INSTRUCTION MANUAL

FOR

Displacement Type Level Transmitter

MODEL : SDT-420

Rev.0.1

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목차 / TABLE OF CONTENTS

Section	Title	Page
1	BEFORE INSTALLATION	3
2	INTRODUCTION	4
3	FEATURES	4
4	PRINCIPLE OF OPERATION	5
5	SPECIFICATION	9
6	NAME PLATE	11
7	INSTALLATION	12
8	DISPLACER	14
9	WIRING	15
10	CONFIGURATION	18
11	TROUBLE SHOOTING	30
12	REMOTE CONFIGURATION HHT 375	31

1. Before Installing

· Read this manual thoroughly and become familiar with it before installing or operating this Displacement type Level Transmitter (SDT-420).

1.1 Safety Precautions

· Read the safety precautions carefully before using this instrument.
The safety precautions described herein should be strictly complied with for safety operations and are classified to DANGER, WARNING and CAUTION.

⚠ DANGER ⚠

It is highly recommended not to touch the Input/Output terminal unit directly as it can cause an electric shock.

⚠ WARNING ⚠

1. Where there are any concerns that a small trouble or an abnormal operation can cause any serious accidents, an appropriate safety protecting circuit should be installed in order to prevent those serious accidents.
2. Prepare a separate power switch for this instrument.
3. Confirm that the voltage of power source is consistent with the rated voltage of the instrument.
4. Do not hook up the power cable before completing all wiring connections.
5. User can choose an Explosion Proof type for the installation to a potentially explosive location so check if the purchased instrument is the Ex-proof type when installing to a potentially explosive location.
Also, a safety barrier should be installed when installing to a potentially explosive location. (Safety Barrier grounding: 1 Class grounding)
6. Do not disassemble, alter or repair it as they can cause malfunction, abnormal working, fire or electric shock.
7. Turn the main power switch off before mounting or dismounting this instrument in order to prevent possible electric shock, malfunction, or breakdown.
8. The using ways that are not designed by the manufacturer may cause damages or losses on property.

1.2 Precautions during the Installation & Operation

1) The information included in this manual is subject to change without prior notice.
2) Check if all specifications are consistent with the products you ordered.
3) Inspect the instrument for any damages that may have occurred during the transportation.
4) For securing an appropriate operation, the ambient temperature should be between 0 ~ 70℃ and the humidity should be between 0~99%RH(No condensation).
5) Do not install or use this instrument in the location where generates corrosive gases (especially hazardous gases or ammonia gas) or combustible gases unless the instrument is an explosion proof type.
6) Do not install or use the instrument in the location where vibration may affect directly to.
7) Do not clean the instrument with organic solvent such as alcohol or benzene, and use a neutral detergent.
8) Do not install or use the instrument in the location where generates noticeable inductive interference, electrostatics or magnetic noise.
9) Keep the instrument away from the direct sunlight or radiation heat.
10) Do not use the instrument in a location of which the altitude is more than 2000 meters.
11) In the event of water leaking into the instrument, contact us or a dealer and ask for an inspection before using in order to avoid any short circuits or fires.
12) To avoid any impact from inductive noises, the input signal line should be in a certain distance from power lines or load lines.

13) Turn the main power switch off before wiring or exchanging sensors.
14) Do not connect any wire to unused terminals.
15) Verify the terminal polarity then perform the electric wiring correctly.
16) Install the switches or circuit breakers close to the operator in order to allow easy access.
17) Periodical maintenance is recommended to secure the safe operations.
18) Some components are expendable which have their own lifetimes, whereas some parts are degraded with the passage of time.
19) We offer a two year guarantee for this instrument including its components, if it is properly used.
20) Do not move the Displacer with the Torsion Bar connected.

21) Pay attention to possible shocks during moving or installing it.
22) Try not to let moisture or dust get into the electric circuit.
23) Do not disassemble this instrument.
24) An additional explosion-proof cable gland should be used to the cable entry when installing this instrument to a potentially explosive location.
25) Additional measures, such as a thermostat, air purging or vent hole should be considered to prevent dew condensations inside the circuit.

⚠ The installation of Displacement Type Level Transmitter (SDT) should always be followed by the instructions on this manual.

2. INTRODUCTION

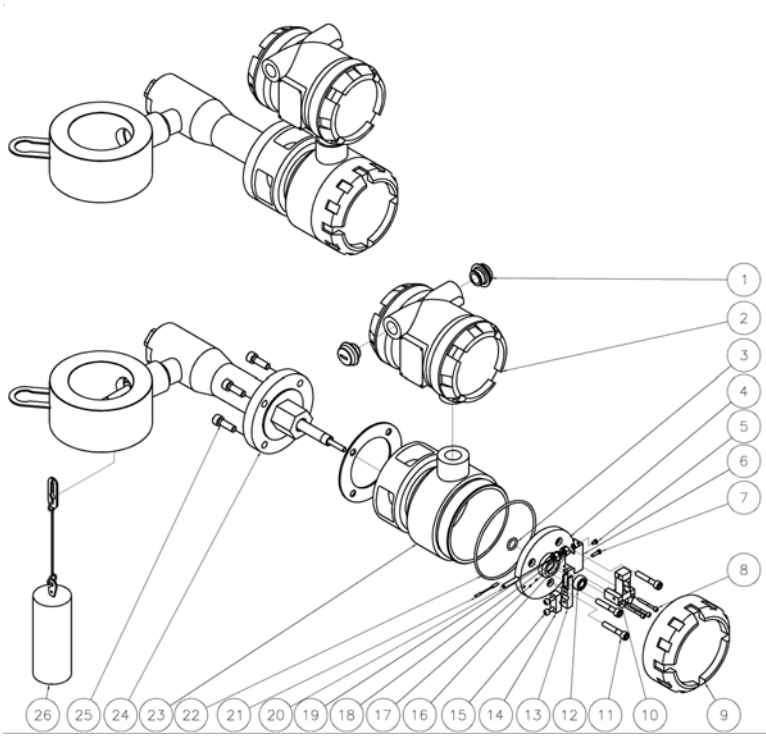
· For the safe and efficient operation of various high temperature and high pressure steam drums, boilers and reactors used in Firepower Plants, Glass & Cement Plants, Petrochemical Plants and Steel & Paper manufacturing Plants, close monitoring and controlling of the interface level between water and vapor is very important. As these steam drums are working under extremely high temperature and pressure conditions, the instruments related to measuring and controlling the level must be defect-free. Otherwise, minor defects may bring serious damages to the other equipments or financial losses.
· However the industry had relied on the instruments like Sight Glass or Float Type Level switches and had experienced many troubles so the demand for the alternative instruments had increased. To respond to this market demand, Seojin committed to the development of Displacement Type Level Transmitter based on its experiences and know-how, and finally has succeeded in launching this model to the market. Our Displacement Type Level Transmitter can assure the reliable operation even under the harsh circumstance like 200kgf/㎠ and 450℃.
· This Displacement Type Level Transmitter is designed for measuring not only the level of on liquid but also the interface level between two different liquids. Its operation is based on the buoyancy principles of Archimedes and it supports remote monitoring by the configuration with PC (With SIEMENS PDM Software) or Universal Hand Held Terminal (HART Field Communicator). This instrument also supports the conventional way of operation and control so the users can operate and control it using keypads at the field.

3. FEATURES

· Communication Protocol: HART / SIEMENS PDM.
· Measuring Range: 300 ~ 5000㎜
· Process Temperature: -40 ~ 450℃
· Process Pressure: 200kgf/㎠
· Output Signal: 2wire Type 4 ~ 20㎃, HART. LCD
· Specific Gravity: 0.5 ~ 1.5
· Accuracy: ±0.5% F.S.
· Fluid ends material: 316SS, PTFE, MONEL, etc.
· Equip with a continuous self-diagnosis function.
· Display various units (%, ㎃, ℃, and so on).
· No factory calibration is necessary. By entering the data of density, temperature and measuring length at the field, this instrument can be started to operate.

4. PRINCIPLE OF OPERATION

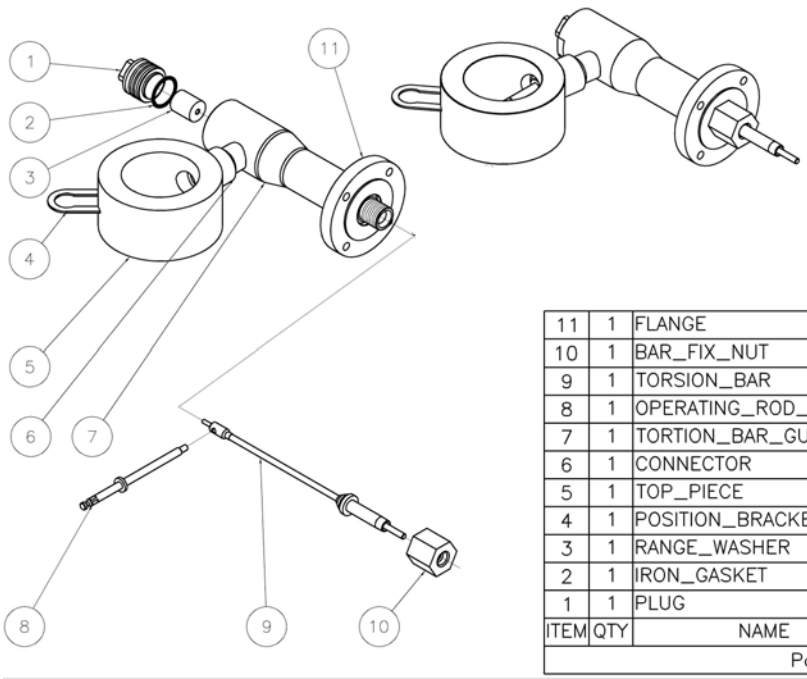
4.1 Overview (Explosion Proof Type)



ITEM	QTY	NAME	MATERIAL	NOTE
26	1	DISPLACER	316SS	
25	4	CYLINDER HEAD CAP SCREW – KS B 1003 – M8X25	304SS	
24	1	TORTION_BAR_GUARD	304SS	
23	1	ADJUST HOUSING EX	ADC12	
22	1	O-RING_G95	NBR	JIS G system
21	1	HANGER	CS	
20	1	HANGER ASS'Y	CS	
19	1	NUT M3 X0.5 PICTH	304SS	
18	1	NUT M5 X0.5 PICTH	304SS	
17	1	WASHER	304SS	
16	1	M3 NUT	304SS	
15	2	CYLINDER HEAD CAP SCREW – KS B 1003 – M4X20	304SS	
14	1	BAR_FIXTURE_B	304SS	
13	1	BAR_FIXTURE_A	304SS	
12	1	DEEP GROOVE BALL BEARING – KS B 2023 – 626 – 6 X 19 X 6	304SS	
11	7	CYLINDER HEAD CAP SCREW – KS B 1003 – M6X35	304SS	
10	1	LOAD CELL		
9	1	ADJUST HOUSING COVER EX	ADC12	
8	7	CYLINDER HEAD CAP SCREW – KS B 1003 M3X25	304SS	
7	1	LOAD CELL SCREW	SUS304	
6	1	LOAD CELL COVER	SUS304	
5	1	LOAD CELL COVER SCREW	SUS304	
4	1	ADJUST FRAME	ADC12	
3	3	O-RING – KS B 2805	FPM	
2	1	DISPLAY_HOUSING	ADC12	
1	2	CP1001	ABS	

