

PARTI-MAG II

Electromagnetic Flowmeter for Full and Partially Full Pipelines (Free and Surface Pipelines) Model DP41 and DP46

D184S024U02 Rev. 01 / 11.2001

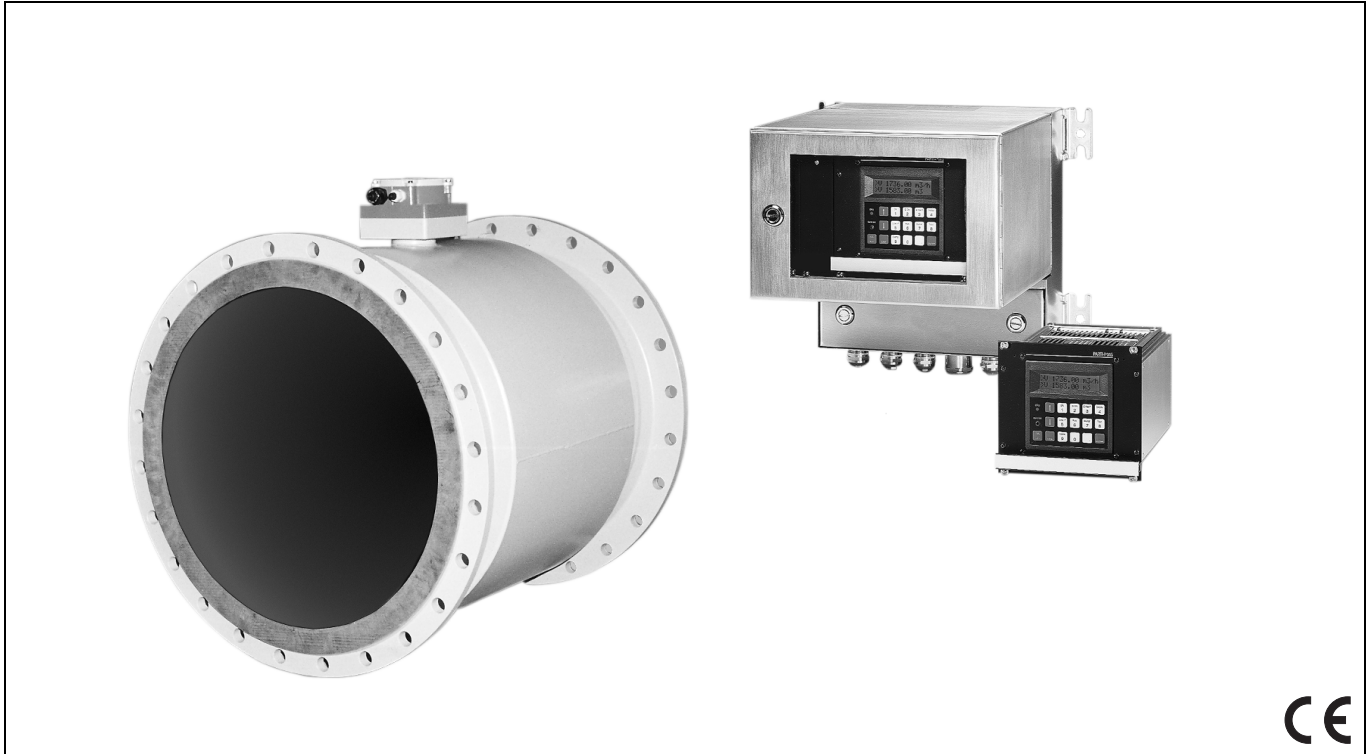


Fig.1 PARTI-MAG II Flowmetering System

Application

The flowrate of liquids and slurries with electrical conductivities of at least $50 \mu\text{S}/\text{cm}$ up to $10 \text{ mS}/\text{cm}$ can be measured even when the pipeline is partially full. The PARTI-MAG II consists of a flowmeter primary and a remote mounted converter. A functional description may be found on page 2. The PARTI-MAG II is characterized by the following design features:

- PARTI-MAG II, microprocessor converter with flowrate indication and totalization in engineering units.
- Especially suitable for flow metering in partially full pipelines (e.g. for rain retention basins, clarifier in- and outflow).
- In the partially full flow regime it is unaffected by backflow.
- Short in- and outlet straight sections: 5xDN upstream and 3xDN downstream of the meter.
- Minimum required fill level 10 % of the flowmeter diameter.
- Output signal cut-off activated when level drops below minimum fill level of 10 % DN.
- Meter size range from DN 150 to DN 2000.
- Standard-Design, model DP41.
- Ex-Design, model DP46.
- A wide application spectrum can be satisfied by the large variety of liner and electrode materials available.
- User friendly parameter entry directly at the converter.
- Factory calibrated; no on-site calibration required.
- Automatic system monitoring with error diagnostics in clear text plus an output alarm signal.
- Exceptional accuracy with long term stability.
- Absolute zero stability.
- Accuracy:
 - with partially for full pipes: 3 % or 5 % of rate,
 - with full pipe: 1 % of rate.
- 2 user configurable contact outputs for forward/reverse flow direction signal, alarm signal.
- Flow range settings from 0.5 m/s to 10 m/s.
- Max. signal cable length 50 m.

Accuracy, Reference Conditions and Functional Description

Reference Conditions Based on EN 29104:

Fluid Temperature

20 °C ± 2K

Ambient Temperature

20 °C ± 2K

Supply Power

Line voltage per Instrument Tag $U_N \pm 1 \%$

Straight Pipe Installation Requirements

Upstream >10 x DN,
Downstream > 5 x DN,
DN = Flowmeter primary diameter

Warm Up Time

30 min

Accuracy: (Pulse Output)

• **Full Pipe**

- $Q > 0.04 Q_{maxDN}$ 1 % of rate
- $Q < 0,04 Q_{maxDN}$ 0.0004 Q_{maxDN}

• **Partially Full Pipe**

($v > 0.2$ m/s); ($h > 0.1$ x DN)

(for DN 150 only: $h > 0,15$ x DN)

- $Q > Q_{\bar{u}}$ 3 % of rate
- $Q_{min} < Q < Q_{\bar{u}}$ 5 % of rate
where $Q_{\bar{u}} = 0.02 Q_{maxDN}$
and $Q_{min} = 0.001 Q_{maxDN}$
(For values of Q_{maxDN} see Table Page 3)

Current Output Effects

Same as pulse output plus $\pm 0.1 \%$ of rate

Functional Description

The basis for the electromagnetic flowmeter is Faraday's law of induction. A conductive fluid flows through a pipe perpendicular to the direction of a magnetic field (see Fig. 3).

$$U_E \sim B \times D \times v$$

The voltages generated in the fluid are measured by a number of electrodes pairs. They are arranged in the meter tube in such a manner that for each cross sectional flow area (full or partially full) the electrode pair with the optimal weighting factor is utilized for the measurements. One additional electrode is integrated for full pipe detection. In addition to the optimized measurement of the average flow velocity the four electrode pairs are also utilized for determining the fill level through utilization of a superimposed ac field.

The signal voltage U_E is corrected using the partially full characteristic curves stored in the converter and converted into a flowrate proportional output signal.

