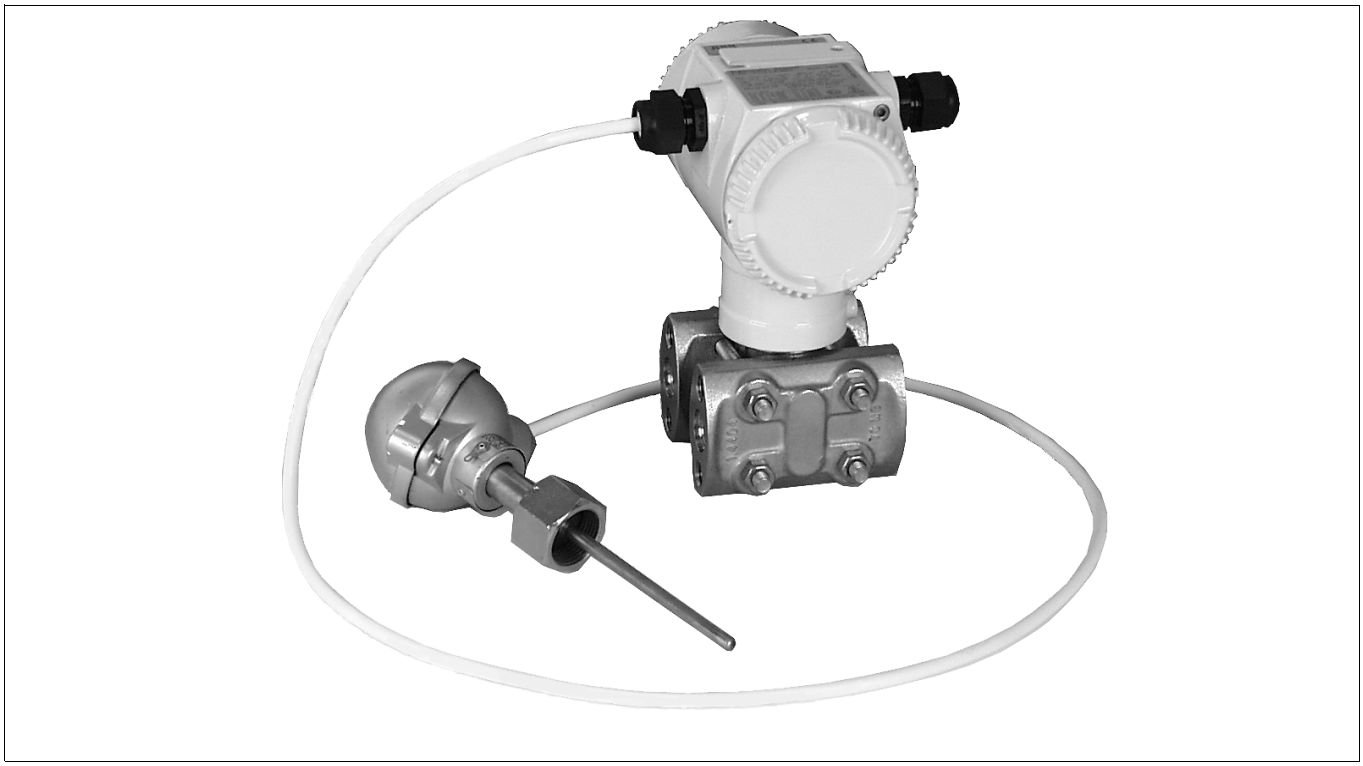
Multi Vision™
Multivariable Transmitter

2010TC for Differential Pressure, Pressure and Process Temperature (Mass Flow)

42/15-714-3 EN

Instructions



Contents

1 Safety

General safety precautions and health protection

To ensure safe operation of the 2010TC Transmitter, the following instructions have to be observed:

Please read these instructions / operating manual carefully prior to assembly and commissioning!

For reasons of clarity, the instructions do not contain all details on all types of product and do therefore not take into account every conceivable case of assembly, operation or maintenance. If you want further information or if special problems arise which are not treated in detail in the instructions, please ask the manufacturer for the necessary information.
Moreover we would like to point out that the content of these instructions is neither part of nor provided for changing a previous or existing agreement, promise or legal relationship.
All obligations of ABB Automation Products GmbH result from the respective sales contract which also comprises the complete and solely valid warranty clauses. Such contractual warranty clauses will neither be limited nor extended by the content of these instructions.

Observe warning signs at packaging, etc.!

For assembly, electrical connection, commissioning and maintenance of the transmitter, only qualified and authorized specialists are to be employed.
Qualified specialists are persons who are experienced in the assembly, electrical connection, commissioning and operation of the transmitter or similar devices holding the necessary qualifications for their job, e.g.:

- Training or instruction and / or authorization to operate and maintain devices / systems according to the safety engineering standard for electric circuits, high pressures and aggressive media.
- Training or instruction according to the safety engineering standard regarding maintenance and use of adequate safety systems.

For the sake of your own safety, we draw your attention to the fact that for the electrical connection, only sufficiently isolated tools acc. to DIN EN 60 900 may be used.

- Zurthermore, the pertinent safety regulations concerning the-construction and operation of electrical installations, e.g. the rule regarding technical working material §3 (safety rule for instruments), have to be observed.
- The pertinent standards, e.g. DIN 31 000 / VDE 1000.
- The regulations and recommendations relating to explosion protection if explosion-proof transmitters are to be installed.
- The device can be operated with high pressure and aggressive media.

Serious injury and / or considerable material damage can therefore be caused when this device is handled incorrectly.

- The regulations, standards, recommendations and rules mentioned in these instructions are valid in Germany. When using the transmitter in other countries, the pertinent national rule-shave to be observed.

Correct usage

The 2010TC Transmitter measures accurately and simultaneously the differential pressure (effective pressure), the static pressure and, with a Pt100 in four-wire technique, the process temperature of aggressive and non-aggressive gases, vapors and liquids. The measuring ranges are graduated from 10 mbar to 20 bar, each for the nominal pressure stages PN 20, PN 100 and PN 410. The transmitter can be overloaded on one side up to the relevant nominal pressure.

2 Transport and Storage

After unpacking the transmitter, check the device for transport damage. Check the packing material for accessories. During the intermediate storage / transport, store and transport the transmitter in the original packaging only. See section 11 "Technical Data" for permissible ambient conditions regarding storage and transport. The storage time is indefinite, however, the warranty conditions stipulated in the order confirmation of the supplier are valid.

3 General Description

The digital 2010TC Transmitter is a communicating field device with microprocessor-controlled electronic in multi-sensor technology for multivariable applications.

For bi-directional communication, an FSK signal according to the HART® Protocol is overlaid to transmitters with 4 ... 20 mA output signal whereas, in case of fully digital transmitters, communication is effected via the fieldbus protocols PROFIBUS-PA or FOUNDATION Fieldbus, depending on the model.
The communication software SMART VISION® allows PC-based configuration, scanning and testing of transmitters according to the respective protocol. Communication is also possible by means of a handheld terminal provided that the transmitters are working according to the HART® protocol.
For "local" operation, a control unit is optionally available which can also be retrofitted. The control unit consists of two keys for the adjustment of zero and span and a write protect key (except for devices with FOUNDATION Fieldbus Protocol). In conjunction with an installed LCD indicator, a complete external configuration and parameter setting of the transmitter is possible via the "local control unit", irrespective of the selected communication protocol.
As standard, the amplifier housing has a coat of varnish resistant to aggressive atmosphere; the process connection is made of stainless steel or Hastelloy C. The housing cover and the push button unit can be sealed.
The relevant transmitter data, such as transmitter type, communication, wetted parts material (O-ring, separating diaphragm or measuring diaphragm), measuring range, min. span, operating voltage, output signal, adjusted span and serial number (F.-No.) are to be found on the type plate. **In case of inquiries, please always indicate this number which is valid worldwide!**
For explosion-proof transmitters, the explosion protection type is described on a separate plate.
Another separate plate in front of the "local" control unit shows the functions of the three control elements by means of readily comprehensible symbols. Additionally, a tie-on plate indicating the measuring point identification may be attached (optional).

Principle of operation and construction

The transmitter has a modular design and consists of the differential pressure sensor module with an integrated electronic matching unit and an amplifier with control unit as well as an input for a Pt100 resistance thermometer in four-wire technique for process temperature.
The completely welded sensor body is a twin-chamber system with an integral overload diaphragm, an internal silicon absolute pressure sensor and a silicon differential pressure sensor. The absolute pressure sensor, which is only exposed to the pressure at the high pressure side (⊕), acts as a reference value to compensate for the static pressure. The differential pressure sensor is connected via a capillary tube to the negative side / reference vacuum of the sensor body. The applied differential pressure (dp) is transferred via the separating diaphragm and the fill fluid to the measuring diaphragm of the silicon differential pressure sensor.
A minimal deflection of the silicon diaphragm changes the output voltage of the pick-up system. This pressure-proportional output voltage is digitized by the electronic matching unit and fed to the electronic. The electronic linearizes and temperature compensates this signal before it is converted, together with the state variables dp, p and T, into a compensated electric signal proportional to mass flow. Apart from the mass flow (qm), the process variables dp, p, T and qv are also available for further processing.

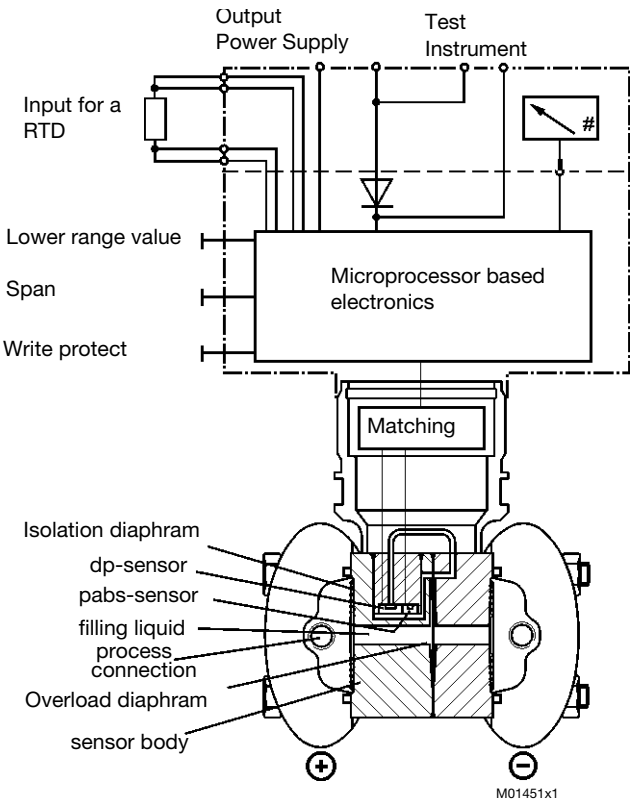


Figure 1. Transmitter 2010TC

Depending on the model, the transmitter is connected to the process by means of oval flanges with fastening threads according to DIN 19213 (M10 / M12) or 7/16-20 UNF, 1/4-18 NPT female thread or remote seal.
The transmitter operates with a 2-wire system. The same wires are used for the operating voltage (depending on the transmitter, see section 11 "Technical Data") and the output signal (4...20 mA or digital). The electrical connection is made via cable entry or plug.
In case of HART® devices , the output signal 4...20 mA can be measured at the "TEST" sockets without interrupting the signal circuit (not applicable in case of fieldbus devices!).
A fixing possibility is provided for a stainless steel tie-on plate indicating the measuring point identification.
Lower range value and upper range value can be set by means of "local" keys (optional, can be retrofitted) and, if required, the keys can be interlocked with the write protect switch (except for devices with FOUNDATION Fieldbus Protocol).
The transmitter may be equipped with an LCD indicator which can be read from the front (optional, can be retrofitted).
In conjunction with the LCD indicator, an external parameter setting and configuration of the most important transmitter functions / data is possible via the "local" control unit (see section 7 "Operation").

4 Mounting

General

Before mounting the transmitter, check whether the model meets the measurement and safety requirements of the measuring point, e.g., with regard to materials, pressure rating, temperature, explosion protection and operating voltage. The relevant recommendations, regulations, standards and the rules for prevention of accidents must also be observed! (e.g. VDE / VDI 3512, DIN 19210, VBG, Elex V, etc.)
Measurement accuracy is largely dependent upon correct installation of the transmitter and the related measurement piping. The measuring set-up should be screened as much as possible from critical ambient conditions such as major temperature variations, vibration and shock. If unfavorable ambient conditions cannot be avoided owing to reasons related to building structure, measuring requirements or other reasons, this may influence the measurement quality! (see section 11 "Technical Data").
If remote seals with capillary tubes are attached to the transmitter, see also the Instructions 42/15-813 EN.

Transmitter

The transmitter can be flanged directly to the shut-off armature. There is also a mounting bracket for wall or pipe mounting (2" pipe) available as an accessory.
The transmitter has to be mounted in such a way that the process flange axes are vertical (horizontal in case of barrel-type amplifier housing) in order to avoid zero shifts. If the transmitter were installed inclined, the hydrostatic pressure of the filling fluid would exert pressure on the measuring diaphragm and thus cause a zero shift! A zero point correction would then be necessary.
Various versions are available for connecting the measurement piping. Unconnected process connections on the sensor must be sealed with the enclosed screw plugs (1/4-18 NPT). For this purpose, use your officially approved sealing material. Please refer to section 12 "Dimensional Diagrams" for possible mounting with bracket.

Pressure / differential pressure measurement

(please also refer to VDE/VDI 3512 parts 1 and 3)

- For a liquid medium, as far as possible, the transmitter has to be attached below, but at least on the same height so that possibly arising gas can get back into the process.
- For a vapor medium, the transmitter has to be mounted below the sampling studs so that the measurement piping remains filled with condensate. Balancing vessels are not absolutely necessary, but vapor must not get into the measuring chambers of the sensor. Pay attention to equal liquid columns in both effective pressure lines above the transmitter.
- For small spans and vapor measuring medium, condensate vessels possibly have to be used.
- In case of using condensate vessels (vapor measurement), the equal height of the vessels in the effective pressure lines has to be observed.
- The transmitter can be connected directly onto the shut-off armature. There is also a mounting bracket for wall or pipe mounting (2" pipe) available as an accessory. The transmitter has to be mounted in such a way that the caps are vertical so as to avoid zero shifts. If the transmitter were installed inclined, the hydrostatic pressure of the filling fluid would exert pressure on the measuring diaphragm and thus cause a zero shift! A zero point correction would then be necessary.

