azbil

CM2-GTX100-2002

AT9000 Advanced Transmitter Differential Pressure/ Pressure Transmitter FOUNDATION™ Fieldbus Model

GTX_ _D, GTX_ _G, GTX_ _A, GTX_ _F, GTX_ _R, GTX_ _U, GTX_ _S

Operation Manual

Azbil Corporation

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Important

- Make sure that this manual is delivered to the user of this product.
- It is prohibited to copy or reprint this manual in whole or in part without permission.
- The contents of this manual are subject to change without notice.
- We have taken all possible measures to ensure the accuracy of this manual, but please contact us if you find any errors or missing information.
- Note that we cannot in some cases accept responsibility for the results of the customer's operation of this product.
- FOUNDATION is a trademark of FieldComm Group.

Introduction

Thank you very much for purchasing our AT9000 Advanced Transmitter FOUNDATION Fieldbus model. The AT9000 Advanced Transmitter FOUNDATION Fieldbus model (hereafter also “this device”) is a smart differential pressure and gauge pressure transmitter that can connect to the FOUNDATION Fieldbus.

Structure of this Series

The GTX series is composed as follows.

AT9000 Advanced Transmitter			
Differential Pressure Transmitters	Gauge Pressure Transmitters	Absolute Pressure Transmitters	Flange-Mounted Differential Pressure Transmitters
GTX15D GTX30D GTX31D GTX32D GTX40D GTX41D GTX42D GTX71D GTX72D	GTX60G GTX71G GTX82G	GTX30A GTX60A	GTX25F GTX60F

AT9000 Advanced Transmitter		
Remote Seal Differential Pressure Transmitters	Remote Seal Gauge Pressure Transmitters	Remote Seal Absolute Pressure Transmitters
GTX35R GTX40R	GTX35U GTX60U GTX71U GTX82U	GTX30S GTX60S

Verification

- When you first receive the product, please confirm that the received product has the correct specifications, and that no damage occurred during transport. This product was shipped only after being tested under a rigorous quality control program. In the unlikely event that there are problems regarding quality or specifications, please notify us of the model number and production number appearing on the nameplate.
- The nameplate is affixed on the upper portion of the case.

Notations in this Operation Manual

The next section explains safety precautions to prevent any injuries to you or other people, as well as damage to properties.

⚠ **Warning**	Warning notes are aimed at preventing dangerous situations in which the product user could be seriously or fatally harmed as a result of product misuse.
⚠ **Caution**	Cautionary notes are aimed at preventing dangerous situations in which the product user could sustain minor injuries or material damage could occur as a result of product misuse.

This manual is written using the following symbols and markings.

	This indicates "prohibited conduct" that the user should never attempt.
	This represents an "instruction" that the user must always follow.
Important	This illustrates precautionary matters in respect to possible significant system problems, or equipment damage.
Note	This illustrates precautionary matters related to equipment operation and function.

Product Usage Precautions

This product was designed, developed, and manufactured as a general-purpose model or explosion-proof model, depending on the specifications. Do not use this product for applications in which its operation directly affects human life, or for nuclear energy applications in radiation controlled areas.

Especially for:

- Safety equipment whose purpose is to protect people
- Direct control of transportation equipment
- Aircraft
- Spacecraft

and the like, where safety is a necessity, be sure to use this product in a context in which the overall safety of the systems and equipment is taken into account using, for example, fail-safe design, redundant design, and periodic inspection.

For information regarding system design, application design, usage methods, product applications, etc., consult with the relevant personnel at our company. Please understand that we cannot in some cases accept responsibility for the results of use of this equipment by the customer.

Safety Precautions

These safety precautions are intended to help you to use the product safely and correctly, and to prevent injury to yourself or others as well as damage to property. Be sure to follow all safety precautions. Please also read and understand this manual carefully before attempting to do any installation, wiring, or maintenance.

The product warranty will be void if it is used in a way not specified.

Installation Precautions

⚠ Warning	
❗	Use this product within the limits of the described usage conditions (explosion proofing, pressure rating, temperature, humidity, voltage, vibration, shock, installation orientation, ambient atmosphere, and the like). Usage outside of these limits can cause instrument failure or fire, resulting in a danger of scalding or other harm.
❗	Explosion-proof models should be installed so that the device's temperature stays below the upper limit. If this temperature is exceeded, explosion-proof functioning cannot be guaranteed. Comply with the ambient temperature and wetted temperature requirements, and if necessary, adopt an insulation solution or select a place with good ventilation.
❗	When working in an explosion-hazard area, perform installation and implementation according to the methods prescribed by the hazard guidelines.
❗	For explosion-proof models, be sure to use the provided (specified) flameproof packing cable gland for the signal wiring port of the device. Using anything other than the supplied (specified) component will jeopardize the explosion-proof function.
❗	If changing the wiring orientation for an explosion-proof model, use the supplied (specified) elbow joint. Using anything other than the supplied (specified) component will jeopardize the explosion-proof function.
❗	To ensure safety, have a qualified person with specific technical expertise in instrumentation work, electrical work, etc., perform the installation, wiring, and the like. There is a risk of electric shock during the process.
❗	Use a power supply for this product which has overcurrent protection.
🛇	When installing the product, make sure that the gaskets do not stick out at the connections with the process (connections between adapter flanges and flanges). There is a danger that the process fluid will leak out and cause scalding or other harm.
❗	When fastening a flange-mount transmitter or remote-seal transmitter to the flange, tighten the bolts, etc., evenly to the specified tightening torque. If they are not properly tightened, there is a danger that the process fluid will leak out and cause scalding or other harm.
❗	If the process fluid is harmful to humans, take safety countermeasures by wearing goggles, a mask, etc. There is a danger of scalding or other harm if it gets on the skin or in the eyes, or if it is inhaled.
❗	The threads on this device and on the process pipes should conform to the same standard. If different standard threads are connected, there is a danger that the process fluid will leak out and cause scalding or other harm.
❗	If the connecting thread of a direct-mount transmitter is a parallel thread, use the gasket supplied with the product. If a gasket is not used, or a gasket other than the supplied gasket is used, there is a danger that the process fluid will leak out and cause scalding or other harm.
❗	If the connecting thread of a direct-mount transmitter is tapered, wind sealing tape around it. Without sealing tape, there is a danger that the process fluid will leak out and cause scalding or other harm.
🛇	If the connecting thread of a direct-mount transmitter is tapered, do not loosen it after it has been tightened. There is a danger that the process fluid will leak out and cause scalding or other harm.
❗	Before starting to use this device, check to make sure the vent plug and drain plug are closed.
❗	Be sure to take safety precautions while working.

⚠ Caution	
!	When transporting or installing this product, use mechanical assistance or have two or more people carry the product. Lifting and lowering the product without sufficient care can cause injuries or product damage. Depending on the specifications, the mass of this product may in some cases exceed 10 kg.
!	Ground the product properly in accordance with the instructions in this operation manual. Improper grounding may have an effect on the output or violate the explosion-proof guidelines.
⃠	After installation, do not use the device as a scaffold. Doing so can cause equipment damage or injury.
⃠	Be careful not to strike the glass portion of the display with tools, etc. Damage or injury might occur.
⃠	If the connecting thread of a direct-mount transmitter is male, do not take off the protective cap that came with it until right before installation. The threads are sharp and may cut your hand.

Wiring Precautions

⚠ Warning	
!	To ensure safety, have a qualified person with specific technical expertise in instrumentation work, electrical work, etc., perform the installation, wiring, and the like. There is a risk of electric shock during the process.
!	Use a power supply for this product which has overcurrent protection.
!	Turn off the power during wiring. There is a risk of electric shock.
⃠	Do not do wiring work with wet hands. There is a risk of electric shock.
!	Wear gloves when wiring. There is a risk of electric shock.
!	Fasten the case cover completely. If there is a gap, the device will not be explosion-proof.
!	Lock the case cover. Locking is required.

⚠ Caution	
!	Wire according to the specifications. Incorrect wiring can cause instrument damage or malfunction.
!	Supply power must comply with the specifications. Inputting the wrong power can damage the instrument.
!	Ground the product properly in accordance with the instructions in this operation manual. Improper grounding may have an effect on the output or violate the explosion-proof guidelines.

Operation Precautions

⚠ Warning	
⃠	When clearing the vents and drains, do not touch the process fluid that comes out of the vent or drain. There is a danger of scalding or other harm.
!	If the process fluid is harmful to humans, take safety countermeasures by wearing goggles, a mask, etc. There is a danger of scalding or other harm if it gets on the skin or in the eyes, or if it is inhaled.

Maintenance Precautions

⚠ Warning	
⃠	When using the product in an explosion-hazard area, do not open the device case cover. There is a risk of explosion, etc.
⃠	Do not inspect or disassemble explosion-proof equipment while it is energized in an explosion-proof area.
!	When detaching this product from the process for maintenance, clear the vents and drains. There is a danger of scalding or other harm from residual pressure or remaining process fluid.
⃠	When clearing the vents and drains, do not touch the process fluid that comes out of the vent or drain. There is a danger of scalding or other harm.
!	If the process fluid is harmful to humans, take safety countermeasures by wearing goggles, a mask, etc. There is a danger of scalding or other harm if it gets on the skin or in the eyes, or if it is inhaled.
!	Replace damaged gaskets with new ones. If this product is operated in a damaged state, it will not be possible to ensure sufficient performance of the seals, and there is a danger that the process fluid will spew out, resulting in scalding or other harm.
!	If the o-ring that seals the case cover is damaged, replace it with a new one. A damaged o-ring can cause corrosion or leakage inside the equipment, resulting in electrical shock or impaired functioning of the equipment.
!	Fasten the case cover completely. If there is a gap, the device will not be explosion-proof.
!	Lock the case cover. Locking is required.
!	If the case cover is corroded, deformed, or damaged, replace it with a new one. Otherwise the explosion-proof function may be impaired.
⃠	Do not modify this product. Doing so may lead to product failure, electric shock, etc.

⚠ Caution	
⃠	If this product is used with high-temperature fluids, do not touch it carelessly. Since the unit is likely to be hot, you may burn yourself.
!	When this product is no longer to be used, dispose of it in accordance with local regulations, treating it as industrial waste.
⃠	Do not reuse this product in whole or in part.

Communication Device Usage Precautions

If communication devices such as transceivers, cellular phones, PHS phones, or pagers are used in the vicinity of this product, depending on the transmission frequencies being used there may be cases in which the product does not function properly, so please observe the following precautions.

> **Note**
>
> - Check the distance at which the communication device does not affect the operation of this product, and maintain at least that distance when using the communication device.
> - Close the case cover of the transmission unit before using communication devices.

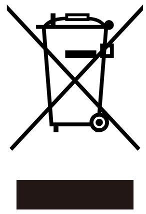
Cautions to Disposal of Electrical and Electronic Equipment

Disposal of Electrical and Electronic Equipment (for Environmental Protection)

This is an industrial product subject to the WEEE Directive.

Do not dispose of electrical and electronic equipment in the same way as household waste.

Old products contain valuable raw materials and must be returned to an authorized collection point for correct disposal or recycling.



Product unpacking, verification, and storage

Unpacking

This device is a precision instrument. Handle it carefully in order to prevent accidents, injuries, etc.

Verifying accessories

Upon unpacking the product, verify that the Center Body and the following items have been included.

- Standard accessory: M3 hex key (1)

Checking specifications

The specifications appear on the product's nameplate. Compare them to the expected specifications. In particular, be sure to check the following specifications.

- Tag No. (TAG No.)
- Model Number (MODEL)
- Production Number (PROD. No.)
- High and low limits of the setting range (RANGE)
- Supply voltage (SUPPLY)
- FF information (DD file name, CF file name, software version)
- Explosion-proofing test conformity label (if explosion-proofing specification applies)

Inquiries

Please direct inquiries regarding this product to the branch office or sales office of our company which is closest to you.

When making an inquiry, be sure to let us know the following numbers appearing on the nameplate.

- Model Number (MODEL)
- Production Number (PROD. NO.)

Storage

If the product is to be placed in long-term storage immediately after purchase, please observe the following precautions.

- Store the product indoors in a low-vibration, low-impact area which has stable temperature and humidity.
- Store the product in the packed state in which it was delivered.

Structure and Use of the Operation Manual

This manual explains the structure and usage of the device in the following order.

1. Device Function, Composition, and Structure

This chapter explains the function, composition, and structure of each component. If you are using this device for the first time, please read starting from this chapter.

2. Device Installation

This chapter explains information necessary for device installation, piping and wiring.

Particularly with regard to installation method, this chapter contains explanations for each type of process fluid.

Refer to this chapter if you are responsible for installation, piping or wiring.

3. Starting and Stopping this Device

This chapter explains the minimum information needed for preparation and use, as well as for stopping operation. It also explains the method of setting the tag No. and of verifying the specifications after delivery. Explanations are categorized according to the process fluid, except for information on the basic operation of Communicator.

Before use, please read this chapter.

4. Operation by Fieldbus Communication

This chapter describes operations that are performed using fieldbus communication.

Refer to this chapter for information regarding the basics of operations, configuring and changing settings, etc.

5. Maintenance and Troubleshooting of this Device

This chapter describes the maintenance of this device and countermeasures to take if problems occur. Refer to this chapter as necessary for applicable information and take appropriate measures.

Appendix P

Standard specifications, model numbers, and external dimensions of the device. Please refer to applicable sections as necessary.

FM Foundation™ Fieldbus Intrinsically Safe (in accordance with NEC)

1. Marking information

［FISCO and Entity］

Intrinsically safe for Class I, II, III / Division 1 / Groups A,B,C,D,E,F & G / T4:
-30℃≤Tamb≤+60℃;
Class I / Zone 0 / AEx ia IIC / T4 : -30℃≤Tamb≤+60℃;
FISCO parameters: Vmax=17.5V, Imax=380mA, Pmax=5.32W, Ci=1.2nF, Li=10uH
Entity Parameters : Vmax=24V, Imax=250mA, Pmax=1.2W, Ci=1.2nF, Li=10uH

Class I / Zone 2 / AEx ic IIC / T4 : -30℃≤Tamb≤+60℃;
FISCO Parameters : Vmax=17.5V, Ci=1.2nF, Li=10uH
Entity Parameters : Vmax=32V, Ci=1.2nF, Li=10uH
Hazardous(classified) locations; Indoor/Outdoor Type 4X, IP66/IP67;

［Nonincendive］

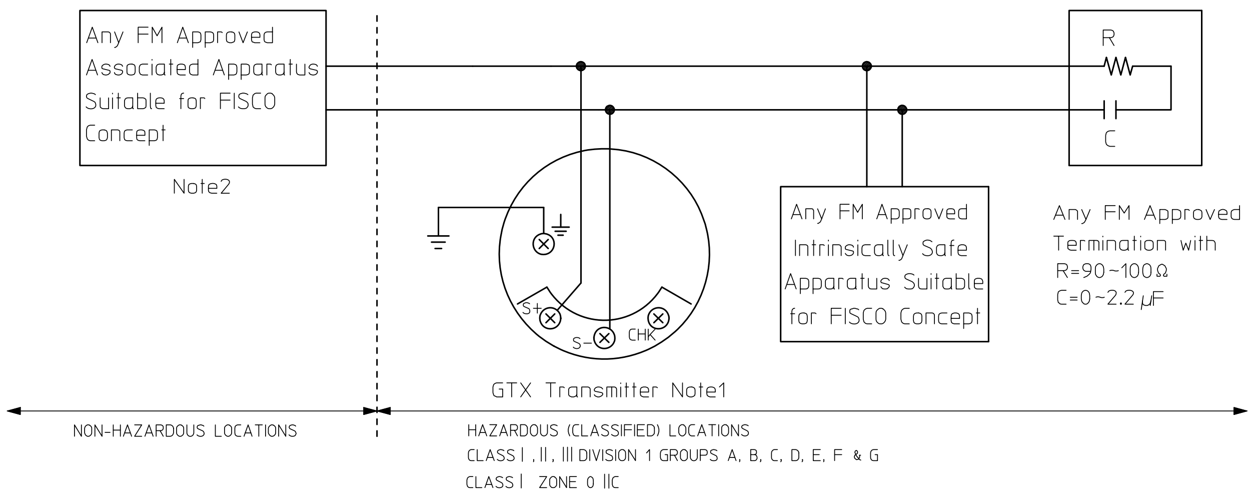
Nonincendive, with nonincendive field wiring parameters,
Class I/Division 2/Groups A,B,C&D/T4;-30℃≤Tamb≤+60℃;
Nonincendive for Class I/Zone 2/IIC/T4: -30℃≤Tamb≤+60℃;
Suitable for Class II,III/Division 2/Groups E,F &G/T4: -30℃≤Tamb≤+60℃;
Hazardous(classified) locations; Indoor/Outdoor Type 4X, IP66/IP67;
Nonincendive field wiring parameters: Vmax=32V, Ci=1.2nF, Li=10uH

2. Applicable standards

FM3600:2011, FM3610:2010, FM3611:2004, FM3810:2005, ANSI/NEMA250:2003, ANSI/IEC60529:2004, ANSI/ISA60079-0:2013, ANSI/ISA60079-11:2014,ANSI/NEMA250:1991

3. Instruction for safe use

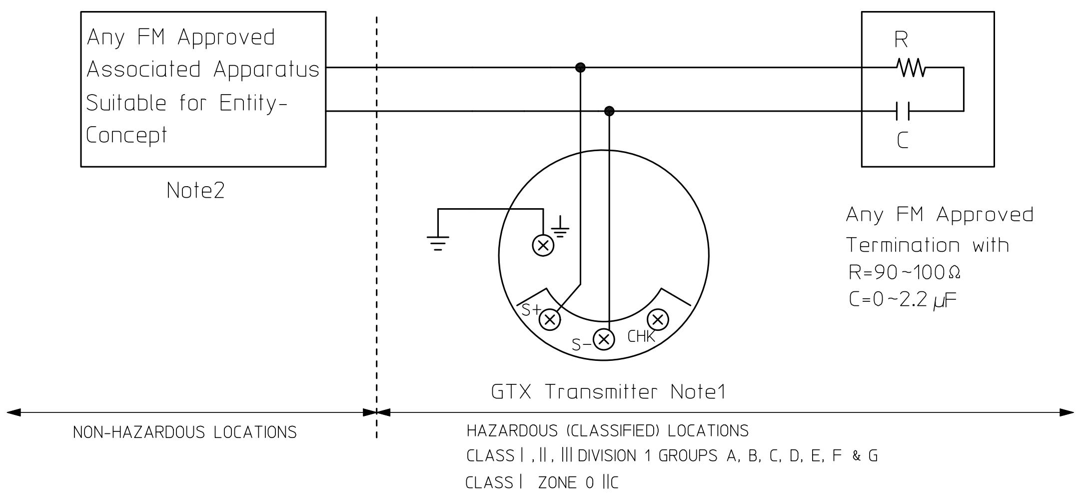
- The installer shall ensure that, giving consideration to the effect of process temperature, the equipment's maximum specified operating ambient temperature of 60°C is not exceeded in service.
- Although the circuit does not withstand the 500V free from earth requirement the input circuit is functionally isolated from earth up to a voltage of 200V.
  The installer shall ensure isolation between the circuits and the frame of the equipment.
- The equipment shall be installed in suitable equipment enclosure which is capable of accepting one or more of the Class I, Division2 wiring methods specified in the National Electrial Code (ANSI/NFPA 70), meets the requirements of ANSI/ISA 82.02.01 and is in compliance with the enclosure, mounting, spacing and segregation requirements of the ultimate application.



NOTES:

1. FISCO PARAMETERS OF GTX Transmitter
   Vmax=17.5V, Imax=380mA, Pmax=5.32W, Ci=1.2nF, Li=10μH
2. INTERCONNECTION IS ALLOWED BETWEEN GTX TRANSMITTER AND FM FISCO APPROVED ASSOCIATED APPARATUS. THE ASSOCIATED APPARATUS SHOULD BE INSTALLED ACCORDING TO THE MANUFACTURER'S INSTRUCTION.
   THE FM APPROVED ASSOCIATED APPARATUS INCLUDES ANY FM ENTITY APPROVED SINGLE OR DUAL BARRIER.
3. DUST-TIGHT CONDUIT SEAL SHOULD BE USED WHEN INSTALLED IN CLASS II AND CLASS III ENVIRONMENTS.
4. INTRINSICALLY SAFE INSTALLATION SHOULD BE IN ACCORDANCE WITH ANSI/ISA RP12.6 "INSTALLATION OF INTRINSICALLY SAFE SYSTEMS FOR HAZARDOUS (CLASSIFIED) LOCATIONS" AND THE NATIONAL ELECTRICAL CODE (ANSI/NFPA70).
5. INSTALLATION OF ALL FM APPROVED EQUIPMENTS SHALL BE IN ACCORDANCE WITH THE MANUFACTURERS INSTALLATION DRAWINGS WHEN INSTALLING THE EQUIPMENT.
6. THE POWER SUPPLY CONNECTED TO THE ASSOCIATED APPARATUS MUST NOT USE OR GENERATE MORE THAN 250 Vrms OR Vdc.
7. AEx ib IS SUITABLE ONLY FOR CLASS I, ZONE 1 HAZARDOUS (CLASSIFIED) LOCATIONS AND IS NOT SUITABLE FOR CLASS I, ZONE 0 or CLASS I, DIVISION1 HAZARDOUS (CLASSIFIED) LOCATIONS.

名称 TITLE		
INSTALLATION DRAWING FM I.S. (FISCO) for ia		
図番 DWG.NO. 80396357	改番 REV. 01	シート SHT.
		A3



NOTES:

1. Entity PARAMETERS OF GTX Transmitter
Vmax=24V, Imax=250mA, Pmax=1.2W, Ci=1.2nF, Li=10μH

2. INTERCONNECTION IS ALLOWED BETWEEN GTX TRANSMITTER AND FM FISCO APPROVED ASSOCIATED APPARATUS. THE ASSOCIATED APPARATUS SHOULD BE INSTALLED ACCORDING TO THE MANUFACTURER'S INSTRUCTION.
THE FM APPROVED ASSOCIATED APPARATUS INCLUDES ANY FM ENTITY APPROVED SINGLE OR DUAL BARRIER.

3. DUST-TIGHT CONDUIT SEAL SHOULD BE USED WHEN INSTALLED IN CLASS II AND CLASS III ENVIRONMENTS.

4. INTRINSICALLY SAFE INSTALLATION SHOULD BE IN ACCORDANCE WITH ANSI/ISA RP12.6 "INSTALLATION OF INTRINSICALLY SAFE SYSTEMS FOR HAZARDOUS (CLASSIFIED) LOCATIONS" AND THE NATIONAL ELECTRICAL CODE (ANSI/NFPA70).

5. INSTALLATION OF ALL FM APPROVED EQUIPMENTS SHALL BE IN ACCORDANCE WITH THE MANUFACTURERS INSTALLATION DRAWINGS WHEN INSTALLING THE EQUIPMENT.

6. TO DETERMINE PROPER MATCHING OF I.S. EQUIPMENT AND THE MAXIMUM WIRING LENGTH USE, THE FOLLOWING FORMULAS SHALL BE SATISFIED:

   V_{oc} or $V_t \leq V_{max}$,
   I_{sc} or $I_t \leq I_{max}$,
   $C_a \geq C_i + C_w$ (WIRING)
   $L_a \geq L_i + L_w$ (WIRING)
   C_a : MAXIMUM ALLOWED CAPACITANCE OF THE LOOP
   L_a : MAXIMUM ALLOWED INDUCTANCE OF THE LOOP

7. THE POWER SUPPLY CONNECTED TO THE ASSOCIATED APPARATUS MUST NOT USE OR GENERATE MORE THAN 250 Vrms OR Vdc.

8. AEx ib IS SUITABLE ONLY FOR CLASS I, ZONE 1 HAZARDOUS (CLASSIFIED) LOCATIONS AND IS NOT SUITABLE FOR CLASS I, ZONE 0 or CLASS I, DIVISION1 HAZARDOUS (CLASSIFIED) LOCATIONS.

CONSIDERATION OF AN INTRINSICALLY SAFE LOOP BASED ON ENTITY PARAMETERS

THE ENTITY CONCEPT ALLOWS INTERCONNECTION OF INTRINSICALLY SAFE APPARATUS TO ASSOCIATED APPARATUS NOT SPECIFICALLY EXAMINED IN SUCH COMBINATION.

BASICALLY, THE MAXIMUM UNPROTECTED CAPACITANCE (Ci) AND INDUCTANCE (Li) OF THE INTRINSICALLY SAFE APPARATUS, INCLUDING INTERCONNECTING WIRING PARAMETERS (Lw, Cw), MUST BE EQUAL TO OR LESS THAN THE CAPACITANCE (Ca) AND INDUCTANCE (La) WHICH CAN BE SAFELY CONNECTED TO THE ASSOCIATED APPARATUS. ALSO, THE MAXIMUM OUTPUT PARAMETERS (Voc, Isc, Po) OF THE ASSOCIATED APPARATUS MUST BE EQUAL TO OR LESS THAN THE MAXIMUM ENTITY PARAMETERS (Vmax, Imax, Pmax) OF THE INTRINSICALLY SAFE APPARATUS.

TITLE	INSTALLATION DRAWING FM I.S. (Entity) for ia
DWG.NO.	80396358
REV.	01
SHT.	
	A3

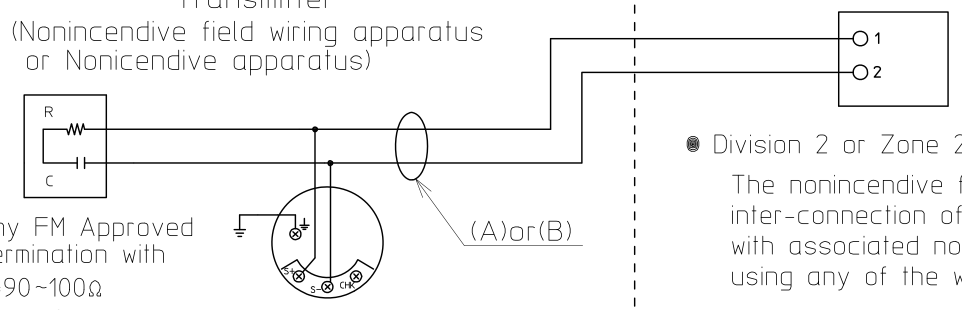
Hazardous (Classified) Locations

NI, with NIFW Parameters,
for CL I, DIV 2, GPs A, B, C & D, T4 : CL I,
Zone2, GP IIC, T4 : Suitable for CL II & III,
DIV 2, GPs E, F & G, T4 : -30°C ≤ Tamb ≤ +60°C

Non-Hazardous Locations

Receiver
(Associated nonincendive field wiring apparatus necessary only for nonincendive field wiring)

Transmitter
(Nonincendive field wiring apparatus or Nonincendive apparatus)



Any FM Approved Termination with
R=90~100Ω
C=0~2.2μF

- (A) Nonincendive Field Wiring per NEC

  Terminals S+, S− :
  Vmax=32V Imax=38mA
  Ci=1.2nF, Li=10μH

- (B) Wiring Methods for Div.2 locations except Nonincendive Field Wiring per NEC

- Division 2 or Zone 2 installation

  The nonincendive field wiring circuit concept allows the inter-connection of nonincendive field wiring apparatus, with associated nonincendive field wiring apparatus, using any of the wiring methods permitted for unclassified locations.

  The nonincendive field wiring is established under the following conditions:

  Vmax ≥ Voc or Vt,
  Ca ≥ Ci + Ccable,
  La ≥ Li + Lcable.

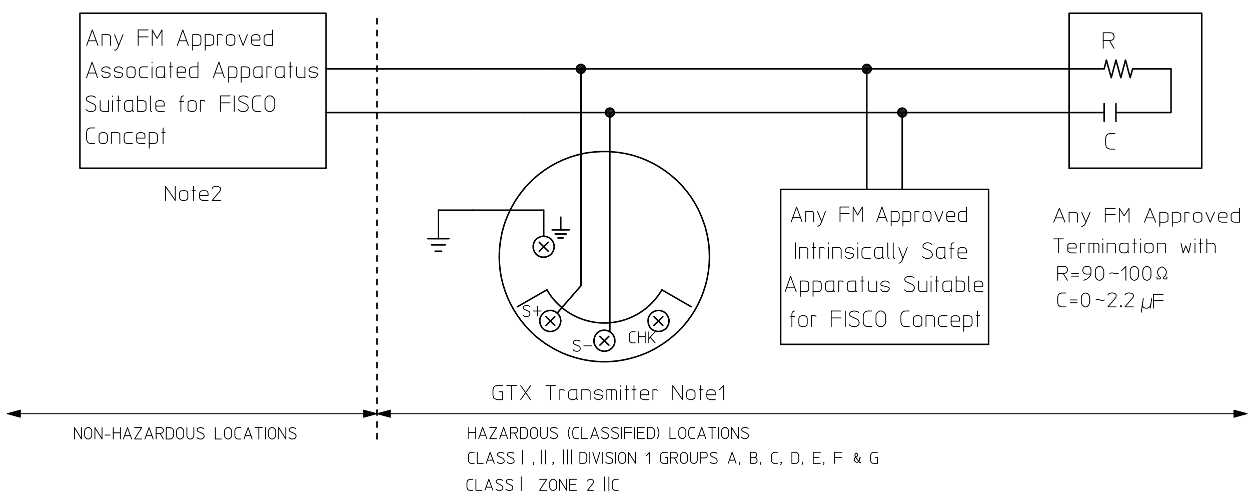
  NOTE: Imax need not be greater than Isc or It of the associated nonincendive field wiring apparatus because the converter provides the outputs with the current controlled circuit.

- Associated nonincendive field wiring apparatus is not permitted to use or generate more than 250V r.m.s.

図番 DWG.NO. 80396359

名称 TITLE
Installation Drawing
FM NI / NIFW

図番 DWG.NO. 80396359 | 改番 REV. 01 | シート SHT. | A4

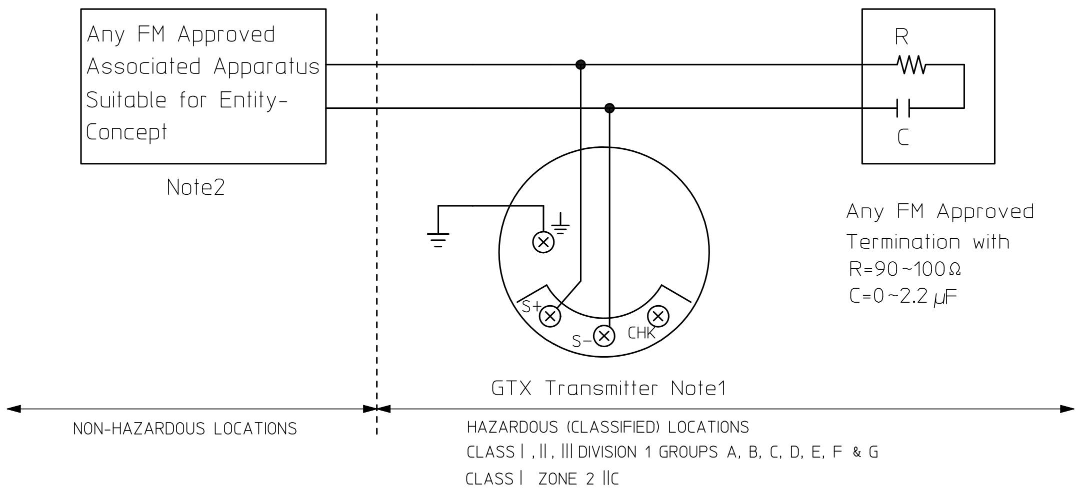


NOTES :

1. FISCO PARAMETERS OF GTX Transmitter
   Vmax=17.5V, Imax=380mA, Pmax=5.32W, Ci=1.2nF, Li=10μH
2. INTERCONNECTION IS ALLOWED BETWEEN GTX TRANSMITTER AND FM FISCO APPROVED ASSOCIATED APPARATUS. THE ASSOCIATED APPARATUS SHOULD BE INSTALLED ACCORDING TO THE MANUFACTURER'S INSTRUCTION.
   THE FM APPROVED ASSOCIATED APPARATUS INCLUDES ANY FM ENTITY APPROVED SINGLE OR DUAL BARRIER.
3. DUST-TIGHT CONDUIT SEAL SHOULD BE USED WHEN INSTALLED IN CLASS II AND CLASS III ENVIRONMENTS.
4. INTRINSICALLY SAFE INSTALLATION SHOULD BE IN ACCORDANCE WITH ANSI/ISA RP12.6 "INSTALLATION OF INTRINSICALLY SAFE SYSTEMS FOR HAZARDOUS (CLASSIFIED) LOCATIONS" AND THE NATIONAL ELECTRICAL CODE (ANSI/NFPA70).
5. INSTALLATION OF ALL FM APPROVED EQUIPMENTS SHALL BE IN ACCORDANCE WITH THE MANUFACTURERS INSTALLATION DRAWINGS WHEN INSTALLING THE EQUIPMENT.
6. THE POWER SUPPLY CONNECTED TO THE ASSOCIATED APPARATUS MUST NOT USE OR GENERATE MORE THAN 250 Vrms OR Vdc.

名称 TITLE	INSTALLATION DRAWING FM I.S. (FISCO) for ic
図番 DWG.NO.	80396543
改番 REV.	01
シート SHT.	/
	A3

80396544



NOTES:

1. Entity PARAMETERS OF GTX Transmitter
Vmax=32V, Imax=250mA, Pmax=1.2W, Ci=1.2nF, Li=10μH

2. INTERCONNECTION IS ALLOWED BETWEEN GTX TRANSMITTER AND FM FISCO APPROVED ASSOCIATED APPARATUS. THE ASSOCIATED APPARATUS SHOULD BE INSTALLED ACCORDING TO THE MANUFACTURER'S INSTRUCTION.
THE FM APPROVED ASSOCIATED APPARATUS INCLUDES ANY FM ENTITY APPROVED SINGLE OR DUAL BARRIER.

3. DUST-TIGHT CONDUIT SEAL SHOULD BE USED WHEN INSTALLED IN CLASS II AND CLASS III ENVIRONMENTS.

4. INTRINSICALLY SAFE INSTALLATION SHOULD BE IN ACCORDANCE WITH ANSI/ISA RP12.6 "INSTALLATION OF INTRINSICALLY SAFE SYSTEMS FOR HAZARDOUS (CLASSIFIED) LOCATIONS" AND THE NATIONAL ELECTRICAL CODE (ANSI/NFPA70).

5. INSTALLATION OF ALL FM APPROVED EQUIPMENTS SHALL BE IN ACCORDANCE WITH THE MANUFACTURERS INSTALLATION DRAWINGS WHEN INSTALLING THE EQUIPMENT.

6. TO DETERMINE PROPER MATCHING OF I.S.EQUIPMENT AND THE MAXIMUM WIRING LENGTH USE, THE FOLLOWING FORMULAS SHALL BE SATISFIED:

   V_{oc} or $V_t \leq V_{max}$,
   I_{sc} or $I_t \leq I_{max}$,
   $C_a \geq C_i + C_w$ (WIRING)
   $L_a \geq L_i + L_w$ (WIRING)
   Ca : MAXIMUM ALLOWED CAPACITANCE OF THE LOOP
   La : MAXIMUM ALLOWED INDUCTANCE OF THE LOOP

7. THE POWER SUPPLY CONNECTED TO THE ASSOCIATED APPARATUS MUST NOT USE OR GENERATE MORE THAN 250 Vrms OR Vdc.

CONSIDERATION OF AN INTRINSICALLY SAFE LOOP BASED ON ENTITY PARAMETERS

THE ENTITY CONCEPT ALLOWS INTERCONNECTION OF INTRINSICALLY SAFE APPARATUS TO ASSOCIATED APPARATUS NOT SPECIFICALLY EXAMINED IN SUCH COMBINATION.

BASICALLY, THE MAXIMUM UNPROTECTED CAPACITANCE (Ci) AND INDUCTANCE (Li) OF THE INTRINSICALLY SAFE APPARATUS, INCLUDING INTERCONNECTING WIRING PARAMETERS (Lw, Cw), MUST BE EQUAL TO OR LESS THAN THE CAPACITANCE (Ca) AND INDUCTANCE (La) WHICH CAN BE SAFELY CONNECTED TO THE ASSOCIATED APPARATUS. ALSO, THE MAXIMUM OUTPUT PARAMETERS (Voc, Isc, Po) OF THE ASSOCIATED APPARATUS MUST BE EQUAL TO OR LESS THAN THE MAXIMUM ENTITY PARAMETERS (Vmax, Imax, Pmax) OF THE INTRINSICALLY SAFE APPARATUS.

名称 TITLE		
INSTALLATION DRAWING FM I.S. (Entity) for ic		
図番 DWG.NO. 80396544	改番 REV. 01	シート SHT.

A3

FM Explosionproof / Dust-ignition proof Approval

1. Marking information

Explosionproof for Class I, Division 1, Groups A, B, C and D; Class I, Zone 1, AEx d IIC

Dust-Ignitionproof for Class II, III, Division 1, Groups E, F and G

T5 -40°C ≤ Tamb ≤ +85°C

Hazardous locations

Indoor / Outdoor Type 4X, IP67

Factory sealed, conduit seal not required for Division applications

Caution - Use supply wires suitable for 5°C above surrounding ambient

2. Applicable standards

FM3600:2011, FM3615:2006, FM3810:2005, ANSI/ISA60079-0:2013, ANSI/ISA60079-1:R2013, ANSI/ISA60079-11:2014, ANSI/NEMA250:1991, ANSI/IEC60529:2004

3. Instruction for safe use

Installations shall comply with the relevant requirements of the National Electrical Code® (ANSI / FAPA 70).

ATEX Flameproof and Dust Certifications (English)

1. Marking information

CE 0344 Ex KEMA 08ATEX0004X

II 1/2 G Ex db IIC T6 Ga/Gb -30°C ≤ Tamb ≤ +75°C -30°C ≤$T_{PROCESS}$≤85℃
II 1/2 G Ex db IIC T5 Ga/Gb -30°C ≤ Tamb ≤ +80°C -30°C ≤$T_{PROCESS}$≤100℃
II 1/2 G Ex db IIC T4 Ga/Gb -30°C ≤ Tamb ≤ +80°C -30°C ≤$T_{PROCESS}$≤110℃
II 2 D Ex tb IIIC T85°C Db -30°C ≤ Tamb ≤ +75°C -30°C ≤$T_{PROCESS}$≤85℃
II 2 D Ex tb IIIC T100°C Db -30°C ≤ Tamb ≤ +75°C -30°C ≤$T_{PROCESS}$≤100℃
II 2 D Ex tb IIIC T110°C Db -30°C ≤ Tamb ≤ +75°C -30°C ≤$T_{PROCESS}$≤110℃
IP66/IP67

2. Applicable standards

- EN 60079-0: 2012+A11:2013
- EN 60079-1: 2014
- EN 60079-26: 2015
- EN 60079-31: 2014

3. Installation Instruction

3.1 To maintain the degree of protection of at least IP66 in accordance with IEC60529, suitable cable entries must be used and correctly installed. Unused openings must be closed with a suitable stopping plug.

3.2 Use supply wire suitable for 5℃ above surrounding ambient.

3.3 When Model No. is given with GTXxxx-x…x-yx…x-x…,
if y=A, the thread type of the end of all entries is 1/2 NPT, or
if y=B, the thread type of the end of all entries is M20.

3.4 The earthing wire and the cable lug shall be assembled and the earthing wire secured close to the cable lug to prevent it from being pulled sideways. The tightening torque of the earthing secure is 1.2±0.1N·m.

4. Specific conditions of use

4.1 The enclosure of the Model GTX is made of aluminum, so if it mounted in an area where the use of 1G apparatus is required, it must be installed in such a way that, even in the event of rare incidents, ignition sources due to impact of friction sparks are excluded.

4.2 For the use in the area where EPL Db apparatus is required, electrostatic discharge shall be avoided.

4.3 See Table 5-1 in the clause 5.1.2 for the material of the barrier diaphragm.

The barrier diaphragm shall not be subjected environmental conditions which might adversely affect the partition wall, for example corrosion.

4.4 Repairs of flameproof joints are allowed only by manufacturer.

4.5 The equipment must be returned to the manufacturer in case of failure.

4.6 The wetted parts with process fluid are suitable for EPL Ga and other parts are suitable for EPL Gb.

4.7 This product is specified for vibrating as follows.

-For the enclosure material

Amplitude: 0.42mm / Frequency: 5~60Hz

-For the enclosure material of stainless steel only for inline type

Amplitude: 0-21mm / Frequency: 10~60Hz

-For the enclosure material other than stainless steel only for inline type

Amplitude: 0-15mm / Frequency: 10~60Hz

IECEx Flameproof and Dust Certifications (English)

1. Marking information

IECEx KEM 08.0001X

Ex db IIC T6 Ga/Gb	-30°C ≤ Tamb ≤ +75°C	-30°C ≤$T_{PROCESS}$≤85℃
Ex db IIC T5 Ga/Gb	-30°C ≤ Tamb ≤ +80°C	-30°C ≤$T_{PROCESS}$≤100℃
Ex db IIC T4 Ga/Gb	-30°C ≤ Tamb ≤ +80°C	-30°C ≤$T_{PROCESS}$≤110℃
Ex tb IIIC T85°C Db	-30°C ≤ Tamb ≤ +75°C	-30°C ≤$T_{PROCESS}$≤85℃
Ex tb IIIC T100°C Db	-30°C ≤ Tamb ≤ +75°C	-30°C ≤$T_{PROCESS}$≤100℃
Ex tb IIIC T110°C Db	-30°C ≤ Tamb ≤ +75°C	-30°C ≤$T_{PROCESS}$≤110℃

IP66/IP67

2. Applicable standards

- IEC 60079-0: 2011
- IEC 60079-1: 2014
- IEC 60079-26: 2014
- IEC 60079-31: 2014

3. Installation Instruction

3.1 To maintain the degree of protection of at least IP66 in accordance with IEC60529, suitable cable entries must be used and correctly installed. Unused openings must be closed with a suitable stopping plug.

3.2 Use supply wire suitable for 5℃ above surrounding ambient.

3.3 When Model No. is given with GTXxxx-x…x-yx…x-x…,

if y=A, the thread type of the end of all entries is 1/2 NPT, or

if y=B, the thread type of the end of all entries is M20

3.4 The earthing wire and the cable lug shall be assembled and the earthing wire secured close to the cable lug to prevent it from being pulled sideways. The tightening torque of the earthing secure is 1.2±0.1N･m.

4. Specific conditions of use

4.1 The enclosure of the Model GTX is made of aluminum, so if it mounted in Zone 0, where the use of Ga apparatus is required, it must be installed in such a way that, even in the event of rare incidents, ignition sources due to impact of friction sparks are excluded.

4.2 For the use in the area where EPL Db apparatus is required, electrostatic discharge shall be avoided.

4.3 See Table 5-1 in the clause 5.1.2 for the material of the barrier diaphragm.

The barrier diaphragm shall not be subjected environmental conditions which might adversely affect the partition wall, for example corrosion.

4.4 Repairs of flameproof joints are allowed only by manufacturer.

4.5 The equipment must be returned to the manufacturer in case of failure.

4.6 The wetted parts with process fluid are suitable for EPL Ga and other parts are suitable for EPL Gb.

4.7 This product is specified for vibrating as follows.

-For the enclosure material

Amplitude: 0.42mm / Frequency: 5~60Hz

-For the enclosure material of stainless steel only for inline type

Amplitude: 0-21mm / Frequency: 10~60Hz

-For the enclosure material other than stainless steel only for inline type

Amplitude: 0-15mm / Frequency: 10~60Hz

ATEX Intrinsic Safety Certifications for Gas and Dust (English)

1. Marking information

1.1 Intrinsic safety ia

CE 0344   Ex DEKRA 12ATEX0023X

FISCO Field Device

II 1 G Ex ia IIC T4 Ga

II 1 D Ex ia IIIC T120 °C Da

Ui = 17.5V, Ii = 380mA, Pi = 5.32W, Ci = 1.2nF, Li = 10μH, or
Ui = 24V, Ii = 200mA, Pi = 1.2W, Ci = 1.2nF, Li = 10μH

-30 °C ≤ Tamb ≤ +60 °C Tprocess = 110 °C IP66 / IP67

INSTALL IN ACCORDANCE WITH USER MANUAL

1.2 Intrinsic safety ic

CE   Ex DEKRA 12ATEX0024

FISCO Field Device

II 3 G Ex ic IIC T4 Gc

II 3 D Ex ic IIIC T120°C Dc

Ui = 32V, Ci = 1.2nF, Li = 10μH

-30 °C ≤ Tamb ≤ +60 °C Tprocess = 110 °C IP66 / IP67

INSTALL IN ACCORDANCE WITH USER MANUAL

2. Applicable standards

・EN 60079-0:2012+A11

・EN 60079-11:2012

3. Condition of Certification

Because the enclosure of the Advanced Transmitter Model GTX with Foundation Fieldbus is made of aluminium, if it is mounted in an area where the use of 1 G apparatus is required, it must be installed such, that, even in the event of rare incidents, ignition sources due to impact and friction sparks are excluded.

4. Instruction for safe use

Although the circuit does not withstand the 500 V free from earth requirement the input circuit is functionally isolated from earth up to a voltage of 200 V.

IECEx Intrinsic Safety Certifications for Gas and Dust (English)

1. Marking information

Certificate No. IECEx DEK 12.0001X

(intrinsic safety ia)

FISCO Field Device

Ex ia IIC T4 Ga

Ex ia IIIC T120 °C Da

Ui = 17.5V, Ii = 380mA, Pi = 5.32W, Ci = 1.2nF, Li = 10μH, or
Ui = 24V, Ii = 200mA, Pi = 1.2W, Ci = 1.2nF, Li = 10μH

-30 °C ≤ Tamb ≤ +60 °C Tprocess = 110 °C IP66 / IP67

INSTALL IN ACCORDANCE WITH USER MANUAL

(intrinsic safety ic)

FISCO Field Device

Ex ic IIC T4 Gc

Ex ic IIIC T120°C Dc

Ui = 32V, Ci = 1.2nF, Li = 10μH

-30 °C ≤ Tamb ≤ +60 °C Tprocess = 110 °C IP66 / IP67

INSTALL IN ACCORDANCE WITH USER MANUAL

2. Applicable standards

・IEC 60079-0:2011

・IEC 60079-11:2011

3. Condition of Certification

Because the enclosure of the Advanced Transmitter Model GTX with Foundation Fieldbus is made of aluminium, if it is mounted in an area where the use of EPL Ga equipment is required, it must be installed such, that, even in the event of rare incidents, ignition sources due to impact and friction sparks are excluded.

4. Instruction for safe use

Although the circuit does not withstand the 500 V free from earth requirement the input circuit is functionally isolated from earth up to a voltage of 200 V.

Table of Contents

Chapter 1. Device Configuration and Structure

■ ***Summary***

The chapter illustrates the basic functionality, configuration, and structure of the device.

Please read this chapter to understand the basics of this device if using it for the first time.

1-1. Functionality and Configuration of this Device

1-1-1. Functionality and Configuration of this Device

■ ***Introduction***

This device measures differential pressure using a differential pressure sensor on a compound semiconductor sensor, and transmits flow rate, pressure, and liquid level data.

It also measures changes in the static pressure and ambient temperature, which influence accurate differential pressure measurement, via a static pressure sensor and temperature sensor located on the compound semiconductor sensor. By comparing these measurements with measurements made at the factory, it compensates for temperature and pressure and adjusts the measured differential pressure to the true differential pressure, which it outputs. This device is composed of a differential pressure sensor, a temperature sensor, a static pressure sensor, a multiplexer, and an A/D converter in the meter body, along with a microprocessor, and various data storage elements in the transmission unit.

■ ***Functionality and Configuration***

Figure 1-1 below illustrates the basic functionality and configuration of this device.

The flow rate, pressure, and liquid level of the process fluid are conveyed to the differential pressure sensor on the compound semiconductor chip of the meter body.

The output of this sensor undergoes A/D conversion simultaneously with the temperature and static pressure detected by the temperature sensor and static pressure sensor on the compound semiconductor sensor.

These converted signals are processed by the microprocessor, converted again to a Foundation Fieldbus signal, and are output.

- PROM: The input-output characteristics, temperature characteristics, static pressure characteristics, device type, settable range, etc., of the meter are stored here.
- EEPROM: This is non-volatile memory that maintains various transmitter settings even when the power is off.
- A/D: Converts analog signals to a digital signals.
- FF: Outputs via a Foundation Fieldbus signal.

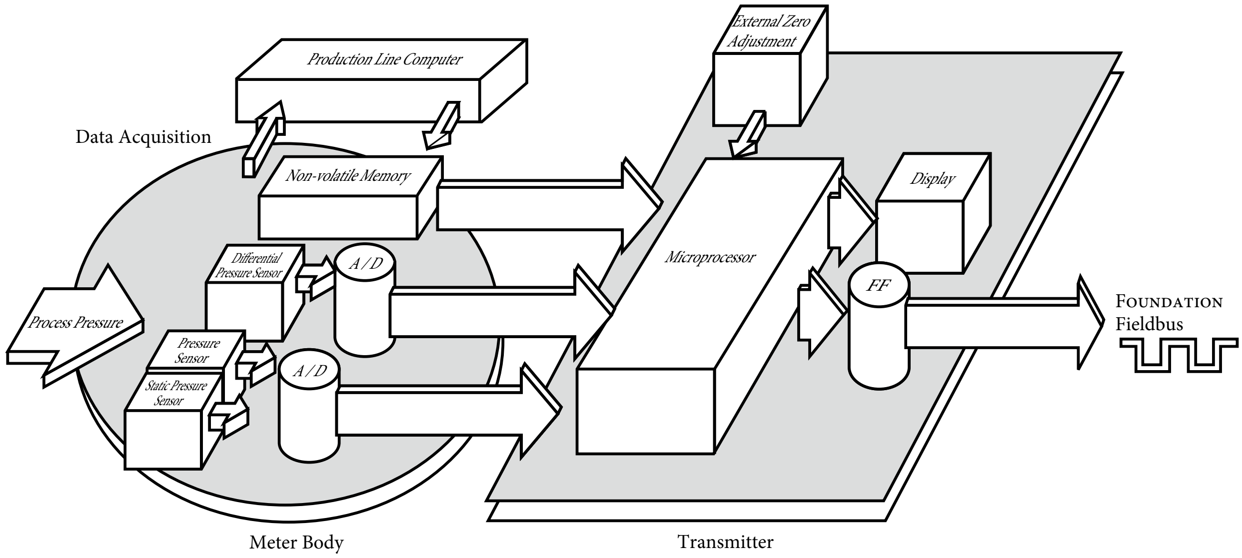


Figure 1-1. Block Diagram of this Device

1-1-2. Part Names of the Device

■ *Introduction*

The device is mainly composed of a terminal block, electronics module, transmitter case, indicator, center body, etc.

■ *Structure and Part Names of the Device*

Figure 1-2 below shows the structure and part names of this device.

- Center Body:
  Composed of a compound semiconductor sensor, a pressure-receiving diaphragm, an excess pressure protection mechanism, etc.
- Center Body Covers:
  There are two of these, which enclose the center body from both sides. Connect the connecting pipe here.
- Bolt/nuts:
  Hold the center body between the two center body covers.
- Detector Section:
  Composed of a compound semiconductor sensor, pressure-receiving diaphragm, flange, capillary tube, etc.
- Electronics Module:
  This is the electronic circuit that processes and transmits the differential pressure signal, etc.
- Transmitter Case:
  Houses the electronics module, terminal block, etc.
- Case Cover:
  Cover for sealing the transmission unit case.
- Terminal Block:
  Terminals for electrical signal connections. Communicator can also be connected here.

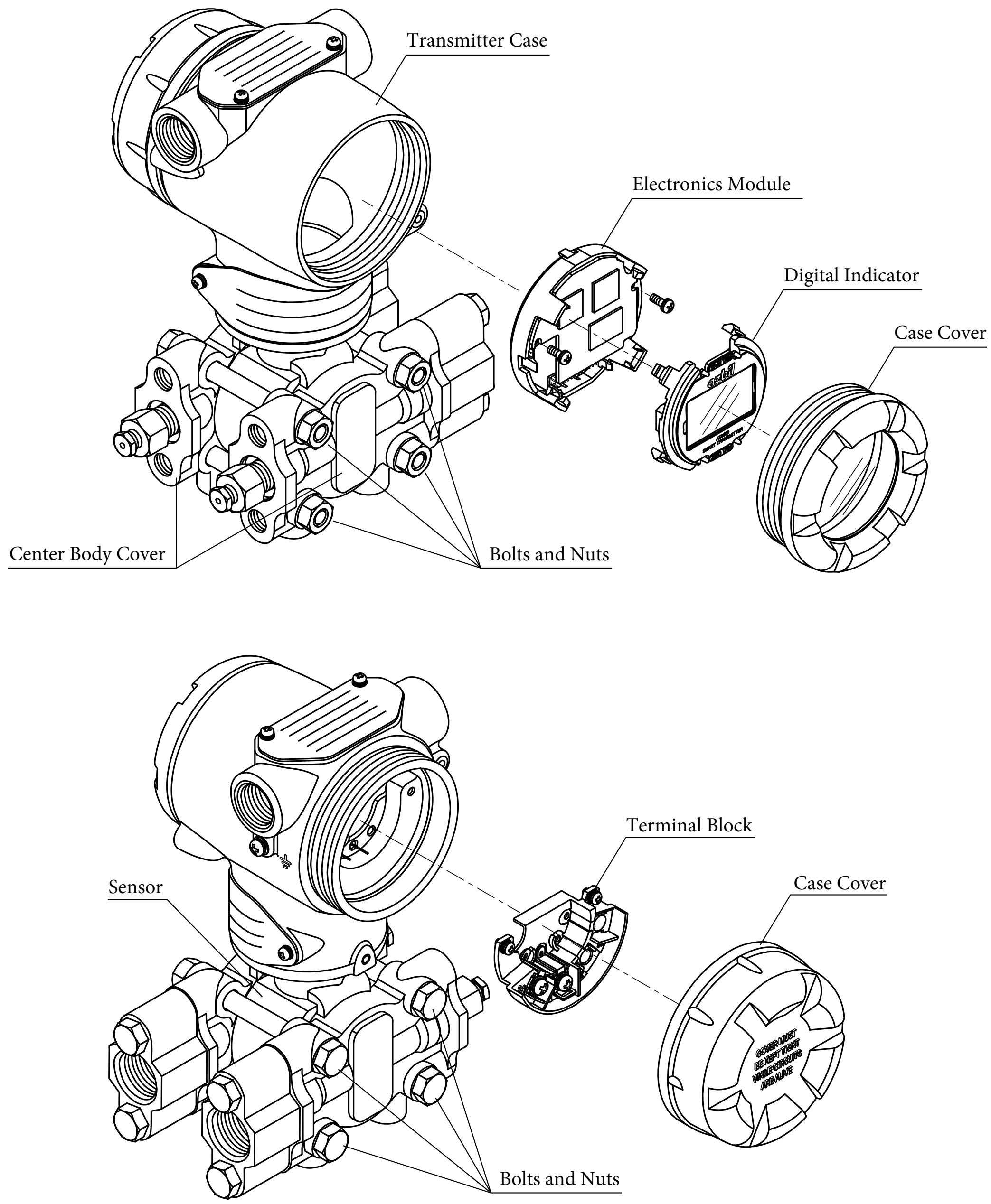


Figure 1-2. Transmitter Structure

1-1-3. Device Lineup

There are 3 main types of this device, differing in their method of pressure measurement.

- Differential Pressure Type
- Gauge Pressure Type
- Absolute Pressure Type

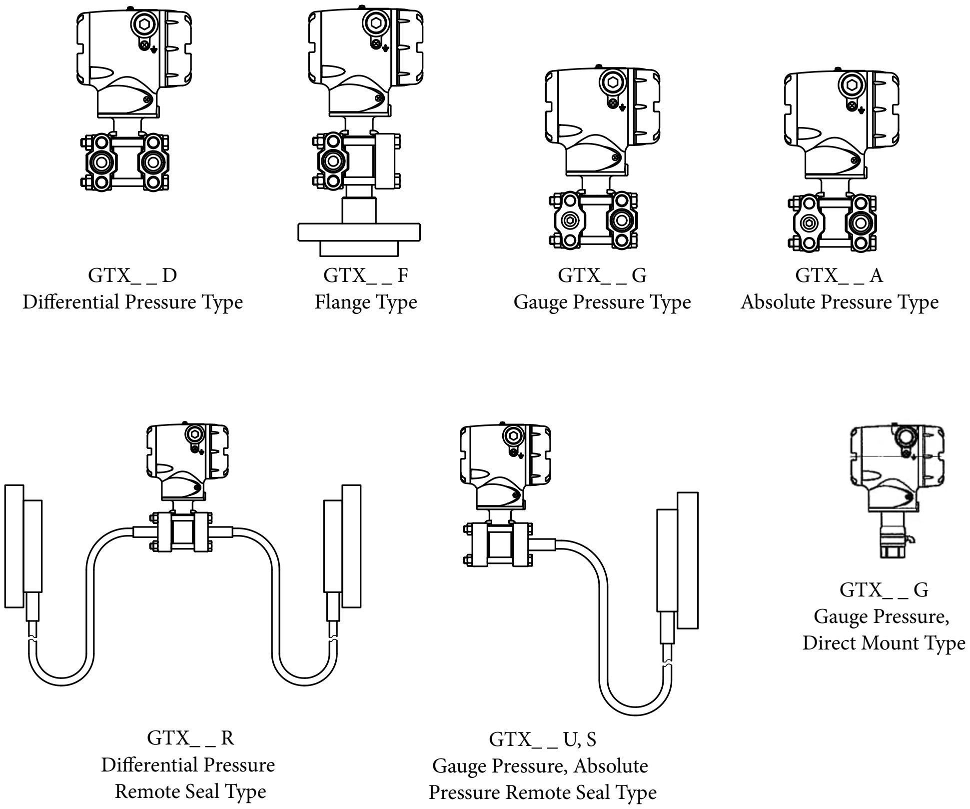


Figure 1-3. Name on the Indicator Display

1-1-4. Indicator (Optional)

For details, please refer to 4-6, “Display Transducer Block.”

Chapter 2. Installation of this Device

■ ***Summary***

This chapter covers important points related to installing this device and setting up its piping and wiring. Individuals in charge of installation work should read this chapter.

⚠ Warning	
!	Use this product within the limits of the described usage conditions (explosion proofing, pressure rating, temperature, humidity, voltage, vibration, shock, installation orientation, ambient atmosphere, and the like). Usage outside of these limits can cause instrument failure or fire, resulting in a danger of scalding or other harm.
!	When working in an explosion-hazard area, perform installation and implementation according to the methods prescribed by the hazard guidelines.
!	To ensure safety, have a qualified person with specific technical expertise in instrumentation work, electrical work, etc., perform the installation, wiring, and the like. There is a risk of electric shock during the process.
!	Use a power supply for this product which has overcurrent protection.

⚠ Caution	
!	Ground the product properly in accordance with the instructions in this operation manual. Improper grounding may have an effect on the output or violate the explosion-proof guidelines.

2-1. Installation Location Selection Criteria

2-1-1. General Installation Conditions

■ ***Introduction***

Follow the selection criteria described here in order to enable this device to operate with peak performance over the long term.

■ ***Installation Location Selection Criteria***

Select an installation location for this device in accordance with the following criteria.

- Choose a location with as little temperature variation as possible.
- Avoid installing the device in an area which is exposed to radiant heat from the plant.
- For areas in which there is a risk that the process fluid, fill fluid, etc., might freeze, take heat insulation measures.
- Choose an area with minimal exposure to vibration and impact.
- Avoid installation in areas with a corrosive atmosphere.
- For external zero adjustment (optional), since the output of this device can undergo variations in locations with strong magnetism (locations with motors, pumps, etc., with 400 A/m or higher), install the device at least 1 m away from such locations.
- Do not subject connecting pipes attached to this device to vibration.

2-2. Installation

⚠ Caution
After installation, do not use the device as a scaffold. Doing so can cause equipment damage or injury.
Be careful not to strike the glass portion of the display with tools, etc. Damage or injury might occur.
When transporting or installing this product, use mechanical assistance or have two or more people carry the product. Lifting and lowering the product without sufficient care can cause injuries or product damage. Depending on the specifications, the mass of this product may in some cases exceed 10 kg.

2-2-1. Installation Dimensions

Refer to the outline of the device in Appendix P.

2-2-2. Installation Location

Refer to 2-1-1, "General Installation Conditions."

2-2-3. Transmitter Body Installation

■ *Components Required for Installation*

In order to install this device, have the following items ready.

- 2 inch (50 mm) pipe
- Mounting bracket (U-bolts, nuts, and mounting bolts) --- optional

■ *Installation Method*

Refer to the following diagram for installation.

Use a mounting bracket and fasten using 2 inch (50 mm) pipe 12U bolt. There are four bolt holes on the rear surface of the pressure receiving main body; mount the bracket there. The pipe should be fastened securely so that it does not move.

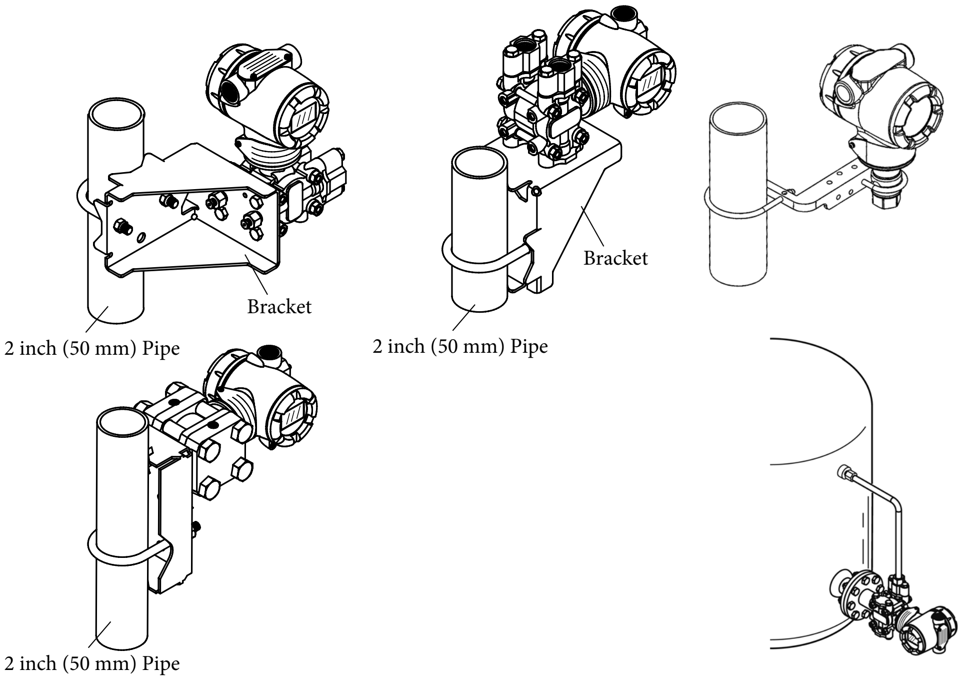


Figure 2-1. Typical Bracket Mounted and Flange Mounted Installations

(A) Rotate electronics housing 90° horizontally.

Loosen 3 mm set screw on outside neck of transmitter. Rotate electronics housing in a maximum of 90 degree increments (left or right) from the center to a position you require and tighten the set screw.

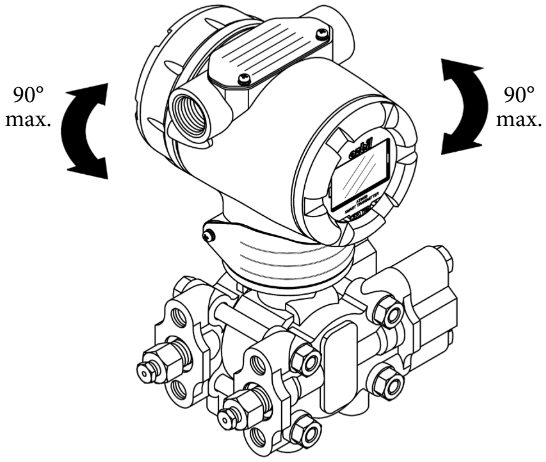


Figure 2-2.

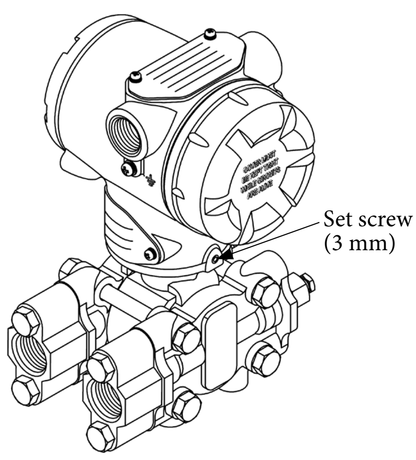


Figure 2-3.

(B) Rotate digital display module

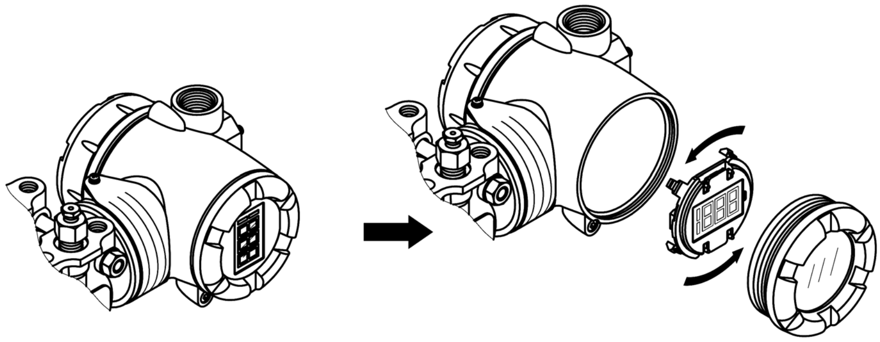


Figure 2-4.

<Example of Sealed Tank Level Measurement>

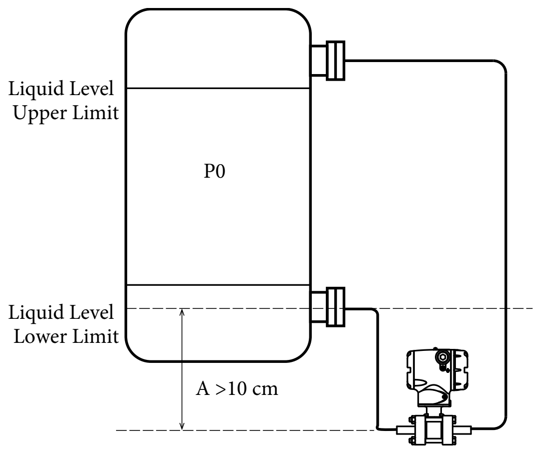


Figure 2-5. Example of Sealed Tank Level Measurement

Note

Please be careful of the following when installing model GTX_ _R.

- Attach the transmitter in a location which is at least 10 cm lower than the location of the tank nozzle. Refer to "Installation Position of Remote-Seal Transmitter for Sealed Tank" below if it can't be installed at least 10 cm lower.
- If the measurement fluid includes hydrogen, please contact us for handling instructions.
- For high-temperature high-vacuum environments: when the process fluid temperature and ambient temperature dip below 10°C, the transmitter's response speed goes down. Therefore, set up the device such that the ambient temperature of the capillary tubes and center body is always at least 10°C.

Installation Position of Remote-Seal Transmitter for Sealed Tank

If the transmitter itself is installed higher than the lower flange of the sealed tank, the following conditions must be satisfied. When considering the mounting position of the remote-seal transmitter, the situation when the tank is empty must be considered.

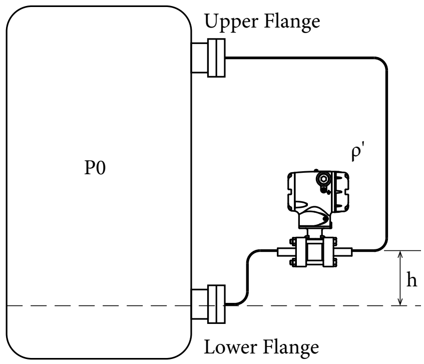


Figure 2-6. Installation Position on the Sealed Tank

P0: Tank internal pressure (absolute pressure: kPa abs)

ρ': Specific gravity of the fill fluid inside the capillary

h: Vertical distance from lower tank flange to the transmitter

If the transmitter is attached as in Figure 2-6, the pressure received by the diaphragm surface of the lower flange of the transmitter body includes not only the internal pressure of the tank but also the pressure of the fill fluid in the capillary tube section.

The pressure applied on this diaphragm surface needs to be greater than the lower range value P (kPa abs) of the allowable pressure of the transmitter body, and the requirements for it are described below.

When the tank's internal pressure is that of a vacuum, you will need to take special precautions, as the installation in Figure 2-6 means that the diaphragm surface of the transmitter body on the lower flange side will be pulled more by negative pressure.

$P0+(-\rho' h/102)\geq P$ 1 kPa=102 mmH_2O

$h\leq(P0-P)\times102/\rho'$

	Fill Fluid Specific Gravity ρ′	Lower Limit of Allowable Pressure P (kPa abs)	Wetted Temperature Range (°C)
General-purpose	0.935	2	−40 to +40
High-temperature model	1.07	2	−5 to +90
For high-temperature vacuum	1.07	0.133	−5 to +100
For high-temperature high-vacuum	1.09	0.133	10 to 250
For oxygen or chlorine	1.87	53	−10 to +40

Note

- If the wetted temperature range in the above table has been exceeded, the allowable pressure low limit will change as well, so refer to the specifications carefully before proceeding.
- The ambient temperature range should be the narrower of the contact liquid temperature range given in the above table and the ambient temperature normal operating range.

Example: Consider using the general-use remote-seal transmitter model GTX_ _R for a vacuum-condition application.