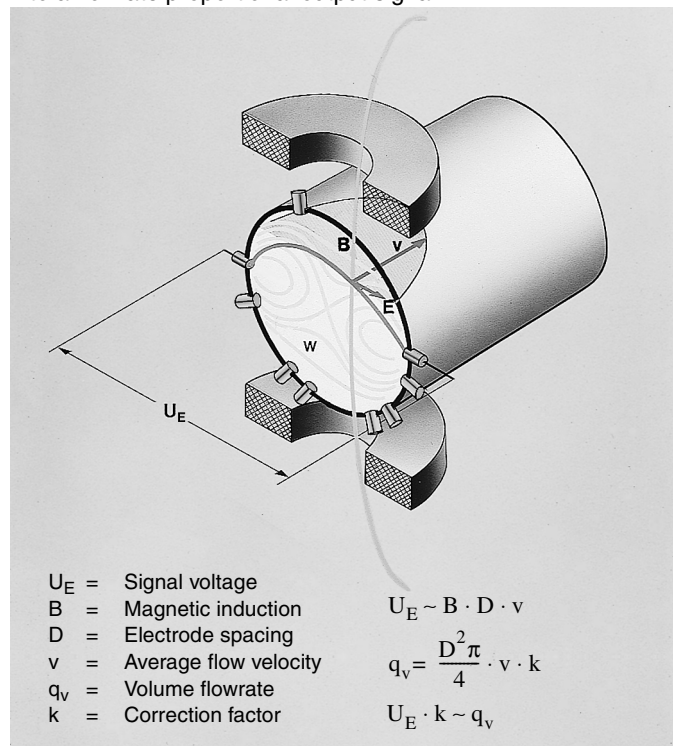


Fig.3 Measurement Principle

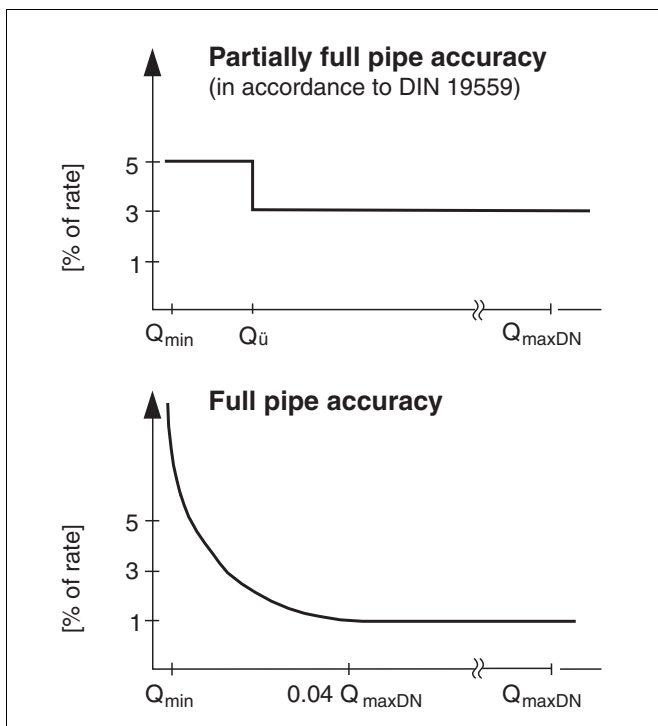


Fig.2 Accuracy of the Flowmeter System PARTI-MAG II

Technical Data: Flowmeter Primary, Model DP41 and DP46



Fig. 4 Flowmeter Primary

Flowrate Nomograph for Full Pipelines

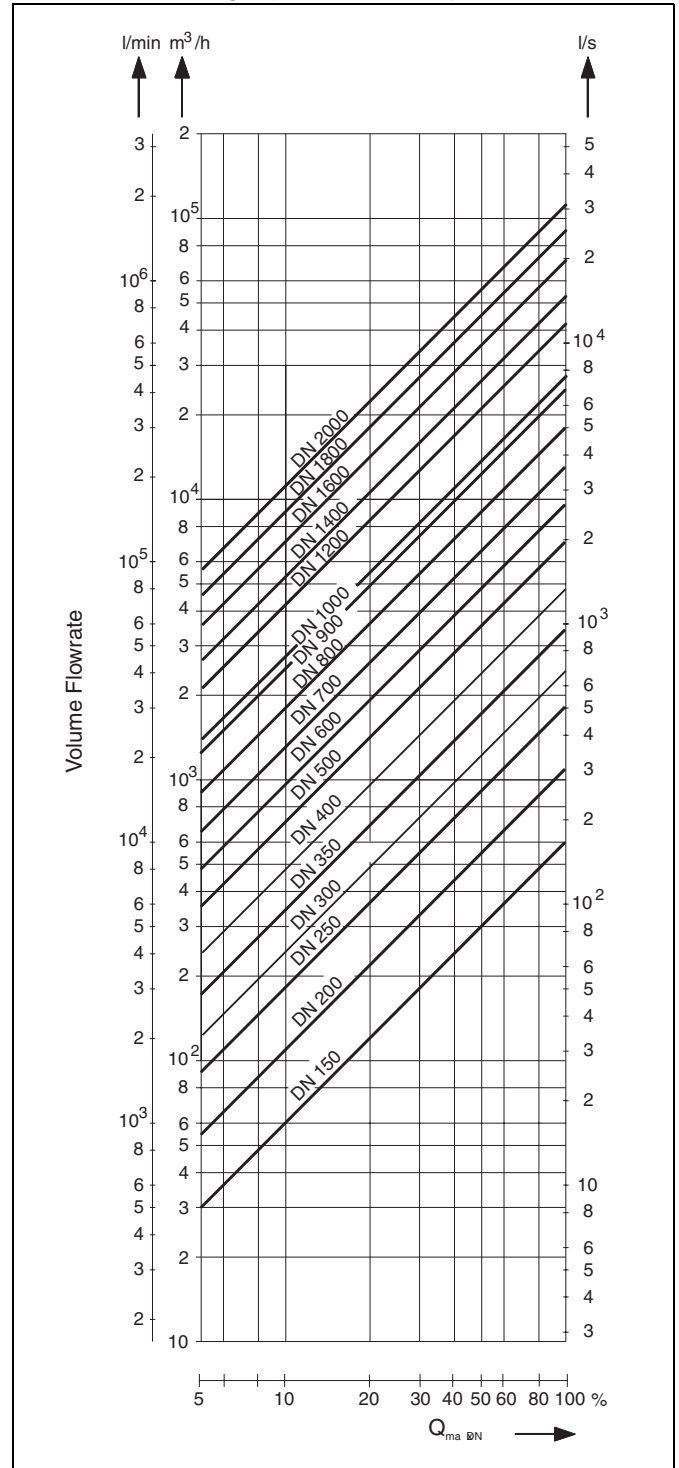


Fig.5 Flowrate Nomograph for DN 150 to DN 2000

Meter Size, Pressure Rating and Flow Ranges

Meter Size DN	Standard Press Rating PN	Min. Range Setting	Max. Range Setting Q _{max} DN
150	10/16	0 to 8.3 l/s	0 to 166.7 l/s
200	10/16	0 to 15.0 l/s	0 to 300 l/s
250	10/16	0 to 25.0 l/s	0 to 500 l/s
300	10/16	0 to 33.33 l/s	0 to 667 l/s
350	10/16	0 to 45.83 l/s	0 to 917 l/s
400	10/16	0 to 62.50 l/s	0 to 1250 l/s
500	10	0 to 91.67 l/s	0 to 1833 l/s
600	10	0 to 133.33 l/s	0 to 2667 l/s
700	10	0 to 183.33 l/s	0 to 3667 l/s
800	10	0 to 272.20 l/s	0 to 5000 l/s
900	10	0 to 333.33 l/s	0 to 6667 l/s
1000	10	0 to 375 l/s	0 to 7500 l/s
1200	6	0 to 590 l/s	0 to 11600 l/s
1400	6	0 to 750 l/s	0 to 15000 l/s
1600	6	0 to 1000 l/s	0 to 20000 l/s
1800	6	0 to 1250 l/s	0 to 25000 l/s
2000	6	0 to 1590 l/s	0 to 31700 l/s

Sizing Information

It is important to note that at max. flow rate the pipe should be at least 50 % full. Otherwise the meter size should be reduced. The conductivity of the liquid has to be within the range of 50 μS/cm up to 10 μS/cm. For selecting the optimum flowmeter size for your application a sizing program is available on a 3 1/2" disc for IBM compatible PC's. All required calculation values are integrated in the program.

Note

- When the level drops below the minimum allowable value of 10 % of the flowmeter primary diameter, (15 % only for DN 150), an automatic shut off of the output signals occurs.