Temperature measurement

(please also refer to VDE/VDI 3511)

- Resonance vibrations, e.g., by changing the immersion depth, have to be avoided.
- In case of a large temperature difference between measuring medium and ambience, the measurement error due to heat conduction has to be minimized by a suitable isolation of the mounting place.
- In pipelines with large diameter, important temperature differences arise which are kept in strands even over long distances. These temperature layers have to be prevented by sufficiently long mixing sections / whirl installations.
- Sensors of class "A" have to be used in order to achieve the maximum accuracy.
- The lengths of the protective tubes should be 15...20 times the protective tube diameters for gas measurements and / or 3...5 times for liquid measurements.
- Resistance thermometers are described in the Data Sheets: 10/10-3.22 to 10/10-3.24

Measurement piping

- The following points must be observed for correct installation:
- Keep the measurement piping as short as possible and avoid sharp bends.
- Lay the measurement piping so that no deposits can accumulate. Gradients should not be less than 8 %.
- Measurement piping should be blown through with compressed air or, better still, flushed through with the measuring medium before connecting to the measuring element.
- If the medium is a liquid / vapor, the filling liquid must be at the same level in both pipes. If using separating liquids, both pipes must be filled to the same height.
- Keep both pipes at the same temperature whenever possible.
- Completely bleed measurement piping if the medium is a liquid.
- Lay the measurement piping so that gas bubbles, when measuring liquids, or condensate when measuring gases, can flow back into the process piping.
- Ensure that the measurement piping is correctly connected + HP and - LP side on sensor, seals,...).
- Ensure that there are no leaks in the piping.
- Lay the measurement piping so that blowouts do not occur via the sensor.

5 Electrical Connection

The relevant guidelines must be observed during the electrical installation!

Since the transmitter has no switch-off elements, overcurrent protection devices or mains disconnection possibilities must be provided on the system side (overvoltage protection at option).

Check that the existing operating voltage corresponds to that indicated on the type plate.
For power supply and output signal, the same lines are used. **Consult the enclosed connection diagram!** Depending on the supplied model, the electrical connection is made via cable entry 1/2-14 NPT or M 20 x 1.5 or via plug Han 8 U. The screw terminals are suitable for wire cross-sections up to 2.5 mm2.
Caution: For transmitters of category 3 regarding the application in "Zone 2" the cable gland has to be provided by the customer. For this purpose there is a thread of size M 20 x 1.5 in the electronic housing. The cable gland must comply with the protection type "Increased Safety EEx e" according to the directions 94/9/EG (ATEX). Furthermore, the conditions stated in the type test certificate of the cable gland have to be observed!
Note:
1. (Applies to transmitters acc. to Canadian Standard (CSA) explosion proof „Electrical connection with cable conduit“)
To ensure the Type 4X and IP 67 degree of protection the conduit must be screwed into the housing 1/2“ NPT female using a suitable sealing compound. The blanking plug has been sealed with Molykote DX, the use of any other sealing compound is done so at owners own risk.
2. If the type of protection ”Flameproof enclosure” (EEx d) applies to the transmitter, lock the enclosure cover by means of the attachment screw (Fig. 10).
Here we would like to point out that an increased expenditure of force will be necessary to remove the enclosure cover after several weeks. This effect is not caused by the thread, but just by the kind of sealing.
Attention: For the purpose of simulation, a 100 Ω-resistance has been mounted between the terminals 11 to 14. This must be removed before connecting the Pt100.

Electrical connection in the cable connection compartment

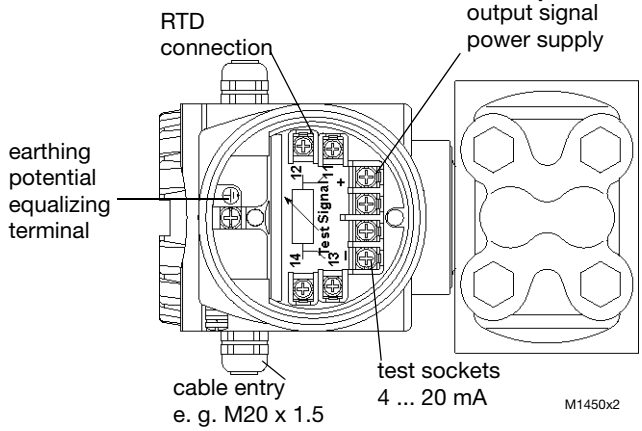


Figure 2. Cable connection compartment

The electrical connection is effected behind the enclosure cover on the side of the connection compartment which can be screwed off. The signal line and the line for the Pt100 resistance thermometer are led separately into the cable connection compartment. On principle, an M 20 x 1.5 screwed cable gland made of metal is provided for the Pt100 cable as, preferably, shielded cable should be used. The screen has to be connected within the metal screwing!

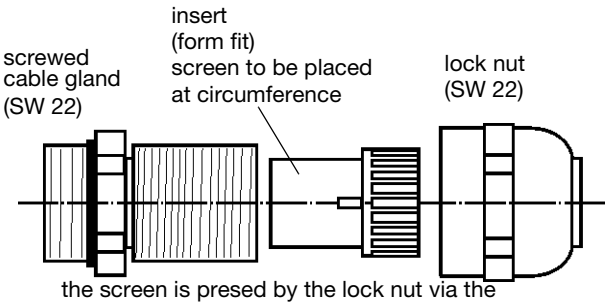
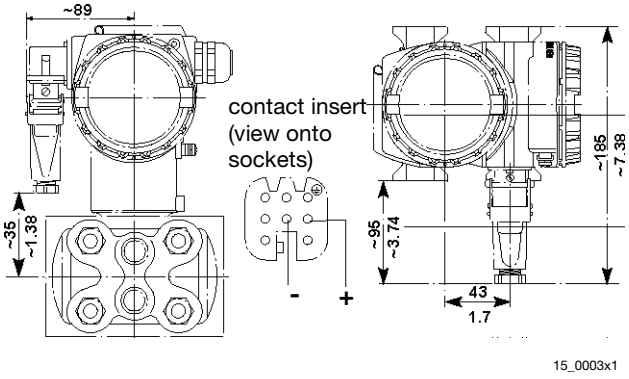


Figure 3. Metal screwing

For the signal line, the screwed cable gland is always made of plastic. The M 20 x 1.5 screwed cable gland and the plug Han 8U including socket connector are supplied whereas the screwed cable gland 1/2-14NPT has to be provided by the customer. Please take care that here, too, a metal screwing is used.
The screwed cable glands M 20 x 1.4 made of plastic which are supplied by the factory are only loosely screwed into the electronic housing. To achieve the degree of protection IP 67, the screwing must be hand-tight by means of a suitable tool (hexagon insert bit, SW 22).

SIGNAL (+) and (-):	Operating voltage
TEST (+) and (-):	Test sockets for 4...20 mA (HART), not available for fieldbus transmitters
Terminals 11 to 14:	Connection for Pt100 12 and 14 = Supply 11 and 13 = Signal

Electrical connection with plug



„barrel-type“ „DIN-type“

Figure 4. Plug connection

Mounting of the socket connector

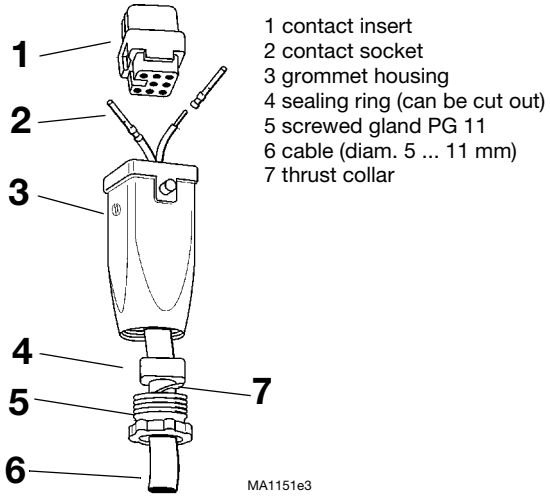
The socket connector for the cable connection is attached to the transmitter in component parts.

Installation (see Figure 5):

The contact sockets (2) are crimped or soldered onto the cable ends (wire cross-section 0.75...1 mm²) from which 1.5...2 cm of the sheath and about 8 mm of the insulation has been removed and inserted from the rear into the contact insert (1). The screwed gland (5), thrust ring (7), sealing ring (4) and grommet housing (3) must be pushed onto the cable in the specified order prior to installation (the sealing ring (4) may have to be adapted to the cable diameter first).

Attention:

Check the connecting points again before pressing the sockets all the way into the contact insert. Incorrectly installed sockets can only be removed again with a special removal tool (item no.: 0949 813) or with a standard ball pen refill.



1 contact insert
2 contact socket
3 grommet housing
4 sealing ring (can be cut out)
5 screwed gland PG 11
6 cable (diam. 5 ... 11 mm)
7 thrust collar

Figure 5. Mounting of the socket connector

A connection terminal is available for grounding (PE) on the transmitter exterior and also in the plug. Both terminals are electrically interconnected.

Protective conductor / grounding

The transmitter operates within the specified accuracy with common mode voltages between the signal lines and the housing up to 250 V. On principle, the transmitter has to be supplied from a voltage source, which is safely separated from the mains, with an output voltage of max. 60 VDC. In order to fulfill the requirements of the low-voltage guidelines and the relevant EN 61010 rules for the installation of electrical components, the housing must be provided with a protective circuit (e.g. grounding, protective conductor) if voltages of > 60 VDC could occur.

Set-up of the signal circuit / communication circuit for transmitters with 4...20 mA output signal (HART® Protocol)

The transmitter can be operated via a modem by means of a PC or laptop. The modem can be connected in parallel to the transmitter at any place in the signal circuit. Communication between transmitter and modem is made via AC signals which are overlaid to the analog 4...20 mA output signal. This modulation is effected without averaging and therefore, it does not influence the measuring signal.
Communication between transmitter and PC or laptop is only possible if the signal circuit is set up as shown in Figure 6. The resistance between the connecting point of the FSK modem and the power supply must be at least 250 ohm including the internal resistance of the supply unit. If this value is not reached with the normal installation, an additional resistance must be used.
The additional resistance has already been installed by the manufacturer in the supply units TZN 128 and TZN 129.
In the "FSK bus" mode, the TZN 128 allows to communicate directly via the supply unit..

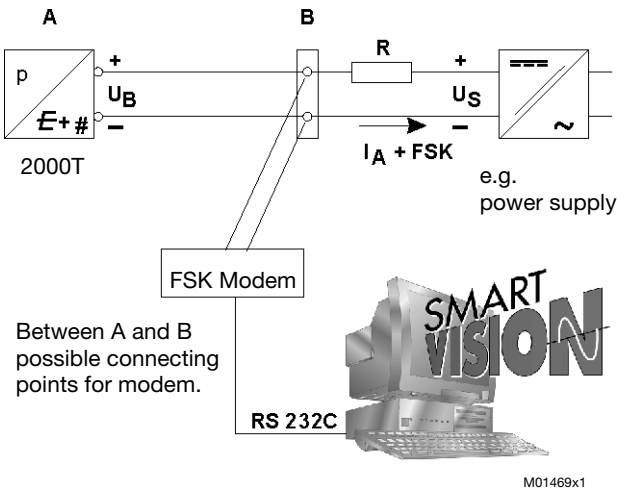


Figure 6. Communication mode: "point-to-point "

For power supply, either supply units, batteries or power packs can be used which must be designed to ensure that the operating voltage UB of the transmitter is always between 10.9 and 45 V DC (for LCD indicator 14 ... 45 V DC).
The max. current of 20 ... 22.5 mA which may occur by overranging according to the respective parameter setting, must be taken into account. The minimum value for US results from this. If further signal receivers (e.g. indicators) are connected into the signal circuit, their resistance must also be taken into account.

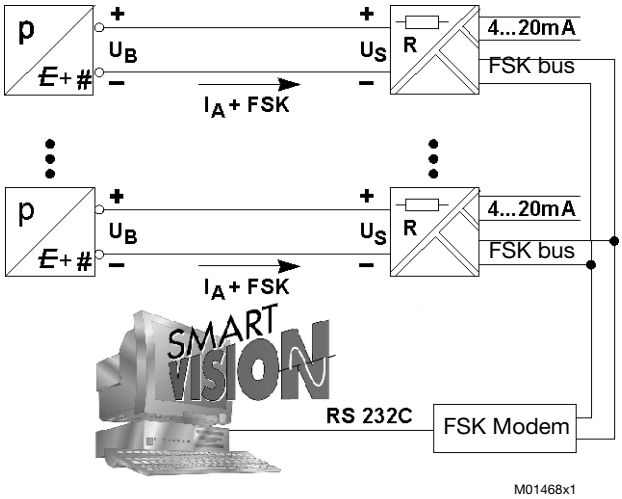


Figure 7. Communication mode: "FSK bus"

Notes on connecting cable

To allow communication between transmitter and PC/laptop, cabling must meet the following requirements:
It is recommended to use shielded and twisted pair lines.
The minimum wire diameter should be:
- 0.51 mm for lines up to 1500 m
- 0.81 mm for lines longer than 1500 m

The maximum line length is limited to:
- 3000 m for twin-core cable
- 1500 m for multicore cable

The actually possible line length of the electric circuit depends on the total capacitance and joint resistance; it can be estimated according to the following formula:

$$L = \frac{65 \times 10^6}{R \times C} - \frac{C_f + 10000}{C}$$

L = Line length in m
R = Joint resistance in
C = Line capacitance in pF
Cf = Capacitance of the devices existing within the circuit

The shield should be grounded on one side only.
Laying together with other electric circuits (with inductive load, etc.) and the proximity of large electrical installations should be avoided.
Max. permissible residual ripple of the supply voltage during communication:
7 Vss at 50 Hz ≤ f ≤ 100 Hz
1 Vss at 100 Hz < f ≤ 200 Hz
0.2 Vss at 200 Hz < f ≤ 300 Hz

Notes on PROFIBUS-PA transmitters

PROFIBUS-PA transmitters are provided for the connection to segment couplers DP / PA. The permissible terminal voltage ranges from 10.2... 32 V DC. Current consumption is 14 mA (at average transmission).
A shielded cable is recommended. Contacting of the shield is effected in the metal screwing. The transmitter must be grounded.
The transient behavior corresponds to the draft DIN IEC 65C / 155 / CDV dated June 1996. When operating with an Ex-segment coupler according to DIN EN 61 158-2 October 1994, the max. number of devices may be reduced by a time-dependent current limitation.
The output signal of the transmitter is transferred digitally according to IEC 61158-2. For PROFIBUS-PA, the communication protocol corresponds to Version 3.0, Class B, Ident-No.: 04C2 HEX (EN 50 170).
During cyclic data traffic, the OUT variable is transmitted. It is composed of the output value and 1 byte status information. The output value is transmitted with 4 bytes as IEEE-754 Floating-Point-Type.
For further notes on PROFIBUS-PA, e.g. on the subject "Ident Number", please refer to the "Supplementary Instructions 42/15-712-Z0.20", the Data Sheet "Installation Proposals 10/63-0.40" and the Internet address *http://www.profibus.com*.

