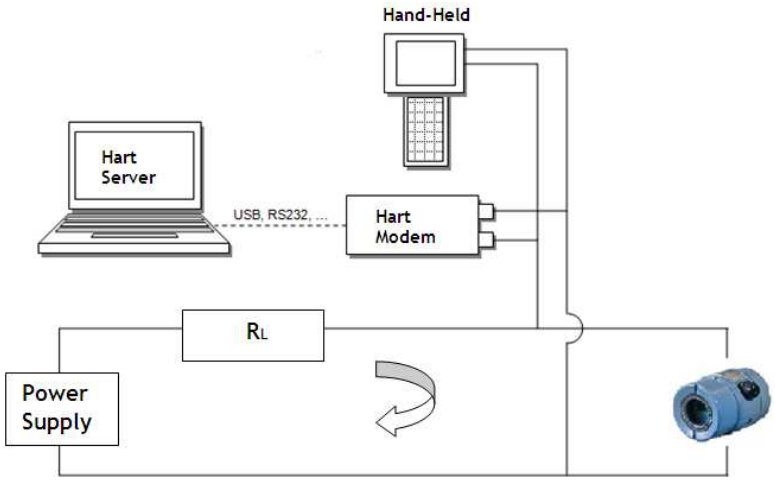


Figure 6: 4÷20 mA + Hart® modem connection

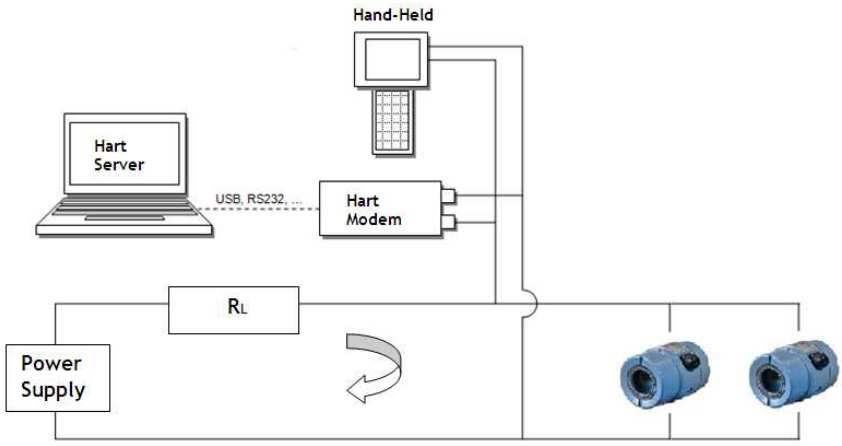


Figure 7: only Hart® multidrop connection

INFORMATION!
At maximum 15 transmitters could be connected in parallel on the same line.
Attention: when more transmitters are connected on the same line the current standing on the resistor (250-ohm) is equal to

4mA x N of connected instruments.

This could cause a high electric potential. Be sure power supply is sufficient.

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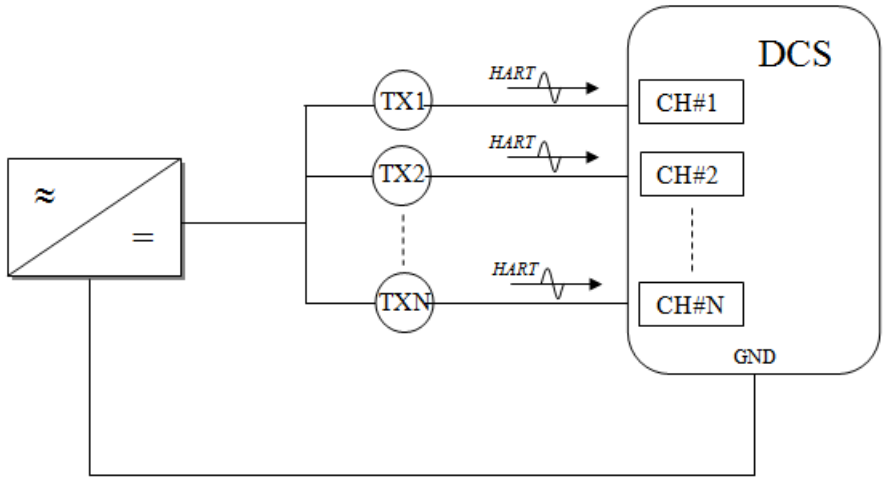


Figure 8: DCS connection

MANDATORY!
Transmitter response time is <256ms.
DCS POLLING time must be set approximately at 800ms in order to avoid updating problems both in analog and digital measurement.
On request the transmitter can be supplied in order to support a Polling time of 500ms but with a minimal consumption of 5 mA.

3.6 → EXPLOSION PROOF PROTECTION

In case of use in areas with danger of explosion, it must be verified that the identified type of transmitter fits for the classification of the zone and for the presence of flammable substances in the plant (see 6 → MARKING).
The safety essential requisite against the risk of explosion in the classified areas are fixed from the European Directives 2014/34/EU of 26 February 2014 (as far as it concerns the 'Equipment') and 1999/92/EC of December 16th 1999 (as far as it concerns the 'Working Environment').

WARNING!
For the electrical connections please follow the instructions brought in this operator manuals taking care that for the use in classified areas it is necessary to foresee the standard EN 60079-14.
The accessories for cable entry (which must be threaded ½" NPT) must be certified following the Standards EN 60079-Series (for Tamb >70°C must be certified for T > 90°C).

PROHIBITION!
Do not open the covers or any part of the device in dangerous area when circuit alive.
For explosion proof safety installation, it is mandatory to disconnect the electric supply before opening the device.

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3.7 → EARTHING

WARNING!
The earth connection is required to prevent damage to people and malfunction of the instrument.

- **Case 1: Installing the instrument in a plant devoid of earthing systems**

In the case where the plant devoid of earthing, it is necessary to connect the earth wire to the terminal block through the cable that carries the signal and the power supply (**Figure 4**).

- **Case 2: Installing the instrument in a plant provided with earthing systems**

Make sure the earthing (GND) of the system has the least resistance possible.
You can add an additional earth wire with section not less than 4 mm^2 to ensure such connection.

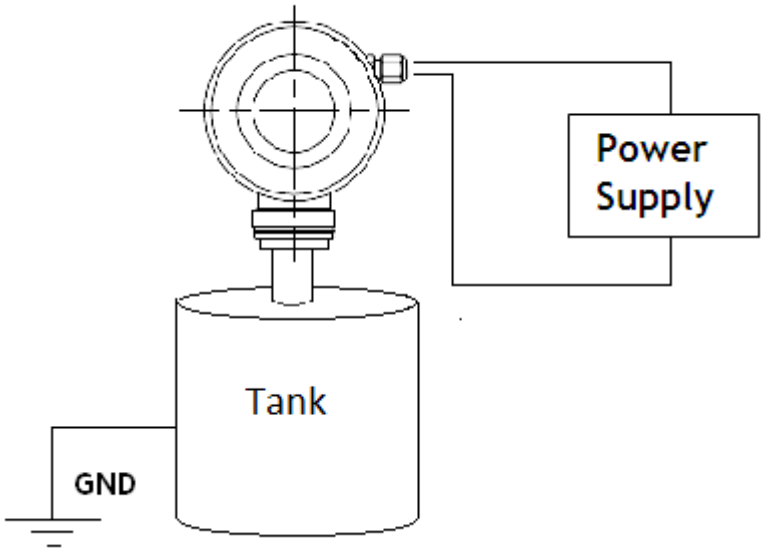


Figure 9: 4 ÷ 20 mA loop connection with plant provided with earthing systems

WARNING!
In the case represented in **Figure 10**, within the earth wire may also scroll through the current protection of other instruments where the earthing of the system (GND) had not been carried out in an optimal manner.

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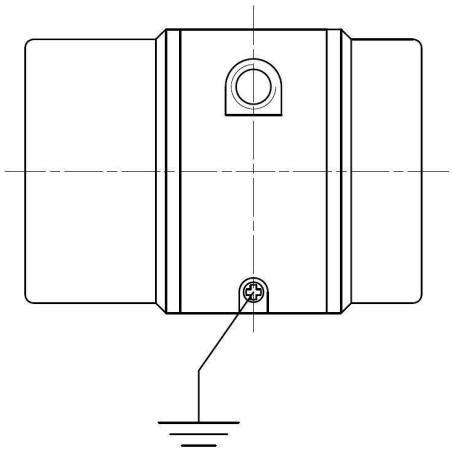


Figure 10: earthing in the housing

WARNING!
The hose must not be considered as a protection against electric shock for the protection of security, but as protection against electromagnetic interference of the instrument. Therefore, in the case of long distance cable (L> 20 m), both ends of the braid must be connected to the chassis or to the connectors. In the case of cables L <20 meters, will be sufficient to connect the braid only from the side "Power Supply".

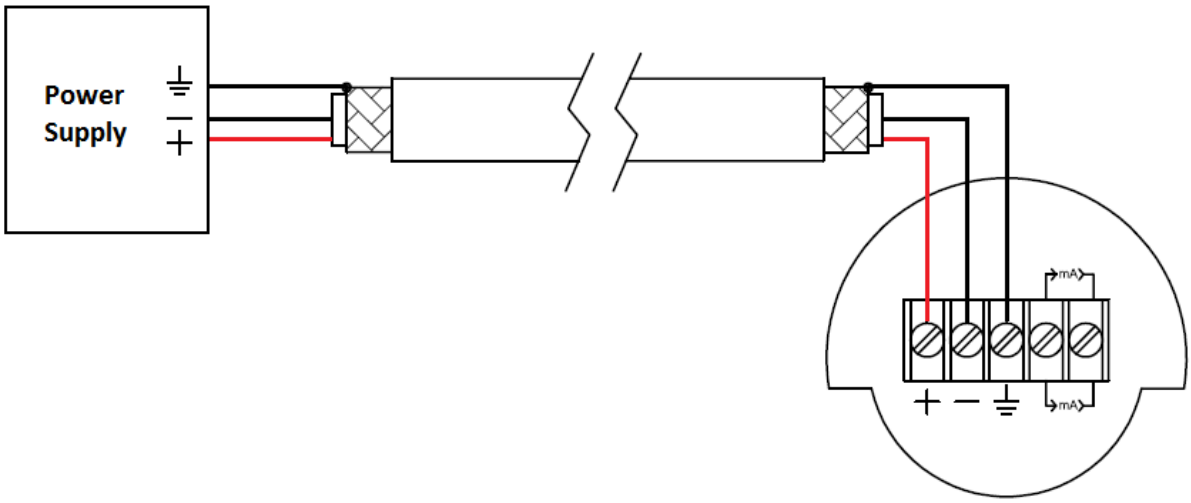


Figure 11: earthing of the sock for cables longer than 20 meters

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4 → OPERATIONS

Each transmitter is calibrated in factory and has on the nameplate the configuration data. If not differently stated in the purchase order the transmitter is configured as follow:

Upper Range Value (Highest temperature value): refer to the data sheet of unit
Lower Range Value (Lower temperature value)**:** refer to the data sheet of unit
Damping **0 sec**.

4.1 → CONFIGURATION

The transmitter shows the status and the measure on the dot matrix LCD (**Figure 12**). The span is from -99999 to 999999.
The input signal to the transmitter can be related to the output signal in the following ways:

- **Direct mode** = 4 ÷ 20mA output
- **Reverse mode** = 20 ÷ 4mA output

The direct mode is obtained by setting the lower range point with the lowest value of the range (e.g. 0 °C) and by setting the upper range point with the highest value (e.g. 5 °C). The reverse mode is obtained by setting the lower range point with the highest value of the range (e.g. 5 °C) and by setting the upper range point with the lowest value (e.g. 0 °C).
The instrument can calculate different variables. From the main screen (where the current measure is shown), you can select, using the buttons ⇩ **Next Page** and ⇧ **Previous Page**, the desired variable to keep on the display. There are available the following variables:

- PV;
- Percentage;
- Current
- Ambient temperature (after 10 seconds the PV measure is restored on the screen)

The selected variable is saved and retained even after the instrument is restarted. So, if you want a different variable, then you have to select it again.

SECTION LEAVED INTENTIONALLY BLANK

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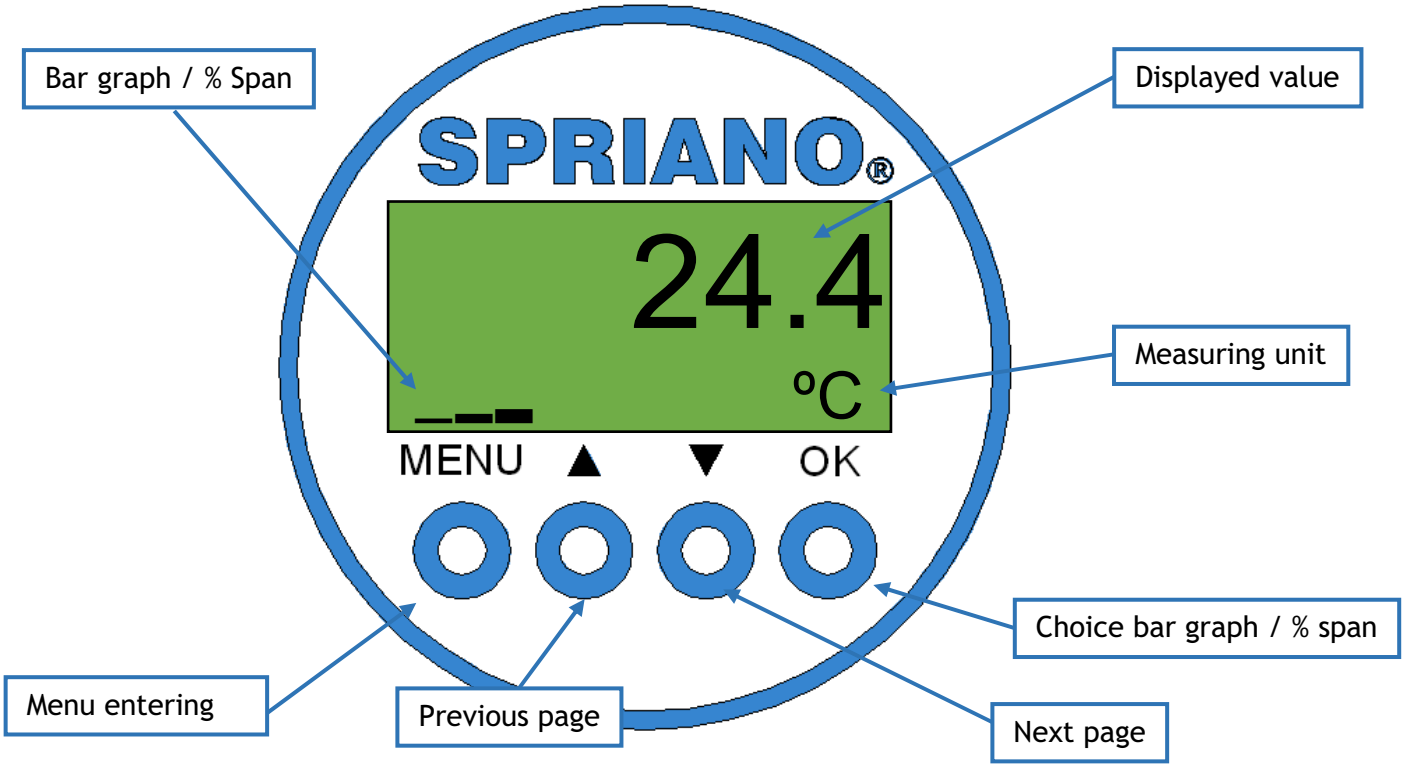


Figure 12: SST72 display

It will be possible to display one of the following variables on the screen:

TEMPERATURE (PV) 23.27 °C	CURRENT (TV) 4.220 mA
PERCENTAGE (SV) 34.73 %	AMBIENT TEMPERATURE (FV) 24.2 (A) °C After 10 seconds the PV measure is restored on the screen.

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4.2 → KEYBOARD CONFIGURATION

The electronic transmitters have some configuration functions available via keyboard and LCD display, provided with the transmitters themselves.

- Press the [MENU] button to enter the password entering dialog (the default password is 0000). Confirm by [OK] to enter the configuration menu.
- The display will allow to choose from the different functions described in the table below. Use the ⇧ and ⇩ buttons to show the sequence of the available functions and press [OK] to confirm the selected function.
- When the display is in numerical entering mode, the cursor will blink.
- To move the cursor press the ⇩ button; to raise the value of the digit press the ⇧ button. Press the [OK] button to confirm; use instead the [MENU] button to cancel the modifications and to go back to the standard display.

Function	Display name	Use	Choice span
Zero setting	**LRV**	Measure linked to the zero and to the 4mA output. The measuring unit is shown in the lower right corner of the display	Between the sensor limits
Full span setting	**URV**	Measure linked to the full span and to the 20mA output. The measuring unit is shown in the lower right corner of the display	Between the sensor limits
Measuring unit selection	**PV UNIT**	Measuring unit selection from the available ones. Press ⇧ o ⇩ to scroll.	°C °F °K
Fault configuration	**ALARM TYPE**	Fault condition analog output selection.	NONE = no action 21mA 3.85mA LAST = last read value
Damping setting	**DAMP VALUE**	Insert the signal averaging time constant.	0 ÷ 60s
Zero re-setting	**OFFSET**	Enter the offset value to be applied to the measure.	±10°C ±18°F ±10°K

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Function	Display name	Use	Choice span
4mA input automatic setting (zero)	**SET LRV**	At button pushing the transmitter will automatically link the 4mA output to the actual reference input.	-
20mA output Entrant setting	**SET URV**	At button pushing the transmitter will automatically link the 20mA output to the actual reference output.	-
Analog output test	**LOOP TEST**	It is possible to fix the analog output of the transmitter to a required mA value.	3.85 ÷ 21mA
Analog output calibration	**CAL 4-20mA**	The transmitter fixes the output to 4mA and asks by display to check the value (OK? YES/NO). Choose NO if the output is incorrect and insert the value read on an external Ammeter. Do it again until necessary. The same procedure for 20mA follows.	-
Hart® polling address	**ADDRESS**	Hart® polling address modification.	0 ÷ 15
Transmitter information	**INFO**	The polling address, the lower sensor limit (LSL), the upper sensor limit (USL) and the firmware revision are shown.	-
Password setting	**PASSWORD**	Allows to insert a new password for the transmitter. To be used with care.	0000 ÷ 9999

INFORMATION!
The password is in 4 digits format and spans from 0000 to 9999. If you can't remember or find the password you set, please contact our technical department.

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5 → MAINTENANCE AND TROUBLESHOOTING

Although transmitters SST7X do not require a maintenance on periodical basis, it is good practice to regularly check the general transmitter status, the possible presence of rust or damage on the case or on the measuring element and the presence of clogging in the process connection.



PROHIBITION!
Repair, maintenance and/or overhaul of the equipment shall only be conducted by the manufacturer himself, or by a repairer he has qualified or authorized.

Is forbidden during the maintenance operation to use the tool as a handle or step.



Please refer to the following pages scheme for troubleshooting.
In any case contact our technical department for help.

Condition	Potential source	Solution
The transmitter doesn't turn on	Supply	Check the supply voltage to be 12,5Vdc<V_{supply}<30Vdc.
	Polarity	Check the transmitter connection polarity.
	Electrical load	Check that the load is less than the maximum allowed.
Measure is incorrect	Process	Accurately verify the compatibility between the process and the connection type.
	Sensor drift	Apply zero input conditions to the transmitter and use the OFFSET command.
	EMC interference	Accurately verify the possible presence of electromagnetic interference on the supply line. Check the PE connection.
Erratic analog output	Wrong span limits	Use the LRV and URV commando (or SET LRV and SET URV) to correct the output.
	Uncalibrated analog output	Use the LOOP TEST command to verify the analog output calibration. If it is not correct, use the CAL4-20mA command to calibrate the output.
	Incorrect HART® settings	Use the ADDRESS command to verify that the polling address is set to 0.

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Condizione	Causa potenziale	Soluzione
Analog output <4mA or >20mA	Transmitter in fault mode	Check if the output isn't out of the allowed span or check the presence of a failure (e1, e2, … on display).
	Wrong fault settings	Check the settings using the ALARM TYPE command.
Unstable measure	Measuring disturbs	Set an input average using the DAMP VALUE command (i.e. 10 seconds).
Impossible to access the menu	Wrong / forgotten password	Contact us for help

5.1 → DISPLAY ERROR CODES

Type of error	Description
OVR	OVER RANGE: this message is shown if PV is greater than URV by 20% of the span
UDR	UNDER RANGE: this message is shown if PV is lower than LRV by 20% of the span
LCD OV	LCD OV: this message is shown if PV < -99999 or PV >99999. In this case could depends by damage of sensor or display
EE CHK ERR	This message depends by an error configuration of the EEPROM memory
EE ADC ERR	This message is shown if there are PV calculus error in primary ADC input. If it persist contact Spriano® for help
T EX AD ER	This message is shown if there are on external temperature signal calculus error in secondary ADC input. If it persist contact Spriano® for help
T IN AD ER	This message is shown if there are on internal temperature signal calculus error in secondary ADC input. If it persist contact Spriano® for help

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5.2 → SPARE PARTS

Together with the request of spare parts it is required to indicate Serial Number of the Transmitter to control that the correct components will be delivered.

Item	Product Code	Description	Quantity
01	DISPLAY COVER	Cover with display glass	1
02	BLIND COVER	Blind cover terminals side	1
03	COVER O-RINGS	Gaskets for housing covers	2

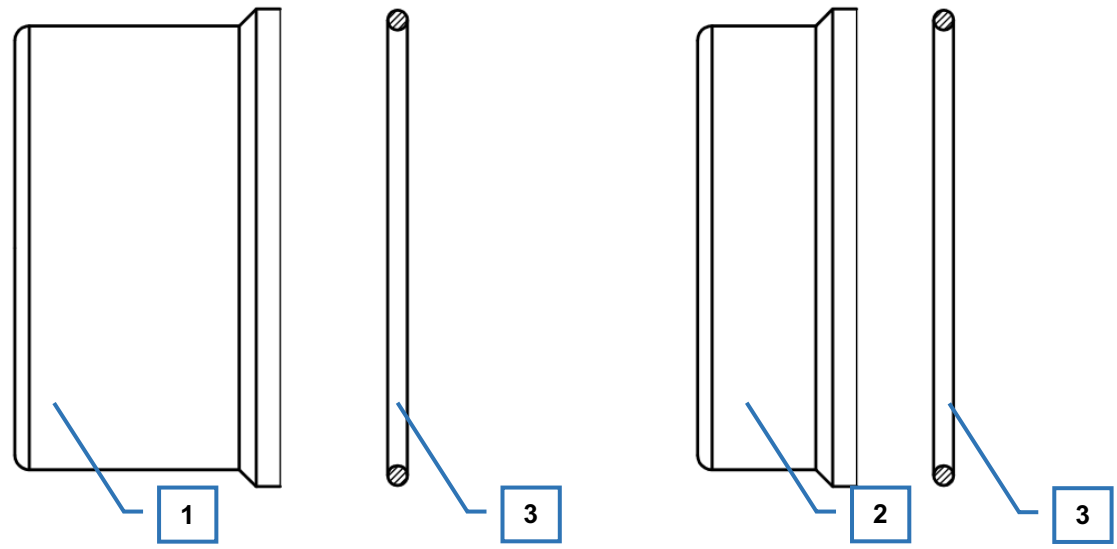


Figura 13: spare parts

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6 → MARKING

On the transmitter enclosure is fixed an identification plate with inscriptions showing the characteristic data of the instrument.
Refer to **Figure 14**, the Transmitter is provided with the following information:

1. Name and address of the manufacturer
2. CE marking followed by the identification number of the notified body involved in the production phase
3. Designation of series or type
4. Serial number (with the Year of construction)
5. ATEX marking for equipment-group II, followed by the specific marking of explosion protection (see 1.3 → Definitions And Symbols)
6. PED essential allowable limits: allowable Fluids, Maximum working pressure (PS), Nominal size (DN), etc.

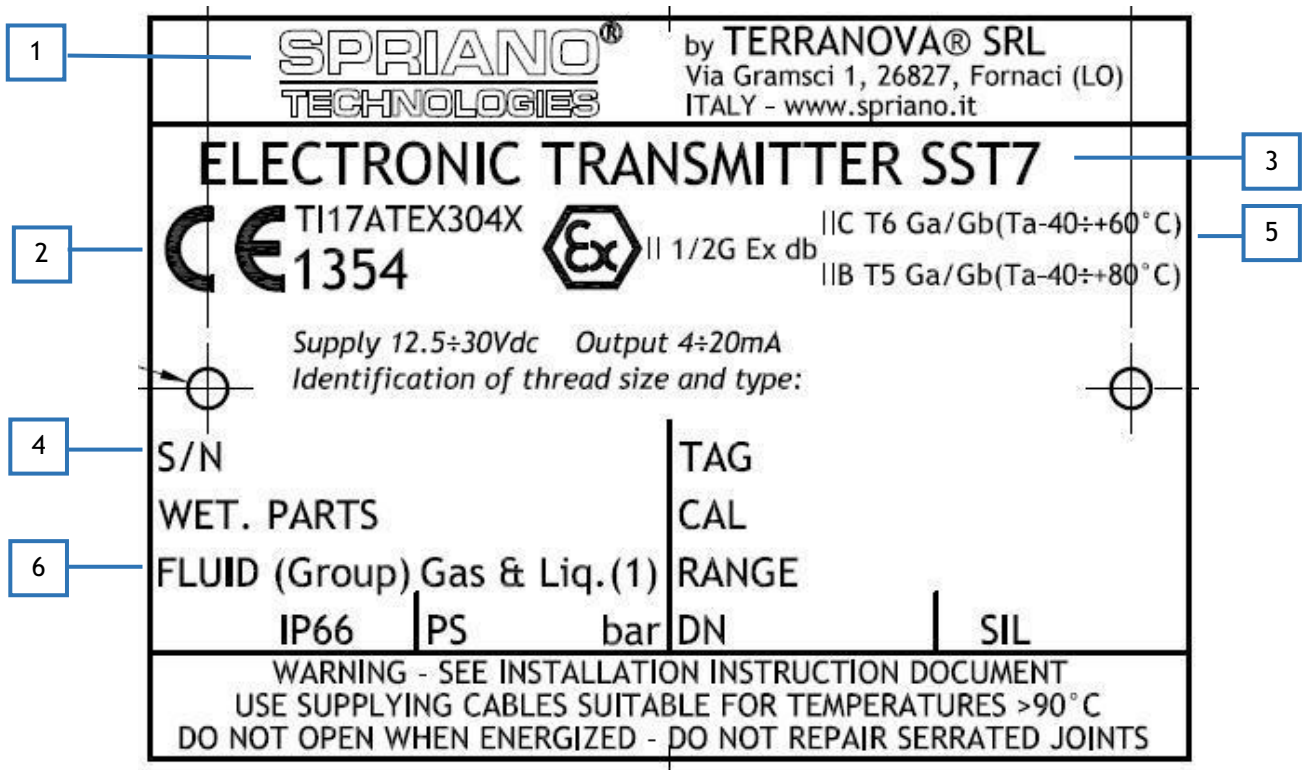


Figure 14: marking plate

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7 → DATA SHEET

FUNCTIONAL DATA
With reference to the following, please note these definitions:
Nominal range: (referred to the sensor mounted in the instrument) the measured temperature range for which the sensor has been designed. Defined as a minimum and maximum value.
Nominal span: the interval between the minimum and maximum values of the sensor nominal range. The span is a single number.
Measuring range: the minimum and maximum range values for which the transmitter is to be calibrated.
Measuring span: the interval between minimum and maximum values of the measuring range.
Input scale initial value or zero input: minimum temperature value within in the measuring range.
Input full scale value: maximum temperature value within in the measuring range.

TRANSMITTER PARAMETERS
The parameters that are available for display and setting are:
Measuring span: possibility to change from 3.33% to 100% of the nominal span.
Zero adjustment: digital calibration ± 15%.
Low/upper range values: they can be set within the nominal range provided that the span > minimum span.
Damping: digitally adjustable from 0 to 60 sec. (minimum response time ~ 0,1 sec.).
Reverse output: automatically obtained via software.
Transfer function: linear/square root via software.
Self test: in case of malfunction the analog output is forced to the fail-safe state 3.85 mA or 21 mA.
Measuring units: 3 different temperature units or % of the measuring span, selectable via software.

PHYSICAL CHARACTERISTICS.
Power supply: 12,5-30 Vdc
Output signal:
Analog 4-20mA, 2 wires.
Digital using HART® protocol
Response time: <256 ms (Std Hart®)
Measured value update frequency:
4-20 mA + Hart® output: ~1s
Hart® output only: ~500 ms (on request)
Polling time:
4-20 mA + Hart® output: ~800 ms
Hart® output only: ~500 ms (on request)

AMBIENT CONDITIONS
Temperature:
Process fluid: -40 ÷ +80°C (remote mounting: up to 350°C; remote mounting and thermowell: up to 500°C)
Housing: -40 ÷ +80°C
Handling and storage: -40 ÷ +90°C
Relative Humidity: 0 a 100% R.H.
LCD display reading: -10 ÷ +65°C

PERFORMANCES
Digital accuracy (εDGT): 0.1%FS / 100°C
Thermoelement accuracy (εPT100): see "Tolerance classes for PT100 thermocouples (IEC751)"
Output resolution: < 0,01% nominal range (at 20°C)
Total accuracy[1] (εTOT): εDGT + εPT100
Dead band: negligible
Display resolution: 0.1

INFLUENCE OF OPERATING CONDITIONS
Power supply effect:
Negligible between 12,5 and 30 V d.c.

[1] Including hysteresis, non-linearity and repeatability (IEC 60770)

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PHYSICAL SPECIFICATIONS
Housing: die cast aluminum alloy EN AW-6082 finished with epoxy resin (RAL 5014). It is dust and sand tight and protected against sea wave effects as defined by IEC IP66. Suitable for tropical climate operation as defined by DIN 50015.
Covers O-ring: EPDM.
Nameplate: stainless steel, fixed on housing.
Calibration
Standard: at nominal range, direct action, linear.
Optional: at the conditions specified with the order.
Electrical connections: two cable entries on electronic housing, 1/2" NPT and cable gland PG 13,5 for 7 to 12mm diameter cable.
Terminal board: 2 terminals for signal wiring up to 1.5 mm2 (14 AWG). Connection for ground and cable shield.
Mounting position: any position.
Net weight: 2kg approx.

PROCESS WETTED PARTS
Thermowell: AISI 316.

OPTIONS
Bracket: for 2 inch pipe mounting.
Stainless Steel Housing: AISI 316 (IP66).

7.1 → FUNCTIONAL SAFETY ACCORDING TO IEC 61508 / IEC 61511

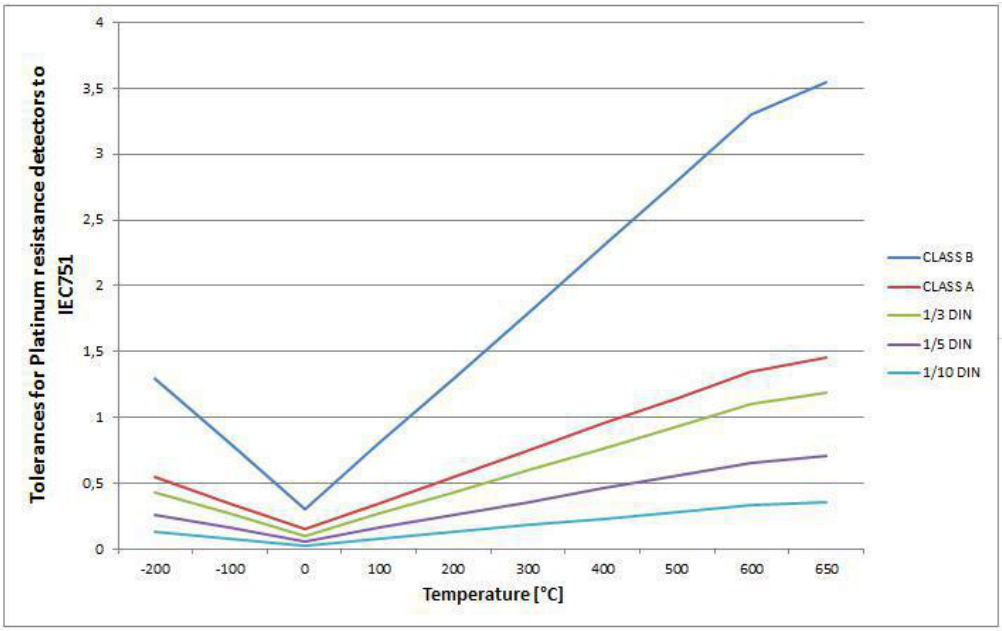
The assessment of the safety critical and dangerous random errors results, provided that the attached safety instructions are observed and an annual function test is performed, in the following parameters:

Transmitter Type	λ_{DD}	λ_{DU}	λ_{S}	λ_{TOT}	SFF	SIL
SST72	7.5072×10^{-8}	1.0725×10^{-8}	8.0434×10^{-8}	1.6623×10^{-7}	91.67%	2

7.2 → TOLERANCE CLASSES FOR PT100 THERMOCOUPLES (EPT100)

Temp. [°C]	CLASS B [± °C]	CLASS A [± °C]	1/3 DIN [± °C]	1/5 DIN [± °C]	1/10 DIN [± °C]
-200	1.3	0.55	0.44	0.26	0.13
-100	0.8	0.35	0.27	0.16	0.08
0	0.3	0.15	0.1	0.06	0.03
100	0.8	0.35	0.27	0.16	0.08
200	1.3	0.55	0.44	0.26	0.13
300	1.8	0.75	0.6	0.36	0.18
400	2.3	0.95	0.77	0.46	0.23
500	2.8	1.15	0.94	0.56	0.28
600	3.3	1.35	1.1	0.66	0.33
650	3.6	1.45	1.2	0.72	0.36

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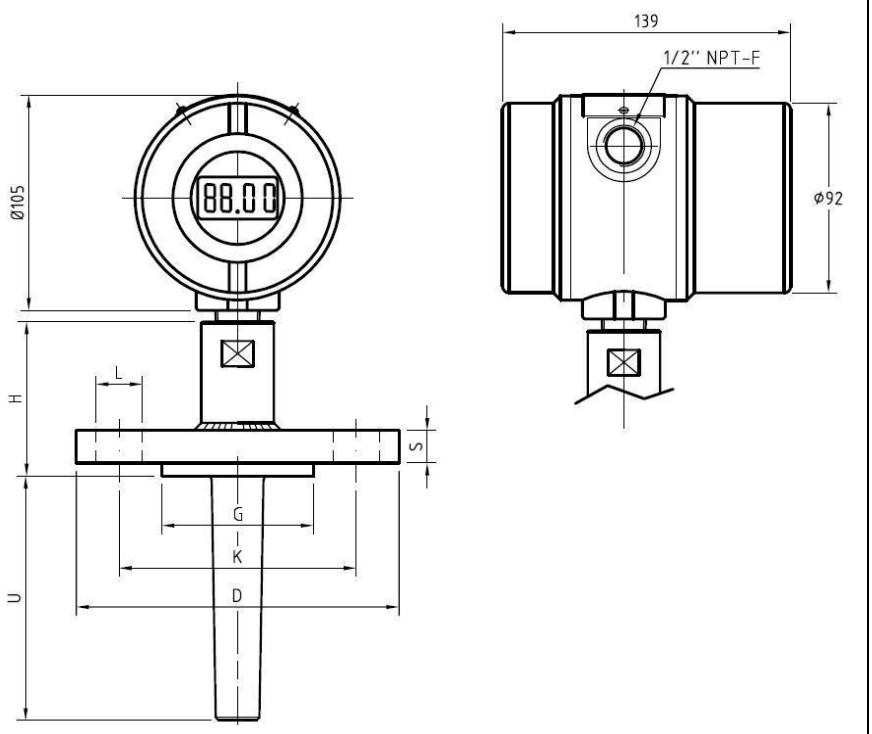


The total instrument accuracy ε_{TOT} is given by the formula:

$$\varepsilon_{TOT} = \varepsilon_{PT100} + \varepsilon_{DGT} \quad [\pm^{\circ}C]$$

where ε_{PT100} is the thermoelement accuracy (see table) and ε_{DGT} is the digital accuracy (see performances).

7.3 → MAIN DIMENSIONS



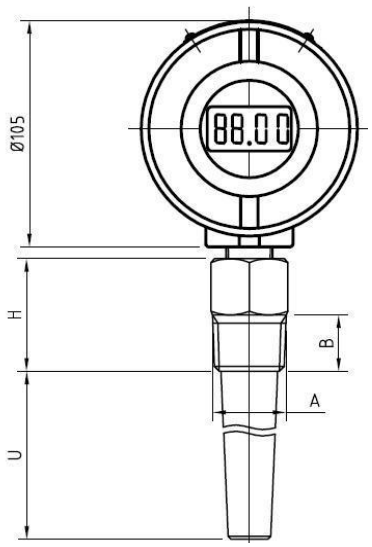


Figure 15: main dimensions and process connections (UNI, ASME…)

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OPERATING and MAINTENANCE MANUAL for KRG RADAR LEVEL TRANSMITTER

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KRG Transmitters



Introduction

This manual does not contain all information about each type of equipment, nor does it take into account all possible cases of assembly, operation and maintenance.
For more information or to particular problems not covered in the manual, please contact our technical department.
The guarantee is that provided for in ns. General conditions of assistance. This guarantee is neither expanded nor limited by the information contained in this manual.

Attention!

This equipment must be installed and used only by qualified personnel who have previously verified the correctness of the power supply so that it is in normal operation and in case of failure of the system or its parts no dangerous voltage can reach the equipment. As the instrument can be used with high pressure and with aggressive substances should be kept in mind that improper use can lead to serious damage to people and things. A proper and safe operation requires an adequate transportation, storage and installation as well as maintenance. And 'therefore necessary to give the equipment to people who have experience with the installation, commissioning and operation and who are in possession of qualifications to carry out their tasks with regard to "Safety Standards".

The Company reserves the right
To change the contents of
This manual without notice.

Note:

For instruments in ATEX version, the instructions in this manual must be integrated with the requirements contained in the additional safety notices.

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Before reading this manual

Read this manual carefully and make sure to fully understand its contents before installing and operating this equipment. When handling the equipment, always follow directions in this manual. **VALCOM SRL.** is not at all liable for an injury and/or a damage resulting from misuse of this equipment by the user that is contrary to these cautionary notes.

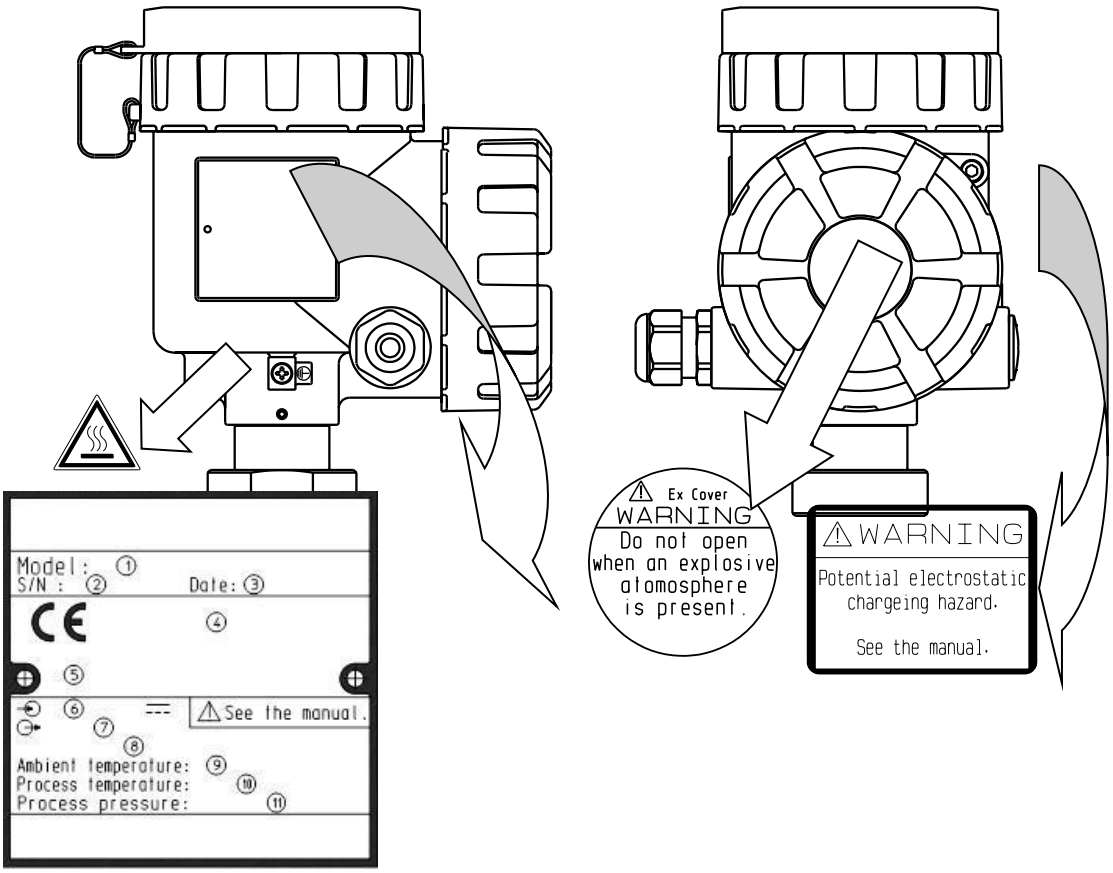
In this manual and on the equipment, the following safety symbols are used to ensure the equipment is used safety and to protect operators and property from possible hazards or damage. Read the explanations below carefully and familiarize yourself with the symbols.

Safety symbols

DANGER	Indicates that incorrect usage can result directly in death or serious injury to the operator.
WARNING	Indicates that incorrect usage may result in loss of life or serious injury to the operator.
CAUTION	Indicates that incorrect usage may result in injury to the operator or damage to the equipment.
	Indicates referring to information for usage of the function or features. (Put on the equipment)
NOTE	Indicates attention to information for usage of the function or features.
	Indicates Protective conductor terminal.
	Indicates Earth terminal. (Functional earth terminal)
	Indicates that close to the power line.
⎓	Indicates Direct current, "DC".
HOT CAUTION	Indicates that close to the high temperature part.

Labels and attached place

The type label contains the most important data for identification and use of the equipment.



NOTE : Ex only

Product code (Refer to Chapter 1.)
② Serial number
③ Date of manufacture
④ Ex certification No.(Ex only)
⑤ Ex approval classes (Ex) or IP code (Non-Ex)
⑥ Power supply
⑦ Signal output
⑧ Ex parameters (Ex only)
⑨ Ambient temperature
⑩ Process temperature
⑪ Process pressure

Fig. 1 Labels

Introduction

Thank you very much for purchasing **Valcom SRL** Microwave Level gauge KRG-10.This manual provides safety precautions for the Microwave Level gauge KRG-10 and explains specifications, functions, structure, installation, operations and troubleshooting in detail. Please be sure to read this manual thoroughly to ensure proper use of the equipment.

Attention

1. Deliver this manual to the user of the equipment.
2. Read this manual well.
   Be sure to read the manual thoroughly to figure out important information.
3. Keep this manual with care.
   The equipment needs to be handled with reference to this manual. Assign a person to take charge and prepare a storage place where the manual will be kept safely and available for immediate use when necessary.
4. If you lose this manual, obtain a new copy immediately.
   If you lose this manual, contact the seller and obtain a new copy. Note that the new copy is not free.
5. Check that the warning label is not damaged.
   If the warning label on the equipment is unreadable, contact the seller.
6. This manual is protected by copyright laws and all rights are reserved.
   No part of this document may be transmitted or distributed without the prior consent of VALCOM SRL.

Notes on the manual

1. This manual is based on the standard specifications of the equipment. If your approved drawing of specifications is different from this manual, the approval specification takes precedence over this manual.
2. This manual describes the operation, features, and performance details of the equipment. But it cannot be valid in particular situations.
3. The contents of this manual may be changed in the future without advanced notice.
4. This manual has been carefully prepared. However, if there were questions, errors, and omissions, then please inform seller or manufacturer.
5. If the change (e.g. specification changes, structural changes, change parts etc.) does not affect functionality and performance, the manual may not be revised or updated. We appreciate your understanding.
6. Company and product names (trade name) used in this manual are trademarks or registered trademarks of their respective owners. And in this manual, TM, R marks are not indicated.

Warranty of the equipment after delivery

1. The warranty period of the equipment is described in product specifications. The equipment will be repaired free of charge during the warranty period if failure due to design deficiencies or defective of workmanship has occurred. However, if the case corresponds to any of the following items (a to f), seller and manufacturer disclaims implied warranties.
   a) Failure based on the force majeure (e.g. typhoons, earthquakes, lightning, war, rebellion, revolution etc.)
   b) Failure due to equipment or parts that is not provided by the manufacturer (e.g. power supply, cable, etc.)
   c) Failure resulting from repair or modification by anyone other than the manufacturer.

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d) Failure due to the harsh conditions that exceed predetermined environmental conditions for transport or storage, which is indicated by the manufacturer in this manual.
e) Failure caused by use or storage in a corrosive atmosphere.
f) Failure caused by improper handling or operation by user.

2. Warranty set forth in this paragraph, is only guaranteed by the manufacturer. In any case, the manufacturer will not be responsible for secondary damage, due to delivery equipment malfunction, or poor performance.
3. When the equipment has failed, please contact the seller.
4. If there is a problem with the equipment, please contact the seller and inform specifically about the description of the problem, model name, and serial number. If you have a schematic or data, please also send them.
5. Failed equipment may or may not be repaired for free. We will judge based on the results of our investigation.

Safety instructions and warnings

For safety, please follow the following items.

WARNING

·Please follow the safety instructions in this manual. When dealing with the equipment contrary to instructions, seller and manufacturer cannot guarantee safety.
·Unauthorized modification of this equipment is strictly prohibited. For such damage or defect caused by unauthorized modification, seller and manufacturer do not assume any responsibility.

WARNING

If the measurement object is toxic, please handle with caution even after removing and maintenance of this equipment. For residual material on the equipment, please note as well, inhalation or contact with the material may be harmful.

WARNING

For seal O-ring material, please carefully check the characteristics of the process material. Leakage of process fluids caused by improper material selection, it can harm to the human body or the equipment. For the structure of the parts of the equipment, please be sure to contact if you have any questions.

WARNING

Gases and vapors may pass through resin material such as PTFE and PVDF. With increasing pressure and temperature, the rate of leakage is increased. For the environment, please check the selection of antenna and seal O-ring material.

WARNING

For process connection, flange and bolts are optional. If you need a flange with hole, please check details of modification described in this manual. (Refer to Chapter 10.) If the flange does not satisfy the modification conditions, then the gas or vapor, such as used in the process, may leak.

CAUTION

- When transferring the equipment, please be careful not to damage the human body by dropping it.

CAUTION

- For Ex application, in order to guarantee the Ex performance, there are severe restrictions for structure, location, external wiring, maintenance, and repair. There is a risk of explosion, if you do not adhere to the restrictions.

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Prohibitions and precautions for equipment protection

For equipment protection, adhere to the following precautions.

CAUTION

·Do not apply a shock to the equipment body such as by dropping.
·Do not use the equipment outside the specified environment condition (ambient temperature and humidity).
·Do not use the equipment outside the specified voltage.
·Do not use a scratched or bare wire (power, coaxial, or signal cable).
·For equipment operations, open the cover at the top of the body and use the display and keyboard on the panel. Do not modify the electronic circuits inside the panel. Operations also can be performed in dedicated software on a PC.
·Never disassemble or modify the equipment. If an equipment failure occurs, contact the seller.
·For transport, please follow the following items of equipment.
a) Please follow the temperature range specifications.
b) Please use the original packaging for delivery.
•For equipment storage, please follow the following items.
a) Please follow the temperature range of the specification.
b) Please avoid direct sunlight.
c) Please avoid places where there is vibration or shock.
d) Please do not leave in the presence of corrosive gases.
e) Please do not leave in humid place.
•Please follow the conditions of use in order to guarantee the performance of Ex equipment.

HOT CAUTION

There is a case, the antenna is a high temperature by the process. Do not touched carelessly, because of there is a risk of burns.

⚠ CAUTION

Please follow the following items. If any of these conditions are not satisfied, incorrect measurement value might be displayed or outputted, or may not be measured.

- Please check the installation condition described in this manual.
- Please use the equipment under predetermined power supply voltage range, in the range of ambient temperature and humidity, which are described in this manual.
- Please do not apply Impact or vibration to the equipment.
- If the equipment is in a high noise area, it may not work properly or may be broken.
- If signal for measurement cannot be detected, the warning mark flashes on the LCD. Also, when an abnormal measurement is detected, a predetermined alarm is outputted. Please take appropriate action in such a case.
- Before you change equipment parameters, see appropriate section in this manual. And please set the parameter correctly. If you set wrong parameter, the measurement may not to be accurate or may be impossible.

Precautions on using

- Before using the product, please check the model name and corresponding specifications.
- The following accessory has been attached to this equipment. Please confirm that there is no shortage.
  a) CD-ROM (User's guide (this manual), Configuration software)
  b) Cable grand (only Non-Ex type)
  c) O-ring (for fixing the flange : The material is due to specification)

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Chapter 1 Configuration

1.1 Product overview

KRG-10 is microwave level gauge measuring distance between the equipment and product surface by time-of-flight principle.

1.2 Product construction

KRG-10 consists of transmitter head and antenna.
LCD module can be attached in the transmitter head, which is an optional item. The LCD module is used to enter instrument parameters and displays measuring data.
The cable gland is another option.