Technical Data: Flowmeter Primary, Model DP41 and DP46

Max. Allow. Fluid Temperature and Pressure

Standard Design to 130 °C

Liner	Meter Size DN	P _{Operate}	at	T _{Operate} °C
Hard rubber	150 to 250	40 bar	<	90
	300 to 1000	16 bar	<	90
	1200 to 2000	6 bar	<	90
Soft rubber	150 to 250	40 bar	<	20
		10 bar	<	50
	300 to 1000	16 bar	<	20
		10 bar	<	50
	1200 to 2000	6 bar	<	20
		6 bar	<	50
PTFE	150 to 250	40 bar	<	20
	300 to 600	10 bar	<	130

(Other meter sizes, pressure ratings, temperature classes upon request)

Min. Allow. Absolute Pressure

Liner	Meter Size DN	P _{Operate} mbar abs	at	T _{Operate} °C
Hard rubber	150 to 2000	0	<	90
Soft rubber	150 to 2000	0	<	50
PTFE	150 to 600	270	<	20
		400	<	100
		500	<	130

Materials

Liner Material	Electrode Material		Electrode Design
	Standard	Others	
Hard rubber Soft rubber	SS No. 1.4571	Hast. B-2/C-4 Titanium Tantalum Platinum/Iridium	Rounded Head
PTFE	SS No. 1.4571	SS No. 1.4571 Hast. B-2, C4 (upon request) Titanium Tantalum Platinum/Iridium	Rounded Head
Other Parts	Standard	Others	
Flanges	Steel	SS No. 1.4571	

Temperature Diagram

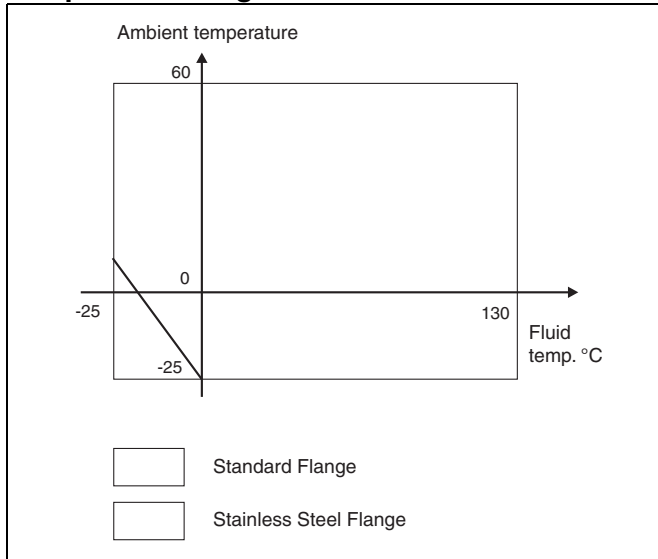


Fig.6 Fluid temperature as a function of the ambient temperature

Specifications with model DP46 (Ex-Design)

Max. allowable Fluid-Temperature, max. ambient Temperature, Temperature Classes are shown in table:

Size DN	Temperature-class	Max. ambient temperature [°C]	Max. fluid temperature [°C]
150 – 250	T4	60	90
150 – 250	T4	50	110
150 – 250	T4	40	130
300 – 900	T4	60	90
300 – 900	T4	50	110
300 – 900	T4	40	130
1000 – 3000	T4	60	90
1000 – 3000	T4	50	110

max. ambient Temperature for primary: -20 to +60 °C

Technical Data: Flowmeter Primary, Model DP41 and DP46**Protection Class**

IP 67

IP 68 (Max. submergence depth 5 m)

Pipeline VibrationMax. allowable 15 m/s^2 (10 - 150 Hz)**Connections****Process Connection**

Flange

Electrical Connection

Screw terminals

Cable connectors DN 150 to DN 2000

Excitation cable Pg 13.5

Signal cable Pg 16/21

Weight

See Dimension Drawings beginning on Page 6

Design**DN 150 to DN 250**Two piece half-shell housing: Cast Alum., painted¹⁾Connection box: Cast Alum., painted²⁾

Flanges: a) Zinc plated steel (standard)

b) SS No. 1.4571 (option)

DN 300 to DN 2000Housing: welded steel design, painted¹⁾Connection box: Cast Alum., painted²⁾

Flanges: Steel, painted (standard)

SS No. 1.4571 (option)

1) Paint coat $60 \mu\text{m}$ thick, similar to RAL 9002

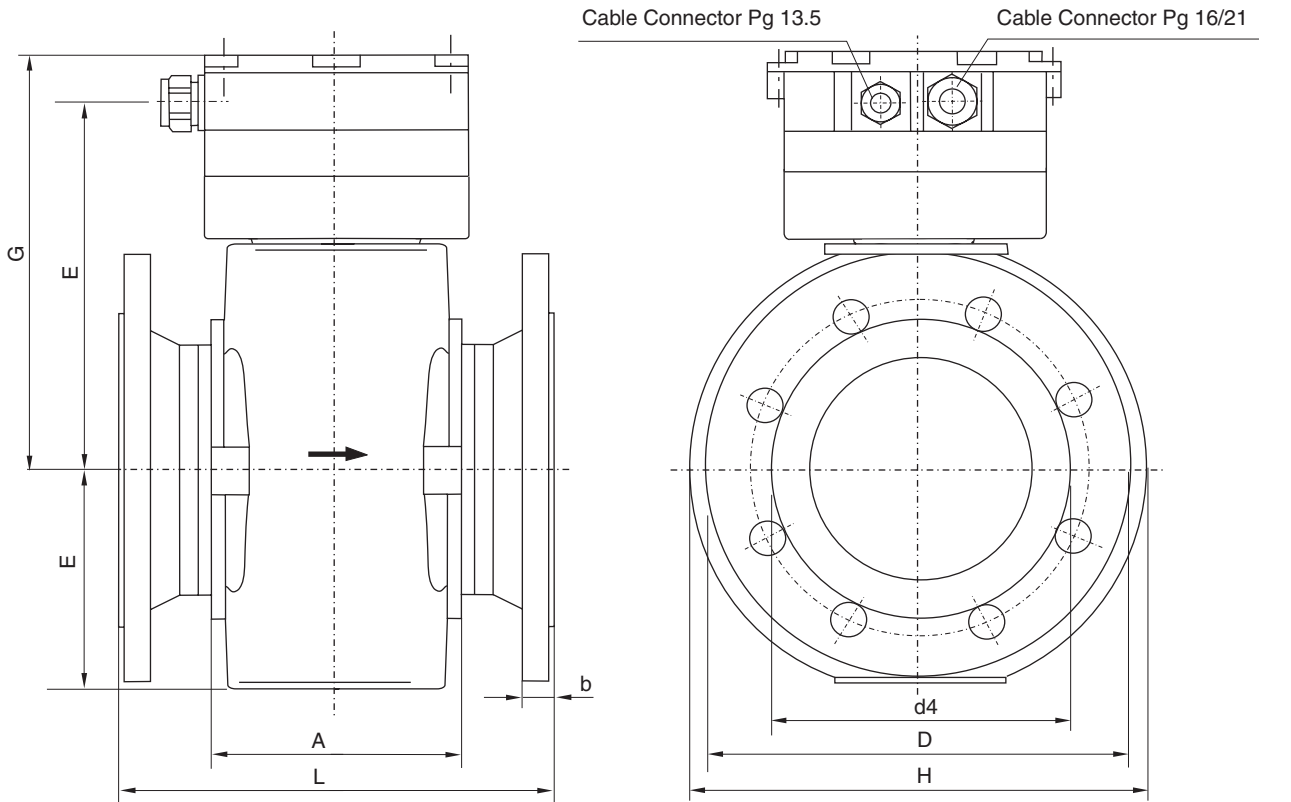
2) Similar to RAL 7012

Ex-Protection **Primary DP 46**

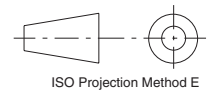
II 2 G EEx em [ib] II C T4, TÜV 97 ATEX 1219X

Category 2 G (Zone 1)

Dimension Drawings: Flowmeter Primary Model DP41 and DP46, DN 150 - DN 250, DIN-Flanges



All dim's in mm



Flange Dimensions per DIN				Meter Dimensions								Weight	
DN	PN	D	d4	b	A	L	L ¹⁾	L ²⁾	G	E	F	H	kg
150	10	285	212	25	170	300	305	310	275	242	148	310	29
	16	285	212	25	170	300	305	310	275	242	148	310	29
200	10	340	268	28	195	350	355	360	315	274	179	340	56
	16	340	268	28	195	350	355	360	315	274	179	340	56
250	10	395	320	30	250	450	455	460	344	301	207	395	82
	16	405	320	30	250	450	455	460	344	301	207	405	82

- 1) Standard with one grounding ring of SS No. 1.4571. Other materials and DN 300 and above upon request. See also Note "Grounding" Page 9 and Footnote Ordering Information Page 10.
- 2) With protection flanges. Protection flanges provide the grounding. Grounding plate not required. For hard rubber liners + 4 mm for gaskets.

