

Microwave Level Gauge

KRG-10










User's Guide

Before reading this manual

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

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

Safety symbols

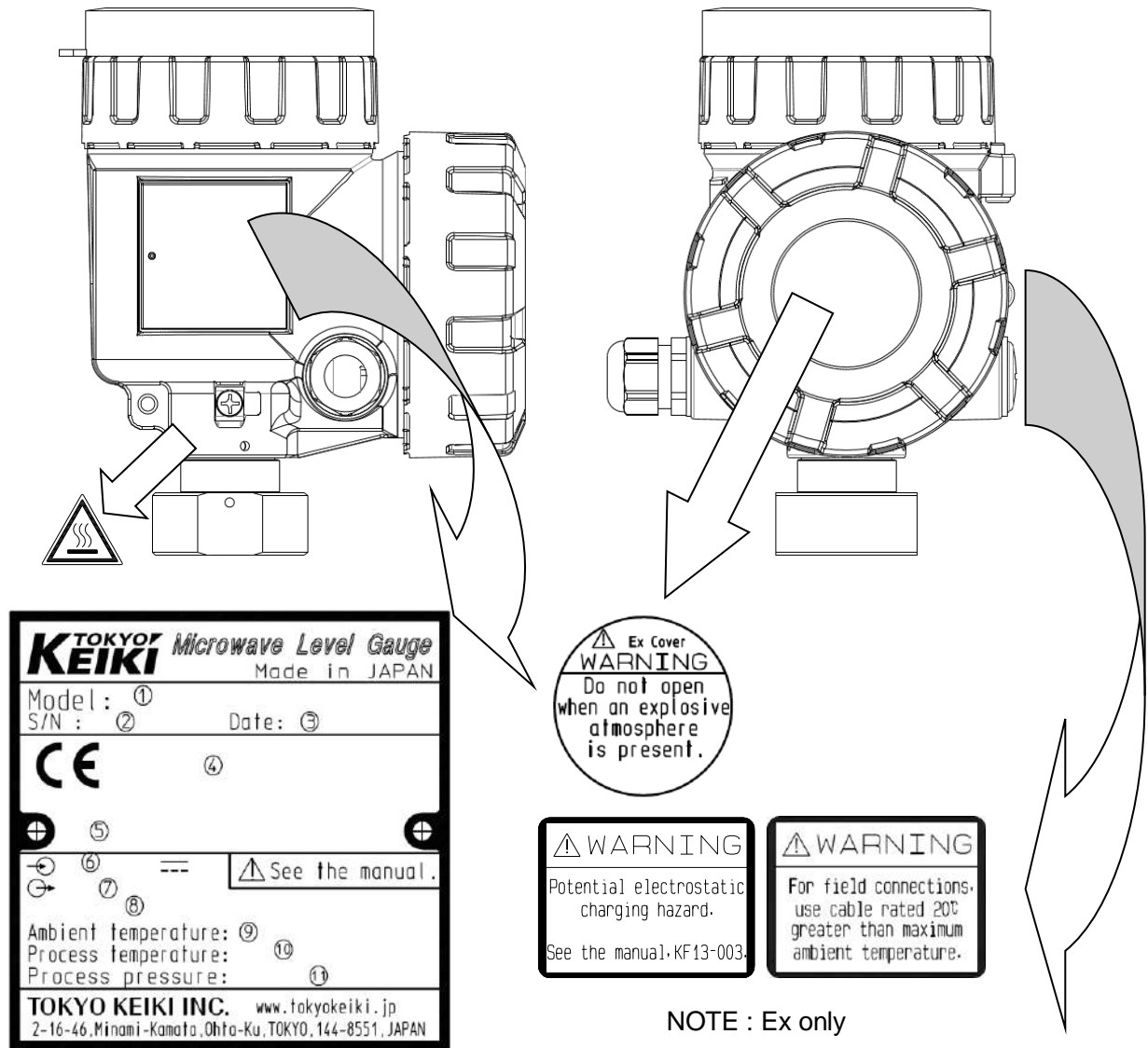
| | |
|--|--|
|  DANGER | Indicates that incorrect usage can result directly in death or serious injury to the operator. |
|  WARNING | Indicates that incorrect usage may result in loss of life or serious injury to the operator. |
|  CAUTION | Indicates that incorrect usage may result in injury to the operator or damage to the device. |
|  | Indicates referring to information for usage of the function or features. (Put on the device) |
| 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. |

EU DECLARATION OF CONFORMITY (SIMPLIFIED)

Hereby, TOKYO KEIKI INC., declares that the Radio equipment type KRG-10 is in compliance with Directive 2014/53/EU. The full text of the EU declaration of conformity is available at the following internet address: <https://www.tokyokeiki.jp/e/products/detail.html?pdid=180>

Labels and attached place

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



- ① Product code (Refer to Chapter 1.)
- ② Serial number
- ③ Date of manufacture
- ④ Ex certification No.(Ex only)
- ⑤ Ex marking (Ex) or IP code (Non-Ex)
- ⑥ Operating voltage
- ⑦ Signal output
- ⑧ Intrinsic safety parameter (Ex only)
- ⑨ Ambient temperature
- ⑩ Process temperature
- ⑪ Process pressure

Fig. 1 Labels

Introduction

Thank you very much for purchasing **TOKYO KEIKI**'s 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 device.

Attention

1. Deliver this manual to the user of the device.

2. Read this manual well.

Be sure to read the manual thoroughly to figure out important information.

3. Keep this manual with care.

The device 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 device 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 TOKYO KEIKI .

Notes on the manual

1. This manual is based on the standard specifications of the device. 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 device. 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, and firmware update etc.) does not affect functionality and performance, the manual may not be revised or updated. We appreciate your understanding.

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KALREZ® Registered trademark of DuPont Performance Elastomers L.L.C., Wilmington, USA.

Safety instructions and warnings

For safety, please follow the following items.



WARNING

- Please follow the safety instructions in this manual. When dealing with the device contrary to instructions, seller and manufacturer cannot guarantee safety.
- Unauthorized modification of this device 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 device. For residual material on the device, 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 device. For the structure of the parts of the device, 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 device, 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.

This device show the symbol “X”, that require special conditions of use,

- Grounding is required, as accumulation evasion of static electricity;
- For rod antenna and PTFE sealing antenna, it must be used flange (optional), seal gasket (optional) and O-ring (accessory), to satisfy protection class IP66 or IP67.

Prohibitions and precautions for device protection

For device protection, adhere to the following precautions.

**CAUTION**

- Do not apply a shock to the device body such as by dropping.
- Do not use the device outside the specified environment condition (ambient temperature and humidity).
- Do not use the device outside the specified voltage.
- Do not use a scratched or bare wire (power, coaxial, or signal cable).
- For device 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 device. If an device failure occurs, contact the seller.
- For transport, please follow the following items of device.
 - a) Please follow the temperature range specifications.
 - b) Please use the original packaging for delivery.
- For device 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 device.

**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 device under predetermined power operating 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 device.
- If the device 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 device 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.
- Please tighten firmly so as not flooded from the gap between the display cover or terminal box cover. Please note that there is no shortage of tightening. Also, Check whether different cover is not attached.
- Please be careful not flooded from wiring port.

**CAUTION**

This equipment has been evaluated for conformity in business environments and may cause radio interference when used in home environments.

Precautions on using

- Before using the product, please check the model name and corresponding specifications.
- The following accessory has been attached to this device. Please confirm that there is no shortage.
 - a) CD-ROM (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 a depends on specifications. The LCD module is used to enter instrument parameters and displays measuring data.

The cable gland also depends on specifications.

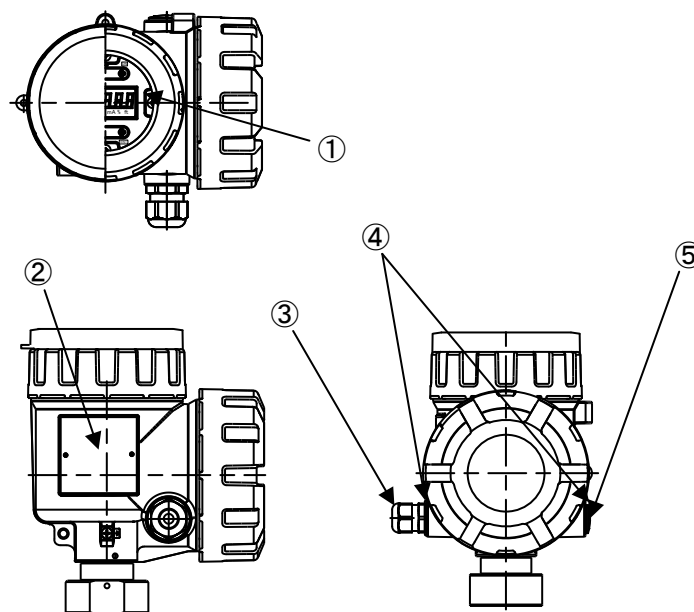


Fig. 1.2.1 Configuration of transmitter head

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

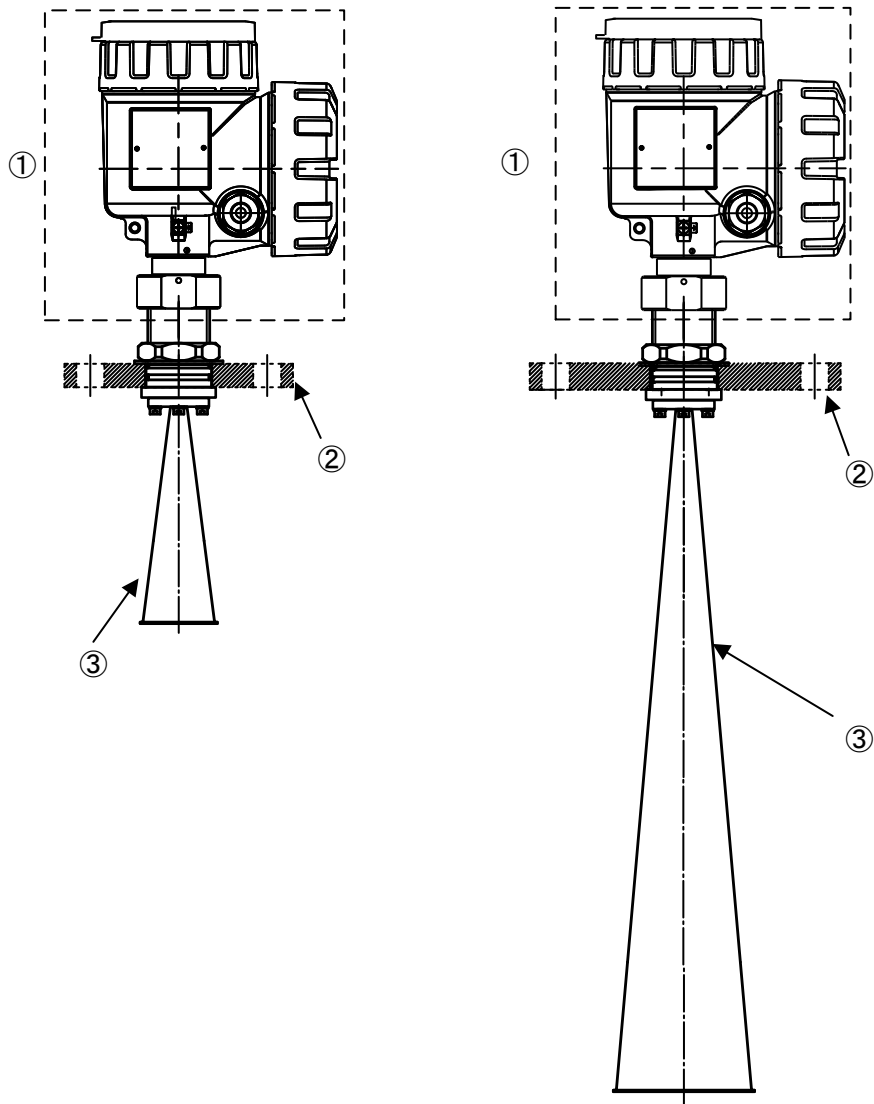


Fig. 1.2.2 Transmitter head with cone antenna

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

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

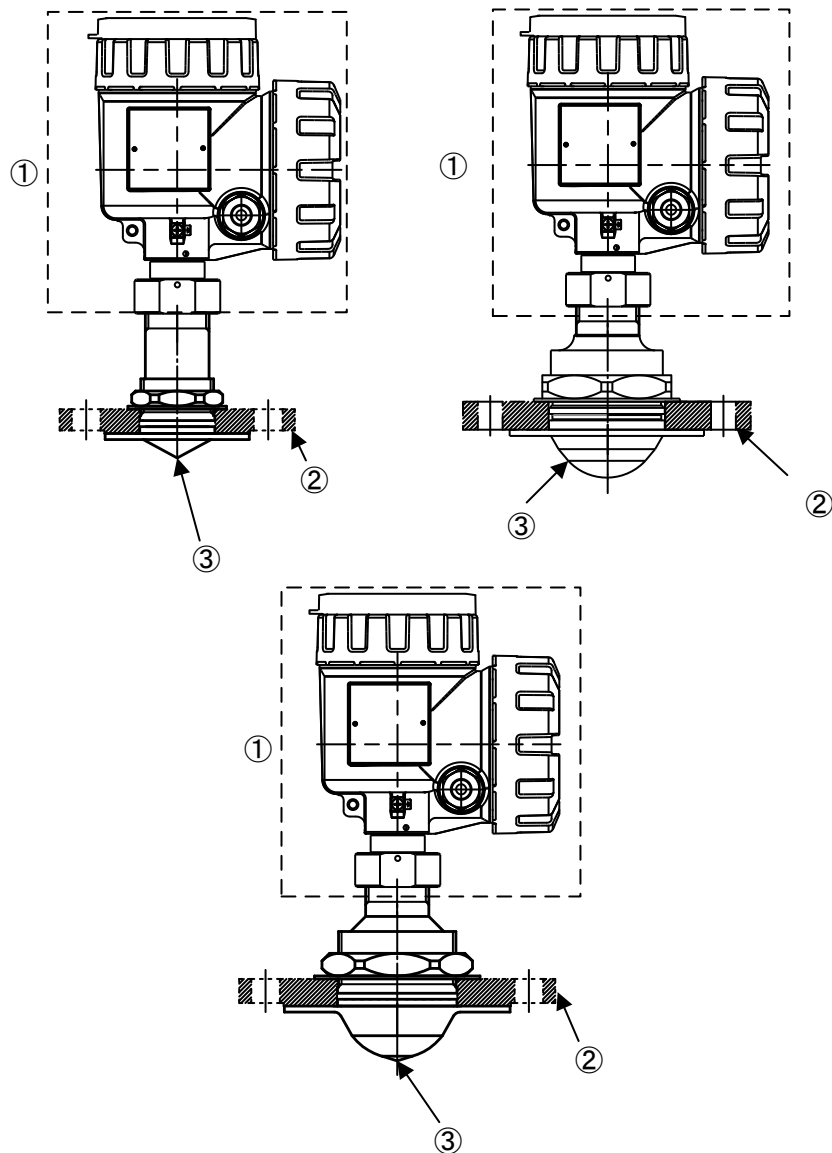


Fig. 1.2.3 Transmitter head with PTFE sealing antenna

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

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

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

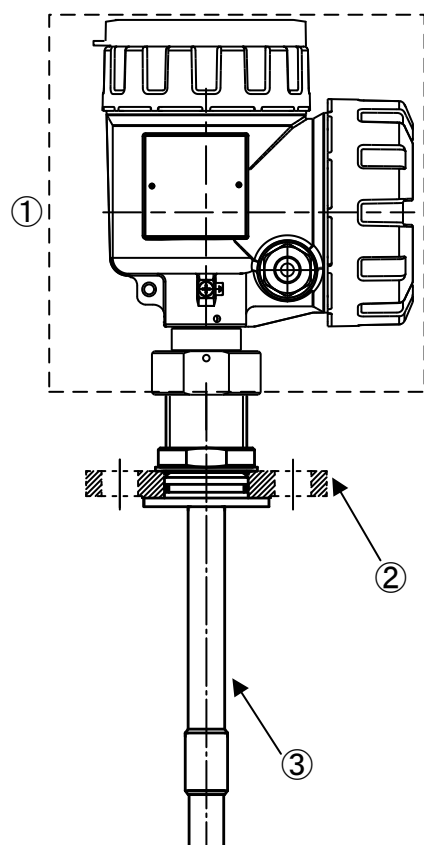


Fig. 1.2.4 Transmitter head with rod antenna

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.
- (4) For rod antenna and PTFE sealing antenna, it must be used flange (optional), seal gasket (optional) and O-ring (accessory), to satisfy protection class IP66 or IP67. Also when mounting the flange, please tighten depending on the size of the bolt properly .

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.

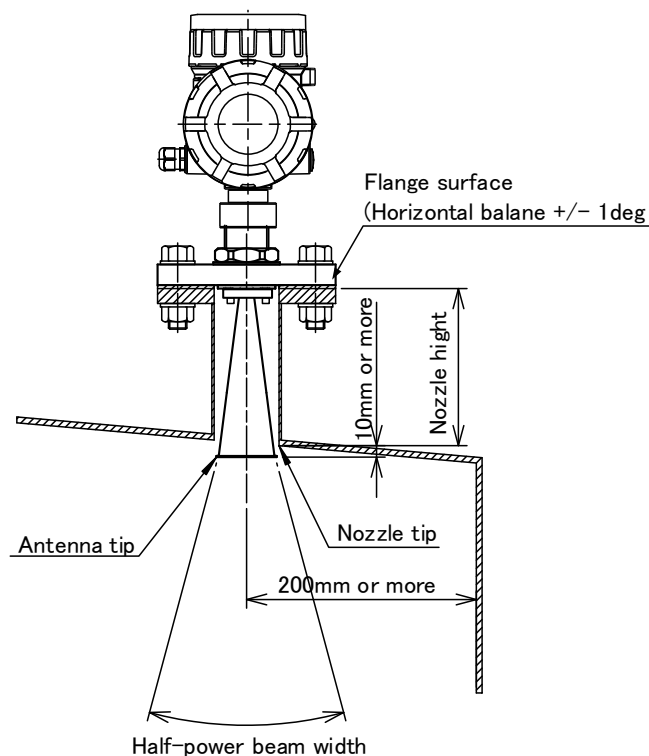


Fig. 2.2.1 Installation example of cone antenna

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 |
| 3" (75mm) PTFE Sealing antenna | 500 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.

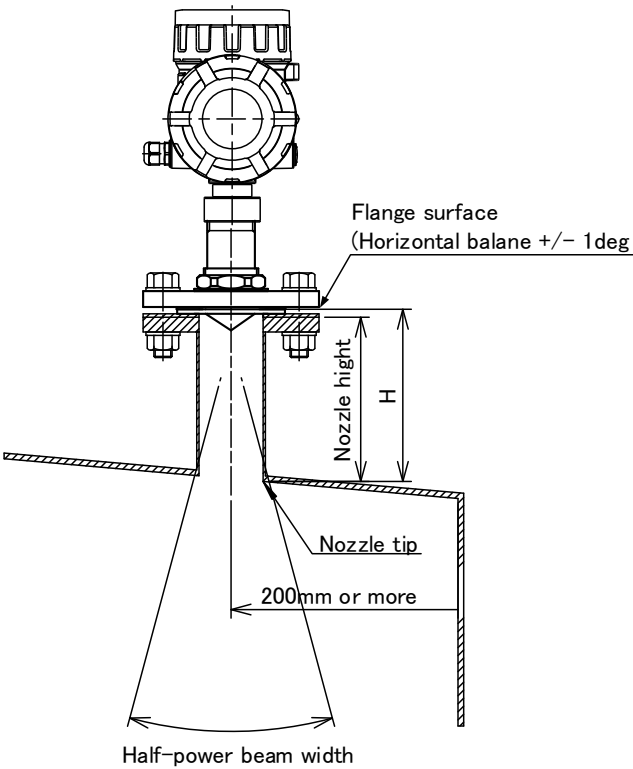


Fig. 2.2.2 Installation example of PTFE sealing antenna

2.2.3 Rod antenna

Please keep to leave extension of rod antenna over 40mm from nozzle tip. Extension of Rod antenna length is 186mm.

NOTE: : In case that extension of rod antenna is not satisfied to leave over 40mm from nozzle tip, enough microwave can not get into the tank inside. It may affect stable measurement.

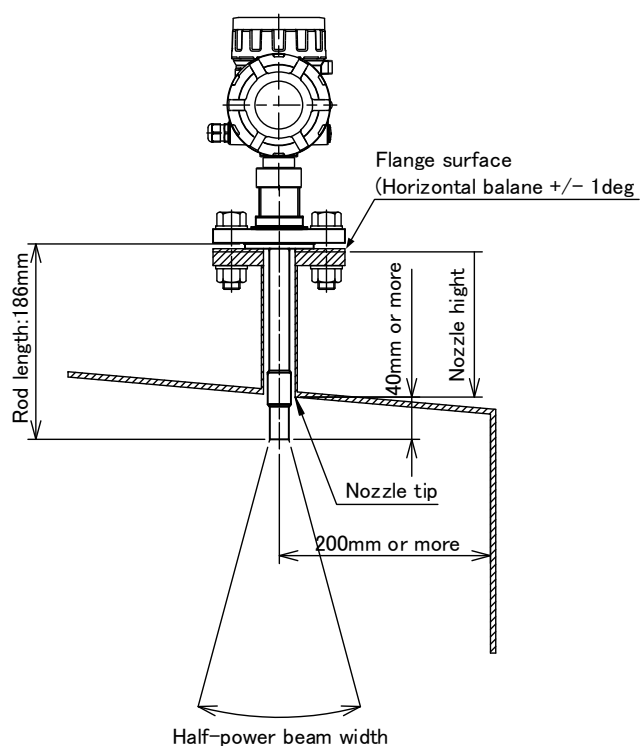


Fig. 2.2.3 Installation example of rod antenna

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

| | | Beam area (m) | | | |
|-------------------|----|--|----------------------------|--|----------------|
| Antenna type | | 2" Cone antenna/ 2" PTFE sealing antenna | 3" PTFE sealing antenna | 4" Cone antenna/ 4" PTFE sealing antenna | 1" Rod antenna |
| Beam angle (deg.) | | 18 | 12 | 8 | 25 |
| Distance (m) | 5 | 1.6 | 1.1 | 0.7 | 2.2 |
| | 10 | 3.2 | 2.1 | 1.4 | - |
| | 15 | - | 3.2 | 2.1 | - |
| | 20 | - | 4.2 | 2.8 | - |
| | 25 | - | 5.3 | 3.5 | - |
| | 30 | - | - | 4.2 | - |

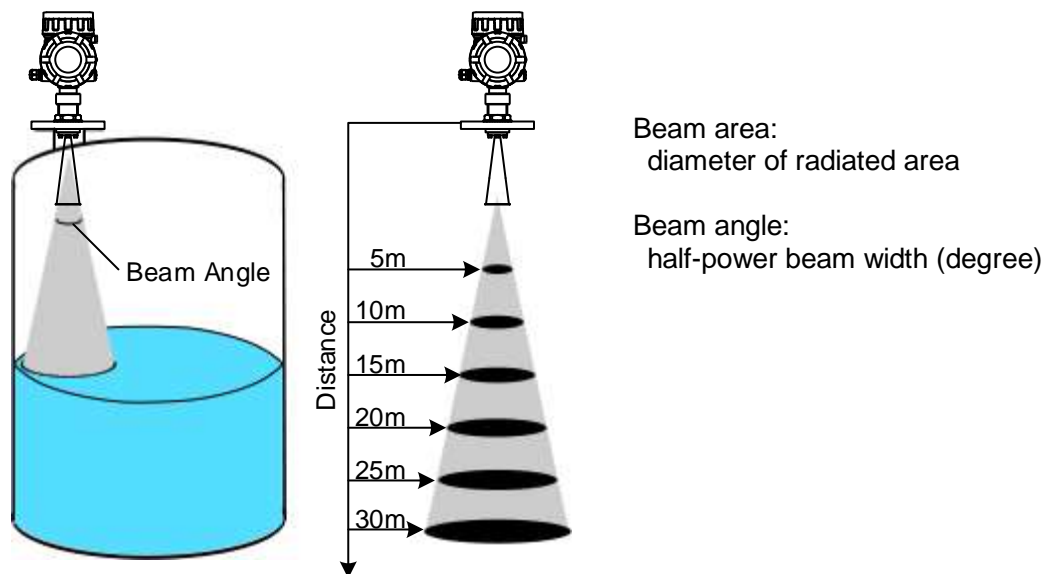


Fig. 2.3.1 Beam area and distance

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 (refer to the 2.7 Tips for stable measurement). 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.

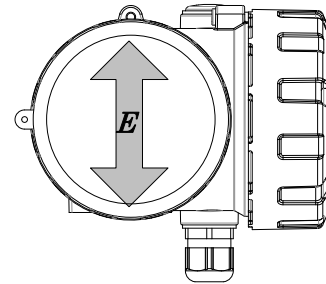


Fig. 2.7.1 Oscillation direction

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 is as shown in the Fig.2.7.1.1

In case mounting the transmitter 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)

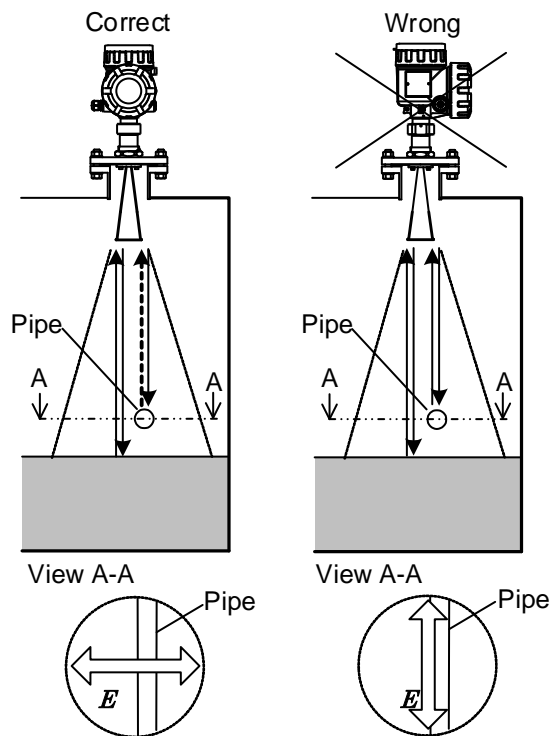


Fig. 2.7.2 Installation method when the pipe is present in the space

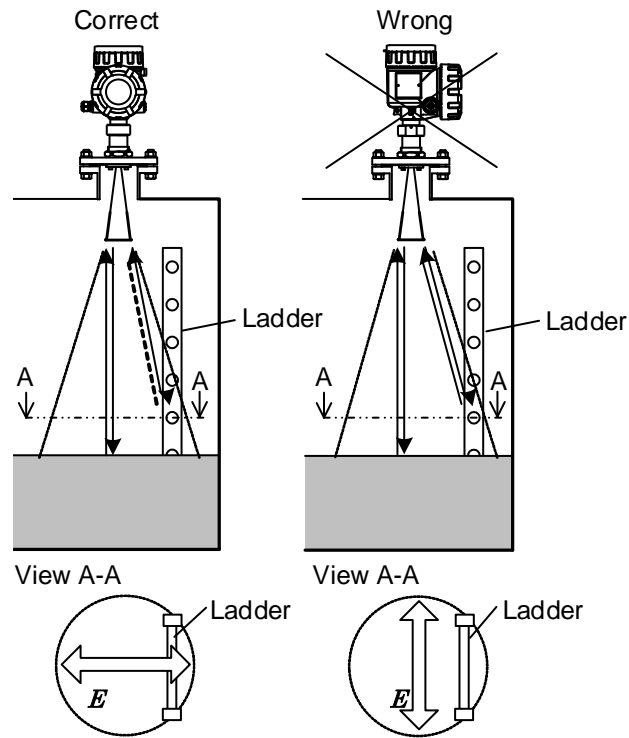


Fig. 2.7.3 Installation method when the ladder rungs are present in the space

2.7.2 Shoulders and struts

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

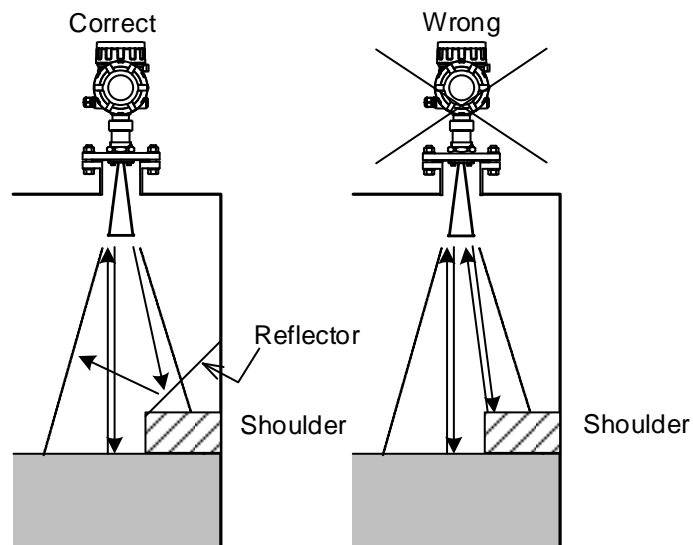


Fig. 2.7.4 Installation method when the shoulders and support struts are present in the space

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.

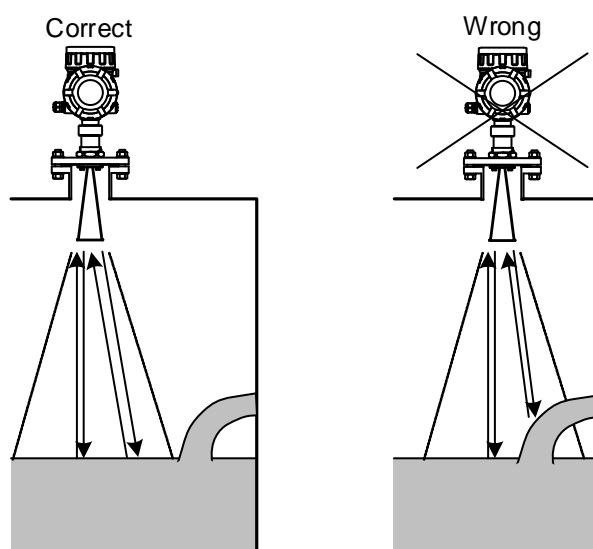


Fig. 2.7.5 Installation method for near the tank inlet

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.

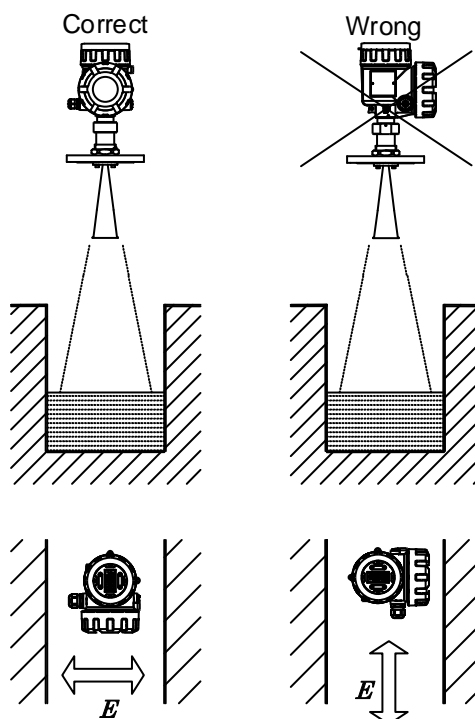


Fig. 2.7.6 Installation method for the narrow channel

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.

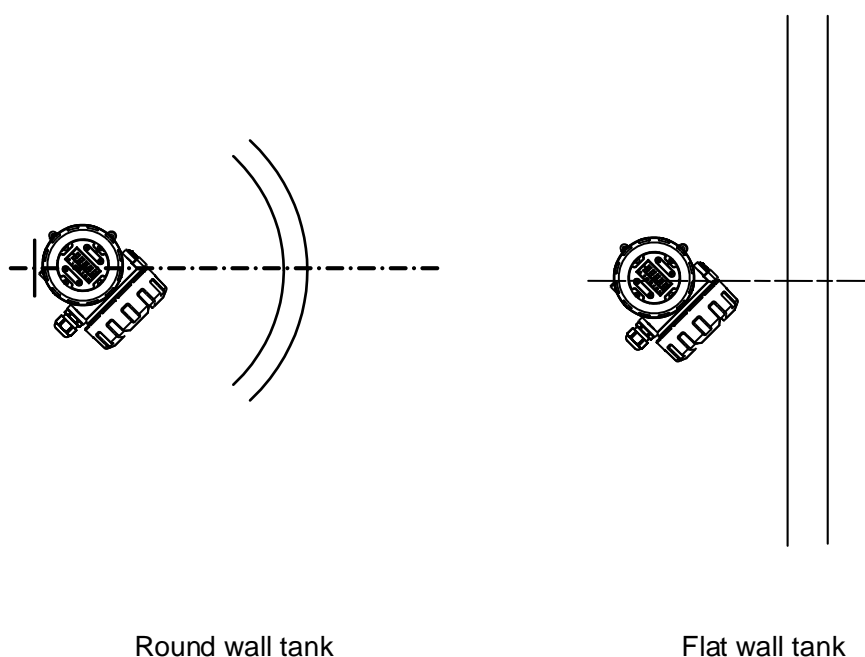


Fig. 2.7.7 Installation method for the tank wall

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 out side 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.

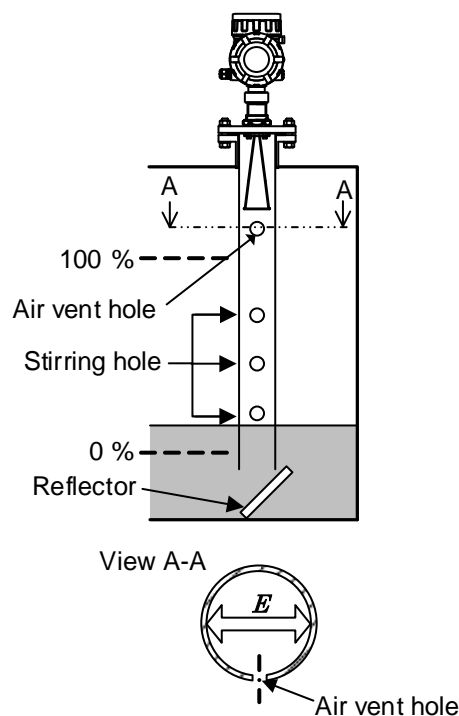


Fig. 2.8.1 Pipe installation

- In case of installing to bypass pipe, to retain defined accuracy, keep enough length as high hold off distance more than 500mm from maximum liquid surface and also low hold off distance 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.

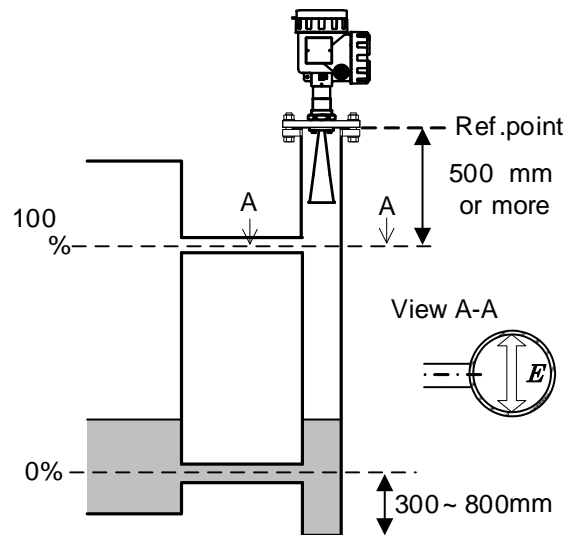


Fig. 2.8.2 Bypass pipe installation

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 is optional.

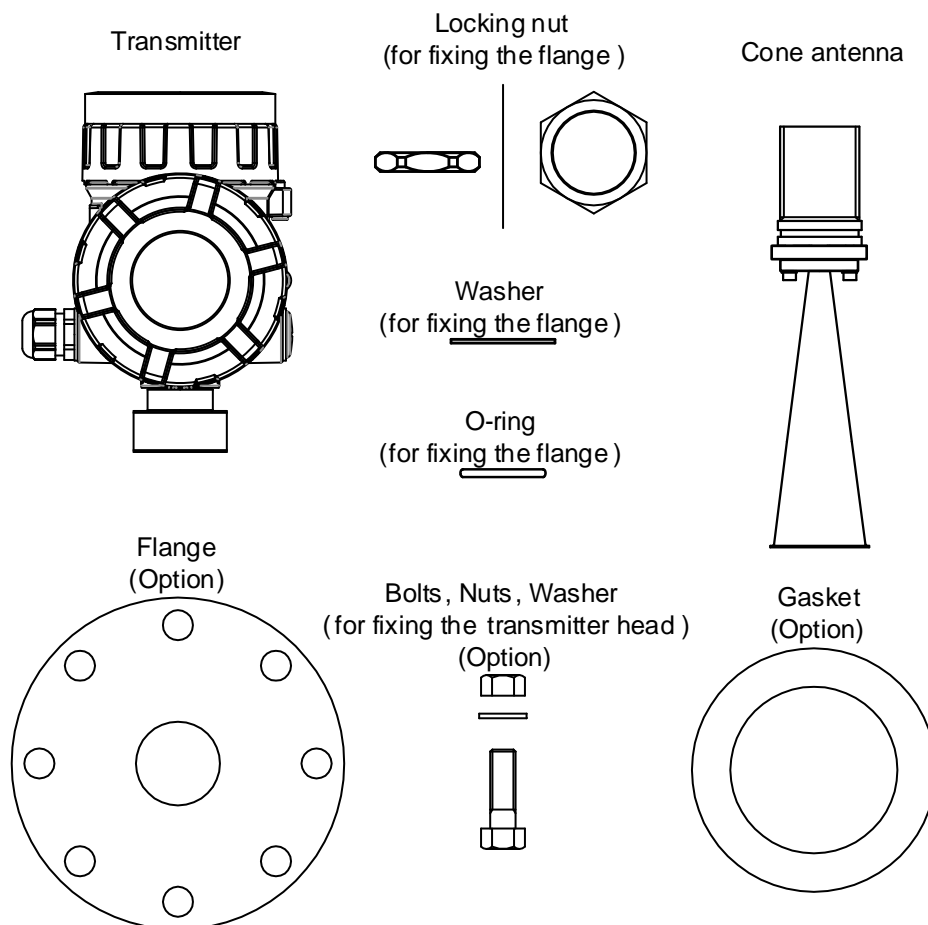


Fig. 2.10.1 Required item for cone antenna installation

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

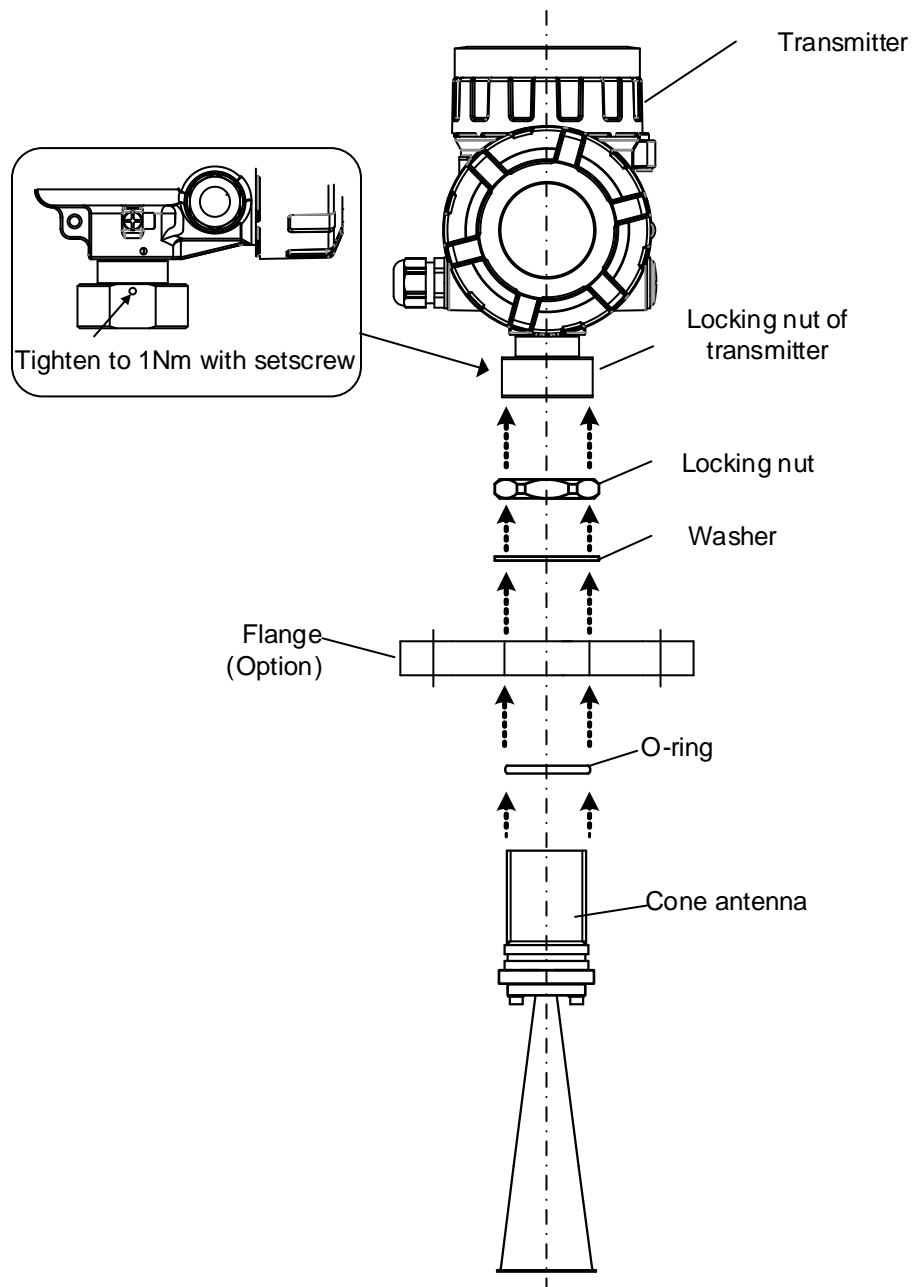


Fig. 2.10.2 Antenna assembling

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

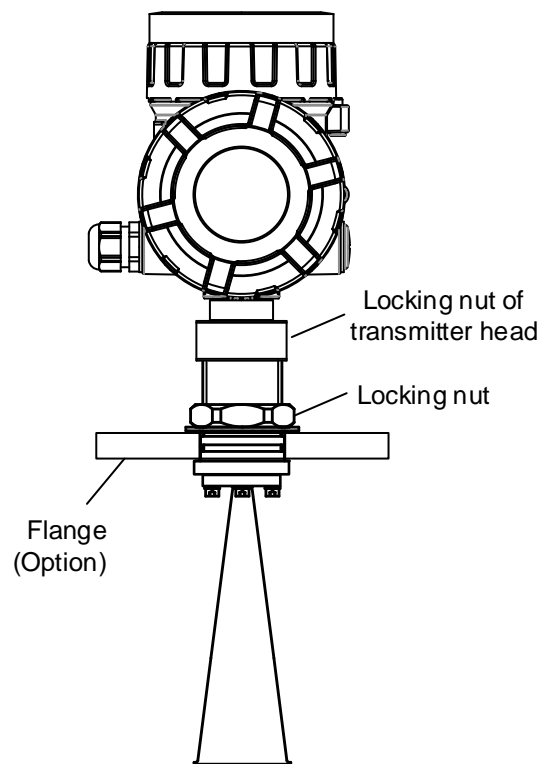


Fig. 2.10.3 Transmitter fixing

- (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.

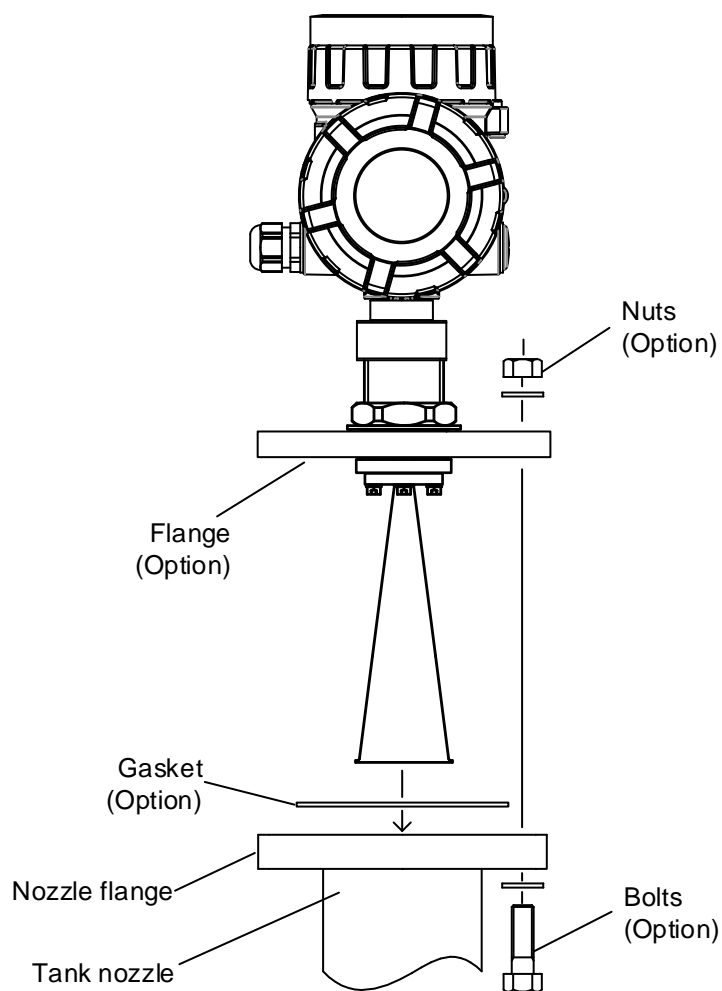


Fig. 2.10.4 Installing onto the tank nozzle

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 is optional item.

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.
- It must be used flange (optional), seal gasket (optional) and O-ring (accessory), to satisfy protection class IP66 or IP67.

