

CORIOLIS MASS FLOW AND DENSITY METERS

AI.CMF Series



BEST MEASUREMENT PERFORMANCE

- Best measurement performance on liquid mass flow, and density measurements
- Optimum gas mass flow measurement
- Reliable two-phase flow measurement for the most complicate applications
- Excellent design to reduce installation cost and eliminate daily maintenance

BEST FIT-FOR-APPLICATION

- Wide range of line size from DN1 to DN250
- Wide application coverage of hygienic, cryogenic, high pressure and high temperature
- Broad range of I/O outputs and expansive communication protocols

OVERVIEW

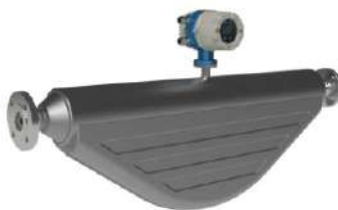
AI.CMF Series as provides optimum mass flow, density and temperature measurement performance, and also calculate volume flow, total flow and fluid composition in real-time. Currently AI.CMF Series meter has four series which are TS, US, VS and CNG; meanwhile each series has its own integral and remote types:



TS



US



VS



CNG

A typical AI.CMF Series meter is made up of a flow sensor and a signal transmitter. Flow sensor is designed using two vibrated tubes, and signal transmitter is employed with digital signal processor (DSP), and dynamic vibration balance (DVB) circuit to deliver fast response but accurate measurement performance. In addition, in situ node-configuration, diagnostics and data recording are easily handled via HART or Modbus RTU communication.

DESIGN & BENEFIT

- Delicate flow tube structure design
- Dedicated ASIC with digital signal processor (DSP)
- Dynamic vibration balance (DVB) technology employed
- 2-point compensation for temperature and process pressure respectively
- Amplify the impact of Coriolis force and deliver high Sensitivity
- Guarantee the accurate measurement performance both on liquid and gas
- Enhance the measurement stability
- Improve the measurement performance

APPLICATION

AI.CMF Series meters are suitable for most complex and challenging environment for liquid, gas and slurry applications:

Process fluid	Typical application	Industries	
<ul style="list-style-type: none"> ● Liquid ● Gas ● Slurry 	<ul style="list-style-type: none"> ■ Custody Transfer ■ Reactor Feed Ratio ■ Density Measurement ■ Batch Control 	<ul style="list-style-type: none"> ◆ Chemicals ◆ Food & Beverages ◆ Machinery ◆ Minerals & Mining ◆ Oil & Gas 	<ul style="list-style-type: none"> ◆ Pharmaceuticals ◆ Power Plant ◆ Pulp & Paper ◆ Water ◆ Waste Water

SENSOR MATERIAL

The general selection of wetted parts and of non-wetted parts of a AI.CMF Series meter is as follows:

Wetted part	Material	Non-Wetted part	Material
Flow tube	316L stainless steel	Sensor case	304 stainless steel
Flow splitter	316L stainless steel	Transmitter housing	Aluminum Die-Cast
Flange	316L stainless steel	Remote junction box	Aluminum Die-Cast

Note: For special material selection, please refer to ORDERING INFORMATION or contact our sales people for the details.

SENSOR SIZE

AI.CMF Series meters have developed from the size of DN5 to DN250. However, currently not full sizes are manufactured and available for the four series. Please refer to the following table for the details:

Line size	mm	inch	TS	US	CNG	VS
DN001	1	1/25		CMF-US-001		
DN002	2	1/12				CMF-VS-002
DN005	5	3/16				CMF-VS-005
DN010	10	3/8				CMF-VS-010
DN015	15	2/3	CMF-TS-015N CMF-TS-015H		CMF-CNG-015	CMF-VS-015
DN025	25	1	CMF-TS-025N CMF-TS-025H		CMF-CNG-025	CMF-VS-025
DN040	40	1-1/2		CMF-US-040N CMF-US-040H		
DN050	50	2		CMF-US-050N CMF-US-050H		
DN080	80	3		CMF-US-080N CMF-US-080H		
DN100	100	4		CMF-US-100N CMF-US-100H		
DN150	150	6		CMF-US-150N CMF-US-150H		
DN200	200	8		CMF-US-200N		
DN250	250	10		CMF-US-250N		

