

Swirl Flowmeter SWIRL-SM

with Microprocessor Converter



The
Year
2000
compatible

Fig. 1 SWIRL-SM

The SWIRL-SM Flowmeter is a member of the new SWIRL 4 Flowmeter Series from Bailey-Fischer & Porter. The flowrate of gases, steam and liquids can be metered with the SWIRL-SM over wide flow ranges independent of the fluid properties.

The SWIRL-SM is characterized by the following **design and application features**:

- No moving parts, no wear, no maintenance.
- Short or no flow conditioning sections.
- Wide flow ranges to 1:25.
- Same sensor and converter for all fluids, meter sizes and designs
- Easiest installation and start-up - simply install in the pipeline and complete the electrical connections.
- Ex-Design: TÜV ATEX 1160 II 2G EEx ib IIC T4
- μ P controlled converter incorporating modern digital filtering technology tested per EMC-NAMUR-Requirements
- High reliability achieved through utilization of modern SMD technology and extensive integration, e.g. user specific circuitry.
- Converter in a field mount housing or 19"-Design
- Pressure and temperature compensated for gas and steam.
- High contrast LC-Display, alphanumeric, 2x16 character display with both lines user configurable.
- Multiple function tests including manual process control by entering user selected flowrate values.

- Standard 0/4 to 20 mA current output and galvanically isolated pulse output.
- Accuracy $\leq \pm 0.5$ % of rate.
- Double sensor design with 2 independent converters for safety relevant applications.
- Communication: HART[®]-Protocol
ASCII-Protocol (RS232C or RS485)
Profibus DP
- Sensor and converter completely compatible with the Vortex Flowmeters VORTEX-VM.

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SWIRL-SM

Swirl Flowmeter with Microprocessor-Converter

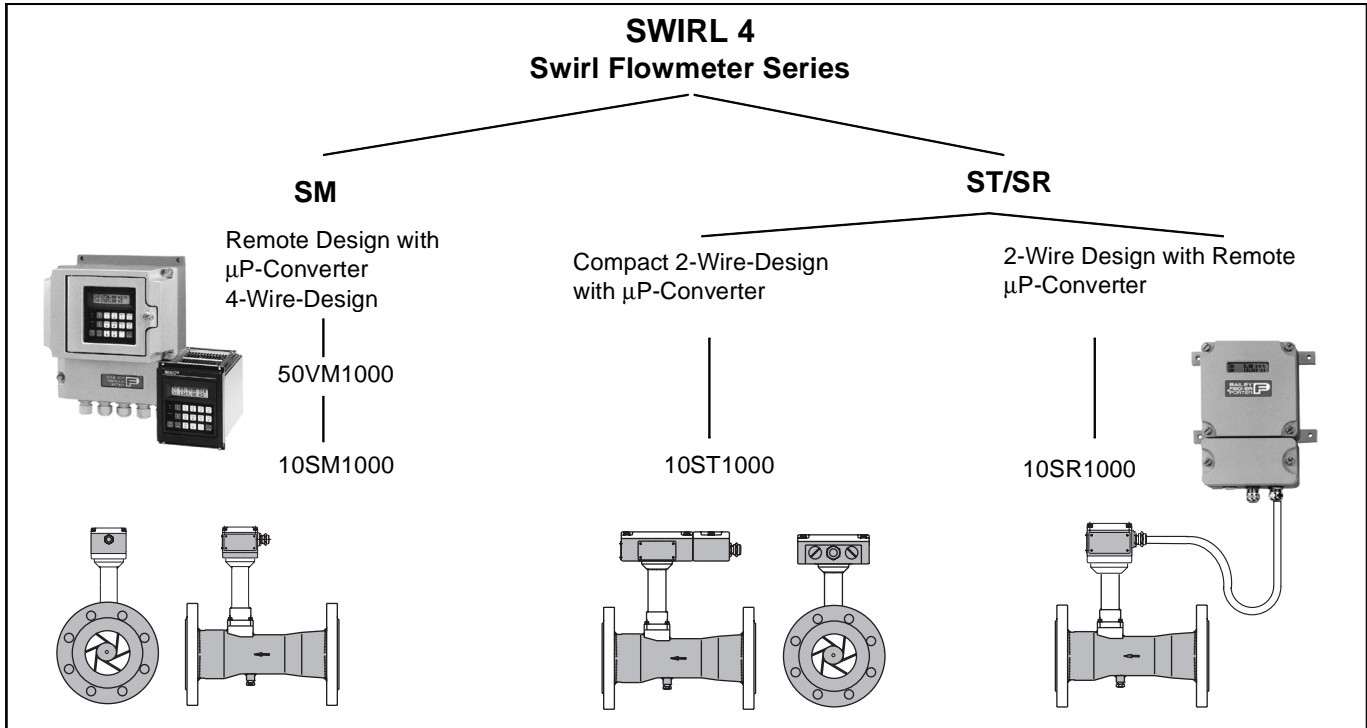


Fig. 2 SWIRL 4 Series

Principle of Operation

The guide body in the inlet forces the axially entering flow stream into a rotational movement. A vortex core, which is forced into a spiral shaped secondary rotation by the backflow, forms in the center of the rotation (Fig. 3). The frequency of this secondary rotation is proportional to the flowrate and is linear over a wide flow range when the internal geometry has been optimized. This frequency is measured by a piezo-sensor. The flowrate proportional frequency signal generated in the flowmeter primary is processed in the converter into a 4 - 20 mA current output signal.

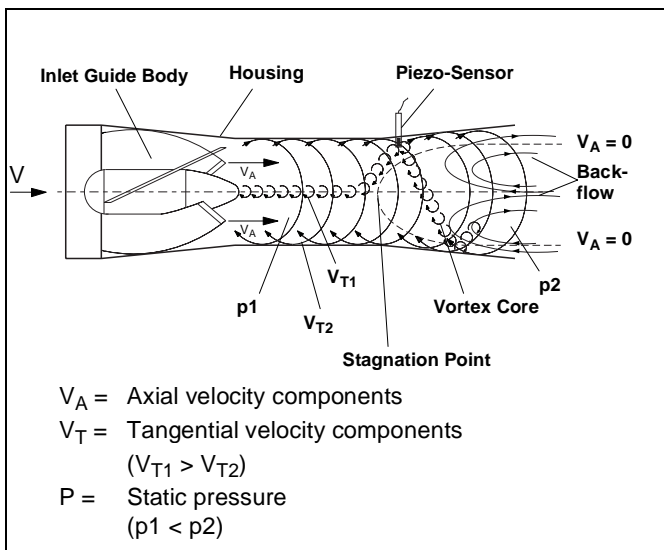


Fig. 3 Principle of Operation, Swirl Flowmeter

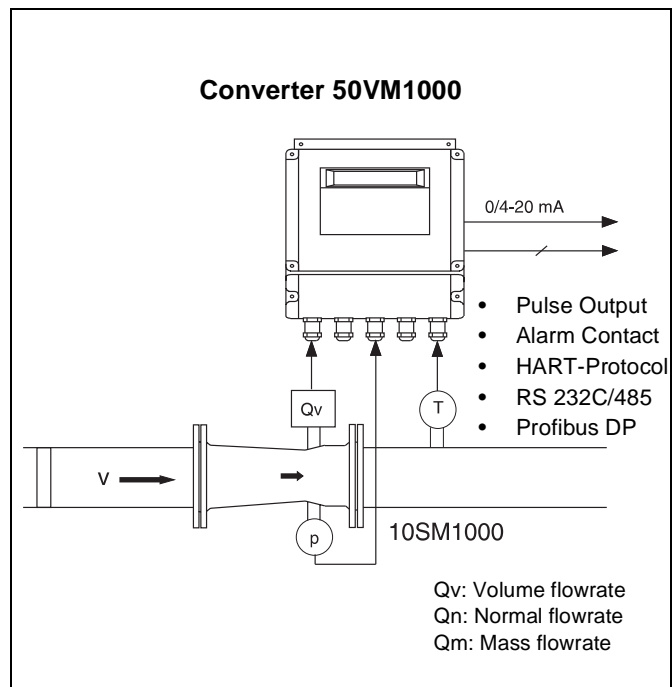


Fig. 4 Gas and Steam Flow Metering with Pressure and Temperature Compensation

It is possible to pressure and temperature compensate gas and steam flowrate measurements. An additional pressure and temperature input is included in the converter. Therefore the flowrate output signals from the converter can be either normal flowrate Q_n (based on the normal conditions: pressure = 1013 mbar; temperature = 0 °C) or mass flowrate Q_m (Fig. 4).

Specifications

Meter Sizes, Flow Ranges, Pressure Drop

Fluid, Gas

Meter Size		Flow Range [m ³ /h]		Frequency [Hz] at Qvmax
Inch	DN	Qvmin	Qvmax	
1/2	15	2.5	16	1900
3/4	20	2.5	25	1200
1	25	5	50	1200
1-1/4	32	7	130	1300
1-1/2	40	12	200	1400
2	50	18	350	1200
3	80	60	850	690
4	100	65	1500	700
6	150	150	3600	470
8	200	200	5000	330
12	300	400	10000	160
16	400	1000	20000	150

Table. 1 Flow Ranges Gases (Air at 20 °C, 1013 mbar,
 $\rho = 1.205 \text{ kg/m}^3$)

The maximum flowrate of the flowmeter primary should not be set to less than 0.5 x RangeMax, however, it can be set as low as 0.15 Qvmax when required.

The meter size selection is made based on the **maximum actual volume flowrate (Qv) at operating conditions**. If the desired flowrate value is expressed in normal (normal conditions: temperature = 0 °C, pressure = 1013 mbar) or mass flowrate units, then the desired flowrate value must first be converted to the equivalent actual volume flowrate at operating conditions before the most suitable meter size can be determined from the Flow Range Table (Table 1).