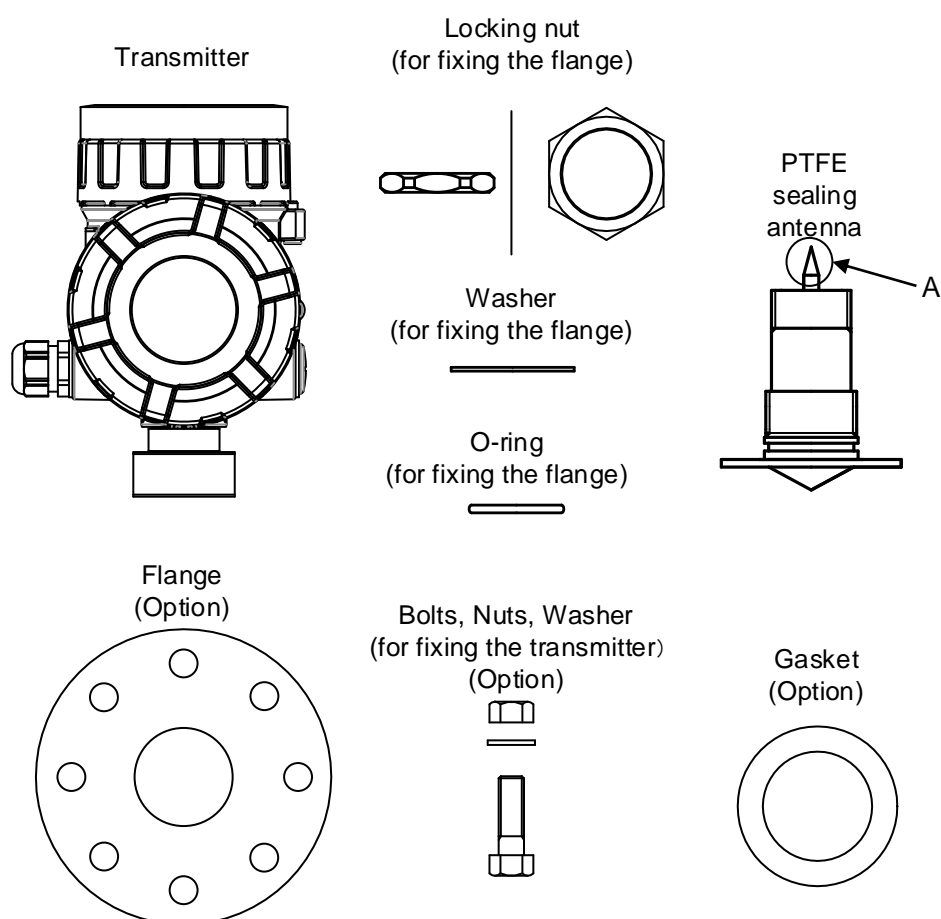


Fig. 2.10.5 Required item for PTFE sealing antenna installation

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

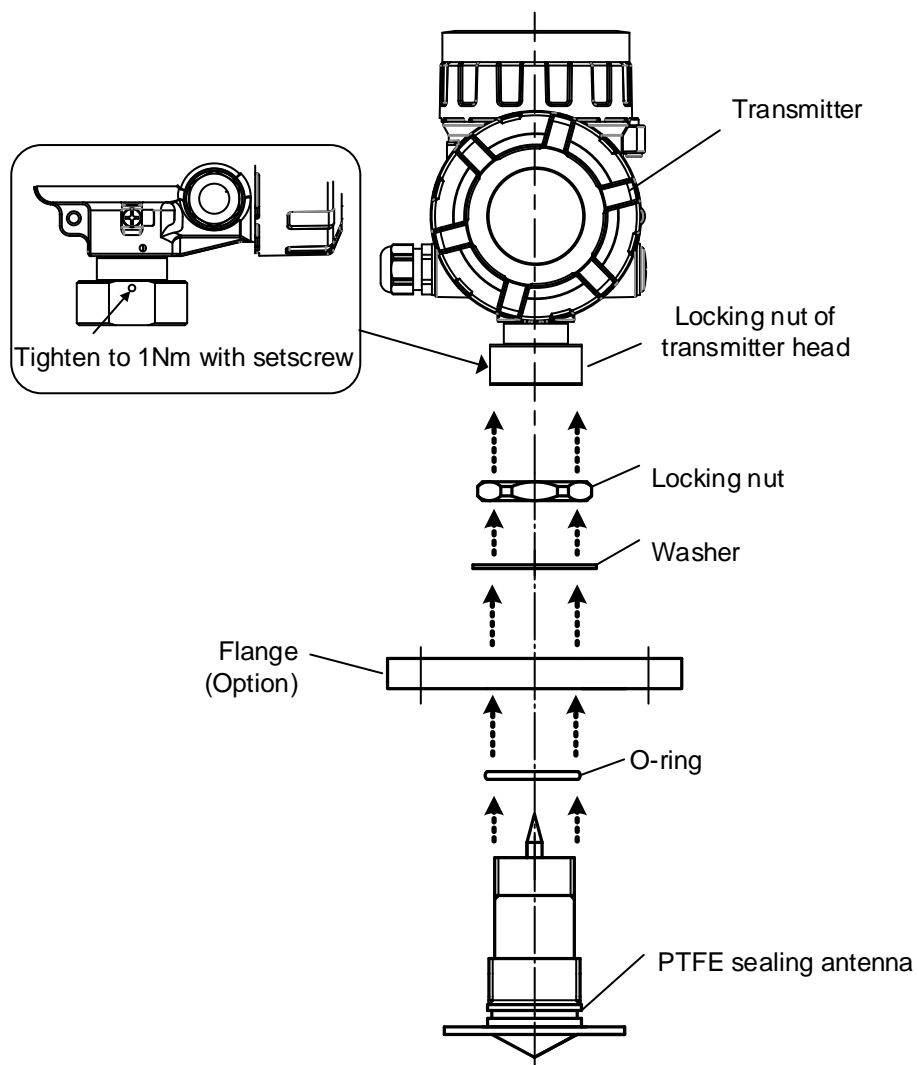


Fig. 2.10.6 Antenna assembling

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

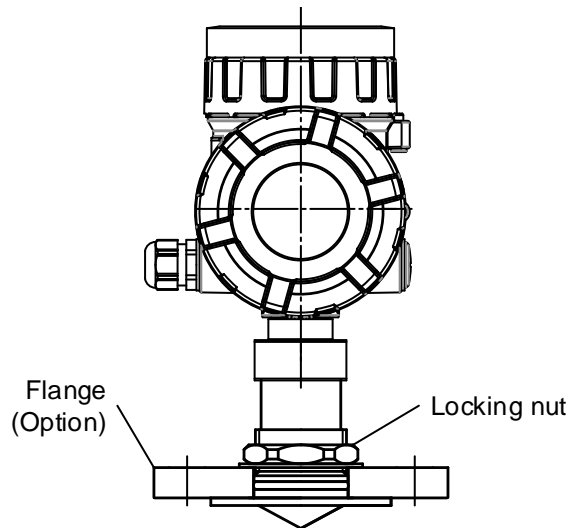


Fig. 2.10.7 Transmitter fixing

(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

Please tighten all bolts evenly and appropriately to prevent leakages of internal gases and also to retain waterproof performance.
The outer plate of PTFE sealing antennas must be fastened with flanges of the proper size corresponding each antenna. A fastening torque of bolts is typically 60Nm for this case.

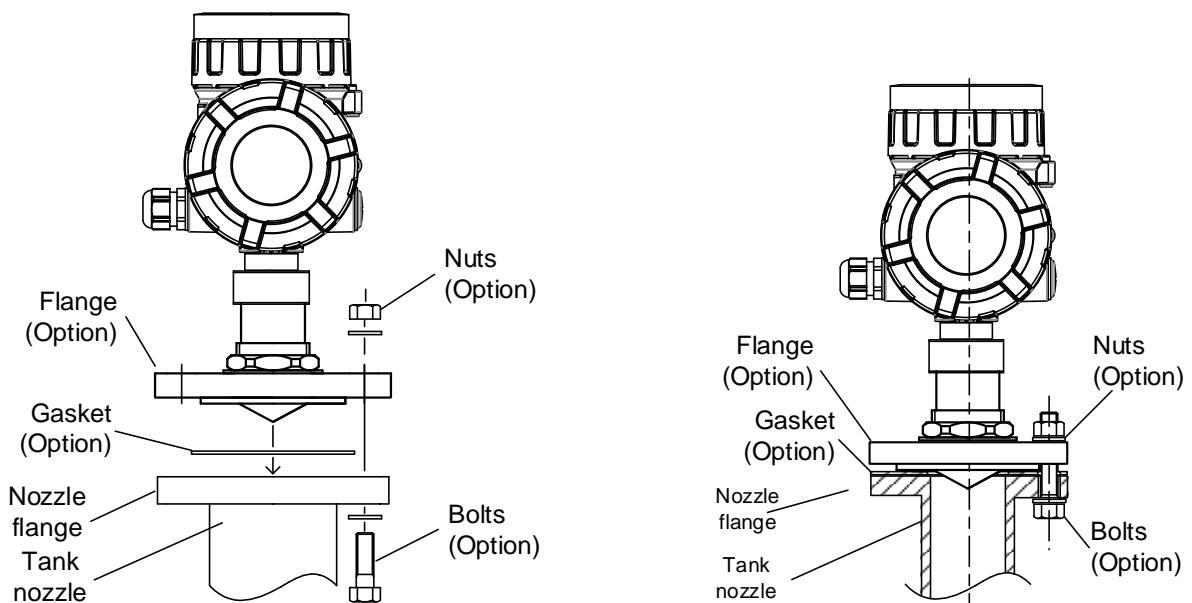


Fig. 2.10.8 Installing onto the tank nozzle

(5) If a nozzle flange is different from the proper size for the antenna, an adapter must be used for the appropriate installation. The adapter must be fasten with flanges as figure shown below. The hole of corresponding size in the adapter must be opened. For 2", 3" and 4" PTFE sealing antenna, these hole sizes are typically 51mm, 76mm and 102mm. Gaskets must have sufficient width to cover surfaces between flanges and the adapter for preventing any leakage.

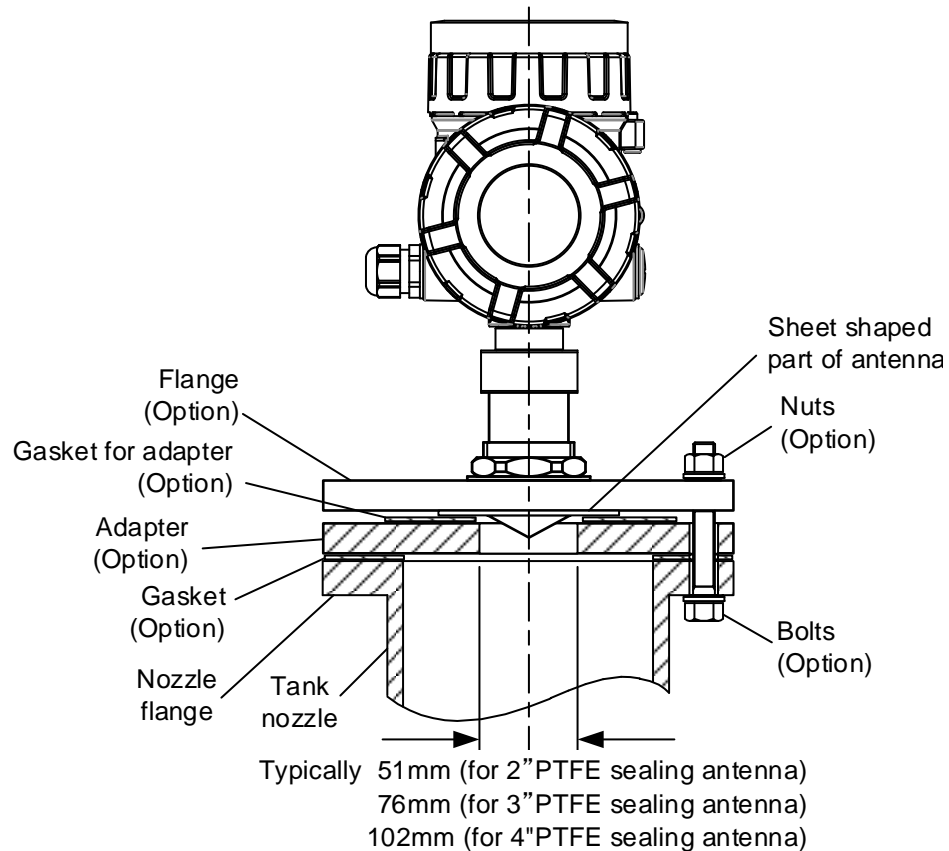


Fig. 2.10.9 Installing onto the tank nozzle

2.10.3 Rod antenna

(1) Required parts for rod antenna installation are as follows.

- Flange is optional item.
- Sealing gasket, bolts or nuts is optional item.

NOTE:

- Please treat not to bend or 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.
- It must be used flange (optional), seal gasket (optional) and O-ring (accessory), to satisfy protection class IP66 or IP67.

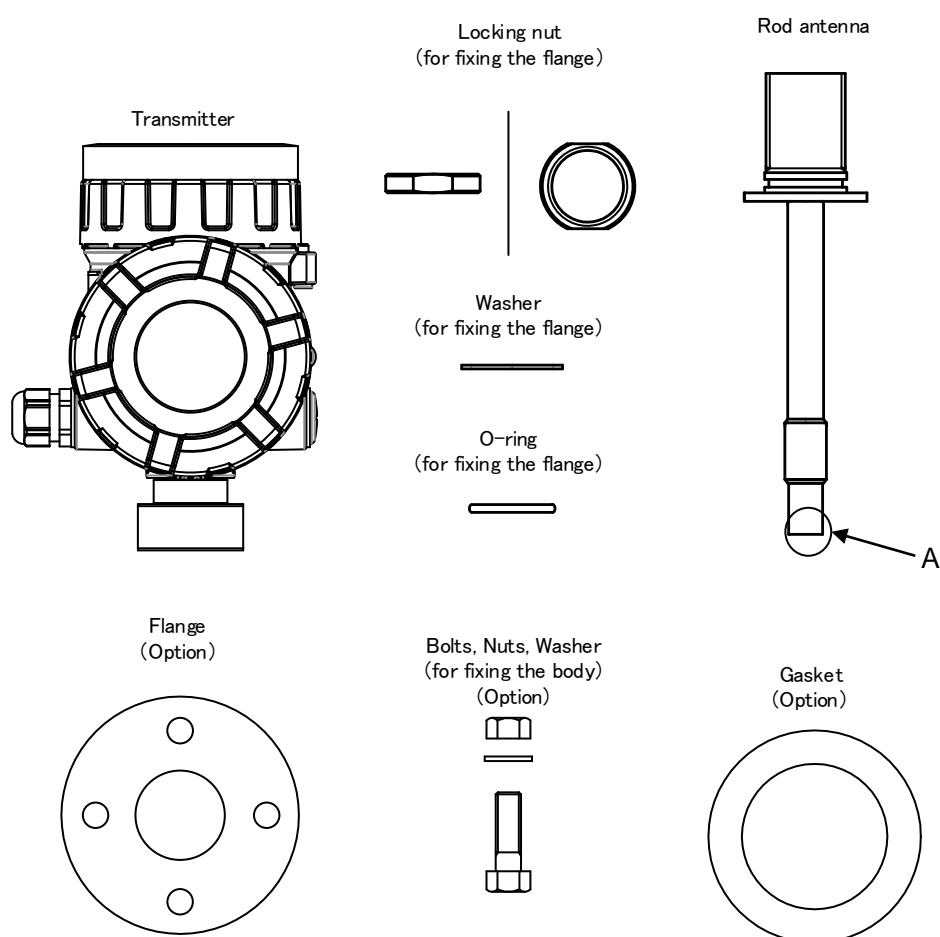


Fig. 2.10.10 Required item for Rod antenna installation

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

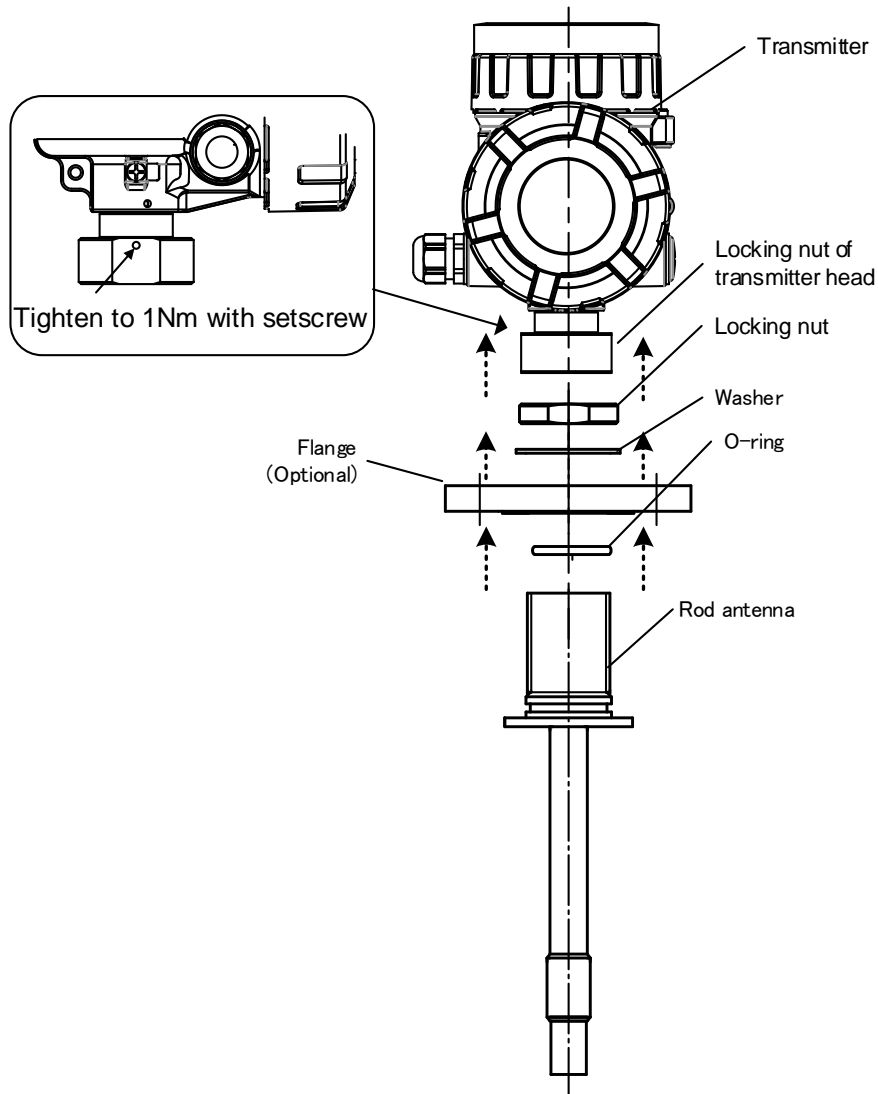


Fig. 2.10.11 Antenna assembling

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

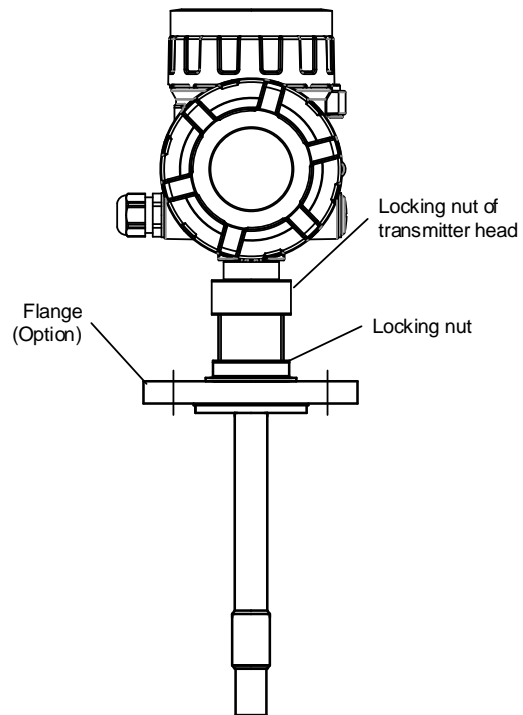


Fig. 2.10.12 Transmitter fixing

- (4) Place the gasket on the tank nozzle.
Tighten the assembled unit by the bolts and nuts as below.



CAUTION

Please tighten all bolts evenly and appropriately to prevent leakages of internal gases and also to retain waterproof performance.

The outer plate of the rod antenna must be fastened with flanges of the proper size corresponding the antenna. A fastening torque of bolts is typically 60Nm for this case.

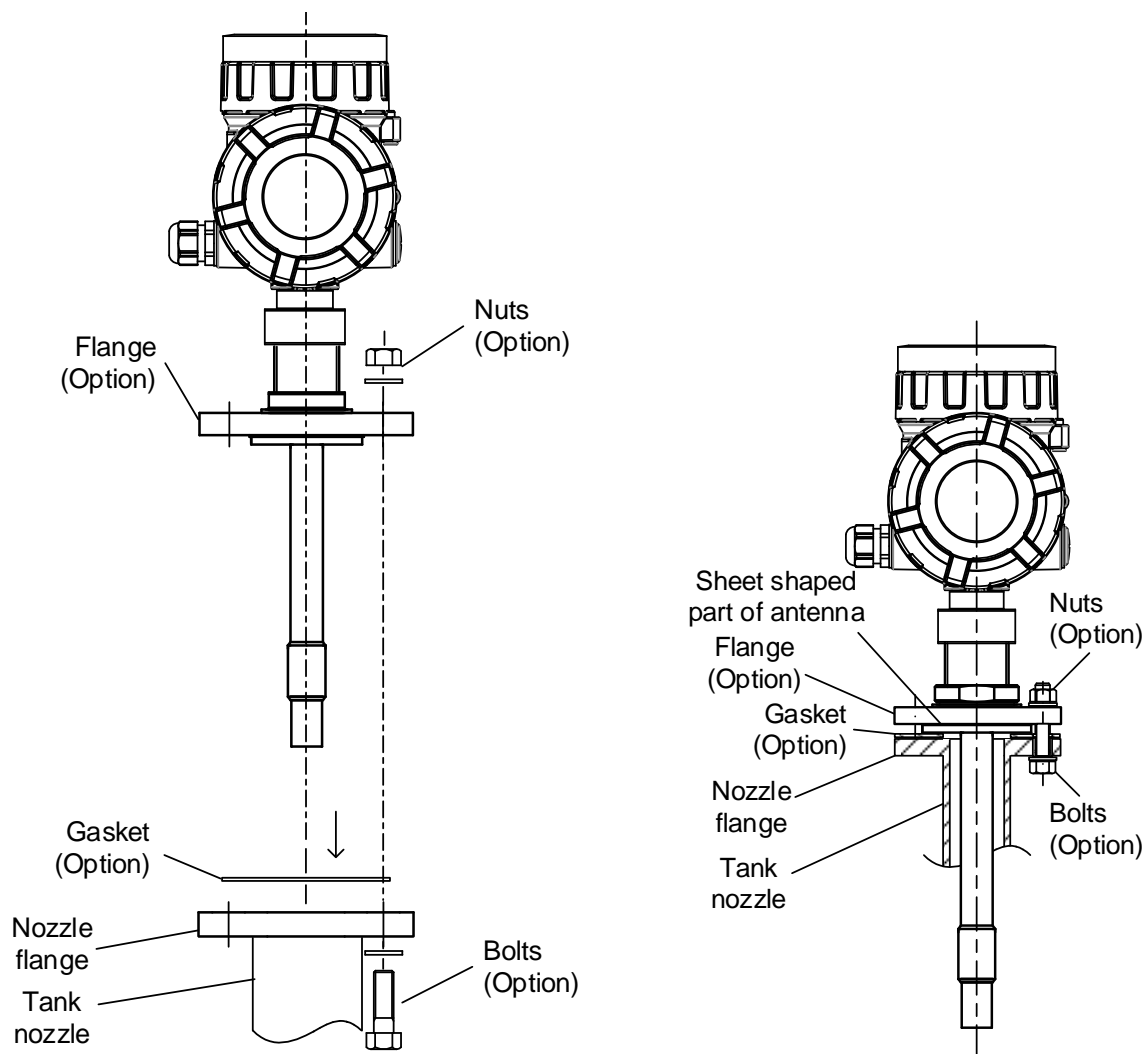


Fig. 2.10.13 Installing onto the tank nozzle

(5) If a nozzle flange is different from the proper size for the antenna, an adapter must be used for the appropriate installation. The adapter must be fasten with flanges as figure shown below. The hole of corresponding size in the adapter must be opened. For the rod antenna, the hole size is typically 26mm. Gaskets must have sufficient width to cover surfaces between flanges and the adapter for preventing any leakage.

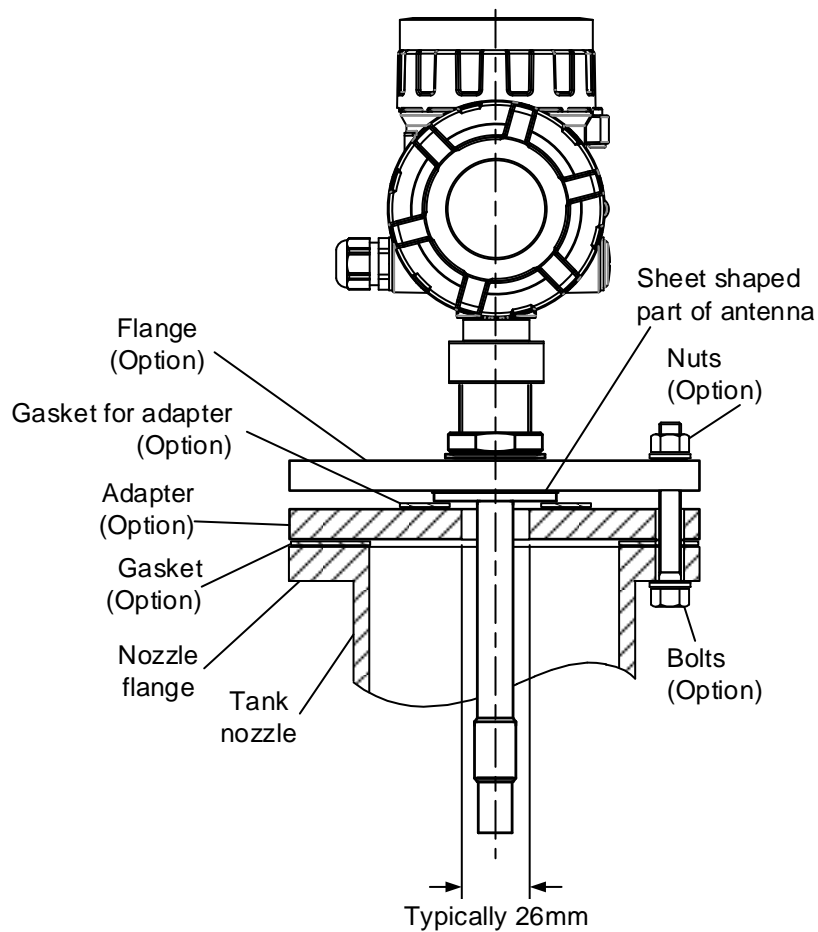


Fig. 2.10.14 Installing onto the tank nozzle

Chapter 3 Electrical installation

3.1 Connection to transmitter



CAUTION

- Wiring work must be done non-hazardous area.
- Be sure to stop the power supply to the transmitter 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 transmitter and its connected accessories.
- The cable gland, the terminal cover and the LCD cover should be attached properly.
- During installation, if you remove the cable gland, the Ex blind plug or the Non-Ex blind plug from the cable entry, please properly tightened when mounting again. Similarly, please properly tightened the LCD cover and the terminal cover. (Please refer to the 3.1.2 Mounting method of terminal cover and cable gland.)
- The cover must be screwed in completely before boot and secured by screwing out the lid locking screw all the way to the stop.

3.1.1 Wiring procedure

Wiring procedures are as follows,

- (1) Ensure the power supply is turned off on the line.
- (2) Loosen the lock screw of the terminal cover, and remove the terminal cover.
- (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. For the cable gland of Non-Ex products, tightening torque of the cable is 6.0 ± 0.2 Nm.
- (7) Tighten the terminal cover and lock screw again. (Please refer to the 3.1.2 Mounting method of terminal cover and cable gland.)
- (8) Connect external ground terminal.

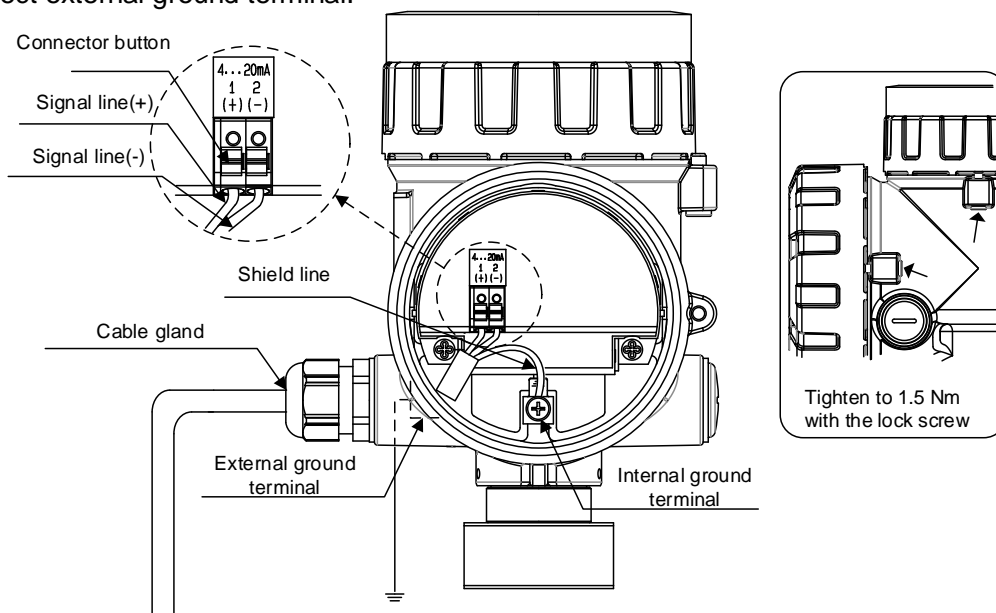


Fig. 3.1.1 Connecting diagram

3.1.2 Mounting method of terminal cover and cable gland

To satisfy waterproof performance of IP class, please keep following conditions.

- During installation, if you remove cable gland, Ex blind plug or Non-Ex blind plug, please tighten at torque shown in Table 3.1.1 when mounting again. For cable gland and blind plug of Non-Ex products, please make sure to use the attached rubber washer.
- Tighten the LCD cover and terminal cover until the O-ring cannot be seen as shown in Figure 3.1.3.

Table 3.1.1 Tightening torques of cable ground, Ex Blind plug and Non-Ex blind plug

| Ex approval | Cable gland | Ex Blind plug | Non-Ex Blind plug |
|-------------|-------------|---------------|-------------------|
| Ex | ---※1 | 3.5±0.2Nm | --- |
| Non-Ex | 6.0±0.2Nm | --- | 1.9±0.1Nm |

※1 For Ex products, please select the IP class qualified cable gland. Please contact cable gland manufacturers such as recommended tightening torque.

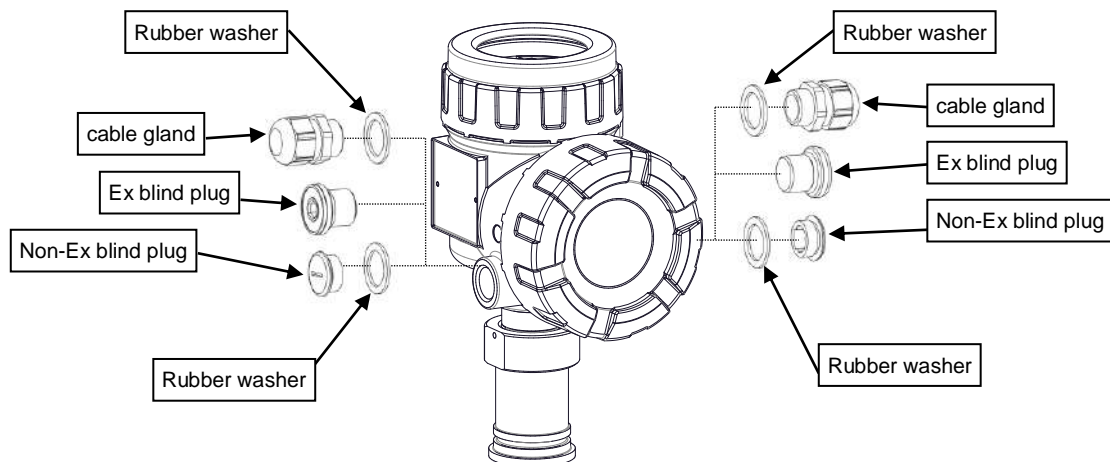


Fig. 3.1.2 Names of parts

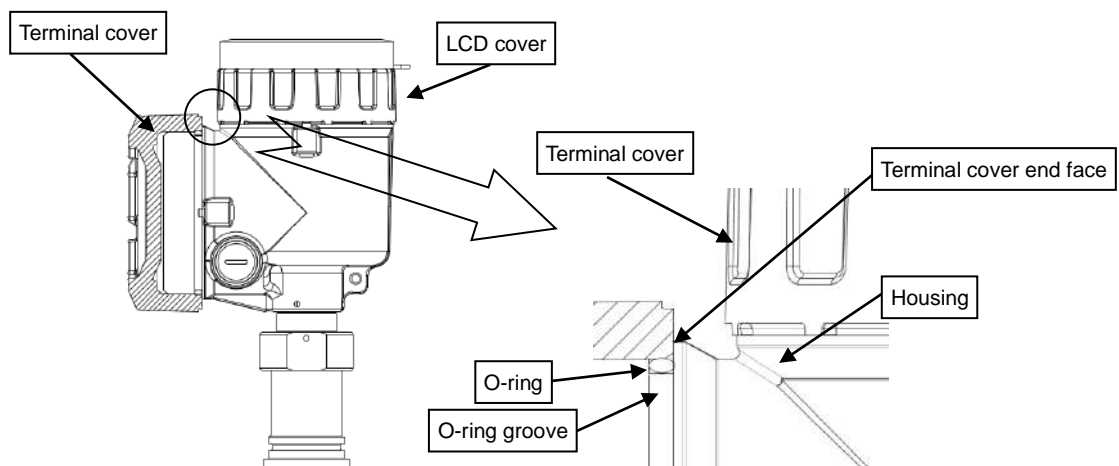


Fig. 3.1.3 Mounting the terminal cover (handling of the LCD cover is same)

Installation of accessories

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

(1) Non-Ex connection example

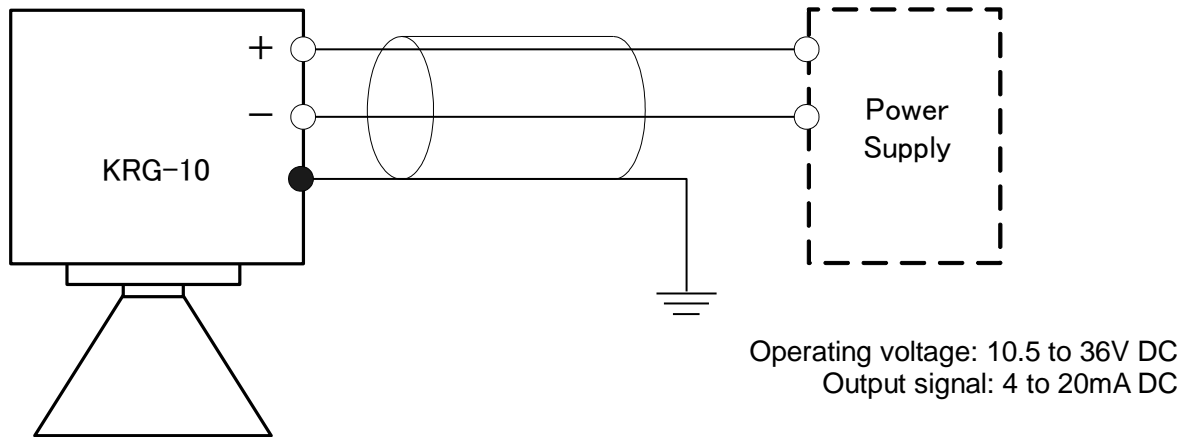



Fig. 3.1.4 Non-Ex connection example

(2) Ex ia connection example.

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

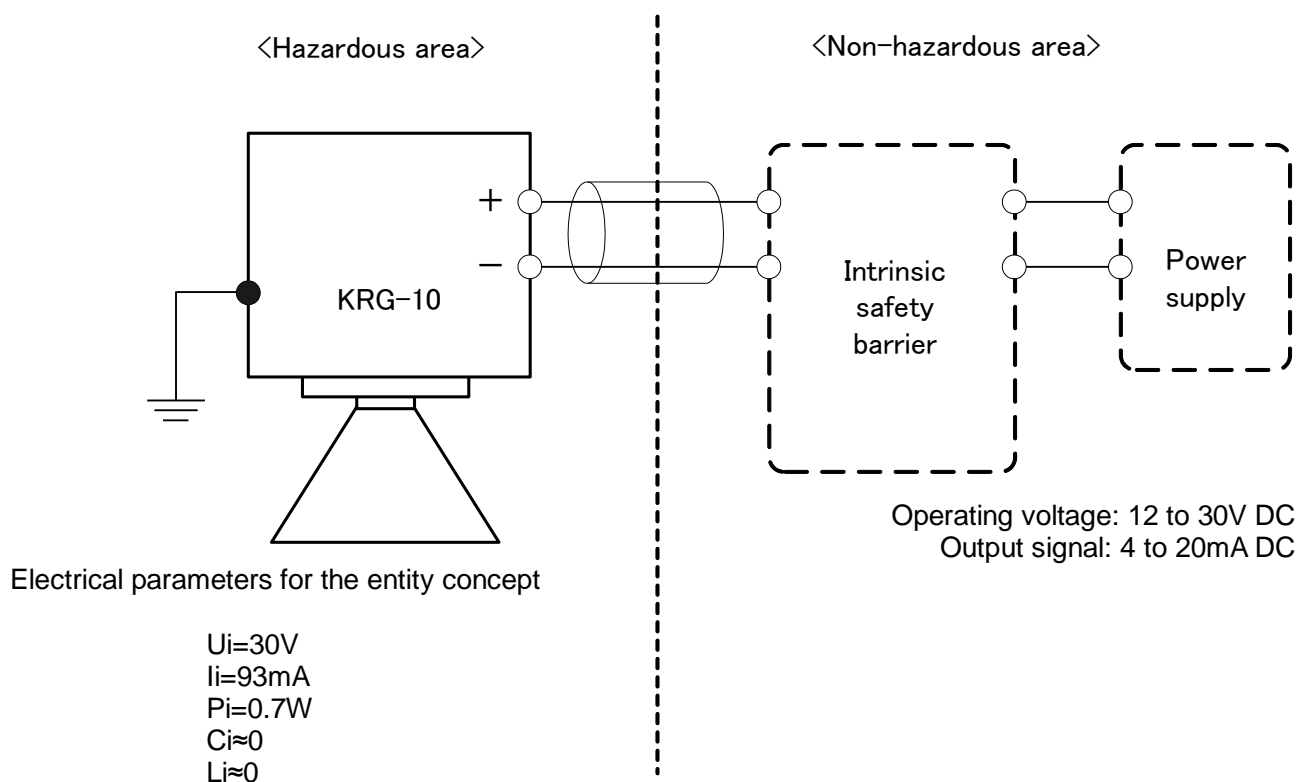



Fig. 3.1.5 Intrinsic safety connection example.

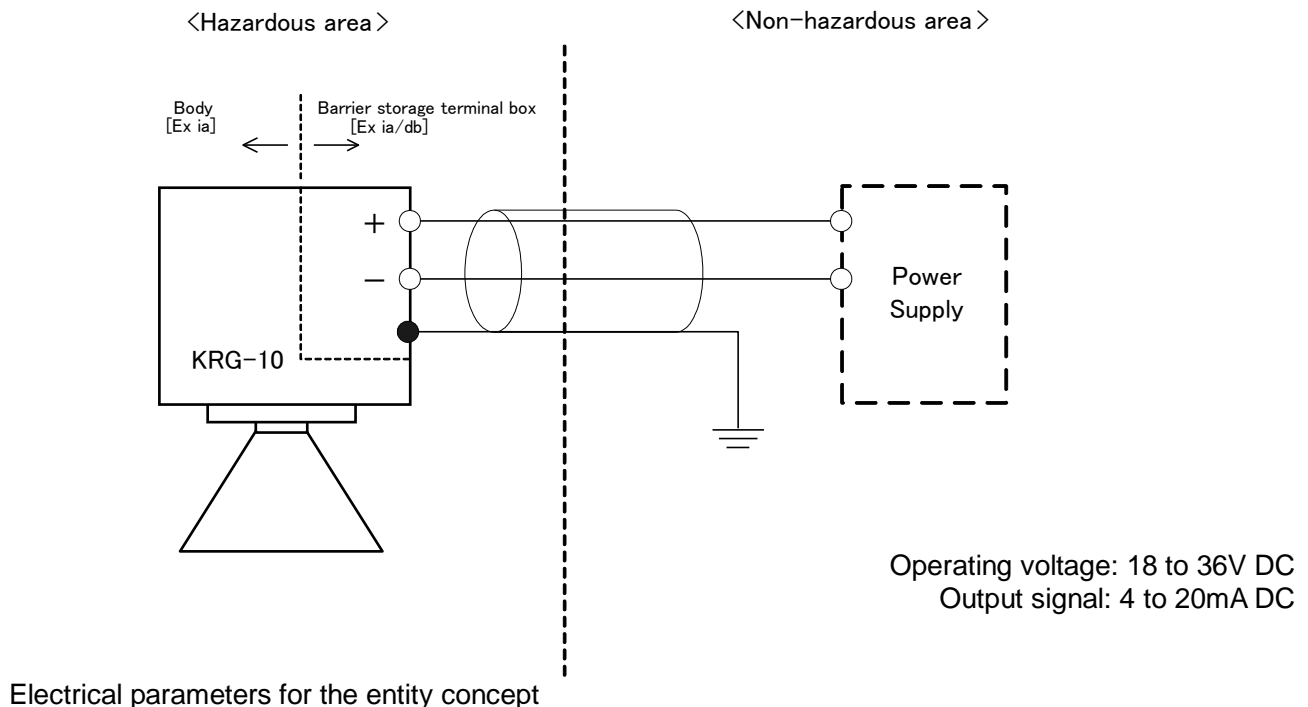
NOTE:

- 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 use paint thinner or other chemical products. Wipe away any dirt with a soft cloth.
- Do not modify any of structure.
- Following requirements must be kept in accordance with ATEX / IECEx regulation.

| | |
|---------------------|--|
| Ambient temperature | -40 to 60°C |
| Process temperature | Please refer to the "Safety Instructions". |
- Intrinsic safety barrier must satisfy the rating of electrical parameters for the entity concept.
- Cable inductance ($=L_w$) and capacitance ($=C_w$) should be chosen so as to lower the rating of Intrinsic safety barrier allowable inductance ($=L_o$) and capacitance ($=C_o$).
- Perform grounding structure.

(3) Ex ia/db connection example.

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



$U_m = 250V$ AC 50/60Hz

Fig. 3.1.6 Ex ia/db 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 use paint thinner or other chemical products. Wipe away any dirt with a soft cloth.
- Do not modify any of structure.
- Following requirements must be kept in accordance with ATEX / IECEx regulation.

| | |
|---------------------|--|
| Ambient temperature | -40 to 60°C |
| Process temperature | Please refer to the "Safety Instructions". |
- Perform grounding structure (grounding resistance < 10 Ω).

3.2 Cable requirement

Required specification: Twisted pair 2 core shielded cable (0.5 to 2.5mm-sq / AWG 20 to 12)

Cable entry: 2 ports / M20 x 1.5 (Cable dia; 6.5 to 9mm)

3.3 Load resistance

Refer to the Fig 3.3.1 for details.

The maximum load resistance at the maximum operating voltage used in each equipment specification is shown in ② and ③ in Fig 3.3.1. (for example : maximum operating 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 operating voltage of 250Ω

① in Fig 3.3.1. (Non-Ex:16V DC, Ex ia:17.5V DC, Ex ia/db :23.5V DC)

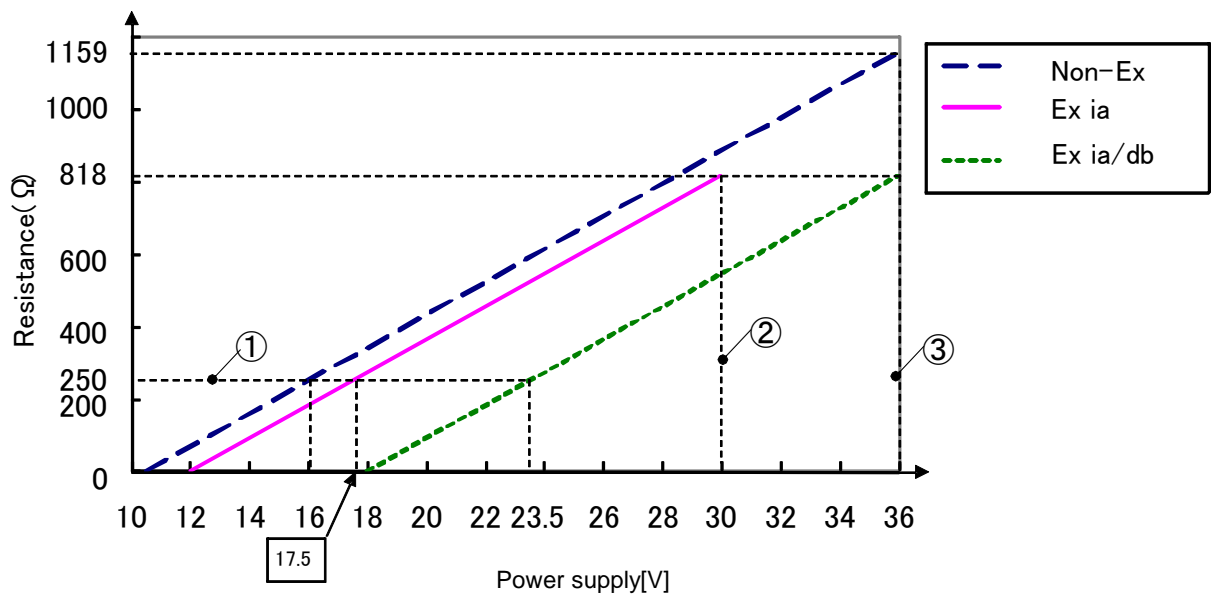


Fig 3.3.1 Load resistance

- ① : HART load
- ② : Power operating voltage limit Ex ia equipment
- ③ : Power operating voltage limit Non-Ex, Ex ia/db equipment

3.4 Power Supply

Operating voltage : 10.5 to 36V DC (Non-Ex), 12 to 30V DC (Ex ia), 18 to 36V DC (EX ia/db),
Max. Current: 22mA

3.5 Cable shielding and grounding

In case of Non-Ex and Intrinsic safety, perform grounding structure.(grounding resistance<100Ω) In case of Flameproof enclosures, perform grounding structure.(grounding resistance<10Ω)

Grounding terminal is outside of the transmitter 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

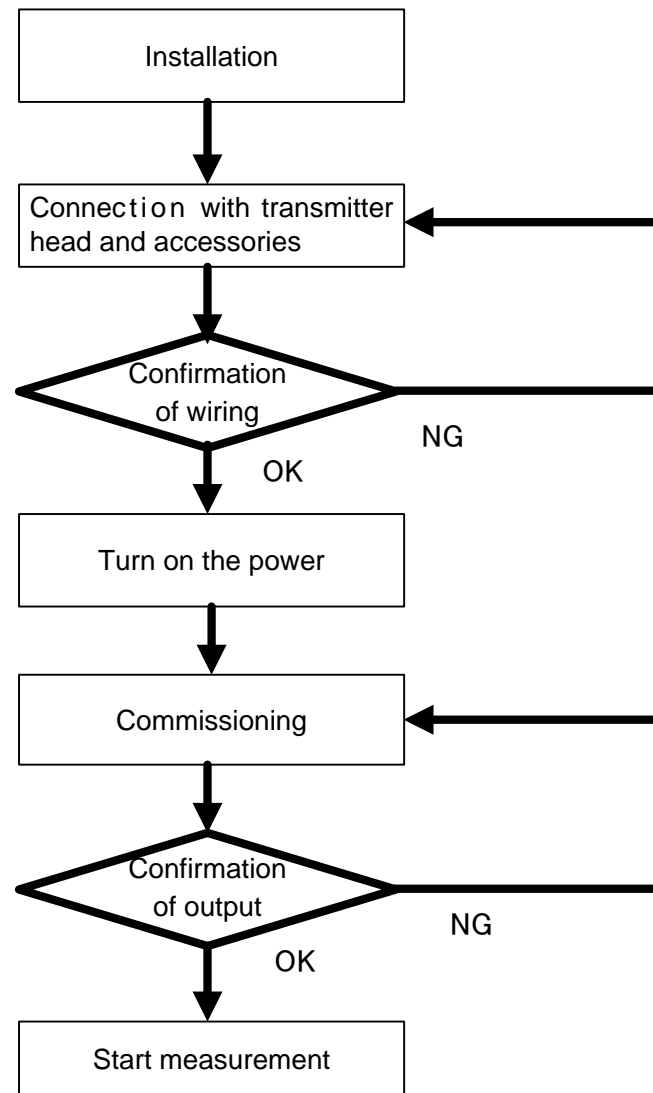


Fig. 4.1.1 Step for starting measurement

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**).

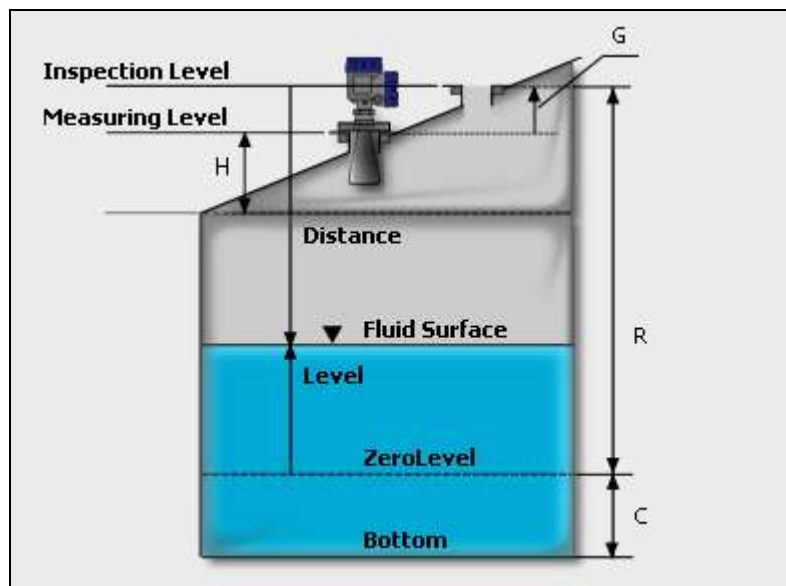


Fig. 4.5.1 Basic setting parameters diagram

Chapter 5 LCD and Key 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 transmitter or any of accessories while wiring work to prevent electrical shock.
- The cover must be screwed in completely before boot and secured by screwing out the lid locking screw all the way to the stop.