Parts List

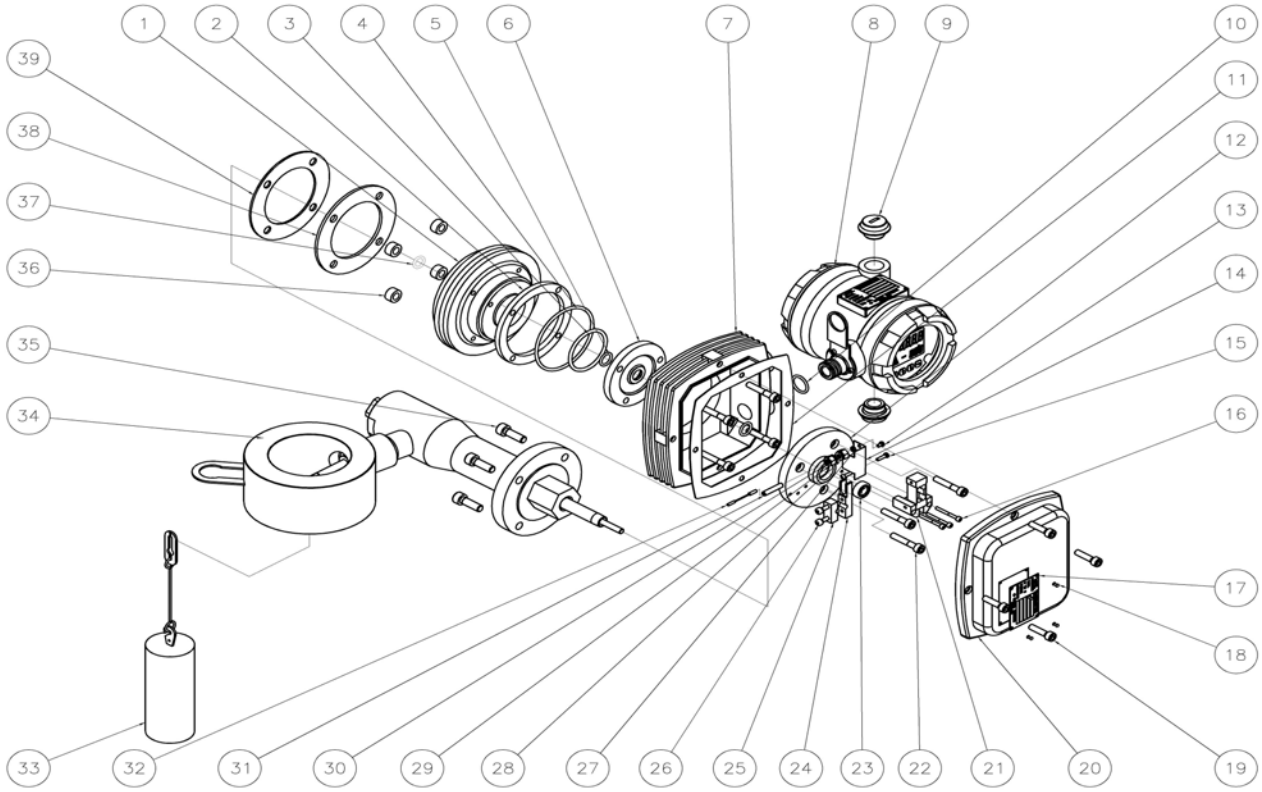
4.2 Torsion Bar Assembly



ITEM	QTY	NAME	MATERIAL	NOTE
11	1	FLANGE	304SS	
10	1	BAR_FIX_NUT	304SS	
9	1	TORSION_BAR	316SS	
8	1	OPERATING_ROD_ASSAY	316SS	
7	1	TORTION_BAR_GUARD	304SS	
6	1	CONNECTOR	304SS	
5	1	TOP_PIECE	304SS	
4	1	POSITION_BRACKET	304SS	
3	1	RANGE_WASHER	304SS	
2	1	IRON_GASKET	SOFT IRON	
1	1	PLUG	304SS	

Parts List

4.3 Overview (Intrinsically Safety Type)



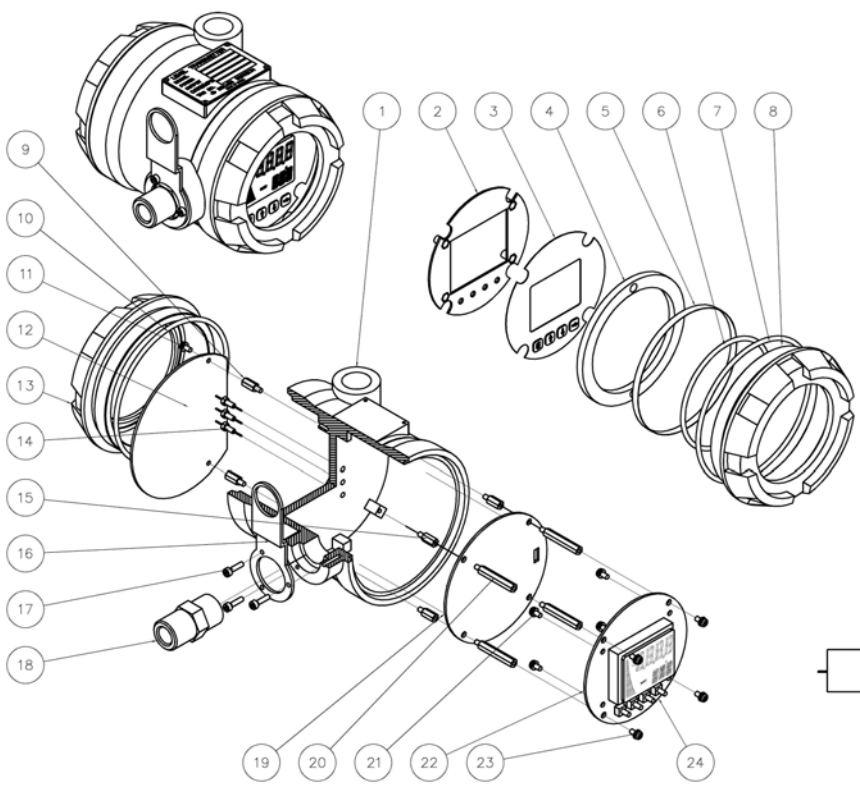
ITEM	QTY	NAME	MATERIAL	NOTE
21	1	LOAD CELL		
20	1	HOUSING COVER	ADC12	
19	4	CYLINDER HEAD CAP SCREW – KS B 1003 – M6X25	304SS	
18	4	SMALL RIVET – KS B 1101 – 2X7	304SS	
17	1	NAME PLATE	304SS	
16	3	CYLINDER HEAD CAP SCREW – KS B 1003 M3X25	304SS	
15	1	LOAD CELL SCREW	SUS304	
14	1	LOAD CELL COVER	SUS304	
13	1	LOAD CELL COVER SCREW	SUS304	
12	1	ADJUST FRAME	ADC12	
11	1	GASKET FIBER	FIBER	
10	3	O–RING – KS B 2805	FPM	
9	2	CP1001	ABS	
8	1	DISPLAY HOUSING	ADC12	
7	1	ADJUST HOUSING	ADC12	
6	1	RESISTOR PLATE	PPS	
5	2	O–RING – KS B 2805	FPM	
4	1	O–RING G75	FPM	
3	1	O–RING P46	FPM	
2	1	RESISTOR RING	PPS	
1	1	RADIATION HOUSING	A6061	

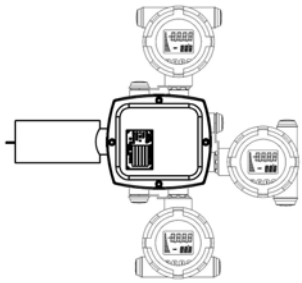
Parts List

ITEM	QTY	NAME	MATERIAL	NOTE
39	1	GASKET	ASBESTOS	
38	1	GASKET PLATE	304SS	
37	1	O–RING – KS B 2805	FPM	
36	4	SUPPORT RING	AL6065	
35	4	CYLINDER HEAD CAP SCREW – KS B 1003 – M8X25	304SS	
34	1	TORTION BAR GUARD	304SS	
33	1	DISPLACER	316SS	
32	1	LOAD CELL HANGER	CS	
31	1	LOAD CELL HANGER GUIDE	CS	
30	1	NUT M3 X0.5 PICTH	304SS	
29	2	NUT M5 X0.5 PICTH	304SS	
28	2	WASHER	304SS	
27	1	M3 NUT	304SS	
26	2	CYLINDER HEAD CAP SCREW – KS B 1003 – M4X20	304SS	
25	1	BAR FIXTURE B	304SS	
24	1	BAR FIXTURE A	304SS	
23	1	DEEP GROOVE BALL BEARING – KS B 2023 – 626 – 6 X 19 X 6	304SS	
22	7	CYLINDER HEAD CAP SCREW – KS B 1003 – M6X35	304SS	

Parts List

4.4 Displayer Assembly





DISPLAYER ORIENTATION

ITEM	NAME	ITEM	NAME
1	DISPLAY HOUSING	13	TERMINAL BLOCK COVER
2	COVER PCB	14	THRU CAPACITOR
3	MASK	15	BASE PCB SUPPORT
4	RETAINING RING	16	DISPLAY BRACKET
5	GLASS WINDOW	17	CYLINDER HEAD SCREW M3
6	STOP RING	18	CONNECTOR
7	O RING	19	MAIN BOARD PCB
8	DISPLAY COVER	20	MAIN PCB SUPPORT
9	TERMINAL BLOCK BOARD SUPPORT	21	DISPLAY PCB BOLT
10	O RING	22	LCD BOARD PCB
11	DISPLAY PCB BOLT	23	MAIN PCB BOLT
12	TERMINAL BLOCK PCB	24	DISPLAY PCB

4.5 Principles of Operation

· The Displacer (Fig3. – ITEM 33)'s buoyancy is transmitted to the Torsion Bar (Fig.2 - ITEM 9) through the Operating Rod Assembly (Fig2. – ITEM 8) then converted to electrical signals by the compressive force or tensile force of the Load Cell connected to the bar fixture. The Wheatstone Bridge Circuit of this load cell is consisted of a thermometer and 4 thin metallic strain gauges. The voltages generated from the Load Cell is converted into 4~20mA output signals of 2 wires by an amplifier device.

4.5.1 Principles of Measuring

· According to the Archimedes' Principle which states that the buoyant force on a submerged object is equal to the fluid displaced, the submerged displacer of which the shape is cylinder is used for measuring the level and the density of a fluid and the interface levels between two different liquids.

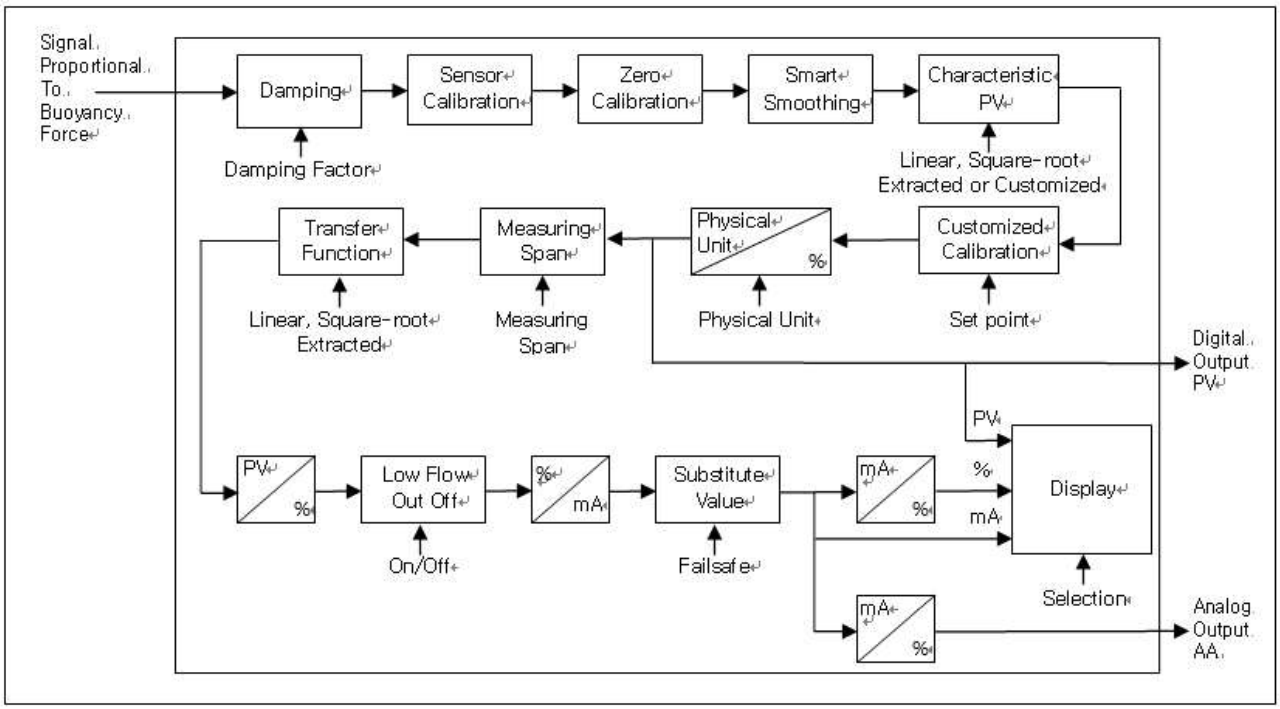
· The buoyancy changes in proportion to the changes of a level and this is converted to measuring values. The displacer needs to be completely submerged for measuring the density or the interface level.

· The following shows the general formula for calculating the buoyancy applied to the displacer.

$$F_A = V_x \times \rho_1 \times g + (V - V_x)\rho_2 \times g \quad \text{---- (FM.1)}$$

F_A : Buoyancy
V : Displacer's total volume
V_x : Volume of the displacer submerged in the fluid of which the density ρ_1
ρ_1 : Average density of the lower fluid
ρ_2 : Average density of the upper fluid
g : Acceleration of gravity

4.5.2 Block Diagram



5. SPECIFICATION

5.1 Model & Range

SDT- 420 / 300 ~ 3,000㎜

5.2 Electric Specifications

Power Supply

- General Operating: 12 ~ 30V(No Load)
- Hart Communication: 17.5 ~ 30V
- Hart LoopResistance: 250 ~ 550Ω (24Vdc)
  = (Supply Voltage - 12Vdc) / (22㎃)
- Update Time: 0.1sec
- Output Signal: 4 ~ 20㎃dc / HART
- Turn-on Time: 5sec

5.3 Performance Specifications

- Reference Accuracy: < 0.5% F.S
- Operation Condition Effects
  Ambient Temperature: -10 ~ 60℃
  Zero < 0.1% / 10K
  Span < 0.07% / 10K
  (0.1*Max Measure Span/Adjusted Measure Span
  ± 0.07* Measure Value/Adjusted Measure Span) % / 10K
  < -1℃ / > 60℃ ..... Twice value
  Humidity Limits: < 99%
  Process Temp. Limit: 450℃
  Long Term Stability: < 0.5% of F.S / 6 Month at 20℃

5.4 Physical Specification

Materials

- Wafer Body : 304SS, A105, 316LSS, LTCS
- Torque Tube : 316LSS, Inconel 600
- Displacer : 304, 316L, PTFE, PTFE with 25% Carbon
- Suspension : 316L
- Amplifier Housing : ADC12 Polyurethane Coated

Marking (Intrinsic Safety 'i')
All units have a rating label, which carries the following important information:
DISPLACEMENT TYPE LEVEL TRANSMITTER
Model : SDT-420
Code : Ex ia IIC T4 IP65
-20℃≤Ta≤+60℃

Type Approval Standards
The unit has EC Type Examination and IECEx certificates issued by INERIS and has been approved to the following standards:

- IEC 60079-0(2007) – Electrical apparatus for potentially explosive atmospheres (General requirements)
- IEC 60079-11(2006) – Electrical apparatus for potentially explosive atmospheres (Intrinsic Safety 'i')
- IEC 60529(1999) – Degree of protection provided by enclosures (IP Code)
- Other Reference Standards : ISO, IEC, EN, DIN, NEMA, etc.

