

Gas density sensor

For gas density, temperature and pressure of insulating gases Model GD-20 with Modbus® or analogue 4 ... 20 mA signal

WIKA data sheet SP 60.77

Applications

- Permanent monitoring of the relevant gas condition parameters in closed tanks
- For indoor and outdoor SF₆ gas-insulated equipment
- Density measurement of alternative insulating gases in electrical equipment or in the laboratory

Special features

- High-accuracy sensing technology
- Digital Modbus® RTU or analogue 4 ... 20 mA output signal
- IP67 ingress protection, optionally with IP6K9K field case
- High long-term stability and EMC characteristics
- Compact design



Fig. left: Model GD-20-D, plastic circular connector

Fig. centre: Model GD-20-D, metal circular connector

Fig. right: Model GD-20-A, metal circular connector

Description

Permanent monitoring

In order to prevent system errors in switchgear and thus network outages, the permanent monitoring of the gas density is essential.

The model GD-20 calculates the current gas density from the pressure and temperature using a complex virial equation in the gas density sensor's powerful microprocessor. Changes in pressure resulting from thermal effects will be compensated by this and will not affect the output value.

Modbus® fieldbus

The RS-485 interface communicates using the Modbus® RTU protocol. The instrument's output parameters and their units can be configured and read according to requirements. The model GD-20 can be freely configured ex-works for any defined gas mixture consisting of SF₆, N₂, CF₄, O₂, CO₂, C4-FN, He and Ar.

The calculation is based on the partial pressure method of the individual gas components.

Signal stability

Due to its high long-term stability, the sensor is maintenance-free and requires no calibration. Due to the hermetically sealed weld seam and a measuring cell design without sealing elements, the permanent leak tightness of the measuring cell is ensured.

The gas density sensor is also available with analogue output signal (4 ... 20 mA) for output of the compensated pressure (p at 20 °C [68 °F]) or SF₆ gas density in g/l.

Specifications

Overview of versions	
Model GD-20-D	Digital sensing technology
Plastic circular connector	
Metal circular connector (heavy-duty)	
Model GD-20-A	Analogue sensing technology
Plastic circular connector	
Metal circular connector (heavy-duty)	
Metal cable outlet	
Field case	

Basic information	
Pressure reference	Absolute
Case	
Material	316L
Case options	■ Field case ■ Cable outlet ■ Metal cable outlet, shield optionally connected (heavy-duty version)

Digital sensing technology, model GD-20-D

Compensated pressure range in bar abs. [psi abs.] at 20 °C [68 °F] (g/l SF ₆)	Pressure in bar abs. [psi abs.]	Temperature	Output parameters	Output signal
0 ... 2 [0 ... 29] (12.28)	0 ... 2.4 [0 ... 34.81]	-40 ... +80 °C [-40 ... +176 °F]	■ Density ■ Pressure at 20 °C [68 °F] ■ Pressure ■ Temperature	Modbus® RTU
0 ... 3 [0 ... 43.51] (18.65)	0 ... 3.7 [0 ... 53.66]			
0 ... 6 [0 ... 87.02] (38.87)	0 ... 7.5 [0 ... 108.78]			
0 ... 8 [0 ... 116.03] (53.4)	0 ... 10.1 [0 ... 146.49]			
0 ... 10 [0 ... 145.04] (68.96)	0 ... 12.9 [0 ... 187.10]			
0 ... 12 [0 ... 174.05] (85.79)	0 ... 15.7 [0 ... 227.71]			
0 ... 16 [0 ... 232.06] (124.64)	0 ... 21.3 [0 ... 308.93]			

Accuracy specifications		
Accuracy ¹⁾		
Compensated pressure ranges in bar abs. [psi abs.] at 20 °C [68 °F] (g/l SF ₆) 0 ... 2 [0 ... 29] (12.28) 0 ... 6 [0 ... 87.02] (38.87) 0 ... 3 [0 ... 43.51] (18.65)	For -40 ... -20 °C [-40 ... -4 °F]	■ ±2 % ■ ±1.5 %
	For -20 ... +80 °C [-4 ... +176 °F]	■ ±1.25 % ■ ±0.75 %
Compensated pressure ranges in bar abs. [psi abs.] at 20 °C [68 °F] (g/l SF ₆) 0 ... 8 [0 ... 116.03] (53.4) 0 ... 10 [0 ... 145.04] (68.96) 0 ... 12 [0 ... 174.05] (85.79) 0 ... 16 [0 ... 232.06] (124.64)	For -40 ... +80 °C [-40 ... +176 °F]	■ ±1.25 % ■ ±0.6 %
Long-term stability at reference conditions	±0.1 % per year for the density signal	
Pressure accuracy	■ ±1 % at 20 °C [68 °F] ■ ±0.2 % at 20 °C [68 °F]	
Temperature accuracy	±1.5 K	
Reference conditions	Per IEC 61298-1	

