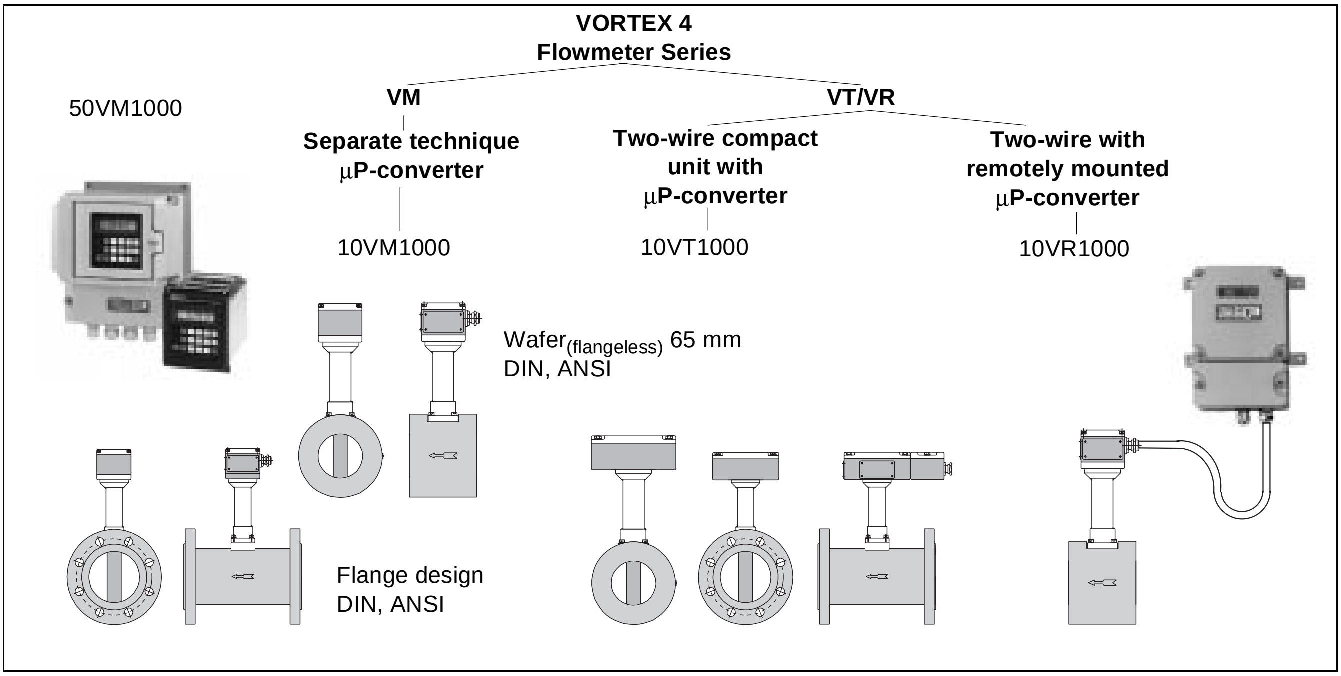
Vortex Flowmeter VORTEX-VM with µP-converter technology



The VORTEX-VM flowmeter is a member of the new Bailey-Fischer & Porter VORTEX 4 Series.

The flowrate of steam, gases and fluids can be measured with the VORTEX-VM over a large range, independent of the physical properties of the fluids.

VORTEX-VM is distinguished by the following **design and application characteristics:**

- No moving parts, no wear, no maintenance.
- Sturdy and simple construction of primary with welded shedder bar, material stainless steel 1.4571 or Hastelloy-C.
- Same sensor and preamplifier electronics for all fluids, meter sizes and types of design.
- Simplest installation and start up - only installation in pipeline and electrical connection.
- Explosion proof design:
  TÜV 97 ATEX 1160 II 2G EEx ib IIC T4.
- µP-controlled converter electronics with modern digital filter technique, checked in accordance with the EMV-NAMUR requirements.
- Primary and converter interchangeable.
- High contrast, illuminated LC-Display, alphanumeric, 2 x 16 characters; both lines in the display freely configurable.
- Press. and temp. compensation for gases and steam.
- Extensive function tests, including manual process control through the entry of user selected flowrates.
- Standardized 0/4-20 mA current output and active, galvanically isolated pulse output.
- Multiple options: limit values (Min, Max), field mounted housing or 19” design.
- Communication: - HART®–Protocol
  - ASCII-Protocol (RS232C or RS485)
  - Profibus-DP
- Measured value deviation (Re > 20.000/40.000)
  Fluids: ≤ ± 0,75 % of measured value
  Gases/steam: ≤ ± 1 % measured value
- Dual sensor design with two independent sensor and converters.

Fig. 1 VORTEX-VM, Primary 10VM1000 and converter 50VM1000

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Vortex flowmeter with µP-converter

Principle of operation

The operation of the VORTEX-XM flowmeter is based on the Karman vortex street. Eddies are alternately generated on each side of the bluff body (shedder) when the medium flows against the bluff body. The flow causes theses eddies to be shed resulting in the formation of a series of eddies (Karman vortex street, Fig. 2).

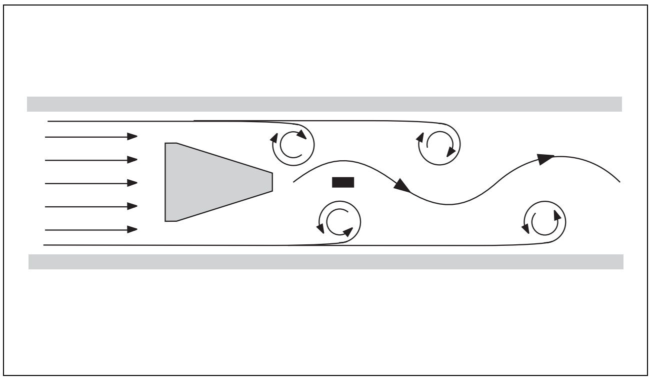

Fig. 2 Karman vortex street

The shedding frequency **f** is proportional to the flow velocity **v** and inversely proportional to the width of the bluff body **d**:

$$f = St \times \frac{v}{d}$$

St is the dimensionless Strouhal number, a constant, which characterizes the quality of the Vortex flowmeter.

Through proper design and dimensions of the shedder the value **St** remains constant over a wide range of Reynolds number **Re** (Fig. 3).

$$Re = \frac{v \times D}{\nu}$$

ν = kinematic viscosity
D = meter diameter

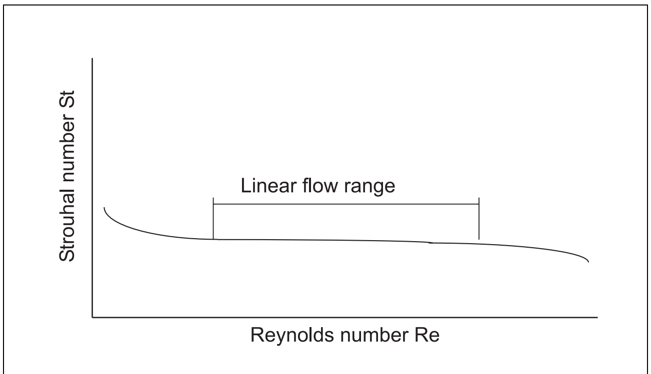

Fig. 3 Strouhal no. versus Reynolds no.

The shedding frequency which is to be utilized as the measurement is dependent of the flow rate and independent of the fluid density and viscosity.

The localized pressure variations resulting from the shedding eddies are detected by a piezo-sensor and converted to pulses corresponding to the eddy frequency.

These pulses are processed in the converter into frequency signals for further processing (scaled), or direct current signals.

There is the possibility to compensate for pressure and temperature when metering gas flows. Additional converter input terminals are available for pressure and temperature signals. Therefore the converter output signals can refer either to flow Q_v or standard volume Q_n (normal press. = 1013 mbar and temperature = 0 °C) or mass flow rate Q_m (requires a density input) units (Fig. 4).

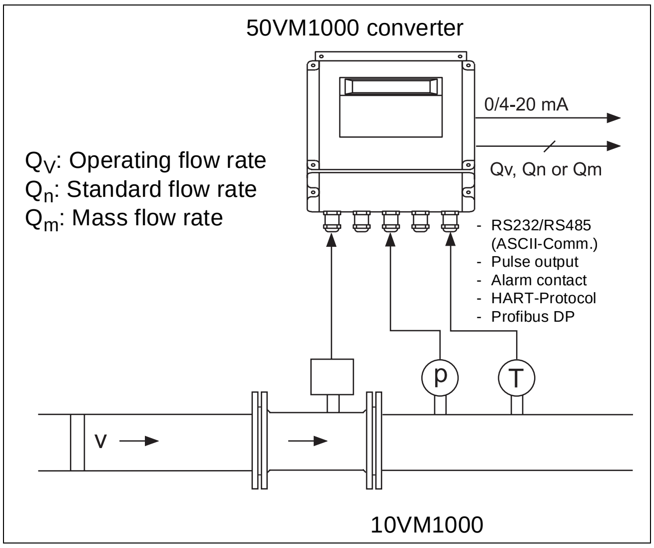

Fig. 4 Gas or steam measurement with pressure and temperature compensation

Technical Data
Primary - meter sizes, flow ranges, pressure drop

Meter size selection

The meter size selection is a function of the maximum operating flow rate (Q_V). To achieve a maximum of measuring spans, this flow rate should be at least one-half of the maximum flow rate (Q_V max DN) per meter size. The linear measuring range (see accuracy data) corresponds to a Reynolds number range from 20.000/40.000 (meter size ≥ DN 150 (6")) up to 7.000.000.

If the flow rate to be measured is in standard (normal temp. and pressure: 0 °C, 1013 mbar) or mass flow units, these values must first be converted to actual flow units at operating conditions in order to select the appropriate meter size from the flow range tables (1,2 and 3).

1. Conversion standard density (ρ_n) --> operating density (ρ)

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

2. Conversion to operating flow rate (Q_V)

a) from standard volume flow rate (Q_n) -->

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

b) from mass flow rate (Qm) -->

$$Qv = \frac{Qm}{\rho}$$

3. Dynamic viscosity (η) --> kinematic viscosity (ν)

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

ρ = operating density [kg/m^3]

ρ_n = standard density [kg/m^3]

p = operating pressure [bar]

T = operating temperature [°C]

Q_V = operating flow rate [m^3/h]

Q_n = standard flow rate [m^3/h]

Q_m = mass flow rate [kg/h]

η = dynamic viscosity [Pas]

ν = kinamatic viscosity [m^2/s]

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.