SENSOR SIZE

Reference operating conditions

For determining the performance capabilities of AI.CMF Series meters, the following conditions need to be concerned:

Flow measurement accuracy includes the combined effects of linearity, repeatability, hysteresis and other non-linearities

Measurement performance is based on calibration with water as the process fluid at typical process conditions

- 20 to 30°C and 200 to 400 KPa

Measurement performance is based on collected frequency or pulse outputs by the flowmeter

Accuracy and repeatability of liquids & slurries

Performance specification	Standard
Mass flow/volume flow accuracy	$\pm 0.10\%$ of rate
Mass flow/volume flow repeatability	$\leq 0.05\%$ of rate
Density accuracy	$\pm 0.0005 \text{ g/cm}^3$ (0.5 kg/m^3)
Density repeatability	$\pm 0.0002 \text{ g/cm}^3$ (0.2 kg/m^3)
Temperature accuracy	$\pm 1^\circ\text{C}$ ($\pm 1.8^\circ\text{F}$)
Temperature repeatability	$\pm 0.1^\circ\text{C}$ ($\pm 0.18^\circ\text{F}$)

Note: - Density range: 0.1 to 3.0 g/cm³ (100 to 3,000kg/m³)

- Temperature range: -240 to +400°C (400 to 752°F)

Accuracy and repeatability of Gases

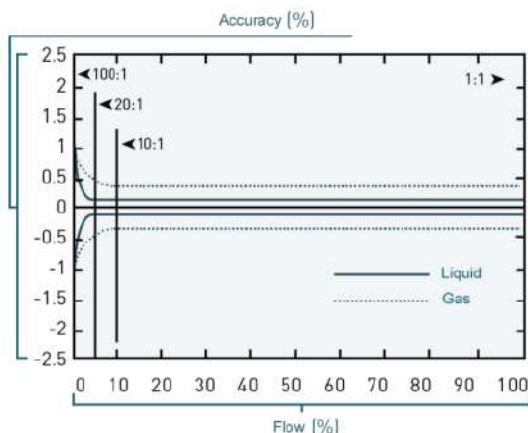
Performance Specification	Standard
Mass flow/volume flow accuracy	$\pm 0.35\%$ of rate
Mass flow/volume flow repeatability	$\leq 0.17\%$ of rate
Temperature accuracy	$\pm 1^\circ\text{C}$ ($\pm 1.8^\circ\text{F}$)
Temperature repeatability	$\pm 0.1^\circ\text{C}$ ($\pm 0.18^\circ\text{F}$)

Note: - Gas density: not applicable

- Temperature range: -240 to +400°C (400 to 752°F)

Typical curve

The following figure and curve illustrate accuracy, repeatability and pressure loss for water:



Range ability	500:1	100:1	20:1	10:1	1:1
Accuracy of liquid ($\pm \%$)	2.5	0.8	0.1	0.1	0.1
Accuracy of gas ($\pm \%$)	2.5	1.5	0.5	0.35	0.35
Pressure loss					
Liquid (psi)	~0	~0	0.1	0.25	14.5
Liquid (bar)	~0	~0	0.01	0.02	1.0
Gas (psi)	0	0	0.1	0.35	15.0
Gas (bar)	0	0	0.01	0.02	1.03