Fig.7 Flowmeter Primary DN 150 to DN 250 (DIN-Flanges)

Dimension Drawings: Flowmeter Primary Model DP41 and DP46, DN 300 - DN 2000, DIN-Flanges

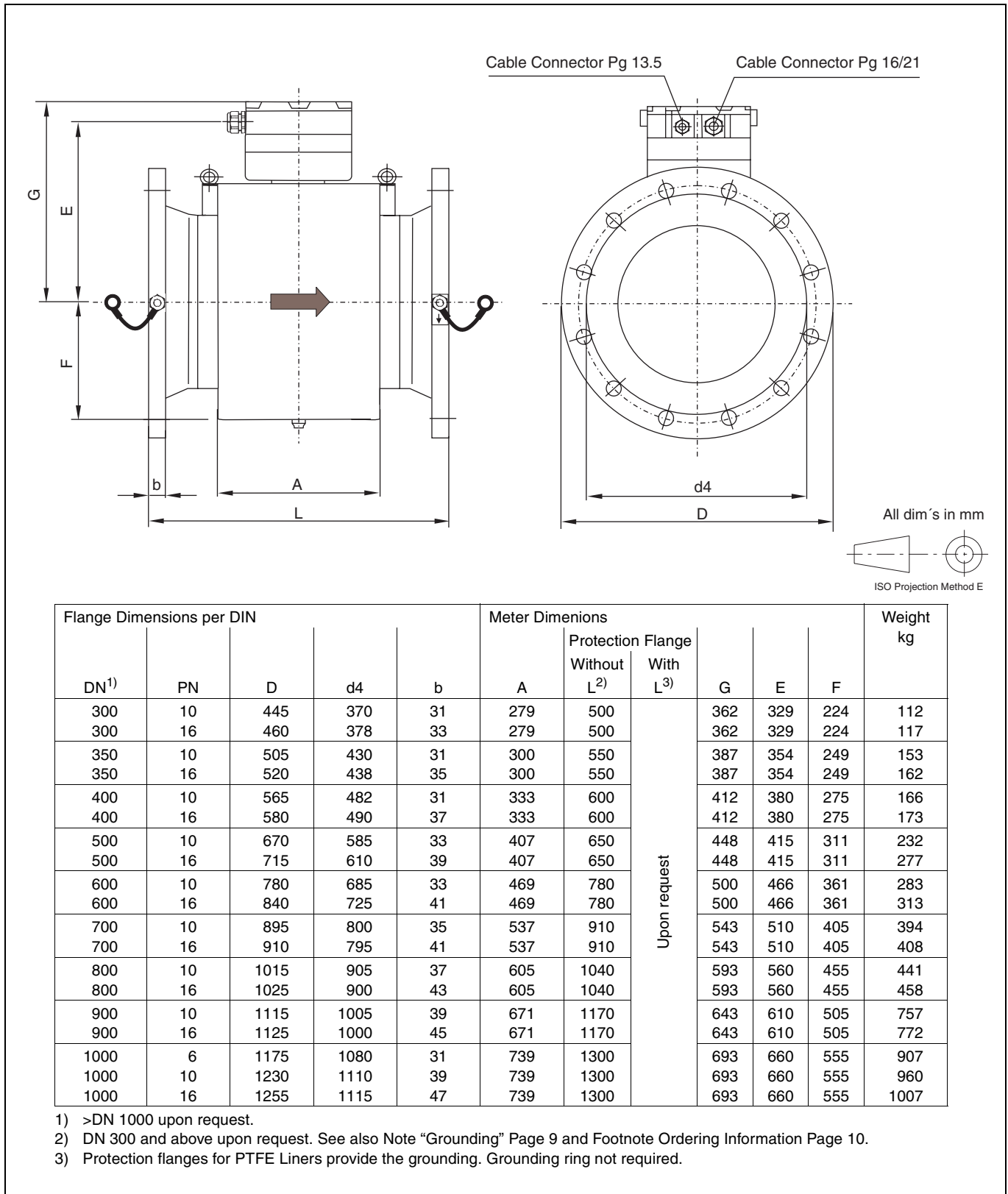


Fig.8 Flowmeter Primary DN 300 to DN 2000 (DIN Flanges)

Dimension Drawings: Flowmeter Primary Model DP41 and DP46, DN 150 - DN 900, ANSI-Flanges

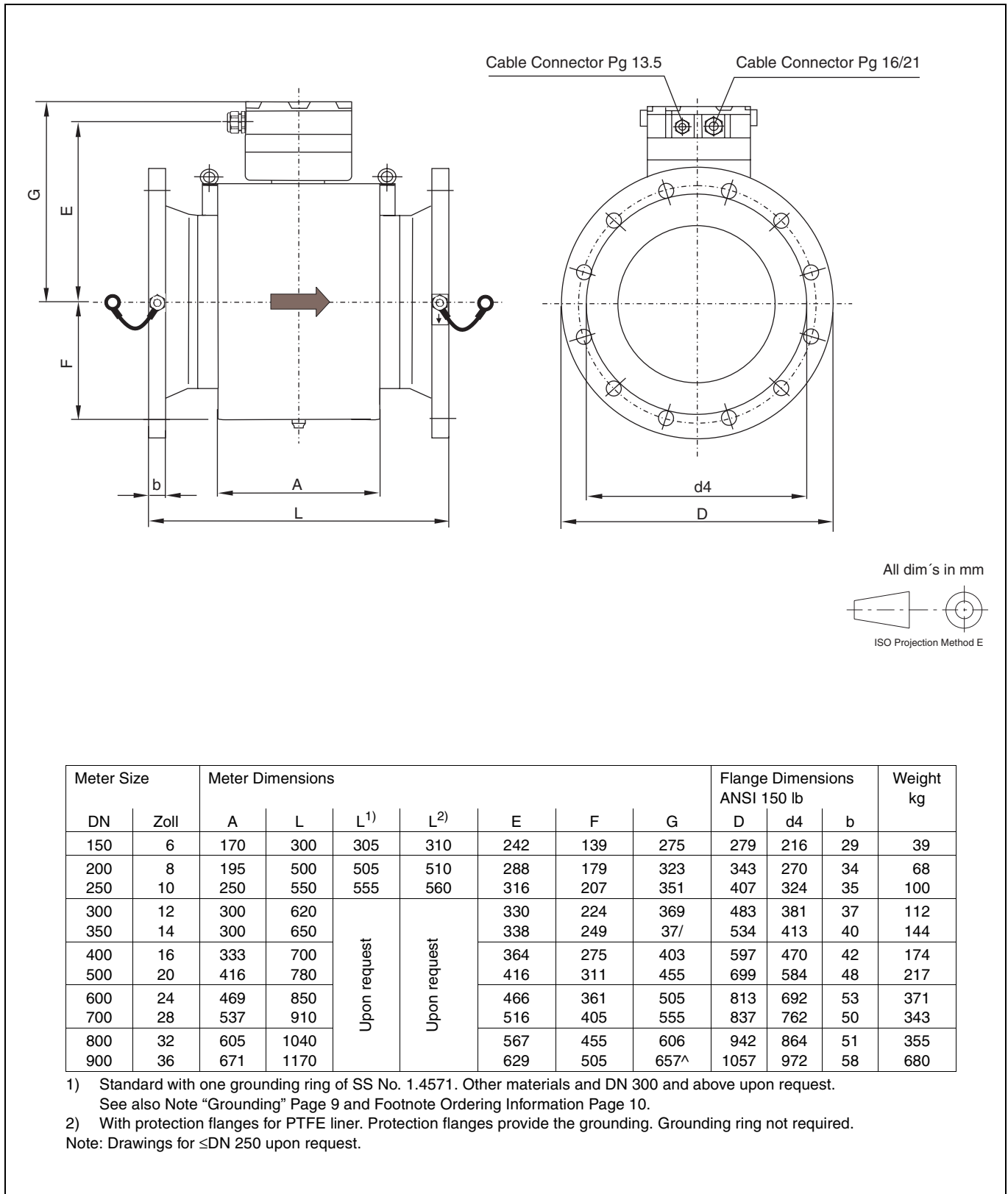


Fig.9 Flowmeter Primary DN 150 to DN 900 (ANSI Flanges)

Installation Requirements and Grounding Flowmeter Primary

Electrode Axis

The electromagnetic flowmeter for metering in partially full pipelines is to be installed axisymmetrically so that the upper electrode pair is exactly horizontal. An ideal installation with horizontal electrodes is shown in Fig. 10.