¹⁾ Specifications apply to measurement of the compensated pressure over the entire temperature range from -40 ... +80 °C [-40 ... +176 °F]; valid only for pure SF₆ gas and a gas mixture consisting of 6 % C₄-FN, 5 % O₂ and 89 % CO₂.

Analogue sensing technology, model GD-20-A

Compensated pressure range in bar abs. [psi abs.] at 20 °C [68 °F] (g/l SF ₆)	Accuracy ¹⁾	Output parameters	Output signal
0 ... 2 [0 ... 29] (12.28)	■ ±2 % ■ ±1.5 %	Absolute pressure at 20 °C [68 °F]	4 ... 20 mA
0 ... 3 [0 ... 43.51] (18.65)			
0 ... 6 [0 ... 87.02] (38.87)			
0 ... 8 [0 ... 116.03] (53.4)			
0 ... 10 [0 ... 145.04] (68.96)			
0 ... 12 [0 ... 174.05] (85.79)			
0 ... 16 [0 ... 232.06] (124.64)			

1) Specifications apply to measurement of the compensated pressure over the entire temperature range from -40 ... +80 °C [-40 ... +176 °F]; valid only for pure SF₆ gas. Accuracy is achieved after a maximum of 60 minutes operating time.

Density range in g/l SF ₆ (compensated pressure in bar abs. [psi abs.] at 20 °C [68 °F])	Accuracy ¹⁾	Output parameters	Output signal
0 ... 10 [0 ... 145.04] (1.64)	■ ±2 % ■ ±1.5 %	SF ₆ gas density in g/l	4 ... 20 mA
0 ... 16 [0 ... 232.06] (2.59)			
0 ... 25 [0 ... 362.59] (3.97)			
0 ... 40 [0 ... 580.15] (6.16)			
0 ... 60 [0 ... 870.22] (8.87)			
0 ... 80 [0 ... 1160.30] (11.33)			

1) Specifications apply to measurement of the compensated pressure over the entire temperature range from -40 ... +80 °C [-40 ... +176 °F]; valid only for pure SF₆ gas. Accuracy is achieved after a maximum of 60 minutes operating time.

Overload safety and burst pressure

Compensated pressure range in bar abs. at 20 °C [68 °F] (g/l SF ₆)	Overload safety in bar abs.	Burst pressure in bar abs.
0 ... 2 (12.28)	6.2	10
0 ... 3 (18.65)	14.5	24
0 ... 6 (38.87)	14.5	24
0 ... 8 (53.4)	31	52
0 ... 10 (68.96)	31	52
0 ... 12 (85.79)	31	52
0 ... 16 (124.64)	62	103

Suitable for the following gases ¹⁾

Name in accordance with IUPAC ²⁾ nomenclature	Abbreviation	Description (CAS no.)
Sulphur hexafluoride	SF ₆	2551-62-4
Nitrogen	N ₂	7727-37-9
Tetrafluoromethane	CF ₄	75-73-0
Oxygen ³⁾	O ₂	7782-44-7
Carbon dioxide	CO ₂	124-38-9
2,3,3,3-Tetrafluoro-2-(trifluoromethyl)propanenitrile ⁴⁾	C4-FN (fluoronitrile)	42532-60-5
Helium	He	7440-59-7
Argon	Ar	7440-37-1

1) Gas mixtures and components can be individually configured and combined ex-works. Liquid gases can only be measured in the gaseous phase.

2) International Union of Pure and Applied Chemistry

3) The oxygen measuring range is limited to <30 volume percent.

4) Available as an option

Gas mixtures and components can be individually configured and combined ex-works. The calculation is based on the physical principle of the partial pressure method. Subsequent modification of the gas mixture is optionally possible.