LIQUID FLOW RANGE

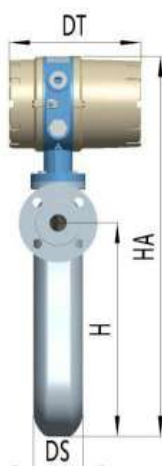
CMF series	Model	Liquid(Max. Flowrate)		K - gas coefficient
		lb/min	kg/h	
TS	CMF-TS-015N	37	1,000	90
	CMF-TS-015H	220	6,000	140
	CMF-TS-025N	220	6,000	140
	CMF-TS-025H	735	20,000	140
US	CMF-US-001N	0.6	16	60
	CMF-US-040N	735	20,000	140
	CMF-US-040H	1,100	30,000	140
	CMF-US-050N	1,100	30,000	140
	CMF-US-050H	2,200	60,000	160
	CMF-US-080N	2,200	60,000	160
	CMF-US-080H	6,600	180,000	215
	CMF-US-100N	3,700	100,000	200
	CMF-US-100H	10,300	280,000	230
	CMF-US-150N	11,000	300,000	230
	CMF-US-150H	23,515	640,000	240
	CMF-US-200N	40,425	1,100,000	250
	CMF-US-250N	66,000	1,800,000	300
CNG	CMF-CNG-015	220	6,000	120
	CMF-CNG-025	440	12,000	200
VS	CMF-VS-002	3	80	60
	CMF-VS-005	11	300	70
	CMF-VS-010	37	1,000	70
	CMF-VS-015	220	6,000	70
	CMF-VS-025	660	18,000	70

Gas Flow Range = Liquid flow range × gas process density / K

DIMENSION

The following dimensional drawings provide a basic guideline for sizing and planning. The representative of a 316L stainless steel model fitted with ANSI 150 RF flange and T1 transmitter.

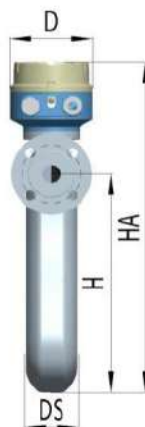
1. ITS - Integral TS Unit: inch (mm)



Model	Line size	L	H	HA	DS	DT
CMF-TS-015N	1/2 (15)	10-1/16 (256)	9-1/16 (230)	18-15/16 (480)	2- 1/ 2 (64)	7-9/16 (192)
CMF-TS-015H	1/2 (15)	12 (304)	12-5/8 (320)	22-7/16 (570)	2-13/16 (72)	7-9/16 (192)
CMF-TS-025N	1 (25)	12 (304)	12-5/8 (320)	22-7/16 (570)	2-13/16 (72)	7-9/16 (192)
CMF-TS-025H	1 (25)	22-5/8 (574)	24-15/16 (622)	49-11/16 (795)	4- 3/ 4 (121)	7-9/16 (192)

2. RTS - Remote TS

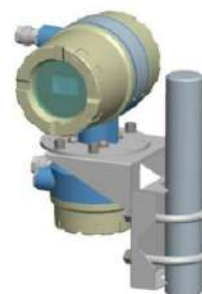
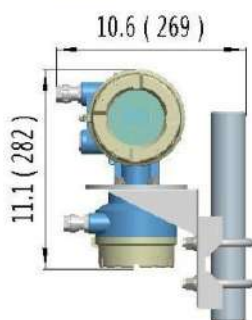
Unit: inch (mm)



Model	Line size	L	H	HA	DS	D
CMF-TS-015N	1/2 (15)	10-1/16 (256)	9-1/16 (230)	15-5/8 (397)	2- 1/ 2 (64)	4-5/8 (117)
CMF-TS-015H	1/2 (15)	12 (304)	12-5/8 (320)	19-1/8 (485)	2- 13/16 (72)	4-5/8 (117)
CMF-TS-025N	1 (25)	12 (304)	12-5/8 (320)	19-1/8 (485)	2- 13/16 (72)	4-5/8 (117)
CMF-TS-025H	1 (25)	22-5/8 (574)	20-9/16 (522)	28-1/32 (712)	4- 3/ 4 (121)	4-5/8 (117)