- Wetted temperature is at ambient temperature
- Lower range limit of allowable pressure (P) is 2 kPa abs (15 mmHg abs.)
- Specific gravity of the fill fluid (ρ’) is 0.935

Therefore, the relationship must be as follows to satisfy the transmitter specifications:

$P0+(-\rho' h/102) \geq P$

$1 \text{ kPa}=102 \text{ mmH}_2\text{O}$

If the tank’s internal pressure (P0) drops to 3 kPa abs., the allowable range for h can be represented by the following formula.

$h \leq (P0-P) \times 102/\rho'$

Since P0=3, P=2, ρ’=0.935,

$h \leq (3-2) \times 102/0.935=109 \text{ mm}.$

Accordingly, the transmitter can be attached at a location up to 109 mm above the lower tank flange.

Important

If the above conditions are not satisfied, the diaphragm surface will be pulled by negative pressure exceeding the usage range, resulting in the fill fluid reaching saturation vapor pressure and causing bubbles to form. If the negative pressure becomes even greater, the diaphragm may buckle and become damaged.

Recognizing that it may not necessarily be clear to customers what values to use in calculating the requirements, we recommend placing the transmitter body at least 10 cm lower than the lower flange.

2-2-4. Installation Orientation of the Transmitter

There aren't any special requirements for the installation orientation, but the best way is to install it so that the pressure-receiving diaphragm is vertical.

When it is installed on a slant, follow the procedure mentioned below to adjust the zero point.

Note

Do not use the zero-point adjustment procedure for model GTX_ _A/GTX_ _S transmitters.

Please conduct the zero point adjustment afterwards. Refer to Chapter 4, "General Installation Conditions" on how to use the communicator.

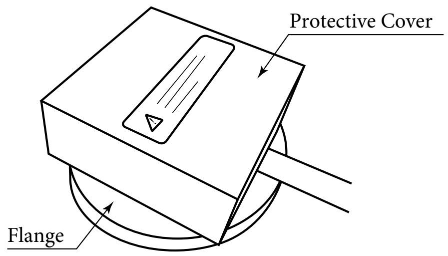
2-2-5. Integration with the Process (GTX_ _F/GTX_ _R/GTX_ _U/GTX_ _S)

⚠ Warning

- When fastening a flange-mount transmitter or remote-seal transmitter to the flange, tighten the bolts, etc., evenly to the specified tightening torque. If they are not properly tightened, there is a danger that the process fluid will leak out and cause scalding or other harm.
- If the process fluid is harmful to humans, take safety countermeasures by wearing goggles, a mask, etc. There is a danger of scalding or other harm if it gets on the skin or in the eyes, or if it is inhaled.
- When installing the product, make sure that the gaskets do not stick out at the connections with the process (connections between adapter flanges and flanges). There is a danger that the process fluid will leak out and cause scalding or other harm.

Note

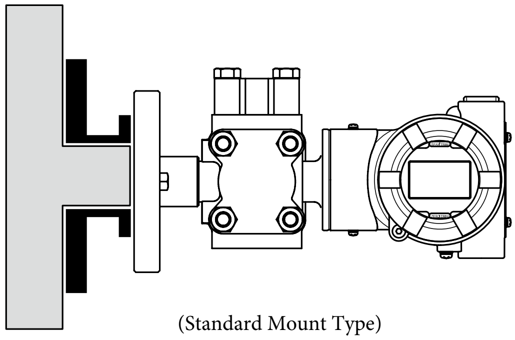
A protective cover is placed on the wetted diaphragm when shipped from the factory. Please remove it when installing.



Example: if using remote sealing

Installation of GTX_ _K Transmitter

Please refer to Figure 2-7 for attaching the flange to the process.



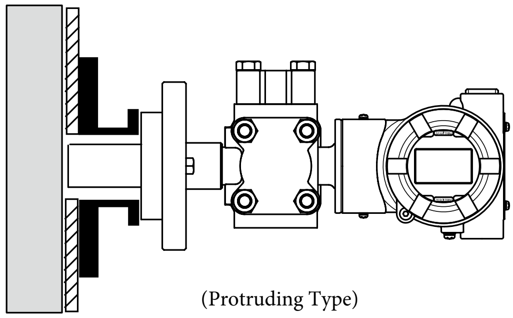


Figure 2-7. Tank Connection Diagram

When using the adapter flange, refer to section 6-1-2 for the tightening torque.

Piping

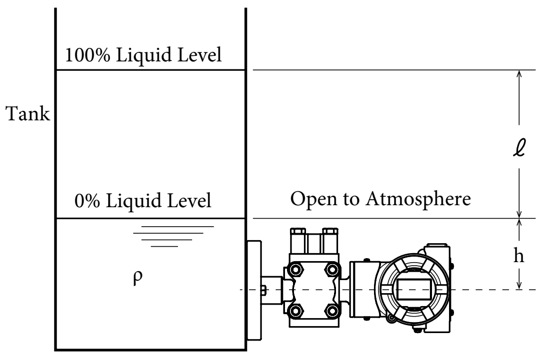


Figure 2-8. Measuring the Liquid Level of Sealed Tank (GTX_ _F)

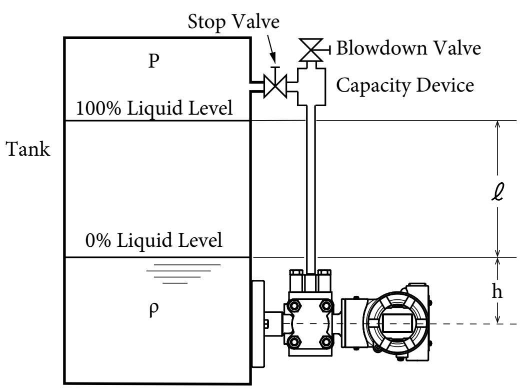


Figure 2-9. Liquid Level Measurement (by GTX_ _F) of Sealed Tank with Gas Seal (Dry Leg) Connecting Pipe

Installation of GTX_ _R/GTX_ _U/GTX_ _S Transmitter

1. Attach the process-side flange using mounting bolts and gaskets*. To prevent leaks, tighten the bolts equally firmly. In order to lessen the effects of ambient temperature difference, bundle together the high pressure side and low pressure side capillary tubes. In addition, fasten the capillary tubes so that they do not move around due to wind, vibration, etc. (We recommend loosely winding remaining capillary tube and fixing it in place)

   * Prepare the flange gasket on the process side. When using semi-metallic or rubber gaskets, select ones which are shaped so as to not come into contact with the diaphragm of the detector.

2. Flanges used for measuring the liquid level of an open container should be securely attached at a place with low temperature change and no vibration. Make sure to put some protection on the seal diaphragm so that it does not get damaged or collect drained liquid or dust.

Note

- When handling the capillary tube, do not twist it.
- When unwinding a capillary tube, hold the flange portion and turn the tube such that it reverts to a big loop.
- We recommend installing the capillary tube so that it runs downward instead of horizontally.
- Do not turn the capillary tube in a way that twists it where it connects to the flange.
- We recommend securing the middle of the capillary tube to prevent vibration.

3. Selection of Flange Gasket (3B Flush Mount Type)
   Please be careful of the following when selecting the flange gasket. The diaphragm diameter is 95 mm, so if a commercially available 3B gasket is used, it will come into contact with the diaphragm and may cause malfunction. Select appropriate materials based on the fluid, the working pressure, the temperature, etc., and also be careful of the inner diameter. (The inner diameter needs to be such that the gasket does not touch the diaphragm even if it is displaced or flattened)

Important

- If the flange shape is of the 3B flush mount type, its diaphragm diameter is 95 mm, so a commercial 3B gasket (inner diameter of 80 to 90 mm) should not be used. Since the inner diameter of a commercial 3B gasket is too small, it may come in contact with the diaphragm, resulting in errors or damage to the diaphragm.
- Select a gasket that will not contact the diaphragm even if the gasket shifts or becomes deformed. If the gasket is made of soft material, it may be deformed when it is attached.

Note
• Center the gasket accurately. The gasket can sag or become misaligned, especially if it is vertical. • If the gasket has an FEP film, install it according to the "Attaching the FEP Film" section below, and do not overtighten. • If the transmitter is installed on the flange located on the upper side of the process, the tank's inner pressure must be at atmospheric pressure or higher. If tank pressure will drop below this range, be sure to install the transmitter on the low side of the process.

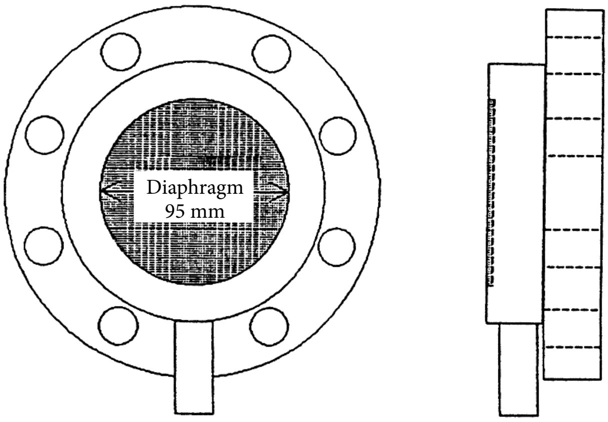


Figure 2-10. Full View of Pressure Receiver

Gasket Selection Example

Fluid: sea water
Temperature: ambient temperature
Pressure: 300 kPa max
With FEP film
Flange: 3BJIS10k

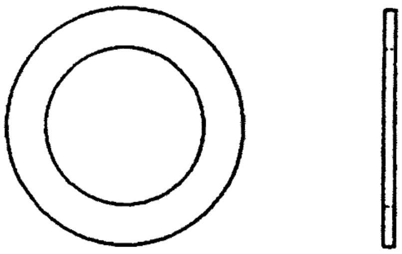


Figure 2-11. Full view of the gasket

■ *Mounting the Flange for Measurement of Liquid Level by GTX_ _R Transmitter*

The following is a precautionary note on measuring the liquid level of sealed tanks. Refer to section 3-11-1 on how to calculate the setting range, as well as connection examples of closed tanks.

Note

- The setting range when attaching a high-pressure (HP) side transmitter flange to the upper portion of the tank is different from that when attaching one to the lower portion of the tank. For complete details, see pages 3-37 and 3-38.
- When attaching a high-pressure (HP) side transmitter flange to the lower portion of the tank, and enabling the fill fluid compensation feature, add a minus sign (–) on the height value.
- For model GTR40R, be sure to attach the high-pressure (HP) side of the transmitter to the upper portion of the tank.

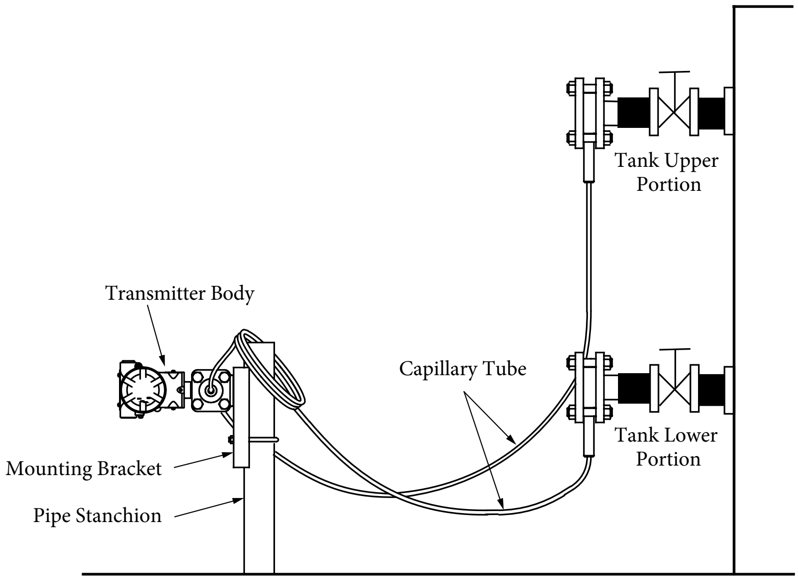


Figure 2-12. Example of Mounting on a Sealed Tank

■ *Mounting the Flange for Measurement of Liquid Level by GTX_ _U/GTX_ _S Transmitter*

The following is a mounting example for measuring the liquid level of open tanks.

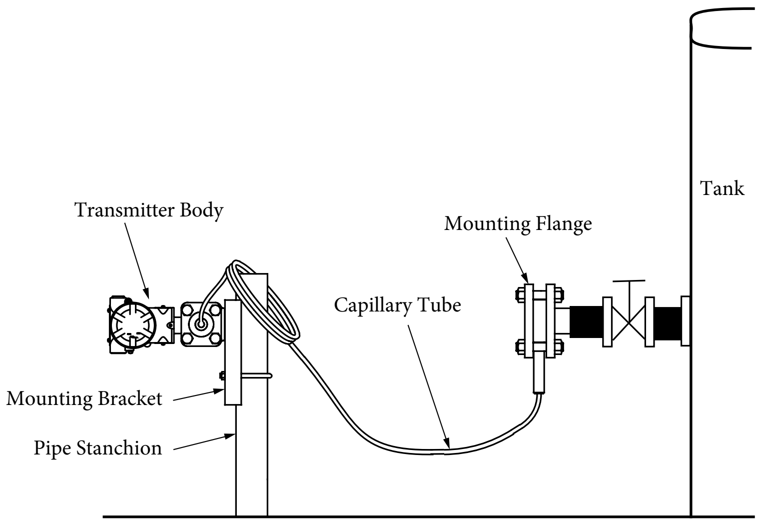


Figure 2-13. Example of Mounting on an Open Tank

2-2-6. Attaching the FEP Film (for GTX_ _R/GTX_ _U)

■ *3B Flange*

Do the following just before mounting the pressure-receiving flange.

1. Hold the diaphragm surface of the pressure-receiving flange of the transmitter so that it faces upward.

2. Apply about 15 g of Daiflon grease (No. DG.203, Daikin Industries Ltd.) to the diaphragm surface, and spread it across the entire surface with your finger. (The average thickness of the grease on the diaphragm will be about 2 mm)

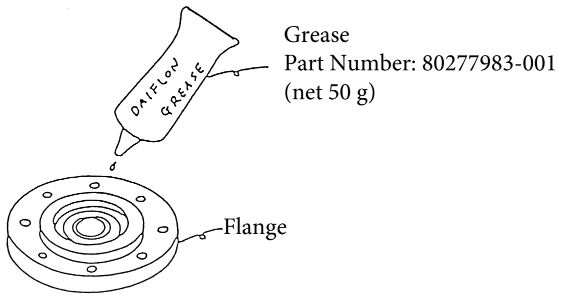


Figure 2-14.

3. Fit the FEP film onto the diaphragm's raised surface.

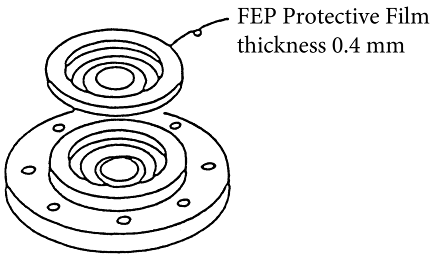


Figure 2-15.

4. Press the film outward from the center of the diaphragm so that the grease sticks out from the periphery. Press slowly so no air remains between the diaphragm and the FEP film.

   Press the grease out until there is almost none left on the raised face area. After pressing out 5.7 g of grease, the thickness of the grease on the diaphragm surface will be about 0.5 mm. When doing this, be careful not to apply excessive force that would cause deformation.

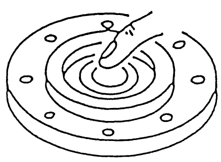


Figure 2-16.

5. Place the gasket against the flange of the pressure-receiver, and attach it to the process flange. Tighten bolts and nuts to about 20 N·m.

6. If work is impeded due to zero point fluctuation, use a communicator or the like to acquire input data from before and after fastening the flange, and check that the fluctuation is around ±0.1 kPa. Large fluctuation range will cause zero point shifts, so please redo it in such a case.

> **Note**
>
> The process of coating grease so that the zero point fluctuation can be minimized requires skill. If it doesn't go well, please contact our service representative.

■ *1-1/2, 2B Flange*

Do the following just before mounting the instrument's pressure-receiver flange on the process flange.

1. Hold the diaphragm surface of the pressure-receiver flange of the transmitter so that it faces upward.
2. Apply about 10 g of Daiflon grease (No. DG-203, Daikin Industries Ltd.) to the flange diaphragm surface and the surfaces around the flange gasket, and spread it evenly on the gasket surface with your finger so that it reaches a thickness of about 0.5 mm

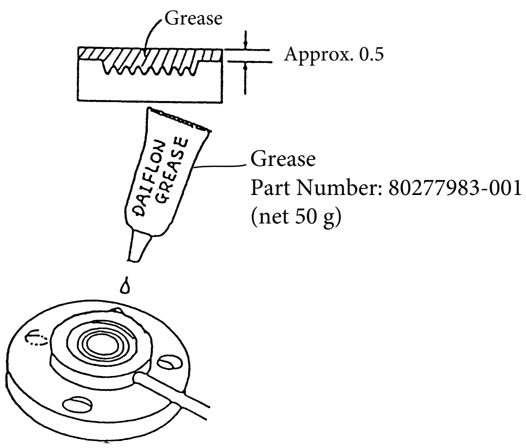


Figure 2-17.

> **Note**
>
> - When applying the grease, do not apply excessive force that might deform the diaphragm.
> - Make sure that no air (bubbles) are left in the grease.

3. Fit the FEP film onto the flange diaphragm surface. When doing this, lift one side and fit the film gently from the opposite side so that no air remains.

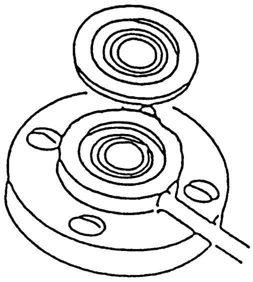


Figure 2-18.

Note
• Make the FEP film fit closely onto the metallic diaphragm.
• Make sure that the wave portion of the FE5P film does not bulge out.

4. After attachment, confirm that no air remains between the diaphragm and the FEP film. If air remains, the measurement accuracy error might worsen. In this case, press the air out with your finger outward from the center of the diaphragm.

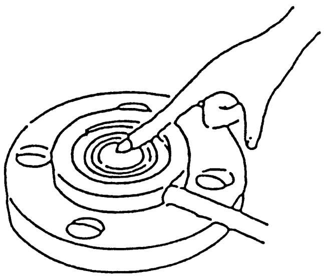


Figure 2-19.

5. Place the FEP-wrapped gasket against the pressure-receiving flange, and attach it to the process flange. The guidelines (reference values) for the tightening torque of bolts and nuts is shown in Table 2-1.

Important
Apply an equal amaount of torque to each bolt.

Table 2-1. Torque (Reference Values)

Flange Rating	Tightening Torque (N·cm)
JIS10K - 50A	30
JIS10K - 40A	20
ANSI/JPI 150# - 2B	28
ANSI/JPI 150# - 1 ½B	20

2-2-7. Installation of Models GTX_ _R with Direct Mounting Kit

■ *Overview*

The inclusion of a direct-mounting kit (adapter, tube clamps) with the remote-seal transmitter makes easy tank level instrumentation possible. Using the kit alleviates the need to attach the transmitter body to a stanchion. In addition, with our proprietary fill fluid temperature compensation feature and capillary tube wiring, which are included as standard features with remote-seal transmitters, the temperature characteristics can be captured.

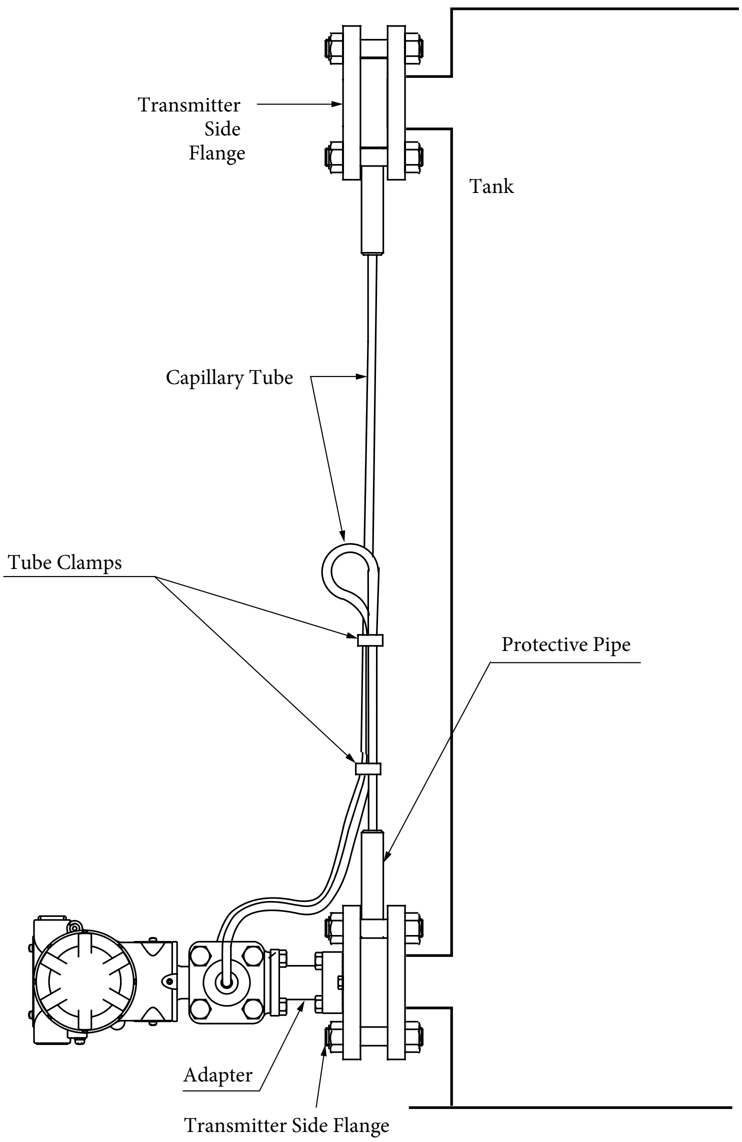


Figure 2-20. Direct-Mounting Installation Example

Figure 2-21. Direct-Mounting Kit

■ Features

1. Neat, easy, no-hassle instrumentation
    - Direct mounting on the tank using an adapter. Since a 2B stanchion pipe is unnecessary, you can save a lot of space around the tank.
    - Capillary tube can be easily held in place using the tube clamps. If you know the distance between the tank flanges, can order a product with the optimal capillary tube length.
2. Outstanding ambient temperature characteristics
    - By means of its fill fluid temperature compensation feature (patent pending), Azbil Corporation's remote seal can minimize the effects of ambient temperature changes on the fill fluid pressure applied as head pressure and can greatly improve zero point shift. (Effect of seasonal temperature change in the case of conventional technology is 1/5 to 1/10.)
    - By bundling capillary tubes with special tube clamps, zero point shift due to capillary temperature difference can be reduced by 50% compared to the conventional method.

■ Specification

This section gives the specifications for the direct-mounting Kit included with the remote-seal transmitters. Refer to Appendix P for the specifications of compatible remote-seal transmitters.

—Direct Mounting Kit Specifications—

Materials:

Adapter	SCS13 (SUS304 equivalent)
Adapter fastening bolts	SUS304 (M8)
Tube clamps	Nickel-plated brass

Adapter Mount:

Instrument side	Mount using 4 adapter fastening bolts
Flange side	Mount using 4 adapter fastening bolts
Tube clamp	For bundling the folded-back capillary tube with the other one

Mass: approx. 600 g

■ Compatible transmitter: GTX_ _R

Only for a general model of the above remote-seal of differential pressure transmitter. Cannot be combined with a high-temperature model, high-temperature vacuum model, or high-temperature high-vacuum model.

Installation Overview

1. Attachment Dimensions

   Figure 2-22 shows the adapter assembly diagram when mounted on the process, Figure 2-23 is a diagram of the adapter, and Figure 2-24 shows the adapter's length. For all other dimensions, Refer to the diagram in Appendix P.

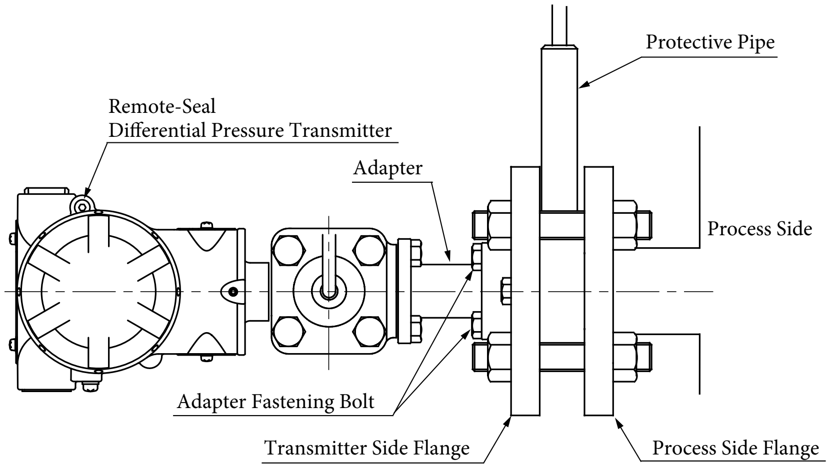


Figure 2-22. Adapter Assembly Diagram (for GTX_ _R)

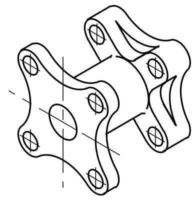


Figure 2-23. Adapter

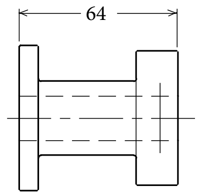


Figure 2-24. Adapter length

2. Installation Location

   Refer to 2-1-1, "General Installation Conditions."

3. Installation Method

   (1) Attach the adapter to the transmitter
   Confirm that the adapter is firmly attached to the transmitter with four bolts.
   Make sure that it is not loose.

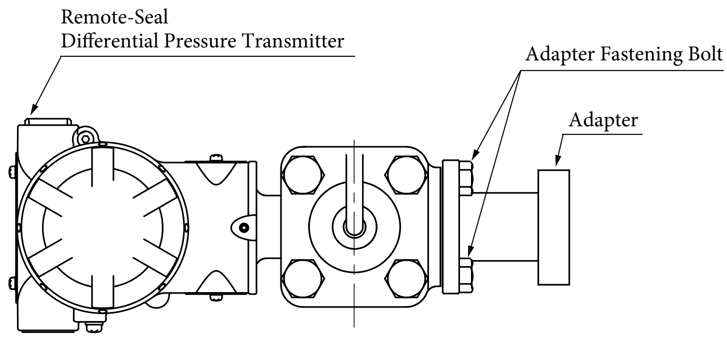


Figure 2-25. Transmitter Adapter Mount

(2) Mount the transmitter-side flange (to which the transmitter will be attached) to the process-side flange

⚠ Warning
When fastening a flange-mount transmitter or remote-seal transmitter to the flange, tighten the bolts, etc., evenly to the specified tightening torque. If they are not properly tightened, there is a danger that the process fluid will leak out and cause scalding or other harm.
If the process fluid is harmful to humans, take safety countermeasures by wearing goggles, a mask, etc. There is a danger of scalding or other harm if it gets on the skin or in the eyes, or if it is inhaled.

Before attaching the transmitter-side flange* to the adapter (which is attached to the transmitter), bolt the flange to the process-side flange.

* The transmitter can be mounted on either the high pressure or low pressure-side flange.

Note
• If instrumenting a sealed tank using anything other than the model GTX35R, always mount the high pressure-side connection flange (HP) to the upper side of the process.

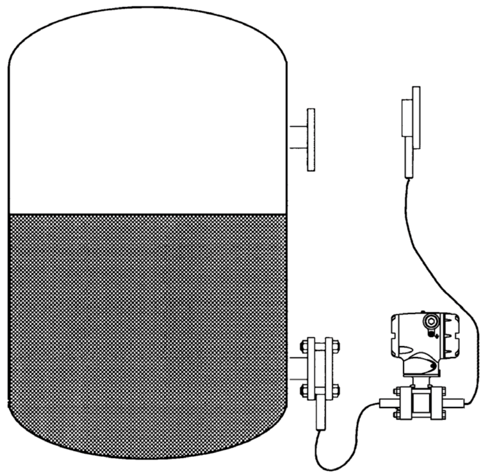


Figure 2-26. Mounting the Process-Side Flange (Example 1)

(3) Mount the flange on the process flange
Attach the transmitter-side flange to the process-side flange using a mounting bolt and gasket.

(4) Selecting the flange gasket
Prepare the flange gasket on the process-side. For this, select a shape that doesn't allow it to come in contact with the pressure-receiving diaphragm. Select appropriate materials based on the fluid, the working pressure, the temperature, etc., and also be careful of the inside diameter.

Important

- If the flange shape is of the 3B flush mount type, its diaphragm diameter is 95 mm, so a commercial 3B gasket (inner diameter of 80 to 90 mm) should not be used. Since the inner diameter of a commercial 3B gasket is too small, it may come in contact with the diaphragm, resulting in errors or damage to the diaphragm.
- Select a gasket that will not contact the diaphragm, even if the gasket shifts or becomes deformed. If the gasket is made of soft material, it may be deformed when it is attached.

Note

- Center the gasket accurately. The gasket can sag or become misaligned, especially if it is vertical.
- If the gasket has an FEP film, install it according to the "Attaching the FEP Film" section below, and do not overtighten.
- If the transmitter is installed on the flange located on the upper side of the process, the tank's inner pressure must be at atmospheric pressure or higher. If tank pressure will drop below this range, be sure to install the transmitter on the low side of the process.

(5) Mount the transmitter and adapter on the transmitter-side flange
Securely fasten the transmitter body + adapter from step (1) to the transmitter-side flange mounted in step (2) using 4 fastening bolts.

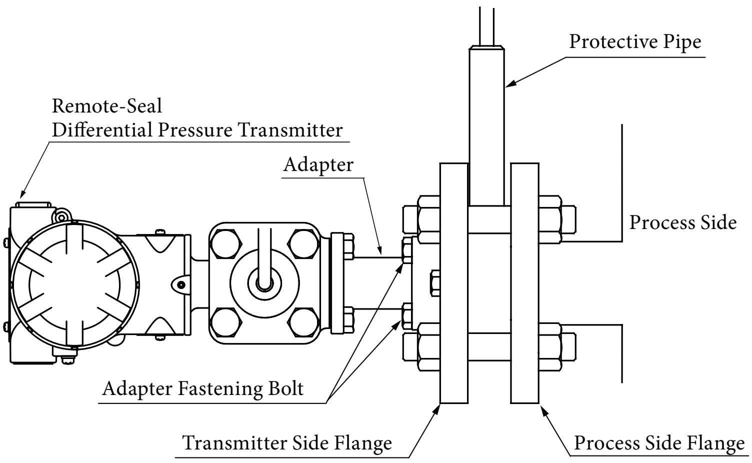


Figure 2-27. Mounting the Transmitter Flange

(6) Mount the other transmitter-side flange onto the process-side flange
Mount the remaining transmitter-side on the process-side flange (see Figure 2-29 and (3), (4)).

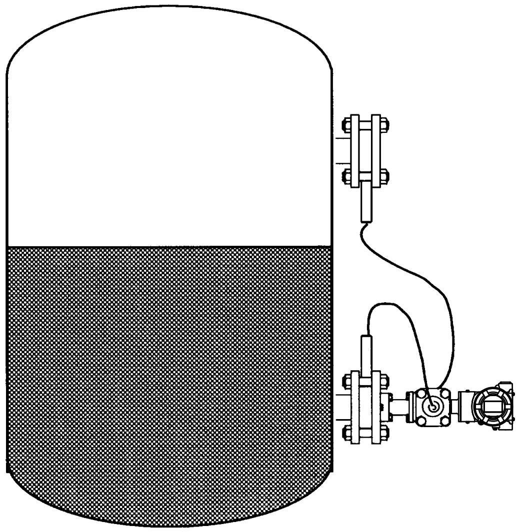


Figure 2-28. Mounting the Process-Side Flange (Example 2)

4. Bundle the capillary tubes using the tube clamp already attached to one capillary tube. Securely fasten the tube clamps but be careful not to crush the capillary tubes.

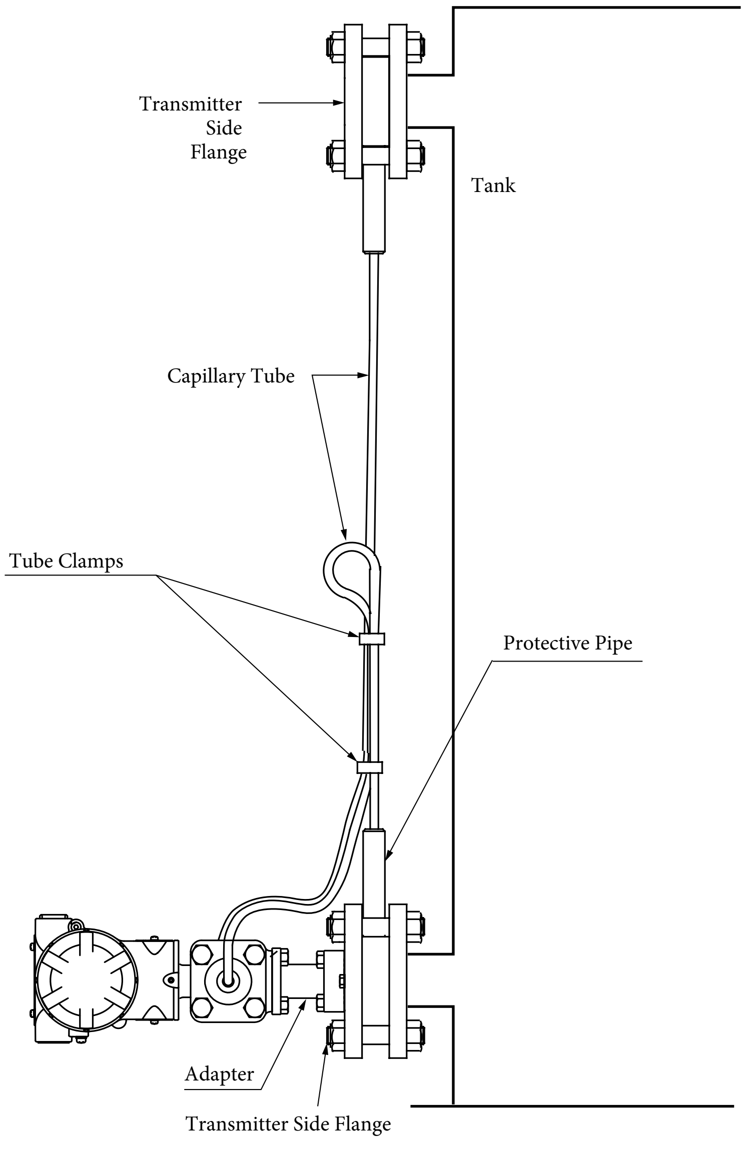


Figure 2-29. Mounting the Tube Clamps

5. Handling the capillary tube
   (a) When handling the capillary tube, do not twist it.
   (b) When unwinding a capillary tube, hold the flange portion and turn the tube such that it reverts to a big loop.
   (c) We recommend installing the capillary tube so that it runs downward instead of horizontally.
   (d) Do not turn the capillary tube in a way that twists it where it connects to the flange.
   (e) We recommend securing the middle of the capillary tube to prevent vibration.

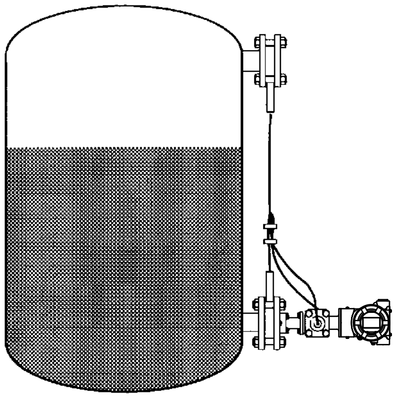
Note

- As shown in Figure 2-30, if you wish to raise a folded capillary tube, higher than the lower flange of the process, the tank's internal pressure must be at least as high as the atmospheric pressure. If the tank's internal pressure will drop lower, the folded capillary tube must always be lower than the lower flange of the process.
- If you wish to lead out the capillary tube upward, always specify the olefin coating for the tube.
- If the olefin coating is not used, the capillary tube output should run downward. If it runs upward, rain water may collect in the protective pipe of the capillary outlet.

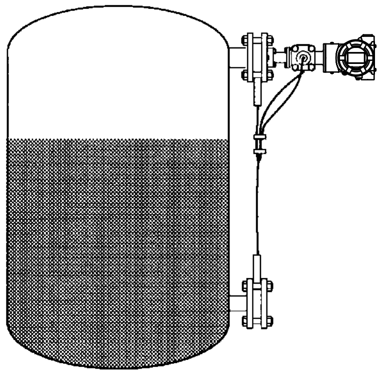
6. Zero Adjustment
   After installing the transmitter on the tank, adjust the zero point.
   Refer to sections 3-8 to 3-10 for the zero point adjustment method.

7. Setting the Fill Fluid Temperature Compensation Function
   Set the height between the flanges using the communicator.
   Refer to section 4-5-5 for the setting procedure and features.
   Enabling this function will minimize the effects of ambient temperature change and greatly improve zero point shift.

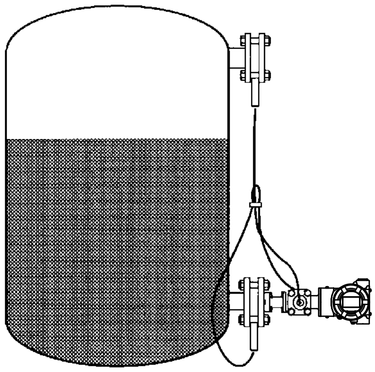
8. Installation Examples for Various Conditions



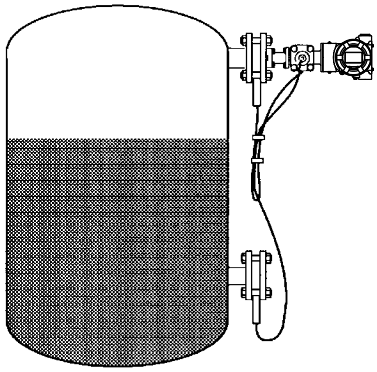
Tank Internal Pressure: 1 atm
Attachment: bottom of tank
Capillary Tube Olefin Coating: yes



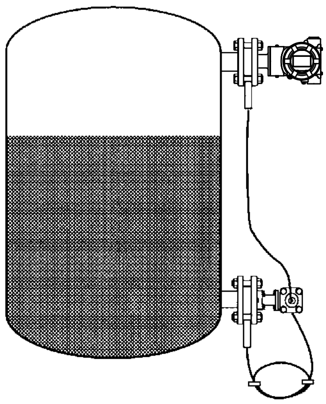
Tank Internal Pressure: 1 atm
Attachment: top of tank
Capillary Tube Olefin Coating: yes



Tank Internal Pressure: 1 atm
Attachment: bottom of tank
Capillary Tube Olefin Coating: no



Tank Internal Pressure: 1 atm
Attachment: top of tank
Capillary Tube Olefin Coating: no



Tank Internal Pressure: vacuum (lower than atmospheric pressure)

Figure 2-30. Installation Examples for Various Conditions

2-2-8. 1/2B Remote Installation (GTX_ _R/GTX_ _U)

■ *Installation Overview*

1. Attachment Dimensions

   Refer to the section on external dimensions in Appendix P

2. Installation Method

   (1) Attach the adapter to the transmitter
   Confirm that the end of the capillary tube is firmly fastened to the adapter with 4 pairs of bolts/nuts. Coat the bolts with grease.

   (2) Mounting onto the process
   The following is an example of mounting on the tank. Refer to section 2-2-5, “Integration with the Process (GTX_ _F/GTX_ _R/GTX_ _U/GTX_ _S),” for details.

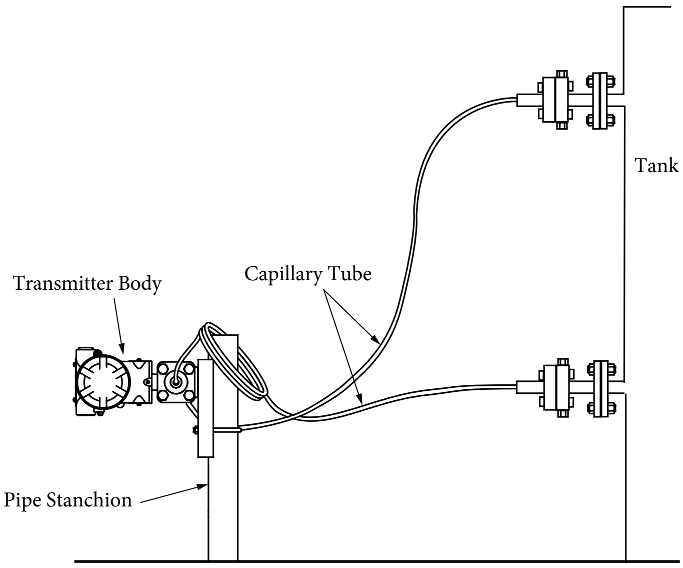


Figure 2-31. Tank Level Instrumentation Example

Note

- When handling capillary tubes, be careful not to twist them.
- The bend diameter of the capillary tubes is 5 cm minimum. Do not bend them beyond that by applying excessive force.
- In addition, depending on its properties, the process fluid may in some cases solidify in the adapter and impede measurement. Keep the area around the adapter sufficiently warm so that the process fluid does not solidify.

2-2-9. Inline (Direct) Mounting (GTX_ _G)

This device can be directly screwed onto the process pipes (direct mounting) or optionally, can be mounted using the mounting brackets on a 2 inch pipe or panel.

■ *For Direct Mounting*

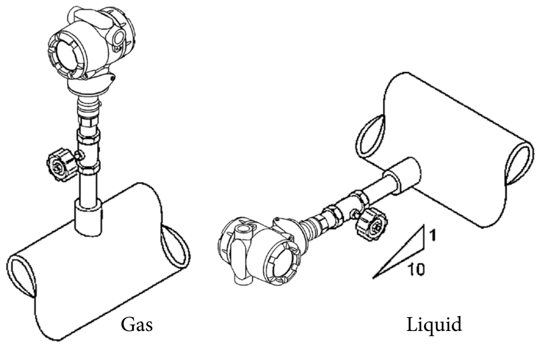


Figure 2-32. Direct Mounting Instrumentation Example

⚠ Warning

- The threads on this device and on the process pipes should conform to the same standard. If different standard threads are connected, there is a danger that the process fluid will leak out and cause scalding or other harm.
- If the connecting thread of a direct-mount transmitter is a parallel thread, use the gasket supplied with the product. If a gasket is not used, or a gasket other than the supplied gasket is used, there is a danger that the process fluid will leak out and cause scalding or other harm.
- If the connecting thread of a direct-mount transmitter is tapered, wind sealing tape around it. Without sealing tape, there is a danger that the process fluid will leak out and cause scalding or other harm.
- If the connecting thread of a direct-mount transmitter is tapered, do not loosen it after it has been tightened. There is a danger that the process fluid will leak out and cause scalding or other harm.

  If the orientation of the indicators and terminal blocks need to be aligned to each other, unlock the device's case, and rotate only the case itself. (Allowable rotation range: within ±180°)

⚠ Caution

If the device's connecting thread is male, do not take off the protective cap that came with it until right before installation.

The thread is sharp and may cut your hand.

Important

- When screwing in the device to the process pipes, tighten it using a tool such as a wrench, holding the hexagonal area (Figure 2-33). If you tighten while holding the case, the case itself will rotate excessively, which might snap the internal wiring.
- If the device is tightened when it is filled with the process liquid, it may be subject to excessive pressure and be damaged. Leave some air space as illustrated in Figure 2-34.

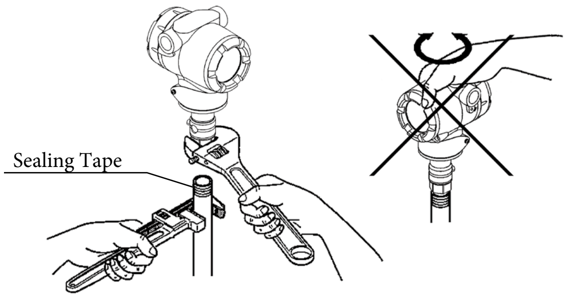


Figure 2-33. Installation Precautions

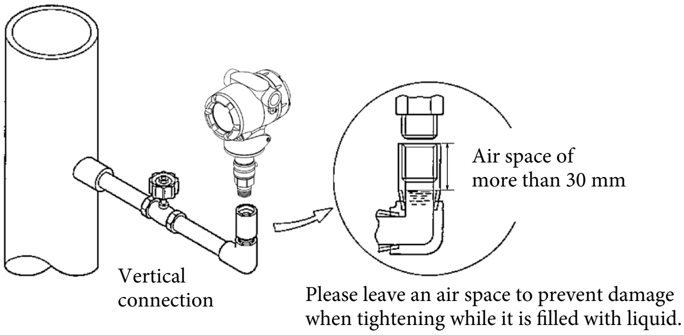


Figure 2-34. Installation Precautions

Note

- Do not block the pipe that is open to the air. If blocked, accurate measurement is not possible.
- Do not pull out the pipe that is open to the air. It contains a filter to prevent foreign objects from entering inside the pipe. Without the filter, moisture or dust may enter, causing inaccurate measurement.
- Point the rubber fitting, which covers the pipe that is open to the air, downward so that rainwater does not get inside. If rain water gets in, accurate measurement is not possible.

■ *When Using Mounting Brackets (Optional)*

Mounting brackets are provided as an option. Using mounting brackets, 2 inch pipe mounting or panel mounting are possible.

Mounting brackets can be purchased separately.

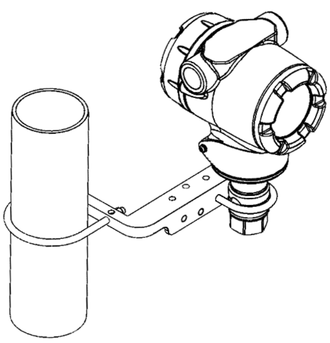


Figure 2-35. Example of Installation on 2 inch Pipe with Mounting Bracket

Note

- If you are mounting the device on 2 inch pipe or panel with a mounting bracket, make sure to consider the device's mass, wetted-part temperature, and vibration before instrumentation.
- Take process fluid into account when considering how to connect the connecting pipes.
- Select a location for the pressure outlet that does not receive any unnecessary dynamic pressure.
- Install the device in a place where the connecting pipes from the pressure outlet to the instrumentation will not be too long, and the head difference is minimized.
- Proper tightening torque value (for reference) 3 to 4 N·m (bolt size: M5, material: SUS304)

2-3. Piping

⚠ Warning

When installing the product, make sure that the gaskets do not stick out at the connections with the process (connections between adapter flanges and flanges). There is a danger that the process fluid will leak out and cause scalding or other harm.

If the process fluid is harmful to humans, take safety countermeasures by wearing goggles, a mask, etc. There is a danger of scalding or other harm if it gets on the skin or in the eyes, or if it is inhaled.

2-3-1. Flow Rate Measurement Piping (GTX_ _D)

2-3-1-1. Piping Detail

■ ***Introduction***

The piping method differs based on the device's position, status of pipeline installation, etc, but in general it uses a three-way manifold valve, and if necessary, involves connecting an extension pipe.

For the model GTX_ _D, note that there are high pressure side and low pressure side pipe connection ports.

The three-way manifold valve is sold separately.

■ ***Three-Way Manifold Valve (sold separately)***

The general form of the three-way manifold valve is as follows.

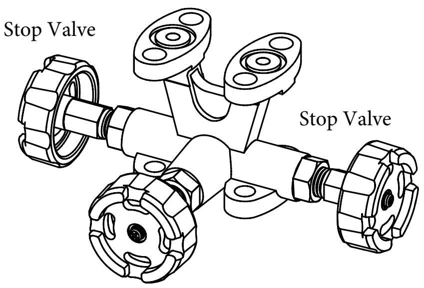


Figure 2-36. Three-Way Manifold Valve

■ *Extension Pipe (sold separately)*

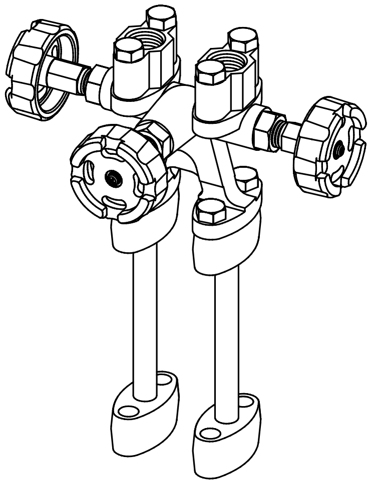


Figure 2-37. Extension Pipe

■ *Mark on High Pressure-Side of the Device*

An "H" is displayed on the high pressure side of the center body of this device to indicate high pressure, so be sure to check this during piping. (The side without a mark is the low pressure side).

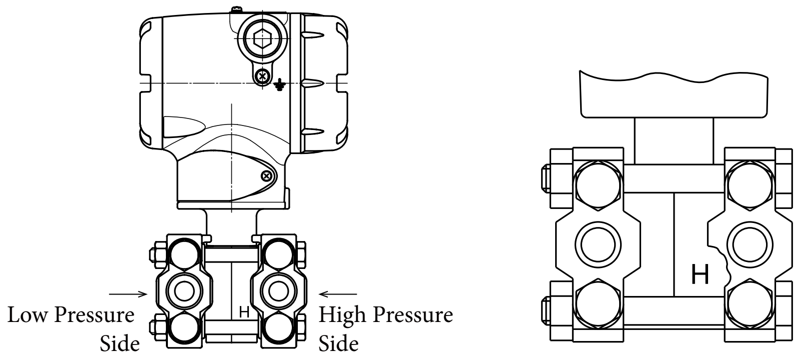


Figure 2-38. Mark on High Pressure Side of Center Body

■ *Pipe Selection*

Determine the schedule number, nominal thickness, etc., of the connecting pipes from the process according to the conditions, such as the process pressure, etc.

An example of a steel pipe is 1/2B, schedule number 80.

■ *Required Components*

The following components are required for piping. See the piping example figure.

- Three-Way Manifold Valve
- Piping
- Master Valve
- Unions or Flanges
- T-Joint
- Drain Valve
- Drain Plug
- Vent Plug
- Seal Pot (only for piping for vapor flow rate measurement)

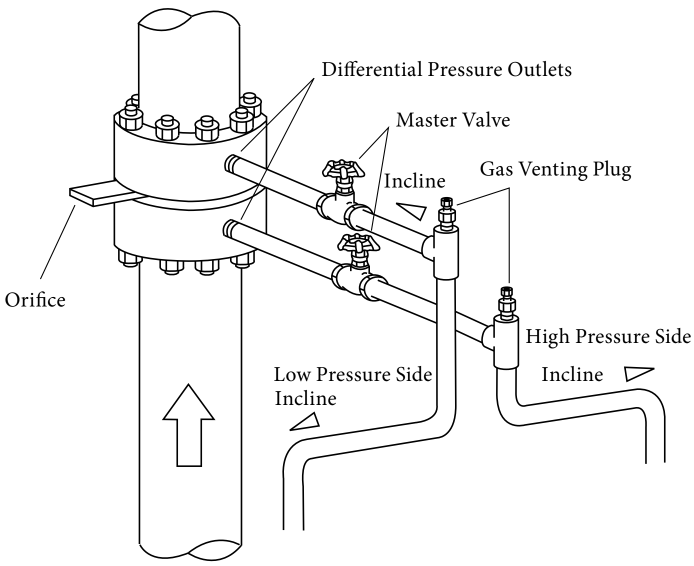
2-3-1-2. Liquid or Gas Flow Rate Measurement Piping

■ *Recommended Piping Example 1*

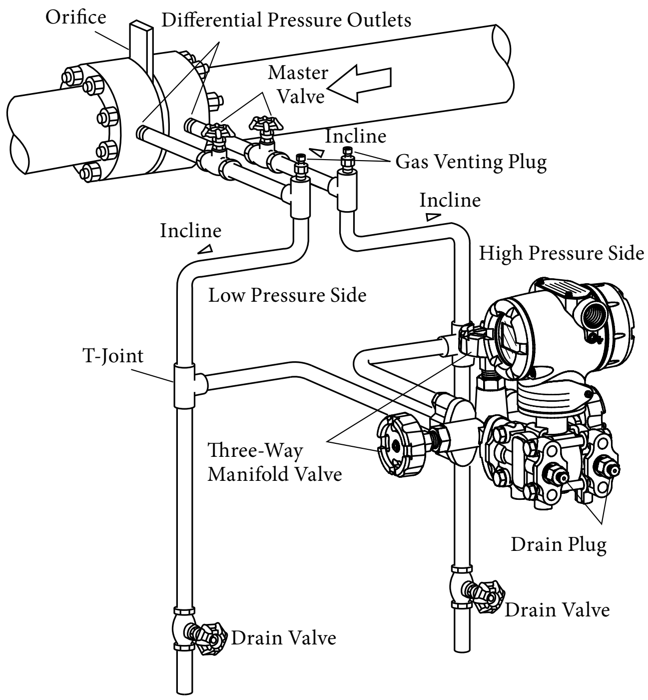
The following is a typical piping example in which the device is lower than the differential pressure outlets from the process pipe. See Figure 2-39, Figure 2-40.

Be sure to observe the following points.

- The piping of the differential pressure outlet should be on an incline.
  Meaning of the incline symbol ◿ in the figure: Low Level ◿ High Level
- After performing piping, confirm that there are no pressure leaks in the connecting pipes, three-way manifold valve, transmitter, etc.



Process Pipe (Vertical)



Process Pipe (Horizontal)

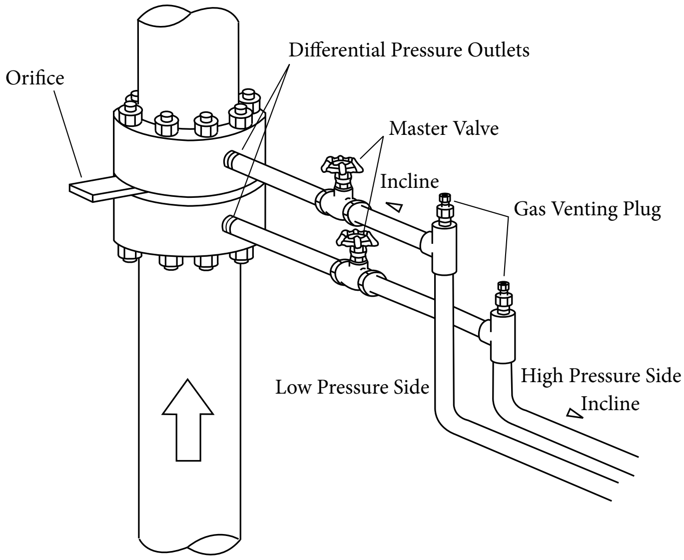
Figure 2-39. Examples of Piping for Measuring Fluid or Gas Flow Rate
(If the device is lower than the differential pressure outlets from the process pipe)

■ *Recommended Piping Example 2*

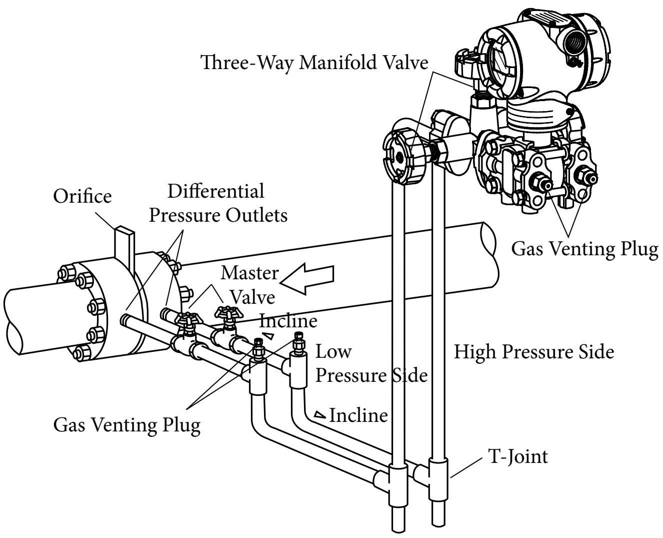
Figure 2-40 illustrates a typical piping example in which the device is higher than the differential pressure outlets from the process pipe.

Be sure to observe the following points.

- The piping of the differential pressure outlet should be installed on an incline.
  Meaning of the incline symbol ⊿ in the figure: Low Level ⊿ High Level
- After connecting the piping, confirm that there are no pressure leaks in the connecting pipes, three-way manifold valve, transmitter, etc.



Process Pipe (Vertical)



Process Pipe (Horizontal)

Figure 2-40. Example of Piping for Measuring Fluid or Gas Flow Rate
(If the device is higher than the differential pressure outlets from the process pipe)

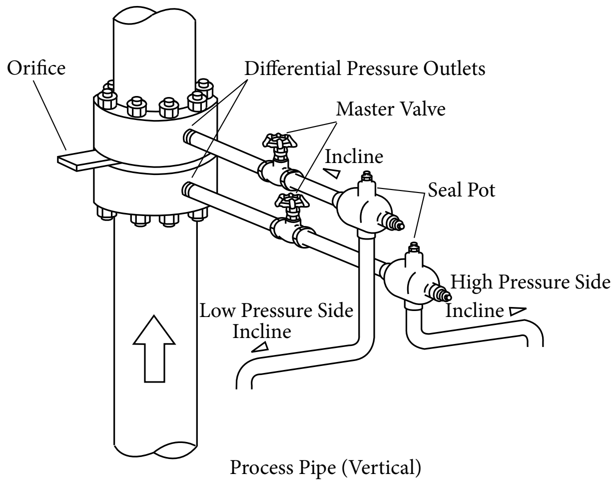
2-3-1-3. Vapor Flow Rate Measurement Piping

■ *Recommended Piping Example*

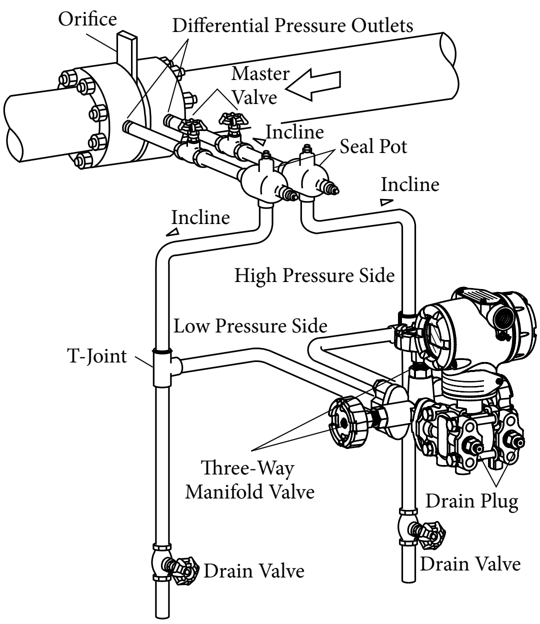
Figure 2-41 illustrates a typical piping example in which the device is lower than the differential pressure outlets from the process pipe.

Make sure to ensure the following.

- The piping of the differential pressure outlet should be installed on an incline.
  Meaning of the incline symbol ◺ in the figure: Low Level ◺ High Level
- After connecting the piping, confirm that there are no pressure leaks in the connecting pipes, three-way manifold valve, transmitter, etc.
- When the piping process pipe is vertical, installing the seal pot at different heights as shown in Figure 2-41 prevents zero drift in the differential pressure gauge, which otherwise would occur readily. Incidentally, in this case it is not possible to perform the usual zero adjustment using the three-way manifold valve. Use the communicator to do zero adjustment for any zero shifts that result from the seal pot being at a different level than the water dripping.



Process Pipe (Vertical)



Process Pipe (Horizontal)

Figure 2-41. Example of Piping for Measuring Vapor Flow Rate
(If the device is lower than the differential pressure outlets from the process pipe)

2-3-2. Piping for Pressure Measurement (GTX_ _D/GTX_ _G/GTX_ _A)

2-3-2-1. Piping Detail

■ *Introduction*

Connect the high pressure side to the process pipe, and open the low pressure side to the atmosphere.

■ *Mark on High Pressure-Side of the Device*

An "H" is displayed on the high pressure side of the center body of this device to indicate high pressure, so be sure to check this during piping. (The side without a mark is the low pressure side).

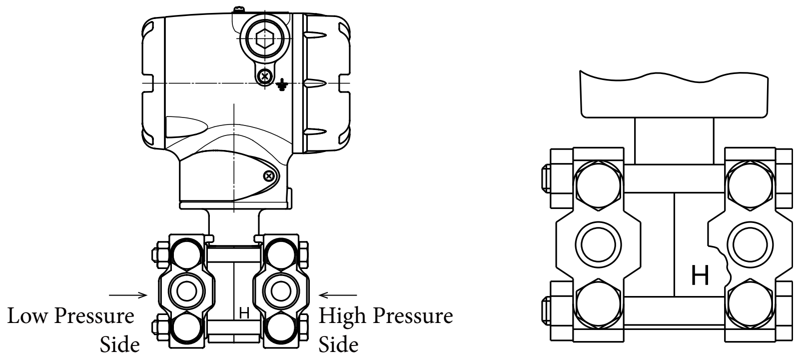


Figure 2-42. Mark on High Pressure Side of Center Body

■ *Required Components*

The following components are required for piping. See the piping example diagrams.

- Piping
- Master Valve
- Unions or Flanges
- T-Joint
- Drain Valve
- Drain Plug
- Gas Venting Plug

2-3-2-2. Piping for Pressure Measurement

■ *Recommended Piping Example*

This example represents a typical piping example for measuring gas pressure. Make sure of the following.

- The piping of the pressure outlet should be installed vertically.
- After connecting the piping, confirm that there are no pressure leaks in the connecting pipes, transmitter, etc.

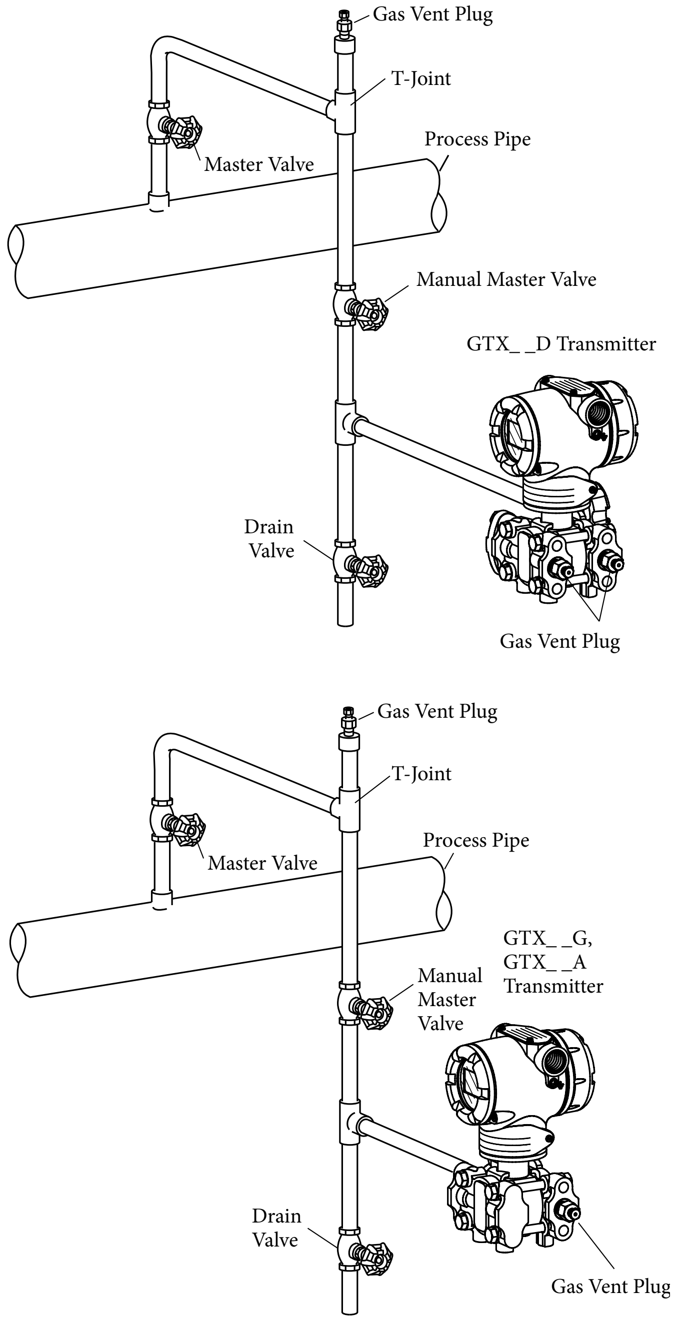


Figure 2-43. Piping for Pressure Measurement

■ *Piping Method*

The piping method for measuring fluid pressure differs depending on the meter's installation position, pipeline conditions, etc. The figure shows typical piping examples using a pressure gauge.

Run the piping as shown below.

1. Use a T-shaped coupling for the connecting pipe.
2. Install a master valve between the connecting pipe inlet and the T-shaped coupling.
3. If the process uses horizontal piping, set the incline so that the drain from the pressure line can escape.

   Note: choose wisely the standard, shape, pipe dimensions, and material of the coupling if the pressure is high.
4. As for the piping from the process, determine the schedule number, nominal thickness, etc., of the conduit according to factors like the process pressure.

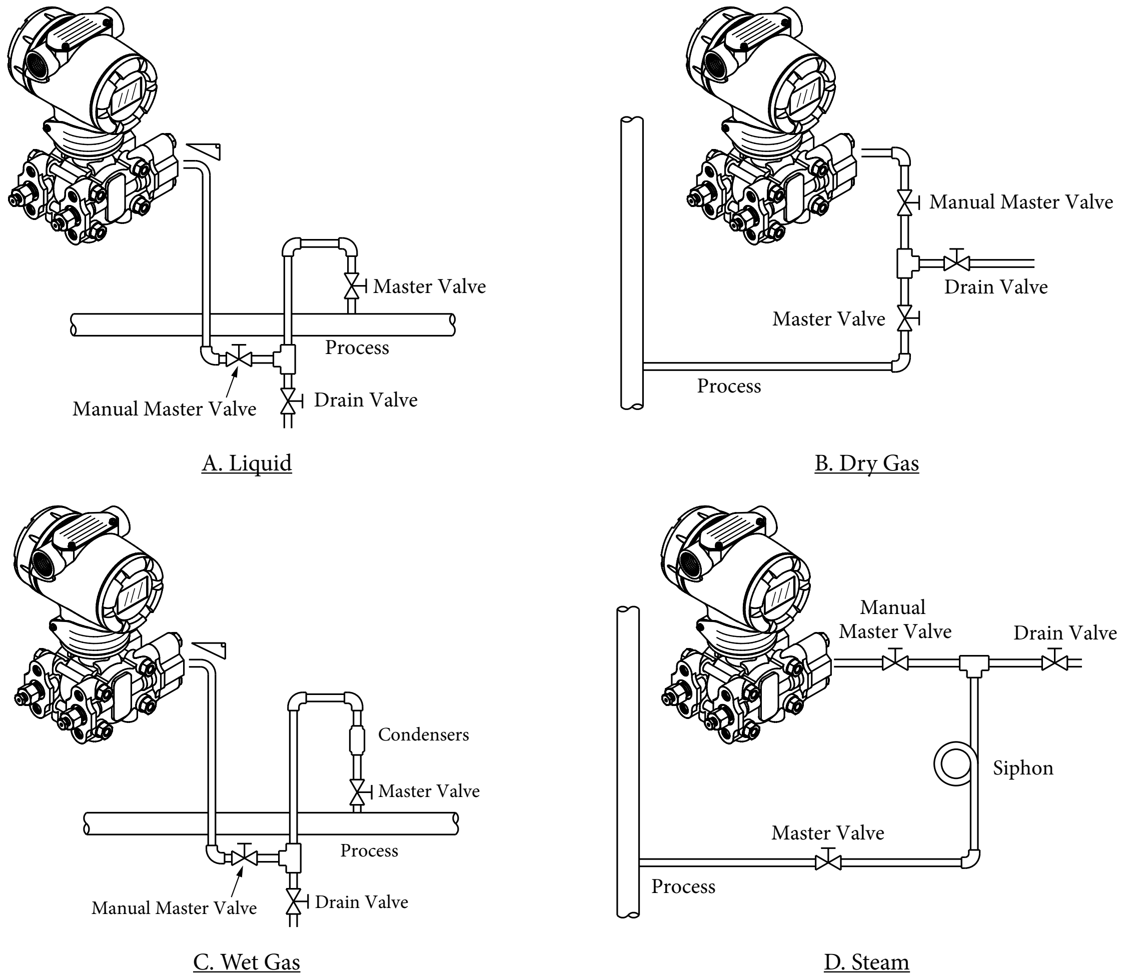


Figure 2-44. Piping Example

■ *Auxiliary Equipment*

1. Oil Seal and Air Purge
   If it is inconvenient to guide the pressure medium (such as fluid with suspension, high viscosity, or corrosiveness) directly to the element, do a seal or purge. There are various ways of doing a seal or purge. Please contact us for more information.
2. Preventing Pulsation
   If there is extreme pulsation or excessive pressure variation in the process, install a throttle valve, etc., in the conduit.

2-3-3. Piping for Liquid Level Measurement (GTX_ _D/GTX_ _G)

2-3-3-1. Piping Detail

■ *Introduction*

The method of measuring the liquid level in a tank using a GTX_ _D transmitter differs depending on whether the tank is open or sealed. In addition, if the tank is sealed, the piping method also will differ depending on whether the gas seal method (dry leg) or the liquid seal method (wet leg) is used. If measuring the liquid level using a GTX_ _G transmitter, it will generally be measured via an open tank.

■ *Mark on High Pressure-Side of GTX_ _D*

An "H" is displayed on the high pressure side of the center body of GTX_ _D to indicate high pressure, so be sure to check this during piping. (The side without a mark is the low pressure side).