BARRIER PARAMETER : Ui=28V Ii=93mA Li=0.051mH Ci=12.4nF

Marking ATEX (Flameproof Enclosure)
All units have a rating label, which carries the following important information:
DISPLACEMENT TYPE LEVEL TRANSMITTER
Model : SDT-420
Code : Ex d IIC T6 Gb IP65
-20℃≤Ta≤+60℃

Certificate No : IECEx KTL 10.0006
INERIS 11 ATEX 0001

Equipment Group and Category  II2G

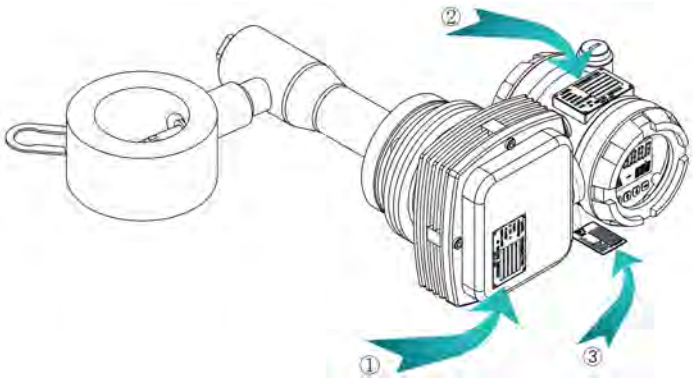
CE Marking
Notified Body No. CE ***

Warnings: DO NOT OPEN WHEN ENERGIZED.
POWER OFF TO INSTALL & UNINSTALL

Type Approval Standards
The unit has EC Type Examination and IECEx certificates issued by INERIS and has been approved to the following standards:
EN60079-0 IEC60079-0 General Requirements
EN60079-1 IEC60079-1 Flameproof Enclosure "d"

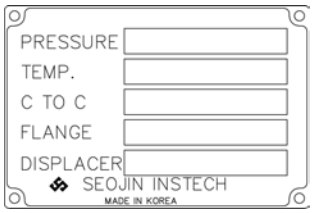
Special Conditions For Safe Use
T6: T° Process : -20℃ to +60℃

6. NAME PLATE

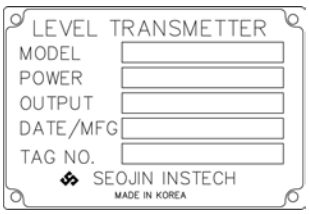


Name Plates are attached on this transmitter; one is attached on ① (The Adjusting Housing), which includes the information about process conditions such as pressure, temperature, C to C, flange rating and the size of displacer. Another is attached on ② (The Displayer), which includes Model No., Input Power, Output signal, the date of manufacture and Tag No. The others are hung on ③ (The Adjusting Housing Connector), which includes power, output, pressure, temperature, C to C, flange rating, size of Displacer, specification & type, certificate number, certificate date, certificate standards, certificate authority, manufacture date, manufacturer.

①



②



OR

OR

Standard Type Intrinsic Safety Type ATEX Explosion Proof Type

③

Explosion Proof Type

7. INSTALLATION

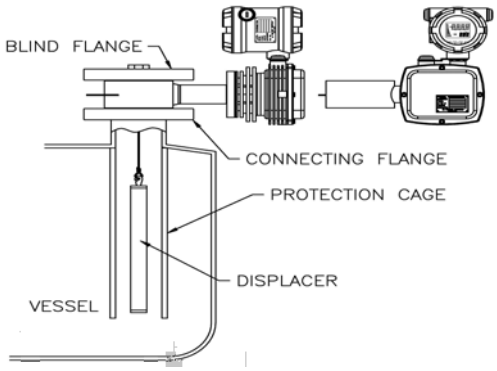
· This transmitter is normally installed directly on top of a vessel or on the side of a vessel using a displacer chamber.
· Before installing, check if the tolerable pressure and the surrounding temperature are appropriate.

7.1 When Applying to a High Temperature Process

· The allowable surrounding temperature should be considered when applying to a high temperature process. For example, when this instrument is applied to the concentrated process that has high thermal capacity (such as saturated vapor of 300 degrees Celsius) or if the Water Assembly is mounted on a heating jacket or a heater of the heat media of which the temperature is more than 300 degrees Celsius, the surrounding temperature of the Adjust Housing and the Displayer should be less than 50 degrees Celsius. In case of exceeding the maximum allowable surrounding temperature(Adjust Housing: 85℃/Displayer: 70℃), all parts that have radiant heat such as Water Assembly, Chamber, Drum and Vessel should be insulated so that the radiant heat would not be transmitted to the Adjust housing and the Displayer. The Adjust housing and the Displayer should not be exposed to the direct sunlight.

7.2 To Install on Top of a Vessel Directly

· As shown in the picture, mount the instrument on top of a vessel using the connection flange.
· If levels fluctuate a lot, a protection cage which has a vent should be prepared.
· The clearance between the protection cage and the displacer should be in 5~10㎜.



7.3 To Install to the External Chamber Mounted on the Side of a Vessel

· The Chamber should be mounted exactly perpendicularly and appropriate bolts & nuts and gaskets should be used.

7.4 Precautions for the Installation on the Side of a Vessel

· Compensation of the density error

In spite of every efforts to keep the temperature, the water or steam kept in the pipe or the chamber which is connected to the side of a vessel tends to be cooled down easily by the influences of the outside temperature, which causes the water or steam in the pipe or the chamber to have comparably higher density than the water or steam preserved in the vessel. As a result of that, the specific gravity of the water or steam in the chamber (pipe) becomes higher and this can bring level differences up to around 150㎜.
This can't be overcome by merely changing the pipe shape or taking measures to keep the temperature, and it will become an obstacle to get accurate level data.

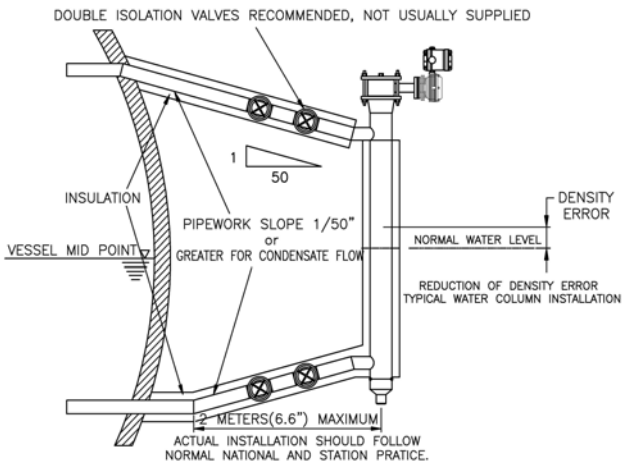


FIG. 8

· In that case, the below explained method can be considered to suppress the density (specific gravity) error within 20㎜.
· As shown in the picture above (Fig. 8), expose the upper branch of the steam pipe to the air in part so that the Latent Heat of Condensation generated by the liquefaction of the steam can be transmitted to the water preserved in the water vessel, and this latent heat of condensation makes the water temperature go up and can minimize the temperature difference, which eventually makes the measurement error minimize. The pipes and lagging materials should be installed to have slopes like the right Fig. 8

7.5 Installation Procedure

7.5.1 Preparation

1) Check the Tag No., specifications and the Displacer Tag No.
2) Check the items listed below.
   ① SENSOR BODY 1SET - Check the Tag No.
   ② DISPLACER 1SET – Check the Tag No., length and so on.
   ③ BLIND FLANGE 1SET – Check the flange rating, size, material and a vent plug.
   ④ GASKET 2PCS – Check the rating, size and material.
   ⑤ STUD BOLT/NUT 4 OR 8SETS - Check the length, material and so on.

7.5.2 Installation

Step 1: To Assemble the Sensor Body on to the Connection Flange
(Refer to Fig.9)
- Put a proper gasket on top of the connection flange.
- Put the torsion bar guard on the connection flange and then insert a stud bolt into the position bracket to secure the safety.
- Insert the stud bolt toward the connection flange from above the position bracket, and assemble with a nut.
- Make sure that enough length of nut thread is engaged to the stud bolt.
- Locate the gasket and the sensor body to be the center of the connection flange.

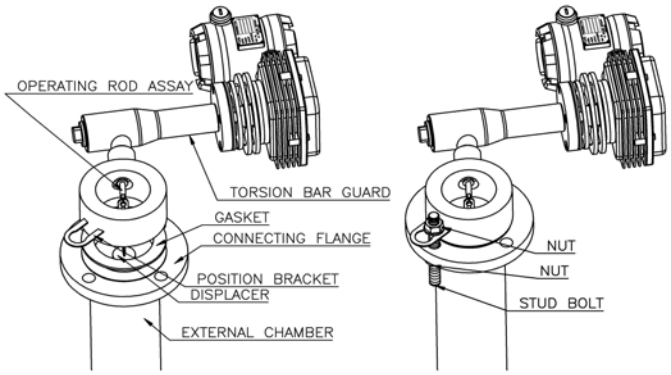


FIG. 9

Step 2: To Assemble the Displacer
(Refer to Fig. 10)
- Put the displacer into a chamber through the space of the operating rod.
- Insert the connector link hook into the groove of the operating rod's hole then rotate the connector link hook to lock (see Fig.10).

⚠ Note
In case of the instrument of which the displacer length is less than 800㎜, assemble the displacer with the operating rod before mounting the connection flange as it is not long enough to pass through the operating rod.

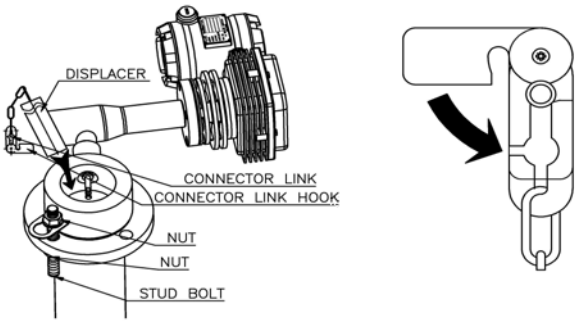


FIG. 10

Step 3: To Assemble the Blind Flange
(Refer to Fig.11)
- Put a gasket on the serrated face of the torsion bar guard.
- Place the blind flange on top of that and position the bolt-holes to those of the connection flange.
- A vent plug should be prepared on the blind flange.

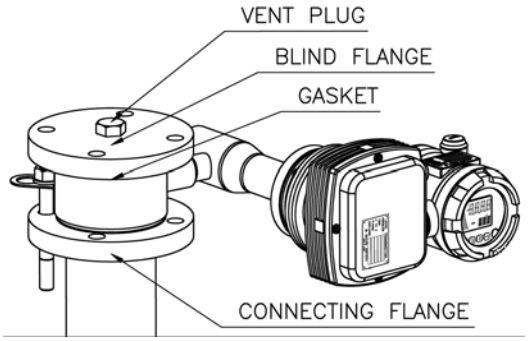


FIG. 11

Step 4: To Fix the Stud Bolt & Nut
(Refer to Fig.12)

· Insert the stud bolts into the bolt holes of the flange and then tighten with the nuts using fingers (do not use a tool).
· Remove the nut fitted to the position bracket and tighten the stud bolts so that the connection flange and the blind flange would be assembled.

· The number of stud bolts depends on the flange size.
· When tightening the stud bolts, tighten them one by one gradually with constant torque in diagonal cross pattern, not tightening at once. Using a torque wrench is recommended.