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

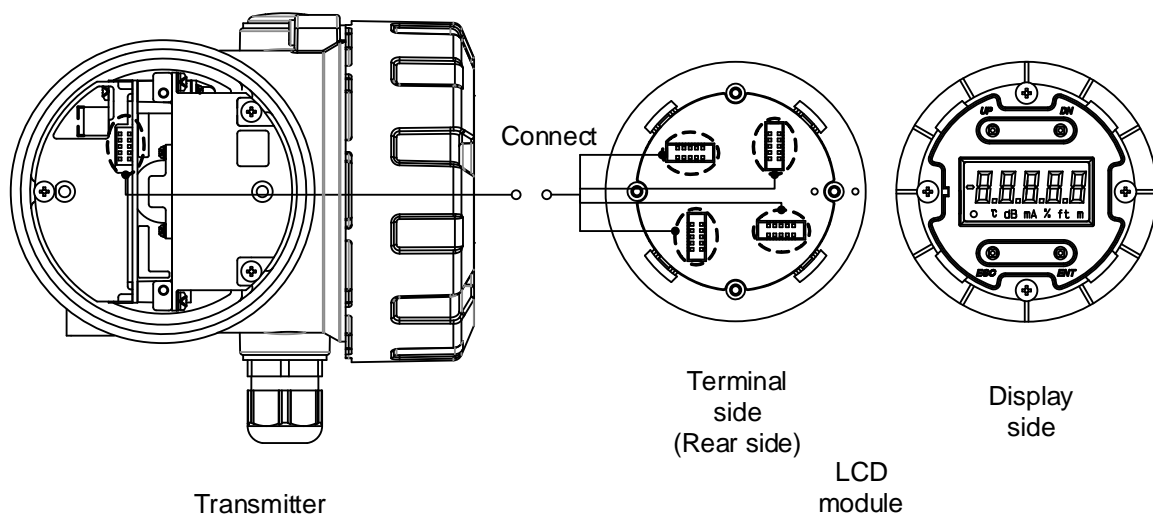


Fig. 5.1.1 LCD module connection

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.

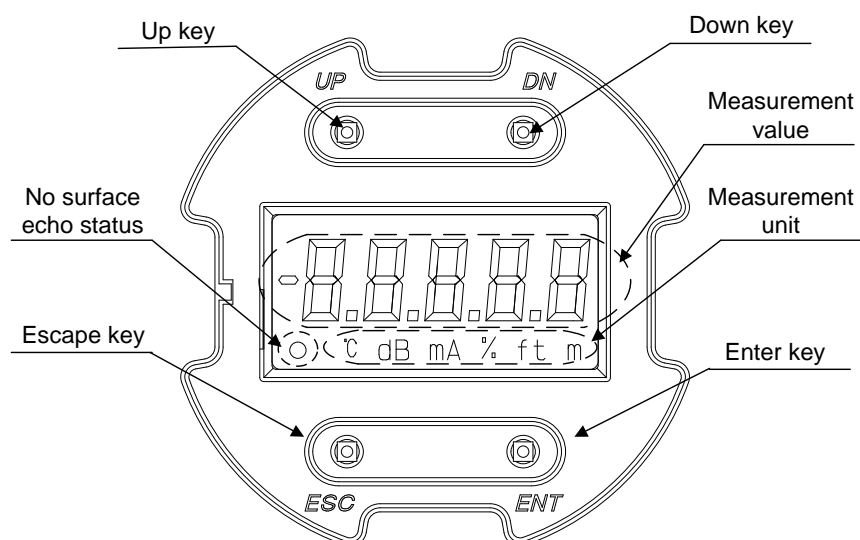


Fig. 5.1.2 LCD

Measured value

Table. 5.1.1 Measured value

| LCD Indication | 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 Ratio | % | + | 5 digits max. (Integral 3+ Decimal 2) |
| Flow Ratio | % | + | 5 digits max. (Integral 3+ Decimal 2) |
| Elapsed Time from Start | - | + | 5 digits max. (Integral number) |
| Search Count | - | + | 3 digits max. (Integral number) |
| Elapsed Time from Final Search | - | + | 5 digits max. (Integral number) |
| Margin of Sensitivity | dB | ± | 3 digits max. (Integral number) |

5.2 4-Keys

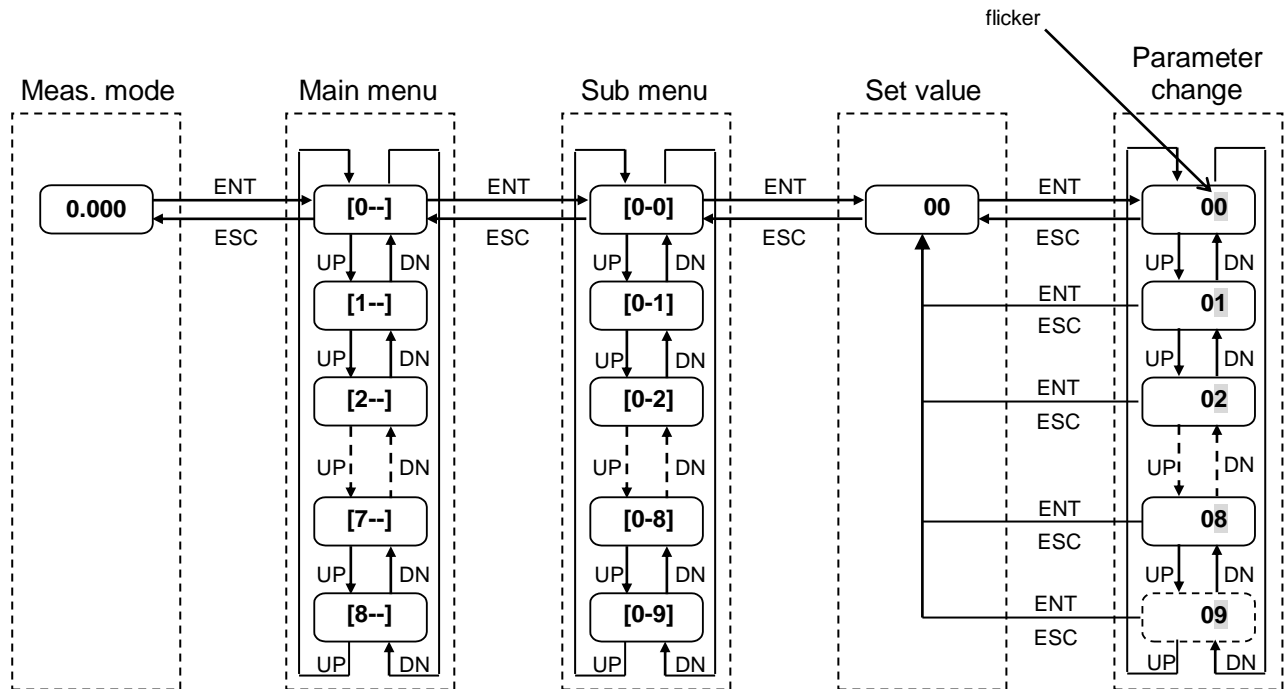


Fig. 5.2.1 Menu transition

Key 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".

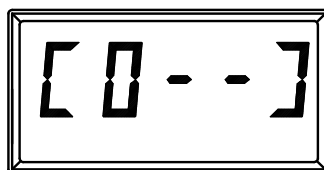


Fig. 5.2.3 LCD main menu No.

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

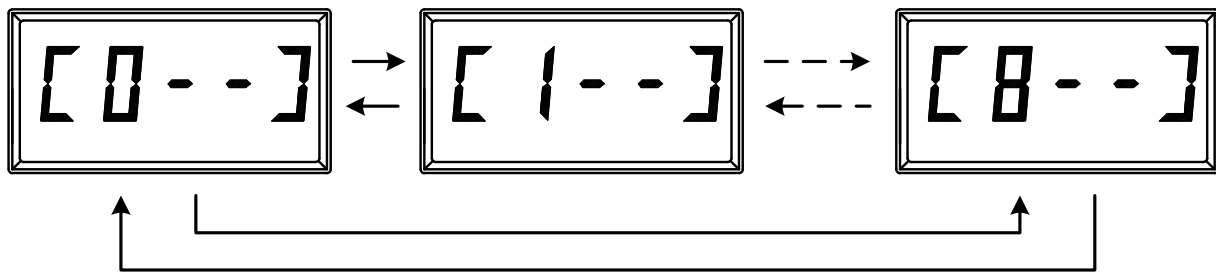


Fig. 5.2.4 Change main menu No.

(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”.

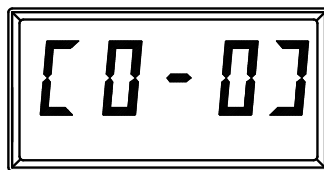


Fig. 5.2.5 LCD sub menu No.

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

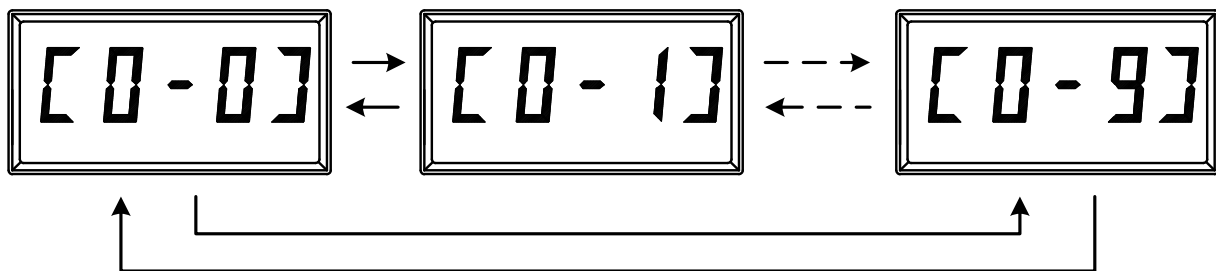


Fig. 5.2.6 Change sub menu No.

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

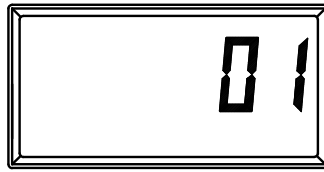


Fig. 5.2.7 LCD set value

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

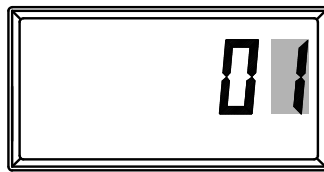


Fig. 5.2.8 Input set value

(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.

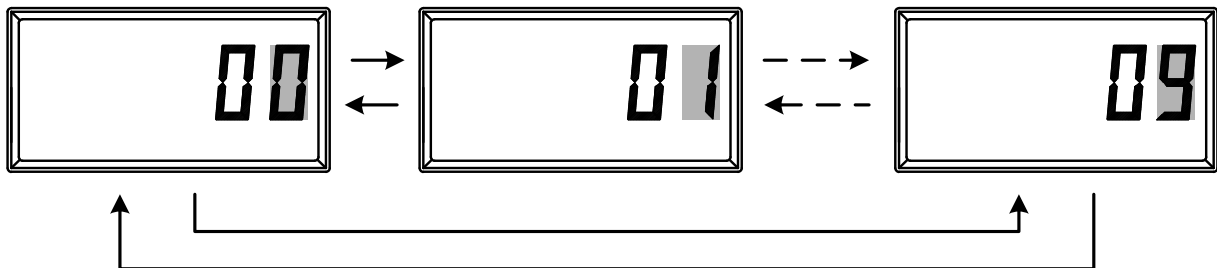


Fig. 5.2.9 Change flickered value

(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--] Basic setting | [0-0] | LCD Indication | 0 | - | 0 ~ 14 |
| | [0-1] | Measurement Unit | 0 | - | 0, 1 |
| | [0-2] | Antenna Type | 2" cone | - | 0 ~ 4, 11, 12, 16 (Do not set outside the setting range.) |
| | | | 4" cone | | |
| | | | 2" PTFE sealing | | |
| | | | 4" PTFE sealing | | |
| | | | 1" Rod | | |
| | | | 2" Pipe | | |
| | | | 4" Pipe | | |
| | | | 3" PTFE sealing | | |
| | [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] | Antenna Type | H | m or Ft | 0.136 ~ 99.999 0.436 ~ 99.999 0.100 ~ 99.999 0.100 ~ 99.999 0.100 ~ 99.999 0.400 ~ 99.999 0.136 ~ 99.999 0.436 ~ 99.999 |
| | | | 2" cone (Ex-types) | | |
| | | | 4" cone (Ex-types) | | |
| | | | 2" PTFE sealing | | |
| | | | 3" PTFE sealing | | |
| | | | 4" PTFE sealing | | |
| | | | 1" Rod | | |
| | | | 2" Pipe (Ex-types) | | |
| | | | 4" Pipe (Ex-types) | | |
| | [0-7] | C | 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 Calc. Method | 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 Calc. Method | 0 | - | 0 ~ 4 |
| | [2-1] | Weir Type | 0 | - | 0 ~ 3 |
| | [2-2] | Nominal (PF) | 0 | - | 0 ~ 13 |
| | [2-3] | B (Breadth of channel) | 0.5 | m or Ft | 0.000 ~ 99.999 |
| | [2-4] | b (Width of weir) | 0.15 | m or Ft | 0.000 ~ 99.999 |
| | [2-5] | D (Height of weir edge relative to bottom of channel) | 0.3 | m or Ft | 0.000 ~ 99.999 |
| | [2-6] | v (Kinematic viscosity of fluid) | 1 | - | 0.000 ~ 99.999 |
| | [2-7] | Flow Unit | 1 | - | 0 ~ 15 |

| Main menu | Sub menu | Parameters | Default | Unit | Range |
|--------------------------------|----------|---|---------|---------|-------------------|
| [3--] Analog Current Output | [3-0] | Analog Current 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--] Measurement Support | [3-4] | Analog Current Output Range - Minimum Value | 3.8 | mA | 3.8 ~ 4.1 |
| | [3-5] | Analog Current Output Range - Maximum Value | 20.5 | mA | 19 ~ 20.5 |
| | [3-6] | Alarm Output Factor | 0 | - | 0 ~ 2 |
| | [4-0] | Averaging Time | 60 | - | 1 ~ 120 |
| | [4-1] | Median Filter | 0 | - | 0 ~ 120 |
| | [4-2] | Re-search Delay | 30 | - | 1 ~ 120 |
| | [4-3] | Alarm Delay | 30 | - | 1 ~ 120 |
| [5--] Outlier Removal | [4-4] | Surface Detect Mode | 0 | - | 0, 1 |
| | [4-5] | Negative Level as Zero | 0 | - | 0, 1 |
| | [4-6] | Noise Margin | 15 | dB | 0 ~ 255 |
| | [5-0] | Valid Window | 0.8 | m or Ft | 0.000 ~ 99.999 |
| | [5-1] | Double Bounce - Double Bounce Removal | 0 | - | 0, 1 |
| [6--] Tracking | [5-2] | Double Bounce - Double Bounce Offset | 0 | m or Ft | -99.999 ~ 99.999 |
| | [5-3] | Tank Bottom - Bottom Visible | 0 | - | 0, 1 |
| | [5-4] | Tank Bottom - Window | 0.3 | m or Ft | 0.000 ~ 99.999 |
| | [6-0] | Level Tracking | 0 | - | 0, 1 |
| [7--] Calibration | [6-1] | Level Prediction | 0 | - | 0, 1 |
| | [6-2] | Slow Search - Slow Search | 0 | - | 0, 1 |
| | [6-3] | Slow Search - Speed | 0 | m or Ft | 0.000 ~ 99.999 |
| | [6-4] | Empty Tank Detection - Empty Tank Detection | 0 | - | 0, 1 |
| | | | 0 | m or Ft | 0.000 ~ 99.999 |
| | [6-5] | Empty Tank Detection - Position | 0 | m or Ft | 0.000 ~ 99.999 |
| [8--] Tools | [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 |
| | [7-5] | Flow Offset Calibration | 0 | - | 0 ~ 99999 |
| | [7-6] | Flow Span Calibration | 1 | - | 0.010 ~ 2.000 |
| [8--] Tools | [7-7] | Flow Cutoff | 0 | - | 0 ~ 99999 |
| | [8-0] | Search | 0 | - | 0, 1 |
| | [8-1] | Parameter Backup / Recovery | 0 | - | 0, 1, 2 |
| | [8-2] | Reboot | 0 | - | 0, 1 |
| | [8-3] | Device Status | - | - | - |
| [8--] Tools | [8-4] | Firmware Version | - | - | - |
| | [8-5] | HART Multidrop Mode | 1 | - | 0, 1 |

5.4 Parameter instructions

In this section, the details of the setting parameters of each menu are explained.

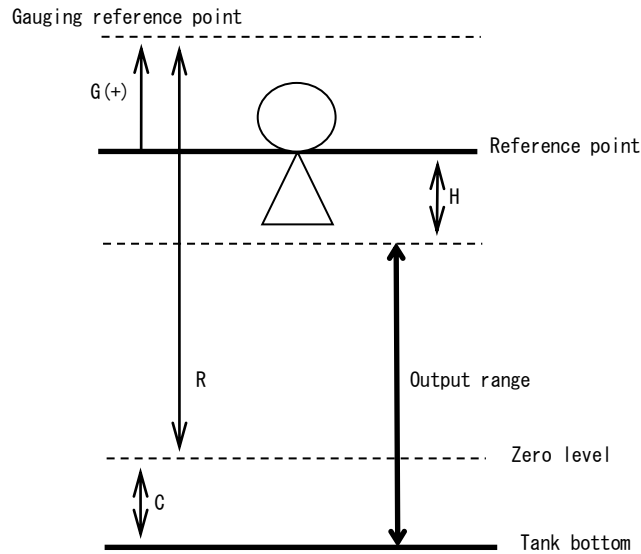


Fig. 5.4.1 Basic setting

Refer to Table 5.3.1 for set range of each parameter.

[0-0] LCD Indication

- 0: Level
- 1: Distance
- 2: Volume
- 3: Flow
- 4: Current
- 5: Sig-Amp
- 6: Temperature
- 7: Max Volume
- 8: Max Flow
- 9: Volume Ratio
- 10: Flow Ratio
- 11: Elapsed Time from Start
- 12: Search Count Number of searches executed
- 13: Elapsed Time from Final Search
- 14: Margin of Sensitivity

[0-1] Measuring Unit

- 0: m
- 1: Ft

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

[0-2] Antenna Type

Enter the type of the antenna pipe.

Usually, it is not necessary for antenna type to be input.

- 0: 2" Cone
- 1: 4" Cone
- 2: 2" PTFE Seal
- 3: 4" PTFE Seal
- 4: 1" Rod
- 11: 2" Pipe
- 12: 4" Pipe
- 16: 3" PTFE Seal

[0-3] Bore

Enter the inner diameter of the antenna pipe.

[0-4] G

Enter the parameter G, distance from reference point to gauging reference point.

[0-5] R

Enter the parameter R, distance from gauging reference point to zero level.

[0-6] H

Enter the parameter H, hold off distance from reference point.

The echo within H is not detected. When the surface moves within H, the device may malfunction. Please set H in the area where the surface does not come in.

The minimum value of H is limited by the antenna type. For example, when the antenna type is set to 4" cone antenna, and H is set to 0.1m, H is forced to minimum hold off distance 0.436m.

Table. 5.4.1 Minimum hold off distance of each antenna

| Antenna type | Minimum hold off distance [m] |
|---------------------------|-------------------------------|
| 2" cone antenna | 0.136 |
| 4" cone antenna | 0.436 |
| 2" PTFE sealing antenna | 0.1 |
| 3" PTFE sealing antenna | 0.1 |
| 4" PTFE sealing antenna | 0.1 |
| 1" rod antenna | 0.4 |
| 2" pipe + 2" cone antenna | 0.136 |
| 4" pipe + 4" cone antenna | 0.436 |

[0-7] C

Enter the parameter C, distance from zero level to tank bottom.

Liquid surface level is usually displayed in a negative value in the range of C. Negative output value is forced to zero by setting Negative Level as Zero to ON.

[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. The position of the decimal point becomes the set in **[0-8] Number of decimal places for Display Offset**.

[1-0] Volume Calc. Method

Volume converter.

Selectable a formula of volume conversion from following 5 ways.

- 0: No Calc.
- 1: Vertical Cylinder Tank
- 2: Spherical Tank
- 3: Horizontal Cylinder Tank
- 4: User Defined

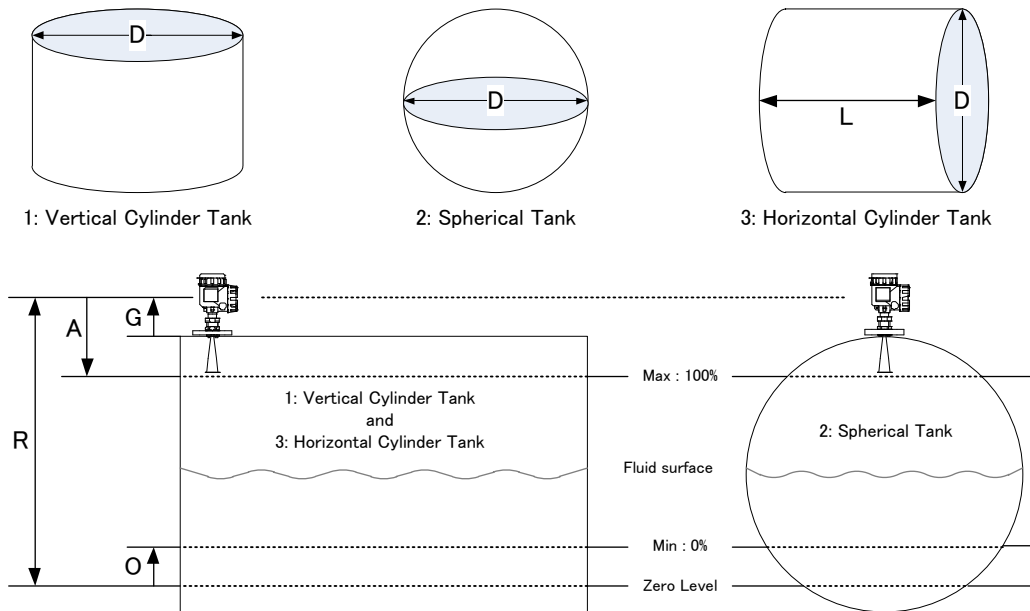


Fig. 5.4.2 Volume Calc. Method

[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

Please refer to **6.3.2 Calc. Volume** for the details from [1-0] to [1-5].

[2-0] Flow Calc. Method

Flow rate converter.

Selectable formula of flow rate conversion from following 5 way.

- 0: No Calc.
- 1: Weir_JIS_B8302 : Refer to a Table 6.3.1
- 2: Flume_JIS
- 3: User Defined : Select if user defined table conversion is used.
- 4: Weir_JIS_K0094 : Refer to a Table 6.3.2)

[2-1] Weir Type

Weir formula. (JIS B 8302 or JIS K 0094)

- 0: 60° Triangular weir (*JIS B 8302 only)
- 1: 90° Triangular weir
- 2: Rectangular weir
- 3: Full-Width weir

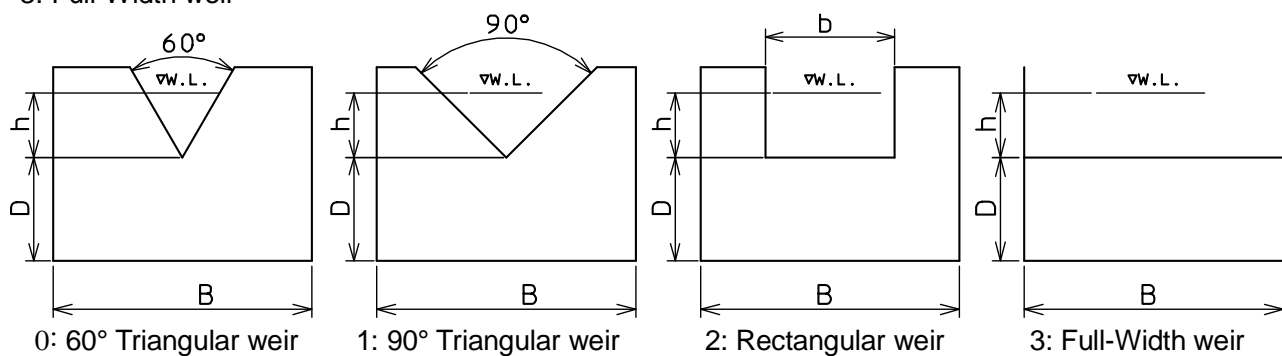


Fig. 5.4.3 Weir type

[2-2] Nominal (PF)

Parshall Flume Formula. (JIS B 7553)

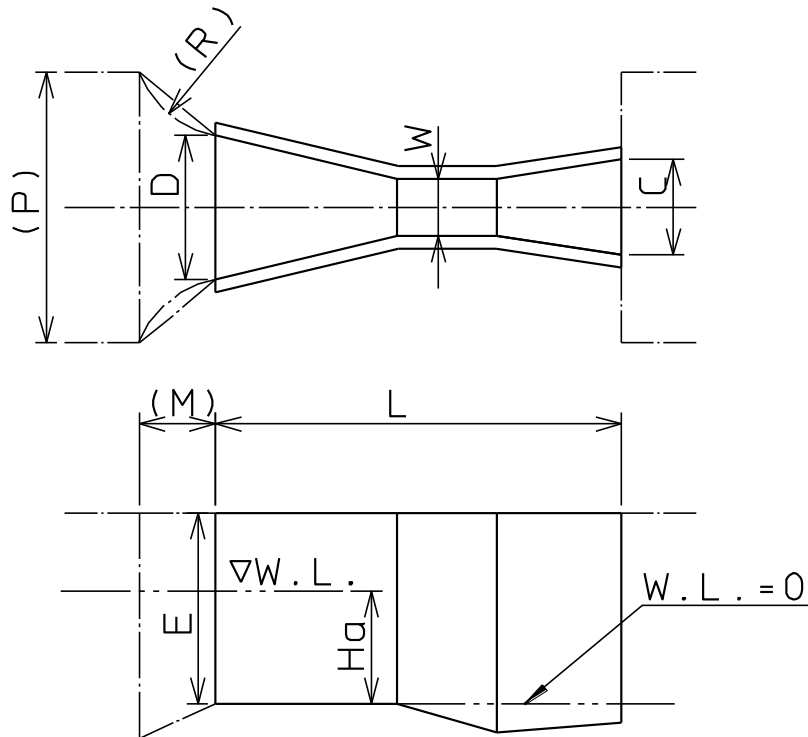
Select size of parshall flume.

- 0: PF-01
- 1: PF-02
- 2: PF-03
- 3: PF-06
- 4: PF-09
- 5: PF-10
- 6: PF-15
- 7: PF-20
- 8: PF-30
- 9: PF-40
- 10: PF-50
- 11: PF-60
- 12: PF-70
- 13: 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. 5.4.4 Parshall Flume

[2-3] B (Breadth of channel)

Channel width. (Please refer Fig 5.4.3 Weir type)

[2-4] b (Width of weir)

Weir width. (Please refer 2: Edged Square of Fig 5.4.3 Weir type)

[2-5] D (Height of weir edge relative to bottom of channel)

Liquid height from notch end. (Please refer Fig 5.4.3 Weir type)

[2-6] v (Kinematic viscosity of fluid)

Input a value of kinematic viscosity coefficient.

[2-7] Flow Unit

Flow rate unit.

Select unit for flow rate.

- 0: m³/D
- 1: m³/h
- 2: m³/min
- 3: m³/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: Ft³/D
- 13: Ft³/h
- 14: Ft³/min
- 15: Ft³/sec

[3-0] Analog Current Output Parameter

Enter the content of parameters output at 4-20mA.

- 0: Level
- 1: Distance
- 2: Volume
- 3: Flow
- 4: Sig-Amp

[3-1] Minimum Output

Enter the Analog Current Output value corresponding to 4 mA.

(Level / Distance / Volume / Flow / Sig-Amp)

[3-2] Maximum Output

Enter the Analog Current Output value corresponding to 20 mA.

(Level / Distance / Volume / Flow / Sig-Amp)

[3-3] Alarm Selection

Enter the content of alarm output.

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

[3-4] Minimum Value

Enter the minimum value of analog current output range.

[3-5] Maximum Value

Enter the maximum value of analog current output range.

[3-6] Alarm Output Factor

Enter the factor of alarm output.

- | | |
|----------------------|--|
| 0: No Receiving Echo | Select if alarm is output when echo cannot be detected |
| 1: Device Failure | Select if alarm is output when the device failure |
| 2: Both | Select if alarm is output when echo cannot be detected or the device failure |

[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.

Please refer to **6.6.1 Measurement Support** for the details.

[4-2] Re-search Delay

Time delay after loss of surface echo until search 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] Surface Detect Mode

Enter the echo detected as the liquid level echo.

- | | |
|---------------|---|
| 0: Max Echo | Max strength echo defined as surface echo |
| 1: First Echo | First echo defined as surface echo |

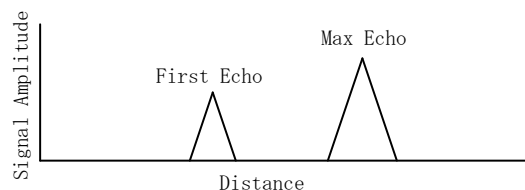


Fig. 5.4.5 Surface Detect Mode

[4-5] Negative Level as Zero

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.

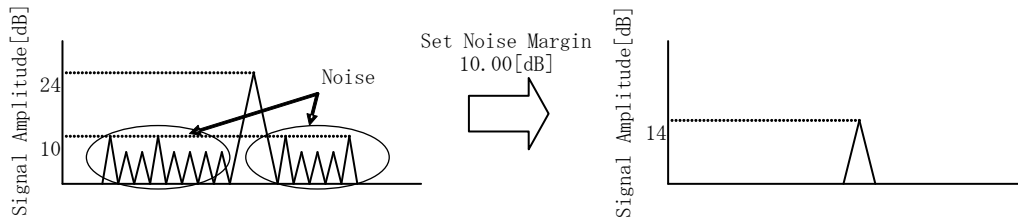


Fig. 5.4.6 Noise margin

[5-0] Valid Window

Enter the valid window for detecting echo. 2 times the setting value becomes the range of valid window with a central focus on the surface echo.

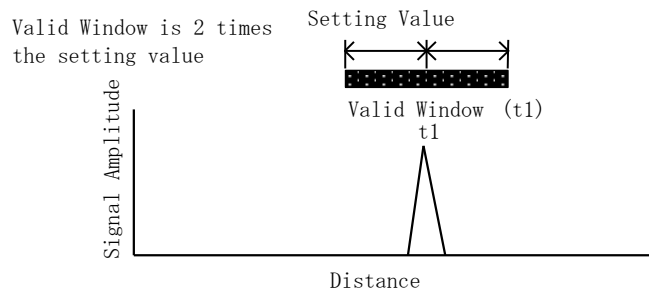


Fig. 5.4.7 Valid window

[5-1] Double Bounce Removal

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. This value is used to remove the reflection echo from top surface of tank.

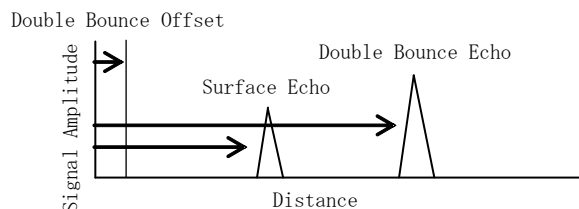


Fig. 5.4.8 Double bounce

[5-3] Bottom Visible

While this function is "On", a detected tank 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

Enter the window for tank bottom echo recognition.

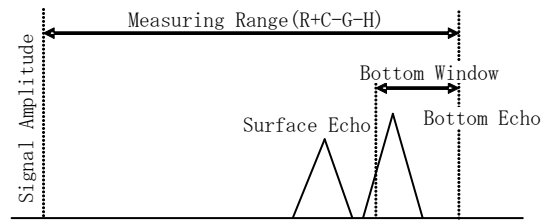


Fig. 5.4.9 Tank bottom echo & Bottom window

[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

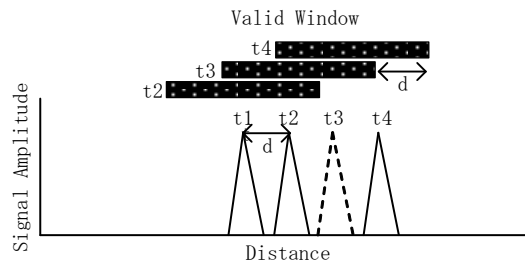


Fig. 5.4.10 Level tracking

[6-1] Level 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 and the re-search delay time has passed.

- 0: Off
- 1: On

[6-3] Slow Search Speed

Set the distance per second to enlarge the effective window during slow search.
The distance to be enlarged varies depending on the search time.

Note:

- Search time[s] = “Boot Mode” setting, “Normal” 15 sec / “Fast” 4 sec
- Slow Search Speed[d] = speed [m/sec] × Search time [sec]

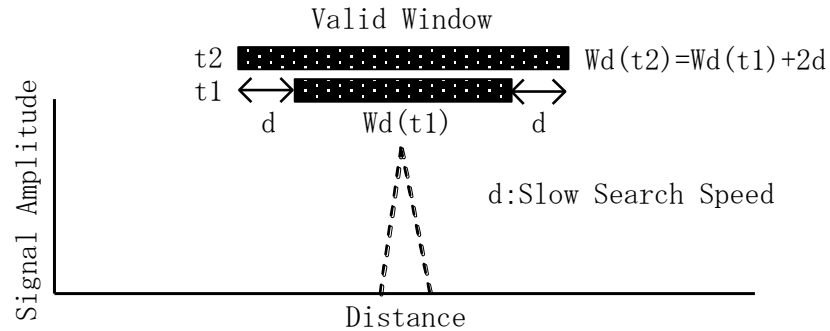


Fig. 5.4.11 Slow search

[6-4] Empty Tank Detection

While this function is "On", liquid level "0" will be outputted if the last position of surface echo was lower than empty tank detection position when echo was lost.

- 0: Off
- 1: On

[6-5] Empty Tank Detection Position

Enter a threshold value (distance from tank bottom) as empty tank detection position to recognize measured level as empty level (Parameter [R]+[C]) if measured level is lower than the threshold value.

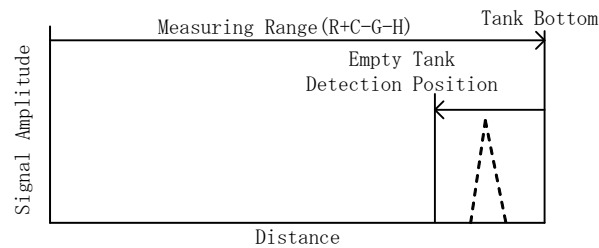


Fig. 5.4.12 Empty Tank Detection

[7-0] Fixed Current Output

Enter a current value to fix output current from the transmitter for output calibration.

When the fixed current output is set to 0mA, fixed current mode is canceled and current value that selected as [3-0] **Analog Current Output Parameter** is output. In addition, fixed current mode is canceled by turning on a power supply again or performing [8-2] **Reboot**.

[7-1] Calibration - 4 mA Calibration

In fixed current output mode with current set at 4 mA, input ammeter reading.
The procedure is as follows.

- (1) Preparation
Connect an ammeter.
- (2) **[7-0]Fixed Current Output**
Current set at 4.000 mA.
- (3) **[7-1]Calibration - 4 mA Calibration**
Enter the current measurement value. (Range: 3.500 ~ 4.500mA)
Check the current measurement value.
- (4) **[7-0]Fixed Current Output**
Current set at 0.000 mA.
- (5) Finish
Return to the original connection.

[7-2] Calibration - 20 mA Calibration

In fixed current output mode with current set at 20 mA, input ammeter reading.

Same procedure as **[7-1] Calibration**

Current set at 20.000 mA.

Enter the measurement value. (Range: 15.000 ~ 25.000mA)

[7-3] Offset Calibration

Enter an offset value to be adjusted.

[7-4] Span Calibration

Enter a span value to be adjusted.

[7-5] Flow Offset Calibration

Enter an offset value to be adjusted flow measurement value.

[7-6] Flow Span Calibration

Enter a span value to be adjusted flow measurement value.

[7-7] Flow Cutoff

Enter a cutoff value to be adjusted flow measurement value. When the flow measurement value is less than set value, "0" flow will be imposed.

[8-0] Search

Mandatory surface echo is searched.

- | | |
|-----------|--------------------------|
| 0: | Default. |
| 1: Search | Searched by "1" setting. |

[8-1] Parameter Backup / Recovery

By running "Recovery", Inputted parameters in the device are replaced by factory default values.

By running "Backup", factory default values in time of factory shipment are replaced by the inputted parameters in the device. Please note, factory default values are deleted by running "Backup".

Please do not turn off the power for 5 seconds, after running "Backup".

No replaceable parameters

Noise Table, Volume Table, Flow Table, Fixed Echo Position, HART Address

- | | |
|-------------|---------------------------|
| 0: | Default. |
| 1: Recovery | Recovered by "1" setting. |
| 2: Backup | Backed up by "2" setting. |

[8-2] Reboot

The device is rebooted.

- 0: Default.
1: Reboot Rebooted by "1" setting.

[8-3] Device Status

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 could not be recovered by rebooting, please contact your representative. |
| E-02 | RAM (RAM Error) | RAM failure | |
| E-03 | Transmitter (Transmit/Receiving circuit error) | Transmitter failure | |
| 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 Calc. Method (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.

[8-5] HART Multidrop Mode

While this function is "On", HART multidrop mode is effective.

- 0: On
1: Off

Chapter 6 Operations by configuration software

6.1 Overview

6.1.1 System configuration

You can adjust the device 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

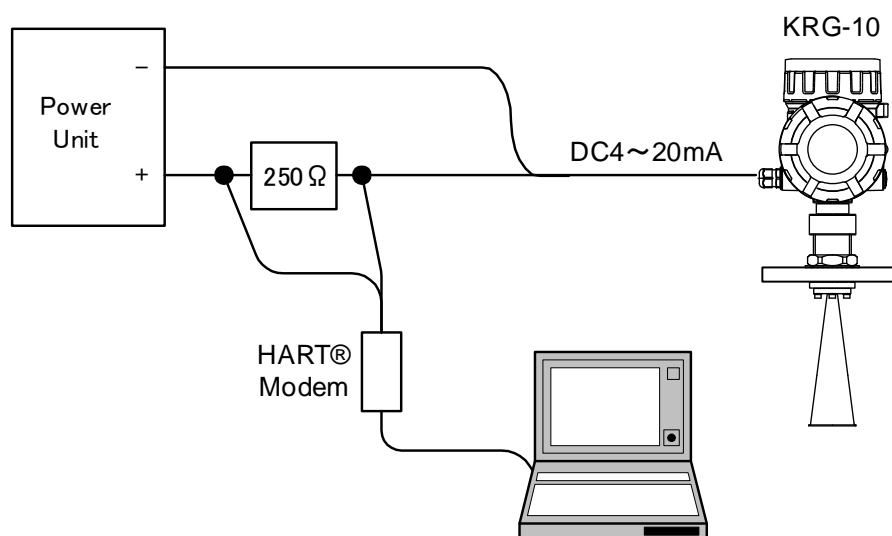


Fig. 6.1.1 System configuration

6.1.2 What is Level Config?

Level Config is the configuration software for KRG-10 that enables to adjust the device by using a PC. Using HART for communication, it is possible to set parameters for the device 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 7 / 8.1 / 10
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".

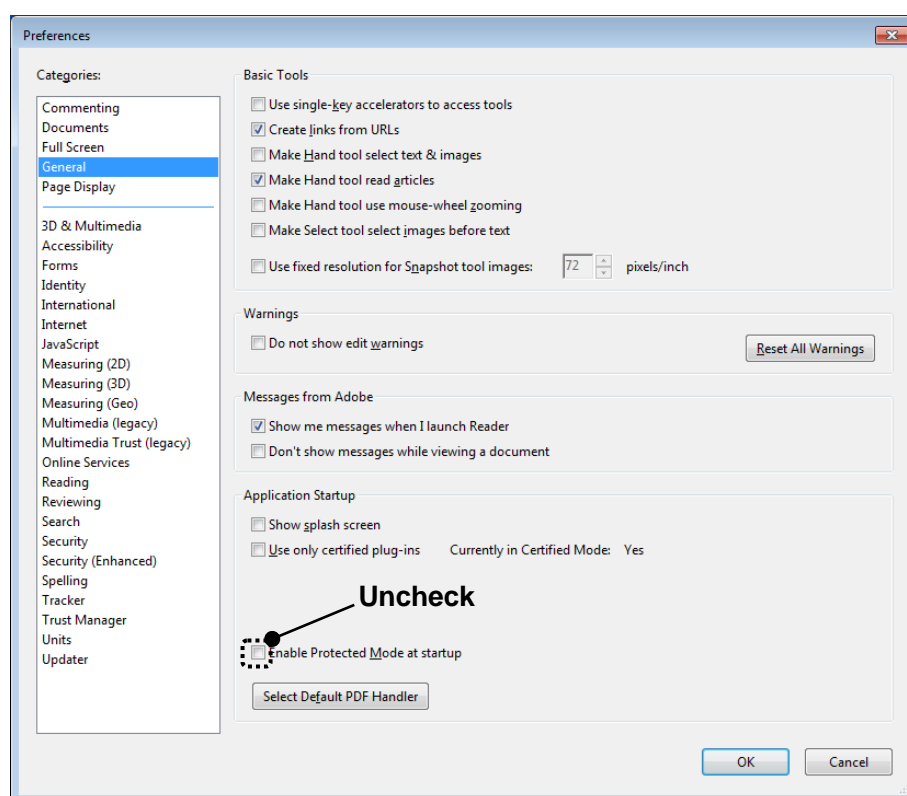


Fig. 6.1.2 Setting for Adobe Acrobat Reader (example)

*** Categories may vary according to the version of Adobe Acrobat Reader.**

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. Press Windows + R keys.
2. "Run" command box type "control", enter. Select view small and click Device Manager (In Windows 7 / 8.1/ 10, 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.

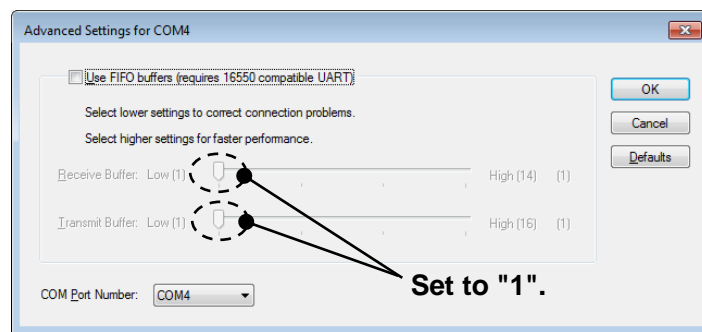


Fig. 6.1.3 COM port settings

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

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

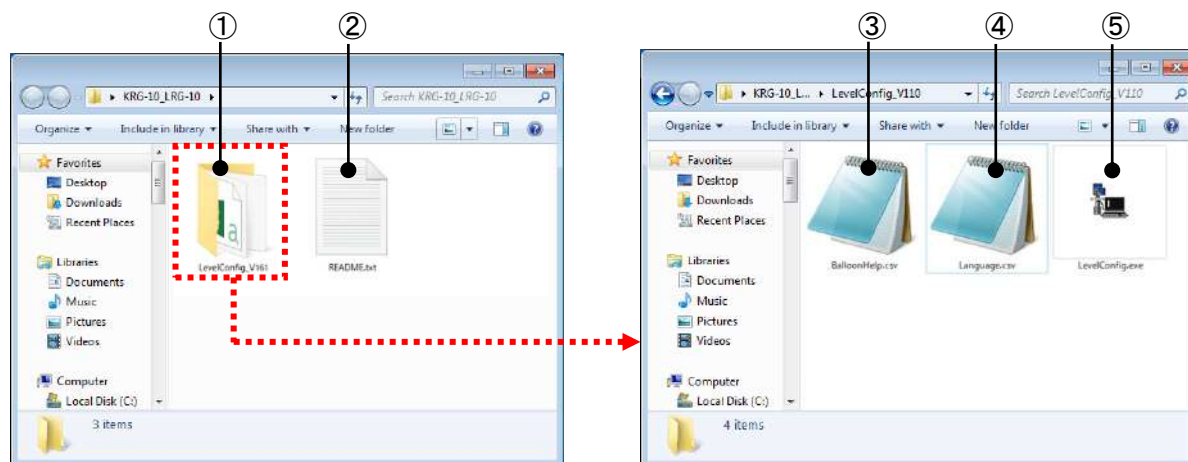


Fig. 6.1.4 Distributed files

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.

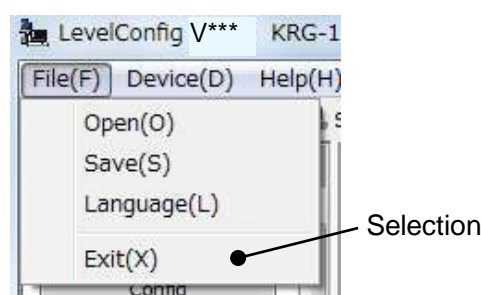


Fig. 6.1.5 Menu bar exit button

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



Fig. 6.1.6 Window close button

When there is the parameter which is not written in the device, the following confirmation window is displayed. Then the configuration software is closed when you click the "OK" button.

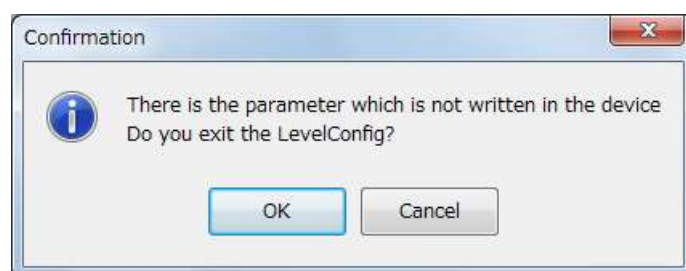


Fig. 6.1.7 Close confirmation window

*** 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
- Device type number
- Communication master mode
- Folder name you saved last time

6.1.8 Window

The configuration of the basic window is shown below.

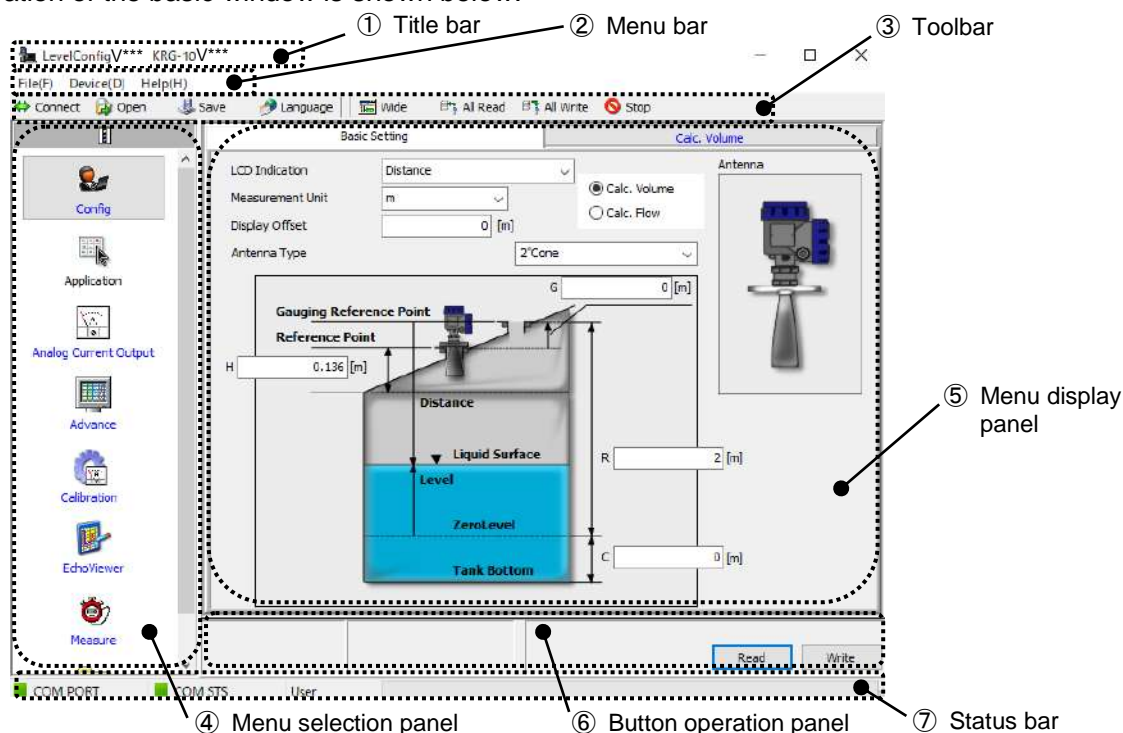


Fig. 6.1.8 Basic window configuration

Name / function of each panel:

① Title bar

In the title bar, name and version of configuration software, connected device name, and firmware version are displayed.

