Summary

Indicating ranges

Pressure						
mbar						
-2.5 to 0	-1.5 to	+1	-1 to	+1.5	0 to	2.5
-4 to 0	-2.5 to	+1.5	-1.5 to	+2.5	0 to	4
-6 to 0	-4 to	+2	-2 to	+4	0 to	6
-10 to 0	-6 to	+4	-4 to	+6	0 to	10
-16 to 0	-10 to	+6	-6 to	+10	0 to	16
-25 to 0	-15 to	-10	-10 to	-15	0 to	25
-40 to 0	-25 to	+15	-15 to	+25	0 to	40
-60 to 0	-40 to	+20	-20 to	+40	0 to	60
-100 to 0	-60 to	+40	-40 to	+60	0 to	100
-160 to 0	-100 to	+60	-60 to	+100	0 to	160
-250 to 0	-150 to	+100	-100 to	+150	0 to	250
-400 to 0	-250 to	+150	-150 to	+250	0 to	400
bar						
-0.6 to 0	-0.4 to	+0.2	-0.2 to	+0.4	0 to	0.6
-1 to 0	-0.6 to	+0.4	-0.4 to	+0.6	0 to	1
			-1 to	+0.6	0 to	1.6
			-1 to	+1.5	0 to	2.5
			-1 to	+3	0 to	4
			-1 to	+5	0 to	6
			-1 to	+9	0 to	10
			-1 to	+15	0 to	16
					0 to	25
					0 to	40
					0 to	60
					0 to	100
					0 to	160
					0 to	250
					0 to	400
					0 to	600
					0 to	1000

Pressure gauge for

Pressure

Bourdon tube			Membrane type			Capsule type		
–	R	L	–	R	L	–	R	L
Page 1/126			Page 1/129			Page 1/133		

Supplementary equipment
– None
R Remote transmitter
L Limit contact

Pressure ranges

Pressure
mbar
0 to 100
0 to 160
0 to 250
0 to 400
0 to 600
bar
0 to 1
0 to 1.6
0 to 2.5
0 to 4
0 to 6
0 to 10
0 to 16
0 to 25
0 to 40
0 to 60
0 to 100
0 to 160
0 to 250
0 to 400
0 to 600
0 to 1000
-1 to 0
-0.6 to 0
-0.4 to 0
-0.25 to 0
-0.16 to 0
-0.1 to 0

SITRANS P, Z series, 7MF156. for

Pres-sure	Absolute pressure
Electric sensor	
Page 1/135	

Application

The pressure gauges are used to measure pressures above or below atmospheric (DIN 1314). The reference point for the pressure measurement is the actual atmospheric pressure at the place of installation.

The SI dimension for pressure is the Pascal (Pa)
1 Pa = 1 N/m^2 (DIN 1314)

It has proven appropriate to use the tenth part of the Megapascal (MPa), the bar, since the bar is a pressure unit with the magnitude of the atmospheric pressure.
1 bar = 0.1 MPa = 0.1 N/mm^2 = 10^5 Pa

The millibar (mbar) is used for low pressures.
1 mbar = 10^3 bar = 10^2 Pa

Pressure gauges with a scale for other dimensions are available as "Further designs".

Pressure gauges with a Bourdon-tube mechanism are suitable for corrosive and non-corrosive gases, vapors and liquids.

Pressure gauges with a membrane-type mechanism are suitable for corrosive and non-corrosive gases, vapors and liquids; the designs with an open measuring flange are also suitable for viscous and pulpy media.
Pressure gauges with a capsule-type mechanism are suitable for corrosive and non-corrosive gases as well as non-condensing gases.
Pressure gauges filled with a damping liquid for damping the indication are suitable for pulsating media and vibrating measuring points. Condensed water cannot form in them, and thus corrosion of the internal components is largely inhibited.
A pressure surge reducer can be connected upstream of the gauge to protect the gauge if there are pressure surges or pulsations in the medium.
If temperatures below 0 °C occur, the formation of condensation must be prevented which would ice-up the mechanism and the inside of the housing. All pressure gauges are approved for temperatures of the medium up to 100 °C.

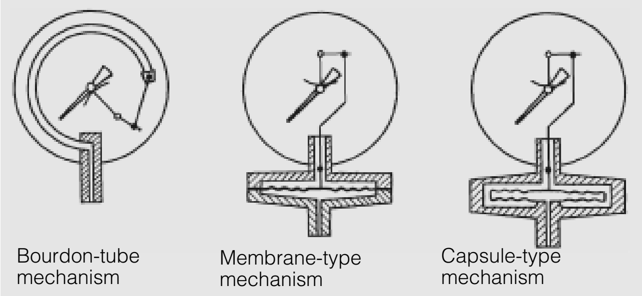


Fig. 1/141 Cross-section of the spring-type mechanisms

The pressure gauges can be fitted with a remote transmitter for transmission of the measured values to electric indicators, recorders or controllers. Pressure gauges with limit contacts (electric limit transmitters) are available for triggering switching operations when specific measured values are reached.

Design

The housings are made of CrNi steel suitable for direct mounting at the point of measurement or for panel mounting.
The glass panes of the pressure gauges are made of laminated safety glass to DIN 16 006[1]) or flat instrument glass.
Circular dials correspond to DIN 16 109[1]).
The scales for the display ranges are divided according to DIN 16 128[1]).
The housings have a coupling to DIN 16 288[1]): male thread of coupling G½ DIN ISO 228/1 or M 20 × 1.5.

Mode of operation

The pressure deforms the spring which in turn moves the coupled pointer.

Overload protection fitted in pressure gauges with spring-type mechanisms

Application

The overload protection only provides a safeguard against **short-term** overload. The overload protection cannot be retrofitted!

[1]) The standard will be replaced in the future by DIN EN 837 Parts 1 to 3.

Technical data

Overload: The product between the full-scale value and the overload protection results in the maximum pressure to which the spring can be exposed without damage.

Pressure gauge	Full-scale value	Overload protection
• With Bourdon-tube mechanism (7MD1001)	≤ 100 bar ≤ 400 bar > 400 bar	2 fold 1.5 fold Not increased (standard)
• With membrane-type mechanism (7MD1101)	All ranges	10 fold for positive indicating ranges, but ≤ 40 bar
• With capsule-type mechanism (7MD1201)	No additional overload protection possible	

Technical description

Application

Pressure gauges are equipped with remote transmitters if the measured value is not only to be indicated at the point of measurement but is to also be transmitted to another location and used e.g. for control purposes.

The output signal of the remote transmitter is a load-independent direct current of 4 to 20 mA (two-wire connection) or 0 to 20 mA (three-wire connection) which is linearly proportional to the mechanical indication (rising characteristic).

Mode of operation

Bourdon-tube, membrane-type or capsule-type mechanisms are used to measure the pressure. The movement of the measuring element is used mechanically to deflect the dial, and electrically converted into an electric output signal by a sensor which measures the magnetic field. The EMC characteristics have been tested according to EN 50 081-2 and EN 50 082-2, and guarantee accurate measurement of the signal even under rough operating conditions.

The remote transmitter has no feedback effects on the mechanical indication.

Technical data

Output	
Output signal S	
• Two-wire connection	4 to 20 mA
• Three-wire connection	0 to 20 mA
Load	$R_A \le (U_H - 10\ V)/0.02\ A$ in Ω
Accuracy	
Reference conditions	Fixed-point setting
Conformity error with	
• Class 1.6 for local indicator	± 1.0 % of full-scale value
• Class 1.0 for local indicator	± 0.8 % of full-scale value
Hysteresis with	
• Class 1.6 for local indicator	± 0.8 % of full-scale value
• Class 1.0 for local indicator	± 0.5 % of full-scale value
Response time	Approx. 50 ms
Adjustability	
• Zero, electric	± 5 % of full-scale value
• Span, electric	± 5 % of full-scale value
Power supply effect	≤ 0.1 % of full-scale value
Load effect	≤ 0.1 % of full-scale value
Rated operating conditions	
Ambient temperature	-20 to +60 °C
Temperature range for medium	-25 to +100 °C
Compensated temperature range	-25 to +60 °C
• Mean temperature coefficient	
- Zero	≤ 0.3 % of full-scale value / 10 K
- Span	≤ 0.3 % of full-scale value / 10 K
Degree of protection	IP 65 to EN 60 529
Electromagnetic compatibility (EMC)	
• Emitted interference	To EN 50 081-1, March 1993 and EN 50 081-2, March 1994
• Noise immunity	To EN 50 082-2, March 1995
Electrical protection	Protected against incorrect polarity and overvoltages
Design	
Dimensions (W x H x D) in mm	See Fig. 1/143
Electrical connection	Cable box, screw terminals up to 2.5 mm^2
Power supply	
Terminal voltage	DC 10 to 30 V
Permissible residual ripple	$U_{pp} \le 10$ %

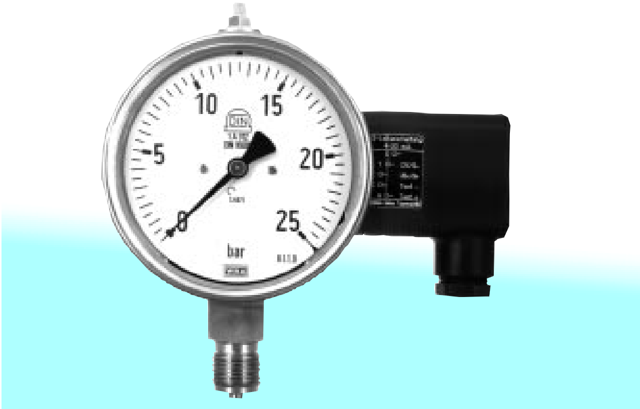


Fig. 1/142 Pressure gauge with remote transmitter

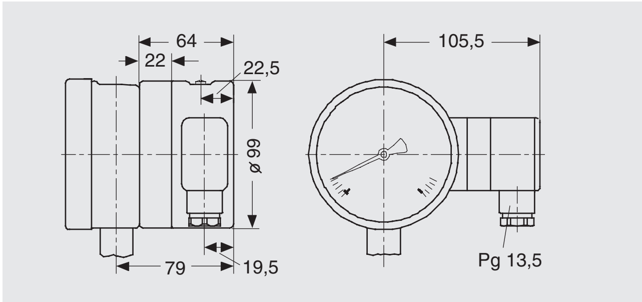


Fig. 1/143 Dimensions

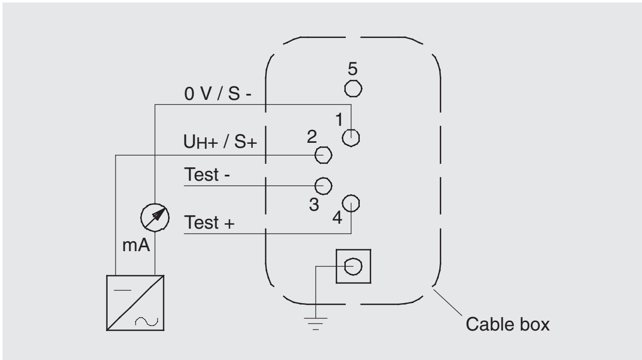


Fig. 1/144 Terminal assignments for two-wire system (U_H = power supply, S = output signal)

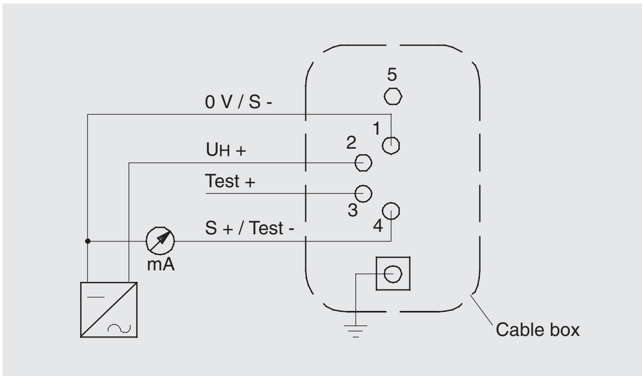


Fig. 1/145 Terminal assignments for three-wire system (U_H = power supply, S = output signal)

Application

The limit contact activates a circuit when the measured pressure reaches a specific value. The switching point is adjustable and can be read on a limit indicator on the scale of the pressure gauge.

The magnetic spring contact switches directly. It can be used if vibrations occur at the point of measurement or if there are small pulsed changes in the pressure of the measured medium. A relay must be connected if the power consumption of the consumers (e.g. horns, sirens or contactors) exceeds the switching capacity of the limit contact. The relay should be of low inductance.

The inductive limit contact operates as a proximity contact. It triggers an isolating amplifier (order separately), e.g. 7NG4040, which has a sufficient switching capacity. The inductive limit contact can be used in corrosive atmospheres.

Design

The limit contact can be set to any maximum or minimum value using a removable key. The lock is located in the window.
In the case of double limit contacts, the two contacts can only be shifted together up to the smallest specified interval. Superimposed or overlapping settings are not possible!

Mode of operation

Magnetic spring limit contacts

The pointer of the pressure gauge drags a contact arm which triggers the switching operation. The contact arm touches a contact pin or leaves it when the measured value exceeds or falls below the set limit. A small permanent magnet is located next to the contact pin. This accelerates the switch-on procedure shortly before the limit is reached, increases the contact pressure, and slightly delays the switch-off procedure so that the contacts are separated suddenly.

Inductive limit contacts

The pointer of the pressure gauge moves a metal control lug which influences the high-frequency magnetic field of a pair of coils. This field is generated by an oscillator. Once the limit has been reached, the control lug enters the stray field of the pair of coils. The oscillation amplitude is then reduced. An electronic amplifier coupled to the oscillator then controls a transistor in the input circuit of the separate isolating amplifier, e.g. 7NG4040. The transistor triggers the actual switching procedure.

Technical data

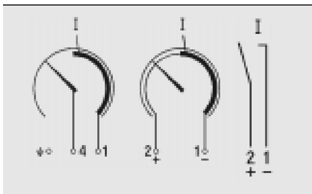
Magnetic spring limit contacts	1 or 2
Smallest interval between double contacts	4 % of indicating span
Switching capacity	Max. 30 W / 50 VA (non-filled indicators) Max. 20 W / 20 VA (filled indicators) Min. 0.25 W / 0.25 VA
Loading capacity	Max. 1 A, min. 20 mA
Voltage	Max. AC/DC 230 V, min. AC/DC 24 V
Contact material	Ag80 Ni20
Electrical connection	Cable box with Pg 13.5 screwed gland, terminals for max. 2.5 mm^2 conductors
Inductive limit contacts	1 or 2

Further data depend on the isolating amplifier, e.g. 7NG4040.

