ABB MEASUREMENT & ANALYTICS | OPERATING INSTRUCTION

266 with FOUNDATION Fieldbus Communication

Pressure transmitters

Engineered solutions for all applications

Measurement made easy

266 models

Introduction

The 2600T family provides comprehensive range of top quality pressure measurement products, specifically designed to meet the widest range of applications ranging from arduous conditions in offshore oil and gas to the laboratory environment of the pharmaceutical industry.

For more information

Further publications for 2600T series pressure products are available for free download from www.abb.com/pressure

or by scanning this code:

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1 Introduction

Instruction manual structure

The present manual provides information on installing, operating, troubleshooting the 266 pressure transmitter. Every section of the present manual is specifically dedicated to the specific phase of the transmitter lifecycle starting from the receipt of the transmitter and its identification, passing to the installation, to the electrical connections, to the configuration and to the troubleshooting and maintenance operations.

Models covered by this manual

The present manual can be used for all the 266 models with exception done for the 266C (multivariable version).

Product description

The pressure transmitters model 266 is a modular range of fieldmounted, microprocessor based electronic transmitters, multiple sensor technologies. Accurate and reliable measurement of differential pressure, gauge and absolute pressure, flow and liquid level is provided, in the even most difficult and hazardous industrial environments. Model 266 can be configured to provide specific industrial output signals according to FOUNDATION Fieldbus communication.

2 Safety

General safety information

The “Safety” section provides an overview of the safety aspects to be observed for operation of the device.
The device has been constructed in accordance with the state of the art and is operationally safe. It has been tested and left the factory in perfect working conditions. The information in the manual, as well as the applicable documentation and certificates, must be observed and followed in order to maintain this condition throughout the period of operation.
Full compliance with the general safety requirements must be observed during operation of the device. In addition to the general information, the individual sections in the manual contain descriptions of processes or procedural instructions with specific safety information.
Only by observing all of the safety information can you reduce to the minimum the risk of hazards for personnel and/or environment. These instructions are intended as an overview and do not contain detailed information on all available models or every conceivable event that may occur during setup, operation, and maintenance work.
For additional information, or in the event of specific problems not covered in detail by these operating instructions, please contact the manufacturer. In addition, ABB declares that the contents of this manual are not part of any prior or existing agreements, commitments, or legal relationships; nor are they intended to amend these.

All obligations of ABB arise from the conditions of the relevant sales agreement, which also contains the solely binding warranty regulations in full. These contractual warranty provisions are neither extended nor limited by the information provided in this manual.

⚠ WARNING

Only qualified and authorized specialist personnel should be charged with installation, electrical connection, commissioning, and maintenance of the transmitter. Qualified personnel are persons who have experience in installation, electrical wiring connection, commissioning, and operation of the transmitter or similar devices, and hold the necessary qualifications such as:

- Training or instruction, i.e., authorization to operate and maintain devices or systems according to safety engineering standards for electrical circuits, high pressures, and aggressive media
- Training or instruction in accordance with safety engineering standards regarding maintenance and use of adequate safety systems.

For safety reasons, ABB draws your attention to the fact that only sufficiently insulated tools conforming to DIN EN 60900 may be used.

Since the transmitter may form part of a safety chain, we recommend replacing the device immediately if any defects are detected. In case of use in Hazardous Area non sparking tools only must be employed.

In addition, you must observe the relevant safety regulations regarding the installation and operation of electrical systems, and the relevant standards, regulations and guidelines about explosion protection.

⚠ WARNING

The device can be operated at high levels of pressure and with aggressive media. As a result, serious injury or significant property damage may occur if this device is operated incorrectly.

Improper use

It is prohibited to use the device for the following purposes:
- As a climbing aid, e.g., for mounting purposes
- As a support for external loads, e.g., as a support for pipes.
- Adding material, e.g., by painting over the name plate or welding/soldering on parts
- Removing material, e.g., by drilling the housing.

Repairs, alterations, and enhancements, or the installation of replacement parts, are only permissible as far as these are described in the manual. Approval by ABB must be requested for any activities beyond this scope. Repairs performed by ABB-authorized centers are excluded from this.

Technical limit values

The device is designed for use exclusively within the values stated on the name plates and within the technical limit values specified on the data sheets.
The following technical limit values must be observed:

- The Maximum Working Pressure may not be exceeded.
- The Maximum ambient operating temperature may not be exceeded.
- The Maximum process temperature may not be exceeded.
- The housing protection type must be observed.

Warranty prevision

Using the device in a manner that does not fall within the scope of its intended use, disregarding this manual, using underqualified personnel, or making unauthorized alterations, releases the manufacturer from any liability for any resulting damage. This makes the manufacturer's warranty null and void.

Use of instruction

The symbols used in this document are explained below:

⚠ DANGER

The signal word '**DANGER**' indicates an imminent danger. Failure to observe this information will result in death or severe injury.

⚠ WARNING

The signal word '**WARNING**' indicates an imminent danger. Failure to observe this information may result in death or severe injury.

⚠ CAUTION

The signal word '**CAUTION**' indicates an imminent danger. Failure to observe this information may result in minor or moderate injury.

NOTICE

The signal word '**NOTICE**' indicates potential damage to material or its surrounding area.

IMPORTANT

This message indicates operator tips or particularly useful information. It does not indicate a dangerous or damaging situation.

Operator liability

Prior to using corrosive and abrasive materials for measurement purposes, the operator must check the level of resistance of all parts coming into contact with the materials to be measured. ABB will gladly support you in selecting the materials, but cannot accept any liability in doing so.
The operators must strictly observe the applicable national regulations with regard to installation, function tests, repairs, and maintenance of electrical devices.

Qualified personnel

Installation, commissioning, and maintenance of the device may only be performed by trained specialist personnel who have been authorized by the plant operator. The specialist personnel must have read and understood the manual and comply with its instructions.

Returning devices

Use the original packaging or suitably secure shipping package if you need to return the device for repair or recalibration purposes. Fill out the return form (see the end of the document) and include this with the device.
According to EC guidelines and other local laws for hazardous materials, the owner of hazardous waste is responsible for its disposal. The owner must observe the proper regulations for shipping purposes.
All devices sent back to ABB must be free from any hazardous materials (acids, alkalis, solvents, etc.).

Disposal

ABB actively promotes environmental awareness and has an operational management system that meets the requirements of DIN EN ISO 9001:2000, EN ISO 14001:2004, and OHSAS 18001. Our products and solutions are intended to have minimum impact on the environment and persons during manufacturing, storage, transport, use and disposal.
This includes the environmentally friendly use of natural resources. ABB conducts an open dialog with the public through its publications.
This product/solution is manufactured from materials that can be reused by specialist recycling companies.

Information on WEEE Directive 2012/19/EU

This product or solution is subject to the WEEE Directive 2012/19/EU (Waste Electrical and Electronic Equipment) or corresponding national laws. Starting from August 15th 2018, electrical and electronic equipment marked with the crossed-out wheeled bin symbol may not be disposed as unsorted municipal waste. Waste of electrical and electronic equipment (WEEE) shall be treated separately using the national collection framework available to customers for the return, recycling and treatment of WEEE.

Proper disposal prevents negative effects on people and the environment, and supports the reuse of valuable raw materials. ABB can accept and dispose of returns for a fee.

Transport and storage

- After unpacking the pressure transmitter, check the device for transport damage.
- Check the packaging material for accessories.
- During intermediate storage or transport, store the pressure transmitter in the original packaging only.

For information on permissible ambient conditions for storage and transport, see “Technical data”. Although there is no limit on the duration of storage, the warranty conditions stipulated on the order acknowledgment from the supplier still apply.

Safety information for electrical installation

Electrical connections may only be established by authorized specialist personnel in accordance with the electrical circuit diagrams. The electrical connection information in the manual must be observed; otherwise, the applicable protection type may be affected. Ground the measurement system according to requirements.

Safety information for inspection and maintenance

⚠ WARNING

There is no EMC protection or protection against accidental contact when the housing cover is open. There are electric circuits within the housing which are dangerous if touched. Therefore, the auxiliary power must be switched off before opening the housing cover.

⚠ WARNING

The device can be operated at high pressure and with aggressive media. Any process media released may cause severe injuries. Depressurize the pipeline/tank before opening the transmitter connection.

Corrective maintenance work may only be performed by trained personnel.

- Before removing the device, depressurize it and any adjacent lines or containers.
- Check whether hazardous materials have been used as materials to be measured before opening the device.
- Residual amounts of hazardous substances may still be present in the device and could escape when the device is opened.
- Within the scope of operator responsibility, check the following as part of a regular inspection:
  – Pressure-bearing walls/lining of the pressure device
  – Measurement-related function
  – Leak-tightness
  – Wear (corrosion)

3 Transmitter overview

Transmitter components overview

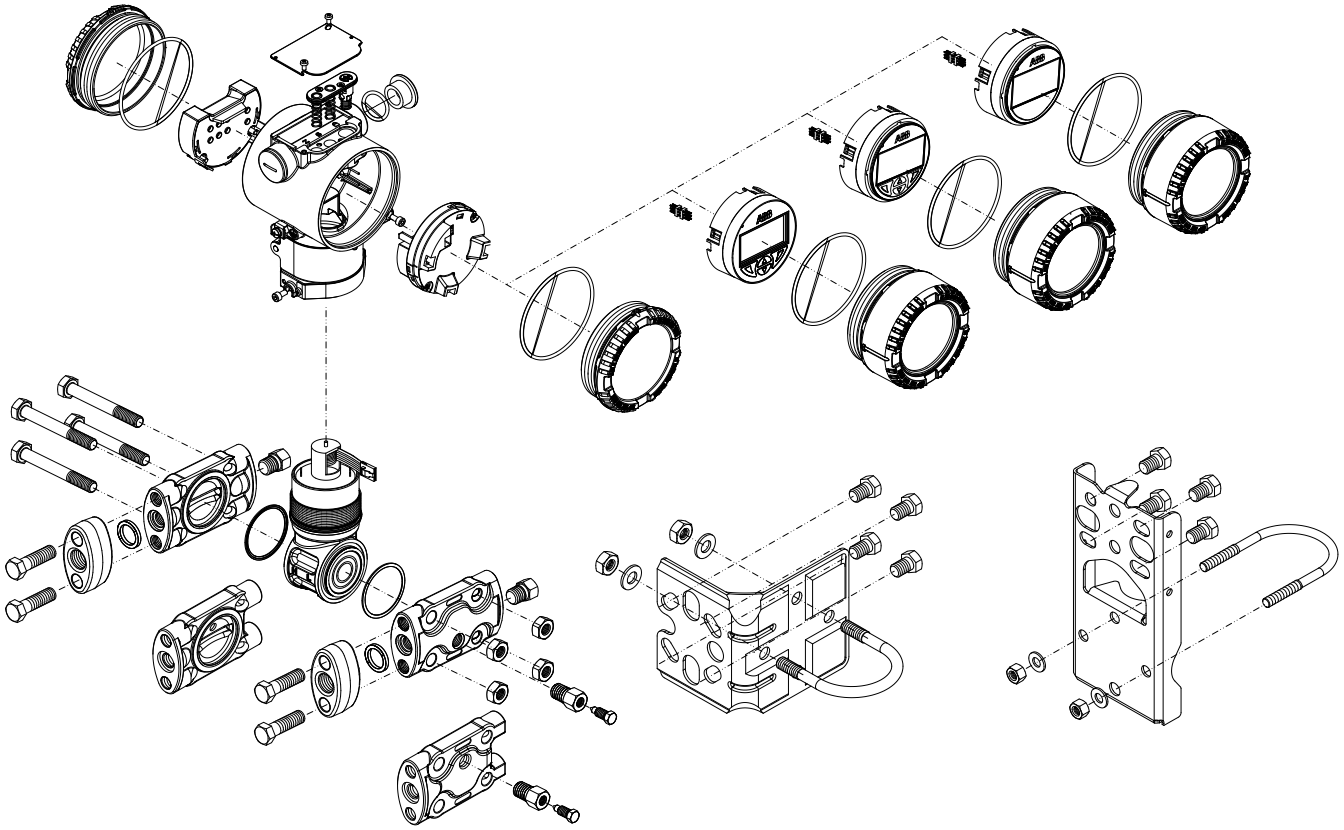


Figure 1: Differential pressure transmitter components

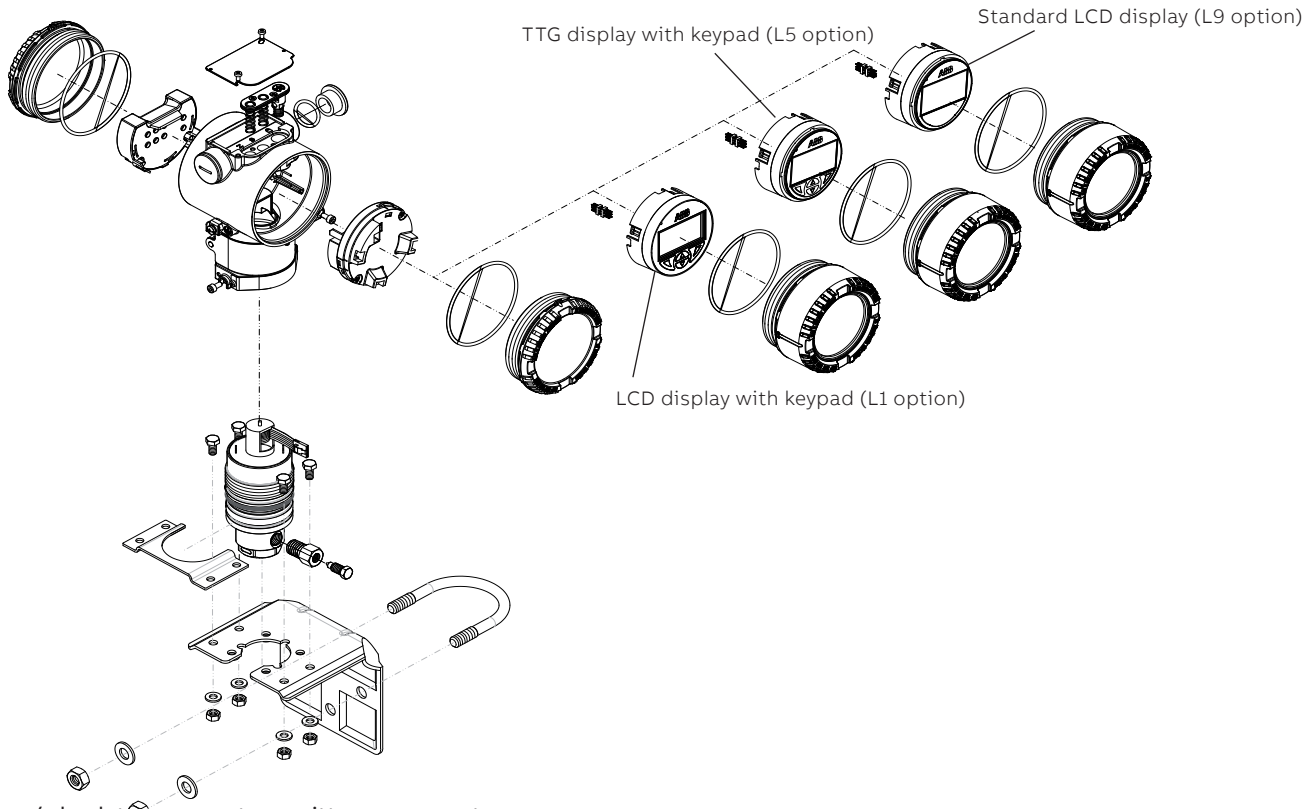


Figure 2: Gauge / absolute pressure transmitter components

IMPORTANT

Above pictures show only two different kinds of transmitters equipped with Barrel type housing. Please note that DIN housings are available.

Range & Span consideration

The 2600T Transmitter Specification Sheets provide all information concerning the Range and Span limits in relation to the model and the sensor code.
The terminology currently used to define the various parameters is as follows:

- URL: Upper Range Limit of a specific sensor. The highest value of the measured value that the transmitter can be adjusted to measure.
- LRL: Lower Range Limit of a specific sensor. The lowest value of the measured value that the transmitter can be adjusted to measure.
- URV: Upper Range Value. The highest value of the measured value to which the transmitter is calibrated.
- LRV: Lower Range Value. The lowest value of the measured value to which the transmitter is calibrated.
- SPAN: The algebraic difference between the Upper and Lower Range Values. The minimum span (MIN SPAN) is the minimum value that can be used without degradation of the specified performance. The calibration span (CAL SPAN) is the difference between Upper Range Value (URV) and Lower Range Value (LRV).
- TD: (or Turn Down Ratio) is the ratio between the maximum span and the calibrated span.

The transmitter can be calibrated with any range between the LRL and the URL with the following limitations:

- LRL ≤ LRV ≤ (URL - CAL SPAN)
- CAL SPAN ≥ MIN SPAN
- URV ≤ URL

4 Opening the box

Identification

The instrument is identified by the data plates shown in Figure 3. The certification plate (ref. A): contains the certification related parameters for use in Hazardous area.
The Nameplate (ref. B), always made of AISI 316 ss, provides information concerning the model code, maximum working pressure, range and span limits, power supply, output signal, diaphragms material, fill fluid, range limit, serial number, maximum process working pressure (PS) and temperature (TS).
The Tag plate, instead, provides customer tag number and calibrated range.
Both certification and tag plates are supplied self-adhesive attached to the electronics housing, as standard. Option I2 allows to select these plates as metal AISI 316 ss fastened to the electronics housing with rivets.
The instrument may be used as a pressure accessory as defined by the Pressure Equipment Directive 2014/68/EU:
- category III module H for PS > 20 MPa, 200 bar
- art. 4, par. 3 Sound Engineering Practice (SEP) for PS < 20 MPa, 200 bar and for all PS values of 266xRx models.

In this case, near the CE mark, you will find the number of the notified body (0474) that has verified the compliance according to module H.
266 pressure transmitters comply with directive EMC 2014/30/EU.

The certification plate (ref.A) shown here is issued by ABB S.p.A, 22016 Tremezzina, Italy, with the numbers:
- FM09ATEX0023X or IECEx FME 16.0002X (Ex db, Ex tb)
- FM09ATEX0024X or IECEx FME 16.0003X (Ex ia)
- FM09ATEX0025X or IECEx FME 16.0004X (Ex ic) (Ex nA)

CE-Identification number of the notified bodies to Pressure Equipment Directive: 0474, to ATEX certification: 0722, to IECEx certification: IT/CES/QAR07.0001.
The certification plate may also be issued by
- ABB India Limited, 560058 Bangalore, India -
- ABB Engineering Limited, Shanghai 201319, P.R. China
- ABB Inc. Warminster PA 18974, USA

with the same certification numbers.

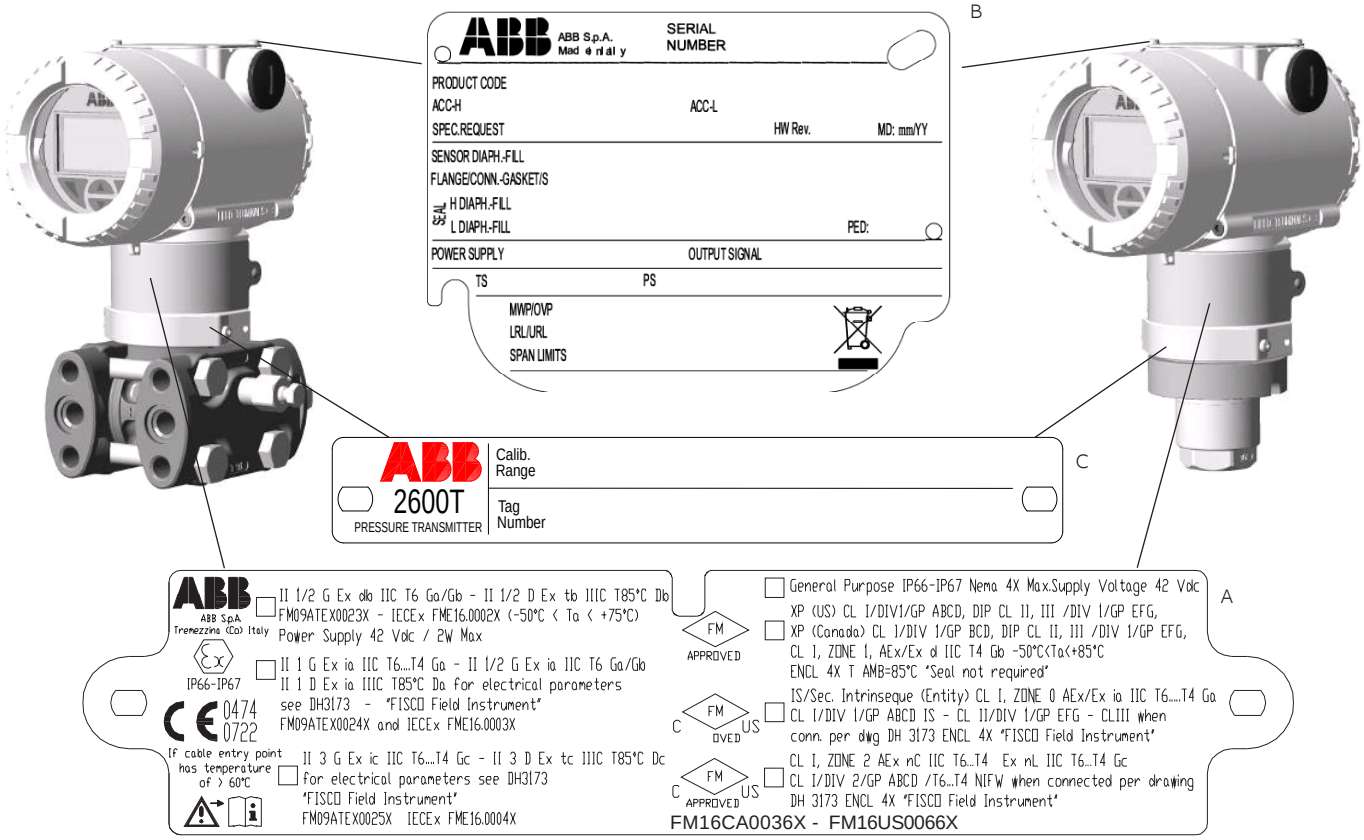


Figure 3: Product identification

Optional wired-on SST plate (I1)

The 266 transmitter can be supplied with the optional “Wired On Stainless Steel plate” (figure 4) which is permanently laser printed with a custom text specified in phase of order. The available space consists in 4 lines with 32 characters per line. The plate will be connected to the transmitter with a Stainless Steel wire.

Figure 4: 4-line layout of the optional wired-on Stainless Steel plate

Handling

The instrument does not require any special precautions during handling although normal good practice should be observed.

Storage

The instrument does not require any special treatment if stored as dispatched and within the specified ambient conditions. There is no limit to the storage period, although the terms of guarantee remain as agreed with the Company and as given in the order acknowledgement.

5 Mounting

General

Study these installation instructions carefully before proceeding. Failure to observe the warnings and instructions may cause a malfunction or personal hazard. Before installing the transmitter, check whether the device design meets the requirements of the measuring point from a measurement technology and safety point of view.
This applies in respect of the explosion protection certification, measuring range, gauge pressure stability, temperature (Ambient and Process), operating voltage.
The suitability of the materials must be checked as regards their resistance to the media. This applies in respect of the:

- Gasket
- Process connection, isolating diaphragm, etc.

In addition, the relevant directives, regulations, standards, and accident prevention regulations must be observed (e.g., VDE/VDI 3512, DIN 19210, VBG, Elex V, etc.). Measurement accuracy is largely dependent on correct installation of the pressure transmitter and, if applicable, the associated measuring pipe(s). As far as possible, the measuring setup should be free from critical ambient conditions such as large variations in temperature, vibrations, or shocks.

IMPORTANT

If unfavorable ambient conditions cannot be avoided for reasons relating to building structure, measurement technology, or other issues, the measurement quality may be affected. If a remote seal with capillary tube is installed on the transmitter, the additional operating instructions for remote seals and the related data sheets must be observed.

IP protection & designation

The housings for 266 transmitters are certified as conforming to protection type IP66 / IP67 (according tonIEC 60529) or NEMA 4X (according to NEMA 250).
The first number indicates the type of protection the integrated electronics have against the entry of foreign bodies, including dust.
“6” means that housing is dust-proof (i.e., no ingress of dust).
The second number indicates the type of protection the housing has against the entry of water.
“6” means that housing is protected against water; specifically, powerful jets of water under standardized conditions.
“7” means that housing is protected against water; specifically, against the effects of temporary immersion in water under standardized water pressure and temporal conditions.

Mounting the transmitter

Transmitter factory configuration consideration
The 266 pressure transmitter in your hands has been factory calibrated to reflect the published declared performance specification; no further calibration is required in normal condition.

ABB typically configures 266 pressure transmitters according to the user requirements. A typical configuration includes:
- TAG number
- Calibrated span
- Output linearization
- LCD display configuration

Hazardous area considerations
The transmitter must be installed in hazardous area only if it is properly certified. The certification plate is permanently fixed on the neck of the transmitter top housing. The 266 Pressure Transmitter Line can have the following certifications:

INTRINSIC SAFETY Ex ia:
- ATEX Europe (code E1) approval
  II 1 G Ex ia IIC T6...T4 Ga, II 1/2 G Ex ia IIC T6...T4 Ga/Gb,
  II 1 D Ex ia IIIC T85 °C Da, II 1/2 D Ex ia IIIC T85 °C Da;
  IP66, IP67.
- IECEx (code E8) approval
  Ex ia IIC T6...T4 Ga/Gb, Ex ia IIIC T85 °C Da; IP66, IP67.

EXPLOSION PROOF:
- ATEX Europe (code E2) approval
  II 1/2 G Ex db IIC T6 Ga/Gb Ta=–50 °C to +75 °C,
  II 1/2 D Ex tb IIIC T85 °C Db Ta = –50 °C to +75 °C;
  IP66, IP67.
- IECEx (code E9) approval
  Ex db IIC T6 Ga/Gb Ta=–50 °C to +75 °C,
  Ex tb IIIC T85 °C Db Ta = –50 °C to +75 °C; IP66, IP67.

FM Approvals US (code E6), FM Approvals Canada (code E4):
- Explosionproof (US): Class I, Division 1,
  Groups A, B, C, D; T5
- Explosionproof (Canada): Class I, Division 1,
  Groups B, C, D; T5
- Dust-ignitionproof: Class II, Division 1, Groups E, F, G;
  Class III, Div. 1; T5
- Flameproof (US): Class I, Zone 1 AEx d IIC T4 Gb
- Flameproof (Canada): Class I, Zone 1 Ex d IIC T4 Gb
- Nonincendive: Class I, Division 2, Groups A, B, C, D T6...T4
- Energy limited (US): Class I, Zone 2 AEx nC IIC T6...T4
- Energy limited (Canada): Class I, Zone 2 Ex nC IIC T6...T4
- Intrinsically safe: Class I, II, III, Division 1,
  Groups A, B, C, D, E, F, G T6...T4
  Class I, Zone 0 AEx ia IIC T6...T4 (US)
  Class I, Zone 0 Ex ia IIC T6...T4 (Canada)

Type 4X, IP66, IP67 for all above markings.

COMBINED FM Approvals US and Canada
- Intrinsically safe (code EA)

COMBINED ATEX, FM and IECEx Approvals (code EN)

Technical Regulations Customs Union EAC (Russia, Kazakhstan, Belarus), Inmetro (Brazil), Kosha (Korea)

NEPSI China approvals:
- INTRINSIC SAFETY Ex ia (code EY):
  Ex ia IIC T4/T5/T6 Ga, Ex ia IIC T4/T5/T6 Ga/Gb,
  Ex iaD 20 T85/T100/T135, Ex iaD 20/21 T85/T100/T135.
- EXPLOSION PROOF (code EZ):
  Ex d IIC T6 Gb, Ex tD A21 IP67 T85 °C.
- INTRINSIC SAFETY Ex ic (code ES):
  Ex ic IIC T4~T6 Gc, Ex nA IIC T4~T6 Gc,
  Ex tD A22 IP67 T85 °C.

IMPORTANT

REFER TO CERTIFICATES FOR AMBIENT TEMPERATURE RANGES RELATED TO THE DIFFERENT TEMPERATURE CLASSES.

HIGH STATIC VERSION IS NOT IN COMPLIANCE WITH ISA 12.27.01 FOR SEALING REQUIREMENTS, SPECIFICALLY FOR FM APPROVAL (Canada).

⚠ WARNING

General Risk for model 266 used in zone 0.

The enclosure contains aluminum and is considered to present a potential risk of ignition by impact or friction. Care must be taken into account during installation and use to prevent impact or friction. pening the housing cover.

Pressure Equipment Directive (PED) (2014/68/EU)

Devices with PS > 200 bar

Devices with a permissible pressure PS >200 bar have been subject to a conformity validation. The data label includes the following specifications:

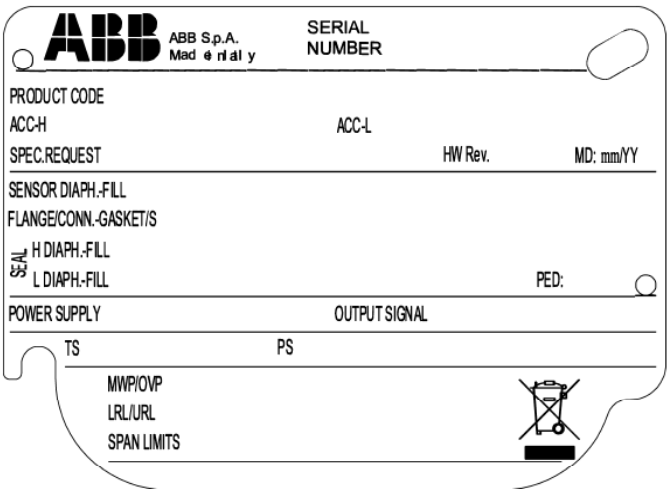


Figure 5: 266 nameplate with PED data

Devices with PS ≤200 bar

Devices with a permissible pressure PS ≤200 bar correspond to article 3 paragraph (3). They have not been subject to a conformity validation. These instruments were designed and manufactured acc. to SEP Sound Engineering Practices.

Mounting a DP sensor transmitter

The pressure transmitter models 266DSH, 266MST and 266RST can be mounted directly on the manifold. A mounting bracket for wall or pipe mounting (2" pipe) is also available as an accessory. For models 266DRH, 266MRT and 266RRT always mounting brackets should be used. Ideally, the pressure transmitter should be mounted in a vertical position to prevent subsequent zero shifts.

IMPORTANT

If the transmitter is installed inclined with respect to the vertical, the filling liquid exerts hydrostatic pressure on the measuring diaphragm, resulting in a zero shift. In such an event, the zero point can be corrected via the zero push-button or via the "set PV to zero" command. Please refer to the following paragraph for further details. For transmitters without diaphragm seals, please read the considerations on the Vent/Drain.

During installation of the transmitter, zero shifts caused by mounting (e.g., a slightly oblique mounting position due to a remote seal, etc.) may occur; these must be corrected.

IMPORTANT

The transmitter must have reached its operating temperature (approx. 5 min. after startup, if the transmitter has already reached the ambient temperature).

This correction can be executed only if the Calibration Lower Range value is 0.0 and must be made with process (dp or p) = 0.

The correction consists in the Zero elevation/suppression operation and can be done in two ways:

1. Locally by acting on the Z push button when the electronic switch SW 3 is set to 0,
2. From remote station via FF communication writing 0.0 in the PTRB_DESIRED_PRIMARY_VALUE

In case the Calibration Lower Range value is not 0.0 then the correction cannot be made with the local Z push button, but it can be done only from remote station via FF communication writing the correct measure value in the PTRB_DESIRED_PRIMARY_VALUE

IMPORTANT

After the above operations the Calibration Range Values are not changed. The desired process output value is produced through an internal calculation by applying an offset at the measured value.

NOTICE

In case of a High Static differential pressure transmitter (266DSH.x.H) please always open the equalization valve of the manifold (if installed) before applying pressure to the transmitter. High Static pressure can damage the sensor causing a zero shift and a serious decrease of the total performance in terms of accuracy. In this case, please perform a full sensor trim.

It is important to mount the transmitter and to lay the process piping so that gas bubbles, when measuring liquids, or condensate when measuring gases, will flow back to the process and not enter the transmitter measuring chamber. Optional Vent/drain valves (code V1/V2/V3) on the transmitter are located on the sensor flanges.
The transmitter has to be positioned so that these drain/vent valves will be located higher than the taps on liquid service in order to allow the venting of entrapped gas or below the taps on gas service in order to allow the air to vent off or condensate to drain off.

For safety reasons, take care of the drain/vent valves position so that when the process fluid is removed during the drain/vent operation it is directed down and away from technicians. It is recommended to mount the transmitter to prevent this possible source of damage for unskilled operators.

Figure 6: Drain/vent valves configuration (respectively V1, V2, V3)

IMPORTANT

In case of a High Static differential pressure transmitter, please notice that the Vent/Drain valves can be configured only on the process axis (V1).

Bracket mounting (optional)

Different mounting brackets are available please refer to the relevant installation drawing below:

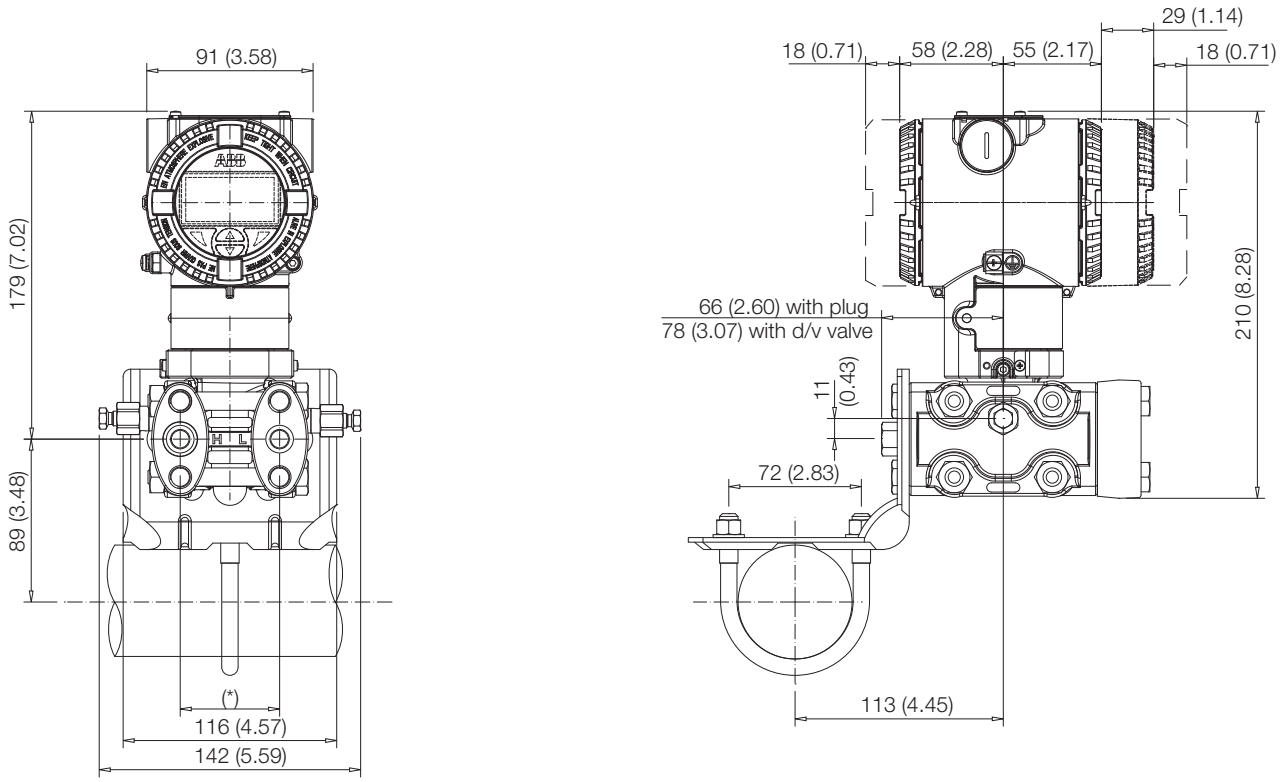


Figure 7: Differential Pressure Style transmitter with barrel housing installed on a horizontal pipe with optional bracket (B2)

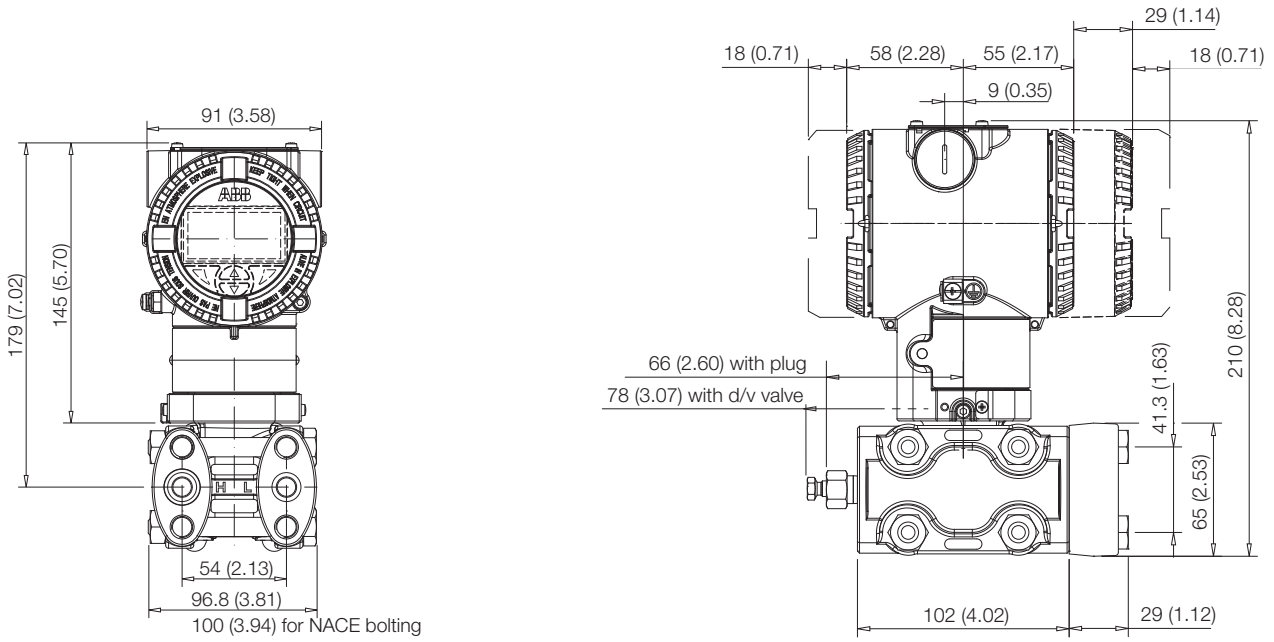


Figure 8: Differential Pressure Style transmitter (High Static option)

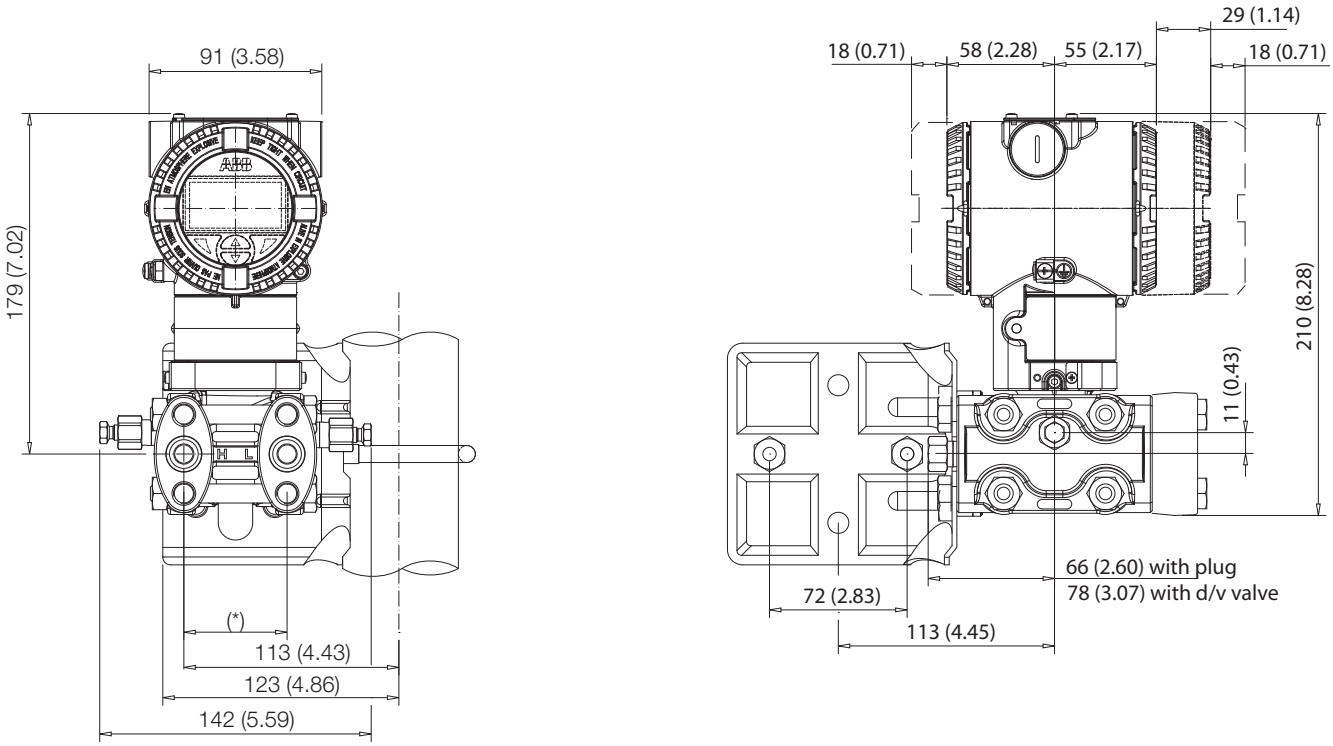


Figure 9: Differential Pressure Style transmitter with barrel housing installed on a vertical pipe with optional bracket (B2)

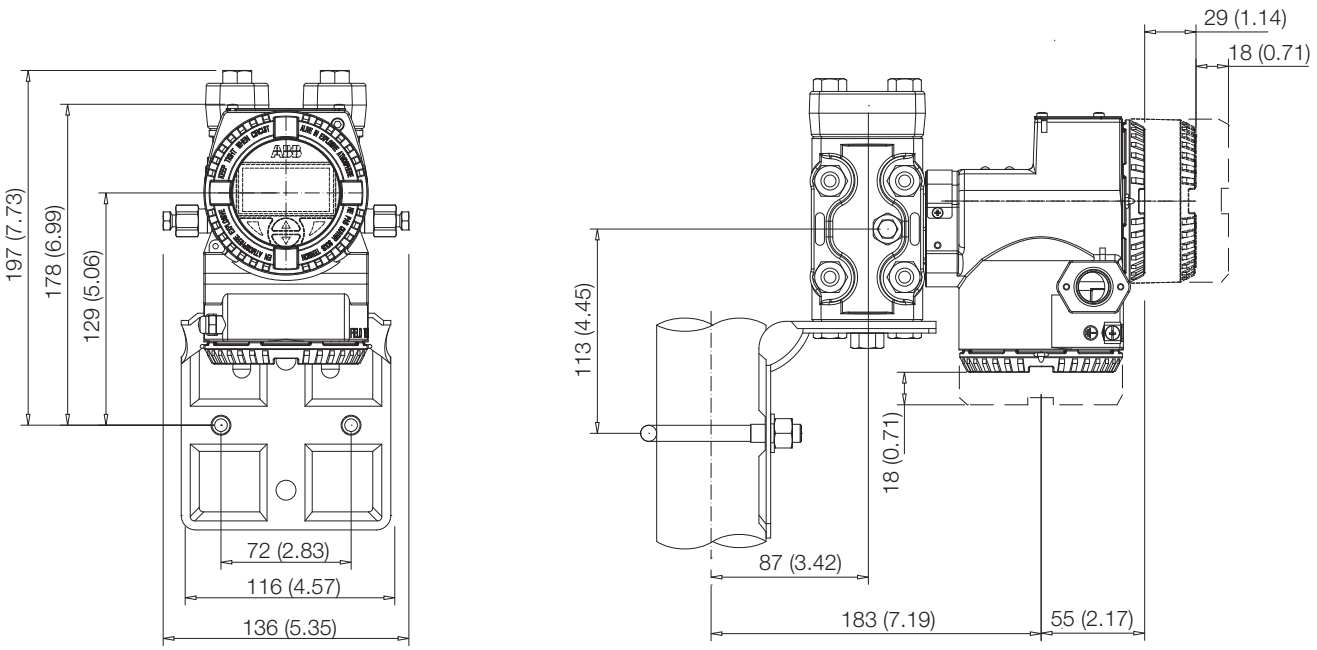


Figure 10: Differential Pressure Style transmitter with DIN housing installed on a Vertical pipe with optional bracket (B2) installation for AIR/GAS measurements

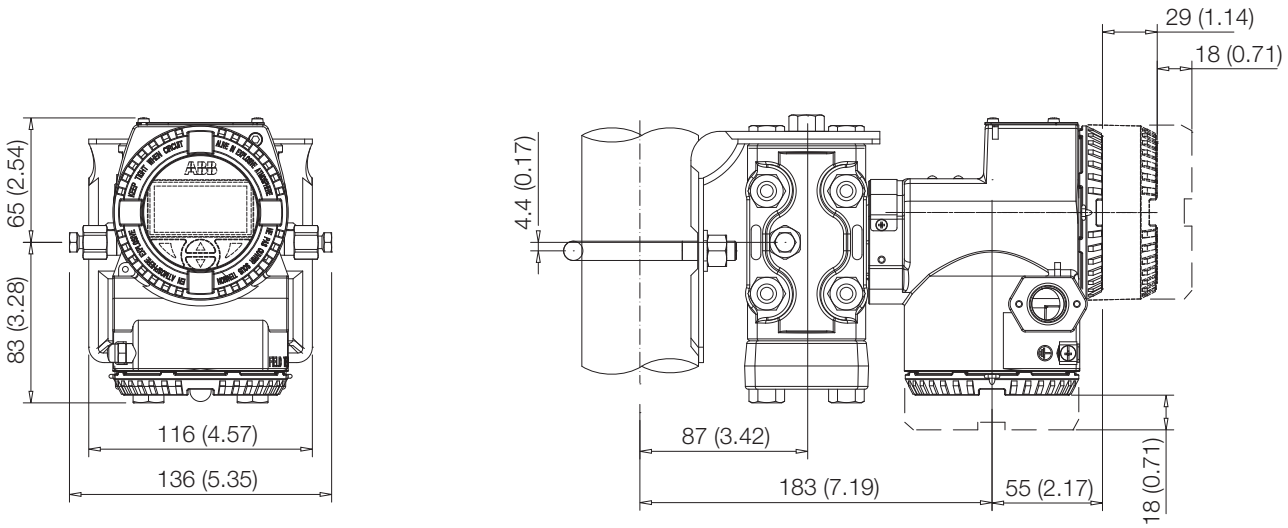


Figure 11: Differential Pressure Style transmitter with barrel housing and Kynar inserts installed on a horizontal pipe with optional bracket (B2)

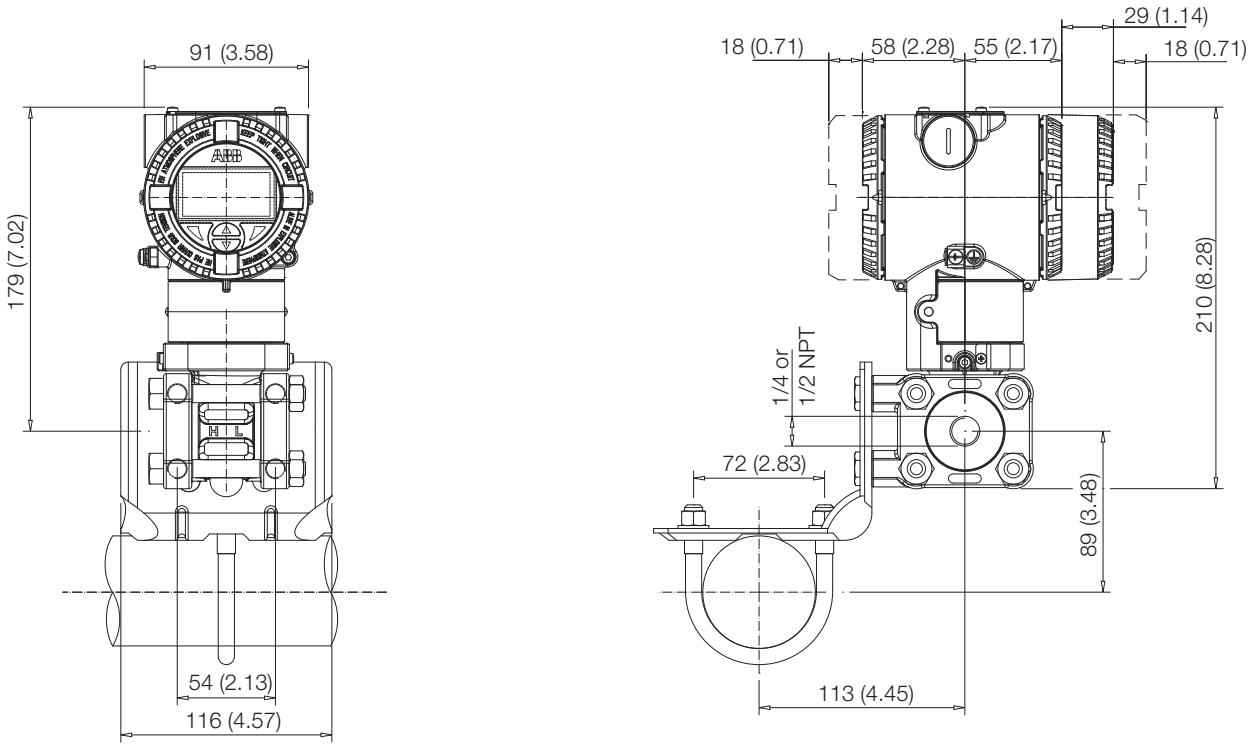


Figure 12: Differential Pressure Style transmitter with barrel housing and Kynar inserts installed on a vertical pipe with optional bracket (B2)

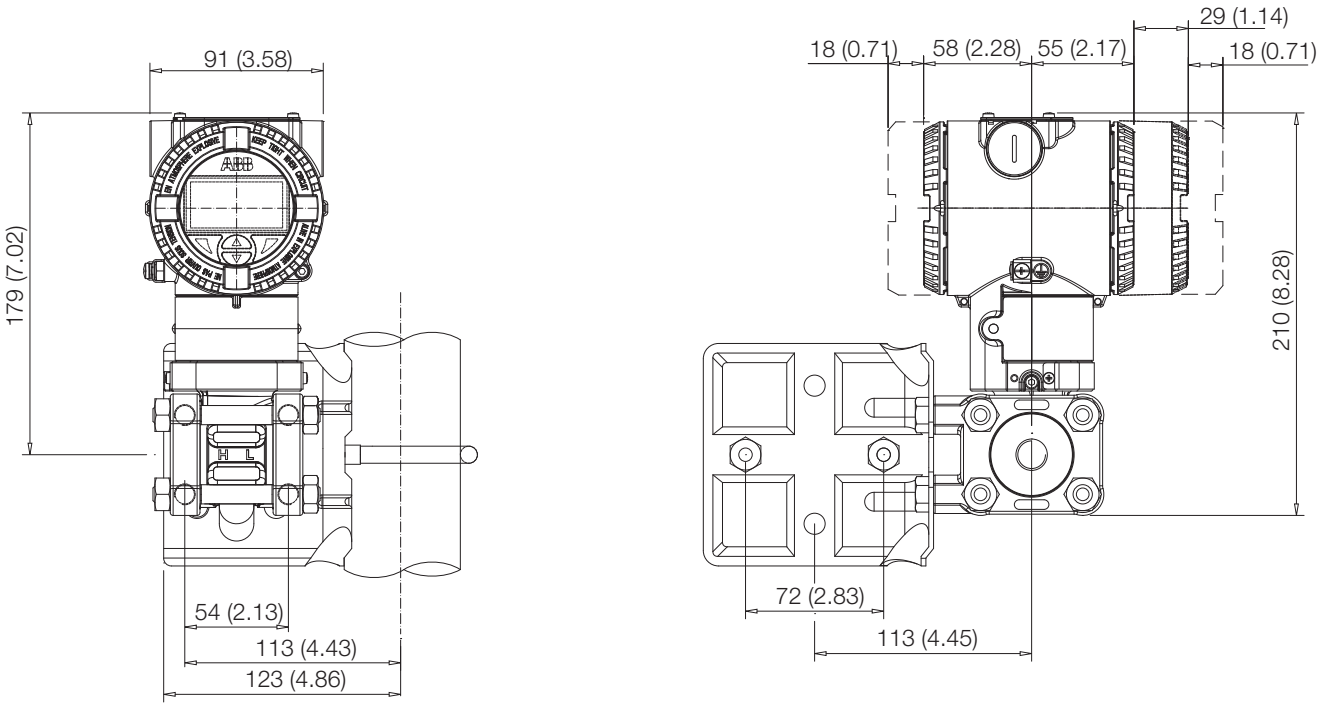


Figure 13: Differential Pressure Style transmitter with barrel housing and Kynar inserts installed on a vertical pipe with optional bracket (B2)

B2 Pipe and wall mounting bracket details

All the bolts and nuts supplied are necessary for the installation on pipe. In case of panel or wall installation, the U-bolt and the U-bolt nuts and washers will not have to be used. The bolts for panel mounting are not within the scope of supply.