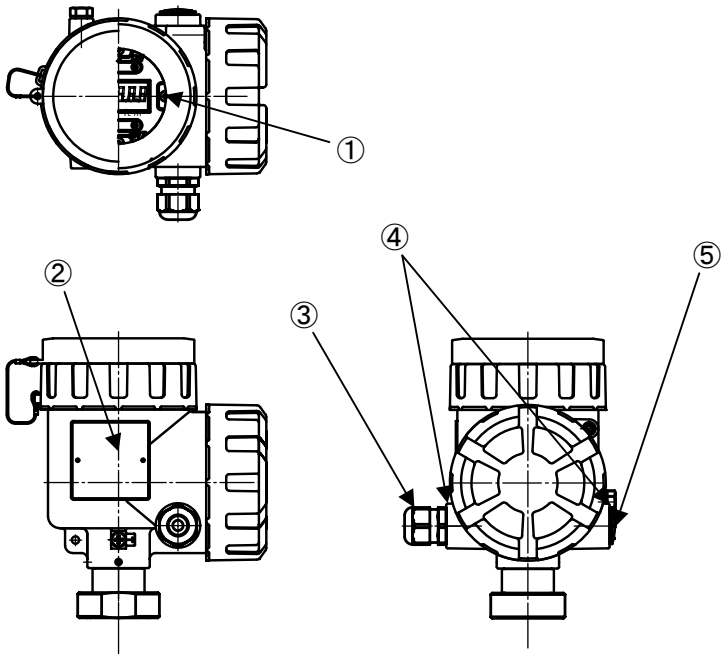


Fig. 1.2.1 Configuration of transmitter head

1. LCD module (option)
2. Label
3. Cable gland (option)
4. Wiring port
5. Blind plug

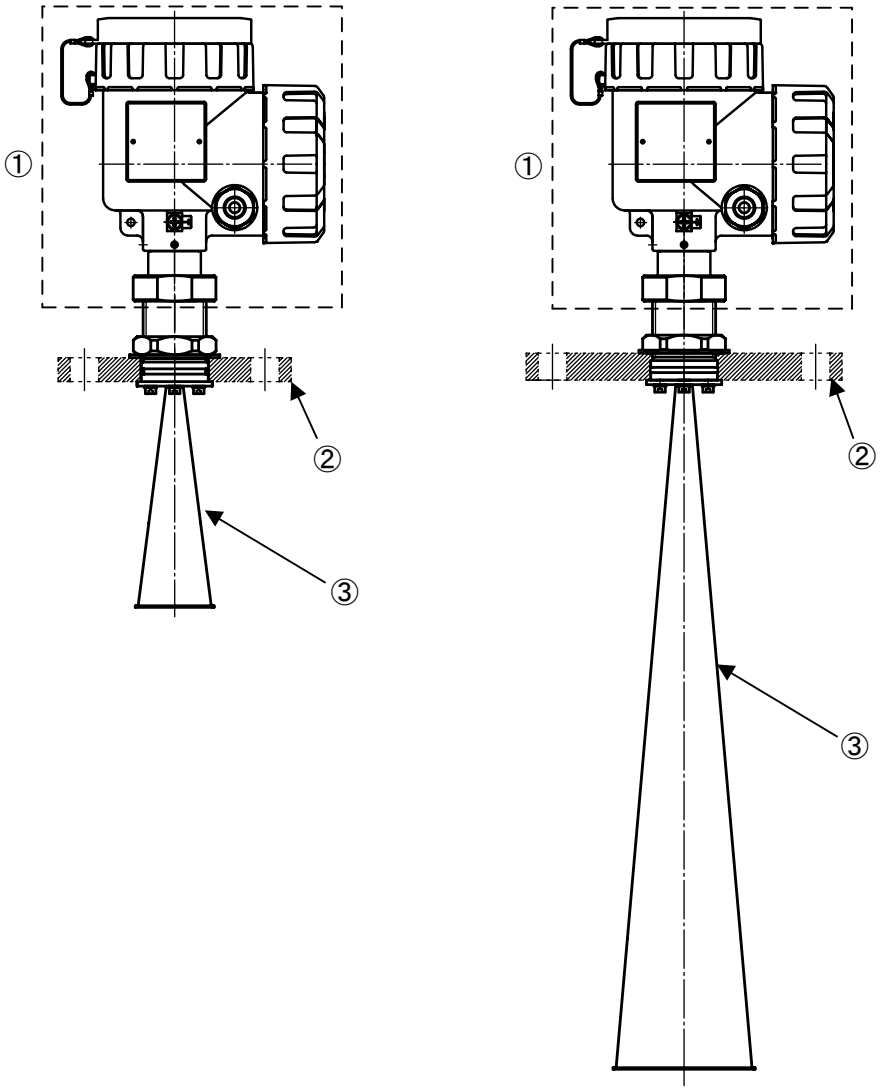


Fig. 1.2.2 Transmitter head with cone antenna

1. Transmitter head
2. Flange (option)
3. 2" cone antenna

1. Transmitter head
2. Flange (option)
3. 4" cone antenna

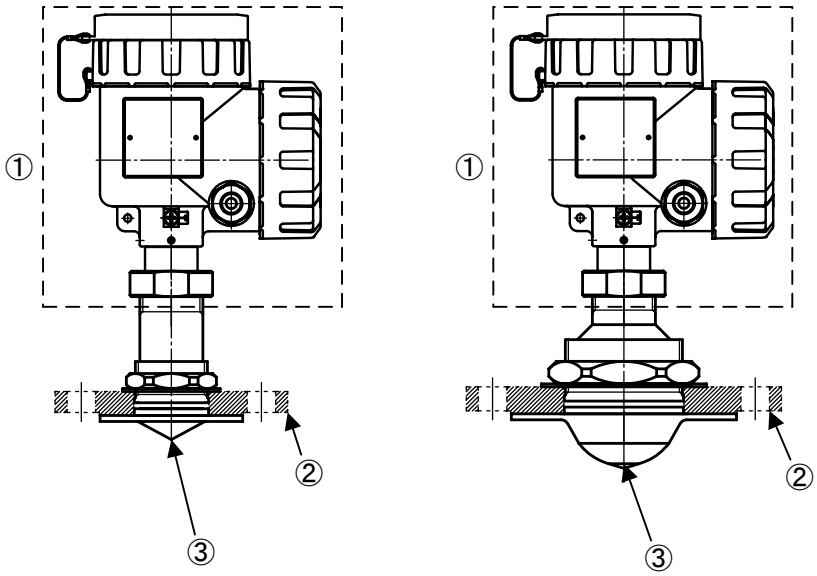


Fig. 1.2.3 Transmitter head with PTFE sealing antenna

1. Transmitter head
2. Flange (option)
3. 2" PTFE sealing antenna

1. Transmitter head
2. Flange (option)
3. 4" PTFE sealing antenna

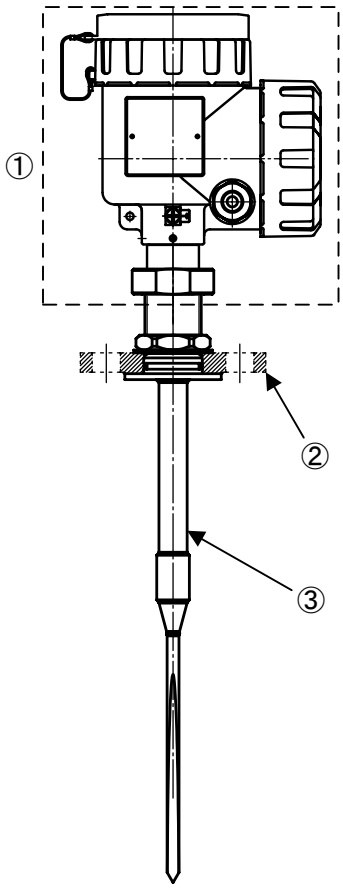


Fig. 1.2.4 Transmitter head with rod antenna

1. Transmitter head
2. Flange (option)
3. 1" rod antenna

Chapter 2 Installation

2.1 Note

CAUTION

- Installation at inappropriate location or improper installation procedure may cause incorrect measurement. Please refer to this manual for proper installation.
- Please arrange installation in accordance with local radio regulation.

2.2 Appropriate location for installation

For stable measurement, please keep following conditions,

(1) Non-centered position: Installed at center of the tank may cause of noise as symmetrical disturbance.

(2) 200mm from tank wall: Antenna center should be better to keep more than 200mm from the tank wall to propagate enough microwaves.

(3) +/- 1deg horizontal balance: Please keep less than 1 deg against nozzle flange surface to get better signal strength to liquid surface.

2.2.1 Cone antenna

Please keep antenna tip exposed to tank inside over 10mm for stable measurement.

NOTE: In case that antenna tip is buried inside nozzle, it may cause noise reflection.

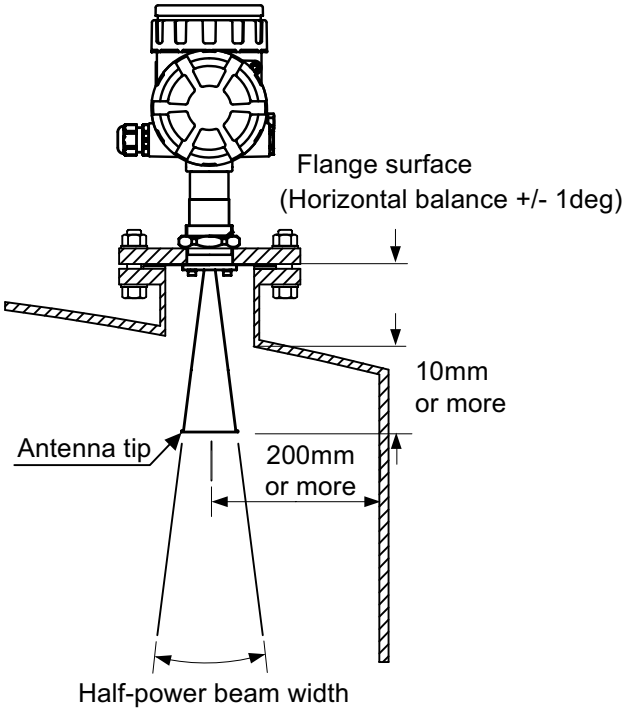


Fig. 2.2.1 Installation example of cone antenna

2.2.2 PTFE sealing antenna

The process connection nozzle inside diameter must be smaller than sealing plate to keep inside tank pressure.
Maximum height of nozzle will be limited antenna size accordingly as below.

Table 2.2.1 Maximum height of nozzle

2" (50mm) PTFE Sealing antenna	150 mm
4" (100mm) PTFE Sealing antenna	500 mm

NOTE: In case that maximum height of nozzle is not satisfied limitation in accordance with above definition, it may cause noise reflection.

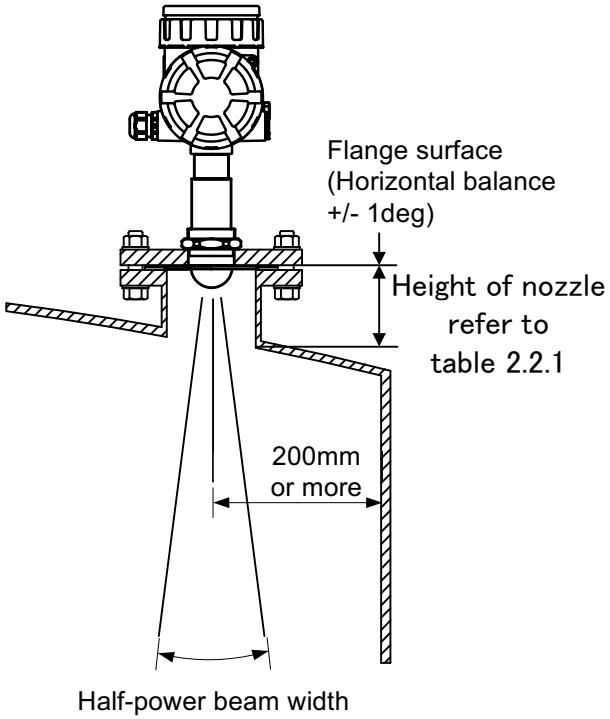


Fig. 2.2.2 Installation example of PTFE sealing antenna

2.2.3 Rod antenna

The end of inactive zone must be exposed to inside tank more than 10mm for stable measurement. Standard length of inactive zone is 150mm.

NOTE: In case that maximum height of nozzle is exceed 150mm, enough microwave can not get into the tank inside. It may affect stable measurement.

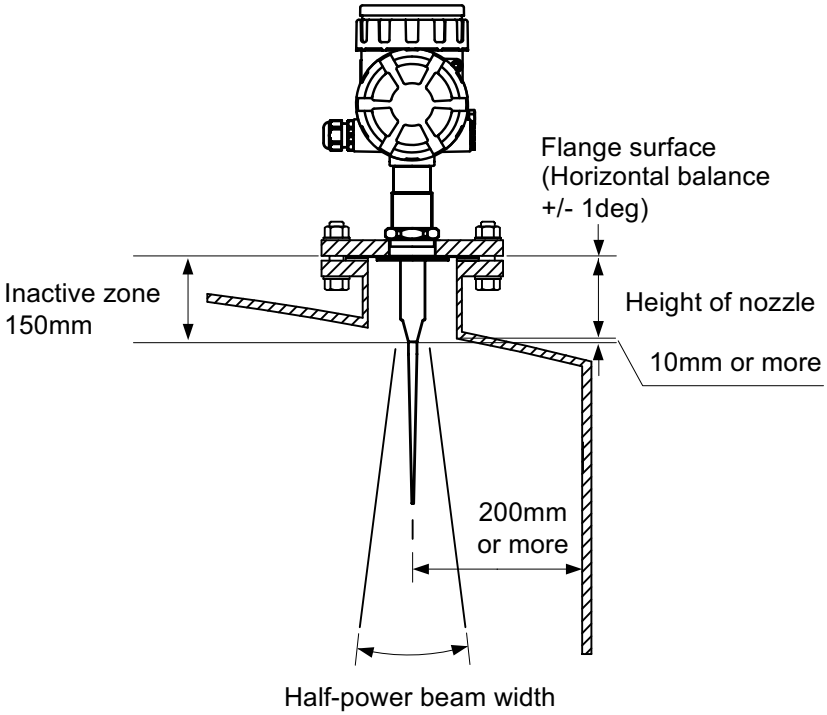


Fig. 2.2.3 Installation example of rod antenna

2.3 Beam area

Please install level gauge avoiding any obstructions in the following beam area, which may any cause of disturbance reflection.

Table 2.3.1 Beam angle, Distance, and Beam area

Antenna		Cono / *Cone*		Affacciata / *Flush antenna*		A punta da 1‘‘ *1‘‘ rod*
		2‘‘	4‘‘	2‘‘	4‘‘	
Angolo di emissione (α) *Beam angle (a)*		18°	8°	18°	8°	25°
Distanza [m] *Distance [m]*	5	1.6	0.7	1.6	0.7	2.2
	10	3.2	1.4	3.2	1.4	
	15		2.1		2.1	
	20		2.8		2.8	
	25		3.5			
	30		4.2			

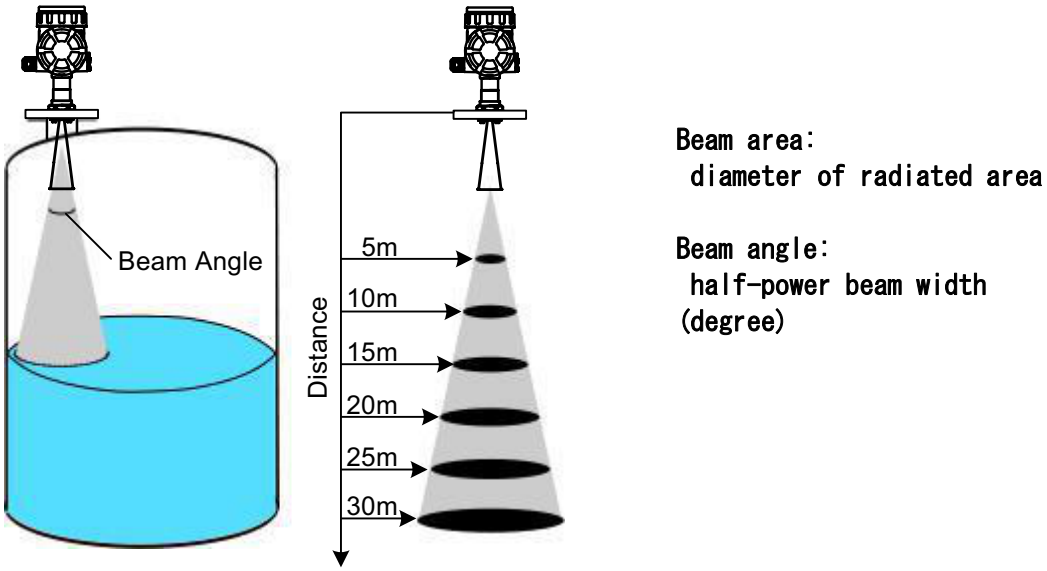


Fig. 2.2.4 Beam area and distance

2.4 Tilt of antenna

The antenna keep attaches a horizontal, for microwave to be irradiated perpendicular to the liquid surface.

2.5 Cable connection

The level gauge may be rotated its direction to get better reflection echo strength. Thus keep approximately 1m as extra length.

2.6 Measuring range

(1) Higher dielectric constant provides higher reflection and longer measurable range.
(2) Larger antenna can have larger reflection for stable measurement and longer measuring range.
(3) Turbulent or foamy surface decrease reflection signal strength which may let measurable range be shorter.
(4) Contamination to antenna inside or dusty air layer may decrease reflection signal strength which may let measurable range be shorter.
Contamination to antenna can cause reduced sensitivity, please remove contamination.
(5) Any of obstructions may cause disturbance echo (noise) which affects stable measurement.
(6) In case target surface is smaller than beam area, enough reflection may not return. It may let measurable range be shorter.
(7) If the measurement atmosphere in absorbing gases such as ammonia or some fluorocarbons, contact with the seller.

2.7 Tips for stable measurement

Level gauge should be installed away from any obstacle inside tank which may cause of disturbance as basic. In case some of them are unavoidable, following tips may be solution for stable measurement.
The rod antenna have deflection direction, attach the antenna in the direction that has been set. (Refer to **2.10.3 Rod antenna**)

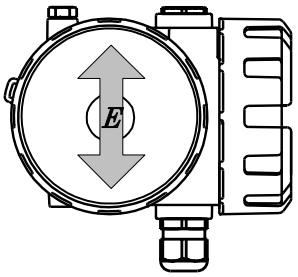


Fig. 2.7.1 Oscillation

NOTE: "*E*" means plane of polarization of the microwave.

2.7.1 Against pipe structure or ladder

Microwave reflections from elongated metal objects such as thin pipes or ladders rungs are largest when the axis of such objects are in parallel with the electric field. The orientation of the electric field generated by transmitter head is as shown in the Fig.2.7.1.1
In case mounting the transmitter head as this electric field is not in parallel with the axis of the obstacle, it will reduce or emit affection of the false echo.
(In certain circumstances, such as size, shape, and position of the pipe, there is also that there is no effect)

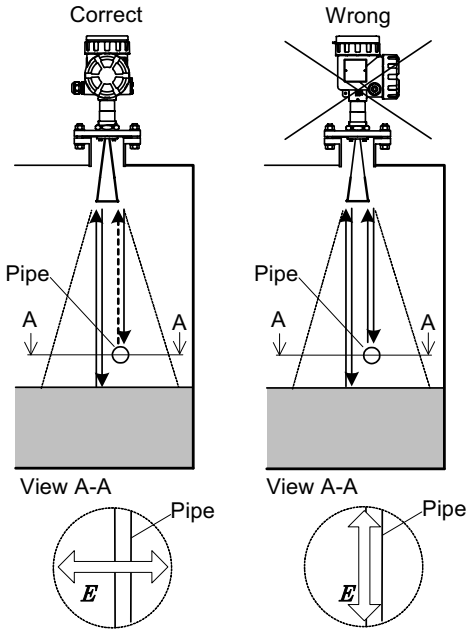


Fig. 2.7.1.1 Installation method when the pipe is present in the space

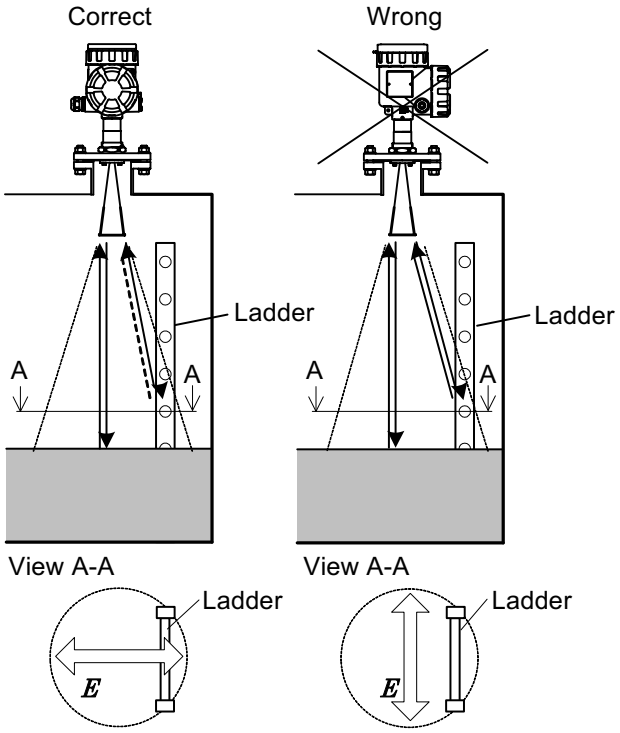


Fig. 2.7.1.2 Installation method when the ladder rungs are present in the space

.7.2 Shoulders and struts

Install a reflector (flat metal plate) above the obstacle as shown in the Fig. 2.7.2.

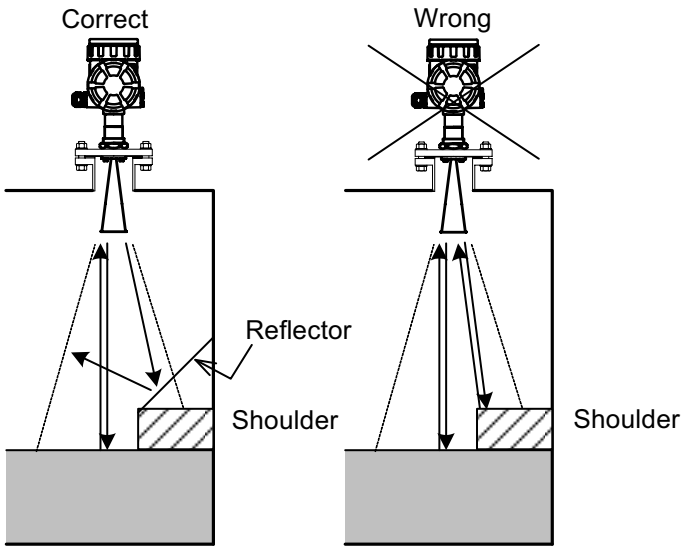


Fig. 2.7.2 Installation method when the shoulders and support struts are present in the space

2.7.3 Near tank inlet

Nearby tank inlet may have turbulent, foam or splash which decrease reflection echo strength. Level gauge should be installed avoiding such location.

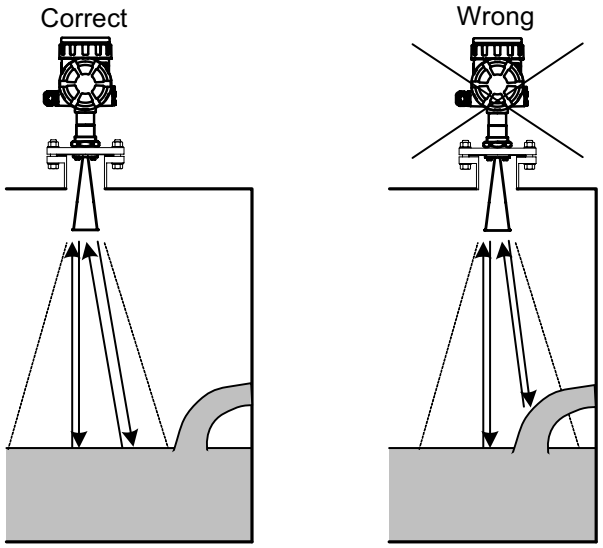


Fig. 2.7.3 Installation method for near the tank inlet

Factory & Sales: Via Gramsci, 1 – 26827 Terranova Passerini (LO) - Italy
Legal Office: Via Rosso Medardo, 16 – 20159 Milano (MI) - Italy
Ph: +39 0377 911066 – Fax: +39 0377 919156
VAT IT07848810151

2.7.4 Narrow channel

With conditions such as the distance to the water surface width of the channel, from the level meter, edge effects and the liquid surface and the walls are different. By changing the polarization of the microwave, you may be able to reduce the influence of the edge.

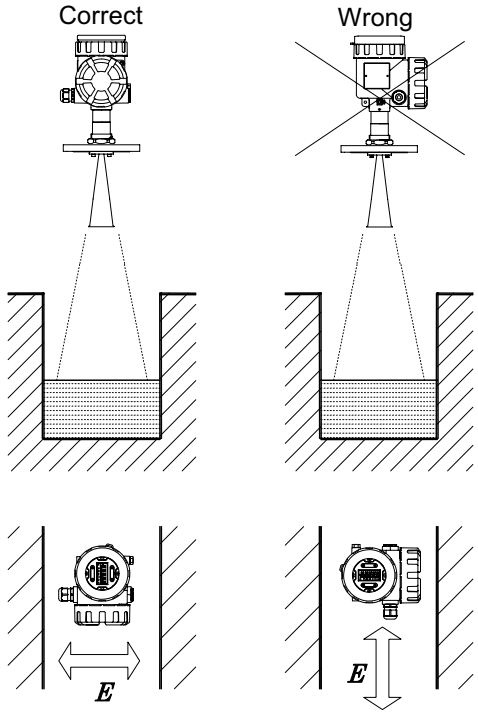


Fig. 2.7.4 Installation method for the narrow channel

2.7.5 Tank installation

For round tank applications, install level gauge as the axis of the electric field is oriented 45 degrees to the tank wall to avoid influences from edge reflections off channel walls and the liquid surface.
For flat wall tank applications, install level gauge as the axis of the electric field is oriented 45 degrees to the tank wall.

However, the distance from the wall and level meter ,and wall materials, depending on the range of the measured distance, in some cases, who have a horizontal or vertical on the wall, the wall electric field is measurably better.

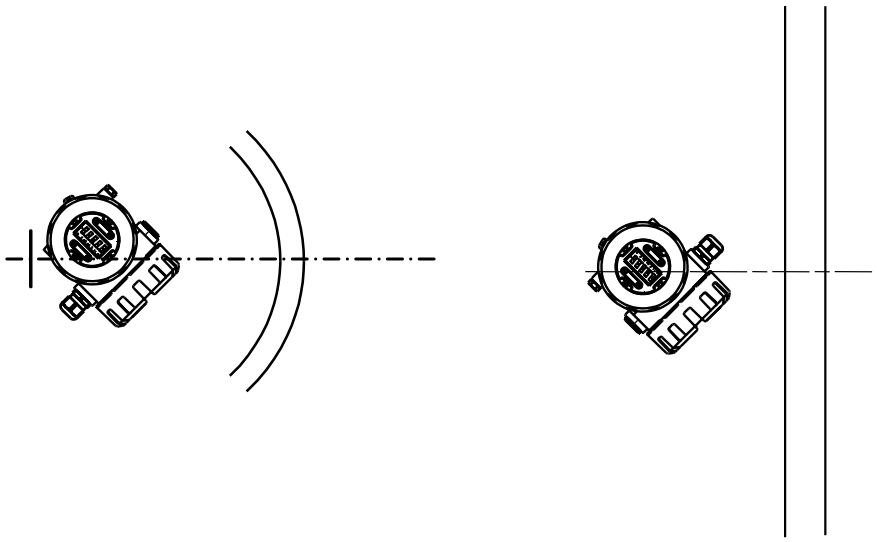


Fig. 2.7.5 Installation method for the tank wall

2.8 Pipe installation

Microwave can propagate only inside of metal pipe. Following features are for the application for pipe installation.

- It can use existing metal pipe without replacement.
- It will not be affected by any obstacle reflection disturbance outside of the pipe.
- The deterioration of the signal is much smaller than free space propagation. Thus even low dielectric constant liquid may have longer measurable range.
- Pipe can be used as stilling well against turbulence.

NOTE:

- Antenna should be selected 4" or 2" cone antenna type.
- Pipe material should be metal.
- Pipe length should cover all measuring range.
- The gap between antenna outer diameter and pipe inner diameter should be less than 2 mm.
- Air vent hole (approx. 5mm-10mm) must be positioned above maximum liquid level.
- Low dielectric constant liquid may require to attach bottom reflection plate as Fig. 2.2.12.
- In case target liquid is non-homogeneous characteristic or has multiple layer, some of slits may be required for mixing each in and outside liquid. Those slits should be less than 5mm and positioned right-angled against "*E*".
- In case target liquid has high viscosity, periodical cleaning maintenance may be required.
- In case the pipe will have strong stress, pipe should be fixed to wall or protection arm.
- Inside pipe, between flange connections or welding requires smooth finish.

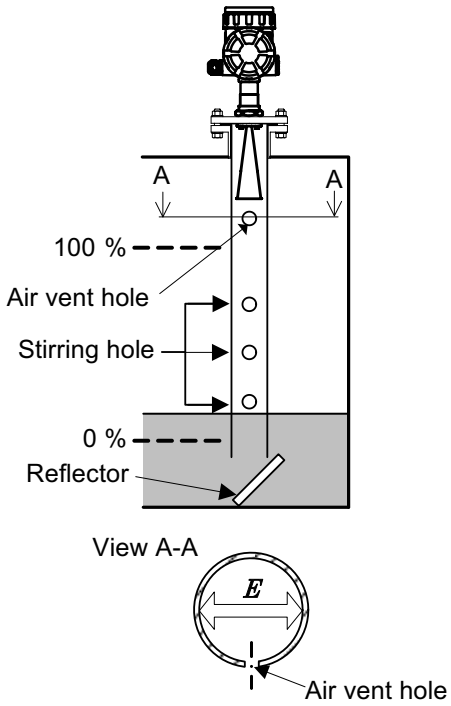


Fig. 2.8.1 Pipe installation

- In case of installing to bypass pipe, to retain defined accuracy, keep enough length as high dead zone more than 500mm from maximum liquid surface and also low dead zone approximately 300~800mm to minimum liquid surface from pipe end.
- To minimize the effects of reflected waves from the connection pipe connecting the tank and the bypass pipe, please note the following points.
- "*E*" of Level gauge should be positioned right-angled against connection pipe.
- Inside pipe, between pipe connections, flange connections or welding requires smooth finish.
- Diameter of Connection pipe should be smaller 1/3 of bypass pipe.

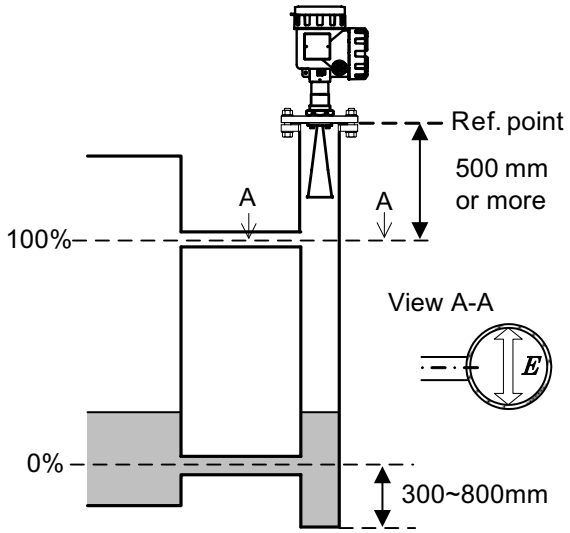


Fig. 2.8.2 Bypass pipe installation

2.9 Required tools

Following tool will be required to install this level gauge.
·Monkey wrench
·Hexagon wrench (3mm)

2.10 Installation

WARNING

Do not damage antenna sealing parts.
Keep gasket and flange surface clean to retain inside tank pressure.
Damaged seals, non-clean gasket or non-flat flange surface may cause gas leakage when the level gauge will be installed on pressurized tanks.

2.10.1 Cone antenna

(1) Required parts for cone antenna installation are as follows.
· Flange is optional item.
· Sealing gasket, bolts or nuts are out of scope for standard items.

NOTE: Please treat not to bend on be damaged the point of “A”. In case of this place is bent or damaged, it may cause noise reflection.

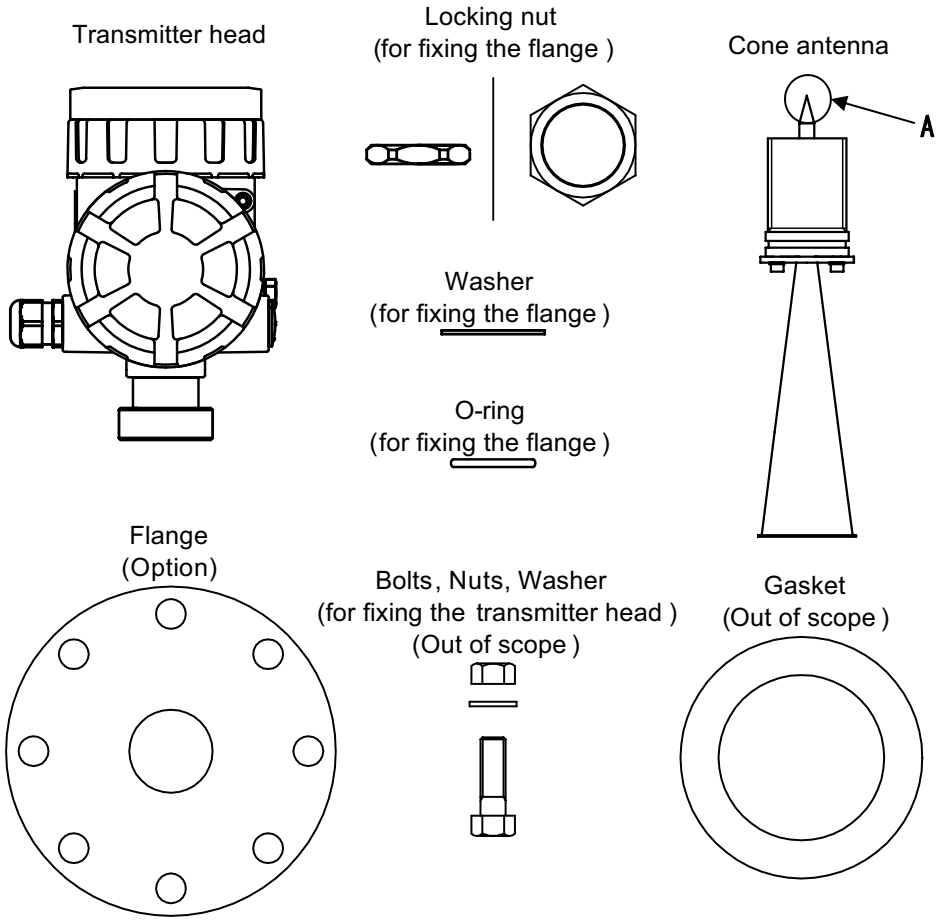


Fig. 2.10.1.1 Required item for cone antenna installation

(2) Fasten cone antenna with O-ring. Pass through flange and washer, then secured with locking nut. Let transmitter head fix to cone antenna unit by locking nut.

NOTE:
· Please apply the grease lubricating for O-ring.
· Please be careful there is no adhesion of dirt for O-ring through assembling.

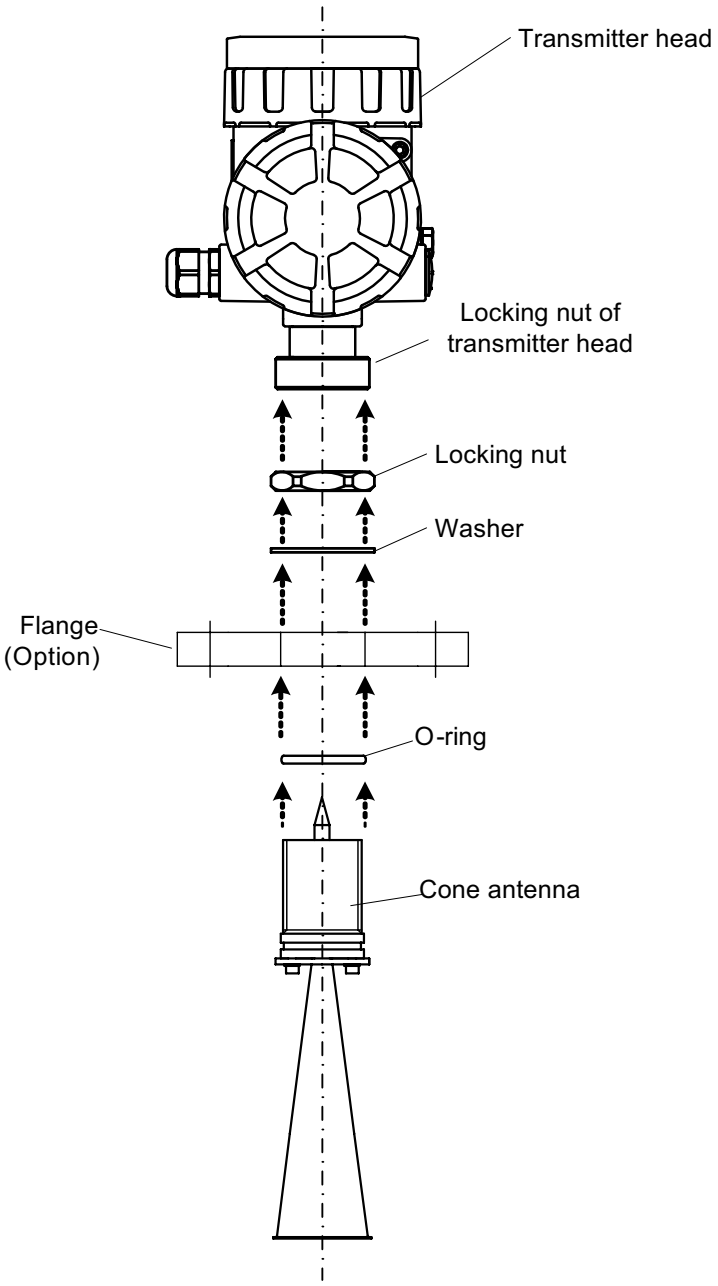


Fig. 2.10.1.2 Antenna assembling

(3) Tighten locking nuts as below, then fixing transmitter head and antenna unit with flange.

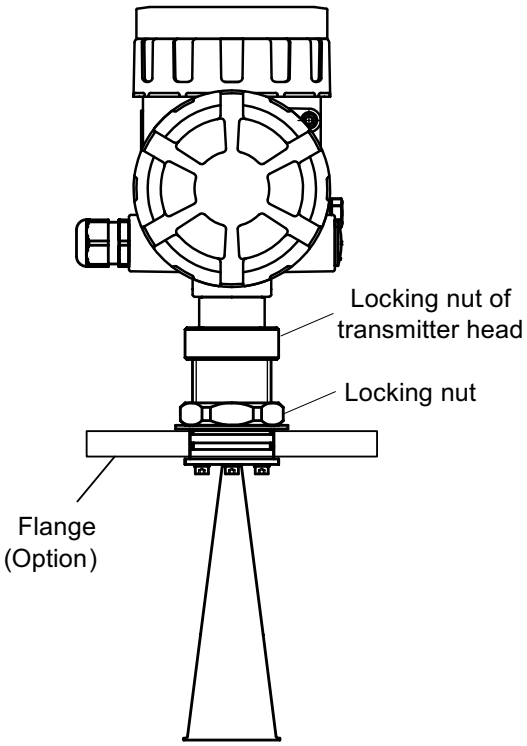


Fig. 2.10.1.3 Transmitter head fixing

(4) Place the gasket on the tank nozzle. Carefully fit the flange and the cone antenna on the tank nozzle. Tighten the assembled unit by the bolts and nuts as below.

⚠ CAUTION
Tighten the assembly to retain the internal gas without any leakage.

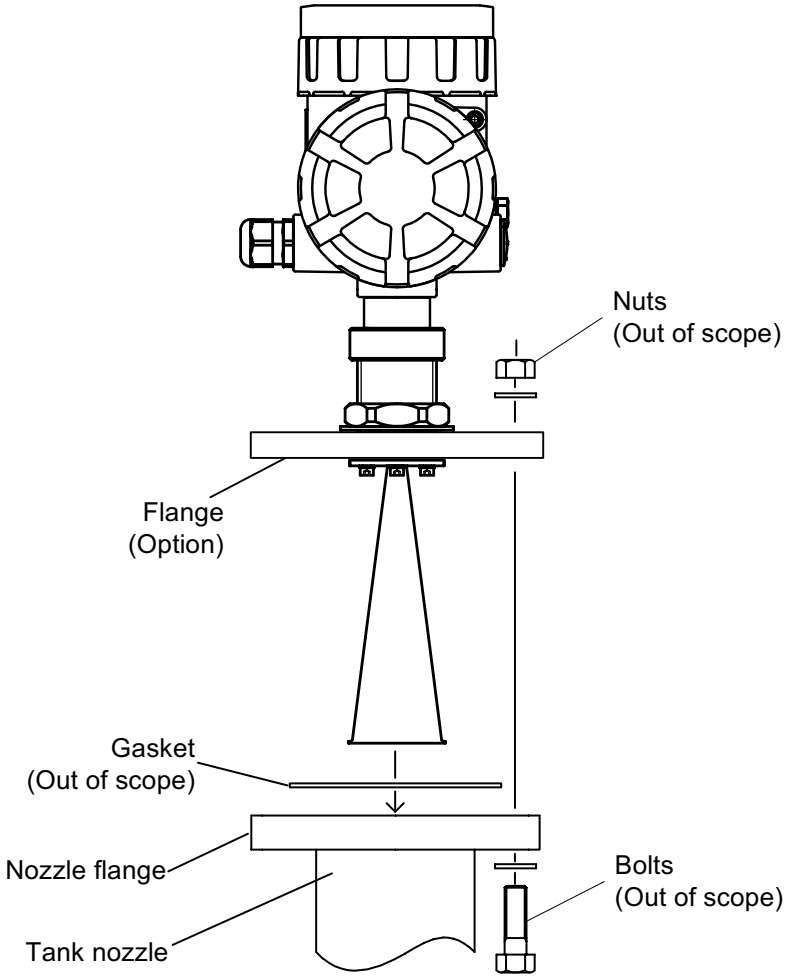


Fig. 2.10.1.4 Installing onto the tank nozzle

2.10.2 PTFE sealing antenna

(1) Required parts for PTFE sealing antenna installation are as follows.
- Flange is optional item.
- Sealing gasket, bolts or nuts are out of scope for standard items.

NOTE:
- Please treat not to bend on be damaged the point of "A". In case of this place is bent or damaged, it may cause noise reflection.
- Do not use metal gasket which may disturb proper microwave propagation.

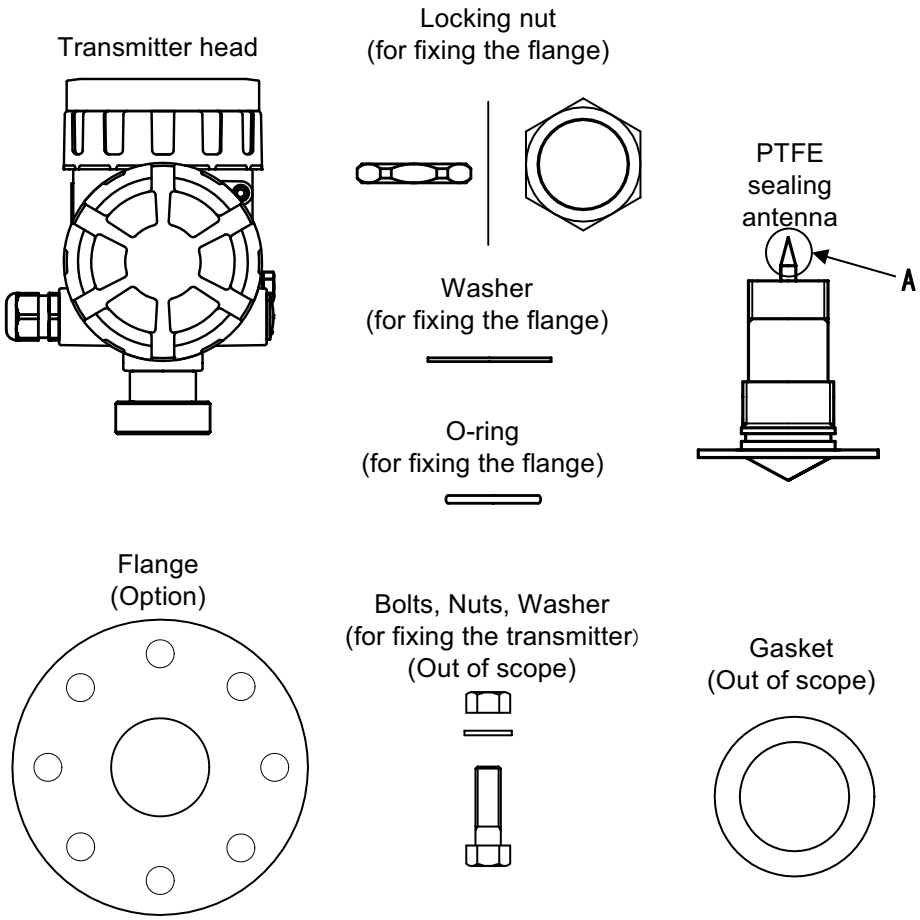


Fig. 2.10.2.1 Required item for cone antenna installation

(2) Fasten PTFE sealing antenna with O-ring. Pass through flange and washer, then secured with locking nut. Let transmitter head fix to PTFE sealing antenna unit by locking nut.

NOTE:

- Please apply the grease lubricating for O-ring.
- Please be careful there is no adhesion of dirt for O-ring through assembling.

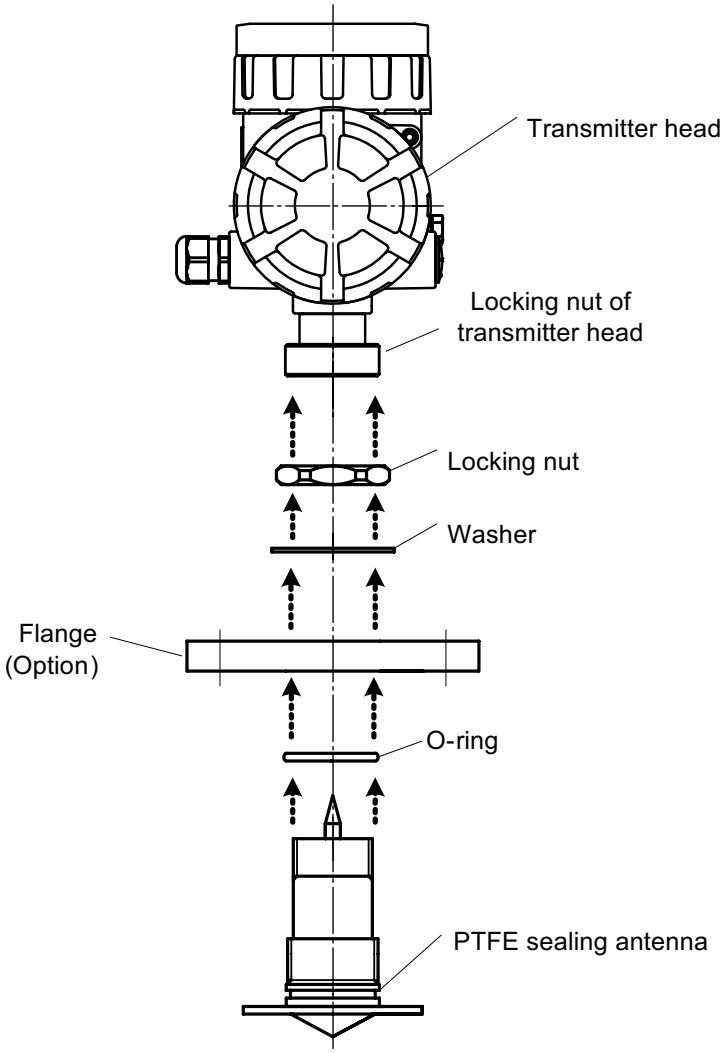


Fig. 2.10.2.2 Antenna assembling

(3) Tighten locking nuts as below, then fixing transmitter head and antenna unit with flange.

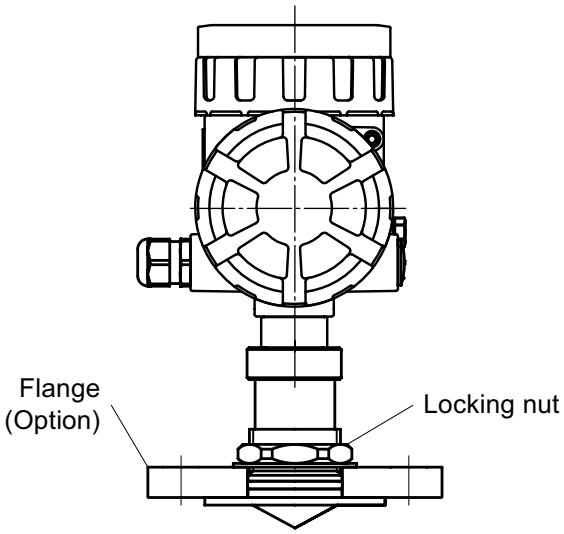


Fig. 2.10.2.3 Transmitter head fixing

(4) Place the gasket on the tank nozzle. Carefully fit the flange and the PTFE sealing antenna on the tank nozzle. Tighten the assembled unit by the bolts and nuts as below.

CAUTION

Tighten the assembly to retain the internal gas without any leakage.

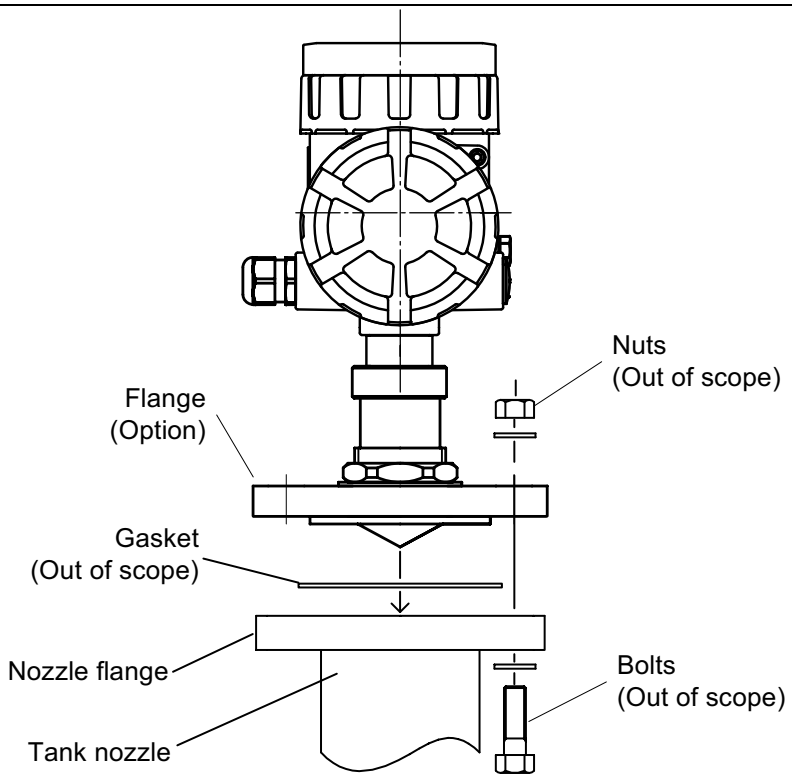


Fig. 2.10.2.4 Installing onto the tank nozzle

2.10.3 Rod antenna

(1)Required parts for rod antenna installation are as follows.
· Flange is optional item.
· Sealing gasket, bolts or nuts are out of scope for standard items.

NOTE:
· Please treat not to bend on be damaged the point of "A". In case of this place is bent or damaged, it may cause noise reflection.
· Do not use metal gasket which may disturb proper microwave propagation.

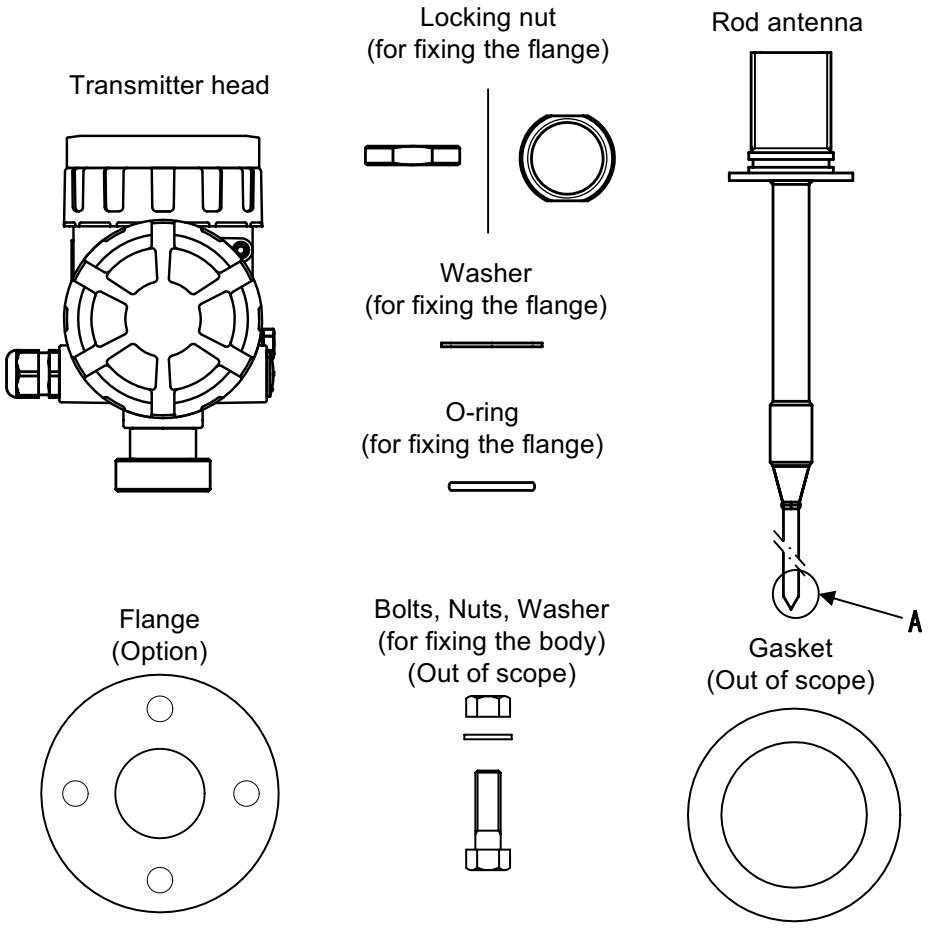


Fig. 2.10.3.1 Required item for cone antenna installation

(2) Fasten rod antenna with O-ring. Pass through flange and washer, then secured with locking nut. Let transmitter head fix to rod antenna unit by locking nut.