② Menu bar

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

③ Toolbar

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

④ Menu selection panel

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

⑤ Menu display panel

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

⑥ Button operation panel

The area where button operations in each menu are performed.

⑦ Status bar

In the status bar, the status of the connection to the device 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

| <u>Basic menu</u> [Menu] | [Tab] | [Content] |
|------------------------------|----------------------------|---|
| Config | | Basic settings, volume calculation settings and flow rate calculation settings. |
| | Basic Setting | Reading basic setting parameters from the device and writing basic parameters to the device. |
| | Calc. Volume | Reading volume calculation parameters from the device and writing volume calculation parameters to the device. |
| | Calc. Flow | Reading flow rate calculation parameters from the device and writing flow rate calculation parameters to the device. |
| Analog Current Output | | Reading analog current output parameters from the device and writing analog current output parameters to the device. |
| Application | | Auto configuration parameters depend on installation environment and purpose of use. |
| Advance | | Measurement support settings, outlier removal settings, and tracking settings. |
| | Measurement Support | Reading measurement support parameters from the device and writing measurement support parameters to the device. |
| | Outlier Removal | Reading outlier removal parameters from the device and writing outlier removal parameters to the device. |
| | Tracking | Reading tracking parameters from the device and writing tracking parameters to the device. |
| Calibration | | Analog settings, level settings and checks. |
| | Analog | Reading analog parameters from the device and writing analog parameters to the device. |
| | Level | Reading level parameters from the device and writing level parameters to the device. |
| | Check | Current loop check and table check. |
| Echo Viewer | | Reading the fixed echo from the device, writing the fixed echo to the device and general operations of the echo curve. |
| Measure | | Reading the echo list from the device, reading the maximum value from the device and general operations of measurement. |
| Tools | | Reset and errors. |
| | Reset | Executing the device reset. |
| | Error | Reading the device status. |

Table 6.1.2 Structure and content of other menus

| <u>Other menus</u> [Menu] | [Content] |
|------------------------------|---|
| Device Connection | Connecting to the equipment and disconnecting from the equipment. |
| Language Setting | Setting the display language. |

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.

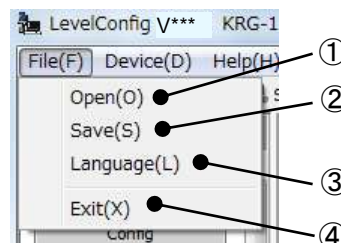


Fig. 6.1.9 Menu bar "File"

<Device menu>

- ① Use this to connect to the device.
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 application wizard will open according to click operation.
- ④ Use this to switch menus.
The analog current output menu will open according to click operation.
- ⑤ Use this to switch menus.
The advanced settings menu will open according to click operation.
- ⑥ Use this to switch menus.
The calibration menu will open according to click operation.
- ⑦ Use this to switch menus.
The Echo Viewer menu will open according to click operation.
- ⑧ Use this to switch menus.
The measurement menu will open according to click operation.
- ⑨ Use this to switch menus.
The tool menu will open according to click operation.

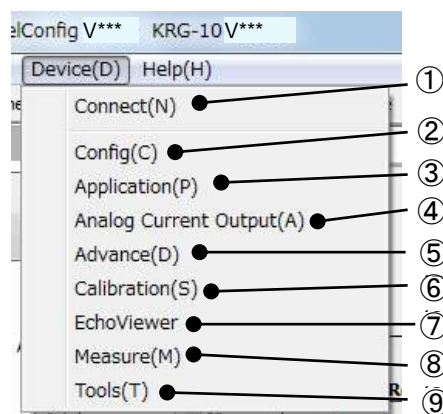


Fig. 6.1.10 Menu bar "Device"

<Help menu>

- ① Displays the version information of the configuration software.












Fig. 6.1.11 Menu bar "Help"

6.1.11 Explanation of the toolbar

The toolbar is used to call functions that are used relatively frequently, such as option functions. Toolbar items are shown in the following table.

Table 6.1.3 Toolbar

| | | |
|---|-------|--|
|  Connect | ----- | Use to connect to the device. 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. |
|  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 device. |
|  All Write | ----- | Writes all parameter values of the configuration software to the device. |
|  Stop | ----- | Forcibly stops communication with the device. |

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 device. Status bar items are shown below.

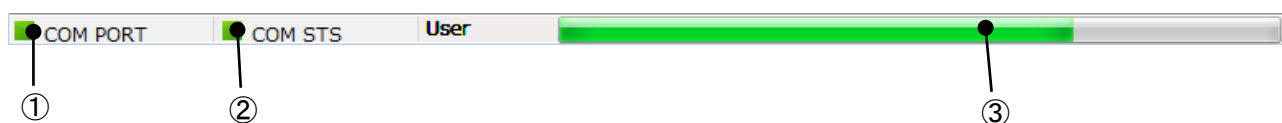


Fig. 6.1.12 Status bar

- 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 toolbar, the following window is displayed.

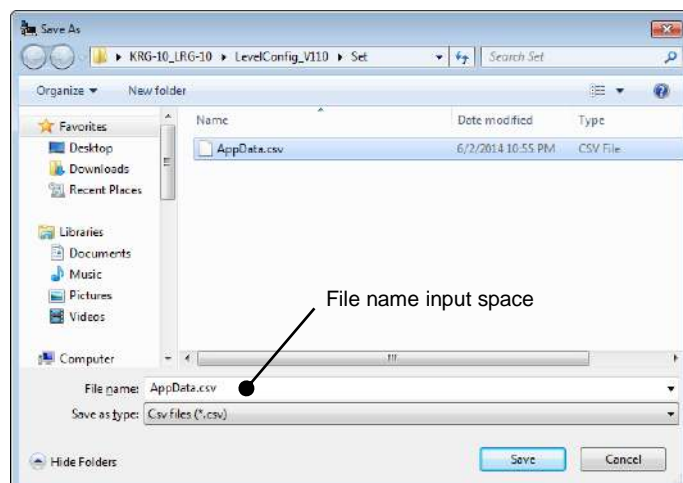


Fig. 6.1.13 File save dialog box

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 toolbar, the following window is displayed.

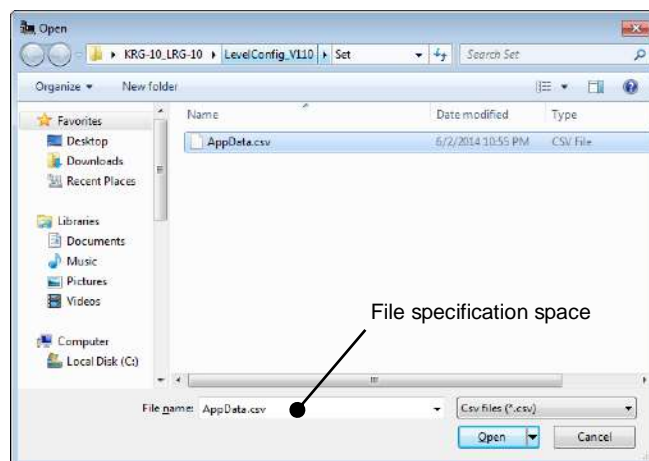


Fig. 6.1.14 File open dialog box

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 toolbar, the following window is displayed.

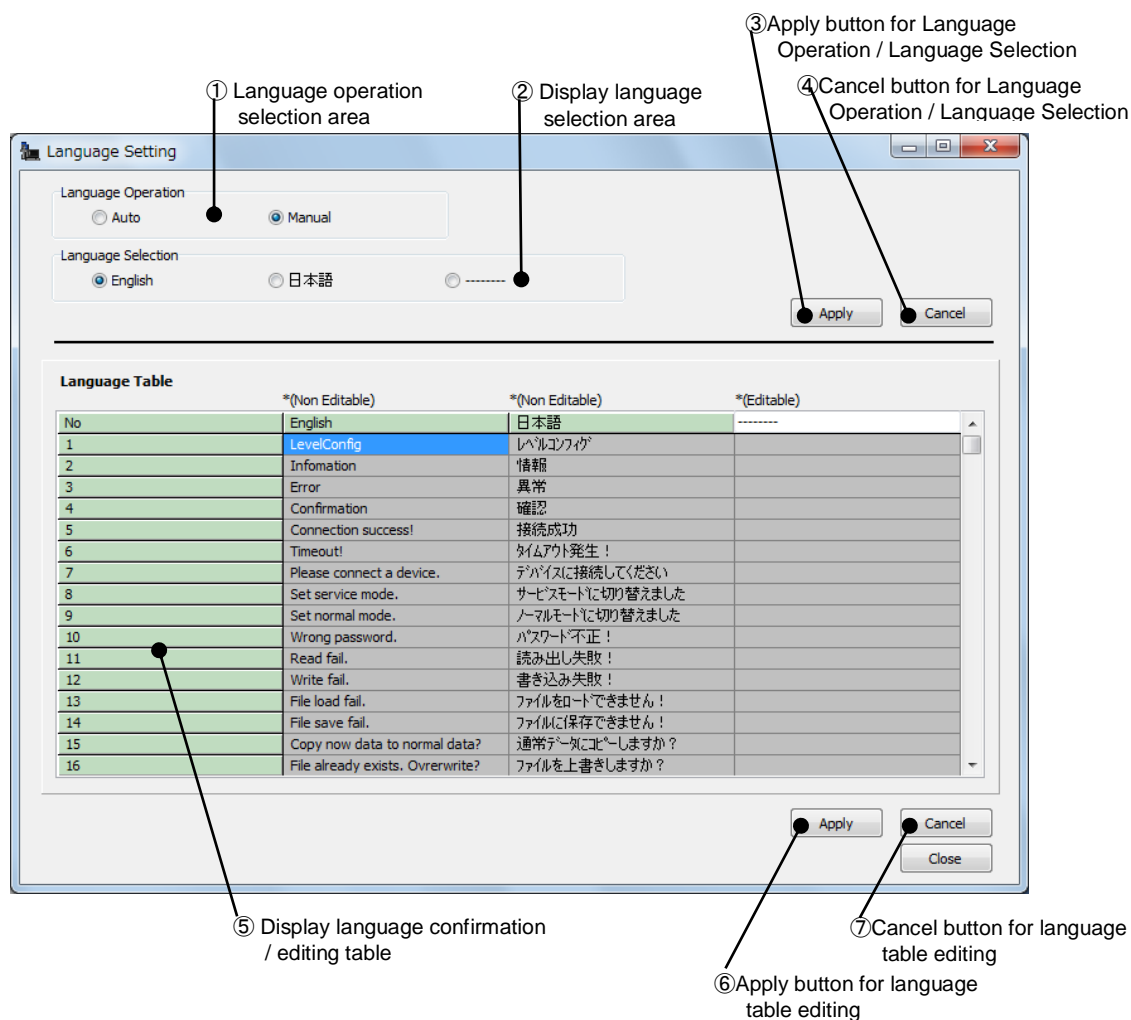


Fig. 6.1.15 Language settings menu

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 ③ of 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.

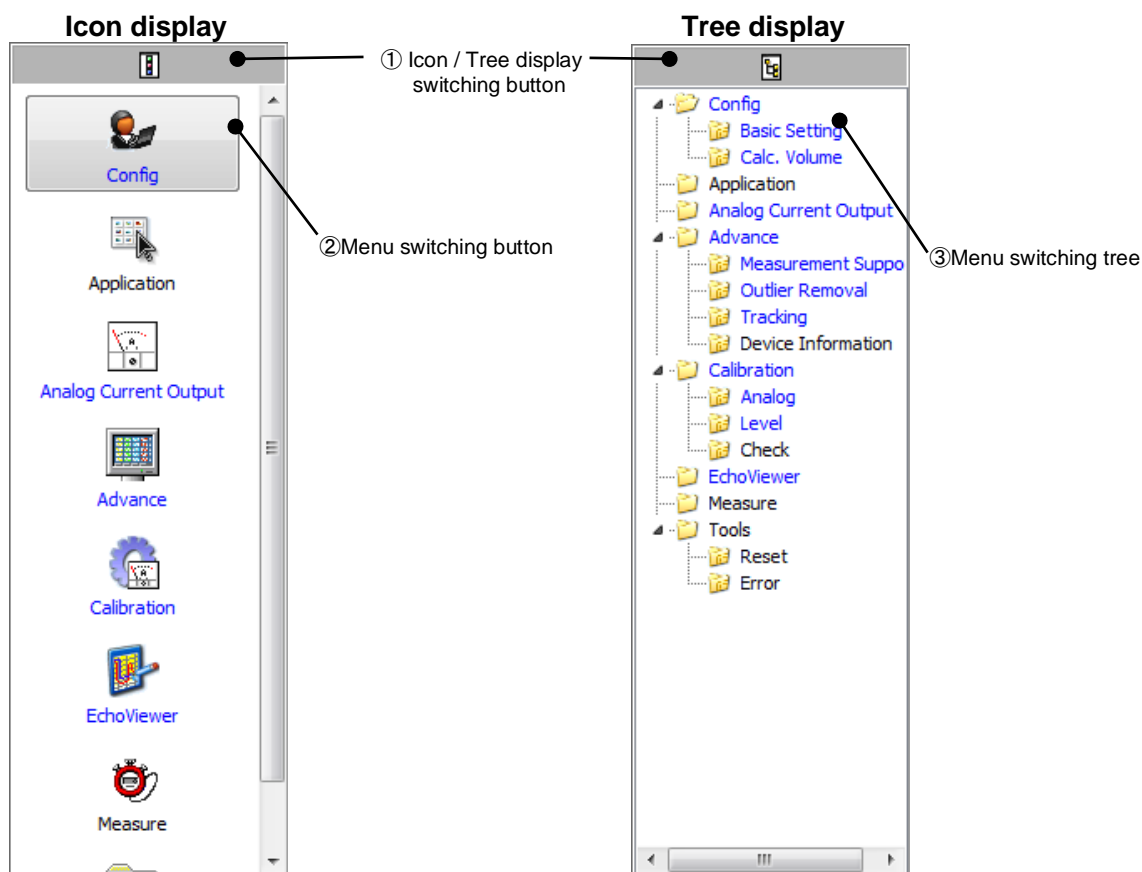


Fig. 6.1.16 Displaying the menu selection panel

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. If there is the parameter that is not written in at the device, the menu is displayed in a blue character. During communicating with the device, menu switching button and menu switching tree cannot be operated.

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 toolbar. When enlarged, the menu selection panel cannot be used, but the menu can be switched by using the menu bar.

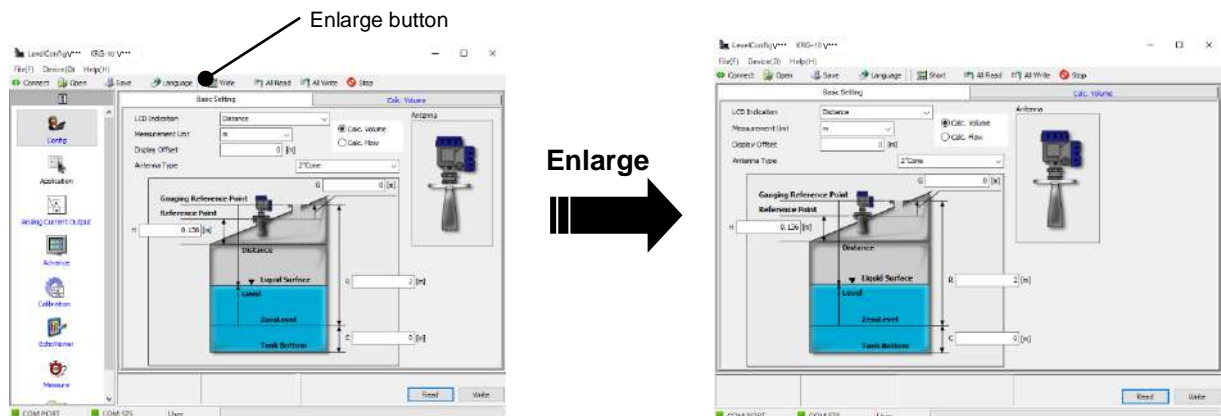


Fig. 6.1.17 Enlarging the menu

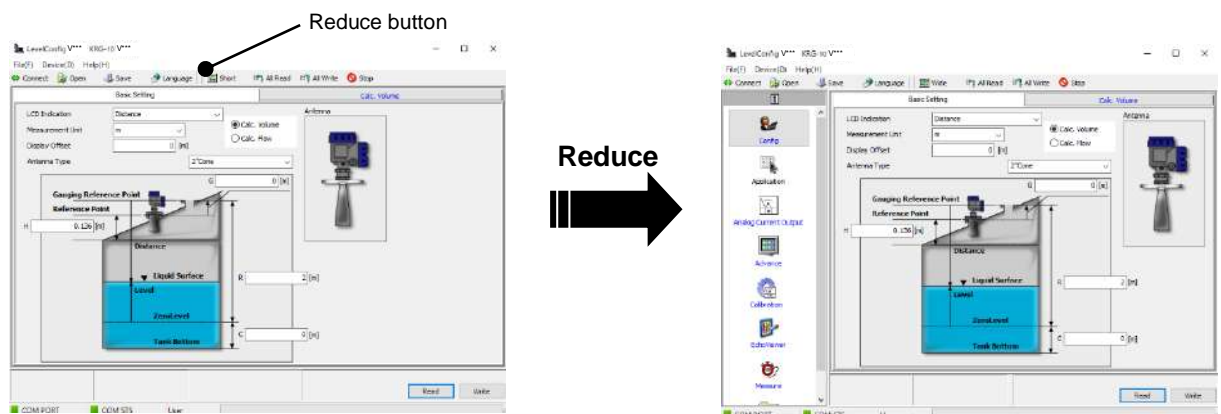


Fig. 6.1.18 Reducing the menu

6.1.18 Read all settings

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

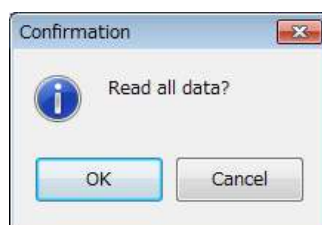


Fig. 6.1.19 Read all confirmation dialog box

6.1.19 Write all settings

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

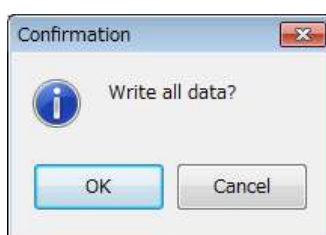


Fig. 6.1.20 Write all confirmation dialog box

6.1.20 Stop communication

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

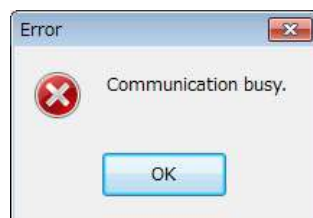


Fig. 6.1.21 Communication busy dialog box

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

6.1.21 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.

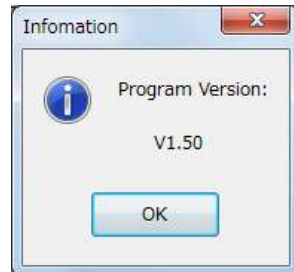


Fig. 6.1.22 Version information (example)

To close the window, click "OK".

6.2 Connecting to the device

This section explains how to connect to or disconnect from the device.

To connect to or disconnect from the device, click "Connect" on the menu bar or toolbar. Then the following window is displayed. (The following window is automatically displayed when the configuration software is initially started.)

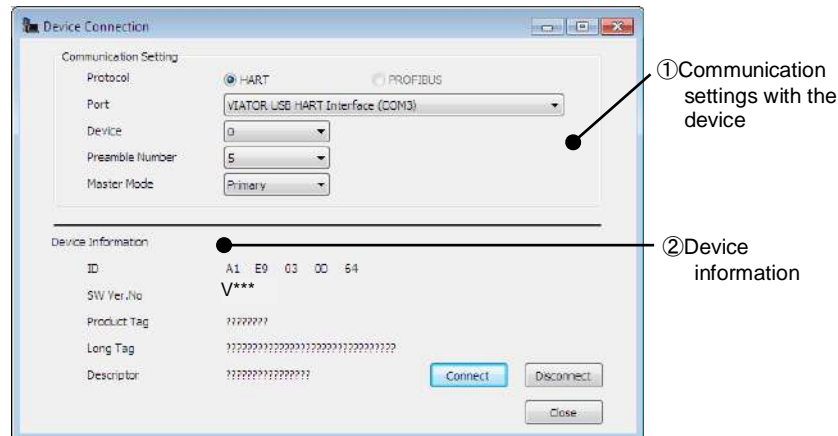


Fig. 6.2.1 Device connection menu

6.2.1 Connection

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

- | | |
|-------------------|--|
| - Protocol | Support HART The device of the 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) |
| - Master Mode | Specify the master mode of HART communication |

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

If connection succeeded



If connection failed



(Device connection window is automatically closed)

Fig. 6.2.2 Connection response dialog box

If connection is successful, the device 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.

| Device Information | |
|--------------------|----------------------------------|
| ID | A1 E9 03 0D 64 |
| SW Ver.No | V*** |
| Product Tag | ??????? |
| Long Tag | ???????????????????????????????? |
| Descriptor | ???????????????? |

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

6.2.2 Disconnection

To disconnect the configuration software from the device, click "Disconnect". After disconnecting, the device 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 device. If you click "Basic Setting" tab or "Basic Setting" in the tree display, the following window is displayed. Data that does not match the status of the device will be displayed with a yellow () and data that matches the status of the device will be displayed with a white (). The color of cell will be displayed with a light gray () in case of the input error.

* If there is the parameter that is not written in at the device, it becomes the blue character.

* It is not possible to simultaneously display the volume calculation menu and flow calculation menu.

* Only when antenna type is following type, bore is displayed.
- 2" pipe
- 4" pipe

Fig. 6.3.1 Basic settings menu

(1) Reading basic settings data

To read the basic settings data from the device, 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 device, 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 Indication | Content displayed on the LCD (Level / distance / volume / flow / output current / signal amplitude / electronic temperature / maximum volume / maximum flow / volume ratio / flow ratio / elapsed time from start / search count / elapsed time from final search / margin of sensitivity) |
| - 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 / 3" PTFE Sealing / 4" PTFE Sealing / 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 reference point to gauging reference point (-99.999m to 99.999m) |
| - R | Distance from gauging reference point to zero level (0.0m to 99.999m) |
| - C | Distance from zero level to bottom of tank (0.0m to 99.999m) |
| - H | Hold off distance (0.0m to 99.999m) |



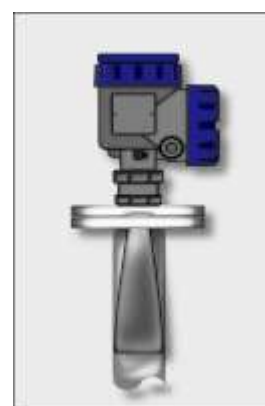
Cone



PTFE Sealing



Rod



Pipe

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 device. 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 device will be displayed with a yellow () and data that matches the status of the device will be displayed with a white (). The color of cell will be displayed with a light gray () in case of the input error.

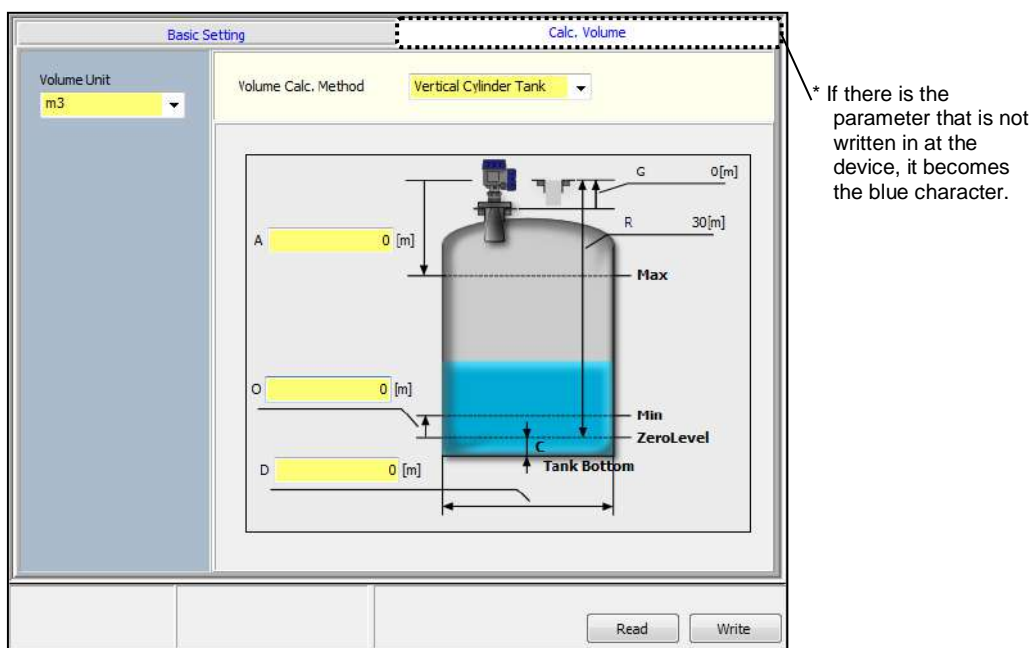


Fig. 6.3.3 Volume calculation menu

(1) Reading volume calculation data

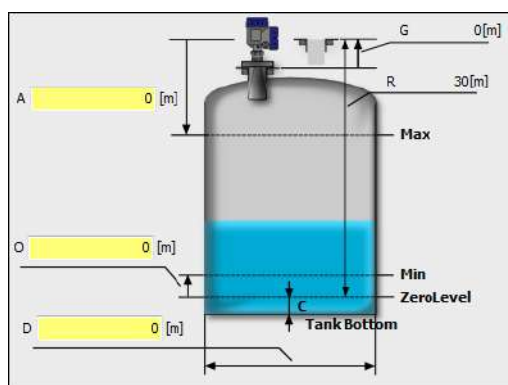
To read the volume calculation data from the device, click the "Read" button. After reading starts, wait momentarily until the processing progress on the status bar stops.

(2) Writing volume calculation data

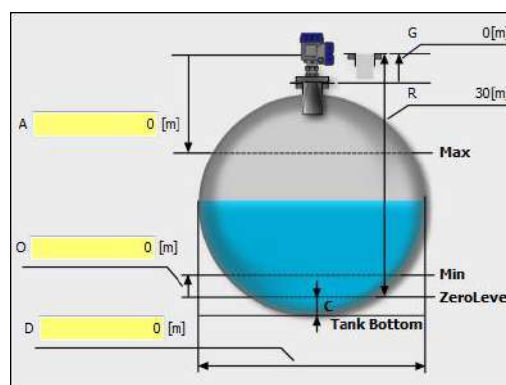
To write the volume calculation data to the device, input the data to write and then click the "Write" button. After writing starts, wait momentarily until the processing progress on the status bar stops.

Calc. Volume data

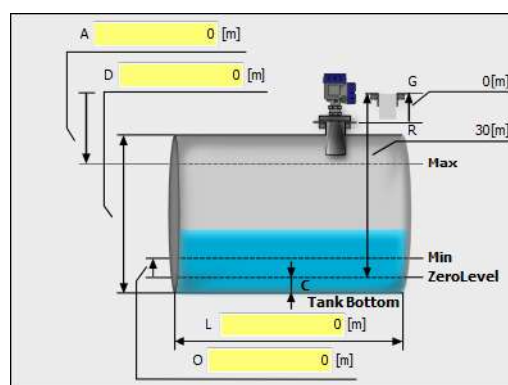
- Volume Calc. Method Tank shape
(Unknown / Vertical Cylinder Tank / Spherical Tank / Horizontal Cylinder Tank / User Defined (Volume Table))
- A Distance to the full level of the measured tank
(-99.999m to 99.999m)
- O Measured tank offset
(-99.999m to 99.999m)
- D Measured tank diameter
(0.0m to 99.999m)
- 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 (0.0m³ to 99999.0m³))
- Volume Unit Measured volume units
(m³/US Gallons/Barrels/Ft³)
*The volume unit in a sentence is indicated as a case of “m³” setup.



Vertical Cylinder Tank



Spherical Tank



Horizontal Cylinder Tank

Volume Table

Point Number

| | Level[m] | Volume[m3] |
|----|----------|------------|
| 1 | 0 | 0 |
| 2 | 0 | 0 |
| 3 | 0 | 0 |
| 4 | 0 | 0 |
| 5 | 0 | 0 |
| 6 | 0 | 0 |
| 7 | 0 | 0 |
| 8 | 0 | 0 |
| 9 | 0 | 0 |
| 10 | 0 | 0 |
| 11 | 0 | 0 |
| 12 | 0 | 0 |

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 device. 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 device will be displayed with a yellow () and data that matches the status of the device will be displayed with a white (). The color of cell will be displayed with a light gray () in case of the input error.

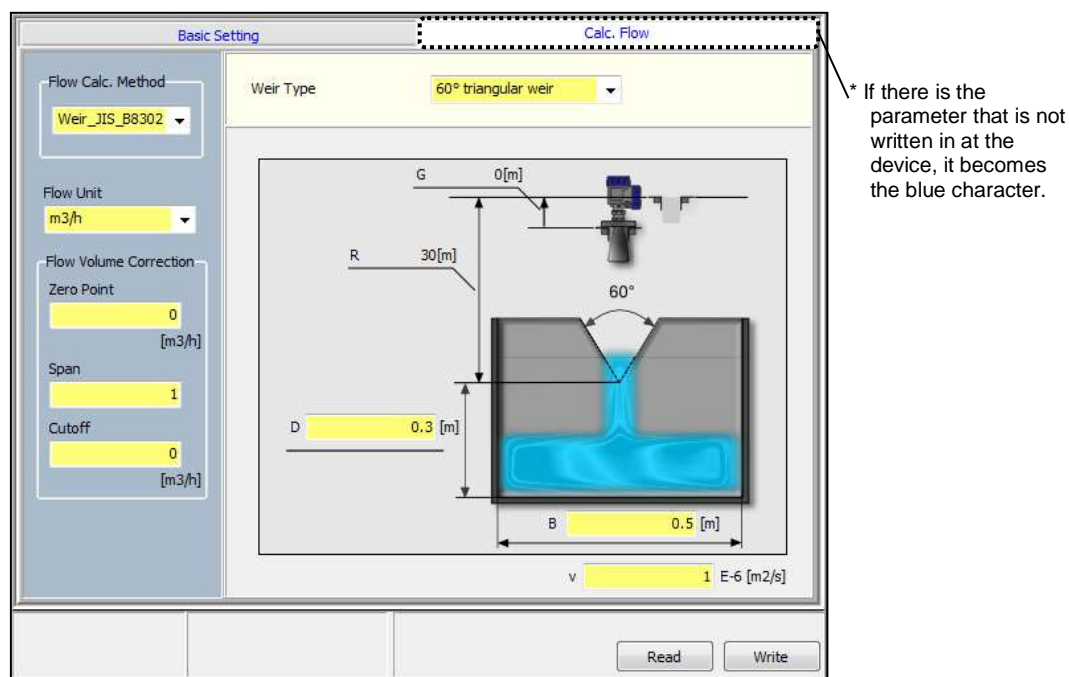


Fig. 6.3.5 Flow rate calculation menu

(1) Reading flow rate calculation data

To read the flow rate calculation data from the device, 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 device, 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 Calc. Method Shape of flow meter
(Unknown / Weir_JIS_B8302 / Flume_JIS / User Defined (Flow Table) /
Weir_JIS_K0094 (*It is supported by firmware version 1.3.0 or later))
*When the weir exceeds application range of Table 6.3.1, choose
"Weir_JIS_K0094".

Common data

- Flow Unit Measured flow rate unit
(m³/US Gallons/Barrels/Ft³ per D, h, min, sec) *The flow rate
unit in a sentence is indicated as a case of "m³/h" setup.

Weir JIS B8302 data

- Weir Type Weir type (refer to a Table 6.3.1)
(60° triangular weir / 90° triangular weir / Rectangular weir /Full - width weir)
- B Breadth of channel
(0.0m to 99.999m)
- b Width of weir
(0.0m to 99.999m)
- ν Kinematic viscosity of fluid (Default: water = 1×10^{-6} m²/sec)
(0.0×10^{-6} m²/sec to 99.999×10^{-6} m²/sec)
- D Height of weir edge relative to bottom of channel
(0.0m to 99.999m)

Flume JIS data

Size of Parshall 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 (refer to a Table 6.3.3))

User Defined data

- Point No. Number of points of flow rate table
(0 to 100)
- Flow Table Flow rate table
(Level value (-99.999m to 99.999m),
flow rate value (refer to a Table 6.3.1 and a Table 6.3.2))

Weir JIS K0094 data (*It is supported by firmware version 1.3.0 or later)

- Weir Type Weir type (refer to a Table 6.3.2)
(90° triangular weir / Rectangular weir /Full - width weir)
- B Breadth of channel
(0.0m to 99.999m)
- b Width of weir
(0.0m to 99.999m)

Flow Correction data (*It is supported by firmware version 1.1.0 or later)

- Zero Point Zero point adjustment value
(refer to a Table 6.3.5)
- Span Span calibration value
(0.01 to 2.0)
- Cutoff Function that when the flow measurement value is less than set value, "0" flow
will be imposed
(refer to a Table 6.3.4)

Table 6.3.1 Flow calculation formula of weir and application range (JIS B 8302)

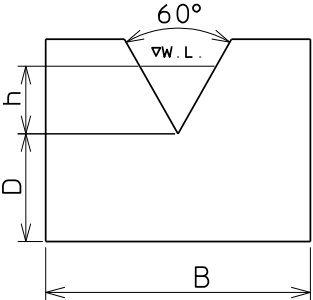
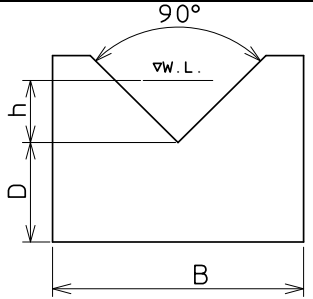
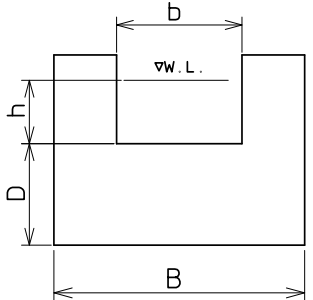
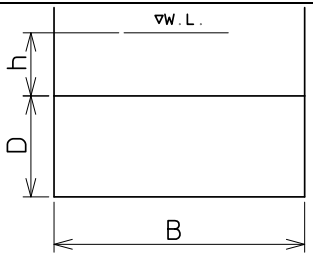
| | | JIS B 8302 | |
|---------------------|---|--|--|
| | | Flow calculation formula | Application range |
| 60° Triangular weir |  | $Q = 0.577Kh^{5/2}$ $K = 83 + \frac{1.978}{BR^{1/2}}$ $R = 0.1h\sqrt{h/\nu}$ | $B = 0.44 \sim 1.0 \text{ [m]}$ $h = 0.04 \sim 0.12 \text{ [m]}$ $D = 0.1 \sim 0.13 \text{ [m]}$ |
| 90° Triangular weir |  | $Q = Kh^{5/2}$ $K = 81.2 + \frac{0.24}{h} + \left(8.4 + \frac{12}{\sqrt{D}}\right)\left(\frac{h}{B} - 0.09\right)^2$ | $B = 0.5 \sim 1.2 \text{ [m]}$ $D = 0.1 \sim 0.75 \text{ [m]}$ $h = 0.07 \sim 0.26 \text{ [m]}$ $h \leq \frac{B}{3} \text{ [m]}$ |
| Rectangular weir |  | $Q = Kbh^{3/2}$ $K = 107.1 + \frac{0.177}{h} + 14.2\frac{h}{D} - 25.7\sqrt{\frac{(B-b)h}{DB}} + 2.04\sqrt{\frac{B}{D}}$ | $B = 0.5 \sim 6.3 \text{ [m]}$ $b = 0.15 \sim 5 \text{ [m]}$ $D = 0.15 \sim 3.5 \text{ [m]}$ $\frac{bD}{B^2} \geq 0.06$ $h = 0.03 \sim 0.45\sqrt{b} \text{ [m]}$ |
| Full-width weir |  | $Q = KBh^{3/2}$ $K = 107.1 + \left(\frac{0.177}{h} + 14.2\frac{h}{D}\right)(1 + \varepsilon)$ $D \leq 1 \text{ m}, \varepsilon = 0$ $D > 1 \text{ m}, \varepsilon = 0.55(D - 1)$ | $B \geq 0.5 \text{ [m]}$ $D = 0.3 \sim 2.5 \text{ [m]}$ $h = 0.03 \sim D \text{ [m]}$ $h \leq 0.8 \text{ [m]}$ $h \leq \frac{B}{4} \text{ [m]}$ |
| Remarks | <p>Q: Flow rate [m³/min] K: Flow coefficient B: Breadth of channel[m]</p> <p>b: Width of wier [m] D: Height of weir edge relative to bottom of channel [m] ν: Kinematic viscosity of water = 0.01 [cm²/sec]</p> <p>When the weir exceeds application range of each setting such as “B” or “b”, then select Flow Calc. Method to “Weir_JIS_K0094”.</p> | | |

Table 6.3.2 Flow calculation formula of weir (JIS K 0094)

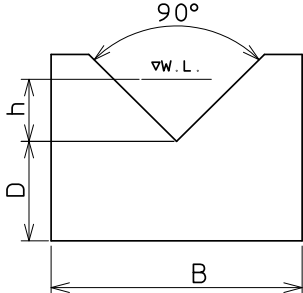
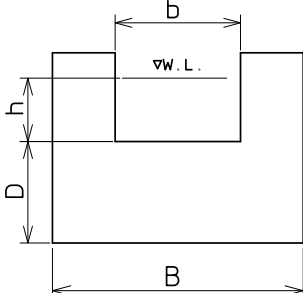
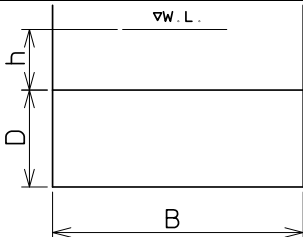
| | | JIS K 0094 |
|--------------------|--|---|
| | | Flow calculation formula |
| 90°Triangular weir |  | $Q = 1.40 \times h^{5/2} \times 60$ Thomson formula |
| Rectangular weir |  | $Q = 1.84(b - 0.2h)h^{3/2} \times 60$ Francis formula |
| Full-width weir |  | $Q = 1.84 \times B \cdot h^{3/2} \times 60$ Francis formula |
| Remarks | Q: Flow rate [m ³ /min] B: Breadth of channel[m] <div style="margin-left: 300px;">b: Width of wier [m]</div> | |

Table 6.3.3 Dimensions of Parshall Flumes and Flow calculation formula

| Size | W | Flow rate [m ³ /h] | C | D | E | R | M | P | L | Flow calculation formula |
|-------|--------|----------------------------------|------|------|-----|-----|-----|------|------|-----------------------------|
| PF-01 | 25.4 | 1 ~ 30 | 93 | 167 | 450 | 300 | 200 | 600 | 635 | $Q=217.31 Ha^{1.55}$ |
| PF-02 | 50.8 | 2 ~ 63 | 135 | 214 | 450 | 350 | 250 | 724 | 774 | $434.63 Ha^{1.55}$ |
| PF-03 | 76.2 | 3 ~ 193 | 178 | 259 | 610 | 406 | 305 | 768 | 914 | $653.52 Ha^{1.547}$ |
| PF-06 | 152.4 | 5 ~ 398 | 394 | 397 | 610 | 406 | 305 | 902 | 1525 | $1372.508 Ha^{1.58}$ |
| PF-09 | 228.6 | 9 ~ 907 | 381 | 575 | 762 | 406 | 305 | 1080 | 1626 | $1927.494 Ha^{1.53}$ |
| PF-10 | 304.8 | 11 ~ 1641 | 610 | 845 | 914 | 508 | 381 | 1492 | 2867 | $2487.635 Ha^{1.527}$ |
| PF-15 | 457.2 | 15 ~ 2508 | 762 | 1026 | 914 | 508 | 381 | 1676 | 2943 | $3803.469 Ha^{1.5381}$ |
| PF-20 | 609.6 | 43 ~ 3374 | 914 | 1207 | 914 | 508 | 381 | 1854 | 3019 | $5141.625 Ha^{1.5497}$ |
| PF-30 | 914.4 | 62 ~ 5138 | 1219 | 1572 | 914 | 508 | 381 | 2223 | 3169 | $7864.138 Ha^{1.5661}$ |
| PF-40 | 1219.2 | 133 ~ 6922 | 1524 | 1937 | 914 | 610 | 457 | 2711 | 3318 | $10633.846 Ha^{1.5779}$ |
| PF-50 | 1524.0 | 163 ~ 8726 | 1829 | 2302 | 914 | 610 | 457 | 3080 | 3467 | $13436.837 Ha^{1.587}$ |
| PF-60 | 1828.8 | 265 ~ 10551 | 2134 | 2667 | 914 | 610 | 457 | 3442 | 3616 | $16270.018 Ha^{1.5946}$ |
| PF-70 | 2133.6 | 306 ~ 12736 | 2438 | 3032 | 914 | 610 | 457 | 3810 | 3766 | $19126.673 Ha^{1.601}$ |
| PF-80 | 2438.4 | 357 ~ 14221 | 2743 | 3397 | 914 | 610 | 457 | 4172 | 3915 | $22002.05 Ha^{1.56065}$ |

Q: Flow rate [m³/h]

Ha: Measurement head [m]

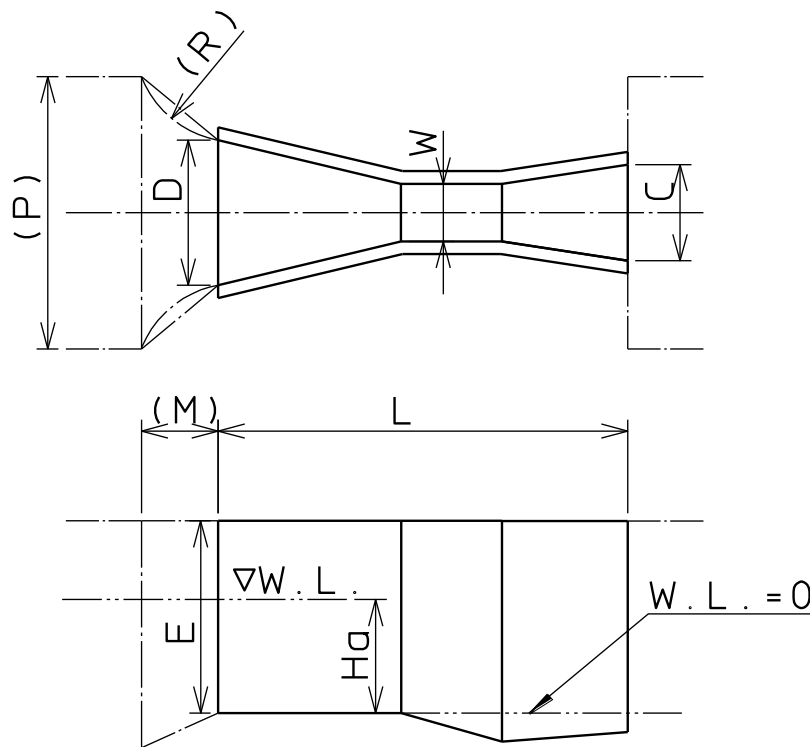


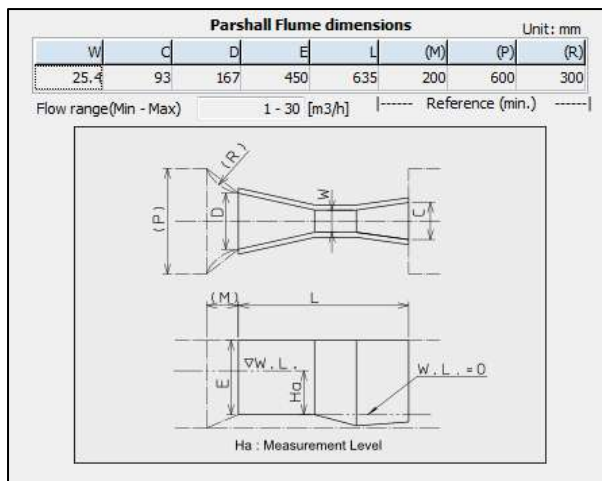
Fig. 6.3.6 Parshall Flume

Table 6.3.4 Input range depend on flow unit (flow rate value and cutoff)

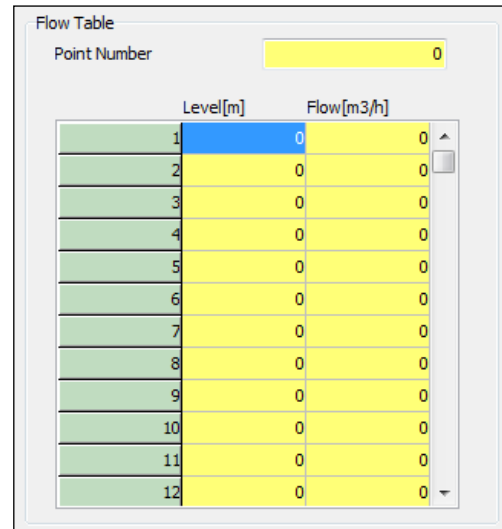
| Flow Unit | Minimum | Maximum |
|----------------------|---------|----------|
| m ³ /D | 0.0 | 2399976 |
| m ³ /h | 0.0 | 99999.0 |
| m ³ /min | 0.0 | 1666.65 |
| m ³ /sec | 0.0 | 27.777 |
| US Gallons/D | 0.0 | 9999999 |
| US Gallons/h | 0.0 | 9999999 |
| US Gallons/min | 0.0 | 440280.2 |
| US Gallons/sec | 0.0 | 7338.003 |
| Barrels/D | 0.0 | 9999999 |
| Barrels/h | 0.0 | 628971.7 |
| Barrels/min | 0.0 | 10482.86 |
| Barrels/sec | 0.0 | 174.714 |
| Ft ³ /D | 0.0 | 9999999 |
| Ft ³ /h | 0.0 | 3531431 |
| Ft ³ /min | 0.0 | 58857.19 |
| Ft ³ /sec | 0.0 | 980.953 |

Table 6.3.5 Input range depend on flow unit (Zero point)

| Flow Unit | Minimum | Maximum |
|----------------------|------------|----------|
| m ³ /D | -2399976 | 2399976 |
| m ³ /h | -99999.0 | 99999.0 |
| m ³ /min | -1666.65 | 1666.65 |
| m ³ /sec | -27.777 | 27.777 |
| US Gallons/D | -9999999 | 9999999 |
| US Gallons/h | -9999999 | 9999999 |
| US Gallons/min | -440280.2 | 440280.2 |
| US Gallons/sec | -7338.003 | 7338.003 |
| Barrels/D | -9999999 | 9999999 |
| Barrels/h | -628971.7 | 628971.7 |
| Barrels/min | -10482.863 | 10482.86 |
| Barrels/sec | -174.714 | 174.714 |
| Ft ³ /D | -9999999 | 9999999 |
| Ft ³ /h | -3531431 | 3531431 |
| Ft ³ /min | -58857.19 | 58857.19 |
| Ft ³ /sec | -980.953 | 980.953 |

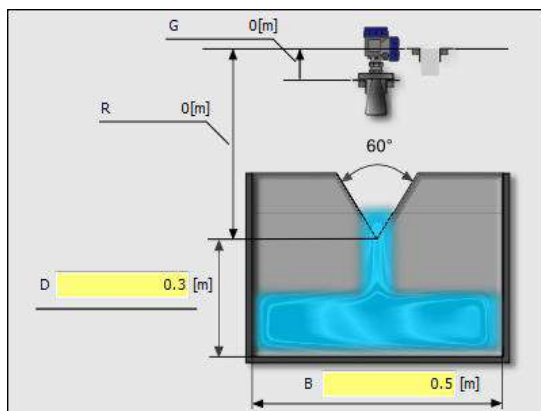


Flume_JIS

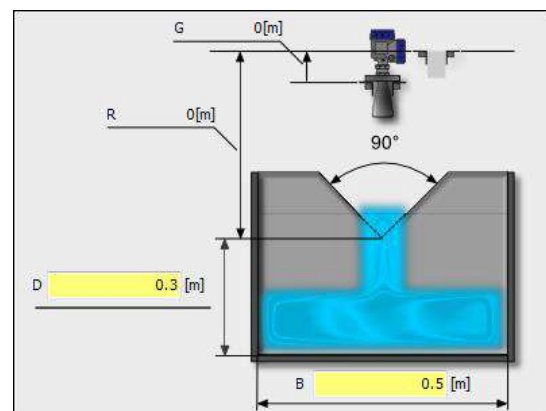


User Defined (Flow Table)

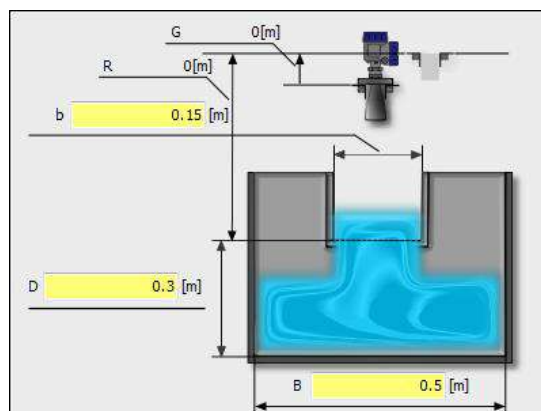
Fig. 6.3.7 Flow Calc. Method



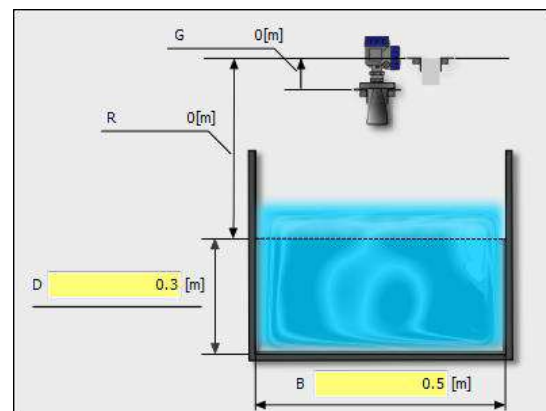
60° Triangular weir



90° Triangular weir



Rectangular weir



Full-width weir

Fig. 6.3.8 Weir Type

6.4 Application

This section explains the application setting function.