Minimum (linear flow rate, liquids

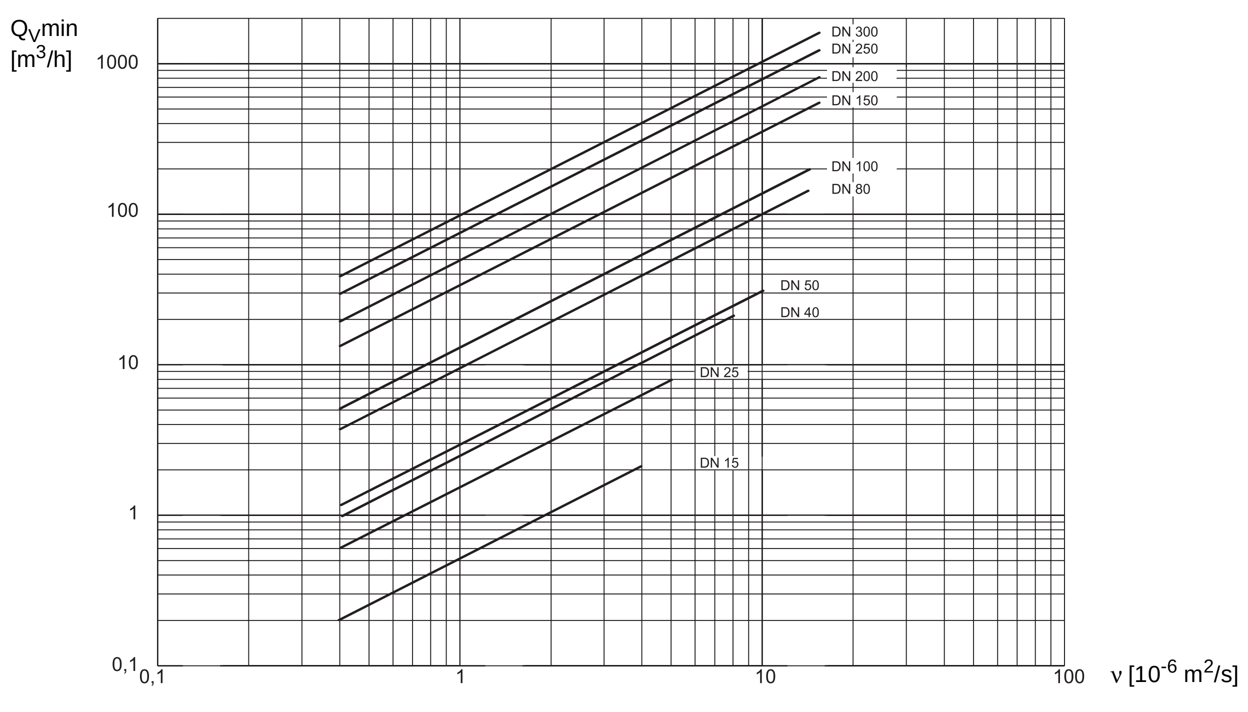

Fig. 5 Minimum liquid flow rates versus kinematic viscosity

Technical Data
Primaty - meter sizes, flow ranges, pressure drop

Maximum flow rate, liquids

DN	$Q_V$min [m^3/h]	$Q_V$max DN [m^3/h]	Frequency [Hz] at $Q_V$max DN
15	0,5	6	400
25	0,8	18	240
40	2,4	48	190
50	3	70	150
80	8	170	100
100	10	270	70
150	30	630	50
200	70	1000	32
250	60	1700	28
300	95	2400	25

Table 1 Maximum flow rate, liquids

Pressure drop, liquids

See Fig. 6 for water (20 °C, 1013 mbar, ρ = 998 kg/m^3).
For other liquid densities (ρ) use the following equation to calculate the pressure drop:

$$\Delta p' = \frac{\rho}{998} \times \Delta p$$

$\Delta p'$ = pressure drop, operating liquid [mbar]

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

Static positive pressure, liquids

A static positive pressure is required downstream of the meter to prevent cavitation when metering liquids. This pressure can be estimated using the following equation:

$p_2 \geq 1{,}3 \times p_{Vapor} + 2{,}6 \times \Delta p'$

p_2 = Downstream static positive pressure [mbar]

p_{Vapor} = Liquid vapor pressure at operating temperature [mbar]

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

Example for liquids:

Desired is the meter size (DN) for the metering of 55 m^3/h liquid with a density of 850 kg/m^3 and a kinematic viscosity of 2 cSt (=2 x 10^{-6} m^2/s).

1. Q_V = max. 55 m^3/h --> DN 50 (see table 1): $Q_V$max DN= 70 m^3/h
2. Min. linear flow rate at 2 cSt, (from Fig. 6): $Q_V$min = 6 m^3/h
3. Pressure drop ρ = 850 kg/m^3: $\Delta p'$ = 425 mbar

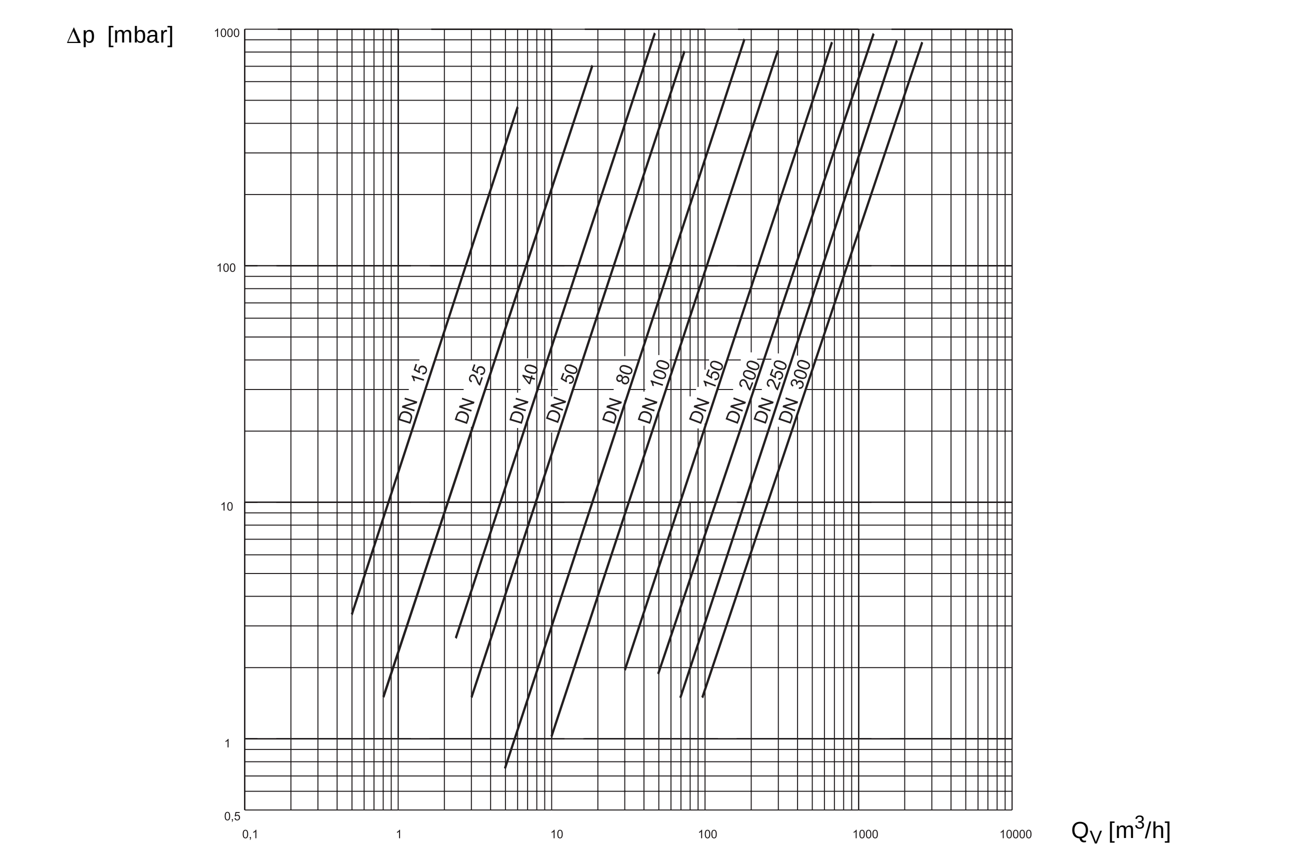

Fig. 6 Pressure drop, water (20 °C, 1013 mbar, ρ = 998 kg/m^3), DIN

Technical Data
Primary - meter sizes, flow ranges, pressure drop

Flow rates, gas/superheated steam

DN	Qmin / $Q_V$max DN [m³/h]		Frequency [Hz] at $Q_V$max DN	
	DIN	ANSI	DIN	ANSI
15	24	24	1620	2080
25	150	82	1990	2000
40	390	320	1520	2000
50	500	450	1030	1300
80	1200	1000	700	870
100	1900	1900	500	670
150	4500	4050	360	450
200	8000	8000	240	240
250	14000	14000	260	260
300	20000	20000	214	240

Table 2 Flow rates, gas/superheated steam

Example for gas:

Desired is the meter size (DN) for the metering of 2540 Nm³/h CO_2-gas; temperature = 85 °C, pressure = 5 bar abs.

ρ_n= 1,97 kg/m³

1. Convert ρ_n-->ρ : =7,4 kg/m³
2. Convert Nm³/h --> m³/h: Q_V = 676 m³/h
   --> size selection: DN 80 ($Q_V$max = 1200 m³/h)
3. Pressure drop at ρ = 7,4 kg/m³: $\Delta p'$ = 100 mbar
4. Min. linear flow rate for ρ = 7,4 kg/m³ (from Fig. 7):
   $Q_V$min = 45m³/h,
   Convert m³/h --> Nm³/h: $Q_V$min = 169 Nm³/h

Pressure drop gas/superheated steam

See Fig. 8 for air (at 20 °C, 1013 mbar, = 1,2 kg/m³)
For other liquid densities the pressure drop is calculated using the following equation:

$$\Delta p' = \frac{\rho}{1,2} \times \Delta p$$

$\Delta p'$ = medium pressure drop [mbar]

Δp = air pressure drop (from Fig. 6) [mbar]

Standard density of some selected gases:

Gas	Standard density [kg/m³]
Acetylene	1,172
Air	1,29
Ammonia	0,771
Argon	1,780
Butane	2,700
Ethane	1,350
Ethylene	1,260
Hydrogen	0,0899
Methane	0,717
Neutral gas	0,828
Neon	0,89
Nitrogen	1,25
Oxygen	1,43
Propane	2,02
Propelene	1,915