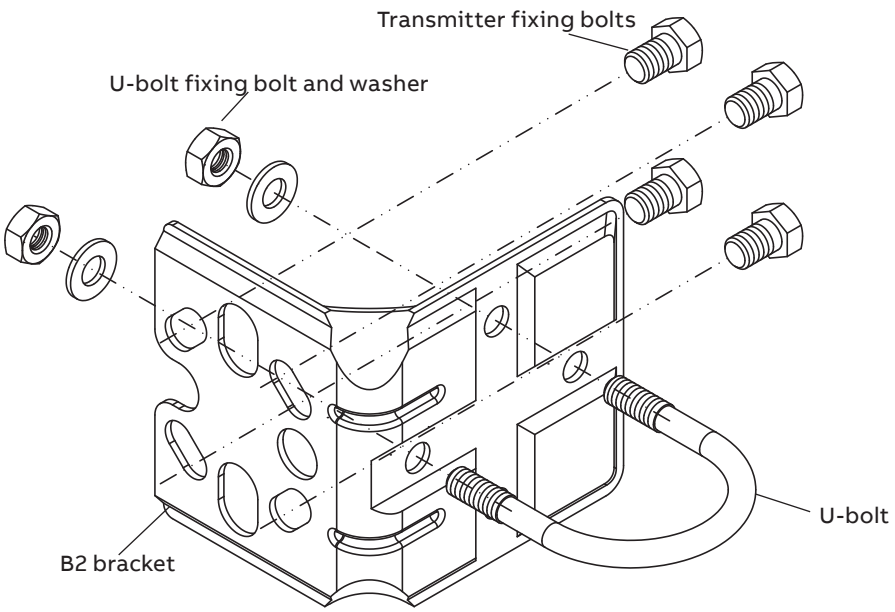


Figure 14: Pipe and wall mounting bracket kit (B2)

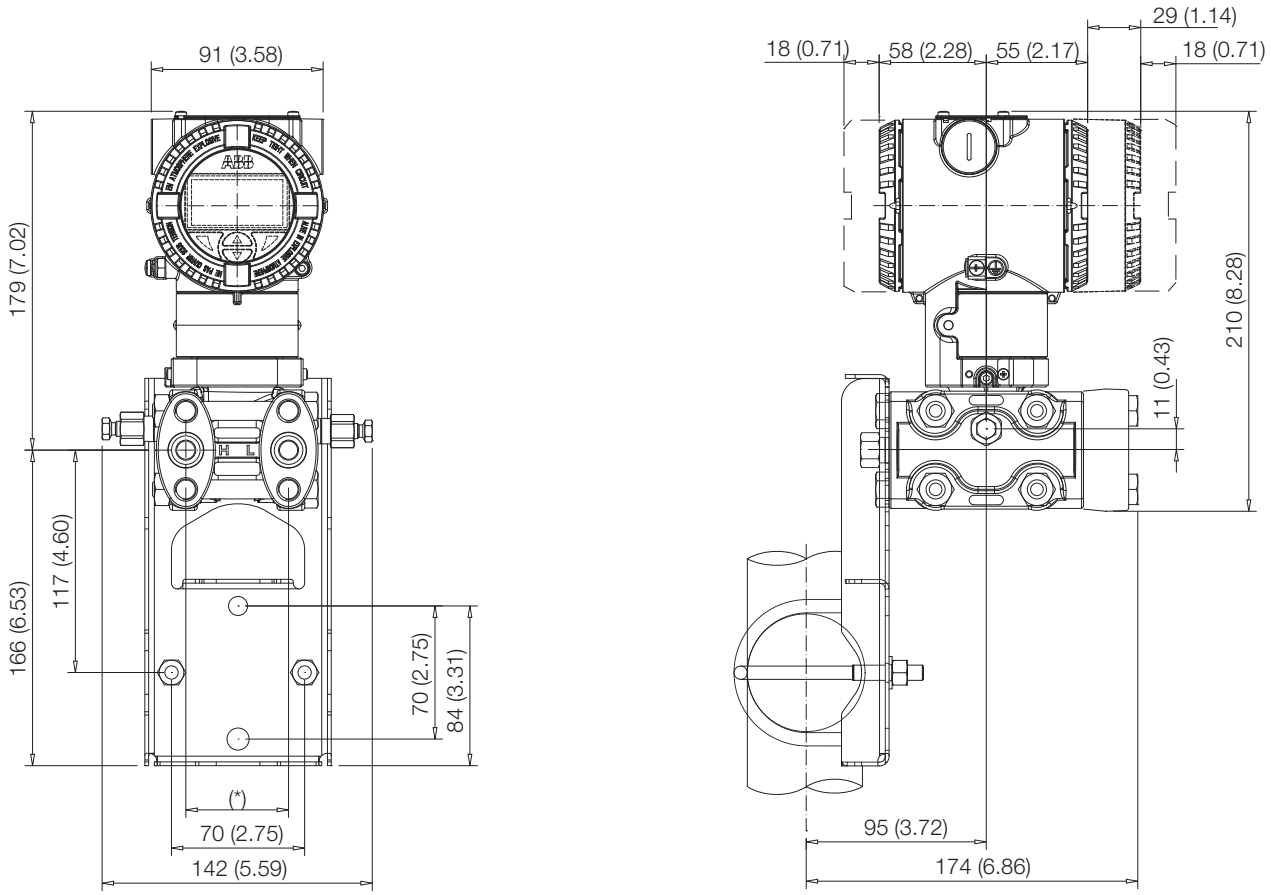


Figure 15: Differential Pressure Style transmitter with barrel housing installed on a box pipe with optional bracket for SST housing (B5)

B5 Flat type bracket details

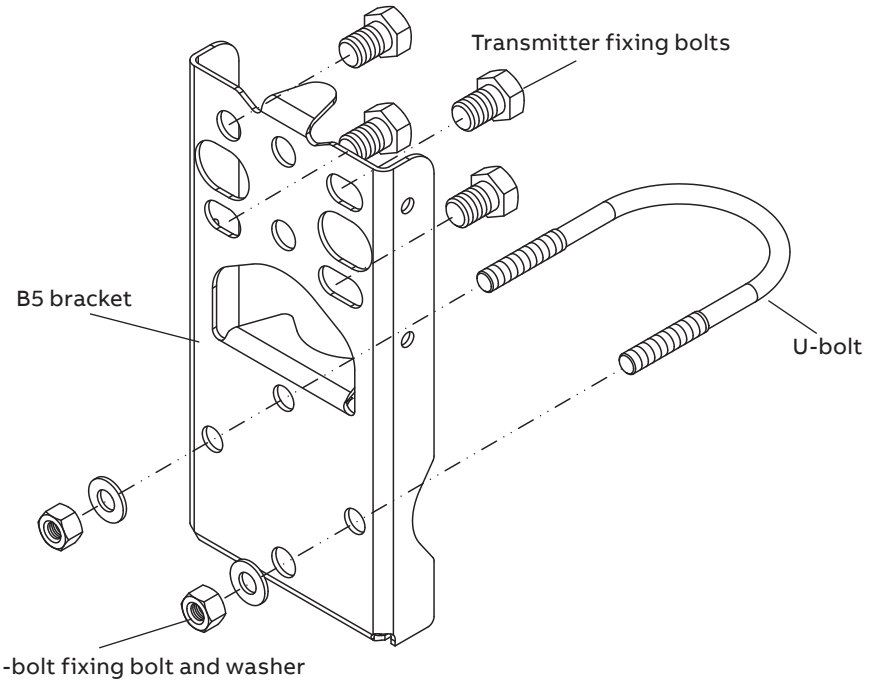


Figure 16: Flat type mounting bracket kit (B5)

Mounting a P style pressure transmitter

The pressure transmitter can be mounted directly on the manifold. A mounting bracket for wall or pipe mounting (2" pipe) is also available as an accessory. Ideally, the pressure transmitter should be mounted in a vertical position to prevent subsequent zero shifts.

IMPORTANT

If the transmitter is installed inclined with respect to the vertical, the filling liquid exerts hydrostatic pressure on the measuring diaphragm, resulting in a zero shift. In such an event, the zero point can be corrected via the zero push-button or via the "set PV to zero" command. Please refer to paragraph 5.5for further details. For transmitters without diaphragm seals the Vent / Drain considerations below should be taken into account.

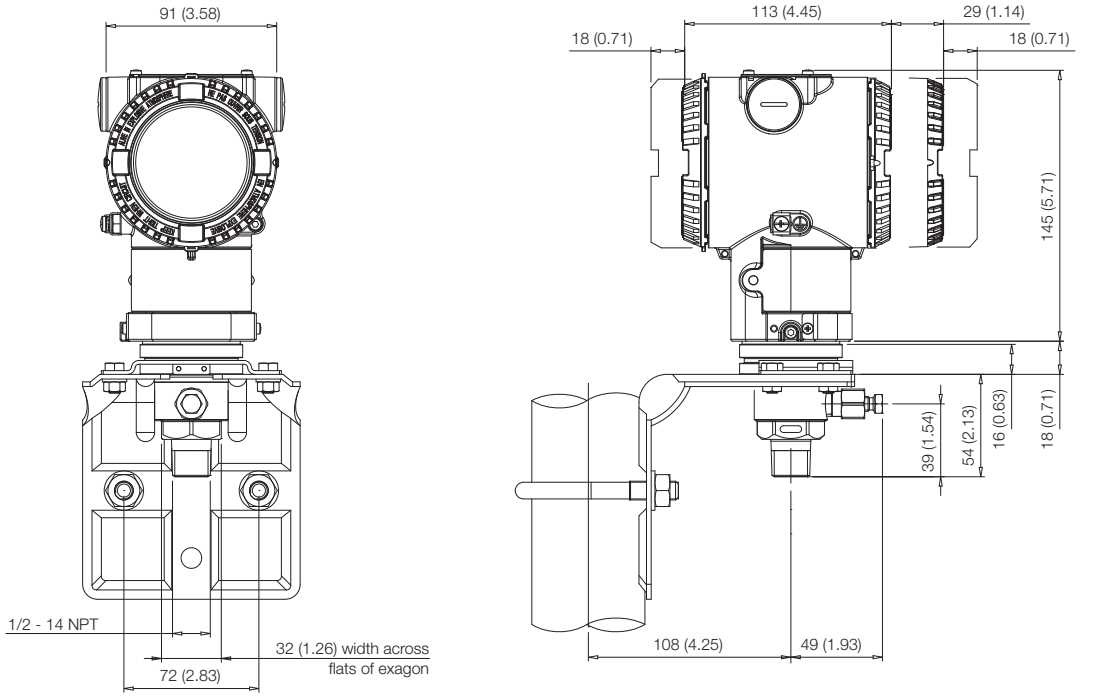


Figure 17: Model 266H or 266N High overload resistant P-Style transmitter with ½-14 NPT male process connection and barrel housing installed on a 2"pipe with optional bracket (B1 carbon steel or B2 Stainless Steel 316L)

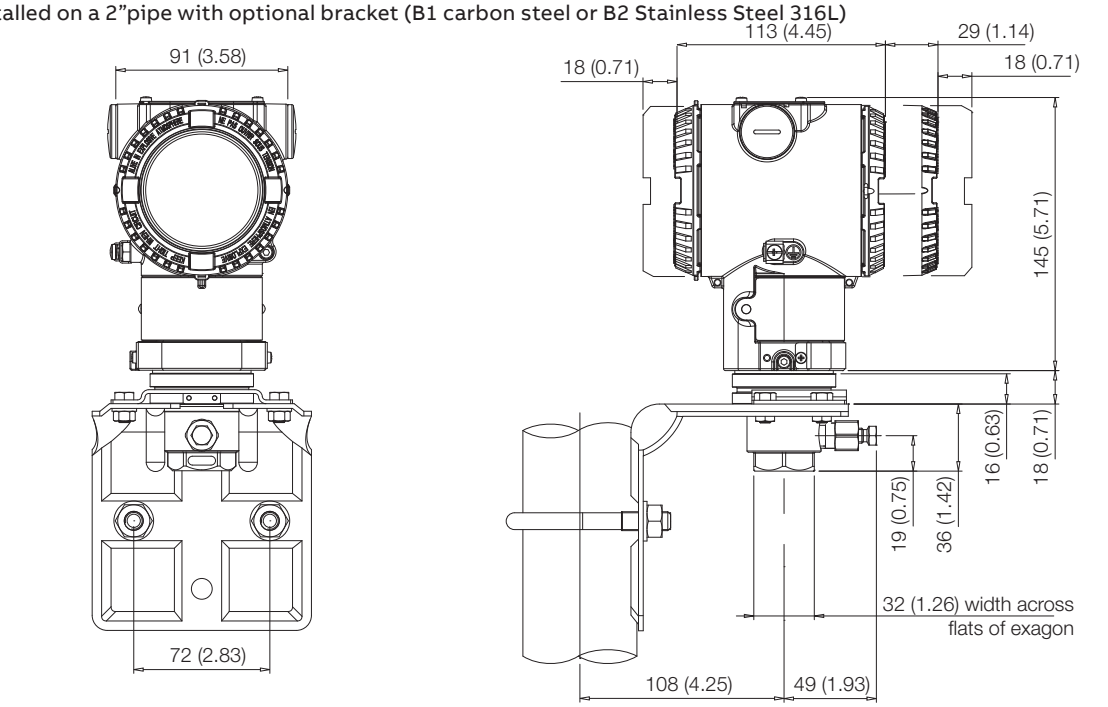


Figure 18: Model 266H or 266N High overload resistant P-Style transmitter with ½-14 NPT female process connection and barrel housing installed on a 2"pipe with optional bracket (B1 carbon steel or B2 Stainless Steel 316L)

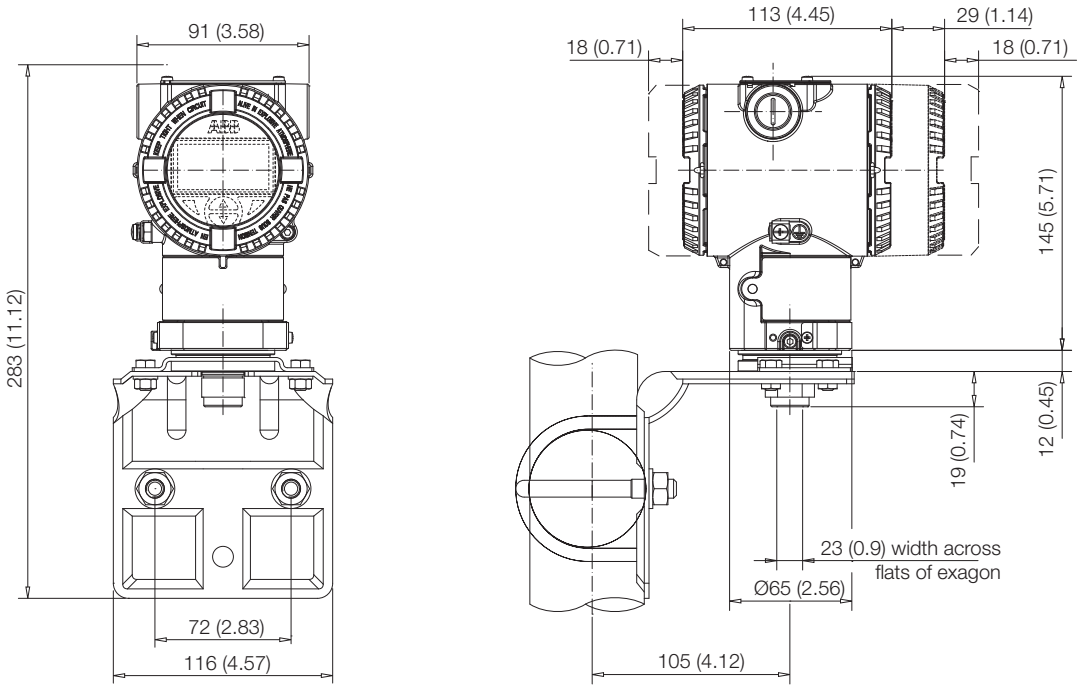


Figure 19: Model 266H or 266N High overload resistant P-Style transmitter with sensor Z with barrel housing installed on a 2”pipe with optional bracket (B1 carbon steel or B2 Stainless Steel 316L)

NOTICE

Potential damage to transmitter. In case of FOUNDATION Fieldbus gauge pressure transmitter with 1050 bar/15000 psi sensor range (266HSH.Z or 266GSH.Z) and 1/4” NPT process connection, please always perform sensor low trimming to remove possible zero shift and a prevent serious decrease of the total performance in terms of accuracy. Sensor low trim can be performed from DD based FF Masters.

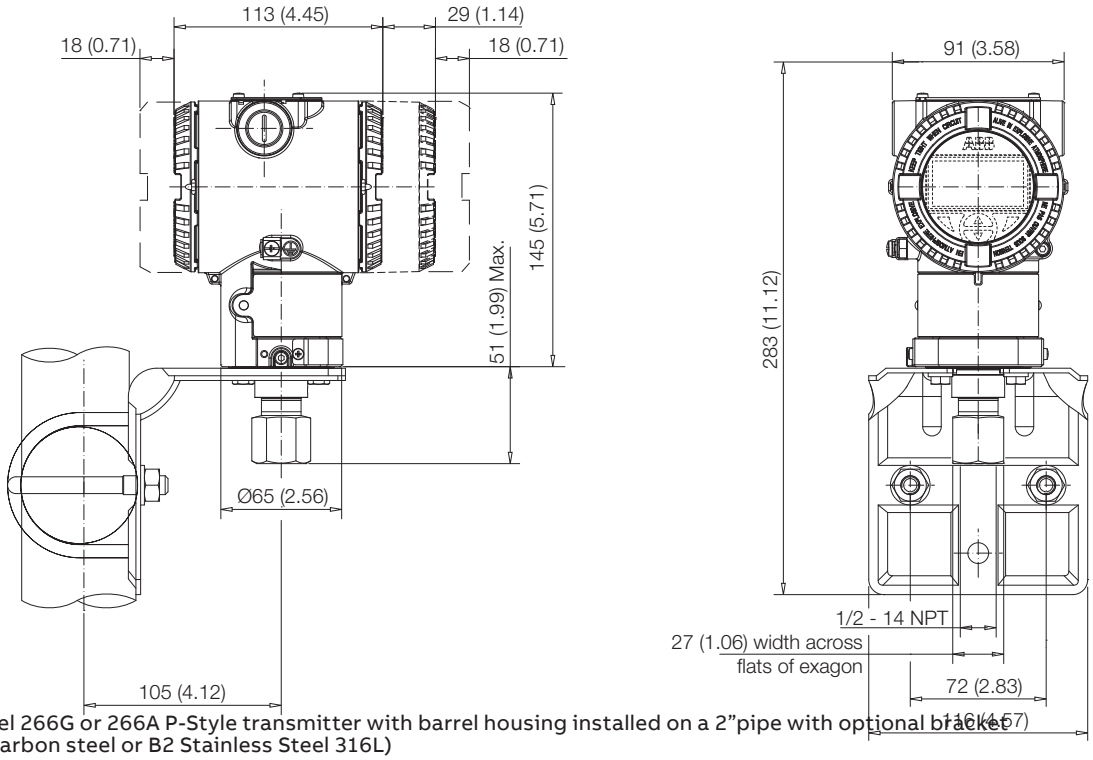


Figure 20: Model 266G or 266A P-Style transmitter with barrel housing installed on a 2”pipe with optional bracket (B1 carbon steel or B2 Stainless Steel 316L)

B6 and B7 Barrel housing bracket details

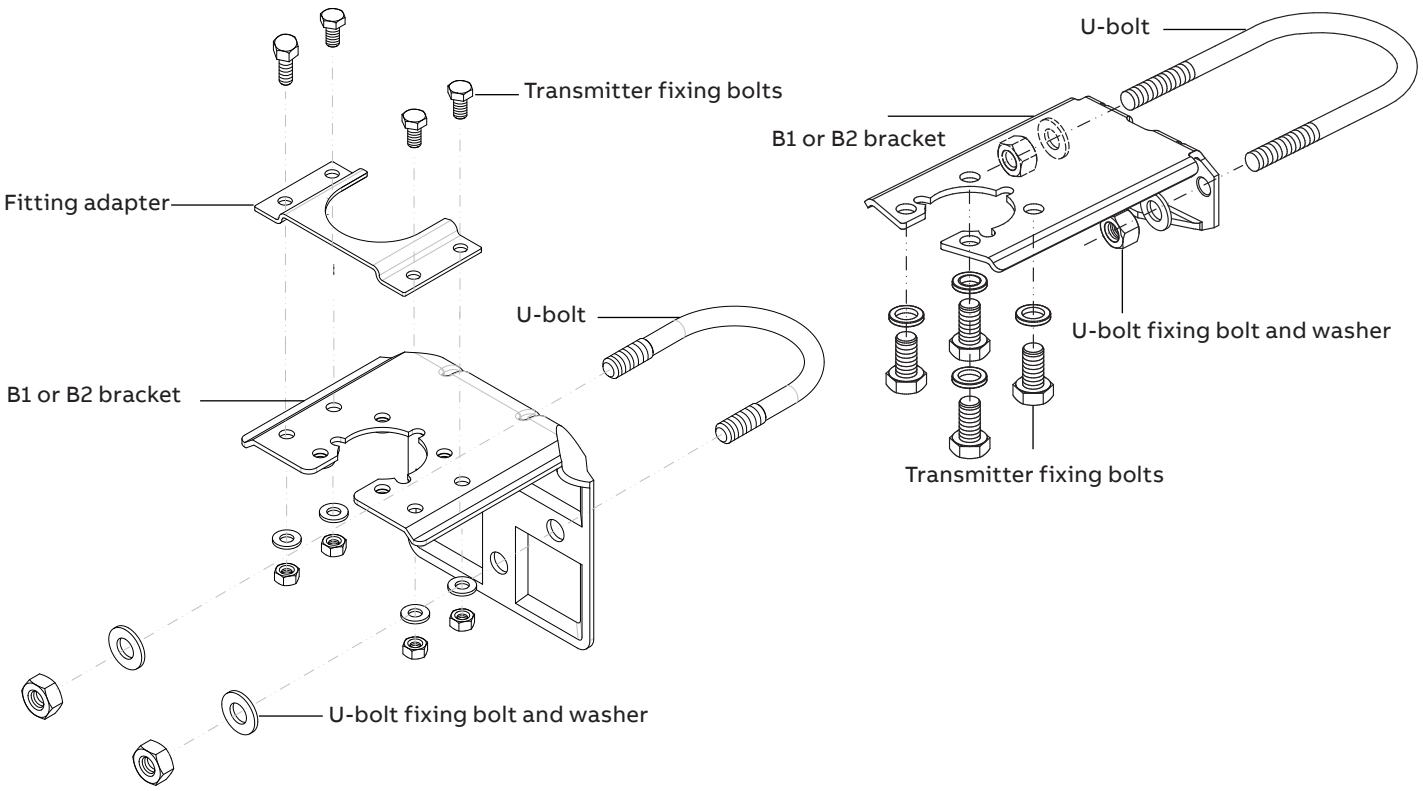


Figure 21: Pipe and wall mounting bracket kits for P style transmitter with Barrel housing

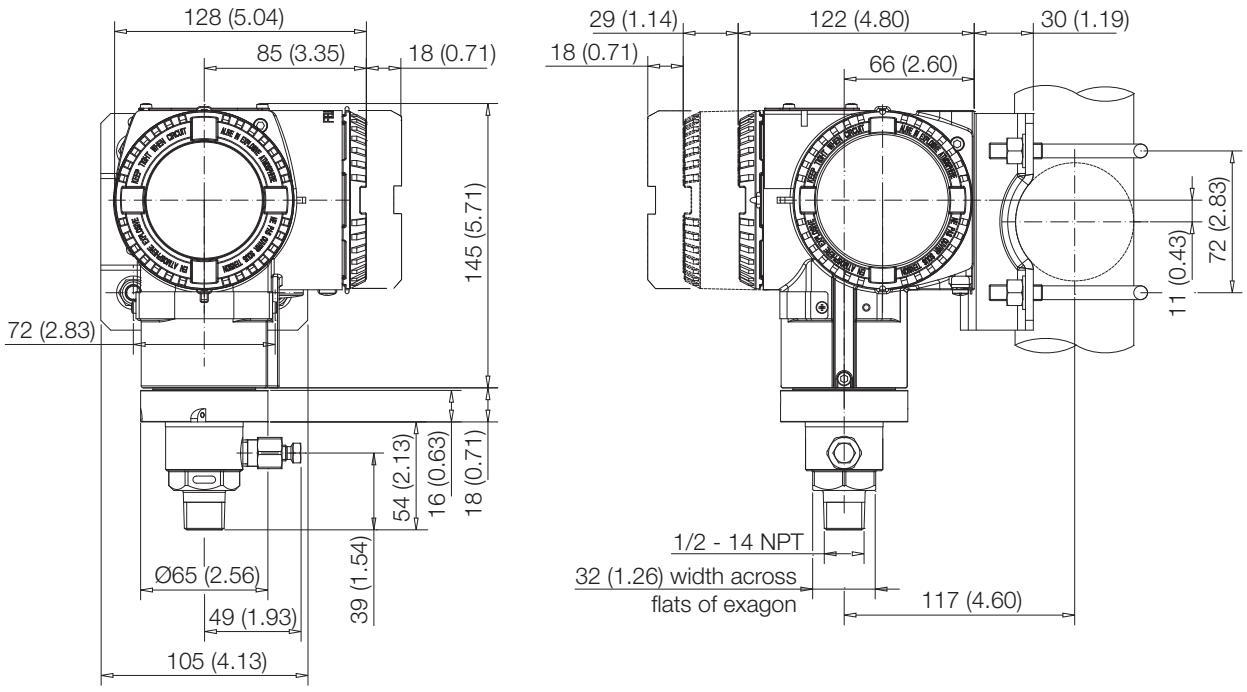


Figure 22: Model 266H or 266N Hi overload resistant P-Style transmitter with DIN housing installed on a 2” pipe with optional bracket (B2 Stainless Steel 316L)

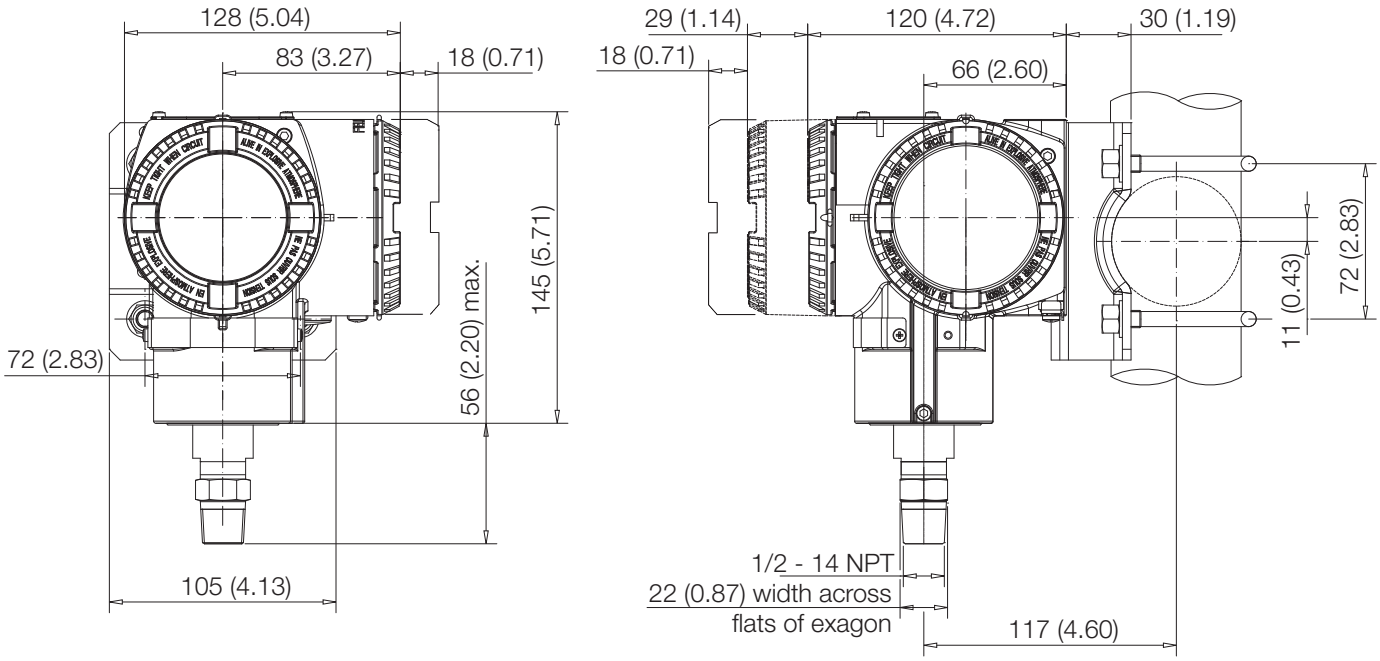


Figure 23: Model 266G or 266A P-Style transmitter with DIN housing installed on a 2”pipe with optional bracket (B2 Stainless Steel 316L)

DIN Housing bracket details

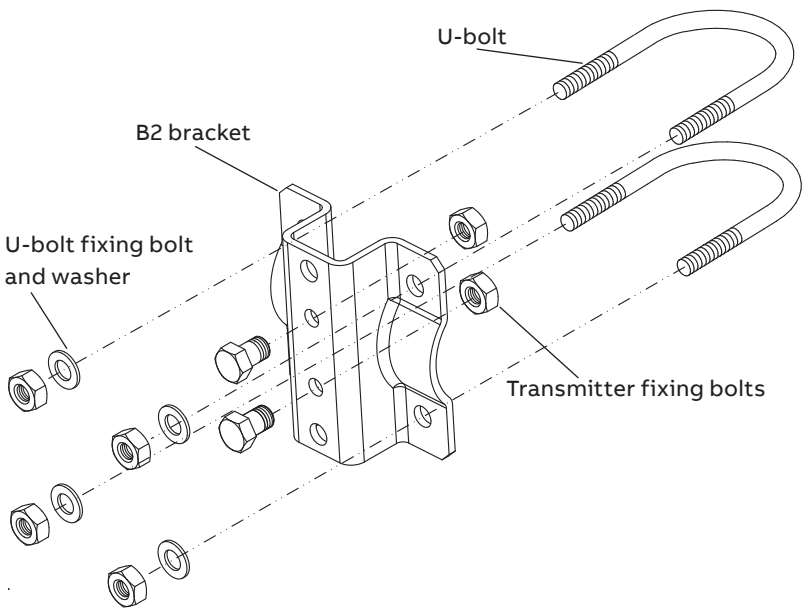


Figure 24: Pipe and wall mounting bracket kit (B2) for P style transmitter with DIN housing

Transmitter housing rotation

To improve field access to the wiring or the visibility of the optional LCD meter, the transmitter housing may be rotated through 360° and fixed in any position. A stop prevents the housing from being turned too far. In order to proceed with housing rotation, the housing stop tang-screw has to be unscrewed by approximately 1 rotation (do not pull it out) and, once the desired position has been reached, retightened.

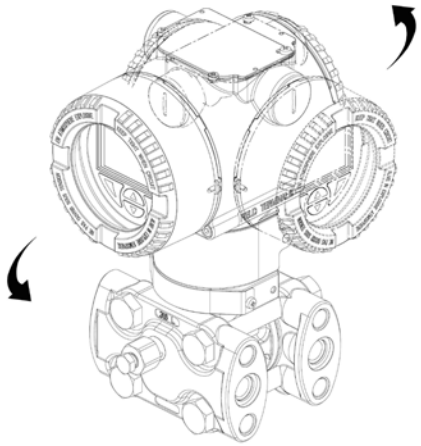


Figure 25: Housing rotation

Impulse piping connection for standard instruments

In order for the pipes to be laid correctly, the following points must be observed:

- The measuring pipes must be as short as possible and free from sharp bends.
- Lay the impulse piping in such a way that no deposits accumulate in them. Gradients should not be less than approx. 8% (ascending or descending).
- The measuring pipes should be blown through with compressed air or, better yet, flushed through with the measuring medium before connection.
- Where a fluid/vaporous measuring medium is being used, the liquid in both measuring pipes must be at the same level. If a separating liquid is being used, both measuring pipes must be filled to the same level (266Dx and 266Mx).
- Although it is not absolutely necessary to use balancing vessels with vaporous measuring media, measures must be taken to prevent steam entering the measuring chambers of the measuring equipment (266Dx and 266Mx).
- It may be necessary to use condensate vessels, etc., with small spans and vaporous measuring media (266Dx and 266Mx).
- If using condensate vessels (steam measurement), you should ensure that the vessels are at the same elevation in the differential pressure piping (266Dx and 266Mx).
- As far as possible, keep both impulse lines at the same temperature (266Dx and 266Mx).
- Completely depressurize the impulse lines if the medium is a fluid.
- Lay the impulse lines in such a way that gas bubbles (when measuring fluids) or condensate (when measuring gases) can flow back into the process line.
- Ensure that the impulse lines are connected correctly (High and Low pressure sides connected to measuring equipment, seals...).
- Make sure the connection is tight.
- Lay the impulse line in such a way that prevents the medium from being blown out over the measuring equipment.

⚠ CAUTION

Process leaks may cause harm or result in death. Install and tighten process connectors and all accessories (including manifolds) before applying pressure. In case of toxic or otherwise dangerous process fluid, take any precautions as recommended in the relevant Material Safety Data Sheet when draining or venting. Use only a 12 mm (15/32“) hexagonal spanner to tighten the bracket bolts.

Process connections considerations

266 differential pressure transmitter process connections on the transmitter flange are 1/4 - 18 NPT, with a centers distance of 54mm (2.13in) between the connections. The process connections on the transmitter flange are on centers to allow direct mounting to a three-valve or five-valve manifold. Flange adapter unions with 1/2 - 14 NPT connections are available as an option. Rotate one or both of the flange adapters to attain connection centers of 51 mm (2.01 in), 54 mm (2.13 in) or 57 mm (2.24 in).
To install adapters, perform the following procedure:

1. Position the adapters with the O-ring in place.
2. Bolt the adapters to the transmitter using the bolts supplied.
3. Tighten the bolts to a torque value of 25Nm (stainless steel bolts) or 15Nm (for Stainless steel NACE bolts).

Deviations for models 266Mx, 266Rx and for PTFE O-rings:
- pretightening hand-tight.
- Pretightening to 10 Nm.
- Final tightening to 50 Nm.

For model 266PS, 266VS and 266RS, it is only possible to have one adapter, with low pressure side flange without process connection and drain/vent valve.
For high static model (266DSH.x.H) tighten the bolts to a torque value of 40 Nm (regardless of the material of the bolts used). In case of PTFE O-rings, pretightening to 10 Nm and final tightening to 50 Nm.

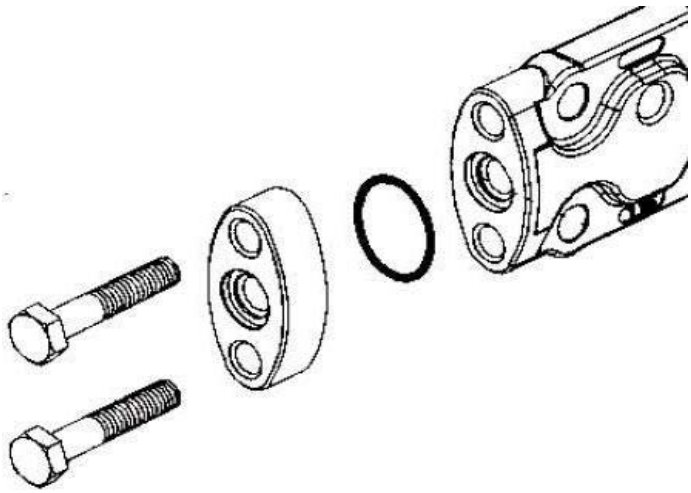


Figure 26: Adapter

Kynar inserts connection

When connecting Pressure transmitters equipped with kynar inserts tighten the bolts to 15 Nm max.

Screw torques for models 266MS and 266RS with Kynar inserts

The following procedures apply to process flange screws and nuts:
- Pretightening to 2 Nm (working crosswise).
- Pretightening to 10 Nm (working crosswise)
- Final tightening by a tightening angle of 180°, working in two stages of 90° for each screw, and working crosswise.

Figure 27: Kynar insert

Installation recommendations

Impulse piping configuration depends on the specific measurement application.

Steam (condensable vapor) or clean liquids flow measurement

- Place taps to the side of the line.
- Mount beside or below the taps.
- Mount the drain/vent valve upward.
- In case of steam application fill the vertical section of the connecting lines with a compatible fluid through the filling tees.

The process fluid must enter the transmitter primary:

1. Open equalizing valve (C)
2. Close low pressure (B) and high pressure (A) valves .
3. Open gate valves
4. Slowly open high pressure (A) valve to admit process fluid to both sides of primary.
5. Vent or drain the primary unit and then close the valves.
6. Open the (B) valve and close the equalizing valve.

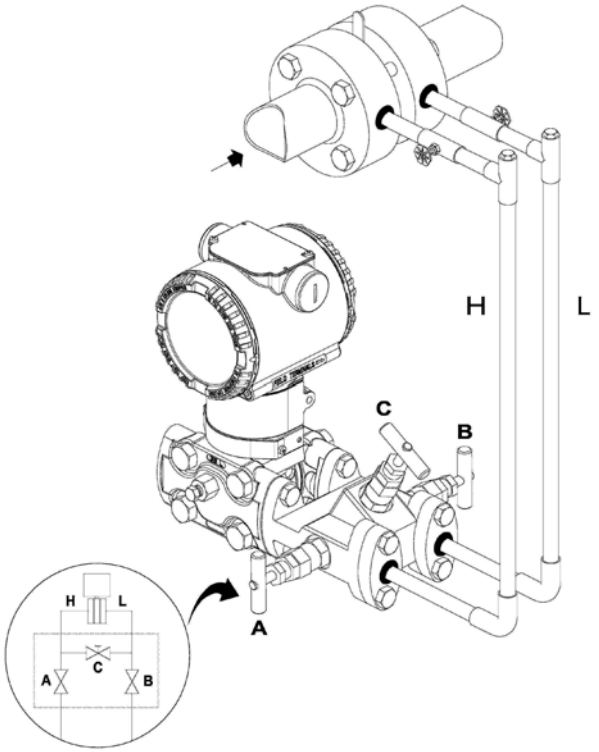


Figure 28: Steam or clean liquid flow measurement (transmitter and manifold)

Gas or liquid (with solids in suspension) flow measurement

- Place the taps to the top or side of the line.
- Mount the transmitter above the taps.

The process fluid must enter the transmitter primary:

1. Open equalizing valve (C)
2. Close low pressure (B) and high pressure (A) valves .
3. Open gate valves
4. Slowly open high pressure (A) valve to admit process fluid to both sides of primary.
5. Vent or drain the primary unit and then close the valves.
6. Open the (B) valve and close the equalizing valve.

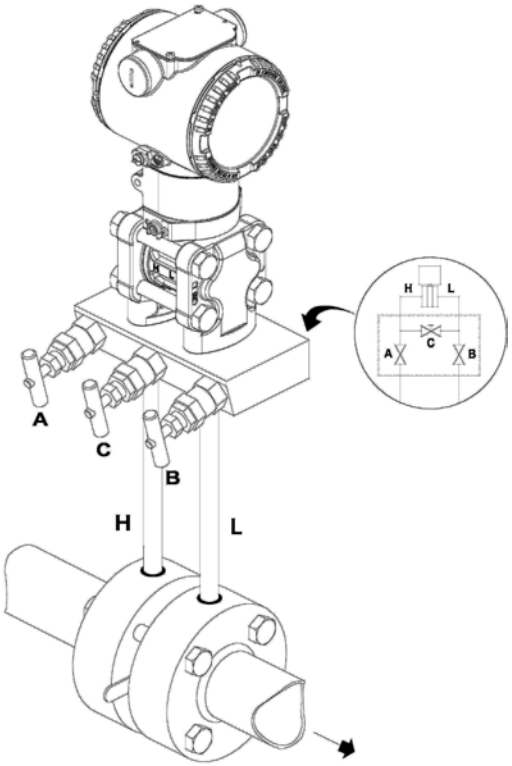


Figure 29: Gas or liquid flow measurement (transmitter and manifold)

Liquid level measurements on closed tanks and non condensable fluids (dry leg)

- Mount the transmitter at the same height or below the lowest level to be measured.
- Connect the + (H) side of the transmitter to the bottom of the tank.
- Connect the - (L) side of the transmitter to the upper part of the tank, above the maximum level of the tank.

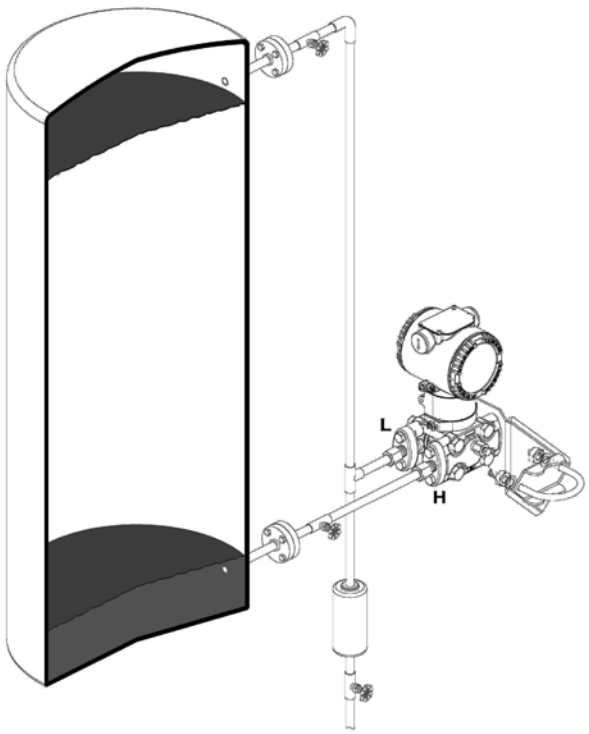


Figure 30: Level measurement on closed tank with dry leg

Liquid level measurement with closed tanks and condensable fluids (wet leg)

- Mount the transmitter at the same height or below the lowest level to be measured.
- Connect the + (H) side of the transmitter to the bottom of the tank.
- Connect the - (L) side of the transmitter to the upper part of the tank.
- Fill the vertical section of the connecting line to the upper part of the tank with a compatible liquid through the dedicated filling tee.

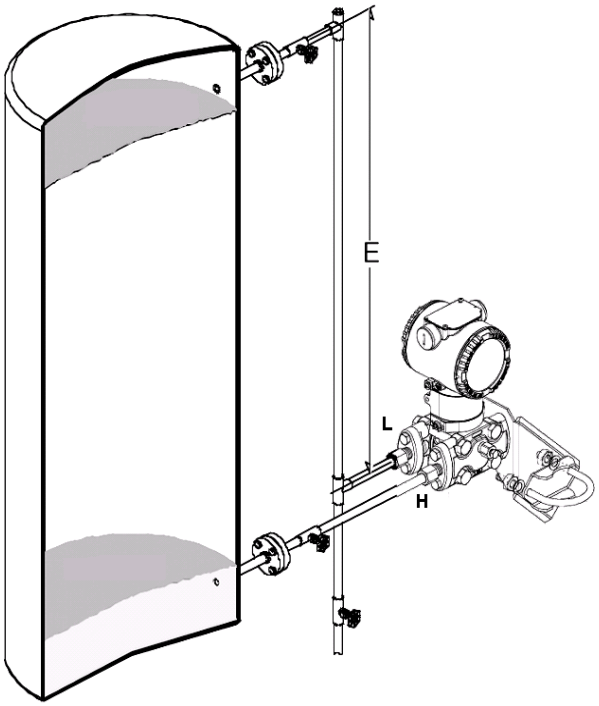


Figure 31: Level measurement on closed tank with wet leg

Liquid level measurement with open tanks

- Mount the transmitter at the same height or below the lowest level to be measured.
- Connect the + (H) side to the bottom of the tank.
- Vent the "–" (L) side of the transmitter to the atmosphere (in this case a gauge pressure is shown; the (L) side is already vented to the atmosphere).

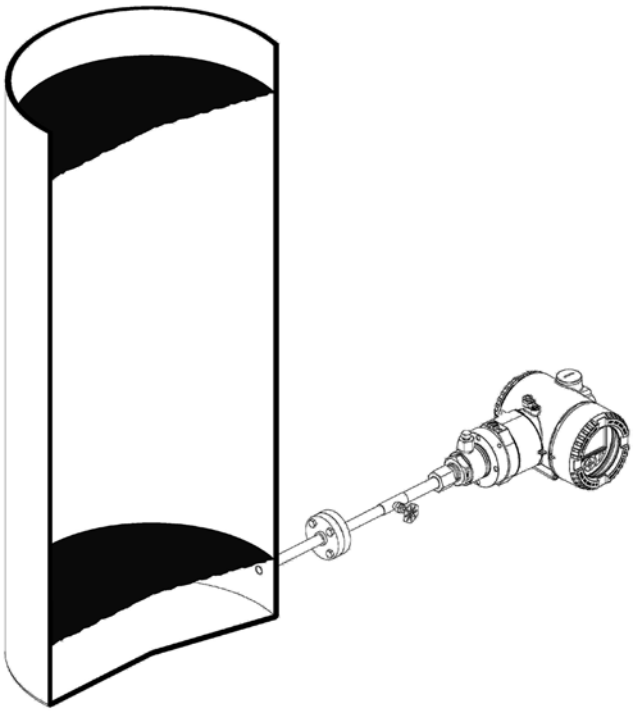


Figure 32: Level measurement on open tank with P style transmitter

Pressure or absolute pressure measurement of a tank

- Place the taps in the upper part of the tank.
- Mount the transmitter above the elevation of the process tap (both pressure and differential pressure transmitter can be used).
- Connect the transmitter to the tank.

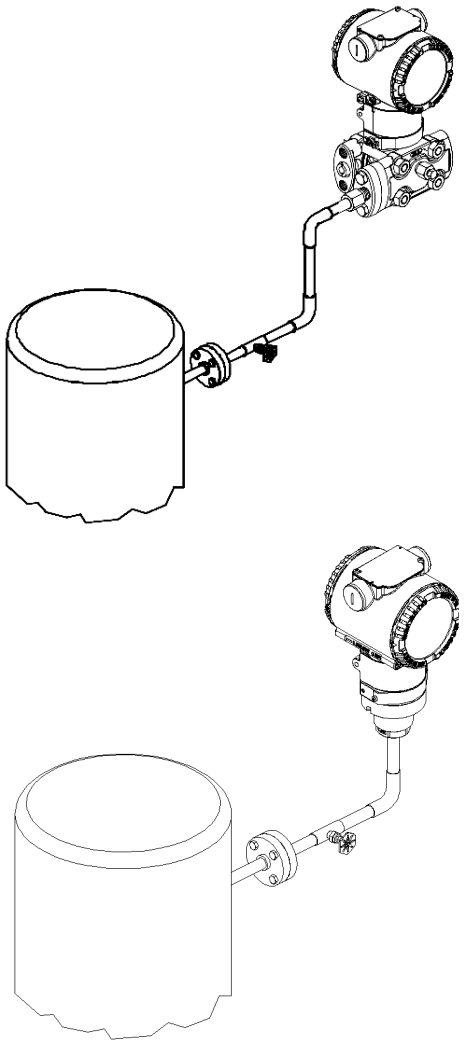


Figure 33: Gauge or absolute pressure measurement on a tank

Pressure or absolute pressure measurement of a liquid in a pipe

- Place the tap at the side of the line.
- Mount the transmitter (both pressure and differential pressure transmitters) beside or below the tap for clean fluids, above the tap for dirty fluids.
- Connect the + (H) side of the transmitter to the pipe.

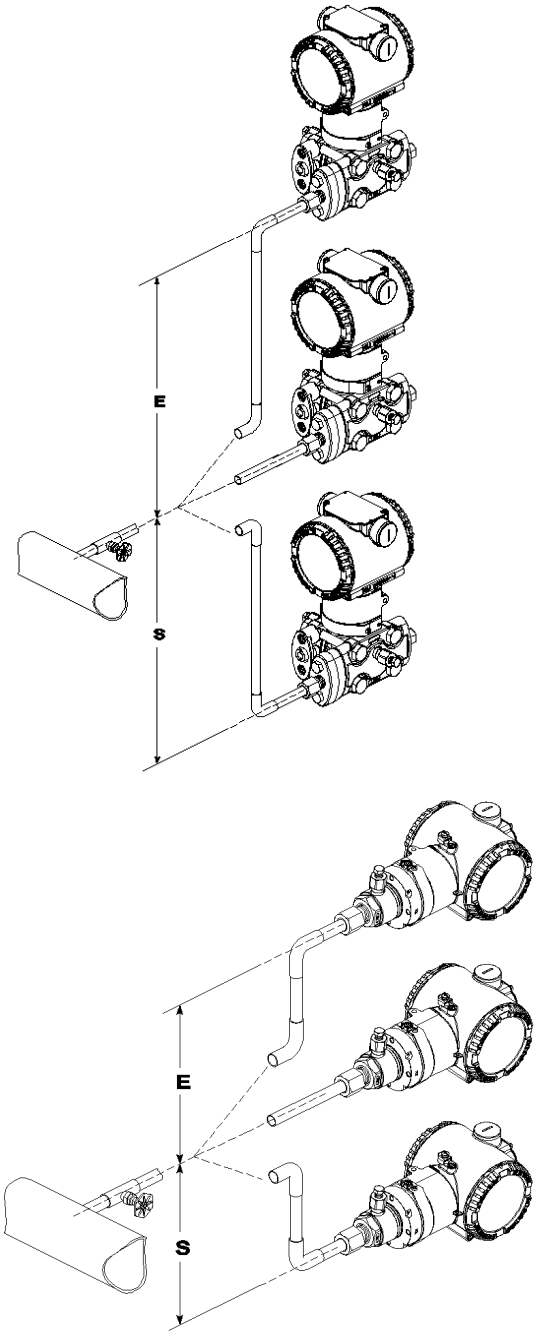


Figure 34: Gauge or absolute pressure measurement of a liquid in a pipe

Pressure or absolute pressure measurement of a condensable vapor in a pipe

- Place the tap at the side of the line.
- Mount the transmitter (both pressure and differential pressure transmitter) below the tap.
- Connect the + (H) side of the transmitter to the pipe.
- Fill the vertical section of the connecting line to the tap with a compatible liquid through the dedicated filling tee.

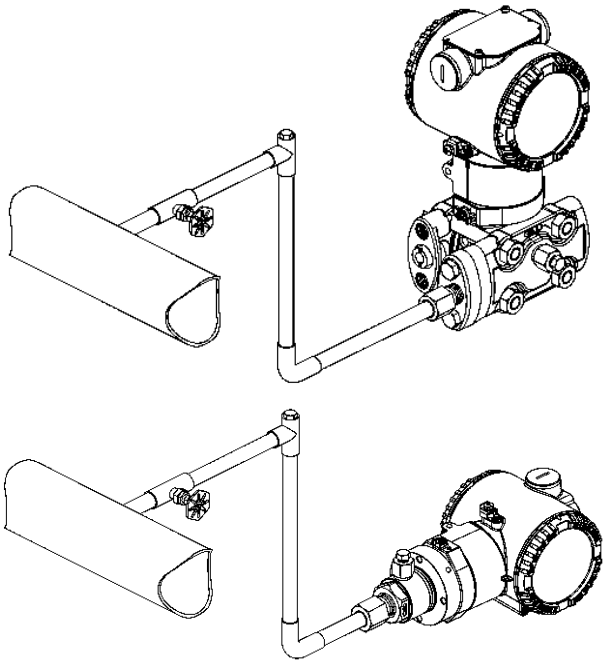


Figure 35: Gauge or absolute pressure measurement of condensable vapor

Pressure or absolute pressure measurement of a gas in a pipe

- Place the tap at the top or side of the line.
- Mount the transmitter (both pressure and differential pressure transmitter) beside or above the tap.
- Connect the transmitter to the pipe.

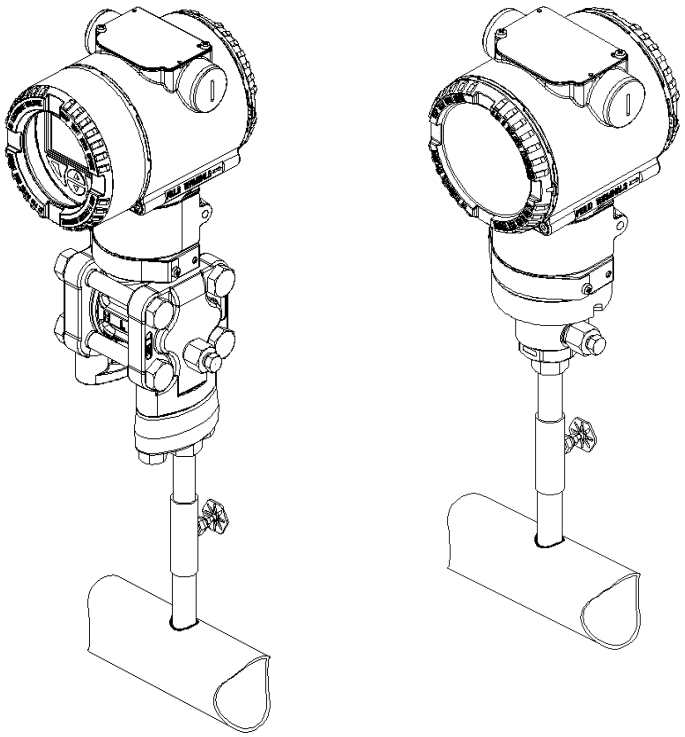


Figure 36: Gauge or absolute pressure measurement of gas in a pipe

6 Device introduction

Fieldbus Foundation communication protocol

Foundation Fieldbus™ is an all-digital, serial, two-way communication system that serves as a Local Area Network (LAN) for factory/plant instrumentation and control devices.

IMPORTANT

Further information on FOUNDATION Fieldbus can be found from the Fieldcomm Group organization website www.Fieldcommgroup.org, from the ABB website www.abb.com/fieldbus and/or from standards IEC 61158, IEC 61784, EN 50170/DIN 19245 and EN 50020 (FISCO model).

