CAMERON

Cost-Effective Coriolis Flow Meters

CamCor™ PRO Series Meters

GENERAL SPECIFICATION
50284153, Rev. 02

GENERAL

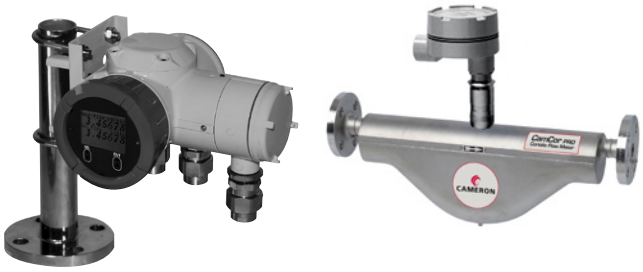
Equipped with a sophisticated transmitter (including a self-diagnostics feature, large display, and field configurability via keypad), the Cameron PRO Series are cost-effective process-grade Coriolis flow meters.

FEATURES

- Extensive self-diagnostic capabilities (connection faults, pipeline variations, media pulsation, etc.)
- Configurable via keypad or digital communications
- Fast response and calculation frequency
- User-configurable alarms
- Dual independent pulse outputs, dual independent current outputs, one status output and one status input
- Enhanced maintenance functions (event/user change logging and downloads, recoverable factory configuration and calibration, etc.)
- Compatible with Modbus and HART communication protocols

UNITS

The specifications for the PRO Series meters are presented in two sections: U.S. Customary units and Metric units. U.S. customary units are presented beginning on this page. For metric units, see Appendix A: Metric Units, page A-1.



Separately-mounted transmitter

ADDITIONAL INFORMATION

To view available product configurations and to request additional information, see Appendix B: Product Codes and Inquiry Form, page B-1.

GENERAL PERFORMANCE

Mass Flow Rate

Item		Description					
Model		CP006	CP010	CP015	CP025	CP040	CP050
Flow rate	Guaranteed minimum rate (lb/min)	0.88	2.82	7.05	21.2	70.5	70.5
	Minimum setting rate (lb/min)	2.2	7.05	17.6	52.9	176	176
	Maximum service rate (lb/min)	22	70.5	176	529	1764	1764
	Maximum allowable rate (lb/min)	44.1	141	353	1058	3527	3527
	Uncertainty	±0.2% of reading (± zero stability)					
	Repeatability	±0.1% of reading (± 1/2 of zero stability)					
	Zero stability (lb/min)	0.0033	0.011	0.026	0.079	0.265	0.265
Density (Liquid)	Metering range	0.3 to 2 g/mL					
	Uncertainty	±0.003 g/mL					
Analog output uncertainty		±0.1% of full scale					

* During testing, zero stability and flow rate during the test should read in the same measurement unit.

$$ZS = \frac{\text{Zero stability}}{\text{Current flow rate}} \times 100\%$$

Volumetric Flow Rate ❶

Item	Description					
Model	CP006	CP010	CP015	CP025	CP040	CP050
Guaranteed minimum rate (gal/min)	0.106	0.338	0.846	2.54	8.46	8.46
Minimum setting rate (gal/min)	0.264	0.846	2.12	6.35	21.2	21.2
Maximum service rate (gal/min)	2.64	8.46	21.2	63.5	212	212
Maximum allowable rate (gal/min)	5.29	16.9	42.3	127	423	423

1. Calculations based on water (specific gravity of 1) at 59°F (mass = 62.37 lb/ft^3). Actual flow ranges vary with media density. To determine the flow range for your fluid, divide the values above by the fluid's specific gravity.

GENERAL SPECIFICATIONS

Sensor Unit

Item		Description					
Model		CP006	CP010	CP015	CP025	CP040	CP050
Nominal size (in.)		1/2	1/2	1/2	1	1-1/2	2
Materials	Wetted parts	SUS316L					
	Housing	SUS304					
Process connection		ASME 150, 300, 600 RF; IDF Ferrule; Threaded (CP006, CP010 and CP015 only)					
Applicable fluid		Liquid					
Density range		0.3 to 2.0 g/mL					
Temperature range ❶		–40°F to 257°F ❷					
Maximum operating pressure		Dependent on process connection					
Flow direction		Bidirectional					
Explosion-proof configuration		CSA, ATEX, IECEx (Refer to Explosion-proof Specifications, page 11 for details.)					
Dust-tight, waterproof configuration		IP66/67					

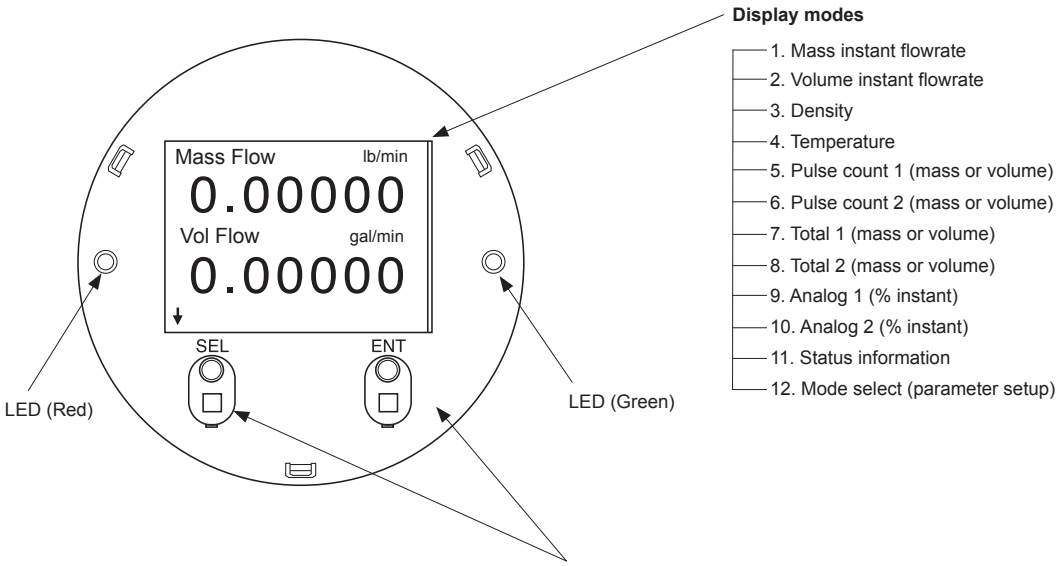
1. Refer to Explosion-proof Specifications, page 11. In case of non-explosion-proof model, up to 257˚F is permitted. However, the product must be used within the maximum ambient temperature of 113˚F.
2. Cleaning in place (CIP) is permitted within the temperature range.

Transmitter

Item		Description
Model		PA0K
Power supply		85 to 264 VAC 50/60 Hz or 20 to 30 VDC (Safety rated 100 to 240 VAC 50/60 Hz)
Power consumption		Maximum 15 W
Ambient temperature		−40°F to 131°F ❶
Transmission length (separate type)		Maximum 5 m (interconnect cable used) ❷
Applicable EU directive		EMC Directive: 2004/108/EC, ATEX Directive: 94/9/EC
Applicable EN standards		EMC: EN55011: 1998/A1, 1999/A2: 2002, Group 1, Class B; EN61000-6-2: 2001/EN061326-1: 2006 ATEX: EN60079-0: 2012; EN60079-1: 2007; EN60079-11: 2012 IECEx : IEC60079-0: 2011; IEC60079-1: 2007-04; IEC60079-11: 2011
Explosion-proof configuration		CSA, ATEX, IECEx (Refer to Explosion-proof Specifications, page 11 for details.)
Dust-tight, waterproof configuration		IP66/67
Transmitter configuration		Integral or separately-mounted
Finish		Paint type: Baked enamel; Paint color: Light gray (RAL7035)
Display		LCD display provided (128×64 dots), backlight (white, orange); Two infrared sensors; Two LEDs (green and red)
Weight		Integrally-mounted model: approx. 7.94 lb; Separately-mounted model: approx. 11 lb
Communication interface ❺	HART	Protocol Version 7, Hybrid Bell 202
	Modbus	RS-485: Baud rate: 9600 bps, 19200 bps, 38400 bps RTU or ASCII response time: 25 to 50 ms
Damping (default)		Flow rate, 0.8 sec.; Density, 4 sec.; Temperature, 2.5 sec.
Low flow cutoff (default)		Under 1.0% of maximum service flow rate
Pulse output		Open drain (equivalent to open collector): Minimum 10V to 30V, 50 mADC, ON resistance ≥0.6Ω OR Voltage: 1.5V maximum (low level), 13V minimum (high level), output impedance: 2.2 kΩ; Setting range: 0.1 to 10000 Hz (Maximum 11000 Hz)
Analog output		4 to 20 mADC (maximum load 600Ω) Select two outputs ❸ from instant flowrate (mass or volume) temperature, and density.
Status output		Open drain (equivalent to open collector): 30V maximum, 50 mADC, ON resistance ≥0.6Ω; Select one output ❹ from error, flow direction, or high/low alarm (default is error)
Status input		Contact-closure (Form "a" contact) 200Ω maximum (short), 100 kΩ minimum (open); Select one output from remote zero, total reset, 0% signal lock, or function off (default is function off)

1. Below –4°F, the display loses its visibility due to weakened contrast. Both the display and infrared sensor may exhibit slow responses below –4°F.
2. If signal transmission length exceeds the maximum length, consult the factory.
3. HART communications are available only across the Analog Output 1.
4. The status output can also be configured to activate when meter zeroing is in process.
5. Electrical noise filtering components are installed in connections between power source, output, communications, and chassis.

DISPLAY

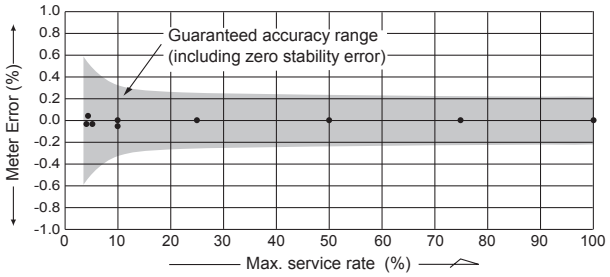


- LCD backlight available in white and orange. Color changes according to the status of flow meter.
- In most cases, the backlight shuts off automatically if the optical sensor does not respond within a user-defined duration.

