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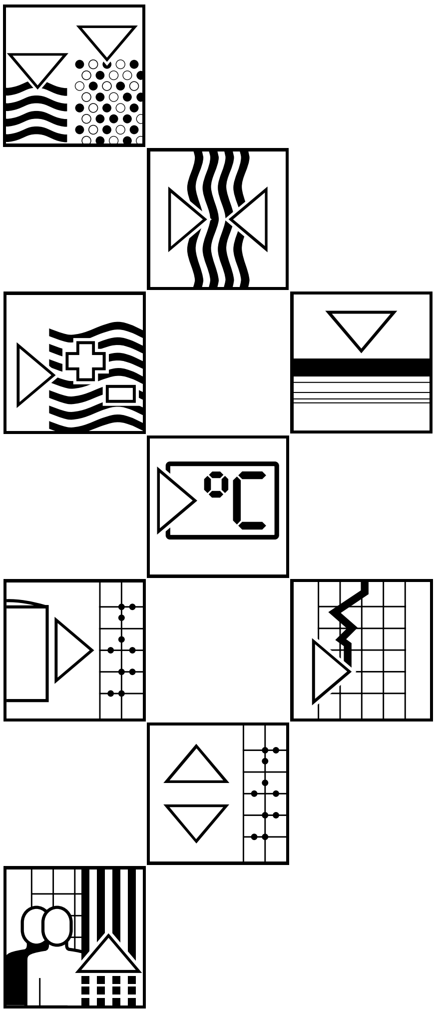
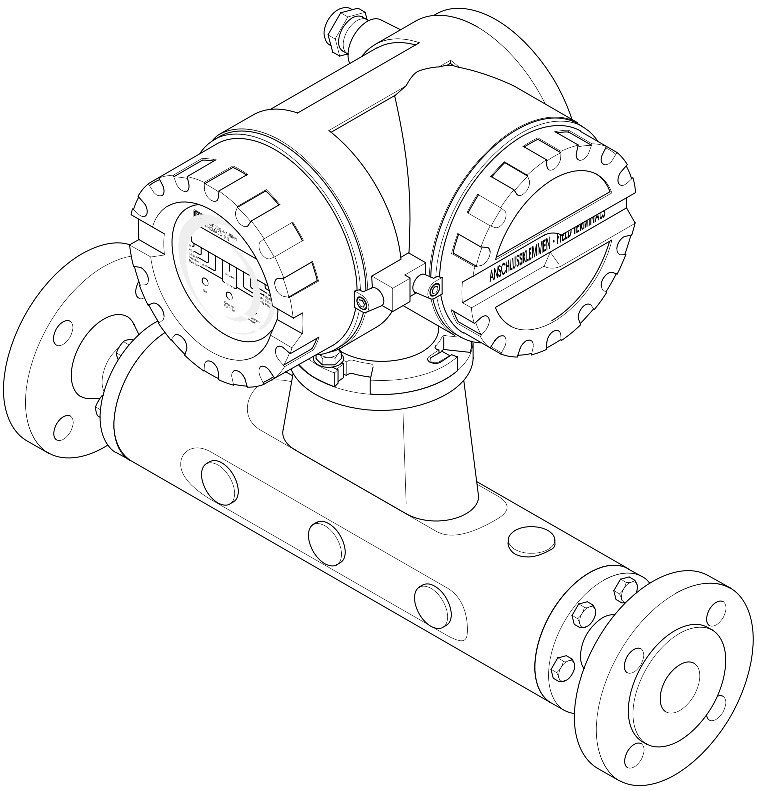
V3.02.XX (communications)

promass 60 (HART ®) Mass Flow Measuring System

Operating Manual





Endress+Hauser
The Power of Know How

Brief Operating Instructions

With the following instructions, you may configure your measuring instrument quickly and easily.

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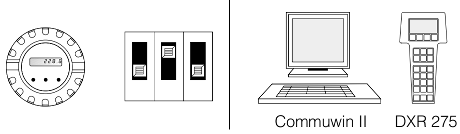
- Mounting → page 11
- Electrical connection → page 17

Selection of operating mode
→ page 21

DIP switches & local display

HART protocol via



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- Engineering units (US/SI) → page 22
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Auxiliary input → page 55

For optimum measuring accuracy
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- Empty pipe detection → page 51

Contents

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1 Safety Instructions

1.1 Correct usage

- The Promass 60 is only to be used for measuring the mass flow rate of liquids and gases. At the same time, the system also measures fluid density and thus allows calculation of volume flow.
- The manufacturer assumes no liability for damage caused by incorrect use of the instrument.
- Instruments which are used in the explosion hazardous area are supplied with a separate “Ex documentation”, which is an *integral part of this Operating Manual.* The instructions and connected loads provided in this supplement must absolutely be observed. An appropriate icon is shown on the front page of the Ex documentation according to the approval given and the test centre.

1.2 Dangers and notes

All instruments are designed to meet state-of-the-art safety requirements. They have been tested, and have left the works in an operationally perfectly safe condition. The devices were developed according to EN 61010 “Protection Measures for Electronic Equipment for Measurement, Control, Regulation and Laboratory Procedures”). A hazardous situation may occur if the flowmeter is not used for the purpose it was designed for or is used incorrectly. Please carefully note the information provided in this Operating Manual indicated by the following pictograms:

Warning!
A “warning” indicates actions or procedures which, if not performed correctly, may lead to personal injury or a safety hazard.
Please strictly observe the instructions supplied and proceed carefully.

Caution!
A “caution” indicates actions or procedures which, if not performed correctly, may lead to faulty operations or the destruction of the instrument.
Please strictly observe the respective instructions.

Note!
A “note” indicates actions or procedures which, if not performed correctly, may indirectly affect operations or lead to an unexpected instrument response.

1.3 Operational safety

- The Promass 60 measuring system fulfils all general requirements for electromagnetic compatibility (EMC) according to EN 50081 Part 1 and 2 / EN 50082 Part 1 and 2 as well as the NAMUR recommendations.
- Extensive self-monitoring of the measuring system gives operational safety. Any errors which may occur are given at the configured status output, e.g. power failure, system error, etc.
- On power failure, all data of the measuring system are safely stored in the EEPROM (no batteries required).

1.4 Personnel for installation, start-up and operation

- Mounting, electrical installation, start-up and maintenance of the instrument may only be carried out by trained personnel authorized by the operator of the facility. Personnel must absolutely and without fail read and understand this Operating Manual before carrying out its instructions.
- The instrument may only be operated by personnel who are authorized and trained by the operator of the facility. All instructions in this Manual are to be observed without fail.
- In case of corrosive fluids, the resistance of the material of all wetted parts such as measuring tubes, gaskets, and process connections is to be verified. This also applies to fluids used to clean the Promass sensor (for wetted parts materials → see page 92). Endress+Hauser will be glad to provide information and help.
- Please observe all provisions valid for your country and pertaining to the opening and repairing of electrical devices.
- The installer has to make sure that the measuring system is correctly wired according to the wiring diagrams. The measuring system is to be grounded.

Warning!

Danger from electric shock!
With the housing cover removed, protection against accidental contact is no longer present.
Components with high voltages are exposed below the local display (danger from electric shock). When programming according to section 5.3, avoid any contact with the electronic components which lie below the local display, and do not use any electrically conductive object to depress the programming keys.

1.5 Repairs, dangerous chemicals

The following procedures must be carried out before a Promass 60 flowmeter is sent to Endress+Hauser for repair:
- A note must always be enclosed with the instrument, containing a description of the fault, the application, and the chemical and physical properties of the product being measured.
- Remove all residue which may be present. Pay special attention to the gasket grooves and crevices where fluid may be present. This is especially important if the fluid is dangerous to health, e.g. corrosive, poisonous, carcinogenic, radioactive, etc.
- No instrument should be returned to us without all dangerous material being removed first, e.g. in scratches or diffused through plastic.

Incomplete cleaning of the instrument may result in waste disposal or cause harm to personnel (burns, etc.). Any costs arising from this will be charged to the owner of the instrument.

1.6 Technical improvements

The manufacturer reserves the right to modify technical data without prior notice. Your local E+H Sales Office will supply you with all current information and any updates to this Operating Manual.

2 Description of the System

2.1 Application

The Promass 60 measuring system measures the mass and volume flow of fluids having widely differing characteristics:
- Chocolate, condensed milk, syrup
- Oils, fats
- Acids, alkalis
- Varnishes, paints
- Suspensions
- Pharmaceuticals, catalytic converters, inhibitors
- Gases, etc.

The Promass 60 is used wherever mass flow measurement is of critical importance:
- Mixing and batching of various raw materials
- Controlling of processes
- Measurement of fluids with quickly changing densities
- Control and monitoring of product quality

The advantages of this measurement process are demonstrated by its successful use in food processing, the pharmaceutical industry, the chemical and petrochemical industries, waste disposal, energy production, etc.

2.2 Measuring principle

The measuring principle is based on the controlled generation of Coriolis forces. These forces are always present when both translational (straight line) and angular (rotational) movement occur simultaneously.

$\vec{F}_C \quad = 2 \cdot \Delta m \, (\vec{\omega} \times \vec{v})$

$\vec{F}_C$ = Coriolis force
Δm = mass of moving body
$\vec{\omega}$ = angular velocity
$\vec{v}$ = radial velocity in a rotating or oscillating system

The amplitude of the Coriolis force depends on the moving mass Δm, its velocity in the system $\vec{v}$ and therefore its mass flow.

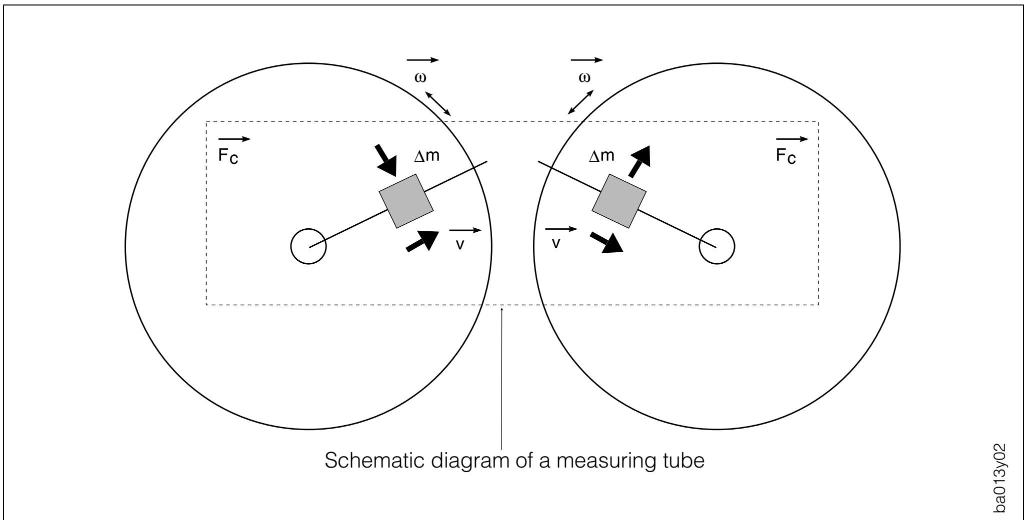
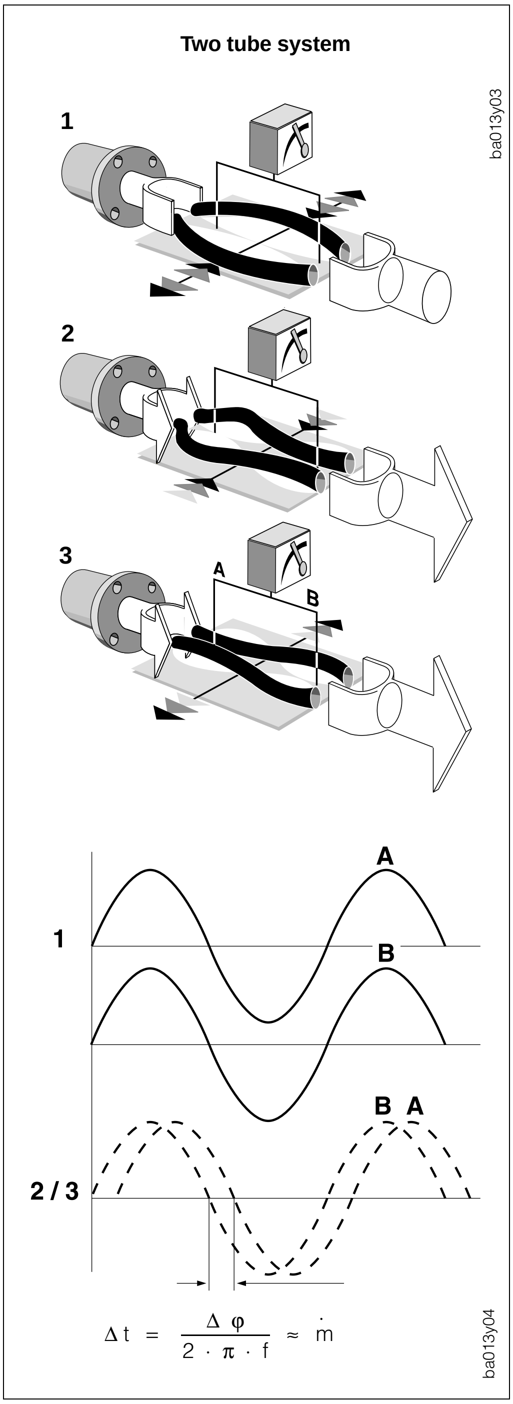


Fig. 1:
Coriolis forces in the Promass measuring tubes

Fig. 2:
Phase shift of tube vibration with mass flow.



The Promass uses an oscillation instead of a constant angular velocity $\vec{\omega}$ and two parallel measuring tubes (Promass M and F), with fluid flowing through them, are made to oscillate in antiphase so that they act like a tuning fork.
The Coriolis forces produced at the measuring tubes cause a phase shift in the tube oscillation (see Fig. 2):

- When there is zero flow, i.e. with the fluid standing still, both tubes oscillate in phase (**1**).
- When there is mass flow, the tube oscillation is decelerated at the inlet (**2**) and accelerated at the outlet (**3**).

As the mass flow rate increases, the phase difference also increases (**A-B**). The oscillations of the measuring tubes are determined using electrodynamic sensors at the inlet and outlet.

Unlike Promass M and F, Promass A and I only has a single measuring tube. However, the measuring principle and function of all sensors are identical.

The operating principle is independent of temperature, pressure, viscosity, conductivity or flow profile.

Balanced Measuring System

Two-tube system (Promass M, F)

The system balance is ensured by the two measuring tubes vibrating in antiphase.

Single tube system (Promass A, I)

For single tube systems, other design solutions are necessary for system balance than for two-tube systems.

Promass A:
For Promass A, an internal reference mass is used for this purpose.

Promass I:
For Promass I, the system balance necessary for flawless measurement is generated by exciting an eccentrically located, counter-oscillating pendulum mass.
This TMB™ (Torsion Mode Balanced) system is patented and guarantees accurate measurement, also with changing process and ambient conditions. The installation of Promass I is for this reason just as easy as with two-tube systems! Special fastening measures before and after the meter are therefore not necessary.

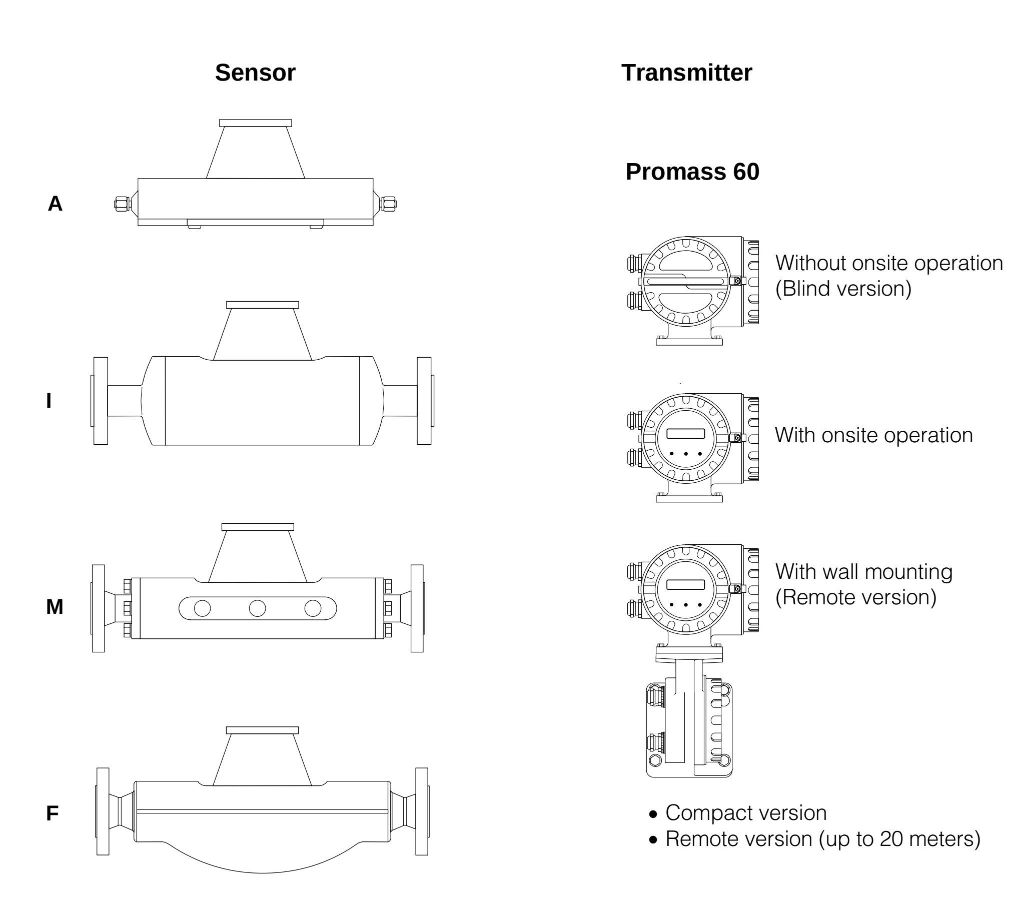
Density measurement
The measuring tubes are always made to oscillate at their resonant frequency.
This excitation frequency adjusts automatically as soon as the mass, and therefore the density, of the oscillating system changes (measuring tubes and fluid).
The resonant frequency is thus a function of the density of the fluid and enables the microprocessor to produce a density signal.

Temperature measurement
The temperature of the measuring tubes is determined and used to compensate for temperature effects. The signal produced is a function of the product temperature.

2.3 The Promass 60 measuring system

The Promass 60 measuring system is mechanically and electronically designed for maximum flexibility with the transmitters and sensors being combined in any variation.

The measuring system consists of:
- Transmitter: Promass 60
- Sensor: Promass A, I, M or F



A	DN 1... 4:	For very small flow quantities, single tube system in SS or Alloy C-22
I	DN 8... 50:	Single straight tube system (titanium), completely welded version
M	DN 8... 80:	Two straight measuring tubes (titanium), containment vessel up to 100 bar
	DN 8... 25:	High pressure version, system pressure up to 350 bar
F	DN 8...100:	Two slightly curved measuring tubes in SS or Alloy C-22 (only for DN 8...80), completely welded version

Technical data: see page 87

ba013y05

Fig. 3:
Promass 60 measuring system

Caution!
The Promass 60 measuring system is available with various Ex approvals.
Your E+H representative will be pleased to supply information on the approvals available at present.
All Ex information and specifications are included in a separate documentation which can be sent by E+H on request.

Caution!

3 Mounting and Installation

Warning!

Warning!
- All instructions given in this section are to be observed at all times in order to ensure safe and reliable operation of the measuring system.
- Mounting regulations and technical specifications for Ex-certified instruments may differ from those given below. All mounting regulations and connection values in the Ex documentation must, therefore, be strictly observed.

3.1 General information

Protection IP 67 (EN 60529)
The instruments fulfil all the requirements for IP 67. After successful installation in the field or after servicing, the following points must always be observed in order to ensure protection to IP 67:

- Housing gaskets must be clean and undamaged when inserted in the gasket groove. The gaskets may need to be dried, cleaned or replaced.
- All housing screws and the housing cover must be firmly tightened.
- The cables used for connecting must have the correct outer diameter.
- The cable gland must be firmly tightened (see Fig. 4).
- The cable must loop down before entering the cable gland to ensure that no moisture can enter it (see Fig. 4).
- Any cable gland not used must be replaced with a blind plug.
- The protective bush should not be removed from the cable gland.

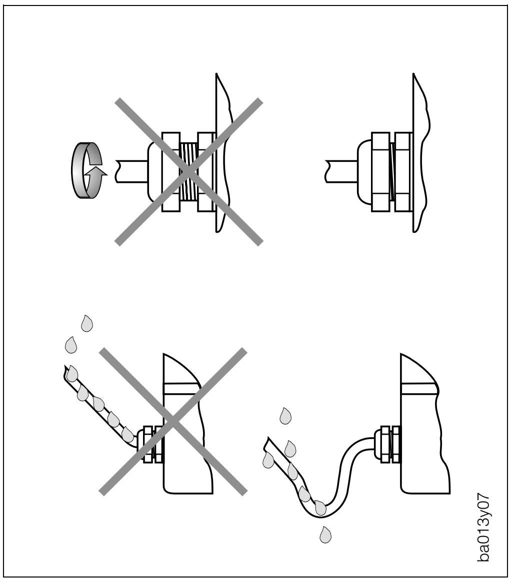
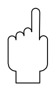


Fig. 4:
Mounting notes for cable glands

Temperature ranges
- The maximum approved ambient and fluid temperatures must be observed (see page 91)
- An all-weather cover should be used to protect from direct sunlight when mounting in the open. This is especially important in warmer climates and with high ambient temperatures.

Tracing, thermal insulation
With certain fluids heat transfer at the sensor must be avoided. A wide range of materials can be used to assure the necessary insulation.
Heating can be provided either electrically, e.g. by heating sheets or supplied by copper pipes with heated water or steam. Heating elements for heat tracing are available for all sensors.



Caution!

Caution!
Danger of the electronics overheating! The connector between the sensor/transmitter housings of the compact version must not be insulated or heated.
The connection housing of the remote version should also be kept free.
Depending on the fluid temperature, certain installation positions are to be observed (see Fig. 8).

System pressure
It is important to avoid cavitation as this can affect the oscillation of the measuring tubes.

- No special measures need be taken for fluids which have properties similar to those of water under normal conditions.
- With volatile liquids (hydrocarbons, solvents, liquified gas), the vapour pressure must not drop below a point where the liquid then begins to boil.
  It is also important not to release gases which are found naturally in many liquids. This can be prevented by maintaining a high enough system pressure.

Note!

Note!
Ideally the sensor should be mounted

- on the discharge side of pumps (avoiding low pressure)
- at the lowest point of a vertical piping

Purge connections
The sensor second containment vessel is filled with dry nitrogen (N_2). The purge connection is only to be opened when the vessel is afterward immediately filled with a dry, inert gas (corrosion protection!).

3.2 Transport to the measuring point (DN 40...100)

For transport, measuring instruments with nominal diameters of DN 40...100 may not be lifted at the transmitter housing or at the connection housing of the remote version.

Use shoulder straps for transport to the measuring points and wrap them around both process connections (see Fig. 5). Avoid using chains as this might damage the housing, e.g. scratch the coat of lacquer.

Warning!

Warning!
Danger of injury by slipping measuring instrument. The centre of gravity of the entire device is higher than the two suspension points of the shoulder straps. Make sure that the device does not turn or slip due to the higher centre of gravity during transport.

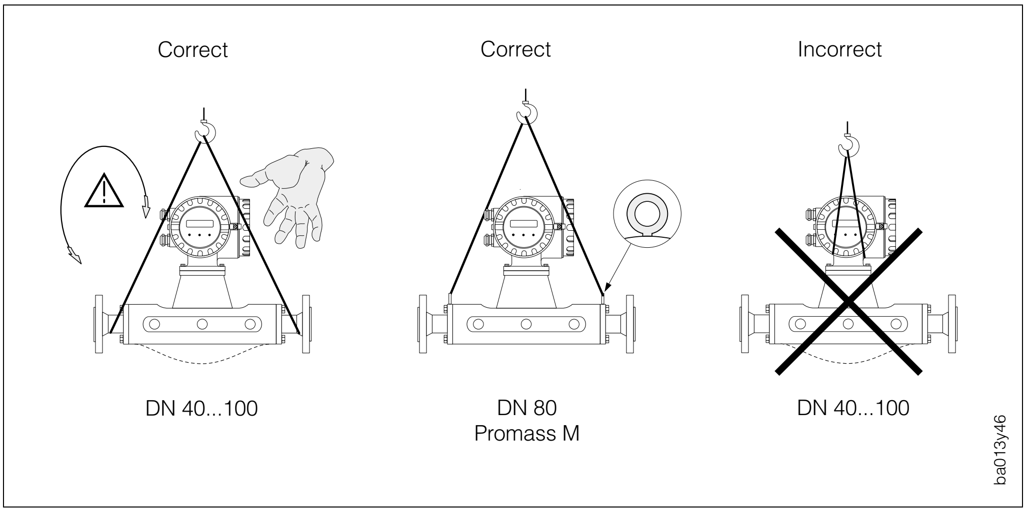


Fig. 5:
Transporting the sensor DN 40...100

3.3 Mounting

- No special fittings such as brackets are required. External forces are absorbed by the construction of the device, e.g. by the containment vessel.
- For mechanical reasons, and to protect the pipeline, support is recommended for heavy sensors.
- Due to the high frequency of the measuring tubes, the Promass 60 measuring system is unaffected by plant vibration.
- When mounting, no special precautions need to be taken for turbulence-generating devices (valves, bends, T-pieces, etc.) as long as no cavitation occurs.

The following installation instructions are to be carried out for correct operation of the measuring system:

Orientation (Promass A)

Vertical
This is best with the flow direction upwards. Entrained solids sink downward and gases rise away from the measuring tube when the product is not flowing. This also allows the measuring tube to be completely drained and protects it from solids build-up.

Horizontal
When correctly installed, the transmitter housing is either above or below the piping. This assures that no gas bubbles may collect or solids be deposited in the curved measuring tube.

Wall and post mounting
The sensor may not be suspended in the piping, that is, without support or fixation to avoid excessive stress on the material around the process connection.

The sensor housing base plate allows a table, wall, or post mounting. The post mounting requires a special mounting set:

DN 1, 2: Order No. 50077972
DN 4: Order No. 50079218

DN	A [mm]	B [mm]
1	145	160
2	145	160
4	175	220

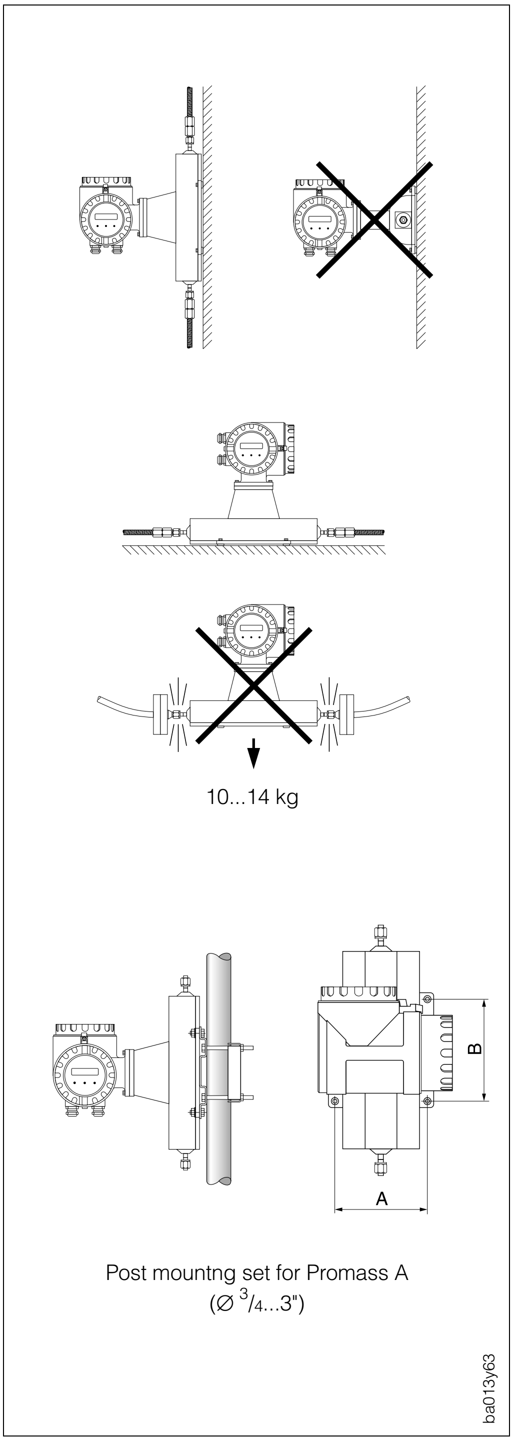


Fig. 6:
Orientation Promass A

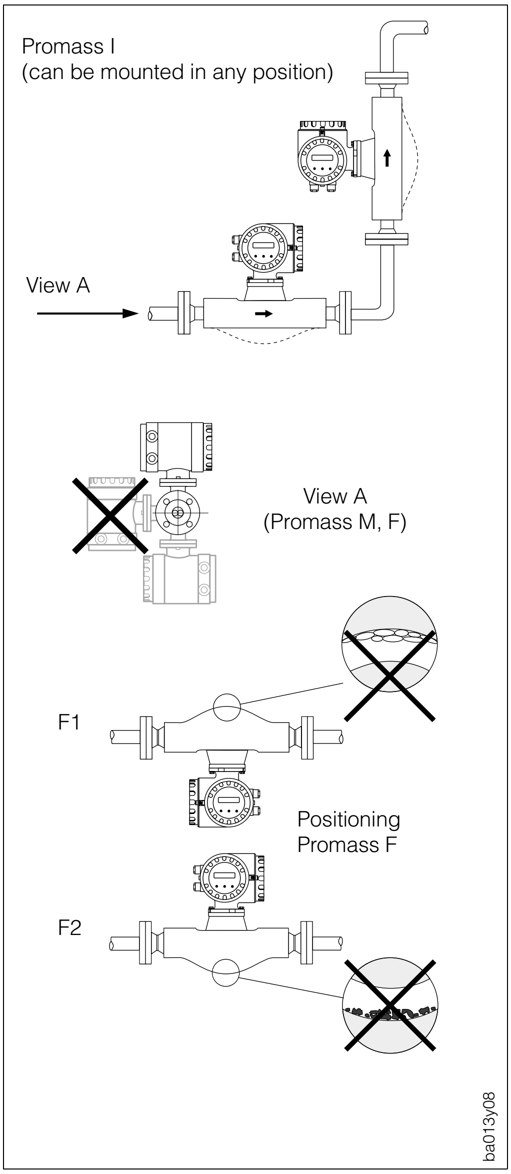


Fig. 7:
Orientation Promass I, M, F

Orientation (Promass I, M, F)

Vertical
This is best with the flow direction upwards. Entrained solids sink downward and gases rise away from the measuring tubes when the product is not flowing. This also allows the measuring tubes to be completely drained and protects them from solids build-up.