Qvmin for gases with a density <1.2 kg/m³

The minimum actual volume flowrate Qvmin for gases with lower densities can be calculated using the following equation:

$$Q_{vmin}' = Q_{vmin} \times \sqrt{\frac{\rho_{tbl}}{\rho}}$$

Qvmin = Min. actual flowrate at reference conditions (Tbl. 1)

$\rho =$ Density at operating conditions [kg/m³]

$\rho_{tbl} =$ Density at reference conditions 1.2 kg/m³

1. Convert Normal Density (ρ_n) --> Actual Density (ρ)

$$\rho = \rho_n \times \frac{1,013 + p}{1,013} \times \frac{273}{273 + T}$$

2. Convert to Actual Flowrate (Qv)

a) Starting with normal flowrate (Qn) -->

$$Q_V = Q_n \frac{\rho_n}{\rho} = Q_n \frac{1,013}{1,013 + p} \times \frac{273 + T}{273}$$

b) Starting with mass flowrate (Qm) -->

$$Q_V = \frac{Q_m}{\rho}$$

3. Dynamic Viscosity (η) --> Kinematic Viscosity (ν)

$$\nu = \frac{\eta}{\rho}$$

ρ = Operating density [kg/m³]

ρ_n = Normal density [kg/m³]

p = Operating pressure [bar] (gauge pressure)

T = Operating temperature [°C]

Q_V = Actual volume flowrate [m³/h]

Q_n = Normal flowrate [m³/h]

Q_m = Mass flowrate [kg/h]

η = Dynamic viscosity [Pas]

ν = Kinematic viscosity [m²/s]

Example for Gases:

Find the meter size for metering 1200 m³/h (qn) carbon dioxide; Temperature = 30 °C; pressure = 5 bar; $\rho_n = 1.977 \text{ kg/m}^3$

1. Convert ρ_n to ρ : $\rho = 10.57 \text{ kg/m}^3$
2. Convert from m³/h (qn) to m³/h (qv): $Q_v = 224 \text{ m}^3/\text{h}$
-> Flow Range for 2" [DN 50] (see Tbl 1): 18 - 350 m³/h
3. Pressure drop at $Q_v = 224 \text{ m}^3/\text{h}$ and $\rho = 10.57 \text{ kg/m}^3$
 $\Delta p' = 350 \text{ mbar}$

Pressure Drop [mbar]

See Fig. 5 for air (20 °C, 1013 mbar, $\rho = 1.205 \text{ kg/m}^3$).

For other fluid densities the pressure drop can be calculated using the following equation:

$$\Delta p' = \frac{\rho}{1,205} \times \Delta p$$

$\Delta p' =$ Pressure drop, fluid [mbar]

$\Delta p =$ Pressure drop, air (from Fig. 5) [mbar]

$\rho =$ Fluid density (at operating conditions) [kg/m³]

Product-Selection and Product-Specification Programs

For the selection of a flowmeter suitable for a specific application a program called "FlowSelect" is available from Bailey-Fischer & Porter.

For flowrate conversion calculations and specifications for the selected flowmeter type an additional program, "FlowCalc" is available.

Both are WINDOWS programs and are available at no cost upon request.

SWIRL-SM

Specifications Meter Sizes, Flow Ranges, Pressure Drop

Normal Densities for Selected Gases:

Gas	Normal Density [kg/m ³]
Acetylene	1.172
Air	1.290
Ammonia	0.771
Argon	1.780
Butane	2.700
Carbon dioxide	1.970
Carbon monoxide	1.250
Ethane	1.350
Ethylene	1.260
Hydrogen	0.0899
Methane	0.717
Natural gas	0.828
Neon	0.890
Nitrogen	1.250
Oxygen	1.430
Propane	2.020
Propylene	1.915

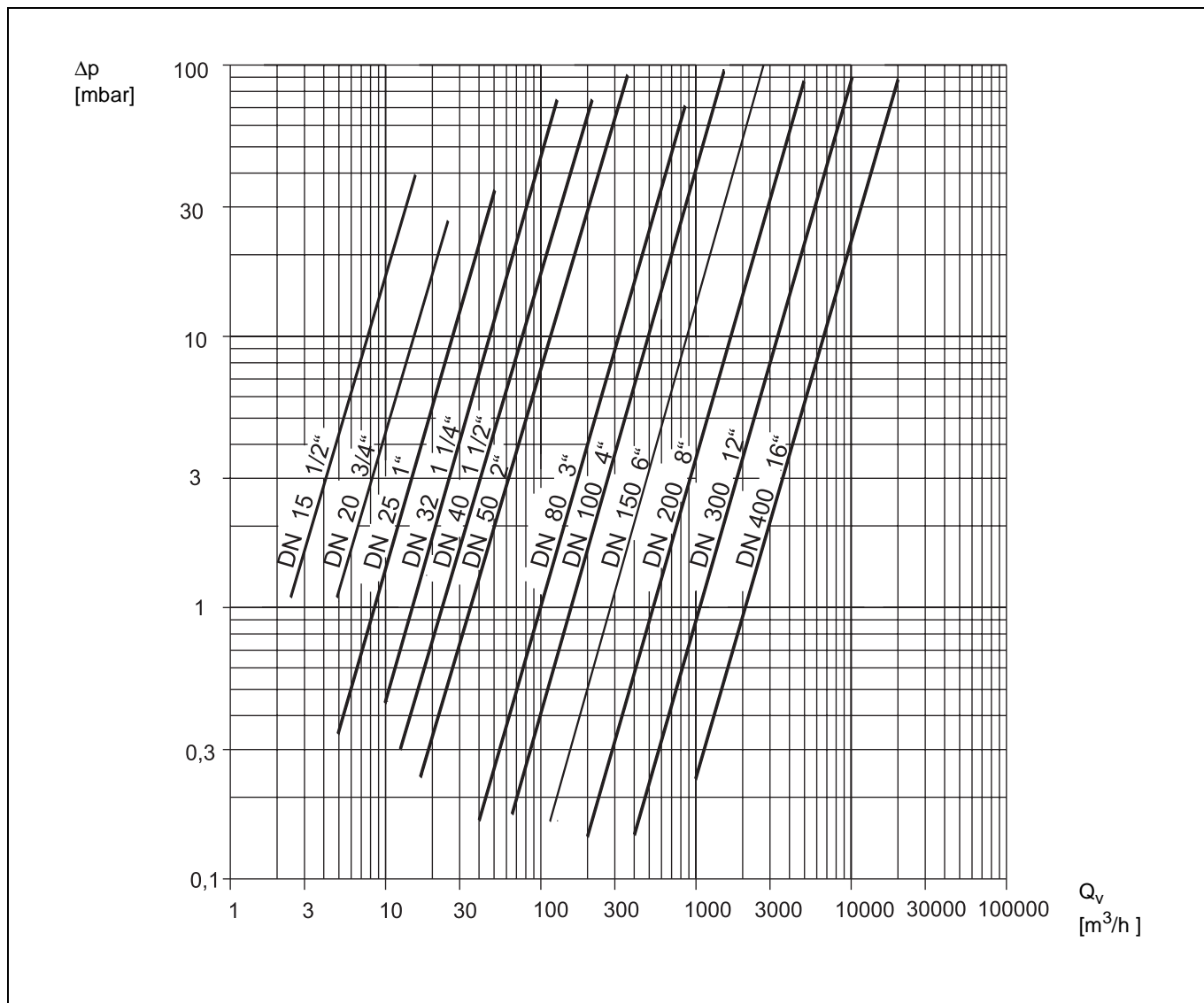


Fig. 5 Pressure Drop, Air (20 °C, 1013 mbar, $\rho = 1.205 \text{ kg/m}^3$)

Specifications

Meter Sizes, Flow Ranges, Pressure Drop

Fluid, Liquid

Meter Size		Flow Range m ³ /h		Frequency at Q _V max [Hz]	Re min
Inch	DN	Q _V min	Q _V max		
1/2	15	0.1	1.6	185	2100
3/4	20	0.2	2	100	3500
1	25	0.4	6	135	5200
1-1/4	32	0.8	10	107	7600
1-1/2	40	1.6	16	110	13500
2	50	2.5	25	90	17300
3	80	3.5	100	78	15000
4	100	5	150	77	17500
6	150	15	370	50	35000
8	200	25	500	30	44000
12	300	100	1000	16	118000
16	400	180	1800	13	160000

Table.2: Flow Ranges Liquids

The maximum flowrate of the flowmeter primary should not be set to less than 0.5 x Q_Vmax, however, it can be set as low as 0.15 Q_Vmax if required.

1. Convert Mass Flowrate Q_m to Volume Flowrate Q_v:

$$Q_V = \frac{Q_m}{\rho}$$

ρ = Operating density [kg/m³]

Q_V = Volume flowrate [m³/h]

Q_m = Mass flowrate [kg/h]

2. Pressure Drop [mbar]

See Fig. 6 for water (ρ = 1000 kg/m³)

For other fluid densities the pressure drop can be calculated using the following equation:

$$\Delta p' = \frac{\rho}{1000} \times \Delta p$$

Δp' = Pressure drop, fluid [mbar]

Δp = Pressure drop, water (from Fig. 6) [mbar]

ρ = Density, fluid (at operating conditions) [kg/m³]

3. Positive Static Pressure

To prevent cavitation during liquid measurements a positive static pressure (back pressure) is required downstream from the meter. The value can be estimated using the following equation:

$$p_2 \geq 1.3 \times p_{Vapor} + 2.6 \times \Delta p'$$

p₂ = Downstream static pressure [mbar]

p_{Vapor} = Vapor pressure of the liquid at operating temperature [mbar]

Δp' = Pressure drop, fluid [mbar]

Example for Liquids:

Find the meter size for metering 45 m³/h liquid with a density of 850 kg/m³.

- Q_V = 45 m³/h --> 3" [DN 80]: 3.5 - 70 m³/h (see Tbl. 2)
- Pressure drop at Q_V = 45 m³/h and ρ = 850 kg/m³
Δp' = 170 mbar.

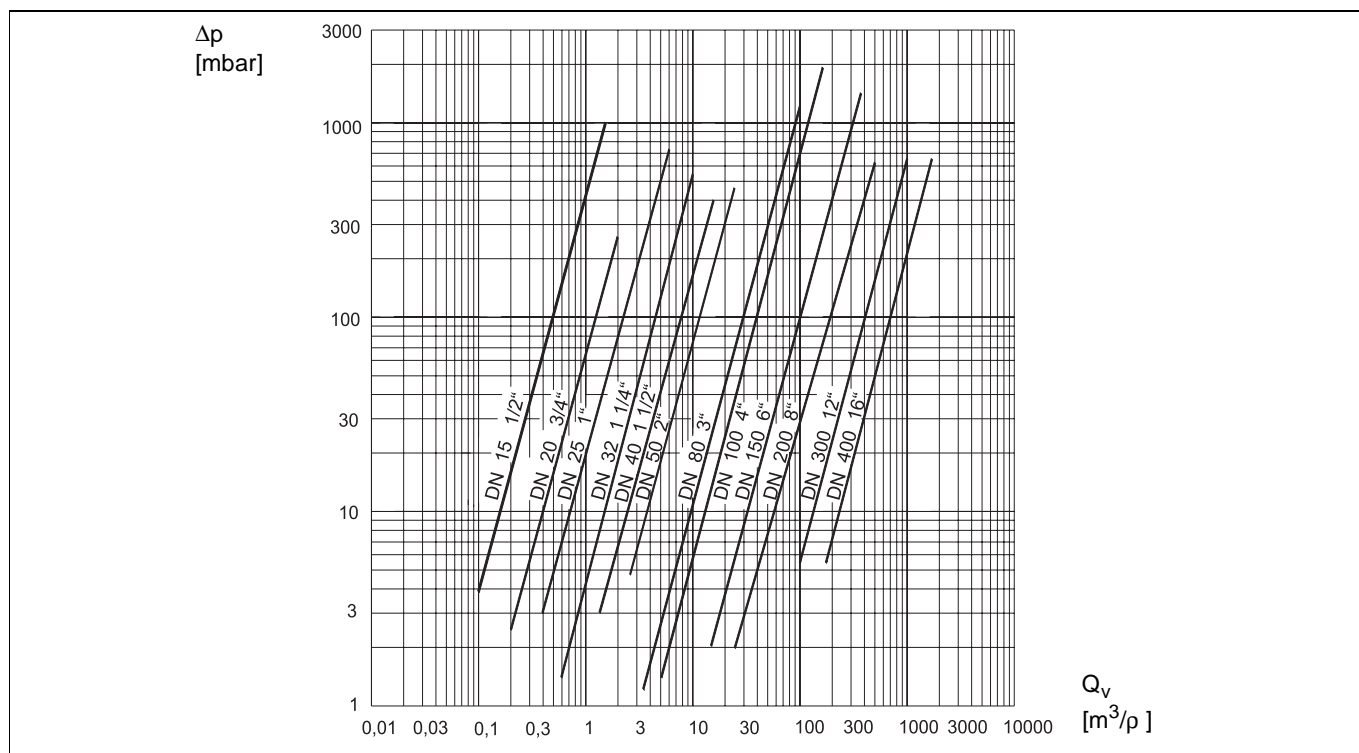


Fig. 6 Pressure Drop Water (ρ = 1000 kg/m³)