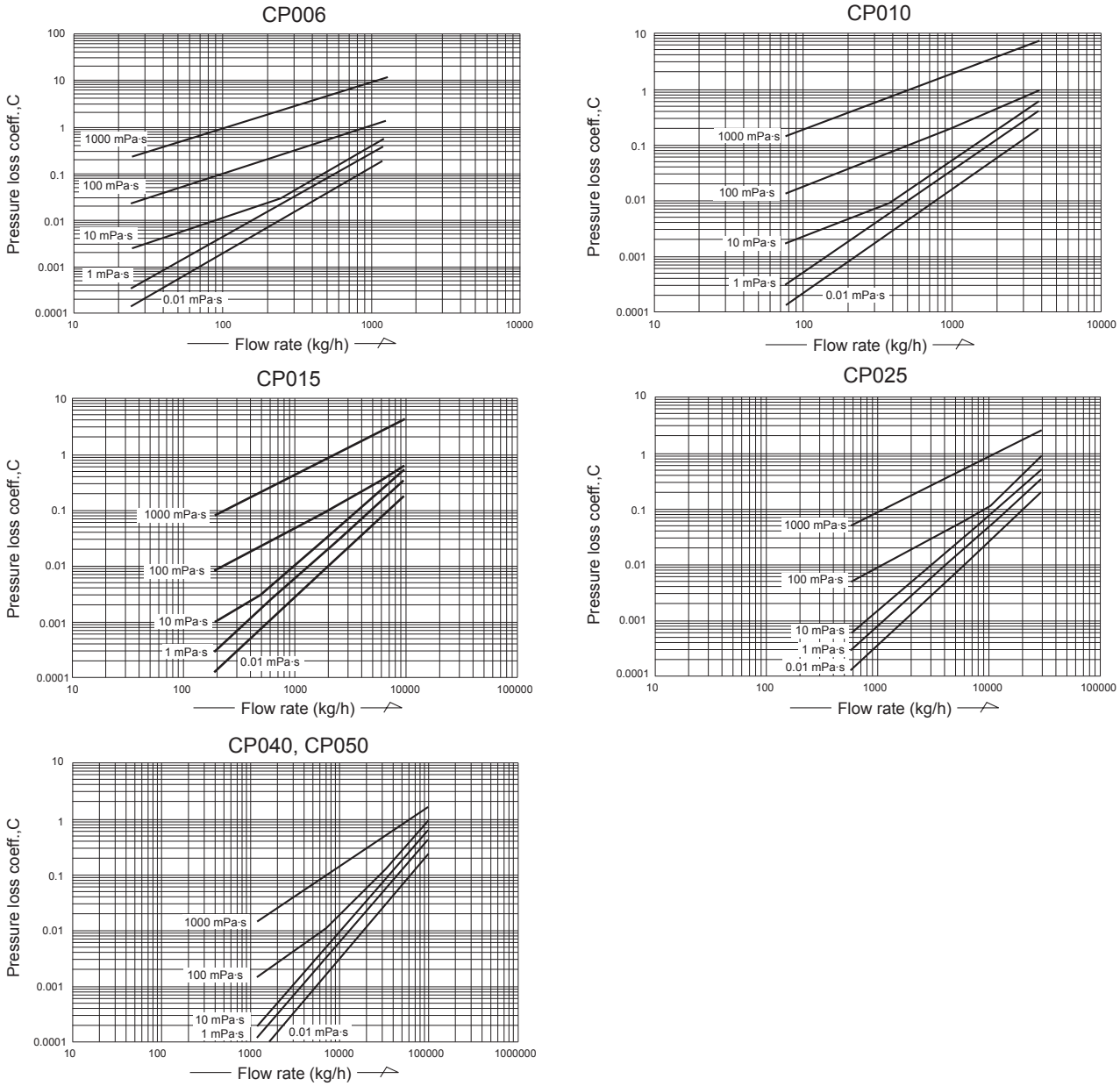
To select the mode, touch the infrared optical sensor panel through the front glass.

PERFORMANCE

Meter Error



Pressure Loss



How to Determine Pressure Loss*

Find the pressure loss factor "C" for a given parameter from its flow rate (kg/h) and viscosity (mPa·s), then divide "C" by specific gravity "d" ("1" for water) as shown in the following formula:

$$\Delta P = \frac{C}{d} \text{ (MPa)}$$

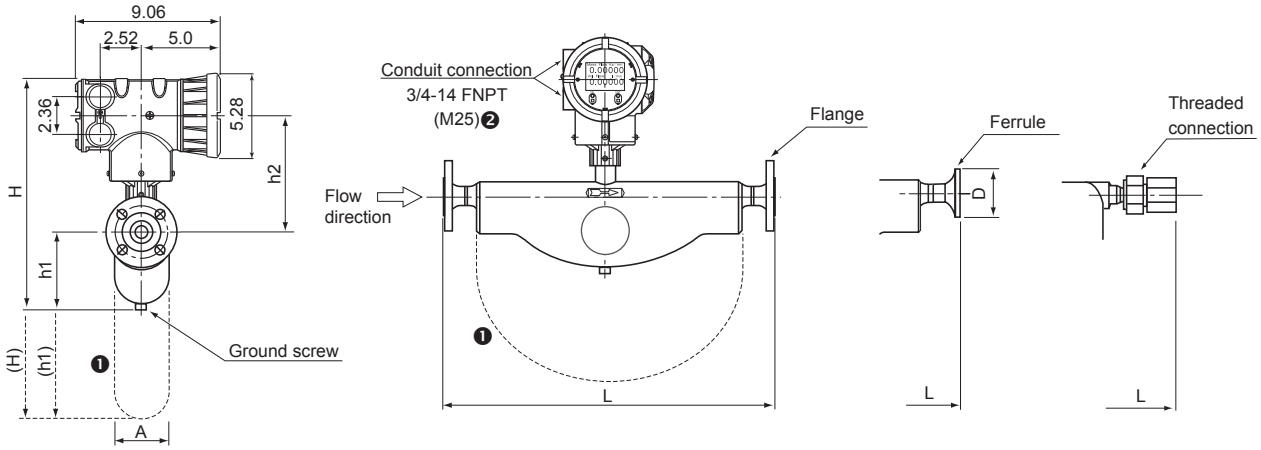
*For high viscosity liquids not shown in these graphs, calculate the pressure loss using the following formula:

$$\Delta P2 = C \times \frac{\mu 2}{\mu 1} \times \frac{1}{d}$$

where $\Delta P2$ = Pressure loss of high-viscosity liquid (MPa)
$\mu 1$ = Maximum viscosity shown in the graph (mPa·s)
$\mu 2$ = Viscosity of high-viscosity liquid (mPa·s)
d = Specific gravity of high-viscosity liquid ("1" for water)
C = Pressure loss factor

DIMENSIONS [UNITS IN INCHES]

Transmitter*: Integrally-mounted



* Pressure-tight packing assembly only provided for explosion-proof models. See Explosion-proof Specifications, page 11, for details.

Model	Nominal size (in.)	ASME			H	h1	h2	A	Approx. Weight (lb)
		150	300	600					
		L							
CP006	1/2	14.5	14.9	15.4	13.5	3.7	7.56	2.32	16.1
CP010	1/2	16	16.3	16.8	13.4	3.7	7.44	2.32	16.8
CP015	1/2	20.2	20.5	21	17	6.61	8.11	3.58	25.6
CP025	1	23.7	24.1	24.6	16.8	6.89	7.64	3.58	31.3
CP040	1-1/2	26	26.5	27.1	22.8	12.7	7.76	4.92	72.3
CP050	2	26.1	26.6	27.4	22.8	12.7	7.76	4.92	73.2

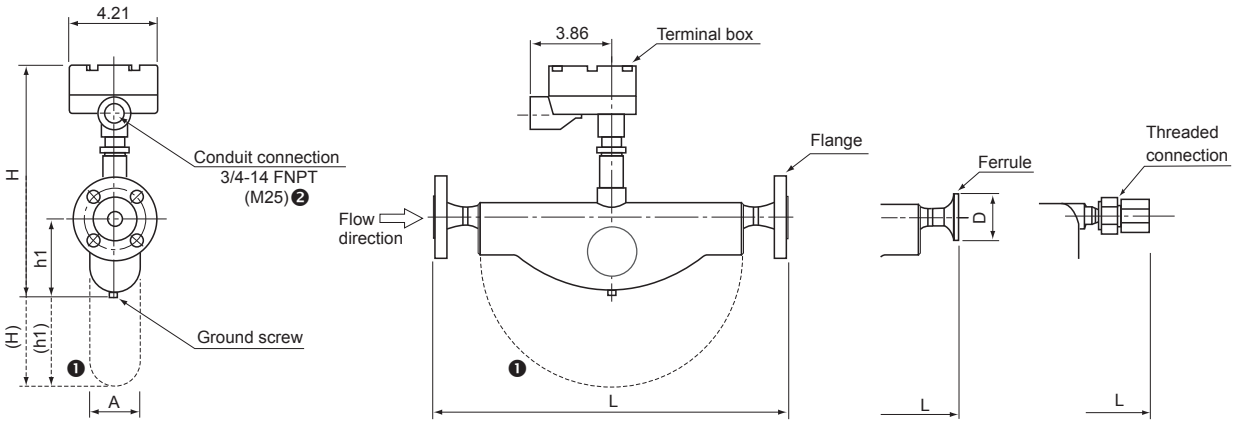
Model	Ferrule			
	Connection ❸	L	D	Approx. Weight (lb)
CP006	10A	13.1	1.34	11.5
CP010	15A	15	1.34	13.4
CP015	15A	18.7	1.34	21.8
CP025	25 (ISO), IDF 1S	22	1.99	24.5
CP040	38 (ISO), IDF 1.5S	23.9	1.99	64.6
CP050	51 (ISO), IDF 2S	23.9	2.52	64.6

Model	Threaded		
	Connection	L (in.)	Approx. Weight (lb)
CP006	1/2-14 FNPT	15.7	11.5
CP010	1/2-14 FNPT	17.2	13.4
CP015	3/4-14 FNPT	22.4	21.8

1. Dotted lines show the envelope of models CP040 and CP050.
2. Conduit connections are 3/4-14 FNPT for CSA units and M25 for ATEX units.
3. Process connection: A = mm, S (sanitary) = in.