Minimum flow rate, gases/superheated steam

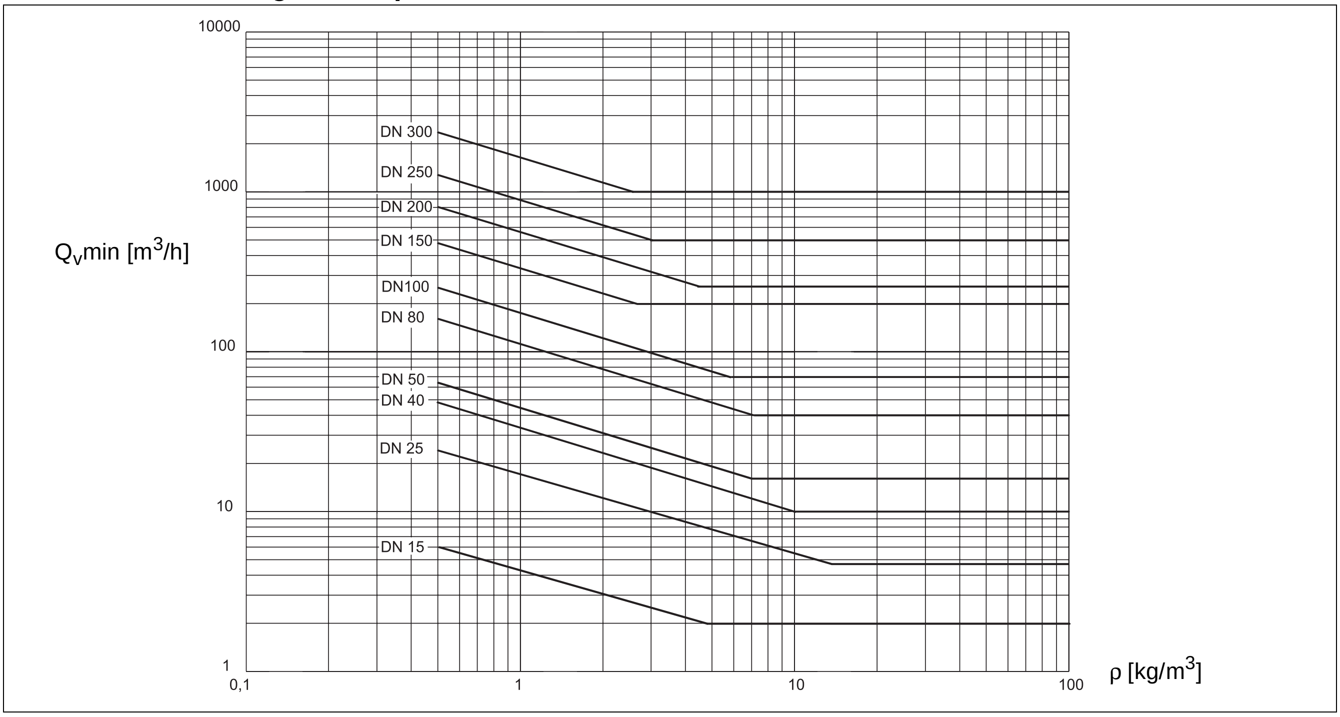

Fig. 7 Minimum flow rate, gases/superheated steam versus medium density, DIN

Technical Data
Primary - meter sizes, flow ranges, pressure drop

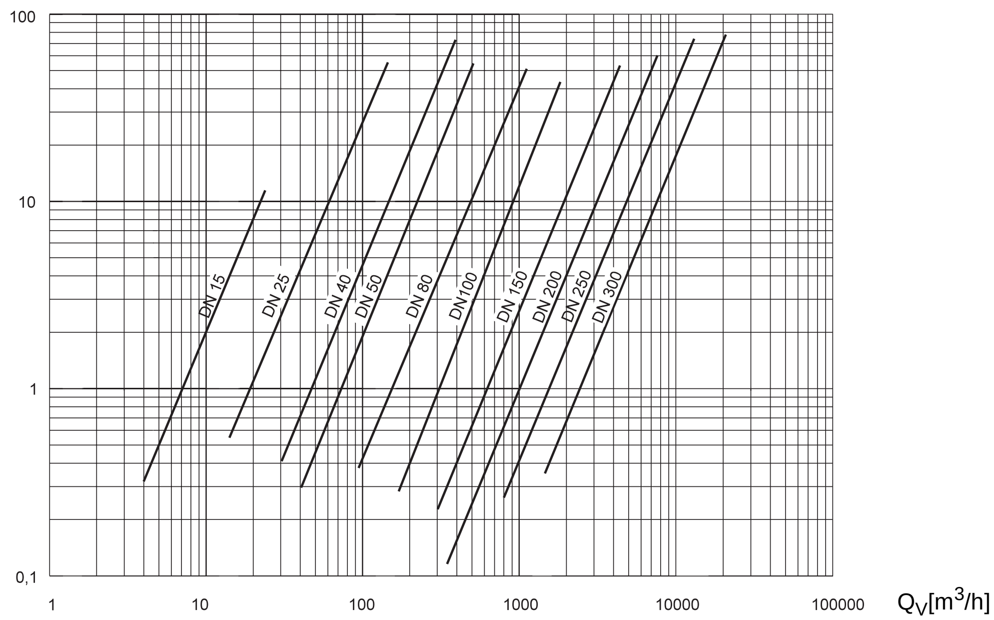

Fig. 8 Pressure drop, air (20 °C, 1013 mbar, ρ = 1,2 kg/m^3), DIN

Flow rates, saturated steam [kg/h]

Example for saturated steam:

Desired is the flow range for DN 50 at 7 bar a.

--> from table 3: DN 50: 84 - 1835 kg/h

Additional information: Saturated steam temp. = 165 °C
Saturated steam density = 3,67 kg/m^3

p[bar a] DN	0,5	1	1,5	2	3	4	5	6	7	8	9	10	12	15	25	30	35	40
15 min	3	4	5	6	7	8	9	10	10	11	12	12	14	15	21	25	30	34
max	7	14	21	27	40	52	64	76	88	100	112	124	147	182	300	360	420	480
25 min	9	13	15	17	21	24	27	29	31	33	35	37	41	45	58	69	81	92
max	45	89	129	169	248	324	401	476	551	624	699	773	920	1140	1875	2250	2625	3000
40 min	18	25	30	35	42	48	54	59	63	67	71	75	81	91	131	158	184	210
max	117	230	335	440	644	842	1041	1236	1431	1622	1817	2009	2391	2964	4875	5850	6825	7800
50 min	24	34	41	47	56	64	72	78	84	89	95	95	109	128	210	252	294	336
max	150	295	430	565	825	1080	1335	1585	1835	2080	2330	2575	3065	3800	6250	7500	8750	10000
80 min	60	84	102	116	141	161	179	195	210	223	236	249	270	302	481	578	674	770
max	360	708	1032	1355	1980	2592	3204	3804	4404	4992	5592	6180	7356	9120	15000	18000	21000	24000
100 min	90	126	152	175	211	241	269	293	315	335	355	373	407	493	811	974	1136	1298
max	570	1121	1634	2145	3135	4104	5073	6023	6973	7904	8854	9785	11647	14440	23750	28500	33250	38000
150 min	180	252	305	349	422	483	577	685	793	899	1007	1112	1324	1642	2700	3240	3780	4320
max	1350	2655	3870	5081	7425	9720	12015	14265	16515	18720	20970	23175	27585	34200	56250	67500	78750	90000
200 min	150	213	311	408	597	781	966	1147	1327	1505	1685	1863	2217	2749	4521	5425	6330	7234
max	2400	4720	6880	9032	13200	17280	21360	25360	29360	33280	37280	41200	49040	60800	100000	120000	140000	160000
250 min	480	673	813	931	1126	1288	1517	1801	2086	2363	2647	2926	3482	4318	7101	8622	9942	11362
max	4200	8260	12040	15806	23100	30240	37380	44380	51380	58240	65240	72100	85820	106400	175000	210000	245000	280000
300 min	840	1178	1422	1630	1970	2254	2506	2731	2951	3345	3747	4141	4929	6111	100051	12062	14072	16082
max	6000	11800	17200	22580	33000	43200	53400	63400	73400	83200	93200	103000	122600	152000	250000	300000	350000	400000
Density sat [kg/m^3]	0,30	0,59	0,86	1,13	1,65	2,16	2,67	3,17	3,67	4,16	4,66	5,15	6,13	7,60	12,50	15,00	17,50	20,00
Temp. Tsat [°C]	81,3	99,6	111,4	120,0	133,0	144,0	152,0	159,0	165,0	170,0	175,0	180,0	188,0	198,0	224,0	234,0	242,0	250,0

Table 3: Saturated steam flow ranges DIN design

Technical Data
Primary

Fig. 9 10VM1000 primary, wafer design

Measurement accuracy and reproducibility

Accuracy (incl. converter), linear range
(Re > 10.000; DN 150 is Re > 40.000):

Gas/steam: ≤ ± 1 % of flow rate

Liquids: ≤ ± 0,75 % of flow rate

Reproducibility

≤ 0,2 % of flow rate

Overflow capability:

Gases:
15 % beyond maximum flow rate

Flüssigkeiten:
15 % beyond maximum flow rate;
Note: Cavitation is not allowed to be present

Operating pressure:

Flanged design: DIN PN 10 to 40, option up to PN 160
ANSI Class 150/300, option up to 1200 lbs

Wafer$_{(flangeless)}$: DIN PN 10 to 40 option up to PN 160,
ANSI Class 150/300, option up to 900 lbs

Other ratings upon request.

Connections:

Process connection

Flanges per DIN or ANSI standards, wafer$_{(flangeless)}$

Electrical connection

Terminal strip (screw-type)
Screw-type conduit fitting Pg 13,5

Enclosure classification:

IP 65

Weights and dimensions:

see dimension drawings

Materials:

Housing
Stn. stl. 1.4571 (316ti), option: Hastelloy-C

Flange
Stn. stl. 1.4571 (316ti), option: Hastelloy-C

Shedder
Stn. stl. 1.4571 (316ti), option: Hastelloy-C

Sensor
Stn. stl. 1.4571 (316ti), option: Hastelloy-C

Sensor seal

Kalrez O-Ring:	0 °C to 280 °C
Viton O-Ring:	-55 °C to 230 °C
PTFE O-Ring:	-200 °C to 200 °C
HT-Special :	-55 °C to 320 °C

Other materials upon request.

Ambient conditions:

Ambient temperature: - 55 °C to + 60 °C
Resistance to climate
changes (per DIN 40040): GSG
relative humidity: max. 85 %, yearly averagel ≤ 65 %

Explosion proof design:

Explosion protection for 10VM1000 designed for II 2G EEx ib IIC T4 in conjunction with Zener barrier (see page 16).
Distance between primary and Zener barrier ≤ 150 m
(for explosion group IIC with a cable capacity of 160 pF/m).
Ambient temperature -20 °C to +60 °C
(up to -55 °C upon request).
Fluid temperature -55 °C to +280 °C.

Installation of primary

The following recommendations should be observed when installing the primary in the pipeline.

Upstream and downstream pipe sections

The flow profile should enter the flowmeter undisturbed to assure optimum operation.

An approx. 15 times the meter size DN long straight pipe section is to install upstream of the primary.

The upstream straight pipe section should be at least 25 times the meter size DN long after elbows, reducers.

A 5 times the meter size DN long straight pipe section is to install downstream of the primary (Fig. 11).

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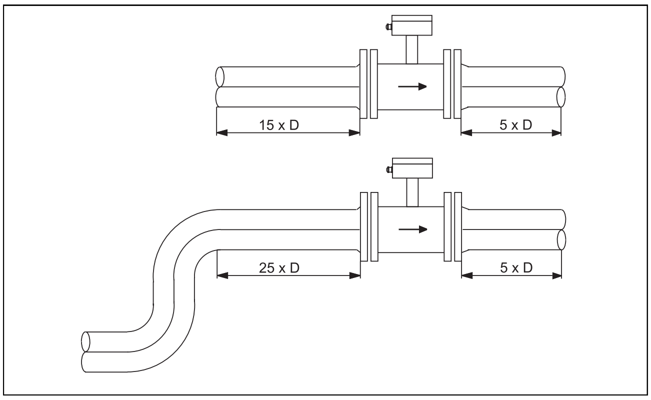


Fig. 10 Inlet and outlet straight pipe sections

Flow control devices are to install downstream of primary (see Fig. 11).

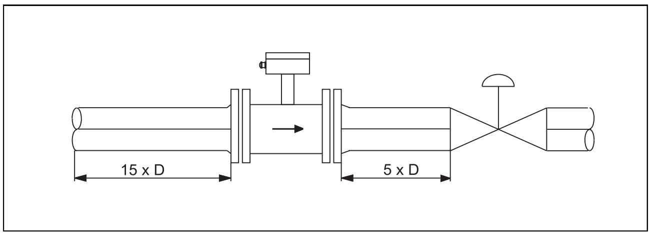


Fig. 11 Control device location

Pressure and temperature measurement

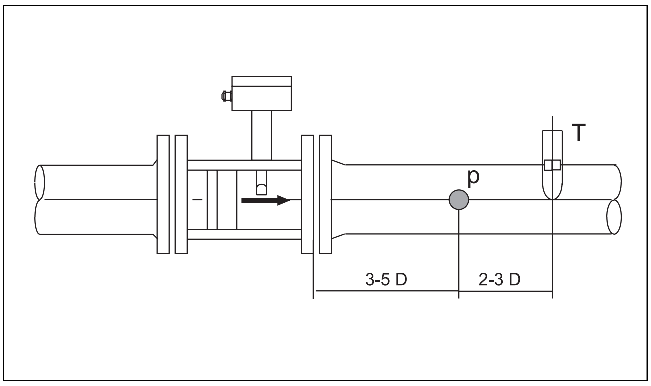


Fig. 12 Pressure and temperature measurement locations

Centering of wafer$_{\text{(flangeless)}}$ design

The centering of the wafer design instrument is carried out using the outside diameter of the primary and the mounting stud bolts. Accessory for instruments of special pressure ratings such as bolt sleeves or installation rings are additionally delivered.

