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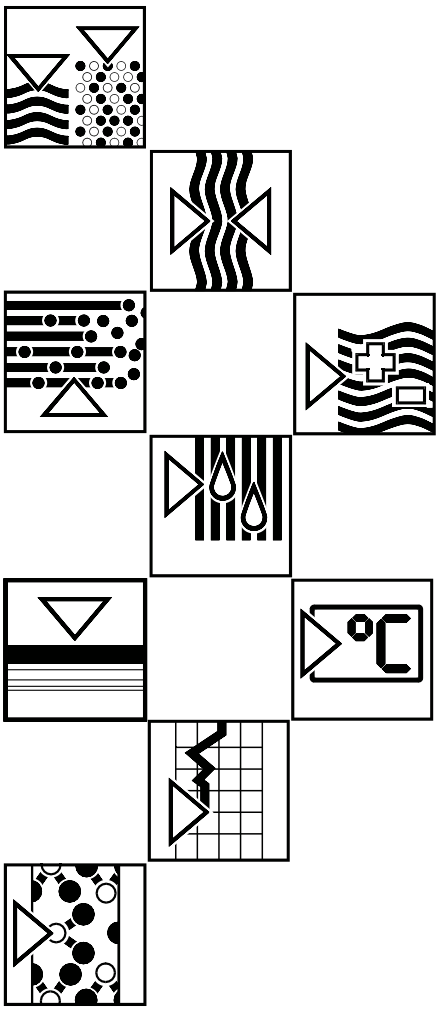
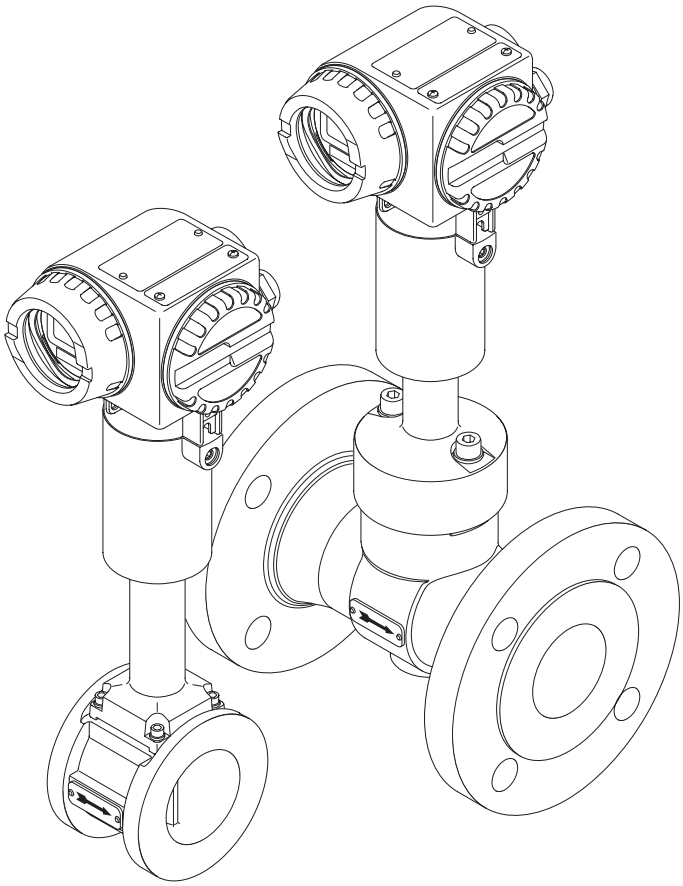
Nr. 50072931

Valid as of software version
1.1.XX

prowirl 70
Vortex Flow Measuring System

Operating Manual





Endress+Hauser

Nothing beats know-how

Safety Instructions

Warning!
Please observe without fail the safety instructions in Chapter 1 (page 5).

Documentation for Ex instruments

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 of this document according to the approval given and the test centre.

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Contents

1 Safety Instructions

1.1 Correct Usage

- Prowirl 70 is only to be used for measuring the flow of gas, steam and liquids.
- The manufacturer assumes no liability for damage caused by incorrect use of the instrument.

1.2 Dangers and Notes

All instruments are designed to meet state-of-the-art safety requirements, 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 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.


Warning!

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


Caution!

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


Note!

1.3 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 pipe, bluff body, sensor and gaskets is to be verified (for wetted parts materials, see Chapter 9). This also applies to fluids used to clean the Prowirl flowmeter.
- The installer has to make sure that the measuring system is correctly wired up according to the wiring diagrams. The measuring system is to be grounded.
- Please observe all provisions valid for your country and pertaining to opening and repair of electrical devices.

1.4 Repairs, Dangerous Chemicals

The following procedures must be carried out before a Prowirl 70 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 fluids.
- 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 cost for waste disposal or cause harm to personnel (burns, etc). Any costs arising from this will be charged to the owner of the instrument.

1.5 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 System Description

2.1 Fields of application

The Prowirl 70 vortex flowmeter measures the volumetric flow of fluids having widely differing characteristics:
- Saturated steam
- Superheated steam
- Gases
- Low-viscosity liquids

Applications include:
- Energy production, heat supplies
- Chemicals and petrochemicals
- Food processing
- OEM

Prowirl measures the volumetric flow at process conditions. If the process pressure and temperature are constant, Prowirl can be programmed to display or output the flowrate in mass, energy or corrected volume units.
In cases where process conditions are changing, the universal E+H Compart DXF 351 flow computer calculates these values continuously using signals from Prowirl and from additional pressure and temperature transmitters.

2.2 Measuring Principle

Vortex flowmeters operate on the physical principle of the Karman vortex street. When a fluid flows past a bluff body, vortices are alternately formed on the sides of that body and then detached or shed by the flow. The frequency of vortex shedding is proportional to the mean flow velocity and, therefore, the volumetric flow (with Re >4000).

$$\text{Vortex frequency} = \frac{St \cdot v}{d}$$

St = Strouhal number
v = velocity fluid
d = width bluff body

Alternating pressure changes caused by the vortices are transmitted via lateral ports into the bluff body.
The DSC sensor is located within the bluff body and is well protected from water hammer and temperature or pressure shocks. The sensor detects the pressure pulses and converts these into electrical signals.

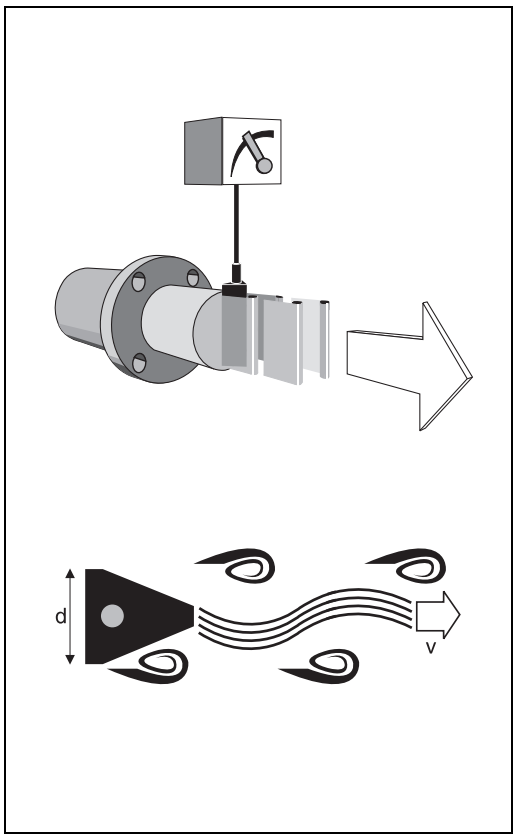


Fig. 1:
Measuring principle – vortex shedding behind a bluff body in a flow stream

The sensor amplifier processes the sinusoidal sensor signal into a flow-proportional pulse frequency. This is then converted by the transmitter (or flow computer) into a standard output signal.

The same sensor and electronics are used for all nominal diameters and fluids. The sensor signal is galvanically isolated in the preamplifier from the output signal.

2.3 Prowirl 70 Measuring System

A measuring system consists of:
- Prowirl 70 transmitter
- Prowirl F, W, H or D sensor

The high performance, universal Prowirl electronics can be freely combined with the various proven meter body styles. This guarantees flexibility when matching a complete meter to specific industrial process conditions.

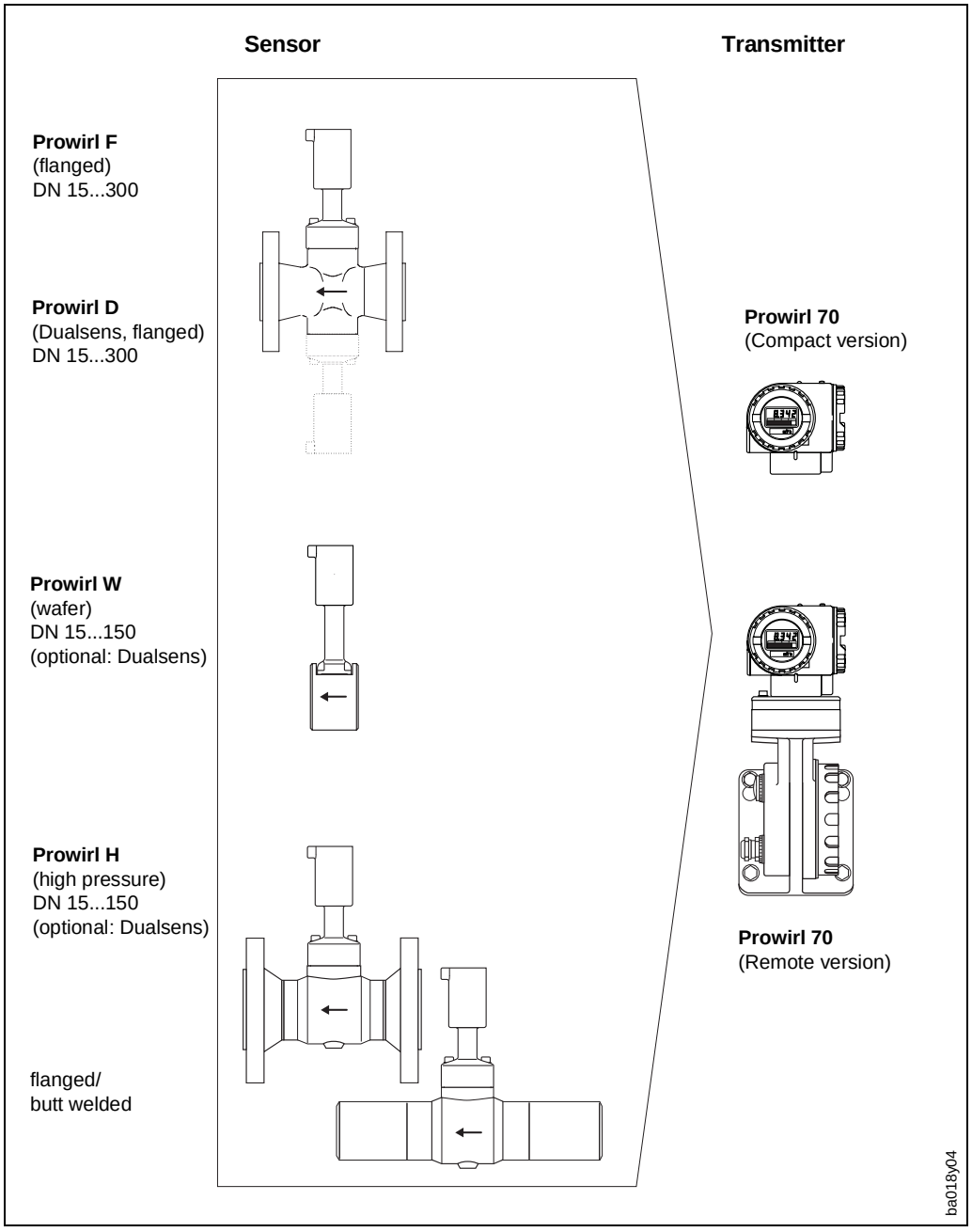


Fig. 2:
Prowirl 70 measuring system

Prowirl 70 Measuring System: Compact/Remote Versions

Compact version

The Prowirl 70 transmitter and sensor form one mechanical unit.

Remote version

The transmitter is mounted remotely from the sensor.

See page 23 for cable specifications.

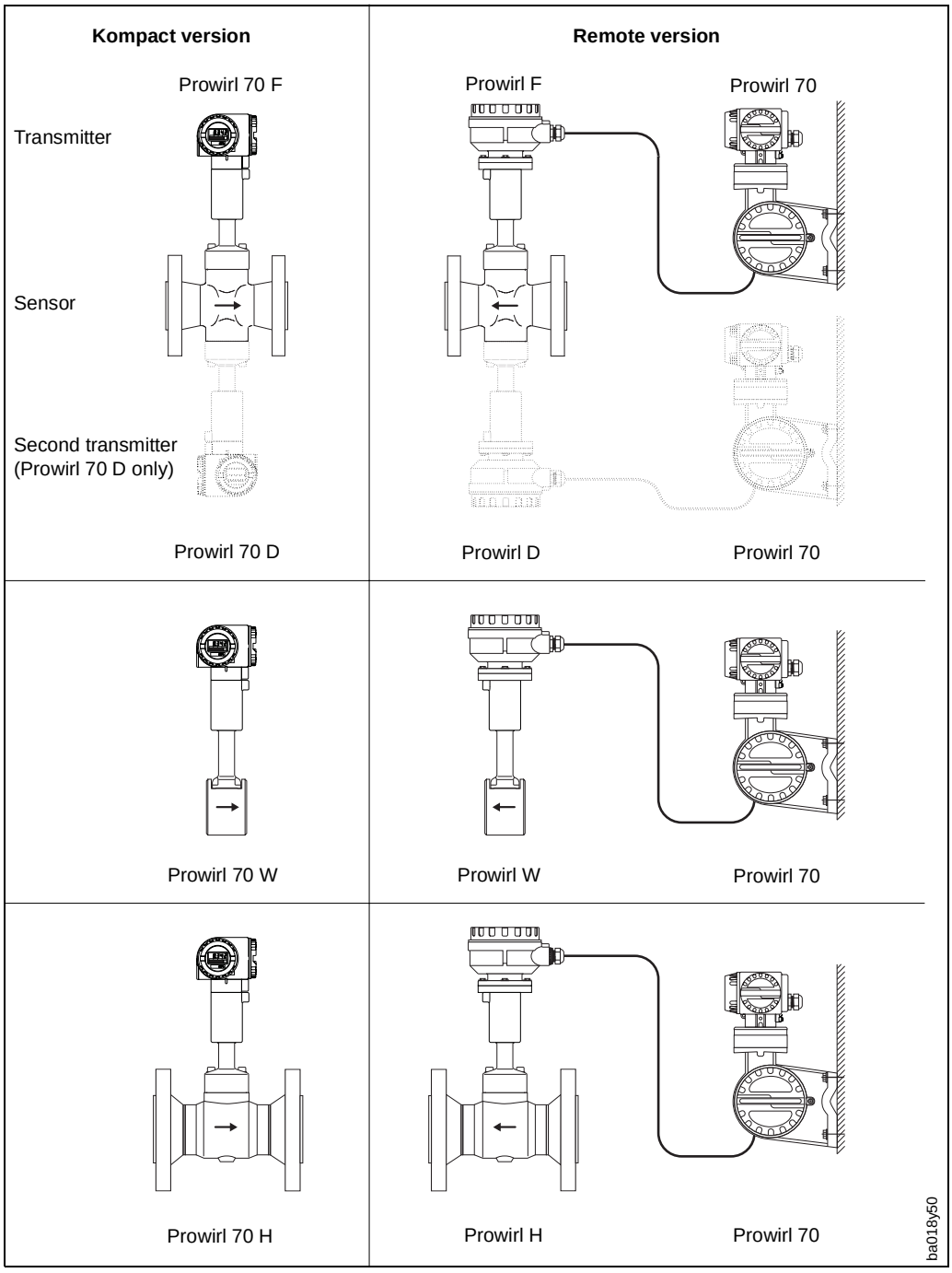


Fig. 3:
Prowirl 70 measuring system compact/remote versions

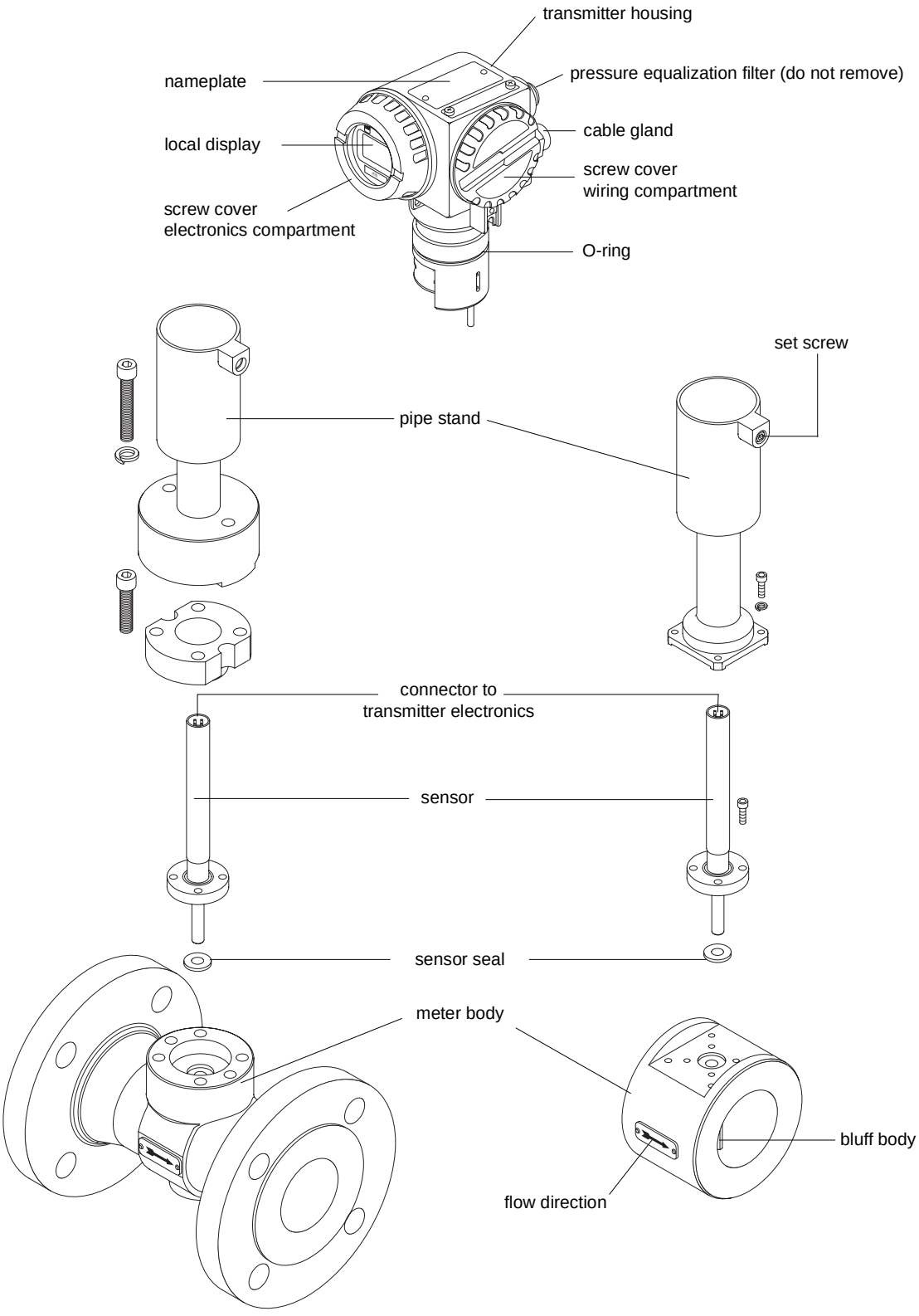


Fig. 4:
Construction of the Prowirl 70

3 Mounting and Installation

Caution!
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.

3.1 General Information

Protection IP 65 (EN 60529)
The instruments fulfil all the requirements for IP 65. For successful installation in the field or after servicing, the following points must always be observed in order to ensure protection to IP 65:

- 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. 5).
- The cable must loop down before entering the cable gland to ensure that no moisture can enter it (see Fig. 5).
- Any cable glands not used are to be replaced with a plug.
- The protective bushing should not be removed from the cable gland.

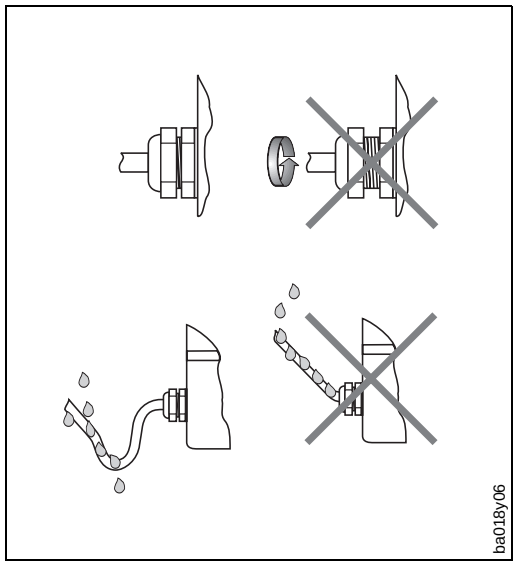


Fig. 5:
IP 65 Protection

Temperature Ranges
- The maximum approved ambient and process temperatures must be observed (see pages 60 to 62).
- Observe also the instructions on piping insulation and mounting position (see page 14).

Pressure Pulses/Measuring Accuracy
Reciprocating pumps and compressors create strong changes in process pressure in the piping and thus cause additional measuring errors. These pressure pulses must be reduced by appropriate measures, e.g.:
- using expansion tanks (for gases and liquids),
- with compressed air chambers (for liquids),
- with inlet expanders (for gas),
- with a more suitable mounting location.