Notes on explosion protection

For the installation (electrical connection, grounding / potential equalization, etc.) of explosion-proof transmitters, the national statutory orders, DIN/VDE rules, guidelines for explosion protection and the explosion proofness test certificate of the device have to be observed. The certified explosion proofness of the transmitter is indicated on the type plate.

Transmitters of the type of protection "Intrinsically safe EEx i" according to Directive 94 / 9 / EG (ATEX):

- Install only intrinsically safe devices within the transmitter signal circuit.
- The signal circuit may be interrupted even when the transmitter is in operation (e.g. disconnect and connect signal lines).
- The housing may be opened during operation.
- Transmitters with and without remote seal of the type of protection "Intrinsically safe EEx i" may be mounted directly at zone 0 if they are supplied by means of an intrinsically safe electric circuit EEx ia or EEx ib.
- Test circuit (terminals "TEST + / - "): of the type of protection "Intrinsically safe" only for connection to passive intrinsically safe electric circuits. Category, explosion group as well as the maximum values for Uo, Io and Po of the intrinsically safe test circuit are determined by the connected intrinsically safe signal circuit. Observe the rules of interconnection!

Transmitters of the category 3 to be used in "Zone 2" according to Directive 94 / 9 / EG (ATEX):

- The transmitter has to be connected by means of a certified screwed cable gland (type of protection "Increased safety EEx e" according to ATEX).
- It is not permitted to open the housing during operation (operating voltage switched on)!

Transmitters for use in areas with inflammable dust in acc. with guideline 94 / 9 / EC (ATEX)

The transmitter can only be connected via a certified cable gland in acc. with EN 50 014: 1997 (not in scope of supply). The cable gland must also meet the degree of protection IP 67 requirements.
Under consideration of the intrinsic heat generation, the smoulder temperature of the dusts must be at least 85 deg. K above the ambient temperature.
When using remote seals with an anti-stick coating, one must con-

sider the possible danger of an electro-static discharge under consideration of the medium and the transportation speed.

Transmitters of the type of protection "Flameproof enclosure EEx d" according to Directive 94 /9 / EG (ATEX):

- It is not permitted to open the housing during operation (operating voltage switched on)!
- The following set-up instructions have to be observed:

1. The transmitter has to be connected via suitable cable and line entries or piping systems which meet the requirements according to EN 50 018:1994, Section 13.1 and / or 13.2 and for which a separate test certificate is available!
2. Unused openings of the housing have to be closed according to EN 50 018:1994, Section 11.9!
3. Cable and line entries as well as blanking plugs which do not correspond to the points 1. and 2. must not be used!

- To align the transmitter (torsion by max. 360°) at the measuring point, the rotatable housing can be loosened at the shaft between sensor and housing:
  - Release the attachment screw by max. 1 rotation.
  - Align the housing.
  - Retighten the attachment screw!
- Before switching on the operating voltage:
  - Close the housing.
  - Secure enclosure cover by turning the attachment screw (hexagon socket screw) to the left.
  - Protect housing from torsion by turning the attachment screw (stud) to the right.
- Enclosure cover, electronic housing and sensor may only be replaced by approved components!

Type Examination Certificate / Conformity Statement

For transmitters in explosion-proof design, the EC Type Examination Certificate and / or Conformity Statement must be observed as part of these Instructions.

6 Commissioning

After installing the transmitter, it is placed into operation by switching on the operating voltage.

- Check the following before switching on the operating voltage:
  - Process connections.
  - Electrical connections.
  - That the measurement piping and measuring chamber of the transmitter are completely filled with the medium.
- Subsequently it is placed into operation.
  The shut-off armatures should be operated in the following sequence (basic setting: all valves closed):

1. Open the shut-off valves on the pressure tap connections - if present.
2. Open the pressure compensation valve of the shut-off armature.
3. Open the positive shut-off valve.
4. Close the pressure compensation valve.
5. Open the negative shut-off valve.

- Proceed in the reverse order when taking the unit out of opera tion.

If, in case of transmitters of the type of protection "Intrinsically safe", a current meter is connected to the test sockets or a modem is connected in parallel when an explosion hazard is existing, the sums of the capacitance and inductance of all circuits including transmitter (see type plate) must be equal to or smaller than the permissible capacitance and inductance of the intrinsically safe signal circuit (see type plate of the supply unit). Only passive or explosion-proof test devices or indicators may be connected.
If the output signal is slow to stabilize, a high damping time constant has probably been set in the transmitter.

Notes on transmitters with 4...20 mA output signal (HART® - Protocol)

If the applied pressure is within the values indicated on the type plate, the output current ranges between 4 and 20 mA. If the applied pressure exceeds the calibrated range, the output current is between 3.5 mA and 4 mA in case of underranging or between 20 mA and 22.5 mA (according to the respective parameter setting) in case of overranging; standard setting: 3.8 / 20.5 mA.
In order to prevent errors in the lower flow ranges, it is possible, via the communication tool SMART VISION, to adjust the "Zero suppressor" and / or the "Lin./Sq. rt. transition point". Should no values have been given, then the factory set values will be: 5 % for the "Lin./Sq. rt. transition point" and 6 % for the "Zero suppressor" of the maximum flow, i.e. the 2010TC operates only with the "Zero suppressor".
A current of < 4 mA or > 20 mA may also indicate that the microprocessor has detected an internal error; standard setting: 21 mA. Via the communication tool SMART VISION, an exact diagnosis of the error can be performed. A short-time interruption of power supply results in an initialization of the electronic (restart of the program).

Write protection

Write protection prevents an illegal overwriting of the configuration data. If write protection is activated, the function of the keys 0 % and 100 % is disabled. However, it is still possible to read out the configuration data by means of SMART VISION (or another comparable communication tool).
If necessary, the control unit can be leaded.
Write protection is activated as follows (see also symbolism on the plate):

1. First, fully press down the switch with an appropriate screw driver.
2. Then turn the switch clockwise by 90 °∠ .

For deactivation, the switch has to be pushed down a little and turned counterclockwise by 90 °∠ .

Oblique sensor / zero correction

During the installation of the transmitter, zero shifts (e.g. slightly inclined mounting position, different liquid columns in the differential pressure lines, remote seals, etc.) caused by mounting may occur which have to be corrected.
Note: For correction, the transmitter must have reached its operating temperature (approx. 5 min after switch-on if the transmitter has already assumed ambient temperature). The correction has to be made at "zero" flow (dp = 0)! There are two possibilities (point 1A or 1B) to perform the correction:

1A. Push button unit and LCD indicator have to be available. Call up the menu item "SHIFT ZERO" via the keys "M" and "+". The correction is made by pressing the key "M" (refer to section 7 "Operation").
or

1B. By means of the communication tool SMART VISION using the menu path **Configuration_Differential Pressure Measurement_Process Variable** and the button <Balance> in the field “Oblique Sensor” .

2. The transmitter has to be put into the operating state.

Rotate housing with regard to the sensor

The electronic housing can be rotated through 360°Ð and can be fixed in any position. A stop prevents the housing from being turned too far.
To this effect, the fixing screw at the housing shaft (hexagon socket screw SW 2.5 mm, see section 12 "Dimensional Diagrams") must be released and hand-tightened after the position has been reached.

Assembly / disassembly of push button unit (Figure 8)

- Loosen the screw of the protective cap and turn it aside.
- Push the lock completely out of the push button unit, e.g., by means of a suitable screw driver.
- Remove the uncovered square nut from the push button unit.
- Loosen the fastening screw of the push button unit by a Torx screw driver (size T10) and pull the latter out of the electronic housing.
- If necessary, insert a spacer and tighten it by the attached screw.

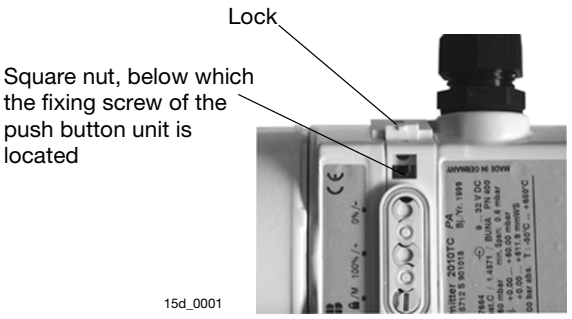


Figure 8. Push button unit - disassembly / assembly

Assembly / disassembly of LCD indicator

- Unscrew enclosure cover of the electronic compartment (see Figure 8) (in case of EEx d type, observe section "Secure enclosure coverfor EEx d").
- Plug LCD indicator. Depending on the mounting position of the transmitter, the LCD indicator can be slipped on in four different positions; in this way turns by ± 90° or ± 180° are possible.

Note: If the LCD indicator is backlit (option, however, not for fieldbus transmitters) there is a three-core cable with plug on the back of the indicator. Connect this plug with the 3-pole plug strip in the electronic compartment (see Figure 9) before slipping on the indicator.
If there is a jumper on the 3-pole plug strip, it has to be removed and plugged into the "socket for jumper".

- Fasten LCD indicator with both screws.
- Hand-screw the enclosure cover (if necessary, observe section "Secure enclosure cover for EEx d").

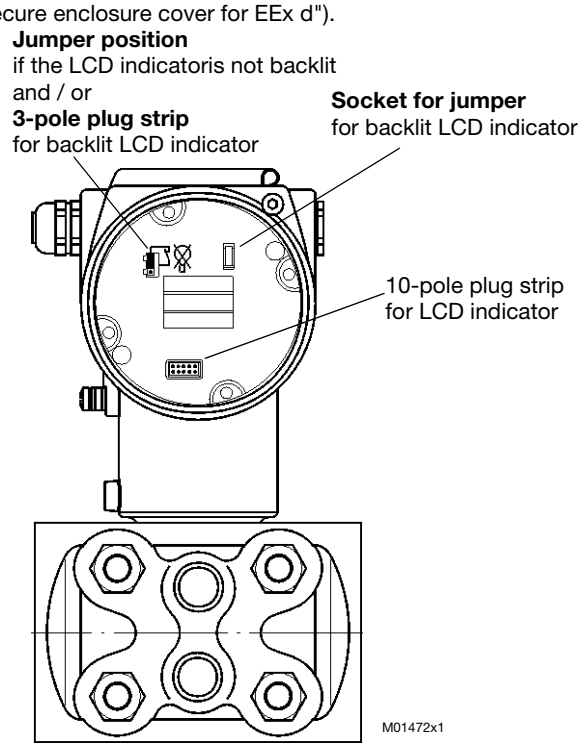


Figure 9. Electronic compartment - LCD indicator mounting

Secure enclosure cover for EEx d

On the top right of the electronic housing front, there is an attachment screw (hexagon socket screw, SW 3 mm).

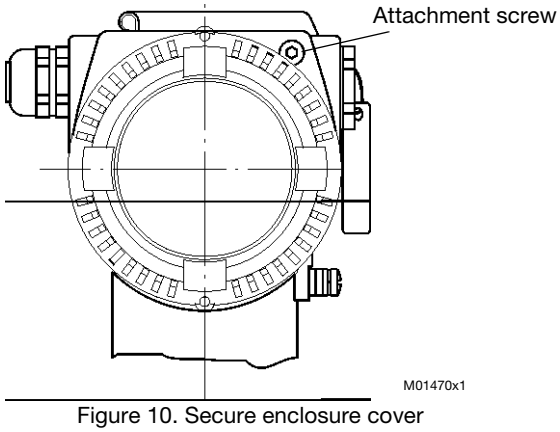


Figure 10. Secure enclosure cover

- Turn enclosure cover hand-tight into the housing.
- Secure enclosure cover by turning the attachment screw to the left. In doing so, the screw must be unscrewed to the stop of the screw head at the housing cover.

7 Operation

- There is no protection against electric shock when the enclosure covers are open. Do not touch live parts.
- The key functions "0 %" (for lower range value setting) and "100 %" (for upper range value setting) are not available. The write protection s, however, is active.
- The key functions "M", "+" and "-" for the configuration of the transmitter together with the LCD indicator are available.

.

Figure 11. Key legend plate

Lower and upper range value can only be calibrated by means of the communication tool SMART VISION. Please observe that the 2010TC is a flow transmitter and that the lower range value must always be set to 0 % = 0 mbar.

The transmitter has been calibrated by the manufacturer according to the order data. The set values for lower range and upper range are indicated on the type plate.

Operation via SMART VISION®

System requirements

- SMART VISION®
  SMART VISION® as from Version 4.00.31
  When installing the DTM (Device Type Manager), SMART VISION® is updated to Version 4.00.43.
- Operating systems
  - Windows NT 4.0
  - Internet Explorer as from Version 5.0

Note:

The DTM is started by means of the right mouse button or via the menu item "Device" with "Edit". After a "Connection setup", first the data of the 2000T should be loaded completely. Changed data are underlined and displayed in blue. These data are transmitted to the device via "Store data in the device".

After the data have been saved in the transmitter, their nonvolatile storage is effected automatically. To do this, power supply to the transmitter must be continued for 2 minutes. If this is not observed, the previous data will become active again during the next operation.
In case of software versions < 0.20 (< 20 for HART), storage will only be effected after disconnection.
For Profibus devices, the disconnection of "Local operation" only becomes effective in case of cyclic communication. If write protection is set by means of the DTM, the setting of the 2010TC can no more changed via the control keys.
For Profibus devices, the slave address must be indicated correctly in the project tree of SMART VISION®. Communication name and description are automatically updated when loading the device data.
The most important calibration / parameterization possibilities under SMART VISION® are shortly described in the following. You will find further notes on the menu items in the context-sensitive help.
Before carrying out any setting, please ensure that write protection has neither been activated on the transmitter itself (key s), or via SMART VISION®(menu path **Configuration_Basic Parameters _General _Local Operation)**.