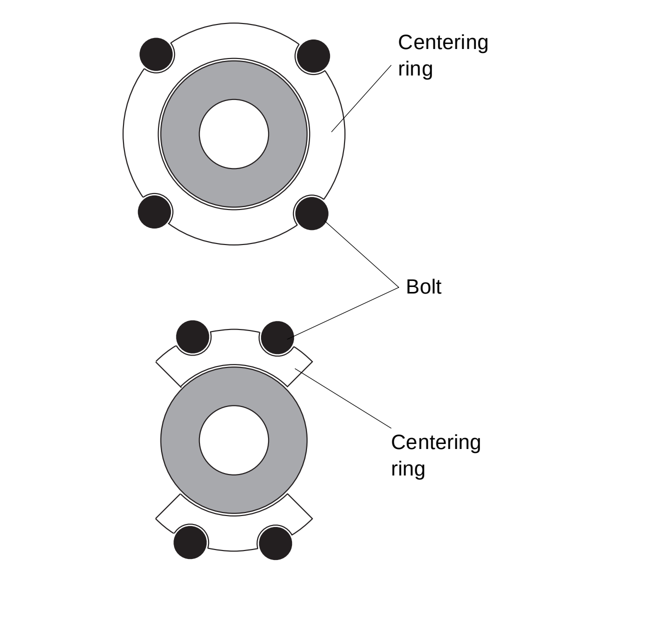


Fig. 13 Wafer design installation using centering ring or segment

Additional installation recommendations

- When carrying out liquid measurements, ensure that the primary is always full with liquid.
- For horizontal installation and fluid temperatures > 150 °C the arrangement as shown in Fig. 14 is recommended.
- If gas pockets are present provide for a gas separator.
- Pipeline vibrations are to be absorbed upstream and downstream of the flowmeter.

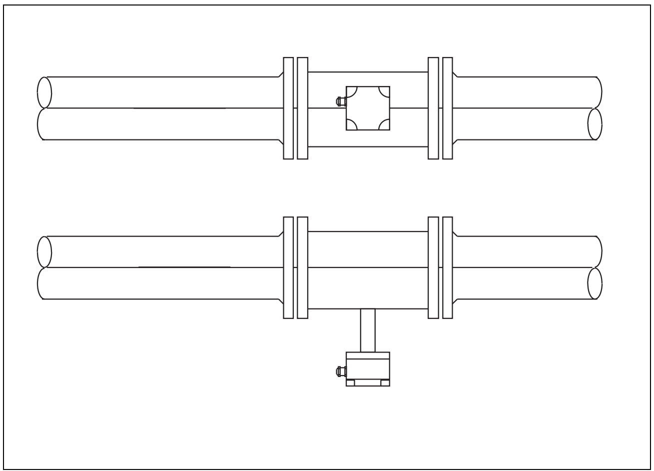
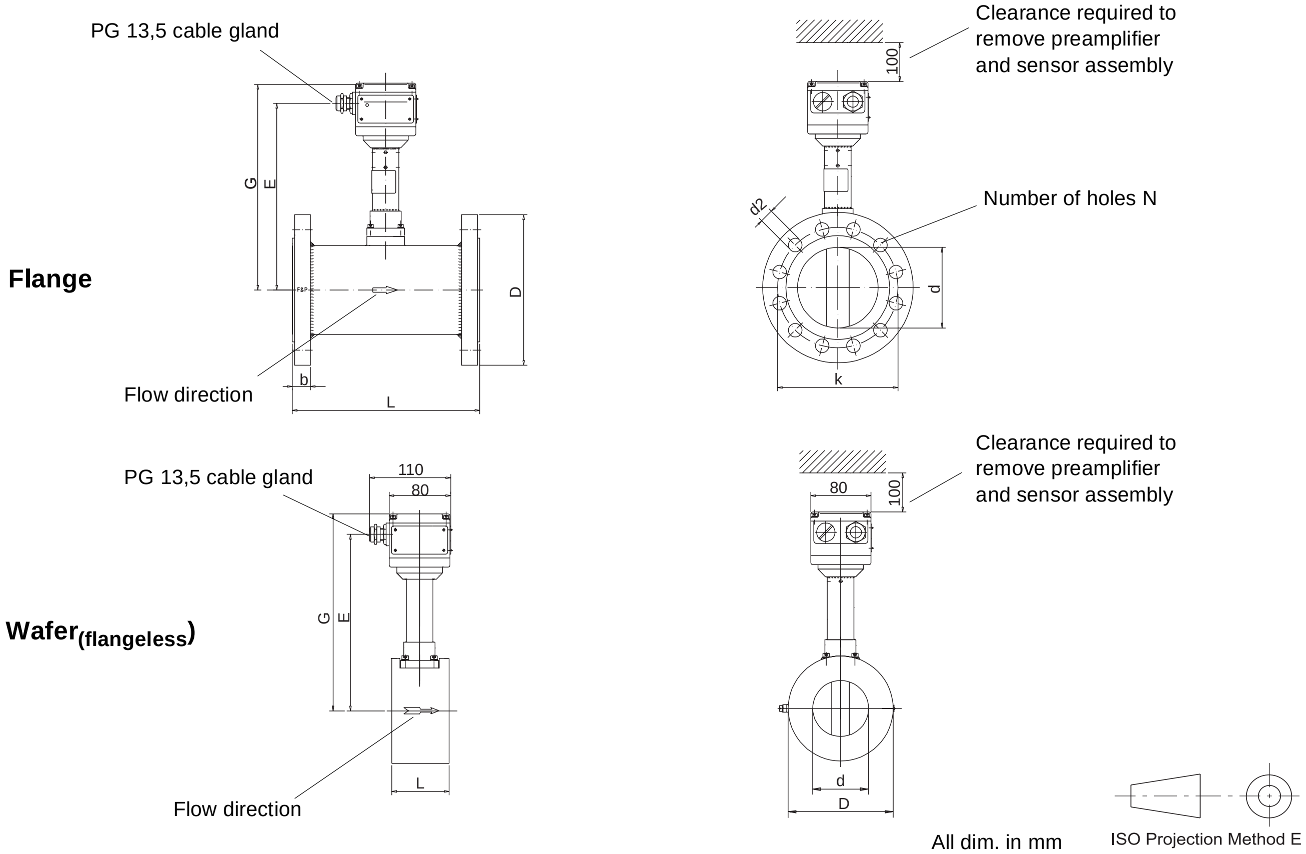


Fig. 14 High temperature installation

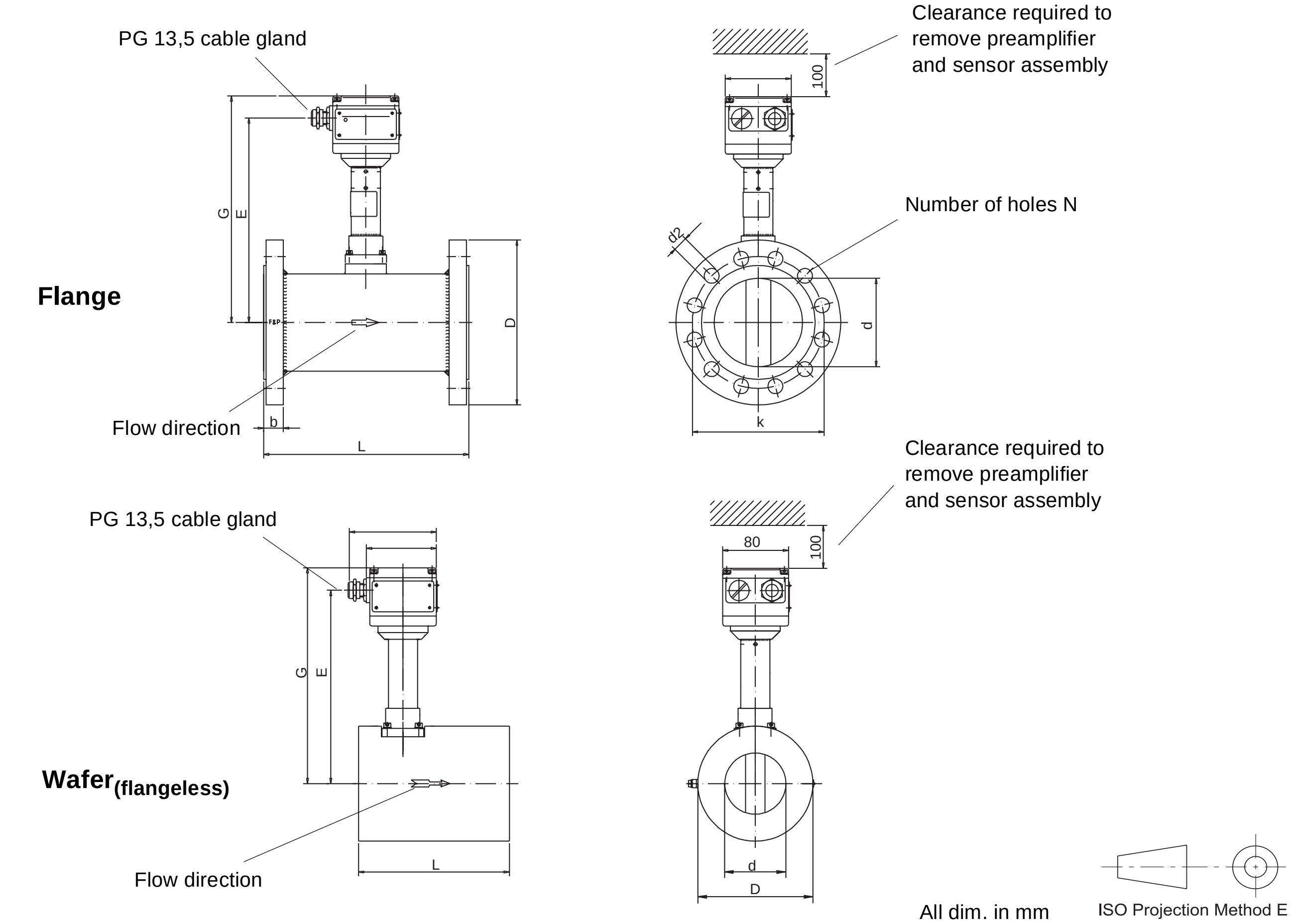
Dimension drawings
VORTEX-VM, primary, DIN



Meter size DN	Pressure rating PN	L	E	D	G	k	d2	d	b	N	Weight [kg]
DN	PN	**Flange**									
15	10-40	200	217	95	242	65	14	17,3	16	4	4,5
25	10-40	200	220	115	245	85	14	28,5	20	4	5
40	10-40	200	211	150	236	110	18	43,1	20	4	6,5
50	10-40	200	220	165	245	125	18	54,5	22	4	8,7
80	10-40	200	238	200	263	160	18	82,5	26	8	13
100	10-16 25-40	250	246	220 235	270	180 190	18 22	107	22 26	8	14,8 17,8
150	10-16 25-40	300	273	285 300	298	240 250	22 26	159,3	24 30	8	25,4 33,5
200	10-16 25-40	350	300	340 360/375	330	295 310/320	22 26/30	206,5	26 32/36	8/12 12	
250	10-16 25-40	450	328	395/405 425/450	353	350/355 370/385	23/27 30/33	260,5	26 32/38	12	
300	10-16 25-40	500	353	445/460 485/515	378	400/410 430/450	23/27 30/33	309	26/28 34/42	12 16	
DN	PN	**Wafer(flangeless)**									
15	10-40	65	217	55	242	-	-	17,3	-	-	
25	10-40	65	230	73	255	-	-	28,5	-	-	4
40	10-40	65	213	94	238	-	-	43,1	-	-	4,7
50	10-40	65	215	109	245	-	-	54,5	-	-	5,5
80	10-40	65	230	144	260	-	-	82,5	-	-	7,5
100	10-40	65	238	164	268	-	-	107,1	-	-	8,4
150	10-40	65	265	220	300	-	-	159,3	-	-	13