Note!

Note!
The ratio between pressure pulsation ΔP_p and the vortex intensity ΔP_w is in direct relation to the resulting measuring error. The ratio $\Delta P_p/\Delta P_w$ should not exceed 15 so that the measuring accuracy for the Prowirl measuring system is always maintained:

$$\Delta P_w = 1{,}47 \cdot 10^{-5} \cdot \rho \cdot v^2 \qquad \text{and} \qquad \frac{\Delta P_p}{\Delta P_w} < 15$$

ΔP_p = pressure pulsation [bar]
ΔP_w = vortex intensity [bar]
ρ = density of the liquid [kg/m^3]
v = mean flow velocity [m/s]

Minimum Back Pressure and Cavitation with Liquids
Shocks caused by cavitation* can substantially disturb (liquid) measurement or even make measurement impossible. This may result in damage in the area of the bluff body.
To prevent cavitation, a sufficiently high back pressure must be maintained at the flowmeter outlet. The minimum back pressure is determined by the following formula:

$$p \geq 2.6\,\Delta p + 1.25\,p_D$$

p = minimum pipeline pressure [bar abs.], 5 x DN downstream of the sensor
Δp = pressure drop across the meter body [bar]
p_D = liquid vapour pressure at operating conditions [bar abs.]

(* Cavitation: A sudden pressure drop due to a throat in the pipe may cause a flowing liquid to locally fall below its vapour pressure and therefore allow bubbles to form. These bubbles implode downstream with increasing liquid pressure leading to the above mentioned shocks)

Additional Notes!
- When measuring liquids, the meter should be installed where the pipeline is always full (e.g. in vertical pipelines).
- Free-standing pipes subject to strong vibration should be firmly attached or supported upstream and downstream of the meter.
- A gas separator should be used in the pipeline if a liquid tends to form gas bubbles.
- Ensure that condensate can be removed from steam pipes.

3.2 Installation

The following minimum installation recommendations are to be observed when installing the Prowirl 70 vortex flowmeter in the pipeline. In order to achieve optimum measuring accuracy, the inner diameters of the flowmeter and the process piping should be identical.

Inlet and Outlet Sections
An undisturbed flow profile is a prerequisite for accurate vortex flow measurement. The minimum recommendations for clear pipework on either side of the flowmeter are:
- Inlet section: min. 10 x DN
- Outlet section: min. 5 x DN

If flow disturbances such as pipe elbows, reducers, expanders, etc. are located upstream of the measuring point, then longer inlet sections are required (see Fig. 6).
This also applies to valves. Wherever possible, they should be installed downstream of the sensor.

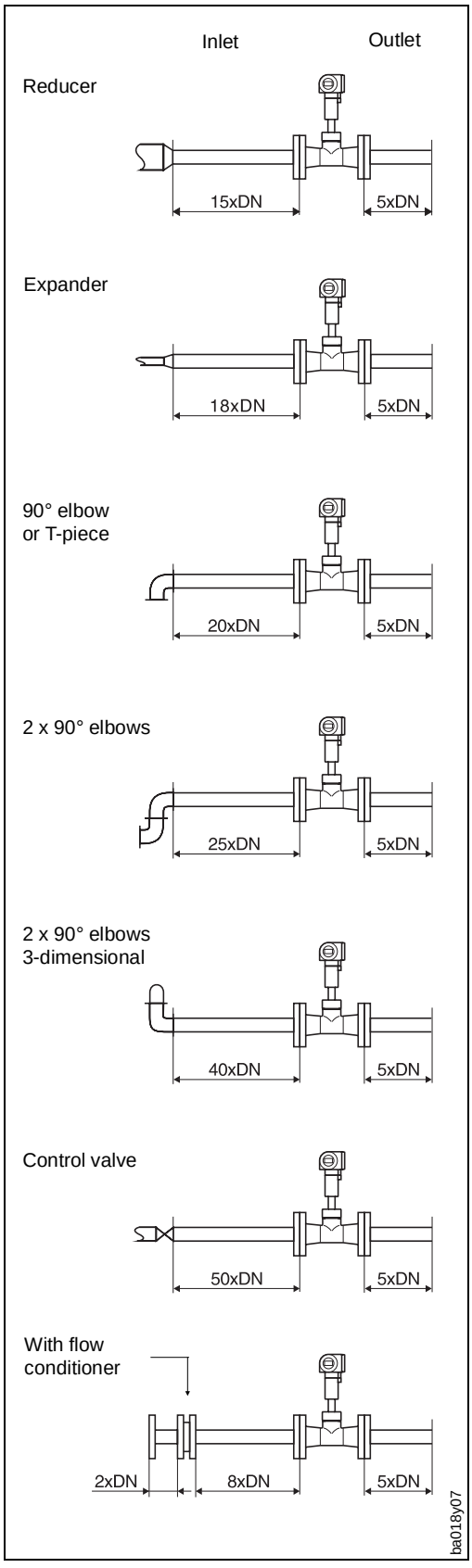
Note!
If two or more flow disturbances are located upstream, then the longest inlet pipe section is recommended. In such cases, a flow conditioner should be used.

Flow Conditioner
With limited space and large pipes, it is not always possible to have the inlet sections given above. The specially developed perforated plate flow rectifier reduces the inlet path to 10 x DN.
The flow rectifier is held between two piping flanges and centred with the flange bolts. It rectifies distorted flow profiles efficiently with very little pressure loss:

$\Delta p\ [mbar] = 0.0085 \cdot \rho\ [kg/m^3] \cdot v^2\ [m/s]$

- Example with steam:
  p = 10 bar abs.; t = 240 °C $\Rightarrow \rho$ = 4.39 kg/m³
  v = 40 m/s
  $\Delta p = 0.0085 \cdot 4.39\ kg/m^3 \cdot (40\ m/s)^2$ = 59.7 mbar

- Example with H_2O condensate (80 °C):
  ρ = 965 kg/m³; v = 2.5 m/s
  $\Delta p = 0.0085 \cdot 965\ kg/m^3 \cdot (2.5\ m/s)^2$ = 51.3 mbar



Note!

Fig. 6:
Inlet and outlet piping requirements

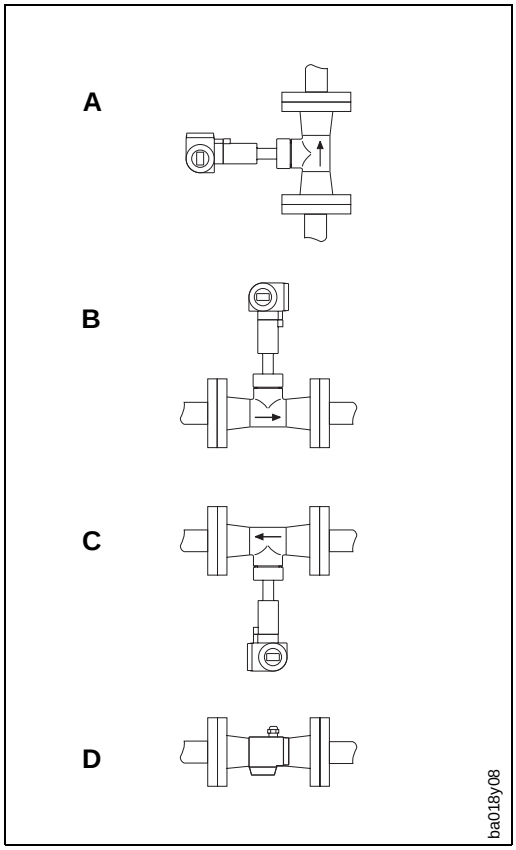


Fig. 7:
Orientation and process temperature

Installation Site

The Prowirl measuring system can be mounted in any position in the piping although for extremes of process temperatures, the following orientations are recommended:

High process temperatures (e.g. steam):
- Horizontal pipeline: install according to C or D
- Vertical pipeline: install according to A, with flow direction upwards for liquids, to ensure a full pipe.

Low process temperatures (cryogenics):
- Horizontal pipeline: install according to B or D
- Vertical pipeline: install according to A, with flow direction upwards for liquids, to ensure a full pipe.

Heat may accumulate where hot pipelines are mounted directly under a roof (Ambient temperatures see page 62).
Ensure flow direction corresponds to the arrow on the meter body.

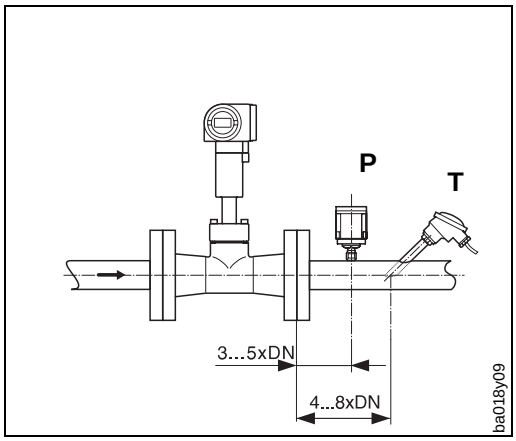


Fig. 8:
Pressure and temperature transmitter location

Pressure and temperature transmitters are to be positioned downstream of Prowirl so that optimum vortex shedding is not affected (see adjacent figure).

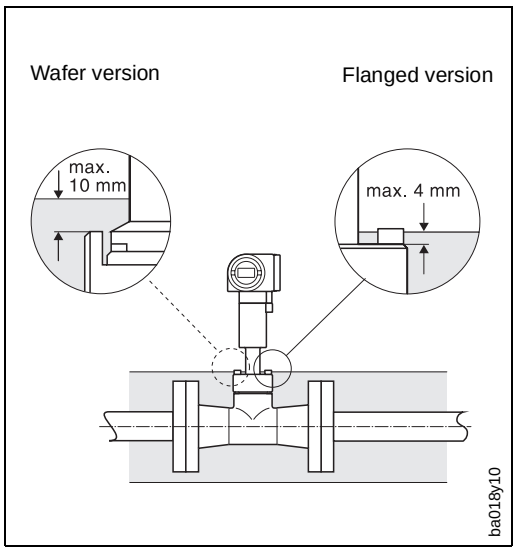


Fig. 9:
Pipeline insulation

Pipeline Insulation

Pipeline insulation is necessary to prevent energy loss in hot and cryogenic processes. When insulating ensure that sufficient pipe stand surface area is
exposed. This applies to both compact and remote versions. The exposed area serves as a radiator and protects the electronics from extreme heat (or from excessive cooling).

Minimum Spacing
When servicing or connecting the "Flowjack" simulator, it is necessary to remove the Prowirl transmitter housing from the pipe stand (→ securing screw, see Fig. 4). When installing in the piping, observe the following cable lengths and minimum space:
- Minimum space above the housing: 12 cm; all other sides 10 cm
- Cable length required: L + 15 cm

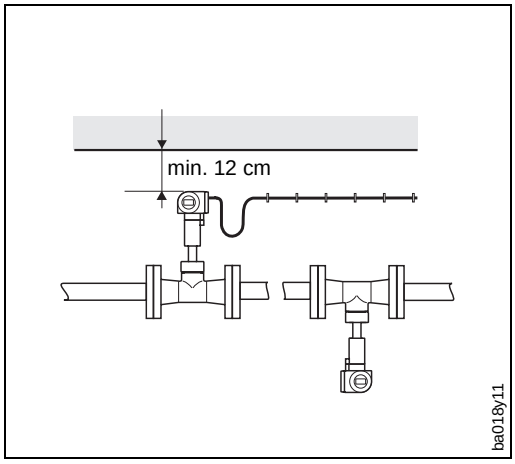


Fig. 10: Minimum spacing and cable lengths

Figure 11 illustrates the minimum spacing requirements for the remote version.

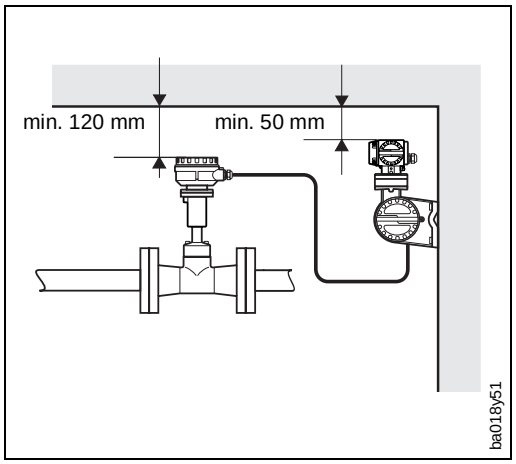


Fig. 11: Minimum spacing and cable lengths

Caution!
Removing the transmitter from the pipe stand is to be carried out by E+H service personnel only! Additional information is given in the Prowirl service manual.

3.3 Mounting the Meter Body

Caution!

Caution!

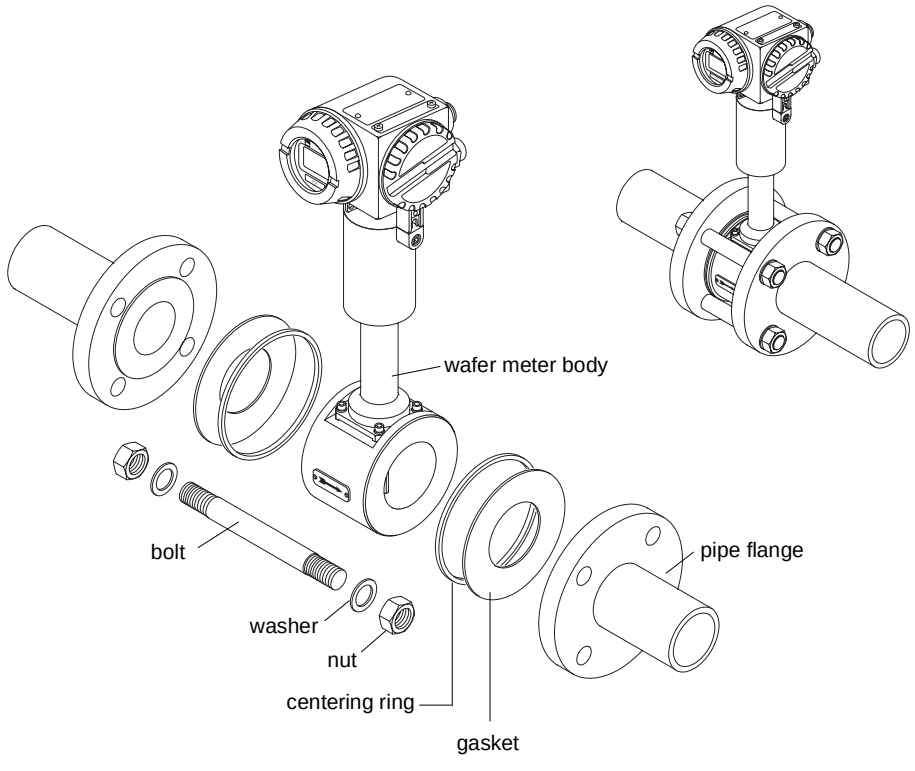
Note the following points before mounting the sensor:

- The meter body is protected by two protective disks against damage during transport. Remove both protective disks before installing the flowmeter in the pipeline.
- Ensure that the inner diameters of the gaskets are identical or larger than those of the meter body and process piping. Gaskets which protrude into the flow affect vortex formation and lead to inaccurate measurement. Therefore the gaskets delivered by E+H come with a slighty bigger inner diameter than the meter body.
- Ensure that the direction of the arrow on the meter body agrees with the direction of flow in the pipeline.
- Face-to-face lengths:
  Prowirl F (flanged version), Prowirl H (high pressure version): see pages 55 f.
  Prowirl W (wafer): 65 mm

Mounting Prowirl W

Mounting of the wafer is carried out using a mounting set consisting of:

- bolts
- centering rings
- nuts
- washers
- gaskets



Procedure:

1. Place one centering ring over each side of the meter body.
2. Mount two or more bolts as required with washers on both piping flanges.
3. Adjust the sensor together with the two centering rings between the bolts already mounted and the piping flanges (incl. the two seals).
4. Mount the rest of the bolts.
5. Screw tight the hex nuts.

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Fig. 12: Mounting of the Prowirl W wafer version

Mounting Prowirl H (butt-weld version)
The following must be observed when welding the high pressure butt weld version into the piping:
- maximum 7000 Joule/cm
- intermediate temperature <30 °C

Caution!
All regulations concerning welding and materials used are to be observed.


Caution!

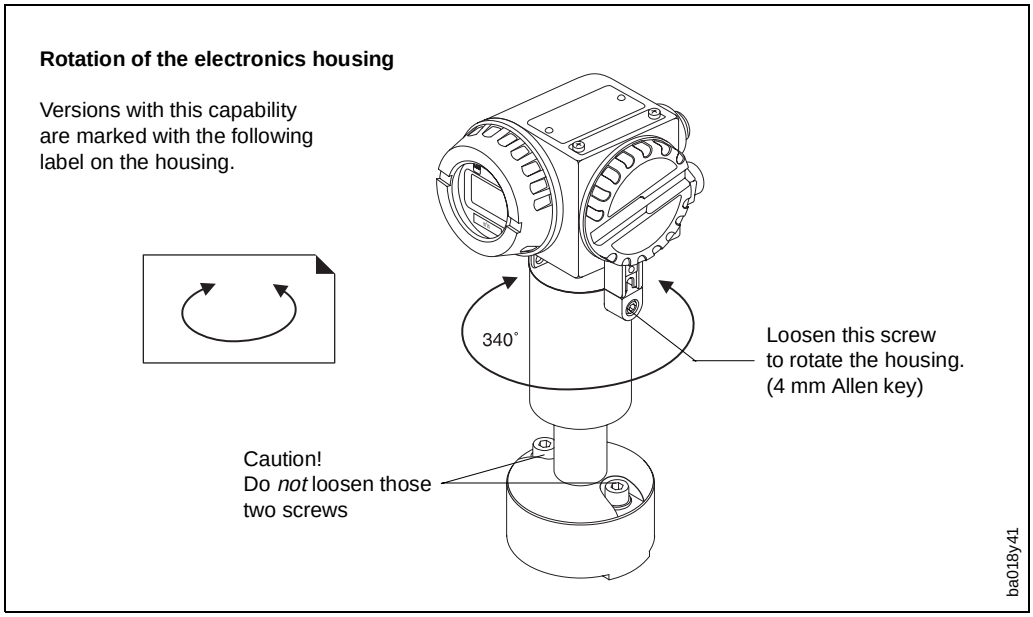
3.4 Electronics Housing/Local Display (Mounting/Rotating)

The electronics housing of Prowirl 70 is rotatable on the pipe stand as follows:

- remove securing screw at the pipe stand (minimum 1 turn)
- rotate the housing into the ideal position
  Caution!
  Do not rotate over mechanical stop!
- fasten the securing screw

Caution!

The display of Prowirl 70 can be rotated in 90° steps (see Fig. 15, 16).



Caution!

Fig. 13: Rotation of compact version electronics housing

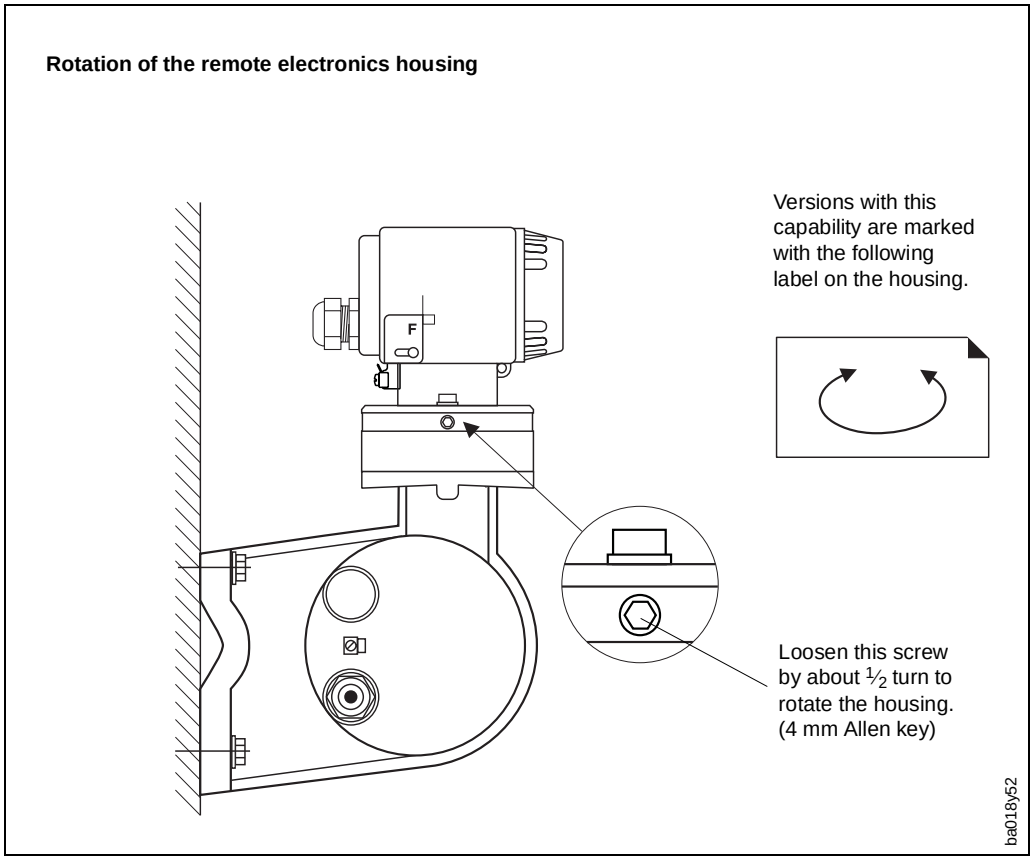
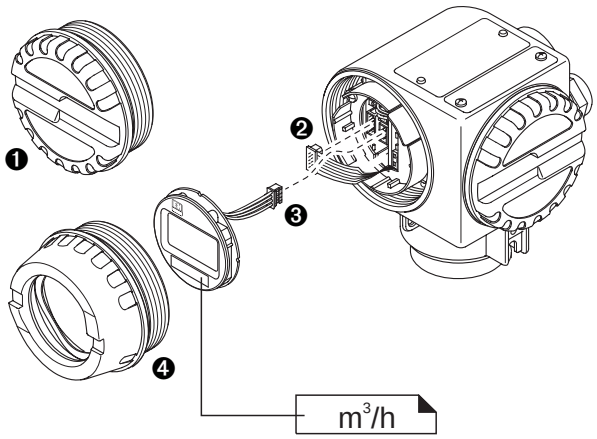


Fig. 14: Rotation of the remote version transmitter housing

Mounting/removing the local display



Open the cover ❶ or ❹,
unplug the ribbon cable ❷ coming from the preamplifier; the socket for the plug for the local display is covered by it.
Plug in the display plug ❸ and mount the local display,
mount new cover with sight glass ❹.