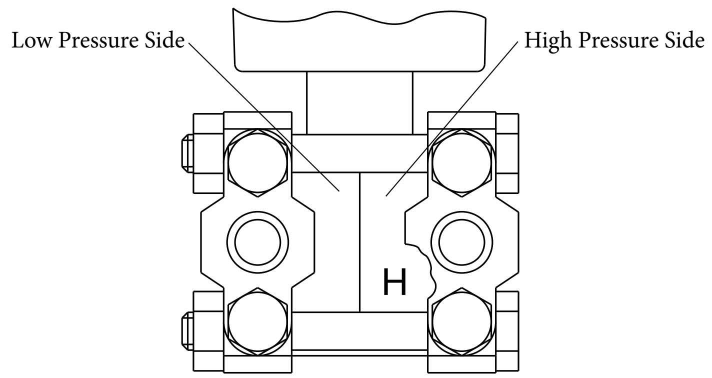


Figure 2-45. Mark on High Pressure Side of Center Body

Note

If the amount of suppression specified on the nameplate at the time of product shipment is more than 50% of the span, the "H" is engraved on the lower left side towards the front. In this case, connect the high pressure side of the process connection port on the right side (where nothing is carved, i.e. the carved H) toward the front.

Example range: when range is –50 to +20 kPa.

Suppression=50 kPa Span=70 kPa

Since 50>70/2=35, the amount of suppression is greater than half the span. When the H is carved on the lower left side toward the front, the high pressure side of the process connection port will be on the right hand side.

■ *Required Components*

The following components are required for piping. See the piping example figure.

- Three-Way Manifold Valve Piping
- Master Valve
- Unions or Flanges
- T-Joint
- Drain Valve
- Drain Plug
- Seal Pot (only for sealed tank, wet leg)

2-3-3-2. Open Tank Piping

■ *Recommended Piping Example*

For open tanks, connect the high pressure side of the device to the lower portion of the tank, and open the low pressure side to the atmosphere.

After connecting the piping, confirm that there are no pressure leaks from the connecting pipes, transmitter, three-way manifold valve, etc.

A typical piping example is shown below.

Always connect the high pressure side of the device to the lower part of the tank.

The device should also be installed lower than the lowest liquid level to be measured.

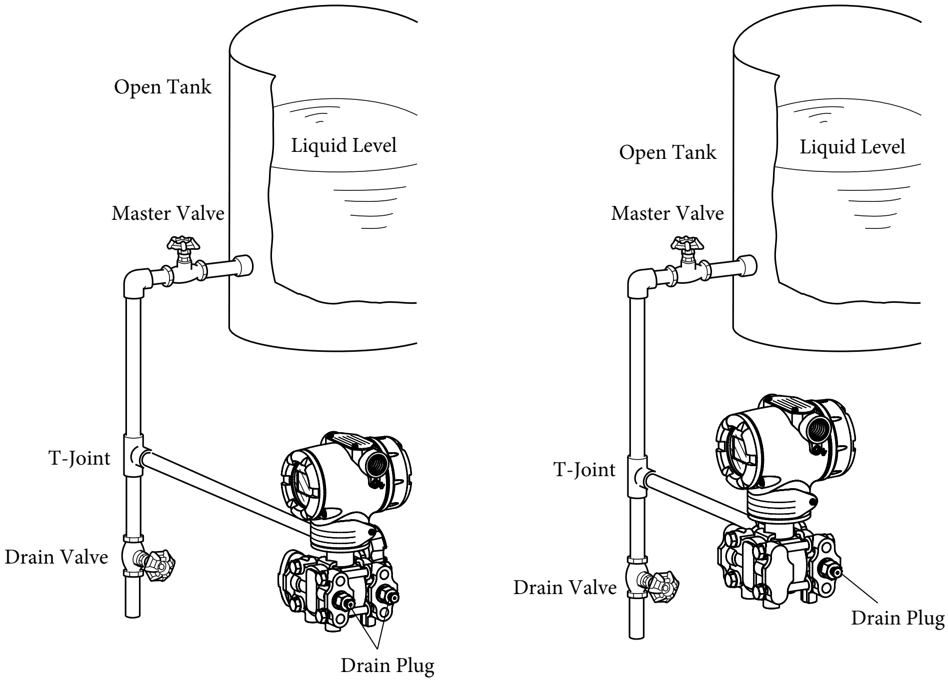


Figure 2-46. Open Tank Piping Example

2-3-3-3. Sealed Tank Piping

■ *Recommended Dry Leg Piping Example*

For dry leg, connect the high pressure side of the device to the lower portion of the tank, and connect the low pressure side to piping for the tank's gas seal. After connecting the piping, confirm that there are no pressure leaks from the connecting pipes, transmitter, three-way manifold valve, etc.

A typical piping example for the GTX_ _D transmitter is illustrated below.

Always connect the high pressure side of the transmitter to the lower tank area.

The device should also be installed lower than the lowest liquid level to be measured.

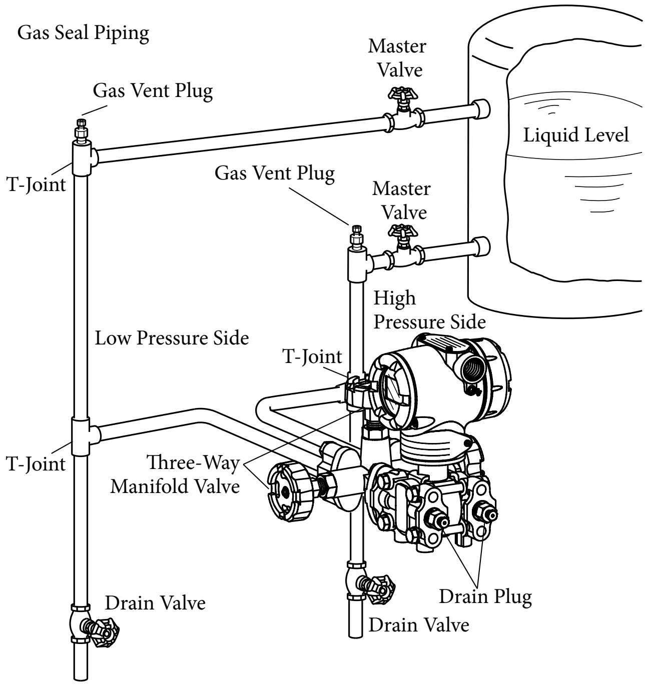


Figure 2-47. Closed Tank, Dry Leg Piping Example

■ *Recommended Wet Leg Piping Example*

For wet leg configuration, connect the high pressure side of the device to the piping for the tank's liquid seal, and connect the low pressure side to the lower portion of the tank. After connecting the piping, confirm that there are no pressure leaks from the connecting pipes, transmitter, three-way manifold valve, etc.

A typical piping example involving the GTX_ _D transmitter is illustrated below. Always connect the high pressure side of the transmitter to the upper tank area.

The device should also be installed lower than the lowest liquid level to be measured.

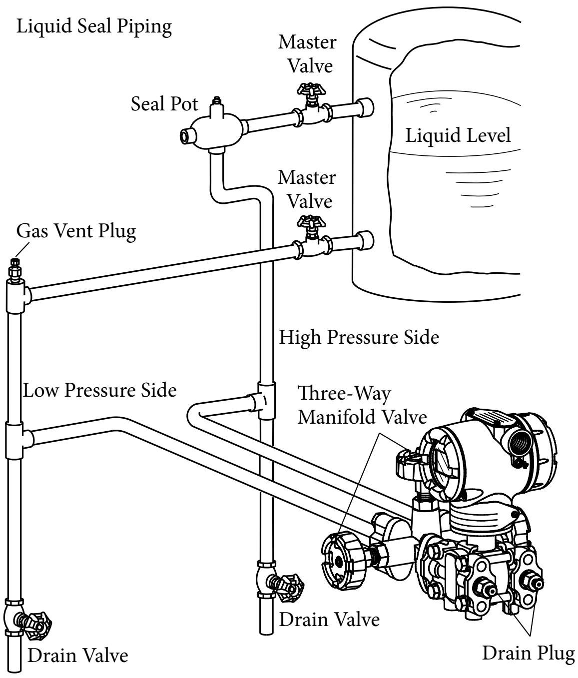


Figure 2-48. Closed Tank, Wet Leg Piping Example

2-4. Electrical Wiring

2-4-1. General Wiring

■ *Introduction*

Wiring which is not subject to explosion-proofing standards is described below.

⚠ Warning	
❗	Turn off the power during wiring. There is a risk of electric shock.
🛇	Do not do wiring work with wet hands. There is a risk of electric shock.
❗	Wear gloves when wiring. There is a risk of electric shock.
❗	Use a power supply for this product which has overcurrent protection.
❗	To ensure safety, have a qualified person with specific technical expertise in instrumentation work, electrical work, etc., perform the installation, wiring, and the like. There is a risk of electric shock during the process.

⚠ Caution	
❗	Ground the product properly in accordance with the instructions in this operation manual. Improper grounding may have an effect on the output or violate the explosion-proof guidelines.
❗	Wire according to the specifications. Incorrect wiring can cause instrument damage or malfunction.
❗	Supply power should comply with the specifications. Inputting an incorrect power supply can damage the instrument.

■ *Wiring*

When wiring, refer to the following diagram.

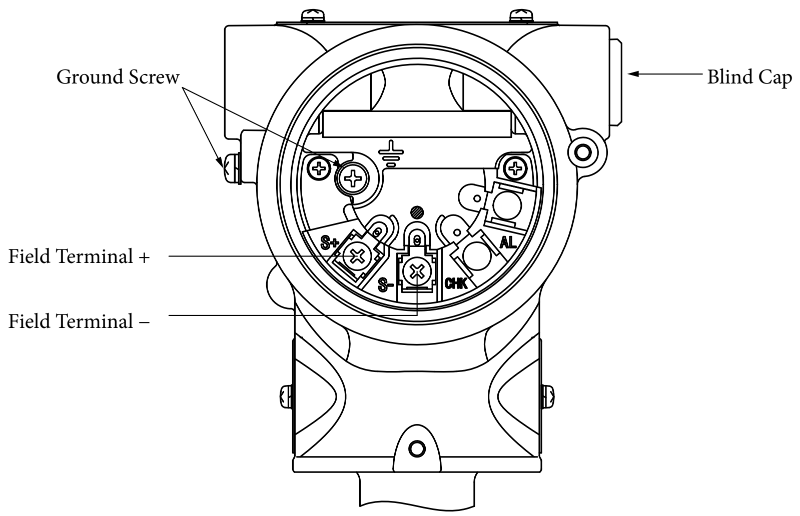


Figure 2-49. Wiring

■ *Wiring Conduit*

Wiring to the transmitter case should be run as follows.

- When running wiring to the device terminal, connect a conduit pipe to the conduit port on the side of the device and route the wiring through it.
- In order to prevent rainwater from entering the device, block off the conduit connectors with sealant or seal plugs.
- Install the wiring cables so that they enter from the bottom of the device.
- Use elbows for changing electrical wiring orientation as necessary.

■ *Ground*

There are grounding terminals in two areas (above terminal block (G) and externally (⏚)); ground to either of these.

- Connect the ground terminal to a D-type ground (grounding resistance of less than 100 Ω) or better.
- For explosion-proof models, grounding work is absolutely necessary.
- Precautions for when there is welding work near the transmitter. Ground welding machines and welding power transformers directly; do not ground them to the stanchion pipe to which the transmitter is attached. It may be affected by the welding current.
- Insert the external ground wires to the terminal between the two flat washers. (Do not directly connect to the housing)

2-5. Changing the Position of the Process Connection Port

2-5-1. Changing the Vertical Position of the Process Connection Port (Model GTX_ _D/GTX_ _G/GTX_ _A/GTX_ _F)

■ *Introduction*

The vertical position of the process connection port of the center body cover of model GTX_ _D/GTX_ _G/GTX_ _A/GTX_ _F is preset, but it may be modified. Changing the position of the process connection port from lower area to upper area is done as follows.

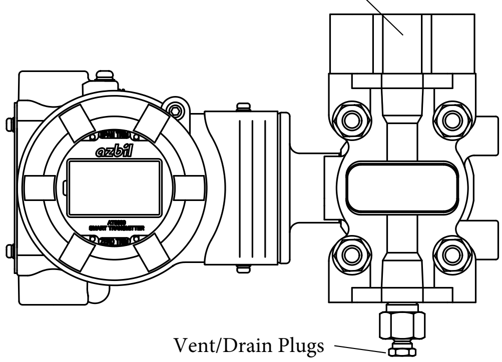


Figure 2-50. Changing the Vertical Position of the Process Connection Port

Step	Procedure
1	Remove the four bolts that hold the left and right adapter flanges.
2	Remove the two left and right vent/drain plugs.
3	Using the bolts, fasten the two adapter flanges to the upper portion of the device. Tighten the bolts to the prescribed torque. Tightening torque: SNB 7, SUS 630 20±1 N·m SUS 304 10±0.5 N·m
4	Wrap sealing tape around the threaded portion of the two vent/drain plugs, and spray them with a lubricant.
5	Fasten the vent/drain plugs to the lower portion of the device. Tighten the plugs in accordance with the prescribed torque. Tightening torque: 5±0.3 N·m

Move the process connection port from the upper area to the lower area using an analogous procedure.

Chapter 3. Starting and Stopping this Device

Summary

This chapter explains how to connect the communicator to this device.

It also gives information necessary for preparation before measurement, starting and completing the measurement, device maintenance and stopping the operation to conduct replacement, according to the type of measurement.

3-1. Preparing for Operation

3-1-1. Connecting the Communicator

General Principle on Key Operation

Please be careful of the following when operating the communicator key.

- Slowly and accurately push the key in. If the display doesn't respond, it means that the key has not been inserted yet. Slowly try to insert it again.
- If the data display window screen doesn't respond even after inserting the key, the key may be one that is not used with this device. Find the correct key and insert it.
- If you wish to redo the operation from the initial state, refer to Chapter 5.

Communicator Connection Position

Figure 3-1 specifies how to connect the communicator to the device.

Note
Always connect the communicator's communication cable and the device's terminal as follows. • Red wire: Field Terminal + • Black wire: Field Terminal –

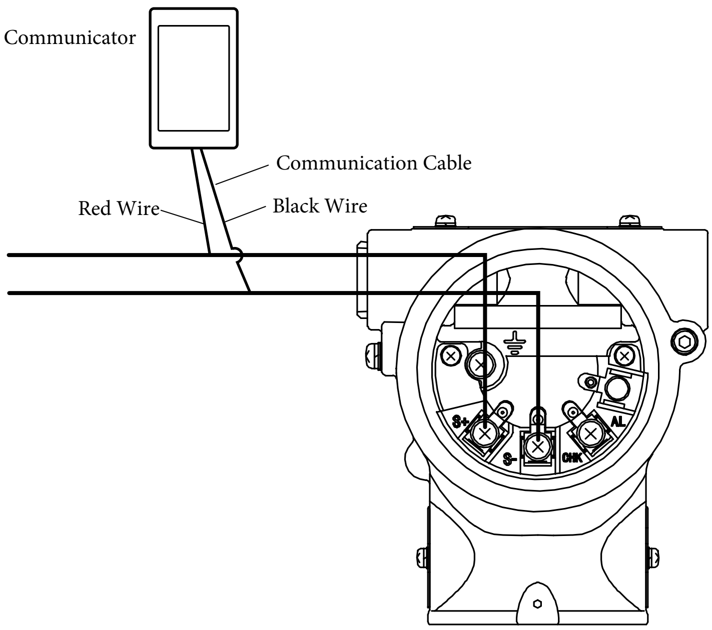


Figure 3-1. Connection with Communicator

3-2. Measurement Using GTX_ _D

3-2-1. Flow Rate Measurement

3-2-1-1. Preparing for Operation

■ ***Important Points***

⚠ Warning

⃠ When clearing the vents and drains, do not touch the process fluid that comes out of the vent or drain. There is a danger of scalding or other harm.

❗ If the process fluid is harmful to humans, take safety countermeasures by wearing goggles, a mask, etc. There is a danger of scalding or other harm if it gets on the skin or in the eyes, or if it is inhaled.

Important

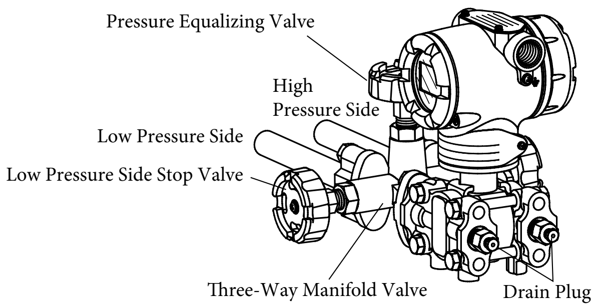
Confirm that the process is in manual control mode. If it is in automatic control mode, be sure to switch it to manual control mode before starting the following procedure.

Note

Before commencing the following procedure, the differential pressure outlet valves (master valves), drain valves, gas vent plugs (see Figure 2-36, Figure 2-37) and the stop valve of the three-way manifold valve must be closed on both the high pressure and low pressure sides. In addition, confirm that the equalizer valve of the three-way manifold valve is open.

In the procedure below, the process pressure is applied to the device's pressure-receiver.

Introducing Process Pressure

Step	Procedure
1	Open the high and low pressure side master valves (see Figure 2-36, Figure 2-37), and introduce process fluid into the connecting pipe.
2	Fill the pressure receiver of the device with process fluid. (1) Gradually open the stop valve on the high pressure side. When it is filled with process fluid, close the valve. (2) Gradually open the stop valve on the low pressure side. When it is filled with process fluid, close the valve. 
3	Set the differential pressure applied to the device to zero. Gradually open the stop valve on the high pressure side, and introduce process pressure into the device's pressure receiver. The device will attain a state (the equalized pressure state) in which equal pressure will be applied to the high pressure side and low pressure side of the device.
4	Confirm that there are no pressure leaks in the connecting pipes, the three-way manifold valve, the device itself, etc.

Zero Point Calibration with the Communicator

Check if the device input is 0 kPa.

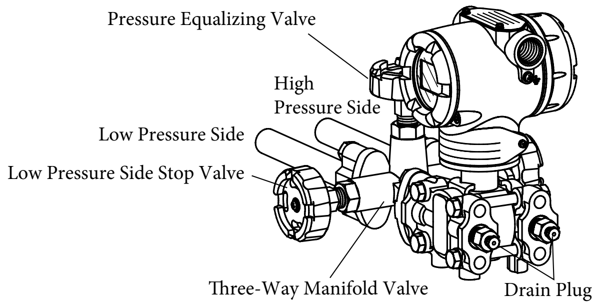
If it is not at 0 kPa, follow the instructions in Chapter 4, "Operation by Fieldbus Communication," and calibrate the device.

3-2-1-2. Starting Operation

■ ***Procedure***

Follow the procedure below to operate the valve and apply the differential process pressure to the device, then use the communicator key to display the measured value.

Operation to Apply the Process Pressure

Step	Procedure
1	Confirm that the valves of the three-way manifold valve are in the following state. (1) High pressure side stop valve: fully open (2) Low pressure side stop valve: fully closed (3) Equalizer valve: fully open
2	(1) Close the equalizer valve. (2) Gradually open the low pressure-side stop valve. 

Displaying the Measured Value

Using the communicator, check the measured value. After concluding the measurement, disconnect the clip of the communication cable and switch the process to normal operation.

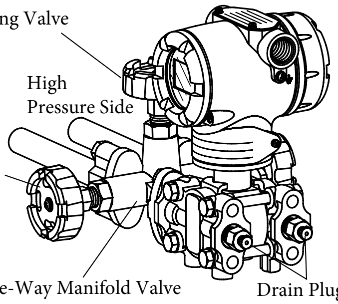
Note
Completely close the case lid of the transmitter. If it is not securely closed, rainwater and the like can enter the device and cause damage to the terminals, electronics modules, etc., located inside.

- If the input and output values are not given, recheck the set range and input/output values. If there are still no input/output values, refer to Chapter 6 for troubleshooting.
- If the data display value doesn't stabilize, refer to Chapter 4 and adjust the damping time constant.

3-2-1-3. Stopping Operation

■ *Procedure*

To stop operation of the device, carry out the following procedure.

Step	Procedure
1	Turn off the power to the device.
2	Confirm that the valves of the three-way manifold valve are in the following state. (1) Close the low pressure side stop valve. (2) Open the equalizer valve. (3) Close the high pressure side stop valve. 
3	Close the master valve on the high and low pressure sides (see Figure 2-36, Figure 2-37).

Note

- If operation will be stopped for a long period of time, remove the process fluid from inside the connecting pipes and the device's pressure receiver.
- Leave the equalizer valve open.

3-2-2. Measuring the Gas Pressure

3-2-2-1. Preparing for Operation

⚠ Warning

When clearing the vents and drains, do not touch the process fluid that comes out of the vent or drain. There is a danger of scalding or other harm.

If the process fluid is harmful to humans, take safety countermeasures by wearing goggles, a mask, etc. There is a danger of scalding or other harm if it gets on the skin or in the eyes, or if it is inhaled.

Important

Confirm that the process is in manual control mode. If it was in automatic control mode, be sure to confirm that it has been switched to manual mode.

Note

Before commencing the following procedure, check that the pressure outlet valves (master valves), manual master valve, drain valves, and gas vent plugs (see Figure 2-40) are closed.

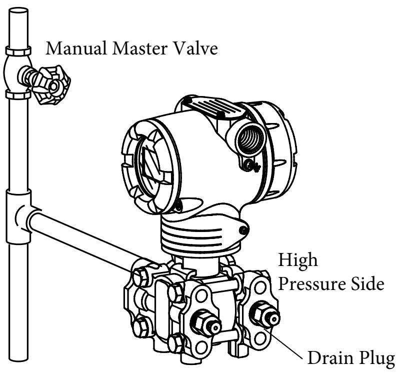
■ *Procedure*

The procedures below are used to calibrate the zero point and introduce process pressure.

Zero Point Calibration

Step	Procedure
1	Open the vent plug on both sides (high pressure and low pressure side) and release the gas in the pressure receiver.
2	Refer to Chapter 4, "Operation by Fieldbus Communication," for instructions on how to conduct zero-point calibration.
3	After finishing calibration, close the high pressure side vent plug.

Introducing Process Pressure and Bleeding Air

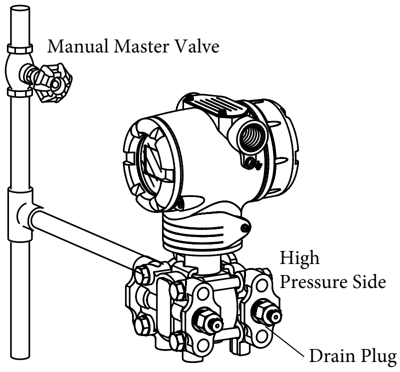
Step	Procedure
1	(1) Open the master valves (see Figure 2-40), and apply the process pressure into the connecting pipe. (2) Gradually open the manual master valve, and introduce process pressure into the pressure receiver.
2	(1) Gradually open the high pressure side vent plug to remove the air from the center body. (2) When the air has been removed, close the plug and the manual master valve. 
3	Confirm that there are no pressure leaks in the connecting pipes and the device itself.

3-2-2-2. Starting Operation

■ *Procedure*

Follow the procedure below to operate the valve and introduce process pressure into the device, and then use the communicator key to display the measured value.

Introducing Process Pressure

Step	Procedure
1	Gradually open the manual master valve. 

Displaying the Measured Value

Using the communicator, check the measured value. After concluding the measurement, disconnect the clip of the communication cable and switch the process to normal operation.

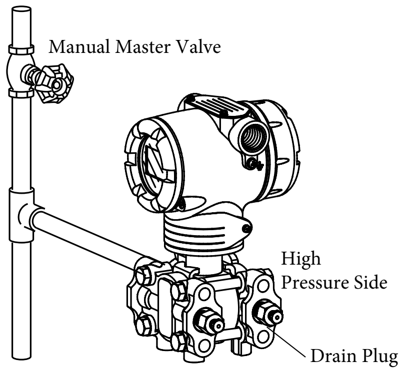
Note
Completely close the case lid of the transmitter. If it is not securely closed, rainwater and the like can enter the device and cause damage to the terminals, electronics modules, etc., located inside.

- If the input and output values are not given, recheck the set range and input/output values. If there are still no input/output values, refer to Chapter 6 for troubleshooting.
- If the data display value doesn't stabilize, refer to Chapter 4 and adjust the damping time constant.

3-2-2-3. Stopping Operation

■ *Procedure*

To stop the operation of the device, carry out the following procedure.

Step	Procedure
1	Turn off the power to the device.
2	Close the manual master valve. 
3	Close the master valves (see Figure 2-40).

Note

If operation will be stopped for a long period of time, remove the process fluid from inside the connecting pipes and the device's pressure receiver.

3-2-3. Open Tank and Sealed Tank (Dry Leg) Liquid Level Measurement

3-2-3-1. Preparing for Operation

⚠ Warning

- When clearing the vents and drains, do not touch the process fluid that comes out of the vent or drain. There is a danger of scalding or other harm.
- If the process fluid is harmful to humans, take safety countermeasures by wearing goggles, a mask, etc. There is a danger of scalding or other harm if it gets on the skin or in the eyes, or if it is inhaled.

Important

Confirm that the process is in manual control mode. If it is in automatic control mode, be sure to switch it to manual control mode before starting the following procedure.

Note

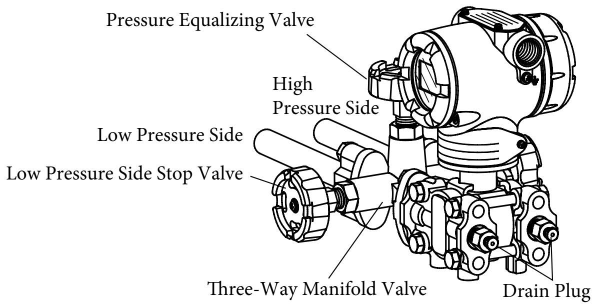
Check to make sure the differential pressure outlet valves (master valves), drain valves, gas vent plugs (see Figure 2-43, Figure 2-44,) and the stop valve of the three-way manifold valve are closed on both the high pressure and low pressure sides, and the equalizer valve of the three-way manifold valve is opened.

Calculating the Setting Range

To calculate the setting range, refer to section 3-11.

Step	Procedure
1	Open the drain plug and stop valve on both sides (high pressure and low pressure side) and release the gas in the pressure receiver. Blow out the fluid remaining inside the receiver, and remove it.
2	Refer to Chapter 4, "Operation by Fieldbus Communication," on how to conduct zero-point calibration.
3	After calibration is completed, close the high pressure-side drain plug, high pressure-side stop valve, and equalizer valve.

Introducing Process Pressure

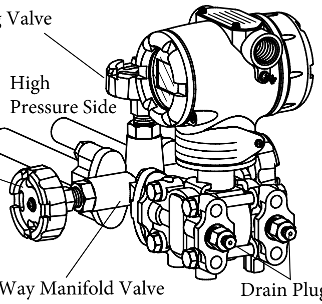
Step	Procedure
1	(1) Open the master valves (see Figure 2-43), and apply the process pressure into the connecting pipe. (2) Gradually open the high pressure-side stop valve, introduce process pressure into the device's pressure receiver, and when the pressure application is complete, close the high pressure-side stop valves. 
2	Confirm that there are no pressure leaks in the connecting pipes, the three-way manifold valve, the device itself, etc.

3-2-3-2. Starting Operation

Procedure

Follow the procedure below to operate the valve and introduce differential process pressure into the device, and then use the communicator key to display the measured value.

Introducing Process Pressure

Step	Procedure
1	Confirm that the valves of the manifold valve are in the following state. (1) High pressure side stop valve: fully closed (2) Low pressure side stop valve: fully open (3) Equalizer valve: fully closed 
2	Gradually open the high pressure-side stop valve.

Zero Point Adjustment during Measurement

To adjust the zero point while the device is measuring, refer to section 3-8.

Displaying the Measured Value

Using the communicator, check the measured value. After concluding the measurement, disconnect the clip of the communication cable and switch the process to normal operation.

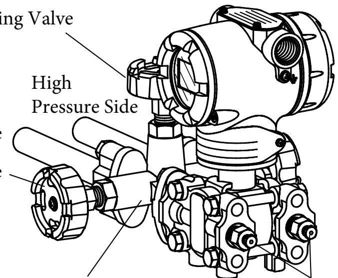
Note
Completely close the case lid of the transmitter. If it is not securely closed, rainwater and the like can enter the device and cause damage to the terminals, electronics modules, etc., located inside.

- If the input and output values are not given, recheck the set range and input/output values. If there are still no input/output values, refer to Chapter 6 for troubleshooting.
- If the data display value doesn't stabilize, refer to Chapter 4 and adjust the damping time constant.

3-2-3-3. Stopping Operation

■ *Procedure*

To stop operation of the device, carry out the following procedure.

Step	Procedure
1	Turn off the power to the device.
2	Operate the valves of the three-way manifold valve in the following order. (1) Close the low pressure side stop valve. (2) Open the equalizer valve. (3) Close the high pressure side stop valve. 
3	Close the master valve (see Figure 2-43).

Note

- If operation will be stopped for a long period of time, remove the process fluid from inside the connecting pipes and the device's pressure receiver.
- Leave the equalizer valve open.

3-2-4. Sealed Tank (Wet Leg) Liquid Level Measurement

3-2-4-1. Preparing for Operation

■ *Important Points*

⚠ Warning

When clearing the vents and drains, do not touch the process fluid that comes out of the vent or drain. There is a danger of scalding or other harm.

If the process fluid is harmful to humans, take safety countermeasures by wearing goggles, a mask, etc. There is a danger of scalding or other harm if it gets on the skin or in the eyes, or if it is inhaled.

Important

Confirm that the process is in manual control mode. If it is in automatic control mode, be sure to switch it to manual control mode before starting the following procedure.

Note

Check to make sure the differential pressure outlet valves (master valves), drain valves, gas vent plugs (see Figure 2-45) and the stop valve of the three-way manifold valve are closed on both the high pressure and low pressure sides, and the equalizer valve of the three-way manifold valve is opened.

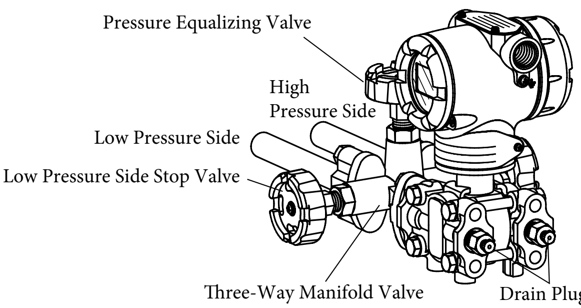
Calculating the Setting Range

To calculate the setting range, refer to section 3-11.

Procedure

The procedures below are used to calibrate the zero point and introduce process pressure.

Zero Point Calibration of the Device

Step	Procedure
1	Inject fill fluid through the seal pot, and fill the connecting pipe with fill fluid.
2	Gradually open the stop valves and drain plugs on both the high/low pressure side, and fill the device's pressure receiver with fill fluid.
3	After the fill fluid outflows from the drain plug, close the low pressure-side stop valve and drain plug. The device will attain a state (of equalized pressure) in which equal pressure will be applied to the high pressure side and low pressure side of the device.
4	Refer to Chapter 4, "Operation by Fieldbus Communication," for instructions on how to conduct zero-point calibration.
5	After finishing calibration, first close the equalizer valve, and then open the low pressure side stop valve and drain plug, and remove the fill fluid on the low pressure side. Finally, close the low pressure-side stop valve and drain plug. 

Introducing Process Pressure

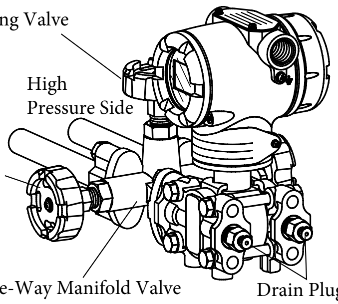
Step	Procedure
1	Open the master valves (see Figure 2-42), and introduce process fluid into the connecting pipe.
2	Gradually open the low pressure-side stop valve, introduce the process fluid into the device's pressure receiver, and when the pressure application is complete, close the low pressure-side stop valves.
3	Confirm that there are no pressure leaks in the connecting pipes, the three-way manifold valve, the device itself, etc.

3-2-4-2. Starting Operation

■ *Procedure*

Follow the procedure below to operate the valve and introduce the differential process pressure into the device, and then use the communicator to display the measured value.

Introducing Process Pressure

Step	Procedure
1	Confirm that the valves of the manifold valve are in the following state. (1) High pressure side stop valve: fully closed (2) Low pressure side stop valve: fully closed (3) Equalizer valve: fully closed
2	Fill the liquid seal pipes with fill fluid.
3	(1) Gradually open the high pressure-side stop valve. (2) Gradually open the low pressure-side stop valve. 

■ *Zero Point Adjustment during Measurement*

For zero point adjustment during measurement, refer to section 3-7.

Displaying the Measured Value

Using the communicator, check the measured value. After concluding the measurement, disconnect the clip of the communication cable and switch the process to normal operation.

Note

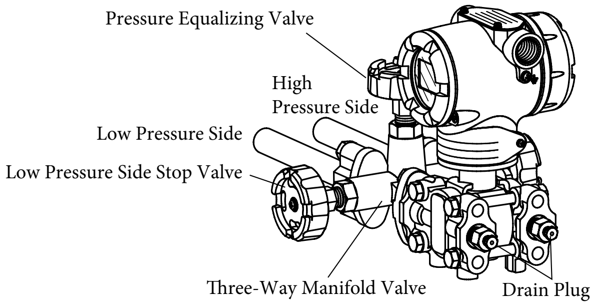
Completely close the case lid of the transmitter. If it is not securely closed, rainwater and the like can enter the device and cause damage to the terminals, electronics modules, etc., located inside.

- If the input and output values are not given, recheck the set range and input/output values. If there are still no input/output values, refer to Chapter 6 for troubleshooting.
- If the data display value doesn't stabilize, refer to Chapter 4 and adjust the damping time constant.

3-2-4-3. Stopping Operation

■ ***Procedure***

To stop operation of the device, carry out the following procedure.

Step	Procedure
1	Turn off the power to the device.
2	Operate the valves of the three-way manifold valve in the following order. (1) Close the low pressure side stop valve. (2) Open the equalizer valve. (3) Close the high pressure side stop valve. 
3	Close the master valve (see Figure 2-45).

Note

Model GTX_ _A is an absolute pressure gauge. Do not perform zero point calibration on it. If zero point adjustment on an absolute pressure gauge becomes necessary, please contact us.

3-3. Measurement with GTX_ _G/GTX_ _A

3-3-1. Pressure Measurement

3-3-1-1. Preparing for Operation

⚠ Warning

When clearing the vents and drains, do not touch the process fluid that comes out of the vent or drain. There is a danger of scalding or other harm.

If the process fluid is harmful to humans, take safety countermeasures by wearing goggles, a mask, etc. There is a danger of scalding or other harm if it gets on the skin or in the eyes, or if it is inhaled.

Important

Confirm that the process is in manual control mode. If it is in automatic control mode, be sure to switch it to manual control mode before starting the following procedure.

Note

Before beginning the following procedure, the differential pressure outlet valves (master valves), drain valves, and gas vent plugs (see Figure 2-40) must be closed.

■ *Gas Pressure Measurement Procedure*

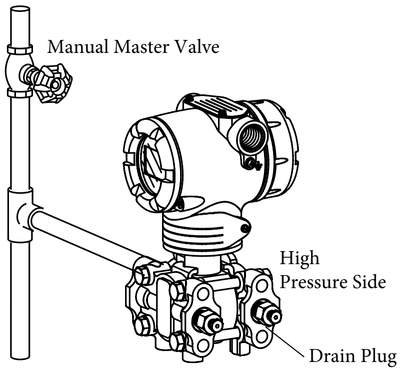
The procedures below are used to calibrate the zero point and introduce process pressure.

Step	Procedure
1	Open the vent plug and release the gas in the pressure receiver.
2	Refer to Chapter 4, "Operation by Fieldbus Communication," on how to conduct zero-point calibration.
3	After finishing calibration, close the vent plug.

Note

Model GTX_ _A is an absolute pressure gauge. Do not perform zero point calibration on it. If zero point adjustment on an absolute pressure gauge becomes necessary, please contact us.

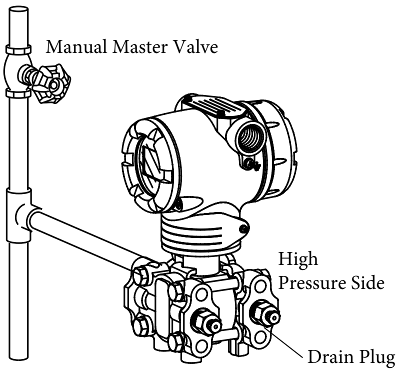
Introducing Process Pressure and Bleeding Air

Step	Procedure
1	(1) Open the master valves (see Figure 2-37), and introduce process pressure into the connecting pipe. If the process temperature here is high, wait until the connecting pipe cools down. (2) Gradually open the manual master valve, and introduce process pressure into the pressure receiver.
2	(1) Gradually open the vent plug to remove the air from the center body. (2) When the air has been removed, close the plug and the manual master valve. 
3	Confirm that there are no pressure leaks in the connecting pipes and the device itself.

3-3-1-2. Starting Operation

Follow the procedure below to operate the valve and apply the process pressure to the device, and then use the communicator key to display the measured value.

Operation to Apply the Process Pressure

Step	Procedure
1	Gradually open the manual master valve. 

Displaying the Measured Value

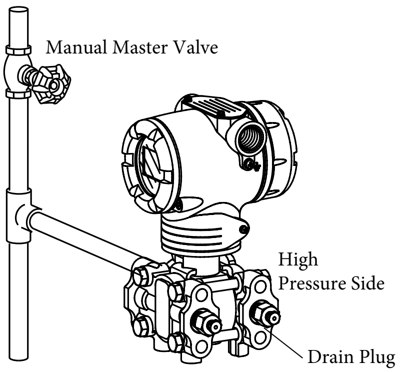
Using the communicator, check the measured value. After concluding the measurement, disconnect the clip of the communication cable and switch the process to normal operation.

Note
Completely close the case lid of the transmitter. If it is not securely closed, rainwater and the like can enter the device and cause damage to the terminals, electronics modules, etc., located inside.

3-3-1-3. Stopping Operation

■ ***Procedure***

To stop the operation of the device, carry out the following procedure.

Step	Procedure
1	Turn off the power to the device.
2	Close the manual master valve. 
3	Close the master valves (see Figure 2-40).

Note
If operation will be stopped for a long period of time, remove the process fluid from inside the connecting pipes and the device's pressure receiver.

3-3-2. Liquid Level Measurement

3-3-2-1. Preparing for Operation

⚠ Warning

- When clearing the vents and drains, do not touch the process fluid that comes out of the vent or drain. There is a danger of scalding or other harm.
- If the process fluid is harmful to humans, take safety countermeasures by wearing goggles, a mask, etc. There is a danger of scalding or other harm if it gets on the skin or in the eyes, or if it is inhaled.

Important

Confirm that the process is in manual control mode. If it is in automatic control mode, be sure to switch it to manual control mode before starting the following procedure.

Note

Before conducting the following procedure, the differential pressure outlet valves (master valves), drain valves and gas vent plugs (see Figure 2-40) must be closed.

■ *Calculating the Setting Range*

To calculate the setting range, refer to section 3-11.

■ *Procedure*

The procedures below are used to calibrate the zero point and introduce process pressure.

Zero Point Adjustment of the Device

Step	Procedure
1	Open the drain plugs, and open the pressure receiver to the atmosphere. Blow out any fluid remaining inside the receiver, and remove it.
2	Refer to section 3-2-1 on zero point adjustment, and then conduct the zero point calibration.
3	After finishing calibration, close the drain plugs.

Introducing Process Pressure

Step	Procedure
1	(1) Gradually open the master valves (see Figure 2-43), and apply the process pressure into the connecting pipe. (2) After the application of process pressure into the device's pressure receiver is complete, close the master valve.
2	Confirm that there are no pressure leaks in the connecting pipes, the device itself, etc.

3-3-2-2. Starting Operation

Procedure

Follow the procedure below to operate the valve and apply the process pressure to the device, then operate the communicator key to display the measured value.

Applying the Process Pressure

Step	Procedure
1	Gradually open the master valve (see Figure 2-43).

Zero Point Adjustment during Measurement

For zero point adjustment during measurement, refer to section 3-8.

Displaying the Measured Value

Using the communicator, check the measured value. After concluding the measurement, disconnect the clip of the communication cable and switch the process to normal operation.

Note
Completely close the case lid of the transmitter. If it is not securely closed, rainwater and the like can enter the device and cause damage to the terminals, electronics modules, etc., located inside.

- If the input and output values are not given, recheck the set range and input/output values. If there are still no input/output values, refer to Chapter 5 for troubleshooting.
- If the data display value doesn't stabilize, refer to Chapter 4 and adjust the damping time constant.

3-3-2-3. Stopping Operation

Procedure

To stop operation of the device, carry out the following procedure.

Step	Procedure
1	Turn off the power to the device.
2	Close the master valve (see Figure 2-43).

Note
If operation will be stopped for a long period of time, remove the process fluid from inside the connecting pipes and the device's pressure receiver.

3-4. Measurement Using GTX_ _F

3-4-1. Liquid Level Measurement

3-4-1-1. Preparing for Operation

⚠ Warning

When clearing the vents and drains, do not touch the process fluid that comes out of the vent or drain. There is a danger of scalding or other harm.

If the process fluid is harmful to humans, take safety countermeasures by wearing goggles, a mask, etc. There is a danger of scalding or other harm if it gets on the skin or in the eyes, or if it is inhaled.

Important

Confirm that the process is in manual control mode. If it is in automatic control mode, be sure to switch it to manual control mode before starting the following procedure.

Note

Check to make sure the master valve, drain valve and gas vent plug (see Figure 2-44) are closed.

■ ***Checking the Minimum Liquid Level (zero position) and Zero Point during Input Equalization***

The zero position of the liquid level to be measured is at the center of the seal diaphragm on the device's process connection flange (see Figure 3-2). As a result, the measuring range H extends from the center of the transmitter flange to the height of the specification range. However, the zero point check must be conducted after lowering the container liquid level until it is at least at the bottom of the process flange diaphragm. In other words, check the zero point check by putting the diaphragms on the high pressure side and the low pressure side into an equalized pressure state. Refer to section 2-2-4 on how to conduct the checks.

Note:

The output in respect to the changes in the liquid level from minimum liquid level (0% LEVEL) to the height of 25 mm is not scaled, because the output relationship follows the diagram on the right.

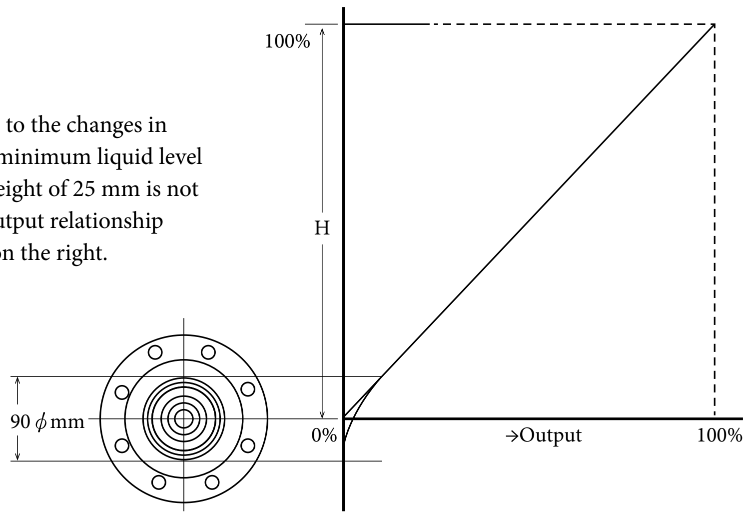


Figure 3-2. Minimum Liquid Level Property

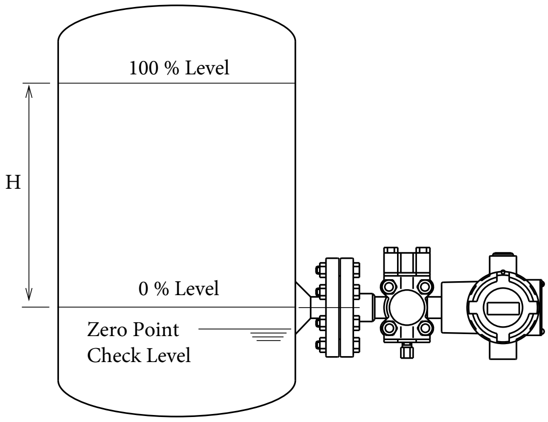


Figure 3-3. Deciding on the Zero Position

■ *Zero Adjustment*

Zero adjustment of this device can be performed by communicating with the device using a communicator, or via external zero adjustment (optional).

■ *Procedure*

1. <u>If the Liquid Level in the Tank Can be Set to the Lower Range Value (0%) of the Measuring Range</u>

   (1) Using the Communicator
   Refer to sections 3-8, "Zero Adjustment at Actual Level," and 3-9, "Setting the Range via Equivalent Input Pressure (Zero Adjustment)."

   (2) Via External Zero Adjustment (Optional)
   Refer to section 3-10, "External Zero Adjustment (Optional)."

2. <u>If the Liquid Level in the Tank Cannot be Set to the Lower Range Value (0%) of the Measuring Range</u>

   (1) Using the Communicator
   Refer to section 3-8, "Zero Adjustment at Actual Level."

   (2) Via External Zero Adjustment (Optional)
   Refer to section 3-10, "External Zero Adjustment (Optional)."

3-4-1-2. Starting Operation

After finishing the aforementioned zero adjustment, the device will be operating. Please conduct the following checks.

1. Verify if the input/output values are given.
   - If input/output values are not given, confirm the range and, the mounting position of the flange within the process, and recalibrate. If there are still no input/output values, refer to Chapter 6 for troubleshooting.

2. Check the data display.
   - If the data display value doesn't stabilize, refer to Chapter 4 and adjust the damping time constant.

3. Be careful to do the following correctly.
   - Disconnect the communicator from the device terminal, and check each terminal to make sure it is not loose.
   - Close the case cover. Screw on the cover tightly until you can't screw it in any more.
   - The device features a locking structure. Close the cover and then tighten the lock with a hexagonal wrench.

3-4-1-3. Stopping Operation

Turn off the power to the device.

Note
If operation will be stopped for a long period of time, remove the process fluid within the connecting pipes and fluid that touches the device's pressure receiver.

3-5. Measurement Using GTX_ _R

When the device begins to operate, adjust it under the actual process conditions. The fill fluid's specific gravity is as specified in Appendix P, and the specific gravity change due to temperature is 0.0008/°C. For calculations concerning the specific gravity in this chapter, use the capillary tube's temperature.

3-5-1. Liquid Level Measurement

3-5-1-1. Preparing for Operation

⚠ Warning
When clearing the vents and drains, do not touch the process fluid that comes out of the vent or drain. There is a danger of scalding or other harm.
If the process fluid is harmful to humans, take safety countermeasures by wearing goggles, a mask, etc. There is a danger of scalding or other harm if it gets on the skin or in the eyes, or if it is inhaled.

Important
Confirm that the process is in manual control mode. If it is in automatic control mode, be sure to switch it to manual control mode before starting the following procedure.

Note
Check to make sure the master valve, drain valve and gas vent plug (see Figure 2-44) are closed.

■ ***Checking the Minimum Liquid Level (zero position) and Zero Point during Input Equalization***

The zero position of the liquid level to be measured is at the center of the seal diaphragm on the device's process connection flange (see Figure 3-4). As a result, the measuring range H extends from the center of the transmitter flange to the height of the specification range. However, the zero point check must be conducted after lowering the container liquid level until it is at least at the bottom of the process flange diaphragm. This assumes that the low pressure-side diaphragm is mounted at the same height as the high pressure-side diaphragm, and it requires a state where no head pressure is being applied from the liquid. In other words, check the zero point by putting the diaphragms on the high pressure side and low pressure side into an equalized pressure state. Refer to section 2-2-4 on how to conduct the checks.

Note:

The output in respect to the changes in the liquid level from minimum liquid level (0% LEVEL) to the height of 25 mm is not scaled, because the output relationship follows the diagram on the right.

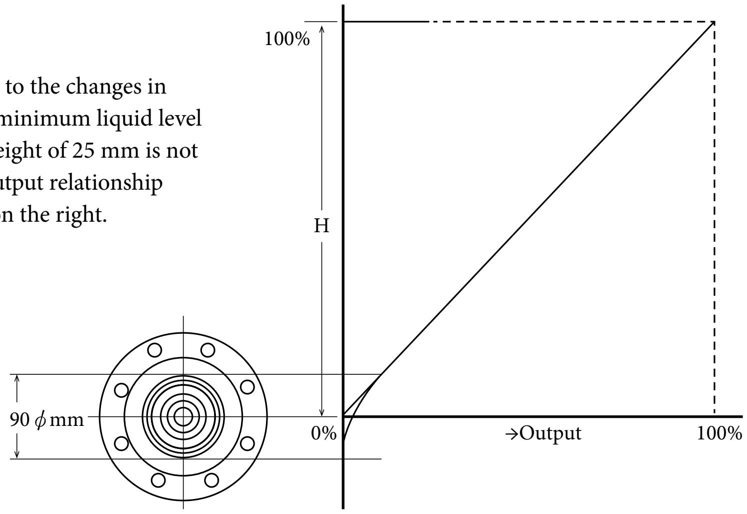


Figure 3-4. Minimum Liquid Level Property

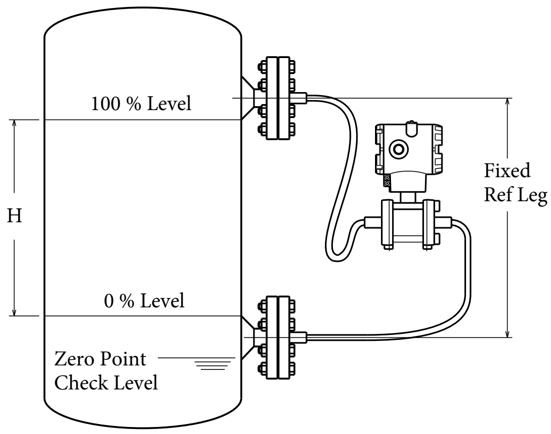


Figure 3-5. Deciding on the Zero Position

■ *Zero Adjustment*

Zero adjustment of this device can be performed by communicating with the device using a communicator, or via external zero adjustment (optional).

■ *Procedure*

1. <u>If the Liquid Level in the Tank Can be Set to the Lower Range Value (0%) of the Measuring Range</u>

   (1) Using the Communicator
   Refer to sections 3-8, "Zero Adjustment at Actual Level," and 3-9, "Setting the Range via Equivalent Input Pressure (Zero Adjustment)."

   (2) Via External Zero Adjustment (Optional)
   Refer to section 3-10, "External Zero Adjustment (Optional)."

2. <u>If the Liquid Level in the Tank Cannot be Set to the Lower Range Value (0%) of the Measuring Range</u>

   (1) Using the Communicator
   Refer to section 3-8, "Zero Adjustment at Actual Level."

   (2) Via External Zero Adjustment (Optional)
   Refer to section 3-10, "External Zero Adjustment (Optional)."

3-5-1-2. Starting Operation

After finishing the aforementioned zero adjustment, the device will be operating. Please conduct the following checks.

1. Verify if input/output values are given.
    - If the input/output values are not given, confirm the range and the mounting position of the flange within the process, and recalibrate. If there are still no input/output values, refer to Chapter 6 for troubleshooting.
2. Check the data display.
    - If the data display value doesn't stabilize, refer to Chapter 4 and adjust the damping time constant.
3. Be careful to do the following correctly.
    - Disconnect the communicator from the device terminal, and check each terminal to make sure it is not loose.
    - Close the case cover. Screw on the cover tightly until you can't screw it in any more.
    - The device features a locking structure. Close the cover and then tighten the lock with a hexagonal wrench.

3-5-1-3. Stopping Operation

Turn off the power to the device.

Note

If operation will be stopped for a long period of time, remove the flange portions of the device, clean the diaphragm with a soft brush and some solvent, and store it. When doing so, be careful not to deform or scratch the diaphragm.

3-5-2. Cautions during Flow Rate Measurement

When measuring the flow rate, keep in mind the relationship between the flange mounting method and flow rate measurement.

Given the structure of GTX_ _R in this case, please always finish the zero point check before releasing fluid into the main pipe, as you won't be able to install an equalizer valve or stop valve.

In addition, if there are differential pressure flange outlets on the vertical pipe, the high-pressure-side flange and the low-pressure-side flange will be positioned at different heights. In this case, determine the zero point using the lower range value (LRV) setting.

3-5-3. Flange Mounting for Flow Rate Measurement

■ ***Mounting Procedure***

When measuring the flow rate, the positioning of the tap of the differential pressure outlet will follow the pipe tap method.

Therefore, if the inner pipe diameter is D, install the differential pressure outlet tap at a position that is 2.5D away from the upstream orifice surface for the high-pressure-side tap, as well as at a position that is 8D away from the downstream orifice surface for the low-pressure-side tap. Connect the differential pressure outlet tap by directly mounting the transmitter's flange part.

Note

- When handling the capillary tube, do not twist it.
- When unwinding a capillary tube, hold the flange portion and turn the tube such that it reverts to a big loop.
- We recommend installing the capillary tube so that it runs downward instead of horizontally.

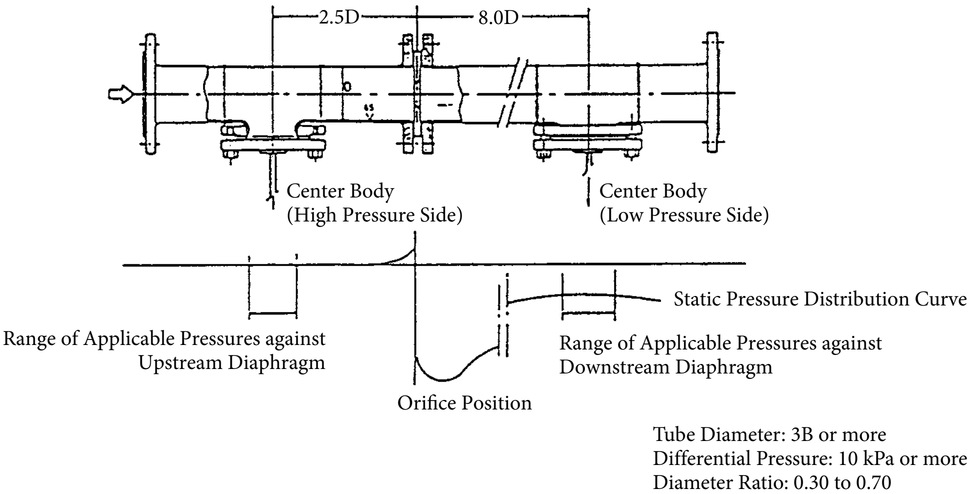


Figure 3-6. Orifice Plate Assembly

3-6. Measurement Using GTX_ _R

In the course of starting operation, perform adjustment during the process' actual state. The fill fluid's specific gravity is as specified in Appendix A's specs, and the specific gravity change due to temperature is 0.0008/°C. For calculations concerning the specific gravity in this chapter, use the capillary tube's temperature.

3-6-1. Liquid Level Measurement

3-6-1-1. Preparing for Operation

⚠ Warning

When clearing the vents and drains, do not touch the process fluid that comes out of the vent or drain. There is a danger of scalding or other harm.

If the process fluid is harmful to humans, take safety countermeasures by wearing goggles, a mask, etc. There is a danger of scalding or other harm if it gets on the skin or in the eyes, or if it is inhaled.

Important

Confirm that the process is in manual control mode. If it's in automatic control mode, be sure to switch it to manual control mode before starting the following procedure.

Note

In terms of piping, check to make sure the master valve, drain valve and gas vent plug (see Figure 2-44) are closed.

■ *Checking the Minimum Liquid Level (zero position) and Zero Point during Input Equalization*

The zero position of the liquid level to be measured is at the center of the seal diaphragm on the device's process connection flange (see Figure 3-7). As a result, the measuring range H extends from the center of the transmitter flange to the height of the specification range. However, the zero point check must be conducted after lowering the container liquid level until it is at least at the bottom of the process flange diaphragm. This assumes that the low pressure-side diaphragm is mounted at the same height as the high pressure-side diaphragm, and it requires a state where no head pressure is being applied from the liquid. In other words, check the zero point check by putting the diaphragms on the high pressure side and the low pressure side into an equalized pressure state. Refer to section 2-2-4 on how to conduct the checks.

Note:

The output in respect to the changes in the liquid level from minimum liquid level (0% LEVEL) to the height of 25 mm is not scaled, because the output relationship follows the diagram on the right.

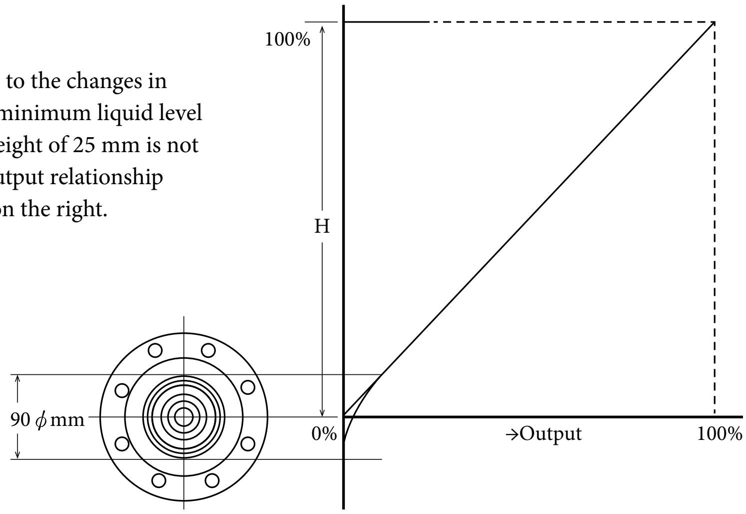


Figure 3-7. Minimum Liquid Level Property

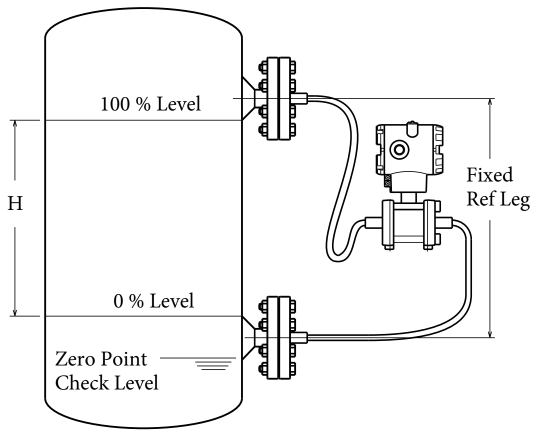


Figure 3-8. Deciding on the Zero Position

■ *Zero Adjustment*

Zero adjustment of this device can be performed by communicating with the device using a communicator, or via external zero adjustment (optional).

■ *Procedure*

1. If the Liquid Level in the Tank can be Set to the Lower Range Value (0%) of the Measuring Range

   (1) Using the Communicator
   Refer to sections 3-8, "Zero Adjustment at Actual Level," and 3-9, "Setting the Range via Equivalent Input Pressure (Zero Adjustment)."

   (2) Via External Zero Adjustment (Optional)
   Refer to section 3-10, "External Zero Adjustment (Optional)."

2. If the Liquid Level in the Tank cannot be Set to the Lower Range Value (0%) of the Measuring Range

   (1) Using the Communicator
   Refer to section 3-8, "Zero Adjustment at Actual Level."

   (2) Via External Zero Adjustment (Optional)
   Refer to section 3-10, "External Zero Adjustment (Optional)."

3-6-1-2. Starting Operation

After finishing the aforementioned zero adjustment, it will be in an operating state. Please conduct the following checks.

1. Verify if the input/output values are supported.
   - If the input/output values are not supported, confirm the range, the mounting position of the flange within the process, and recalibrate. If the input/output values are still unsupported, refer to Chapter 6 to do some troubleshooting.

2. Confirm the data display.
   - If the data display value doesn't stabilize, refer to Chapter 4 and adjust the damping time constant.

3. Be careful to do the following correctly.
   - Disconnect the communicator from the device terminal, and check if each terminal is not loose.
   - Close the case cover. Screw on the cover tightly until you can't screw it in no more.
   - The device features a locking structure, so close the cover before tightening the lock with a hexagonal wrench.

3-6-1-3. Stopping Operation

Turn off the power to the device.

Note
If operation will be stopped for a long period of time, remove the flange portions of the device, clean the diaphragm with a soft brush and some solvent, and store it. When doing so, be careful not to deform or scratch the diaphragm.

3-6-2. Cautions for Flow Rate Measurement

When measuring the flow rate, conduct the operation while referencing the flange mounting relative to the flow rate measurement.

Given the structure of model GTX_ _F in this case, please always finish the zero point check before releasing the fluid in the main pipe, as you won't be able to install equalizer valve or stop valve.

In addition, if there are differential pressure flange outlets on the vertical pipe, the high-pressure-side flange and the low-pressure-side flange will be positioned at different heights. In this case, determine the zero point using the lower range value (LRV) setting.

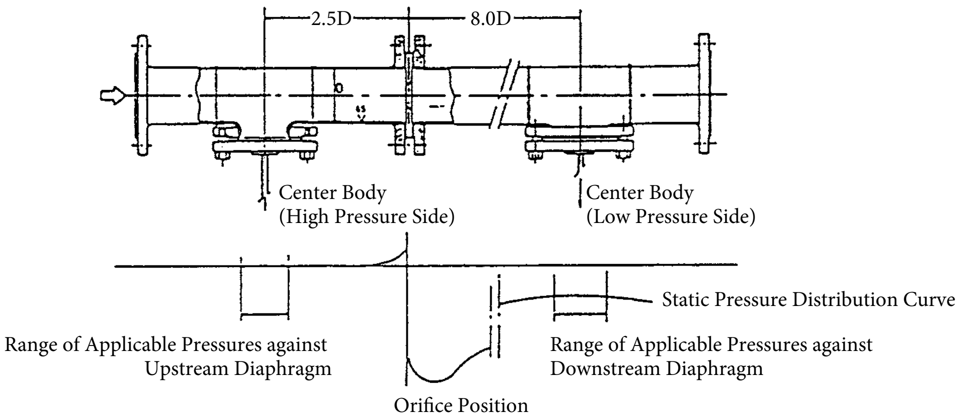
3-6-3. Flange Mounting for Flow Rate Measurement

■ *Mounting Procedure*

When measuring the flow rate, the positioning of the tap of the differential pressure outlet will follow the pipe tap method.

Therefore, if we assume that the inner pipe diameter is D,please install the differential pressure outlet tap to a position that is 2.5D away from the upstream orifice surface for the high-pressure-side tap, as well as to a position that is 8D away from the downstream orifice surface for the low-pressure-side tap. Connect the differential pressure outlet tap by directly mounting the transmitter's flange area.

Note
• When handling the capillary tube, do not twist it. • When unwinding a capillary tube, hold the flange portion and turn the tube such that it reverts to a big loop. • We recommend installing the capillary tube so that it runs downward instead of horizontally.



Tube Diameter: 3B or more
Differential Pressure: 10 kPa or more
Diameter Ratio: 0.30 to 0.70

Figure 3-9. Orifice Plate Assembly

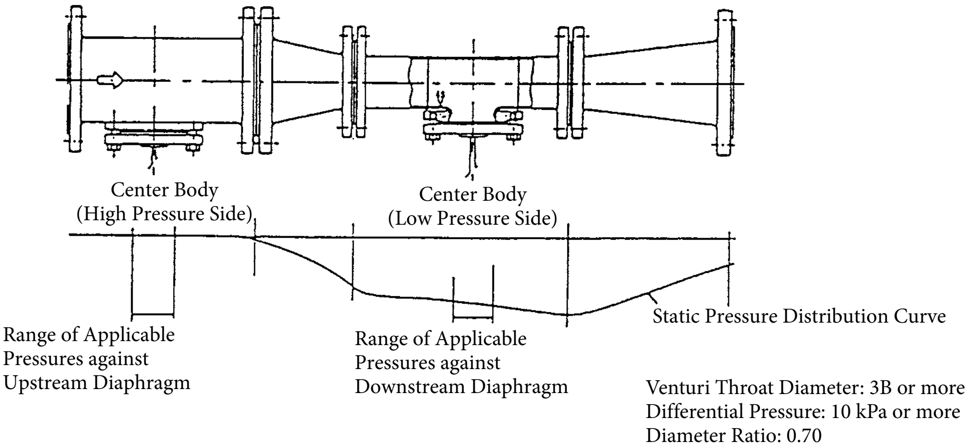


Figure 3-10. Venturi Tube Assembly

3-7. Measurement Using GTX_ _U/GTX_ _S

In the course of starting operation, perform adjustment during the process' actual state. The fill fluid's specific gravity is as specified in Appendix A's specs, and the specific gravity change due to temperature is 0.0008/°C. For calculations concerning the specific gravity in this chapter, use the capillary tube's temperature.

3-7-1. Measuring the Liquid Level and Pressure

3-7-1-1. Preparing for Operation

⚠ Warning

- When clearing the vents and drains, do not touch the process fluid that comes out of the vent or drain. There is a danger of scalding or other harm.
- If the process fluid is harmful to humans, take safety countermeasures by wearing goggles, a mask, etc. There is a danger of scalding or other harm if it gets on the skin or in the eyes, or if it is inhaled.

Important

Confirm that the process is in manual control mode. If it's in automatic control mode, be sure to switch it to manual control mode before starting the following procedure.

Note

In terms of piping, check to make sure the master valve, drain valve and gas vent plug (see Figure 2-44) are closed.

■ *Minimum Level (Zero Position) for Liquid Level Measurement*

The zero position of the liquid level to be measured is at the center of the seal diaphragm on the device's process connection flange (see Figure 3-11). As a result, the measuring range H extends from the center of the transmitter flange to the height of the specification range. However, the zero point check must be conducted after lowering the container liquid level until it is at least at the bottom of the process flange diaphragm.

Note:

The output in respect to the changes in the liquid level from minimum liquid level (0% LEVEL) to the height of 25 mm is not scaled, because the output relationship follows the diagram on the right.

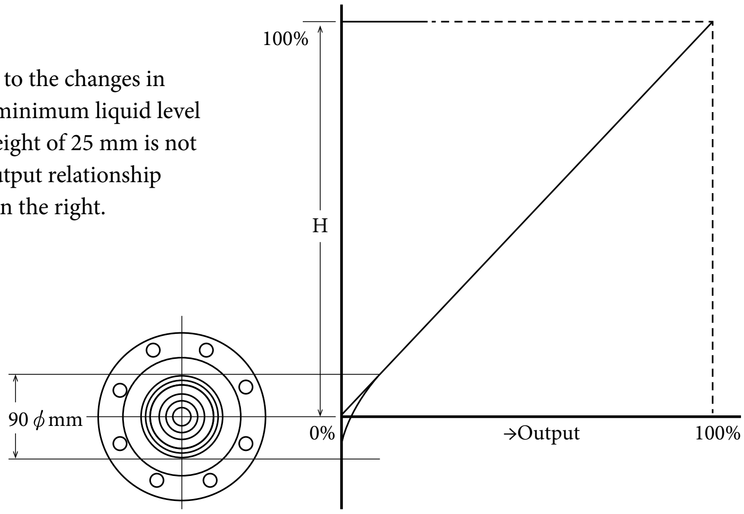


Figure 3-11. Minimum Liquid Level Property

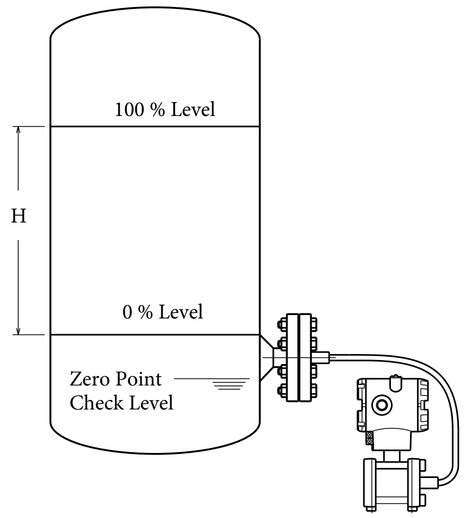


Figure 3-12. Deciding on the Zero Position

■ *Zero Adjustment*

Zero adjustment of this device can be performed by communicating with the device using a communicator, or via external zero adjustment (optional).

■ *Procedure*

1. If the Liquid Level in the Tank can be Set to the Lower Range Value (0%) of the Measuring Range

    (1) Using the Communicator
    Refer to sections 3-8, "Zero Adjustment at Actual Level," and 3-9, "Setting the Range via Equivalent Input Pressure (Zero Adjustment)."

    (2) Via External Zero Adjustment (Optional)
    Refer to section 3-10, "External Zero Adjustment (Optional)."

2. If the Liquid Level in the Tank cannot be Set to the Lower Range Value (0%) of the Measuring Range

    (1) Using the Communicator
    Refer to section 3-8, "Zero Adjustment at Actual Level."

    (2) Via External Zero Adjustment (Optional)
    Refer to section 3-10, "External Zero Adjustment (Optional)."

3-7-1-2. Starting Operation

After finishing the aforementioned zero adjustment, it will be in an operating state. Please conduct the following checks.

1. Verify if the input/output values are supported.
   - If the input/output values are not supported, confirm the range, the mounting position of the flange within the process, and recalibrate. If the input/output values are still unsupported, refer to Chapter 6 to do some troubleshooting.
2. Confirm the data display.
   - If the data display value doesn't stabilize, refer to Chapter 4 and adjust the damping time constant.
3. Be careful to do the following correctly.
   - Disconnect the communicator from the device terminal, and check if each terminal is not loose.
   - Close the case cover. Screw on the cover tightly until you can't screw it in no more.
   - The device features a locking structure, so close the cover before tightening the lock with a hexagonal wrench.

3-7-1-3. Stopping Operation

Turn off the power to the device.

