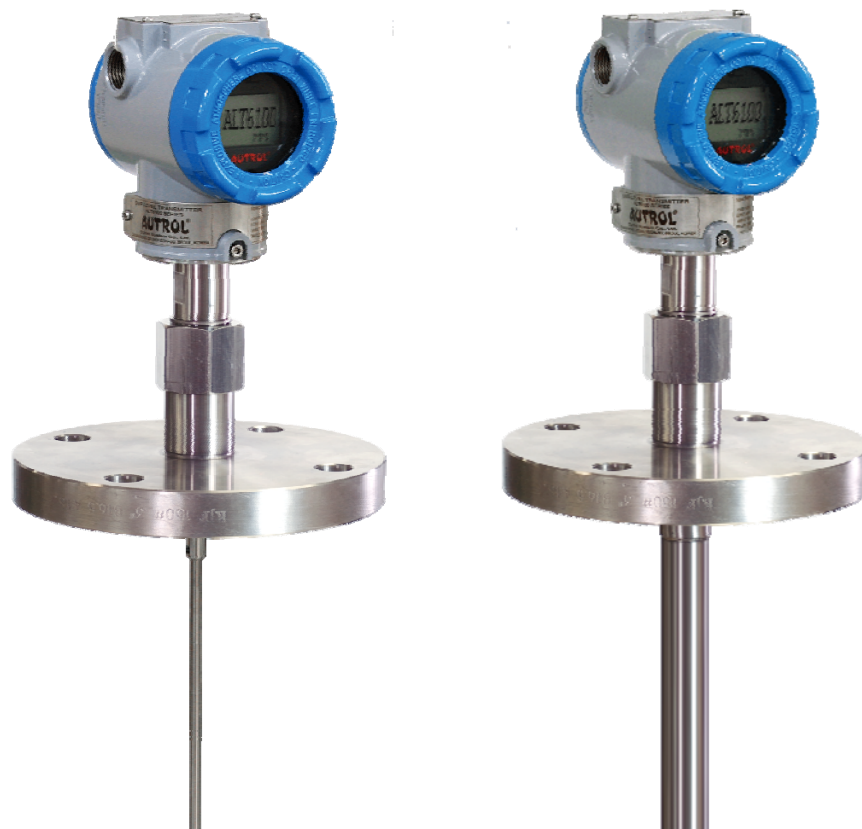


Operation Manual

M6100-K01D

ALT-6100 Series

Smart Guided Wave Radar Level Transmitter



AUTROL®
since 1989

두 온 시 스템 (주)

Duon System Co., Ltd.

www.autrol.com

Notice

This document was prepared for efficient handling of ALT-6100, such as installation and use.

Prior to handling ALT-6100, read and understand this document sufficiently.

The information and specification included in this document may change without prior notice.

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1 Introduction

This manual contains contents of Installation /Operation /Maintenance necessary for optimal use of ALT-6100.

Transmitter may be affected by the ambient conditions of installation. Hence, read and understand this manual completely prior to installation and activation.

WARNING

- ◆ Educated and qualified personnel only are authorized to install Transmitter.
- ◆ It is very dangerous and may cause accident for the unauthorized to handle Transmitter.
- ◆ When the Transmitter power is on, do not open the Transmitter cover under Explosive Atmospheres.
- ◆ Prior to connecting HHT under Explosive Atmosphere, check if measurement equipments connected to power-line is installed in accordance with intrinsic safety regulations.
- ◆ Avoid contact between power-line and terminal. High voltage of lead wire may cause electric shock.

Manual Composition

This Operating Manual explains contents necessary for installing, activating, and maintaining ALT-6100.

Chapter 2: This chapter describes understanding, features, and system composition of the Guided Wave Radar Level Transmitter.

Chapter 3: This chapter describes mostly core items from purchasing Transmitter to its site installation including directions for handling and storage of Transmitter, selection of installation location, and insulation, and flameproof structure.

Chapter 4: This chapter describes installation work and procedure, design drawing, and considerations at installation of Transmitter.

Chapter 5: This chapter describes electrical installation work and procedure, wiring method and drawing, and other electrical considerations of Transmitter.

Chapter 6: This chapter describes the function and method to set up Transmitter, Button manipulation, and Electronic Circuit Module

set-up.

Chapter 7: This chapter describes failure diagnosis and maintenance of Transmitter.

1 Introduction

Technical Support

For technical support to Transmitter, all ways are possible including telephone or ON/OFF Line, and for detailed contact address of each service area, refer to www.utorol.com

Company Head Office Address

Tel. : 02) 860-7900

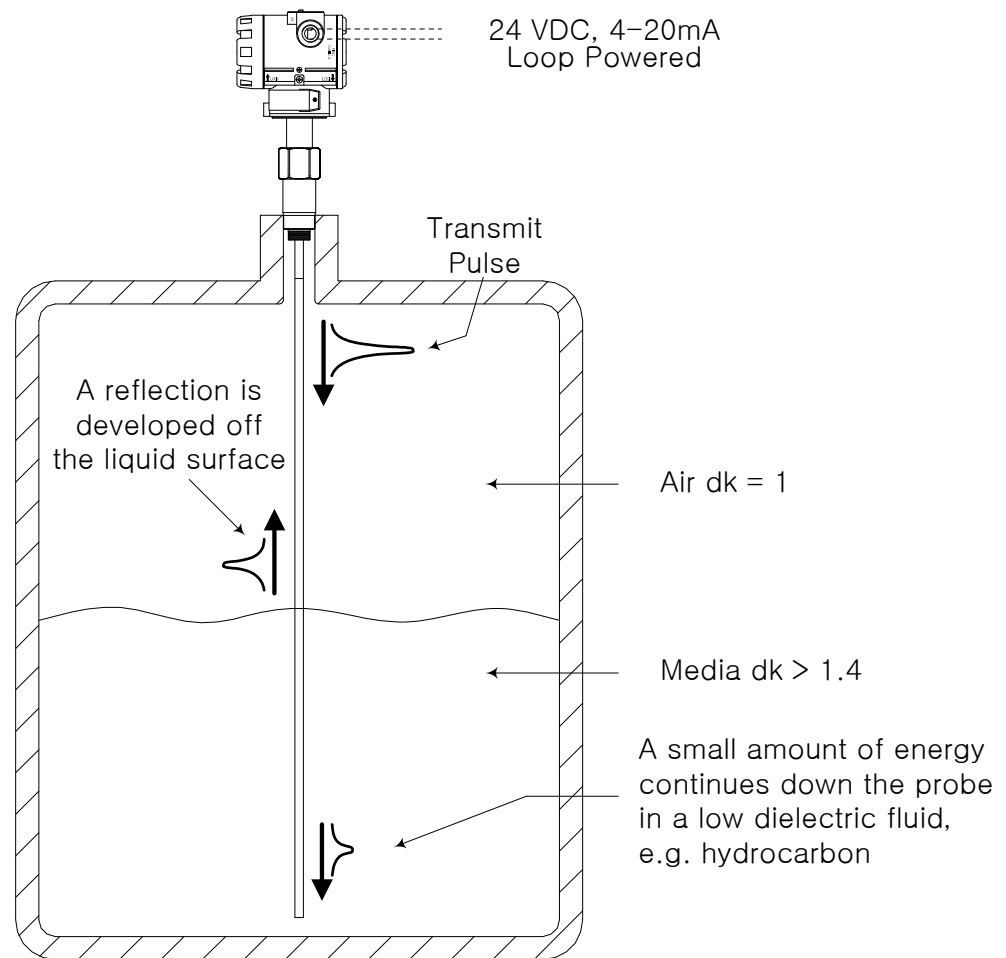
Address : Duon System Co., 60-31, Gasan-dong,
Deuncheon-gu, Seoul

2 Transmitter Overview

Operation Principle

ALT-6100 Smart GWR Level Transmitter (Autrol® Smart Guided Wave Radar Level Transmitter) is the micro-processor based Transmitter, and measures level based on TDR (Time Domain Reflectometry) technology. It has the function to print out a measured value as 4~20mA analog current in the 2-wire type or a digital value by HART communication, and transmit it to be used by control system such as DCS or PLC.

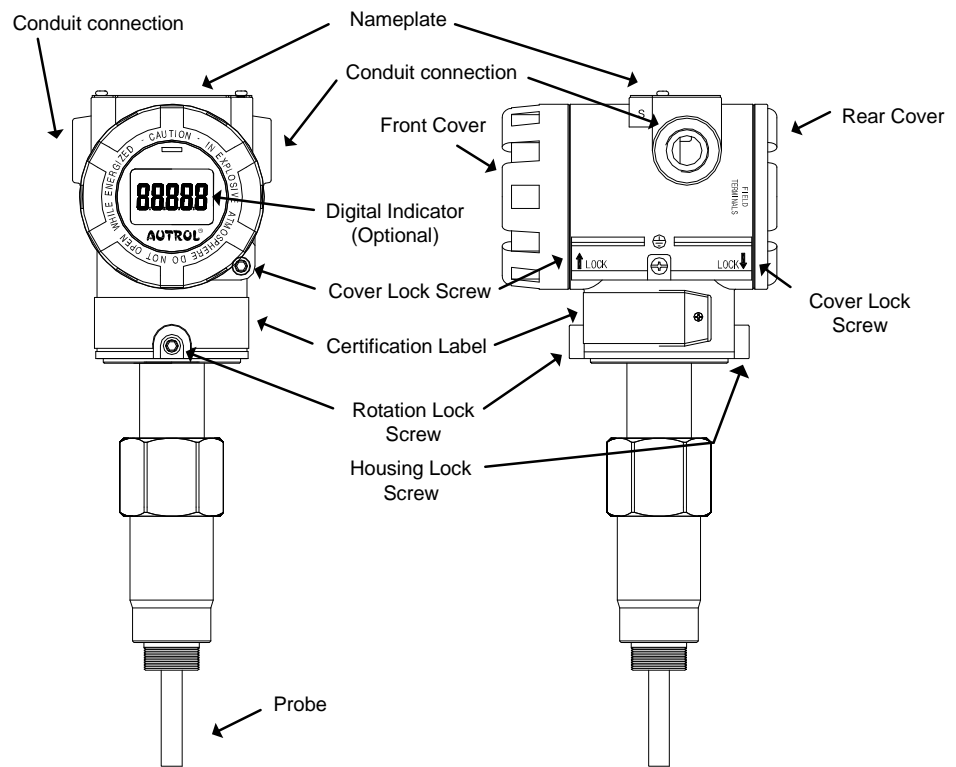
The pulse generated by Transmitter is transmitted through probe and reflected at the surface of the measured material to come back. Here, the back and forth time from when the pulse was transmitted to when it is received after reflection is measured and converted to distance and level. Reflection of pulse occurs due to the difference of dielectric constant between air and measured material, and the reflected pulse strength is proportional to dielectric constant. Hence, as dielectric constant of measured material is higher, stable measurement is possible.



[Figure 2-1] Measurement Method

2 Transmitter Overview

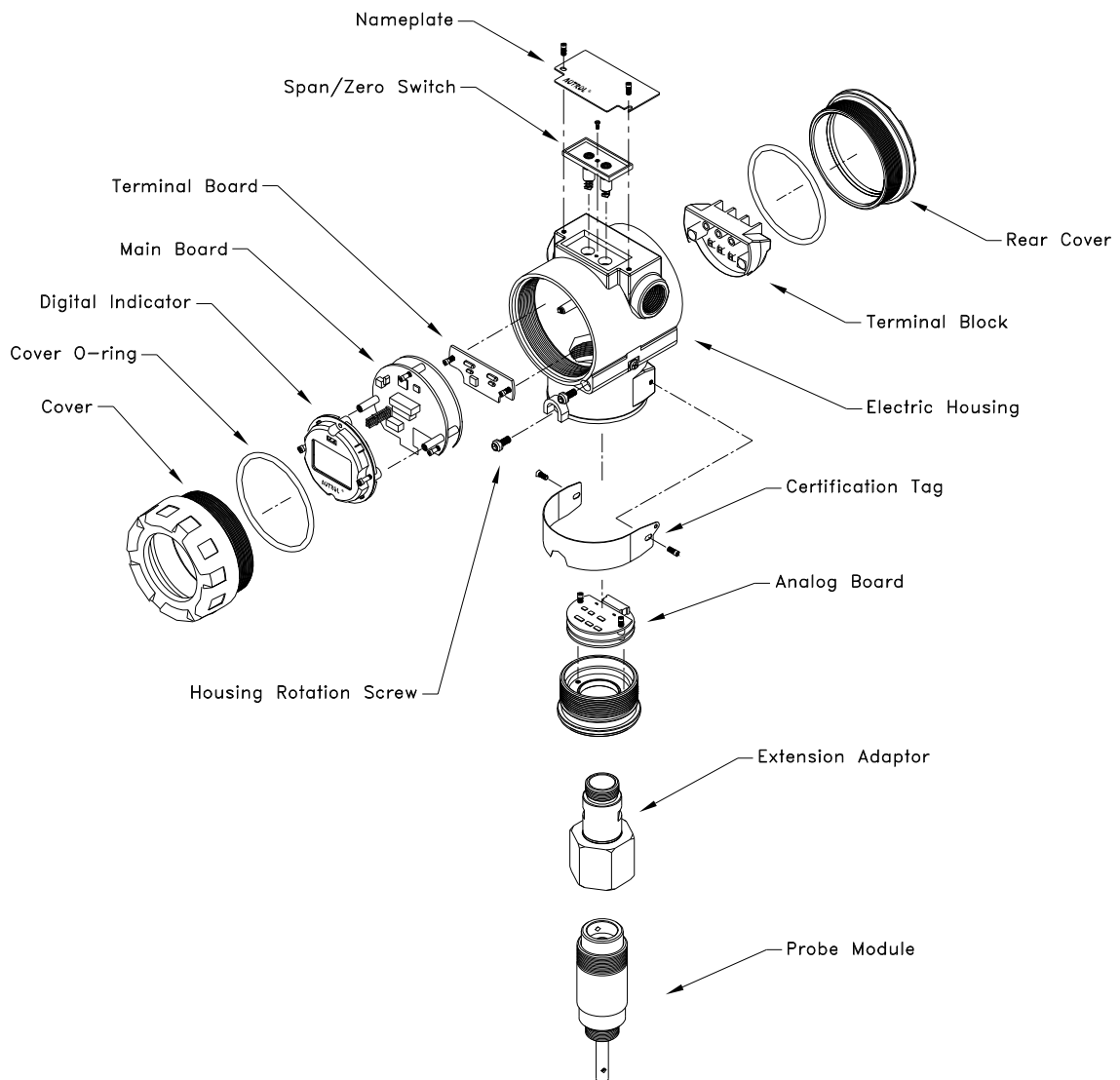
Features	<ul style="list-style-type: none">• High precision of +/- 3mm.• Materials of very low dielectric constant of 1.4 such as butane and LNG are measurable.• Usable in both Liquid and Solid.• This is direct measurement method of Top-down, and not affected by state change of process (density, conductivity, temperature, pressure, humidity etc...).• Effects of dust, vapor, and turbulence are minimized.• Because signal is guided, this is not affected by disturbance and Tank Structure.• Easy Calibration and Maintenance.
Application	<ul style="list-style-type: none">• Oil, gas and refining• Chemical and petrochemical• Power• Pulp and paper• Water and sewage treatment• Food and beverage• Pharmaceutical
Transmitter Component	<p>Components of ALT-6100 are shown in the Figure below.</p>



[Figure 2-2] Composition of the Transmitter Exterior

- Loosening and taking out Cover Lock Screw, you can fix Front and Rear Cover not to be loosened.
- Tightening Rotation Lock Screw, you can fix housing not to be rotated, and to rotate housing you have to loosen Rotation Lock Screw. Housing is rotatable to the maximum of 360 degree.