Feature overview

The 2600T-266 PdP Foundation Fieldbus is a Link Master Device implementing the following Blocks:

- 1 Enhanced Resource Block
- 3 Enhanced Analog Input Function Blocks
- 1 Enhanced PID Function Block
- 1 Standard Arithmetic Function Block
- 1 Standard Integrator Function Block
- 1 Standard Input Selector Function Block
- 1 Standard Control Selector Function Block
- 1 Standard Signal Characterizer Function Block
- 1 Enhanced Pressure with Calibration Transducer Block
- 1 Custom HMI Transducer Block
- 1 Custom Advanced Diagnostic Transducer Block with “Plugged Input Line Detection” algorithm.

Registration details

All the Registration details are available from the Fieldbus Foundation webpage at the following link:
https://www.fieldcommgroup.org/registered-products/a9bdb882-37b8-e811-8158-e0071b66cfe1

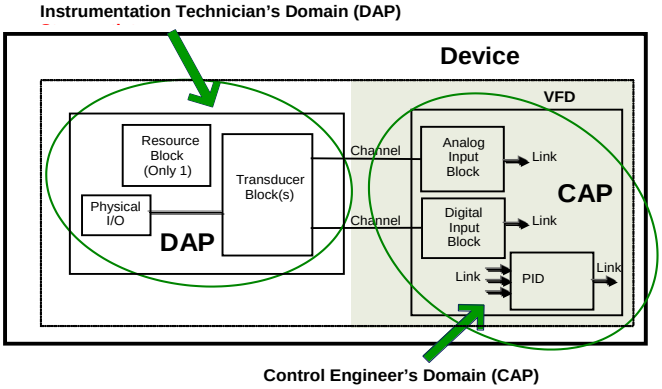


Figure 37: Device function block application

FF device structure

The Foundation Fieldbus devices can be divided into two parts under the point of view of technical competence who must take care of its configuration and use.

- The Device Application Process (DAP) is device specific and stays with the device wherever it is used.
- The Control Application Process (CAP) is configured for the specific plant location and may be spread over multiple devices.

Communication between the DAP and CAP takes place using channels. Each I/O function block in the CAP has exclusive use of exactly one channel. A channel may be bi-directional and it may have multiple values.

Device Application Process (DAP)

The DAP is used primarily by the instrumentation technician or maintenance personnel for configuring I/O when the instrument is going to be installed in the plant and/or during maintenance operations and for this reason mainly focused on the Resource Block and Transducer Blocks of the device.

Control Application Process (CAP)

The CAP is used by the control engineer for configuring the plant control strategy and for this reason mainly focused on the Function Blocks of the device.

IMPORTANT

For convenience, all the device parameters mentioned in this document are written with the prefix indicating the block into where they are mapped:

- RB_ = Resource Block
- PRTB_ = Pressure Transducer Block
- ADTB_ = Advanced Diagnostic Transducer Block
- HMI_ = HMI Transducer Block
- AIx _ = Analog Input Function Blocks where the x is the number of the AI (1, 2, 3).

IMPORTANT

For all the complete details about the device parameters and their block mapping refer to the dedicated section of this Manual:

7 Transmitter wiring

⚠ WARNING - GENERAL RISK

Observe the applicable regulations governing electrical installation. Connections must only be established in a dead-voltage state. Since the transmitter has no switch-off elements, overvoltage protection devices, lightning protection, and voltage separation capacity must be provided at the plant (overvoltage/lightning protection is optional). Check that the existing operating voltage corresponds to the voltage indicated on the name plate. The same lines are used for both the power supply and output signal. In case the surge protection option is present and the transmitter is installed in a Hazardous area, the transmitter has to be power supplied from a voltage source isolated from mains (galvanic separation). Furthermore the potential equalization for the entire powering cable must be guaranteed since the intrinsic safety circuit of the transmitter is grounded.

⚠ WARNING - GENERAL RISK

Electrical shock can result in death or serious injury. Avoid contact with the leads and terminals. High voltage that may be present on leads can cause electrical shock.

⚠ WARNING - GENERAL RISK

Do NOT make electrical connections unless the electrical code designation stamped on the transmitter data plate agrees with the classification of the area in which the transmitter is to be installed. Failure to comply with this warning can result in fire or explosion.

Cable connection

Depending on the design supplied, the electrical connection is established via a cable entry, M20 x 1.5 or 1/2-14 NPT thread, or Han 8D plug (8U) (PROFIBUS PA and FOUNDATION Fieldbus: M12 x 1 or 7/8 plug). The screw terminals are suitable for wire cross sections of up to 2.5 mm2 (AWG 14).

IMPORTANT

With Category 3 transmitters for use in “Zone 2”, a qualified cable gland for this type of protection must be installed by the customer (see the section “Hazardous Area Consideration”). An M20 x 1.5 threads is located in the electronics housing for this purpose.

For transmitters with “Flameproof enclosure” (Ex d) type of protection, the housing cover must be secured using the locking screw.

FOUNDATION Fieldbus wiring

The 2600T-266 PdP FF is a Bus Powered device with Fieldbus Foundation output. The two wires of the bus have to be connected as in the picture.

IMPORTANT

The 266 PdP FF is not Polarity Sensitive.

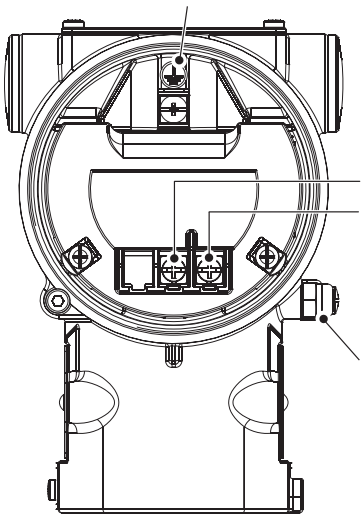


Figure 38: Device function block application

Simple FF network and system architecture

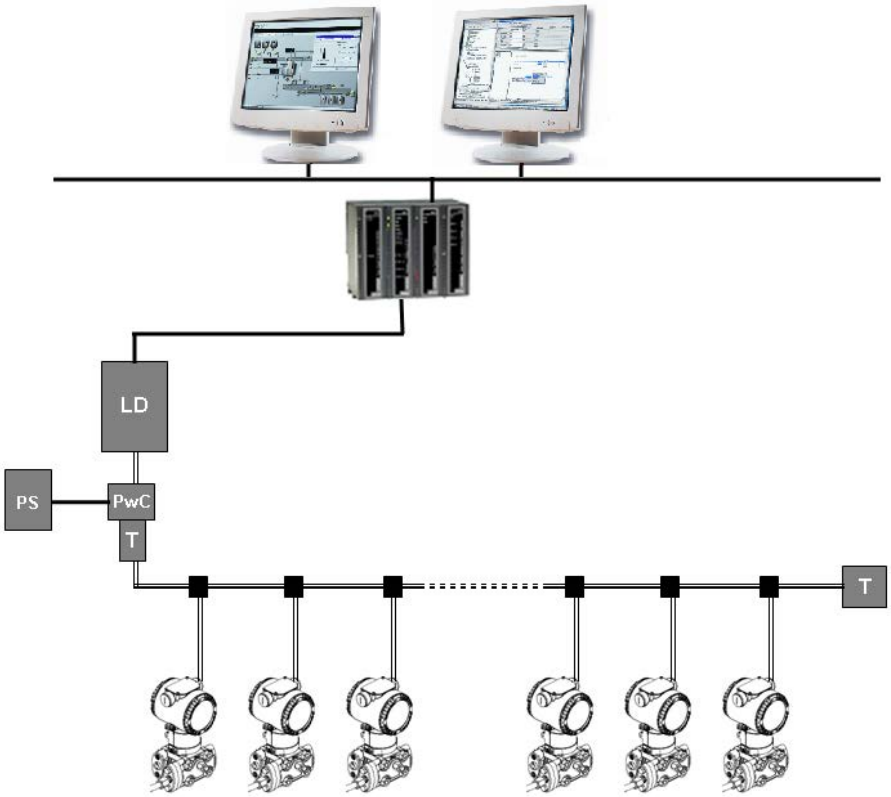


Figure 39: FOUNDATION Fieldbus architecture

Wiring procedure

Follow these steps to wire the transmitter:

- Remove the temporary plastic cap from one of the two electrical connection ports located at both sides in the upper part of the transmitter housing.
- These connection ports may have a ½ inch internal NPT or M20 threads. Various adaptors and bushings can be fitted to these threads to comply with plant wiring (conduit) standards.
- Remove the housing cover of the “field terminals” side. See the indication on the label on top of the housing.

In an Explosion-Proof / Flame-Proof installation, do not remove the transmitter covers when power is applied to the unit.

- Run the cable through the cable gland and the open port.
- Connect the positive lead to the “+” terminal, and the negative lead to the “–” terminal.
- Plug and seal the electrical ports. Make sure that when the installation has been completed, the electrical ports are properly sealed against entry of rain and/or corrosive vapors and gases.

⚠ WARNING - GENERAL RISK

Cable, cable gland and unused port plug must be in accordance with the intended type of protection (e.g. intrinsically safe, explosion proof, etc.) and degree of protection (e.g. IP6x according to IEC EN 60529 or NEMA 4x). See also the “EX SAFETY” ASPECTS AND “IP” PROTECTION. In particular, for explosion proof installation, remove the red temporary plastic cap and plug the unused opening with a plug certified for explosion containment..

- If applicable, install wiring with a drip loop. Arrange the drip loop so the bottom is lower than the conduit connections and the transmitter housing.
- Put back the housing cover, turn it to seat O-ring into the housing and then continue to hand tighten until the cover contacts the housing metal-to-metal. In Ex-d (Explosion Proof) installation, lock the cover rotation by turning the set nut (use the 2mm Allen key supplied with the instrument).

Grounding

A terminal is available on both the outside of the housing and in the plug for grounding (PE) the transmitter. Both terminals are electrically connected to one another.

Protective Grounding

All transmitters are supplied with an external ground connection for protective grounding.
Wire this ground connection to a suitable earth ground. For a transmitter measuring loop an earth ground should maintain a resistance of 5 ohms or less.
Use a heavy duty conductor, at least 15 AWG / 1,6 mm2 Ø.

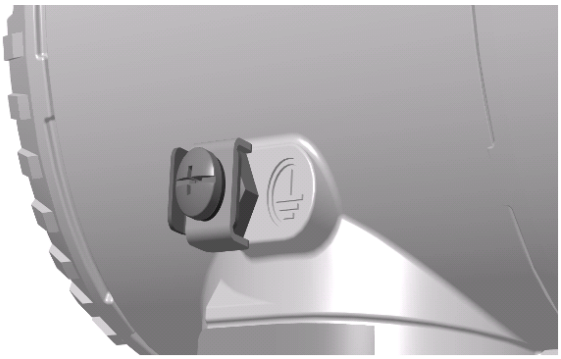


Figure 40: Ground connection on transmitter housing

⚠ WARNING - GENERAL RISK

A protective grounding connection is absolutely necessary to insure personnel protection, to protect against surge (in case of installation of this option) and to prevent explosions in potentially explosive environment.

Integrated lightning protection (optional)

The transmitter housing must be connected using the grounding terminal (PA), by means of a short connection with the equipotential bonding. Equipotential bonding minimum diameter of 4 mm2 (AWG 12) is required throughout the cable routing area.
In the case of transmitters with integrated lightning protection (optional), the intrinsically safe circuit is connected to the equipotential bonding for safety reasons.

IMPORTANT

Test voltage withstand capability can no longer be ensured when this protective circuit is used.

8 Electronics

Fault protection

The 266 PdP electronic implements the circuitry for the fault current protection. Whenever a fatal failure occurs and the current consumption increase over the 20 mA, this circuitry provides to disconnect the device from the bus, in order to preserve alive the rest of the bus that, otherwise, could drop down with all the other connected devices.

On board switches

On the electronic unit (behind the Local Display when installed) there are 4 switches, with the following functionality:

SW 1 – Replace Mode
In UP position (1) it enables the Replacement operation. It must be used in combination with the SW 2 that selects which part of the Transmitter is going to be replaced.
SW 2 – Replace Mode - details
In UP position (1) it selects the Sensor Replacement. The entire transmitter's configuration data are kept valid in the electronics and copied into the memory of the new sensor once it is connected. In OFF position (0) it selects the Electronics Replacement. The entire transmitter's configuration data are kept valid in the sensor memory and copied into the memory of the new electronics once it is connected.
SW 3 – Push Buttons Mode
This switch selects the type of operation executed with the housing push buttons located under the type plate. In UP position (1) it enables the push buttons for the ranging operation. In OFF position (0) it enables the push buttons for the PV bias Set/Reset operations.
SW 4 – Simulation Mode
This switch in UP position (1) enables the Standard Simulation feature mandatory for FF devices.
266FF can simulate diagnostic conditions by writing the error to be simulated into "RB_FD_SIMULATE" (index 67) or can simulate the value and status output of the PRTB going in input to the AI, by writing into "AIx_SIMULATE" (index 9).
However, this writing has effect only if the HW switch 4 has been previously moved in ON position (SIMUL MODE ENABLE).

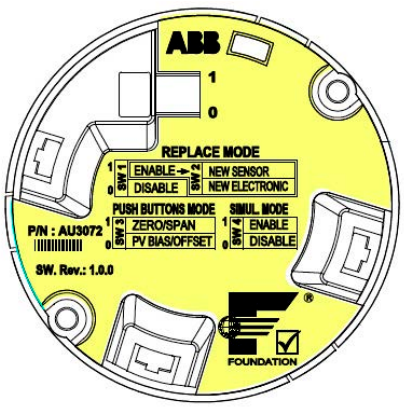


Figure 41: FOUNDATION Fieldbus communication board

Factory default configuration

The on-board switches are set by default in OFF position (0). Therefore:

SW 1 – Replace Mode is disabled.

SW 2 – Replace Mode - details on New Electronic but with no effect since SW 1 is on OFF position.

SW 3 – Push Buttons Mode on OFF position (0). With this configuration, the external non-intrusive push buttons perform the PV bias Set/Reset function by default.

SW 4 – Simulation Mode on OFF position (0). The Simulation mode is disabled. It can be performed only when the hardware dip-switch is alligned to the same software functionality.

9 Local pushbuttons

Installing/Removing the external pushbuttons

Three push buttons Zero (Z), Span (S) and Write Protection (small Lock icon) are located under the identification nameplate, as shown by the figure.
To gain access to the local adjustments release the fixing screws of the nameplate and rotate clockwise the identification plate.

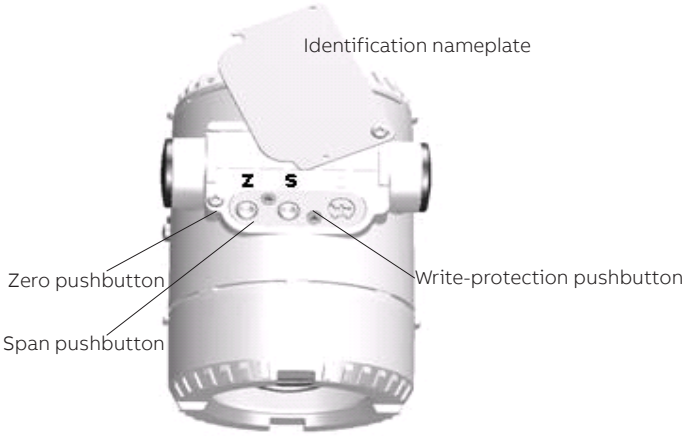


Figure 42: Pushbutton

⚠ WARNING

Potential damage to parts. Operating the control buttons with a magnetic screwdriver is not permitted.

Operations

The Z and S buttons are enabled by default but can be disabled with the **RB_LOCAL_OPERATIONS** parameter.
The Hardware Write Protection button (small Lock icon) works only if the **RB_FEATURE_SEL.HW Write Lock Supported** is set.
Write protection prevents the configuration data from being overwritten by unauthorized users. If write protection is enabled, the Z and S buttons are disabled.
However, it is still possible to read out the configuration data using graphical user interface or communication tools (DD or DTM based).
The control unit may be leaded if required.
Write protection is activated as follows (also refer to the symbols on the plate):

- First, use a suitable screwdriver to press the switch down.
- Then turn the switch clockwise by 90°.

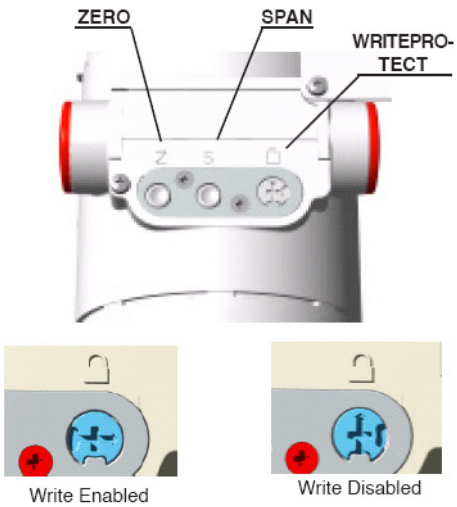


Figure 43: Pushbuttons - functionalities

IMPORTANT

To deactivate the switch, push it down slightly and then turn counter clockwise by 90°.

IMPORTANT

The function of the Z and S buttons changes accordingly with the SW 3 selection.

Wet Ranging operation – SW 3 = 1
The Z (Zero) button performs the 'Lower Range Setting' operation and sets as 0% the actual measured pressure value. After the 'Z' button is kept pushed for more than 2 seconds, when released, the pressure value measured in input is written in the **PRTB_PRIMARY_VALUE_RANGE_0%**.
The **PRTB_PRIMARY_VALUE_RANGE_100%** is shifted in order to keep the same SPAN.
Before:
- Span = (**PRTB_PRIMARY_VALUE_RANGE_100%** - **PRTB_PRIMARY_VALUE_RANGE_0%**)

After:
- **PRTB_PRIMARY_VALUE_RANGE_0%** = **PRTB_CAL_VALUE**
- **PRTB_PRIMARY_VALUE_RANGE_100%** = **SPAN + PRTB_ PRIMARY_VALUE _RANGE_0%**

The S button performs the 'Upper Range Setting' operation and sets as 100% of the calibration scale the actual measured pressure value. After the 'S' button is kept pushed for more than 2 seconds, when released, the pressure value measured in input is written in the **PRTB_PRIMARY_VALUE_RANGE_100%**.
The SPAN changes as consequence.
- **PRTB_PRIMARY_VALUE _RANGE_100%** = **PRTB_ CAL_VALUE**

PV Scaling operation – SW 3 = 0
T The Z button performs the 'ZERO elevation/suppression' operation. After the 'Z' button is kept pushed for more than 2 second, when released, the **PTRB_PRIMARY_VALUE** is zeroed. The zeroing is achieved writing an offset value into **PTRB_BIAS_VALUE** to be used in the calculation of the **PTRB_PRIMARY_VALUE**
- **PTRB_BIAS_VALUE** = (**PRTB_CAL_VALUE** - **PRTB_DESIRED_PRIMARY_VALUE**)

The **PTRB_BIAS_VALUE** (positive or negative) is added in the calculation algorithm at the **PTRB_CAL_VALUE** for the production of the **PTRB_PRIMARY_VALUE**.
- PTRB_PRIMARY_VALUE = (PRTB_CAL_VALUE + PRTB_BIAS_VALUE)

The S button (3) performs the 'Reset ZERO elevation/ suppression' operation. After the 'S' button is kept pushed for more than 1 second, when released, the PTRB_BIAS_VALUE is reset to Zero eliminating in this way any effect of elevation or suppression for the **PTRB_PRIMARY_VALUE** that, after this operation, returns to produce again the same value of the **PTRB_CAL_VALUE**.
- **PTRB_BIAS_VALUE = 0.0**
- **PTRB_PRIMARY_VALUE = PTRB_CAL_VALUE**

IMPORTANT

For more details about the above mentioned parameters, please refer to the dedicated section of this Manual.

10 HMI local indicator

The 266 PdP has optionally available a local HMI Dot matrix LCD with 4 buttons keypad. The keys (1), (4), (2) and (3) are used for the menu-controlled configuration.
Gain access to the display by unscrewing the windowed cover.
Please observe the Hazardous area prescription before proceeding with the cover removal.
There are two types of available local HMI both connected to the communication board:

Conventional version (L1 option)

The keypad operability doesn't require any activation procedure.

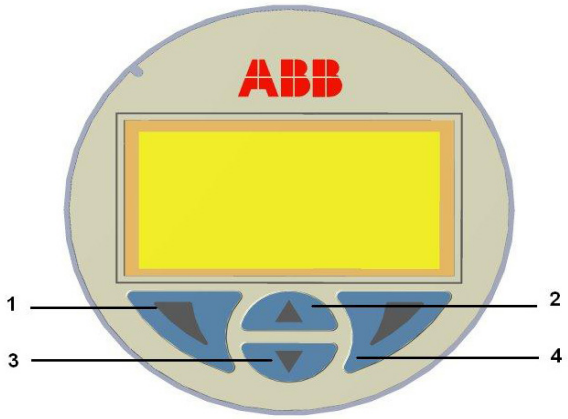


Figure 44: Display keypad

TTG (Trough The Glass) version (L5 option)

The TTG technology allows the user to operate on the keypad of the HMI without the need of opening the windowed cover of the transmitter. The capacitive pickups will detect the presence of your finger in front of the respective button activating the specific command.
At the transmitter power-on the HMI automatically calibrate its sensitivity, it is mandatory for the proper functioning of the TTG HMI that the cover is properly tightened at power-on.
In case the cover has been removed to access the communication board, it is recommended to power off and power-on again the transmitter once the windowed cover has been set in place and properly tightened.
For safety reasons the keypad needs a specific activation procedure before to became usable.

Installing/Removing the LCD display

1 Unscrew the housing cover of the communication board/ LCD side.

IMPORTANT

With an Ex d / Flameproof design, please refer to the section "Securing the housing cover with Ex d".

1 Attach the LCD display. Depending on the mounting position of the pressure transmitter, the LCD display may be attached in four different positions. This enables ± 90° or ± 180° rotations.

IMPORTANT

Retighten the housing cover until it is hand-tight. If necessary, refer to the section “Securing the housing cover in fl

Figure 45: Windowed front cover and LCD display

Integral display rotation

In case an optional integral display meter is installed, it is possible to mount the display in four different positions rotated clockwise or counterclockwise with 90° steps.
To rotate the LCD, simply open the windowed cover (Hazardous area prescriptions must be respected), pull-out the display housing from the communication board.. Reposition the LCD connector according to the new desired position. Push back the LCD module on the communication board. Be sure that the 4 plastic fixing locks are properly in place.

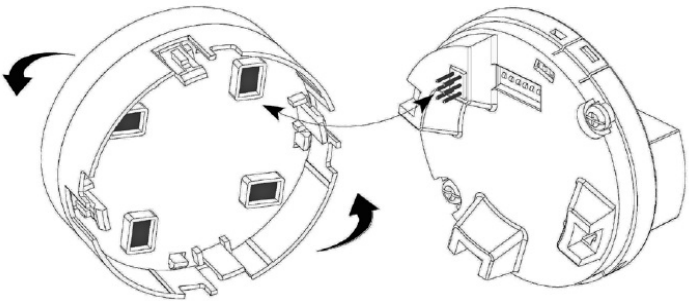


Figure 46: Display rotation

LCD structure

The Display DOT matrix is split in 4 rows each reserved to display different data:
The first row displays the Device TAG and Node Address and these data are always visible. The line/s and bar-graph view depend by the **HMI_MODE** Selection Each variable is displayed together with its own identification string of max three characters, on the left side of the values, when two lines mode is selected, or below the value when one line mode is selected.
The list of all the identification strings is available in the **HMI_VARIABLE_1** within the HMITB table, see "APPENDIX A – Device Data Blocks".
Example of how the indicator looks with One and Two lines plus bar-graph:

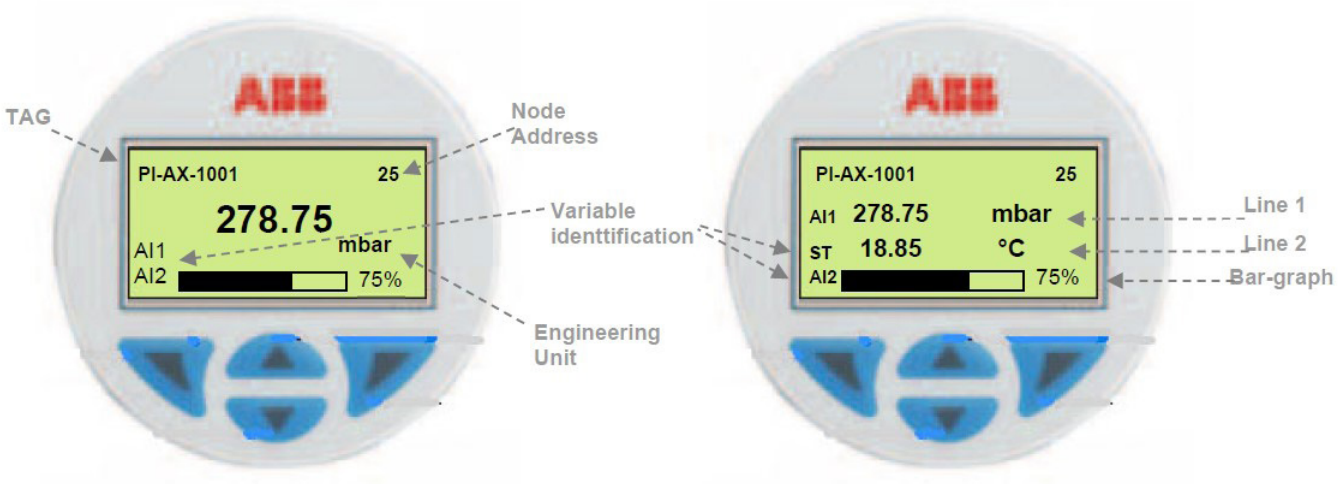


Figure 47: Display layout

During the normal activity, when the display is working as indicator, there are two special symbols/icons in the bottom corners of the display associated to the buttons (1) and (4).
When they are pressed it is enabled their own function as follow:
- The Button (4) activate the display local device menu prompting the menu "Display"
- The Button (1) activate the display local operator menu

HMI Operations

The Local display is usable for different purposes.
- Variable Indicator
- Diagnostic Indicator
- Configuration tool
- Feedback of the local push button operations

HMI as Variable Indicator

This is the normal activity of the local HMI. It is refreshed every 2 seconds displaying the selected variables among those calculated every loop in the PRTB as well as inside the Function Blocks of the transmitter.
The variables to be displayed can be selected in two ways:
- Locally using the optional LCD keypad from the menu "**Display/settings/...**" see HMI menu Structure for further information.
- From remote station via Fieldbus communication writing in the HMITB.

In the HMITB there are up to 4 variables called **HMI_VARIABLE_x** (where x is from 1 to 4) and each of them can be set with one variable to be displayed, selected from a list of 10 different variables. Then the **HMI_LINE_1**, **HMI_LINE_2** and **HMI_BARGRAPH** must be set to one of the **HMI_VARIABLE_x** depending by which variable the user wants see on the Line 1 or Line 2 or bargraph. The parameter **HMI_SEQUENCE** allows the enabling of the automatic scrolling of the 4 **HMI_VARIABLE_x**

IMPORTANT

It is recommended to use the Auto-scrolling only with HMI_MODE set to One Line.

HMI can be set to work in 4 different modes:

Operating mode	Features
One line	Only one variable with its unit code is displayed
One line and bargraph	One variable with its unit code is displayed and another variable can be selected to be displayed in percentage by the bar-graph
Two lines	Two variables with unit code are displayed together (one for each line)
Two lines and bargraph	Two variables with unit code are displayed together (one for each line) and another variable can be selected to be displayed in percentage by the bargraph

The Mode selection can be done through the remote setting of the **HMI_MODE** parameter or locally from the HMI menu "**Display/ Settings/Mode**"

HMI as Diagnostic Indicator

During the normal activity, when the display is working as indicator, it can also display diagnostic info when errors or warning are detected. In this case a message appears in the low side of the display below the bar-graph. The message is the combination of the the NAMUR NE107 icon and the string relating the source of the error i.e. the component where the problem has been detected.

NAMUR icons	Description	Source of error
	Error / Failure	ELECTRONICS
	Functional check (e.g. during simulation)	SENSOR
	Out of Spec (e.g. Sensor temperature outside the specs limits)	PROCESS
	Maintenance required	CONFIGURATION

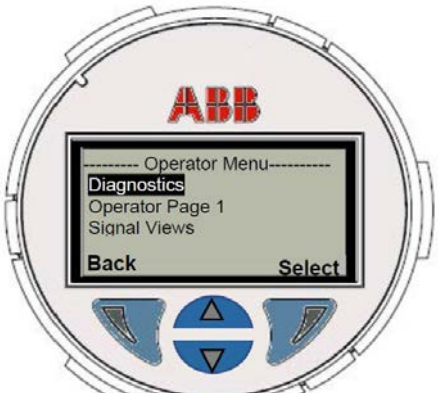
Example of "Maintenance / Sensor" and "Failure / Electronics" diagnostic messages

Figure 48: Diagnostic messages

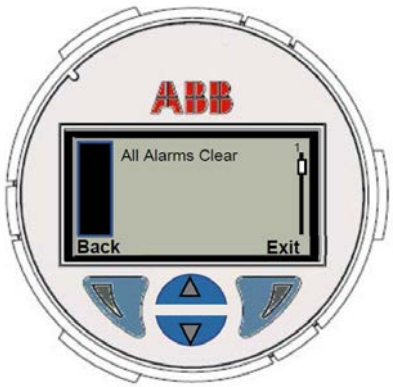
When such messages are displayed, it is also possible to get their detail directly from the display itself by pressing the Button (1).

Local operator menu

Pressing the button (1) the display opens the Operator menu. If the display is TTG type it is before necessary to activate the buttons 1 by pressing the buttons 2 and 3 together for approx. 4 seconds until the special icons/symbols appears in the two corners in the low side of the display.
For conventional HMI the above activation is not necessary.
The two special icons/symbols are permanently displayed and pressing the Button 1, the local HMI enter in the local operator menu without the needs to be previously activated.
The local operation menu has three entries, and selecting "Diagnostics", scrolling the cursor up and down using the central buttons 2 and 3, it is possible to visualize the device status/health.



When no errors are active, it appears the string "All Alarms Clear".



Vice-versa, when at least one error condition is active, it is displayed a corresponding error code and its source as process, sensor, electronics…..
The error code is the combination of the letter relating its NAMUR NE107 classification (F, M, S, C), followed by a number of 6 digit.

The Namur classification correspond at how that error has been mapped in the RB_FD_xx_MAP (Where xx = FAIL; MAINT; OFFSPEC; CHECK). If more errors are active together, they are displayed into this page according to their priority.
They can be visualized by scrolling up/down the screen with the two central buttons and their order is indicated by the bar and number on the right side of the display.
The format of how the detailed diagnostic info are displayed is "**XA.BBB**" where:

X = NAMUR NE107 Categories	**A = Priority (Higher number = higher priority)**	**BBB = error code**
F = Failure		
M = Maintenance		
O = Out of Specification		
C = Function Check		

IMPORTANT

The list and details of the possible HMI error code are described in the dedicated sections' tables.

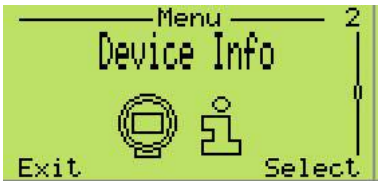
HMI as configuration tool

During the normal activity of indicator, pressing the button (4) the display enter in the Local device menu.

Local menu details

Once the display enters in the local menus, be aware of the following details:

- The menu / submenu name is displayed above in the LCD display…….i.e. “Device Info”



- The number/line of the currently selected menu item is displayed in the upper right of the LCD display……..i.e. (2)
- A scroll bar is located on the right edge of the LCD display which shows the relative position of the currently selected menu item within the menu.
- Both of the keys (1) and (4) can have various functions. The meaning of these buttons is displayed below in the LCD display above the respective buttons i.e. “Exit” and “Select”
- You can browse through the menu or select a number within a parameter value using both keys (2) and (3). The button (4) selects the desired menu item.

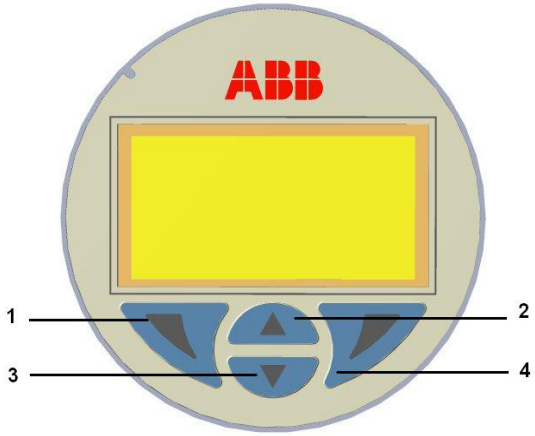


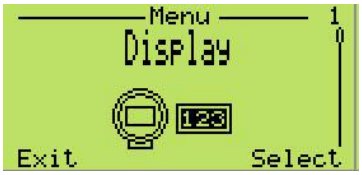
Figure 49: Display keypad

Button (1) functionalities	Meaning
Exit	Exit menu
Back	Back one submenu
Cancel	Exit without saving the selected parameter value
Next	Select next position for entering numerical values or letters

Button (4) functionalities	Meaning
Select	Select submenu/parameter
Edit	Edit parameter
Ok	Save selected parameter and display stored parameter value

Local device menus

The local menus allow the reading of the most relevant device parameters or the setting of the local HMI parameters without to access through the FF protocols. It consists in 3 root menus each with submenus:



1 Language
2 Display Revision

3 Contrast
4 Settings

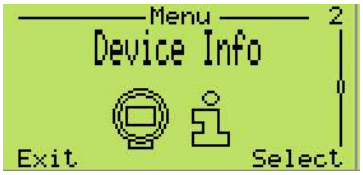
- 4.1 Mode
- 4.2 Line 1 view
- 4.3 Line 2 view
- 4.4 Bar view
- 4.5 Sequence
- 4.6 Variable 2
- 4.7 Variable 3
- 4.8 Variable 4
- 4.9 Variable 4

5 Display Scaling

- 5.1 Display Unit
- 5.2 Lower Range value
- 5.3 Upper Range value

6 Security

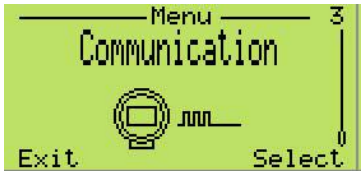
- 6.1 Display protection
- 6.2 Change password



1 Sensor Type
2 High Sensor limit

3 Low Sensor limit
4 Minimum span

5 Hardware revision
6 Software revision



1 TAG
2 Address

3 Device revision
4 DD revision

5 Device type

IMPORTANT

Refer to the Block Mapping tables into Annex A for details about the above parameters available from the local menus.

Display setting

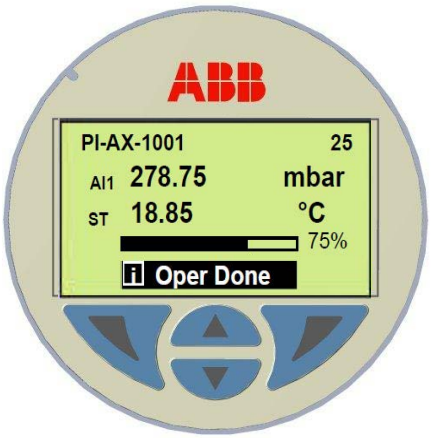
The menus “Device Info” and “Communication” are used to read the device settings. The parameters can just be read but not modified from the local menus.

The menu “Display” is the only one which allow to locally modify the display configuration itself. It is possible to change its operating mode between one or two lines as well as select the device variable to be displayed in the first and/or second line other than the bar-graph.

HMI as Feedback of the local push button operations

As consequence of the operations described in the apposite section, when the Z or S buttons are released, the feedback of the executed operation is displayed in the bottom of the LCD see the example below with one of the following strings:

Message	Description
! Oper Done	The push button operation has been successfully executed
! Proc Too Low	The Pressure measured in input is too low and not acceptable for the requested operation
! Proc Too High	The Pressure measured in input is too high and not acceptable for the requested operation
! New URV Error	The Zero (Z) operation cannot be accepted because the URV would be shifted outside the Upper Sensor limit
! Span Error	The Span (S) operation cannot be accepted because the new URV would be too close to the LRV and their difference lower than the Minimum Span value
! Oper Disabled	The push button operation has been refused because the Write Protection is enabled with the hardware button or in **PB_WRITE_LOCKING** or because the Local Operation is disabled in the **PB_LOCAL_OP_ENA**



11 Device Configuration/Setting through FF communication

When the 266 PdP transmitter has to be used in a FF project and/or connected to any type of Host, the first operation is to import in the Host the Device drivers, typically the EDD and CFF files.
The EDD and CF files can be downloaded from the ABB website www.abb.com/measurement or from the Fiedcommgroup website www.fieldcommgroup.org/registered-products
When the DD and CF files has been imported in the Host then:

- The blocks implemented in the device and their parameters are visible and addressable for read or write operations.
- The device can be instantiated into a network project assigning a node address and TAG and its Function Blocks can be instantiated into a Function Block Application (FBAP).

Commissioning

Once the transmitter has been installed, it is put into operation by switching on the operating voltage.
Check the following before switching on the operating voltage:

- Process connections
- Electrical connection
- The impulse line/s and the measuring chamber of the measuring equipment must be filled with the measuring medium.

The transmitter can then be put into operation. To do this, the shut-off valves must be actuated in the following sequence (in the default setting, all valves are closed):

(Differential models) 266Dx or 266Mx

1. Open the shut-off valves on the pressure tap connection (if present).
2. Open the pressure equalization valve of the manifold.
3. Open the positive shut-off valve (on the manifold)
4. Open the negative shut-off valve (on the manifold)
5. Close the pressure equalization valve..

(Gauge & Absolute models) 266Gx, 266Ax, 266Hx, 266Nx, 266Px, 266Vx

1. Open the shut-off valve on the pressure tap connection (if present).
2. Open the positive shut-off valve.

To put the transmitter out of operation, carry out the steps in reverse order.

IMPORTANT

For the absolute pressure transmitters model 266AS or 266NS or 266VS with sensor range C, F or G, please be aware that the measuring equipment will have been overloaded by the atmospheric pressure due to the long periods of transport and storage involved. For this reason, you will need to allow a starting time of approx. 30 min. after commissioning, until the sensor has stabilized to such an extent that the specified accuracy can be maintained.

If, when using „intrinsically safe“ transmitters, an ammeter is connected to the output circuit or a modem is connected in parallel while there is a risk of explosion, the sums of the capacitances and inductances of all circuits, including the transmitter (see EC-type-examination certificate) must be equal to or less than the permissible capacitances and inductances of the intrinsically safe signal circuit (see EC-type-examination certificate for the supply unit). Only passive or explosion-proof devices or indicators may be connected.

If the output signal stabilizes only slowly, it is likely that a large damping time constant has been set on the transmitter.

Correction of the mounting position

During installation of the transmitter, zero shifts caused by mounting (e.g., a slightly oblique mounting position due to a remote seal, etc.) may occur; these must be corrected.

IMPORTANT

The transmitter must have reached its operating temperature (approx. 5 min. after startup, if the transmitter has already reached the ambient temperature).

...Device Configuration/Setting through FF communication

This correction can be executed only if the Calibration Lower Range value is 0.0 and must be made with process (dp or p) = 0.

The correction consists in the Zero elevation/suppression operation and can be done in two ways:

1 Locally by acting on the Z push button when the electronic switch SW 3 is set to 0, see dedicated section

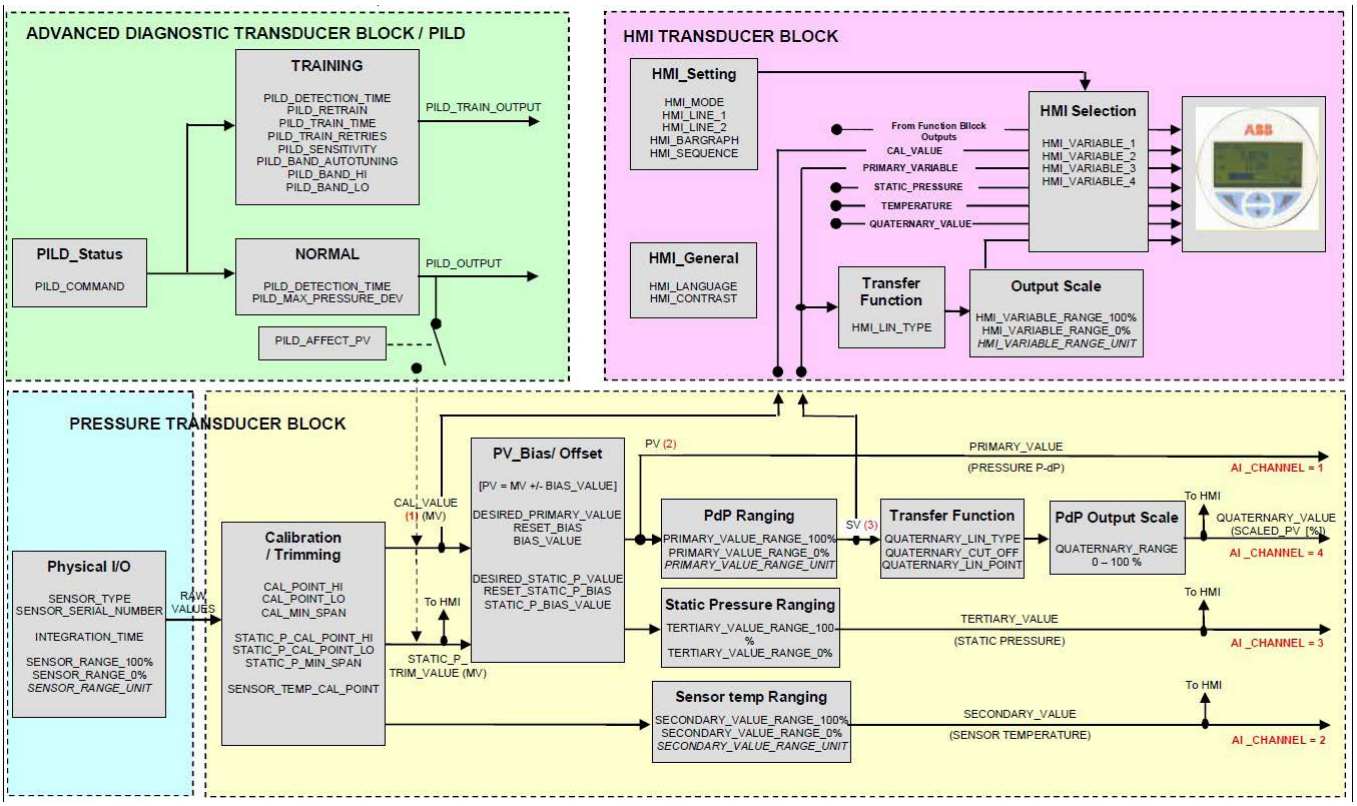
2 From remote station via FF communication writing 0.0 in the PTRB_DESIRED_PRIMARY_VALUE

In case the Calibration Lower Range value is not 0.0 then the correction cannot be executed through the local Z push button, but it can be done only from remote station via FF communication writing the correct measure value in the PTRB_DESIRED_PRIMARY_VALUE

IMPORTANT

After the above operations the Calibration Range Values are not changed. The desired process output value is produced through an internal calculation by applying an offset at the measured value.

Transducer Blocks Diagram



Initialization

The 266 PdP implements up to three Analog Input Blocks.

Each AI produce in output one variable (AIx_OUT) suitable to be linked to other downstream function blocks. The three AIs receive in input one of the dynamic variables produced by the Pressure Transducer Block selected trough the AIx_CHANNEL setting.

The default AIx_CHANNEL setting is:

- The Analog Input 1 is set to Channel 1 and receives in input the PRTB_PRIMARY_VALUE (Process Pressure) (AI1_CHANNEL = 1).
- The Analog Input 2 is set to Channel 3 and receives in input the PRTB_TERTIARY_VALUE (Static Pressure) (AI2_CHANNEL = 3).
- The Analog Input 3 is set to Channel 2 and receives in input the PRTB_SECONDARY_VALUE (Sensor Temperature) (AI3_CHANNEL = 2)

Hovewer all the 3 AIx_CHANNEL can be switched to receive in input up to different 4 PRTB variables:

AI CHANNEL	Variables	PRTB_Variable
0	Uninitialized	None
1	Pressure Process Value	PRIMARY_VALUE
2	Sensor Temperature	SECONDARY_VALUE
3	Static Pressure	TERTIARY_VALUE
4	Scaled Process Value	QUATERNARY_VALUE

Factory settings

Transmitters are calibrated at the factory to the customer's specified measuring range. The calibrated range and tag number are provided on the name plate. If this data has not been specified, the transmitter will be delivered with the following configuration:

Process info	Parameter	Factory setting
Node Address		248
TAG	PD_TAG	"PI000"
Calibration Lower Range Value 0%	PRTB_PRIMARY_VALUE_RANGE_0%	0.0
Calibration Upper Range Value 100%	PRTB_PRIMARY_VALUE_RANGE_100%	PTRB_SENSOR_RANGE_100%
Calibration Unit	PRTB_PRIMARY_VALUE_RANGE_UNIT	Kpa
Transfer function	PTRB_QUATERNARY_VALUE_LIN_TYPE	Linear
Display Mode	HMI_MODE	One Line
Display Variable	HMI_LINE1	HMI_VARIABLE_1 = PRTB_PRIMARY_VALUE
Analog Input 1 setting		
Channel	AI1_CHANNEL	1 = PV
Damping	AI1_PV_FTIME	0 second
Calibation Lower Range Value 0%	AI1_XD_SCALE 0%	0.0
Calibation Upper Range Value 100%	AI1_XD_SCALE 100%	PTRB_SENSOR_RANGE_100%
Calibration Unit	AI1_XD_SCALE_UNIT	Kpa
Output scale 0%	AI1_OUT_SCALE 0%	0.0
Output scale 100%	AI1_OUT_SCALE 100%	PTRB_SENSOR_RANGE_100%
Output Scale Unit	AI1_OUT_SCALE_UNIT	Kpa
Linearization	AI1_L_TYPE	Direct
Critical Limit Low	AI1_LO_LO_LIM	AI1_OUT_SCALE 0% - 10% of the SPAN
Advisory Limit Low	AI1_LO_LIM	
Advisory Limit High	AI1_HI_LIM	AI1_OUT_SCALE 100% + 10% of the SPAN
Critical Limit High	AI1_HI_HI_LIM	
Alarm Hysteresis	AI1_ALARM_HYS	0.5% of the SPAN

...Device Configuration/Setting through FF communication

Analog Input 2 setting (Applicable only for Differential Pressure Sensor types)		
Channel	AI2_CHANNEL	3 = Static Pressure
Damping	AI2_PV_FTIME	0 second
Calibation Lower Range Value 0%	AI2_XD_SCALE 0%	0.0
Calibation Upper Range Value 100%	AI2_XD_SCALE 100%	PTRB_TERTIARY_VALUE_RANGE_100%
Calibration Unit	AI2_XD_SCALE_UNIT	MPa
Output scale 0%	AI2_OUT_SCALE 0%	0.0
Output scale 100%	AI2_OUT_SCALE 100%	PTRB_TERTIARY_VALUE_RANGE_100%
Output Scale Unit	AI2_OUT_SCALE_UNIT	MPa
Linearization	AI2_L_TYPE	Direct
Critical Limit Low	AI2_LO_LO_LIM	AI2_OUT_SCALE 0% - 10% of the SPAN
Advisory Limit Low	AI2_LO_LIM	
Advisory Limit High	AI2_HI_LIM	AI2_OUT_SCALE 100% + 10% of the SPAN
Critical Limit High	AI2_HI_HI_LIM	
Alarm Hysteresis	AI2_ALARM_HYS	0.5% of the SPAN

Analog Input 3 setting		
Channel	AI3_CHANNEL	2 = Sensor temperature
Damping	AI3_PV_FTIME	0 second
Calibation Lower Range Value 0%	AI3_XD_SCALE 0%	PTRB_ SECONDARY_VALUE_RANGE_0%
Calibation Upper Range Value 100%	AI3_XD_SCALE 100%	PTRB_ SECONDARY_VALUE_RANGE_100%
Calibration Unit	AI3_XD_SCALE_UNIT	°C
Output scale 0%	AI3_OUT_SCALE 0%	PTRB_ SECONDARY_VALUE_RANGE_0%
Output scale 100%	AI3_OUT_SCALE 100%	PTRB_ SECONDARY_VALUE_RANGE_100%
Output Scale Unit	AI3_OUT_SCALE_UNIT	°C
Linearization	AI3_L_TYPE	Direct
Critical Limit Low	AI3_LO_LO_LIM	AI3_OUT_SCALE 0% - 10% of the SPAN
Advisory Limit Low	AI3_LO_LIM	
Advisory Limit High	AI3_HI_LIM	AI3_OUT_SCALE 100% + 10% of the SPAN
Critical Limit High	AI3_HI_HI_LIM	
Alarm Hysteresis	AI3_ALARM_HYS	0.5% of the SPAN

IMPORTANT

All the above configurable parameters can be afterward modified via DD based software tools.

User settings

Generally, the 266 PdP pressure transmitters are delivered pre-configured on as per purchase order request, suitable in order to measure Pressure, Level, Flow or Volume. For the device configuration it is necessary to know at least the following process info as minimum:

- **TAG**
- **Calibration Range/Scale and its engineering unit** as range of pressure to be measured in input
- **Output Range/Scale and its engineering unit**

The Linearization Type could be both, directly communicated by the client, or identified in the factory, depending by the engineering unit of the of the Output Scale.

For some measurements, the linearization type is set inside the AI block (Aix_L_TYPE) while, for more complex measurements, the Linearization type must to be set inside the Pressure Transducer Block (PTRB_QUATERNARY_VALUE LIN_TYPE).

Pressure and Level measurement setting

Process info	Device parameter to be configured
TAG	PD_TAG
Calibration Lower Range Value 0%	PRTB_PRIMARY_VALUE_RANGE_ 0% AI1_XD_SCALE 0%"
Calibration Upper Range Value 100%	PRTB_PRIMARY_VALUE_RANGE _100% AI1_XD_SCALE 100%
Calibration Unit	PRTB_PRIMARY_VALUE_RANGE _UNIT AI1_XD_SCALE_UNIT"
Linearization Type	AI1_L_TYPE = Indirect
Output scale 0%	AI1_OUT_SCALE 0%
Output scale 100%	AI1_OUT_SCALE 100%
Output Scale Unit	AI1_OUT_SCALE Unit Code
	AI1_CHANNEL = 1

Normal Flow measurement setting

Process info	Device parameter to be configured
TAG	PD_TAG
Calibration Lower Range Value 0%	PRTB_PRIMARY_VALUE_RANGE_ 0% AI1_XD_SCALE 0%"
Calibration Upper Range Value 100%	PRTB_PRIMARY_VALUE_RANGE _100% AI1_XD_SCALE 100%
Calibration Unit	PRTB_PRIMARY_VALUE_RANGE _UNIT AI1_XD_SCALE_UNIT
Linearization Type	AI1_L_TYPE = Indirect Square Root
Output scale 0%	AI1_OUT_SCALE 0%
Output scale 100%	AI1_OUT_SCALE 100%
Output Scale Unit	AI1_OUT_SCALE Unit Code
	AI1_CHANNEL = 1

...Device Configuration/Setting through FF communication

Special Flow measurement setting

Process info	Device parameter to be configured	
TAG	PD_TAG	
Calibration Lower Range Value 0%	PRTB_PRIMARY_VALUE_RANGE_ 0%	
Calibration Upper Range Value 100%	PRTB_PRIMARY_VALUE_RANGE _100%	
Calibration Unit	PRTB_PRIMARY_VALUE_RANGE _UNIT	
Linearization Type	QUATERNARY_VALUE_LIN_TYPE	Square Root
		SQRT 3° pow
		SQRT 5° pow
		Bidirectional Flow
Output scale 0%	AI1_OUT_SCALE 0%	
Output scale 100%	AI1_OUT_SCALE 100%	
Output Scale Unit	AI1_OUT_SCALE Unit Code	
	AI1_CHANNEL = 4	
	AI1_L_TYPE = Indirect	
	AI1_XD_XCALE = 0.0 / 100.0 / %	

Linear Volume measurement setting

Process info	Device parameter to be configured
TAG	PD_TAG
Calibration Lower Range Value 0%	PRTB_PRIMARY_VALUE_RANGE_ 0% AI1_XD_SCALE 0%"
Calibration Upper Range Value 100%	PRTB_PRIMARY_VALUE_RANGE _100% AI1_XD_SCALE 100%"
Calibration Unit	PRTB_PRIMARY_VALUE_RANGE _UNIT AI1_XD_SCALE_UNIT
Linearization Type	AI1_L_TYPE = Indirect
Output scale 0%	AI1_OUT_SCALE 0%
Output scale 100%	AI1_OUT_SCALE 100%
Output Scale Unit	AI1_OUT_SCALE Unit Code
	AI1_CHANNEL = 1

Special Volume measurement setting

Process info	Device parameter to be configured	
TAG	PD_TAG	
Calibration Lower Range Value 0%	PRTB_PRIMARY_VALUE_RANGE_ 0%	
Calibration Upper Range Value 100%	PRTB_PRIMARY_VALUE_RANGE _100%	
Calibration Unit	PRTB_PRIMARY_VALUE_RANGE _UNIT	
Linearization Type	QUATERNARY_VALUE_LIN_TYPE	Linear
		Cylindrical lying container
		Spherical container
Output scale 0%	AI1_OUT_SCALE 0%	
Output scale 100%	AI1_OUT_SCALE 100%	
Output Scale Unit	AI1_OUT_SCALE Unit Code	
	AI1_CHANNEL = 4	
	AI1_L_TYPE = Indirect	
	AI1_XD_XCALE = 0.0 / 100.0 / %	

Further common setting

Process info	Device parameter to be configured
Node Address	
Damping	AI1_PV_FTIME
Critical Limit Low	AI1_LO_LO_LIM
Advisory Limit Low	AI1_LO_LIM
Advisory Limit High	AI1_HI_LIM
Critical Limit High	AI1_HI_HI_LIM
Alarm Hysteresis	AI1_ALARM_HYS

IMPORTANT

No field calibration is normally requested, the transmitter has been trimmed to the calibration points (URV and LRV) to provide the best performances in the real operating range.