A level has been installed in the customer connection box on the flowmeter primary. It is an additional aid in assuring that the flowmeter primary is correctly leveled

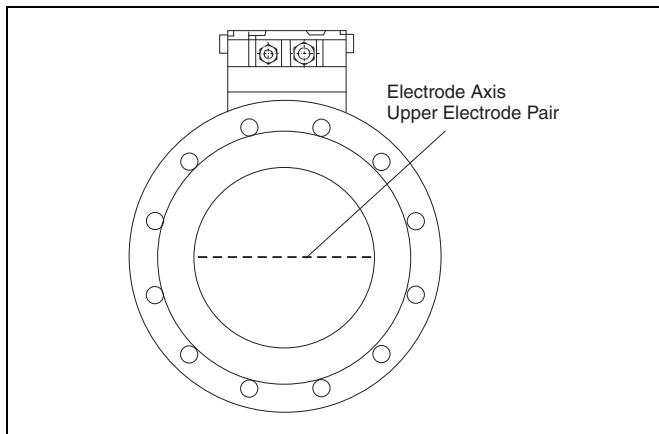


Fig.10 Electrode Axis

In- and Outlet Sections

The flow profile within the meter must be axisymmetric when the pipe is full. The flow stream must be free of swirl and pulsations. No standing eddies should exist within the meter, such as may occur after elbows or tangential entries.

A hydraulic jump is to be avoided in the metering section. The max. allowable pipeline slope is 5 %. Slope changes within the in- and outlet sections are to be avoided.

Note:

- The following installation requirements are to be observed:
 - A straight section with the same diameter as the flowmeter and a length of at least 5 times the diameter is to be installed upstream and one 3 times the diameter downstream (Fig. 11). Sharp edges in the vicinity of the flowmeter are to be avoided. No additional inlets or outlets are to exist in the inlet section.
 - For cleaning and examination purposes a inspection opening is recommended (see Fig. 11).

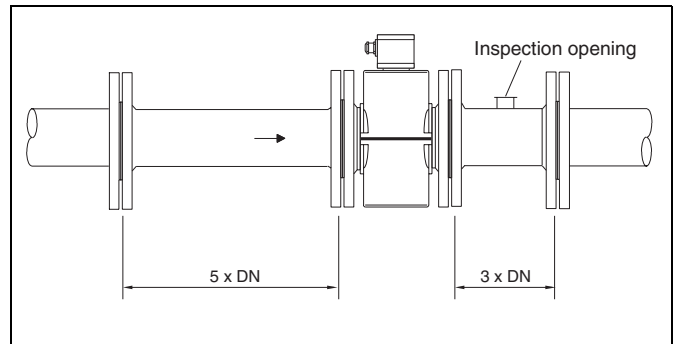


Fig.11 In- and Outlet Sections

Pipeline Transitions

Transitions from other pipeline sizes or geometries should be made so that the in- and outlet section requirements mentioned previously are maintained. Steps in the bottom of the pipeline are to be avoided.

Grounding

For satisfactory operation of an electromagnetic flowmeter grounding is essential. The ground screws on the flowmeter primary are to be connected to the protection ground in accordance with VDE 0100, Part 540. For technical reasons this potential should be identical to that of the fluid.

For plastic pipes or pipes with electrically insulating liners the ground connection is made using grounding rings or ground electrodes. **Flowmeters with hard or soft rubber liners include in the flange area a conductive element for grounding. Therefore additional grounding rings or grounding electrodes are not required** (see Note: Ordering Information Page 10). When stray currents are present in the fluid and a PTFE or PFA Teflon lined flowmeter primary is installed grounding rings or grounding electrodes at the in- and outlet ends of the meter are recommended.

With model DP46 (Ex-design), grounding terminals and primary flanges have to be connected to Potential Equalization.

Sizing Information

For selecting the optimum meter size a sizing program is available on a 3 1/2" disc. All required calculation values are integrated in the program.

It is recommended that a plan of the installation site be provided to ABB Automation Products during the planning phase for evaluation.

Installation Requirements and Grounding Flowmeter Primary

In addition to the Ordering Number please supply the following information: Fluid, fluid temperature, operating pressure, pipeline type, (grounding ring, grounding electrode). Installation sketch with slopes..

Standard design	DP41F																			
Ex-design	DP46F																			
Liner material																				
Hard rubber		H																		
Soft rubber		S																		
PTFE		T																		
Meter size																				
DN 150																				
DN 200																				
DN 250																				
DN 300																				
DN 350																				
DN 400																				
DN 500																				
DN 600																				
DN 700																				
DN 800																				
DN 900																				
DN 1000																				
DN 1200																				
DN 1400																				
DN 1600																				
DN 1800																				
DN 2000																				
Measuring electrodes¹⁾																				
SST 1.4571																				
Hastelloy B-2 (upon request)																				
Hastelloy C-4 (upon request)																				
Titanium																				
Tantalum																				
Platinum-Iridium																				
Others																				
Pressure rating																				
DIN PN 10																				
DIN PN 16																				
DIN PN 25																				
DIN PN 40																				
ANSI 150 lb																				
ANSI 300 lb																				
JIS K10 (upon request)																				
Flange material																				
Steel																				
SST 1.4571																				
Others																				
Flange accessories																				
Without																				
Protection flange 1.4571 (both sides)																				
Grounding ring 1.4571 (fastened on one side)																				
Others																				
Temperature range																				
Standard design																				
Certification																				
Ex with model DP46 or no Certificate with model DP41																				
3.1B acc. to 10204 with model DP41 or DP46																				
Protection																				
IP 67																				
IP 68 (Hose fitting)																				

1) Grounding electrodes for hard rubber and soft rubber are Standard.
 With PTFE liner a grounding ring is required in case of plastic pipeline.
 Please complete details for ordering: Remote signal converter 50XP2000 page 14.

Technical Date: Converter, Model 50XP2000



Fig.12 Converter Field Mount Housing and 19"-Rack Mount Housing

Electrical Connections

Screw terminals
 5 x Cable connectors Pg 13.5
 1 x Cable connector Pg 16/21 for signal cable

Weight

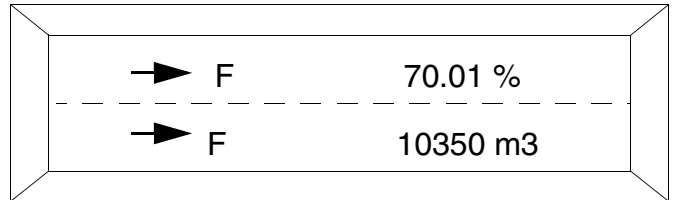
Field mount housing ca. 9.3 kg
 19"-Insert cassette ca. 2.8 kg

Signal Cable/Excitation Cable

The max. cable length between the flowmeter primary and the converter is 50m. Signal and excitation cable are preassembled and connected to the converter prior to shipment (field mount housing). Ordering Number see Page 14.

Display

2x16 character dot-matrix display in Super-twisted technology with LED background lighting. The flow direction is indicated in the 1st line and the instantaneous flowrate in % of the selected flow range or in engineering units. In the 2nd line the value of the integrated flow is displayed in engineering units. Separate totalizer values for each flow direction, 7 digit plus overflow counter.



Flow Range

Continuous, 0.5 m/s to 10 m/s

Conductivity

≥50 μS/cm

Response Time

0 - 99% Step function (equiv. to 5 τ) >10 s

Damping

Settings to 200 s

Supply Power

115/230 V AC ±10 %
 24 V AC ±10 %
 50/60 Hz ±6 %
 Ripple < 1.5 Vp

Magnetic Field Excitation

6 1/4 Hz, 7 1/2 Hz (50/60 Hz Power supply)

Power Consumption

DN 150 to DN 2000
 < 60 VA (primary including converter)

Ambient Temperature

-20 to +50 °C

Protection Class per EN 60529

IP 65 for field mount housing
 IP 00 for 19" rack mount design

Design

Stainless steel wall mount housing
 19"-Insert, 167 mm deep, 28 TE, 3 HE

Parameter Settings

Entry is made from the keypad, menu controlled in clear text dialog. All parameter settings, including totalizer values are stored for a 10 year period in EEPROMs. The meter location parameters can be uploaded by pressing a button after a converter exchange. Forward/Reverse Metering

The direction is indicated in the display by arrows and over a contact output, optocoupler design, for an external alarm.

Technical Date: Converter, Model 50XP2000

Input Signals

Passive or active over operating contact (closer).
When the pipeline empties all output signals can be turned off.