Appropriate Torque							
Stud Bolt		*M16*	*M20*	*M24*	*M27*	*M30*	*M36*
Torque	*N·m*	*95*	*185*	*310*	*450*	*630*	*1080*
Torque	*kg·cm*	*969*	*1887*	*3162*	*4590*	*6026*	*11016*

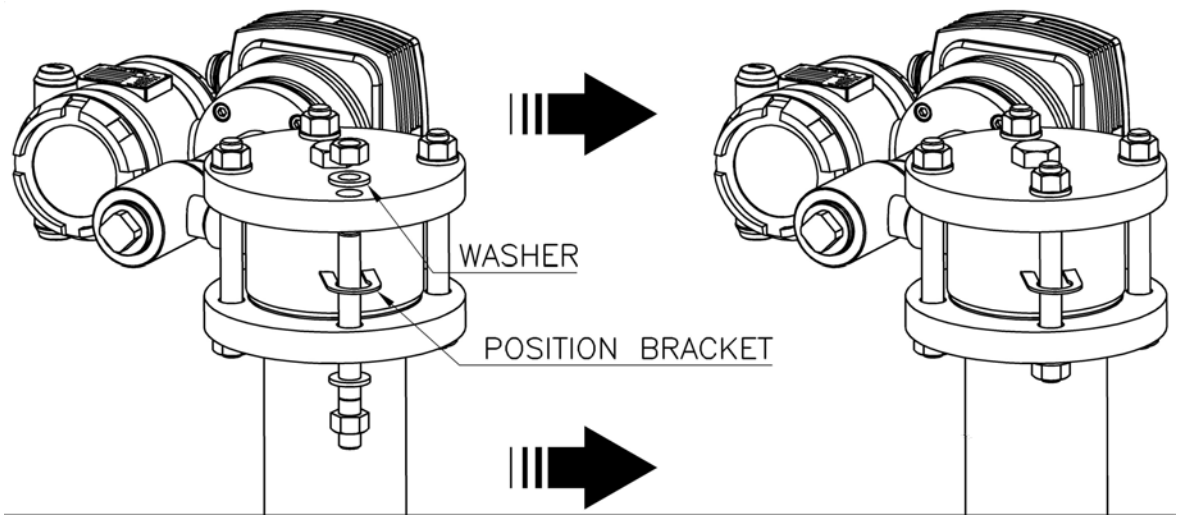


FIG. 12

8. DISPLACER

· Verify if the specification of the displayer is relevant to the displacer. The displayer is calibrated at the factory according to the requested specification before the shipment. Every displacer includes the tag number or the length on it.

8.1 Applying Pressure

· The pressure applied to the displacer should be designed according to the pressure of the pressure vessel when it would be in the highest temperature. The material of displacer depends on the kind of process or the customer's request. The table below shows the standard specification by each measuring range.

Material	316L									
Displacer Length	φ	Vol.	Weight		PN	Φ	Vol.	Weight		PN
L	mm	㎤	N	kgf/㎠	bar	mm	㎤	N	kgf/㎠	bar
mm										
350	60,3	1000	19	1.94	100	42,4	500	18	1.84	250
500	48,3	920	17	1.73	100	42,4	710	24	2.45	250
750	42,4	1060	21	2.14	100	33,7	670	21	2.14	250
1000	33,7	890	17	1.73	100	26,9	570	18	1.84	250
1200	33,7	1070	20	2.04	100	26,9	680	22	2.24	250
1500	26,9	850	16	1.63	100	21,3	540	17	1.73	250
1800	26,9	1020	19	1.94	100	21,3	640	20	2.04	250
2000	26,9	1140	21	2.14	100	21,3	710	22	2.24	250
2500	21,3	890	20	2.04	100	17,2	580	16	1.63	250
3000	21,3	1070	24	2.45	100	17,2	700	23	2.35	250
inch										
14	60,3	1020	20	2.04	100	42,4	510	18	1.84	250
32	42,4	1150	23	2.35	100	33,7	730	23	2.35	250
48	33,7	1090	20	2.04	100	26,9	690	22	2.24	250
60	26,9	870	16	1.63	100	21,3	540	18	1.84	250
72	26,9	1040	19	1.94	100	21,3	650	21	2.14	250
84	26,9	1210	22	2.24	100	21,3	760	23	2.35	250
96	21,3	870	20	2.04	100	17,2	570	16	1.63	250
120	21,3	1090	25	2.55	100	17,2	710	24	2.45	250

9. WIRING

9.1 To Connect the Signal Line (Standard Type)

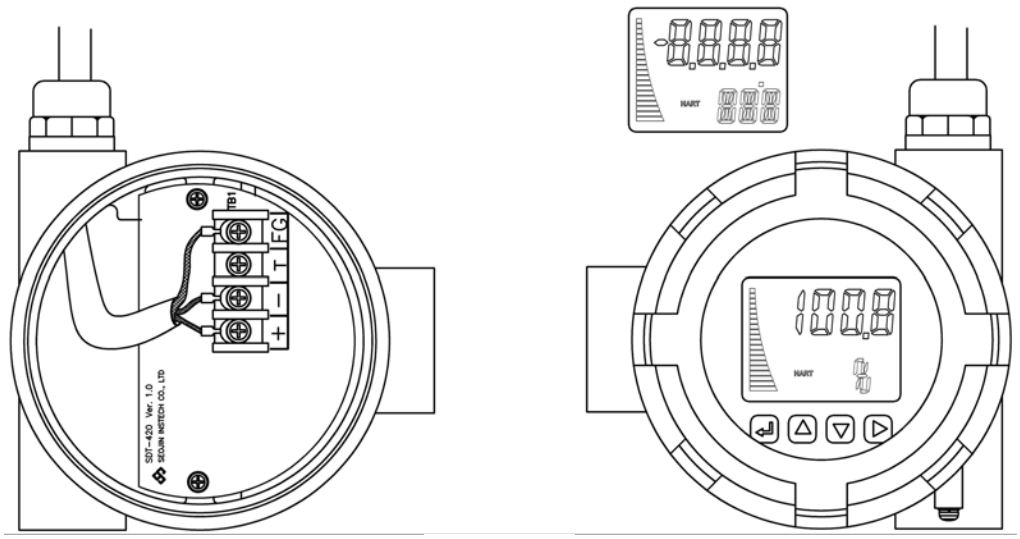
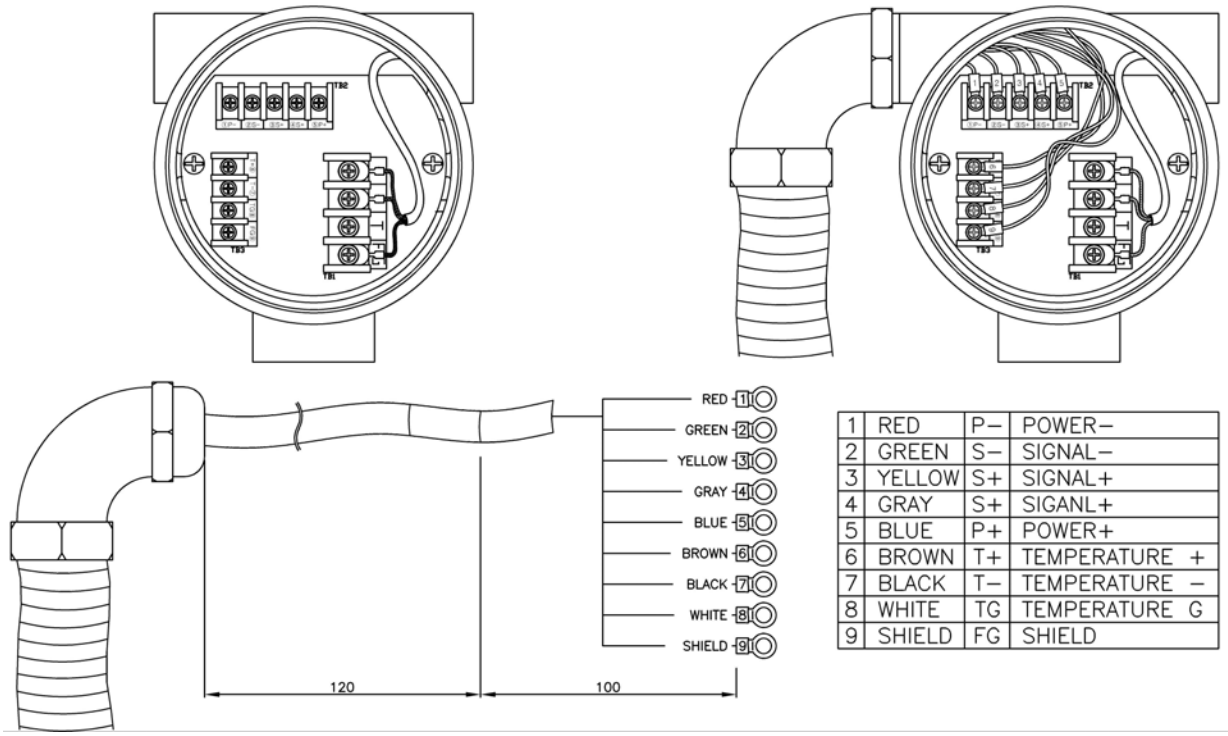


Fig. 13

- Loosen the T.B Cover (Fig.4 – ITEM 13) of the displayer and then insert the line through the cable gland (PG13.5).
- 2-Core Shield Wire should be used for the signal line.
- In case of installation into an explosive area, an Explosion Proof Cable Gland (not supplied) must be used instead of the Standard Cable Gland. For the standard cable gland, PG13.5 can be applied and the thread size can be selected from 1/2NPT, 1/2PF, 1/2PT, and M20 according to a customer's request.

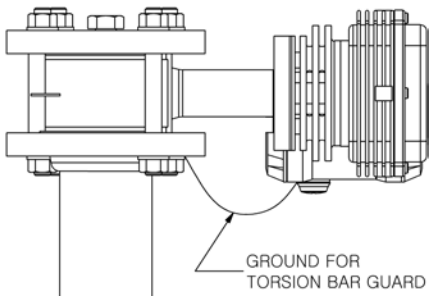
9.1.1 To Connect the Signal Line (Remote Type)

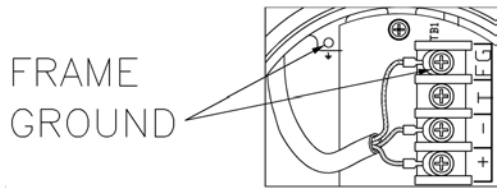


1	RED	P−	POWER−
2	GREEN	S−	SIGNAL−
3	YELLOW	S+	SIGNAL+
4	GRAY	S+	SIGANL+
5	BLUE	P+	POWER+
6	BROWN	T+	TEMPERATURE +
7	BLACK	T−	TEMPERATURE −
8	WHITE	TG	TEMPERATURE G
9	SHIELD	FG	SHIELD

9.2 Grounding

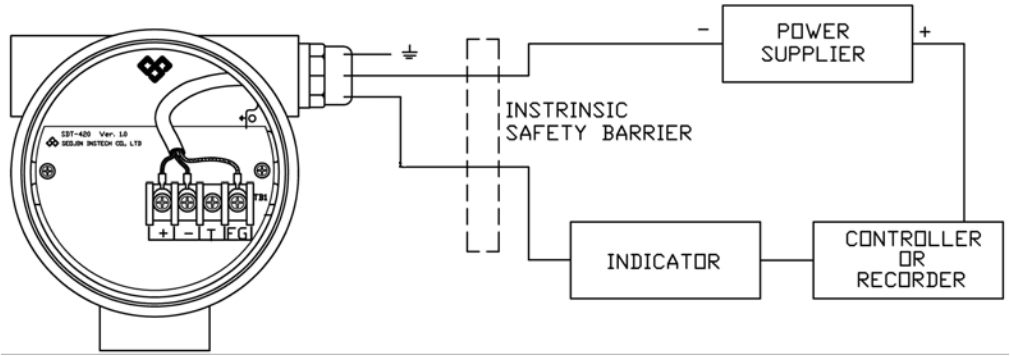
· The instrument should be connected to a ground terminal when there is any concern of influence by electromagnetic waves or noises, or electromagnetic fields.
· Even if a non-conductivity gasket is used, the ground connection must be done between the connection flange and the torsion bar guard.





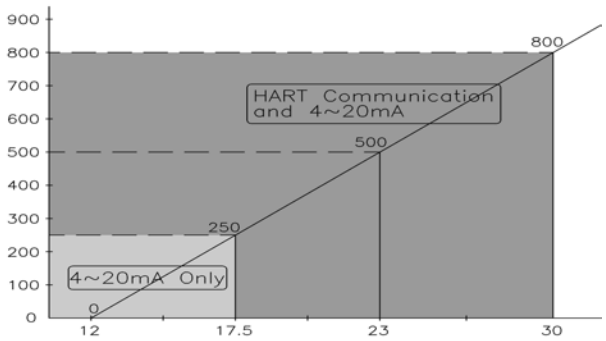
· The displayer is designed to protect itself against reverse polarity.
· Using a Twisted Pair Cable (22AWG min) is recommended to maintain the best performance.
· Installing the displayer near an alternating-current power supply or switching system should be avoided.
· The ground of the instrument should be connected to the surface of the earth.
· In case of a Shield Cable, the shield should be grounded at the power supply ground only.

9.3 Wiring Diagram



⚠ Notes

· The cable impedance is defined to the maximum length possible to do the digital communication, however using low impedance's cable is recommended. For example, the maximum connection length between two points of 250Ω Load and the Single Twisted Cable 22AWG-207 pf/m is approximately 1000m.