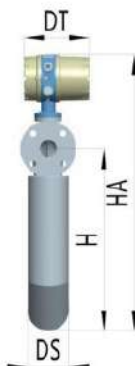
3. T1 Transmitter

Unit: inch (mm)



4. IUS - Integral US

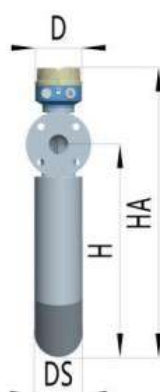
Unit: inch (mm)



Model	Line size	L	H	HA	DS	DT
CMF-US-040N	1-1/2 (40)	22-5/8 (574)	20-9/16 (522)	31-9/32 (794)	4- 3/ 4 (121)	7-9/16 (192)
CMF-US-040H	1-1/2 (40)	24-1/2 (622)	21-3/8 (542)	32-7/32 (817)	4- 3/ 4 (121)	7-9/16 (192)
CMF-US-050N	2 (50)	24-1/2 (622)	21-3/8 (542)	32-7/32 (817)	4- 3/ 4 (121)	7-9/16 (192)
CMF-US-050H	2 (50)	27-21/32 (702)	25-15/16 (658)	36-27/32 (936)	5- 29 / 32 (150)	7-9/16 (192)
CMF-US-080N	3 (80)	30-1/16 (763)	26-11/16 (678)	38-5/32 (969)	5- 29 / 32 (150)	7-9/16 (192)
CMF-US-080H	3 (80)	33-7/16 (850)	33-7/8 (861)	46-11/32 (1,177)	7- 23 / 32 (196)	7-9/16 (192)
CMF-US-100N	4 (100)	32-1/4 (822)	28-29/32 (733)	41-5/32 (1,045)	5- 29 / 32 (150)	7-9/16 (192)
CMF-US-100H	4 (100)	41-29/32 (1,064)	45-9/32 (1,150)	58-21/32 (1,490)	11 - 29 / 32 (302)	7-9/16 (192)
CMF-US-150N	6 (150)	45-11/16 (1,160)	39-1/8 (994)	52-13/32 (1,331)	9- 21 / 32 (245)	7-9/16 (192)
CMF-US-150H	6 (150)	40-5/16 (1,240)	49-1/2 (1,257)	64-9/16 (1,627)	12 - 27 / 32 (326)	7-9/16 (192)
CMF-US-200N	8 (200)	49-15/16 (1,268)	49-1/2 (1,257)	64-9/16 (1,627)	12 - 27 / 32 (326)	7-9/16 (192)
CMF-US-250N	10 (250)	69-5/16 (1,760)	68-15/16 (1,751)	853/8 (2,168)	17-1/8 (435)	7-9/16 (192)

5. Remote US

Unit: inch (mm)



Model	Line size	L	H	HA	DS	D
CMF-US-040N	1-1/2 (40)	22-5/8 (574)	20-9/16 (522)	28-1/32 (712)	4- 3/ 4 (121)	4-5/8 (117)
CMF-US-040H	1-1/2 (40)	24-1/2 (622)	21-3/8 (542)	28-15/16 (735)	4- 3/ 4 (121)	4-5/8 (117)
CMF-US-050N	2 (50)	24-1/2 (642)	21-3/8 (542)	28-15/16 (735)	4- 3/ 4 (121)	4-5/8 (117)
CMF-US-050H	2 (50)	27 - 21 /32 (702)	25-15/16 (658)	33-5/8 (854)	5- 29 / 32 (150)	4-5/8 (117)
CMF-US-080N	3 (80)	30-1/16 (763)	26-11/1 (678)	34-15/16 (887)	5- 29 / 32 (150)	4-5/8 (117)
CMF-US-080H	3 (80)	33-7/16 (850)	33-7/8 (861)	43-1/8 (1,095)	7- 23 / 32 (196)	4-5/8 (117)
CMF-US-100N	4 (100)	32-1/4 (822)	28-29/32 (733)	36-27/32 (963)	5- 29 / 32 (150)	4-5/8 (117)
CMF-US-100H	4 (100)	41-29/32 (1,064)	45-9/32 (1,150)	55-7/16 (1,408)	11-29/32 (302)	4-5/8 (117)
CMF-US-150N	6 (150)	45-11/16 (1,160)	39-1/8 (994)	49-3/16 (1,249)	9- 21 / 32 (245)	4-5/8 (117)
CMF-US-150H	6 (150)	40-5/16 (1,240)	49-1/2 (1,257)	60-13/16 (1,545)	12-27/32 (326)	4-5/8 (117)
CMF-US-200N	8 (200)	49-15/16 (1,268)	49-1/2 (1,257)	60-13/16 (1,545)	12-27/32 (326)	4-5/8 (117)
CMF-US-250N	10 (250)	69-5/16 (1,760)	68-15/16 (1,751)	82-1/8 (2,086)	17-1/8 (435)	4-5/8 (117)