Adhesive label with factory set engineering unit for flow or totaliser. Please fit a new label from the enclosed set in case measuring units are changed (see page 32).

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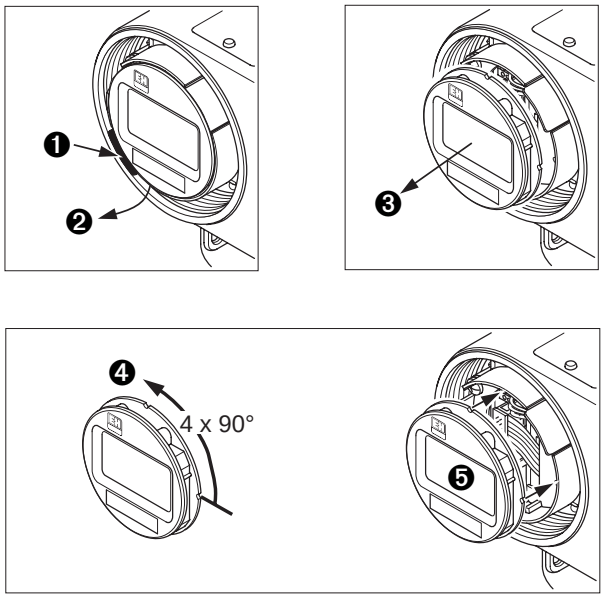
Fig. 15:
Mounting the local display

Rotating the local display



Press the latch ❶ outwards,
tilt display forward ❷ and remove ❸.

Rotate ❹ (4 x 90°), align and insert ❺ the local display. The display snaps in.

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Fig. 16:
Rotating the local display

4 Electrical Connection

4.1 General Information

The information in Section 2.1 must be observed in order to maintain IP 65 protection.

4.2 Connecting the Transmitter

Caution!
- All relevant national electrical regulations must be observed.
- For installation of Prowirl 70 in a hazardous area please read the separate operating manual EX002...
- The power supply voltage is max. 30 V DC.

Procedure:
1. Unscrew the wiring compartment cover.
2. Feed the power and signal cables through the cable gland.
3. Wire up according to the wiring diagrams (see diagram in the screw cover or Fig. 17, 18, 19)
4. Screw the wiring compartment cover securely back onto the transmitter housing.

4.3 Wiring Diagrams

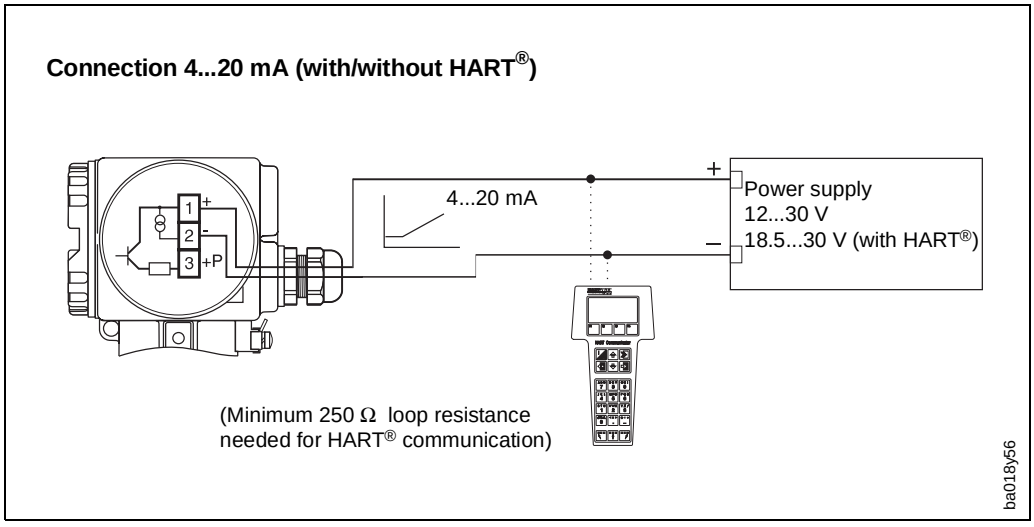


Fig. 17:
Multiple outputs 4...20 mA and open collector (with/without HART)

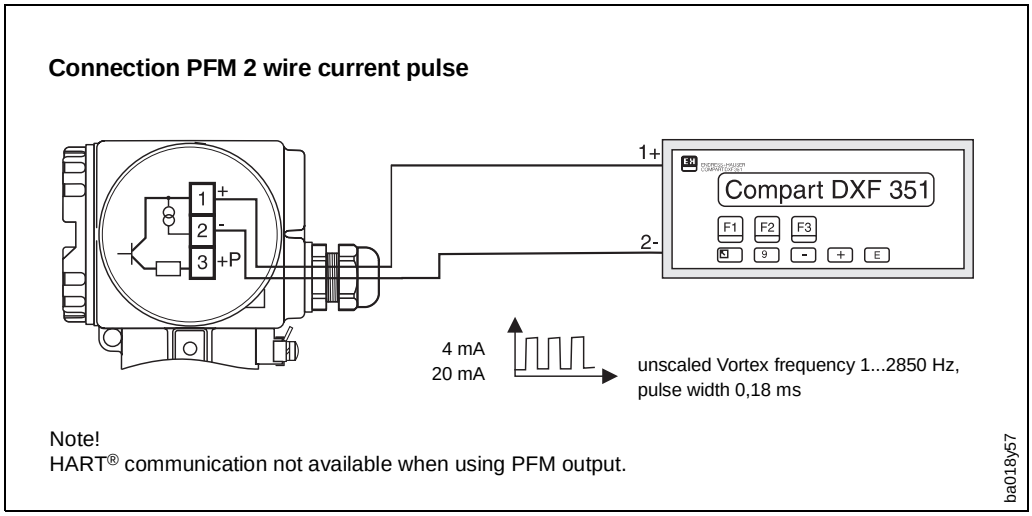


Fig. 18:
Connection of PFM 2 wire current pulse

Connection 4...20 mA (with/without HART®)

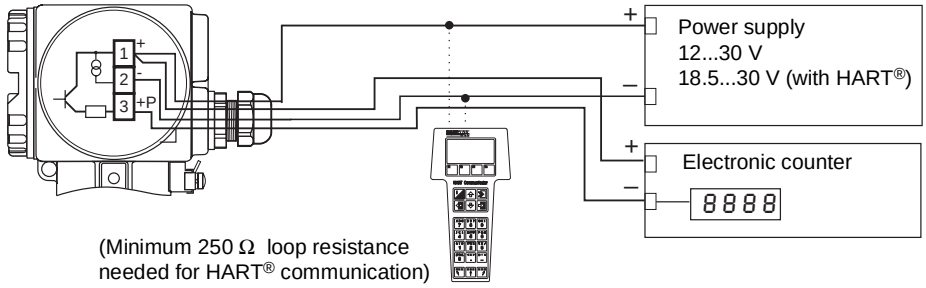
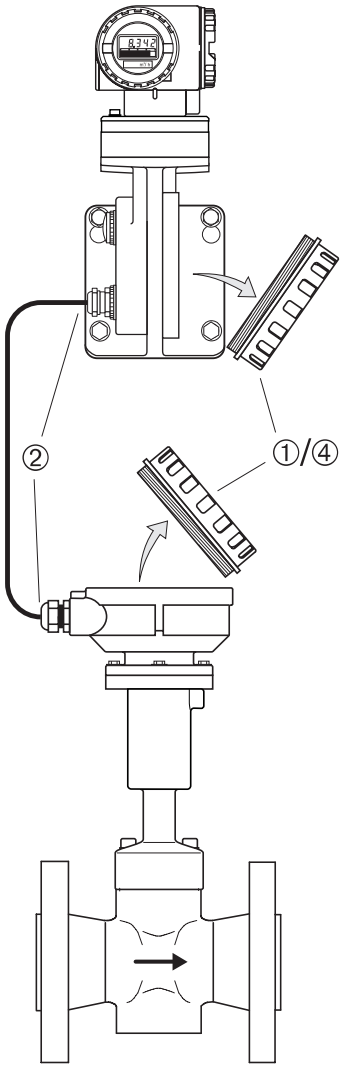


Fig. 19:
Multiple outputs 4...20 mA and open collector (with/without HART)

Connection between remote transmitter and sensor



1. Open the covers of the wiring compartments of transmitter and sensor.
2. Feed the signal cable (stripped as shown in Fig. 21) through the appropriate cable glands. Inside the cable gland are two washers and a spring, with which contact to the shield of the connecting cable is made. When opening the cable gland and removing the rubber insert, take care that these parts are not lost.
3. Connect the wires as shown in the diagram below.
4. Replace the covers of the wiring compartments securely.

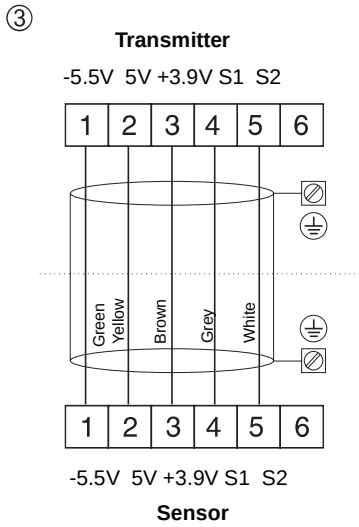


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Fig. 20:
Connection between remote transmitter and sensor

4.4 Cable Connection

The cable between sensor and transmitter is available factory prepared in lengths of 10, 20 or 30 m.
For preparing a cable, Fig. 21 is to be observed.
To maintain 10 V/m RFI-immunity the special cable glands (U71, PG13.5, model 2522211s04, manufactured by Pflitsch) that are delivered with this instrument must be used, or wiring must be in conduit.

The shielded cable must meet the following specifications:

Cable diameter	5.0... 8.0 mm
Shield diameter	8.0...10.5 mm
Conductor cross section	0.2... 6.0 mm^2
Maximum capacitance	250 pF/m

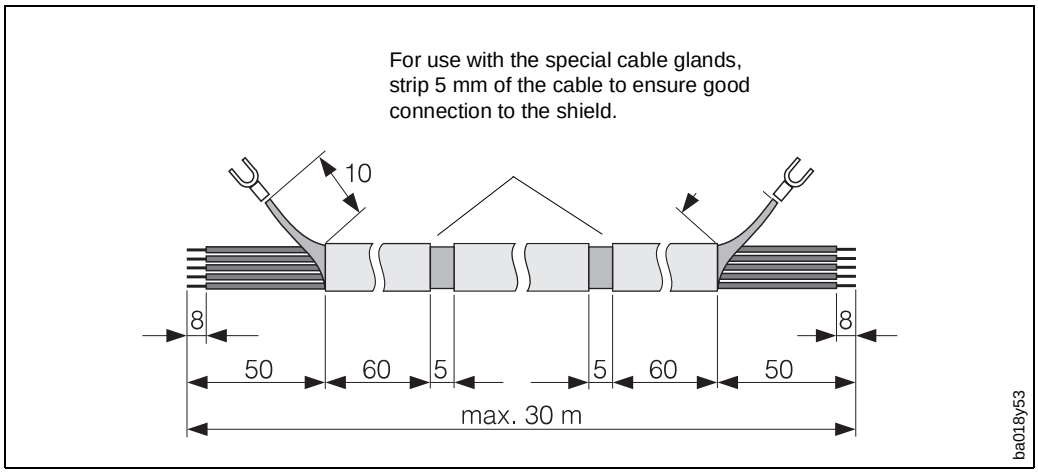


Fig. 21: Instructions for stripping the connection cable between remote transmitter and sensor

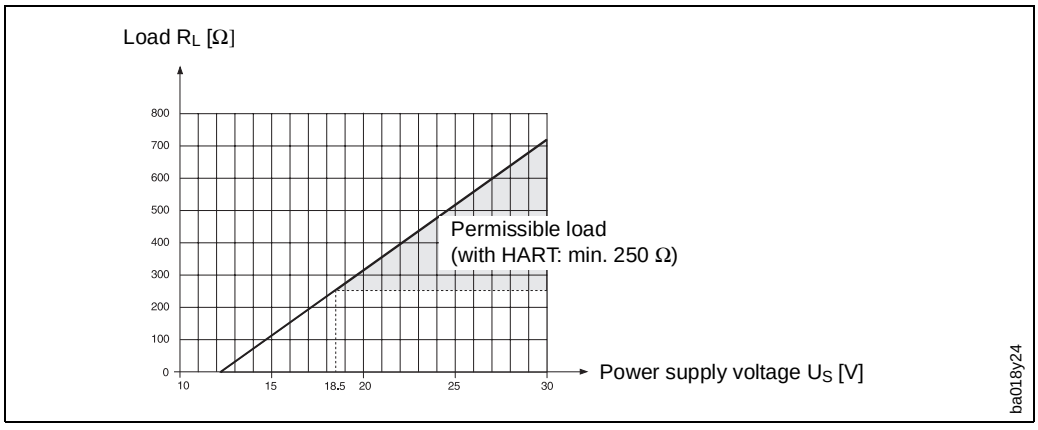


Fig. 22: Load on analogue current output

$$R_L = \frac{U_S - U_{KI}}{I_{max} \cdot 10^{-3}} = \frac{U_S - 12}{0.025}\ \Omega$$

R_L = load resistance
U_S = power supply voltage (12...30 V DC)
U_{KI} = Prowirl terminal voltage (min. 12 V DC)
I_{max} = output current (25 mA)

Note!
For data transfer via HART protocol (→ handheld terminal, see page 47), the minimum load resistance is 250 Ω (U_S = min. 18.5 V DC).


Note!

4.5 Commissioning

Caution!
Newly installed piping should always be thoroughly rinsed through before mounting the meter, to prevent mechanical damage.

Before powering up the meter, the following checks should be carried out:
- **Installation:** Ensure that the directional arrow on the meter body agrees with the actual flow direction.
- **Electrical connection:** Check electrical connections as shown on page 21 f.
- **Power supply:** Ensure that the power supply voltage does not exceed 30 V DC.

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

5 Operation (local display, pushbuttons)

The Prowirl 70 measuring system has a number of functions which the user can individually set **as required** according to process conditions.

Note!
- Under normal circumstances reprogramming the functions of Prowirl is **not** required as the flowmeter is already configured according to customer-specific data in the factory before delivery.
- A summary of all factory-set values and selections is given on page 28 f. (Table A and B).
- The individual functions are described and explained in detail in section 6.

Note!

5.1 Display and Operating Elements

The Prowirl transmitter is operated by four pushbuttons using the local display. This enables individual functions to be selected and parameters or values to be entered.

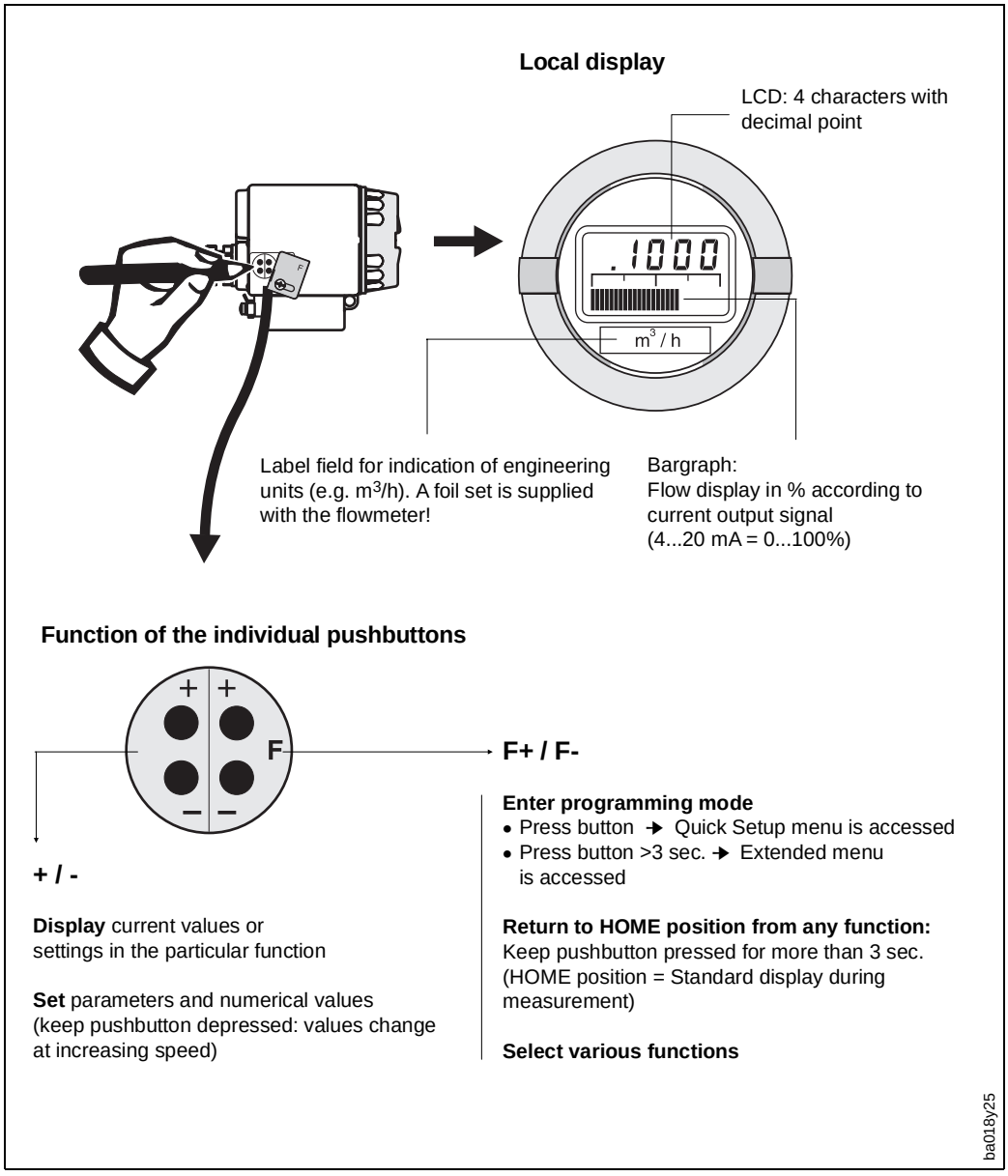


Fig. 23:
Display and operating elements of the Prowirl 70

5.2 Selecting Functions and Changing Parameters

Changing values or settings in a function is carried out as follows (see Fig. 24 and Fig. 25):

❶ Enter the programming mode
❷ Select the function
❸ Enable programming (if locked)
❹ Change values/settings
❺ Leave the programming mode; return to the HOME position.
(Programming is locked again if no pushbutton is pressed for 60 seconds).