Fig. 15 Dimension drawings of VORTEX-VM primary, DIN

Dimension drawings
VORTEX-VM primary, ANSI



Meter size / Pressure rating		L	E	D	G	k	d2	d	b	N	Weight [kg]
ANSI	lbs	**Flange**									
1"	150/300	200	220	108/124	245	79,4/88,9	15,9/19	24,3	16/19	4/4	5,7/6
1-1/2"	150/300	200	211	127/155,7	225	98,4/144,3	15,9/ 22,6	38	19,5/22,6	4/4	5,5/8,3
2"	150/300	200	220	152,4/165	245	120,6/127	19	49,2	21/24	4/8	8,5/11,3
3"	150/300	200	238	190,5/209,5	263	152,2/168,3	19/22,2	73,7	25/30	4/8	12,5/17,1
4"	150/300	250	246	228,6/254	270	190,5/200	19/22,2	97,2	26/34	8/8	18,4/27,4
6"	150/300	300	273	279,4/317,5	298	241,3/270	22,2	146,4	27/38	8/12	32/38
8"	150/300	350	305	343/381	330	298/330,2	22,2	193,2	30/40	8/12	
10"	150/300	450	328	406,4/444,5	349	362/387,2	25,4/ 28,4	254,5	30,2/47,4	12	
12"	150/300	500	353	482,6/520,7	375	431,8/450,8	25,4/ 31,7	304,8	31,8/50,8	12/16	
ANSI	lbs	**Wafer$_{(flangeless)}$**									
1/2"	150/300	112,5	217	52,2	242	-	-	13,9	-	-	
1"	150/300	112,5	243	70,5	257	-	-	24,3	-	-	5
1-1/2"	150/300	113	212	89,7	239	-	-	38,1	-	-	6
2"	150/300	112,5	212	104,6	238/284	-	-	49,2	-	-	8,3
3"	150/300	111	234	138,5	260	-	-	73,7	-	-	11,1
4"	150/300	116	247	174,6	273	-	-	97,2	-	-	17,1
6"	150/300	137	274	222,2	300	-	-	146,4	-	-	25,7

Fig. 16 Dimension drawings of VORTEX-VM primary, ANSI

Technical Data
VORTEX-VM, 50VM1000 converter

Fig. 17 50VM1000 converter

Flow ranges
Continuously adjustable between the $Q_v$min and $Q_v$max corresponding to the frequency output of the primary.

Parameter entry
The entry can be made using the membrane keyboard (16 keys) in clear text dialog with the digital display, through communication ports or via the HART-protocol using a PC.

Data security
Storage of the totalizer values in a NV-RAM with a more than 10 years memory without external power supply in case of power failure or cut-off.

Additional data security of all parameters related to the measuring point, is provided by two serial EEPROMs, one located in the signal converter the other one on the external terminal board of the converter.

The EEPROMs permit a single quick exchange of the converter electronics (converter plug-in unit) because no parameter input is required. Data are read out from the external EEPROM into the exchange one after pressing corresponding keys.

The accuracy of the system remains unchanged.

Functional tests
Individual elements can be tested through the built in self-test software. All converter outputs can be simulated for start up and checking corresponding to self selected flow rates (manual process simulation).

Operating mode

Primary
The converter can be connected to different types of Bailey-Fischer & Porter primaries - vortex or swirlmeters. The operating mode parameter is utilized to synchronize the converter with the primary.

Fluid
The primary can be used for gases/steam or liquid flow measurement. The flow ranges vary by fluid type for the various meter sizes.

Operating mode (actual, standard, mass)
The output signals can be referenced either to operating flow (actual flow conditions), standard flow (standard conditions: p = 1013 mbar, T = 0 °C) or mass flow (density entry is required).

Damping
Adjustable between 0,2 and 100 s

Low flow cut-off
Adjustable between 0 to 10 % of $Q_v$max DN

Power supply
230 / 115 / 48 / 24 V AC ±10 %, 47 - 64 Hz;
48/24 V DC, +30 %, -25 %

Power consumption
< 15 W (including primary)

Ambient temperature
-55 °C to 60 °C (-20 °C is standard)

Structural shape
Wall mounted housing made of cast aluminum, painted,
19” rack mounting unit, 167 mm long

Enclosure classification per DIN 40050 for wall mounted housing
IP 65

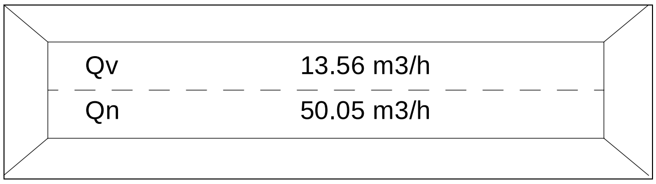
Weight
Wall mounted housing: approx. 4,2 kg
19” rack mounting unit: approx. 1,8 kg

Technical Data
VORTEX-VM, 50VM1000 converter

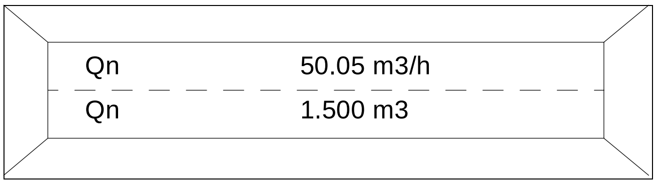
Display

High contrast, supertwisted 2x16 characters LC-Display, with background lighting for indication of instantaneous flow rate, totalized flow, pressure, temperature etc.
The display parameters are freely selectable. Both display lines can be multiplexed to alternately display two parameters.

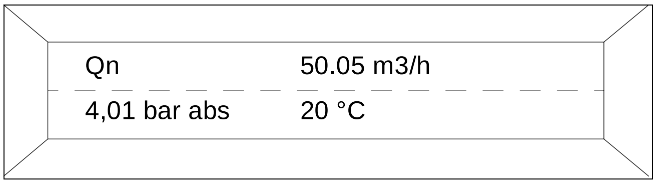
Examples:



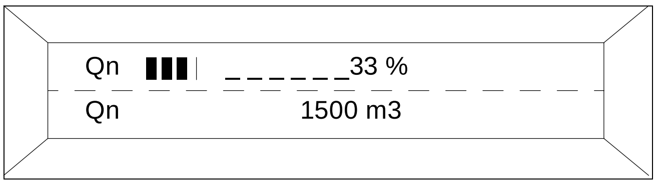
1st line: Operating flow rate
2nd line: Standard flow rate



1st line: Standard flow rate
2nd line: Totalizer flow rate



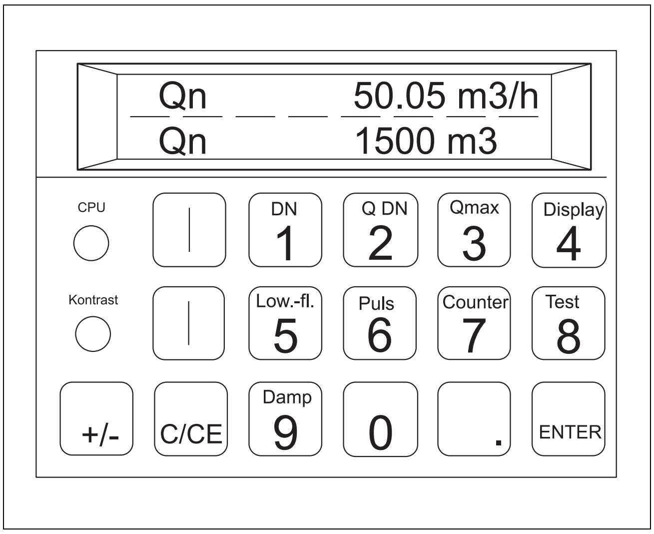
1st line: Standard flow rate
2nd line: Pressure [bar abs] and temperature [°C]



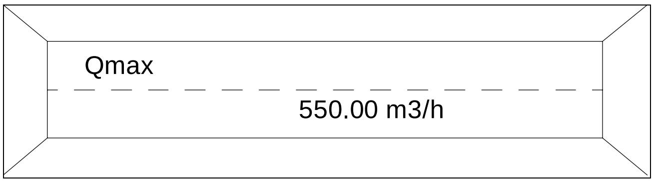
1st line: Flow rate as bargraph and in % of set upper range limit
2nd line: Totalizer standard flow rate

Operation

The operation of the converter is carried out using a sealed keypad with double function keys and in different languages.

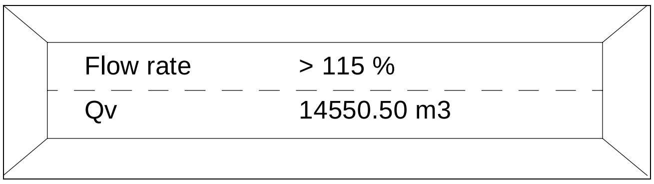


Example of measuring range setting (key Qmax)



Error message in the display

Automatic system monitoring with clear text error diagnosis in the display and providing a signal on the alarm output.



Technical Data
VORTEX-VM, 50VM1000 converter

Communication

The HART-Protocol, the serial interface RS232/485 or the Profibus-DP interface module enables VORTEX-VM to digital comunication. All instrument and measuring point parameters can be transmitted from the sigal converter to the process control system or PC (PC = personal computer). Vice versa, reconfiguration of the converter is possible this way. As configuration tool can be used SMART-VISION®.

HART®-Protocol

The HART-Protocol provides for communication between a process control system, hand terminal and the 50VM1000 converter. If communication via HART-Protocol is desired the serial interface is not available.

The digital communication occurs through the use of an alternating current superimposed on the analog output which does not affect any of the other instruments connected to the output signal. This feature is only available with the 4-20 mA current output.

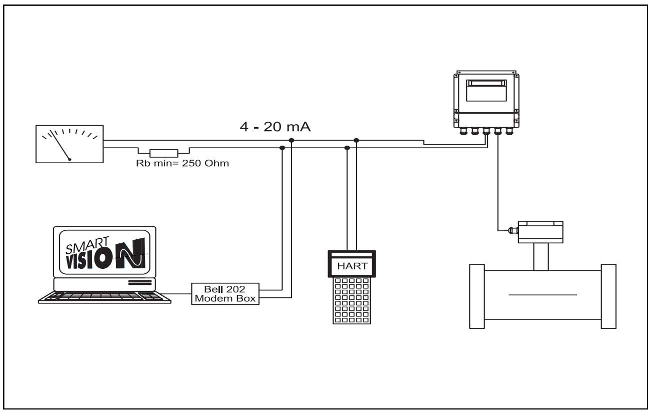


Fig. 18 50VM1000 converter

Transmission mode

FSK-modulation on the 4-20 mA current output in accordane with the Bell 202 standard. Max. signal amplitude 1,2 mA_{SS}.

Representation logic 1: 1200 Hz
Representation logic 0: 2200 Hz

Current output load

Min. > 250 Ω, Max. < 750 Ω

Maximum cable length

1500 m AWG 24 twisted

Baud rate

1200 Baud

Serial interface

The serial interface (terminals: V1 to V4) is available in the RS 485 or RS 232C/V24 mode. For using Profibus DP a special Profibus-DP-Modul is plugged in.

RS232

Terminals: ⊥, TD, RD
Generator side V_{pp} = -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, Baud rate 9600 Baud.
We recommended a shielded data transmission line.