IMPORTANT

In case the calibrated range must be changed, please refer to the dedicated section of this manual.

APPENDIX A – Device Data Blocks

The device parameters are listed in the following tables. You can access the parameters by means of the index number. The individual blocks each contain standard parameters, block parameters and manufacturerspecific parameters.
Using DD based configuration tools as an operating program, input screens are available as a user interface.

Analogue variable format
The output of each AI block as well as many variables calculated and available from the different blocks of the transmitter is composed of 5 bytes.
The Variable is of 32-bit size in Floating Point format (4 bytes) plus a Status Byte (1 Byte).

Variable format - Floating Point Format IEEE-754

Byte n								Byte n + 1								Byte n + 2								Byte n + 3							
Bit 7	Bit 6							Bit 7	Bit 6							Bit 7								Bit 7							
S	2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}	2^{-1}	2^{-2}	2^{-3}	2^{-4}	2^{-5}	2^{-6}	2^{-7}	2^{-8}	2^{-9}	2^{-10}	2^{-11}	2^{-12}	2^{-13}	2^{-14}	2^{-15}	2^{-16}	2^{-17}	2^{-18}	2^{-19}	2^{-20}	2^{-21}	2^{-22}	2^{-23}
	EXPONENT							MANTISSA								MANTISSA								MANTISSA							

Example: 40 F0 00 00 (hex) = 0100 000 111 000 000 000 000 000 (binary)

Calculation: Value = $(-1)^{S} * 2^{(Exponent - 127)} * (1 + Mantissa)$
Value = $(-1)^{0} * 2^{(129 - 127)} * (1 + 2^{-1} + 2^{-2} + 2^{-3})$
Value = 1 * 4 * (1 + 0.5 + 0.25 + 0.125) = 7.5

Status
The Status byte is the fifth byte of any out value and represents the Quality of the variable. Each Transducer and Function Block produces a specific set of Status Bytes.

IMPORTANT

Refer to the specific Block in order to see which Status bytes it produces.

Device Application Process (DAP) blocks

Resource Block (RB)

Overview

This block contains data that is specific to the hardware that is associated with the resource. All data is modelled as Contained, so there are no links to this block. The data is not processed in the way that a function block processes data, so there is no function schematic.

This block contains and manages all the diagnostic info available from the 266 PdP in compliance with the NAMUR NE107 recommendations.

The parameters relating the NAMUR NE107 requirements are those with the prefix FD_xxx

Each root error is mapped into one of the four NAMUR NE107 classifications (Failure, Maintenance, Out of Specifications and Function Check) triggering the transmission of the relating Alarm to the hosts.

This parameter set is intended to be the minimum required for the Function Block Application associated with the resource in which it resides. Some parameters that could be in the set, like calibration data and ambient temperature, are more appropriately part of their respective transducer blocks.

The ITK_VER parameter identifies the version of the Interoperability Tester used by the Fieldbus Foundation in certifying the device as interoperable.

Block Mapping

Idx	Parameter		Description / Range / Selections / Notes		
0	BLOCK_OBJ		In the Block Object data structure, there are different items describing the block characteristics. Execution period, Number of parameters in the block, the DD Revision, Profile Revision, View Objects characteristics and so on		
1	ST_REV		The revision level of the Static data associated with the Function Block. The revision level is incremented each time a static parameter value (S – under Storage) in the block is changed.		
2	TAG_DESC		The user description of the intended application of the block		
3	STRATEGY		The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.		
4	ALERT_KEY		The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.		
5	MODE_BLK	TARGET	AUTO / OOS	The selectable modes by the operator.	
		ACTUAL		The mode the block is currently in.	
		PERMITTED	AUTO / OOS	Allowed modes that the target may take on	
		NORMAL	AUTO	The common mode for the Actual.	
6	BLOCK_ERR		This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown.		
			Bit 3 = Simulate Active	The SW4 of the electronic is in ON position enabling the Simulation.	
			Bit 6 = Device Needs Maintenance Soon	SEE its correspondence to Device root errors in the dedicated section of this manual	
			Bit 11 = Lost NV Data		
			Bit 15 = Out of Service	“The Resource Block MODE_BLK_ACTUAL = Out of Service. **Also, the Actual mode of all the Funct.Blocks is forced to OOS”**	
7	RS_STATE		State machine of the function block application.		
8	TEST_RW		Read/Write test parameter – used only for conformance testing.		
9	DD_RESOURCE		String identifying the tag of the resource, which contains the Device Description for this resource.		
10	MANUFAC_ID		Manufacturer Identification number	ABB = 0x000320	used by an interface device to locate the DD file for the resource
11	DEV_TYPE		Manufacturer’s model number associated with the resource	266 PdP = 0x0007	
12	DEV_REV		Manufacturer’s revision number associated with the resource.	0x02	
13	DD_REV		Revision of the DD associated with the resource	0x01	
14	GRANT_DENY		Options for controlling access of host computer and local control panels to operating, tuning and alarm parameters of the block.		
15	HARD_TYPES		Bit 0	Scalar Input	The type of Hardware available as channel numbers

...Block Mapping

Idx	Parameter	Description / Range / Selections / Notes			
16	RESTART	0	Uninitialized		
		1	Run		
		2	Restart resource		
		3	Restart with default		
		4	Restart process		
		5	Special Restart	See also SPECIAL_RESTART (index 76)	
		6	Special Operations	See also SPECIAL_OPERATION (Index 77)	
17	FEATURES	Used to show supported resource block options			
18	FEATURES_SEL	Used to select resource block options. For the 266 PdP they are:		Bit 1	Reports Supported
				Bit 2	Fault State Supported
				Bit 3	SW Write Lock Supported
				Bit 4	HW Write Lock Supported
				Bit 10	Multi-bit Alarm (Bit-Alarm) Support
19	CYCLE_TYPE	Identifies the block execution methods for this resource			
20	CYCLE_SEL	**Bit 1**	**Scheduled**	Used to select the block execution methods for this resource.	
		Bit 2	Completion of block execution		
21	MIN_CYCLE_T	Time duration of the shorted cycle interval of which the resource is capable.			
22	MEMORY_SIZE	Available configuration memory in the empty resource. To be checked before attempting a download			
23	NV_CYCLE_TIME	Minimum time interval for writing copies of NV parameters to non-volatile memory. Zero means it will be never automatically copied.			
24	FREE_SPACE	Percent of memory available for further configuration. Zero in a preconfigured device			
25	FREE_TIME	Percent of the block processing time that is free to process additional blocks.			
26	SHED_RCAS	Time duration at which to give up on computer writes to function block Rcas locations. Shed from Rcas shall never happen when Shed_Rcas = 0			
27	SHED_ROUT	Time duration at which to give up on computer writes to function block Rout locations. Shed from Rout shall never happen when Shed_Rout = 0			
28	FAULT_STATE	Fault State			
29	SET_FSTATE	Set Fault State			
30	CLR_FSTATE	Clear Fault State			
31	MAX_NOTIFY	Maximum number of unconfirmed alert notify messages possible			
32	LIM_NOTIFY	Maximum number of unconfirmed alert notify messages allowed			
33	CONFIRM_TIME	The min time between retries of alert report. Retries shall not happen when Confirm_Time = 0			
34	WRITE_LOCK	**1**	**Unlocked (default),**		
		2	Locked	If locked is selected, no writes are allowed except than Unlock. Block inputs will continue to be updated	
35	UPDATE_EVT	This alert is generated by any change to the static data			
36	BLOCK_ALM	"The block alarm is used for all configuration, hardware, connection failure or system problems in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active Status in the status parameter. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active Status, if the subcode has changed"			
37	ALARM_SUM	The alert status associated to the function block			
38	ACK_OPTION	**0**	**Auto Ack Disabled (default)**	Selection of whether alarms associated the function block will be automatically acknowledged	
		1	Auto Ack Enabled		
39	WRITE_PRI	Priority of the alarm generated by clearing the write_lock			
40	WRITE_ALM	This alert is generated if the write_lock parameter is cleared			
41	ITK_VER	Major revision number of the Interoperability test case used in certifying this device as interoperable. See the ITK version used for the 266 PdP registration from https://www.fieldcommgroup.org/registered-products			
42	CB_SW_REV	“XX.YY.ZZ” (07.02.01)			

Idx	Parameter	Description / Range / Selections / Notes	
43	CB_HW_REV	"XX.YY.ZZ" (01.00.00)	
44	CAPABILITY_LEV	Not Supported	
45	COMPATIBILITY_REV	0x01	
46	FD_VER	Indicates value of major version of instrument diagnostics specifications (FF-912).	
47	FD_FAIL_ACTIVE	Active error conditions mapped as Failure	**According to the NAMUR NE107 Categories.** Bit = 0 – No Error active Bit = 1 – Error active It is bit string, and multiple conditions may be shown. **SEE its bit MAPPING DETAIL in the dedicated section**
48	FD_OFFSPEC_ACTIVE	Active error conditions mapped as Out of Specification	
49	FD_MAINT_ACTIVE	Active error conditions mapped as Maintenance	
50	FD_CHECK_ACTIVE	Active error conditions mapped as Check Function	
51	FD_FAIL_MAP	Errors Mapped as Failure	**Default mapping:** **Bit 1** Static Pressure Sensor failure **Bit 2** Sensor Temperature failure **Bit 3** Pressure or Diff.Pressure Sensor failure **Bit 4** Pressure or Diff.Pressure Out of Sensor limits **Bit 5** Static Pressure Out of Sensor Limits **Bit 11** Pressure Over-range **Bit 12** Sensor Signal not Valid **Bit 14** Sensor memory fail **Bit 17** Electronic memory fail
52	FD_OFFSPEC_MAP	Errors Mapped as Out of Spec	**Default mapping:** **Bit 6** Sensor Temperature Out of the Operating Limits **Bit 10** Primary Variable Out of Range
53	FD_MAINT_MAP	Errors Mapped as Maintenance:	**Default Mapping:** **Bit 7** Replace operation required **Bit 8** PILD output condition detected **Bit 9** PILD operating condition has changed. New PILD training is required **Bit 14** Sensor Non-Volatile memory write error **Bit 15** Electronic Interface error with the connected sensor **Bit 17** Electronic Non-Volatile memory write error **Bit 19** Max.Working pressure limit has been exceeded
54	FD_CHECK_MAP	Errors Mapped as Check Function	**Default Mapping:** **Bit 0** Function Check **Bit 18** Input simulation active
55	FD_FAIL_MASK	Fail error to be masked	**Default no error masked**
56	FD_OFFSPEC_MASK	Out of Spec errors to be masked	
57	FD_MAINT_MASK	Maintenance errors to be masked	
58	FD_CHECK_MASK	Function Check errors to be masked	
59	FD_FAIL_ALM	Fail Alarm Object	
60	FD_OFFSPEC_ALM	Out of Spec Alarm Object	
61	FD_MAINT_ALM	Maintenance Alarm Object	
62	FD_CHECK_ALM	Function Check Alarm Object	
63	FD_FAIL_PRI	Fail error priority	
64	FD_OFFSPEC_PRI	Out of Spec error priority	
65	FD_MAINT_PRI	Maintenance error priority	
66	FD_CHECK_PRI	Function Check error priority	
67	FD_SIMULATE	**1**: Disabled ***Default*** **2**: Active	The simulation can be enabled only if the SW4 of the electronics is in moved to Simul Mode = ON (1) position
68	FD_RECOMMEN_ACT	Numeric Code defining the corrective action to be taken for the problem solution. When the Device's DD has been imported in the Hosts it converts the numeric code into a Textual info comprehensible for the user	
69	EXTENDED_ACTIVE	Some of the Active Errors of Fail, Maint, Out of Spec, Function Check classification could be produced by more root causes that can be seen by reading this parameter. **SEE its bit MAPPING DETAIL in the dedicated section**	
70	DIAGNOSIS_HISTORY	The bit associated at each error condition is permanently set after the condition became set at least one time Its bit mapping is the same as for x_ACTIVE. **SEE its bit MAPPING DETAIL in the dedicated section**	

...Block Mapping

Idx	Parameter		Description / Range / Selections / Notes		
71	MESSAGE		Message		
72	DESCRIPTOR		Descriptor		Reserved to the User.
73	INSTALLATION_DATE		Installation date		
74	DIAGNOSIS_CONDITION_IDX		The writing of an Error code in this parameter updates the DIAGNOSIS_DETAILS with details of that error.		
75	DIAGNOSIS_DETAILS	COUNTER	After the idx 74 has been written with an error code, all its details are returned by reading this parameter		N° of time the specified error has been detected during the device's life
		TIME_COUNTER			Sum of all the periods of time the specified error has been active as dd/hh/mm/ss
		LAST_TIME			Time of when the error became active the last occurrence as dd/hh/mm/ss
76	SPECIAL_RESTART		Bit 11	AR pre-setting	After the selection of one or more blocks from this list and its writing to SPECIAL_RESTART, then the restart operation is executed by writing "Special Restart" in the RB_RESTART. All the selected Blocks are set with a pre-defined configuration allowing their switching to AUTO Mode. PS: The Function Blocks must have been previously instantiated into a Function Block Application otherwise cannot move out from OOS.
			Bit 12	IS pre-setting	
			Bit 14	IT pre-setting	
			Bit 17	SC pre-setting	
			Bit 23	PID pre-setting	
			Bit 25	CS pre-setting	
			Bit 29	AI pre-setting	
			Bit 30	RB pre-setting	
77	SPECIAL_OPERATIONS		0	Do nothing	**See the dedicated section**
			8	Reset Device Configuration to Default Configuration	
			9	Reset PdP Sensor Trimming to Factory Trim	
			12	Reset PdP Sensor Trimming to User Trim	
			10	Reset Static Press Sensor Trimming to Factory Trim	
			13	Reset Static Press Sensor Trimming to User Trim	
			11	Reset Sensor Temp Trimming to Factory Trim	
			14	Reset Sensor Temp Trimming to User Trim	
			1	Save current Device Configuration as Default Configuration	
			2	Save actual PdP Sensor Trimming as PdP Factory Trim	
			3	Save actual Static Press Sensor Trimming as Static Press Factory Trim	
			4	Save actual Sensor temp Trimming as Sensor Temp Factory Trim	
			5	Save actual PdP Sensor Trimming as PdP User Trim	
			6	Save actual Static Press Sensor Trimming as Static Press User Trim	
			7	Save actual Sensor temp Trimming as Sensor Temp User Trim	
78	LOCAL_OPERATIONS		0: Disabled		Local operation via PUSH BUTTONS are not allowed
			1: Enabled	***Default***	Local operation via PUSH BUTTONS are allowed
79	DEVICE_SERIAL_NUMBER		Serial Number of the Transmitter as printed on the main Type Plate (on the housing).		

Special operations

Savings

In order to keep a valid device setting to be used as reference when a valid condition has to be recovered in case of wrong operations, it is possible save all the above calibrations as Factory or User calibrations and the complete device configuration. The possible savings are the following and are executed in two steps:

1 Selecting and writing the proper save operation in the RB_SPECIAL_OPERATION

2 Selecting and writing in the RB_RESTART = Special Operations

Save Configuration as Default	When this operation is executed, the complete device configuration is saved as default configuration at which the device returns when the Reset to Default configuration is executed. After the device has been properly configured, the user can decide to save it as a default configuration in order to recover it if necessary
Save P-dP Trimming as Factory	The P-dP Sensor calibration/trimming is saved as Factory Calibration. This operation is typically executed in the Factory after the Sensor has been calibrated to the customer's specified measuring range or, in case the customer didn't requested any measuring range, at the maximum sensor range
Save Static P Trimming as Factory	The Static P Sensor calibration/trimming is saved as Factory Calibration.
Save Sensor Temp Trimming as Factory	The Sensor Temp. calibration/trimming is saved as Factory Calibration
Save P-dP Trimming as User	The P-dP Sensor calibration/trimming is saved as User Calibration. This operation is typically executed by the user after the Sensor has been calibrated at the desired measuring range.
Save Static P Trimming as User	The Static P Sensor calibration/trimming is saved as User Calibration
Save Sensor Temp Trimming as User	The Sensor Temp. calibration/trimming is saved as User Calibration

Resets

The transmitter offers some reset operations executed in two steps:

1 Selecting and writing the proper reset code in the RB_SPECIAL_OPERATION

2 Selecting and writing in the RB_RESTART = Special Operations

Reset Configuration to Default Values	When this operation is executed, the complete device configuration returns to the configuration previously saved as default configuration.
Reset P-dP Trimming to Factory	Return the P-dP Sensor calibration/trimming at the calibration previously saved as Factory Calibration
Reset Static P Trimming to Factory	Return the Static Pressure Sensor calibration/trimming at the calibration previously saved as Factory Calibration
Reset Sensor Temp Trimming to Factory	Return the Sensor temperature calibration/trimming at the calibration previously saved as Factory Calibration
Reset P-dP Trimming to User	Return the P-dP Sensor calibration/trimming at the calibration previously saved as User Calibration.
Reset Static P Trimming to User	Return the Static Pressure Sensor calibration/trimming at the calibration previously saved as User Calibration
Reset Sensor Temp Trimming to User	Return the Sensor temperature calibration/trimming at the calibration previously saved as User Calibration

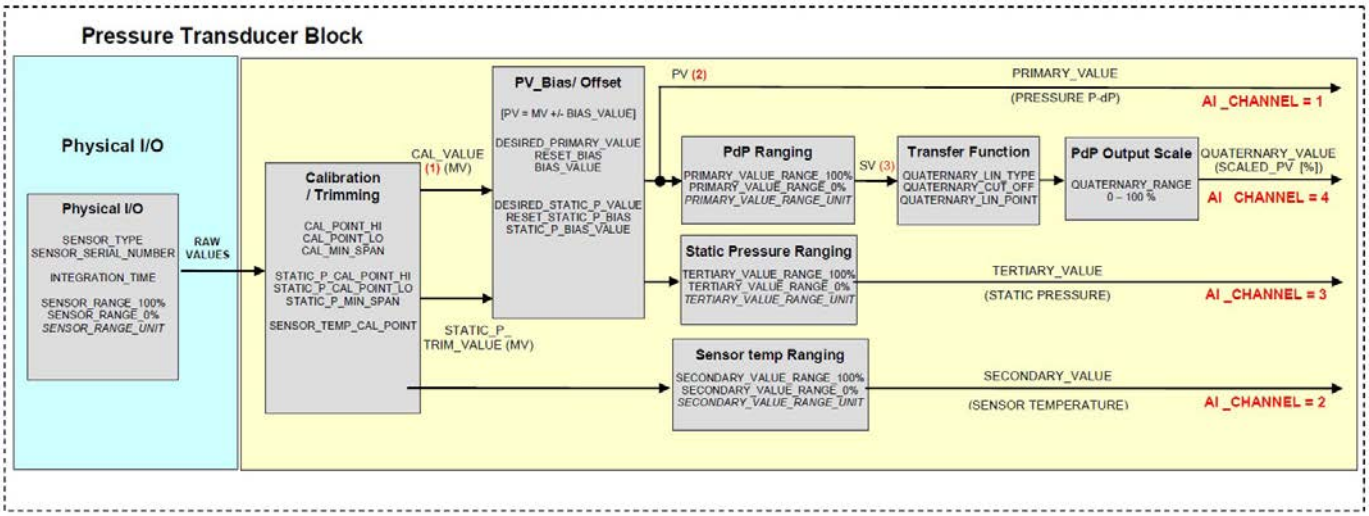
Pressure Transducer Block (PRTB)

Overview

This pressure transducer block is implemented within devices whose primary process sensor has the purpose to measure pressure, or differential pressure (P-dP)

In addition, at the pressure value as primary measurement, there are other variables that can be selected trough the Channel as input for the Analog Input blocks, these are the Sensor Temperature, the Static Pressure, for Differential pressure sensors only, and the Scaled PV identified respectively as Secondary, Tertiary and Quaternary variables

Block Diagram



Description

The Physical I/O represents the physical interface with the process and is part of the device's Pressure Transducer.

The physical I/O takes care to execute the basic manufacturer device specific algorithm with the purpose to convert the raw signal representing the measured process value into a digital format. The physical I/O operations are:

1 Sampling of the primary raw signal changing according the process changes.

2 Validation and Elaboration of the sampled primary raw signal

3 Linearization and Compensation

Result of the above operations is the RAW_VALUES produced in output of the physical I/O, see the Block Diagram, and used as input for the Pressure Transducer Block.

The first Pressure Transducer Block operation is the Calibration/trimming of the RAW_VALUES in order to adjust its digital value to match the real pressure measured by the Sensor block.

The RAW_VALUES after the calibration became the calibrated Measured Values (MV) represented by the PRTB_CAL_VALUE and, for differential sensors only, PRTB_STATIC_P_TRIM_VALUE.

These Measured Values matches and represents the real inputs sampled by the sensor and any further calculation has the scope to transform them to a Process Variables (PV).

In this perspective the first calculation applied is the elevation/suppression within the PV-Bias/Offset step executed for different reasons like the correction of the mounting position or for example in any condition where part of the measure must not be considered as part of the process.

Equations

Once the MV and PV are calculated and available in the PRTB then it can produces different type of measurements depending by the selected PRTB_QUATERNARY_LIN_TYPE and applying the following formula:

Measurement Type	QUATERNARY_LIN_TYPE		Formula
Pressure / Level		Linear	PRIMARY_VALUE = CAL_VALUE [MV] +/- BIAS_VALUE
Flow	QLT	Linear	PV = CAL_VALUE [MV] +/- BIAS_VALUE SV = (PV – PV_RANGE_0%) / (PV_RANGE_100% - PV_RANGE_0%) QUATERNARY_VALUE [%] = (QLT (SV) * (QUATERNARY_100% - QUATERNARY_0%) + QUATERNARY_0%
		Square root	
		SQRT 3° pow	
		SQRT 5° pow	
		Bidirectional Flow	
Volume	QLT	Cylindrical lying container	PV = CAL_VALUE [MV] +/- BIAS_VALUE SV = (PV – PV_RANGE_0%) / (PV_RANGE_100% - PV_RANGE_0%) QUATERNARY_VALUE [%] = (QLT (SV) * (QUATERNARY_100% - QUATERNARY_0%)) + QUATERNARY_0%
		Spherical container	

Transfer Function

The transfer output functions available in the 266 Pressure Transducer Block are described in details

- Linear for differential, gauge and absolute pressure or level measurements
- Sq. Root (x) for flow measurements using restriction type primary element, like orifice plate, integral orifice, Venturi or Dall tube and similar.
- Sq. Root (x3) for open channel flow measurements using rectangular or trapezoidal weir
- Sq. Root (x5) for open channel flow measurements using V-notch (triangular) weir.
- Bidirectional Flow
- Cylindrical lying tank
- Spherical tank

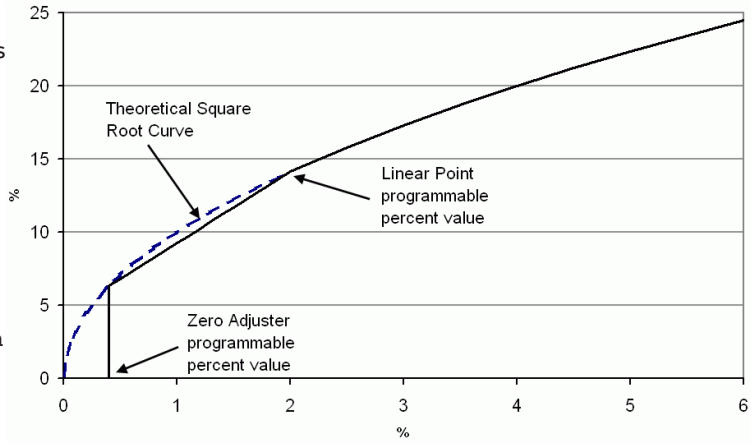
These output functions can be selected writing in PRTB_QUATERNARY_LIN_TYPE activated using a DD based Configuration Tool. The transfer function can be applied to the Process Variable only or also to the indication (in engineering units).

Linear

Using this function, the relationship between the input (measured value), expressed in % of the calibrated span and the output is linear (i.e.: at 0% input, corresponds 0% output - at 50% input corresponds 50% output - and at 100% input corresponds 100% output). No further settings are possible here.

Square Root

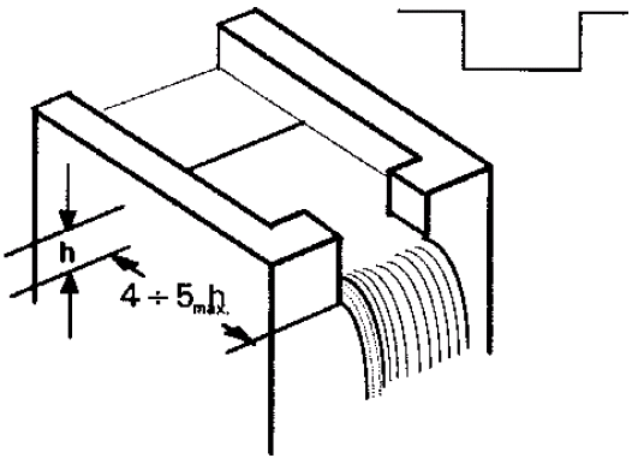
Using the Square Root function, the output (in % of the span) is proportional to the square root of the input signal in percentage of the calibrated span (i.e.: the instrument gives an analog output proportional to the rate of flow). The possibility to have the full Square Root function is given.
To avoid the extremely high gain error with the input approaching zero, the transmitter output is linear with the input up with a slope of 1 up to 0.5% and then still linear with the appropriated slope to a programmable percentage value between 10 % and 20%. This option is offer in order to ensure a more stable output when the signal is close to zero avoiding errors due to the high gain of the square root.



To neglect the values with the input approaching zero, the transmitter output is zero with the input up to a programmable percentage value between 0 % and 20%. This option is offer in order to ensure a more stable flow measure.
This option is possible for all the listed output functions.

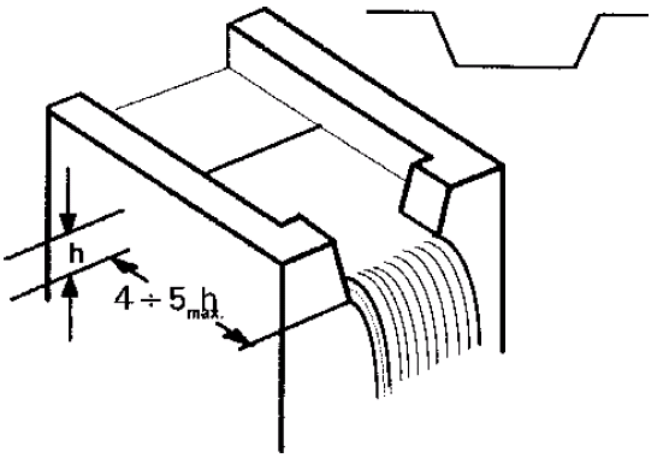
Square root to the 3rd power

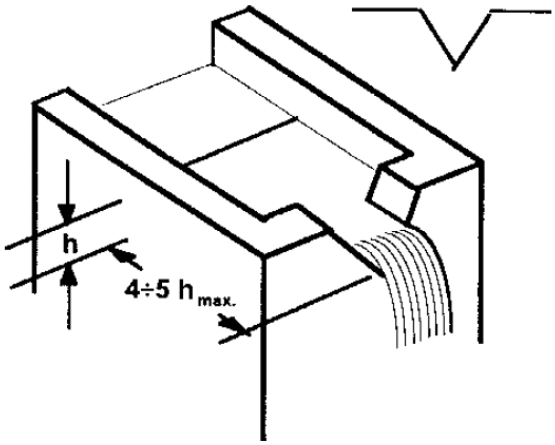
The The x3 Square root Transfer function can be used for open channel (see figures on the right) flow measurement using ISO 1438 rectangular weirs (Hamilton Smith, Kindsvater-Carter, Rehbock formulas) or trapezoidal weirs (Cippoletti formulas) and ISO 1438 Venturi flumes. In these types of devices the relationship between the flow and the developed head h (the differential pressure measured by the transmitter) is proportional to h3/2 or square root of h3.
Other types of Venturi or Parshall flume do not follow this relationship.
Using this function, the output (in % of the span) is proportional to the square root of the third power of the input signal in % of the calibrated span: the instrument gives an output proportional to the rate of flow calculated using the above mentioned formulas.



Square root to the 5th power

The x5 Square root Transfer function can be used for open channel flow measurement using ISO 1438 Vnotch (triangular) weirs (see figure on the right) where the relationship between the flow and the developed head h (the differential pressure measured by the transmitter) is proportional to h5/2 or square root of h5.
Using this function, the output (in % of the span) is proportional to the square root of the fifth power of the input signal in % of the calibrated span: the instrument (it gives an output proportional to the rate of flow calculated using the Kingsvater-Shen formula).





Bidirectional Flow

This mode is used when the transmitter is connected to a bidirectional flow element (wedge meter etc). The bidirectional function, applied to the transmitter input (x) expressed in percentage of the calibrated span, has the following form:
Output = 1/2 + 1/2 sign (x) · x 1/2 where: x and Output should be normalized in the range 0 to 1 for calculation purpose, with the following Output meaning:

- Output = 0 means 0%
- Output = 1 means 100%

This function can be used for flow measurement purpose when the flow is in both the directions and the primary elements are designed to perform this type of measure. As an example, if we have a bidirectional flow measurement application with the following data:

- Max reverse flow rate: -100 lt/h
- Max flow rate: +100 lt/h

The differential pressure generated by the flow primary is for the maximum flow rate 2500 mmH2O, for the max reverse flow rate 2500 mmH2O.
The transmitter will have to be configured as follows:

Calibrated span:	LRV	= -2500mmH2O
	URV	= 2500mmH2O
	Linearization Type	= Bidirectional flow

Once configured as above the transmitter will deliver:

flowrate 100 lt/hr reverse:	output= 0%
no flowrate:	output= 50%
Flow rate 100 lt/h:	output= 100%

Cylindric lying tank
This function is used to measure the volumetric level into a cylindrical horizontal tank with flat ends. The transmitter calculates the volume from the measured filling level.

Spherical Tank
This function is used to measure the volumetric level into a spherical tank. The transmitter calculates the volume from the measured filling level.

Block Mapping

Idx	Parameter		Description / Range / Selections / Notes	
0	BLOCK_OBJ		In the Block Object data structure, there are different items describing the block characteristics. Execution period, Number of parameters in the block, the DD Revision, Profile Revision, View Objects characteristics and so on	
1	ST_REV		The revision level of the Static data associated with the Function Block. The revision level is incremented each time a static parameter value (S – under Storage) in the block is changed.	
2	TAG_DESC		The user description of the intended application of the block	
3	STRATEGY		The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.	
4	ALERT_KEY		The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.	
5	MODE_BLK	TARGET	AUTO / OOS	The selectable modes by the operator.
		ACTUAL		The mode the block is currently in.
		PERMITTED	AUTO / OOS	Allowed modes that the target may take on
		NORMAL	AUTO	The common mode for the Actual.
6	BLOCK_ERR		This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown.	
			Bit 0 = Other	
			Bit 4 =Local Override	
			Bit 7 = Sensor Failure detected by this block/process variable has a status of BAD, Sensor Failure	
			Bit 15 = Out of Service	
7	UPDATE_EVT		This alert is generated by any change to the static data	
8	BLOCK_ALM		The block alarm is used for all configuration, hardware, and connection failure or system problems in the block. The cause of the alert is entered in the sub-code field. The first alert to become active will set the Active Status in the status parameter. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active Status, if the sub-code has changed	
9	TRANSDUCER_DIRECTORY		Directory that specifies the number and starting indices of the transducers in the transducer block	
10	TRANSDUCER_TYPE		Identifies the transducer type.	TN-016 – **100 = Standard Pressure with calibration**
11	TRANSDUCER TYPE VERSION		The version of the transducer identified by TRANSDUCER_TYPE in the form 0xAABB where AA is the major revision of the transducer specification on which the transducer is based, and BB is a revision number assigned and controlled by the manufacturer of the device.	
12	XD_ERROR		Transducer block error sub-code	
13	COLLECTION_DIRECTORY		Directory that specifies the number, starting index, and the DD items IDs of the data collections in each transducer within a transducer block	
14	PRIMARY_VALUE_TYPE		Selects the type of measurement represented in PRIMARY_VALUE. Changing has no calculation effect	

...Block Mapping

Idx	Parameter	Description / Range / Selections / Notes		
15	PRIMARY_VALUE	Pressure Process (PdP) in output from PRTB and input to the AI with Channel = 1		
16	PRIMARY_VALUE_RANGE	The High and Low range limit values, the engineering units code and the number of digits to the right of the decimal point Used as input scaling for the production of the Scaled PV		
17	CAL_POINT_HI	PdP Sensor Calibration point High value expressed in CAL_UNIT		
18	CAL_POINT_LO	PdP Sensor Calibration point Low value expressed in CAL_UNIT		
19	CAL_MIN_SPAN	PdP Sensor Calibration minimum Span value expressed in CAL_UNIT. When calibration is done, the two calibrated points (high and low) must not be too close together.		
20	CAL_VALUE	PdP Process Value after the Calibration. Reference value to be adjusted with the calibration operations		
21	CAL_UNIT	Calibration Unit.	Only Pressure Units are allowed	
22	XD_OPTION	Options which the user may select to alter transducer behavior.	Bit 0: Connected Channel Status BAD in MAN (LSB)* Bit 1: Connected Channel Status UNC in MAN	
23	SENSOR_TYPE	Type of Sensor	TN-016 **– 121 = Pressure sensor unknown**	
24	SENSOR_RANGE	The High and Low PdP physical sensor limits with the engineering units code (Press Only)		
25	SENSOR_SERIAL_NUMBER	Serial Number of the sensor		
26	SENSOR_CAL_METHOD	The method of last sensor calibration. ISO defines several standard methods of calibration. This parameter is intended to record that method, or if some other method was used.		
27	SENSOR_CAL_LOC	The location of last sensor calibration.		
28	SENSOR_CAL_DATE	The date of the last sensor calibration.		
29	SENSOR_CAL_WHO	The name of the person responsible for the last sensor calibration.		
30	SENSOR_DIAPHRAGM_MATERIAL	Defines the construction material of the isolating diaphragms.		
31	SENSOR_FILL_FLUID	Defines the type of fill fluid used in the sensor		
32	SECONDARY_VALUE	Sensor Temperature in output from PRTB and input to the AI with Channel = 2		
33	SECONDARY_VALUE_RANGE	The High and Low Sensor Temp Limits with the engineering units code (Temp Only)		Only the Unit is changeable. The limits/ranges are automatically converted.
34	TERTIARY_VALUE	Static Pressure in output from PRTB and input to the AI with Channel = 3		
35	TERTIARY_VALUE_RANGE	The High and Low Static Pressure Sensor Limits with the engineering units code (Press Only)		Only the Unit is changeable. The limits/ranges are automatically converted.
36	QUATERNARY_VALUE	Scaled_PV in in output from PRTB and input to the AI with Channel = 4		
37	QUATERNARY_VALUE_RANGE	The High and Low Scaled_PV Limits with the engineering unit code. Used as Output Scaling to produce the Scaled_PV		Fixed set to 0 / 100 % with 2 decimals
38	QUATERNARY_LIN_TYPE	0	**Linear (default)**	Transfer Function for **Scaled_PV**
		1	Square root	
		2	SQRT 3° pow	
		3	SQRT 5° pow	
		4	cylindrical lying container	
		5	spherical container	
		6	Bidirectional Flow	
39	QUATERNARY_VALUE_CUT_OFF	0% to 20% [default = 6%]	Valid Only for QUATERNARY_LIN_TYPE = Square Root or Bidirectional Flow	
40	QUATERNARY_VALUE_LINEAR_POINT	0% or 5% to 20% [default = 5%]		
41	DESIDERED_PV	Expressed in PRIMARY_VALUE_UNIT	Force the Measured Pressure to a selected Value setting an offset between Measured and Process values → **PV = MV +/- BIAS → PRIMARY_VALUE = CAL_VALUE +/- BIAS_VALUE**	
42	RESET_BIAS	Reset BIAS_VALUE to 0.0 so that → **PRIMARY_VALUE = CAL_VALUE**		
43	BIAS_VALUE	Expressed in PRIMARY_VALUE_UNIT	Read the offset between the Measured and Process values → **BIAS_VALUE = CAL_VALUE – PRIMARY_VALUE**	
44	STATIC_P_CAL_POINT_HI	Static Pressure Calibration point High expressed in STATIC_P_CAL_UNIT		

Idx	Parameter	Description / Range / Selections / Notes	
45	STATIC_P_CAL_POINT_LO	Static Pressure Calibration point Low expressed in STATIC_P_CAL_UNIT	
46	STATIC_P_CAL_MIN_SPAN	Expressed in STATIC_P_CAL_UNIT.	Static Pressure Sensor Calibration minimum Span value. When calibration is done, the two calibrated points (high and low) must not be too close together.
47	STATIC_P_CAL_UNIT	Static Pressure Calibration Only Pressure Units are allowed	
48	STATIC_P_TRIM_VALUE	Static Pressure Value after the Calibration. Reference value to be adjusted with the calibration operations	
49	DESIDERED_STATIC_P_VALUE	Expressed in TERTIARY_VALUE_RANGE.Unit	Force the Measured Static Pressure to a selected Value setting an offset between Measured and Process value. → **TERTIARY_VALUE = STATIC_P_TRIM_VALUE +/- STATIC_P_BIAS_VALUE**
50	RESET_STATIC_P_BIAS	Reset BIAS_VALUE to 0.0 so that → TERTIARY_VALUE = STATIC_P_TRIM_VALUE	
51	STATIC_P_BIAS_VALUE	Expressed in TERTIARY_VALUE_RANGE.Unit	Read the offset between Measured and Process values → **STATIC_P_BIAS_VALUE = STATIC_P TRIM_VALUE – TERTIARY_VALUE**
52	MAX_WORKING_PRESSURE	Expressed in TERTIARY_VALUE_RANGE Unit	Max Sensor Working Pressure
53	SENSOR_TEMP_CAL_POINT	Expressed in SECONDARY_VALUE_RANGE.Unit	Sensor Temperature Calibration Point An adjustment of the sensor temperature is effected by writing the correct temperature value. This setting has no influence to the accuracy of the pressure measurement
54	SET_UPPER_RANGE_POINT_PV	SPAN Button emulation for Process Value	The instant measured value is written to PRIMARY_VALUE_RANGE_100%
55	SET_LOWER_RANGE_POINT_PV	ZERO Button emulation for Process Value.	The instant measured value is written to PRIMARY_VALUE_RANGE_0%
56	PARALLEL_SHIFT_PV	The PRIMARY_VALUE_RANGE is shifted to produce the desired percentage in output.	The PRIMARY_VALUE_RANGE span remains unchanged. See dedicated section
57	MODULE_TYPE	Type of Transducer technology (piezo, inductive, capacitive)	
58	SENSOR_O_RING_MATERIAL_HSP	Sensor O-Ring Material	High Side
59	PROCESS_CONNECTION_TYPE_HSP	Process connection type	
60	PROCESS_CONNECT_MATERIAL_HSP	Process connection material	
61	DRAIN_VENT_MATERIAL_HSP	Drain vent Material	
62	SENSOR_O_RING_MATERIAL_LSP	Sensor O-Ring Material	Low Side
63	PROCESS_CONNECTION_TYPE_LSP	Process connection type	
64	PROCESS_CONNECT _MATERIAL_LSP	Process connection material	
65	DRAIN_VENT_MATERIAL_LSP	Drain vent Material	
66	GAUGE_ABS_PROC_CONNECT_MTL	Process connection material for Gauge or Absolute sensor types	
67	REMOTE_SEALS_TYPE_HSP	Remote Seal type	High Side
68	REMOTE_SEALS_FILL_FLUID_HSP	Remote Seal Fill Fluid	
69	REMOTE_SEALS_ISOLATOR_HSP	Remote Seal Isolator	
70	REMOTE_SEALS_TYPE_LSP	Remote Seal type	Low Side
71	REMOTE_SEALS_FILL_FLUID_LSP	Remote Seal Fill Fluid	
72	REMOTE_SEALS_ISOLATOR_LSP	Remote Seal Isolator	

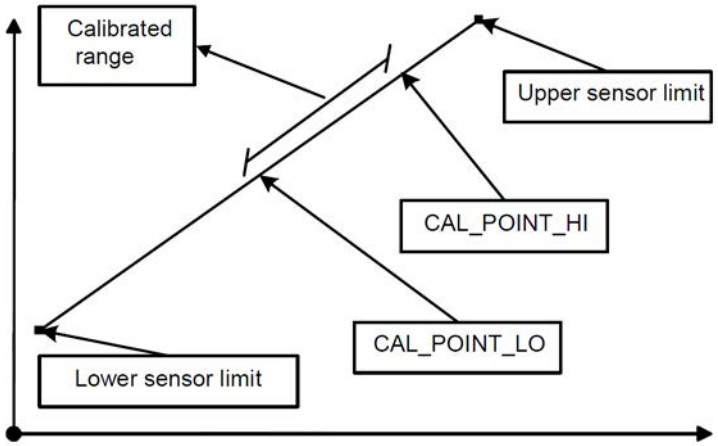
...Block Mapping

Idx	Parameter	Description / Range / Selections / Notes	
73	REMOTE_SEALS_NUMBER	1 One	
		2 Two	
		3 One on low side	
		4 One on high side	
		251 None	
74	PRESSURE_SIMULATION_ ENABLE	**0: Disabled/OFF**	
		1: Enabled/ON	
75	PRESSURE_SIMULATION_VALUE	Expressed in CAL_UNIT	Pressure/dP Simulation Value to be simulated in input
76	STATIC_PR_SIMULATION_ ENABLE	**0: Disabled/OFF**	
		1: Enabled/ON	
77	STATIC_PR_SIMULATION_ VALUE	Expressed in STATIC_P_CAL_UNIT	Static Press Simulation Value to be simulated in input
78	SENSOR_TEMP_SIMULATION_ ENABL E	**0: Disabled/OFF**	
		1: Enabled/ON	
79	SENSOR_TEMP_SIMULATION_ VALUE	Expressed in SECONDARY_VALUE_RANGE.Unit	Sensor Temp Simulation Value to be simulated in input
80	INTEGRATION_TIME	From 0.01 to 1.28 seconds This parameter is available only for piezo-resistive and capacitive sensor types	The Integration Time of the A/D converter can be changed between 0.1s and 1.28s in steps of 0.01s. The accuracy of the transmitter will be higher with a high Integration Time. The transmitter will be faster with a short Integration Time but the output will be more noisy depending on the process conditions. The output will rise linear with 10ms cycle after a step of the input value. The end value will be reached with expiration of the Integration Time. The default value of the Integration Time is 0.3s for transmitters with ≥0.04% accuracy and 1.28s for transmitter with 0.025% accuracy. The setting of the integration time is independent from the Damping. The Integration Time shall be set to 1.28s for the calibration of the pressure measurement.

Sensor Calibration

The transmitter makes available to the user some operations that can be useful during the device life cycle. These operations are supported and can be executed with the EDD based configuration tools, or also by following the instructions/descriptions below.

Sensor Trimming/calibration
The scope of the sensor trimming/calibration is to adjust and make accurate as much as possible the sensor conversion to a pressure value in digital format.
The sensors of the 266 are calibrated/trimmed in the factory to the customer's specified measuring range therefore it could be necessary change or correct the sensor calibration later on as maintenance operation.
Two points are necessary to perform a sensor calibration. Low sensor calibration point (Zero) writing in PRTB_CAL_POINT_LO and High sensor calibration point (Span) writing in PRTB_CAL_POINT_HI. The minimum distance from the two points must be greater than minimum span PRTB_CAL_MIN_SPAN



P-dP Sensor Low Trimming
With this operation the PRTB_CAL_VALUE is automatically adjusted, in order to match the real value of the pressure applied in input, in the low part of the working range. The following sequence of operations is required:

1. Apply a reference pressure in input using a reference pressure generator.
2. Select the engineering unit of the measure in the PRTB_CAL_UNIT (Pressure Unit Only)
3. Read the measure produced by the transmitter from the PRTB_CAL_VALUE.
4. If this value doesn't match the pressure applied in input, enter the correct known applied pressure value in the PRTB_CAL_POINT_LO and write to the transmitter. This writing executes an internal algorithm that produces the new correction coefficients.
5. Read again the PRTB_CAL_VALUE and check if its value now matches the applied pressure.

P-dP Sensor High Trimming
With this operation the PRTB_CAL_VALUE is automatically adjusted, in order to match the real value of the pressure applied in input, in the high part of the working range. The following sequence of operations is required:

1. Apply a reference pressure in input using a reference pressure generator.
2. Select the engineering unit of the measure in the PRTB_CAL_UNIT (Pressure Unit Only)
3. Read the measure produced by the transmitter from the PRTB_CAL_VALUE.
4. If this value doesn't match the pressure applied in input, enter the correct known applied pressure value in the PRTB_CAL_POINT_HI and write to the transmitter. This writing executes an internal algorithm that produces the new correction coefficients.
5. Read again the PRTB_CAL_VALUE and check if its value now matches the applied pressure

...Sensor Calibration

Static Pressure Low Trimming
With this operation the PRTB_STATIC_P_TRIMMED_VALUE is automatically adjusted, in order to match the real value of Static Pressure applied at the transducer in the lower part of the range. The following sequence of operations is required:
1- Select the engineering unit of the measure in the PRTB_STATIC_P_CAL_UNIT (Pressure Unit Only)
2- Read the Static Pressure value from the PRTB_STATIC_P_TRIMMED_VALUE.
3- If this value doesn't match the known Static Pressure applied in input at the transducer, enter the correct value in the PRTB_STATIC_P_CAL_POINT_LO and write to the transmitter. This writing executes an internal algorithm that produces the new correction coefficients.
4- Read again the PRTB_STATIC_P_TRIMMED_VALUE and check if its value now matches the real Static Pressure value

Static Pressure High Trimming (for piezo dP sensor only)
With this operation the PRTB_STATIC_P_TRIMMED_VALUE is automatically adjusted, in order to match the real value of Static Pressure applied at the transducer in the upper part of the range. The following sequence of operations is required:
1. Select the engineering unit of the measure in the PRTB_STATIC_P_CAL_UNIT (Pressure Unit Only)
2. Read the Static Pressure value from the PRTB_STATIC_P_TRIMMED_VALUE.
3. If this value doesn't match the known Static Pressure applied in input at the transducer, enter the correct value in the PRTB_STATIC_P_CAL_POINT_HI and write to the transmitter. This writing executes an internal algorithm that produces the new correction coefficients.
4. Read again the PRTB_STATIC_P_TRIMMED_VALUE and check if its value now matches the real Static Pressure value

Sensor Temperature Trimming
With this operation the PRTB_SECONDARY_VALUE (Sensor Temperature) is automatically adjusted, in order to match the real value of the sensor temperature. The following sequence of operations is required:
1. Select the engineering unit of the temperature in the PRTB_SECONDARY_VALUE_RANGE_UNIT (Temperature Unit Only)
2. Read the Sensor Temperature value from the PRTB_SECONDARY_VALUE.
3. If this value doesn't match the known Sensor Temperature of the transducer, enter the correct value in the PRTB_SENSOR_TEMP_CAL_POINT and write to the transmitter. This writing executes an internal algorithm that produces the new correction coefficients.
4. Read again the PRTB_SECONDARY_VALUE and check if its value now matches the real Sensor temperature value

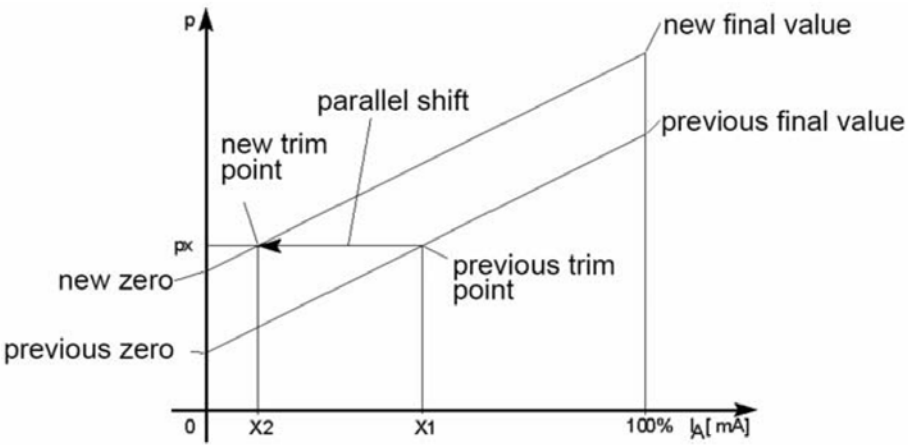
Parallel Shift (P-dP)
In case the process (dp or p) cannot be led to 0 it is possible correct the measure performing the Parallel Shift operation. Typically, this operation is applicable for Level measurements.
Having the possibility to see/read the actual measure in percent, if it is not what expected, then it is possible to write/enter the percentage of what the transmitter process should measure. The correction consists in the shift of the calibration range values PRTB_PRIMARY_VALUE_RANGE 0% and PRTB_PRIMARY_VALUE_RANGE 100% with the scope in order to produce in output the measure, PRTB_QUATERNARY_VALUE at the desired percentage.
The parallel shift is executed by writing the desired percent value in the PTRB_PARALLEL_SHIFT_PV

IMPORTANT

After the parallel shift execution, the percent value of the PRTB_QUATERNARY_VALUE matches the desired percentage only if the PRTB_LIN_TYPE is set to Linear.

If an AI block is set to CHANNEL = 4 it receives in input the PRTB_QUATERNARY_VALUE and in this case the AI_OUT matches the desired percentage as well only if the AI_L_TYPE is set to Linear.

This makes it possible to set the output signal of several measuring devices that measure the same process variable to the same value without having to perform a calibration with applied pressure.
E.G. the transmitter output can be adjusted to gauge-glass for level measurement.
This function can - under the following circumstances - be carried out at any point on the characteristic:
Process variable within the adjusted measuring range - transmitter with linear transfer function.

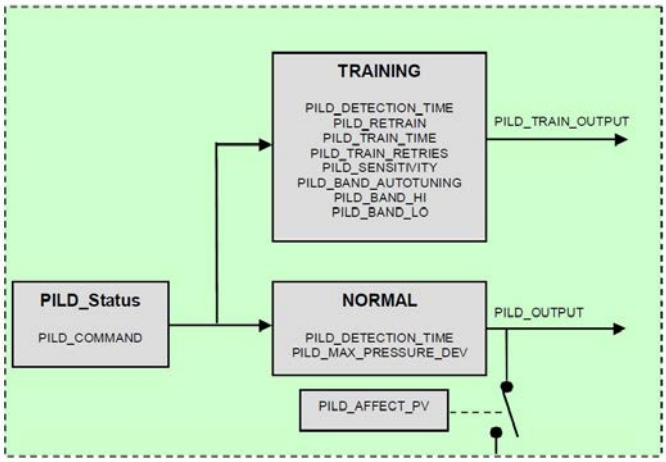


When a pressure px is applied, the transmitter displays the standardized output value x1 in percent. Due to the present application the value x2 should be displayed. Enter this new value x2 in the line PRTB_PARALLEL_SHIFT_PV, the transmitter calculates the new zero and the new final value and adopts these new settings in the PRTB_PRIMARY_VALUE_RANGE 0% and PRTB_PRIMARY_VALUE_RANGE 100%.

Advanced Diagnostic Transducer Block (ADTB)

Overview

The advanced diagnostic transducer block contains some historic/statistical information and all the parameters related with the PILD algorithm. The goal of this block is to supervise the device and set diagnostic alarms under transducer abnormal condition to the control system modifying the pressure transducer block primary value status and raising the proper alarm bit in the ADTB_BLOCK_ERR and RB_MAINTENANCE_ACTIVE.



Description

The Plugged Impulse Line Detection (PILD) is a function aimed at detecting the blockage of the process connections of the instrument and any type of problem occurring at the internal hydraulic circuit of the sensor. The PILD algorithm is executed in two distinct phases:

Training Phase:

Selecting ADTB_PILD_COMMAND = TRAIN the training phase get starts analysing and learning the normal condition of the process dynamics in term of noises of the primary signal detected when the process is working the Training Phase can take long time depending by the PILD settings of ADTB_PILD_TRAIN_TIME, ADTB_PILD_RETRIES……, then, if the training phase is successfully completed with good result, ADTB_PILD_TRAINING_OUTPUT = PILD_TRAIN_OK the PILD pass to the second phase of process consisting in the monitoring of the process dynamics.

...Advanced Diagnostic Transducer Block (ADTB)

In case the training phase didn't complete successfully, it is possible to read the reason because it didn't success from the ADTB_PILD_TRAINING_OUTPUT as:

- Process Instable during training
- Process not available during training
- Not good process condition for training
- Training not done

Monitoring Phase:

The algorithm performs a continuous sampling and comparison of the current process conditions noises with what memorized during the training phase. Differences have been experienced being consequences of something bad into the process connections to the sensor like dirty, ice and so on which tap/plug the pipe/s partially or totally.

Whenever a pipe plugging/tapping is detected, the ADTB_PILD_OUTPUT that was set to NORMAL during the monitoring phase changes to one of the following conditions:

- Line on side H plugged
- Line on side L plugged
- Both lines H and L plugged
- An undefined line plugged

In this case also the device diagnosis is affected setting the bit Pild_Output in the RB_MAINTENANCE_ACTIVE and the specific bit of the above detailed 4 info in the RB_EXTENDED_ACTIVE .

When one of the above conditions has been detected, there is the possibility that the process variables in output from the PRTB continue to be produced with GOOD status.

In this way the AI blocks receiving in input the variables from the PRTB works normally and the operator could have not evidence of the wrong conditions. For this reason it is possible make a choice in order to decide to affect or not the PRTB variables when the plugging conditions have been detected. This selection is possible with the ADTB_PILD_AFFECT_PV variable. When it is selected to true, and the Plugging conditions are detected, the GOOD status that would be produced in output for the PRTB_PRIMARY_VALUE, PRTB_SECONDARY_VALUE, PRTB_TERTIARY_VALUE, PRTB_QUATERNARY_VALUE are all forced to BAD status

The PILD algorithm loses the train every time it is switched off. The algorithm is switched off automatically for every error condition, except when the pressure violates the maximum pressure deviation and the retrain is selected.