DIMENSIONS [UNITS IN INCHES]

Transmitter: Separately-mounted



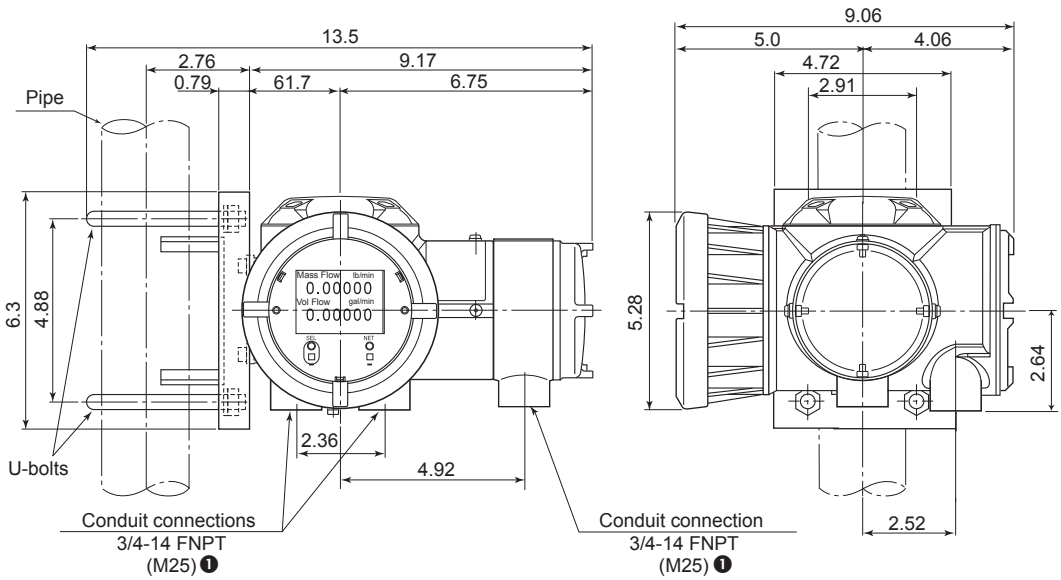
Model	Nominal size (in.)	ASME			H	h1	A	Approx. Weight (lb)
		150	300	600				
		L						
CP006	1/2	14.53	14.9	15.4	11.9	3.7	2.32	10.4
CP010	1/2	16	16.3	16.8	11.7	6.22	2.32	11
CP015	1/2	20.2	20.5	21	15.7	6.61	3.58	19.8
CP025	1	23.7	24.1	24.6	15.1	6.89	3.58	25.6
CP040	1-1/2	26	26.5	27.1	21.1	12.7	4.92	66.6
CP050	2	26.1	26.6	27.4	21.1	12.7	4.92	67.5

Model	Ferrule			
	Connection ❸	L	D	Approx. Weight (lb)
CP006	10A	13.1	1.34	5.73
CP010	15A	15	1.34	7.72
CP015	15A	18.7	1.34	16.1
CP025	25 (ISO), IDF 1S	22	1.99	18.7
CP040	38 (ISO), IDF 1.5S	23.9	1.99	58.9
CP050	51 (ISO), IDF 2S	23.9	2.52	58.9

Model	Threaded		
	Connection	L (in.)	Approx. Weight (lb)
CP006	1/2-14 FNPT	15.7	5.73
CP010	1/2-14 FNPT	17.2	7.72
CP015	3/4-14 FNPT	22.4	16.1

1. Dotted lines show the envelope of models CP040 and CP050.
2. Conduit connections are 3/4-14 FNPT for CSA units and M25 for ATEX units.
3. Process connection: A = mm, S (sanitary) = in.

Separately-mounted Transmitter

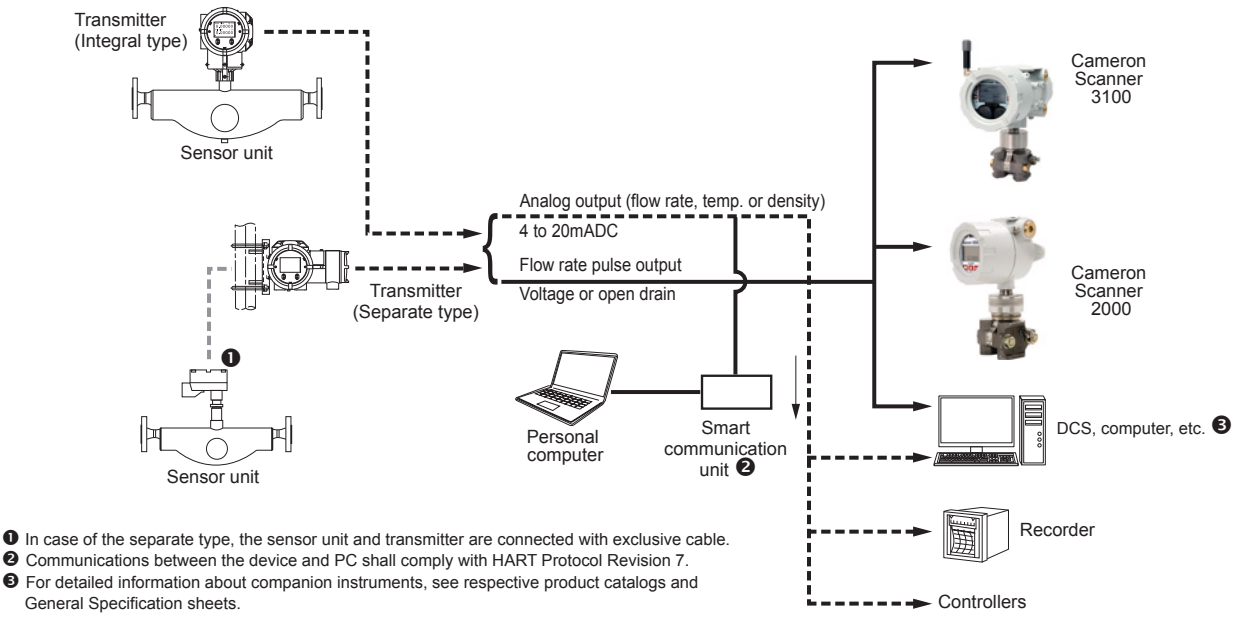


❶ Conduit connections are 3/4-14 FNPT for CSA units and M25 for ATEX units.

Pipe mounting hardware (U-bolts) are furnished as standard accessories. The pipe must be provided by the customer.

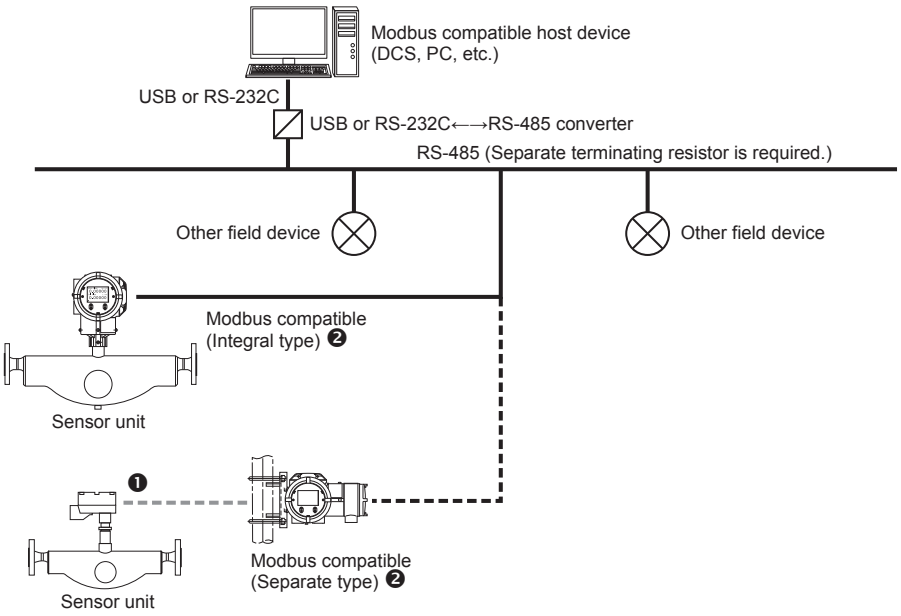
REMOTE MEASURING SYSTEM

HART Protocol



❶ In case of the separate type, the sensor unit and transmitter are connected with exclusive cable.
❷ Communications between the device and PC shall comply with HART Protocol Revision 7.
❸ For detailed information about companion instruments, see respective product catalogs and General Specification sheets.

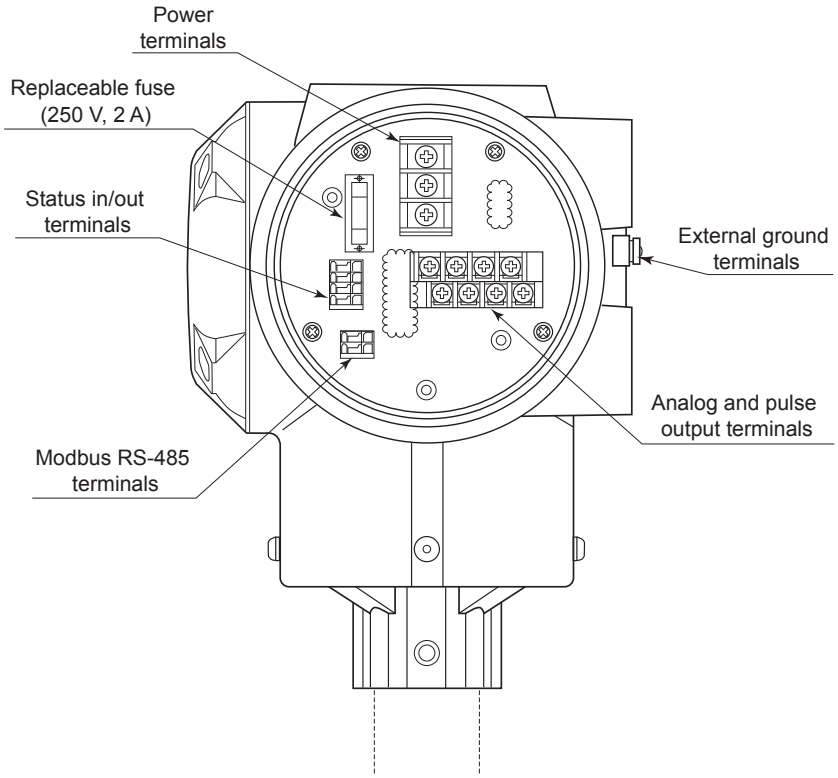
Modbus Protocol



❶ Sensor unit and separate type transmitter are connected with the exclusive interconnect cable.
❷ The transmitter requires a separate power source (AC or DC) for its main power supply.