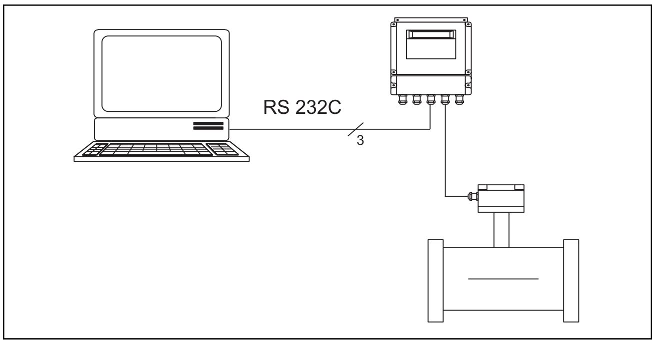


Fig. 19 Communication via RS 232C interface

RS485

Terminals: T-, T+, R-, R+
V_{pp} = 5 V, Input impedance ≥ 12 kΩ
Max. cable length: 1200 m
Baud rate: 110 - 9600, 14400, 28800 Baud
Max. of 32 instruments in parallel connected to one bus. We recommend a shielded twisted-pair data transmission line.

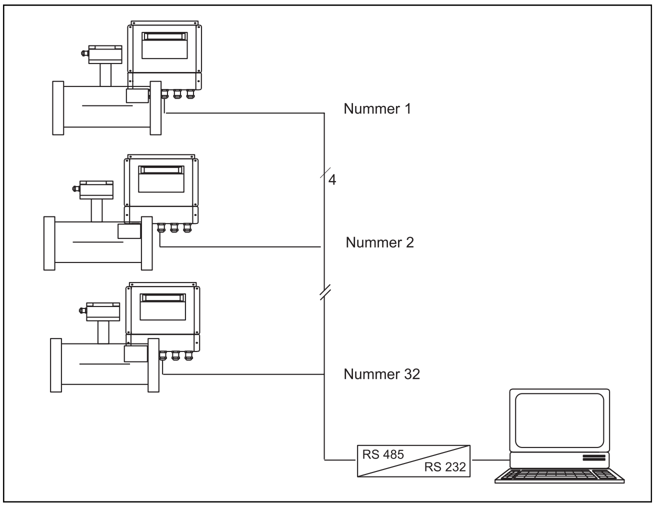


Fig. 20 Communication via RS485 interface

Technical Data
VORTEX-VM, 50VM1000 converter

Profibus-DP, DIN 19245
Terminals: V1, V2, V4, G2

Terminal	Function	Meaning
V1	RxD/TxD-P (B)	Receive/transmit-Data-P
V2	RxD/TxD-N (A)	Receive/transmit-Data-N
V4	VP	Power supply +5 V DC
G2	DGND (C)	Data reference potential (-5 V DC)

Cable specification:
A shielded and twisted data cable is recommended.
Max. cable length 1200 m (Cable Type A)
Characteristic impedance: 135 to 165 Ω
Capacity: < 30pF/m
Max. 32 instruments per segment
Baud rate: 9,6 to 1500 kbit/s
Distributed capacitance <30 pF/m, loop resistance 110 Ω/km
Tap line only to 1 m.
Incoming and outgoing cables on one terminal.

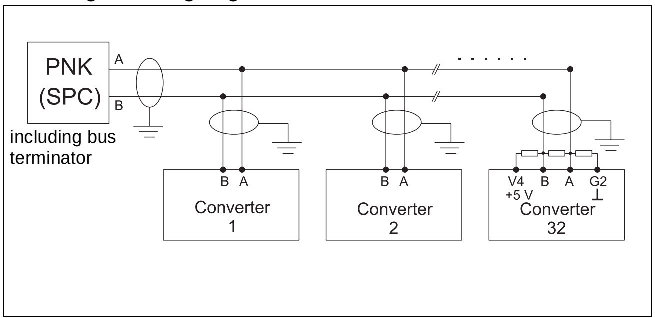


Fig. 21 Communication with Profibus DP

Electrical connections
Terminal strip (screw-type)
Screw-type conduit fitting PG 13,5

Signal cable
3-core shielded cable. Maximum signal cable length between primary and converter 800 m, or 200 Ω conduit loss.

A 10 m long signal cable is provided as standard.
Cable capacity: 160 pF/m.

Input signals

External output cut-off
Passive, via optocoupler galvanically isolated.
Terminals U2/22 with internal power supply.

External totalizer reset
Passive, via optocoupler galvanically isolated. For resetting of totalizer value and -overflow. Terminals U2/31 with internal power supply.

Pressure measurement
Current input 0 - 20, 4 - 20 mA

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

  Max. Load [Ω] = $\frac{26V - U_M[V]}{0,02A}$

  U_M = Transmitter supply voltage [V]

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

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

  U_S = External supply voltage [V]

Temperature measurement
Pt 100 resistance, connection using 2-, 3- or 4-wire technology.

Signal input:	UT+, UT-
Supply current:	IT+, 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: +/-

With 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 is adjustable with a factor between 0,001 and 1000.
Pulse width is adjustable between 0,016 ms and 1000 ms. The pulse output is galvanically isolated from the current output.

- Active
Voltage pulses 24 V DC square wave, load 150 Ω
Terminals: 9/11

- Passive
Optocoupler 5 V < U_{CE} < 25 V, 5 mA < I_{CE} < 30 mA
Terminals: 55/56

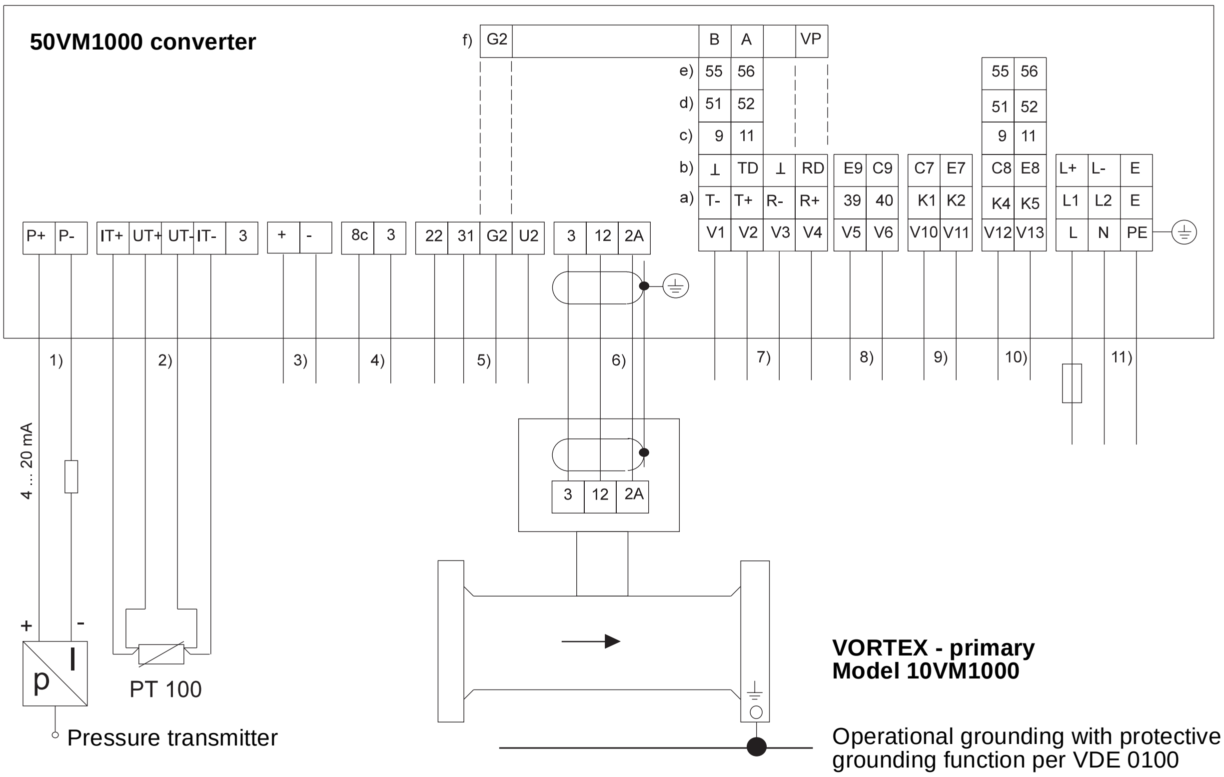
- Passive
Relay contact, normally open < 3 W, < 250 mA, < 28 V DC
Terminals: 51/52

Contact outputs
Flow rate limit alarm MAX (V10, V11) and MIN (V12, V13) and alarm output (V5, V6) (system monitoring) are available options using either relay contact - max. 3 W, 250 mA, 28 V DC or Optocoupler, $U_{CE} \leq 25$ V, $I_{CE} \leq 7,5$ mA. These options are specified by the details for ordering. In addition the signalling is indicated in the display.

The scaled pulse output (standard: active) is not available with the MIN-Alarm. If additionally the scaled pulse output is required, terminals V1, V2 can be utilized. The serial interface is then no longer available.

Note:
The instrument is in accordance with the NAMUR recommendations "EMC regulations for manufacturer and user of electrical instruments and systems - part 1".

Terminal diagram
10VM1000 primary - 50VM1000 converter



1) Pressure input (current input)
Pressure sensor 0/4 - 20 mA; P+ = 30 V (w/o load)

2) Temperature input
Pt100 resistance, IP = 1 mA, UP = 19,5 - 247 mV for -200 °C to +400 °C

3) Current output
Adjustable: load ≤ 750 or 1500 Ω at 0/4 - 20 or 0/2 - 10 mA

4) Metering frequency, test output, +5 V (TTL); 19 “ optocoupler

5) 22/U2: External output cut-off, passive via optocoupler galvanically isolated.
31/U2: External totalizer reset, passive via optocoupler galvanically isolated.

6) Signal cable (shield only connected to the converter).

7) Interfaces or pulse output**
   a) Serial interface RS 485
   b) Serial interface RS 232 C / 24 V
   c) Scaled pulse output, active 24 V DC, load ≥ 150 Ω
   d) Scaled pulse output, passive, relay contact (NO) ≤ 3 W, ≤ 250 mA, ≤ 28 V DC
   e) Scaled pulse output, optocoupler, 5 V < U_{CE} ≤ 25 V, 5 mA < I_{CE} ≤ 7,5 mA
   f) Interface Profibus DP, Terminals: V1, V2, V4, G2.