SWIRL-SM**Specifications
Meter Sizes, Flow Ranges, Pressure Drop****Flow Ranges, Saturated Steam [kg/h]****Example for saturated steam:**

Find the flow range for a 2" [DN50] flowmeter at 7 bar a.

--> from Table 3: 2" [DN50]: 66 - 1285 kg/h

Additional information: Sat. steam temp.= 165 °C

Sat. steam density = 3.67 kg/m³

p[bar a] DN / Inch	0.5	1	1.5	2	3	4	5	6	7	8	9	10	12	15	25	30	35	40
15 min	2	2	3	3	4	4	4	5	5	6	6	6	7	8	11	13	15	17
1/2 max	5	9	14	18	26	35	43	51	59	67	75	82	98	122	200	240	280	320
20 min	4.8	3	2.8	3	4	5	7	8	9	10	12	13	15	19	31.5	37.5	43.7	50
3/4 max	7.5	15	21.5	28	41	54	67	79	92	104	117	129	153	190	312.5	375	437.5	500
25 min	9.7	7	5.7	6	8	11	13	16	18	21	23	26	31	38	62.5	75	87.5	100
1 max	15	30	43	56	83	108	134	159	184	208	233	258	307	380	625	750	875	1000
32 min	31.3	15.2	12.3	12.7	17.8	23.7	29.6	34.7	38.9	54.2	51.6	56.7	67.7	83.8	137.5	165	192.5	220
1-1/4 max	39	77	111.8	147	215	281	347	412	477	541	606	670	797	988	1625	1950	2275	2600
40 min	6.9	9.7	11.7	13.4	19	24.9	30.7	36.5	42.3	41.9	53.6	59.2	70.5	87.5	143.8	112.5	201.3	230
1-1/2 max	63	1239	180	237	346	453.6	561	665	770	873	978	1081	1287	1596	2625	3150	3675	4200
50 min	34.9	25	20.6	20	30	39	48	57	66	75	84	93	110	137	225	270	315	360
2 max	105	207	301	395	578	756	935	1110	1285	1456	1631	1803	2060	2660	4375	5250	6125	7000
80 min	77.6	55	45.8	45	66	86	107	127	147	166	186	206	245	304	500	600	700	800
3 max	255	502	731	960	1403	1836	2270	2695	3120	3536	3961	4378	5211	6460	10625	12750	14875	17000
100 min	126.1	90	74.4	73	107	140	174	206	239	270	303	335	398	494	812.5	975	1137.5	1300
4 max	450	885	1290	1694	2475	3240	4005	4755	5505	6240	6990	7725	9195	11400	18750	22500	26250	30000
150 min	232.8	166	137.4	135	198	259	320	380	440	499	559	618	736	912	1500	1800	2100	2400
6 max	1110	2182	3181	4181	6105	7992	9879	11766	13653	15540	17427	19314	22681	28120	46250	55500	64750	74000
200 min	388	277	229	226	330	432	534	634	734	832	932	1030	1226	1520	2500	3000	3500	4000
8 max	1500	2950	4300	5645	8250	10800	13350	15850	18350	20800	23300	25750	30650	38000	62500	75000	87500	100000
300 min	776	553	458	452	660	864	1068	1268	1468	1664	1864	2060	2452	3040	5000	6000	7000	8000
12 max	3000	5900	8600	11290	16500	21600	26700	31700	36700	41600	46600	51500	61300	76000	125000	150000	175000	200000
400 min	1940	1383	1146	1129	1650	2160	2670	3170	3670	4160	4660	5150	6130	7600	12500	15000	17500	20000
16 max	6000	11800	17200	22580	33000	43200	53400	63400	73400	83200	93200	103000	122600	152000	250000	300000	350000	400000
Density ρ_{sat} [kg/m ³]	0.3	0.59	0.86	1.13	1.65	2.16	2.67	3.17	3.67	4.16	4.66	5.15	6.13	7.6	12.5	15	17.5	20
Temp. Tsat [°C]	81.3	99.6	111.4	120	133	144	152	159	165	170	175	180	188	198	224	234	242	250

Table. 3: Saturated Steam Flow Ranges

Specifications



Fig. 7 SWIRL-SM, 10SM1000

Accuracy and Reproducibility

Accuracy

≤ ± 0.5 % of rate (at reference conditions)

Reproducibility

≤ 0.2 % of rate

Overrange:

Gases:

15 % over the maximum flowrate

Liquids:

15 % over the maximum flowrate

Note: Cavitation may not occur

Operating Pressure:

Flange design:	DIN PN 10 to PN 100
	ANSI Class 150/300/600
	(Size dependent)

Other designs to PN160/CL 1200 upon request.

Connections:

Process Connections

Flanges per DIN or ANSI

Electrical Connections

Screw terminals, connectors PG 13.5

Protection Class:

IP 65

Materials:

Meter Housing

SS 316Ti [Mat'l No. 1.4571]

Flanges

SS 316Ti [Mat'l No. 1.4571]

Inlet Guide Body

SS 316Ti [Mat'l No. 1.4571]

Sensor

SS 316Ti [Mat'l No. 1.4571]

Sensor Gaskets

Kalrez O-Ring: 0 °C to 280 °C

Viton O-Ring: -55 °C to 230 °C

PTFE O-Ring: -55 °C to 200 °C

Other materials upon request.

Housing, Converter Module

Cast light metal, painted

Weight:

See Dimensions, Fig. 11, 12

Fluid Temperature:

-55 °C to +280 °C (Standard)

-55 °C to +280 °C (Ex-Design)

The allowable temperature range for the gasket materials must be considered.

Ambient Conditions:

Climate resistance (per DIN 40040):GSG

Relative humidity: max. 85 %, yearly average ≤ 65 %

Explosion Protected Design:

	TÜV 97 ATEX 1160
	II 2G EEx ib IIC T4

Ex-protection for 10SM1000 in II 2G EEx ib IIC T4 in connection with zenerbarrier 55SB13..

(see interconnection diagram Fig. 19).

Distance between primary and zenerbarrier ≤ 150 m (for Explosiongroup IIC with cable capacity of 160 pF/m).

Ambient temperature: -20°C to +60°C

(down to -55°C upon request)

Fluid temperature: -55°C to +280°C

Installation

The flowmeter primary should be installed in the pipeline taking into consideration the following information.

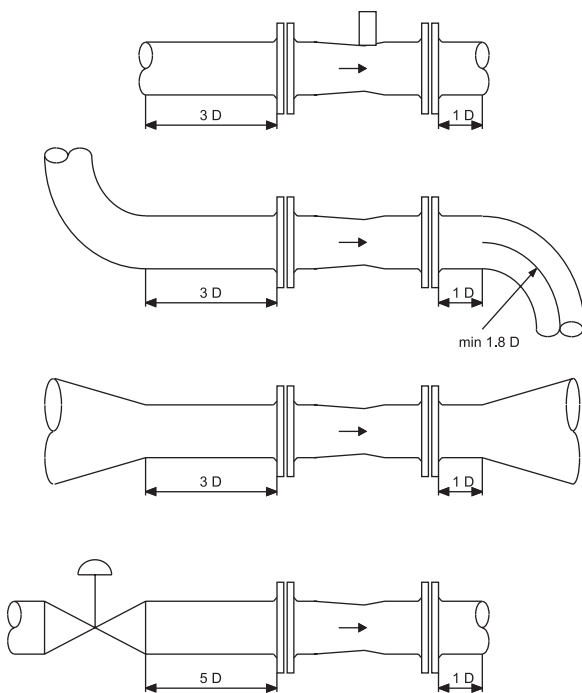
In- and Outlet Sections

As a result of the operating principle of the Swirl Flowmeter practically no in- or outlet sections are required. Recommended in- and outlet sections are shown in Fig. 8 for various installation conditions. No in- or outlet sections are required when the radius of single or double elbows up- or downstream of the flowmeter primary exceeds $1.8 \times D$. No additional up- or downstream sections are required downstream for flanged reducers per DIN 28545 ($\alpha/2 = 8^\circ$).

Pressure and Temperature Measurements

Additional Installation Information

- For liquids, assure that the flowmeter primary is always completely filled with fluid.
- For installations in horizontal pipelines with fluid temperatures $> 150^\circ\text{C}$, the installation scheme shown in Fig. 10 is recommended.
- When gas bubble formation is possible, gas separators should be provided.
- For installations in long pipelines in which vibrations are present, the vibrations should be damped.