2 Transmitter Overview



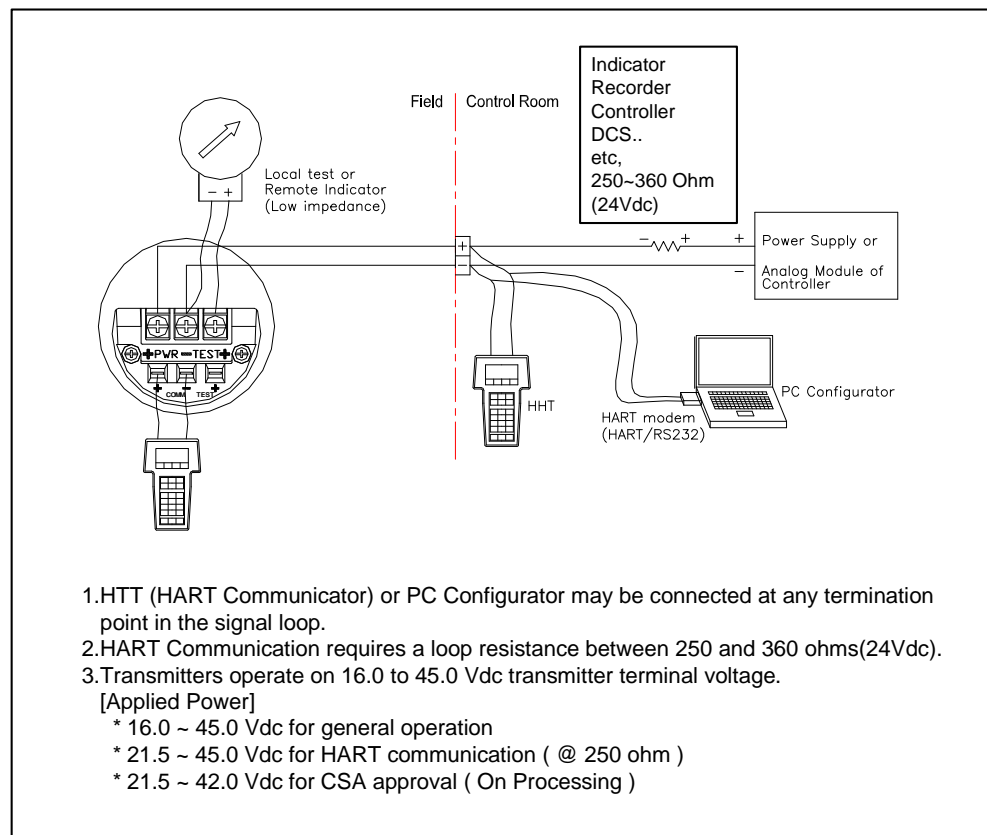
[Figure 2-3] Exploded View

**System
Composition**

ALT-6100 has flameproof structure and its precision (precision and accuracy) is very high with outstanding reliability and, because digital communication is enabled, is suitable for the system that requires high reliability and telecommunication.

This Transmitter is the 2-wire Loop Powered Transmitter and uses power line for power supply along with output signal line. In other words, because 4~20 mA and HART communication signal are sent along the 2-wire for power supply, its installation and Maintenance is easy.

Transmitter can do HART communication with the host control system, HHT (HART Hand-Held Terminal), or PC and PDA control Software (PC & PDA Configurator). Therefore, it can execute functions such as change, configure, test, and calibration of each Transmitter parameter through HART communication. In the case that Transmitter is connected to analog input port or output port of control system, it has its own resistance of 250ohm. Hence, separate loop resistance is unnecessary for HART communication. In the case that Transmitter is connected to simple 24V DC Power Supply only, HART communication is enabled by connecting 250~360 Ohm loop resistance in series.



[Figure 2-4] System Composition Drawing

3 Directions for Handling

This chapter describes directions for handling and storage of Transmitter, selection of installation location, and insulation, and flameproof structure.

Unpacking

In the event of unpacking Transmitter, be careful not to damage packing box, the Transmitter and parts in the box, and protector. In the event of transporting Transmitter to other place, transport after re-packing in the original state, and be careful not to make a damage during transporting.

Checking Model and Specification

The Transmitter model name and specification are indicated on the nameplate attached to the Transmitter exterior. Check if it is the desired specification and model.

Storage

The following precautions should be observed when the Transmitter is stored, especially for a long period.

- (1) Select a storage area that meets the following conditions:
 - (a) No exposure to rain or water.
 - (b) Minimum vibration and shock.
 - (c) If possible, ambient temperature of 25°C and humidity of 65% RH is desired, but the condition should at least be
 - Ambient temperature: -40~85°C (without LCD module)
 - Relative Humidity: -30~80°C (with LCD module)
 - Relative Humidity: 5%~100% RH (40°C)
- (2) Store transmitter in the same packing state of delivery.
- (3) In the case of storing a transmitter that has been used, remove every measuring material from the surfaces of probe and Transmitter. In particular, when dealing with contaminating materials, handle with care in accordance with the permitted procedure.

Selection of installation location

The transmitter is designed to operate under severe environmental conditions. However, to ensure stable and accurate long term operation, the following precautions must be observed in selecting an installation location.

- (1) Avoid locations subject to wide temperature variation or a significant temperature rate of change. Choose where the operation ambient temperature of the Transmitter specification is satisfied. If the location is exposed to severe radiant heat, adequate insulation or ventilation should be provided.
- (2) Select such a place that corrosion does not occur due to chemicals. In case of installing in a corrosive environment, select such materials for the Transmitter sensor and probe that can withstand the corresponding corrosive environment. Also, to prevent corrosion due to rain drops staying in wire pipe, which is not a corrosive environment though, there has to be appropriate ventilation.
- (3) Select an installation site of minimum shock and vibration. In the case of installing under severe vibration, it is better to install Transmitter using auxiliary support.
- (4) In the case of installing in a flameproof region, select the location suitable for flameproof standard and check if the Transmitter certification is appropriate for the corresponding gas.
- (5) Select the place maintenance is easy. Maintenance needs a space where housing can be rotated 180 degree. Also, there should be a space where you can open terminal block cover and Transmitter front cover to manipulate interior parts.

NOTE

- ◆ Transmitter is designed to withstand electric noise of high frequency wave, but if wireless transmitter & receiver is used near Transmitter or Transmitter exterior wiring, Transmitter may be affected by high frequency wave noise. To test this influence, observe the noise effect moving the wireless transmitter & receiver slowly from a long distance of a few meters from Transmitter. After this observation, always use wireless transmitter & receiver outside the noise effect region only.

4 Installation

This chapter describes installation work and procedure, design drawing, and considerations at installation of Transmitter.

Precautions

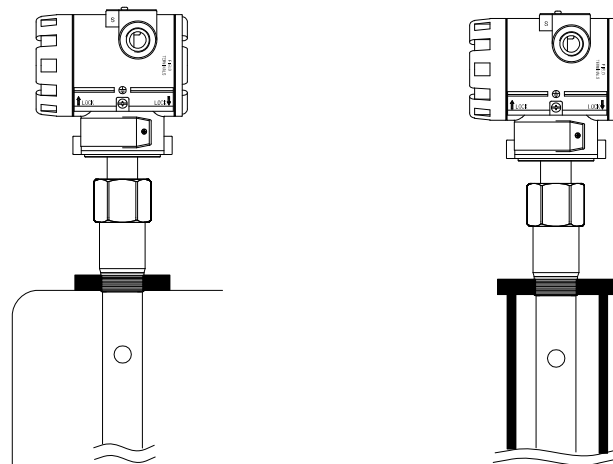
Prior to installing a Transmitter, read chapter “Selection of Installation Location” and examine suitability of the installation location.

WARNING

- ◆ Educated and qualified personnel only are authorized to install Transmitter.
- ◆ It is very dangerous and may cause accident for the unauthorized to handle Transmitter.
- ◆ When the Transmitter power is on, do not open the Transmitter cover under Explosive Atmospheres.
- ◆ Prior to connecting HHT under Explosive Atmosphere, check if measurement equipments connected to power-line is installed in accordance with intrinsic safety regulations.
- ◆ Avoid contact between power-line and terminal. High voltage of lead wire may cause electric shock.

Preliminary Examination before Installation

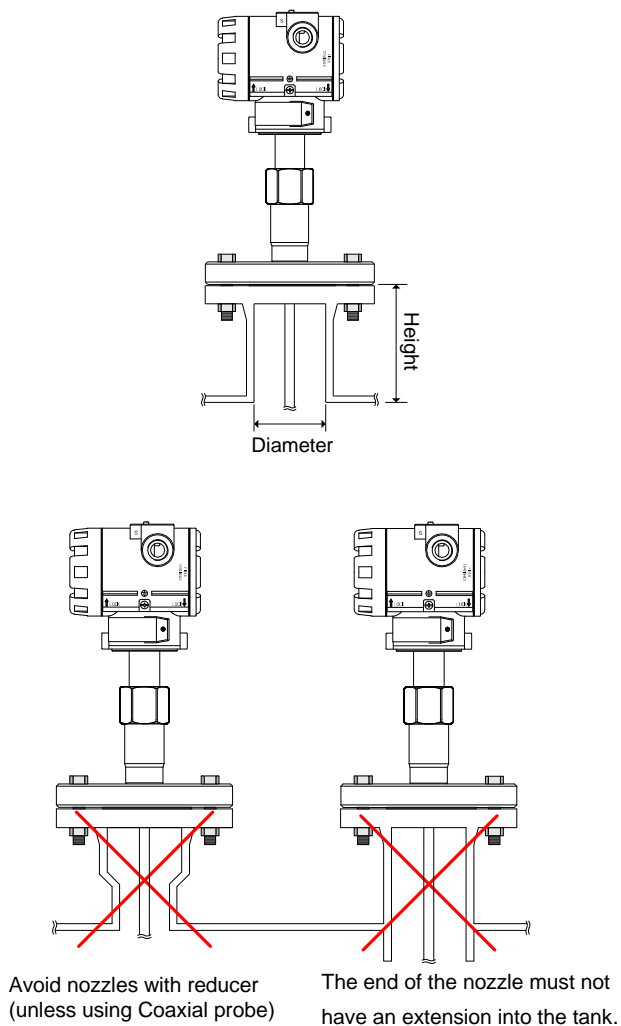
ALT-6100 is easy to mount on tank roof or threaded pipe using thread of the Transmitter body, and provides various flanges for mounting on nozzle.



Mounting on tank roof.

Mounting in threaded pipe.

[Figure 4-1] Threaded Connection



[Figure 4-2] Flange Connection on Nozzles

Transmitter can be mounted on nozzle using a suitable flange. But, the nozzle should satisfy conditions of Table 4-1 such as minimum diameter and maximum nozzle height.

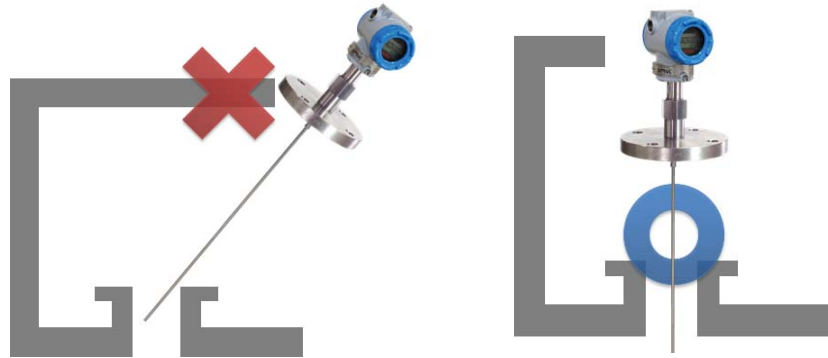
[Table 4-1] Minimum nozzle diameter and maximum nozzle height (mm)

	Single Rod	Twin Rod	Coaxial
Diameter MIN.	150	150	>Probe diameter
Heigh MAX.	100 + Diameter	100 + Diameter	

Also, the nozzle height should be less than nozzle diameter, if possible, and the nozzle end should not be extended into Tank.

4 Installation

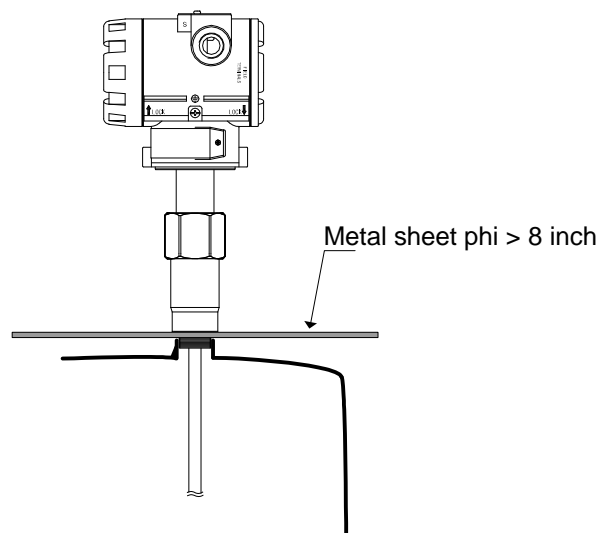
In case there is a structure over the installation location, Rigid Rod and Coaxial probe can hardly be inserted for installation. Hence, Flexible probe should be used.



[Figure 4-3] Installation problems caused by structure

Installation on Nonmetal Vessel

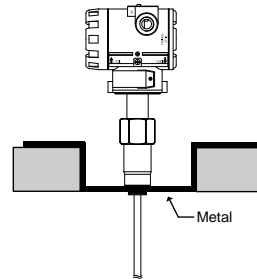
In the case of using a Single Rod probe for nonmetal vessel, metal flange of at least 2 inches should be used for optimized performance. To use the thread connection method for nonmetal vessel, metal sheets should be installed additionally. But, Coaxial probe can be used limitlessly for nonmetal vessel.



[Figure 4-4] Installation on nonmetal vessel

Installation on Concrete

In the case of installation on concrete, concrete diameter should be bigger than concrete width. Otherwise, it can be installed as the Figure below.



[Figure 4-5] Installation on concrete

Solid Measured Medium

In the case that measured medium is solid, Flexible Single Rod probe is most appropriate, and install in accordance with the following directions:

- (1) Prior to installing, vacate Silo.
- (2) The probe end should be at least 300 mm above the Silo floor or fixed on the floor.
- (3) Silo and Transmitter earth terminal should earth.
- (4) When the flange is used, install without a nozzle, if possible. If any, the nozzle should be bigger than 100mm.
- (5) Install Transmitter at a position that is away from the Tank wall by the distance of "Tank radius/2", if possible, and the distance should be at least 500 mm.

Because the medium is solid, the silo roof will get load, and care should be taken for the followings:

- (1) The silo roof should be designed to bear load.
- (2) The load is determined by silo size, media density, and friction coefficient.
- (3) Flexural strength of the probe should be checked.

Installation on Bypass Pipe

In the following cases, bypass pipe should be installed.

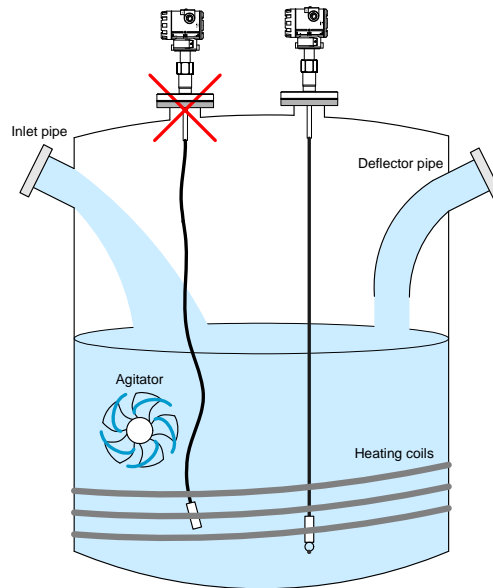
- (1) High conductivity bubbles exist in tank.
- (2) Severe turbulent exist in tank.
- (3) Excessively many complicated structures exist in tank.

4 Installation

In the case of using Flexible and Rigid Rod probe, the bypass pipe diameter should be bigger than 100mm.

Liquid Measured Medium

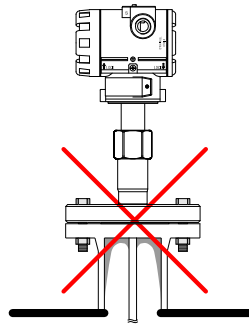
The mounting location of Transmitter should be determined carefully considering the interior state of Tank. Transmitter should be installed where the influence of obstacles is minimized.



[Figure 4-6] Condition of Tank interior

On mounting Transmitter, be careful about the followings:

- (1) Do not install near the process inlet pipe.
- (2) Do not install near agitator.
- (3) In case turbulence occurs inside Tank, probe should be fixed on the floor.
- (4) Do not install near heating coil.
- (5) Prevent probe from contacting nozzle and other objects.
- (6) In the case of using Flexible probe, stretch it tight to keep it parallel with the Tank wall, and secure the distance from wall to at least 100mm (longer than 300mm is recommended).
- (7) In case it is installed near the process inlet pipe, deflector pipe should be installed.
- (8) In case nozzle may develop build-up, install without nozzle.

