General Specifications

ROTA*MASS* Total Insight
Coriolis Mass Flow and Density Meter
Addendum to General Specifications for Prime 1H

ROTA*MASS*
Total Insight

GS Addendum for Prime 1H

This document is an addendum to the General Specifications GS 01U10B04-00⌄ ⌐-R. It describes the differences of the delivered product compared to the applicable "General Specifications" that specifies standard devices of ROTAMASS Total Insight series. The deviations could be model code related, design or configuration only and are described on the next pages.

Applicable documents:
- General Specifications GS 01U10B04-00⌄ ⌐-R
- Addendum to:
  - General Specifications for PROFIBUS PA GS 01U10B00-02EN-R
  - General Specifications for Universal Spare Transmitter GS 01U10B00-06EN-R

Application and measuring ranges

Measuring range Prime 1H

	Prime 1H
Mass flow range	
Typical connection size	DN100, 4"
Q_{nom}	170 t/h (6200 lb/min)
Q_{max}	255 t/h (9400 lb/min)
Maximum volume flow	
(Water)	255 m³/h (2140 barrels/h)
Range of fluid density	
	0 – 5 kg/l (0 – 310 lb/ft³)
Process fluid temperature range	
Standard[1]	-70 – 200 °C (-94 – 392 °F)

[1] May be further restricted depending on the design.

Q_{nom} – Nominal mass flow
Q_{max} – Maximum mass flow

The nominal mass flow Q_{nom} is defined as the mass flow of water (temperature: 20 °C) at 1 bar (14.5 psi) pressure loss across the flow meter.

Mass flow

Mass flow of liquids:

Meter size	Typical connection size	Qnom in t/h (lb/min)	Qmax in t/h (lb/min)
Prime 1H	DN100, 4"	170 (6200)	255 (9400)

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Volume flow

Volume flow of liquids (water at 20 °C):

Meter size	Volume flow (at 1 bar pressure loss) in m³/h (barrels/h)	Maximum volume flow in m³/h (barrels/h)
Prime 1H	170 (1420)	255 (2140)

Accuracy

In this chapter, maximum deviations are indicated as absolute values.
All accuracy data are given in +/- values.

Overview of P1H specific accuracies

Achievable accuracies for liquids:

Measured quantity		Accuracy for transmitters	
		Essential	Ultimate
Density	Accuracy[2]	4 g/l (0.25 lb/ft³)	1.0 g/l (0.06 lb/ft³)
	Repeatability	2 g/l (0.13 lb/ft³)	0.5 g/l (0.03 lb/ft³)

[2] Best accuracy per transmitter type.

Zero point stability of the mass flow

In case of no flow, the maximum measured flow rate is called *Zero point stability*.
Zero point values are shown in the table below.

Meter size	Zero point stability Z in kg/h (lb/h)
Prime 1H	8.5 (18.7)

Mass flow accuracy

Above mass flow Q_{flat}, maximum deviation is constant and referred to as D_{flat}. It depends on the product version and can be found in the tables in chapter Accuracy of mass flow and density according to the model code.

Use the following formulas to calculate the maximum deviation D:

$$Q_m \geq Q_{flat} \quad \Rightarrow \quad D = D_{flat}$$

$$Q_m < Q_{flat} \quad \Rightarrow \quad D = \frac{a \times 100\ \%}{Q_m} + b$$

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Meter size	Model code position 9	D_{flat} in %	Q_{flat} in kg/h	a in kg/h	b in %
	E3, E7	0.2	6800	13.6	0
	D3, D7	0.15	7650	10.9	0.0071
Prime 1H	C3, C7	0.1	8500	9.44	-0.0111
	70	0.75	6800	13.6	0.55
	50	0.5	7650	10.9	0.357

D Maximum deviation in %
D_{flat} Maximum deviation for high flow rates in %
a, b Constants

Q_m Mass flow in kg/h
Q_{flat} Mass flow value above which D_{flat} applies, in kg/h

Accuracy of density

For liquids

Meter size	Transmitter	Maximum deviation of density[1] in g/l (lb/ft³)
Prime 1H	Essential	Down to 4 (0.25)
	Ultimate	Down to 1 (0.06)

[1] Deviations possible depending on product version (type of calibration)

Accuracy of mass flow and density according to the model code

Accuracy for flow rate as well as density is selected via model code position 9. Here a distinction is made between devices for measuring liquids and devices for measuring gases. No accuracy for density measurement is specified for gas measurement devices.