You can write parameters that depend on installation condition such as rapid change, tank automatically by application setting wizard. After the application setting, User parameters will be changed into the suitable value.

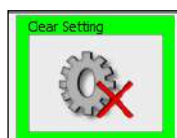


CAUTION

- If the setting is done by using the application setting function, that may have the parameters initially setting is changed, after the basic settings data (parameters) setting,
- Please set again the parameters if necessary, check that again after the application setting up.

1) Select application

If you click "Application" on the menu bar or the menu selection panel, application setting wizard is displayed. Please select application to set from displayed items. The frame color of a selected item changes to green.



Selected



Unselected

Fig. 6.4.1 Selected item

The display of the application setting wizard changes depending on a selected item.

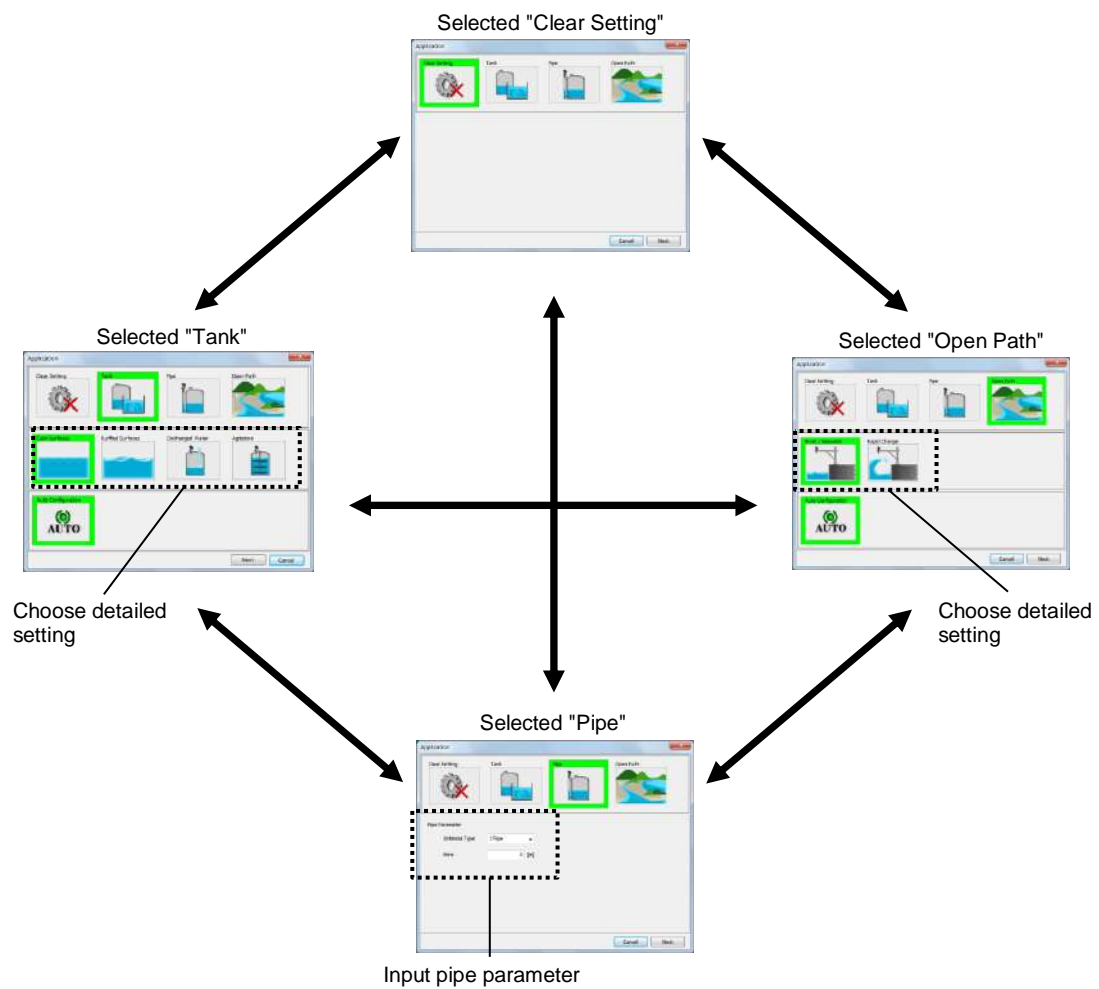


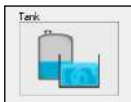
Fig. 6.4.2 Application setting wizard

Selected item



Clear Setting

Select when you clear application parameters.



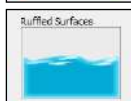
Tank

Select when you measure in a tank.



Calm Surfaces

Select when the device is used on the calm surface.
(wave height less than 5mm)



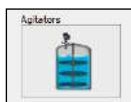
Ruffled Surfaces

Select when the device is used on the surface with ruffles.
(wave height more than 5 mm)



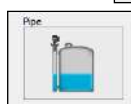
Discharged water

Select when much turbulent ruffles occurred due to inlet of liquids. (exp. more than 100 L/s from 5m height)



Agitators

Select when the device is used in the tank with the agitators.



Pipe

Select when the device is used with pipe.

User input parameter

- Antenna Type

Antenna type

(2" pipe / 4" pipe)

- Bore

Internal diameter of the pipe

(0.0m to 99999.0m)



Open Path

Select when the device is used for measurement of open path surface.
(e.g. River / Seawater level)



River / Seawater

Select when the device is used to measure the slow change of the surface. (e.g. River / Seawater level)



Rapid Change

Select when the device is used to measure the rapid change of the surface. (e.g. Tsunami detection)

*A wave height level may be rough estimation for parameter settings.

2) Writing parameter

After selecting required application, if you click "Next", the following window will be displayed. Click "OK" to write the most suitable parameter depend on selected item to the device, then application setting wizard will be finished.

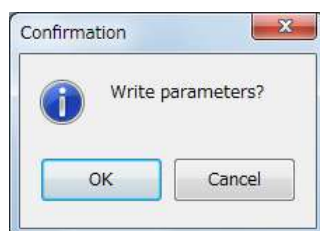


Fig. 6.4.3 Writing confirm dialog

6.5 Analog Current Output

This section explains the functions of the analog current output menu.

In the analog current output menu, it is possible to read / write analog current output data (parameters) for the device. If you click "Analog Current Output" in the menu bar or menu selection panel, the following window is displayed. Data that does not match the status of the device will be displayed with a yellow () and data that matches the status of the device will be displayed with a white (). The color of cell will be displayed with a light gray () in case of the input error.

The screenshot shows a software window titled "Analog Current Output Parameter". It contains several settings:

- Analog Current Output Parameter:** A dropdown menu set to "Level".
- Alarm Selection:** A dropdown menu set to "Hold".
- Minimum Output:** A text input field with the value "0" and the unit "[m]".
- Maximum Output:** A text input field with the value "30" and the unit "[m]".
- Analog Current Output Range:**
 - Output Range Setting:** A dropdown menu set to "NAMUR NE43".
 - Minimum Value:** A text input field with the value "3.8" and the unit "[mA]".
 - Maximum Value:** A text input field with the value "20.5" and the unit "[mA]".
- Alarm Output Factor:** A dropdown menu set to "No Receiving Echo".

At the bottom right of the window, there are two buttons: "Read" and "Write".

Fig. 6.5.1 Analog current output menu

(1) Reading analog current output data

To read analog current output data from the device, click the "Read" button. After reading starts, wait momentarily until the processing progress on the status bar stops.

(2) Writing analog current output data

To write analog current output data to the device, 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 Current Output data

- Analog Current Output Parameter Content of parameters output at 4-20mA
(Level / Distance / Volume / Flow / Signal Amp.)
- Alarm Selection Content of alarm output
(High (22.0mA)/Low (3.6mA)/Hold)
- Minimum Output Setting value of analog current output parameter of 4mA
(Level / Distance (-99.999m to 99.999m),
Volume (0.0m³ to 99999.0m³),
Flow (0.0m³/sec to 99999.0m³/sec),
Signal Amp. (0dB to 200dB)
- Maximum Output Setting value of analog current output parameter of 20mA
(Level / Distance (-99.999m to 99.999m),
Volume (0.0m³ to 99999.0m³),
Flow (0.0m³/sec to 99999.0m³/sec),
Signal Amp. (0dB to 200dB)
- Alarm Output Factor (*It is supported by firmware version 1.6.1 or later)
Factor causing alarm output
(No Receiving Echo / Device Failure / Both)

Analog Current Output Range data (*It is supported by firmware version 1.6.0 or later)

- Output Range Setting Content of analog current output range
 - NAMUR NE43
Minimum Value: 3.8mA
Maximum Value: 20.5mA
 - Legacy(4-20mA)
Minimum Value: 4mA
Maximum Value: 20mA
 - Custom
Enter the Minimum Value and the Maximum
Value individually
- Minimum Value Setting the minimum value of analog current output
range. Only when Output Range Setting is "Custom", this
value is settable.
(3.8mA to 4.1mA)
- Maximum Value Setting the maximum value of analog current output
range. Only when Output Range Setting is "Custom", this
value is settable.
(19mA to 20.5mA)

The alarm output value does not change even if the Analog Current Output Range data was changed.

6.6 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.

6.6.1 Measurement Support

On the measurement support menu, it is possible to read / write measurement support data (parameters) for the device. If you click "Measurement Support" tab or "Measurement Support" in the tree display, the following window is displayed. Data that does not match the status of the device will be displayed with a yellow () and data that matches the status of the device will be displayed with a white (). The color of cell will be displayed with a light gray () in case of the input error.

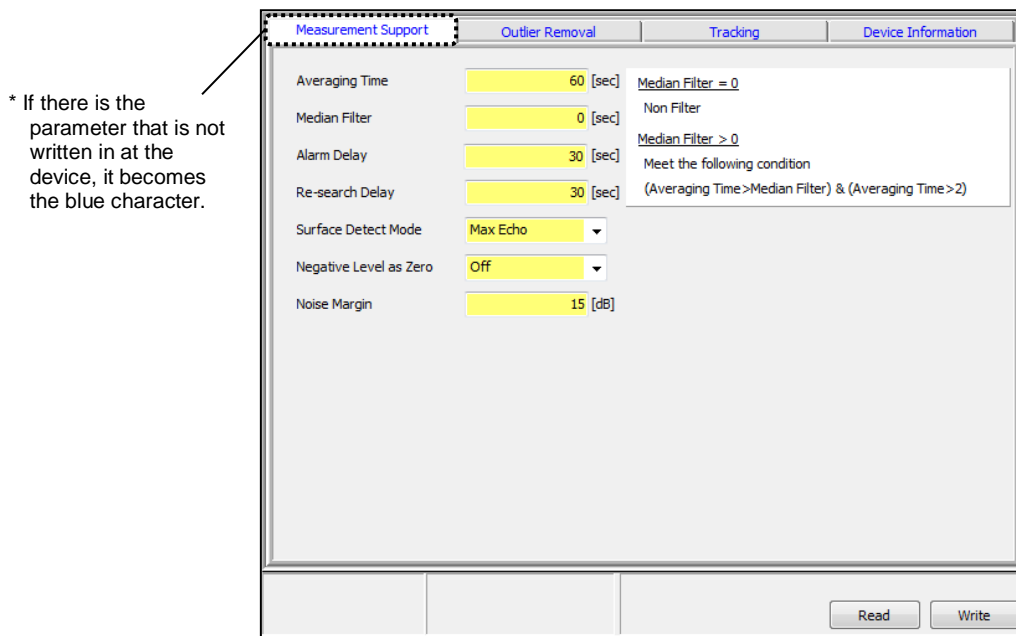


Fig. 6.6.1 Measurement support menu

(1) Reading measurement support data

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

(2) Writing measurement support data

To write the measurement support data to the device, 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.

Measurement 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 / Default: 0 sec)

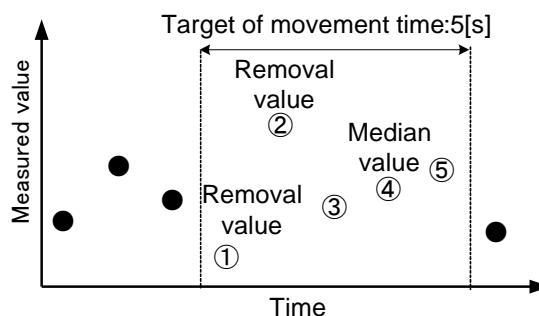


Fig. 6.6.2 Median Filter

Fig. 6.6.2 indicates setting at “Average Time” 5sec and “Median Filter” 2sec. KRG-10 will generate 1 measured result (process value) every 1 second. 5 sec means KRG-10 can generate 5 measured values. In case that you will set 2 sec for Median Filter value, it means removing 2 values from 5 measured values to get median value by 3 measured values.

Number of measurement values – Median Filter time = Calculated values

To get smooth value, Median Filter should be set as minimum.
On the contrary, Median Filter should be set as maximum to get vivid value such as rapid level changing condition.

- Alarm Delay Time until alarm is output after data was missed
(1sec to 120sec)
- Re-search Delay Time until searching the liquid level echo after data was missed
(1sec to 120sec)
- Surface Detect Mode Echo detected as the liquid level echo
(Max Echo / first Echo)

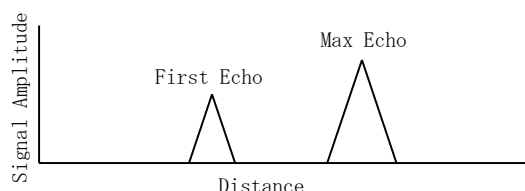


Fig. 6.6.3 Surface Detect Mode

- Negative Level as Zero 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)

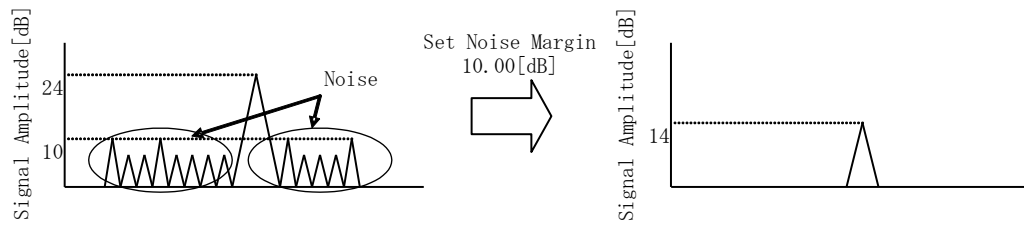


Fig. 6.6.4 Noise Margin

6.6.2 Outlier Removal

On the outlier removal menu, it is possible to read / write outlier removal data (parameters) for the device. 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 device will be displayed with a yellow () and data that matches the status of the device will be displayed with a white (). The color of cell will be displayed with a light gray () in case of the input error.

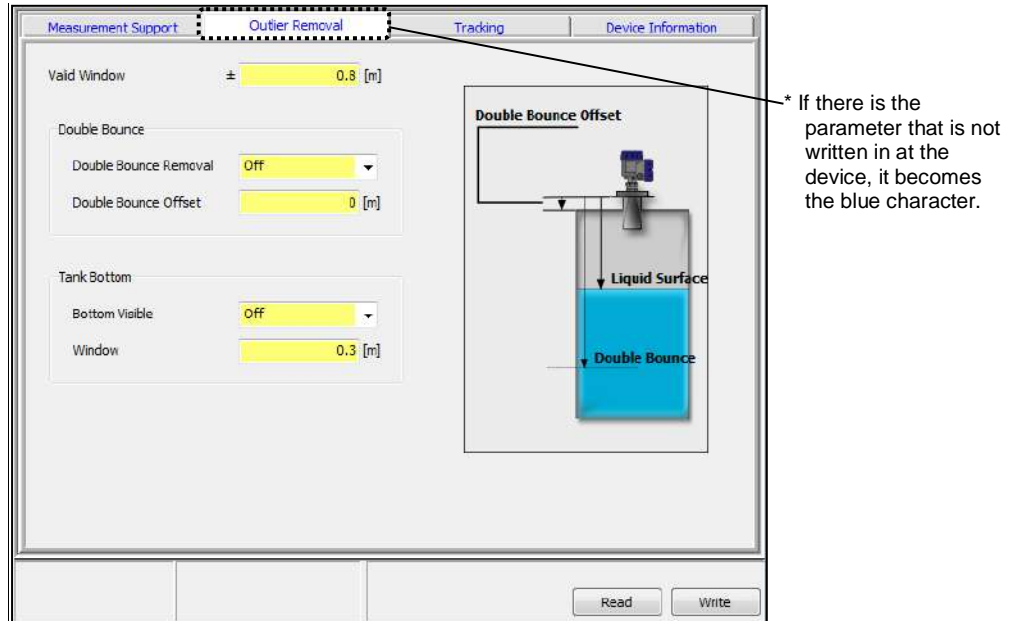


Fig. 6.6.5 Outlier removal menu

(1) Reading outlier removal data

To read outlier removal data from the device, 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 device, 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

Window for determining valid values / outliers with respect to the detected echo. Valid Window is 2 times the setting value.
(0.0m to 99.999m)

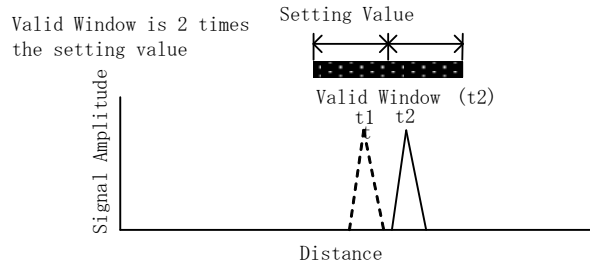


Fig. 6.6.6 Valid Window

- Double Bounce

Function for removal as an outlier when multiple echoes are detected (ON/OFF)

- Double Bounce Offset

Offset value from the flange surface to the upper surface of the tank (-99.999m to 99.999m)

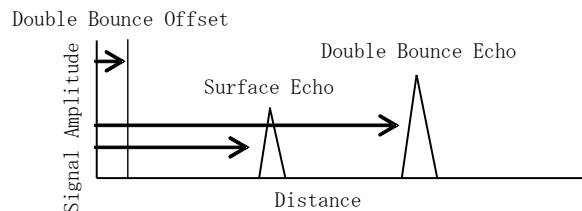


Fig. 6.6.7 Double bounce

- Bottom Visible

Function for removal as an outlier when the detected echo is in the tank bottom surface position (ON/OFF)

- Window

Tank bottom surface position width (0.0m to 99.999m)

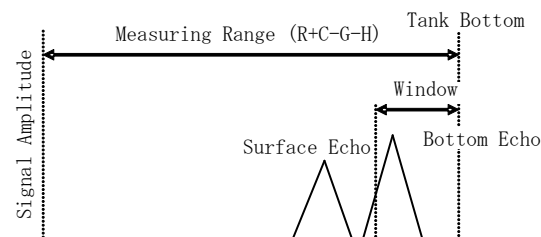


Fig. 6.6.8 Bottom Visible

6.6.3 Tracking

On the tracking menu, it is possible to read / write tracking data (parameters) for the device. If you click "Tracking" tab or "Tracking" in the tree display, the following window is displayed. Data that does not match the status of the device will be displayed with a yellow () and data that matches the status of the device will be displayed with a white (). The color of cell will be displayed with a light gray () in case of the input error.

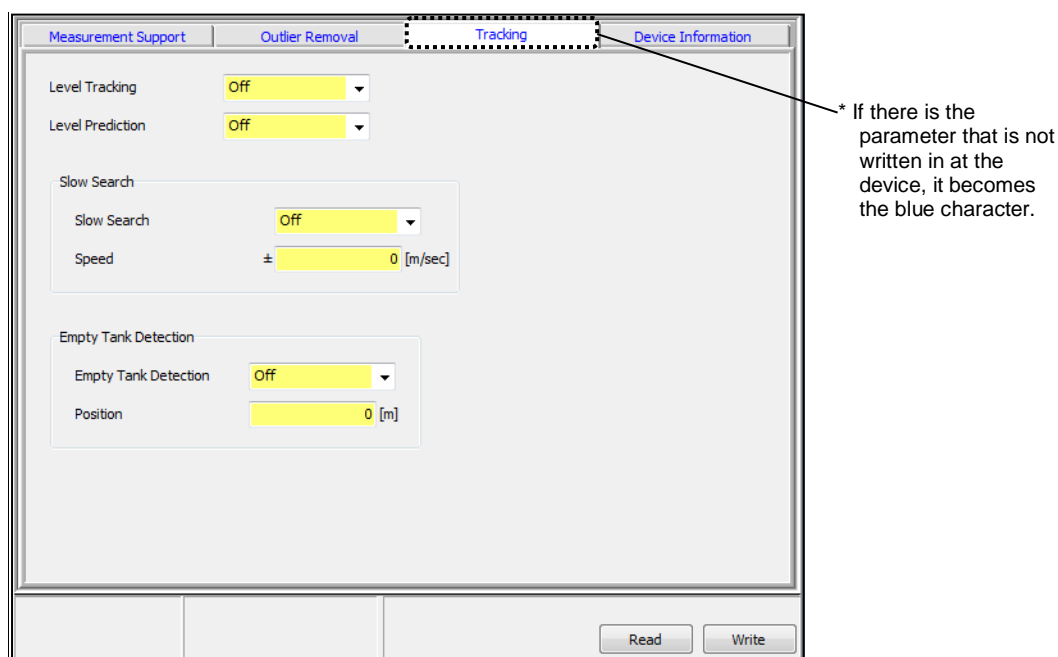


Fig. 6.6.9 Tracking menu

(1) Reading tracking data

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

(2) Writing tracking data

To write the tracking data to the device, 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.

Tracking 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)

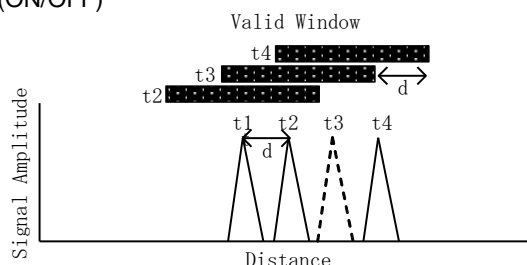


Fig. 6.6.10 Level tracking

- Level 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

If this function is set to ON when valid echo detection could not be performed for Re-search Delay, the valid window is enlarged, using as reference the position where the immediately prior echo disappeared.

(ON/OFF)

- Slow Search-Speed

Set the distance per second to enlarge the effective window during slow search. The distance to be enlarged varies depending on the search time. (0.0m to 99.999m)

Note:

- Search time[s] = "Boot Mode" setting, "Normal" 15 sec / "Fast" 4 sec
- Slow Search Speed[d] = speed [m/sec] × Search time [sec]

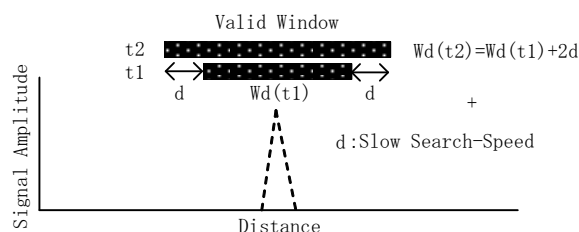


Fig. 6.6.11 Slow search

- Empty Tank Detection

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 empty tank detection position, if valid echo detection could not be performed (ON/OFF)

- Position

Empty tank detection position (0.0m to 99.999m)

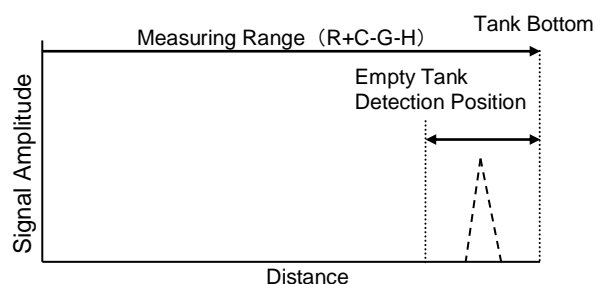


Fig. 6.6.12 Empty tank detection

6.6.4 Device Information

On the device information menu, it is possible to read / write device information data (parameters) for the device. If you click "Device Information" tab or "Device Information" in the tree display, the following window is displayed. Data that does not match the status of the device will be displayed with a yellow () and data that matches the status of the device will be displayed with a white (). The color of cell will be displayed with a light gray () in case of the input error.

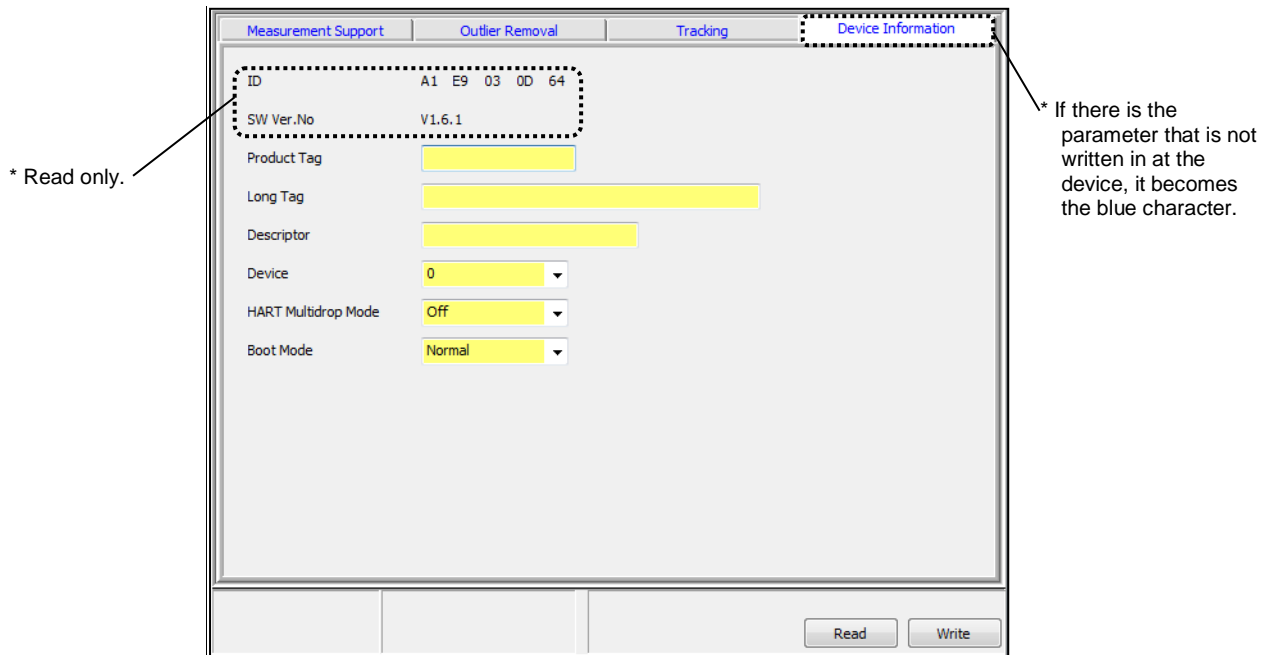


Fig. 6.6.13 Device information menu

(1) Reading device information data

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

(2) Writing device information data

To write the device information data to the device, 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.

Device information data

- ID ID number to identify the device
(Read only)
- SW Ver.No Firmware version of the device
(Read only)
- Product Tag Character string of Packed ASCII (uppercase alphanumeric characters and punctuation characters) used for identification of HART communication
(Up to 8 characters)
- Long Tag Character string of ISO Latin-1 (upper and lower case alphanumeric characters, punctuation characters, and characters used in the EU zone) used for identification of HART communication
(Up to 32 characters)
- Descriptor Character string of Packed ASCII (uppercase alphanumeric characters and punctuation characters) used for identification of HART communication
(Up to 16 characters)
- Device Number used to identify connected device of HART communication
(0 to 63)
- HART Multidrop Mode Mode in which multiple field devices are connected on the same wiring
(ON/OFF)
- Boot Mode (*It is supported by firmware version 1.6.1 or later)
Select startup mode.
The recommended setting is "Normal".
Setting to "High Speed" is fast startup and reduced power consumption, but the liquid surface may not be measured when used in low signal amplitude or noisy environment.
(Normal/Fast)

6.7 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.

6.7.1 Analog

In the analog menu, it is possible to read / write analog data (parameters) for the device. 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 device will be displayed with a yellow () and data that matches the status of the device will be displayed with a white (). The color of cell will be displayed with a light gray () in case of the input error.

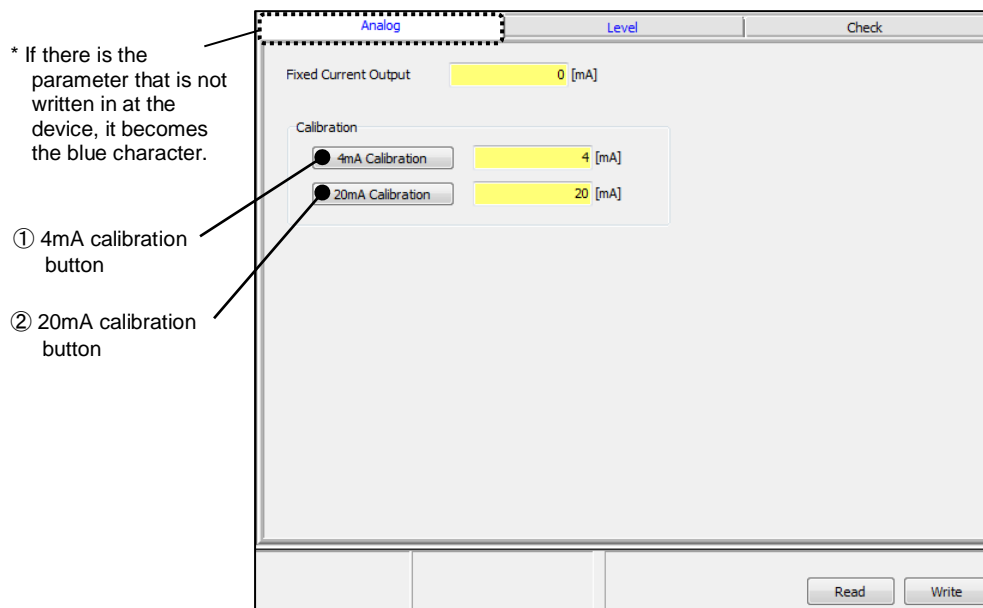


Fig. 6.7.1 Analog menu

(1) Reading analog data

To read the analog data from the device, 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 device, 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 device, click the "4mA Calibration" button ①. The following window will be displayed, so then click "OK" to output a fixed current of 4mA.

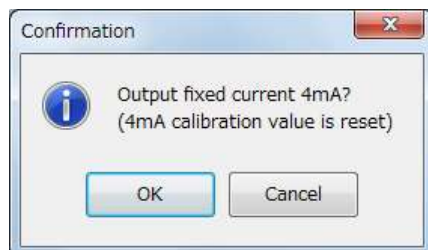


Fig. 6.7.2 4mA calibration confirmation dialog box



Fig. 6.7.3 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 device.

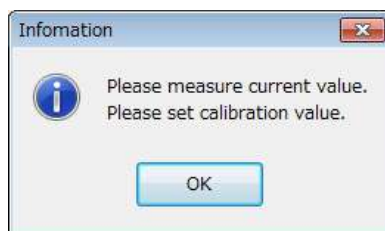


Fig. 6.7.4 Measurement / calibration value setting instructions dialog box

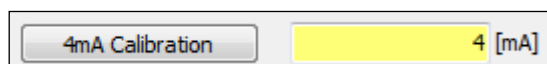


Fig. 6.7.5 Input 4mA calibration value

The 4mA calibration is now finished.

(4) 20mA calibration

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

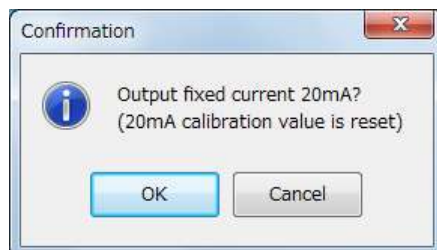


Fig. 6.7.6 20mA calibration confirmation dialog box



Fig. 6.7.7 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 device.

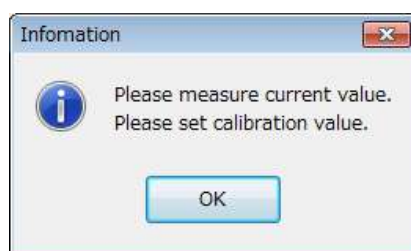


Fig. 6.7.8 Measurement / calibration value setting instructions dialog box



Fig. 6.7.9 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 current output
(3.5mA to 4.5mA)
- 20mA Calibration 20mA calibration value of analog current output
(15.0mA to 25.0mA)

6.7.2 Level

In the level menu, it is possible to read / write level data (parameters) for the device. 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 device will be displayed with a yellow () and data that matches the status of the device will be displayed with a white (). The color of cell will be displayed with a light gray () in case of the input error.

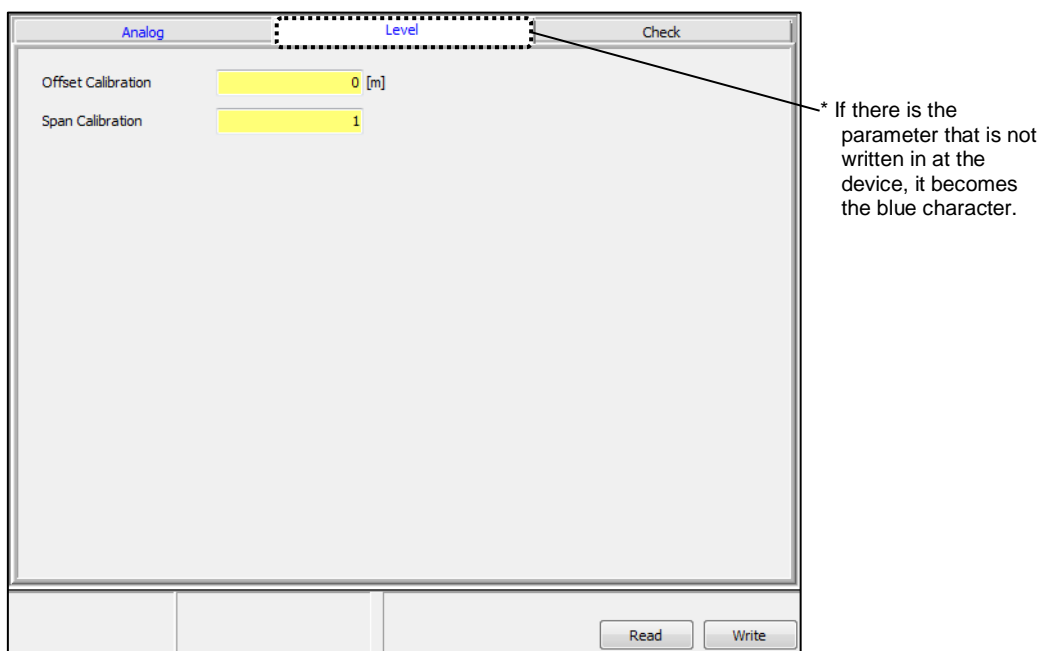


Fig. 6.7.10 Level menu

(1) Reading level data

To read the level data from the device, 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 device, 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) |

6.7.3 Check

In the check menu, it is possible to perform an analog current 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.

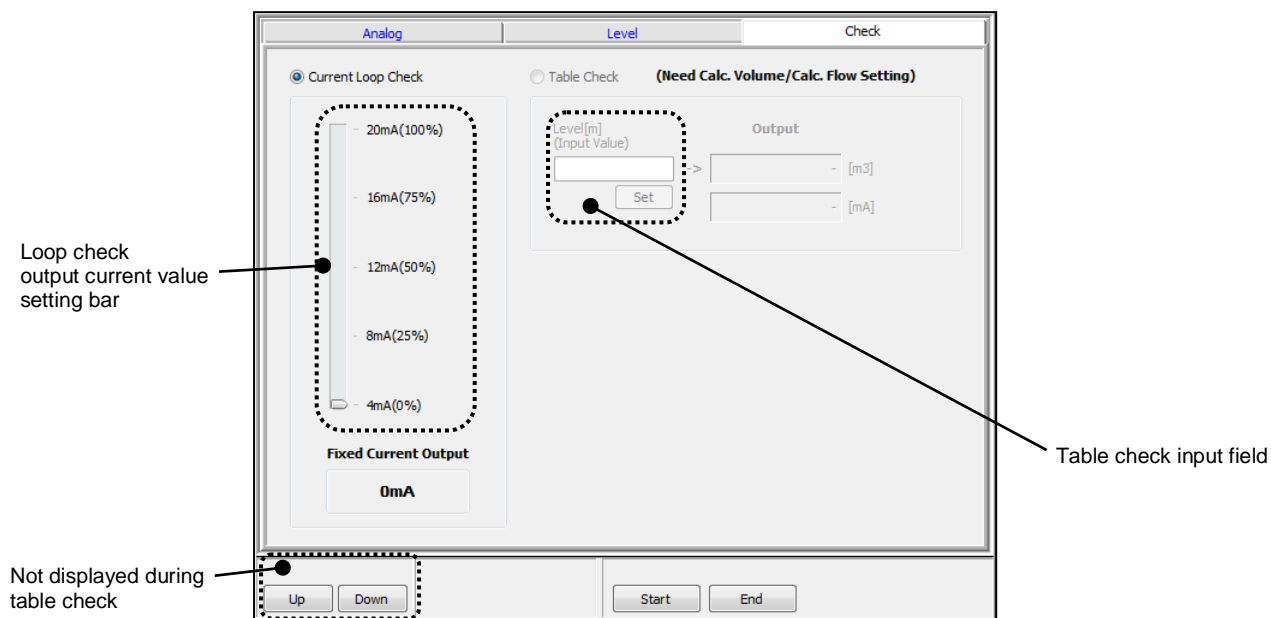



Fig. 6.7.11 Check menu

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

(1) Current Loop Check

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

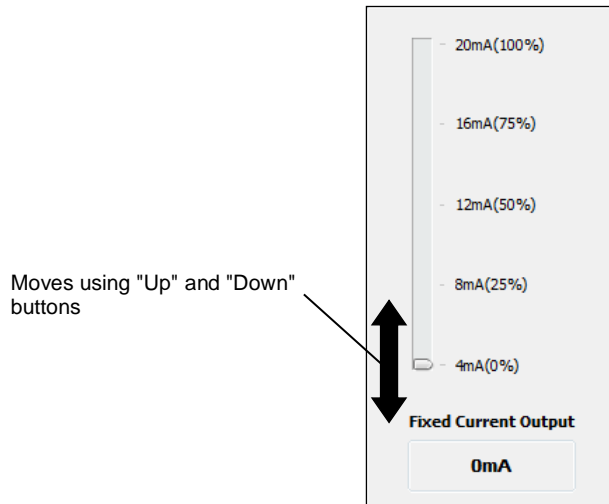


Fig. 6.7.12 Output current value setting bar

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

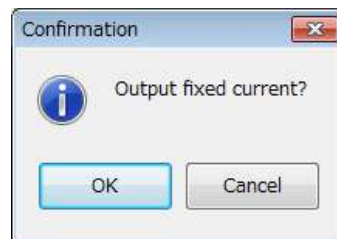


Fig. 6.7.13 Fixed current output confirmation dialog box

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

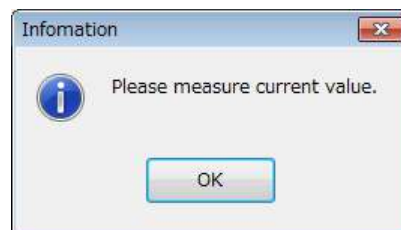



Fig. 6.7.14 Current value measurement instructions dialog box

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

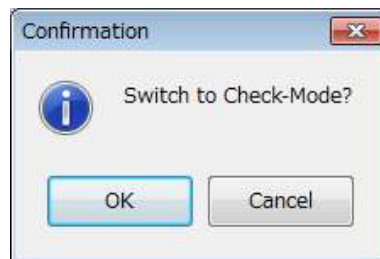


Fig. 6.7.15 Table check start confirmation dialog box

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".

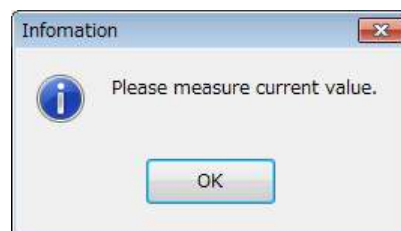


Fig. 6.7.16 Current value measurement instructions dialog box

The following output results are displayed.

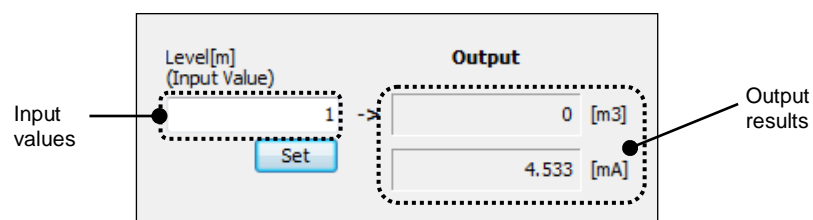


Fig. 6.7.17 Table check output results

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".

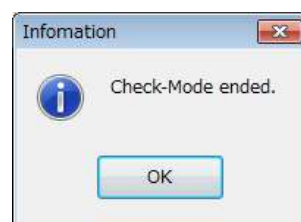


Fig. 6.7.18 Table check finish confirmation dialog box

6.8 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 device and write such data to the device. 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 device, the fixed disturbance echo value display area will be displayed with a yellow (0). And when data matches the status of the device, the fixed disturbance echo value display area will be displayed with a white (0). The color of cell will be displayed with a light gray () in case of the input error.

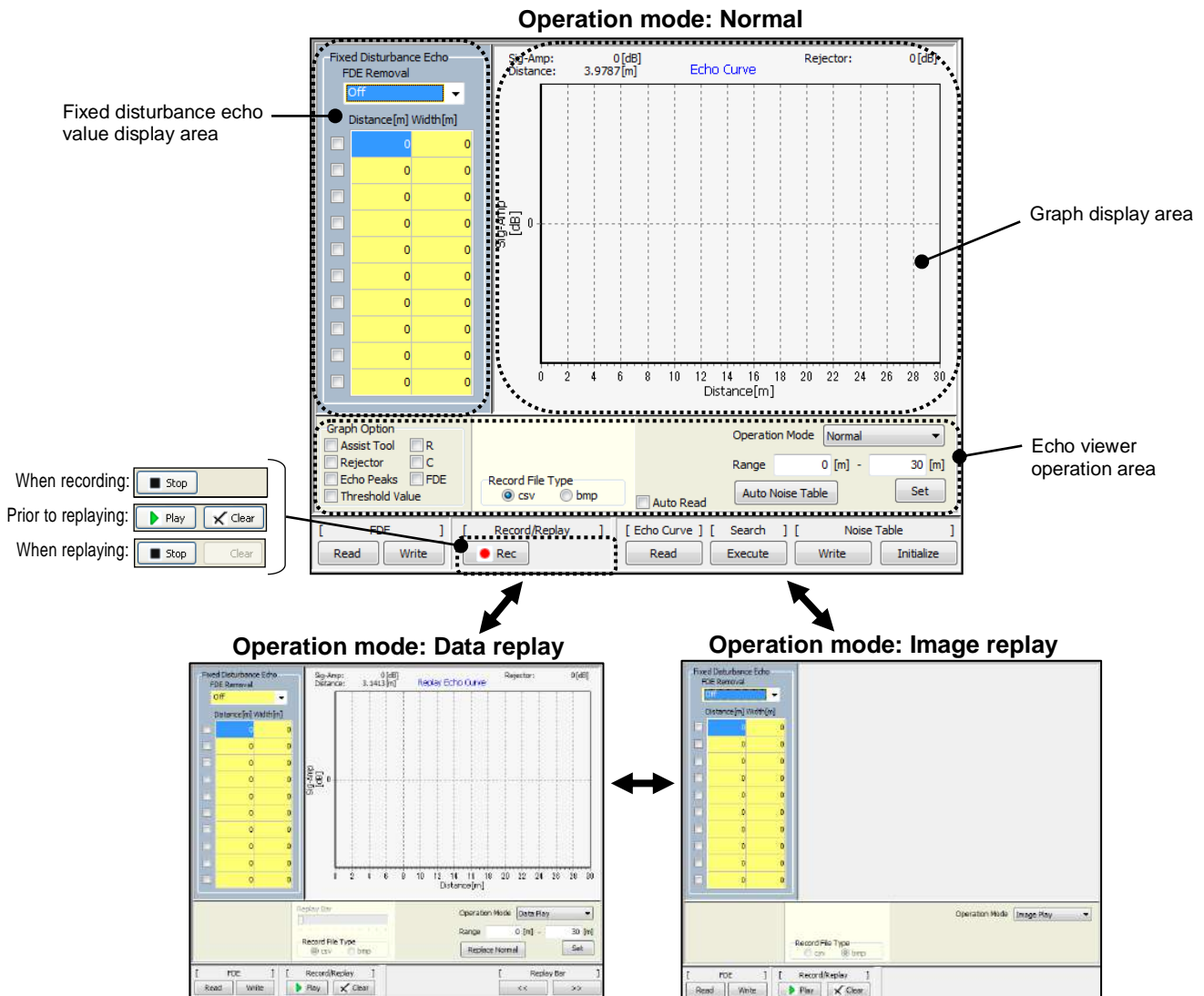


Fig. 6.8.1 Echo viewer menu

(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 device in the set range and displayed in the graph.

Fig. 6.8.2 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). If you want to display "Threshold Value" in the graph, set the "Threshold Level" from the graph option in the echo viewer operation area by check (☒ Threshold Value).

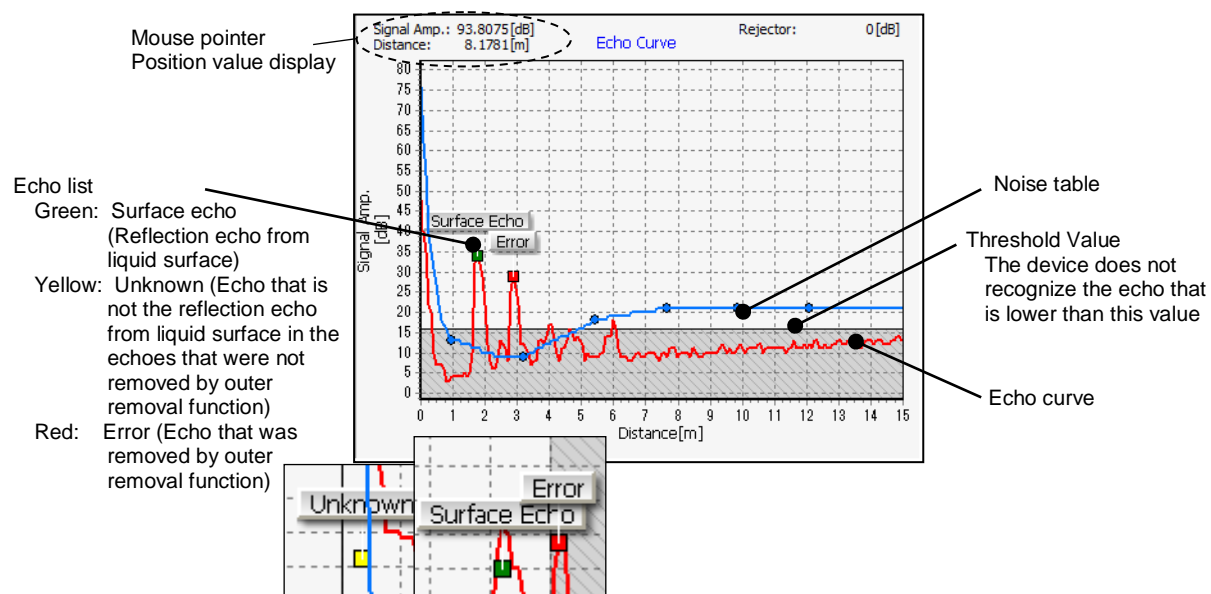


Fig. 6.8.3 Echo curve graph

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.