Output signal	
Voltage supply	DC 10 ... 30 V
Power consumption	
Model GD-20-A	$\leq 0.75 \text{ W}$
Model GD-20-D	$\leq 0.45 \text{ W}$
Maximum permissible load R_A (model GD-20-A)	$R_A \leq (U_B - 9.5 \text{ V}) / 0.023 \text{ A}$ with R_A in Ω and U_B in V
Time response	
Settling time ¹⁾	$< 10 \text{ ms}$
Switch-on time ²⁾	$\leq 500 \text{ ms}$

1) E.g. with any sudden pressure spikes

2) Time after switching on until the first measured value is output.

Process connection	
Thread size	■ G ½ B ■ G ¼ B ■ G ¾ B JIS ■ 1/4 NPT ■ DN 6 female via adapter ■ DN 8 female via adapter ■ DN 20 female via adapter ■ Malmquist (M30 x 2) female via adapter ■ G ½ JIS ■ M20 x 1.5

Electrical connection	
Digital version (model GD-20-D)	■ Modbus®-RTU via RS-485 interface ■ Circular connector M12 x 1 metal (5-pin) ■ Circular connector M12 x 1 plastic (5-pin)
Analogue version (model GD-20-A)	■ Circular connector M12 x 1 metal (5-pin) ■ Circular connector M12 x 1 plastic (5-pin)

Circular connector M12 x 1 (5-pin) for digital version (model GD-20-D)			
	1	-	-
	2	U_+	Auxiliary power
	3	U_-	Ground
	4	A	RS-485 signal
	5	B	RS-485 signal

Circular connector M12 x 1 (5-pin) for analogue version (model GD-20-A)			
	1	U_+	Auxiliary power
	2	-	-
	3	U_-	Ground
	4	-	-
	5	-	-

Output parameters	
Digital version (model GD-20-D)	
Absolute pressure at 20 °C [68 °F]	■ bar ■ MPa ■ kPa ■ psi ■ Pa ■ N/cm²
Gauge pressure based on 1,013 mbar at 20 °C [68 °F]	■ bar ■ MPa ■ kPa ■ psi ■ Pa ■ N/cm²
Density	■ g/l ■ kg/m³
Temperature	■ °C ■ °F ■ K
Absolute pressure	■ bar ■ MPa ■ kPa ■ psi ■ Pa ■ N/cm²
Gauge pressure based on 1,013 mbar	■ bar ■ MPa ■ kPa ■ psi ■ Pa ■ N/cm²
Analogue version (model GD-20-A)	Absolute pressure at 20 °C [68 °F] or gas density in g/l for SF ₆ gas as 4 ... 20 mA current signal

Communication	
Interface	RS-485
Modbus®	
Baud rate	1200 ... 115200
Transmission mode	RTU
Parity	None, even, odd

Operating conditions	
Ambient temperature range	-40 ... +80 °C [-40 ... +176 °F]
Storage temperature range	-40 ... +70 °C [-40 ... +158 °F]
Humidity	≤ 95 % relative humidity
Condensation	Non-condensing
Vibration resistance	■ 5g, 15 ... 2,000 Hz, for versions with field case ■ 20g, 30 ... 2,000 Hz, for versions without field case
Shock resistance	
Single shock loads	500g (1.4 ms, 1 shock, 3 axes)
Continuous shock	100g (4 ms, 10,000 shocks, 3 axes)

Operating conditions		
Ingress protection (IP code) ¹⁾		
M12 x 1 plastic	IP67, with mating connector	
M12 x 1 metal	IP67 ²⁾ , with mating connector	
Cable outlet plastic	IP67, with cable	
Cable outlet metal	IP67, with cable	
Field case	IP6K9K, with cable / blind plug	
Electrical safety		
Model GD-20-D	Reverse polarity voltage U ₊ vs. U ₋	DC 30 V ³⁾
Model GD-20-A	Reverse polarity voltage U ₊ vs. U ₋	DC 40 V
EMC tests		
Immunity to EMF	30 V/m (at 80 MHz to 6 GHz)	
Surge immunity per IEC 61000-4-5	2 kV on instrument case (shield connected on both sides) 1 kV, non-symmetrical, lines to ground, RS-485-A to RS-485-B, U ₊ vs. U ₋	
ESD per IEC 61000-4-2	8 kV contact discharge, 15 kV indirect discharge, 8 kV indirect discharge	
Immunity against conducted HF signals per IEC 61000-4-6	10 V at 150 kHz to 80 MHz	
Immunity against fast transients (burst) per IEC 61000-4-4	4 kV	

1) The respective IP ingress protection and UL type rating applies to electrical outputs with plug-type design when plugged in or with cable / blind plug. The mating connector must be suitable for the required ingress protection and UL type rating.