RC ☐☐☐☐ - ☐☐☐ - ☐**☐** - ☐ - ☐ - ☐☐ / ☐☐
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
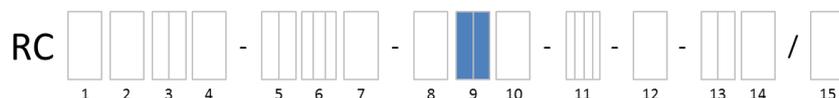
For liquids – Essential transmitter

Model code position 9	Maximum deviation of density[1] in g/l	Applicable measuring range of accuracy in kg/l	Maximum deviation D_{flat} for mass flow in %
			Prime 1H
E7	4	0.3 – 3.6	0.2

For liquids – Ultimate transmitter

| Model code position 9	Maximum deviation of density[1] in g/l	Applicable measuring range of accuracy in kg/l	Maximum deviation D_{flat} for mass flow in %
			Prime 1H
E3	1	0.3 – 2.0	0.2
D7	4	0.3 – 3.6	0.15
D3	1	0.3 – 2.0	0.15
C7	4	0.3 – 3.6	0.1
C3	1	0.3 – 2.0	0.1

[1] Specified maximum deviation is achieved within the applicable measuring range for density.

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Process pressure effect

Meter size	Deviation of Flow		Deviation of Density	
	in % of rate per bar	in % of rate per psi	in g/l per bar	in g/l per psi
Prime 1H	-0.0233	-0.00161	-0.120	-0.0083

Process fluid temperature effect

Temperature effect on density measurement (liquids)
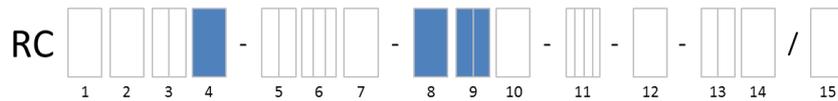
Process fluid temperature influence:

Formula for metric values

$$D'_\rho = \pm k \times abs\,(T_{pro} - 20\,°C)$$

Formula for imperial values

$$D'_\rho = \pm k \times abs\,(T_{pro} - 68\,°F)$$

D'_ρ Additional density deviation due to the effect of fluid temperature in g/l (lb/ft3)
T pro Process fluid temperature in °C (°F)
k Constant for temperature effect on density measurement in g/l × 1/°C (lb/ft3 × 1/°F)

Constants for particular meter size and model code position:

Meter Size	Model code position 4	Model code position 8	Model code position 9	k in g/l × 1/°C (lb/ft³ × 1/°F)
Prime 1H	S	0	C3, C7, D3, D7, E3, E7	0.12 (0.0042)

Operating conditions

Process conditions

Secondary containment

| Meter size	Rupture pressure in bar (psi)
Prime 1H	30 (435)

Ambient conditions

Temperature specification in hazardous areas

For maximum ambient and process fluid temperatures please refer to Explosion Proof Type Manuals IM 01U10X0_-00_ _-R.
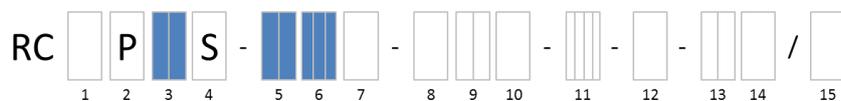
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Mechanical specification

Process connections, dimensions and weights of sensor

Remote type
(with standard neck)

