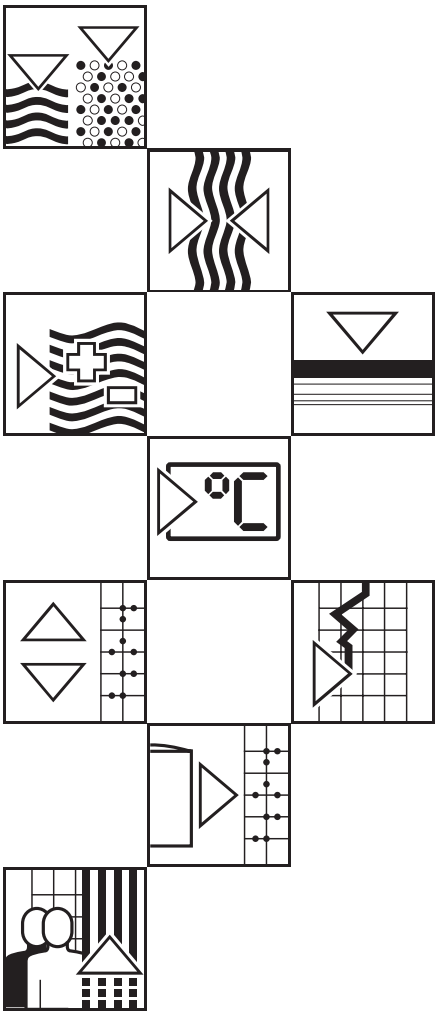
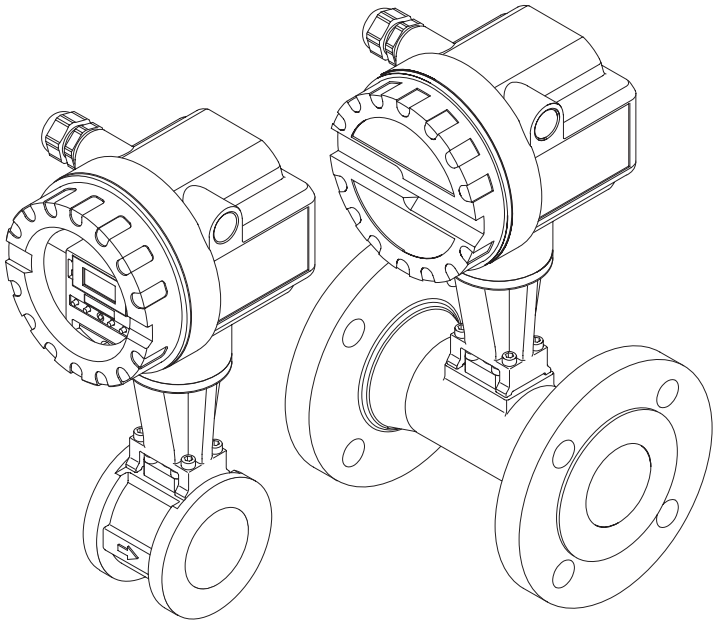
BA 032D/06/en/03.00
No. 50084976
CV 5.0

valid as of software version
1.0.02

prowirl 77
Vortex Flow Measuring System (Version: 4...20 mA/HART)

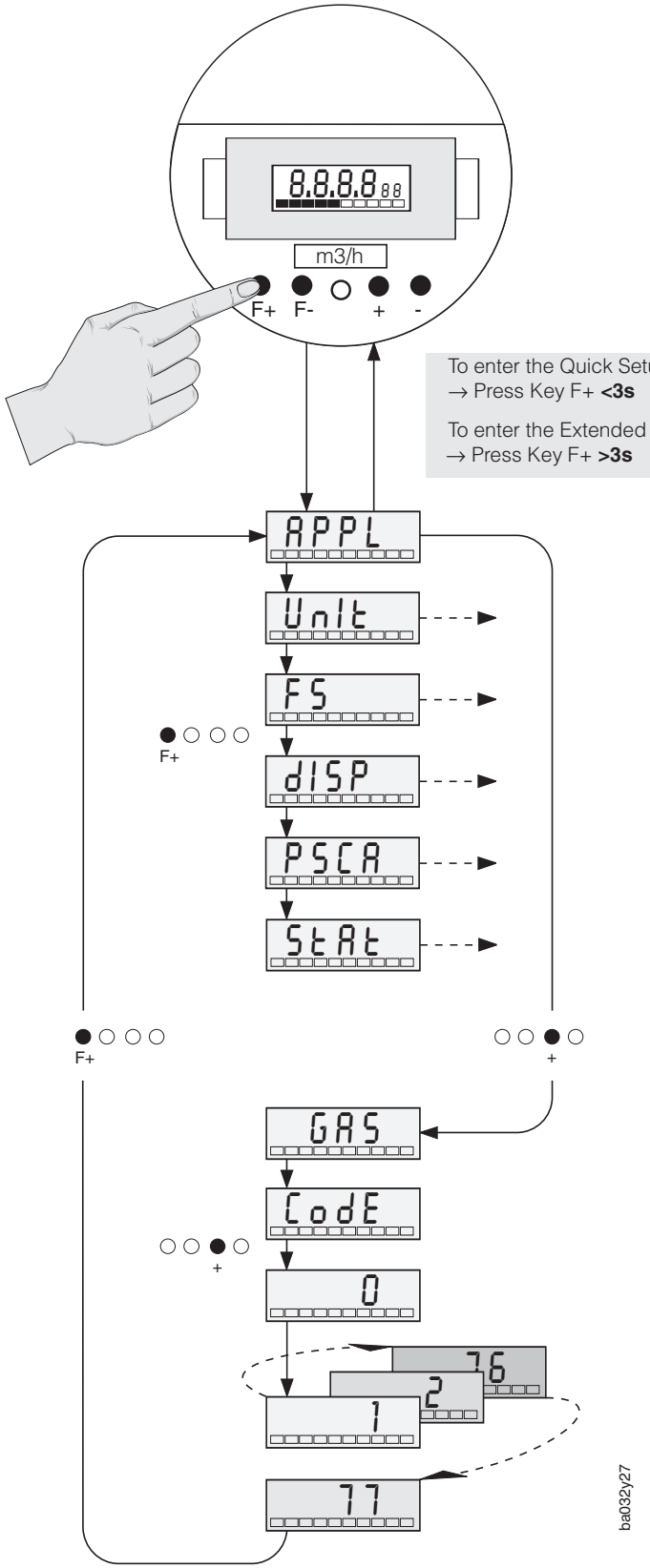
Operating Manual





Endress+Hauser
The Power of Know How

Operating summary (for copying) for Version 4...20 mA / HART



Example of operating procedure “Unlocking Programming”

Quick Setup menu (Prowirl 77)			
		Display	Selecting / Entering values
Application (Fluid)		APPL	LI = Liquid, GAS = Gas / Steam
Flow units		Unlt	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
Full scale value		FS	Input (UnIt)
Display mode		dISP	PErc = Flow in %, rAtE = Flow rate in vol./time, Ltot = Totaliser, Htot = Totaliser overflows
Pulse scaling	*	PSCA	Input (UnIt)
Diagnosis code	*	StAt	E1XX = system error, E2XX = warning message

* Display → dependent on the settings made in other functions

Note!
First jump to the HOME position in order to move from the Quick Setup menu to the tended menu.

Note!

To enter the Quick Setup menu:
→ Press Key F+ **<3s**

To enter the Extended menu:
→ Press Key F+ **>3s**

Return to the HOME position from any function → Press Key F+ **>3s**

(HOME position = standard display during normal operation)

Extended menu (Prowirl 77)			
		Display	Selecting / Entering values
Flow rate		Fu00	Display (Flow units)
Vortex frequency		Fu01	Display (Hz)
Totaliser		Fu02	Display (Totaliser units)
Totaliser overflow		Fu03	Display (number of overruns)
Flow units		Unlt	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
Totaliser units		Fu11	0 = dm^3, 1 = m^3, 2 = ACF, 3 = Igallons, 4 = gallons, 5 = USER = user defined
User-defined units flow rate	*	Fu12	Input (Unit)
User-defined units totaliser	*	Fu14	Input (Unit)
Output signal		Fu20	4...20 (mA), PULS (scaleable Open Collector pulse output), PF (PFM current pulses)
Full scale value		FS	Input (Unit)
Time constant		Fu22	Input (Unit)
Failsafe mode	*	Fu23	Lo ≤ 3.6 (mA), Hi = 22 (mA), run = norm. meas. value
Simulation	*	Fu24	OFF, 3.6 (mA), 4 (mA), 12 (mA), 20 (mA), 22 (mA)
Nominal current	*	Fu25	Display: 4...20.5 (mA)
Pulse scaling	*	PSCA	Input (UnIt)
Pulse width	*	Fu31	Input 0.05...2.00 (s)
Simulation pulse output	*	Fu32	OFF, 1 (Hz), 50 (Hz), 100 (Hz)
Nominal frequency	*	Fu33	Display 0.000...100.0 (Hz)
Display mode		dISP	PErc = Flow in %, rAtE = Flow rate in vol./time, Ltot = Totaliser, Htot = Totaliser overflows
Totaliser reset		Fu41	ESC = not reset to zero, rESE = set to zero
Private code definition	*	Fu50	Input 0...9999
Access code entry		CodE	Input 0...9999
Meter status	*	StAt	E1XX = system error, E2XX = warning message
Software main board		Fu53	Display
Hardware main board		Fu55	Display
Application (Fluid)		APPL	LI = Liquid, GAS = Gas/Steam
Nominal diameter		dn	15...300 (mm)
K-factor		CALF	0.010...999.9 (pulses/dm^3), as printed on meter
Therm. exp. coef.		Fu63	Display (x 10^{-5}/Kelvin)
Process temperature		Fu64	Input 0...999 (Kelvin)
Amplification		Fu65	1 = very low, 2 = low, nor = normal, 3 = high

* Display → dependent on the settings made in other functions

Note!
First jump to the HOME position in order to move from the Extended menu to the Quick Setup menu.

Note!

Contents

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Registered trademark of Inco Alloys International, Inc., Huntington, USA

1 Safety Instructions

1.1 Correct usage

- Prowirl 77 is only to be used for measuring the volumentric flow rate of saturated steam, superheated steam, gases and liquids. If the process pressure and temperature are constant, then Prowirl 77 can also indicate the flow rate in units of mass, energy or corrected volume.
- The manufacturer assumes no liability for damage caused by incorrect use of the instrument.
- Instruments which are ordered with hazardous area approvals 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 be closely observed! An appropriate pictogram is shown on the front page of the Ex documentation according to the approval given and the test centre.

1.2 Dangers and notes

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

- The Prowirl 77 measuring system fulfills the general safety regulations according to EN 61010 and the interference immunity regulations (EMC) according to European standard EN 50081 Part 1 and 2 / EN 50082 Part 1 and 2 as well as NAMUR recommendations.
- Housing ingress protection IP 67 to EN 60529.
- A comprehensive self-monitoring feature of the measuring system ensures high operational safety. In cases of error, the current output assumes a predefined response, the signal of the pulse output is set to the fall-back value of 0 Hz. The appropriate error messages are shown on the LCD.
- On power failure, the configuration data of the measuring system remain in the EEPROM (without batteries). The totalizer remains on the value last shown.

1.4 Personnel for installation, start-up and operation

- Mounting, electrical installation, start-up and maintenance of the instrument may only be carried out by trained personnel authorised 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 authorised 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 compatibility of the material of all wetted parts such as measuring pipe, bluff body, sensor and gaskets is to be verified. This also applies to fluids used to clean the Prowirl 77 flowmeter. Endress+Hauser will be pleased to provide you with any help required.
- 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.


Warning!

There is no longer any contact protection once the housing cover is removed

Please observe all provisions valid for your country pertaining to opening and repair of electrical devices.

1.5 Repairs, dangerous chemicals

The following procedures must be carried out before a Prowirl 77 is sent to Endress+Hauser for repair:

- A note must be enclosed with the instrument, containing a description of the fault, the application and the chemical and physical properties of the fluid being measured.
- Remove all residue which may be present. Pay special attention to the gasket grooves and crevices where fluid may be present. This is especially important if the fluid is dangerous to health, e.g. corrosive, poisonous, carcinogenic, radioactive, etc.
- No instrument should be returned to us without all dangerous material being removed first.

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

1.6 Technical improvements

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

2 System Description

The Prowirl 77 vortex flowmeter measures the volumetric flow of steam, gases and liquids for fluid temperatures in the range of -200...+400 °C and at nominal pressures of up to PN 160 / ANSI class 600.

Prowirl 77 measures the volumetric flow at operating conditions. If the process pressure and temperature are constant, Prowirl 77 can be programmed to supply the flow rate in mass, energy or corrected volume units.

2.1 Prowirl 77 measuring system (4...20 mA version)

A measuring system consists of:
- Prowirl 77 transmitter in the versions shown below
- Prowirl 77 W, Prowirl 77 F or Prowirl 77 H body

The Prowirl 77 transmitter is available in different versions which differ in the type of electrical output signals and digital communication capabilities. The transmitter can be equipped with a local display and local programming capability using push-buttons. The transmitters that are equipped with a display come with a glass cover, the others come with an aluminium cover (see Fig. 1).

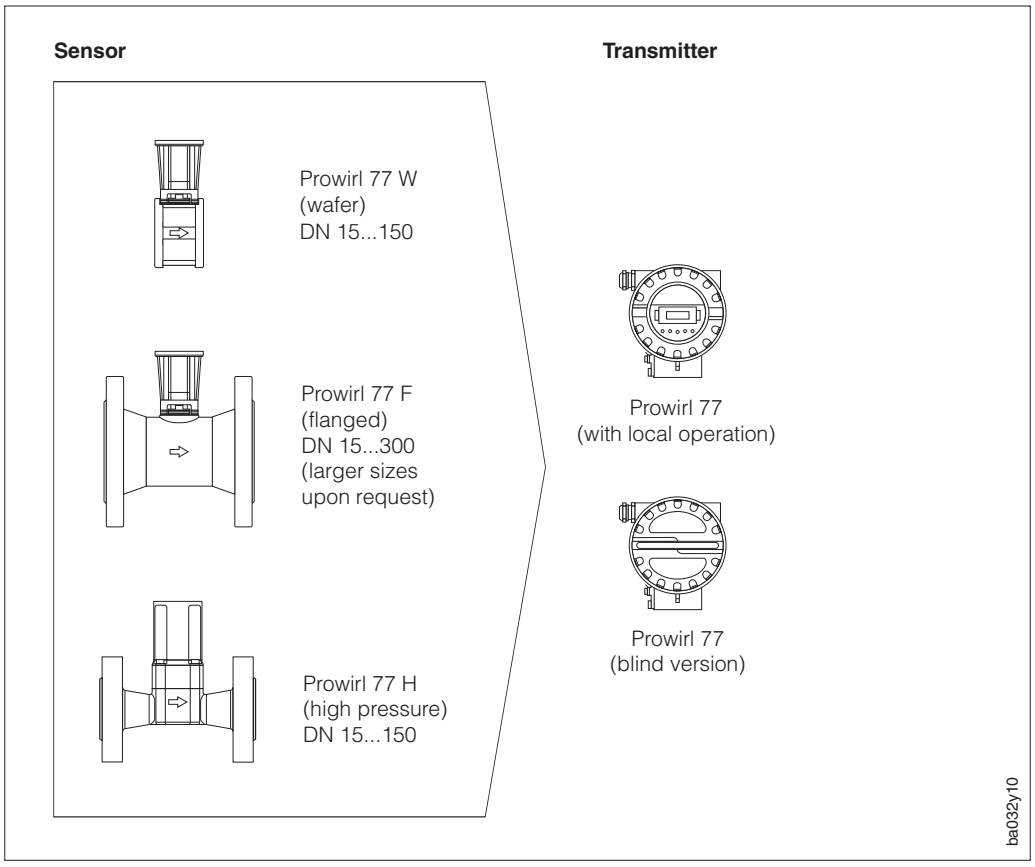


Fig. 1
Prowirl 77 measuring system

This operating manual describes the “4...20 mA” version. All transmitters of this version offer a 4...20 mA current output, with optional HART digital communication and/or with local display and programming capabilities. Transmitters with local display and programming can be reconfigured to output either scaleable pulses (open collector or voltage pulses) or two-wire unscaled current pulses (PFM).

The Prowirl 77 transmitter is available in two other versions:
- Version “PFM”
- Version “PROFIBUS-PA”

Operation of those versions is not included in this operating manual. Separate operating manuals for those instruments are available on request.

The various Prowirl 77 transmitters can be freely combined with all meter body versions. This guarantees flexibility when matching a complete meter to specific industrial process conditions.

3 Mounting and Installation

3.1 General information

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

- 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 an outer diameter in the specified range.
- The cable gland must be firmly tightened (see Fig. 2).
- The cable must loop down before entering the cable gland to ensure that no moisture can enter it (see Fig. 2).
- Any unused cable glands are to be replaced with a plug.
- The protective bushing should not be removed from the cable gland.