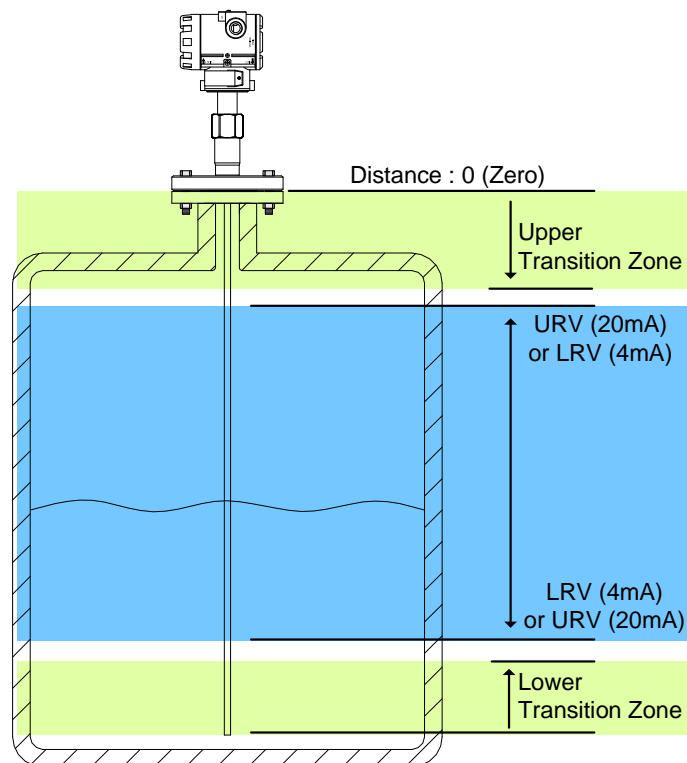


[Figure 4-7] Occurrence of Build-up

Transition Zones

In the Transmitter, there are certain regions, at the probe starting and ending parts, where linearity and precision are poor, and this region is called a Transition Zone. As in Figure 4-8, the region at the probe starting part, i.e., the point of 0 Distance, where precision decreases is called Upper Transition Zone, and the region at the probe ending part where precision decreases is called Lower Transition Zone.

Transition Zones for each probe are shown in Table 4-2.



[Figure 4-8] Transition Zones

4 Installation

[Table 4-2] Transition Zone for each Probe

	Dielectric Constant	Coaxial	Rigid Single Rod	Flexible Single Rod	Rigid Twin Rod	Flexible Twin Rod
Upper Transition Zone	80	100 mm	100 mm	300 mm	100 mm	300 mm
	2	150 mm	160 mm		150 mm	
Lower Transition Zone	80	100 mm	70 mm	300 mm	100 mm	300 mm
	2	150 mm	100 mm		150 mm	

**The Dead Zone may come up to 150 mm from Zero points within Upper Transition Zone if the device type is Flexible Single Rod or Flexible Twin Rod

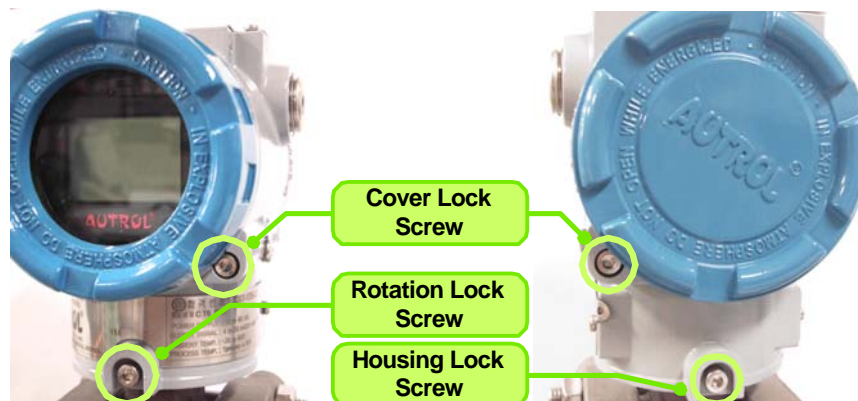
If using region includes a Transition Zone, measured value is not accurate and sometimes measurement is impossible depending on circumstances. Hence, it is recommended to use excluding Transition Zones. In case using region should include Transition Zones, use after inquiring at the company Technical Support Center.

Housing Rotation and Lock Screw

After Transmitter installation, housing can be rotated for wiring work or adjusting indication direction of indicator. To rotate housing, loosen Rotation Lock Screw and rotate housing to the desired direction. After completing housing direction adjustment, do not forget to tighten Rotation Lock Screw to fix housing.

NOTE

- ◆ Housing is mechanically designed to be rotated up to 360°. In case of forced rotation exceeding the limit, Transmitter may be damaged.



[Figure 4-9] Lock Screw

After completely removing Rotation Lock Screw and Housing Lock Screw, it is possible to separate housing and sensor body of Transmitter by rotating housing. But, internal electronic boards should be removed in advance before separating housing and sensor body.

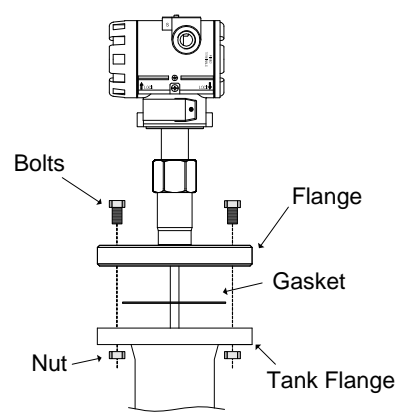
Cover Lock Screw fixes the front and rear covers to prevent them from loosening. Fully loosened, the Screw is stuck to the Cover side and Cover is fixed not to turn. Closing Cover Lock Screw again, you can open it by turning Cover.

Mounting

Transmitter may be assembled either in the flange method or in the thread method depending on the Tank Structure. The method, flange or thread, is determined on purchase order, and the product is delivered in one of the two methods. Only authorized personnel should install the Transmitter.

The flange method installation proceeds as follows:

- (1) Put gasket on tank flange.
- (2) After inserting probe into Tank, install the Transmitter on Tank and tighten flange bolts. In the case of using a probe coated by teflon, be careful not to make a damage to coating inserting the probe into Tank.
- (3) Loosen Rotation Lock Screw at the housing neck area, and rotate housing to the appropriate direction, taking into consideration cable connection and LCD screen direction.
- (4) Close Rotation Lock Screw at the housing neck area.

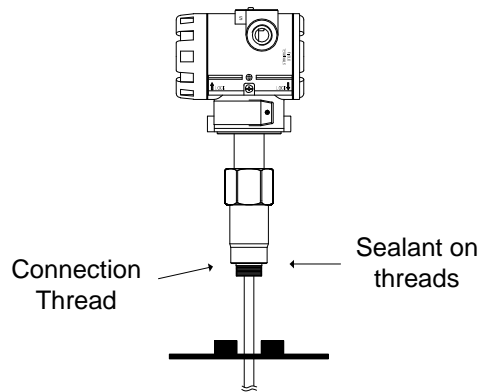


[Figure 4-10] Installation at flange

4 Installation

The thread method installation proceeds as follows:

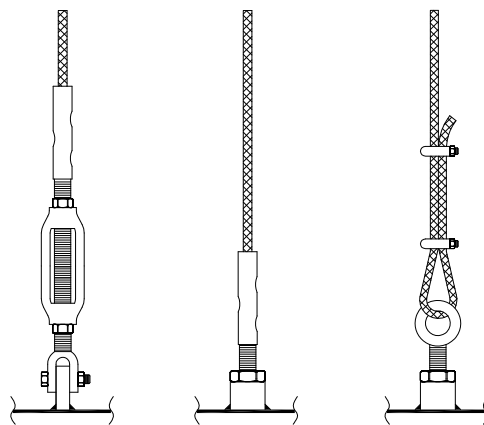
- (1) At the time of installing BSP/G Thread, put gasket on and, other than that, make seal treatment on threads using teflon tape for sealing.
- (2) After inserting probe into Tank, install Transmitter to Tank and tighten the Tank connection for fixing.
- (3) Loosen Rotation Lock Screw at the housing neck area, and rotate housing to the appropriate direction, taking into consideration cable connection and LCD screen direction.
- (4) Close Rotation Lock Screw at the housing neck area.



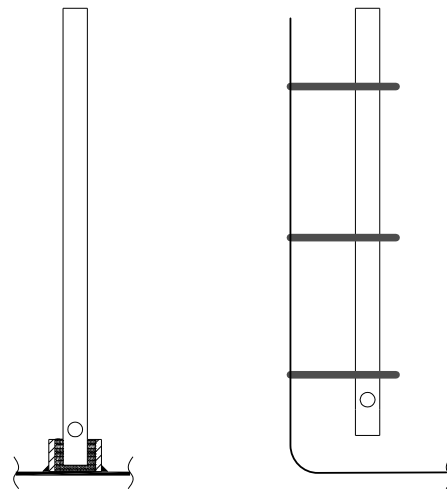
[Figure 4-11] Installation with Thread

Probe Fixing

In case turbulence exists in Tank or media state is not stable, it is necessary to fix probe to the floor. There are various probe fixing methods depending on probe type as belows:



[Figure 4-12] Flexible Rod Probe fixing



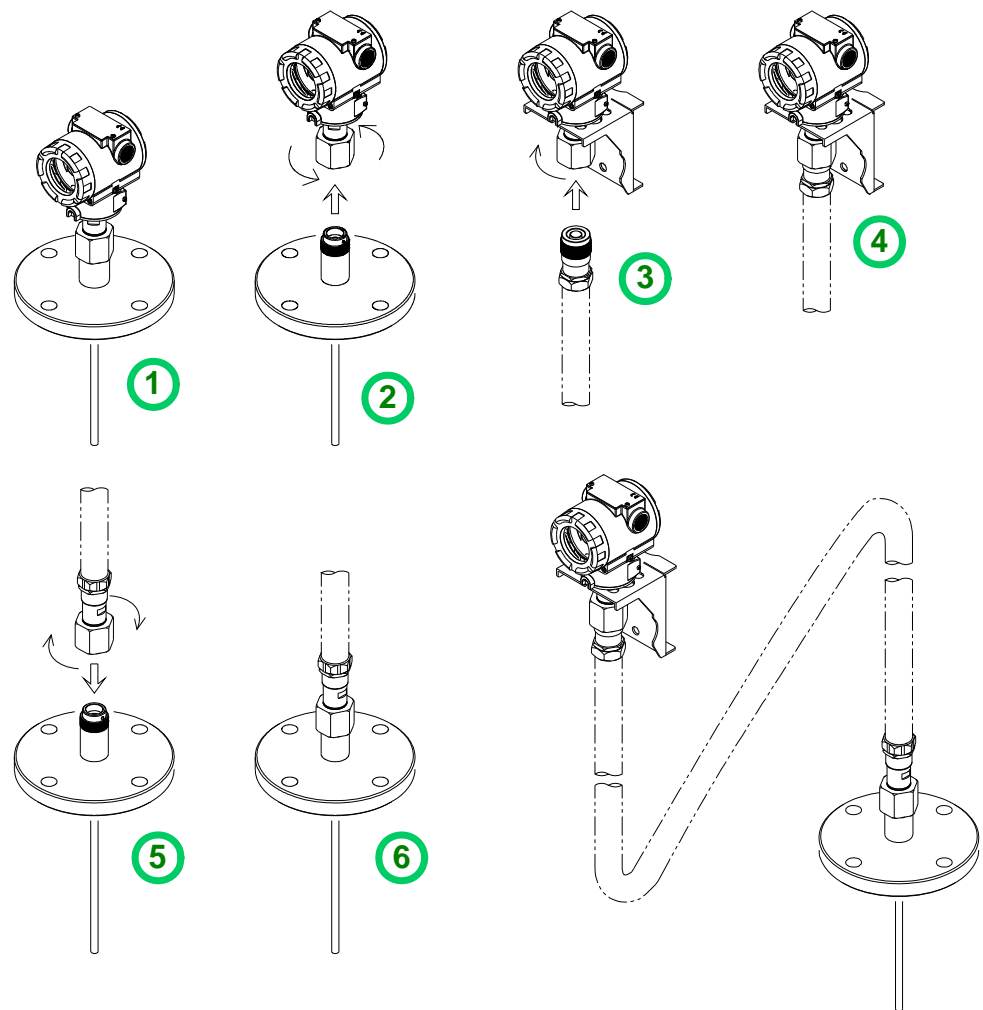
[Figure 4-13] Coaxial probe fixing

For detailed information on probe fixing, contact the company head office.

Housing Extension Cable Installation

Using housing extension cable, it is possible to install housing in a location different from the probe installation location. Housing extension cable is option, hence it should be ordered at the time of purchase. When housing extension cable is used, the maximum measurement distance of the probe is shortened. Hence, it should be used after checking the probe specification at the company head office. For the housing extension cable installation procedure, refer to below:

4 Installation



[Figure 4-14] Housing extension cable installation procedure

[Figure 4-14] shows installation procedure of housing extension cable.

5 Electrical Installation

This chapter describes electrical specification review, installation procedure, installation drawing, and other installation considerations of Transmitter.

WARNING

- ◆ Educated and qualified personnel only are authorized to install Transmitter.
- ◆ It is very dangerous and may cause accident for the unauthorized to handle Transmitter.
- ◆ When the Transmitter power is on, do not open the Transmitter cover under Explosive Atmospheres.
- ◆ Prior to connecting HHT under Explosive Atmosphere, check if measurement equipments connected to power-line is installed in accordance with intrinsic safety regulations.
- ◆ Avoid contact between power-line and terminal. High voltage of lead wire may cause electric shock.

Directions for Wiring

- (1) Install cable at a location as far as possible from electric noise sources such as large size transformers, motors, power supplies.
- (2) Spread waterproof sealer over every thread. (non-hardening silicon type sealer is recommended.)
- (3) To avoid noise signal, do not install signal line and power line simultaneously in duct.
- (4) The Flameproof Transmitter should be wired in accordance with specified requirements to keep the flameproof feature effectively of the corresponding Transmitter.

Cable Material Selection

- (1) Use at least 600V-class PVC insulated wire or equivalent standard wire and cable (to ensure proper communication, 24AWG or higher capacity wire should be used and the length should not exceed 1,500m.)
- (2) For stable operation of Transmitter, it is recommended to use shielded twisted pair cable.
- (3) Use cable suitable for the corresponding ambient temperature.
- (4) Use cable suitable for the corresponding environmental conditions in case oil, solvent, corrosive gas or liquid exist.
- (5) For terminal treatment of lead wire, non-brazed Terminal lug is

5 Electrical Installation

recommended, and it is also recommended to insulate the lead wire ending part with shrinking tube.

Condition of Power Supply Voltage and Load Resistance

Range of internal terminal voltage which can be used as power supply of ALT-6100 is as follows:

General Standard type	16 ~ 45 Vdc
Pressure-resistant & flameproof type	16 ~ 42 Vdc

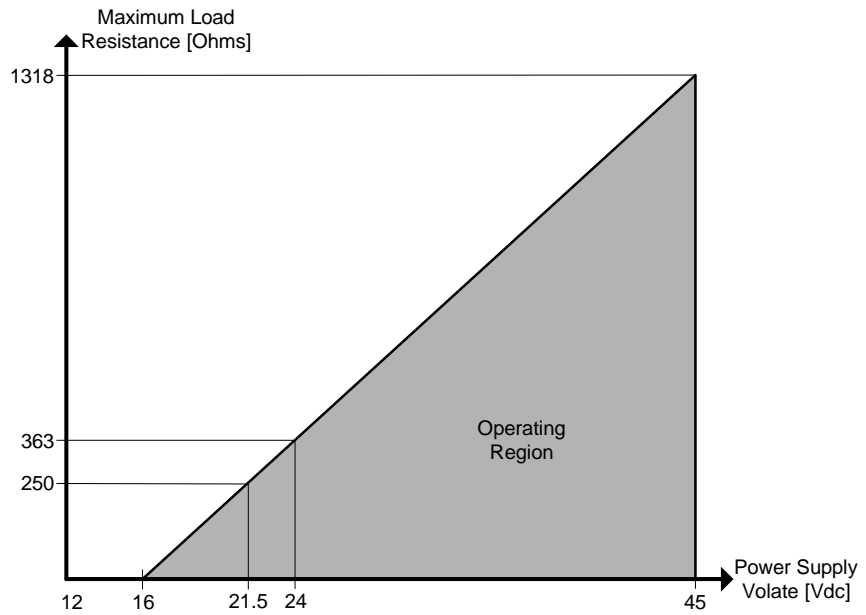
In constructing power supply Loop, the relation between power and load resistance is as below, and should satisfy the condition. (V_{min} = minimal movement terminal voltage:16V, I_{max} = maximum current of loop:22mA)

$$\begin{aligned} R_{max} &= (E - V_{min}) / I_{max} \\ &= (E - 16V) / 0.022A \quad (\text{General Standard type}) \end{aligned}$$

Hence, when the power supply voltage E is determined, the load resistance should be less than or equal to R_{max} (at HART communication, load resistance should be higher than 250 ohm.)

$$\begin{aligned} E_{min} &= I_{max} * R + V_{min} \\ &= 0.022A * R + 16V \quad (\text{General Standard type}) \end{aligned}$$

When the load resistance R is determined, power supply voltage should be higher than or equal to E_{min} .