Historical/statistical info

From this block can be also read the Minimum and Maximum values measured by the transducer of Pressure, Static Pressure and Sensor Temperature plus the total working time and the number of device power.

Block Mapping

Idx	Parameter		Description / Range / Selections / Notes			
0	BLOCK_OBJ		In the Block Object data structure, there are different items describing the block characteristics. Execution period, Number of parameters in the block, the DD Revision, Profile Revision, View Objects characteristics and so on			
1	ST_REV		The revision level of the Static data associated with the Function Block. The revision level is incremented each time a static parameter value (S – under Storage) in the block is changed.			
2	TAG_DESC		The user description of the intended application of the block			
3	STRATEGY		The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.			
4	ALERT_KEY		The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.			
5	MODE_BLK	TARGET	AUTO / OOS			The selectable modes by the operator.
		ACTUAL				The mode the block is currently in.
		PERMITTED	AUTO / OOS			The allowed modes the operator can select as Target
		NORMAL	AUTO			The common mode for the Actual.
6	BLOCK_ERR		This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown.			
			Bit 6 = Device Needs Maintenance Soon			Refer to the section “Diagnostic, Block_err and Status Byte” from page 29
			Bit 15 = Out of Service			The MODE_BLK_ACTUAL = Out of Service.
7	UPDATE_EVT		This alert is generated by any change to the static data			
8	BLOCK_ALM		The block alarm is used for all configuration, hardware, and connection failure or system problems in the block. The cause of the alert is entered in the sub-code field. The first alert to become active will set the Active Status in the status parameter. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active Status, if the sub-code has changed			
9	TRANSDUCER_DIRECTORY		Directory that specifies the number and starting indices of the transducers in the transducer block			
10	TRANSDUCER_TYPE		Identifies the transducer type.			
11	TRANSDUCER_TYPE_VERSION		The version of the transducer identified by TRANSDUCER_TYPE in the form 0xAABB where AA is the major revision of the transducer specification on which the transducer is based, and BB is a revision number assigned and controlled by the manufacturer of the device.			
12	XD_ERROR		Transducer block error sub-code			
13	COLLECTION_DIRECTORY		Directory that specifies the number, starting indices, and the DD items IDs of the data collections in each transducer within a tb			
14	PILD_COMMAND		Activation / deactivation of the PILD algorithms	**0:**	**IDLE**	**default value**
				1:	GO_OFF	Switch OFF the PILD algorithm
				2:	TRAIN	Start the training phase
				3:	STOP TRAINING	Stop the training phase of the algorithm before its natural ending
			Status of the PILD algorithm	0:	OFF	The algorithm is Inactive (Default value)
				1:	NORMAL	The algorithm is Active
				2:	TRAINING	The algorithm is in training phase

Block Mapping

Idx	Parameter	Description / Range / Selections / Notes			
15	PILD_STATUS	Status of the PILD algorithm	0:	OFF	The algorithm is Inactive (Default value)
			1:	NORMAL	The algorithm is Active
			2:	TRAINING	The algorithm is in training phase
16	PILD_OUTPUT	Status of the Impulse Lines	Bit 0	Normal	The process connections are OK and the device is working normally. Lines Not Plugged
			Bit 1	Not Valid	When the PILD algorithm is not working like, for example, during the Training phase or if the training phase didn't produce a valid result
			Bit 2	Max Pressure Deviation	The pressure value currently detected is too different from what used for the Training. A new Training is necessary for this new process condition
			Bit 3	One Line Plugged	One undetected process connection is plugged. It was not possible identify which one
			Bit 4	Two Lines Plugged	Both the Process connections, high side (+) and low side (-) are plugged
			Bit 5	Line H Plugged	The Process connection on the high side (+) is plugged
			Bit 6	Line L Plugged	The Process connection on the low side (-) is plugged
			Bit 7	not used	
17	PILD_AFFECT_PV	This parameter indicates if the PILD algorithm must affect the PRTB_PRIMARY_VALUE. if YES, when the PILD reveals an abnormal situation, it sets the PRTB_PRIMARY_VALUE Status to BAD.	0	No	Doesn't affect primary value status (default value)
			1	Yes	Affect primary value status
18	PILD_DETECTION_TIME	This parameter represents the length of the algorithm slot. This is the time interval (minutes) over which the algorithm bases the decision on the plugging state of the impulse lines			
19	PILD_MAX_PRESSURE_DEV	This parameter is used in the normal operation checks. It is the maximum allowed deviation of the differential pressure from the mean differential pressure Red in the training phase. If the deviation is greater, than the PILD output is set to OUTPUT NOT VALID, because the conditions are too different from the training phase			
20	PILD_RETRAIN	The PILD algorithm can be forced to train again when the process conditions pass the maximum allowed deviation	0	No	Re-trainings are Disabled / not executed
			1	Yes	Affect primary value status
21	PILD_TRAIN_TIME	This parameter represents the duration of the training period			
22	PILD_TRAIN_RETRIES	At the end of the training procedure, there are the training checks on the Red data. If they fail, the algorithm is allowed to retry the procedure adding a further slot of data. This parameter is the max number of allowed retries			

Idx	Parameter	Description / Range / Selections / Notes			
23	PILD_TRAIN_OUTPUT	This parameter gives information on the status of the training phase	Bit 0:	PILD Train Not Done	Training not yet executed
			Bit 1:	PILD Train OK	Training correct
			Bit 2:	PILD Train Frequency Tuning	The training phase is checking the signal frequency for its execution
			Bit 3:	PILD Train Power Instable	Signal power has passed the max. allowed deviation This process condition is considered instable for a good training
			Bit 4:	PILD Train Pressure Instable	Pressure has passed the max.allowed deviation. This process condition is considered instable for a good training
			Bit 5:	PILD Train Low Noise	The Noise of the process is too low for allowing a good training
			Bit 6:	not used	
			Bit 7:	not used	
24	PILD_SENSITIVITY	Algorithm sensibility	1:	LOWEST	
			2:	VERY LOW	
			3:	LOW	
			4:	MEDIUM (Default)	
			5:	HIGH	
			6:	VERY HIGH	
			7:	HIGHEST	
25	PILD_BAND_ AUTOTUNING	PILD auto tuning enable/disable	0	No	Doesn't perform auto tune (default value)
			1	Yes	Performs Auto Tune
26	PILD_BAND_LO	Writable only if PILD_BAND_AUTOTUNING is set to 0			
27	PILD_BAND_HI				
28	PWR_ON_CNT	Power On Counter. Number of the device Power on			
29	TOT_WORK_TIME	Total Working hours. Total amount of time the transmitter has been kept switched on			
30	PAR_WORK_TIME	Partial Working hours. Partial amount of time the transmitter has been switched on.			The user can clear this counter
31	MAX_PdP_VALUE	Max Historical Sensor value	Resettable from RESET_MIN_MAX_VALUE		
32	MIN_PdP_VALUE	Min Historical Sensor value			
33	MAX_SENS_TEMP_VAL	Max Historical temp. value			
34	MIN_SENS_TEMP_VAL	Min Historical temp. value			
35	MAX_STATIC_PRESS_VAL	Max Historical Static Press value			
36	MIN_STATIC_PRESS_VAL	Min Historical Static Press value			
37	SERVICE_MAX_PdP_VALUE	For service Use. Max Historical Sensor value	Resettable from RESET_SERV_MIN_MAX_VALUE		
38	SERVICE_MIN_PdP_VALUE	For service Use. Min Historical Sensor value			
39	SERV_MAX_SENS_TEMP_VAL	For service Use. Max Historical temp. value			
40	SERV_MIN_SENS_TEMP_VAL	For service Use. Min Historical temp. value			
41	SERV_MAX_STATIC_PRESS_VAL	For service Use. Max Historical Static Press value			
42	SERV_MIN_STATIC_PRESS_VAL	For service Use. Min Historical Static Press value			
36	RESET_MIN_MAX_VALUE	Reset the selected User Min Max values	0	None	
			1	Reset PdP Values	
			2	Reset Sensor Temperature Values	
			3	Reset Static Pressure Values	

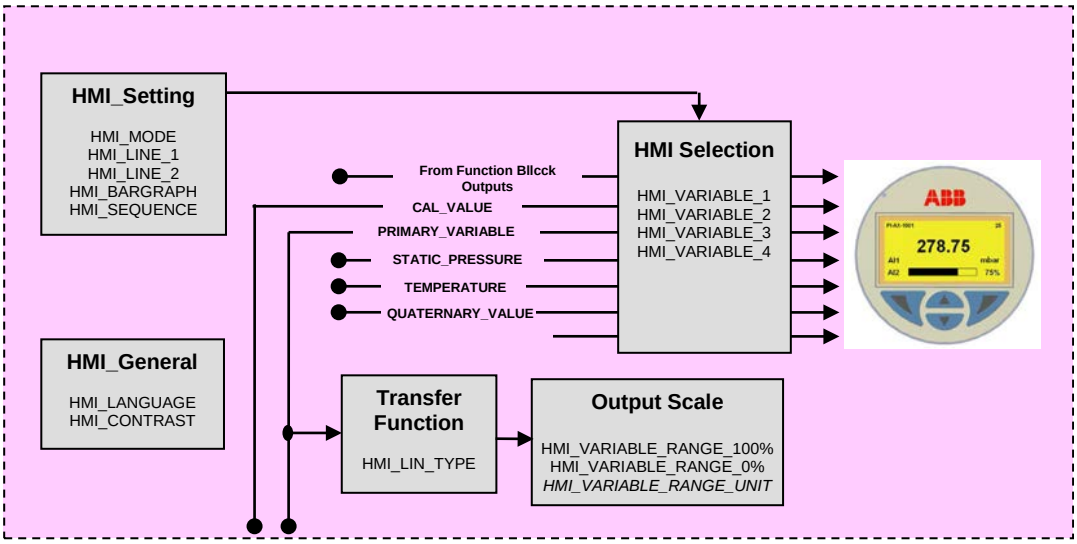
HMI Transducer Block (HMITB)

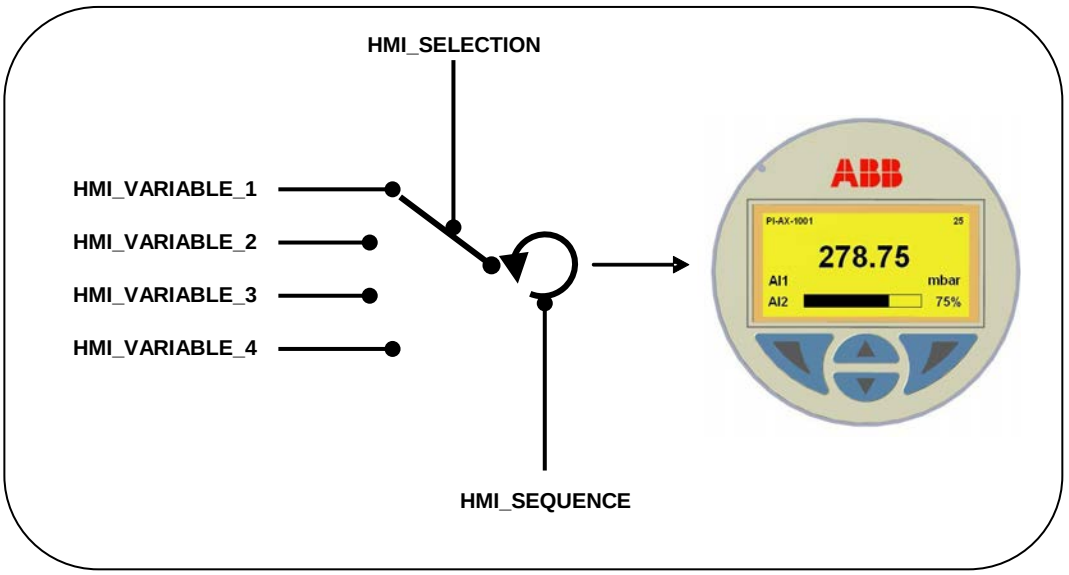
Overview

14.1. Overview

The display transducer block is an independent block dedicated to the management of the local display and the local operations via push buttons.

Block Diagram





Description

The HMI Transducer Block contains all the parameters allowing the display configuration. Refer to the dedicated section of this manual.

Idx	Parameter		Description / Range / Selections / Notes	
0	BLOCK_OBJ		In the Block Object data structure, there are different items describing the block characteristics. Execution period, Number of parameters in the block, the DD Revision, Profile Revision, View Objects characteristics and so on	
1	ST_REV		The revision level of the Static data associated with the Function Block. The revision level is incremented each time a static parameter value (S – under Storage) in the block is changed.	
2	TAG_DESC		The user description of the intended application of the block	
3	STRATEGY		The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.	
4	ALERT_KEY		The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.	
5	MODE_BLK	TARGET	AUTO / OOS	The selectable modes by the operator.
		ACTUAL		The mode the block is currently in.
		PERMITTED	AUTO / OOS	The allowed modes the operator can select as Target
		NORMAL	AUTO	The common mode for the Actual.
6	BLOCK_ERR		This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown.	
			Bit 15 = Out of Service	The MODE_BLK_ACTUAL = Out of Service.
7	UPDATE_EVT		This alert is generated by any change to the static data	
8	BLOCK_ALM		The block alarm is used for all configuration, hardware, and connection failure or system problems in the block. The cause of the alert is entered in the sub-code field. The first alert to become active will set the Active Status in the status parameter. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active Status, if the sub-code has changed.	
9	TRANSDUCER_DIRECTORY		Directory that specifies the number and starting indices of the transducers in the transducer block	
10	TRANSDUCER_TYPE		Identifies the transducer type.	
11	TRANSDUCER_TYPE_VERSION		The version of the transducer identified by TRANSDUCER_TYPE in the form 0xAABB where AA is the major revision of the transducer specification on which the transducer is based, and BB is a revision number assigned and controlled by the manufacturer of the device.	
12	XD_ERROR		Transducer block error sub-code	
13	COLLECTION_DIRECTORY		Directory that specifies the number, starting indices, and the DD items IDs of the data collections in each transducer within a tb	
14	HMI_CONTRAST		Display Contrast 0 ....100 [50]	
15	HMI_LANGUAGE		**0: English (default)**	
			1: German	
			2 French	
			3 Spanish	
			4: Italian	
16	HMI_MODE		5: One Line	
			6: One Line with Bargraph (default)	
			9: Two Lines	
			10: Two Lines with Bargraph	
17	HMI_SW_REV		0 Not Installed	
			xxx Display SW Revision	
18	HMI_LIN_TYPE		**0: Linear (default)**	Active only if one of the 4 HMI_Variable_x is set to HMI_Variable. In this case the PRTB_PRIMARY_VALUE is calculated with the selected HMI_LIN_TYPE and the result ready to be scaled with the HMI_VARIABLE_RANGE.
			1: Square root	
			2: SQRT 3° pow	
			3: SQRT 5° pow	
			4: Cylindrical lying container	
			5: Spherical container	
			6: Bidirectional Flow	

Idx	Parameter	Description / Range / Selections / Notes		
19	HMI_VARIABLE_RANGE	The High and Low HMI Scale limits with the engineering units code		Scaling applied at the PRTB_PRIMARY_VALUE for displaying purpose only and has not effect on the PRTB_PRIMARY_VALUE in input at the AI blocks.
20	HMI_VARIABLE_CUSTOM_UNIT	Textual custom unit		
21	HMI_LINE_1	**1:**	**HMI_Variable 1 (default)**	
		2:	HMI_Variable 2	
		3:	HMI_Variable 3	
		4:	HMI_Variable 4	
22	HMI_LINE_2	Same as HMI_LINE_1		
23	HMI_BARGRAPH	Same as HMI_LINE_1		
24	HMI_SEQUENCE	0	Sequence/Autoscrolling OFF	
		1	Sequence/Autoscrolling ON	
25	HMI_VARIABLE_1	In order to recognize the displayed variable among all those in this list, it appears a three character string in the left side of the value when two lines mode is selected and below the value when One Line Mode is selected. The strings for any variables are:		
		0:	**P-dP (default)**	**'PV'**
		6:	OUT AI_1	'AI1'
		7:	OUT % AI_1	'%1'
		8:	OUT AI_2	'AI2'
		9:	OUT % AI_2	'%2'
		10:	OUT AI_3	'AI3'
		11:	OUT % AI_3	'%3'
		1:	Sensor Temp	'ST'
		2:	Static Pressure	'SP'
		19:	HMI Variable	'HMI'
		4:	PV Trim Value	'TPV'
		5	Static Pressure Trim Value	'TSP'
		3	Scaled PV	'LIN'
		16	OUT1 SC	'SC1'
		17	OUT2 SC	'SC2'
		12	OUT PID	'PID'
		18	OUT AR	'AR'
		14	OUT IS	'IS'
		15	OUT IT	'IT'
		13	OUT CS	'CS'
26	HMI_VARIABLE_2	Same as HMI_VARIABLE_1		
27	HMI_VARIABLE_3	Same as HMI_VARIABLE_1		
28	HMI_VARIABLE_4	Same as HMI_VARIABLE_1		

Device Diagnostic

The 266 PdP FF produces different type of diagnostic information:

- Device Diagnostic
  These are the diagnostic information produced by the Resource and Transducer Blocks and refer to the device status/health
- Process Diagnostic
  These are the diagnostic information which are seen through process variable status and process alarms such as the HI, HI HI, LO, LO LO, DV HI and DV LO alarms implemented in various Function blocks.

Scope of this section is to describe the Device Diagnostic to be consumed in the Asset Management Software.

Standard errors

The FF standard parameter defining the device diagnostic conditions is the BLOCK_ERR contained by each block and mapped as follow:

BLOCK_ERR mapping	
Bit 0	Other
Bit 1	Block Configuration Error
Bit 2	Link Configuration Error
Bit 3	Simulate Active
Bit 4	Local Override
Bit 5	Device Fault State Set
Bit 6	Device Needs Maintenance Soon
Bit 7	Sensor Failure detected by this block/process variable has a status of BAD, Sensor Failure
Bit 8	Output Failure detected by this block/backcalculation input has a status of BAD, Device Failure
Bit 9	Memory Failure
Bit 10	Lost Static Data
Bit 11	Lost NV Data
Bit 12	Readback Check Failed
Bit 13	Device Needs Maintenance Now
Bit 14	Power Up
Bit 15	Out of Service

...Device Diagnostic

The device diagnostic info are split into four different alert type parameters relating the four NAMUR NE107 classifications.

- RB_FAIL_ACTIVE
- RB_OFFSPEC_ACTIVE
- RB_MAINTENANCE_ACTIVE
- RB_CHECK_ACTIVE

Each error is represented by a bit and all the above parameters have the same error bit mapping.
When the device firmware detects an error condition, its corresponding bit is set into one of the above 4 parameters depending by into which of the RB_x_MAP parameter below the error bit has been mapped:

- RB_FAIL_MAP
- RB_OFFSPEC_MAP
- RB_MAINTENANCE_MAP
- RB_CHECK_MAP

When an error condition mapped into RB_FAIL_MAP became true, its corresponding bit is set into RB_FAIL_ACTIVE and. if enabled, the FAIL_ALARM telegram transmitted.
If the same error is then mapped into RB_MAINTENANCE_MAP, when it is detected again, its corresponding bit is set into RB_MAINTENANCE_ACTIVE and the MAINTENANCE_ALARM telegram transmitted.
All the error conditions mapped in the above parameters can be simulated or masked from RB_SIMULATE or RB_x_MASK
Before to simulate an error condition, the device must be configured to operate in Simulation Mode by moving the switch 4 of the electronics in ON position and writing “Active” into the RB_SIMULATE_EN/DIS. parameter.
Then, once an error bit is simulated active by writing into RB_SIMULATE, its feed-back is readable from RB_DIAGNOSTIC_VALUE parameter.

IMPORTANT

Only one condition/bit per time can be simulated.

For some error conditions, the bit mapped in the above parameters is not exhaustive to identify the real root cause of the problem and, for this reason, additional detailed information about the specific error condition have been mapped into RB_EXTENDED_ACTIVE parameters.

Device Diagnostic Mapping

This table shows the bit mapping of RB_x_ACTIVE and RB_EXTENDED_ACTIVE parameters with the relating error name and NAMUR NE107 category.

Cat.	Error	RB_fail / maintenance / offspec / check_ ACTIVE (indexes 47, 48, 49, 50)		RB_EXTENDED_ACTIVE (index 69)	
	Function Check	Bit 0	PRTB NormalMode = AUTO and PRTB TargetMode != AUTO		
	Sensor Invalid	Bit 1	The transducer is not able to generate a valid signal due to one of the following conditions (see RB_EXTENDED_ACTIVE)	Bit 0	The primary signal of the sensor is no longer available
	Sensor Memory Fail	Bit 2	The data in the sensor memory are corrupted precluding the correct functionality of the device	Bit 1	The sensor and the connected electronics are incompatible
	Memory Failure	Bit 3	The device data loaded at the start up are corrupted precluding the correct functionality of the device		
	P-dP Sensor Fail	Bit 4	The sensor signal value is incorrect due to a mechanical failure i.e. Loss of fill fluid from the cell; ruptured diaphragm, broken sensor...		
	Static Pressure Sensor Fail	Bit 5	The sensor signal value is incorrect due to a mechanical failure i.e. The circuitry for the sampling of the static pressure has failed... Valid for Differential pressure models		
	Sensor Temperature Fail	Bit 6	The circuitry for the sampling of the temperature has failed. The measurement accuracy is decreased more than the acceptable error		
	Pressure Overrange	Bit 7	The Pressure is outside the overpressure limit and risk to damage the sensor		
	P-dP Out Of Limit	Bit 8	The measured Process Pressure is outside the sensor limits and no longer representing the true applied process value		
	Static Pressure Out Of Limit	Bit 9	The measured Static pressure is above its operational limit		
	Input Simulation Active	Bit 10	The Input Simulation function is Active At least one of these variables is simulated	Bit 2	The Pressure Value produced in output is calculated starting from a simulated input
				Bit 3	The Static Pressure Value produced in output is calculated starting from a simulated input
				Bit 4	The Sensor Temp Value produced in output is calculated starting from a simulated input
	Sensor Temperature Out Of Limit	Bit 11	The measured sensor temperature is outside of its operational limits		
	Max. Working Pressure Exceeded	Bit 12	The measured Static Pressure is higher than the acceptable mechanical limit of the process connection elements.		
	Primary Variable Out of Range	Bit 13	Process value is outside its High or Low working range		

...Device Diagnostic Mapping

Cat.	Error	RB_fail / maintenance / offspec / check_ ACTIVE (indexes 47, 48, 49, 50)		RB_EXTENDED_ACTIVE (index 69)	
	Electronic Interface error.	Bit 14	Exchange of non-critical data between sensor and electronics is precluded due to problem in the transmitter circuit of the electronics or in receiver circuit of the sensor		
	Non-Volatile Sensor memory burn error	Bit 15	Writings to the Sensor non-Volatile Memory were not successful. The device works without problems but any replacement operation is compromised because the back-up configuration is not updated		
	Non-Volatile Electronics memory burn error	Bit 16	Writings to the electronic Non-Volatile Memory were not successful. The device continue to work without problems but after the next power cycle the last configuration will be lost		
	Replace Info	Bit 17	An element of the transmitter has been changed (sensor or electronics) and the correct replacement operation must be executed	Bit 5	The Replace operation is required after the changing of the electronics or of the sensor. Both the directions are allowed, from Electronic (CB) to Sensor (FE) or from Sensor (FE) to Electronic (CB)
				Bit 6	The Replace operation is required after the changing of the electronics or of the sensor but it is allowed only from Electronic (CB) to Sensor (FE)
				Bit 7	The Replace operation has been attempted but with wrong direction
	PILD Output	Bit 18	The PILD algorithm has detected impulse lines plugged. The Plugged Line can be one among:	Bit 10	PILD algorithm has detected both impulse lines plugged.
				Bit 11	PILD algorithm has detected a plugged impulse line on the HIGH side.
				Bit 12	PILD algorithm has detected a plugged impulse line on the LOW side.
				Bit 13	PILD algorithm has detected one plugged impulse line.
	PILD Changed Operating Conditions	Bit 19	The pressure value currently detected is too different from what used for the PILD Training		

Diagnostic, BlOCK_ERR and Status Byte

In this table are grouped together the errors produced by the same item. In addition, for each error is specified the corresponding standard BLOCK_ERR bit, the Error Code shown in the HMI Diagnostic page and the Status Byte assumed by the dynamic variables of the Pressure Transducer Block.

Cat.	Error	Block err	HMI code	PRTB_x_VALUE Status					
Electronics errors				**PRIMARY**	**SECONDARY**	**TERTIARY**	**QUATERNARY**	**PDP_TRIM**	**SP_TRIM**
	Memory Failure	RB.Lost NV Data	F116.023	BAD Device Failure No Limit					
	Electronic Interface error.	RB.Device Needs Maintenance Soon	M030.020	GOOD_NC Non Specific No Limit					
	Non-Volatile memory burn error	RB.Device Needs Maintenance Soon	M026.024	GOOD_NC Non Specific No Limit					
Pressure sensor errors				**PRIMARY**	**SECONDARY**	**TERTIARY**	**QUATERNARY**	**PDP_TRIM**	**SP_TRIM**
	Sensor Invalid	PRTB.Sensor Failure	F120.016	BAD Sensor Failure No Limit					
	Sensor Memory Fail	PRTB.Sensor Failure	F118.017	BAD Sensor Failure No Limit					
	P-dP Sensor Fail	PRTB.Sensor Failure	F114.003	BAD Sensor Failure No Limit	GOOD_NC Non Specific No Limit	GOOD_NC Non Specific No Limit	BAD Sensor Failure No Limit		GOOD_NC Non Specific No Limit
	Static Pressure Sensor Fail	PRTB.Sensor Failure	F112.001	UNCERTAIN Sensor Conversion Not Accurate No Limit	GOOD_NC Non Specific No Limit	BAD Sensor Failure No Limit	UNCERTAIN Sensor Conversion Not Accurate No Limit		BAD Sensor Failure No Limit
	Sensor Temperature Fail	PRTB.Sensor Failure	F110.002	UNCERTAIN Sensor Conversion Not Accurate No Limit	BAD Sensor Failure No Limit	UNCERTAIN Sensor Conversion Not Accurate No Limit			
	NonVolatile memory burn error	RB.Device Needs Maintenance Soon	M028.018	GOOD_NC Non Specific No Limit					
Installation / start-up errors				**PRIMARY**	**SECONDARY**	**TERTIARY**	**QUATERNARY**	**PDP_TRIM**	**SP_TRIM**
	Out of Service	RB.Out of Service		GOOD_NC Non Specific No Limit			**Note:The AI1,2,3 OUT Goes to BAD**		
	Input Simulation Active	PRTB.Local Override	C088.030	GOOD_NC Non Specific No Limit					
	Replace Info	RB.Device Needs Maintenance Soon	M020.007	GOOD_NC Non Specific No Limit					
Process errors				**PRIMARY**	**SECONDARY**	**TERTIARY**	**QUATERNARY**	**PDP_TRIM**	**SP_TRIM**
	Pressure Overrange	PRTB.Other	F104.011	BAD Non Specific No Limit	GOOD_NC Non Specific No Limit		BAD Non Specific No Limit		GOOD_NC Non Specific No Limit
	P-dP Out Of Limit	PRTB.Other	F102.004	UNCERTAIN Non Specific No Limit	GOOD_NC Non Specific No Limit		UNCERTAIN Non Specific No Limit		GOOD_NC Non Specific No Limit
	Static Pressure Out Of Limit	PRTB.Other	F100.005	UNCERTAIN Sensor Conversion Not Accurate No Limit	GOOD_NC Non Specific No Limit	UNCERTAIN Non Specific No Limit	UNCERTAIN Sensor Conversion Not Accurate No Limit		UNCERTAIN Non Specific No Limit
	Sensor Temperature Out Of Limit	PRTB.Other	S054.006	UNCERTAIN Sensor Conversion Not Accurate No Limit	UNCERTAIN Non Specific No Limit	UNCERTAIN Sensor Conversion Not Accurate No Limit			
	Max. Working Pressure Exceeded	PRTB.Other	M052.031	GOOD_NC Non Specific No Limit					

...Diagnostic, BlOCK_ERR and Status Byte

Cat.	Error		Block err	HMI code	PRTB_x_VALUE Status					
Process errors					**PRIMARY**	**SECONDARY**	**TERTIARY**	**QUATERNARY**	**PDP_TRIM**	**SP_TRIM**
⚠	Primary Variable Out of Range	High Range	PRTB.Other	S050.010	GOOD_NC Non Specific No Limit			UNCERTAIN engineering unit range violation High Limit	GOOD_NC Non Specific No Limit	
		Low Range						UNCERTAIN engineering unit range violation Low Limit		
	PILD Output	PILD Affect PV = 0	ADTB.Device Needs Maintenance Soon	M018.038	GOOD_NC Non Specific No Limit					
		PILD Affect PV = 1			BAD Sensor Failure No Limit	GOOD_NC Non Specific No Limit	BAD Sensor Failure No Limit			
	PILD Changed Operating Conditions	PILD Affect PV = 0	ADTB.Device Needs Maintenance Soon	M018.038	GOOD_NC Non Specific No Limit					
		PILD Affect PV = 1			BAD Sensor Failure No Limit	GOOD_NC Non Specific No Limit	BAD Sensor Failure No Limit			
	Out Of Service		PRTB.Out of Service		BAD Out of Service					

Device Troubleshooting

Cat	Error		HMI code	Description	Possible Cause	Suggested Actions
Electronics errors						
	Memory Failure		F116.023	The device data loaded at the start up are corrupted precluding the correct functionality of the device	Electronic memory corrupted	The electronics must be replaced
	Electronic Interface error.		M030.020	Exchange of data between Electronics and Sensor have problems	Exchange of non-critical data between sensor and electronics is precluded due to problem in the transmitter circuit of the electronics or in receiver circuit of the sensor	Power cycle the device and retry the operation, if the error persist the electronics should be replaced
	Non-Volatile memory burn error		M026.024	The device continue to work without problems but at the next power cycle the new configuration will be lost	Writings to the electronic non-Volatile Memory was not successful	The electronics should be replaced as soon as possible.
Pressure sensor errors						
	Sensor Invalid	Missing Primary Signal	F120.016	The primary signal of the sensor is no longer available. The transducer is not in a condition to generate a valid signal.	The sensor signal is not being updated correctly as a result of an electronics failure, sensor error or a poorly connected sensor cable.	Check cable connection, check sensor and if problem persists, the sensor must be replaced.
		Invalid Sensor		Sensor and/or the connected electronics are incompatible	The sensor model/version is not longer compatible with the connected electronic version	The sensor must be replaced
	Sensor Memory Fail		F118.017	The data in the sensor memory are corrupted precluding the correct functionality of the device	Sensor memory corrupted	The Sensor must be replaced
	P-dP Sensor Fail		F114.003	The sensor signal value is incorrect due to a mechanical failure	Mechanical damage to the sensor. Loss of fill fluid from the cell; ruptured diaphragm, broken sensor....	The Sensor must be replaced
	Static Pressure Sensor Fail		F112.001	The sensor signal value is incorrect due to a mechanical failure. Valid only for Differential pressure models	The circuitry for the sampling of the static pressure has failed.	The Sensor must be replaced

...Device Troubleshooting

Cat	Error		HMI code	Description	Possible Cause	Suggested Actions
Pressure sensor errors						
	Sensor Temperature Fail		F110.002	The measurement accuracy is decreased more than the acceptable error	The circuitry for the sampling of the temperature has failed.	The Sensor must be replaced
	Non-Volatile memory burn error		M028.018	The device continue to work without problems but any replacement operation is compromised because the back-up configuration is not updated	Writings to the Sensor non-Volatile Memory was not successful	The Sensor should be replaced as soon as possible.
Installation / start-up errors						
	RB Out of Service			Device configured to be Out of Service or initializing	Resource Block is configured to be Out of Service	The TARGET MODE of the Resource Block must be switched in AUTO
	Input Simulation Active	PdP simulation	C088.030	The Process Value is simulated to became the P-dP value measured in input	The P-dP Value in output is calculated from a value simulated in input	Use DD based configurator (AVB Professional - Hand held) to place device back into normal operating mode (Remove the input simulation)
		Static Pressure simulation		The Process Value is simulated to became the Static Pressure value measured in input	The Static Pressure Value in output is calculated from a value simulated in input	
		Sensor Temp simulation		The Sensor Temperature Value is simulated to became the measured Sensor Temperature value	The Sensor Temperature Value in output is calculated from a value simulated in input	
	Replace Info	Replace required – Both data direction valid	M020.007	The Replace operation is required after the changing of the electronics or of the sensor	The Electronics or the Sensor have been changed but the replacement operation has not been executed	The replacement operation must be executed: – Move the SW 1 of the electronics in position 1 (= Enable replace mode). – Select the SW 2 the element that has been changed between new Sensor or new electronics – Power Cycle the device – Move the SW 1 of the electronics in position 0
		Replace required – FE to CB not applicable		The Replace operation is required after the changing of the electronics or of the sensor	The Electronics or the Sensor has been changed and a replacement operation for a new sensor has to be executed.	The replacement operation must be executed: Only electronics data can be copied into the sensor – Move the SW 1 to Enable replace mode (1) – Select with the SW 2 to New Sensor (1) – Power Cycle the device – Move the SW 1 to Disable replace mode (0)
		Replace enabled – FE to CB not applicable		The Replace operation has been attempted but with wrong direction	The Electronics or the Sensor have been changed, The replacement has been enabled but with a wrong direction (SW 2 = 0)	Change the replacement direction (if possible) – The SW 1 is already set to Enable replace mode – Select with the SW 2 to New Sensor (1) – Power Cycle the device – Move the SW 1 to Disable replace mode (0)
Process errors						
	Pressure Overrange		F104.011	An overpressure has been detected	This effect could be produced by other equipment on the process, (valves...). Exceeding the pressure range can cause reduced accuracy or mechanical damage to the diaphragm material and may require calibration/replacement.	The compatibility of pressure transmitter model and process conditions has to be checked. A different transmitter type could be required

...Device Troubleshooting

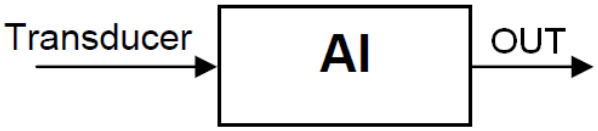
Cat	Error		HMI code	Description	Possible Cause	Suggested Actions
Process errors						
	P-dP Out Of Limit		F102.004	The measured Process Pressure value is outside the sensor limits and no longer representing the true applied process value.	The measurement range has not been correctly calculated OR an incorrect transducer model has been selected.	The compatibility of pressure transmitter model and process conditions has to be checked. Probably a different transmitter type is required.
	Static Pressure Out Of Limit		F100.005	The measured Static pressure is above its operational limit	The static pressure of the process exceeds the limit of the sensor. Exceeding the Static Pressure can reduce accuracy, mechanically damage the diaphragm and may require calibration/replacement. An incorrect transducer model could have been selected.	The compatibility of pressure transmitter model and process conditions has to be checked. Probably a different transmitter type is required.
	Sensor Temperature Out Of Limit		S054.006	The measured sensor temperature is outside of its operational limits	The temperature of the process environment affects the pressure transmitter; Excess temperature can reduce accuracy, degrade device components and may require calibration/replacement.	The compatibility of pressure transmitter model and process conditions has to be checked. A different installation type could be required e.g. use of remote seals.
	Max. Working Pressure Exceeded		M052.031	The measured Static Pressure is higher than the acceptable mechanical limit for the process connection elements.	The static pressure of the process exceeds the limit of the max working Pressure supported by the transmitter. Exceeding the Max Working Pressure can mechanically damage the process connections (flanges, pipes....) and/or be dangerous	The compatibility of the process connection type and material with process conditions has to be checked. A different installation type could be required e.g. use of remote seals.
	Primary Variable Out of Range		S050.010	Process value is outside its working range	The measured pressure value is beyond its Low or High scaling limits	Adjust the working range if possible.
	PILD Output	Both Impulse Lines Plugged	M018.008	PILD algorithm has detected both impulse lines plugged.	Both connections between the pressure sensor and the process are blocked either by plugging or closed valves.	Check valves and impulse line. Clean impulse line if necessary and initiate PILD training
		High Side Plugged		PILD algorithm has detected a plugged impulse line on the HIGH side.	The connection between the pressure sensor and the process on the HIGH side is blocked either by plugging or closed valves.	
		Low Side Plugged		PILD algorithm has detected a plugged impulse line on the LOW side.	The connection between the pressure sensor and the process on the LOW side is blocked either by plugging or closed valves	
		Undefined line plugged		PILD algorithm has detected one plugged impulse line.	One of the connections between the pressure sensor and the process is blocked either by plugging or closed valves.	
	PILD Changed Operating Conditions		M016.009	The pressure value currently detected is too different from what used for the PILD Training	Process conditions have changed to an extent that new settings for the PILD algorithm are needed.	A new Training is necessary for this new process condition
	PRTB Out Of Service			Transducer Block is Out of Service.	Power has been reapplied resulting in the re-initialization of the device.	Check transducer block configuration and make sure that the Target Mode has been set to Automatic Mode.

Control Application Process (CAP) Blocks

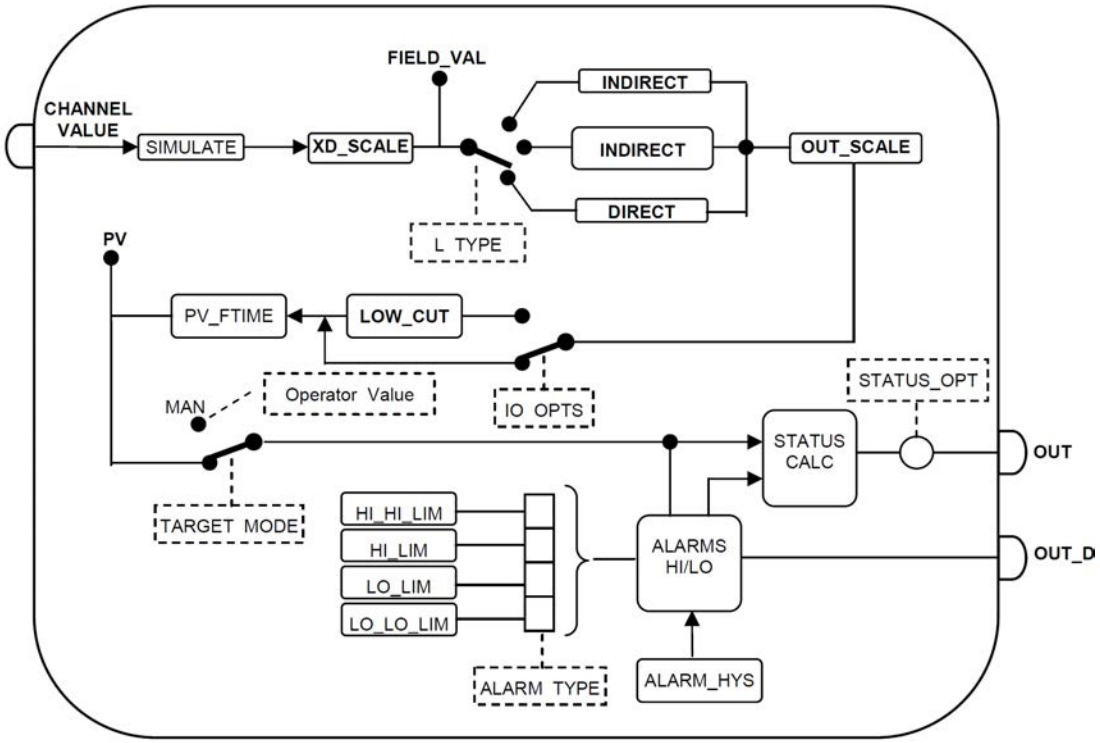
Enhanced-Analog Input Function Block (E-AI)

Overview

The Analog Input receives in input variables produced in the Transducer Block via the selected CHANNEL. It is possible that some transmitters have more Transducer Blocks or more variables produced within one Transducer Block. The CHANNEL setting allows the user to select the desired variable to be used in input for the AI.



Block Diagram



Description

Transducer scaling (XD_SCALE) is applied to the value from the channel to produce the FIELD_VAL in percent. The XD_SCALE units code must match the channel units code (if one exists), or the block will remain in O/S mode after being configured. A block alarm for units mismatch will be generated. The OUT_SCALE is normally the same as the transducer, but if L_TYPE is set to Indirect or Ind.Sqr.Root, OUT_SCALE determines the conversion from FIELD_VAL to the output. PV and OUT always have identical scaling. OUT_SCALE provides scaling for PV. The PV is always the value that the block will place in OUT if the mode is Auto. If Man is allowed, someone may write a value to the output. The status will prevent any attempt at closed loop control using the Man value, by setting the Limit value to Constant.

The LOW_CUT parameter has a corresponding “Low cut-off” option in the IO_OPTS bit string. If the option bit is true, any calculated output below the low cut-off value will be changed to zero. This is only useful for zero based measurement devices, such as flow.

The PV filter, whose time constant is PV_FTIME, is applied to the PV, and not the FIELD_VAL.

Equations

The Analog Input receive in input the Transduce Block variable Value selected with the CHANNEL. The Input Value is represented as CHANNEL Value in the following formula:

$$FIELD\_VAL = 100 * \frac{CHANNEL\_VALUE\ XD\_SCALE\_0\%}{XD\_SCALE\_100\%\ XD\_SCALE\_0\%}$$

...Equations

Depending by the L_TYPE selection the following signal conversions are applied:

L_TYPE	Formula
Direct	PV = CHANNEL_VALUE
Indirect	This conversion is applied when the XD_SCALE values are different from the OUT_SCALE values PV = FIELD_VAL% * (OUT_SCALE_100% - OUT_SCALE_0%) + OUT_SCALE_0%
Indirect Square Root	IF FIELD_VAL < 0.0 PV = OUT_SCALE 0% ELSE IF FIELD_VAL < LOW_CUT PV = OUT_SCALE 0% ELSE PV = √ Field_Val% * (OUT_SCALE_100% - OUT_SCALE_0%) + OUT_SCALE_0%

Configuration hints

The minimum configuration for having the AI working and/or moving out from the OOS needs at least the following settings:

- CHANNEL different by 0 (uninitialized)
- XD_SCALE = OUT_SCALE
- L_TYPE = Direct

** The minimum configuration can be set also via the RB_SPECIAL_RESTART

Block Mapping

Idx	Parameter		Description / Range / Selections / Note		
0	BLOCK_OBJ		In the Block Object data structure, there are different items describing the block characteristics. Execution period, Number of parameters in the block, the DD Revision, Profile Revision, View Objects characteristics and so on		
1	ST_REV		The revision level of the Static data associated with the Function Block. The revision level is incremented each time a static parameter value (S – under Storage) in the block is changed.		
2	TAG_DESC		The user description of the intended application of the block		
3	STRATEGY		The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.		
4	ALERT_KEY		The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.		
5	MODE_BLK	TARGET	AUTO / MAN / OOS		The selectable modes by the operator.
		ACTUAL			The mode the block is currently in.
		PERMITTED	AUTO / MAN / OOS		Allowed modes that the target may take on
		NORMAL	AUTO		The common mode for the Actual.
6	BLOCK_ERR		This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown.		
7	PV		The process variable used in block execution, expressed in XD_SCALE Unit Code		
8	OUT		The block output value calculated as a result of the block execution, expressed in XD_SCALE unit code		Writeable only if MODE_BLK.ACTUAL = MAN
9	SIMULATE		Allow to simulate Value and Status that should be received from the PRTB.		
10	XD_SCALE		Input Scale		All the values are associated with the channel input value
11	OUT_SCALE		Output scale		All the values are associated with the OUT
12	GRANT_DENY				
13	IO_OPTS		Option which the user can select to alter Input and Output block processing		
			Bit 10	Low Cut Off	Enable/Disable the LOW_CUT Off effect in the AI calculation
			Bit 12	Unit conversion	Enable/Disable the automatic Unit conversion of the variables in input at the AI from the PRTB when their unit is different by the XD_SCALE.Unit
14	STATUS_OPTS		Options which the user can select for the block processing of status. The available selections are:		
			Bit 3	Propagate Fault Forward	Enable/Disable the propagation of the Status byte from the PRTB in input at the AI to its Output
			Bit 6	Uncertain if Limited	
			Bit 7	BAD if Limited	
			Bit 8	Uncertain if MAN Mode	
15	CHANNEL		0	Uninitialized	** Doesn't allow at the AI to move out from OOS
			1	Pressure Process Value	P-dP
			2	Sensor temperature	ST
			3	Static Pressure	SP
			4	Scaled Process Value	Lin PV

...Block Mapping

Idx	Parameter	Description / Range / Selections / Note		
16	L_TYPE	0	Uninitialized	** Doesn't allow at the AI to move out from OOS
		1	Direct	PV = CHANNEL_VALUE – To be used when XD_SCALE = OUT_SCALE
		2	Indirect	PV = FIELD_VAL% * (OUT_SCALE_100% - OUT_SCALE_0%) + OUT_SCALE_0% To be used when XD_SCALE != OUT_SCALE
		3	Indirect Square Root	IF FIELD_VAL < 0.0 when PV = OUT_SCALE 0% ELSE IF FIELD_VAL < LOW_CUT when PV = OUT_SCALE 0% ELSE when PV = √ Field_Val% * (OUT_SCALE_100% - OUT_SCALE_0%) + OUT_SCALE_0%
17	LOW_CUT	0 or >0		Limit used in square root processing. A value of zero percent of scale is used in block processing if the transducer falls below this limit, in % of scale. The features may be used to eliminate noise near zero for a flow sensor.
18	PV_FTIME	0....60 seconds		Time constant of a single exponential filter for the PV, expressed in seconds. This is the time necessary for reach the 63% of the variation in input.
19	FIELD_VAL	The percent of the value from the Transducer block or from the simulation value, when enabled, before the characterisation (L_ TYPE) and Filtering (PV_FTIME).		
20	UPDATE_EVT	This alert is generated by any change to the static data		
21	BLOCK_ALM	The block alarm is used for all configuration, hardware, connection failure or system problems in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active Status in the status parameter. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active Status, if the subcode has changed.		
22	ALARM_SUM	The summary alarm is used for all process alarm in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active Status in the status parameter. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Actve Status, if the subcode has changed.		
23	ACK_OPTION	Used to set auto acknowledgment of the alarms		
24	ALARM_HYS	0 or > 0 expressed as percent of the OUT_SCALE span (default =[0.5%])		Alarm Hysteresis is the amount the PV must return within the alarm limit before the alarm condition clears.
25	HI_HI_PRI	0 - 15		Expressed in OUT_SCALE unit.
26	HI_HI_LIM	Critical Limit High		
27	HI_PRI	0 - 15		
28	HI_LIM	Advisory Limit High		
29	LO_PRI	0 - 15		
30	LO_LIM	Advisory Limit Low		
31	LO_LO_PRI	0 - 15		
32	LO_LO_LIM	Critical Limit Low		
33	HI_HI_ALM	Critical High Alarm		
34	HI_ALM	Advisory High Alarm		

Idx	Parameter	Description / Range / Selections / Note		
35	LO_ALM	Advisory Low Alarm		
36	LO_LO_ALM	Critical Low Alarm		
37	BLOCK_ERR_DESC	These parameters are used by a device to report more specific details regarding persistent errors that are reported through BLOCK_ERR.		Channel Not Initialized
				Wrong Channel
				Channel Unit Mismatch
				L_Type Not initialized
				Wrong L_Type
38	OUT_D	Digital Output Value set when the AI_OUT Value, over-cross the thresholds selected with the ALARM_SEL_TYPE. The ALARM_HYS enter in the calculation for setting and clearing the Digital state in order to avoid continuous changing whenever the Out Float value is around to the threshold.		Writeable only if MODE_BLK.ACTUAL = MAN
39	ALARM_SEL_TYPE	Bit 0	HI_HI_LIM	0 – Alarm Diabled 1 – Alarm Enabled Selection of the AI Limits used as threshold for producing the Digital output when the OUT Value over-cross the selected limits (more of one limit can be simultaneously enabled)
		Bit 1	HI_LIM	
		Bit 2	LO_LIM	
		Bit 3	LO_LO_LIM	

Diagnostic

Block_Err	Possible Reasons	OUT Status
Block Configuration error	– CHANNEL = 0 (uninitialized) – L_TYPE = 0 (uninitialized) – XD_SCALE != OUT_SCALE and LIN_TYPE = DIRECT – CHANNEL = 4 (Scaled_PV), and L_TYPE = Indirect Square Root – CHANNEL = 4 (Scaled_PV), and XD_SCALE different by 0/100 %	When the Block Configuration Error is set, the AI cannot exit from OOS and the OOS condition is also set in the AI Block Error. In this case the OUT_STATUS = BAD-OOS overrides the BAD-Configuration Error
Simulate active	The Simulation has been set with the HW switch and the SIMULATE_EN/DIS = Active	The OUT_STATUS is produced as result of the normal calculation within the AI block but starting from a simulated Status instead of the real TB Status
Input Failure/process variable has BAD status	The value in input coming from the TB has BAD Status.	IF STATUS_OPTS-Propagate Fault Forward = Set: – BAD Sensor Fail – BAD Device Fail Received in input from the TB are produced also as AI OUT Status. All the other BAD status are propagated as: – BAD-not specific. IF STATUS_OPTS-Propagate Fault Forward = Clear: All the BAD status are propagated as – BAD-not specific
Out-of-Service	The Actual_Mode is OUT OF SERVICE	The OUT_STATUS is BAD-OOS. In case of concomitance with other conditions this is the status produced in output because this is the High priority Status condition

OUT Status

Binary Code	Decimal Code	Quality	Sub-Status	Status_Opts	Descrition
0000 0000	0	BAD	non specific	Propagate Fault Forward = Clear	The value in input at the AI has BAD status
0000 00xx	1-3	BAD	non specific	BAD if Limited = Set	The value in input at the AI has status limit set “low limited” or “high limited” or “constant”
0000 1100	12	BAD	Device Failure	Propagate Fault Forward = Set	The value in input at the AI has BAD-Device Failure status
0001 0000	16	BAD	Sensor Failure	Propagate Fault Forward = Set	The value in input at the AI has BAD-Sensor Failure status
0001 1111	31	BAD	Out of Service		The AI_MODE_BLK.ACTUAL = OOS
0100 0000	64	UNCERTAIN	non specific	Propagate Fault Forward = Clear	The value in input at the AI has UNCERTAIN status
0100 00xx	65--67	UNCERTAIN	non specific	UNCERTAIN if Limited = set	The value in input at the AI has status limit set “low limited” or “high limited” or “constant”. See NOTE A
0100 1000	72	UNCERTAIN	Substitute set	UNCERTAIN if Man Mode = set	The MODE_BLK.ACTUAL of the AI = MAN

0101 0100	84	UNCERTAIN	engineering unit range violation		IF (OUT > (OUT_SCALE_100% + 10%)) OR (OUT < (OUT_SCALE_0% - 10%))
					In case of reverse range, See NOTE B
					IF (OUT < (OUT_SCALE_100% - 10%) OR. (OUT > (OUT_SCALE_0% + 10%)

1000 0000	128	GOOD_NC	ok		The value in input at the AI has GOOD_NC status
1000 0100	132	GOOD_NC	Active block alarm	ACK_OPTION = set	When an AI BLOCK_ERR condition is set, if the AI goes in OOS, the OUT status cannot be set to GOOD_NC.Active block alarm. See NOTE C
1000 1010	138	GOOD_NC	Active Advisory Alarm	ACK_OPTION = set	The OUT_VALUE is outside the limits (HI_HI, HI, LO, LO_LO) and the priority of the limits is between 3 and 7
1000 1110	142	GOOD_NC	Active Critical Alarm	ACK_OPTION = set	The OUT_VALUE is outside the limits (HI_HI, HI, LO, LO_LO) and the priority of the limits is between 8 and 15
1000 1001	137	GOOD_NC	Unack block alarm	ACK_OPTION = clear	When an AI BLOCK_ERR condition is set, if the AI goes in OOS, the OUT status cannot be set to GOOD_NC.Unack block alarm. See NOTE C below
1000 1101	141	GOOD_NC	Unack advisory alarm	ACK_OPTION = clear	The OUT_VALUE is outside the limits (HI_HI, HI, LO, LO_LO) and the priority of the limits is between 3 and 7
1010 0100	104	GOOD_NC	Unack critical alarm	ACK_OPTION = clear	The OUT_VALUE is outside the limits (HI_HI, HI, LO, LO_LO) and the priority of the limits is between 8 and 15

NOTE A: When the Transducer Block value goes outside the Range Limits, it should be Limited at the Range Limit high or low, and the Status should be set to GOOD_NC- High Limited or Low Limited.

NOTE B: The XD_SCALE and/or OUT_SCALE can be set with EU0% value greater than EU100% value. In this case the test of the OUT value with the range values is inverted.