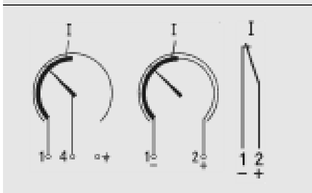
Connections and switching functions

Connections		Switching functions
Magnetic spring limit contact	Inductive limit contact	

Single limit contact

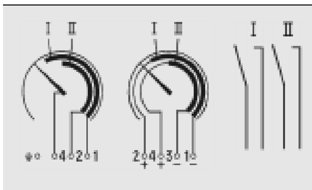


NO contact for rising indication corresponding to NC contact for falling indication

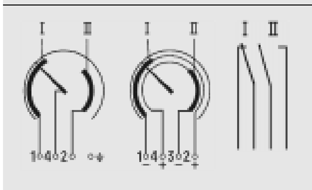


NO contact for falling indication corresponding to NC contact for rising indication

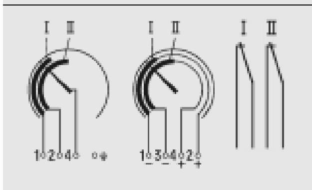
Double limit contacts



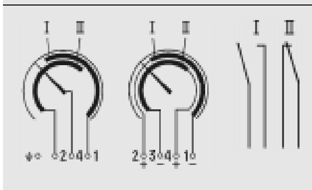
Limit contact I:
NO contact for rising indication corresponding to NC contact for falling indication
Limit contact II:
NO contact for rising indication corresponding to NC contact for falling indication



Limit contact I:
NO contact for falling indication corresponding to NC contact for rising indication
Limit contact II:
NO contact for rising indication corresponding to NC contact for falling indication



Limit contact I:
NO contact for falling indication corresponding to NC contact for rising indication
Limit contact II
NO contact for falling indication corresponding to NC contact for rising indication



Limit contact I:
NO contact for rising indication corresponding to NC contact for falling indication
Limit contact II:
NO contact for falling indication corresponding to NC contact for rising indication

With an increasing indication, limit contact I always switches first, with a falling indication limit contact II. The sequence cannot be reversed (no overlapping of contacts).

Contact designations:

NO contact (also make contact)
The contact closes a previously open circuit either with a rising or falling indication.

NC contact (also break contact)
The contact opens a previously closed circuit either with a rising or falling indication.

Rising indication
Clockwise pointer deflection.

Falling indication
Counterclockwise pointer deflection.

Pressure gauges
with Bourdon-tube mechanism

7MD1001

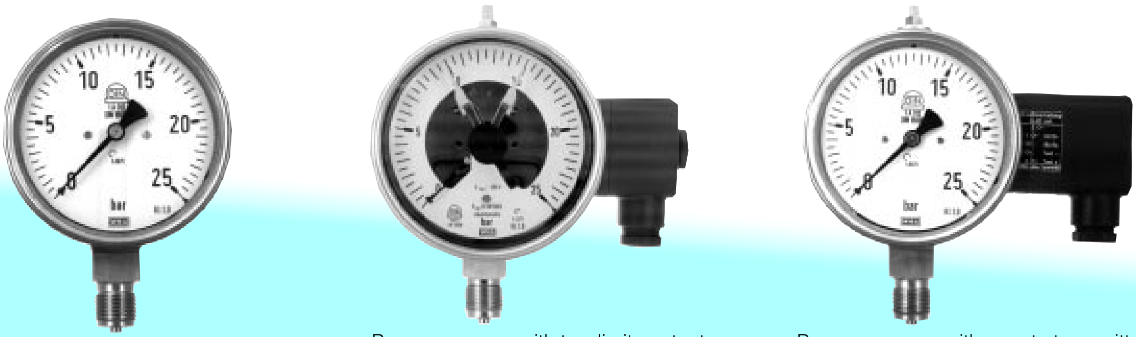


Fig. 1/146 Pressure gauges with Bourdon-tube mechanism for direct mounting

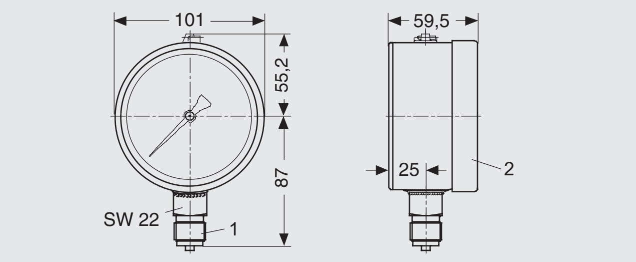
Application

The pressure gauges are suitable for corrosive and non-corrosive gases, vapors and liquids.

Technical data

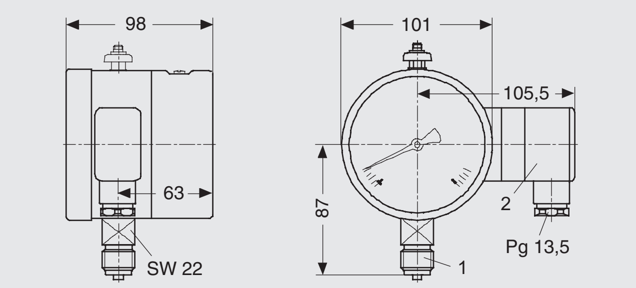
Input		
Measured variable	Pressure	
Measuring range • Span	0.6 to 1000 bar	
Accuracy		
Error limits	Class 1.0 to DIN 16 005	
Rated operating conditions		
Installation conditions Mounting position	Scale vertical	
Ambient conditions		
Ambient temperature	-20 to +60 °C At temperatures below 0 °C, prevent condensation from being formed and icing-up the measuring spring and the inside of the housing	
Temperature of medium	≤ 200 °C, (≤ 100 °C with damping liquids)	
Degree of protection to EN 60 529	IP 54; IP 65 with damping liquid	
Conditions of medium Pressure limit		
• Steady load • Alternating load • Short-term overload	100 % of full-scale value 90 % of full-scale value 1.3 times the span	
Design		
Approx. weight in kg	Without damping liquid	With damping liquid
• Without supplementary equipment	0.65	0.9
• With limit signal transmitter	0.9	1.2
• With remote transmitter	0.95	1.2
Dimensions (W x H x D)	See Figs. 1/147 to 1/150	

Design (continued)	
Material	
• Wetted parts materials - Coupling	Stainless steel, mat. No. 1.4571, with thread G½ DIN ISO 228/1 or M20 x 1.5; washer DIN 16 258 is suitable
• Non-wetted parts materials - Bourdon tube - Front pane - Housing	Stainless steel, mat. No. 1.4571 Multi-layer safety glass Stainless steel, mat. No. 1.4301, bright drawn; optionally filled with damping liquid; unbreakable partition between Bourdon tube and dial; rear panel with pressure release outlet
- Pointer mechanism	Made of CrNi steel
Electrical connection	Cable box with Pg 13.5 screwed gland, terminals for max. 2.5 mm^2 conductors
Safety design	To DIN 16 006
Supplementary equipment	See pages 1/124 and 1/125
Indicator	
Range	According to Ordering data
Scale	Circular
Pointer deflection	0 to 270°



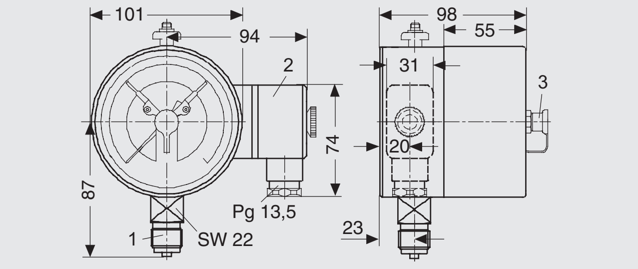
1 Coupling G½ or M20 x 1.5 2 Bayonet ring

Fig. 1/147 Pressure for direct mounting without supplementary equipment, dimensions



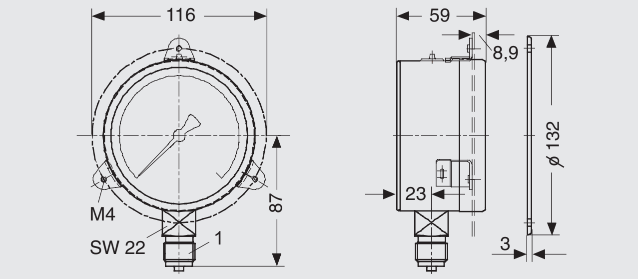
1 Coupling G½ or M20 x 1.5
2 Cable box or plug for electric connections

Fig. 1/148 Pressure gauge for direct mounting, with remote transmitter, dimensions



1 Coupling G½ or M20 x 1.5
2 Cable box or plug for electric connections
3 Removable key for limit contacts

Fig. 1/149 Pressure gauge for direct mounting, with limit contacts, dimensions



1 Coupling G½ or M20 x 1.5

Fig. 1/150 Pressure gauge for panel mounting, without supplementary equipment, dimensions
(see Figs. 1/148 and 1/149 for dimensions of supplementary equipment)

7MD1001

Ordering data

Pressure gauge with Bourdon-tube mechanism

Order No. **7MD1001-** ■■■■■ - ■■■■

Design		Damping liquid	Pos. 1	Pos. 2	Pos. 3	Pos. 4–5	Last pos.
Safety design to DIN 16 006							
Direct mounting			1				
Panel mounting			2				
Supplementary electric equipment		**Damping liquid**					
None		Without		A		0 0	0
None		With		A		0 0	1
Remote transmitter							
Power supply	Characteristic						
Two-wire system							
DC 10 to 30 V	Rising	Without		B		0 0	0
DC 10 to 30 V	Rising	With		B		0 0	2
Three-wire system							
DC 10 to 30 V	Rising	Without		C		0 0	0
DC 10 to 30 V	Rising	With		C		0 0	2
Inductive limit contacts 1 limit contact							
NO contact for rising indication		Without		D		1 1	0
NO contact for rising indication		With		D		1 1	2
NO contact for falling indication		Without		D		1 2	0
NO contact for falling indication		With		D		1 2	2
2 limit contacts							
NO contact I for indication	NO contact II for indication						
Rising	Rising	Without		E		2 1	0
Rising	Rising	With		E		2 1	2
Falling	Rising	Without		E		2 2	0
Falling	Rising	With		E		2 2	2
Falling	Falling	Without		E		2 3	0
Falling	Falling	With		E		2 3	2
Rising	Falling	Without		E		2 4	0
Rising	Falling	With		E		2 4	2
Magnetic spring limit contacts 1 limit contact							
NO contact for rising indication		Without		F		1 1	0
NO contact for rising indication		With		F		1 1	2
NO contact for falling indication		Without		F		1 2	0
NO contact for falling indication		With		F		1 2	2
2 limit contacts							
NO contact I for indication	NO contact II for indication						
Rising	Rising	Without		G		2 1	0
Rising	Rising	With		G		2 1	2
Falling	Rising	Without		G		2 2	0
Falling	Rising	With		G		2 2	2
Falling	Falling	Without		G		2 3	0
Falling	Falling	With		G		2 3	2
Rising	Falling	Without		G		2 4	0
Rising	Falling	With		G		2 4	2
Pressure connection: thread G½					A		
M20 x 1.5					B		

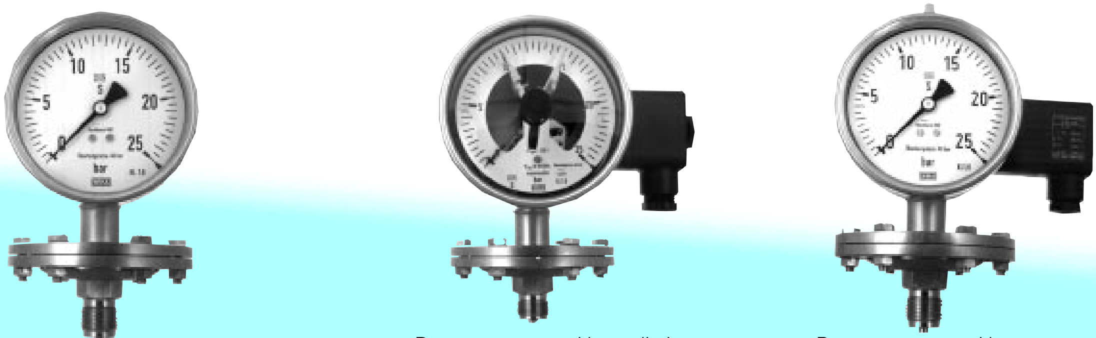
Ordering data

Further designs (Please add **"-Z"** to Order No.)	Order code	Plain text
Degreased mechanism: for measuring oxygen	**A03**	**–**
Overload protection fitted (description on page 1/123)	**A21**	**–**
Report with listing of individual measured values; 5 points/gauge	**A24**	**–**
Plug connector instead of cable box; degree of protection EN 60 529/IEC 529 – IP 65; approved for AC 250 V; conductor cross-section up to 2.5 mm^2	**A06**	**–**
Red mark on the scale to identify a particular value	**Y03**	**Red mark at ... bar**
Additional scale inscription, e.g. "Steam" or "Boiler 1"	**Y04**	**Scale inscription: ...**
Other indicating range: dimension other than bar or mbar or/and numbers other than those in the Ordering data (non-official units such as kp/cm^2 or mm water gauge are only available on export models)	**Y05**	**Indicating range: ... to ... ...**
Non-linear scale graduation, e.g. quadratic or calculated according to information from customer. Start-of-scale and full-scale values must correspond with those of a listed indicating range in the Ordering data	**Y06**	**Scale graduation: ...**
Additional second scale	**Y07**	**2nd scale ... to ... ...**
Identification on housing Plastic foil labelled; e.g. "Measuring point P100"	**Y08**	**Housing identification: ...**

Other special scales and colored scale sections on request.

Order codes additive, any sequence.

Span bar	Indicating range bar	Code
0.6	0 to 0.6	1 A A
1	0 to 1	1 B A
1.6	0 to 1.6	1 C A
2.5	0 to 2.5	1 D A
4	0 to 4	1 E A
6	0 to 6	1 F A
10	0 to 10	1 G A
16	0 to 16	1 H A
25	0 to 25	1 J A
40	0 to 40	1 K A
60	0 to 60	1 L A
100	0 to 100	2 A A
160	0 to 160	2 B A
250	0 to 250	2 C A
400	0 to 400	2 D A
600	0 to 600	2 E A
1000	0 to 1000	3 A A
1	-1 to +0	4 A A
1.6	-1 to +0.6	4 B A
2.5	-1 to +1.5	4 C A
4	-1 to +3	4 D A
6	-1 to +5	4 E A
10	-1 to +9	4 F A
16	-1 to +15	4 G A



Pressure gauge with two limit contacts

Pressure gauge with remote transmitter

Fig. 1/151 Pressure gauges with membrane mechanism for direct mounting

Application

The pressure gauges are suitable for corrosive and non-corrosive gases, vapors and liquids; designs with a measuring flange open at the bottom are also suitable for viscous and pulpy media.