- **Adjust damping**

  Menu path:
  Configuration_Differential Pressure Measurement_Output
  The required value has to be entered in the field "Output parameters" in the line "Damping".
- **Correct sensor misalignment**

  Menu path:
  Configuration_Differential Pressure Measureent_Process Variable
  Actuate the button <Balance> in the field "Sensor misalignment". Balancing is immediately effected with nonvolatile storage in the transmitter.
- **Change flow unit**

  Menu path:
  Configuration_Flow Measurement_Primary Device
  The required unit has to be selected from the pop-up list in the line "Mass flow" or "Volume flow".
- **Adjust lower and upper range value**

  Menu path:
  Configuration_Differential Pressure Measurement_Process Variable
  In the field "Scaling", the adjustment is possible in two ways:
  Value input: The required value / values has / have to be entered in the input fields "Lower range value" and / or "Upper range value".
  or
  Process pressure acceptance: For the adjustment, the lower range value (always 0 mbar !) and the upper range value are preset as pressure at the sensor. Make sure that the measuring limits are not exceeded. Pressure reducing stations with adjustable pressure and comparative displays can be used as sensors. When connecting, take care to avoid residual liquids (with gaseous test media) or air bubbles (with liquid test media) in the piping since they can cause errors. The pressure reducing station should have an accuracy of at least 3 times better than the transmitter to be tested.
  Attention: The lower range value must always be 0 mbar. It is only useful to change the upper range value, if the primary element is also changed and thus the orifice calculation data. Otherwise, a change of the upper range value will have no effect on the calculation of mass flow or of the analog output current here.

Operation with "local keys" (at the device) with LCD indicator

The retrofit / optional control unit comprises 2 keys and a write protect switch. For the keys / the switch, physical connections through the housing are not required.
In conjunction with an LCD indicator, the transmitter can be configured with the keys (- / + / M) as follows:
(Note: Indications in ( ) designate the menu item, they are shown in the 1st and 2nd line of the indicator.
The complete structure tree is shown in Figure 14.

- Exit the menu (EXIT).
- Display of measured and calculated values (VIEW).
- Correct zero drift (e.g. sensor misalignment) (SHIFTZERO).
- Damping (DAMPING).
- Output current in case of an error (ALARM CURRENT); only available for 4...20 mA devices with HARTâ Protocol.
- Displayed value on the LCD indicator (DISPLAY).
- Temperature unit (UNIT) of internal temperature sensor.
- Fieldbus address (ADDRESS); only available for devices with PROFIBUS-PA Protocol (for devices with FOUNDATION Fieldbus and / or HARTâ Protocol, configuration of the fieldbus address is only possible by means of a communication tool such as SMART VISION®).

The following functions must not be executed as they will lead to wrong functions:

- GET 0%
- GET 100%
- SET 0%
- SET 100%
- OFFSET SHIFT (parallel shift) and
- UNIT (unit for pressure, differential pressure and temperature).

Attention: The unit for mass / standard volume flow or operating volume flow can only be changed by means of SMART VISION.
In the following, some of the a.m. menu items are described in detail.

Notes on "Display of values (VIEW)“ / „(DISPLAY)“

2 Percent value of mass flow, e.g.: 63.75 %
3 Output signal in mA for HART; for PROFIBUS-PA and FOUNDATION Fieldbus this is the OUT value of static pressure
6 Static pressure (incl. condensate column), e.g.: 3 bar

The values **1** to **5** can optionally be displayed during running operation when adjusting the indicator with "DISPLAY".

Notes on “Damping (DAMPING)”

A fluctuating output signal of the transmitter, caused by the process, can be electrically smoothed (damped).
The additional time constant is adjustable between 0 sec. and 60 sec. in step sizes of 0.001s.
The damping set in this way does not affect the measured value indicated digitally in physical units, but only the derivatives such as analog output current, free process variable, input signal for controller, etc.

Notes on "Fieldbus address (ADDRESS)"

Under this path, the fieldbus-slave-address may be changed. Enter a figure between 0 and 126 for the selected transmitter.
Remark: Generally, the manufacturer assigns the address 126 to all new devices! The transmitters should get different addresses in order to allow the addressing of a specific device. If, e.g., the device data are loaded via the communication tool SMART VISION after the address has been changed, the connection set-up is executed again, and possibly an error message appears. Acknowledge this with "Repeat", then the data will be loaded without any problem.

Measured value display

The LCD indicator

2-line, 7-character, 19-segment alphanumeric display with additional bar chart display. Optionally, the indicator is available with back illumination (not combinable with fieldbus transmitters).

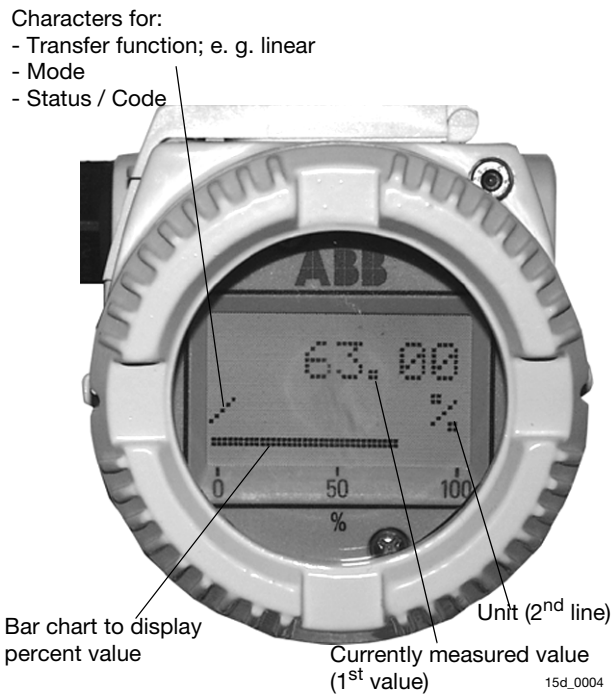


Figure 12. LCD-indicator (optional)

Display of the physical value

At the first position of the first line, the sign is displayed, and the following six positions show the amount of the measured value. The comma is placed in such a way that the maximum value can be displayed with these six positions. The place of the comma is not changed. A comma at the sixth position is not displayed. Thus it is possible to display max. +/-999999. If this value is exceeded Overflow . indicated. In the second line, the unit is displayed with the last five positions.
The first position shows the following characters, if necessary, one after the other. Display changes every second
.

Display for	**Character**	**Comment**
Transfer function	⎍, √ or /	Always one of these characters appears.
Write protection	–	Only if write protection has been set.
Cyclic communication	.....	Only in case of PROFIBUS-PA
Status available (e.g. measuring range infringement or hardware error)		Only if a status is available.
Code of displayed value	1...9	see menu Display (see structure tree)
Transmitter is busy		This character overwrites other characters.

Table 1: Legend

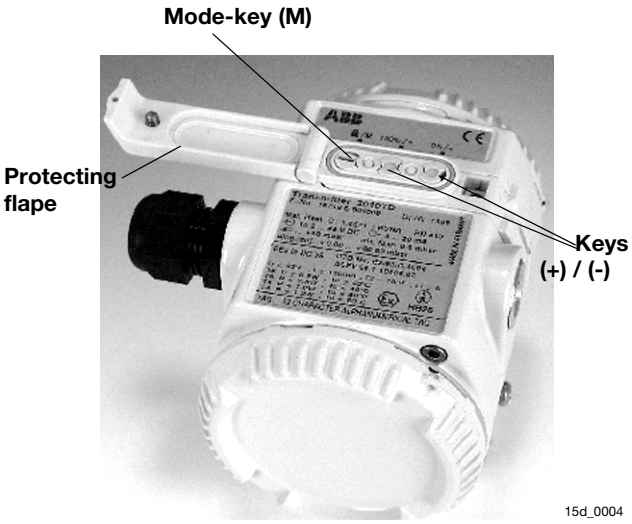


Figure 13. Control elements (optional)

Display of the percent value

	Display on LCD indicator
1st line	Percent value, limits: -25% to 125%, 2 decimal places
2nd line	1st position: Transfer function (Table 1) 2nd position: Write protection (Table 1) 7th position: %
Bar chart	2% steps - from -2% to +10%, no hysteresis

Table 2: Percent value display on LCD indicator

Program control

To make the keys accessible, release the screw and turn the protection cap aside (see Figure 13). With the mode key "M", you can start menu-controlled programming. To call the next menu item, press the key "+". You will return via the key "- ". Submenu items / selection lists are activated via the mode key "M". A numerical value can only be changed via the keys "+" and " - ". It must be taken into account that the key "+" changes the value (each keystroke increases the value by 1), whereas the position of the value to be changed is reached via the key " - ". Acknowledge changes with the mode key "M"; the subsequent OK acknowledgement (via the key "M", "+" or "-") writes the new value into the failsafe storage. An adjusting process can be aborted by pressing simultaneously the keys "+" and "-". From any main menu item, you can return to the menu item "EXIT" by simultaneously pressing the "+" and "-" keys. When the adjustment has been finished, quit the program via the menu item "EXIT".

By means of the following structure tree, you will get an overview of the selection / programming possibilities

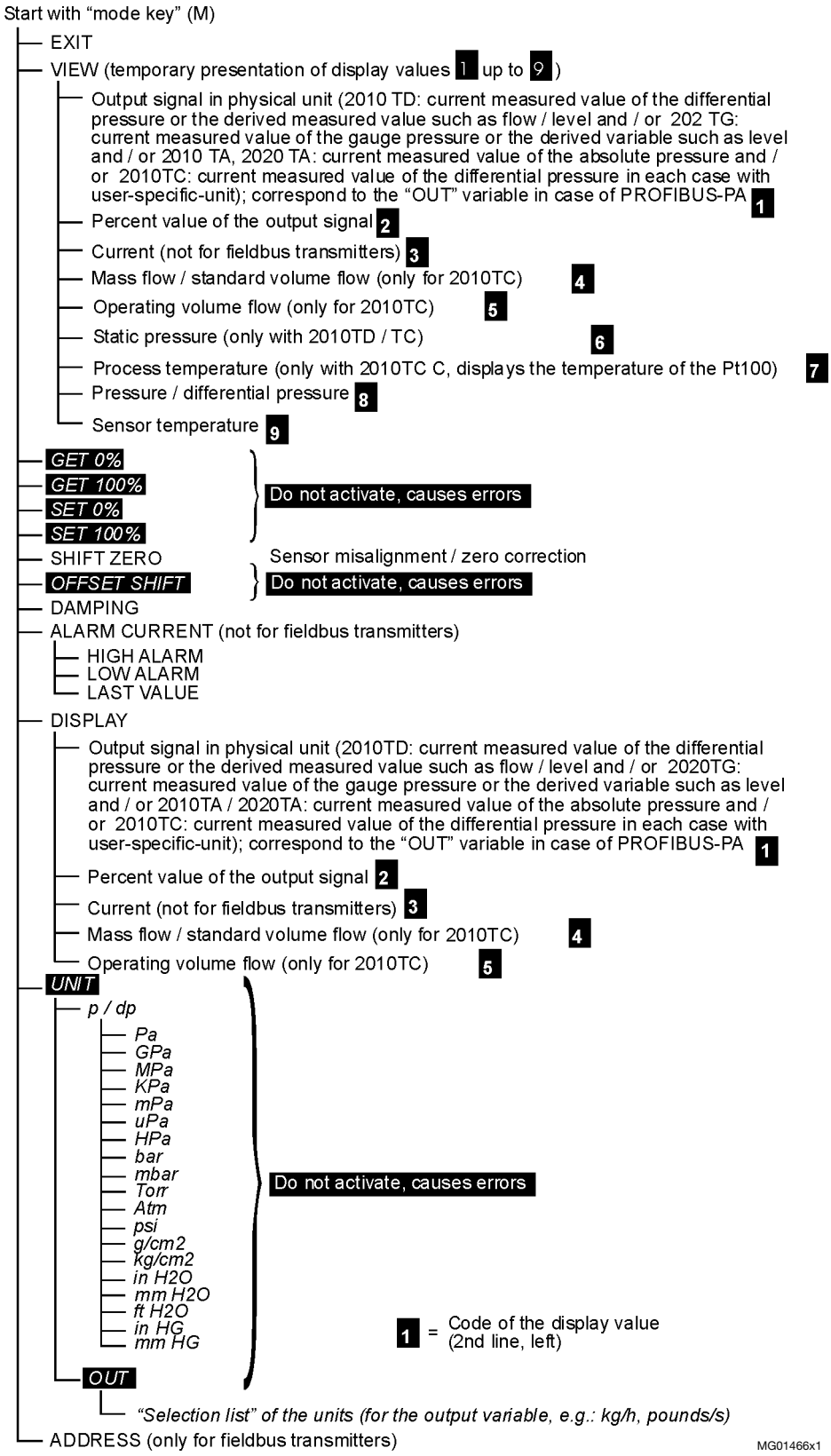


Figure 14. Structure tree

Operation with PC / laptop

To configure the transmitter via PC / laptop, the software SMART VISION is required. Please refer to the software description for operating instructions.

Communication protocol:	PROFIBUS-PA® or Foundation Fieldbus® or HART®
Hardware:	for HART® : FSK modem for PC / notebook

Configuration of flow measurement with SMART VISION®

If the transmitter has been configured at the manufacturer's work for the measuring point according to the specifications given by the user in the questionnaire (refer to page 20), you do not have to do anything else than to assemble the transmitter as specified (perhaps correct the sensor misalignment - refer to menu path **Confi-guration_Differential Pressure Measurement_Process Variable**), pressurize the transmitter and connect it to power supply; then the measuring point is ready for operation. If the transmitter is equipped with an LCD indicator, the current mass flow (default setting) is displayed immediately.
However, if you want to make changes, e.g., concerning the configuration of mass flow measurement, you need a communication tool, e.g., SMART VISION. By means of this tool, the device can be configured completely. It supports the HART Protocol as well as the fieldbus protocols "PROFIBUS-PA and FOUNDATION Fieldbus", and it is operable on a PC / notebook and / or in an automation system.
The necessary working steps for the installation of SMART VISION are described in the installation instructions delivered with the software. The parameters can be adjusted via the path **Configuration_Flow Measurement**.
The program offers the possibility to configure, to interrogate and to test the transmitter. Furthermore, an offline configuration can be carried out via an internal database. Each configuration step is submitted to a plausibility check. The <F1> key provides extensive context-sensitive help at very stage throughout the complete program.
Attention: Immediately after the delivery of the transmitters and / or before changing the configuration, we recommend to save the existing configuration data on a data medium using the path **File_Save**.

Notes on configuration

● **Configuration_Flow Measurement_Basic Setting**

Here measuring medium and correction range are defined. The units being displayed for differential pressure, static pressure and temperature are identical with the units specified using the path **Configuration_Differential Pressure Measurement (and / or Static Pressure Measurement or Temperature Measurement**). The min. and max. values which are indicated for the operating range should be within the setting values specified using the path **Configuration_Differential Pressure Measurement (and / or Static Pressure Measurement or Temperature Measurement**).