Note
If operation will be stopped for a long period of time, remove the flange portions of the device, clean the diaphragm with a soft brush and some solvent, and store it. When doing so, be careful not to deform or scratch the diaphragm.

3-8. Zero Adjustment at Actual Level

Introduction

To adjust the zero point while the liquid level is being measured, without actually draining the liquid to the zero level, it is possible to make adjustment using an output value correlated with the actual level as measured by a level gauge (etc.). The following Figure 3-13 diagram shows an example in which a remote-seal gauge pressure transmitter is used in a sealed tank.

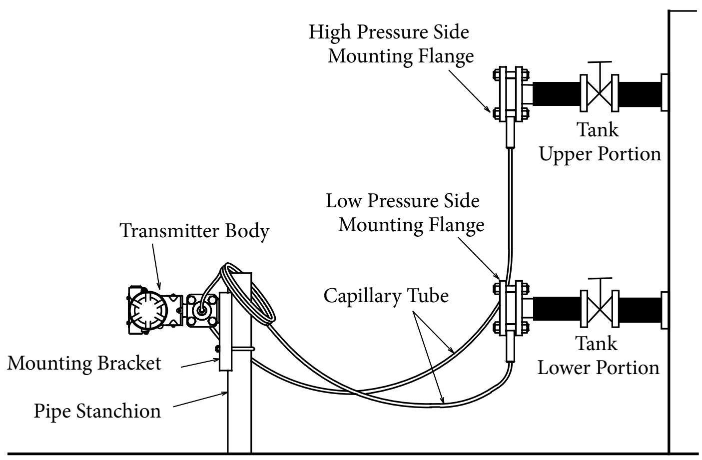


Figure 3-13. Adjusting the Actual Level during Liquid Level Measurement

Procedure

Follow the procedure below to adjust the output value so that it matches the actual level during the liquid level measurement.

If you wish to use the fill fluid temperature compensation feature, activate the temperature compensation feature before doing the zero adjustment.

To set the temperature compensation feature, refer to section 4-2-6. The following shows the adjustment method that can be used when the level gauge shows a liquid level of 50%.

Refer to Chapter 4, "Operation by Fieldbus Communication," on how to set the communicator.

3-9. Setting the Range via Equivalent Input Pressure (Zero Adjustment)

Introduction

By applying the pressure corresponding to the desired range to the transmitter, you may set the PV value that matches the actual pressure. The PV value gets automatically set from the desired the liquid level or input pressure, which would signify the completion of the zero adjustment.

Procedure

This is the procedure for conducting the zero adjustment under the following conditions. If you wish to use the fill fluid temperature compensation feature, activate the temperature compensation feature before doing the zero adjustment. To set the temperature compensation feature, refer to section 4-2-6.

Refer to Chapter 4, "Operation by Fieldbus Communication," on how to set the communicator.

3-10. External Zero Adjustment (Optional)

Introduction

When equipped with the external zero adjustment function, this device allows zero adjustment on-site even if a communicator is not used.

Procedure

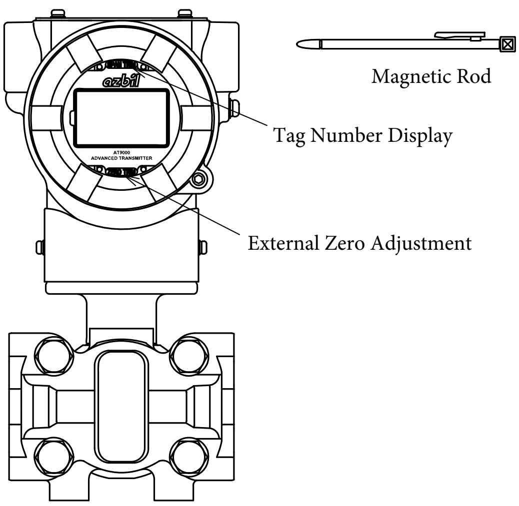


Figure 3-14. External Zero Adjustment

■ *External Zero Adjustment Method*

External zero adjustment method is as follows.

Step	Procedure
1	Accurately apply the differential pressure (or pressure) to the device that will serve as the 0% reference point for the setting range.
2	From above the glass window, touch the special-purpose magnetic bar to the location labeled “ZERO TRIM” continuously for at least 3 seconds. When the PV value of the transmitter gets adjusted to 0, and the magnet stick gets moved away from the glass window, the zero adjustment has completed. • When a communication is made from the communicator during a zero-point adjustment, the adjustment stops while in communication. • When communicating from the communicator while conducting the zero-point adjustment, you may only ready the setting value and setting status.

3-11. Calculating the Setting Range for Liquid Level Measurement

3-11-1. Setting Range of the Open Tank and Sealed Tank (Dry Leg or Remote Seal)

■ *Calculation Example Using Model GTX_ _D*

Calculate the setting range as follows.

In this calculation, density and distance are represented by the following symbols.

The density is constant during liquid level measurement.

ρ: Specific gravity of liquid in tank

ρ_0: Specific gravity of liquid in high pressure side connecting pipe

l: Distance between the 100% liquid level and the 0% liquid level (measuring range)

h: Distance between the 0% liquid level and the high-pressure-side outlet

d: Distance between the high-pressure-side outlet and transmitter

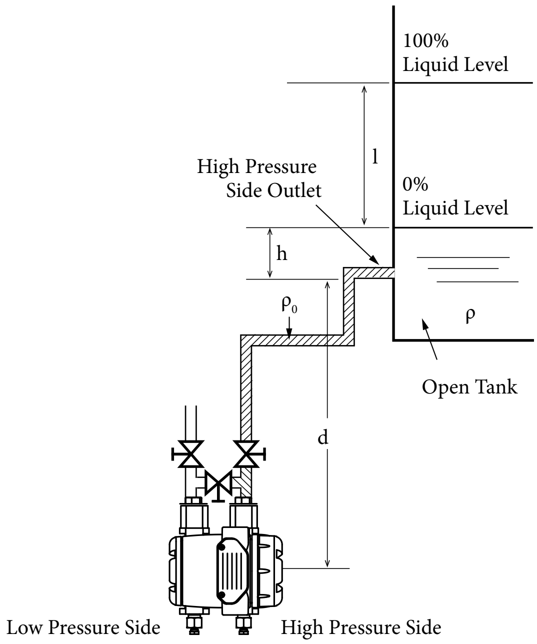


Figure 3-15. When Tank is Open

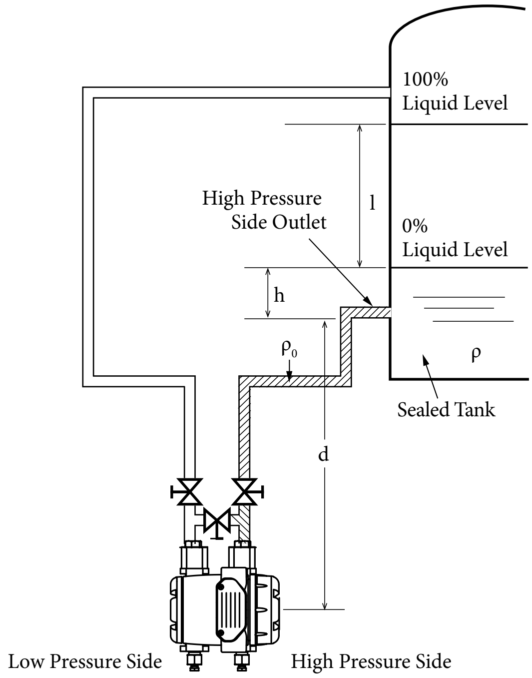


Figure 3-16. When Tank is Open (Dry Leg)

0%   Differential pressure of the liquid level
(high-pressure-side pressure–low-pressure-side pressure)
$=h\rho+d\rho_0=LRV$

100%   Differential pressure of the liquid level
(high-pressure-side pressure–low-pressure-side pressure)
$=l\rho+h\rho+d\rho_0=(l+h)\rho+d\rho_0=URV$

Therefore, set the following values accordingly:
Lower Range Value (LRV): $h\rho+d\rho_0$, Upper Range Value (URV): $(l+h)\rho+d\rho_0$

Calculation example: When l=1500 mm, h=250 mm, d=500 mm, $\rho = 0.9$, $\rho_0=1.0$

Differential pressure at 0% liquid level $=(250\times0.9)+(500\times1.0)=725$ mmH_2O=7.110 kPa

Differential pressure at 100% liquid level $=\{(1500+250)\times0.9\}+(500\times1.0)=2075$ mmH_2O
=20.35 kPa

Therefore, set the following values accordingly:
Lower Range Value (LRV): 7.110 kPa, Upper range value (URV): 20.35 kPa.

■ *Calculation Example Using Model GTX_ _D*

Calculate the setting range as follows.

In this calculation, density and distance are represented by the following symbols.

The density is constant during liquid level measurement.

ρ: Specific gravity of liquid in tank

ρ_0: Specific gravity of liquid inside the connecting pipe

l: Distance between the 100% liquid level and the 0% liquid level (measuring range)

h: Distance between the 0% liquid level and the high-pressure-side outlet

d: Distance between the high-pressure-side outlet and transmitter

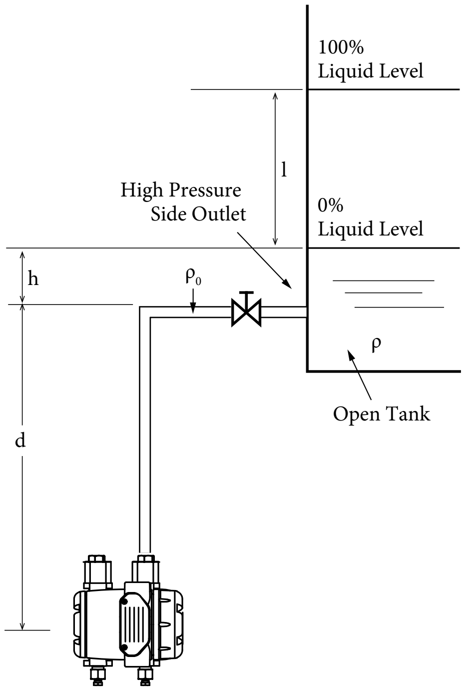


Figure 3-17.

Pressure at 0% liquid level $=h\rho+d\rho_0=$LRV

Pressure at 100% liquid level $=l\rho+h\rho+d\rho_0=(l+h)\rho+d\rho_0=$URV

Therefore, set the following values accordingly:

Lower Range Value (LRV): $h\rho+d\rho_0$,Upper Range Value (URV): $(l+h)\rho+d\rho_0$

Calculation example: When l=1500 mm, h=250 mm, d=500 mm, $\rho=0.9$, $\rho_0=1.0$

Differential pressure at 0% liquid level $=(250\times0.9)+(500\times1.0)=725$ mmH_2O=7.110 kPa

Differential pressure at 100% liquid level $=\{(1500+250)\times0.9\}+(500\times1.0)=2075$ mmH_2O =20.35 kPa

Therefore, set the following values accordingly:

Lower Range Value (LRV): 7.110 kPa, Upper range value (URV): 20.35 kPa.

■ *Calculation Example Using Model GTX_ _F*

Calculate the setting range as follows.

In this calculation, density and distance are represented by the following symbols.

The density is constant during liquid level measurement.

ρ: Specific gravity of liquid in tank

l: Distance between the 100% liquid level and the 0% liquid level (measuring range)

h: Distance between the 0% liquid level and the high-pressure-side outlet

d: Distance between the high-pressure-side outlet and transmitter

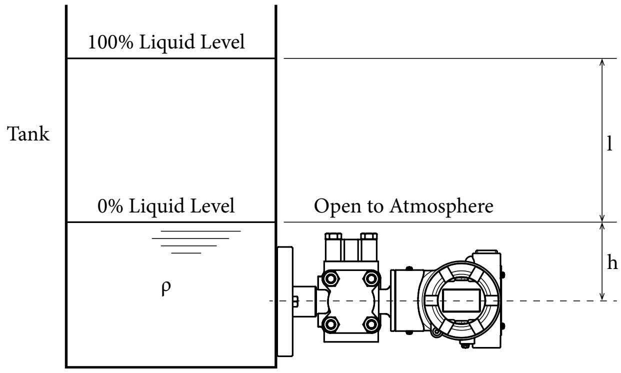


Figure 3-18. When Tank is Open

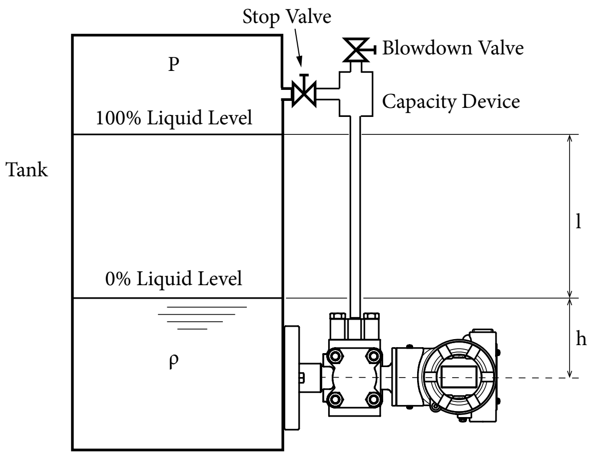


Figure 3-19. When Tank is Open (Dry Leg)

0%   Differential pressure of the liquid level
(high-pressure-side pressure–low-pressure-side pressure)
=hρ=LRV

100%   Differential pressure of the liquid level
(high-pressure-side pressure–low-pressure-side pressure)
=lρ+hρ=(l+h)ρ=URV

Therefore, set the following values accordingly:
Lower Range Value (LRV): hρ, Upper Range Value (URV): (l+h)ρ.

Calculation example: When l=1500 mm, h=250 mm, ρ=0.9

Differential pressure at 0% liquid level =250×0.9=225 mmH_2O=2.206 kPa

Differential pressure at 100% liquid level =(1500+250)×0.9=1575 mmH_2O=15.45 kPa

Therefore, set the following values accordingly:
Lower Range Value (LRV): 2.206 kPa, Upper range value (URV): 15.45 kPa.

Calculation Example Using Model GTX_ _R

Calculate the setting range as follows.

In this calculation, density and distance are represented by the following symbols.

The density is constant during liquid level measurement.

- ρ: Specific gravity of liquid in tank
- ρ_0: Specific gravity of the fill fluid
- l: Distance between the 100% liquid level and the 0% liquid level (measuring range)
- h: Distance between the 0% liquid level and the high-pressure-side outlet
- d: Distance between the high-pressure-side outlet and transmitter

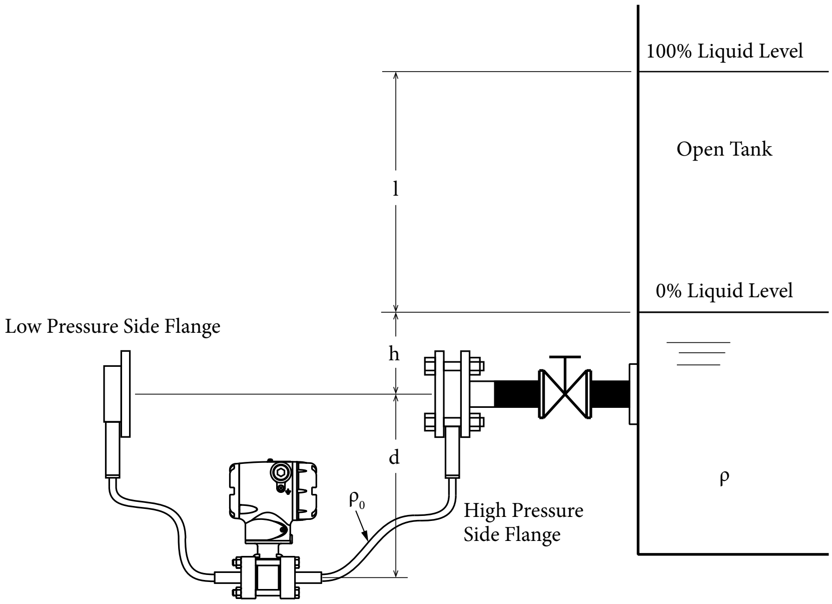


Figure 3-20. When Tank is Open

0% Differential pressure of the liquid level
(high-pressure-side pressure–low-pressure-side pressure)
$=h\rho=LRV$

100% Differential pressure of the liquid level
(high-pressure-side pressure–low-pressure-side pressure)
$=l\rho+h\rho=(l+h)\rho=URV$

Therefore, set the following values accordingly:
Lower Range Value (LRV): $h\rho$, Upper Range Value (URV): $(l+h)\rho$.

Calculation example:
When l=1500 mm, h=250 mm, d=500 mm, $\rho=0.9$, $\rho_0=0.935$ (general remote)

Differential pressure at 0% liquid level $=250\times0.9=225$ $mmH_2O=2.206$ kPa

Differential pressure at 100% liquid level $=(1500+250)\times0.9=1575$ $mmH_2O=15.45$ kPa

Therefore, set the following values accordingly:
Lower Range Value (LRV): 2.206 kPa, Upper range value (URV): 15.45 kPa.

■ *Calculation Example Using Model GTX_ _U*

Calculate the setting range as follows.

In this calculation, density and distance are represented by the following symbols.

The density is constant during liquid level measurement.

ρ: Specific gravity of liquid in tank
ρ_0: Specific gravity of the fill fluid
l: Distance between the 100% liquid level and the 0% liquid level (measuring range)
h: Distance between the 0% liquid level and the high-pressure-side outlet
d: Distance between the process outlet and transmitter

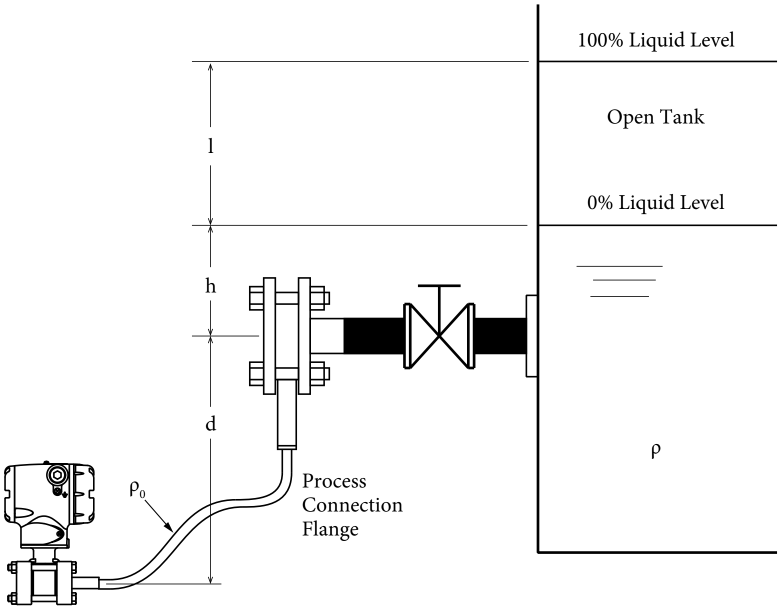


Figure 3-21. When Tank is Open

Differential pressure at 0% liquid level $=h\rho+d\rho_0=LRV$

Differential pressure at 100% liquid level $=l\rho+h\rho+d\rho_0=(l+h)\rho+d\rho_0=URV$

Therefore, set the following values accordingly:
Lower Range Value (LRV): $h\rho+d\rho_0$, Upper Range Value (URV): $(l+h)\rho+d\rho_0$

Calculation example: When l=1500 mm, h=250 mm, d=500 mm, ρ=0.9, ρ_0=1.0

Differential pressure at 0% liquid level =(250×0.9)+(500×1.0)=725 mmH_2O=7.110 kPa

Differential pressure at 100% liquid level ={(1500+250)×0.9}+(500×1.0)=2075 mmH_2O
=20.35 kPa

Therefore, set the following values accordingly:
Lower Range Value (LRV): 7.110 kPa, Upper range value (URV): 20.35 kPa.

3-11-2. Sealed Tank (Wet Leg or Remote Seal) Setting Range

■ *Calculation Example Using Model GTX_ _D*

Calculate the setting range as follows.

In this calculation, density and distance are represented by the following symbols.

The density is constant during liquid level measurement.

ρ: Specific gravity of liquid in tank

ρ_0: Specific gravity of the fill fluid

l: Distance between the 100% liquid level and the 0% liquid level (measuring range)

h: Distance between the 0% liquid level and the transmitter

d: Distance between the high-pressure-side outlet and transmitter

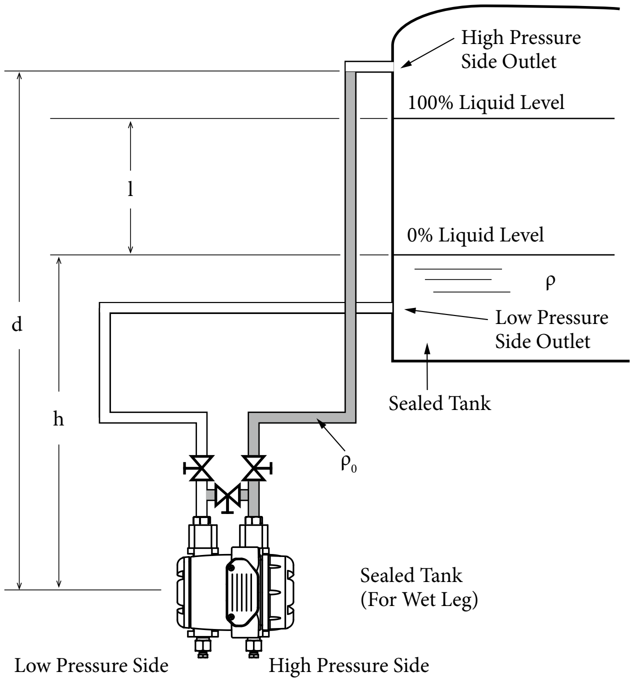


Figure 3-22. In the Case of Sealed Tank (For Wet Leg)

0% Differential pressure of the liquid level
(high-pressure-side pressure–low-pressure-side pressure)
$=d\rho_0-h\rho=LRV$

100% Differential pressure of the liquid level
(high-pressure-side pressure–low-pressure-side pressure)
$=d\rho_0-(l+h)\rho=URV$

Therefore, set the following values accordingly:
Lower Range Value (LRV): $d\rho_0-h\rho$, Upper Range Value (URV): $d\rho_0-(l+h)\rho$.

Calculation example: When l=1500 mm, h=250 mm, d=2000 mm, $\rho=0.9$, $\rho_0=1.0$

Differential pressure at 0% liquid level $=(2000\times1.0)-(250\times0.9)=1775$ mmH_2O
$=17.41$ kPa

Differential pressure at 100% liquid level $=(2000\times1.0)-(1500+250)\times0.9=425$ mmH_2O
$=4.168$ kPa

Therefore, set the following values accordingly:
Lower Range Value (LRV): 17.41 kPa, Upper range value (URV): 4.168 kPa.

■ *Calculation Example Using Model GTX_ _F*

Calculate the setting range as follows.

In this calculation, density and distance are represented by the following symbols.

The density is constant during liquid level measurement.

ρ: Specific gravity of liquid in tank

ρ_0: Specific gravity of the fill fluid

l: Distance between the 100% liquid level and the 0% liquid level (measuring range)

h: Distance between the 0% liquid level and the transmitter

d: Distance between the low-pressure-side outlet and transmitter

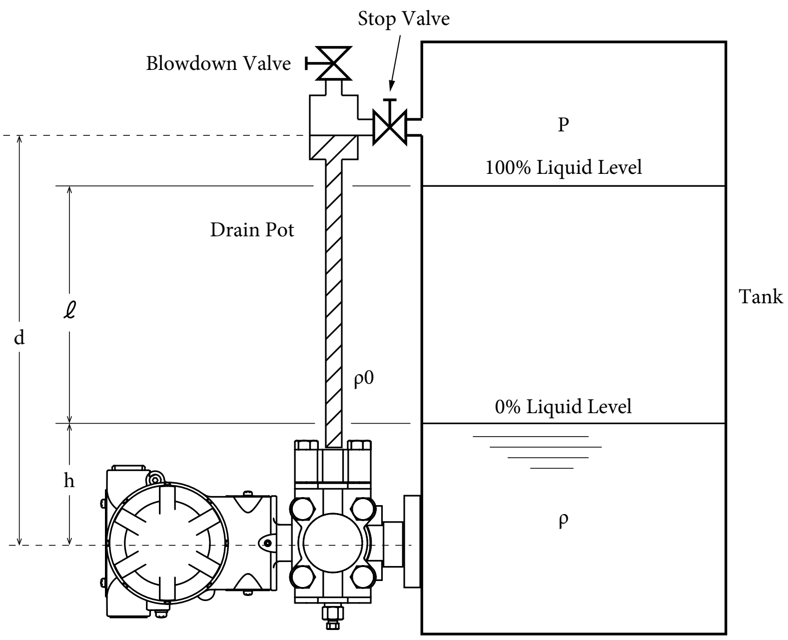


Figure 3-23. In the Case of Sealed Tank (for wet leg)

0% Differential pressure of the liquid level
(high-pressure-side pressure−low-pressure-side pressure)
$= h\rho - d\rho_0 = LRV$

100% Differential pressure of the liquid level
(high-pressure-side pressure−low-pressure-side pressure)
$= (l + h)\rho - d\rho_0 = URV$

Therefore, set the following values accordingly:
Lower Range Value (LRV): $h\rho - d\rho_0$, Upper Range Value (URV): $(l+h)\rho - d\rho_0$

Calculation example: When l=1500 mm, h=250 mm, d=2000 mm, ρ=0.9, ρ_0=1.0

Differential pressure at 0% liquid level $=(250\times0.9)-(2000\times1.0)=-1775$ mmH_2O
$=-17.41$ kPa

Differential pressure at 100% liquid level $=(1500+250)\times0.9-(2000\times1.0)=-425$ mmH_2O
$=-4.168$ kPa

Therefore, set the following values accordingly:
Lower Range Value (LRV): −17.41 kPa, Upper Range Value (URV): −4.168 kPa.

Calculation Example Using Model GTX_ _R

Calculate the setting range as follows.

1. If attaching the high pressure side flange to the upper portion of the tank

In this calculation, density and distance are represented by the following symbols.

Note
Please always connect in this manner for model GTX40R.

The density is constant during liquid level measurement.

ρ: Specific gravity of liquid in tank

ρ_0: Specific gravity of the fill fluid

l: Distance between the 100% liquid level and the 0% liquid level (measuring range)

h: Distance between the 0% liquid level and flange at tank bottom

d: Distance between the tank flanges

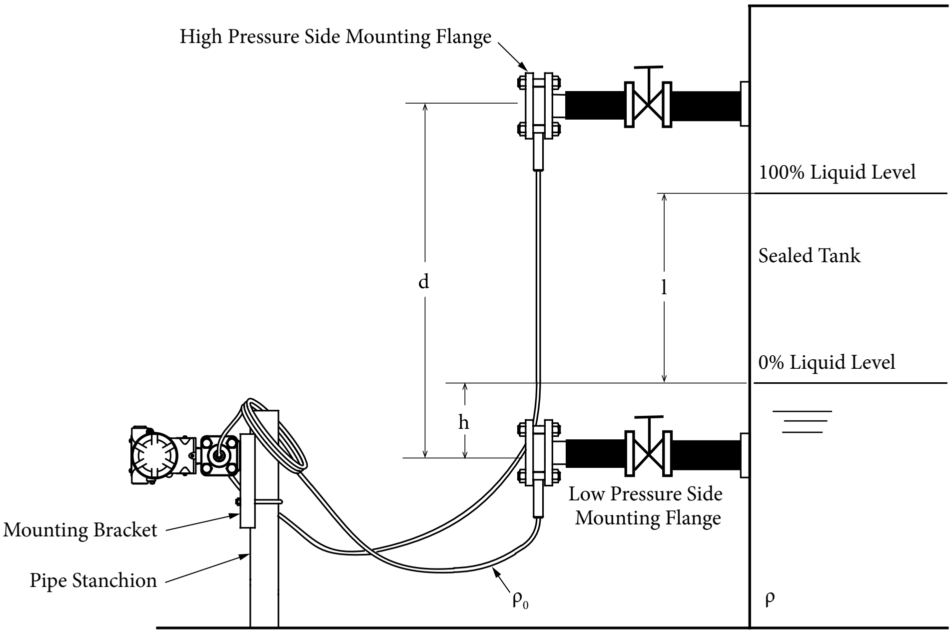


Figure 3-24. When Tank is Sealed

0% Differential pressure of the liquid level
(high-pressure-side pressure–low-pressure-side pressure)
$=d\rho_0-h\rho=LRV$

100% Differential pressure of the liquid level
(high-pressure-side pressure–low-pressure-side pressure)
$=d\rho_0-(l+h)\rho=URV$

Therefore, set the following values accordingly:
Lower Range Value (LRV): $d\rho_0-h\rho$, Upper Range Value (URV): $d\rho_0-(l+h)\rho$.

Calculation example:
When l=1500 mm, h=250 mm, d=2000 mm, ρ=0.9, ρ_0=0.935 (general remote)

Differential pressure at 0% liquid level =(2000×0.935)−(250×0.9)=1645 mmH_2O
=16.13 kPa

Differential pressure at 100% liquid level =(2000×0.935)−(1500+250)×0.9=295 mmH_2O
=2.893 kPa

Therefore, set the following values accordingly:
Lower Range Value (LRV): 16.13 kPa, Upper range value (URV): 2.893 kPa.

2. If attaching the high pressure side flange to the lower portion of the tank

In this calculation, density and distance are represented by the following symbols.

Note
This connection is possible with the GTX35R.

In addition, if enabling the fill fluid temperature compensation feature, affix a minus sign (−) to the height setting.

The density is constant during liquid level measurement.

ρ: Specific gravity of liquid in tank

ρ_0: Specific gravity of the fill fluid

l: Distance between the 100% liquid level and the 0% liquid level (measuring range)

h: Distance between the 0% liquid level and flange at tank bottom

d: Distance between the tank

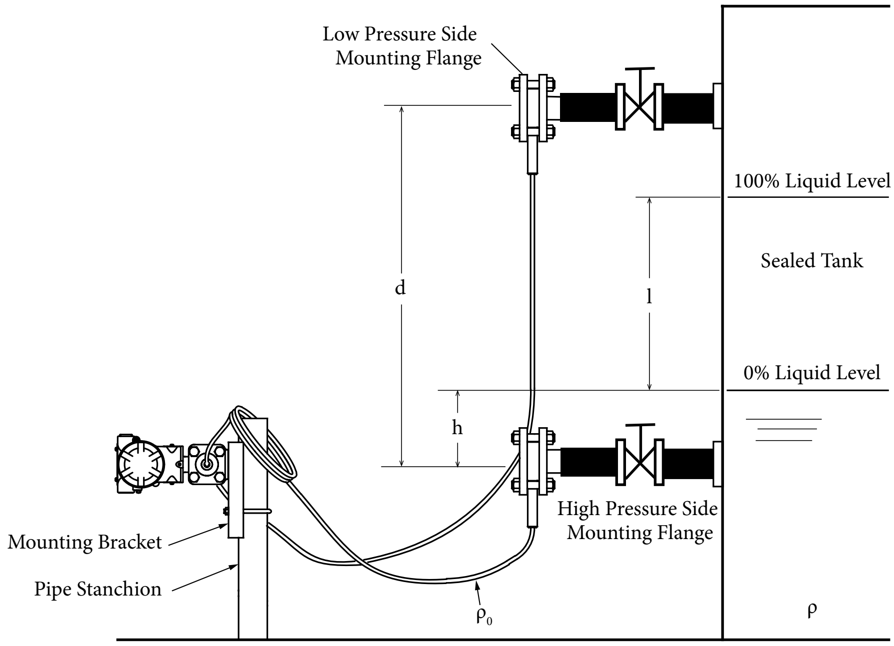


Figure 3-25. When Tank is Sealed

0% Differential pressure of the liquid level
(high-pressure-side pressure−low-pressure-side pressure)
$= h\rho - d\rho_0 = LRV$

100% Differential pressure of the liquid level
(high-pressure-side pressure−low-pressure-side pressure)
$= (l + h)\rho - d\rho_0 = URV$

Therefore, set the following values accordingly:
Lower Range Value (LRV): $h\rho - d\rho_0$, Upper Range Value (URV): $(l+h)\rho - d\rho_0$

Calculation example:
When l=1500 mm, h=250 mm, d=2000 mm, ρ=0.9, ρ_0=0.935 (general remote)

Differential pressure at 0% liquid level =(250×0.9)−(2000×0.935)=−1645 mmH_2O
=−16.13 kPa

Differential pressure at 100% liquid level =(1500+250)×0.9−(2000×0.935)=−295 mmH_2O
=−2.893 kPa

Therefore, set the following values accordingly:
Lower Range Value (LRV): −16.13 kPa, Upper range value (URV): −2.893 kPa.

Chapter 4. Operation by Fieldbus Communication

4-1. Overview

4-1-1. Introduction

This chapter describes operations that are performed using fieldbus communication.

Refer to this chapter for information regarding the basics of operations, data setting and modification, etc.

4-1-2. Fieldbus Communication Menu

There are the following 5 types of menus for the field bus communicator, depending on the host to be used.

- Communicator Device Menu (refer to Appendix A)
  Displays the parameters for setting, adjusting, etc. the transmitter. This can be displayed with the host (hand held communicator) that supports the device menu. (i.e. EMERSON 475 Communicator)
- Communicator Block Menu (refer to Appendix A)
  Displays the parameters for setting, adjusting, etc. the transmitter in the menu at each block. This can be displayed with the host (hand held communicator) that supports the block menu. (i.e. EMERSON 475 Communicator)
- PC Device Menu (refer to Appendix A)
  Displays the parameters for setting, adjusting, etc. the transmitter. This can be displayed with the host (PC) that supports the device menu.
- PC Block Menu (refer to Appendix A)
  Displays the parameters for setting, adjusting, etc. the transmitter in the menu at each block. This can be displayed with the host (PC) that supports the block menu. (i.e. Azbil Device Management System InnovativeField Organizer)
- Parameter List
  This lists all the parameters for each block.
  Resource Block (refer to Appendix C)
  Pressure Transducer Block (refer to Appendix D)
  Display Transducer Block (refer to Appendix G)
  Diagnostics Transducer Block (refer to Appendix M)

4-2. Main Settings

The main settings are as follows.

This section is mainly explained using the communicator device menu.

Please refer to Appendix A for the communicator device menu.

4-2-1. Setting the Tag Number

Tag No. cannot be set using the communicator device menu.

4-2-2. Setting the Output Format

It cannot be setup using the communicator device menu.

4-2-3. Setting the Digital Indicator

This is set using the Display Transducer Block. Please refer to 4-6, "Display Transducer Block."

If setting with the communicator device menu, go to [Device] > [Display configuration]. To set each item, please refer to 4-6, "Display Transducer Block."

4-2-4. Setting the Pressure Unit

This is set using the Pressure Transducer Block and AI Function Block.

Set the Unit Index of the PRIMARY_VALUE_RANGE in the 4-5, "Pressure Transducer Block."

4-2-5. Setting the Measuring Range

This is set with the AI Function Block.

4-2-6. Setting the Fill Fluid Temperature Compensation Function

This is set using the Pressure Transducer Block. Set the HEIGHT_VALUE described in 4-5, "Pressure Transducer Block."

4-2-7. Setting the Damping Time Constant

This is set using the Pressure Transducer Block and AI Function Block. The DAMPING_CONSTANT is normally set in the 4-5, "Pressure Transducer Block." During this process, set the PV_FTIME (a damping time constant of AI Function Block) to 0.0.

4-2-8. Setting the Alarm

The upper and lower alarm limits of the output value are set using the AI Function Block.

To set all other alarms, please refer to 4-7, "Diagnostic Transducer Block."

4-3. Overall Configuration of the AT9000 FF

The block configuration of AT9000 FF is as follows.

Table 4-1. Block configuration of AT9000 FF.

Block Name	Abbreviation	Number of Implementation	Overview
Resource Block	RB	1	Block that includes mainly information on the device hardware
Pressure Transducer Block	PRESS TB	1	Block that calculates differential pressure and pressure
Display Transducer Block	DISP TB	1	Block that controls the LCD display
Diagnostic Transducer Block	DIAG TB	0/1 *2	Block that executes the diagnosis
Analog Input Function Block	AI	2/4 *1	Block that receives the measurement from the input channel of the transducer block, calculates scaling, etc. and outputs the result
Discrete Input Function Block	DI	2	Block that receives the limit switch data from the transducer block, conducts invert calculation and damping time calculation, and outputs the result
PID Control Function Block	PID	1	Block that calculates the PID control using the measurements from AI and local set points, and then outputs its result as a control input to AO on the downstream side
Output Splitter Function Block	OS	1	Block that feeds a single input into two individual linear functions to spit out two individual ones, and enable the control of two systems
Input Selector Function Block	IS	1	Block that generates output based on the behaviors specified from several inputs
Arithmetic Function Block	AR	1	Block that conducts calculation using calculation formats (10 types) necessary to calculate the temperature and flow rate

*1. Set to 4 if there's advanced diagnosis, 2 if not

*2. Set to 1 if there's advanced diagnosis, 0 if not

4-4. Resource Block

Resource Block is a block that includes mainly information on the device hardware. Several basic parameters within this block may affect the operation, including function block process, alert process, etc. Furthermore, information the host device uses to identify the type of field device will also be included in this. If these parameters are not set correctly, it may interfere with the inter-device messages.

For information on parameters (MODE_BLK, FEATURES, FEATURES_SEL, MANFAC_ID, DEV_TYPE, DEV_REV, DD_REV) that you need to especially take caution in terms of delivery of messages within a resource block.

For all other parameters, please refer to the Resource Block Parameter List in Appendix C.

Please refer to the next section regarding the field diagnostic function.

4-4-1. Field Diagnostics

Field diagnostics is a function that summarizes and notifies the device status and diagnosis result.

Diagnosis result is categorized into the following four categories. Categorization of each diagnosis result can be set and modified by the user.

Maintenance	Maintenance Required Although the output signal is valid, the wear reserve is nearly exhausted or a function will soon be restricted due to operational conditions
Off Specification	Off-Spec Usage Off-spec means that the device is operating outside its specified range or an internal diagnostic indicates deviations from measured or set values due to internal problems in the device or process characteristics
Check Function	Functional Check Required Output signal temporarily invalid due to on-going work on the device.
Failed	Failure Output signal invalid due to malfunction in the field device or its peripherals.

Out of the resource block parameters, the ones with "FD_" at the beginning of their name are the parameters related to field diagnostics.

FD_VER

This is the main version of the field diagnostic specifications that is being referenced.

FD_FAIL_MAP, FD_OFFSPEC_MAP, FD_MAINT_MAP, FD_CHECK_MAP

FD_*_MAP is the parameter that selects the items to be reflected in FD_*_ACTIVE. This parameter is used to decide which category each diagnosis item should be categorized into.

FD_FAIL_ACTIVE, FD_OFFSPEC_ACTIVE, FD_MAINT_ACTIVE, FD_CHECK_ACTIVE

When errors categorized to each category are detected, it gets reflected onto these parameters.

FD_FAIL_MASK, FD_OFFSPEC_MASK, FD_MAINT_MASK, FD_CHECK_MASK

You can use FD_*_MASK to decide whether to notify FD_*_ALM of the diagnostic result generated with FD_*_ACTIVE. It will be queued into the notification queue if it hasn't been masked.

FD_FAIL_PRI, FD_OFFSPEC_PRI, FD_MAINT_PRI, FD_CHECK_PRI

Sets the priority of the alarm notification. When this value is 0, detection and notification will not be conducted.

FD_FAIL_ALM, FD_OFFSPEC_ALM, FD_MAINT_ALM, FD_CHECK_ALM

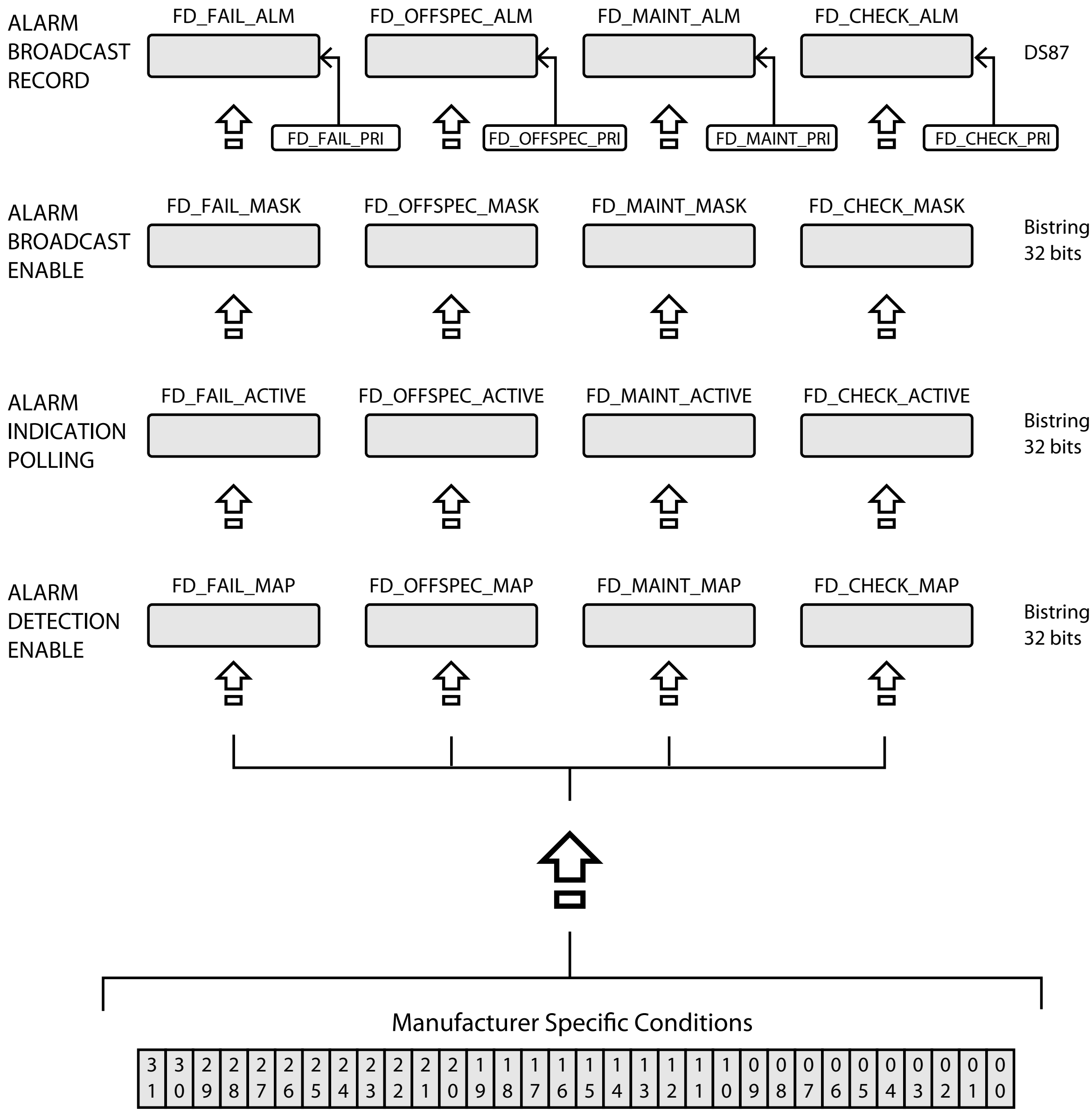
This is the alarm notification history.

FD_SIMULATE

You may simulate the diagnosis result. Furthermore, you may confirm the actual diagnosis result.

FD_RECOMMEN_ACT

These are the actions we would like the users to implemented in regards to the diagnosis result.



The detail of each bit is as follows.

bit	Description	Factory Default MAP Setting	Diagnosis Representative Block	Unit LCD Display
31	Electrical Module Failure	FAIL	Press TB, RB	EM Fail
28	Meter Body Failure	FAIL	Press TB	MB Fail
27	Invalid Database	FAIL	Press TB	DB Fail
23	Meter Body Over Temperature	OFFSPEC	Press TB	OvrTemp
22	Meter Body Overload or Failure	OFFSPEC	Press TB	OvrLoad
15	External Zero Switch Failure	MAINT	Press TB	SwcFail
14	Not Calibrated	MAINT	Press TB	NoCalib
13	Zero Calibration Amount Exceeds ± 5 %	MAINT	Press TB	Ex Zero
12	Span Calibration Amount Exceeds ±5 %	MAINT	Press TB	Ex Span
10	Pressure Frequency Index Alarm	MAINT	Diag TB	PressFq
9	Standard Deviation Alarm	MAINT	Diag TB	Std Dev
8	Overload Count Alarm	MAINT	Diag TB	OOR Cnt
0	Check bit for ITK	CHECK	Diag TB, Press TB, Disp TB	Check

4-5. Pressure Transducer Block

This explains the functions of the Pressure Transducer Block. Pressure Transducer Block will be hereinafter referred to as "PRESS TB."

PRESS TB gets input from the sensor, calculates the differential pressure or pressure, as well as the sensor temperature, and then outputs it as channel value to AI FB. Furthermore, the limit switch function outputs alert to DI FB. There are also the external zero adjustment function, which use the external zero adjustment switch as the input, as well as the self diagnosis function and history function. The self-diagnostic result is reflected on the Resource Block as well.

4-5-1. Function Block Diagram

The function block of PRESS TB is described below.

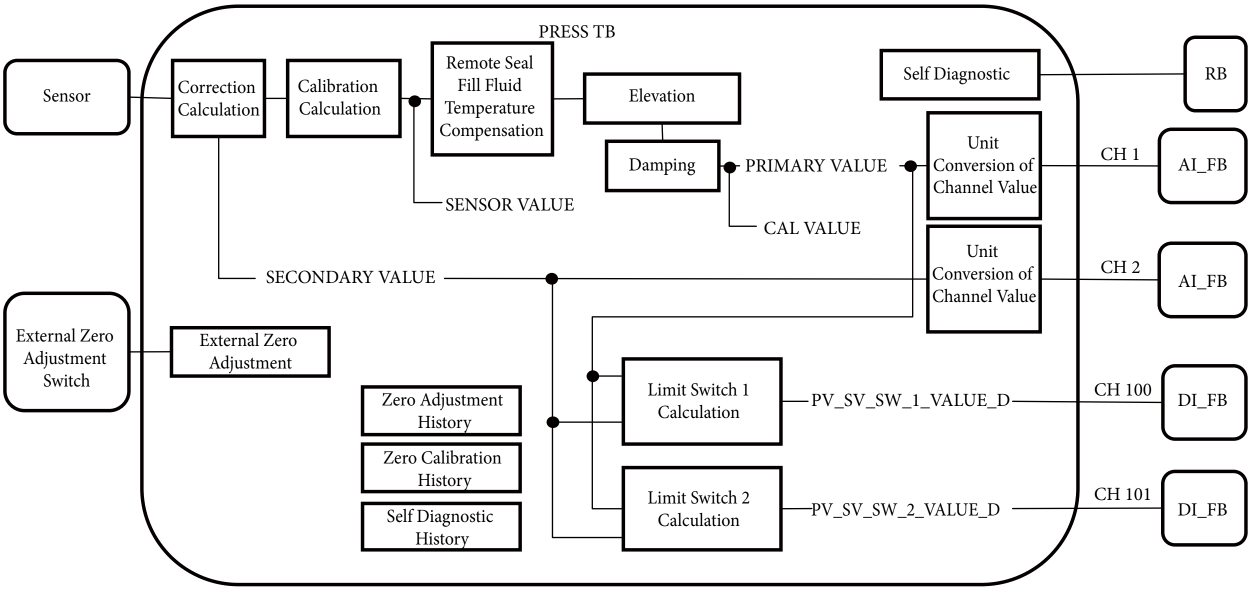


Figure 4-1. PRESS TB Function Block Diagram

Compensation Calculation

This calculates the input pressure and temperature (SECONDARY_VALUE) by making a compensation calculation of the output values from the static pressure sensor and temperature sensor, via the characterization data stored in the meter body's memory.

Calibration Calculation

Input pressure is calibrated using the zero point calibration value and span point calibration value. The calibrated value becomes the SENSOR_VALUE.

Remote Seal Fill Fluid Temperature Compensation

With the remote-seal differential pressure transmitter, the density of the fill fluid inside the capillary tube changes based on the changes in the ambient temperature. Remote-seal fill fluid temperature compensation corrects the differential pressure changes due to changes in the fluid's density due to changes in the ambient temperature.

Elevation

This conducts the zero shift zero adjustment via cancellation of the connecting pipe's sealed liquid, and the specific on-site placement.

Damping Time

This suppresses sudden change in the pressure value.
The values after damping time become: PRIMARY_VALUE and CAL_VALUE.

Unit Conversion of Channel Value

This function converts the channel value into a unit specified by AI FB, and hands it over to AI FB, whenever PRESS TB is requested by AI FB for the Channel Value, and if the unit of the PRESS TB's Channel Value and the unit of AI FB connected to that Channel differ. The unit of XD_SCALE of FB connected to CH1 needs to be a pressure unit, and unit of XD_SCALE of AI FB connected to CH2 needs to be a temperature unit. If it is not correct, it will be a configuration error.

Channel

PRESS TB has 4 channels. The channel numbers, output, FB (Function Block) to which it can connect are as follows.

Table 4-2. The channel numbers, output, FB (Function Block) to which it can connect

Channel number	Channel output	FB that can connect to a channel
1	PRIMARY_VALUE	AI FB
2	SECONDARY_VALUE	AI FB
100	PV_SV_SW_1_VALUE_D	DI FB
101	PV_SV_SW_2_VALUE_D	DI FB

Limit Switch Calculation

Limit switch is a function that outputs 1 if the input exceeds the threshold, and 0 if it doesn't. The output becomes an input of DI FB (Discrete Input Function Block). There are two types: Limit Switch 1 and Limit Switch 2.

External Zero Adjustment

Zero adjust is done via the zero adjustment switch on the lower area of the LCD display. This is operated with a magnet attached to the transmitter.

Self-Diagnosis

This implements the self diagnosis of the transmitter. The diagnostic result also gets reflected on the Resource Block (RB).

History

There are the following 3 types of history.

- Zero Adjustment History
- Zero Calibration History
- Self Diagnosis History

4-5-2. Parameter List

For the parameters held by PRESS TB, please refer to Appendix D, "Pressure Transducer Block Parameter List."

4-5-3. Setting the Pressure Unit

In the communicator's device menu (refer to Appendix A), go to [Device]>[Basic Setup]>[Primary Value Range.Units Index].

Please refer to Appendix E for the pressure unit that can be set.

4-5-4. Zero Adjustment via Input Pressure

In the communicator's device menu (refer to Appendix A), go to [Device]>[Basic Setup]>[Zero Adjustment] to conduct the adjustment.

Please refer to section 3-10, "External Zero Adjustment (Optional)."

4-5-5. Setting the Fill Fluid Temperature Compensation Function

This function is useful during connection with model GTX_ _R.

Menu will not get displayed during connection with models other than model GTX_ _R.

This is Azbil Corporation's proprietary compensation function, which minimizes the zero shift due to changes in the density of the fill fluid in a remote-seal differential pressure transmitter. It measures the ambient temperature with the transmitter unit's temperature sensor, and compensates the density.

To active this function, set the height between the flanges of the tank to which the transmitter unit will be mounted on.

- Example 1: Input the set Point

  Height between flanges, set the value in communicator's device menu (refer to Appendix A) by going to [Device]>[Basic Setup]>[Height Value] Input the height between flanges using "m" as the unit.

- Example 2: Auto Set Point

  Height between flanges, set the value in communicator's device menu (refer to Appendix A) by going to [Device]>[Basic Setup]>[Auto Height Calculation] (Amb. Temp. Compensation).

4-5-6. Calibration

PRESS TB has four calibration functions: zero calibration, span calibration, restoration of the factory calibration value and calibration value reset.

The following devices are required for zero calibration and span calibration.

Equipment Used

- Standard Pressure Generator:

  Those that can generate a pressure close to the measuring range of the test unit.

  Accuracy: ±0.05 F.S. or ±0.1% setting

Calibration Requirements

Please satisfy the following requirements for the actual pressure calibration.

- Perform calibration in a windless test chamber. (If there is a wind, pressure will be applied to the pressure receiver on the side that is open to the atmosphere, which may exert an effect on calibration accuracy)
- Standard temperature is 23°C, humidity is 65%. (If no sudden change occurs, ambient temperature can be in the range of 15°C to 35°C and normal humidity between 45% to 75%)
- The ideal accuracy of the measuring instrument is at least 4 times the accuracy of the transmitter to be calibrated.
- ELEVATION_VALUE, HEIGHT_VALUE should be set to 0.
- Set CAL_UNIT to your desired unit.

4-5-6-1. Zero Calibration

This function calibrates the zero point so that the current input pressure becomes the same value as what was written in CAL_POINT_LO.

Zero calibration occurs when a value is written in CAL_POINT_LO.

<Working Example>

- Set the pressure or differential pressure to 0.
- Wait a while until the pressure or differential pressure becomes stable.
- Write 0.0 to CAL_POINT_LO. Zero calibration occurs at this moment.
- Verify whether CAL_VALUE is close to 0.0.

4-5-6-2. Span Calibration

This function span calibrates the current input pressure so that it becomes the same value as what was written in CAL_POINT_HI.

Span calibration occurs when a value is written in CAL_POINT_HI.

<Working Example>

- Put pressure or differential pressure for the span to calibrate via the standard pressure generator.
- Wait a while until the pressure or differential pressure becomes stable.
- Write the span value that is to be calibrated to CAL_POINT_HI. Span calibration occurs at this moment.
- Verify whether CAL_VALUE is near the calibrated span value.

4-5-6-3. Restoring the Factory Calibration Value

Restoration of the factory calibration value returns the zero calibration value and span calibration value to that of factory default.

It can be operated with the Resource Block (RB).

<Working Example>

- Set the RB's Actual Mode to Auto.
- Confirm that RB's Actual Mode is set to Auto.
- Write 12 as value for RB's RESTART (Resets transducer block factory calibration).
- The zero calibration value and span calibration value return to that of factory default.
- RB's RESTART returns to 0.

4-5-6-4. Calibration Value Reset

This resets the zero calibration value and span calibration value. Zero calibration value and span calibration value get reset to 0.0 and 1.0, respectively.

Please conduct the zero calibration (and span calibration) after a calibration value reset. This will clear the uncalibrated flag.

<Working Example>

- Write 254 as a value of RESET_CALIBRATION (Reset Calibration). This will reset the calibration value.
- When the calibration value is reset, RESET_CALIBRATION returns to 0 (None).

4-5-7. Self-Diagnosis

Press TB conducts a self-diagnosis of the transmitter, and as a result, outputs the following four items.

XD_ERROR	Represents the device errors
BLOCK_ERR	Represents the block errors
BLOCK_ERR_DESC_1	Represents the detail of the BLOCK_ERR
BLOCK_ERR_DESC_2	Represents the detail of the BLOCK_ERR

The detail of XD_ERROR is as follows. If several errors have occurred, the one with the largest value will get selected.

Value	Description	Detail
17	General error	An error has occurred that could not be classified as one of the errors below.
18	Calibration error	An error occurred during calibration of the device or a calibration error has been detected during operation of the device.
19	Configuration error	An error occurred during configuration of the device or a configuration error has been detected during operation of the device.
20	Electronics Failure	An electronic component has failed.
22	I/O Failure	An I/O failure has occurred
23	Data Integrity Error	Indicates that data stored within the system may no longer be valid due to NVM checksum failure, data verify after write failure, etc.

The detail of BLOCK_ERR is as follows. When several errors are present, each bit gets set, as they are bit-handled.

Value	Description	Detail
bit 0	Other	BLOCK_ERR_DESC_1's bit 12, 13, 14, 15, 21, 22, 23, 24
bit 1	Block Configuration Error	BLOCK_ERR_DESC_2's bit 28, 29, 30, 31
bit 7	Sensor Failure detected by this block	BLOCK_ERR_DESC_1's bit 25, 26, 27, 28, 29, 30, 31
bit 15	Out-of-SERVICE	

The detail of BLOCK_ERR_DESC_1 is as follows. This is the detailed information on BLOCK_ERR.

Value	Description	Recommended Action	Influence on the BLOCK_ERR
bit 12	Span Calibration Amount Exceeds by ±5%	Execute Calibration	bit 0
bit 13	Zero Calibration Amount Exceeds by ±5%	Execute Calibration	bit 0
bit 14	Not Calibrated	Execute Calibration	bit 0
bit 15	External Zero Switch Failure	Replace LCD Module. Please Contact Customer Service.	bit 0
bit 21	Meter Body Overload or Failure	Check Operating Conditions	bit 0
bit 22	Meter Body Over Temperature	Check Operating Conditions	bit 0
bit 23	Invalid Database	Replace Electrical Module. Please Contact Customer Service.	bit 0
bit 24	Sensor Characteristic Data Failure	Replace Meter Body. Please Contact Customer Service.	bit 0
bit 25	Pressure Sensor Failure	Replace Meter Body. Please Contact Customer Service.	bit 7
bit 26	Analog/Digital Conversion Failure	Replace Meter Body. Please Contact Customer Service.	bit 7
bit 27	Sensor Module NVM Failure	Replace Electrical Module. Please Contact Customer Service.	bit 7
bit 28	Sensor Module RAM Failure	Replace Electrical Module. Please Contact Customer Service.	bit 7
bit 29	Sensor Module ROM Failure	Replace Electrical Module. Please Contact Customer Service.	bit 7
bit 30	Sensor Module CPU Failure	Replace Electrical Module. Please Contact Customer Service.	bit 7
bit 31	CPU-to-CPU Communications Error	Replace Electrical Module. Please Contact Customer Service.	bit 7

The detail of BLOCK_ERR_DESC_2 is as follows. This is the detailed information on BLOCK_ERR.

Value	Description	Recommended Action	Influence on the BLOCK_ERR
bit 28	PV/SV Switch 2 Configuration Error	PV/SV Switch 2 settings is not correct. Please verify the settings.	bit 1
bit 29	PV/SV Switch 1 Configuration Error	PV/SV Switch 1 settings is not correct. Please verify the settings.	bit 1
bit 30	SVR Configuration Error	Secondary Value Range settings (EU_100 and EU_0) are not correct. Please verify the settings.	bit 1
bit 31	PVR Configuration Error	Primary Value Range settings (EU_100 and EU_0) are not correct. Please verify the settings.	bit 1

4-5-8. History

There are the following 3 history functions.

- Zero Adjustment History
- Zero Calibration History
- Self-Diagnostic History

4-5-8-1. Zero Adjustment History

The history will remain if zero adjustment is conducted.

It will get recorded in the order of occurrence, from ELEVATION_RECORD_1 to ELEVATION_RECORD_30.

The latest history will be ELEVATION_RECORD_1.

The latest 30 histories get stored, and anything older than that gets deleted.

The following three items get recorded.

Date Implementation Date

Select Implementation Method

0: None	Unimplemented
1: Elevation Command	Execute in the adjustment command
2: Manual Elevation Input	Direct input
3: External Adjustment	Execute via external zero adjustment

Value Elevation Value (unit is CAL_UNIT)

4-5-8-2. Zero Calibration History

The history will remain if zero calibration is conducted.

It gets recorded in the order of occurrence, from ZERO_CAL_RECORD_1 to ZERO_CAL_RECORD_30.

The latest history is represented by ZERO_CAL_RECORD_1.

The latest 30 histories get stored, and anything older than that gets deleted.

The following two items get recorded.

Date Implementation Date

Value Calibration Value (Unit is %)

4-5-8-3. Self-Diagnostic History

As a result of a self-diagnosis, a history record will be written when error occurs or when returning from error.

It gets recorded in the order of occurrence, from SELF_DIAG_RECORD _1 to SELF_DIAG_RECORD _30.

The latest history is represented as SELF_DIAG_RECORD _1.

If 30 histories get written, no other new self-diagnostic result gets recorded.

Therefore, we recommend deleting the history after confirming the self-diagnostic history. Please refer to the next chapter on how to delete it.

The following four items get recorded in the self-diagnostic history.

BLOCK_ERR	Represents the block errors
BLOCK_ERR_DESC_1	Represents the detail of the BLOCK_ERR
SELF_DIAG_SUMMARY	Summary of self-diagnosis
SELF_DIAG_RECORD_1 to 40	Self-diagnostic history

4-5-8-4. Deletion of Self-Diagnostic History

User may arbitrarily initialize (delete) the self-diagnostic history.

(1) Initializing the SELF_DIAG_SUMMARY

Write 1 {Reset Self-Diagnostic Summary} to ERASE_SELF_DIAG_RECORDS.
The value of ERASE_SELF_DIAG_RECORDS returns to 0 {None} immediately after it is written.

This will initialize the SELF_DIAG_SUMMARY.

(2) Initialization of SELF_DIAG_RECORD_1 to 40

Write 2 {Reset Self-Diagnostic Records} to ERASE_SELF_DIAG_RECORDS.

The value of ERASE_SELF_DIAG_RECORDS returns to 0 {None} immediately after it is written.

This will initialize the SELF_DIAG_RECORD_1 to 40.

4-6. Display Transducer Block

This explains the functions of the Display Transducer Block. Display Transducer Block will be hereinafter referred to as Disp_TB.

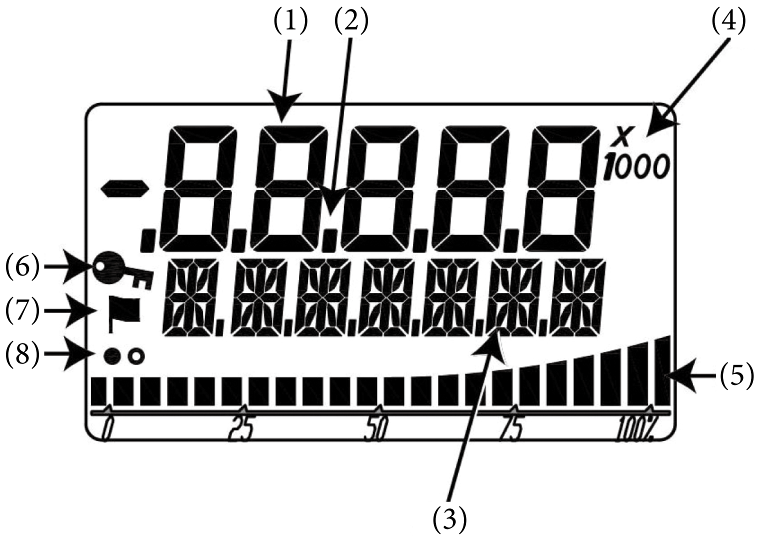
Disp_TB is a block that converts the output value of a block specified by the user, and converts the device's diagnostic information into a display data. Converted display data get output to the digital indicator.

4-6-1. Parameter List

For the parameters held by Disp_TB, please refer to Appendix G, "Display Transducer Block Parameter List."

4-6-2. Indicator Display

The indicator display is comprised of the following detail.



No.	Display resource	Description	Display category
(1)	7 segments (5 digits)	Main number display, alarm number	Numerical part
(2)	Decimal point (5 digits)	Decimal point	
(3)	16 segments (7 digits)	Tag, unit, status detail, alarm detail	String part
(4)	Exponent	None, ×10, ×100, ×1000	Other
(5)	Bar graph (22)	% bar graph	Bar graph part
(6)	Key symbol	Write protect status	Other
(7)	Flag symbol	Status history	
(8)	Display update symbol	It represents that an LCD has been updated via alternating flashes. It signifies that an LCD display function is properly working.	

Table of Character Pattern Display of the 7 Segments in (1)

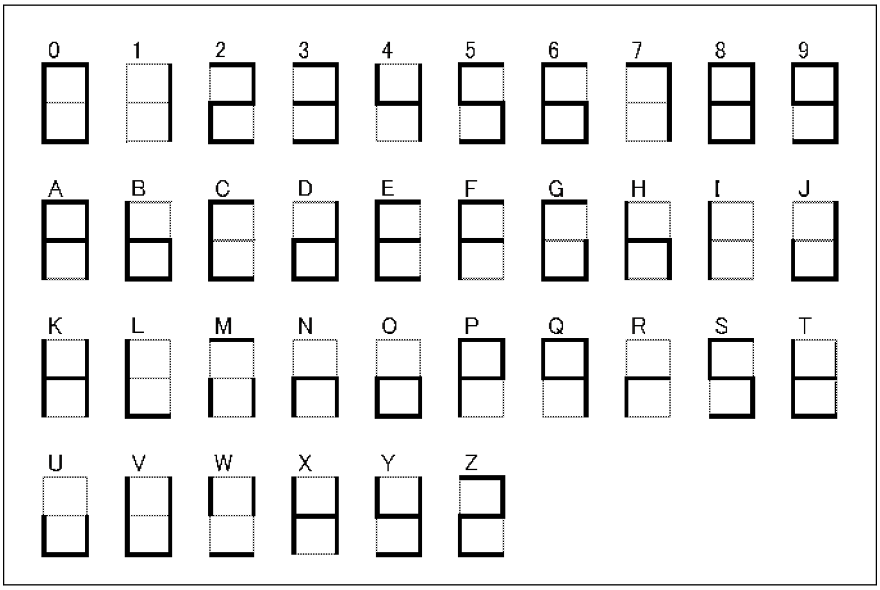


Table of Character Pattern Display of 16 Segments from (3)

4-6-3. Display During Operation

When in operation, it displays in the following order.

[All segments lights up (about 3 sec)] → [All segment lights go off (about 3 sec)] → [Preparation display] → [Regular display]

For the above "Preparation display," "FF" and "initial" get written to the numerical part and string part, respectively.

4-6-4. Regular Display

With the factory default setting, the OUT value of AI Function Block is displayed.

With the factory default setting, it gets displayed periodically according to the following sequence.

Sequence Number	1	2	3
Numerical part	AI:OUT value	AI:OUT value	AI:OUT value
String part	AI_OUT (Tag)	% (Specified Unit)	(Status)
Display Time	5	5	5

If changing the display time, change the following parameter setting.
DISPLAY_CYCLE: can set it to a value between 1 sec and 10 sec

Furthermore, if changing the display of this string part, change the following parameter setting.

DISPLAY_INFO_SELECTION: factory default is 0x07 (Tag, Unit, Status are all selected)
For example, if not displaying Tag and Status, and displaying only Unit, change the setting to 0x02. Please refer to Appendix G.

If changing the display detail from the factory default OUT value of the AI Function Block to other parameter, change the following parameter.

BLOCK_TAG_SELECTION_1: specifies Block Tag of the block to be displayed.
PARAM_SELECTION_1: specifies the parameter to be displayed in the block.
DISPLAY_TAG_1: sets the Tag to be displayed.

For example, if you wish to change the display detail to Primary_Value of Pressure TB,

(1) Set PRESSURE_TB in BLOCK_TAG_SELECTION_1. (PRESSURE_TB of Block Tag is the factory default value. If it has been changed since factory shipment, set this modified value)

(2) Verify that BLOCK_TYPE_SELECTION_1 is now 0x0158 Pressure_TB.

(3) Select 15:PRIMARY_VALUE for PARAM_SELECTION_1

(4) For example, change DISPLAY_TAG_1, which is the tag to be displayed, to PV.
For other displayable parameters, please refer to Appendix H.

Note

If you change the Block Tag of the block that you are trying to set the display for, the setting will not get properly implemented.

If you had changed the Block Tag, turn the device power off and then on again, or write "4 {Restart Processor}" to Resource Block's RESTART section and then restart your device.

4-6-5. Several Parameter Display

Disp_TB can display a maximum of 4 parameters sequentially and periodically. This section will explain the setting of displaying two parameters as an example.

This explains how to set it to display the OUT value of AI Function Block and sensor temperature (SECONDARY_VALUE) of Pressure TB periodically.

The factory default setting sets it so that it only displays the OUT value of AI Function Block. In addition, if adding the sensor temperature (SECONDARY_VALUE) of Pressure TB as the second parameter, enable bit1: Parameter 2 of the DISPLAY_PARAM_SELECTION. DISPLAY_PARAM_SELECTION will change from the factory default 0x01 to 0x03.

Next, you will set BLOCK_TAG_SELECTION_2 to PRESSURE_TB.

Verify that BLOCK_TYPE_SELECTION_2 is now set to 0x0158 Pressure_TB (PRESSURE_TB of Block Tag is the factory default value. If it has been changed since factory shipment, set this modified value).

Select 34: SECONDARY_VALUE for PARAM_SELECTION_2.

Set the DISPLAY_TAG_2, a display tag, to TEMP for example.

By conducting the above setting, it gets displayed periodically according to the following sequence.

Sequence Number	1	2	3	4	5	6
Numerical part	AI: OUT value	AI: OUT value	AI: OUT value	PressTB: SV value	PressTB: SV value	PressTB: SV value
String part	AI_OUT	(Specified Unit)	(Status)	TEMP	(Specified Unit)	(Status)
Display Time	5	5	5	5	5	5

If changing the display time, change the DISPLAY_CYCLE setting. This can be set within the range of 1 to 10 seconds.

Set the following to display the third parameter along with the above.

DISPLAY_PARAM_SELECTION: 0x07 (enable bit2: Parameter 3 as well)
BLOCK_TAG_SELECTION_3: set the Block Tag to be displayed
PARAM_SELECTION_3: select the parameter to be displayed
DISPLAY_TAG_3: set the Tag to be displayed

Set the following to display the fourth parameter as well.

DISPLAY_PARAM_SELECTION: 0x0f (enable bit3: Parameter 4 as well)
BLOCK_TAG_SELECTION_4: set the Block Tag to be displayed
PARAM_SELECTION_4: select the parameter to be displayed
DISPLAY_TAG_4: set the Tag to be displayed

Please refer to Appendix G for detail on Disp_TB parameters.

Note

If you change the Block Tag of the block that you had set via BLOCK_TAG_SELECTION_n (n=1, 2, 3, 4), the setting will not get properly implemented.

If you had changed the Block Tag, turn the device power off and then on again, or write "4 {Restart Processor}" to Resource Block's RESTART section and then restart your device.

4-6-6. Status Display

Please refer to Appendix J for the status displayed by the string part.