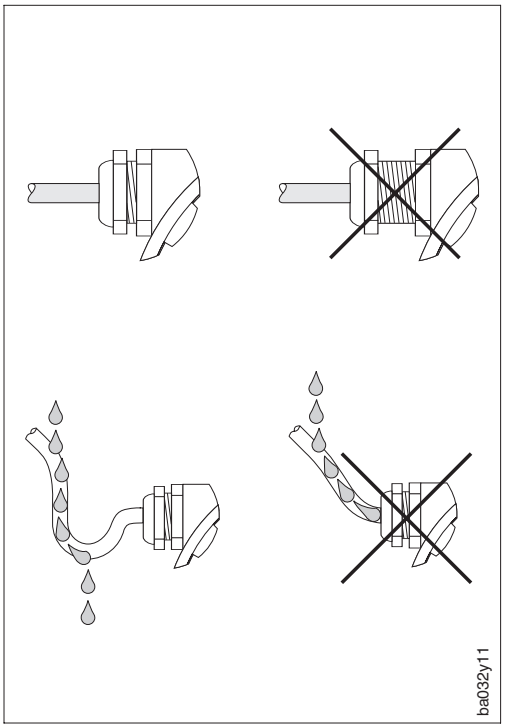


Fig. 2
Protection IP 67

Temperature ranges
- The maximum approved ambient and process temperatures must be observed (see page 50).
- Observe also the instructions on piping insulation and mounting position (see page 11).

3.2 Installation

A vortex flowmeter requires a fully developed flow profile as a prerequisite for measuring volume accurately. The following points must therefore be noted when mounting the Prowirl 77 in the pipeline.

Pipe inner diameter
When ordering, ensure that the nominal diameter and pipe schedule (DIN/ANSI/JIS) are correct, since calibration of the flowmeter and therefore the achieveable accuracy of the measuring point are dependent on these specifications.

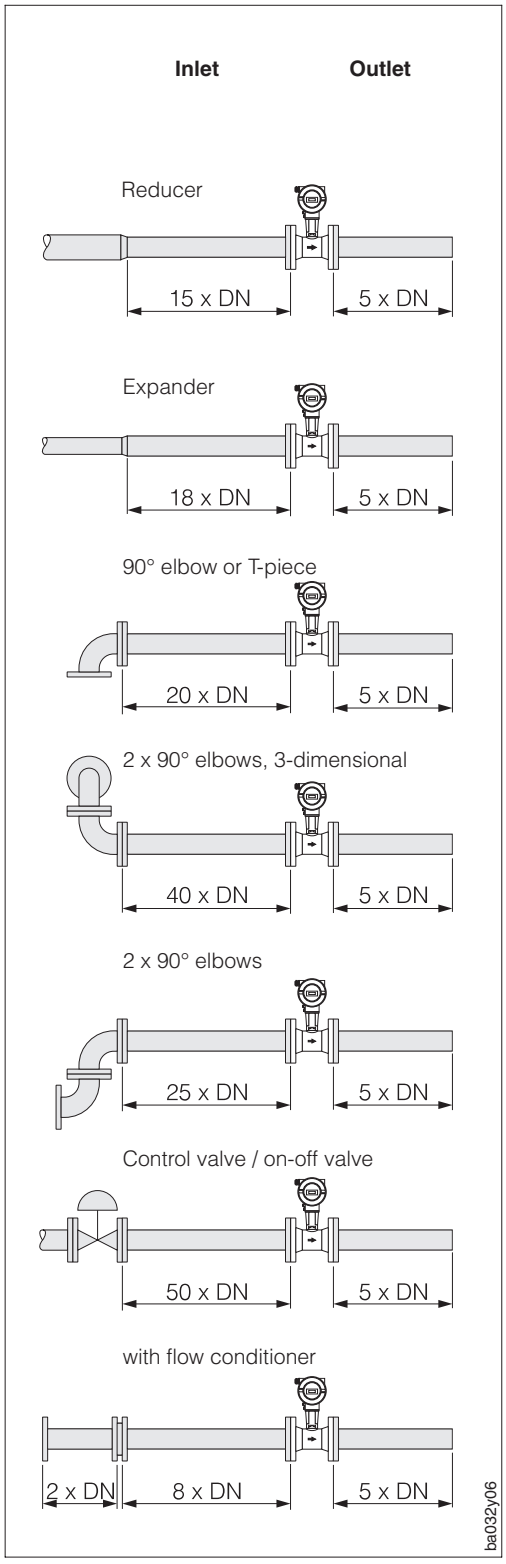


Fig. 3
Inlet and outlet piping requirements

Inlet and outlet sections
To ensure an undisturbed flow profile, the vortex flowmeter should be mounted upstream of any flow disturbances such as pipe elbows, reducers or valves, otherwise the longest possible section of piping should be between the disturbance and the flowmeter. The figures on the left show the *minimum section of straight piping* downstream of the disturbance as multiples of the nominal diameter of the pipe in DN. If two or more flow disturbances are located upstream, then the longest inlet section recommended should be used.

There must also be a straight outlet section of sufficient length downstream from the flowmeter to ensure that the vortices are properly developed.

Flow conditioner
With limited space and large pipes, it is not always possible to use the inlet sections given above. In such cases the specially developed perforated plate flow conditioner (see pages 47 and 48) can be fitted as shown on the left. The flow conditioner is held between two piping flanges and centred with the flange bolts. It reduces the length of the inlet section downstream from flow disturbances to 10 x DN while maintaining full measurement accuracy.

Installation site
The Prowirl 77 can be mounted in any position in the piping. An arrow on the meter body shows the direction of flow.

For measuring liquids in vertical pipes, the meter should be installed in upwards flow direction (Fig. A) to ensure a full pipe.

For horizontal pipelines, positions B, C and D are possible. With hot piping (e.g. steam), position C or D must be selected in order to respect the maximum permissible ambient temperature at the electronics.

For ambient temperatures see Technical Data, page 49.

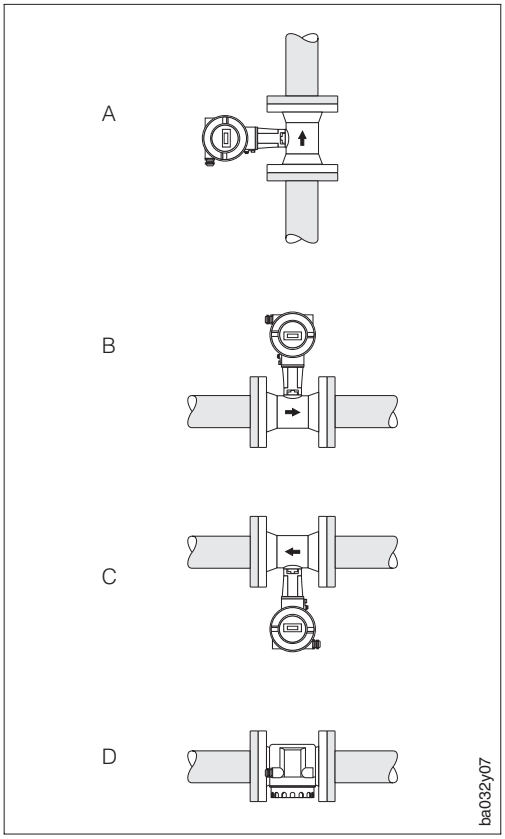


Fig. 4
Orientation

Pressure and temperature measurement points
Pressure and temperature measurement points are to be mounted *downstream* of the Prowirl 77 in order to affect vortex formation as little as possible.

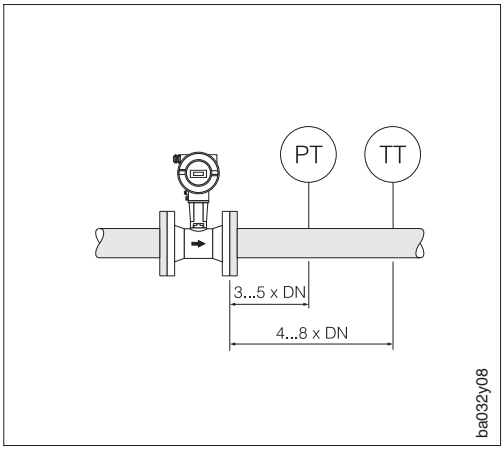


Fig. 5
Mounting pressure and temperature sensors

Pipeline insulation wafer/flanged version
Pipeline insulation is often used to prevent energy loss in hot processes.

Caution!
When insulating, ensure that sufficient pipe stand surface area is exposed. The exposed area serves as a radiator and protects the electronics from overheating.

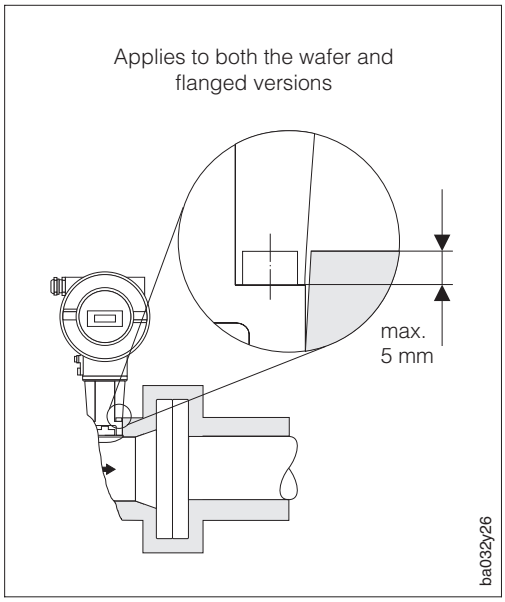


Fig. 6
Pipeline insulation wafer/flanged version

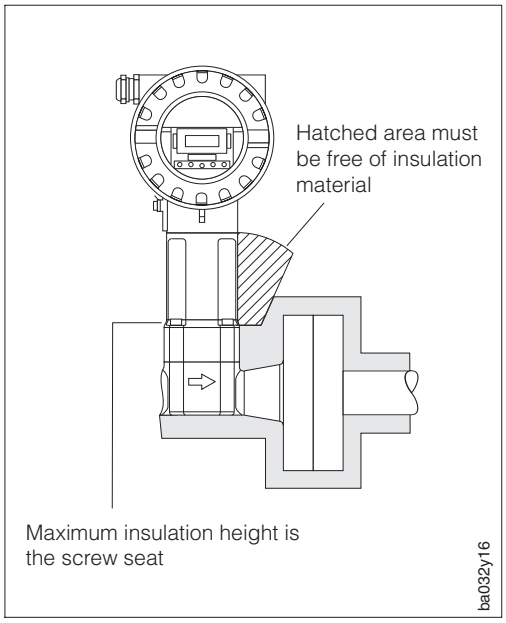


Fig. 8
Piping insulation
high pressure version

Piping insulation
high pressure version

The pipe stand must be free from insulation in order to guarantee temperature radiation and therefore to keep the electronics from overheating.

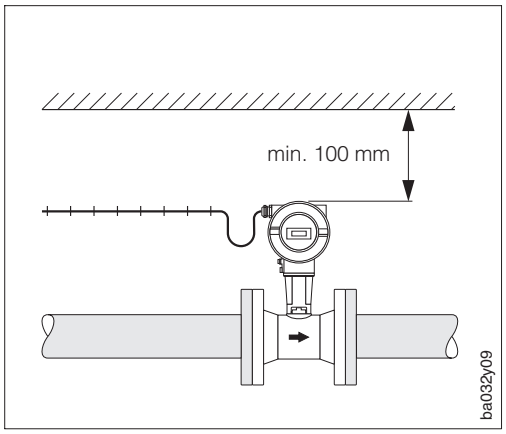


Fig. 7
Minimum spacing for mounting and removing the transmitter housing

Minimum spacing

When servicing or connecting the "Flowjack" simulator, it is necessary to remove the transmitter housing from the housing support.
When installing in the piping, observe the following cable lengths and minimum space:

- Minimum space in all directions 100 mm
- Cable length required L + 150 mm

Caution!
Removing the transmitter from the pipe stand is to be carried out by E+H service personnel only!

3.3 Mounting the flowmeter

Caution!
Note the following points before installing the flowmeter:

- Remove all packaging used for transport and protective coverings from the flowmeter 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 behind the bluff body and lead to inaccurate measurement. Therefore, the gaskets delivered by E+H come with a slightly bigger inner diameter than the measuring pipe.
- 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 W (wafer version), 65 mm
  – Prowirl F (flanged version) → see page 44
  – Prowirl H (high pressure version) → see page 46

Mounting Prowirl W
Mounting the wafer is carried out using a mounting set consisting of:
- bolts
- centering rings
- nuts
- washers
- gaskets

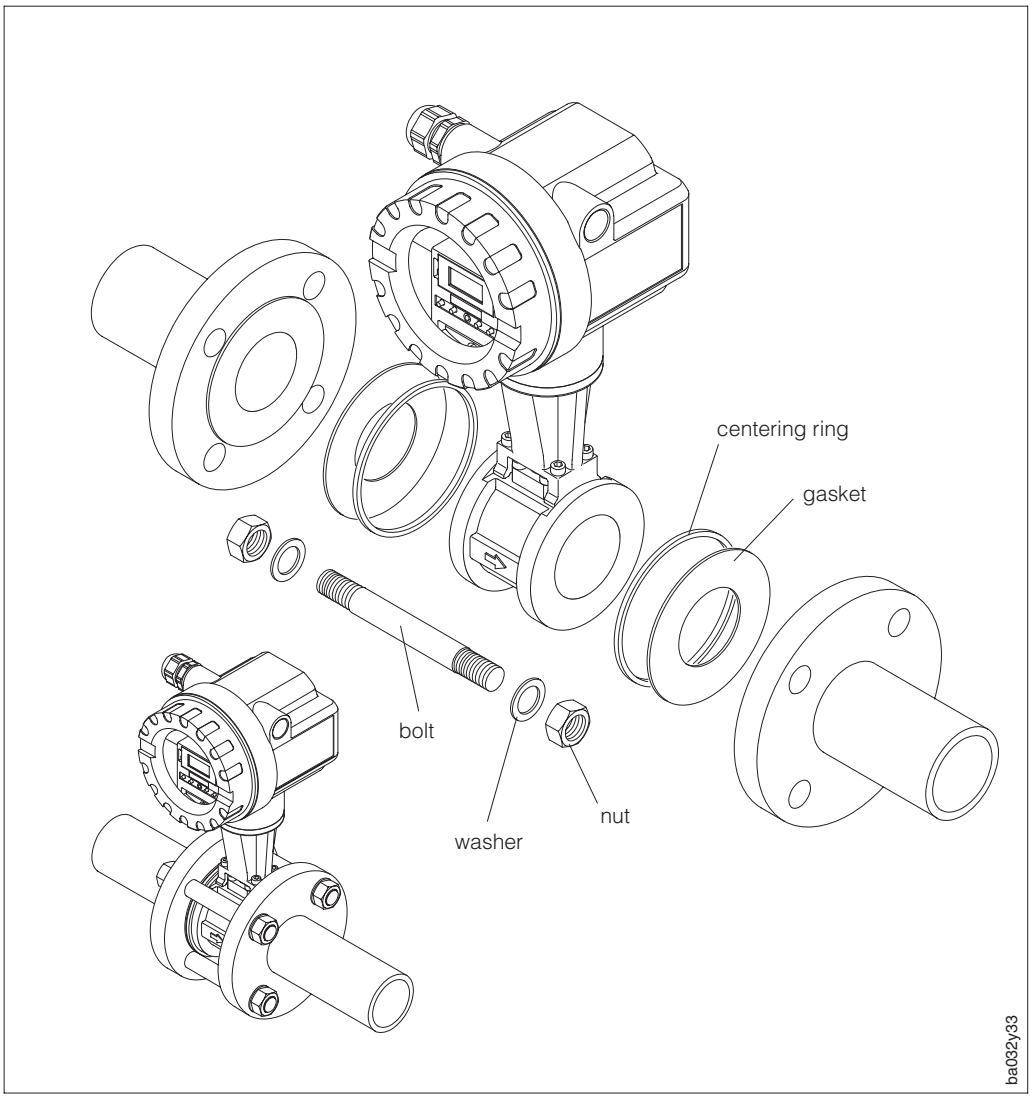


Fig. 9
Mounting the Prowirl W wafer version

3.4 Electronics housing / Local display (Mounting/Rotating)

The electronics housing of Prowirl 77 can be rotated in 90° steps on the pipe stand to put the local display in the best position to be read.
This is carried out as follows:
① Remove the securing screw at the pipe stand (minimum one turn).
② Pull out the electronics housing to the mechanical stop and then rotate it to the position required (in 90° steps). Push the housing back into the housing support.
③ Fasten the securing screw.