NOTE:

·Please apply the grease lubricating for O-ring.

·Please be careful there is no adhesion of dirt for O-ring through assembling.

·Please note direction of the rod antenna. (Please let orthogonal oscillation direction and the mounting section marker)

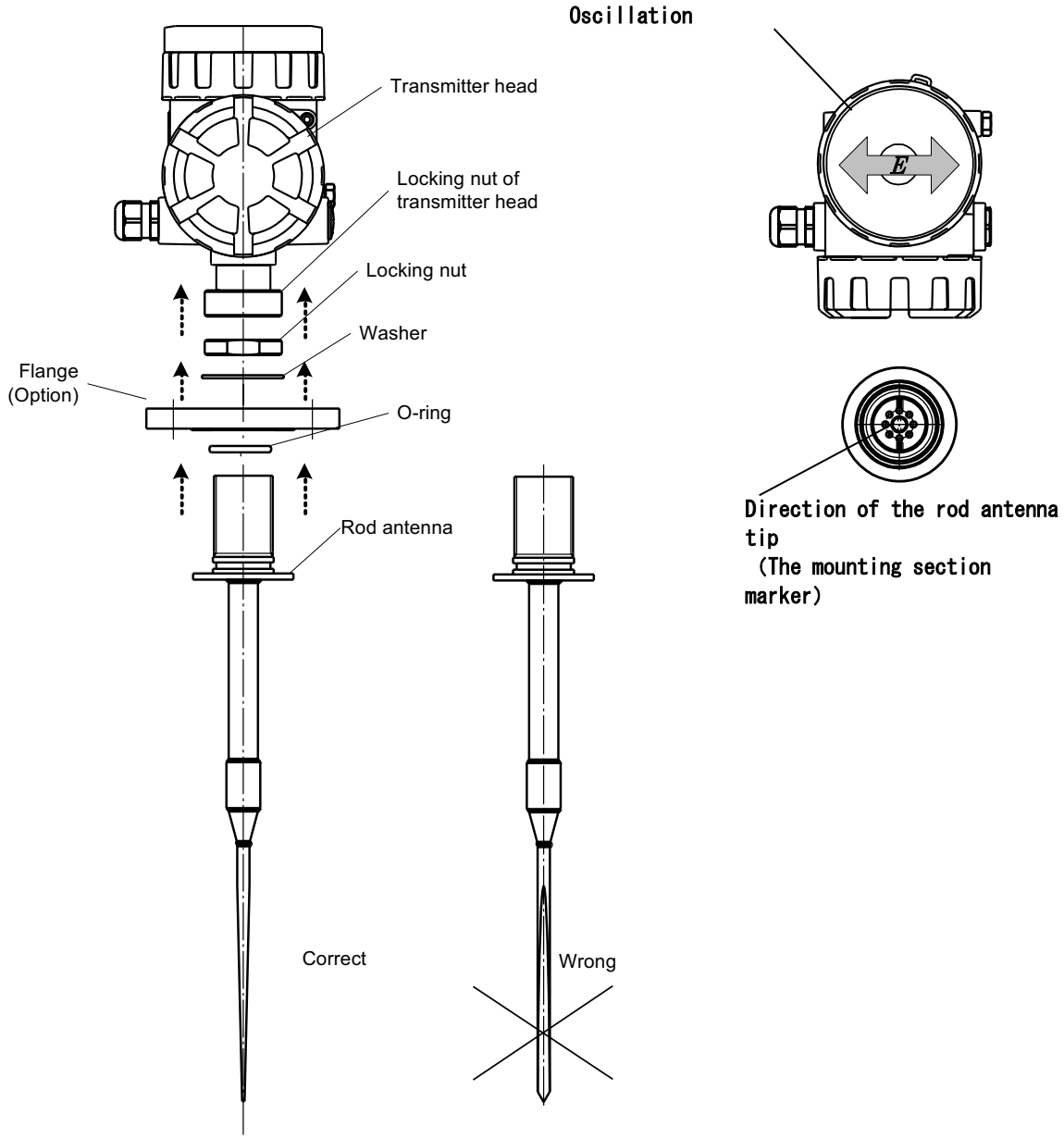


Fig. 2.4.10 Antenna assembling

(3) Tighten locking nuts as below, then fixing transmitter head and antenna unit with flange.

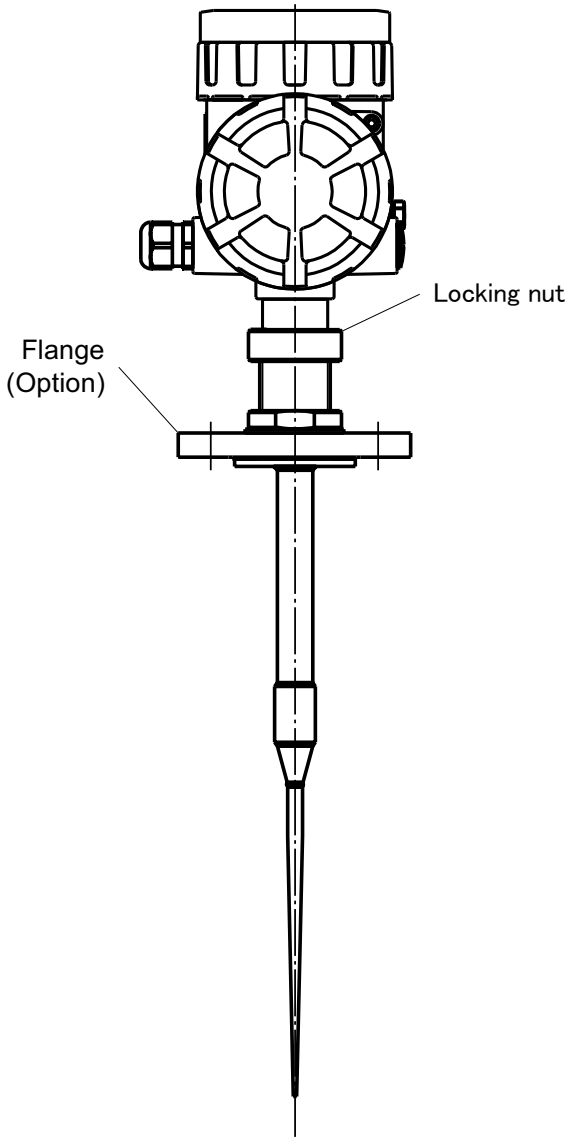


Fig. 2.4.11 Transmitter head fixing

(4) Place the gasket on the tank nozzle.
Carefully fit the flange and the PTFE sealing antenna on the tank nozzle.
Tighten the assembled unit by the bolts and nuts as below.

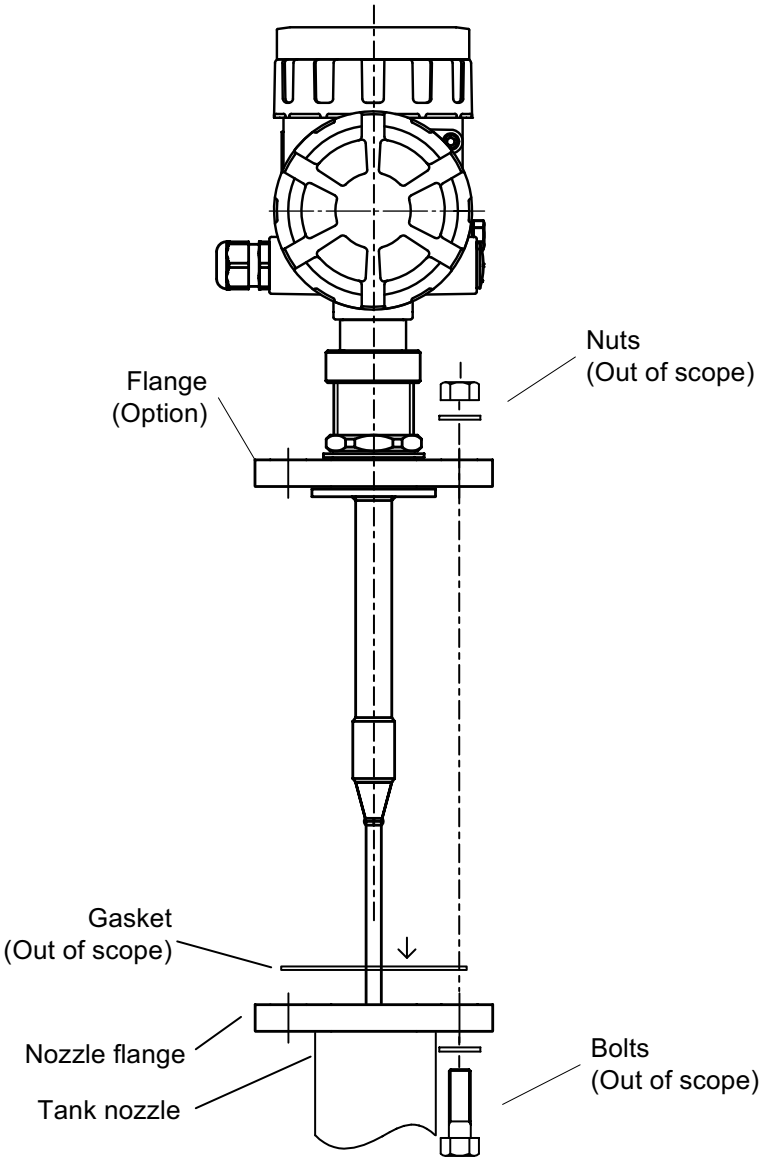


Fig. 2.4.12 Installing onto the tank nozzle

Chapter 3 Electrical installation

3.1 Connection to transducer

⚠ CAUTION
·Wiring work must be done non-hazardous area. ·Be sure to stop the power supply to the transducer or any of accessories during wiring work to prevent electrical shock. ·Make sure that wire polarity is made correctly as incorrect wiring may result in damage to the transducer and its connected accessories. ·The cable gland should be attached properly.

3.1.1 Wiring procedure

Wiring procedures are as follows,
(1) Ensure the power supply is turned off on the line.
(2) Remove the cover of the terminal box.
(3) Put the cable into the box through the cable gland.
(4) Strip approx. 1cm of insulation from the end of the cable and connect with proper polarity. Place the cable core into the connector by pushing connector button with a slot screw driver.
(5) Cable shield should be connected to the internal ground terminal.
(6) Cable gland should be tightened properly.
Once tighten the cable gland until the cable fixed, then add extra 1 round as finish.
(7) Fix the cover of the terminal box back.
(8) Connect external ground terminal.

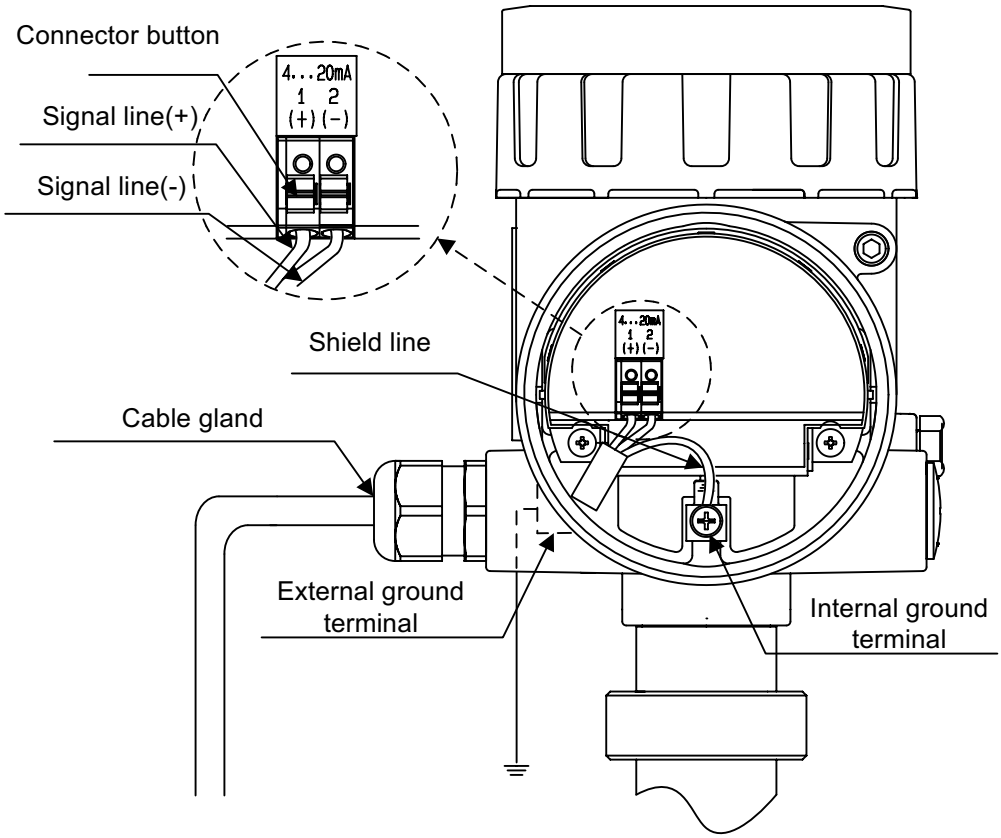


Fig. 3.1.1 Connecting diagram

Installation of accessories

After wiring of transmitter head side, then proceed confection of accessories.
Followings are example of wiring.

(1) Non-Ex connection example

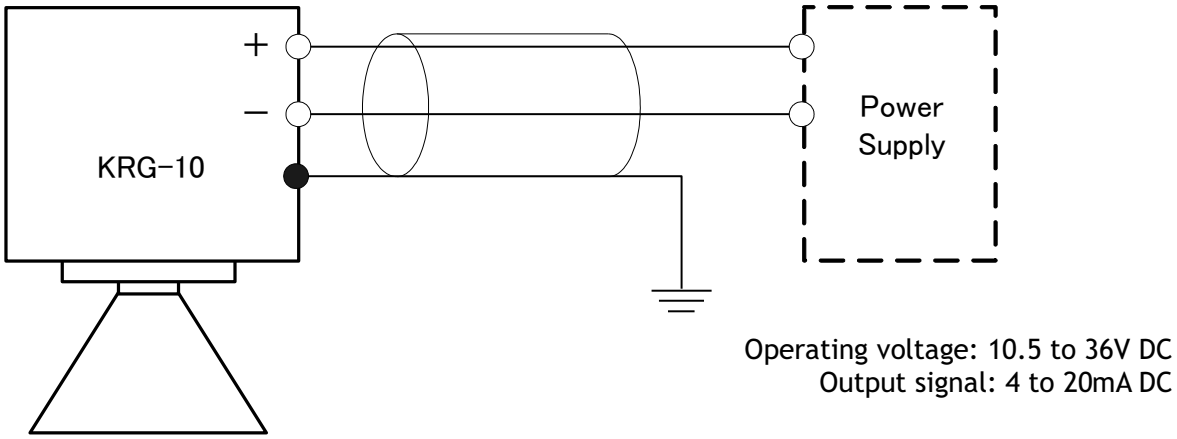
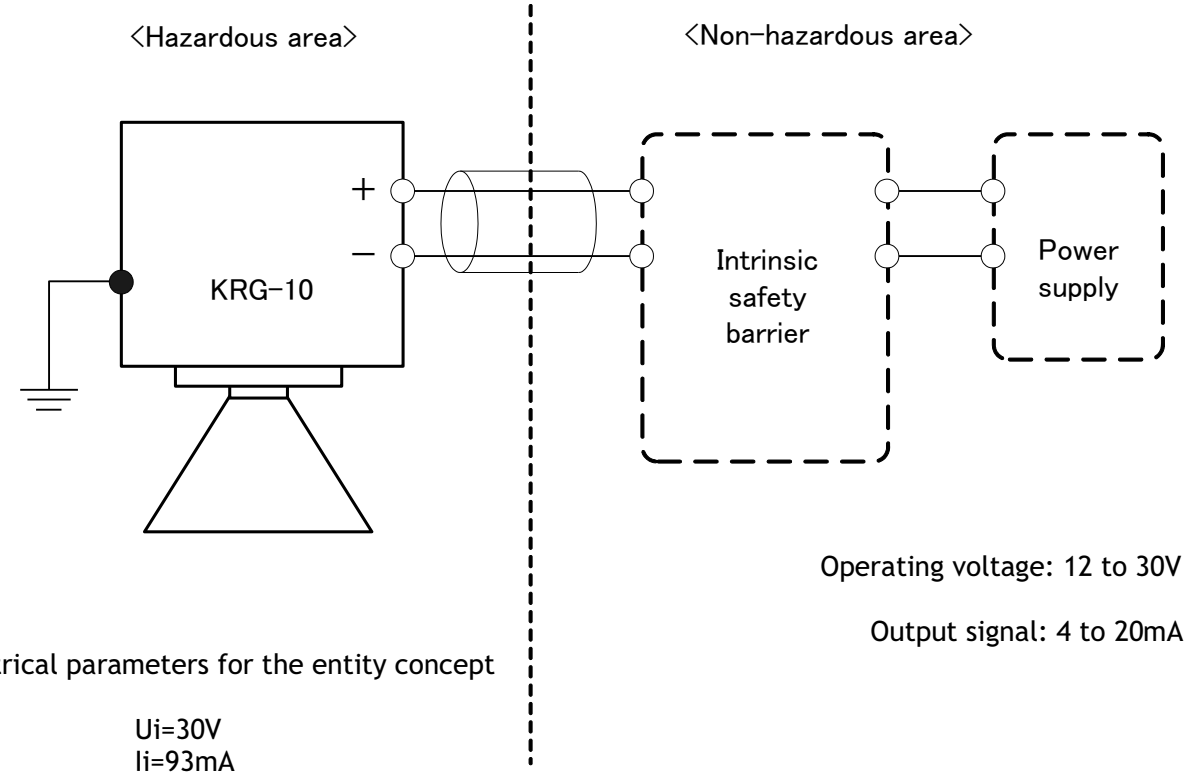


Fig. 3.1.2 Non-Ex connection example

(2) Ex-i connection example.

⚠ CAUTION



Operating voltage: 12 to 30V DC

Output signal: 4 to 20mA DC

Electrical parameters for the entity concept

Ui=30V
Ii=93mA
Pi=0.7W
Ci≈0
Li≈0

Fig. 3.1.3 Ex-i connection example.

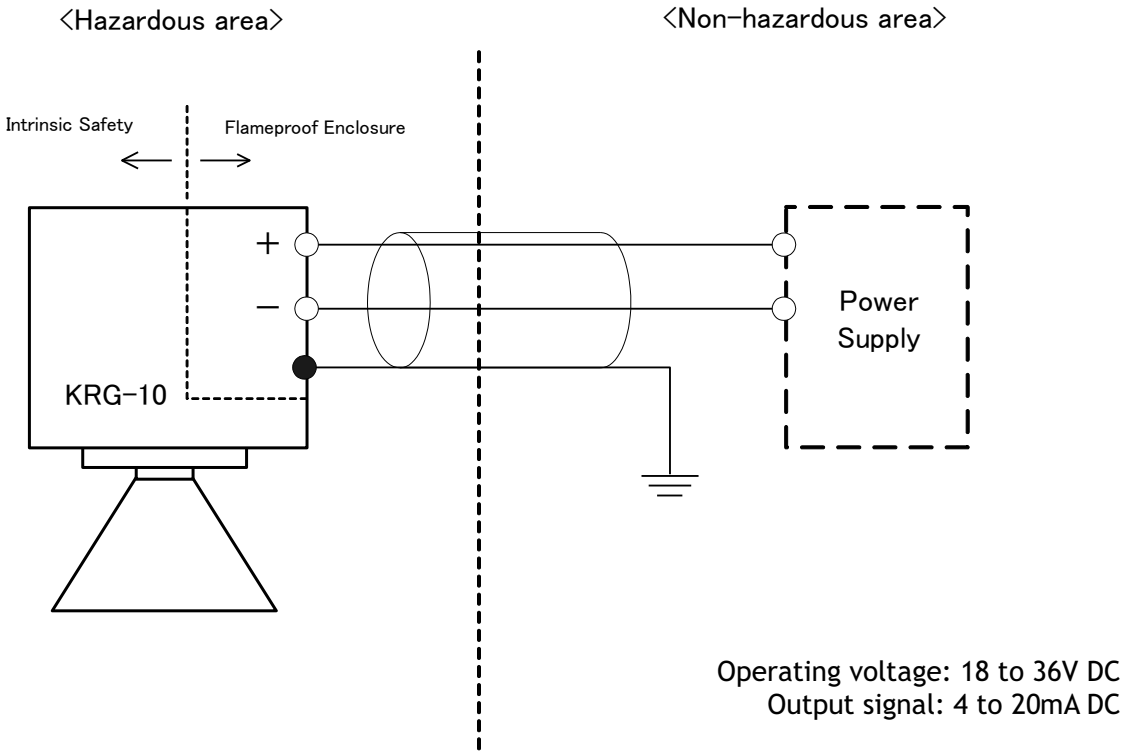
NOTE:
・Select appropriate ATEX/IECEx classified product to satisfy the Ex requirement.
・Grounding must be connected.
・Do not open either of lids, while the power is supplied or in the explosive gas and dust atmosphere.
・Do not make static electricity.
・Do not modify any of construction.
・Following requirements must be kept in accordance with ATEX/IECEx regulation.

Ambient temperature	-40 to 60°C
Target temperature	< 130°C
Cable max. rated temperature	> 60°C

・Intrinsic safety barrier must satisfy the rating of electrical parameters for the entity concept.
・Distribution cable inductance (=Lw) and capacitance (=Cw) should be chosen so as to lower the rating of Intrinsic safety barrier allowable inductance (=Lo) and capacitance (=Lo).
・Perform grounding construction.

(3) Ex-d+i connection example.

⚠ CAUTION
Ensure the requirement of wiring with Ex product must be satisfied.



Electrical parameters for the entity concept

Um = 250V AC 50/60Hz

Fig. 3.1.4 Ex-d+i connection example

NOTE:
・Select appropriate ATEX / IECEx classified product to satisfy the Ex requirement.
・Do not open either of lids, while the power is supplied or in the explosive gas and dust atmosphere.
・Do not make static electricity.
・Do not modify any of construction.
・Following requirements must be kept in accordance with ATEX/IECEx regulation.

Ambient temperature	-40 to 60˚C
Target temperature	< 130˚C
Cable max. rated temperature	> 60˚C

・Perform grounding construction (grounding resistance<10Ω).

3.2 Cable requirement

Required specification: Twisted pair 2 core shielded cable (0.2 to 2.5mm-sq / AWG 24 to 14)
Cable entry: 2 ports / M20 x 1.5 (Cable dia; 6.5 to 9mm)

3.3 Allowable resistance

Refer to the Fig 3.1.5 for details.
The maximum load resistance at the maximum supply voltage used in each equipment specification is shown in ② and ③ in Fig 3.1.5. (for example : maximum supply voltage in the Non-Ex specification so 36V DC, maximum load resistance is 1159Ω)
NOTE: Resistors used in HART communication is 250Ω. It shows the power supply voltage of 250Ω ① in Fig 3.1.5. (23.5V DC)

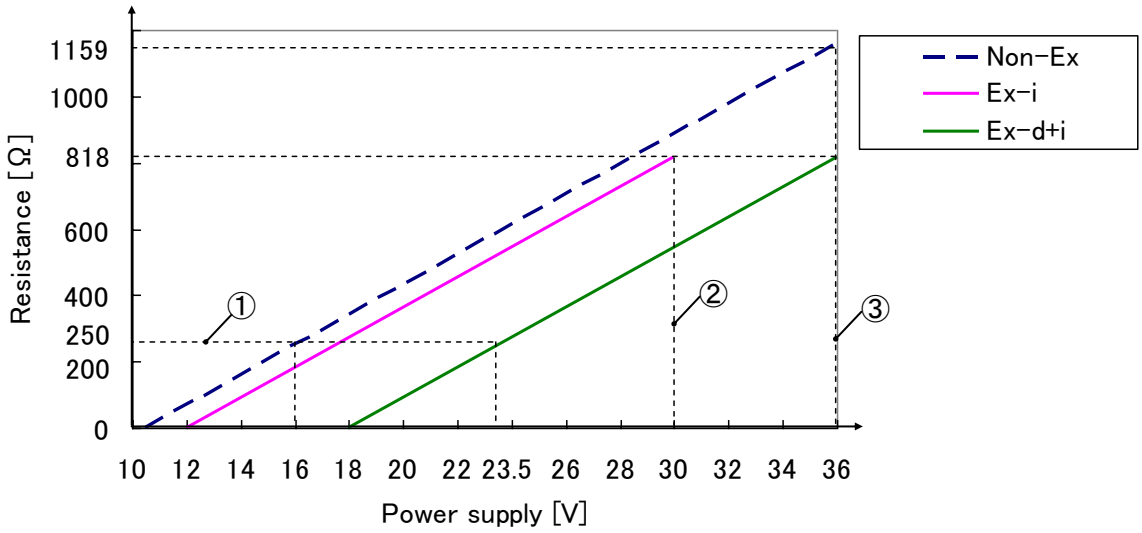


Fig 3.1.5 Allowable resistance

①: HART load
②: Power supply voltage limit Ex-i equipment
③: Power supply voltage limit Non-Ex and Ex-d equipment

3.4 Power

Power Supply: 10.5 to 36V DC (Non-Ex),12 to 30V DC (Ex-i),18 to 36V DC (Ex-d+i),
Max. Current: 22mA

3.5 Cable screening and grounding

In case of Non-Ex and Ex-i, perform grounding construction.(grounding resistance<100Ω) In case of Ex-d+I, perform grounding construction.(grounding resistance<10Ω)
Grounding terminal is outside of the transmitter head and inside of the terminal box, respectively. May use which grounding terminal.
If screened cable is necessary, connect the cable screen on both ends to ground potential. In the terminal box, the screen must be connected directly to the internal ground terminal.

⚠ **WARNING**
Ex equipment installation requires connection with the earth line.

Chapter 4 Commissioning

4.1 Step for starting measurement

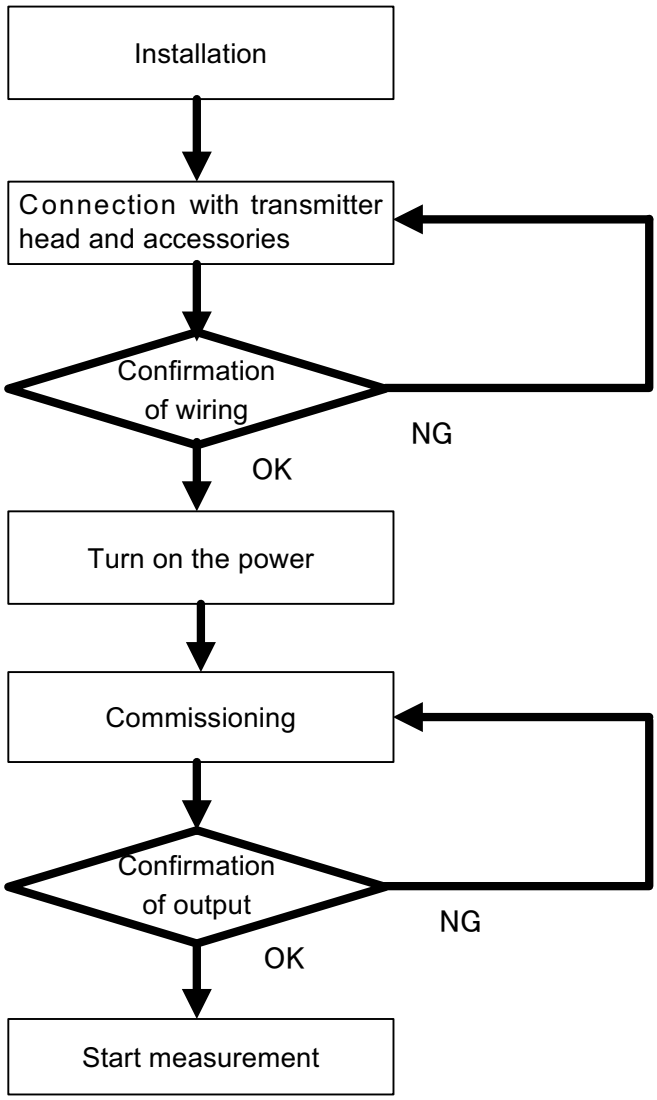


Fig. 4.1.1 Step for starting measurement

NOTE:
·Connection procedure should be referred **Chapter 3 Electrical installation**.
·This level gauge can be configured through the keys (and display) or HART communication.
- in case of using the keys (and display) : refer to **Chapter 5 LCD and 4-Keys operation**.
- in case of using HART communication : refer to **Chapter 6 Operation by configuration software**.

4.2 Installation

Please refer to **Chapter 2 Installation**.
Installation instructions are described in the chapter.

4.3 Connection

To connect the equipment to external devices (e.g. power supply), please refer to **Chapter 3 Electrical installation**.
If error exists, the equipment do not work properly. Including connection of grounding, please check the connection.
If you use the configuration software on PC, you must prepare a HART modem for communication and operation. For method of connection, please refer to **Chapter 6 Operation by configuration software**.

4.4 Turn on/off

The equipment has no switch for turning on and off.
The measurement operation starts automatically when power is applied.
If a LCD module is mounted in the transmitter head, the LCD displays measurement data or information of the equipment while turning on.

4.5 Setup measurement parameters

After commissioning you must set parameters in the equipment for proper measurement.
The parameter setting can be carried out by 2 means.

- LCD and 4-key.
  Please refer to **Chapter 5 LCD and 4-Keys operation**.

- Configuration software on PC
  Please refer to **Chapter 6 Operation by configuration software**.
  To set the parameter by configuration software, you must establish the connection between the software and the equipment before communication operation. Please refer to **6.2 Connecting to the instrument**.

By any method above, you can change measurement parameters in the equipment. But you can easily set complicating parameters by the configuration software. The configuration software is recommended for setup.
For proper measurement, at least, please set the parameters listed below.

1) Base setting
Parameters of operating condition must be set properly before starting measurement.
Please set LCD output parameter, G,R,C,H. About the base setting parameters, please refer to Fig 4.5.1. About meaning of parameters, please refer to **Chapter 5 LCD and 4-Keys operation**, **Chapter 6 Operation by configuration software** and **Chapter 7 Precautions on equipment settings**.
For operation by LCD and 4-key, please refer to table 5.3.1. in **5.3 Key parameter list.**
For operation by configuration software, please refer to **6.3.1 Basic Settings**.

If you utilize Calc Volume or Calc Flow features, you must set corresponding parameters.

2) Analog out (in the case of use)
Please set analog output parameter, minimum output, maximum output.
For operation by LCD and 4-key, please refer to table 5.3.1 in **5.3 Key parameter list**.

In usual case, other parameters are not to be set. However, in particular case, you need to change parameters. please refer to **Chapter 7 Precautions on equipment settings**.
Non-volatile memory stores parameter data while power off, so parameters are need to be set once.

If the measurement is not accurate or is impossible, please check the parameter and installation(**Chapter 2 Installation**) and connection(**Chapter 3 Electrical installation**).

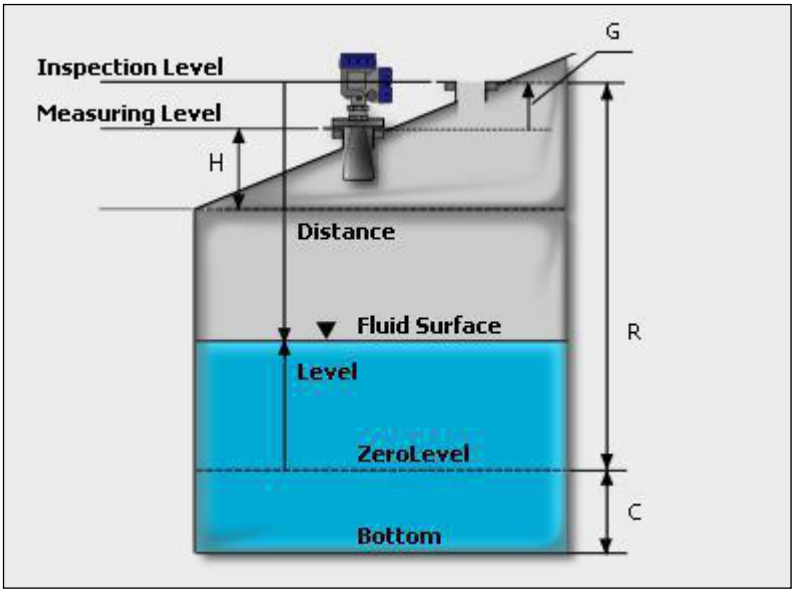


Fig. 4.5.1 Basic setting parameters diagram

Chapter 5 LCD and 4-Keys operation

5.1 LCD

LCD module connection and direction

⚠ CAUTION
·Commissioning work should be done in non-hazardous area atmosphere. ·Be sure to stop power supply to the transducer or any of accessories while wiring work to prevent electrical shock.

LCD module is removable and it can place 4 pattern directions.
Turn off the power when LCD direction is changed.

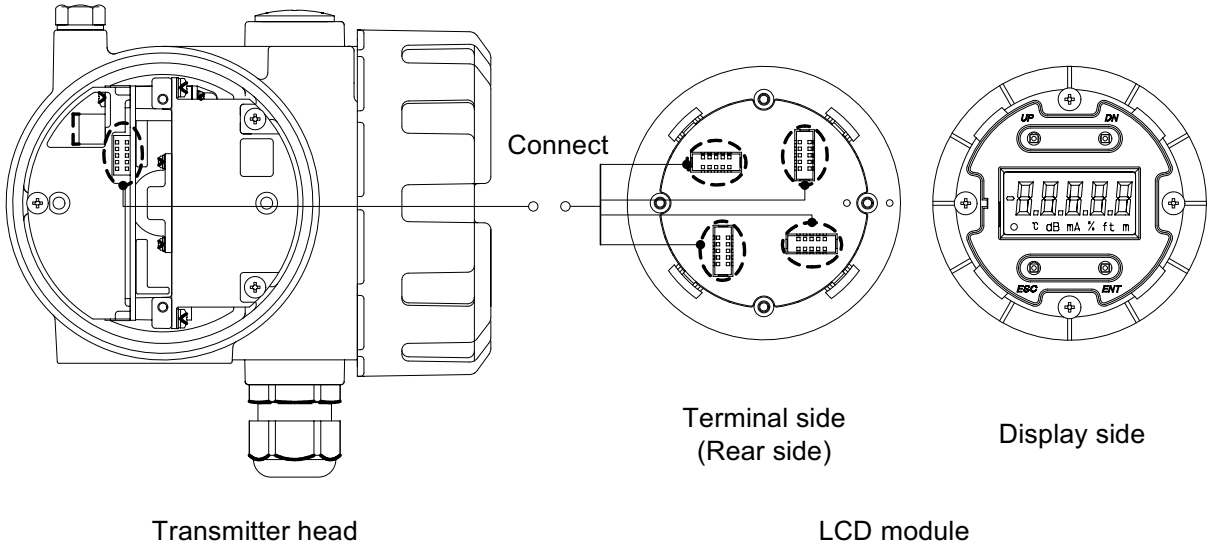


Fig. 5.1.1 LCD module connection

Name for LCD & operational 4-Keys

Measured data and units are displayed during normal operation. Blinking display of the last measured value indicates that level gauge is in alarm mode.
If the measurement is failure, “No surface echo status” flashes.
When the keys are used in configuration mode, the menu number or configuration data is displayed.

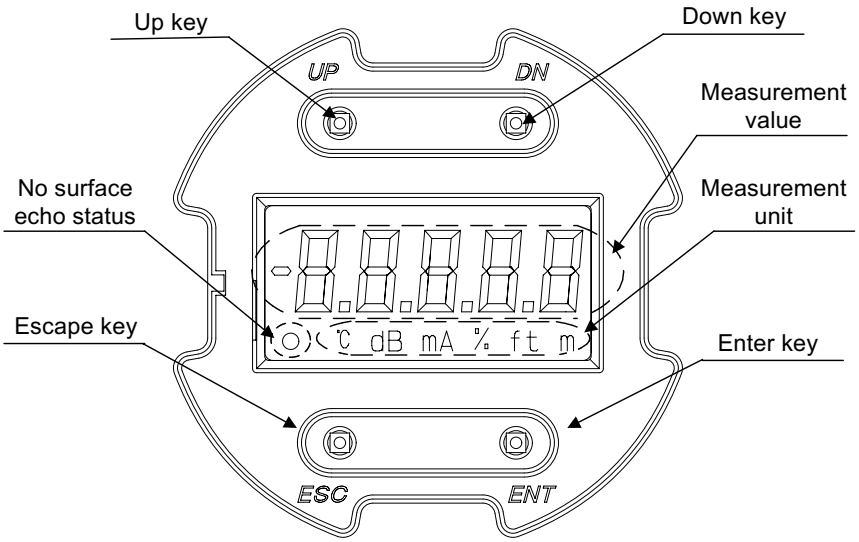


Fig. 5.1.2 LCD

Measured value

Table. 5.1.1 Measured value

LCD Output Parameter	Unit	sign	Digit
Level	m or Ft	±	5 digits max. (Integral + Decimal number)
Distance	M or Ft	±	5 digits max. (Integral + Decimal number)
Volume	-	+	5 digits max. (Integral + Decimal number)
Flow	-	+	5 digits max. (Integral + Decimal number)
Current	mA	+	5 digits max. (Integral 2+ Decimal 3)
Signal Amplitude	dB	+	3 digits max. (Integral number)
Temperature	˚C	±	4 digits max. (Integral 3+ Decimal 1)
Max Volume	-	+	5 digits max. (Integral + Decimal number)
Max Flow	-	+	5 digits max. (Integral + Decimal number)
Volume (%)	%	+	5 digits max. (Integral 3+ Decimal 2)
Flow (%)	%	+	5 digits max. (Integral 3+ Decimal 2)

5.2 4-Keys

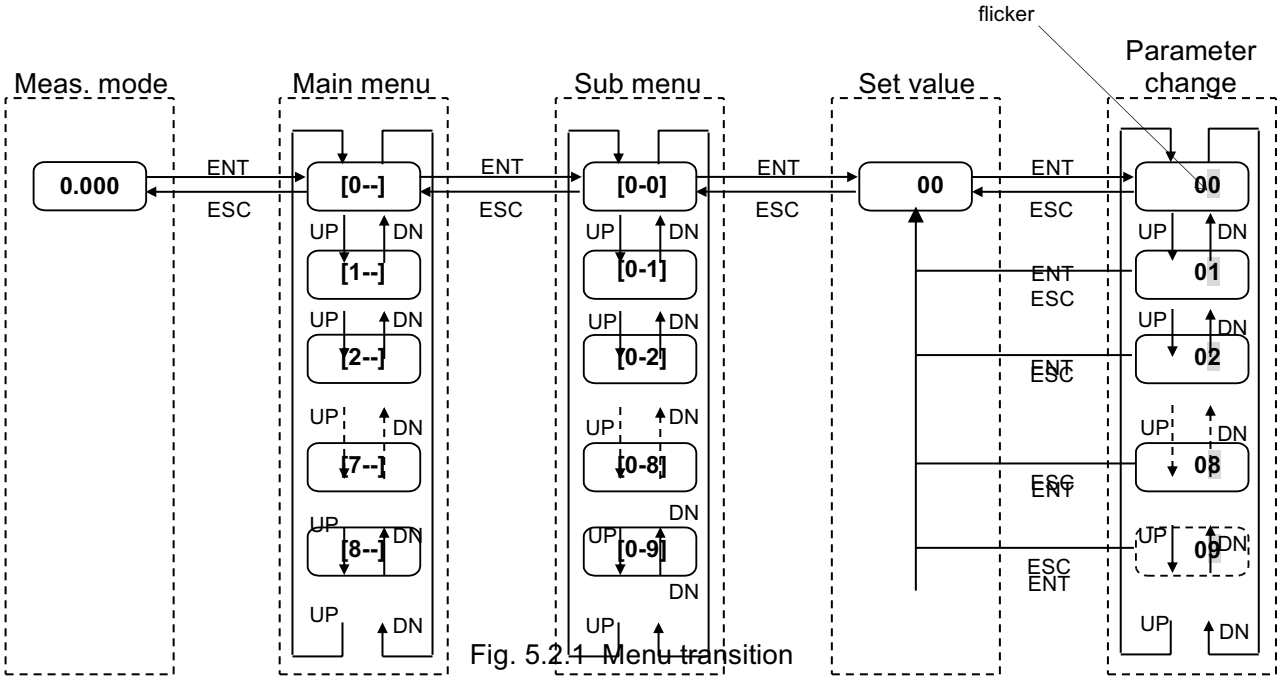


Fig. 5.2.1 Menu transition

4-Keys operation

(1) Measurement value will be shown when the power is supplied.



Fig. 5.2.2 LCD measurement value

(2) Proceed into setting mode when “ENT” key clicked. Main menu No. will be shown as below. Below example shows “Menu-0”.

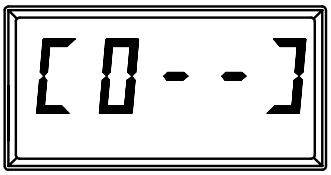


Fig. 5.2.3 LCD main menu No.

(3) Main menu can be change from 0 to 8 by “UP” or “DN” key.

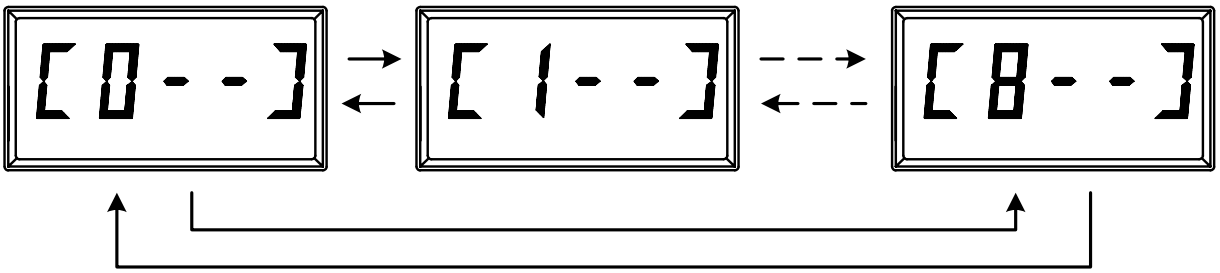


Fig. 5.2.4 Change main menu No.

(4) When “ENT” key is clicked in main menu, sub menu will be shown as below. Below example shows “main menu-0” + “sub menu-0”.

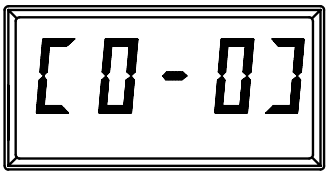


Fig. 5.2.5 LCD sub menu No.

(5) Sub menu can be changed from 0 to 9 by “UP” or “DN” key.

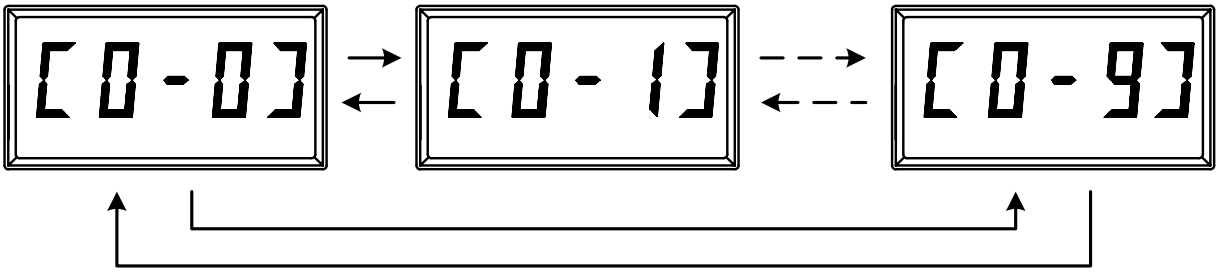


Fig. 5.2.6 Change sub menu No.

(6) When “ENT” key is clicked after sub menu number is decided, set value will be shown as below.



Fig. 5.2.7 LCD set value

(7) In case of change the set value, click “ENT” key again, the lowest digit of set value will flicker.



Fig. 5.2.8 Input set value

(8) Flickered value can be changed by “UP” or “DN” key. When “ENT” key is clicked, the flickered value will be decided and changed to next digit.

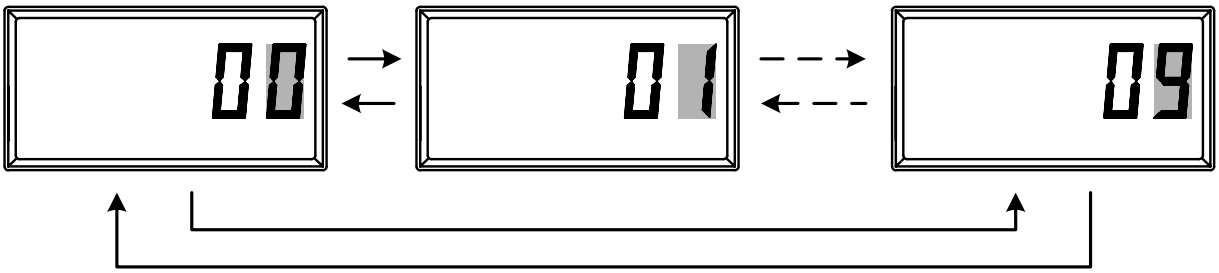


Fig. 5.2.9 Change flickered value

(9) Changed parameter can be canceled by “ESC” key until final digit is confirmed.

(10) By click of “ESC” key, display mode will move to upper menu such as setting mode -> Sub menu -> Main menu -> Meas. Mode.

Example

When "R" parameter is set to 6.555 m from 10 m.

Table 5.2.1 Example

Step	Key	Display	Description
1	-	7.555 m	Measuring level (Meas. mode)
2	ENT	[0 - -]	Main menu
3	ENT	[0 - 0]	Sub menu
4	UP	[0 - 1]	
5	UP	[0 - 2]	
6	UP	[0 - 3]	
7	UP	[0 - 4]	
8	UP	[0 - 5]	
9	ENT	10.000	
10	ENT	10.000	"0" flickers
11	UP x 5	10.005	x 5: push 5 times
12	ENT	10.005	
13	UP x 5	10.055	
14	ENT	10.055	
15	UP x 5	10.555	
16	ENT	10.555	
17	DN x 4	16.555	
18	ENT	16.555	
19	DN	06.555	
20	ENT	06.555	
21	ESC	[0 - 5]	Sub menu
22	ESC	[0 - -]	Main menu
23	ESC	4.110 m	Measuring level (Meas. mode)

5.3 Key parameter list

Table 5.3.1 Key parameter list

Main menu	Sub menu	Parameters	Default	Unit	Range
[0--] Base Setting	[0-0]	LCD output Parameter	0	-	0 ~ 10
	[0-1]	Measurement Unit	0	-	0, 1
	[0-2]	Antenna Type	0	-	0 ~ 12
	[0-3]	Bore	0	m or Ft	0.000 ~ 99.999
	[0-4]	G	0	m or Ft	-99.999 ~ 99.999
	[0-5]	R	30	m or Ft	0.000 ~ 99.999
	[0-6]	C	0	m or Ft	0.000 ~ 99.999
	[0-7]	H	0	m or Ft	0.000 ~ 99.999
	[0-8]	Number of decimal places for Display Offset	3	-	0 ~ 3
	[0-9]	Display Offset	0	m or Ft	-99999 ~ 99999
[1--] Calc Volume	[1-0]	Volume Type	0	-	0 ~ 4
	[1-1]	D (Diameter)	1	m or Ft	0.000 ~ 99.999
	[1-2]	L (Length)	1	m or Ft	0.000 ~ 99.999
	[1-3]	O (Offset)	0	m or Ft	-99.999 ~ 99.999
	[1-4]	A (Distance To Full Level)	0	m or Ft	-99.999 ~ 99.999
	[1-5]	Volume Unit	0	-	0 ~ 3
[2--] Calc Flow	[2-0]	Flow Type	0	-	0 ~ 3
	[2-1]	Weir Type	0	-	0 ~ 3
	[2-2]	Nominal (PF)	0	-	0 ~ 13
	[2-3]	B (Water Way Width)	0.5	m or Ft	0.000 ~ 99.999
	[2-4]	b (Weir Width)	0.15	m or Ft	0.000 ~ 99.999
	[2-5]	D (Height To Notch)	0.3	m or Ft	0.000 ~ 99.999
	[2-6]	v (Kinematic Viscosity)	1	-	0.000 ~ 99.999
	[2-7]	Flow Unit	0	-	0 ~ 15
[3--] Analog Out	[3-0]	Analog Output Parameter	0	-	0 ~ 4
	[3-1]	Minimum Output	0	m or Ft	-99.999 ~ 99.999
			0	-	0 ~ 99999
			0	dB	0.00 ~ 200.00
	[3-2]	Maximum Output	30	m or Ft	-99.999 ~ 99.999
			100	-	0 ~ 99999
			100	dB	0.00 ~ 200.00
	[3-3]	Alarm Selection	0	-	0 ~ 2

[4--] Measure Support	[4-0]	Averaging Time	60	-	1 ~ 120
	[4-1]	Median Filter	0	-	0 ~ 120
	[4-2]	Research Delay	30	-	1 ~ 120
	[4-3]	Alarm Delay	30	-	1 ~ 120
	[4-4]	Echo Detect	0	-	0, 1
	[4-5]	Zero Minus Value	0	-	0, 1
	[4-6]	Noise Margin	15	dB	0 ~ 255
[5--] Outlier Removal	[5-0]	Valid Window Width	0.8	m or Ft	0.000 ~ 99.999
	[5-1]	Double Bounce - Double Bounce	0	-	0, 1
	[5-2]	Double Bounce - Double Bounce Offset	0	m or Ft	-99.999 ~ 99.999
	[5-3]	Bottom - Bottom Visible	0	-	0, 1
	[5-4]	Bottom - Window Width	0.3	m or Ft	0.000 ~ 99.999

[6--] Valule Hold	[6-0]	Level Tracking	0	-	0, 1
	[6-1]	Output Prediction	0	-	0, 1
	[6-2]	Slow Search - Slow Search	0	-	0, 1
	[6-3]	Slow Search - Window Exp-Width	0	m or Ft	0.000 ~ 99.999
	[6-4]	Zero Cut - Zero Cut	0	-	0, 1
	[6-5]	Zero Cut - Position	0	m or Ft	0.000 ~ 99.999
[7--] Calibration	[7-0]	Fixed Current Output	0	mA	0, 3.600 ~ 22.000
	[7-1]	Calibration - 4mA Calibration	4	mA	3.500 ~ 4.500
	[7-2]	Calibration - 20mA Calibration	20	mA	15.000 ~ 25.000
	[7-3]	Offset Calibration	0	m or Ft	-1.000 ~ 1.000
	[7-4]	Span Calibration	1	-	0.500 ~ 1.500
[8--] Tools	[8-0]	Research	0	-	0, 1
	[8-1]	Parameter Initialize	0	-	0, 1
	[8-2]	Reboot	0	-	0, 1
	[8-3]	Error	-	-	-
	[8-4]	Firmware Version	-	-	-

5.4 Parameter instructions

[0-0] LCD Output Parameter

0: Level	Level of target
1: Distance	Distance between gauging reference point and target
2: Volume	Volume
3: Flow	Flow rate
4: Current	Current value (mA) (4-20 mA)
5: Sig-Amp	Signal strength amplitude (dB)
6: Temperature	Internal Temperature (°C)
7: Max Volume	Max. value of volume settings
8: Max Flow	Max. value of flow rate settings
9: Volume (%)	Volume (%)
10: Flow (%)	Flow rate (%)

[0-1] Measuring Unit

0: m	Sets display in Metric units
1: Ft	Sets display in Feet units

Note: When 'Measuring Unit' is changed, units of other parameters also change.