Technical data

Input		
Measured variable	Pressure	
Measuring range • Span	16 mbar to 40 bar	
Accuracy		
Error limits	To DIN 16 005	
• Membrane without Teflon coating	Class 1.6	
• Membrane with Teflon coating	Class 2.0	
Rated operating conditions		
Installation conditions Mounting position	Scale vertical	
Ambient conditions Ambient temperature	-20 to +60 °C At temperatures below 0 °C, prevent condensation from being formed and icing-up the measuring spring and the inside of the housing	
Temperature of medium	≤ 100 °C	
Degree of prot. to EN 60 529 • Without damping liquid • With damping liquid	 IP 54 IP 65	
Conditions of medium Pressure limit		
• Steady load	100 % of full-scale value	
• Alternating load	90 % of full-scale value	
• Short-term overload - ≤ 0.25 bar and > 2.5 bar - > 0.25 bar and ≤ 2.5 bar	 500 % of full-scale value 300 % of full-scale value, 500 % of full-scale value with upper part of measuring flange made of CrNi steel, but ≤ 40 bar	
Design		
Approx. weight in kg	Upper part of measuring flange	
	100 mm diam.	160 mm diam.
• Basic pressure gauge	1.4	2.6
• Damping liquid	0.4	0.4
• Limit signal transmitter	0.3	0.3
• Remote transmitter	0.3	0.3
Approx. additional weight in kg with open lower part of flange		
• DN 25/DN 50	0.9/2.5	3/3
• Di 64/Di 122	0/-	-/0
• DN 125	-	3.9
Dimensions (W x H x D) in mm	See Figs. 1/152 to 1/154	

Design	(continued)
Material	
• Wetted parts materials - Coupling for closed measuring flange	Steel, mat. No. 1.0330, or NiCr steel, mat. No. 1.4571, with thread G½ DIN ISO 228/1 or M20 x 1.5; washer DIN 16 258 is suitable
• Non-wetted parts materials - Membrane	Without/with PTFE coating, horizontal
With upper part of measuring flange: steel ≤ 2.5 bar > 2.5 bar	 CrNi steel, mat. No. 1.4571 CrNi steel, mat. No. 1.4568
With upper part of measuring flange: CrNi steel ≤ 250 mbar > 250 mbar	 CrNi steel, mat. No. 1.4571 NiCrCo alloy (Durathern)
- Upper part of measuring flange	Steel, mat. No. 1.0330, black enamelled or CrNi steel, mat. No. 1.4301
- Bottom part of measuring flange	Steel, mat. No. 1.0330, black enamelled or CrNi steel, mat. No. 1.4571
- Front pane Upper part of flange: steel	 Flat instrument glass
Upper part of flange: NiCr steel	Multi-layer safety glass
- Housing	CrNi steel, mat. No. 1.4301, bright drawn; optionally filled with damping liquid; with upper part of flange made of CrNi steel: additional rear panel with pressure release outlet
- Pointer mechanism Upper part of flange: steel	 Cu alloy
Upper part of flange: NiCr steel	CrNi steel
Electrical connection	Cable box with Pg 13.5 screwed gland, terminals for max. 2.5 mm^2 conductors
Safety design	To DIN 16 006
Supplementary equipment	See pages 1/124 and 1/125
Indicator	
Range	According to Ordering data
Scale	Circular
Pointer deflection	0 to 270°

Ordering data

Pressure gauge
with membrane-type mechanism

Direct mounting

Upper part of measuring flange made of steel, black enamelled

			Order No. Upper part of meas. flange 160 mm diameter. Possible spans 16[1])/25/40/60/100/160/250 mbar. 7MD1101-	Order No. Upper part of meas. flange 100 mm diameter. Possible spans 0.4/0.6/1/1.6/2.5/4/6/16/25/40 bar. 7MD1101-
Membrane	Uncoated		0	2
	With PTFE coating		1	3
Supplementary electric equipment		**Damping liquid**		
None		Without	A 0 0 … 0	A 0 0 … 0
		With	A 0 0 … 1	A 0 0 … 1
Remote transmitter				
Power supply	Characteristic			
Two-wire system				
DC 10 to 30 V	Rising	Without	B 0 0 … 0	B 0 0 … 0
		With	B 0 0 … 2	B 0 0 … 2
Three-wire system				
DC 10 to 30 V	Rising	Without	C 0 0 … 0	C 0 0 … 0
		With	C 0 0 … 2	C 0 0 … 2
Inductive limit contacts				
1 limit contact				
NO contact for rising indication		Without	D 1 1 … 0	D 1 1 … 0
		With	D 1 1 … 2	D 1 1 … 2
NO contact for falling indication		Without	D 1 2 … 0	D 1 2 … 0
		With	D 1 2 … 2	D 1 2 … 2
2 limit contacts				
NO contact I for indication	NO contact II for indication			
Rising	Rising	Without	E 2 1 … 0	E 2 1 … 0
		With	E 2 1 … 2	E 2 1 … 2
Falling	Rising	Without	E 2 2 … 0	E 2 2 … 0
		With	E 2 2 … 2	E 2 2 … 2
Falling	Falling	Without	E 2 3 … 0	E 2 3 … 0
		With	E 2 3 … 2	E 2 3 … 2
Rising	Falling	Without	E 2 4 … 0	E 2 4 … 0
		With	E 2 4 … 2	E 2 4 … 2
Magnetic spring limit contacts				
1 limit contact				
NO contact for rising indication		Without	F 1 1 … 0	F 1 1 … 0
		With	F 1 1 … 2	F 1 1 … 2
NO contact for falling indication		Without	F 1 2 … 0	F 1 2 … 0
		With	F 1 2 … 2	F 1 2 … 2
2 limit contacts				
NO contact I for indication	NO contact II for indication			
Rising	Rising	Without	G 2 1 … 0	G 2 1 … 0
		With	G 2 1 … 2	G 2 1 … 2
Falling	Rising	Without	G 2 2 … 0	G 2 2 … 0
		With	G 2 2 … 2	G 2 2 … 2
Falling	Falling	Without	G 2 3 … 0	G 2 3 … 0
		With	G 2 3 … 2	G 2 3 … 2
Rising	Falling	Without	G 2 4 … 0	G 2 4 … 0
		With	G 2 4 … 2	G 2 4 … 2

Flange lower part (see Figs. 1/154 to 1/156)

Material	Form	Pressure connection	Outer diameter	DN/Di	160 mm	Outer diam.	DN/Di	100 mm
Steel, black enamelled	Closed	G½	160 mm	–	L	100 mm	–	A
		M20 x 1.5	160 mm	–	M	100 mm	–	B
	Open	Sealing face	160 mm	25	N	100 mm	64	C
			160 mm	122	P	115 mm	25	D
			240 mm	125	Q	165 mm	50	E
CrNi steel	Closed	G½	160 mm	–	R	100 mm	–	F
		M20 x 1.5	160 mm	–	S	100 mm	–	G
	Open	Sealing face	160 mm	25	T	100 mm	64	H
			160 mm	122	U	115 mm	25	J
			240 mm	125	V	165 mm	50	K

1) Not with designs with limit contact

Spans for 100 mm flange

Span bar	Indicating range bar	
0.4	0 to + 0.4	2 J A
	- 0.4 to 0	2 K A
	- 0.25 to + 0.15	2 L A
	- 0.15 to + 0.25	2 M A
0.6	0 to + 0.6	2 N A
	- 0.6 to 0	2 P A
	- 0.4 to + 0.2	2 Q A
	- 0.2 to + 0.4	2 R A
1	0 to + 1	2 S A
	- 1 to 0	2 T A
	- 0.6 to + 0.4	2 U A
	- 0.4 to + 0.6	2 V A
1.6	0 to + 1.6	3 A A
	- 1 to 0.6	3 B A
2.5	0 to + 2.5	3 C A
	- 1 to + 1.5	3 D A
4	0 to + 4	3 E A
	- 1 to + 3	3 F A
6	0 to + 6	3 G A
	- 1 to + 5	3 H A
10	0 to + 10	3 J A
	- 1 to + 9	3 K A
16	0 to + 16	3 L A
	- 1 to + 15	3 M A
25	0 to + 25	3 N A
40	0 to + 40	3 P A

Spans for 160 mm flange

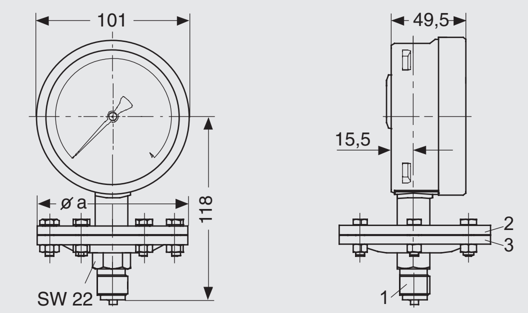
Span bar	Indicating range bar	
16	0 to +16	1 A B
	-16 to 0	1 B B
	-10 to +6	1 C B
	-6 to +10	1 D B
25	0 to +25	1 E B
	-25 to 0	1 F B
	-15 to +10	1 G B
	-10 to +15	1 H B
40	0 to +40	1 J B
	-40 to 0	1 K B
	-25 to +15	1 L B
	-15 to +25	1 M B
60	0 to +60	1 N B
	-60 to 0	1 P B
	-40 to +20	1 Q B
	-20 to +40	1 R B
100	0 to +100	1 S B
	-100 to 0	1 T B
	-60 to +40	1 U B
	-40 to +60	1 V B
160	0 to +160	2 A B
	-160 to 0	2 B B
	-100 to +60	2 C B
	-60 to +100	2 D B
250	0 to +250	2 E B
	-250 to 0	2 F B
	-150 to +100	2 G B
	-100 to +150	2 H B

Ordering data

Further designs (please add **"-Z"** to Order No.)	Order code	Plain text
Upper part of measuring flange X 5 CrNi 18 9, mat. No. 1.4301; safety design	**B01**	–
Overload protection fitted (description on page 1/123)	**A21**	–
Report with listing of individual measured values; 5 points/gauge	**A24**	–
Plug connector instead of cable box; degree of protection EN 60 529/IEC 529 – IP 65; approved for AC 250 V; conductor cross-section up to 2.5 mm^2	**A06**	–
Red mark on the scale to identify a particular value	**Y03**	**Red mark at ... bar or ... mbar**
Additional scale inscription, e.g. "Steam" or "Boiler 1"	**Y04**	**Scale inscription: ...**
Other indicating range: dimension other than bar or mbar or/and numbers other than those in the Ordering data (non-official units such as kp/cm^2 or mm water gauge are only available on export models)	**Y05**	**Indicating range: ... to ... ...**
Non-linear scale graduation, e.g. quadratic or calculated according to information from customer. Start-of-scale and full-scale values must correspond with those of a listed indicating range in the Ordering data	**Y06**	**Scale graduation: ...**
Additional second scale	**Y07**	**2nd scale ... to ... ...**
Identification on housing Plastic foil labelled; e.g. "Measuring point P100"	**Y08**	**Housing identification: ...**

Other special scales and colored scale sections on request.

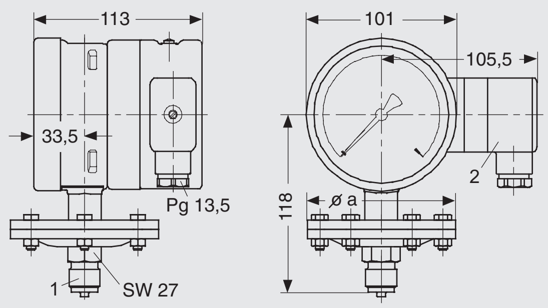
Order codes additive, any sequence.



Ø a	Span		Gauge 7MD1101-
mm	min. bar	max. bar	-■■■■■ - .... ↑
100	0.4	40	A, B, F, G
160	0.16	0.25	L, M, R, S

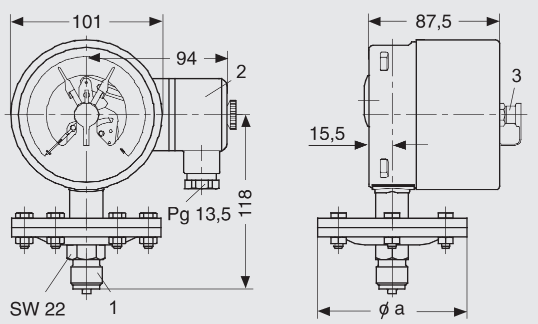
1 Coupling, G½ or M20 x 1.5
2 Upper part of measuring flange
3 Lower part of measuring flange

Fig. 1/152 Pressure gauge without supplementary equipment, measuring flange closed; dimensions



Ø a as in Fig. 1/152
1 Coupling, G½ or M20 x 1.5
2 Cable box or plug for electric connections

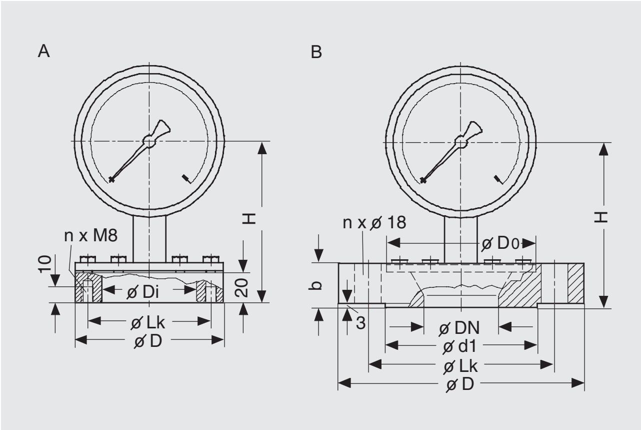
Fig. 1/153 Pressure gauge with remote transmitter, measuring flange closed; dimensions



Ø a	Span		Gauge 7MD1101-
mm	min.	max. bar	-■■■■■ - .... ↑
100	0.4 bar	40	A, B, F, G
160	25 mbar	0.25	L, M, R, S

1 Coupling, G½ or M20 x 1.5
2 Cable box or plug for electric connections
3 Removable key for limit contacts

Fig. 1/154 Pressure gauge with limit contacts, measuring flange closed; dimensions



A

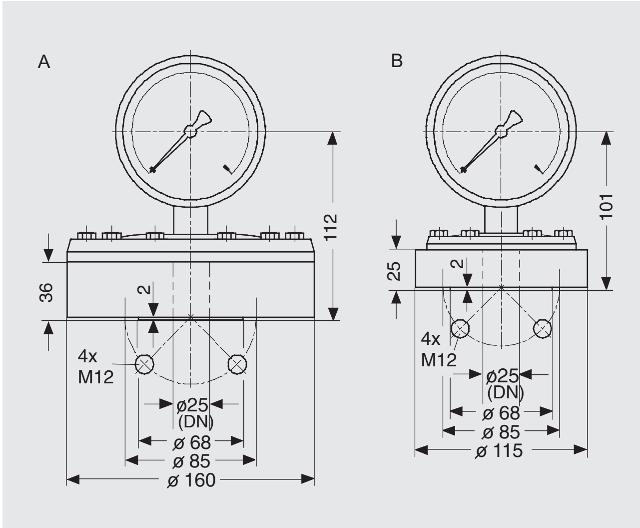
D mm	Lk mm	Di mm	No. of holes	H mm	Span min.	max.	Gauge 7MD1101- -■■■■■ - ....
100	83	64	6	97	0.4 bar	40 bar	C, H
160	140	122	10	128	16 mbar	0.25 bar	P, U

B

Measuring flange								Span		Gauge
Upper part	Lower part						No. of holes	min.	max.	7MD1101-
D_O	D	Lk	d_1	DN	b	H	n			-■■■■■-...
mm	mm	mm	mm		mm	mm		bar	bar	
100	165	125	102	50	26.5	100	4	0.4	40	E, K
160	240	200	178	125	18	95	8	0.16	25	Q, V

All other dimensions correspond to those of the pressure gauges with a closed measuring flange (Figs. 1/152 to 1/154)

Fig. 1/155 Pressure gauge with measuring flange open at bottom; dimensions
(A: upper and lower parts with same external diameter;
B: external diameter of lower part greater than that of upper part; mating flange to DIN 2501, sealing face form D to DIN 2526; DN 50/PN 40 and DN 125/PN 6)



	DN	Span min.	max.	Gauge 7MD1101- -■■■■■ - ....
A	25	16 mbar	250 mbar	N, T
B	25	0.4 bar	40 bar	D, J

All other dimensions correspond to those of the pressure gauges with a closed measuring flange (Figs. 1/152 to 1/154)

Fig. 1/156 Pressure gauge with measuring flange open at bottom for DN 25/PN 40; dimensions (mating flange to DIN 2501, sealing face form D to DIN 2516)

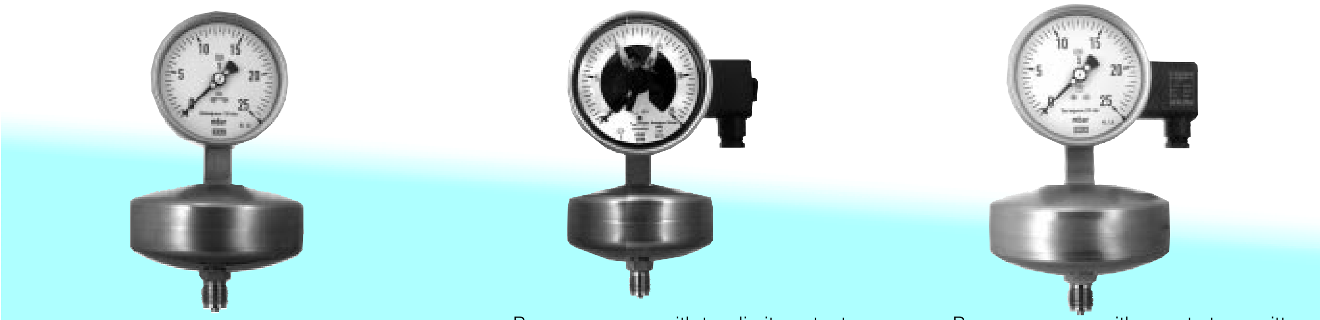

Pressure gauge with two limit contacts
Pressure gauge with remote transmitter

Fig. 1/157 Pressure gauges with capsule-type mechanism for direct mounting

Application

The pressure gauges are suitable for corrosive, non-condensing gases (not for vapors and liquids).