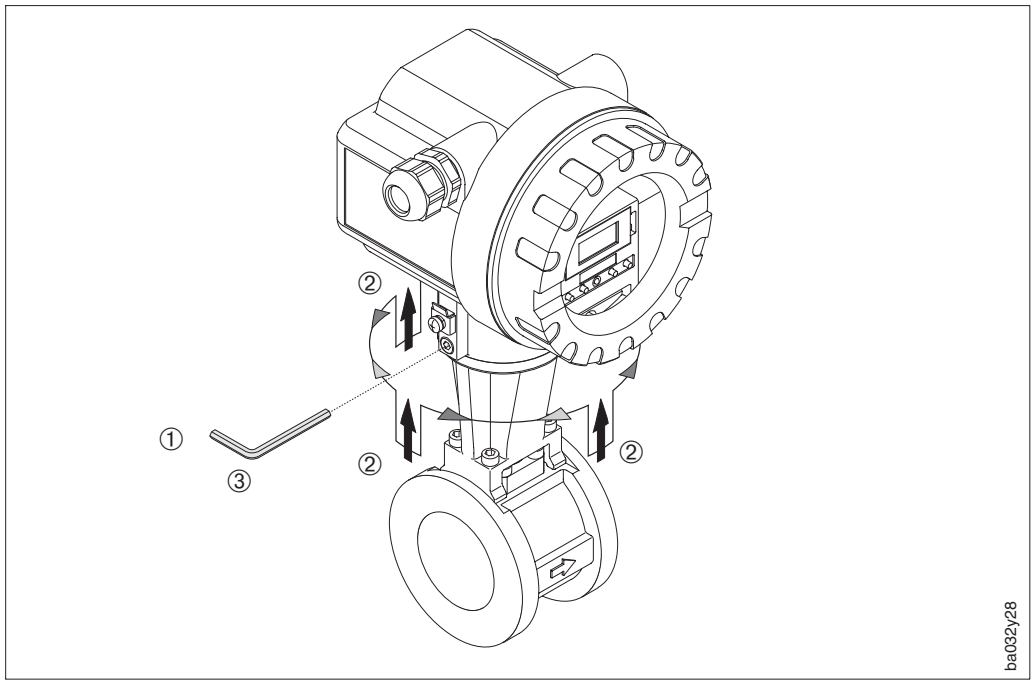


Fig. 10
Rotating the electronics housing

The LCD can also be rotated 180° to ensure that the display matches various orientations in a pipeline.

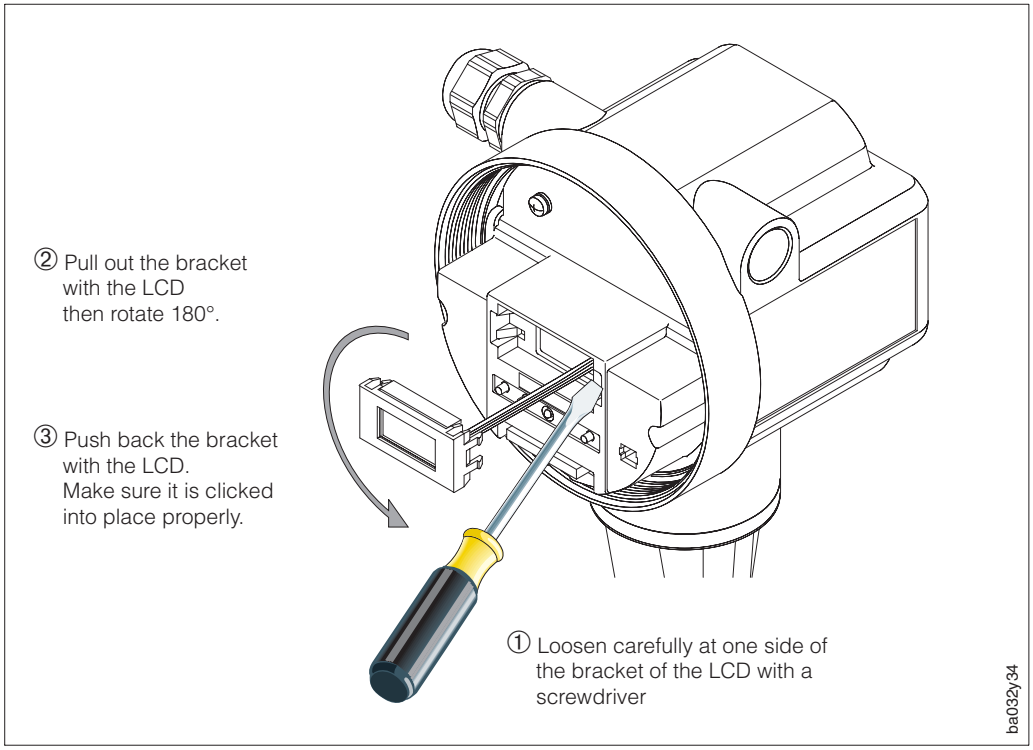


Fig. 11
Rotating the local display

4 Electrical Connection

4.1 Connecting the transmitter

Caution!
- All relevant national installation regulations must be observed.
- When installing an Ex version transmitter, please read the separate Ex documentation supplied.
- The power supply is max. 30 V DC (Ex d/XP: max. 36 V DC).

Procedure
1. Unscrew the front cover.
2. Loosen the two Phillips screws on the upper cover plate and let it swing down.
3. Feed the power and signal cables through the cable gland.
4. Wire up according to the wiring diagrams shown on the following pages.
5. Replace the cover plate and secure.
6. Screw the front cover securely again to the transmitter housing.

4.2 Wiring diagrams

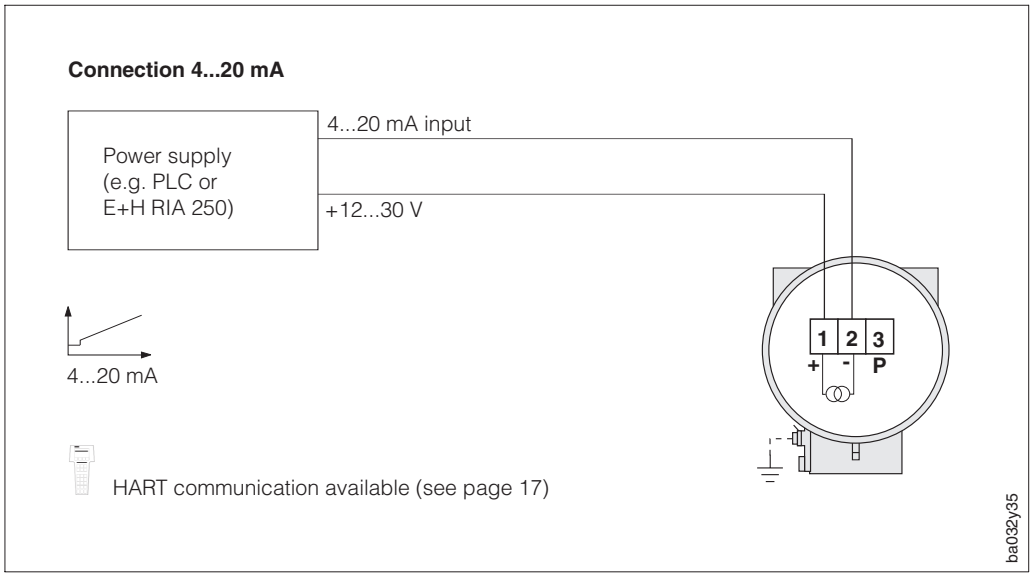


Fig. 12
Connection 4...20 mA

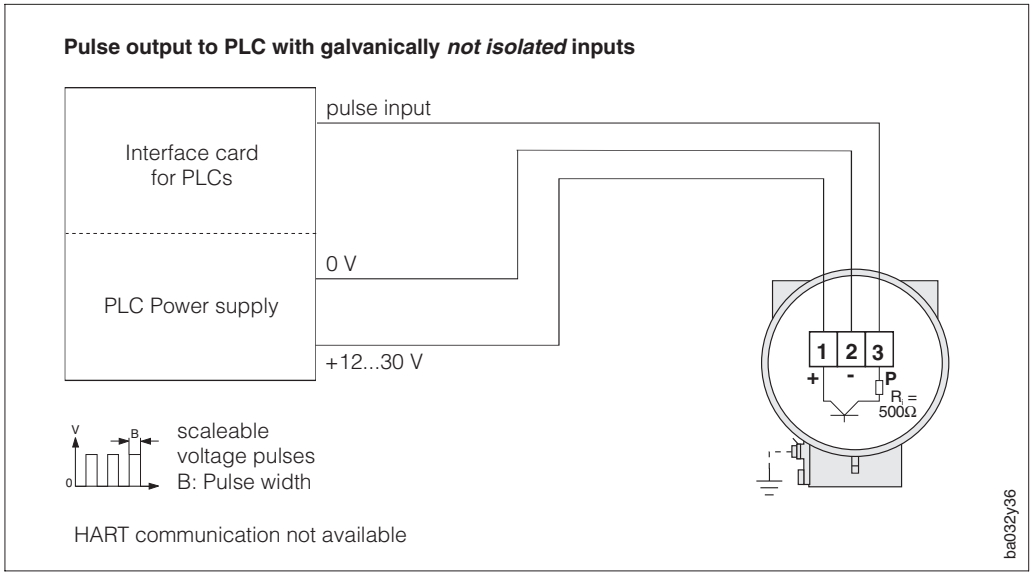


Fig. 13
Pulse output to PLC with galvanically not isolated inputs

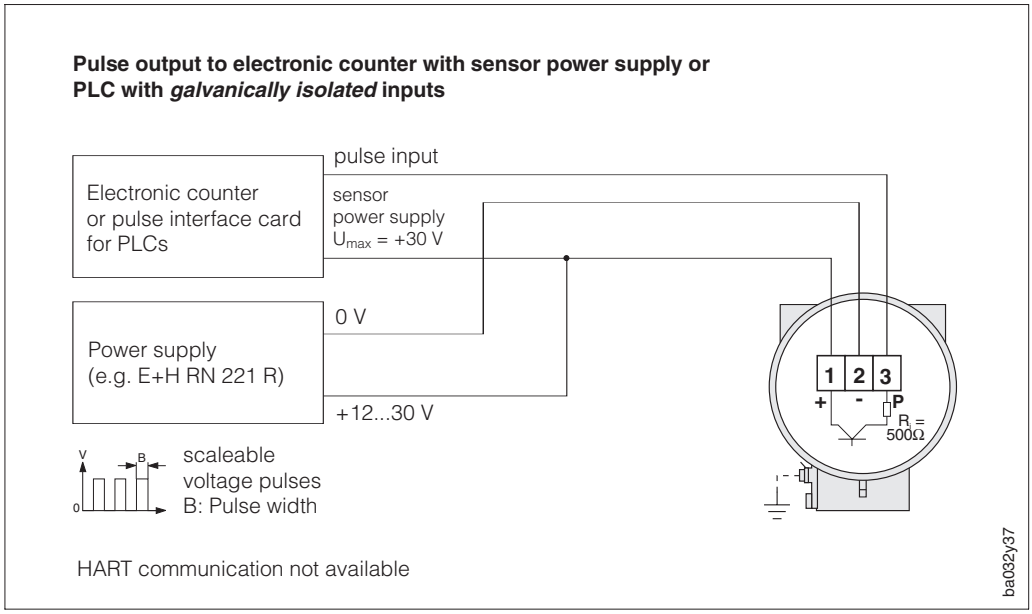


Fig. 14
Pulse output to electronic counter with sensor power supply or PLC with galvanically isolated inputs

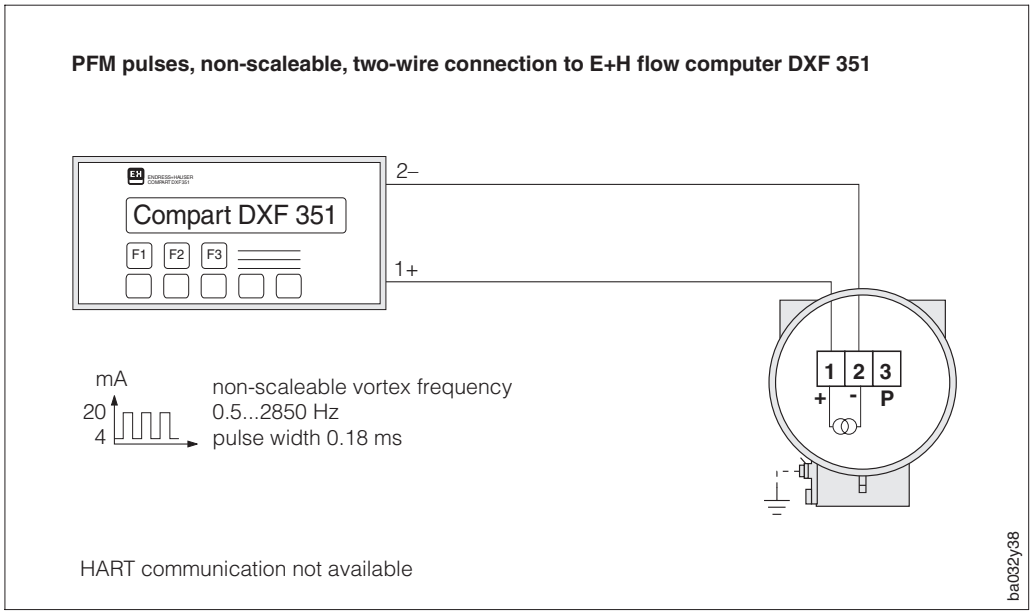


Fig. 15
PFM pulses, non-scaleable, two-wire connection to E+H flow computer DXF 351

4.3 Load

$$R_B = \frac{U_S - U_{KI}}{I_{max} \cdot 10^{-3}} = \frac{U_S - 12}{0.022}$$

R_B = load resistance
U_S = power supply voltage (12...30 V DC)
U_{KI} = Prowirl 77 terminal voltage (min. 12 V DC)
I_{max} = output current (22 mA)

Note!
For data transfer via HART protocol, the minimum load resistance is 250 Ω;
U_S = min. 17.5 V DC.

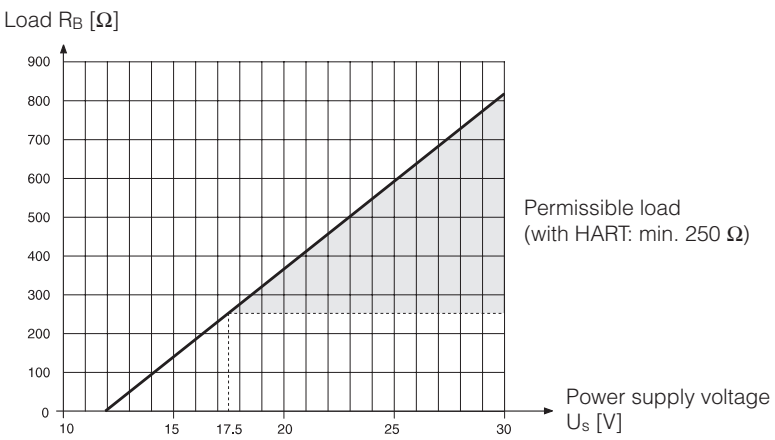


Fig. 16
Load on analogue current output

4.4 Connecting HART

The HART handheld unit DXR 275 is connected over the 4...20 mA signal cable. For the connection of a sensor in Ex version, please refer to the seperate Ex documentation.

The minimum load for the DXR 275 is 250 Ω. The maximum load on the current output depends on the power supply (see Fig. 16).

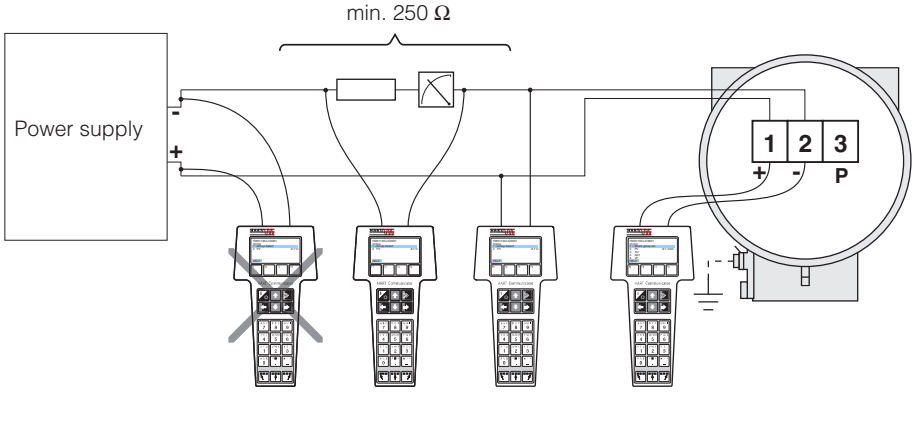


Fig. 17
Electrical connection of the HART DXR 275 handheld terminal

Note!
Power supply 17.5...30 V. If the power supply has an internal resistance of min. 250 Ω, the power supply can range between 12 and 30 V. In this case the HART handheld can be connected directly to the power supply.

4.5 Connection for Commuwin II operation

The Prowirl 77 can be connected to the RS 232C serial interface of a personal computer via the Commubox FXA 191 for remote operation using the E+H “Commuwin II” software and HART DDE server.