Horizontal
- Promass I (single tube):
  Because of the straight measuring tube, the sensor can be mounted in any position of the piping.

- Promass M, F:
  The measuring tubes must lie side by side. When correctly installed, the transmitter housing is either above or below the piping (see view A).

- Promass F:
  Promass F measuring tubes are slightly curved. Therefore, the sensor position is to be adapted to the fluid properties for horizontal installation:

  F1: not suitable for outgassing fluids
  F2: not suitable for fluids with solids content

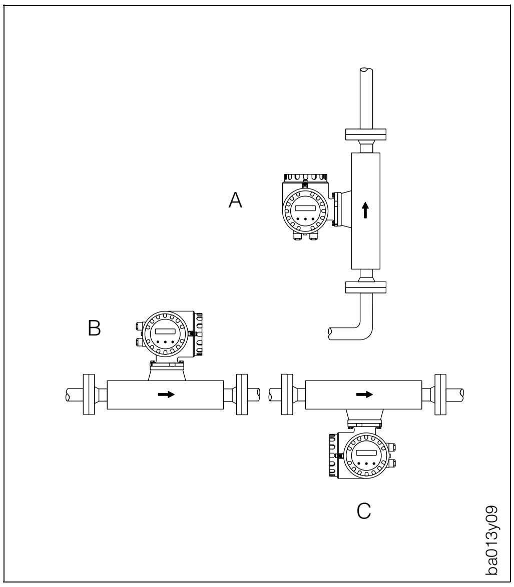


Fig. 8:
Fluid temperature and orientation

Fluid temperature/orientation

To ensure that the permitted ambient temperature range for the transmitter is not exceeded (-25...+60 °C) positioning is recommended as follows:

High fluid temperature
- Vertical piping: Position A
- Horizontal piping: Position C

Low fluid temperature
- Vertical piping: Position A
- Horizontal piping: Position B

Mounting location

Air or entrained gases in the measuring tube may cause errors in measurement and therefore the following mounting installations are to be avoided:

- Do not install at the highest point of the piping.
- Do not install in a vertical pipeline directly upstream of a free pipe outlet.

Correct installation is still possible using the recommendation in the adjacent Figure. Restrictions in the piping or an orifice with a smaller cross section than the measuring instrument can prevent the sensor from running empty during measurement.

Nominal diameter	Ø Orifice/restriction
DN 1	0.8 mm
DN 2	1.5 mm
DN 4	3.0 mm
DN 8	6.0 mm
DN 15	10.0 mm
DN 15 *	15.0 mm
DN 25	14.0 mm
DN 25 *	24.0 mm
DN 40	22.0 mm
DN 40 *	35.0 mm
DN 50	28.0 mm
DN 80	50.0 mm
DN 100	65.0 mm

* DN 15, 25, 40 “FB” =
Full bore versions of Promass I

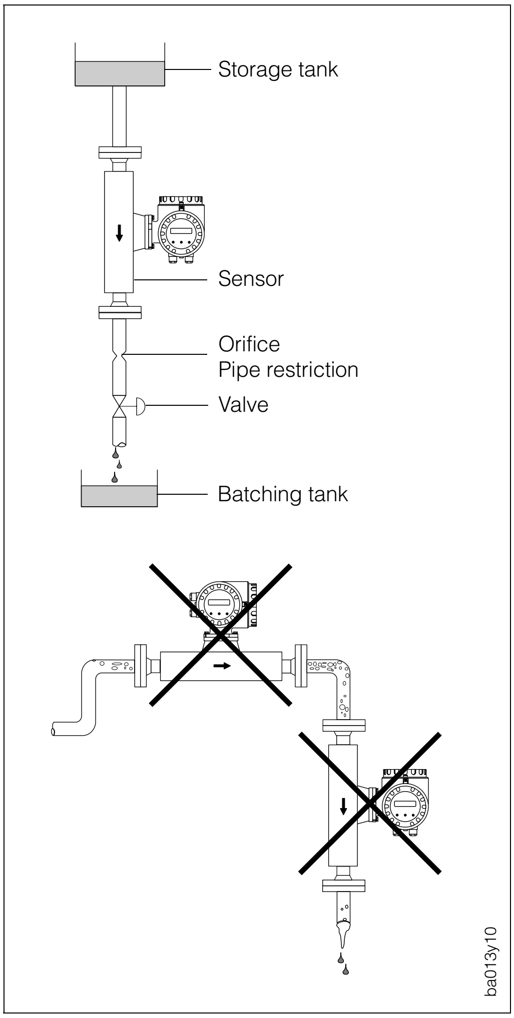
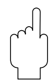


*Fig. 9:
Mounting location (vertical piping)*

Mounting the transmitter

A wall bracket for the transmitter housing and a 10 or 20 meter, ready-to-use, sensor connection cable is in the scope of supply for the remote version.



Caution!

Caution!

- Please pay attention to page 19 “Connecting the Remote Version”.
- Fix the cable or fix it in a conduit.
- Do not lay cable in the vicinity of electrical machines or switching elements.
- In case of the remote version, the connection housing of the sensor may not be insulated.
- Ensure potential equalisation between the transmitter and the sensor (see page 19).

For post mounting a special mounting set is available (Order No. 50076905).

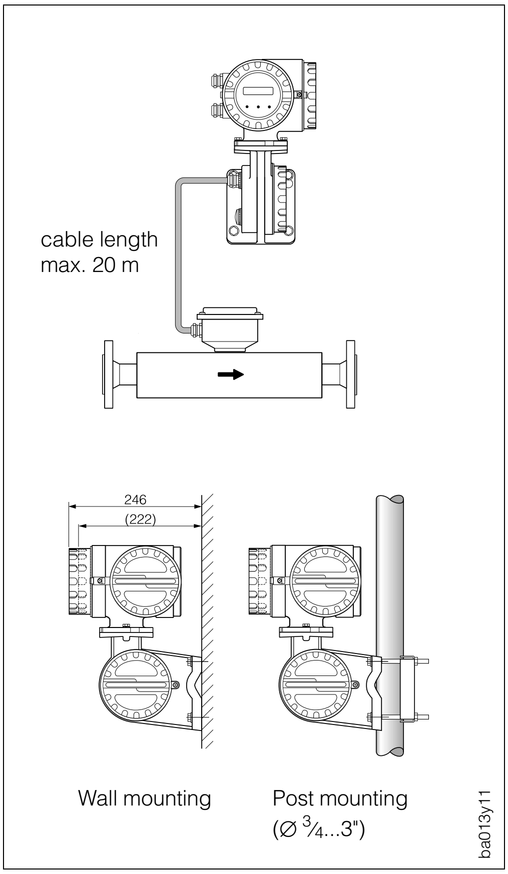


*Fig. 10:
Mounting the transmitter
(Remote version)*

3.4 Rotating the transmitter housing and local display

With the compact version, the transmitter housing and the display field can be rotated in 90° steps so that the instrument can be mounted in almost any position in the piping to ensure easy handling and read-off.

Warning!

Warning!
The following description does not apply to Ex-certified measuring instruments. Please observe the respective, separate Ex documentation in every detail.

Rotating the transmitter housing

❶ Loosen the mounting screws (approx. two turns).

❷ Rotate the transmitter housing as far as the groove of the nut.

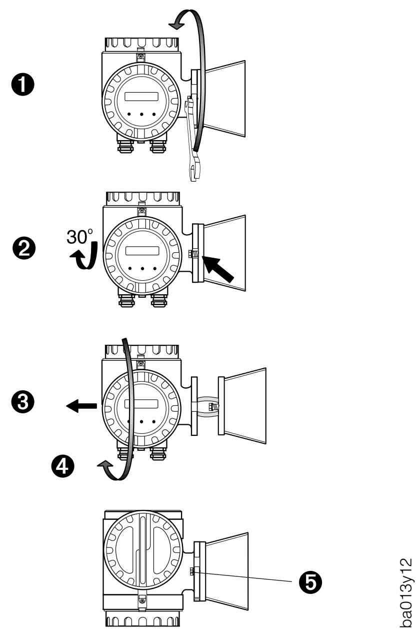
❸ Carefully pull out the transmitter housing.

Caution!

Caution!
Do not damage the connection cable between the transmitter and sensor!

❹ Rotate the transmitter housing to the position required.

❺ Push back into the latch again and tighten the two screws securely.



Rotating the local display

Warning!

Warning!
Danger from electric shock.
Switch off power supply before opening the housing.

❶ Loosen the safety grip (3 mm Allen key).

❷ Unscrew the cover from the electronics area.

❸ Undo both Phillips screws.

❹ Rotate the display.

❺ Tighten the Phillips screws again.

❻ Replace the cover of the electronics area on the transmitter housing.

❼ Tighten the Allen screws of the safety grip securely.

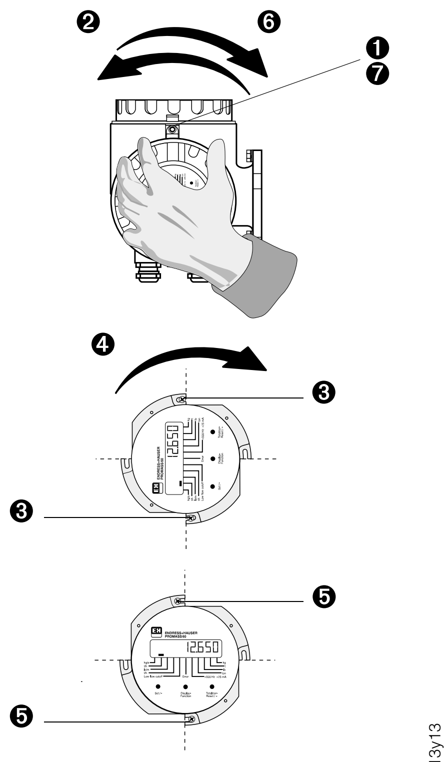


Fig. 11:
Rotating the transmitter housing and the local display

4 Electrical Connection

4.1 General information

Warning!

- The information in Section 3.1 must be observed in order to maintain protection to IP 67.
- When connecting Ex-certified flowmeters, all appropriate instructions and connection diagrams in the separate Ex documentation to this Operating Manual must be observed.
- When using the remote version, only sensors and transmitters with the same serial number are to connected together. Communication errors if this is not the case.

Warning!

4.2 Connecting the transmitter

Warning!

- Danger from electric shock! Switch off the power supply before unscrewing the cover!
- Connect the ground wire to the ground terminal on the housing before turning on the power supply.
- Check that the local power supply and frequency agree with the information on the nameplate. All relevant national regulations for mounting must also be observed.

Warning!

❶ Loosen the screws of the safety grip (3 mm Allen key).

❷ Unscrew the cover of the terminal compartment.

❸ Push the power and signal cables through the appropriate cable glands.

❹ Wire up according to the connection diagrams (see diagram in the screw cover or Fig. 13):

The power supply is connected to Terminal 1 (L1 or L+), Terminal 2 (N or L–) and the ground terminal.
- Stranded-wire cabling: cover with an end sleeve max. 4 mm^2
- Single wire cabling: max. 6 mm^2

❺ Screw the cover of the terminal compartment securely back onto the transmitter housing.

❻ Tighten the Allen screws of the safety grip securely.

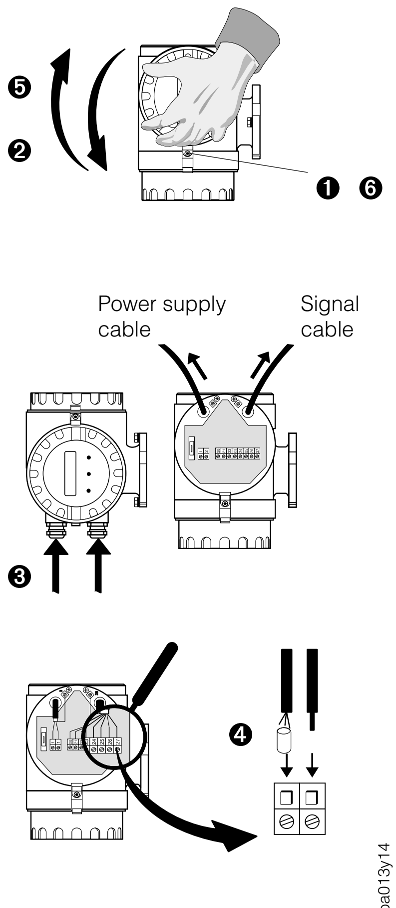


Fig. 12: Connecting the Promass 60 transmitter

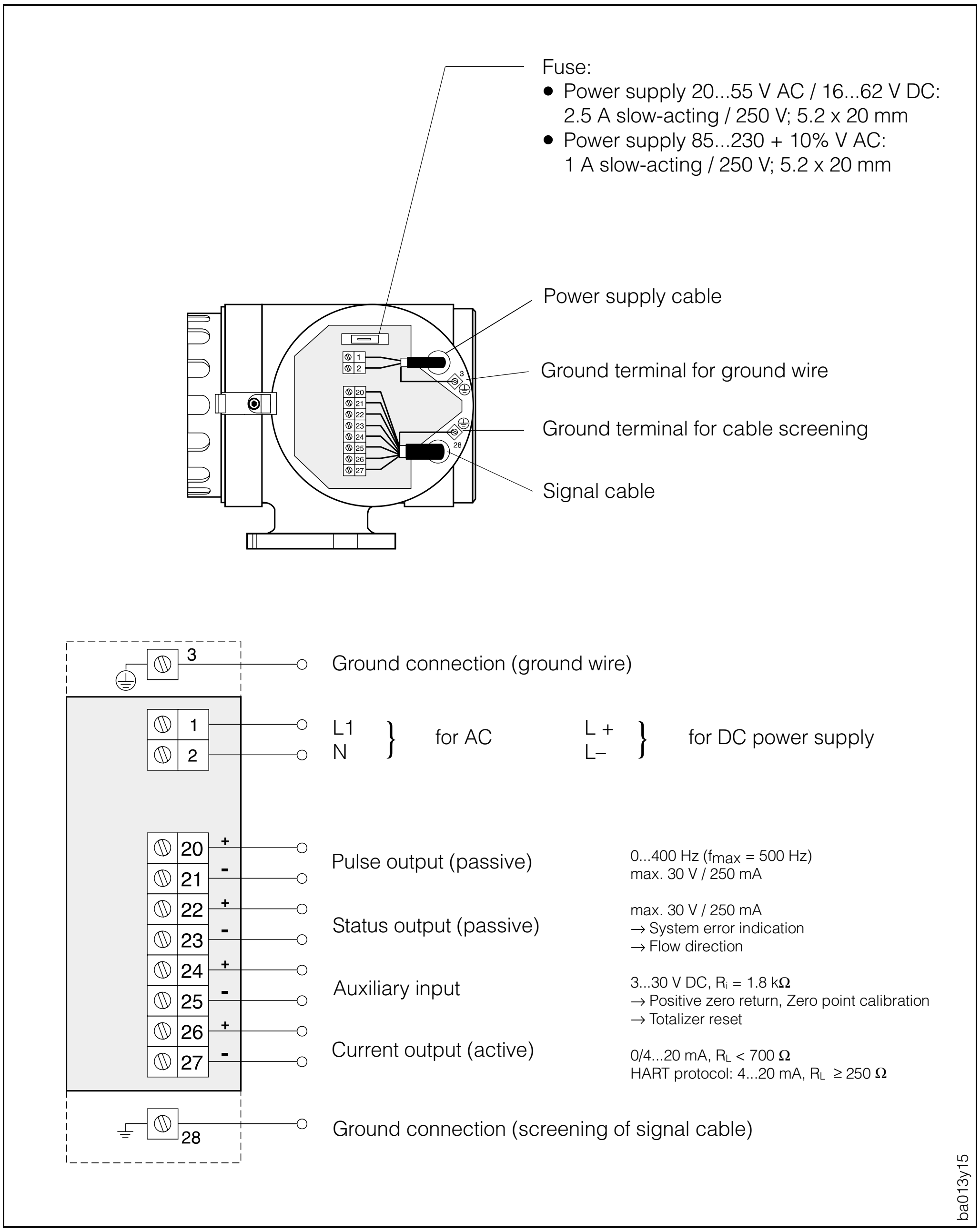


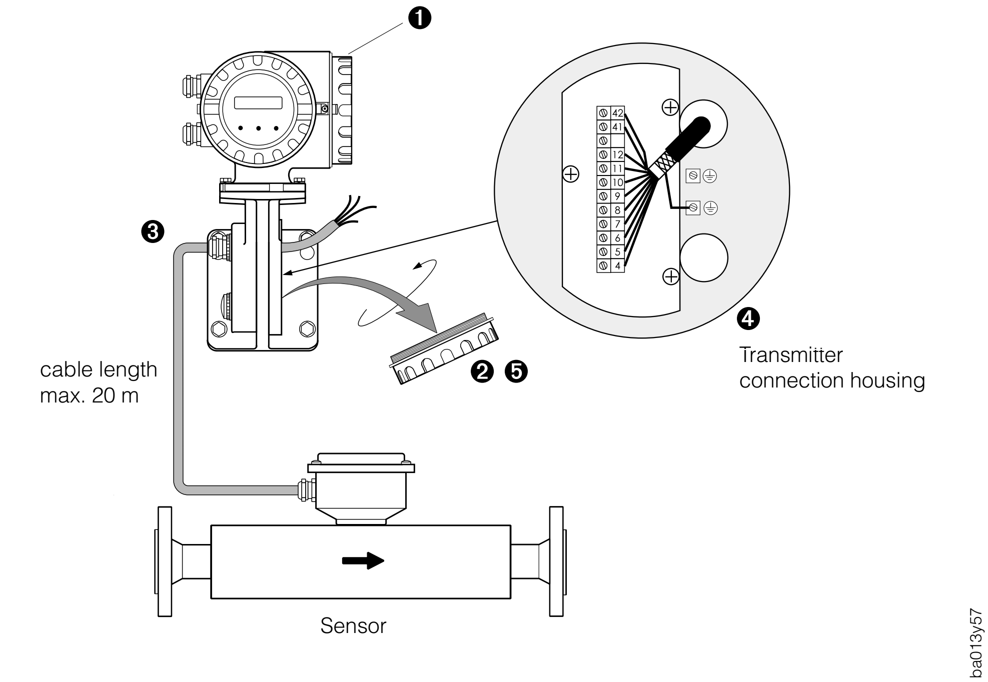
Fig. 13:
Electrical connection:
power supply, input and outputs

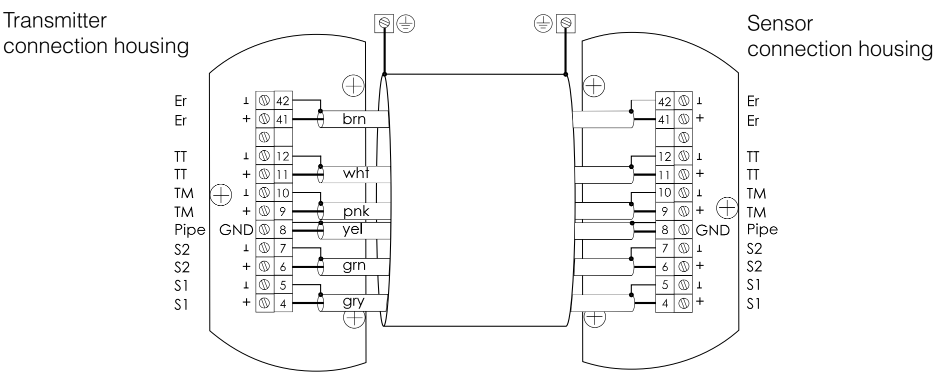
4.3 Connecting the remote version

The remote version is supplied with a 10 or 20 meter ready-to-use cable which is already connected to the sensor.

Warning!
Danger from electrical shock! Switch off the power supply before unscrewing the cover of the electronics area from the transmitter housing and the cover from the connection housing.

❶ Connection in the terminal area is carried out as described for the compact version (see page 17, 18)
❷ Loosen the safety grip (3 mm Allen key). Unscrew the cover of the transmitter connection area.
❸ Push the connection cable through the appropriate cable gland.
❹ Connect the cable according to the electrical connection diagram (see Figure below or diagram in the screw cover).
❺ Screw on the connection housing cover again securely. Tighten the Allen screws of the safety grip securely.





Cable specifications:
brn = brown; wht = white; pnk = pink; yel = yellow; grn = green; gry = grey
6 x 0.38 mm² PVC cable with *common* screening and individually screened cores.
Conductor resistance: ≤ 50 Ω/km; Capacitance: core/screen ≤ 420 pF/m
Permanent operating temperature: –25...+90 °C

With the remote-mounted version the cables between sensor and transmitter must always be screened and grounded at both ends. This is done at the ground terminals inside the connection housing of sensor and transmitter.

ba013e58

Fig. 14:
Connecting the remote version

4.4 Connecting HART Handheld DXR 275

The following connection versions are available to the user:

- Direct connection to the Promass transmitter via Terminals 26 / 27
- Connection via the analogue 4...20 mA cable of the current output

Note!

Note!
In both cases the measuring loop must have a minimum resistance of 250 Ω.

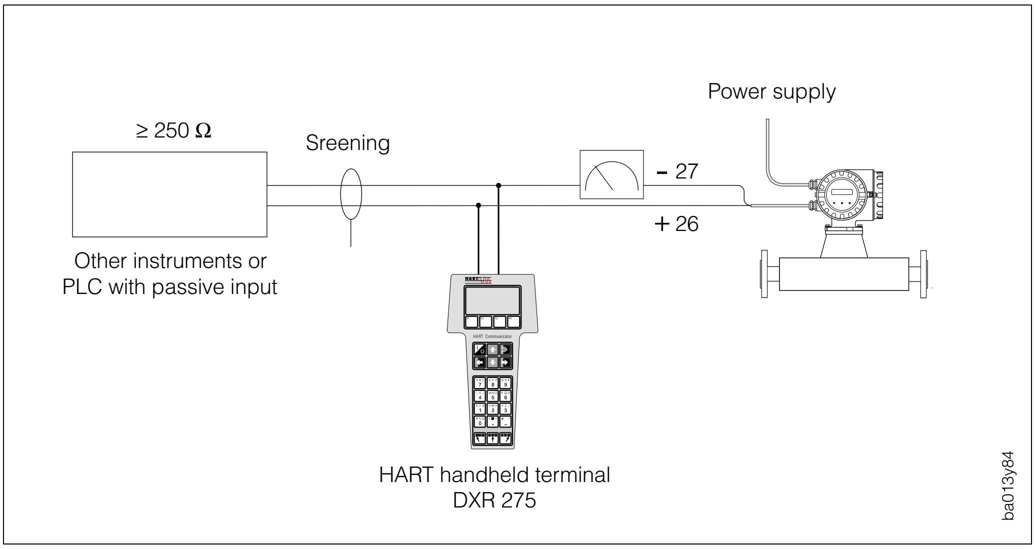


*Fig. 15:
Electrical connection
HART-handheld DXR 275*

4.5 Connecting Commubox FXA 191 (Commuwin II)

The following connection versions are available to the user:

- Direct connection to the Promass transmitter via Terminals 26/27
- Connection via the analogue 4...20 mA cable of the current output

Note!

Note!

- In both cases the measuring loop must have a minimum resistance of 250 Ω .
- Move the switch on the Commubox to 'HART'!

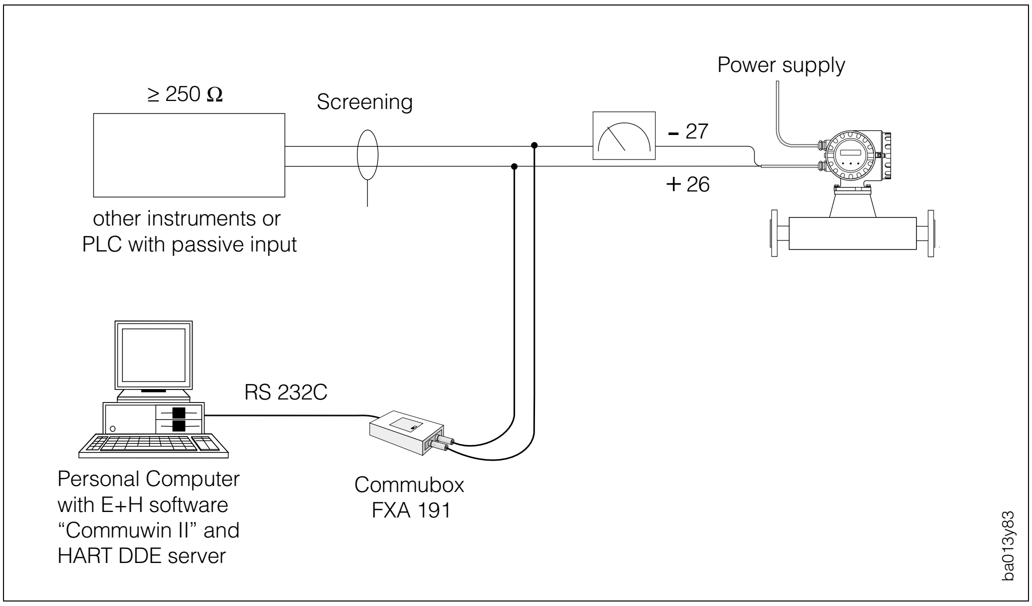


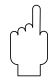
*Fig. 16:
Electrical connection
Commubox FXA 191*

5 Operation

5.1 Selection of operating mode (DIP switches/display, HART)

Promass 60 can basically be operated in two different ways:
- Configuration with DIP switches and/or the local display
- Configuration with HART protocol (e.g. via Commuwin II, HART handheld, etc.)

The two operating modes can **not** be used simultaneously. By using the “DIP/HART” switch on the communication pcb (see Fig. 17), the operating mode is fixed and thereby also the instrument’s functionality. An overview of all instrument functions, depending on the operating mode, can be found in Chapter 10.

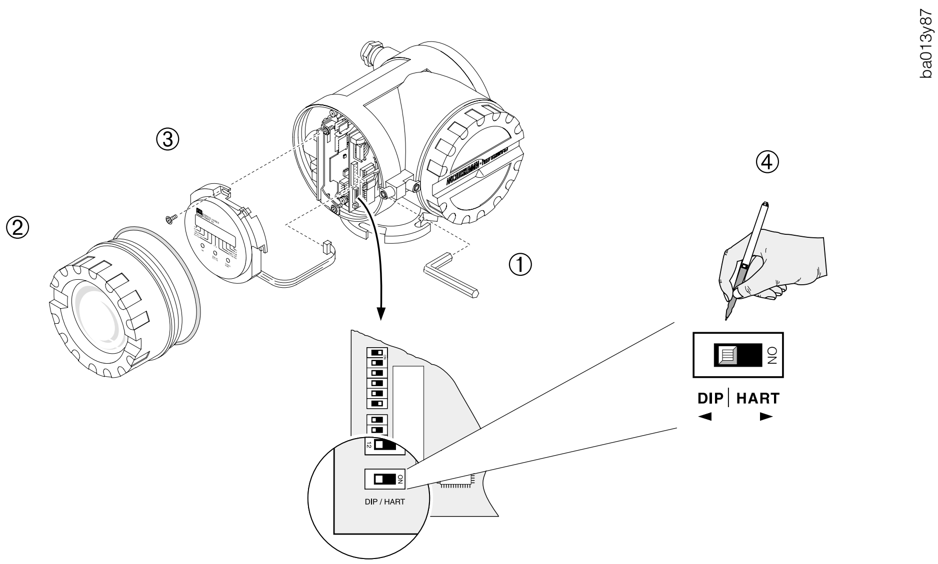

Caution!

Caution!
With the switch in the “HART” position, switches Nr. 1–12 are deactivated. Switching back to the “DIP” switch operating mode overwrites settings or data entries previously made in the HART or Commuwin matrix.

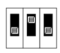

Warning!

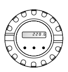
Warning!
- Danger from electrical shock! Switch off the power supply before unscrewing the cover of the electronics area from the transmitter housing.
- Do not fail to observe the supplementary Ex documentation for Ex-certified instruments, especially the waiting time before opening the housing.

1. Loosen the screws of the safety grip (3 mm Allen key).
2. Unscrew the cover of the electronics area.
3. Remove the local display if present.
4. Set “DIP/HART” to the desired position (also DIP switch Nrs. 1–12 if applicable, see page 22)
5. Reassemble in reverse sequence.



“DIP” → Configuration with *DIP switches & display*


DIP switches:
Basic instrument functions → page 22


Local display:
Additional functions → page 24

“HART” (ON) → Configuration with *HART protocol*

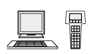

HART handheld → page 25
Commuwin II → page 27

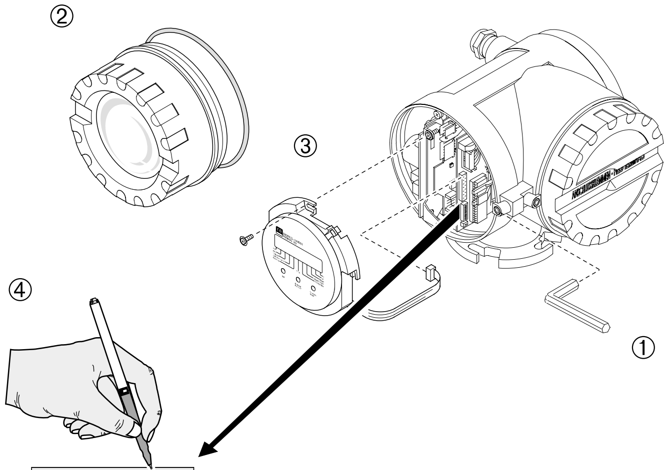
Fig. 17:
Selection of operating mode (function overview: see page 97)

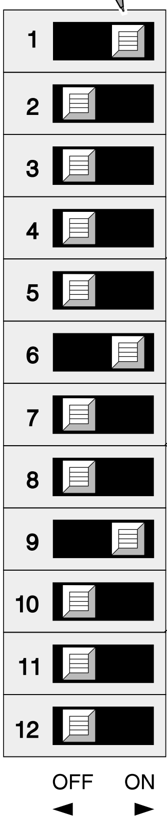
5.2 Configuration with DIP switches

Warning!

Warning!
- Danger from electrical shock! Switch off the power supply before unscrewing the cover of the electronics area from the transmitter housing.
- Do not fail to observe the supplementary Ex documentation for Ex-certified instruments, especially the waiting time before opening the housing.

1. Loosen the screws of the safety grip (3 mm Allen key).
2. Unscrew the cover of the electronics area.
3. Remove the local display if present (see page 16).
4. Set the DIP switches (description of functions → see page 31 ff.) .
5. Reassemble in reverse sequence.





ON Creep suppression activated
OFF Creep suppression deactivated

ON Status output: flow direction
OFF Status output: indication of system errors

ON US engineering units [lb, gal]
OFF SI engineering units [kg, t; l, m^3]

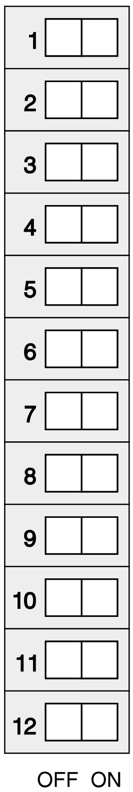
ON 0...20 mA current range
OFF 4...20 mA current range

Setting pulse value:
For switch settings → see **Tables** on page 37

Scaling the full scale value (= flow at 20 mA)
For switch settings → see **Tables** on page 38
(Current output)

ON Auxiliary input: Positive zero return *)
OFF Auxiliary input: Zero point calibration *)

ON Short-cycle batching on **)
OFF Short-cycle batching off



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Factory settings
DIP switches No. 1–12

client settings

Fig. 18:
Setting instrument functions with DIP switches

Note!