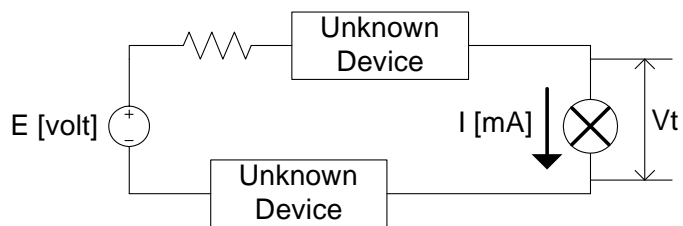
[Figure 5-1] Power Supply Voltage VS Load Resistance

NOTE

◆ In the case of intrinsic safety Transmitter, external load resistance includes safety barrier resistance.

Power Supply Examination for Transmitter replacement

When an old Transmitter is replaced, if the loop composition is unknown, approximate calculation is possible in the method below.



[Figure 5-2] An example Loop with unknown composition

$$E_{min} = I_{max} * (E - Vt) / I + V_{min}$$

$$= 0.022A * (E - Vt) / I + 16V \text{ (General Standard Type)}$$

But, in the above formula, the load on loop is considered as resistance and if non-resistance load exists on loop, formula will be different. **Hence, accurate power specification can be made only if the loop composition is**

5 Electrical Installation

accurately known.

Transmitter Wiring

In the side of Transmitter housing, open the cover located in the direction of indication, "FIELD TERMINALS", you will find terminal block that wire is connected. Power and indicator line are connected to this place, and wire is led in through 1/2 NPT lead-in pipe in the side of housing. Unused lead-in pipes should be blocked and sealed with metal plug. Preliminary examination should be conducted to check if the wire to be used on the site has no problem for connecting to Transmitter.

WARNING

- ◆ When the Transmitter power is on, do not open the Transmitter cover under Explosive Atmospheres.
- ◆ Prior to connecting HHT under Explosive Atmosphere, check if measurement equipments connected to power-line is installed in accordance with intrinsic safety regulations.
- ◆ Avoid contact between power-line and terminal. High voltage of lead wire may cause electric shock.

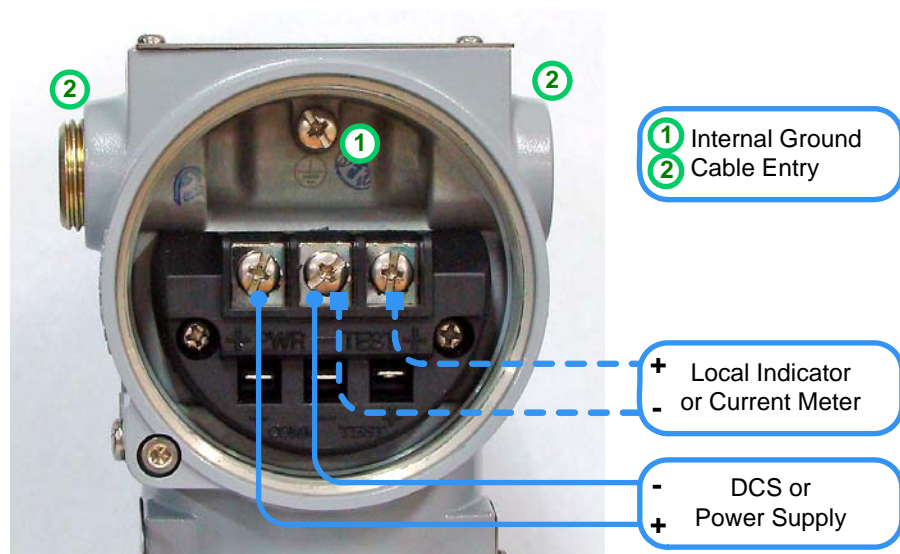
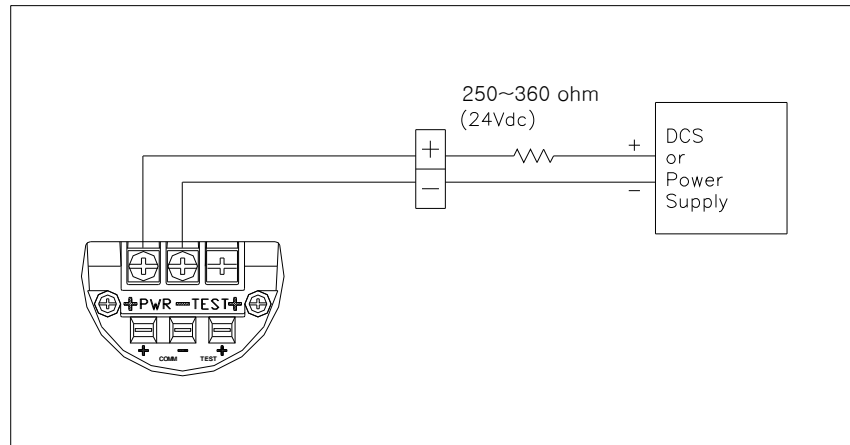
Transmitter Wiring procedure is as follows:

- (1) Turn off Power Supply.
- (2) Open the terminal block cover.
- (3) After inserting cable through cable lead-in pipe located in the side of housing, connect it to terminal as in [Figure 5-3]. Connecting to terminal, be careful about polarity of power supply and terminal. In particular, connecting the "TEST+" terminal and the power supply "+" may damage Transmitter elements. Hence, never connect it.
- (4) Block unused lead-in pipes with metal plug but, to keep the Transmitter interior sealed, you have to make an appropriate treatment in accordance with ambient environment.
- (5) Close the terminal block cover. Especially, in the case of using flameproof region, flameproof requirements should be completely satisfied.
- (6) Tighten the lead-in pipe which cable passed with cable grand but, to keep the Transmitter interior sealed, you have to make an appropriate treatment in accordance with ambient environment.
- (7) To prevent water from entering on the connected cable surface, form the drip loop.
- (8) To use HART communication, 250 ~ 360 ohm (in the standard of 24V power supply) loop resistance should be connected to the power supply Loop in series.

NOTE

- ◆ High voltage (AC power supply) should never be approved to Transmitter terminal. Transmitter may be damaged.

5 Electrical Installation



[Figure 5-3] Connection of the Transmitter terminal block

Test Terminal

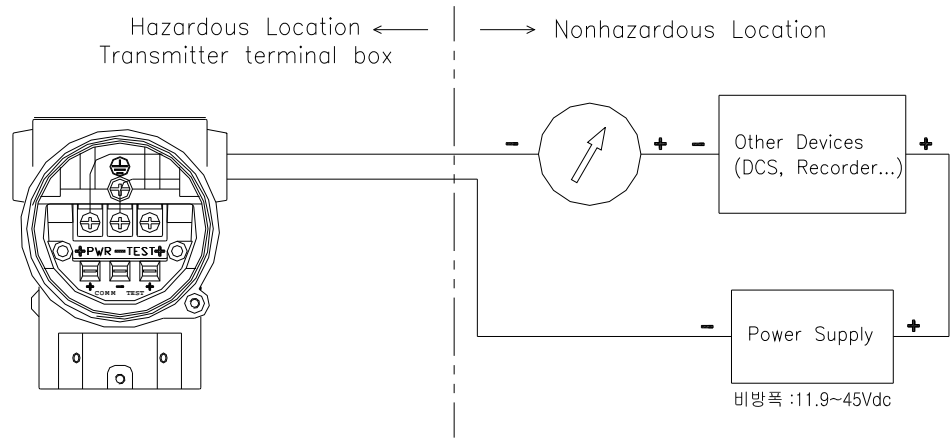
In general, for current measurement, disconnect power line and connect ampere meter in series. ALT-6100 provides test terminal at the Transmitter terminal block to enable measurement of the Transmitter output current without disconnecting power line. As in [Figure 5-3], it is possible to measure current by connecting a Local Indicator or ampere meter to the test terminal. Connecting an ampere meter to the TEST terminal, you have to be careful of charge positivity or negativity. For normal measurement, you have to use an ampere meter with internal resistance below 10 ohm. In case the ampere internal resistance is 30 ohm, an error of about 10% of the current value occurs.

Loop

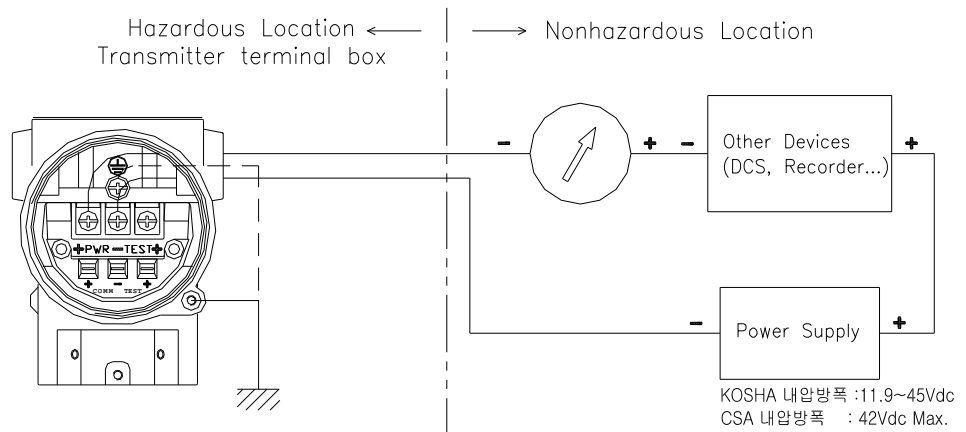
AUTROL SERIES Transmitter adopts 2-wire transmit system. Signal line and

Composition

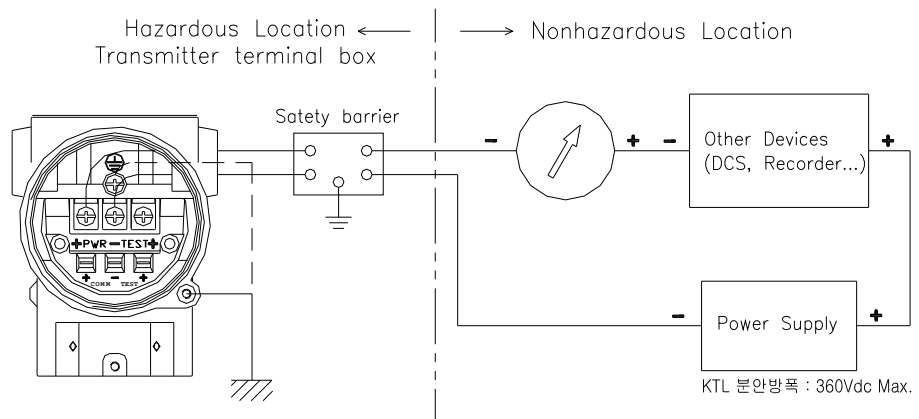
power line are used together, and power connected to Transmitter is DC Power and connected as below:



[Figure 5-4] Non-flameproof loop composition



[Figure 5-5] Flameproof loop composition



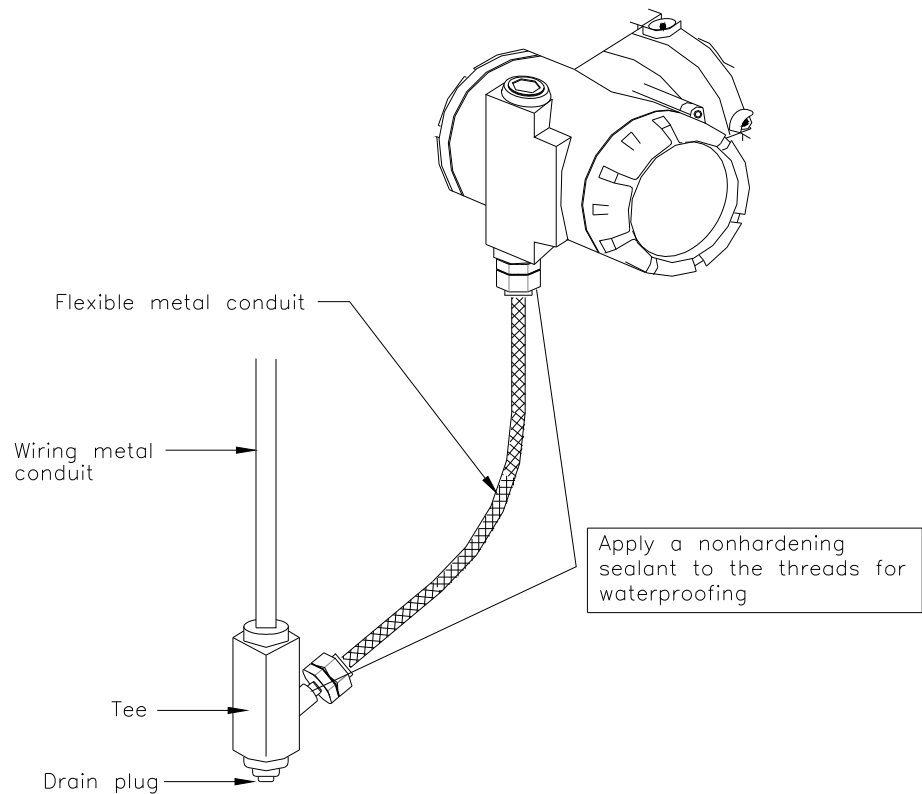
[Figure 5-6] Loop composition of the intrinsic safety structure

5 Electrical Installation

In the intrinsic safety type, Safety Barrier should be included in Loop and connected.

Wiring Installation

- (1) In the case of general shape and intrinsic safety structure
Connect cable using metal conduit or waterproof cable glands.
 - To make the waterproof structure, use non-hardening mounting medium on the thread at the Transmitter-side terminal block and flexible conduit.

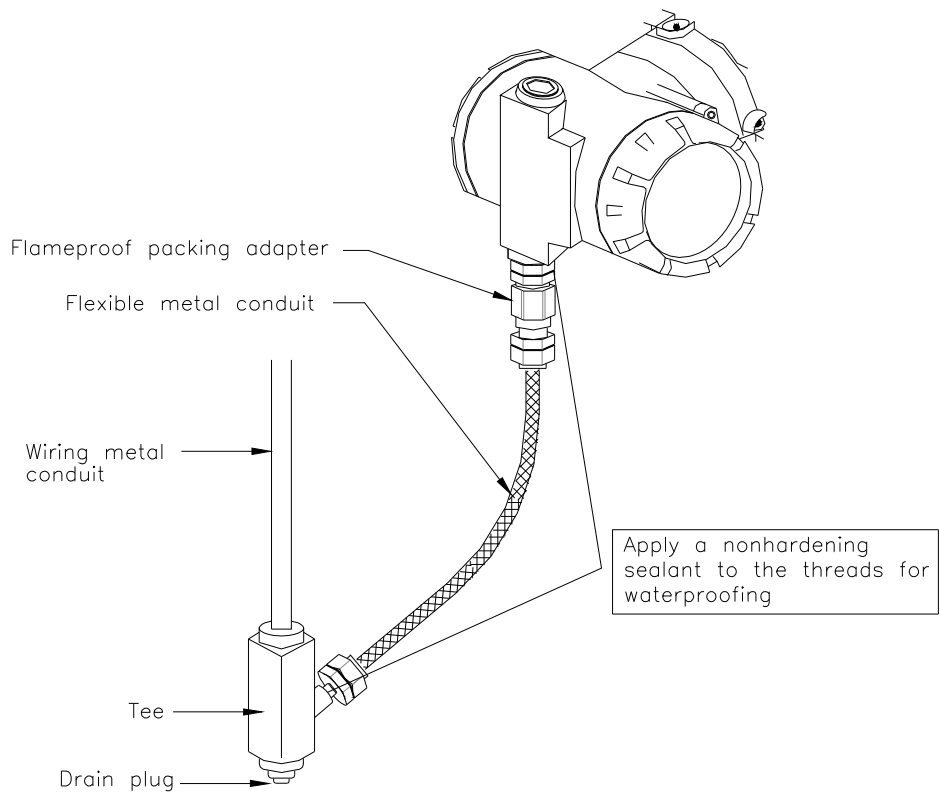


[Figure 5-7] Typical Wiring Using Flexible Metal Conduit

(2) In the case of KOSHA pressure-resistant and flameproof
 Perform cable wiring using Flameproof Packing Adapter or Flameproof
 Metal Conduit.