4-6-7. Unit Display

Specify the display unit via UNIT_SELCTION_n. You can select either Auto (0) or Custom (1).

If Auto, the unit specified in the display parameter range will get displayed. Please refer to the parameter list, which includes the display parameter, and section in Appendix L, "Display Transducer Block Display Status List."

If Custom, the first 7 characters of the unit (max 32 characters) specified in CUSTOM_UNIT_n will get displayed.

4-6-8. Irregular Display

During OOS and CPU-to-CPU communication error, the regular display will be switched to irregular display.

4-6-8-1. OOS Display

When Disp_TB is OOS (Out Of Service), it will display the following.

Numerical part	(Lights off)
String part	DSP_OOS

Switching to Auto will change it back to regular display.

4-6-8-2. CPU-to-CPU Communication Error Display

When a CPU-to-CPU communication error occurs inside the transmitter, the following gets displayed.

Numerical part	FF
String part	_discon

If the above display problem occurs, please consult the distributor.

4-6-8-3. Alarm Display

When an alarm is activated, the alarm display strings of Appendix K will get periodically displayed.

4-7. Diagnostic Transducer Block

This explains the functions of the Diagnostic Transducer Block. Diagnostic Transducer Block will be hereinafter referred to as Diag_TB.

Diag_TB calculates the pressure frequency index, standard deviation and excess pressure occurrence frequency. Furthermore, it determines whether the pressure frequency index, standard deviation or excess pressure occurrence frequency has exceeded the threshold, and notifies the result to Resource Block (RB).

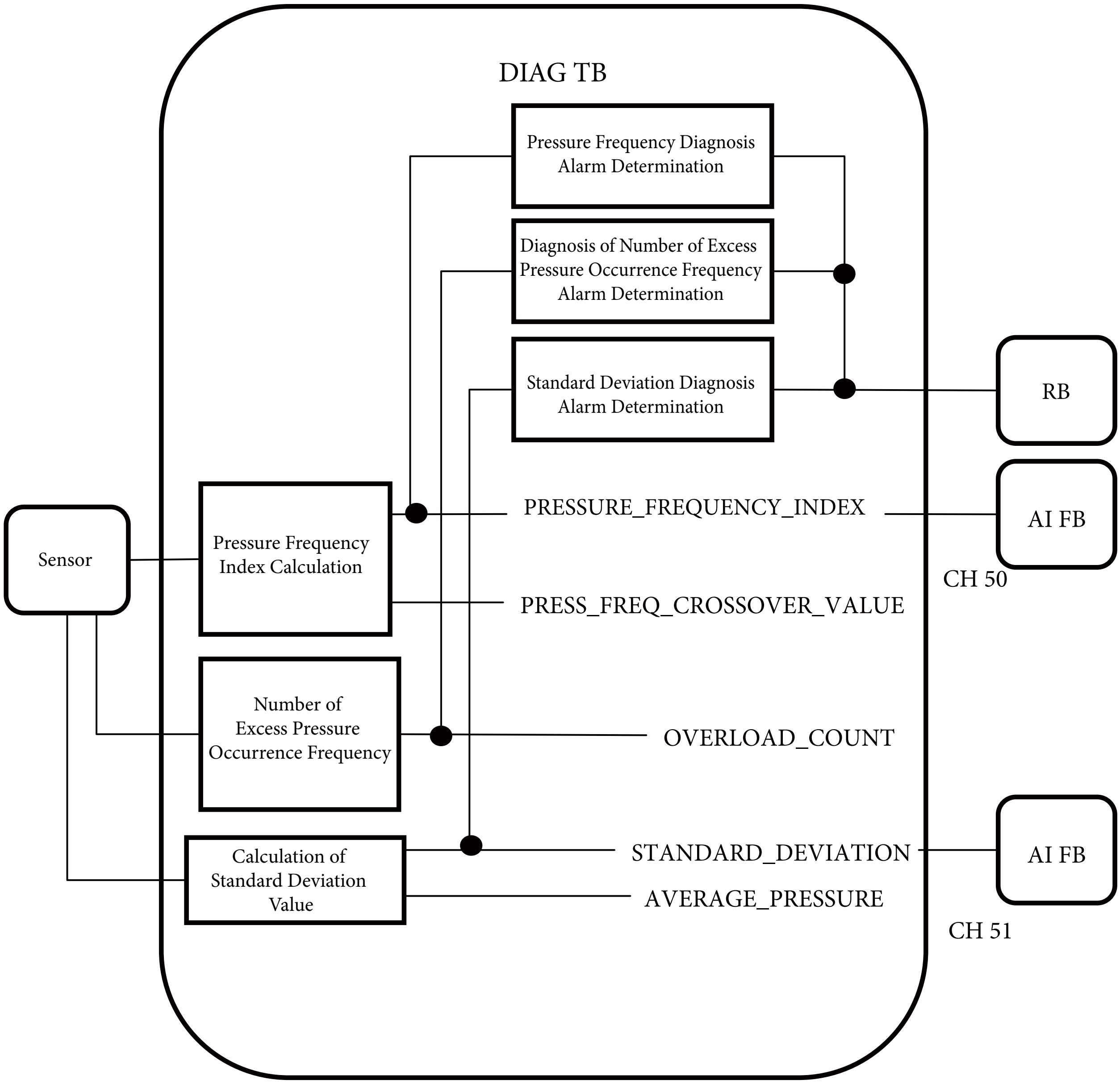
The pressure frequency index and standard deviation may be output to AI FB.

4-7-1. Parameter List

For the list of parameters held by Diag_TB, please refer to Appendix M, "Diagnostics Transducer Block Parameter List."

4-7-2. Function Block Diagram

The function block of Diag_TB is described below.



Channel

Diag_TB has two channels. The channel number, output and FB (function block), to which it can connect, of each channel are as follows.

Table 4-3. Diag_RB's channel number, output, FB (Function Block) to which it can connect

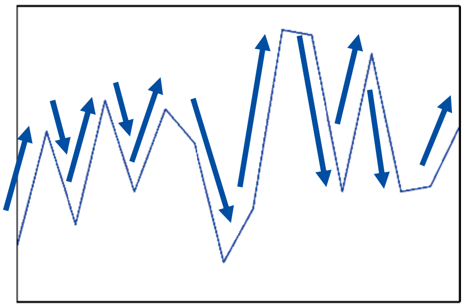
Channel number	Channel output	FB that can connect to a channel
50	PRESSURE_FREQUENCY_INDEX	AI FB
51	STANDARDE_DEVIATION	AI_FB

4-7-3. Pressure Frequency Index

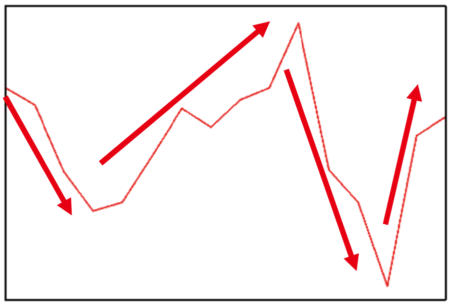
Pressure frequency index is a numerical representation of the frequency of the vertical volatility (oscillation) of the input pressure, via a range between 0 and 1. This is calculated based on the frequency of vertical volatility in a span of few minutes. By observing the changes in this value, it is possible to detect the changes in the process. For example, it can be utilized for the connecting pipe clog diagnosis.

If you wish to utilize it for the connecting pipe clog diagnosis, please refer to Appendix N.

The following is a working example that can grasp the changes in the volatile frequency of the input pressure during normal state as well as during changes.



Normal state



During a change

4-7-3-1. Warning regarding the Pressure Frequency Index

Please pay careful attention to the following precautionary notes when utilizing the pressure frequency index.

The pressure frequency index changes based on several factors. Therefore, it is sometimes difficult to determine certain abnormality or phenomenon just from looking at this index alone.

If it was abnormal to begin with, it won't be able to capture changes due to such abnormalities. Please conduct works associated with Preparation (section 4-7-3-3) during a normal state.

Even if sudden abnormality occurs, the pressure frequency index does not immediately change. This is because it requires few minutes to accurately calculate the pressure perturbation frequency. Furthermore, if the abnormality duration is small and it quickly returned to normal state, the alarm may not be activated due to such small index change.

If the transmitter is placed in an environment with large vibrations, a false alarm may be generated, as it won't be able to correct detect abnormalities.

4-7-3-2. Pressure Frequency Index related Parameters

Pressure Frequency Index related parameters are as follows. For attribute detail, please refer to Appendix M, "Diagnostics Transducer Block Parameter List." There are some limitations while in a mode that allows writes. Please refer to the parameter list.

PRESSURE_FREQUENCY_INDEX	Pressure Frequency Index
PRESSURE_FREQUENCY_INDEX_MAX	High Limit of Pressure Frequency Index
PRESSURE_FREQUENCY_INDEX_MIN	Low Limit of Pressure Frequency Index
PRESS_FREQ_IDX_RANGE	Pressure Frequency Index Range
RESET_PRESSURE_FREQUENCY_INDEX	Reset Pressure Frequency Index
PRESS_FREQ_INDEX_ALARM_USE	Operation Mode for the Pressure Frequency Index Diagnosis Alarm
PRESS_FREQ_INDEX_HI_LIMIT	High Limit of Pressure Frequency Index (diagnosis alarm threshold (high side))
PRESS_FREQ_INDEX_LO_LIMIT	Low Limit of Pressure Frequency Index (diagnosis alarm threshold (low side))
PRESS_FREQ_IDX_SENSOR_SELECTION	Sensor Selection
PRESS_FREQ_CALC_PV_HI_LIMIT	High Limit of Pressure Value Filter
PRESS_FREQ_CALC_PV_LO_LIMIT	Low Limit of Pressure Value Filter
PRESS_FREQ_CALC_PV_UNIT	Pressure Value Filter Unit
PRESS_FREQ_FILTER_CONSTANT	Pressure Frequency Filter Constant

4-7-3-3. Preparation

First, observation must be made during a normal state of the process. A good amount of observation time is from several hours to about a day (adjust the required time based on a criteria, if the operating condition can vary greatly).

One observation method is to observe the trend of the pressure frequency index, but if not, an easily method is to measure the max and lower range values of the pressure frequency index.

(1) Pressure Frequency Index Trend Observation

To observe the trend in the pressure frequency index, connect the Channel #50 to AI FB.

(2) Measuring the Max and lower range values of the Pressure Frequency Index

To measure the max and lower range values of the pressure frequency index, please refer to the following procedure.

When the process state is normal and stabilized, reset the pressure frequency index, the max and the lower range values of it, and start the measurement of the max and lower range values.

Write 1 to RESET_PRESSURE_FREQUENCY_INDEX {Reset} to reset it.

This will reset the pressure frequency index, as well as its max and lower range values.

Please also note that when it is reset, the correct values for the reset parameters will not be obtainable until the pressure frequency index is newly calculated.

After a set time has elapsed, observe the value of the following two variables.

PRESSURE_FREQUENCY_INDEX_MAX	High Limit of Pressure Frequency Index
PRESSURE_FREQUENCY_INDEX_MIN	Low Limit of Pressure Frequency Index

4-7-3-4. Setting the Alarm

Set the following two variables relating to the upper and lower range values of the pressure frequency index based on the observation result in the preparation section.

PRESS_FREQ_INDEX_HI_LIMIT	High Limit of Pressure Frequency Index (diagnosis alarm threshold (high side))
PRESS_FREQ_INDEX_LO_LIMIT	Low Limit of Pressure Frequency Index (diagnosis alarm threshold (low side))

Next, set the operation mode of the pressure frequency diagnosis alarm. Set the following parameters.

PRESS_FREQ_INDEX_ALARM_USE

0: No operation

1: Upper range value only

2: Lower range value only

3: Upper and lower range values

4-7-3-5. Alarm Detection

When the pressure frequency index alarm is detected, it is notified to the resource block. Please refer to section 4-4-1, "Field Diagnostics."

4-7-3-6. Sensor Select and P Sampling Interval

The sensor can be selected and the P sensor sampling interval can be set with PRESS_FREQ_IDX_SENSOR_SELECTION.

For differential pressure gauge (DP):

0: DP, 120 ms (factory default setting)

1: DP, 240 ms

2: DP, 360 ms

10: SP, 360 ms

For pressure gauge (GP) or absolute pressure gauge (AP):

0: DP, 120 ms (factory default setting)

1: DP, 240 ms

2: DP, 360 ms

Sensor Select:

For the differential pressure gauge, the DP sensor can be selected, as well as the SP sensor. By selecting the SP sensor, the static pressure oscillation on the high pressure side can be detected. By using this static pressure oscillation, you can monitor the process or application status from a viewpoint different from the differential pressure oscillation.

For example, when utilizing it for the connecting pipe clog detection, changes in the pressure oscillation frequency due to single side clog may appear before during static pressure as opposed to differential pressure, and therefore, the SP sensor may be able to detect the clog faster in this case.

However, the calculation of the pressure frequency index via the SP sensor data is limited to situations where the pressures applicable for measurement are sufficiently high, and the pressure oscillation can be detected using an SP sensor.

P Sampling Interval:

The sampling interval of the differential pressure or pressure value data used in the calculation of the pressure frequency index during the selection of [DP Sensor] in [Sensor Select] may be selected from either 120 ms/240 ms/360 ms.

Shortening the vertical oscillation detection interval will heighten the Upper Range Value of the detectable frequency, but as the interval for conducting the vertical oscillation detection process will shorten as well, the lower range value will get higher as well. Making it longer will lower the lower range value of the detectable frequency, and can allow the detection of very low frequency.

When detecting a phenomenon with influence from high frequency like during connecting pipe clog, it is generally better to shorten the vertical oscillation detection interval, but when the pressure oscillation is already low to begin with, it will actually make the detection more difficult, as the frequency will be outside the detectable frequency range. As such, it is necessary to set the sampling interval after considering the pressure oscillation frequency during the normal state, as well as the frequency range during an abnormality.

4-7-3-7. Filter Adjustment

The pressure frequency index is originally for detecting the process abnormality. However, if the pressure or flow rate itself changes slowly in 40 sec to 5 minute interval (low frequency oscillation), the index may get lower even if no process abnormality exists. Since these changes in pressure and flow rate can happen during a normal operating state, one might falsely conclude of an abnormality by looking at the reduced index, and make it difficult to correctly determine a real one when it occurs.

To counteract this, you can conduct a high pass filter process before counting the vertical oscillation frequency and removing the low frequency components, thereby minimizing false conclusions of abnormality due to the index reduction.

You can change the filter effect (filter coefficient) within the range of 0.0 to 1.0. The factory default setting is 0.0.

If you wish to increase the effect of removing the low frequency components, increase the filter value; if you wish to decrease it, reduce the filter value.

However, please be careful, as it may reduce the abnormality detection performance if it is increased too much.

4-7-4. Standard Deviation

This calculates the standard deviation of the input pressure. This can be utilized for diagnosis that detects the changes in the process status.

4-7-4-1. Calculating Formula

The standard deviation (s) is calculated using the following formula.

$$s = \frac{1}{n}\sum_{i=0}^{n}(x_i - \overline{x})^2 = \overline{x^2} - (\overline{x})^2$$

s: standard deviation

x: input pressure

n: sample number

4-7-4-2. Standard Deviation related Parameter

Standard deviation related parameters are as follows. For the attribute detail, please refer to Appendix M, "Diagnostics Transducer Block Parameter List." There are some limitations while in a mode that allows writes. Please refer to the parameter list.

STANDARD_DEVIATION	Standard Deviation
STANDARD_DEVIATION_MAX	High Limit of Standard Deviation
STANDARD_DEVIATION_MIN	Low Limit of Standard Deviation
AVERAGE_PRESSURE	Average Pressure
STD_DEVIATION_RANGE	Standard Deviation Range
RESET_STANDARD_DEVIATION	Reset Standard Deviation and Average Value
STANDARD_DEVIATION_SAMPLE_COUNT	Calculation Sample Number
STANDARD_DEVIATION_ALARM_USE	Operation Mode for the Standard Deviation Alarm
STANDARD_DEVIATION_HI_LIMIT	High Limit of the Standard Deviation (alarm threshold (high side))
STANDARD_DEVIATION_LO_LIMIT	Low Limit of the Standard Deviation (alarm threshold (low side))

4-7-4-3. Preparation

First, observation must be made during a normal state of the process. A good amount of observation time is from 1 hour to about several hours (adjust the required time based on a criteria, if the operating condition can vary greatly).

One observation method is to observe the trend of the standard deviation, but if not, an easily method is to measure the max and lower range values of the standard deviation.

(3) Observing the Standard Deviation Trend

To observe the trend in the standard deviation, connect the Channel #51 to AI FB.

(4) Measuring the Max and lower range values of the Standard Deviation

To measure the max and lower range values of the standard deviation, please refer to the following procedure.

When the process state is normal and stabilized, reset the standard deviation, the max and the lower range values of it, and start the measurement of the max and lower range values.

Write 1 to RESET_STANDARD_DEVIATION {Reset} to reset it.

This will reset the standard deviation, its max and lower range values and average pressure.

After a set time has elapsed, observe the value of the following two variables.

STANDARD_DEVIATION_MAX	High Limit of Standard Deviation
STANDARD_DEVIATION_MIN	Low Limit of Standard Deviation

4-7-4-4. Setting the Alarm

Set the following two variables relating to the upper and lower range values of the standard deviation based on the observation result in the preparation section.

STANDARD_DEVIATION_HI_LIMIT	High Limit of the Standard Deviation (alarm threshold (high side))
STANDARD_DEVIATION_LO_LIMIT	Low Limit of the Standard Deviation (alarm threshold (low side))

Next, set the operation mode of the standard deviation diagnosis alarm. Set the following parameters.

STANDARD_DEVIATION_ALARM_USE

0: No operation

1: Upper range value only

2: Lower range value only

3: Upper and lower range values

4-7-4-5. Alarm Detection

When the standard deviation alarm is detected, it is notified to the resource block. Please refer to section 4-4-1, "Field Diagnostics."

4-7-4-6. Sample Number

The factory default sample number of the pressure that calculates the standard deviation is 1000 times. Since the sample rate is about 60 ms, standard deviation will get calculated about once every 60 seconds.

If changing the sample number, set the following parameters.

STANDARD_DEVIATION_SAMPLE_COUNT

You can set it to between 1000 times (about 1 min) to 60,000 times (about 1 hour). Modify the setting as necessary.

4-7-5. Excess Pressure Occurrence Frequency

This counts the number of times Press_TB's SENSOR_VALUE (pressure after calibration) exceeded the configured threshold pressure (high or low side). When the occurrence frequency exceeds the configured excess pressure occurrence alarm threshold, the alarm will activate.

4-7-5-1. Excess Pressure Occurrence Frequency related Parameter

Excess pressure related parameters are as follows. For the attribute detail, please refer to Appendix M, "Diagnostics Transducer Block Parameter List." There are some limitations while in a mode that allows writes. Please refer to the parameter list.

OOR_PRESSURE_COUNT	Excess Pressure Occurrence Frequency
RESET_OOR_PRESSURE_COUNT	Reset Excess Pressure Occurrence Frequency
NORMAL_PRESSURE_HI_LIMIT	High Limit of Regular Pressure via Excess Pressure occurrence Frequency Feature
NORMAL_PRESSURE_LO_LIMIT	Low Limit of Regular Pressure via Excess Pressure occurrence Frequency Feature
OOR_PRESSURE_UNIT	Unit of Regular Pressure via Excess Pressure Occurrence Frequency Feature
OOR_ALARM_USE	Operation Mode of the Excess Pressure Occurrence Frequency Alarm
OOR_ALARM_THRESHOLD	Threshold of the Excess Pressure Occurrence Frequency Alarm

4-7-5-2. Setting the Threshold Pressure

This sets the following threshold pressure (high and low side) of the excess pressure occurrence frequency count and the unit of the excess pressure threshold pressure.

NORMAL_PRESSURE_HI_LIMIT	High Limit of Regular Pressure via Excess Pressure occurrence Frequency Feature
NORMAL_PRESSURE_LO_LIMIT	Low Limit of Regular Pressure via Excess Pressure occurrence Frequency Feature
OOR_PRESSURE_UNIT	Unit of Regular Pressure via Excess Pressure Occurrence Frequency Feature

4-7-5-3. Resetting the Excess Pressure Occurrence Frequency

If you wish to reset the excess pressure occurrence frequency count, conduct the following procedures.

Write {1: Reset} to the following parameter.

RESET_OOR_PRESSURE_COUNT

After resetting, it will return to {0: None}.

4-7-5-4. Setting the Excess Pressure Occurrence Frequency Alarm Threshold

Set the following parameter as the excess pressure occurrence frequency alarm threshold.
OOR_ALARM_THRESHOLD

It can be set to any value below 100,000 times.

4-7-5-5. Setting the Operation Mode of the Excess Pressure Occurrence Frequency Alarm

Next, set the operation mode of the excess pressure occurrence frequency alarm. Set the following parameters.

OOR_ALARM_USE

0: No operation

1: Operation on

4-7-5-6. Alarm Detection

When the excess pressure occurrence frequency alarm is detected, it is notified to the resource block. Please refer to section 4-4-1, "Field Diagnostics."

Chapter 5. Operation via External Switch (Optional)

You can use the magnet stick that is attached to the transmitter to display the node address, tag number, and implement external zero adjustment.

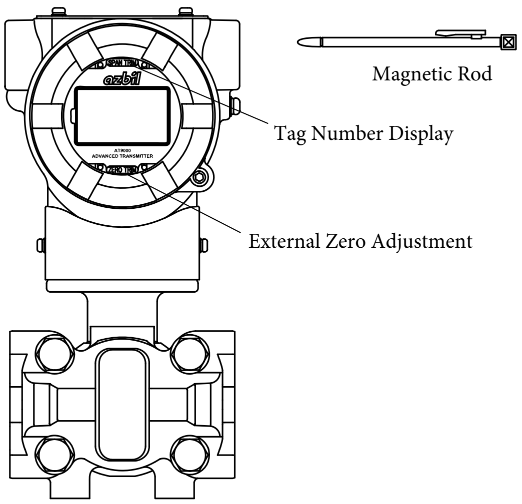


Figure 5-1. Operation via External Switch

5-1. Display of Node Address and Tag Number

Touch the Figure 5-1's "tag number display" area with the magnetic stick. The node address and tag number will be displayed.

5-2. External Zero Adjustment

■ *External Zero Adjustment Method*

External zero adjustment method is as follows.

Step	Procedure
1	Accurately apply the differential pressure (or pressure) to the device that will serve as the 0% reference point for the setting range.
2	From above the glass window, touch the special-purpose magnetic bar to the location labeled "ZERO TRIM" continuously for at least 3 seconds. When the PV value of the transmitter gets adjusted to 0, and the magnet stick gets moved away from the glass window, the zero adjustment has completed.

Chapter 6. Maintenance and Troubleshooting of this Device

Summary

This chapter describes this device's data storage, assembly and disassembly, output checking, calibration methods, and countermeasures if problems occur.

⚠ Warning
⃠ When using the product in an explosion-hazard area, do not open the device case cover. There is a risk of explosion, etc.
❗ When detaching this product from the process for maintenance, clear the vents and drains. There is a danger of scalding and other harm from residual pressure or remaining process fluid.
❗ If the process fluid is harmful to humans, take safety countermeasures by wearing goggles, a mask, etc. There is a danger of scalding or other harm if it gets on the skin or in the eyes, or if it is inhaled.
⃠ When clearing the vents and drains, do not touch the process fluid that comes out of the vent or drain. There is a danger of scalding or other harm.
⃠ Do not modify this product. Doing so may lead to product failure, electric shock, etc.
⃠ Do not inspect or disassemble the explosion-proof equipment while it is energized in the explosion-proof area.

⚠ Caution
⃠ If this product is used with high-temperature fluids, do not touch it carelessly. Since the unit is likely to be hot, you may burn yourself.
❗ When this product is no longer to be used, dispose of it in accordance with local regulations, treating it as industrial waste.
⃠ Do not reuse this product in whole or in part.

Note
If you wish to stop the operation of this product due to maintenance, etc., please follow the procedures for the specific model type listed in Chapter 3 of this operation manual.

6-1. Assembly and Disassembly of this Device

6-1-1. Attaching and Detaching the Case Cover

This product has a locking structure. When detaching the case cover, first take out the lock using a standard hexagonal wrench. When attaching the case cover, first screw on the case cover tightly, and then fasten the lock using the hexagonal wrench.

⚠ Warning
If the o-ring that seals the case cover is damaged, replace it with a new one. A damaged o-ring can cause corrosion or leakage inside the equipment, resulting in electrical shock or impaired functioning of the equipment.
Fasten the case cover completely. If there is a gap, the device will not be explosion-proof.
Lock the case cover. Locking is required.
If the case cover is corroded, deformed, or damaged, replace it with a new one. Otherwise the explosion-proof function may be impaired.

Note
After detaching the case cover, be careful that dust, rainwater, etc, do not enter the inside of the transmitter case. This could cause corrosion.

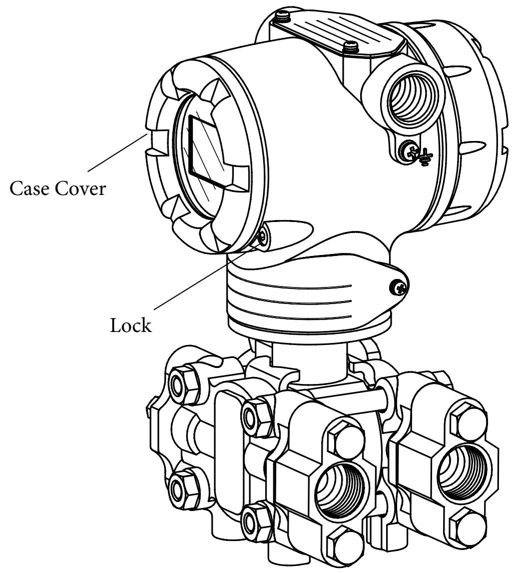


Figure 6-1. Locking the Equipment (Model GTX_ _ D)

6-1-2. Detaching and Mounting of the Center Body Cover (Model GTX_ _D/GTX_ _G/ GTX_ _A/GTX_ _F)

■ *Detaching*

When detaching the center body cover, remove the four sets of nuts and bolts shown in the Figure 6-2 below.

Note
After detaching the center body cover, be careful not to scratch the diaphragm.

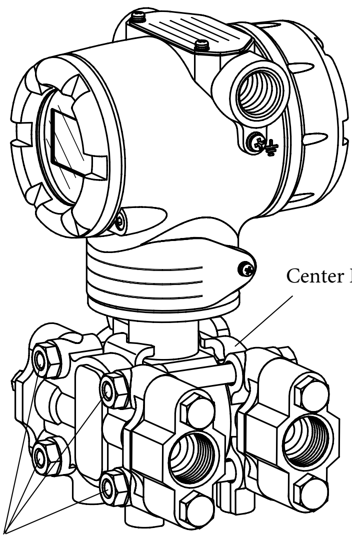


Figure 6-2. Fastening Bolt for the Center Body Cover

■ *Mounting*

⚠Warning
Replace damaged gaskets with a new one. If this product is operated in a damaged state, it will not be possible to ensure sufficient performance of the seals, and there is a danger of bursting occurring in the target object and resulting in scalding and other deleterious health effects.

When attaching the center body cover, fasten the bolts to the appropriate tightening torque below.

Table 6-1. Cover Bolt and Nut and Tightening Torque

Model No.	Wetted Part Material	Bolt and Nut Material	Bolt and Nut Tightening Torque (N·m)		
			Center Body Cover Material SCS14A		Center Body Cover Material PVC
			New Gasket When in Use	When Reusing	Center Body Cover Commonalities When Reusing
GTX15D	SUS316	SUS304	15±1	10±1	—
GTX31D GTX41D	SUS316 ASTMB575	SNB7	22±2	17±1	10±1
		SUS630	22±2	17±1	—
		SUS304	15±1	10±1	10±1
GTX31D GTX41D GTX71D	Tantalum SUS316L	SNB7	22±2	17±1	10±1
		SUS630	—	—	—
		SUS304	15±1	10±1	10±1
GTX32D GTX42D GTX72D	SUS316	SNB7	90±20	90±20	—
		SUS630	90±20	90±20	—
		SUS304	55±10	55±10	—
GTX60G GTX71G	SUS316 ASTMB575	SNB7	22±2	17±1	10±1
		SUS630	22±2	17±1	—
		SUS304	15±1	10±1	10±1
GTX60G GTX71G	Tantalum SUS316L	SNB7	22±2	17±1	10±1
		SUS630	22±2	17±1	—
		SUS304	15±1	20±1	10±1
GTX82G	SUS316 ASTM	SNB7	90±20	90±20	—
		SUS630	90±20	90±20	—
		SUS304	55±10	55±10	—
GTX30A GTX60A	SUS316 ASTM, tantalum SUS316L	SNB7	22±2	17±1	—
		SUS630	22±2	17±1	—
		SUS304	15±1	10±1	—
GTX35F GTX60F	SUS316	SNB7	22±2	17±1	—
		SUS630	22±2	17±1	—
		SUS304	15±1	10±1	—

Table 6-2. Adapter Flange Bolt and Nut Tightening Torque

Bolt and Nut Material	Bolt and Nut Tightening Torque (N·m)	
	Adapter Flange Material SCS14A	Adapter Flange Material PVC
SNB7	20±1	7±0.5
SUS630	20±1	—
SUS304	10±0.5	7±0.5

6-1-3. Cleaning the Device

■ *Introduction*

In order to maintain the accuracy and satisfactory performance of the transmitter, it is necessary to thoroughly clean the transmitter and pipes. If, for example, sediment accumulates in the pressure chamber of the transmitter, it can cause measurement errors.

■ *Cleaning the Center Body (Model GTX_ _D/GTX_ _G/GTX_ _A/GTX_ _F)*

The cleaning method is as follows.

1. Take off the hexagonal bolt from the center body, and remove the cover.
2. Clean the interior of the diaphragm and the cover, etc, using a soft brush and solvent. When doing so, be careful not to deform or scratch the diaphragm.
3. During re-assembly, replace cover gaskets with new ones if necessary.
4. Fasten bolts and nuts to the prescribed fastening torque. (section 6-1-2)

When measuring and stopping operation of a device in a cold area in which there is a risk that water (etc.) may freeze, remove the water from the center body. (Loosen the drain plug before you do this)

■ *Maintenance of the Detector Section (Remote Seal Type)*

There is no need for routine maintenance and inspection. If the flanges are removed for maintenance, clean the diaphragm with a soft brush and solvent. When doing so, be careful not to deform or scratch the diaphragm.

6-2. Input Pressure Calibration

This section describes calibration work which is performed at our company and at designated service stations. Since precise reference input devices and measuring instruments are necessary, this is not work that will typically be carried out by users, but it is described in case it absolutely must be performed.

For details, please refer to 4-5-6, “Calibration.”

6-3. History Function

There are three types of history function, as follows.

- Zero Adjustment History
- Zero Calibration History
- Self-Diagnostic History

For details, please refer to 4-5-8, “History.”

6-4. Troubleshooting

If the transmitter does not operate, or if it operates erroneously, check the following sections.

Table 6-3. Troubleshooting Phenomena and Solutions

Phenomenon	Countermeasures
Nothing is displayed on the display	• Confirm that the correct power supply voltage is being applied. • Confirm that the power supply is connected.
Output is fixed at 0	• Confirm that the device's settings are correct. • Confirm that the flow rate is not in the low-flow cutoff range. • Confirm that there are no clogs in the pipes.
Output is off	• Confirm that fluid is not leaking from the pipes. • Confirm that fluid is not flowing in reverse. • Confirm that the respective directions of the high pressure side and low pressure side connections are correct. • Confirm that the transmitter is not tilted.

In addition to the above, check the following.

- Use the self-diagnostic result communicator to verify the result of the self diagnosis
- Whether the respective directions of the high pressure side and low pressure side connections are correct
- Whether there are leaks in the pipe connectors
- Whether the product-side bolt fasteners are loose
- Whether any pipes are loose or disconnected
- Whether the wiring connections are properly done
- Whether the power supply voltage is the same as specified in the specification
- Whether the pressure and temperature are in accordance with the specifications
- Whether there are any strong sources of magnetism or electrical noise nearby

If the situation does not improve even after checking the above, stop using the device, turn off the power, and contact one of our branch offices, sales offices, or distributors. When contacting, please have the following information handy.

- Product Number
- FF Version: Resource Block SOFTWARE_REV
- Tx Version: Pressur TB SENSOR_SOFTWARE_REV

For information on the device's digital indicator message and solutions, please refer to Table 6-4.

Please refer to Item 2 below for verifying the diagnostic message from the fieldbus communication and the corresponding solutions.

- 4-4-1, "Field Diagnostics."
- 4-5-7, "Self-Diagnosis" (Pressure TB)

Table 6-4. Digital Indicator Display Message and Solution

Unit LCD Display	Description	Countermeasures
EM Fail	Electrical Module Failure	There is a problem with the printed circuit board, so please contact customer service.
MB Fail	Meter Body Failure	There is a problem with the sensor or printed circuit board, so please contact customer service.
DB Fail	Invalid Database	There is a problem with the printed circuit board, so please contact customer service.
OvrTemp	Meter Body Over Temperature	Change the placement so that the temperature of the meter body falls within the specified range. Otherwise, please verify the process.
OvrLoad	Meter Body Overload or Failure	• Confirm that the input pressure is within the specified range. • If the input pressure is high, either lower the input pressure or, if necessary, calibrate using a device with a large range.
SwcFail	External Zero Switch Failure	There is a problem with the external zero adjustment switch or the printed circuit board. Contact customer service.
NoCalib	Not Calibrated	Restore the calibration value at the time of shipping, or calibrate the high and low limits of the setting range.
Ex Zero	Zero Calibration Amount Exceeds ±5%	Check that the input pressure is appropriate for the calibration value, and calibrate again.
Ex Span	Span Calibration Amount Exceeds ±5%	Check that the input pressure is appropriate for the calibration value, and calibrate again.
PressFq	Pressure Frequency Index Alarm	Please verify the process.
Std Dev	Standard Deviation Alarm	Please verify the process.
OOR Cnt	Overload Count Alarm	Please verify the process.
Check	Check bit for ITK	Please contact customer service.

6-5. Insulation Resistance Test and Dielectric Strength Test

Important

As a rule, do not perform the insulation resistance test and dielectric strength test. Performing this test may damage the built-in lightning arrester for surge voltage absorption. If these tests absolutely must be carried out, follow the specified procedure closely.

Test Procedure

- Detach the device's exterior wiring.
- Short the respective + and – SUPPLY terminals.
- Perform the test in between these short circuits and the ground terminals.
- Applied voltage and decision criteria are as follows. In order to prevent damage to the meter, do not apply voltages higher than the values shown below.

Decision Criteria

The decision criteria for these tests are as follows.

Test	Decision Criteria
Insulation Resistance Test	$2x10^7$ Ω or higher at test voltage 25 V DC (25°C, 60%RH or lower)
Dielectric Strength	50 V AC, 1 min., set current at 2 mA

Appendix A. GTXFF DD Menu List Table

Menu Table	Parameter Name	Description	Style	Block
Process Variables		Displays the process value and its chart	WINDOW	Press_TB
Monitoring		Displays all process values	PAGE	Press_TB
Primary Value.Status	PRIMARY_VALUE.STATUS	This is the status of PRIMARY_VALUE value.	Parameter	Press_TB
Primary ValueVaue	PRIMARY_VALUE.VALUE	This is the PRIMARY_VALUE value (pressure value).	Parameter	Press_TB
Secondary Value.Status	SECONDARY_VALUE.STATUS	This is the SECONDARY_VALUE value (temperature value).	Parameter	Press_TB
Secondary Value.Value	SECONDARY_VALUEVALUE	This is the status of the SECONDARY_ VALUE value (temperature value).	Parameter	Press_TB
*2 Mode			GROUP	Press_TB
*2 Block Tag	BLOCK_TAG	Block tag	Parameter	Press_TB
*2 Block Mode. Target	MODE_BLK.TARGET	Block Mode .TARGET	Parameter	Press_TB
*2 Block Mode. Actual	MODE_BLK.ACTUAL	Block Mode .ACTUAL	Parameter	Press_TB
*2 Change Mode to OOS	change_mode_to_oos_method	Set target mode to OOS	Method	Press_TB
*2 Change Mode to MAN	change_mode_to_man_method	Set target mode to MAN	Method	Press_TB
*2 Change Mode to MAN	change_mode_to_auto_method	Set target mode to AUTO	Method	Press_TB
Trend		Trend	PAGE	Press_TB
Trend	pv_sv_chart	If possible, 1 piece of trend with pressure and temperature	Chart	Press_TB
Gauge		Gauge	PAGE	Press_TB
Pressure(PV) Gauge	pv_chart		Chart	Press_TB
Temperature(SV) Gauge	sv_chart		Chart	Press_TB
Device (block, if at block level)		Device setting/adjustment/testing	WINDOW	All
Basic Setup		Pre-operation Preparation	PAGE	Press_TB
Primary Value Range.Units Index	PRIMARY_VALUE_RANGEUNITS_INDEX	This is the value set as the unit of PRI-MARY_VALUE value (pressure value).	Parameter	Press_TB
Damping Constant	DAMPING_CONSTANT	This is the damping time coefficient of the PRIMARY_VALUE (pressure value).	Parameter	Press_TB
Secondary Value Range.Units Index	SECONDARY_VALUE_RANGEUNITS_INDEX	This is the value set for the unit of SEC-ONDARY_VALUE value (temperature value).	Parameter	Press_TB
Zero Adjustment	zero_adjustment_method	Zero adjustment (elevation adjustment)	Method	Press_TB
*1 Height Value	HEIGHT_VALUE	This compensates for the effect of tem-perature change from the fill fluid of the remote-seal transmitter. Input the height between the flanges to conduct this compensation.	Parameter	Press_TB
*1 Auto Height Calculation (Amb. Temp. Compensation)	auto_height_calculation_method	Ambient temperature compensation	Method	Press_TB
*1, *3 Auto Range (Closed Tank)	auto_range_method	Auto range setting (sealed tank)	Method	Device
*2 Mode			GROUP	Press_TB
Pressure Transmitter Configuration			PAGE	Press_TB
Pressure(PV)			GROUP	Press_TB
Primary Value Range.EU at 100%	PRIMARY_VALUE_RANGE.EU_100	This is the Upper Range Value range of the PRIMARY_VALUE value (pressure value).	Parameter	Press_TB
Primary Value Range.EU at 0%	PRIMARY_VALUE_RANGE.EU_0	This is the lower range value range of the PRIMARY_VALUE value (pressure value).	Parameter	Press_TB
Primary Value Range.Units Index	PRIMARY_VALUE_RANGEUNITS_INDEX	This is the value set as the unit of PRI-MARY_VALUE value (pressure value).	Parameter	Press_TB
Primary Value Range.Decimal	PRIMARY_VALUE_RANGE.DECIMAL	This is the value set for the decimal point position of the PRIMARY_VALUE value (pressure value).	Parameter	Press_TB
Damping Constant	DAMPING_CONSTANT	This is the damping time coefficient of the PRIMARY_VALUE (pressure value).	Parameter	Press_TB
Temperature(SV)			GROUP	Press_TB
Secondary Value Range.EU at 100%	SECONDARY_VALUE_RANGE.EU_100	This is the value set for the upper value range of the SECONDARY_VALUE value (temperature value).	Parameter	Press_TB
Secondary Value Range.EU at 0%	SECONDARY_VALUE_RANGE.EU_0	This is the value set for the lower value range of the SECONDARY_VALUE value (temperature value).	Parameter	Press_TB
Secondary Value Range.Units Index	SECONDARY_VALUE_RANGEUNITS_INDEX	This is the value set for the unit of SEC-ONDARY_VALUE value (temperature value).	Parameter	Press_TB
Secondary Value Range. Decimal	SECONDARY_VALUE_RANGE.DECIMAL	This is the value set for the decimal point position of the SECONDARY_VALUE value (temperature value).	Parameter	Press_TB
Press(PV)/Temp(SV) Switch 1		You turn this switch ON when PV (pres-sure) or SV (temperature) exceeds the threshold	GROUP	Press_TB
PV/SV Switch 1 Value D.Status	PV_SV_SW_1_VALUE_D.STATUS	This is the switch status	Parameter	Press_TB

Menu Table				Parameter Name	Description	Style	Block
			PV/SV Switch 1 Value D.Value	PV_SV_SW_1_VALUE_D.VALUE	This is the switch	Parameter	Press_TB
			PV/SV Switch 1 Source	PV_SV_SW_1_SOURCE	Select the input to which PV/SV Switch 1 gets applied from Pressure(PV) or Temperature(SV).	Parameter	Press_TB
			PV/SV Switch 1 Mode	PV_SV_SW_1_MODE	Select whether the alarm output of PV/SV Switch 1 is high alarm or low alarm.	Parameter	Press_TB
			PV/SV Switch 1 Threshold	PV_SV_SW_1_THRESHOLD	Now set the threshold for the PV/SV switch. (When the PV/SV Switch 1 Mode is "high," and if it goes above the preset value, the PV/SV Switch 1 turns ON. When the PV/SV Switch 1 Mode is "low," and if it goes below the preset value, the PV/SV Switch 1 turns ON).	Parameter	Press_TB
			PV/SV Switch 1 Hysteresis	PV_SV_SW_1_HYSTERESIS	Now set the hysteresis of the PV/SV switch. This is to set the hysteresis for the interval starting from when the PV/SV Switch 1 is turned ON, until it turns OFF once again.	Parameter	Press_TB
		Press(PV)/Temp(SV) Switch 2				GROUP	Press_TB
			PV/SV Switch 2 Value D.Status	PV_SV_SW_2_VALUE_D.STATUS	This is the switch status	Parameter	Press_TB
			PV/SV Switch 2 Value D.Value	PV_SV_SW_2_VALUE_D.VALUE	This is the switch	Parameter	Press_TB
			PV/SV Switch 2 Source	PV_SV_SW_2_SOURCE	Select the input to which PV/SV Switch 2 gets applied from Pressure(PV) or Temperature(SV).	Parameter	Press_TB
			PV/SV Switch 2 Mode	PV_SV_SW_2_MODE	Select whether the alarm output of PV/SV Switch 2 is high alarm or low alarm.	Parameter	Press_TB
			PV/SV Switch 2 Threshold	PV_SV_SW_2_THRESHOLD	Now set the threshold for the PV/SV switch. (When the PV/SV Switch 2 Mode is "high," and if it goes above the preset value, the PV/SV Switch 2 turns ON. When the PV/SV Switch 2 Mode is "low," and if it goes below the preset value, the PV/SV Switch 2 turns ON).	Parameter	Press_TB
			PV/SV Switch 2 Hysteresis	PV_SV_SW_2_HYSTERESIS	Now set the hysteresis of the PV/SV switch. This is to set the hysteresis for the interval starting from when the PV/SV Switch 2 is turned ON, until it turns OFF once again.	Parameter	Press_TB
	*1	Remote-seal			Displays only when REMOTE_SEAL_FLAG is ON	GROUP	Press_TB
		*1	Height Value	HEIGHT_VALUE	This compensates for the effect of temperature change from the fill fluid of the remote-seal transmitter. Input the height between the flanges to conduct this compensation.	Parameter	Press_TB
		*1	Auto Height Calculation (Amb. Temp. Compensation)	auto_height_calculation_method	Ambient temperature compensation	Method	Press_TB
		*1, *3	Auto Range (Closed Tank)	auto_range_method	Auto range setting (sealed tank)	Method	Device
	*2	Mode				GROUP	Press_TB
	Display Configuration				Display setting	PAGE	Disp_TB
		Display Parameter Selection		DISPLAY_PARAM_SELECTION		Parameter	Disp_TB
		Display Information Selection		DISPLAY_INFO_SELECTION		Parameter	Disp_TB
		Display Cycle		DISPLAY_CYCLE		Parameter	Disp_TB
		Display Parameter 1				GROUP	Disp_TB
			Block Type Selection 1	BLOCK_TYPE_SELECTION_1		Parameter	Disp_TB
			Block Tag Selection 1	BLOCK_TAG_SELECTION_1		Parameter	Disp_TB
			Parameter Selection 1	PARAM_SELECTION_1		Parameter	Disp_TB
			Display Tag 1	DISPLAY_TAG_1		Parameter	Disp_TB
			Unit Selection 1	UNIT_SELECTION_1		Parameter	Disp_TB
			Custom Unit 1	CUSTOM_UNIT_1		Parameter	Disp_TB
			Exponent Selection 1	EXPONENT_SELECTION_1		Parameter	Disp_TB
		Display Parameter 2				GROUP	Disp_TB
			Block Type Selection 2	BLOCK_TYPE_SELECTION_2		Parameter	Disp_TB
			Block Tag Selection 2	BLOCK_TAG_SELECTION_2		Parameter	Disp_TB
			Parameter Selection 2	PARAM_SELECTION_2		Parameter	Disp_TB
			Display Tag 2	DISPLAY_TAG_2		Parameter	Disp_TB
			Unit Selection 2	UNIT_SELECTION_2		Parameter	Disp_TB
			Custom Unit 2	CUSTOM_UNIT_2		Parameter	Disp_TB
			Exponent Selection 2	EXPONENT_SELECTION_2		Parameter	Disp_TB
		Display Parameter 3				GROUP	Disp_TB
			Block Type Selection 3	BLOCK_TYPE_SELECTION_3		Parameter	Disp_TB
			Block Tag Selection 3	BLOCK_TAG_SELECTION_3		Parameter	Disp_TB
			Parameter Selection 3	PARAM_SELECTION_3		Parameter	Disp_TB
			Display Tag 3	DISPLAY_TAG_3		Parameter	Disp_TB
			Unit Selection 3	UNIT_SELECTION_3		Parameter	Disp_TB

Menu Table					Parameter Name	Description	Style	Block
			Custom Unit 3		CUSTOM_UNIT_3		Parameter	Disp_TB
			Exponent Selection 3		EXPONENT_SELECTION_3		Parameter	Disp_TB
		Display Parameter 4					GROUP	Disp_TB
			Block Type Selection 4		BLOCK_TYPE_SELECTION_4		Parameter	Disp_TB
			Block Tag Selection 4		BLOCK_TAG_SELECTION_4		Parameter	Disp_TB
			Parameter Selection 4		PARAM_SELECTION_4		Parameter	Disp_TB
			Display Tag 4		DISPLAY_TAG_4		Parameter	Disp_TB
			Unit Selection 4		UNIT_SELECTION_4		Parameter	Disp_TB
			Custom Unit 4		CUSTOM_UNIT_4		Parameter	Disp_TB
			Exponent Selection 4		EXPONENT_SELECTION_4		Parameter	Disp_TB
	*2	Mode					GROUP	Disp_TB
	Maintenance					Menu used by a service rep during maintenance	PAGE	All
		Adjustment					GROUP	Press_TB
			Zero Adjustment		zero_adjustment_method	Zero adjustment (elevation adjustment)	Method	Press_TB
			Actual Pressure Adjustment		actual_pressure_adjustment_method	Zero Adjustment of the Intermediate Value	Method	Press_TB
			Actual Level % Adjustment		actual_level_adjustment_method		Method	Press_TB
			Reset Elevation Value		reset_elevation_value_method	Adjustment value reset	Method	Press_TB
			Calibration Value.Status		CAL_VALUE.STATUS	This is the status of a value resulting from converting PRIMARY_VALUE value into a unit specified in CAL_UNIT.	Parameter	Press_TB
			Calibration Value.Value		CAL_VALUE.VALUE	This is the value resulting from converting PRIMARY_VALUE value into a unit specified in CAL_UNIT.	Parameter	Press_TB
			Calibration Units		CAL_UNIT	This is the unit of values related to the calibration.	Parameter	Press_TB
		Calibration					GROUP	Press_TB
			Zero Calibration		zero_calibration_method	Zero calibration	Method	Press_TB
			Upper Calibration		upper_calibration_method	LRV calibration	Method	Press_TB
			Lower Calibration		lower_calibration_method	URV calibration	Method	Press_TB
			Reset Calibration		reset_calibration_method	Calibration reset	Method	Press_TB
			Calibration Value.Status		CAL_VALUE.STATUS	This is the status of a value resulting from converting PRIMARY_VALUE value into a unit specified in CAL_UNIT.	Parameter	Press_TB
			Calibration Value.Value		CAL_VALUE.VALUE	This is the value resulting from converting PRIMARY_VALUE value into a unit specified in CAL_UNIT.	Parameter	Press_TB
			Calibration Units		CAL_UNIT	This is the unit of values related to the calibration.	Parameter	Press_TB
	*3	Restart				Restart	GROUP	RB
			Restores Factory default blocks		restore_factory_default_blocks_method	Return to the factory default data	Method	RB
			Resets transducer block Factory calibration		resets_tb_factory_calibration_methoed	Return to the factory default calibrated data	Method	RB
		Calibration Details				Detailed calibration memo	GROUP	Press_TB
			Sensor Calibration method		SENSOR_CAL_METHOD	You can specify the adjustment method of the pressure gauge that was last implemented.	Parameter	Press_TB
			Sensor Calibration Location		SENSOR_CAL_LOC	You can specify the information on the place of the last adjustment that was implemented on the pressure gauge.	Parameter	Press_TB
			Sensor Calibration Date		SENSOR_CAL_DATE	You can specify the time for when the pressure gauge was last adjusted.	Parameter	Press_TB
			Sensor Calibration Who		SENSOR_CAL_WHO	You can specify the executor of the last adjustment that was implemented on the pressure gauge.	Parameter	Press_TB
	*2	Mode					GROUP	Press_TB
	Device Information					Display and setting of the device information	PAGE	All
		Device Image					Image	RB
		Device Identification				Device information	GROUP	RB
			Manufacturer Id		MANUFAC_ID	Manufacturer ID	Parameter	RB
			Device Type		DEV_TYPE	Device type	Parameter	RB
			ITK Version		ITK_VER	ITK version	Parameter	RB
			Revisions			Revision	GROUP	RB
				Device Revision	DEV_REV	Device revision	Parameter	RB
				DD Revision	DD_REV	DD revision	Parameter	RB
				Hardware Revision	HARDWARE_REV	Hardware revision	Parameter	RB
				Software Revision	SOFTWARE_REV	Software revision	Parameter	RB
				Capability Level	CAPABILITY_LEV	Capability level	Parameter	RB
		Pressure Transmitter Information				Transmitter information	GROUP	Press_TB

Menu Table	Parameter Name	Description	Style	Block
Production Number	PROD_NUM	This is the product number of the gauge pressure transmitter.	Parameter	Press_TB
Sensor Serial Number	SENSOR_SN	This is the meter body serial number.	Parameter	Press_TB
Sensor Software Revision	SENSOR_SOFTWARE_REV	This is the software revision of the sensor module.	Parameter	Press_TB
Sensor Type	SENSOR_TYPE	This is the sensor type.	Parameter	Press_TB
Primary Value Type	PRIMARY_VALUE_TYPE	This is the type of the PRIMARY_VALUE value (pressure value).	Parameter	Press_TB
Max Working Pressure	MAX_WORKING_PRESSURE	This is the maximum working pressure.	Parameter	Press_TB
Sensor Value	SENSOR_VALUE	This is the parameter representing the pressure measurement.	Parameter	Press_TB
Sensor Range.EU at 100%	SENSOR_RANGE.EU_100	This represents the Upper Range Value of the measurable pressure.	Parameter	Press_TB
Sensor Range.EU at 0%	SENSOR_RANGE.EU_0	This represents the lower range value of the measurable pressure.	Parameter	Press_TB
Sensor Range.Units Index	SENSOR_RANGE.UNITS_INDEX	This represents the unit of the measurable pressure.	Parameter	Press_TB
Sensor Range.Decimal	SENSOR_RANGE.DECIMAL	This represents the position of the decimal point of the measurable pressure.	Parameter	Press_TB
External Zero Adjusment Mode	EXT_ZERO_ADJ_ENABLED	This is the value set for the feasibility of the implementation of external zero adjustment.	Parameter	Press_TB
Write Lock	WRITE_LOCK	Light lock	Parameter	RB
*2 Mode			GROUP	Press_TB
*3 Block Mode		Display and setting of the mode of each block	PAGE	All
*3 Resource Block Mode			GROUP	RB
*3 Block Mode.Target	MODE_BLK.TARGET		Parameter	RB
*3 Block Mode.Actual	MODE_BLK.ACTUAL		Parameter	RB
*3 Change Mode to OOS	change_mode_to_oos_method	Set target mode to OOS	Method	RB
*3 Change Mode to AUTO	change_mode_to_auto_method	Set target mode to AUTO	Method	RB
*3 Pressure_TB Mode			GROUP	Press_TB
*3 Block Mode.Target	MODE_BLK.TARGET		Parameter	Press_TB
*3 Block Mode.Actual	MODE_BLK.ACTUAL		Parameter	Press_TB
*3 Change Mode to OOS	change_mode_to_oos_method	Set target mode to OOS	Method	Press_TB
*3 Change Mode to MAN	change_mode_to_man_method	Set target mode to MAN	Method	Press_TB
*3 Change Mode to AUTO	change_mode_to_auto_method	Set target mode to AUTO	Method	Press_TB
*3 Display_TB Mode			GROUP	Disp_TB
*3 Block Mode.Target	MODE_BLK.TARGET		Parameter	Disp_TB
*3 Block Mode.Actual	MODE_BLK.ACTUAL		Parameter	Disp_TB
*3 Change Mode to OOS	change_mode_to_oos_method	Set target mode to OOS	Method	Disp_TB
*3 Change Mode to AUTO	change_mode_to_auto_method	Set target mode to AUTO	Method	Disp_TB
*3 Diagnostic_TB Mode			GROUP	Diag_TB
*3 Block Mode.Target	MODE_BLK.TARGET		Parameter	Diag_TB
*3 Block Mode.Actual	MODE_BLK.ACTUAL		Parameter	Diag_TB
*3 Change Mode to OOS	change_mode_to_oos_method	Set target mode to OOS	Method	Diag_TB
*3 Change Mode to AUTO	change_mode_to_auto_method	Set target mode to AUTO	Method	Diag_TB
Diagnostics		Display and setting of device diagnosis	MENU	All
*3 Device Alarm		Display and setting of NAMUR	WINDOW	RB
Device Alarm Detection		Display and setting of alert information for the NAMUR4 category	PAGE	RB
Alarm Indication		Display of errors currently active	GROUP	RB
Fail Active	FD_FAIL_ACTIVE		Parameter	RB
Offspec Active	FD_OFFSPEC_ACTIVE		Parameter	RB
Maintenance Active	FD_MAINT_ACTIVE		Parameter	RB
Check Active	FD_CHECK_ACTIVE		Parameter	RB
Alarm Detection Enable		User setting - NAMUR 4 category	GROUP	RB
Fail Map	FD_FAIL_MAP		Parameter	RB
Offspec Map	FD_OFFSPEC_MAP		Parameter	RB
Maintenance Map	FD_MAINT_MAP		Parameter	RB
Check Map	FD_CHECK_MAP		Parameter	RB
Field Diagnostic Simulate		NAMUR bit assign simulation	GROUP	RB
Field Diagnostic Simulate. Diagnostic Simulate Value	FD_SIMULATE.DIAGNOSTIC_SIMULATE_ VALUE		Parameter	RB
Field Diagnostic Simulate. Diagnostic Value	FD_SIMULATE.DIAGNOSTIC_VALUE		Parameter	RB
Field Diagnostic Simulate. Simulate En/Disable	FD_SIMULATE.ENABLE_DISABLE		Parameter	RB
Recommended Action	FD_RECOMMEN_ACT		Parameter	RB
*2 Mode			GROUP	RB

Menu Table						Parameter Name	Description	Style	Block
		Alert Reporting					Alert notification to the host	PAGE	RB
			Alarm Broadcast Record				If the host verified the notification from the device	GROUP	RB
				Fail Diagnostic Alarm				GROUP	RB
					Fail Diagnostic Alarm. Unacknowledged	FD_FAIL_ALM.UNACKNOWLEDGED		Parameter	RB
					Fail Diagnostic Alarm. Alarm State	FD_FAIL_ALM.ALARM_STATE		Parameter	RB
					Fail Diagnostic Alarm. Time Stamp	FD_FAIL_ALM.TIME_STAMP		Parameter	RB
					Fail Diagnostic Alarm. Subcode	FD_FAIL_ALM.SUB_CODE		Parameter	RB
					Fail Diagnostic Alarm. Value	FD_FAIL_ALM.VALUE		Parameter	RB
				Offspec Alarm				GROUP	RB
					Offspec Alarm. Unacknowledged	FD_OFFSPEC_ALM.UNACKNOWLEDGED		Parameter	RB
					Offspec Alarm.Alarm State	FD_OFFSPEC_ALM.ALARM_STATE		Parameter	RB
					Offspec Alarm.Time Stamp	FD_OFFSPEC_ALM.TIME_STAMP		Parameter	RB
					Offspec Alarm. Subcode	FD_OFFSPEC_ALM.SUB_CODE		Parameter	RB
					Offspec Alarm.Value	FD_OFFSPEC_ALM.VALUE		Parameter	RB
				Maintenance Alarm				GROUP	RB
					Maintenance Alarm. Unacknowledged	FD_MAINT_ALM.UNACKNOWLEDGED		Parameter	RB
					Maintenance Alarm. Alarm State	FD_MAINT_ALM.ALARM_STATE		Parameter	RB
					Maintenance Alarm. Time Stamp	FD_MAINT_ALM.TIME_STAMP		Parameter	RB
					Maintenance Alarm. Subcode	FD_MAINT_ALM.SUB_CODE		Parameter	RB
					Maintenance Alarm. Value	FD_MAINT_ALM.VALUE		Parameter	RB
				Check Alarm				GROUP	RB
					Check Alarm. Unacknowledged	FD_CHECK_ALM.UNACKNOWLEDGED		Parameter	RB
					Check Alarm.Alarm State	FD_CHECK_ALM.ALARM_STATE		Parameter	RB
					Check Alarm.Time Stamp	FD_CHECK_ALM.TIME_STAMP		Parameter	RB
					Check Alarm.Subcode	FD_CHECK_ALM.SUB_CODE		Parameter	RB
					Check Alarm.Value	FD_CHECK_ALM.VALUE		Parameter	RB
			Alarm Broadcast Enable				User setting - whether to notify the host or not	GROUP	RB
					Fail Mask	FD_FAIL_MASK		Parameter	RB
					Offspec Mask	FD_OFFSPEC_MASK		Parameter	RB
					Maintenance Mask	FD_MAINT_MASK		Parameter	RB
					Check Mask	FD_CHECK_MASK		Parameter	RB
			Priority				User setting - alarm priority	GROUP	RB
					Fail Priority	FD_FAIL_PRI		Parameter	RB
					Offspec Priority	FD_OFFSEPC_PRI		Parameter	RB
					Maintenance Priority	FD_MAINT_PRI		Parameter	RB
					Check Priority	FD_CHECK_PRI		Parameter	RB
		*2	Mode					GROUP	RB
*3	Diagnostic Status						Diagnosis status	WINDOW	All
		Pressure_TB Diagnostic Status					Press_TB diagnosis status	PAGE	Press_TB
			Electrical Module Failure				Electrical Module Failure	GROUP	Press_TB
				CPU-to-CPU Communications Error		block_err_desc_1_press[BIT_31_4BYTE]	CPU-to-CPU Communications Error	bit	Press_TB
				Sensor Module CPU Failure		block_err_desc_1_press[BIT_30_4BYTE]	Sensor module CPU failure	bit	Press_TB
				Sensor Module ROM Failure		block_err_desc_1_press[BIT_29_4BYTE]	Sensor module ROM failure	bit	Press_TB
				Sensor Module RAM Failure		block_err_desc_1_press[BIT_28_4BYTE]	Sensor module RAM failure	bit	Press_TB
				Sensor Modue NVM Failure		block_err_desc_1_press[BIT_27_4BYTE]	Sensor module NVM failure	bit	Press_TB
			Meter Body Failure				Meter Body Failure	GROUP	Press_TB
				Analog/Digital Conversion Failure		block_err_desc_1_press[BIT_26_4BYTE]	AD conversion failure	bit	Press_TB
				Pressure Sensor Failure		block_err_desc_1_press[BIT_25_4BYTE]	Pressure sensor failure	bit	Press_TB

Menu Table	Parameter Name	Description	Style	Block
Sensor Characteristic Data Failure	block_err_desc_1_press[BIT_24_4BYTE]	Characterization data failure	bit	Press_TB
Invalid Database	block_err_desc_1_press[BIT_23_4BYTE]	Equipment data failure	bit	Press_TB
Meter Body Over Temperature	block_err_desc_1_press[BIT_22_4BYTE]	Pressure sensor temperature failure	bit	Press_TB
Meter Body Overload or Failure	block_err_desc_1_press[BIT_21_4BYTE]	Excess pressure or meter body failure	bit	Press_TB
External Zero Switch Failure	block_err_desc_1_press[BIT_15_4BYTE]	External zero adjustment switch error	bit	Press_TB
Not Calibrated	block_err_desc_1_press[BIT_14_4BYTE]	Uncalibrated	bit	Press_TB
Excess Amount of Zero Correction	block_err_desc_1_press[BIT_13_4BYTE]	Zero calibration amount exceeds by ±5%	bit	Press_TB
Excess Amount of Span Correction	block_err_desc_1_press[BIT_12_4BYTE]	Span calibration amount exceeds by ±10%	bit	Press_TB
Self-Diagnostic Records Space Full	block_err_desc_1_press[BIT_1_4BYTE]	No space in the self diagnosis history	bit	Press_TB
Configuration Error			GROUP	Press_TB
PVR Configuration Error	block_err_desc_2_press[BIT_31_4BYTE]	PVR configuration failure	bit	Press_TB
SVR Configuration Error	block_err_desc_2_press[BIT_30_4BYTE]	SVR Configuration Error	bit	Press_TB
PV/SV Switch 1 Threshold Configuration Error	block_err_desc_2_press[BIT_29_4BYTE]	PV_SV_SW_1_THRESHOLD configuration failure	bit	Press_TB
PV/SV Switch 1 Hysteresis Configuration Error	block_err_desc_2_press[BIT_28_4BYTE]	PV_SV_SW_1_HYSTERESIS configuration failure	bit	Press_TB
PV/SV Switch 2 Threshold Configuration Error	block_err_desc_2_press[BIT_27_4BYTE]	PV_SV_SW_2_THRESHOLD configuration failure	bit	Press_TB
PV/SV Switch 2 Hysteresis Configuration Error	block_err_desc_2_press[BIT_26_4BYTE]	PV_SV_SW_2_HYSTERESIS configuration failure	bit	Press_TB
*2 Mode			GROUP	Press_TB
Display_TB Diagnostic Status		Disp_TB diagnosis status	PAGE	Disp_TB
Parameter 1 Configuration Error	[BIT_0_4BYTE]		bit	Disp_TB
Parameter 2 Configuration Error	[BIT_1_4BYTE]		bit	Disp_TB
Parameter 3 Configuration Error	[BIT_2_4BYTE]		bit	Disp_TB
Parameter 4 Configuration Error	[BIT_3_4BYTE]		bit	Disp_TB
Parameter/Information Selection Error	[BIT_4_4BYTE]		bit	Disp_TB
*2 Mode			GROUP	Disp_TB
Diagnostic_TB Diagnostic Status		Diag_TB diagnosis status	PAGE	Diag_TB
Electrical Module Failure		Electrical Module Failure	GROUP	Diag_TB
CPU-to-CPU Communications Error	block_err_desc_1_diag[BIT_31_4BYTE]	CPU-to-CPU Communications Error	bit	Diag_TB
Sensor Module CPU Failure	block_err_desc_1_diag[BIT_30_4BYTE]	Sensor module CPU failure	bit	Diag_TB
Sensor Module ROM Failure	block_err_desc_1_diag[BIT_29_4BYTE]	Sensor module ROM failure	bit	Diag_TB
Sensor Module RAM Failure	block_err_desc_1_diag[BIT_28_4BYTE]	Sensor module RAM failure	bit	Diag_TB
Sensor Modue NVM Failure	block_err_desc_1_diag[BIT_27_4BYTE]	Sensor module NVM failure	bit	Diag_TB
Meter Body Failure		Meter Body Failure	GROUP	Diag_TB
Analog/Digital Conversion Failure	block_err_desc_1_diag[BIT_26_4BYTE]	AD conversion failure	bit	Diag_TB
Pressure Sensor Failure	block_err_desc_1_diag[BIT_25_4BYTE]	Pressure sensor failure	bit	Diag_TB
Sensor Characteristic Data Failure	block_err_desc_1_diag[BIT_24_4BYTE]	Characterization data failure	bit	Diag_TB
Invalid Database	block_err_desc_1_diag[BIT_23_4BYTE]	Equipment data failure	bit	Diag_TB
Pressure Frequency Index Alarm	block_err_desc_1_diag[BIT_7_4BYTE]	Pressure frequency index alarm	bit	Diag_TB
Standard Deviation Alarm	block_err_desc_1_diag[BIT_6_4BYTE]	Standard deviation alarm	bit	Diag_TB
Out-of-Range Alarm	block_err_desc_1_diag[BIT_5_4BYTE]	Excess pressure occurrence frequency alarm	bit	Diag_TB
Configuration Error		Meter Body Failure	GROUP	Diag_TB
Press Freq Calculation PV Limit Configuration Error	block_err_desc_2_diag[BIT_31_4BYTE]	PRESS_FREQ_CALC_PV_HI/LO_LIMIT configuration failure	bit	Diag_TB
Press Freq Index Limit Configuration Error	block_err_desc_2_diag[BIT_30_4BYTE]	PRESS_FREQ_INDEX_HI/LO_LIMIT setting alarm	bit	Diag_TB
Normal Pressure Limit Configuration Error	block_err_desc_2_diag[BIT_29_4BYTE]	NORMAL_PRESSURE_HI/LO_LIMIT setting alarm	bit	Diag_TB
Standard Deviation Limit Configuration Error	block_err_desc_2_diag[BIT_28_4BYTE]	STANDARD_DEVIATION_HI/LO_LIMIT setting alarm	bit	Diag_TB
*2 Mode			GROUP	Diag_TB
Records			WINDOW	All
Self-Diagnostic Records			PAGE	Press_TB

Menu Table				Parameter Name	Description	Style	Block
			Self-Diagnostic Summary	SELF_DIAG_SUMMARY	This is the list of self diagnosis errors that have been displayed up to now.	Parameter	Press_TB
			Self-Diagnostic Records Grid	self_diag_records_grid	40 records of auto diagnosis history are displayed in the table	Grid	Press_TB
			Erase Self-Diagnostic Summary and Records	erase_self_diag_method		Method	Press_TB
		*2	Mode			GROUP	Press_TB
		Elevation Records				PAGE	Press_TB
			Elevation Records Grid	elevation_records_grid	30 records of elevation adjustment value history are displayed in the table	Grid	Press_TB
		*2	Mode			GROUP	Press_TB
		Zero Calibration Records				PAGE	Press_TB
			Zero Calibration Records Graph	zero_cal_records_graph	Displays zero calibration history	Graph	Press_TB
			Zero Calibration Records Grid	zero_cal_records_grid	Displays 30 records of zero calibration value history	Grid	Press_TB
		*2	Mode			GROUP	Press_TB
		Operator Action Records				PAGE	Disp_TB
			Operator Action Records Grid	operator_action_records_grid		Grid	Disp_TB
			Erase Operator Action Records	erase_operator action_records_method		Method	Disp_TB
		*2	Mode			GROUP	Disp_TB
	Diagnostic Setup				Diagnosis setting	WINDOW	Diag_TB
		Pressure Frequency Diagnostic			Pressure frequency diagnosis	PAGE	Diag_TB
			Pressure Frequency Index Trend	pressure_frequency_index_chart	Displays the pressure frequency index	Chart	Diag_TB
			Pressure Frequency Index. Status	PRESSURE_FREQUENCY_INDEX.STATUS	This is the status of clog index value.	Parameter	Diag_TB
			Pressure Frequency Index. Value	PRESSURE_FREQUENCY_INDEX.VALUE	This is the clog index value.	Parameter	Diag_TB
			Press Freq Idx Sensor Selection	PRESS_FREQ_IDX_SENSOR_SELECTION	If the equipment is differential pressure transmitter, you will set the calculation of clog index value from either of the values of the static pressure sensor, and decide on the sensor's sampling cycle. If the equipment is either atmospheric pressure transmitter or absolute pressure transmitter, you will determine the sampling cycle of the differential pressure sensor.	Parameter	Diag_TB
			Press Freq Calc PV High Limit	PRESS_FREQ_CALC_PV_HI_LIMIT	It will calculate the pressure frequency index only when the pressure value is less than this value.	Parameter	Diag_TB
			Press Freq Calc PV Low Limit	PRESS_FREQ_CALC_PV_LO_LIMIT	It will calculate the pressure frequency index only when the pressure value is more than this value.	Parameter	Diag_TB
			Press Freq Calc PV Unit	PRESS_FREQ_CALC_PV_UNIT	Select the pressure value unit during pressure frequency diagnosis.	Parameter	Diag_TB
			Press Freq Filter Constant	PRESS_FREQ_FILTER_CONSTANT	Set the constant of the filter used for the calculation of the pressure frequency index. The larger the value, the less false alarms will occur because low frequencies will be heavily removed, but as the variation width of the pressure frequency index becomes smaller, it will get more difficult to set the alarm threshold.	Parameter	Diag_TB
			Press Freq Index Threshold High	PRESS_FREQ_INDEX_THRESHOLD_HI	This is the threshold (high side) of the pressure frequency alarm. The alarm gets activated when Blockage Alarm Enabled is "high and low," and when the pressure frequency index is greater than this threshold.	Parameter	Diag_TB
			Press Freq Index Threshold Low	PRESS_FREQ_INDEX_THRESHOLD_LO	This is the threshold (low side) of the pressure frequency alarm. The alarm gets activated when Blockage Alarm Enabled is either "low" or "high and low," and when the pressure frequency index is less than this threshold.	Parameter	Diag_TB
			Press Freq Index Alarm Enabled	PRESS_FREQ_INDEX_ALARM_ENABLED	This sets whether to activate the alarm when the pressure frequency index goes over the HIGH-side clog threshold, or goes below the LOW-side clog threshold.	Parameter	Diag_TB
		*2	Mode			GROUP	Diag_TB
		Standard Deviation			Standard deviation (of PV value)	PAGE	Diag_TB
			Standard Deviation Trend	standard_deviation_chart	Displays the standard deviation value	Chart	Diag_TB
			Standard Deviation	STANDARD_DEVIATION	This is the standard deviation of the pressure measurement within a certain period.	Parameter	Diag_TB
			Average Pressure	AVERAGE_PRESSURE	This is the average value of the pressure measurement within a certain period.	Parameter	Diag_TB

Menu Table					Parameter Name	Description	Style	Block
			Standard Deviation Unit		STANDARD_DEVIATION_UNIT	Select the unit of pressure's standard deviation and average value.	Parameter	Diag_TB
			Reset Standard Deviation		reset_standard_deviation_method	Standard Deviation Value Reset	Method	Diag_TB
			Standard Deviation Sample Count		STANDARD_DEVIATION_SAMPLE_COUNT	This sets the number of samples used to calculate the pressure's standard deviation and average value. Samples once every 60 ms.	Parameter	Diag_TB
		*2	Mode				GROUP	Diag_TB
		Overload Count				Overload frequency	PAGE	Diag_TB
			Overload Count Graph		overload_count_chart	Displays the overload frequency	Chart	Diag_TB
		*2	Overload Count				GROUP	Diag_TB
				Overload Count	OVERLOAD_COUNT	This is the overload frequency. You can reset it.	Parameter	Diag_TB
				Reset Overload Count	reset_overload_count_method	Overload Frequency Reset	Method	Diag_TB
				Overload Count Threshold	OVERLOAD_COUNT_THRESHOLD	This is the threshold of overload frequency. The alarm gets activated when the Overload Count Alarm Enabled is "Enabled," and when the overload frequency goes over this threshold.	Parameter	Diag_TB
				Overload Count Alarm Enabled	OVERLOAD_COUNT_ALARM_ENABLED	This sets whether to activate the alarm or not when the overload frequency goes over the overload frequency threshold.	Parameter	Diag_TB
		*2	Lifetime Overload Count				GROUP	Diag_TB
				Lifetime Overload Count	LIFETIME_OVERLOAD_COUNT	This is the totalized value of the overload frequency after factory shipment. Cannot reset.	Parameter	Diag_TB
				Lifetime OL Count Threshold	LIFETIME_OL_COUNT_THRESHOLD	This is the threshold of lifetime overload frequency. The alarm gets activated when the Lifetime OL Count Alarm Enabled is "Enabled," and when the lifetime overload frequency goes over this threshold.	Parameter	Diag_TB
				Lifetime OL Count Alarm Enabled	LIFETIME_OL_COUNT_ALARM_ENABLED	This sets whether to activate the alarm or not when the lifetime overload frequency goes over the lifetime overload frequency threshold.	Parameter	Diag_TB
		*2	Mode				GROUP	Diag_TB
	Block Diagnostics					Block Diagnosis	WINDOW	All
		Resource Block Diagnostics					PAGE	RB
			Block Error		BLOCK_ERR		Parameter	RB
		*2	Mode				GROUP	RB
	*3	Pressure_TB Diagnostics					PAGE	Press_TB
			Block Error		BLOCK_ERR		Parameter	Press_TB
			Block Error Description 1		BLOCK_ERR_DESC_1		Parameter	Press_TB
			Block Error Description 2		BLOCK_ERR_DESC_2		Parameter	Press_TB
		*2	Mode				GROUP	Press_TB
	*3	Display_TB Diagnostics					PAGE	Disp_TB
			Block Error		BLOCK_ERR		Parameter	Disp_TB
			Block Error Description		BLOCK_ERR_DESC_1		Parameter	Disp_TB
		*2	Mode				GROUP	Disp_TB
	*3	Diagnostic_TB Diagnostics					PAGE	Diag_TB
			Block Error		BLOCK_ERR		Parameter	Diag_TB
			Block Error Description 1		BLOCK_ERR_DESC_1		Parameter	Diag_TB
			Block Error Description 2		BLOCK_ERR_DESC_2		Parameter	Diag_TB
		*2	Mode				GROUP	Diag_TB

*1. Displays only for remote seal types

*2. It does not get displayed in hand held communicator device menu. For detailed items of the Mode menu, please refer to the Monitoring menu.