Dimensions

Flowmeter Primaries, DIN, DN 15 to 50, ANSI, Sizes 1/2" to 2"

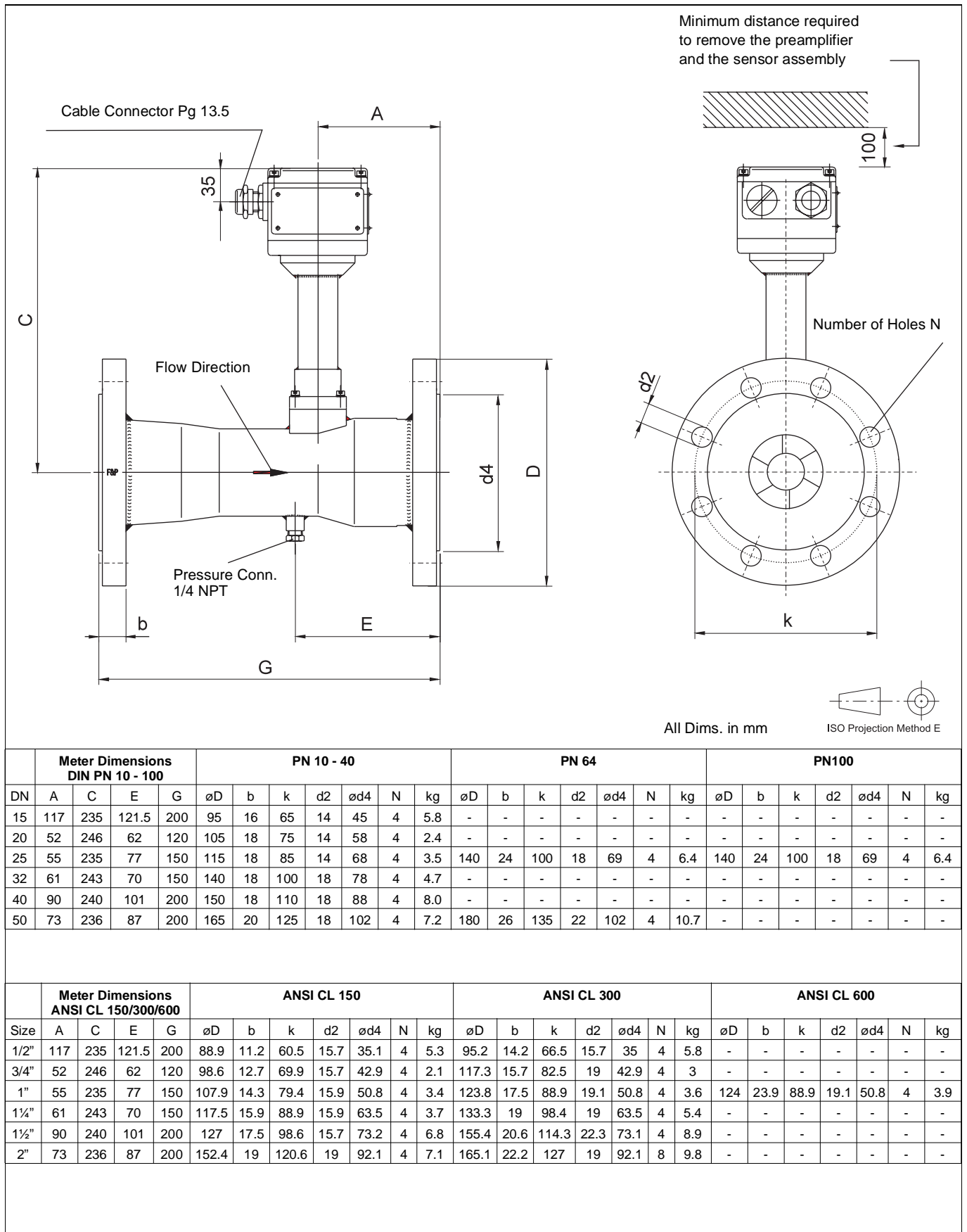


Fig. 11 Dimensions , DIN, DN 15 to 50, ANSI, DN 1/2" to 2"

SWIRL-SM

Dimensions

Flowmeter Primaries, DIN, DN 80 - DN 400 ANSI, Sizes 3" to 16"

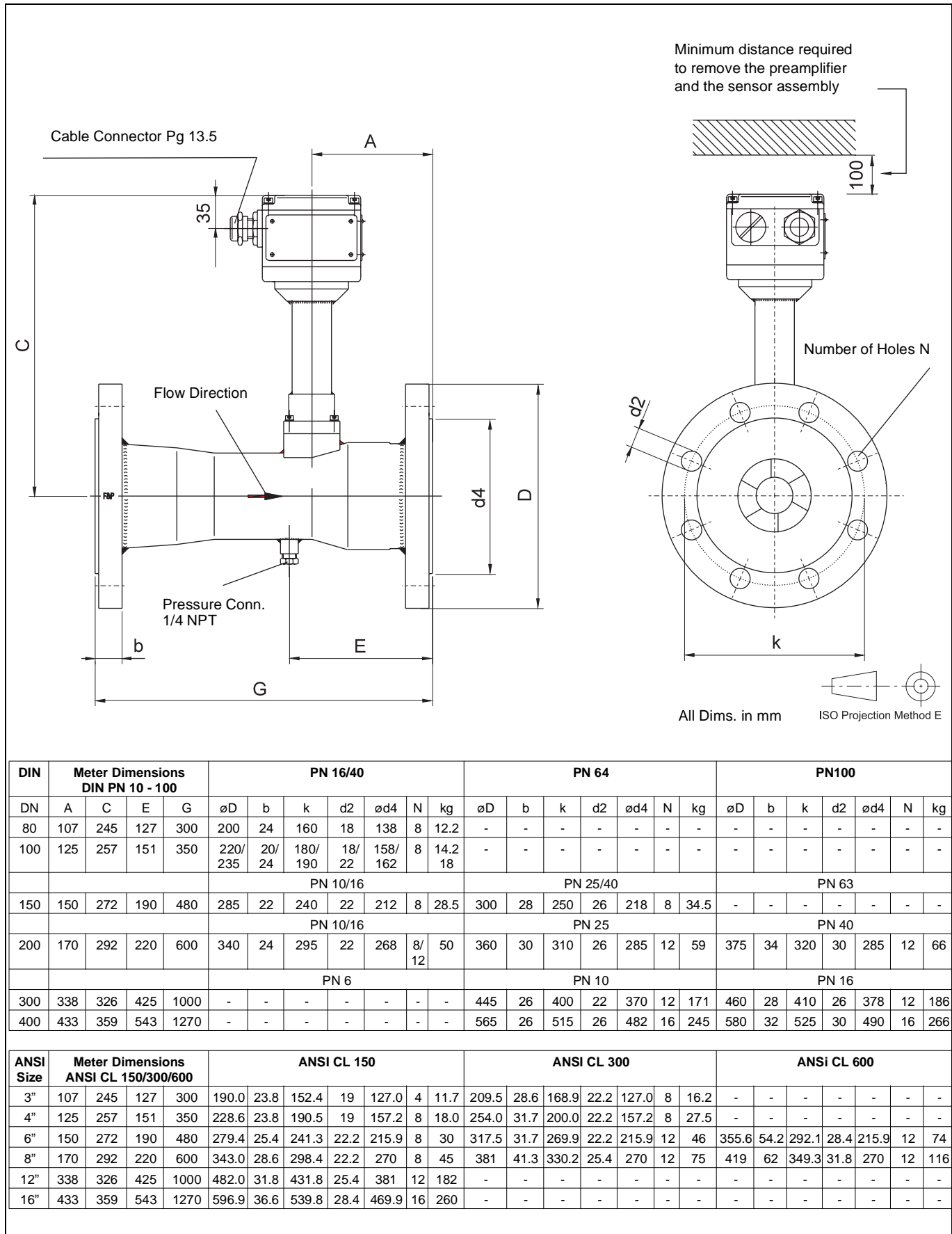


Fig. 12 Dimensions per DIN , DN 80 to DN 400 and per ANSI, 3" to 16"

Specifications

Converter SWIRL-SM, 50 VM1000



Fig. 13 Converter 50VM1000

Flow Ranges

Continuous settings between the Q_{vmin} and Q_{vmax} values of the flowmeter primary.

Parameter Entries

The data can be entered using the foil keypad (16 keys) in a clear text dialog with the display or by digital communication over the data link (ASCII-Protocol or Profibus DP) or from a PC utilizing the HART-Protocol.

Data Protection

The totalizer values are stored in an NV-RAM for a period of 10 years without external power when the power is turned off or during a power outage. Double protection is provided by storing all the meter location specific parameters in a serial EEPROM in the converter as well as in an EEPROM installed on the external connection board. The converter module can be easily replaced. A single key stroke is all that is required to upload all the data stored in the external EEPROM into the new converter; the accuracy of the system remains unchanged.

Function Tests

The individual internal subassemblies of the converter can be checked using the built-in software function tests. Simulated current output values can be entered during start-up or for service (manual process control).

Operating Settings

Flowmeter Primary

The converter can be connected to a variety of flowmeter primaries - Swirl Flowmeters and Vortex Flowmeters from Bailey-Fischer & Porter. This parameter setting is used to synchronize the flowmeter primary and the converter.

Fluid

The flowmeter primary can be utilized to meter gases/steam or liquids. The flow ranges are a function of the fluid and the flowmeter primary size selections.

Operating Mode (Volume, Normal, Mass)

The output signals can be based on volume flowrate (at the operating conditions), normal flowrate (based on the normal conditions: $p = 1013 \text{ mbar}$, $T = 0 \text{ °C}$) or mass flowrate (density entry required).

Damping

Can be set between 0.2 and 100 s.

Low Flow Cutoff

Can be set between 0 to 10 % of Q_{vmax} .

Supply Power

230 / 115 / 48 / 24 V AC $\pm 10 \%$, 47 - 64 Hz;
48/24 V DC, +30 %, -25 %

Power

< 15 W (incl. flowmeter primary)

Ambient Temperature

-55 °C to 60 °C (-20 °C is standard)

Design

Light metal cast wall mount housing, painted
19"-Insert cassette, 167 mm.

Protection Class per EN 60529

Wall mount housing: IP65
19"-Insert cassette: IP00

Weight

Wall mount housing: approx. 4.2 kg
19"-Insert cassette: approx. 1.8 kg

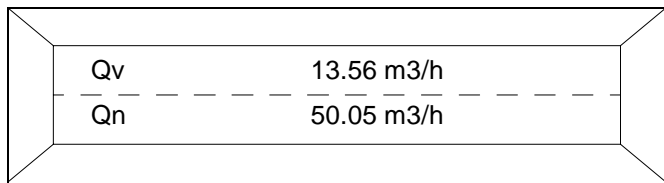
SWIRL-SM

Specifications Converter SWIRL-SM, 50VM1000

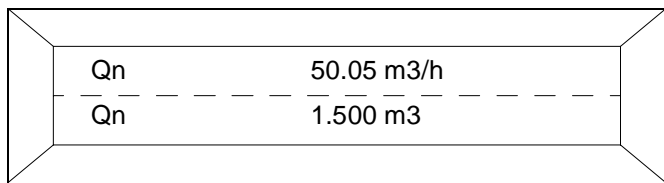
Display

High contrast, supertwisted LC-Display, 2 x 16 characters with background lighting. For display of the instantaneous flowrate, totalized flow, pressure, temperature, etc..

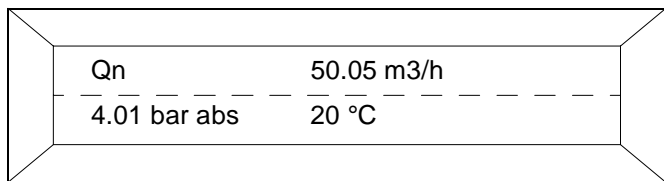
The values to be displayed are user selected. Two values can be displayed in each line alternately in the Multiplex-Mode.