(a) Cable wiring using Flameproof Packing Adapter

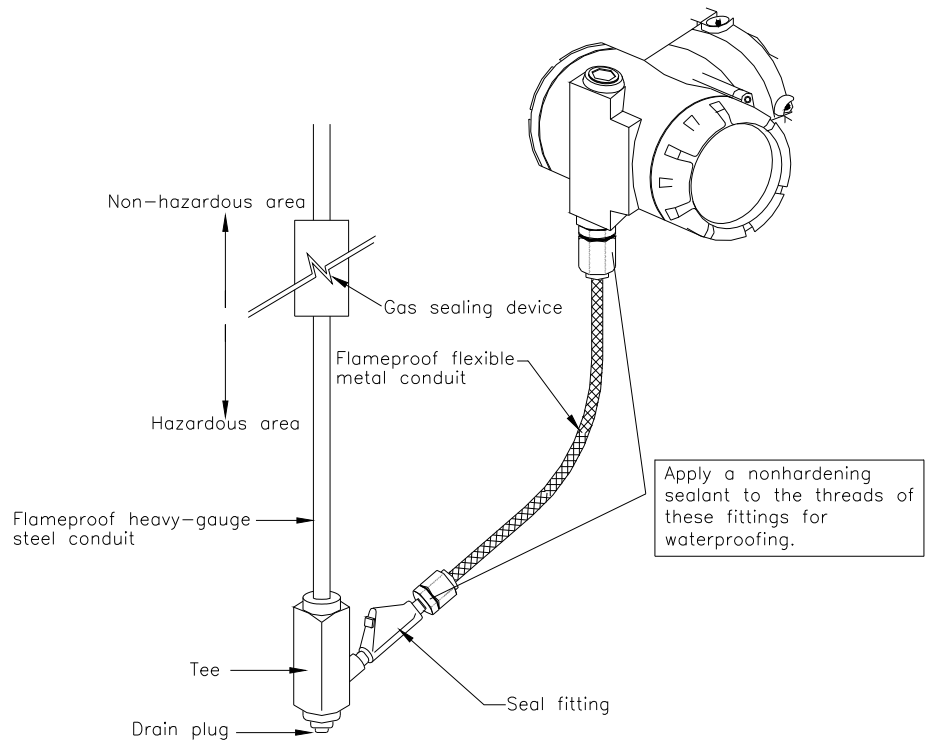
- ◇ Use the packing adapter that was certified of flameproof at KOSHA.
- ◇ To make the waterproof structure, use non-hardening mounting medium on the thread at the Transmitter-side terminal block and packing adaptor.
- ◇ Mount packing adapter on the terminal block part of the Transmitter. Screw in packing adapter to the point that O-ring contact terminal block box and threads overlaps at least 5 times.



[Figure 5-8] Flameproof Wiring Using Flameproof Packing Adapter

5 Electrical Installation

- b) Flameproof Metal Conduit wiring.
- ◇ Use Flameproof Flexible Metal Conduit.
 - ◇ To make the Sealed Structure, install Seal Fitting near terminal block connection.
 - ◇ To make the waterproof structure, use non-hardening mounting medium on the thread at the Transmitter terminal block, Flexible Metal Conduit, and Seal Fitting.



After wiring, impregnate the fitting with a compound to seal tubing.

[Figure 5-9] Flameproof Wiring Using Metal Conduit

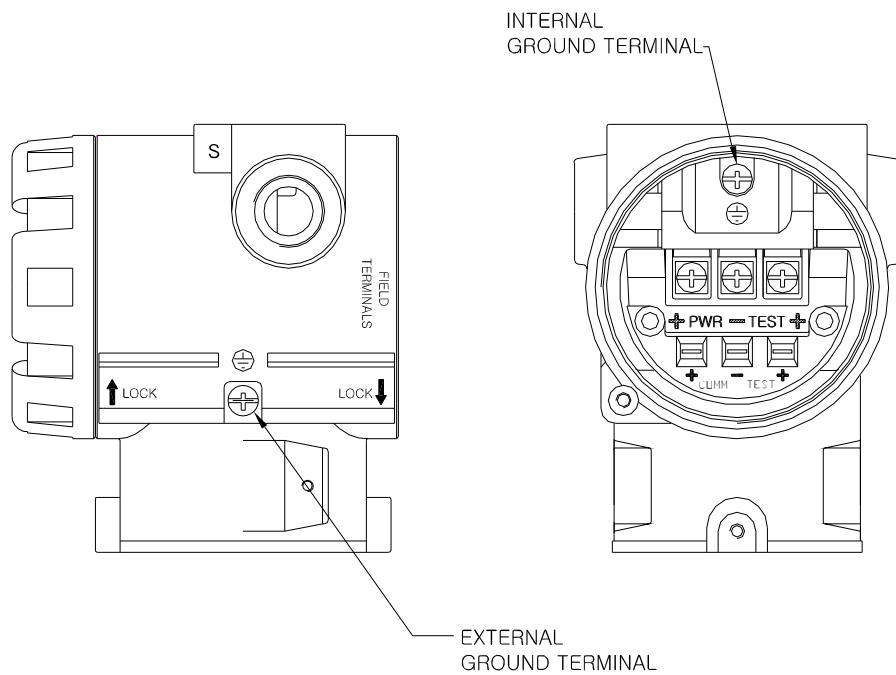
Earth

- (1) At the Transmitter installation, housing should be connected to earth. Earth should satisfy electric standards of the country it is installed, and make the earth resistance as small as possible.(ex.: below 10 ohm)

NOTE

◆ In the case of using built-in thunderbolt protector, it should especially satisfy KS standards (earth resistance: below 10 ohm).

- (2) Earth terminal is at both interior and exterior of terminal block box, any of them can be used.
- (3) Use 600V-level PVC insulated wire.



[Figure 5-10] Ground Terminal

6 Configuration

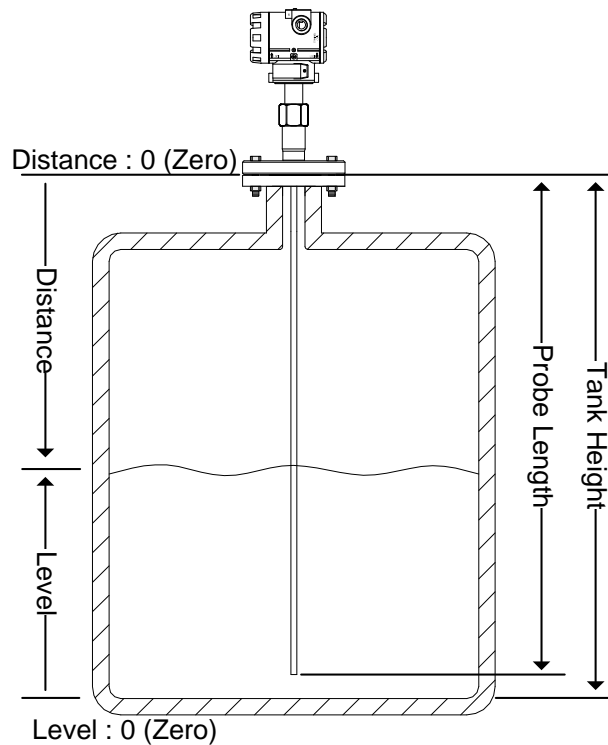
ALT-6100 is configured and calibrated completely at the time of factory shipment based on purchase order. Therefore, basically, the delivered Transmitter can be used right away on site without configuration and calibration. For configuration change, calibration, and product verification, operate after understanding content of this chapter sufficiently.

WARNING

- ◆ When the Transmitter power is on, do not open the Transmitter cover under Explosive Atmospheres.
- ◆ Prior to connecting HHT under Explosive Atmosphere, check if measurement equipments connected to power-line is installed in accordance with intrinsic safety regulations.
- ◆ Avoid contact between power-line and terminal. High voltage of lead wire may cause electric shock.
- ◆ Controlling the Transmitter connected to operational process may cause accidents. Manipulate only after verifying suspension of process.

Parameters for
Level
Measurement

To measure Level, set up parameters of Tank Structure as below.



[Figure 6-1] Tank Structure

Distance

Distance from Transmitter to the surface of measuring medium (result of measurement). The point where Transmitter and probe meet is 0 (Zero) and the distance increases in the direction of probe. For level measuring, Transmitter first measures Distance and converts it to the Level value.

Level

Distance from the floor surface to the surface of measuring medium (result of measurement). The floor surface is 0 (Zero) and the level increases upward. This is the value that measures how much of medium is stored in the Tank.

Tank Height

Tank height is set up. This is the distance from the Tank floor to the Transmitter installation position, and the parameter that should be set up necessarily to measure Level. More correctly, this is the distance from “the position where Level is desired to be measured as 0 (Zero)” to the Transmitter installation position. In general, the Tank floor level is set up as 0 (Zero). But, if the level of a different position other than the floor is desired to be considered as 0 (Zero), you can make the desired set-up by adjusting the Tank Height. For detailed explanation, refer to “Level Set-up Exercise”. **Tank Height should always be larger than the Upper Range**

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Value.

Level and Distance should satisfy
$$\text{Level} = \text{Tank Height} - \text{Distance}$$

Level Adjustment To control level with input value, change Tank Height.
Hence, $\text{Tank Height} = \text{Input Value} + \text{Distance}$

Probe Length Set up the probe length. If weight pendulum or other structure is used, this is set up as “purely measurable length” excluding pendulum. This value is set up in advance at the time of factory shipment, and should be changed only when the probe length is adjusted or the probe fixing method is changed. Probe Length is not involved in Level arithmetics and is used only in error inspection.

Probe Angle It is preferable to install probe in parallel with Tank wall, but in case probe is installed in inclination, the inclined angle can be compensated by adjusting the Probe Angle. Probe Angle is set up as 0 degree if the probe is installed in parallel with Tank wall, and set-up is allowed in the range of 0~ 70 degree.

Analog Output 4~20mA Analog Output is the Primary Value converted to current value within Range. Primary Value can be chosen either as Distance or Level.

Range is set up as LRV (Lower Range Value) ~ URV (Upper Range Value), and output is 4mA when Primary Value is equal to LRV and 20mA when Primary Value is equal to URV.

Output Unit Set-up To indicate the measured Primary Value on LCD and HART, you can set up a desired unit. Usable units are as follows:

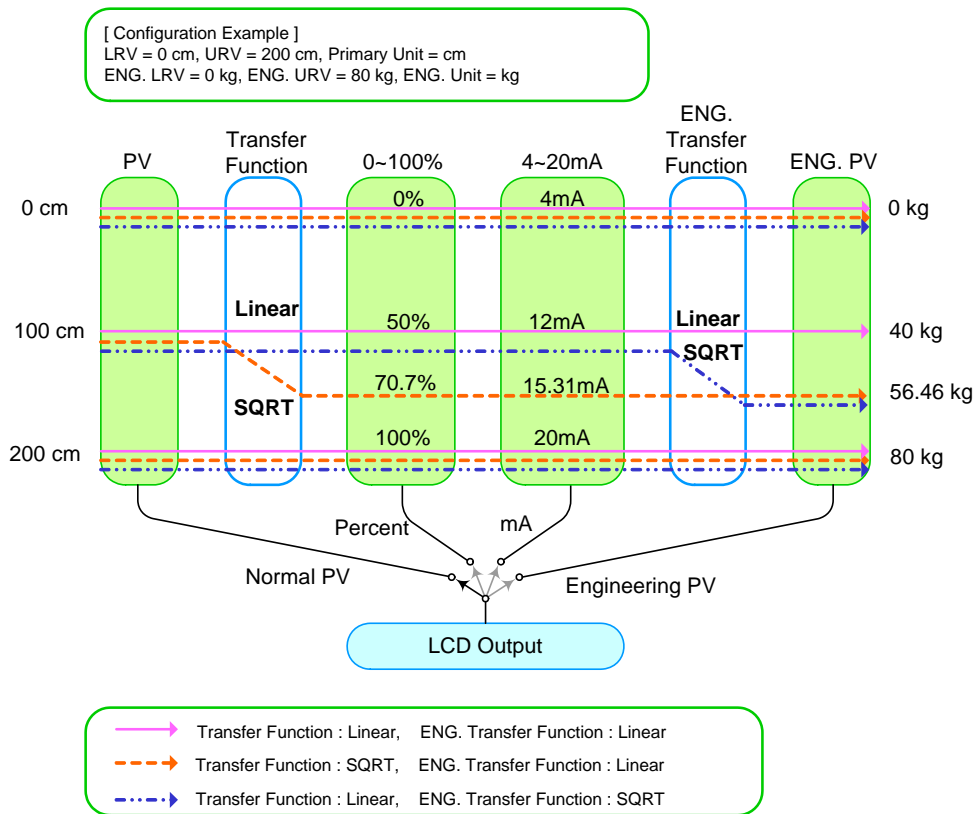
Usable units	feet, meter, inch, cm, mm
--------------	---------------------------

AUTROL Series Transmitters provide additional units for use through LCD Engineering Mode. But, because LCD Engineering Mode is the method to set up the way LCD screen indicates, the unit added by LCD Engineering

Mode is used only in the LCD indication while HART uses the previously set-up unit.

LCD Engineering Mode

ALT-6100 can print out measured results in various ways on the LCD screen. LCD Engineering Mode is the function that converts measured result to “numerical value with different weight” and prints out on the LCD screen. LCD Engineering Mode sets up Engineering Range separately, and maps measured result (0~100%) to Engineering Range and prints out on LCD. For the measured value handling procedure in the LCD Engineering Mode, refer to [Figure 6-2]. It should be noticed that both Transfer Function and ENG. Transfer Function cannot be simultaneously set up as SQRT.

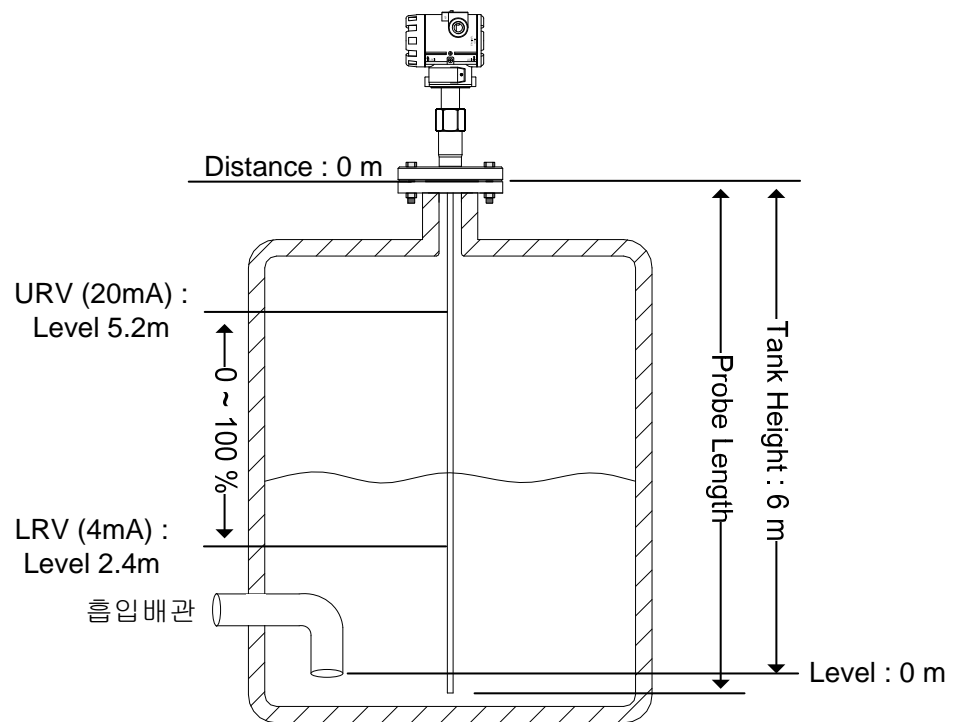


[Figure 6-2] Measured value handling procedure

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Level Set-up Excercise

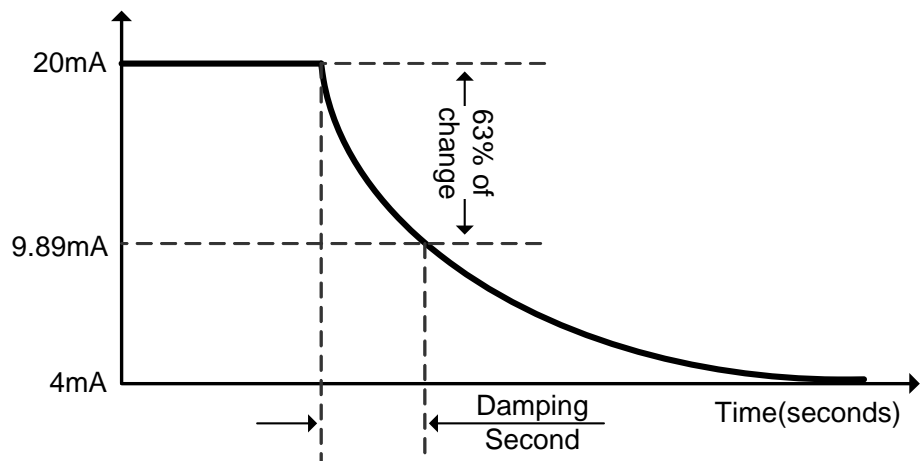
We are going to install a Transmitter of the structure of [Figure 6-3]. Inhale pipe is inserted into the tank lower part for pump, and we will take the level at the inhale pipe end as 0 m. Tank Height is set up as the distance from the inhale pipe ending position to the Transmitter, and LRV (Lower Range Value) corresponding to 4 mA is set up as the position 2.4m above the inhale pipe ending. Similarly, URV (Upper Range Valeu) corresponding to 20 mA is set up as the position 5.2 m above the inhale pipe ending. Hence, the measurement span is $5.2 - 2.4 = 2.8\text{m}$.