NOTE C: This status can be set only if the specific AI Block_Err condition doesn’t force the AI to OOS

Troubleshooting

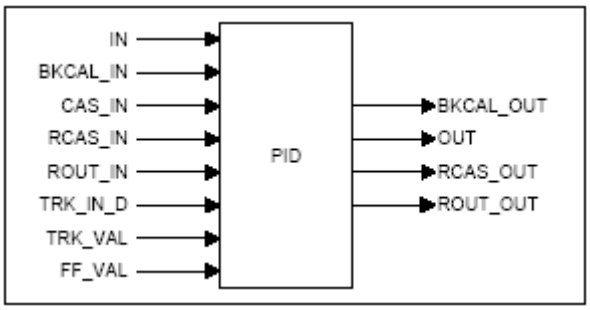
Problem	Possible cause	Solution
The Block cannot be removed from OOS mode	The Target Mode is set to OOS	Set the Target Mode to something different by OOS
	The Configuration Error bit is set in the BLOCK_ERR	– Set the CHANNEL to a valid value different by 0 – Set L_TYPE = DIRECT – If XD_SCALE = OUT_SCALE – Set LIN_TYPE = INDIRECT or IND.SQ ROOT – if XD_SCALE different by OUT_SCALE – IF the AI_CHANNEL = 4 set the AI_LIN_TYPE = indirect – IF the AI_CHANNEL = 4 set the XD_SCALE = 0 / 100 % – Enable IO_OTPS.Unit Conversion
	The RESOURCE BLOCK is not in AUTO mode	Set the Target Mode of the RESOURCE BLOCK to AUTO mode
	The Target Mode is not set to AUTO	Design the FB Application correctly and download it to the devices
The Block cannot be switched in AUTO mode	The Simulation has been set with the HW switch and the SIMULATE_EN/DIS = Active	The OUT_STATUS is produced as result of the normal calculation within the AI block but starting from a simulated Status instead of the real TB Status
The OUT Status has the Limit bits (0, 1) set to Constant	The Target Mode is not set to AUTO	Set the Target Mode to AUTO
Block Alarm Not Working (Events not notified)	The FEATURE_SEL has not the Reports bit Set	Set the REPORTS bit in the FEATURE_SEL of the RESOURCE BLOCK
	LIM_NOTIFY value is less of the MAX_ NOTIFY value	Set the value of LIM_NOTIFY equal, at least, to the MAX_NOTIFY value
	STATUS_OPTS has the Propagate Fault Forward bit Set	This bit should be cleared for producing the alarm

Enhanced-PID Function Block (E-PID)

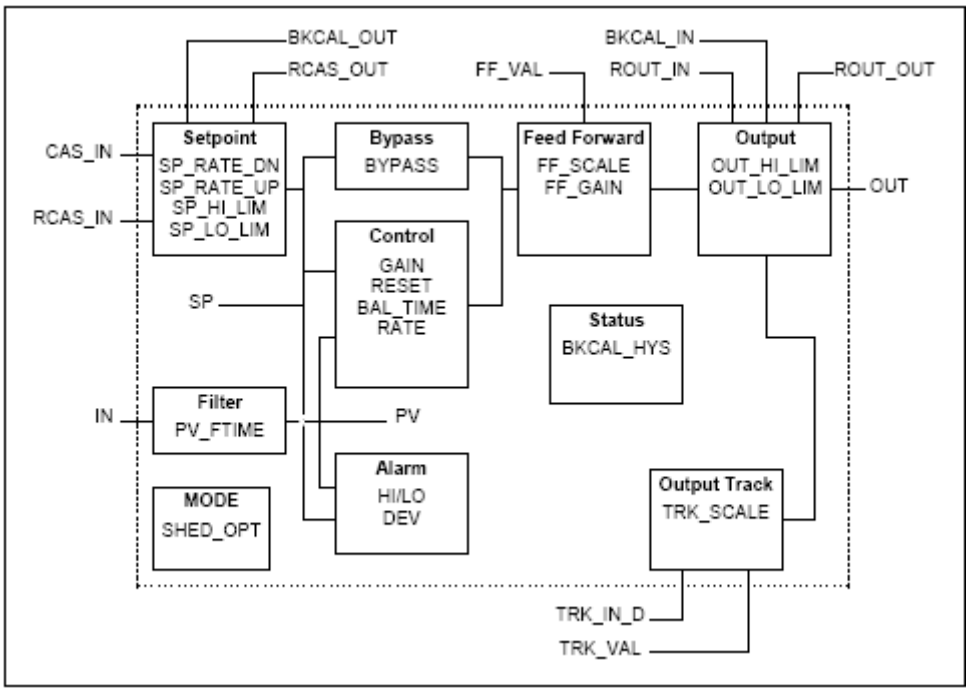
Overview

The PID block is key to many control schemes and is used almost universally, with the exception of PD, which is used when the process itself does the integration. As long as an error exists, the PID function will integrate the error, which moves the output in a direction to correct the error. PID blocks may be cascaded when the difference in process time constants of a primary and secondary process measurement makes it necessary or desirable.

The PID receives in input the value produced in output from an upstream function block like Analog Input, and provides to apply the algorithm with the Proportional, Integral, Derivative contribute as previously configured.



Block Diagram



Description

The Process Value to be controlled is connected to the IN input. This value is passed through a filter whose time constant is PV_ FTIME. The value is then shown as the PV, which is used in conjunction with the SP in the PID algorithm. A PID will not integrate if the limit status of IN is constant. A full PV and DV alarm sub-function is provided. The PV has a status, although it is a Contained parameter. This status is a copy of IN's status unless IN is good and there is a PV or block alarm. The full cascade SP sub-function is used, with rate and absolute limits.

There are additional control options which will cause the SP value to track the PV value when the block is in an actual mode of IMan, LO, Man or ROut. Limits do not cause SP-PV tracking.

There is a switch for BYPASS, which is available to the operator if the Bypass Enable control option is true. Bypass is used in secondary cascade controllers that have a bad PV. The Bypass Enable option is necessary because not all cascade control schemes will be stable if BYPASS is true. BYPASS can only be changed when the block mode is Man or O/S. While it is set, the value of SP, in percent of range, is passed directly to the target output, and the value of OUT is used for BKCAL_OUT. When the mode is changed to Cas, the upstream block is requested to initialize to the value of OUT. When a block is in Cas mode, then on the transition out of bypass, the upstream block is requested to initialize to the PV value, regardless of the "Use PV for BKCAL_OUT" option.

GAIN, RESET, and RATE are the tuning constants for the P, I, and D terms, respectively. Gain is a dimensionless number. RESET and RATE are time constants expressed in seconds. There are existing controllers that are tuned by the inverse value of some or all of them, such as proportional band and repeats per minute. The human interface to these parameters should be able to display the user's preference.
The Direct Acting control option, if true, causes the output to increase when the PV exceeds the SP. If false, the output will decrease when the PV exceeds the SP. It will make the difference between positive and negative feedback, so it must be set properly, and never changed while in an automatic mode. The setting of the option must also be used in calculating the limit state for BKCAL_OUT.
The output supports the feed forward algorithm. The FF_VAL input brings in an external value which is proportional to some disturbance in the control loop. The value is converted to percent of output span using the values of parameter FF_SCALE. This value is multiplied by the FF_GAIN and added to the target output of the PID algorithm.
If the status of FF_VAL is Bad, the last usable value will be used, because this prevents bumping the output. When the status returns to good, the block will adjust its integral term to maintain the previous output.
The output supports the track algorithm.
There is an option to use either the SP value after limiting or the PV value for the BKCAL_OUT value.

Equations
The algorithm applied is as in the following formula:

$$OUT = GAIN \cdot \left[(BETA \cdot SP - PV) + \frac{1}{RESET \cdot s}(SP - PV) + \frac{RATE \cdot s}{T1\_RATE \cdot s + 1}(GAMMA\ SP - PV) \right] + FF\_VAL$$

Where the **standard variables** are:

GAIN:	Proportional Gain Value
RESET:	Integral action Time constant in seconds
s:	Laplace operator
RATE:	Derivative action time constant in seconds
FF_VAL:	Feed-forward contribution from the feed-forward input
SP:	Setpoint
PV:	Process Variable

And the **enhanced variables** are:

T1_RATE:	Derivative 1st order filter
BETA:	Setpoint weight proportional part [0…1]
GAMMA:	Setpoint weight derivative part [0…1]

Configuration hints
The minimum configuration for having the PID working and/or moving out from the OOS needs at least the following settings:
- OUT_HI_LIM > OUT_LO_LIM
- SP_HI_LIM > SP_LO_LIM
- BYPASS = OFF
- SHED_OPT = Normal Shed Normal Return
- GAIN > 0

Block Mapping

Idx	Parameter		Description / Range / Selections / Note	
0	BLOCK_OBJ		In the Block Object data structure, there are different items describing the block characteristics. Execution period, Number of parameters in the block, the DD Revision, Profile Revision, View Objects characteristics and so on	
1	ST_REV		The revision level of the Static data associated with the Function Block. The revision level is incremented each time a static parameter value (S – under Storage) in the block is changed.	
2	TAG_DESC		The user description of the intended application of the block	
3	STRATEGY		The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.	
4	ALERT_KEY		The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.	
5	MODE_BLK	TARGET	AUTO / MAN / CAS / RCAS / ROUT / OOS	The selectable modes by the operator.
		ACTUAL		The mode the block is currently in.
		PERMITTED	AUTO/MAN/OOS/IMAN/CAS/RCAS/ROUT/LO	Allowed modes that the target may take on
		NORMAL	AUTO / CAS	The common mode for the Actual.
6	BLOCK_ERR		This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown.	
7	PV		The process variable used in block execution, expressed in PV_SCALE unit Code	
8	SP		The analog Set Point value of this block, expressed in PV_SCALE Unit Code	Acceptable value: PV_SCALE +/- 10%
9	OUT		The block output value calculated as a result of the block execution, expressed in OUT_SCALE unit code	Writeable only if MODE_BLK.ACTUAL = MAN
10	PV_SCALE		The high and low scale values, engineering units code, and number of digits to the right of the decimal point to be used in displaying the PV parameter and parameters which have the same scaling as PV.	
11	OUT_SCALE		The high and low scale values, engineering units code, and number of digits to the right of the decimal point to be used in displaying the OUT parameter and parameters which have the same scaling as OUT.	
12	GRANT_DENY			
13	CONTROL_OPTS		Options the user may select to alter the calculation done in a control loop	
			Bit 0	Bypass Enable
			Bit 1	SP-PV Track in Man
			Bit 2	SP-PV Track in ROut
			Bit 3	SP-PV Track in LO or IMan
			Bit 4	SP Track retained target
			Bit 5	Direct Acting
			Bit 6	Track if Bad TRK_IN_D
			Bit 7	Track Enable
			Bit 8	Track in Manual
			Bit 9	Use PV for BKCAL_OUT
			Bit 12	Obey limits if CAS or RCAS
			Bit 13	No out limits in Manual

Idx	Parameter	Description / Range / Selections / Note	
14	STATUS_OPTS	Options which the user can select for the block processing of status. The available selections are:	
		Bit 0	Initiate Fault Sate if BAD IN
		Bit 1	Initiate Fault Sate if BAD CAS_IN
		Bit 2	Use Uncertain as Good
		Bit 5	Target to Manual if BAD IN
		Bit 9	Target AUTO if BAD CAS_IN
		Bit 10	Target to Man if BAD TRK_IN_D
		Bit 11	IFS if BAD TRK_IN_D
15	IN	The Primary Input Value for the block coming from another block. Expressed in PV_SCALE Unit	
16	PV_FTIME	0....60 seconds	Time constant of a single exponential filter for the PV, expressed in seconds. This is the time necessary for reach the 63% of the variation in input.
17	BYPASS	The normal control algorithm may be bypassed trough this parameter. When bypass is set, the set point value (in percent) will be directly transferred to the output.	
		1	OFF
		2	ON
18	CAS_IN	Remote set point value from another block. Expressed in PV_SCALE Unit Code	
19	SP_RATE_DN	0 or > 0 Expressed in PV_SCALE Unit per seconds	Ramp rate at which downward setpoint changes are acted on in Auto mode, in PV units per second. If the ramp rate is set to zero, then the setpoint will be used immediately. For control blocks, rate limiting will apply only in Auto.
20	SP_RATE_UP		Ramp rate at which upward setpoint changes are acted on in Auto mode, in PV units per second. If the ramp rate is set to zero, then the setpoint will be used immediately. For control blocks, rate limiting will apply only in Auto.
21	SP_HI_LIM	Acceptable value: PV_SCALE +/- 10% Expressed in PV_SCALE Unit	The setpoint high limit is the highest setpoint operator entry that can be used for the block.
22	SP_LO_LIM		The setpoint low limit is the lowest setpoint operator entry that can be used for the block.
23	GAIN	0 or > 0	The proportional gain value.
24	RESET	0 or > 0	The integral time constant, expressed in seconds per repeat
25	BAL_TIME	0 or > 0	The specified time for the internal working value of bias to return to operator set bias. Also used to specify the time constant at which the integral term will move to obtain balance when the output is limited and the mode is AUTO, CAS, or RCAS. Expressed in seconds
26	RATE	0 or > 0	The derivative action time constant expressed in seconds
27	BKCAL_IN	The analog input value from another block's BKCAL_OUT output that is used to prevent reset windup and to initialize the control loop. Expressed in OUT_SCALE Unit Code	
28	OUT_HI_LIM	Acceptable value: OUT_SCALE +/- 10% Expressed in OUT_SCALE Unit	Limits the maximum output value.
29	OUT_LO_LIM		Limits the minimum output value.
30	BCAL_HYS	0 to 50% [Default = 0.5%] – Expressed as percent of the OUT_SCALE span	The amount that the output must change away from its output limit before the limit status is turned off.
31	BKCAL_OUT	Expressed in PV_SCALE Unit	Value and status required by an upper block's BKCAL_IN so that it may prevent reset windup and provide bumpless transfer to closed loop control.
32	RCAS_IN	Expressed in PV_SCALE Unit Used when mode is RCAS	Target setpoint value provided by a supervisory host.

...Block Mapping

Idx	Parameter	Description / Range / Selections / Note	
33	ROUT_IN	Expressed in OUT_SCALE Unit Used when the mode is ROUT.	Target output value provided by a supervisory host
34	SHED_OPT	Define actions to be taken on remote control device timeout	
35	RCAS_OUT	Expressed in PV_SCALE Unit. Used when mode is RCAS.	Block setpoint Value after ramping – provided by a supervisory host for back calculations and to allow action to be taken under limiting conditions or mode change
36	ROUT_OUT	Expressed in OUT_SCALE Unit. Used when mode is ROUT.	Block output Value provided to a supervisory host for a back calculation to allow action to be taken under limiting conditions or mode change
37	TRK_SCALE	The high and low scale values, engineering units code, and number of digits to the right of the decimal point, associated with TRK_VAL.	
38	TRK_IN_D	This discrete input is used to initiate external tracking of the block output to the value specified by TRK_VAL.	
39	TRK_VAL	Expressed in TRK_SCALE Unit.	This input is used as the track value when external tracking is enabled by TRK_IN_D.
40	FF_VAL	Expressed in FF_SCALE Unit.	The feed forward value and status
41	FF_SCALE	The high and low scale values, engineering units code, and number of digits to the right of the decimal point associated with FF_VAL	
42	FF_GAIN	The gain that the feed forward inpt is multiplied by before it is added to the calculated control output.	
43	UPDATE_EVT	This alert is generated by any change to the static data	
44	BLOCK_ALM	The block alarm is used for all configuration, hardware, connection failure or system problems in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active Status in the status parameter. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active Status, if the subcode has changed	
45	ALARM_SUM	The summary alarm is used for all process alarm in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active Status in the status parameter. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Actve Status, if the subcode has changed.	
46	ACK_OPTION	Used to set auto acknowledgment of the alarms	
47	ALARM_HYS	Alarm Hysteresis is the amount the PV must return within the alarm limit before the alarm condition clears.	0 or > 0 expressed as percent of the OUT_SCALE span (default =[0.5%])
48	HI_HI_PRI	0 - 15	Expressed in OUT_SCALE unit.
49	HI_HI_LIM	Critical Limit High producing the High-High Alarm	
50	HI_PRI	0 - 15	
51	HI_LIM	Advisory Limit High producing the High Alarm	
52	LO_PRI	0 - 15	
53	LO_LIM	Advisory Limit Low producing the Low Alarm	
54	LO_LO_PRI	0 – 15	
55	LO_LO_LIM	Critical Limit Low producing the Low-Low Alarm	
56	DV_HI_PRI	0 - 15	
57	DV_HI_LIM	Deviation High Limit producing the Deviation High Alarm	
58	DV_LO_PRI	0 - 15	
59	DV_LO_LIM	Deviation Low Limit producing the Deviation Low Alarm	
60	HI_HI_ALM	High-High Alarm	
61	HI_ALM	High Alarm	
62	LO_ALM	Low Alarm	
63	LO_LO_ALM	Low-Low Alarm	
64	DV_HI_ALM	Deviation High Alarm	
65	DV_LO_ALM	Deviation Low Alarm	
66	T1_RATE	Derivative 1st order filter	
67	BETA	Set-point weight proportional part	
61	GAMMA	Set-point weight derivative part	

Diagnostic

Block_Err	Possible Reasons	OUT Status
Block Configuration error	- SHED_OPT = 0 (uninitialized) - BYPASS = 0 (uninitialized) - OUT_HI_LIM =< OUT_LO_LIM - SP_HI_LIM =< SP_LO_LIM	BAD + Out Of Service See Note A
Local Override	MODE_BLK.Actual = Local Override	NO EFFECT
Input Failure/process variable has BAD status	BAD quality Status in input at the PID_IN.	Depends by the STATUS_OPTS
Out-of-Service	The Actual_Mode is OUT OF SERVICE	BAD + Out Of Service

NOTE A: The specific block cannot be switched out from OUT OF SERVICE due to the Configuration Error. The Bad-Configuration Error Status is overridden by the Bad-Out Of Service Status.

OUT Status

The OUT Status can be affected by the setting of the STATUS_OPTS

Troubleshooting

Problem	Possible cause	Solution
The Block cannot be removed from OOS mode	The Target Mode is not set different of OOS	Set the Target Mode to something different by OOS
	The Configuration Error bit is set in the BLOCK_ERR	- Set the OUT_HI_LIM > OUT_LO_LIM - Set the SP_HI_LIM > SP_LO_LIM - Set BYPASS to ON or OFF but different by 0 (uninitialized) - Set SHED_OPT different by 0
	The RESOURCE BLOCK is not in AUTO mode	Set the Target Mode of the RESOURCE BLOCK to AUTO mode
	The Block is not scheduled	Design the FB Application correctly and download it to the devices
The Block cannot be removed from IMAN mode	Something wrong in the BKCAL_IN	- The Status received in input of the BKCAL_IN is BAD Not Connected. Configure the link with the downstream block - The downstream block is producing a BAD status or Not Invited. Check the reason on the downstream block
The Block cannot be switched in AUTO mode	The Target Mode is not set to AUTO	Set the Target Mode to AUTO
	Something wrong in the IN	- The Status received in input of the IN is BAD Not Connected. Configure the link with the upstream block - The upstream block is producing a BAD status or Not Invited. Check the reason on the upstream block
The Block cannot be switched in CAS mode	The Target Mode is not set to CASCADE	Set the Target Mode to CASCADE
	Something wrong in the CAS_IN	- The Status received in input of the CAS_IN is BAD Not Connected. Configure the link of the CAS_IN with another block - The upstream block is producing a BAD status or Not Invited. Check the reason on the upstream block
Block Alarm Not Working (Events not notified)	The FEATURE_SEL has not the Reports bit Set	Set the REPORTS bit in the FEATURE_SEL of the RESOURCE BLOCK

Arithmetic Function Block (AR)

Overview

This block is designed to permit simple use of popular measurement math functions. The user does not have to know how to write equations. The math algorithm is selected by name, chosen by the user for the function to be done.

The following algorithms are available selectable from ARTH_TYPE:

1 Flow compensation, linear.

2 Flow compensation, square root.

3 Flow compensation, approximate.

4 BTU flow.

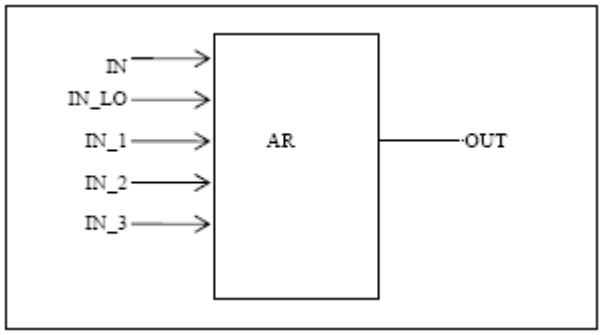
5 Traditional Multiply Divide.

6 Average.

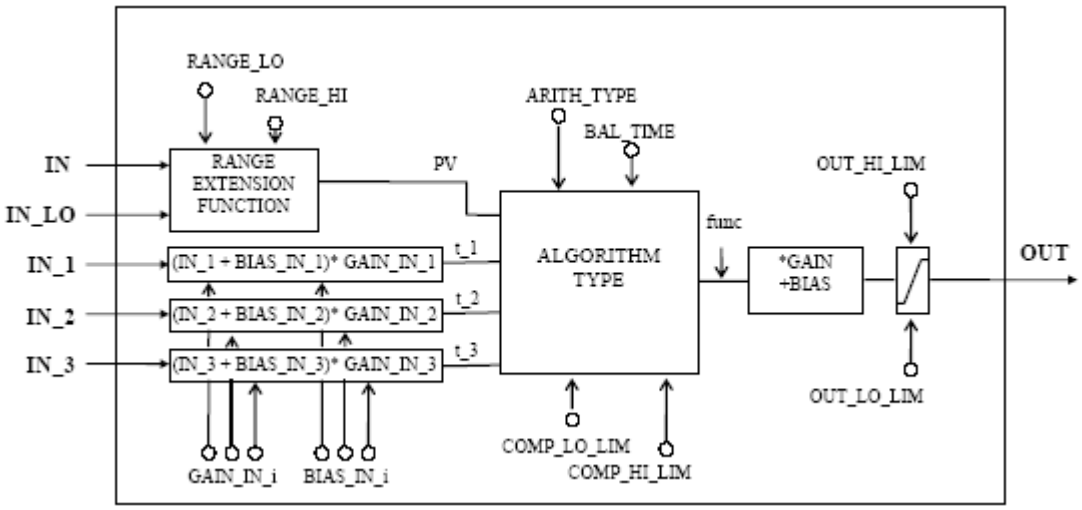
7 Traditional Summer.

8 Fourth order polynomial.

9 Simple HTG compensated level.



Block Diagram



Description

The AR block is intended for use in calculating measurements from combinations of signals from sensors. It is not intended to be used in a control path, so it does not support control status propagation or back calculation. It has no process alarms.

The block has 5 inputs. The first two are dedicated to a range extension function that results in a PV, with status reflecting the input in use.

The remaining three inputs are combined with the PV in a selection of four term math functions that have been found useful in a variety of measurements. The inputs used to form the PV should come from devices with the desired engineering units, so that the PV enters the equation with the right units. Each of the additional inputs has a bias and gain constant. The bias can be used to correct for absolute temperature or pressure. The gain can be used to normalize terms within a square root function. The output also has gain and bias constants for any further adjustment required. The range extension function has a graduated transfer, controlled by two constants referenced to IN. An internal value, g, is zero for IN less than RANGE_LO. It is one when IN is greater than RANGE_HI. It is interpolated from zero to one over the range of RANGE_LO to RANGE_HI. The equation for PV follows:

PV = g * IN + (1-g) * IN_LO.

If the status of IN_LO is unusable and IN is usable and greater than RANGE_LO, then g should be set to one. If the status of IN is unusable, and IN_LO is usable and less than RANGE_HI, then **g** should be set to zero. In each case the PV should have a status of Good until the condition no longer applies. Otherwise, the status of IN_LO is used for the PV if **g** is less than 0.5, while IN is used for **g** greater than or equal to 0.5. An optional internal hysteresis may be used to calculate the status switching point.
Six constants are used for the three auxiliary inputs. Each has a BIAS_IN_i and a GAIN_IN_i. The output has a BIAS and a GAIN static constant. For the inputs, the bias is added and the gain is applied to the sum. The result is an internal value called t_i in the function equations. The equation for each auxiliary input is the following:
t_i = (IN_i + BIAS_IN_i) * GAIN_IN_i
The flow compensation functions have limits on the amount of compensation applied to the PV, to assure graceful degradation if an auxiliary input is unstable. The internal limited value is **f**.

Equations

Algorythm type	Description	Function
Flow Compensation Linear	Used for density compensation of Volume flow	**OUT=** {f · PV · GAIN + BIAS} Where f = $\frac{\mathbf{t\_1}}{\mathbf{t\_2}}$ is limited
Flow Compensation Square Root	Usually: – IN_1 is pressure – (t_1) – IN_2 is temperature – (t_2) – IN_3 is the compressibility factor Z – (t_3)	**OUT=** {f · PV · GAIN + BIAS} Where f = $\sqrt{\frac{\mathbf{t\_1}}{\mathbf{t\_2 \cdot t\_3}}}$ for **Volumetric Flow** is limited For the calculation of the Volumetric Flow **t_3 = Z** The compressibility factor Z can be set writing into the IN_3 a constant value **Z** or can be calculated by a previous block linked in the IN_3. **OUT=** {f · PV · GAIN + BIAS} Where f = $\sqrt{\frac{\mathbf{t\_1 \cdot t\_3}}{\mathbf{t\_2}}}$ for Volumetric Flow is limited In case it would be necessary produce the Mass Flow, the compressibility factor Z must be set as into the IN_3 as $\frac{1}{Z}$
Flow Compensation Approximate	Both IN_1 and IN_2 would be connected to the same temperature NOTE: – The Square Root of the third power can be achieved connecting the input to IN and IN_1. – The Square Root of the fifth power can be achieved connecting the input to IN, IN_1, IN_3.	**OUT=** {f · PV · GAIN + BIAS} Where f = $\sqrt{\mathbf{t\_1 \cdot t\_2 \cdot t\_3^2}}$ is limited
BTU Flow	– IN_1 is the inlet temperature – IN_2 is the outlet temperature	**OUT=** {f · PV · GAIN + BIAS} Where f = t_1 – t_2 is limited
Traditional Multiply Divide		**OUT=** {f · PV · GAIN + BIAS} Where f = $\frac{\mathbf{t\_1}}{\mathbf{t\_2}}$ + t_3 is limited
Average		**OUT=** $\frac{PV + t\_1 + t\_2 + t\_3}{f}$ · GAIN + BIAS f= number of inputs used in computation
Traditional Summer		**OUT=** (PV + t_1 + t_2 + t_3) · GAIN + BIAS
Fourth Order Polynomial	All inputs except IN_LO (not used) are linked together	**OUT=** (PV + t_1^2 + t_2^3 + t_3^4) · GAIN + BIAS
Simple HTG Compensated Level	– The PV is the tank base pressure – IN_1 is the top pressure – (t_1) – IN_2 is the density correction pressure – (t_2) – GAIN is the height of the density tap	**OUT=** $\frac{\mathbf{PV - t\_1}}{\mathbf{PV - t\_2}}$ · GAIN + BIAS

Configuration hints

The minimum configuration for having the AR working and/or moving out from the OOS needs at least the following settings:

- Set ARITH_TYPE with a valid value. It must be different by 0 and in the range 1 – 9
- If the selected ARITH_TYPE is in the range between 1-5 (limited functions), the output limits COMP_HI_LIM > COMP_LO_LIM
- The BAL_TIME must be greater than the Block Execution Time
- When the ARITH_TYPE = 6 (Average) in case of no inputs available the output will be set to NaN (Not a Number)
- Set the GAIN with value different by 0

Block Mapping

Idx	Parameter		Description / Range / Selections / Note	
0	BLOCK_OBJ		In the Block Object data structure, there are different items describing the block characteristics. Execution period, Number of parameters in the block, the DD Revision, Profile Revision, View Objects characteristics and so on	
1	ST_REV		The revision level of the Static data associated with the Function Block. The revision level is incremented each time a static parameter value (S – under Storage) in the block is changed.	
2	TAG_DESC		The user description of the intended application of the block	
3	STRATEGY		The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.	
4	ALERT_KEY		The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.	
5	MODE_BLK	TARGET	AUTO / MAN / OOS	The selectable modes by the operator.
		ACTUAL		The mode the block is currently in.
		PERMITTED	AUTO / MAN / OOS	Allowed modes that the target may take on
		NORMAL	AUTO	The common mode for the Actual.
6	BLOCK_ERR		This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown.	
7	PV		The process variable used in block execution, expressed in PV_SCALE unit Code	
8	OUT		The block output value calculated as a result of the block execution, expressed in OUT_SCALE unit	Writeable only if MODE_BLK.ACTUAL = MAN
9	PRE_OUT		expressed in OUT_SCALE unit	Displays what would be the OUT value and status if the mode was Auto or lower.
10	PV_SCALE		The high and low scale values, engineering units code, and number of digits to the right of the decimal point to be used in displaying the PV parameter and parameters which have the same scaling as PV.	
11	OUT_RANGE		The high and low scale values, engineering units code, and number of digits to the right of the decimal point to be used in displaying the scaling for the output. It has no effect on the block	
12	GRANT_DENY			
13	INPUT_OPTS		Options the user may select to alter the calculation done in a control loop	
			Bit 0	IN Use uncertain as good
			Bit 1	IN_LO Use uncertain as good
			Bit 2	IN_1 Use uncertain as good
			Bit 3	IN_1 Use bad as good
			Bit 4	IN_2 Use uncertain as good
			Bit 5	IN_2 Use bad as good
			Bit 6	IN_3 Use uncertain as good
			Bit 7	IN_3 Use bad as good
14	IN		The Primary Input Value for the block coming from another block. Expressed in PV_SCALE Unit	
15	IN_LO		Input for the low range transmitter, in a range extension application. Expressed in PV_SCALE Unit	
16	IN_1		The Primary Input Value for the block coming from another block. Expressed in PV_SCALE Unit	
17	IN_2		The Primary Input Value for the block coming from another block. Expressed in PV_SCALE Unit	
18	IN_3		The Primary Input Value for the block coming from another block. Expressed in PV_SCALE Unit	
19	RANGE_HI		Constant Value above which the range extension has switched to the high range transmitter Expressed in PV_SCALE Unit	
20	RANGE_LO		Constant Value below which the range extension has switched to the low range transmitter Expressed in PV_SCALE Unit.	

Idx	Parameter	Description / Range / Selections / Note	
21	BIAS_IN_1	The constant to be added to IN_1	
22	GAIN_IN_1	The constant to be multiplied times (IN_1 + Bias)	
23	BIAS_IN_2	The constant to be added to IN_2	
24	GAIN_IN_2	The constant to be multiplied times (IN_2 + Bias)	
25	BIAS_IN_3	The constant to be added to IN_3	
26	GAIN_IN_3	The constant to be multiplied times (IN_3 + Bias)	
27	COMP_HI_LIM	The high limit imposed on the PV compensation term. Expressed in PV_SCALE Unit Code	
28	COMP_LO_LIM	The low limit imposed on the PV compensation term. Expressed in PV_SCALE Unit Code	
29	ARTH_TYPE	The identification number of the arithmetic algorithm	
		1 Flow Compensation, Linear	
		2 Flow Compensation, Square Root	
		3 Flow Compensation, Approximate	
		4 BTU Flow	
		5 Traditional Multiple Divide	
		6 Average	
		7 Traditional Summer	
		8 Fourth Order Polynomial	
		9 Simple HTG compensated Level	
30	BAL_TIME	Acceptable value: OUT_SCALE +/- 10% Expressed in OUT_SCALE Unit	The specified time for the internal working value of bias to return to operator set bias. Also used to specify the time constant at which the integral term will move to obtain balance when the output is limited and the mode is AUTO, CAS, or RCAS. Expressed in seconds
31	BIAS	Expressed in OUT_SCALE Unit	The bias value used in computing the function block output
32	GAIN	0 or > 0	Dimensionless value used by the block algorithm in calculating the block output
33	OUT_HI_LIM	Acceptable value: OUT_SCALE +/- 10% Expressed in OUT_SCALE Unit	Limits the maximum output value.
34	OUT_LO_LIM		Limits the minimum output value.
35	UPDATE_EVT	This alert is generated by any change to the static data	
36	BLOCK_ALM	The block alarm is used for all configuration, hardware, connection failure or system problems in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active Status in the status parameter. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active Status, if the subcode has changed	

Diagnostic

Block_Err	Possible Reasons	OUT Status
Block Configuration error	- ARITH_TYPE = 0 (uninitialized) - GAIN = 0 - if COMP_HI_LIM =< COMP_LO_LIM and ARITH_TYPE in the range 1-5 - if BAL_TIME =< macrocycle and different by 0	BAD + Out Of Service **See Note A**
Input Failure/process variable has BAD status	At least one of the inputs used in the Output calculation is not usable**: **For the inputs IN and IN_LO usable status are:: - GOOD_NC - GOOD_C - UNCERTAIN with INPUT_OPTION = Use uncertain	The worst Status of the used inputs
Out-of-Service	The Actual_Mode is OUT OF SERVICE	BAD + Out Of Service

NOTE A: The specific block cannot be switched out from OUT OF SERVICE due to the Configuration Error. The Bad-Configuration Error Status is overridden by the Bad-Out Of Service Status.

OUT Status

Status of PV depends by the factor g. If it is less than 0,5 it will be used the Status of IN_LO otherwise it will use the Status of IN
The inputs with status byte different by GOOD are controlled by the INPUT_OPTS. The status of unused inputs is ignored.
The Status of the OUT will be the same of PV except when the PV is GOOD and the Status of the auxiliary inputs is NOT GOOD and the INPUT_OPTS is not configured to use it. In this case the Status of the OUT is UNCERTAIN.
Otherwise the OUT Status id the worst of the inputs used in the calculation after applying the INPUT_OPTS

Troubleshooting

Problem	Possible cause	Solution
The Block cannot be removed from OOS mode	The Target Mode is not set to AUTO	Set the Target Mode to AUTO and/or remove the OOS
	The Configuration Error bit is set in the BLOCK_ERR	– Set the ARITH_TYPE with a valid value. It must be different by 0 and in the range 1 – 9 – Set the GAIN with value different by 0 – Set COMP_HI_LIM > COMP_LO_LIM when ARITH_TYPE in the range 1-5 – Set BAL_TIME > of the Macrocycle IF different by 0
	The RESOURCE BLOCK is not in AUTO mode	Set the Target Mode of the RESOURCE BLOCK to AUTO mode
	The Block is not scheduled	Design the FB Application correctly and download it to the devices
The OUT Status is BAD	At least one of used inputs have a BAD status	Check the upstream blocks
The OUT Status is UNCERTAIN	At least one of the used inputs have an UNCERTAIN status	Check the upstream blocks
The OUT Status has the Limit bits (0, 1) set to Constant	The Actual Mode is set to MAN	Set the Target Mode to AUTO
Block Alarm Not Working (Events not notified)	The FEATURE_SEL has not the Reports bit Set	Set the REPORTS bit in the FEATURE_SEL of the RESOURCE BLOCK
	LIM_NOTIFY value is less of the MAX_NOTIFY value	Set the value of LIM_NOTIFY equal, at least, to the MAX_NOTIFY value

Input Selector Function Block (IS)

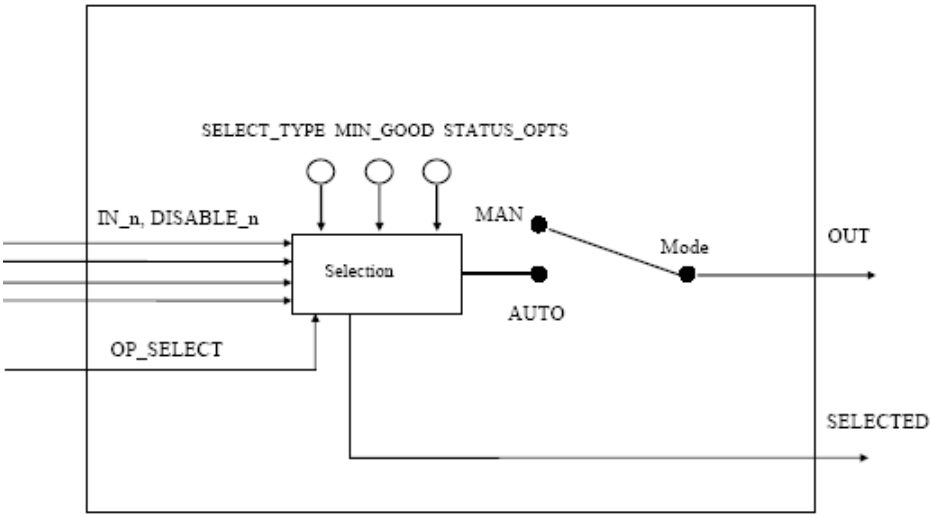
Overview

The signal selector block provides selection of up to four inputs and generates an output based on the configured action. This block normally receives its inputs from AI blocks. The block performs maximum, minimum, middle, average and 'first good' signal selection.

With a combination of parameter configuration options, the block can function as a rotary position switch, or a validated priority selection based on the use of the first good parameter and the disable_n parameter. As a switch the block can receive switching information from either the connected inputs or from an operator input. The block also supports the concept of a middle selection. Although the normal configuration for this feature would be with three signals the block should generate an average of the middle two if four signals are configured or the average of two if three are configured and a bad status is passed to one of the inputs.

Logic is provided for handling uncertain and bad signals in conjunction with configured actions. The intended application of this block is to provide control signal selection in the forward path only, therefore, no back-calculation support is provided. SELECTED is a second output that indicates which input has been selected by the algorithm.

Block Diagram



Description

This block is intended to be used in a forward path only and is not intended to receive signals from the output of a controller. There is no back-calculation support or propagation of control status values. The processing of the block is as follows.

Input processing

If DISABLE_n is true, then don't process (ignore) the respective input IN_n.

Process the Use Uncertain as Good status options. Discard (ignore) inputs whose status is BAD.

If there are no inputs left, or fewer than MIN_GOOD inputs, then set the value of SELECTED to zero. Do not do selection processing.

Selection Processing

If OP_SELECT is non-zero, the OP_SELECT value shall determine the selected input, regardless of the SELECT_TYPE selection. Set SELECTED to the number of the input used.

If SELECT_TYPE is First Good, transfer the value of the first remaining input to the output of the block. Set SELECTED to the number of the input used.

If SELECT_TYPE is Minimum, sort the remaining inputs by value. Transfer the lowest value to the output of the block. Set SELECTED to the number of the input with the lowest value.

If SELECT_TYPE is Maximum, sort the remaining inputs by value. Transfer the highest value to the output of the block. Set SELECTED to the number of the input with the highest value.

If SELECT_TYPE is Middle, sort the remaining inputs by value. If there are 3 or 4 values, discard the highest and lowest value. If two values are left, compute their average. Transfer the value to the output of the block. Set SELECTED to zero if an average was used, else set SELECTED to the number of the input with the middle value.
If SELECT_TYPE is Average compute the average of the remaining inputs and transfer the value to the output of the block. Set SELECTED to the number of inputs used in the average.

Limit Processing

The computations to determine high and low limit conditions for the output can be complex. They should be done to the best of the designer's ability. The limits of OUT should be able to tell a PID to stop integrating if the measurement cannot move.

Equations

With the SELECT_TYPE it is possible select the following algorithms:

Algorythm type	Description
First Good	Select the first available Input with Good Status
Minimum	Select the minimum value of the Inputs
Maximum	Select the maximum value of the Inputs
Middle	Calculate the middle of three inputs or the average of the two middle inputs if four inputs are defined
Average	Calculate the average value of the inputs

Configuration hints

The minimum configuration for having the IS working and/or moving out from the OOS needs at least the following settings:

- Set the SELECT_TYPE with a valid value. It must be different by 0 and in the range 1 – 5

Idx	Parameter		Description / Range / Selections / Note	
0	BLOCK_OBJ		In the Block Object data structure, there are different items describing the block characteristics. Execution period, Number of parameters in the block, the DD Revision, Profile Revision, View Objects characteristics and so on	
1	ST_REV		The revision level of the Static data associated with the Function Block. The revision level is incremented each time a static parameter value (S – under Storage) in the block is changed.	
2	TAG_DESC		The user description of the intended application of the block	
3	STRATEGY		The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.	
4	ALERT_KEY		The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.	
5	MODE_BLK	TARGET	AUTO / MAN / OOS	The selectable modes by the operator.
		ACTUAL		The mode the block is currently in.
		PERMITTED	AUTO / MAN / OOS	Allowed modes that the target may take on
		NORMAL	AUTO	The common mode for the Actual.
6	BLOCK_ERR		This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown.	
7	OUT		The block output value calculated as a result of the block execution, expressed in OUT_SCALE unit	Writeable only if MODE_BLK.ACTUAL = MAN
8	OUT_RANGE		The high and low scale values, engineering units code, and number of digits to the right of the decimal point to be used in displaying the scaling for the output. It has no effect on the block	
9	GRANT_DENY			
10	STATUS_OPTS		Options which the user can select for the block processing of status. The available selections are:	
		Bit 3	Propagate Fault Forward	Enable/Disable the propagation of the Status byte from the PRTB in input at the AI to its Output
		Bit 6	Uncertain if Limited	
		Bit 7	BAD if Limited	
		Bit 8	Uncertain if MAN Mode	
11	IN_1		Input 1 Value and Status	
12	IN_2		Input 2 Value and Status	
13	IN_3		Input 3 Value and Status	
14	IN_4		Input 4 Value and Status	
15	DISABLE_1	0	Use	Parameter to switch off the input 1 from being used
		1	Disable	
16	DISABLE_2	0	Use	Parameter to switch off the input 2 from being used
		1	Disable	
17	DISABLE_3	0	Use	Parameter to switch off the input 3 from being used
		1	Disable	
18	DISABLE_4	0	Use	Parameter to switch off the input 4 from being used
		1	Disable	
19	SEL_TYPE		This parameter specifies the type of selector action	
		1	First Good	
		2	Minimum	
		3	Maximum	
		4	Middle	
		5	Average	
20	MIN_GOOD		0 - 4	If the number of inputs which are good is less than the value of MIN_GOOD then set the out status to bad.
21	SELECTED		0 - 4	An integer indicating which input has been selected
22	OP_SELECTED		0 - 4	An operator settable parameter to force a given input to be used
23	UPDATE_EVT		This alert is generated by any change to the static data	
24	BLOCK_ALM		The block alarm is used for all configuration, hardware, connection failure or system problems in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active Status in the status parameter. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active Status, if the subcode has changed	

Diagnostic

Block_Err	Possible Reasons	OUT Status
Block Configuration error	SELECT_TYPE = 0 (uninitialized)	BAD + Out Of Service **See Note A**
Input Failure/process variable has BAD status	SELECT_TYPE = AVERAGE and at least one IN is BAD	BAD + non specific
Out-of-Service	The Actual_Mode is OUT OF SERVICE	BAD + Out Of Service

NOTE A: The specific block cannot be switched out from OUT OF SERVICE due to the Configuration Error. The Bad-Configuration Error Status is overridden by the Bad-Out Of Service Status.

OUT Status

When in AUTO mode the OUT reflects the Value and Status of the selected input (IN_x).
If there are no inputs used, or the number of inputs with GOOD status is less than the MIN_GOOD value, the OUT status shall be BAD-Non Specific.
The SELECTED output shall have Good(NC) status, unless the block is out of service.
With the STATUS_OPTS it is possible selects the following options:

- **Use Uncertain as Good:** Set the IS_OUT status to Good when the Selected Input Status is Uncertain
- **Uncertain if Manual Mode:** The Status of the IS_OUT is set to Uncertain when the Mode is set to Manual

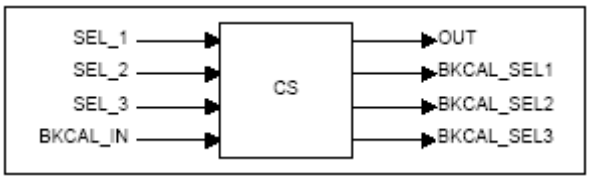
Troubleshooting

Problem	Possible cause	Solution
The Block cannot be removed from OOS mode	The Target Mode is not set to AUTO	Set the Target Mode to AUTO and/or remove the OOS
	The Configuration Error bit is set in the BLOCK_ERR	Set the SELECT_TYPE with a valid value. It must be different by 0 and in the range 1 – 5
	The RESOURCE BLOCK is not in AUTO mode	Set the Target Mode of the RESOURCE BLOCK to AUTO mode
	The Block is not scheduled	Design the FB Application correctly and download it to the devices
The OUT Status is BAD	All the Inputs have a BAD status	Check the upstream blocks
	The number of inputs with GOOD status is less than the MIN_GOOD value	
	The OP_SELECT is different by 0 and force in output and Input with BAD status	
	The SELECT_TYPE = AVERAGE and at least one Input has Status BAD	
The OUT Status has the Limit bits (0, 1) set to Constant	The Actual Mode is set to MAN	Set the Target Mode to AUTO
Block Alarm Not Working (Events not notified)	The FEATURE_SEL has not the Reports bit Set	Set the REPORTS bit in the FEATURE_SEL of the RESOURCE BLOCK

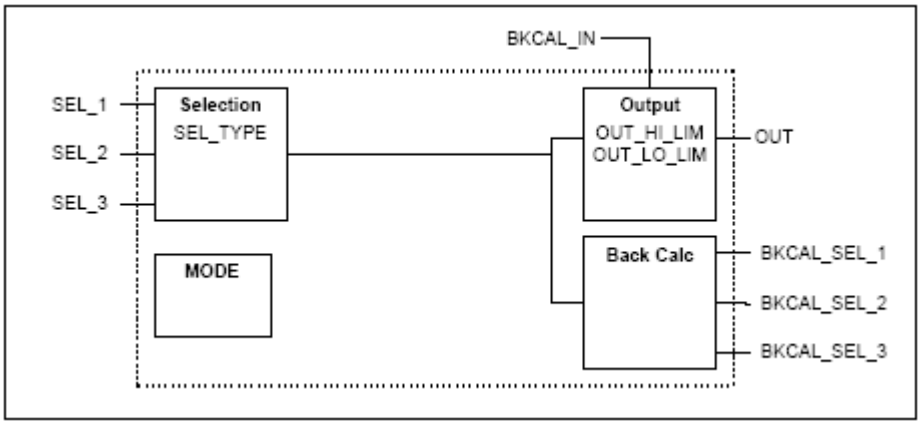
Control Selector Function Block (CS)

Overview

The control selector block is intended to select one of two or three control signals in a manner determined by SEL_TYPE, when the block is in Auto mode. A different block, described in Part 3, is used for selecting a measurement from input or calculation blocks.



Block Diagram



Description

All inputs to the selector block are assumed to have the same scaling as OUT, since any one of them may be selected to be OUT. Three separate BKCAL_SEL_N outputs are available, one for each SEL_N input. The status will indicate those inputs that are not selected. Control blocks that are not selected are limited in one direction only, determined by the type of selector. The value of each BKCAL_SEL_N output is the same as OUT. The limits of back calculation outputs corresponding to deselected inputs will be high for a low selector and low for a high selector, or one of each for a mid selector.

Equations

With the SEL_TYPE it is possible select the following algorithms:

1 High

2 Low

3 Middle

Configuration hints

The minimum configuration for having the CS working and/or moving out from the OOS needs at least the following settings:

- Set the SEL_TYPE with a valid value. It must be different by 0 and in the range 1 – 3

Block Mapping

Idx	Parameter		Description / Range / Selections / Note		
0	BLOCK_OBJ		In the Block Object data structure, there are different items describing the block characteristics. Execution period, Number of parameters in the block, the DD Revision, Profile Revision, View Objects characteristics and so on		
1	ST_REV		The revision level of the Static data associated with the Function Block. The revision level is incremented each time a static parameter value (S – under Storage) in the block is changed.		
2	TAG_DESC		The user description of the intended application of the block		
3	STRATEGY		The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.		
4	ALERT_KEY		The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.		
5	MODE_BLK	TARGET	AUTO / MAN / OOS	The selectable modes by the operator.	
		ACTUAL		The mode the block is currently in.	
		PERMITTED	AUTO / MAN / OOS	Allowed modes that the target may take on	
		NORMAL	AUTO	The common mode for the Actual.	
6	BLOCK_ERR		This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown.		
7	OUT		The block output value calculated as a result of the block execution, expressed in OUT_SCALE unit	Writeable only if MODE_BLK.ACTUAL = MAN	
8	OUT_SCALE		The high and low scale values, engineering units code, and number of digits to the right of the decimal point to be used in displaying the OUT parameter and parameters which have the same scaling as OUT.		
9	GRANT_DENY				
10	STATUS_OPTS		Options which the user can select for the block processing of status. The available selections are:		
			Bit 0	IFS if BAD IN	
			Bit 2	Use Uncertain as Good	
11	SEL_1		First input value to the selector	Expressed in OUT_SCALE Unit	
12	SEL_2		Second input value to the selector		
13	SEL_3		Third input value to the selector		
14	SEL_TYPE		This parameter specifies the type of selector action	2	Low
			1	High	3	Middle
15	BKCAL_IN		The analog input value from another block's BKCAL_OUT output that is used to prevent reset windup and to initialize the control loop. Expressed in OUT_SCALE Unit		
16	OUT_HI_LIM		Acceptable value: OUT_SCALE +/- 10% Expressed in OUT_SCALE Unit	Limits the maximum output value.	
17	OUT_LO_LIM			Limits the minimum output value.	
18	BKCAL_SEL_1		Control selector Value and Status associated with SEL_1 input which is provided to BKCAL_IN of the block connected to SEL_1 in order to prevent reset windup. Expressed in OUT_SCALE Unit		
19	BKCAL_SEL_2		Control selector Value and Status associated with SEL_2 input which is provided to BKCAL_IN of the block connected to SEL_2 in order to prevent reset windup. Expressed in OUT_SCALE Unit		
20	BKCAL_SEL_3		Control selector Value and Status associated with SEL_3 input which is provided to BKCAL_IN of the block connected to SEL_3 in order to prevent reset windup. Expressed in OUT_SCALE Unit		
21	UPDATE_EVT		This alert is generated by any change to the static data		
22	BLOCK_ALM		The block alarm is used for all configuration, hardware, connection failure or system problems in the block. The cause of the alert is entered in the subcode field. The alert will set the Active Status in the status parameter. When the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active Status, if the subcode has changed		

Diagnostic

Block_Err	Possible Reasons	OUT Status
Block Configuration error	SELECT_TYPE = 0 (uninitialized)	BAD + Out Of Service **See Note A**
Input Failure/process variable has BAD status	The value linked in input coming from the upstream blocks has BAD Status.	As Calculated and depending by the STATUS_OPTS
Out-of-Service	The Actual_Mode is OUT OF SERVICE	BAD + Out Of Service

NOTE A: The specific block cannot be switched out from OUT OF SERVICE due to the Configuration Error. The Bad-Configuration Error Status is overridden by the Bad-Out Of Service Status.

OUT Status

The OUT Status of the CS block is the same of the Selected Input exception for:

- If input is Uncertain, the output is Bad unless the STATUS_OPTS is set to **Use Uncertain as Good**.
- If all the inputs are Bad the CS mode goes to MAN as well as it does the PID. This condition produces the OUT Status to be set to IFS if the STATUS_OPTS is set to **IFS if BAD IN**.
- If no inputs have been linked or are valid the OUT Status is set to Bad - Configuration Error

Supported STATUS_OPTS:

- IFS if BAD IN
- Use Uncertain as GOOD

Status supported for other output variables:

- If the BKCAL_IN status is NI or IR, this status is transferred to the three BKCAL_SEL_x.
- If the BKCAL_IN status is not normal it is transferred to the selected BKCAL_SEL_x output.
- The BKCAL_SEL_x Status of the deselected inputs is set to Not Selected with the appropriate high or low limit set.
- When the CS is in MAN no inputs are selected. All the BKCAL_SEL_x status are set to Not Invited and Constant limits with the same value of OUT.

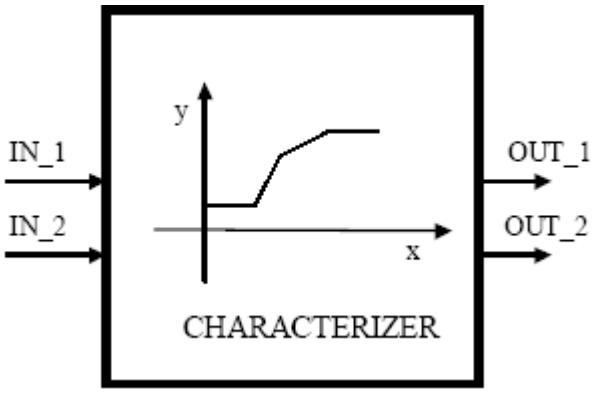
Troubleshooting

Problem	Possible cause	Solution
The Block cannot be removed from OOS mode	The Target Mode is not set to AUTO	Set the Target Mode to AUTO and/or remove the OOS
	The Configuration Error bit is set in the BLOCK_ERR	- Set the SEL_TYPE with a valid value. It must be different by 0 and in the range 1 – 3 - Set OUT_HI_LIM > OUT_LO_LIM
	The RESOURCE BLOCK is not in AUTO mode	Set the Target Mode of the RESOURCE BLOCK to AUTO mode
	The Block is not scheduled	Design the FB Application correctly and download it to the devices
The Block is in MAN mode	The Target Mode is set to MAN	Set the Target Mode to AUTO
	An used input has Bad Status	Check the upstream blocks
	The Selected input has UNCERTAIN Status	Set the STATUS_OPTS to Use Uncertain as Good
The OUT Status is BAD	There are no inputs linked in (OUT Status = BAD Configuration Error)	Review the FB application design
The OUT Status has the Limit bits (0, 1) set to Constant	The Actual Mode is set to MAN	Set the Target Mode to AUTO
Block Alarm Not Working (Events not notified)	The FEATURE_SEL has not the Reports bit Set	Set the REPORTS bit in the FEATURE_SEL of the RESOURCE BLOCK
	LIM_NOTIFY value is less of the MAX_NOTIFY value	Set the value of LIM_NOTIFY equal, at least, to the MAX_NOTIFY value

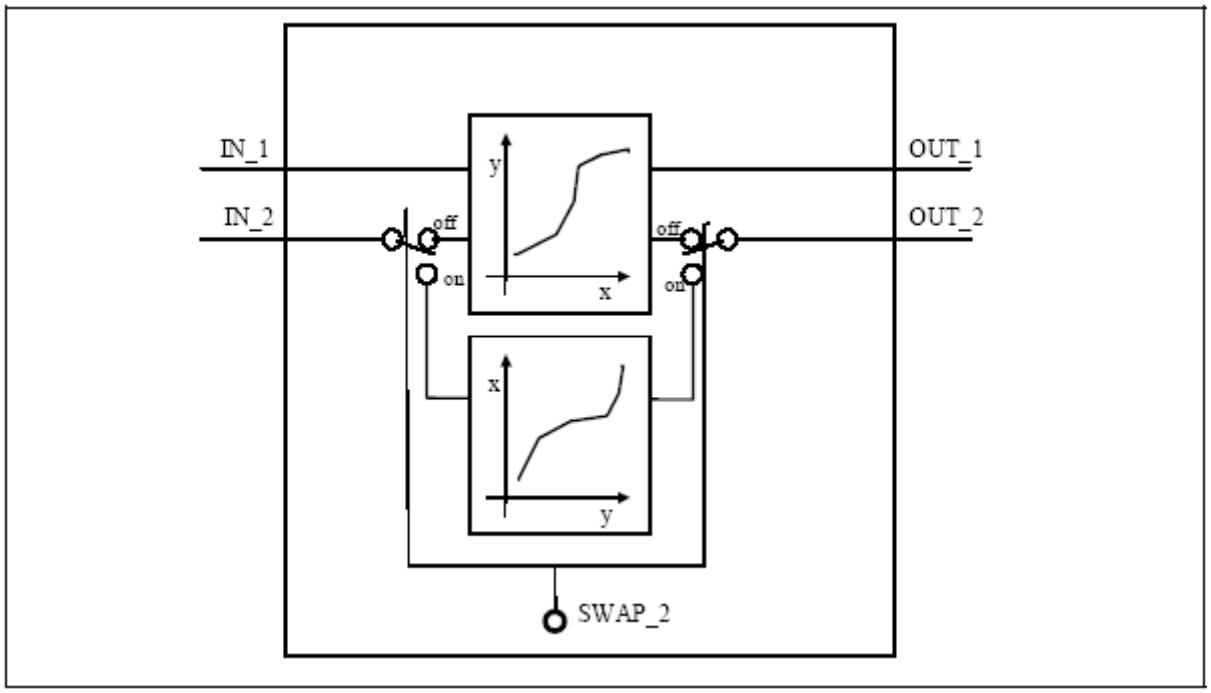
Signal Characterizer Function Block (SC)

Overview

The signal characterizer block has two sections, each with an output that is a non-linear function of the respective input. The non-linear function is determined by a single look-up table with 21 arbitrary x-y pairs. The status of an input is copied to the corresponding output, so the block may be used in the control or process signal path. An option can swap the axes of the function for section 2, so that it can be used in the backward control path.