Note!
On request, Promass 60 measuring instruments are also available with customised parameterisation.

**) or totalizer reset via local display (see page 35)*
***) For filling cycle up to <60 sec.*

5.3 Configuration with the local display

Using the Promass 60 local display, important variables can be read off and controlled directly at the measuring point. Three operating keys are used to select and activate the various functions.

- Actual flow rate (display function)
- Actual totalizer value (display function)
- Number of totalizer overflows (display function)
- Alternating display flow/totalizer
- Static zero point calibration
- Enter zero point
- Density-value display/start density calibration
- Mass or volume measurement
- Pressure pulse suppression (batching)
- Test function for checking the display elements

The function of the auxiliary input may additionally be changed with the help of a jumper positioned on the local display (see page 35).
All measurement data (e.g. totalizer value) and configuration values are safely stored on power supply failure. With system errors the outputs respond as described on page 59.

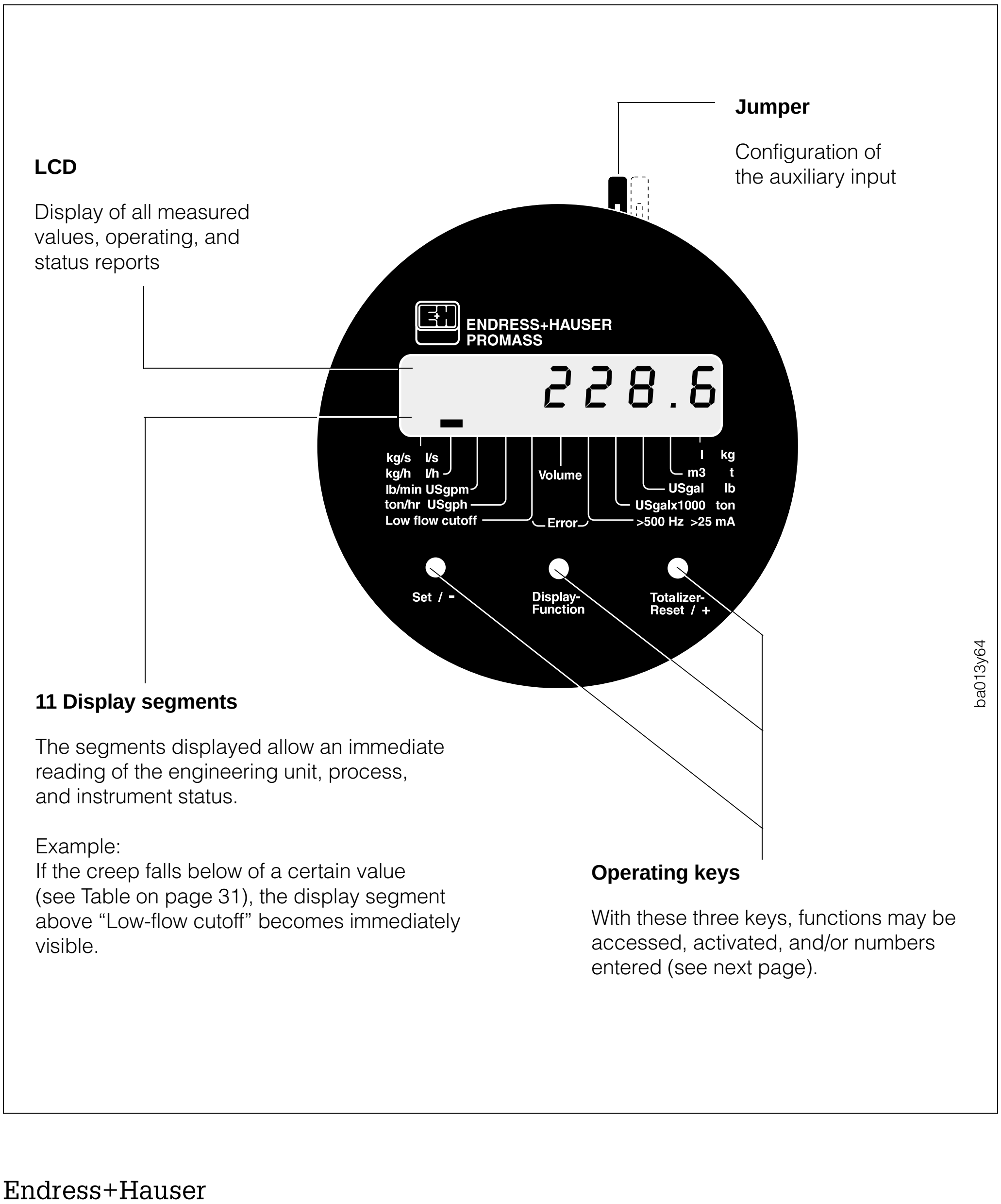


Fig. 19:
Local display Promass 60

Operation of the local display

It is possible to access, activate, and set various functions in sequence with the help of the three operating keys on the local display.

Warning!

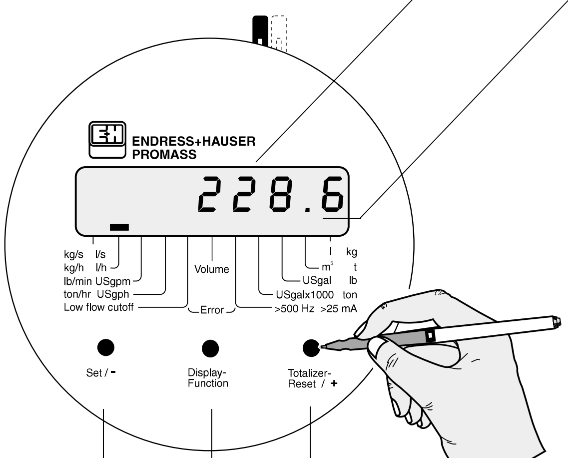
Warning!
Danger from electrical shock! With the housing cover removed, protection against accidental contact is no longer present.
Components with high voltages are exposed below the local display (danger from electric shock). Avoid any contact with the electronic components which lie below the local display, and do not use any electrically conductive object to depress the programming keys.

1. Loosen Allen screw (3 mm) of the safety grip. Unscrew the cover of the electronics compartment.
2. The keys may now be operated by pressing with a thin (non-conductive) pin. A switching cycle takes about 0.5...0.8 seconds.
3. Firmly screw back the cover of the electronics compartment to the transmitter housing once the settings have been entered. Firmly tighten the Allen screw of the safety grip.

Jumper
Configuration of auxiliary input
→ see page 35

LCD, 8-character
All measured values, operating and status indications are shown here.

11 display segments
The appropriate segments serve to provide clear identification of engineering units, instrument and process status:
- Creep too low (Low flow cutoff)
- Velocity of fluids is too high: full scale value exceeded, >500 Hz >25 mA
- System fault (Error)
- Present engineering units
- Volume measuring activated/ de-activated



Totalizer reset / +
- This key is used for resetting the totalizer to '0' (in the "tot" function only).
- Entering of numerical values (+)

Display function
This key is used for selecting the function resp. the display mode required:

- rAtE Flow rate display
- tot Totalizer display
- dISP-OF Display totalizer overflow
- rAtE-tot Display flow rate and totalizer
- 0.-AdJuSt Zero point adjustment
- PIP0 Zero point value
- dEnSItY Density adjustment
- MAS-VOL Operating mode (mass/volume)
- PrES-SUP Pressure pulse suppression
- tESt Display test function

Function description → see page 39

Set / –
This key is used for carrying out the following operations within the appropriate function:
- Selecting the engineering units
- Entering of numerical values (–)
- Zero point or density calibration.

Fig. 20:
Operation of the local display

5.4 Configuration with the HART protocol

For configuration with HART protocol, there are basically two possibilities:
- Configuration with the “HART handheld DXR 275”.
- Configuration with a PC using special software, e.g. “Commuwin II” and the “Commubox FXA 191” HART modem.

All functions available with HART protocol are fully described in Chapter 6.3.

Configuration using the “HART handheld DXR 275”
Selection of Promass 60 instrument functions when using the HART handheld is via various menu levels or using the HART operating matrix respectively (see Fig. 22).

Note!

Notes!
- The HART protocol requires a 4...20 mA setting for the current output. The 0...20 mA setting is only selectable with the DIP switches.
- All functions are accessible at all times with the HART handheld terminal i.e. programming is not locked.
  The HART operating matrix can, however, be locked by entering any value except “0 or 60” in the function “ACCESS CODE”. Data can then no longer be changed. The operating matrix can again be enabled by entering the code number “0 or 60”.
- Further information on the HART handheld is given in the appropriate operating manual in the carrying case.

Procedure

1. Switch on handheld terminal:
   a. The transmitter is not yet connected → The HART main menu is displayed → Continue with “Online”
   b. The transmitter is already connected → The menue level “Online” is immediately shown.
2. “Online” menu level:
   → Actual measurement data including flow, totalizer sum, etc. are continually shown.
   → Via “MATRIX GROUP” you have access to the HART operating matrix (see page 26), then to the function group (e.g. CURRENT OUTPUT) and finally to the desired function, e.g. “FULL SCALE”.
3. Enter values or change the setting.
4. The field “SEND” is shown by pressing the “F2” function key. By pressing the “F2” key, all values and settings entered with the handheld terminal are registered by the Promass measuring system. Confirm with the “F4” key.
5. Press “F3” HOME function key to return to the “Online” menu level. The actual values measured by the Promass flowmeter with the new settings can now be read off.

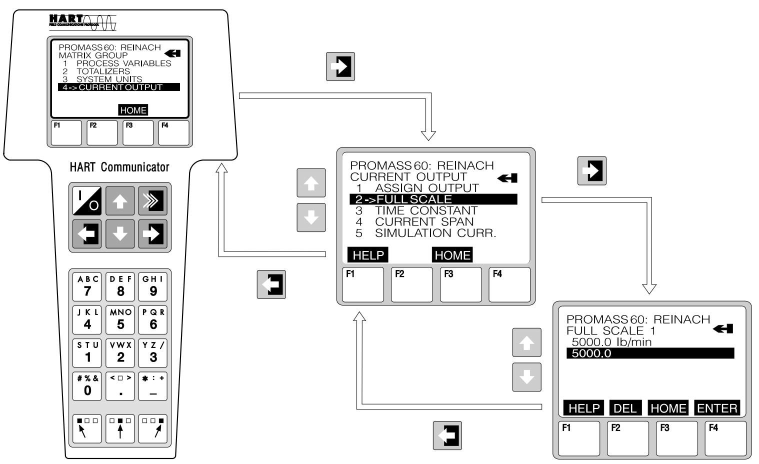


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Fig. 21: Operating the HART handheld (example)

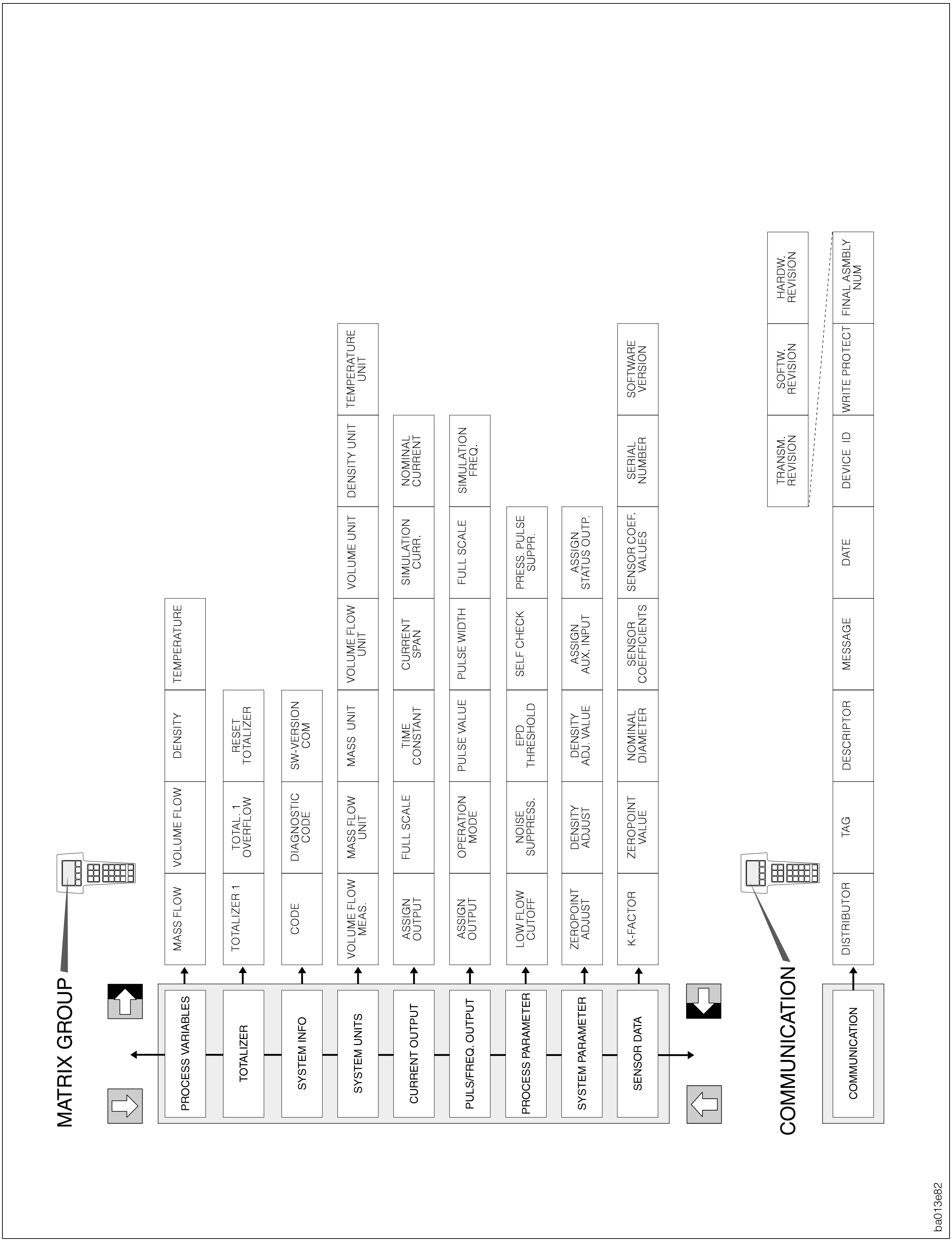


Fig. 22:
HART operating matrix Promass 60
(Function description: see page 43)

Configuration using "Commuwin II" software
Commuwin II is a universal program for remote operation of field and control-room devices.
With the Commubox FXA 191, the Promass 60 can be connected to the RS 232 serial interface of a personal computer. This makes remote configuration possible using the E+H Commuwin II program.

Commuwin II offers the following functions:
- parameterization of functions (see operating matrix, page 28),
- visualization of measuring values,
- saving of instrument parameters,
- device diagnostics (see page 63 ff.),
- measuring-point documentation.

Commuwin II may also be combined with other software packages to visualize processes.

Note!
For additional information on Commuwin II, see the following E+H documentation:
- System Information: SI 018F/00/en "Commuwin II"
- Operating Manual: BA 124F/00/en "Commuwin II Operating Program"

Note!

5.5 Commissioning

Before switching on the measuring system, the following checks should be carried out again:

- *Installation (see page 11)*
  Does the directional arrow on the nameplate agree with the actual flow direction in the piping?

- *Electrical connection (see page 17)*
  Check electrical connections and terminal coding. Check that the local power supply and frequency agree with the information stated on the nameplate.

- *Configuration mode (see page 21)*
  Is the "DIP / HART" DIP switch in the desired position?

If these checks are successful, then switch on the power supply.
The instrument is now ready for use.

“Commuwin II” operating matrix					
		H0	**H1**	**H2**	**H3**
V0	**PROCESS VARIABLE**	**MASS FLOW**	**VOLUME FLOW**	**DENSITY**	**TEMPERATURE**
V1	**TOTALIZERS**	**TOTALIZER 1**	**TOTAL. 1 OVERFLOW**	**RESET TOTALIZER** 0: CANCEL 1: TOTALIZER 1	
V2	**SYSTEM INFO**	**ACCESS CODE**	**DIAGNOSTIC CODE**	**MULTI DROP ADDRESS**	**SOFTWARE VER. COM**
V3	**SYSTEM UNITS**	**VOLUME FLOW MEAS** 0: OFF 1: VOLUME FLOW	**MASS FLOW UNIT** 3: kg/s 5: kg/h 10: lb/min 13: ton/hr	**MASS UNIT** 1: kg 2: t 3: lb 4: ton	**FLOW RATE UNIT** 5: l/s 7: l/h 18: Ugpm 19: Ugph
V4	**CURRENT OUTPUT**	**ASSIGN OUTPUT** 0: MASS FLOW 1: VOLUME FLOW	**FULL SCALE 1**	**TIME CONSTANT**	**CURRENT RANGE** 1: 4–20 mA 3: 4–20 mA NAMUR
V5	**PULS / FREQ. OUTPUT**	**ASSIGN PULS / FREQ** 0: MASS FLOW 1: VOLUME FLOW	**OPERATION MODE** 0: PULSE 1: FREQUENCY	**PULSE VALUE**	**PULSE WIDTH**
V6	**PROCESSING PARA.**	**LOW FLOW CUTOFF**	**NOISE SUPPRESSION**	**EPD THRESHOLD**	**SELF CHECK** 1: CYCLIC 2: SMARTPLUS
V7	**SYSTEM PARAMETER**	**ZERO ADJUST** 0: CANCEL 1: START	**CALIBR. MODE** 0: FLUID 1 2: DENSITY ADJUST 4. CANCEL	**DENS. ADJ. VALUE**	**ASSIGN AUX. INPUT** 0: RESET TOTAL. 1 1: ZEROPOINT ADJUST 2: POS. ZERO RETURN
V8	**SENSOR DATA**	**K-FACTOR**	**ZEROPOINT**	**NOMINAL DIAMETER**	**SENSOR DATA**
V9	**SERVICE & ANALYSIS**				
VA	**SETUP**	**TAG NUMBER**			

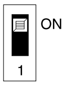
"Commuwin II" operating matrix			
H4	**H5**	**H6**	**H7...H9**
VOLUME UNIT 2: l 4: m3 6: USgal 8: USgal*1000	**DENSITY UNIT** 1: kg/dm3 7: g/cc	**TEMPERATURE UNIT** 0: C (Celsius) 1: K (Kelvin) 2: F (Fahrenheit) 3: R (Rankine)	
SIMULATION CURR. 0: OFF 2: 2 mA 3: 4 mA 5: 12 mA 7: 22 mA 8: 25 mA	**ACTUAL CURRENT**		
FULL SCALE FLOW	**SIMULATION FREQ.** 0: OFF 1: 0 Hz 2: 2 Hz 3: 10 Hz 4: 1 kHz		
PRESS. PULSE SUPPR			
O. OPEN COLLECTOR (Assign Status Output) 0: ERROR 1: FLOW DIRECTION	**RESET DEVICE** **0: CANCEL** **7: REBOOT SYSTEM**		
SENSOR DATA VALUE	**SERIAL NUMBER**	**SOFTWARE VERSION**	

6 Function Description

6.1 DIP switch functions

Function description (DIP switches)

Creep suppression

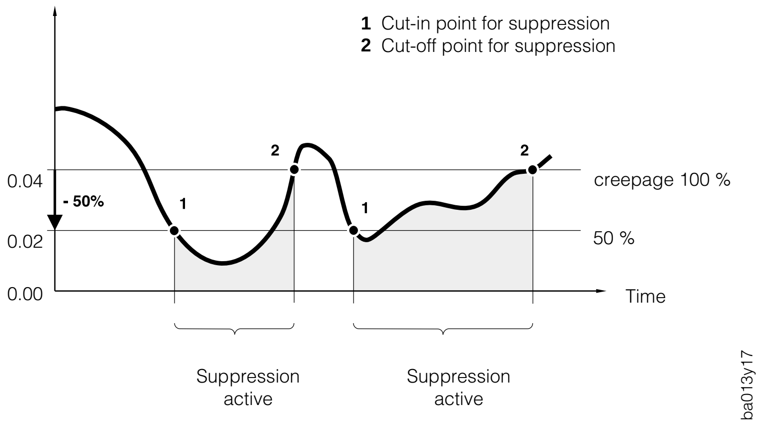


Factory setting

Creep suppression prevents “false flow” in the lower part of the measuring range from being detected (e.g. varying liquid at standstill). This enables flows to be suppressed which should no be measured or totalised.
With flow variations in the lower measuring range, the hysteresis (–50% of the creepage) prevents the creep suppression from continually turning on and off.

Cut-in point (1)
When the velocity of the fluid is less than 0.02 m/s creep suppression is activated and all output signals (pulse and analog signals) are set to the fall back value (0/4 mA logical “0”).

Cut-off point (2)
When the velocity of the fluid again exceeds 0.04 m/s, creep suppression is deactivated.



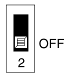
Cut-in and cut-off points

DN	On	Off	On	Off	On	Off
[mm]	in [kg/h] resp. [l/h] **		in [lb/min]		in [USgal/min] **	
1	0.05655	0.11310	0.00208	0.00416	0.00025	0.00050
2	0.22619	0.45239	0.00831	0.01662	0.00100	0.00199
4	0.90478	1.80956	0.03324	0.06649	0.00398	0.00797
8	3.61911	7.23823	0.13298	0.26596	0.01593	0.03187
15	12.72345	25.44690	0.46751	0.93501	0.05602	0.11204
15*/25	35.34292	70.68583	1.29863	2.59726	0.15561	0.31122
25*/40	90.47787	180.95574	3.32449	6.64899	0.39836	0.79672
40*/50	141.37167	282.74334	5.19452	10.38904	0.62244	1.24488
80	361.91147	723.82295	13.29797	26.59594	1.59345	3.18690
100	565.48668	1130.97336	20.77773	41.55546	2.48977	4.97954

* DN 15, 25, 40 “FB” = Full bore versions Promass I
** with ρ = 1.000 kg/dm^3

Function description (DIP switches)

Status output



Factory setting

The status output can optionally be configured for:
ON → Signalling the direction of flow
OFF → Error messages (System error) or power supply failure

Status output configuration	Status	Response Open Collector (transistor) 22 23
Indication of system errors	system O.K.	closed
	Fault indication	open
	Power supply failure	open
Flow direction	forwards	open
	reverse	closed

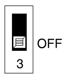
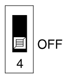
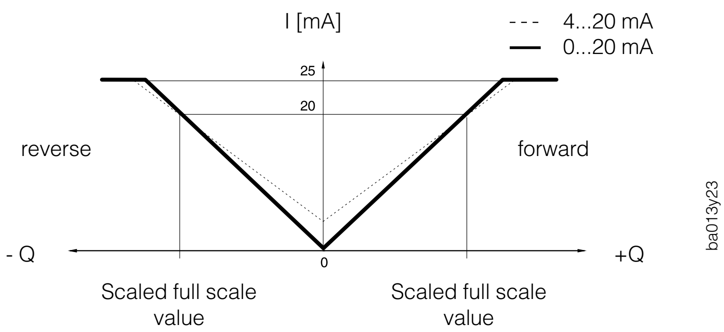
"closed" → Open Collector conductive
"open" → Open Collector non-conductive

Note!

Notes!
- The status output acts as a normally closed contact, i.e. in normal operation, free from fault, the output is closed (transistor conducting, see above figure).
- The behaviour of the outputs in the event of a fault is described on page 59.

"Unidirectional" or "bidirectional" operating mode:
The Promass 60 measuring system can operate either bidirectionally or in one direction only. Selecting the operating mode is, however, directly coupled with the configuration of the status output:

Status output	Operating mode	Current / pulse output
ON (flow direction)	bidirectional	always active (signal output in both flow directions)
OFF (error messages)	unidirectional	active only with positive flow direction (no signal output with negative flow, reverse)

Function description (DIP switches)	
System units  Factory setting	Select the desired unit system with this function: **ON** → US unit **OFF** → SI unit 1 lb = 0.4536 kg 1 ton = 907.1847 kg 1 USgal = 3.7854 l
Current range  Factory setting	The current at zero flow (Q = 0) can be set to 0 or 4 mA. The current for the full scale value is always 20 mA. Scaling is possible up to 25 mA, i.e. up to 125% of the full scale value. Example (operating mode = bidirectional)  At zero flow (Q = 0) and the DIP switch is: **ON** → Zero scale = 0 mA **OFF** → Zero scale = 4 mA

Function description (DIP switches)

Pulse value

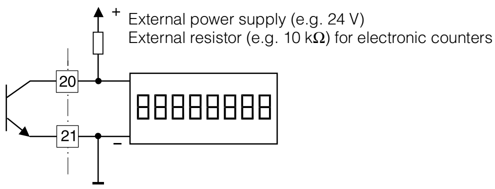
Factory setting

The pulse value indicates for which freely selectable mass an output pulse is supplied. These pulses may be added up by an external totalizer to determine the total mass flow since the start of the measurement.
The pulse-pause ratio is approx. 1:1. The pulse width is limited to a maximum of 10 s (≤0.05 Hz). At f_{max} = 500 Hz the maximum pulse width is 1 ms.

Eight pulse values are selectable using DIP switches No. 5–7 (see **Tables** on page 37).

Connection diagrams for mechanical and electronic counters
Example for counters *without* an internal power supply

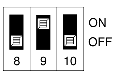
Bidirectional measurement (forward and reverse):



Unidirectional measurement (forward):
The Promass 60 measuring system can also be operated unidirectionally. The selection of “bidirectional” or “unidirectional” operating mode is however directly coupled with the configuration of the status output (see page 32).

Values for voltage and resistor for external counters can be found in the technical data of instruments which are connected.

Full scale value (Current output)



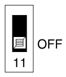
Factory setting

The current output supplies signals between 0/4...20 mA, corresponding to the momentary value of the flow. By setting the full scale value, a maximum desired flow is assigned to a current of 20 mA.
Any scaling always applies to both flow directions (bidirectional).
Given the respective configuration, the flow direction is displayed at the status output.

Eight full scale values are selectable using DIP switches Nrs. 8–10 (see **Tables** on page 38).

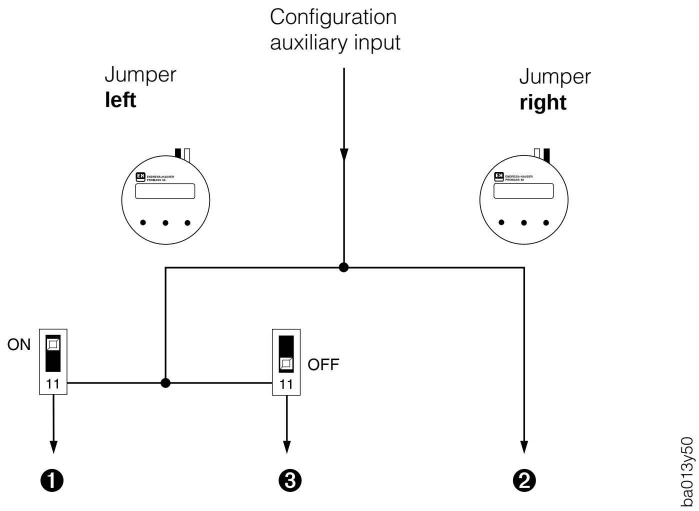
Function description (DIP switches)

Auxiliary input



Factory setting

By applying a voltage of 3...30 V DC to the auxiliary input, various functions may be activated. The selection of these functions is made with DIP switch No. 11 and/or a jumper on the local display:



❶ **Positive zero return (ON)**
As long as the external voltage is applied, the current output is set to 0/4 mA; the pulse output to the closed-circuit voltage (transistor non-conductive).
Eight dashes for the flow rate are shown on the display when positive zero return is active.
Application: Interruption of the measuring process, e.g. during the time a piping is cleaned.

❷ **Setting the totalizer to zero**
After applying an exernal voltage to the auxiliary input, the totalizer is automatically reset to “zero”.

Note!
The totalizer can also be reset using the “Totalizer-Reset” key on the local display (see page 24).

Note!

❸ **Zero-point calibration (OFF)**

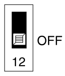
1. First observe the requirements and conditions for a zero point adjustment (see page 39).

2. Before the zero point adjustment, ensure that DIP switch No. 11 is in fact in the “OFF” position (see page 22)

3. Start the zero point adjustment by applying an external voltage to the auxiliary input. The time during which the external voltage is applied is to be selected, from 110 ms...10 s. The zero point adjustment is also possible by connecting a multimeter (set to “Diode test”) to the auxiliary input terminals.

Note!
The zero point adjustment can also be performed using the local display with the “0.-AdJUSt” function (see page 39).

Note!

Function description (DIP switches)	
Short-cycle batching  Factory setting	By activating this function (ON), a better reproducibility for short batching cycles can be achieved. **ON** → for batching times <60 s **OFF** → for batching times >60 s and for continuous measuring mode

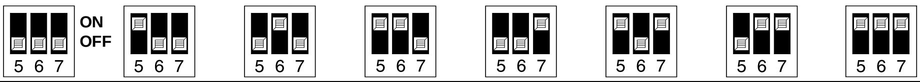
Pulse values (DIP switches)

Eight preset pulse values can be selected for each nominal diameter by using Switches No. 5, 6 and 7. Setting the max. pulse value(s) thus corresponds to a frequency of f = 400 Hz. As a rule, the last of the switch settings shown is for v = 10 m/s (ρ = 1000 kg/m^3) at f = 400 Hz.

MASS – Pulse value

SI units [g; kg; t]

Factory settings



DN	5 6 7	5 6 7	5 6 7 (Factory settings)	5 6 7	5 6 7	5 6 7	5 6 7	5 6 7
1	0.0001 g	0.001 g	0.01 g	0.1 g	1 g	10 g	100 g	0.000020 kg
2	0.01 g	0.1 g	1 g	10 g	100 g	1 kg	10 kg	0.000079 kg
4	0.1 g	1 g	10 g	100 g	1 kg	10 kg	100 kg	0.000314 kg
8	1 g	10 g	100 g	1 kg	10 kg	100 kg	1 t	0.001257 kg
15	1 g	10 g	100 g	1 kg	10 kg	100 kg	1 t	0.004418 kg
15*/25	10 g	100 g	1 kg	10 kg	100 kg	1 t	10 t	0.012272 kg
25*/40	10 g	100 g	1 kg	10 kg	100 kg	1 t	10 t	0.031416 kg
40*/50	10 g	100 g	1 kg	10 kg	100 kg	1 t	10 t	0.049087 kg
80	100 g	1 kg	10 kg	100 kg	1 t	10 t	100 t	0.125664 kg
100	1 kg	10 kg	100 kg	1 t	10 t	100 t	1000 t	0.196350 kg

US units [lb]

DN								
1	0.0000001	0.000001	0.00001	0.0001	0.001	0.01	0.1	0.000043
2	0.00001	0.0001	0.001	0.01	0.1	1	10	0.000174
4	0.0001	0.001	0.01	0.1	1	10	100	0.000697
8	0.001	0.01	0.1	1	10	100	1000	0.002787
15	0.001	0.01	0.1	1	10	100	1000	0.009797
15*/25	0.01	0.1	1	10	100	1000	10000	0.027213
25*/40	0.01	0.1	1	10	100	1000	10000	0.069665
40*/50	0.01	0.1	1	10	100	1000	10000	0.108851
80	0.1	1	10	100	1000	10000	100000	0.278659
100	1	10	100	1000	10000	100000	1000000	0.435397

Caution!