[Figure 6-3] Example of Level Set-up

Damping Time Set-up

Damping is the function that mitigates abrupt change of input for output without reflecting it directly. Also, it filters periodic noise and vibrating component contained in measured values. Damping Second is defined as the time it takes for the output to reach 63% of the variation when the input changes instantly. Damping Second should be set up taking into consideration of necessary response time of system, stability of signal, and other requirements.



[Figure 6-4] Damping Second

Damping Second is set up as a value in the range of 0 ~ 60 sec and as 1 sec at the time of factory shipment. The set-up value (Second) should be considered as the "coefficient representing Damping". Although it was defined as "the time to reach 63%" but, in reality, it should be understood as "degree of mitigation rather than "time". Especially, setting up Damping Second as 1 sec does not mean that output is updated every second.

Transmitter Information Set-up

Setting up the Transmitter, Transmitter information such as Tag and Message can be entered. Enter information helpful to Transmitter identification, calibration, and management to Transmitter Information. For detailed content of setting up Transmitter Information, refer to "STT30 for ALT-6100 User Manual".

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Fail Mode Alarm Set-up

ALT-6100 automatically and continuously performs self-diagnostic function. If the self-diagnostic function detects a failure, the transmitter drives its analog current output exceeding the normal saturation value. The transmitter can choose the output current that will be sent out at the time of alarming depending choice of the failure mode alarm switch. See the Table below for output values depending on set-up.

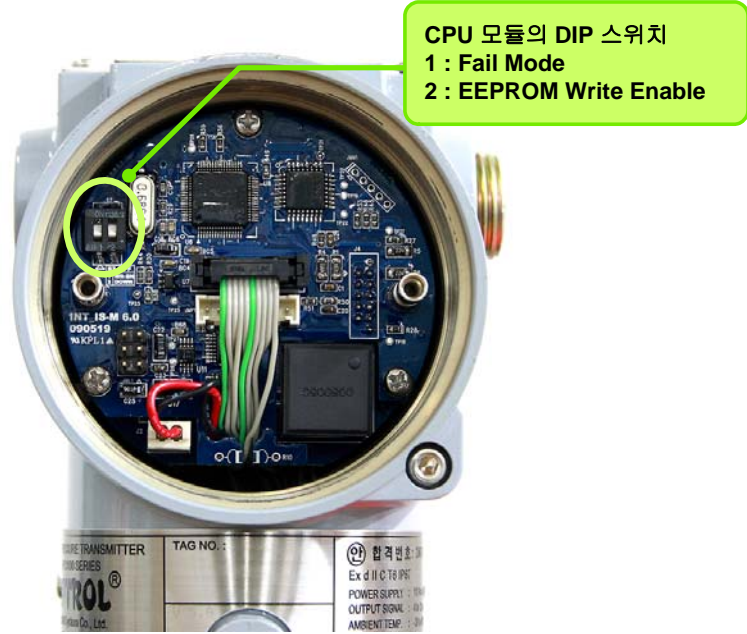
Level	4~20mA Saturation	4~20mA Alarm
Low/Down	3.9 mA	≤ 3.78 mA
High/Up	20.8 mA	≥ 21.1 mA

Fail Mode Select Switches are in two locations, LCD Module and Main CPU Module, and they are connected circuital. In the case of no LCD Module, use the CPU Module Fail Mode Select Switch and otherwise use the LCD Module Switch. In this case, CPU Module is selected to "Down". If Jumper is not inserted, it is assumed to be selected to "Down".

(For Jumper Select Switch refer to Figure 3-2, 3-3)

Fail mode Selection	With LCD Module		Without LCD Module
	CPU Module	LCD Module	CPU Module
Fail Down	Down	Down	Down
Fail Up	Down	Up	Up
	Up	Don't care	

DIP Switch in the CPU Module



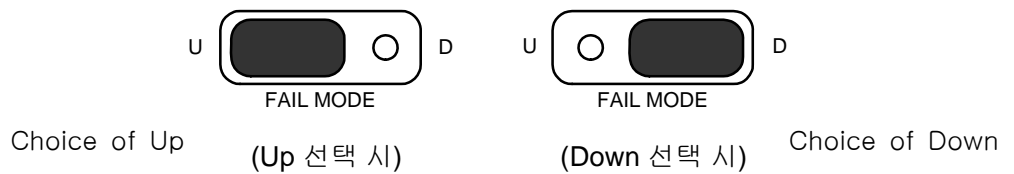
[Figure 6-5] DIP Switch in the CPU Module



[Figure 6-6] DIP Switch Set-up in the CPU Module



[Figure 6-7] Fail Mode Selection Jumper Switch in the CPU Module



[Figure 6-8] Fail Mode Selection Jumper Switch in the CPU Module

EEPROM Write Enable

Various configurations and variables set up in the Transmitter are stored in the non-volatile memory called EEPROM (Electrically Erasable Programmable ROM) in the Transmitter interior. To prevent the data stored in the non-volatile memory from being changed and damaged, Write-Protected Mode can be used and this can be chosen using Jumper Switch. If Switch No. 1 is turned on, Write-Protected Mode is set up and every setting up is not stored in the Transmitter. On the contrary, if the switch is turned off Write Enable Mode is set up and it is possible to change every set up normally. (Refer to [Figure 6-6])

In the Write Protected Mode, every Write is impossible using HART communication, ZERO and SPAN Button.

NOTE

- ◆ It is possible to prohibit manipulation of ZERO and SPAN Button only by removing the magnetic button in the housing upper part.

Function and Set-up using Button

ALT-6100 is designed to enable basic set-up only by Transmitter own buttons without additional devices. Because progression of button manipulation is displayed on LCD, button manipulation can be used only in products containing LCD module. Opening the Name Plate cover in the housing top, you can see ZERO and SPAN buttons. ALT-6100 uses contactless magnetic buttons, which are completely separated from the Transmitter interior. Hence, this is suitable for the case, such as flameproof environment, that Transmitter interior should be sealed.



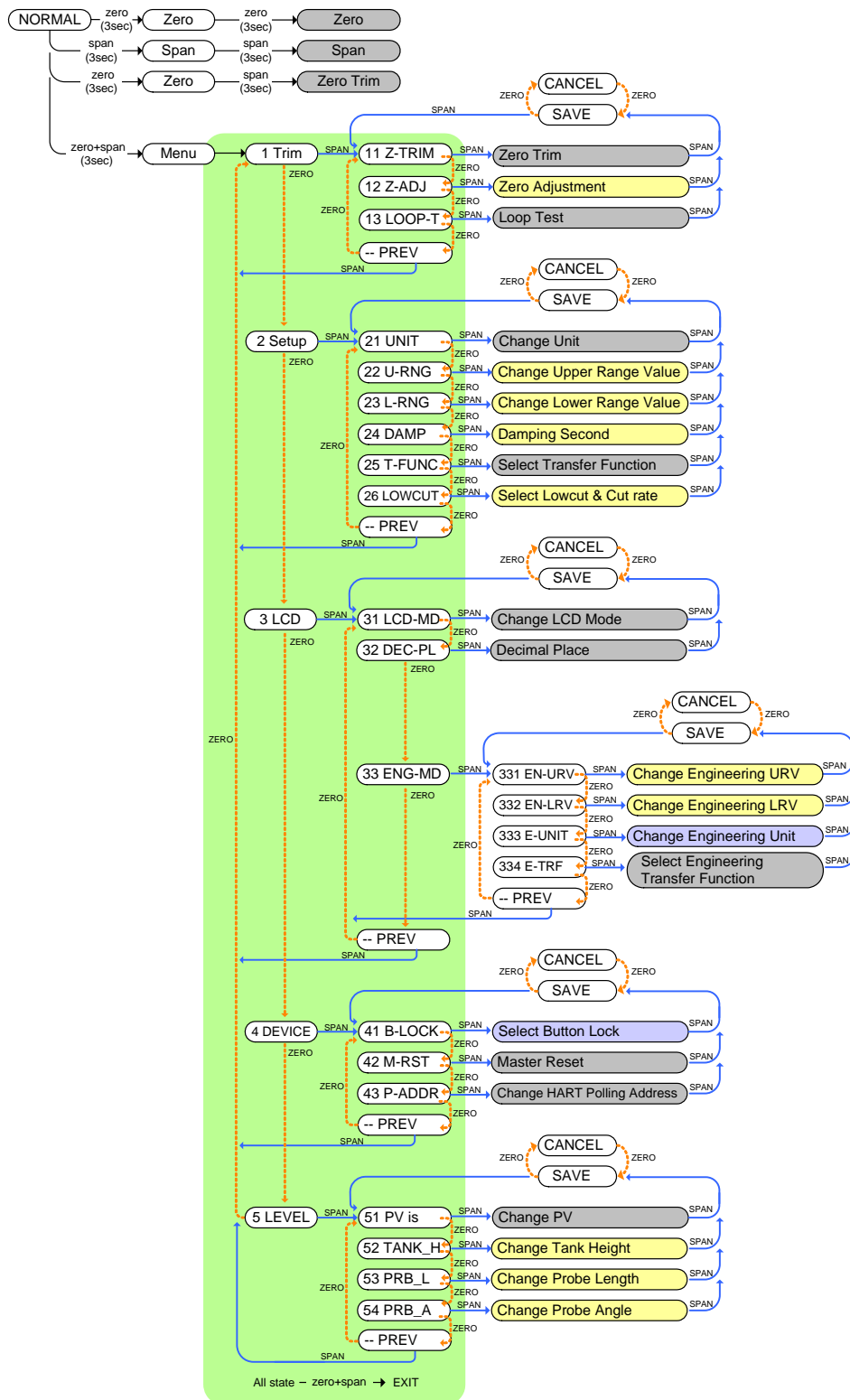
[Figure 6-9] ZERO/SPAN Button in the Transmitter

NOTE

- ◆ ZERO and SPAN button are designed to be active by finger push but, depending on use environment, tools such as pen or screw driver should be used to push deep for accurate action.
- ◆ If magnetic screw driver is used, button may not be active. Hence, non-magnetic screw driver should definitely be used.

To provide various set-up functions with 2 buttons, ZERO and SPAN, ALT-6100 allows menu control in the Tree method.

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[Figure 6-10] Button Input 상태도

- (1) Moving within menu: Zero
- (2) Going to low level menu or execution: SPAN

- (3) Button manipulation ending or moving to a different DIGIT: ZERO + SPAN (simultaneous push of ZERO and SPAN)
- (4) Button input time: – 3 seconds in Normal mode
 - Instant after entering the menu Tree.

In the Normal Operation Mode, after pushing ZERO Button 3 seconds and releasing, push ZERO Button 3 seconds again. Then, ZERO-function is executed.

In the Normal Operation Mode, after pushing SPAN Button 3 seconds and releasing, push SPAN Button 3 seconds again. Then, SPAN-function is executed.

In the normal operation mode, if you push ZERO+SPAN button for 3 seconds, LCD displays "Menu" and, if you release button, LCD displays the initial item "1 Trim" and you enter the menu Tree.

After that, button may be pushed shortly for input. In the menu Tree, you can push ZERO button to move to the next item and push SPAN button to execute the indicated item or to move to low level menu. If you choose "-- PREV" out of the menu items and push SPAN button, you go to high level menu

After entering the menu Tree, if the currently chosen item is within the green region in [Figure 6-10], ZERO+SPAN input terminates button manipulation and returns you to the normal mode. In the menu Tree, if ZERO and SPAN button is pushed long the pushed button is input repeatedly

After completing choice and input of each function, choose "SAVE" and "CANCEL" to confirm the result of application. "SAVE" and "CANCEL" are converted each time ZERO button is pushed, and if you choose "SAVE" and push SPAN input is applied, and if you choose "CANCEL" and push SPAN the present input is cancelled.

NOTE

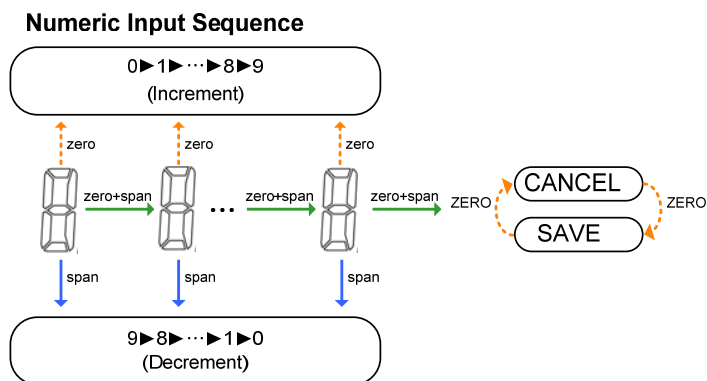
- ◆ If no action is done for about 5 minutes after pushing a Button, Transmitter is out of the menu function.
- ◆ Even during Button manipulation, measurement and 4~20mA output action is done normally, but be careful that output current may change at the time of set-up change.
- ◆ This manipulation method can be applied to **Firmware Revision 2.0** and higher versions and, for lower version products, refer to the “M6100-K01C” document.

Numeric Input Method

Functions that require numeric input: **12 Zero Adjustment, 22 Change Upper Range Value, 23 Change Lower Range Value, 24 Damping Second** are functions that require numeric input.

Numerical input method: Once numerical input starts, the highest input DIGIT flickers. Then, if you push ZERO the number increases while if you push SPAN the number decreases. If you push ZERO+SPAN after changing to the desired number, the next DIGIT flickers and you can use ZERO and SPAN button to change value in the same method.

After repeating the above procedure and changing value to the last DIGIT, push ZERO+SPAN to complete numerical input, and make the final check of the entered value. While LCD displays "SAVE", push SPAN button to apply the entered value and complete numerical input procedure. If you push ZERO button while LCD displays "SAVE", "CANCEL" is displayed. Then, if you push SPAN button the entered value is cancelled.

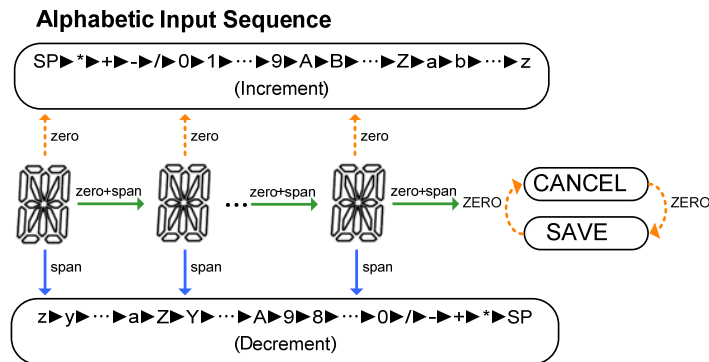


[Figure 6-11] Conceptual diagram of numeric input

Alphabetic Input Method

Functions that require alphabetic input: **333 Change Engineering Unit and 41 Select Button Lock** require alphabetic input.

Alphabetic input method is the same as numerical input method except that not only number but also letter and partly special character can be enter into each DIGIT.



[Figure 6–12] Conceptual diagram of alphabetic input

Execution Excercise for each Function

- (1) ZERO set-up : The currently measured PV is set up as Lower Range Value (4 mA).
 - (a) Control process to the level to be set up as 4 mA.
 - (b) Maintain stable level for longer than 10 sec.
 - (c) If LCD displays "ZERO"-message by pushing ZERO Button for longer than 3 sec, release Button after checking the message.
 - (d) After 1 sec, Push ZERO Button again for longer than 3 sec, LCD displays "-ZR-" and ZERO set-up is completed.
 - (e) **At the time of ZERO set-up, Upper Range Value is also controlled to maintain the currently set-up span.** In other words, if ZERO is executed, the following set-up is obtained: LRV = PV, URV = PV + span.

- (2) SPAN set-up : The currently measured PV is set up as Upper Range Value (20 mA).
 - (a) Control process to the level to be set up as 20 mA.
 - (b) Maintain stable level for longer than 10 seconds.
 - (c) If LCD displays "SPAN"-message by pushing SPAN Button for longer than 3seconds, release Button after checking the message.
 - (d) After 1 sec, Push SPAN Button again for longer than 3 sec, LCD displays "-SP-" and SPAN set-up is completed.
 - (e) In SPAN function, only URV is set up to "URV = PV".

- (3) Zero Trim : Calibrate such that the currently measured PV is to be 0(zero).
 - (a) Push ZERO+SPAN Button to execute menu.
 - (b) If "1 TRIM" is displayed, push SPAN Button to go to low level menu.
 - (c) If "11 Z-TRIM" is displayed, push SPAN Button to execute Zero

Trim.