Connection over the 4...20 mA signal cable analogue to the HART handheld.
The maximum load on the current output depends on the power supply (see page 17).

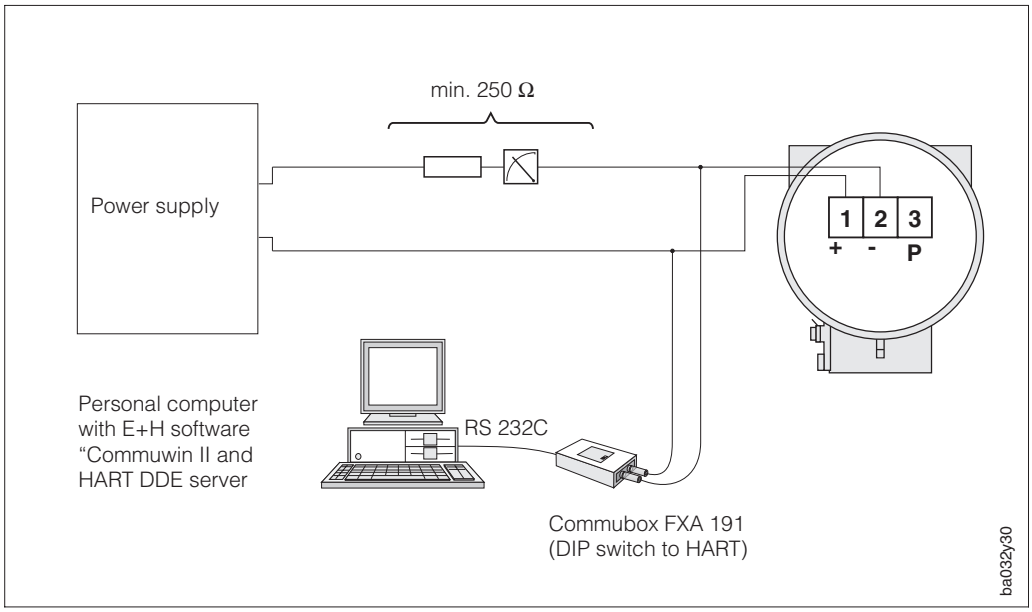


Fig. 18
Electrical connection of the Commubox FXA 191

Note!
Power supply 17.5...30 V. If the power supply has an internal resistance of min. 250 Ω, the power supply can range between 12 and 30 V. In this case the Commubox can be connected directly to the power supply.

5 Operation

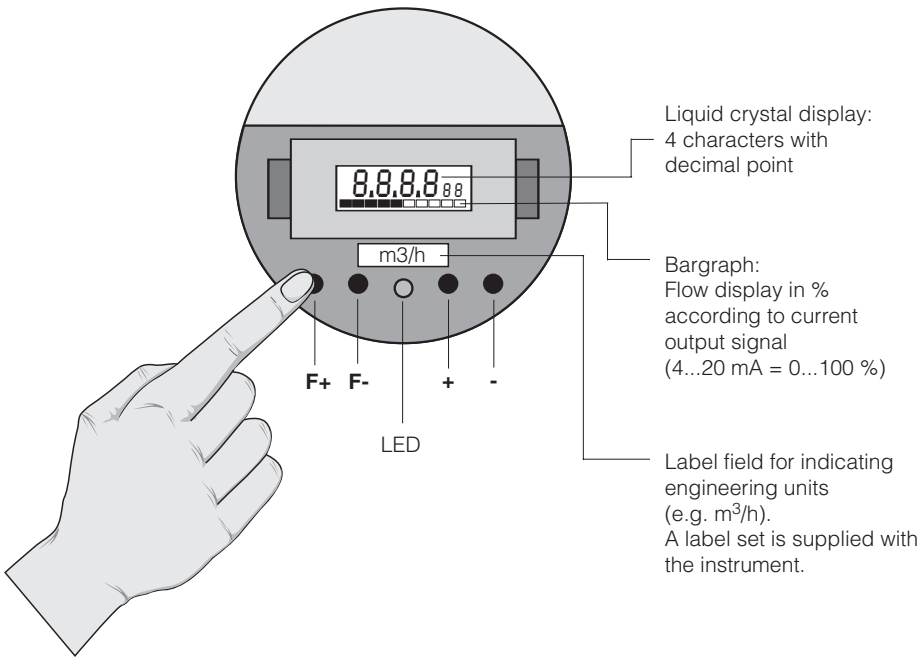
The Prowirl 77 measuring system has a number of functions which the user can individually set according to process conditions.

Note!
- Under normal circumstances reprogramming the functions of Prowirl is not required since the flowmeter is already configured in the factory.
- A summary of all factory-set values and selections is given on page 25 ff.

Note!

5.1 Display and operating elements

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



Use F+ / F- to:

1. Enter programming mode
- Press Key F+ (<3 sec.) → Quick Setup menu is accessed
- Press Key F+ (>3 sec.) → Extended menu is accessed

2. Return to HOME position from any function:
Keep Key F+ pressed (>3 sec.)

HOME position = standard display during measurement

3. Select various functions

Use + / - to:

1. Display actual values or settings in the particular function

2. Change numerical values / settings (keep key depressed: values change at increasing speed)

ba032y12

Fig. 19
Display and operating elements of the Prowirl 77

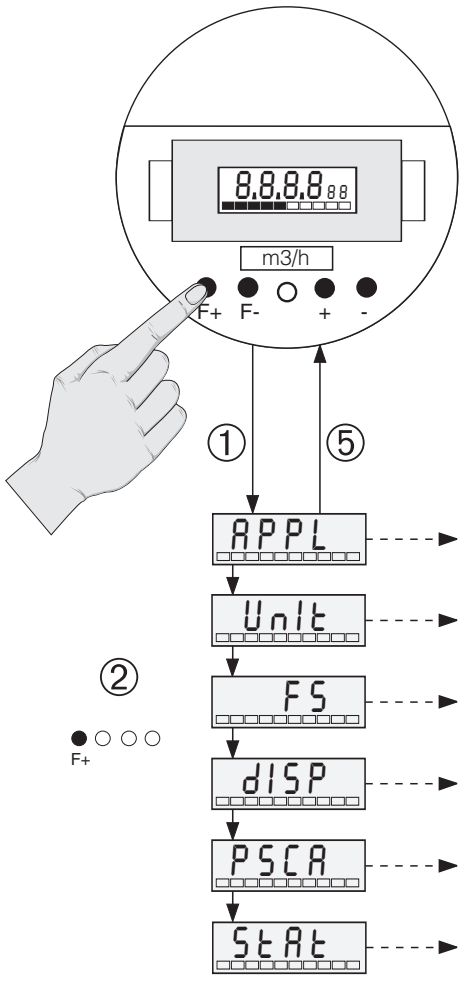
5.2 Select functions and change parameters

Changing numerical values or settings in a function is carried out as follows (see Fig. 20 and 21).

Remove the housing cover
① Enter the programming mode (key F+)
② Select the function (key F+/F-)
③ Enable programming if locked (key +/-, confirm with F+)
④ Change numerical values/settings (key +/-)
⑤ Leave the programming mode; return to the HOME position (key F+, >3s)
(Programming is then locked again if no key is pressed for 60 seconds)
Replace and secure the housing cover

Note!

Note!
See page 2 for a summary of contents in the Quick Setup menu or the Extended menu.



Entering the programming menus

① Press key F+:

<3 s: *Quick Setup menu*
for the most important instrument functions.
A summary is given on page 2.

>3 s: *Extended menu*
this contains all functions of the Prowirl 77.
A summary is given on page 2.

Moving between the Quick Setup and Extended menus is only possible by jumping to the HOME position ⑤.

Returning to the HOME position

⑤ Press key F+ (>3 s)
This is automatic if no key is pressed within 3 min. (with locked programming only).

Entering the submenus, see Fig. 21 on following page

ba032y20

Fig. 20
Selecting functions

The following functions are explained using the function “APPL” = fluid to be measured as an example:

③ **Enable programming**
Enter code number (factory setting = 77)

Lock programming
- After returning to the HOME position programming is locked again if no key is pressed for 60 seconds.
- Programming can also be locked by entering any number in the Function “CodE” (not customer code).

④ **Changing functions**

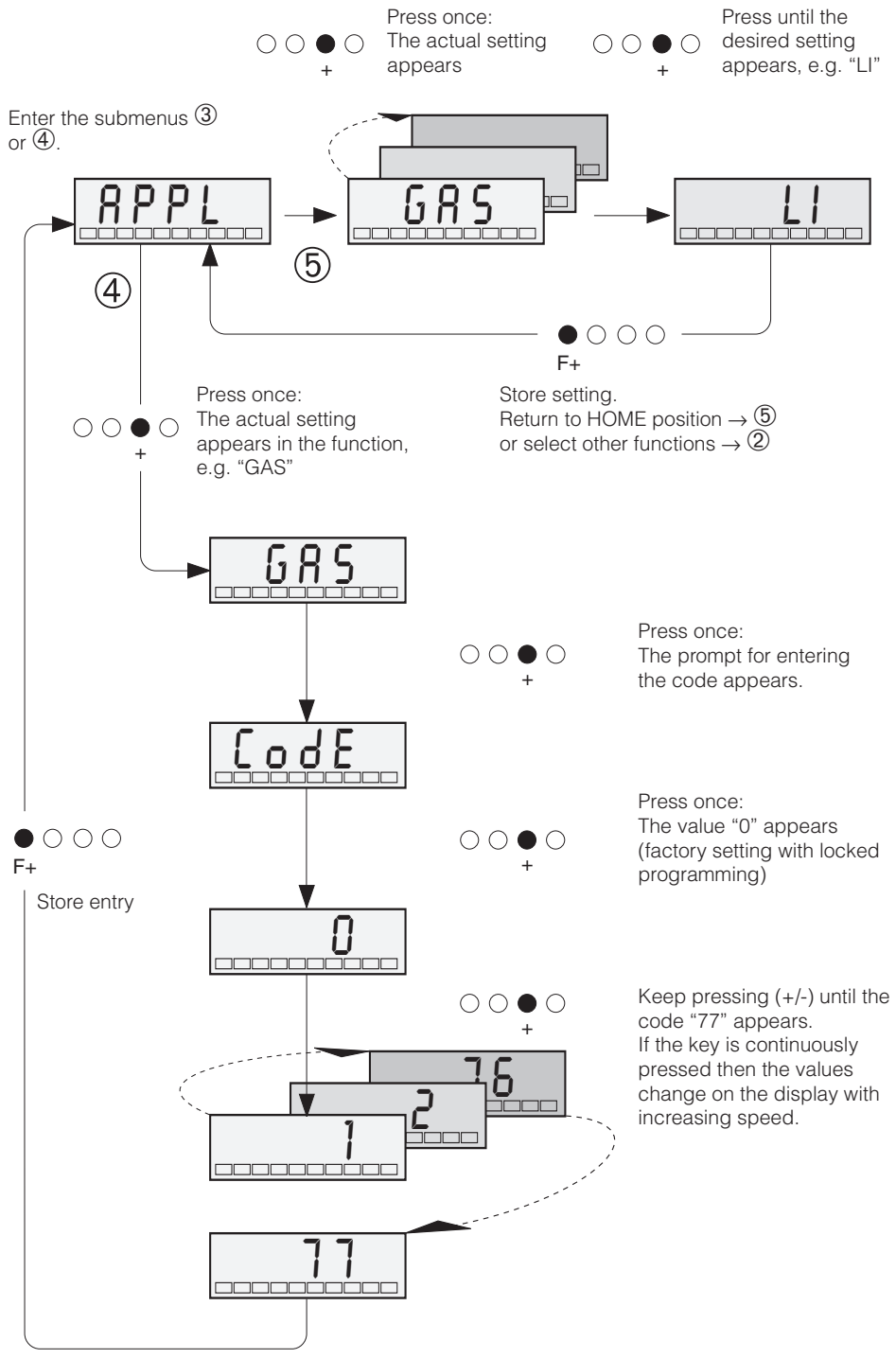


Fig. 21
Enable programming, change functions

5.3 Operate Prowirl 77 with the HART handheld terminal

Operating the Prowirl 77 measuring system using a handheld terminal is different from local operation. Selecting all Prowirl 77 functions using the HART handheld terminal is carried out on different menu levels using the E+H programming matrix (see page 23).

Note!

- The Prowirl 77 flowmeter can only be operated with a HART handheld terminal if the handheld contains the appropriate software (DDL = Device Description Language of the Prowirl 77). If this is not the case, then the memory module of the HART handheld terminal 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 “4-20” setting is selected in the “Fu20” function (see page 31).
- All Prowirl 77 functions are described in Section 6 (see page 25 ff.).

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. Information concerning offline-programming is found in the operating manual for the “Communicator DXR 275”. Continue with “Offline”.
   b. The flowmeter is already connected → The menu level “Online” is immediately shown.

   The current measurement data such as flow, totaliser value, etc. are continually shown in the “Online” menu level. You are also able to jump from it to the Prowirl 77 programming matrix (see Fig. 23). 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. Confirm with function key F4.

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 the Prowirl 77.

5. Press the “F3” HOME function key to return to the “Online” menu level. The actual values measured by the Prowirl 77 with the new settings can now be read off.