[0-2] Antenna Type

0: 2”Cone	2" cone antenna
1: 4”Cone	4" cone antenna
2: 2”PTFE Seal	2" PTFE sealing antenna
3: 4”PTFE Seal	4" PTFE sealing antenna
4: 1”Rod	1" rod antenna
11: 2”Pipe	2" pipe + 2” cone antenna
12: 4”Pipe	4" pipe + 4” cone antenna

[0-3] Bore
Enter the inner diameter of the antenna pipe.

[0-4] G
Enter the parameter G, distance between reference point and gauging reference point.

[0-5] R
Enter the parameter R, measurement range.

[0-6] H
Enter the parameter H, dead zone.

[0-7] C
Enter the parameter C, below measurement range.

[0-8] number of decimal places for Display Offset
Enter the number of digits displayed after the decimal point of Display Offset.

[0-9] Display Offset
Enter the offset parameter for level and distance values on LCD.

[1-0] Volume Type
Volume converter.
Selectable a formula of volume conversion from following 5 ways.
0: Unknown : Select if volume conversion is not used.
1: Vertical Cylinder : Select if Vertical Cylinder conversion is used.
2: Spherical : Select if Spherical conversion is used.
3: Horizontal Cylinder : Select if Horizontal Cylinder conversion is used.
4: User Defined : Select if user defined table conversion is used.

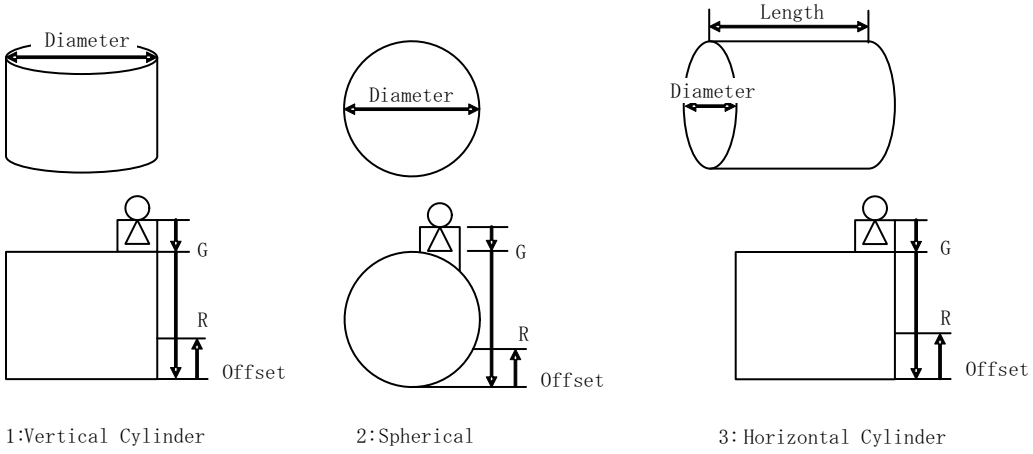


Fig. 5.4.1 Volume type

[1-1] D (Diameter)
Enter the parameter D, diameter of the tank.

[1-2] L (Length)
Enter the parameter L, length of the tank.

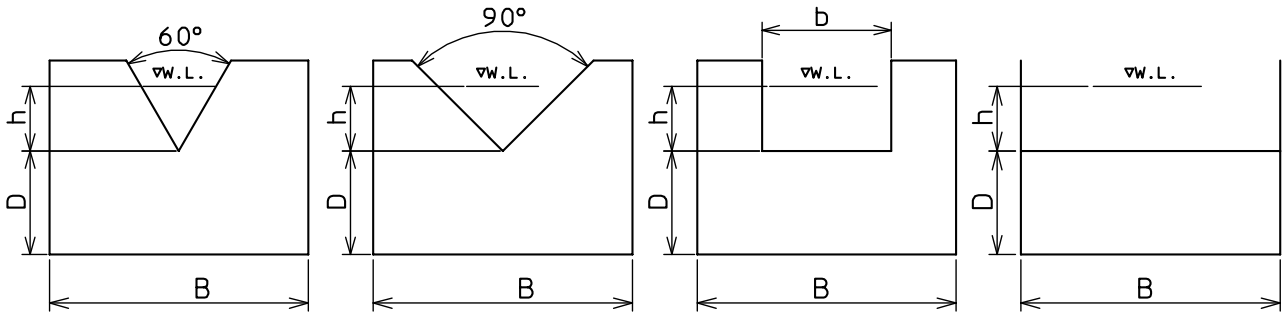
[1-3] O (Offset)
Enter the parameter O, offset of the tank.

[1-4] A (Distance To Full Level)
Enter the parameter A, distance to full level of the tank.

[1-5] Volume Unit
Select unit for Volume.
0: m^3
1: US Gallons
2: Barrels
3: Ft^3

[2-0] Flow Type
Flow rate converter.
Selectable formula of flow rate conversion from following 4 way.
0: Unknown : Select if flow conversion is not used.
1: Weir_JIS : Select if weir conversion is used.
2: Flume_JIS : Select if flume conversion is used.
3: User Defined : Select if user defined table conversion is used.

[2-1] Weir Type
Weir formula. (JIS B 8302)
0: Edged 60Deg Triangle
1: Edged 90Deg Triangle
2: Edged Square
3: Overall Width



0: Edged 60Deg Triangle 1: Edged 90Deg Triangle 2: Edged Square 3: Overall Width

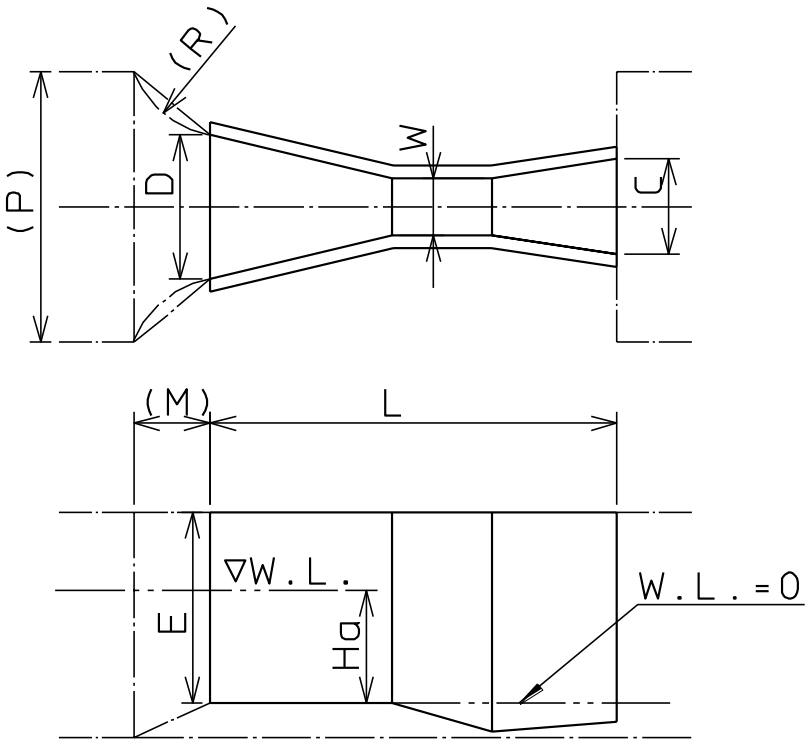
Fig. 5.4.2 Weir type

[2-2] Nominal (PF)
Parshall Flume Formula. (JIS B 7553)
Select size of parshall flume.

0: PF-01	Flume for PF-01
1: PF-02	Flume for PF-02
2: PF-03	Flume for PF-03
3: PF-06	Flume for PF-06
4: PF-09	Flume for PF-09
5: PF-10	Flume for PF-10
6: PF-15	Flume for PF-15
7: PF-20	Flume for PF-20
8: PF-30	Flume for PF-30
9: PF-40	Flume for PF-40
10: PF-50	Flume for PF-50
11: PF-60	Flume for PF-60
12: PF-70	Flume for PF-70
13: PF-80	Flume for PF-80

Table 5.4.1 Parshall Flume dimensions Unit : mm

PF size	Flow range [m^3/h]	W	C	D	E	L	Reference (min.)		
							(M)	(P)	(R)
PF-01	1～30	25.4	93	167	450	635	200	600	300
PF-02	2～63	50.8	135	214	450	774	250	724	350
PF-03	3～193	76.2	178	259	610	914	305	768	406
PF-06	5～398	152.4	394	397	610	1525	305	902	406
PF-09	9～907	228.6	381	575	762	1626	305	1080	406
PF-10	11～1641	304.8	610	845	914	2867	381	1492	508
PF-15	15～2508	457.2	762	1026	914	2943	381	1676	508
PF-20	43～3374	609.6	914	1207	914	3019	381	1854	508
PF-30	62～5138	914.4	1219	1572	914	3169	457	2223	508
PF-40	133～6922	1219.2	1524	1937	914	3318	457	2711	610
PF-50	163～8726	1524.0	1829	2302	914	3467	457	3080	610
PF-60	265～10551	1828.8	2134	2667	914	3616	457	3442	610
PF-70	306～12376	2133.6	2438	3032	914	3765	457	3810	610
PF-80	357～14221	2438.4	2743	3397	914	3915	457	4172	610



NOTE : Ha = Measurement level

Fig. 5.4.3 Parshall Flume

[2-3] B (Water Way Width)
Channel width. (Please refer Fig 5.4.2 Weir type)

[2-4] b (Weir Width)
Weir width. (Please refer 2: Edged Square of Fig 5.4.2 Weir type)

[2-5] D (Height To Notch)
Liquid height from notch end. (Please refer Fig 5.4.2 Weir type)

[2-6] v (Kinematic Viscosity)
Input a value of kinematic viscosity coefficient.

[2-7] Flow Unit
Flow rate unit.
Select unit for flow rate.
0: m^3/D
1: m^3/h
2: m^3/min
3: m^3/sec
4: US Gallons/D
5: US Gallons/h
6: US Gallons/min
7: US Gallons/sec
8: Barrels/D
9: Barrels/h
10: Barrels/min
11: Barrels/sec
12: Ft^3/D
13: Ft^3/h
14: Ft^3/min
15: Ft^3/sec

[3-0] Analog Output Parameter

0: Level	Level value converted to 4-20 mA
1: Distance	Distance value converted to 4-20 mA
2: Volume	Volume value converted to 4-20 mA
3: Flow	Flow rate value converted to 4-20 mA
4: Sig-Amp	Signal strength amplitude value converted to 4-20 mA

[3-1] Minimum Output
Enter the measured value corresponding to 4 mA.

[3-2] Maximum Output
Enter the measured value corresponding to 20 mA.

[3-3] Alarm Selection

0: High	22 mA alarm output
1: Low	3.6 mA alarm output
2: Hold	Hold last value

[4-0] Averaging Time
Measuring value is averaged in accordance with [sec] setting.

[4-1] Median Filter
Set allowable value using calculation to get accurate measured value.

[4-2] Research Delay
Time delay after loss of surface echo until research in accordance with [sec] setting.

[4-3] Alarm Delay
Time delay after loss of surface echo until alarm signals in accordance with [sec] setting.

[4-4] Echo Detect
0: Max Echo Max strength echo defined as surface echo
1: First Echo First echo defined as surface echo

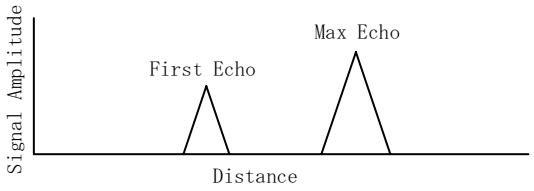


Fig. 5.4.4 Echo detect

[4-5] Zero Minus Value
While this function is "On", zero level will be outputted instead of negative level.
0: Off
1: On

[4-6] Noise Margin
Noise is eliminated in accordance with [dB] setting.

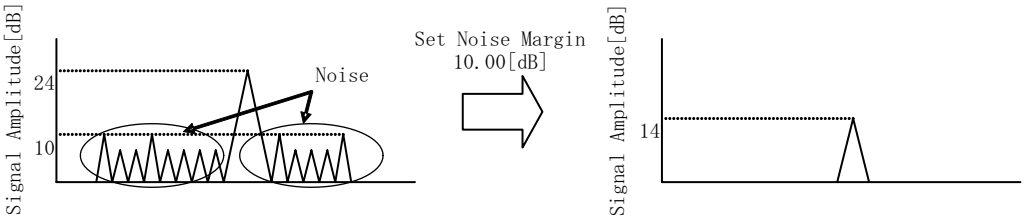


Fig. 5.4.5 Noise margin

[5-0] Valid Window Width
Enter the valid window width for detecting echo.

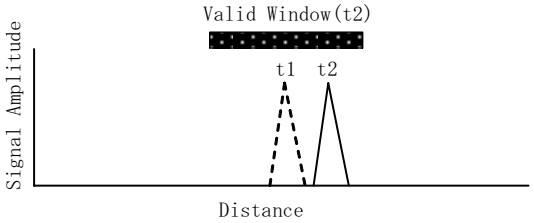


Fig. 5.4.6 Valid window width

[5-1] Double Bounce
While this function is "On", detected multi-bounce echoes (double bounce, triple bounce etc.) will be ignored.
0: Off
1: On

[5-2] Double Bounce Offset
Enter the offset value from gauging reference point to top surface of tank.

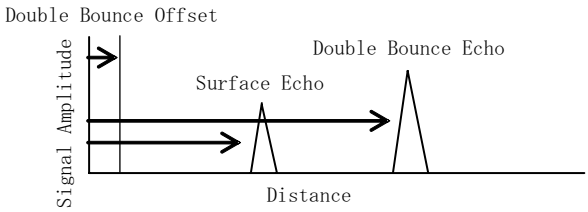


Fig. 5.4.7 Double bounce

[5-3] Bottom Visible
While this function is "On", a detected bottom echo will be ignored.
0: Off When tank bottom echo is smaller than surface echo (such as with water), setting "0" invalidates this function.
1: On When tank bottom echo is larger than surface echo (such as with oil fluids) setting "1" will be effective against echo misdetection.

[5-4] Bottom Window Width
Enter the window width for bottom echo recognition.

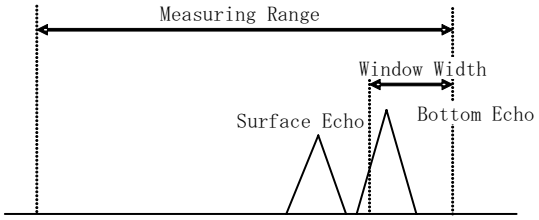


Fig. 5.4.8 Bottom echo & Bottom window

[6-0] Level Tracking
While this function is "On", the valid window shall be shifted in accordance with change of liquid level, if echo was lost.
0: Off /
1: On

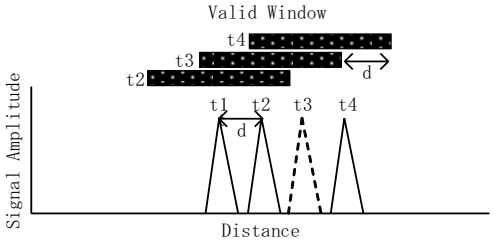


Fig. 5.4.9 Level tracking

[6-1] Output Prediction
While this function is "On", predicted value will be outputted according to change of liquid level, if echo was lost.
0: Off
1: On

[6-2] Slow Search
While this function is "On", width of valid window will be expanded at the last position of echo from liquid surface, if echo was lost.
0: Off
1: On

[6-3] Window Exp-Width
Enter a rate of width expansion of the valid window for slow search.

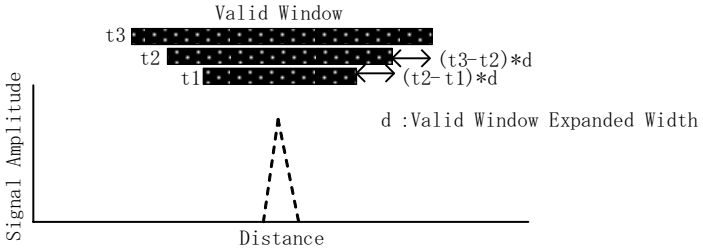


Fig. 5.4.10 Slow search

[6-4] Zero Cut
While this function is "On", liquid level “0” will be outputted if the last position of surface echo was lower than zero cut position when echo was lost.
0: Off
1: On

[6-5] Zero Cut Position
Enter a threshold value (distance from bottom) as Zero cut position to recognize measured level as empty level (Parameter [R]+[C]) if measured level is lower than the threshold value.

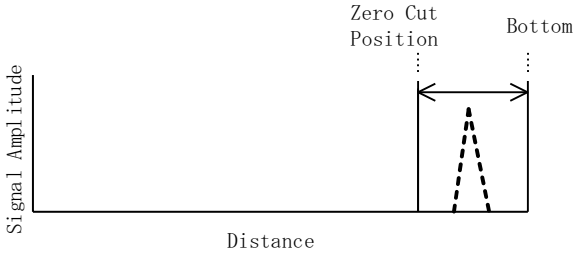


Fig. 5.4.10 Zero cut

[7-0] Fixed Current Output
Enter a current value to fix output current from the transmitter for output calibration.

[7-1] Calibration - 4 mA Calibration
In fixed current output mode with current set at 4 mA, input ammeter reading.

[7-2] Calibration - 20 mA Calibration
In fixed current output mode with current set at 20 mA, input ammeter reading.

[7-3] Offset Calibration
Enter an offset value to be adjusted.

[7-4] Span Calibration
Enter a span value to be adjusted.

[8-0] Research
Mandatory surface echo is researched.
0: Default.
1: Research Researched by "1" setting.

[8-1] Parameter Initialize
Inputted parameters in the device are initialized. All parameters will revert to factory default values.
0: Default.
1: Initialization Initialized by "1" setting.

[8-2] Reboot
The device is rebooted.
0: Default.
1: Reboot Rebooted by "1" setting.

[8-3] Error
Error code will be shown on LCD. Detail meanings are as below.

Table. 5.4.2 Error code

Code	Description	Possible Cause	Counter-measure
E-00	Normal	-	-
E-01	ROM (ROM Error)	ROM failure	Even if the transmitter head could not be recovered by rebooting, please contact your representative.
E-02	RAM (RAM Error)	RAM failure	
E-03	Transmitter (Transmit/Receiving circuit error)	Not detected transmitting wave during measurement	
E-04	Volume Table, Flow Table (Input parameter error in the tables)	Inputted inconsistent data in volume table or flow rate Table, otherwise deviation between Point number and data	Check volume table or flow rate table's data.
E-05	Flow Type (Flow rate conversion error)	Out of limit for weir formula	Check weir construction and input parameters.

Note: In case that multiple error detected, error code will be shown in following order.
E-01 > E-02 > E-03 > E-04 > E-05

[8-4] Firmware Version
Firmware version of the device will be shown LCD.

Chapter 6 Operations by configuration software

6.1 Overview

6.1.1 System configuration

You can adjust the instrument by connecting a HART modem to the computer and using the specialized configuration software “Level Config”. Power can be supplied from the Power Unit, PLC, DCS, etc.
A connection example is shown in the following Fig.6.1.1

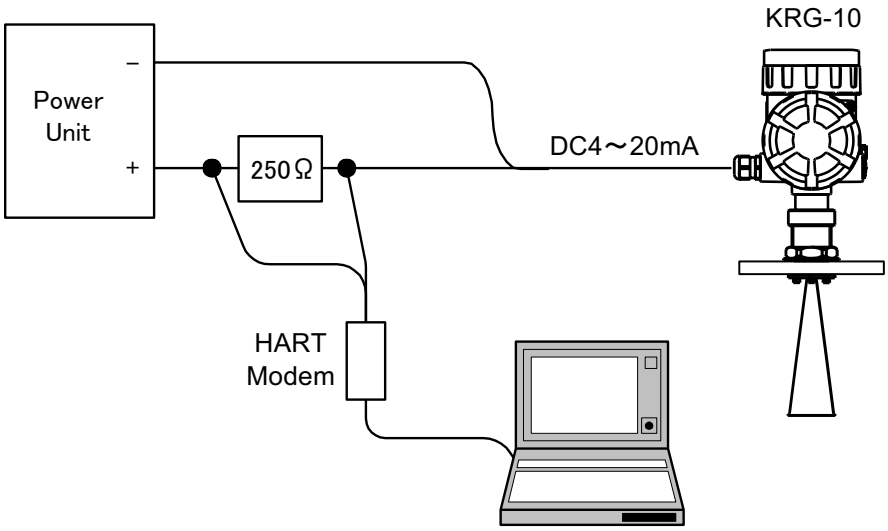


Fig. 6.1.1 System configuration

6.1.2 What is Level Config?

Level Config is the configuration software for KRG-10 that enables to adjust the instrument by using a PC. Using HART for communication, it is possible to set parameters for the instrument and to monitor measurement values, states, etc.
You must establish the connection between the software and the equipment before communication operation. Please refer to **Section 6.2**.

6.1.3 Software operating environment

Supported OS:	Microsoft Windows XP / Vista / 7
Communication conditions:	Operation on a PC that can use a HART modem
Screen resolution:	SVGA(800×600[dot]) or higher
Required software:	Adobe Acrobat Reader

*** In case of using Adobe Acrobat Reader 10.0 or later, the following environment setting must be implemented for Adobe Acrobat Reader.**

Setting for Adobe Acrobat Reader: Uncheck "Enable Protected Mode at startup".

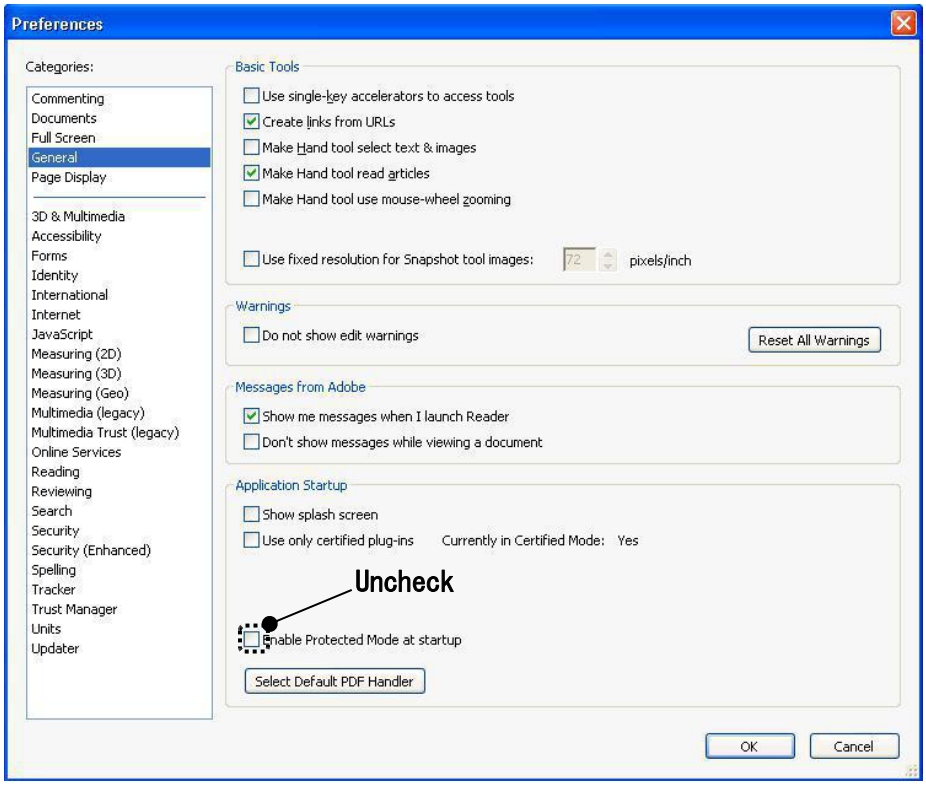


Fig. 6.1.2 Setting for Adobe Acrobat Reader

Display setting: Select smaller (100%) for the size of text and other items on the screen.
*** In case of using Windows 7, the following display setting is required.**

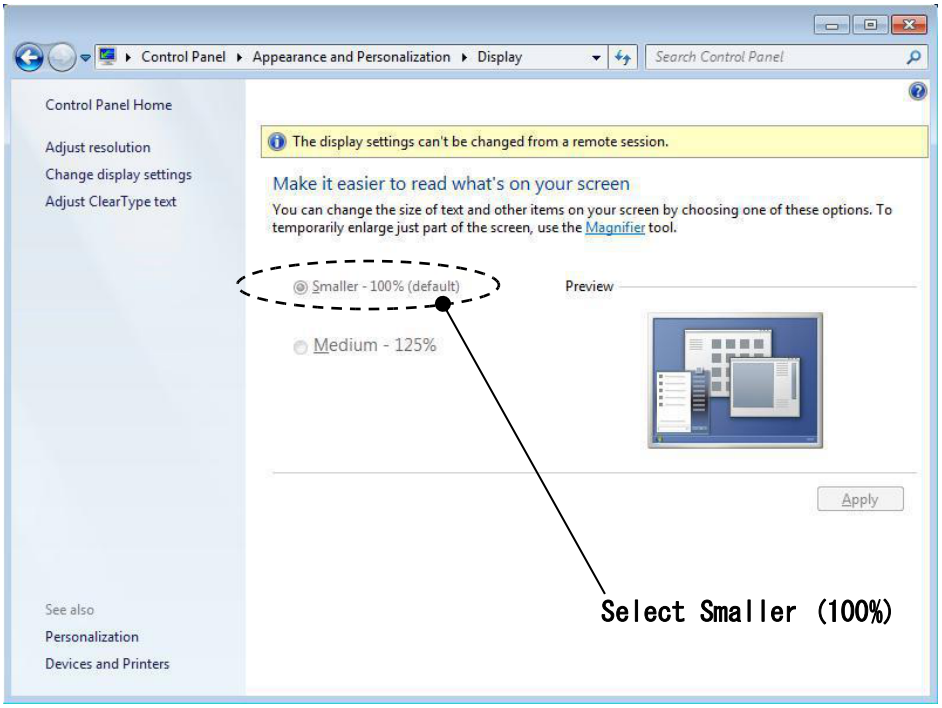


Fig. 6.1.3 Display setting in Windows 7

COM port settings: In case of using a HART modem of a serial interface type, you must set "1" for the receive buffer and transmit buffer of the COM port according to the following procedure:

1. Open the "Control Panel" from the "Start" tab.
2. Select the "Hardware" tab in "System", and click "Device Manager". (In Windows 7, click "Device Manager" directly.)
3. In the tree view, expand the "Ports (COM & LPT)" node.
4. Select the "Communications Port" tab. Click the right mouse button, and select "Properties".
5. Select the "Port Settings" tab and click "Advanced".
6. Set the receive buffer and transmit buffer to "1".
7. Click "OK".
8. Restart the computer.

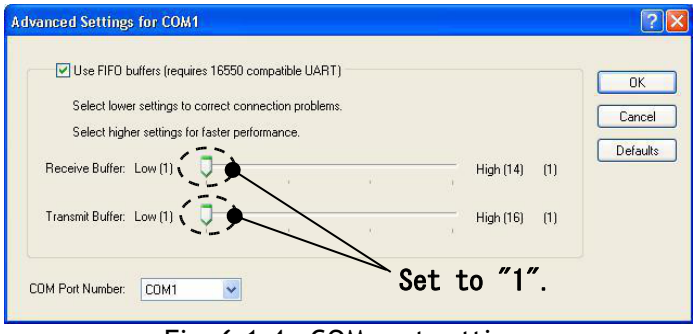


Fig. 6.1.4 COM port settings

6.1.4 Installing the configuration software

Copy the distributed library and unzip it in a desired location.
The folder "KRG-10" (hereinafter "main folder") is created.

Distributed file

Document: Manual folder ..①
Level Config_V***: Configuration software folder ..②
README: Quick instruction document ..③
(in the folder of LevelConfig_V***)
HelpPage.txt: Settings file for calling the Help file ...④
Language.csv: Display language settings file ...⑤
Level Config.exe: Program body of the configuration software ..⑥

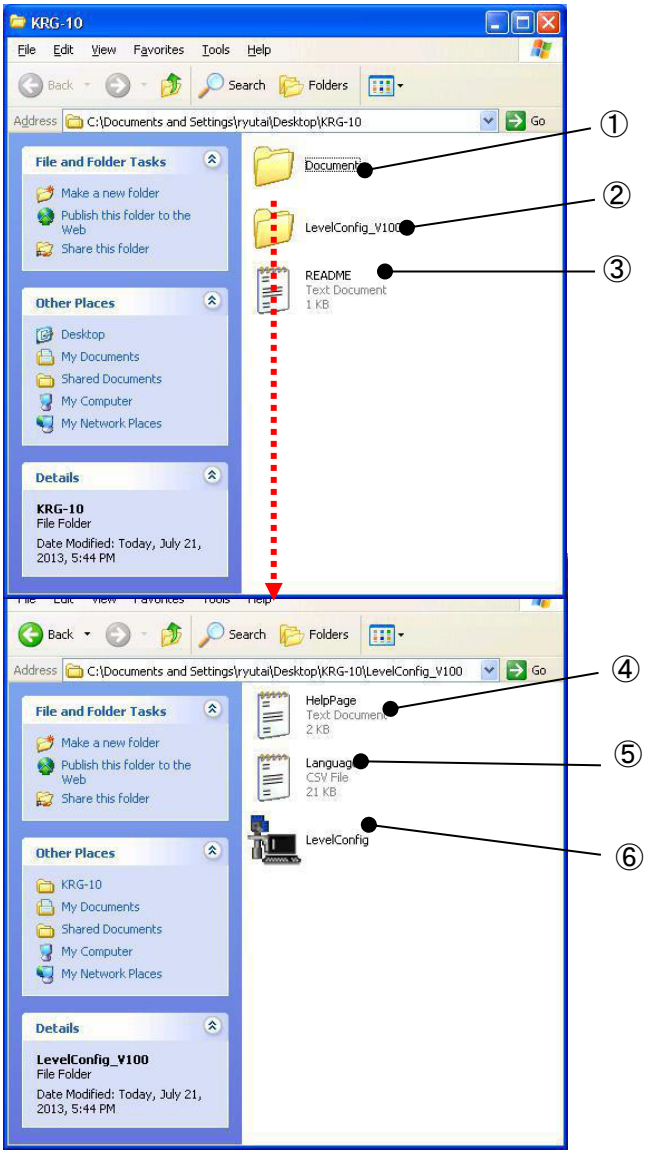


Fig. 6.1.5 Distributed files

6.1.5 Uninstalling the configuration software

Delete the main folder from the PC.

6.1.6 Starting the configuration software

To start the configuration software, double click "Level Config.exe", the program body of the configuration software, in the configuration software folder.

6.1.7 Closing the configuration software

You can select the following two methods to close the configuration software.

●Select "Exit" in "File" on the menu bar.

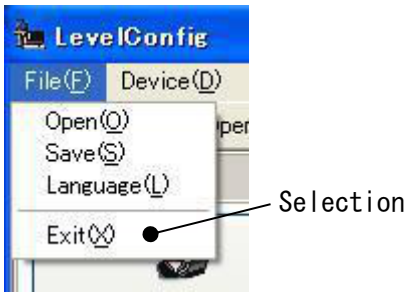


Fig. 6.1.6 Menu bar exit button

● Click the "x" button (close button) in the upper right of the window.

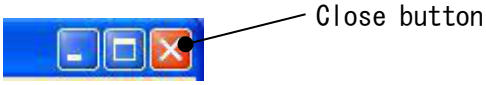


Fig. 6.1.7 Window close button

*** Initial settings file**

If you start the configuration software, an initial settings file "LevelConfig.ini" is automatically created in the configuration software folder at the next time that the program is closed. The basic settings of the configuration software are saved in the initial settings file. To reset the basic settings and return to default values, delete the initial settings file from the configuration software folder.

[Basic settings of the configuration software]

- Window position
- Window size
- Display language operation method (automatic / manual)
- Display language (English / Japanese / a third language)
- Communication protocol
- Communication port number
- Communication device number
- Preamble number
- Instrument type number

6.1.8 Window

The configuration of the basic window is shown below.

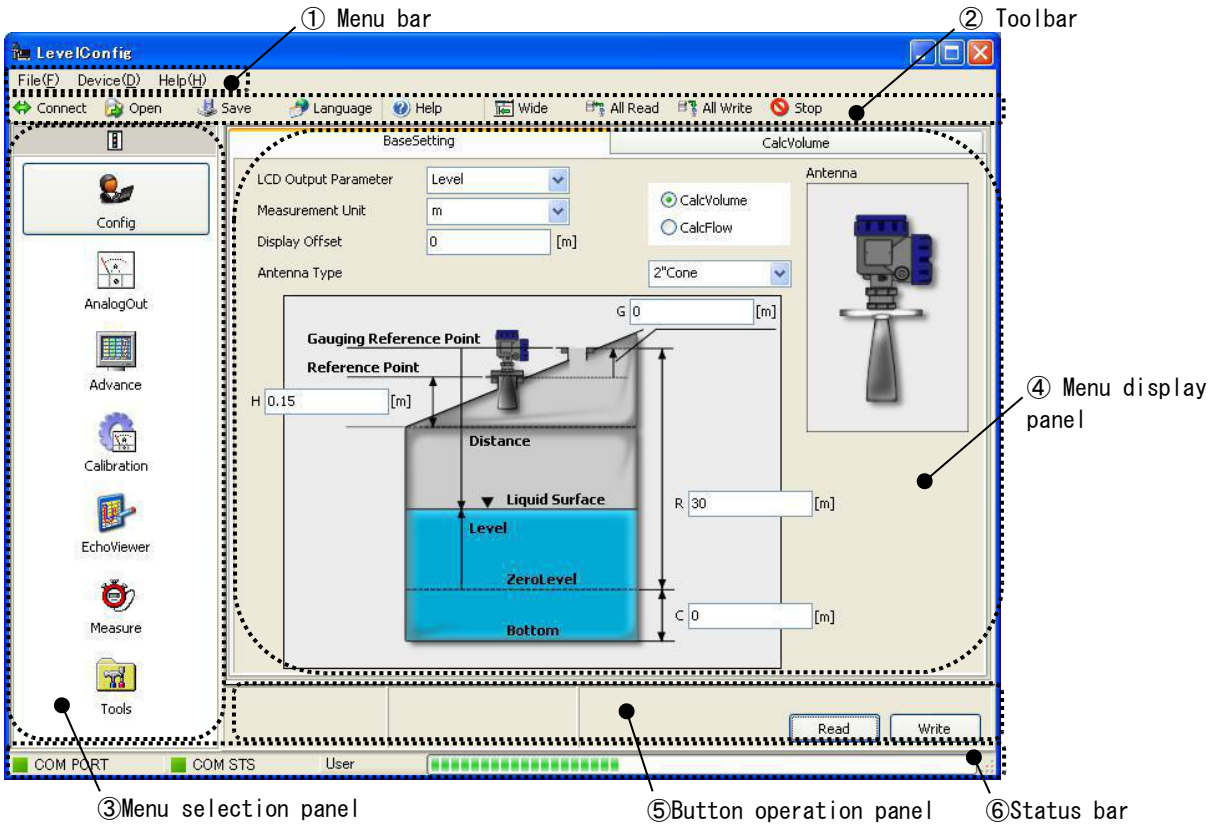


Fig. 6.1.8 Basic window configuration

Name / function of each panel:

① Menu bar
In the Menu bar, you can switch menus and select functions from the pull down menus.

② Toolbar
In the toolbar, you can select functions that are used relatively frequently using button operations.

③ Menu selection panel
In the menu selection panel, you can switch menus using button or tree hierarchy display operations.

④ Menu display panel
In the menu display panel, menus such as those for setting the instrument parameters, monitoring the instrument status, analyzing echoes and measuring are displayed.

⑤ Button operation panel
The area where button operations in each menu are performed.

⑥ Status bar
In the status bar, the status of the connection to the instrument and the communication progress are displayed.

6.1.9 Menus

It is possible to switch menus using the menu bar, menu selection panel (button / tree), or tab operations. The menu structure and the contents of each menu are shown in the following table.

Table 6 1.1 Structure and content of the basic menu

Basic menu

[Menu]	[Tab]	[Content]
Config		Basic settings, volume calculation settings and flow rate calculation settings.
	Base Setting	Reading basic setting parameters from the instrument and writing basic parameters to the instrument.
	Calc Volume	Reading volume calculation parameters from the instrument and writing volume calculation parameters to the instrument.
	Calc Flow	Reading flow rate calculation parameters from the instrument and writing flow rate calculation parameters to the instrument.
Analog Out		Reading analog output parameters from the instrument and writing analog output parameters to the instrument.
Advance		Measurement support settings, outlier removal settings, and measurement value hold settings.
	Measure Support	Reading measurement support parameters from the instrument and writing measurement support parameters to the instrument.
	Outlier Removal	Reading outlier removal parameters from the instrument and writing outlier removal parameters to the instrument.
	Value Hold	Reading measurement value hold parameters from the instrument and writing measurement value hold parameters to the instrument.
Calibration		Analog settings, level settings and checks.
	Analog	Reading analog parameters from the instrument and writing analog parameters to the instrument.
	Level	Reading level parameters from the instrument and writing level parameters to the instrument.
	Check	Loop check and table check.
Echo Viewer		Reading the fixed echo from the instrument, writing the fixed echo to the instrument and general operations of the echo curve.
Measure		Reading the echo list from the instrument, reading the maximum value from the instrument and general operations of measurement.
Tools		Reset and errors.
	Reset	Executing the instrument reset.
	Error	Reading the instrument status.

Table 6 1.2 Structure and content of other menus

Other menus

[Menu]	[Content]
Device Connection	Connecting to the equipment and disconnecting from the equipment.
Language Setting	Setting the display language.
Help	Referencing Help.

6.1.10 Explanation of the menu bar

The menu bar is used to call general functions except option functions. Menu bar items are shown below.

<File menu>
① Reads the saved parameter, echo curve, and other values from a file.
② Saves the current parameter values, and the read echo curve and other values to a file.
③ Use this to set up languages. The language setting menu will open according to click operation.
④ Closes the configuration software.

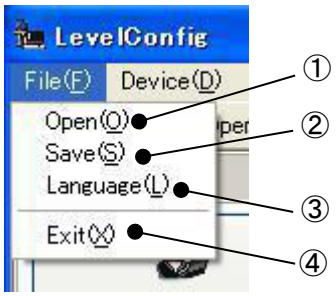


Fig. 6.1.9 Menu bar "File"

<Device menu>
① Use this to connect to the instrument.
The device connections menu will open according to click operation.
② Use this to switch menus.
The configuration menu will open according to click operation.
③ Use this to switch menus.
The analog output menu will open according to click operation.
④ Use this to switch menus.
The advanced settings menu will open according to click operation.
⑤ Use this to switch menus.
The calibration menu will open according to click operation.
⑥ Use this to switch menus.
The Echo Viewer menu will open according to click operation.
⑦ Use this to switch menus.
The measurement menu will open according to click operation.
⑧ Use this to switch menus.
The tool menu will open according to click operation.

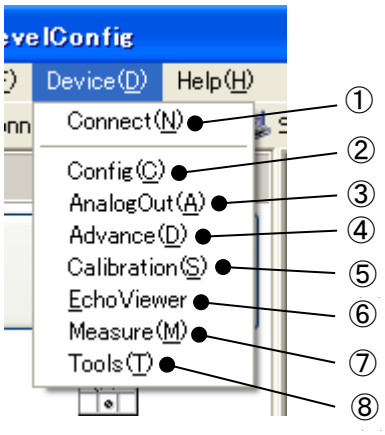


Fig. 6.1.10 Menu bar "Device"

<Help menu>
① Use this to reference Help.
The help menu will open according to click operation.
② Displays the version information of the configuration software.



Fig. 6.1.11 Menu bar "Help"

6.1.11 Explanation of the tool bar

The tool bar is used to call functions that are used relatively infrequently, such as option functions. Tool bar items are shown in the following table.

Table 6 1.3 Toolbar

Connect	-------	Use to connect to the instrument. The device connections menu will open according to click operation.
Open	-------	Reads from a file the saved parameter, echo curve, and other values.
Save	-------	Saves the current parameter values, and the read echo curve and other values to a file.
Language	-------	Use this to set up languages. The language settings menu will open according to click operation.
Help	-------	Use to reference Help. The Help menu will open according to click operation.
Wide	-------	Enlarges the menu display panel and button operation panel areas. The menu selection panel becomes unusable.
Short	-------	Reduces the menu display panel and button operation panel areas. The menu selection panel becomes usable.
All Read	-------	Reads all current parameter values of the instrument.
All Write	-------	Writes all parameter values of the configuration software to the instrument.
Stop	-------	Forcibly stops communication with the instrument.

6.1.12 Explanation of the status bar

The status bar displays the Action status of the configuration software; for example, the status of communication with the instrument. Status bar items are shown below.



Fig. 6.1.12 Status bar

① Communication Port: Displays the status of the communication port. (Normal: Green / Error: Red)
② Communication Status: Displays the status of communication. (Normal: Green / Error: Red)
③ Progress Bar: Displays the processing progress.

6.1.13 Saving settings

This section explains how to save settings.
If you click "Save" in the menu bar or tool bar, the following window is displayed.

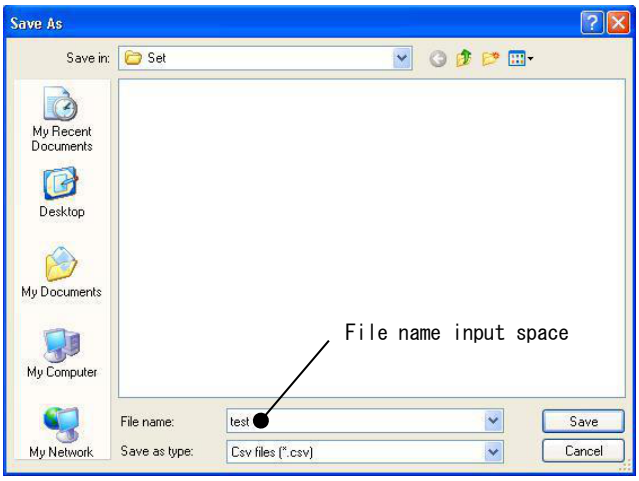


Fig. 6.1.13 File save dialog box

If you click the "Save" button after inputting the file name in “file name input space” , the current parameter values as well as echo curve and other values that were read are saved to a file. The file is saved in .csv format, so it is possible to check it in Microsoft Excel, etc.

6.1.14 Restoring settings

This section explains how to restore settings.
If you click "Open" in the menu bar or tool bar, the following window is displayed.

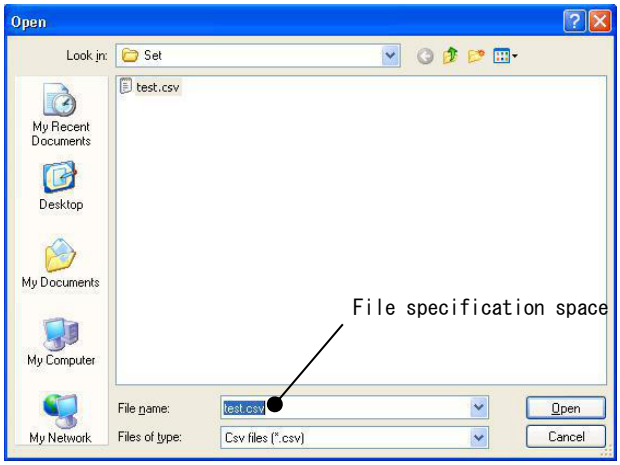


Fig. 6.1.14 File open dialog box

If you click the "Open" button after specifying the file that you would like to restore in “file specification space”, the parameter values and echo curve and other values saved in the specified files are restored.

6.1.15 Language settings

This section explains how to set up display languages.
If you click "Language" in the menu bar or tool bar, the following window is displayed.

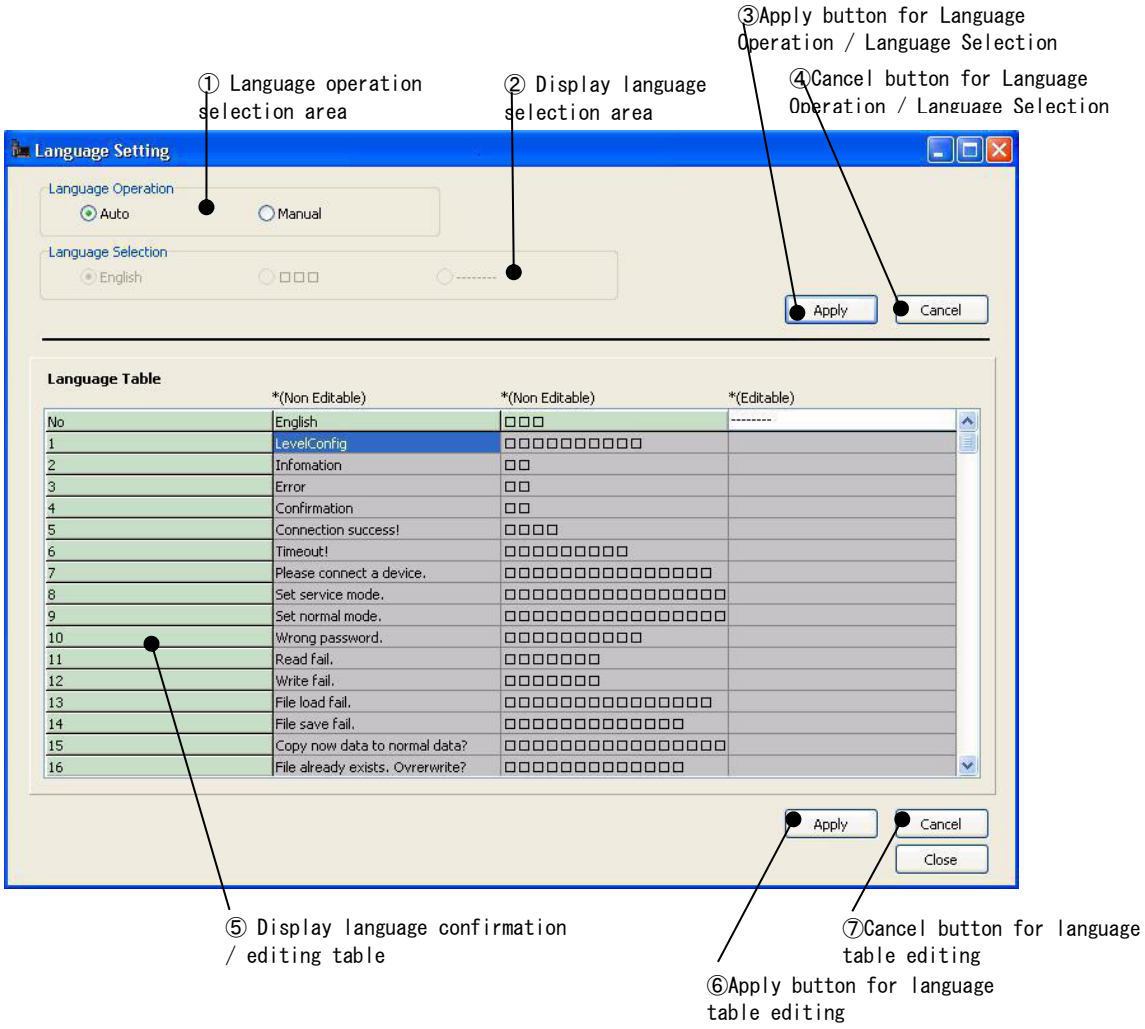


Fig. 6.1.15 Language settings menu

The settings items of the language menu are shown below.
(1) Switching language operations
(2) Switching the display language
(3) Language table settings

Refer to the following page for details on each item.

(1) Switching language operations

The language operation method can be selected to be automatic or manual.

- [Auto] If the default language of the user (PC language setting) is "Japanese," the display language will be Japanese. Otherwise, the display language will be English.
- [Manual] The display language will be the language specified in display language setting area ②.

If you click the "Apply" button ③of Language Operation / Language Selection after selecting the language operation method in language operation selection area ①, the language operation method will be saved internally. The language operation method that was set is also reflected from the next restart. To cancel the settings, click the "Cancel" button ④ for Language Operation / Language Selection. To close the language setting menu after settings are finished, click the "Close" button.

(2) Switching the display language

The display languages that can be selected are English / Japanese / or a third language.

- [English] The display language will be English.
- [Japanese] The display language will be Japanese.
- [Third language] The display language will be a third language set in the language table.

If you click the "Apply" button ③ for Language Operation / Language Selection after selecting the display language in display language selection area ②, the display language will be saved internally and changed set language. To cancel the settings, click the "Cancel" button ④ for Language Operation / Language Selection. To close the language setting menu after settings are finished, click the "Close" button.

(3) Language table settings

Using the language table, [Third language] settings can be performed. (Note that [English] and [Japanese] cannot be set.)

Enter the display language name and display language in the editable space of the display language confirmation / editing table ⑤. The edit space becomes editable by double-clicking it. If you click the "Apply" button ⑥ for language table editing, the settings will be saved internally. The display language that was set is also reflected from the next restart. To cancel the settings, click the "Cancel" button ⑦ for language table editing. To close the language setting menu after settings are finished, click the "Close" button.

6.1.16 Icon / Tree display

The following two display methods are used to display the menu selection panel.

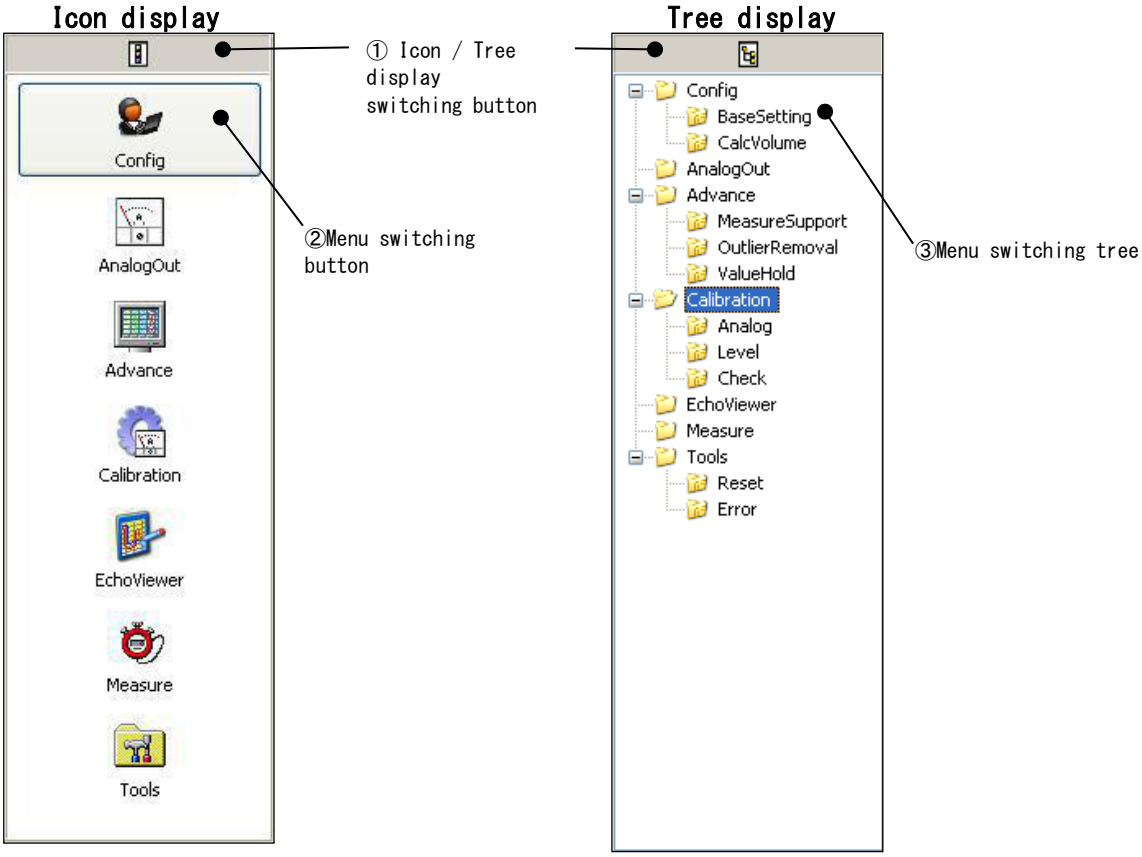


Fig. 6.1.16 Displaying the menu selection panel

It is possible to switch the menu selection panel display by clicking the icon / tree display switching button ①. If the menu selection panel display is icon display, it is possible to switch the menu by using the menu switching button ②. If the menu selection panel display is tree display, it is possible to switch the menu by using the menu switching tree ③.