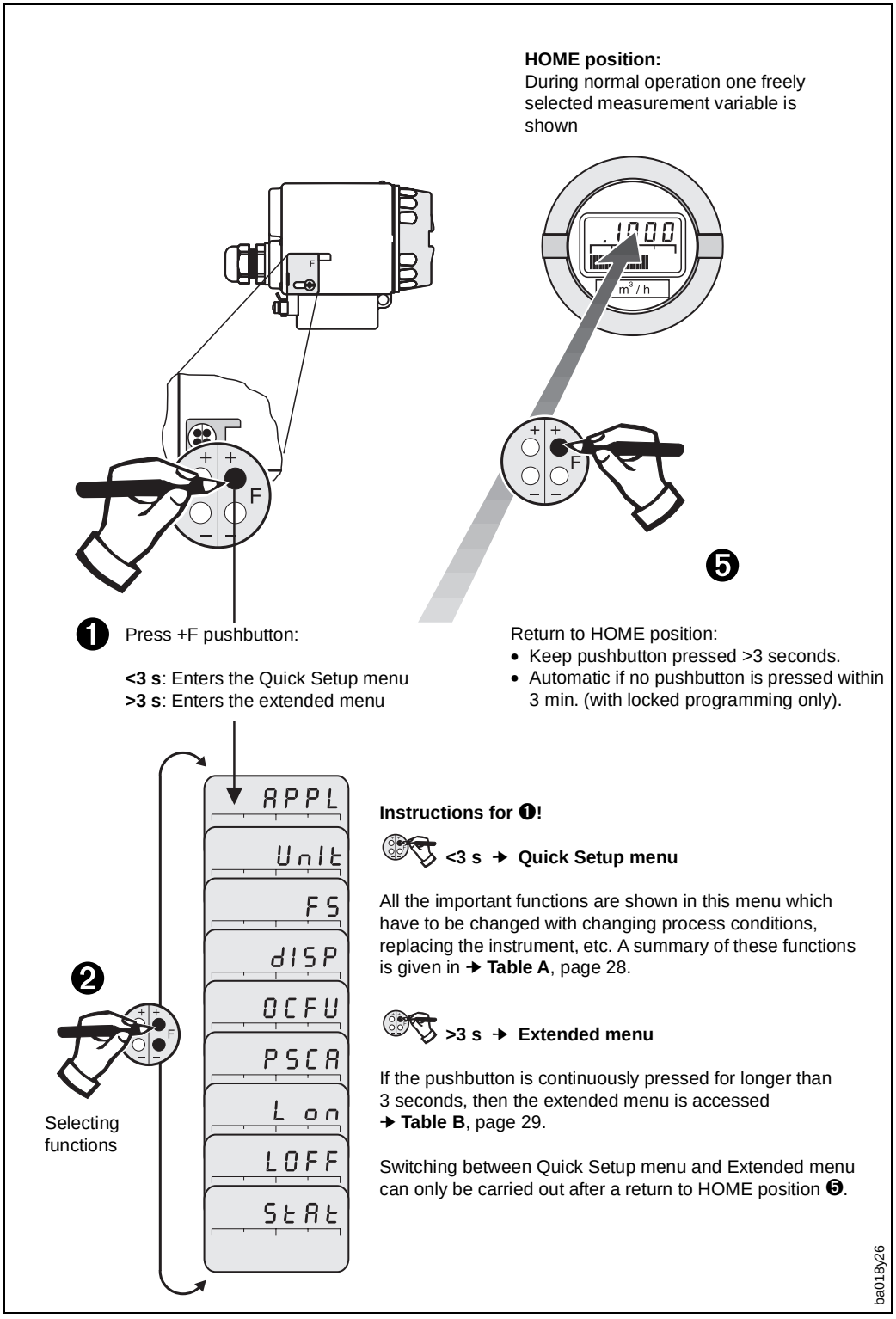
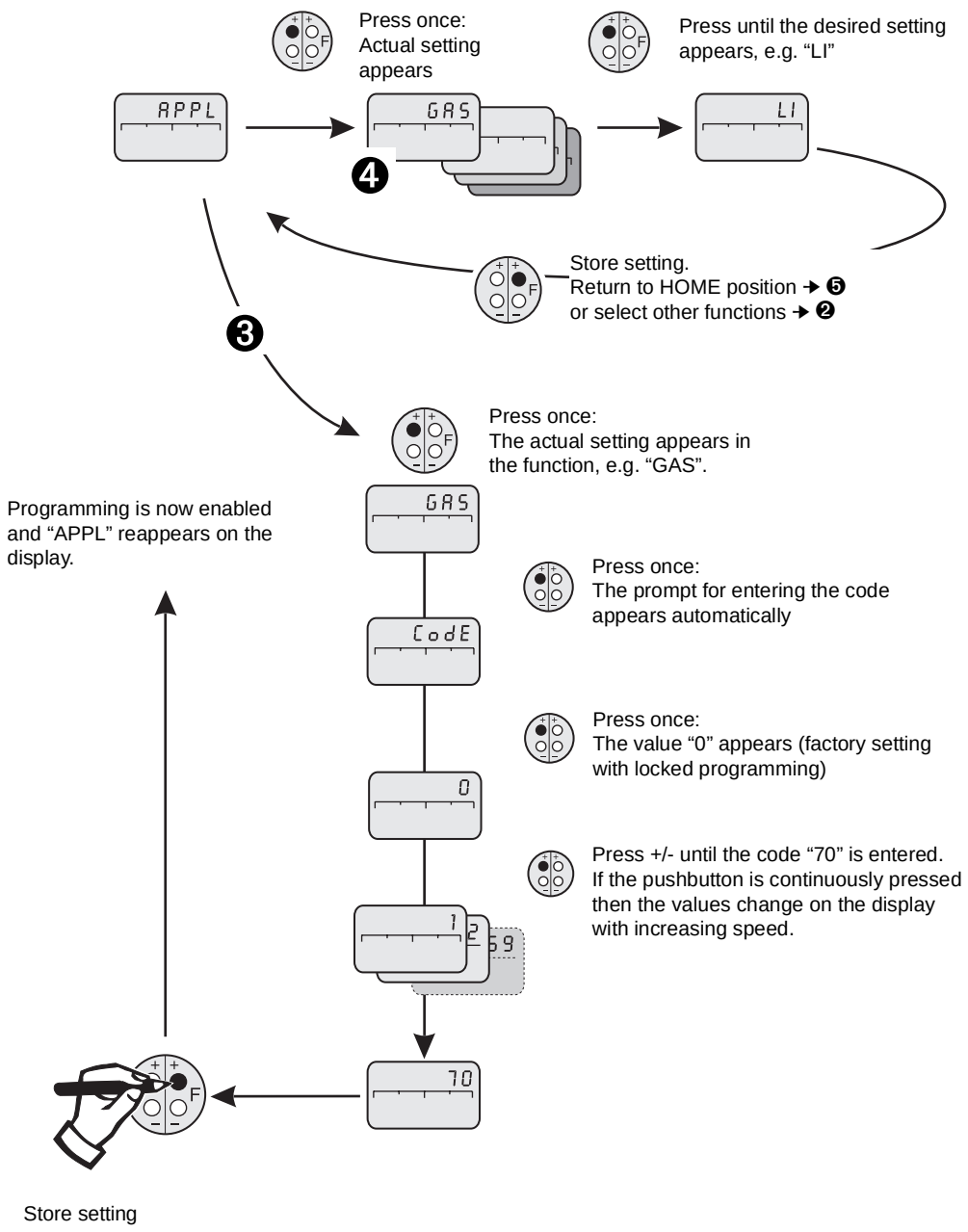


Fig. 24:
Selecting the functions



Enable programming

➔ Enter code number (factory setting = 70. Personal code number: see page 42)

Lock programming

➔ After return to the HOME position programming is locked again if no pushbutton is pressed for 60 seconds.

➔ Programming can also be locked by entering any number in Function “CodE” (not customer code).

Fig. 25:
Enabling programming, changing functions

<3 s →

TABLE A
Quick Setup menu

Function / Parameter	Display text	Settings: Selecting or entering values	Factory settings
Fluid → see page 45	APPL	LI = Liquid GAS = Gas/steam	according to order details
Flowrate units → see page 32	Unit	0 = dm^3/s, 1 = dm^3/min, 2 = dm^3/h, 3 = m^3/s, 4 = m^3/min, 5 = m^3/h, 6 = ACFS, 7 = ACFM, 8 = ACFH, 9 = IGPS, 10 = IGPM, 11 = IGPH, 12 = gps, 13 = gpm, 14 = gph, 15 = user-defined units	0 = dm^3/s (l/s)
Full scale value → see page 37	FS	4-digit number with floating decimal Note! Choose the desired measuring unit first, see function “Unlt”	dependent upon nominal diameter and fluid
Display mode (HOME position) → see page 41	dISP	Proc = Flow in % rAtE = Flowrate (vol/time) Ltot = Totaliser Htot = Totaliser overflows	rAtE
Open collector functions → see page 39	OCFU	Pout = Pulse output AOn = Fault output active “on” (on error: open collector conducting) AOFF = Fault output active “off” (on error: open collector **not** conducting) L = Limit switch	Pout
Pulse scaling → see page 39	PSCA	4-digit number with floating decimal Note! Choose the desired measuring unit first, see function “Fu11”, page 32	dependent upon nominal diameter and fluid
Switch on point (limit value) → see page 40	L on	4-digit number with floating decimal Note! Choose the desired measuring unit first, see function “Unlt”	dependent upon nominal diameter and fluid
Switch off point (limit value) → see page 40	LOFF	4-digit number with floating decimal Note! Choose the desired measuring unit first, see function “Unlt”	dependent upon nominal diameter and fluid
Present meter status → see page 43	StAt	Display (only in case of error/failure): Error code for system faults/warnings, e.g. E102 → Internal EEPROM error	–

Note!
- Functions “PSCA”, “L on” and “LOFF” appear on the display only when the open collector output has been configured accordingly (→ “OCFU”).
- Function “StAt” is shown only with system error/warning messages present.

>3 s →

TABLE B
Extended menu

Function / Parameter	Display text	Settings: Selecting or entering values	Factory settings
Actual measured values			
Flowrate	FuOO	(display only)	–
Vortex frequency	FuO1	(display only)	–
Totaliser	FuO2	(display only)	–
Totaliser overflow	FuO3	(display only)	–
System units			
Flow units	Unit	0 = dm^3/s, 1 = dm^3/min, 2 = dm^3/h, 3 = m^3/s, 4 = m^3/min, 5 = m^3/h, 6 = ACFS, 7 = ACFM, 8 = ACFH, 9 = IGPS, 10 = IGPM, 11 = IGPH, 12 = gps, 13 = gpm, 14 = gph, 15 = user-defined units (see Functions “Fu12” and “Fu13”).	0 = dm^3/s (= l/s)
Totaliser units	Fu11	0 = dm^3, 1 = m^3, 2 = ACF, 3 = Igallons, 4 = gallons, 5 = user-defined units (see Functions “Fu14” and “Fu15”)	0 = dm^3 (= litre)
User-defined units – flowrate (conversion factor: mantissa)	Fu12	0.1...1.0	1
User-defined units – flowrate (conversion factor: exponent)	Fu13	-30...+30	0
User-defined units – totaliser (conversion factor: mantissa)	Fu14	0.1...1.0	1
User-defined units – totaliser (conversion factor: exponent)	Fu15	-30...+30	0
Current output			
PFM pulse (4/20 mA current pulses)	Fu20	OFF = 4...20 mA analogue output signal On = PFM current pulses (4/20 mA)	OFF
Full scale value	FS	4-digit number with floating decimal Note! First choose the desired measuring unit before entering the value.	dependent upon nominal diameter and fluid
Time constant (current output damping)	Fu22	0.2...100.0 (seconds)	2 (s)
Failsafe mode	Fu23	Lo = minimum current value (current signal on error set to ≤3.6 mA, digital communication via HART and INTENSOR is then not guaranteed HI = set to max. current value (current signal on error set to ≥21 mA) run = normal measured value supplied despite error	HI
Simulation	Fu24	OFF – 4 (mA) – 12 (mA) – 20 (mA)	OFF
Nominal current	Fu25	(display only: 4.00...20.50 mA)	–
Open collector output (not available with Ex d version)			
Open collector functions	OCFU	Pout = Pulse output AOn = Fault output active “on” (on error: open collector conducting) AOFF = Fault output active “off” (on error: open collector **not** conducting) L = Limit switch	Pout

Functions of the Quick Setup menu (Table A)

Continued on next page

>3 s →

TABLE B
Extended menu

Function / Parameter	Display text	Settings: Selecting or entering values	Factory settings
Pulse scaling	PSCA	4-digit number with floating decimal	dependent upon nominal diameter and fluid
Simulation (pulse output)	Fu32	OFF – 1 (Hz) – 50 (Hz) – 100 (Hz)	OFF
Nominal frequency	Fu33	(display only: 0.0000...100.0 Hz)	–
Switch on point (limit value)	L on	4-digit number with floating decimal Note! First choose the desired measuring unit before entering the value.	dependent upon nominal diameter and fluid
Switch off point (limit value)	LOFF	4-digit number with floating decimal Note! First choose the desired measuring unit before entering the value.	dependent upon nominal diameter and fluid
Display			
Display mode (HOME position)	dISP	Proc = Flow in % rAtE = Flowrate (vol/time) Htot = Totaliser overflows Ltot = Totaliser	rAtE
Totaliser reset	Fu41	ESC = Totaliser not reset to zero rESE = Totaliser set to zero	ESC
System parameters			
Private code definition (personal code number)	Fu50	0...9999	70
Access code entry (enable programming)	CodE	0...9999	0
Present meter status	StAt	Display (see page 43): Error code for system faults/warnings E101 – E102 – E103 E201 – E202 – E203 – E204	–
Software version: Main board	Fu53	(display only)	–
Software version: Preamplifier	Fu54	(display only)	–
Hardware version: Main board	Fu55	(display only)	–
Measuring system data			
Fluid	APPL	LI = Liquid GAS = Gas/steam	according to order details
Nominal diameter	dn	15...300 (mm), othr = other	dependent upon flowmeter
K-factor (sensor)	CALF	4-digit number with floating decimal: corresponding to 0.0001...9999 pulses/dm^3	dependent upon flowmeter
Thermal expansion coefficient (meter body)	Fu63	4-digit number with floating decimal: Stainless steel: α = 4.88 Hastelloy C22: α = 3.40 Titanium: α = 2.62	4.88
Process temperature	Fu64	4-digit number with floating decimal: 0...1073 (Kelvin)	293.2 (K) (~20 °C)
Amplification (preamplifier)	Fu65	Amplification of the sensor signals in the preamplifier: 1 = very low 2 = low nor = normal 3 = high	nor

Functions of the Quick Setup menu (Table A)

6 Functions

This section gives a detailed description as well as all the information required for using Prowirl functions. Factory settings are shown in ***italics***.

Function group **ACTUAL MEASURED VALUES**	
Flowrate F u 0 0	Selecting this function automatically displays the actual volumetric flowrate being measured (volume/time). The engineering units used can be defined or changed in function "UnIt" (see page 32). **Display:** 4-digit number with floating decimal, e.g. 150.2 (dm^3/s)
Vortex frequency F u 0 1	Selecting this function automatically displays the actual vortex frequency being measured by the sensor (see also page 7). **Display:** 4-digit number with floating decimal, e.g. 300.1 (engineering units: Hz)
Totaliser F u 0 2	Selecting this function automatically displays the totalised flow quantity from when measurement began. The effective amount is calculated from the sum of the value shown in this function and the sum of the overruns (see function "Fu03"). Note! In cases of error the totaliser remains at the value last shown. Exception: loss of power supply. In this case the totalizer is set to 0. **Display:** 4-digit number with floating decimal, e.g. 123.4 (dm^3)
Totaliser overflow F u 0 3	The totalised flow is shown as a max. 4-digit number with floating decimal (see function “Fu02”). Larger numbers (>9999) can be read off in this function as overruns. The effective amount is calculated from the sum of the overruns (x 10,000) and the value shown in function "Fu02". *Example:* Display of 23 overruns: 23 (= 230,000 dm^3) The value shown in function "Fu02" is 129.7 (dm^3) Total amount = 230,129.7 (dm^3) Note! A max. of 999 overruns are shown. The display then begins to flash. In this case it is recommended that larger engineering units are selected so that the actual totaliser value can be read off (see page 28, function “Fu11”). **Display:** max. 3-digit number, e.g. 645 (overruns)


Note!


Note!

Function group **SYSTEM UNITS**	
Flow units UnIt	In this function the engineering unit can be selected for volumetric flow (volume/time). The engineering units selected here also define those for: • Full scale value (current output, see page 37) • Switch on and switch off point (limit value, see page 40) For this reason this function must be set before the two above. Attach the adhesive label showing the engineering unit to the field provided on the local display if it was changed! **Selection:**  ***0 = dm³/s***, 1 = dm^3/min, 2 = dm^3/h, 3 = m^3/s, 4 = m^3/min, 5 = m^3/h, 6 = ACFS, 7 = ACFM, 8 = ACFH, 9 = IGPS, 10 = IGPM, 11 = IGPH, 12 = gps, 13 = gpm, 14 = gph, 15 = user-defined units (see functions "Fu12" and "Fu13", page 33). (1 dm^3 = 1 litre)
Totaliser Units Full	In this function the engineering unit can be selected for the totaliser. The engineering unit selected here also defines that for pulse scaling (m^3 → m^3/pulse). Attach the adhesive label showing the engineering unit to the field provided on the local display if it was changed! **Selection:**  ***0 = dm³***, 1 = m^3, 2 = ACF, 3 = Igallons, 4 = gallons, 5 = user-defined units (see functions "Fu14" and " Fu15", page 34). (1 dm^3 = 1 litre)

Function group
SYSTEM UNITS

User-defined units flowrate

Fu12
(mantissa)

Fu13
(exponent)

As well as the engineering units offered (selection "0"..."14" in function "Unit"), the flowrate can also be displayed or output in other, user-defined units (selection "15").

For this purpose, a conversion factor can be entered in functions "Fu12" and "Fu13" giving the exact ratio of how many of the desired units correspond to the internally used reference unit of "1 dm^3/s".

1 dm^3/s = factor · [1 user-defined unit]

Example:

1 dm^3/s is equivalent to:

- 60 dm^3/min. → factor = 60
- 1/100 hectoliters/s → factor = 0.01
- 0.7 kg/s with a fluid density of 700 kg/m^3 → factor = 0.7

Convert this factor into the format: "0.XXXX" · $10^{"Y"}$

- in function "Fu12", enter the mantissa (0.XXXX)
- in function "Fu13", enter the exponent (Y)

Caution!
Prowirl 70 always measures volumetric flowrate at actual operating conditions. The conversion method described here remains valid only for constant and exactly known process conditions. Any deviation from the assumed process conditions can lead to significant errors. In such cases the E+H flowcomputer Compart DXF 351 can be used with pressure and temperature sensors, to continuously calculate the exact corrected volume or mass flow.


Caution!

Note!
- Please observe the comprehensive calculation instruction and examples on the following pages for calculation of mass and corrected volume flow.
- Attach an adhesive label showing the engineering unit on the field provided on the local display (see page 19).
- The user defined unit must be entered before setting the full scale value ("FS" function, see page 37) and the limit switch points (functions "L on" and "LOFF").


Note!

Input:

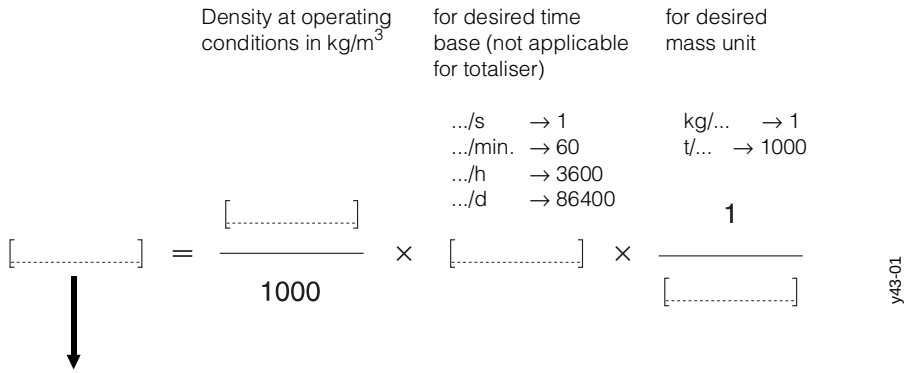
Mantissa (Fu12):
4-digit number with floating decimal: 0.1...1.0

Exponent (Fu13):
2-digit number: –30...+30

Function group
SYSTEM UNITS

Instructions for user-defined mass units

The following example further explains pages 33 and 36.



Factor (example)	Mantissa (in "Fu12" resp."Fu14")	Exponent [in "Fu13" resp. "Fu15")
86.4	.8640	+2
8.737	.8737	+1
0.1234	.1234	0
0.012	.1200	-1
0.00787	.7870	-2

Examples:

To display the mass flow of superheated steam at 200 °C and 12 bar in "kg/h". According to the steam table the density is 5.91 kg/m^3:

$$\text{Factor} = \frac{5.91}{1000} \cdot 3600 \cdot \frac{1}{1} = 21.276 \quad \rightarrow \text{"Fu12" = ".2128" and "Fu13" = "2"}$$

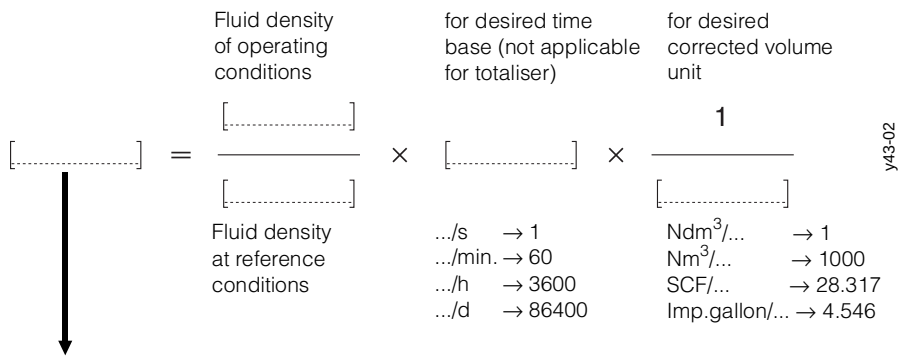
To display the totaliser in "kg" for the same superheated steam application (density 5.91 kg/m^3):

$$\text{Factor} = \frac{5.91}{1000} \cdot \frac{1}{1} = 0.005910 \quad \rightarrow \text{"Fu14" = ".5910" and "Fu15" = "-2"}$$

Function group
SYSTEM UNITS

Instructions for user-defined corrected volume units

The following example further explains pages 33 and 36.



Factor (example)	Mantissa (in "Fu12" resp. "Fu14")	Exponent [in "Fu13" resp."Fu15")
86.4	.8640	+2
8.737	.8737	+1
0.1234	.1234	0
0.012	.1200	-1
0.00787	.7870	-2

Examples:

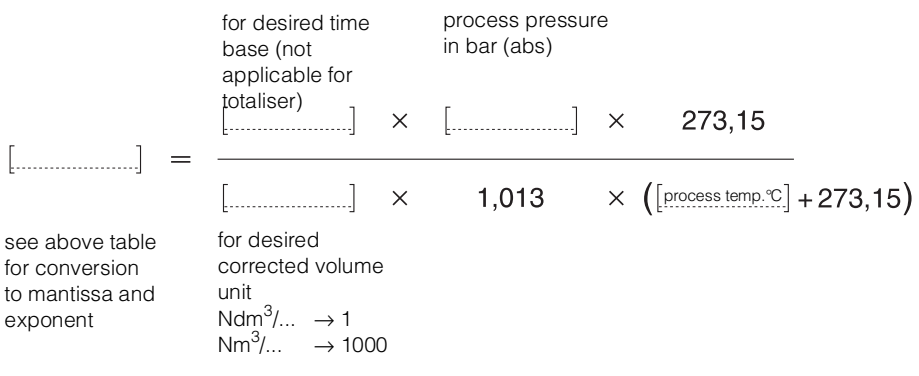
To display the corrected volume flow of compressed air at 3 bar and 60 °C in "Nm^3/h".
The density is 3.14 kg/m^3 for those operating conditions. The density of air at reference conditions (1.013 bar, 0 °C) is 1.2936 kg/m^3:

$$\text{Factor} = \frac{3.14}{1.2936} \cdot 3600 \cdot \frac{1}{1000} = 8.738 \quad \rightarrow \text{"Fu12" = ".8736 and "Fu13" = "1"}$$

To display the corrected volume total in "Nm^3" for the same application (compressed air at 3 bar, 60 °C):

$$\text{Factor} = \frac{3.14}{1.2936} \cdot \frac{1}{1000} = 0.002427 \quad \rightarrow \text{"Fu14" = ".2427" and "Fu15" = "-2"}$$

For **ideal gases** the following simplified formula can be used to calculate corrected volumes (only when reference conditions are at 0 °C and 1.013 bar).