WIRING DIAGRAMS

Transmitter Power and Input/Output Signal Wiring

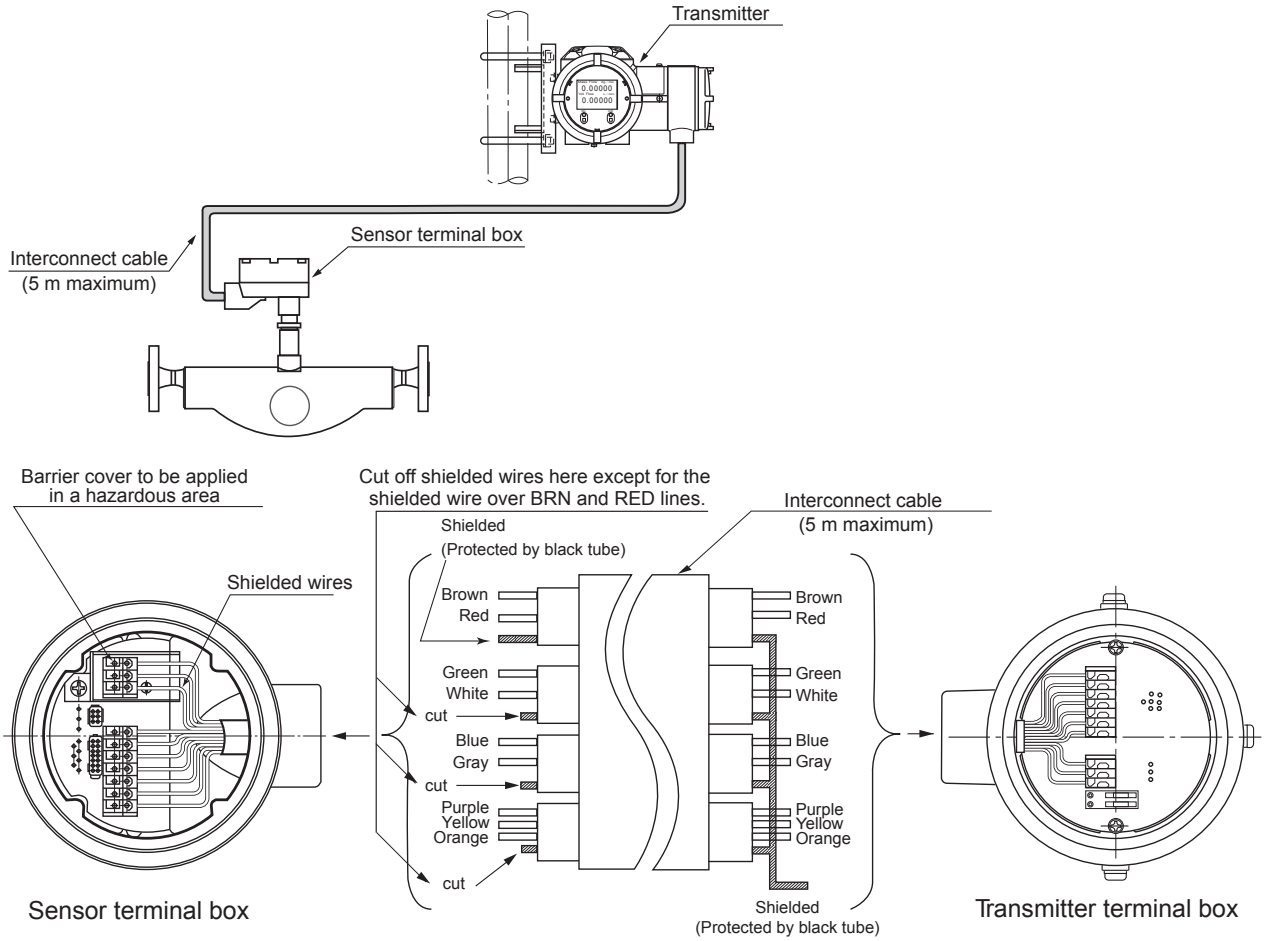


Terminal Identification and Description

Item	Label	Description	Remarks
Signal	A1 (+)	Analog Output 1 (4 to 20 mA)	Maximum load resistance is 600Ω for Analog Outputs 1 and 2.
	A1 (–)		
	A2 (+)	Analog Output 2 (4 to 20 mA)	
	A2 (–)		
	P1 (+)	Pulse Output 1 (voltage/open drain)	Maximum pulse output (voltage) transmission length: • 10 m @ 10 kHz • 100 m @ 1 kHz • 1 km @ 100 Hz Minimum conductor size: 18 AWG
	P1 (–)		
	P2 (+)	Pulse Output 2 (voltage/open drain)	
	P2 (–)		
	SI (+)	Status Input (contact)	—
	SI (–)		
	SO (+)	Status Output (open drain)	
	SO (–)		
	I/O (+)	Expanded Input/Output (Modbus communication, etc.)	For Modbus communications: • Maximum transmission length: 1200 m • Minimum conductor size: 18 AWG
	I/O (–)		
Power	L (+)	Power (with DC power: +)	—
	GND	Earth Ground	
	N (–)	Power (with DC power: –)	

WIRING DIAGRAMS

Wiring Between Sensor Unit and Separately-mounted Transmitter



Use a dedicated interconnect cable and prepare shielded wire as follows.

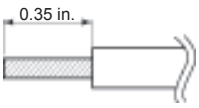
Transmitter end

1. Bundle shielded wires colored in brown/red, green/white, blue/grey and purple/yellow/orange and cover the wires with a black tube.
2. Connect only one wire to the terminal box (black), taking care to avoid potential contact with the housing or conductive parts.

Sensor end

1. Cover the brown/red shielded wire with a black tube and connect it to the terminal box, taking care to avoid potential contact with the housing or conductive parts.
2. Clip all shielded wires except brown/red as shown in the above figure.

Recommended cable end treatment

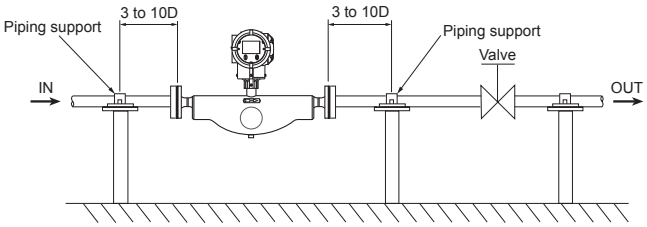


Use of a crimp pin terminal is not necessary.

INSTALLATION

Typical Installation

3. Avoid pipeline stresses on the meter.
4. The meter should be supported near each process connection, as shown in the illustration on the right.
5. Avoid supporting the meter body directly.
6. The pipeline should be arranged such that the meter is constantly filled with the process fluid. However, avoid installing it in a low point in the piping where slurries may build up.
7. Provide a valve downstream of the meter to allow zeroing by obtaining a true zero flow. We recommend providing another valve upstream of the meter for servicing or maintenance.



Precautions at Installation

1. Locate the meter at least 3.28 feet from large transformers, motors, or other sources of electromagnetic induction. Also avoid installation near sources of excessive vibration, such as motors and pumps.
2. In case of measurement of a process fluid which requires heat retention, heat trace may be applied directly to the sensor body. Heat trace should be held below 257˚F.
3. The sensor unit is of gas-tight construction. To prevent dew condensation inside in a low-temperature application, it is filled with argon gas. To avoid damaging the sensor, do not drop the sensor unit or otherwise subject it to impact shocks.
4. In a horizontal run, install the sensor unit with the transmitter up, as shown in the typical installation figure.
5. A control valve should be located downstream of the meter. In an arrangement where cavitation may possibly take place, locate it at least 16.4 feet away.

Cavitation Prevention

Cavitation can cause a loss of meter accuracy in measurement. To prevent cavitation, maintain line pressure upstream and downstream of the meter. Avoid opening the line to the atmosphere immediately downstream of the meter. Care must be taken particularly with high vapor pressure liquids. It is recommended that back pressure in the meter (downstream pressure) be kept above the value calculated by the formula below:

$Pd = 2\Delta P + 1.25Pv$

Where Pd = Downstream pressure (psia)

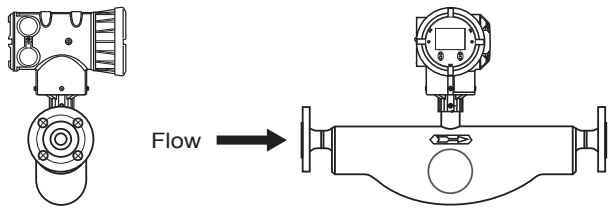
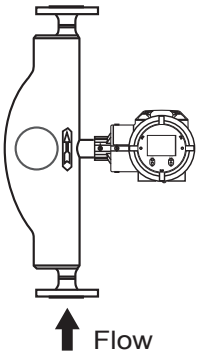
ΔP = Pressure loss across the meter (psig)

Pv = Steam pressure of the process fluid at measurement (psia)

Calculation based on API Manual of Petroleum Measurement, Chapter 5.6, Section 6.3.2.

Physical Orientation

The unit may be installed in a horizontal or vertical line. Specify physical orientation when ordering.

Installation Orientation	Horizontal Piping	Vertical Piping
		

EXPLOSION-PROOF SPECIFICATIONS

CSA

Integral type

- Transmitter ratings: Class I, Zone 1, Ex d ib IIB T4 Gb
  Class I, Zone 1, AEx d ib IIB T4 Gb
- Transmitter and sensor ambient temperature: –40°F to 131°F
- Fluid temperature: –40°F to 158°F (CP015)
  –40°F to 176°F (Other than CP015)
- Sensor ratings: Class I, Zone 1, Ex ib IIB T4 Gb
  Class I, Zone 1, AEx ib IIB T4 Gb
- Sensor to be connected: CP006 through CP050
- Communication: HART, Modbus

Separate type

- Transmitter ratings: Class I, Zone 1, Ex d [ib] IIB T6 Gb
  Class I, Zone 1, AEx d [ib] IIB T6 Gb
- Transmitter ambient temperature: –40°F to 131°F
- Fluid temperature, Temp. Class 3: −40˚F to 257˚F (All models)
- Fluid temperature, Temp. Class 4: –40°F to 158°F (CP015)
  –40°F to 176°F (Other than CP015)
- Sensor ratings: Class I, Zone 1, Ex ib IIB T3, T4 Gb
  Class I, Zone 1, AEx ib IIB T3, T4 Gb
- Sensor to be connected: CP006 to CP050
- Sensor ambient temperature: −40˚F to 140˚F
- Communication: HART, Modbus

ATEX/IECEx

Integral type

- Transmitter ratings: II 2G Ex d ib IIB T4 Gb
- Transmitter and sensor ambient temperature: –40°F to 131°F
- Fluid temperature: –40°F to 158°F (CP015)
  –40°F to 176°F (Other than CP015)
- Sensor ratings: II 2G Ex ib IIB T4 Gb
- Sensor to be connected: CP006 to CP050
- Communication: HART, Modbus

Separate type

- Transmitter ratings: II 2G Ex d [ib] IIC T6 Gb
- Transmitter ambient temperature.: –40°F to 131°F
- Fluid temperature, Temp. Class 3: −40˚F to 257˚F (All models)
- Fluid temperature, Temp. Class 4: –40°F to 158°F (CP015)
  –40°F to 176°F (Other than CP015)
- Sensor ratings: II 2G Ex ib IIB T3, T4
- Sensor to be connected: CP006 to CP050
- Sensor ambient temperature: −40˚F to 140˚F
- Communication: HART, Modbus

This page is intentionally blank.