Integral type
(with transmitter)
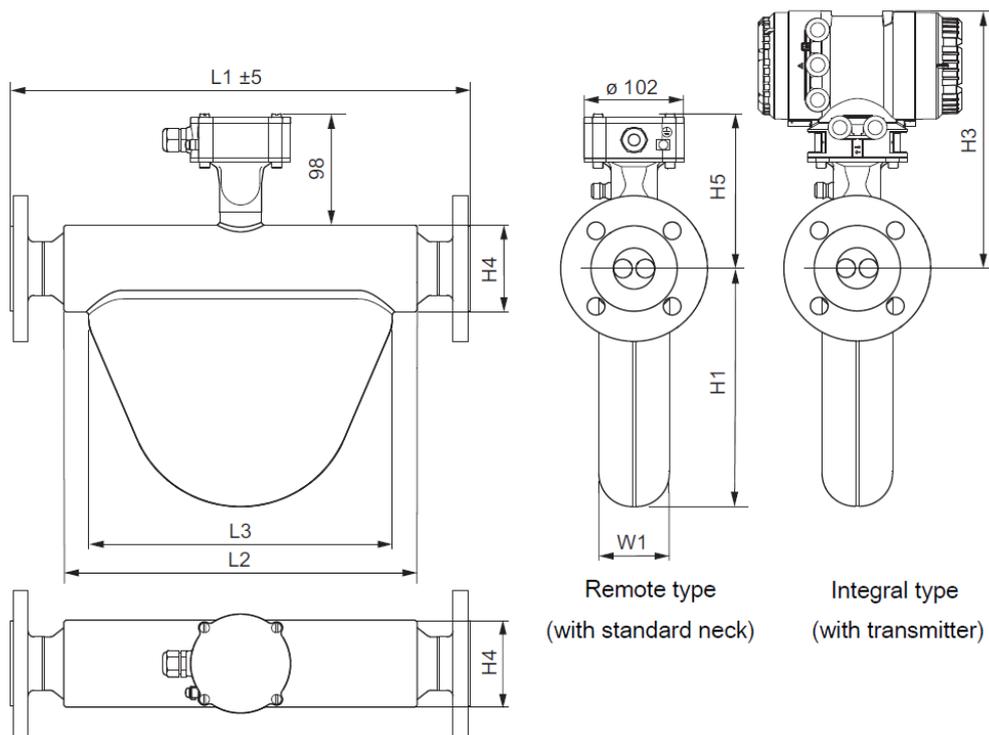
Dimensions in mm

Meter Size	L2	L3	H1	H3	H4	H5	W1
	in mm (inch)						
Prime 1H	682 (26.9)	620 (24.4)	482 (19.0)	330 (13.0)	168 (6.6)	201 (7.9)	150 (5.9)

Overall length L1 and weight of sensor

Process connections		Model code pos.		Prime 1H	
		5	6	L1 in mm (inch)	Weight in kg (lb)
Suitable for ASME B16.5	ASME 3" class 150, raised face (RF)	80	BA1	870 (34.3)	71.2 (157)
	ASME 3" class 300, raised face (RF)		BA2	880 (34.6)	75.0 (165)
	ASME 3" class 600, raised face (RF)		BA4	900 (35.4)	77.7 (171)
	ASME 3" class 600, ring joint (RJ)		CA4	900 (35.4)	78.3 (173)