6.1.17 Enlarging / Reducing the window

It is possible to enlarge or reduce the menu display panel and button operation panel areas by clicking the "Wide" or "Short" buttons on the tool bar. When enlarged, the menu selection panel cannot be used, but the menu can be switched by using the menu bar.

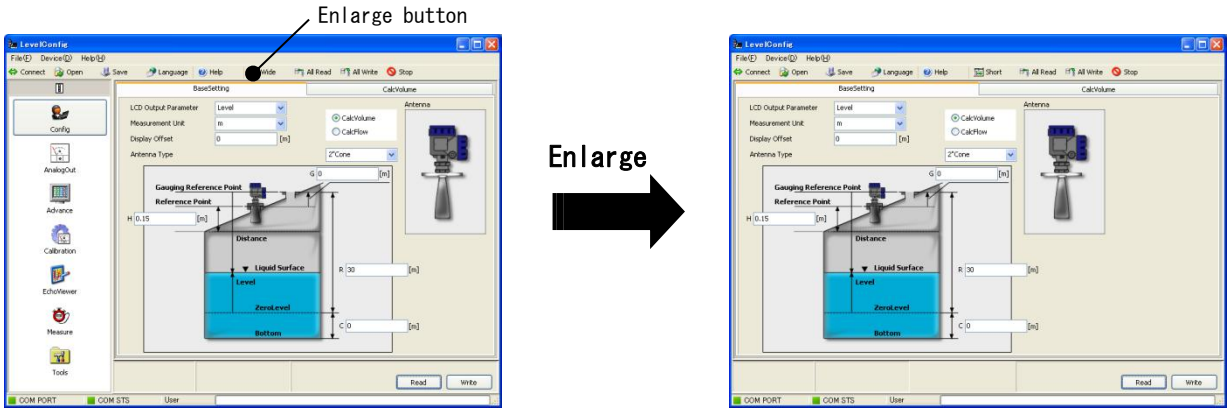


Fig. 6.1.17 Enlarging the menu

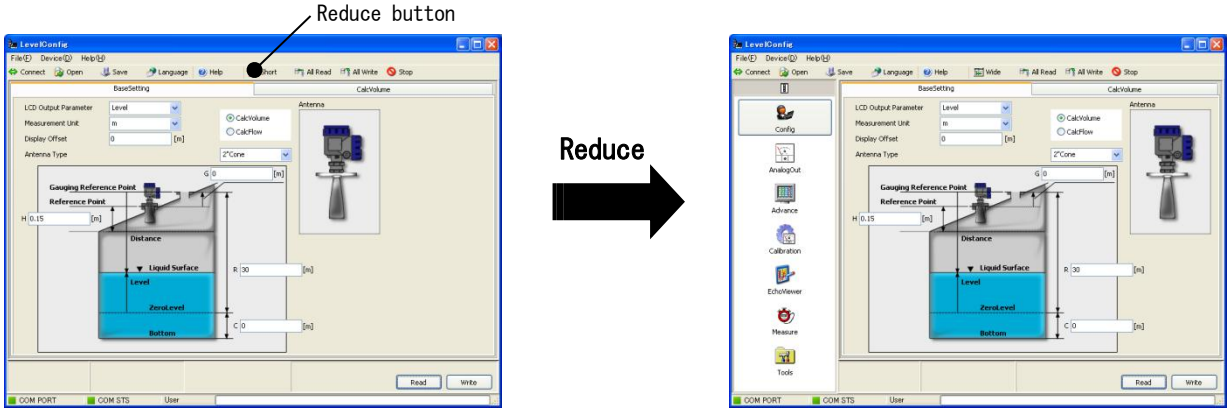


Fig. 6.1.18 Reducing the menu

6.1.18 Read all settings

It is possible to read all of the setting parameters of the instrument together on the configuration software. To start reading all of the parameters, click "All Read" on the tool bar. Then the following window will be displayed, so click "OK" to begin reading all of the parameters.



Fig. 6.1.19 Read all confirmation dialog box

6.1.19 Write all settings

It is possible to write all of the setting parameters of the configuration software together to the instrument. To start writing all of the parameters, click "All Write" on the tool bar. Then the following window will be displayed, so click "OK" to begin writing all of the parameters.



Fig. 6.1.20 Write all confirmation dialog box

6.1.20 Stop communication

If you cause another communication event while communicating with the instrument, the following dialog box will appear.



Fig. 6.1.21 Write all confirmation dialog box

If you want to interrupt current communication while communication with the instrument is occurring, it is possible to forcibly stop communication. To stop communication, click "Stop" on the tool bar.

6.1.21 Referencing help

This section explains how to reference Help.
If you click "Level Config Help" in the menu bar or "Help" in the tool bar, the following window is displayed.

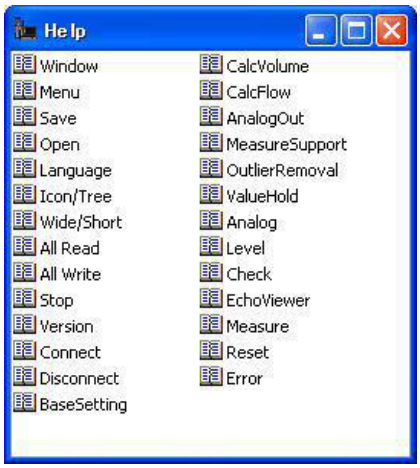


Fig. 6.1.22 Help menu

If you select and double click a keyword to reference in Help from the keywords displayed in the window, pages related to the keyword of the Help file (this manual) will be displayed. Note that if there is no .pdf format Help file (this Manual) in the Manual folder, or if the file is damaged, it will not be displayed correctly.

6.1.22 Checking version information

This section explains how to check version information.
If you click "Level Config Version" in the menu bar, the following window is displayed.

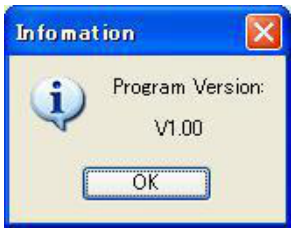


Fig. 6.1.23 Version information

To close the window, click "OK".

6.2 Connecting to the instrument

This section explains how to connect to or disconnect from the instrument.
To connect to or disconnect from the instrument, click "Connect" on the menu bar or tool bar. Then the following window is displayed. (The following window is automatically displayed when the configuration software is initially started.)

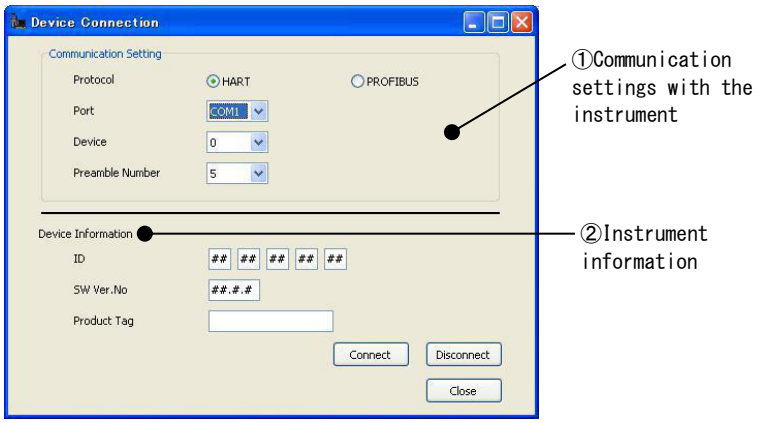


Fig. 6.2.1 Device connection menu

6.2.1 Connection

To connect the configuration software to the instrument, first perform communication settings with the instrument.

- Protocol Select HART or PROFIBUS (Pending)

The instrument of the selected interface must be correctly connected.

- Port Specify the COM port for communication
- Device Specify the device number (0 to 63)
- Preamble Number Specify the preamble number (5 to 20)

After finishing communication settings, click "Connect". The following window is displayed according to the communication status with the instrument.



Fig. 6.2.2 Connection response dialog box

If connection is successful, the instrument information ② of the connection destination is displayed as shown in the following example. If you want to confirm the connection, do so by re-opening the window. If connection failed, confirm the connection pathway.

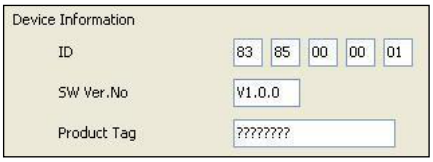


Fig. 6.2.3 Instrument information when connection is successful (example)

6.2.2 Disconnection

To disconnect the configuration software from the instrument, click "Disconnect". After disconnecting, the instrument information is reset.

6.3 Settings

This section explains the functions of the settings menu.
To open the settings menu, click "Config" on the menu bar or menu selection panel.

6.3.1 Basic Settings

On the basic settings menu, it is possible to read / write the basic settings data (parameters) for the instrument. If you click "Base Setting" tab or "Base Setting" in the tree display, the following window is displayed. Data that does not match the status of the instrument will be displayed with a yellow (0) and data that matches the status of the instrument will be displayed with a white (0).

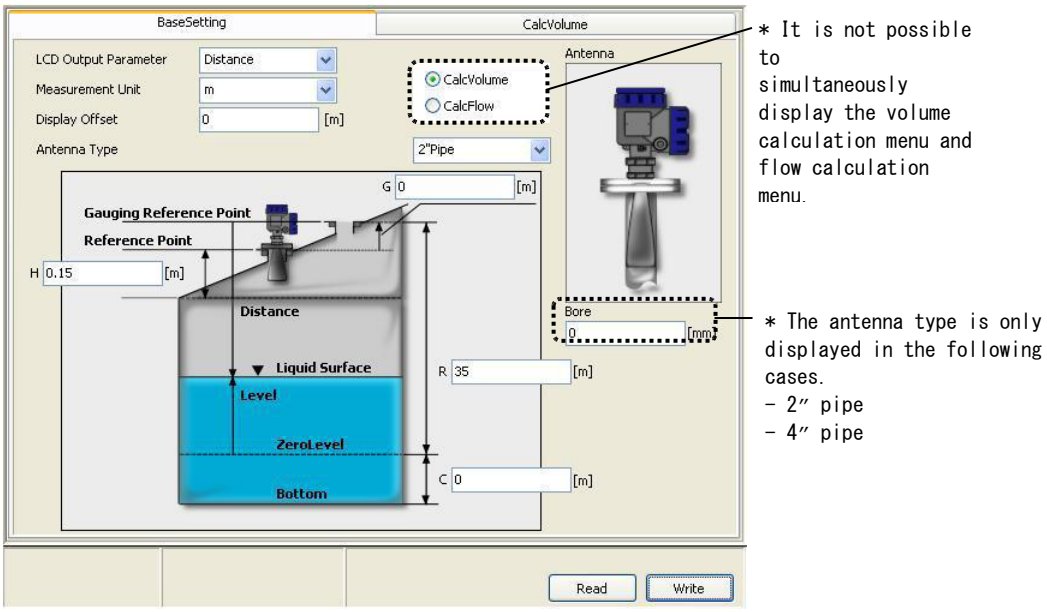


Fig. 6.3.1 Basic settings menu

(1) Reading basic settings data

To read the basic settings data from the instrument, click the "Read" button. After reading starts, wait momentarily until the processing progress on the status bar stops.

(2) Writing basic settings data

To write the basic settings data to the instrument, input the data to write and then click the "Write" button. After writing starts, wait momentarily until the processing progress on the status bar stops.

Basic Settings data

- LCD Output Parameter Content displayed on the LCD (Level / distance / volume / flow / output current / signal amplitude / internal temperature / maximum volume / maximum flow)
- Measurement Unit Measurement units (m/Ft) *The distance unit in a sentence is indicated as a case of “m” setup.
- Display Offset Offset of level / distance displayed on the LCD (-99999.0m to 99999.0m)
- Antenna Type Antenna type
  ● High Power (use only)
  (2” cone / 4” cone / 2”PTFE Sealing / 4” PTFE Seal ing 1” rod / 2” pipe / 4” pipe)
- Bore Internal diameter of the pipe (valid only when 2” pipe / 4” pipe is selected) (0.0m to 99999.0m)
- G Distance from the reference point to the gauging reference point (-99.999m to 99.999m)
- R Measurement range (0.0m to 99.999m)
- C Measurement range at or below the zero level (0.0m to 99.999m)
- H Dead band (0.0m to 99.999m)

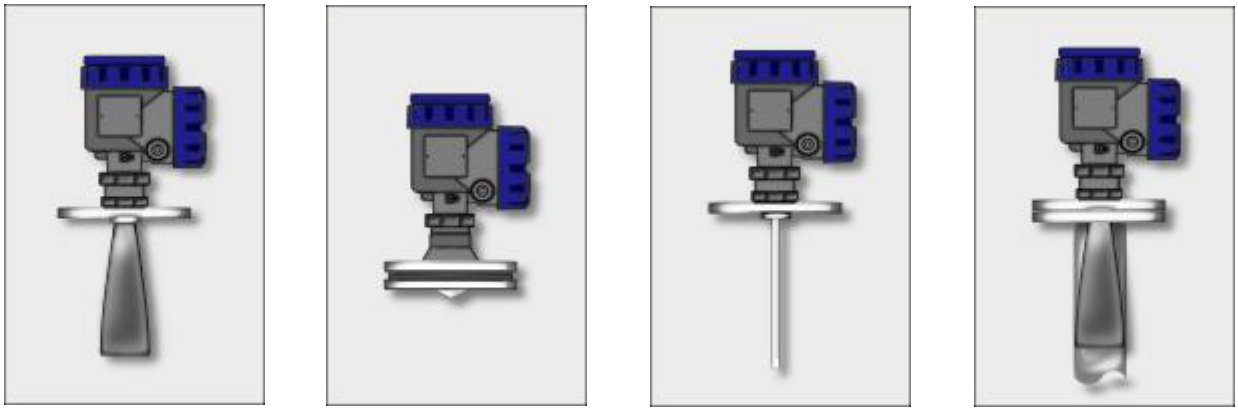


Fig. 6.3.2 Antenna type

6.3.2 Calc Volume

On the calc volume menu, it is possible to read / write volume calculation data (parameters) for the instrument. If you click "Calc Volume" tab or "Calc Volume" in the tree display, the following window is displayed. Data that does not match the status of the instrument will be displayed with a yellow (0) and data that matches the status of the instrument will be displayed with a white (0).

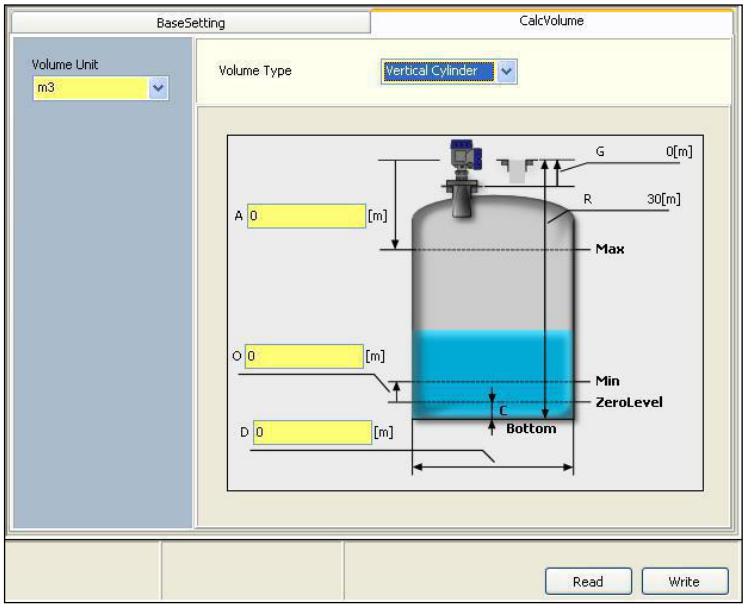


Fig. 6.3.3 Volume calculation menu

(1) Reading volume calculation data

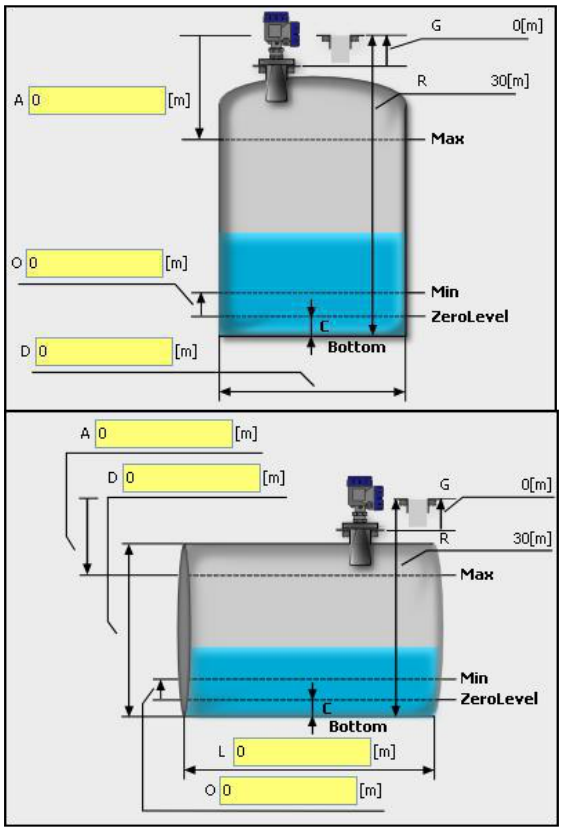
To read the volume calculation data from the instrument, click the "Read" button. After reading starts, wait momentarily until the processing progress on the status bar stops.

(2) Writing volume calculation data

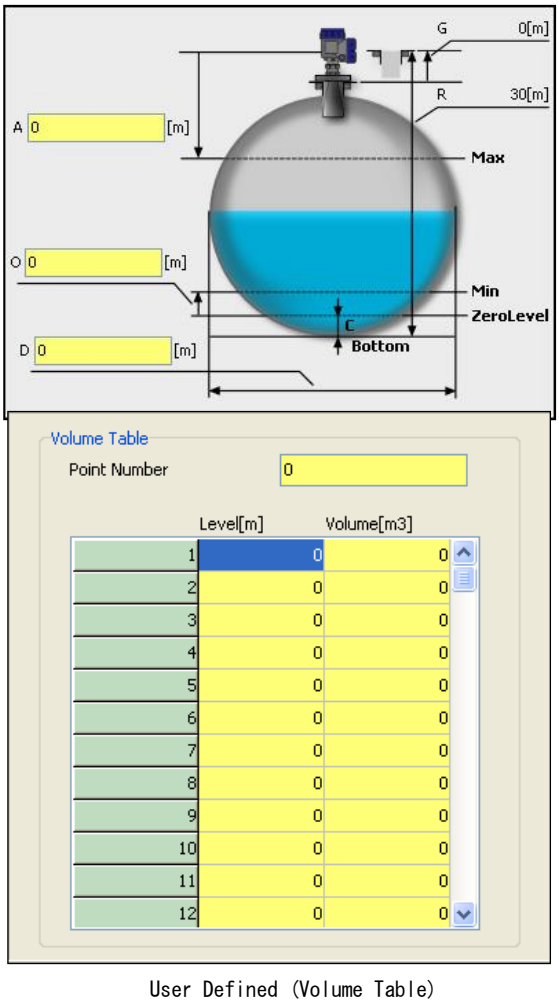
To write the volume calculation data to the instrument, input the data to write and then click the "Write" button. After writing starts, wait momentarily until the processing progress on the status bar stops.

Calc Volume data

- Volume Type — Tank shape
(Unknown / Vertical Cylinder / Spherical / Horizontal Cylinder / User Defined (Volume Table))
- A — Distance to the full level of the measured tank
(-99.999m to 99.999m)
- O — Measured tank offset
(-99.999m to 99.999m)
- D — Measured tank diameter
(0.0m to 99.999m)
- L — Measured tank length
(0.0m to 99.999m)
- Point Number — Number of points of volume table
(0 to 100)
- Volume Table — Volume table
(Level value (-99.999m to 99.999m), volume value (0.0m^3 to 99999.0m^3))
- Volume Unit — Measured volume units
(m^3/US Gallons/Barrels/Ft^3) *The volume unit in a sentence is indicated as a case of "m^3" setup.



Horizontal Cylinder



User Defined (Volume Table)

Fig. 6.3.4 Volume Type

6.3.3 Calc Flow

On the calc flow menu, it is possible to read / write flow rate calculation data (parameters) for the instrument. If you click "Calc Flow" tab or "Calc Flow" in the tree display, the following window is displayed. Data that does not match the status of the instrument will be displayed with a yellow (0) and data that matches the status of the instrument will be displayed with a white (0).

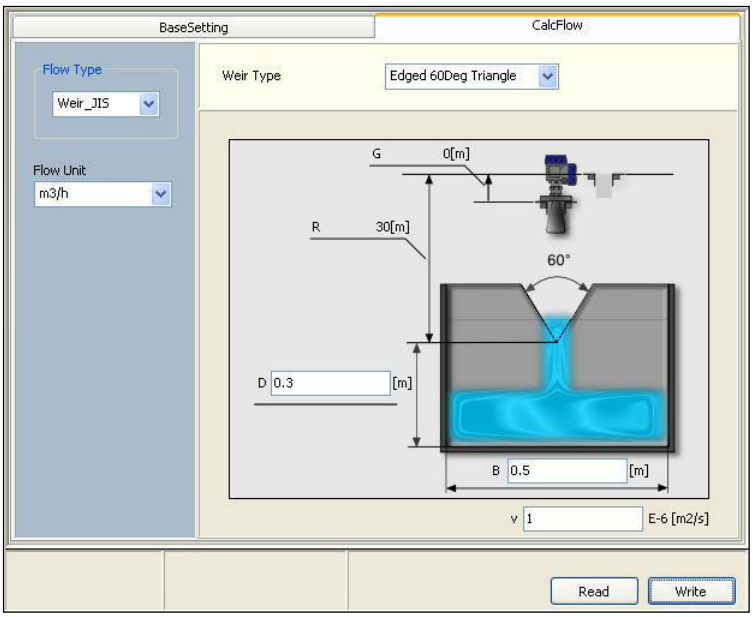


Fig. 6.3.5 Flow rate calculation menu

(1) Reading flow rate calculation data

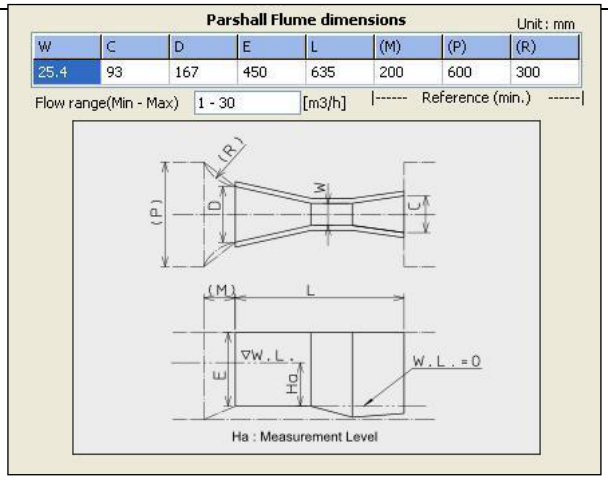
To read the flow rate calculation data from the instrument, click the "Read" button. After reading starts, wait momentarily until the processing progress on the status bar stops.

(2) Writing flow rate calculation data

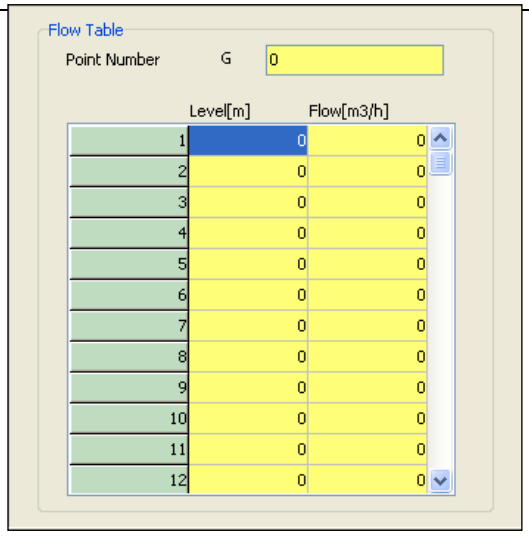
To write the flow rate calculation data to the instrument, input the data to write and then click the "Write" button. After writing starts, wait momentarily until the processing progress on the status bar stops.

Calc Flow data

- Flow Type Shape of flowmeter
(Unknown / Weir_JIS / Flume_JIS / User Defined (Flow Table))
- Weir Type Weir type
(Edged 60Deg Triangle / Edged 90Deg Triangle / Edged Square / Overall Width)
- B Width of the water path of the measured weir
(0.0m to 99.999m)
- b Width of the measured weir
(0.0m to 99.999m)
- v Kinematic viscosity coefficient of fluid
($0.0\times10^{-6}m^2$/sec to $99.999\times10^{-6}m^2$/sec)
- D Height to the notch of the measured weir
(0.0m to 99.999m)
- Nominal diameter of partial flume
(PF-01/PF-02/PF-03/PF-06/PF-09/PF-10/PF-15/PF-20/PF-30/PF-40/PF-50/PF-60/PF-70/PF-80)
- Point No. Number of points of flow rate table
(0.0 to 100)
- Flow Table Flow rate table
(Level value (-99.999m to 99.999m),
flow rate value ($0.0m^3$ to $99999.0m^3$))
- Flow Unit Measured flow rate unit
(m^3/US Gallons/Barrels/Ft^3 per D, h, min, sec) *The flow rate unit in a sentence is indicated as a case of "m^3/sec" setup.

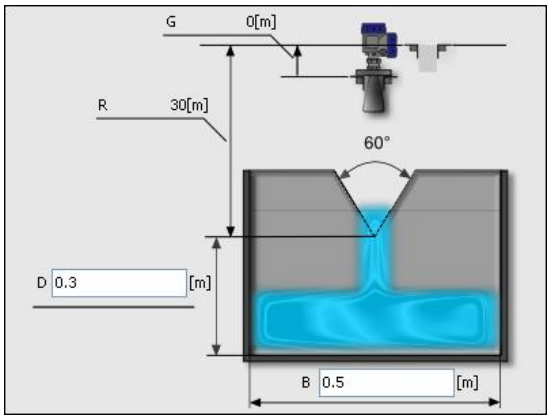


Flume_JIS

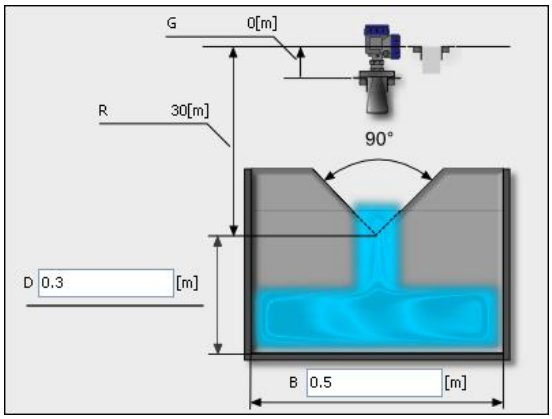


User Defined (Flow Table)

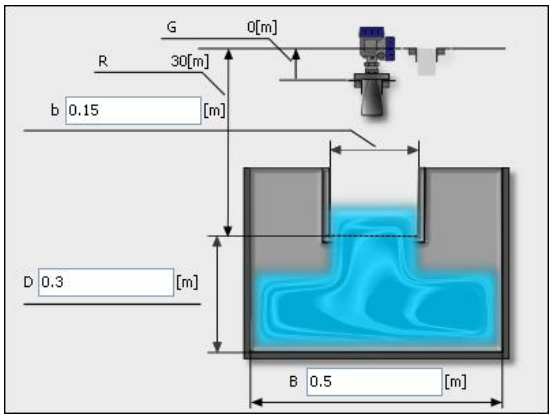
Fig. 6.3.6 Flow Type



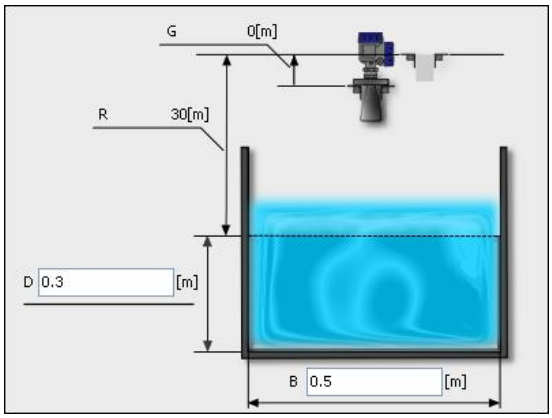
Edged 60Deg Triangle



Edged 90Deg Triangle



Edged Square



Overall Width

Fig. 6.3.7 Weir Type

6.4 Analog Output

This section explains the functions of the analog output menu.
In the analog output menu, it is possible to read / write analog output data (parameters) for the instrument. If you click "Analog Out" in the menu bar or menu selection panel, the following window is displayed. Data that does not match the status of the instrument will be displayed with a yellow (0) and data that matches the status of the instrument will be displayed with a white (0).

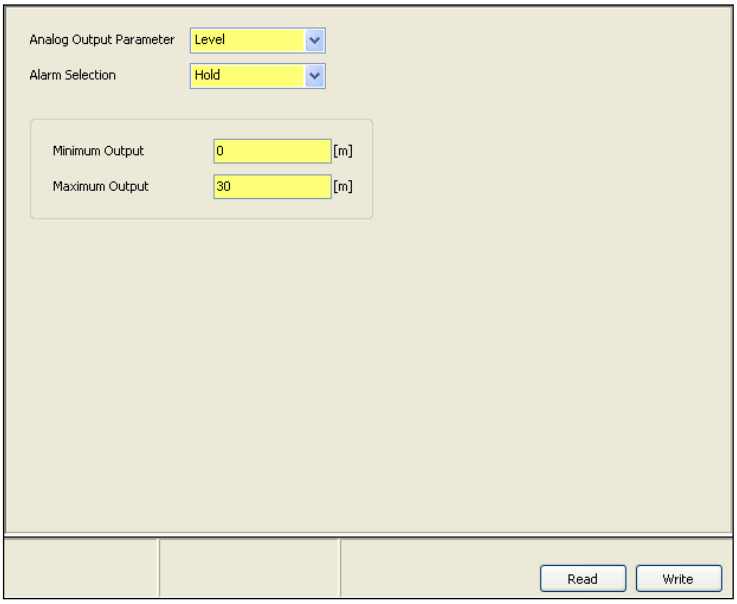


Fig. 6.4.1 Analog output menu

(1) Reading analog output data
To read analog output data from the instrument, click the "Read" button. After reading starts, wait momentarily until the processing progress on the status bar stops.

(2) Writing analog output data
To write analog output data to the instrument, input the data to write and then click the "Write" button. After writing starts, wait momentarily until the processing progress on the status bar stops.

Analog Output data

- Analog Output Parameter — Content of parameters output at 4-20mA
(Level / Distance / Volume / Flow / Sig-Amp)
- Alarm Selection — Content of alarm output
(High (22.0mA)/Low (3.6mA)/Hold)
- Minimum Output — Setting value of analog output parameter of 4mA
(Level / Distance (-99.999m to 99.999m),
Volume (0.0m3 to 99999.0m^3),
Flow (0.0m3/sec to 99999.0m3/sec),
Sig-Amp (0dB to 200dB))
- Maximum Output — Setting value of analog output parameter of 20mA
(Level / Distance (-99.999m to 99.999m),
Volume (0.0m^3 to 99999.0m3),
Flow (0.0m^3/sec to 99999.0m^3/sec),
Sig-Amp (0dB to 200dB))

6.5 Advanced settings

This section explains the functions of the advanced settings menu.
To open the advanced settings menu, click "Advance" on the menu bar or menu selection panel.

6.5.1 Measure Support

On the measure support menu, it is possible to read / write measure support data (parameters) for the instrument. If you click "Measure Support" tab or "Measure Support" in the tree display, the following window is displayed. Data that does not match the status of the instrument will be displayed with a yellow (0) and data that matches the status of the instrument will be displayed with a white (0).

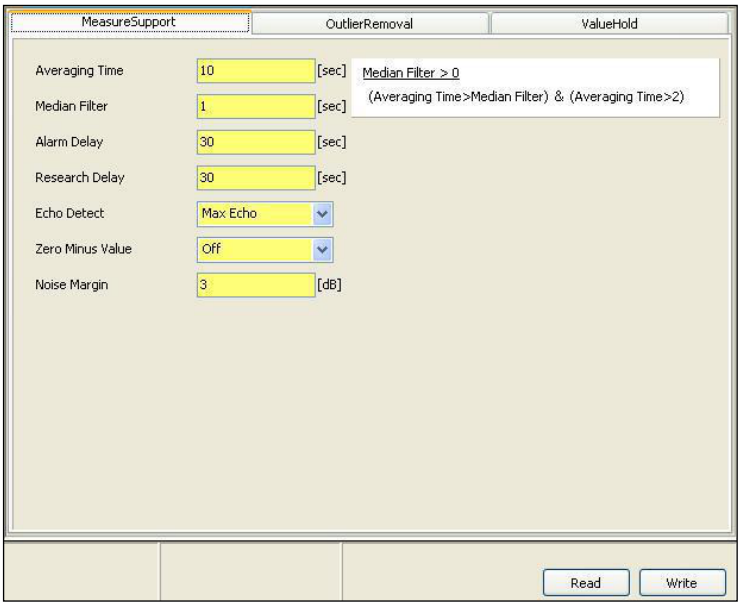


Fig. 6.5.1 Measure support menu

(1) Reading measure support data
To read the measure support data from the instrument, click the "Read" button. After reading starts, wait momentarily until the processing progress on the status bar stops.

(2) Writing measure support data
To write the measure support data to the instrument, input the data to write and then click the "Write" button. After writing starts, wait momentarily until the processing progress on the status bar stops.

Measure Support data

- Averaging Time — Mean movement time for measurement value (1sec to 120sec)
- Median Filter — Number of excluding deviations in the measurement values within the mean movement time. (0sec to 120sec)
- Alarm Delay — Time until alarm is output after data was missed (1sec to 120sec)
- Research Delay — Time until searching the liquid level echo after data was missed (1sec to 120sec)
- Echo Detect — Echo detected as the liquid level echo (Max Echo / first Echo)

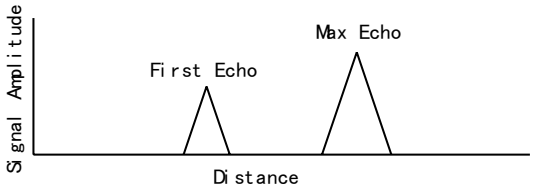


Fig. 6.5.2 Echo Detect

- Zero Minus Value — Function that forcibly sets the negative value of the liquid level to zero (ON/OFF)
- Noise Margin — The amount of the signal level decreased to mask the noise when the noise level is loud (0dB to 255dB)

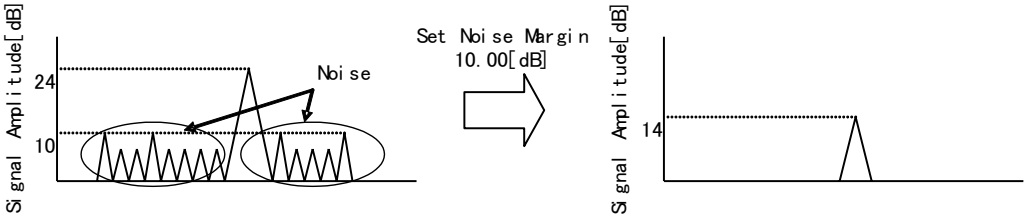


Fig. 6.5.3 Noise Margin

6.5.2 Outlier Removal

On the outlier removal menu, it is possible to read / write outlier removal data (parameters) for the instrument. If you click "Outlier Removal" tab or "Outlier Removal" in the tree display, the following window is displayed. Data that does not match the status of the instrument will be displayed with a yellow (0) and data that matches the status of the instrument will be displayed with a white
(0).

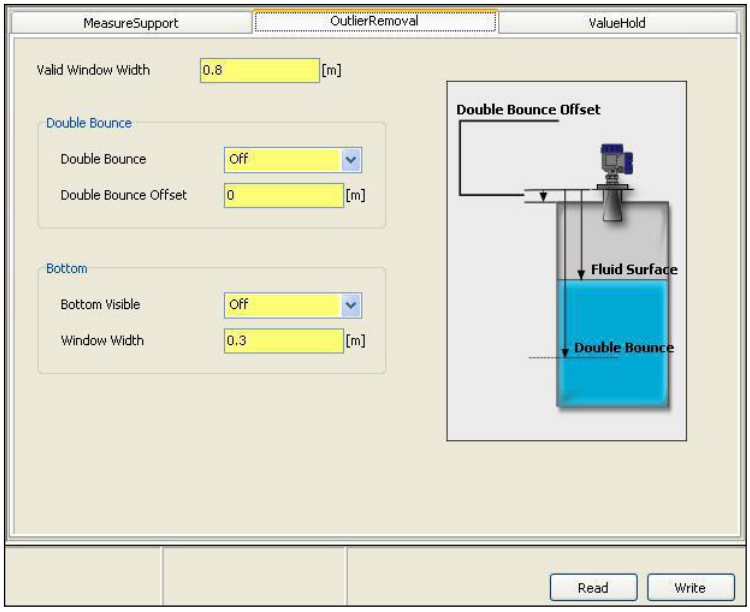


Fig. 6.5.4 Outlier removal menu

(1) Reading outlier removal data

To read outlier removal data from the instrument, click the "Read" button. After reading starts, wait momentarily until the processing progress on the status bar stops.

(2) Writing outlier removal data

To write outlier removal data to the instrument, input the data to write and then click the "Write" button. After writing starts, wait momentarily until the processing progress on the status bar stops.

Outlier Removal data

- Valid Window Width Window width for determining valid values / outliers with respect to the detected echo

(0.0m to 99.999m)

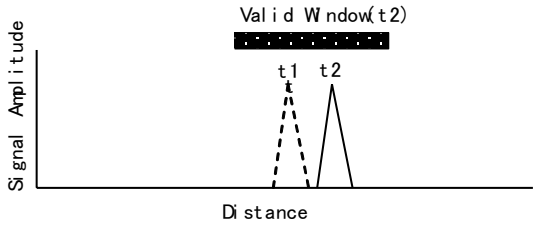


Fig. 6.5.5 Valid window width

- Double Bounce (ON/OFF) Function for removal as an outlier when multiple echoes are detected
- Double Bounce Offset Offset value from the flange surface to the upper surface of the tank (-99.999m to 99.999m)

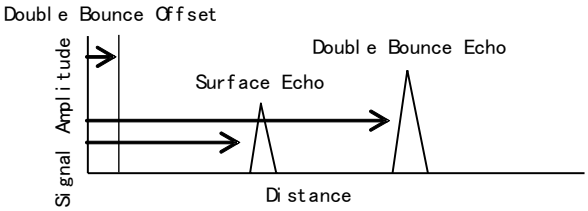


Fig. 6.5.6 Double bounce

- Bottom Visible surface position (ON/OFF) Function for removal as an outlier when the detected echo is in the bottom
- Window Width Bottom surface position width (0.0m to 99.999m)

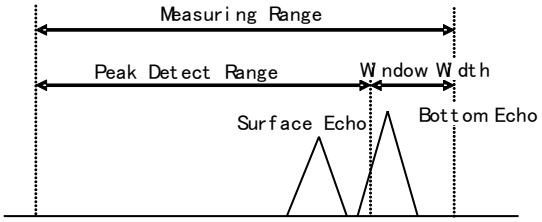


Fig. 6.5.7 Bottom Visible

6.5.3 Value Hold

On the value hold menu, it is possible to read / write measurement value hold data (parameters) for the instrument. If you click "Value Hold" tab or "Value Hold" in the tree display, the following window is displayed. Data that does not match the status of the instrument will be displayed with a yellow (0) and data that matches the status of the instrument will be displayed with a white (0).

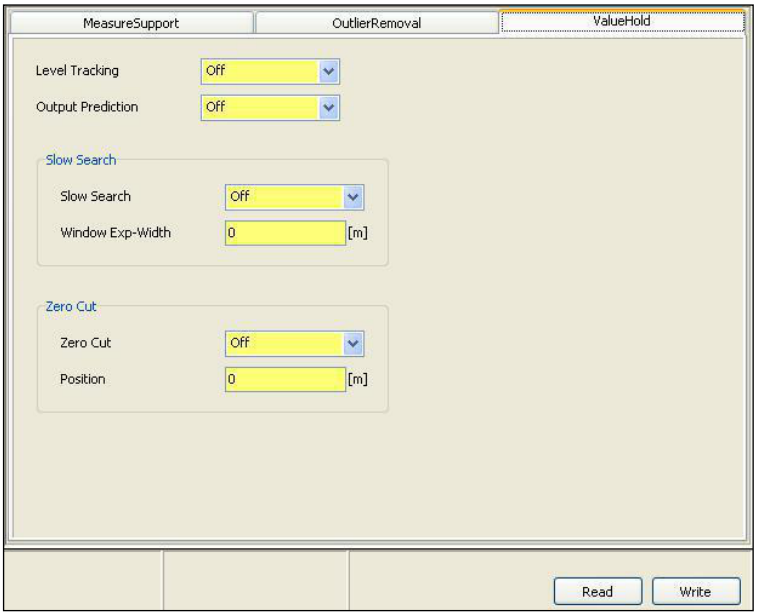


Fig. 6.5.8 Measurement value hold menu

(1) Reading measurement value hold data

To read the measurement value hold data from the instrument, click the "Read" button. After reading starts, wait momentarily until the processing progress on the status bar stops.

(2) Writing measurement value hold data

To write the measurement value hold data to the instrument, input the data to write and then click the "Write" button. After writing starts, wait momentarily until the processing progress on the status bar stops.

Value Hold data

- Level Tracking Function for moving the valid window from immediately prior liquid level variation if valid echo detection could not be performed
(ON/OFF)

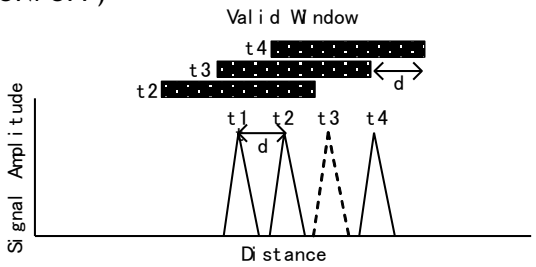


Fig. 6.5.9 Level tracking

- Output Prediction Function that outputs the liquid level predicted from the immediately prior liquid level variation, if valid echo detection could not be performed
(ON/OFF)
- Slow Search Function that enlarges the valid window width, using as reference the position where the immediately prior echo disappeared, if valid echo detection could not be performed
(ON/OFF)
- Window Exp-Width Valid window enlargement width of slow search
(0.0m to 99.999m)

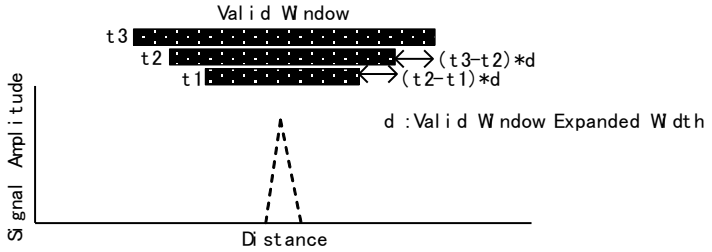


Fig. 6.5.10 Slow search

- Zero Cut Function that considers the liquid level to be zero if the level of the immediately prior liquid surface echo is at or less than the zero cut position, if valid echo detection could not be performed.
(ON/OFF)
- Position Zero cut position
(0.0m to 99.999m)

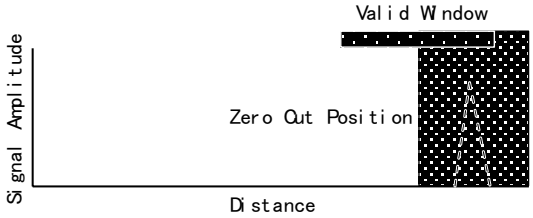


Fig. 6.5.11 Zero cut

6.6 Calibration

This section explains the functions of the calibration menu.
To open the calibration menu, click "Calibration" on the menu bar or menu selection panel.

6.6.1 Analog

In the analog menu, it is possible to read / write analog data (parameters) for the instrument. If you click "Analog" tab or "Analog" in the tree display, the following window is displayed. Data that does not match the status of the instrument will be displayed with a yellow (0) and data that matches the status of the instrument will be displayed with a white (0).

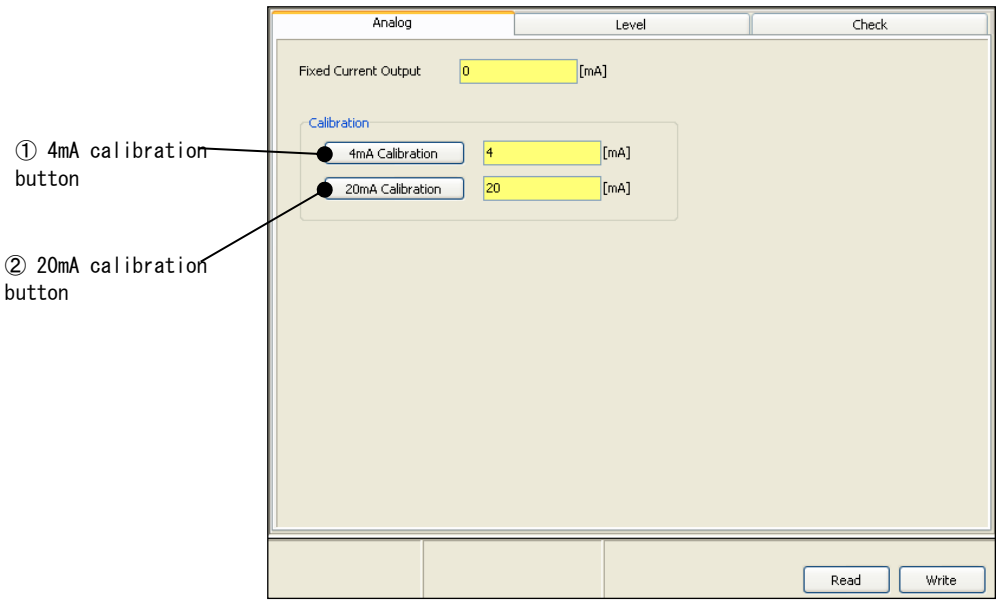


Fig. 6.6.1 Analog menu

(1) Reading analog data
To read the analog data from the instrument, click the "Read" button. After reading starts, wait momentarily until the processing progress on the status bar stops.

(2) Writing analog data
To write the analog data to the instrument, input the data to write and then click the "Write" button. After writing starts, wait momentarily until the processing progress on the status bar stops.

(3) 4mA calibration

To perform a 4mA calibration on the instrument, click the "4mA Calibration" button ①. The following window will be displayed, so then click "OK" to output a fixed current of 4mA.



Fig. 6.6.2 4mA calibration confirmation dialog box



Fig. 6.6.3 4mA output

Then the following window will be displayed, so follow the window display to measure the output current. After clicking "OK" once measurement has finished, input the calibration value (present current value) and click the "Write" button to write the calibration value to the instrument.

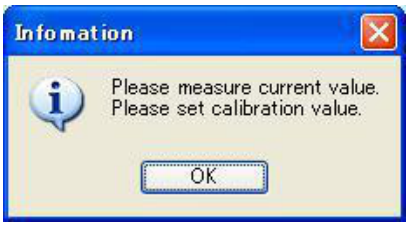


Fig. 6.6.4 Measurement / calibration value setting instructions dialog box

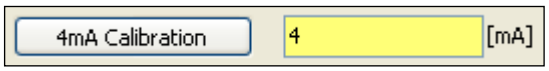


Fig. 6.6.5 Input 4mA calibration value

The 4mA calibration is now finished.

(4) 20mA calibration

To perform a 20mA calibration on the instrument, click the "20mA Calibration" button ②. The following window will be displayed, so then click "OK" to output a fixed current of 20mA.



Fig. 6.6.6 20mA calibration confirmation dialog box



Fig. 6.6.7 20mA output

Then the following window will be displayed, so follow the window display to measure the output current. After clicking "OK" once measurement has finished, input the calibration value (present current value) and click the "Write" button to write the calibration value to the instrument.

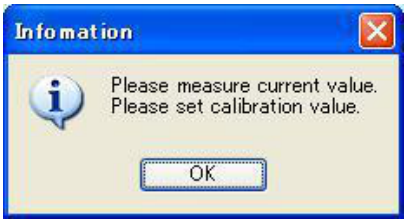


Fig. 6.6.8 Measurement / calibration value setting instructions dialog box

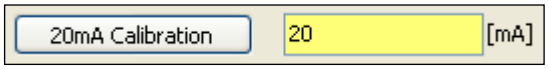


Fig. 6.6.9 Input 20mA calibration value

The 20mA calibration is now finished.

Analog data

- Fixed Current Output Fixed current that is output (ON (3.6mA to 22.0mA)/OFF (0mA))
- 4mA Calibration 4mA calibration value of analog output (3.5mA to 4.5mA)
- 20mA Calibration 20mA calibration value of analog output (15.0mA to 25.0mA)

6.6.2 Level

In the level menu, it is possible to read / write level data (parameters) for the instrument. If you click "Level" tab or "Level" in the tree display, the following window is displayed. Data that does not match the status of the instrument will be displayed with a yellow (0) and data that matches the status of the instrument will be displayed with a white (0).

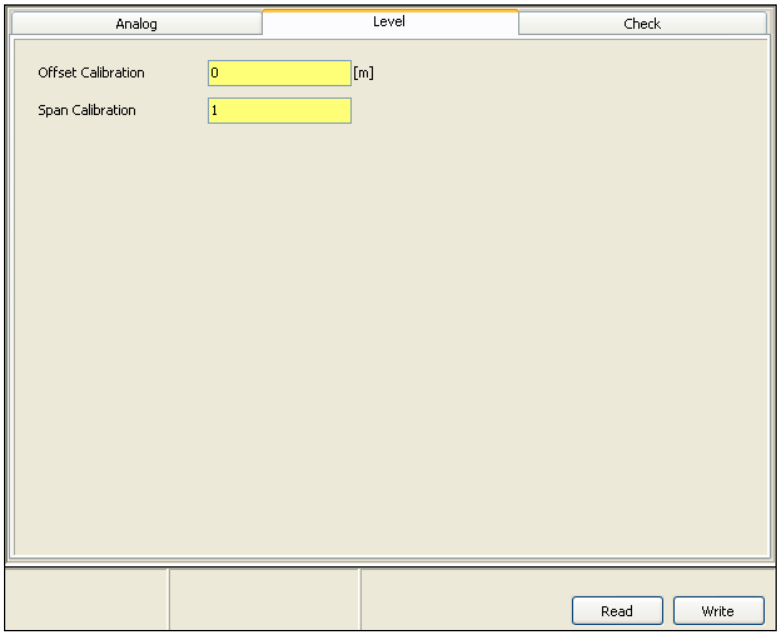


Fig. 6.6.10 Level menu

(1) Reading level data

To read the level data from the instrument, click the "Read" button. After reading starts, wait momentarily until the processing progress on the status bar stops.

(2) Writing level data

To write the level data to the instrument, input the data to write and then click the "Write" button. After writing starts, wait momentarily until the processing progress on the status bar stops.

Level data

- Offset Calibration	Zero point adjustment value (-1.0m to 1.0m)
- Span Calibration	Span calibration value (0.5 to 1.5)

6.6.3 Check

In the check menu, it is possible to perform an analog output loop check and an output check after setting the volume / flow table. If you click "Check" tab or "Check" in the tree display, the following window is displayed.