*3. It cannot be displayed in the block menu.

Appendix B. Priority of Block Mode

The meaning of the word "Mode" inside the table regarding the parameter list for appendices after Appendix C is as follows.

Mode: target mode with the lowest priority out of all the target modes that are requested to change a parameter. See Table B-1.

Lowest priority target mode required to allow a change to the parameter to be made - see Table B-1 for the priorities in sequential order

Table B-1. Block Mode Priority

Mode	Priority	Definition
ROut	0 - lowest	Remote output
RCas	1	Remote cascade
Cas	2	Cascade
Auto	3	Auto
Man	4	Manual
LO	5	Local override
IMan	6	Initialization manual
OOS	7 - highest	Out of service

Appendix C. Resource Block Parameter List

Index	Parameter Mnemonic	Obj Type	Data Type/Structure	Sub Parameter	Store -R/W	Size	Valid Range (GTX)	Units	Mode
1	ST_REV	S	Unsigned 16	—	S-R	2	0≤X≤65535	none	
2	TAG_DESC	S	Octet String	—	S-R/W	32		na	
3	STRATEGY	S	Unsigned 16	—	S-R/W	2	0-65535	none	
4	ALERT_KEY	S	Unsigned 8	—	S-R/W	1	1-255	none	
5	MODE_BLK	R	Bit String	Target	N-R/W	1	bit 3: Auto bit 7: OOS	na	
			Bit String	Actual	D-R	1	bit 3: Auto bit 7: OOS		
			Bit String	Permitted	S-R/W	1	bit 3: Auto bit 7: OOS		
			Bit String	Normal	S-R/W	1	bit 3: Auto bit 7: OOS		
6	BLOCK_ERR	S	Bit String	—	D-R	2	0: Other 1: Block Configuration Error 2: Link Configuration Error 3: Simulate Active 5: Device Fault State Set 6: Device Needs Maintenance Soon 9: Memory Failure 10: Lost Static Data 11: Lost NV Data 13: Device Needs Maintenance Now 14: Power-up 15: Out-of-Service	E	
7	RS_STATE	S	Unsigned 8	—	D-R	1	0: Undefined 1: Start/Restart 2: Initialization 3: Online Linking 4: Online 5: Standby 6: Failure	E	
8	TEST_RW	R	Boolean	Value 1	D-R/W	1		none	
			Integer 8	Value 2		1			
			Integer 16	Value 3		2			
			Integer 32	Value 4		4			
			Unsigned 8	Value 5		1			
			Unsigned 16	Value 6		2			
			Unsigned 32	Value 7		4			
			Float	Value 8		4			
			Visible String	Value 9		32			
			Octet String	Value 10		32			
			Date	Value 11		7			
			Time of Day	Value 12		6			
			Time Difference	Value 13		6			
			Bit String	Value 14		2			
			Time Value	Value 15		8			
9	DD_RESOURCE	S	Visible String	—	S-R	32		na	
10	MANUFAC_ID	S	Unsigned 32	—	S-R	4	0x0DFC96	none	
11	DEV_TYPE	S	Unsigned 16	—	S-R	2	0≤X≤0xFFFF	E	
12	DEV_REV	S	Unsigned 8	—	S-R	1	0≤X≤0xFF	none	
13	DD_REV	S	Unsigned 8	—	S-R	1	0≤X≤0xFF	none	
14	GRANT_DENY	R	Bit String	Grant	S-R/W	1	bit 0: Program bit 1: Tune bit 2: Alarm bit 3: Local bit 4: Operate bit 5: Service bit 6: Diagnostic	na	
			Bit String	Deny	S-R/W	1	bit 0: Program Denied bit 1: Tune Denied bit 2: Alarm Denied bit 3: Local Denied bit 4: Operate Denied bit 5: Service Denied bit 6: Diagnostics Denied		
15	HARD_TYPES	S	Bit String	—	S-R	2	bit 0: Scalar Input	na	

Index	Parameter Mnemonic	Obj Type	Data Type/Structure	Sub Parameter	Store -R/W	Size	Valid Range (GTX)	Units	Mode
16	RESTART	S	Unsigned 8	—	D-R/W	1	1: Run 2: Restart resource 3: Restart with defaults 4: Restart processor 11: Restores Factory default blocks 12: Resets transducer block Factory calibration	E	*1
17	FEATURES	S	Bit String	—	S-R	2	bit 0: Unicode strings bit 1: Reports supported bit 2: Fault State supported bit 3: Soft Write lock supportedx bit 10: Multi-bit Alarm (Bit-Alarm) Support bit 12: Deferral of Inter-Paramter Write Checks	na	
18	FEATURE_SEL	S	Bit String	—	S-R/W	2	bit 0: Unicode strings bit 1: Reports supported bit 2: Fault State supported bit 3: Soft Write lock supportedx bit 10: Multi-bit Alarm (Bit-Alarm) Support bit 12: Deferral of Inter-Paramter Write Checks	na	
19	CYCLE_TYPE	S	Bit String	—	S-R	2	bit 0: Scheduled	na	
20	CYCLE_SEL	S	Bit String	—	S-R/W	2	bit 0: Scheduled	na	
21	MIN_CYCLE_T	S	Unsigned 32	—	S-R	4	4000	1/32 msec	
22	MEMORY_SIZE	S	Unsigned 16	—	S-R	2	0	Kbytes	
23	NV_CYCLE_T	S	Unsigned 32	—	S-R	4	345600000 (3h)	1/32 msec	
24	FREE_SPACE	S	Float	—	D-R	4	0≤X≤100	%	
25	FREE_TIME	S	Float	—	D-R	4	0≤X≤100	%	
26	SHED_RCAS	S	Unsigned 32	—	S-R/W	4	0≤X≤0xFFFFFFFF	1/32 msec	
27	SHED_ROUT	S	Unsigned 32	—	S-R/W	4	0≤X≤0xFFFFFFFF	1/32 msec	
28	FAULT_STATE	S	Unsigned 8	—	N-R	1	1: Clear 2: Active	E	
29	SET_FSTATE	S	Unsigned 8	—	D-R/W	1	1: Off 2: Set	E	
30	CLR_FSTATE	S	Unsigned 8	—	D-R/W	1	1: Off 2: Set	E	
31	MAX_NOTIFY	S	Unsigned 8	—	S-R	1	3	none	
32	LIM_NOTIFY	S	Unsigned 8	—	S-R/W	1	0≤X≤3	none	
33	CONFIRM_TIME	S	Unsigned 32	—	S-R/W	4	0≤X≤0xFFFFFFFF	1/32 msec	
34	WRITE_LOCK	S	Unsigned 8	—	S-R/W	1	1: Unlocked 2: Locked	E	
35	UPDATE_EVT	R	Unsigned 8	Unacknowledged	D-R/W	1	0: Undefined 1: Acknowledged 2: Unacknowledged	na	
			Unsigned 8	Update State	D-R	1	0: Undefined 1: Update reported 2: Update not reported		
			Time Value	Time Stamp	D-R	8			
			Unsigned 16	Static Revision	D-R	2	0≤X≤65535		
			Unsigned 16	Relative Index	D-R	2	0≤X≤65535		
36	BLOCK_ALM	R	Unsigned 8	Unacknowledged	D-R/W	1	0: Undefined 1: Acknowledged 2: Unacknowledged	na	
			Unsigned 8	Alarm State	D-R	1	0: Undefined 1: Clear - reported 2: Clear - not reported 3: Active - reported 4: Active - not reported		
			Time Value	Time Stamp	D-R	8			
			Unsigned 16	Subcode	D-R	2			
			Unsigned 8	Value	D-R	1			
37	ALARM_SUM	R	Bit String	Current	D-R	2	0: Discrete alarm 7: Block Alarm 8: Fail Alarm 9: Off Spec Alarm 10: Maintenance Alarm 11: Check Alarm	na	
			Bit String	Unacknowledged	D-R	2			
			Bit String	Unreported	D-R	2			
			Bit String	Disabled	S-R/W	2			

Index	Parameter Mnemonic	Obj Type	Data Type/Structure	Sub Parameter	Store -R/W	Size	Valid Range (GTX)	Units	Mode
38	ACK_OPTION	S	Bit String	—	S-R/W	2	0: Auto Ack Disabled 1: Auto Ack Enabled	na	
39	WRITE_PRI	S	Unsigned 8	—	S-R/W	1	0≤X≤15	none	
40	WRITE_ALM	R	Unsigned 8	Unacknowledged	D-R/W	1	0: Undefined 1: Acknowledged 2: Unacknowledged	none	
			Unsigned 8	Alarm State	D-R	1	0: Undefined 1: Clear - reported 2: Clear - not reported 3: Active - reported 4: Active - not reported		
			Time Value	Time Stamp	D-R	8			
			Unsigned 16	Subcode	D-R	2			
			Unsigned 8	Value	D-R	1			
41	ITK_VER	S	Unsigned 16	—	S-R	2	Set by FF	none	
42	FD_VER	S	Unsigned 16	—	S-R	2		na	
43	FD_FAIL_ACTIVE	S	Bit String	—	D-R	4	*DS3 bit 31: Electrical Module Failure bit 28: Meter Body Failure bit 27: Invalid Database bit 23: Meter Body Over Temperature bit 22: Meter Body Overload or Failure bit 15: External Zero Switch Failure bit 14: Not Calibrated bit 13: Excess Amount of Zero Correction bit 12: Excess Amount of Span Correction bit 10: Pressure Frequency Index Alarm bit 9: Standard Deviation Alarm bit 8: Overload Count Alarm bit 0: Check	na	
44	FD_OFFSPEC_ACTIVE	S	Bit String	—	D-R	4	*DS3	na	
45	FD_MAINT_ACTIVE	S	Bit String	—	D-R	4	*DS3	na	
46	FD_CHECK_ACTIVE	S	Bit String	—	D-R	4	*DS3	na	
47	FD_FAIL_MAP	S	Bit String	—	S-R/W	4	*DS3	na	
48	FD_OFFSPEC_MAP	S	Bit String	—	S-R/W	4	*DS3	na	
49	FD_MAINT_MAP	S	Bit String	—	S-R/W	4	*DS3	na	
50	FD_CHECK_MAP	S	Bit String	—	S-R/W	4	*DS3	na	
51	FD_FAIL_MASK	S	Bit String	—	S-R/W	4	*DS3	na	
52	FD_OFFSPEC_MASK	S	Bit String	—	S-R/W	4	*DS3	na	
53	FD_MAINT_MASK	S	Bit String	—	S-R/W	4	*DS3	na	
54	FD_CHECK_MASK	S	Bit String	—	S-R/W	4	*DS3	na	
55	FD_FAIL_ALM	R	Unsigned 8	Unacknowledged	D-R/W	1	0: Undefined 1: Acknowledged 2: Unacknowledged	na	
			Unsigned 8	Alarm State	D-R	1	0: Undefined 1: Clear - reported 2: Clear - not reported 3: Active - reported 4: Active - not reported		
			Time Value	Time Stamp	D-R	8			
			Unsigned 32	Subcode	D-R	4			
			Unsigned 8	Value	D-R	1			
56	FD_OFFSPEC_ALM	R	Unsigned 8	Unacknowledged	D-R/W	1	0: Undefined 1: Acknowledged 2: Unacknowledged	na	
			Unsigned 8	Alarm State	D-R	1	0: Undefined 1: Clear - reported 2: Clear - not reported 3: Active - reported 4: Active - not reported		
			Time Value	Time Stamp	D-R	8			
			Unsigned 32	Subcode	D-R	4			
			Unsigned 8	Value	D-R	1			

Index	Parameter Mnemonic	Obj Type	Data Type/Structure	Sub Parameter	Store -R/W	Size	Valid Range (GTX)	Units	Mode
57	FD_MAINT_ALM	R	Unsigned 8	Unacknowledged	D-R/W	1	0: Undefined 1: Acknowledged 2: Unacknowledged	na	
			Unsigned 8	Alarm State	D-R	1	0: Undefined 1: Clear - reported 2: Clear - not reported 3: Active - reported 4: Active - not reported		
			Time Value	Time Stamp	D-R	8			
			Unsigned 32	Subcode	D-R	4			
			Unsigned 8	Value	D-R	1			
58	FD_CHECK_ALM	R	Unsigned 8	Unacknowledged	D-R/W	1	0: Undefined 1: Acknowledged 2: Unacknowledged	na	
			Unsigned 8	Alarm State	D-R	1	0: Undefined 1: Clear - reported 2: Clear - not reported 3: Active - reported 4: Active - not reported		
			Time Value	Time Stamp	D-R	8			
			Unsigned 32	Subcode	D-R	4			
			Unsigned 8	Value	D-R	1			
59	FD_FAIL_PRI	S	Unsigned 8	—	S-R/W	1	0≤X≤15	na	
60	FD_OFFSPEC_PRI	S	Unsigned 8	—	S-R/W	1	0≤X≤15	na	
61	FD_MAINT_PRI	S	Unsigned 8	—	S-R/W	1	0≤X≤15	na	
62	FD_CHECK_PRI	S	Unsigned 8	—	S-R/W	1	0≤X≤15	na	
63	FD_SIMULATE	R	Bit String	Diagnostic Simulate Value	D-R/W	4	*DS3	na	
			Bit String	Diagnostic Value	D-R	4	*DS3		
			Unsigned 8	Simulate En/ Disable	D-R/W	1	0: Not Initialized 1: Simulation Disabled 2: Simulation Active		
64	FD_RECOMMEN_ACT	S	Unsigned 16	—	D-R	2	0: Uninitialized 1: No Action Required 2: Replace Electrical Module 3: Replace Meter Body 4: Execute Calibration 5: Check process and/or Impulse Line 6: Check Operating Conditions 7: Other	na	
65	CAPABILITY_LEV	S	Unsigned 8	—	S-R	1	0: Capability level not supported 1: Standard Model 2: Advanced Diagnostics Model	na	
66	HARDWARE_REV	S	Visible String	—	S-R	32		na	
67	SOFTWARE_REV	S	Visible String	—	S-R	32		na	
68	SIM_ACTIVE_SW	S	Unsigned 16	—	D-R/W	2	0: Disabled 1: Active	none	

*1. Rewriting is possible in all the modes, but the restart operation is only done when the Mode is changed to Auto.

Appendix D. Pressure Transducer Block Parameter List

Index	Parameter Mnemonic	Obj Type	Data Type/Structure	Sub Parameter	Store -R/W	Size	Valid Range	Units	Mode
1	ST_REV	S	Unsigned 16		S-R	2	0≤X≤65535	none	
2	TAG_DESC	S	Octet String (32)		S-R/W	32		na	
3	STRATEGY	S	Unsigned 16		S-R/W	2		none	
4	ALERT_KEY	S	Unsigned 8		S-R/W	1	1≤255	none	
5	MODE_BLK	R	Bit String	Target	N-R/W	1	bit 3: Auto bit 4: Man bit 7: OOS	na	
			Bit String	Actual	D-R	1	bit 3: Auto bit 4: Man bit 7: OOS		
			Bit String	Permitted	S-R/W	1	bit 3: Auto bit 4: Man bit 7: OOS		
			Bit String	Normal	S-R/W	1	bit 3: Auto bit 4: Man bit 7: OOS		
6	BLOCK_ERR	S	Bit String (2)		D-R	2	bit 0: Other bit 1: Block Configuration Error bit 7: Sensor Failure detected by this block bit 15:Out-of-SERVICE	E	
7	UPDATE_EVT	R	Unsigned 8	Unacknowledged	D-R/W	1	(0: undefined) 1: Acknowedged 2: Unacknowledged	na	
			Unsigned 8	Update State	D-R	1	0: Undefined 1: Update reported 2: Updaate not reported		
			Time Value	Time Stamp	D-R	8			
			Unsigned 16	Static Revision	D-R	2			
			Unsigned 16	Relative Index	D-R	2			
8	BLOCK_ALM	R	Unsigned 8	Unacknowledged	D-R/W	1	(0: undefined) 1: Acknowedged 2: Unacknowledged	na	
			Unsigned 8	Alarm State	D-R	1	0: Undefined 1: Clear - reported 2: Clear - not reported 3: Active - reported 4: Active - not reported		
			Time Value	Time Stamp	D-R	8			
			Unsigned 16	Subcode	D-R	2			
			Unsigned 8	Value	D-R	1			
9	TRANSDUCER_DIRECTORY	A	Array of Unsigned 16 with 1 element	[0]	S-R	2		none	
10	TRANSDUCER_TYPE	S	Unsigned 16		S-R	2	100: Standard Pressure with Calibration	E	
11	TRANSDUCER_TYPE_VER	S	Unsigned 16		N-R	2	0x0201	none	
12	XD_ERROR	S	Unsigned 8		D-R	1	17: Generic error 18: Calibration error 19: Configuration error 20: Electronics Failure 22: I/O Failure 23: Data Integrity Error	E	
13	COLLECTION_DIRECTORY	A	Array of Unsigned 32 with 1 element	[0]	S-R	4		none	
14	PRIMARY_VALUE_TYPE	S	Unsigned 16		S-R	2	107: differential pressure 108: gauge pressure 109: absolute pressure	E	Man
15	PRIMARY_VALUE	R	Unsigned 8	Status	D-R	1		PVR	
			Float	Value	D-R	4			

Index	Parameter Mnemonic	Obj Type	Data Type/Structure	Sub Parameter	Store -R/W	Size	Valid Range	Units	Mode
16	PRIMARY_VALUE_RANGE	R	Float	EU at 100%	S-R/W	4	|X|≤(SR.EU100×1.5) EU at 0% ≠ EU at 100% *Refer to note 1	PVR	Man
			Float	EU at 0%	S-R/W	4	|X|≤(SR.EU100×1.5) EU at 0% ≠ EU at 100% *Refer to note 1		
			Unsigned 16	Units Index	S-R/W	2			
			Integer 8	Decimal Point	S-R/W	1	−128 to +127		
17	CAL_POINT_HI	S	Float		S-R/W	4	|X|≤(SR.EU100×1.5)	CU	Man
18	CAL_POINT_LO	S	Float		S-R/W	4	|X|≤(SR.EU100×1.5)	CU	Man
19	CAL_MIN_SPAN	S	Float		D-R	4		CU	
20	CAL_VALUE	R	Unsigned 8	Status	D-R	1		CU	
			Float	Value	D-R	4			
21	CAL_UNIT	S	Unsigned 16		S-R/W	2		CU	Man
22	XD_OPTS	S	Bit String (4)		S-R/W	4	bit 0: Connected Channel Status BAD in MAN bit 1: Connected Channel Status UNC in MAN	na	OOS
23	SENSOR_TYPE	S	Unsigned 16		S-R	2	125: Piezo resistive	E	Man
24	SENSOR_RANGE	R	Float	EU at 100%	S-R	4		SR	Man
			Float	EU at 0%	S-R	4			
			Unsigned 16	Units Index	S-R/W	2			
			Integer 8	Decimal Point	S-R/W	1			
25	SENSOR_SN	S	Visible String (32)		S-R	32		na	
26	SENSOR_CAL_METHOD	S	Unsigned 8		S-R/W	1	100: volumetric 101: static weigh 102: dynamic weigh 103: factory trim standard calibration 104: user trim standard calibration 105: factory trim special calibration 106: user trim special calibration 255: other	E	
27	SENSOR_CAL_LOC	S	Visible String (32)		S-R/W	32		na	
28	SENSOR_CAL_DATE	S	Date		S-R/W	7		none	
29	SENSOR_CAL_WHO	S	Visible String (32)		S-R/W	32		na	
30	SENSOR_ISOLATOR_MTL	S	Unsigned 16		S-R	2	0: Undefined	E	
31	SENSOR_FILL_FLUID	S	Unsigned 16		S-R	2	0: Undefined	E	
32	BLOCK_ERR_DESC_1	S	Bit String (4)		D-R	4		na	
33	BLOCK_ERR_DESC_2	S	Bit String (4)		D-R	4		na	
34	SECONDARY_VALUE	R	Unsigned 8	Status	D-R	1		SVR	
			Float	Value	D-R	4			
35	SECONDARY_VALUE_RANGE	R	Float	EU at 100%	S-R/W	4	−40°C≤X≤+85°C EU at 0% ≠ EU at 100% *Refer to note 1	SVR	
			Float	EU at 0%	S-R/W	4	−40°C≤X≤+85°C EU at 0% ≠ EU at 100% *Refer to note 1		
			Unsigned 16	Units Index	S-R/W	2			
			Integer 8	Decimal Point	S-R/W	1	−128 to +127		
36	DAMPING_CONSTANT	S	Float		S-R/W	4	0≤X≤128	Sec	
37	SENSOR_VALUE	S	Float		D-R	4		SR	
38	PV_SV_SW_1_VALUE_D	R	Unsigned 8	Status	D-R	1		E	
			Unsigned 8	Value	D-R	1	0: OFF 1: ON		
39	PV_SV_SW_1_SOURCE	S	Unsigned 8		S-R/W	1	1: Pressure (PV) 2: Temperature (SV)	E	OOS
40	PV_SV_SW_1_MODE	S	Unsigned 8		S-R/W	1	0: Low 1: High	E	OOS
41	PV_SV_SW_1_THRESHOLD	S	Float		S-R/W	4	When PV_SV_SW_1_SOURCE = 1 {Pressure (PV)} |X|≤(SR.EU100×1.5) When PV_SV_SW_1_SOURCE = 2 {Temperature (SV)} −40°C≤X≤+85°C *Refer to note 2	PVR or SVR	OOS

Index	Parameter Mnemonic	Obj Type	Data Type/Structure	Sub Parameter	Store -R/W	Size	Valid Range	Units	Mode
42	PV_SV_SW_1_ HYSTERESIS	S	Float		S-R/W	4	When PV_SV_SW_1_SOURCE = 1 {Pressure (PV)} 0≤X≤(SR.EU100×0.05) When PV_SV_SW_1_SOURCE = 2 {Temperature (SV)} 0°C≤X≤5°C *Refer to notes 3, 4	PVR or SVR	OOS
43	PV_SV_SW_2_VALUE_D	R	Unsigned 8	Status	D-R	1		E	
			Unsigned 8	Value	D-R	1	0: OFF 1: ON		
44	PV_SV_SW_2_SOURCE	S	Unsigned 8		S-R/W	1	1: Pressure (PV) 2: Temperature (SV)	E	OOS
45	PV_SV_SW_2_MODE	S	Unsigned 8		S-R/W	1	0: Low 1: High	E	OOS
46	PV_SV_SW_2_ THRESHOLD	S	Float		S-R/W	4	When PV_SV_SW_2_SOURCE = 1 {Pressure (PV)} |X|≤(SR.EU100×1.5) When PV_SV_SW_2_SOURCE = 2 {Temperature (SV)} −40°C≤X≤+85°C *Refer to note 2	PVR or SVR	OOS
47	PV_SV_SW_2_ HYSTERESIS	S	Float		S-R/W	4	When PV_SV_SW_2_SOURCE = 1 {Pressure (PV)} 0≤X≤(SR.EU100×0.05) When PV_SV_SW_2_SOURCE = 2 {Temperature (SV)} 0°C≤X≤5°C *Refer to notes 3, 4	PVR or SVR	OOS
48	RESET_CALIBRATION	S	Unsigned 8		D-R/W	1	0: None 254: Reset Calibration	E	Man
49	REMOTE_SEAL_TEMP_ COMPENSATION	S	Unsigned 8		S-R	1	0: Disabled 1: Enabled	E	
50	HEIGHT_VALUE	S	Float		S-R/W	4	−30≤X≤+30	m	Man
51	ELEVATION_CMD	S	Unsigned 8		D-R/W	1	0: None 1: Set Elevation (Zero Adjustment) 2: Reset Elevation	E	
52	ELEVATION_VALUE	S	Float		S-R/W	4	|X|≤(SR.EU100×1.5)	CU	
53	EXT_ZERO_ADJ_USE	S	Unsigned 8		S-R/W	1	0: Disabled 1: Enabled	E	OOS
54	SENSOR_SOFTWARE_ REV	S	Visible String (4)		S-R	4		na	
55	PROD_NUM	S	Visible String (32)		S-R/W	32		na	OOS
56	MAX_WORKING_ PRESSURE	S	Visible String (32)		S-R/W	32		na	OOS
57	ERASE_SELF_DIAG_ RECORDS	S	Unsigned 8		D-R/W	1	0: None 1: Reset Self Diag Sum 2: Reset Self Diag Records	E	
58	SELF_DIAG_SUMMARY	S	Bit String (4)		N-R	4		na	
59	SELF_DIAG_RECORD_1	R	Time Value	Date	N-R	8		None	
			Unsigned 8	Status	N-R	1	0: None 1: Occur 2: Clear	E	
			Unsigned 8	Value	N-R	1	Refer to Sheet “SELF_DIAG_RECORD”	E	
60	SELF_DIAG_RECORD_2	R	Time Value	Date	N-R	8		None	
			Unsigned 8	Status	N-R	1	0: None 1: Occur 2: Clear	E	
			Unsigned 8	Value	N-R	1	Refer to Sheet “SELF_DIAG_RECORD”	E	
61	SELF_DIAG_RECORD_3	R	Time Value	Date	N-R	8		None	
			Unsigned 8	Status	N-R	1	0: None 1: Occur 2: Clear	E	
			Unsigned 8	Value	N-R	1	Refer to Sheet “SELF_DIAG_RECORD”	E	

Index	Parameter Mnemonic	Obj Type	Data Type/Structure	Sub Parameter	Store -R/W	Size	Valid Range	Units	Mode
62	SELF_DIAG_RECORD_4	R	Time Value	Date	N-R	8		None	
			Unsigned 8	Status	N-R	1	0: None 1: Occur 2: Clear	E	
			Unsigned 8	Value	N-R	1	Refer to Sheet “SELF_DIAG_RECORD”	E	
63	SELF_DIAG_RECORD_5	R	Time Value	Date	N-R	8		None	
			Unsigned 8	Status	N-R	1	0: None 1: Occur 2: Clear	E	
			Unsigned 8	Value	N-R	1	Refer to Sheet “SELF_DIAG_RECORD”	E	
64	SELF_DIAG_RECORD_6	R	Time Value	Date	N-R	8		None	
			Unsigned 8	Status	N-R	1	0: None 1: Occur 2: Clear	E	
			Unsigned 8	Value	N-R	1	Refer to Sheet “SELF_DIAG_RECORD”	E	
65	SELF_DIAG_RECORD_7	R	Time Value	Date	N-R	8		None	
			Unsigned 8	Status	N-R	1	0: None 1: Occur 2: Clear	E	
			Unsigned 8	Value	N-R	1	Refer to Sheet “SELF_DIAG_RECORD”	E	
66	SELF_DIAG_RECORD_8	R	Time Value	Date	N-R	8		None	
			Unsigned 8	Status	N-R	1	0: None 1: Occur 2: Clear	E	
			Unsigned 8	Value	N-R	1	Refer to Sheet “SELF_DIAG_RECORD”	E	
67	SELF_DIAG_RECORD_9	R	Time Value	Date	N-R	8		None	
			Unsigned 8	Status	N-R	1	0: None 1: Occur 2: Clear	E	
			Unsigned 8	Value	N-R	1	Refer to Sheet “SELF_DIAG_RECORD”	E	
68	SELF_DIAG_RECORD_10	R	Time Value	Date	N-R	8		None	
			Unsigned 8	Status	N-R	1	0: None 1: Occur 2: Clear	E	
			Unsigned 8	Value	N-R	1	Refer to Sheet “SELF_DIAG_RECORD”	E	
69	SELF_DIAG_RECORD_11	R	Time Value	Date	N-R	8		None	
			Unsigned 8	Status	N-R	1	0: None 1: Occur 2: Clear	E	
			Unsigned 8	Value	N-R	1	Refer to Sheet “SELF_DIAG_RECORD”	E	
70	SELF_DIAG_RECORD_12	R	Time Value	Date	N-R	8		None	
			Unsigned 8	Status	N-R	1	0: None 1: Occur 2: Clear	E	
			Unsigned 8	Value	N-R	1	Refer to Sheet “SELF_DIAG_RECORD”	E	
71	SELF_DIAG_RECORD_13	R	Time Value	Date	N-R	8		None	
			Unsigned 8	Status	N-R	1	0: None 1: Occur 2: Clear	E	
			Unsigned 8	Value	N-R	1	Refer to Sheet “SELF_DIAG_RECORD”	E	
72	SELF_DIAG_RECORD_14	R	Time Value	Date	N-R	8		None	
			Unsigned 8	Status	N-R	1	0: None 1: Occur 2: Clear	E	
			Unsigned 8	Value	N-R	1	Refer to Sheet “SELF_DIAG_RECORD”	E	
73	SELF_DIAG_RECORD_15	R	Time Value	Date	N-R	8		None	
			Unsigned 8	Status	N-R	1	0: None 1: Occur 2: Clear	E	
			Unsigned 8	Value	N-R	1	Refer to Sheet “SELF_DIAG_RECORD”	E	

Index	Parameter Mnemonic	Obj Type	Data Type/Structure		Sub Parameter	Store -R/W	Size	Valid Range	Units	Mode
74	SELF_DIAG_RECORD_16	R		Time Value	Date	N-R	8		None	
				Unsigned 8	Status	N-R	1	0: None 1: Occur 2: Clear	E	
				Unsigned 8	Value	N-R	1	Refer to Sheet “SELF_DIAG_RECORD”	E	
75	SELF_DIAG_RECORD_17	R		Time Value	Date	N-R	8		None	
				Unsigned 8	Status	N-R	1	0: None 1: Occur 2: Clear	E	
				Unsigned 8	Value	N-R	1	Refer to Sheet “SELF_DIAG_RECORD”	E	
76	SELF_DIAG_RECORD_18	R		Time Value	Date	N-R	8		None	
				Unsigned 8	Status	N-R	1	0: None 1: Occur 2: Clear	E	
				Unsigned 8	Value	N-R	1	Refer to Sheet “SELF_DIAG_RECORD”	E	
77	SELF_DIAG_RECORD_19	R		Time Value	Date	N-R	8		None	
				Unsigned 8	Status	N-R	1	0: None 1: Occur 2: Clear	E	
				Unsigned 8	Value	N-R	1	Refer to Sheet “SELF_DIAG_RECORD”	E	
78	SELF_DIAG_RECORD_20	R		Time Value	Date	N-R	8		None	
				Unsigned 8	Status	N-R	1	0: None 1: Occur 2: Clear	E	
				Unsigned 8	Value	N-R	1	Refer to Sheet “SELF_DIAG_RECORD”	E	
79	SELF_DIAG_RECORD_21	R		Time Value	Date	N-R	8		None	
				Unsigned 8	Status	N-R	1	0: None 1: Occur 2: Clear	E	
				Unsigned 8	Value	N-R	1	Refer to Sheet “SELF_DIAG_RECORD”	E	
80	SELF_DIAG_RECORD_22	R		Time Value	Date	N-R	8		None	
				Unsigned 8	Status	N-R	1	0: None 1: Occur 2: Clear	E	
				Unsigned 8	Value	N-R	1	Refer to Sheet “SELF_DIAG_RECORD”	E	
81	SELF_DIAG_RECORD_23	R		Time Value	Date	N-R	8		None	
				Unsigned 8	Status	N-R	1	0: None 1: Occur 2: Clear	E	
				Unsigned 8	Value	N-R	1	Refer to Sheet “SELF_DIAG_RECORD”	E	
82	SELF_DIAG_RECORD_24	R		Time Value	Date	N-R	8		None	
				Unsigned 8	Status	N-R	1	0: None 1: Occur 2: Clear	E	
				Unsigned 8	Value	N-R	1	Refer to Sheet “SELF_DIAG_RECORD”	E	
83	SELF_DIAG_RECORD_25	R		Time Value	Date	N-R	8		None	
				Unsigned 8	Status	N-R	1	0: None 1: Occur 2: Clear	E	
				Unsigned 8	Value	N-R	1	Refer to Sheet “SELF_DIAG_RECORD”	E	
84	SELF_DIAG_RECORD_26	R		Time Value	Date	N-R	8		None	
				Unsigned 8	Status	N-R	1	0: None 1: Occur 2: Clear	E	
				Unsigned 8	Value	N-R	1	Refer to Sheet “SELF_DIAG_RECORD”	E	
85	SELF_DIAG_RECORD_27	R		Time Value	Date	N-R	8		None	
				Unsigned 8	Status	N-R	1	0: None 1: Occur 2: Clear	E	
				Unsigned 8	Value	N-R	1	Refer to Sheet “SELF_DIAG_RECORD”	E	

Index	Parameter Mnemonic	Obj Type	Data Type/Structure	Sub Parameter	Store -R/W	Size	Valid Range	Units	Mode
86	SELF_DIAG_RECORD_28	R	Time Value	Date	N-R	8		None	
			Unsigned 8	Status	N-R	1	0: None 1: Occur 2: Clear	E	
			Unsigned 8	Value	N-R	1	Refer to Sheet “SELF_DIAG_RECORD”	E	
87	SELF_DIAG_RECORD_29	R	Time Value	Date	N-R	8		None	
			Unsigned 8	Status	N-R	1	0: None 1: Occur 2: Clear	E	
			Unsigned 8	Value	N-R	1	Refer to Sheet “SELF_DIAG_RECORD”	E	
88	SELF_DIAG_RECORD_30	R	Time Value	Date	N-R	8		None	
			Unsigned 8	Status	N-R	1	0: None 1: Occur 2: Clear	E	
			Unsigned 8	Value	N-R	1	Refer to Sheet “SELF_DIAG_RECORD”	E	
89	SELF_DIAG_RECORD_31	R	Time Value	Date	N-R	8		None	
			Unsigned 8	Status	N-R	1	0: None 1: Occur 2: Clear	E	
			Unsigned 8	Value	N-R	1	Refer to Sheet “SELF_DIAG_RECORD”	E	
90	SELF_DIAG_RECORD_32	R	Time Value	Date	N-R	8		None	
			Unsigned 8	Status	N-R	1	0: None 1: Occur 2: Clear	E	
			Unsigned 8	Value	N-R	1	Refer to Sheet “SELF_DIAG_RECORD”	E	
91	SELF_DIAG_RECORD_33	R	Time Value	Date	N-R	8		None	
			Unsigned 8	Status	N-R	1	0: None 1: Occur 2: Clear	E	
			Unsigned 8	Value	N-R	1	Refer to Sheet “SELF_DIAG_RECORD”	E	
92	SELF_DIAG_RECORD_34	R	Time Value	Date	N-R	8		None	
			Unsigned 8	Status	N-R	1	0: None 1: Occur 2: Clear	E	
			Unsigned 8	Value	N-R	1	Refer to Sheet “SELF_DIAG_RECORD”	E	
93	SELF_DIAG_RECORD_35	R	Time Value	Date	N-R	8		None	
			Unsigned 8	Status	N-R	1	0: None 1: Occur 2: Clear	E	
			Unsigned 8	Value	N-R	1	Refer to Sheet “SELF_DIAG_RECORD”	E	
94	SELF_DIAG_RECORD_36	R	Time Value	Date	N-R	8		None	
			Unsigned 8	Status	N-R	1	0: None 1: Occur 2: Clear	E	
			Unsigned 8	Value	N-R	1	Refer to Sheet “SELF_DIAG_RECORD”	E	
95	SELF_DIAG_RECORD_37	R	Time Value	Date	N-R	8		None	
			Unsigned 8	Status	N-R	1	0: None 1: Occur 2: Clear	E	
			Unsigned 8	Value	N-R	1	Refer to Sheet “SELF_DIAG_RECORD”	E	
96	SELF_DIAG_RECORD_38	R	Time Value	Date	N-R	8		None	
			Unsigned 8	Status	N-R	1	0: None 1: Occur 2: Clear	E	
			Unsigned 8	Value	N-R	1	Refer to Sheet “SELF_DIAG_RECORD”	E	
97	SELF_DIAG_RECORD_39	R	Time Value	Date	N-R	8		None	
			Unsigned 8	Status	N-R	1	0: None 1: Occur 2: Clear	E	
			Unsigned 8	Value	N-R	1	Refer to Sheet “SELF_DIAG_RECORD”	E	
98	SELF_DIAG_RECORD_40	R	Time Value	Date	N-R	8		None	
			Unsigned 8	Status	N-R	1	0: None 1: Occur 2: Clear	E	
			Unsigned 8	Value	N-R	1	Refer to Sheet “SELF_DIAG_RECORD”	E	

Index	Parameter Mnemonic	Obj Type	Data Type/Structure	Sub Parameter	Store -R/W	Size	Valid Range	Units	Mode
99	ZERO_CAL_RECORD_1	R	Time Value	Date	N-R	8		None	
			Float	Value	N-R	4		%	
100	ZERO_CAL_RECORD_2	R	Time Value	Date	N-R	8		None	
			Float	Value	N-R	4		%	
101	ZERO_CAL_RECORD_3	R	Time Value	Date	N-R	8		None	
			Float	Value	N-R	4		%	
102	ZERO_CAL_RECORD_4	R	Time Value	Date	N-R	8		None	
			Float	Value	N-R	4		%	
103	ZERO_CAL_RECORD_5	R	Time Value	Date	N-R	8		None	
			Float	Value	N-R	4		%	
104	ZERO_CAL_RECORD_6	R	Time Value	Date	N-R	8		None	
			Float	Value	N-R	4		%	
105	ZERO_CAL_RECORD_7	R	Time Value	Date	N-R	8		None	
			Float	Value	N-R	4		%	
106	ZERO_CAL_RECORD_8	R	Time Value	Date	N-R	8		None	
			Float	Value	N-R	4		%	
107	ZERO_CAL_RECORD_9	R	Time Value	Date	N-R	8		None	
			Float	Value	N-R	4		%	
108	ZERO_CAL_RECORD_10	R	Time Value	Date	N-R	8		None	
			Float	Value	N-R	4		%	
109	ZERO_CAL_RECORD_11	R	Time Value	Date	N-R	8		None	
			Float	Value	N-R	4		%	
110	ZERO_CAL_RECORD_12	R	Time Value	Date	N-R	8		None	
			Float	Value	N-R	4		%	
111	ZERO_CAL_RECORD_13	R	Time Value	Date	N-R	8		None	
			Float	Value	N-R	4		%	
112	ZERO_CAL_RECORD_14	R	Time Value	Date	N-R	8		None	
			Float	Value	N-R	4		%	
113	ZERO_CAL_RECORD_15	R	Time Value	Date	N-R	8		None	
			Float	Value	N-R	4		%	
114	ZERO_CAL_RECORD_16	R	Time Value	Date	N-R	8		None	
			Float	Value	N-R	4		%	
115	ZERO_CAL_RECORD_17	R	Time Value	Date	N-R	8		None	
			Float	Value	N-R	4		%	
116	ZERO_CAL_RECORD_18	R	Time Value	Date	N-R	8		None	
			Float	Value	N-R	4		%	
117	ZERO_CAL_RECORD_19	R	Time Value	Date	N-R	8		None	
			Float	Value	N-R	4		%	
118	ZERO_CAL_RECORD_20	R	Time Value	Date	N-R	8		None	
			Float	Value	N-R	4		%	
119	ZERO_CAL_RECORD_21	R	Time Value	Date	N-R	8		None	
			Float	Value	N-R	4		%	
120	ZERO_CAL_RECORD_22	R	Time Value	Date	N-R	8		None	
			Float	Value	N-R	4		%	
121	ZERO_CAL_RECORD_23	R	Time Value	Date	N-R	8		None	
			Float	Value	N-R	4		%	
122	ZERO_CAL_RECORD_24	R	Time Value	Date	N-R	8		None	
			Float	Value	N-R	4		%	
123	ZERO_CAL_RECORD_25	R	Time Value	Date	N-R	8		None	
			Float	Value	N-R	4		%	
124	ZERO_CAL_RECORD_26	R	Time Value	Date	N-R	8		None	
			Float	Value	N-R	4		%	
125	ZERO_CAL_RECORD_27	R	Time Value	Date	N-R	8		None	
			Float	Value	N-R	4		%	
126	ZERO_CAL_RECORD_28	R	Time Value	Date	N-R	8		None	
			Float	Value	N-R	4		%	
127	ZERO_CAL_RECORD_29	R	Time Value	Date	N-R	8		None	
			Float	Value	N-R	4		%	
128	ZERO_CAL_RECORD_30	R	Time Value	Date	N-R	8		None	
			Float	Value	N-R	4		%	

Index	Parameter Mnemonic	Obj Type	Data Type/Structure	Sub Parameter	Store -R/W	Size	Valid Range	Units	Mode
129	ELEVATION_RECORD_1	R	Time Value	Date	N-R	8		None	
			Unsigned 8	Select	N-R	1	0: None 1: Elevation Command 2: Manual Elevation Input 3: External Adjustment	E	
			Float	Value	N-R	4		CU	
130	ELEVATION_RECORD_2	R	Time Value	Date	N-R	8		None	
			Unsigned 8	Select	N-R	1	0: None 1: Elevation Command 2: Manual Elevation Input 3: External Adjustment	E	
			Float	Value	N-R	4		CU	
131	ELEVATION_RECORD_3	R	Time Value	Date	N-R	8		None	
			Unsigned 8	Select	N-R	1	0: None 1: Elevation Command 2: Manual Elevation Input 3: External Adjustment	E	
			Float	Value	N-R	4		CU	
132	ELEVATION_RECORD_4	R	Time Value	Date	N-R	8		None	
			Unsigned 8	Select	N-R	1	0: None 1: Elevation Command 2: Manual Elevation Input 3: External Adjustment	E	
			Float	Value	N-R	4		CU	
133	ELEVATION_RECORD_5	R	Time Value	Date	N-R	8		None	
			Unsigned 8	Select	N-R	1	0: None 1: Elevation Command 2: Manual Elevation Input 3: External Adjustment	E	
			Float	Value	N-R	4		CU	
134	ELEVATION_RECORD_6	R	Time Value	Date	N-R	8		None	
			Unsigned 8	Select	N-R	1	0: None 1: Elevation Command 2: Manual Elevation Input 3: External Adjustment	E	
			Float	Value	N-R	4		CU	
135	ELEVATION_RECORD_7	R	Time Value	Date	N-R	8		None	
			Unsigned 8	Select	N-R	1	0: None 1: Elevation Command 2: Manual Elevation Input 3: External Adjustment	E	
			Float	Value	N-R	4		CU	
136	ELEVATION_RECORD_8	R	Time Value	Date	N-R	8		None	
			Unsigned 8	Select	N-R	1	0: None 1: Elevation Command 2: Manual Elevation Input 3: External Adjustment	E	
			Float	Value	N-R	4		CU	
137	ELEVATION_RECORD_9	R	Time Value	Date	N-R	8		None	
			Unsigned 8	Select	N-R	1	0: None 1: Elevation Command 2: Manual Elevation Input 3: External Adjustment	E	
			Float	Value	N-R	4		CU	
138	ELEVATION_RECORD_10	R	Time Value	Date	N-R	8		None	
			Unsigned 8	Select	N-R	1	0: None 1: Elevation Command 2: Manual Elevation Input 3: External Adjustment	E	
			Float	Value	N-R	4		CU	
139	ELEVATION_RECORD_11	R	Time Value	Date	N-R	8		None	
			Unsigned 8	Select	N-R	1	0: None 1: Elevation Command 2: Manual Elevation Input 3: External Adjustment	E	
			Float	Value	N-R	4		CU	

Index	Parameter Mnemonic	Obj Type	Data Type/Structure	Sub Parameter	Store -R/W	Size	Valid Range	Units	Mode
140	ELEVATION_RECORD_12	R	Time Value	Date	N-R	8		None	
			Unsigned 8	Select	N-R	1	0: None 1: Elevation Command 2: Manual Elevation Input 3: External Adjustment	E	
			Float	Value	N-R	4		CU	
141	ELEVATION_RECORD_13	R	Time Value	Date	N-R	8		None	
			Unsigned 8	Select	N-R	1	0: None 1: Elevation Command 2: Manual Elevation Input 3: External Adjustment	E	
			Float	Value	N-R	4		CU	
142	ELEVATION_RECORD_14	R	Time Value	Date	N-R	8		None	
			Unsigned 8	Select	N-R	1	0: None 1: Elevation Command 2: Manual Elevation Input 3: External Adjustment	E	
			Float	Value	N-R	4		CU	
143	ELEVATION_RECORD_15	R	Time Value	Date	N-R	8		None	
			Unsigned 8	Select	N-R	1	0: None 1: Elevation Command 2: Manual Elevation Input 3: External Adjustment	E	
			Float	Value	N-R	4		CU	
144	ELEVATION_RECORD_16	R	Time Value	Date	N-R	8		None	
			Unsigned 8	Select	N-R	1	0: None 1: Elevation Command 2: Manual Elevation Input 3: External Adjustment	E	
			Float	Value	N-R	4		CU	
145	ELEVATION_RECORD_17	R	Time Value	Date	N-R	8		None	
			Unsigned 8	Select	N-R	1	0: None 1: Elevation Command 2: Manual Elevation Input 3: External Adjustment	E	
			Float	Value	N-R	4		CU	
146	ELEVATION_RECORD_18	R	Time Value	Date	N-R	8		None	
			Unsigned 8	Select	N-R	1	0: None 1: Elevation Command 2: Manual Elevation Input 3: External Adjustment	E	
			Float	Value	N-R	4		CU	
147	ELEVATION_RECORD_19	R	Time Value	Date	N-R	8		None	
			Unsigned 8	Select	N-R	1	0: None 1: Elevation Command 2: Manual Elevation Input 3: External Adjustment	E	
			Float	Value	N-R	4		CU	
148	ELEVATION_RECORD_20	R	Time Value	Date	N-R	8		None	
			Unsigned 8	Select	N-R	1	0: None 1: Elevation Command 2: Manual Elevation Input 3: External Adjustment	E	
			Float	Value	N-R	4		CU	
149	ELEVATION_RECORD_21	R	Time Value	Date	N-R	8		None	
			Unsigned 8	Select	N-R	1	0: None 1: Elevation Command 2: Manual Elevation Input 3: External Adjustment	E	
			Float	Value	N-R	4		CU	
150	ELEVATION_RECORD_22	R	Time Value	Date	N-R	8		None	
			Unsigned 8	Select	N-R	1	0: None 1: Elevation Command 2: Manual Elevation Input 3: External Adjustment	E	
			Float	Value	N-R	4		CU	

Index	Parameter Mnemonic	Obj Type	Data Type/Structure		Sub Parameter	Store -R/W	Size	Valid Range	Units	Mode
151	ELEVATION_RECORD_23	R		Time Value	Date	N-R	8		None	
				Unsigned 8	Select	N-R	1	0: None 1: Elevation Command 2: Manual Elevation Input 3: External Adjustment	E	
				Float	Value	N-R	4		CU	
152	ELEVATION_RECORD_24	R		Time Value	Date	N-R	8		None	
				Unsigned 8	Select	N-R	1	0: None 1: Elevation Command 2: Manual Elevation Input 3: External Adjustment	E	
				Float	Value	N-R	4		CU	
153	ELEVATION_RECORD_25	R		Time Value	Date	N-R	8		None	
				Unsigned 8	Select	N-R	1	0: None 1: Elevation Command 2: Manual Elevation Input 3: External Adjustment	E	
				Float	Value	N-R	4		CU	
154	ELEVATION_RECORD_26	R		Time Value	Date	N-R	8		None	
				Unsigned 8	Select	N-R	1	0: None 1: Elevation Command 2: Manual Elevation Input 3: External Adjustment	E	
				Float	Value	N-R	4		CU	
155	ELEVATION_RECORD_27	R		Time Value	Date	N-R	8		None	
				Unsigned 8	Select	N-R	1	0: None 1: Elevation Command 2: Manual Elevation Input 3: External Adjustment	E	
				Float	Value	N-R	4		CU	
156	ELEVATION_RECORD_28	R		Time Value	Date	N-R	8		None	
				Unsigned 8	Select	N-R	1	0: None 1: Elevation Command 2: Manual Elevation Input 3: External Adjustment	E	
				Float	Value	N-R	4		CU	
157	ELEVATION_RECORD_29	R		Time Value	Date	N-R	8		None	
				Unsigned 8	Select	N-R	1	0: None 1: Elevation Command 2: Manual Elevation Input 3: External Adjustment	E	
				Float	Value	N-R	4		CU	
158	ELEVATION_RECORD_30	R		Time Value	Date	N-R	8		None	
				Unsigned 8	Select	N-R	1	0: None 1: Elevation Command 2: Manual Elevation Input 3: External Adjustment	E	
				Float	Value	N-R	4		CU	

Note 1. If deferral checks are valid, the write range becomes infinite.
Regardless of whether the deferral checks are valid or invalid, writing EU at 0% ≠ EU at 100% will give an error.

Note 2. If deferral checks are valid, the write range becomes infinite.

Note 3. If deferral checks are valid, the write range becomes greater than 0.

Note 4. If the unit is not °C, then the value range that results from unit converting 0 to 5°C as the temperature range becomes the Valid Range. (°C or K: 0 to 5, °F or °R: 0 to 9)

Appendix E. Pressure Transducer Block Pressure Unit Table

Value	Display (Unit)	Description
1130	Pa	pascal
1132	MPa	megapascal
1133	kPa	kilopascal
1136	hPa	hectopascal
1137	bar	bar
1138	mbar	millibar
1139	torr	torr
1140	atm	atmospheres
1141	psi	pounds per square inch
1145	kg/cm^2	kilogram per square centimeter
1146	inH_2O	inches of water
1147	inH_2O (4°C)	inches of water at 4°C
1148	inH_2O (68°F)	inches of water at 68°F
1149	mmH_2O	millimeters of water
1150	mmH_2O (4°C)	millimeters of water at 4°C
1151	mmH_2O (68°F)	millimeters of water at 68°F
1152	ftH_2O	feet of water
1153	ftH_2O (4°C)	feet of water at 4°C
1154	ftH_2O (68°F)	feet of water at 68°F
1155	inHg	inches of mercury
1156	inHg (0°C)	inches of mercury at 0°C
1157	mmHg	millimeters of mercury
1158	mmHg (0°C)	millimeters of mercury at 0°C

Note: It will only display the SI unit depending on the host.

Appendix F. Pressure Transducer Block Temperature Unit Table

Value	Display (Unit)	Description
1000	K	Kelvin
1001	°C	degree Celsius
1002	°F	degree Fahrenheit
1003	°R	degree Rankine

Note: It will only display the SI unit depending on the host.

Appendix G. Display Transducer Block Parameter List

Index	Parameter Mnemonic	Obj Type	Data Type/Structure	Sub Parameter	Store -R/W	Size	Valid Range	Units	Mode
1	ST_REV	S	Unsigned 16	—	S-R	2	0≤X≤65535	none	
2	TAG_DESC	S	Octet String	—	S-R/W	32		na	
3	STRATEGY	S	Unsigned 16	—	S-R/W	2		none	
4	ALERT_KEY	S	Unsigned 8	—	S-R/W	1	1≤X≤255	none	
5	MODE_BLK	R	Bit String	Target	N-R/W	1	bit 3: Auto bit 7: OOS	na	
			Bit String	Actual	D-R	1			
			Bit String	Permitted	S-R/W	1			
			Bit String	Normal	S-R/W	1			
6	BLOCK_ERR	S	Bit String	—	D-R	2	bit 0: Other bit 1: Block Configuration Error bit 15: Out-of-Service	E	
7	UPDATE_EVT	R	Unsigned 8	Unacknowledged	D-R/W	1	(0: Undefined) 1: Acknowledged 2: Unacknowledged	na	
			Unsigned 8	Update State	D-R	1	0: Undefined 1: Update reported 2: Update not reported		
			Time Value	Time Stamp	D-R	8			
			Unsigned 16	Static Revision	D-R	2			
			Unsigned 16	Relative Index	D-R	2			
8	BLOCK_ALM	R	Unsigned 8	Unacknowledged	D-R/W	1	(0: Undefined) 1: Acknowledged 2: Unacknowledged	na	
			Unsigned 8	Alarm State	D-R	1	0: Undefined 1: Clear - reported 2: Clear - not reported 3: Active - reported 4: Active - not reported		
			Time Value	Time Stamp	D-R	8			
			Unsigned 16	Subcode	D-R	2			
			Unsigned 8	Value	D-R	1			
9	TRANSDUCER_ DIRECTORY	A	Unsigned 16 [1]	—	S-R	2		none	
10	TRANSDUCER_TYPE	S	Unsigned 16	—	S-R	2		E	
11	TRANSDUCER_TYPE_ VER	S	Unsigned 16	—	N-R	2		none	
12	XD_ERROR	S	Unsigned 8	—	D-R	1	19:Configration Error	E	
13	COLLECTION_ DIRECTORY	A	Unsigned 32 [1]	—	S-R	4		none	
14	BLOCK_ERR_DESC_1	S	Bit String	—	D-R	4	bit 0:Parameter 1 Configuration Error bit 1:Parameter 2 Configuration Error bit 2:Parameter 3 Configuration Error bit 3:Parameter 4 Configuration Error bit 4:Parameter/Information Selection Error	na	
15	DISPLAY_PARAM_ SELECTION	S	Bit String	—	S-R/W	1	bit 0:Parameter 1 bit 1:Parameter 2 bit 2:Parameter 3 bit 3:Parameter 4	na	
16	DISPLAY_INFO_ SELECTION	S	Bit String	—	S-R/W	1	bit 0:Tag bit 1:Unit bit 2:Status	na	
17	DISPLAY_CYCLE	S	Unsigned 8	—	S-R/W	1	1≤X≤10	[s]	
18	BLOCK_TYPE_ SELECTION_1	S	Unsigned 16	—	D-R	2		E	
19	BLOCK_TAG_ SELECTION_1	S	Visible String (32)	—	S-R/W	32	1 character≤X≤32 character	na	
20	PARAM_SELECTION_1	S	Unsigned 16	—	S-R/W	1		na	
21	DISPLAY_TAG_1	S	Visible String (32)	—	S-R/W	32	1 character≤X≤32 character	na	
22	UNIT_SELECTION_1	S	Unsigned 8	—	S-R/W	1	0: Auto 1: Custom	na	
23	CUSTOM_UNIT_1	S	Visible String (32)	—	S-R/W	32	1 character≤X≤32 character	na	
24	EXPONENT_ SELECTION_1	S	Unsigned 8	—	S-R/W	1	0: None 1: x10 2: x100 3: x1000	na	
25	BLOCK_TYPE_ SELECTION_2	S	Unsigned 16	—	D-R	2		E	

Index	Parameter Mnemonic	Obj Type	Data Type/Structure	Sub Parameter	Store -R/W	Size	Valid Range	Units	Mode
26	BLOCK_TAG_ SELECTION_2	S	Visible String (32)	—	S-R/W	32	1 character≤X≤32 character	na	
27	PARAM_SELECTION_2	S	Unsigned 16	—	S-R/W	1		na	
28	DISPLAY_TAG_2	S	Visible String (32)	—	S-R/W	32	1 character≤X≤32 character		
29	UNIT_SELECTION_2	S	Unsigned 8	—	S-R/W	1	0: Auto 1: Custom	na	
30	CUSTOM_UNIT_2	S	Visible String (32)	—	S-R/W	32	1 character≤X≤32 character	na	
31	EXPONENT_ SELECTION_2	S	Unsigned 8	—	S-R/W	1	0: None 1: x10 2: x100 3: x1000	na	
32	BLOCK_TYPE_ SELECTION_3	S	Unsigned 16	—	D-R	2		E	
33	BLOCK_TAG_ SELECTION_3	S	Visible String (32)	—	S-R/W	32	1 character≤X≤32 character	na	
34	PARAM_SELECTION_3	S	Unsigned 16	—	S-R/W	1		na	
35	DISPLAY_TAG_3	S	Visible String (32)	—	S-R/W	32	1 character≤X≤32 character	na	
36	UNIT_SELECTION_3	S	Unsigned 8	—	S-R/W	1	0: Auto 1: Custom	na	
37	CUSTOM_UNIT_3	S	Visible String (32)	—	S-R/W	32	1 character≤X≤32 character	na	
38	EXPONENT_ SELECTION_3	S	Unsigned 8	—	S-R/W	1	0: None 1: x10 2: x100 3: x1000	na	
39	BLOCK_TYPE_ SELECTION_4	S	Unsigned 16	—	D-R	2		E	
40	BLOCK_TAG_ SELECTION_4	S	Visible String (32)	—	S-R/W	32	1 character≤X≤32 character	na	
41	PARAM_SELECTION_4	S	Unsigned 16	—	S-R/W	1		na	
42	DISPLAY_TAG_4	S	Visible String (32)	—	S-R/W	32	1 character≤X≤32 character	na	
43	UNIT_SELECTION_4	S	Unsigned 8	—	S-R/W	1	0: Auto 1: Custom	na	
44	CUSTOM_UNIT_4	S	Visible String (32)	—	S-R/W	32	1 character≤X≤32 character	na	
45	EXPONENT_ SELECTION_4	S	Unsigned 8	—	S-R/W	1	0: None 1: x10 2: x100 3: x1000	na	
46	ERASE_OPERATOR_ ACTION_RECORDS	S	Unsigned 8	—	S-R/W	1	0: None 1: Erase	na	
47	OPERATOR_ACTION_ RECORD_1	R	Time Value	Date	N-R	8		none	
			Unsigned 8	Value	N-R	1	0x00: Local User I/F Inactive 0x80: Local User I/F Active	E	
48	OPERATOR_ACTION_ RECORD_2	R	Time Value	Date	N-R	8		none	
			Unsigned 8	Value	N-R	1	0x00: Local User I/F Inactive 0x80: Local User I/F Active	E	
49	OPERATOR_ACTION_ RECORD_3	R	Time Value	Date	N-R	8		none	
			Unsigned 8	Value	N-R	1	0x00: Local User I/F Inactive 0x80: Local User I/F Active	E	
50	OPERATOR_ACTION_ RECORD_4	R	Time Value	Date	N-R	8		none	
			Unsigned 8	Value	N-R	1	0x00: Local User I/F Inactive 0x80: Local User I/F Active	E	
51	OPERATOR_ACTION_ RECORD_5	R	Time Value	Date	N-R	8		none	
			Unsigned 8	Value	N-R	1	0x00: Local User I/F Inactive 0x80: Local User I/F Active	E	
52	OPERATOR_ACTION_ RECORD_6	R	Time Value	Date	N-R	8		none	
			Unsigned 8	Value	N-R	1	0x00: Local User I/F Inactive 0x80: Local User I/F Active	E	
53	OPERATOR_ACTION_ RECORD_7	R	Time Value	Date	N-R	8		none	
			Unsigned 8	Value	N-R	1	0x00: Local User I/F Inactive 0x80: Local User I/F Active	E	
54	OPERATOR_ACTION_ RECORD_8	R	Time Value	Date	N-R	8		none	
			Unsigned 8	Value	N-R	1	0x00: Local User I/F Inactive 0x80: Local User I/F Active	E	
55	OPERATOR_ACTION_ RECORD_9	R	Time Value	Date	N-R	8		none	
			Unsigned 8	Value	N-R	1	0x00: Local User I/F Inactive 0x80: Local User I/F Active	E	
56	OPERATOR_ACTION_ RECORD_10	R	Time Value	Date	N-R	8		none	
			Unsigned 8	Value	N-R	1	0x00: Local User I/F Inactive 0x80: Local User I/F Active	E	

Appendix H. Display Transducer Block Displayable Parameter List

Block	Profile Number	Parameter	Index	Range	Index
Press_TB	0x0158	PRIMARY_VALUE	15	PRIMARY_VALUE_RANGE	16
		SECONDARY_VALUE	34	SECONDARY_VALUE_RANGE	35
DiagTB	0x8016	PRESSURE_FREQUENCY_INDEX	16	PRESS_FREQ_IDX_RANGE	19
		STANDARD_DEVIATION	37	STD_DEVIATION_RANGE	41
AI	0x0101	OUT	8	OUT_SCALE	11
PID	0x0108	OUT	9	OUT_SCALE	11
		IN	15	PV_SCALE	10
		CAS_IN	18	PV_SCALE	10
		BKCAL_IN	27	OUT_SCALE	11
		BKCAL_OUT	31	PV_SCALE	10
		RCAS_IN	32	PV_SCALE	10
		ROUT_IN	33	OUT_SCALE	11
		RCAS_OUT	35	PV_SCALE	10
		ROUT_OUT	36	OUT_SCALE	11
		TRK_VAL	39	TRK_SCALE	37
		FF_VAL	40	FF_SCALE	41
IS	0x0126	OUT	7	OUT_RANGE	8
		IN_1	11	OUT_RANGE	8
		IN_2	12	OUT_RANGE	8
		IN_3	13	OUT_RANGE	8
		IN_4	14	OUT_RANGE	8
OS	0x011C	OUT_1	8	OUT_1_RANGE	10
		OUT_2	9	OUT_2_RANGE	11
		CAS_IN	14	No unit	×
		BKCAL_IN_1	19	OUT_1_RANGE	10
		BKCAL_IN_2	20	OUT_2_RANGE	11
		BKCAL_OUT	15	No unit	×
AR	0x0127	OUT	8	OUT_RANGE	11
		IN	14	PV_SCALE	10
		IN_LO	15	PV_SCALE	10
		IN1	16	PV_SCALE	10
		IN2	17	PV_SCALE	10
		IN3	18	PV_SCALE	10

Appendix J. Display Transducer Block Display Status List

Quality	Sub-status	Display string	Status detail
0: Bad	0	Bad_0	Non-specific
	1	Bad_1	Configuration Error
	2	Bad_2	Not Connected
	3	Bad_3	Device Failure
	4	Bad_4	Sensor Failure
	5	Bad_5	No Comm, with LUV
	6	Bad_6	No Comm, no LUV
	7	Bad_7	Out of Service
	8	Bad_8	Transducer in MAN
1: Uncertain	0	Unctn_0	Non-specific
	1	Unctn_1	Last Usable Value
	2	Unctn_2	Substitute / Manual Entry
	3	Unctn_3	Initial Value
	4	Unctn_4	Sensor Conversion not Accurate
	5	Unctn_5	Engineering Unit Range Violation
	6	Unctn_6	Sub-normal
	7	Unctn_7	Transducer in MAN
2: GOOD (NC)	0	GD-NC_0	Non-specific
	1	GD-NC_1	Active Block Alarm
	2	GD-NC_2	Active Advisory Alarm
	3	GD-NC_3	Active Critical Alarm
	4	GD-NC_4	Unack Block Alarm
	5	GD-NC_5	Unack Advisory Alarm
	6	GD-NC_6	Unack Critical Alarm
	8	GD-NC_8	Initial Fault State (IFS)
3: GOOD (C)	0	GD-C_0	Non-specific
	1	GD-C_1	Initialization Acknowledge
	2	GD-C_2	Initialization Request
	3	GD-C_3	Not Invited
	4	GD-C_4	Not Selected
	6	GD-C_6	Local Override
	7	GD-C_7	Fault State Active
	8	GD-C_8	Initial Fault State(IFS)

Appendix K. Display Transducer Block Display Status List

FD_xxx_ACTIVE Bit	Display number	Display string	Description
0	1	Check	Check Function Bit
1		Unused	
2		Unused	
3		Unused	
4		Unused	
5		Unused	
6		Unused	
7		Unused	
8	9	OOR Cnt	Out-of-Range Count Alarm
9	10	Std Dev	Standard Deviation Alarm
10	11	PressFq	Pressure Frequency Index Alarm
11		Unused	
12	13	Ex Span	Excess Span Amount of Zero Correction
13	14	Ex Zero	Excess Zero Amount of Zero Correction
14	15	NoCalib	Not Calibrated
15	16	SwcFail	External Zero Switch Failure
16		Unused	
17		Unused	
18		Unused	
19		Unused	
20		Unused	
21		Unused	
22	23	OvrLoad	Meter Body Overload or Failure
23	24	OvrTemp	Meter Body Over Temperature
24		Unused	
25		Unused	
26		Unused	
27	28	DB Fail	Invalid Database
28	29	MB Fail	Meter Body Failure
29		Unused	
30		Unused	
31	32	EM Fail	Electrical Module Failure

Appendix L. Display Transducer Block Display Status List

LCD-displayed string when UNIT_SELCTION_n is set to "Auto"

Unit Code	Unit String Displayed in LCD	Description
1000	K	Kelvin
1001	degC	degree Celsius
1002	degF	degree Fahrenheit
1003	degR	degree Rankine
1034	m3	cubic meter
1036	cm3	cubic centimeter
1038	L	liter
1048	gal	US gallon
1049	ImpGal	Imperial gallon
1051	bbl	barrel
1088	kg	kilogram
1089	g	gram
1092	t	metric ton
1094	lb	pound (mass)
1130	Pa	pascal
1131	GPa	gigapascal
1132	MPa	megapascal
1133	KPa	kilopascal
1134	mPa	milipascal
1135	uPa	micropascal
1136	hPa	hectopascal
1137	bar	bar
1138	mbar	millibar
1139	torr	torr
1140	atm	Atmospheres
1141	psi	pounds per square inch
1142	psia	pounds per square inch
1143	psig	pounds per square inch gauge
1144	gcm2	gram per square centimeter
1145	kgcm2	kilogram per square
1146	inH2O	inches of water
1147	inH2O4C	inches of water at 4°C
1148	inH2O68	inches of water at 68°F
1149	mmH2O	millimeters of water
1150	mmH2O4C	millimeters of water at 4°C
1151	mmH2O68	millimeters of water 68°F
1152	ftH2O	feet of water
1153	ftH2O4C	feet of water at 4°C
1154	ftH2O68	Feet of water at 68°F
1155	inHg	inches of mercury
1156	inHg_0C	inches of mercury at 0°C
1157	mmHg	millimeters of mercury