Caution!
Before using these tables, please note the following:

Mass or volume measurement
Access operating mode with local display → see page 24.

SI units
Switch No. 3 → OFF

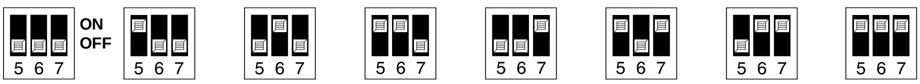
US units
Switch No. 3 → ON

* DN 15, 25, 40 “FB” = Full bore versions Promass I

VOLUME – Pulse value

SI units [ml; l; m^3]

Factory settings



DN	5 6 7	5 6 7	5 6 7 (Factory settings)	5 6 7	5 6 7	5 6 7	5 6 7	5 6 7
1	0.0001 ml	0.001 ml	0.01 ml	0.1 ml	1 ml	10 ml	100 ml	0.000020 l
2	0.01 ml	0.1 ml	1 ml	10 ml	100 ml	1 l	10 l	0.000079 l
4	0.1 ml	1 ml	10 ml	100 ml	1 l	10 l	100 l	0.000314 l
8	1 ml	10 ml	100 ml	1 l	10 l	100 l	1 m3	0.001257 l
15	1 ml	10 ml	100 ml	1 l	10 l	100 l	1 m^3	0.004418 l
15*/25	10 ml	100 ml	1 l	10 l	100 l	1 m3	10 m^3	0.012272 l
25*/40	10 ml	100 ml	1 l	10 l	100 l	1 m^3	10 m^3	0.031416 l
40*/50	10 ml	100 ml	1 l	10 l	100 l	1 m^3	10 m^3	0.049087 l
80	100 ml	1 l	10 l	100 l	1 m3	10 m^3	100 m^3	0.125664 l
100	1 l	10 l	100 l	1 m^3	10 m^3	100 m^3	1000 m^3	0.196350 l

US units [USgal]

DN								
1	0.0000001	0.000001	0.00001	0.0001	0.001	0.01	0.1	0.000005
2	0.00001	0.0001	0.001	0.01	0.1	1	10	0.000021
4	0.0001	0.001	0.01	0.1	1	10	100	0.000083
8	0.001	0.01	0.1	1	10	100	1000	0.000334
15	0.001	0.01	0.1	1	10	100	1000	0.001174
15*/25	0.01	0.1	1	10	100	1000	10000	0.003261
25*/40	0.01	0.1	1	10	100	1000	10000	0.008348
40*/50	0.01	0.1	1	10	100	1000	10000	0.013043
80	0.1	1	10	100	1000	10000	100000	0.033391
100	1	10	100	1000	10000	100000	1000000	0.052173

Example:
A pulse frequency of f = 20 Hz should not be exceeded (e.g. input frequency of an electronic totalizer). The nominal diameter should be 25 mm; the flow rate Q = 21.6 t/h.

$$\text{Pulse value} = \frac{Q}{f_{max}} =$$

$$\frac{21.6\ t/h}{20\ s^{-1}} = \frac{6\ kg/s}{20\ s^{-1}} = 0.3\ kg$$

Using the pulse value calculated (for DN 25), select the next highest switch setting → 1 kg per pulse (OFF–ON–OFF).

(In the opposite way, the exact pulse frequency can be determined using a known flow rate Q and a selected pulse value)

* DN 15, 25, 40 “FB” = Full bore versions Promass I

Caution!

Caution!
Before using these tables, please note the following:

Mass or volume measurement
Access operating mode with local display → see page 24.

SI units
Switch No. 3 → OFF

US units
Switch No. 3 → ON

* DN 15, 25, 40 "FB" = Full bore versions Promass I

Full scale values (DIP switches)

For every nominal diameter, eight preset flow rates (full scale values) can be selected for a current of 20 mA using Switches No. 8, 9 and 10.

MASS – Full scale value (current output)

SI units [kg/h]

DN	5 6 7 (ON / OFF)	5 6 7	5 6 7 (Factory settings)	5 6 7	5 6 7	5 6 7	5 6 7	5 6 7
1	1	2	3	4	5	10	16	20
2	5	10	15	20	25	50	80	100
4	20	40	60	80	100	200	320	400
8	100	200	300	400	500	1000	1600	2000
15	300	600	900	1200	1500	3000	4800	6000
15*/25	1000	2000	3000	4000	5000	10000	16000	20000
25*/40	2000	4000	6000	8000	10000	20000	32000	40000
40*/50	4000	8000	12000	16000	20000	40000	64000	80000
80	9000	18000	27000	36000	45000	90000	144000	180000
100	14000	28000	42000	56000	70000	140000	224000	280000

US units [lb/min]

DN								
1	0.05	0.10	0.15	0.20	0.25	0.50	0.80	1.00
2	0.20	0.40	0.60	0.80	1.00	2.00	3.20	4.00
4	0.75	1.50	2.25	3.00	3.75	7.50	12.00	15.00
8	4.00	8.00	12.00	16.00	20.00	40.00	64.00	80.00
15	10.00	20.00	30.00	40.00	50.00	100.00	160.00	200.00
15*/25	30.00	60.00	90.00	120.00	150.00	300.00	480.00	600.00
25*/40	75.00	150.00	225.00	300.00	375.00	750.00	1200.00	1500.00
40*/50	125.00	250.00	375.00	500.00	625.00	1250.00	2000.00	2500.00
80	325.00	650.00	975.00	1300.00	1625.00	3250.00	5200.00	6500.00
100	425.00	850.00	1275.00	1700.00	2125.00	4250.00	6800.00	8500.00

* DN 15, 25, 40 "FB" = Full bore versions Promass I

VOLUME – Full scale value (current output)

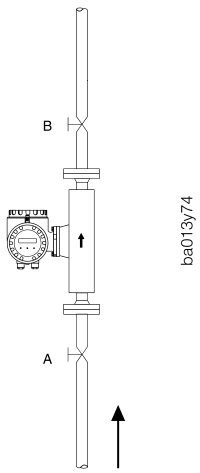
SI units [l/h]

DN	5 6 7 (ON / OFF)	5 6 7	5 6 7 (Factory settings)	5 6 7	5 6 7	5 6 7	5 6 7	5 6 7
1	1	2	3	4	5	10	16	20
2	5	10	15	20	25	50	80	100
4	20	40	60	80	100	200	320	400
8	100	200	300	400	500	1000	1600	2000
15	300	600	900	1200	1500	3000	4800	6000
15*/25	1000	2000	3000	4000	5000	10000	16000	20000
25*/40	2000	4000	6000	8000	10000	20000	32000	40000
40*/50	4000	8000	12000	16000	20000	40000	64000	80000
80	9000	18000	27000	36000	45000	90000	144000	180000
100	14000	28000	42000	56000	70000	140000	224000	280000

US units [USgal/min]

DN								
1	0.005	0.010	0.015	0.020	0.025	0.050	0.080	0.100
2	0.025	0.050	0.075	0.100	0.125	0.250	0.400	0.500
4	0.100	0.200	0.300	0.400	0.500	1.000	1.600	2.000
8	0.500	1.000	1.500	2.000	2.500	5.000	8.000	10.000
15	1.500	3.000	4.500	6.000	7.500	15.000	24.000	30.000
15*/25	4.000	8.000	12.000	16.000	20.000	40.000	64.000	80.000
25*/40	10.000	20.000	30.000	40.000	50.000	100.000	160.000	200.000
40*/50	15.000	30.000	45.000	60.000	75.000	150.000	240.000	300.000
80	40.000	80.000	120.000	160.000	200.000	400.000	640.000	800.000
100	50.000	100.000	150.000	200.000	250.000	500.000	800.000	1000.000

6.2 Local display functions

Function description (Local display)	
rAtE	Display of actual flow rate or totalizer amount. A negative flow direction is indicated on the display by a minus sign. *Selection of engineering units* ➔ Press “**Set**” key Caution! SI/US units are selected using the DIP switches on the communication board (see page 22).
tot	
dISP-OF	Display of the number of totalizer overruns with values > 9999999.
rAtE-tot	Alternating displays (approx. every 10 s) of actual flow and totalizer value.
O.-AdJUSt	With this function, the zero point adjustment can be automatically started. The new zero point determined by the system is taken over in the PIPO function. The adjustment procedure is as described below: Note! Alternatively, the zero point adjustment can also be initiated using the auxiliary input (see page 35). **General information for zero point calibration** All Promass sensors are calibrated using the most up-to-date technology available with the zero point stated on the nameplate. Calibration is carried out according to reference conditions (see page 89). Therefore a zero point calibration is **generally not** necessary! Practical experience has shown that a zero point calibration is only required in special cases: • to achieve highest measuring accuracy • with extreme process or operating conditions (e.g. with very high process temperatures or high viscosity) **Requirements** – For fluids without gas or solids content – Zero point calibration is carried out using completely filled measuring tubes and at “no-flow” with e.g. shut-off valves both upstream and downstream of the sensor or by using existing shut-off and sliding valves: *Normal operation* • Open valves A and B *Zero point calibration **with** pumping pressure* • Open valve A • Close valve B *Zero point calibration **without** pumping pressure* • Close valve A • Open valve B  Caution! With difficult fluids (outgassing fluids or fluids with solids content) it may be that no stable zero point can be achieved despite carrying out a number of zero point calibrations. In such cases, please contact your E+H Service Centre. (continued on next page)

Function description (Local display)	
0.-AdJUSt (continued)	**Carrying out a zero point calibration:** 1. Run the plant for as long as necessary until it is operating normally. 2. Stop the flow (v = 0 m/s). 3. Check the shut-off valves (for leaks). Also check the operating pressure. 4. Carry out the zero point calibration as follows: a) Select the function 0.-AdJUSt by pressing the “Display Function” key. b) Begin the zero point calibration by pressing the “**Set**” key. During calibration the message AdJ-bUSY is shown on the display for approx. 30 seconds. If a zero point calibration cannot be carried out, e.g. with v >0.1 m/s, then an LED will flash on the communication board (see page 60). Any local display present will give the error message “AdJ-Error”. After a successful adjustment, the newly determined zero point value (PIPO) appears on the display. The instrument will now work with the newly determined zero point value.
PIPO	In this function, the zero point can be entered which is determined by a “dynamic” zero point calibration. Caution! Dynamic zero point calibration is only required for very special applications! Under normal circumstances, such a calibration is carried out only by the E+H service technician or by an authorised person. *Entry* ➔ Press **+** / **–** keys

Caution!

Function description (Local display)

dEnSItY

With this function a one-point density calibration can be carried out on site.
The internal density calibration values are newly calculated and subsequently stored in the Promass 60 measuring system.
For this purpose, the actual measured density is first displayed in kg/dm^3.

General information for density calibration

With a density calibration, optimum measurement accuracy will be achieved in the calculation of the flow volume. In addition, a calibration is required in the following cases:

- The sensor does not exactly measure the density value expected by the user based on laboratory analysis.
- The fluid characteristics lie outside of the measurement points or reference conditions used by the factory, and with which the instrument was calibrated.

Requirements

- Density adjustment on site always demands that the operator accurately knows the density of the fluid, for example from laboratory tests.
- The density adjust value entered here may deviate from the currently measured fluid density by max. ±10%. For larger differences the density calibration is no longer possible.
- Errors in the entered density value directly affect the volume calculation!
- Density adjustment changes the density calibration values entered at the factory or by the service engineer.

Carrying out density adjustment

1. Fill the sensor with fluid. Ensure that the measuring tubes are completely filled and that the fluid is free of gas bubbles.

2. Wait until the temperature between the fluid and the measuring tube is constant (time taken → depends on the temperature and the fluid).

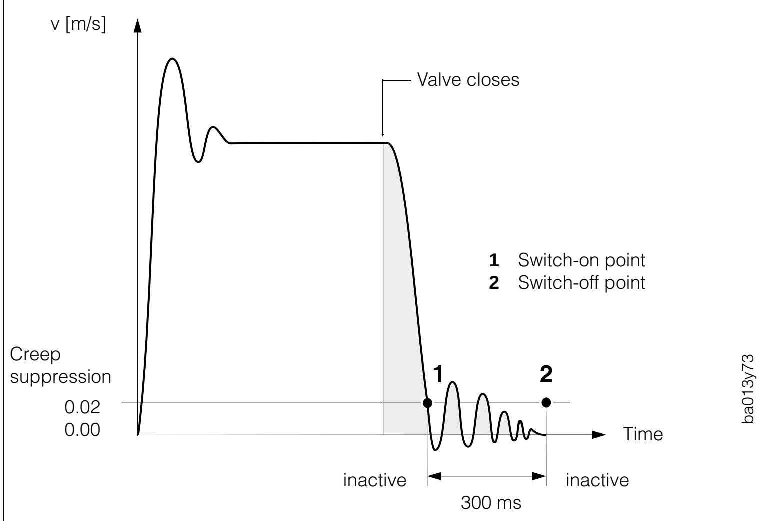
3. *Enter desired density value* ➔ Press **+ / –** keys
   With the entry of small density values the volume flow will be output correspondingly large.

4. Press the display function key for an automatic display of the subfunction "dEnS-AdJ".

5. *Start density calibration* ➔ Press "**Set**" key
   During the calibration the "AdJ-bUSY" report is displayed for about 4 seconds, followed by a display of the calibrated density value.

Note!
Repeat the procedure (point 4 and 5), if an error message is displayed.
Check the plant and process conditions if necessary.

Note!

Function description (Local display)	
MAS-VOL	With this function you determine whether Promass 60 shall work as a mass-flow or volume-flow device. *Selection mass/volume* ➔ Press “**Set**” key Display segment “Volume” shown ⟶ Volume Display segment “Volume” not shown ⟶ Mass
PrES-SUP	Turn pressure pulse suppression on or off: When closing the metering valves, there may be a sudden but strong rush of liquid in the piping which is then detected by the measuring system. The pulses derived from this will be counted, and produce an incorrect result in the totalizer, especially in batching operations. Because of this, the Promass 60 has a function for pressure pulse suppression which eliminates or rectifies interference coming from the plant. To activate pressure pulse suppression ➔ Press “**Set**” key (On, OFF) Factory setting = OFF **Switch-on point** If the velocity of the fluid falls below 0.02 m/s, then pressure pulse suppression is activated. Current and pulse/frequency output are then inactive for 300 ms, independent of the actual flow rate (current output → 0 mA or 4 mA; pulse/frequency output → 0 Hz). **Switch-off point** The pressure pulse suppression is again deactivated after 300 ms.  Pressure pulse suppression Note! To use the pressure pulse suppression, the "creep suppression" function must be activated.
tESt	After selecting this function an automatic test of all display elements is carried out. The following displays are shown in sequence: 1. +8.8.8.8.8.8.8.8. (incl. display segments) 2. -0 0 0 0 0 0 0 0 (without display segments) 3. All display elements are blank 4. The actual flow rate is displayed

Note!

6.3 HART protocol functions

Please note the following:

- In the table's left column are the function descriptors for both the Commuwin II operating program as well as for the HART handheld device (in brackets if they differ from each other).
- Factory settings are always shown in ***bold italic*** text.
- The entry possibilities within the individual functions are shown with the special ( ) key symbol:

Function group PROCESS VARIABLE (HART)	
MASS FLOW	Display of currently measured mass flow (e.g. 462.87 kg/h; –731.63 lb/min). The measuring value can be read off either via PC (Commuwin II) or via the HART handheld device.
VOLUME FLOW	Display of currently measured volume flow (e.g. 5.5445 l/s; –731.63 Ugph). The volume flow is derived from the measured mass flow and the measured density of the fluid. The measuring value can be read off either via PC (Commuwin II) or via the HART handheld device.
DENSITY	Display of currently measured fluid density (e.g. 1.2345 kg/dm^3; 1.0015 g/cc). The measuring value can be read off either via PC (Commuwin II) or via the HART handheld device.
TEMPERATURE	Display of currently measured fluid temperature (e.g. –23.4 °C; 160.0 °F; 295.4 K). The measuring value can be read off either via PC (Commuwin II) or via the HART handheld device.
Function group TOTALIZERS (HART)	
TOTALIZER 1 (TOTAL. 1)	Display of totalized flow rate since the initial measuring operation or the last totalizer reset. This value is either positive or negative depending on the flow direction (e.g. 9.568440 t; -4925.631 kg). The measuring value can be read off either via PC (Commuwin II) or via the HART handheld device. Notes! • The number of totalizer overflows is shown in "TOTAL. 1 OVERFLOW". • The totalizer function is coupled directly with the configuration of the status output (see page 55): – *Status output → "FLOW DIRECTION"* The totalizer takes into account positive and negative flow directions. – *Status output → "FAILURE"* The totalizer *only* takes into account positive flow directions. • In cases of error the totalizer is coupled to the error response of the pulse/frequency ouput (see page 59).

Note!

Function group TOTALIZERS (HART)	
TOTAL. 1 OVERFLOW	Display of totalizer overflows. On the display the totalized flow is shown as a max. 7-digit number with floating decimal point. Larger numbers (>9,999,999) can be read off in this function as overflows. The effective amount is calculated from the sum of the value shown in the function “TOTAL. 1 OVERFLOW” and in the function “TOTALIZER 1”. The measuring value can be read off either via PC (Commuwin II) or via the HART handheld device. *Example:* Display of 2 overruns: **2** = $2 \cdot 10^7$ kg = 20,000,000 kg The value shown in the function “TOTALIZER 1” = 196,845.7 kg Total amount = 20,196,845.7 kg
RESET TOTALIZER	Reset totalizer to “Zero”. Note! • The overflow value as well as the value shown in the function “TOTALIZER 1” are reset to zero. • The totalizer can also be reset through the auxiliary inputs (see page 55). **CANCEL** – TOTALIZER 1
Function group SYSTEM INFO (HART)	
ACCESS CODE (CODE)	Enter a code number (= 60) to release the programming. All data of the operating matrix are thus protected against unauthorised access. Note! Programming can also be locked by entering any number (except “0 or 60”) in this function. 4-digit number: 0...9999
DIAGNOSTIC CODE	With this function, all error and status messages which occur during operation can be read off. *Error codes / error messages:* A listing of all error and status messages, including corresponding measures for correction, can be found on page 63 ff.
MULTI DROP ADDRESS	Select the bus address for carrying out data transfer via the HART protocol. Note! The current output is set to 4 mA if the address is not “0”. 2-digit number: ***0***...15

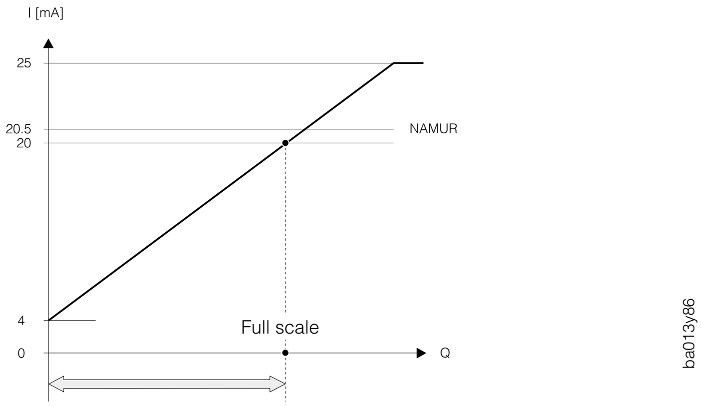
Note!

Note!

Note!

Function group SYSTEM INFO (HART)	
SOFTWARE VER. COM (SW-VERSION COM)	Display of software currently installed on the Promass communication board. The numbers of the software version have the following meaning: The value can be read off either via PC (Commuwin II) or via the HART handheld device. V 3 . 02 . 00 Number changes if minor alterations are made to the new software. This also applies to special versions of software. Number changes if the new software contains additional functions. Number changes if basic alterations have to be made to the software, e.g. owing to technical modifications to the instrument.
Function group SYSTEM UNITS (HART)	
VOLUME FLOW MEAS.	Turning the “volume measurement” operating mode on or off. This function determines whether the Promass 60 is basically working as a volume or mass flowmeter. The setting selected here simultaneously determines the operating mode of the: • Current output, • Frequency output and • Totalizer. ***OFF*** (= Mass flow) – VOLUME FLOW
MASS FLOW UNIT	Select the units required for mass flow rate (mass/time). The units selected here also define those for: • Full scale value of current output • Full scale value of frequency output • Creep rate ***kg/s*** – kg/h – lb/min – ton/hr
MASS UNIT	Select the units required for mass. The units selected here also define those for: • Pulse value (e.g. kg/p) • Totalizer ***kg*** – t – lb – ton

Function group SYSTEM UNITS (HART)	
FLOW RATE UNITS (VOLUME FLOW UNIT)	Select the units required for volume flow rate (volume/time). The volume flow rate is derived from the measured density of the fluid and the mass flow rate. The units selected here also define those for: • Full scale value of current output • Full scale value of frequency output ***l/s*** – l/h – Ugpm – Ugph
VOLUME UNIT	Select the units required for volume flow. The flow volume is derived from the measured density of the fluid and the mass flow. The units selected here also define those for: • Pulse value (z.B. $m^3 \rightarrow m^3/p$) • Totalizer ***l*** – m^3 – USgal – USgal * 1000
DENSITY UNIT	Select the units required for density. The units selected here also define those for: • Threshold value for Empty Pipe Detection • Density adjustment value ***kg/dm³*** – g/cc
TEMPERATURE UNIT	Select the units for temperature. The unit selected here also applies to the displayed min./max. temperatures in the “SENSOR DATA” function. ***°C (CELSIUS)*** – K (KELVIN) – °F (FAHRENHEIT) – °R (RANKINE)

Function group CURRENT OUTPUT (HART)	
ASSIGN OUTPUT	Display of which measurement variable is assigned to the current output: MASS FLOW or VOLUME FLOW. The measuring value can be read off either via PC (Commuwin II) or via the HART handheld device. Note! If the “VOLUME FLOW MEAS.” function is turned off, the current output is automatically configured for mass flow (see page 45).
FULL SCALE	Entry of the desired full scale value for the mass or volume flow. The full scale value corresponds to the 20 mA signal.  Note! If the status output is configured for “FLOW DIRECTION”, the full scale values always apply to both flow directions (bidirectional). Caution! For installations with piston pumps, the full scale value has to be adjusted to the actual peak-flow values and not to the mean flow. Numeric entry (e.g. 245.92 kg/h; 8.1327 l/s) Factory setting: ***dependent*** on the nominal diameter
TIME CONSTANT	Select the time constant to determine whether the current output signal reacts quickly (small time constant) or slowly (larger time constant) to rapidly changing variables (e.g. flow rate). The time constant does not affect the behaviour of the display. Numeric entry: 0.01...99 s Factory setting: ***1.00 s***
CURRENT RANGE (CURRENT SPAN)	Setting of the 0/4 mA quiescent current. The current for the scaled full scale value (=100%) is always 20 mA. A choice can be made between the current output corresponding to NAMUR recommendations (max. 20.5 mA) or the current output with maximum 25 mA. Note! The 0...20 mA setting is only selectable via DIP switch (“DIP” operating mode). ***4–20 mA*** → max. 25 mA 4–20 mA (NAMUR) → max. 20.5 mA (NAMUR)

Note!

Note!

Caution!

Note!

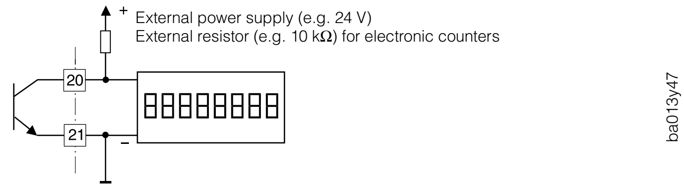
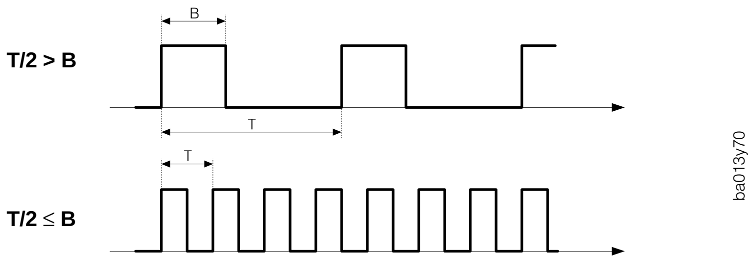
Function group CURRENT OUTPUT (HART)	
SIMULATION CURRENT	Simulation of the output current corresponding to 0%, 50% or 100% of the set current range. In addition, errors may be simulated. *Application example:* • Checking instruments connected • Checking the adjustment of the internal current signal Notes! • The selected simulation mode affects only the current output. The flowmeter remains fully operational for measurement during simulation, i.e. totalizer, flow display etc. are operating normally. • Positive zero return interrupts any simulation being carried out and sets the output current to 0 mA or 4 mA (see page 55). At 4–20 (25 mA): ***OFF*** – 2 mA – 4 mA – 12 mA – 20 mA – 25 mA At 4–20 mA (Current output acc. to NAMUR): ***OFF*** – 2 mA – 4 mA – 12 mA – 20 mA – 22 mA
ACTUAL CURRENT (NOMINAL CURRENT)	In this function, the current and calculated target value of the output current is shown (0.00...25.00 mA). The effective current can vary slightly due to external effects such as temperature.

Note!

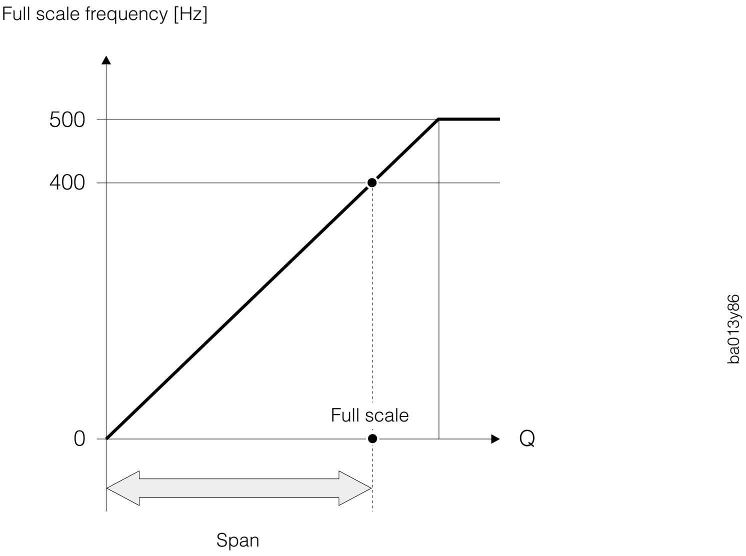
Function group PULS / FREQ. OUTPUT (HART)	
ASSIGN OUTPUT	In this function, a particular variable can be assigned to the pulse/frequency output (MASS or VOLUME). The value can be read off either via PC (Commuwin II) or via the HART handheld device. Note! If the “VOLUME FLOW MEAS.” function is turned off, the pulse/frequency output is automatically configured for mass flow (see page 45).
OPERATION MODE	In this function, the output is configured as a pulse or frequency output. ***PULSE*** – FREQUENCY
PULSE VALUE	Define the flow quantity per output pulse. By means of an external counter the sum of these pulses can be totalized and the total quantity determined since the start of measurement. Note! This function is only available if the setting “PULSE” is selected in the function “OPERATION MODE”. Numeric entry: e.g. 240.00 kg Factory setting: ***dependent*** on the nominal diameter (continued on next page)

Note!

Note!

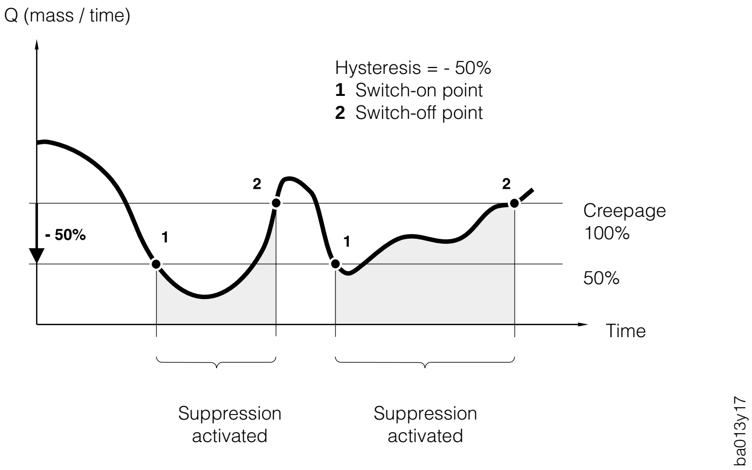
Function group PULS / FREQ. OUTPUT (HART)	
PULSE VALUE (continued)	**Connection diagrams for mechanical and electronic counters** Example for counters *without* an internal power supply *Bidirectional measurement (forward and reverse):*  *Unidirectional measurement (forward):* The Promass 60 measuring system can also be operated unidirectionally. The selection of “bidirectional” or “unidirectional” operating mode is however directly coupled with the configuration of the status output (see page 55). Values for voltage and resistor for external counters can be found in the technical data sheet of instruments which are connected.
PULSE WIDTH	Set the maximum pulse width for example for external counters with max. possible input frequency. The pulse width is limited to the set value. If the frequency resulting from the selected pulse value and the current flow rate is too high (T/2 < selected pulse width B), the pulses emitted are automatically reduced to half the cycle. The pulse/pause ratio is then 1:1 (see Figure). *Example:* Pulse width B = 1 sec. • At T = 3 s → pulse width = 1 s; pause period = 2 s • At T = 1 s → pulse width = 0.5 s; pause period = 0.5 s  B = Pulse width The above figure applies to positive pulses. Note! This function is only available if the setting “PULSE” is selected in the “OPERATION MODE” function. Numeric entry: 0.05...10.00 s Factory setting: ***10.00 s***

Note!