8) Alarm contact, opened at alarm
   a) Alarm contact, relay, opened at alarm ≤ 3 W, ≤ 250 mA, ≤ 28 V DC
   b) Alarm output, optocoupler, U_{CE} ≤ 25 V, I_{CE} ≤ 7,5 mA

9) Max-Alarm
   a) Alarm contact, relay, opened at alarm, ≤ 3 W, ≤ 250 mA, ≤ 28 V DC.
   b) Alarm output, optocoupler, U_{CE} ≤ 25 V, I_{CE} ≤ 7,5 mA

10) Pulse output or Min-Alarm**
   a) Alarm contact, relay, opened at alarm, ≤ 3 W, ≤ 250 mA, ≤ 28 V DC.
   b) Alarm output, optocoupler, U_{CE} ≤ 25 V, I_{CE} ≤ 7,5 mA
   c) Scaled pulse output, active 24 V DC load ≤ 150 Ω
   d) Scaled pulse output, passive, relay contact (NO) ≤ 3 W, ≤ 250 mA, ≤ 28 V DC.
   e) Scaled pulse output, optocoupler, 5 V < U_{CE} < 25 V; 5 mA < I_{CE} < 30 mA

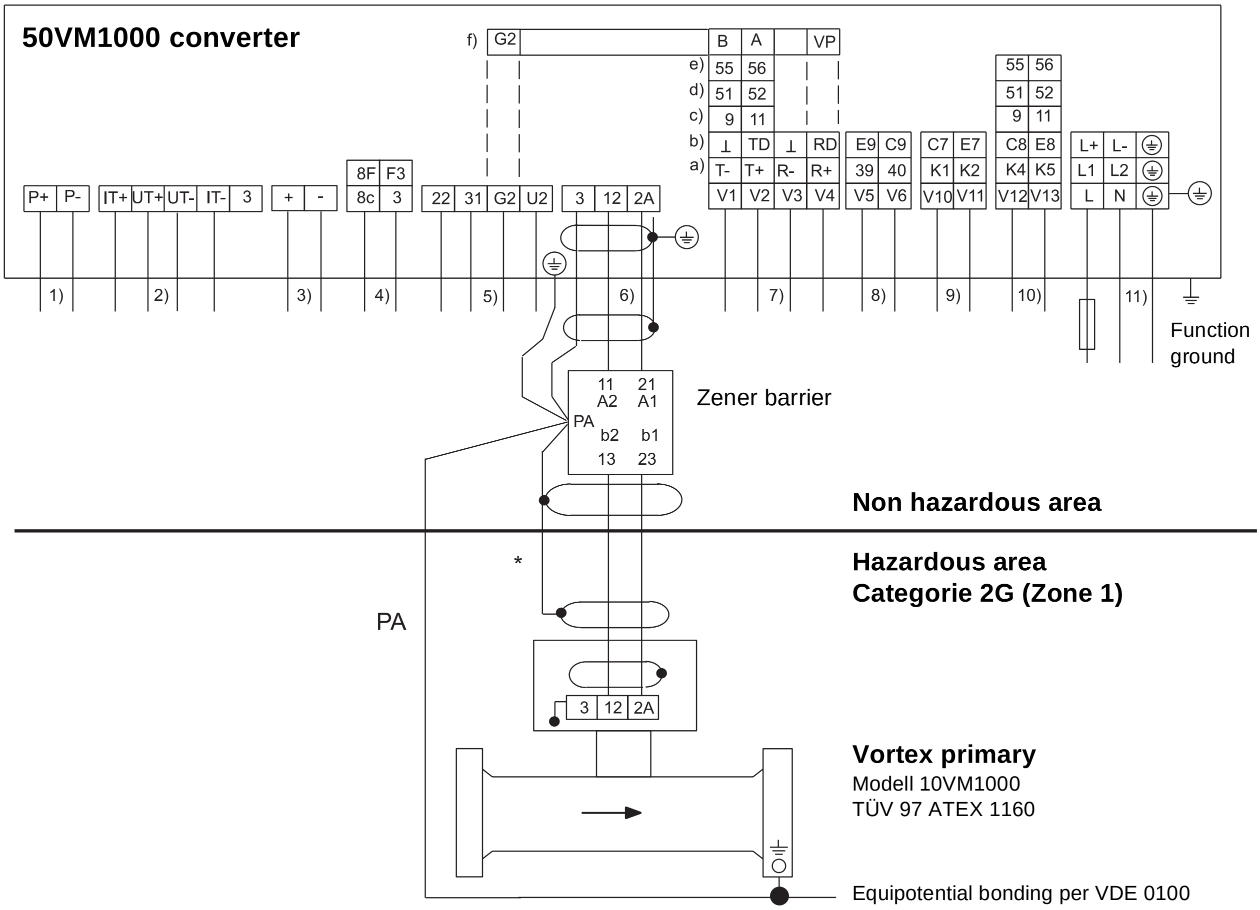
11 Power supply, see nameplate

* $R_L\,[\Omega] = \dfrac{26V - U_M[V]}{0,02A}$

** V12, V13 are the standard pulse output terminals of the “Field mounted” design. The pulse output signal only can be tapped from terminals V1, V2 of the 19” rack mounted design.

Fig. 22 Terminal diagram 10V1000 primary - 50V1000 converter

Terminal diagram 10VM1000 primary 50VM1000 converter in Ex-conditions



***** max. cable length 150 m for:
- Explosion-proof type IIC
- Signal cable 1D173D1030

- Zener barrier for mounting on C profile
  Order no.: 55SB131A0
- Zener barrier mounted on a 19 "-pc board
  Order no.: 55SB132A1

Terminal diagram safety barrier on 19 "- pc-board**

Type F, multiple plug PA leading

	A1	A2	b1	b2	PA
Zener barrier Order no. 55SB131A1	21	11	23	13	PA
19" pc-board with 1 module Order no. 55SB132A1 Terminal diagram module A	d4	z14	z28	z22	d16
19" pc-board with 2 modules Order no. 55SB133A1 Terminal diagram module B	d2	z12	d26	d22	z16
19" pc-board with 3 modules Order no. 55SB134A1 Terminal diagram module C	z2	d12	d30	z20	d18
19" pc-board with 4 modules Order no. 55SB135A1 Terminal diagram module D	z4	d14	z32	d20	z18