Technical data

Input	
Measured variable	Pressure
Measuring range	
• Span	0.6 to 100 mbar
Accuracy	
Error limits	Class 1.0 to DIN 16 005
Rated operating conditions	
Installation conditions	
Mounting position	Scale vertical
Ambient conditions	
Ambient temperature	-20 to +60 °C At temperatures below 0 °C, prevent condensation from being formed and icing-up the measuring spring and the inside of the housing
Temperature of medium	≤ 100 °C
Degree of prot. to EN 60 529	IP 54
Conditions of medium	
Pressure limit	
• Steady load	100 % of full-scale value
• Alternating load	90 % of full-scale value
• Short-term overload	5000 % of full-scale value
Design	
Approx. weight in kg	
• Without supplementary equipment	1.6
• With limit signal transmitter	1.8
• With remote transmitter	1.9
Dimensions (W x H x D) in mm	See Figs. 1/158 to 1/160
Material	
• Wetted parts materials	
- Coupling	CrNi steel, mat. No. 1.4571, with thread G½ DIN ISO 228/1 or M20 x 1.5; washer DIN 16 258 is suitable
• Non-wetted parts materials	
- Capsule element	CrNi steel, mat. No. 1.4571, horizontally arranged
- Front pane	Multi-layer safety glass
- Housing	CrNi steel, bright drawn; rear panel with pressure release outlet
- Pointer mechanism	Made of CrNi steel
Electrical connection	Cable box with Pg 13.5 screwed gland, terminals for max. 2.5 mm²
Safety design	To DIN 16 006
Supplementary equipment	See pages 1/124 and 1/125
Indicator	
Range	According to Ordering data
Scale	Circular
Pointer deflection	0 to 270°

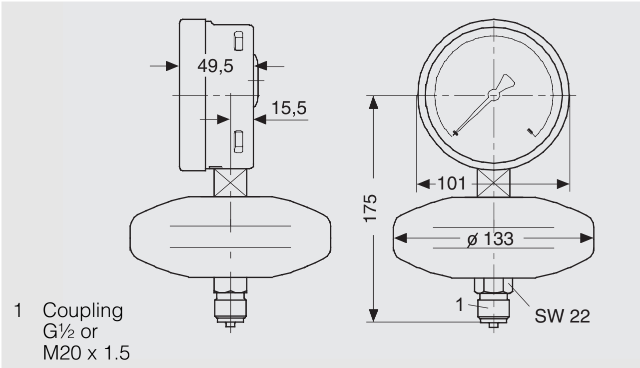


Fig. 1/158 Pressure gauge without supplementary equipment, dimensions

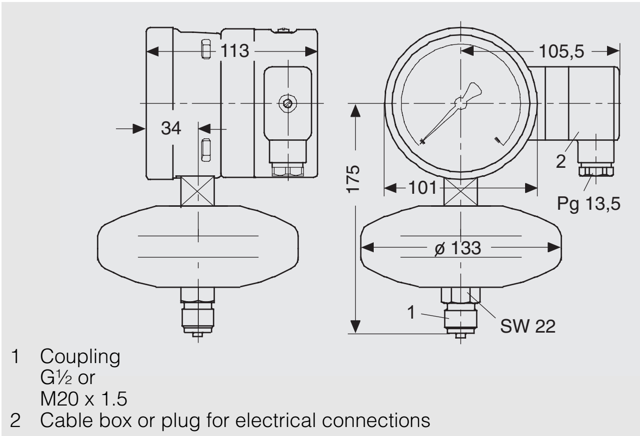


Fig. 1/159 Pressure gauge with remote transmitter, dimensions

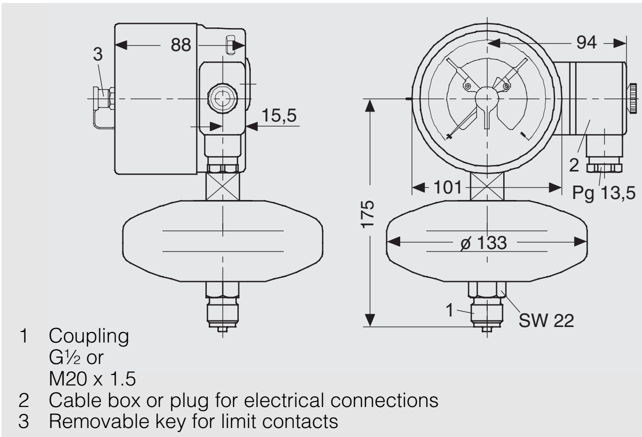


Fig. 1/160 Pressure gauge with limit contacts, dimensions

Ordering data

Press. gauge with capsule-type mechanism Safety design, direct mounting			Order No. **7MD1201-** **2 ■ ■ ■ ■ - ■ ■ A 0**
Supplementary electric equipment			
None			A 0 0
Remote transmitter	Power supply	Charact.	
Two-wire system	DC 10 ... 30 V	Rising	B 0 0
Three-wire system	DC 10 ... 30 V	Rising	C 0 0
Inductive limit contacts 1 limit contact			
NO contact for rising indication			D 1 1
NO contact for falling indication			D 1 2
2 limit contacts			
NO contact I for indication	NO contact II for indication		
Rising	Rising		E 2 1
Falling	Rising		E 2 2
Falling	Falling		E 2 3
Rising	Falling		E 2 4
Magnetic spring limit contacts 1 limit contact			
NO contact for rising indication			F 1 1
NO contact for falling indication			F 1 2
2 limit contacts			
NO contact I for indication	NO contact II for indication		
Rising	Rising		G 2 1
Falling	Rising		G 2 2
Falling	Falling		G 2 3
Rising	Falling		G 2 4
Pressure connection: thread G½			A
M20 x 1.5			B

Span mbar	Indicating range mbar	Order No.
2.5	0 to +2.5	1 A
	-2.5 to 0	2 A
	-1.5 to +1	3 A
	-1 to +1.5	4 A
4	0 to +4	1 B
	-4 to 0	2 B
	-2.5 to +1.5	3 B
	-1.5 to +2.5	4 B
6	0 to +6	1 C
	-6 to 0	2 C
	-4 to +2	3 C
	-2 to +4	4 C
10	0 to +10	1 D
	-10 to 0	2 D
	-6 to +4	3 D
	-4 to +6	4 D
16	0 to +16	1 E
	-16 to 0	2 E
	-10 to +6	3 E
	-6 to +10	4 E
25	0 to +25	1 F
	-25 to 0	2 F
	-15 to +10	3 F
	-10 to +15	4 F
40	0 to +40	1 G
	-40 to 0	2 G
	-25 to +15	3 G
	-15 to +25	4 G
60	0 to +60	1 H
	-60 to 0	2 H
	-40 to +20	3 H
	-20 to +40	4 H
100	0 to +100	1 J
	-100 to 0	2 J
	-60 to +40	3 J
	-40 to +60	4 J

Ordering data

Further designs (please add **"-Z"** to Order No.)	Order code	Plain text
Report with listing of individual measured values; 5 points/gauge	**A24**	**–**
Plug connector instead of cable box; degree of protection EN 60 529/IEC 529 – IP 65; approved for AC 250 V; conductor cross-section up to 2.5 mm^2	**A06**	**–**
Red mark on the scale to identify a particular value	**Y03**	**Red mark at ... bar or... mbar**
Additional scale inscription, e.g. "Boiler 1"	**Y04**	**Scale inscription: ...**
Other indicating range: dimension other than bar or mbar or/and numbers other than those in the Ordering data (non-official units such as kp/cm^2 or mm water gauge are only available on export models)	**Y05**	**Indicating range: ... to ... ...**
Non-linear scale graduation, e.g. quadratic or calculated according to information from customer. Start-of-scale and full-scale values must correspond with those of a listed indicating range in the Ordering data	**Y06**	**Scale graduation: ...**
Additional second scale	**Y07**	**2nd scale ... to ... ...**
Identification on housing Plastic foil labelled; e.g. "Measuring point P100"	**Y08**	**Housing identification: ...**

Other special scales and colored scale sections on request.

Order codes additive, any sequence!

Application

The transmitters 7MF1560 and 7MF1563 are used to measure the absolute and relative pressures or the level of liquids and gases, the transmitter 7MF1562 to measure the relative pressure of gases, liquids and steam.

They are used in the chemical, pharmaceutical and food industries, in mechanical engineering, shipbuilding, water supply and conservation etc.

An application example for the 7MF1562 is the measurement of compressed air containing oil in compressors or compressor stations.

Design

The pressure transmitters contain a piezo-resistive measuring cell with stainless steel diaphragm (7MF1560) or a thin-film cell with ceramic diaphragm (7MF1562 and 7MF1563) which can also be used for corrosive media, and an electronics board, fitted together in a stainless steel (7MF1560 and 7MF1563) or brass (7MF1562) housing. With the transmitter 7MF1560, the measuring cell and the electronics are potted together.

The transmitter has a process connection G½A (male thread), or G1/8A (female thread) to DIN 16 288 made of stainless steel or brass.

The electrical connection is via a plug (DIN 43 650) with Pg 9 cable inlet.

Mode of operation

The silicon measuring cell of the transmitter has a piezo-resistive bridge on which the operating pressure is transmitted via silicone oil and a stainless steel seal diaphragm. The transmitters 7MF1562 and 7MF1563 have a thin-film strain gauge which is mounted on a ceramic diaphragm.

Every measuring cell is temperature-compensated.

The voltage output by the measuring cell is converted by an amplifier into an output current of 4 to 20 mA.

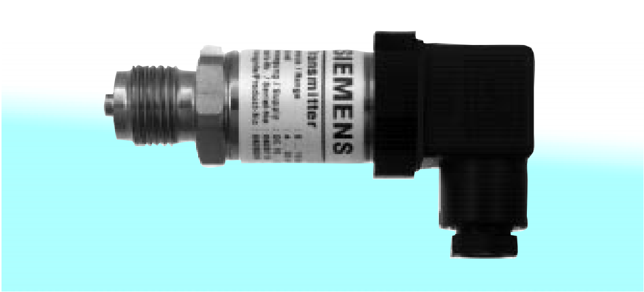


Fig. 1/163 Pressure transmitters 7MF1560, 7MF1562 and 7MF1563

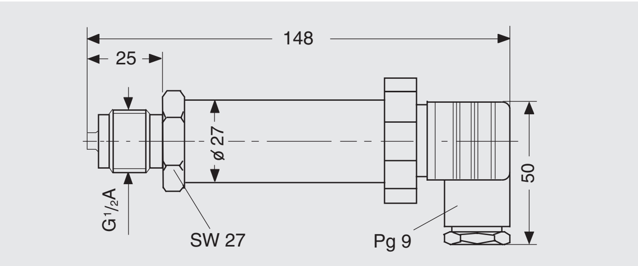


Fig. 1/164 Pressure transmitter 7MF1560, dimensions

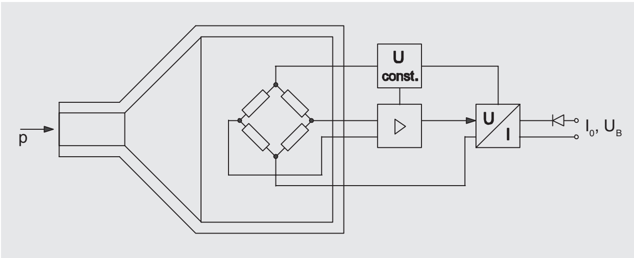


Fig. 1/161 Pressure transmitters 7MF1560, 7MF1562 and 7MF1563, mode of operation

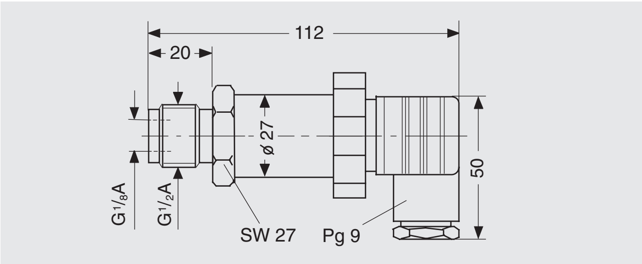


Fig. 1/165 Pressure transmitter 7MF1562, dimensions

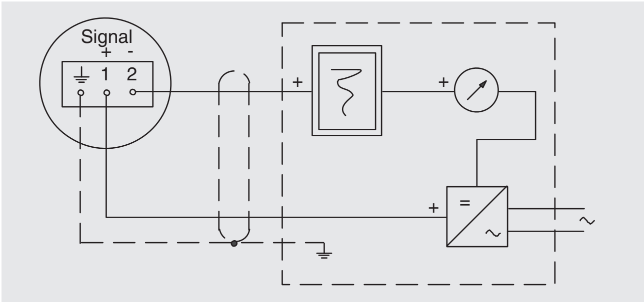


Fig. 1/162 Pressure transmitters 7MF1560, 7MF1562 and 7MF1563, connection diagram