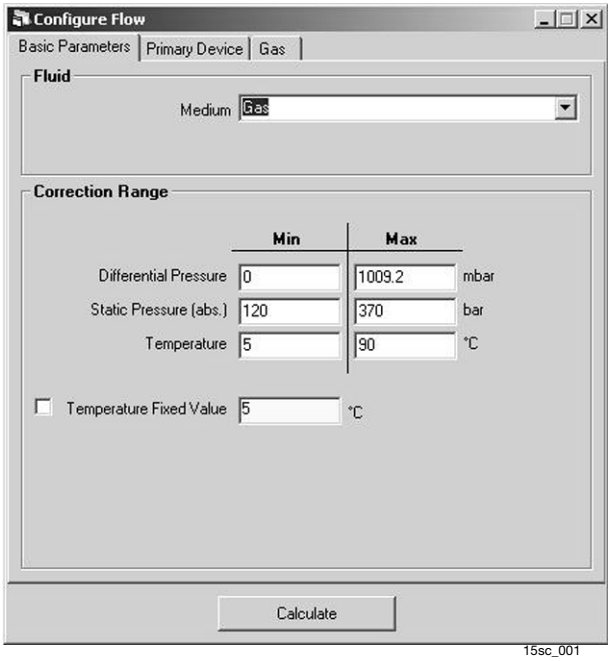


Figure 15. Configuration window - Basic setting

● **Configuration_Flow Measurement_Primary Device**

The calculation values of the throttling device entered here are the basis for flow calculation. Incomplete or wrong data will lead to calculation errors. Please take care that the values are transferred from a valid calculation sheet to the window!
The following specifications regarding the primary device are required:

Throttling device

- ❏ Throttling device
- ❏ For selection:
  - "Orifice" with threshold pressure tapping according to ISO,
  - ISA 1932 - nozzle
  - further primary devices see questionaire „Flow Compensation“ ff.
- ❏ Differential pressure, calculation value of the primary device.
- ❏ Absolute pressure, calculation value of the primary device.
- ❏ Temperature, calculation value of the primary device.
- ❏ Density of measuring medium, calculation value of the primary device.
- ❏ Mass flow, calculation value of the primary device.
- ❏ Volume flow, calculation value of the primary device.
- ❏ Ratio of diameters, calculation value of the primary device.
- ❏ Reynolds' number, calculation value of the primary device.
- ❏ Percent value for Re, calculation value of the primary device. This percent value shows at which flow the Reynolds' number is indicated. Typical values are 100% and 67%.

Only required for gas measurement:

- ❏ Standard density, calculation value of the primary device.
- ❏ Isotropic exponent, calculation value of the primary device.
- ❏ For detailed specification please refer to questionaire „Flow Compensation“

Depending on the software variant of the 2010TC, the displayed values for absolute pressure, temperature and density can be provided with a gray background and underlined in blue even if the data have been loaded directly from the device. Due to the adjusted units, a conversion has been performed here for the representation in the DTM.

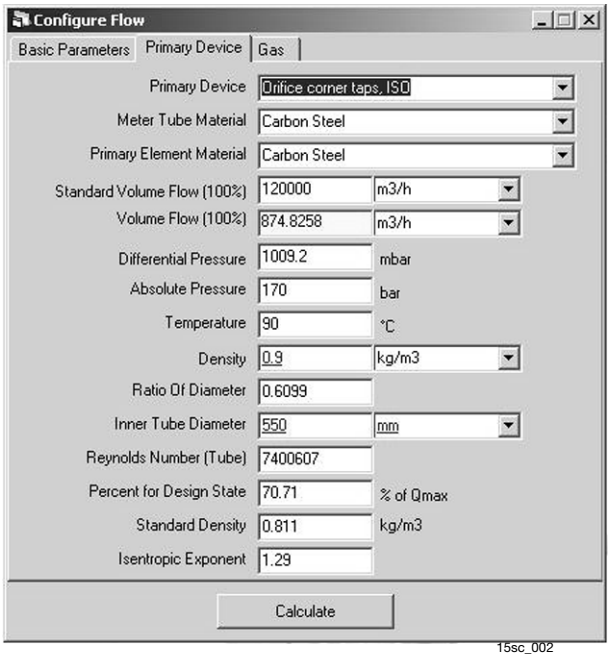


Figure 16. Configuration window - Primary device

- **Configuration_Flow Measurement_Gas**

In case of gaseous measuring media, the name of the medium can be entered and saved in the transmitter.
For exact calculations, it is possible to indicate real gas factor and / or compressibility factors for the respective measuring medium. To do this, select <With correction > and enter the corresponding values into the table.
The real gas factor / compressibility factor is only calculated for "Real gases". For "Ideal gases", K=1 (at low pressures and high temperatures, air and other gases behave like an "Ideal gas").

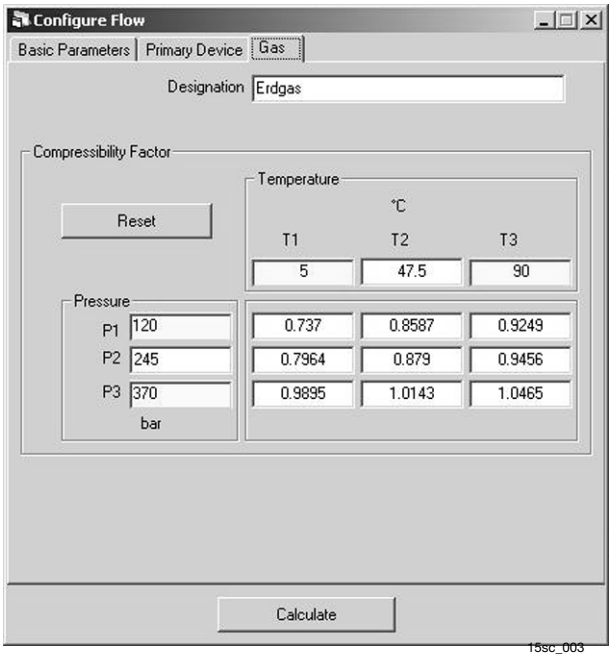


Figure 17. Configuration window - Gas

- **Configuration_Flow Measurement_Liquid**

In case of liquids, the density must be indicated for at least two (min./max.) temperature values to perform correction computing. Between these values, the density is interpolated.
To achieve a higher accuracy, up to four other temperature values can be indicated with the density.
For the measuring medium water, the density is calculated automatically as a function of temperature and static pressure.

- **Configuration_Basic Parameters**

Write protection

If "Device write-protected" is selected, no data can be written from the communication tool into the device.

Local Operation

Via this function, the keyboard on the transmitter can be switched off completely. Thus it is possible to protect the setting from unauthorized access (for PROFIBUS-PA devices, only possible with cyclic communication).

Indicator value

Depending on the type, the alphanumeric indicator can display the following values:

- ❏ Output pressure (pressure, differential pressure or absolute pressure in the selected unit),
- ❏ Percent value pressure, differential pressure, absolute pressure orflow,
- ❏ Current (output current in mA, only for HART devices),
- ❏ Mass flow and / or standard volume flow (in case of gas),
- ❏ Volume flow.

In addition to measured values, the indicator displays diagnostic messages, max. and min. alarm, measured value overflow (OVERFL) as well as configuration changes. An indicator can be installed later without any difficulty.

Sensor temperature unit

Please enter here the unit for the sensor temperature.
If the temperature dimension is changed, all associated values will be converted to this dimension and displayed accordingly.
Temperature values for the process temperature (PT100) are not affected by this dimensional change.

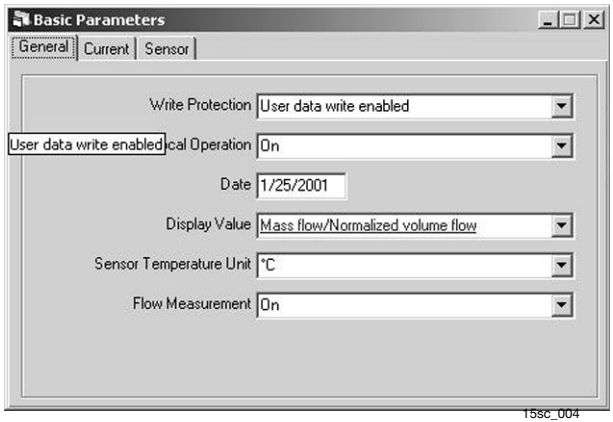


Figure 18. Configuration window - Basic parameters

8 Maintenance

The transmitter is maintenance-free.

It is sufficient to check the output signal - depending on the operating conditions - at regular intervals according to section 7 "Operation".
If deposits in the sensor are to be expected, the sensor should also be cleaned at regular intervals - depending on the operating conditions. Cleaning should preferably be carried out in the workshop.
Replace defective transmitters / units according to the "Spare Parts Data Sheet".

Dismantling / fitting the process flanges

If remote seals are fitted to the sensor, **do not** dismantle the process flanges!

1. Undo the process flange screws diagonally opposite each other. (hexagon insert bit, SW 13 mm)
2. Carefully remove the process flanges so as not to damage the separating diaphragms.
3. Using a soft brush and a suitable solvent thoroughly clean the separating diaphragms and, if necessary, the process flanges. Do not use sharp or pointed tools.
4. Renew the process flange O-rings (Parts List 10/15-9.00).
5. Fit the process flanges onto the sensor body. Take care not to damage the separating diaphragms.
   Note: The flange faces of the 2 process flanges must be in one plane and at right angles to the electronic housing.
6. Check that the process flange screw thread moves easily: Tighten the nut by hand up to the screw head. If this is not possible, use new screws and nuts (Parts List 10/15-9.00).
7. Lubricate the screw threads and contact faces of the screwed joint with, for instance, "Anti-Seize AS 040 P" (supplier: P.W. Weidling & Sohn GmbH & Co. KG, D-Münster).
   With cleanliness stages, the corresponding regulations must be observed, e.g. DIN 25410!
8. **For 2010TC with measuring ranges ≥ 60mbar**
   First tighten the diagonally opposite process flange screws or nuts to the initial torque M_F = 10 Nm (1.0 kpm) using a torque wrench. Then tighten fully by continuing to turn each diagonally opposite screw or nut in two steps of 90 ° each through the tightening angle α_A = 180 °.
9. **For 2010TC with measuring range 10mbar**
   Tighten the diagonally opposite process flange screws alternately in two steps using a torque wrench.
   Tightening torque M_A = 10 Nm (1.0 kpm).
10. Check for leaks.
    Apply pressure with max. 1.3 x PN (bar) where the pressure has to be applied simultaneously to both sides of the sensor.
11. Check the lower range value and the upper range value in accordance with section 7 "Operation".

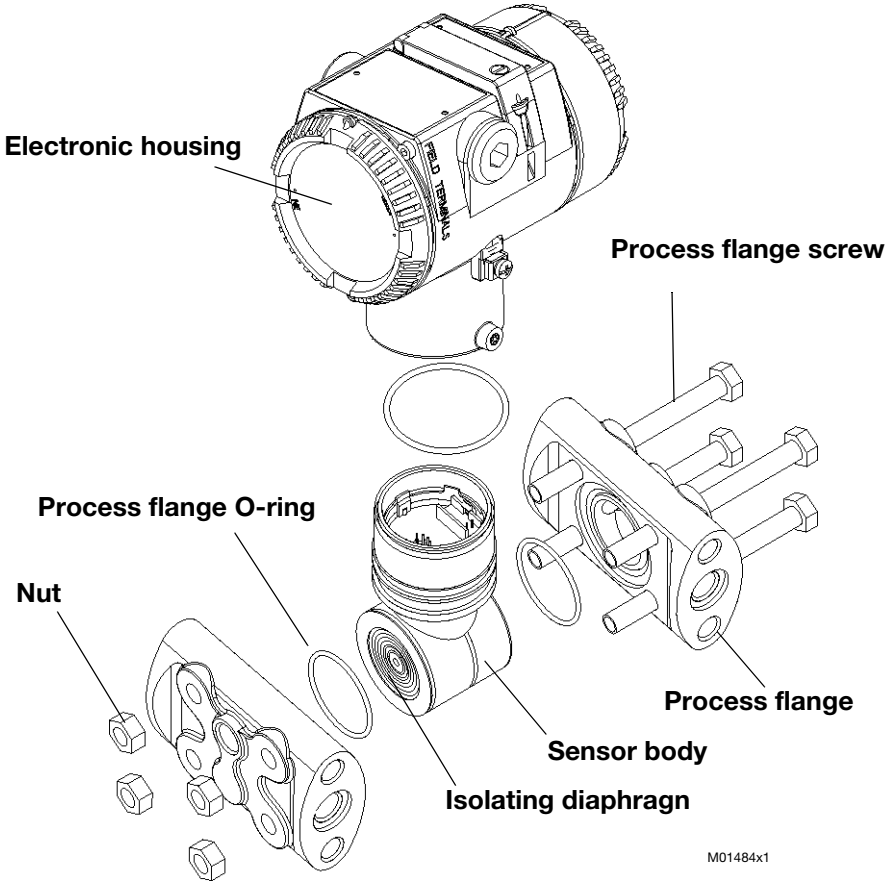


Figure 19. Exploded view

9 Repairs

Attention: Explosion-proof transmitters may only be repaired by the manufacturer, or they must be certified by an acknowledged expert after the repair has been carried out!
Observe the pertinent safety regulations before, during and after repairs.
Disassemble the transmitter only to such extent as necessary for cleaning, checking, repairing and replacement of defective parts.
Observe section 8 "Maintenance"!
Sensor as well as sensor with attached remote seal can only be repaired by the manufacturer.
If it is necessary to screw off the electronic housing from the sensor / sensor body, first remove the electronic from the electronic housing in order to prevent it from being damaged. To do this, first screw off the enclosure cover (Attachment screw!, see Figure 10), then remove a possible LCD indicator from the electronic (loosen 2 screws), loosen both fastening screws of the electronic and carefully withdraw it from the electronic housing. Pull off the two plugs from the electronic. (Both plugs are equipped with a mechanical polarity safeguard and the smaller one additionally with a mechanical locking: Take the plug on the face between thumb and index finger and press the locking bar into the plug direction, then remove the plug from the holder.) Put the electronic on a suitable support. Screw off the electronic housing from the sensor / sensor body.

Return

Defective transmitters / units are to be sent to the repair department, if possible, stating the fault and its cause.
Note: When ordering spare parts or instruments, please quote the serial number (F.-No.) of the original transmitter.

Address:

ABB Process Industries
Department PID / SWM
Schillerstraße 72
D-32425 Minden

10 Mass Flow Measurement

The 2010TC dynamically measures all process variables required for the calculation of a pressure and temperature corrected gas / steam flow measurement and / or temperature corrected liquid flow measurement.
The specific instrument design will be performed by the manufacturer based on the questionnaire answered by the user.
Water, superheated steam, saturated steam, gases (air) or fluids are possible measuring media.
The current DTM (Device Type Manager) for the 2010TC supports orifice and nozzle as primary elements. On demand, the configuration for other primary elements can be performed by the manufacturer.