· Provided that the maximum connection length of the analog signal is restricted by the loads of current loop (the cables and instrument connected).

. To obtain the 4/20mA output signal, the lowest supply voltage should be determined as a function related to the load relation. The related formula is as follow.

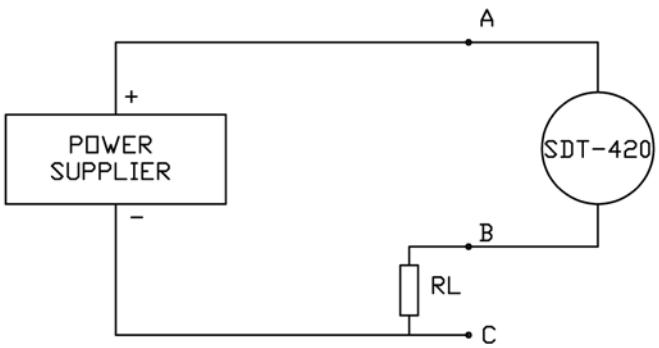
$$\text{Supply Voltage} = 22\text{mA} \times R + 12\text{VDC} \quad \text{----} \quad \text{(FM2)}$$

Additional Information

· At least 250Ω should be loaded on the loop for HART communication.
· In case of multi-drop connection, the load to the resistance is equal to 4mA x N (the number of instruments connected).
· Sufficient power should be supplied.
(Supply Voltage = 250 x N * 22mA+12Volt)

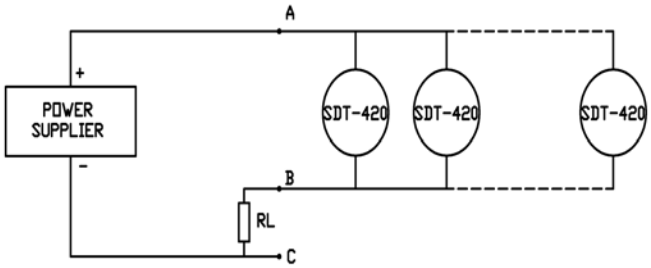
9.3.1 To Connect SDT-420 Directly to Power Supplier (Point to Point Connection)

· RL= Min. 250Ω
· Possible to do the digital communication and output the analog signal between 4 and 20mA
· If a Digital Communicator (HTT, SIEMENS, PDM, AMS FIMS, etc) is connected or the measuring range of 4~20mA is converted from the voltages (using a recorder), the measurement can be performed by connecting A and B, or B and C.



9.3.2 To Connect Plural SDT-420s to One Power Supplier (Multidrop Connection)

· RL= Min. 250Ω
· The power consumption of each transmitter is fixed to 4mA and the digital communication only is possible.
· If a Digital Communicator (HTT, SIEMENS, PDM, AMS FIMS, etc) is connected, the measurement can be performed by connecting A and B, or B and C, provided that the digital signal only can be used for the measurement.



10. CONFIGURATION

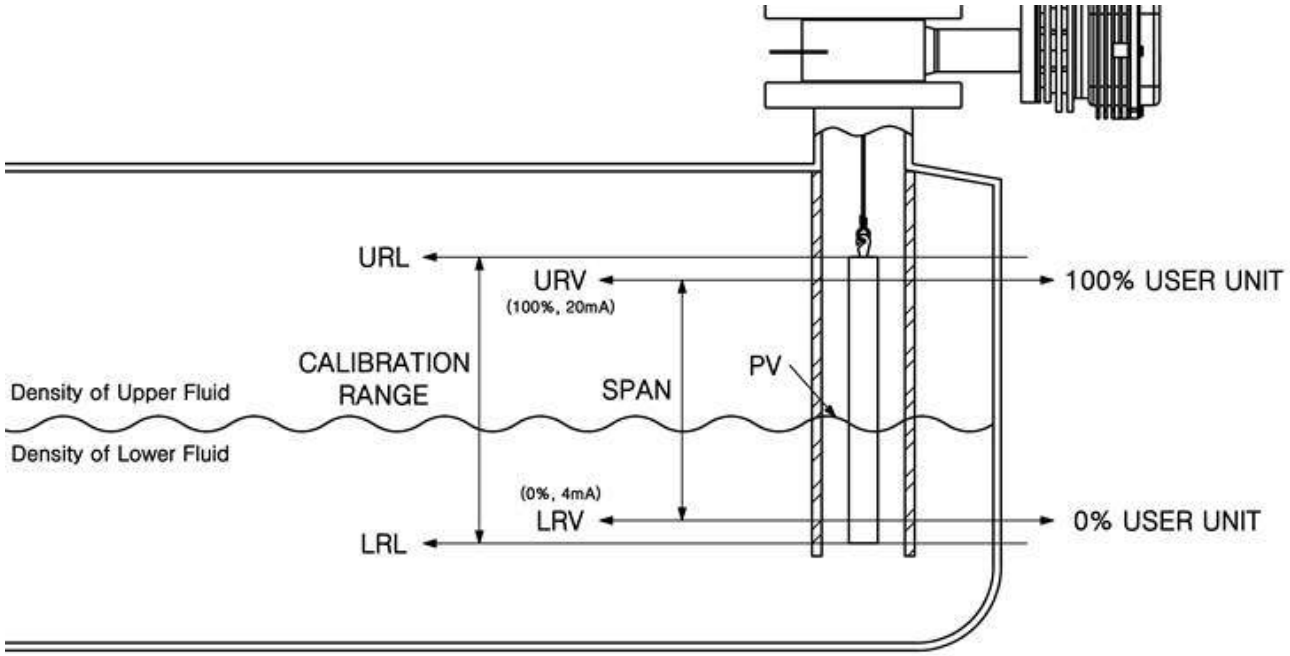
⚠ Notes

· Two valid data can be transmitted in one second by the digital communication and this should be considered if the configuration is being performed during the operation.
· The factors altered and saved at a close range or even remotely are written to the EPROM and the data can be damaged if the power is shut off during writing the data to the EPROM. Therefore, be sure that the power supply is working appropriately and in a stable status in order not to cause any trouble during data communication.

※ This is an installation guide for the Point to Point configuration.
To install and operate SDT-420 properly, the calibration should be performed with appropriate variables according to the installed environment. Some of these variables should be checked and inputted by a user at the field, whereas some of them would be inputted at the factory before shipment. SDT-420 supports three different ways of variable editing as explained below.

① Local Configuration & Calibration: By means of the keypad on the display mask of the displayer.
② Remote Configuration & Calibration: By means of the SIEMENS PDM Computer Program.
③ HART Communicator Configuration & Calibration: By means of the HART Program.

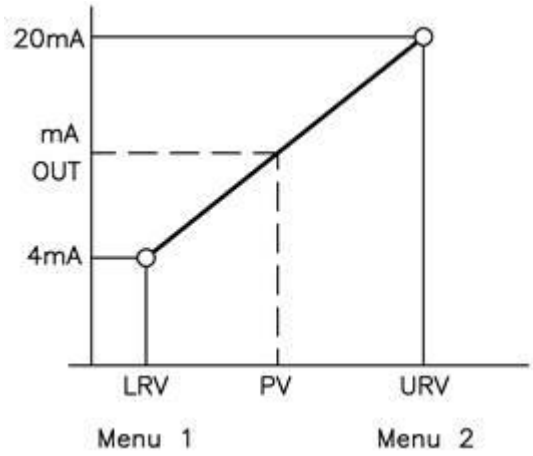
10.1 Configuration Terms



HART	Highway Addressable Remote Transducer
PV(Primary Variable)	Primary measure variable with the 4/20mA output The level value that is being measured
USL(Upper Sensor Limit)	Maximum measurable value of sensor
LSL(Lower Sensor Limit)	Minimum measurable value of sensor
Calibration Range	Measuring range between USL and LSL
URV	Highest output value of the calibrated range
LRV	Lowest output value of the calibrated range
Span	URV ~ LRV
Minimum Span	(USL - LSL) / 8
Primary Master	Typically a Computer, RS-232- HART, ex(SIMATIC PDM)
Second Master	Typically a HHT(Hand Held Terminal)-375

10.2 Configuration Value Output

10.2.1 Principle of Configuration Value Output



$$\text{mA OUT} = \left(\frac{PV - LRV}{URV - LRV}\right) \times 16mA + 4mA$$

$$\% = \left(\frac{PV - LRV}{URV - LRV}\right) \times 100$$

10.2.2 Principle of User Unit Configuration Value Output

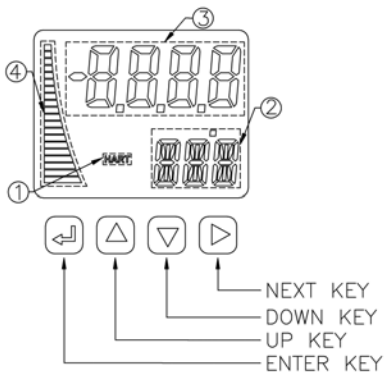
[MENU12] [0%] USER UNIT = User LRV

[MENU13] [100%] USER UNIT = User URV

$$\text{USER UNIT Value} = \text{Measured\%} \frac{(\text{USER URV} - \text{USER LRV})}{100} + \text{USER LRV}$$

10.3 Local Configuration

· Open the displayer cover by twisting it, then you can access to the Mask. For the descriptions of each part, see right figure



10.3.1 Display Layout

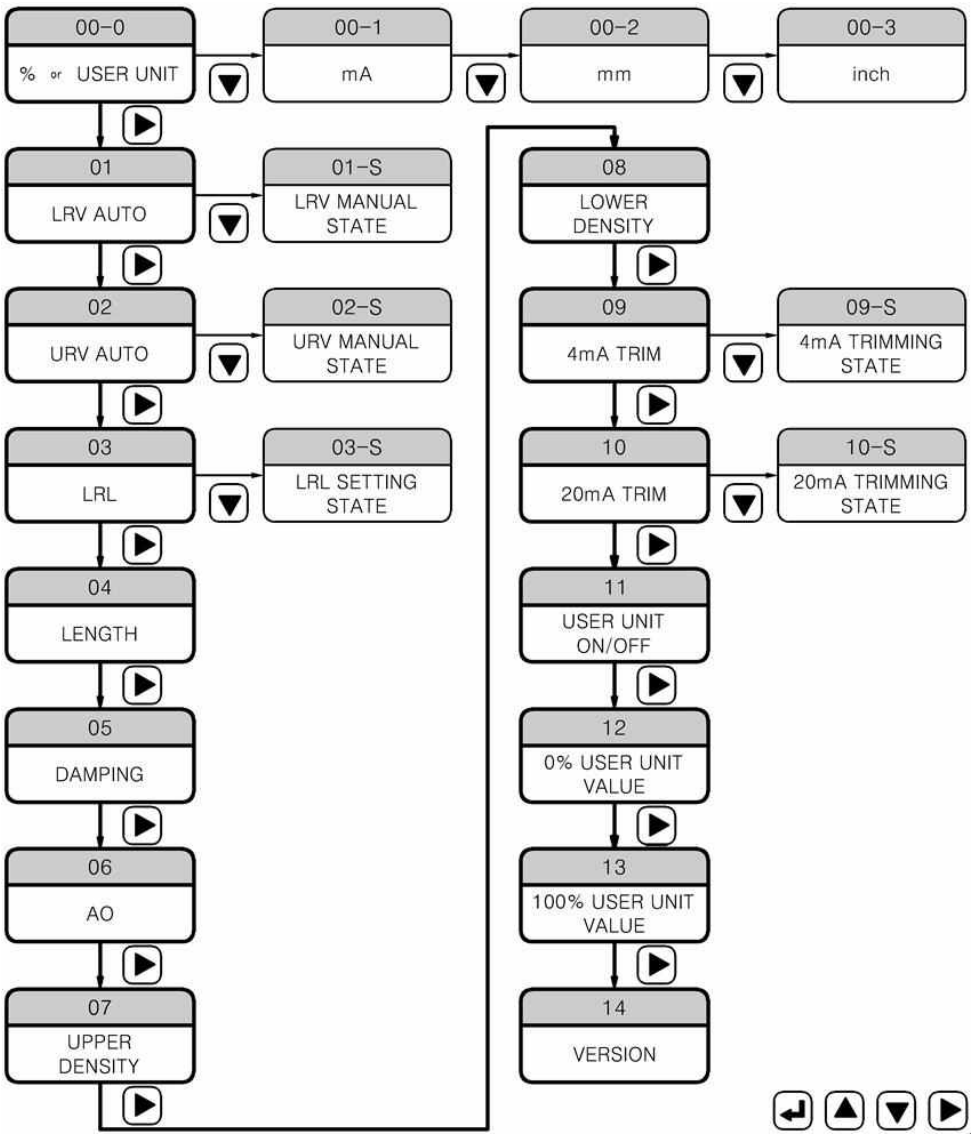
① PV Section: Show numeric information up to 4 digits.
② Mode Section: Show the current mode.
③ Hart Section: Light on when the HART communication is connected.
④ Bar Graph Section: The current level is shown in a bar graph.

10.3.2 Keypad

: Enter Key	Save the current settings or changes.
: Up Key	Increase values or switch the state.
: Down Key	Decrease values or switch the state.
: Next Key	Switch the program mode.