Function group PULS / FREQ. OUTPUT (HART)	
FULL SCALE	Entry of the desired full scale value for the mass or volume flow. The full scale value always corresponds to a full scale frequency of 400 Hz. Notes! This function is only available, if “FREQUENCY” has been set in the function “OPERATION MODE” (see page 48).  5-digit number with floating decimal point (e.g. 245.92 kg/h; 8.1327 l/s) Factory setting: ***dependent*** on the nominal diameter
SIMULATION FREQ.	With this function preset frequency signals can be simulated in order to check, for example, any instruments connected. The simulated signals are always symmetrical (pulse/pause ratio = 1:1). Notes! • The flowmeter remains fully operational for measurement during simulation, i.e. totalizer, flow display etc. continue to operate normally. • Positive zero return interrupts a simulation in progress and sets the output signal to the fall-back value. ***OFF*** – 0 Hz – 2 Hz – 10 Hz – 1 kHz

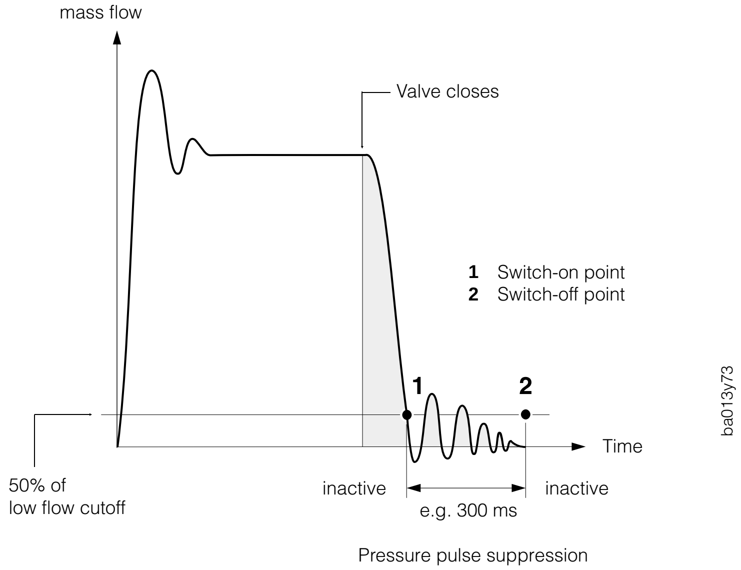
Note!

Note!

Function group PROCESSING PARA. (HART)	
LOW FLOW CUTOFF	Set the desired switching points for creep suppression (= low flow cutoff). The creep suppression prevents the flow rate being registered in the lowest measuring range (e.g.a variable column of liquid at standstill). The suppression works with a hysteresis of –50% of the creep value (see Figure).  Numeric entry (e.g. 25.000 kg/h) Factory setting: ***dependent*** on the nominal diameter
NOISE SUPPRESS.	With the help of the interference blanking (software filter), you can reduce the sensitivity of the flow signal to pulsating flow and peak interferences, e.g. in case of solids-containing fluids or gas pockets. ***0.00***...2.00 seconds (in 10 ms-steps) 0.00 seconds = OFF 2.00 seconds = high damping
EPD THRESHOLD	EPD = Empty Pipe Detection: With empty measuring tubes the density of the fluid falls below a specified value (= response or threshold value) which can be specified in this function. Caution! • For gas measurement we strictly recommend to switch off the empty pipe detection (set EPD THRESHOLD to 0,0000 kg/l). • Select a correspondingly low EPD response value so that the difference to the effective density of the fluid is sufficiently large enough. This ensures that only totally empty measuring tubes are detected, and not those partly filled. Notes! • When the preset response value is reached or exceeded, the flow is set to the value “0.0000” and the density to the EPD threshold value. • Switching on and off the EPD operates at a time constant of 1 second. Numeric entry: 0.0000...5.9999 kg/l Factory setting: ***0.0000*** (= switched off)

Caution!

Note!

Function group PROCESSING PARA. (HART)	
SELF CHECK	With this function, a better reproducibility for short batching cycles can be achieved. **_CYCLIC_** for batching times > 60 s and for continoues measuring mode SMARTPLUS for batching times < 60 s
PRESS. PULSE SUPPR.	The time interval of the active pressure pulse suppression is defined in this function. When closing a valve, there may be a sudden but strong rush of liquid in the piping which is then detected by the measuring system. The pulses will be counted, and produce an incorrect result in the totalizer, especially in filling operations. Because of this, the Promass 60 has a function for pressure pulse suppression (= transient signal suppression) which can eliminate such interferences. Note! For using the pressure pulse suppression, the low flow cutoff must be set to a value > 0 (see page 51). **Switch-on point** Pressure pulse suppression is activated after the flow velocity falls below 50% of creepage. The following applies during the pressure pulse suppression: • Current output → is set to 4 mA • Pulse output → is set to 0 Hz (at the fall back value) • Display flow = 0 • Display totalizer → remain at the last appplicable value **Switch-off point** The pressure pulse suppression is again deactivated after the set time interval (e.g. after 300 ms)  Numeric entry: 0.00...10.00 seconds Factory setting: **_0.00 s_** (= switched off) Caution! For batching applications, always select the time interval for pressure pulse suppression to be smaller than the set time interval between batching cycles. This ensures that there is no positive zero return in the start phase of a filling cycle.

Note!

Caution!

Function group SYSTEM PARAMETER (HART)

ZERO ADJUST

(ZEROPOINT ADJUST)

This function enables a zero point adjustment to be automatically carried out. The new zero point determined by the measuring system is adopted by the function “ZEROPOINT”.

General information for zero point calibration
All Promass sensors are calibrated using the most up-to-date technology available with the zero point stated on the nameplate. Calibration is carried out according to the reference conditions (see page 89). Therefore a zero point calibration is generally **not** necessary!

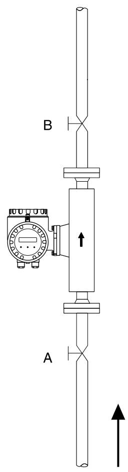
Practical experience has shown that a zero point calibration is only required in special cases:
- to achieve highest measuring accuracy
- with extreme process conditions (e.g. with very high fluid temperatures or high viscosity)

Requirements
– For fluids without gas or solids
– Zero point calibration is carried out using completely filled measuring tubes and at no-flow with e.g. shut-off valves both upstream and downstream of the sensor or by using existing shut-off and sliding valves, etc.:

Normal operation
- Open valves A and B

Zero point calibration ***with*** *pumping pressure*
- Open valve A
- Close valve B

Zero point calibration ***with*** *pumping pressure*
- Close valve A
- Open valve B



Caution!

Caution!
With difficult fluids (outgassing fluids or fluids with solids content) it is possible that no stable zero point can be achieved despite carrying out a number of zero point calibrations. In such cases, please contact your E+H Service Centre.

Carrying out a zero point calibration
1. Run the plant for as long as necessary until it is operating normally.
2. Stop the flow (v = 0 m/s).
3. Check the shut-off valves (for leaks). Also check the operating pressure.
4. Now start the zero point adjustment:

+ – ***CANCEL*** – START

Note!

Note!
- Error messages and system status during the zero point adjustment can be called up via the “DIAGNOSIS CODE” function (see page 63).
- The zero point adjustment can also be performed via the auxiliary input (see page 55).

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Function group SYSTEM PARAMETER (HART)	
CALIBR. MODE (DENSITY ADJUST)	With this function a one-point density adjustment can be carried out on site. The internal density calibration values are newly calculated and subsequently stored in the Promass 60 measuring system (see page 57). **General information for density adjustment** With a density calibration, optimum measurement accuracy will be achieved in the calculation of the flow volume. In addition, a calibration is required in the following cases: • The sensor does not exactly measure the density value expected by the user based on laboratory analysis. • The fluid characteristics lie outside of the measurement points or reference conditions used by the factory, and with which the instrument was calibrated. **Requirements** • Density adjustment on site always demands that the operator accurately knows the density of the fluid, for example from laboratory tests. • The density adjust value entered here may deviate from the currently measured fluid density by max. ±10%. For larger differences the density calibration is no longer possible. • Errors in the entered density adjust value directly affect the volume calculation. • Density adjustment changes the density calibration values entered at the factory or by the service engineer. **Carrying out density adjustment** 1. Fill the sensor with fluid. Ensure that the measuring tubes are completely filled and that the fluid is free of gas bubbles. 2. Wait until the temperature between the fluid and the measuring tube is constant (time taken → depends on the temperature and the fluid). 3. Enter the target value of your fluid in the function “DENSITY ADJ. VALUE”. With the entry of small density values the volume flow will be output correspondingly large. 4. Then select the setting “FLUID 1” in the function “DENSITY ADJUST” and confirm this entry. Promass 60 now measures a new density specific resonance frequency for the measuring tubes and fluid. Note! Repeat the procedure (point 3, 4) if an error message is displayed. Check the plant and process conditions if necessary. 5. Select the setting “DENSITY ADJUST” and confirm this entry. The density adjustment values are now calculated and then stored in the transmitter. ***CANCEL*** – FLUID 1 – DENSITY ADJUST
DENS. ADJ. VALUE (DENSITY ADJ. VALUE)	Setting of the “target density” (= density adjust value) of the particular fluid for which you want to carry out a field density adjustment. The density adjust value corresponds to the fluid density determined e.g. by laboratory tests. Performing a field density calibration → see function “DENSITY ADJUST” Note! The density adjust value entered here may deviate from the currently measured fluid density by max. ±10%. Numeric entry: 0.1...5.9999 kg/l

Note!

Note!

Function group SYSTEM PARAMETER (HART)

ASSIGN AUX. INPUT

Select or assign the auxiliary input function.
The corresponding function is activated by applying an external voltage to the auxiliary input.

+/- POS. ZERO RETURN – ***ZEROPOINT ADJUST*** – RESET TOTAL. 1

O. OPEN COLLECTOR

(ASSIGN STATUS OUTP.)

Select or assign the status output function.

Notes!
- The status output acts as a normally closed contact, i.e. in normal operation, free from fault, the output is closed (transistor conducting, see Figure).
- The behaviour of the outputs in the event of a fault is described on page 59.

Note!

+/- ***ERROR*** – FLOW DIRECTION

Configuring status output	Status	Response Open Collector (transistor) 22 23
ERROR	system O.K.	closed
	Fault indication	open
	Power supply failure	open
FLOW DIRECTION	forwards	open
	reverse	closed

“closed” → Open Collector conductive
“open” → Open Collector non-conductive

“Unidirectional” or “bidirectional” operating mode:
Promass 60 measuring system can operate either bidirectionally or in one direction only. Selecting the operating mode is, however, directly coupled with the configuration of the status output:

Status output	Operating mode	Current / pulse output
FLOW DIRECTION	bidirectional	always active (signal output in both flow directions)
ERROR	unidirectional	active only with positive flow direction (no signal output with negative flow, reverse)

Function group SYSTEM PARAMETER (HART)	
RESET DEVICE	With this function Promass 60 can be restarted without the power supply being switched off and on. Note! With a “restart” all error entries in the function “DIAGNOSTIC CODE” are deleted. Caution! This function is **not** available with using the HART handheld. ***CANCEL*** – REBOOT SYSTEM
Function group SENSOR DATA (HART)	
K-FACTOR	Display of current calibration factor of the Promass sensor. The factory determined K-factor is printed on the sensor nameplate. Max. 5-digit number (0.1000...5.9999) Factory setting: ***dependent*** on the nominal diameter of sensor and its calibration Caution! The calibration factor may only be altered under special circumstances. The appropriate E+H Service Centre should first be contacted before this is done.
ZEROPOINT (ZEROPOINT VALUE)	In this function, the zero point correction currently used by the sensor can be called up and/or changed. Max. 5-digit number (–10000...+10000) Factory setting: ***dependent*** on the nominal diameter of sensor and its calibration Example: Correction factor 100 = 1% of Q_{ref} with v = 1 m/s (ρ = 1 kg/l) Correction factor 100 = 0.5 % of Q_{ref} with v = 2 m/s (ρ = 1 kg/l)
NOMINAL DIAMETER	In this function, the actual nominal diameter of the sensor is shown (e.g. 25 mm).

Function group SENSOR DATA (HART)	
SENSOR DATA / SENSOR DATA VALUES (SENSOR COEF. VALUES)	In this function, other calibration data and information on the sensor can be called up. Changes to the calibration values shown in this function can only be carried out by an E+H service technician. This also applies to resetting calibration values originally done in the factory. Caution! A density adjustment on site (see page 54) can alter the calibration values C0, C1, C2, C3, C4 and C5. ***CANCEL*** DENSITY COEF. C 0 DENSITY COEF. C 1 DENSITY COEF. C 2 DENSITY COEF. C 3 DENSITY COEF. C 4 DENSITY COEF. C 5 TEMP. COEF. Km TEMP. COEF. Kt CAL. COEF. Kd 1 CAL. COEF. Kd 2 MIN. TEMPERATURE (lowest fluid temperature measured) MAX. TEMPERATURE (highest fluid temperature measured) For each of these calibration coefficients you can call up the particular value.
SERIAL NUMBER	In this function the serial number of the sensor is shown: 6-digit number (100000...999999)
SOFTWARE VERSION	In this function, the current software is shown which is installed on the amplifier board. The numbers of the software version have the following meaning: V4. 00 . 00 A I M F A/I/M/F: Type of Promass sensor. Second "00": Number changes if minor alterations are made to the new software. This also applies to special versions of software. First "00": Number changes if the new software contains additional functions. "4": Number changes if basic alterations have to be made to the software, e.g. owing to technical modifications to the instrument.
Function group SETUP (HART)	
TAG NUMBER (TAG)	Display or entry of measuring point description (max. 8 characters).

Caution!

7 Diagnosis and Trouble-shooting

7.1 Response of the measuring system on error

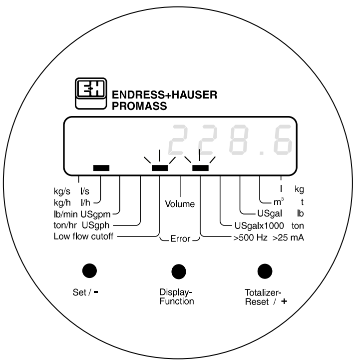
Note!

Notes!
- Fault indications which occur during operation are indicated at the status output if it is specifically configured.
- System errors are also shown on the local display of the Promass 60 independent of the configuration of the status output.
- A detailed error diagnosis is only possible if Promass 60 is being configured with HART protocol (see page 63).

The Promass 60 measuring system responds to errors in the following ways:

<table>
<tr><th>Type of fault</th><th>Reaction of outputs</th></tr>
<tr><td>• System error
• Power supply failure</td><td>➤ Status output:
The output is open, i.e. the Open Collector is not conducting, as long as the fault is not corrected (see page 32, 55)

➤ Pulse output:
No pulses supplied as long as the fault is not corrected.

➤ Current output:
The current is set at a defined value, as long as the fault is not corrected:
0...20 mA → 0 mA
4...20 mA → 2 mA</td></tr>
<tr><td colspan="2">Other error diagnosis possibilities
• via LED → page 60
• via error codes (HART) → page 63</td></tr>
<tr><th colspan="2">Displayed errors</th></tr>
<tr><td>

ba013y66</td><td>➤ System error or fluid velocity too high (v > 12.5 m/s)
→ two “Error”segments visible
→ display flashes

➤ Process error (pulse and/or current output exceeded)
→ “> 500 Hz > 25 mA” segment visible</td></tr>
</table>

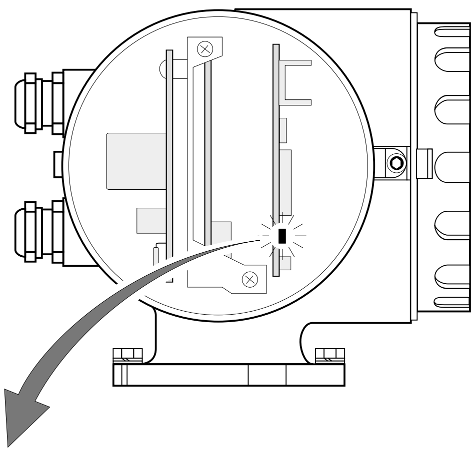
Fault diagnosis using LED

An LED (light emitting diode), with which a simple error diagnosis is **always** possible, can be found on the communications pcb. In the following cases, this is especially important:

- With instruments *without* a local display
- If the status output has *not* been configured for “System error indication” (but for “flow direction indication” instead).
- If an error diagnosis via HART protocol is *no* longer possible.

Warning!

Warning!
- Danger of electric shock! With the housing cover removed, protection against accidental contact is no longer present. Absolutely avoid all contact with any of the electronic parts.
- For Ex-certified instruments, this type of error diagnosis cannot be executed as the electronics compartment may only be opened if *no* power is present at the transmitter.



LED lights up:	→	Measuring system is OK
LED flashes:	→	Measuring system indicates system error (fault)
	→	Zero point calibration not possible. LED flashes for approx. 30 sec.
	→	During zero point calibration the LED flashes more slowly at approx. 0.25 Hz.
LED does not light up:	→	Measuring system no longer functions (transmitter failure)

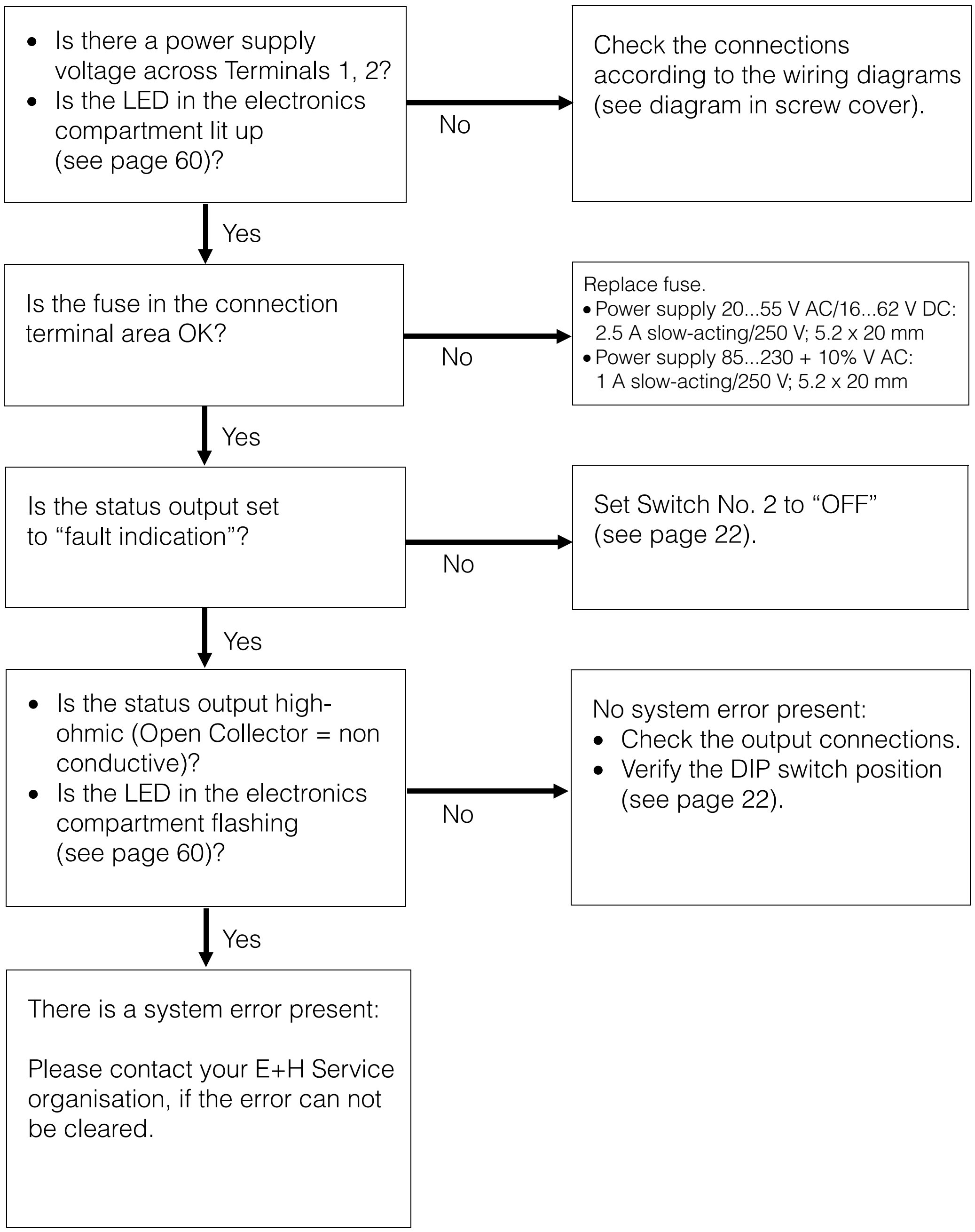
ba013y29

Fig. 23:
Error check using LED

7.2 Trouble-shooting instructions (operation via DIP switch)

All instruments undergo various stages of quality control during production. The last of these stages is the wet calibration carried out on state-of-the-art calibration rigs.

A summary of possible causes of errors is given below to help you identify faults:



7.3 Trouble-shooting instructions (operation via HART protocol)

All instruments undergo various stages of quality control during production. The last of these stages is the wet calibration carried out on state-of-the-art calibration rigs.

A summary of possible causes of errors is given below to help you identify faults:

- Is there a power supply voltage across Terminals 1, 2?
- Is the LED in the electronics compartment lit up (see page 60)?

No → Check the connections according to the wiring diagrams (see diagram in screw cover).

Yes ↓

Is the fuse in the connection terminal area OK?

No → Replace fuse:
- Power supply 20...55 V AC/16...62 V DC: 2.5 A slow-acting/250 V; 5.2 x 20 mm
- Power supply 85...230 + 10% V AC: 1 A slow-acting/250 V; 5.2 x 20 mm

Yes ↓

Is the status output set to “fault indication”?

No → Set “ASSIGN STATUS OUT.” function to “ERROR”

Yes ↓

- Is the status output high-ohmic (Open Collector = non conductive) ?
- Is the LED in the electronics compartment flashing (see page 60)?

No → No system error present:
- Check the output connections.
- Verify the instrument configuration (see page 97 ff.).
- Check the process conditions and initiate corrective measures.
  Error code → see page 66

Yes ↓

There is a system error present:
Error code → see page 63

Please contact your E+H Service organisation, if the error can not be cleared.

7.4 Error, alarm and status messages

SYSTEM ERROR Error code / Display text		Cause	Remedy
0	**–**	No system error present	–
1	**LOW VOLTAGE DETECTED**	*System error power unit:* The power unit is supplying a too low voltage.	By E+H-Service
2	**TUBES NOT OSCILLATING**	– Instrument error or – Application problem.	– By E+H-Service – Check application: • gas/solids content • system pressure, etc.
3	**DAT FAILURE**	*System error amplifier:* Error on access to data in DAT (calibration values of the sensor).	By E+H-Service
4	**EEPROM FAILURE**	*System error amplifier:* Error on access to EEPROM data (calibration values of the amplifier).	By E+H-Service
5	**RAM FAILURE**	*System error amplifier:* Error on access to working memory (RAM) of the processor.	By E+H-Service
6	**PICK-UP FAILURE**	The sensor coil is defective.	By E+H-Service
7	**LOW VOLTAGE DETECTED** (Amplifier)	*System error amplifier:* The amplifier is detecting a too low voltage. Power unit or amplifier defective.	By E+H-Service
8	**TEMP. CIRCUIT FAILURE**	*System error amplifier:* Temperature switching of the amplifier defective.	By E+H-Service

SYSTEM ERROR Error code / Display text		Cause	Remedy
9	**ASIC FAILURE**	*System error amplifier:* The ASIC on the amplifier board is defective.	By E+H-Service
10	**TEMP. SENSOR MEAS. TUBES**	*System error amplifier:* The temperature sensor of the measuring tube(s) is defective.	By E+H-Service
11	**TEMP. SENSOR CARRIER TUBE**	*System error amplifier:* The temperature sensor of the secondary containment is defective.	By E+H-Service
24	**NO AMPLIFIER RESPONSE**	Data transfer between amplifier and communications module not possible.	By E+H-Service
25	**VALUE NOT ACCEPTED**	An internally stored value cannot be read by the communications module.	– Restarting the measuring system may be required: Switch off power supply and then switch it on again. – Otherwise by E+H-Service
26	**EEPROM FAILURE**	*System error COM-module:* Error on access to EEPROM data (process and calibration data of communications module).	By E+H-Service
27	**RAM FAILURE**	*System error COM-module:* Error on access to the working memory (RAM).	By E+H-Service
28	**ROM FAILURE**	*System error COM-module:* Error on access to the programme memory (ROM).	By E+H-Service
29	**LOW VOLTAGE DETECTED**	*System error COM-module:* DC/DC converter is supplying a power voltage which is too low.	By E+H-Service

SYSTEM ERROR Error code / Display text		Cause	Remedy
30	**VOLTAGE REFERENCE**	*System error COM-module:* Reference voltage outside tolerance, i.e. correct functioning of the current output is no longer guaranteed.	By E+H-Service
31	**EEPROM HW DATA ERROR**	*System error COM-module:* The EEPROM is empty or a part of the data is overwritten. Default values from the ROM are written in. The measuring system can still operate on a makeshift basis using these values.	By E+H-Service
32	**EEPROM PARA. DATA ERR**	*System error COM-module:* A part of the EEPROM data is damaged or has been overwritten. Default values from the ROM are written in. The measuring system can still operateon a makeshift basis using these values.	By E+H-Service
33	**EEPROM TOT. DATA ERROR**	*System error COM-module:* A part of the EEPROM data (totalizer block) is damaged or has been overwritten. The default value “0” is entered in the totalizer.	By E+H-Service

ALARM MESSAGES Error code / Display text		Cause	Remedy
49	**DAT CONTAINS DEFAULT DATA**	Empty DAT on the amplifier board. The instrument is operating with default values (factory settings).	By E+H-Service
50	**EXCIT. CURRENT LIMIT**	The max. excitation current for the excitation coil has been attained with specified fluid characteristics at limit values (e.g. gas or solids content). The instrument is continuing to operate correctly.	If the excitation current is no longer sufficient, then the application conditions are to be changed, e.g.: – Increase system pressure – Check fluid properties (gas / solids content).
51	**SLUG FLOW CONDITIONS**	The medium is hetero-geneous (gas/solids content). The current needed to excite the measuring tubes therefore varies significantly.	Check application or fluid properties respectively (gas / solids content).
52	**EMPTY PIPE**	Application problem: – air in the measuring tube(s) – density too low, partly filled or empty measuring tubes	Check application. Ensure that the measuring tubes are always filled with liquid (see page 51: Empty Pipe Detection).
53	**FLOW TOO HIGH**	Velocity of liquid in the measuring tube(s) exceeds >12.5 m/s. Measuring range of transmitter electronics is exceeded.	Lower the flow rate
54	**ZERO ADJUST NOT POSSIBLE**	The zero point calibration is not possible or has been cancelled.	The zero point adjustment may only be performed with zero flow (v = 0 m/s). See page 53.
72	**CURRENT OUTP. OVERFLOW**	The actual measured value is outside the range preset by the scaled full scale value.	– Increase the full scale value accordingly (see page 47) – Lower the flow rate
74	**FREQUENCY OUTP. OVERFLOW**	The actual measured value is outside the range preset by the scaled full scale value.	– Increase the full scale value accordingly (see page 50) – Lower the flow rate

STATUS MESSAGES Error code / Display text		Cause	Remedy
96	**POS. ZERO-RET. ACTIVE**	Measured value suppression is activated.	Not required
98	**FREQ. OUTPUT SIMUL. ACTIVE**	Frequency simulation is activated.	Not required
101	**CURRENT OUTPUT SIMUL. ACTIVE**	Current simulation is activated.	Not required
–	**ZERO ADJUST RUNNING**	Zero point adjustment running.	Not required

7.5 Replacing the transmitter electronics

Warning!

- Danger from electric shock. Switch off power supply before unscrewing the cover of the electronics area from the transmitter housing.
- The local power supply voltage and frequency must agree with the technical data of the power supply boards used.
- The regulations given in the separate Ex documentation are to be observed when using Ex instruments.

❶ Loosen the screws of the safety grip (3 mm Allen key).

❷ Unscrew the cover of the electronics area of the transmitter housing.

❸ Remove the local display (if present):
a) Loosen the mounting screws of the display module.
b) Unplug the ribbon cable of the display module from the communication board.

❹ Unplug the 2-pole plug of the power supply cable (by pressing down the catch) from the power supply board.

❺ Remove the cable board of the screened cable (incl. the DAT module connected) from the amplifier board.

❻ Loosen the two Phillips screws of the board support plate. Carefully remove the support plate approx. 4-5 cm out of the transmitter housing.

❼ Remove the excitation current cable plug from the power supply board.

❽ Remove the ribbon cable plug (connection cable to the terminal area) from the communication board.

❾ The entire transmitter electronics, together with the board support plate, can now be completely removed from the housing.

Caution!
The Promass M and F electronics are not identical with those of Promass A or Promass I.

❿ Replace the old transmitter electronics with new transmitter electronics.
Reassemble in reverse sequence.

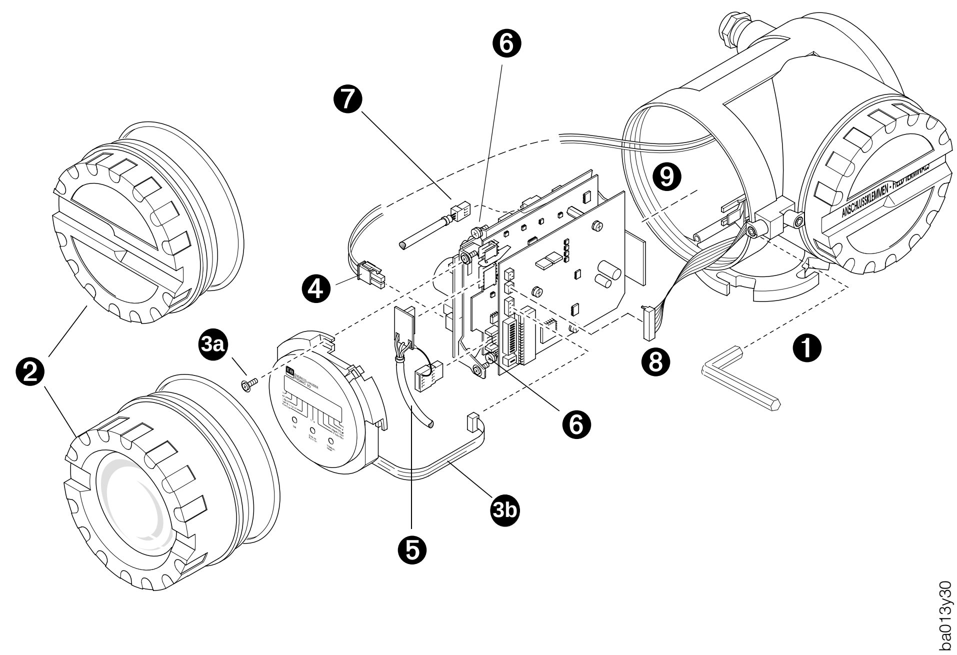


Fig. 24:
Replacing the Promass 60 transmitter electronics

7.6 Replacing the fuse


Warning!

Warning!
- Danger from electric shock! Switch off the power supply before unscrewing the cover of the terminal compartment from the transmitter housing.
- For flowmeters with Ex approvals the guidelines in the separate Ex documentation must be strictly followed.

The instrument fuse can be found in the wiring compartment → see page 18

Exclusively use the following types of fuses:
- Power supply 20...55 V AC / 16...62 V DC
  2.5 A slow-acting / 250 V; 5.2 x 20 mm

- Power supply 85...230 +10% V AC
  1 A slow-acting / 250 V; 5.2 x 20 mm

8 Dimensions

Note!
Information on dimensions and weights of Ex instruments may differ from that shown.
Please refer to the separate Ex documentation.