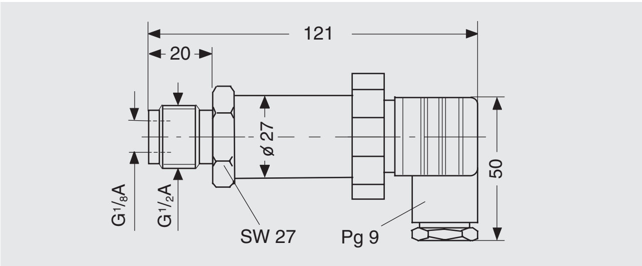


Fig. 1/166 Pressure transmitter 7MF1563, dimensions

Technical data

	7MF1560	7MF1562	7MF1563
Application		See page 1/135	
Mode of operation and system design		See page 1/135	
Measuring principle	Piezo-resistive	Thin-film strain gauge	Thin-film strain gauge
Input			
Measured variable	Pressure and absolute pressure	Pressure	Pressure and absolute pressure
Measuring range	0 to 400 bar	0 to 25 bar	0 to 400 bar
Output			
Output signal		4 to 20 mA	
Load		$(U_B - 10\ V) / 0.02\ A$	
Characteristic		Linear rising	
Accuracy			
Error in measurement (at 25 °C, including conformity error, hysteresis and repeatability)	0.2 % of full-scale value - typical	0.5 % of full-scale value - typical	0.25 % of full-scale value - typical
Response time T_{99}		< 0.1 s	
Long-term drift			
• Start-of-scale value	0.2 % of full-scale value/year	0.3 % of full-scale value/year - typical	0.25 % of full-scale value/year
• Span	0.2 % of full-scale value/year	0.3 % of full-scale value/year - typical	0.25 % of full-scale value/year
Ambient temperature effect			
• Start-of-scale value	0.25 %/10 K of full-scale value	0.3 %/10 K of full-scale value - typical	0.25 %/10 K of full-scale value
• Span	0.25 %/10 K of full-scale value	0.3 %/10 K of full-scale value - typical.	0.25 %/10 K of full-scale value
Vibration influence		0.05 %/g to 500 Hz in all directions (to IEC 68-2-64)	
Power supply influence		0.01 %/V	
Rated operating conditions			
Ambient conditions			
• Ambient temperature		-25 to +85 °C	
• Storage temperature		-50 to +100 °C	
• Degree of protection (to EN 60 529)		IP 65	
• Electromagnetic compatibility			
- Emitted interference		To EN 50 081	
- Noise immunity		To EN 50 082	
Medium conditions			
• Process temperature limits		-30 °C to +120 °C	
• Process pressure limits		See overload pressure (ordering data on page 1/137)	
Design			
Weight (without options)	Approx. 0.3 kg	Approx. 0.2 kg	Approx. 0.25 kg
Dimensions		See dimensional drawings on page 1/135	
Material			
• Wetted parts materials			
- Measuring cell	Stainless steel, mat. No. 1.4571	Al_2O_3 - 96 %	Al_2O_3 - 96 %
- Process connection	Stainless steel, mat. No. 1.4571	Brass, mat. No. 2.0402	Stainless steel, mat. No. 1.4571
- O-ring	Fully-welded design	Viton	Viton
• Non-wetted parts materials			
- Housing	Stainless steel, mat. No. 1.4571	Brass, mat. No. 2.0402	Stainless steel, mat. No. 1.4571
- Plug connector		Plastic housing, to DIN 43 650, form A	
Process connection	G½A - male thread (DIN 16 288), remote seals on request	G½A - male thread G$^1/_8$A - female thread	G½A - male thread G$^1/_8$A - female thread
Electrical connection (to DIN 43 650)		Pg 9	
Power supply			
Terminal voltage on transmitter	10 to 40 V DC	10 to 36 V DC	10 to 36 V DC

Ordering data

	Order No.	Order code
Transmitter SITRANS P, Z series		
7MF1560, for pressure and absolute pressure	**7MF1560-□□□ 0 0**	**+ □□□**
7MF1562, for pressure	**7MF1562-□□□ 0 0**	**+ □□□**
7MF1563, for pressure and absolute pressure Two-wire system, rising characteristic	**7MF1563-□□□ 0 0**	**+ □□□**

Measuring range	Overload pressure 7MF1560	Overload pressure 7MF1562	Overload pressure 7MF1563	7MF1560 Pressure	7MF1560 Absolute pressure	7MF1562 Pressure	7MF1563 Pressure	7MF1563 Absolute pressure	Order code
0 to 250 mbar	4 bar			**2AD**	**4AD**	–	–	–	
0 to 400 mbar	4 bar			**2AE**	**4AE**	–	–	–	
0 to 600 mbar	4 bar			**2AG**	**4AG**	–	–	–	
0 to 1 bar	4 bar		7 bar	**3BA**	**5BA**	–	**3BA**	**5BA**	
0 to 1.6 bar	7 bar		7 bar	**3BB**	**5BB**	–	**3BB**	**5BB**	
0 to 2.5 bar	14 bar		12 bar	**3BD**	**5BD**	–	**3BD**	**5BD**	
0 to 4 bar	14 bar		12 bar	**3BE**	**5BE**	–	**3BE**	**5BE**	
0 to 6 bar	14 bar		25 bar	**3BG**	**5BG**	–	**3BG**	**5BG**	
0 to 10 bar	34 bar		25 bar	**3CA**	**5CA**	–	**3CA**	**5CA**	
0 to 16 bar	34 bar	32 bar	50 bar	**3CB**	**5CB**	**3CB**	**3CB**	**5CB**	
0 to 25 bar	70 bar	64 bar	120 bar	**3CD**		**3CD**	**3CD**		
0 to 40 bar	140 bar		120 bar	**3CE**		–	**3CE**		
0 to 60 bar	140 bar		250 bar	**3CG**		–	**3CG**		
0 to 100 bar	340 bar		250 bar	**3DA**	–	–	**3DA**	–	
0 to 160 bar	340 bar		500 bar	**3DB**	–	–	**3DB**	–	
0 to 250 bar	700 bar		500 bar	**3DD**	–	–	**3DD**	–	
0 to 400 bar	700 bar		600 bar	**3DE**	–	–	**3DE**	–	
Other version Add Order code and plain text: Measuring range: ... to ... (m)bar				**9AA**	**9AB**	**9AA**	**9AA**	**9AB**	**H1Y**

Available ex stock

Pressure surge reducer

M56340

Application

The pressure surge reducer protects the pressure gauge from damage, excessive wear and inaccurate or oscillating deflections. It is used if pulsations occur in the medium (e.g. in low-speed reciprocating pumps and compressors) or if sudden increases or drops in the pressure of the medium can be expected (e.g. in hydraulic presses and tensile test machines).

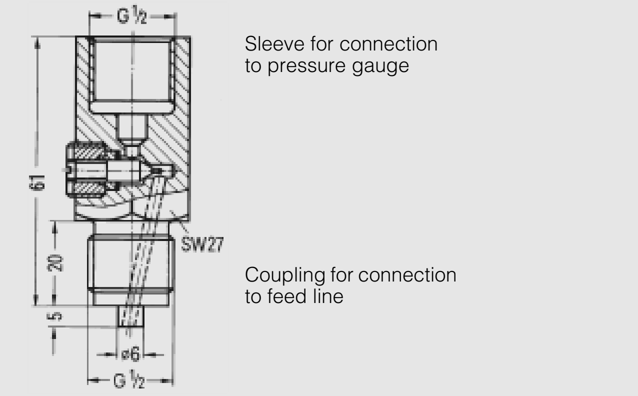


Fig. 1/167 Pressure reducer, dimensions

Design

Housing made of brass or stainless steel;
adjustable nozzle;
sleeve for connection to the pressure gauge;
coupling for connection to the feed line.

Ordering data

Pressure surge reducer		Approx. weight in kg	Order No.
Material	Full-scale value		
Brass	≤ 250 bar	0.21	**M56340-A54**
Stainless steel	≤ 400 bar	0.21	**M56340-A59**

Shut-off valves for pressure gauges and transmitters

M56340

Application

Suitable for corrosive and non-corrosive gases, vapors and liquids.

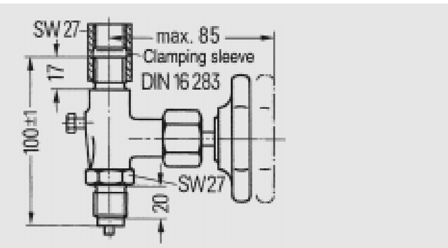
A water trap (see page 1/102) must be connected upstream of the valve if the process temperature exceeds 120 °C.
See page 1/98 ff for shut-off valves form B and instrument brackets.

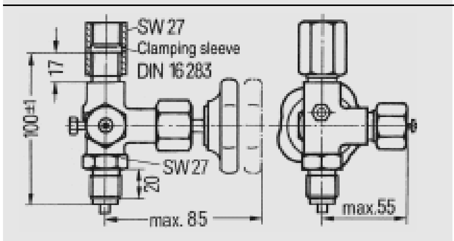
Design

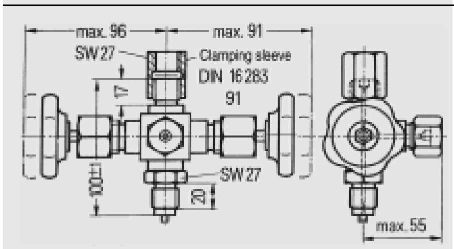
Valve housing made of brass (polished), steel (gunmetal finish) or stainless steel (polished), spindle and venting screw made of stainless steel, handwheel made of moulded material.

Instrument connection: clamping sleeve to DIN 16 283, G½
Process connection: coupling to DIN 16 288, G½
Test connection: thread M20 × 1.5

Ordering data







	Material of valve housing Abbreviated name	Mat. No.	Max. operating pressure	Approx. weight in kg	Order No.
Shut-off valve form A DIN 16 270	CuZn40Pb2	2.0402	250 bar	0.5	**M56340-A27**
	C 22.8 gunmetal finish	1.0460	400 bar	0.5	**M56340-A28**
	X 6 CrNiMoTi 17 122	1.4571	400 bar	0.5	**M56340-A29**
Shut-off valve form A DIN 16 271 with test connection, sealing cap with lens seal	CuZn40Pb2	2.0402	250 bar	0.5	**M56340-A30**
	C 22.8 gunmetal finish	1.0460	400 bar	0.5	**M56340-A31**
	X 6 CrNiMoTi 17 122	1.4571	400 bar	0.5	**M56340-A32**
Double shut-off valve similar to DIN 16 272 form A, but with small test flange, 60 mm x 25 mm x 10 mm	CuZn40Pb2	2.0402	250 bar	1	**M56340-A33**
	C 22.8 gunmetal finish	1.0460	400 bar	1	**M56340-A34**
	X 6 CrNiMoTi 17 122	1.4571	400 bar	1	**M56340-A35**
DIN 16 272, form A with test connection (M20 x 1.5), sealing cap with venting hole on side	CuZn40Pb2	2.0402	250 bar	1	**M56340-A36**
	C 22.8 gunmetal finish	1.0460	400 bar	1	**M56340-A37**
	X 6 CrNiMoTi 17 122	1.4571	400 bar	1	**M56340-A38**

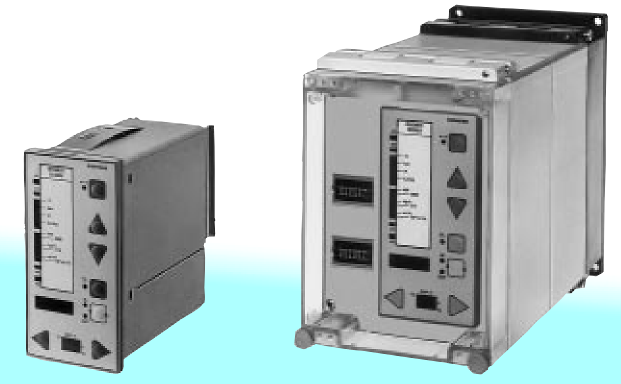
Application

The programmable measured-value computer is designed for use as:

- **Correction computer**
  if flow or level values have to be corrected because of changing pressures or temperatures
- **Function transmitter**
  for simulating defined characteristics
- **Enthalpy computer**
  if the energy content of steam has to be determined
- **Heat quantity computer**
  if the heat quantity has to be determined for steam, condensation or water.

These computing functions are supported and extended by additional features:

- Transmitter monitoring
- Limit signalling
- Linearization of input variables
- Output value limiting
- Fault signalling
- Serial interface.



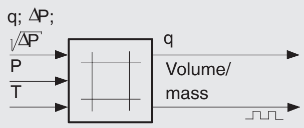
For panel mounting For field mounting

Fig. 1/168 Measured-value computer 7NG1002

Simulation

- Mathematical functions y = f(x) or U_a = f(U_e)
- Non-linear relationships between input and output variables (physical variables, measured variables or control variables).

1. Correction computer for flow measurement



Measured media: water, steam, saturated steam and gases

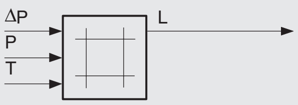
Measurement of instantaneous and effective volume or mass flow.

Flow measurement

- with primary differential pressure devices or
- with other differential pressure methods (e.g. back-pressure sensors) which also require correction of the density *(p, T)*.

When correcting the density, the instantaneous values of the pressure and temperature (only pressure correction for saturated steam) are measured cyclically, and the true value of the flow is calculated.

2. Correction computer for hydrostatic level measurement



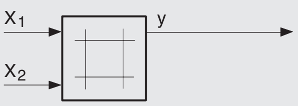
Measured medium: water

Measurement of instantaneous level in the pressure vessel for boiling water in

- power plants of electricity supply companies and
- industrial and municipal power plants.

Calculation of instantaneous level with cyclic measurement of steam pressure if the latter changes during the process.

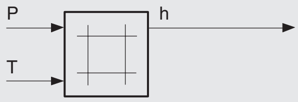
3. Function transmitter or curve calculator



Determination of function values

- Determination of volumes in vessels and tanks
- Linearization of valve characteristics

4. Enthalpy computer



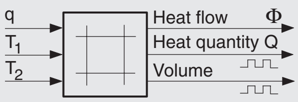
Measured medium: steam

Determination of specific enthalpy (energy content)

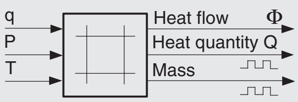
- Determination of heat balance with heat exchangers
- Determination of thermal efficiency for controlling steam generators.

Calculation of the energy content of steam from the instantaneous values of pressure and temperature as the state variables; necessary because of changes in the process (variations in pressure and temperature).

5. Heat quantity computer, calorimetric counter



Measured medium: water



Measured medium: steam, condensation

Determination of thermal energy Q of a heat transfer medium

Determination of heat quantity used at district heating transfer stations, process stations in the chemical and process engineering industries, in industrial and municipal power plants.

Calculation, display and output of heat quantity and heat output with the measured instantaneous values of temperature (inlet and return) and/or pressure of water, condensation and steam as the measured media.

Design

There are two designs:

- Measured-value computer for panel or desk mounting
- Measured-value computer fitted in housing for field mounting.

Introduction

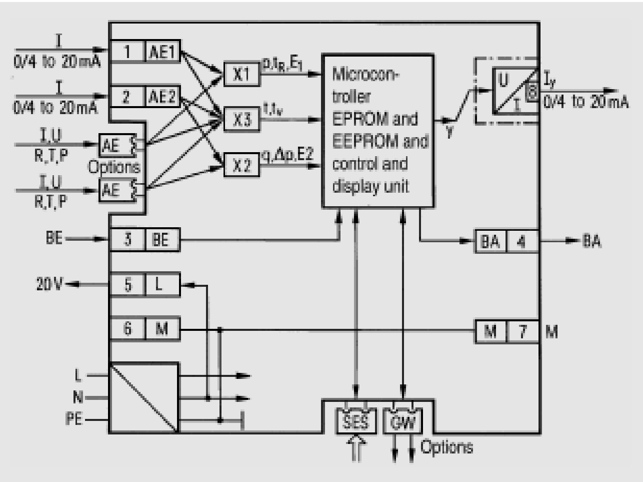


Fig. 1/169 Measured-value computer 7NG1002, function diagram

The measured-value computer comprises:

- Control and display unit with main board (CPU)
- Motherboard with power supply unit and switching elements for the input and output circuits which are always present
- Plastic housing

The basic device additionally contains:

- 2 analog inputs AE1 and AE2 without electrical isolation for 0/4 to 20 mA
- 1 binary input BE (0 to 24 V) for various functions
- 1 binary output BA (0 to 24 V) for various functions
- 1 analog output I_y.

In addition, four slots present in the basic device can be equipped with options to extend the functions.

Slot 1

AE3 Input module with electrical isolation for 0/4 to 20 mA or 0 to 10 V
or
input module for resistance transmitter, also for current source without electrical isolation (adjustable)
or
input module for Pt 100 in two-wire, three-wire or four-wire system
or
input module with electrical isolation for thermocouples, linearization for parameters.