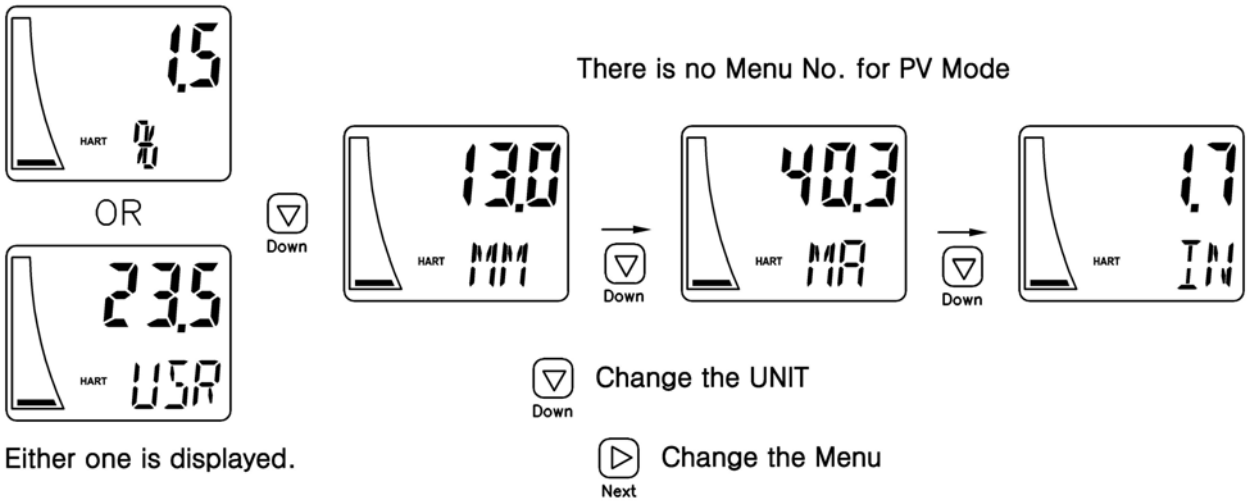
10.4 Menu Map

The numeric information on the upper part of the boxes below shows the current menu which is displayed on the Menu section and the current mode or menu can be switched by pushing the button shown left or below the box.
"M" is being displayed on the Mode section during storing the changed settings.



10.5 Menu Configuration

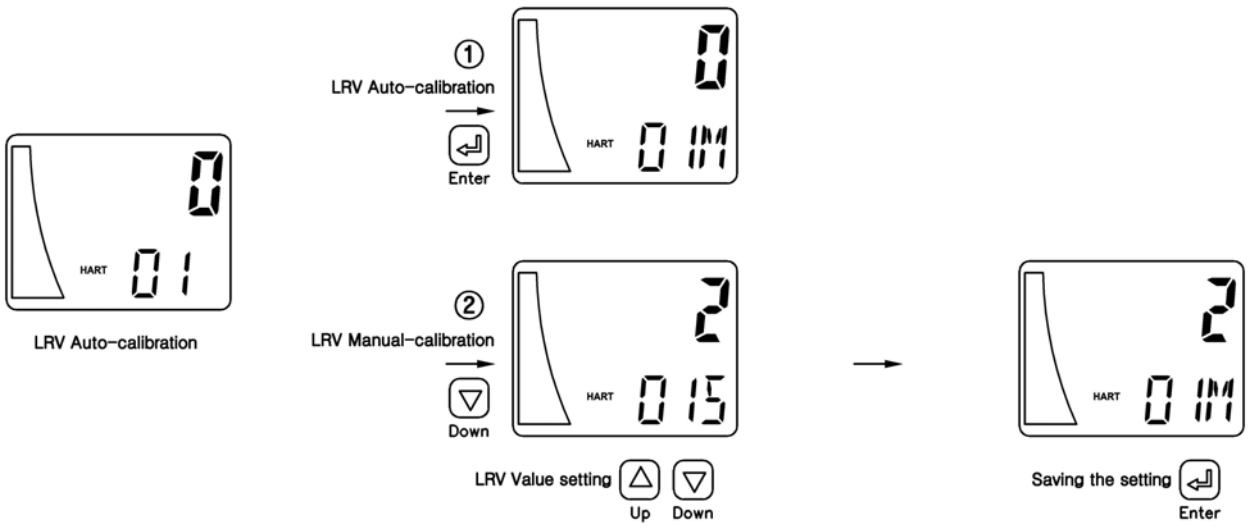
10.5.1 Present Variable Display Mode (PV)



* PV that is being measured currently can be displayed in various units.

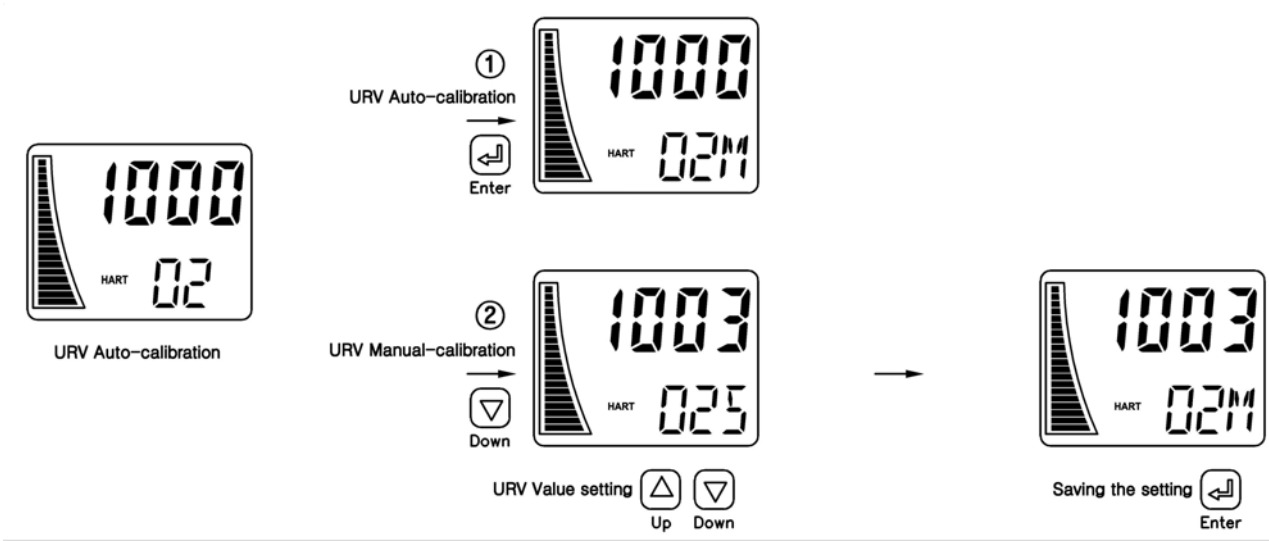
- % : *Percentage Value of SPAN (URV-LRV)*
- USER UNIT : *Ratio Value of USER UNIT*
- mA : *Analog Output (4 ~ 20 mA)*
- mm : *LRL in mm*
- inch : *LRL in inch*

10.5.2 LRV Calibration Mode (0% Zero Percentage)



- Menu 01 : LRV Auto Calibration
  · Fill the medium to a tank until the level corresponds to the LRV.
  · Save the calibration values by pressing the Enter key.
  · The level of the actual medium is saved as LRV.
- Menu 01-S : LRV Manual Calibration
  · Go to ManualStatebypressingtheDown Key.
  · Input the length (㎜) from LRL to LRV using the Up / Down Keys.
  · Save the calibration setting by pressing the Enter Key.

10.5.3 URV Calibration Mode (100% Hundred Percentage)



- Menu 02 : URV Auto Calibration Mode
  · Fill the medium to a tank until the level corresponds to the URV.
  · Save the calibration value by pressing the Enter Key.
  · The current level of the medium is saved as URV.

- Menu 02-S : URVManualCalibrationState
  · Go to the Manual state by the Down Key
  · Set the length between LRL and URV in millimeter using Up and Down Keys.
  · Save the calibration values by pressing the Enter Key.

10.5.4 LRL Auto Calibration Mode (ZERO)

- Menu 03 : LRL Auto Calibration Mode
  · LRL Calibration Setting Protection Mode

- Menu 03-S : LRL Auto Calibration State
  · Go to the Setting state (03-S) by pressing the Down Key.
  · Fill the medium to a tank till the level corresponds to the LRL.
  · Save the calibration values by pressing the Enter Key.

10.5.5 Length Calibration Mode

- Menu 04 : Length Calibration Mode

· Measure the actual length (㎜) from the LRL to the current level.

· Adjust the length (㎜) shown on the LCD using the Up / Down Keys so that it becomes the same as the actual length (㎜).

· Save the setting by pressing the Enter Key.

10.5.6 Damping Setting Mode

- Menu 05: Damping Setting Mode

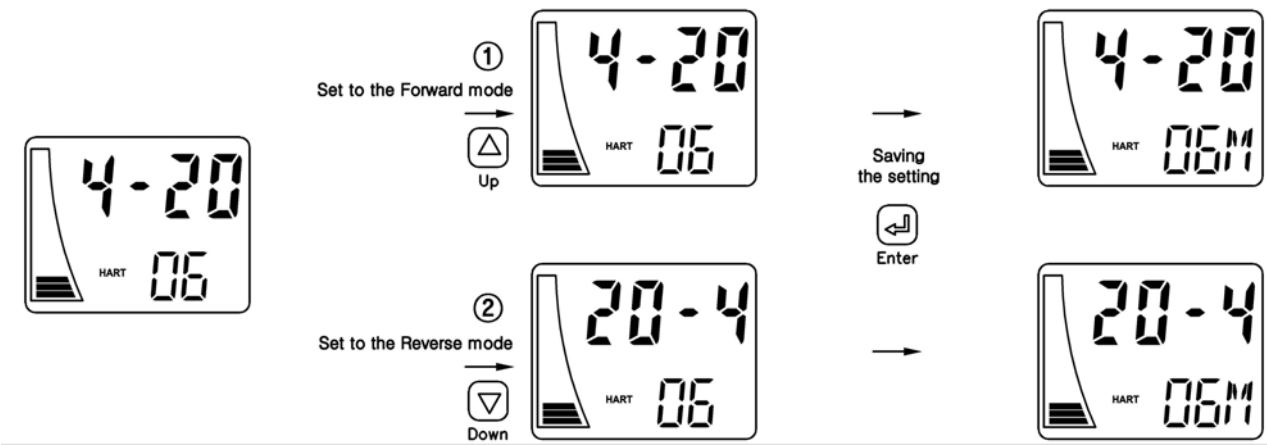
· Set the Damping Time using the Up / Down Keys.

· Save the value by pressing the Enter Key.

· The maximum Damping Time can be set is 30 sec.

10.5.7 Analog Output Setting Mode

- Menu 06 : Analog Output Setting Mode



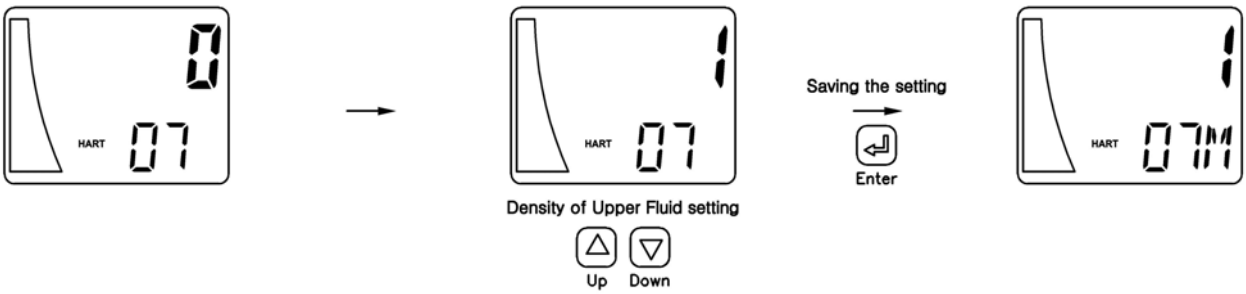
* Forward Mode : 0% (4㎃) ~ 100% (20㎃)

* Reverse Mode : 0% (20㎃) ~ 100% (4㎃)

· Set the Analog output mode by the Up and Down Keys and then save the changes by pressing the Enter key.

10.5.8 Density of the Upper Fluid Setting Mode

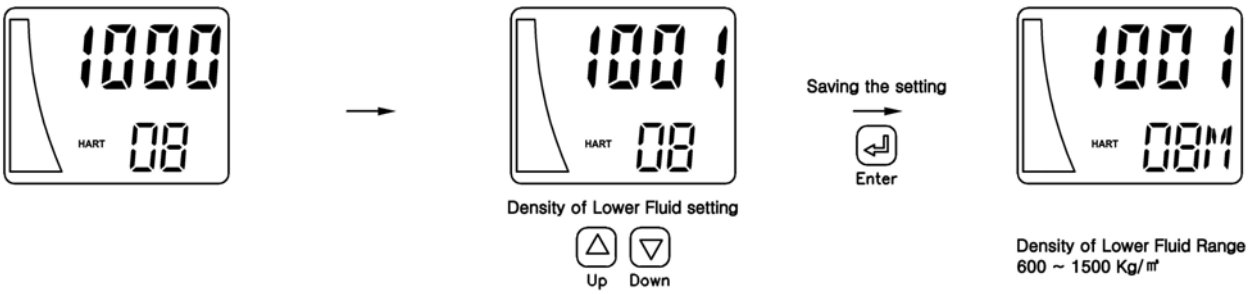
- Menu 07 : Density of the Upper Fluid Setting Mode



· Set the Density of the Upper Fluid using the Up and Down keys.
· Save the changes by pressing the Enter Key.