2) Type Rating 6

3) SELV and LEC/Class2

Approvals

Logo	Description	Country
	EU declaration of conformity	European Union
	EMC Directive	
	EN 61326 emission (group 1, class B) and immunity (industrial environment)	
	RoHS directive	

Optional approvals

Logo	Description	Country
	UL ¹⁾ Component approval	USA and Canada

1) GD-20-D with M12 x 1 metal connection

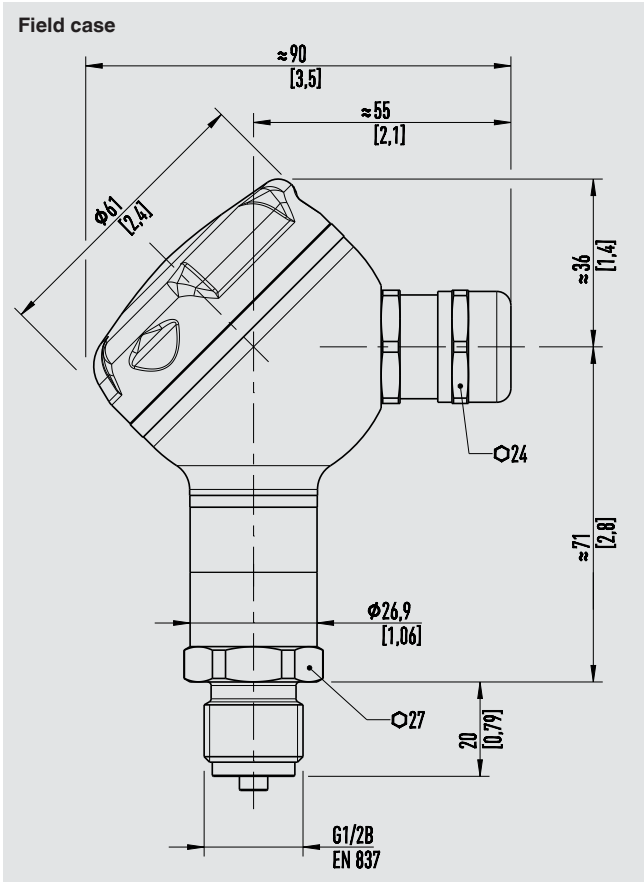
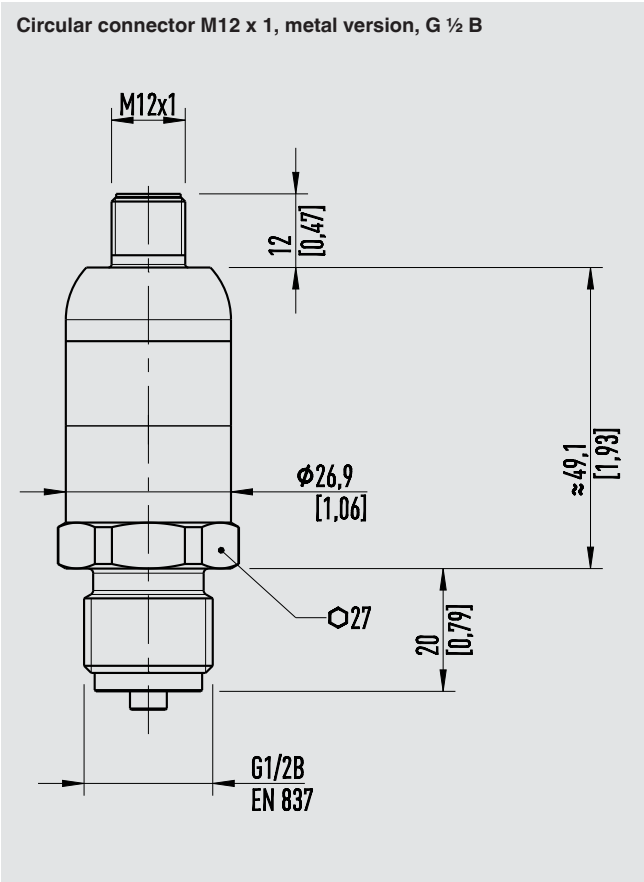
Manufacturer's declaration