Appendix A: Metric Units

GENERAL PERFORMANCE

Mass Flow Rate

Item		Description					
Model		CP006	CP010	CP015	CP025	CP040	CP050
Flow rate	Guaranteed minimum rate (kg/h)	24	76.8	192	576	1920	1920
	Minimum setting rate (kg/h)	60	192	480	1440	4800	4800
	Maximum service rate (kg/h)	600	1920	4800	14400	48000	48000
	Maximum allowable rate (kg/h)	1200	3840	9600	28800	96000	96000
	Uncertainty	±0.2% of reading (± zero stability)					
	Repeatability	±0.1% of reading (± 1/2 of zero stability)					
	Zero stability (kg/h)	0.09	0.288	0.72	2.16	7.2	
Density (Liquid)	Metering range	0.3 to 2 g/mL					
	Uncertainty	±0.003 g/mL					
Analog output uncertainty		±0.1% of full scale					

* Zero stability and flow rate during the test should read in the same measurement unit.

$$ZS = \frac{\text{Zero stability}}{\text{Current flow rate}} \times 100\%$$

Volumetric Flow Rate

Item	Description					
Model	CP006	CP010	CP015	CP025	CP040	CP050
Guaranteed minimum rate (ltr/min)	0.400	1.28	3.20	9.61	32.0	32.0
Minimum setting rate (ltr/min)	1.00	3.20	8.00	24.0	80.1	80.1
Maximum service rate (ltr/min)	10.0	32.0	80.0	240	801	801
Maximum allowable rate (ltr/min)	20.0	64.1	160	480	1601	1601

GENERAL SPECIFICATIONS

Sensor Unit

Item		Description					
Model		CP006	CP010	CP015	CP025	CP040	CP050
Nominal size (mm)		10	15	15	25	40	50
Materials	Wetted parts	SUS316L					
	Housing	SUS304					
Process connection		ASME 150, 300, 600 RF, IDF Ferrule; Threaded (CP006, CP010 and CP015 only)					
Applicable fluid		Liquid					
Density range		0.3 to 2.0 g/mL					
Temperature range ❶		–40°C to 125°C ❷					
Maximum operating pressure		Dependent on process connection					
Flow direction		Bidirectional					
Explosion-proof configuration		CSA, ATEX, IECEx (Refer to Explosion-proof Specifications, page A-10 for details.)					
Dust-tight, waterproof configuration		IP66/67					

1. Refer to Explosion-proof Specifications, page A-10. In case of non-explosion-proof model, up to 125˚C is permitted. However, the product must be used within the maximum ambient temperature of 45˚C.
2. Cleaning in place (CIP) is permitted within the temperature range.

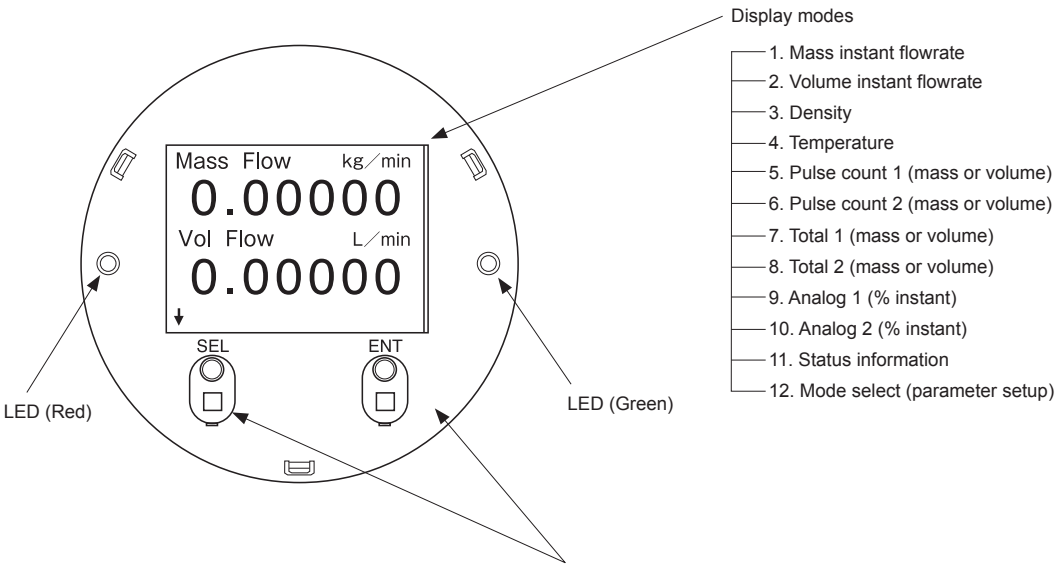
GENERAL SPECIFICATIONS

Transmitter

Item	Description	
Model	PA0K	
Power supply	85 to 264 VAC 50/60 Hz or 20 to 30 VDC (Safety rated 100 to 240 VAC 50/60 Hz)	
Power consumption	Maximum 15 W	
Ambient temperature	−40°C to 55°C ❶	
Transmission length (separate type)	Maximum 5 m (interconnect cable used) ❷	
Applicable EU directive	EMC Directive: 2004/108/EC, ATEX Directive: 94/9/EC	
Applicable EN standards	EMC: EN55011: 1998/A1, 1999/A2: 2002, Group 1, Class B; EN61000-6-2: 2001/EN061326-1: 2006 ATEX: EN60079-0: 2012; EN60079-1: 2007; EN60079-11: 2012 IECEx : IEC60079-0: 2011; IEC60079-1: 2007-04; IEC60079-11: 2011	
Explosion-proof configuration	CSA, ATEX, IECEx (Refer to Explosion-proof Specifications, page A-10 for details.)	
Dust-tight, waterproof configuration	IP66/67	
Transmitter configuration	Integral or separately-mounted	
Finish	Paint type: Baked enamel; Paint color: Light gray (RAL7035)	
Display	LCD display provided (128×64 dots), backlight (white, orange); Two infrared sensors; Two LEDs (green and red)	
Weight	Integrally-mounted model: approx. 3.6 kg; Separately-mounted model: approx. 5.0 kg	
Communication interface ❺	HART	Protocol Version 7, Hybrid Bell 202
	Modbus	RS-485 Modbus Protocol: Baud rate–9600 bps, 19200 bps, 38400 bps RTU or ASCII response time: 25 to 50 ms
Damping (default)	Flow rate, 0.8 sec.; Density, 4 sec.; Temperature, 2.5 sec.	
Low flow cutoff (default)	Under 1.0% of maximum service flow rate	
Pulse output	Open drain (equivalent to open collector): Minimum 10V to 30V, 50 mADC, ON resistance ≥0.6Ω OR Voltage: 1.5V maximum (low level), 13V minimum (high level), output impedance: 2.2 kΩ; Setting range: 0.1 to 10000 Hz (Maximum 11000 Hz)	
Analog output	Select two outputs ❸	4 to 20 mADC (maximum load 600Ω) from instant flowrate (mass or volume) temperature, and density.
Status output	Open drain (equivalent to open collector): 30V maximum, 50 mADC, ON resistance ≥0.6Ω; Select one output from error ❹, flow direction, or high/low alarm (default is error)	
Status input	Contact-closure (Form "a" contact) 200Ω maximum (short), 100 kΩ minimum (open); Select one output from remote zero, total reset, 0% signal lock, or function off (default is function off)	

1. Below –20°C, the display loses its visibility due to weakened contrast. Both the display and infrared sensor may exhibit slow responses below –20°C.
2. If signal transmission length exceeds the maximum length, consult the factory.
3. HART communications are available only across the Analog Output 1.
4. The status output can also be configured to activate when meter zeroing is in process.
5. Electrical noise filtering components are installed in connections between power source, output, communications, and chassis.

DISPLAY

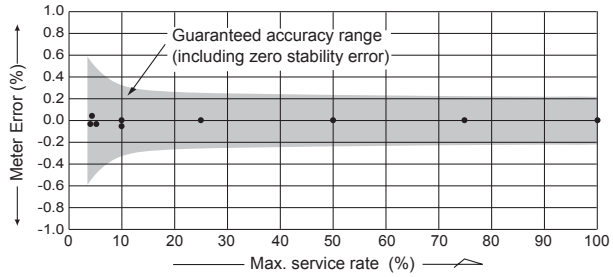


- LCD backlight available in white and orange. Color changes according to the status of flow meter.
- In most cases, the backlight shuts off automatically if the optical sensor does not respond within a user-defined duration.

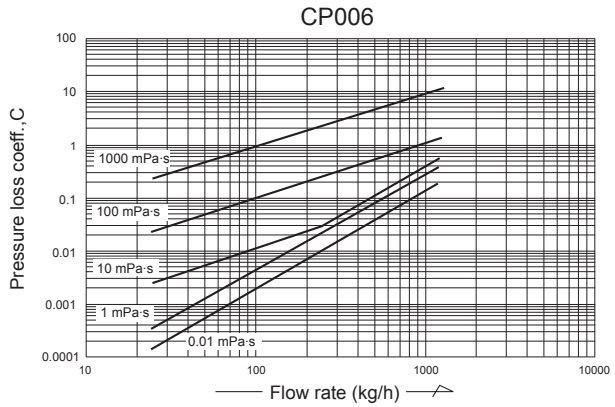
To select the mode, touch the infrared optical sensor panel through the front glass.

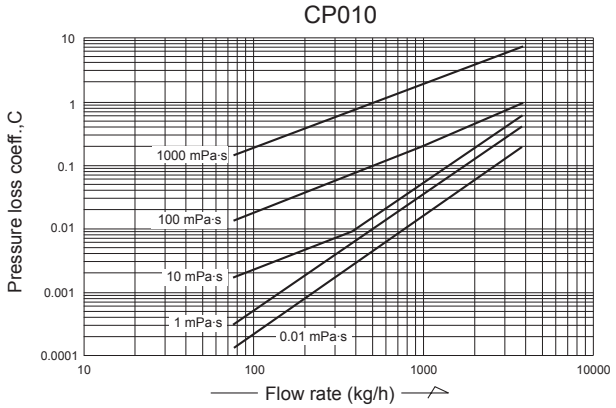
PERFORMANCE

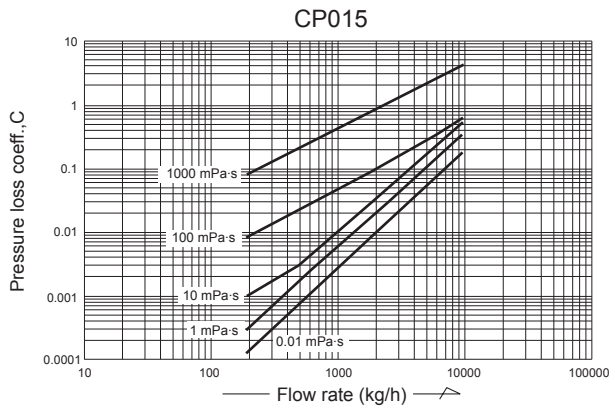
Meter Error

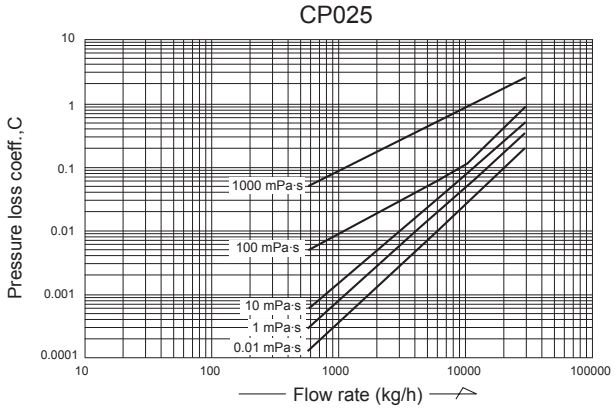


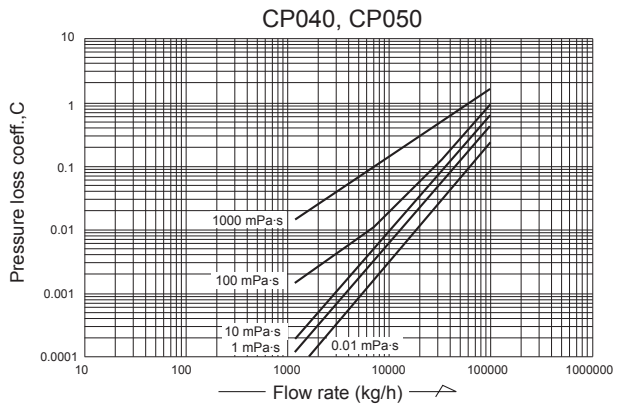
Pressure Loss











How to Determine Pressure Loss*

Find the pressure loss factor "C" for a given parameter from its flow rate (kg/h) and viscosity (mPa·s), then divide "C" by specific gravity "d" ("1" for water) as shown in the following formula:

$$\Delta P = \frac{C}{d} \text{ (MPa)}$$

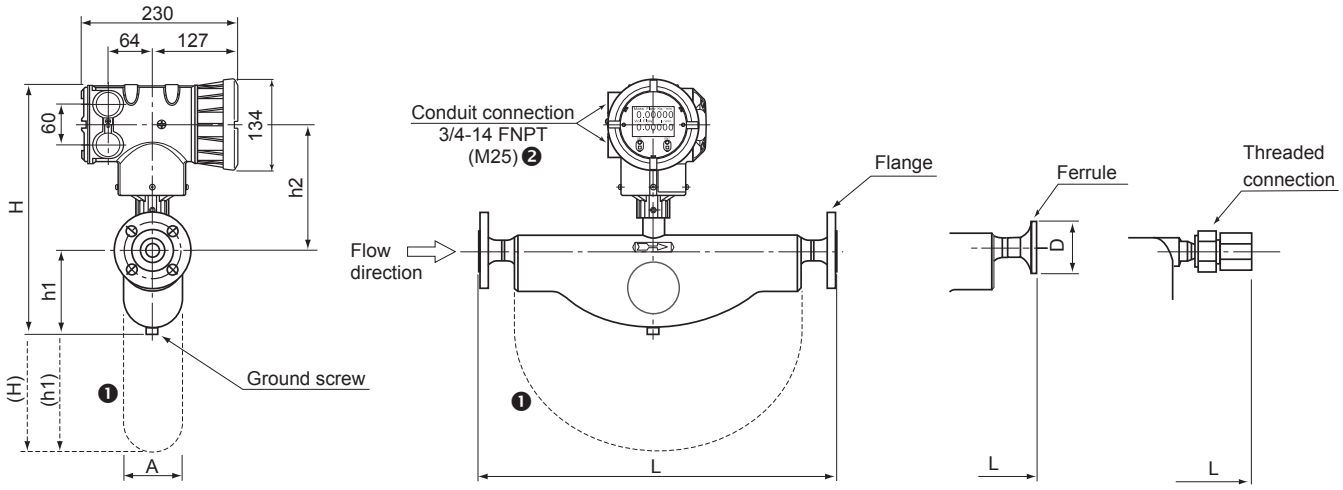
*For high viscosity liquids not shown in these graphs, calculate the pressure loss using the following formula:

$$\Delta P2 = C \times \frac{\mu 2}{\mu 1} \times \frac{1}{d}$$

where $\Delta P2$ = Pressure loss of high-viscosity liquid (MPa)
$\mu 1$ = Maximum viscosity shown in the graph (mPa·s)
$\mu 2$ = Viscosity of high-viscosity liquid (mPa·s)
d = Specific gravity of high-viscosity liquid ("1" for water)
C = Pressure loss factor

DIMENSIONS [UNITS IN MILLIMETERS]

Transmitter*: Integrally-mounted



*Pressure-tight packing assembly only provided for explosion-proof models. See Explosion-proof Specifications, page A-10, for details.

Model	Nominal size (mm)	ASME			H	h1	h2	A	Approx. Weight (kg)
		150	300	600					
		L							
CP006	10	369	378	390.5	344	94	192	59	7.3
CP010	15	406	415	427.5	341	94	189	59	7.6
CP015	15	512	521	533.5	432	168	206	91	11.6
CP025	25	601	613	626	426	175	194	91	14.2
CP040	40	660	673	688.5	578	323	197	125	32.8
CP050	50	663	676	695	578	323	197	125	33.2

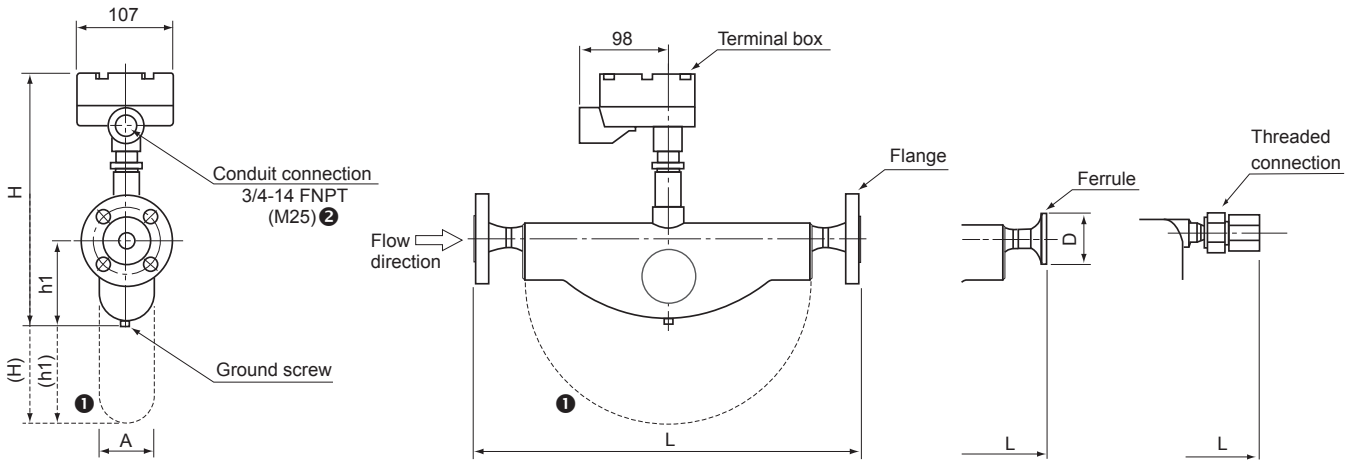
Model	Ferrule			
	Connection ❸	L	D	Approx. Weight (kg)
CP006	10A	333	34	5.2
CP010	15A	380	34	6.1
CP015	15A	476	34	9.9
CP025	25 (ISO), IDF 1S	559	50.5	11.1
CP040	38 (ISO), IDF 1.5S	606	50.5	29.3
CP050	51 (ISO), IDF 2S		64	

	Threaded		
Model	Threaded Connection	L (mm)	Approx. Weight (kg)
CP006	1/2-14 FNPT	399	5.2
CP010	1/2-14 FNPT	435.5	6.1
CP015	3/4-14 FNPT	588	9.9

1. Dotted lines show the envelope of models CP040 and CP050.
2. Conduit connections are 3/4-14 FNPT for CSA units and M25 for ATEX units.
3. Process connection: A = mm, S (sanitary) = in.

DIMENSIONS [UNITS IN MILLIMETERS]

Transmitter: Separately-mounted



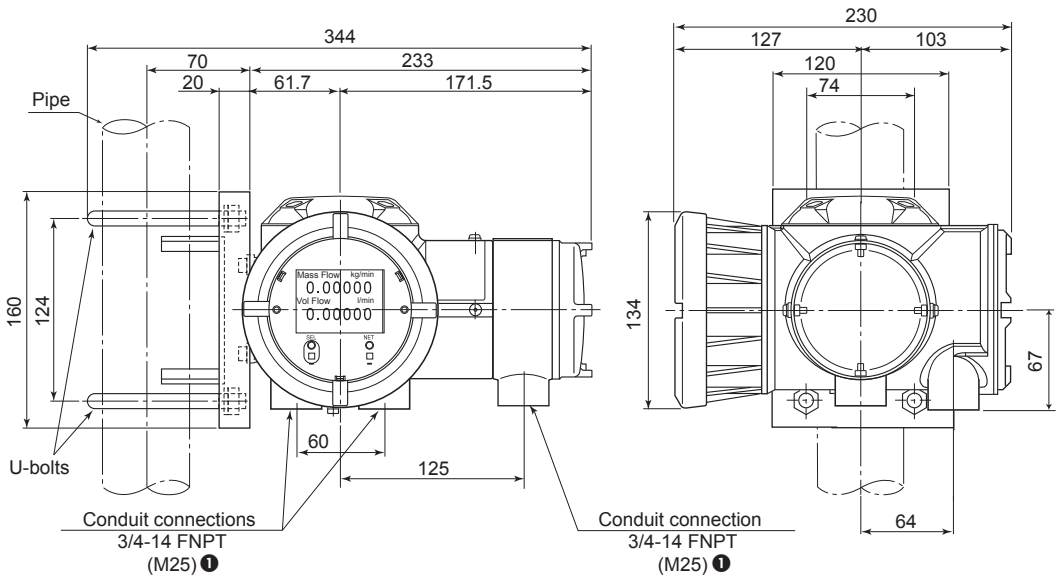
Model	Nominal size (mm)	ASME			H	h1	A	Approx. Weight (kg)
		150	300	600				
		L						
CP006	10	369	378	390.5	301	94	59	4.7
CP010	15	406	415	427.5	298	158	59	5.0
CP015	15	512	521	533.5	389	168	91	9.0
CP025	25	601	613	626	384	175	91	11.6
CP040	40	660	673	688.5	535	323	125	30.2
CP050	50	663	676	695	535	323	125	30.6

Model	Ferrule			
	Connection ❸	L	D	Approx. Weight (kg)
CP006	10A	333	34	2.6
CP010	15A	380	34	3.5
CP015	15A	476	34	7.3
CP025	25 (ISO), IDF 1S	559	50.5	8.5
CP040	38 (ISO), IDF 1.5S	606	50.5	26.7
CP050	51 (ISO), IDF 2S	606	64	26.7

Model	Threaded		
	Threaded Connection	L (mm)	Approx. Weight (kg)
CP006	1/2-14 FNPT	399	2.6
CP010	1/2-14 FNPT	435.5	3.5
CP015	3/4-14 FNPT	588	7.3

1. Dotted lines show the envelope of models CP040 and CP050.
2. Conduit connections are 3/4-14 FNPT for CSA units and M25 for ATEX units.
3. Process connection: A = mm, S (sanitary) = in.