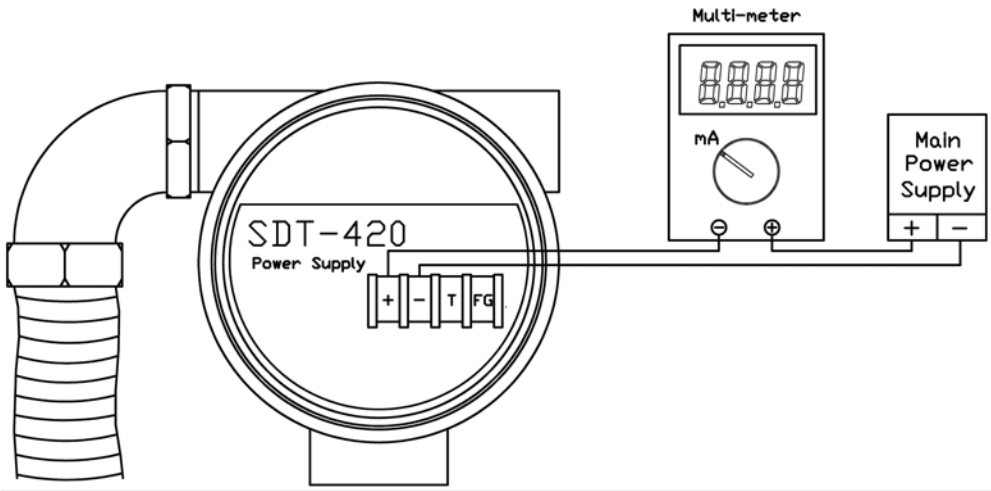
10.5.9 Density of the Lower Fluid Setting Mode

- Menu 08 : Density of the Lower Fluid Setting Mode



· Set the Density of the Lower Fluid using the Up and Down Keys.
· Save the setting by pressing the Enter key.
Density of the Lower Fluid : 600 ~ 1500 kg/㎥

Trim Ready Mode



10.5.10 4mA Trim Mode

- Menu 09 : 4mA Trim Ready Mode
  · Analog Output according to SPAN (4mA Trim Protection Mode)

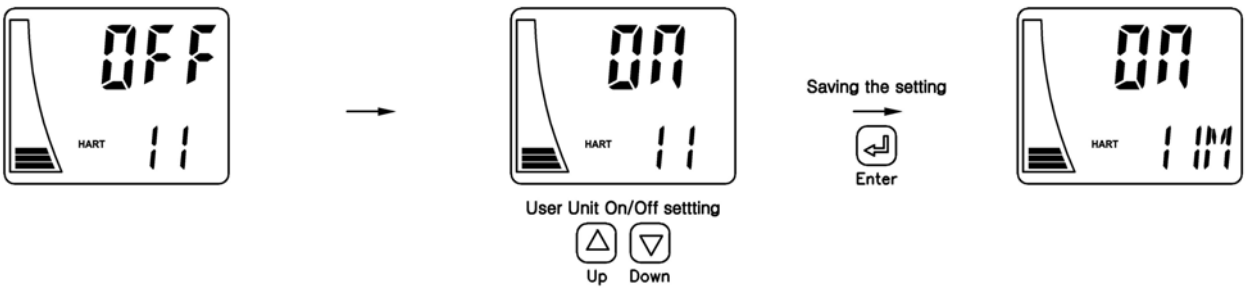
- Menu 09-S : 4mA Trimming State
  · Go to TrimmingState(09-S)bypressingtheDownKey.
  · Set the current output to be exactly 4mA using the Up and Down Keys.
  · Save the trimming value by pressing the Enter Key.

10.5.11 20mA Trim Mode

- Menu 10 : 20mA Trim Ready Mode
  · Analog Output according to SPAN (20mA Trim Protection Mode)

- Menu 10-S : 20mA Trimming State
  · Go to Trimming State(10-S) using the Down key.
  · Set the current output to be exactly 20mA using the Up and Down Keys.
  · Save the trimming value by pressing the Enter Key.

10.5.12 User Unit ON/OFF Mode



- Menu 11 : User Unit ON/OFF Mode
  · Set the User Unit Display to either ON or OFF using the Up or Down Keys.
  · Save the changes by pressing the Enter key.

  * When the User Unit was set to ON, the figures are shown in [USER UNIT] instead of [%] on the main display.

10.5.13 0% User Unit Value Setting Mode

- Menu 12 : 0% User Unit Value Setting Mode

· Input the value that will be displayed when the output is 4mA (0%).
· Save the value by pressing the Enter Key.
* When the output is 4mA (0%), this value (User Unit) will be displayed.

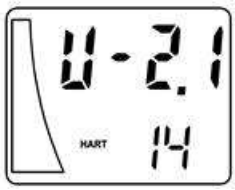
10.5.14 100% User Unit Value Setting Mode

- Menu 13 : 100% User Unit Value Setting Mode

· Input the value that will be displayed when the output is 20mA (100%).
· Save the value by pressing the Enter Key.
* When the output is 20mA (100%), this value (in User Unit) will be displayed.

10.5.15 Version View Mode

- Menu 14 : Version View Mode



* Current Version Display *
SW Version will be displayed.

10.6 Water Calibration Procedures

· The default unit for all factors in this program is millimeter so the figures displayed on the LCD are the converted ones from the figures in millimeter.

- Pre-checking

· Go to Menu 08 - 10.3.9 [Density of the Lower Fluid Setting Mode] and check if the low density is set to 1000 which is water density.
· If the density is set to the process condition, adjust the setting value using the Up / Down Keys.
· Checking of the low density setting is very important as this affects to the instrument accuracy a lot.
· For example, if the calibration is conducted with Water (Density: 1000kg/㎥ and if the low density is set to 900, it will cause 10% errors.
· Be sure that the unit of setting values of this procedure is millimeter.
· Check if the installation and wiring have been done according to 7.5 [Installation Procedure] and 9. [Wiring].

1. Zero Span (0%) Setting
   1) Fill water into the chamber or the tank till the 0% level.
   2) Go to Menu 03 and set the value according to 10.3.4 [LRL Auto Calibration Mode] in this manual.
   3) Go to Menu 01 to see if the value is set to "0", and if not, change it to "0".
   4) Now the instrument will output 4㎃ when the level is 0mm. If the value would be set to 10 at Menu 01, the instrument will output 4㎃ when the level is 10mm.

2. Full Span (100%) Setting
   1) Fill water into the chamber or the tank till the full span (100%) of the measuring range.
   2) Go to Menu 04 and set the value according to 10.3.5 [Length Calibration Mode] in this manual. (The setting procedures must be finalized with the Enter Key to save the changes.)
   Ex.1) If the actual length from 0% to 100% is 2345㎜ and if the LCD PV Window shows '2300', then increase this value to 2345 using the Up Key. Finalize the setting procedures by pushing the Enter key. In this example, 2345 will be the absolute standard value.

> ⚠ CAUTION ⚠
> *Menu 04 should be adjusted only during calibration procedure.*
> *Adjusting during the normal operation will cause the change of the Span Gain.*

   3) Go to Menu 02 and set the value according to 10.3.3 [URV Calibration Mode] in this manual.
   In the example above, the value should be set to 2345 so that the instrument outputs 20㎃ when the water level is 2345㎜. If the value would be set to 2000, then the LCD PV Window shows 20㎃ when the water level is 2000. This means that [㎃] only is changed without changing [㎜]. This setting can adjust [㎃] output by applying a random number using the URV Manual Calibration function during the operation on demand.

3. Calibration Verification
   To see if the calibration has been done appropriately, change the water level in order of 0%, 20%, 40%, 60%, 80%, 100%, 80%, 60%, 40%, 20%, 0%, and check the outputs and the measuring values.

4. After completing all the procedures, change the Density of Menu 08 to the current process' density.

10.7 Interface Measurement Calibration Procedures

· The default unit for all factors in this program is millimeter so the figures displayed on the LCD are the converted ones from the figures in millimeter.

- Pre-checking

· As shown in the picture below, Displacer be should submerged in M1, M2.

> ⚠ CAUTION ⚠
> If it is exposed to the M3 on the displacer, It dose not measure the testing by forming two interface on it.

· Go to Menu 07 -10.3.8 [Density of the Upper Fluid Setting Mode] and check the density value of M2.
· Go to Menu 08 - 10.3.9 [Density of the Lower Fluid Setting Mode] and check the density value of M1.
· Example measurement (M1: Water, M2: Oil, M3: Gas or Air)

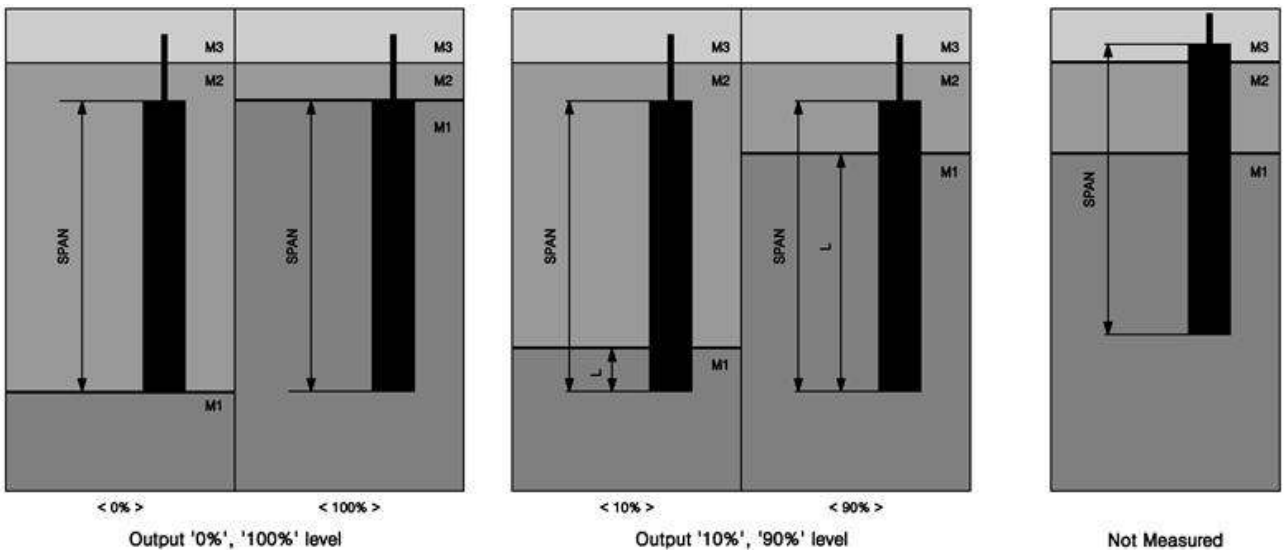


FIG. 22

1. Zero Span (0%) Setting
   1) Submerge Displacer completely in the M2(Object to be measured)
   2) Fill the M1(Measurement) in the chamber or the tank till the 0% level.
   3) Go to Menu 03 and set the value according to 10.3.4 [LRL Auto Calibration Mode] in this manual.
   4) Go to Menu 01 to see if the value is set to "0", and if not, change it to "0"
   5) This mean the instrument output 4mA when the level is 0mm. If the value would be set to 10 at Menu 01, the instrument will output 4mA when the level is 10㎜.

2. Full Span (100%) Setting
   1) Fill M1(Measurement) into the chamber or the tank till the span (100%) of the measuring range.
   2) Go to Menu 04 and set the value according to 10.3.5 [Length Calibration Mode] in this manual.
   3) Go to Menu 02 and set the value according to 10.3.4 [LRL Auto Calibration Mode] in this manual.

> ⚠ CAUTION ⚠
> Should set using Enter Key

3. Calibration Verification
   To see if the calibration has been done appropriately, change the water level in order of 0%, 20%, 40%, 60%, 80%, 100%, 80%, 60%, 40%, 20%, 0%, and check the outputs and the measuring values.

11. TROUBLE-SHOOTING

Symptom	*Check Point*
The signal output indicates Zero	*Check the polarity if it is in the right direction.* *Check the Power line.* *Check the Power voltage.*
Communication Error	*Check the Load resistance.* *Check the Power line.* *Check the master connection.* *Perform a polling.*
The signal output is beyond 22mA or below than 3.8㎃.	*Check the PV reading.* *Check if the applied PV is in the measuring range.* *Check if the applied PV is in the nominal sensor range.* *Check the displacer placement.*
The signal output doesn't change at all.	*Check if it is the Fixed current mode.* *Check the displacer placement.*
Erratic reading for PV(Hunting)	*Check the displacer placement.* *Check the damping time.*
Transmitter is turned off when the current output rises.	*Check the power supply / Load relation.*
The signal output doesn't correspond to PV.	*Perform a D/A trim.*
PV Zero is not correct	*Check displacer placement.* *Perform PV zero setting.*

11.1 Troubleshooting for leakage of Flange connection part & Gasket assembly part

· When occur and detect leakage in the chamber flange connection part & Gasket assembly part, process in accordance with the following.