6. IVS - Integral VS
Unit: inch (mm)



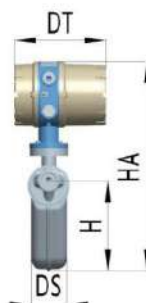
Model	Line size	L	H	HA	DS	DT
CMF-VS-015	1/2 (15)	17-1/2 (444)	7-1/2 (190)	17-4/5 (452)	3-1/2 (89)	7-9/16 (192)
CMF-VS-025	1 (25)	17-1/2 (444)	7-1/2 (190)	17-4/5 (452)	3-1/2 (89)	7-9/16 (192)

7. RVS - Remote VS
Unit: inch (mm)



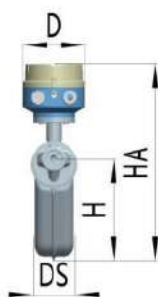
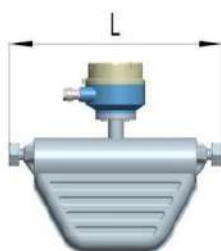
Model	Line size	L	H	HA	DS	D
CMF-VS-015	1/2 (15)	17-1/2 (444)	7-1/2 (190)	14-9/16 (370)	3-1/2 (89)	4-5/8 (117)
CMF-VS-025	1 (25)	17-1/2 (444)	7-1/2 (190)	14-9/16 (370)	3-1/2 (89)	4-5/8 (117)

8. ICNG - Integral CNG
Unit: inch (mm)



Model	Line size	L	H	HA	DS	DT
CMF-CNG-015	1/2 (15)	16-3/8 (416)	7-1/2 (190)	17-13/16 (453)	2-15/16 (75)	7-9/16 (192)
CMF-CNG-025	1 (25)	18-1/8 (462)	8-15/16 (227)	19-1/2 (495)	3-3/4 (95)	7-9/16 (192)

9. RCNG - Remote CNG
Unit: inch (mm)



Model	Line size	L	H	HA	DS	D
CMF-CNG-015	1/2 (15)	16-3/8 (416)	7-1/2 (190)	14-9/16 (370)	2-15/16 (75)	4-5/8 (117)
CMF-CNG-025	1 (25)	18-1/8 (462)	8-15/16 (227)	16-1/4 (413)	3-3/4 (95)	4-5/8 (117)

SENSOR INSTALLATION

Sensor installation has significant effect on the performance of a AI.CMF Series meter. In general the installation should be chosen to ensure the flow tube which is always filled with the process fluid and to prevent accumulation of other media.