Slot 2

AE4 Fitting possible as for slot AE3.

Slot 3

GW Output module with two floating contacts for limit signalling or as pulse output
or
output module with four 24-V binary outputs for limit signalling A1, A2, A3, A4 or with two pulse outputs and two limit outputs A3, A4.

Slot 4

SES Interface module for serial data transmission to higher-level systems.

The various modules for slots 1 to 4 are identical to the function modules for the SIPART DR 20 controller (Catalog MP 31, "Compact Controllers"). The modules can thus be freely interchanged between the SIPART DR 20 controller and the measured-value computer.

Mode of operation

General

The measured-value computer has a built-in microprocessor for calculating physical processes.

Operation is carried out in three modes:
- Process operation
- Configuring
- Parameterization.

The desired function is selected by the user by setting the structure switches; no programming knowledge is required (setting using the questionnaire, page 1/147, is also possible). The total function of the measured-value computer results from the combination of individual configuring switches. Operating values and measuring ranges are set by parameterizing the measured-value computer. The program produced specifically for the task is stored in a non-volatile data memory.

The program of the measured-value computer is executed with a fixed cycle time of 125 ms. A process image is generated at the beginning of each routine, i.e. the analog and binary inputs as well as the activation of keys are recorded, and the process variables received from the serial interface are imported. All calculations are carried out using these input signals. The data are then passed on to the display elements, the D/A converter and the binary outputs. The calculated variables are stored and are available for serial data exchange.

The serial data exchange between the measured-value computer and higher-level systems (control systems, PC stations) is handled by an interface module (option).

In addition to its calculation functions, the measured-value computer has a comprehensive range of additional functions:

Monitoring of transmitters connected to the analog inputs of the measured-value computer (AE1 to AE4, e.g. for pressure, temperature and flow), limit monitoring and signalling of input and output signals, checking of arithmetic ranges, alarm signalling, cyclic checking of arithmetic functions and reliable performance of the device, disabling of parameterization and configuring, switchover to safety mode, linearization of input signals, standardization of input and output signals.

Input signals

Signal assignment

The input variables (p, t, Δp, q, E_1, E_2, t_R) can be assigned to the operands X1, X2, X3 via the four analog inputs AE1 to AE4 (current 0/4 to 20 mA, voltage, resistance, Pt 100 resistance thermometer or thermocouple) using the structure switches.

Up to three analog input variables are required depending on the calculation carried out by the computer.

Square-root extraction

The operand X2 can be square-rooted in the flow and heat quantity computer.

Linearization

The operands X1 and X3 can be linearized by polygon-based interpolation (comprising 8 straight lines).

Computer type	Input variables		
Correction computer for flow	Pressure	Flow	Temperature
Level computer	Pressure	Uncorrected level	Temperature
Enthalpy computer	Pressure		Temperature
Heat quantity computer	Pressure or temperature (return)	Flow	Temperature (inlet)
Function transmitter	E1	E2	
Analog inputs	AE1, AE3	AE2, AE4	AE1 to AE4
Operands	X1	X2	X3

Table 1/8 Assignment of input variables to the operands X1, X2, X3

Binary input

Connection of the binary input (BE) results in:

- Disabling of parameterization and configuring
- Scanning of instantaneous statuses via serial interfaces
- Setting of connection factor to 1
- Switching over to safety mode.

Output signals

Analog output

The following are output as a current signal: the corrected mass or volume flow with the flow correction computer, the corrected level with the correction computer for level, the specific enthalpy with the enthalpy computer, the heat flow or heat output with the heat quantity computer, and y_a = f (E1, E2) with the function transmitter.

The output signal can be configured as 0 or 4 to 20 mA.

Binary output

The binary output of the basic device can be configured in different manners:

- Pulses with a selectable significance can be output for mass, volume or heat quantity. For example, one pulse can be output for 1 m^3 or 10 kWh according to the configuration of "Pulse significance".
- Message "Computer in manual mode"
- Signalling of transmitter fault or violation of arithmetic range
- Setting of correction factor to 1.

In addition to the binary output of the basic device, double and fourfold binary outputs are available as options. These are used, *inter alia*, for limit signalling of A1 and A2 or A1 to A4.

With the flow correction and heat quantity computers, one or two pulse outputs can be configured instead of one or two limits (A1 or A1 and A2). Output A1 is always assigned to mass or volume, and output A2 to the heat quantity.

Transmitter monitoring

The transmitter monitoring function can be configured. The preprocessed measured values are monitored for range violation (< –3% or > 103%). If an error is detected, the associated analog input (AE1 to AE4) is output on the four-digit display. The other analog inputs (AE1 to AE4) are also displayed if several inputs are violated simultaneously. In addition, all individual messages are linked together by an OR element; the signal MuSt generated by this is available at the binary output and can be passed on as an alarm via the serial interface.

Standardization of input and output signals

By selecting the parameters EA and EE (referred to the input value X2) as well as AA and AE (referred to the output value I_y), the user is able to increase or decrease the measuring range corresponding to the output signal I_y compared to the measuring range corresponding to the input signal AE2 (operand X2).

Serial interface

An additional module (interface module) is used by the measured-value computer to transmit and receive operating states, process variables, parameters and structure switch settings via a serial interface. Up to 32 devices containing this interface module can be connected to a bus.

Data transmission is carried out between 300 and 9600 bits/s depending on the transmission rate set on structure switch S44, and in half-duplex mode with asynchronous transmission of ASCII characters in a 10-bit frame (start bit, ASCII character with 7 bits, parity bit and stop bit). To permit telegrams to be repeated in the event of faults, the fault character "NAK" is transmitted in full-duplex. The computer is passive and only reacts to requests. The complete bus must be controlled by the higher-level system. Structure switches are used to define the response of the serial interface or the station number in the bus (between 0 and 31). These structure switches can only be set manually on the device.

Using a detailed interface description (Order No. C73000-B7476-C131), it is possible to generate software for linking to higher-level systems.

Important accessory components for the serial link can be found in Catalog MP 31 "Compact Controllers" (Coupling with systems).

Arithmetic functions

Flow connection for the differential pressure method

The arithmetic function "Flow correction" is used with the flow measurement of water, steam, saturated steam and gases to correct the flow values if the change in density of the measured medium depending on the temperature and pressure cannot be neglected in the process system.

The measured-value computer calculates the correction factor f depending on the medium and on the actual flow as a mass or volume flow (with gases: volume flow referred to operating or standard conditions), and calculates the instantaneous, corrected flow value.

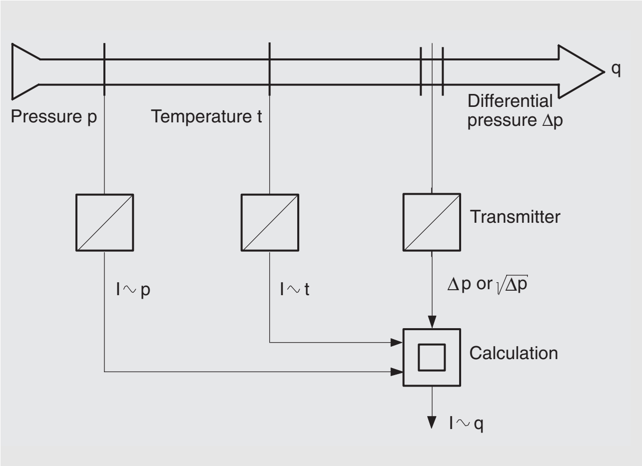


Fig. 1/170 Flow correction, function diagram

Introduction

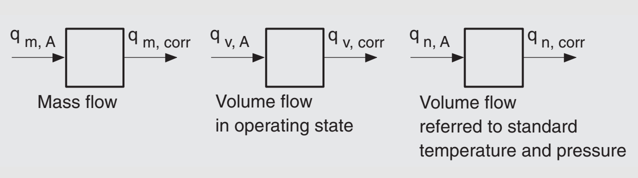


Fig. 1/171 Flow correction

The calculated and corrected flow value is present as a current signal at the analog output of the measured-value computer for further processing. The volume or mass is available as a pulse sequence at the binary output of the basic device and the limit module for driving external counters.

Fundamentals of flow correction for the differential pressure method

The flow correction computer measures the temperature-dependent and pressure-dependent change in density of the medium at every point in time (calculation cycle 125 s) in the operating state (index 1). It calculates the instantaneous, corrected flow value as a mass or volume flow using the fixed reference values for pressure and temperature in the design state (index A) (Fig. 1/171).

This change in density is taken into consideration in the flow equation using the correction factor f.

The corrected flow is as follows:

Mass flow

$$q_{m,\,corr} = q_{m,\,A} \cdot f \qquad (1)$$

$$\text{Correction factor } f = \sqrt{\frac{\rho_1}{\rho_A}} \qquad (1a)$$

Volume flow in operating state

$$q_{v,\,corr} = q_{v,\,A} \cdot f \qquad (2)$$

$$\text{Correction factor } f = \sqrt{\frac{\rho_A}{\rho_1}} \qquad (2a)$$

Volume flow referred to standard temperature and pressure

$$q_{n,\,corr} = q_{n,\,A} \cdot f \qquad (3)$$

$$\text{Correction factor } f = \sqrt{\frac{\rho_1}{\rho_A}} \qquad (3a)$$

A flow correction is not possible for linear flow measuring procedures.

Flow correction for measurements using primary differential pressure devices (Table 1/9).
The correction factor must be square-rooted in the case of flow measurements using primary differential pressure devices since the differential pressure generated by the restriction is proportional to the square of the flow.

Flow of gases referred to standard temperature and pressure (digital display of volume flow in operating state).
With gas as the measured medium, the true value of the "Volume flow in operating state (q_v)" is calculated from the input variable "Volume flow referred to standard temperature and pressure (q_n)" and indicated on the digital display on the front of the measured-value computer. The corrected value "Volume flow referred to standard temperature and pressure (q_n)" is then output as a signal of 0 or 4 to 20 mA.

Measured medium	Mass flow in operating state	Volume flow in operating state	Volume flow referred to standard temperature and pressure
Water	$\sqrt{\frac{\rho_1}{\rho_A}}$ $\sqrt{\frac{v_A}{v_1}}$	$\sqrt{\frac{\rho_A}{\rho_1}}$ $\sqrt{\frac{v_1}{v_A}}$	–
Steam and saturated steam	$\sqrt{\frac{\rho_1}{\rho_A}}$ $\sqrt{\frac{v_A}{v_1}}$	$\sqrt{\frac{\rho_A}{\rho_1}}$ $\sqrt{\frac{v_1}{v_A}}$	–
Gas (dry)	–	$\sqrt{\frac{p_A \cdot T_1}{p_1 \cdot T_A}}$	$\sqrt{\frac{p_1 \cdot T_A}{p_A \cdot T_1}}$

ρ_1 Density in operating state
ρ_A Density in design state
p_1 Pressure in operating state
p_A Pressure in design state
t_1 Temperature in operating state
t_A Temperature in design state
v_1 Specific volume referred to operating state
v_A Specific volume referred to design state

Table 1/9 Correction factors for flow measurement using primary differential pressure devices for water, steam and saturated steam as well as gases

Measured medium	Pressure bar	Temperature °C	Fault signal display
Steam	1 to 301 $p \le 40$ $p > 40$	 (t_s + 10) to 800 (t_s + 30) to 800	 0.9 > p > 303 bar 10 > t > 804 °C
Saturated steam	1 to 221		0.9 > p > 223 bar
Water	1 to 301	10 to 300	0.9 > p > 303 bar 10 > t > 303 °C
Gas	Any	Any	

t_s Saturated steam temperature

Table 1/10 Application ranges and limit data of correction computer for flow

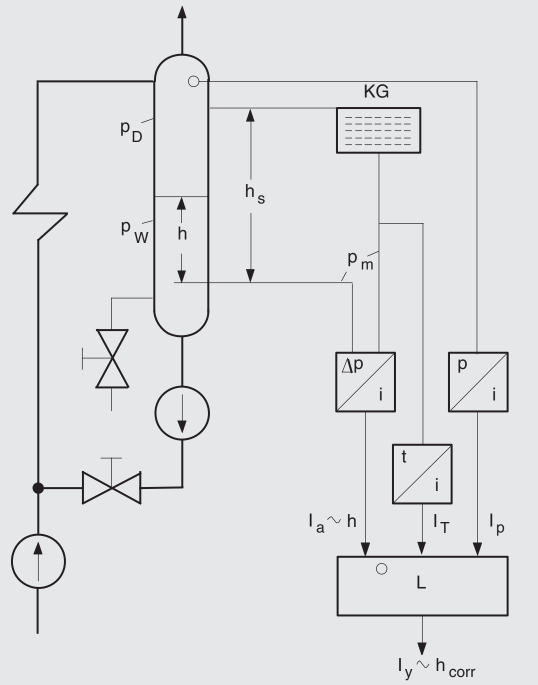
Level correction

The hydrostatic measuring procedure is used, *inter alia*, to measure the level of boiling water in closed pressure vessels. The level of boiling water in the pressure vessel is measured using a differential pressure transmitter whose output signal is subsequently corrected by the measured-value computer depending on the pressure, i.e. according to the current vessel pressure.

The equation for the true level h_{corr} of the boiling water is as follows:

$$h_{corr} = \frac{\rho_{w1} - \rho_{d1}}{\rho_w - \rho_o} \cdot h - \frac{\rho_d - \rho_{d1}}{\rho_w - \rho_d} \cdot h_s + \frac{\rho_m - \rho_{m1}}{\rho_w - \rho_d} \cdot h_s \qquad (3)$$

h Level output by differential pressure transmitter
h_s Distance between measuring points
ρ_w Density of boiling water at current pressure
ρ_{w1} Density of boiling water at p_{abs} = 1 bar
ρ_m Density of water in reference column at current temperature and current pressure of reference column
ρ_{m1} Density of water in reference column at p_{abs} = 1 bar and reference temperature of reference column
ρ_d Density of saturated steam at current pressure
ρ_{d1} Density of saturated steam at p_{abs} = 1 bar



h	Level output by differential pressure transmitter
h_{corr}	Corrected level
h_s	Distance between measuring points
p_D	Pressure of steam column
p_m	Average density of water in the reference column
p_W	Pressure of water column
L	Level computer
KG	Condensation vessel

Fig. 1/172 Hydrostatic level measurement

The level computer carries out the pressure correction with or without compensation of the reference column temperature (operand X3).

Larger variations in the temperature of the reference column should be taken into account as the 3rd input variable in the correction calculation for the current level.

The corrected level is available as a current signal at the analog output of the measured-value computer for further processing.

Pressure	1 to 201 bar
Temperature (cold reference column)	0 to 100 °C
Fault display	> 210 bar

Table 1/11 Application range and limit data

Enthalpy

The enthalpy computer is required to produce heat balances and to determine and monitor thermal efficiencies.

The measured-value computer determines
the specific enthalpy h – the energy content in kJ/kg – of superheated steam according to Koch's equation of state from pressure and temperature as the state variables.

The computer can be used, for example with a steam-heated heat exchanger, to determine the heat content h_1 of the applied steam or the steam content h_2 of the dissipated steam. Further possibilities for use of the enthalpy computer include the control of steam generators. Heating faults can be rapidly detected and eliminated using the specific enthalpy as the secondary controlled variable. Heating faults mean changes in the ratio between the heat quantity Q applied to the consumer and the steam throughput q_m. These are automatically reflected by a change e.g. in the enthalpy of the slightly superheated steam following the water trap:

$$\Delta h - \Delta \frac{Q}{qm} \tag{4}$$

Measured medium	Pressure bar	Temperature °C	Fault display
Steam	1 to 300	100 to 800	p_x > 303 bar 100 > t_x > 804 °C

Table 1/12 Application ranges and limit data of enthalpy computer

Heat quantity

Heat quantity computers are used to determine the thermal energy Q of a heat transfer medium (such as water or steam). In order to determine the heat quantity of liquids, knowledge is required of the flow, inlet temperature, return temperature and density as well as the heat-specific properties of the heat transfer medium.