· Once, process in accordance with the following after close shut-off valve with chamber and understand process condition.

1. In the case of the High-temperature, high- pressure
   - If chamber is pressured, process in accordance with the following for tightening the bolt is inefficient.
   ① Cool chamber in the air to below 100℃.
   ② Vent valve or vent plug open slowly and lower pressure in the chamber to atmospheric pressure after cool down the chamber enough.
   ③ Tighten assembly part to appropriate torque with suitable spanner again.
   If assembly part tightened to appropriate torque, process the below ⑥ for reconsider gasket fault or finished flange surface.
   ④ Open slowly shut-off valve on top assembly-part of chamber for leakage-part detection after verify tightening of all of assembly part. If leakage still detected, process the below ⑥.
   ⑤ If you any problems, open slowly shut-off valve on bottom assembly-part of chamber.
   ⑥ If leakage still detected, after repeat ① & ②, process you should inspect gasket & flange surface after disassemble assembly-part.
   ⑦ Use the lubricant to remove foreign matter (graphite and so on) for inspect finished flange surface. If finished surface damaged, contact seojin-instech for re-manufacturing.
2. In the case of condensing gas or explosive matter
   - Process in accordance with the following after remove source of ignition from the instrument.
   ① Remove all of contents in the chamber through vent, drain valve and pip line for remove pressure in the chamber.
   ② Follow sequence over 1. - ③~⑦.

· When you replace the gasket, you should follow flange fabrication procedure as shown at the below.
- Passages shown at the below are quoted by LANL Engineering Standards Manual OST220-03-01-ESM Section D20, ASME B31.3 Piping Guide - Appendix E.

1. Table 7 provides the maximum allowable torque values for common bolt materials. These torque values shall not be exceeded. The torque values listed in Table 7 result in a

preload stress of 90% of the ASME B31.3 Specified Minimum Yield Strength.

	Torque		(ft·lbs) (kg·m)			Torque		(ft·lbs) (kg·m)	
Bolt Size	A307	B8 c1.1	B8 c1.2	B7	Bolt Size	A307	B8 c1.1	B8 c1.2	B7
½	34	29	95	100	1¼	585	490	1060	1715
	4.7	4.01	13.13	13.83		80.88	67.74	146.55	237.11
⅝	69	57	190	200	1⅜	770	640	1070	2250
	9.54	7.88	26.27	27.65		106.46	88.48	147.93	311.07
¾	120	100	335	355	1½	1020	850	1420	2985
	16.59	13.83	46.32	49.08		141.02	117.52	196.32	412.69
⅞	195	160	435	570	1⅝	1475	1230	-	4305
	26.96	22.12	60.14	78.81		203.93	170.05		595.19
1	295	245	650	295	1¾	1615	1345	-	4710
	40.78	33.87	89.87	118.21		223.28	185.95		651.18
1⅛	415	345	750	415	1⅞	2300	1915	-	6710
	57.38	47.7	103.69	167.98		317.99	264.76		927.69

TABLE 7- Maximum Allowable Torque Values

2. The pattern in which bolts are tightened is extremely important. If performed improperly tightening can cause the flange to move out of parallel. A staggered crisscross-torquing pattern, shown in the following figure 23, must be used to tighten the bolts. No more than one third of the final torque should be achieved during a first step.

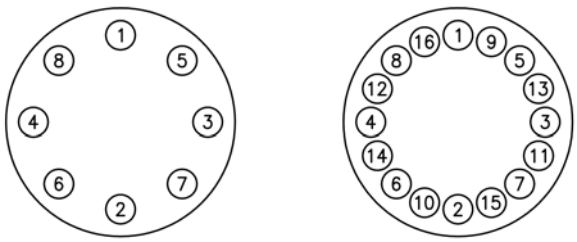


FIG.23 – Typical Torquing Sequence

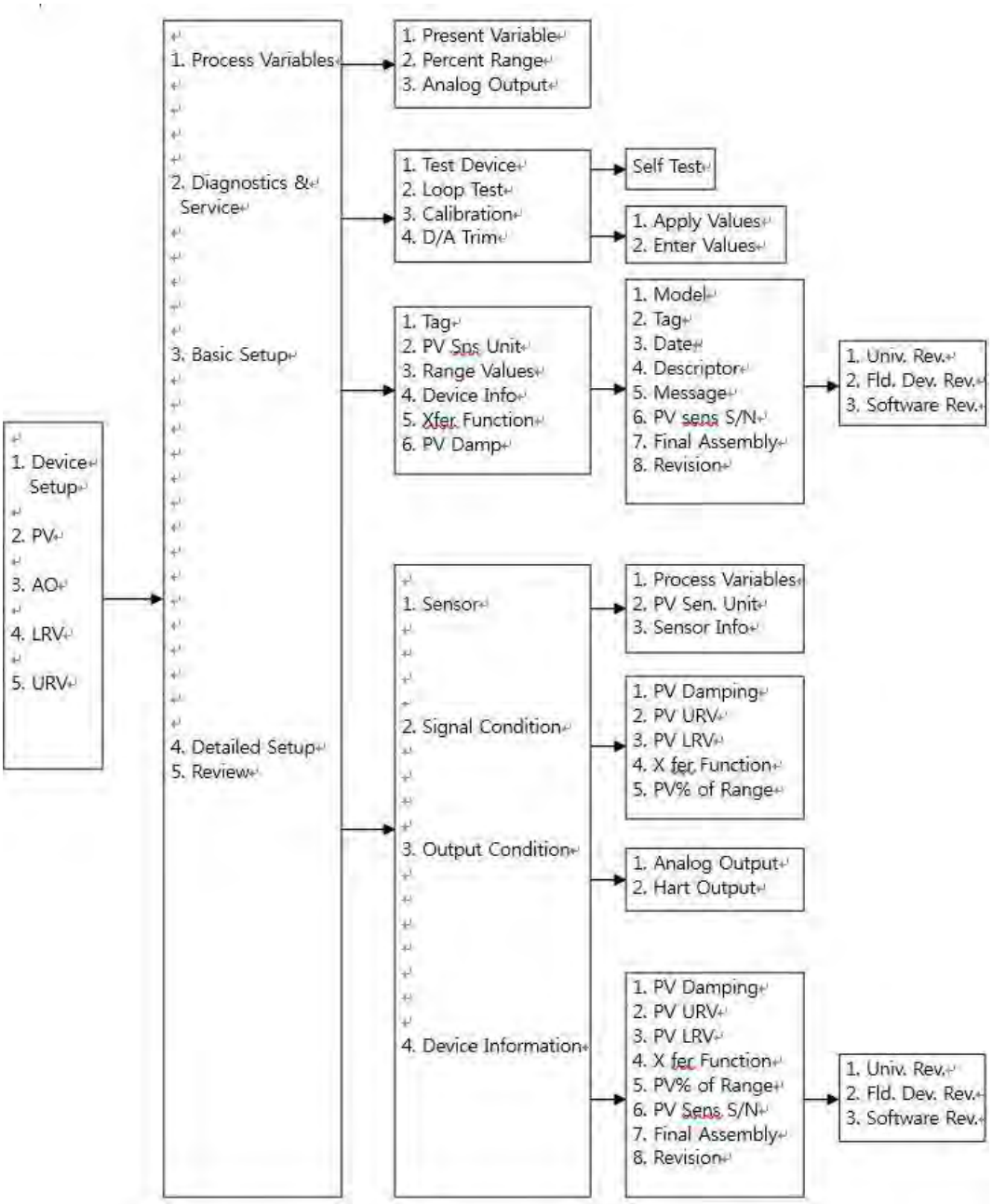
3. Confirm that the flanges are horizontal after the first tightening process. If flanges are not horizontal at this moment, repeat torquing process twice after set the tool for tightening torque on ⅓ of the specified final torque and confirm the horizontal condition. If the flanges are not horizontal or the full contact of face has not been achieved, engineering must evaluate for excessive misalignment.

12. REMOTE CONFIGURATION TYPE HHT 375

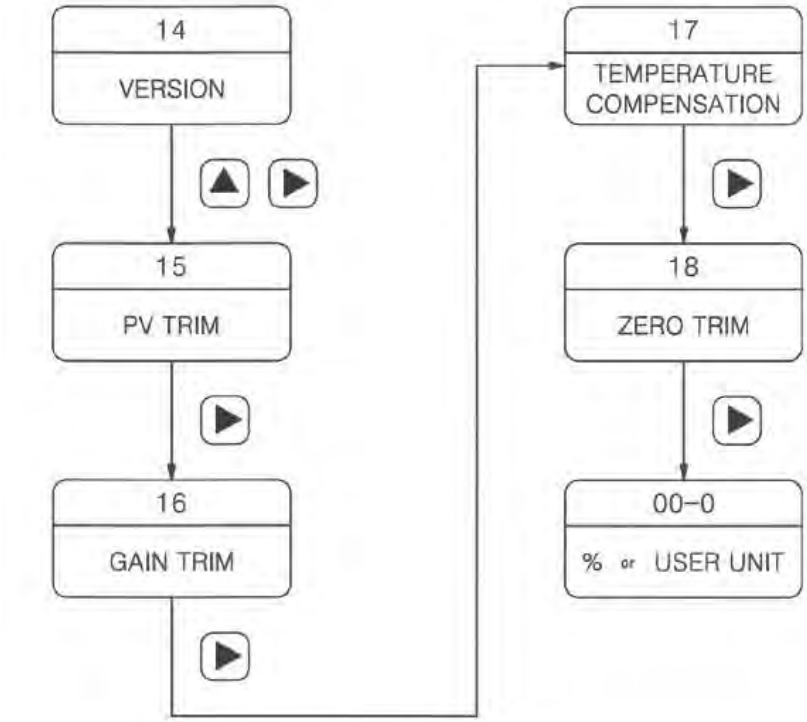
12.1. General

HHT(375) is the terminal which supports remote communication interface of the transmitter.

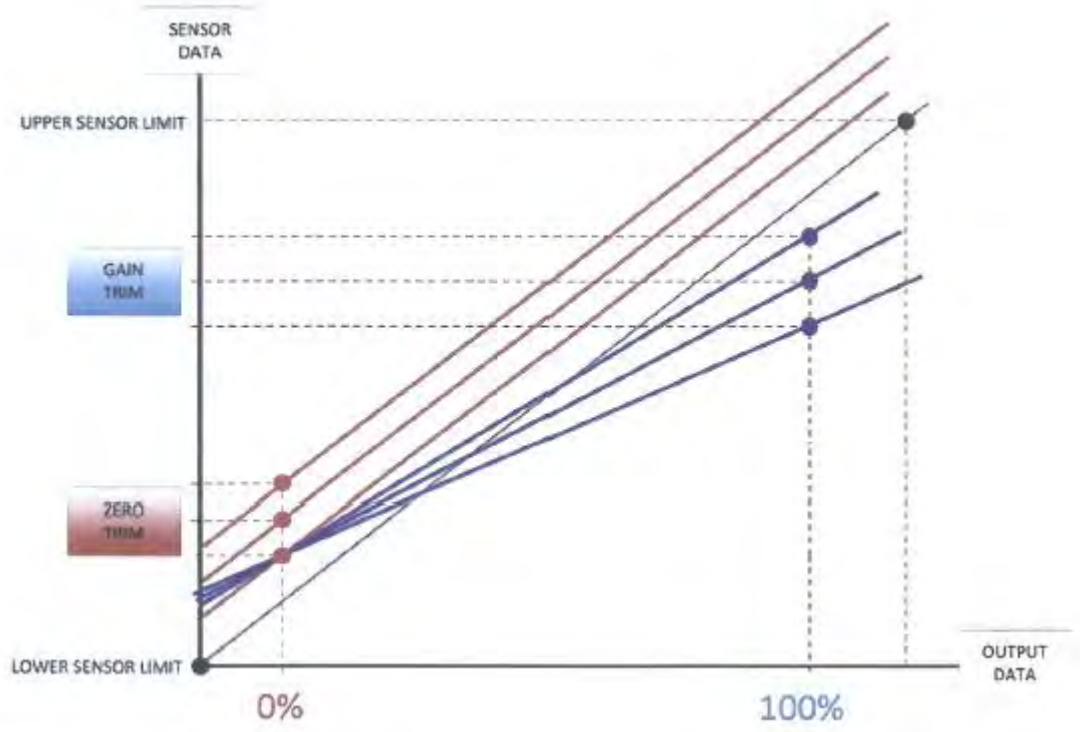
12.2. Generic Online Menu Map



※ Hidden Menu



Hidden Menu Map



1. PV TRIM

   Change the output result by offset from current PV value.

2. GAIN TRIM

   Change the Gain value by modifying the slope of output graph.

3. TEMPERATURE COMPENSATION

   Change the compensated temperature.

4. ZERO TRIM

   Change the output result by offset zero value.

- End -