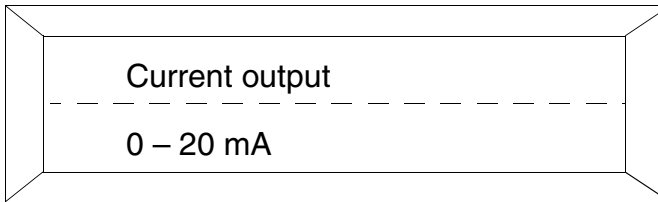
Totalizer Reset

Passive or active over operating contact (closer).
The internal totalizer values can be reset.
Optocoupler: $16\text{ V} \leq U_{CE} \leq 30\text{ V DC}$, $R_i = 2000\text{ Ohm}$

Output Signals

Isolation In/Output

All in- and outputs are isolated from the signal circuit and each other.



Current Output

0/4 - 20 mA, load < 1000 Ohm
0/2 - 20 mA, load < 2000 Ohm
Can be switched by the software

Scaled Pulse Output

Scaled pulse output, separate for each flow direction, max. count frequency 5 kHz. The pulse factor can be set between 0.001 and 1000. Pulse width can be set between 0.1 and 2000 ms.

Active

Voltage pulses 24 V rectangular, load > 150 Ω

Option

Passive, optocoupler
 $5\text{ V} < U_{CE} < 30\text{ V DC}$
 $2\text{ mA} < I_{CE} < 220\text{ mA}$, $f_{max} 5\text{ kHz}$

Contact Output for System Monitoring

During an error condition the internal system monitor displays a clear text error message and activates a contact output.

Select optocoupler or relay (opens for alarm).
Errors encountered are stored in an error register.

Optocoupler: $16\text{ V} < U_{CEH} < 30\text{ V}$; $0\text{ V} < U_{CEL} < 3.5\text{ V}$
 $0\text{ mA} < I_{CEH} < 0.2\text{ mA}$; $2\text{ mA} < I_{CEL} < 15\text{ mA}$

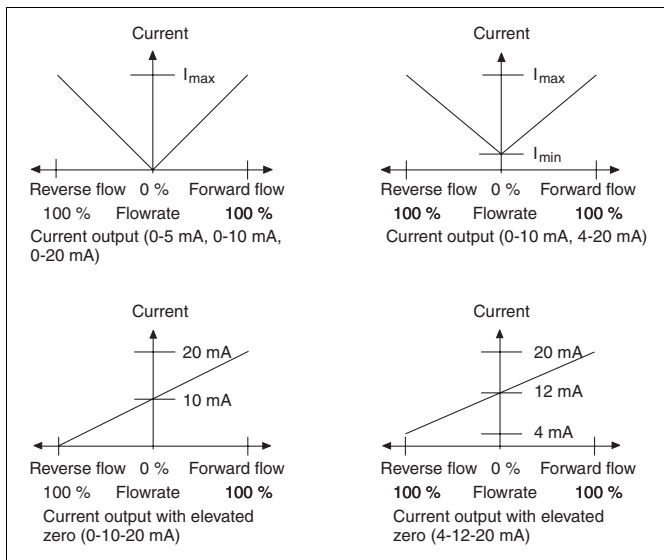
Relay: max. 3 W, max. 250 mA,
max. 30 V DC

Configurable Contact Outputs

The following functions can be software selected for the contact outputs:

Forward/reverse flow direction signal
Max. alarm or min. alarm for flowrate

Optocoupler: $16\text{ V} < U_{CEH} < 30\text{ V}$; $0\text{ V} < U_{CEL} < 3.5\text{ V}$
 $0\text{ mA} < I_{CEH} < 0.2\text{ mA}$; $2\text{ mA} < I_{CEL} < 15\text{ mA}$