Block Diagram



Description

The block calculates OUT_1 from IN_1 and OUT_2 from IN_2 using a curve given by the points:
[x1 ;y1], [x2 ; y2] ... [x21 ; y21] where x corresponds to the Input and y to the Output. The x-coordinates are given in engineering units of X_RANGE. The y-coordinates are given in engineering units of Y_RANGE. The only useful mode is Auto.

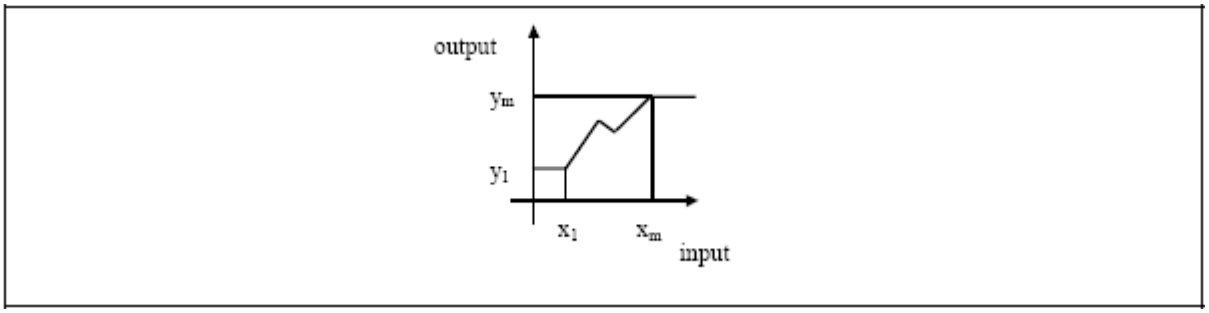
Calculation and the curve:

OUT_1 is related to IN_1 and OUT_2 to IN_2 by the same curve, but there is no relation between IN_1 and IN_2 or between OUT_1 and OUT_2.

An output value may be calculated by linear interpolation between two points bracketing the input value.

Values of x should increase monotonically, so that interpolation may be possible. If not, a configuration error shall be set in BLOCK_ERR and the actual mode of the block shall go to Out of Service. Write checks may also be implemented, but they may force the order of entry of the x terms.

If the curve has m points, m<21, the non-configured points, [xm+1; ym+1], [xm+2; ym+2], ... [x21; y21] shall be set to +INFINITY to mark them as unused.
Since x1 is the smallest specified value for the input and xm is the largest, the output shall be at y1 when the input is smaller than x1 and at ym when the input is larger than xm. Since the ends of the y curve act as limits, the OUT status shall show when either limit is active.



Reversing path 2:
A reverse function swaps the interpretation of IN_2 and OUT_2, which provides a way to do back calculation using the same curve.
If the parameter SWAP_2 is set true, the block shall provide:
IN_1 = x and OUT_1 = y while IN_2 = y and OUT_2 = x
If the function is not monotonic in y and SWAP_2 is true, then BLOCK_ERR shall indicate a configuration error and the actual mode go to Out of Service as above for x. A function is called monotonic when y values always increase or decrease when x values increase, e.g. the function does not present peaks, valleys, or flat spots.
If SWAP_2 = false, IN_1 and IN_2 have the same engineering units defined in X_RANGE and OUT_1 and OUT_2 use the units defined in Y_RANGE.
If SWAP_2 = true, OUT _1 and IN_2 have Y_RANGE and OUT_2 and IN_1 have X_RANGE.

Configuration hints
The minimum configuration for having the SC working and/or moving out from the OOS needs at least the following settings:
- Set SWAP_2 different by 0
- Set at least one X and Y pairs
- Set the X values monotonically increasing or the Y values monotonically increasing or decreasing

Block Mapping

Idx	Parameter		Description / Range / Selections / Note	
0	BLOCK_OBJ		In the Block Object data structure, there are different items describing the block characteristics. Execution period, Number of parameters in the block, the DD Revision, Profile Revision, View Objects characteristics and so on	
1	ST_REV		The revision level of the Static data associated with the Function Block. The revision level is incremented each time a static parameter value (S – under Storage) in the block is changed.	
2	TAG_DESC		The user description of the intended application of the block	
3	STRATEGY		The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.	
4	ALERT_KEY		The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.	
5	MODE_BLK	TARGET	AUTO / MAN / OOS	The selectable modes by the operator.
		ACTUAL		The mode the block is currently in.
		PERMITTED	AUTO / MAN / OOS	Allowed modes that the target may take on
		NORMAL	AUTO	The common mode for the Actual.
6	BLOCK_ERR		This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown.	
7	OUT_1		The block output 1 value and Status calculated as a result of the block execution,	Writeable only if MODE_BLK.ACTUAL = MAN
8	OUT_2		The block output 2 value and Status calculated as a result of the block execution,	
9	X_RANGE		The high and low scale values, engineering units code, and number of digits to the right of the decimal point to be used in displaying the variables corresponding to the x-axis for display. It has no effect on the block	
10	Y_RANGE		The high and low scale values, engineering units code, and number of digits to the right of the decimal point to be used in displaying the variables corresponding to the y-axis for display. It has no effect on the block.	
11	GRANT_DENY			
12	IN_1		Input 1 Value and Status	
13	IN_2		Input 2 Value and Status	
14	SWAP_2		Changes the algorithm in such a way that IN_2 corresponds to “y” and OUT_2 to “x”.	
			1	No Swap
			2	Swap
15	CURVE_X		Curve input points. The xi points of the curve are defined by an array of 21 points	
16	CURVE_Y		Curve output points. The yi points of the curve are defined by an array of 21 points	
17	UPDATE_EVT		This alert is generated by any change to the static data	
18	BLOCK_ALM		The block alarm is used for all configuration, hardware, connection failure or system problems in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active Status in the status parameter. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active Status, if the subcode has changed.	

Diagnostic

Block_Err	Possible Reasons	OUT Status
Block Configuration error	- SWAP_2 = 0 (uninitialized) - No X, Y point set - SWAP = FALSE and X values do not increase monotonically - SWAP = TRUE and X values do not increase monotonically OR Y values do not increase or decrease monotonically	BAD + Out Of Service **See Note A**
Input Failure/process variable has BAD status	The value linked in input coming from the upstream blocks has BAD Status.	- The Status of IN_1 is propagated to the OUT_ 1 - The Status of IN_2 is propagated to the OUT_2
Out-of-Service	The Actual_Mode is OUT OF SERVICE	BAD + Out Of Service

NOTE A: The specific block cannot be switched out from OUT OF SERVICE due to the Configuration Error. The Bad-Configuration Error Status is overridden by the Bad-Out Of Service Status.

OUT Status

OUT_1 shall reflect the status of IN_1 and OUT_2 shall reflect the status of IN_2. The sub-status shall also be passed to the outputs. If one of the curve limits is reached or the input is limited, the appropriate limit should be indicated in the output sub-status. Limits shall be reversed if the curve slope is negative.

If SWAP_2 is set, cascade initialization is controlled by the lower block. When this block is in O/S mode, the cascade to both the lower and upper blocks shall be broken by Bad status at the outputs. When this block goes to Auto mode, the lower block can begin cascade initialization with status values that pass through this block to the upper block. Answering status signals from the upper block pass through this block to the lower block.

- The block does not use STATUS_OPTS.

Troubleshooting

Problem	Possible cause	Solution
The Block cannot be removed from OOS mode	The Target Mode is not set to AUTO	Set the Target Mode to AUTO and/or remove the OOS
	The Configuration Error bit is set in the BLOCK_ERR	– Set SWAP_2 different by 0 – Set at least one X, Y pairs – IF SWAP = FALSE set X points with increasing monotonically values – IF SWAP = TRUE set X points with increasing monotonically values and Y points with increasing or decreasing monotonically values
	The RESOURCE BLOCK is not in AUTO mode	Set the Target Mode of the RESOURCE BLOCK to AUTO mode
	The Block is not scheduled	Design the FB Application correctly and download it to the devices
The OUT Status is BAD	The used input has Bad Status	Check the upstream blocks
	There are no inputs linked in (OUT Status = BAD Configuration Error)	Review the FB application design
The OUT Status has the Limit bits (0, 1) set to Constant	The Actual Mode is set to MAN	Set the Target Mode to AUTO
Block Alarm Not Working (Events not notified)	The FEATURE_SEL has not the Reports bit Set	Set the REPORTS bit in the FEATURE_SEL of the RESOURCE BLOCK
	LIM_NOTIFY value is less of the MAX_NOTIFY value	Set the value of LIM_NOTIFY equal, at least, to the MAX_NOTIFY value

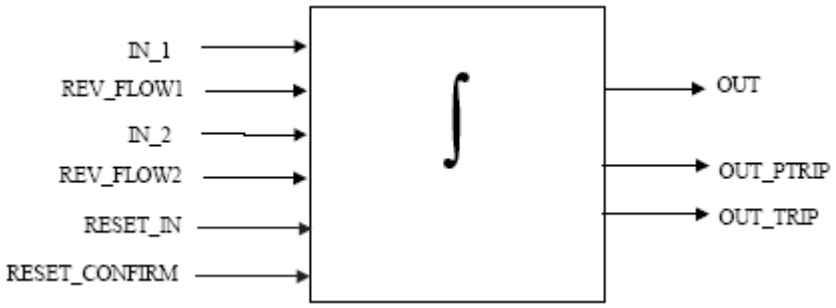
Integrator Function Block (IT)

Overview

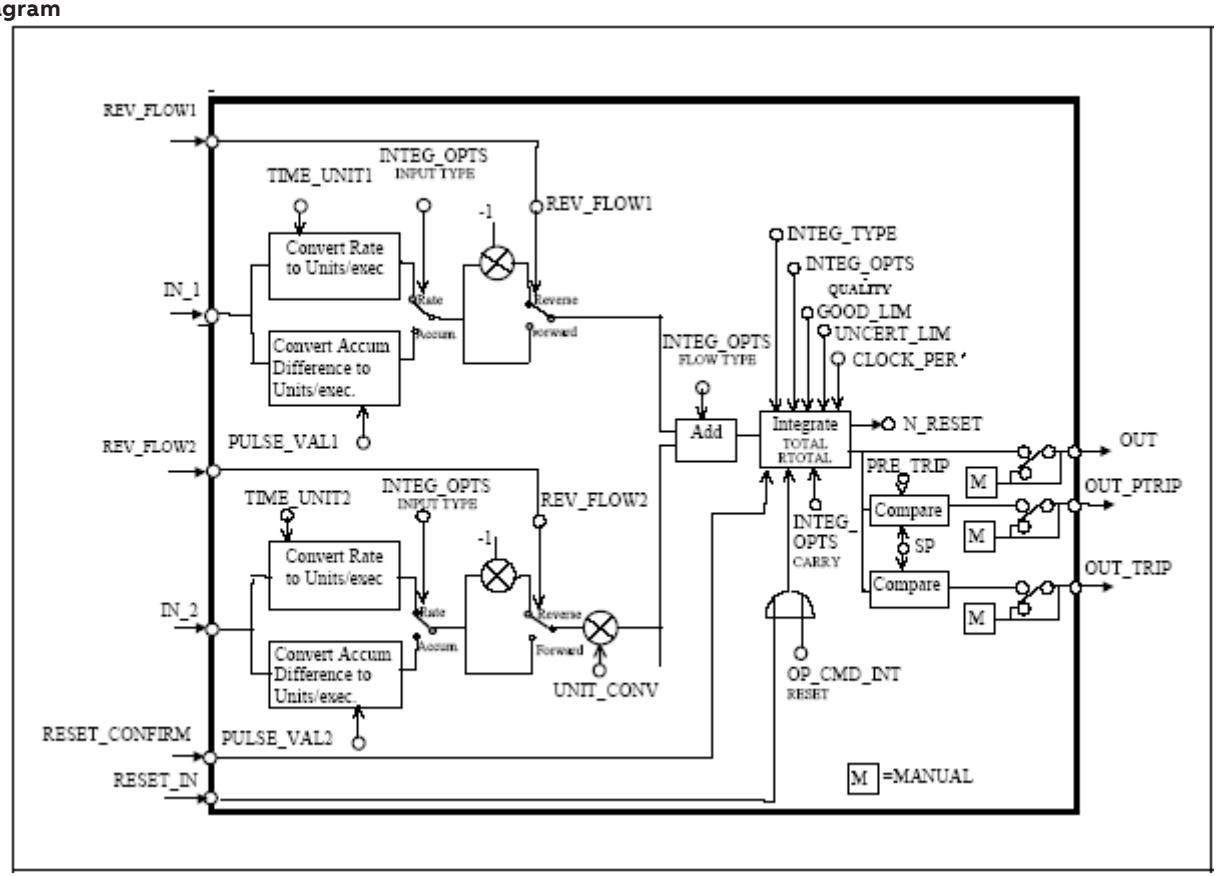
The Integrator Function Block integrates a variable as a function of the time or accumulates the counts from a Pulse Input block (to be described in another specification). The block may be used as a totalizer that counts up until reset or as a batch totalizer that has a setpoint, where the integrated or accumulated value is compared to pre-trip and trip settings, generating discrete signals when these settings are reached. The integrated value may go up, starting from zero, or down, starting from the trip value. The block has two flow inputs so that it can calculate and integrate net flow. This can be used to calculate volume or mass variation in vessels or as an optimizing tool for flow ratio control.

In order to determine the amount of uncertain or bad readings, the block integrates the variables with bad or bad and uncertain status separately. The values used in this second integration are the values with good status just before they went from good to bad or uncertain.

The ratio of good to total counts determines the output status. Absolute values are used to avoid problems with changing signs.



Block Diagram



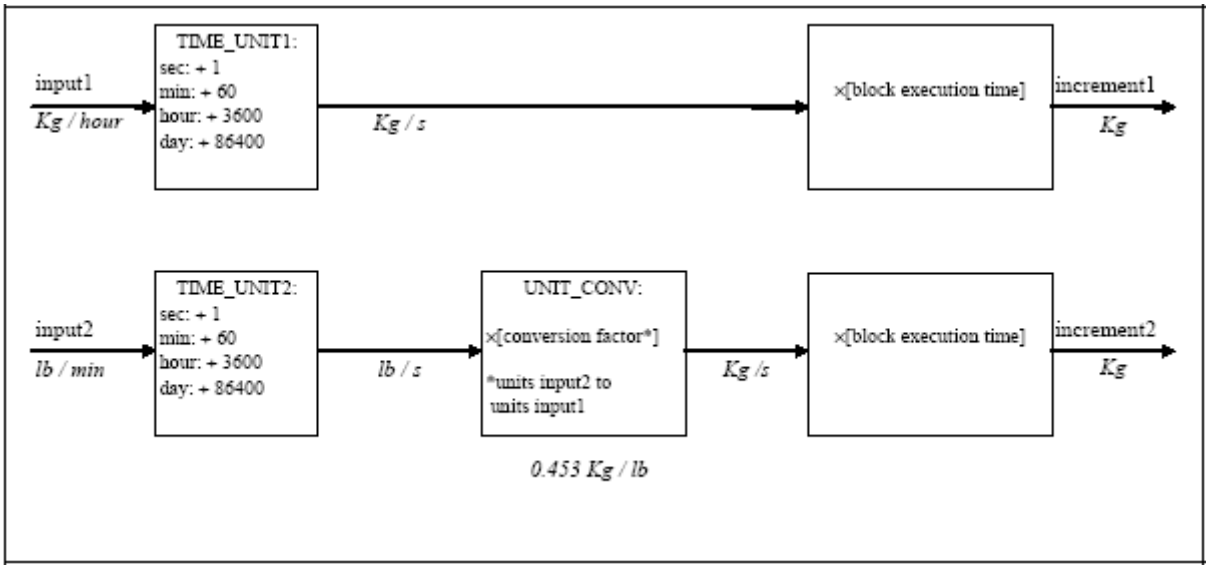
Description

The function of this block is in keeping with common industry practice. There is nothing to be tested here concerning the calculation of the integral term. The following description is a guide to the use of the parameters.The basic function of the Integrator block is to integrate an analog value over time. It can also accumulate the pulses coming from Pulse Input blocks or from other Integrator blocks. This block is normally used to totalize flow, giving total mass or volume over a certain time, or totalize power, giving the total energy.

Inputs

The block has two dual purpose inputs, IN_1 and IN_2. If IN_2 is not connected (does not have a corresponding link object) then calculations for IN_2 may be omitted. Each input can receive a measurement per unit of time (rate) or an accumulated number of pulses. The usage is as follows:

Rate - Used when the variable connected to the input is a rate, i.e., Kg/s, w, Gal/hour, etc. This input can come from the rate output OUT of a Pulse Input block or from the output of an Analog Input block.
Accum - Used when the input comes from the OUT_ACCUM output of a Pulse Input block, which represents a continuous accumulation of pulse counts from a transducer, or from the output of another Integrator block.
The input type is configured in the bit string parameter INTEG_OPTS. The bits corresponding to IN_1 and IN_2 can be set false for Rate or true for Accum.
If the input option is Rate:
Each input needs a parameter to define the rate time unit: TIME_UNIT1 or TIME_UNIT2. The time units are used to convert the two rates in units of mass, volume or energy per second The second analog input may have to be converted into the same units of the first input. This is achieved by a unit conversion factor, given by the parameter UNIT_CONV.
Each rate, multiplied by the block execution time, gives the mass, volume or energy increment per block execution.
This increment should be added or subtracted in a register, according to some rules defined below.
The following diagram is an example of the use of two Rate inputs:



If the input option is Accum:
A counter input normally comes from a Pulse Input block OUT_ACCUM. It can also be connected to the output of another integrator block. The OUT_ACCUM of the Pulse Input block represents a continuous accumulation of pulses from the flow transducer, while the output OUT of an Integrator represents an integration or accumulation of analog inputs.
The Integrator block should determine the number of additional counts from the counter input readings since the last execution. As the output ACCUM_OUT of the Pulse Input block wraps up when the counting reaches 999,999 and does not increment or decrement by more than 499,999 per cycle, the difference in counts is determined as follows:

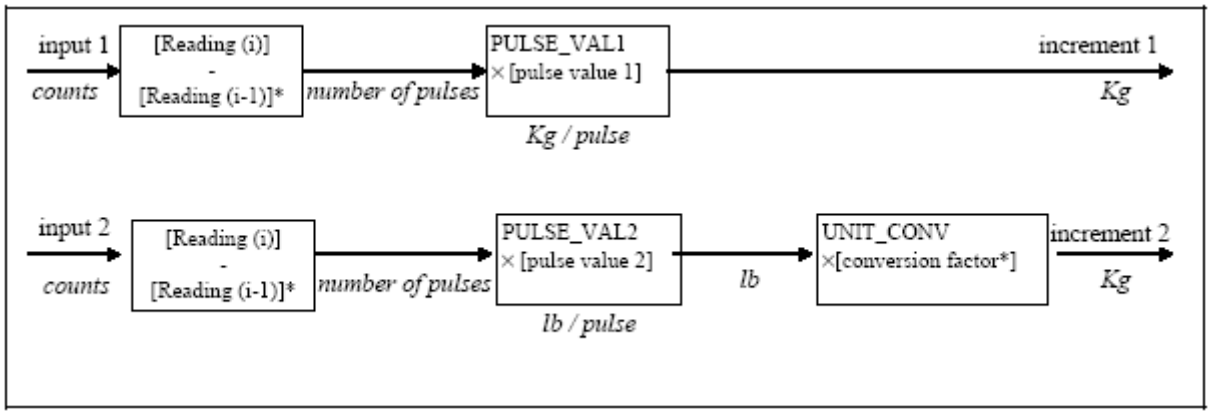
a) If the difference between the reading in one cycle and the reading in the preceding cycle is less than 500,000 or greater than (-500,000), the difference should be taken as the variation.

b) If the difference between the reading in one cycle and the reading in the preceding cycle is greater than or equal to (+500,000), add (-1,000,000) and use the result as the variation.

c) If the difference between the reading in one cycle and the reading in the preceding cycle is more negative than or equal to (-500,000), add (+1,000,000) and use the result as the variation.

If the output OUT of another integrator block is used, that block should be programmed to obey the rules listed above.
The variation of each input should be multiplied by the value, in engineering units, of each pulse given by PULSE_VAL1 or PULSE_VAL2, as appropriate. The result is the increment in engineering units of, for example, mass, volume or energy per block execution.

Example:



Net Flow
To discern between forward and reverse flows, the Integrator block considers a negative sign as an indication of reverse flow. Some flowmeters already indicate forward and reverse flows by adding a sign to the measurement value. Others use a separate binary signal. This signal can be connected to the inputs REV_FLOW1 and REV_FLOW2, where True should invert the signal of the corresponding input.
The net flow is obtained by adding the two increments. The net increment should have a positive or negative signal to indicate the net flow direction. In order to integrate the difference between the inflow and outflow of a tank, for example, the second one can be assigned to be negative.
The net flow direction to be considered in the totalization is defined in INTEG_OPTS. The following options are available:
FORWARD = only positive flows (after application of REV_FLOWi) are totalized. The negative values should be treated as zero. FORWARD is selected when the bit corresponding to Forward is set to true.
REVERSE = only negative flows are totalized. The positive values should be treated as zero. The option bit Reverse should be set to true TOTAL = both positive and negative values should be totalized. Both option bits Forward and Reverse should be set to true or to false.

Integration of Inputs:
There are three internal registers used for the totalization:
Total = The net increment is added every cycle, regardless of status.
Atotal = The absolute value of the net increment is added every cycle, regardless of status.
Rtotal = The absolute value of the net increments with bad status (rejects) are added to this register.
These internal registers may have greater precision than the standard floating point value. The value of Rtotal requires the same precision as Atotal in order to be able to accumulate floating point fractions so that they are not lost as arithmetic underflow. The value of a register that corresponds to standard floating point is called the most significant part of the register.
The most significant part of Total can be read in the output OUT, and of Rtotal in RTOTAL. OUT_RANGE is used only for display of the totals by a host. The high and low range values of OUT_RANGE have no effect on the block.
Types of integration:
The value of OUT can start from zero and go up or it can start from a Setpoint value (TOTAL_SP) and go down.
Reset may be automatic, periodic, or on demand. This is defined by the enumerated parameter INTEG_TYPE:

1 UP_AUTO Counts up with automatic reset when TOTAL_SP is reached

2 UP_DEM Counts up with demand reset

3 DN_AUTO Counts down with automatic reset when zero is reached

4 DN_DEM Counts down with demand reset

5 PERIODIC Counts up and is reset periodically according to CLOCK_PER

6 DEMAND Counts up and is reset on demand

7 PER&DEM Counts up and is reset periodically or on demand

The first four types indicate use as a batch totalizer with a setpoint TOTAL_SP. This is not the standard SP because it does not have the structure of SP that is defined in FF-890. The count does not stop at TOTAL_SP going up or zero going down, as it is important to get the true total of flow. Two outputs, OUT_TRIP and OUT_PTRIP, are associated with the four types.
See Batch totalizer outputs below.

The next three types indicate that TOTAL_SP and the trip outputs are not used. The Periodic type (5) disables operator reset.
The internal registers always add the net increments. Counting down is done by setting OUT to the value of TOTAL_SP minus the most significant part of Total.

Block Mapping

Idx	Parameter		Description / Range / Selections / Note	
0	BLOCK_OBJ		In the Block Object data structure, there are different items describing the block characteristics. Execution period, Number of parameters in the block, the DD Revision, Profile Revision, View Objects characteristics and so on	
1	ST_REV		The revision level of the Static data associated with the Function Block. The revision level is incremented each time a static parameter value (S – under Storage) in the block is changed.	
2	TAG_DESC		The user description of the intended application of the block	
3	STRATEGY		The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.	
4	ALERT_KEY		The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.	
5	MODE_BLK	TARGET	AUTO / MAN / OOS	The selectable modes by the operator.
		ACTUAL		The mode the block is currently in.
		PERMITTED	AUTO / MAN / OOS	Allowed modes that the target may take on
		NORMAL	AUTO	The common mode for the Actual.
6	BLOCK_ERR		This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown.	
7	TOTAL_SP		0 or > 0	Set Point for a batch UP totalization. When the OUT reaches it, the OUT is reset and the N_RESET is incremented.
8	OUT		This variable is the most significant part of the internal Total (Total = net increment added every cycle regardless of status). The OUT value is expressed in OUT_RANGE Unit.	Writeable only if MODE_BLK.ACTUAL = MAN
9	OUT_RANGE		The high and low scale values, engineering units code, and number of digits to the right of the decimal point used only for displaying of the totals (OUT, STOTAL, RTOTAL SRTOTAL) by a host. The high and low range values of OUT_RANGE have no effect on the block	
10	GRANT_DENY			
11	STATUS_OPTS		Options which the user can select for the block processing of status. The available selections are:	
			Bit 8	Uncertain if MAN Mode
12	IN_1		Input 1. If the input is not set to Accumulate in the INTEG_OPTS it is expressed in unit/sec, unit/min, unit/h or unit/day, if the input is set to Accumulate it is expressed in number of pulses.	
13	IN_2		Input 2. If the input is not set to Accumulate in the INTEG_OPTS it is expressed in unit/sec, unit/min, unit/h or unit/day, if the input is set to Accumulate it is expressed in number of pulses.	
14	OUT_TRIP		0	OFF
			1	ON
15	OUT_PTRIP		0	OFF
			1	ON

Idx	Parameter	Description / Range / Selections / Note		
16	TIME_UNIT_1	Time unit of the IN_1. It is used to convert the IN_1 in unit per seconds.		
		0	Not Initialized	
		1	Seconds	
		2	Minutes	
		3	Hours	
		4	days	
17	TIME_UNIT_2	Time unit of the IN_2. It is used to convert the IN_2 in unit per seconds.		
		0	Not Initialized	
		1	Seconds	
		2	Minutes	
		3	Hours	
		4	days	
18	UNIT_CONV	Only Positive values accepted, not zero		Factor to convert the engineering unit of the input 2 into the engineering unit of input 1
19	PULSE_VAL 1	0 or > 0		If the input 1 is set to Accumulation this value converts the number of pulses in the engineer unit. It is expressed in unit per pulse
20	PULSE_VAL 2	0 or > 0		If the input 2 is set to Accumulation this value converts the number of pulses in the engineer unit. It is expressed in unit per pulse
21	REV_FLOW 1	0	FORWARD	In order to discern between forward and reverse flows, the Integrator block considers the negative sign as an indication of reverse flow. Some flowmeters already indicate forward and reverse flows by adding a sign to the measurement value. Others use a separate binary signal. This signal can be connected to the inputs REV_FLOW 1 for the IN_1, when it is True the IN_1 is inverted.
		1	REVERSE	
22	REV_FLOW 2	0	FORWARD	In order to discern between forward and reverse flows, the Integrator block considers the negative sign as an indication of reverse flow. Some flowmeters already indicate forward and reverse flows by adding a sign to the measurement value. Others use a separate binary signal. This signal can be connected to the inputs REV_FLOW 2 for the IN_2, when it is True the IN_2 is inverted.
		1	REVERSE	
23	RESET_IN	0	OFF	External signal used to reset the totalizer
		1	ON	
24	STOTAL	After Reset the block should take a snapshot/copy of the OUT just prior to the reset and move the value to the register STOTAL. The information should be kept until the next reset. Expressed in OUT_RANGE Unit		
25	RTOTAL	This value is the most significant part of the internal RTOTAL (RTOTAL = The absolute value of the net increments with bad status (rejects) are added to this register). Expressed in OUT_RANGE Unit		
26	SRTOTAL	After Reset the block should take a snapshot/copy of the RTOTAL just prior to the reset and move the value to the register SRTOTAL. The information should be kept until the next reset. Expressed in OUT_RANGE Unit		
27	SSP	After Reset the block should take a snapshot/copy of the TOTAL_SP just prior to the reset and move the value to the register SSP. The information should be kept until the next reset. Expressed in OUT_RANGE Unit		

...Block Mapping

Idx	Parameter	Description / Range / Selections / Note		
28	INTEG_TYPE	Defines the type of counting (up or down) and the type of resetting (demand or periodic)		
		0	Not Initialized	
		1	UP AUTO	
		2	UP DEM	
		3	DN AUTO	
		4	DN DEM	
		5	PERIODIC	
		6	DEMAND	
		7	PER & DEM	
29	INTEG_OPTS	A bit string to configure the type of input (rate or accum.) used in each input, the flow direction to be considered in the totalization, the status to be considered in TOTAL and if the totalization residue shall be used in the next batch (only when INTEG_TYPE = UP_AUTO or DN_AUTO).		
		Bit 0	Input 1 Accumulate	
		Bit 1	Input 2 Accumulate	
		Bit 2	Flow Forward	
		Bit 3	Flow Reverse	
		Bit 4	Use Uncertain	
		Bit 5	Use Bad	
		Bit 6	Carry	
		Bit 7	Add zero if Bad	
		Bit 8	Confirm Reset	
		Bit 9	Generate Reset Event	
30	CLOCK_ERR	0 or > 0		Establishes the period for periodic reset, in seconds
31	PRE_TRIP	0 or > 0		Value used for the OUT_PTRIP setting. It adjusts the amount of mass, volume or energy that should set OUT_PTRIP when the integration reaches (TOTAL_SP - PRE_TRIP) when counting UP or PRE_TRIP when counting DOWN. Expressed in OUT_RANGE Unit
32	N_RESET	The number of resets is counted in the register N_RESET. This counter can not be written or reset. It provides verification that the TOTAL has not been reset since N_RESET was last checked. The counter should roll over from 999999 to 0.		
33	PCT_INCL	This value is the % of the absolute net increment with good status respect of the absolute net increment regardless of the status.		
34	GOOD_LIM	If PCT_INCL ≥ GOOD_LIM and the mode is AUTO the status of the OUT is GOOD_NC otherwise check the other limit. Expressed in %		
35	UNCERT_LIM	If PCT_INCL ≥ UNCERT_LIM and the mode is AUTO the status of the OUT is UNCERTAIN otherwise is BAD. Expressed in %		
36	OP_CMD_INT	0	OFF	Operator reset command. Resets the totalizer
		1	ON	
37	OUTAGE_LIM	0 or > 0		The max, tolerated duration for power failure. This value is used by the host expressed in seconds
38	RESET_CONFIRM	0	OFF	If the Confirm Reset in the INTEG_OPTS is set, any further reset will be prevented until a logic 1 is not received in input to the RESET_CONFIRM. If not connected it acts like a momentary dynamic parameter. This ensures that a host has recorded the snapshot values before the next reset can occur.
		1	CONFIRM	
39	UPDATE_EVT	This alert is generated by any change to the static data		
40	BLOCK_ALM	The block alarm is used for all configuration, hardware, connection failure or system problems in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active Status in the status parameter. When the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active Status, if the subcode has changed		

Operating Mode

In manual mode, the outputs are disconnected from the algorithm and the user can set the values of O UT, RTOTAL, OUT_TRIPand OUT_PTRIP for test purposes. No integration takes place. When the block is switched to Auto, the integration starts from the value set manually. Each write to OUT or RTOTAL shall increment the N_RESET counter. In auto mode, the outputs follow the algorithm.

Diagnostic

Block_Err	Possible Reasons	OUT Status
Block Configuration error	– TIME_UNIT1 = 0 – TIME_UNIT2 = 0 – INTEG_TYPE = 0 – IF INTEG_OPTS = IN_1 ACCUMULATE o PULSE_VAL1 = 0 – IF INTEG_OPTS = IN_2 ACCUMULATE o PULSE_VAL2 = 0 – IF INTEG_TYPE = PERIODIC o CLOCK_PER = 0	BAD + Out Of Service See Note A
Input Failure/process variable has BAD status	The value linked in input coming from the upstream blocks has BAD Status.	Calculated according the algorithm. See the OUT STATUS section below
Out-of-Service	The Actual_Mode is OUT OF SERVICE	BAD + Out Of Service

NOTE A: The specific block cannot be switched out from OUT OF SERVICE due to the Configuration Error. The Bad-Configuration Error Status is overridden by the Bad-Out Of Service Status.

OUT status

If an input has a status of Uncertain or Bad, it shall be treated as explained below. The limit status of the inputs is ignored, as is the substatus. Either Good(C) or Good(NC) are accepted as good.

The increment calculated from an input has an internal status that is either good or bad. If the input status is Good(C) or Good(NC) the increment status is good. If the input status is Uncertain, the increment status is bad, and the last good value is used unless the option Use Uncertain is set in INTEG_OPTS, and then the increment status is good and the new value is used. If the input status is Bad, the increment status is bad, and the last good value is used unless the option Use Bad is set in INTEG_OPTS, and then the increment status is good and the last good value is used.

The two increments are added together, and the resulting status is the worst of the two.

The option Add zero if bad in INTEG_OPTS causes the net increment to be zero if its status is bad.

The percentage of bad or uncertain and bad counts may be determined by calculating the value of PCT_INCL from Rtotal and Atotal.

Since Atotal is the sum of increments with good and bad status, and Rtotal is the sum of increments with bad status, Atotal minus Rtotal is exactly equal to the total of increments with good status. If msp is used to mean “most significant part” and Atotal is not zero then the percent of good values may be calculated as:

PCT_INCL = 100 * (1 - (msp of Rtotal) / (msp of Atotal))

If Atotal is zero, then PCT_INCL shall be 100 if Rtotal is also zero, or 0 if Rtotal is not zero.

If the block mode is Auto, if PCT_INCL ≥ GOOD_LIM, the status of OUT shall be Good, or else if PCT_INCL ≥ UNCERT_LIM, the status of OUT shall be Uncertain, or else the status of OUT shall be Bad.

If the block mode is Manual, then the status of OUT, OUT_PTRIP, and OUT_TRIP will be Good (NC) constant when then status option Uncertain if Man is not selected. If this status option is selected and the block mode is manual, then the status of these three outputs will be Uncertain constant. No limits are applied to the output.

APPENDIX B – Device installation and commissioning into ABB Control System

In order to make 266 PdP working with any FF host it is necessary perform some operations as described in the following sections. The description below is based on the 266 PdP connected to an ABB System but a similar approach is in general valid also for other non ABB hosts. A summary of the required operations is:

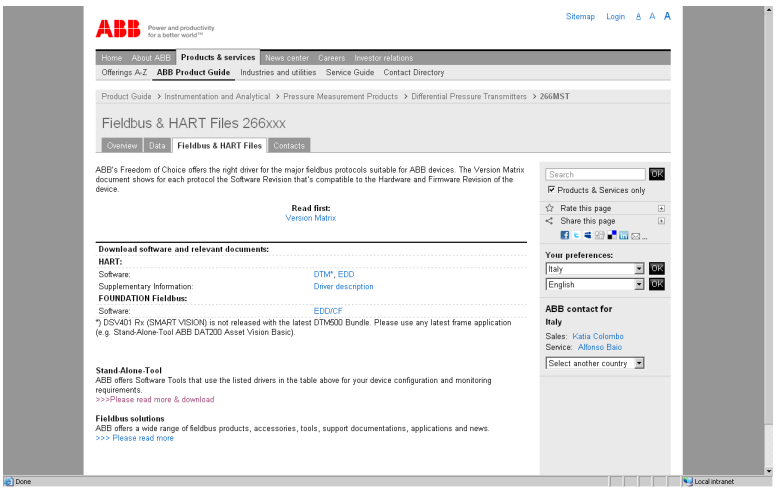
- Off Line Configuration
  Importing of the FF device drivers DD&CFF in the host
  Design of the FF H1 network
  Design of the FBAP
- ON Line Configuration
  Assignment of the FF device
  Downloading of the FBAP to the H1 network and devices
  Device and/or Blocks Configuration.

⚠ CAUTION

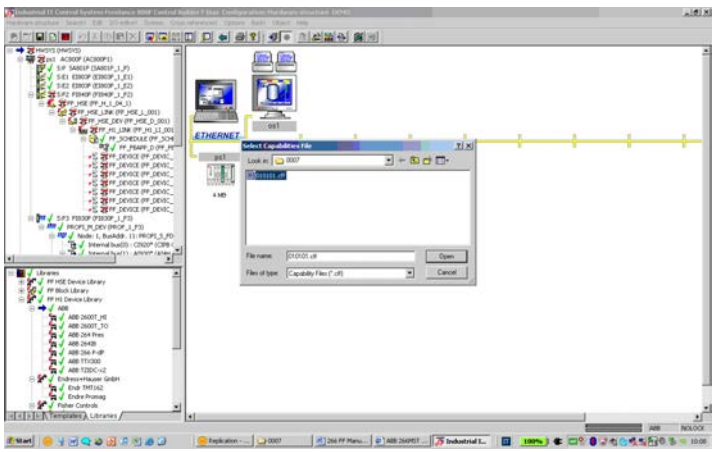
The first part of the operations is executed in OFF-Line. OFF line means that is not necessary has the real device connected on the FF H1 network to the host.

Importing of the FF device drivers DD&CFF in the host

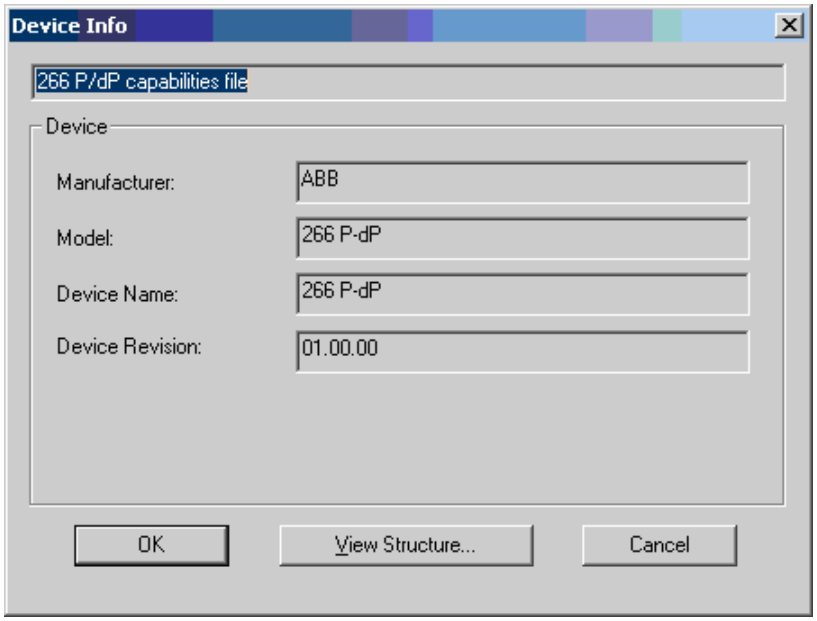
The DD&CFF drivers of the 266 PdP FOUNDATION™ Fieldbus have to be previously downloaded from the From the ABB web-site, www.abb.com/instrumentation select the 266 PdP and from the Fieldbus&Hart page download the FOUNDATION Fieldbus EDD/CF file into a dedicate directory



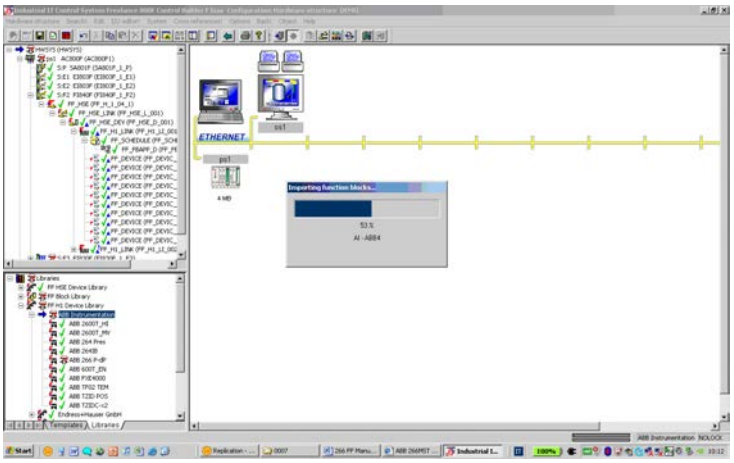
Then from the Engineering Station of the System (Control Builder) open Libraries and select “insert”.
The “Select Capability File” window is opened and from its browser search the downloaded 266 PdP Capability File (CFF) in the hard disk. Once it has been found press “Open”.



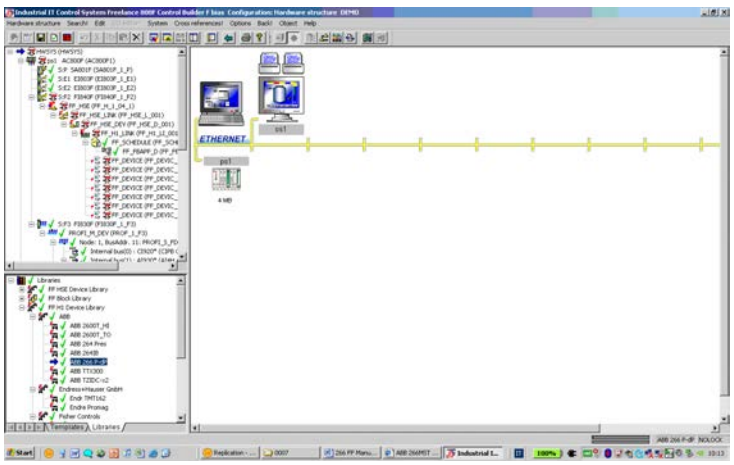
The “Device Info” box appears and then press “OK”.



The “Importing Function blocks….” get start. Wait until all the blocks are fully imported….. (100%).

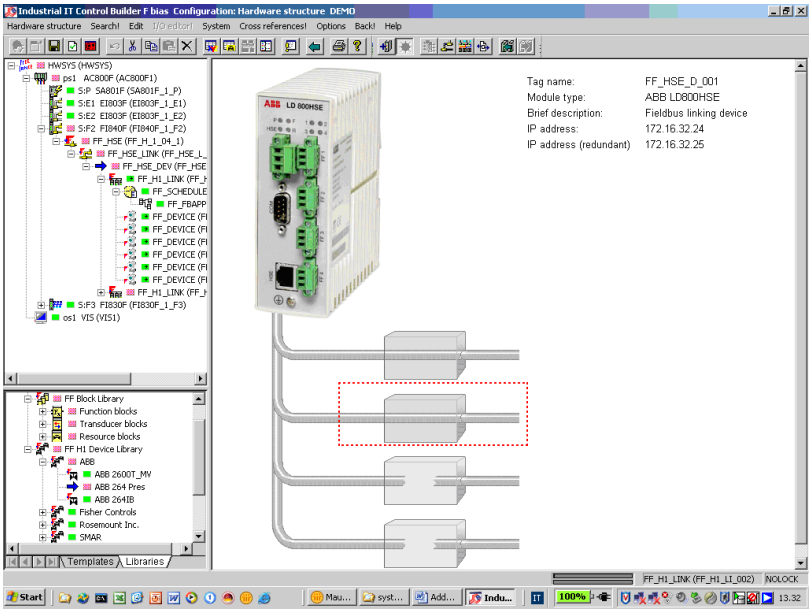


When completed, the “ABB 266 PdP” appears now in the FF library.

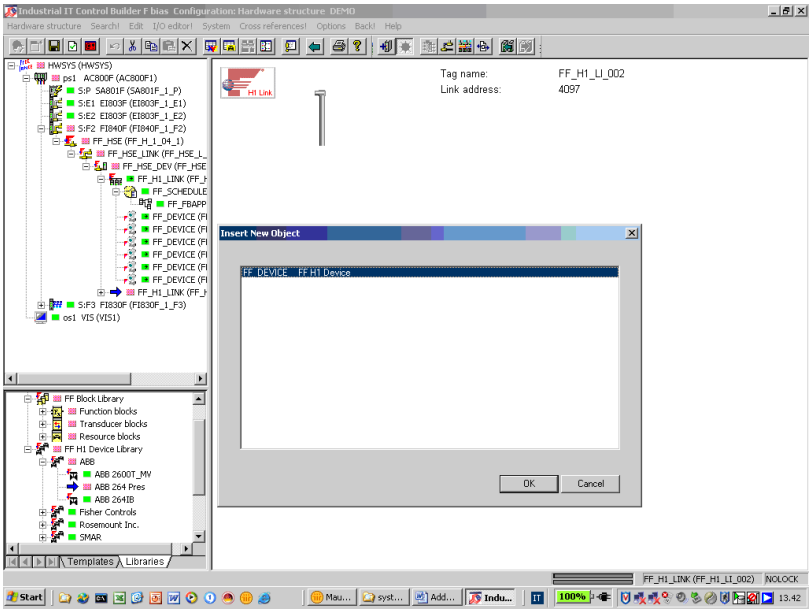


Design of the FF H1 network

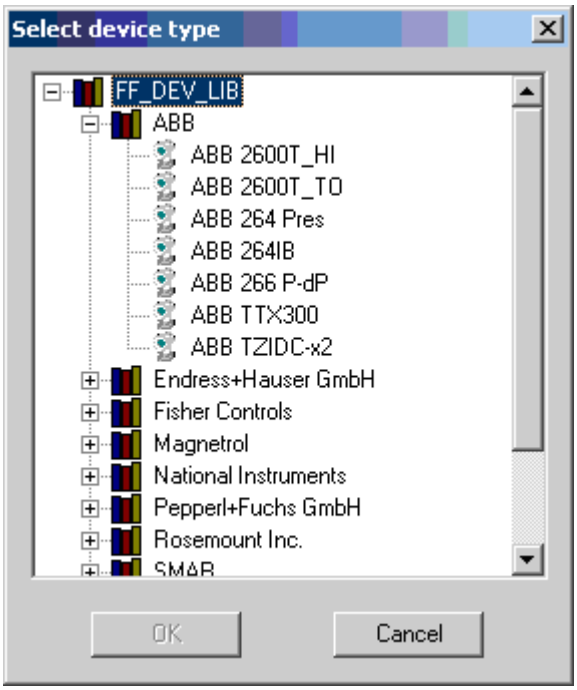
Select one of the four (4) FF H1 segments supported by the ABB Linking Device LD800HSE with a double right mouse click on the desired line.



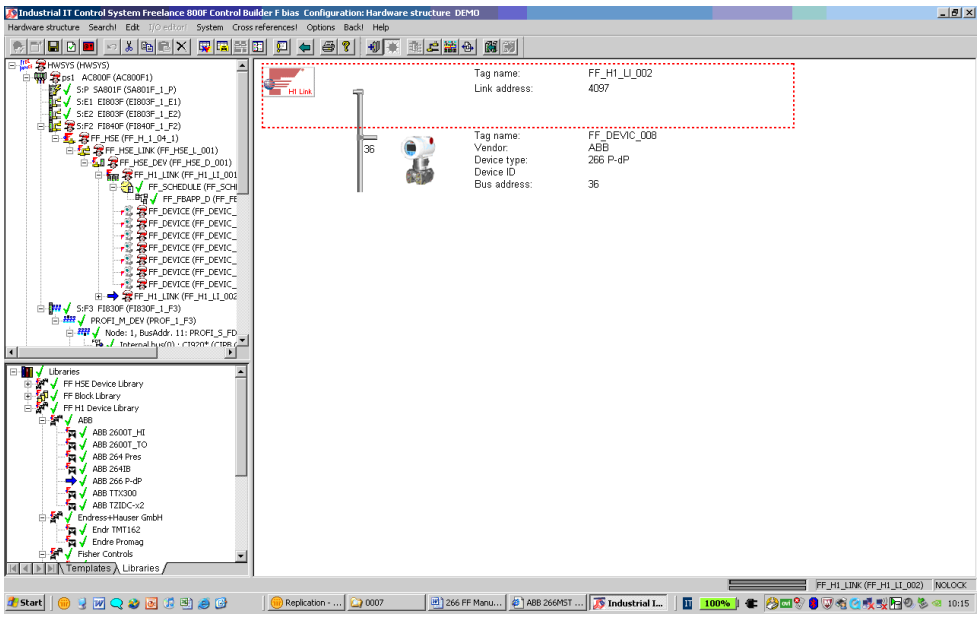
Select Insert with a right mouse click, the “Insert new object” box appears and press “OK”.



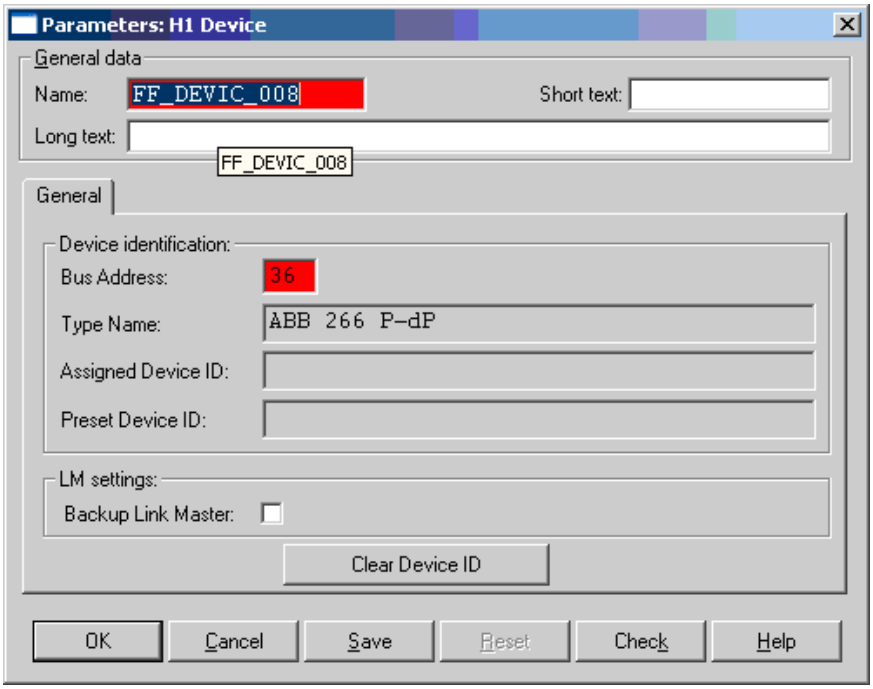
The “Select device type” box appears with a list of manufacturers and device types depending by the DD/CFF drivers imported in the host. Under ABB are available the drivers of the FF ABB devices.



Select “ABB 266 PdP” and press OK. The 266 PdP appears now in the H1 segment with predefined TAG and Address…….

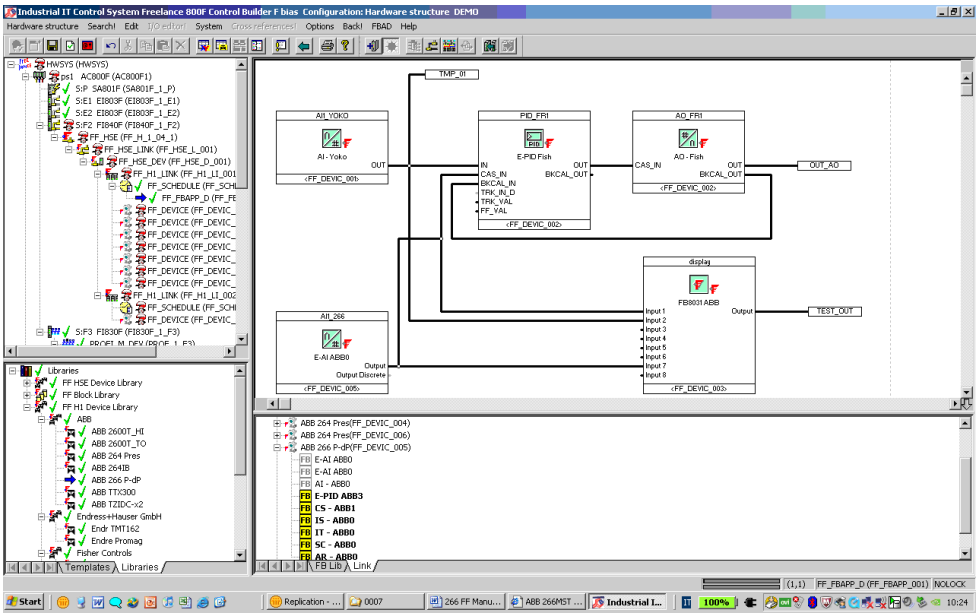


.....parameters that can be changed as desired opening the “Parameters” box of the device with a right mouse click. From this box is also possible select the Backup Link Master function (LAS) of the device.