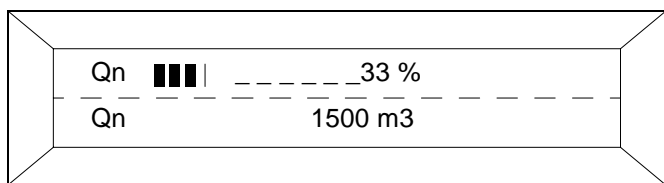
1st Line: Volume flowrate
2nd Line: Normal flowrate



1st Line: Normal flowrate
2nd Line: Totalized normal flowrate



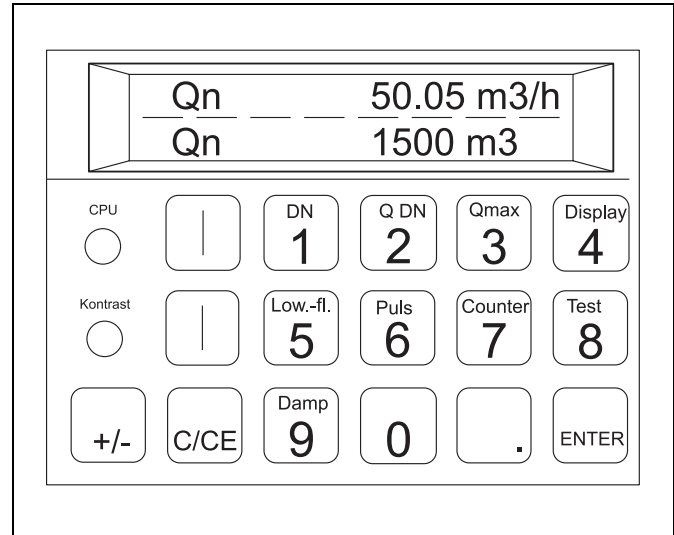
1st Line: Normal flowrate
2nd Line: Pressure [bar abs] and temperature [°C]



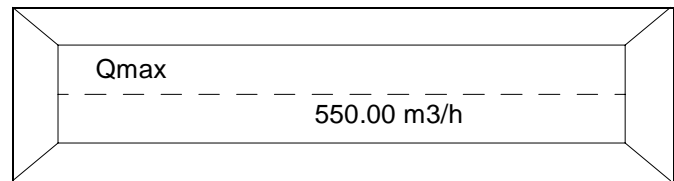
1st Line: Flowrate as a bargraph in % of flow range end value setting
2nd Line: Totalized normal flowrate

Operation

The converter can be operated from a user friendly foil keypad with double function keys in a variety of languages.

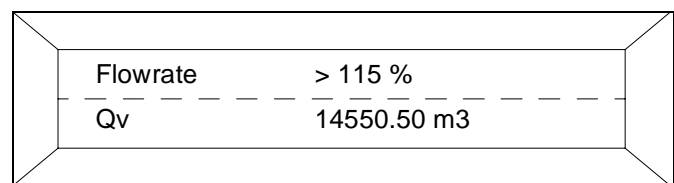


Example: Flow range setting using the Qmax key



Error Messages in the Display

Automatic system monitoring with error diagnostics indicated by clear text messages in the display and by an output alarm signal.



Specifications

Converter SWIRL-SM, 50VM1000

Communication

Digital communication with the SWIRL-SM is possible utilizing the HART-Protocol, the serial data link RS232/485 connections or the Profibus-DP. All instrument and meter location parameters can be transmitted from the converter to a process control system or PC. In the reverse direction, it is possible to configure the converter in a similar manner. The software SMART-VISION® can be used as a configuration tool.

HART®-Protocol

The HART-Protocol provides for digital communication between a process control system/PC or handheld terminal and the 50SM1000 converter. When communication using the HART-Protocol is required, the serial data link is not available. The digital communication utilizes an ac signal superimposed on the current output (4 - 20 mA), which does not affect any other instruments connected to the output

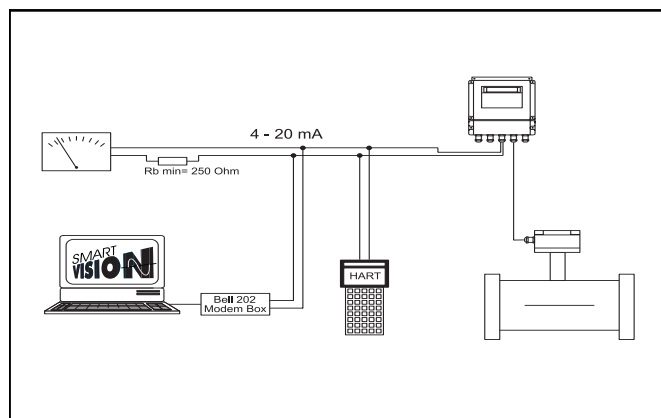


Fig. 14 Converter 50VM1000

Transmission Mode

FSK-Modulation on the 4 -20 mA current output per Bell 202 Standard. Maximum signal amplitude 1.2 mA_{pp}.

Logic. 1: 1200 Hz
 Logic. 0: 2200 Hz

Current Output Load

Min. = 250 Ω, Max. = 750 Ω

Max. Cable Length

1500 m AWG 24 twisted

Baudrate

1200 Baud

Serial Data Link

The serial data links (terminals V1 to V4) are available in RS485, RS232C/V24 configurations. For the Profibus DP option a Profibus DP-Module is installed.

RS232

Terminals: ⊥, TD, RD
 Generator side V_{SS} = -8 V, V_{CC} = +8 V
 Typ. output current 10 mA
 Receiver side max. input voltage ± 30 V
 Typ. input current ± 5.5 mA at ± 25 V input voltage,
 Max. cable length: 15 m, Baudrate 9600 Baud.
 A shielded data cable is recommended.

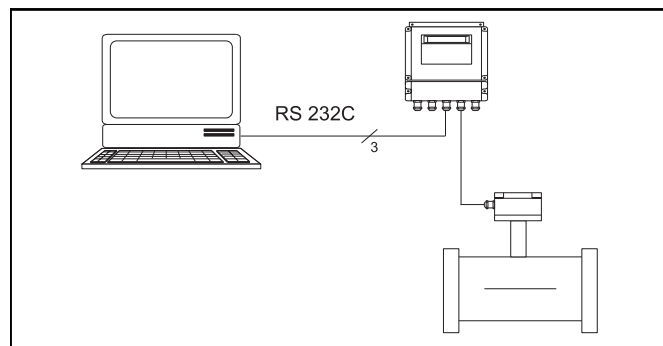


Fig. 15 Communication with RS232 Data Link

RS485

Terminals: T-, T+, R-, R+
 V_{SS} = 5 V, input impedance ≥ 12 kΩ
 Max. cable length: 1200 m
 Baudrate: 110 - 9600, 14400, 28800 Baud
 Max. 32 Instruments in parallel on a single bus.
 A shielded data cable is recommended with individually twisted pairs.

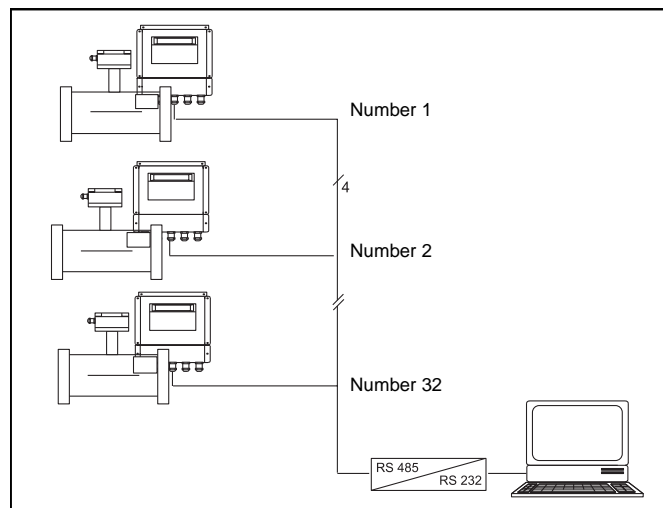


Fig. 16 Communication over a RS485-Data Link

Specifications Converter SWIRL-SM, 50VM1000

Profibus-DP per DIN 19245

Terminals: V1, V2, V4, G2

Terminal	Function	Reference
V1	RxD/TxD-P (B)	Receive/Send-Data-P
V2	RxD/TxD-N (A)	Receive/Send-Data-N
V4	VP	Supply voltage-Plus (+5 V DC)
G2	DGND (C)	Data reference potential (-5 V DC)

Cable Specifications:

- 2 conductor, twisted, shielded, max 1200 m, Cable Type A
- Characteristic impedance : 135 to 165 Ω
- Distributed capacitance : < 30pF/m
- Max. 32 Instruments per Profibus-DP Segment
- Loop resistance : 110 Ω/km
- Baudrate : 9.6 to 1500 kbit/s
- Cabling : continuous loop thru terminals
- Length of tap line : ≤1 m

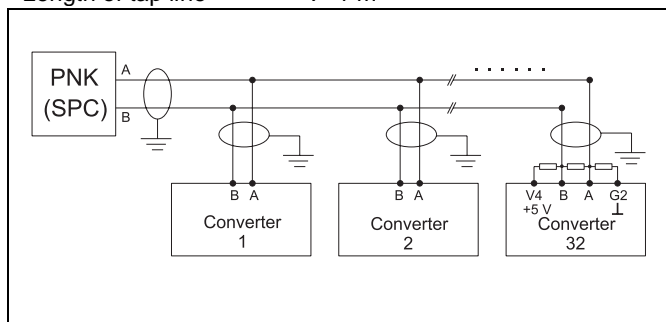


Fig. 17 Communication with Profibus DP

Electrical Connectors

PG 13.5

Signal Cable

3-conductor shielded cable, max. length between flowmeter primary and converter is 800 m or. 200 Ω cable resistance
A 10 m length of signal cable (standard) is included with the shipment from BF & P: Cable capacitance: 160 pF/m.

Input Signals

External Zero Return

Passive over optocoupler, galvanically isolated. Connect to Terminals U2/22 with internal power supply.

External Totalizer Reset

Passive over optocoupler, galvanically isolated. For resetting the totalizer and overflow counter values. Connect to Terminals U2/31 with internal power supply.

Pressure Measurements

Current input 0 - 20, 4 - 20 mA

- Terminals P+/P- (4 - 20 mA) for power supply from converter; supply voltage 26 V DC;

$$\text{Max. load } [\Omega] = \frac{26V - U_M V}{0,02A}$$

U_M = Transmitter supply voltage [V]

- Terminals P-/3 (0/4 - 20 mA) for external power supply;

$$\text{Max. load } [\Omega] = \frac{U_S V - U_M V}{0,02A} - 200\Omega$$

U_S = External supply voltage [V]

Temperature Measurements

Pt 100 Resistance Instrument

Connect in 2-, 3- or 4- Wire configuration.