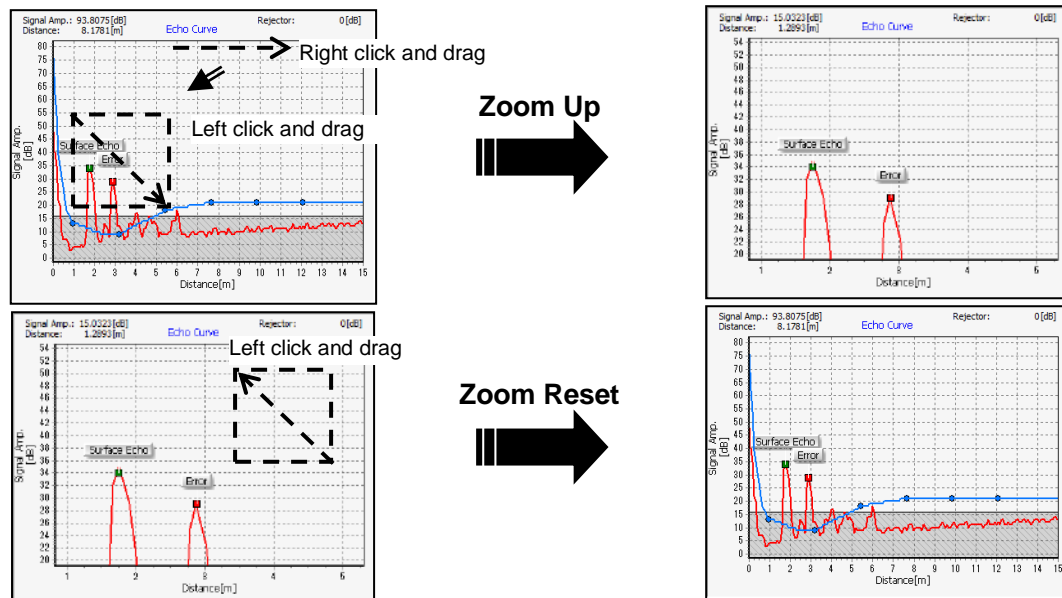


Fig. 6.8.4 Graph zoom up and zoom reset

(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.

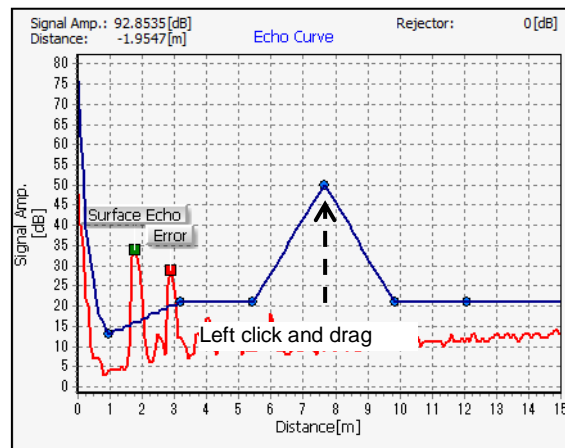
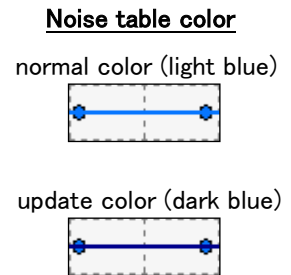


Fig. 6.8.5 Direct editing of the noise table points



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

(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 device 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.

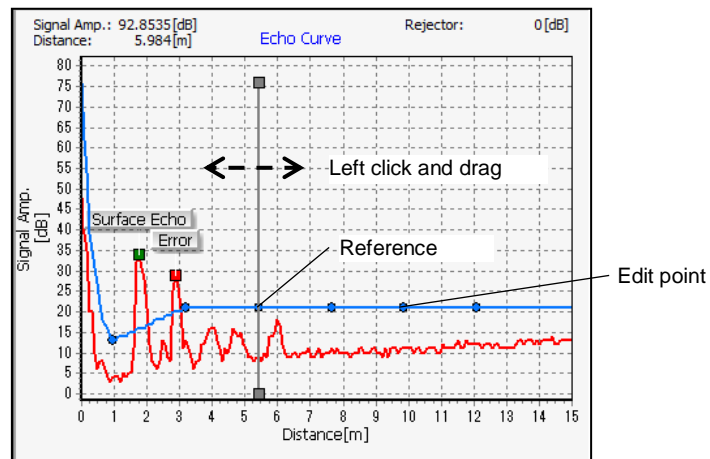


Fig. 6.8.6 Setting the reference point using the assist tool

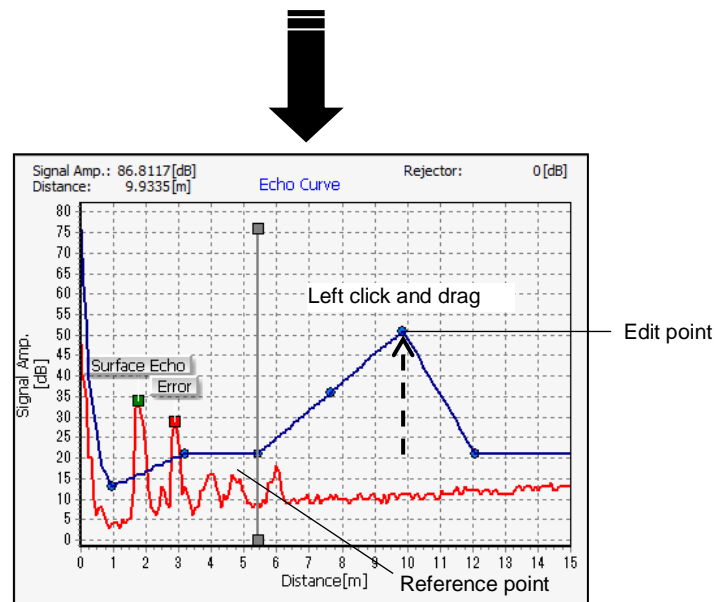


Fig. 6.8.7 Making the interval between the reference point and edit point linear by using the assist tool

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

(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.

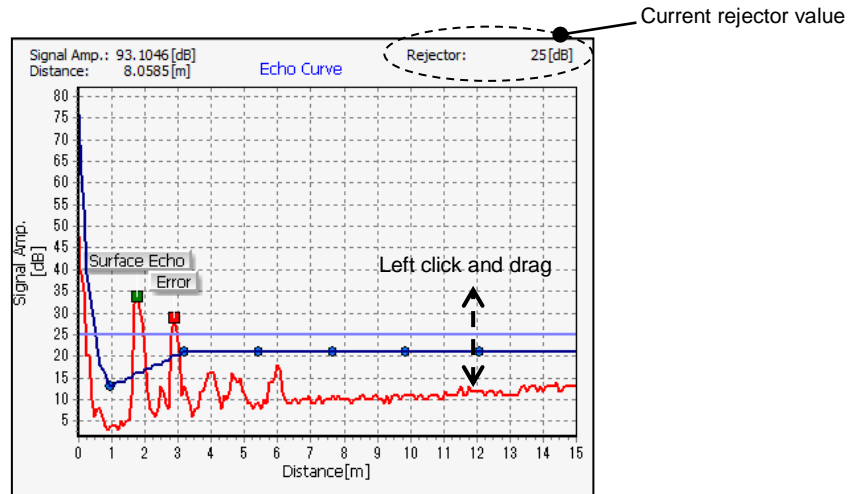


Fig. 6.8.8 Setting the minimum value of the noise table using the rejector

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

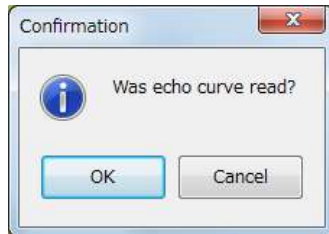


Fig. 6.8.9 Echo curve reading confirmation dialog box

Please confirm that the echo curve data has been read. Click "OK" after it confirmed, then the following window will be displayed.

They are available only when manual input was checked device

Fig. 6.8.10 Auto noise table setting value input window

Click "Apply" after input margin data and exclusion area data. Then setting value which it was approximated by drawing point interval of noise table is displayed, and "Next" button makes it effective.

Margin data

- Distance Margin of the distance for the echo curve
 (0.0m to 2.0m)
- Signal Amp. Margin of the signal amplitude for the echo curve
 (0dB to 20dB)

Exclusion area data

- Auto-Recognition The position of the echo recognized in the echo list is set in the exclusion area. If the double bounce removal is set to ON, double-bounce echo and triple-bounce echo are set in the exclusion area.
- Manual Input The exclusion area is set by inputting central distance and exclusion range
- Don't Exclusion The exclusion area is not set. the noise table is set throughout the echo curve.
- Central Distance Central distance of the auto noise table exclusion area

- Exclusion Range (More than 0.0m)
Range of the auto noise table exclusion area
(More than 0.0m)

After setting value confirmation, if you click "Next", the following window will be displayed.

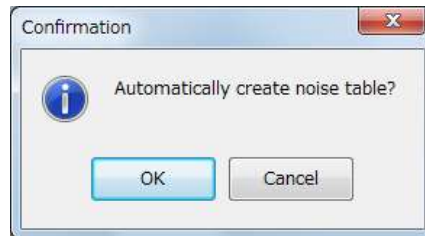
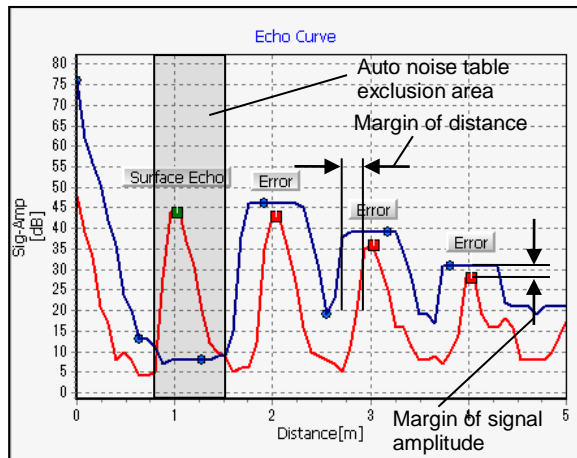


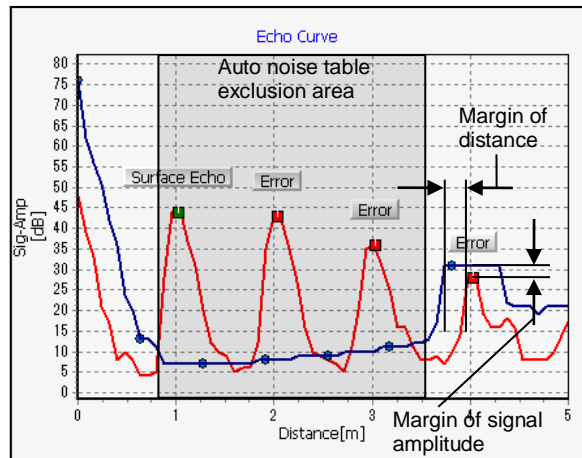
Fig. 6.8.11 Noise table automatic creation dialog box

If you click "OK", the noise table will be automatically set in the echo curve data that is displayed. The noise table included in the auto noise table exclusion area is linearized. When the noise table covers the surface echo, adjust again so that the noise table does not cover the surface echo.

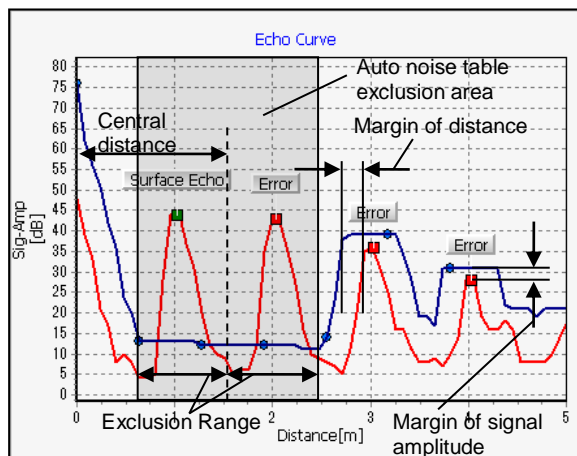
To write the noise table to the device, click [Noise Table] --> "Write" button. All points are written to the device.



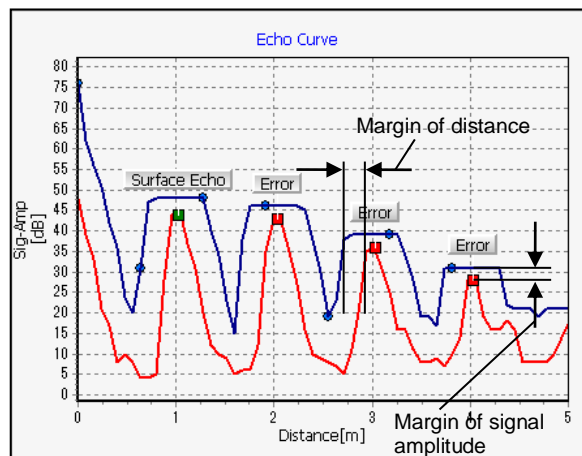
Auto-Recognition, Double Bounce Removal : OFF



Auto-Recognition, Double Bounce Removal : ON



Manual Input



Don't Exclusion

Fig. 6.8.12 Noise table automatic creation (example)

(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.

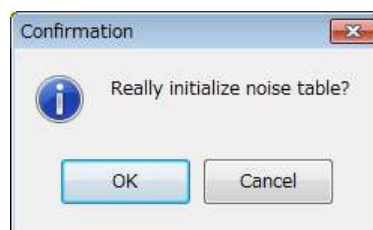


Fig. 6.8.13 Noise table initialization confirmation dialog box

(4) Reading fixed disturbance echo data

To read the fixed disturbance echo data from the device, 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 device, 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 writing valid data (☒ data marked with a check) in the fixed disturbance echo value display area will be written. Be aware that writing 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). Data that matches the status of the device and data that does not match the status of the device are displayed in black and red, respectively.

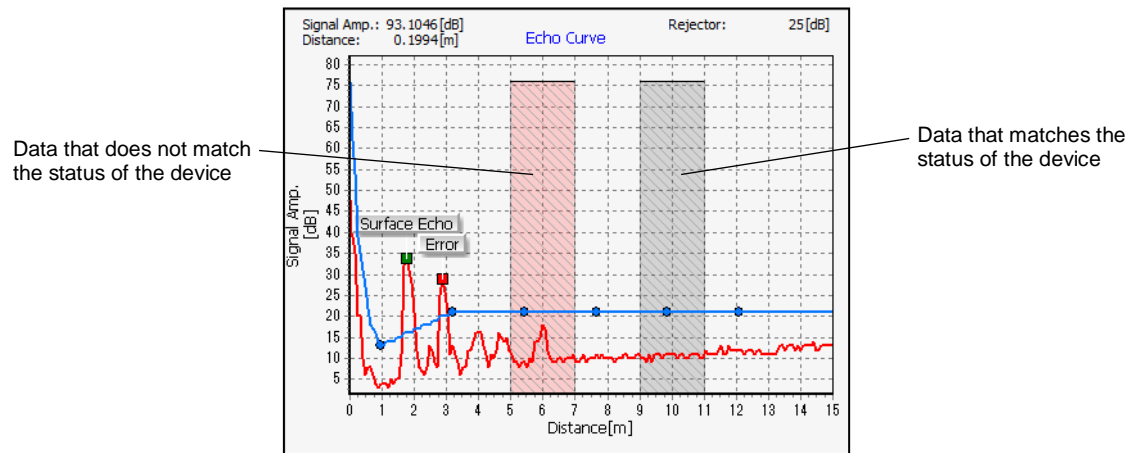


Fig. 6.8.14 Displaying fixed disturbance echo data

(7) Executing search

To start device search, click [Search] --> "Execute" button. Then the following window will be displayed, so then click "OK" to start search.

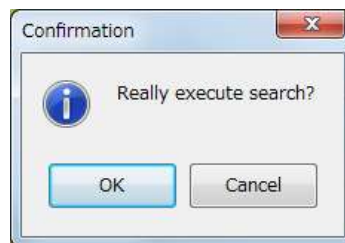


Fig. 6.8.15 Search execution confirmation dialog box

(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. 6.8.16 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.

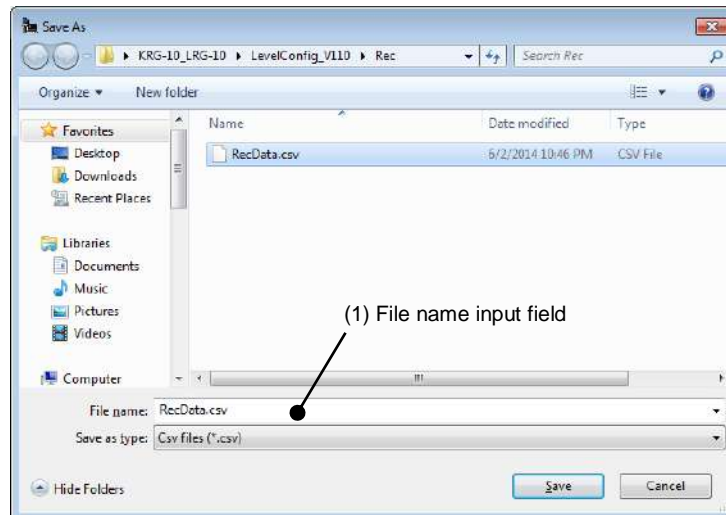


Fig. 6.8.17 File save dialog box

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.

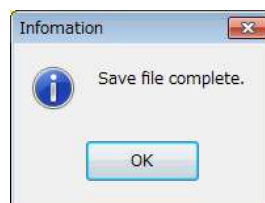



Fig. 6.8.18 Echo curve data recording complete confirmation dialog box

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

To record echo curve data in bmp format, select "bmp" () 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.

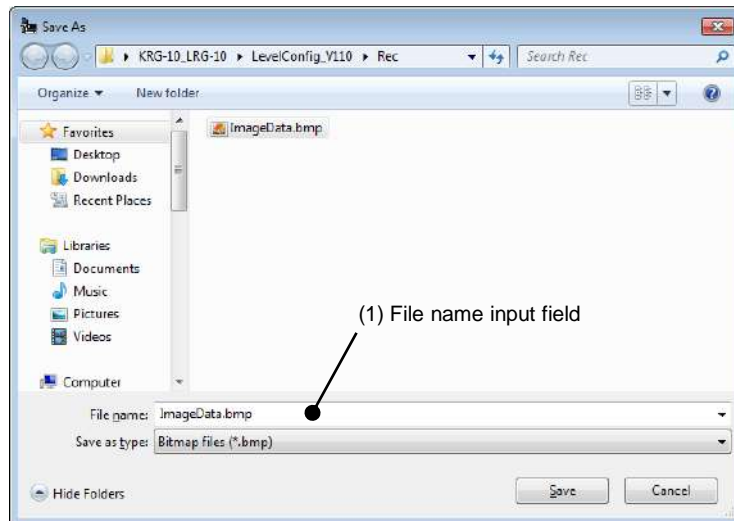


Fig. 6.8.19 File save dialog box

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.

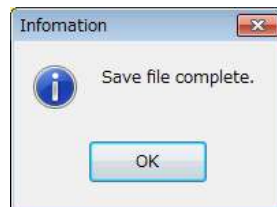


Fig. 6.8.20 Echo curve data recording complete confirmation dialog box

(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.

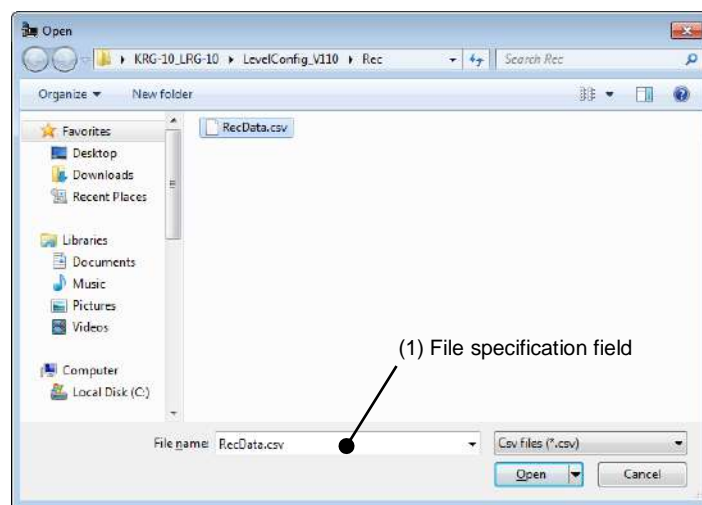


Fig. 6.8.21 File open dialog box

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.

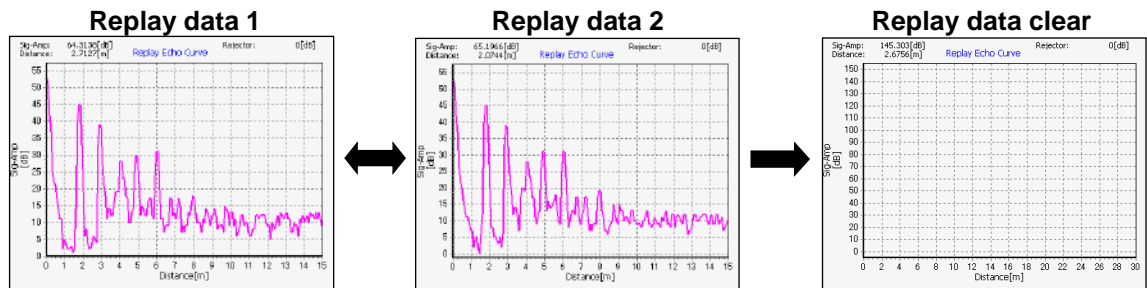


Fig. 6.8.22 Replaying echo curve data

- 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".

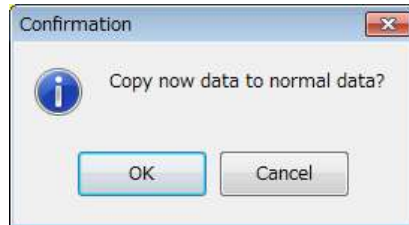


Fig. 6.8.23 Normal data conversion confirmation dialog box

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

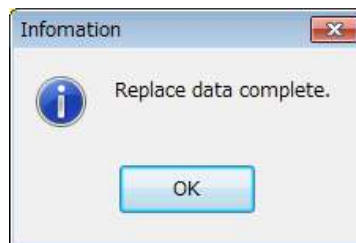


Fig. 6.8.24 Normal data conversion complete dialog box

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.

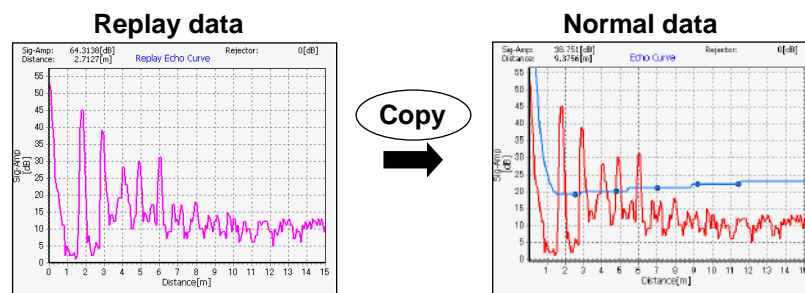


Fig. 6.8.25 Normal data conversion

(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.

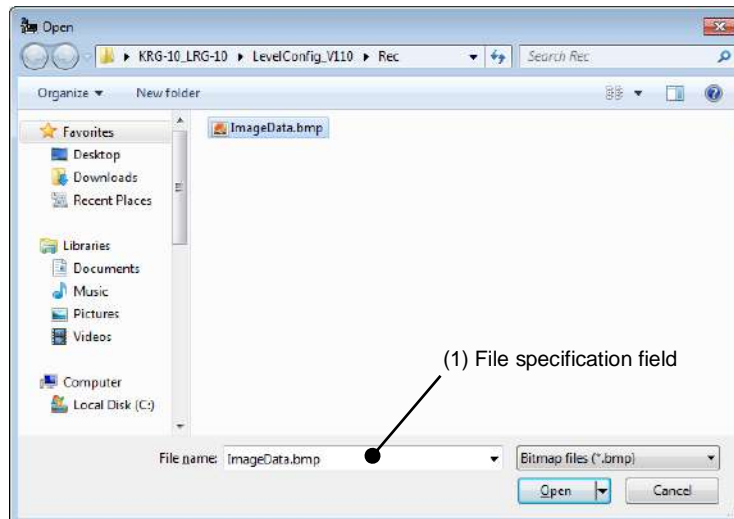


Fig. 6.8.26 File open dialog box

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

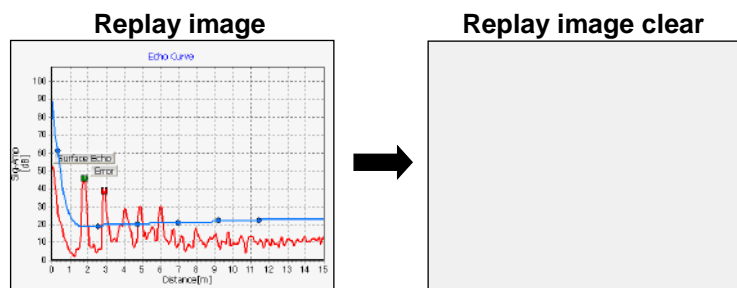


Fig. 6.8.27 Replaying echo curve images

6.9 Measuring

This section explains the functions of the measure menu.

In the measure menu, measurement parameters of the device can be displayed / analyzed and Echo List data / maximum values of the device can be read. On firmware V1.6.1 or later, HART variables can be set / read. If you click "Measure" in the menu bar or menu selection panel, the following window is displayed.

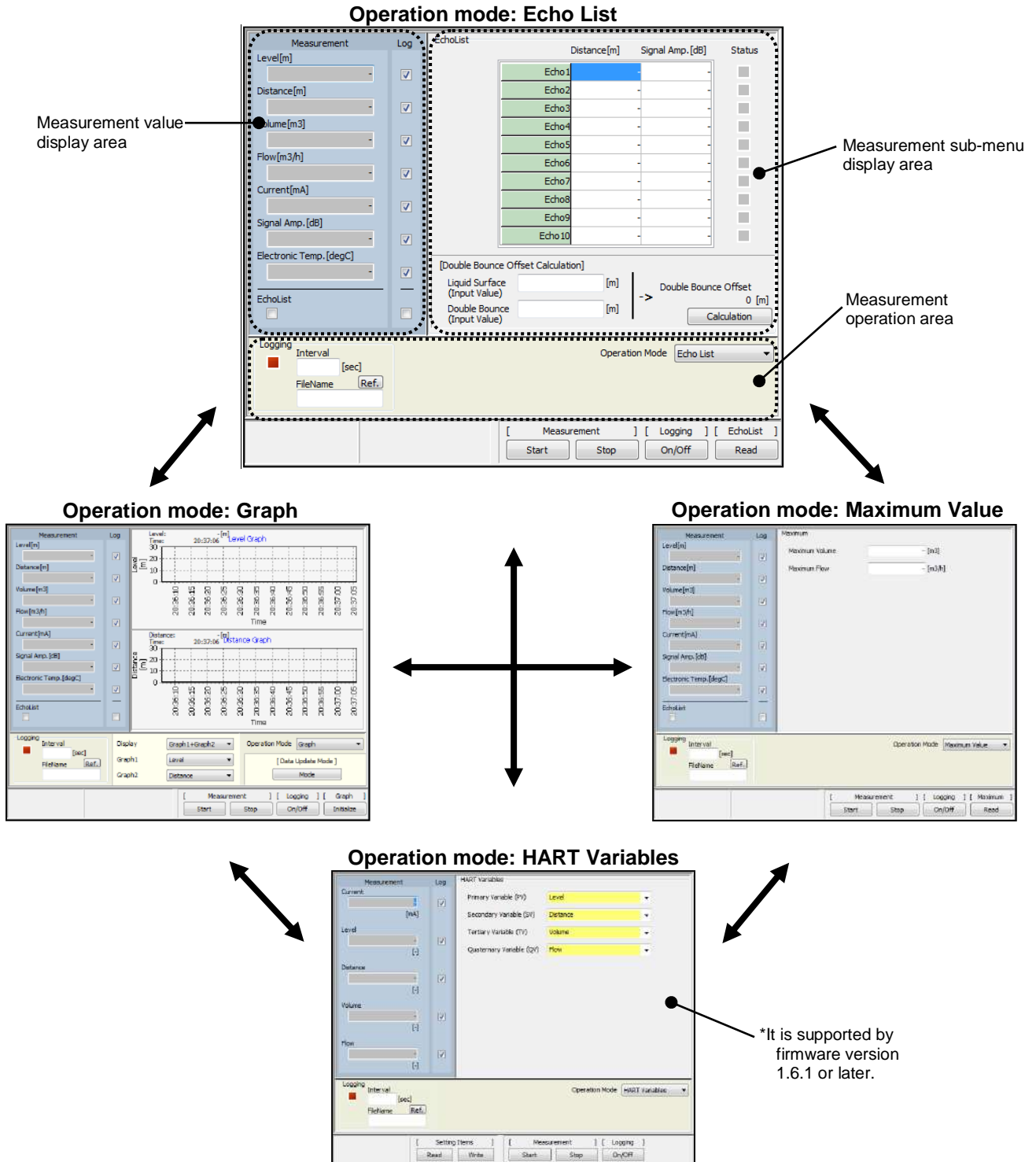


Fig. 6.9.1 Measure menu

(1) Starting measurement

To start device 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.

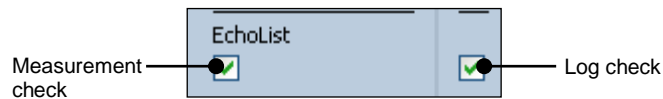


Fig. 6.9.2 Changing the measurement period

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

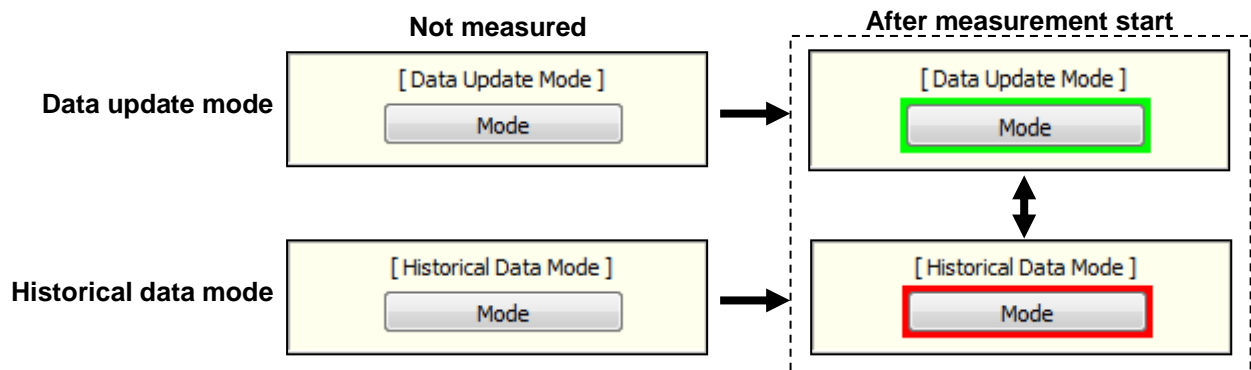


Fig. 6.9.3 Measurement mode transition 1 (Not measured -> Measurement start)

(2) Checking measurement values

The following two methods are used to check device 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, device 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 measurement value display area becomes green during measurement, and the measurement value display area becomes gray when measurement is not activated. If “Negative Level as Zero” is set to ON and level become 0m, level and distance are displayed in parentheses. The setting of “Negative Level as Zero” is determined by the setting at the start of measurement.

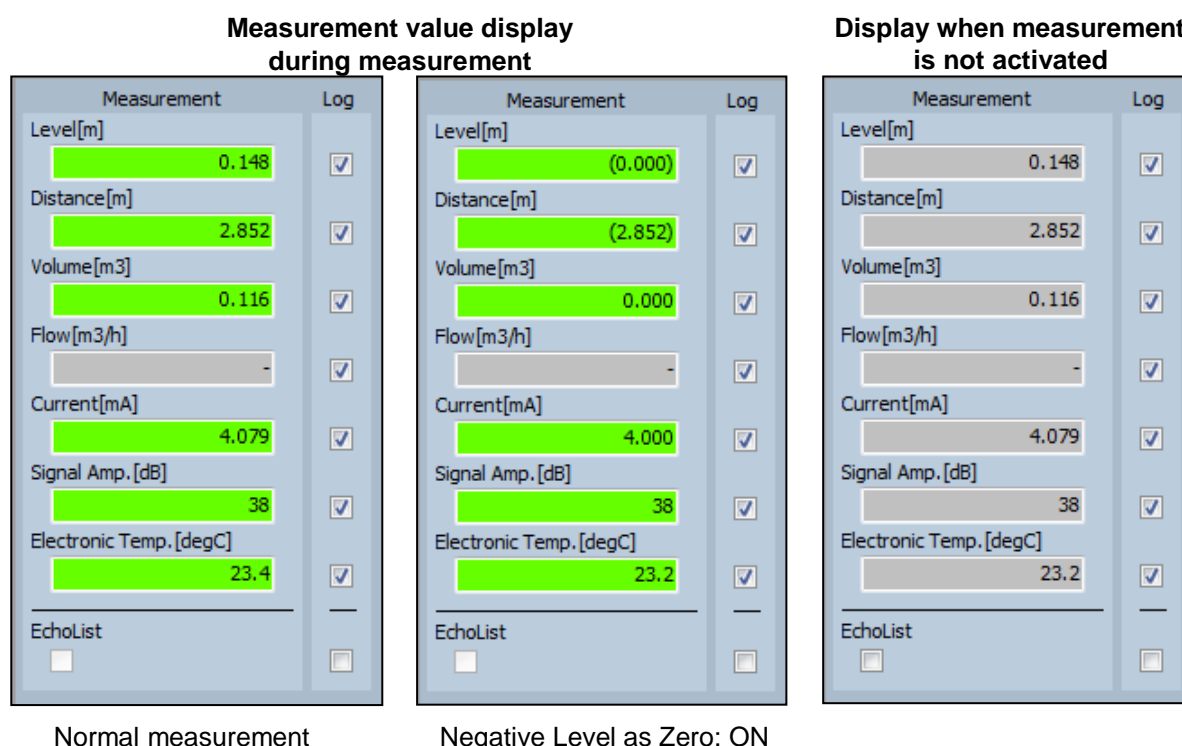
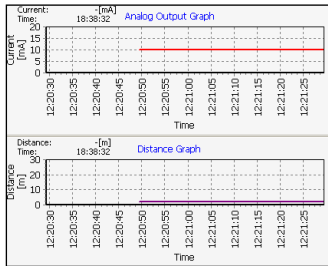


Fig. 6.9.4 Checking measurement parameters by value

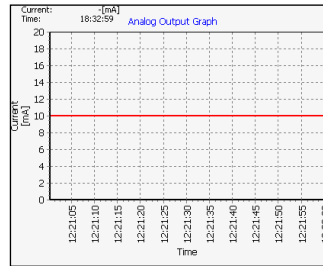
(2-2) Checking each measurement parameter by graph

To confirm device 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.

Graph 1 + Graph 2 Display



Graph 1 Only Display



Graph 2 Only Display

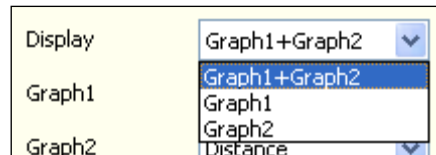
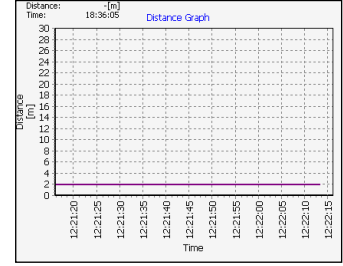


Fig. 6.9.5 Selecting a display graph

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.

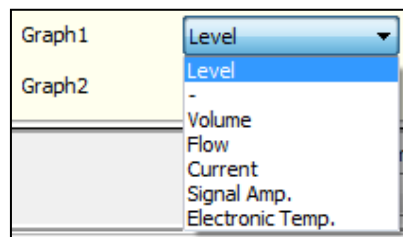


Fig. 6.9.6 Switching graph 1 display parameters

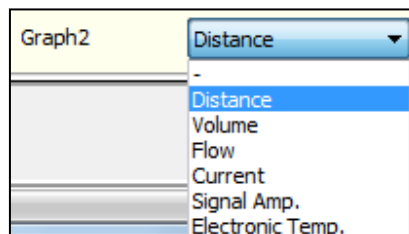


Fig. 6.9.7 Switching graph 2 display parameters

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 device 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.

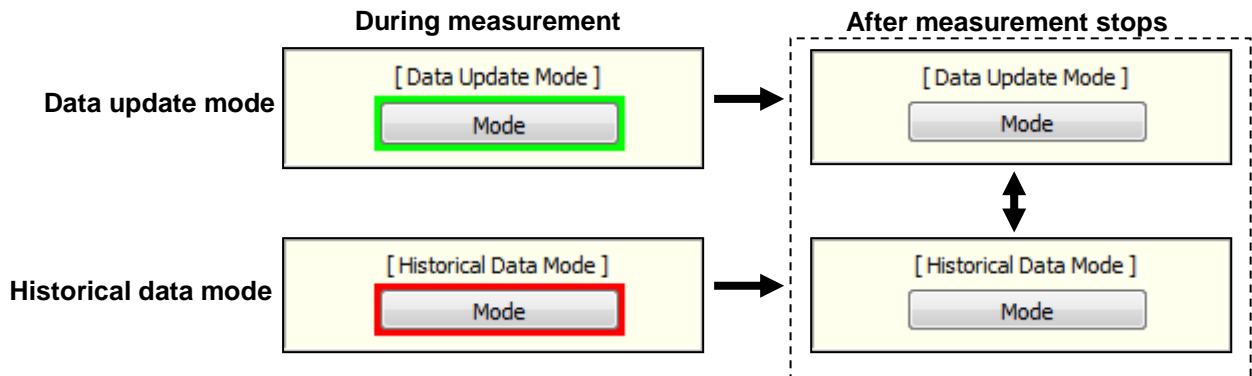


Fig. 6.9.8 Measurement mode transition 2 (During measurement -> Measurement stop)

(4) Logging measurement values

Device 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.

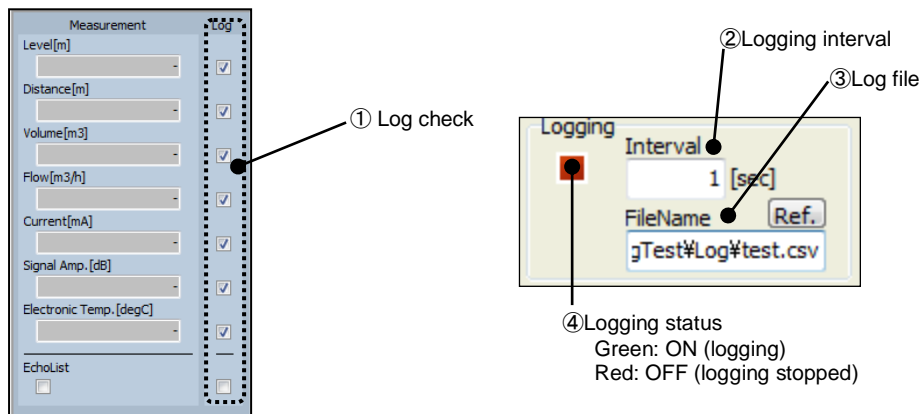


Fig. 6.9.9 Logging settings

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.

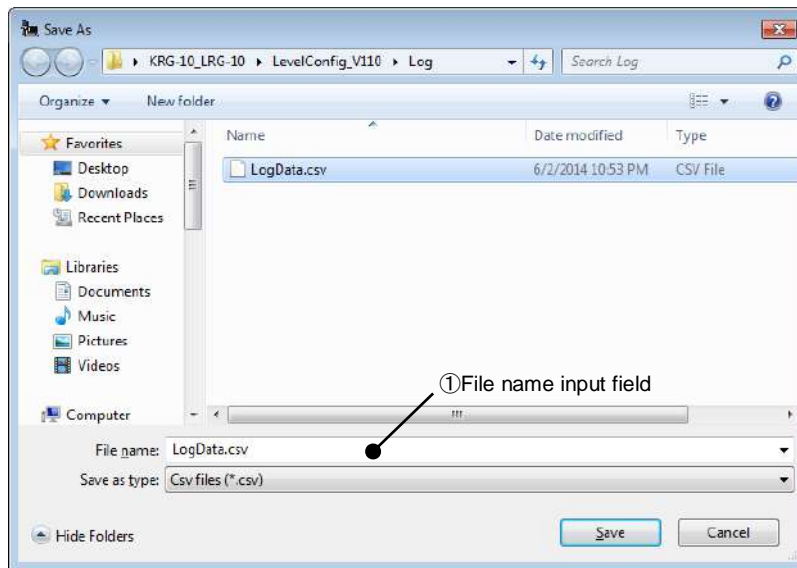
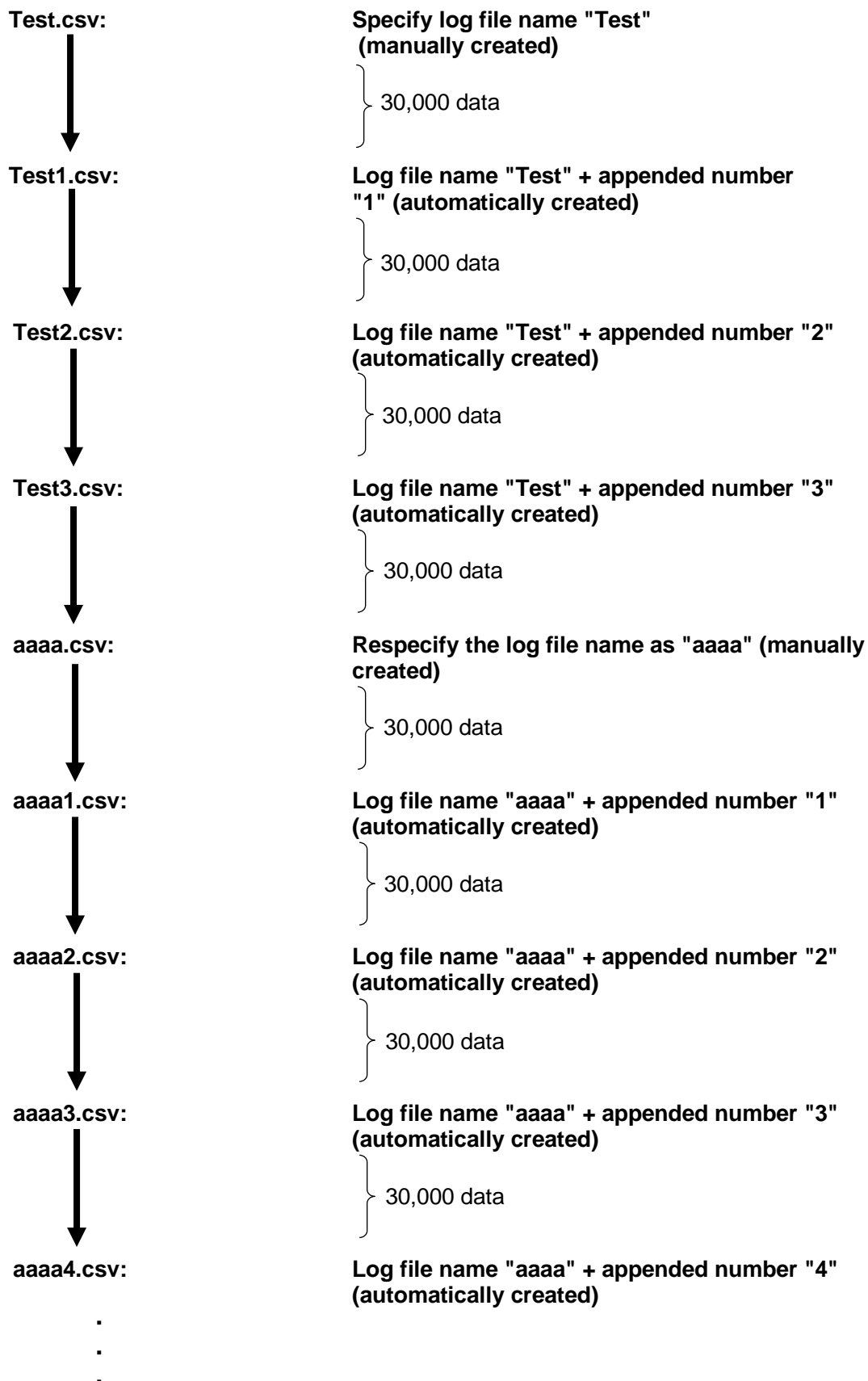


Fig. 6.9.10 Log file specification dialog box

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 data 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 data. An operation example of automatic file creation is shown below.

The maximum capacity of log file when recording 30,000 data is approximately 4 [MB].

- 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 "Mode" button in the measurement operation area.

- Data update mode (the measurement graph is being updated and measurement graph operations cannot be performed)
- Historical data mode (the measurement graph has been stopped and measurement graph operations can be performed)

(5-1) Data update mode

Data update 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) Historical data mode

Historical data 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 historical data 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.

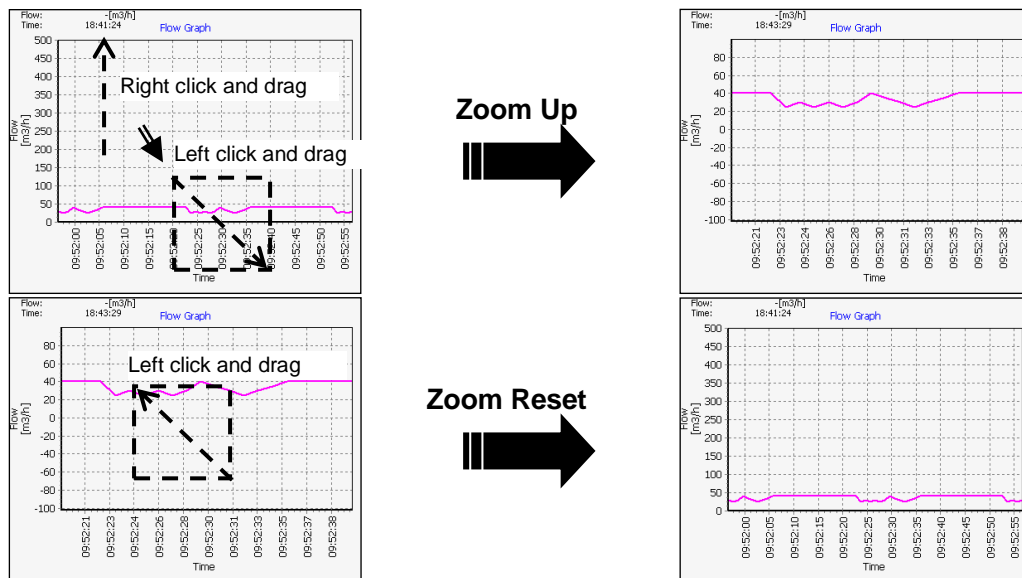


Fig. 6.9.11 Graph Drag / Zoom Up / Zoom Reset

- Range settings

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

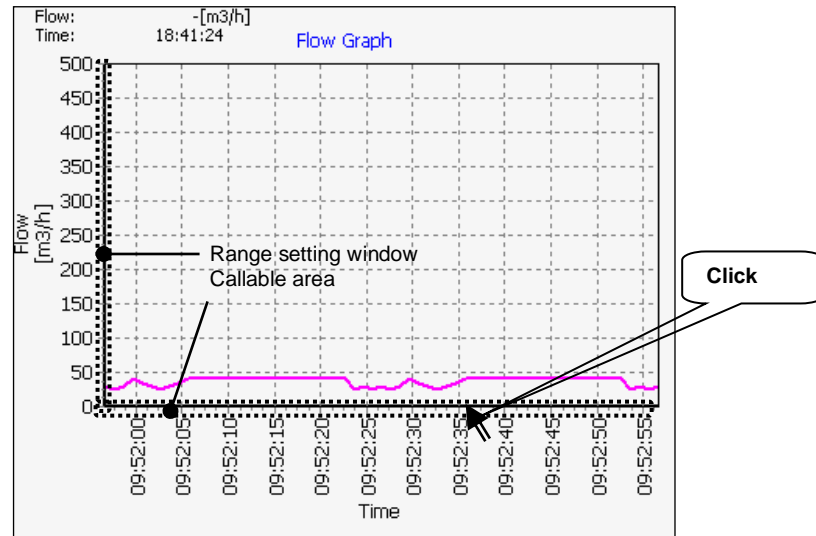


Fig. 6.9.12 Calling the range setting window

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.