Dimension Drawings: Converter, Model 50XP2000

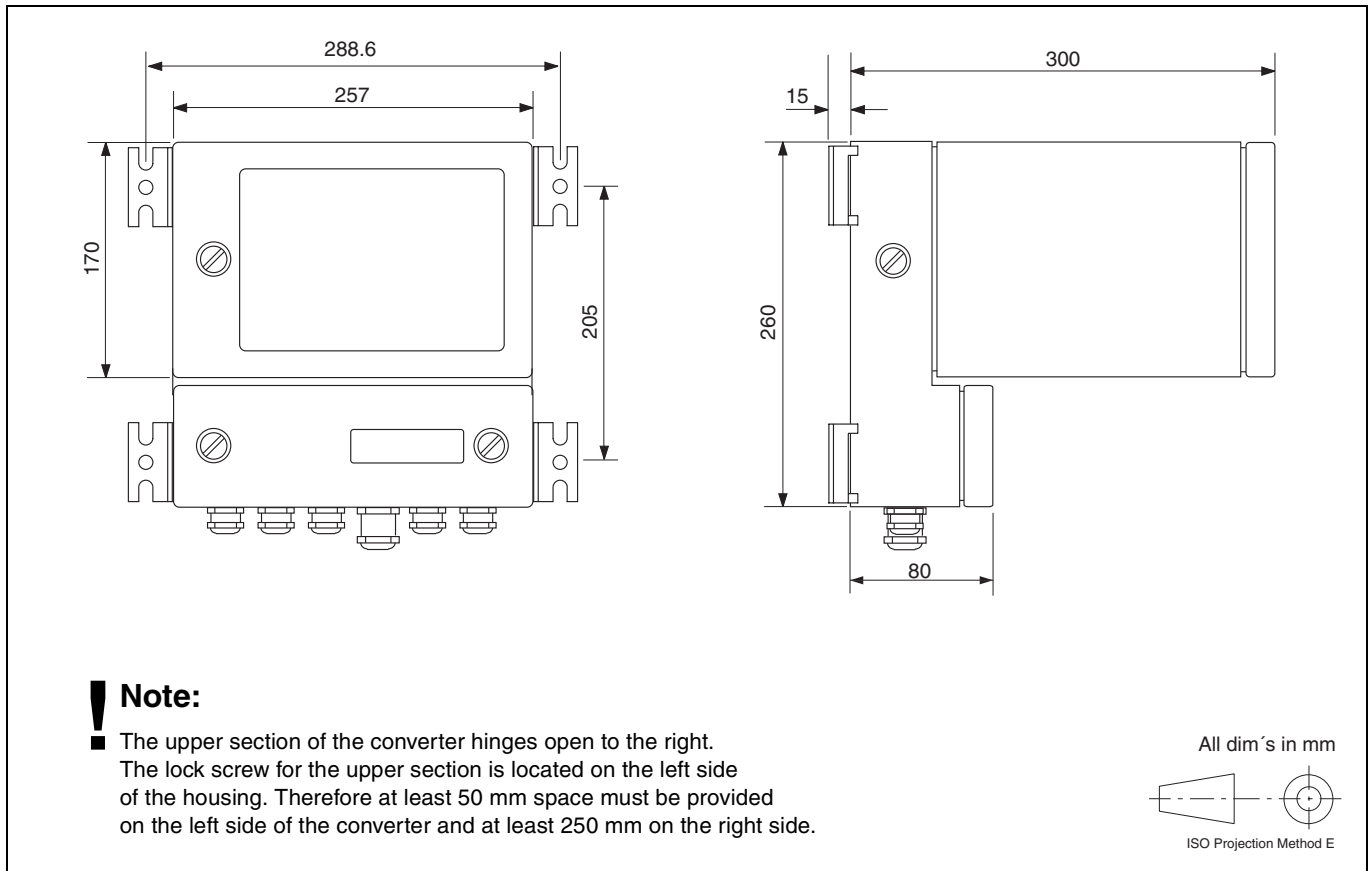


Fig.13 Dimensions, Field Mount Housing PARTI-MAG II

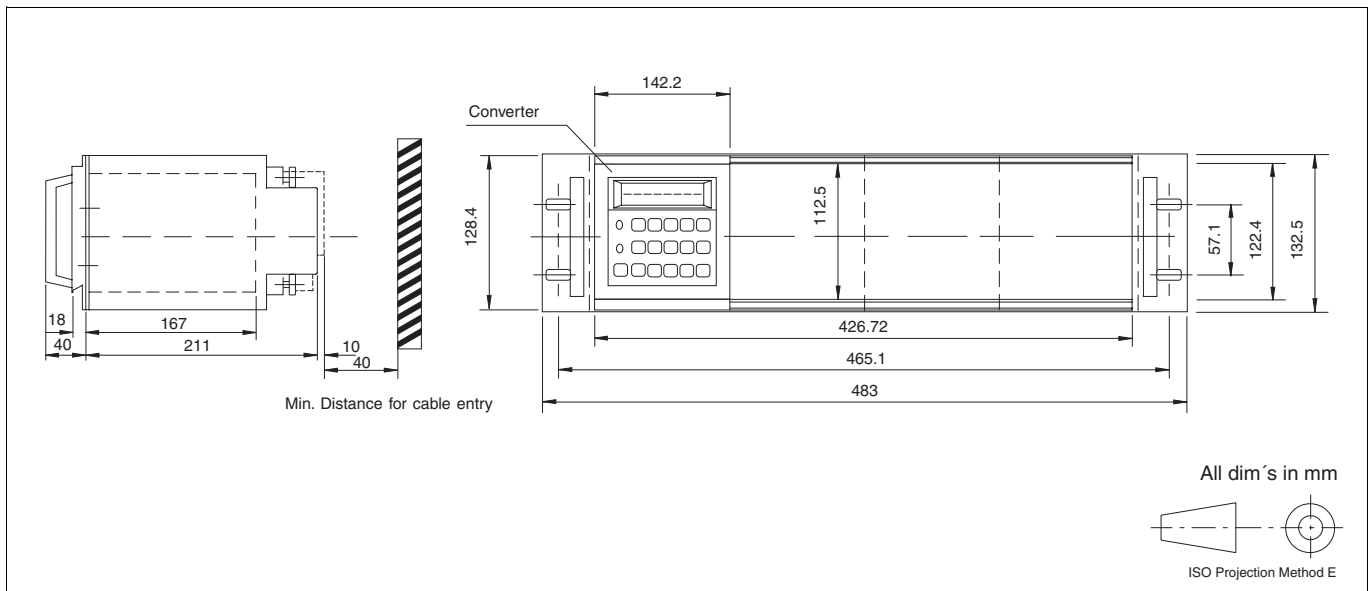


Fig.14 Dimensions, 19"-Design

Ordering Information: Converter, Model 50XP2000

In addition to the Ordering Number please supply the following information: Flow range

Order number	50XP2																			
Remote signal converter																				
Excitation frequency																				
6 1/4 Hz (50 Hz)																				
7 1/2 Hz (60 Hz)																				
Certifications																				
Without																				
Alarm output																				
Passive optocoupler																				
Passive relay																				
Design level (specified by ABB)																				
Software level (specified by ABB)																				
Housing																				
Field housing with window																				G
19"-plug-in unit																				M
Pulse outputserial data link																				
Aktive (Standard)Without																				0
Passive optocouplerWithout																				1
WithoutRS 485																				2
Passive optocouplerRS 485																				5
Operating mode																				
Continuous flow measurement																				0
Additional option																				
Without																				A
Power supply																				
230 V 50/60 Hz																				A
115 V 50/60 Hz																				B
24 V 50/60 Hz																				C
Nameplate																				
German																				1
English																				2
French																				3
Signal- and excitation cable length																				
0 m (if converter electronic is required for spare part for example)																				00
5 m																				05
10 m																				10
15 m																				15
20 m																				20
25 m																				25
30 m																				30
35 m																				35
40 m																				40
45 m																				45
50 m																				50

Shielded signal/excitation cable, pre-configured connected to remote converter (field housing version) when shipped.

Interconnection Diagram for standard design, Primary DP41 with converter 50XP2000