** A 19" pc-board can be assembled with a maximum of 4 modules.

Fig. 23 Terminal assignment: see Fig. 22

Examples of input connections

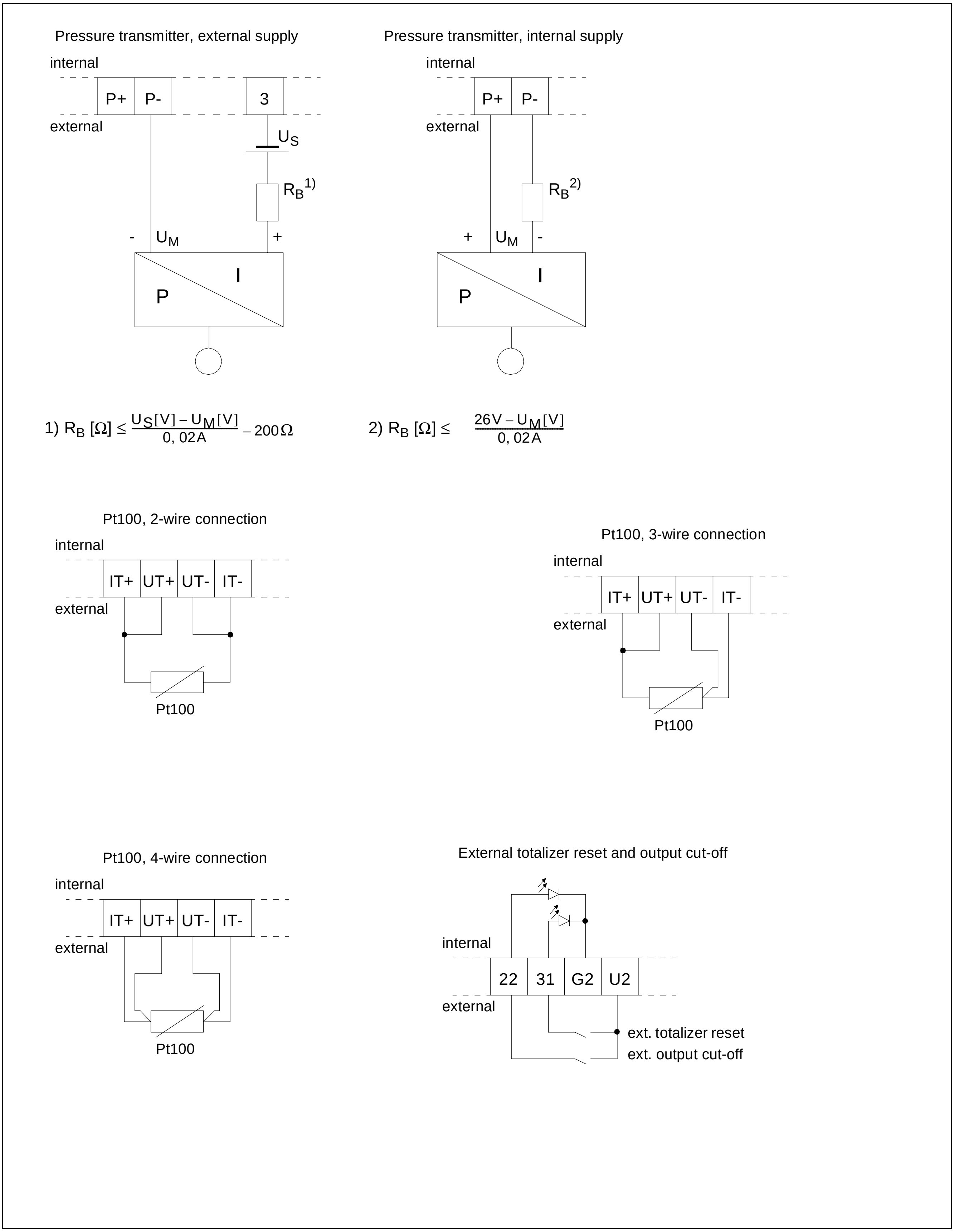


Fig. 24 Connection examples

Examples of output connections

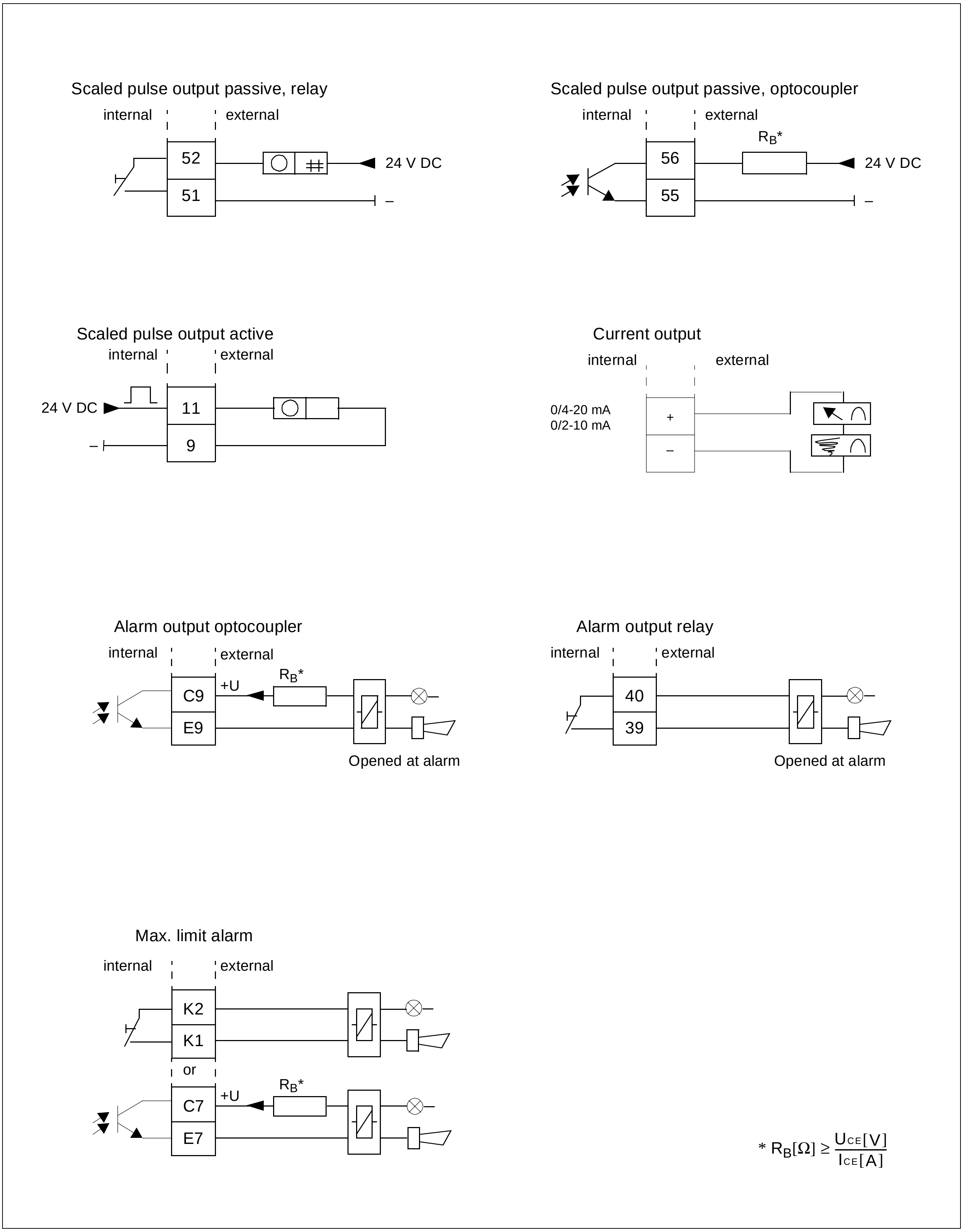


Fig. 25 Connection examples

Dimension drawing of VORTEX-VM, 50VM1000 converter

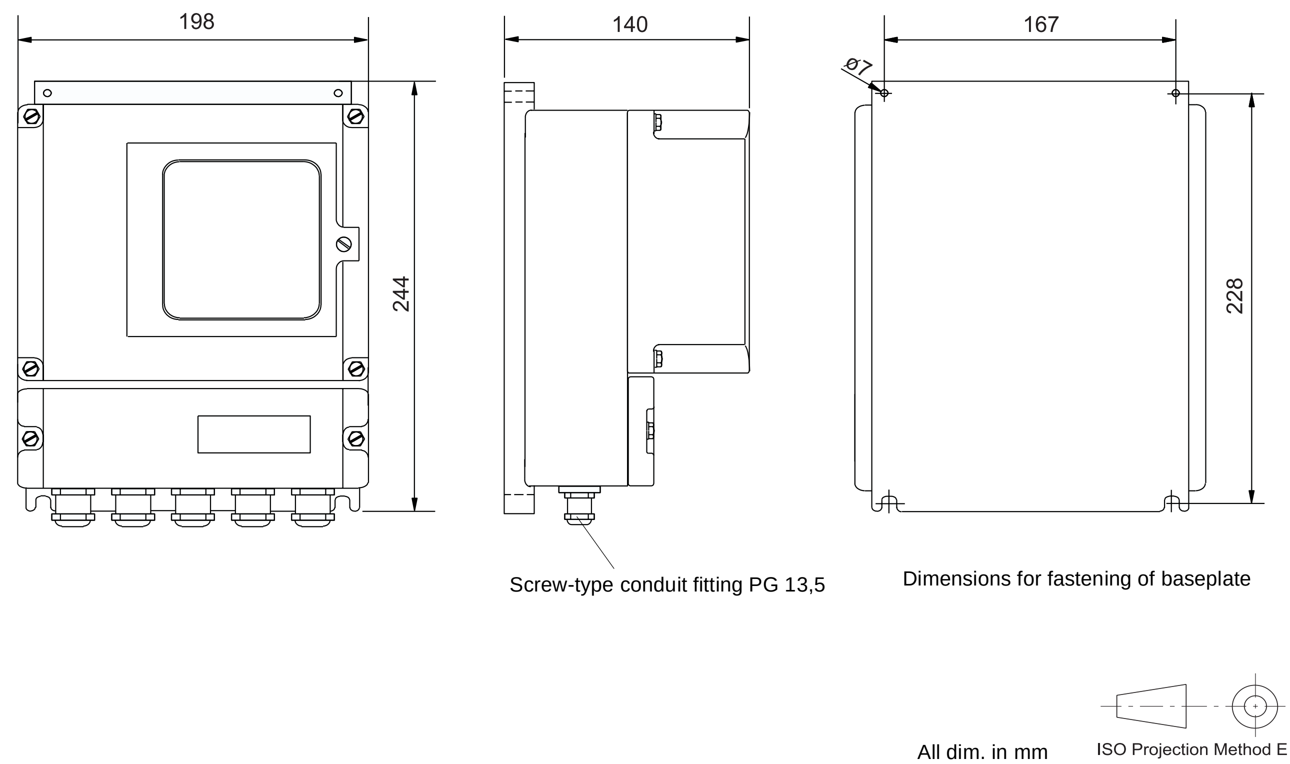


Fig. 26 Dimension drawing of field mounted housing for 50VM1000 converter

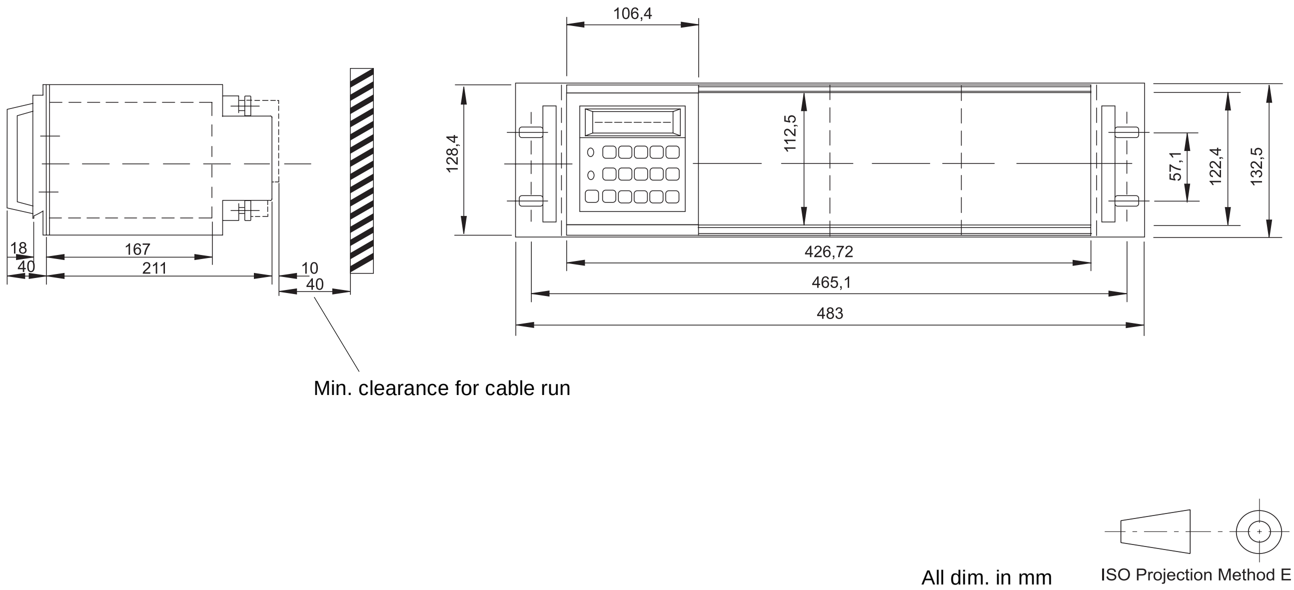


Fig. 27 Dimension drawing for 19” rack mounted 50VM1000 converter

VORTEX-VM

Details for ordering primary

Order number **10VM1**

Series			
Standard			**1**
Dual sensor (size ≥ DN 40)			**2**
Process connection			
Flange			**1**
Wafer(flangeless), DIN			**2**
Wafer(flangeless), ANSI			**3**
Fluid			
Liquid			**1**
Gas			**2**
Natural gas			**3**
Steam			**4**
Superheated steam			**5**
Oxygen[1)]			**6**
Others			**9**
Materials			
Housing	**Shedder**	**Sensor**	
Stn. stl. 1.4571	Stn. stl. 1.4571	Stn. stl. 1.4571	**1**
Stn. stl. 1.4571	Hastelloy C	Stn. stl. 1.4571	**2**
Hastelloy C	Hastelloy C	Hastelloy C	**3**
Stn. stl. 1.4571	Hastelloy C	Hastelloy C	**4**
Others			**9**
Design level			**A**
Meter size			
DN 15 / 1/2”			**A**
DN 25 / 1”			**B**
DN 40 / 1 1/2”			**C**
DN 50 / 2”			**D**
DN 80 / 3”			**E**
DN 100 / 4”			**F**
DN 150 / 6”			**G**
DN 200 / 8”			**H**
DN 250 / 10”			**J**
DN 300 / 12”			**K**
Pressure rating			
DIN PN 10			**B**
DIN PN 16			**C**
DIN PN 25			**D**
DIN PN 40			**E**
DIN PN 64			**F**
DIN PN 100			**G**
ANSI 150 lb			**K**
ANSI 300 lb			**L**
Others			**Z**
Sensor design			
Standard with groove			**2**
Erweiterter Temperaturbereich (bis 320 °C)			**5**
Others			**9**
Sensor seal	**Temperature range**		
Kalrez O-Ring	0°C to 280 °C		**3**
Viton O-Ring	-55 °C to 230 °C		**4**
PTFE O-Ring	-200 °C (Ex -55 °C) to 200 °C		**5**
HT-Special	-55 °C to 320 °C		**6**
Others			**9**
Certification			
Standard, none			**A**
EEx, Zener-barrier required[2)]			**B**
Certificate on material testing per EN 10204-3.1B			**C**
EEx + certificate on material testing per EN 10204-3.1B [2)]			**D**
Calibration			
Standard			**3**
Nameplate			
German			**1**
English			**2**

1) Flowmeter for oxygen application, cleaned and marked.
2) Zener-barrier for C profile mounting (none hazardous area) order no.: 55SB131A0
Zener-barrier for 19” rack mounting (non hazardous area) order no.: 55SB132A1
Signal cable (10 m are included in price for instrument) Part no.: 1D173D1018, Ex Part no.: 1D173D1030

Details for ordering converter

Order number	10VM1
Pulse output	
Activ (standard)	1
Relay	2
Optocoupler	9
Interface	
None	0
Serial interface RS485 1)	1
Serial interface RS232 1)	2
Profibus-DP1)	3
Others	9
Primary	
10VM1000, 10SM1000	0
10S*5000 Piezo	1
10S*5000 NTC	2
10S*5000 NTC Ex	3
Design level	*
Software level	*
Housing	
Field mounted housing, keypad accessible	G
19" rack mounted 167 mm with connection board	M
Others	Z
Schaltausgänge	
None (only plug-in)	0
Optocoupler	1
Relay	2
Signalling	
None	A
Limit alarm "MAX/MIN" 2)3)	B
Limit alarms "MAX" 2)	C
Others	Z
Option	
None	A
PT-compensation	B
HART-Protocol	C
PT+HART-Protocol	D
Others	Z
Power supply	
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
Nameplate	
German	1
English	2
Others	9

1) With option HART-Protocol not available. For 19" design only pulse output optocoupler available.
2) For 19" design only optocoupler available.
3) No pulse output available.

Questionaire
VORTEX-VM

Customer:	**Date:**
Mrs./Mr:	**Department:**
Telephone:	**Telefax:**

Medium: State:	☐ Steam	☐ Gas	☐ Liquid
Flow rate: (Min, Max, working point)	m^3/h		☐ Standard state ☐ Actual state
Density: (Min, Max, working point)	kg/m^3		☐ Standard state ☐ Actual state
Viskosity: (Min, Max, working point) (please specify for liquids)	mPas		
Temperature of medium: (Min, Max, working point) **Ambient temperature:**	°C °C		
Pressure rating: (Min, Max, working point)	bar		
PT compensation (for gases)	☐ Yes		☐ No
Explosion protection:	☐ Yes		☐ No
Actual pipeline diameter	mm		

Products:

- Variable Area Flowmeters
- Electromagnetic Flowmeters
- Vortex and Swirlmeters
- Mass Flowmeters
- Converter for Pressure and Differential Pressure
- Dispensing Systems for Gases and Liquids
- Ultrasonic Concentration Measurements

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Elsag Bailey
Process Automation

Certified according to DIN EN ISO 9001