- In the case of **water**, the measured-value computer uses the flow value and the difference between the inlet and return temperatures to determine the heat flow converted in a consumer or the heat output. When using primary differential pressure devices, the **flow value** is **corrected** in the computer. In the case of condensation, the heat flow is determined from the flow value and the temperature.
- In the case of **steam**, the measured-value computer uses the flow value, pressure and temperature to calculate the heat flow applied to a consumer. When using primary differential pressure devices, the **flow value** is **corrected** in the computer.

The volume heat flow is determined according to the equation

$$\Phi = q_V \cdot h \cdot \rho \tag{5}$$

and the mass heat flow according to the equation

$$\Phi = q_m \cdot h \tag{6}$$

When carrying out heat quantity measurements using water, the flow value can be assigned to either the inlet or return.

The heat quantity can be determined according to the following equations for water and steam by integrating the heat flow or heat output with respect to time:

$$\text{Heat quantity with volume flow } Q = \int_{t_0}^{t_1} (V \cdot \rho \cdot \Delta h)dt \tag{7}$$

$$\text{Heat quantity with mass flow } Q = \int_{t_0}^{t_1} (m \cdot \Delta h)dt \tag{8}$$

The heat flow is available as a current signal at the analog output of the measured-value computer for further processing. The heat quantity is available as a pulse sequence at the binary output for driving an external counter.

Technical data

The flow (volume or mass flow) is output on the digital display as an instantaneous intermediate variable (mnemonic "q_V"). It can be output as a pulse if the binary output card is fitted and configured accordingly, and integrated in a counter (volume or mass).

Measured medium	Pressure bar	Temperature °C	Fault display
Steam	1 to 301		
	$p \leq 40$	$(t_S + 10)$ to 800	$0.9 > p > 303$ bar
	$p \geq 40$	$(t_S + 30)$ to 800	$10 > t > 804$ °C
Water	1 to 40	t_V: 15 to 200 t_R: 10 to 195	$0.9 > p > 40$ bar $t_V > 200$ °C $t_R < 10$ °C

Nominal temperature difference (NTD) ≥ 10 °C

Table 1/13 Application ranges and limit data of heat quantity computer

Function transmitter

The function transmitter simulates mathematical functions y = f (x) in the 1st quadrant which are steady over the complete range.

The functional equation is as follows:

$$y = E1 \cdot c1 + E2 \cdot c2 \quad (9)$$

The function transmitter is used where a non-linear relationship exists between the input and output variables, e.g. when starting up physical or chemical processes or when correcting physical variables (e.g. valve characteristics).

The desired function is simulated by the fixed assignment of 13 ordinate values (interpolation points) to the input signal.

The user can select functions with or without smoothing at the interpolation points. Smoothed functions are simulated using parabolas, non-rounded functions by straight lines.

It is possible to add two input voltages E1 and E2 weighted by two constants c1 and c2 (y = f (E1, c1, E2, c2)). The total of the two voltages then applies as the input voltage for the function transmitter. The two constants can be adjusted between –199.9 and +199,9%. This means that it is important when using only one input voltage that it is applied through the quasi-open input of the other. If one or two input voltages are to be connected, it must be ensured that c1 and/or c2 are also parameterized different from zero.

It is also possible to implement the function "Correction factor = 1" for the function transmitter by pressing a key or using the binary input. In this case, the output signal is equal to the addition of E1 and E2 with the corresponding factors c1 and c2 (y = E1 · c1 + E2 · c2).

Technical data - Measured-value computer

Input	
Analog inputs AE1 and AE2	
• Input signal	0 to 20 mA or 4 to 20 mA
• Input resistance	249 Ω ± 0.1%
Binary input BE	
• Signal state "0"	≤ 4.5 V or open
• Signal state "1"	13 to 35 V
• Input resistance	≥ 27 kΩ
Output	
Binary output BA (with wired-OR diodes)	
• Signal state "0"	≤ 1.5 V
• Signal state "1"	19 to 26 V
• Permissible load	30 mA, short-circuit-proof
• Short-circuit current	< 220 mA, short-circuit-proof
Analog output I_y	
• Output signal	0 to 20 mA or 4 to 20 mA
• Permissible load	0 to 750 Ω
• Load voltage	–1 to +16 V
• Open-circuit voltage	≤ 21 V
• Influence of load	≤ 0.1%
• Resolution	0.1%
• Zero error	≤ 0.1% of full-scale value
• Full-scale value error	≤ 0.3% of span
• Conformity error	≤ 0.1% of span
Voltage output for transmitter supply	DC 20 to 26 V
• Permissible load	60 mA, short-circuit-proof
• Short-circuit current	< 200 mA, pulsed
Coupling with other systems	See Instruction Manual C73000-B7476-C131 or Catalog MP 31 ("Compact Controllers")
Accuracy	
Computer cycle time	125 ms ± 0.1%
A/D conversion	
• Method	Successive approximation per input > 120 conversions and mean-value generations within 20 or 16.67 ms
• Resolution	11 bits
• Zero error	≤ 0.2% of full-scale value
• Full-scale value error	≤ 0.3% of span
• Conformity error	≤ 0.2% of span
• Ambient temperature effect	0.2% of full-scale value per 10 K
Rated operating conditions	
Installation conditions	
Type of installation	Panel or field mounting
Ambient conditions	
Ambient temperature	0 to 50 °C
Storage and transport temperature	–25 to +75 °C
Climate class	XXF DIN 40 040
Degree of protection to EN 60 529	
• For panel mounting	
- Connections	IP 20 (plugged)
- Housing	IP 30
- Front panel	IP 64
• For field mounting	IP 65
Design	
Weight	
• For panel mounting	Approx. 1.2 kg
• For field mounting	Approx. 2.6 kg
• Housing for field mounting	Approx. 1.4 kg
Dimensions	See page 1/146
Power supply	
Power supply unit	AC 240, 230, 220, 120, 115, 110 or 24 V, 48 to 63 Hz,
Power consumption	Approx. 21 VA DC 24 V, approx. 21 W

Technical data - Measured-value computer (continued)

Display	
Display for process variables, configuring unit and parameters	4-digit 7-segment display
• Character color	Red
• Character height	7 mm
• Display range	–1999 to +9999
• Decimal point	Can be set
• Measuring rate	0.125 to 5 s, adjustable together with y indicator
• Resolution	1 digit
• Display error	Corresponding to A/D converter and analog inputs
Display for engineering unit	10 red LEDs
Display for output value	2-digit 7-segment display
• Character color	Red
• Character height	7 mm
• Display range	–9 to +109% (display h0 = 100%, display h9 = 109%)
• Measuring rate	0.125 to 5 s, adjustable together with y indicator
• Resolution	1 digit = 1%
• Display error	Corresponding to A/D converter and analog inputs

Technical data - Supplementary modules

Analog input module for current or voltage	
Current	0 to 20 mA; 4 to 20 mA by configuring
• Input resistance	
- Difference	49.9 Ω ± 0.1%
• Permissible common-mode voltage (rated range)	0 to 10 V
Voltage	0 to 10 V
• Input resistance	
- Difference	200 kΩ
- Common mode	200 kΩ
• Permissible common-mode voltage	–10 to +10 V
Connection diagram	See Instruction Manual C73000-B7476-C130
Weight	Approx. 0.1 kg
Analog input module for Pt 100 resistance thermometer	$19\ \Omega \leq \Delta R \leq 375.51\ \Omega$ –200 °C to +800 °C
Supply voltage	100 mV/ΔR
Line resistances R_L	
• Two-wire system	$R_{L1} + R_{L4} \leq 10\ \Omega$
• Three-wire system	$R_{L1} = R_{L3} = R_{L4} \leq 50\ \Omega$
• Four-wire system	$R_L \leq 80\ \Omega$
Connection diagram	See Instruction Manual C73000-B7476-C130
Weight	Approx. 0.1 kg
Analog input module for other resistance thermometers	$80\ \Omega \leq \Delta R \leq 1200\ \Omega$
Supply current	Approx. 5 mA ± 5%
Line resistances R_L	
• Two-wire system	< 10 Ω
• Three-wire system	< 10 Ω
• Four-wire system	< 10 Ω
Connection diagram	See Instruction Manual C73000-B7476-C130
Weight	Approx. 0.1 kg

Technical data - supplementary modules (continued)

Analog input module for thermocouples	$10\ mV \leq \Delta U \leq 600\ mV$
Current	0 to 20 mA; 4 to 20 mA by configuring
Input resistance	
• Difference	2 MΩ
• Common mode	1 MΩ
Permissible common-mode voltage	–10 to +10 V
Line resistances R_L	
• Two-wire system	$R_{L3} + R_{L4} \leq 300\ \Omega$
Connection diagram	See Instruction Manual C73000-B7476-C130
Weight	Approx. 0.1 kg
Relay output module	Output of limits, passive pulses for volume/mass and heat quantity
Contact material	Ag-Ni
Loading capacity	
• Max. switching voltage	AC 30 V, DC 35 V
• Max. switching current	AC/DC 5 A
• Max. switching power	AC 150 VA, DC 100 W, 24 V DC 80 W, 30 V
Connection diagram	See Instruction Manual C73000-B7476-C130
Weight	Approx. 0.1 kg
Binary output module	Output of active pulses for limits and counters (volume/mass and heat quantity)
Input	1 binary input
• Input signal	13 to 35 V
Output	4 binary outputs, including 2 outputs for limit monitors and 2 further outputs for limit monitors or 1 or 2 pulse outputs for volume, mass or heat quantity
• Output signal	20 to 26 V
• Max. load current	30 mA, short-circuit-proof
• Short-circuit current	< 200 mA, pulsed
• Destruction limit, static	–1 or +35 V
Connection diagram	See Instruction Manual C73000-B7476-C130
Weight	Approx. 0.1 kg
Interface module	Serial interface
Transmitted signals	V.24/V.28 signals to CCITT-V.24
Transmitted data	Operating state, process variables, parameters and configuring switches
Transmission procedure	To DIN 66 258 A or B
Character format	10 bits (start bit, ASCII characters with 7 bits, parity bit and stop bit)
Transmission rate	300 to 9600 bits/s
Transmission	Asynchronous, half-duplex; full-duplex for NAK
Stations which can be addressed	32
Time monitoring of data traffic	1 to 25 s
Electrical isolation	Txd: without Rxd: with opto isolator
Cable length at 9600 bits/s	Max. 10 m, max. 1000 m with additional bus driver C73451-A347-B202 (20-mA current loop)
Connection diagram	See Instruction Manual C73000-B7476-C130
Weight	Approx. 0.1 kg
Digital thumbwheel switch	For volume/mass and heat quantity
Power supply	DC 24 V ± 10%, approx. 50 mW
Counting frequency	Max. 10 pulses/s
Pulse duration	Min. 50 ms
Pulse/pause ratio	1 : 1
Temperature range	–10 to +50 °C
Number of digits	6
Character size	17 mm × 4 mm
Degree of protection (front panel)	IP 65 to EN 60 529
Dimensions	See page 1/146

Dimensional drawings, ordering data

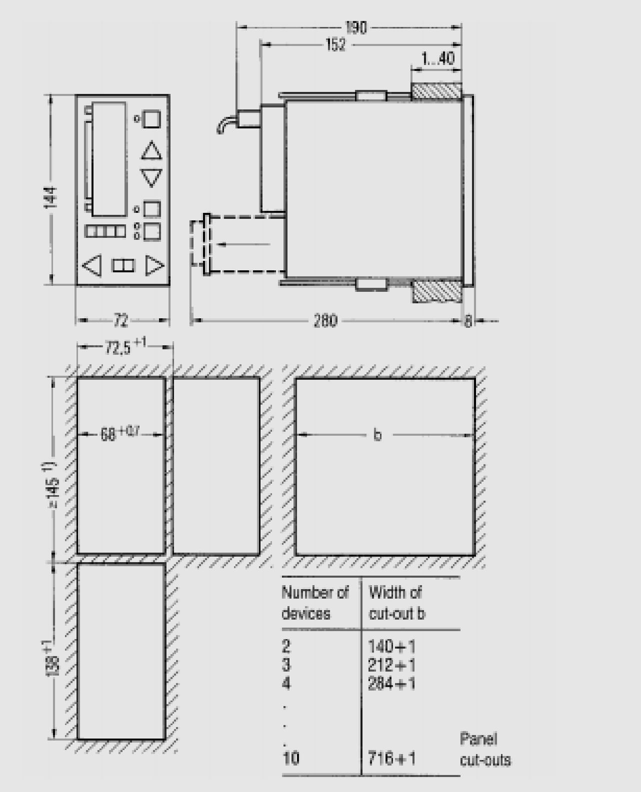


Fig. 1/173 Measured-value computer 7NG1002 for panel mounting, dim.

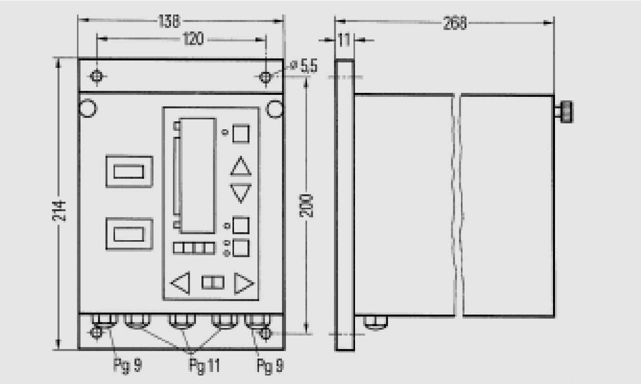


Fig. 1/174 Measured-value computer 7NG1002 for field mounting, dim.

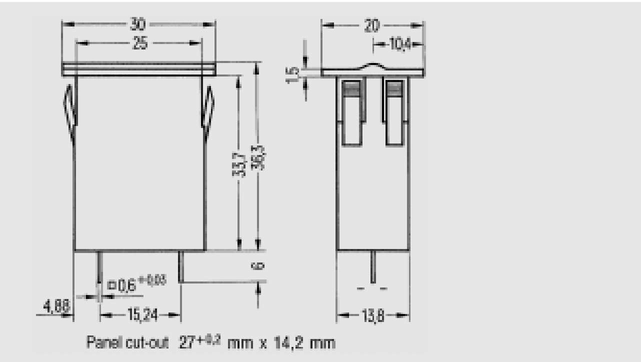


Fig. 1/175 Digital thumbwheel switch, dimensions

1) Mounting immediately on top of one another is permitted when the permissible ambient temperature is taken into account.
2) Adjustment means configuring and parameterization of the computer.
3) Please add "**-Z**" to the Order No.; Order codes additive, any sequence.