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Process connections		Model code pos.		Prime 1H	
		5	6	L1 in mm (inch)	Weight in kg (lb)
Suitable for ASME B16.5	ASME 4" class 150, raised face (RF)	1H	BA1	850 (33.5)	74.4 (164)
	ASME 4" class 300, raised face (RF)		BA2	850 (33.5)	81.8 (180)
	ASME 4" class 600, raised face (RF)		BA4	920 (36.2)	94.0 (207)
	ASME 4" class 600, ring joint (RJ)		CA4	920 (36.2)	94.6 (209)
	ASME 5" class 150, raised face (RF)	1Q	BA1	870 (34.3)	77.0 (170)
	ASME 5" class 300, raised face (RF)		BA2	890 (35.0)	89.4 (197)
	ASME 5" class 600, raised face (RF)		BA4	920 (36.2)	114.2 (252)
	ASME 5" class 600, ring joint (RJ)		CA4	920 (36.2)	114.9 (253)
Suitable for EN 1092-1	EN DN80 PN40, type B1, raised face (RF)	80	BD4	870 (34.3)	71.6 (158)
	EN DN80 PN40, type D, with groove		GD4	870 (34.3)	71.1 (157)
	EN DN80 PN40, type E, with spigot		ED4	870 (34.3)	70.7 (156)
	EN DN80 PN40, type F, with recess		FD4	870 (34.3)	70.9 (156)
	EN DN80 PN100, type B1, raised face (RF)		BD6	890 (35.0)	79.1 (174)
	EN DN80 PN100, type D, with groove		GD6	890 (35.0)	78.9 (174)
	EN DN80 PN100, type E, with spigot		ED6	890 (35.0)	78.3 (173)
	EN DN80 PN100, type F, with recess		FD6	890 (35.0)	78.7 (174)
	EN DN100 PN40, type B1, raised face (RF)	1H	BD4	850 (33.5)	73.8 (163)
	EN DN100 PN40, type D, with groove		GD4	850 (33.5)	73.6 (162)
	EN DN100 PN40, type E, with spigot		ED4	850 (33.5)	73.0 (161)
	EN DN100 PN40, type F, with recess		FD4	850 (33.5)	73.3 (162)
	EN DN100 PN100, type B1, raised face (RF)		BD6	870 (34.3)	85.2 (188)
	EN DN100 PN100, type D, with groove		GD6	870 (34.3)	84.8 (187)
	EN DN100 PN100, type E, with spigot		ED6	870 (34.3)	84.0 (185)
	EN DN100 PN100, type F, with recess		FD6	870 (34.3)	84.5 (186)

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Process connections		Model code pos.		Prime 1H	
		5	6	L1 in mm (inch	Weight in kg (lb)
Suitable for EN 1092-1	EN DN125 PN40, type B1, raised face (RF)	1Q	BD4	860 (33.9)	78.5 (173)
	EN DN125 PN40, type D, with groove		GD4	860 (33.9)	78.1 (172)
	EN DN125 PN40, type E, with spigot		ED4	860 (33.9)	77.4 (171)
	EN DN125 PN40, type F, with recess		FD4	860 (33.9)	77.7 (171)
	EN DN125 PN100, type B1, raised face (RF)		BD6	880 (34.6)	98.0 (216)
	EN DN125 PN100, type D, with groove		GD6	880 (34.6)	97.6 (215)
	EN DN125 PN100, type E, with spigot		ED6	880 (34.6)	96.3 (212)
	EN DN125 PN100, type F, with recess		FD6	880 (34.6)	97.1 (214)
Suitable for JIS B 2220	JIS DN80 10K	80	BJ1	880 (34.6)	68.7 (151)
	JIS DN80 20K		BJ2	880 (34.6)	71.0 (157)
	JIS DN100 10K	1H	BJ1	850 (33.5)	69.8 (154)
	JIS DN100 20K		BJ2	850 (33.5)	73.4 (162)
	JIS DN125 10K	1Q	BJ1	850 (33.5)	73.5 (162)
	JIS DN125 20K		BJ2	850 (33.5)	79.7 (176)
Suitable for JPI	JPI 3" class 150	80	BP1	870 (34.3)	71.2 (157)
	JPI 3" class 300		BP2	880 (34.6)	75.1 (166)
	JPI 3" class 600		BP4	900 (35.4)	77.8 (172)
	JPI 4" class 150	1H	BP1	850 (33.5)	74.5 (164)
	JPI 4" class 300		BP2	850 (33.5)	81.9 (181)
	JPI 4" class 600		BP4	920 (36.2)	93.9 (207)
	JPI 5" class 150	1Q	BP1	870 (34.3)	77.1 (170)
	JPI 5" class 300		BP2	890 (35.0)	89.6 (198)