1. Typical installations recommended



Upright installation for liquid



Inverted installation for gas



Flagpole installation for slurry

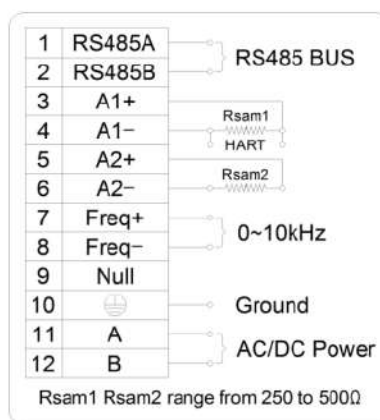
WIRING

1. Internal wiring for Integral AI.CMF Series meter

- Between sensor & transmitter is complete before it leaves the factory
- Customers do not need to do wiring on site after installation
- T1 transmitter layout and terminals illustrated below



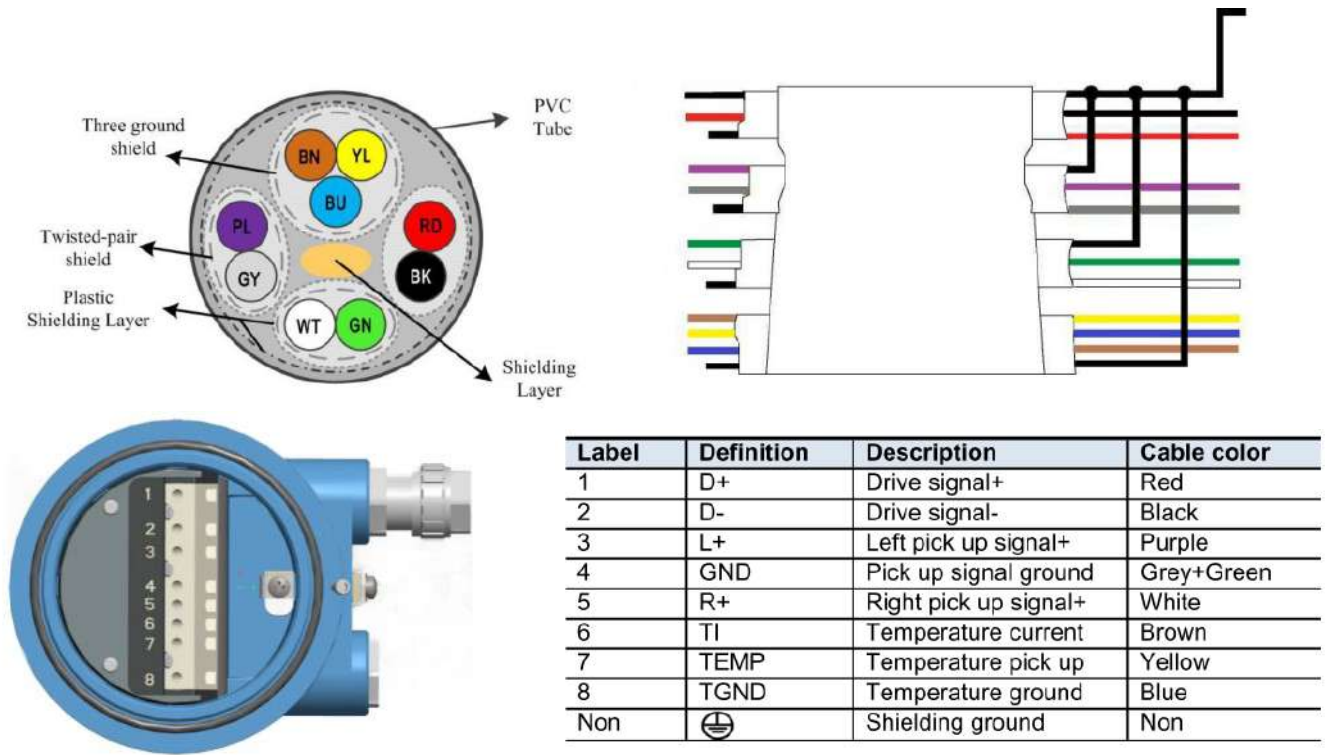
T1 transmitter terminal layout



T1 transmitter terminals

2. Cable wiring for Remote AI.CMF Series meter

- Only using Walsn dedicated 9-wire cable to connect flow sensor to transmitter
- Customer needs to do wiring job on site after sensor installation
- On site, wires connected to terminals of the remote junction box; meanwhile, on transmitter side, wires connected to the transmitter terminals
- Standard cable length is 10m, and the longest cable is less than 100m
- Walsn dedicated 9-wire cable illustrated below