Function group
SYSTEM UNITS

User-defined units totaliser

Fu14
(mantissa)

Fu15
(exponent)

As well as the engineering units offered (selection "0"..."4" in "Fu11" function) for the totaliser, other user-defined units (selection "5") can also be used.

For this purpose, a conversion factor can be entered in functions "Fu14" and "Fu15" giving the exact ratio of how many of the desired units correspond to the internally used reference unit of "1 dm^3".

1 dm^3/s = factor · [1 user-defined unit]

Example:

1 dm^3/s is equivalent to:

- 1000 cm^3 → factor = 1000
- 1/100 hectoliters/s → factor = 0.01
- 0.7 kg/s with a fluid density of 700 kg/m^3 → factor = 0.7

Convert this factor into the format: "0.XXXX" · $10^{"Y"}$

- in function "Fu14", enter the mantissa (0.XXXX)
- in function "Fu15", enter the exponent (Y)


Caution!

Caution!
Prowirl 70 always measures volumetric flowrate at actual operating conditions. The conversion method described here remains valid only for constant and exactly known process conditions. Any deviation from the assumed process conditions can lead to significant errors. In such cases the E+H flowcomputer Compart DXF 351 can be used with pressure and temperature sensors, to continuously calculate the exact corrected volume or mass flow.


Note!

Note!
- Please observe the comprehensive calculation instructions and examples on the previous pages for calculation of mass and corrected volume.
- Attach an adhesive label showing the engineering unit on the field provided on the local display (see page 19).
- The user defined unit must be entered before entering the pulse scaling ("PSCA" function, see page 39).

Input:

Mantissa (Fu14):
4-digit number with floating decimal: 0.1...1.0

Exponent (Fu15):
2-digit number: –30...+30

Function group
CURRENT OUTPUT

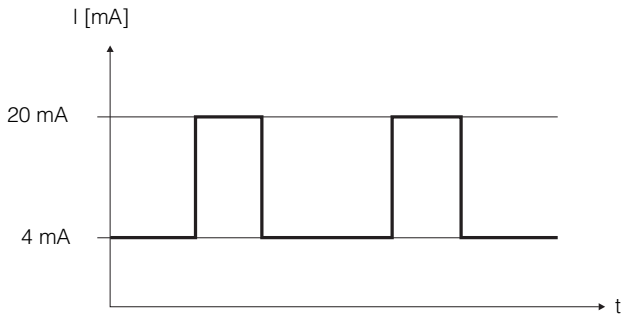
PFM pulse

F u 2 0

In this function the current output can be configured to provide PFM current pulses. In this case the vortex frequency is directly avaible at the same two terminals which would otherwise be used for the 4...20 mA DC current output, i.e. a specified flow volume produces a corresponding current pulse. This ensures a highly accurate signal which can be used, for example, for further processing by the E+H Compart DXF 351 flow computer.

Note!
In PFM mode the bar graph always displays 0%.

Note!



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Selection:

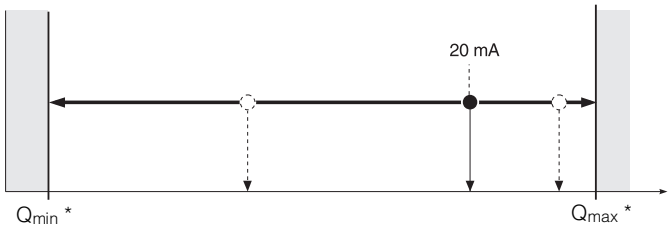
OFF = The current output gives continuous 4...20 mA current signal with HART or INTENSOR communication protocol.
On = PFM pulses via current output terminals

Full scale value

F S

In this function the flowrate value required is assigned to the 20 mA current (= setting the full scale value).

The engineering units for flowrate can be defined or changed in function "UnIt" (see page 32). Please first chose the desired measuring unit before entering a value in this function.



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* Q_{min} is the minimum flowrate where a reliable measurement is still possible. Below Q_{min} ↘ unstable vortex shedding. Q_{max} is the maximum flowrate. The values for Q_{min} and Q_{max} depend on the application (gas/liquid) and the meter type (DIN, ANSI, see page 63).

Input:

4-digit number with floating decimal, e.g. 126.7 (dm^3/min)
Factory set: ***dependent*** upon nominal diameter, internal pipe diameter and type of fluid (gas, liquid)

Function group **CURRENT OUTPUT**	
Time constant F u 2 2	Selecting the time constant determines how quickly the current output signal and the display respond to rapidly fluctuating flowrates (small time constant) or are delayed (large time constant). Note! The time constant defines the lower limit of the response time of the current output. If the vortex period is larger than the selected time constant, then this is increased automatically. **Input:**  3-digit number with fixed decimal: 0.2...100.0 (seconds) Factory set: ***5.0*** (seconds)
Failsafe mode F u 2 3	In cases of fault it is advisable for safety reasons that the current output assumes a previously defined status which can be set in this function. This function is only available if the setting "OFF" is selected in function "Fu20" (see page 37). **Selection:**  Lo = minimum current value (the current signal is set to ≤3.6 mA on error) ***HI*** = maximum current value (the current signal is set to ≥21 mA on error) run = normal measured value given despite error
Simulation F u 2 4	In this function the output current can be simulated to correspond to 0%, 50% or 100% of the current range (4, 12, 20 mA) to check wiring or connected instruments. This function is only available if the setting "OFF" is selected in function "Fu20" (see page 37). Note! • The simulation mode affects only the current output. During simulation the flowmeter remains fully operational for measurement, i.e. totaliser, flow display and pulse output are operating normally. • If OFF is not selected, in HOME position the bar graph shows the selected output current simulation value in % and not the actual flowrate in %. **Selection:**  ***OFF*** (current output follows actual measured value) – 4 (mA) – 12 (mA) – 20 (mA)
Nominal current F u 2 5	In this function is shown the actual value of the output current. This function is only available if the setting "OFF" is selected in function "Fu20" (see page 37). **Display:** Actual value: 4.00...20.50 (mA) (or 3.6 resp. 22 mA as fault indication; see function "Fu23")


Note!


Note!

Function group
OPEN COLLECTOR OUTPUT

Note!
With the Ex d (explosion proof) version, the complete OPEN COLLECTOR OUTPUT function group is not available.

Note!

Open Collector functions

OCFU

Various functions can be assigned to the open collector output. This output operates independently of the current output.

Selection:

Pout = Pulse output: An output pulse is produced for a freely selectable flowrate (see also function "PSCA").
AOn = Fault output: active 'on'. In cases of error, e.g. with defective sensor, the open collector is conducting.
AOFF = Fault output: active 'off'. In cases of error, e.g. with defective sensor, the open collector is **not** conducting.
L = The output is configured as a 'limit switch'.
The appropriate switch on and switch off points can be set in functions "L on" and "LOFF" (see page 40).

Pulse scaling

PSCA

In this function the freely selectable flow quantity is determined which an output pulse represents.

This function is only available if the setting "Pout" is selected in function "OCFU".
The engineering units for pulse scaling can be defined or changed in function "Fu11" (see page 32).
Ensure that the pulse scaling is chosen so that the pulse frequency for minimum/maximum flow falls within the range of 0.000007...100 Hz.
Frequencies of 1 Hz and higher are output with 50/50 duty cycle, lower frequencies are output with a fixed pulse width of 0.5 seconds.

Input:

4-digit number with floating decimal, e.g. 1.000 (m^3/pulse)
Factory set: ***dependent*** upon nominal diameter and type of fluid (gas, liquid)

Simulation (pulse output)

Fu32

With this function predefined frequency signals can be simulated, for example, to check instruments connected.
This function is only available if the setting "Pout" is selected in the function "OCFU".

Note!

Note!
During simulation the flowmeter remains fully operational for measurement, i.e. totaliser, flow display and current output are operating normally.

Selection:

OFF – 1 (Hz) – 50 (Hz) – 100 (Hz)

Function group
OPEN COLLECTOR OUTPUT

Nominal frequency

FU33

In this function is shown the actual value of the pulse output which is calculated from the pulse scaling.

This function is only available if the setting "Pout" is selected in function "OCFU".

Display:

4-digit number with floating decimal: 0.0000...100.0 (Hz)

Switch on point (limit value)

L on

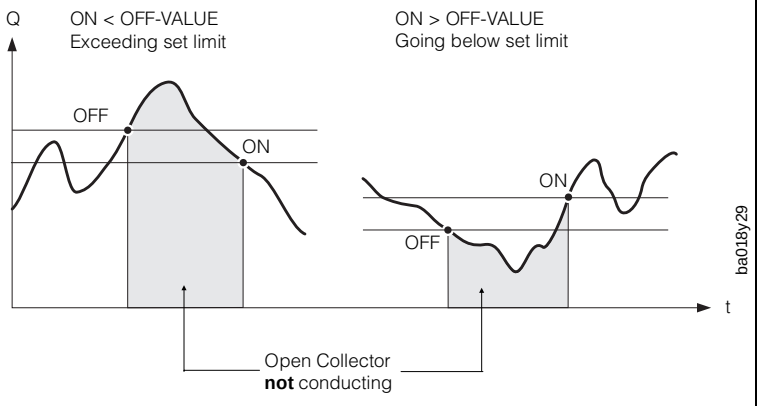
If you have configured the open collector output for 'limit switch', you can set the required switchpoints in these two functions. If the flowrate reaches these limit values, then the open collector becomes conducting or non-conducting (see figure).
These two functions are only available if the setting "L" is selected in function "OCFU" (see page 39).

Switch off point (limit value)

LOFF

Entering slightly different on and off limit values prevents constant switching when flow is near the set points. The same value can be entered for the on and off switch points. In this case the open collector is conducting when the flow is above the set point and not conducting when the flow is below the set point.

The engineering units for the switchpoints can be defined or changed in function "UnIt" (see page 32). Select the desired engineering unit before entering limit values in this function.
In case a fault is detected, the open collector goes into a defined stato for safety reasons. Independent of settings for “L on” and “LOFF”, the open collector becomes “non-conductive” in case of fault indication when configured as “limit switch”.



Input:

4-digit number with floating decimal, e.g. 850.0 (dm^3/min)
Factory set: ***dependent*** upon nominal diameter and type of fluid (gas, liquid)

Function group **DISPLAY**	
Display mode dISP	In this function the variable is defined which should be displayed during normal operation ("HOME position" = standard display). Attach the adhesive label showing the engineering unit on the field provided on the local display, in case you change the factory setting. **Selection:**  Proc = Display flowrate in % ***rAtE*** = Display flowrate (vol/time, see also page 32) Ltot = Display totaliser (see also page 31) Htot = Display the number of totaliser overruns (see also page 31) Note! For setting "Proc", the value shown on the display refers to the full scale value set in function "FS" (see page 37).
Totaliser reset FuNI	In this function the totaliser (incl. overruns) can be set to 'zero' (reset). **Selection:**  ***ESC*** = Totaliser will not be reset rESE = Totaliser is reset to zero


Note!

Function group **SYSTEM PARAMETERS**	
Private code (definition) FuS0	In this function a personal code number can be defined with which programming can be enabled. The code number can only be altered when programming has been enabled. When programming is locked this function is not available and access to the personal code number by third parties is not possible. Programming is **always** enabled with code number "0". **Input:**  max. 4-digit number: 0...9999 Factory set: ***70***
Access code CodE	All data of the Prowirl measuring system are protected against unauthorised changes. Only by first entering a code number in this function is programming enabled and the settings of the instrument can then be altered. If in any function the pushbuttons + / – are pressed, then the measuring system jumps automatically into this function and the display shows the CodE prompt to enter the code number (if programming is locked): → Enter code number 70 (factory set) or → Enter previously defined personal code number (see function "Fu50") Lock programming: After jumping to the HOME position, programming is locked again after 60 seconds if no pushbutton is pressed during this time. Programming can also be locked by entering any number (not the code number) in this function. If you can no longer find your personal code number, then the Endress+Hauser Service Organisation will be pleased to help you. **Input:**  max. 4-digit number: 0...9999 Factory set: ***0***

Function group
SYSTEM PARAMETERS

Meter status

5tAt

In this function all present error messages can be called up.
Errors which occur during operation are shown by a flashing display.
The Prowirl measuring system differentiates between two types of error messages:

System error message:
An error code flashes on the display (HOME position).
These errors directly affect the measurement → Correct the error **immediately** (see below).
Error response of the current output: see function “Fu23”, page 38.
Error response of the pulse output: the signal is set to the fall-back value = 0 Hz.

Warning message:
The actual measured value flashes on the display (HOME position).
The bargraph also flashes if the measuring range is exceeded.
These errors do **not** affect the measurement → The measuring system continues to measure but these “non-critical” errors are to be corrected as soon as possible.

Note!
- This function is only viewable when an error/warning message exists.
- When a number of errors have occurred, the one with the highest priority is shown.
- No system or warning messages are shown while in programming mode (except in functions “Fu00”, “Fu01”, “Fu02”, “Fu03”, “Fu25" and “Fu33”).
- Once the error has been corrected, the normal measured value is again shown on the display resp. the bargraph stops flashing.


Note!

Display and remedial action

System error *messages:*
E101 = Sensor is defective → To be corrected by E+H Service
E102 = Internal EEPROM error (check sum error) → To be corrected by E+H Service
E103 = Communications error with sensor → Measuring system should be restarted (switch off power supply and then switch on again); otherwise to be corrected by E+H Service.

Warning messages:
E201 = DAT error (no access to DAT possible, DAT not plugged in) → To be corrected by E+H Service
E202 = DAT error (check sum error) → To be corrected by E+H Service
E203 = The measuring range of the current output is exceeded → Check application, decrease flowrate or extend full scale value.
E204 = The measuring range of the pulse output is exceeded → Check application, decrease flowrate or adjust pulse scaling.

Function group **SYSTEM PARAMETERS**	
Software version main board FunS3	In this function the current software is shown which is installed on both the main board and the preamplifier board. The numbers have the following meaning: **Display:** 1.1.02 Number changes if minor alterations are made to the new software. This also applies to special versions of the software. Number changes if the new software contains additional functions. Number changes if basic alterations have to be made to the software, e.g. due to technical modifications to the instrument.
Software version preamplifier FunS4	
Hardware version main board FunS5	In this function the current hardware version of the main board is shown. The numbers have the following meaning: **Display:** 1.1.02 Number changes if minor alterations have been made to the new hardware. Number changes if the new hardware contains additional functions. Number changes if basic alterations have to be made to the hardware, e.g. due to technical modifications to the instrument.

Function group **MEASURING SYSTEM DATA**	
Fluid APPL	In this function the process fluid is set. The nominal diameter and the setting selected here define the filter setting of the preamplifier. **Selection:** LI = flow measurement for liquids ***GAS*** = flow measurement for gas/steam
Nominal diameter dn	In this function the nominal diameter of the flowmeter may be entered or changed. This is required when: • Replacing transmitter electronics (without using the old DAT) • Replacing a defective DAT • Mounting transmitter electronics on a new meter body having a different nominal diameter. Caution! • Under normal circumstances the nominal diameter should not be changed. Any alteration affects the functions of the entire measuring system and especially its measuring accuracy. • If the value of the nominal diameter is changed then a new K-factor (see function "CALF") must be entered. **Selection:** 15 – 25 – 40 – 50 – 80 – 100 –150 – 200 – 250 – 300 – othr (other) Factory set: ***dependent*** upon the meter body used
K-factor CALF	In this function the K-factor of the sensor may be entered or changed. The K-factor describes how many vortices (pulses per dm^3) occur behind the bluff body as a function of the flowrate of the fluid and the nominal diameter. This value is determined in the factory by calibration and assigned to the sensor. Caution! Under normal circumstances the K-factor should not be altered. **Input:** 4-digit number with floating decimal, Min. value: corresponding to 0.0001 pulse/dm^3 Max. value: corresponding to 9999 pulse/dm^3 Factory setting: ***dependent*** upon the meter body used

Caution!

Caution!

Function group **MEASURING SYSTEM DATA**	
Thermal expansion coefficient F u 6 3	Depending on the temperature of the fluid, the meter body expands in function of the thermal expansion coefficient of the pipe material. Caution! The expansion coefficient for the material used for the measuring pipe is programmed in the factory for all flowmeters before being sent out. Under normal conditions this coefficient should therefore not be changed! Entering a new coefficient is only required if the transmitter electronics are mounted on a meter body of a different material. **Input:** 4-digit number with floating decimal: 0...10 Factory settings: ***dependent*** upon meter body material 4.88 (Stainless steel); 3.40 (Hastelloy C22); 2.62 (Titanium)
Process temperature F u 6 4	With increasing process temperatures, the meter body expands slightly according to the body material's coefficient of thermal expansion. In this function an average process temperature can be entered which, in combination with the factory-set meter expansion coefficient (see "Fu63"), compensates for this effect. Optimizing for a fixed temperature makes sense only for a known and constant process temperature. Due to the very temperature tolerant K-factor, this correction is only necessary in case of considerable deviations from the calibration temperature (20 °C, ~293.2 K). Caution! • When used in combination with a flow computer, do not modify the factory setting of 293.2 (K) in Prowirl and only do corrections in the computer itself, as it bases compensation on actual fluid temperature. • If Prowirl is run in PFM mode (see "Fu20", page 37) thermal expansion compensation can be carried out in the flow computer only. **Input:** 4-digit number with floating decimal: 0...1073 (Kelvin); (~-273...+800 °C) Factory setting: ***293.2*** K (~20 °C)
Amplification F u 6 5	All Prowirl flowmeters are set for optimum operation at the process conditions stated by the customer when ordering. Under certain process conditions the effects of interference signals (e.g. by strong vibration) can be suppressed by adjusting the amplifier. Adjusting the amplifier can also extend the measuring range: • For slow flowing fluid with low density and weak interference effects. • For fast flowing fluid with high density and strong interference effects (plant vibration) or pressure pulses. An incorrectly set amplifier can have the following consequences: • The measuring range is limited so that small flowrates are no longer detected or indicated. • Unwanted interference effects are detected so that flow is still indicated even when the fluid is not flowing. **Selection:** 1 = very low 2 = low ***nor*** = normal 3 = high

Caution!

Caution!

7 Interfaces

7.1 HART®

The Prowirl 70 vortex flowmeter can be calibrated and measured values called up both locally (see page 25 f.), and with the HART protocol using the universal DXR 275 handheld terminal or an appropriate modem.
This section contains information related to:
- Electrical connections
- Operation of the HART handheld terminal
- E+H programming matrix for HART

Caution!
Further information on the handheld terminal is found in the operating manual for the DXR 275.

Connecting the DXR 275 handheld terminal
The following connection versions are available to the user (see Fig. 26).
- Direct connection to the Prowirl flowmeter via Terminals 1 and 2
- Connection via the analogue 4...20 mA signal cable

In both cases the measuring loop must have a resistance of at least 250 Ω between the power supply and the handheld terminal. The max. load on the current output is dependent on the power supply voltage (see page 23).

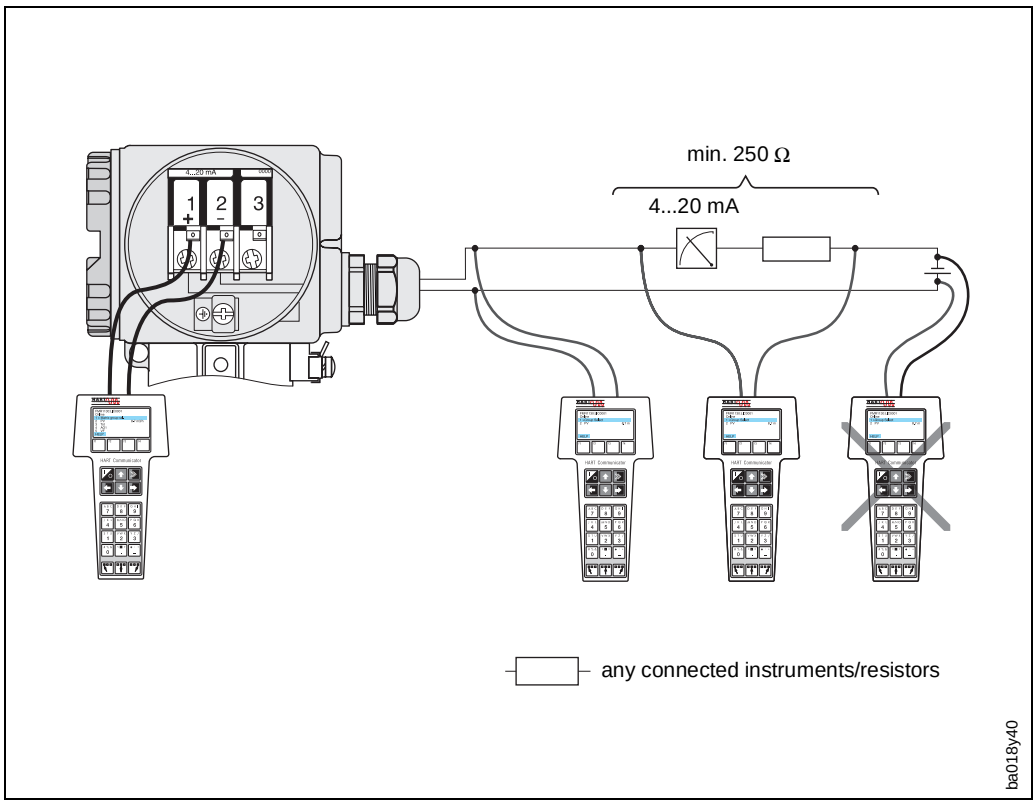


Fig. 26:
Electrical connection HART handheld terminal

Operating Prowirl 70 using the HART Communicator

Operating the Prowirl measuring system using a handheld terminal is different from local operation using pushbuttons. Selecting all Prowirl functions using the HART Communicator is carried out on different menu levels (see Fig. 27) as well as with an E+H programming menu (see Fig. 28).