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Transmitter specification

Output signals

Active current output *Iout*

	Value
Nominal output current	4 – 20 mA
Maximum output current range	2.4 – 21.6 mA
Load resistance	≤ 750 Ω
Load resistance for secure HART communication	230 – 600 Ω

Passive current output *Iout*

	Value
Nominal output current	4 – 20 mA
Maximum output current range	2.4 – 21.6 mA
External power supply	10.5 – 32 V_{DC}
Load resistance for secure HART communication	230 – 600 Ω
Load resistance at current output	≤ 911 Ω

If mass- or volume flow is measured via current output I*out* two additional deviation effects have to be taken into account.

- The I*out* –base specification ΔI_{base} contains all combined effects of output adjustment, linearity, power supply variation, load resistance variation, short and long term drift for one year.
- The I*out* –ambient temperature specification $\Delta I(T_{amb})$ gives an additional deviation effect if the ambient temperature of the transmitter differs from 20 °C.

Both additional output deviation effects have to be added to the basic mass flow, or volume flow deviation. They are based on a 95 % (2σ) confidence level.

$$\boldsymbol{D_I} = \sqrt{\boldsymbol{D^2} + \left(\frac{\Delta I_{base}}{I(Q)}\right)^2 + \left(\frac{\Delta I(T_{amb})}{I(Q)}\right)^2}$$

D_I	maximum deviation of mass- or volume flow by I*out*
D	maximum deviation of mass- or volume flow[1] by frequency / pulse-output
$I(Q)$	I*out* depending on mass- or volume flow
ΔI_{base}	maximum deviation of I*out* by combined effects

$$\Delta I_{base} = a \times I(Q) + b$$

$\Delta I(T_{amb})$ maximum deviation of I*out* by deviation of the transmitter ambient temperature from 20°C

$$\Delta I(T) = (c \times I(Q) + d) \times (T - 20\,°C)$$

Description	Model code pos. 13	a in ppm	b in µA	c in ppm/K	d in µA/K
Non-intrinsically safe I*out* (active or passive)	JA, JB, JC, JD, JE, JF, JG, JH, JJ, JK, JL, JM, JN, M6	160	2.3	7	0
Intrinsically safe I*out* (passive)	JP, JQ, JR, JS	170	1.9	7	0.06

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[1] Formula of volume flow accuracy D_V, please see GS 01U10B04-00＿＿-R, chapter "4.6 Volume flow accuracy"