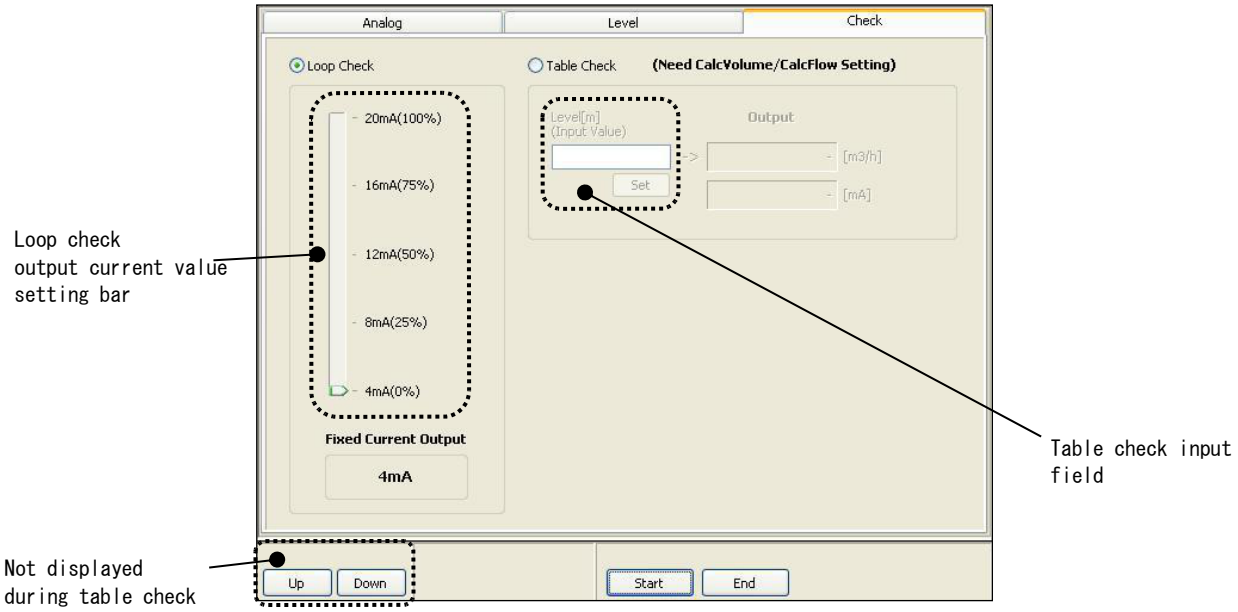


Fig. 6.6.11 Check menu

* NOTE: That to perform a table check, you must have set the volume calculation or flow rate calculation in advance.

(1) Loop Check

To perform a loop check, select loop check ( ) and then use the "Up" and "Down" buttons to select the output current value.

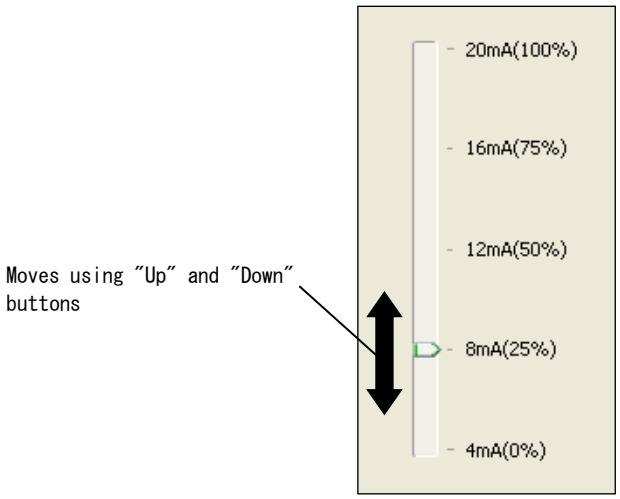


Fig. 6.6.12 Output current value setting bar

Then, if you click the "Start" button, the following window will be displayed, so click "OK", and loop check will begin.



Fig. 6.6.13 Fixed current output confirmation dialog box

Then the following window will be displayed, so follow the window display to measure the output current. When measurement has finished, click "OK".

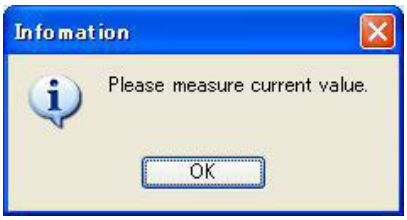


Fig. 6.6.14 Current value measurement instructions dialog box

It is then possible to repeat the next current value measurement in a similar manner by using the "Up" and "Down" buttons. To finish loop check, click the "End" button. The current output value after loop check has finished returns to the measurement value.

(2) Table Check

To perform a table check, select table check ( ) and then click the "Start" button. Then the following window will be displayed, so click "OK" to transition to table check mode, and table check will begin.



Fig. 6.6.15 Table check start confirmation dialog box

Next, input level values and click the "Set" button in the table check input area. The following window will be displayed, so follow the window display to measure the output current. When measurement has finished, click "OK".

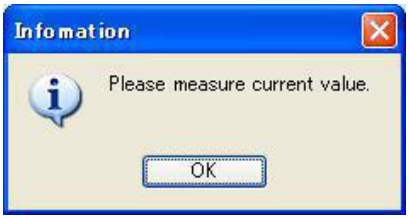


Fig. 6.6.16 Current value measurement instructions dialog box

The following output results are displayed.

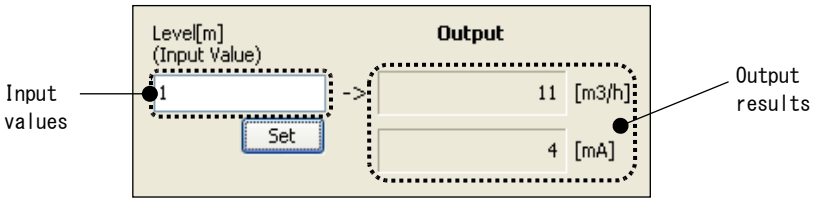


Fig. 6.6.17 Table check output results

It is possible to repeatedly check the table by performing similar operations in table check mode. To finish table check, click the "End" button. After table check is finished, the following window is displayed, so click "OK".

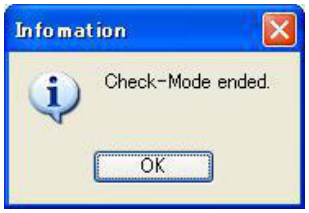


Fig. 6.6.18 Table check finish confirmation dialog box

6.7 Echo Viewer

This section explains the functions of the Echo Viewer menu.
In the Echo Viewer menu, it is possible to read fixed disturbance echo data (parameters) from the instrument and write such data to the instrument. In the Echo Viewer, it is also possible to display and analyze signal amplitude within the measurement range. If you click "Echo Viewer" in the menu bar or menu selection panel, the following window is displayed. When data does not match the status of the instrument, the fixed disturbance echo value display area will be displayed with a yellow (0). And when data matches the status of the instrument, the fixed disturbance echo value display area will be displayed with a white (0).

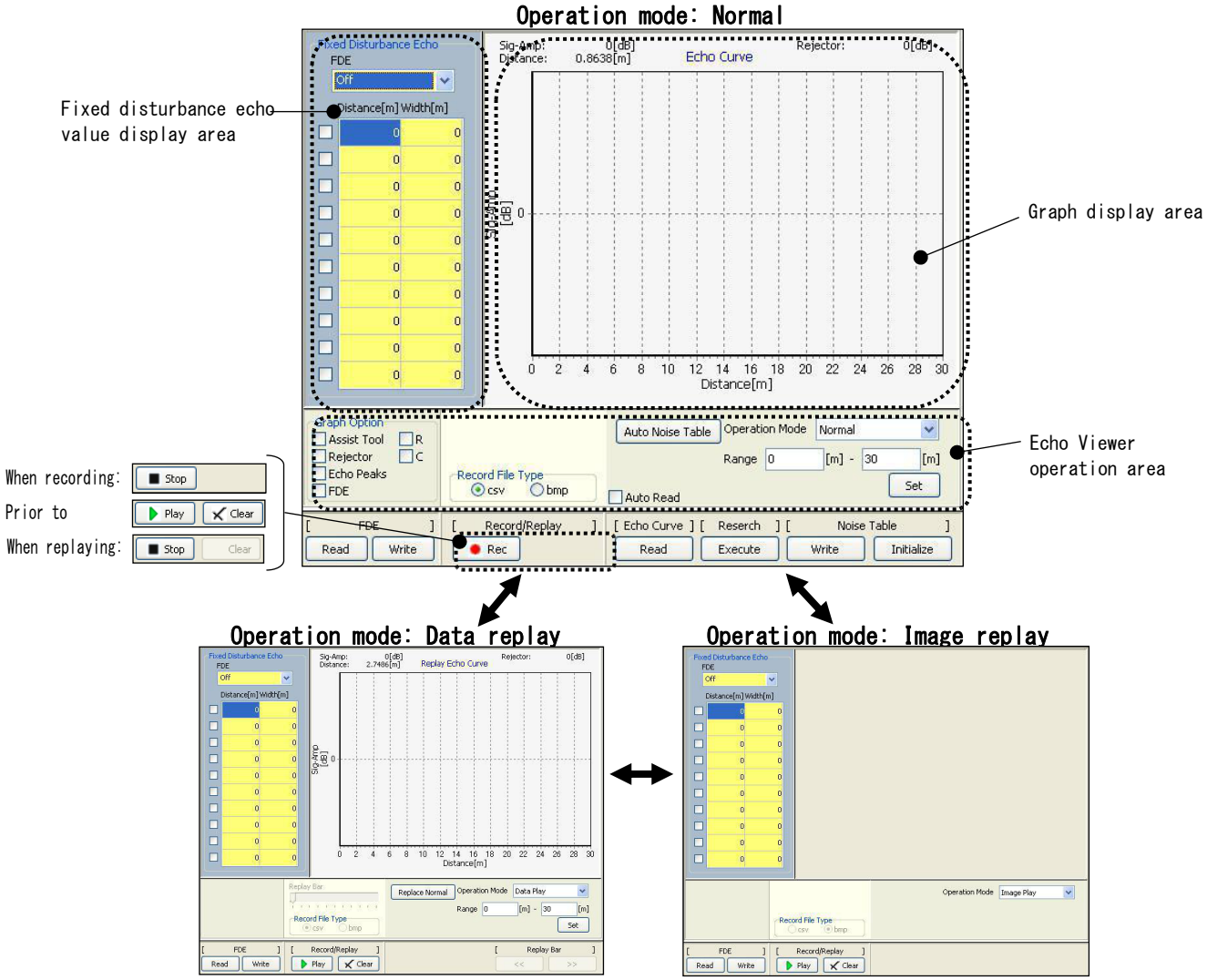


Fig. 6.7.1 Echo Viewer Menu

(1) Display range settings

To set the display range, input the range and click the "Set" button in the Echo Viewer operation area. The echo curve data is read from the instrument in the set range and displayed in the graph.

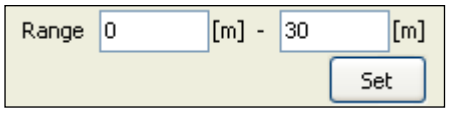


Fig. 6.7.2 Display range settings

(2) Reading echo curve data

To read echo curve data, click [Echo Curve] --> "Read" button. After reading starts, wait momentarily until the processing progress on the status bar stops. If the echo curve data is read normally, The Echo Curve similar to that in the following window (example) and the Noise Table that was simultaneously read will be displayed in the graph. At this time, if you set the Echo Peaks display in Graph Option in the Echo Viewer operation area to ON (Echo Peaks), the Echo List that was simultaneously read will be superimposed on the graph. If you want to continuously read echo curve data, once echo curve data begins to be read in a state of setting Auto Read in the Echo Viewer operation area to ON (Auto Read), the echo curve data will be continuously read during the period that Auto Read is ON. If you want to stop Auto Read, set it to OFF (Auto Read). After final reading is complete, Auto Read will stop. If you want to display range of R in the graph, set the R display in Graph Option in the Echo Viewer operation area to ON (R), Also, If you want to display range of C in the graph, set the C display in Graph Option in the Echo Viewer operation area to ON (C),

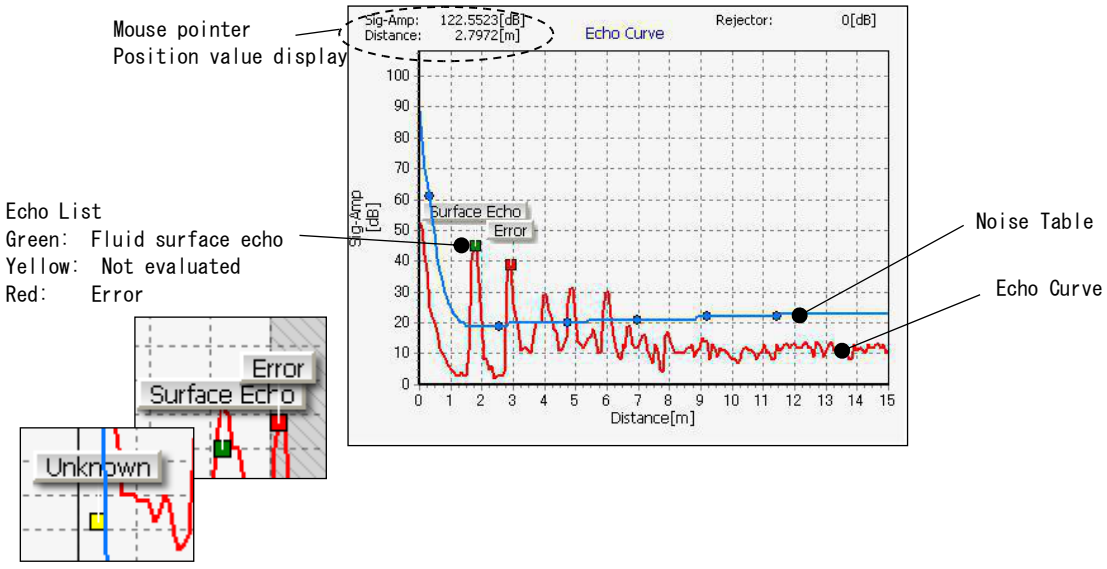


Fig. 6.7.3 Echo curve graph

It is possible to change the display range of the graph by right clicking on the graph and then dragging. Also, it is possible to perform Zoom Up and Zoom Reset by dragging downward to the bottom right on the graph and by dragging upward to the left on the graph, respectively.

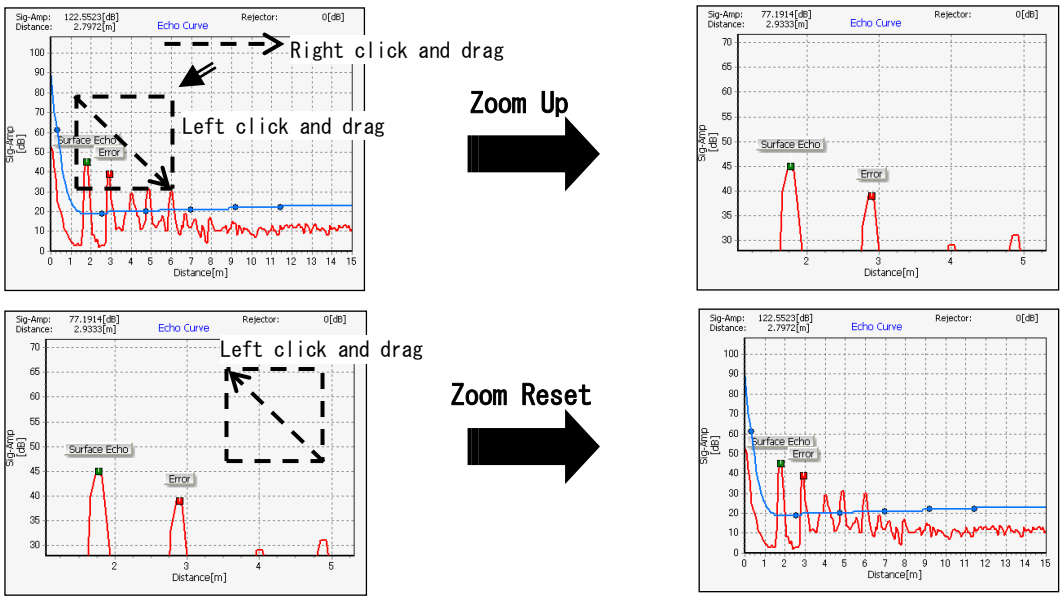


Fig. 6.7.4 Graph Zoom Up and Zoom Reset

(3) Noise table operations

It is possible to edit the read noise table on the graph. There are 6 editing methods, which are as follows:

- Directly editing the noise table points
- Reverting the edited noise table to its state prior to editing
- Using the Assist Tool to gather together a two-point interval of noise table points to make a linear plot
- Using the rejector to set the minimum value of the noise table
- Automatically setting the noise table in the echo curve data
- Initializing the noise table

(3-1) Directly editing the noise table points

The mouse can be used to directly specify noise table points on the graph to edit. Use the mouse to directly click the noise table point to edit and then simply drag it upward or downward to change the value. The edited noise table will be displayed in the update color.

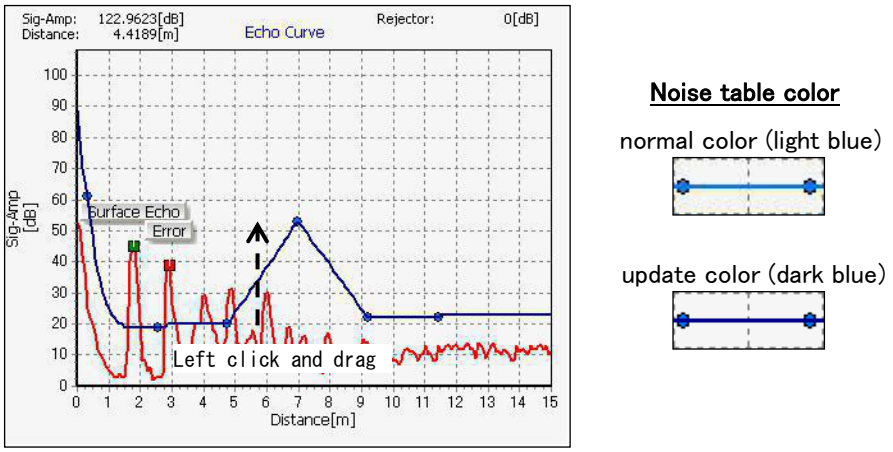


Fig. 6.7.5 Direct editing of the noise table points

To write the noise table to the instrument, click [Noise Table] --> "Write" button. The updated points are written to the instrument.

(3-2) Reverting the edited noise table to its state prior to editing

If you want to revert an edited noise table to its state prior to editing, it is possible to return it to its state immediately after it was read from the instrument by double clicking on the graph. At this time, you can check that the noise table has returned to its previous state, because the display color of the noise table will have changed from the update color to the normal color.

(3-3) Using the Assist Tool to gather together a two-point interval of noise table points to make a linear plot

It is possible to use the Assist Tool to gather together a two-point interval of noise table points to make a linear plot. To operate the Assist Tool, set the Assist Tool display in Graph Option on the Echo Viewer operation area to ON (☑ Assist Tool). Use the mouse to directly click on the displayed Assist Tool, and simply drag left and right to match the reference point. Next, use the mouse to directly click the edit point and simply drag up and down. This will make the interval between the reference point and edit point linear, and all of the point values in that range will change. The Assist Tool will move in the distance direction in agreement with the noise table points. The edited noise table will be displayed in the update color.

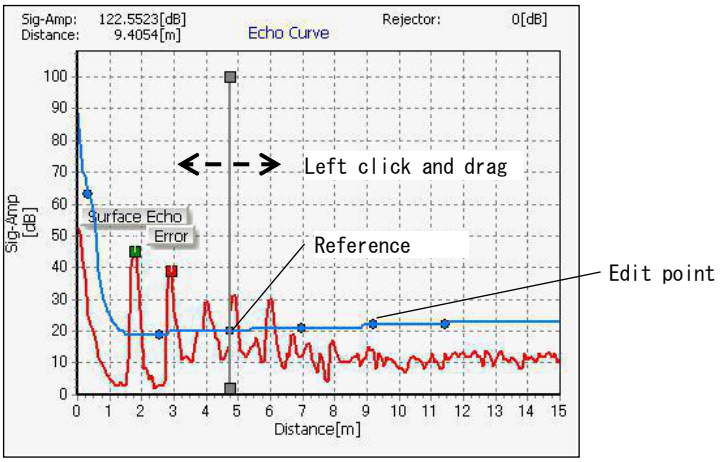


Fig. 6.7.6 Setting the reference point using the Assist Tool

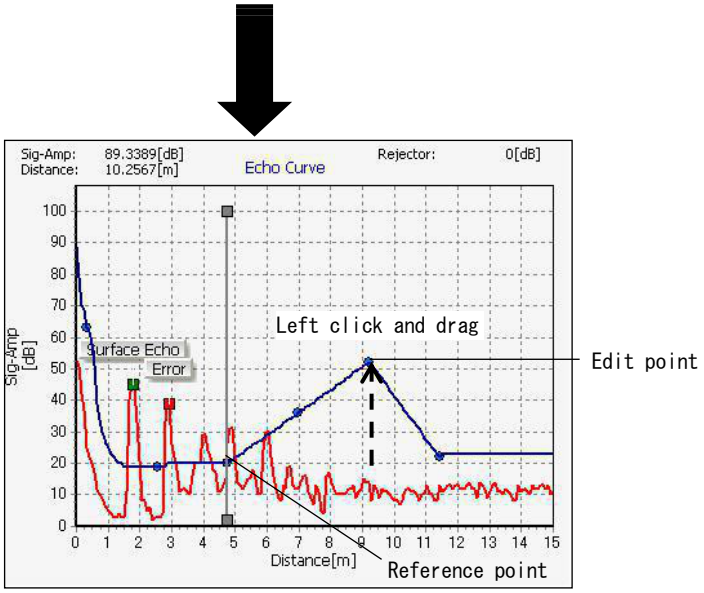


Fig. 6.7.7 Making the interval between the reference point and edit point linear by using the Assist Tool

To write the noise table to the instrument, click [Noise Table] --> "Write" button. The updated points are written to the instrument.

(3-4) Using the rejector to set the minimum value of the noise table.

The minimum value of the noise table can be set by using the rejector. To operate the Rejector, set the Rejector display in Graph Option on the Echo Viewer operation area to ON (☑ Rejector). Use the mouse to directly click the displayed rejector, and then simply drag it upward or downward to change the value. When the rejector is applied to the noise table, the noise table will be considered edited and will be displayed in the update color.

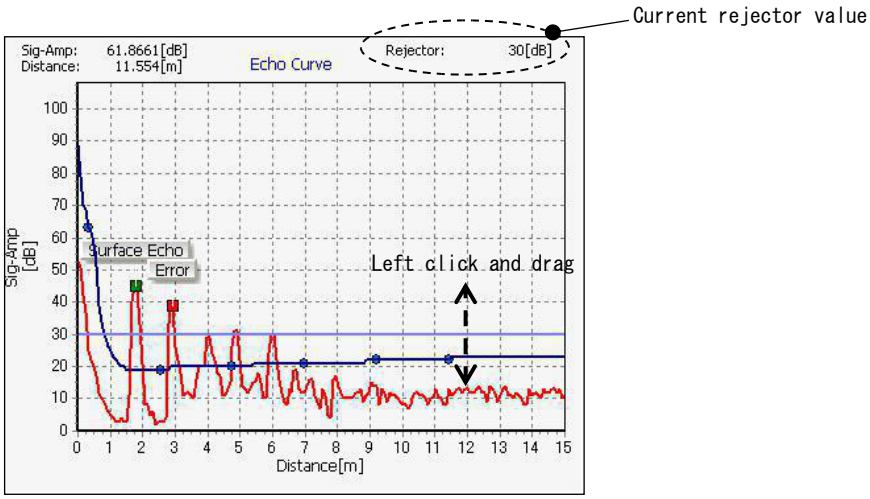


Fig. 6.7.8 Setting the minimum value of the noise table using the Rejector

To write the noise table to the instrument, click [Noise Table] --> "Write" button. The updated points are written to the instrument. If the noise table point values are smaller than the rejector values, rejector values are written.

(3-5) Automatically setting the noise table in the echo curve data

The noise table can be automatically set in the echo curve data. If you click the "Auto Noise Table" button in the Echo Viewer operation area, the following window is displayed.

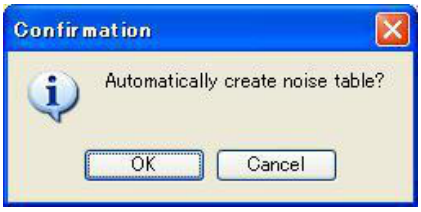


Fig. 6.7.9 Noise table automatic creation confirmation dialog box

If you click "OK", the noise table will be automatically set in the echo curve data that is displayed. When the Noise Table cover the surface echo, adjust again so that the Noise Table do not cover the surface echo.

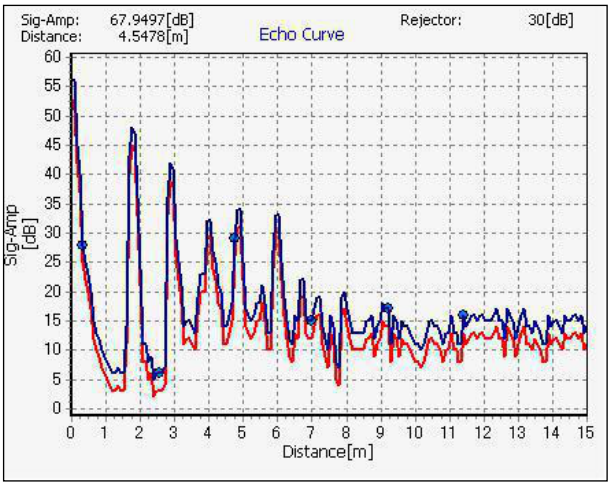


Fig. 6.7.10 Noise table automatic creation

To write the noise table to the instrument, click [Noise Table] --> "Write" button. All points are written to the instrument.

(3-6) Initializing the noise table

To initialize the noise table, click [Noise Table] --> "Initialize" button. The following window will be displayed, so then click "OK" to initialize the noise table.

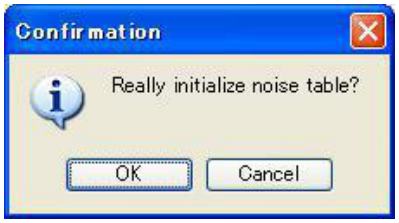


Fig. 6.7.11 Noise table initialization confirmation dialog box

(4) Reading fixed disturbance echo data

To read the fixed disturbance echo data from the instrument, click [FDE] --> "Read" button. After reading starts, wait momentarily until the processing progress on the status bar stops.

(5) Writing fixed disturbance echo data

To write the fixed disturbance echo data to the instrument, input the data to write and then click [FDE] --> "Write" button. After starting writing, wait momentarily until the processing progress on the status bar stops. When writing, only the valid data (☑ data marked with a check) in the fixed disturbance echo value display area will be written. Be aware that invalid data (☐ data that is not marked with a check) will not be written.

(6) Displaying fixed disturbance echo data

To display fixed disturbance echo data, set the FDE display in Graph Option on the Echo Viewer operation area to ON (☑FDE). If the FDE parameter is ON, the fixed disturbance echo data is superimposed on the graph as shown in the following window (example). Valid data (☑ data marked with a check) and invalid data (☐ data that is not marked with a check) are displayed in black and red, respectively.

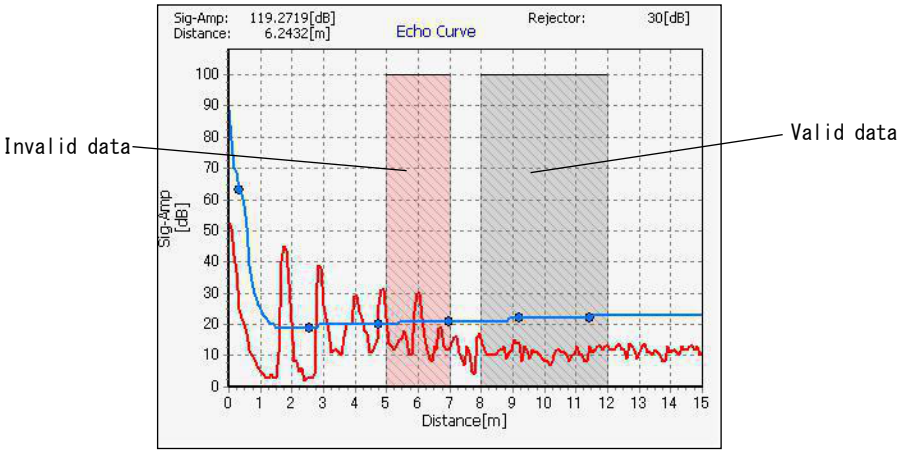


Fig. 6.7.12 Displaying fixed disturbance echo data

(7) Executing research

To start instrument research, click [Research] --> "Execute" button. Then the following window will be displayed, so then click "OK" to start research.

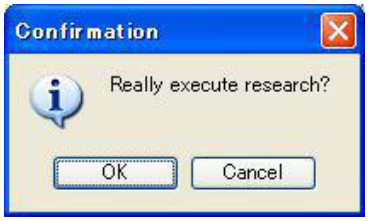


Fig. 6.7.13 Research execution confirmation dialog box

(8) Recording echo curve data

The read echo curve data can be internally recorded. There are two record formats, which are as follows:

- csv format (comma separated)
- bmp format (bit map image)

Before starting to record, first select the record format from the Record File Type in the Echo Viewer operation area.



Fig. 6.7.14 Selecting a record format

(8-1) Recording echo curve data in csv format

To record echo curve data in csv format, select "csv" () from the Record File Type in the Echo Viewer operation area. To start recording, first click the "Rec" button, and then specify the record file. The following window is displayed, so after inputting the file name in the file name input field, click the "Save" button.

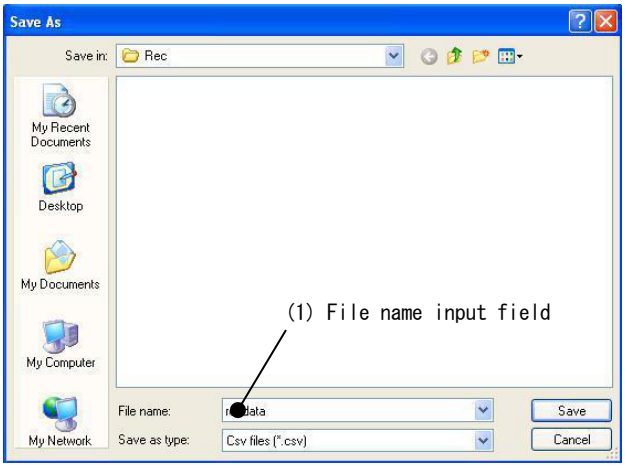


Fig. 6.7.15 File save dialog box

After specifying the record file, start csv recording of the echo curve data. The echo curve data that is then read is internally recorded to the specified file. To finish recording, click the "Stop" button. Then the following window will be displayed, so then click "OK" to finish recording.

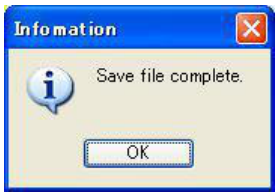


Fig. 6.7.16 Echo curve data recording complete confirmation dialog box

(8-2) Recording echo curve data in bmp format

To record echo curve data in bmp format, select "bmp" (bmp) from the Record File Type in the Echo Viewer operation area. To start recording, first click the "Rec" button, and then specify the record file. The following window is displayed, so after inputting the file name in the file name input field, click the "Save" button.

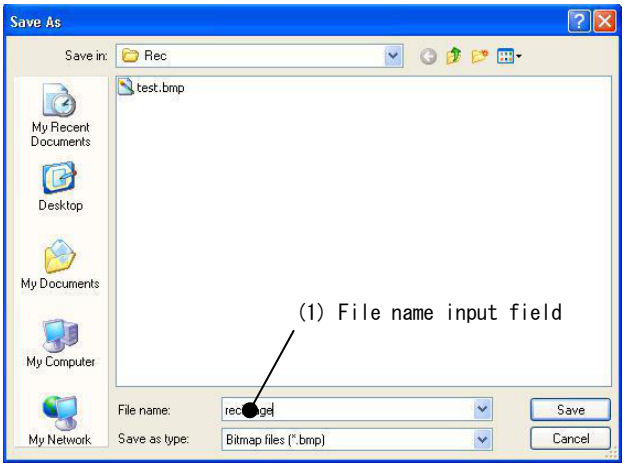


Fig. 6.7.17 File save dialog box

After specifying the record file, start bmp recording of the echo curve data. Then the following window will be displayed, so then click "OK" to finish recording.

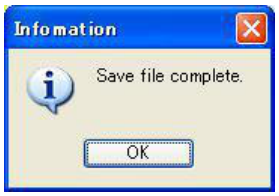


Fig. 6.7.18 Echo curve data recording complete confirmation dialog box

(9) Replaying echo curve data

The internally recorded echo curve data can be replayed. There are two replay methods, which are as follows:

- Data replay (replays record file in csv format)
- Image replay (replays record file in bmp format)

(9-1) Replaying data

To replay data, switch the operation mode in the Echo Viewer operation area to "Data Replay". To start replaying, first click the "Play" button, and then specify the replay file. The following window is displayed, so after specifying the file that you want to replay in the file specification field, click the "Open" button.

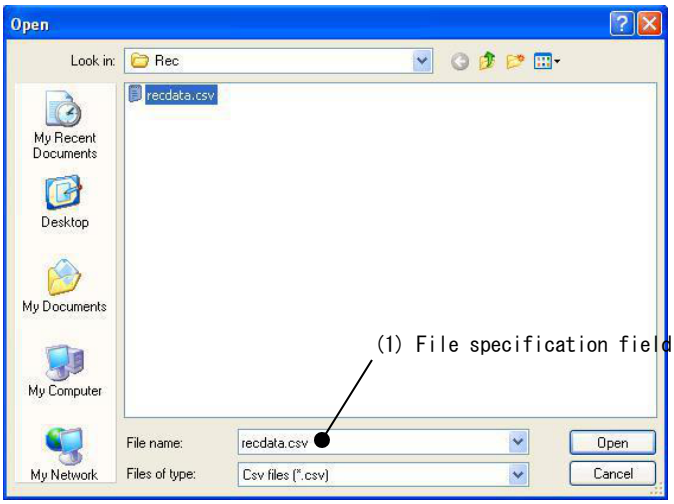


Fig. 6.7.19 File open dialog box

After specifying the replay file, the replay data will be expanded internally. Use the mouse to directly click on the slider of the replay bar, and by simply dragging left and right or clicking [Replay Bar] --> "<<" and ">>" buttons, the graph display of the replay data can be switched. The display range during replay can be set and Zoom Up and Zoom Reset operations on the graph can be performed, as is the case in normal mode. To finish replaying, click the "Stop" button. If you want to clear the displayed graph, click the "Clear" button.

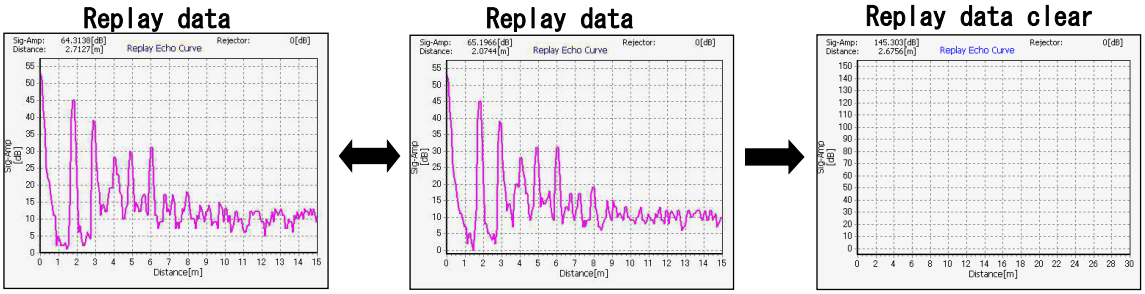


Fig. 6.7.20 Replaying echo curve data

● Normal data conversion

In the data replay function, replay data that is displayed in the graph during data replay can be copied to normal data. To copy replay data to normal data, click the "Replace Normal" button in the Echo Viewer operation area while the replay data is displayed on the graph. Then the following window will be displayed, so click "OK".

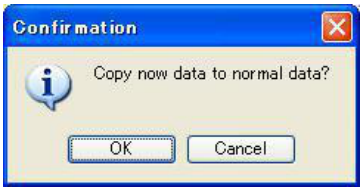


Fig. 6.7.21 Normal data conversion confirmation dialog box

When copying from the replay data to the normal data is complete, the following window is displayed, so click "OK".



Fig. 6.7.22 Normal data conversion complete dialog box

After conversion to normal data, switch the operation mode to "Normal" to check that normal data is displayed on the graph. If normal data has been normally converted to replay data, data conversion is complete.

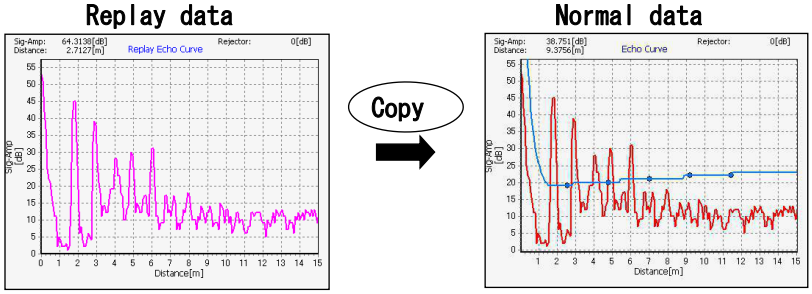


Fig. 6.7.23 Normal data conversion

(9-2) Replaying images

To replay images, switch the operation mode in the Echo Viewer operation area to "Image Play". To start replaying, first click the "Play" button, and then specify the replay file. The following window is displayed, so after specifying the file that you want to replay in the file specification field, click the "Open" button.

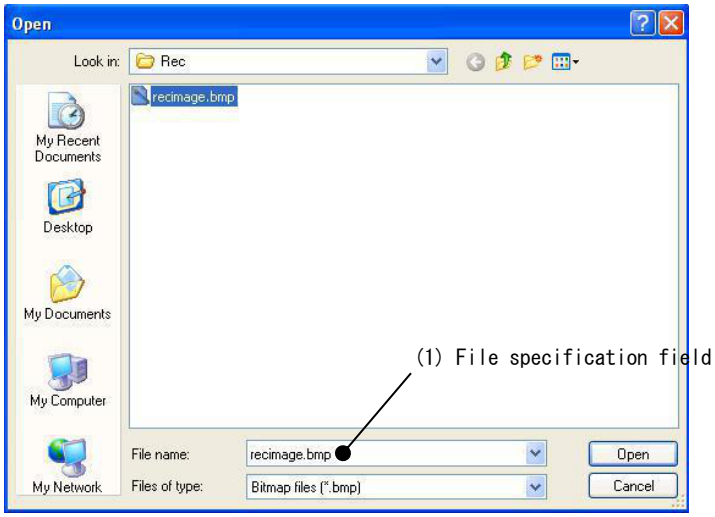


Fig. 6.7.24 File open dialog box

After specifying the replay file, the replay data will be displayed. If you want to clear the displayed graph, click the "Clear" button.

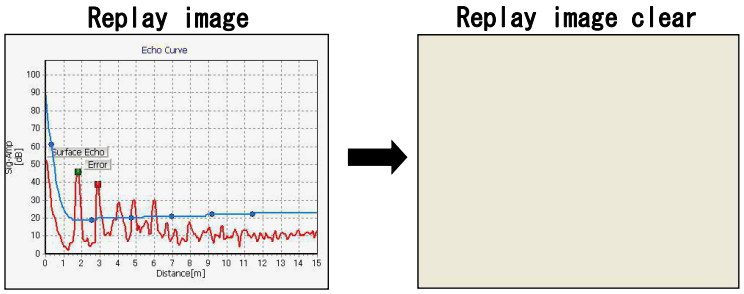


Fig. 6.7.25 Replaying echo curve images

6.8 Measuring

This section explains the functions of the measure menu.
In the measure menu, measurement parameters of the instrument can be displayed / analyzed and Echo List data / maximum values of the instrument can be read. If you click "Measure" in the menu bar or menu selection panel, the following window is displayed.

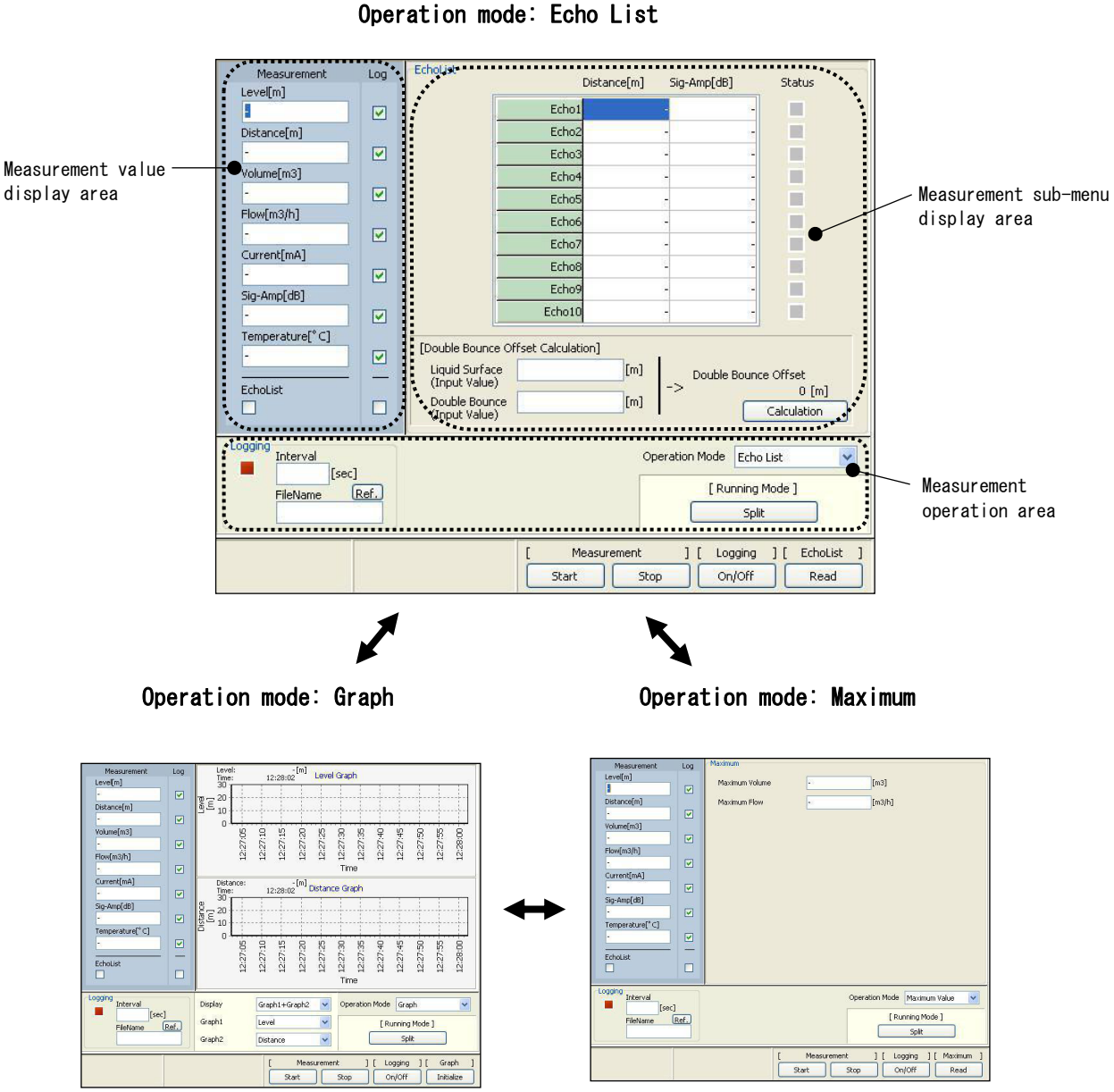


Fig. 6.8.1 Measure menu

(1) Starting measurement

To start instrument measurement, click [Measurement] --> "Start" button. Measurement is started in the period indicated below.

Measurement period
1 sec: When Echo List measurement / log is not included
5 sec: When Echo List measurement / log is included

Although the normal measurement interval is 1 second, if there is a check mark for either the Echo List measurement or log in the measurement value display area, an Echo List measurement is added, so the measurement interval changes to 5 seconds.

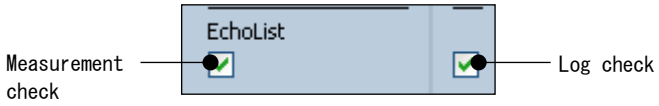


Fig. 6.8.2 Changing the measurement period

After measurement has started, the measurement mode display changes as follows. Details on switching the measurement mode are described later.

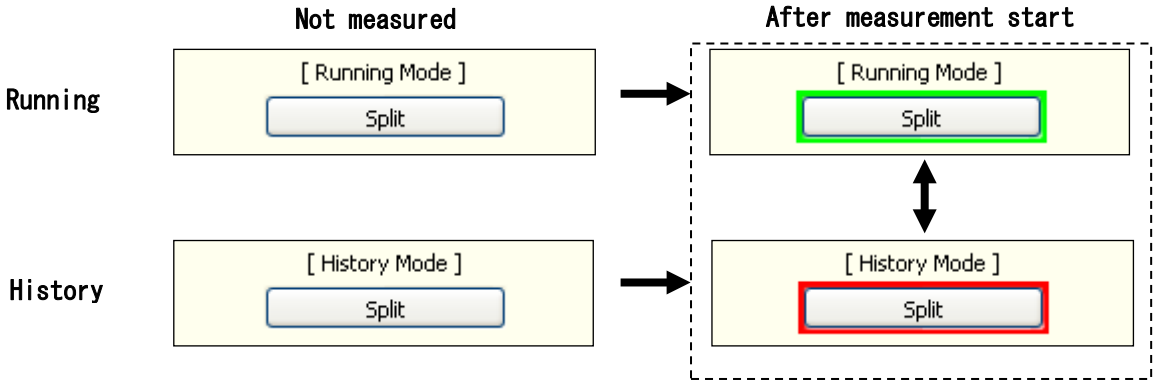


Fig. 6.8.3 Measurement mode transition 1 (Not measured -> Measurement start)

(2) Checking measurement values

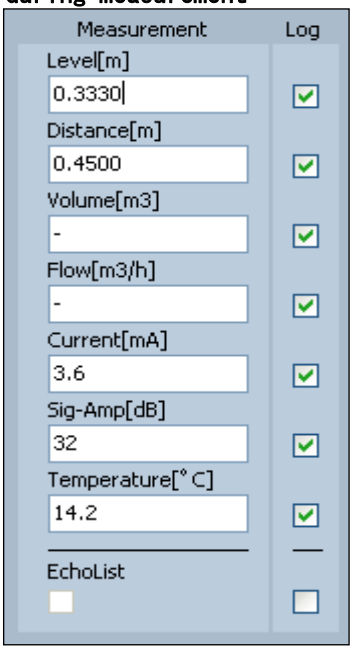
The following two methods are used to check instrument measurement values.

- Checking each measurement parameter by value
- Checking each measurement parameter by graph

(2-1) Checking each measurement parameter by value

Using the measurement value display area, instrument measurement values can be checked by value for each parameter. The most recent measurement parameter values are displayed in the measurement value display area. The display is a bar display when measurement is not yet performed.

Measurement value display during measurement



Bar display when measurement is not yet performed

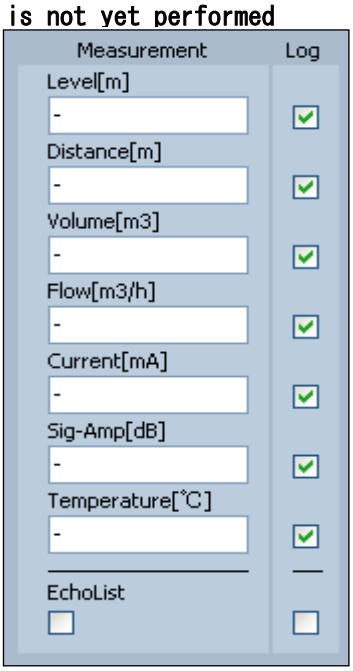


Fig. 6.8.4 Checking measurement parameters by value

(2-2) Checking each measurement parameter by graph

To confirm instrument measurement values by graph for each parameter, switch the operation mode in the measurement operation area to "Graph". A maximum of two graphs can be displayed simultaneously in the measurement sub-menu display area. The graphs to display can be selected from those in "Display" in the measurement operation area.

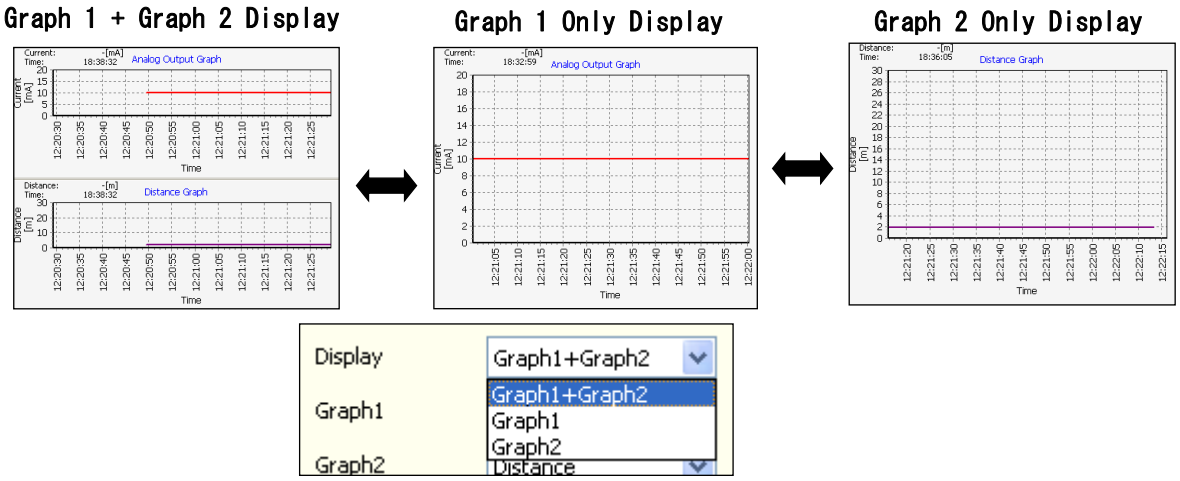


Fig. 6.8.5 Selecting a display graph

Each type of graph 1 / graph 2 display parameters can be changed by selecting "Graph 1" or "Graph 2" in the measurement operation area. It is not possible to select the same parameters in graphs 1 and 2 simultaneously.

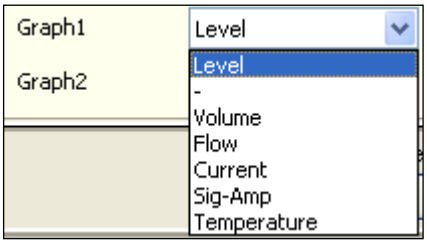


Fig. 6.8.6 Switching graph 1 display parameters

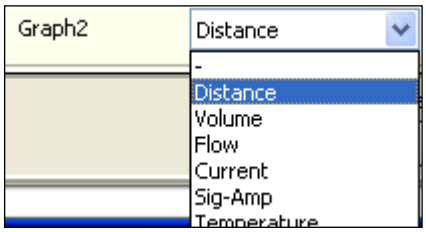


Fig. 6.8.7 Switching graph 2 display parameters

To initialize all measurement data, click [Graph] --> "Initialize" button. This clears the history and graph display of all measurement parameters. Be aware that once data has been initialized it cannot be restored to its original state thereafter.

(3) Stopping measurement

To stop instrument measurement, click [Measurement] --> "Stop" button. This stops measurement. After measurement has stopped, the measurement mode display changes as follows. Details on switching the measurement mode are described later.