Note!

- The Prowirl flowmeter can only be operated with a HART Communicator if the appropriate software (DDL = Device Description Language of the Prowirl 70) is installed in it. If this is not the case then the memory module of the HART Communicator may need to be replaced or suitable software installed. Please contact your local E+H Service Office for further information.
- The digital signals of the HART protocol can only be superimposed on the analogue 4...20 mA current signal. Ensure, therefore, that the "OFF" setting is selected in the "Fu20" function (see page 37), i.e. no PFM pulses are produced at the current output.
- All Prowirl functions are described in detail in Sect. 5 (see page 31 f.)

Procedure:

1. Turn on the handheld terminal:

   a. The flowmeter is not yet connected ➔ The HART main menu is displayed. This menu level is shown with every HART programming procedure, i.e. independent of flowmeter type. Further information is found in the operating manual for the "Communicator DXR 275". Continue with "Online"
   b. The flowmeter is already connected ➔ The menu level "Online" is immediately shown.

   In the "Online" menu level are continually shown the actual measurement data such as flow, totaliser value, etc. You are also able to jump from it to the Prowirl programming matrix (see Fig. 28). All function groups and functions accessed by HART are systematically arranged and shown in this matrix.

2. Select the function group using the "Matrix group selection", e.g. analogue output, and then the function required, e.g. upper range value (full scale value). All settings or values in the particular function can be seen immediately.
3. Enter values or change the setting.
4. The field "SEND" is shown above the “F2” function key. By pressing this key all values/settings entered with the handheld terminal are transferred to Prowirl.
5. Press the “F3” HOME function key to return to the "Online" menu level. The actual values measured by the Prowirl flowmeter with the new settings can now be read off.

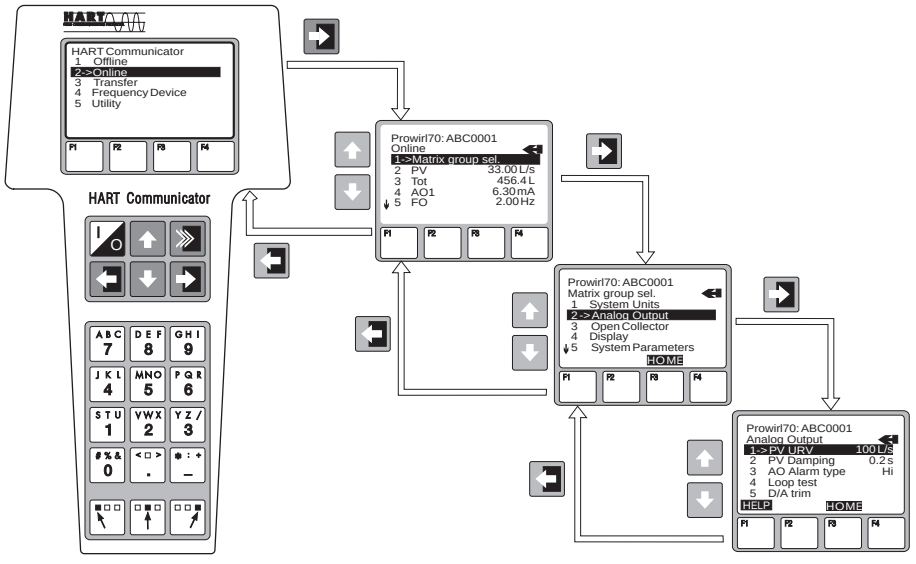
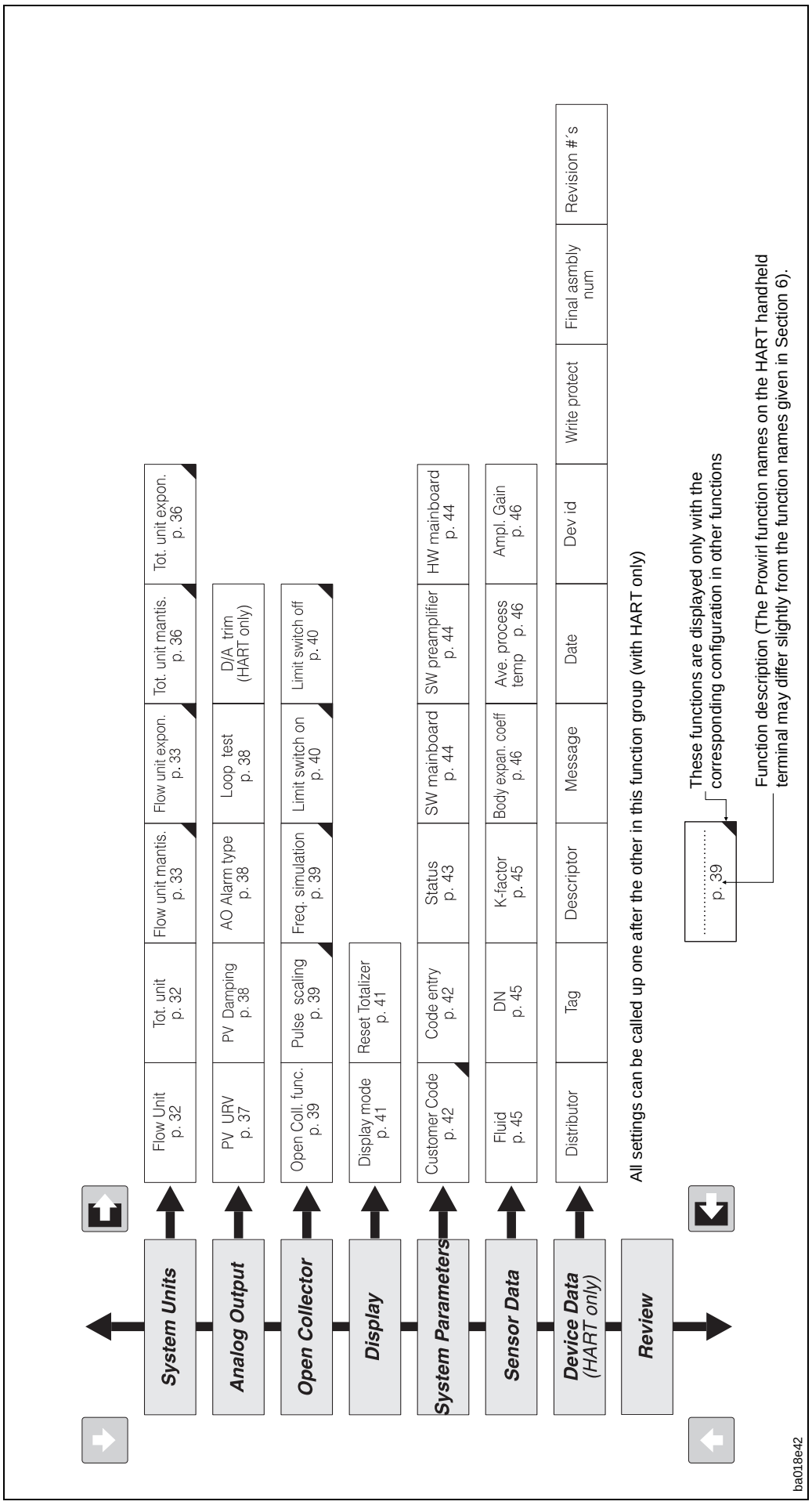


Fig. 27: Operating the handheld terminal using the “analogue output” as an example



Write Protect
Contrary to local operation, all functions are always accessible with the HART protocol, i.e. programming is not locked. If, however, you enter the value -1 in the function "Code Entry", then data transmission to the Prowirl measuring system is no longer possible with the handheld terminal.

Fig. 28:
HART programming matrix Prowirl 70

7.2 INTENSOR

The Prowirl 70 vortex flowmeter can be calibrated and measured values called up both locally (see page 25 f.), and using INTENSOR protocol via the intrinsically safe power supply module FXN 671 and a gateway.
This section contains information related to:
- system description
- electrical connection
- setup and
- operation

Note!
Further information is found in the operating manual for the FXN 671.

System description
The measuring system consists of:
- The Prowirl 70 vortex meter with INTENSOR protocol,
- The FXN 671 transmitter power supply module,
- Gateway ZA 67x.

The Prowirl 70 vortex flowmeter with INTENSOR protocol is connected to Rackbus via the FXN 671intrinsically safe power supply module.
A digital connection can be made to a bus system via the Gateway ZA 67x (Profibus, Modbus, FIP) and thus to a personal computer, or else to a process control system (PCS) or programmable logic controllers (PLC).
The parameters of the meter can be modified, called up or errors identified using Rackbus and INTENSOR protocol.

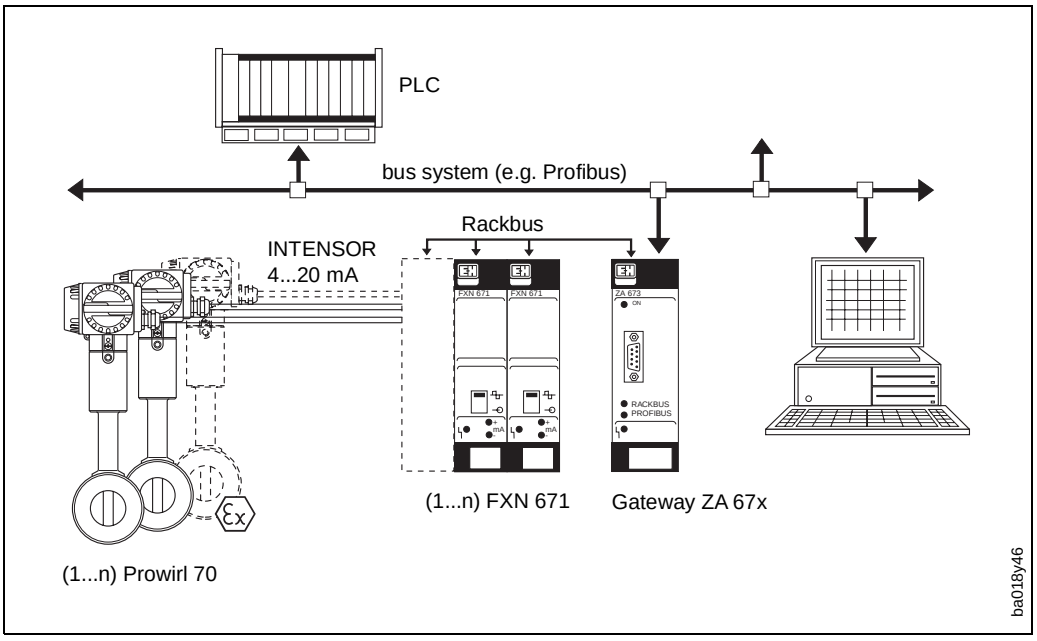


Fig. 29:
Connecting the Prowirl 70 to a bus system

Intrinsically safe power supply module FXN 671
FXN 671 is a transmitter power supply which galvanically isolates the 4...20 mA signal from a field transmitter, and retransmits it to higher level systems. At the same time, it converts the INTENSOR protocol (superimposed on the 4...20 mA signal) to Rackbus protocol. Since the power supplied by FXN 671 is intrinsically safe, instruments in hazardous areas can be connected (in this case, the corresponding Ex-documentation has to be observed). Connection to bus systems is via a Gateway.

Note!
The "Commulog VU 260" handheld terminal is not compatible with Prowirl 70.

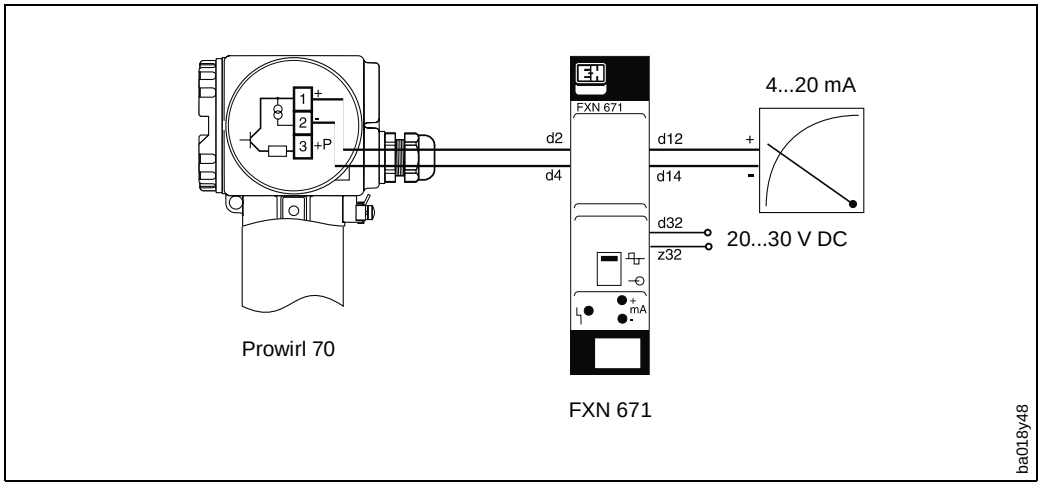


Fig. 30:
Operating principle of the FXN 671 transmitter power supply module

Settings

The following settings must be carried out on the FXN 671 for communication with the Prowirl 70 via the INTENSOR protocol and Rackbus:

- Move the slide switch upwards on the FXN 671 front panel (Fig. 31)
  => Rackbus communication activated. Prowirl 70 local programming is disabled as long as the slide on the FXN 671 front panel is in the upper position.
- The current signal loop must be closed => A jumper between Terminals d12 and d14 or a maximum output load of 250 Ω is required.
- Hook switch SW1 open (Fig. 31) => Resistor 250 Ω connected.
- Set Rackbus address using DIP switches SW2 (Fig. 31) => An address between 0 and 63 is set.
- Only the 4...20 mA current signal can be superimposed by the INTENSOR protocol. Make sure that Prowirl 70 function FuSO is set to "OFF"; no PFM pulses at the current output.

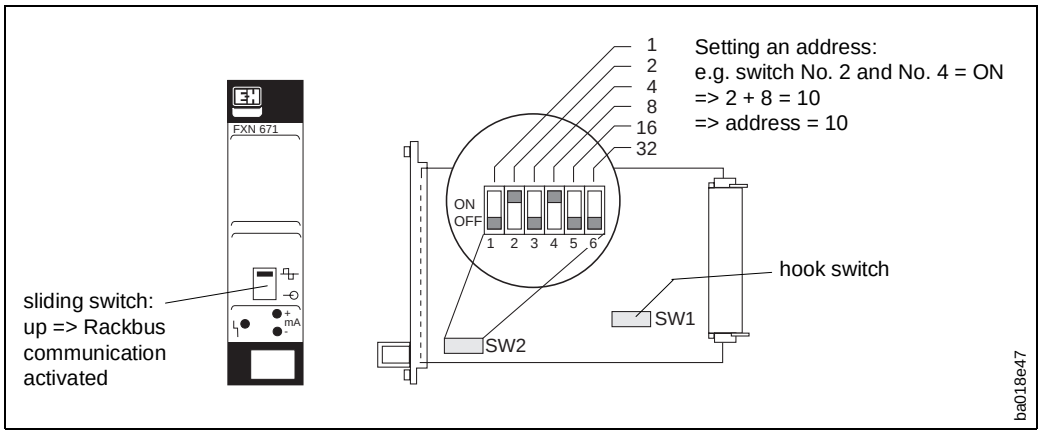


Fig. 31:
FXN 671 settings

Electrical connection

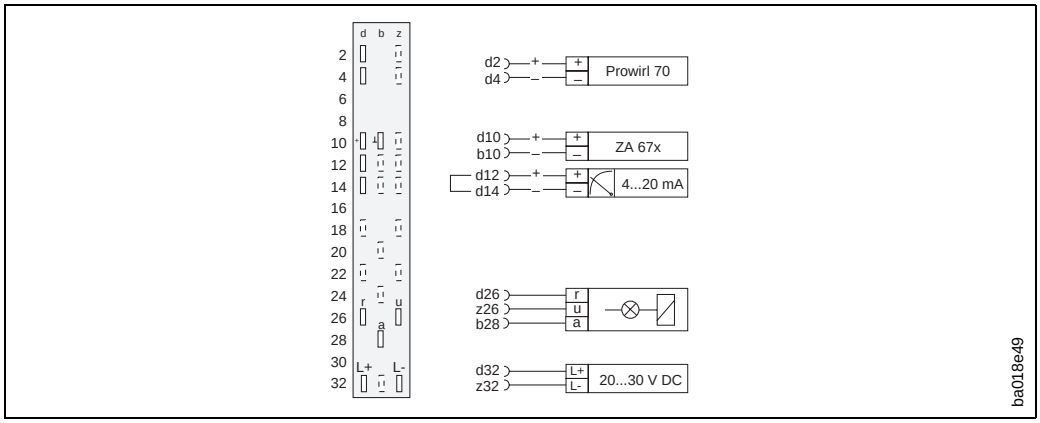


Fig. 32:
FXN 671 connections

Programming Matrix for Rackbus INTENSOR

	GROUP SELECT	H0	H1	H2	H3	H4	H5
V0	MEASURED VALUE	**FLOW RATE (** Fu00)	**VORTEX FREQUENCY (** Fu01)	**TOTALIZED VOL.** (Fu02)			
V1	SYSTEM-UNITS	**FLOW UNIT** (Unit) 0: dm^3/s 1: dm^3/min 2: dm^3/h 3: m^3/s 4: m^3/min 5: m^3/h 6: ACF/s 7: ACF/min 8: ACF/h 9: ImpG/s 10: ImpG/min 11: ImpG/h 12: USG/s 13: USG/min 14: USG/h 15: USER	**VOLUME UNIT** (Fu11) 0: dm^3 1: m^3 2: ACF 3: ImpGal 4: USGal 5: USER	**FLOW UNIT MANTIS.** (Fu12)	**FLOW UNIT EXPON.** (Fu13)	**TOT. UNIT MANTIS.** (Fu14)	**TOT. UNIT EXPON.** (Fu15)
V2	CURRENT OUTPUT		**VALUE FOR 20 mA** (F5)	**TIME CONSTANT** (Fu22)	**FAILSAFE MODE** (Fu23) 0: MIN (-10%) 1: MAX (110%) 2: CONTINUE	**SIMULATION CURR.** (Fu24) 0: OFF 1: 4 mA 2: 12 mA 3: 20 mA	**SACTUAL CURRENT (** Fu25)
V3	O. OPEN COLLECTOR	**OUTPUT SIGNAL** (OCFU) 0: PULSE 1: NORMALY CLOSED 2: NORMALY OPEN 3: LIMIT	**PULSE VALUE** (PSCA)	**SIMULATION FREQ. (** Fu32)	**ACTUAL FREQ.** (Fu33)	**SWITCH-ON POINT** (Lon)	**SWITCH-OFF POINT (** LOFF)
V4	DISPLAY	**CONFIG. DISPLAY (** disP) 0: FLOW [%] 1: FLOW [UNITS] 2: TOTALIZER 3: TOTAL. OVERFLOW	**RESET TOTALIZER (** Fu41) 0: YES 1: NO				
V5	SYSTEM PARAMETER		**ACCESS CODE** (Code)		**SW-MAINBOARD** (Fu53)	**SW-PREAMPLIFIER** (Fu54)	**HARDWARE VERSION** (Fu55)
V6	SENSOR DATA	**APPLICATION** (APPL) 0: LIQUID 6: GAS/STEAM	**NOMINAL DIAMETER** (dn) 0: DN 15 (0.5") 1: DN 25 (1") 2: DN 40 (1.5") 3: DN 50 (2") 4: DN 80 (3") 5: DN 100 (4") 6: DN 150 (6") 7: DN 200 (8") 8: DN 250 (10") 9: DN 300 (12") 10: OTHERS	**CALIBR. FACTOR** (CALF)	**EXPANSION COEFF. (** Fu63)	**TEMPERATURE ENTRY** (Fu64)	**SELECT GAIN RANGE** (Fu65) 0: LOW 1: MEDIUM 2: NORMAL 3: HIGH
V7							
V8							
V9		**DIAGNOSTIC CODE**	**LAST DIAGNOSTIC**		**INSTR.&SOFTW. NO.**	**RACKBUS ADDRESS**	
V10	SETUP	**TAG NUMBER**	**SET USER TEXT**	**SERIAL NUMBER**			

8 Troubleshooting

8.1 System Fault Indication

The response of the measuring system on fault is described in detail on page 43 (→ function "StAt").