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Ordering information

Overview model code Prime 1H

Model code position	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	Description	Restriction
Trans-mitter	E														Essential (base function)	not with accuracy E3, D7, D3, C7, C3, 50 not with communication type and I/O JH, JJ, JK, JL, JM, JN, M2, M7 not with option CST, AC␣, CGC, C52, BT, VM
	U														Ultimate (high function)	not with accuracy E7, 70 not with display 0
Sensor	P														Prime	-
Meter size		1H													Nominal mass flow: 170 t/h (6200 lb/min) Maximum mass flow: 255 t/h (9400 lb/min)	not with option EPT
Material wetted parts			S												Stainless steel 1.4404/316L	-
Process connection size				80											DN80, 3"	
				1H											DN100, 4"	-
				1Q											DN125, 5"	
Process connection type						BA1									ASME flange class 150, suitable for ASME B16.5, raised face (RF)	see chapter *"Overall length L1 and weight of sensor"*
						BA2									ASME flange class 300, suitable for ASME B16.5, raised face (RF)	
						BA4									ASME flange class 600, suitable for ASME B16.5, raised face (RF)	
						CA4									ASME flange class 600, suitable for ASME B16.5, ring joint (RJ)	
						BD4									EN flange PN 40, suitable for EN 1092-1 type B1, raised face (RF)	not with option WPA, RTA, PTA, P2␣ see chapter *"Overall length L1 and weight of sensor"*
						ED4									EN flange PN 40, suitable for EN 1092-1 type E, spigot	
						FD4									EN flange PN 40, suitable for EN 1092-1 type F, recess	
						GD4									EN flange PN 40, suitable for EN 1092-1 type D, groove	
						BD6									EN flange PN 100, suitable for EN 1092-1 type B1, raised face (RF)	
						ED6									EN flange PN 100, suitable for EN 1092-1 type E, spigot	
						FD6									EN flange PN 100, suitable for EN 1092-1 type F, recess	
						GD6									EN flange PN 100, suitable for EN 1092-1 type D, groove	
						BJ1									JIS flange 10K, suitable for JIS B 2220	
						BJ2									JIS flange 20K, suitable for JIS B 2220	
						BP1									JPI flange class 150	
						BP2									JPI flange class 300	
Sensor housing material								0							Stainless steel 1.4301/304, 1.4404/316L	-
Process fluid temperature range									0						Standard, integral type: -50 – 150 °C (-58 – 302 °F), remote type: -70 – 200 °C (-94 – 392 °F)	-

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Model code position	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	Description	Restriction
Mass flow and density accuracy									E7						Liquid: 0.2 % maximum mass flow deviation Dflat, 4 g/l density deviation	not with transmitter U
									E3						Liquid: 0.2 % maximum mass flow deviation Dflat, 1 g/l density deviation	not with transmitter E
									D7						Liquid: 0.15 % maximum mass flow deviation Dflat, 4 g/l density deviation	
									D3						Liquid: 0.15 % maximum mass flow deviation Dflat, 1 g/l density deviation	
									C7						Liquid: 0.1 % maximum mass flow deviation Dflat, 4 g/l density deviation	
									C3						Liquid: 0.1 % maximum mass flow deviation Dflat, 1 g/l density deviation	
									70						Gas: 0.75 % maximum mass flow deviation Dflat,	not with transmitter U not with option CST, AC␣, C52, VM
									50						Gas: 0.5 % maximum mass flow deviation Dflat,	not with transmitter E not with option CST, AC␣, C52, VM
Design and housing										0					Integral type with "urethane-cured polyester powder coating" coated aluminum transmitter housing	not with option L␣␣␣, MC␣, Y␣␣␣
										2					Integral type with "corrosion protection coating" coated aluminium transmitter housing	
										A					Remote type with "urethane-cured polyester powder coating" coated aluminum transmitter housing and standard neck sensor	not with option RB
										E					Remote type with "corrosion protection coating" coated aluminium transmitter housing and standard neck sensor	
										J					Remote type stainless steel transmitter and standard neck sensor	not with Ex approval KF21, SF21, GF21, UF21, NF21, PF21 not with option RB
Ex approval											NN00				None	not with communication type and I/O JP, JQ, JR, JS, G1 not with option EPT, Q11
											KF21				ATEX, explosion group IIC and IIIC	not with design and housing J
											KF22				ATEX, explosion group IIB and IIIC	-
											SF21				IECEx, explosion group IIC and IIIC	not with design and housing J not with option Q11
											SF22				IECEx, explosion group IIB and IIIC	not with option Q11
											GF21				EAC Ex, explosion group IIC and IIIC	not with design and housing J only with option VE or VR not with option Q11
											GF22				EAC Ex, explosion group IIB and IIIC	only with option VE or VR not with option Q11
											FF11				FM, groups A, B, C, D, E, F, G	not with cable entries 4
											FF12				FM, groups C, D, E, F, G	not with communication type and I/O G␣ not with option Y␣␣␣, Q11, KC, VE, VR
											UF21				INMETRO, explosion group IIC and IIIC	not with design and housing J not with option Q11
											UF22				INMETRO, explosion group IIB and IIIC	not with option Q11