- (d) "SAVE" is displayed, push SPAN Button to save set-up value.
- (4) Zero Adjustment : Calibrate such that the currently measured PV is to be a desired value.
- (a) Push ZERO+SPAN Button to execute menu.
 - (b) If "1 TRIM" is displayed, push SPAN Button to go to low level menu.
 - (c) If "11 Z-TRIM" is displayed, push ZERO Button to move within menu.
 - (d) If "12 Z-ADJ" is displayed, push SPAN Button to execute Zero Adjustment.
 - (e) LCD displays '0.0' and the highest input DIGIT flickers.
--- For example, to modify the currently measured PV to 14... ---
 - (f) If the flickering DIGIT is not tens place, push ZERO+SPAN button until tens place flickers.
 - (g) When tens place flickers, push ZERO button once to change the LCD display value to "10.0". Then, push ZERO+SPAN button.
 - (h) When units place flickers, push ZERO button 4 times to change the LCD display value to "14.0". Then, until "SAVE" is displayed, push ZERO+SPAN button repeatedly.
 - (i) "SAVE" is displayed, push SPAN Button to save set-up value.
- (5) Loop Test : Fix the 4~20mA Loop Current output to a certain value.
- (a) Push ZERO+SPAN Button to execute menu.
 - (b) If "1 TRIM" is displayed, push SPAN Button to go to low level menu.
 - (c) If "11 Z-TRIM" is displayed, push ZERO Button to move within menu.
 - (d) If "12 Z-ADJ" is displayed, push ZERO Button to move within menu.
 - (e) If "13 LOOP-T" is displayed, push SPAN Button to execute Loop Test.
 - (f) If Loop Test Function is performed, usable modes are indicated in the 2nd line of LCD, and indication contents are as follows:

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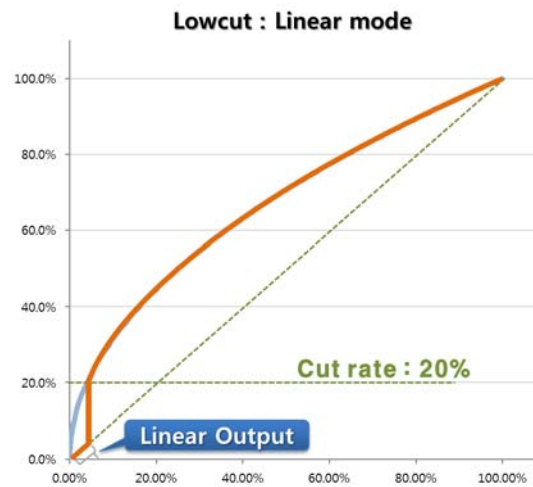
Indication Content	Explanation
OFF	The current that corresponds to PV measured without using Loop Test function is sent out
mA-HLD	The present current is fixed and sent out
4mA, 8mA, 12mA, 16mA 20mA	Each chosen current is fixed and sent out
OTHER	The current value user entered as input is fixed and sent out. After choosing OTHER, push SPAN button. Then, a value is entered and current is fixed to that value.

- (g) Every time ZERO Button is pushed, Mode is changed, and after choosing the desired mode, use SPAN Button to choose set-up value.
- (h) "SAVE" is displayed, push SPAN Button to save set-up value.
- (i) Once current is fixed, it is kept fixed regardless of changes to measured value and parameters, and repeat the above procedure to turn off function or keep the function until the power is turned off and on. Also, if current is fixed using Loop Test function, the present current is maintained along with "Loop" message on LCD.
- (6) Change Unit : Change the display unit.
- (a) Push ZERO+SPAN Button to execute menu.
- (b) If "1 TRIM" is displayed, push ZERO Button to move within menu.
- (c) If "2 SETUP" is displayed, push SPAN Button to go to low level menu.
- (d) If "21 UNIT" is displayed, push SPAN Button to execute Change Unit.
- (e) Until the desired Unit is displayed in the LCD lower part, push ZERO button repeatedly.
- (f) If the desired variable is displayed, push SPAN Button to choose.
- (g) "SAVE" is displayed, push SPAN Button to save set-up value.
- (7) Change Upper Range Value : Change URV.
- (a) Push ZERO+SPAN Button to execute menu.
- (b) If "1 TRIM" is displayed, push ZERO Button to move within menu.
- (c) If "2 SETUP" is displayed, push SPAN Button to go to low level menu.
- (d) If "21 UNIT" is displayed, push ZERO Button to move within menu.
- (e) If "22 U-RNG" is displayed, push SPAN Button to execute function.
- (f) LCD displays the present set-up value and the highest input DIGIT

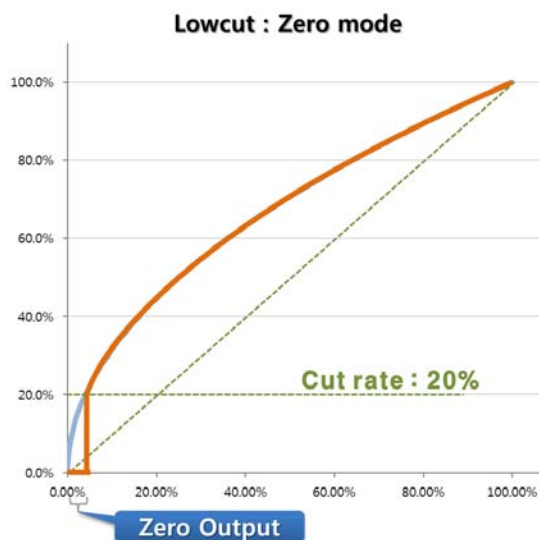
- flickers.
- (g) Numerical input method is the same as in (4) Zero Adjustment.
- (8) Change Lower Range Value : Change LRV.
- (a) Push ZERO+SPAN Button to execute menu.
 - (b) If "1 TRIM" is displayed, push ZERO Button to move within menu.
 - (c) If "2 SETUP" is displayed, push SPAN Button to go to low level menu.
 - (d) If "21 UNIT" is displayed, push ZERO Button to move within menu.
 - (e) If "22 U-RNG" is displayed, push ZERO Button to move within menu.
 - (f) If "23 L-RNG" is displayed, push SPAN Button to execute function.
 - (g) LCD displays the present set-up value and the highest input DIGIT flickers.
 - (h) Numerical input method is the same as in (4) Zero Adjustment.
- (9) Damping Second : Change Damping Second.
- (a) Push ZERO+SPAN Button to execute menu.
 - (b) If "1 TRIM" is displayed, push ZERO Button to move within menu.
 - (c) If "2 SETUP" is displayed, push SPAN Button to go to low level menu.
 - (d) If "21 UNIT" is displayed, push ZERO Button to move within menu.
 - (e) If "22 U-RNG" is displayed, push ZERO Button to move within menu.
 - (f) If "23 L-RNG" is displayed, push ZERO Button to move within menu.
 - (g) If "24 DAMP" is displayed, push SPAN Button to execute function.
 - (h) LCD displays the present set-up value and the tens place DIGIT flickers.
 - (i) Numerical input method is the same as in (4) Zero Adjustment.
- (10) Select Transfer Function : Choose Transfer Function for the 4~20mA output.
- (a) Push ZERO+SPAN Button to execute menu.
 - (b) If "1 TRIM" is displayed, push ZERO Button to move within menu.
 - (c) If "2 SETUP" is displayed, push SPAN Button to go to low level menu.
 - (d) If "21 UNIT" is displayed, push ZERO Button to move within menu.
 - (e) If "22 U-RNG" is displayed, push ZERO Button to move within menu.
 - (f) If "23 L-RNG" is displayed, push ZERO Button to move within

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- menu.
- (g) If "24 DAMP" is displayed, push ZERO Button to move within menu.
 - (h) If "25 T-FUNC" is displayed, push SPAN Button to execute function.
 - (i) Until the desired Transfer Function, either "LINEAR" or "SQRT", is displayed on the LCD lower part, push ZERO button repeatedly.
 - (j) If the desired Transfer Function is displayed, push SPAN Button to complete set-up.
 - (k) "SAVE" is displayed, push SPAN Button to save set-up value.
- (11) Select Lowcut & Cut rate : : Set up Low cut and Cut rate that will be used when the SQRT Transfer Function is chosen.
- (a) Push ZERO+SPAN Button to execute menu.
 - (b) If "1 TRIM" is displayed, push ZERO Button to move within menu.
 - (c) If "2 SETUP" is displayed, push SPAN Button to go to low level menu.
 - (d) If "21 UNIT" is displayed, push ZERO Button to move within menu.
 - (e) If "22 U-RNG" is displayed, push ZERO Button to move within menu.
 - (f) If "23 L-RNG" is displayed, push ZERO Button to move within menu.
 - (g) If "24 DAMP" is displayed, push ZERO Button to move within menu.
 - (h) If "25 T-FUNC" is displayed, push ZERO Button to move within menu.
 - (i) If "26 LOWCUT" is displayed, push SPAN Button to execute function.
 - (j) Every time ZERO button is pushed, the LCD lower part displays "LINEAR", "ZERO", and "C-RATE" in the order. If SPAN button is pushed after choosing "LINEAR" and "ZERO", Low cut mode is set up as Linear and Zero, respectively. If SPAN button is pushed after choosing "C-RATE", a number is entered and set up as Cut rate.
 - (k) "SAVE" is displayed, push SPAN Button to save set-up value.
- * If SQRT Transfer Function is chosen, output changes severely even by a small change to input in the region of low pressure. Because this may cause distortion to input analysis, a technique of applying non-SQRT Transfer Function is used when pressure is lower than a certain value. This product supports this function by setting up Low cut mode.



When Lowcut is set up as Linear mode, apply linear Transfer Function if pressure is lower than Cut rate.



When Low cut is set up as Zero mode, Zero is printed out if pressure is lower than Cut rate.

[Figure 6-13] Lowcut mode comparison

- (12) Change LCD Mode : Change the LCD indication method.
 - (a) Push ZERO+SPAN Button to execute menu.
 - (b) If "1 TRIM" is displayed, push ZERO Button to move within menu.
 - (c) If "2 SETUP" is displayed, push ZERO Button to move within menu.
 - (d) If "3 LCD" is displayed, push SPAN Button to go to low level menu.
 - (e) If "31 LCD-MD" is displayed, push SPAN Button to execute function.
 - (f) If LCD Mode set-up function is performed, usable LCD modes are indicated in the 2nd line of LCD, and indication contents are as follows:

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Indication Content	Explanation
NOR_RO	Normal Rotation Mode. PV, %, mA are indicated alternately.
NOR_PV	Normal PV Mode. Only measured PV is indicated.
NOR_%	Normal Percent Mode. Measured PV is indicated in Percent with respect to Range.
NOR_mA	Normal mA Mode. 4~20mA current values are indicated for measured PV.
ENG_RO	Engineering Rotation Mode. Engineering PV, %, mA are indicated alternately.
ENG_PV	Engineering PV Mode. Converted PV is indicated in the set-up Engineering Range.

(g) Whenever ZERO Button is pushed, LCD Mode is changed, and after choosing the desired mode, use SPAN Button to save set-up values.

(13) Decimal Place : Set up decimal place of the numerical value displayed on LCD.

- (a) Push ZERO+SPAN Button to execute menu.
- (b) If "1 TRIM" is displayed, push ZERO Button to move within menu.
- (c) If "2 SETUP" is displayed, push ZERO Button to move within menu.
- (d) If "3 LCD" is displayed, push SPAN Button to go to low level menu.
- (e) If "31 LCD-MD" is displayed, push ZERO Button to move within menu.
- (f) If "32 DEC-PL" is displayed, push SPAN Button to execute function.
- (g) If Decimal Place set-up function is performed, decimal point indicating method is indicated in the 2nd line of LCD, and indication contents are as follows:

Indication Content	Explanation	Highest possible number to indicate
AUTO	Decimal point is automatically formed depending on the number to be indicated.	99999
5-0	Decimal point is not indicated.	99999
4-1	Indicate to 1 decimal place	9999.9
3-2	Indicate to 2 decimal places	999.99
2-3	Indicate to 3 decimal places	99.999
1-4	Indicate to 4 decimal places	9.9999

- (h) 1st line of LCD indicates 0.0 in the chosen method.
 - (i) Whenever ZERO Button is pushed, indication method is changed, and after choosing the desired indication method, use SPAN Button to save set-up value.
 - (j) Content set up as decimal place is effective to indicate PV and engineering value, and mA and % are indicated in the format of 3-2 irrespective of set-up content.
 - (k) In the event of indicating a number larger than the largest possible number LCD can indicate, 2nd line of LCD indicates LCD_OV message and the currently set up Unit letters alternately.
- (14) Change Engineering URV : Set up URV (Upper Range Value) which is used in LCD Engineering Mode.
- (a) Push ZERO+SPAN Button to execute menu.
 - (b) If "1 TRIM" is displayed, push ZERO Button to move within menu.
 - (c) If "2 SETUP" is displayed, push ZERO Button to move within menu.
 - (d) If "3 LCD" is displayed, push SPAN Button to go to low level menu.
 - (e) If "31 LCD-MD" is displayed, push ZERO Button to move within menu.
 - (f) If "32 DEC-PL" is displayed, push ZERO Button to move within menu.
 - (g) If "33 ENG-MD" is displayed, push SPAN Button to go to low level menu.
 - (h) If "331 EN-URV" is displayed, push SPAN Button to execute function.
 - (i) LCD displays the present set-up value and the highest input DIGIT flickers.
 - (j) Numerical input method is the same as in (4) Zero Adjustment.


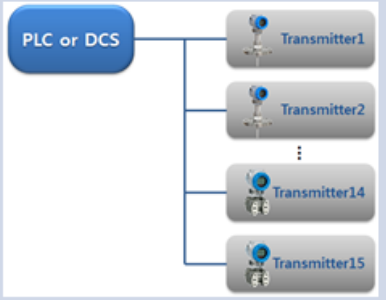
- (15) Change Engineering LRV : Set up LRV (Lower Range Value) which is used in LCD Engineering Mode.
- (a) Push ZERO+SPAN Button to execute menu.
 - (b) If "1 TRIM" is displayed, push ZERO Button to move within menu.
 - (c) If "2 SETUP" is displayed, push ZERO Button to move within menu.
 - (d) If "3 LCD" is displayed, push SPAN Button to go to low level menu.
 - (e) If "31 LCD-MD" is displayed, push ZERO Button to move within menu.
 - (f) If "32 DEC-PL" is displayed, push ZERO Button to move within menu.
 - (g) If "33 ENG-MD" is displayed, push SPAN Button to go to low level menu.
 - (h) If "331 EN-URV" is displayed, push ZERO Button to move within menu.
 - (i) If "332 EN-LRV" is displayed, push SPAN Button to execute function.
 - (j) LCD displays the present set-up value and the highest input DIGIT flickers.
 - (k) Numerical input method is the same as in (4) Zero Adjustment.
- (16) Change Engineering Unit : Set up the Unit used in the LCD Engineering Mode.
- (a) Push ZERO+SPAN Button to execute menu.
 - (b) If "1 TRIM" is displayed, push ZERO Button to move within menu.
 - (c) If "2 SETUP" is displayed, push ZERO Button to move within menu.
 - (d) If "3 LCD" is displayed, push SPAN Button to go to low level menu.
 - (e) If "31 LCD-MD" is displayed, push ZERO Button to move within menu.
 - (f) If "32 DEC-PL" is displayed, push ZERO Button to move within menu.
 - (g) If "33 ENG-MD" is displayed, push SPAN Button to go to low level menu.
 - (h) If "331 EN-URV" is displayed, push ZERO Button to move within menu.
 - (i) If "332 EN-LRV" is displayed, push ZERO Button to move within menu.
 - (j) If "333 E-UNIT" is displayed, push SPAN Button to execute function.

- (k) The 1st position in the LCD lower part flickers while letters are entered to be used as the LCD Engineering Unit.
 - (l) Letter input method is the same as numerical input method except "not only number but also letter and partly special character can be enter into each DIGIT". Hence, enter in the same procedure as in (4) Zero Adjustment.
 - (m) Engineering Unit entered through button manipulation gives the same result as User Define Unit under the communication environment of STT30 or HHT (Handheld Terminal).
- (17) Select Engineering Transfer Function : Choose Transfer Function in the LCD Engineering Mode.
- (a) Push ZERO+SPAN Button to execute menu.
 - (b) If "1 TRIM" is displayed, push ZERO Button to move within menu.
 - (c) If "2 SETUP" is displayed, push ZERO Button to move within menu.
 - (d) If "3 LCD" is displayed, push SPAN Button to go to low level menu.
 - (e) If "31 LCD-MD" is displayed, push ZERO Button to move within menu.
 - (f) If "32 DEC-PL" is displayed, push ZERO Button to move within menu.
 - (g) If "33 ENG-MD" is displayed, push SPAN Button to go to low level menu.
 - (h) If "331 EN-URV" is displayed, push ZERO Button to move within menu.
 - (i) If "332 EN-LRV" is displayed, push ZERO Button to move within menu.
 - (j) If "333 E-UNIT" is displayed, push ZERO Button to move within menu.
 - (k) If "334 E-TRF" is displayed, push SPAN Button to execute function.
 - (l) Until the desired Transfer Function, either "LINEAR" or "SQRT", is displayed on the LCD lower part, push ZERO button repeatedly.
 - (m) the desired Transfer Function is displayed, push SPAN Button to complete set-up.
 - (n) "SAVE" is displayed, push SPAN Button to save set-up value.
- (18) Select Button Lock : Set up Button Lock.
- (a) Push ZERO+SPAN Button to execute menu.
 - (b) If "1 TRIM" is displayed, push ZERO Button to move within menu.
 - (c) If "2 SETUP" is displayed, push ZERO Button to move within menu.
 - (d) If "3 LCD" is displayed, push ZERO Button to move within menu.