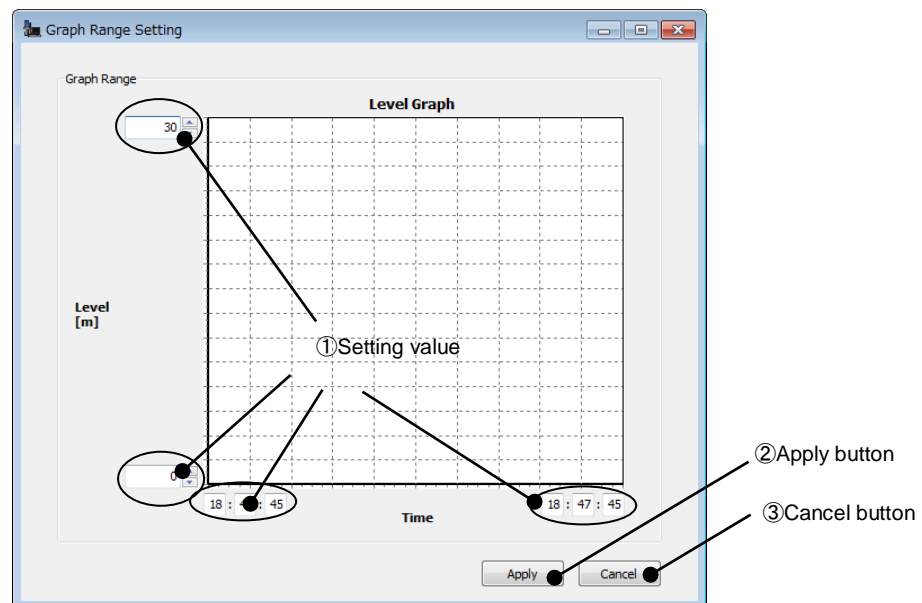


Fig. 6.9.13 Range setting window

(6) Reading Echo List data

The Echo List table (distance / signal Amplitude list) can be read from the device. 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 device.

The EchoList window displays a table with the following data:

| | Distance[m] | Signal Amp.[dB] | Status |
|--------|-------------|-----------------|--------|
| Echo1 | 1.774 | 34 | Green |
| Echo2 | 1.864 | 29 | Yellow |
| Echo3 | 2.889 | 30 | Red |
| Echo4 | - | - | Grey |
| Echo5 | - | - | Grey |
| Echo6 | - | - | Grey |
| Echo7 | - | - | Grey |
| Echo8 | - | - | Grey |
| Echo9 | - | - | Grey |
| Echo10 | - | - | Grey |

Below the table is a section for [Double Bounce Offset Calculation] with input fields for Liquid Surface (Input Value) and Double Bounce (Input Value) in [m], a right arrow, and a Double Bounce Offset 0 [m] with a Calculation button.

The measurement operation area contains buttons for [Measurement], [Logging], [EchoList], [Start], [Stop], [On/Off], and [Read]. The [EchoList] button is highlighted with a dashed box, and an arrow points to the [Read] button.

Echo List "Read" button

Fig. 6.9.14 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. 6.8.3 Echo curve graph.)

Double bounce offset calculation can be performed based on the results of the echo list data that was read from the device.

- 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.

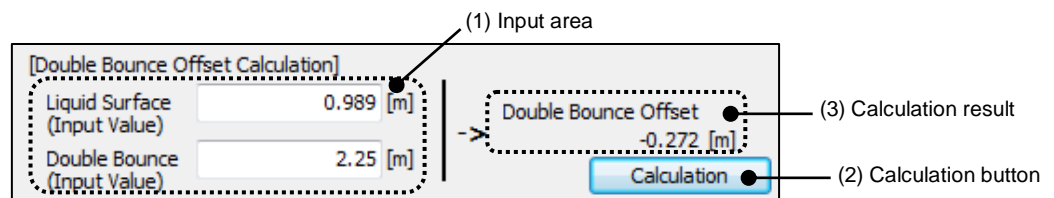


Fig. 6.9.15 Double bounce offset calculation

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

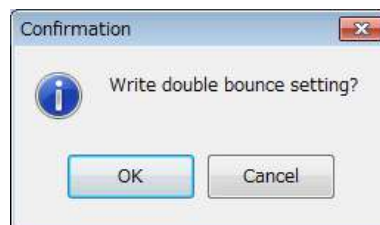


Fig. 6.9.16 Double bounce offset confirmation instructions dialog box

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

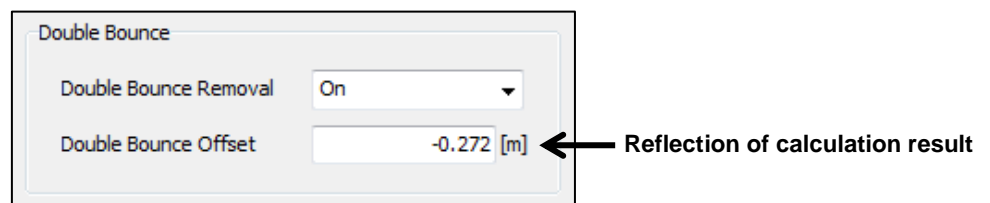
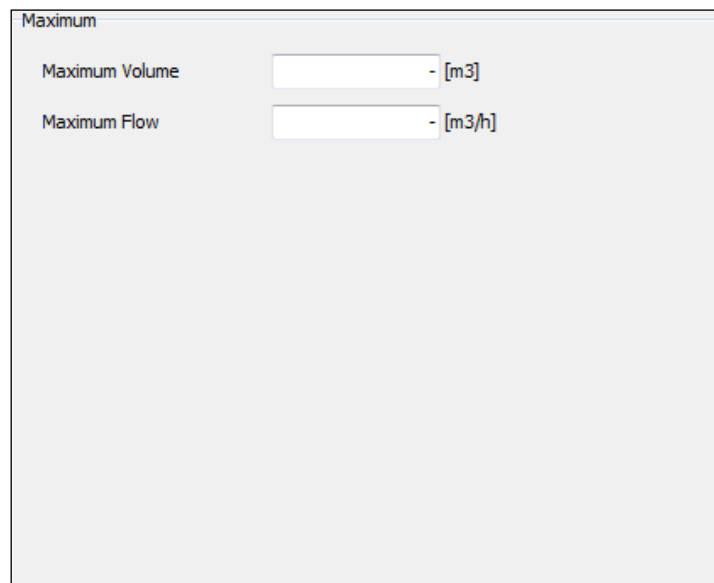


Fig. 6.9.17 Double bounce offset value

(7) Reading maximum values

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



The screenshot shows a window titled "Maximum". Inside, there are two rows of controls. The first row is labeled "Maximum Volume" and has a text input field followed by a unit indicator "[m3]". The second row is labeled "Maximum Flow" and has a text input field followed by a unit indicator "[m3/h]".

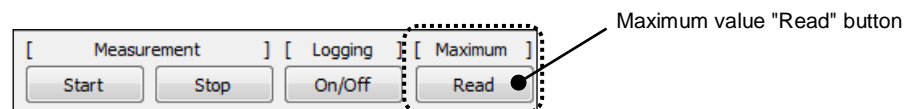


Fig. 6.9.18 Reading maximum values

Maximum value

- Maximum Volume: The maximum volume value calculated from the volume calc. method (If the volume calc. method 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 Calc. Method settings are "No Calculation", the maximum flow rate value will not be displayed.)

(8) Setting HART variables (*It is supported by firmware version 1.6.1 or later)

To set HART variables, switch the operation mode in the measurement operation area to "HART Variables". Click [Setting Items] --> "Read" button to read the assignment of HART variables from the device. Then, click [Setting Items] --> "Write" button to write the assignment of HART variables to the device.

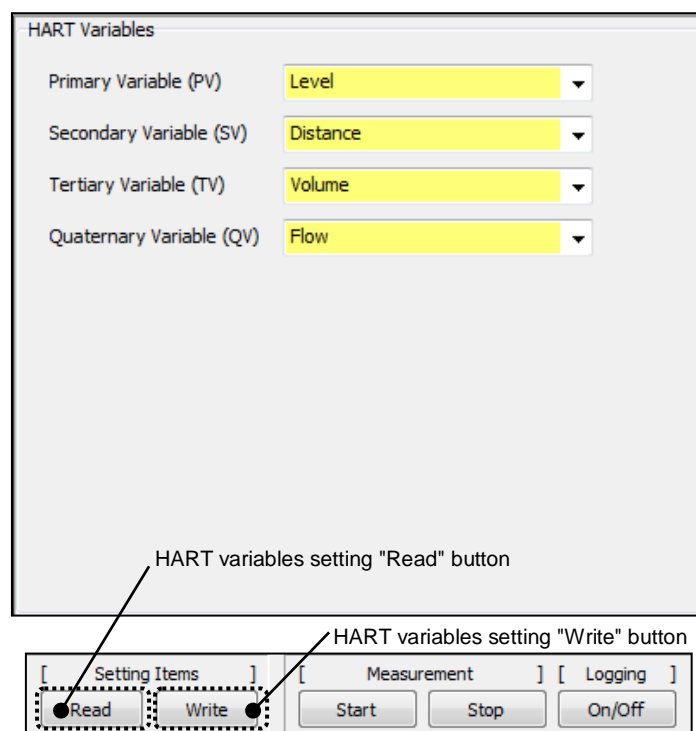


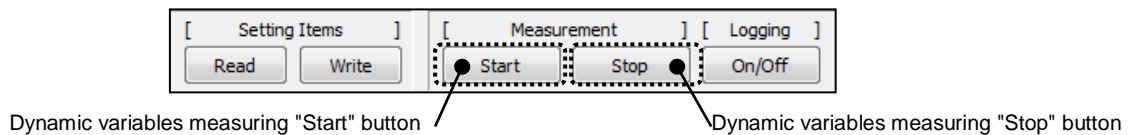
Fig. 6.9.19 Setting HART variables

HART variables

- Primary Variable (PV): Setting item to be assigned to PV
(Level / Distance / Volume / Flow / Signal Amp.)
- Secondary Variable (SV): Setting item to be assigned to SV
(Level / Distance / Volume / Flow / Signal Amp. / Unused / Electronic Temp. / Maximum Volume / Maximum Flow / Volume Ratio / Flow Ratio / Elapsed Time from Start / Search Count / Elapsed Time from Final Search / Margin of Sensitivity)
- Tertiary Variable (TV): Setting item to be assigned to TV
(Level / Distance / Volume / Flow / Signal Amp. / Unused / Electronic Temp. / Maximum Volume / Maximum Flow / Volume Ratio / Flow Ratio / Elapsed Time from Start / Search Count / Elapsed Time from Final Search / Margin of Sensitivity)
- Quaternary Variable (QV): Setting item to be assigned to QV
(Level / Distance / Volume / Flow / Signal Amp. / Unused / Electronic Temp. / Maximum Volume / Maximum Flow / Volume Ratio / Flow Ratio / Elapsed Time from Start / Search Count / Elapsed Time from Final Search / Margin of Sensitivity)

(9) Measuring HART variables (*It is supported by firmware version 1.6.1 or later)

To measure HART variables, switch the operation mode in the measurement operation area to "HART Variables". Click [Measurement] --> "Start" button to start HART variables measurement. Then, click [Measurement] --> "Stop" button to stop HART variables measurement. Also device measurement data of HART variables can be saved to a log file. The setting method of the log file is the same as (4) Logging measurement values.



Measurement value display during measurement

| Measurement | Log |
|-------------------------------------|-------------------------------------|
| Current 18.478 [mA] | <input checked="" type="checkbox"/> |
| Level 27.147 [m] | <input checked="" type="checkbox"/> |
| Electronic Temp. 24.6 [degC] | <input checked="" type="checkbox"/> |
| Elapsed Time from Start 1 [h] | <input checked="" type="checkbox"/> |
| Margin of Sensitivity 38 [dB] | <input checked="" type="checkbox"/> |

Display when measurement is not activated

| Measurement | Log |
|-------------------------------------|-------------------------------------|
| Current 18.478 [mA] | <input checked="" type="checkbox"/> |
| Level 27.147 [m] | <input checked="" type="checkbox"/> |
| Electronic Temp. 24.4 [degC] | <input checked="" type="checkbox"/> |
| Elapsed Time from Start 1 [h] | <input checked="" type="checkbox"/> |
| Margin of Sensitivity 38 [dB] | <input checked="" type="checkbox"/> |

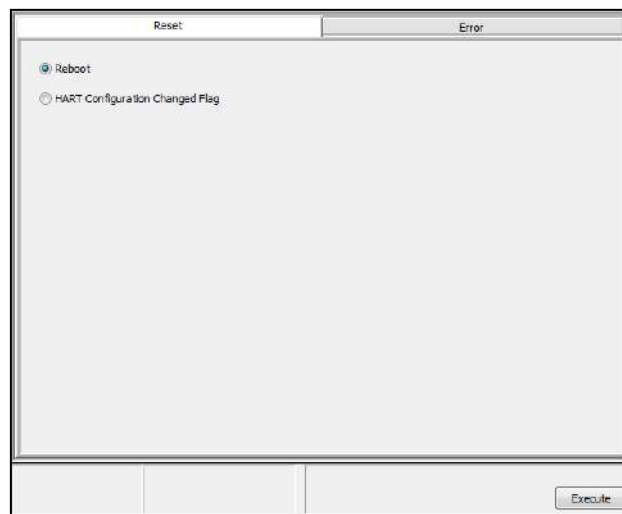
Fig. 6.9.20 Measuring dynamic variables

6.10 Tools

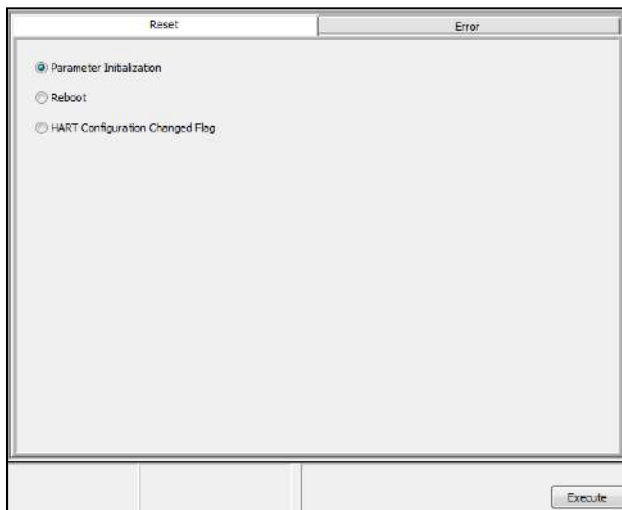
This section explains the functions of the tool menu.
To open the tool menu, click "Tools" on the menu bar or menu selection panel.

6.10.1 Reset

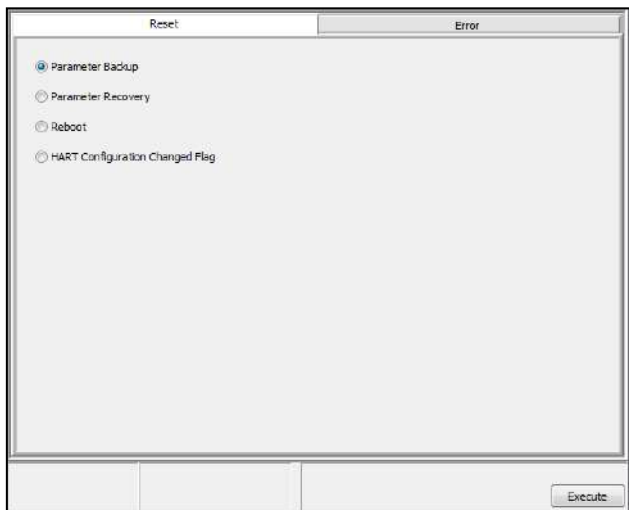
In the Reset menu, device reset operations can be performed. There are four types of resets, which are Parameter Initialization, Parameter Backup, Parameter Recovery and Reboot. The operation to be able to perform in a reset menu varies according to a firmware version. If you click "Reset" tab or "Reset" in the tree display, the following window is displayed.



Firmware version less than 1.4.1




Firmware version between 1.4.1 and less than 1.5.0



Firmware version 1.5.0 or later

Fig. 6.10.1 Reset menu

(1) Executing Parameter Initialization(*It is supported by firmware version between 1.4.1 and less than 1.5.0)

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

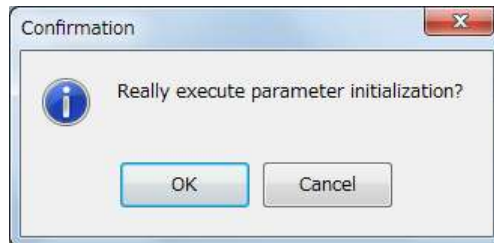



Fig. 6.10.2 Parameter initialization confirmation dialog box

The parameters that are initialized by config software

Parameters except the noise table, fixed disturbance echo, and HART bus address.

(2) Executing Parameter Backup(*It is supported by firmware version 1.5.0 or later)

To backup device parameters, select "Parameter Backup" (), and then click the "Execute" button. The following window will be displayed, so then click "OK", the setting parameters are stored in the inside of the device. When parameter backup is executed, you have to be very careful because factory-configured parameters are overwritten and removed.

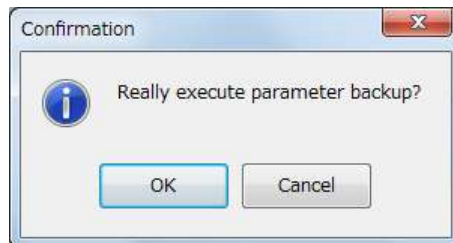



Fig. 6.10.3 Parameter backup confirmation dialog box

Please don't turn off power for five seconds after executing parameter backup because it leads to device failure.

The parameters that are initialized by config software

Parameters except the noise table, fixed disturbance echo, and HART bus address.

(3) Executing Parameter Recovery(*It is supported by firmware version 1.5.0 or later)

To recovery device parameters, select "Parameter Recovery" (), and then click the "Execute" button. The following window will be displayed, so then click "OK", the parameters stored in the inside of the device are loaded. When parameter backup is never executed, factory-configured parameters are loaded.

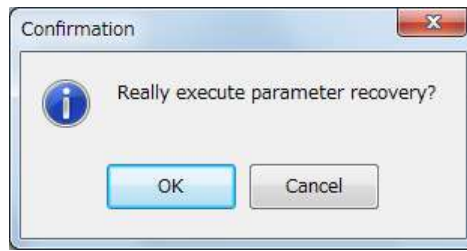



Fig. 6.10.4 Parameter recovery confirmation dialog box

The parameters that are initialized by config software
Parameters except the noise table, fixed disturbance echo, and HART bus address.

(4) Executing Reboot

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

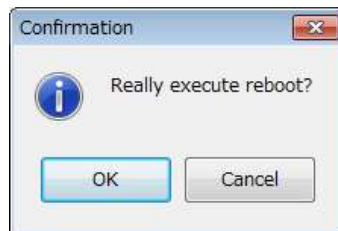



Fig. 6.10.5 Reboot confirmation dialog box

(5) Executing Reset HART Configuration Changed Flag

To reset HART configuration changed flag, select "HART Configuration Changed Flag " (), and then click the "Execute" button. The following window will be displayed, so then click "OK" to reset the HART configuration changed flag.

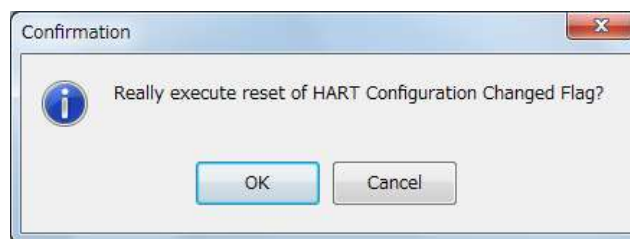


Fig. 6.10.6 HART Configuration changed flag reset confirmation dialog box

6.10.2 Error

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

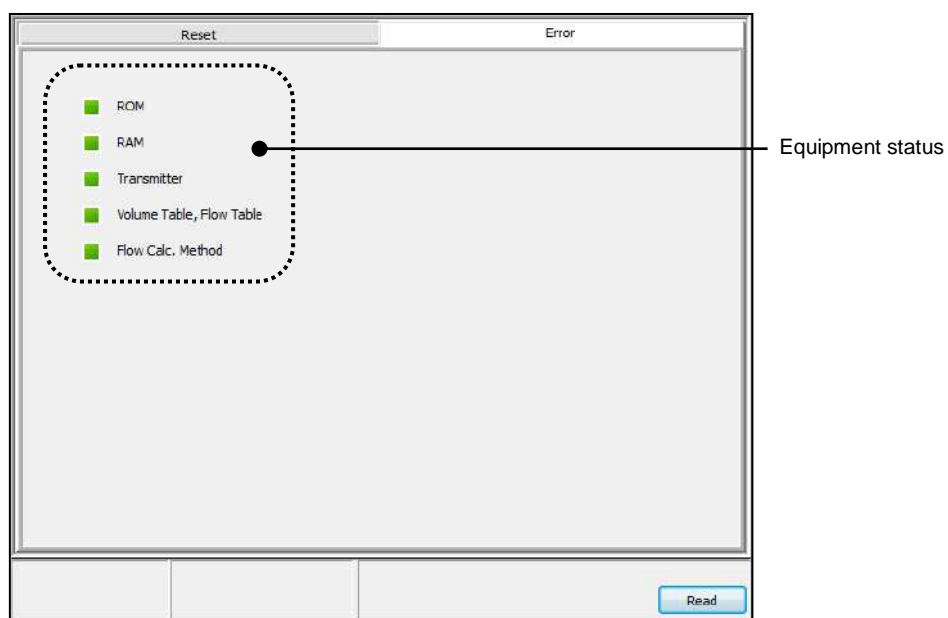


Fig. 6.10.7 Error menu

(1) Reading the device status

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

Device status

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

Table 6.10.1. Device status

| Display | Description | Status | Conceivable cause | Action |
|--------------------------|---------------------------------------|--------|--|---|
| ROM | ROM status | Green | Normal | — |
| | | Red | ROM failure | If power cycling does not fix the problem, replace the electronic components. |
| RAM | RAM status | Green | Normal | — |
| | | Red | RAM failure | If power cycling does not fix the problem, replace the electronic components. |
| Transmitter | Transmitter status | Green | Normal | — |
| | | Red | Transmitter failure | 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 Calc. Method | 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 device settings

7.1 Basic setting parameters diagram

Basic setting parameters are shown in the following diagram.

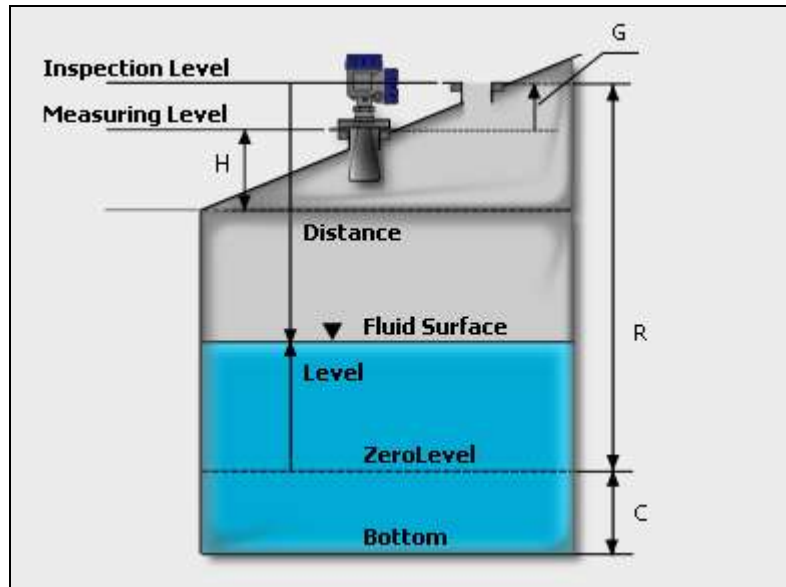


Fig. 7.1.1 Basic setting parameters diagram

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 current 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 rejecter 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 rejecter can be set using the configuration software. The noise table consists of a line graph connecting a maximum of 513 points. The rejecter 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 **6.8 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.

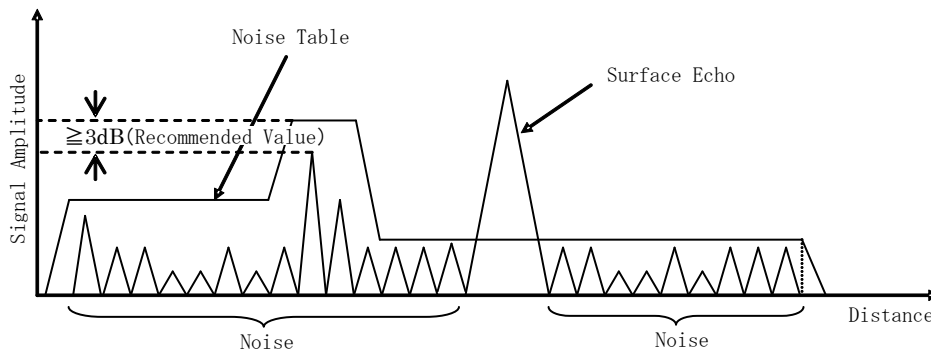


Fig. 7.3.1 Setting example of threshold value

7.4 Setting volume calculation / flow calculation

(1) Volume calculation

To calculate volume, select a standard tank shape from among those in the "Volume calc. method" 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 volume table.

| Level[m] | Volume[m3] |
|----------|------------|
| 1 | 100 |
| 2 | 100 |
| 3 | 100 |
| 4 | 100 |
| 5 | 100 |
| 6 | 150 |
| 7 | 150 |
| 8 | 150 |
| 9 | 150 |
| 10 | 150 |
| 11 | 150 |
| 12 | 150 |

Figure 7.4.1 Setting volume table

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 device status table error occurs, and functions will not operate. For details on device status, refer to **5.4 Parameter instructions --> [8-3] Device Status** or **6.10 Tools --> Error**.

(2) Flow calculation

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

Table 7.4.2 Standard channel shape setting parameters

| Setting parameters / channel shape | Weir (JIS B 8302) | | | | Flume (JIS B 7553) |
|---|-----------------------|-----------------------|---------------------|--------------------|-----------------------|
| | 60°triangular weir | 90°triangular weir | Rectangular weir | Full-width weir | |
| B (width of channel) | ● | ● | ● | ● | - |
| b (width of weir) | - | - | ● | - | - |
| ν (kinematic viscosity of water) | ● | - | - | - | - |
| D (height of weir edge relative to bottom of channel) | ● | ● | ● | ● | - |
| Flume shape (Nominal) | - | - | - | - | ● |

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

Flow Table

Point Number: 20

| | Level[m] | Flow[m3/h] |
|----|----------|------------|
| 1 | 1 | 100 |
| 2 | 2 | 100 |
| 3 | 3 | 100 |
| 4 | 4 | 100 |
| 5 | 5 | 100 |
| 6 | 6 | 150 |
| 7 | 7 | 150 |
| 8 | 8 | 150 |
| 9 | 9 | 150 |
| 10 | 10 | 150 |
| 11 | 11 | 150 |
| 12 | 12 | 150 |

Figure 7.4.2 Setting flow table

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]), a device status table error occurs, and functions will not operate. For details on device status, refer to **5.4 Parameter instruction --> [8-3] Device Status** or **6.10 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 current output

If you are calibrating the analog current 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 current 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 device 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 device 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 case 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 **6.6.1 Measure support**.

7.9 Double 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 Double 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 **6.6.2 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 **6.9 Measuring Double bounce offset calculation**.

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 **6.8 Echo Viewer**.

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 is generally not required, be aware of the following.

- (1) Wipe away any dirt on the transmitter 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.

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 are not affected.

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

(2) Sealing parts

The lifetime of the sealing parts used in this equipment may be varied by site conditions. We recommend periodical maintenance and check by authorized service engineers.

.

(3) Built-in arrester (non-ex model only)

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.

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 6.7 Calibration**)

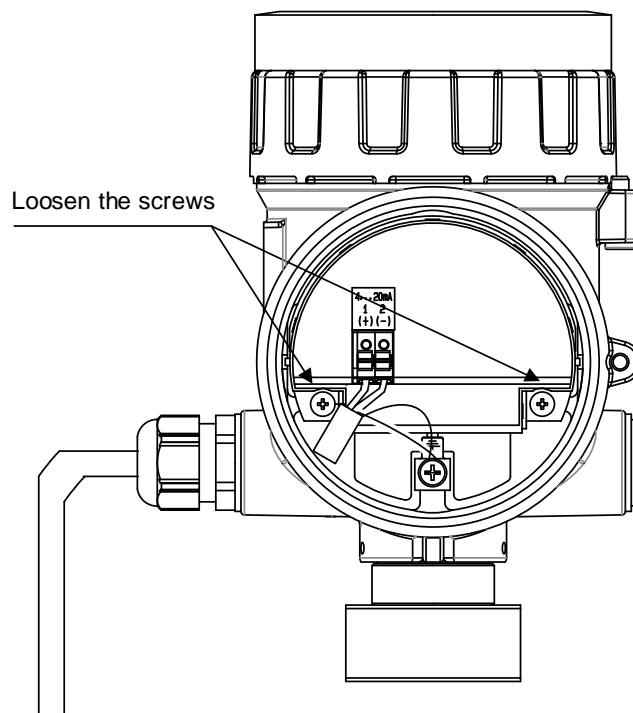
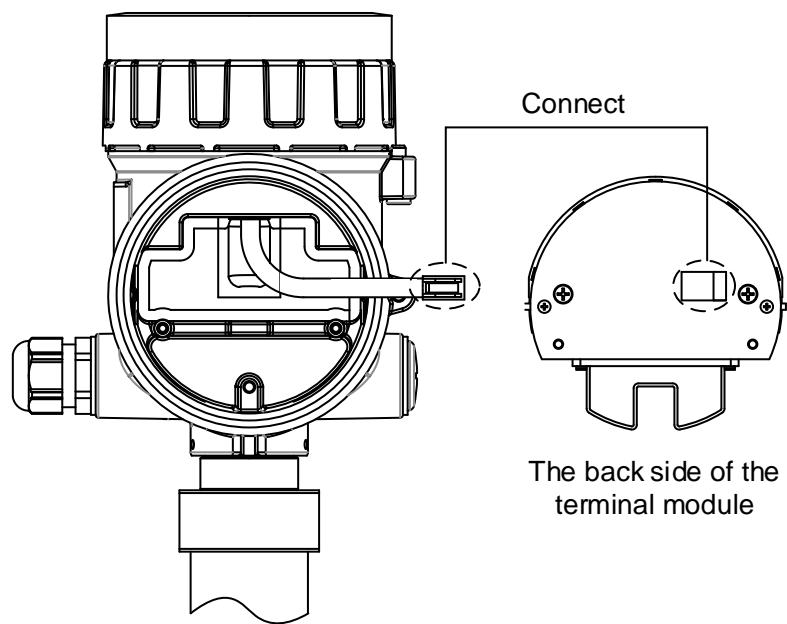


Fig. 8.5.1 Dismounting the terminal module



Transmitter head
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**.

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 | | |
| Medium | Liquid/Solid | Liquid | |
| | Dielectric constant | $\epsilon_r \geq 1.8$ | |
| | Process Temperature | Non-Ex | |
| | | Cone antenna | FKM:-10 to +150 °C Kalrez:-20 to +150 °C VMQ:-40 to +150 °C |
| | | PTFE sealing antenna | FKM:-10 to +200 °C VMQ:-40 to +180 °C |
| | | Rod antenna | VMQ:-40 to +150 °C |
| | | NOTE: •For Ex equipment, please refer to the “Safety Instructions”. •Temperature range differs depending on the O-ring material. •FKM(Fluorine-containing rubber) •Kalrez(Kalrez6375) •VMQ(Silicone rubber) •The maximum temperature of Ex-types is due to temperature class and ambient temperature of Ex. | |
| | Process pressure | Cone antenna | -0.1 to +1.5 MPa |
| | | PTFE sealing antenna | -0.1 to +1.5 MPa |
| Rod antenna | | -0.1 to +1.5 MPa | |
| Maximum measuring range | 4" cone antenna | 30m | |
| | 2" cone antenna | 10m | |
| | 4" PTFE sealing antenna | 30m | |
| | 3" PTFE sealing antenna | 25m | |
| | 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) | | |
| Repeatability | | ≤ ±1mm | | |
| Temperature drift | | 10mm _{p-p} or less than ±3mm/10K | | |
| Maximum measured error | Cone antenna | ±2mm | | |
| | PTFE sealing antenna | | | |
| | 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 protection | Selectable form Non-Ex, Intrinsically Safe, Flame Proof | | | |
| | Intrinsic safety parameters : Ui=30V, Ii=93mA, Pi=700mW, Ci=negligible, Li=negligible, Associated apparatus parameter : Um=250V AC | | | |
| Ex approval | ATEX | EN60079-0:2018 EN60079-1:2014 EN60079-11:2012 EN60079-26:2015 EN60529:1991 +A1:2000+A2:2013 | Intrinsically Safe FM13ATEX0069X | |
| | | | II 1 G Ex ia IIC T4 Ga Ta = -40°C to +60°C, IP66 II 1 D Ex ia IIIC T135°C Da Ta = -40°C to +60°C, IP66 | |
| | | | Flame Proof FM13ATEX0069X | |
| | | | II 1/2 G Ex ia/db IIC T4 Ga/Gb Ta = -40°C to +60°C, IP66 | |
| | IECEX | IEC 60079-0:2017 IEC 60079-1:2014-06 IEC 60079-11:2011 IEC 60079-26:2014-10 | Intrinsically Safe IECEX FMG 13.0039X | |
| | | | Ex ia IIC T4 Ga Ta = -40°C to +60°C, IP66 Ex ia IIIC T135°C Da Ta = -40°C to +60°C, IP66 | |
| | | | Flame Proof IECEX FMG 13.0039X | |
| | | | Ex ia/db IIC T4 Ga/Gb Ta = -40°C to +60°C, IP66 | |
| | KCs | IEC 60079-0:2017 IEC 60079-1:2014 IEC 60079-11:2011 IEC 60079-26:2014 | Flame Proof | |
| | | | Ex ia/db IIC T4 Ga/Gb | |
| | NOTE: Please observe the information in the documentation "Safety Instructions". | | | |
| | EMC directive | | EN61326-1:2013 | |
| | Low voltage directive | | EN61010-1:2010 | |
| | RE directive | | EN302372:2016 | |

NOTE : Please contact us for Japanese explosion-proof products.

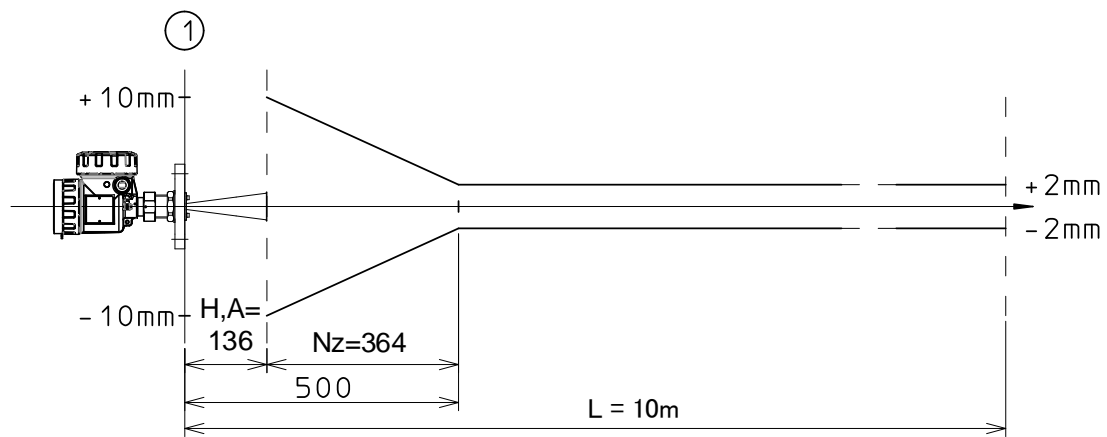


Fig. 10.1.1 Maximum measured error of 2" cone antenna

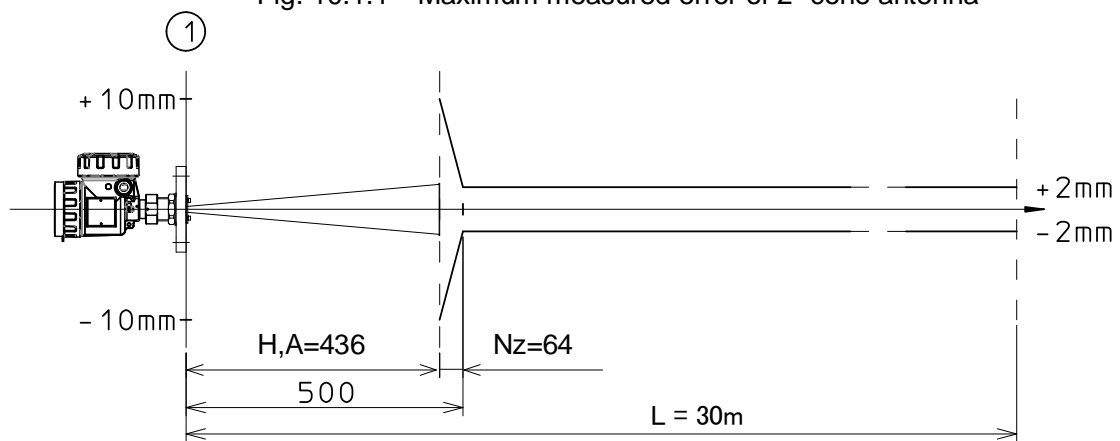


Fig. 10.1.2 Maximum measured error of 4" cone antenna

NOTE: ①=Reference plane, A=Antenna length, H=Hold off distance, Nz=Proximity zone

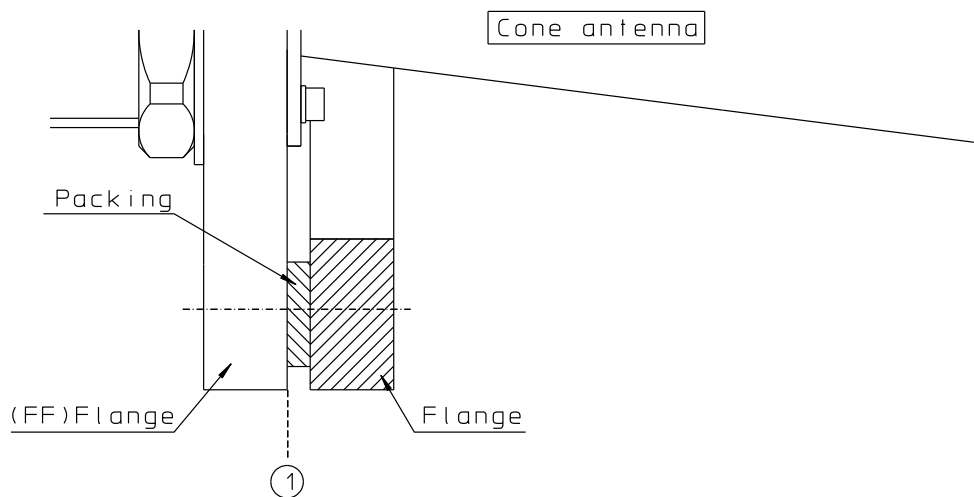


Fig. 10.1.3 Reference plane of cone antenna

NOTE: Reference plane is end of flange.

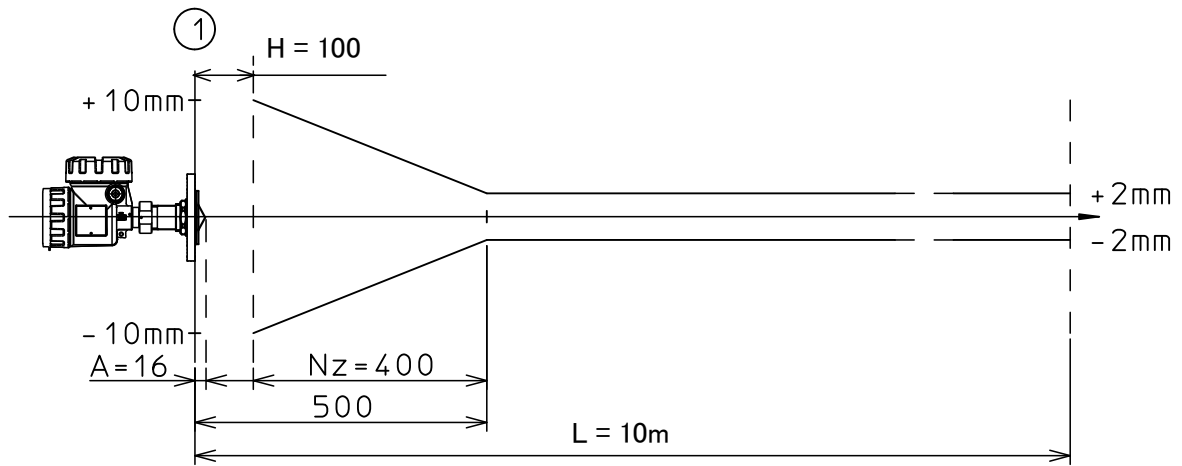


Fig. 10.1.4 Maximum measured error of 2" PTFE sealing antenna

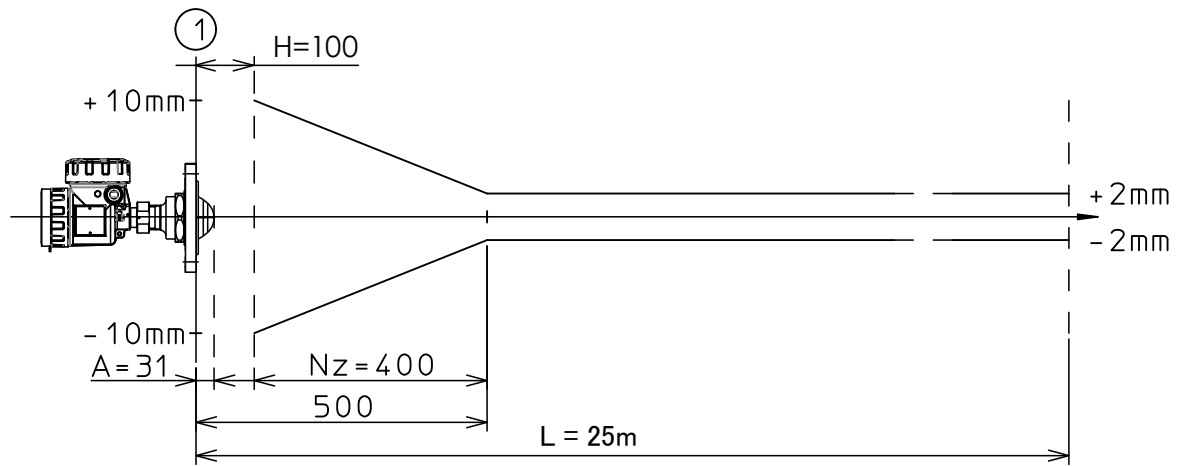


Fig. 10.1.5 Maximum measured error of 3" PTFE sealing antenna

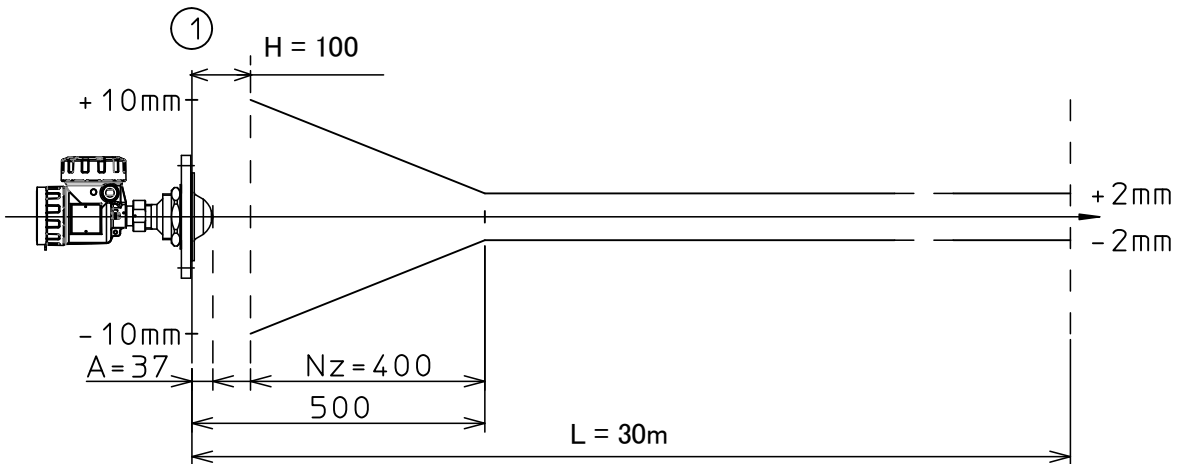


Fig. 10.1.6 Maximum measured error of 4" PTFE sealing antenna

NOTE: ①=Reference plane, A=Antenna length, H=Hold off distance, Nz=Proximity zone

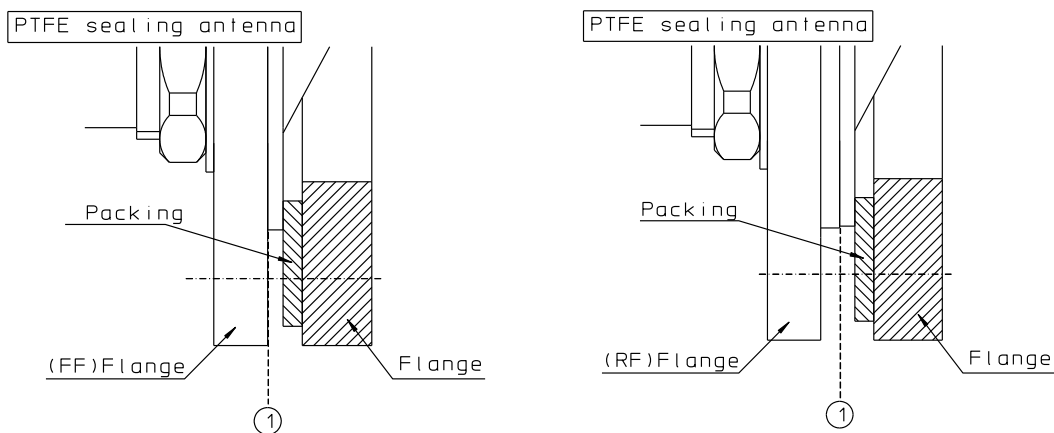


Fig. 10.1.7 Reference plane of PTFE sealing antenna

NOTE: Reference plane is end of flange.