Note!

8.1 Dimensions Promass 60 A

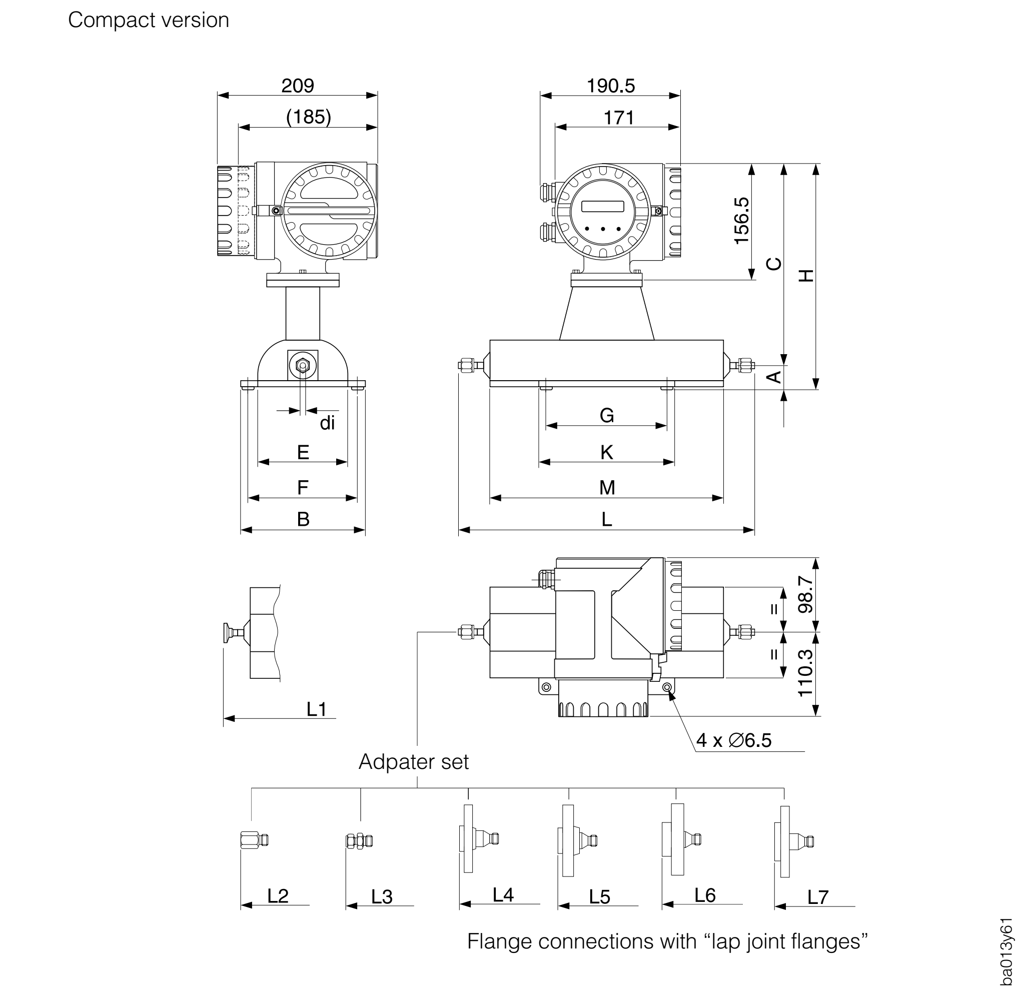


Fig. 25:
Dimensions Promass 60 A
Compact version

Process connec-tions	**L** 4-VCO-4 fittings	**L1** $^1/_2$" Tri-Clamp	**L2** $^1/_4$" NPT-F	**L3** SWAGELOK DN 1, 2: $^1/_8$", $^1/_4$" DN 4: $^1/_4$"	**L4** $^1/_2$" flange (ANSI)	**L5**	**L6** DN 15 flange (DIN, JIS)	**L7**
					Cl 150	Cl 300	PN 40	10K
DN 1	290	296	361	359.6	393	393	393	393
DN 2	372	378	443	441.6	475	475	475	475
DN 4	497	503	568	571.6	600	600	600	600

Diameter DIN	ANSI	**di**	**A**	**B**	**C**	**E**	**F**	**G**	**H**	**K**	**M**	**Weight** [kg]
DN 1	$^1/_{24}$"	1.1	32	165	269.5	120	145	160	301.5	180	228	10
DN 2	$^1/_{12}$"	1.8	32	165	269.5	120	145	160	301.5	180	310	11
DN 2*	$^1/_{12}$"	1.4	32	165	269.5	120	145	160	301.5	180	310	11
DN 4	$^1/_8$"	3.5	32	195	279.5	150	175	220	311.5	240	435	15
DN 4*	$^1/_8$"	3.0	32	195	279.5	150	175	220	311.5	240	435	15

All dimensions in [mm]; * High pressure version

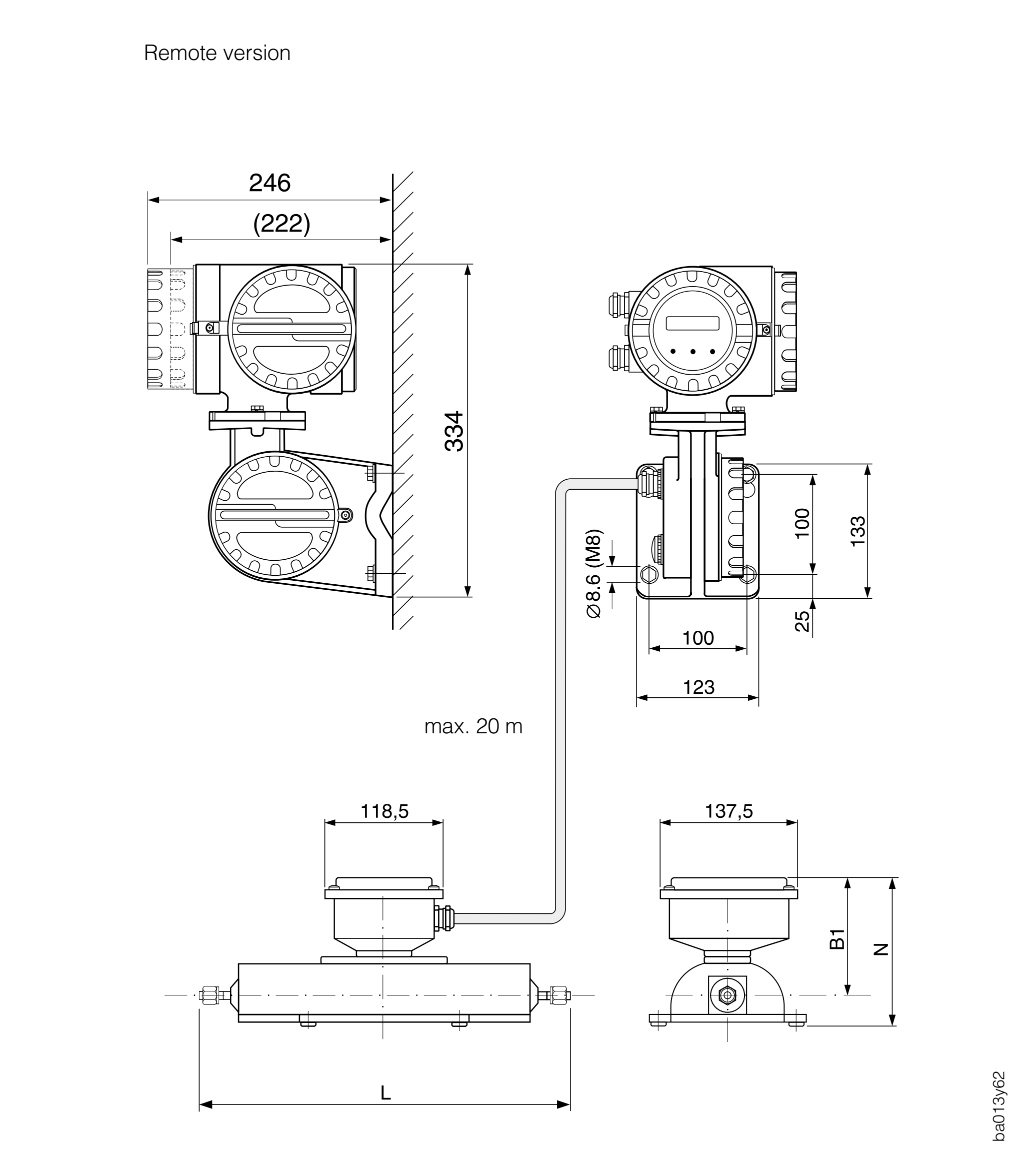


Fig. 26:
Dimensions Promass 60 A
Remote version

Diameter DIN	ANSI	**B1** [mm]	**N** [mm]	**L**
DN 1 DN 2 DN 4	$^1/_{24}$" $^1/_{12}$" $^1/_8$"	122 122 132	154 154 164	Dimensions dependent on the process connections (see previous page)

Wetted parts materials:

Measuring tubes:	SS 1.4539 (904L), Alloy C-22 2.4602 (N 06022)
4-VCO-4 fittings	SS 1.4539 (904L), Alloy C-22 2.4602 (N 06022)
½ " Tri-Clamp	SS 1.4539 (904L)
Adapter sets:	
⅛" or ¼" SWAGELOK	SS 1.4401 (316)
¼" NPT-F	SS 1.4539 (904L), Alloy C-22 2.4602 (N 06022)
Flange:	
DIN, ANSI, JIS	SS 1.4539 (904L), Alloy C-22 2.4602 (N 06022) lap joint flanges (not wetted), 1.4404 (316L)
Gasket (O-ring)	Viton (–15...+200 °C), Kalrez (–30...+210 °C), Silicone (–60...+200 °C), EPDM (–40...+160 °C)

8.2 Dimensions Promass 60 I

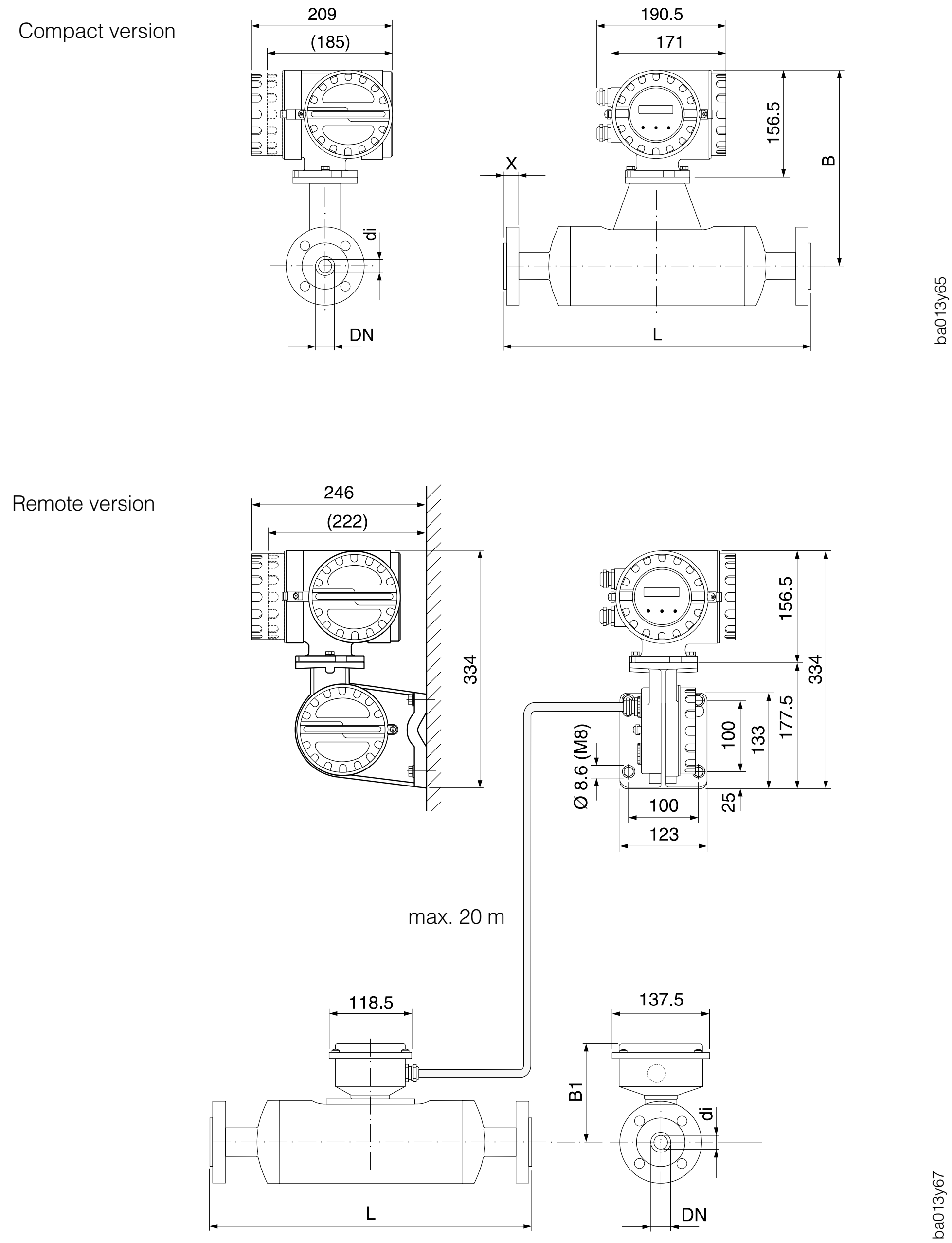


Fig. 27:
Dimensions Promass 60 I

Diameter DIN	ANSI	L	x	B [mm]	B1 [mm]	di [mm]	Weight [kg]
DN 8	$^3/_8$"	Dimensions dependent on the process connections (see Chapter 8.7)		288.0	138.5	8.55	12
DN 15	$^1/_2$"			288.0	138.5	11.38	15
DN 15 *	$^1/_2$"			288.0	138.5	17.07	20
DN 25	1"			288.0	138.5	17.07	20
DN 25 *	1"			301.5	152.0	25.60	41
DN 40	$1^1/_2$"			301.5	152.0	25.60	41
DN 40 *	$1^1/_2$"			316.5	167.0	35.62	67
DN 50	2"			316.5	167.0	35.62	67

* DN 15, 25, 40 “FB” = Full bore versions of Promass I
DN 8: with DN 15 flanges as standard;
All weights stated are those for the compact version

8.3 Dimensions Promass 60 M

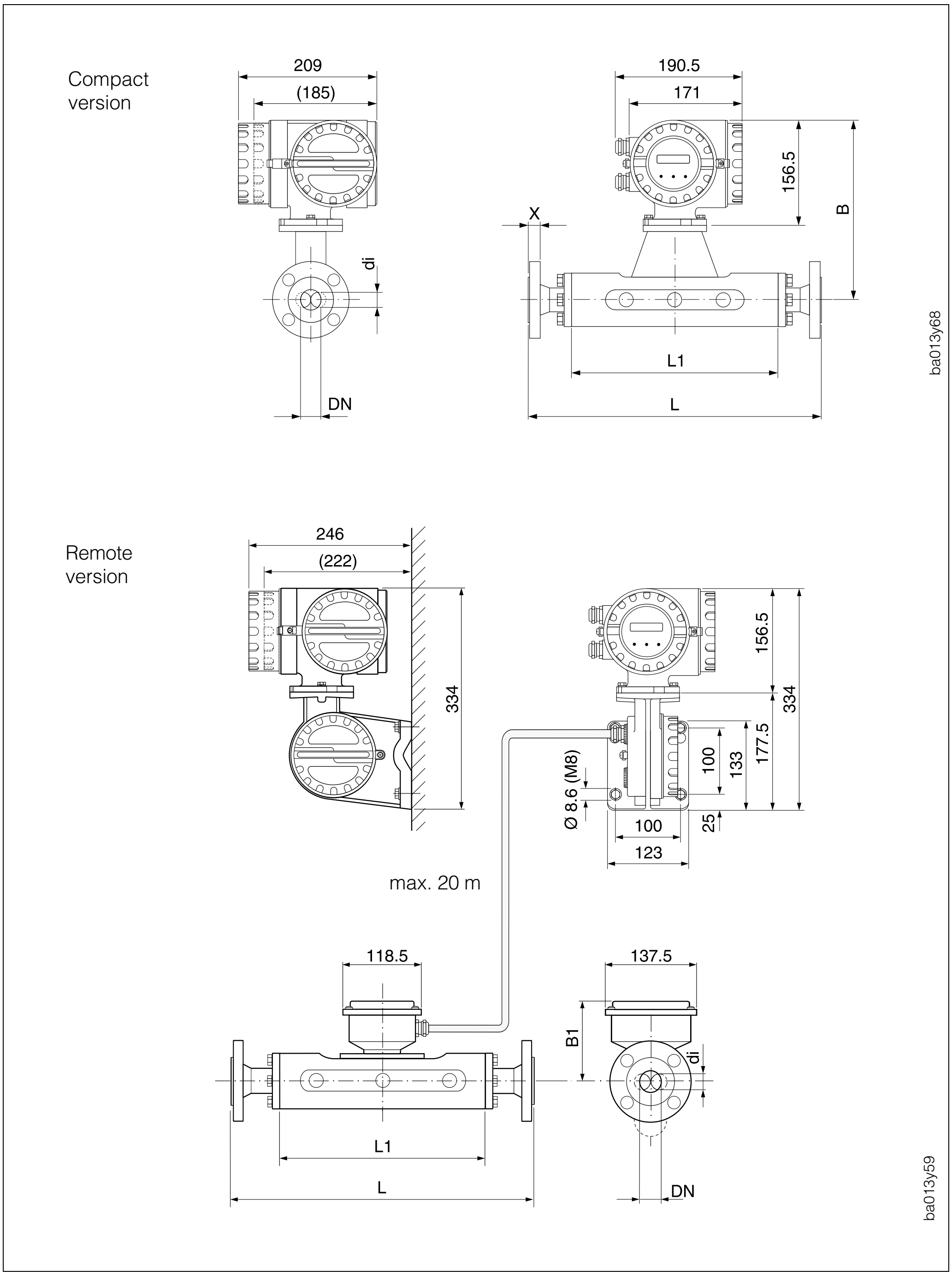


Fig. 28: Dimensions Promass 60 M

Diameter DIN	Diameter ANSI	L	x	L1	B [mm]	B1 [mm]	di [mm]	Weight [kg]
DN 8	3/8"	Dimensions dependent on the process connections (see Chapter 8.7)		256	262.5	113.0	5.53	11
DN 15	1/2"			286	264.5	114.5	8.55	12
DN 25	1"			310	268.5	119.0	11.38	15
DN 40	1 1/2"			410	279.5	130.0	17.07	24
DN 50	2"			544	289.5	140.0	25.60	41
DN 80	3"			644	305.5	156.0	38.46	67
DN 100 *	4"			–	305.5	156.0	38.46	71

DN 8: with DN 15 flanges as standard;
* DN 100 / 4": nominal diameter DN 80 / 3" with DN 100 / 4" flanges
All weights stated are those for the compact version

8.4 Dimensions Promass 60 M (high pressure)

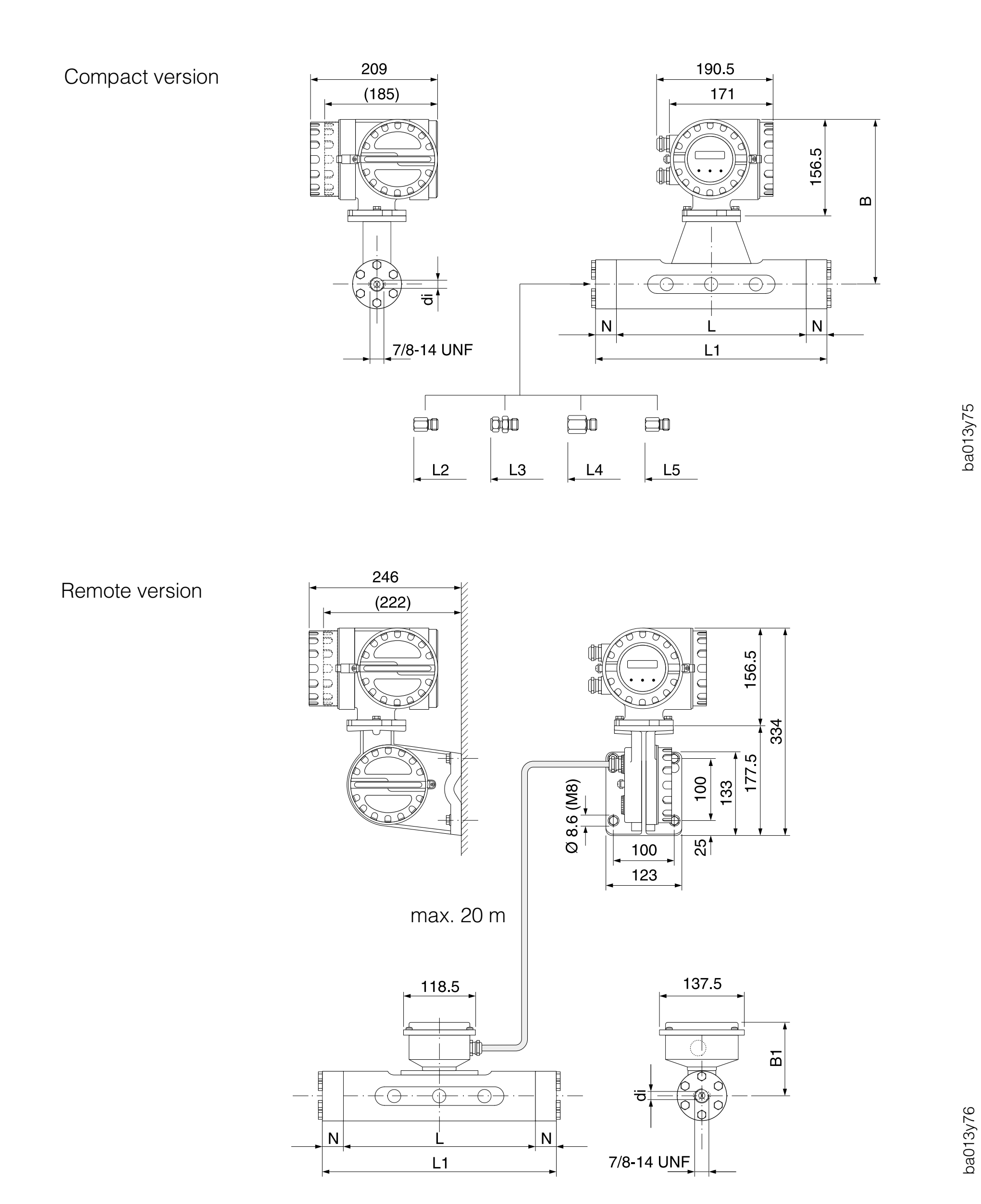


*Fig. 29:
Dimensions Promass 60 M
(High pressure version)*

Process connections	**N**	**L** without	**L1** with	**L2** G $^3/_8$"	**L3** VCO with $^1/_2$" SWAGELOK	**L4** $^1/_2$" NPT	**L5** $^3/_8$" NPT
		Connector		[mm]	[mm]	[mm]	[mm]
DN 8	24	256	304	355.8	366.4	370	355.8
DN 15	24	286	334	385.8	396.4	400	385.8
DN 25	34	310	378	429.8	440.4	444	429.8

Process connection materials
Connector → SS 1.4404 (316L)
Fittings → SS 1.4401 (316)

Couplings and connectors optimized for CNG (Compressed Natural Gas) applications.

Diameter DIN	 ANSI	**B** [mm]	**B1** [mm]	**di** [mm]	**Weight** [kg]
DN 8	$^3/_8$"	262.5	113.0	4.93	11
DN 15	$^1/_2$"	264.5	114.5	7.75	12
DN 25	1"	268.5	119.0	10.20	15

8.5 Dimensions Promass 60 M (without process connections)

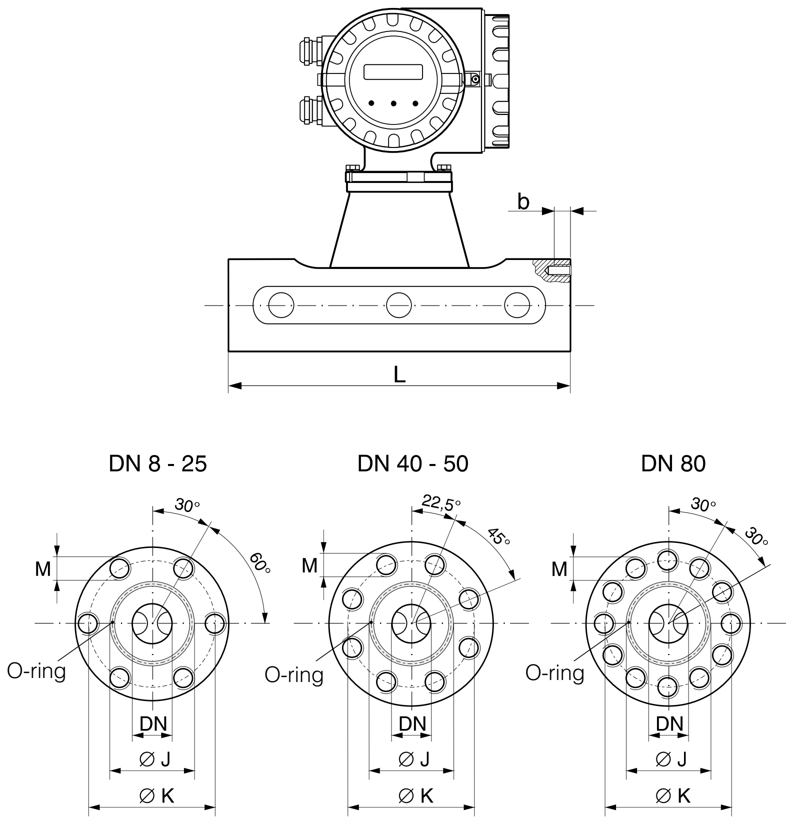


Fig. 30:
Dimensions Promass 60 M without process connections

Diameter DN		Dimensions			Coupling		Minimum screw depth	Torque	Lubricated thread	O-ring	
DIN	ANSI	Ø L [mm]	Ø J [mm]	Ø K [mm]	Screws M	Depth b [mm]	[mm]	[Nm]	yes / no	Diam. [mm]	Inside-Ø [mm]
8	$^{3}/_{8}$"	256	27	54	6 x M 8	12	10	30.0	no	2.62	21.89
8 *	$^{3}/_{8}$"	256	27	54	6 x M 8	12	10	19.3	yes	2.62	21.89
15	$^{1}/_{2}$"	286	35	56	6 x M 8	12	10	30.0	no	2.62	29.82
15 *	$^{1}/_{2}$"	286	35	56	6 x M 8	12	10	19.3	yes	2.62	29.82
25	1"	310	40	62	6 x M 8	12	10	30.0	no	2.62	34.60
25 *	1"	310	40	62	6 x M 8	12	10	19.3	yes	2.62	34.60
40	1$^{1}/_{2}$"	410	53	80	8 x M 10	15	13	60.0	no	2.62	47.30
50	2"	544	73	94	8 x M 10	15	13	60.0	yes	2.62	67.95
80	3"	644	102	128	12 x M 12	18	15	100.0	yes	3.53	94.84

* High pressure version;
Permissible thread: A4 - 80; Lubricant: Molykote P37

8.6 Dimensions Promass 60 F

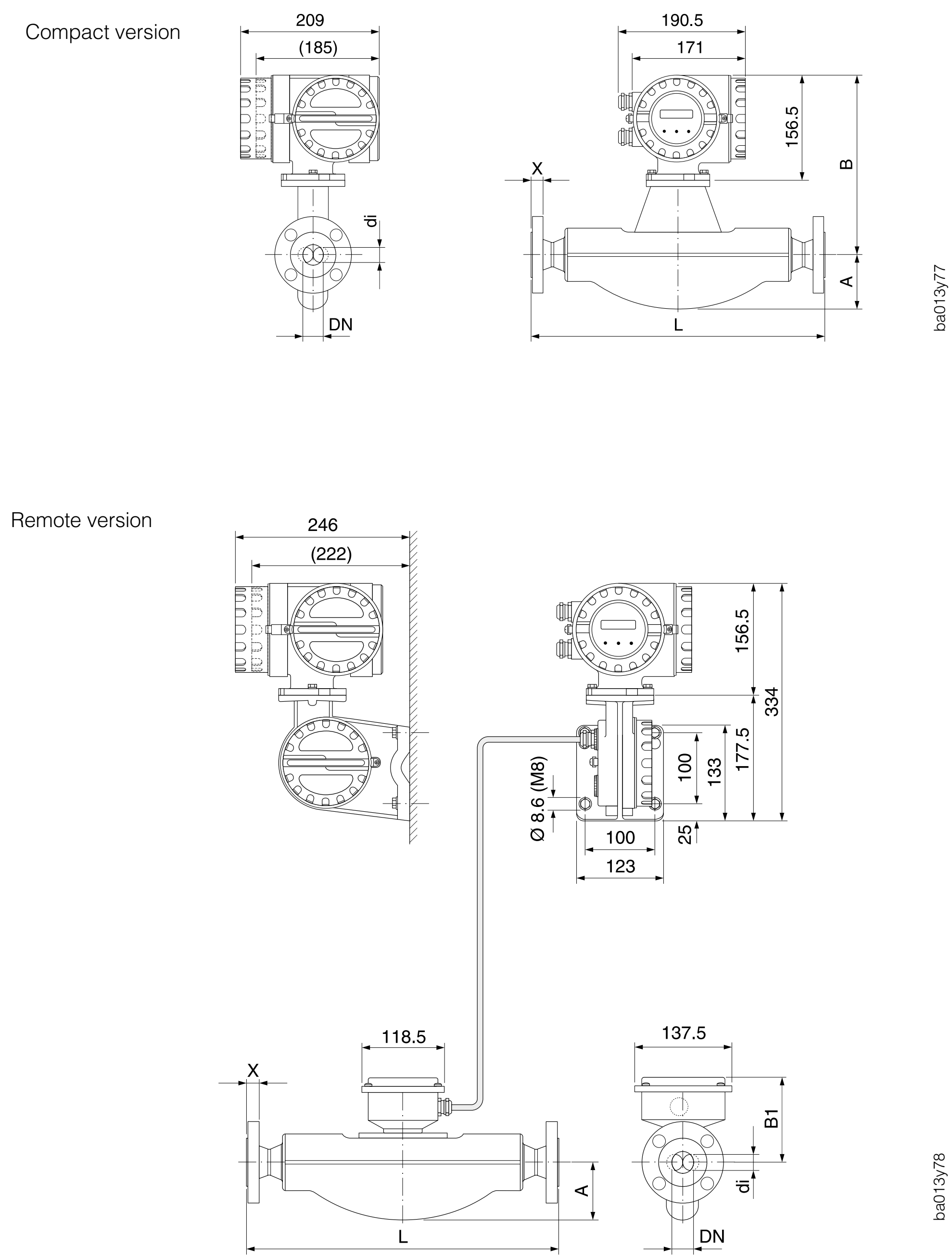


Fig. 31: Dimensions Promass 60 F

Diameter DIN	ANSI	L	x	A [mm]	B [mm]	B1 [mm]	di [mm]	Weight [kg]
DN 8	3/8"	Dimensions dependent on the process connections (see Chapter 8.7)		75	262.5	113.0	5.35	11
DN 15	1/2"			75	262.5	113.0	8.30	12
DN 25	1"			75	262.5	113.0	12.00	14
DN 40	1 1/2"			105	267.5	118.0	17.60	19
DN 50	2"			141	279.5	130.0	26.00	30
DN 80	3"			200	301.0	151.5	40.50	55
DN 100 *	4"			200	301.0	151.5	40.50	61
DN 100	4"			247	320.0	163.0	51.20	96
DN 150 **	6"			247	320.0	163.0	51.20	108