Unit Code	Unit String Displayed in LCD	Description
1158	mmHg_0C	millimeters of mercury
1318	g/s	gram per second
1319	g/m	gram per minute
1320	g/h	gram per hour
1321	g/d	gram per day
1322	kg/s	kilogram per second
1323	kg/m	kilogram per minute
1324	kg/h	kilogram per hour
1325	kg/d	kilogram per day
1326	t/s	metric ton per second
1327	t/m	metric ton per minute
1328	t/h	metric ton per hour
1329	t/d	metric ton per day
1330	lb/s	pound per second
1331	lb/m	pound per minute
1332	lb/h	pound per hour
1333	lb/d	pound per day
1334	STon/s	short ton per second
1335	STon/m	short ton per minute
1336	STon/h	short ton per hour
1337	STon/d	short ton per day
1338	LTon/s	long ton per second
1339	LTon/m	long ton per minute
1340	LTon/h	long ton per hour
1341	LTon/d	long ton per day
1342	%	percent
1347	m3/s	cubic meter per second
1348	m3/m	cubic meter per minute
1349	m3/h	cubic meter per hour
1350	m3/d	cubic meter per day
1351	L/s	liter per second
1352	L/m	liter per minute
1353	L/h	liter per hour
1354	L/d	liter per day
1355	ML/d	megaliter per day
1356	CFS	cubic feet per second
1357	CFM	cubic feet per minute
1358	CFH	cubic feet per hour
1359	ft3/d	cubic feet per day
1360	SCFM	standard cubic feet per minute
1361	SCFH	standard cubic feet per hour
1362	gal/s	US gallon per second
1363	GPM	US gallon per minute
1364	gal/h	US gallon per hour
1365	gal/d	US gallon per day

Unit Code	Unit String Displayed in LCD	Description
1366	Mgal/d	mega US gallon per day
1367	IpGal/s	Imperial gallon per second
1368	IpGal/m	Imperial gallon per minute
1369	IpGal/h	Imperial gallon per hour
1370	IpGal/d	Imperial gallon per day
1371	bbl/s	barrel per second
1372	bbl/m	barrel per minute
1373	bbl/h	barrel per hour
1374	bbl/d	barrel per day
1449	mgal/s	milli US gallon per second
1450	kgal/s	kilo US gallon per second
1451	Mgal/s	mega US gallon per second
1453	mgal/m	mili US gallon per minute
1454	kgal/m	kilo US gallon per minute
1455	Mgal/m	mega US gallon per minute
1457	mgal/h	mili US gallon per hour
1458	kgal/h	kilo US gallon per hour
1459	Mgal/h	mega US gallon per hour
1461	mgal/d	mili US gallon per day
1462	kgal/d	kilo US gallon per day
1463	Mgal/d	mega US gallon per day
1464	mIpGa/s	milli imperial gallon per
1465	kIpGa/s	kilo imperial gallon per
1466	MIpGa/s	mega imperial gallon per
1468	mIpGa/m	mili imperial gallon per day
1469	kIpGa/m	kilo imperial gallon per day
1470	MIpGa/m	mega imperial gallon per day
1472	mIpGa/h	mili imperial gallon per hour
1473	kIpGa/h	kilo imperial gallon per hour
1474	MIpGa/h	mega imperial gallon per hour
1476	mIpGa/d	mili imperial gallon per day
1477	kIpGa/d	kilo imperial gallon per day
1478	MIpGa/d	mega imperial gallon per day
1482	Mbbl/s	megabarrel per second
1486	Mbbl/m	megabarrel per minute
1490	Mbbl/h	megabarrel per hour
1494	Mbbl/d	megabarrel per day
1496	mm3/s	cubic millimeter per second
1497	km3/s	cubic kilometer per second
1498	Mm3/s	cubic megameter per second
1500	mm3/m	cubic millimeter per minute
1501	km3/m	cubic kilometer per minute
1502	Mm3/m	cubic megameter per minute
1504	mm3/h	cubic millimeter per hour
1505	km3/h	cubic kilometer per hour

Unit Code	Unit String Displayed in LCD	Description
1506	Mm3/h	cubic megameter per hour
1508	mm3/d	cubic millimeter per day
1509	km3/d	cubic kilometer per day
1510	Mm3/d	cubic megameter per day
1511	cm3/s	cubic centimeter per second
1512	cm3/m	cubic centimeter per minute
1513	cm3/h	cubic centimeter per hour
1514	cm3/d	cubic centimeter per day
1518	kL/m	kiloliter per minute
1519	kL/h	kiloliter per hour
1520	kL/d	kiloliter per day
1522	Nm3/s	Normal cubic meter per second
1523	Nm3/m	Normal cubic meter per minute
1524	Nm3/h	Normal cubic meter per hour
1525	Nm3/d	Normal cubic meter per day
1527	Sm3/s	Standard cubic meter per second
1528	Sm3/m	Standard cubic meter per minute
1529	Sm3/h	Standard cubic meter per hour
1530	Sm3/d	Standard cubic meter per day
1532	NL/s	Normal liter per second
1533	NL/m	Normal liter per minute
1534	NL/h	Normal liter per hour
1535	NL/d	Normal liter per day
1537	SL/s	Standard liter per second
1538	SL/m	Standard liter per minute
1539	SL/h	Standard liter per hour
1540	SL/d	Standard liter per day
1589	mL/m	milliliters per minute
1617	ML/h	megaliter per hour
1618	ML/m	megaliter per minute
1619	kL/s	kiloliter per second
1620	kft3/d	cubic kilofeet per day
1621	kCFH	cubic kilofeet per hour
1622	kCFM	cubic kilofeet per minute
1623	kCFS	cubic kilofeet per second
1624	mft3/d	cubic millifeet per day
1625	mCFH	cubic kilofeet per hour
1626	mCFM	cubic kilofeet per minute
1627	mCFS	cubic kilofeet per second
1648	kgal	kilogallon
1649	kImpGal	kilo-imperial gallon
1653	Mft3/d	cubic Megafeet per day
1654	Mm3/d	cubic Megameters per day

Appendix M. Diagnostics Transducer Block Parameter List

Index	Parameter Mnemonic	Obj Type	Data Type/Structure		Sub Parameter	Store -R/W	Size	Valid Range	Units	Mode
1	ST_REV	S	Unsigned 16			S-R	2	0≤X≤65535	none	
2	TAG_DESC	S	Octet String (32)			S-R/W	32		na	
3	STRATEGY	S	Unsigned 16			S-R/W	2		none	
4	ALERT_KEY	S	Unsigned 8			S-R/W	1	1 ≤ 255	none	
5	MODE_BLK	R		Bit String	Target	N-R/W	1	bit 3: Auto bit 4: Man bit 7: OOS	na	
				Bit String	Actual	D-R	1	bit 3: Auto bit 4: Man bit 7: OOS		
				Bit String	Permitted	S-R/W	1	bit 3: Auto bit 4: Man bit 7: OOS		
				Bit String	Normal	S-R/W	1	bit 3: Auto bit 4: Man bit 7: OOS		
6	BLOCK_ERR	S	Bit String (2)			D-R	2	bit 0: Other bit 1: Block Configuration Error bit 7: Sensor Failure detected by this block bit 15: Out-of-SERVICE	E	
7	UPDATE_EVT	R		Unsigned 8	Unacknowledged	D-R/W	1	(0: undefined) 1: Acknowedged 2: Unacknowledged	na	
				Unsigned 8	Update State	D-R	1	0: Undefined 1: Update reported 2: Updaate not reported		
				Time Value	Time Stamp	D-R	8			
				Unsigned 16	Static Revision	D-R	2			
				Unsigned 16	Relative Index	D-R	2			
8	BLOCK_ALM	R		Unsigned 8	Unacknowledged	D-R/W	1	(0: undefined) 1: Acknowedged 2: Unacknowledged	na	
				Unsigned 8	Alarm State	D-R	1	0: Undefined 1: Clear - reported 2: Clear - not reported 3: Active - reported 4: Active - not reported		
				Time Value	Time Stamp	D-R	8			
				Unsigned 16	Subcode	D-R	2			
				Unsigned 8	Value	D-R	1			
9	TRANSDUCER_ DIRECTORY	A	Unsigned 16 [1]			S-R	2		none	
10	TRANSDUCER_TYPE	S	Unsigned 16			S-R	2	100: Standard Pressure with Calibration	E	
11	TRANSDUCER_TYPE_ VER	S	Unsigned 16			N-R	2	0x0101	none	
12	XD_ERROR	S	Unsigned 8			D-R	1	19: Configuration error 20: Electronics Failure 22: I/O Failure 23: Data Integrity Error	E	
13	COLLECTION_ DIRECTORY	A	Unsigned 32 [1]			S-R	4		none	
14	BLOCK_ERR_DESC_1	S	Bit String (4)			D-R	4		E	
15	BLOCK_ERR_DESC_2	S	Bit String (4)			D-R	4		E	
16	PRESSURE_ FREQUENCY_INDEX	R		Unsigned 8	Status	D-R	1		PFIR*4	
				Float	Value	D-R	4	0.0≤X≤1.0		
17	PRESSURE_ FREQUENCY_INDEX_ MAX	S	Float			D-R		0.0≤X≤1.0	PFIR*4	
18	PRESSURE_ FREQUENCY_INDEX_ MIN	S	Float			D-R		0.0≤X≤1.0	PFIR*4	

Index	Parameter Mnemonic	Obj Type	Data Type/Structure	Sub Parameter	Store -R/W	Size	Valid Range	Units	Mode
19	PRESS_FREQ_IDX_RANGE	R	Float	EU at 100%	S-R	4	1.0	PFIR*4	
			Float	EU at 0%	S-R	4	0.0		
			Unsigned 16	Units Index	S-R	2	1615: Unitless		
			Integer 8	Decimal Point	S-R	1	4		
20	RESET_PRESSURE_FREQUENCY_INDEX	S	Unsigned 8		D-R/W	1	0: None 1: Reset	E	
21	PRESS_FREQ_CALC_PV_HI_LIMIT	S	Float		S-R/W	4	PRESS_FREQ_CALC_PV_HI_LIMIT ≠ PRESS_FREQ_CALC_PV_LO_LIMIT Note 1: |X| ≤ PRESS TB of SR.EU100×1.5 Note 1: PRESS_FREQ_CALC_PV_LO_LIMIT < PRESS_FREQ_CALC_PV_HI_LIMIT	PFCPU*2	OOS
22	PRESS_FREQ_CALC_PV_LO_LIMIT	S	Float		S-R/W	4	PRESS_FREQ_CALC_PV_HI_LIMIT ≠ PRESS_FREQ_CALC_PV_LO_LIMIT Note 1: |X| ≤ PRESS TB of SR.EU100×1.5 Note 1: PRESS_FREQ_CALC_PV_LO_LIMIT < PRESS_FREQ_CALC_PV_HI_LIMIT	PFCPU*2	OOS
23	PRESS_FREQ_CALC_PV_UNIT	S	Unsigned 16		S-R/W	2		PFCPU*2	OOS
24	PRESSURE_MEASUREMENT_TYPE	S	Unsigned 16		S-R	2	107: differential pressure 108: gauge pressure 109: absolute pressure	E	
25	PRESS_FREQ_IDX_SENSOR_SELECTION	S	Unsigned 8		S-R/W	1	When the PRESSURE_MEASUREMENT_TYPE is set to 107 {differential pressure}: 0: DP, 120 ms 1: DP, 240 ms 2: DP, 360 ms 10: SP, 360 ms For all other condition: 0: DP, 120 ms 1: DP, 240 ms 2: DP, 360 ms	E	OOS
26	PRESS_FREQ_FILTER_CONSTANT	S	Float		S-R/W	4	0.0≤X≤1.0	none	OOS
27	PRESS_FREQ_INDEX_ALARM_USE	S	Unsigned 8		S-R/W	1	0: Disabled 1: Enabled (High) 2: Enabled (Low) 3: Enabled (High and Low)	E	OOS
28	PRESS_FREQ_INDEX_HI_LIMIT	S	Float		S-R/W	4	0.0≤X≤1.0 PRESS_FREQ_INDEXHI_LIMIT ≠ PRESS_FREQ_INDEX_LO_LIMIT Note 1: PRESS_FREQ_INDEX_LO_LIMIT < PRESS_FREQ_INDEX_HI_LIMIT	PFIR*4	OOS
29	PRESS_FREQ_INDEX_LO_LIMIT	S	Float		S-R/W	4	0.0≤X≤1.0 PRESS_FREQ_INDEX_HI_LIMIT ≠ PRESS_FREQ_INDEX_LO_LIMIT Note 1: PRESS_FREQ_INDEX_LO_LIMIT < PRESS_FREQ_INDEX_HI_LIMIT	PFIR*4	OOS
30	OOR_PRESSURE_COUNT	S	Unsigned 32		N-R	4	0≤X≤100000	none	
31	RESET_OOR_PRESSURE_COUNT	S	Unsigned 8		D-R/W	1	0: None 1: Reset	E	
32	NORMAL_PRESSURE_HI_LIMIT	S	Float		S-R/W	4	NORMAL_PRESSURE_HI_LIMIT ≠ NORMAL_PRESSURE_LO_LIMIT Note 1: |X| ≤ PRESS TB of SR.EU100×1.5 Note 1: NORMAL_PRESSURE_LO_LIMIT < NORMAL_PRESSURE_HI_LIMIT	OCU*5	OOS
33	NORMAL_PRESSURE_LO_LIMIT	S	Float		S-R/W	4	NORMAL_PRESSURE_HI_LIMIT ≠ NORMAL_PRESSURE_LO_LIMIT Note 1: |X| ≤ PRESS TB of SR.EU100×1.5 Note 1: NORMAL_PRESSURE_LO_LIMIT < NORMAL_PRESSURE_HI_LIMIT	OCU*5	OOS

Index	Parameter Mnemonic	Obj Type	Data Type/Structure	Sub Parameter	Store -R/W	Size	Valid Range	Units	Mode
34	OOR_PRESSURE_UNIT	S	Unsigned 16		S-R/W	2		OCU*5	OOS
35	OOR_COUNT_ALARM_ USE	S	Unsigned 8		S-R/W	1	0: Disabled 1: Enabled	E	OOS
36	OOR_COUNT_ALARM_ THRESHOLD	S	Unsigned 32		S-R/W	4	1≤X≤100000	none	OOS
37	STANDARD_DEVIATION	R	Unsigned 8	Status	D-R	1		SDR*3	
			Float	Value	D-R	4			
38	STANDARD_ DEVIATION_MAX	S	Float		D-R	4		SDR*3	
39	STANDARD_ DEVIATION_MIN	S	Float		D-R	4		SDR*3	
40	AVERAGE_PRESSURE	S	Float		D-R	4		SDR*3	
41	STD_DEVIATION_ RANGE	R	Float	EU at 100%	S-R/W	4	EU at 100% ≠ EU at 0%	SDR*3	OOS
			Float	EU at 0%	S-R/W	4	EU at 100% ≠ EU at 0%		
			Unsigned 16	Units Index	S-R/W	2			
			Integer 8	Decimal Point	S-R/W	1	−128 to +127		
42	RESET_STANDARD_ DEVIATION	S	Unsigned 8		D-R/W	1	0: None 1: Reset	E	
43	STANDARD_ DEVIATION_SAMPLE_ COUNT	S	Unsigned 16		S-R/W	2	1000≤X≤60000	none	OOS
44	STANDARD_ DEVIATION_ALARM_ USE	S	Unsigned 8		S-R/W	1	0: Disabled 1: Enabled (High) 2: Enabled (Low) 3: Enabled (High and Low)	E	OOS
45	STANDARD_ DEVIATION_HI_LIMIT	S	Float		S-R/W	4	0 ≤ X STANDARD_DEVIATION_HI_ LIMIT ≠ STANDARD_DEVIATION_ LO_LIMIT Note 1: STANDARD_DEVIATION_ LO_LIMIT < STANDARD_ DEVIATION_HI_LIMIT	SDR*3	OOS
46	STANDARD_ DEVIATION_LO_LIMIT	S	Float		S-R/W	4	0 ≤ X STANDARD_DEVIATION_HI_ LIMIT ≠ STANDARD_DEVIATION_ LO_LIMIT Note 1: STANDARD_DEVIATION_ LO_LIMIT < STANDARD_ DEVIATION_HI_LIMIT	SDR*3	OOS
47	PRESS_FREQ_ CROSSOVER_VALUE	A	Unsigned 16[4]		D-R	8	0≤X≤255	none	

*1. If deferral checks are invalid, conduct a light check. If deferral checks are valid, do not conduct light check.
*2. Abbreviation of PRESS_FREQ_CALC_PV_UNIT
*3. Abbreviation of STANDARD_DEVIATION_RANGE
*4. Abbreviation of PRESSURE_FREQUENCY_INDEX_RANGE
*5. Abbreviation of OVERLOAD_COUNT_UNIT

Appendix N. Diagnosis of Connecting Pipe Clogging via Pressure Frequency Index

This appendix explains the abnormal assessment, setting method and operation verification method during the application of pressure frequency index to the connecting pipe clogging diagnosis. For general description of the pressure frequency index, please refer to 4-7-3, "Pressure Frequency Index."

Section N1 explains the principal behind the connecting pipe clogging diagnosis. Please read this first

Sections N2 through N4 describe the setting procedures for the diagnosis function per transmitter and application category.

- If measuring the pressure using a pressure gauge, please refer to Section N2.
- If measuring the differential pressure or the flow rate using the differential pressure gauge, please refer to section N3.
- If measuring the level, please refer to section N4.

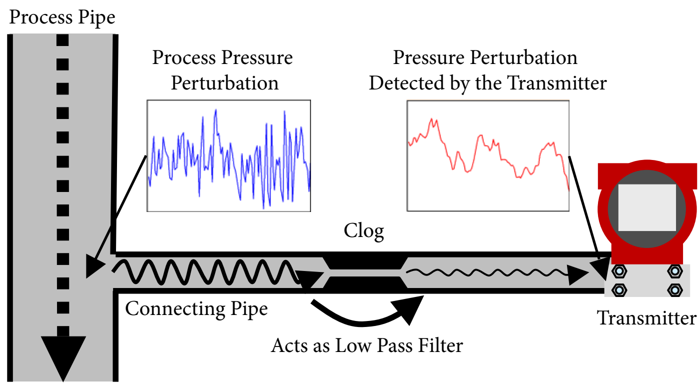
Section N5 is a supplement that explains the parameters related to the clog diagnosis.

N1. Principles

The pressure of fluid that is flowing is irregular and is frequently volatile. The pressure frequency index is an index of the frequency of detected volatility. Big index means that the volatility is high with large numbers of high frequencies. Small index means that the volatility is small, meaning that it fluctuates less, and that there aren't that many high frequencies relatively.

There are several causes of volatility. First of all, there is the perturbation of pressures generated from the current. This perturbation changes greatly based on the pressure and flow rate, but will always exist if there is flow. This perturbation is the most important factor in the connecting pipe clogging diagnosis. The pressure will also differ depending on pumps, compressors, agitators, etc. These variations may be useful for the clog diagnosis depending on its cycle and frequency.

Pressure perturbation is detected by the Differential Pressure and Gauge Pressure Transmitter through the connecting pipe. If the connecting pipe is normal, the process perturbation directly gets transmitted to the transmitter since there isn't anything obstructing the path. On the other hand, if the connecting pipe is clogged, the clog and piping system act as low pass filters against pressure perturbation. This is because the clog blocks the liquid's flow, so that the pressure on both ends of the clog cannot stay the same in a short amount of time. Therefore, even if the process pressure has high frequency perturbation, it becomes harder for it to get transmitted to the transmitter located on the other side.



The pressure frequency index is an index of the frequency of volatile movements of the pressure perturbation, and reflects the perturbation frequency. Therefore, the clogging of the connecting pipe acts as a low pass filter; if the high frequency components of the perturbation can be minimized, then the index value will also decrease. With this system, the clogging of connecting pipe is diagnosed according to the pressure frequency index.

However, if there are differential pressures, clogging diagnosis becomes more difficult, as the two pressure perturbation will be averaged out, but the principle still remains the same in the sense that the clogging of connecting pipe and the piping system acts as a low pass filter.

N2. Setting Method via Pressure Gauge

N2-1. Clog and Pressure Frequency Index

Pressure frequency index changes based on the clogging of the connecting pipe. Generally, the pressure frequency index gets smaller according to how the clog progresses. It normally doesn't get larger.

N2-2. Precautions on Clog Diagnosis

Please pay careful attention to the following precautionary notes when using the pressure frequency index for connecting pipe clog diagnosis.

Clog diagnosis cannot be conducted if the perturbation is extremely small, or if the perturbation frequency is low. This is because the pressure needs to include sufficient perturbation in order to calculate the pressure frequency index with high accuracy. The following is a list of specific examples.

- When there's no liquid flow or if the flow rate is extremely slow.
- When the liquid's viscosity is high.

Variation in pressure frequency index does not always mean that a clog exists. The index sometime changes due to factors other than the connecting pipe clog. the following is a list of examples of other index varying factors.

Changes in the operational conditions (turning on/off, number of units, rotational speed, etc.) such as pump, compressor, etc.

- Mixing bubbles inside the process pipes and connecting pipes
- Changes in the viscosity of process liquid
- Flow rate variation due to bulb hunting, etc

Furthermore, you can sometimes estimate whether the cause is the clogging or not by comparing both the pressure frequency index and standard deviation to the normal state. If standard deviation increased at the same time the pressure frequency index decreased, then there is high chance that the low-frequency perturbation increased due to factors other than the decrease in high frequency perturbation from clogging.

With the batch process, there are many instances of the pressure frequency index fluctuating depending on the procedure, operation and phase. Therefore, the index sometimes fluctuates violently due to factors other than the connecting pipe clog.

Depending on the substance causing the clog, index variation sometimes remains small even if it is actually clogged, and hence, the alarm does not get activated sometimes. Example: if clogging occurs from substances such as sand gravel, the pressure perturbation can be transmitted through its crevices, and hence, the index variation becomes small.

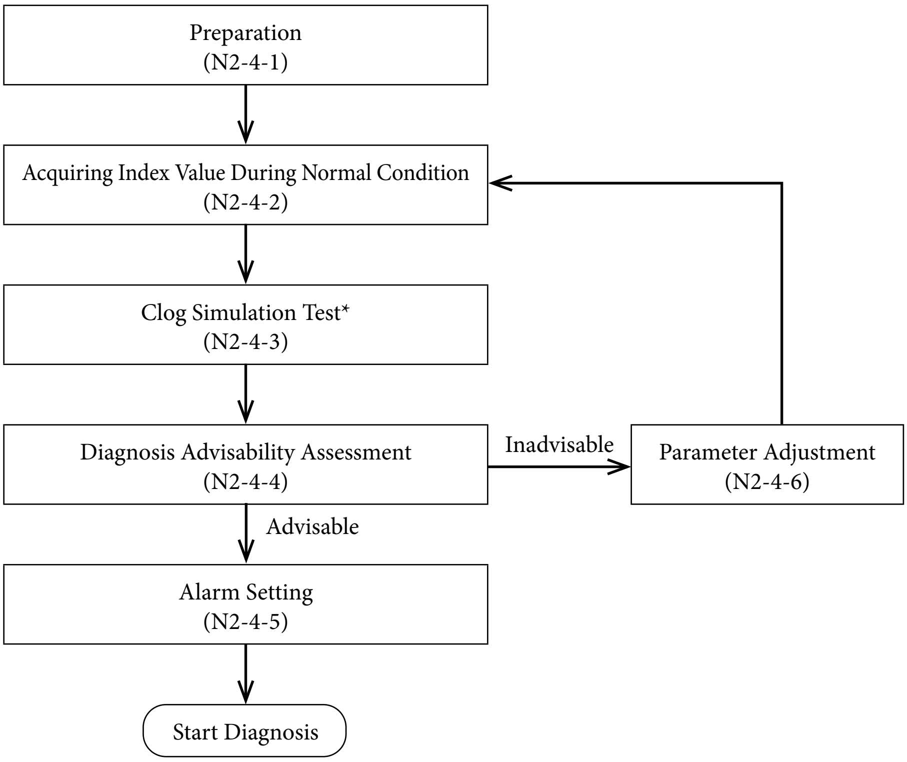
Clog diagnosis sometimes cannot be conducted when connecting pipe has been clogged from the beginning, or if there were already abnormalities in the pressure perturbation frequency from the very beginning. Please conduct the setting procedure (section N2-4) when the connecting pipe is in a normal condition.

Even if sudden clogging occurs, the pressure frequency index does not immediately change. This is because it requires few minutes to accurately calculate the pressure perturbation frequency.

Diagnosis sometimes cannot be conducted if the transmitter is placed in an environment with large vibrations, as it affects the pressure frequency index.

N2-3. Parameter Setting Procedure

To diagnose the clogging of the connecting pipes via the pressure frequency index, you must set the parameters first. The setting procedure is as follows:



Preparation (section N2-4-1)

Initialize the parameters, and prepare to collect the index values.

Acquiring Index Value during Normal State (section N2-4-2)

Acquire the index value, its minimum and maximum values during a normal state.

Clog Simulation (section N2-4-3)

Operate the connecting pipe valve to simulate a clogging state, and acquire its index value.

* If clog simulation test cannot be conducted, skip sections N2-4-3 to N2-4-6 and read section N2-4-7.

Diagnosis Advisability Assessment (section N2-4-4)

Determines whether a normal state and simulated clog state can be differentiated based on its index value.

Alarm Setting (section N2-4-5)

If it determines that a diagnosis is possible, adjust the following parameters and set the alarm based on the collected index values. The diagnosis will start after you complete the setting.

• PRESS_FREQ_INDEX_ALARM_USE	Operation Mode for the Pressure Frequency Index Diagnosis Alarm
• PRESS_FREQ_INDEX_LO_LIMIT	Low Limit of the Pressure Frequency Index (diagnosis alarm threshold (low side))

Parameter Adjustment (section N2-4-6)

If it cannot differentiate, analyze its cause and adjust the following parameters. After adjustment, acquire the index values during normal state again.

• PRESS_FREQ_IDX_SENSOR_SELECTION	Sensor Selection
• PRESS_FREQ_FILTER_CONSTANT	Pressure Frequency Filter Constant
• PRESS_FREQ_CALC_PV_HI_LIMIT	High Limit of Pressure Value Filter
• PRESS_FREQ_CALC_PV_LO_LIMIT	Low Limit of Pressure Value Filter

Refer to the following parameters and PV values during the procedures of acquiring the index values during normal state and clog simulation test.

• PRESSURE_FREQUENCY_INDEX	Pressure Frequency Index
• PRESSURE_FREQUENCY_INDEX_MAX	High Limit of Pressure Frequency Index
• PRESSURE_FREQUENCY_INDEX_MIN	Low Limit of Pressure Frequency Index
• STANDARD_DEVIATION	Standard Deviation
• STANDARD_DEVIATION_MAX	High Limit of Standard Deviation
• STANDARD_DEVIATION_MIN	Low Limit of Standard Deviation

Standard deviation is not directly used in the clog diagnosis, but as it is referential for parameter adjustment, it is recommended to calculate it at the same time as the pressure frequency index.

N2-4. Setting Procedure

This section sequentially explains each procedure of the setting.

N2-4-1. Preparation

Initialize the parameter before conducting setting.

Procedure
(1) Set Sensor Selection (PRESS_FREQ_IDX_SENSOR_SELECTION) to 0 (DP, 120 ms).
(2) Set pressure frequency filter constant (PRESS_FREQ_FILTER_CONSTANT) to 0.15.
(3) Set High Limit of pressure value filter (PRESS_FREQ_CALC_PV_HI_LIMIT) to URV.
(4) Set Low Limit of the pressure value filter (PRESS_FREQ_CALC_PV_LO_LIMIT) to LRV.
(5) Set the operation mode of the pressure frequency index diagnosis alarm (PRESS_FREQ_INDEX_ALARM_USE) to 0 (operation off).

N2-4-2. Acquiring Index Value During Normal State

Collect the index value at normal state when the connecting pipe is not clogged. The collected pressure frequency index and standard deviation are used to determine the advisability of diagnosis, or adjust the parameters later.

Procedure
(1) Check that the connecting pipe is in a normal state. If there are manifold valves, etc. in the connecting pipe, check to see if the pressure is measurable.
(2) Conduct the following: pressure frequency index clearing (set RESET_PRESSURE_FREQUENCY_INDEX to 1) and standard deviation and average value reset (set RESET_STANDARD_DEVIATION to 1). Furthermore, if you clear the pressure frequency index, the pressure frequency index (PRESSURE_FREQUENCY_INDEX), its lower range value (PRESSURE_FREQUENCY_INDEX_MIN) and upper range limit (PRESSURE_FREQUENCY_INDEX_MAX) cannot be accurately acquired for some time. After clearing, please wait until the first index calculation is completed.
(3) Please wait at least 30 minutes, if possible more than an hour during this stage.
(4) Collect and record the pressure frequency index, its min and upper range limits, and PV value.
(5) Collect and record the standard deviation (STANDARD_DEVIATION), its lower range value (STANDARD_DEVIATION_MIN) and upper range limit (STANDARD_DEVIATION_MAX) for reference.

If there are several operating conditions, conduct the aforementioned procedures on as many conditions as possible and collect its data. This is because the pressure frequency index value fluctuates depending on the operating condition, even during a normal state. By covering as much conditions as possible, you can more accurately determine diagnosis advisability and adjust the parameters.

N2-4-3. Clog Simulation Test

If there are valves such as the stop valves in the connecting pipe, you may conduct a clog simulation test using such valve. The collected pressure frequency index and standard deviation during clog simulation state are used to determine the advisability of diagnosis, or adjust the parameters later.

Warning
If you completely close the connecting pipe valve, the transmitter will no longer be able to measure values correctly. Furthermore, even if the valve is not completely closed off, it may extend the time until which the PV value gets updated to the pressure change (this is the same as when the damping time constant of the transmitter is increased). When conducting clog simulation test, please take sufficient precaution to not interfere with the safety and control of the process.

Procedure
(1) Operate the valve of the connecting pipe so that it is either completely closed, or open just slightly (open enough so that the fluid flows slightly).
(2) Conduct the following: pressure frequency index clearing (set RESET_PRESSURE_FREQUENCY_INDEX to 1) and standard deviation and average value reset (set RESET_STANDARD_DEVIATION to 1).
(3) Wait at least 20 minutes during at this state.
(4) Record the pressure frequency index (PRESSURE_FREQUENCY_INDEX), its lower range value (PRESSURE_FREQUENCY_INDEX_MIN), upper range limit (PRESSURE_FREQUENCY_INDEX_MAX) and PV value.
(5) Collect and record the standard deviation (STANDARD_DEVIATION), its lower range value (STANDARD_DEVIATION_MIN) and upper range limit (STANDARD_DEVIATION_MAX) for reference.
If there are several operating conditions, and the index value at normal state changes depending on the condition, we recommend conducting the aforementioned procedures at each condition.

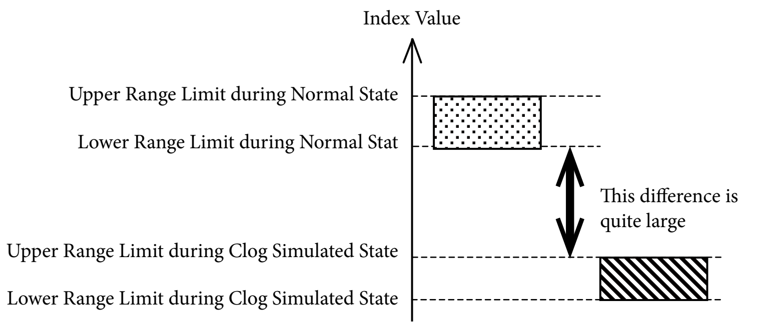
During the clog simulation test, it is necessary to sufficiently clog the connecting pipe valve. This is because the low pass filter effect from the clogging, as explained in the principle section, will not get generated if the flow resistance due to clogging (difficulty of the liquid to flow) is not sufficiently high.

N2-4-4. Diagnosis Advisability Assessment

This assesses whether a clog can be diagnosed from the index values, its min and upper range limits collected during normal state (section N2-4-2) and clog simulated condition (section N2-4-3).

<table>
<tr><th colspan="2">Decision Criteria</th></tr>
<tr><td>

- The upper range limit of the clog simulated state is smaller than the lower range value during normal state
- The difference between the lower range value at normal state and upper range limit at clog simulated state must be the same or greater than the difference between the lower range value and upper range limit at normal state.



</td><td>Diagnosis is advisable</td></tr>
<tr><td>

- If it does not satisfy the aforementioned criteria

</td><td>Diagnosis is not possible or is difficult</td></tr>
</table>

The minimum diagnosis requirement is that the upper range limit of the clog simulated state is smaller than the lower range value during normal state. If it doesn't satisfy this requirement, then it is deemed as inappropriate for diagnosis, because the clog simulated state value might be used as the index value, even if the connecting pipe is normal. Furthermore, if the normal state index value varies due to the operation condition, please conduct the assessment based on the condition at which the min index value is the smallest.

The larger the difference between the lower range value at normal state and upper range limit at simulated clog state, the diagnosis becomes easier. Hence, this value is important. The fact that this difference is the same or greater than the difference between the lower range value and upper range limit at normal state can be used as a criterion for assessing whether diagnosis is possible. On the other hand, if this difference is less than half of the difference between the lower range value and upper range limit at normal state, diagnosis would be difficult. This is because the index value may become close to that at the clogged state, even when the state is normal, which would mean that the differentiation between what is normal and abnormal can get difficult. This situation would also be deemed as inadequate for diagnosis.

If diagnosis is possible, move to section N2-4-5 and set the diagnosis alarm.

If it is deemed inadequate, move to section N2-4-6 and consider adjusting the parameters.

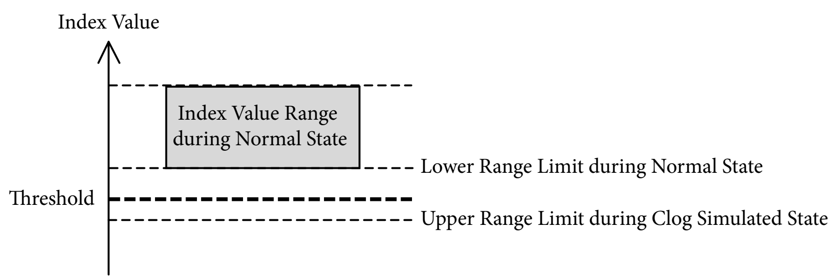
Caution The variation width of the pressure frequency index may get affected by the location of the clog. This effect becomes especially larger when the fluid is comprised of compressed liquid or gas. In this case, the closer the clogging is to the process side, the larger the variation width will be. Therefore, if the actual clog happened near the transmitter compared to the simulated occlusion site, then the changes in the index value sometimes remains small compared to the simulation test, or won't change at all. In addition, if the actual clog happened near the process rather than to the simulated occlusion site, then the index value sometimes changes more violently than that of the simulation test.

N2-4-5. Setting the Diagnosis Alarm

After the diagnosis advisability assessment is over, you will now set the alarm. Please omit this section if you do not want to activate the alarm.

Caution The procedures explained in this manual does not guarantee clog detection or false alarm prevention. The pressure frequency index varies due to factors other than clogging, and it depends on the degree of clogging and the clogging substance. Before setting the alarm, please understand that a threshold setting method that detects clogs 100% of the time without false alarms does not exist.

Let's first decide on the alarm threshold. The threshold is selected from values between the lower range value at normal state and upper range limit at clog simulated state. If threshold nears the lower range value at normal state, the alarm gets activated very fast, but the possibility of false alarm increases as well. Please set the threshold so that it is to some extent distant from the lower range value at normal state, so that there is a margin in between.



After determining the threshold, conduct the following procedure to start the diagnosis.

Procedure
(1) Conduct the Pressure Frequency Index Clear (set RESET_PRESSURE_FREQUENCY_INDEX to 1) operation.
(2) Set the lower range value (PRESS_FREQ_INDEX_LO_LIMIT) of the pressure frequency index to the threshold (lower range value) you defined
(3) Set the alarm operation mode (PRESS_FREQ_INDEX_ALARM_USE) for the pressure frequency index diagnosis to 2 (only for lower range value)

With this setting, the alarm gets activated when the index value goes out of the normal range and nears the value at clog simulated state.

N2-4-6. Parameter Adjustment

If diagnosis is determined be unsuitable, analyze the data collected at normal state (section N2-4-2) and at clog simulated state (section N2-4-3), and adjust the parameter.

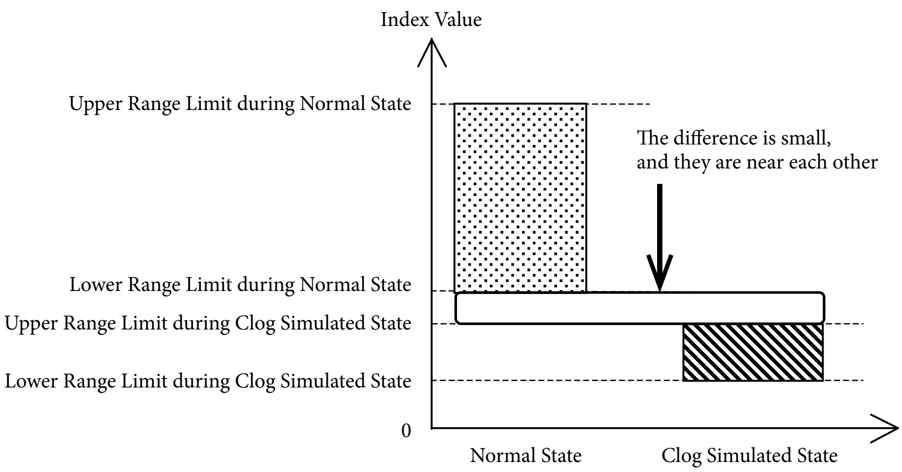
The reason why a diagnosis cannot be conducted is because the index value may decrease to the same level as that at a clogged state, even if the actual state is normal, which results in an inability to differentiate between a normal state and clogged state. There are two major reasons why this happens.

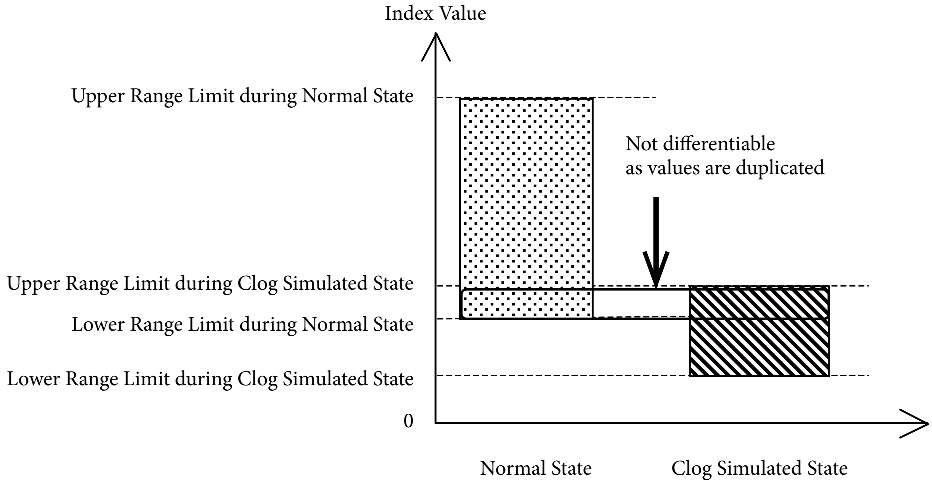
- The variation width of the index value at normal state is large
- The variation width of the index value at clogged state is small

This may be resolved by adjusting the parameter of the pressure frequency index diagnosis. The following explains the mechanism of each situation.

(A) When the variation width of the index value at normal state is large

This example, as in the following diagram, deals with a situation where the index value at clog simulated state becomes small, but the variation of index value at normal state becomes large, and this index value nears or becomes identical to the value at clog simulated state, even if it is not actually clogged.



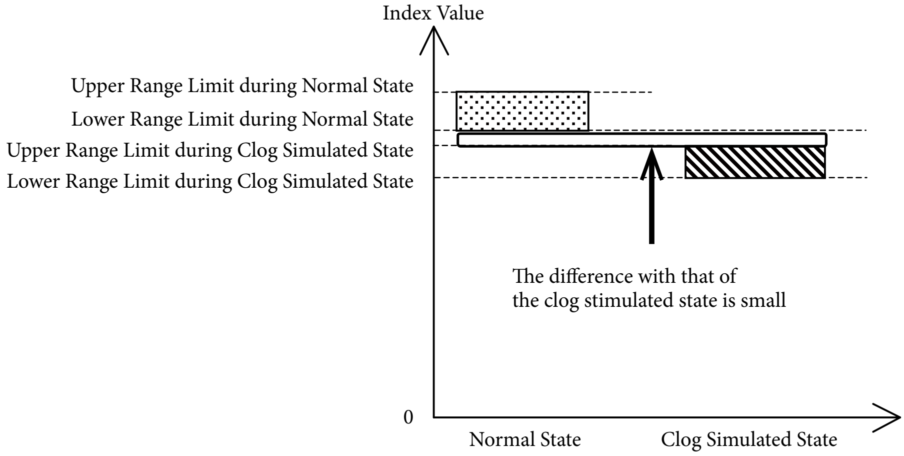


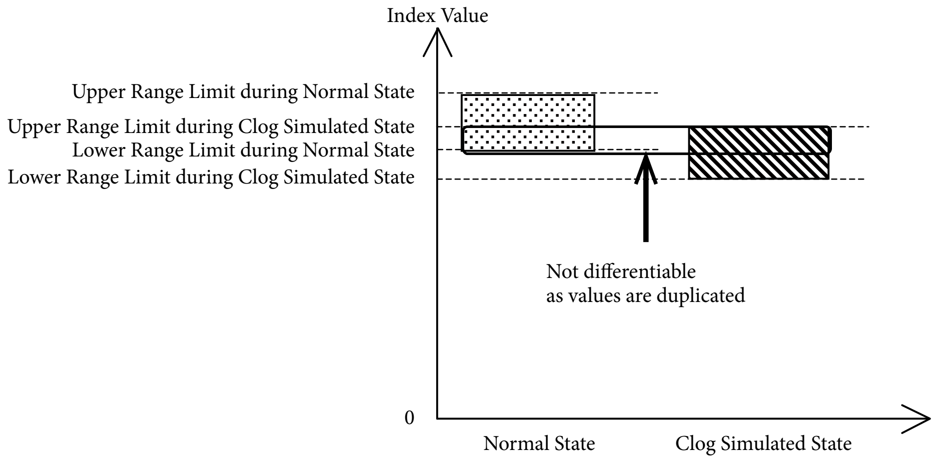
In this case, you must identify what is causing the large variation of the index value at normal state, and reduce such influence. The following will guide you through the adjustment.

Parameter Adjustment Guide	
Phenomenon	**Adjustment Method for Improvement**
It is at normal state, but the index value sometimes decreases significantly. During such, the PV value varies, or the standard deviation increases.	Gradually increase the pressure frequency filter constant (PRESS_FREQ_FILTER_CONSTANT) by 0.02 to 0.05 once at a time.
The index value at normal state greatly fluctuates depending on the operating condition.	Identify whether there's any relationship with the operation condition and the PV value. If there's any PV value range that makes the difference between max and min index values at normal state smaller, or PV value range that doesn't make the lower range value at normal state smaller, set that range up with the High Limit of Pressure Value Filter (PRESS_FREQ_CALC_PV_HI_LIMIT) and Lower Limit (PRESS_FREQ_CALC_PV_LO_LIMIT). If you use this parameter, you can conduct the diagnosis only when there's pressure, and stop the diagnosis when there is not.

(B) When the variation width of the index value at clogged state is small

This example, as in the following diagram, deals with a relatively small variation of the index value at normal state, but without much changes to the index value at clog simulated state.





In this case, it means that either the index values at normal state and clog state are at the same level, or that the index value does not change much even during the clog. In either case, you must identify the cause, and reduce such influence. The following will guide you through the adjustment.

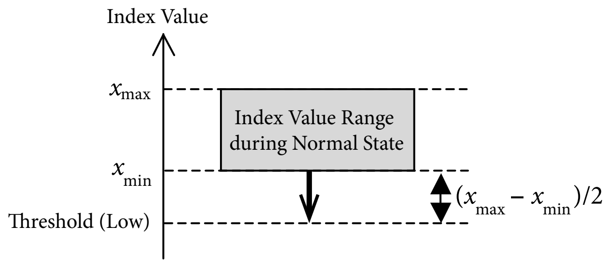
Parameter Adjustment Guide	
Phenomenon	**Adjustment Method for Improvement**
PV value is fluctuating, and low frequency pressure is always fluctuating, so hence, the index value is small even at normal state. The standard deviation is relatively large.	Gradually increase the pressure frequency filter constant (PRESS_FREQ_FILTER_CONSTANT) by 0.02 to 0.05 once at a time.
PV value is not fluctuating, and standard deviation is small. The frequency of the original pressure perturbation is low, and the index value is small (the average index value at normal state is less than 0.1). The liquid viscosity is high.	Modify the Sensor Selection (PRESS_FREQ_IDX_SENSOR_SELECTION). If the current value is 0 (DP, 120 ms), set it to 1 (DP, 240 ms). If the current value is 1 (DP, 240 ms), set it to 2 (DP, 360 ms).
No problems exist with the size and frequency of the original pressure perturbation (the average index value at normal state that is above 0.2). However, the values do not change at all even at clogged state.	Gradually decrease the pressure frequency filter constant (PRESS_FREQ_FILTER_CONSTANT) by 0.02 to 0.05 once at a time.

N2-4-7. If Clog Simulation Test Cannot be Conducted

If you cannot conduct the clog simulation test, you have to determine the threshold with only the index value data at normal state (index value collected in section N2-4-2).

If you were able to collect several index values, calculate its average value μ and standard deviation σ, and determine the threshold based on μ±nσ. If you wish to prevent false alarms as much as possible, we recommend setting n to between 4 and 6.

You may also set the threshold based on the upper range limit x_{max} and lower range value x_{min} of the index value. For example, as described in the following diagram, you may set the threshold by adding and subtracting $(x_{max}–x_{min})/2$ from the lower range value.



The threshold you determined from index value data at normal state alone is not guaranteed that it is appropriate. There are times when the index value reaches the threshold for other reasons beside a clog, or times when the index value does not reach the threshold even if a clog exists. After determining the threshold, observe any changes in the index value for a while, and verify whether it does not exceed the threshold even at normal state, and that there isn't a large difference between the normal value range and the threshold. If necessary, revise the threshold.

N3. Setting Using Differential Pressure Gauge

N3-1. Clog and Pressure Frequency Index

Pressure frequency index changes based on the clogging of the connecting pipe. The pressure frequency index may become smaller or bigger depending on how clogged the connecting pipe is. With the differential pressure measurement, there are two connecting pipes: one at the high pressure side and other at low pressure side. If both of them get clogged for certain period of time, the pressure frequency index gets smaller. However, the index might not get larger, or fluctuate drastically during the clogging process. The reasons for this are as follows.

Differential pressure measurement uses the differential pressure perturbation to calculate the pressure frequency index (except when the static pressure sensor is selected via Sensor Select). The differential pressure perturbation is expressed as a resultant value of the pressure perturbations at the high pressure side and low pressure side. Therefore, if there is an ingredient common to both of the perturbations, they both cancel each other out during normal state, resulting in the detected perturbation becoming smaller than than the original common ingredient. When the balance between these two perturbations fluctuates, the ingredient that has been canceling each other out during the normal state expands, which makes the perturbation greater than that at normal state. Therefore, if there is a difference between the clogging level at high pressure side and low pressure side (i.e. only one side is clogged), then the pressure frequency index sometimes get larger compared to that at the normal state. Furthermore, the index value might not fluctuate even when clogging occurs, which depends on the balance between the factors that are increasing the index, and those that are decreasing it. And if both connecting pipes get clogged above a certain point, the index value will ultimately get smaller as clogging progresses, as the factors decreasing the index will get stronger.

N3-2. Precautions on Clog Diagnosis

Please pay careful attention to the following precautionary notes when using the pressure frequency index for connecting pipe clog diagnosis.

Clog diagnosis cannot be conducted if the perturbation is extremely small, or if the perturbation frequency is low. This is because the pressure and differential pressure need to include sufficient perturbation in order to calculate the pressure frequency index with high accuracy. The following is a list of specific examples.

- When there's no liquid flow or if the flow rate is extremely slow.
- When the liquid's viscosity is high.

Variation in pressure frequency index does not always mean that a clog exists. The index sometime changes due to factors other than the connecting pipe clog. The following is a list of examples of other index varying factors.

- Changes in the operational conditions (turning on/off, number of units, rotational speed, etc.) such as pump, compressor, etc.
- Mixing bubbles inside the process pipes and connecting pipes
- Changes in the viscosity of process liquid
- Flow rate variation due to bulb hunting, etc

Furthermore, you can sometimes estimate whether the cause is the clogging or not by comparing both the pressure frequency index and standard deviation to the normal state. If standard deviation increased at the same time the pressure frequency index decreased, then there is high chance that the low-frequency perturbation increased due to factors other than the decrease in high frequency perturbation from clogging.

Whether the connecting pipe can detect whether only one of the sides is clogged or not depends on the fluid conditions, characteristics of the mechanism causing the differential pressure (orifice, etc.), and several other conditions. If you would like to determine the feasibility of detection beforehand, we strongly recommend verifying this beforehand by following the clog simulation test procedure outlined in section N3-4-3.

Depending on the substance causing the clog, index variation sometimes remains small even if it is actually clogged, and hence, the alarm does not get activated sometimes. Example: if clogging occurs from substances such as sand gravel, the pressure perturbation can be transmitted through its crevices, and hence, the index variation becomes small.

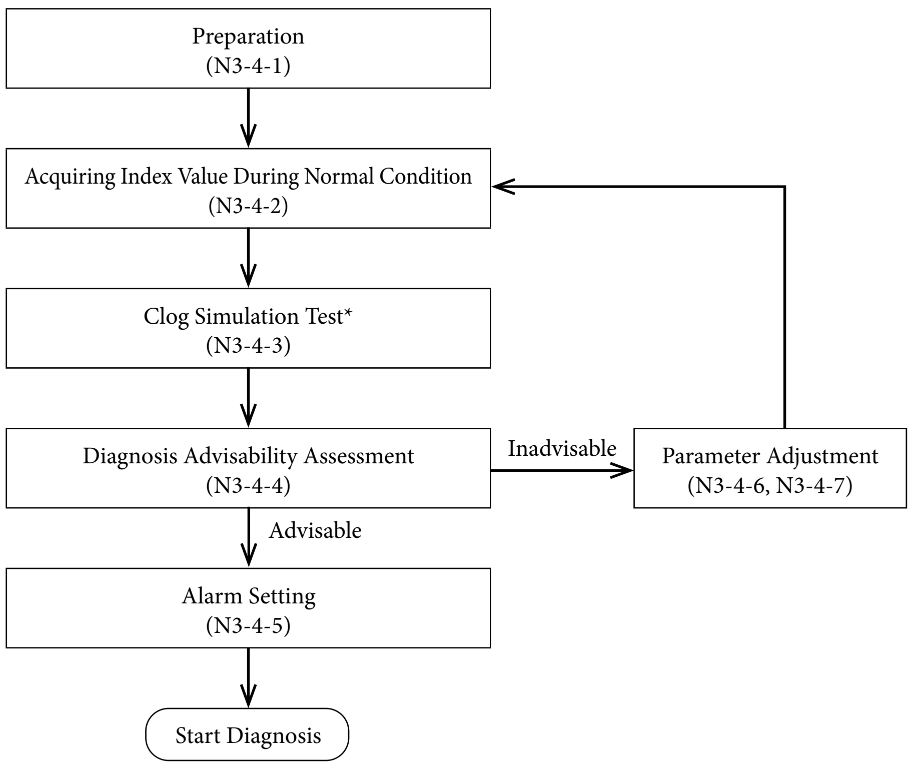
Clog diagnosis sometimes cannot be conducted when connecting pipe has been clogged from the beginning, or if there were already abnormalities in the pressure perturbation frequency from the very beginning. Please conduct the setting procedure (section N3-4) only when the connecting pipe is in a normal condition.

Even if sudden clogging occurs, the pressure frequency index does not immediately change. This is because it requires few minutes to accurately calculate the pressure perturbation frequency.

Diagnosis sometimes cannot be conducted if the transmitter is placed in an environment with large vibrations, as it affects the pressure frequency index.

N3-3. Parameter Setting Procedure

To diagnose the clogging of the connecting pipes via the pressure frequency index, you must set the parameters first. The setting procedure is as follows:



Preparation (section N3-4-1)

Initialize the parameters, and prepare to collect the index values.

Acquiring Index Value during Normal State (section N3-4-2)

Acquire the index value, its minimum and maximum values during a normal state.

Clog Simulation (section N3-4-3)

Operate the connecting pipe valve to simulate a clogging state, and acquire its index value. You will not conduct two simulation tests: one for when both sides are clog simulated (both the high pressure and low pressure sides), as well as test for when one side is clog simulated.

* If clog simulation test cannot be conducted, skip sections N3-4-3 to N3-4-7 and read section N3-4-8.

Diagnosis Advisability Assessment (section N3-4-4)

Determines whether a normal state and simulated clog state can be differentiated based on its index value.

Alarm Setting (section N3-4-5)

If it determines that a diagnosis is possible, adjust the following parameters and set the alarm based on the collected index values. The diagnosis will start after you complete the setting.

• PRESS_FREQ_INDEX_ALARM_USE	Operation Mode for the Pressure Frequency Index Diagnosis Alarm
• PRESS_FREQ_INDEX_LO_LIMIT	Low Limit of the Pressure Frequency Index (diagnosis alarm threshold (low side))
• PRESS_FREQ_INDEX_HI_LIMIT	High Limt of Pressure Frequency Index (threshold of the diagnosis alarm (high side))

Parameter Adjustment (section N3-4-6, N3-4-7)

If it cannot differentiate, analyze its cause and adjust the following parameters. After adjustment, acquire the index values during normal state again.

• PRESS_FREQ_IDX_SENSOR_SELECTION	Sensor Selection
• PRESS_FREQ_FILTER_CONSTANT	Pressure Frequency Filter Constant
• PRESS_FREQ_CALC_PV_HI_LIMIT	High Limit of Pressure Value Filter
• PRESS_FREQ_CALC_PV_LO_LIMIT	Low Limit of Pressure Value Filter

Refer to the following parameters and PV values during the procedures of acquiring the index values during normal state and clog simulation test.

• PRESSURE_FREQUENCY_INDEX	Pressure Frequency Index
• PRESSURE_FREQUENCY_INDEX_MAX	High Limit of Pressure Frequency Index
• PRESSURE_FREQUENCY_INDEX_MIN	Low Limit of Pressure Frequency Index
• STANDARD_DEVIATION	Standard Deviation
• STANDARD_DEVIATION_MAX	High Limit of Standard Deviation
• STANDARD_DEVIATION_MIN	Low Limit of Standard Deviation

Standard deviation is not directly used in the clog diagnosis, but as it is referential for parameter adjustment, it is recommended to calculate it at the same time as the pressure frequency index.

N3-4. Setting Procedure

This section sequentially explains each procedure of the setting.

N3-4-1. Preparation

Initialize the parameter before conducting setting.

Procedure
(1) Set Sensor Selection (PRESS_FREQ_IDX_SENSOR_SELECTION) to 0 (DP, 120 ms).
(2) Set pressure frequency filter constant (PRESS_FREQ_FILTER_CONSTANT) to 0.15.
(3) Set the High Limit of pressure value filter (PRESS_FREQ_CALC_PV_HI_LIMIT) to URV
(4) Set the Low Limit of the pressure value filter (PRESS_FREQ_CALC_PV_LO_LIMIT) to LRV
(5) Set the operation mode of the pressure frequency index diagnosis alarm (PRESS_FREQ_INDEX_ALARM_USE) to 0 (operation off).

N3-4-2. Acquiring Index Value During Normal State

Collect the index value at normal state when the connecting pipe is not clogged. The collected pressure frequency index and standard deviation are used to determine the advisability of diagnosis, or adjust the parameters later.

Procedure
(1) Check that the connecting pipe is in a normal state. If there are manifold valves, etc. in the connecting pipe, check to see if the pressure is measurable.
(2) Conduct the following: pressure frequency index clearing (set RESET_PRESSURE_FREQUENCY_INDEX to 1) and standard deviation and average value reset (set RESET_STANDARD_DEVIATION to 1). Furthermore, if you clear the pressure frequency index, the pressure frequency index (PRESSURE_FREQUENCY_INDEX), its lower range value (PRESSURE_FREQUENCY_INDEX_MIN) and upper range limit (PRESSURE_FREQUENCY_INDEX_MAX) cannot be accurately acquired for some time. After clearing, please wait until the first index calculation is completed.
(3) Please wait at least 30 minutes, if possible more than an hour during this stage.
(4) Collect and record the pressure frequency index (PRESSURE_FREQUENCY_INDEX), its lower range value (PRESSURE_FREQUENCY_INDEX_MIN), upper range limit (PRESSURE_FREQUENCY_INDEX_MAX) and PV value.
(5) Collect and record the standard deviation (STANDARD_DEVIATION), its lower range value (STANDARD_DEVIATION_MIN) and upper range limit (STANDARD_DEVIATION_MAX) for reference.

If there are several operating conditions, conduct the aforementioned procedures on as many conditions as possible and collect its data. This is because the pressure frequency index value fluctuates depending on the operating condition, even during a normal state. By covering as much conditions as possible, you can more accurately determine diagnosis advisability and adjust the parameters.

N3-4-3. Clog Simulation Test

If there are valves such as the manifold valves in the connecting pipe, you may conduct a clog simulation test using such valve. The collected pressure frequency index and standard deviation during clog simulation state are used to determine the advisability of diagnosis, or adjust the parameters later.

Three types of clog simulation test will be conducted. They include the following clog simulation tests: one that tests both sides by closing the valve at the high pressure and low pressure sides, as well as one that tests only one of the sides by closing the valve only for that side. For the single side clog simulation test, a test that closes the high pressure test, and an another that closes the low pressure side will be conducted.

Warning
If you completely close the connecting pipe valve, the transmitter will no longer be able to measure values correctly. Furthermore, even if the valve is not completely closed off, it may extend the time until which the PV value gets updated to the pressure change (this is the same as when the damping time constant of the transmitter is increased). When conducting clog simulation test, please take sufficient precaution to not interfere with the safety and control of the process.

Procedure

(1) Operate the valve of the connecting pipe so that it is either completely closed, or open just slightly (open enough so that the fluid flows slightly).

- Close the valves at both of the connecting pipes at the high pressure and low pressure side for the dual side simulation test.
- For single side clog simulation test (high pressure side), release the connecting pipe valve at the high pressure side, and close the one at the low pressure side.
- For single side clog simulation test (low pressure side), close the connecting pipe valve on the high pressure side, and release the one on the low pressures side.

(2) Conduct the following: pressure frequency index clearing (set RESET_PRESSURE_FREQUENCY_INDEX to 1) and standard deviation and average value reset (set RESET_STANDARD_DEVIATION to 1).

(3) Wait at least 20 minutes during at this state.

(4) Record the pressure frequency index (PRESSURE_FREQUENCY_INDEX), its lower range value (PRESSURE_FREQUENCY_INDEX_MIN), upper range limit (PRESSURE_FREQUENCY_INDEX_MAX) and PV value.

(5) Collect and record the standard deviation (STANDARD_DEVIATION), its lower range value (STANDARD_DEVIATION_MIN) and upper range limit (STANDARD_DEVIATION_MAX) for reference.

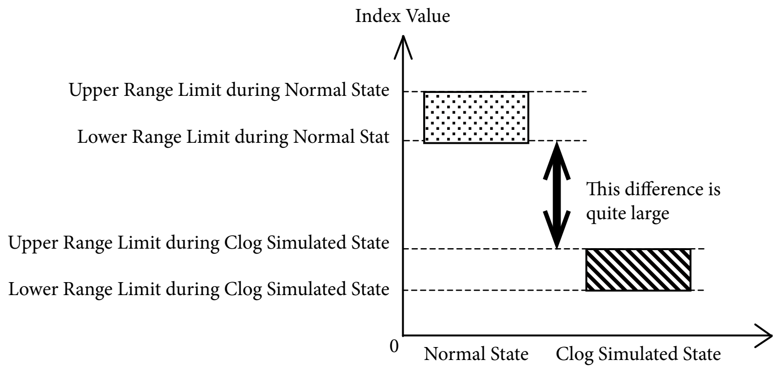
If there are several operating conditions, and the index value at normal state changes depending on the condition, we recommend conducting the aforementioned procedures at each condition.

During the clog simulation test, it is necessary to sufficiently clog the connecting pipe valve. This is because the low pass filter effect from the clogging, as explained in the principle section, will not get generated if the flow resistance due to clogging (difficulty of the liquid to flow) is not sufficiently high.

N3-4-4. Diagnosis Advisability Assessment

This assesses whether a clog can be diagnosed from the index values, its min and upper range limits collected during normal state (section N3-4-2) and clog simulated condition (section N3-4-3).

(A) Assessment of advisability of dual side diagnosis

Decision Criteria	
• The upper range limit of the clog simulated state is smaller than the lower range value during normal state • The difference between the lower range value at normal state and upper range limit at clog simulated state must be the same or greater than the difference between the lower range value and upper range limit at normal state. 	Diagnosis is advisable
• If it does not satisfy the aforementioned criteria	Diagnosis is not possible or is difficult

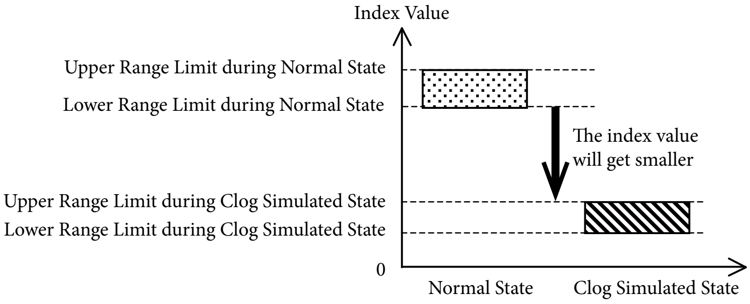
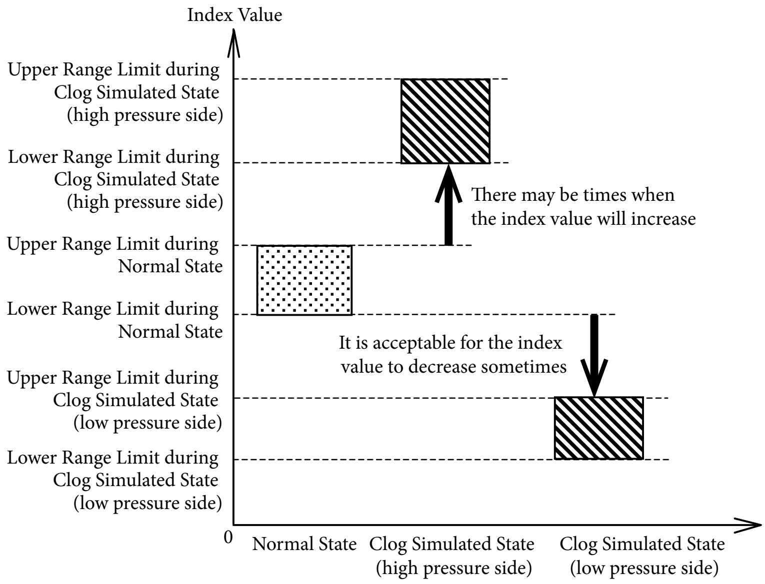
The minimum diagnosis requirement is that the upper range limit of the clog simulated state is smaller than the lower range value during normal state. If it doesn't satisfy this requirement, then it is deemed as inappropriate for diagnosis, because the clog simulated state value might be used as the index value, even if the connecting pipe is normal. Furthermore, if the normal state index value varies due to the operation condition, please conduct the assessment based on the condition at which the min index value is the smallest.

The larger the difference between the lower range value at normal state and upper range limit at simulated clog state, the diagnosis becomes easier. Hence, this value is important. The fact that this difference is the same or greater than the difference between the lower range value and upper range limit at normal state can be used as a criterion for assessing whether diagnosis is possible. On the other hand, if this difference is less than half of the difference between the lower range value and upper range limit at normal state, diagnosis would be difficult. This is because the index value may become close to that at the clogged state, even when the state is normal, which would mean that the differentiation between what is normal and abnormal can get difficult. This situation would also be deemed as inadequate for diagnosis.

If diagnosis is possible, assess advisability of single side diagnosis.

If it is deemed inadequate, move to section N3-4-6 and consider adjusting the parameters.

(B) Assessment of advisability of single side diagnosis

Decision Criteria	
• The upper range limit at the clog simulated state for either the high pressure or low pressure side is smaller than the lower range value at normal state • The difference between the lower range value at normal state and upper range limit at clog simulated state must be the same or greater than the difference between the lower range value and upper range limit at normal state. 	Diagnosis is advisable (Case A)
• The min index value for either the high pressure or low pressure side, or for both, during single side clog simulated state, is bigger than the upper range limit at the normal state. • The difference between the index values of the normal state and clog simulated state must be the same or greater than the difference between the lower range value and upper range limit at normal state. The following diagram is an example of such case. There may be times when the index value will increase no matter which one of them gets clogged. 	Diagnosis is advisable (Case B)
• If it does not satisfy the aforementioned criteria	Diagnosis is not possible or is difficult

If diagnosis is possible, move to section N3-4-5 and set the diagnosis alarm.

If only the single side clogging is deemed as unsuitable for diagnosis, you must either refer to section N3-4-7 and adjust the setting to make it easier to detect single sided clogs, or if you wish to only diagnose dual side clogging, set the diagnosis alarm described in section N3-4-5.

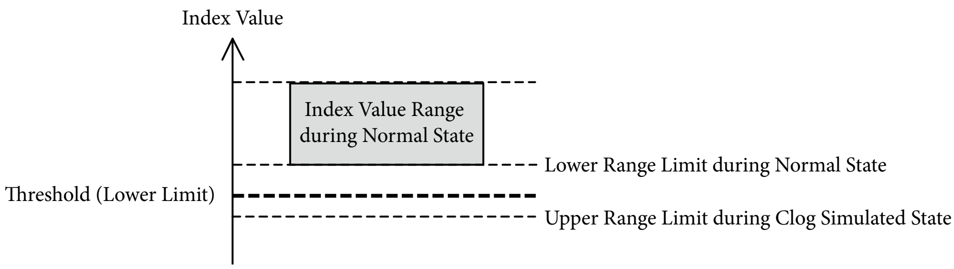
N3-4-5. Setting the Diagnosis Alarm

After the diagnosis advisability assessment is over, you will now set the alarm. Please omit this section if you do not want to activate the alarm.

Caution The procedures explained in this manual does not guarantee clog detection or false alarm prevention. The pressure frequency index varies due to factors other than clogging, and it depends on the degree of clogging and the clogging substance. Before setting the alarm, please understand that a threshold setting method that detects clogs 100% of the time without false alarms does not exist.

(A) If you are diagnosing only dual side clogging, or if your situation was deemed as Case A in section N3-4-4

Let's first decide on the alarm threshold. You are to decide only the lower range value. The threshold is selected from values between the lower range value at normal state and upper range limit at clog simulated state. If threshold nears the lower range value at normal state, the alarm gets activated very fast, but the possibility of false alarm increases as well. Please set the threshold so that it is to some extent distant from the lower range value at normal state, so that there is a margin in between.



After determining the threshold, conduct the following procedure to start the diagnosis.

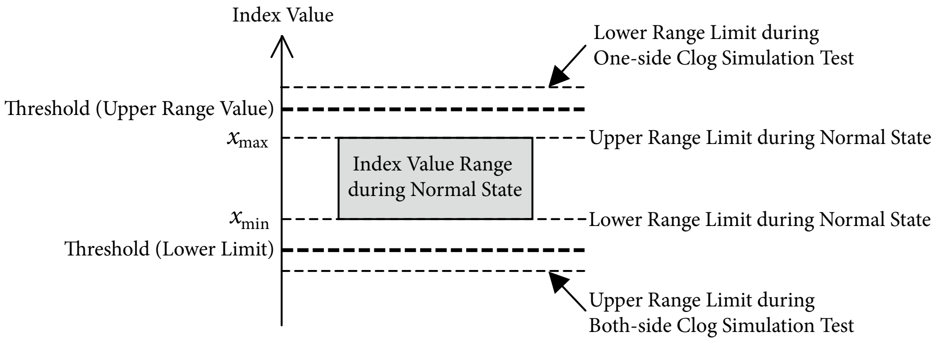
Procedure
(1) Conduct the Pressure Frequency Index Clear (set RESET_PRESSURE_FREQUENCY_INDEX to 1) operation.
(2) Set the lower range value (PRESS_FREQ_INDEX_LO_LIMIT) of the pressure frequency index to the threshold (lower range value) you defined
(3) Set the alarm operation mode (PRESS_FREQ_INDEX_ALARM_USE) for the pressure frequency index diagnosis to 2 (only for lower range value)

With this setting, the alarm gets activated when the index value goes out of the normal range and nears the value at clog simulated state.

(B) If your situation was determined to be Case B in section N3-4-4

Let's first decide on both the upper and lower range values of the alarm threshold. The threshold (Upper Range Value) will be set to a number between the upper range limit at normal state, and lower range value of index value at single side clog simulation state for the side in which the index value had risen. The threshold (lower range value) is set to a value that is between the lower range value at normal state and upper range limit at dual side clog simulated state.

If threshold nears the max or lower range value at normal state, the alarm gets activated very fast, but the possibility of false alarm increases as well. Please set the threshold so that it is to some extent distant from the max or lower range value at normal state, so that there is a margin in between.



After determining the threshold, conduct the following procedure to start the diagnosis.