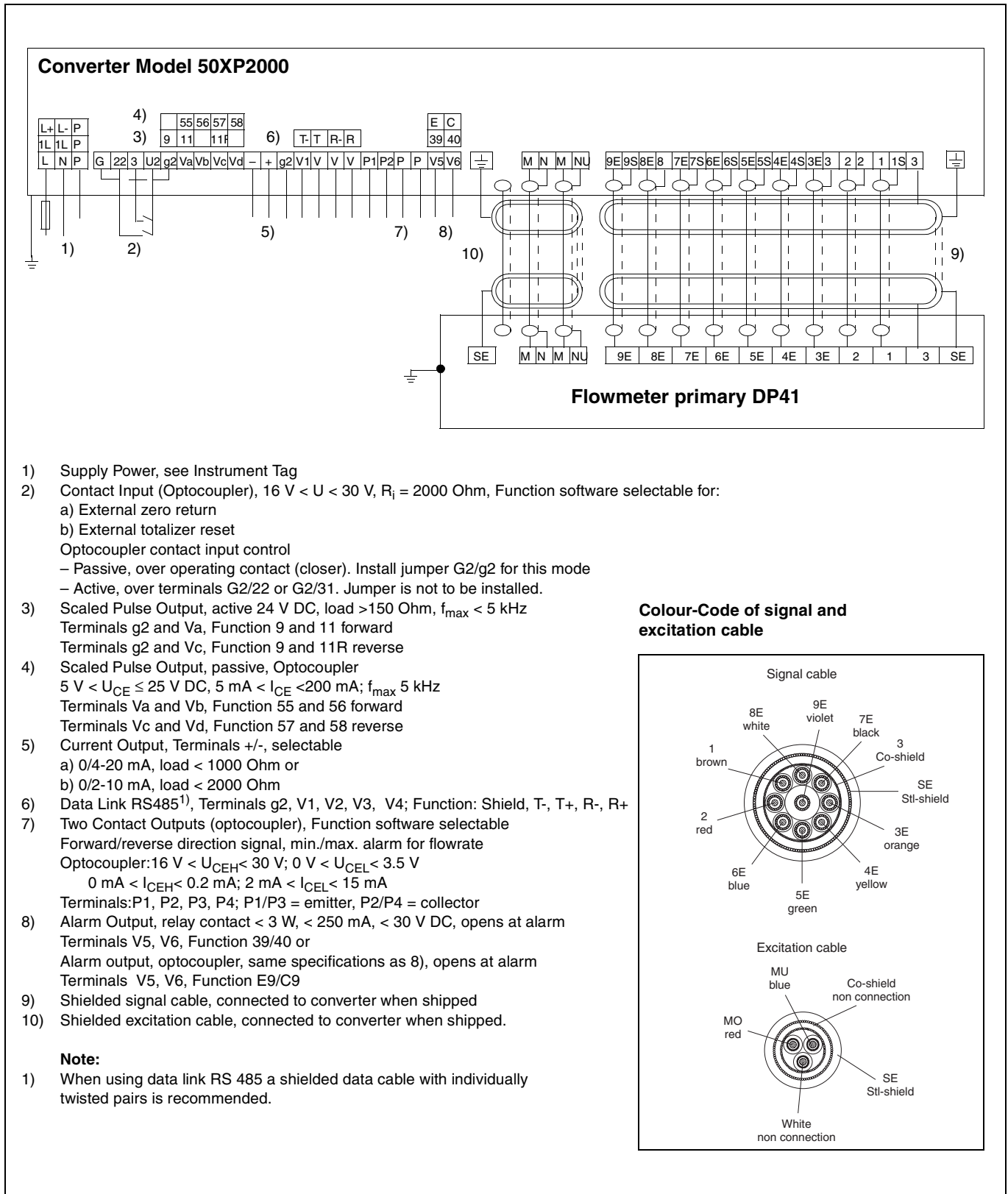


Fig.15 Interconnection Diagram, Converter 50XP2000



Interconnection Diagram for ex-design, Primary DP46 with converter 50XP2000

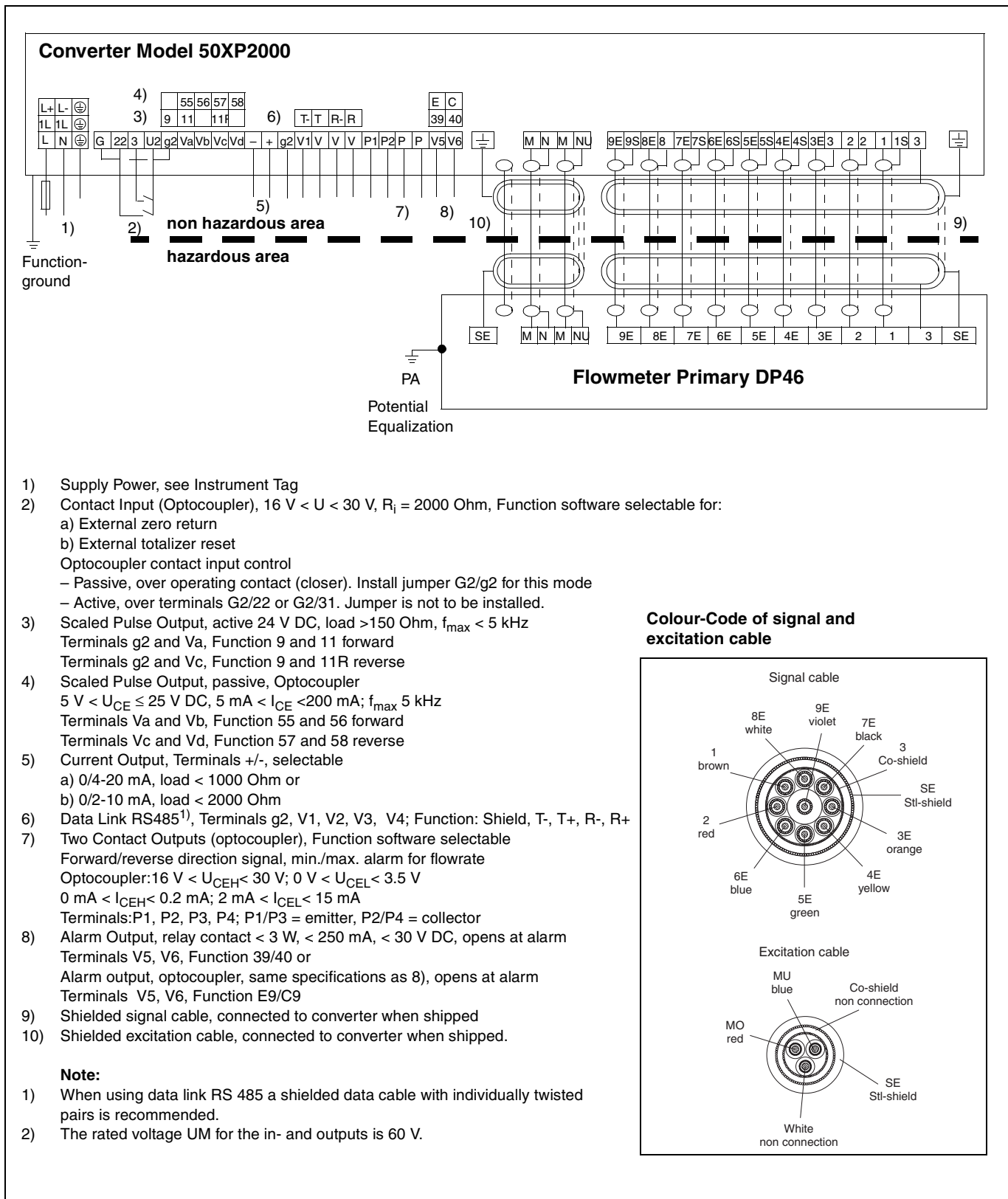


Fig.16 Interconnection Diagram, Converter 50XP2000

Interconnection Examples for Peripherals

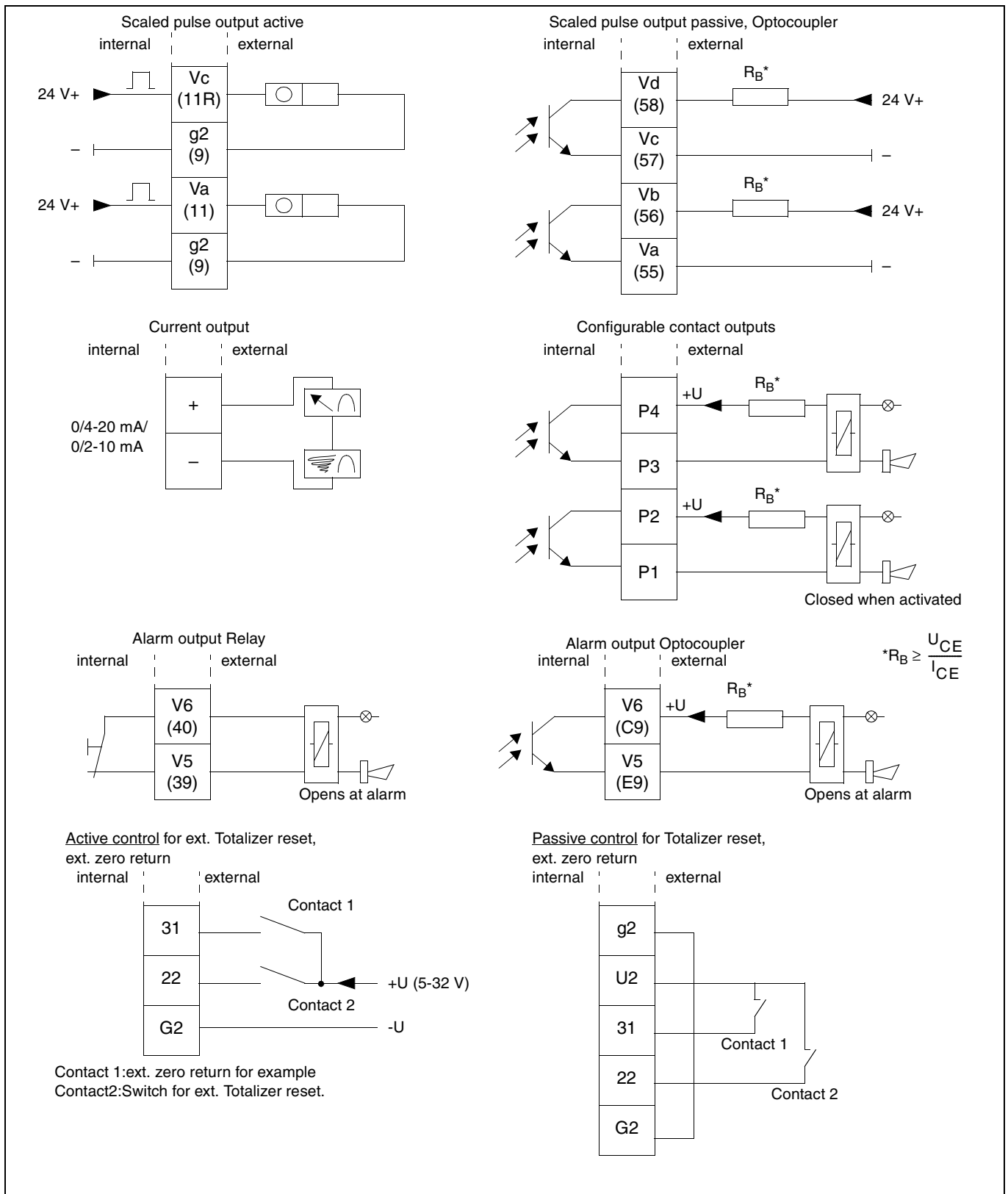


Fig.17 Interconnection Examples for Peripherals

Technical Date: Converter, Model 50XP2000**Serial Data Link**

The serial interface is available in Rs 485 configuration.

RS 485

$V_{pp} = 5 \text{ V}$, input impedance: $\geq 12 \text{ k}\Omega$,

Max. cable length: $\leq 1200 \text{ m}$

Baudrate: 1200-9600 Baud

Max. 32 instruments in parallel on a single bus. A shielded data cable with individually twisted pairs is recommended.

Terminals: V1, V2, V3, V4; Function T-, T+, R-, R+

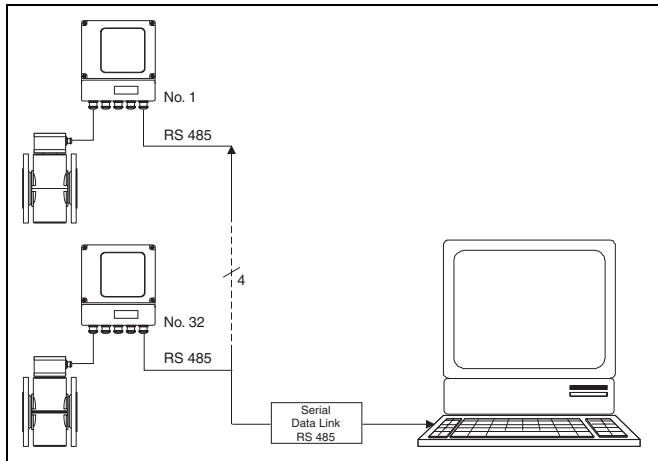


Fig.18 Communication with RS 485 Data Link

Communication via Modem

If the converter is equipped with a serial data link it can be connected to a standard modem (Hayes compatible). All parameters of the converter can be interrogated resp. changed.

ABB

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Certified per DIN EN ISO 9001

Part No. D184S024U02 Rev. 01