Signal input: UT+, UT-

Supply current: +, IT-

Max. cable length: 800 m

Output Signals

Current Output

0/4 - 20 mA, load ≤ 750 Ω

0/2 - 10 mA, load ≤ 1500 Ω

Terminals: +/-

For HART-Protocol:

4 - 20 mA, load: 250 - 500 Ω

The current output is galvanically isolated from all in- and outputs.

Pulse Output

Scaled, max. 10 kHz. Pulse factor per engineering unit which can be set between 0.001 to 1000.

Pulse width can be set between 0.016 ms to 1000 ms. The pulse output is galvanically isolated from the current output.

- Active

Rectangular 24 V DC pulses, load 150 Ω

Terminals: 9/11

- Passive

Optocoupler 5 V < U_{CE} < 25 V, 5 mA < I_{CE} < 30 mA

Terminals: 55/56

- Passive

Relay contact, closes < 3 W, < 250 mA, < 28 V DC

Terminals: 51/52

Contact Outputs

Flowrate limit alarms MAX (V10, V11) and MIN (V12, V13) and alarm output (V5, V6) (system monitor) can be ordered with a relay option - max. 3 W, 250 mA, 28 V DC or optocoupler option, $U_{CE} \leq 25$ V, $I_{CE} \leq 7.5$ mA. An alarm message is also displayed.

The scaled pulse output (standard, active) is not available with a MIN-Alarm. If a pulse output is required it is available at Terminals V1, V2. In this case the serial data link is not available.

Note:

The instrument conforms to the NAMUR-Recommendations "EMC-Guidelines for Manufacturers and Operators of Electronic Systems - Part 1".

Interconnection Diagram Flowmeter Primary 10SM1000 - Converter 50VM1000

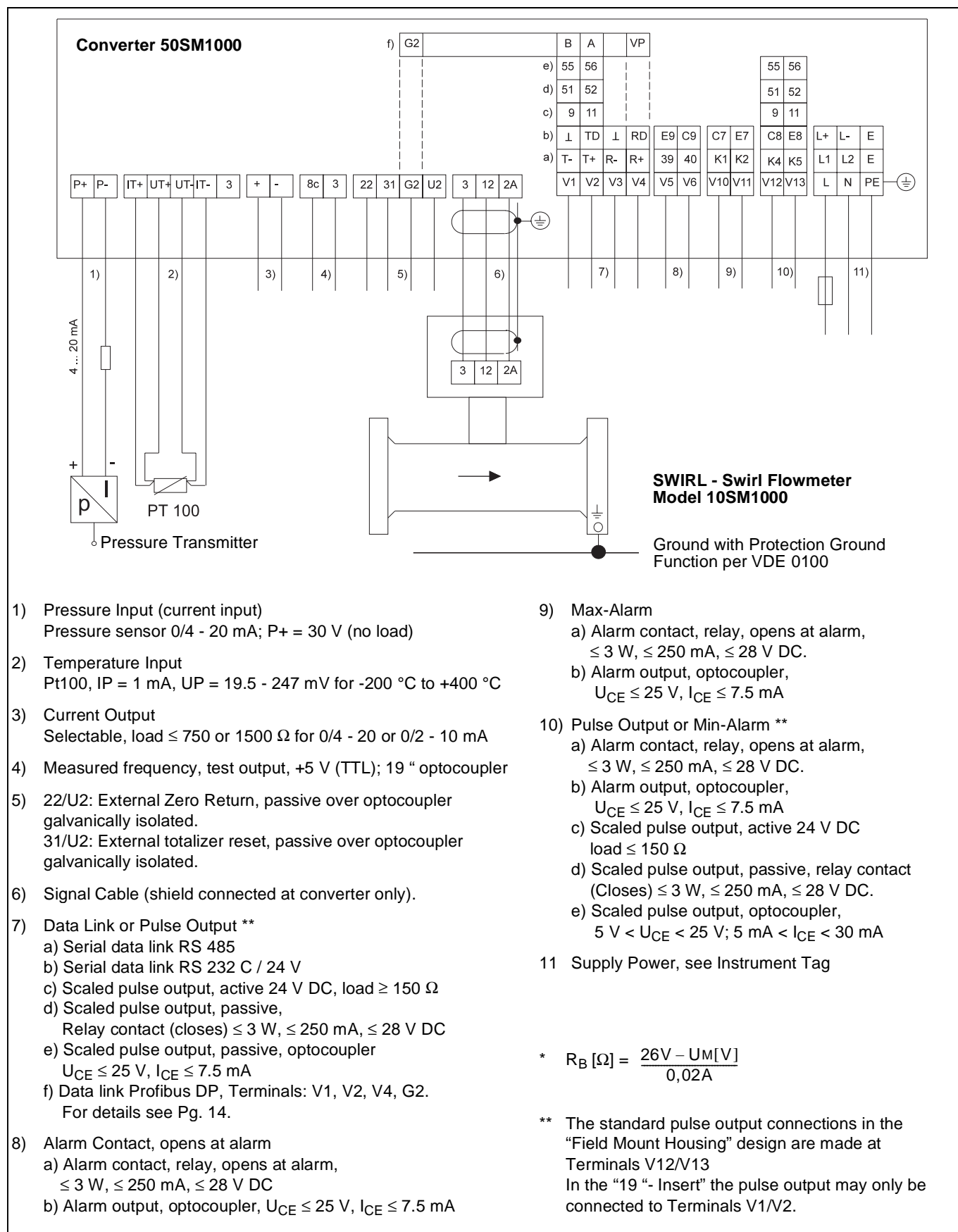


Fig. 18 Interconnection Diagram Flowmeter Primary 10SM1000 - Converter 50VM1000

Interconnection Diagram Flowmeter Primary 10SM1000 Converter 50VM1000 for Ex-Requirements

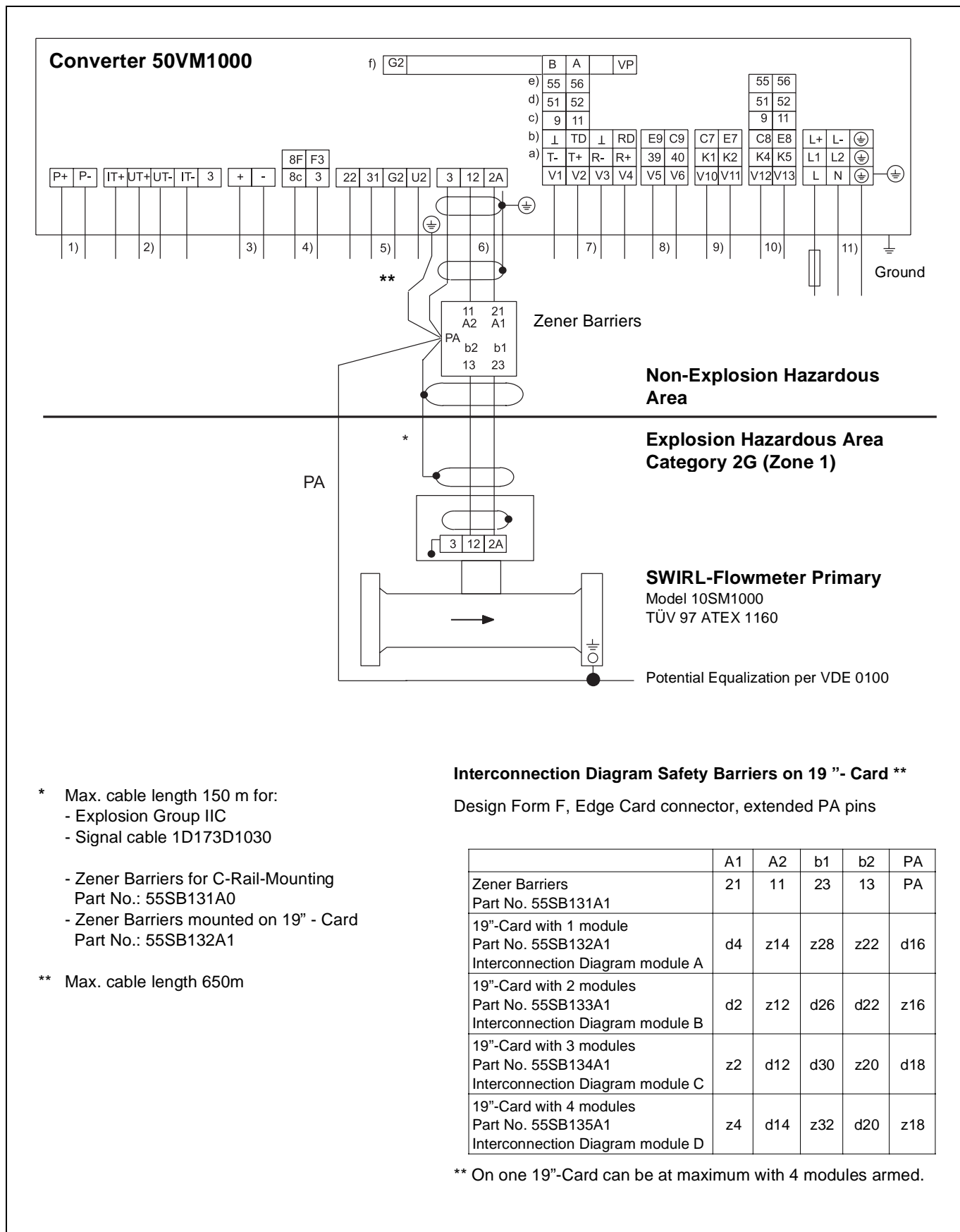
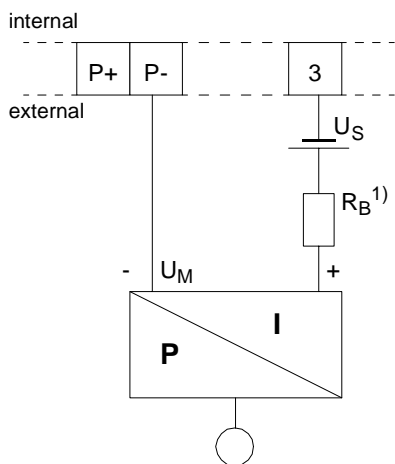


Fig. 19 Terminal Designations: see Fig. 18

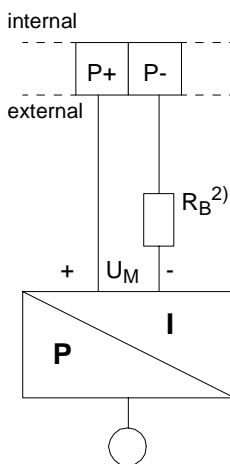
Examples Input Interconnections (Standard)