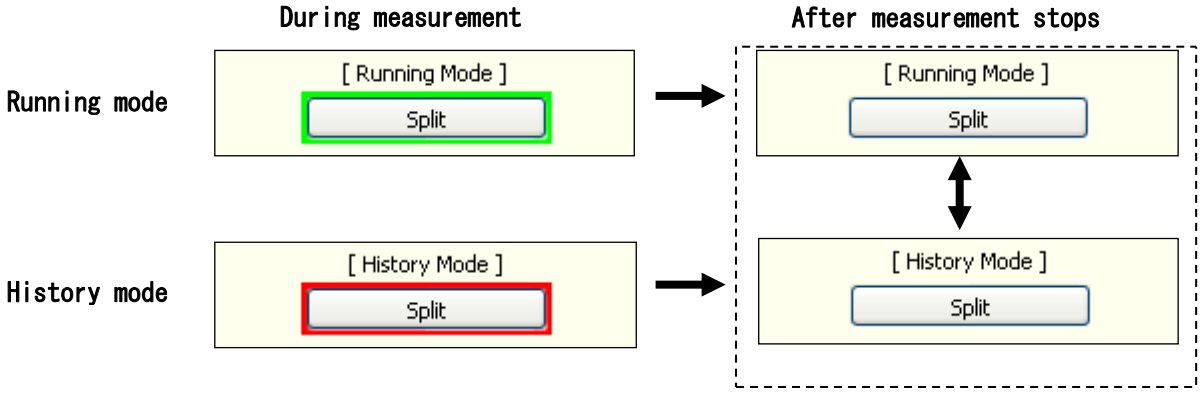


Fig. 6.8.8 Measurement mode transition 2 (During measurement -> Measurement stop)

(4) Logging measurement values

Instrument measurement data can be saved to a file. To save measurement data to a file, place a check mark for the log of the parameter that you want to save that is in the measurement value display area ①, and set the logging interval ② and log file ③. During logging, the logging status ④ is displayed in green, and when logging is stopped, the logging status is displayed in red.

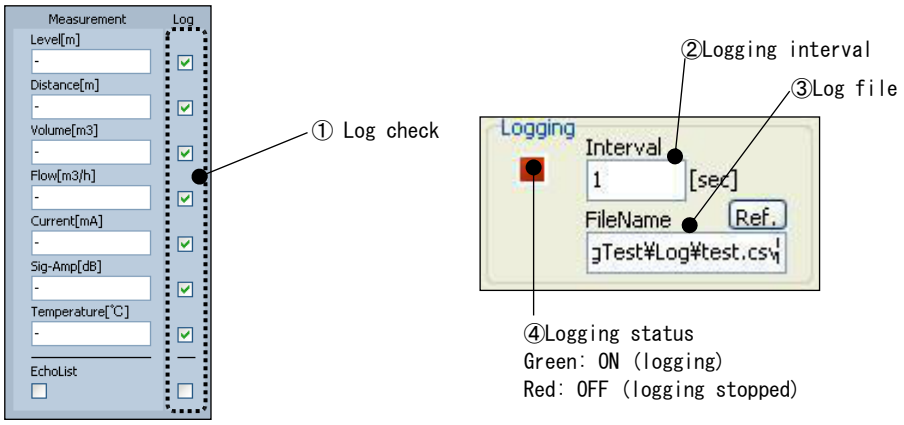


Fig. 6.8.9 Logging settings

Be aware that when logging the Echo List (when there is a check mark for the Echo List log), a logging interval less than 5 seconds cannot be specified. To set the file name and save location for the log file, click the "Ref." button of the log file setting in the measurement operation area. Then the following window is displayed.

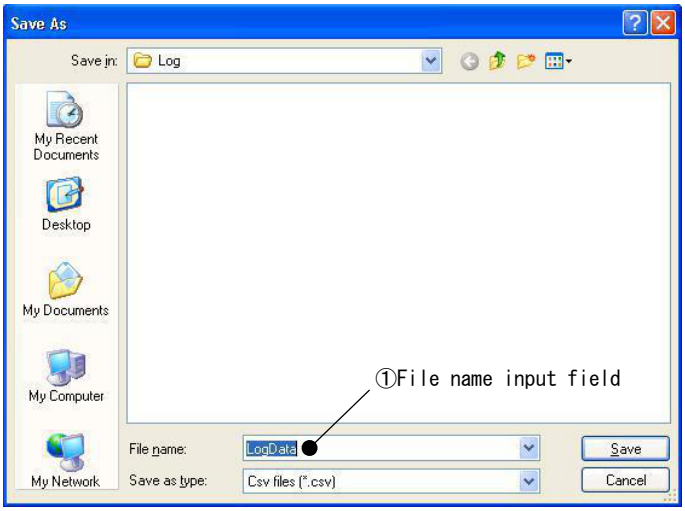
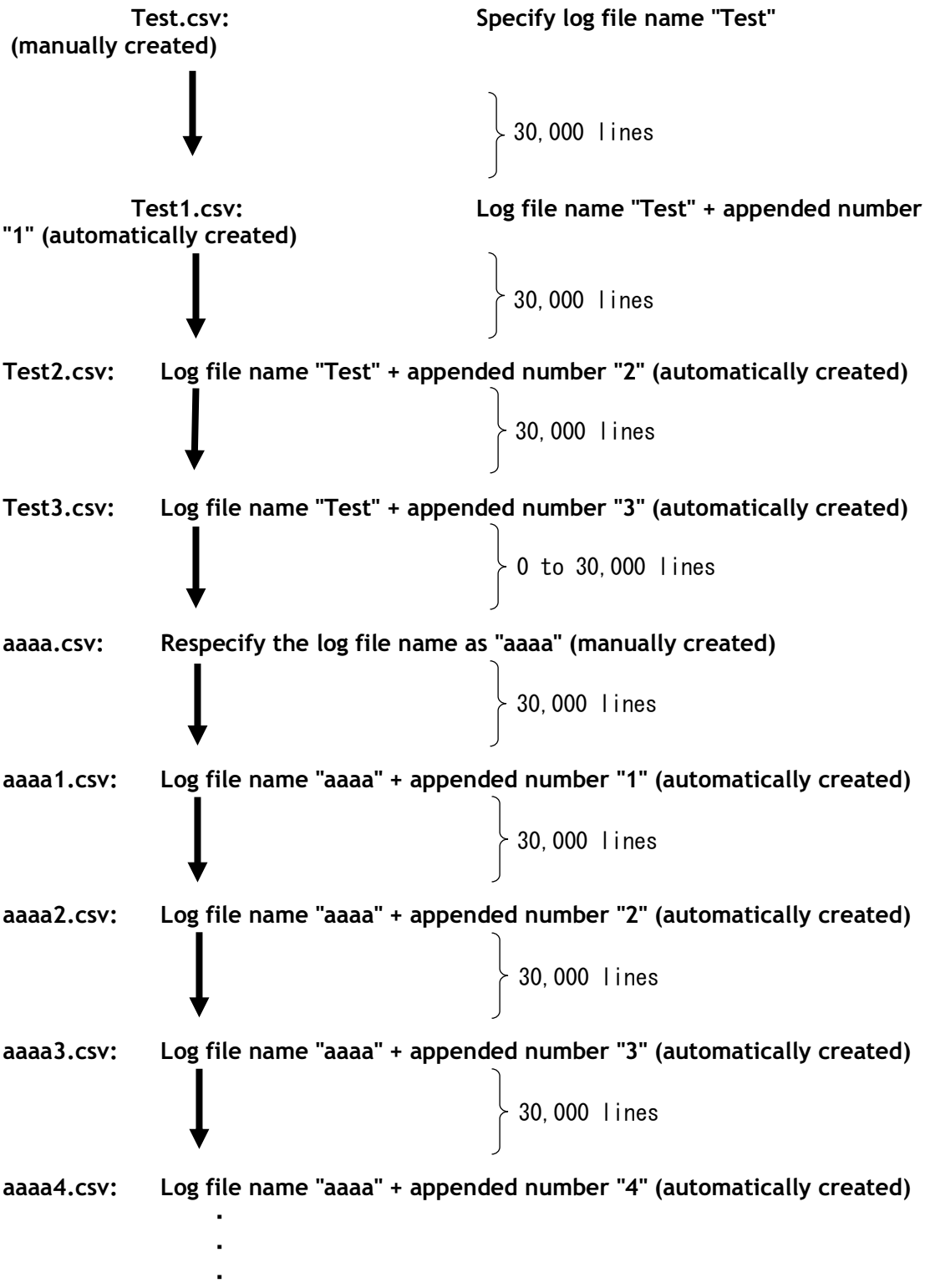


Fig. 6.8.10 Log file specification dialog box

After inputting the log file name in the file name input field ①, click the "Save" button to specify the log file. The log file is saved in csv format. To enable logging during measurement, click [Logging] --> "On/Off" button to turn the logging status ON (green). If you start measurement when the logging status is green, the measurement values will be saved in the log file. To finish logging after stopping measurement, click [Logging] --> "On/Off" button to turn the logging status OFF (red). If you repeat logging continuously without resetting the log file, measurement values will be added to the current settings file. If there are more than 30,000 lines in the log file during logging, a file with an "appended number" appended to the end of the "specified log file name" is automatically created, and data is continuously saved. Be aware that unless a new log file is specified, the "appended number" continues to increase by 1 for every 30,000 lines. An operation example of automatic file creation is shown below.

● Operation example of automatic file creation



(5) Switching the measurement mode

There are two measurement modes, which are as follows: The measurement mode can be switched by clicking the "Split" button in the measurement operation area.

- Running mode (the measurement graph is being updated and measurement graph operations cannot be performed)
- History mode (the measurement graph has been stopped and measurement graph operations can be performed)

(5-1) Running mode

Running mode is the mode in which the graph is regularly updated. Current measurement values can be monitored in real time using the graph, but graph operations cannot be performed.

(5-2) History mode

History mode is the mode in which graph updating has been stopped. Although current measurement values cannot be monitored in real time using the graph, the displayed graph can be analyzed using operations such as Drag / Zoom Up / Zoom Reset. Also, during history mode, the display range of the graph can be changed according to the range settings.

●Graph Drag / Zoom Up / Zoom Reset

It is possible to change the display range of the graph by right clicking on the graph and then dragging. Also, Zoom Up and Zoom Reset can be performed by dragging to the bottom right and top left, respectively.

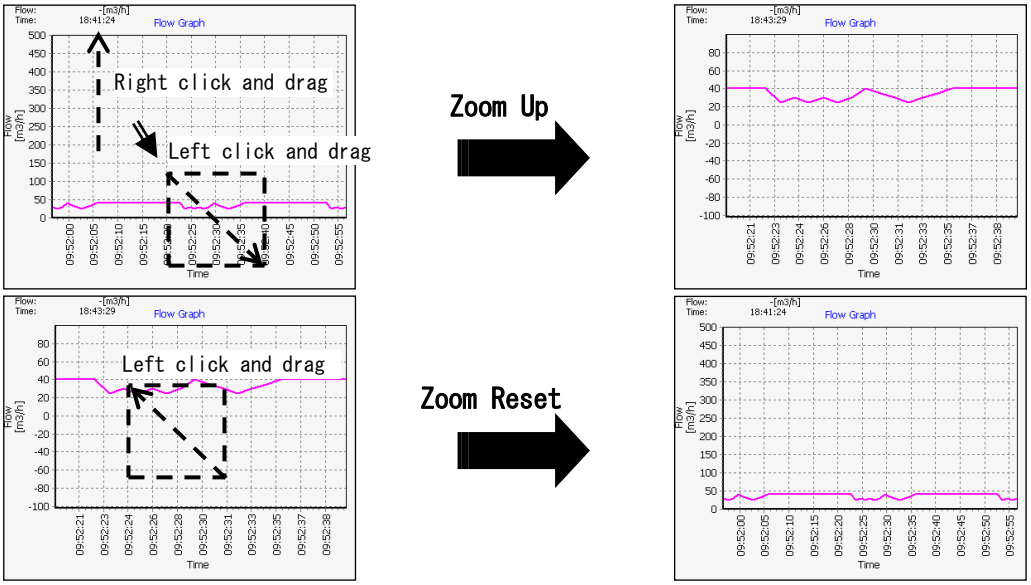


Fig. 6.8.11 Graph Drag / Zoom Up / Zoom Reset

● Range settings

To use range settings to change the display range of the graph, click near a graph scale line.

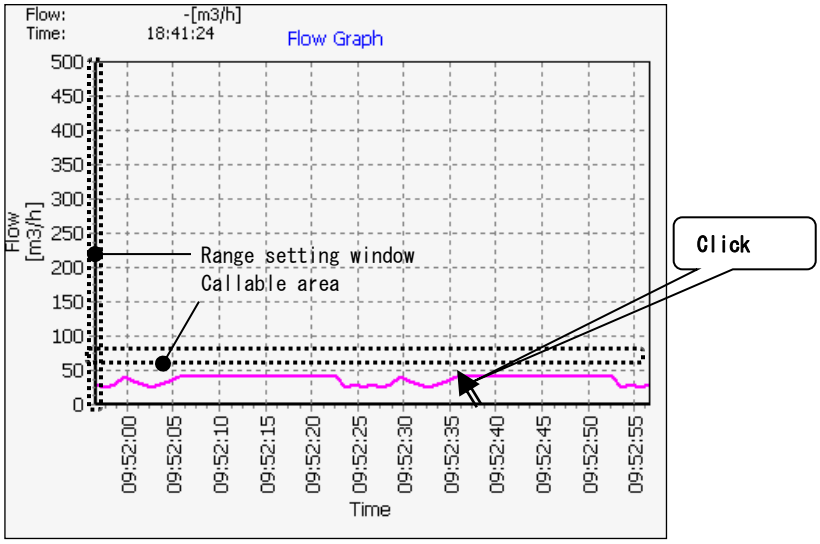


Fig. 6.8.12 Calling the range setting window

Then the following window is displayed. Input setting values ①, and click the "Apply" button ② to change the display range of the graph according to setting values. To cancel the settings, click the "Cancel" button ③.

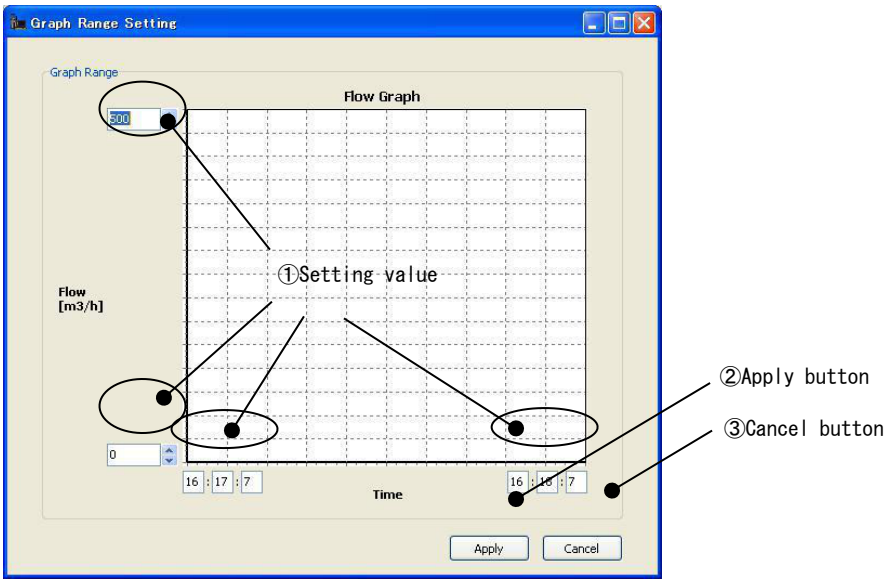


Fig. 6.8.13 Range setting window

(6) Reading Echo List data

The Echo List table (distance / signal Amplitude list) can be read from the instrument. To read the Echo List, switch the operation mode in the measurement operation area to "Echo List". Then, click [Echo List] --> "Read" button to read the Echo List from the instrument.

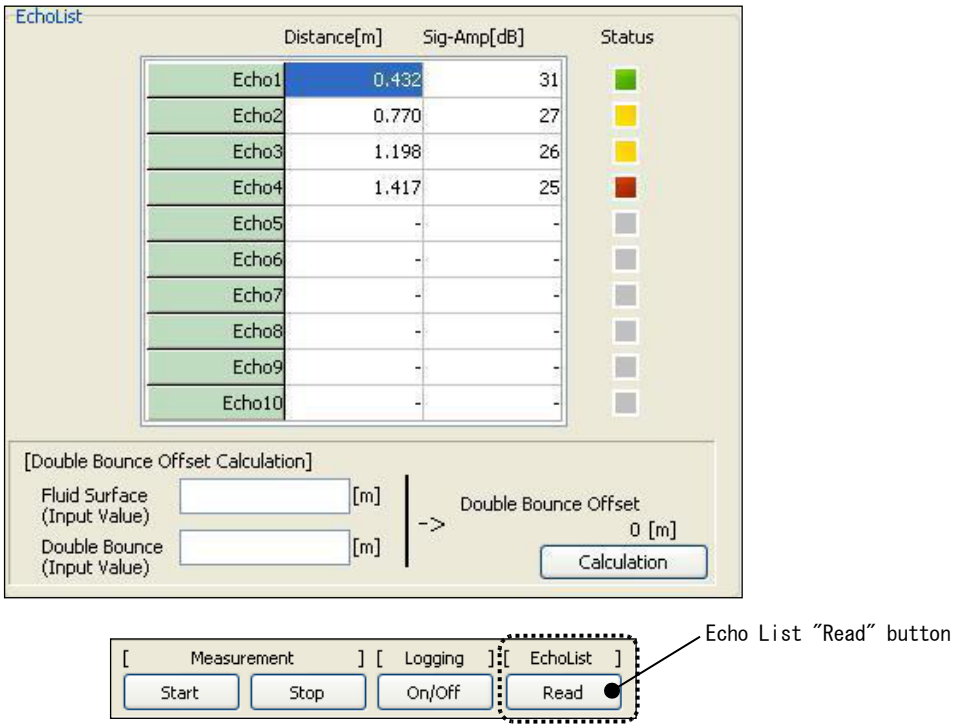


Fig. 6.8.14 Reading the Echo List

The echo list data is displayed with a maximum of 10 points. The displayed echo list data can be confirmed on the echo curve graph. (For details on the status, refer to Fig. 4.2.7.3 Echo curve graph.)
Double bounce offset calculation can be performed based on the results of the echo list data that was read from the instrument.

- Double bounce offset calculation

To calculate the double bounce offset, input the liquid surface and the double bounce value in an input area ((1)), and then click the "Calculation" button ((2)). The calculation result ((3)) is displayed.

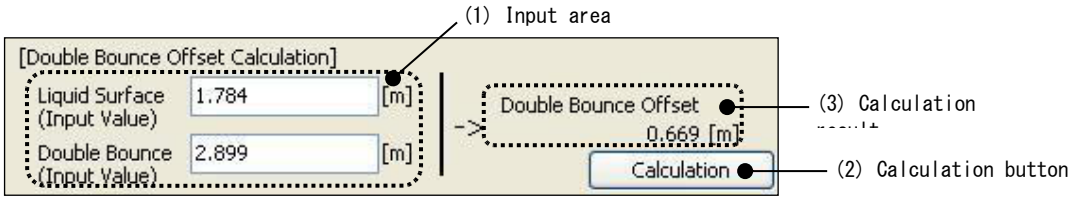


Fig. 6.8.15 Double bounce offset calculation

The following confirmation window will be shown with the calculation result display, so click "OK". The calculation result is written in the instrument as double bounce offset value.

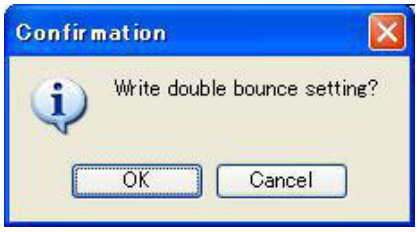


Fig. 6.8.16 Double bounce offset confirmation instructions dialog box

Confirm that the calculation result is reflected in the double bounce offset value in Outlier Removal menu.

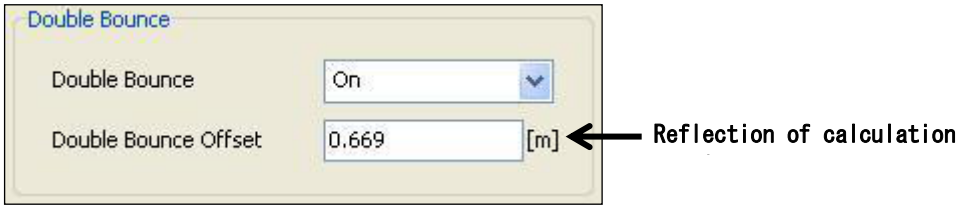


Fig. 6.8.17 Double bounce offset value

(7) Reading maximum values

To read maximum values from the instrument, switch the operation mode in the measurement operation area to "Maximum". Then, click [Maximum] --> "Read" button to read the maximum value from the instrument.

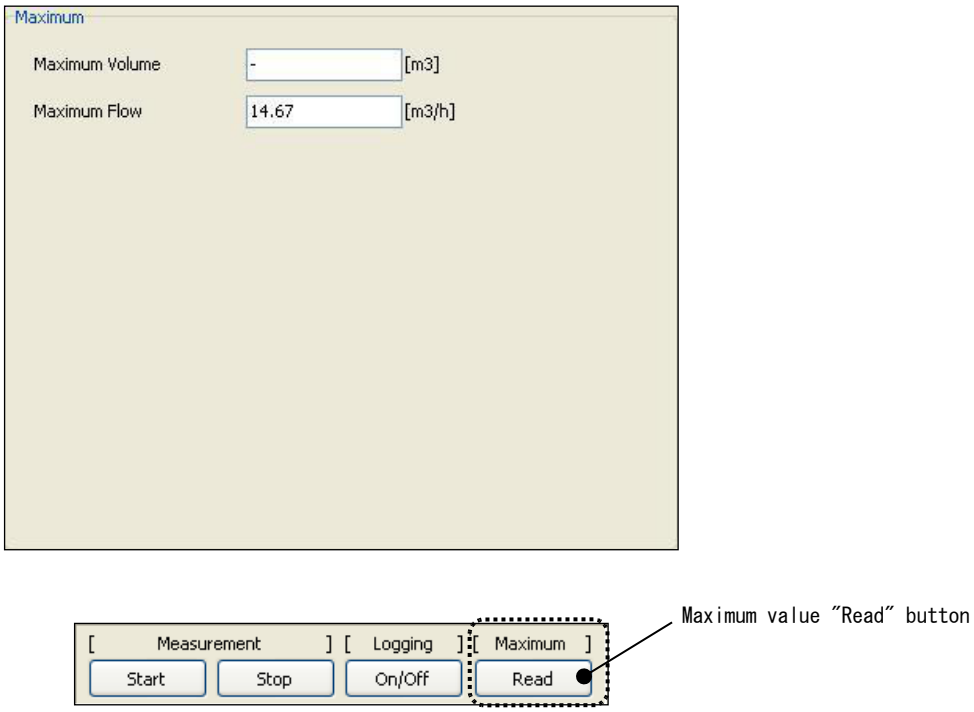


Fig. 6.8.18 Reading maximum values

Maximum value

- Maximum Volume: The maximum volume value calculated from the volume type (If the volume type settings are "No Calculation", the maximum volume value will not be displayed.)
- Maximum Flow: The maximum flow rate value calculated from the flow rate type (If the Flow Type settings are "No Calculation", the maximum flow rate value will not be displayed.)

6.9 Tools

This section explains the functions of the tool menu.
To open the tool menu, click "Tools" on the menu bar or menu selection panel.

6.9.1 Reset

In the Reset menu, instrument reset operations can be performed. There are two types of resets, which are Parameter Initialize and Reboot. If you click "Reset" tab or "Reset" in the tree display, the following window is displayed.

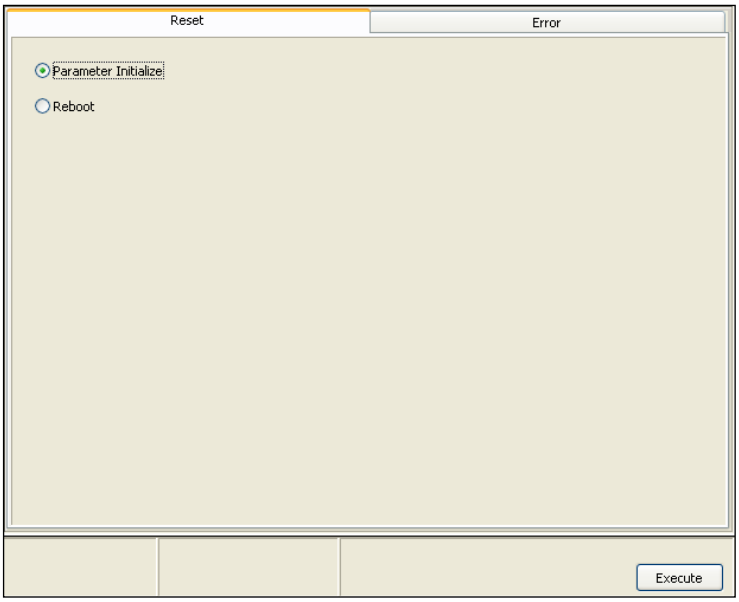


Fig. 6.9.1 Reset menu

(1) Executing Parameter Initialize

To initialize instrument parameters, select "Parameter Initialize"( ), and then click the "Execute" button. The following window will be displayed, so then click "OK" to initialize the instrument parameters.

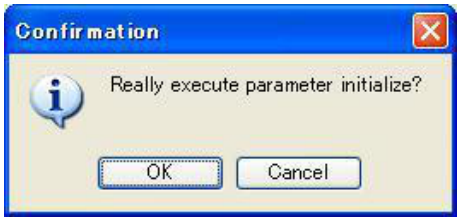


Fig. 6.9.2 Parameter initialize confirmation dialog box

(2) Executing Reboot

To perform instrument reboot, select "Reboot"( ), and then click the "Execute" button. Then the following window will be displayed, so click "OK" to reboot the instrument.



Fig. 6.9.3 Reboot confirmation dialog box

6.9.2 Error

In the Error menu, the status of the instrument can be read and checked. If you click "Error" tab or "Error" in the tree display, the following window is displayed.

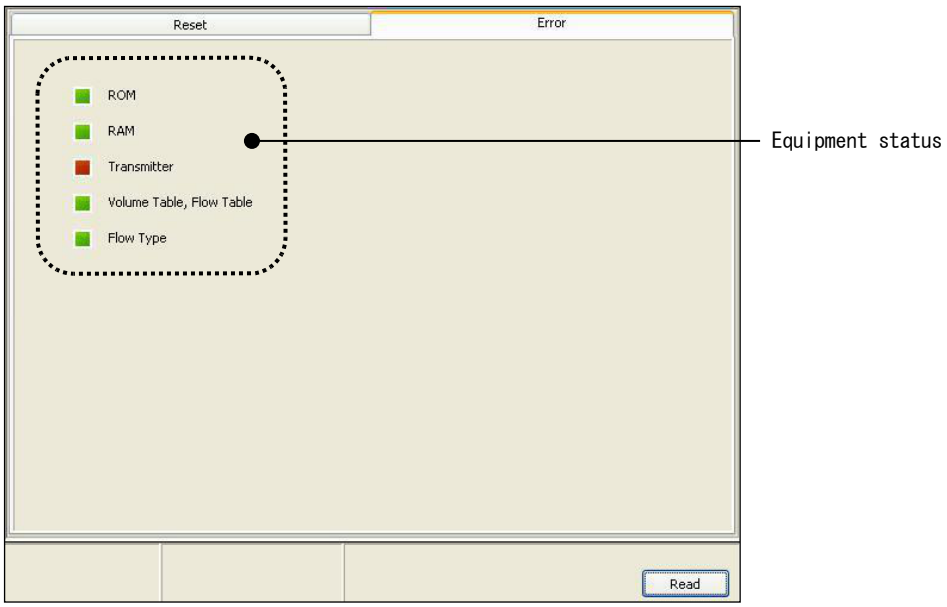


Fig. 6.9.4 Error menu

(1) Reading the instrument status

To read the instrument status from the instrument, click the "Read" button.

Instrument status

Details on the instrument status are shown in the following table.

Table 6 9.1. Instrument status

Display	Description	Status	Conceivable cause	Action
ROM	ROM status	Green	Normal	—
		Red	ROM poor	If power cycling does not fix the problem, replace the electronic components.
RAM	RAM status	Green	Normal	—
		Red	RAM poor	If power cycling does not fix the problem, replace the electronic components.
Transmitter	Transmitter status	Green	Normal	—
		Red	A sending omission has not been detected during measurement	If power cycling does not fix the problem, replace the electronic components.
Volume Table, Flow Table	Volume Table, Flow Table input values	Green	Normal	—
		Red	- Error in size of level value setting in Volume Table or Flow Table - Point Number error in the Volume Table or Flow Table	Check the settings in the volume table or flow table
Flow type	Weir settings	Green	Within the applicability range of JIS B 8302	—
		Red	Outside the applicability range of JIS B 8302	Check the weir settings.

Chapter 7 Precautions on equipment settings

7.1 Basic setting parameters diagram

Basic setting parameters are shown in the following diagram.

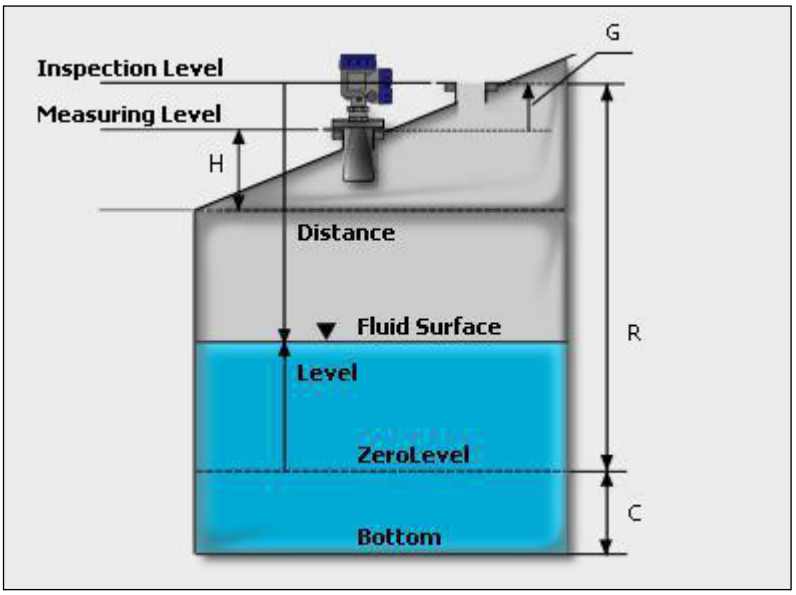


Fig. 7.1.1 Basic setting parameters diagram

7.2 Measuring negative levels

If you set the basic setting parameter "C" to a non-zero number, surfaces at or below the Zero Level, which is the reference level, can be measured. However, be aware that if the Zero Level has been set in the analog output settings to a current value of 4 mA, current at or below 4 mA will not be output. The measurement value can be confirmed using the LCD and configuration software.

7.3 Avoiding noise echo

(1) Masking near antenna

Depending on the shape of the tank, there is sometimes a strong noise echo due to intense multiple reflection between the tank and the surface near the antenna. If affected by this, the surface level might not be able to be measured properly. In this case, you can set the setting parameter "H" to avoid that effect.

(2) Masking due to the noise table

If the reflection echo cannot be recognized normally due to the strong noise level, you can use the noise table or rejector to set the threshold value for recognizing the signal to a value greater than the noise level. Doing so will allow stable measurement to be performed. The threshold value according to the noise table or rejector can be set using the configuration software. The noise table consists of a line graph connecting a maximum of 513 points. The rejector is the straight line that indicates the minimum value of the signal amplitude of the noise table. A threshold value can be set for each point by using the noise table. Use the setting software to read the signal amplitude in the tank before setting the noise table. For information on how to set the threshold value, refer to **6.7 Echo Viewer**.

A setting example of the threshold value is shown in the following figure. Signals smaller than the threshold level of the noise table shown in the figure are ignored.

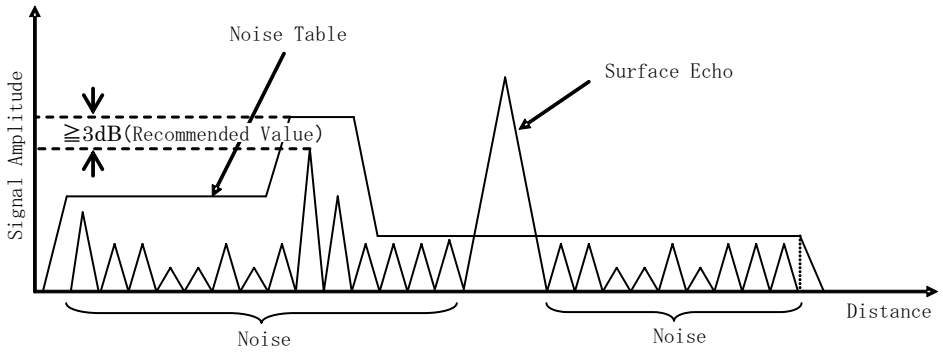


Fig. 7.3.1 Setting example of threshold value

7.4 Setting volume calculation / flow calculation

(1) Volume calculation

To calculate volume, select a standard tank shape from among those in the "Volume Type" setting parameter (vertical cylindrical shape / spherical shape / horizontal cylindrical shape) or select a user definition. If you select a standard tank shape, set each of the required parameters. The standard tank setting parameters are shown in the following table.

Table 7.4.1 Standard tank shape setting parameters

Setting parameter / tank shape	Vertical cylinder shape	Sphere shape	Horizontal cylinder shape
A (Maximum Position)	●	●	●
O (Tank offset)	●	●	●
D (Tank diameter)	●	●	●
L (Tank length)	-	-	●

If you select a user definition, you must set the volume table.

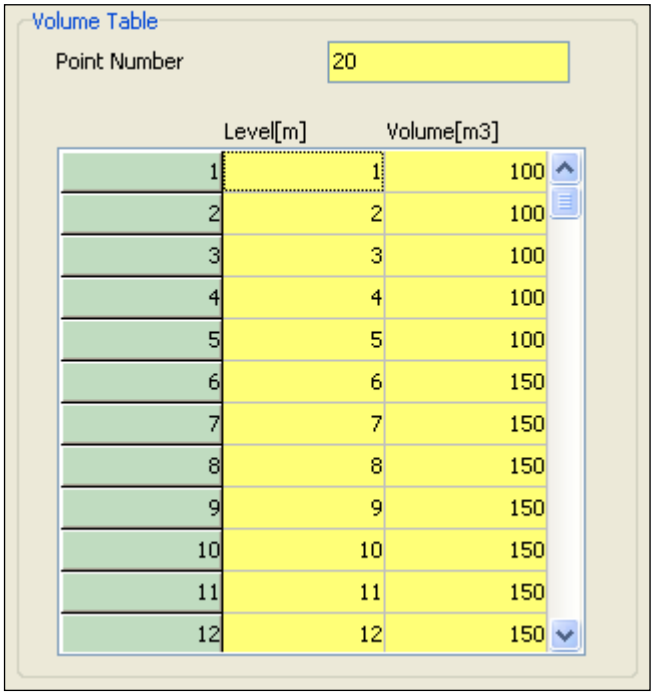


Figure 7.4.1 Setting the volume table

The volume table can be set using the configuration software. Between 2 (minimum) and 100 (maximum) calibration points can be set. If the size of the setting level values is wrong (not in order of smallest [value]), an equipment status table error occurs, and functions will not operate. For details on equipment status, refer to **5.4 Parameter description --> [8-3] Error** or **6.9 Tools --> Error**.

(2) Flow calculation

To calculate flow, select a standard channel shape (weir or flume) from among those in the "Flow Type" setting parameter or select a user definition. If you select a standard flow type, set each of the required parameters. The standard channel setting parameters are shown in the following table.

Table 7.4.2 Standard flow type setting parameters

Setting parameters / tank shape	Weir (JIS B 8302)				Flume (JIS B 7553)
	60°triangular weir	90°triangular weir	Rectangular weir	Suppressed weir	
B (Water path width)	●	●	●	●	-
b (Weir width)	-	-	●	-	-
v (Kinematic viscosity coefficient)	●	-	-	-	-
D (Height to the notch)	●	●	●	●	-
Flume shape (Nominal)	-	-	-	-	●

If you select a user definition, you must set the flow table.

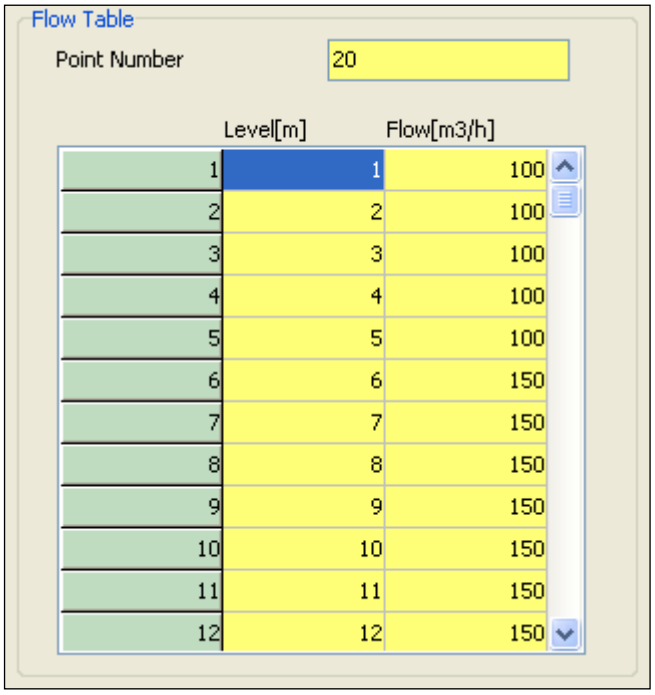


Figure 7.4.2 Setting the flow table

The flow table can be set using the configuration software. Between 2 (minimum) and 100 (maximum) calibration points can be set. If the size of the setting level values is wrong (not in order of smallest [value]), an equipment status table error occurs, and functions will not operate. For details on equipment status, refer to **5.4 Parameter description --> [8-3] Error** or **6.9 Tools --> Error**.

7.5 Measurement near the bottom surface of the tank.

When the liquid to be measured has low permittivity, such as oil, microwaves pass through the liquid and there is a very intense reflection echo of the bottom surface. If the fluid level of such a liquid decreases, a surface echo cannot be distinguished from a bottom echo. Therefore, bottom echoes must be set to be ignored. For liquids with low permittivity, set the setting parameter "Bottom Recognition" to "ON". For liquids with high permittivity, such as water, there is no reflection echo from the bottom, because few microwaves pass through the liquid. Therefore, no considerations need to be made regarding the bottom echo, and thus, the setting parameter "Bottom Recognition" can be set to "OFF".

7.6 Calibrating analog output

If you are calibrating the analog output using the LCD and operation keys, first set the "Fixed Current Output" parameter to current value 4 mA / 20 mA. After setting this, measure the value of the actual output current. If the output current value is different from the setting value, set the measured current value to "4-mA calibration" / "20-mA calibration". After setting this, the output is calibrated.
If you are calibrating the analog output using the configuration software, directly select "4-mA calibration" / "20-mA calibration", and then follow the instructions in the window.

7.7 Calibrating measurement values

If the measured value has shifted, it is possible to perform the corresponding offset adjustment. To perform offset adjustment, set the adjustment value in the "Zero-point Calibration" parameter. Also, in situations such as when the equipment was slanted when it was installed, the corresponding span calibration must be performed. To perform span calibration, set the adjustment value in the "Span Calibration" parameter. Normally, this value is set to "1". For example, if the equipment was slanted when it was installed, the actual distance is longer. By setting a value smaller than "1", that can be corrected.

7.8 Averaging time and Median filter

The averaging time make average for the measurement data group within the set time moving average time. In the casef of waving small liquid level change, it is possible to set a large average time is valid. If the large average time set, follow-up of the liquid level will be bad in the case of fast liquid level change.
Median filter is the ability to remove the minimum value and maximum value from measurement data group when performing a moving average.
The averaging time set 8[sec] and the median filter set 2[sec],
In the case of, Measurement data (8) - Removal data (2) = Valid data (6), it makes an average of 6 data processing.
Please set the valid data of greater than 1, refer to **6.5.1 Measure support**.

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7.9 Dabble Bounce removal

There is a case where the reflected wave from the liquid surface not only is received by the antenna but that received by the antenna is reflected by the liquid surface back reflection in (ceiling) the tank upper surface, for antenna mounting position and tank shape. It calls Dabble Bounce. In the case of flat tank top in particular, there is a possibility to recognize signal strength error is larger than the reflected wave from the liquid surface. It is possible to remove the abnormal value by performing the Double Bounce configuration, refer to **6.5.2 Outlier removal**.
And there is a function to calculate the offset to the tank top from the flange end necessary to double bounce removal, refer to **6.8 Measuring Double bounce offset caliculation**.

7.10 Effect of structure such as a ladder

If the structure and the antenna mounting position is close, the reflection from the structure is received in the antenna, there is a case to make a false recognition. If that is possible, recommended to remove the structure or change the antenna mounting position.
As the next measure, it may become smaller reflected wave from the structure by changing the polarization direction of the microwave, refer to **2.7 Tips for stable measurement**.
As the next measure, it is possible to mask the unwanted reflected wave by changing the noise table, refer to **6.7 Echo Viewer**.

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Chapter 8 Maintenance and inspection

Preventative maintenance and periodic inspection is important to ensure long life and proper functioning of the level gauge.

8.1 Maintenance and inspection

⚠ WARNING
When performing maintenance or inspections, stop the power supply to the equipment. If these measures are not taken, electrical shocks may occur.

Although maintenance of transmitter head is generally not required, be aware of the following.
(1) Wipe away any dirt on the transmitter head with a soft cloth. Do not use paint thinner or other chemical products.
(2) Inspect and clean the warning labels to ensure readability. Contact the nearest distributors in your area when warning labels have dirtied or peeled off.
(3) Do not subject the transmitter to shocks and impacts.

8.2 Maintenance and inspection for Ex parts

⚠ WARNING
When performing maintenance or inspections, stop the power supply to the equipment. If these measures are not taken, electrical shocks or explosion may occur.

(1) Maintenance and inspection should be done by well-trained person who has knowledge of explosion protection.
(2) Maintenance and inspection should be done at non-hazardous area where no explosive gas atmosphere.
(3) Do not subject the transmitter to shocks and impacts.

8.3 Maintenance and inspection for peripheral

Note the following.
(1) Do not handle the wire roughly. It may cause the loose connection or breaking wire.
(2) As to the maintenance and inspection of the peripherals, please refer their operating manuals.

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8.4 Lifetime of components

The equipment has components with operational life expectancies. Periodic inspection of these components is recommended. Please contact the nearest distributors in your area of the manufacturer when any component replacement is required.

(1) LCD

The LCD, which displays measurement value or other information, has an operational lifetime of approximately 5 year at room temperature. The contrast of the LCD may darken when this lifetime is exceeded, but the operational and measurement functions of the transmitter head are not affected.

Generally LCD lifetime may be shortened if it is exposed to direct sunlight or high temperature.

(2) Sealing parts

The types of the packing which is equipped on the transmitter are as follows. The lifetime of these packing differ depending on the operational condition.

Periodic inspection of these components is recommended. In case that any of crack or cutoff found, please contact the nearest distributors in your area of the manufacturer to replace the parts.

Table 8.4.1 Sealing parts

Used part	Material
Transmitter head : LCD cover , Terminal cover	Silicone rubber
LCD cover : Window	Silicone rubber
Transmitter head : Blind volt	Silicone rubber
Transmitter head : Antenna wave guide	Silicone rubber
Transmitter head : Cable Gland, Blind plug (Optional)	EPDM
Cable gland : Inside gasket (Optional)	EPDM / Chloroprene rubber (According to spec.)
Cone antenna : Inside gasket	VMQ / FKM / Karlez (According to spec.)
Antennas : Flange connection gasket	VMQ / FKM / Karlez (According to spec.)

(3) Built-in arrester

Arrester is built into the terminal module to suppress indirect lightning surge due to lightning strikes and protect the internal electronic circuits. Direct lightning strikes and surge that exceed the rating may damage or degrade the arrestor. In addition to lightning damage, the arrester may also be degraded in an environment that superposes the high-voltage surge generated from large power equipment onto the power supply line.

Destruction can be checked on the exterior, it is difficult to determine the deterioration in appearance. Periodical replacement or inspection by qualified service engineer is recommended.

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8.5 Replacement of terminal module

Exchange procedure is as follows,
(1) Turn-off the power supply and open the cover of the terminal box.
(2) Pull connected cables out.
(3) Loosen 2 screws as below indicated.
(4) Remove module connector on the rear side
(5) Exchange terminal module (built-in arrester)
(6) Connect module connector on the rear side
(7) Tighten it with 2 screws, and connect cable as returned
(8) Close the cover of terminal box, and then turn on the power.
(9) Turn-on the power supply and check the 4-20mA signal. Please calibrate 4-20mA signal as necessary. ('Calibration 4-20mA signals' is described in **Chapter 6.6 Calibration**)

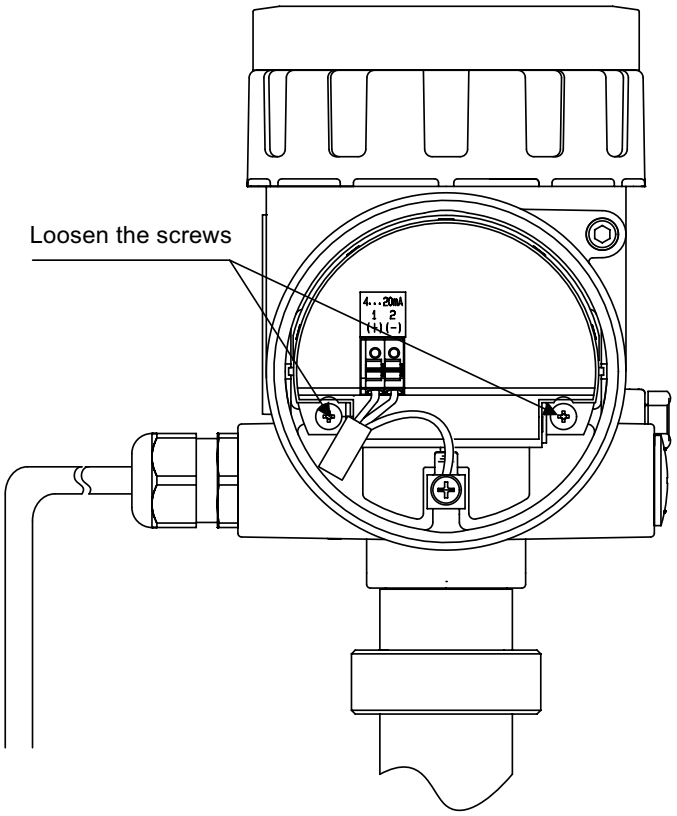


Fig. 8.5.1 Dismounting the terminal module

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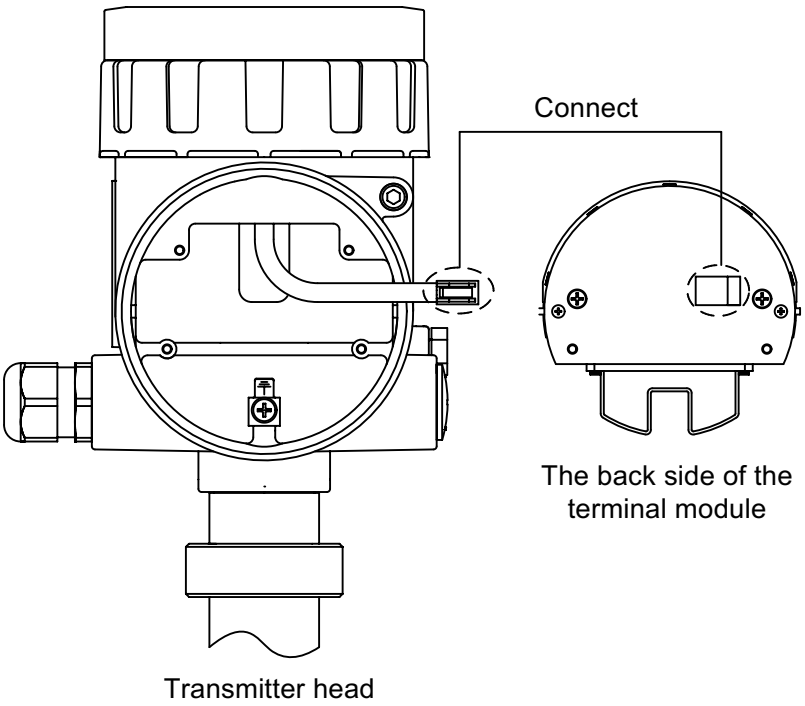


Fig. 8.5.2 Connection of the module

8.6 Calibration

The level gauge has been shipped after calibrated in factory. Periodical verification can be done at the same facility in Japan. Please contact the seller, if you necessary.

Chapter 9 Dismounting

9.1 Dismounting step

⚠ WARNING
Before dismounting, be aware of dangerous process conditions such as e.g. pressure in the vessel, high temperatures, corrosive or toxic products etc.

Take note of chapters **Chapter 2 Installation** and **Chapter 3 Electrical Installation** and carry out the listed reserve order.

9.2 Disposal

In EU area, do not dispose this equipment as household waste, please contact with the nearest representatives. (WEEE directive 2002/96/EG)

Materials: Refer to **Chapter 10 Technical data**.