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Model code position	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	Description	Restriction
Ex approval											NF21				NEPSI, explosion group IIC and IIIC	not with design and housing J only with option CN not with option Q11
											NF22				NEPSI, explosion group IIB and IIIC	only with option CN not with option Q11
											PF21				Korea Ex, explosion group IIC and IIIC	not with design and housing J only with option KC not with option Q11
											PF22				Korea Ex, explosion group IIB and IIIC	only with option KC not with option Q11
Cable entries												2			ANSI ½" NPT	-
												4			ISO M20x1.5	not with Ex approval FF11 or FF12
Communication type and I/O													JA		1 active current output HART, 1 passive pulse or status output	not with option CGC, VM
													JB		2 active current outputs one with HART, 2 passive pulse or status outputs	
													JC		2 active current outputs one with HART, 1 passive pulse or status output, 1 voltage-free status input	
													JD		1 active current output HART, 2 passive pulse or status outputs, 1 passive status output	
													JE		1 active current output HART, 2 passive pulse or status outputs, 1 voltage-free status input	
													JF		1 active current output HART, 1 passive pulse or status output, 1 active pulse or status output with pull-up resistor, 1 voltage-free status input	
													JG		1 active current output HART, 1 passive pulse or status output, 1 active pulse or status output, 1 voltage-free status input	
													JH		1 active current output HART, 1 passive pulse or status output, 1 passive current output, 1 active current input	not with transmitter E
													JJ		1 active current output HART, 2 passive pulse or status outputs, 1 active current input	
													JK		1 active current output HART, 1 passive pulse or status output, 1 voltage-free status input, 1 active current input	
													JL		1 active current output HART, 1 passive pulse or status output, 1 passive current output, 1 passive current input	
													JM		1 active current output HART, 2 passive pulse or status outputs, 1 passive current input	
													JN		1 active current output HART, 1 passive pulse or status output, 1 voltage-free status input, 1 passive current input	

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Model code position	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	Description	Restriction
Communication type and I/O													JP		2 passive current outputs one with HART, 1 passive pulse or status output	not with Ex approval NN00 not with option CGC, MC2, MC3, VM
													JQ		2 passive current outputs one with HART, 2 passive pulse or status outputs	
													JR		2 passive current outputs one with HART, 1 passive NAMUR pulse or status output	
													JS		2 passive current outputs one with HART, 2 passive NAMUR pulse or status outputs	
Communication type and I/O													M0		Modbus output, 1 passive pulse or status output	not with option CGC, PS, BT, VM
													M2		Modbus output, 1 passive pulse or status output, 1 active current input	not with transmitter E, not with option PS, BT, VM
													M3		Modbus output, 2 passive pulse or status outputs	not with option CGC , PS, BT, VM
													M4		Modbus output, 1 passive pulse or status output, 1 active pulse or status output	
													M5		Modbus output, 1 passive pulse or status output, 1 active pulse or status output with pull-up resistor	
													M6		Modbus output, 1 passive pulse or status output, 1 active current output	
													M7		Modbus output, 1 passive pulse or status output, 1 passive current input	not with transmitter E, not with option PS, BT, VM
													G0		Profibus PA, 1 passive pulse output	Not with transmitter E Not with Ex approval FF11 and FF12 Not with option PS, BT, MC2, MC3
													G1		Profibus PA, intrinsic safe, 1 passive pulse output	Not with transmitter E Not with Ex approval FF11, FF12 and NNOO Not with option PS, BT, MC2, MC3, Q11
Display														0	No display	Not with transmitter U
														1	With display	-

Overview options Prime 1H restrictions

Option category	Options	Description	Restriction
Enhanced process temperature (Ex)	EPT	Expanded process fluid temperature range for temperature classes T6, T5, T4 and T3 for hazardous areas	not with meter size 1H not with Ex approval NN00

Other options are available according to the General Specifications GS01U10B04-00˽˽-R.

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