Pressure Transmitter, external supply



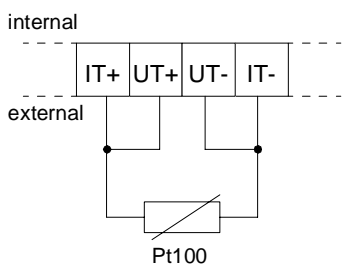
$$1) R_B [\Omega] \leq \frac{U_S V - U_M V}{0,02 A} - 200 \Omega$$

Pressure Transmitter, internal supply

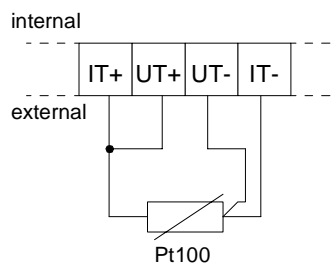


$$2) R_B [\Omega] \leq \frac{26 V - U_M V}{0,02 A}$$

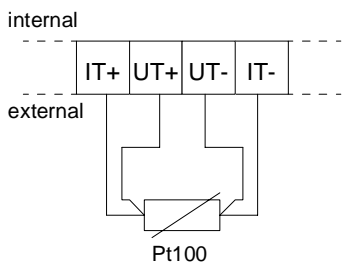
Pt100, 2-Wire Connections



Pt100, 3-Wire Connections



Pt100, 4-Wire Connections



External Totalizer Reset and Zero Return

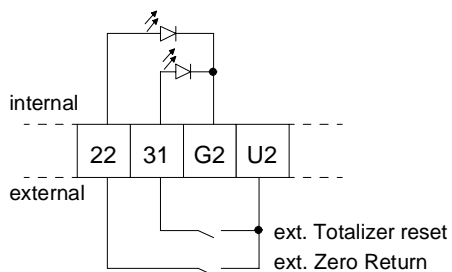
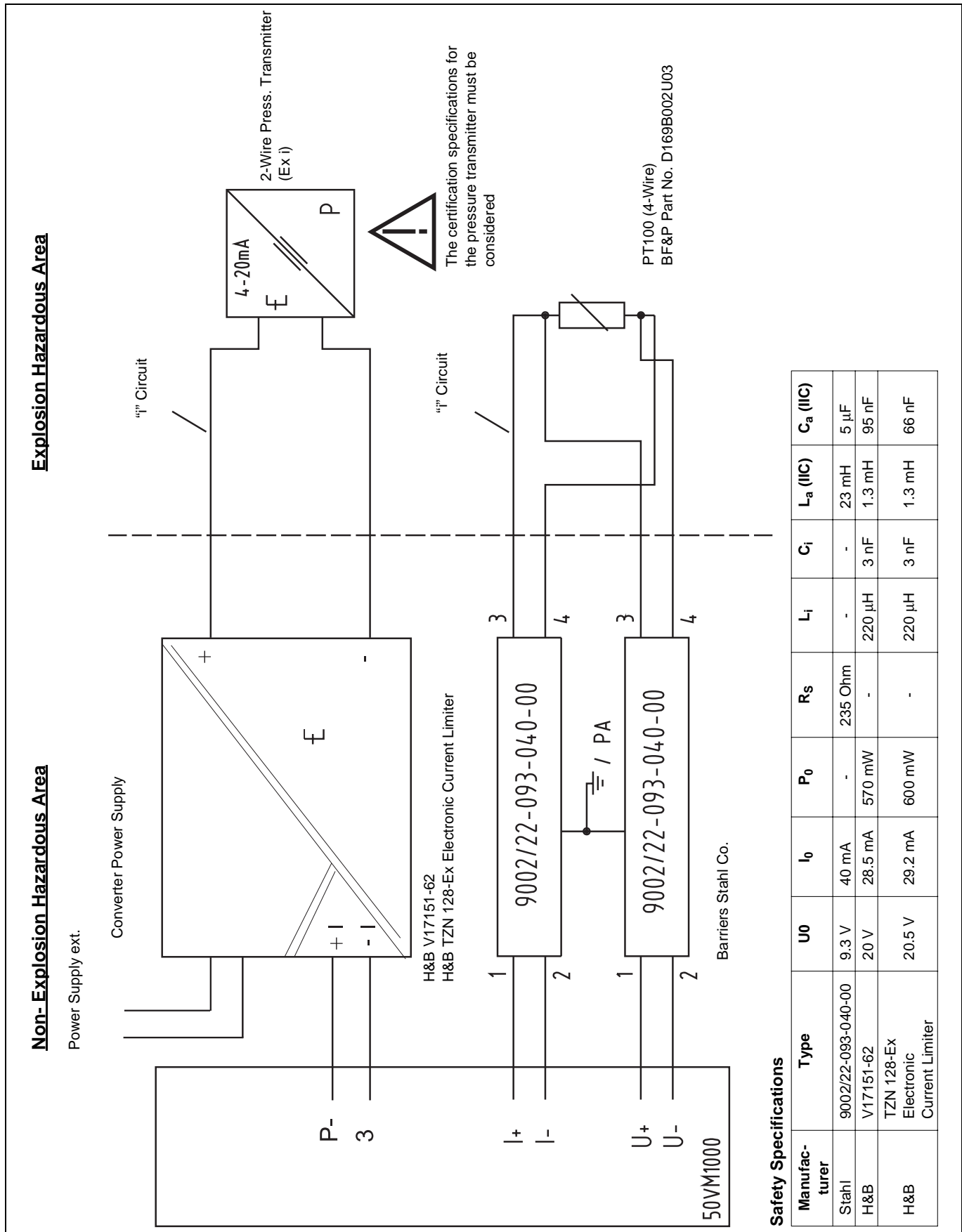


Fig. 20 Input Interconnection Examples

Examples: Input Interconnections for Pressure Transmitter and PT100 for Ex-Requirements



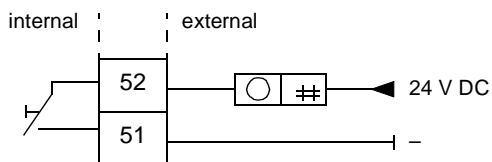
Safety Specifications

Manufacturer	Type	U ₀	I ₀	P ₀	R _S	L _i	C _i	L _a (IIC)	C _a (IIC)
Stahl	9002/22-093-040-00	9.3 V	40 mA	-	235 Ohm	-	-	23 mH	5 µF
H&B	V17151-62	20 V	28.5 mA	570 mW	-	220 µH	3 nF	1.3 mH	95 nF
H&B	TZN 128-Ex Electronic Current Limiter	20.5 V	29.2 mA	600 mW	-	220 µH	3 nF	1.3 mH	66 nF

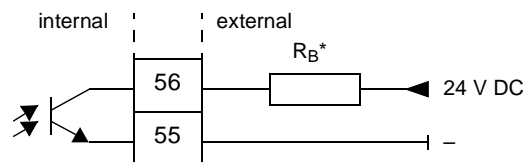
Fig. 21 Interconnection Diagram for Pressure Transmitter and PT100 for Ex-Requirements

Examples: Output Interconnections

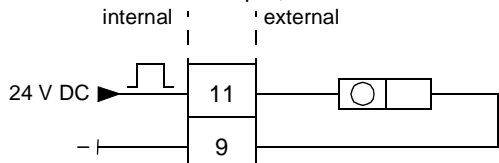
Scaled Pulse Output passive, relay



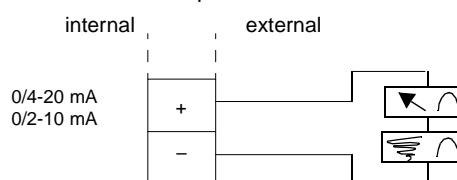
Scaled Pulse Output passive, optocoupler