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Chapter 10 Technical data

10.1 General specifications

Table 10.1.1 General specifications

Measurement principle	The time-of-flight measurement principle with microwave pulses		
Application area	Measurement object	Liquid	
	Relative permittivity	$\varepsilon_r \geq 1.8$	
	Process temperature	4"/2" cone antenna	-40 to +150 °C
		4"/2" PTFE sealing antenna	-40 to +200 °C
		1" rod antenna	-40 to +150 °C
	Process pressure	4"/2" cone antenna	-0.1 to +1.5 MPa
		4"/2" PTFE sealing antenna	-0.1 to +1.5 MPa
		1" rod antenna	-0.1 to +1.5 MPa
Max. measuring range	4" cone antenna	30m	
	2" cone antenna	10m	
	4" PTFE sealing antenna	20m	
	2" PTFE sealing antenna	10m	
	1" rod antenna	5m	
	NOTE: It is a consequence in our environment. It may vary depending on the installation environment and the measurement object.		
Measuring cycle time	1s		
Tracking rate for Level change	Max. 2m/s (R > 3.0m)		
Maximum measured error	4"/2" cone antenna 4"/2" PTFE sealing antenna	±2mm	
	1" rod antenna	±3mm	
	NOTE: ·If the measurement distance is below 0.5m, the measured error is ±10mm. ·It is a consequence in our environment. It may vary depending on the installation environment and the measurement object. ·Deviation by strong, high frequency electromagnetic fields within EN 61326 ≦±50mm		
Type of explosion proof	Non-Ex, Ex-i, Ex-d+i		
	Ex-i parameters : Ui=30V, Ii=93mA, Pi=700mW, Ci=negligible, Li=negligible		

Ex approval (Pending)	ATEX	EN60079-0:2012 EN60079-1:2007 EN60079-11:2012 EN60079-26:2007 EN60079-31:2009	Ex-i	II 1G Ex ia IIC T4 Ga / II 1D Ex ia IIIC 135°C Da IP66
			Ex-d+i	II 2G Ex d ia IIC T4 Gb / II 2D Ex tb IIIC 135°C Db IP66
	IECEx	IEC 60079-0:2011 IEC 60079-1:2006 IEC 60079-11:2011 IEC 60079-26:2006 IEC 60079-31:2008	Ex-i	Ex ia IIC T4 Ga / Ex ia IIIC 135°C Da IP66
			Ex-d+i	Ex d ia IIC T4 Gb / Ex tb IIIC 135°C Db IP66
	TIIS		Ex-i	Ex ia IIC T4
			Ex-d+i	Ex d ia IIC T4
EMC directive	EN61326-1:2006 Class A			
Low voltage directive	EN61010-1:2010			
R & TTE directive	EN302372-1, -2			

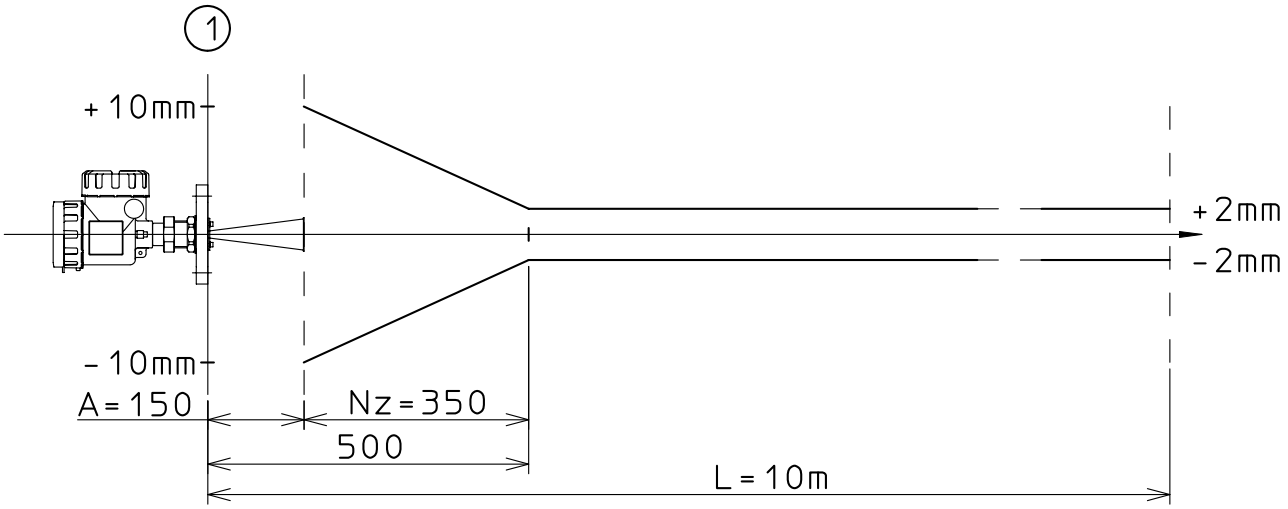


Fig. 10.1.1 Maximum measured error of 2" cone antenna

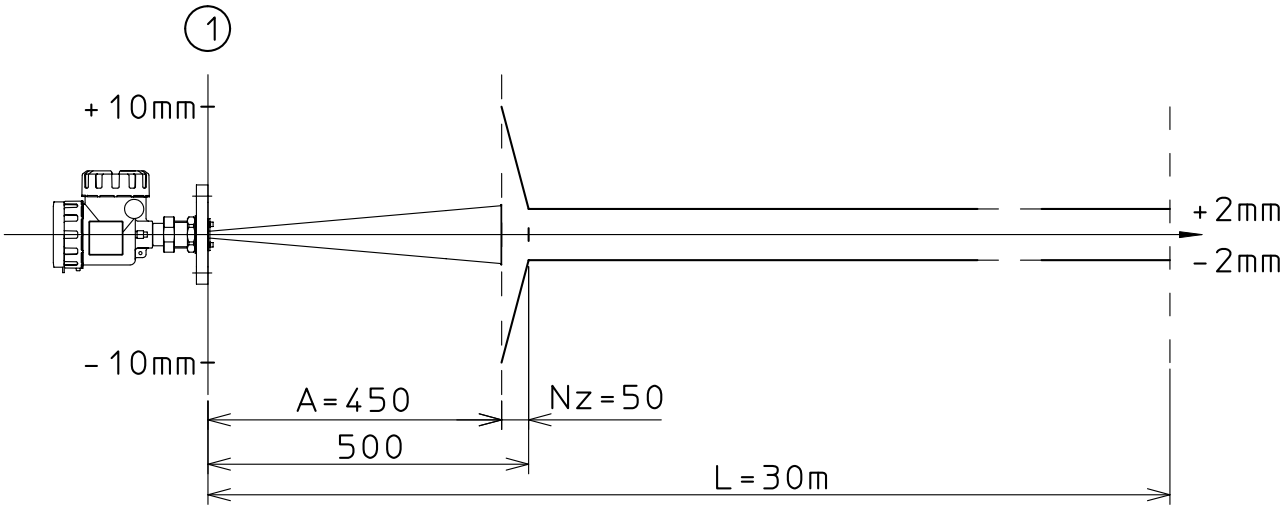


Fig. 10.1.2 Maximum measured error of 4" cone antenna

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NOTE: ①=Reference plane, A=Antenna length, H=Dead zone, Nz=Proximity zone

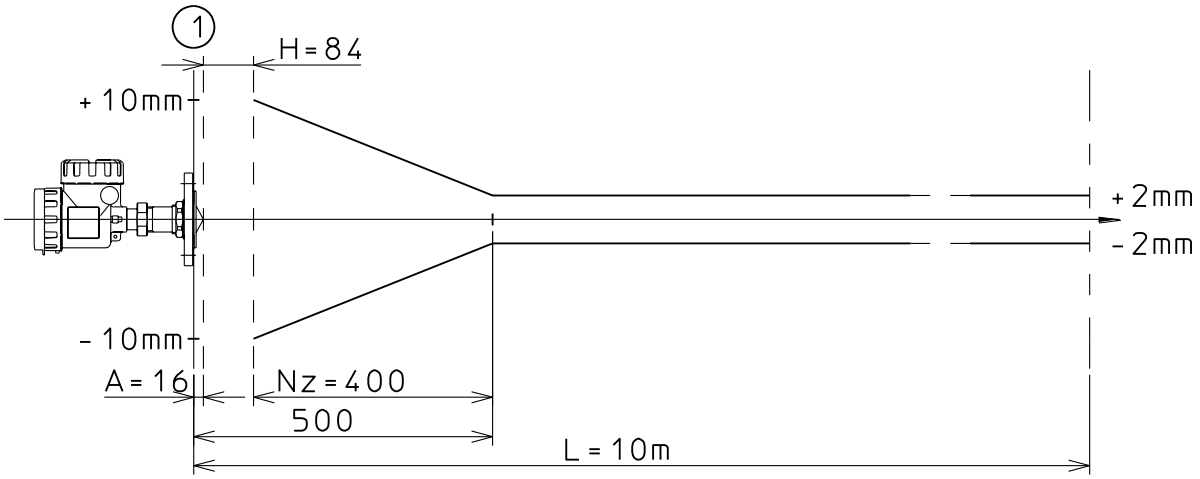


Fig. 10.1.3 Maximum measured error of 2" PTFE sealing antenna

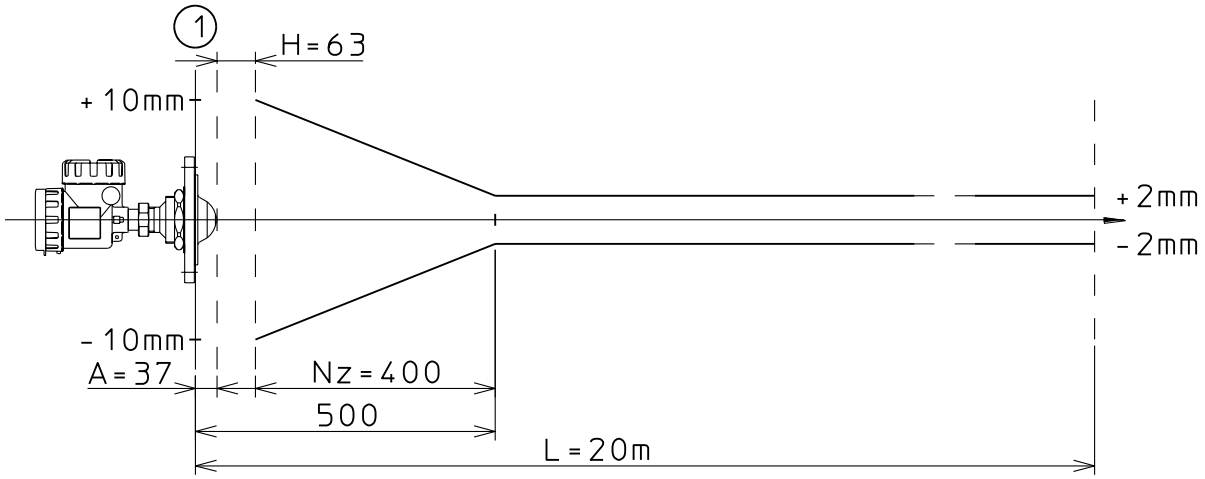
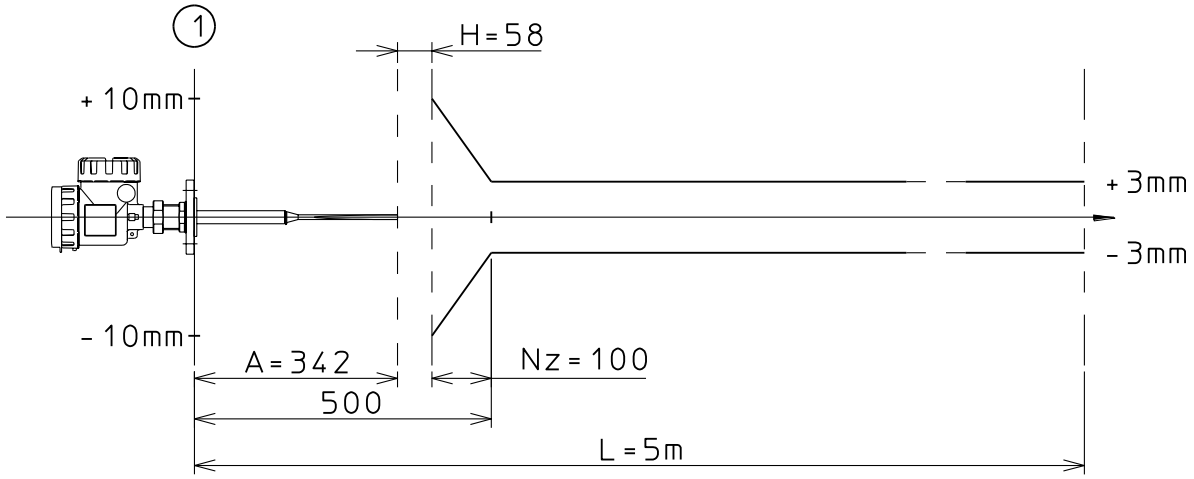


Fig. 10.1.4 Maximum measured error of 4" PTFE sealing antenna



- Fig. 10.1.5 Maximum measured error of 1" rod antenna

NOTE: ①=Reference plane, A=Antenna length, H=Dead zone, Nz=Proximity zone

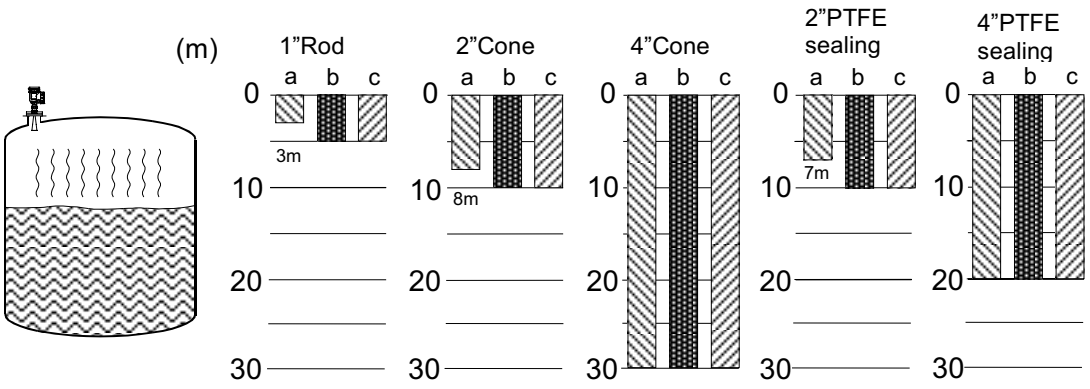


Fig. 10.1.6 Antenna measuring distance of calm surface (reference)

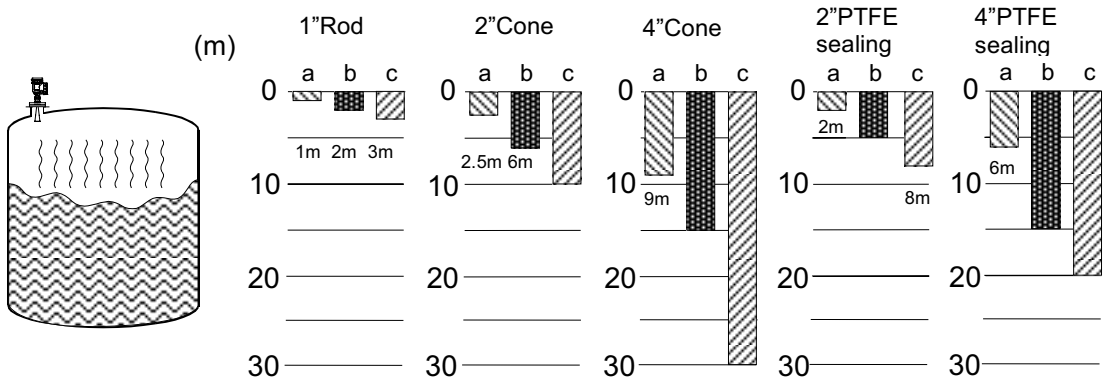


Fig. 10.1.7 Antenna measuring distance of turbulent surface (reference)

a : Oil, Hydraulic carbon, Mainly petroleum industry (ε_r = 1.8 ~ 4.0)

b : Alcohol, Acid (ε_r = 4.0 ~ 10)

c : Water base liquid (ε_r > 10)

NOTE1: In generally, the liquid, which has higher dielectric constant number (= ε_r) such as water, is easily to measure, and calm surface liquid is the same.
NOTE2: On the contrary, low dielectric constant liquid, turbulence surface or forming surface and dirty antenna conditions are relatively difficult to measure.
NOTE3: In the case of measurement the liquid small dielectric constant number or turbulent surface, that case recommend the use of still pipe.

10.2 Transmitter specifications

Table 10.2.1 Transmitter specifications

Microwave	Operating frequency	26GHz	
	Transmitting power	< 5μW	
Power supply	Non-Ex	DC 10.5 to 36V	
	Ex-i	DC 12.0 to 30V	
	Ex-d+i	DC 18.0 to 36V	
Analog output	Current output	4-20mA	
	Resolution	0.4μA	
	Alarm output	Hold, 3.6mA, 22mA	
	Temperature drift	±0.05%FS / 10K (16mA) or ±0.5%FS	
	Response Time	3sec. until statically determinate	
Digital output	HART specification	HART 7	
	Resolution	1mm	
	Fastest output cycle	Every second	
	Repeatability	≤±1mm	
	Temperature drift	less than ±3mm/10K or $10mm_{p-p}$	
Operating and display module (option)	Display	5 digits LCD <Displayed parameters> (Alternative) Level (m or Ft) Distance (m or Ft) Volume (value or %) Flow rate (value or %) Current (mA) Signal strength (dB) Max. volume Max. flow rate Internal temperature (˚C)	
	Method of adjustment	4 keys operation	
Surge immunity	Non-Ex	COM 4kV / Dif 2kV (IEC61000-4-5 level-4)	
	Ex-i	- (30V)	
	Ex-d+i	COM / Dif 250V	
Ambient temperature	Non-Ex (Without display)	-40 to +70 ˚C	
	Non-Ex (With display)	-20 to +70 ˚C	
	Ex-i, Ex-d+i (Without display)	-40 to +60 ˚C	
	Ex-i, Ex-d+i (With display)	-20 to +60 ˚C	
Storage and transport temperature		-40 to +85 ˚C	
Vibration resistance (Resonance Point)		1G at 9 to 200 Hz	
Wiring port	Standard of screw (number of screw holes)	M20 x 1.5 (x 2)	
	Plug and cable gland	Non-Ex	Blind plug[1], cable gland[1]
		Ex-i	Blind plug[1]
		Ex-d+i	Blind plug[1]
	Connection cable outer diameter	Φ7 - 13mm (in case of standard cable gland for Non-Ex)	
	Connection cable core	Stranded wire	0.5 to $2.5mm^2$ (AWG20-12)
		Single wire	0.8 to $2.0mm^2$ (AWG20-12)
Material	Housing	Die-cast aluminum (powder coating)	
	Stainless steel parts	SUS304	
	Seal	VMQ (silicone rubber)	
	Window	Polycarbonate Note: Only with display type	
Structure	Aluminum housing consisting 2 rooms		

Waterproof standard	IP66	
Dimensions	Without display type	180 x 110 x 152 / H x W x L
	With display type	190 x 110 x 152 / H x W x L
Weight	Transmitter head	about 3kg (with LCD module) about 2.9kg (without LCD module)
	2" cone antenna	about 1kg
	4" cone antenna	about 1.4kg
	2" PTFE sealing antenna	about 1.2kg
	4" PTFE sealing antenna	about 2.5kg
	1" rod antenna	about 1kg

NOTE1: Required cable gland and blind plug depends on type of Non-Ex or Ex types (ATEX, IECEx and TIIS).

10.3 Antenna specifications

Table 10.3.1 Cone antenna

Antenna type	Cone	Diameter	·2": (half-power beam width: 18°) ·4": (half-power beam width: 8°)
		Material	SUS316L, PTFE
Operating conditions	Process temperature	-40 to 150 °C NOTE:The maximum temperature of Ex-types is due to temperature class and ambient temperature of explosion proof.	
	Process pressure	-0.1 to 1.5 MPa	
Process fitting	Flange[1)] (JIS B2220, DIN 1092-1, ANSI B16.5 etc)		

1) Option

Table 10.3.2 PTFE sealing antenna

Antenna type	PTFE sealing	Diameter	·2": (half-power beam width: 18°) ·4": (half-power beam width: 8°)
		Material	SUS304, PTFE
Operating conditions	Process temperature	-40 to 200 °C NOTE:The maximum temperature of Ex-types is due to temperature class and ambient temperature of explosion proof.	
	Process pressure	-0.1 to 1.5 MPa	
Process fitting	Flange[1)] (JIS B2220, DIN 1092-1, ANSI B16.5 etc)		

1) Option

Table 10.3.3 Rod antenna

Antenna type	Rod	Diameter	·1": (half-power beam width: 25°)
		Material	SUS304, PTFE(or PFA)
Operating conditions	Process temperature	-40 to 150 °C NOTE:The maximum temperature of Ex-types is due to temperature class and ambient temperature of explosion proof.	
	Process pressure	-0.1 to 1.5 MPa	
Process fitting	Flange[1)] (JIS B2220, DIN 1092-1, ANSI B16.5 etc)		

1) Option

10.4 Digital specifications

Table 10.4.1 HART specifications

Communication protocol	HART protocol
Ver.	7

Table 10.4.2 Accessories Specifications

CD-R	·Configuration software ·User's guide (pdf)

10.5 Function

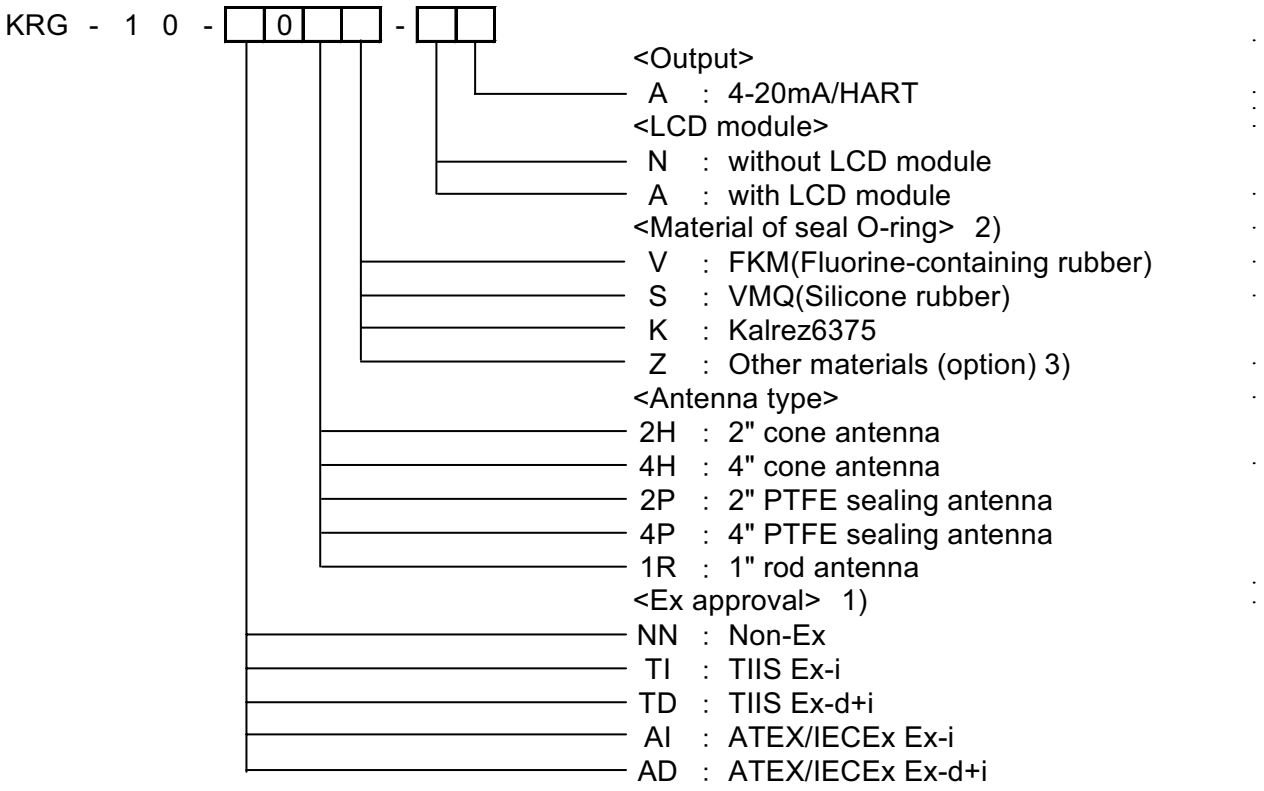
Table 10.5.1 Function (summary)

Function			Description
Basic action	Distance measurement		Measure distance between liquid surface and reference point
Basic settings	Measurement parameters	G	Set distance between reference point and gauging reference point
		R	Set measuring range
		C	Set distance below zero point of level
		H	Set dead zone
	Measurement unit		Select unit from [m] or [ft]
	Antenna type		Set signal sensitivity automatically according to antenna
	Diameter of pipe		Set diameter of pipe
	Display	Digit number	5-digits
		Value displayed	Select from level, distance, signal strength, current value, volume, flow rate and temperature
		Offset	Set offset of level or distance on display
	Analog output	Parameter	One output from level, distance, signal strength, volume and flow rate
		Alarm selection	Choose one from 3.6mA, 22mA and Hold for echo losing alarm
		Alarm delay	Set delay time from losing surface echo until alarm
		Fixed current output	Output a fixed current for adjustment
Volumetric calculation	Tank geometry	Selection	Select tank geometry from vertical cylinder, horizontal cylinder and spherical tank
		Table of volume	Read data table of volume at each level of liquid. Output volume depending on level of liquid.

Flow rate calculation	Channel shape	Selection	Select channel shape from flume or weir
		Table of flow rate	Read data table of flow rate at each level of liquid. Output flow rate depending on level of liquid.
Calibration	Analog output		Two-point calibration at 4mA and 20mA
	Offset calibration, span calibration		Adjust zero and span
Smoothing	Averaging time		Take the average of measuring values depending on [sec] setting (1 to 120 s)
	Median filter		Smooth output values by median filter
Processing after losing surface echo	Level tracking		Move the valid window depending on liquid level
	Slow search		Expand the valid window if surface echo is Lost
	Zero cut		Fix the valid window if liquid level shall be lower down to this value
	Predict output		Output expected level
	Search		Search surface echo
	Alarm		-
Noise table			Set signal threshold for each measurement distance
Outlier removal	Double bounce handler		Ignore multiple reflected echoes
	Valid window width		Set the valid window width for echo detecting
	Bottom echo handler		Ignore the bottom echo
	Disturbance noise elimination		Ignore the echo from the obstacle by registering it
Temperature correction			Correct echo position and level once a minute or every time
Self-diagnosis			Detect internal failure
Viewing internal temperature of the transmitter			-
Echo list			-
Reset	Reboot		Reboot the device
	Parameter initialization		Initialize all parameters

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10.6 Product code



NOTE1: Required cable gland depends on type of explosion proof ATEX, IECEx and TIIS. Each Ex-i & Ex-d+i transmitter head (ATEX and IECEx) should use proper cable gland for explosion proof usage and the attached blind plug.The cable gland for explosion proof shall be prepared as local portion in accordance with safety regulation in each region.And then, The described code of explosion-proof on name plate is different depending on this selection.
NOTE2: If you select the PTFE sealing antenna or the rod antenna, standard material is FKM.
NOTE3: If you need to apply other material for the seal, please consult us.
NOTE4: Flange is an option. Please refer to **Chapter 10.8 Required flange dimensions.**

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10.7 Dimensions and material

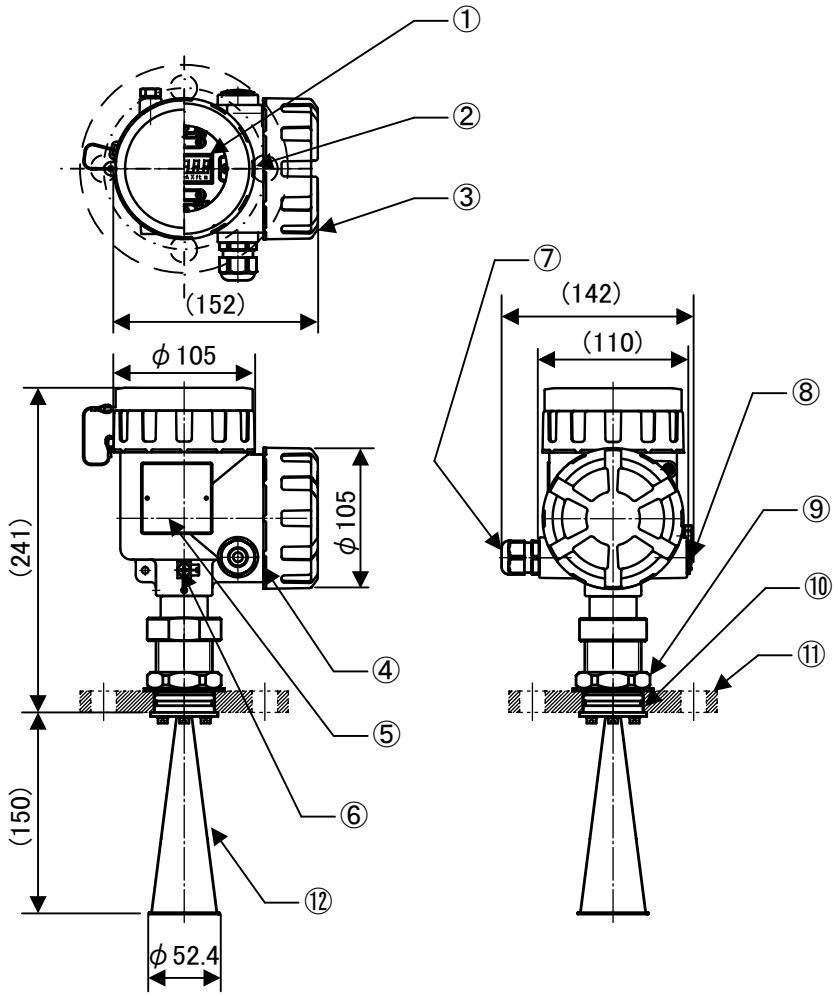


Fig. 10.7.1 KRG-10, 2" cone antenna

1. Window / Polycarbonate
2. Cover (display) / Aluminum
3. Cover (terminal block) / Aluminum
4. Housing / Aluminum
5. Label
6. Ground terminal (M5) / SUS304
7. Cable gland (option)
8. Blind plug
9. Flange lock nut / SUS304
10. O-ring
11. Flange (option)
12. 2" cone antenna / SUS316L

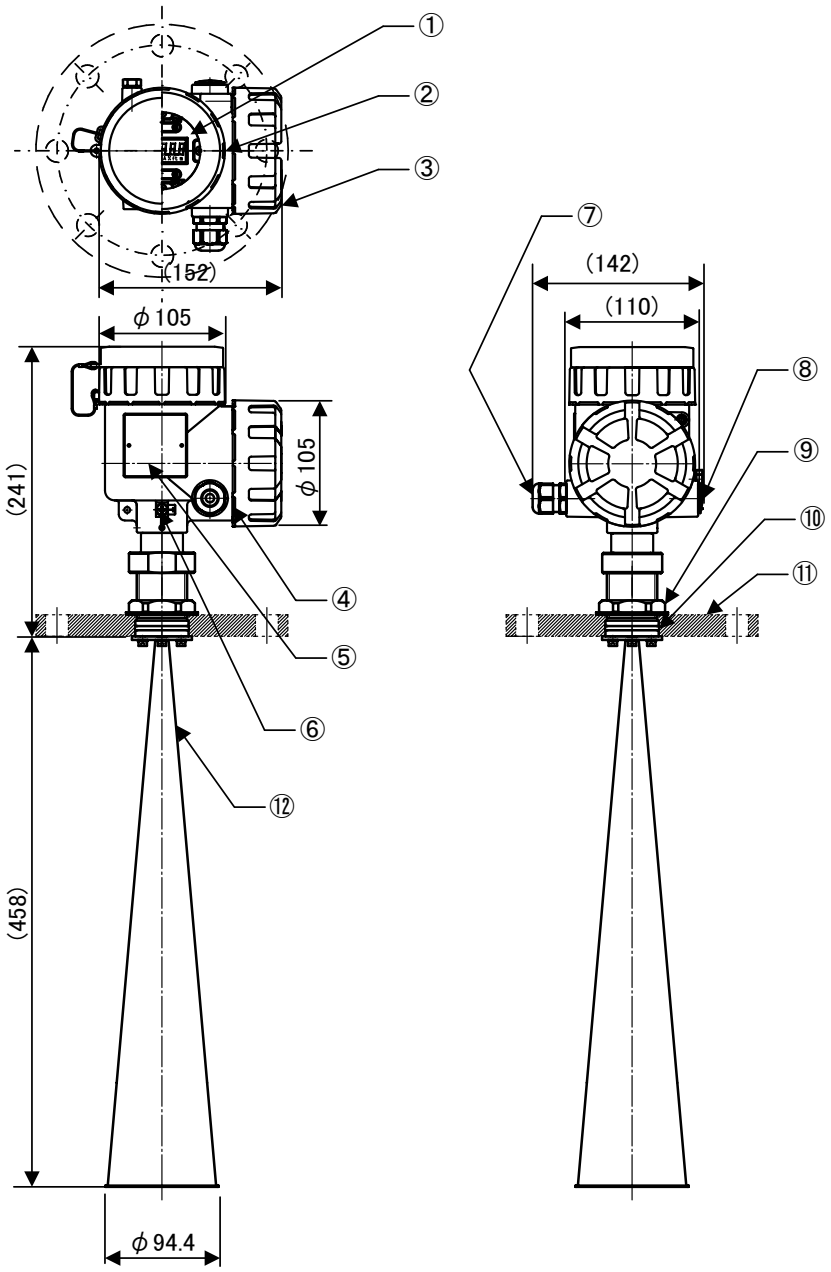


Fig. 10.7.2 KRG-10, 4" cone antenna

1. Window / Polycarbonate
2. Cover (display) / Aluminum
3. Cover (terminal block) / Aluminum
4. Housing / Aluminum
5. Label
6. Ground terminal (M5) / SUS304
7. Cable gland (option)
8. Blind plug
9. Flange lock nut / SUS304
10. O-ring
11. Flange (option)
12. 4" cone antenna / SUS316L

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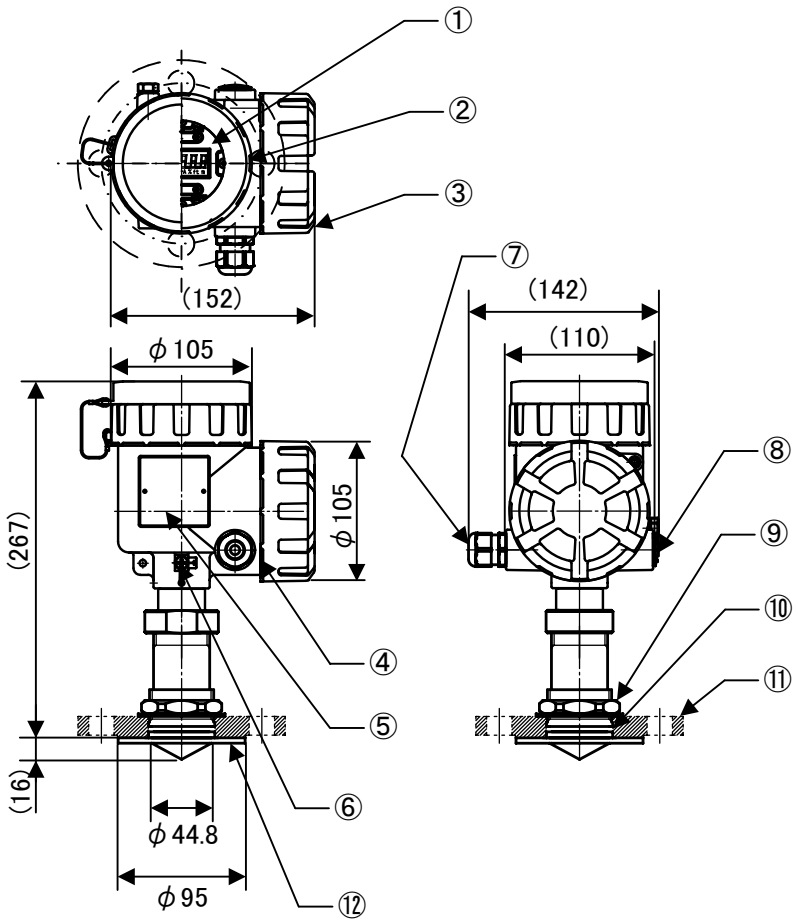


Fig. 10.7.3 KRG-10, 2" PTFE sealing antenna

1. Window / Polycarbonate
2. Cover (display) / Aluminum
3. Cover (terminal block) / Aluminum
4. Housing / Aluminum
5. Label
6. Ground terminal (M5) / SUS304
7. Cable gland (option)
8. Blind plug
9. Flange lock nut / SUS304
10. O-ring
11. Flange (option)
12. 2" PTFE sealing antenna / PTEE

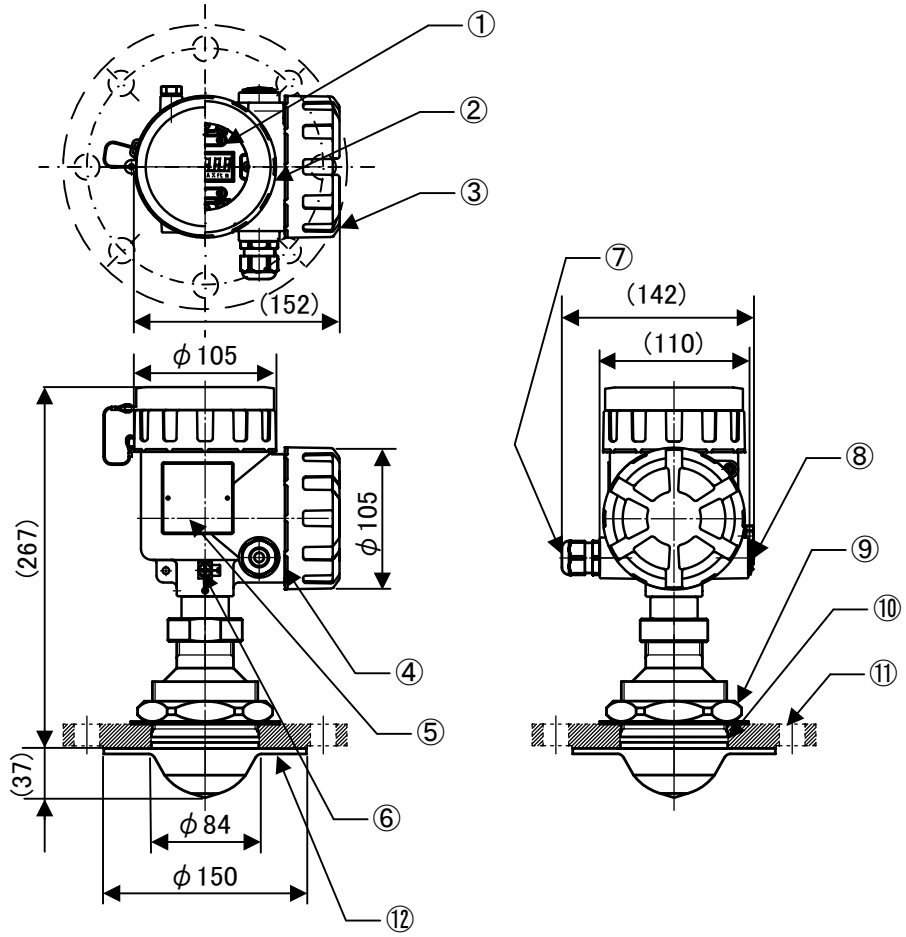


Fig. 10.7.4 KRG-10, 4" PTFE sealing antenna

1. Window / Polycarbonate
2. Cover (display) / Aluminum
3. Cover (terminal block) / Aluminum
4. Housing / Aluminum
5. Label
6. Ground terminal (M5) / SUS304
7. Cable gland (option)
8. Blind plug
9. Flange lock nut / SUS304
10. O-ring
11. Flange (option)
12. 4" PTFE sealing antenna / PTEE

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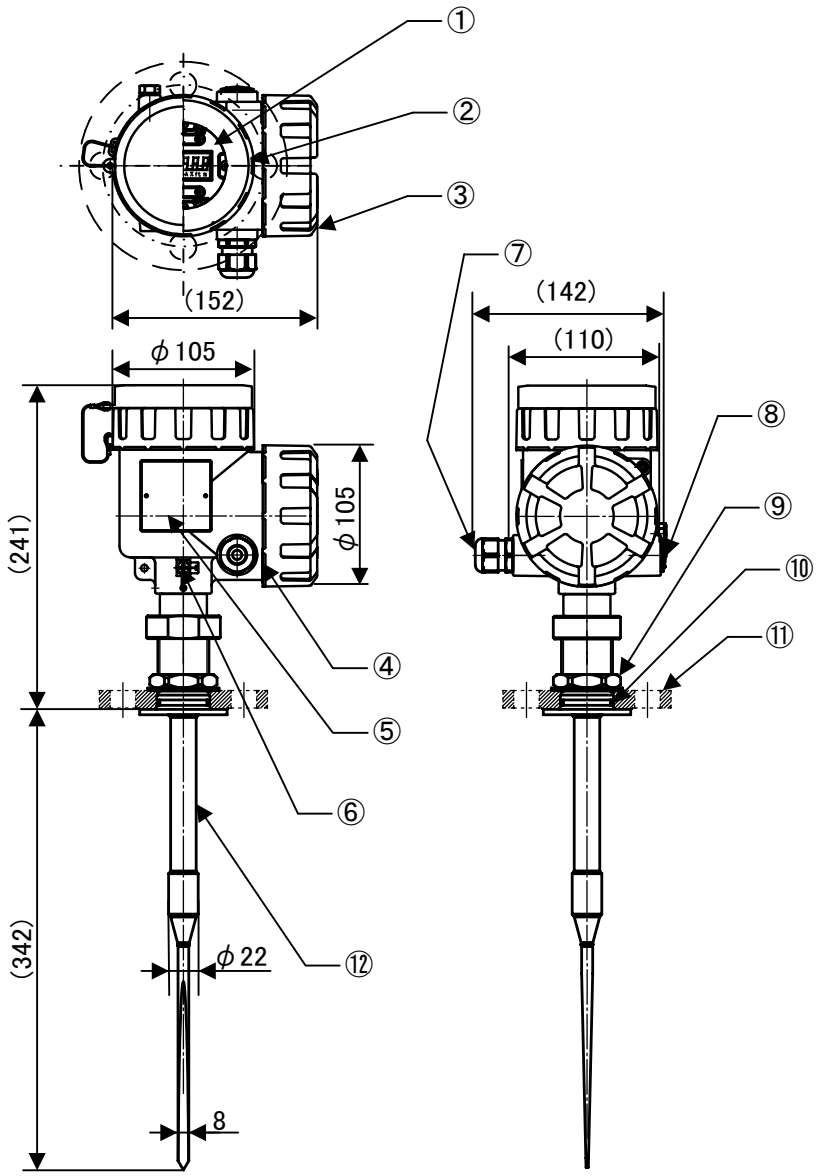


Fig. 10.7.5 KRG-10, 1" rod antenna

1. Window / Polycarbonate
2. Cover (display) / Aluminum
3. Cover (terminal block) / Aluminum
4. Housing / Aluminum
5. Label
6. Ground terminal (M5) / SUS304
7. Cable gland (option)
8. Blind plug
9. Flange lock nut / SUS304
10. O-ring
11. Flange (option)
12. 1" rod antenna / PFA

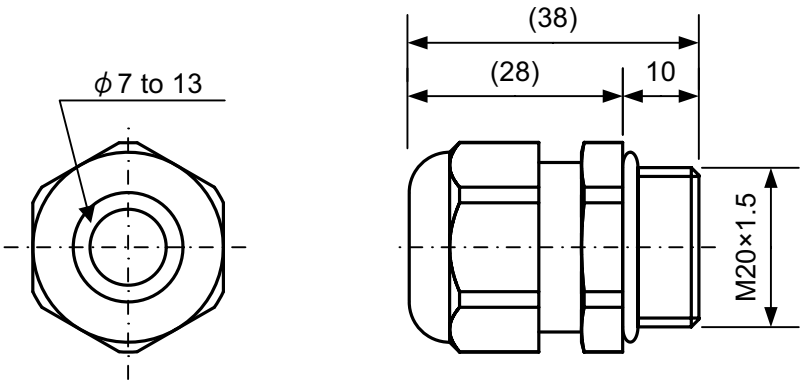
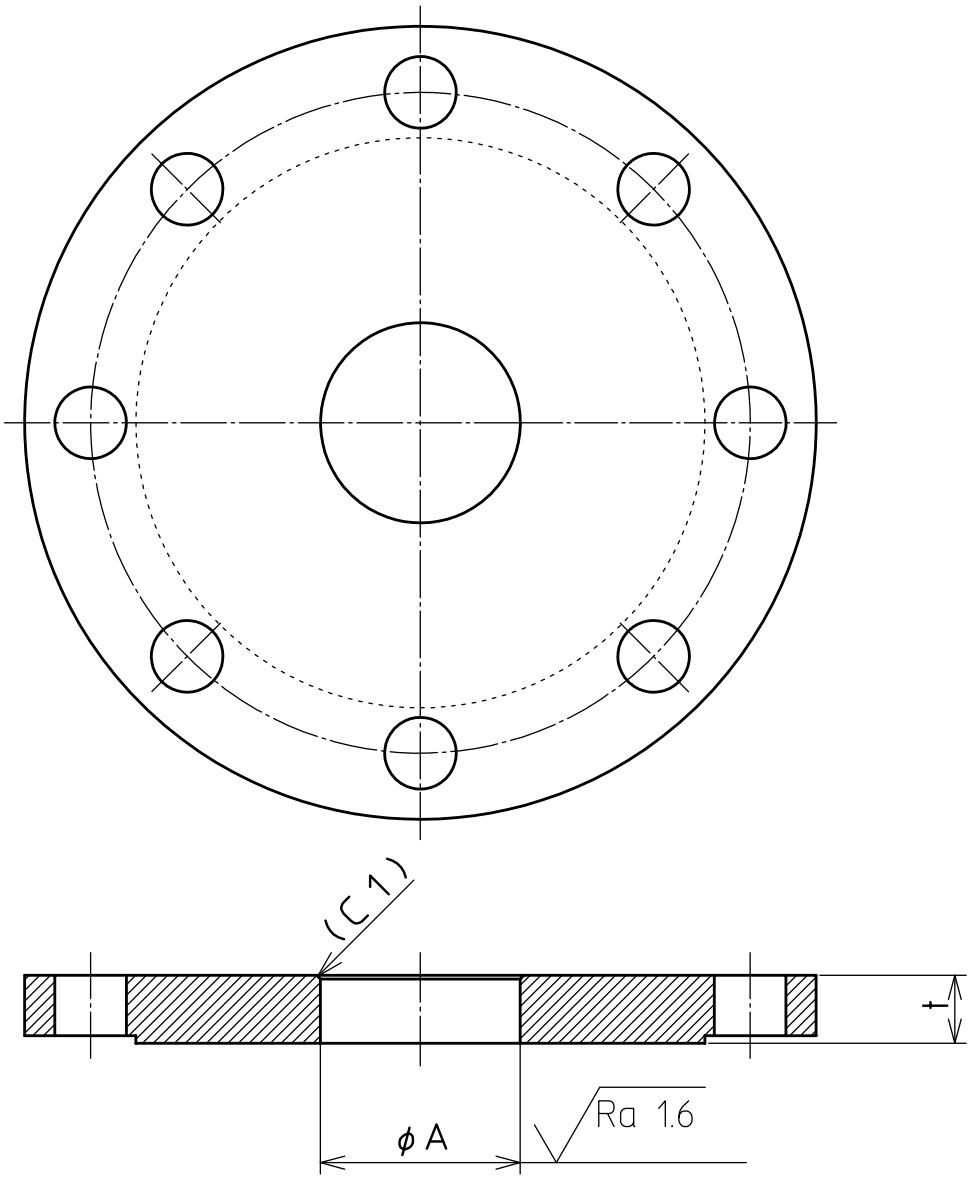


Fig. 10.7.6 Cable gland (Only Non-Ex type)

10.8 Required flange dimensions



Antenna type	ΦA [mm]		t [mm]
		Tolerance	
2" & 4" cone	45	+0.1 0	13 - 35
2" PTFE sealing	50		12 - 25
4" PTFE sealing	80		13 - 35
1" rod	45		10 - 35

Fig. 10.8.1 Required flange dimensions

Chapter 11 Measurement principle

11.1 Measurement principle

KRG-10 takes advantage of the time-of-flight measurement principle with microwave pulses which have central frequency of 26GHz. Placed on the top of tanks, KRG-10 emits microwave pulses toward liquids or pastes in the tank. Microwave pulses reflected from the liquid surface are received by the antenna. The propagation time t is converted into the distance between the transmitter and the liquid surface. Using t and the speed of light c, the distance D is expressed by the following equation.

$D = c \times (t / 2)$ ····· (1)

Using D and the tank height H, the level L is expressed by the following equation.

$L = H - D$ ····· (2)

KRG-10 has a function to remove unwanted echo. By using this function, the user can prevent the erroneous recognition of the reflected wave by unwanted echo. For more information, please refer to **Chapter 5 LCD and 4-Keys operation** and **6 Operation by configuration software**.

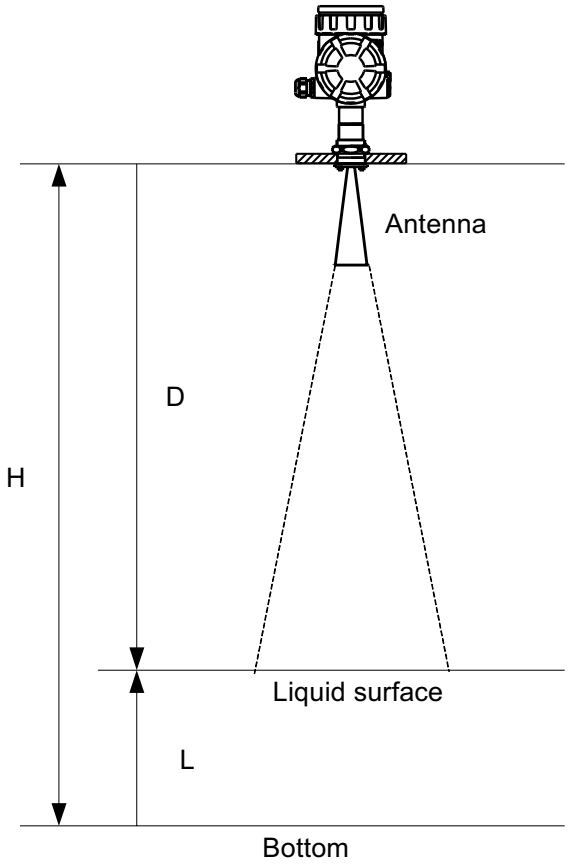


Fig. 11.1.1 Measurement principle

Chapter 12 Trouble shooting

12.1 Tips for solution

When any of trouble concerned with systems happens, please refer to following check points.

Table 12.1.1 Trouble shooting

Trouble	Check Point
No indication on LCD	·Check power line turned on and connected. ·Check LCD connector inserted properly.
Not connectable through HART communicated configuration software	·Check power line turned on and connected. ·Check proper size resistance attached in the line for HART communication. ·Check driver software installed correctly. ·Check correct COM port selected. ·Check correct device number selected. ·Check cable connection.
Parameter setting failure	·Check the value within input-able range. ·Check communication status is OK. In case of communication error, please check connection.
Inaccurate measurement value	·Check input parameter is correct. ·Check measurement status. Left down side dot indication is measuring error (not detected or track proper surface echo).
Analog output does not change	·Check analog lock mode in-activated. ·Check table check mode in-activated. ·Check measurement status. Left down side dot indication is measuring error (not detected or track proper surface echo) ·Check alarm mode in-activated. In case of alarm mode, LCD indication will be flickering.

12.2 Error status

Measuring status can be confirmed by LCD indication. Detail description can be referred on **Chapter 5.4 - [8-3].**
The status can be referred through configuration software as well. Confirmation procedure and detail status description can be referred **Chapter 6.9 Tools** - unexpected state.

12.3 Application errors

When the problem about application happens, please confirm that is shown in the following table and take measures. If the problem does not improve, please contact us.

Table 12.3.1 Application errors

Trouble	Factor	Measure
Measurement value is incorrect.	Settings for the installation is incorrect.	• Please check setting G, R, C, H, the tank shape and so on are correct. (Refer to **6.3 Settings**) • If correction values (the offset value slope) are set, please check that are correct. (Refer to **6.3 Settings**) • Please check the using antenna shape is equal to the configuring antenna shape.
	May have to measure the reflected waves due to noise..	• Please make the appropriate adjustment, refer to the echo curve. (Refer to **6.5 Advanced settings** and **6.7 Echo Viewer**) • There is a possibility of the reflected wave from the antenna contaminations. Please wash of the antenna. • There is a possibility of the reflected wave from the surrounding structure. Please take change oscillation direction or mounting position. (Refer to **2.2 Appropriate location for installation** or **2.7 Tips for stable measurement**) • Please try to set the outlier removal. (Refer to **6.5.2 Outlier Removal**)
	May have to measure the reflected wave by double bounce.	• Please make the appropriate adjustment, refer to the echo curve. (Refer to **6.5 Advanced settings** and **6.7 Echo Viewer**) • Please try to set the outlier removal. (Refer to **6.5.2 Outlier Removal**)
It does not follow the variation of the level.	May have to measure the reflected waves due to noise.	• Please make the appropriate adjustment, refer to the echo curve. (Refer to **6.5 Advanced settings** and **6.7 Echo Viewer**) • There is a possibility of the reflected wave from the antenna contaminations. Please wash of the antenna. • Please try to set the outlier removal. (Refer to **6.5.2 Outlier Removal**)

If the liquid surface is rough, measurement value shows a high value instantaneous.	Since the microwave signal is weakened temporarily for the rough surface, noise reflection becomes stronger.	• Please make the appropriate adjustment, refer to the echo curve. (Refer to **6.5 Advanced settings** and **6.7 Echo Viewer**) • Please optimize the mounting position and oscillation direction. (**2.2 Appropriate location for installation**) • Please change to a large size antenna. (Because of a large antenna in a high sensitivity, tend to noise is small relative to the microwave signal.) • Please try to set the outlier removal. (Refer to **6.5.2 Outlier Removal**)
Measurement indicates a low value momentarily.	May have to measure the reflected waves due to noise.	• There is a possibility of the reflected wave from the surrounding structure. Please take change oscillation direction or mounting position. (Refer to **2.2 Appropriate location for installation** or **2.7 Tips for stable measurement**) • There is a possibility of measuring the short-range noise. Please try widening the dead band or the setting of the outlier removal and so on. (Refer to **6.5 Advanced settings** and **6.7 Echo Viewer**)

Note / Notes

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