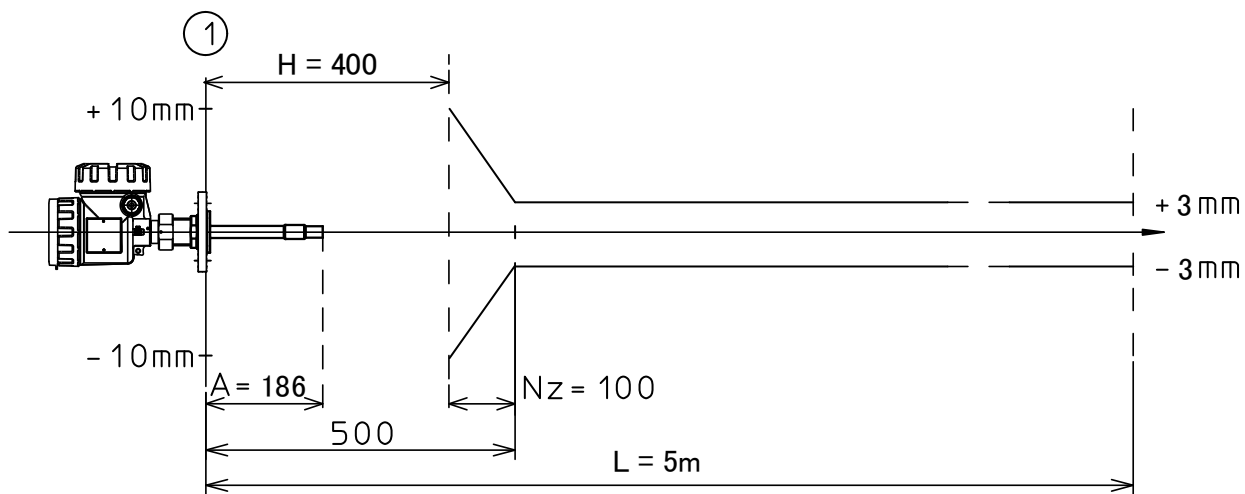


Fig. 10.1.8 Maximum measured error of 1" rod antenna

NOTE: ①=Reference plane, A=Antenna length, H=Hold off distance, Nz=Proximity zone

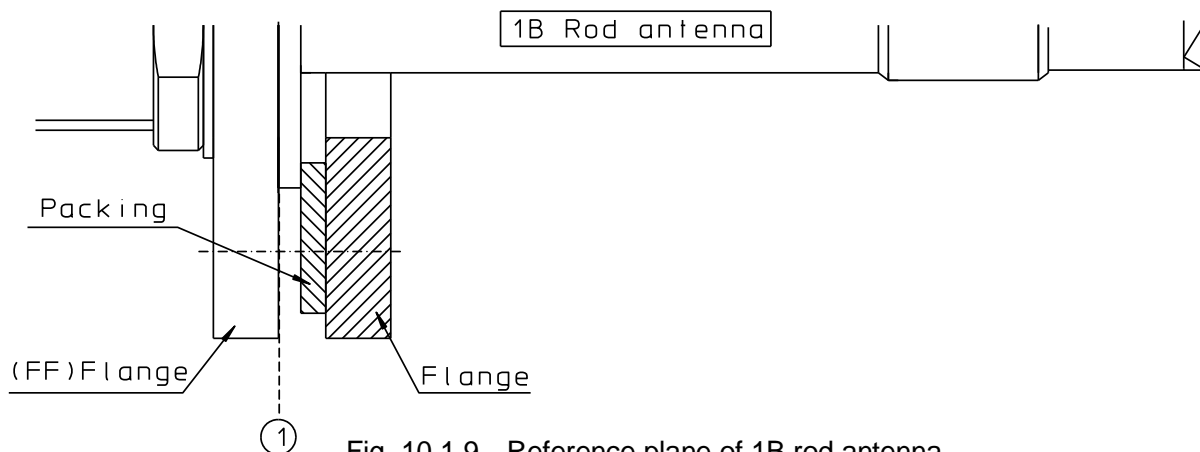


Fig. 10.1.9 Reference plane of 1B rod antenna

NOTE: Reference plane is end of flange.

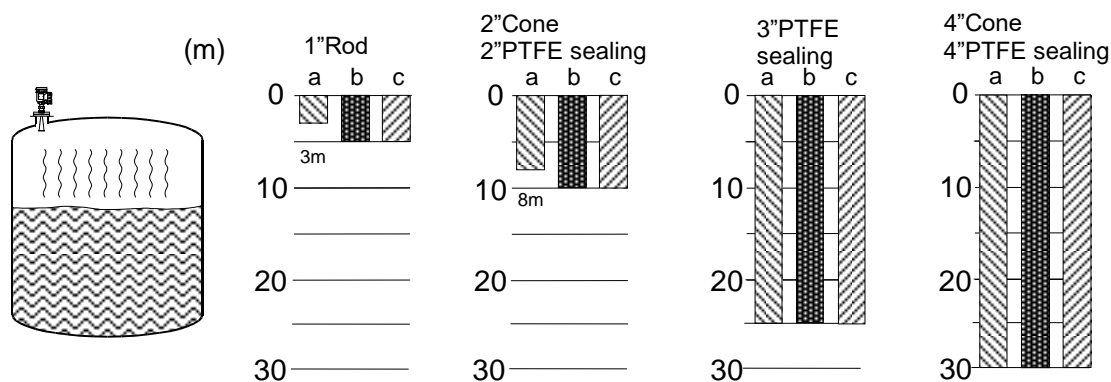


Fig. 10.1.10 Antenna measuring distance of calm surface (reference)

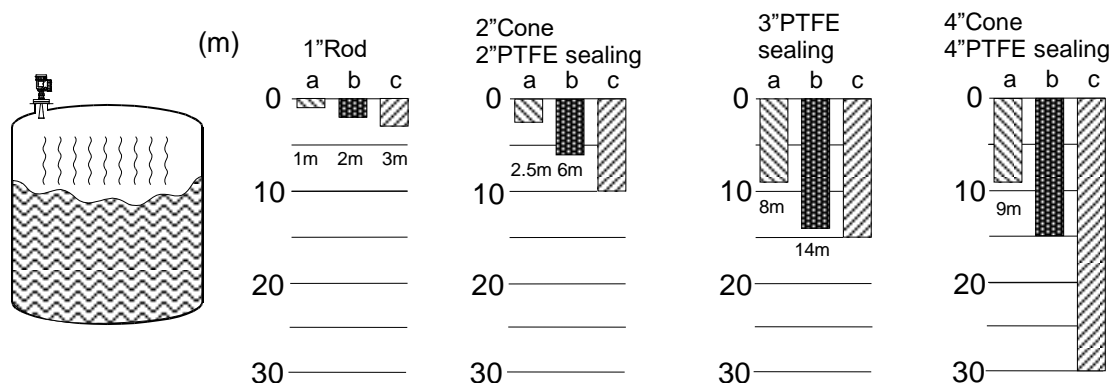





Fig. 10.1.11 Antenna measuring distance of turbulent surface (reference)

-  a : Machine oil, gasoline, hydrocarbons, petroleum ($\epsilon_r = 1.8 \sim 2.7$)
-  b : Rapeseed oil, alcohol, concentrated acid, solvent ($\epsilon_r = 2.7 \sim 10$)
-  c : Water base liquid ($\epsilon_r > 10$)

NOTE1: In generally, the liquid, which has higher dielectric constant number ($= \epsilon_r$) 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 | Frequency | 26GHz | |
| | Power | < 5μW | |
| Operating voltage | Non-Ex | DC 10.5 to 36V | |
| | Ex ia | DC 12 to 30V | |
| | Ex ia/db | DC 18 to 36V | |
| Analog current output | Current output | 4-20mA, 4mA(HART multidrop mode) | |
| | Resolution | 0.4μA | |
| | Alarm output | Hold, 3.6mA, 22mA | |
| | Temperature drift | ±0.05%FS / 10K (16mA) or ±0.5%FS | |
| | Response Time | 2sec. until statically determinate | |
| Digital output | Communication Protocol | HART 7 | |
| | Resolution | 1mm | |
| | Fastest output cycle | 1s | |
| LCD module (Case of with LCD module) | 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 Electronic temperature (°C) | |
| | Method of operation | 4 keys operation | |
| Surge immunity | Non-Ex | COM 4kV / Dif 2kV | |
| | Ex ia | COM 1kV / Dif 30V ¹⁾ | |
| | Ex ia/db | COM 1kV / Dif 250V ¹⁾ | |
| Ambient temperature | Non-Ex (Without LCD display) | -40 to +70 °C | |
| | Non-Ex (With LCD display) | -20 to +70 °C | |
| | Ex ia, Ex ia/db (Without display) | -40 to +60 °C | |
| | Ex ia, Ex ia/db (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 | Non-Ex Blind plug ²⁾ , cable gland ¹⁾ |
| | | Ex ia | Ex Blind plug, Non-Ex Blind plug ²⁾ |
| | | Ex ia/db | Ex Blind plug, Non-Ex Blind plug ²⁾ |
| | 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 (Only in case of "with LCD module") |
| Structure | Aluminum housing with double chamber | |
| Waterproof standard | IP66/IP67 ³⁾ | |
| Dimensions | Without display type | 187mm x 110mm x 157mm / H x W x L |
| | With display type | 193mm x 110mm x 157mm / H x W x L |
| Weight | Transmitter | 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 |
| | 3" PTFE sealing antenna | about 2.0kg |
| | 4" PTFE sealing antenna | about 2.5kg |
| | 1" rod antenna | about 1kg |

NOTE1: Line to Line surge immunity level of Ex equipment depends on the Ui for Ex ia and the Um for Ex ia/db. (See Safety instruction manual)

NOTE2: Required cable gland and blind plug depends on type of Non-Ex or Ex types (ATEX, IECEx, and KCs).

NOTE3: For rod antenna and PTFE sealing antenna, it must be used flange (optional), seal gasket (optional) and O-ring (accessory), to satisfy protection class IP66 or IP67.

Please refer to the safety manual for the type of explosion protection.

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 | Non-Ex | |
| | | FKM:-10 to +150 °C Kalrez:-20 to +150 °C VMQ:-40 to +150 °C | |
| | | NOTE: For Ex equipment, please refer to the “Safety Instructions”. | |
| | 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°) •3": (half-power beam width: 12°) •4": (half-power beam width: 8°) |
| | | Material | SUS304, PTFE |
| Operating conditions | Process temperature | Non-Ex | |
| | | FKM:-10 to +200 °C VMQ:-40 to +180 °C | |
| | | NOTE: For Ex equipment, please refer to the “Safety Instructions”. | |
| | 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 | Non-Ex | |
| | | VMQ:-40 to +150 °C | |
| | | NOTE: For Ex equipment, please refer to the “Safety Instructions”. | |
| | 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 Optional specifications

Table 10.4.1 Optional specifications

| | |
|------|-------------------------|
| CD-R | ▪Configuration software |
|------|-------------------------|

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 Hold off distance |
| | 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 current 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 |
| | | Alarm output factor | Set factor to output alarm |
| 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 current 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 |

| Function | | Description |
|---|---------------------------------|--|
| Tracking | Level tracking | Move the valid window depending on liquid level |
| | Slow search | Expand the valid window if surface echo is Lost |
| | Empty tank detection | Fix the valid window if liquid level shall be lower down to this value |
| | Level prediction | Output expected level |
| | Search | Search surface echo |
| Noise table | | Set signal threshold for each measurement distance |
| Outlier removal | Double bounce removal | Ignore multiple reflected echoes |
| | Valid window | Set the valid window for echo detecting |
| | Bottom visible | Ignore the bottom echo |
| | Fixed disturbance echo removal | Ignore the echo from the obstacle by registering it |
| Temperature compensation | | Correct echo position and level once a minute or every time |
| Self-diagnosis | | Detect internal failure |
| Viewing electronic temperature of the transmitter | | - |
| Echo list | | List candidates of the surface echo |
| HART multidrop mode | | Connect multiple devices on the same wiring |
| Reset | Reboot | Reboot the device |
| | Parameter initialization | Initialize parameters |
| | Parameter backup | Store the setting parameters in the inside of the device |
| | Parameter recovery | Load the parameters that was stored in the inside of the device |
| | HART configuration changed flag | Reset HART configuration changed flag |

Please check the Chapter 5 or Chapter 6, for more information about the function.

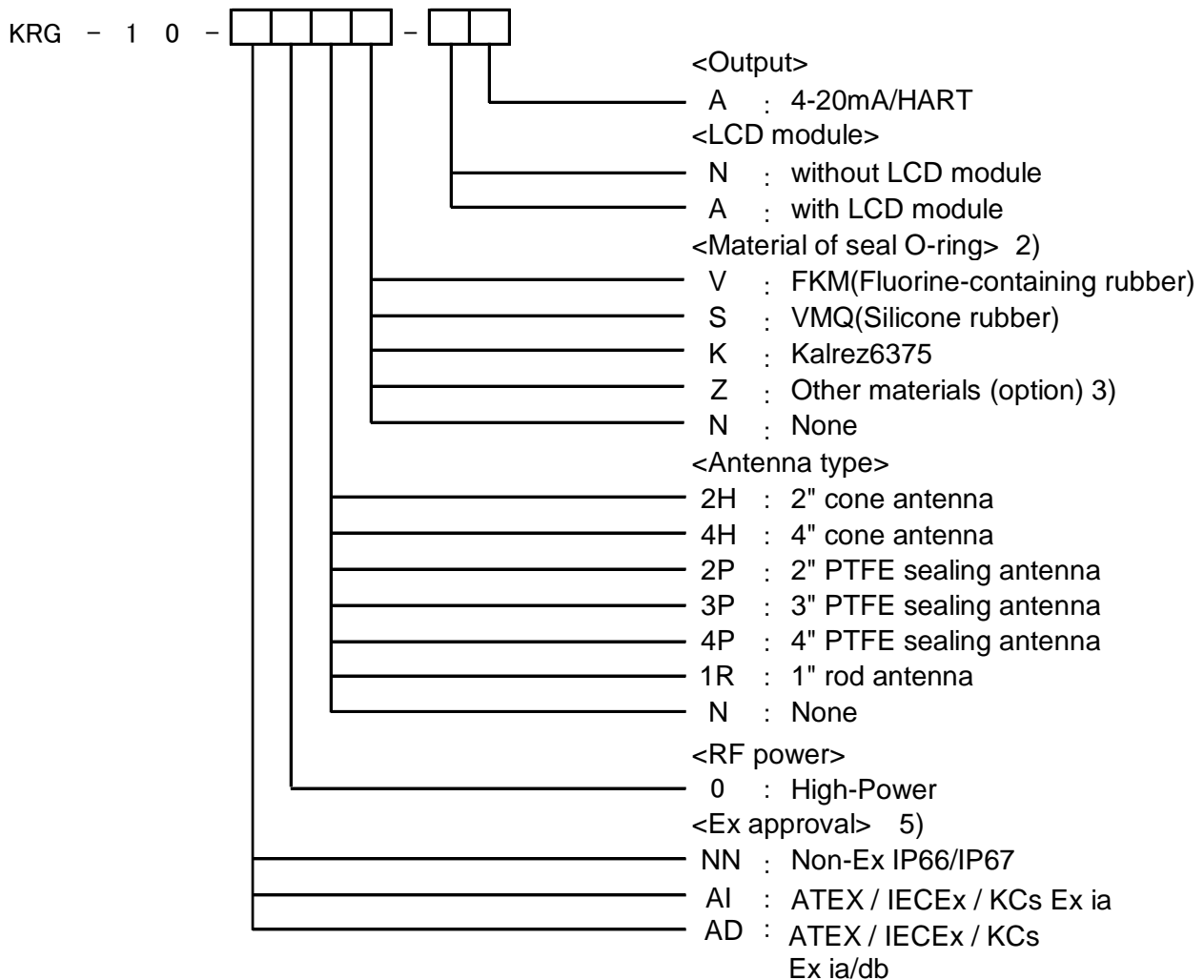
Table 10.5.2 Settings related to HART connection mode

| Setting Parameter | Connection Mode | | Remarks |
|---------------------|-------------------------|------------------------|--|
| | Peer to Peer | Multidrop | |
| Device Number | 0 | 1~63 | Be careful not to overlap with other devices |
| HART Multidrop Mode | OFF | ON | ON only in multi-drop mode |
| HART variables | PV/SV/TV/QV (Arbitrary) | PV/SV/TV/QV (Required) | Digital output only available in multi-drop mode (Analog output fixed at 4 mA) |

NOTE: When installing with multi-drop, proceed multi-drop setting as above.
Before install at site, please change above 3 parameters by using "Peer to Peer" setting.

Please check the Chapter 6.6.4 or Chapter 6.9, for more information about the function.

10.6 Product code



NOTE1: Required cable gland depends on type of explosion protection ATEX, IECEx, and KCs. Each Ex ia & Ex ia/db(ATEX, IECEx, KCs) transmitter 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, Material of seal O-ring is FKM or VMQ.

If you select the rod antenna, Material of seal O-ring is VMQ.

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.

NOTE5: Please refer to the safety instructions to know the IP code for the type of explosion protection.

Also, please contact us for the manufacturing code of explosion-proof products for Japan.

NOTE6: The KC mark model is only the following 9 models.

KRG-10-AD02HV-AA, KRG-10-AD04HV-AA, KRG-10-AD04HS-AA,

KRG-10-AD02PV-AA, KRG-10-AD02PS-AA, KRG-10-AD04PV-AA, KRG-10-AD04PS-AA

KRG-10-AD03PV-AA, KRG-10-AD03PS-AA

10.7 Dimensions and material

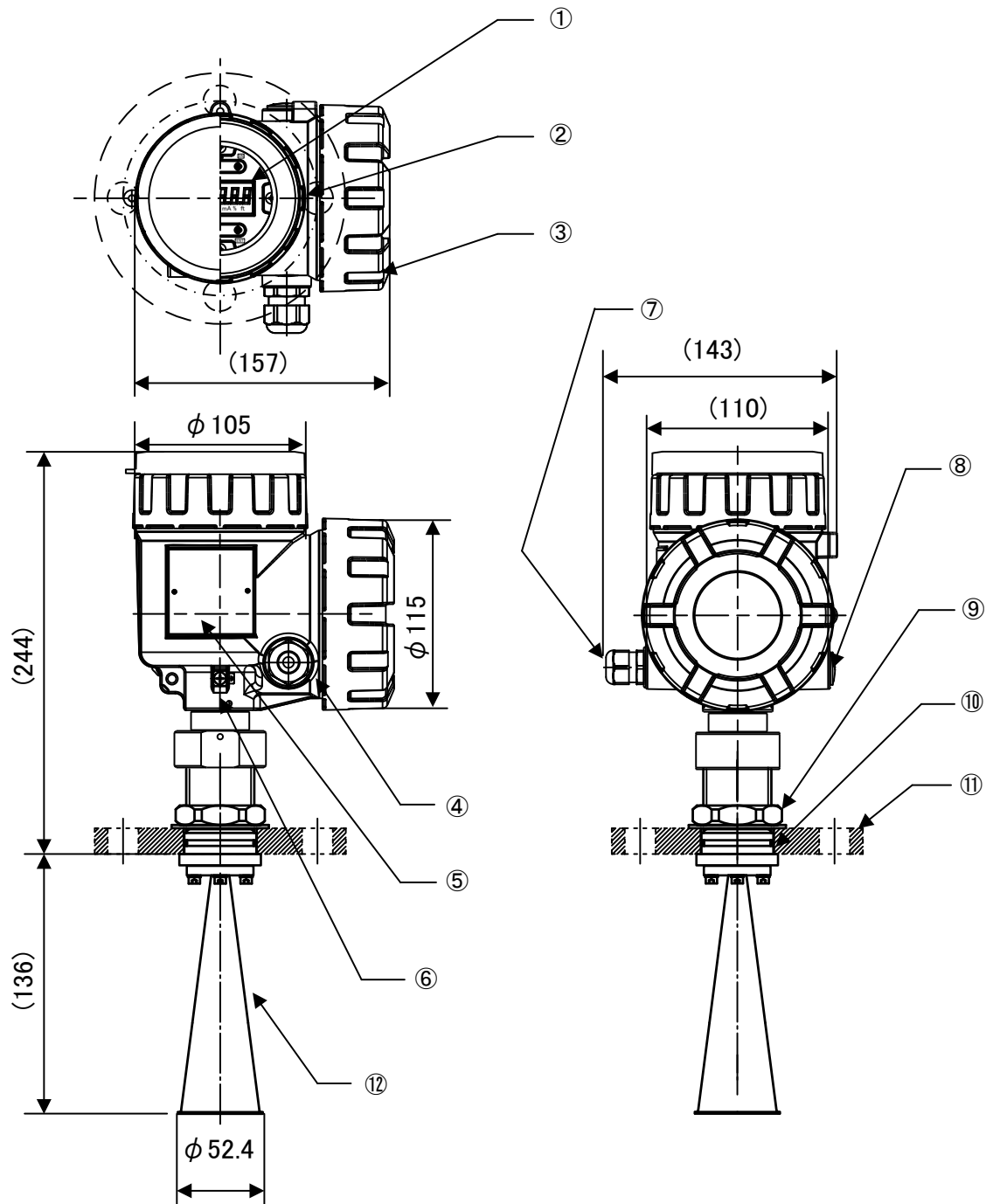


Fig. 10.7.1 KRG-10, 2" cone antenna

- | | |
|--|--|
| 1. Window / Polycarbonate | 7. Cable gland (depends on specifications) |
| 2. Window (For LCD) / AlSi10Mg(Fe) | 8. Blind plug (depends on specifications) |
| 3. Cover (terminal block) / AlSi10Mg(Fe) | 9. Flange lock nut / SUS304 |
| 4. Housing / AlSi10Mg(Fe) | 10. O-ring |
| 5. Label | 11. Flange (option) |
| 6. Ground terminal (M5) / SUS304 | 12. 2" cone antenna / SUS316L |

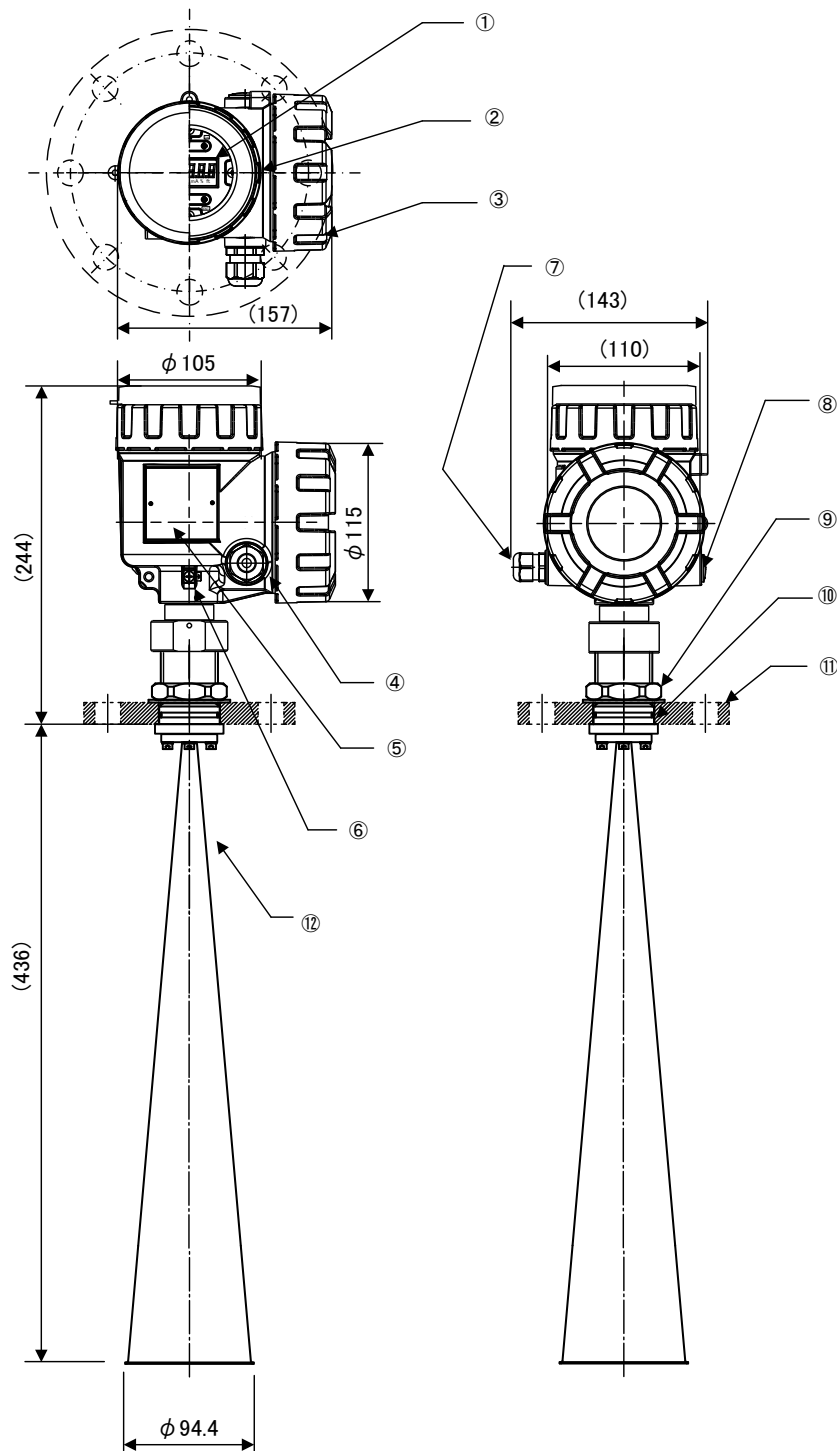


Fig. 10.7.2 KRG-10, 4" cone antenna

- | | |
|--|--|
| 1. Window / Polycarbonate | 7. Cable gland (depends on specifications) |
| 2. Window (For LCD) / AlSi10Mg(Fe) | 8. Blind plug (depends on specifications) |
| 3. Cover (terminal block) / AlSi10Mg(Fe) | 9. Flange lock nut / SUS304 |
| 4. Housing / AlSi10Mg(Fe) | 10. O-ring |
| 5. Label | 11. Flange (option) |
| 6. Ground terminal (M5) / SUS304 | 12. 4" cone antenna / SUS316L |

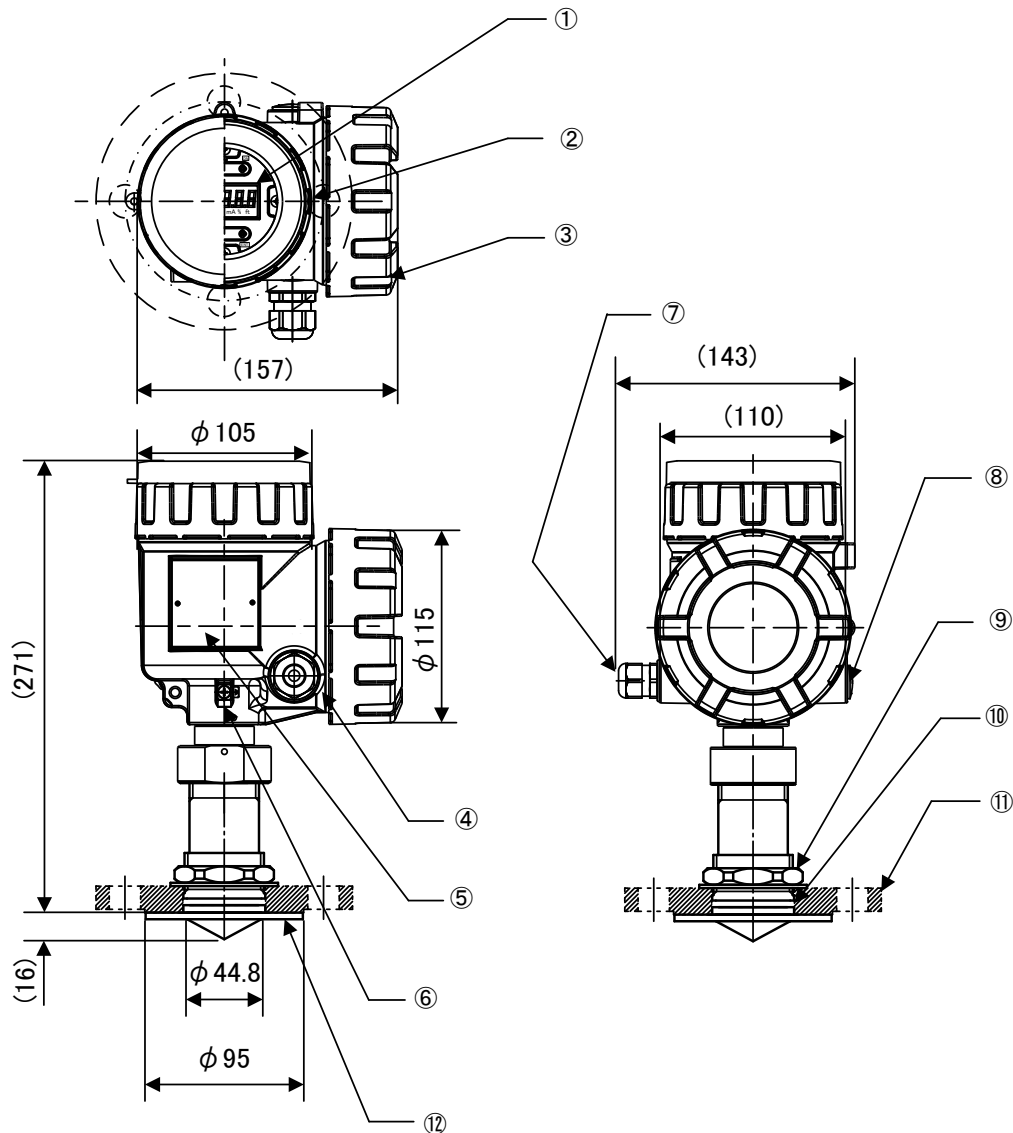


Fig. 10.7.3 KRG-10, 2" PTFE sealing antenna

- | | |
|--|--|
| 1. Window / Polycarbonate | 7. Cable gland (depends on specifications) |
| 2. Window (For LCD) / AlSi10Mg(Fe) | 8. Blind plug (depends on specifications) |
| 3. Cover (terminal block) / AlSi10Mg(Fe) | 9. Flange lock nut / SUS304 |
| 4. Housing / AlSi10Mg(Fe) | 10. O-ring |
| 5. Label | 11. Flange (option) |
| 6. Ground terminal (M5) / SUS304 | 12. 2" PTFE sealing antenna / PTFE |

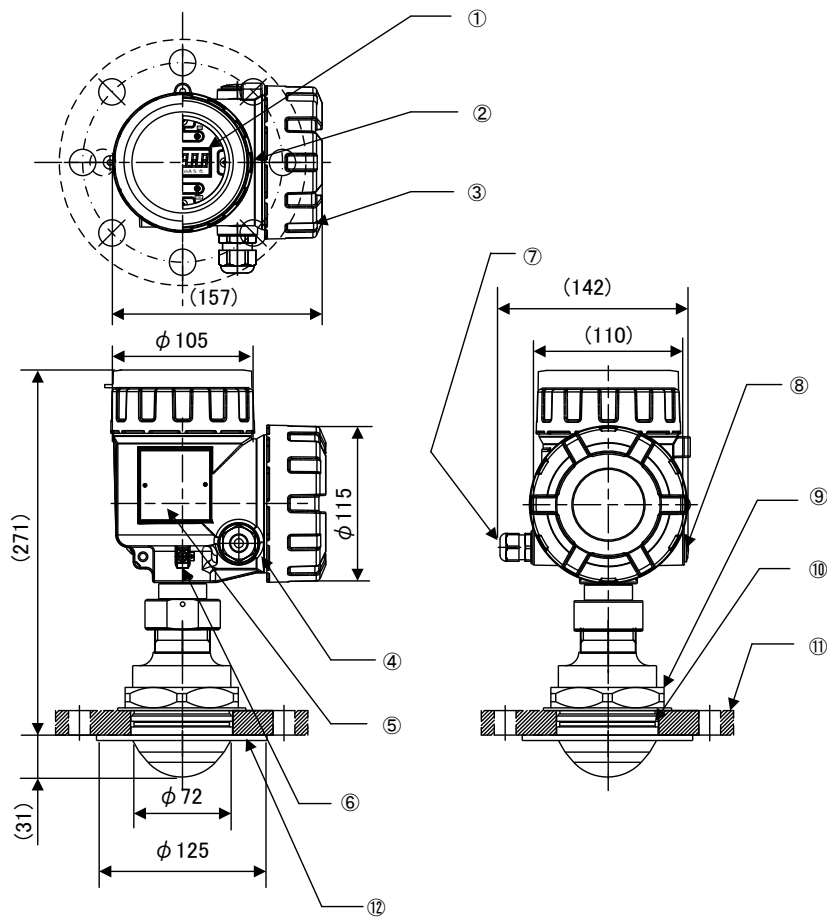


Fig. 10.7.4 KRG-10, 3" PTFE sealing antenna

- | | |
|--|--|
| 1. Window / Polycarbonate | 7. Cable gland (depends on specifications) |
| 2. Window (For LCD) / AlSi10Mg(Fe) | 8. Blind plug (depends on specifications) |
| 3. Cover (terminal block) / AlSi10Mg(Fe) | 9. Flange lock nut / SUS304 |
| 4. Housing / AlSi10Mg(Fe) | 10. O-ring |
| 5. Label | 11. Flange (option) |
| 6. Ground terminal (M5) / SUS304 | 12. 3" PTFE sealing antenna / PTFE |

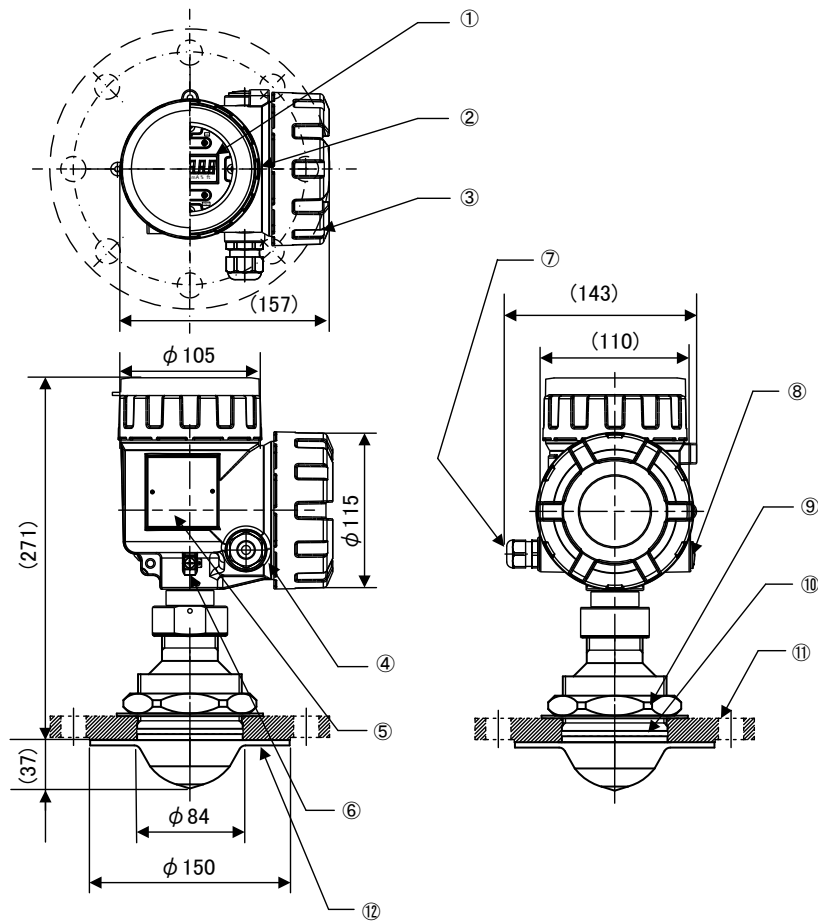


Fig. 10.7.5 KRG-10, 4" PTFE sealing antenna

- | | |
|--|--|
| 1. Window / Polycarbonate | 7. Cable gland (depends on specifications) |
| 2. Window (For LCD) / AlSi10Mg(Fe) | 8. Blind plug (depends on specifications) |
| 3. Cover (terminal block) / AlSi10Mg(Fe) | 9. Flange lock nut / SUS304 |
| 4. Housing / AlSi10Mg(Fe) | 10. O-ring |
| 5. Label | 11. Flange (option) |
| 6. Ground terminal (M5) / SUS304 | 12. 4" PTFE sealing antenna / PTFE |

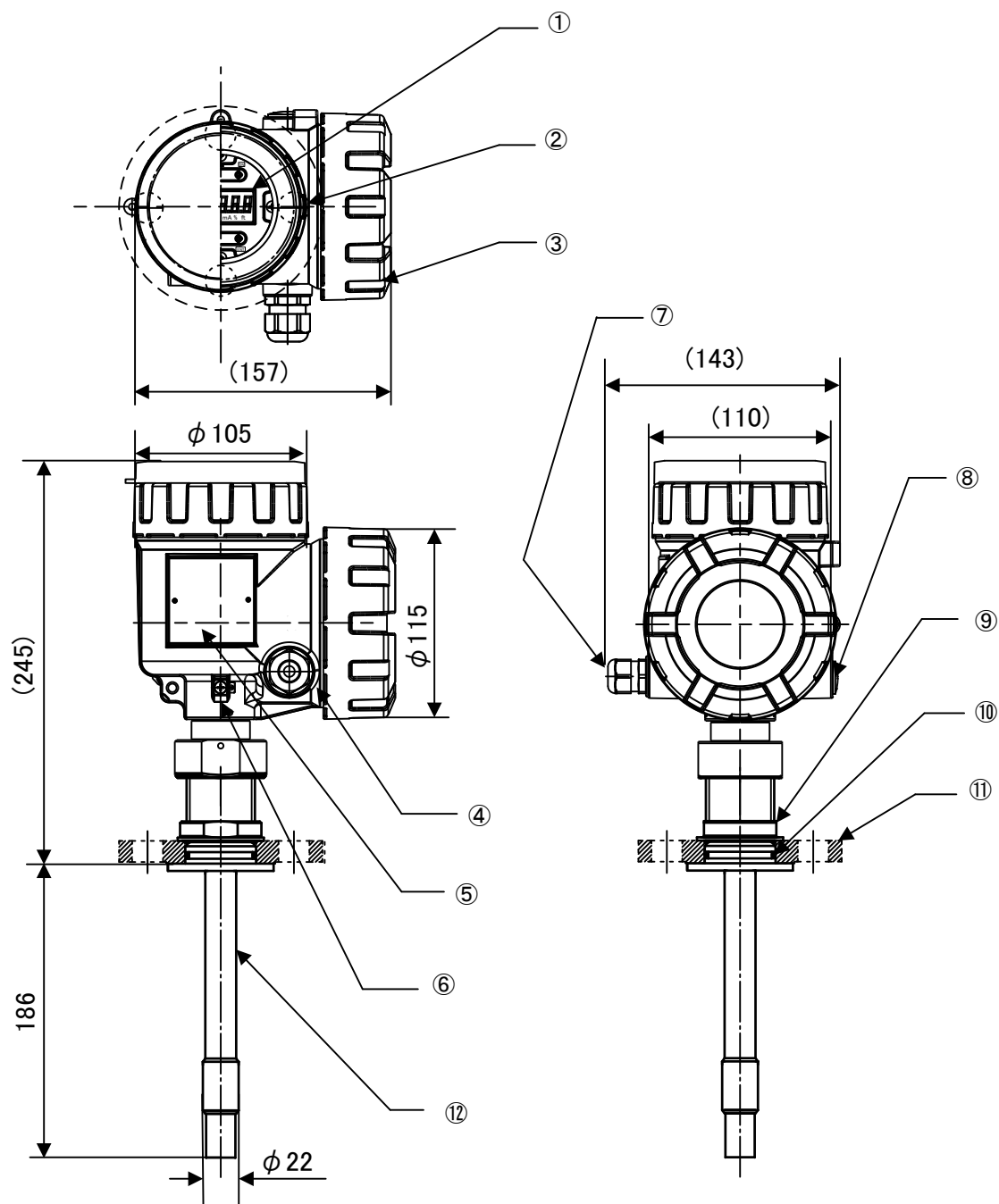


Fig. 10.7.6 KRG-10, 1" rod antenna

- | | |
|--|--|
| 1. Window / Polycarbonate | 7. Cable gland (depends on specifications) |
| 2. Window (For LCD) / AlSi10Mg(Fe) | 8. Blind plug (depends on specifications) |
| 3. Cover (terminal block) / AlSi10Mg(Fe) | 9. Flange lock nut / SUS304 |
| 4. Housing / AlSi10Mg(Fe) | 10. O-ring |
| 5. Label | 11. Flange (option) |
| 6. Ground terminal (M5) / SUS304 | 12. 1" rod antenna / PFA |

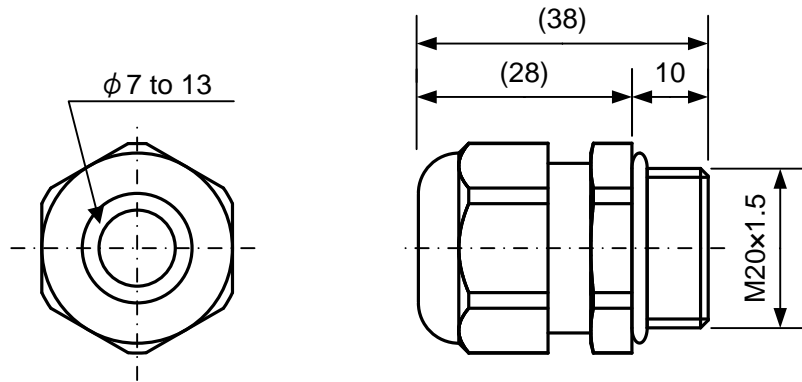
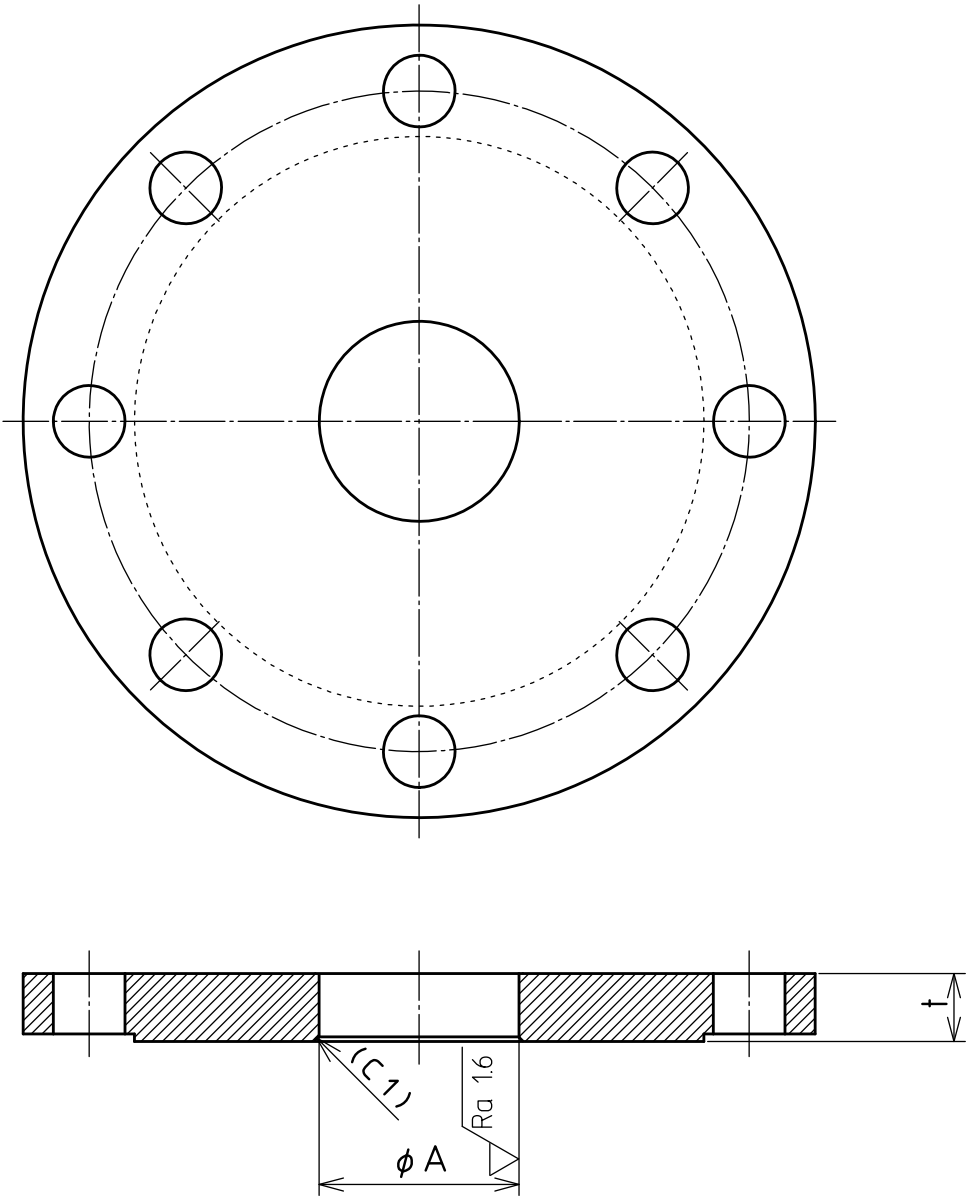


Fig. 10.7.7 Cable gland (Only Non-Ex type)

10.8 Required flange dimensions



| Antenna type | ΦA [mm] | | t [mm] |
|-----------------|---------|-----------|----------|
| | | Tolerance | |
| 2" & 4" cone | 45 | +0.1 0 | 14 to 35 |
| 2" PTFE sealing | 50 | | 12 to 25 |
| 3" PTFE sealing | 75 | | 14 to 35 |
| 4" PTFE sealing | 80 | | 14 to 35 |
| 1" rod | 45 | | 11 to 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.

$$D = c \times (t / 2) \dots\dots\dots(1)$$

Using D and the tank height H , the level L is expressed by the following equation.

$$L = H - D \dots\dots\dots(2)$$

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**.

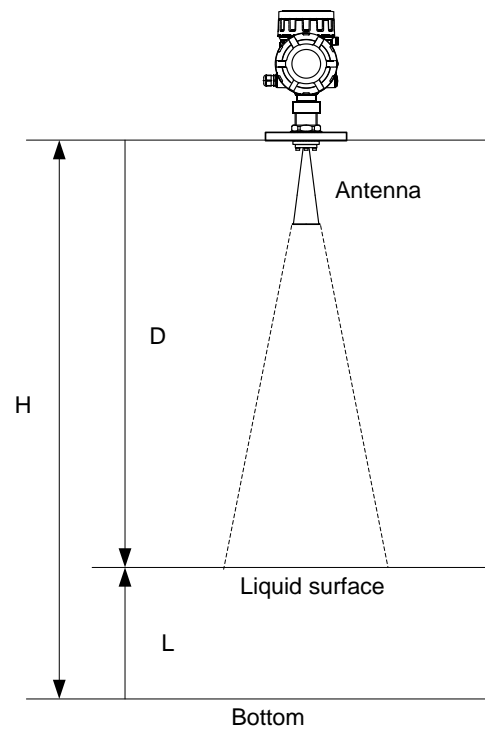


Fig. 11.1.1 Measurement principle

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 | <ul style="list-style-type: none">•Check power line turned on and connected.•Check LCD connector inserted properly. |
| Not connectable through HART communicated configuration software | <ul style="list-style-type: none">•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 | <ul style="list-style-type: none">•Check the value within input-able range.•Check communication status is OK. In case of communication error, please check connection. |
| Inaccurate measurement value | <ul style="list-style-type: none">•Check input parameter is correct.•Check device status. Left down side dot indication is measuring error (not detected or track proper surface echo). |
| Analog current output does not change | <ul style="list-style-type: none">•Check analog lock mode in-activated.•Check table check mode in-activated.•Check device 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 Device 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 6.10 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. | <ul style="list-style-type: none"> • 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.. | <ul style="list-style-type: none"> • Please make the appropriate adjustment, refer to the echo curve. (Refer to 6.6 Advanced settings and 6.8 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 6.6.2 Outlier Removal) |
| | May have to measure the reflected wave by double bounce. | <ul style="list-style-type: none"> • Please make the appropriate adjustment, refer to the echo curve. (Refer to 6.6 Advanced settings and 6.8 Echo Viewer) • Please try to set the outlier removal. (Refer to 6.6.2 Outlier Removal) |
| It does not follow the variation of the level. | May have to measure the reflected waves due to noise. | <ul style="list-style-type: none"> • Please make the appropriate adjustment, refer to the echo curve. (Refer to 6.6 Advanced settings and 6.8 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 6.6.2 Outlier Removal) |

| Trouble | Factor | Measure |
|---|--|---|
| 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. | <ul style="list-style-type: none"> • Please make the appropriate adjustment, refer to the echo curve. (Refer to 6.6 Advanced settings and 6.8 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 6.6.2 Outlier Removal) |
| Measurement indicates a low value momentarily. | May have to measure the reflected waves due to noise. | <ul style="list-style-type: none"> • 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 6.6 Advanced settings and 6.8 Echo Viewer) |

EU DECLARATION OF CONFORMITY (SIMPLIFIED)

Hereby, TOKYO KEIKI INC., declares that the Radio equipment type KRG-10 is in compliance with Directive 2014/53/EU. The full text of the EU declaration of conformity is available at the following internet address: <https://www.tokyoikeiki.jp/e/products/detail.html?pdid=180>

Document No. KF13-001R
Microwave Level Gauge KRG-10
User's Guide
Oct. 2013 1st Edition
Mar. 2022 19th Edition

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