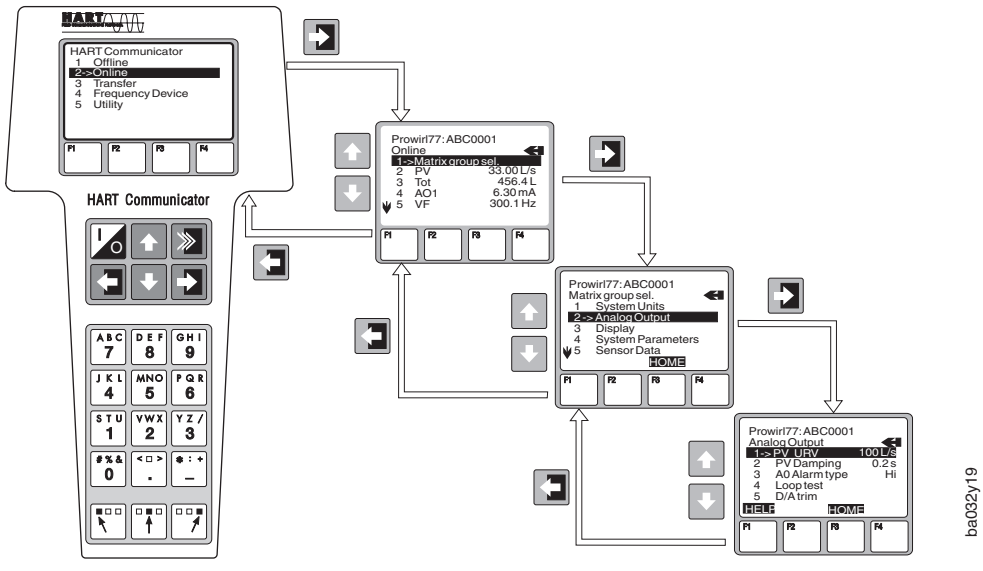


Fig. 22
Operating the handheld terminal using “analogue output” as an example

5.4 HART operating matrix

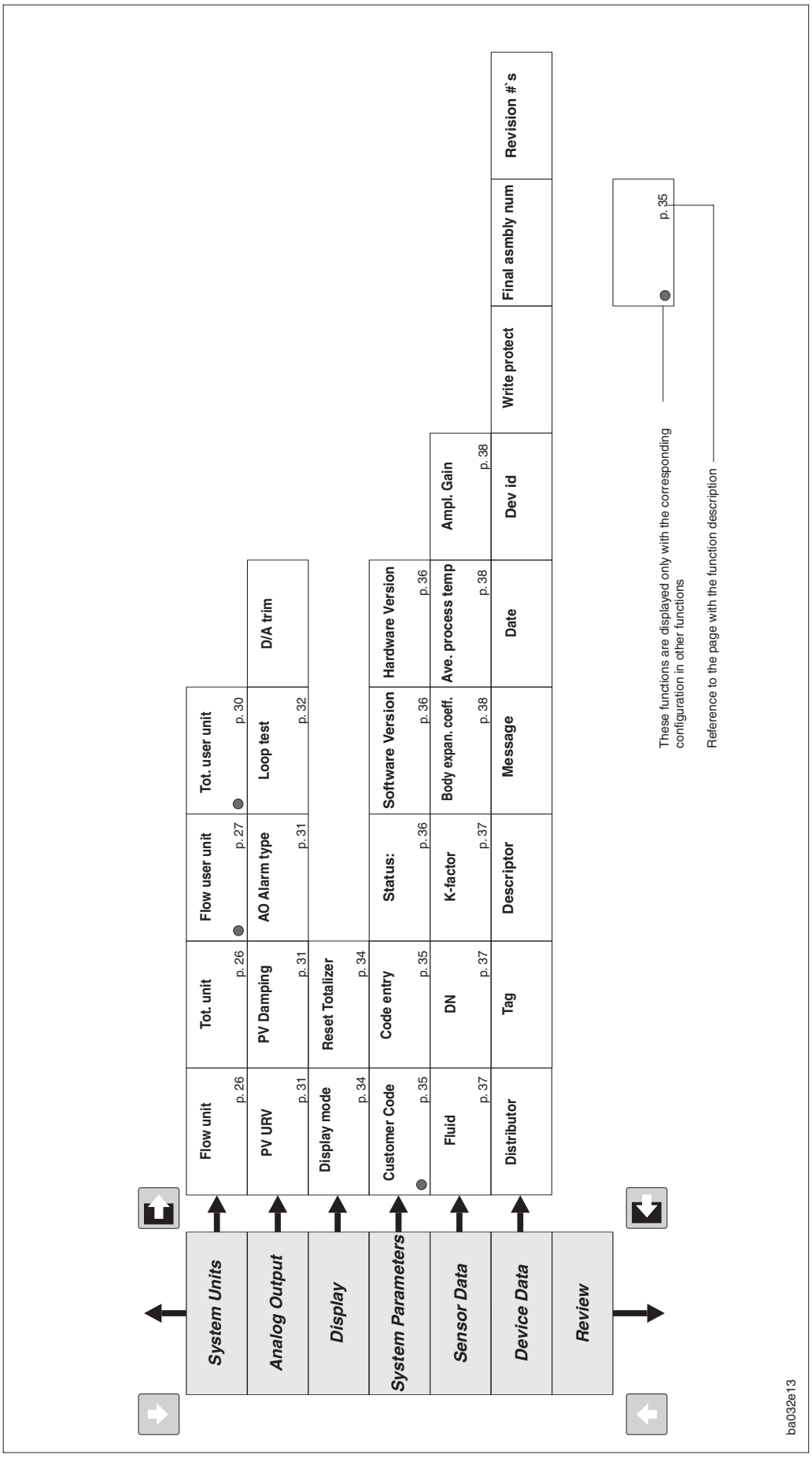


Fig. 23
Programming matrix HART

5.5 Commuwin II operating matrix

		H0	H1	H2	H3	H4	H5
V0	**MEASURED VALUE**	FLOWRATE	VORTEX FREQUENCY	TOTALIZED VOL.			
V1	**SYSTEM-UNITS**	FLOW UNIT	VOLUME UNIT	CUSTOM FLOW UNIT		CUSTOM TOTAL UNIT	
V2	**CURRENT OUTPUT**		VALUE FOR 20 MA	TIME CONSTANT	FAILSAFE MODE	SIMULATION CURR.	ACTUAL CURRENT
V3							
V4	**DISPLAY**	CONFIG. DISPLAY	RESET TOTALIZER				
V5	**SYSTEM PARAMETER**		ACCESS CODE	DIAGNOSTIC CODE	SOFTWARE VERSION		HARDWARE VERSION
V6	**SENSOR DATA**	APPLICATION	NOMINAL DIAMETER	CALIBR. FACTOR	EXPANSION COEFF.	TEMPERATURE ENTRY	SELECT GAIN RANGE
V7							
V8							
V9							
VA	**SETUP**	TAG NUMBER	SERIAL NUMBER				

The programming with Commuwin II is enabled by entering the access code (see page 35).

6 Functions

- Factory settings are shown in ***bold italics***.
- The symbol indicates local operation and
  the symbol indicates the HART handheld terminal.

Function group: ACTUAL MEASURED VALUES HART: Menu level "On-line"	
Flow rate Fu00 PV	Display of actual measured volumetric flow rate (volume/time). The engineering units used can be defined in the function "Unit" (see page 26). *Display:* four-digit number with floating decimal point, e.g. 150.2 (dm^3/s)
Vortex frequency Fu01 VF	Display of actual measured vortex frequency. Page 54 shows a summary of frequency ranges which depend on nominal diameter and application. *Display:* four-digit number with floating decimal point, e.g. 300.1 (Hz)
Totaliser Fu02 Tot	Display of total flow quantity from when measurement began. The effective amount is calculated from the sum of the value shown in function "Fu02" and the sum of the overruns "Fu03" (see below). In the HART handheld terminal the effective total is shown as "Tot.". Note! In cases of error and after loss of power supply the totaliser remains at the value last shown. *Display:* four-digit number with floating decimal point, e.g. 123.4 (dm^3)
Totaliser overflow Fu03	The totalised flow is shown as a max. 4-digit number with floating decimal point in the function "Fu02" (see above). 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". A max. of 9999 overruns is shown. The display then begins to flash. In this case it is recommended that larger engineering units are selected in "Fu11" (see page 26) so that the actual totaliser value can be read off in "Fu02" and "Fu03". *Example:* Display of 23 overruns: 23 (= 230'000 dm^3) The value shown in function "Fu02" 129.7 (dm^3) Total amount = 230'129.7 (dm^3) *Display:* max. four-digit number, e.g. 6453 (overruns)


Note!

Function group: SYSTEM UNITS HART: System Units	
Flow unit  Unit  Flow unit	Unit for volumetric flow (volume/time). These units also define the full scale value of the current output in the function "FS" (see page 31). This function must therefore be set **before** that of the full scale value. Note! If the unit is changed, attach an adhesive label showing the selected engeneering unit to the field provided on the local display. **Selection:** 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 = user defined units (s. function "Fu12", page 27) (1 dm^3 = 1 liter) Factory setting: ***as ordered;*** if not specified by the customer "0" is set.
Totaliser unit  Full  Tot. unit	Units for the totaliser also define the pulse value (m^3 → m^3/pulse). Note! If the unit is changed, attach an adhesive label showing the selected engineering unit to the field provided on the local display. **Selection:** 0 = dm^3, 1 = m^3, 2 = ACF, 3 = Igallons, 4 = gallons, 5 = USER = user defined units (s. function "Fu14", page 30) (1 dm^3 = 1 liter) Factory setting: ***corresponding*** to the flow unit.

Note!

Note!

Function group: SYSTEM UNITS
HART: System Units

User-defined unit flow rate

F u 12

Flow user unit

As well as the engineering units offered (selection “0...14” in function “Unit”), the flow rate can also be displayed or output in other, user-defined units (selection “15”).
For this purpose, a conversion factor can be entered in this function giving the exact ratio of how many of the desired units correspond to the internally used reference “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 hectolitre/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: “X,XXX” · $10^{“Y”}$
Shown on the display: e.g. 1.000-1 corresponds to $1.000 \cdot 10^{-1} = 0.1$
or 5.678 2 corresponds to $5.678 \cdot 10^2 = 567.8$

Caution!
Prowirl 77 always measures volumetric flow rate at actual operating conditions. The conversion method described here only applies to constant and exactly known process conditions.
Any deviation from the assumed process conditions can lead to significant errors. Generally the use of the E+H Compart DXF 351 flowcomputer with pressure and temperature sensors is recommended to continuously calculate the exact corrected volume or mass.

Caution!

Note!
- The factor can be calculated with the E+H sizing program “Applicator” (version 7.01.00 and higher). Choose Prowirl 77 as instrument and enter the operating conditions of your application. The flow rate should be entered in the desired units. In the window “Conversions” with Flow as Unit to Convert, the factor is shown above the table at the right side (format: “X.XXX E (±)YY”).
- Please observe the detailed instructions and examples on the following pages for calculating the mass and corrected volume flow.
- Attach an adhesive label showing the engineering units on the field provided on the local display (see page 19).
- The user-defined units must be entered **before** setting the full scale value (see function “FS”, see page 31).

Note!

Input:
four-digit number with floating decimal point with a single figure exponent:
1.000-9 (corresponds to $1 \cdot 10^{-9}$) ... 9.999 9 (corresponds to $9.999 \cdot 10^9$)

Function group: SYSTEM UNITS
HART: System Units

Instructions for user-defined mass units:

The following instructions explain in more detail pages 27 and 30 .

Density at operating conditions in kg/m³

for desired time base (not for totaliser)
.../s → 1
.../min. → 60
.../h → 3600
.../d → 86400

for desired mass unit
kg/... → 1
t/... → 1000
lbs/... → 0.4536

$$[\ldots] = \frac{[\ldots]}{1000} \times [\ldots] \times \frac{1}{[\ldots]}$$

ba032y01

Factor (Example)	Display
86.4	8.640 1
8.737	8.737
0.1234	1.234-1
0.012	1.200-2
0.00787	7.870-3

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/m³:

$$\text{Factor} = \frac{5.91}{1000} \cdot 3600 \cdot \frac{1}{1} = 21.276 \rightarrow \text{“Fu12”} = 2.128\ 1$$

To display the totaliser in “kg” for the same superheated steam application (density 5.91 kg/m³):

$$\text{Factor} = \frac{5.91}{1000} \cdot \frac{1}{1} = 0.005910 \rightarrow \text{“Fu14”} = 5.910\text{-}3$$

Function group: SYSTEM UNITS
HART: System Units

Instructions for user-defined corrected volume units:

The following instructions explain in more detail pages 27 and 30.

Fluid density at operating conditions | for desired time base (not applicable for totaliser) | for desired corrected volume unit

$$[\quad] = \frac{[\quad]}{[\quad]} \times [\quad] \times \frac{1}{[\quad]}$$

ba032y02

Fluid density at reference conditions (e.g. = 0 °C and 1.013 bar)

.../s	→ 1	Ndm^3/...	→ 1
.../min.	→ 60	Nm^3/...	→ 1000
.../h	→ 3600	SCF/...	→ 28.317
.../d	→ 86400	Imp.gallon/...	→ 4.546

Factor (Example)	Display
86.4	8.640 1
8.737	8.737
0.1234	1.234-1
0.012	1.200-2
0.00787	7.870-3

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:

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

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

$$\text{Factor} = \frac{3.14}{1.2936} \cdot \frac{1}{1000} = 0.002427 \quad \rightarrow \text{"Fu14"} = 2.427\text{-}3$$

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 (abs):

for desired time base (not applicable for totaliser) | process pressure in bar (abs)

$$[\quad] = \frac{[\quad] \times [\quad] \times 273.15}{[\quad] \times 1.013 \times ([\quad] + 273.15)}$$

ba032y03

see above table for conversion to mantissa and exponent | for desired corrected volume Ndm^3/... → 1, Nm^3/... → 1000 | process temperature °C

Function group: SYSTEM UNITS HART: System Units	
User-defined unit totaliser  Fu14  Tot. user unit	As well as the engineering units offered (selection “0...4” in function “Fu11”) for the totaliser, other user-defined units (selection “5”) can also be used. For this purpose, a conversion factor can be entered in this function giving the exact ratio of how many of the desired units correspond to the internally used reference unit “dm^3”. 1 dm^3 = factor · [1 user-defined unit] *Example:* 1 dm^3 is equivalent to • 1000 cm^3 → factor = 1000 • 1/100 hectolitre → factor = 0.01 • 0.7 kg with a fluid density of 700 kg/m^3 → factor = 0.7 Convert this factor into the format: “X.XXX” · $10^{\text{“Y”}}$ Shown on the display: e.g. 1.000-1 corresponds to $1.000 \cdot 10^{-1} = 0.1$ or 5.678 2 corresponds to $5.678 \cdot 10^{2} = 567.8$ Caution! Prowirl 77 always measures volumetric flow rate at actual operating conditions. The conversion method described here only applies to constant and exactly known process conditions. Any deviation from the assumed process conditions can lead to significant errors. Generally the use of the E+H Compart DXF 351 flowcomputer with pressure and temperature sensors is recommended to continuously calculate the exact corrected volume or mass. Note! • The factor can be calculated with the E+H sizing program “Applicator” (version 7.01.00 and higher). Proceed as described on page 27. The factor for the user-defined totaliser units is equal to the factor of the corresponding flow unit .../s. Example: If the user-defined totaliser units is kg, the factor corresponds to the factor for kg/s. • Please observe the detailed instructions and examples on the proceeding pages for calculating the mass and corrected volume flow. • Attach an adhesive label showing the engineering units on the field provided on the local display (see page 19). • The user-defined units must be entered **before** setting the pulse value (function “PSCA”, see page 33). **Input:** four-digit number with floating decimal point with a single figure exponent: 1.000-9 (corresponds to $1 \cdot 10^{-9}$) ... 9.999 9 (corresponds to $9.999 \cdot 10^{9}$)


Caution!

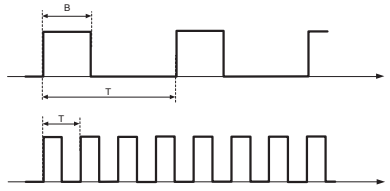

Note!

Function group: CURRENT OUTPUT HART: Analogue Output	
Output signal F u 2 0	Selecting the electrical output signal. The various types of signal are described more fully on page 15 “Electrical Connections”. **Selection:** ***4-20 [mA]*** 4…20 mA current output signal PULS scaleable Open Collector pulse output (not HART-compatible) PF PFM current pulses for direct, non-scaleable output of vortex frequency (not HART-compatible)
Value for 20 mA (Full scale value) F 5 PV URV	Scaling the full scale value assigns the 20 mA current to a defined flow rate. This value also defines 100% for the bargraph and for selection “Display flow rate in %” (see page 34). The engineering units for flow rate can be defined in function “Unit” (see page 26). Please first choose the desired measuring unit before entering the full scale value in this function. Note! Zero flow is always defined as the lower range value assigned to 4 mA. **Input:** four-digit number with floating decimal point, e.g. 126.7 (dm^3/min) Factory setting: ***as ordered;*** if not specified by the customer, factory setting is ***according to*** the table on page 52.
Time constant F u 2 2 PV Damping	The time constant determines the current output signal and the display responds quickly (small time constant) to rapidly fluctuating flow rates or delayed (long time constant). 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 the response time is increased automatically. **Input:** three-digit number with fixed decimal point: 0.2...100.0 (seconds) Factory setting: ***5.0*** (seconds)
Fail-safe mode F u 2 3 AO Alarm type	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 “4-20” is selected in the function “Fu20"(see above). **Selection:** ***HI*** The current signal is set to 22 mA on error Lo The current signal is set to 3.6 mA on error run Normal measured value given despite error

Note!

Function group: CURRENT OUTPUT HART: Analogue Output	
Simulation (current output)  F u 2 4  Loop test	This function enables an output current to simulate 0%, 50% or 100% of the current range. It also enables the error status 3.6 mA and 22 mA to be simulated. *Example:* Checking the wiring or connected instruments is only possible if the appropriate setting is selected in the function “Fu20” (see page 31). Note! • The simulation mode affects only the current output, i.e. totaliser and flow display are operating normally. • During simulation the function “StAt” shows the warning message “E205” (see page 36). **Selection:** ***OFF*** (current output follows actual measured value) - 3.6 [mA] – 4 [mA] – 12 [mA] – 20 [mA] – 22 [mA]
Nominal current  F u 2 5  A01 (under menu level “Online”)	Display of output current which is calculated using the actual flow rate. This function is only available if the setting “4...20” is selected in function “Fu20” (see page 31). *Display:* 4.0...20.5 [mA] (or 3.6 or 22.0 mA on error; see function “Fu23”, page 31)


Note!

Function group: OPEN COLLECTOR OUTPUT	
Pulse value P S C A	The pulse value indicates the amount of flow corresponding to one pulse. This function is available only if the setting “PULS” is selected in function “Fu20” (see page 31). The engineering units for pulse value can be selected in function “Fu11” (see page 26). Select the pulse value so that the pulse frequency for maximum flow does not exceed 100 Hz. **Selection:** four-digit number with floating decimal point, e.g. 1.000 m^3/pulse Factory setting: ***dependent*** on nominal diameter and type of fluid (gas, liquid), see table on page 54
Pulse width F u 3 1	The pulse width can be set in the range 0.05...2.00 s. This function is only available if the setting “PULS” is selected in function “Fu20” (see page 31). **Selection:** three-digit number with fixed decimal point: 0.05...2.00 [s] Factory setting: ***0.5 [s]*** Note! • Non-Ex, Ex i and Ex d version (switch position “passive”): 0V = no pulse • Ex d version (switch position “active”): 0V = pulse value (inverted pulse signal) If the frequency resulting from the selected pulse value at actual flow is too large (selected pulse width B ≥ T2), then the pulse width is automatically reduced to half the periodicity (50/50 duty cycle). B < T/2 B ≥ T/2  ba032y04 B = pulse width
Simulation (pulse output) F u 3 2	With this function predefined frequency signals can be simulated, for example, to check any instruments connected. This function is only available if the setting “PULS” is selected in function “Fu20” (see page 31). Note! The simulation affects only the simulated three-wire pulse output, i.e. totaliser and flow display are operating normally. During simulation the function “Stat” shows the warning message “E206”. **Selection:** ***OFF*** – 1 [Hz] – 50 [Hz] – 100 [Hz]
Nominal frequency F u 3 3	Display of output frequency which is calculated using the actual flow rate. This function is only available if the setting “PULS ” is selected in function “Fu20” (see page 31). *Display:* four-digit number with floating decimal point: 0.000...100.0 [Hz]

Note!

Note!