Design of the Function Block Application (FBAP)

Select the FF Function Block Application section. In the lower part of the screen appears the list of the selected devices and their function blocks. The yellow colour of the blocks means that they are not yet used and thus available. With a drag and drop of the mouse on these blocks is possible move them in the box above ready to be, renamed and linked with other blocks of the same or other devices in order to achieve the desired control strategy.

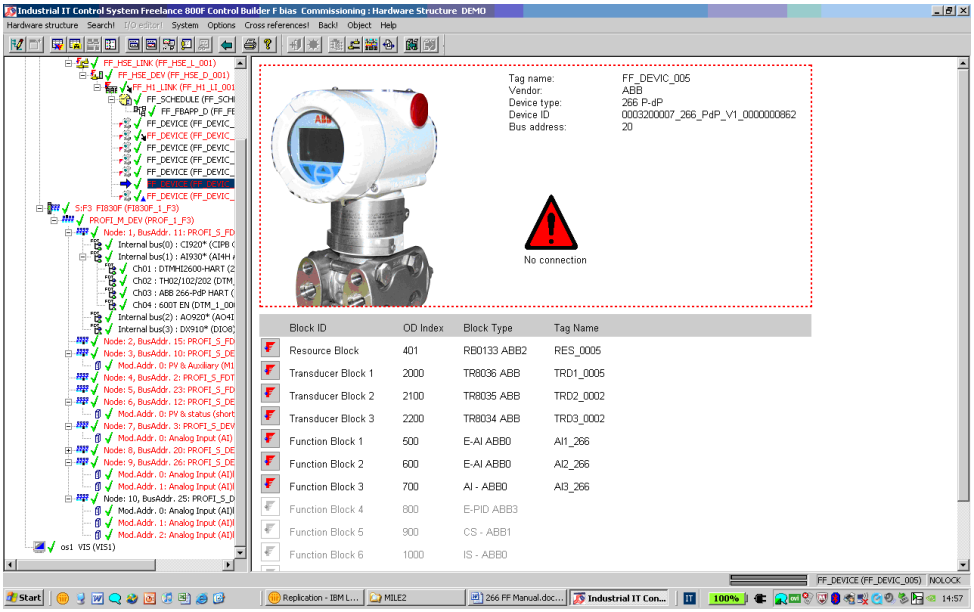


IMPORTANT

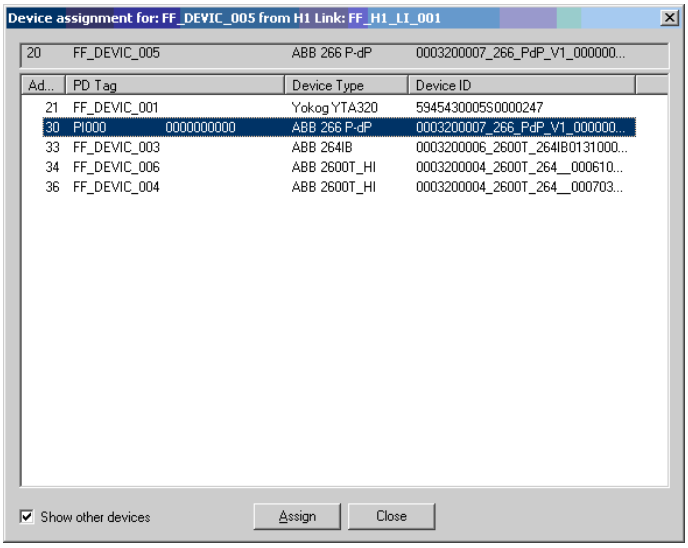
The second part of the operations is executed in ON-Line. ON line means that the real device has to be connected on the FF H1 network to the host.

Assignment of the FF devices

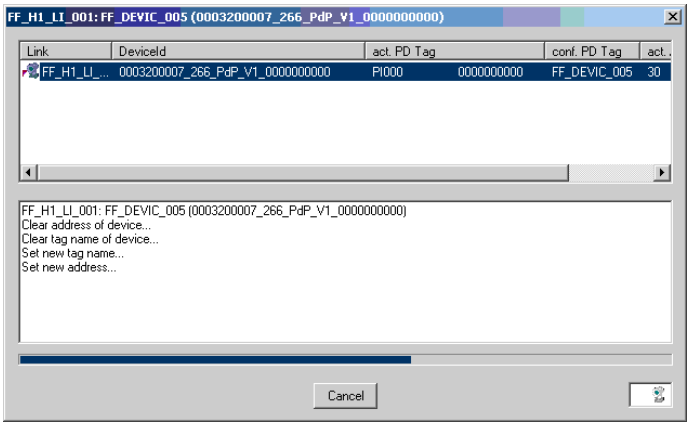
Verify that the 266 PdP appears in the “live List” of the Linking Device.
Then with the right mouse click select “Pre-commissioning” and then with the left mouse click select “Assign device”



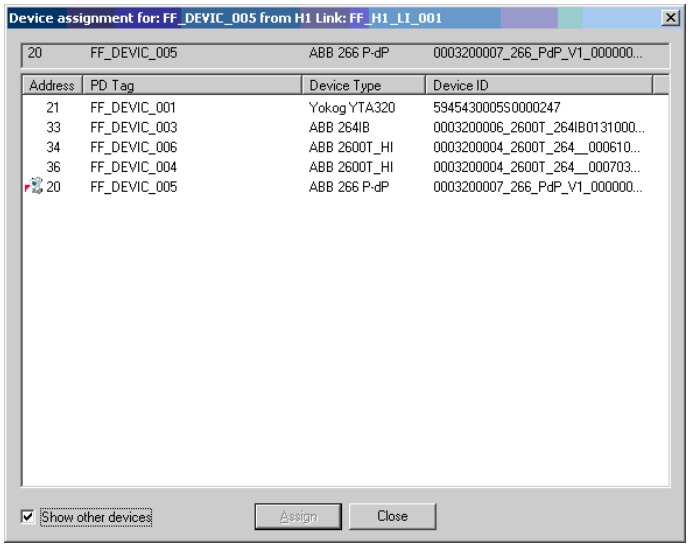
The current configuration of the device appears in the top of the “Device Assignment for: xxxxx” where, in the grey field is shown the configured/desired settings of the device to be commissioned in term of Address, TAG, Device Type and Device_ID, while in the white field are listed all the devices in the live list with their real settings.
Select the new device to be commissioned/assigned with the mouse and press “Assign”.



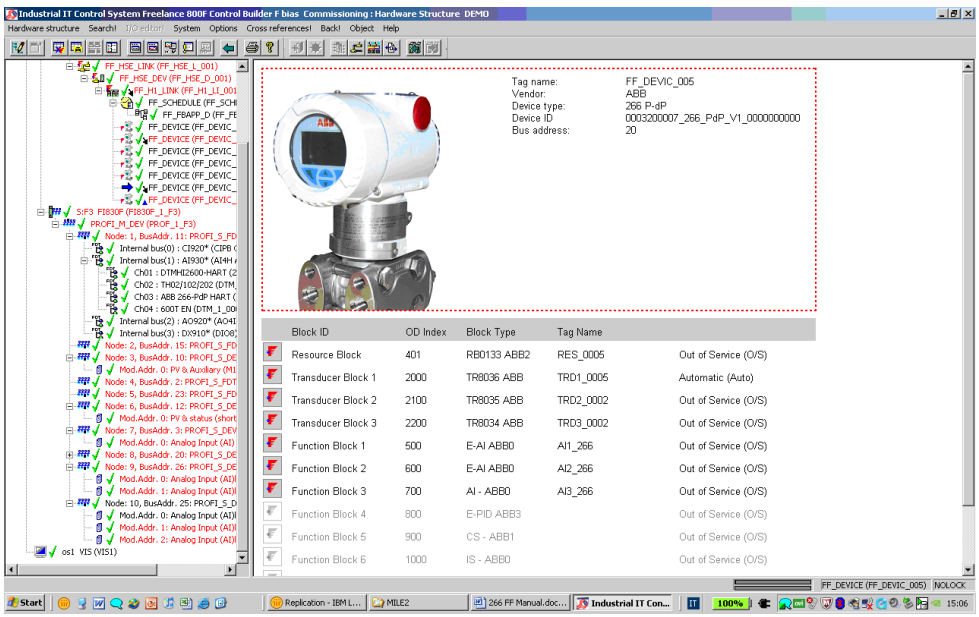
The Assignment get start and step by step it changes the device Address, and TAG as decided in the configuration….(What written in grey field of the“Device Assignment for: xxxxx” window above)



At the end the ABB 266 PdP is displayed with its new setting. In this example the address has been changed from 30 to 20 and the TAG from PI000 to FF_DEVICE_005.

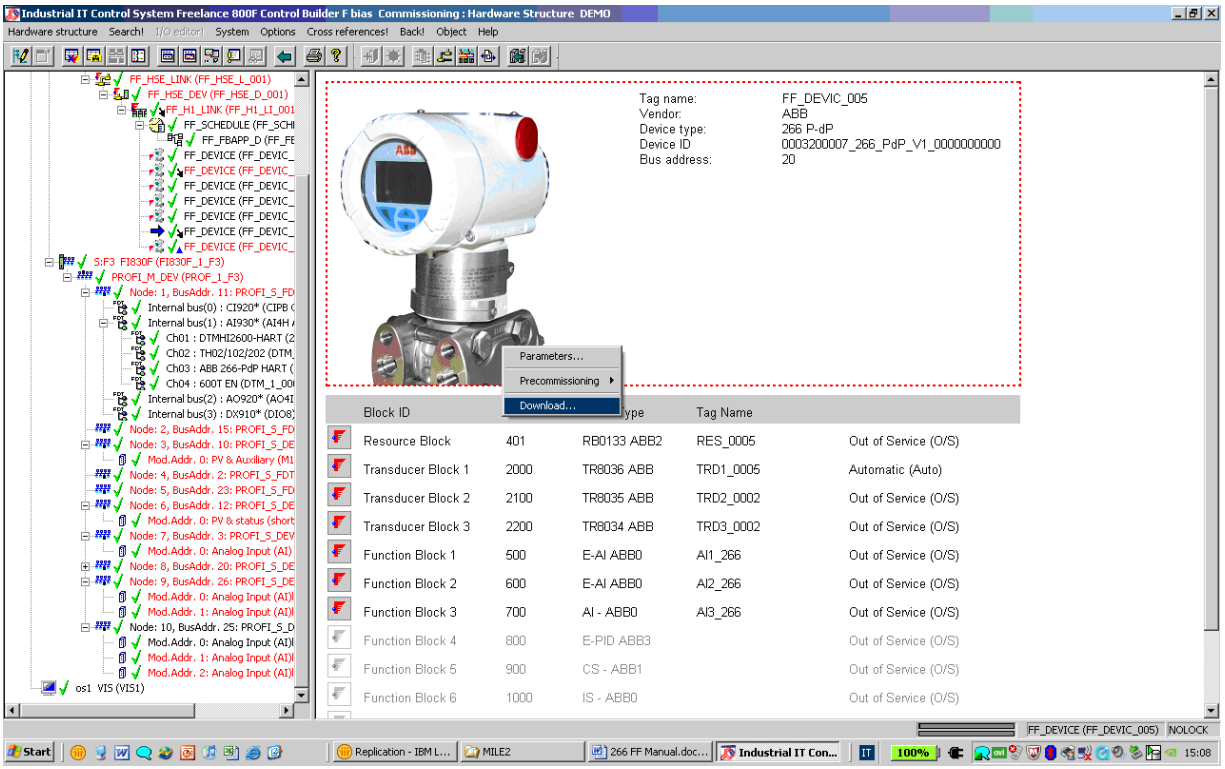


The device appears now alive in the Host, with all the blocks in Out of Service.

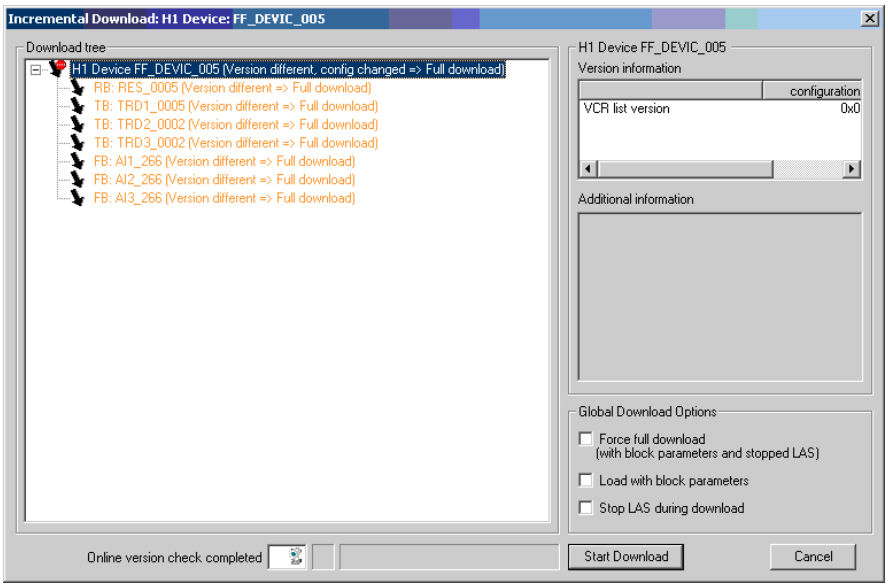


Downloading of the FBAP into the H1 network and devices

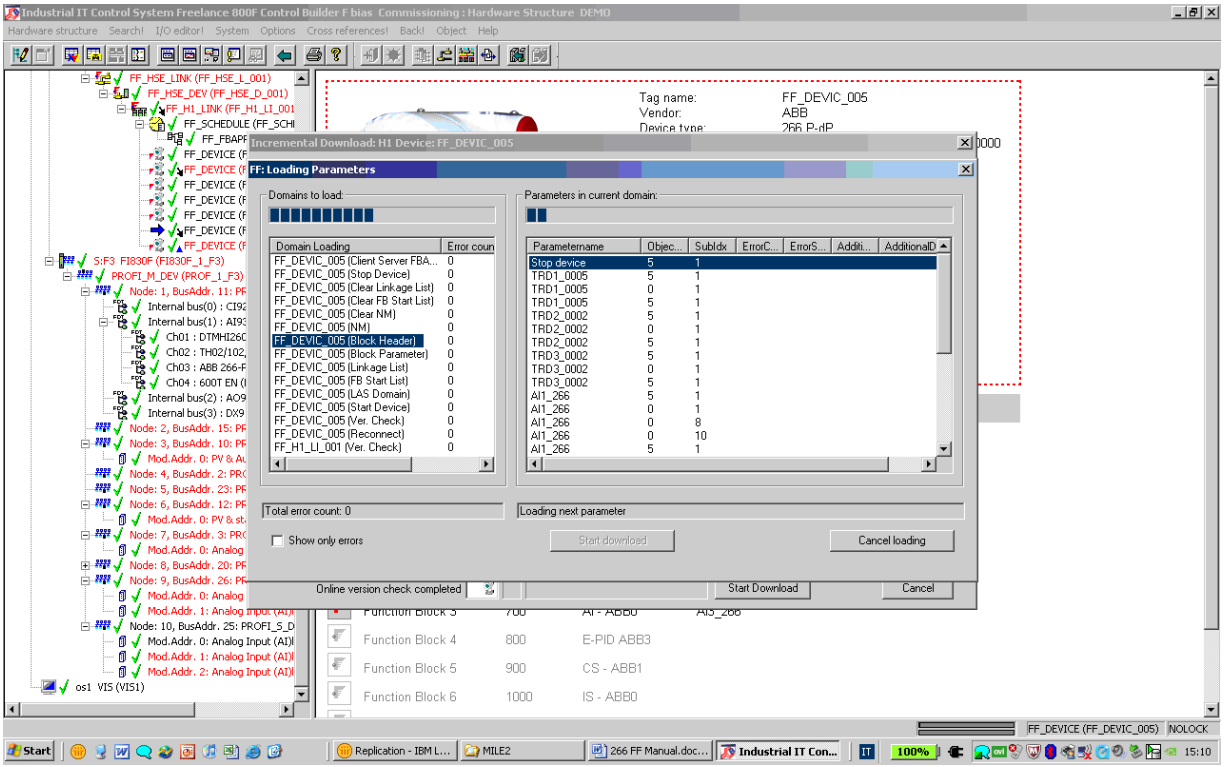
With the right mouse click select “Download”



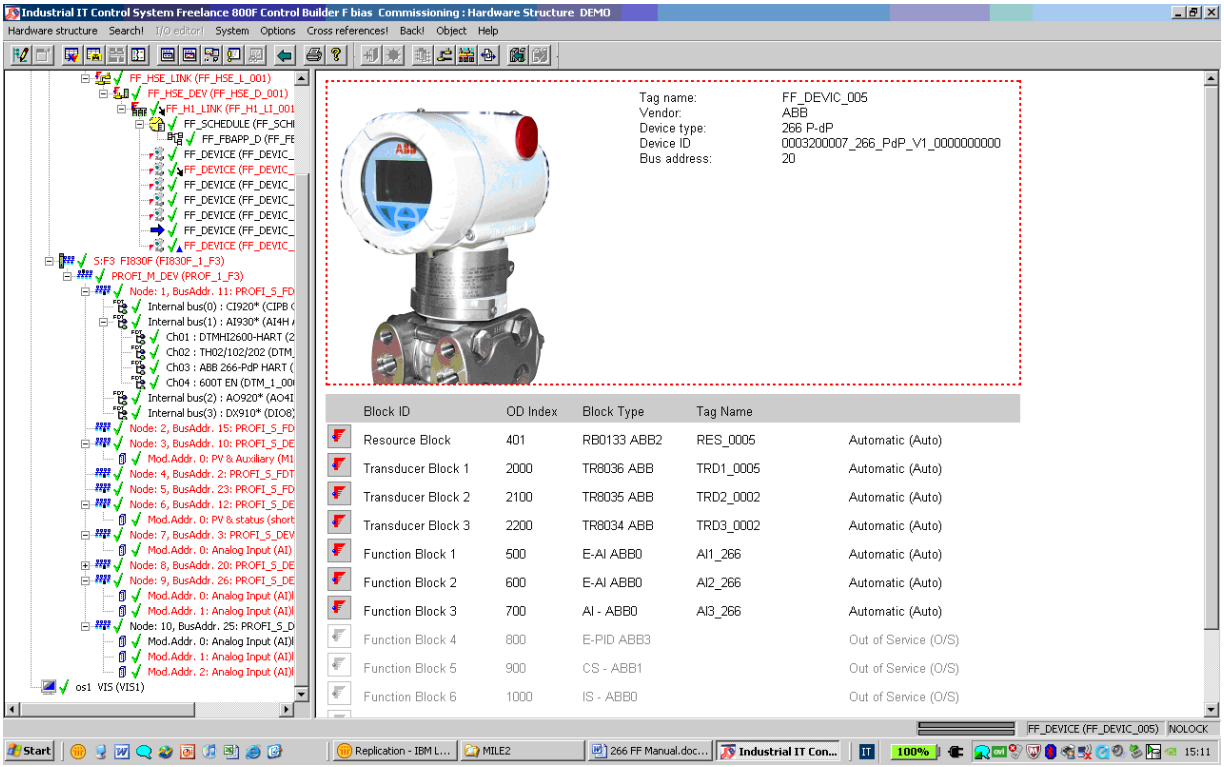
The “Incremental Download” window is open and press “Start Download”.



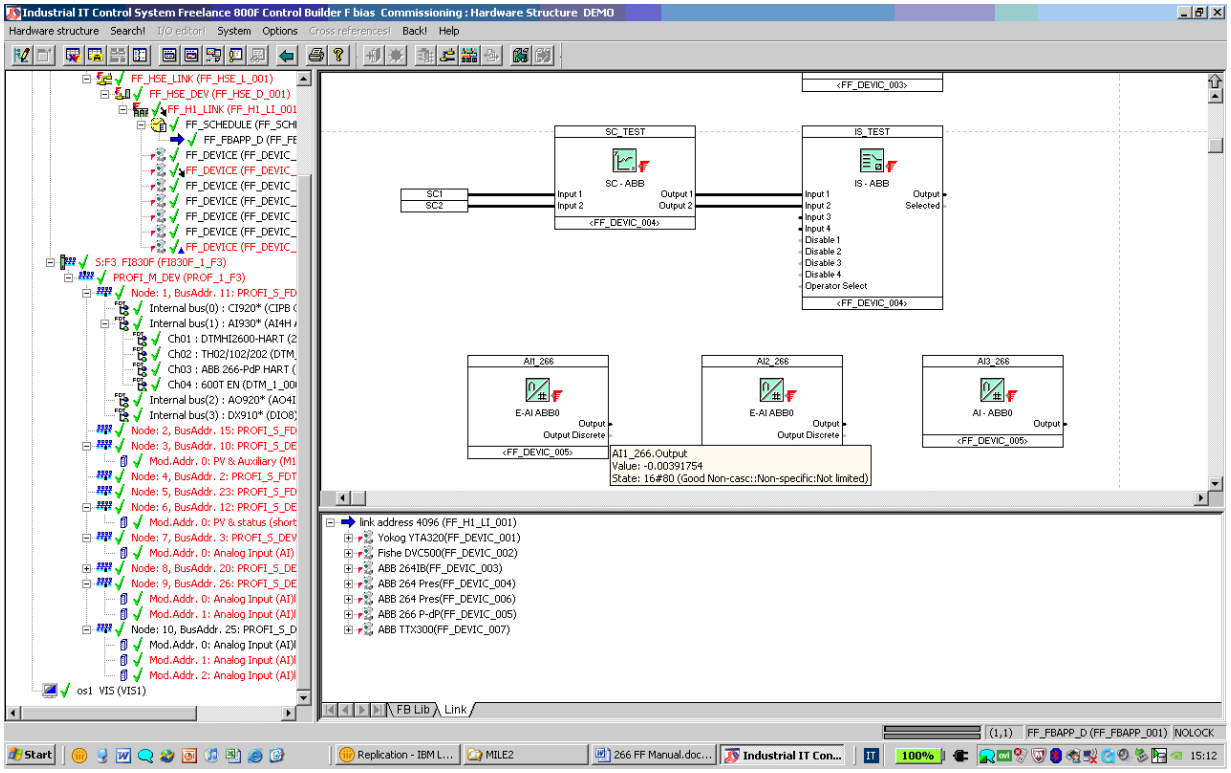
The Parameter downloading gets start and at the end.....



.....the transmitter's blocks used in the FBAP are moved in the AUTO or their Normal Mode.

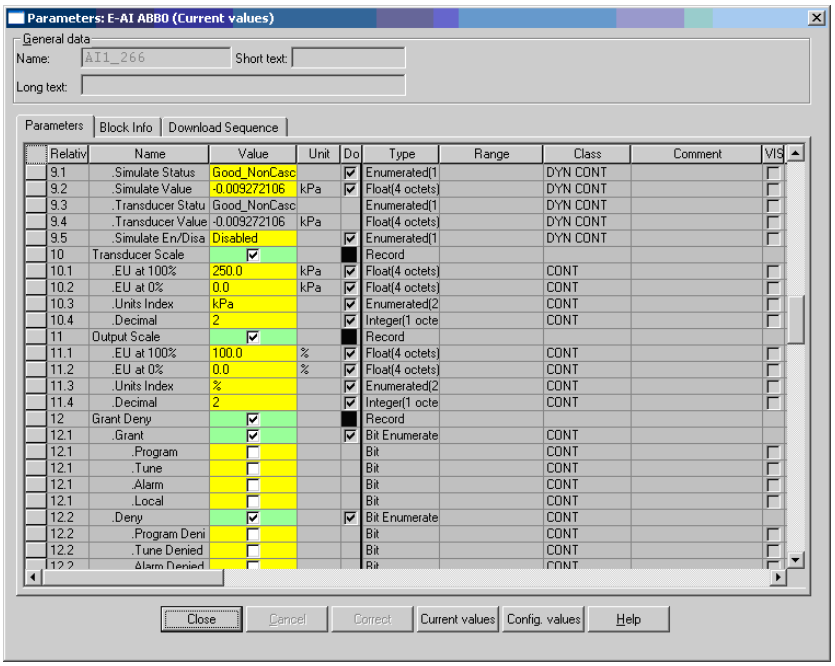


.....and the Function Blocks start to work normally. In the example below the 266 PdP Analog Input block produces the measured pressure value in output

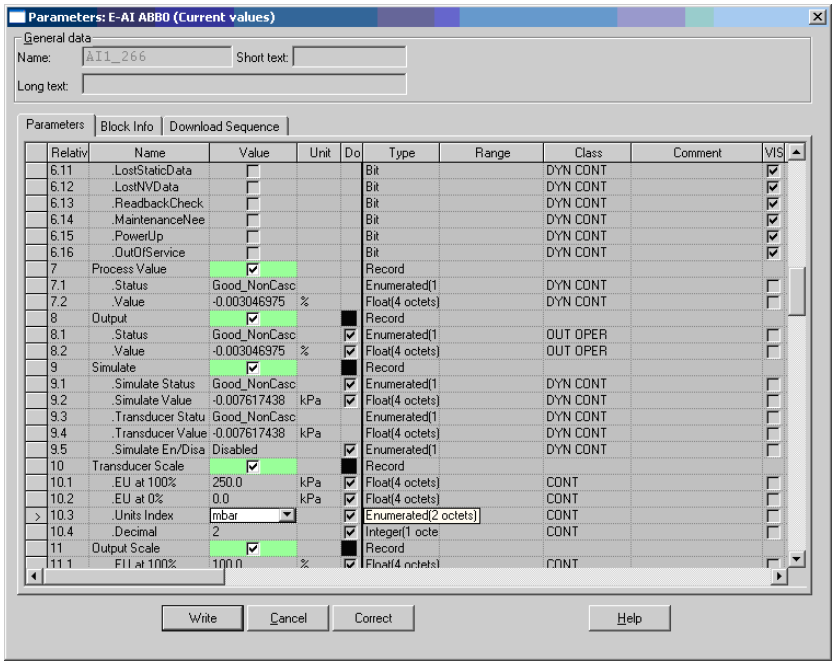


Device and/or Blocks configuration

Whenever the 266 PdP is in this condition, it is then possible open any of the used blocks for read/write operations.
A double right mouse click, when the cursor is over the desired block, open it and the contained variables are read and shown.



Then variables in white or yellow fields can be changed and written in the device pressing the buttons “Write” or “Correct”. The “Write” button change only the actual values The “Correct” button change both the actual values than the configuration values



12 Maintenance

If transmitters are used as intended under normal operating conditions, no maintenance is required. It is sufficient to check the output signal at regular intervals (in accordance with the operating conditions), as described in the instructions in the section “Operation resp. Configuration of the transmitter”. If deposits are expected to accumulate, the measuring equipment should be cleaned on a regular basis, in accordance with the operating conditions. Cleaning should ideally be carried out in a workshop. Repair and maintenance activities may only be performed by authorized customer service personnel. When replacing or repairing individual components, original spare parts must be used.

⚠ CAUTION

Potential damage to parts. The electronic components of the printed circuit board can be damaged by static electricity (observe ESD guidelines). Make sure that the static electricity in your body is discharged when touching electronic components. If a remote seal is mounted on the measuring equipment, it must not be removed (please refer to the dedicated section).

⚠ WARNING - BODILY INJURY

Explosion-proof transmitters must be either repaired by the manufacturer or approved by a certified expert following repair work Observe the relevant safety precautions before, during and after repair work. Only disassemble the transmitter to the extent necessary for cleaning, inspection, repairs, and replacement of damaged components.

Returns and removal

Defective transmitters sent to the repairs department must, wherever possible, be accompanied by your own description of the fault and its underlying cause.

⚠ WARNING - GENERAL RISKS

Before removing or disassembling the device, check for hazardous process conditions such as pressure on the device, high temperatures, aggressive or toxic media, and so on. Read the instructions in the sections “Safety” and “Electrical connection”, and perform the steps outlined there in reverse order.

Pressure transmitter sensor

Essentially maintenance is not required for the transmitter sensor. Anyway the following items should be checked periodically:

- Check the integrity of the pressure boundary (no cracks should be visible on the process connection or on the process flanges.
- Check that there is no leakage from the sensor/flange interface or from the vent/drain valves.
- The process flanges bolts (for 266DS/MS/PS/VS/RS models) should not show excessive rust.
- In case one of the check points above fails, please replace the damaged part with an original spare part.

Please contact your local ABB office for spare parts support information or refer to the spare part list.
The use of non original spare parts makes the warranty void.
In case you want ABB to perform the repair, please send back the transmitter to your local ABB office complete with the return form that you find at the end of this manual and include it with the device.

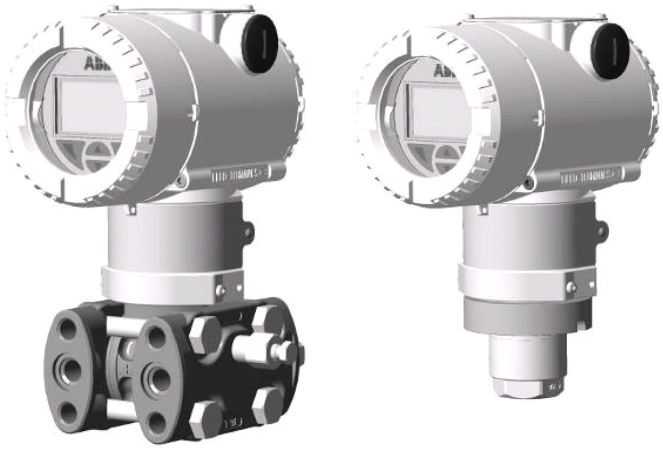


Figure 50: DP and P style pressure transmitter construction

Removing/Installing the process flanges

- Slacken the process flange screws by working on each in a crosswise manner (hexagon head, SW 17 mm (0.67 inch) for 266DS/266PS/266VS or SW 13 mm (0.51 inch) for 266MS/266RS).
- Carefully remove the process flange, making sure that the isolating diaphragms are not damaged in the process.
- Use a soft brush and a suitable solvent to clean the isolating diaphragms and - if necessary - the process flange.
- Insert the new process flange O-rings in the process flange.
- Attach the process flange to the measuring cell. The surfaces of both process flanges must be at the same level and at a right angle to the electronics housing (with the exception of vertical process flanges).
- Check that the process flange screw thread can move freely: Manually turn the nut until it reaches the screw head. If this is not possible, use new screws and nuts.
- Lubricate the screw thread and seats of the screw connection.
- While performing the preliminary and final tightening of the bolts, please act in a crosswise manner.

• Respect the below table indications for reinstalling the process flanges:

Transmitter model and range			Procedure
266DSH / PSH / VSH	Viton Gaskets	All bolting	Use a torque wrench to tighten the bolts to a torque of 25 Nm.
	PTFE Gaskets	Carbon Steel NACE and Stainless Steel	Use a torque wrench to tighten the process flange nuts to a torque of 40 Nm, let the flange stabilize for an hour, unscrew the nuts and tighten again to 25 Nm.
		Stainless Steel NACE	Use a torque wrench to tighten the process flange nuts to a torque of 25 Nm, let the flange stabilize for an hour and perform the final tightening to 25 Nm.
266DSH.x.H (High static option)	Viton Gaskets	All bolting	Use a torque wrench to tighten the bolts to a torque of 31 Nm.
	PTFE Gaskets	All bolting	Use a torque wrench to tighten the process flange nuts to a torque of 40 Nm, let the flange stabilize for an hour, unscrew the nuts and tighten again to 31 Nm.
266DSH range A (1KPa)	All gaskets	All bolting	Use a torque wrench to tighten the process flange screws/nuts to a torque of 14 Nm. Please be aware that in case of bottom work disassembly and reassembly the original performances can not be guarantee anymore.
266DSH / 266PSH with Kynar inserts	All gaskets	All bolting	Use a torque wrench to tighten the process flange screws/nuts to a torque of 15 Nm.
266MSx / 266RSx	All gaskets	All bolting	First, use a torque wrench to tighten the process flange screws/nuts to a joining torque of • MJ = 2 Nm (0.2 kpm), working in a crosswise manner. • Then tighten them with a torque MJ = 10 Nm (1.0 kpm), working in a crosswise manner • Then tighten them fully by turning each nut or screw again (in a crosswise manner) by the tightening angle A = 180°, working in two stages of 90° each. Some transmitter versions are using screws with size M10. If this screws are used the tightening angle A = 270°, working in three stages of 90° each.

Pressure transducer replacement

If the pressure transducer needs to be replaced proceed as follows:

1 Insulate the transmitter from the process by acting on the manifolds or on the insulation valves

2 Open the vent valves to allow sensor depressurization

3 Disconnect the power supply and disconnect the wiring to the transmitter

4 Disconnect the transmitter from its bracket by loosing on the fixing bolts.

5 You should now open the communication board housing compartment cover.

6 The communication board is connected to the sensor via a flat cable and a connector. Remove the communication board by releasing the two fixing screws and gently disconnect the connector from the communication board.

7 The transmitter housing needs now to be disconnected from the pressure transducer. To accomplish such operation, it is necessary to release the tang screw until you will be able to rotate easily the housing.

8 Continue to rotate the electronic housing counterclockwise until its complete removal.

9 Unscrew the fixing bolts from the transducer and remove the process flanges.

10 The orings placed between the diaphragm and the flange (Viton or PTFE) must be replaced after every disassembly.

11 Reassemble the flanges following the steps above in reverse order.

12 The 266 can reconfigure itself with the previous configured parameters thanks to the auto-configuration functionality.

13 Before powering on the transmitter raise dip-switches 1 and 2 in up position. Connect the transmitter to power supply, wait ten seconds and lower dip-switched 1 and 2 .

14 A PV zero bias operation is recommended to align the zero to the installation. This operation should be accomplished after the transmitter has been installed back to its bracket and connected to the manifold. See “Correcting the lower range value / zero shift”.

13 Hazardous Area considerations

Ex Safety aspects and IP Protection (Europe)

According to ATEX Directive (European Directive 2014/34/EU and relative European Standards which can assure compliance with Essential Safety Requirements, i.e., EN 60079-0 (General requirements) EN 60079-1 (Flameproof enclosures “d”), EN 60079-11 (Equipment protection by intrinsic safety “i”), the pressure transmitters of the 2600T SERIES have been certified for the following group, categories, media of dangerous atmosphere, temperature classes, types of protection. Examples of application are also shown below by simple sketches.

a) Certificate ATEX II 1 G Ex ia IIC T4/T5/T6 Ga - FISCO FM Approvals certificate number FM09ATEX0024X (Tremezzina, Warminster, Bangalore and Shanghai products)
The meaning of ATEX code is as follows:

- II : Group for surface areas (not mines)
- 1 : Category
- G : Gas (dangerous media)
- D: Dust (dangerous media)
- T85°C: Maximum surface temperature of the transmitter enclosure with a Ta (ambient temperature) +40°C for Dust (not Gas) with a dust layer up to 50 mm depth.

Certificate IECEx Ex ia IIC T4/T5/T6 Ga/Gb and Ex ia IIIC T85°C Da - FISCO IECEx certificate number IECEx FME 16.0003X (Tremezzina, Warminster, Bangalore, Shanghai products).

IMPORTANT

The number close to the CE marking of the transmitter safety label identifies the Notified Body which has responsibility for the surveillance of the production.

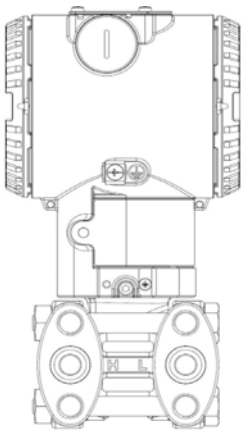
The other marking refers to the protection type used according to relevant EN standards:

- Ex ia: Intrinsic safety, protection level “a”
- IIC: Gas group
- T4: Temperature class of the transmitter (corresponding to 135°C max) with a Ta from -50°C to +85°C
- T5: Temperature class of the transmitter (corresponding to 100°C max) with a Ta from -50°C to +40°C
- T6: Temperature class of the transmitter (corresponding to 85°C max) with a Ta from -50°C to +40°C

About the applications, this transmitter can be used in “Zone 0” (Gas) and “Zone 20” (Dust) classified areas (continuous hazard) as it is shown on the following sketches.

Application for pressure transmitter Ex ia categories 1 Ga and 1 Da

Application with Gas

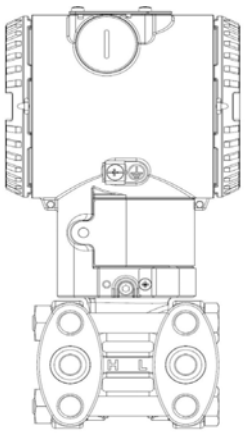


Zone 0

266 Tx Category 1 G Ex ia

Note: the transmitter must be connected to a supply (associated apparatus) certified [Ex ia]

Application with Dust



Zone 20

266 Tx Category 1 DIP6x Ex ia

Note: the protection is mainly assured by the “IP” degree associated to the low power from supply. This can either be [ia] or [ib] certified [Ex ia]

b) Certificate ATEX II 1/2 G Ex ia IIC T4/T5/T6 Ga/Gb and II 1/2 D Ex ia IIIC T85°C Da - FISCO
FM Approvals certificate number FM09ATEX0024X (Tremezzina, Warminster, Bangalore and Shanghai products)
The meaning of ATEX code is as follows:

- II: Group for surface areas (not mines)
- 1/2: Category - It means that only a part of the transmitter complies with category 1 and a second part complies with category 2 (see next application sketch).
- G: Gas (dangerous media)
- D: Dust (dangerous media)
- T85°C: Maximum surface temperature of the transmitter enclosure with a Ta from -50°C to +40°C for Dust (not Gas) with a dust layer up to 50 mm depth. T85°C: as before for Dust for a Ta +85°C..

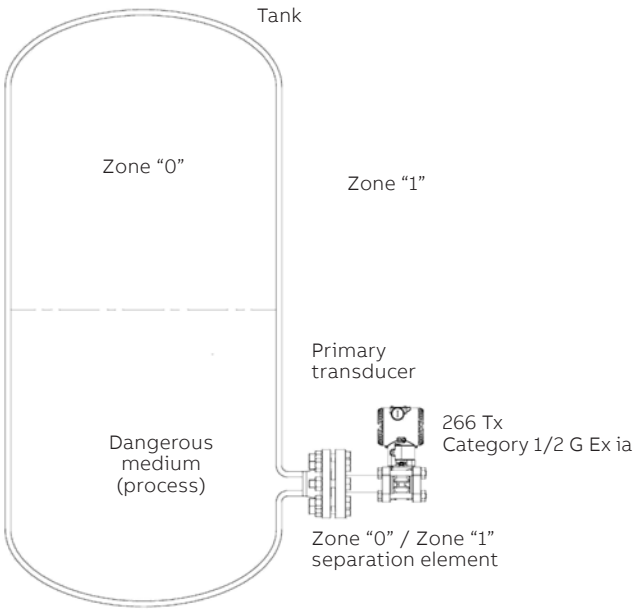
Certificate IECEx Ex ia IIC T4/T5/T6 Ga/Gb and Ex ia IIIC T85°C Da - FISCO
IECEx certificate number IECEx FME 16.0003X (Tremezzina, Warminster, Bangalore, Shanghai products)
The other marking refers to the protection type used according to relevant EN standards:

- Ex ia: Intrinsic safety, protection level “a”
- IIC: Gas group
- T4: Temperature class of the transmitter (corresponding to 135°C max) with a Ta from -50°C to +85°C
- T5: Temperature class of the transmitter (corresponding to 100°C max) with a Ta from -50°C to +40°C
- T6: Temperature class of the transmitter (corresponding to 85°C max) with a Ta from -50°C to +40°C

About the applications, this transmitter can be used in Zone “0” (Gas) classified areas (continuous hazard) with its “process part” only, whereas the remaining part of the transmitter, i.e. its enclosure, can be used in Zone 1 (Gas), only (see sketch below). Reason of this is the process part of the transmitter (normally called primary transducer) that provides inside separation elements to seal off the electrical sensor from the continuously hazardous process, according to the EN 60079-1.
About Dust application, the transmitter is suitable for “Zone 21” according to the EN 60079-0 and EN 60079-11 as it is shown on the relevant part of the sketches.

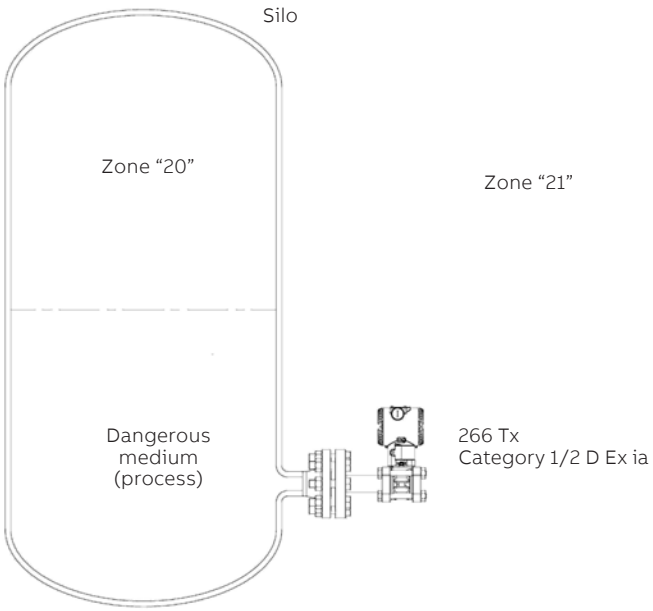
Application for pressure transmitter Ex ia categories 1/2 Ga and 1/2 Da

Application with Gas



Note: the transmitter can be connected to either [ib] or [ia] supply (associated apparatus)certified [Ex ia]
Note for “Primary transducer”: see the certification for exceptions

Application with Dust



Note: the protection is mainly assured by the “IP” degree associated to the low power from supply. This can either be [ia] or [ib]

c) Certificate ATEX II 1/2 G Ex db IIC T6 Ga/Gb and II 1/2 D Ex tb IIIC T85°C Db, Ta = -50°C to +75ºC
FM Approvals Certificate number FM09ATEX0023X (Tremezzina, Warminster, Bangalore and Shanghai products)
The meaning of ATEX code is as follows:

- II: Group for surface areas (not mines)
- 1/2: Category - It means that only a part of the transmitter complies with category 1 and a second part complies with category 2 (see next application sketch).
- G: Gas (dangerous media)
- D: Dust (dangerous media)
- T85°C: Maximum surface temperature of the transmitter enclosure with a Ta (ambient temperature) +75°C for Dust (not Gas) with a dust layer up to 50 mm depth.

IMPORTANT

The number close to the CE marking of the transmitter safety label identifies the Notified Body which has responsibility for the surveillance of the production.

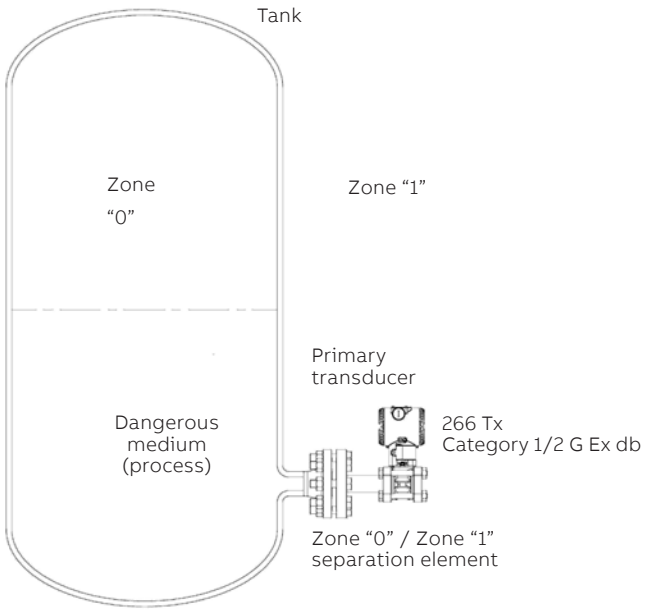
Certificate IIECEx Ex db IIC T6 Ga/Gb and Ex tb IIIC T85°C Db, Ta= -50°C to +75°C
IECEx certificate number IECEx FME 16.0002X (Tremezzina, Warminster, Bangalore and Shanghai products)
The other marking refers to the protection type used according to relevant EN Standards:

- Ex d: Explosion proof
- IIC: Gas group
- T6: Temperature class of the transmitter (corresponding to 85°C max) with a Ta from -50°C to +75°C

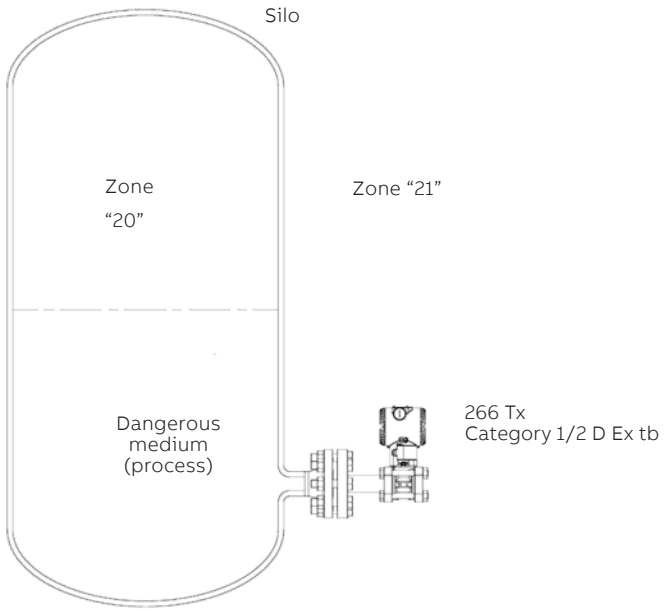
About the applications, this transmitter can be used in Zone “0” (Gas) classified areas (continuous hazard) with its “process part” only, whereas the remaining part of the transmitter, i.e. its enclosure, can be used in Zone 1 (Gas), only (see sketch below). Reason of this is the process part of the transmitter (normally called primary transducer) that provides inside separation elements to seal off the electrical sensor from the continuously hazardous process, according to the EN 60079-1.
About Dust application, the transmitter is suitable for “Zone 21” according to the EN 60079-1 as it is shown on the relevant part of the sketches.

Application for pressure transmitter Ex d categories 1/2 G and 1/2 D

Application with Gas



Application with Dust



IP code

About the degree of protection provided by the enclosure of the pressure transmitter, the 2600T SERIES has been certified IP66 and IP67 according to EN 60529 standard. The first characteristic numeral indicates the protection of the inside electronics against ingress of solid foreign objects including dusts.
The assigned “6” means an enclosure dust-tight (no ingress of dust).
The second characteristic numeral indicates the protection of the inside electronics against ingress of water.
The assigned “6” means an enclosure water-protected against powerful jets projected in powerful jets towards the enclosure from any direction.
The assigned “7” means an enclosure water-protected against a temporary immersion in water under standardized conditions of pressure and time.

d) Certificate ATEX II 3 G Ex ic IIC T4/T5/T6 Gc and
II 3 D Ex tc IIIC T85°C Dc, Ta = -50°C to +75°C
FM Approvals Certificate number FM09ATEX0025X
(Tremezzina, Warminster, Bangalore and Shanghai products)
The meaning of Atex code is as follows :

- II: Group for surface areas (not mines)
- 3: Category of equipment
- G: Gas (dangerous media)
- D: Dust (dangerous media)
- T85°C: Maximum surface temperature of the transmitter enclosure with a Ta from -50°C to +40°C for Dust (not Gas).

IMPORTANT

It is the technical support for the ABB Declaration of Conformity.

IMPORTANT

When installed this transmitter must be supplied by a voltage limiting device which will prevent the rated voltage of 32 V d.c. being exceeded.

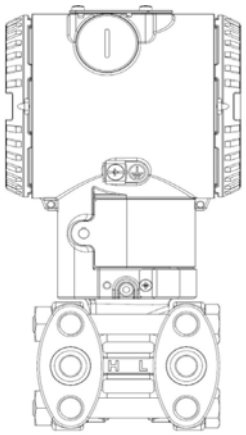
Certificate IECEx Ex ic IIC T4/T5/T6 Gc and
Ex tc IIIC T85°C Dc, Ta = -50°C to +75°C
IECEx certificate number IECEx FME 16.0004X (Tremezzina, Warminster, Bangalore and Shanghai products)
The other marking refers to the protection type used according to relevant EN standards:

- Ex ic: Intrinsic safety, protection level “c”
- IIC: gas group
- T4: Temperature class of the transmitter (which corresponds to 135°C max) with a Ta from -50°C to +85°C
- T5: Temperature class of the transmitter (which corresponds to 100°C max) with a Ta from -50°C to +40°C
- T6: Temperature class of the transmitter (which corresponds to 85°C max) with a Ta from -50°C to +40°C
- Ex tc: type of protection “tc” means protection by enclosure technique

About the applications, this transmitter can be used in Zone 2 (Gas) and in Zone 22 (Dust) (unlikely/infrequent hazard) as it shown on the following sketches..

Application for pressure transmitter Ex ic categories 3 Gc and 3 Dc

Application with Gas

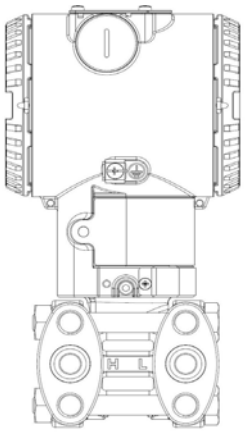


Zone 2

266 Tx Category 3 G Ex ic

Note: the transmitter must be connected to a supply with 32 V d.c. max output voltage as above indicated.

Application with Dust



Zone 22

266 Tx Category 3 D IP6x Ex tc

Note: the protection is mainly assured by the “IP” degree associated to the low power from supply.

IMPORTANT

Note for pressure transmitter with combined approval. Before installation of the Transmitter, the customer should permanently mark his chosen Protection Concept on the safety label. The transmitter can only be used with according to this Protection Concept for the whole life. If two or more types of protection box (on safety label) are permanent marked, the pressure transmitter must be removed from hazardous classified locations. The selected Type of Protection is allowed to be changed only by manufacturer after a new satisfactory assessment.

Electrical parameters (entities)

As consequence of the operations described in the apposite section, when the Z or S buttons are released, the feedback of the executed operation is displayed in the bottom of the LCD see the example below with one of the following strings:

FF Version with or without LCD option

Ui= 24 Vdc Ii= 250 mA Pi= 1.2 W Ci= 5nF Li= 10 uH

Temperature	Temperature	Minimum	Maximum amb. °C	
Class - Gas	Class - Dust	amb. °C	option L1	option L5
T4	T135 °C	-50 °C	+85 °C	+60 °C
T5	T100 °C	-50 °C	+40 °C	+56 °C
T6	T85 °C	-50 °C	+40 °C	+44 °C

FISCO Version with or without LCD option

Ui= 17.5 Vdc Ii= 380 mA Pi= 5.32 W Ci= 5nF Li= 10 uH

Temperature	Temperature	Minimum	Maximum amb. °C	
Class - Gas	Class - Dust	amb. °C	option L1	option L5
T4	T135 °C	-50 °C	+85 °C	+60 °C
T5	T100 °C	-50 °C	+40 °C	+56 °C
T6	T85 °C	-50 °C	+40 °C	+44 °C

Ex Safety aspects and IP Protection (North America)

Applicable standards

According to FM Approvals Standards which can assure compliance with Essential Safety Requirements:

FM 3600:	Electrical Equipment for use in Hazardous (Classified) Locations, General Requirements.
FM 3610:	Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, III, Division 1, and Class I, Zone 0 & 1 Hazardous (Classified) Locations.
FM 3611:	Nonincendive Electrical Equipment for Use in Class I and II, Division 2 and Class III Division 1 and 2 Hazardous (Classified) Locations.
FM 3615:	Explosionproof Electrical Equipment.
FM 3810:	Electrical and Electronic Test, Measuring and Process Control Equipment.
NEMA 250:	Enclosure for Electrical Equipment (1000 Volts Maximum)

Classifications

The 2600T Series pressure transmitters have been certified by FM Approvals for the following Class, Divisions and Gas groups, hazardous classified locations, temperature class and types of protection.

- Explosionproof (US) for Class I, Division 1, Groups A, B, C and D, hazardous (classified) locations.
- Explosionproof (Canada) for Class I, Division 1, Groups B, C and D; T5, hazardous (classified) locations.
- Flameproof (US): Class I, Zone 1 AEx d IIC T4 Gb, hazardous (classified) locations.
- Flameproof (Canada): Class I, Zone 1 Ex d IIC T4 Gb, hazardous (classified) locations.
- Dust Ignition proof for Class II, Division 1, Groups E, F, G, Class III Division 1; T5, hazardous (classified) locations.
- NonIncendive for Class I, Division 2, Groups A, B, C and D, in accordance with Nonincendive field wiring requirements for hazardous (classified) locations.
- Energy limited (US): Class I, Zone 2 AEx nC IIC T6...T4, in accordance with Nonincendive field wiring requirements for hazardous (classified) locations.
- Energy limited (Canada): Class I, Zone 2 Ex nC IIC T6...T4, in accordance with Nonincendive field wiring requirements for hazardous (classified) locations.
- Intrinsically Safe for use in Class I, II and III, Division 1, Groups A, B, C, D, E, F, and G,
  Class I, Zone 0 AEx ia IIC T6...T4 (US)
  Class I, Zone 0 Ex ia IIC T6...T4 (Canada)
  in accordance with Entity requirements for hazardous (classified) locations.
- Temperature class T4 to T6 (dependent on the maximum input current and the maximum ambient temperature).
- Ambient Temperature range -40°C to +85°C (dependent on the maximum input current and the maximum temperature class).
- Electrical Supply range Minimum Volts, Maximum 32 Volts (dependent on the type of protection, maximum ambient temperature, maximum temperature class and communication protocol).
- Type 4X, IP66, IP67 applications Indoors/Outdoors.

For a correct installation in field of 2600T Series pressure transmitters please see the related control drawing.
Note that the associated apparatus must be FM approved.

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