8.2 Error Check List and Correcting Faults

During the production process all instruments are subject to various stages of quality assurance. The last of these controls is wet calibration which is carried out on state-of-the-art calibration rigs. If faults should occur after start-up or during operation, then the following points should be checked using the check list given below:

Electrical Connections
- Is there a power supply at the connection terminals (→ page 21)?
- Check the wiring according to the diagrams (→ page 21, 22).
- Check the load resistors and wiring polarity (→ page 23)

Mounting and Installation
- Have all mounting regulations been followed when installing in the pipeline?
- Have both protective disks been removed from the sensor before mounting (→ page 16)?
- Measuring liquids: Is the pipeline completely filled (→ page 12)?
- The fluid must be single phased!
- Is the back pressure sufficiently high to prevent cavitation (→ page 12)?
- Are the internal diameters of the measuring pipe and the piping identical (→ page 13)?
- Do the inlet and outlet fulfil the following requirements (→ page 13)?
  Circular cross section?
  Visual check for straightness?
  Smooth with no junctions, fittings, dents or build-up?
  No parts (e.g. gaskets) protruding into the piping?
- Are sensor and transmitter isolated from vibration?
  With very strong and continuous vibration of the piping (>1 g, dependent on frequency, amplitude and direction), a flowrate can still be shown under certain conditions with no flow.
  Remedies → Identify the source of the vibration. This is usually in the vicinity of the measuring point. Using the program function "Amplification" (→ page 46), you can eliminate the effects of interference signals which are generated by very strong vibrations.

Process data
- Does the actual flowrate lie within the measuring range of the flowmeter (see table on page 63)? If this is not the case → Check the application and reduce the flow or readjust the full scale value (→ page 37) or pulse scaling (→ page 39).
- Do the process data* such as temperature, pressure, viscosity and density of the fluid agree with the specifications at the time of ordering? If this is not the case → Recheck all program data and inform your E+H Service Office.
  (* These data should be known so that the initial value and linearity range can be checked).
- If pressure pulses (e.g. caused by reciprocating pumps) are superimposed on the operating pressure and have similar frequencies as the vortex shedding frequency, then differences between vortex and pulsation can only be detected under certain conditions using this measuring principle (→ page 12).

8.3 Repairs and Dangerous Chemicals

All instruments sent to Endress+Hauser for repair must always be accompanied by a note containing the following information:
- Description of the application
- Description of the error
- Chemical and physical properties of the product being measured


Caution!

Caution!
The following procedures must be carried out before a Prowirl 70 flowmeter is sent to Endress+Hauser for repair:
- 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 first completely removing all dangerous material (e.g. in scratches or diffused though plastic).

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

8.4 Maintenance

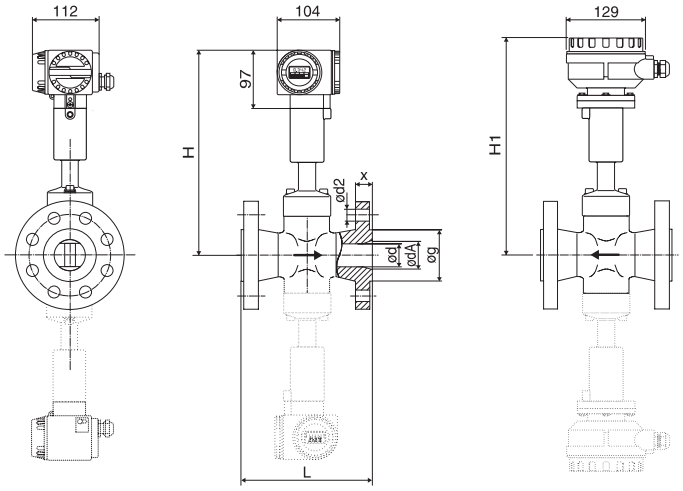
No maintenance is required once the flowmeter has been correctly installed.

9 Technical Data

9.1 Dimensions, Weights

Prowirl 70 F
(Flanged, DN 15...150)

(Dotted section:
flanged Dualsens version)



Remote version

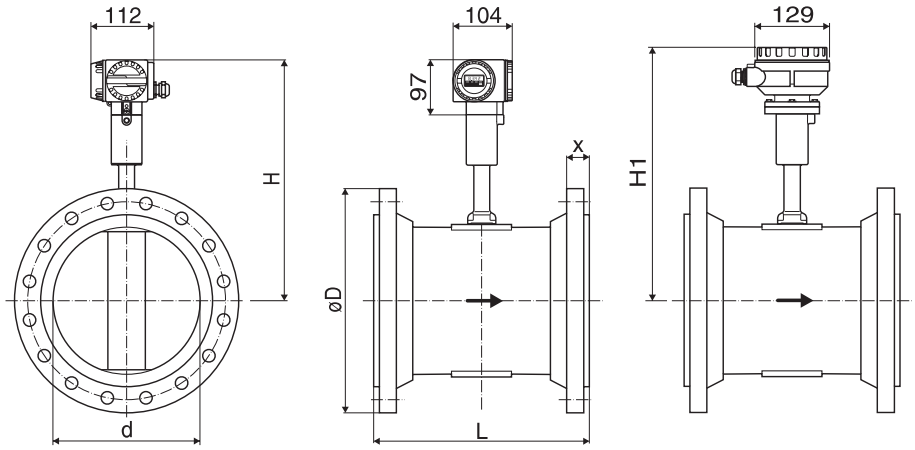
(For dimensions of the remote transmitter see page 59)

ba018y30

DN	Pressure rating Pipe standard		d	dA	n x d2	g	x	L	H	H1	Weight
15 (½")	PN 40	DIN	13.9	17.3	4 x 14	45	17	200	343	360	5 kg
	Cl 150	ANSI Sch 40		15.7	4 x 15.9	34.9	17				
	Cl 300			15.7	4 x 15.9	34.9	17				
	Cl 150	ANSI Sch 80		13.9	4 x 15.9	34.9	17				
	Cl 300			13.9	4 x 15.9	34.9	17				
25 (1")	PN 40	DIN	24.3	28.5	4 x 14	68	19	200	347	364	8 kg
	Cl 150	ANSI Sch 40		26.7	4 x 15.9	50.8	19				
	Cl 300			26.7	4 x 19		19				
	Cl 150	ANSI Sch 80		24.3	4 x 15.9		19				
	Cl 300			24.3	4 x 19		19				
40 (1½")	PN 40	DIN	38.1	43.1	4 x 18	88	21	200	355	372	11 kg
	Cl 150	ANSI Sch 40		40.9	4 x 15.9	73	21				
	Cl 300			40.9	4 x 22.2		21				
	Cl 150	ANSI Sch 80		38.1	4 x 15.9		21				
	Cl 300			38.1	4 x 22.2		21				
50 (2")	PN 40	DIN	49.2	54.5	4 x 18	102	24	200	335	352	13 kg
	Cl 150	ANSI Sch 40		52.6	4 x 19	92.1	24				
	Cl 300			52.6	8 x 19		24				
	Cl 150	ANSI Sch 80		49.2	4 x 19		24				
	Cl 300			49.2	8 x 19		24				
80 (3")	PN 40	DIN	73.7	82.5	8 x 18	138	30	200	346	363	20 kg
	Cl 150	ANSI Sch 40		78	4 x 19	127	30				
	Cl 300			78	8 x 22.2		30				
	Cl 150	ANSI Sch 80		73.7	4 x 19		30				
	Cl 300			73.7	8 x 22.2		30				
100 (4")	PN 16	DIN	97	107.1	8 x 18	158	33	250	360	377	27 kg
	PN 40	DIN		107.1	8 x 22	162	33				
	Cl 150	ANSI Sch 40		102.4	8 x 19	157.2	33				
	Cl 300			102.4	8 x 22.2		33				
	Cl 150	ANSI Sch 80		97	8 x 19		33				
	Cl 300			97	8 x 22.2		33				
150 (6")	PN 16	DIN	146.3	159.3	8 x 22	212	38	300	386	403	55 kg
	PN 40	DIN		159.3	8 x 26	218	38				
	Cl 150	ANSI Sch 40		154.2	8 x 22.2	215.9	38				
	Cl 300			154.2	12 x 22.2		38				
	Cl 150	ANSI Sch 80		146.3	8 x 22.2		38				
	Cl 300			146.3	12 x 22.2		38				

Fig. 33:
Dimensions of Prowirl 70 F/D
DN 15...150,
all dimensions in mm

Prowirl 70 F (Flanged, DN 200...300)



Remote version

(For dimensions of the remote transmitter see page 59)

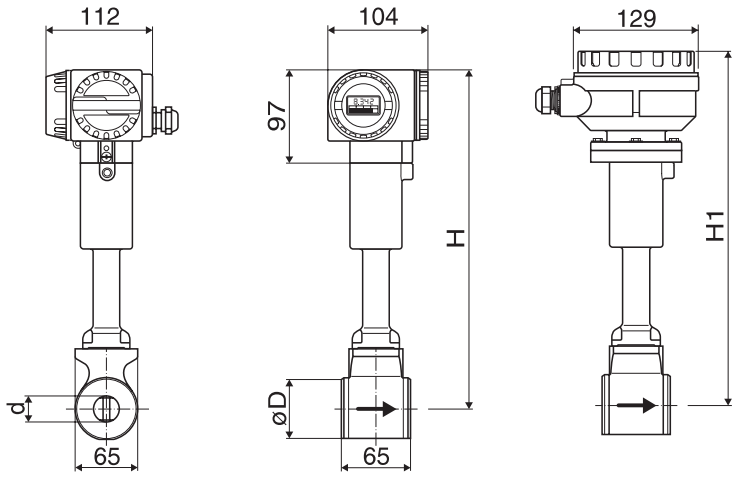
- DIN version:
  To VSM G 18696-18700 with identical connection dimensions as according to DIN 2501
- ANSI version:
  As slip-on-flange according to ANSI B 16.5 Schedule 40

ba018y31

DN	Pressure rating	L [mm]	D [mm]	x [mm]	d [mm]	H [mm]	H1	Weight [kg]
200 (8")	PN 10	300	340	30	205.1	400.5	417.5	39
	PN 16		340	30	205.1			39
	PN 25		360	36	205.1			47
	PN 40		375	40	205.1			55
	Cl 150		342.9	30.8	203.1			45
	Cl 300		381.0	43.5	203.1			70
250 (10")	PN 10	380	395	32	259	425.5	442.5	60
	PN 16		405	36	259			60
	PN 25		425	40	259			72
	PN 40		450	48	259			93
	Cl 150		406.4	32.6	253			75
	Cl 300		444.5	50.1	253			112
300 (12")	PN 10	450	445	32	307.9	451.0	468	85
	PN 16		460	36	307.9			85
	PN 25		485	44	307.9			106
	PN 40		515	52	307.9			106
	Cl 150		482.6	34.2	303.9			112
	Cl 300		520.7	53.2	303.9			156

Fig. 34:
Dimensions of Prowirl 70 F DN 200...300

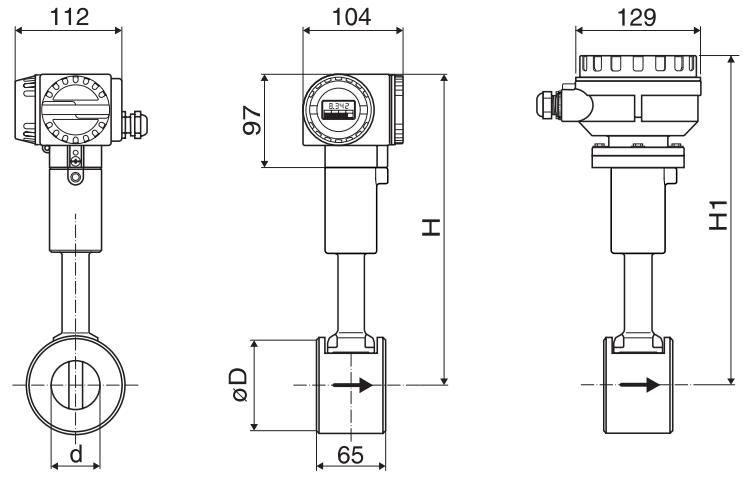
Prowirl 70 W
(Wafer, DN 15...25)



DN		d	D	H	H1	Weight
DIN	ANSI	[mm]	[mm]	[mm]	[mm]	[kg]
15	½"	14	45	340	357	3.5
25	1"	26.6	64	349	366	4

Fig. 35: Dimensions of Prowirl 70 W DN 15...25

Prowirl 70 W
(Wafer, DN 40...150)

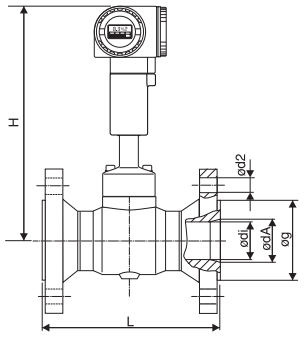


DN		d	D	H	H1	Weight
DIN	ANSI (Sch 40)	[mm]	[mm]	[mm]	[mm]	[kg]
40 –	– 1½"	43.1 40.9	89.3 82.0	316	333	4.5
50 –	– 2"	54.5 52.5	99.3 92.0	321	338	5
80 –	– 3"	82.5 77.9	135.3 127.0	342	359	6
100 –	– 4"	107.1 102.3	155.3 157.2	357	374	9
150 –	– 6"	159,3 154,1	210,3 215,9	387	404	17

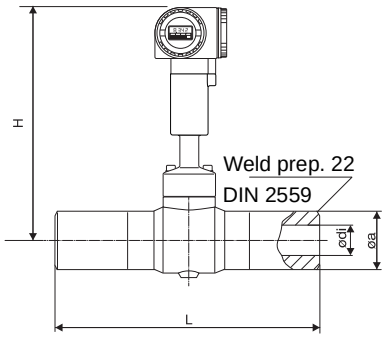
Fig. 36: Dimensions of Prowirl 70 W DN 40...150

Prowirl 70 H (High pressure, DN 15...150)

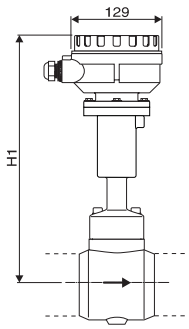
Flanged version



Butt-weld version



Remote version



(For dimensions of the remote transmitter see page 59)

Meter body dimensions as for flanged or butt weld versions.

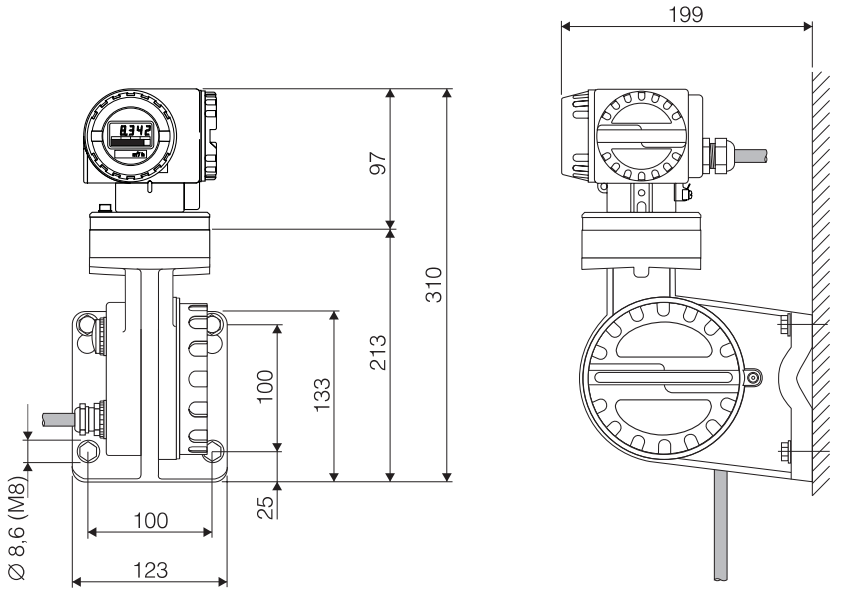
ba018y35

DN	Pressure rating DIN/ANSI	di [mm]	dA [mm]	n x d2 [mm]	g [mm]	L [mm]	a [mm]	H [mm]	H1 [mm]	Pipe standard Flange norm	Weight [kg]
15 ½"	PN 64	14.0	17.3	4 x ø14	45	219	(21.3)	346	363	DIN 2637	11
	PN 100		17.3	4 x ø14	45	219				DIN 2637	11
	PN 160		17.3	4 x ø14	45	219				DIN 2638	11
	PN 250		16.1	4 x ø18	45	248				DIN 2628	14
	Cl 600		14.0	4 x ø15.7	35.1	246				ANSI B 16.5	10
	Cl 900		14.0	4 x ø22.3	35.1	262				ANSI B 16.5	12
	Cl 1500		14.0 (14.0)	4 x ø22.3	35.1	262 (248)				ANSI B 16.5	12 (8)
25 1"	PN 64	24.3	28.5	4 x ø18	68	234	(33.4)	346	363	DIN 2637	13
	PN 100		28.5	4 x ø18	68	234				DIN 2637	13
	PN 160		27.9	4 x ø18	68	234				DIN 2638	13
	PN 250		26.5	4 x ø22	68	248				DIN 2628	15
	Cl 600		24.3	4 x ø19	50.8	254.4				ANSI B 16.5	12
	Cl 900		24.3	4 x ø25.4	50.8	287.7				ANSI B 16.5	16
	Cl 1500		24.3 (24.3)	4 x ø25.4	50.8	287.7 (248)				ANSI B 16.5	16 (8)
40 1½"	PN 64	38.1	42.5	4 x ø22	88	242	(48.3)	350	367	DIN 2637	15
	PN 100		42.5	4 x ø22	88	242				DIN 2637	15
	PN 160		41.1	4 x ø22	88	246				DIN 2638	16
	PN 250		38.1	4 x ø26	88	278				DIN 2628	20
	Cl 600		38.1	4 x ø22.2	73	270.2				ANSI B 16.5	14
	Cl 900		38.1	4 x ø28.4	73.1	305.8				ANSI B 16.5	19
	Cl 1500		38.1 (38.1)	4 x ø28.4	73.1	305.8 (278)				ANSI B 16.5	19 (8)
50 2"	PN 64	47.7	54.5	4 x ø22	102	242	(60.3)	341	358	DIN 2636	16
	PN 100		53.9	4 x ø26	102	254				DIN 2637	19
	PN 160		52.3	4 x ø26	102	268				DIN 2638	19
	PN 250		47.7	8 x ø26	102	288				DIN 2628	22
	Cl 600		49.3	8 x ø19	92.1	276.6				ANSI B 16.5	16
	Cl 900		49.3	8 x ø25.4	91.9	344				ANSI B 16.5	29
	Cl 1500		49.3 (47.7)	8 x ø25.4	91.9	344 (288)				ANSI B 16.5	29 (8)
80 3"	PN 64	73.7	81.7	8 x ø22	138	265	(95.7)	347	364	DIN 2636	21
	PN 100		80.9	8 x ø26	138	277				DIN 2637	25
	PN 160		76.3	8 x ø26	138	293				DIN 2638	27
	PN 250		79.6	8 x ø30	138	325				DIN 2628	40
	Cl 600		73.7	8 x ø22.2	127	299				ANSI B 16.5	25
	Cl 900		73.7	8 x ø25.4	127	349				ANSI B 16.5	36
	Cl 1500		73.7 (73.7)	8 x ø31.7	127	380.4 (325)				ANSI B 16.5	48 (12)
100 4"	PN 64	97.3	106.3	8 x ø26	162	310	(125.7)	359	376	DIN 2636	30
	PN 100		104.3	8 x ø30	162	334				DIN 2637	38
	PN 160		98.3	8 x ø30	162	354				DIN 2638	40
	PN 250		98.6	8 x ø33	162	394				DIN 2628	63
	Cl 600		97.3	8 x ø25.4	157.2	369.4				ANSI B 16.5	37
	Cl 900		97.3	8 x ø31.7	157.2	408				ANSI B 16.5	56
	Cl 1500		97.3 (97.3)	8 x ø35.0	157.2	427 (394)				ANSI B 16.5	70 (20)
150 6"	PN 64	131.8	157.1	8 x ø33	218	436	(168.3)	375	392	DIN 2636	80
	PN 100		154.1	12 x ø33	218	476				DIN 2637	96
	PN 160		143.3	12 x ø33	218	502				DIN 2638	100
	PN 250		142.8	12 x ø36	218	566				DIN 2628	151
	Cl 600		146.3	12 x ø28.4	215.9	493				ANSI B 16.5	105
	Cl 900		146.3	12 x ø31.7	215.9	538				ANSI B 16.5	130
	Cl 1500		146.3 (146.3)	12 x ø38.1	215.9	602 (566)				ANSI B 16.5	172 (52)

(...) for butt-weld version

Fig. 37:
Dimensions of Prowirl 70 H

Transmitter Remote version

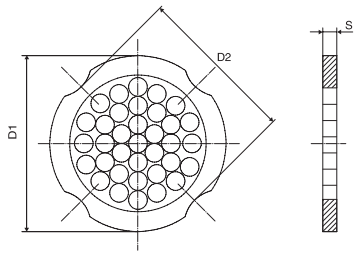


See previous pages for dimensions of the various meter bodies.

ba018y55

Fig. 38: Dimensions of flow conditioner

Flow conditioner



Material
1.4435 (316L)