Theory

As far as conventional transmitters for flow measurement are concerned, the state variables are assumed to be constant in time - e.g., the density of fluids or the density and pressure of steam, i.e., the transmitter only acquires the differential pressure variable. Often, however, the actual state values differ from those values taken as a basis for the calculation so that measuring deviations are inevitable. In case of gases and superheated steam, a 2 % pressure or temperature change of the absolute value already results in a measuring deviation of 1 % for mass flow.
The 2010TC dynamically measures all process variables required for the calculation of a pressure and temperature corrected gas / steam flow measurement and / or temperature corrected liquid flow measurement. From the three measured variables "differential pressure, pressure and temperature", the 2010TC very precisely calculates the dynamically corrected mass flow. If the measuring point is correctly designed, an accuracy of <0.5% referring to the mass flow value can be achieved.

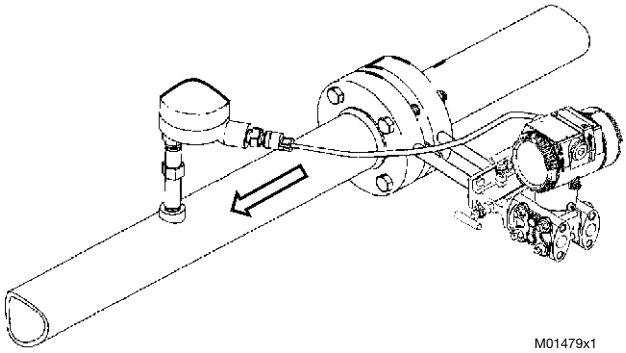


Figure 20. Mounting example - 2010TC with "Barrel housing"

Dynamically corrected, i.e., the diameter of the primary element (d), the inside diameter of the tube (D), density (ρ), flow coefficient (C), coefficient of expansion (ε) and the real gas factor (Z) / compressibility factor (K) are calculated dynamically.
In order to avoid errors when designing the measuring point, all necessary data are entered in a questionnaire which are, e.g., details regarding measuring medium, throttling device, measuring ranges, etc.
The specific instrument design will be performed by the manufacturer based on the questionnaire answered by the user. Air, gas, steam or fluids are possible measuring media.
The following primary elements are supported: Orifice with threshold pressure tapping, ISA 1932 nozzle and others (on demand).

On principle, the mass flow is calculated according to the equation below (acc. to DIN EN ISO 5167 / AGA Report No. 3):

$$q_m = N \times \frac{C \times Y}{\sqrt{1-\beta^4}} \times d^2 \times \sqrt{\Delta p \times \rho}$$

Where: qm = Mass flow
N = Constant, e.g. conversion factor for units
C = Flow coefficient
Y = Coefficient of expansion (gas expansion factor)
β = Opening ratio (d/D)
d = Opening diameter of the primary element
Δp = Differential pressure (effective pressure)
ρ = Density

Calculation of density

The 2010TC can be configured in such a way that, based on temperature and / or pressure changes, the density is compensated as follows:

- Fluids as a function of T according to a polynomial
- Steam as a function of p and T based on a formula
- Gases as a function of p and T according to the gas laws

In case of water and steam, the indicated state of aggregation is always checked by means of the saturated steam limit. If the state of aggregation has changed, the 2010TC continues to calculate with limit values.

Calculation of flow coefficient

The flow coefficient is calculated for all media. When performing the calculation, the primary element type and the design state are taken into account.
The flow coefficient depends on β-ratio, Reynolds' number and primary element.

Calculation of the coefficient of expansion

The dynamic calculation of the coefficient of expansion is only performed for gases and steam. For water and fluids, the coefficient of expansion is ε = 1.
The coefficient of expansion depends on the β-ratio, the isentropic exponent, differential pressure and static pressure. Particularly in case of applications with low static pressure, a correction is useful.

Calculation of real gas factor (Z) / compressibility factor (K)
The real gas factor / compressibility factor is calculated for gases only.

Calculation of the inside diameter of the tube (D) and of the opening diameter of the primary element (d)
On principle, temperature changes of the measuring medium result in an enlargement / reduction of the diameter.
The opening diameters D and d are calculated taking into account the thermal coefficient of expansion of the tube / primary element.

11 Technical Data

Input

Measured variable

Differential pressure, static pressure (absolute pressure) and process temperature

Measuring range (lower and upper range values - dp-sensor)

Lower range value (continuously adjustable)
-100 % to +100 % of the URL
Upper range value (continuously adjustable)
Up to 100 % of the URL

Spans

dp-sensor: The adjusted span must not be lower than the minimum span (recommendation for square root function: at least 10 % of the range).
Measuring Range

Code	min.	max.	SWP (bar)
A	50 Pa / 0.5 mbar	1 kPa / 10 mbar	6
B	200 Pa / 2 mbar	6 kPa / 60 mbar	20/100/410
C	400 Pa / 4 mbar	40 kPa / 400 mbar	20/100/410
D	2.5 kPa / 25 mbar	250 kPa / 2.5 bar	20/100/410
E	20 kPa / 0.2 bar	2 MPa / 20 bar	20/100/410

Code	min.	max.	SWP (psi)
A	0.2 inchH_2O	4 inchH_2O	90
B	0.8 inchH_2O	24 inchH_2O	300/1500/6000
C	1.6 inchH_2O	160 inchH_2O	300/1500/6000
D	10 inchH_2O	1000 inchH_2O)	300/1500/6000
E	80 inchH_2O	290 psi	300/1500/6000

pabs-sensor: The adjusted span must not be lower than the minimum span.
Measuring Range

Code	min. (abs)	max. (abs)
2	4.1 MPa / 41 bar	41 MPa / 410 bar
3	1 MPa / 10 bar	10 MPa / 100 bar
4	200 kPa / 2 bar	2 MPa / 20 bar
5	60 kPa / 0.6 bar	0.6 MPa / 6 bar

(Code 5 for measuring range 10 mbar)

Code	min.	max.
2	600 psia	6000 psia
3	150 psia	1500 psia
4	30 psia	300 psia
5	9 psia	90 psia

(Code 5 for measuring range 10 mbar)

Output signal

Transmitters with 4...20mA

Signal:	analogue 4 ... 20 mA
Output signal limits:	Imin = 3.5 mA, Imax = 22.5 mA (configurable)
Standard setting:	Imin = 3.8 mA, Imax = 20.5 mA

Alarm current

Min. alarm current:	configurable from 3.5 mA to 4 mA, standard setting: 3.6 mA
Max. alarm current:	configurable from 20 mA to 22.5 mA, standard setting: 21 mA
Standard setting:	max. alarm current

Load
Transmitters with 4...20 mA

$$R \leq \frac{Us - 10,5V}{I_{max}} \quad \text{in kOhm}$$

Imax = 20 ... 22.5 mA (configurable)
Us = supply voltage

Min. operating voltage: 10.5 V, with backlit LCD indicator: 14 V
Load required for digital communication > 250 ohm

Fieldbus units

Signal:	digital
Transmission technique:	acc. to IEC 61158-2
Voltage:	10.2 V DC ... 32 V DC
Base current:	14 mA
Transmission rate:	31.25 kbits/s
PROFIBUS-PA:	Version 3.0, Profile B for pressure transmitters; Ident No.: 04C2 HEX
Foundation Fieldbus:	FF-890 / 891, FF- 902 / 903

Characteristic
Flow measurement with complete consideration of all variables affected by p and T.
Calculation is performed as per the formula:

$$q_m = N \times \frac{C \times Y}{\sqrt{1-\beta^4}} \times d^2 \times \sqrt{\Delta p \times \rho}$$

acc. to DIN EN ISO 5167 and / or AGA Report No. 3

Accuracy

Reference conditions
acc. to DIN IEC 770

Temperature:	20 °C (68 °F)
Relative humidity:	65 %
Atmospheric pressure:	1013mbar (1013 hPa, 14.7 psia)

Additional conditions:
Separating diaphragm material "Hastelloy C" [1], fill fluid "silicone oil"
All specifications are limits and relate to the calibrated range. The influences marked ∗ relate to the measuring range (URL) and are to be multiplied by the turn down factor (URL / adjusted span ratio).
The turn down factor should be kept to a minimum.

Conformity
dp-sensor:
0.075 % [2]
Terminal based, including hysteresis and the dead band (optional 0.05 %)
pabs-sensor:
0.1 %
Process temperature (Pt100):
+/- 0.3 °C

Reproducibility
0.01 %

Hysteresis [2]
0.05 %

Warm-up time
< 15s

Rise time
The time behavior of this transmitter results from the rise time of the sensor and an adjustable integration time constant of the A/D converter. A large time constant leads to high resolution which is necessary, e.g., in case of a large turn down ratio, but it simultaneously implies a longer rise time for the output signal. A small time constant involves low resolution, but a shorter rise time and thus a faster response time of the transmitter. For the integration time constant set by the manufacturer, the values indicated in the table below are valid.

Measuring range	
10mbar (4 inchH_2O)	~ 2.6 s
60mbar (25 inchH_2O)	~ 1.4 s
≥ 400mbar (160 inchH_2O)	~ 0.9 s

Additionally adjustable time constant 0...60s

The effect appearing at the output is to be calculated, depending on the operating point, according to the square root transfer function.

Long-term drift
∗ 0.05% per 12 months

Effect of position

* on zero	approx. 3.5 mbar(1.4 inchH_2O) x sin ∠° (∠° = angular deviation in degrees from the nominal mounting position)

Ambient temperature effect (dp- and pabs-sensor)

Thermal change (-40°C ... +80°C)[3)4)] / (-40°F...+176°F)[3)4)]

* on zero	0.1 %
on span	
dp-sensor	0.1 %
pabs-sensor	0.1 %

Temperature coefficient (-40°C...+80°C)[3)4)] / (-40°F...+176°F)[3)4)]

* on zero	0.04 % per 10K (50 °F)
on span	
dp-sensor	0.04 % per 10K (50 °F)
pabs-sensor	0.04 % per 10K (50 °F)

Static pressure effect

Measuring range 10 mbar

* on zero	0.05 % per 1 bar (14.5 psi)
on span	0.05 % per 1 bar (14.5 psi)

Measuring ranges ≥ 60 mbar

* on zero	0.05 % per 100 bar (1450 psi)
on span	0.05 % per 100 bar (1450 psi)

Effect of electromagnetic interference

* 0.05%

---

1) With Tantalum, Monel or gold-plated separating diaphragms, the factor 1.5 is to be taken into account for conformity, static pressure and ambient temperature effect
2) Additionally, with turn down factor > 1:10

$$\pm(0.005 \times \frac{\text{measuring range}}{\text{adjusted span}} - 0.05)\%$$

3) With measuring range 10mbar / 100 bar (4 inchH_2O / 1450 psi): -20°C ... +60°C (-4°F...+140°F)

4) With carbon fluoride filling liquid: -20°C ... +80°C (-68°F...+176°F)

Ambient conditions

Ambient temperature

-40 °C ... +85 °C (for Viton gasket: -20 °C ... +85 °C)
(-40°F ... +185°F (with O-ring Viton: -4°F ... +185°F)),
observe approvals for explosion-protected transmitters.

Storage temperature / transport temperature

-50 °C ... +85 °C, with LCD indicator: -40 °C ... +85 °C
(-58°F ... +185°F, with LCD-indicator: -40°F ... +185°F)

Humidity

Relative humidity:	≤ 95 % annual average
Condensation, icing:	admissible

Protection class

IP 67 acc. to EN 60 529 (= NEMA Standard type 6);
Plug Han 8U: IP 65 (= NEMA Standard type 4X)

Protective varnish

Epoxy resin, gray white, RAL 9002

Shock resistance

Acceleration:	50g
Duration:	11ms

Vibration resistance

2g up to 1000 Hz, for amplifier housing made of "stainless steel", restricted values are valid (on request)

Electromagnetic compatibility (EMC)

Acc. to EN 50 082-2

Definition:	Class 3
Radio suppression (EN 55 011):	Limit class B

Fulfills NAMUR recommendation.

Process conditions

Temperature limit

-50 °C ... +120 °C (-58°F ... +248°F), at process connection up to +400 °C (752°F) in conjunction with remote seals
With gasket:
• PTFE Viton (fluorocaoutchouc (FPM)): -20 °C ... +120 °C (-4°F ... +248°F)

Pressure limit

Static pressure limits: from 3.5kPa abs. (35mbar abs. / 14 inchH_2O abs.) to the nominal pressure PN. Proof pressure up to 1.5 times the nominal pressure simultaneously on both sides of the sensor admissible.

Overload limit

One-sided overload up to the nominal pressure.

Weight

3.5 kg

Material

Sensor body:	stainless steel
Separating diaphragms:	Hastelloy C ** / stainless steel 1.4435**/Tantalum**/Monel**/gold plated
Process flange:	stainlesssteel 1.4404 ** / Hastelloy C ** / Monel ** / PVDF
Nuts and bolts:	A4 **
Blanking plugs:	as process flange material
Fill fluid:	silicone oil / fluorocarbon
Gaskets:	all ranges: • Viton (FPM); color: green • Perbunan (NBR); color: black • EPDM * , color: black furthermore: • ranges ≥ 60mbar (≥ 24 inchH_2O): PTFE * , color: white max. admissible nominal pressure: ≤ 250bar (≤ 3600 psi), min. admissible operating temperature: -20°C (-4°F) • range 10mbar (4 inchH_2O): FEP sheathed silicone, color: gray
Amplifier housing / Enclosure cover:	aluminum with epoxy resin coat / stainless steel

---

** in compliance with NACE MR0175 Class II

11.1 Process connection

Flange connection with fastening thread 7/16-20 UNF and 1/4-18 NPT female thread on both sides or
flange connection according to DIN 19 213 with fastening thread M10 for PN 6bar / PN 20bar / PN 100bar (90 / 300 / 1500 psi) or M12 for PN 410bar (6000 psi) and 1/4-18 NPT female thread on both sides.

11.2 Electrical connection

Two female threads 1/2-14 NPT or M 20x1.5 or one plug Han 8 U. Screw terminals for wire cross-sections up to 2.5 mm ^{2}.

11.3 Power supply

Transmitters with 4...20mA

Power supply:	10.5 ... 45 V DC (14 ... 45 V DC with backlit LCD indicator), inverse polarity protection, observe the approvals for explosion-proof transmitters
Harmonic distortion:	Max. permissible residual ripple of supply voltage during communication: • 7 Vss at 50Hz ≤ f ≤ 100Hz • 1 Vss at 100Hz < f ≤ 200Hz • 0.2 Vss at 200Hz < f ≤ 300Hz

Fieldbus transmitters

Power supply:	10.2 ... 32 V DC inverse polarity protection, observe the approvals for explosion-proof transmitters

Contamination level

2 according to EN 61 010-1 (ANSI / ISA 82.01)

Overvoltage category

II according to EN 61 010-1 (ANSI / ISA 82.01)

12 Certificates and approvals

Observe mounting conditions according to EN 60079-10; 1966ff!