DN 8: with DN 15 flanges as standard;
All weights stated are those for the compact version;
* DN 100 /4": nominal diameter DN 80 / 3" with DN 100 / 4" flanges;
* DN 150 /6": nominal diameter DN 100 / 4" with DN 150 / 6" flanges

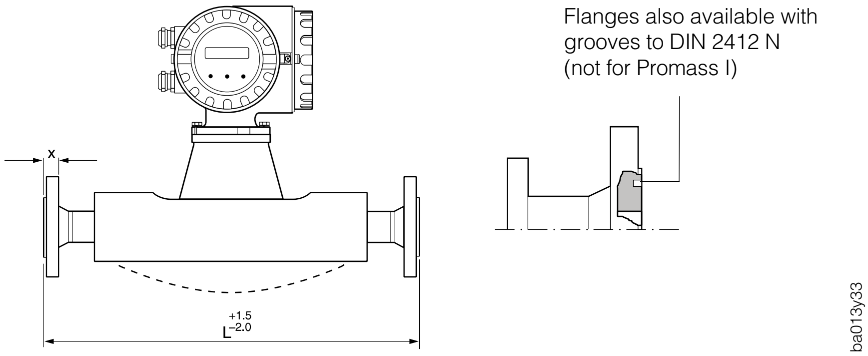
8.7 Dimensions of process connections Promass 60 I, M, F

DIN 2501 process connections

Promass I
Wetted parts: titanium Grade 9
Welded process connections: no internal gaskets

Promass M
Flange material: SS 1.4404 (316L), titanium Grade 2
Gasket material: O-ring in Viton (–15...+200 °C), Kalrez (–30...+210 °C), Silicone (–60...+200 °C), EPDM (–40...+160 °C), FEP-coated (–60...+200 °C)

Promass F
Flange material: (DN 8...100) SS 1.4404 (316L), (DN 8...80) Alloy C-22 2.4602 (N 06022)
Welded process connections: no internal gaskets



Surface finish of the flanges

For PN 16, PN 40: DIN 2526 Form C, R_a 6.3...12.5 µm

For PN 64, PN 100: DIN 2526 Form E, R_a 1.6...3.2 µm

Promass I

Diameter	PN 40 L [mm]	PN 40 x [mm]	PN 64 L [mm]	PN 64 x [mm]	PN 100 L [mm]	PN 100 x [mm]
DN 8	402	20	–	–	402	25
DN 15	438	20	–	–	438	25
DN 15 *	572	19	–	–	578	26
DN 25	578	23	–	–	578	29
DN 25 *	700	22	–	–	706	31
DN 40	708	26	–	–	708	32
DN 40 *	819	24	–	–	825	33
DN 50	827	28	832	34	832	36

DN 8: with DN 15 flanges as standard;
* DN 15, 25, 40 "FB" = Full bore versions of Promass I

Promass M, F

Diameter	PN 16 L [mm]	PN 16 x [mm]	PN 40 L [mm]	PN 40 x [mm]	PN 64 L [mm]	PN 64 x [mm]	PN 100 L [mm]	PN 100 x [mm]
DN 8 *	–	–	370	16	400	20	400	20
DN 15 *	–	–	404	16	420	20	420	20
DN 25	–	–	440	18	470	24	470	24
DN 40	–	–	550	18	590	26	590	26
DN 50	–	–	715	20	724	26	740	28
DN 80	–	–	840	24	875	28	885	32
DN 100 **	874	20	874	24	–	–	–	–
DN 100	1128	20	1128	24	1128	30	1128	36
DN 150 ***	1168	22	1168	28	–	–	–	–

DN 8: with DN 15 flanges as standard; DN 100: only for Promass F available;
* DN 8, DN 15: also available with DN 25, PN 40 flanges (L = 440 mm, x = 18 mm);
** DN 100: nominal diameter DN 80 with DN 100 flanges;
*** DN 150: nominal diameter DN 100 with DN 150 flanges

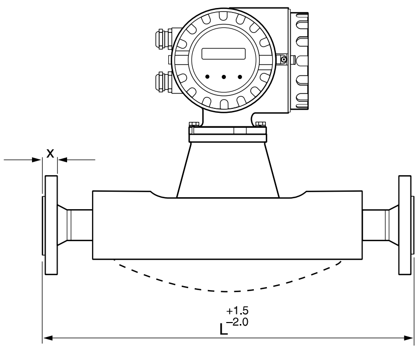
Fig. 32: Dimensions DIN process connections

ANSI B16.5 process connections

Promass I
Wetted parts: titanium Grade 9
Welded process connections: no internal gaskets

Promass M
Flange material: SS 1.4404 (316L), titanium Grade 2
Gasket material: O-ring in Viton (–15...+200 °C), Kalrez (–30...+210 °C), Silicone (–60...+200 °C), EPDM (–40...+160 °C), FEP-coated (–60...+200 °C)

Promass F
Flange material: (DN 8...100) SS 1.4404 (316L), (DN 8...80) Alloy C-22 2.4602 (N 06022)
Welded process connections: no internal gaskets



Surface finish of the flanges

For Class 150, Class 300, Class 600:
R_a 3.2...6.3 µm

ba013y35

Promass I

Diameter		Class 150		Class 300		Class 600	
ANSI	DIN	L [mm]	x [mm]	L [mm]	x [mm]	L [mm]	x [mm]
$^{3}/_{8}$"	DN 8	402	20	402	20	402	20
$^{1}/_{2}$"	DN 15	438	20	438	20	438	20
$^{1}/_{2}$"	DN 15 *	572	19	572	19	578	22
1"	DN 25	578	23	578	23	578	23
1"	DN 25 *	700	22	700	22	706	25
1$^{1}/_{2}$"	DN 40	708	26	708	26	708	28
1$^{1}/_{2}$"	DN 40 *	819	24	819	24	825	29
2"	DN 50	827	28	827	28	832	33

$^{3}/_{8}$" with $^{1}/_{2}$" flanges as standard
* DN 15, 25, 40 "FB" = Full bore versions of Promass I

Promass M, F

Diameter		Class 150		Class 300		Class 600	
ANSI	DIN	L [mm]	x [mm]	L [mm]	x [mm]	L [mm]	x [mm]
$^{3}/_{8}$"	DN 8	370	11.2	370	14.2	400	20.6
$^{1}/_{2}$"	DN 15	404	11.2	404	14.2	420	20.6
1"	DN 25	440	14.2	440	17.5	490	23.9
1$^{1}/_{2}$"	DN 40	550	17.5	550	20.6	600	28.7
2"	DN 50	715	19.1	715	22.3	742	31.8
3"	DN 80	840	23.9	840	28.4	900	38.2
4" **	DN 100	874	23.9	894	31.7	–	–
4"	DN 100	1128	23.9	1128	31.7	1158	48.4
6" ***	DN 150	1168	23.9	–	–	–	–

$^{3}/_{8}$" with $^{1}/_{2}$" flanges as standard; 4" / DN 100: only for Promass F available;
** 4" / DN 100: nominal diameter 3" / DN 80 with 4" / DN 100 flanges;
** 6" / DN 150: nominal diameter 3" / DN 100 with 6" / DN 150 flanges

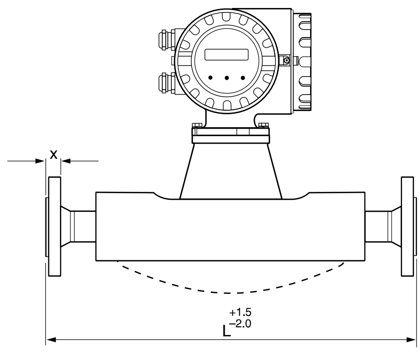
Fig. 33:
Dimensions
ANSI process connections

JIS B2238 process connections

Promass I
Wetted parts: titanium Grade 9
Welded process connections: no internal gaskets

Promass M
Flange material: SS 1.4404 (316L), titanium Grade 2
Gasket material: O-ring in Viton (–15...+200 °C), Kalrez (–30...+210 °C), Silicone (–60...+200 °C), EPDM (–40...+160 °C), FEP coated (–60...+200 °C)

Promass F
Flange material: (DN 8...100) SS 1.4404 (316L), (DN 8...80) Alloy C-22 2.4602 (N 06022)
Welded process connections: no internal gaskets



Surface finish of the flanges

For 10K, 20K, 40K, 63K:
R_a 3.2...6.3 µm

Promass I

Diameter	10K		20K		40K		63K	
	L [mm]	x [mm]	L [mm]	x [mm]	L [mm]	x [mm]	L [mm]	x [mm]
DN 8	–	–	402	20	402	25	402	28
DN 15	–	–	438	20	438	25	438	28
DN 15 *	–	–	572	19	578	26	578	29
DN 25	–	–	578	23	578	27	578	30
DN 25 *	–	–	700	22	706	29	706	32
DN 40	–	–	708	26	708	30	708	36
DN 40 *	–	–	819	24	825	31	825	37
DN 50	827	28	827	28	827	32	832	40

DN 8 with DN 15 flanges as standard
* DN 15, 25, 40 "FB" = Full bore versions of Promass I

Promass M, F

Diameter	10K		20K		40K		63K	
	L [mm]	x [mm]	L [mm]	x [mm]	L [mm]	x [mm]	L [mm]	x [mm]
DN 8	–	–	370	14	400	20	420	23
DN 15	–	–	404	14	425	20	440	23
DN 25	–	–	440	16	485	22	494	27
DN 40	–	–	550	18	600	24	620	32
DN 50	715	16	715	18	760	26	775	34
DN 80	832	18	832	22	890	32	915	40
DN 100 **	864	18	–	–	–	–	–	–
DN 100	1128	18	1128	24	1168	36	1168	44
DN 150 ***	1168	22	–	–	–	–	–	–

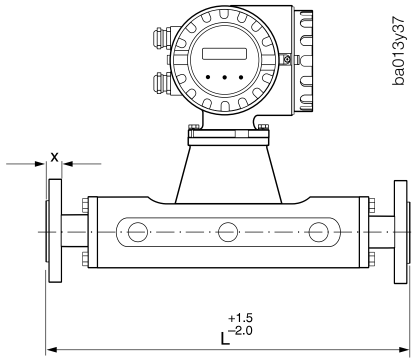
DN 8 with DN 15 flanges as standard; DN 100: only for Promass F available;
** DN 100: nominal diameter DN 80 with DN 100 flanges;
*** DN 150: nominal diameter DN 100 with DN 150 flanges

Fig. 34: Dimensions JIS process connections

PVDF process connections (DIN 2501 / ANSI B16.5 / JIS B2238)

This process connection is *only* available for **Promass M**

Flange material: PVDF
Gasket material: O-ring in Viton (–15...+200 °C), Kalrez (–30...+210 °C), Silicone (–60...+200 °C), EPDM (–40...+160 °C)

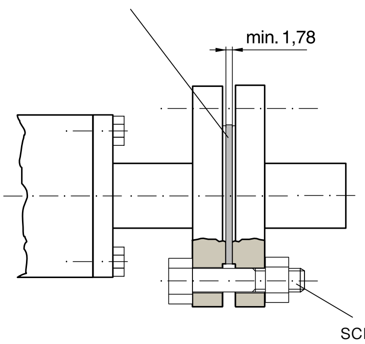


Promass M			
Diameter		PN 16 / Class 150 / 10K	
DIN	ANSI	L [mm]	x [mm]
DN 8	3/8"	370	16
DN 15	1/2"	404	16
DN 25	1"	440	18
DN 40	1 1/2"	550	21
DN 50	2"	715	22

DN 8 resp. 3/8": with DN 15-resp. 1/2" flanges as standard

Screw tightening torques (PVDF process connections)							
Diameter		PN 16		Cl 150		10K	
DIN	ANSI	[Nm]	Screw	[Nm]	Screw	[Nm]	Screw
DN 8	3/8"	4.8	4 x M 12	3.4	4 x UNC 1/2	5.9	4 x M 12
DN 15	1/2"	4.8	4 x M 12	3.4	4 x UNC 1/2	5.9	4 x M 12
DN 25	1"	11.2	4 x M 12	7.3	4 x UNC 1/2	14.1	4 x M 16
DN 40	1 1/2"	25.7	4 x M 16	15.7	4 x UNC 1/2	22.7	4 x M 16
DN 50	2"	35.8	4 x M 16	30.7	4 x UNC 5/8	32.6	4 x M 16

Hardness of gasket: Shore A ≤ 75



Caution!
- When using PVDF process connections
  – Use only gaskets as specified above
  – Use only the specified tightening torques
- For large diameters and heavy dead weights → sensor must be supported!

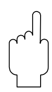


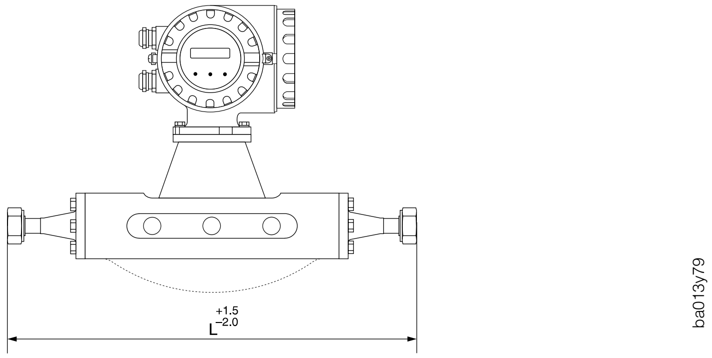
Fig. 35:
Dimensions and screw tightening torques PVDF process connections

VCO process connections

Promass I
Process connection materials: titanium Grade 2
Welded process connections: no internal gaskets

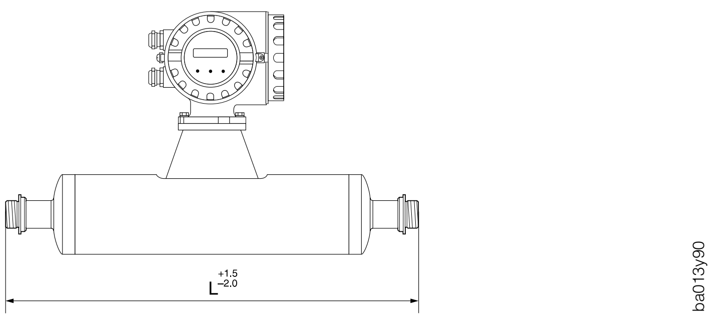
Promass M
Process connection materials: SS 1.4404 (316L)
Gasket material: O-ring in Viton (–15...+200 °C), Kalrez (–30...+210 °C), Silicone (–60...+200 °C), EPDM (–40...+160 °C),

Promass F
Process connection materials: SS 1.4539 (904L)
Welded process connections: no internal gaskets



Diameter / Connection	Promass M	Promass F
	L [mm]	L [mm]
DN 8 8-VCO-4 ($^{1}/_{2}$")	390	390
DN 15 12-VCO-4 ($^{3}/_{4}$")	430	430

Fig. 36:
Dimensions
VCO process connections
(Promass M, F)



Diameter / Connection (without nut)	Promass I
	L [mm]
DN 8 12-VCO-4 ($^{3}/_{4}$")	429
DN 15 12-VCO-4 ($^{3}/_{4}$")	465

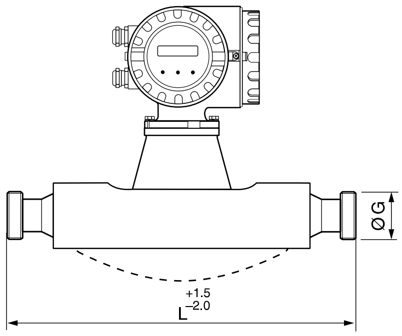
Fig. 37:
Dimensions
VCO process connections
(Promass I)

Hygienic coupling (DIN 11851 / SMS 1145)

Promass I (completely welded version)
Coupling: titanium Grade 2

Promass M (connections with internal gaskets)
Coupling: SS 1.4404 (316L)
Gasket: Silicone flat gasket (–60...+200 °C) or
EPDM (–40...+160 °C), FDA licensed gasket materials

Promass F (completely welded version)
Coupling: SS 1.4404 (316L)
Welded process connections: no internal gaskets



Promass M, F

Diameter	L [mm]	ØG DIN 11851	ØG SMS 1145
DN 8	367	Rd 34 x 1/8"	Rd 40 x 1/6"
DN 15	398	Rd 34 x 1/8"	Rd 40 x 1/6"
DN 25	434	Rd 52 x 1/6"	Rd 40 x 1/6"
DN 40	560	Rd 65 x 1/6"	Rd 60 x 1/6"
DN 50	720	Rd 78 x 1/6"	Rd 70 x 1/6"
DN 80 M	815	Rd 110 x 1/4"	–
DN 80 M	792	–	Rd 98 x 1/6"
DN 80 F	900	Rd 110 x 1/4"	Rd 98 x 1/6"
DN 100 *	1128	Rd 130 x 1/4"	Rd 132 x 1/6"

DN 8: with DN 15 flanges as standard;
* DN 100: only for Promass F available;
3A-version with $R_a \leq 0.8$ µm available

Promass I

	DIN 11851		SMS 1145	
Diameter	L [mm]	ØG	L [mm]	ØG
DN 8	426	Rd 28 x 1/8"	–	–
DN 8	427	Rd 34 x 1/8"	427	Rd 40 x 1/6"
DN 15	462	Rd 28 x 1/8"	–	–
DN 15	463	Rd 34 x 1/8"	463	Rd 40 x 1/6"
DN 15 *	602	Rd 34 x 1/8"	–	–
DN 25	603	Rd 52 x 1/6"	603	Rd 40 x 1/6"
DN 25 *	736	Rd 52 x 1/6"	736	Rd 40 x 1/6"
DN 40	731	Rd 65 x 1/6"	738	Rd 60 x 1/6"
DN 40 *	855	Rd 65 x 1/6"	857	Rd 60 x 1/6"
DN 50	856	Rd 78 x 1/6"	858	Rd 70 x 1/6"

* DN 15, 25, 40 “FB” = Full bore versions of Promass I;
3A version with $R_a \leq 0.8$ µm as standard

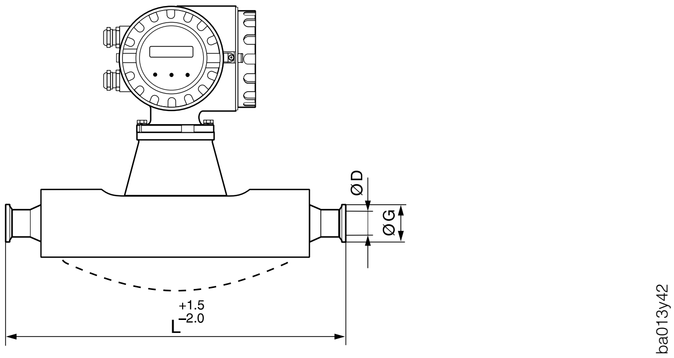
*Fig. 38:
Dimensions
Hygienic coupling
DIN 11851 / SMS 1145*

Tri-Clamp

Promass I (completely welded version)
Tri-Clamp: titanium Grade 2

Promass M (connections with internal gaskets)
Tri-Clamp: SS 1.4404 (316L)
Gasket: Silicone flat gasket (–60...+200 °C) or
EPDM (–40...+160 °C), FDA licensed gasket materials

Promass F (completely welded version)
Tri-Clamp: SS 1.4404 (316L)



Promass M, F

Diameter DIN	Diameter ANSI	Clamp	L [mm]	ØG [mm]	ØD [mm]
DN 8	$^3/_8$"	$^1/_2$"	367	25.0	9.5
DN 8	$^3/_8$"	1"	367	50.4	22.1
DN 15	$^1/_2$"	$^1/_2$"	398	25.0	9.5
DN 15	$^1/_2$"	1"	398	50.4	22.1
DN 25	1"	1"	434	50.4	22.1
DN 40	$1^1/_2$"	$1^1/_2$"	560	50.4	34.8
DN 50	2"	2"	720	63.9	47.5
DN 80 M	3"	3"	801	90.9	72.9
DN 80 F	3"	3"	900	90.9	72.9
DN 100 *	4"	4"	1128	118.9	97.4

$^3/_8$" and $^1/_2$": with 1" connections as standard; DN 100: only for Promass F available;
3A-version with $R_a \leq 0.8$ µm available

Promass I

Diameter DIN	Diameter ANSI	Clamp	L [mm]	ØG [mm]	ØD [mm]
DN 8	$^3/_8$"	$^1/_2$"	426	25.0	9.5
DN 8	$^3/_8$"	$^3/_4$"	426	25.0	16.0
DN 8	$^3/_8$"	1"	427	50.4	22.1
DN 15	$^1/_2$"	$^1/_2$"	462	25.0	9.5
DN 15	$^1/_2$"	$^3/_4$"	462	25.0	16.0
DN 15	$^1/_2$"	1"	463	50.4	22.1
DN 15 *	$^1/_2$"	$^3/_4$"	602	25.0	16.0
DN 25	1"	1"	603	50.4	22.1
DN 25 *	1"	1"	730	50.4	22.1
DN 40	$1^1/_2$"	$1^1/_2$"	731	50.4	34.8
DN 40 *	$1^1/_2$"	$1^1/_2$"	849	50.4	34.8
DN 50	2"	2"	850	63.9	47.5

* DN 15, 25, 40 "FB" = Full bore versions of Promass I;
3A version with $R_a \leq 0.8$ µm or $R_a \leq 0.4$ µm as standard

Fig. 39:
Dimensions Tri-Clamp

8.8 Dimensions of purge connections (pressure vessel monitoring)

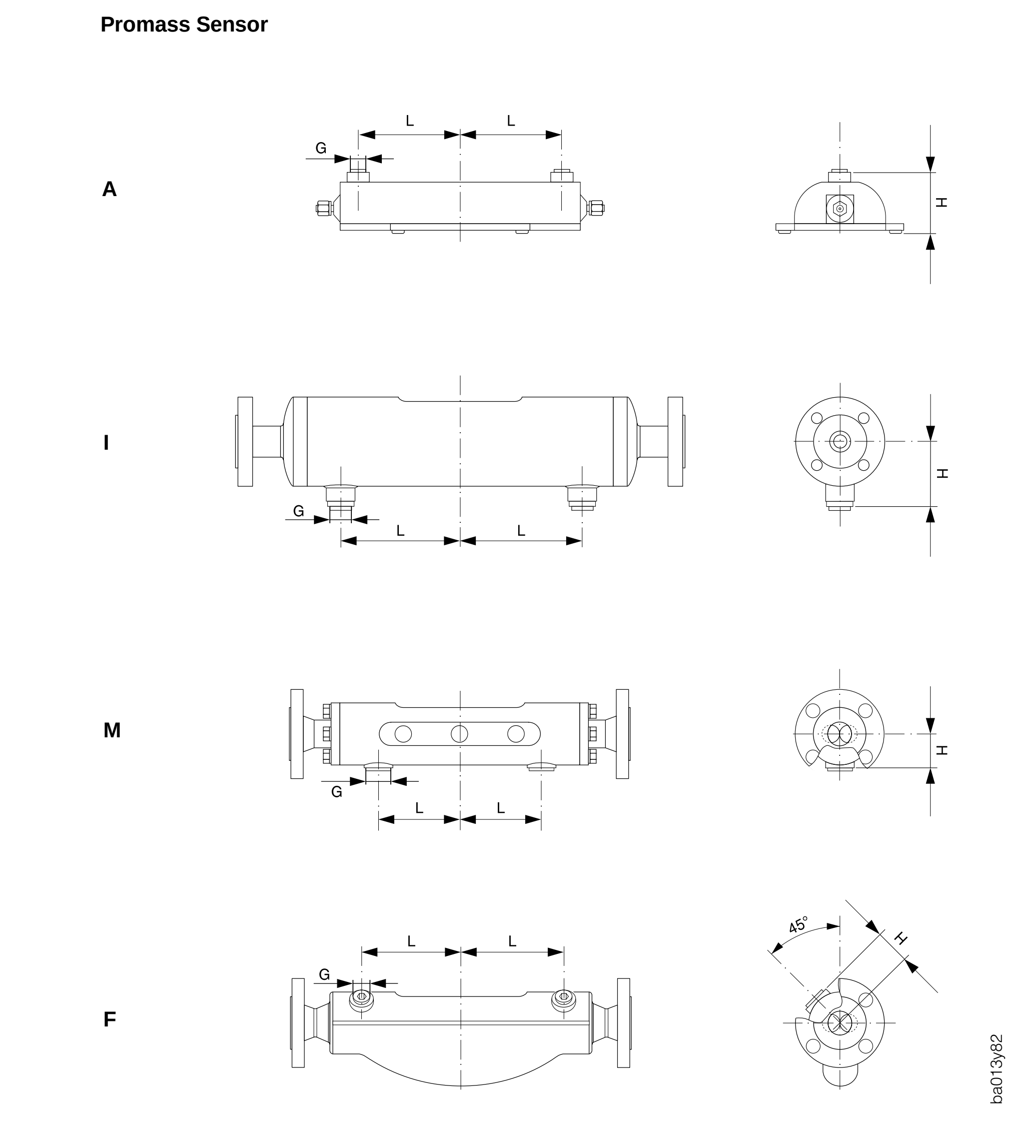


Fig. 40: Dimensions purge fittings (pressure monitoring)

Diameter		Promass A		Promass I		Promass M		Promass F		Connection
DIN	ANSI	L	H	L	H	L	H	L	H	G
DN 1	$^1/_{24}$"	92.0	87.0	–	–	–	–	–	–	$^1/_2$" NPT
DN 2	$^1/_{12}$"	130.0	87.0	–	–	–	–	–	–	$^1/_2$" NPT
DN 4	$^1/_8$"	192.5	97.1	–	–	–	–	–	–	$^1/_2$" NPT
DN 8	$^3/_8$"	–	–	61	78.15	85	44.0	108	47	$^1/_2$" NPT
DN 15	$^1/_2$"	–	–	79	78.15	100	46.5	110	47	$^1/_2$" NPT
DN 15 *	$^1/_2$"	–	–	79	78.15	–	–	–	–	$^1/_2$" NPT
DN 25	1"	–	–	148	78.15	110	50.0	130	47	$^1/_2$" NPT
DN 25 *	1 "	–	–	148	78.15	–	–	–	–	$^1/_2$" NPT
DN 40	$1^1/_2$"	–	–	196	90.85	155	59.0	155	52	$^1/_2$" NPT
DN 40 *	$1^1/_2$"	–	–	196	90.85	–	–	–	–	$^1/_2$" NPT
DN 50	2"	–	–	254	105.25	210	67.5	226	64	$^1/_2$" NPT
DN 80	3"	–	–	–	–	210	81.5	280	86	$^1/_2$" NPT
DN 100	4"	–	–	–	–	–	–	342	100	$^1/_2$" NPT

* DN 15, 25, 40 “FB” = Full bore versions of Promass I

9 Technical Data

Application	
Instrument name	Flow measuring system "Promass 60 (HART)"
Instrument function	Mass and volumetric flow measurement of liquids and gases in closed piping.
Function and system design	
Measuring principle	Mass flow measurement according to the Coriolis measuring principle (see page 7 ff.)
Measuring system	Instrument family "Promass 60" consisting of: Transmitter: Promass 60 Sensors: Promass A, I, F, M • *Promass A* DN 1, 2, 4 and DN 2, 4 high pressure version Single tube system in SS or Alloy C-22 2.4602 (N 06022) • *Promass I* DN 8, 15, 25, 40, 50 (completely welded version) Straight single tube system in titanium DN 15 "FB", DN 25 "FB", DN 40 "FB": Full bore versions of Promass I with a higher full scale value (see table below) • *Promass F* DN 8, 15, 25, 40, 50, 80, 100 (completely welded version) Two slightly curved measuring tubes in SS (DN 8...100) or Alloy C-22 (DN 8...80) • *Promass M* DN 8, 15, 25, 40, 50, 80 Two straight measuring tubes in titanium. Containment vessel up to 100 bar. DN 8,15, 25 high pressure version for operating pressures up to 350 bar Two versions are available: • Compact version • Remote version (max. 20 m)
Input variables	
Measured variables	• Mass flow rate (is proportional to the phase difference of two sensors on the measuring tubes which detect differences in its oscillation) • Fluid density (is proportional to the resonance frequency of the measuring tubes) see page 8. • Fluid temperature (is measured with temperature sensors)
Measuring range	(see table below)

DN [mm]	Ranges of full scale value – Liquid $\dot{m}_{min(L)} ... \dot{m}_{max(L)}$	Ranges of full scale value – Gas $\dot{m}_{min(G)} ... \dot{m}_{max(G)}$
1	0... 20.0 kg/h	The full scale depends on the density of the gas. The full scale value can be determined with the following formula:
2	0...100.0 kg/h	
4	0...450.0 kg/h	$\dot{m}_{max(G)} = \dfrac{\dot{m}_{max(L)} \cdot \rho_{(G)}}{x \cdot 1.6}$
8	0... 2.0 t/h	
15	0... 6.5 t/h	
15 *	0... 18.0 t/h	$\dot{m}_{max(G)}$ = Full scale gas [t/h]
25	0... 18.0 t/h	$\dot{m}_{max(L)}$ = Full scale liquid [t/h] (value from table)
25 *	0... 45.0 t/h	
40	0... 45.0 t/h	
40 *	0... 70.0 t/h	$\rho_{(G)}$ = gas density [kg/m^3] (at operating conditions)
50	0... 70.0 t/h	
80	0...180.0 t/h	x = constant [kg/m^3]
100	0...350.0 t/h	Promass A x = 20 Promass I, M, F x = 100

* DN 15, 25, 40 "FB" = Full bore versions of Promass I

(continued on next page)

Input variables (continued)	
Measuring range (continued)	Example for calculating a gas full scale value: Sensor: Promass F x = 100 Diameter DN 50 70,0 t/h (Full scale value liquid from table on page 87) Gas: Air with a density of 60,3 kg/m3 (at 20°C and 50 bar) $m_{max(G)} = \frac{m_{max(L)} \cdot \rho_{(G)}}{x \cdot 1.6} = \frac{70.0 \cdot 60.3}{100 \cdot 1.6} = 26.4\ t/h$
Operable flow range	up to 1000 : 1 This enables totalizer values to be accurately determined.
Auxiliary input	U = 3...30 V DC, R_i = 1.8 kΩ configurable for zero point adjustment, positive zero return, totalizer reset.
Output variables	
Output signal	• *Current output (with HART protocol)* 0/4...20 mA; R_L < 700 Ω (DIP switch); HART: only with 4...20 mA, R_L ≥ 250 Ω Time constant: approx. 1 s (DIP switch) or freely selectable (HART) Full scale value: 8 values selectable (DIP switch) or freely selectable (HART) Temperature coefficient: typ. 0.01% o.f.s./ °C o.f.s. = of full scale • *Pulse output* Open Collector: 0...400 Hz (f_{max} = 500 Hz) U_{max} = 30 V, I_{max} = 250 mA, Pulse value: 8 values selectable (DIP switch) or freely selectable (HART) Pulse width: max. 10 s (DIP switch) or freely selectable (HART) • *Status output* Open Collector: U_{max} = 30 V, I_{max} = 250 mA, configurable for error messages or flow direction recognition
Signal on alarm	The following applies until the fault has been cleared: • *Current output:* is set to a defined value (0...20 mA → 0 mA; 4...20 mA → 2 mA) • *Pulse output:* no pulses • *Status output:* Output is open, if configured for “error”, (i.e. the Open Collector is not conducting).
Load	See specifications “Output signal”
Creep suppression	• *DIP switch configuration:* – Switch on point at v ≤ 0.02 m/s (for water) – Switch off point at v ≥ 0.04 m/s (for water) • *HART configuration:* – Switching points freely selectable (hysteresis: –50%)

Accuracy

Reference conditions

Error limits based on ISO / DIS 11631:
- 20...30 °C; 2...4 bar
- Calibration facilities based on national standards
- Zero point calibrated under operating conditions
- Field density calibration carried out

Measured error

- *Mass flow rate (liquids):*
  Promass A, M, F ± 0.15% ± [(zero stability / flow rate) x 100]% of rate
  Promass I ± 0.20% ± [(zero stability / flow rate) x 100]% of rate

- *Mass flow rate (gas):*
  Promass A, I, M, F ± 0.50% ± [(zero stability / flow rate) x 100]% of rate

- *Volume flow rate (liquids):*
  Promass A, M ± 0.25% ± [(zero stability / flow rate) x 100]% of rate
  Promass I ± 0.50% ± [(zero stability / flow rate) x 100]% of rate
  Promass F ± 0.20% ± [(zero stability / flow rate) x 100]% of rate

  zero stability → see table below

Note!
- The values given pertain to the pulse/frequency output.
- Additional measuring error of the current output: typ. ± 10 µA

Note!