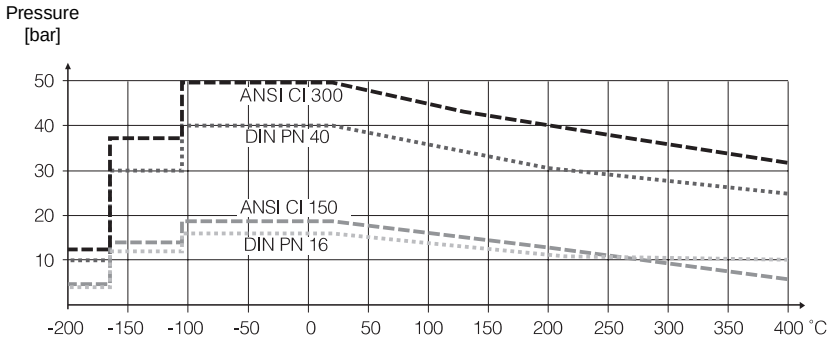
ba018y34

DN	Pressure rating DIN/ANSI		Centering diameter [mm] DIN D1	DIN D2	ANSI D1	ANSI D2	s	Weight [kg] DIN	Weight [kg] ANSI
15 (½")	PN 10...40	Cl 150	–	54.3	51.1	–	2.0	0.04	0.03
	PN 64	Cl 300	64.3	–	56.5	–		0.05	0.04
25 (1")	PN 10...40	Cl 150	74.3	–	–	69.2	3.5	0.12	0.12
	PN 64	Cl 300	85.3	–	74.3	–		0.15	0.12
40 (1½")	PN 10...40	Cl 150	95.3	–	–	88.2	5.3	0.3	0.3
	PN 64	Cl 300	106.3	–	–	97.7		0.4	0.3
50 (2")	PN 10...40	Cl 150	–	110.0	–	106.6	6.8	0.5	0.5
	PN 64	Cl 300	116.3	–	113.0	–		0.6	0.5
80 (3")	PN 10...40	Cl 150	–	145.3	138.4	–	10.1	1.4	1.2
	PN 64	Cl 300	151.3	–	151.3	–		1.4	1.4
100 (4")	PN 10/16	Cl 150	–	165.3	–	176.5	13.3	2.4	2.7
	PN 25/40		171.3	–				2.4	
	PN 64	Cl 300	–	176.5	182.6	–		2.7	2.7
150 (6")	PN 10/16	Cl 150	–	221.0	223.9	–	20.0	6.3	6.3
	PN 25/40		–	227.0				7.8	
	PN 64	Cl 300	252.0	–	252.0	–		7.8	7.8
200 (10")	PN 10		274.0	–			26.3	11.5	
	PN 16	Cl 150	–	274.0	–	274.0		12.3	12.3
	PN 25		280.0	–				12.3	
	PN 40		–	294.0				15.9	
	PN 64	Cl 300	309.0	–	309.0	–		15.9	15.8
250 (10")	PN 10/16	Cl 150	–	330.0	340.0	–	33.0	25.7	25.7
	PN 25		340.0	–				25.7	
	PN 40		–	355.0				27.5	
	PN 64	Cl 300	363.0	–	363.0	–		27.5	27.5
300 (12")	PN 10/16	Cl 150	–	380.0	404.0	–	39.6	36.4	36.4
	PN 25		404.0	–				36.4	
	PN 40/64	Cl 300	420.0	–	420.0	–		44.7	44.6

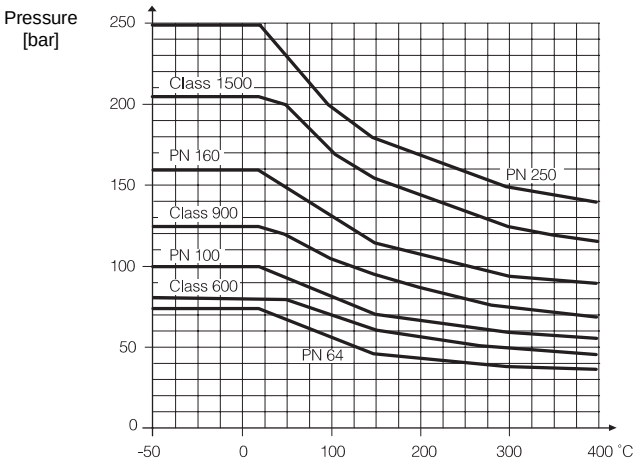
Fig. 39: Dimensions of flow conditioner

9.2 Pressure/Temperature Load Diagrams

Prowirl 70 W, F, D



High pressure (DN 15...150)



Ambient vs. fluid temperatures

For instruments in hazardous areas the temperatures limitations given in the corresponding Ex-documentation have to be observed.

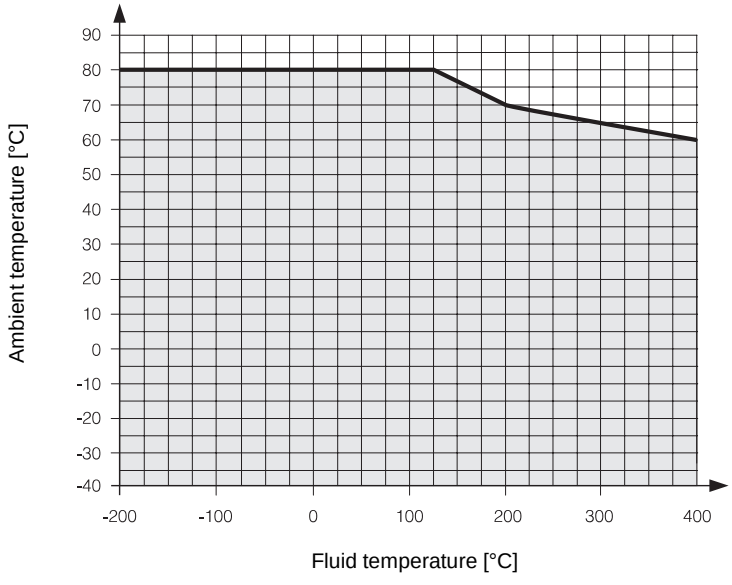


Fig. 40:
Process pressure/temperature and ambient temperatures

9.3 Technical Data: Sensor, Transmitter

Prowirl W/F/H/D Sensor

	Prowirl W → wafer Prowirl F → flanged version Prowirl H → high pressure version (in prep.) Prowirl D → Dualsens version	
Nominal diameter	W: F: H: D: Larger diameters on request	DN 15...150 (DIN/ANSI) DN 15...300 (DIN/ANSI) DN 15...150 (DIN/ANSI) DN 15...300 (DIN/ANSI)
Nominal pressure	W: F/D: H:	PN 10...40 (DIN 2501), Class 150...300 (ANSI B16.5) PN 10...40 (DIN 2501), Class 150...300 (ANSI B16.5) PN 64, 100, 160, 250 (DIN 2636/2637/2638/2628); Class 600, 900, 1500 (ANSI B16.5) Butt-weld version, Class 1500
Permissible process temperature	W/F/D: H:	-200...+400 °C -50...+400 °C; optional for -120 °C min. temperature
• Wetted parts materials:		
Measuring pipe (DN 15...150)	F/D: W: H:	1.4552 (A351 CF8C) 1.4552 (A351 CF8C) 1.4571 (316Ti)
Measuring pipe (>DN 150)	F/D:	1.4571 (316Ti)
Bluff body (DN 15...150)	F/D: W: H:	1.4552 (A351 CF8C) 1.4552 (A351 CF8C) 1.4435 (316L)
Bluff body (>DN 150)	F/D:	1.4435 (316L)
Sensor	W/F/D: H:	1.4435 (316L) Titan Gr. 5
Sensor seal	W/F/D: H:	Graphite; optional Kalrez, Viton, EPDM Graphite with impregnated steel
• Pipe stand material	Stainless steel	

Mounting set (for Prowirl W, wafer version)

Available for all pressure ratings from DIN PN 10...40 or ANSI Class 150 and 300.

Centering rings	2 pcs., stainless steel 1.4301
Bolts	1.7258 galvanised: -50...+400 °C (40 bar) A2-70: -200...+400 °C (40 bar)
Hex nuts	1.7258 galvanised: -50...+400 °C A2-70: -200...+400 °C
Washers	Galvanised steel (DIN 125 A): to +400 °C; A2 DIN 125 A: -200 °C...+400 °C
Gaskets	Graphite, Viton

Prowirl 70 Transmitter

Housing material	Cast aluminium, painted
Protection type	IP 65 (DIN 40050)
Ambient temperature	-40...+80 °C (depending on process temperature) For instruments in hazardous areas the temperature limitations given in the corresponding Ex-documentation have to be oserved.
Vibration immunity	1g to 500 Hz (in all directions)
Electromagnetic compatibility (EMC)	IEC 801 Part 3: E = 10 V/m (80 MHz...1GHz) IEC 801 Part 6: Uo = 10 V (9 kHz...80 MHz)
Power supply	12...30 V DC (without HART, INTENSOR) 18.5...30 V DC (with HART, INTENSOR)
Cable glands	PG 13.5
Threads for cable glands	M20 x 1.5 or ½" NPT or G½"
Connection cable for remote version	see specifications on page 23
Power consumption	<1 W
Galvanic isolation	Between process and outputs
Current output	4...20 mA analogue current output, full scale value and time constant may be set (PFM current pulse programmable, pulse width 0,18 ms
Open collector output	I_{max} ≤10 mA, U_{max} = 30 V, R_i = 900 Ω (HART: only to R_L ≥10 kΩ) • Pulse output; pulse scaling selectable, f_{max} = 100 Hz, 50/50 duty cycle for f ≥1 Hz. Fixed pulse width = 0.5 s for frequencies lower than 1 Hz. • Alarm contact • Limit switch; on/off points selectable
Display	LC display; 4 character with decimal point. Bar graph for analogue display of flowrate in %
Communication	HART protocol via current output, INTENSOR protocol via current output
Data storage	DAT memory module stores all programmed data (without battery)
Hazardous area approvals	EEx ib IIC T1...T6 EEx d IIC T1...T6

Accuracy limits (measuring system)

Liquids	<0.75% o.r. at Re_D >20000 <0.75% o.f.s. at Re_D 4000...20000
Gas/steam	<1% o.r. at Re_D >20000 <1% o.f.s. at Re_D 4000...20000
Current output	Temperature coefficient <0.03% o.f.s./°C
Maximum flow velocity	Liquids: v_{max} = 9 m/s Gas and steam: v_{max} = 75 m/s DN 15: v_{max} = 46 m/s
Reproducibility	±0.2% o.r.

9.4 Measuring Ranges

The following tables are given as guideline for measuring ranges, vortex frequency ranges and k-factors for a typical gas (air at 0 °C and 1.013 bar) and a typical liquid (water, at 20 °C).
Your E+H sales organisation will be pleased to help you select and dimension a flowmeter for your specific application.

Prowirl W (wafer)

Nominal diameter DIN	Air [m^3/h] (at 0 °C, 1.013 bar) [m^3/h]			Water [m^3/h] (at 20 °C) [m^3/h]			K-factor [pulses/dm^3]
	Q_{min}	Q_{max}	frequency range	Q_{min}	Q_{max}	frequency range	min/max
DN 15	4.0	25.4	455.4...2903.5	0.151	4.99	15.9...529.8	389.4...430.4
DN 25	10.6	150	183.6...2504.2	0.38	18.0	6.7...283.8	57.1...63.1
DN 40	27.7	394	112.8...1586.9	0.998	47.3	4.8...189.3	13.8...15.2
DN 50	44.3	630	87.4...1251.3	1.6	75.6	3.2...139	6.8... 7.5
DN 80	102	1443	56.7...801.7	3.65	173	2.1...89	1.9...2.1
DN 100	171	2432	43.7...621.5	6.16	292	1.6...69.3	0.87...0.97
DN 150	379	5381	29.5...418.4	13.6	646	1.1...46.59	0.266...0.294
Nominal diameter ANSI (Sch 40)							
DN 15	4.0	25.4	455.4...2903.5	0.151	4.99	15.9...526	389.4...430.4
DN 25	10.6	150	183.6...2504.2	0.380	18.0	6.3...278.8	57.1...63.1
DN 40	25.0	355	121.5...1691.2	0.898	42.6	4.3...188.2	16.3...18.0
DN 50	41.1	584	92.7...1314	1.48	70.1	3.3...146.3	7.7...8.5
DN 80	90.5	1287	60.5...858	3.26	154	2.2...95.3	2.3...2.5
DN 100	156	2219	46.2...657.7	5.62	266	1.7...73.2	1.014...1.12
DN 150	354	5036	30.6...434.2	12.8	604	1.1...48.3	0.295...0.326

Prowirl F (flange DN 15...150) / Prowirl H (high pressure DN 15...150)

Nominal diameter (all standards)	Air [m^3/h] (at 0 °C, 1.013 bar) [m^3/h]			Water [m^3/h] (at 20 °C) [m^3/h]			K-factor [pulses/dm^3]
	Q_{min}	Q_{max}	frequency range	Qmin	Q_{max}	frequency range	min/max
DN 15	3.94	24.9	455.4...2903.5	0.15	4.92	15.9...523.8	389.4...430.4
DN 25	8.8	125	196...2784.7	0.317	15.0	7.1...311.9	76.2...84.2
DN 40	21.6	308	127.8...1813.8	0.78	36.9	4.6...202	20.1...22.3
DN 50	36.1	513	95...1353.8	1.3	61.6	3.4...150.4	9.0...10.0
DN 80	81	1151	64.1...908.8	2.92	138	2.3...101.3	2.7...3.0
DN 100	140	1994	48...681.6	5.05	239	1.7...75.9	1.16...1.29
DN 150	319	4537	31.2...453.8	11.5	545	1.2...50.5	0.34...0.38

(high pressure version, DN 50 and DN 150: values differ from those given in this table)

Prowirl F (flange DN 200...300)

Nominal diameter DIN	Air [m^3/h] (at 0 °C, 1.013 bar) [m^3/h]			Water [m^3/h] (at 20 °C) [m^3/h]			K-factor [pulses/dm^3]
	Q_{min}	Q_{max}	frequency range	Qmin	Q_{max}	frequency range	min/max
DN 200	627	8916	22.9...325.8	27.6	1070	1...36.2	0.125...0.138
DN 250	1001	14218	18.1...257	55.3	1707	1...28.6	0.0618...0.0683
DN 300	1414	20094	14.9...211	93.3	2412	0.98...23.5	0.0336...0.042
Nominal diameter ANSI (Sch 40)							
DN 200	615	8743	22.5...329.2	26.8	1050	0.98...36.6	0.129...0.142
DN 250	1000	14218	17.3...263.9	55.5	1707	0.94...29.4	0.066...0.074
DN 300	1377	19575	14.5...219.7	89.7	2350	0.94...24.5	0.0372...0.0436

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W

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Tel. (07621) 975-01, Fax (07621) 975-555

Great Britain
❑ Endress+Hauser Ltd.
Manchester
Tel. (0161) 2865000, Fax (0161) 9981841

Greece
I & G Building Services Automation S.A.
Athens
Tel. (01) 9241500, Fax (01) 9221714

Hungary
Mile Ipari-Elektro
Budapest
Tel. (01) 4319800, Fax (01) 4319817

Iceland
BIL ehf
Reykjavik
Tel. (05) 619616, Fax (05) 619617

Ireland
Flomeaco Company Ltd.
Kildare
Tel. (045) 868615, Fax (045) 868182

Italy
❑ Endress+Hauser S.p.A.
Cernusco s/N Milano
Tel. (02) 921921, Fax (02) 92107153

Latvia
Rino TK
Riga
Tel. (07) 315087, Fax (07) 315084

Lithuania
UAB "Agava"
Kaunas
Tel. (07) 202410, Fax (07) 207414

Netherland
❑ Endress+Hauser B.V.
Naarden
Tel. (035) 6958611, Fax (035) 6958825

Norway
❑ Endress+Hauser A/S
Tranby
Tel. (032) 859850, Fax (032) 859851

Poland
❑ Endress+Hauser Polska Sp. z o.o.
Warszawy
Tel. (022) 7201090, Fax (022) 7201085

Portugal
Tecnisis, Lda
Cacém
Tel. (21) 4267290, Fax (21) 4267299

Romania
Romconseng S.R.L.
Bucharest
Tel. (01) 4101634, Fax (01) 4112501

Russia
❑ Endress+Hauser Moscow Office
Moscow
Tel. (095) 1587564, Fax (095) 1589871

Slovakia
Transcom Technik s.r.o.
Bratislava
Tel. (7) 44888684, Fax (7) 44887112

Slovenia
❑ Endress+Hauser D.O.O.
Ljubljana
Tel. (061) 5192217, Fax (061) 5192298

Spain
❑ Endress+Hauser S.A.
Sant Just Desvern
Tel. (93) 4803366, Fax (93) 4733839

Sweden
❑ Endress+Hauser AB
Sollentuna
Tel. (08) 55511600, Fax (08) 55511655

Switzerland
❑ Endress+Hauser AG
Reinach/BL 1
Tel. (061) 7157575, Fax (061) 7111650

Turkey
Intek Endüstriyel Ölcü ve Kontrol Sistemleriİstanbul
Tel. (0212) 2751355, Fax (0212) 2662775

Ukraine
Photonika GmbH
Kiev
Tel. (44) 26881, Fax (44) 26908

Yugoslavia Rep.
Meris d.o.o.
Beograd
Tel. (11) 4441966, Fax (11) 4441966

Africa

Egypt
Anasia
Heliopolis/Cairo
Tel. (02) 4179007, Fax (02) 4179008

Morocco
Oussama S.A.
Casablanca
Tel. (02) 241338, Fax (02) 402657

South Africa
❑ Endress+Hauser Pty. Ltd.
Sandton
Tel. (011) 4441386, Fax (011) 4441977

Tunisia
Controle, Maintenance et Regulation
Tunis
Tel. (01) 793077, Fax (01) 788595

America

Argentina
❑ Endress+Hauser Argentina S.A.
Buenos Aires
Tel. (01) 145227970, Fax (01) 145227909

Bolivia
Tritec S.R.L.
Cochabamba
Tel. (042) 56993, Fax (042) 50981

Brazil
❑ Samson Endress+Hauser Ltda.
Sao Paulo
Tel. (011) 50313455, Fax (011) 50313067

Canada
❑ Endress+Hauser Ltd.
Burlington, Ontario
Tel. (905) 6819292, Fax (905) 6819444

Chile
❑ Endress+Hauser Chile Ltd.
Santiago
Tel. (02) 3213009, Fax (02) 3213025

Colombia
Colsein Ltda.
Bogota D.C.
Tel. (01) 2367659, Fax (01) 6104186

Costa Rica
EURO-TEC S.A.
San Jose
Tel. (02) 961542, Fax (02) 961542

Ecuador
Insetec Cia. Ltda.
Quito
Tel. (02) 269148, Fax (02) 461833

Guatemala
ACISA Automatizacion Y Control Industrial S.A.
Ciudad de Guatemala, C.A.
Tel. (03) 345985, Fax (03) 327431

Mexico
❑ Endress+Hauser S.A. de C.V.
Mexico City
Tel. (5) 5682405, Fax (5) 5687459

Paraguay
Incoel S.R.L.
Asuncion
Tel. (021) 213989, Fax (021) 226583

Uruguay
Circular S.A.
Montevideo
Tel. (02) 925785, Fax (02) 929151

USA
❑ Endress+Hauser Inc.
Greenwood, Indiana
Tel. (317) 535-7138, Fax (317) 535-8498

Venezuela
Controval C.A.
Caracas
Tel. (02) 9440966, Fax (02) 9444554

Asia

China
❑ Endress+Hauser Shanghai Instrumentation Co. Ltd.
Shanghai
Tel. (021) 54902300, Fax (021) 54902303

❑ Endress+Hauser Beijing Office
Beijing
Tel. (010) 68344058, Fax (010) 68344068

Hong Kong
❑ Endress+Hauser HK Ltd.
Hong Kong
Tel. 25283120, Fax 28654171

India
❑ Endress+Hauser (India) Pvt Ltd.
Mumbai
Tel. (022) 8521458, Fax (022) 8521927

Indonesia
PT Grama Bazita
Jakarta
Tel. (21) 7975083, Fax (21) 7975089

Japan
❑ Sakura Endress Co. Ltd.
Tokyo
Tel. (0422) 540613, Fax (0422) 550275

Malaysia
❑ Endress+Hauser (M) Sdn. Bhd.
Petaling Jaya, Selangor Darul Ehsan
Tel. (03) 7334848, Fax (03) 7338800

Pakistan
Speedy Automation
Karachi
Tel. (021) 7722953, Fax (021) 7736884

Papua-Neuguinea
SBS Electrical Pty Limited
Port Moresby
Tel. 3251188, Fax 3259556

Philippines
❑ Endress+Hauser Philippines Inc.
Metro Manila
Tel. (2) 3723601-05, Fax (2) 4121944

Singapore
❑ Endress+Hauser (S.E.A.) Pte., Ltd.
Singapore
Tel. 5668222, Fax 5666848

South Korea
❑ Endress+Hauser (Korea) Co., Ltd.
Seoul
Tel. (02) 6587200, Fax (02) 6592838

Taiwan
Kingjarl Corporation
Taipei R.O.C.
Tel. (02) 27183938, Fax (02) 27134190

Thailand
❑ Endress+Hauser Ltd.
Bangkok
Tel. (2) 9967811-20, Fax (2) 9967810

Vietnam
Tan Viet Bao Co. Ltd.
Ho Chi Minh City
Tel. (08) 8335225, Fax (08) 8335227

Iran
PATSA Co.
Tehran
Tel. (021) 8754748, Fax (021) 8747761

Israel
Instrumetrics Industrial Control Ltd.
Netanya
Tel. (09) 8357090, Fax (09) 8350619

Jordan
A.P. Parpas Engineering S.A.
Amman
Tel. (06) 4643246, Fax (06) 4645707

Kingdom of Saudi Arabia
Anasia Ind. Agencies
Jeddah
Tel. (02) 6710014, Fax (02) 6725929

Lebanon
Network Engineering
Jbeil
Tel. (3) 944080, Fax (9) 548038

Sultanate of Oman
Mustafa Sultan Science & Industry Co. LLC.
Ruwi
Tel. 602009, Fax 607066

United Arab Emirates
Descon Trading EST.
Dubai
Tel. (04) 2653651, Fax (04) 2653264

Yemen
Yemen Company for Ghee and Soap Industry
Taiz
Tel. (04) 230664, Fax (04) 212338

Australia + New Zealand

Australia
ALSTOM Australia Limited
Milperra
Tel. (02) 97747444, Fax (02) 97744667

New Zealand
EMC Industrial Group Limited
Auckland
Tel. (09) 4155110, Fax (09) 4155115

All other countries

❑ Endress+Hauser GmbH+Co.
Instruments International
D-Weil am Rhein
Germany
Tel. (07621) 975-02, Fax (07621) 975345