Procedure
(1) Conduct the Pressure Frequency Index Clear (set RESET_PRESSURE_FREQUENCY_INDEX to 1) operation.
(2) Set the lower range value (PRESS_FREQ_INDEX_LO_LIMIT) of the pressure frequency index to the threshold (lower range value) you defined
(3) Set the Upper Range Value (PRESS_FREQ_INDEX_HI_LIMIT) of the pressure frequency index to the threshold (Upper Range Value) you defined
(4) Set the alarm operation mode (PRESS_FREQ_INDEX_ALARM_USE) for the pressure frequency index diagnosis to 3 (for upper and lower range value)

With this setting, the alarm gets activated when the index value goes out of the normal range and nears the value at clog simulated state.

N3-4-6. Parameter Adjustment (for dual side clog diagnosis)

If dual side diagnosis is determined be unsuitable, analyze the data collected at normal state (section N3-4-2) and at clog simulated state (section N3-4-3), and adjust the parameter.

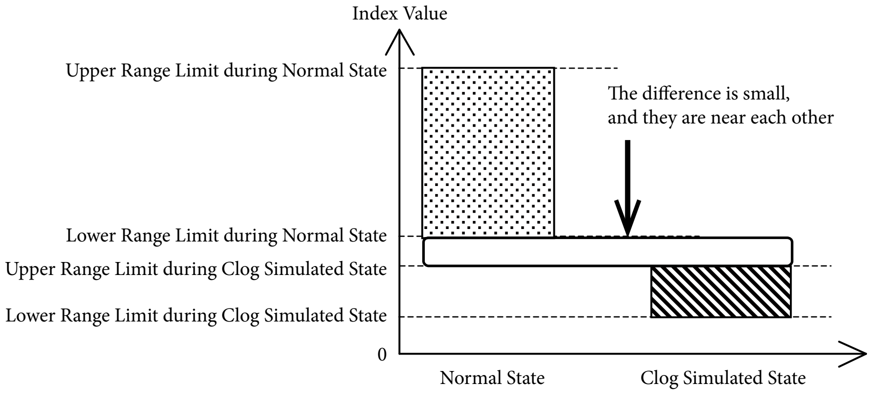
The reason why a diagnosis cannot be conducted is because the index value may decrease to the same level as that at a clogged state, even if the actual state is normal, which results in an inability to differentiate between a normal state and clogged state. There are two major reasons why this happens.

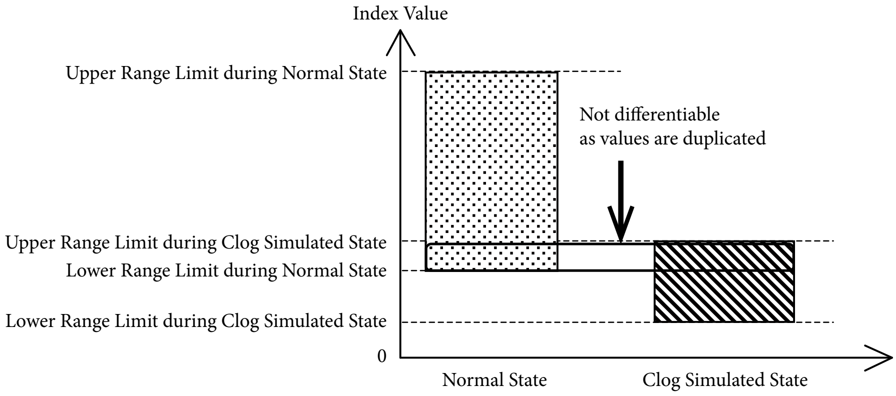
- The variation width of the index value at normal state is large
- The variation width of the index value at clogged state is small

This may be resolved by adjusting the parameter of the pressure frequency index diagnosis. The following explains the mechanism of each situation.

(A) When the variation width of the index value at normal state is large

This example, as in the following diagram, deals with a situation where the index value at clog simulated state becomes small, but the variation of index value at normal state becomes large, and this index value nears or becomes identical to the value at clog simulated state, even if it is not actually clogged.



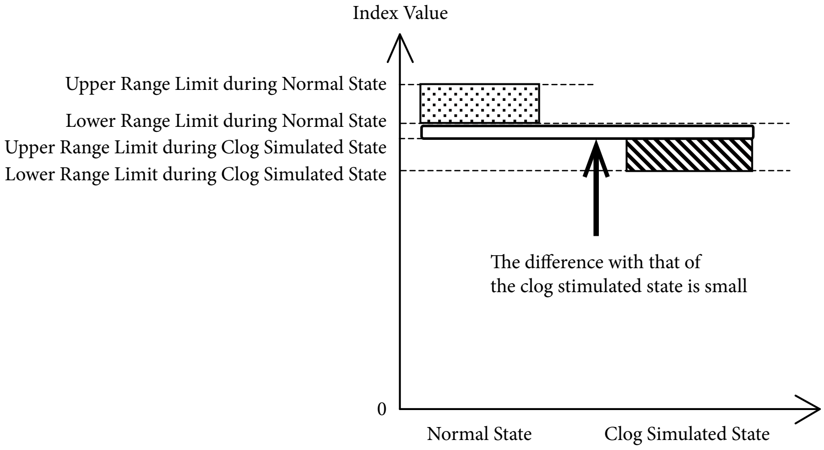


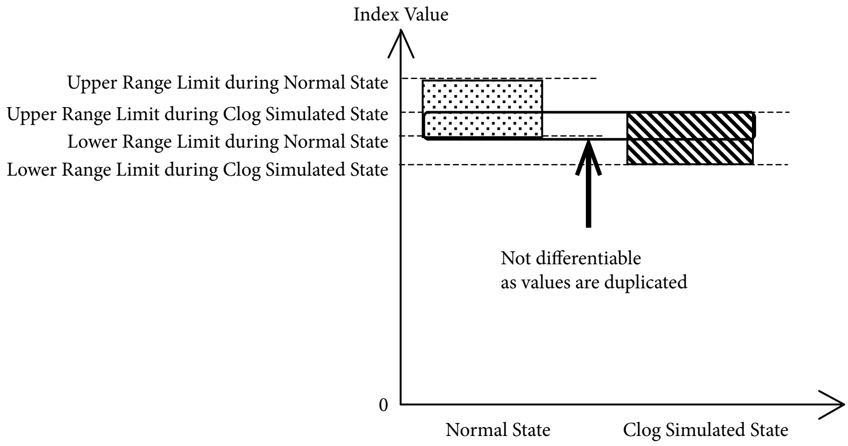
In this case, you must identify what is causing the large variation of the index value at normal state, and reduce such influence. The following will guide you through the adjustment.

Parameter Adjustment Guide	
Phenomenon	Adjustment Method for Improvement
It is at normal state, but the index value sometimes decreases significantly. During such, the PV value varies, or the standard deviation increases.	Gradually increase the pressure frequency filter constant (PRESS_FREQ_FILTER_CONSTANT) by 0.02 to 0.05 once at a time.
The index value at normal state greatly fluctuates depending on the operating condition.	Identify whether there's any relationship with the operation condition and the PV value. If there's any PV value range that makes the difference between max and min index values at normal state smaller, or PV value range that doesn't make the lower range value at normal state smaller, set that range up with the High Limit of Pressure Value Filter (PRESS_FREQ_CALC_PV_HI_LIMIT) and Low Limit (PRESS_FREQ_CALC_PV_LO_LIMIT). This parameter will enable you to diagnose only when there's flow, and stop diagnose when the flow stops, which makes it possible to conduct stable diagnosis even when the liquid flows intermittently.

(B) When the variation width of the index value at clogged state is small

This example, as in the following diagram, deals with a relatively small variation of the index value at normal state, but without much changes to the index value at clog simulated state.





In this case, it means that either the index values at normal state and clog state are at the same level, or that the index value does not change much even during the clog. In either case, you must identify the cause, and reduce such influence. The following will guide you through the adjustment.

Parameter Adjustment Guide	
Phenomenon	Adjustment Method for Improvement
PV value is fluctuating, and low frequency pressure is always fluctuating, so hence, the index value is small even at normal state. The standard deviation is relatively large.	Gradually increase the pressure frequency filter constant (PRESS_FREQ_FILTER_CONSTANT) by 0.02 to 0.05 once at a time.
PV value is not fluctuating, and standard deviation is small. The frequency of the original pressure perturbation is low, and the index value is small (the average index value at normal state is less than 0.1). The liquid viscosity is high.	Modify the Sensor Selection (PRESS_FREQ_IDX_SENSOR_SELECTION). If the current value is 0 (DP, 120 ms), set it to 1 (DP, 240 ms). If the current value is 1 (DP, 240 ms), set it to 2 (DP, 360 ms). Note: This adjustment is possible only when DP is selected at Sensor Select.
No problems exist with the size and frequency of the original pressure perturbation (the average index value at normal state that is above 0.2). However, the values do not change at all even at clogged state.	Gradually decrease the pressure frequency filter constant (PRESS_FREQ_FILTER_CONSTANT) by 0.02 to 0.05 once at a time.

N3-4-7. Parameter Adjustment (for single side clog diagnosis)

If you can only diagnose dual side clogs and not single side clogs, you may be able to fix this by changing the Sensor Select (PRESS_FREQ_IDX_SENSOR_SELECTION) to “SP, 360 ms.” Furthermore, if you conduct this change, the dual side clog diagnostic performance will go down. In addition, changing it doesn’t guarantee that single side clog can be accurately diagnosed. Please make this change under full understanding of this.

If you had changed this, go back to section N3-4-1 and repeat the procedures on acquiring the index value at normal state. You won’t be able to use any data acquired up to this point, so please follow the procedures in sections N3-4-1 to N3-4-4 beforehand to collect the data.

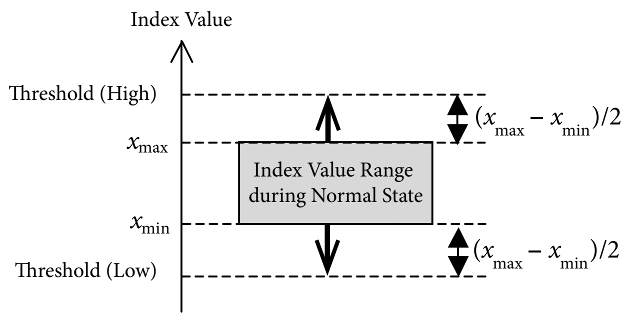
If you can’t diagnose dual side clogs after the change, and the advisability of single side clog diagnosis hasn’t changed, revert back to the original setting. Please also refer to section N3-4-5 and set the diagnosis alarm as if to diagnose only dual side clogs.

N3-4-8. If Clog Simulation Test Cannot be Conducted

If you cannot conduct the clog simulation test, you have to determine the threshold with only the index value data at normal state (index value collected in section N3-4-2).

If you were able to collect several index values, calculate its average value μ and standard deviation σ, and determine the threshold based on μ±nσ. If you wish to prevent false alarms as much as possible, we recommend setting n to between 4 and 6.

You may also set the threshold based on the upper range limit x_{max} and lower range value x_{min} of the index value. For example, as described in the following diagram, you may set the threshold by adding and subtracting $(x_{max}-x_{min})/2$ from the lower range value.



The threshold you determined from index value data at normal state alone is not guaranteed that it is appropriate. There are times when the index value reaches the threshold for other reasons beside a clog, or times when the index value does not reach the threshold even if a clog exists. After determining the threshold, observe any changes in the index value for a while, and verify whether it does not exceed the threshold even at normal state, and that there isn’t a large difference between the normal value range and the threshold. If necessary, revise the threshold.

If you had not conducted a clog simulation test, it is difficult to predict the behavior of the index value during a single side clog. Therefore, clog diagnosis will sometimes be useless even after setting the threshold with the Upper Range Value of Pressure Frequency Index (PRESS_FREQ_INDEX_HI_LIMIT).

N4. Setting with a Level Meter

N4-1. Clog and Pressure Frequency Index

Pressure frequency index changes based on the clogging of the connecting pipe. Generally, the pressure frequency index gets smaller according to how the clog progresses. It normally doesn't get larger.

N4-2. Precautions on Clog Diagnosis

Please pay careful attention to the following precautionary notes when using the pressure frequency index for connecting pipe clog diagnosis.

Clog diagnosis cannot be conducted if the perturbation is extremely small, or if the perturbation frequency is low. This is because the pressure and differential pressure need to include sufficient perturbation in order to calculate the pressure frequency index with high accuracy. The following is a list of specific examples.

- When there's no liquid flow or if the flow rate is extremely slow.
- When the liquid's viscosity is high.
- If there's no source of perturbation due to absence of inflow into or outflow out of the tank, or that it has not been agitated yet, etc.

Variation in pressure frequency index does not always mean that a clog exists. The index sometime changes due to factors other than the connecting pipe clog. The following is a list of examples of other index varying factors.

- Changes in the operational conditions (turning on/off, number of units, rotational speed, etc.) such as pump, compressor, agitators, etc.
- Changes in the viscosity of process liquid

Depending on the substance causing the clog, index variation sometimes remains small even if it is actually clogged, and hence, the alarm does not get activated sometimes. Example: if clogging occurs from substances such as sand gravel, the pressure perturbation can be transmitted through its crevices, and hence, the index variation becomes small.

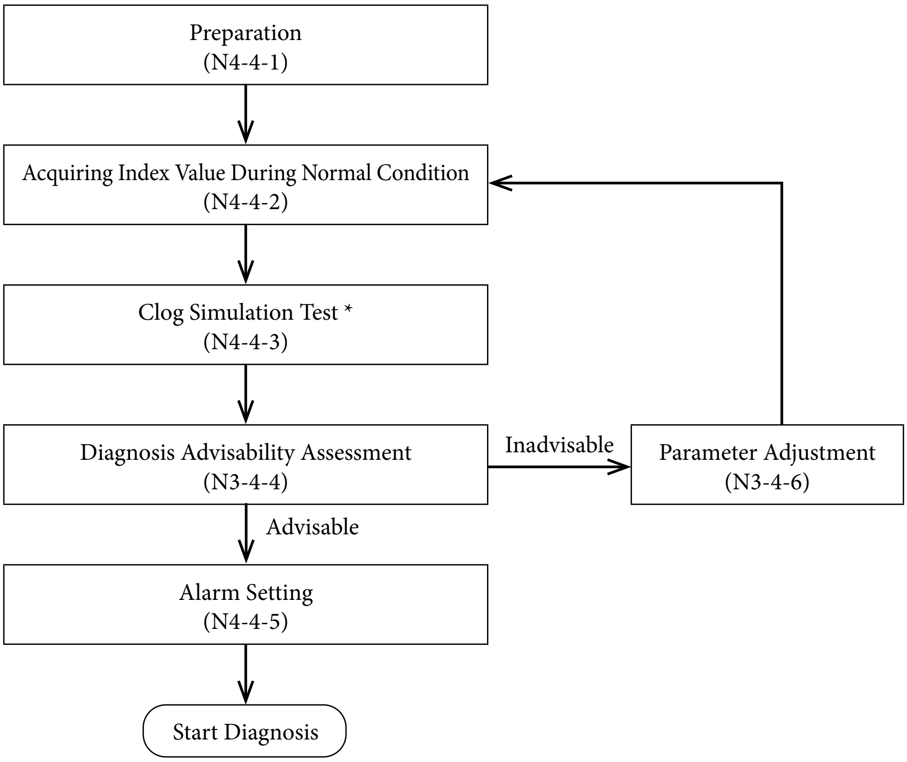
Clog diagnosis sometimes cannot be conducted when connecting pipe has been clogged from the beginning, or if there were already abnormalities in the pressure perturbation frequency from the very beginning. Please conduct the setting procedure (section N4-4) only when the connecting pipe is in a normal condition.

Even if sudden clogging occurs, the pressure frequency index does not immediately change. This is because it requires few minutes to accurately calculate the pressure perturbation frequency.

Diagnosis sometimes cannot be conducted if the transmitter is placed in an environment with large vibrations, as it affects the pressure frequency index.

N4-3. Parameter Setting Procedure

To diagnose the clogging of the connecting pipes via the pressure frequency index, you must set the parameters first. The setting procedure is as follows:



Preparation (section N4-4-1)

Initialize the parameters, and prepare to collect the index values.

Acquiring Index Value during Normal State (section N4-4-2)

Acquire the index value, its minimum and maximum values during a normal state.

Clog Simulation (section N4-4-3)

Operate the connecting pipe valve to simulate a clogging state, and acquire its index value.

* If clog simulation test cannot be conducted, skip sections N4-4-3 to N4-4-6 and read section N4-4-7.

Diagnosis Advisability Assessment (section N4-4-4)

Determines whether a normal state and simulated clog state can be differentiated based on its index value.

Alarm Setting (section N4-4-5)

If it determines that a diagnosis is possible, adjust the following parameters and set the alarm based on the collected index values. The diagnosis will start after you complete the setting.

- PRESS_FREQ_INDEX_ALARM_USE — Operation Mode for the Pressure Frequency Index Diagnosis Alarm
- PRESS_FREQ_INDEX_LO_LIMIT — Low Limit of the Pressure Frequency Index (diagnosis alarm threshold (low side))

Parameter Adjustment (section N4-4-6)

If it cannot differentiate, analyze its cause and adjust the following parameters. After adjustment, acquire the index values during normal state again.

- PRESS_FREQ_IDX_SENSOR_SELECTION Sensor Selection
- PRESS_FREQ_FILTER_CONSTANT Pressure Frequency Filter Constant
- PRESS_FREQ_CALC_PV_HI_LIMIT High Limit of Pressure Value Filter
- PRESS_FREQ_CALC_PV_LO_LIMIT Low Limit of Pressure Value Filter

Refer to the following parameters and PV values during the procedures of acquiring the index values during normal state and clog simulation test.

- PRESSURE_FREQUENCY_INDEX Pressure Frequency Index
- PRESSURE_FREQUENCY_INDEX_MAX High Limit of Pressure Frequency Index
- PRESSURE_FREQUENCY_INDEX_MIN Low Limit of Pressure Frequency Index
- STANDARD_DEVIATION Standard Deviation
- STANDARD_DEVIATION_MAX High Limit of Standard Deviation
- STANDARD_DEVIATION_MIN Low Limit of Standard Deviation

Standard deviation is not directly used in the clog diagnosis, but as it is referential for parameter adjustment, it is recommended to calculate it at the same time as the pressure frequency index.

N4-4. Setting Procedure

This section sequentially explains each procedure of the setting.

N4-4-1. Preparation

Initialize the parameter before conducting setting.

Procedure
(1) Set Sensor Selection (PRESS_FREQ_IDX_SENSOR_SELECTION) to 0 (DP, 120 ms). (2) Set pressure frequency filter constant (PRESS_FREQ_FILTER_CONSTANT) to 0.15. (3) Set the High Limit of pressure value filter (PRESS_FREQ_CALC_PV_HI_LIMIT) to URV (4) Set the Low Limit of the pressure value filter (PRESS_FREQ_CALC_PV_LO_LIMIT) to LRV (5) Set the operation mode of the pressure frequency index diagnosis alarm (PRESS_FREQ_INDEX_ALARM_USE) to 0 (operation off).

N4-4-2. Acquiring Index Value During Normal State

Collect the index value at normal state when the connecting pipe is not clogged. The collected pressure frequency index and standard deviation are used to determine the advisability of diagnosis, or adjust the parameters later.

Procedure
(1) Check that the connecting pipe is in a normal state. If there are manifold valves, etc. in the connecting pipe, check to see if the pressure is measurable. (2) Conduct the following: pressure frequency index clearing (set RESET_PRESSURE_FREQUENCY_INDEX to 1) and standard deviation and average value reset (set RESET_STANDARD_DEVIATION to 1). Furthermore, if you clear the pressure frequency index, the pressure frequency index (PRESSURE_FREQUENCY_INDEX), its Low Limit (PRESSURE_FREQUENCY_INDEX_MIN) and High Limit (PRESSURE_FREQUENCY_INDEX_MAX) cannot be accurately acquired for some time. After clearing, please wait until the first index calculation is completed. (3) Please wait at least 30 minutes, if possible more than an hour during this stage. (4) Collect and record the pressure frequency index (PRESSURE_FREQUENCY_INDEX), its Low Limit (PRESSURE_FREQUENCY_INDEX_MIN), High Limit (PRESSURE_FREQUENCY_INDEX_MAX) and PV value. (5) Collect and record the standard deviation (STANDARD_DEVIATION), its Low Limit (STANDARD_DEVIATION_MIN) and High Limit (STANDARD_DEVIATION_MAX) for reference.

If there are several operating conditions, conduct the aforementioned procedures on as many conditions as possible and collect its data. This is because the pressure frequency index value fluctuates depending on the operating condition, even during a normal state. By covering as much conditions as possible, you can more accurately determine diagnosis advisability and adjust the parameters.

N4-4-3. Clog Simulation Test

If there are valves such as the stop valves in the connecting pipe, you may conduct a clog simulation test using such valve. The collected pressure frequency index and standard deviation during clog simulation state are used to determine the advisability of diagnosis, or adjust the parameters later.

Warning
If you completely close the connecting pipe valve, the transmitter will no longer be able to measure values correctly. Furthermore, even if the valve is not completely closed off, it may extend the time until which the PV value gets updated to the pressure change (this is the same as when the damping time constant of the transmitter is increased). When conducting clog simulation test, please take sufficient precaution to not interfere with the safety and control of the process.

<table>
<tr><th>Procedure</th></tr>
<tr><td>
(1) Operate the valve of the connecting pipe so that it is either completely closed, or open just slightly (open enough so that the fluid flows slightly).

(2) Conduct the following: pressure frequency index clearing (set RESET_PRESSURE_FREQUENCY_INDEX to 1) and standard deviation and average value reset (set RESET_STANDARD_DEVIATION to 1).

(3) Wait at least 20 minutes during at this state.

(4) Record the pressure frequency index (PRESSURE_FREQUENCY_INDEX), its lower range value (PRESSURE_FREQUENCY_INDEX_MIN), upper range limit (PRESSURE_FREQUENCY_INDEX_MAX) and PV value.

(5) Collect and record the standard deviation (STANDARD_DEVIATION), its lower range value (STANDARD_DEVIATION_MIN) and upper range limit (STANDARD_DEVIATION_MAX) for reference.

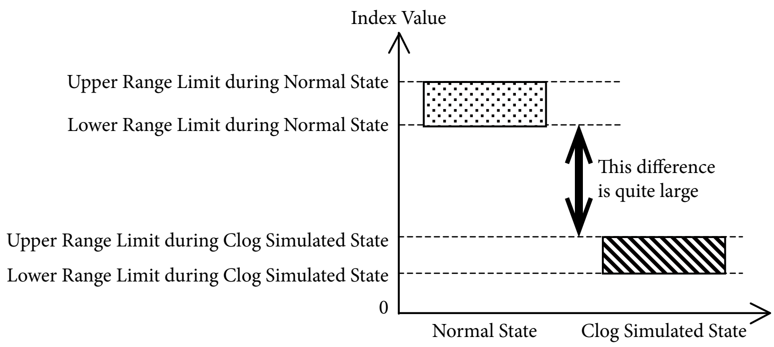
If there are several operating conditions, and the index value at normal state changes depending on the condition, we recommend conducting the aforementioned procedures at each condition.
</td></tr>
</table>

During the clog simulation test, it is necessary to sufficiently clog the connecting pipe valve. This is because the low pass filter effect from the clogging, as explained in the principle section, will not get generated if the flow resistance due to clogging (difficulty of the liquid to flow) is not sufficiently high.

N4-4-4. Diagnosis Advisability Assessment

This assesses whether a clog can be diagnosed from the index values, its min and upper range limits collected during normal state (section N4-4-2) and clog simulated condition (section N4-4-3).

<table>
<tr><th colspan="2">Decision Criteria</th></tr>
<tr><td>
• The upper range limit of the clog simulated state is smaller than the lower range value during normal state

• The difference between the lower range value at normal state and upper range limit at clog simulated state must be the same or greater than the difference between the lower range value and upper range limit at normal state.


</td><td>Diagnosis is advisable</td></tr>
<tr><td>• If it does not satisfy the aforementioned criteria</td><td>Diagnosis is not possible or is difficult</td></tr>
</table>

The minimum diagnosis requirement is that the upper range limit of the clog simulated state is smaller than the lower range value during normal state. If it doesn't satisfy this requirement, then it is deemed as inappropriate for diagnosis, because the clog simulated state value might be used as the index value, even if the connecting pipe is normal. Furthermore, if the normal state index value varies due to the operation condition, please conduct the assessment based on the condition at which the min index value is the smallest.

The larger the difference between the lower range value at normal state and upper range limit at simulated clog state, the diagnosis becomes easier. Hence, this value is important. The fact that this difference is the same or greater than the difference between the lower range value and upper range limit at normal state can be used as a criterion for assessing whether diagnosis is possible. On the other hand, if this difference is less than half of the difference between the lower range value and upper range limit at normal state, diagnosis would be difficult. This is because the index value may become close to that at the clogged state, even when the state is normal, which would mean that the differentiation between what is normal and abnormal can get difficult. This situation would also be deemed as inadequate for diagnosis.

If diagnosis is possible, move to section N4-4-5 and set the diagnosis alarm.

If it is deemed inadequate, move to section N4-4-6 and consider adjusting the parameters.

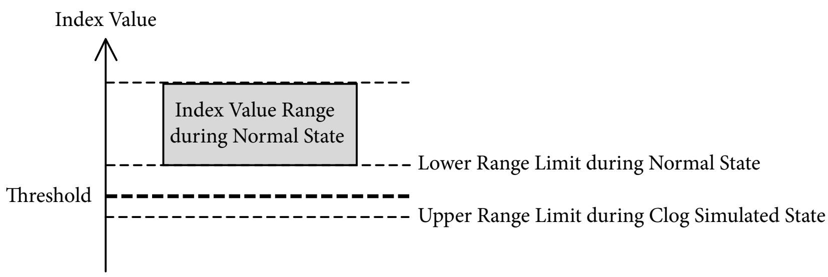
Caution The variation width of the pressure frequency index may get affected by the location of the clog. This effect becomes especially larger when the fluid is comprised of compressed liquid or gas. In this case, the closer the clogging is to the process side, the larger the variation width will be. Therefore, if the actual clog happened near the transmitter compared to the simulated occlusion site, then the changes in the index value sometimes remains small compared to the simulation test, or won't change at all. In addition, if the actual clog happened near the process rather than to the simulated occlusion site, then the index value sometimes changes more violently than that of the simulation test.

N4-4-5. Setting the Diagnosis Alarm

After the diagnosis advisability assessment is over, you will now set the alarm. Please omit this section if you do not want to activate the alarm.

Caution The procedures explained in this manual does not guarantee clog detection or false alarm prevention. The pressure frequency index varies due to factors other than clogging, and it depends on the degree of clogging and the clogging substance. Before setting the alarm, please understand that a threshold setting method that detects clogs 100% of the time without false alarms does not exist.

Let's first decide on the alarm threshold. The threshold is selected from values between the lower range value at normal state and upper range limit at clog simulated state. If threshold nears the lower range value at normal state, the alarm gets activated very fast, but the possibility of false alarm increases as well. Please set the threshold so that it is to some extent distant from the lower range value at normal state, so that there is a margin in between.



After determining the threshold, conduct the following procedure to start the diagnosis.

Procedure
(1) Conduct the Pressure Frequency Index Clear (set RESET_PRESSURE_FREQUENCY_INDEX to 1) operation.
(2) Set the Low Limit (PRESS_FREQ_INDEX_LO_LIMIT) of the pressure frequency index to the threshold (Low Limit) you defined
(3) Set the alarm operation mode (PRESS_FREQ_INDEX_ALARM_USE) for the pressure frequency index diagnosis to 2 (only for Low Limit)

With this setting, the alarm gets activated when the index value goes out of the normal range and nears the value at clog simulated state.

N4-4-6. Parameter Adjustment

If diagnosis is determined be unsuitable, analyze the data collected at normal state (section N4-4-2) and at clog simulated state (section N4-4-3), and adjust the parameter.

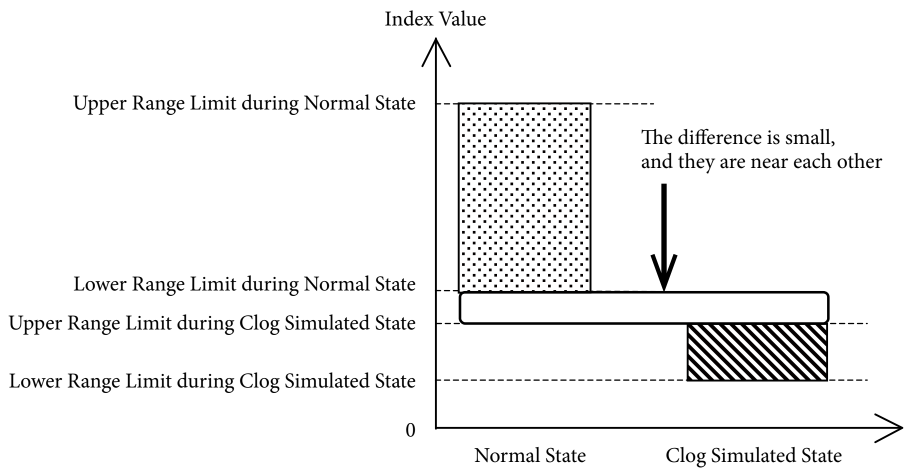
The reason why a diagnosis cannot be conducted is because the index value may decrease to the same level as that at a clogged state, even if the actual state is normal, which results in an inability to differentiate between a normal state and clogged state. There are two major reasons why this happens.

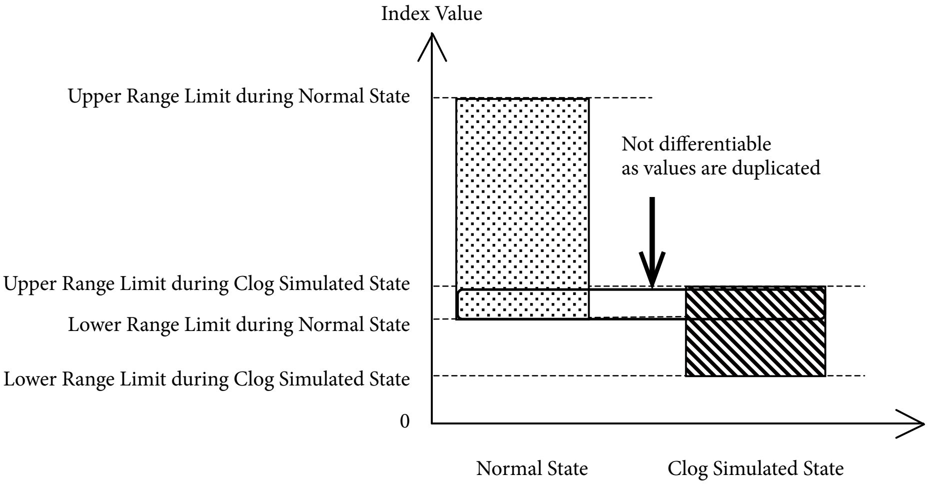
- The variation width of the index value at normal state is large
- The variation width of the index value at clogged state is small

This may be resolved by adjusting the parameter of the pressure frequency index diagnosis. The following explains the mechanism of each situation.

(A) When the variation width of the index value at normal state is large

This example, as in the following diagram, deals with a situation where the index value at clog simulated state becomes small, but the variation of index value at normal state becomes large, and this index value nears or becomes identical to the value at clog simulated state, even if it is not actually clogged.



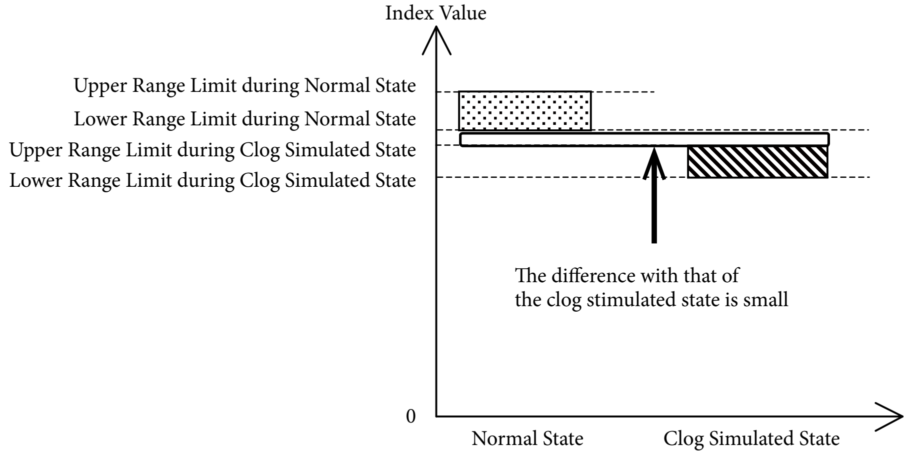


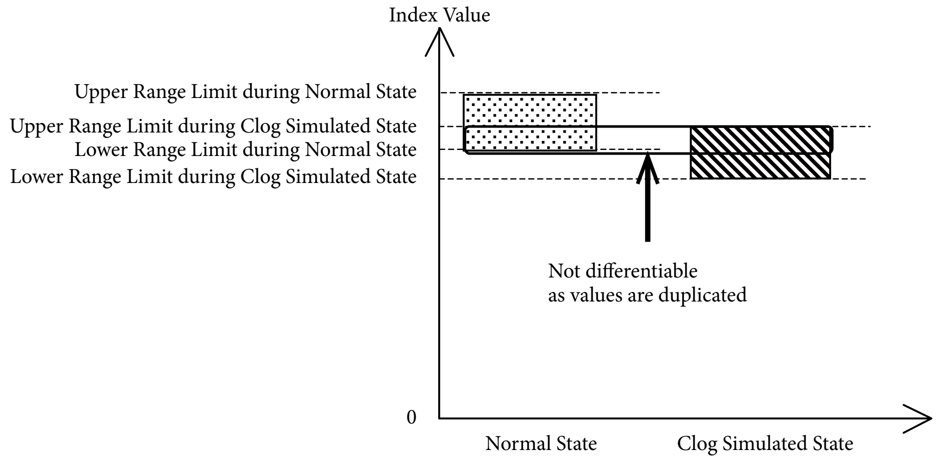
In this case, you must identify what is causing the large variation of the index value at normal state, and reduce such influence. The following will guide you through the adjustment.

Parameter Adjustment Guide	
Phenomenon	**Adjustment Method for Improvement**
It is at normal state, but the index value sometimes decreases significantly. During such, the PV value varies, or the standard deviation increases.	Gradually increase the pressure frequency filter constant (PRESS_FREQ_FILTER_CONSTANT) by 0.02 to 0.05 once at a time.
The index value at normal state greatly fluctuates depending on the operating condition.	Identify whether there's any relationship with the operation condition and the PV value. If there's any PV value range that makes the difference between max and min index values at normal state smaller, or PV value range that doesn't make the lower range value at normal state smaller, set that range up with the High Limit of Pressure Value Filter (PRESS_FREQ_CALC_PV_HI_LIMIT) and Lower Limit (PRESS_FREQ_CALC_PV_LO_LIMIT). If you use this parameter, you can conduct the diagnosis only when there's pressure, and stop the diagnosis when there is not.

(B) When the variation width of the index value at clogged state is small

This example, as in the following diagram, deals with a relatively small variation of the index value at normal state, but without much changes to the index value at clog simulated state.





In this case, it means that either the index values at normal state and clog state are at the same level, or that the index value does not change much even during the clog. In either case, you must identify the cause, and reduce such influence. The following will guide you through the adjustment.

Parameter Adjustment Guide	
Phenomenon	Adjustment Method for Improvement
PV value is fluctuating, and low frequency pressure is always fluctuating, so hence, the index value is small even at normal state. The standard deviation is relatively large.	Gradually increase the pressure frequency filter constant (PRESS_FREQ_FILTER_CONSTANT) by 0.02 to 0.05 once at a time.
PV value is not fluctuating, and standard deviation is small. The frequency of the original pressure perturbation is low, and the index value is small (the average index value at normal state is less than 0.1). The liquid viscosity is high.	Modify the Sensor Selection (PRESS_FREQ_IDX_SENSOR_SELECTION). If the current value is 0 (DP, 120 ms), set it to 1 (DP, 240 ms). If the current value is 1 (DP, 240 ms), set it to 2 (DP, 360 ms).

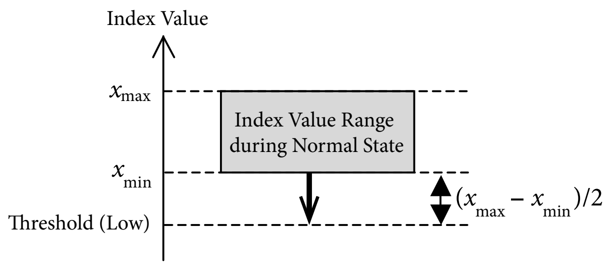
Parameter Adjustment Guide	
Phenomenon	**Adjustment Method for Improvement**
No problems exist with the size and frequency of the original pressure perturbation (the average index value at normal state that is above 0.2). However, the values do not change at all even at clogged state.	Gradually decrease the pressure frequency filter constant (PRESS_FREQ_FILTER_CONSTANT) by 0.02 to 0.05 once at a time.

N4-4-7. If Clog Simulation Test Cannot be Conducted

If you cannot conduct the clog simulation test, you have to determine the threshold with only the index value data at normal state (index value collected in section N4-4-2).

If you were able to collect several index values, calculate its average value μ and standard deviation σ, and determine the threshold based on μ±nσ. If you wish to prevent false alarms as much as possible, we recommend setting n to between 4 and 6.

You may also set the threshold based on the upper range limit x_{max} and lower range value x_{min} of the index value. For example, as described in the following diagram, you may set the threshold by adding and subtracting $(x_{max}-x_{min})/2$ from the lower range value.



The threshold you determined from index value data at normal state alone is not guaranteed that it is appropriate. There are times when the index value reaches the threshold for other reasons beside a clog, or times when the index value does not reach the threshold even if a clog exists. After determining the threshold, observe any changes in the index value for a while, and verify whether it does not exceed the threshold even at normal state, and that there isn't a large difference between the normal value range and the threshold. If necessary, revise the threshold.

N5. Supplementary Explanation of the Parameter

This section explains the parameters for the pressure frequency index diagnosis, and the effect of its clog diagnosis.

The objective of the following explanation is to provide information for users who would like to know more about the functions of each parameter. Please refer to sections 2 - 4 for general setting procedures.

N5-1. Pressure Frequency Filter Constant

Pressure Frequency Filter Constant (PRESS_FREQ_FILTER_CONSTANT) sets the strength of the bypass filter to suppress the reduction of pressure frequency index value due to reasons other than the connecting pipe clog itself.

The factory default is set to 0, where the filter doesn't function at all. However, if you are applying the pressure frequency index to the clog diagnosis, we recommend setting the filter constant and cutting down on the low-frequency fluctuation. We strongly recommend setting the filter constant especially if you had set Sensor Select to SP. If the objective is clog diagnosis, the general recommended filter constant is between 0.12 and 0.18.

If you make this parameter bigger, the filter effect will strengthen. In this scenario, the likelihood of the reduction of index value due to factors other than a clog will diminish. However, if the filter effect is too strong, it becomes more difficult to detect the changes of the frequency when the connecting pipe does get clogged up, and deteriorates the diagnosis function.

If you lower this parameter, the filter effect will get smaller. In this case, deterioration of the diagnosis performance through the filter will get reduced. However, if the filter effect is too weak, it becomes ineffective, and increases the likelihood of the reduction of the index value due to factors other than a clog. As a result, the likelihood of false alarm will increase.

In addition, as a general rule, if the low frequency fluctuation is extremely high (low frequency fluctuation where the variation width exceeds 10 times the standard deviation at normal state), it becomes difficult to counteract its effect even while using this filter.

This filter's cutoff frequency, F_{cut} [Hz] and cutoff period (reciprocal of cutoff frequency) Tcut [s] are as follows. c is the filter constant. Ts is the sampling interval specified with Sensor Select, which is either 0.12 [s], 0.24 [s] or 0.36 [s].

$$F_{cut} = \frac{1}{2\pi Ts} \cos^{-1}\left(1 - \frac{c^2}{2(c+1)}\right)$$

$$T_{cut} = \frac{2\pi Ts}{\cos^{-1}\left(1 - \frac{c^2}{2(c+1)}\right)}$$

N5-2. Sensor Select

Sensor Select (PRESS_FREQ_IDX_SENSOR_SELECTION) can be selected from the following.

0: DP, 120 ms (factory default setting)

1: DP, 240 ms

2: DP, 360 ms

10: SP, 360 ms (can select only the differential pressure gauge)

N5-2-1. P Sampling Interval

If you specified DP for Sensor Select, you may set the P sampling interval to either 120 ms, 240 ms or 360 ms.

It is usually more beneficial to shorten the sampling interval for the clog diagnosis. This is because changes in the pressure perturbation due to clogging get actualized first in the order of the ones with the higher frequencies (for detail, please refer to the section on principles). Since the sampling interval needs to be shortened in order to capture the changes of high frequencies, in general, the clog diagnosis performance goes up if you shorten the sampling interval. However, if you shorten the sampling interval, it becomes more difficult to measure low frequencies. Therefore, if the frequencies of the pressure perturbation are low to begin with, you can diagnose easier by extending the sampling interval.

N5-2-2. Sensor Types

You can specify either DP or SP for the differential pressure gauge's Sensor Select. The difference is the sensor used for the index calculation. It changes the diagnostic properties, as DP mode uses differential pressure sensor, whereas the SP mode uses the static pressure sensor.

The characteristics of clog diagnosis during DP mode are as follows.

- The size of the flow rate or pressure perturbation required for diagnosis becomes smaller compared to SP mode.
- You can heighten the clog sensitivity by selecting 120 ms as the sampling interval. It also increases the index update frequency.
- It may not be able to detect single side clogs.

The characteristics of clog diagnosis during SP mode are as follows.

- The pressure perturbation required for diagnosis becomes larger than during DP mode. Therefore, it may not be diagnosable in SP mode, even if it is in DP.
- Sampling interval will be fixed at 360 ms. Clog sensitivity goes down compared to 120 ms or 240 ms in DP mode, and the index update frequency lessens.
- Single side clogs, which are difficult to detect or undetectable with DP, may be detectable with SP.

The benefit of SP is the fact that the detection capability of the single side clog differs from that of DP. However, it doesn't mean that SP mode can always detect single side clogs. If you can't conduct clog simulation test, and if you determine that a single side clog is undetectable via SP mode through clog simulation test, please select the DP mode. In this case, there are no benefits in selecting SP.

Appendix O. Setting the Range Damping Time Constant during Factory Shipment

The following are the range settings at the time of factory shipping during coarse adjustment.

If range is specified, the product ships with the specified range.

Type	SI units	LRV	URV
GTX15D	Pa	0	500
GTX30D, 31D	kPa	0	50
GTX32D	kPa	0	50
GTX40D, 41D	kPa	0	350
GTX42D	kPa	0	350
GTX71D	MPa	0	7
GTX72D	MPa	0	7
GTX35F	kPa	0	50
GTX60F	MPa	0	0.7
GTX35R	kPa	0	50
GTX40R	kPa	0	350
GTX60G	MPa	0	2
GTX71G	MPa	0	7
GTX82G	MPa	0	20
GTX35U	kPa	0	50
GTX60U	kPa	0	700
GTX71U	MPa	0	2
GTX82U	MPa	0	20
GTX30A	kPa abs	0	13
GTX60A	MPa abs	0	2
GTX30S	kPa abs	0	13
GTX60S	MPa abs	0	0.7

■ *Damping time constant at time of factory shipping**

Model No.	Adjustment span (X)/damping time constant		
GTX	4s	2s	1s
GTX15D	—	0.1 kPa≤X<2 kPa	—
GTX30D, 31D	5 kPa≤X<2.5 kPa	2.5 kPa≤X<5 kPa	5 kPa≤X
GTX32D	0.75 kPa≤X<2.5 kPa	2.5 kPa≤X<5 kPa	5 kPa≤X
GTX40D, 41D	35 kPa≤X<45 kPa	45 kPa≤X<90 kPa	90 kPa≤X
GTX42D	35 kPa≤X<45 kPa	45 kPa≤X<90 kPa	90 kPa≤X
GTX71D	0.25 MPa≤X<0.7 MPa	0.7 MPa≤X<1.4 MPa	1.4 MPa≤X
GTX72D	0.25 MPa≤X<0.7 MPa	0.7 MPa≤X<1.4 MPa	1.4 MPa≤X
GTX35F	—	2.5 kPa≤X<5 kPa	5 kPa≤X
GTX60F	70 kPa≤X<80 kPa	80 kPa≤X<210 kPa	210 kPa≤X
GTX35R	—	2.5 kPa≤X<5 kPa	5 kPa≤X
GTX40R	35 kPa≤X<45 kPa	45 kPa≤X<90 kPa	90 kPa≤X
GTX60G	17.5 kPa≤X<80 kPa	80 kPa≤X<210 kPa	210 kPa≤X
GTX71G	—	0.7 MPa≤X<1.4 MPa	1.4 MPa≤X
GTX82G	—	0.7 MPa≤X<1 MPa	1 MPa≤X
GTX35U	—	2.5 kPa≤X<5 kPa	5 kPa≤X
GTX60U	35 kPa≤X<80 kPa	80 kPa≤X<210 kPa	210 kPa≤X
GTX71U	—	0.7 MPa≤X<1.4 MPa	1.4 MPa≤X
GTX82U	—	0.7 MPa≤X<1 MPa	1 MPa≤X
GTX30A	—	4 kPa abs≤X<5 kPa abs	5 kPa abs≤X
GTX60A	35 kPa abs≤X<80 kPa abs	80 kPa abs≤X<210 kPa abs	210 kPa abs≤X
GTX30S	—	4 kPa abs≤X<5 kPa abs	5 kPa abs≤X
GTX60S	35 kPa abs≤X<80 kPa abs	80 kPa abs≤X<210 kPa abs	210 kPa abs≤X

* If customer makes any specification, the product ships with the specified value setting.

Appendix P. Specification, Performance, Model Number and Dimensions of the Instrument

Common Specifications

For items not described here, refer to the individual specification sheet of each model.

Output Signal	FOUNDATION™ Fieldbus
Communication	FOUNDATION™ Fieldbus (H1)
Registration	Interoperability test ITK 6.1 approved.
Supply Voltage	9 to 32 V DC Limited to 9 to 24 V DC for Fieldbus Intrinsic safety (Entity) ia 9 to 17.5 V DC for FISCO Field Device ia
Current Draw	14.1 mA typ. (15 mA maximum)
EMC Conformity	IEC 61326-1 (industrial electromagnetic environment), IEC 61326-2-3, IEC 61326-2-5
Lightning Protection	±7 kV In accordance with IEC 61000-4-5 Waveform 1.2/50 µs (open-circuit voltage) 8/20 µs (short-circuit current)
Response Time	Below 630 ms (model GTX_ _D/G/A/F, when damping time is set to 0 s.) Below 880 ms (model GTX_ _R/U/S, when damping time is set to 0 s, capillary tube length 5 m, at room temp.)
PV Updating Cycle	60 ms
Indicator	Maximum of four process items displayed alternately. Items: process value (5 digits), unit (7 digits), bar graph, alarm message, write protect status, status record, updated mark

Function Block

Block	Quantity	Synchronous Time	Description
AI	2 (without Q8*) 4 (with Q8*)	75 ms	Used for differential pressure value and sensor temperature. Also used for pressure frequency index and standard deviation when Q8* option is selected.
DI	2	75 ms	Used for the PV/SV switches.
AR	1	75 ms	Calculates equations for temperature and flow.
PID	1	125 ms	Performs control algorithm to minimize differences between measured process variation and a targeted set point. This block also has cascade control, feedforward control and alarm detection function.
OS	1	75 ms	Enables control of two systems from one input (SP value). The input is divided into two outputs, each in accordance with independent linear functions.
IS	1	75 ms	a maximum of four input signals.

Link Master

The AT9000 supports link master functions.

Transducer Block

Pressure transducer block: FF-903

Display transducer block: Provision of control processing of the indicator display

Diagnostic transducer block: Provision of the advanced diagnostics processing (with Q8* option)

*Q8: optional code for "Advanced diagnostics"

Product Approvals

FM Explosionproof for Division system/ Flameproof for Zone system	Certificate: No. 3030557 Standards: FM 3600 (2011), FM 3615 (2006), FM 3810 (2005), ANSI/IEC 60529(2004), ANSI/ISA 60079-0 (2013), ANSI/ISA 60079-1 (R2013), ANSI/NEMA 250 (1991) Marking: Explosionproof for Class I, Division 1, Groups A, B, C and D; Class I, Zone 1, AEx d IIC Dust-Ignitionproof for Class II, III, Division 1, Groups E, F and G T5 −40°C ≤ Tamb ≤ +85°C; Hazardous locations; Indoor/Outdoor Type 4X, IP67 Factory sealed, conduit seal not required for Division applications Caution: Use supply wires suitable for 5 °C above surrounding ambient
FM Intrinsic safety ia/ic FISCO and Fieldbus	Certificate: No. 3052652 Standards: FM 3600 (2011), FM 3610 (2010), FM 3810 (2005), ANSI/IEC 60529 (2004), ANSI/ISA 60079-0 (2013), ANSI/ISA 60079-011 (2014), ANSI/NEMA 250 (1991) Marking/Parameters: [FISCO Field Device ia] CLASS I/ZONE 0/AEx ia IIC/T4, CLASS I, II, III/DIVISION 1/GROUPS A, B, C, D, E, F&G/T4 Vmax=17.5 V, Imax=380 mA, Pmax=5.32 W, Ci=1.2 nF, Li=10 μH [Fieldbus Intrinsic safety (Entity) ia] CLASS I/ZONE 0/AEx ia IIC/T4, CLASS I, II, III/DIVISION 1/GROUPS A, B, C, D, E, F&G/T4 Vmax=24 V, Imax=250 mA, Pmax=1.2 W, Ci=1.2 nF, Li=10 μH [FISCO Field Device ic] CLASS I/ZONE 2/AEx ic IIC/T4, CLASS I, II, III/DIVISION 1/GROUPS A, B, C, D, E, F&G/T4 Vmax=17.5 V, Ci=1.2 nF, Li=10 μH [Fieldbus Intrinsic safety (Entity) ic] CLASS I/ZONE 2/AEx ic IIC/T4, CLASS I, II, III/DIVISION 1/GROUPS A, B, C, D, E, F&G/T4 Vmax=32 V, Ci=1.2 nF, Li=10 μH HAZARDOUS (CLASSIFIED) LOCATIONS: INDOOR/OUTDOOR TYPE 4X, IP66/IP67; −30°C ≤ Tamb ≤ +60°C
FM Fieldbus Nonincendive	Certificate: No. 3052652 Standards: FM 3600 (2011), FM 3611 (2004), FM 3810 (2005), ANSI/IEC 60529 (2004), ANSI/NEMA 250 (1991) Marking/Parameters: NONINCENDIVE, WITH NONINCENDIVE FIFLD WIRING PARAMETERS, CLASS I/DIVISION 2/GROUPS A, B, C&D/T4: −30°C ≤ Tamb ≤ +60°C; NONINCENDIVE FOR CLASS I/ZONE 2/IIC/T4: −30°C ≤ Tamb ≤ +60°C; SUITABLE FOR CLASS II, III /DIVISION 2/GROUPS E, F&G/T4: −30°C ≤ Tamb ≤ +60°C; HAZARDOUS (CLASSIFIED) LOCATIONS: INDOOR/OUTDOOR TYPE 4X, IP66/IP67; NONINCENDIVE FIELD WIRING PARAMETERS: Vmax=32 V, Ci=1.2 nF, Li=10 μH

ATEX Flameproof	Certificate: No. KEMA 08ATEX0004 X Standards: EN 60079-0: 2012+A11, EN 60079-1: 2014, EN 60079-26: 2015, EN 60079-31: 2014 Marking: II 1/2 G Ex db IIC T6 Ga/Gb; −30°C ≤ Tamb ≤ +75°C; −30°C ≤ Tprocess ≤ +85°C II 1/2 G Ex db IIC T5 Ga/Gb; −30°C ≤ Tamb ≤ +80°C; −30°C ≤ Tprocess ≤ +100°C II 1/2 G Ex db IIC T4 Ga/Gb; −30°C ≤ Tamb ≤ +80°C; −30°C ≤ Tprocess ≤ +110°C II 2 D Ex tb IIIC T85°C Db; −30°C ≤ Tamb ≤ +75°C; −30°C ≤ Tprocess ≤ +85°C II 2 D Ex tb IIIC T100°C Db; −30°C ≤ Tamb ≤ +75°C; −30°C ≤ Tprocess ≤ +100°C II 2 D Ex tb IIIC T110°C Db; −30°C ≤ Tamb ≤ +75°C; −30°C ≤ Tprocess ≤ +110°C IP66/IP67 Caution: Use supply wires suitable for 5 °C above surrounding ambient
ATEX Intrinsic safety ia FISCO and Fieldbus	Certificate: No. DEKRA 12ATEX0023 X Standards: EN60079-0: 2012+A11, EN60079-11: 2012 Marking/Parameters: [FISCO Field Device ia] II 1 G Ex ia IIC T4 Ga/II 1 D Ex ia IIIC T120°C Da Ui=17.5 V, li=380 mA, Pi=5.32 W, Ci=1.2 nF, Li=10 µH [Fieldbus Intrinsic safety ia] II 1 G Ex ia IIC T4 Ga/II 1 D Ex ia IIIC T120°C Da Ui=24 V, li=200 mA, Pi=1.2 W, Ci=1.2 nF, Li=10 µH −30°C ≤ Tamb ≤ +60°C Tprocess=110°C IP66/IP67
ATEX Intrinsic safety ic FISCO and Fieldbus	Certificate: No. DEKRA 12ATEX0024 Standards: EN60079-0: 2012+A11, EN60079-11: 2012 Marking/Parameters: [FISCO Field Device ic] II 3 G Ex ic IIC T4 Gc/II 3 D Ex ic IIIC T120°C Dc, Ui=17.5 V, Ci=1.2 nF, Li=10 µH [Fieldbus Intrinsic safety ic] II 3 G Ex ic IIC T4 Gc/II 3 D Ex ic IIIC T120°C Dc, Ui=32 V, Ci=1.2 nF, Li=10 µH −30°C ≤ Tamb ≤ +60°C Tprocess=110°C IP66/IP67
IECEx Flameproof	Certificate: No. KEMA 08ATEX0004 X Standards: IEC 60079-0: 2011, IEC 60079-1: 2014-06, IEC 60079-26: 2014-10, IEC 60079-31: 2014 Marking/Parameters: Ex db IIC T6 Ga/Gb; −30°C ≤ Tamb ≤ +75°C; −30°C ≤ Tprocess ≤ +85°C Ex db IIC T5 Ga/Gb; −30°C ≤ Tamb ≤ +80°C; −30°C ≤ Tprocess ≤ +100°C Ex db IIC T4 Ga/Gb; −30°C ≤ Tamb ≤ +80°C; −30°C ≤ Tprocess ≤ +110°C Ex tb IIIC T85°C Db; −30°C ≤ Tamb ≤ +75°C; −30°C ≤ Tprocess ≤ +85°C Ex tb IIIC T100°C Db; −30°C ≤ Tamb ≤ +75°C; −30°C ≤ Tprocess ≤ +100°C Ex tb IIIC T110°C Db; −30°C ≤ Tamb ≤ +75°C; −30°C ≤ Tprocess ≤ +110°C IP66/IP67 Caution: Use supply wires suitable for 5 °C above surrounding ambient

IECEx Intrinsic safety ia FISCO and Fieldbus	Certificate: No. IECEx DEK 12.0001 X Standards: IEC 60079-0: 2011, IEC 60079-11: 2011 Marking/Parameters: [FISCO Field Device ia] Ex ia IIC T4 Ga/Ex ia IIIC T120°C Da Ui=17.5 V, li=380 mA, Pi=5.32 W, Ci=1.2 nF, Li=10 µH [Fieldbus Intrinsic safety ia] Ex ia IIC T4 Ga/Ex ia IIIC T120°C Da Ui=24 V, li=200 mA, Pi=1.2 W, Ci=1.2 nF, Li=10 µH −30°C ≤ Tamb ≤ +60°C Tprocess=110°C IP66/IP67
IECEx Intrinsic safety ic FISCO and Fieldbus	Certificate: No. IECEx DEK 12.0001 X Standards: IEC 60079-0: 2011, IEC 60079-11: 2011 Marking/Parameters: [FISCO Field Device ic] Ex ic IIC T4 Gc/Ex ic IIIC T120°C Dc, Ui=17.5 V, Ci=1.2 nF, Li=10 µH [Fieldbus Intrinsic safety ic] Ex ic IIC T4 Gc/Ex ic IIIC T120°C Dc, Ui=32 V, Ci=1.2 nF, Li=10 µH −30°C ≤ Tamb ≤ +60°C Tprocess=110°C IP66/IP67

Option

External Zero Adjustment Function	The AT9000 output can be easily adjusted ti zero in the field. When this is performed, the current input pressure is entered to the elevation value. To enable this function, the optional indicator must also be selected.
Advanced Diagnostics	• Pressure Frequency Index Monitoring The frequency of pressure fluctuation is measured, and converted to this specific index. By monitoring this index, the change of fluctuation may be monitored, thus leading to early detection of future troubles such as clogging of pulse lines. Note: The Advanced Diagnostics can not detect the fluctuation under a specific conditions. • Standard Deviation Monitoring This function measures the standard deviation of pressure fluctuation. • Out of range count This function counts the number of times the PV input exceeded a set range.

Factory Settings

Unless otherwise specified, the setting of the AT9000 will be shipped with the following settings.

Items	Synchronous Time	Description
Correcting Range	XD_SCALE [AI_FB_01]	Factory adjusted range
Output Type	L_TYPE [PRESSURE_TB]	(2: INDIRECT)
Damping Time Constant	DAMPING_CONSTANT [PRESSURE_TB]	Prescribed damping constant (See user’s manual)
Output Scale	OUT_SCALE [AI_FB_01]	0 to 100%
Height Between Flanges	HEIGHT_VALUE [PRESSURE_TB]	0 m
Tag	PD_TAG	(Entry of this item is necessary.)
Node Address	NODE_ADDRESS	0xF8

The following items may be preset at the factory according to the ordering information.

Correcting Range

Specify the upper limit and lower limit of correcting range. The upper limit and lower limit are set to EU_100 and EU_0 of XD_SCALE, and the unit is set to UNITS_INDEX.

The unit is selectable from the following pressure units:

Pa, MPa, kPa, hPa, bar, mbar, torr, atm, psi, kg/cm^2, inH_2O, mmH_2O, inHg, mmHg

Output Type

Specify the output type, "Linear" or "Square root"

Damping Time Constant

Specify the damping time constant in seconds.
Range: 0 to 128 s.

Output Scale

Specify the upper limit and lower limit of output range. The upper limit and lower limit are set to OUT_SCALE of AI_FB_01.

When the indicator is selected, the setting of process value for indicator will be shipped with OUT_SCALE of AI_FB_01.

Height Between Flanges

Applicable when the GTX_ _R (remote sealed type differential pressure) transmitter is used for tank level measurement. This value is used for calculation within the temperature compensation function.

Tag (PD_TAG)

Entry of this item is necessary.

Max 32 character

Node Address

0x_ _: "_ _" is hexadecimal.

Selectable range: 0x10 to 0xF7

MODEL SELECTION

For the model codes which are not described below, refer to the following specification sheets depending on the basic model.

SS2-GTX00A-0100, SS2-GTX00G-0200, SS2-GTX00U-0100, SS2-GTX00D-0100,
SS2-GTX00F-0100, SS2-GTX00S-0100, SS2-GTX00G-0100 SS2-GTX00R-0100

GTX _ _ _ - Selection I - Selection II - Option

GTX _ _ _ - I II III IV V VI VII (VIII IX X XI) - I II III IV V VI - Option

code : X (Failure alarm (Burnout output): None (for Fieldbus))

code : See below (Product Approvals)

code : C (OUTPUT : Digital output (FOUNDATION Fieldbus communication))

II	Product Approvals None	XX
	FM Explosionproof for Division system/Flameproof for Zone system	F1
	FM Intrinsic safety ia/ic FISCO and Fieldbus	F4
	FM Fieldbus Nonincendive	F7
	ATEX Flameproof	A1
	ATEX Intrinsic safety ia FISCO and Fieldbus	A4
	ATEX Intrinsic safety ic FISCO and Fieldbus	A7
	IECEx Flameproof	E1
	IECEx Intrinsic safety ia FISCO and Fieldbus	E4
	IECEx Intrinsic safety ic FISCO and Fieldbus	E7

TERMINAL CONNECTION

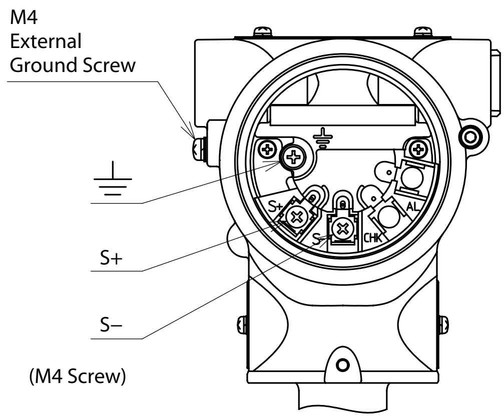


TABLE: Terminal Connection

SYMBOL	DETAILS
S+	Fieldbus+
S–	Fieldbus–
⏚	GROUND

Terms and Conditions

We would like to express our appreciation for your purchase and use of Azbil Corporation's products.

You are required to acknowledge and agree upon the following terms and conditions for your purchase of Azbil Corporation's products (system products, field instruments, control valves, and control products), unless otherwise stated in any separate document, including, without limitation, estimation sheets, written agreements, catalogs, specifications and instruction manuals.

1. Warranty period and warranty scope

1.1 Warranty period

Azbil Corporation's products shall be warranted for one (1) year from the date of your purchase of the said products or the delivery of the said products to a place designated by you.

1.2 Warranty scope

In the event that Azbil Corporation's product has any failure attributable to azbil during the aforementioned warranty period, Azbil Corporation shall, without charge, deliver a replacement for the said product to the place where you purchased, or repair the said product and deliver it to the aforementioned place. Notwithstanding the foregoing, any failure falling under one of the following shall not be covered under this warranty:

(1) Failure caused by your improper use of azbil product (noncompliance with conditions, environment of use, precautions, etc. set forth in catalogs, specifications, instruction manuals, etc.);
(2) Failure caused for other reasons than Azbil Corporation's product;
(3) Failure caused by any modification or repair made by any person other than Azbil Corporation or Azbil Corporation's subcontractors;
(4) Failure caused by your use of Azbil Corporation's product in a manner not conforming to the intended usage of that product;
(5) Failure that the state-of-the-art at the time of Azbil Corporation's shipment did not allow Azbil Corporation to predict; or
(6) Failure that arose from any reason not attributable to Azbil Corporation, including, without limitation, acts of God, disasters, and actions taken by a third party.

Please note that the term "warranty" as used herein refers to equipment-only-warranty, and Azbil Corporation shall not be liable for any damages, including direct, indirect, special, incidental or consequential damages in connection with or arising out of Azbil Corporation's products.

2. Ascertainment of suitability

You are required to ascertain the suitability of Azbil Corporation's product in case of your use of the same with your machinery, equipment, etc. (hereinafter referred to as "Equipment") on your own responsibility, taking the following matters into consideration:

(1) Regulations and standards or laws that your Equipment is to comply with.
(2) Examples of application described in any documents provided by Azbil Corporation are for your reference purpose only, and you are required to check the functions and safety of your Equipment prior to your use.
(3) Measures to be taken to secure the required level of the reliability and safety of your Equipment in your use
Although azbil is constantly making efforts to improve the quality and reliability of Azbil Corporation's products, there exists a possibility that parts and machinery may break down. You are required to provide your Equipment with safety design such as fool-proof design,*1 and fail-safe design*2 (anti-flame propagation design, etc.), whereby preventing any occurrence of physical injuries, fires, significant damage, and so forth. Furthermore, fault avoidance,*3 fault tolerance,*4 or the like should be incorporated so that the said Equipment can satisfy the level of reliability and safety required for your use.

*1. A design that is safe even if the user makes an error.
*2. A design that is safe even if the device fails.
*3. Avoidance of device failure by using highly reliable components, etc.
*4. The use of redundancy.

3. Precautions and restrictions on application

3.1 Restrictions on application

Please follow the table below for use in nuclear power or radiation-related equipment.

	Nuclear power quality*5 required	Nuclear power quality*5 not required
Within a radiation controlled area*6	Cannot be used (except for limit switches for nuclear power*7)	Cannot be used (except for limit switches for nuclear power*7)
Outside a radiation controlled area*6	Cannot be used (except for limit switches for nuclear power*7)	Can be used

*5. Nuclear power quality: compliance with JEAG 4121 required
*6. Radiation controlled area: an area governed by the requirements of article 3 of "Rules on the Prevention of Harm from Ionizing Radiation," article 2 2 4 of "Regulations on Installation and Operation of Nuclear Reactors for Practical Power Generation," article 4 of "Determining the Quantity, etc., of Radiation-Emitting Isotopes,"etc.
*7. Limit switch for nuclear power: a limit switch designed, manufactured and sold according to IEEE 382 and JEAG 4121.

Any Azbil Corporation's products shall not be used for/with medical equipment.

The products are for industrial use. Do not allow general consumers to install or use any Azbil Corporation's product. However, azbil products can be incorporated into products used by general consumers. If you intend to use a product for that purpose, please contact one of our sales representatives.

3.2 Precautions on application

you are required to conduct a consultation with our sales representative and understand detail specifications, cautions for operation, and so forth by reference to catalogs, specifications, instruction manual, etc. in case that you intend to use azbil product for any purposes specified in (1) through (6) below. Moreover, you are required to provide your Equipment with fool-proof design, fail-safe design, anti-flame propagation design, fault avoidance, fault tolerance, and other kinds of protection/safety circuit design on your own responsibility to ensure reliability and safety, whereby preventing problems caused by failure or nonconformity.

(1) For use under such conditions or in such environments as not stated in technical documents, including catalogs, specification, and instruction manuals
(2) For use of specific purposes, such as:
  * Nuclear energy/radiation related facilities
    [When used outside a radiation controlled area and where nuclear power quality is not required]
    [When the limit switch for nuclear power is used]
  * Machinery or equipment for space/sea bottom
  * Transportation equipment
    [Railway, aircraft, vessels, vehicle equipment, etc.]
  * Antidisaster/crime-prevention equipment
  * Burning appliances
  * Electrothermal equipment
  * Amusement facilities
  * Facilities/applications associated directly with billing
(3) Supply systems such as electricity/gas/water supply systems, large-scale communication systems, and traffic/air traffic control systems requiring high reliability
(4) Facilities that are to comply with regulations of governmental/public agencies or specific industries
(5) Machinery or equipment that may affect human lives, human bodies or properties
(6) Other machinery or equipment equivalent to those set forth in items (1) to (5) above which require high reliability and safety

4. Precautions against long-term use

Use of Azbil Corporation's products, including switches, which contain electronic components, over a prolonged period may degrade insulation or increase contact-resistance and may result in heat generation or any other similar problem causing such product or switch to develop safety hazards such as smoking, ignition, and electrification. Although acceleration of the above situation varies depending on the conditions or environment of use of the products, you are required not to use any Azbil Corporation's products for a period exceeding ten (10) years unless otherwise stated in specifications or instruction manuals.

5. Recommendation for renewal

Mechanical components, such as relays and switches, used for Azbil Corporation's products will reach the end of their life due to wear by repetitious open/close operations.

In addition, electronic components such as electrolytic capacitors will reach the end of their life due to aged deterioration based on the conditions or environment in which such electronic components are used. Although acceleration of the above situation varies depending on the conditions or environment of use, the number of open/close operations of relays, etc. as prescribed in specifications or instruction manuals, or depending on the design margin of your machine or equipment, you are required to renew any Azbil Corporation's products every 5 to 10 years unless otherwise specified in specifications or instruction manuals. System products, field instruments (sensors such as pressure/flow/level sensors, regulating valves, etc.) will reach the end of their life due to aged deterioration of parts. For those parts that will reach the end of their life due to aged deterioration, recommended replacement cycles are prescribed. You are required to replace parts based on such recommended replacement cycles.

6. Other precautions

Prior to your use of Azbil Corporation's products, you are required to understand and comply with specifications (e.g., conditions and environment of use), precautions, warnings/cautions/notices as set forth in the technical documents prepared for individual Azbil Corporation's products, such as catalogs, specifications, and instruction manuals to ensure the quality, reliability, and safety of those products.

7. Changes to specifications

Please note that the descriptions contained in any documents provided by azbil are subject to change without notice for improvement or for any other reason. For inquires or information on specifications as you may need to check, please contact our branch offices or sales offices, or your local sales agents.

8. Discontinuance of the supply of products/parts

Please note that the production of any Azbil Corporation's product may be discontinued without notice. After manufacturing is discontinued, we may not be able to provide replacement products even within the warranty period.

For repairable products, we will, in principle, undertake repairs for five (5) years after the discontinuance of those products. In some cases, however, we cannot undertake such repairs for reasons, such as the absence of repair parts. For system products, field instruments, we may not be able to undertake parts replacement for similar reasons.

9. Scope of services

Prices of Azbil Corporation's products do not include any charges for services such as engineer dispatch service. Accordingly, a separate fee will be charged in any of the following cases:

(1) Installation, adjustment, guidance, and attendance at a test run
(2) Maintenance, inspection, adjustment, and repair
(3) Technical guidance and technical education
(4) Special test or special inspection of a product under the conditions specified by you

Please note that we cannot provide any services as set forth above in a nuclear energy controlled area (radiation controlled area) or at a place where the level of exposure to radiation is equivalent to that in a nuclear energy controlled area.

Document Number:	CM2-GTX100-2002
Document Name:	AT9000 Advanced Transmitter Differential Pressure/ Pressure Transmitter FOUNDATION™ Fieldbus Model GTX_ _D, GTX_ _G, GTX_ _A, GTX_ _F, GTX_ _R, GTX_ _U, GTX_ _S Operation Manual
Date:	1st edition: Nov. 2015 3rd edition: Apr. 2021
Issued/Edited by:	Azbil Corporation

Azbil Corporation