Logo	Description
-	China RoHS directive

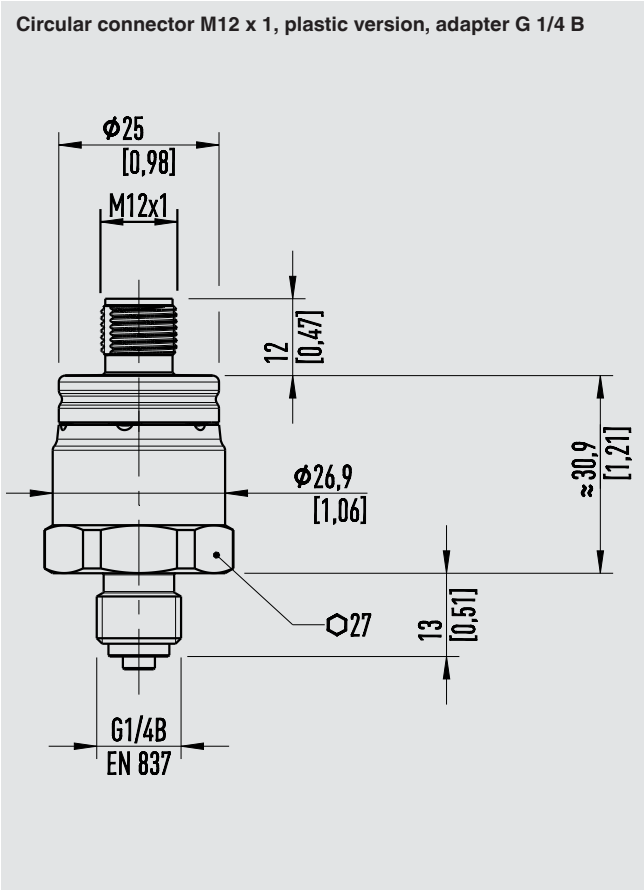
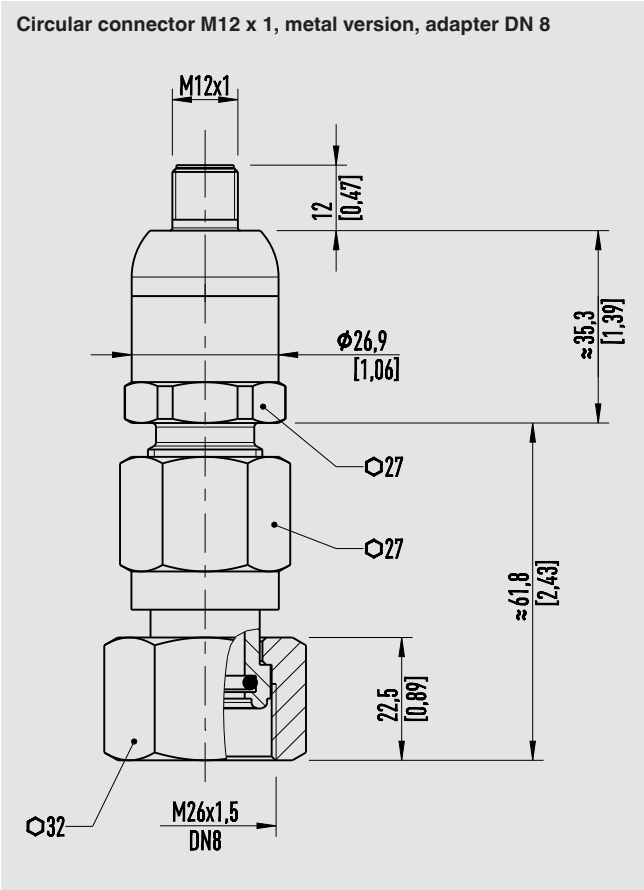
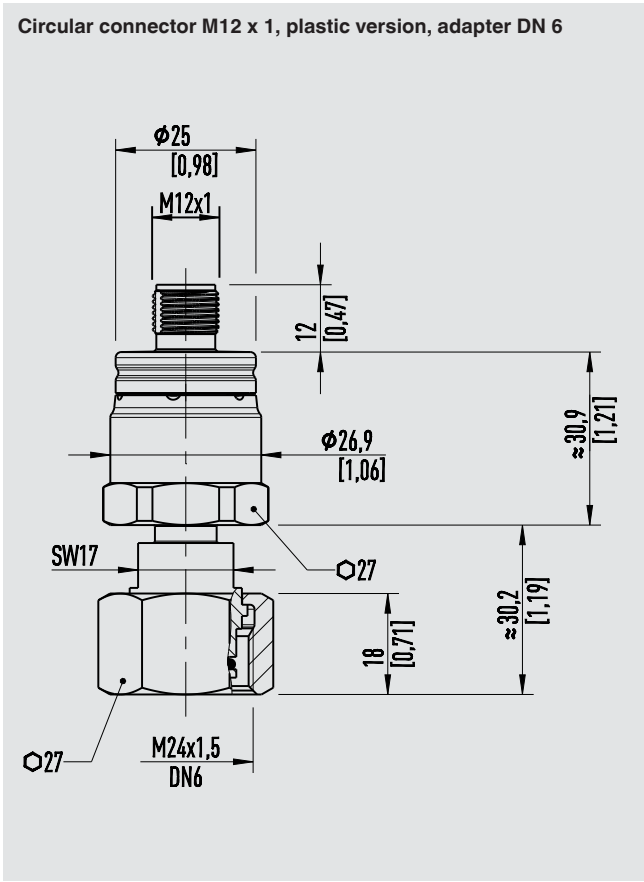
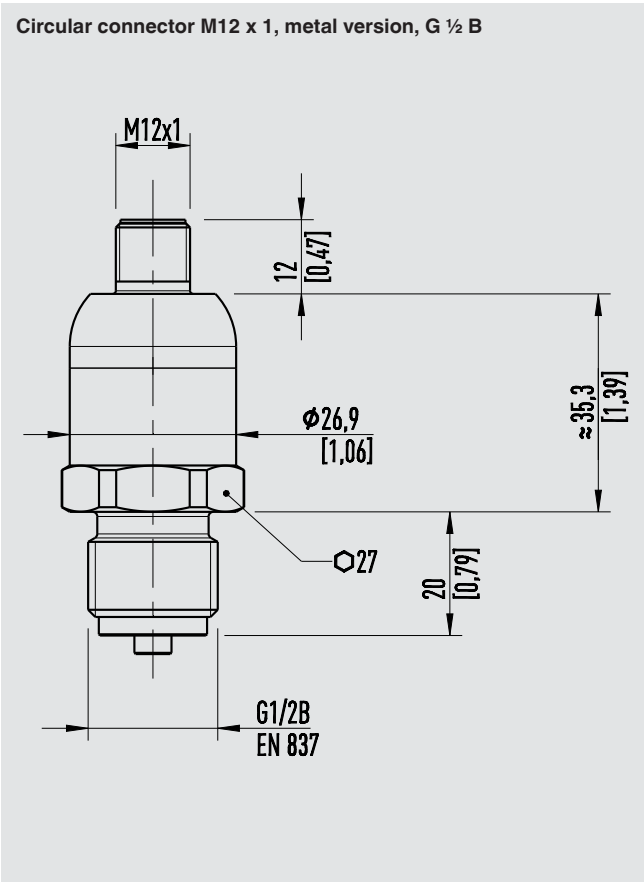
→ For approvals and certificates, see website

Dimensions in mm [in]

Examples of analogue versions, model GD-20-A



Examples of digital versions, model GD-20-D



Optional versions, model GD-20-A

Designation	Case ingress protection	Temperature range in °C [°F]	Shield provided by customer	Shield connected on the instrument side	Assignment	
					U ₊	U ₋
Cable outlet 2 m [6.56 ft], plastic	IP67	-40 ... +80 °C [-40 ... +176 °F]	Yes	-	Brown	Blue
Cable outlet 5 m [16.40 ft], plastic			Yes	-		
Cable outlet 10 m [32.80 ft], plastic			Yes	-		
Cable outlet 2 m [6.56 ft], SS			Yes	-		
Cable outlet 5 m [16.40 ft], SS			Yes	-		
Cable outlet 10 m [32.80 ft], SS			Yes	-		
Cable outlet 2 m [6.56 ft], shield connected, SS			Yes	Yes		
Cable outlet 5 m [16.40 ft], shield connected, SS			Yes	Yes		
Cable outlet 10 m [32.80 ft], shield connected, SS			Yes	Yes		
Field case	IP6K9K		-	-	1	2

Ordering information

Compensated pressure range / Accuracy / Gas mixture / Process connection / Electrical output / Optional version

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