DN [mm]	Max. full scale [kg/h] or [l/h]	Zero stability Promass A, M, F [kg/h] or [l/h]	Zero stability Promass I [kg/h] or [l/h]
DN 1	20	0.0010	—
DN 2	100	0.0050	—
DN 4	450	0.0225	—
DN 8	2000	0.1000	0.200
DN 15	6500	0.3250	0.650
DN 15 *	18000	—	1.800
DN 25	18000	0.90	1.800
DN 25 *	45000	—	4.500
DN 40	45000	2.25	4.500
DN 40 *	70000	—	7.000
DN 50	70000	3.50	7.000
DN 80	180000	9.00	—
DN 100	350000	14.00	—

* DN 15, 25, 40 “FB” = Full bore versions of Promass I

Example for calculating the measuring error:

Promass F → ± 0.15% ± [(zero stability / flow rate) x 100]% of rate
DN 25
Flow rate: 3.6 t/h = 3600 kg/h

$$\text{Measuring error} = \pm 0.15\% \pm \frac{0.9\ \text{kg/h}}{3600\ \text{kg/h}} \cdot 100\% = \pm 0.175\%$$

Accuracy (continued)	
Repeatability	• *Mass flow rate (liquids):* Promass A, I, M, F ± 0.05% ± [$^{1}/_{2}$ x (zero stability / flow rate) x 100]% of rate • *Mass flow rate (gas):* Promass A, M, F ± 0.25% ± [$^{1}/_{2}$ x (zero stability / flow rate) x 100]% of rate Promass I ± 0.25% ± [$^{1}/_{2}$ x (zero stability / flow rate) x 100]% of rate • *Volume flow rate (liquids):* Promass A, M ± 0.10% ± [$^{1}/_{2}$ x (zero stability / flow rate) x 100]% of rate Promass I ± 0.20% ± [$^{1}/_{2}$ x (zero stability / flow rate) x 100]% of rate Promass F ± 0.05% ± [$^{1}/_{2}$ x (zero stability / flow rate) x 100]% of rate zero stability → see table on page 89 *Example for calculating the repeatability:* Promass F → ± 0.05% ± [$^{1}/_{2}$ x (zero stability / flow rate) x 100]% of rate DN 25 Flow rate: 3.6 t/h = 3600 kg/h $\text{Repeatability} = \pm 0.05\% \pm {}^{1}/_{2} \cdot \frac{0.9\ \text{kg/h}}{3600\ \text{kg/h}} \cdot 100\% = \pm 0.0625\%$
Process effects	• *Process temperature effect:* The below value represents the zero point error due to changing process temperature away from temperature at which a zero point adjustment was carried out: Promass A, I, M, F typical = ± 0,0002% of full scale / °C • *Process pressure effect:* The below defined values represent the effect on accuracy of mass flow due to changing process pressure away from calibration pressure (values in % of rate / bar).

DN [mm]	Promass A flow rate %o .r.**/ bar	Promass I flow rate % o.r.**/ bar	Promass M flow rate % o.r.**/ bar	Promass MP flow rate % o.r.**/ bar	Promass F flow rate % o.r.**/ bar
DN 1	none	—	—	—	—
DN 2	none	—	—	—	—
DN 4	none	—	—	—	—
DN 8	—	0.006	0.009	0.006	none
DN 15	—	0.004	0.008	0.005	none
DN 15 *	—	0.006	—	—	—
DN 25	—	0.006	0.009	0.003	none
DN 25 *	—	none	—	—	—
DN 40	—	none	0.005	—	-0.003
DN 40 *	—	0.006	—	—	—
DN 50	—	0.006	none	—	-0.008
DN 80	—	—	none	—	-0.009
DN 100	—	—	—	—	-0.012

* DN 15, 25, 40 “FB” = Full bore versions of Promass I
** o.r. = of rate

Operating conditions	
Installation conditions	
Installation instructions	Orientation: vertical or horizontal. Restrictions on installation and other recommendations → see page 11 ff.
Inlet and outlet sections	Installation site is independent of inlet and outlet sections.
Connection cable length	max. 20 m (remote version)
Ambient conditions	
Ambient temperature	Transmitter: –25...+60 °C (version, enhanced climate resitance: –40...+60 °C) Sensor: –25...+60 °C (version, enhanced climate resistance: –40...+60 °C) • Depending on the fluid temperature, certain installation positions are to be observed to ensure that the permitted ambient temperature range for the transmitter is not exceeded (see page 14) • An all-weather cover should be used to protect the housing from direct sunlight when mounting in the open. This is especially important in warmer climates and with high ambient temperatures. • If the ambient temperature is below –25 °C, it is not to be recommended to use a version with display.
Storage temperature	–40...+80 °C
Degree of protection (EN 60529)	Transmitter: IP 67; NEMA 4X Sensor: IP 67; NEMA 4X
Shock resistance	according to IEC 68-2-31
Vibration resistance	up to 1 g, 10...150 Hz according to IEC 68-2-6
Electromagnetic compatibility (EMC)	According to EN 50081 Part 1 and 2 / EN 50082 Part 1 and 2 as well as to NAMUR recommendations
Process conditions	
Fluid temperature	• *Sensor* Promass A –50...+200 °C Promass I –50...+150 °C Promass M –50...+150 °C Promass F –50...+200 °C • *Gaskets* Viton –15…+200 °C EPDM –40…+160 °C Silicone –60…+200 °C Kalrez –30…+210 °C FEP coated –60…+200 °C (continued on next page)

Operating conditions (continued)	
Nominal pressure	• *Promass A* Fittings: max. 160 bar (standard version) max. 400 bar (high pressure version) Flanges: DIN PN 40 / ANSI Cl 150, Cl 300 / JIS 10K Containment vessel: 25 bar resp. 375 psi • *Promass I* Flanges: DIN PN 40...100 / ANSI Cl 150, Cl 300, Cl 600 / JIS 10K, 20K, 40K, 63K Containment vessel: 25 bar (optional 40 bar) resp. 375 psi (optional 600 psi) • *Promass M* Flanges: DIN PN 40...100 / ANSI Cl 150, Cl 300, Cl 600 / JIS 10K, 20K, 40K, 63K Containment vessel: 40 bar (optional 100 bar) resp. 600 psi (optional 1500 psi) • *Promass M (High pressure version)* Measuring tubes, connector, fittings: max. 350 bar Containment vessel: 100 bar resp. 1500 psi • *Promass F* Flanges: DIN PN 16...100 / ANSI Cl 150, Cl 300, Cl 600 / JIS 10K, 20K, 40K, 63K Containment vessel: DN 8...80: 25 bar resp. 375 psi DN 100: 16 bar resp. 250 psi DN 8...50: optional 40 bar resp. 600 psi Caution! The material load curves (p-T-load diagrams) for all process connections can be found in the technical information TI 029D/06/en.
Pressure loss	dependent on nominal diameter and sensor type (see page 95, 96)
Mechanical construction	
Design, dimensions	see page 71 ff.
Weights	see pages 71, 73–77
Materials	• *Transmitter housing* Powder-coated die-cast aluminium • *Sensor housing/containment vessel* Promass A, I, F: Surfaces resistant to acids and alkalis, SS 1.4301 (304) Promass M: Surfaces resistant to acids and alkalis, DN 8...50: chemically nickel-plated steel, DN 80: SS 1.4313 • *Sensor connection housing (remote version)* SS 1.4301 (304) • *Process connections* Promass A → see page 71 Promass M (High pressure version) → see page 75 Promass I, M, F → see page 78 ff. • *Measuring tubes* Promass A: 1.4539 (904L) stainless steel, Alloy C-22 2.4602 (N 06022) Promass I: titanium Grade 9 Promass M: DN 80: titanium Grade 2 DN 8...50: titanium Grade 9 Promass F: DN 8...100: 1.4539 (904L) stainless steel, DN 8...80: Alloy C-22 2.4602 (N 06022) • *Gaskets* Promass A, F, I: no internal seals Promass M: see page 78 ff. Promass M: High pressure version: Silicone, Viton

Caution!

Mechanical construction (continued)		
Process connections	• *Promass A*	*Welded process connections:* 4-VCO-4 fittings, 1/2" Tri-Clamp *Screw-on process connections:* Flanges (DIN 2501, ANSI B16.5, JIS B2238), NPT-F and SWAGELOK fittings
	• *Promass I*	*Welded process connections:* 12-VCO-4 fittings, Flanges (DIN 2501, ANSI B16.5, JIS B2238), *Sanitary connections: Tri-Clamp,* Hygienic coupling DIN 11851 / SMS 1145
	• *Promass M*	*Screw-on process connections:* 8-VCO-4 fittings, 12-VCO-4 fittings, Flanges (DIN 2501, ANSI B16.5, JIS B2238), *Sanitary connections: Tri-Clamp,* Hygienic coupling DIN 11851 / SMS 1145
	• *Promass M High pressure*	*Screw-on process connections:* G 3/8", 1/2" NPT, 3/8" NPT fittings and 1/2" SWAGELOK coupling, connector with 7/8 14UNF internal thread
	• *Promass F*	*Welded process connections:* 8-VCO-4 fittings, 12-VCO-4 fittings, Flanges (DIN 2501, ANSI B16.5, JIS B2238), *Sanitary connections: Tri-Clamp,* Hygienic coupling DIN 11851 / SMS 1145
Electrical connection	• *Wiring diagrams:* *see page 18, 19* • *Cable glands (In-/outputs; remote version):* PG 13.5 cable glands (5…15 mm) or 1/2" NPT, M20 x 1.5 (8…15 mm), G1/2" threads for cable glands • *Galvanic isolation:* All circuits for inputs, outputs, power supply, and sensor are galvanically isolated from each other. • *Cable specifications (remote version):* see page 19	
User interface		
Operation	The instrument can basically be configured in two different ways: *Configuration with DIP switches and/or the local display:* • DIP switches for setting basic instrument functions • Local display and push-buttons for additional functions • Jumper for configuring the auxiliary input *Configuration using HART protocol:* • HART “Communicator DXR 275” handheld • Commuwin II software (remote configuration, process visualization)	
Display	LC-display, 8 digits 11 segments for displayed engineering units and operating status	
Communication	Current output with superimposed HART protocol	

Power supply	
Supply voltage, Frequency	• *Transmitter:* 85...260 V AC (50...60 Hz) 20... 55 V AC, 16...62 V DC • *Sensor:* is supplied by the transmitter
Power consumption	AC: <15 VA (incl. sensor) DC: <15 W (incl. sensor)
Power supply failure	Bridges min. 1 power cycle (22 ms). • EEPROM saves measuring system data on power failure (no batteries required). • DAT = exchangeable data storage module which stores all sensor data such as calibration data, nominal diameter, sensor version, etc.
Certificates and approvals	
Ex approvals	Information on presently available Ex versions (e.g. CENELEC, SEV, FM, CSA) can be supplied by your E+H Sales Centre on request. All explosion protection data are given in separate documentation available on request.
CE mark	By attaching the CE-mark, Endress+Hauser confirms that the Promass 60 measurement system has been successfully tested and fulfills all legal requirements of the relevant EC directives.
Order information	
Accessories	• Post mounting set for Promass A: DN 1, 2: Order No. 50077972 DN 4: Order No. 50079218 • Post mounting set for remote transmitter housing: Order No. 50076905
Supplementary documentation	System Information Promass SI 014D/06/en Technical Information Promass 63 TI 030D/06/en Operating Manual Promass 60 BA 013D/06/en Operating Manual Promass 63 BA 014D/06/en
Other standards and guidelines	
EN 60529	Degree of protection (IP-Code)
EN 61010	Protection Measures for Electronic Equipment for Measurement, Control, Regulation and Laboratory Procedures
EN 50081	Part 1 and 2 (interference emission)
EN 50082	Part 1 and 2 (interference immunity)
NAMUR	Association of Standards for Control and Regulation in the Chemical Industry

Pressure Loss

The pressure loss is dependent on the characteristics of the fluid and its flow rate.
The following formulae can be used to approximately calculate the pressure loss:

	Promass A / I	Promass M / F
Reynolds No.	$Re = \dfrac{4 \cdot \dot{m}}{\pi \cdot d \cdot \upsilon \cdot \rho}$	$Re = \dfrac{2 \cdot \dot{m}}{\pi \cdot d \cdot \upsilon \cdot \rho}$
Re ≥ 2300 *	$\Delta p = K \cdot \upsilon^{0.25} \cdot \dot{m}^{1.75} \cdot \rho^{-0.75} + \dfrac{K3 \cdot \dot{m}^2}{\rho}$	$\Delta p = K \cdot \upsilon^{0.25} \cdot \dot{m}^{1.85} \cdot \rho^{-0.86}$
Re < 2300	$\Delta p = K1 \cdot \upsilon \cdot \dot{m} + \dfrac{K3 \cdot \dot{m}^2}{\rho}$	$\Delta p = K1 \cdot \upsilon \cdot \dot{m} + \dfrac{K2 \cdot \upsilon^{0.25} \cdot \dot{m}^2}{\rho}$

Δp = pressure loss [mbar]
υ = kinematic viscosity [m^2/s]
$\dot{m}$ = mass flow rate [kg/s]
ρ = fuid density [kg/m^3]
d = internal diameter of measuring tubes [m]
K...K3 = constants dependent on the nominal diameter

* For gases the pressure loss has always to be calculated by use of the formula for Re ≥ 2300.

	Diameter	d [m]	K	K1	K2	K3
Promass A	DN 1	$1.10 \cdot 10^{-3}$	$1.2 \cdot 10^{11}$	$1.3 \cdot 10^{11}$	–	0
	DN 2	$1.80 \cdot 10^{-3}$	$1.6 \cdot 10^{10}$	$2.4 \cdot 10^{10}$	–	0
	DN 4	$3.50 \cdot 10^{-3}$	$9.4 \cdot 10^{8}$	$2.3 \cdot 10^{9}$	–	0
Promass A High press.	DN 2	$1.40 \cdot 10^{-3}$	$5.4 \cdot 10^{10}$	$6.6 \cdot 10^{10}$	–	0
	DN 4	$3.00 \cdot 10^{-3}$	$2.0 \cdot 10^{9}$	$4.3 \cdot 10^{9}$	–	0
Promass I	DN 8	$8.55 \cdot 10^{-3}$	$8.1 \cdot 10^{6}$	$3.9 \cdot 10^{7}$	–	$129.95 \cdot 10^{4}$
	DN 15	$11.38 \cdot 10^{-3}$	$2.3 \cdot 10^{6}$	$1.3 \cdot 10^{7}$	–	$23.33 \cdot 10^{4}$
	DN 15 *	$17.07 \cdot 10^{-3}$	$4.1 \cdot 10^{5}$	$3.3 \cdot 10^{6}$	–	$0.01 \cdot 10^{4}$
	DN 25	$17.07 \cdot 10^{-3}$	$4.1 \cdot 10^{5}$	$3.3 \cdot 10^{6}$	–	$5.89 \cdot 10^{4}$
	DN 25 *	$25.60 \cdot 10^{-3}$	$7.8 \cdot 10^{4}$	$8.5 \cdot 10^{5}$	–	$0.11 \cdot 10^{4}$
	DN 40	$25.60 \cdot 10^{-3}$	$7.8 \cdot 10^{4}$	$8.5 \cdot 10^{5}$	–	$1.19 \cdot 10^{4}$
	DN 40 *	$35.62 \cdot 10^{-3}$	$1.3 \cdot 10^{4}$	$2.0 \cdot 10^{5}$	–	$0.08 \cdot 10^{4}$
	DN 50	$35.62 \cdot 10^{-3}$	$1.3 \cdot 10^{4}$	$2.0 \cdot 10^{5}$	–	$0.25 \cdot 10^{4}$
Promass M	DN 8	$5.53 \cdot 10^{-3}$	$5.2 \cdot 10^{7}$	$8.6 \cdot 10^{7}$	$1.7 \cdot 10^{7}$	–
	DN 15	$8.55 \cdot 10^{-3}$	$5.3 \cdot 10^{6}$	$1.7 \cdot 10^{7}$	$9.7 \cdot 10^{5}$	–
	DN 25	$11.38 \cdot 10^{-3}$	$1.7 \cdot 10^{6}$	$5.8 \cdot 10^{6}$	$4.1 \cdot 10^{5}$	–
	DN 40	$17.07 \cdot 10^{-3}$	$3.2 \cdot 10^{5}$	$1.2 \cdot 10^{6}$	$1.2 \cdot 10^{5}$	–
	DN 50	$25.60 \cdot 10^{-3}$	$6.4 \cdot 10^{4}$	$4.5 \cdot 10^{5}$	$1.3 \cdot 10^{4}$	–
	DN 80	$38.46 \cdot 10^{-3}$	$1.4 \cdot 10^{4}$	$8.2 \cdot 10^{4}$	$3.7 \cdot 10^{3}$	–
Promass M High press.	DN 8	$4.93 \cdot 10^{-3}$	$6.0 \cdot 10^{7}$	$1.4 \cdot 10^{8}$	$2.8 \cdot 10^{7}$	–
	DN 15	$7.75 \cdot 10^{-3}$	$8.0 \cdot 10^{6}$	$2.5 \cdot 10^{7}$	$1.4 \cdot 10^{6}$	–
	DN 25	$10.20 \cdot 10^{-3}$	$2.7 \cdot 10^{6}$	$8.9 \cdot 10^{6}$	$6.3 \cdot 10^{5}$	–
Promass F	DN 8	$5.35 \cdot 10^{-3}$	$5.70 \cdot 10^{7}$	$9.60 \cdot 10^{7}$	$1.90 \cdot 10^{7}$	–
	DN 15	$8.30 \cdot 10^{-3}$	$5.80 \cdot 10^{6}$	$1.90 \cdot 10^{7}$	$10.60 \cdot 10^{5}$	–
	DN 25	$12.00 \cdot 10^{-3}$	$1.90 \cdot 10^{6}$	$6.40 \cdot 10^{6}$	$4.50 \cdot 10^{5}$	–
	DN 40	$17.60 \cdot 10^{-3}$	$3.50 \cdot 10^{5}$	$1.30 \cdot 10^{6}$	$1.30 \cdot 10^{5}$	–
	DN 50	$26.00 \cdot 10^{-3}$	$7.00 \cdot 10^{4}$	$5.00 \cdot 10^{5}$	$1.40 \cdot 10^{4}$	–
	DN 80	$40.50 \cdot 10^{-3}$	$1.10 \cdot 10^{4}$	$7.71 \cdot 10^{4}$	$1.42 \cdot 10^{4}$	–
	DN 100	$51.20 \cdot 10^{-3}$	$3.54 \cdot 10^{3}$	$3.54 \cdot 10^{4}$	$5.40 \cdot 10^{3}$	–

Pressure loss data **inclusive** interface measuring tube(s) / piping
Pressure loss diagrams for water can be found on the following page.

* DN 15, 25, 40 “FB” = Full bore versions of Promass I

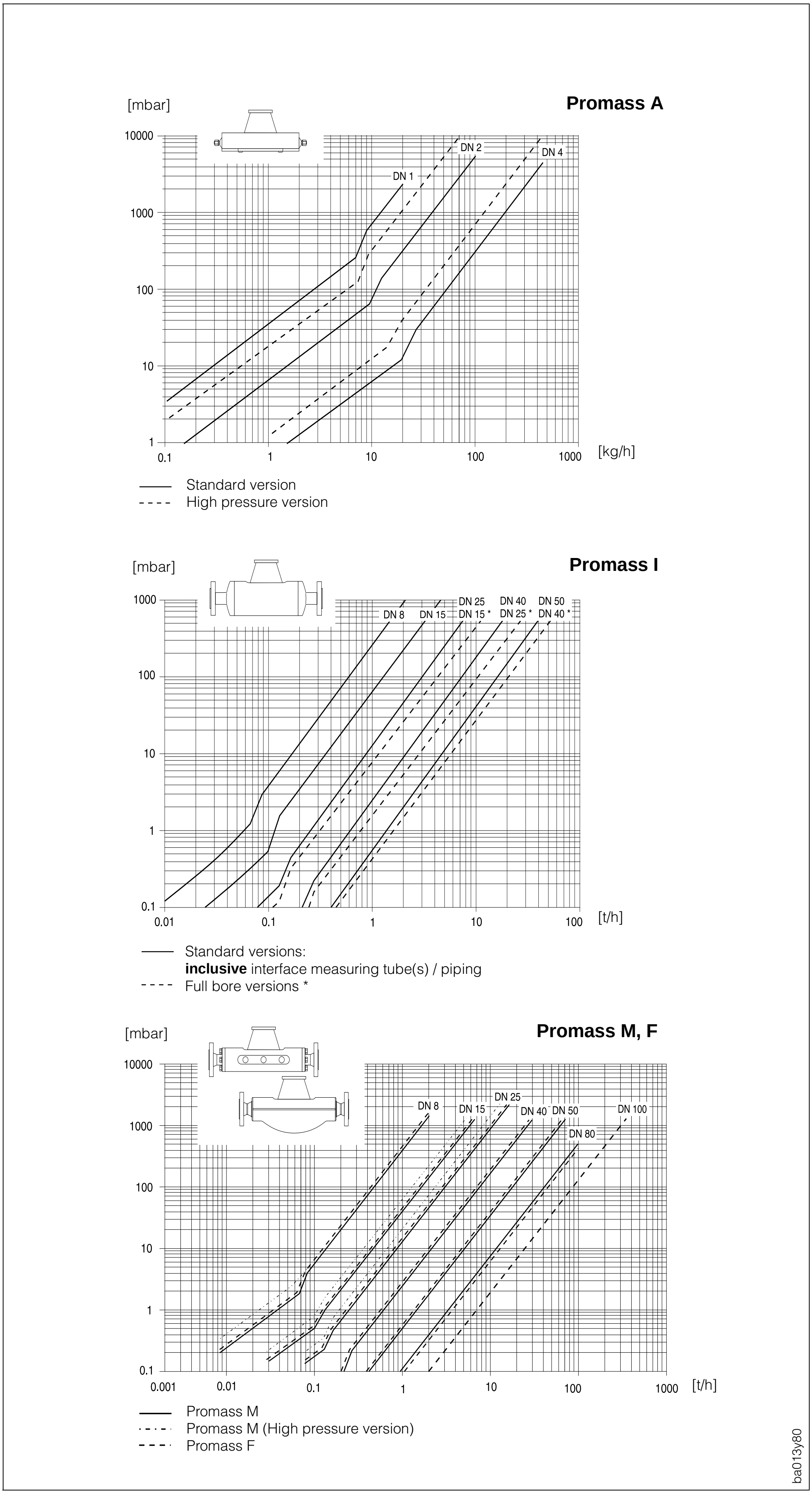
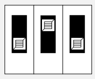
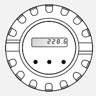
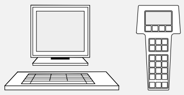
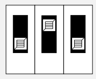
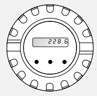


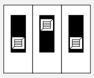
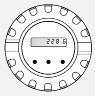
Fig. 41:
Pressure loss with water

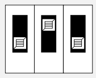
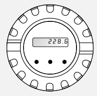
10 Functions at a Glance

	HART Protocol  Commuwin II DXR 275	DIP Switch 	Local Display 
Process Variables			
Mass flow	Display	–	"Display-Function" rAtE / rAtE-tot
Volume flow	Display	–	"Display-Function" rAtE / rAtE-tot
Density	Display	–	"Display-Function" dEnSItY (only with density calibration)
Temperature	Display	–	–
Totalizer			
Totalizer 1	Display	–	"Display-Function" tot / rAtE-tot
Totalizer 1 overflow	Display	–	"Display-Function" dISP-OF
Reset totalizer	CANCEL – TOTALIZER 1	–	Two possibilities: • "Display-Function" tot → with "Totalizer Reset" key • via auxiliary input → jumper on the right!
System Info			
Access code	Numeric entry (60)	–	–
Diagnostic code	Error code display (see page 63 ff.)	–	–
Multi drop address (Commuwin II)	Numeric entry (0...15)	–	–
Software Version Com	Display	–	–
Display test function	–	–	"Display-Function" tESt
System Units			
Volume flow measurement	OFF – VOLUME FLOW	–	"Display-Function" MAS-VOL "Set" key → Selection
System units (SI / US)	–	Switch No. 3: ON = US, OFF = SI	–
Mass flow unit	kg/s – kg/h – lb/min – ton/hr	–	"Display-Function" rAtE "Set" key → Selection
Mass unit	kg – t – lb – ton	–	"Display-Function" tot "Set" key → Selection

Function description	
HART	→ p. 43
DIP Switches	→ p. 31
Local Display	→ p. 39

	HART Protocol  Commuwin II DXR 275	DIP Switch 	Local Display 
System Units			
Volume flow unit	l/s – l/h – Ugpm – Ugph	–	“Display-Function” rAtE “Set” key → Selection
Volume unit	l – m³ – USgal – USgal * 1000	–	“Display-Function” tot “Set” key → Selection
Density unit	kg/dm³ – g/cc	–	–
Temperature unit	°C (Celsius) K (Kelvin) °F (Fahrenheit) °R (Rankine)	–	–
Current Output			
Assign output	Display: MASS FLOW – VOLUME FLOW	–	Display segment “Volume”: visible → Volume not visible → Mass
Full scale	Numeric entry	Switch Nrs. 8, 9 ,10: Eight values selectable (see page 38)	–
Time constant	Numeric entry: 0.01...99.00 s	1 s (fixed value)	1 s (fixed value)
Current span	4–20 mA 4–20 mA (NAMUR)	Switch No. 4: ON = 0...20 mA, OFF = 4...20 mA	–
Simulation current	*At 4–20 (25 mA):* OFF – 2 mA – 4 mA – 12 mA – 20 mA – 25 mA *At 4–20 (NAMUR):* OFF – 2 mA – 4 mA – 12 mA – 20 mA – 22 mA	–	–
Nominal current	Display: 0.00...25.00 mA	–	–
Puls / Freq. Output			
Assign output	Display: MASS FLOW – VOLUME FLOW	–	Display segment “Volume”: visible → Volume not visible → Mass
Operation mode	PULSE – FREQUENCY	Pulse (Frequency if switch Nrs. 5–7: ON – ON – ON)	–
Pulse value	Numeric entry	Switch Nrs. 5, 6, 7: Eight values selectable (see page 37)	–

	HART Protocol  Commuwin II DXR 275	**DIP Switch** 	**Local Display** 
Pulse width	Numeric entry: 0.05...10.00 s	– (max. 10 s)	– (max. 10 s)
Full scale	Numeric entry	–	–
Simulation frequency	OFF – 0 Hz – 2 Hz – 10 Hz – 1 kHz	–	–
Process Parameters			
Low flow cutoff	Numeric entry	Switch No. 1: ON = switched on OFF = switched off	Display segment “Low flow cutoff”
Noise suppression	0,00...2,00 seconds (in 10 ms-steps) 0,00 = OFF 2,00 = high damping	–	–
EPD threshold (Empty Pipe Detection)	Numeric entry (0 = switched off)	–	–
Self checking (batching time <60 s)	CYCLIC – SMARTPLUS	Switch No. 12: OFF = CYCLIC ON = SMARTPLUS	–
Pressure pulse suppression	Time period of activation selectable (0 = switched off)	–	“Display-Function” PrESS-SuP “Set” key → on / off
Zeropoint adjust	CANCEL – START	Switch No. 11: OFF = adjustment Jumper = ***left*** (Display)	“Display-Function” 0.-AdJuSt “Set” key → start
Density adjust	CANCEL – FLUID 1 – DENSITY ADJUST	–	“Display-Function” dEnSItY “Set” key → start
Density adjust value	Numeric entry	–	“Display-Function” dEnSItY key “+/–” → entry
Assign aux. input	POS. ZERO RETURN ZEROPOINT ADJUST RESET TOTAL. 1	Switch No. 11: • *Jumper (Display)* = ***left*** ON → Positive zero return OFF → Zeropoint adjustment • *Jumper (Display)* = ***right*** ON or OFF → Totalizer reset	
Assign status output	ERROR FLOW DIRECTION	Switch No. 2: ON = Flow direction OFF = Error	–
System reset	CANCEL – REBOOT SYSTEM (only available with COMMUWIN II)	–	–

	HART Protocol  Commuwin II DXR 275	DIP Switch 	Local Display 
Sensor Data			
K-Factor	Numeric entry: 0.1000...5.9999		
Zeropoint	Numeric entry: –10000...+10000	–	“Display-Function” PIPO key “+/–” → entry
Nominal diameter	Display (e.g. 25 mm)	–	–
Sensor coefficients (values)	Display: – Density coefficient – Temp. coefficient – Calibration coefficient – Fluid temperature (highest or lowest temperature measured)	–	–
Serial number	Display: 100000...999999	–	–
Software version	Display	–	–
TAG number	Display / Entry: name (e.g. Reinach 1)	–	–

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