12.1 Protection class "Intrinsically safe EEx ia"

(according to the directions 94 / 9 / EG (ATEX))

12.1.1 Transmitter with 4...20 mA output signal and HART communication

Marking: II 1/2 GD T 50°C EEx ia IIC T6
II 1/2 GD T 95°C EEx ia IIC T4

EC-Type-Exam. Certificate:

ZELM 01 ATEX 0064 and 1. supplement

Supply and signal circuit type of protection Intrinsic Safety EEx ib IIB/IIC resp. EEx ia IIB/IIC for connection to supply units with maximum values:

II 1/2 GD T 50°C EEx ia resp. ib IIC T6

II 1/2 GD T 95°C EEx ia resp. ib IIC T4

for Temperature class T4:

Ui = 30 V

Ii = 200 mA

Pi = 0.8 W for T4 with Ta = (-40...85)°C / (-40...185)°F

Pi = 1.0 W for T4 with Ta = (-40...70)°C / (-40...158)°F

for Temperature class T6:

Pi = 0.7 W for T6 with Ta = (-40...40)°C / (-40...104)°F

effective internal capacitance Ci $\leq$ 10 nF

effective internal inductivity Li $\approx$ 0

12.1.2 Field Bus transmitters (PROFIBUS / Foundation Fieldbus)

Marking: II 1/2 GD T 50°C EEx ia IIC T6
II 1/2 GD T 95°C EEx ia IIC T4

EC-Type-Examination Certificate:
ZELM 01 ATEX 0063 and 1. supplement

Supply and signal circuit type of protection Intrinsic Safety EEx ia IIB / IIC resp. EEx ib IIB / IIC for connection to FISCO supply units with rectangular or trapezoidal characteristics with maximum values:

II 1/2 GD T 50°C EEx ia resp. ib IIC T6 — Ui = 17.5
II 1/2 GD T 95°C EEx ia resp. ib IIC T4 — Ii = 360 mA
Pi = 2.52 W

II 1/2 GD T 50°C EEx ia resp. ib IIB T6 — Ui = 17.5 V
II 1/2 GD T 95°C EEx ia resp. ib IIB T4 — Ii = 380 mA
Pi = 5.32 W

resp. for connection to supply unit or barrier with linear characteristics maximum values:

II 1/2 GD T 50°C EEx ia resp. ib IIC T6 — Ui = 24 V
II 1/2 GD T 95°C EEx ia resp. ib IIC T4 — Ii = 250 mA
Pi = 1.2 W

effective internal inductance — Li $\leq$ 10 µH,

effective internal capacitance — Ci $\approx$ 0

:

Temperature class	Ambient temperature minimum	Ambient temperature maximum
T4	-40°C -40°F	+85°C +185°F
T5, T6	-40°C -40°F	+40°C +104°F

Tab. 3: Permissible ambient temperature range in dependence on temperature class

12.1.3 Transmitters of category 3 for the application in "Zone 2" according to the directions 94 / 9 / EG (ATEX)

Marking: II 3 GD T 50°C EEx nL IIC T6
II 3 GD T 95°C EEx nL IIC T4

EC-Type-Examination Certificate: ZELM 01 ATEX 3059 and 1.supplement

Operating conditions:

Supply and signal circuit:

(terminals signal + / -): U $\leq$ 45 V
I $\leq$ 22.5 mA

Ambient temperature range:

Temperature class T4: Ta = (-40 ... 85)°C
(-40 ... 185)°F

Temperature class T5, T6: Ta= (-40 ... 40)°C
(-40 ... 104)°F

12.2 Transmitters of the type of protection "flameproof enclosure EEx d"

(according to the directions 94 / 9 / EG (ATEX))

Marking: II 1/2 G EEx d IIC T6

EC-Type-Examination Certificate: PTB 00 ATEX 1018

Ambient temperature range: (-40 ... 75)°C
(-40 ... 167)°F

12.3 Factory Mutual (FM)

12.3.1 Transmitters with 4...20 mA output signal and HART communication

Intrinsically safe: Class I; Division 1; Groups A, B, C, D;
Class I; Zone 0; Group IIC; AEx ia IIC

Degree of protection: NEMA Type 4X (Indoor or outdoor)

U_{max} = 30 V, C_i = 10.5 nF, Li = 10 µH			
Ambient temperature	**Temperature class**	**I_{max}**	**P_i**
(-40 ... 85)°C (-40 ... 185)°F	T4	200 mA	0.80 W
(-40 ... 70)°C (-40 ... 129)°F			1.00 W
(-40 ... 40)°C	T5	25 mA	0.75W
(-40 ... 104)°F	T6		0.50W

Tab. 4: Permissible ambient temperature range in dependence on temperature class

12.3.2 Field Bus transmitters (PROFIBUS / Foundation Fieldbus)

● Intrinsically Safe:

Class I, II, and III Division 1, Groups A, B, C, D, E,F,G;
Class I, Zone 0, AEx ia Group IIC T6; T4

Non- incendive Class I, II, and III, Division 2,
Groups A, B, C, D, F, G

12.3.3 Transmitter 4 ... 20 mA (HART) and Fieldbus

● Explosion-Proof:

Class I, Division 1, Groups A, B, C, D

Class II/III, Division 1, Groups E, F, G

Degree of protection: NEMA Type 4X (Indoor or outdoor)

12.4 Canadian Standard (CSA)

12.4.1 Transmitters 4...20 mA (HART) and Fieldbus

● Explosion-Proof:

Class I, Division 1, Groups B, C, D

Class II/III, Division 1, Groups E, F, G

Degree of protection:NEMA Type 4X (Indoor or outdoor)

Company	
Order No.	
Measuring point	
In charge	
Dept. / Phone	
Date / Signature	
ABB order no.	
ABB Position no.	
ABB in charge	
Dept. phone	

Primary Device	Orifice Corner Taps, ISO	
	Orifice Flange Taps, ISO	
	Orifice D- and D/2-Taps, ISO	
	Orifice Corner Taps, ASME	
	Orifice Flange Taps, ASME	
	Orifice D- and D/2-Taps, ASME	
	Orifice Flange Taps, AGA3	
	Orifice 2,5D- and 8D-Taps	
	Small bore orrifice, flange taps	
	Small bore orrifice, corner taps taps	
	Nozzle ISA 1932	
	Nozzle, Long Radius Wall Tap, ISO	
	Nozzle, Long Radius Wall Tap, ASME	
	Venturi,Rough Cast Inlet, ISO	
	Venturi, Machined Inlet, ISO	
	Venturi, Welded Inlet, ISO	
	Venturi,Rough Cast Inlet, ASME	
	Venturi, Machined Inlet, ASME	
	Venturi, Welded Inlet, ASME	
	Venturi, Nozzle, ISO	
	Area Averaging Meter	
	Pitot tube, ISO 3966	
	V-Cone	
	Wedge Element	
	Integral Orifice Assembly	
	Density Correction (unknown Primary Element)	

Pipe Diameter			mm	
Material Primary Element		Material Pipe		
Carbon steels		Carbon steels		
Stainless steels, ferritic		Stainless steels, ferritic		
Stainless steels, austenitic		Stainless steels, austenitic		
Copper-base alloys		Copper-base alloys		
Brass		Brass		
Nickel		Nickel		
Hastelloy C		Hastelloy C		
Monel		Monel		

Measuring Range				
	max. measuring range	limits of compensation		
		Lower range value	Upper range value	
Differencial pressure				mbar

Abs. pressure	0 ... 20 bar	bar
	0 ... 100 bar	bar
	0 ... 411 bar	bar
Hydrostatic pressure of liquid column (condensate) (requires zero shift for absolute pressure measurement)		mbar
Temperature measurememement (not for saturated steam)	-50 ... +650 °C	°C
Fixed value for temperature		°C

Calculation values primary element			
Medium	Water		
	Saturated Steam		
	Heated Steam		
Abs. pressure		$p_{abs,r}$ =	bar
Temperature measurememement (not for saturated steam)		t_r =	°C
Mass flow rate		$Q_{m,r}$ =	kg/s
Differential pressure		Δpr =	mbar

Isentropic exponent (not for saturated steam and heated steam)	κ =	
Ratio of diameters (not for Integral Orifice Assembly, Area Averaging Meter, Pitot tube, Density Correction)	β = d/D =	
Reynolds number (only for nozzles and orifices)	Re_D =	
Correction Factor Area Averaging Meter [1] (not for water)		
Calculation done for flow		% x Qr

1) Only necessary if Area Averaging Meter is used as primary element.
If factor should not be taken into consideration or is unknown, please add "0"

Measuring Range				
	max. measuring range	limits of compensation		
		Lower range value	Upper range value	
Differencial pressure				mbar
Abs. pressure	0 ... 20 bar			bar
	0 ... 100 bar			bar
	0 ... 411 bar			bar
Hydrostatic pressure of liquid column (requires zero shift for absolute pressure measurement)				mbar
Temperature measuremement (not for saturated steam)	-50 ... +650 °C			°C
Fixed value for temperature				°C

Calculation values primary element			
Medium (Flüssigkeit)			
Abs. presure		$p_{abs,r}$ =	bar
Temperature		t_r =	°C
Density		ρ_r	kg/m^3
Mass flow rate		$Q_{m,r}$ =	kg/s
Differential pressure		Δpr =	mbar

Ratio of diameters (not for Integral Orifice Assembly, Area Averaging Meter, Pitot tube, Density Correction)	$\beta = d/D$ =	
Reynolds number (only for nozzles and orifices)	Re_D =	
Calculation done for flow		% x Qr

Masurement of liquid Density = f(t), (p = const.)	
t (°C)	ρ ($kg/m^{3)}$

Min.2, max. 6 value pairs necessary

Measuring Range				
	Max. range	Limits of compensation		
		Lower range value	Upper range value	
Differencial pressure				mbar
Abs. pressure	0 ... 20 bar			bar
	0 ... 100 bar			bar
	0 ... 411 bar			bar
Temperature measurement	-50 ... +650 °C			°C
Fixed value for temperature				°C

Calculation values primary element			
Medium (Gas)			
Abs. pressure	$p_{abs,r}$ =		bar
Temperaturr	t_r =		°C
Standard density	ρ_n		kg/m^3
Density	ρ_r		kg/m^3
Standard volume flow rate	$Q_{m,r}$ =		kg/s
Differencial pressure	Δpr =		mbar

Ratio of diameters (not for Integral Orifice Assembly, Area Averaging Meter, Pitot tube, Density Correction)	β = d/D =	
Reynolds number (only for nozzles and orifices)	Re_D =	
Isentropic exponent	κ =	
Correction Factor Area Averaging Meter[1)]		
Calculation done for flow		% x Qr

[1)] Only necessary if Area Averaging Meter is used as primary element.
If factor should not be taken into consideration or is unknown, please add "0"

K-factor should be also compensated,
then the following table has to be fullfilled

If the influence of temperature and pressure on real gas factor /

For correction of real gas factor / compressibility factor						
Real gas factor Z = f(p,t) [1)]			Please mark with cross where applicable			
Compressibility factor K = Z/Zn [1)]						
t (×C)	min =		average =		max =	
pabs(bar)						
min =						
mittel =						
max =						

Linearization Primary Element

If the non-linearity is known for a primary element, e. g. from calibration, a linearization can be done with max. 22 pairs of values. Enter these values (actual differential pressure and ideal theoretical differential pressure) into the table below.

Input	Differencial Pressure
act. value [%]	set point [%]
0	0
100%	100%

13 Dimensional Drawings

Transmitter with barrel-type amplifier housing

Errors and omissions excepted. All dimensions in inches; mm in brackets

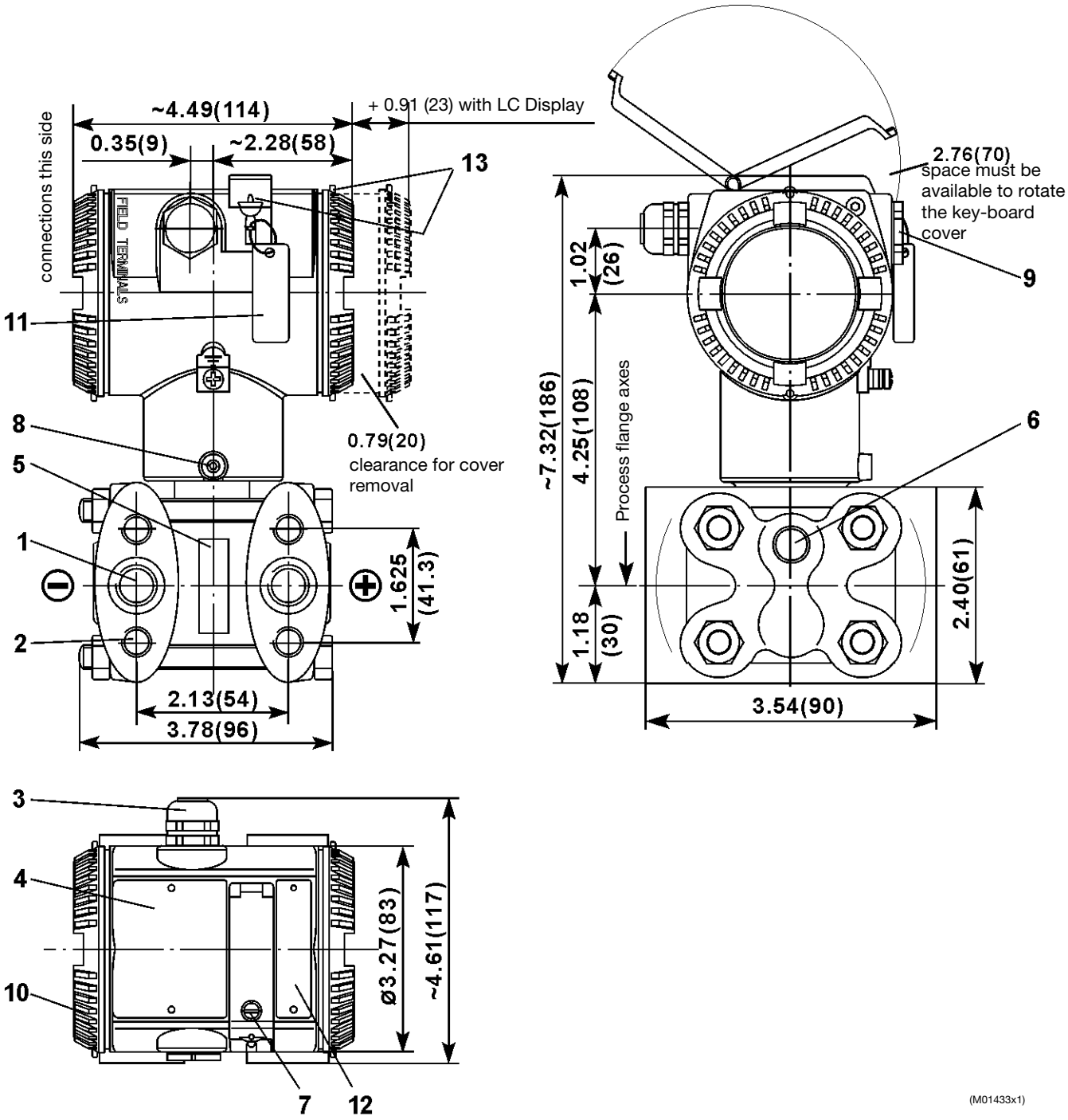


Figure 21.