Separately-mounted Transmitter

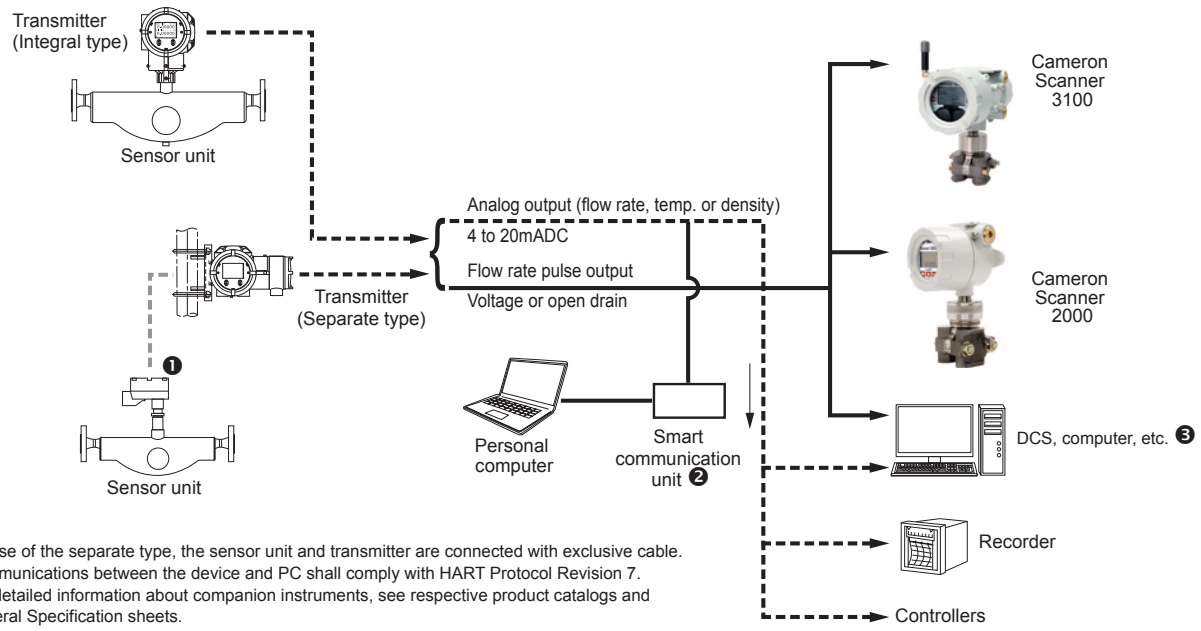


❶ Conduit connections are 3/4-14 FNPT for CSA units and M25 for ATEX units.

Pipe mounting hardware (U-bolts) are furnished as standard accessories. The pipe must be provided by the customer.

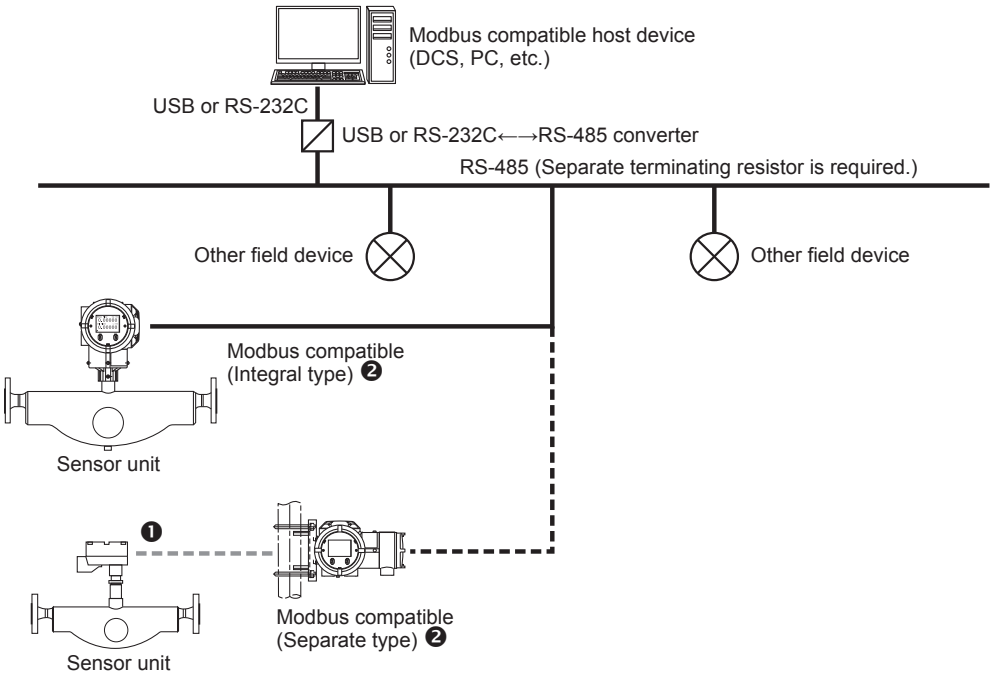
REMOTE MEASURING SYSTEM

HART Protocol



❶ In case of the separate type, the sensor unit and transmitter are connected with exclusive cable.
❷ Communications between the device and PC shall comply with HART Protocol Revision 7.
❸ For detailed information about companion instruments, see respective product catalogs and General Specification sheets.

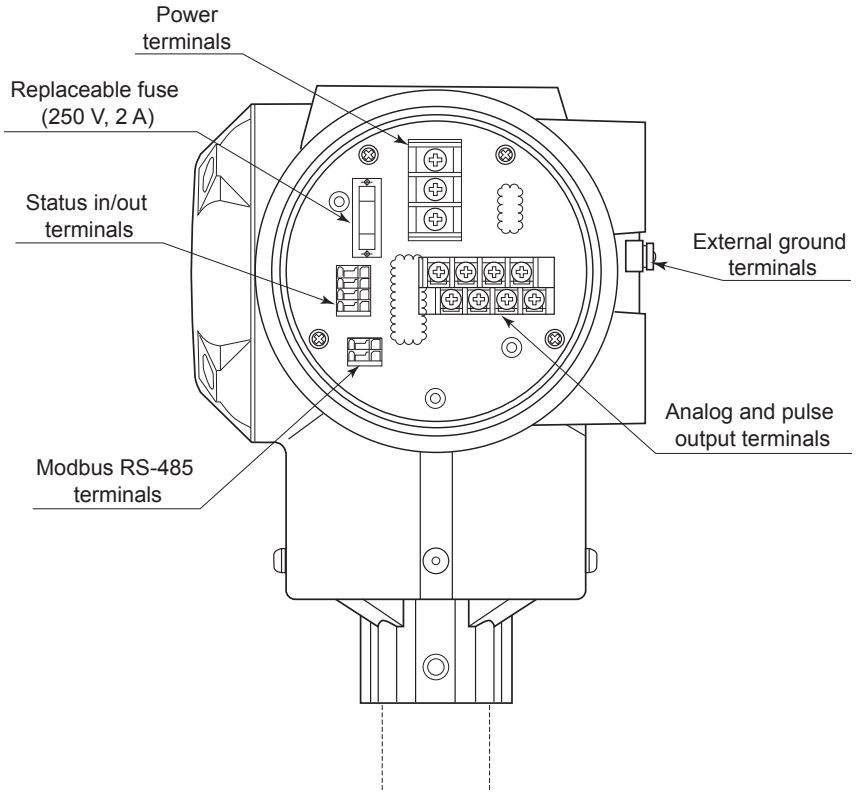
Modbus Protocol



❶ Sensor unit and separate type transmitter are connected with the exclusive interconnect cable.
❷ The transmitter requires a separate power source (AC or DC) for its main power supply.