Terminal layout of Remote junction box

Terminals of Remote junction box

GROUNDING

1. Grounding through sensor terminal

- If the process piping is grounded, the sensor can be grounded directly to the pipe system

2. Grounding through transmitter terminal

- If the pipeline is not conductive or otherwise ungrounded, the transmitter grounding terminal can be directly connected with the instrument protection grounding point

SPECIFICATION

Accuracy	Liquid: $\pm 0.10\%$, $\pm 0.15\%$, $\pm 0.20\%$ Gas: $\pm 0.35\%$
Repeatability	0.05%
Line size	DN5 to DN250
Pressure rating	4MPa, 10MPa
Process connection	304 stainless steel 316L stainless steel Hastelloy C22
Flow tube	316 stainless steel Hastelloy C22
Enclosure rating	IP67
Conduit connection	M20 \times 1.5, 1/2" NPT
Process temperature	-40 to +356°F (-40 to +180°C) with LCD display -40 to +662°F (-40 to +350°C) without LCD display
Meter type	Integral or remote For remote type, the standard cable length: 10m
Signal output	Frequency: 0 to 10KHz Analog: 4-20mA, Error: $\leq \pm 0.002\text{mA}$ Communication: HART or Modbus RTU over 485
Approval and certification	CSA, CE, PCEC

ORDERING INFORMATION (1/4)

Code	Product Description	Notes
CMF	Mass flow meter	
Code	Tube	Notes
TS	T type tube	Upon on pressure loss requirements and process fluid
US	U type tube	
VS	V type tube	
CNG	Dedicated CNG sensor	
Code	Certification	Notes
S	No	Based on explosion-proof requirements
H	Yes	CSA / PCEC / ATEX / IEC
Code	Sensor Type and Cable Length	Notes

000	Integral type (I)	
005~100	Remote type (D) , Cable with 15ft to 300ft (5m to 100m)	Standard cable = 30 ft (10m) for remote type
Code	Line Size	Notes
	3/16, 3/8, 1/2, 3/4, 1, 1-1/2, 2, 3, 4, 6, 8, 10, 12, 14, 16 inch	
001~250	DN5, 10, 15, 20, 25, 40, 50, 80, 100, 150, 200, 250mm	Upon on flow rate

Code	Accuracy	Notes
0	±0.2%	
1	±0.15%	
2	±0.1%	T2/T3 only
3	±0.35%G	Gas
4	±0.5%G	Gas
5	±0.25%G	Gas

Code	Material of Flow Tube	Notes
1	316L Stainless steel	
2	Titanium	
3	Hastelloy C22	Upon on process fluid
9	Customer specify	

ORDERING INFORMATION (2/4)

Code	Pressure Rating of Flow Tube	Notes
L01	CLASS 150# (1.6MPa)	
L02	CLASS 300# (2.5MPa)	
L04	CLASS 300# (4.0MPa)	
M06	CLASS 400# (6.3MPa)	
M10	CLASS 600# (10MPa)	
H16	CLASS 900# (16MPa)	Based on process pressure
H25	CLASS 1500# (25MPa)	
H32	CLASS 2500# (32MPa)	
H40	CLASS 2500# (40MPa)	
X	Customer specify	

Code	Process Connection Material	Notes
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1	304 stainless steel	Upon on process fluid and customer's requirements, usually matching electrode material
2	316L stainless steel	
3	Titanium	
4	Hastelloy C22	
9	Customer specify	