Ordering data	Order No.
Measured-value computer Correction computer for flow or level, function transmitter, enthalpy computer, heat quantity computer with two analog inputs 0 or 4 to 20 mA, one analog output 0 or 4 to 20 mA, one binary input and one binary output	**7NG1002-** **- ■■■■■**
Design for panel mounting	
• Without adjustment2)	**1BA**
• With adjustment2) (specify Order code Y01)	**2BA**
Design for field mounting	
• Without adjustment2)	**3BA**
• With adjustment2) (specify Order code Y01)	**4BA**
Power supply AC 220 V, 200 V	**11**
AC 110 V, 120 V	**12**
AC/DC 24 V	**14**
Further information	Order code3)
Adjustment: configuring and parameterization (computers 7NG1002-2AA.. and -4AA..) Enclose questionnaire (page 1/147) with order.	**Y01**
Additional modules	
Analog input module	
• For current or voltage	**J08**
• For Pt 100 resistance thermometer	**P08**
• For other resistance sensors	**R08**
• For thermocouples	**T08**
Relay output module for limit monitoring or for pulse outputs (volume/mass and heat quantity)	**D18**
Binary output module • Active pulse signals for limit monitoring and digital thumbwheel switches (vol./mass and heat quantity)	**E18**
Interface module V.24 or V.28	**C38**
Digital thumbwheel switch, 6-digit, for flow correction computer and for heat quantity computer	
Display: volume/mass	
• Delivered as single part	**C01**
• Installed (only for computers for field mounting)	**C03**
Display: heat quantity	
• Delivered as single part	**C02**
• Installed (only for computers for field mounting)	**C04**
Special design: Heat computer "Condensation"	**F01**
Parts for retrofitting	Order No.
Housing for field mounting	
Preassembled	**7NG1910-8AA**
Preassembled, with one digital thumbwheel switch, 6-digit, for flow and heat quantity	
• Display: volume/mass	**7NG1910-8AB**
• Display: heat quantity	**7NG1910-8AC**
Preassembled, with two digital thumbwheel switches, 6-digit, for flow and heat quantity • Display: volume/mass and heat quantity	**7NG1910-8AD**
Software	
7NG1002 control program Configuring, parameterization, storage, transmission, reception and display of data; executable with	
MS-DOS 3.x Version 2.2; 3½-inch diskette German	**7NG1800-1AC**
English	**7NG1800-1AD**
Documentation	
Instruction Manual for computer 7NG1002	
• German	**C73000-B7400-C130**
• English	**C73000-B7476-C130**
• French	**C73000-B7477-C130**
Instruction Manual for computer 7NG1002, communication via serial interface, German/English	**C73000-B7474-C131**

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Questionnaire for measured-value computer 7NG1002 for determining the data for configuring and parameterization

Ordered by ______________________________

Order code ______________________________

Order item ______________________________

Measuring point code ______________________________

Person responsible and telephone ____________________ ________ Extension

Customer ______________________________

Factory entry ______________________________

Remarks ______________________________

Measured-value computer ordered:

7NG1002 – ☐ B A 1 ☐ – Z

☐☐☐ + ☐☐☐ + ☐☐☐

The measured-value computer is to be used as:		Data for configuring and parameterization	
• Correction computer for flow	K ☐	See questionnaire Part 1	☐
• Correction computer for level	L ☐	See questionnaire Part 2	☐
• Enthalpy computer	E ☐	See questionnaire Part 3	☐
• Heat quantity computer	W ☐	See questionnaire Part 4	☐
Heat quantity counter	WMZ ☐	See questionnaire Part 4	☐
• Function transmitter	F ☐	See questionnaire Part 5	☐

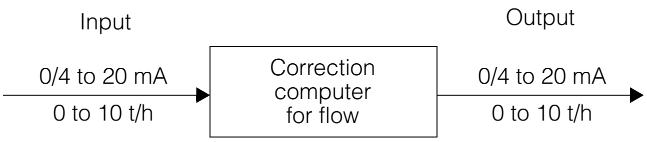
Inputs and outputs

☐ Assignments of inputs and outputs, see page 1/150

Output values

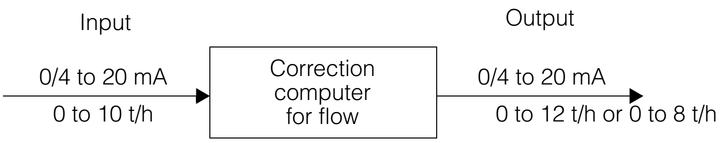
In the basic setting for flow and level, the input and output signals correspond to the same range. In the case of enthalpy and heat quantity, the output variable is determined from the input variables (*p*, *T* or *p*, *T*, *q*).

e.g.



☐ If the output signal is to be assigned to a different measuring range than the input signal, this must be specified under the data for the output variable.

e.g.



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Further settings

e.g.

- Transmitter monitoring ☐
- Limit signalling (for input and output variables) ☐
- Output value limiting I_y (min., max.) ☐
- Reaction with transmitter fault ☐
- Linearization of input variables ☐
- Disabling of configuring and parameterization ☐
- Bus interface ☐
- Other settings ☐

Special features

____

____

Input and output variable

☐ Please mark desired functions, input variables and output variables with a cross

Basic functions of measured-value computer 7NG1002			Inputs								Outputs		
			Input variables	Analog inputs		Inputs module					Analog		Pulse
				I	I	U	R	T	P		I	I	
	Abbre-viation			Current 0 to 20 mA	Current 4 to 20 mA	Volt-age	Resis-tance	Thermo-couple	Pt 100[1])		Current 0 to 20 mA	Current 4 to 20 mA	
☐	K	Correction computer for flow	• Flow	*q*	☐	☐	☐	☐	☐	☐	Corrected flow *q* corr		• Volume *V* ☐
			• Pressure	*p*	☐	☐	☐	☐	☐	☐			or mass *m* ☐
			• Temperature	*t*	☐	☐	☐	☐	☐	☐	☐	☐	
☐	L	Correction computer for level	• Level Diff. pressure	Δp	☐	☐	☐	☐	☐	☐	Corrected level *h* corr		
			• Pressure	*p*	☐	☐	☐	☐	☐	☐			
			• Temperature	*t*	☐	☐	☐	☐	☐	☐	☐	☐	
☐	E	Enthalpy computer									Enthalpy *h*		
			• Pressure	*p*	☐	☐	☐	☐	☐	☐			
			• Temperature	*t*	☐	☐	☐	☐	☐	☐	☐	☐	
☐	W	Heat quantity computer or	• Flow	*q*	☐	☐	☐	☐	☐	☐	Heat flow (heat output) Φ		• Heat quantity *Q* ☐
			• Pressure	*p*	☐	☐	☐	☐	☐	☐			• Volume *V* ☐ or mass *m* ☐
			• Temperature with steam or condensation	*t*	☐	☐	☐	☐	☐	☐			
☐	WMZ	Heat quantity counter	• Temperature with water										
			Inlet	t_V	☐	☐	☐	☐	☐	☐			
			Return	t_R	☐	☐	☐	☐	☐	☐	☐	☐	
☐	F	Function transmitter									Function variable Y		
			• Input variable 1	E_1	☐	☐	☐	☐	☐	☐			
			• Input variable 2	E_2	☐	☐	☐	☐	☐	☐	☐	☐	

We confirm that the data in the questionnaire are complete:

Date ______________________________ Signature ______________________________

The filled-in Part 1, 2, 3, 4 or 5 of the questionnaire (pages 1/149 to 1/153) which applies to the desired function of the measured-value computer must be enclosed.

Please note:

Only questionnaires which have been filled-in completely can be processed.

[1]) Connection in two-wire system ☐
three-wire system ☐
four-wire system ☐

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1 Correction computer for flow

Part 1

1.1 Data of input variables

1.1.1 Flow q

- Flowmeter: Differential pressure transmitter: Δp ☐ or $\sqrt{\Delta p}$ ☐
  A flow correction for linear flow measuring procedure is not possible.

Measured medium: Water (only T correction) ☐ Steam ☐
Saturated steam (only p correction) ☐ Gas ☐

Mass flow q_m Max. ________ , ______ kg/h ☐ t/h ☐
Min. ________ , ______ (if different from 0)

Volume flow q_v in operating state Max. ________ , ______ m^3/h ☐
Min. ________ , ______ (if different from 0)

Volume flow q_n referred to standard temperature and pressure Max. ________ , ______ m^3/h ☐
Min. ________ , ______ (if different from 0)

- Primary differential pressure device data (design data according to design report)

Pressure $p_{e,B}$ ____________ bar[1]) (above atmospheric pressure)
or $p_{abs,B}$ ____________ bar (absolute pressure)

Average atmospheric pressure p_{amb} ____________ bar

Temperature t_B ____________ °C

1.1.2 Pressure p

Measuring range of pressure gauge

p_e ____________ to ____________ bar, pressure transmitter
or p_{abs} ____________ to ____________ bar, absolute pressure transmitter

1.1.3 Temperature t

Measuring range of temperature measuring equipment

t ____________ to ____________ °C

1.2 Correction ranges

Pressure $p_{e,min.}$ ____________ bar; $p_{e,max.}$ ____________ bar (above atmospheric pressure)
or $p_{abs,min.}$ ____________ bar; $p_{abs,max.}$ ____________ bar (absolute pressure)

Temperature $t_{min.}$ ____________ °C, $t_{max.}$ ____________ °C

Additional settings, if required: ______________________________________

1.3 Data of output variables

1.3.1 Analog output variable

If the measuring range corresponding to the output signal (e.g. 0 to 110 t/h) deviates from the measuring range corresponding to the input signal (e.g. 0 to 100 t/h).

- Corrected flow q_{corr}

Start-of-scale value ________ , ______ Dimension _____
Full-scale value ________ , ______ Dimension _____

1.3.2 Output switch-off value

(selectable from 0 to 10% of max. flow $q_{max.}$)

Referred to input signal $q_{max.}$ ____________ %
Referred to output signal $q_{corr,max.}$ ____________ %

1.3.3 Pulse significance of binary output for counting of quantity with flow

- Volume ☐ 1 pulse = ____________ m^3

or

- Mass ☐ 1 pulse = ____________ kg or ____________ t

[1]) If $p_B \leq 2$ it is recommendable to use an absolute pressure transmitter.

2 Correction computer for level

2.1 Data of input variables

2.1.1 Level L

- Differential pressure transmitter ($\Delta p \sim h$)

  Upper level – start-of-scale value h_A ________ , ________ m

  Lower level – full-scale level h_E ________ , ________ m

- Distance between measuring points hs ________ , ________ m

2.1.2 Pressure *p*

- Pressure correction without compensation of fixed reference column temperature, average temperature of reference column ________________ °C, (50 °C is used if no data provided)
- Measuring range of pressure gauge

  p_e ______________ to ______________ bar (above atmospheric pressure)

  or p_{abs} ______________ to ______________ bar (absolute pressure)

2.1.3 Temperature *t*

- Pressure correction with compensation of reference column temperature

  Measuring range of temperature equipment: *t* ______________ to ______________ °C, (max. temperature range: 0 to 100 °C)

Additional settings, if required:

2.2 Data of output variables

2.2.1 Analog output variable

If the measuring range corresponding to the output signal (e.g. 0.100 to 0.350 m) deviates from the measuring range corresponding to the input signal (e.g. 0.100 to 0.300 m).

- Corrected level h_{corr}

  Start-of-scale value ________ , ________ m

  Full-scale value _______ , ________ m

⚠ For pressure correction of the level of boiling water in closed vessels, the **measuring range** must be **equal** to the **distance between the measuring points**, and the transmitter is designed for a calculated pressure of 1 bar (absolute).

Pressure correction means: the static pressure is measured separately and recorded by a correction or measured-value computer.

3 Enthalpy computer

3.1 Data of input variables

3.1.1 Pressure *p*

- Measuring range of pressure gauge

p_e ______________ to ______________ bar (above atmospheric pressure)

or p_{abs} ______________ to ______________ bar (absolute pressure)

3.1.2 Temperature *t*

Measuring range of temperature measuring equipment

t ______________ to ______________ °C

3.2 Data of output variables

3.2.1 Analog output variable

If a certain value is required:

- Max. specific enthalpy *h* at 20 mA __________________ kJ/kg

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4 Heat quantity computer/counter **Part 4**

4.1 Data of input variables

4.1.1 Flow q

- Flowmeter: Differential pressure transmitter: Δp ☐ or $\sqrt{\Delta p}$ ☐ Other: ______

Flow measurement: Inlet ☐

Return ☐

Measured medium: Water ☐ (with T correction with primary differential pressure devices) | Condensation ☐ (with T correction with primary differential pressure devices) | Steam ☐ (with p and T correction with primary differential pressure devices)

Volume flow q_V ______ , ______ m^3/h ☐

Mass flow q_m ______ , ______ kg/h ☐ t/h ☐

- When using a primary differential pressure device

Data from the design report

Pressure $p_{e,\,B}$ ______ bar[1] (above atmospheric pressure)

or $p_{abs,\,B}$ ______ bar (absolute pressure)

Average atmospheric pressure p_{amb} ______ bar

Temperature t_B ______ °C

4.1.2 Pressure p (with steam)

Measuring range of pressure gauge

p_e ______ to ______ bar (above atmospheric pressure)

or p_{abs} ______ to ______ bar (absolute pressure)

4.1.3 Temperature t (with steam)

Measuring range of temperature measuring equipment:

t ______ to ______ °C

4.1.4 Inlet temperature t_V, return temperature t_R (with water)

- Measuring range of temperature measuring equipment in inlet

t_V ______ to ______ °C

- Measuring range of temperature measuring equipment in return

t_R ______ to ______ °C

4.2 Correction ranges

- With steam p and T correction ☐
- With water T correction ☐

Pressure $p_{e,min.}$ ______ bar; $p_{e,max.}$ ______ bar (above atmospheric pressure)

or $p_{abs,min.}$ ______ bar; $p_{abs,max.}$ ______ bar (absolute pressure)

Temperature $t_{min.}$ ______ °C, $t_{max.}$ ______ °C

4.3 Data of output variables

4.3.1 Analog output variable

- Max. heat flow $\Phi_{max.}$ at 20 mA ______ kW ☐ MW ☐

4.3.2 Binary output variables

Heat quantity ☐ 1 pulse ______ kWh ☐ MWh ☐

Volume ☐ 1 pulse ______ m^3 ☐

or

Mass ☐ 1 pulse ______ kg ☐ t ☐

[1]) If $p_B \leq 2$ it is recommendable to use an absolute pressure transmitter.

5 Function transmitter/curve computer

5.1 Data of input variables E1 and E2

- Variable E1 _______________
- Variable E2 _______________

5.2 Function data Y = f(x)

5.2.1 Weighting of input variables E1 and E2

- Constant c1 _______________ % (weighting of input variable E1) — Selectable from –199.9 to +199.9%
- Constant c2 _______________ % (weighting of input variable E2) — Selectable from –199.9 to +199.9%

5.2.2 Definition of arithmetic functions

y = f (E1 · c1 + E2 · c2)

- y = f (E1) ☐
- y = f (E1, c1) ☐
- y = f (E1, c1, E2) ☐
- y = f (E1, c1, E2, c2) ☐

5.2.3 Type of function transmitter

Without smoothing of interpolation points ☐

Without smoothing of interpolation points ☐

5.2.4 Function values of output variable y

Please specify the output variable y in four digits, in % (adjustable from –10 to +110%), depending on the input variables E1 and E2, taking into consideration the constants c1 and c2.

Output variable y (interpolation points 0 to 6)

Interpolation point	0	1	2	3	4	5	6
x value in %	–10	0	10	20	30	40	50
Output y value in %	[1])						

Output variable y (interpolation points 7 to 12)

Interpolation point	7	8	9	10	11	12
x value in %	60	70	80	90	100	110
Output y value in %						[1])

[1]) These y values should be defined for equations of higher order (exponents > 1). The function (y = f(x)) is then determined more exactly between the x values 0 to 10% and 90 to 100%.