1 1/4-18 NPT female thread for process connection or screw plug

2 Thread for fastening screws:
7/16-20 UNF, 16mm deep. Minimum screw-in length: 12mm; however, 15mm for PN 410.
For flange acc. to DIN 19 213: M10 with PN 6, PN 20 and PN 100
M12 with PN 410. Minimum screw-in length acc. to DIN 19 213

3 Electrical connection:
M 20x1.5 cable gland or
1/2-14 NPT female thread or
plug Han 8U

4 Type plate

5 Sensor plate

6 Threaded hole 1/4-18 NPT for drain or vent valve

7 Captive screw for key unit cover

8 Housing rotation stop screw

9 Blind plug

10 Enclosure cover

11 Tie-on plate, e.g., for measuring point identification (optional)

12 Plate, also with key legend.

13 Fastener for seal ring (cover and key-board cover)

Transmitter with DIN-type amplifier housing

Errors and omissions excepted. All dimensions in inches; mm in brackets.

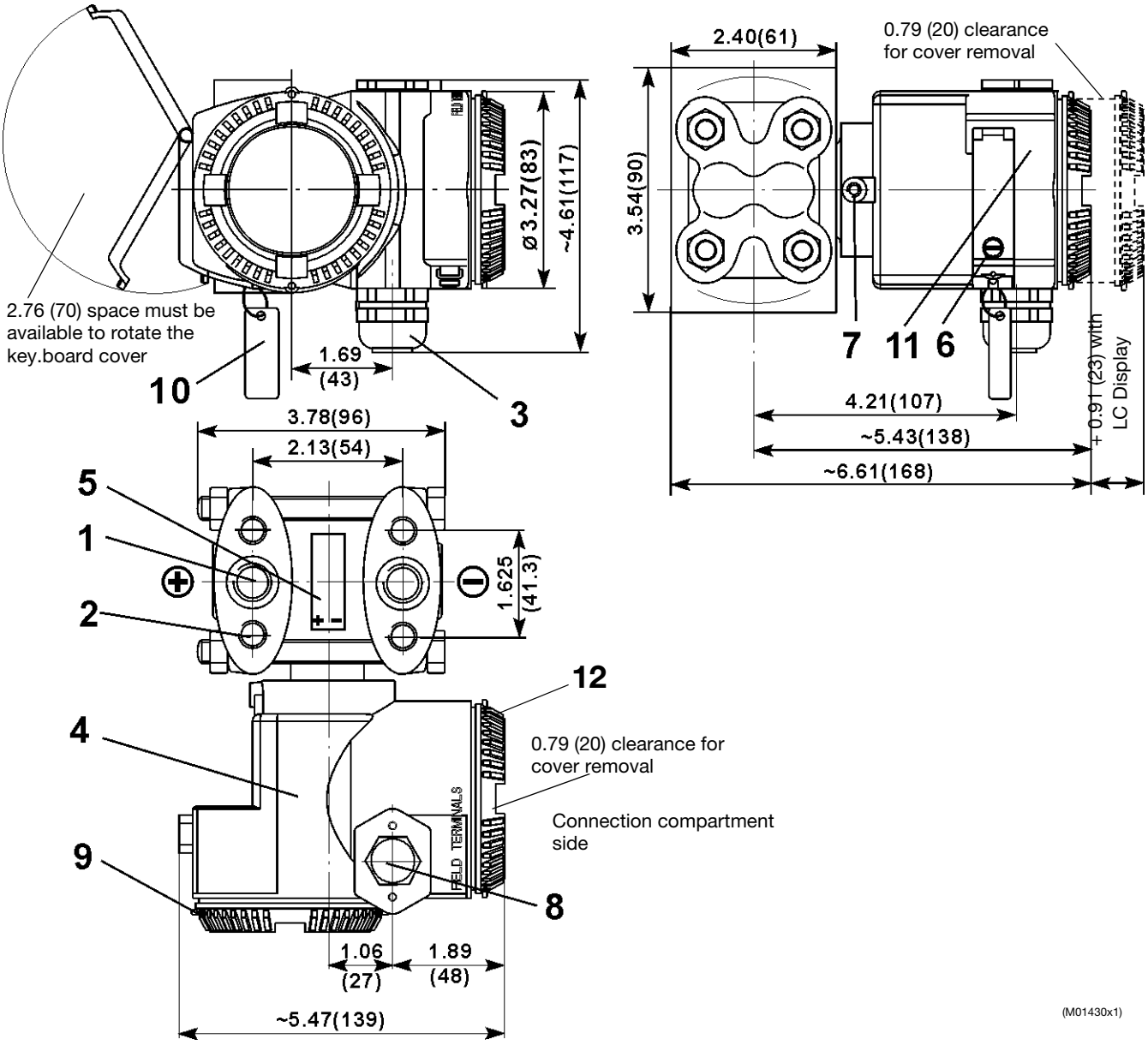


Figure 22.

1 1/4-18 NPT female threadfor process connection or screw plug
2 Thread for fastening screws:
7/16-20 UNF, 16mm deep. Minimum screw-in length:
12mm; however, 15mm for PN 400.
For flange acc. to DIN 19 213: M10 with PN 6, PN 20 and PN 100, M12 with PN 410.
Minimum screw-in length acc. to DIN 19 213.
3 Electrical connection:
M 20x1.5 cable gland or
1/2-14 NPT female thread or plug Han 8U
4 Type plate
5 Sensor plate
6 Captive screw for key unit cover
7 Housing rotation stop screw
8 Blind plug
9 Enclosure cover
10 Tie-on plate, e.g. for measuring point identification (optional).
11 Plate, also with key legend
12 Fastener for seal ring (cover and key-board cover)

14 Mounting Options

With bracket for barrel type electronic housing.

(optional, code 143 / 144)
Errors and omissions excepted. All dimensions in mm.

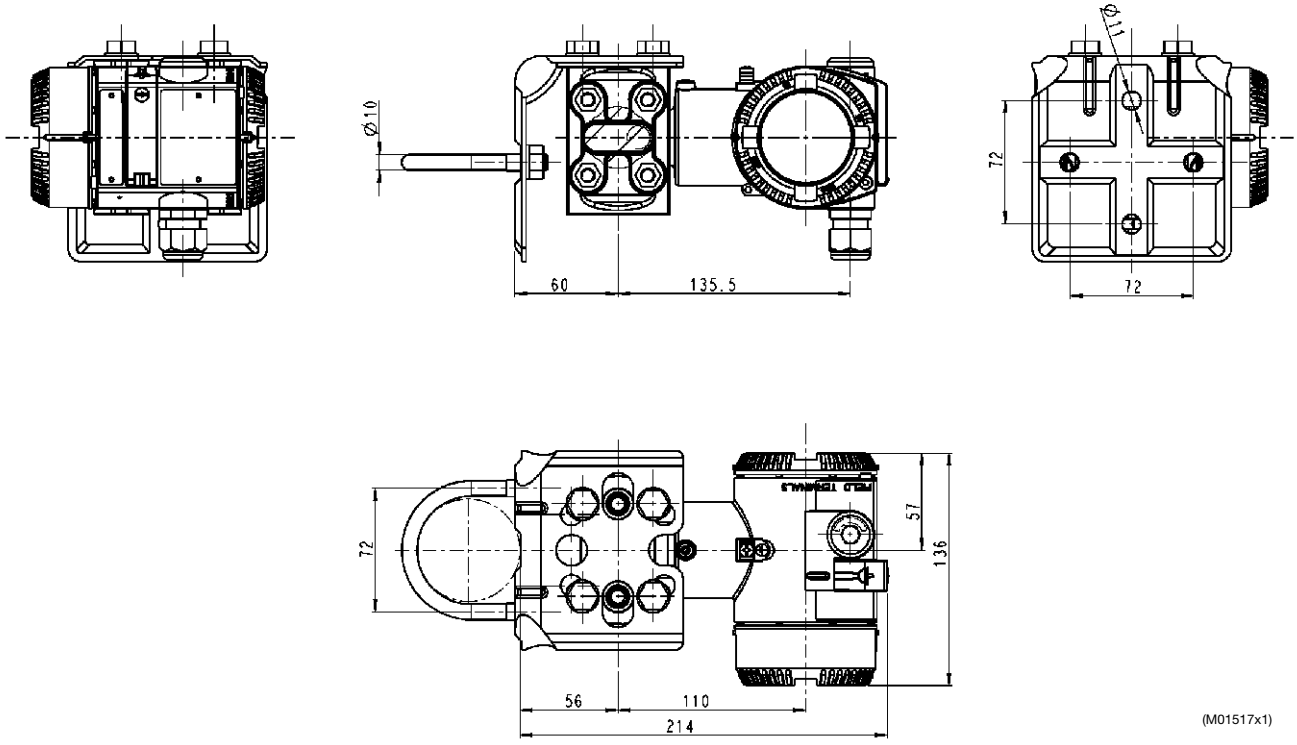


Fig. 23:

Vertical pipe mounting

Horizontal pipe mounting

Vertical pipe mounting and transmitter above the mounting bracket

Horizontal pipe mounting and transmitter above the mounting bracket

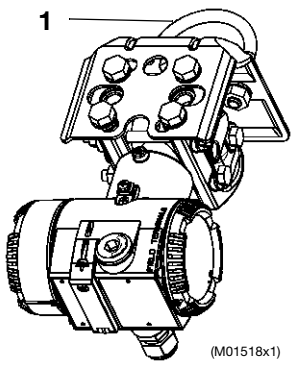


Fig. 24:

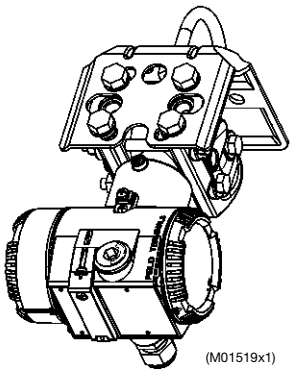


Fig. 25:

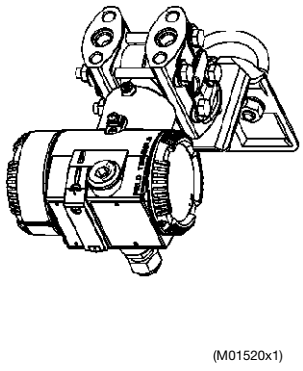


Fig. 26:

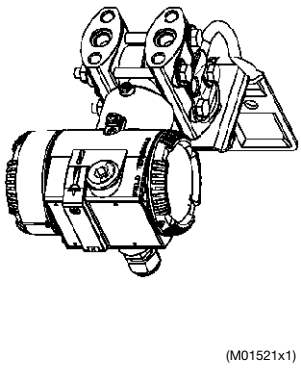


Fig. 27:

1 U-bolt for pipe mounting. Pipe: 2“ (int. diam.) Permissible pipe diam. 53...64 mm

EG-KONFORMITÄTSERKLÄRUNG

EC DECLARATION OF CONFORMITY
ATTESTATION DE CONFORMITE C.E.

Hersteller: *Manufacturer / Fabricant:*	**ABB Automation Products GmbH** **Minden**
Anschrift: *Address / Adresse:*	**Schillerstraße 72** **D-32425 Minden**
Produktbezeichnung: *Product name:* *Désignation du produit:*	**Messumformer Multi Vision – 2010TA, 2010TC, 2010TD, 2020TA, 2020TG** *Transmitter Multi Vision –2010TA, 2010TC, 2010TD, 2020TA, 2020TG* *Transmetteur Multi Vision – 2010TA, 2010TC, 2010TD, 2020TA, 2020TG*

Das Produkt stimmt mit den Vorschriften folgender Europäischer Richtlinien überein:
This product meets the requirements of the following European directives:
Les produits répondent aux exigences des Directives C.E. suivantes:

89/336/EWG *89/336/EEC* *89/336/C.E.E.*	**EMV-Richtlinie *** *Electromagnetic Compatibility Directive ** *Directives concernant la compatibilité électromagnétique **
73/23/EWG *73/23/EEC* *73/23/C.E.E.*	**Niederspannungsrichtlinie *** *EC-Low-Voltage Directive ** *Directives concernant la basse tension **
97/23/EG *97/23/EEC* *97/23/C.E.E.*	**Druckgeräterichtlinie, Kategorie I Modul A** *Pressure Instruments Directive* *Directives concernant les appareils soumis à pression*

Für Geräte in Ex-Ausführung gemäß Kennzeichnung auf Typschild gilt zusätzlich:
For products in Ex design according to identification on nameplate the following is additionally applicable:
Pour des produits en exécution Ex selon marque sur plaque signalétique le suivant est aussi applicable:

94/9/EG *94/9/EEC* *94/9/C.E.E.*	**ATEX-Richtlinie** *ATEX Directive* *ATEX Directive*

*** einschließlich Änderungen und deutscher Umsetzung durch das EMVG und Gerätesicherheitsgesetz**
* *including alterations and German realization by the EMC law and the instruments safety law*
* *y compris les modifications et la réalisation allemande par la loi concernant la compatibilité électromagnétique et la sécurité d'appareils*

Die Übereinstimmung mit den Vorschriften dieser Richtlinien wird nachgewiesen durch die vollständige Einhaltung folgender Normen:
Conformity with the requirements of these Directives is proven by complete adherence to the following standards:
La conformité avec les exigences de ces directives est prouvée par l'observation complète des normes suivantes:

EN 50 081-1 / EN 50 082-2 / EN 61 010-1
Ex: EN 50 014 / EN 50 284 / EN 50 018 / EN 50 020

08.05.2001		
Datum *Date* *Date*	**Dr. Wolfgang Scholz** **Leiter R&D Transmitter** Head of R&D Transmitter Responsable R&D Transmetteur	**Bernd Swider** **Leiter Qualitätsmanagement** Head of Quality Management Responsible Assurance de la Qualité

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Subject to technical changes.

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