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- (e) If "4 DEVICE" is displayed, push SPAN Button to go to low level menu.
 - (f) If "41 B-LOCK" is displayed, push SPAN Button to execute function.
 - (g) Use ZERO button to choose either "LOCK" or "RELEAS" and, then, push SPAN.
 - (h) If "LOCK" is chosen, enter the previous password after messages of "INPUT", "OLD", and "PASSWD". Then, enter new password after messages of "INPUT", "NEW", and "PASSWD", to set up Button Lock (Transmitter's initial password is "000000")
 - (i) If "RELEAS" is chosen, you can cancel Button Lock by entering the existing password after messages of "INPUT" and "PASSWD".
 - (j) Letter input method is the same as numerical input method except "not only number but also letter and partly special character can be enter into each DIGIT". Hence, enter in the same procedure as in (4) Zero Adjustment.
 - (k) If "SAVE" is displayed, push SPAN Button to save set-up value.
 - * If Button Lock is set up, you have to enter password entering into menu Tree after messages of "INPUT" and "PASSWD", and if password is incorrect it is impossible to manipulate through menu Tree.
 - * If wrong password is entered, "PASSER" is displayed and, then, input is cancelled.
- (19) Master Reset : Execute Master Reset of Transmitter.
- (a) Push ZERO+SPAN Button to execute menu.
 - (b) If "1 TRIM" is displayed, push ZERO Button to move within menu.
 - (c) If "2 SETUP" is displayed, push ZERO Button to move within menu.
 - (d) If "3 LCD" is displayed, push ZERO Button to move within menu.
 - (e) If "4 DEVICE" is displayed, push SPAN Button to go to low level menu.
 - (f) If "41 B-LOCK" is displayed, push ZERO Button to move within menu.
 - (g) If "42 M-RST" is displayed, push SPAN Button to execute function.
 - (h) If SPAN Button is pushed after displaying of "SAVE", Transmitter is reset after a while. (Equivalent to turning on and off power).
- (20) Change HART Polling Address : Set up Polling address for HART communication.
- (a) Push ZERO+SPAN Button to execute menu.
 - (b) If "1 TRIM" is displayed, push ZERO Button to move within menu.
 - (c) If "2 SETUP" is displayed, push ZERO Button to move within menu.

- (d) If "3 LCD" is displayed, push ZERO Button to move within menu.
 - (e) If "4 DEVICE" is displayed, push SPAN Button to go to low level menu.
 - (f) If "41 B-LOCK" is displayed, push ZERO Button to move within menu.
 - (g) If "42 M-RST" is displayed, push ZERO Button to move within menu.
 - (h) If "43 P-ADDR" is displayed, push SPAN Button to execute function.
 - (i) LCD displays the present Polling Address, which increases to 0~15 every time ZERO Button is pushed. After choosing a Polling Address in the range of 0~15, push SPAN Button.
 - (j) "SAVE" is displayed, push SPAN Button to save set-up value.
- * If Polling Address is not 0, HART communication is operated in Multidrop, and at the time of setting up Multidrop, M-icon is displayed on the LCD upper part.

	Point to Point	Multidrop
Topology		
Polling Address	0	1 ~ 15
Current Output	4~20mA	4mA Fixed

- (21) PV is : Choose the variable to be used as PV.
 - (a) Push ZERO+SPAN Button to execute menu.
 - (b) If "1 TRIM" is displayed, push ZERO Button to move within menu.
 - (c) If "2 SETUP" is displayed, push ZERO Button to move within menu.
 - (d) If "3 LCD" is displayed, push ZERO Button to move within menu.
 - (e) If "4 DEVICE" is displayed, push ZERO Button to move within menu.
 - (f) If "5 LEVEL" is displayed, push SPAN Button to go to low level menu.
 - (g) If "51 PV is" is displayed, push SPAN Button to execute function.
 - (h) Until the desired variable, Distance or Level, is displayed, push

ZERO Button repeatedly.

- (i) If the desired variable is displayed, push SPAN Button to choose.
 - (j) "SAVE" is displayed, push SPAN Button to save set-up value.
- (22) Tank Height : set up tank height.
- (a) Push ZERO+SPAN Button to execute menu.
 - (b) If "1 TRIM" is displayed, push ZERO Button to move within menu.
 - (c) If "2 SETUP" is displayed, push ZERO Button to move within menu.
 - (d) If "3 LCD" is displayed, push ZERO Button to move within menu.
 - (e) If "4 DEVICE" is displayed, push ZERO Button to move within menu.
 - (f) If "5 LEVEL" is displayed, push SPAN Button to go to low level menu.
 - (g) If "51 PV is" is displayed, push ZERO Button to move within menu.
 - (h) If "52 TANK_H" is displayed, push SPAN Button to execute function.
 - (i) Numerical input method is the same as in (4) Zero Adjustment.
- (23) Probe Length : Set up the probe length.
- (a) Push ZERO+SPAN Button to execute menu.
 - (b) If "1 TRIM" is displayed, push ZERO Button to move within menu.
 - (c) If "2 SETUP" is displayed, push ZERO Button to move within menu.
 - (d) If "3 LCD" is displayed, push ZERO Button to move within menu.
 - (e) If "4 DEVICE" is displayed, push ZERO Button to move within menu.
 - (f) If "5 LEVEL" is displayed, push SPAN Button to go to low level menu.
 - (g) If "51 PV is" is displayed, push ZERO Button to move within menu.
 - (h) If "52 TANK_H" is displayed, push ZERO Button to move within menu.
 - (i) If "53 PRB_ L" is displayed, push SPAN Button to execute function.
 - (j) Numerical input method is the same as in (4) Zero Adjustment.
- (24) Probe Angle : Set up the probe angle.
- (a) Push ZERO+SPAN Button to execute menu.
 - (b) If "1 TRIM" is displayed, push ZERO Button to move within menu.
 - (c) If "2 SETUP" is displayed, push ZERO Button to move within menu.
 - (d) If "3 LCD" is displayed, push ZERO Button to move within menu.
 - (e) If "4 DEVICE" is displayed, push ZERO Button to move within menu.
 - (f) If "5 LEVEL" is displayed, push SPAN Button to go to low level

menu.

- (g) If "51 PV is" is displayed, push ZERO Button to move within menu.
- (h) If "52 TANK_H" is displayed, push ZERO Button to move within menu.
- (i) If "53 PRB_ L" is displayed, push ZERO Button to move within menu.
- (j) If "54 PRB_A" is displayed, push SPAN Button to execute function.
- (k) Numerical input method is the same as in (4) Zero Adjustment.

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Set-up Function Method and Difference

Transmitter can be set up through either HART communicator or Button, and support of each method and differences between the two methods can be seen in the Table below.

Item	Set-up Content	HART	Button	Output that is affected by set-up change
Basic Set-up	Range Change	○	○	Whole output excluding PV displayed on LCD
	Unit Change	○	○	PV displayed on LCD
	Damping Second Change	○	○	Whole Output
	Transfer Function Change	○	○	Whole output excluding PV displayed on LCD
	Low-cut Change	○	○	Whole output excluding PV displayed on LCD
	Loop Test	○	○	Whole output excluding PV displayed on LCD
	PV is changed	○	○	Whole Output
	Tank Height Change	○	○	For Level, whole output
	Probe Length Change	○	○	whole output depending on case
	Probe Angle Change	○	○	Whole Output
Calibration	Zero Trim	○	○	Whole Output
	Zero Adjustment	○	○	Whole Output
	Full Trim	○	×	Whole Output
	D/A Trim	○	×	4~20mA
Transmitter Information Set-up	Polling Address Change	○	○	4~20mA
	Transmitter Basic Information set-up. (Tag, Date, Descriptor, Message etc.)	○	×	-
LCD Display	LCD Mode Change	○	○	Whole LCD indication
	Decimal Place Change	○	○	Whole LCD indication
	LCD Engineering Mode Change (Eng Range, Eng Unit, Eng Transfer Function etc.)	○	○	LCD Engineering Value
Other	Button Lock set-up	△	○	-
	Master Reset	○	○	Whole Output

7 Maintenance

This chapter describes failure diagnosis and maintenance of Transmitter.

WARNING

- ◆ When the Transmitter power is on, do not open the Transmitter cover under Explosive Atmospheres.
- ◆ Prior to connecting HHT under Explosive Atmosphere, check if measurement equipments connected to power-line is installed in accordance with intrinsic safety regulations.
- ◆ Avoid contact between power-line and terminal. High voltage of lead wire may cause electric shock.
- ◆ Controlling the Transmitter connected to operational process may cause accidents. Manipulate only after verifying suspension of process.
- ◆ At the time of removing Transmitter from Tank, you have to check if probe is contaminated and be careful with handling.
- ◆ Handling Transmitter, be careful not to cause gas leakage in the Tank.

Calibration

Due to the nature of GWR measurement method, ALT-6100 can measure accurately without Calibration, but may need calibration because of the site environment and mechanical error of the installation part. For accurate calibration, the material surface in the Tank should be stabilized and Tank should be neither full nor vacant.

Distance calibration procedure is as follows:

- (1) Measure accurately the distance from the Transmitter installation position to the material surface.
- (2) Use HTT and Button to execute Zero Adjustment.
- (3) Enter the actually measured value to calibrate PV.

Level calibration procedure is as follows:

- (1) Measure accurately actual level.
- (2) Control Tank Height for the Transmitter level to be accurate.
- (3) If possible, control Tank Height for maximal Level calibration, and calibrate with Zero Adjustment for more accurate calibration.

NOTE

- ◆ The function of Zero Adjustment is to offset PV to a designated value, but this function is not executed outside the probe's physical measurement Limit.

For details of calibration through HART communication, refer to “STT30 for ALT-6100 User Manual”

D/A Trim

D/A Trim is used to calibrate tiny error of output at the time of 4~20mA output. To maintain precision of measurement, it is preferable to calibrate periodically the analog output. On the site, this function will be very useful when the current seen on the Communicator is different from the actual measured current. For details of calibration through HART communication, refer to “STT30 for ALT-6100 User Manual”.

Loop Test

Loop Test is convenient to check output of the Transmitter's 4~20mA Current Loop, no formation of Loop, and action of other recorder or similar devices connected to Loop. Loop Test procedure is as follows:

- (1) Connect standard ampere meter to Transmitter.
- (2) Choose HHT's Loop Test screen to activate Loop Test.
- (3) Choose the desired output current (4mA/20mA/other).
- (4) Check if the current reading on the connected ampere meter agrees with the current output designated by Loop Test. In case of disagreement, trim the Transmitter output or replace it in case of errors.

Hardware Maintenance

ALT-6100 is designed in terms of functional unit and so Maintenance is convenient. Maintenance for each functional unit is possible, hence if a Transmitter part or module is damaged you can use the Transmitter by replacing the damaged part. For details of purchase or replacement of parts and modules, contact the company service center.

WARNING

- ◆ When the Transmitter power is on, do not open the Transmitter cover under Explosive Atmospheres.

Disassembly procedure of the Electronic Circuit module is as follows:

- (1) Remove power from Transmitter.
- (2) Remove the front cover of Transmitter, and separate mounted LCD module, if any.
- (3) Separate analog connector and power connector from board.
- (4) Loosen 3 fixing screws of the Electronic Circuit module, separate the Electronic Circuit module from housing.

NOTE

- ◆ Replacing the Electronic Circuit module, check set-up of the Fail Mode and EEPROM Write Enable switches, and ensure to set up same as previously.



[Figure 7-1] Electronic circuit module

Assembly procedure of the Electronic Circuit module is as follows:

- (1) Check if the Fail Mode and EEPROM Write Enable switches are set up correctly in the Electronic Circuit module to assemble.
- (2) Insert the Electronic Circuit module carefully into housing.
- (3) After pulling power cable tight, fix the Electronic Circuit module to housing with 3 screws. Be careful not to get power cable caught between housing and screws, which may cause short.
- (4) Connect analog connector and power connector. In case analog connector is connected wrongly, it may cause abnormal measurement.
- (5) Assemble the front cover.

Hardware Failure Diagnosis In case of judging Transmitter malfunction, follow the procedure explained in [Table 7-1] to examine and check if the Transmitter hardware or wiring is proper.

[Table 7-1] Troubleshooting

Phenomena	Cause	Actions to be taken
Transmitter is unable to communicate with HHT	Loop Wiring	<ul style="list-style-type: none"> o. Examine if the resistance between HHT and Power Supply is at least 250 ohm. o. Examine if appropriate voltage is approved for Transmitter. Voltage at the Transmitter power terminal should always be within 16V ~ 45VDC. o. Examine if line is disconnected, short, or multiply grounded. o. Check if LCD displays messages.
High output signal	Sensor Input Fail	<ul style="list-style-type: none"> o. Check if probe is connected normally
	Loop Wiring	<ul style="list-style-type: none"> o. Examine if terminal contact is good, dusted, or damaged.
	Power Supply	<ul style="list-style-type: none"> o. Voltage at the Transmitter power terminal should always be within 16V ~ 45VDC. (Regardless of Loop Current)
	Electronic Circuit Module	<ul style="list-style-type: none"> o. Connect HHT to examine Transmitter's measurement Limit, and check if Calibration is within Sensor Range Limit.
Unstable output signal	Loop Wiring	<ul style="list-style-type: none"> o. Check if voltage at the Transmitter terminal is always within 16V ~ 45VDC. o. Examine if line is disconnected, short, or multiply grounded. o. Connect HHT to check if 4mA, 20mA, or constant current flows. o. If current is measured during digital communication, output value will fluctuate by $\pm 0.013\text{mA}$.
	Electronic Circuit Module	<ul style="list-style-type: none"> o. Connect HHT to check change of PV
Low or no output signal	Sensor Element	<ul style="list-style-type: none"> o. Check if probe is connected normally. o. Check with PV if sensor is Out of Range.
	Loop Wiring	<ul style="list-style-type: none"> o. Check if voltage at the Transmitter terminal is always within 16V ~ 45VDC. o. Examine if line is disconnected, or multiply grounded. o. Examine if polarity of signal terminal is correct. o. Examine Loop impedance
	Electronic Circuit Module	<ul style="list-style-type: none"> o. Connect HHT to examine Transmitter's measurement Limit, and check if Calibration is within Sensor Range Limit..

Appendix I

ALT-6100 Smart Guided Wave Radar Level Transmitter
LCD DISPLAY CODE

Appendix I

Message	Description	Remarks
ADJ-U	During Zero Adj with Button, escapes Zero set-up region (Upper side)	
ADJ-L	During Zero Adj with Button, escapes Zero set-up region (Lower side)	
ZERO	ZERO Button pushed	
SPAN	SPAN Button pushed	
BT-ERR	Button Input Sequence Error	
P-LOCK	Button error in the Protect-Lock state	
ZT-ERR	Range error at Zero Trim (10%)	
-TR-	Zero Trim completed	
ZR-ERR	Range error during ZERO Button Function execution	
SP-ERR	Range error SPAN Button Function execution	
-ZR-	ZERO Button Function completed	
-SP-	SPAN Button Function completed	
-ZA-	Zero Adjustment completed	
-DONE-	Completion of set-up change with Button	
R-OVER	Escape of pressure range at the time of set-up change with Button	
PASSER	Wrong password input	
TOO-H	Input number is too large	
TOO-L	Input number is too small	
LCD_OV	Number to be displayed on LCD escapes indication range	
SCD-ER	Sensor Code Error	
F-RST	Flash Set-up Data Reset	
F-LOCK	Protect Locked during Flash Set-up Data Reset	
F-FAIL	Flash Set-up Data Reset failure	
-FR-	Flash Reset completed	
A-RST	Analog EEPROM initialization started	
A-STOR	Analog EEPROM Total Write	
A-FAIL	Analog EEPROM Total Write failure	
-AC-	Analog EEPROM Total Write completed	
S-FL	Sensor Fail	
S-OP	Sensor Overpressure	

Message	Description	Remarks
AEP-RF	Analog EEPROM read checksum error	
TS-FL	Temperature Sensor error	
AEP-WF	Analog EEPROM write fail	
EOSC	Poor Crystal Set-off (발진?)	
FAVE	Flash Access Violation	
PGM-ER	Program Memory CRC error	