Function group: DISPLAY HART: Display	
Display mode dISP Display mode	Selecting the variable to be displayed during normal operation (“HOME position” = standard display). If you change the factory setting, please attach an adhesive label showing the engineering unit to the field provided on the local display. **Selection:** PErc = Display flow rate in % ***rAtE*** = Display flow rate (volume/time, see page 25) Ltot = Display totaliser (see page 25) Htot = Display totaliser overflow (see page 25) Note! • For setting “PErc“, the value shown on the display refers to the full scale value set in function “FS” (see page 31) • Display damping is set with function “Fu22” (see page 31)
Reset totaliser FuY1 Reset Totalizer	This function sets the totaliser (incl. overruns) to “zero” (reset). **Selection:** ***ESC*** = Totaliser will not be reset rESE = Totaliser is reset to zero

Note!

Function group: SYSTEM PARAMETERS HART: System Parameters	
Customer code  Fu50  Customer code	Selecting a personal code number by which programming can be enabled. The following points should be noted: • 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 customer code "0". All functions are accessible when operating with the HART handheld terminal. This is independent of the customer code used. If the customer code is altered using the handheld terminal, then the new code applies to local operation afterwards. Data transmission from the handheld terminal to the Prowirl 77 can be locked using the function "Code-entry" shown below. This function cannot be seen on the handheld terminal when data transmission is locked. **Input:** max. four-digit number: 0...9999 Factory setting: ***77***
Access code  CodE  Code entry	All data of the Prowirl 77 measuring system are protected against unauthorised changes. Only by entering a code number is programming enabled and the settings of the instrument can then be changed. If in any function the keys "+/-" 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 77 (factory set) or personal code number (see above, function "Fu50") Lock programming: After jumping to the HOME position, programming is locked again after 60 seconds if no key is pressed during this time. Programming can also be locked by entering any number (not the code number) in this function. Note! If you can no longer find your personal code number, then the Endress+Hauser Service Organisation will be pleased to help you. Data transmission from the HART handheld terminal to the Prowirl 77 is locked by entering "-1" in the function "Code entry" in the handheld terminal. Data transmission can then only be enabled by entering the access code already stored in the Prowirl 77. The function "Customer-Code" cannot, therefore, be seen on the handheld terminal when data transmission is locked. **Input:** max. four-figure number: 0...9999 Factory setting: ***0***


Note!


Note!

Function group: SYSTEM PARAMETERS HART: System Parameters	
Meter status 5tAt Status	The appropriate error message is shown in this function if the Prowirl 77 measuring system recognises an error. This function is only available if an error has occurred. Errors which occur during operation are shown by a flashing display. A list of all system errors and alarm messages is given on page 39. Note! • When more than one error is present, the one with the highest priority is displayed. • When operating in the programming mode, no system or warning messages will be shown (except when in functions “Fu00”, “Fu01”, “Fu02”, “Fu03”, “Fu25” and “Fu33”, i.e. all functions displaying measured values). • Once the error has been corrected, the normal measured value will again be shown on the display. **Display and remedial action** See Section “Trouble-shooting” on page 39
Software-version Fu53 Software Version	Display of current software version. The numbers have the following meaning: 1 . 1 . 02 Number changes if minor alterations have been 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 been made to the software.
Hardware-version Fu55 Hardware Version	Display of current hardware version. The numbers have the following meaning: 1 . 1 . 02 Number changes if minor alterations have been made to the new hardware. This also applies to special versions of the hardware. Number changes if the new hardware contains additional functions. Number changes if basic alterations have beebmade to the hardware.

Function group: MEASURING SYSTEM DATA HART: Sensor Data	
Fluid APPL Fluid	Selects whether a fluid or a gas (or steam) is to be measured. The nominal diameter and the setting selected here define the filter setting of the preamplifier. Note! Changing settings in this function also requires a change in the full scale value (function "FS", see page 31). **Selection:** LI = flow measurement for liquids GAS = flow measurement for gas/steam Factory setting: ***according to order;*** if not specified by the customer, ***"LI"*** is set.
Nominal diameter dn DN	Selecting the nominal diameter of the flowmeter. Caution! Any alteration to the nominal diameter affects the entire measuring system and is only required when replacing the flowmeter electronics. It is then necessary to enter a new K-factor in function "CALF" (see below). **Selection:** 15 – 25 – 40 – 50 – 80 – 100 – 150 – 200 – 250 – 300 Factory setting: ***dependent*** on the flowmeter
K-factor sensor CALF K-factor	The K-factor describes how many vortices per unit volume (1 dm^3) occur in the sensor. This value is determined in the factory by calibration and then printed on the meter body. Caution! The K-factor should not be altered under normal circumstances. In order to provide an exact value of K-factors below 1.000 they are shown on the display in logarithmic form: "X.XXX -Y" Example: 0.9871 is shown as "9.871 -1" 0.03620 is shown as "3.620 -2" **Input:** four-digit number with floating decimal point Min. adjustable value: 1.000 -2 (pulse/dm^3) corresponds to 0.010 (pulse/dm^3) Max. adjustable value: 999.9 (pulse/dm^3) Factory setting: ***dependent*** on the flowmeter

Note!

Caution!

Caution!

Function group: MEASURING SYSTEM DATA HART: Sensor Data	
Sensor temperature coefficient Fu63 Body expan. coeff.	The temperature coefficient describes the effects of process temperature on the calibration of the instrument. This coefficient is a function of the meter body and is correctly adjusted in the factory. It must only be altered if a meter body made of another material is mounted at a later date. A setting in this function affects the internal totaliser and the 4...20 mA current output or the scaleable pulse output. It has no effect on the PFM output signal (function "Fu20", see page 31). Any setting in this function affects measurement only if the value of the process temperature "Fu64" is set to a different value than the factory setting 293 K. **Input:** four-digit fixed decimal point: 1.000...9.999 ($\cdot 10^{-5}$ / Kelvin) Factory setting: ***4.88*** ($\cdot 10^{-5}$ / Kelvin) for stainless steel A351-CF3M (1.4404)
Process temperature Fu64 Ave. process temp	The flowmeter (measuring pipe and bluff body) expands according to the process temperature and affects the calibration of the instrument. This effect is proportional to the difference from the calibration temperature 293 K (20°C). By entering the average process temperature, the internal totaliser and the 4...20 mA current output or scaleable pulse output are thus corrected. The PFM output signal, however, cannot be corrected internally. The output signal is selected in function "Fu20" (see page 31). The various output signals are described in section "Electrical Connections" (see page 15). Only an external correction can be made with changing operating temperature or if the PFM output signal is set in the function "Fu20", e.g. in the Compart DXF 351 flowcomputer. In this case the factory set value 293 K (20°C) will be used and the temperature coefficient of the sensor (4.88 · 10^{-5}/Kelvin for A351-CF3M (1.4404) meter body) will be set in the flowcomputer (see function "Fu63"). **Input:** Number with fixed decimal point 0...999 K (Kelvin); this corresponds to -273...726 °C Factory setting: ***293 K*** ; this corresponds to 20 °C Caution: The approved operating temperature of the measuring system is not affected by this setting. Note therefore the application limits given in Section 9 "Technical Data" (see page 49).
Amplification Fu65 Ampl. Gain	All Prowirl 77 flowmeters are set for optimum operation at 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 liquid with low density and weak interference effects → choose a higher amplification level • For fast flowing fluid with high density and strong interference effects (plant vibration) or pressure pulses → choose a lower amplification level An incorrectly set amplifier can have the following consequences: • The measuring range is limited so that small flow rates are no longer detected or indicated → increase amplification. • Unwanted interference effects are detected so that flow is still indicated even under no-flow conditions → reduce amplification. **Selection:** 1 = very low 2 = low ***nor*** = normal 3 = high

Caution!

7 Trouble-shooting

The Prowirl 77 measuring system operates without the need for maintenance. However, if a fault should occur or incorrect measurements are suspected, then the following instructions will be of help in identifying the cause of and remedying any possible errors.

Warning!
- All local regulations and all safety instructions in this operating manual are to be strictly observed when making electrical connections.
- All data and regulations on Ex instruments in the separate Ex documentation are to be strictly observed.

Errors and faults identified by the continuous self-monitoring system can be called up using the HART interface or display.
The Prowirl 77 measuring system distinguishes between two kinds of errors:

System error
This error directly affects flow measurement → remedy the error immediately.
- The operating status LED does not light up.
- Response of the current output → see Function “Fu23”, (see page 31).
- The scaleable pulse output is not alive and no pulses are present.
- The totaliser remains at the last registered value.
- An error code is displayed in the HOME position and in the function “Stat” of the local display.
- An error code is displayed in the function “Status: err/warn” of the HART operating matrix.

System errors		
Code	Cause	Remedy
E101	Defective sensor	Check and, if necessary, replace the sensor through E+H Service
E102	EEPROM error (checksum error)	Contact E+H Service
E 103	Communication error with sensor	Power up the measuring system or contact E+H Service
E106	Download active i.e. configuration data are being digitally transmitted to the Prowirl 77 system	The sensor will operate normally again once download is finished
E116	An error has occurred during the download of configuration data	Reload the configuration data

Warnings
These errors do not affect flow measurement directly → The measurement system continues to measure, however the electrical output signal may be incorrect.
- The operating status LED remains lit.
- The actual measured value flashes in the HOME position of the local display.
- An error code is displayed in the function “Stat” of the local display or in the function “Status: err/warn” of the Hart operating matrix.

Warnings		
Code	Cause	Remedy
E203	The measuring range of the current output is exceeded	Check the application (flow rate too high?) or readjust the full scale value (“FS” see page 31)
E204	The measuring range of the pulse output is exceeded	Check the application (flow rate too high?) or readjust the pulse value (“PSCA” see page 33)
E205	Current output in simulation mode	See function “Fu24” page 32
E206	Pulse output in simulation mode	See function “Fu32” page 33
E211	Correct value of totaliser is not guaranteed (check sum error)	Interrupt power supply briefly. In case of repeated warning → reset totaliser (see “Fu41” on page 34)


Note!

Note!
When more than one error is present, the one with the highest priority is displayed first. When operating in the programming mode, no system or warning messages will be shown on the local display except when in the functions “Fu00”, “Fu01”, “Fu02”, “Fu03”, “Fu25” and “Fu33” (i.e. all functions displaying measured values).
Once the error has been corrected, the normal measured value will again be shown on the local display.

The Prowirl 77 measuring system is fitted with an LED to indicate its operating status. This can be seen through the glass cover of those instruments which have a local display.
The LED can only be seen on those instruments without a local display once the aluminium cover to the electronics and wiring compartments has been removed.

LED does not light up
- Has the wiring been done according to the wiring diagrams on pages 15 ff?
- Is the polarity of the power supply correct?
- Is there a voltage between 12 V and 30 V (Ex d/XP: between 15 V and 36 V) at Terminals 1 and 2 of the Prowirl 77? (Check the load on the cabling and any connected devices)
- The self-monitoring system has detected a system error (see page 39).

Local display flashes
- If the normal measured value flashes, then a warning is indicated (see page 39).
- If the figures “9999” flashes on the local display, then the current measured value can no longer be shown in the units selected. In such cases a larger scale of units must be selected in the function “Unit” (or “Fu11” for the totaliser).

No flow signal
- For liquids: Is the pipeline completely filled? The pipeline must always be completely filled to ensure accurate and reliable flow measurement.
- Has all packing material and protective disks been removed from the meter body?
- Is the electrical output signal (“Fu20”) set correctly?

Flow signal under no-flow conditions
Is the flowmeter subject to vibrations greater than 1g?
In such cases flow may be indicated under no-flow conditions due to the frequency and direction of oscillations (see “Technical Data”, page 49).

Remedial procedure on flowmeter:
– Turn the sensor through 90°. The measuring system is most responsive to vibration in the direction of sensor displacement. The vibration has less effect on the measuring system in other axes.
– The amplification can be reduced using the function “Fu65” (see page 38).

Remedial procedure with mechanical layout of the installation:
– If the source of the vibration (e.g. pump or valve) can be identified, then decoupling or supporting the source can reduce vibration.
– Supporting the pipeline near the flowmeter.

Poor or strongly varying flow signal

- Is the fluid to be measured single-phase and homogeneous?
  The fluid must be single-phase and homogeneous, and the pipeline always completely filled to ensure accurate and reliable flow measurement. In many cases the measuring result may be improved under poor conditions by taking the following measures:
  – For liquids with low gas content in horizontal pipelines, the flowmeter should be mounted with the head pointing downward or to one side. This improves the measuring signal as the sensor is positioned away from any gas bubbles.
  – For liquids with low solids content, the electronic housing should not be mounted pointing downward.
  – For steam or gas with low liquid content, the electronic housing should not be mounted pointing downward.
- Do the inlet and outlet sections correspond to the mounting instructions on page 10?
- Are gaskets of the correct internal diameter (not smaller than the pipeline) and correctly centred?
- Is the static pressure sufficiently large to prevent cavitation at the flowmeter?
- Is the flow within the measuring range of the flowmeter (see “Technical Data” page 49)?
  The start of the measuring range depends on the density and viscosity of the fluid which in turn are functions of temperature. With gases and steam, density is also a function of pressure.
- Are pressure pulsations superimposed on the operating pressure (e.g. due to piston pumps)? These pulsations may affect vortex shedding if they have a similar frequency to that of the vortex shedding itself.
- Have the correct units been selected for flow (“Unit”) or totaliser (“Fu11”)?
- Have the current output (“FS”) or pulse value (“PSCA”) been set correctly?
- Have the fluid (“APPL”) and nominal diameter (“dn”) been set correctly? “APPL” must be set to “LI” for liquids, and set to “GAS” for gases and steam. The nominal diameter of the flowmeter must agree with the setting “dn”. The settings in these two functions determine the filter settings and can thus affect the measuring range.
- Does the K-factor of the instrument agree with the setting in the function “CALF”?

Maintenance / Calibration

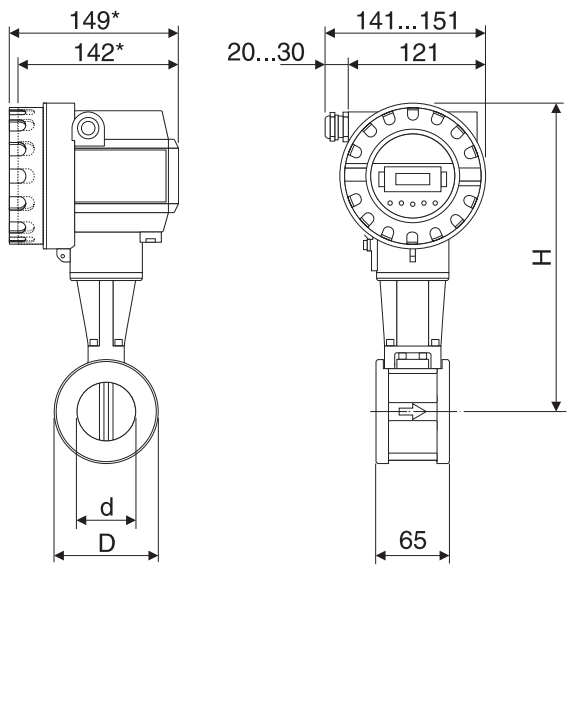
If correctly installed, the meter will operate without maintenance. If installed as a production quality-relevant (ISO 9000) measurement point, the Prowirl 77 can be recalibrated by Endress+Hauser on accredited calibration rigs, traceable according to EN 45001, and supplied with an internationally recognized certificate according to EA (European cooperation for Accreditation of Laboratories).

8 Dimensions and Weights

Note!
The explosion proof instrument has a different housing with separate wiring compartment cover. Please refer to the separate Ex documentation.

Note!

8.1 Dimensions Prowirl 77 W



Dimensions:
*149 mm with glass cover
*142 mm blind version

Wafer version for flanges according to:

- DIN 2501, PN 10...40
- ANSI B16.5, Cl. 150/300, Sch40
- JIS B2238, 10K/20K, Sch40

Mounting kits for self centering mounting between flanges can be ordered with the instrument (see page 13).

Fig. 24
Dimensions of Prowirl 77 W

For the high/low temperature option, H increases by 40 mm and the weight by approx. 0.5 kg.