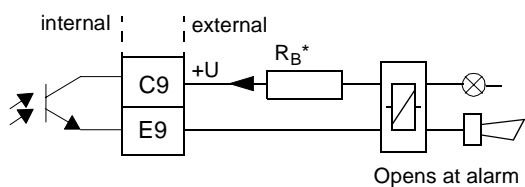
Scaled Pulse Output, active



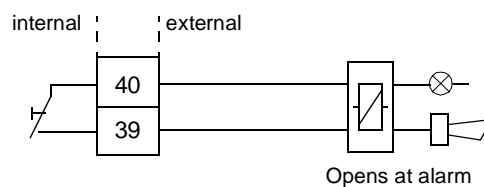
Current Output



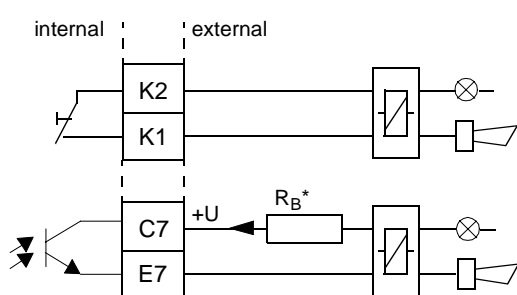
Alarm Output, optocoupler



Alarm Output, relay



Max. Limit Alarm



$$* R_B[\Omega] \geq \frac{U_{CE}[V]}{I_{CE}[A]}$$

Fig. 22 Output Interconnection Examples

SWIRL-SM

Dimensions Converter SWIRL-SM, 50VM1000

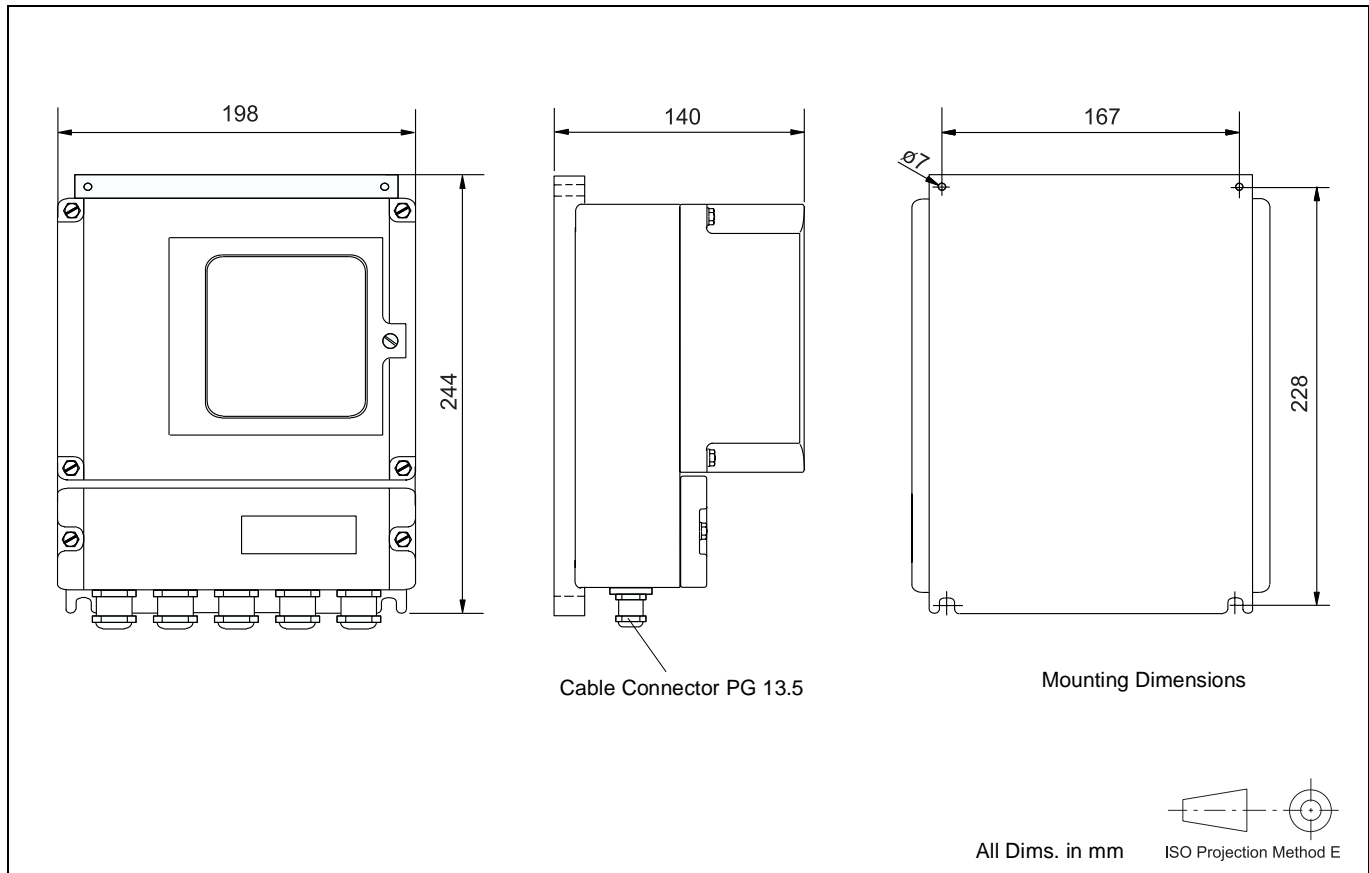


Fig. 23 Dimensions, Field Mount Housing Converter 50VM1000

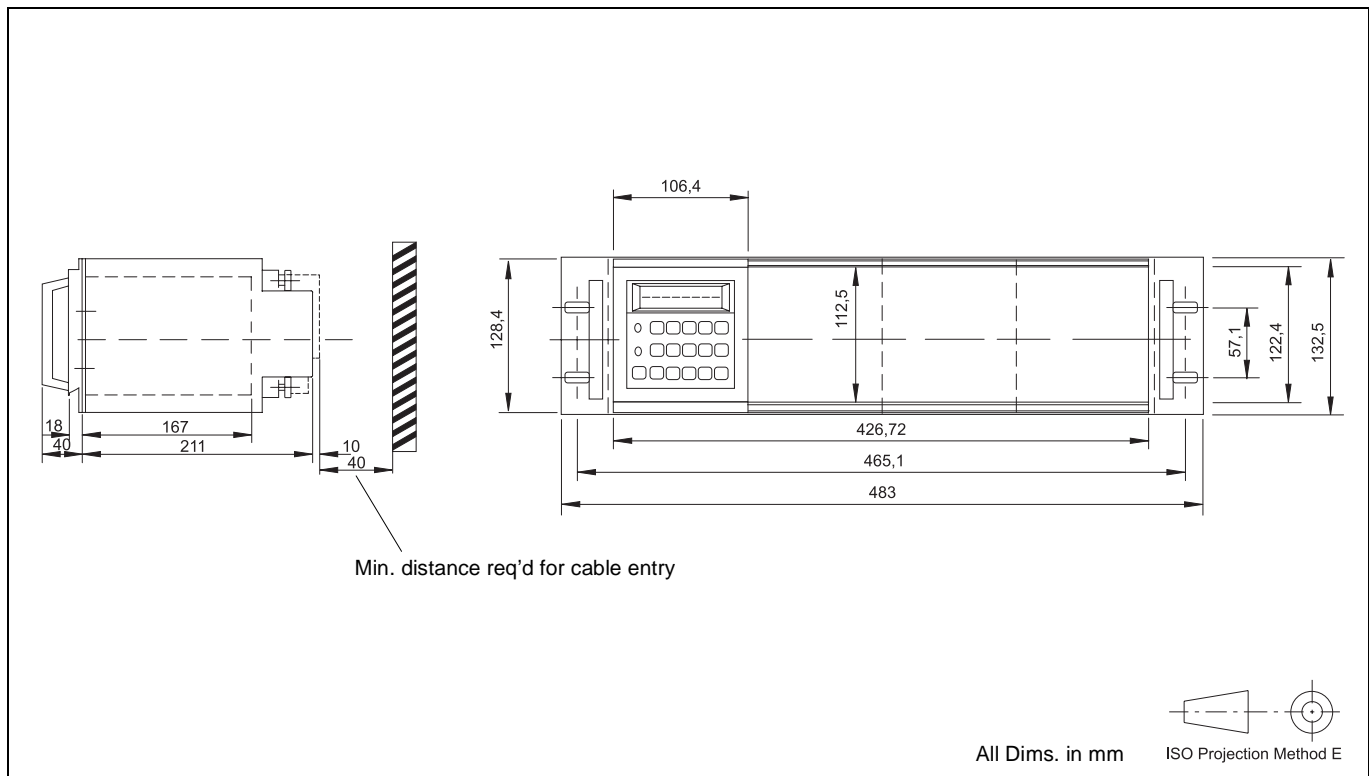


Fig. 24 Dimensions, 19"-Design Converter 50VM1000

Ordering Information

Flowmeter Primary

Ordering Number		10S																		
Instrument Design		Remote (SM-Electronic Module)		M																
Series					1															
Housing, Guide Body Material		SS 316 Ti [No. 1.4571]			1															
		Others			9															
Fluid		Liquid				01														
		Gas				02														
		Natural gas				03														
		Steam				04														
		Superheated steam				05														
		Oxygen ¹⁾				06														
		Others				09														
Design Level																				*
Meter Sizes		Standard Pressure Rating																		
1/2"	DN	15	CL 300 / PN 40																	A
3/4"	DN	20	CL 300 / PN 40																	B
1"	DN	25	CL 300 / PN 40																	C
1-1/4"	DN	32	CL 300 / PN 40																	D
1-1/2"	DN	40	CL 300 / PN 40																	M
2"	DN	50	CL 300 / PN 40																	E
3"	DN	80	CL 300 / PN 40																	F
4"	DN	100	CL 150 / PN 16																	G
6"	DN	150	CL 150 / PN 16																	H
8"	DN	200	CL 150 / PN 16																	I
12"	DN	300	CL 150 / PN 10																	K
16"	DN	400	CL 150 / PN 10																	L
Pressure Rating/Flange		DIN 2501		PN 10																B
				PN 16																C
				PN 25																D
				PN 40																E
		DIN 2512		PN 10																H
		with groove		PN 16																I
				PN 25																K
				PN 40																L
		ANSI		CL 150																P
		ANSI		CL 300																Q
		Others																		Z
Certifications		Standard, none																		1
		ExEx, Zener-Barrier required ²⁾																		2
		Certificate DIN 50049-3.1B																		3
		ExEx + 3.1B ²⁾																		4
Sensor Design		Standard with groove																		A
		Others																		Z
Sensor Gasket		Temperature Range																		
		Kalrez O-Ring		0 °C to +280 °C																3
		Viton O-Ring		-55 °C to +230 °C																4
		PTFE O-Ring		-55 °C to +200 °C																5
		Others																		9
Calibration		Gas- or liquid calibration																		A
Instrument Tag		German																		1
		English																		2

1) Cleaned for Oxygen Service and marked
 2) Zener-Barrier for rail mounting (external to the Ex-Area) Part No.: D177A008U10
 Zener-Barrier for 19"-Insert (external to the Ex-Area) Part No.: D177A019U01

Signal cable (10 m included in instrument price)
 Standard Part No.: 1D173D1018
 Ex Part No.: 1D173D1030

SWIRL-SM

Ordering Information Converter

Ordering Number	50VM1																			
Pulse Output																				
Active (standard)	1																			
Relay	2																			
Optocoupler	9																			
Data Link																				
None	0																			
Serial data link RS485 ¹⁾	1																			
Serial data link RS232 ¹⁾	2																			
Profibus-DP ¹⁾	3																			
Others	9																			
Flowmeter Primary																				
10SM1000, 10VM1000	0																			
10S*5000 Piezo	1																			
10S*5000 NTC	2																			
10S*5000 NTC Ex	3																			
Design Level																				
* * *																				
Software Level																				
* * *																				
Housing																				
Field mounted, keypad accessible																				G
19"-Insert cassette 167 mm with connection board																				M
Others																				Z
Contact Outputs																				
None (only for module)																				0
Optocoupler																				1
Relay																				2
Alarm Signals																				
None																				A
Alarm "MAX/MIN" ²⁾³⁾																				B
Alarm "MAX" ²⁾																				C
Others																				Z
Accessories																				
None																				A
PT-Compensation																				B
HART-Protocol																				C
PT+HART																				D
Others																				Z
Supply Power																				
230 V AC, 50/60 Hz																				A
115 V AC, 50/60 Hz																				B
48 V AC, 50/60 Hz																				C
24 V AC, 50/60 Hz																				D
48 V DC																				E
24 V DC																				F
Instrument Tag																				
German																				1
English																				2
Others																				9

- 1) Not available with HART-Protocol. For 19" pulse output only available with optocoupler.
- 2) For 19" only available with optocoupler.
- 3) Pulse output not available.

Questionnaire SWIRL-SM

Customer:	Date:		
Mr./Mrs./Ms.:	Department:		
Telephone:	Telefax:		
<hr/>			
Fluid: Composition:	<input type="checkbox"/> Steam	<input type="checkbox"/> Gas	<input type="checkbox"/> Liquid
Flowrate: (Min, Max, Operating Value)	m ³ /h	<input type="checkbox"/> Normal conditions <input type="checkbox"/> Operating conditions	
Density: (Min, Max, Operating Value)	kg/m ³	<input type="checkbox"/> Normal conditions <input type="checkbox"/> Operating conditions	
Viscosity: (Min, Max, Operating Value) (for liquids please include)	mPas		
Fluid Temperature: (Min, Max, Operating Value)	°C		
Ambient Temperature:	°C		
Pressure: (Min, Max, Operating Value)	bar		
Ex-Protection:	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
Effective ID of the Pipeline	mm		

Bailey-Fischer & Porter reserves the right to make changes which represent technical improvements without prior notice.

The Product Program includes:

- Variable Area Flowmeters
- Electromagnetic Flowmeters
- Vortex/Swirl Flowmeters
- Mass Flowmeters
- Pressure and Differential Pressure Transmitters
- Gas/Liquid Filling Systems
- Ultrasonic Metering Systems for Concentration Measurements