Code	Process Connection Standard	Notes
A0	ASME B16.5 (ANSI) Class 150	Upon on process piping system
A1	ASME B16.5 (ANSI) Class 300	
A2	ASME B16.5 (ANSI) Class 600	
A3	ASME B16.5 (ANSI) Class 900	
A4	ASME B16.5 (ANSI) Class 1500	
B0	JIS B2220 10K	
B1	JIS B2220 20K	
B2	JIS B2220 40K	
B3	JIS B2220 63K	
C0	GB/T 9115 PN 2.5 MPa	
C1	GB/T 9115 PN 4.0 MPa	
C2	GB/T 9115 PN 6.3 MPa	
C3	GB/T 9115 PN 10 MPa	
C4	GB/T 9115 PN 16 MPa	
C5	GB/T 9115 PN 1.6 MPa	

ORDERING INFORMATION (3/4)

Code	Process Connection Standard	Notes
D0	EN 1092-1 (DIN) PN 16	
D1	EN 1092-1 (DIN) PN 25	
D2	EN 1092-1 (DIN) PN 40	
D3	EN 1092-1 (DIN) PN 63	
D4	EN 1092-1 (DIN) PN 100	
D5	EN 1092-1 (DIN) PN 160	
E0	HG/T 20592 PN 2.5 MPa	
E1	HG/T 20592 PN 4.0 MPa	
E2	HG/T 20592 PN 6.3 MPa	
E3	HG/T 20592 PN 10 MPa	

E4	HG/T 20592 PN 16 MPa
E5	HG/T 20592 PN 1.6 MPa
H0	HG/T 20615 Class 150
H1	HG/T 20615 Class 300
H2	HG/T 20615 Class 600
H3	HG/T 20615 Class 900
H4	HG/T 20615 Class 1500
F1	Sanitary fitting (compatible with Tri-Clamp)
F2	DIN 11851-SI(mm)
F3	DIN 11851-US (inch)
F4	DIN 11864-1 Form A (sanitary) connection
F5	DIN 11864-2 Form A flange plate with slotted connection
F6	SMS 1145 (sanitary) connection
G4	1/2" NPT-F
G5	3/4" NPT-F
G6	1/2" Flange
X0	Customer specify

ORDERING INFORMATION (4/4)

Code	Process Temperature of Sensor	Notes
1	-58 to +356°F (-50 to +180°C)	
4	-58 to +266°F (-50 to +130°C)	
5	-58 to +482°F (-50 to +250°C)	
9	Customer specify	

Code	Enclosure Rating	Notes
1	IP65	
2	IP67	Based on application environment (such as indoor, outdoor, buried)
3	IP68	

Code	Power Supply	Notes
0	85VAC ~ 265VAC 50/60Hz	
1	24VDC	Upon on customer's requirements
2	Self-switching (22VDC/AC~245VDC/AC, 50/60Hz)	

Code	Output Display	Notes
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0	Without display, without keypad	Upon on customer's requirements
1	With display, and keypad	
Code	Output Signal	Notes
0	Analog + Pulse/Frequency	
1	Analog+ Pulse/Frequency + HART	
2	Analog+ Pulse/Frequency + RS485	
3	Analog+ Pulse/Frequency+ Profibus	
Code	Batch Control	Notes
N	Without batch control	Upon on customer's requirements
Y	With batch control	
Code	Conduit Connection	Notes
N	1/2"NPT	Upon on customer's requirements
M	M20×1.5	
P	3/4"NPT	
X	Customer specify	
Code	QIG Language	Notes
E	English	Currently only English language is available for the international market
C	Chinese	
Code	Dedicated Option	Notes
N	Standard capacity	Must be verified
H	High capacity	
Code	Transmitter Version	Notes
T1	Transmitter, version 1.0	



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Company with
Certificate of Quality
System ISO 9001:2015
Cert n°38785/19/S