DN		d	D	H	Weight
DIN / JIS	ANSI	[mm]	[mm]	[mm]	[kg]
15	½"	16.50	45.0	247	3.0
25	1"	27.60	64.0	257	3.2
40	1½"	42.00	82.0	265	3.8
50	2"	53.50	92.0	272	4.1
80	3"	80.25	127.0	286	5.5
100	4"	104.75	157.2	299	6.5
150	6"	156.75	215.9	325	9.0

8.2 Dimensions Prowirl 77 F

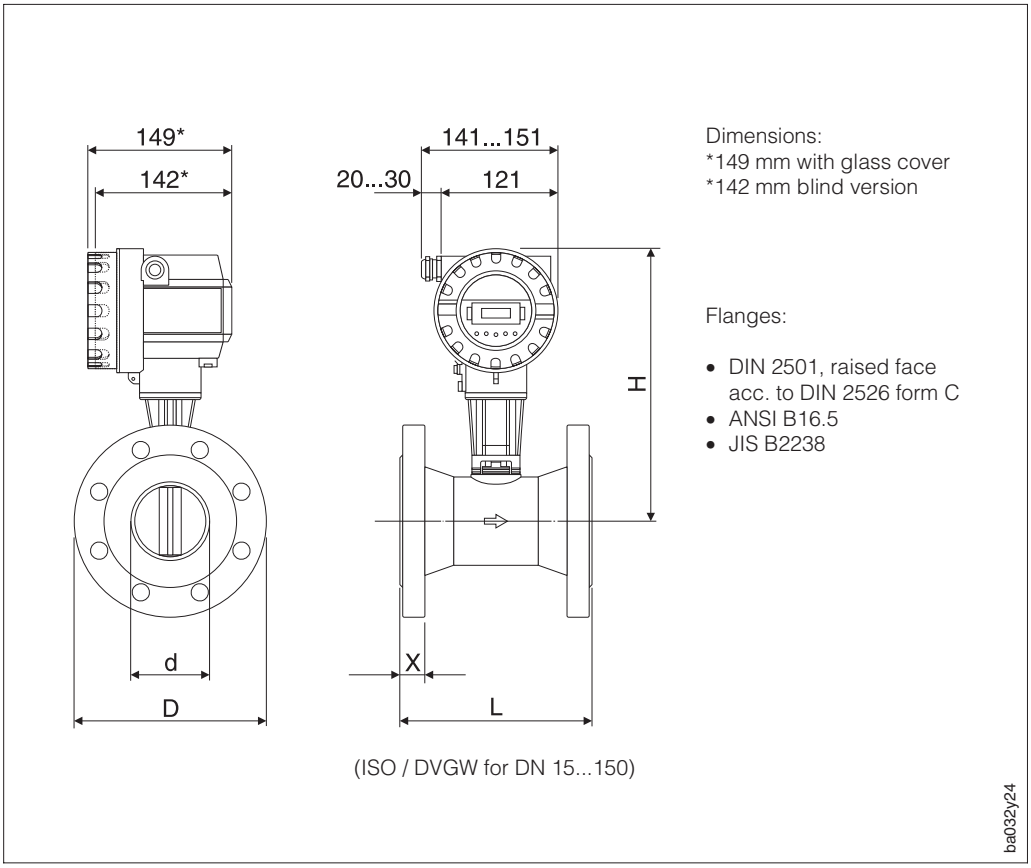


Fig. 25
Dimensions of Prowirl 77 F

For the high/low temperature option, H increases by 40 mm and the weight by approx. 0.5 kg.

DN	Standard	Pressure rating	d [mm]	D [mm]	H [mm]	L [mm]	X [mm]	Weight [kg]
15 / ½"	DIN	PN 40	17.3	95.0	248	200	17	5.0
	ANSI SCHED 40	Cl. 150	15.7	88.9				
		Cl. 300	15.7	95.0				
	ANSI SCHED 80	Cl. 150	13.9	88.9				
		Cl. 300	13.9	95.0				
	JIS SCHED 40	Cl. 20K	16.1	95.0				
	JIS SCHED 80	Cl. 20K	13.9	95.0				
25 / 1"	DIN	PN 40	28.5	115.0	255	200	19	7.0
	ANSI SCHED 40	Cl. 150	26.7	107.9				
		Cl. 300	26.7	123.8				
	ANSI SCHED 80	Cl. 150	24.3	107.9				
		Cl. 300	24.3	123.8				
	JIS SCHED 40	Cl. 20K	27.2	125.0				
	JIS SCHED 80	Cl. 20K	24.3	125.0				
40 / 1½"	DIN	PN 40	43.1	150	263	200	21	10
	ANSI SCHED 40	Cl. 150	40.9	127				
		Cl. 300	40.9	155.6				
	ANSI SCHED 80	Cl. 150	38.1	127				
		Cl. 300	38.1	155.6				
	JIS SCHED 40	Cl. 20K	41.2	140				
	JIS SCHED 80	Cl. 20K	38.1	140				

Continued next page

DN	Standard	Pressure rating	d [mm]	D [mm]	H [mm]	L [mm]	X [mm]	Weight [kg]
50 / 2"	DIN	PN 40	54.5	165	270	200	24	12
	ANSI SCHED 40	Cl. 150	52.6	152.4				
		Cl. 300	52.6	165				
	ANSI SCHED 80	Cl. 150	49.2	152.4				
		Cl. 300	49.2	165				
	JIS SCHED 40	Cl. 10K	52.7	155				
		Cl. 20K	52.7	155				
	JIS SCHED 80	Cl. 10K	49.2	155				
		Cl. 20K	49.2	155				
80 / 3"	DIN	PN 40	82.5	200	283	200	30	20
	ANSI SCHED 40	Cl. 150	78	190.5				
		Cl. 300	78	210				
	ANSI SCHED 80	Cl. 150	73.7	190.5				
		Cl. 300	73.7	210				
	JIS SCHED 40	Cl. 10K	78.1	185				
		Cl. 20K	78.1	200				
	JIS SCHED 80	Cl. 10K	73.7	185				
		Cl. 20K	73.7	200				
100 / 4"	DIN	PN 16	107.1	220	295	250	33	27
		PN 40	107.1	235				
	ANSI SCHED 40	Cl. 150	102.4	228.6				
		Cl. 300	102.4	254				
	ANSI SCHED 80	Cl. 150	97	228.6				
		Cl. 300	97	254				
	JIS SCHED 40	Cl. 10K	102.3	210				
		Cl. 20K	102.3	225				
	JIS SCHED 80	Cl. 10K	97	210				
		Cl. 20K	97	225				
150 / 6"	DIN	PN 16	159.3	285	319	300	38	51
		PN 40	159.3	300				
	ANSI SCHED 40	Cl. 150	154.2	279.4				
		Cl. 300	154.2	317.5				
	ANSI SCHED 80	Cl. 150	146.3	279.4				
		Cl. 300	146.3	317.5				
	JIS SCHED 40	Cl. 10K	151	280				
		Cl. 20K	151	305				
	JIS SCHED 80	Cl. 10K	146.3	280				
		Cl. 20K	146.3	305				
200 / 8"	DIN	PN 10	207.3	340	348	300	43	63
		PN 16						62
		PN 25	206.5	360				68
		PN 40		375				72
	ANSI SCHED 40	Cl. 150	202.7	342.9				64
		Cl. 300		381				76
	JIS SCHED 40	Cl. 10K		330				58
		Cl. 20K		350				64
250 / 10"	DIN	PN 10	260.4	395	375	380	49	88
		PN 16		405				92
		PN 25	258.8	425				100
		PN 40		450				111
	ANSI SCHED 40	Cl. 150	254.5	406.4				92
		Cl. 300		444.5				109
	JIS SCHED 40	Cl. 10K		400				90
		Cl. 20K		430				104
300 / 12"	DIN	PN 10	309.7	445	398	450	53	121
		PN 16		460				129
		PN 25	307.9	485				140
		PN 40		515				158
	ANSI SCHED 40	Cl. 150	304.8	482.6				143
		Cl. 300		520.7				162
	JIS SCHED 40	Cl. 10K		445				119
		Cl. 20K		480				139

8.3 Dimensions of Prowirl 77 H

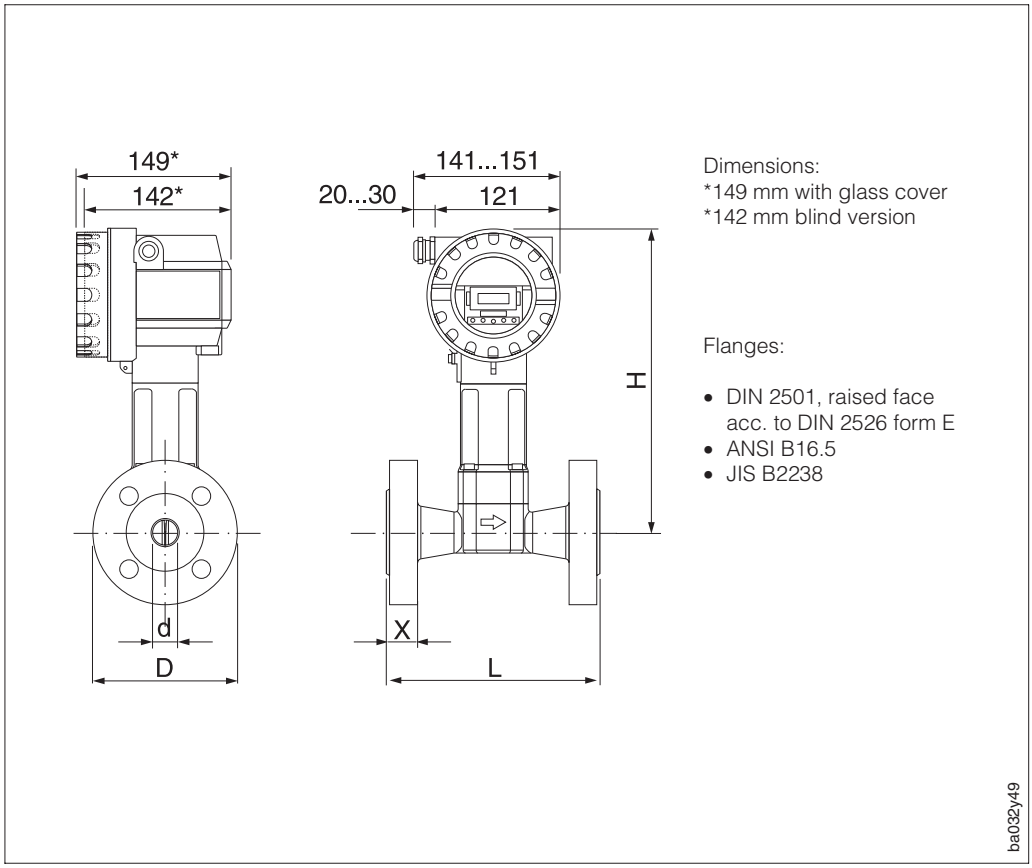


Fig. 26
Dimensions of Prowirl 77 H

DN	Standard	Pressure rating	d [mm]	D [mm]	H [mm]	L [mm]	X [mm]	Weight [kg]
15 / ½"	DIN	PN 160	17.3	105	288	200	22.4	7
	ANSI SCHED 80	Cl. 600	13.9	95,3				6
	JIS SCHED 80	Cl. 40K	13.9	115				8
25 / 1"	DIN	PN 100	28.5	140	295	200	26.4	11
		PN 160	27.9	140				11
	ANSI SCHED 80	Cl. 600	24.3	124				9
	JIS SCHED 80	Cl. 40K	24.3	130				10
40 / 1½"	DIN	PN 100	42.5	170	303	200	30.9	15
		PN 160	41.1	170				15
	ANSI SCHED 80	Cl. 600	38.1	155.4				13
	JIS SCHED 80	Cl. 40K	38.1	160				14
50 / 2"	DIN	PN 64	54.5	180	310	200	32.4	17
		PN 100	53.9	195				19
		PN 160	52.3	195				19
	ANSI SCHED 80	Cl. 600	49.2	165.1				14
	JIS SCHED 80	Cl. 40K	49.2	165				15
80 / 3"	DIN	PN 64	81.7	215	323	200	38.2	24
		PN 100	80.9	230				27
		PN 160	76.3	230				27
	ANSI SCHED 80	Cl. 600	73.7	209.6				22
	JIS SCHED 80	Cl. 40K	73.7	210				24
100 / 4"	DIN	PN 64	106.3	250	335	250	48.9	39
		PN 100	104.3	265				42
		PN 160	98.3	265				42
	ANSI SCHED 80	Cl. 600	97	273.1				43
	JIS SCHED 80	Cl. 40K	97	240				36
150 / 6"	DIN	PN 64	157.1	345	359	300	63.4	86
		PN 100	154.1	355				88
		PN 160	146.3	355				88
	ANSI SCHED 80	Cl. 600	146.3	355.6				87
	JIS SCHED 80	Cl.40K	146.6	325				77

8.4 Dimensions Flow Conditioner (DIN)

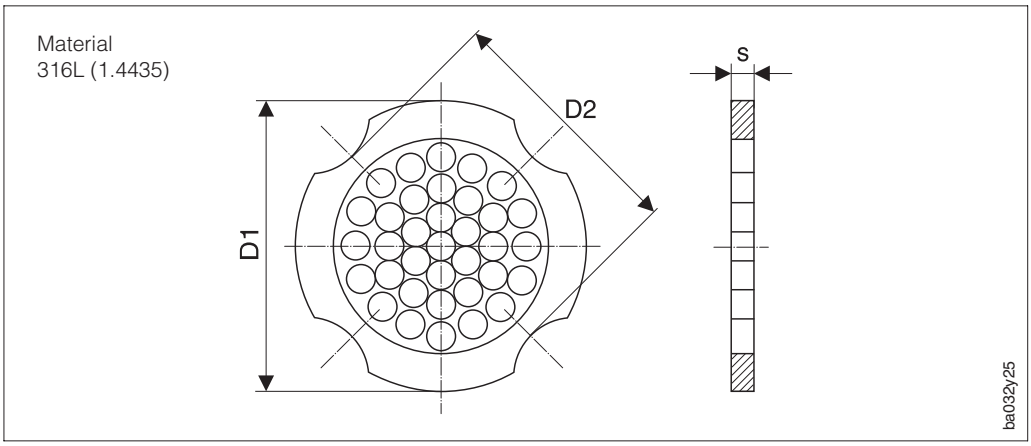


Fig. 27
Flow conditioner

Explanation of entries in column D1 / D2:

D1: The flow conditioner is clamped between bolts at its outer diameter.
D2: The flow conditioner is clamped between bolts at the indentures.

DIN					
DN	**Pressure rating**	**Centering diameter** [mm]	**D1 / D2**	**s**	**Weight** [kg]
15	PN 10...40 PN 64	54.3 64.3	D2 D1	2.0	0.04 0.05
25	PN 10...40 PN 64	74.3 85.3	D1 D1	3.5	0.12 0.15
40	PN 10...40 PN 64	95.3 106.3	D1 D1	5.3	0.3 0.4
50	PN 10...40 PN 64	110.0 116.3	D2 D1	6.8	0.5 0.6
80	PN 10...40 PN 64	145.3 151.3	D2 D1	10.1	1.4 1.4
100	PN 10/16 PN 25/40 PN 64	165.3 171.3 252.0	D2 D1 D1	13.3	2.4 2.4 2.4
150	PN 10/16 PN 25/40 PN 64	221.0 227.0 252.0	D2 D2 D1	20.0	6.3 7.8 7.8
200	PN 10 PN 16 PN 25 PN 40 PN 64	274.0 274.0 280.0 294.0 309.0	D1 D2 D1 D2 D1	26.3	11.5 12.3 12.3 15.9 15.9
250	PN 10/16 PN 25 PN 40 PN 64	330.0 340.0 355.0 363.0	D2 D1 D2 D1	33.0	25.7 25.7 27.5 27.5
300	PN 10/16 PN 25 PN 40/64	380.0 404.0 420.0	D2 D1 D1	39.6	36.4 36.4 44.7

8.5 Dimensions Flow Conditioner (ANSI)

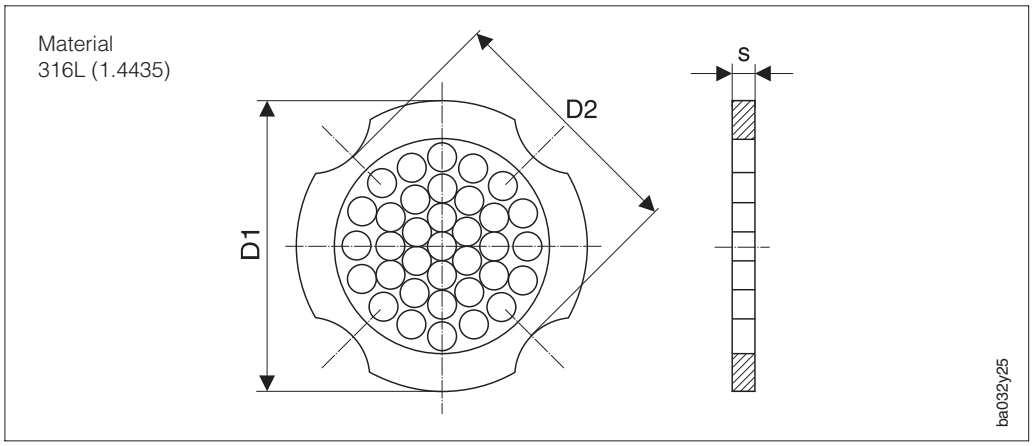


Fig. 28
Flow conditioner

Explanation of entries in column D1 / D2:

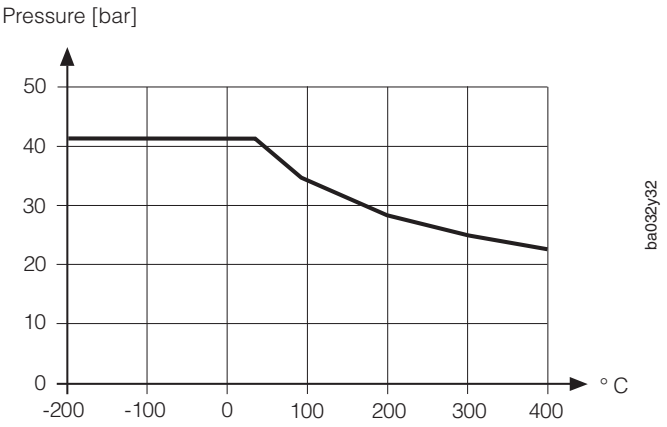
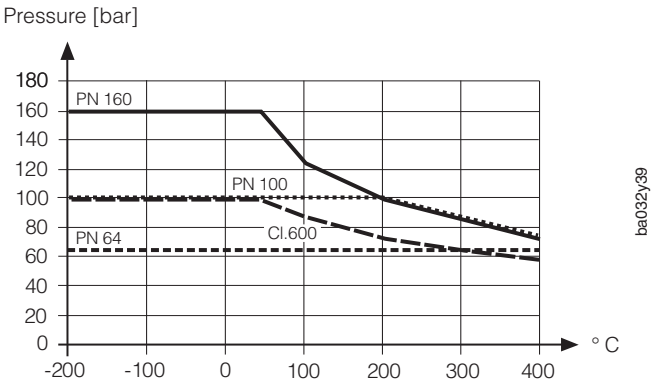
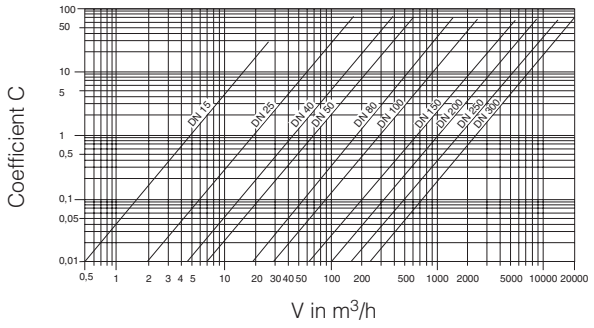
D1: The flow conditioner is clamped between bolts at its outer diameter.
D2: The flow conditioner is clamped between bolts at the indentures.

ANSI					
DN	**Pressure rating**	**Centering diameter** [mm]	**D1 / D2**	**s**	**Weight** [kg]
½"	Cl. 150 Cl. 300	51.1 56.5	D1 D1	2.0	0.03 0.04
1"	Cl. 150 Cl. 300	69.2 74.3	D2 D1	3.5	0.12 0.12
1½"	Cl. 150 Cl. 300	88.2 97.7	D2 D2	5.3	0.3 0.3
2"	Cl. 150 Cl. 300	106.6 113.0	D2 D1	6.8	0.5 0.5
3"	Cl. 150 Cl. 300	138.4 151.3	D1 D1	10.1	1.2 1.4
4"	Cl. 150 Cl. 300	176.5 182.6	D2 D1	13.3	2.7 2.7
6"	Cl. 150 Cl. 300	223.9 252.0	D1 D1	20.0	6.3 7.8
8"	Cl. 150 Cl. 300	274.0 309.0	D2 D1	26.3	12.3 15.8
10"	Cl. 150 Cl. 300	340.0 363.0	D1 D1	33.0	25.7 27.5
12"	Cl. 150 Cl. 300	404.0 420.0	D1 D1	39.6	36.4 44.6

9 Technical Data

Applications	
Designation	Flow measuring system “Prowirl 77”
Function	Measurement of volumetric flow rate of saturated steam, superheated steam. gases and liquids. With constant process temperature and pressure, the Prowirl 77 can also output flow rates in units of mass, energy and corrected volumes.
Operation and system design	
Measurement principle	The Prowirl 77 vortex flowmeter operates on the physical principle of Karman vortex shedding.
Measurement system	The “Prowirl 77” instrument family consists of: • Transmitter: Prowirl 77 “PFM” Prowirl 77 “4...20 mA/HART” Prowirl 77 “PROFIBUS-PA” • Meter body: Prowirl 77 W wafer version, DN 15...150 Prowirl 77 F flanged version, DN 15...300, bigger nominal diameters on request Prowirl 77 H high pressure version, DN 15...150
Input variables	
Measured variables	The average flow velocity and volumetric flow rate are proportional to the frequency of vortex shedding behind the bluff body.
Measuring ranges	The measuring range is dependent on the fluid and the pipe diameter (see page 54). • Full scale value: – Liquids: v_{max} = 9 m/s – Gas / steam: v_{max} = 75 m/s (DN 15 v_{max} = 46 m/s) • Lower range value: – depends on the fluid density and the Reynolds number, Re_{min} = 4000, Re_{linear} = 20000 (see page 54) DN 15 / 25: $v_{min} = \frac{6}{\sqrt{\rho}}$ m/s with ρ in $\frac{kg}{m^3}$ DN 40...300: $v_{min} = \frac{7}{\sqrt{\rho}}$ m/s with ρ in $\frac{kg}{m^3}$
Output variables	
Output signal	• 4...20 mA (optional with HART); full scale value and time constant are adjustable • PFM; two-wire current pulse output unscaled vortex frequency 0.5...2850 Hz, pulse width 0.18 ms • Scaleable pulse output (pulse width 0.05...2850 Hz, f_{max} = 100 Hz) Open collector (passive) or voltage pulses (active) choosable: passive: U_{max} = 30 V, I_{max} = 10 mA, R_i = 500 Ω (Ex d: U_{max} = 36 V, I_{max} = 10 mA, R_i = 200 Ω) active: U_{out} = 10...28 V, I_{max} = 10 mA (Ex d: U_{max} = 11...35 V, Pull-up resistance 38 kΩ)

Output variables (continued)	
Signal on alarm	The following applies for the duration of a fault: • LED: does not light up • Current output: programmable (3.6 mA, 22 mA or supplies values despite error) see page 31 • Open collector / pulse output: not live and no longer supplies pulses. • Totaliser: remains at the last value calculated
Load	See graph on page 17
Galvanic isolation	The electrical connections are galvanically isolated from the sensor.
Measuring accuracy	
Reference conditions	Error limits based on ISO/DIN 11631: • 20...30 °C, 2...4 bar • Calibration rig traceable to national standards
Measured error	Liquids: < 0.75% o.r. for Re >20000 < 0.75% o.f.s. for Re 4000...20000 Gas / steam: < 1% o.r. for Re >20000 < 1% o.f.s. for Re 4000...20000 Current output: temperature coefficient < 0.03% o.f.s./Kelvin
Repeatability	≤ ±0.25% o.r.
Operating conditions	
Installation instruction	Any position (vertical, horizontal) For limitations and other recommendations see page 11
Inlet / outlet sections	Inlet section: minimum 10 x DN Outlet section: minimum 5 x DN (For detailed information on the relationship between pipe installation and pipe internals see page 11)
Ambient temperature	–40...+60 °C When mounted outside, it is recommended that it is protected from direct sunlight by a sun shade, especially in warm climates with high process temperatures.
Ingress protection	IP 67 (NEMA 4X)
Shock and vibration resistance	At least 1 g in every axis over the whole frequency range up to 500 Hz
Electromagnetic compatibility (EMC)	To EN 50081 Part 1 and 2 / EN 50082 Part 1 and 2 and NAMUR industrial standard
Process conditions	
Process temperature	• Fluid: Standard sensor –40...+260 °C High/low temperature sensor –200...+400 °C Wafer type instruments of sizes DN 100 (4") and DN 150 (6") may not be mounted in orientation according to position B (see page 11) for fluid temperatures above 200 °C. • Seal: Graphite –200...+400 °C Viton – 15...+175 °C Kalrez – 20...+220 °C Gylon (PTFE) –200...+260 °C

Process conditions (continued)	
Process pressure	DIN: PN 10...40 ANSI: Class 150 / 300 JIS: 10K / 20K Pressure-temperature curve of Prowirl 77 W and 77 F:  ba032y32 Pressure-temperature curve of Prowirl 77 H:  ba032y39
Pressure loss	Dependent on nominal diameter and fluid: Δp [mbar] = coefficient C · density ρ [kg/m^3]  ba032y31

Mechanical construction	
Construction / dimensions	See pages 43 ff.
Weight	See pages 43 ff.
Materials: *Transmitter housing* *Sensor* *– Wafer / flange* *– Sensor* *– Pipe stand* *Gaskets*	 Powder-coated die-cast aluminium Stainless steel, A351-CF3M (1.4404), complying to NACE MR0175 Stainless steel wetted parts: – Standard and high/low temperature sensor: 316L (1.4435), complying to NACE MR0175 – High pressure sensor: A637 (2.4668) (Inconel 718), complying to NACE MR0175 non-wetted parts: – CF3 (1.4306) Stainless steel, 304L (1.4308) Graphite Viton Kalrez Gylon (PTFE)
Cable entries	Power supply and signal cable (outputs): Cable entry PG 13.5 (5...11.5 mm) or Thread for cable entries: M20 x 1.5 (8...11.5 mm) ½" NPT G½"
Process connections	Wafer: Mounting set (see page 13) for flanges: – DIN 2501, PN 10...40 – ANSI B16.5, Class 150/300, Sch40 – JIS B2238, 10K/20K, Sch40 Flange: – DIN 2501, PN 10...40, raised face acc. to DIN 2526 form C – ANSI B16.5, Class 150/300, Sch40/80 (Sch80 DN 15...150) – JIS B2238, 10K/20K, Sch40/80 (Sch80 DN 15...150) High pressure: – DIN 2501, PN 64...160, raised face acc. to DIN 2526 form E – ANSI B16.5, Class 600, Sch80 – JIS B2238, 40K, Sch80
User interface	
Operation procedure *Display* *Communication*	• Local operation using 4 keys for programming all functions in the E+H operating matrix (see page 19) • LCD: four-figure with 3 decimal points two-figure with exponent Bar graph as flow indicator in % • LED: for status indication • HART operation with the handheld terminal (see page 22) or Commuwin II
Power supply	
Power supply	12...30 V DC (with HART: 17.5...30 V DC) Ex d: 15...36 V DC (with HART: 20.5...36 V DC)
Power consumption	<1 W DC (incl. sensor)
Power failure	• LED → off • The totalizer remains at the value last shown. • All programmed data remain in the EEPROM.

Certificates and approvals	
Ex-approval	*Ex i:* ATEX/CENELEC ⟨Ex⟩ II2G, EEx ib IIC T1...T6 ATEX ⟨Ex⟩ II3G, EEx nA IIC T1...T6 X FM Cl I/II/III Div 1, Groups A...G CSA Class I Div 1, Groups A...D Class II Div 1, Groups E...G Class III Div 1 *Ex d:* ATEX/CENELEC ⟨Ex⟩ II2G, EEx d [ib] IIC T1...T6 FM Cl I/II/III Div 1, Groups A...G CSA Class I Div 1, Groups A...D Class II Div 1, Groups E...G Class III Div 1 More information and electrical connection diagrams can be found in the separate Ex documentation.
CE mark	By attaching the CE mark, Endress+Hauser confirms that the Prowirl 77 has been successfully tested and fulfills all legal requirements of the relevant EC directives.
Ordering	
Accessories	• Mounting set for wafer • Replacement parts according to separate price list • The Compart DXF 351 flowcomputer • Flow conditioner
Supplementary documentation	• Technical Information Prowirl 77 TI 040D/06/en • Operating Manual Prowirl 77 “PFM“ BA 034D/06/en • Operating Manual Prowirl 77 “PROFIBUS-PA“ BA 037D/06/en • System Information Prowirl SI 015D/06/en • System Information Prowirl 77 SI 021D/06/en • Additional Ex documentation: ATEX II2G/CENELEC Zone 1 XA 017D/06/a3 ATEX II3G/CENELEC Zone 2 XA 018D/06/a3 FM EX 016D/06/A2 CSA EX 017D/06/D2

External standards and guidelines

EN 60529	Degree of protection (IP ingress protection)
EN 61010	Protection Measures for Electrical Equipment for Measurement, Control, Regulation and Laboratory Procedures
EN 50081	Part 1 and 2 (interference emission)
EN 50082	Part 1 and 2 (interference immunity)
NAMUR	Normenarbeitsgemeinschaft für Meß- und Regeltechnik in der Chemischen Industrie
NACE	National Association of Corrosion Engineers

9.1 Measuring ranges (sensor)

The tables below show the relationship between measuring ranges and frequency ranges for a typical gas (air, at 0 °C and 1.013 bar) and a typical liquid (water, at 20 °C). The column “K-factor” shows a range of typical values for the K-factor of an instrument of the corresponding size and type (wafer or flange). Your E+H Sales Office will be pleased to provide information on flowmeters for your specific application with regard to the process characteristics of the fluid and operating conditions.

Prowirl 77 W (Wafer)							
DN DIN / ANSI	**Air** (at 0 °C, 1.013 bar) [m^3/h]			**Water** (at 20 °C) [m^3/h]			**K-factor** [pulses/dm^3]
	$\dot{V}_{min}$	$\dot{V}_{max}$	F-range (Hz)	$\dot{V}_{min}$	$\dot{V}_{max}$	F-range (Hz)	min./max.
DN 15 / ½"	4	35	330...2600	0.19	7	10.0...520	245...280
DN 25 / 1"	11	160	180...2300	0.41	19	5.7...300	48...55
DN 40 / 1½"	31	375	140...1650	1.1	45	4.6...200	14...17
DN 50 / 2"	50	610	100...1200	1.8	73	3.3...150	6...8
DN 80 / 3"	112	1370	75... 850	4.0	164	2.2...110	1.9...2.4
DN 100 / 4"	191	2330	70... 800	6.9	279	2.0...100	1.1...1.4
DN 150 / 6"	428	5210	38... 450	15.4	625	1.2... 55	0.27...0.32

Prowirl 77 F (Flange) **Prowirl 77 H (High pressure to DN 150 / 6")**							
DN DIN / ANSI	**Air** (at 0 °C, 1.013 bar) [m^3/h]			**Water** (at 20 °C) [m^3/h]			**K-factor** [pulses/dm^3]
	$\dot{V}_{min}$	$\dot{V}_{max}$	F-range (Hz)	$\dot{V}_{min}$	$\dot{V}_{max}$	F-range (Hz)	min./max.
DN 15 / ½"	3	25	380...2850	0.16	5	14.0...600	390...450
DN 25 / 1"	9	125	200...2700	0.32	15	6.5...340	70...85
DN 40 / 1½"	25	310	150...1750	0.91	37	4.5...220	18...22
DN 50 / 2"	42	510	120...1350	1.5	62	3.7...170	8...11
DN 80 / 3"	95	1150	80... 900	3.4	140	2.5...115	2.5...3.2
DN 100 / 4"	164	2000	60... 700	5.9	240	1.9... 86	1.1...1.4
DN 150 / 6"	373	4540	40... 460	13.4	550	1.2... 57	0.3...0.4
DN 200 / 8"	715	8710	27... 322	25.7	1050	1.0... 39	0.1266...0.1400
DN 250 / 10"	1127	13740	23... 272	40.6	1650	0.8... 33	0.0677...0.0748
DN 300 / 12"	1617	19700	18... 209	58.2	2360	0.6... 25	0.0364...0.0402

9.2 Factory settings (transmitter)

Prowirl 77 W (Wafer)				
DN DIN / ANSI	End of measuring range [dm^3/s] Function "FS" (s. page 31)		Pulse value [dm^3/Imp] Function "PSCA" (s. page 33)	
	Gas	Liquid	Gas	Liquid
DN 15 / ½"	10	2	0.1	0.1
DN 25 / 1"	50	6	1.0	0.1
DN 40 / 1½"	110	13	10.0	1.0
DN 50 / 2"	170	20	10.0	1.0
DN 80 / 3"	400	50	10.0	1.0
DN 100 / 4"	650	80	10.0	1.0
DN 150 / 6"	1500	180	100.0	10.0

Prowirl 77 F (Flange) Prowirl 77 H (High pressure)				
DN DIN / ANSI	End of measuring range [dm^3/s] Function "FS" (s. page 31)		Pulse value [dm^3/Imp] Function "PSCA" (s. page 33)	
	Gas	Liquid	Gas	Liquid
DN 15 / ½"	10	2	0.1	0.1
DN 25 / 1"	50	6	1.0	0.1
DN 40 / 1½"	110	13	10.0	1.0
DN 50 / 2"	170	20	10.0	1.0
DN 80 / 3"	400	50	10.0	1.0
DN 100 / 4"	650	80	10.0	1.0
DN 150 / 6"	1500	180	100.0	10.0
DN 200 / 8"	2500	300	100.0	10.0
DN 250 / 10"	4000	460	100.0	10.0
DN 300 / 12"	5600	660	100.0	10.0

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