WIRING DIAGRAMS

Transmitter Power and Input/Output Signal Wiring

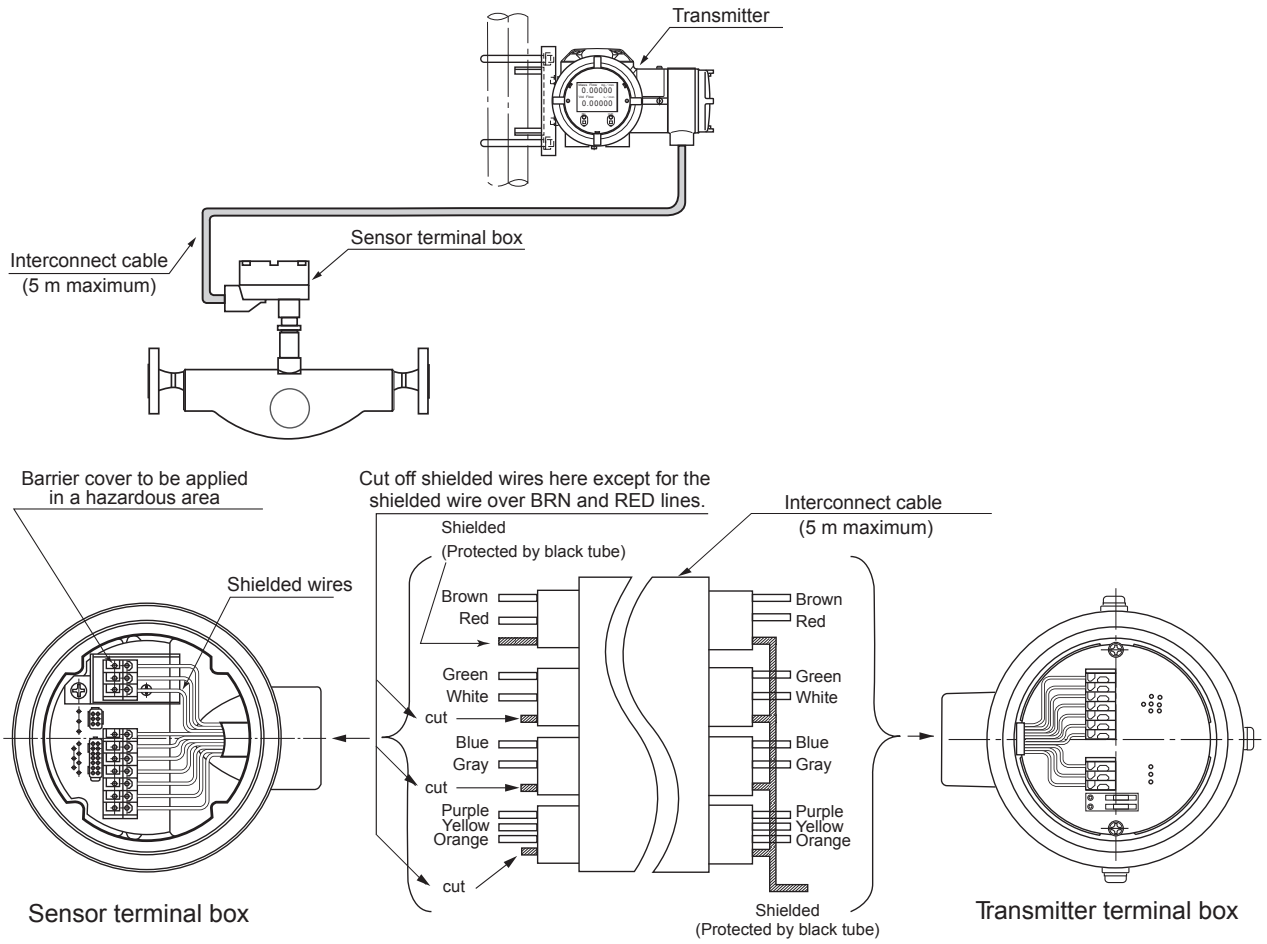


Terminal Identification and Description

Item	Label	Description	Remarks
Signal	A1 (+)	Analog Output 1 (4 to 20 mA)	Maximum load resistance is 600Ω for Analog Outputs 1 and 2.
	A1 (–)		
	A2 (+)	Analog Output 2 (4 to 20 mA)	
	A2 (–)		
	P1 (+)	Pulse Output 1 (voltage/open drain)	Maximum pulse output (voltage) transmission length: • 10 m @ 10 kHz • 100 m @ 1 kHz • 1 km @ 100 Hz Minimum conductor size: 0.75 mm^2
	P1 (–)		
	P2 (+)	Pulse Output 2 (voltage/open drain)	
	P2 (–)		
	SI (+)	Status Input (contact)	—
	SI (–)		
	SO (+)	Status Output (open drain)	
	SO (–)		
	I/O (+)	Expanded Input/Output (Modbus communication, etc.)	For Modbus communications: • Maximum transmission length: 1200 m • Minimum conductor size: 0.75 mm^2
	I/O (–)		
Power	L (+)	Power (with DC power: +)	—
	GND	Earth Ground	
	N (–)	Power (with DC power: –)	

WIRING DIAGRAMS

Wiring Between Sensor Unit and Separately-mounted Transmitter ❶



1. Use interconnect cable.

Use dedicated interconnect cable and prepare shielded wire as follows.

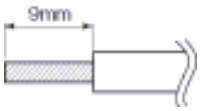
Transmitter end

1. Bundle shielded wires colored in brown/red, green/white, blue/grey and purple/yellow/orange and cover the wires with a black tube.
2. Connect only one wire to the terminal box (black), taking care to avoid potential contact with the housing or conductive parts.

Sensor end

1. Cover the brown/red shielded wire with a black tube and connect it to the terminal box, taking care to avoid potential contact with the housing or conductive parts.
2. Clip all shielded wires except brown/red as shown in the above figure.

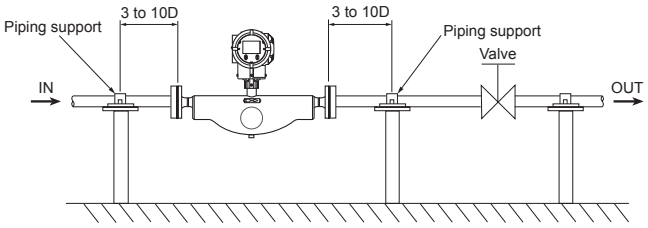
Recommended cable end treatment



Use of a crimp pin terminal is not necessary.

INSTALLATION

Typical Installation



1. Avoid pipeline stresses on the meter.
2. The meter should be supported near each process connection, as shown in the illustration on the right.
3. Avoid supporting the meter body directly.
4. The pipeline should be arranged such that the meter is constantly filled with the process fluid. However, avoid installing it in a low point in the piping where slurries may build up.
5. Provide a valve downstream of the meter to allow zeroing by obtaining a true zero flow. We recommend providing another valve upstream of the meter for servicing or maintenance.

Precautions at Installation

1. Locate the meter at least one meter from large transformers, motors, or other sources of electromagnetic induction. Also avoid installation near sources of excessive vibration, such as motors and pumps.
2. In case of measurement of a process fluid which requires heat retention, heat trace may be applied directly to the sensor body. Heat trace should be held below 125˚C.
3. The sensor unit is of gas-tight construction. To prevent dew condensation inside in a low temperature application, it is filled with argon gas. To avoid damaging the sensor, do not drop the sensor unit or otherwise subject it to impact shocks.
4. In a horizontal run, install the sensor unit with the transmitter up as shown in the typical installation figure.
5. A control valve should be located downstream of the meter. In an arrangement where cavitation may possibly take place, locate it at least 5 meters away.

Cavitation Prevention

Cavitation can cause a loss of meter accuracy in measurement. Maintain line pressure that will not cause cavitation upstream and downstream of the meter for this reason. Avoid opening the line to the atmosphere immediately downstream of the meter.

$Pd = 2\Delta P + 1.25Pv$

Where Pd = Downstream pressure (psia)

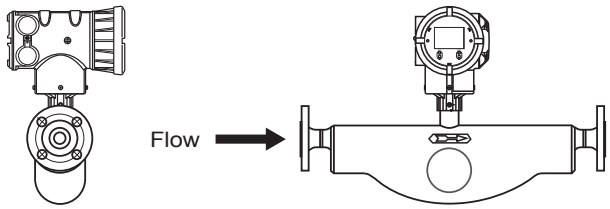
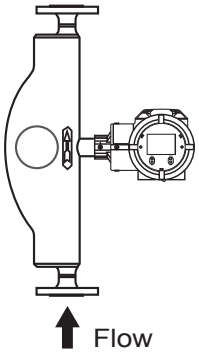
ΔP = Pressure loss across the meter (psig)

Pv = Steam pressure of the process fluid at measurement (psia)

Calculation based on API Manual of Petroleum Measurement Standards, Chapter 5.6, Section 6.3.2.

Physical Orientation

The unit may be installed in a horizontal or vertical line. Specify physical orientation when ordering.

Installation Orientation	Horizontal Piping	Vertical Piping
		

EXPLOSION-PROOF SPECIFICATIONS

CSA

Integral type

- Transmitter ratings: Class I, Zone 1, Ex d ib IIB T4 Gb
  Class I, Zone 1, AEx d ib IIB T4 Gb
- Transmitter and sensor ambient temperature: –40°C to 55°C
- Fluid temperature: –40°C to 70°C (CP015)
  –40°C to 80°C (Other than CP015)
- Sensor ratings: Class I, Zone 1, Ex ib IIB T4 Gb
  Class I, Zone 1, AEx ib IIB T4 Gb
- Sensor to be connected: CP006 through CP050
- Communication: HART, Modbus

Separate type

- Transmitter ratings: Class I, Zone 1, Ex d [ib] IIB T6 Gb
  Class I, Zone 1, AEx d [ib] IIB T6 Gb
- Transmitter ambient temperature: –40°C to 55°C
- Fluid temperature, Temp. Class 3: −40˚C to 125˚C (All models)
- Fluid temperature, Temp. Class 4: −40˚C to 70˚C: CP015
  –40˚C to 80˚C: Other than CP015
- Sensor ratings: Class I, Zone 1, Ex ib IIB T3, T4 Gb
  Class I, Zone 1, AEx ib IIB T3, T4 Gb
- Sensor to be connected: CP006 to CP050
- Sensor ambient temperature: −40˚C to 60°C
- Communication: HART, Modbus

ATEX/IECEx

Integral type

- Transmitter ratings: II 2G Ex d ib IIB T4 Gb
- Transmitter and sensor ambient temperature: –40°C to 55°C
- Fluid temperature: –40°C to 70°C (CP015)
  –40°C to 80°C (Other than CP015)
- Sensor ratings: II 2G Ex ib IIB T4 Gb
- Sensor to be connected: CP006 to CP050
- Communication: HART, Modbus

Separate type

- Transmitter ratings: II 2G Ex d [ib] IIC T6 Gb
- Transmitter ambient temperature.: –40˚C to 55°C
- Fluid temperature, Temp. Class 3: –40˚C to 125˚C (All models)
- Fluid temperature, Temp. Class 4: −40˚C to 70˚C: CP015
  −40˚C to 80˚C: Other than CP015
- Sensor ratings: II 2G Ex ib IIB T3, T4
- Sensor to be connected: CP006 to CP050
- Sensor ambient temperature: −40˚C to 60°C
- Communication: HART, Modbus

Appendix B: Product Codes and Inquiry Form

SENSOR PRODUCT CODES

Item	Product Code 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Description	
Model	C	P																	CamCor PRO Series	
Connection nominal size (mm)			0	0	6														6mm Sensor / 1/2" Flange	
			0	1	0														10mm Sensor / 1/2" Flange	
			0	1	5														15mm Sensor / 1/2" Flange	
			0	2	5														25mm Sensor / 1" Flange	
			0	4	0														40mm Sensor / 1.5" Flange	
			0	5	0														50mm Sensor / 2" Flange	
Fluid category						L													Liquid service	
Temperature category ❶							1												Standard - below 257˚F (125°C)	
Pressure category								1											Standard	
Major parts material									S										SUS316L	
Process connection										A									Threaded (CP006, CP010 and CP015 only)	
										B									Ferrule	
										H									ANSI 150	
										J									ANSI 300	
										K									ANSI 600	
										Z									Special	
Transmitter mounting ❷❸											1								Integrally-mounted	
											2								Separately-mounted	
Power source												1							20 to 30 VDC	
												2							85 to 264 VAC (Safety rated 100 to 240 VAC)	
Analog output ❹❺													A						Output 1: Mass Flow	Output 2: Mass Flow
													B						Output 1: Mass Flow	Output 2: Density
													C						Output 1: Mass Flow	Output 2: Temperature
													D						Output 1: Mass Flow	Output 2: Volume Flow (Live Density)
													E						Output 1: Mass Flow	Output 2: Volume Flow (Fixed Density)
													F						Output 1: Density	Output 2: Temperature
													G						Output 1: Volume Flow (Live Density)	Output 2: Volume Flow (Live Density)
													H						Output 1: Volume Flow (Fixed Density)	Output 2: Density
													J						Output 1: Volume Flow (Live Density)	Output 2: Temperature
													K						Output 1: Volume Flow (Fixed Density)	Output 2: Temperature
Pulse output ❹❺														A					Output 1: Mass Flow	None
														B					Output 1: Volume Flow (Live Density)	None
														C					Output 1: Volume Flow (Fixed Density)	None
														D					Output 1: Mass Flow	Output 2 : Mass Flow
														E					Output 1: Mass Flow	Output 2 : Volume Flow (Live Density)
														F					Output 1: Mass Flow	Output 2: Volume Flow (Fixed Density)
														G					Output 1: Volume Flow (Live Density)	Output 2: Volume Flow (Live Density)
														H					Output 1: Volume Flow (Fixed Density)	Output 2: Volume Flow (Fixed Density)
														J					Output 1: Volume Flow (Live Density)	Output 2: Mass Flow
														K					Output 1: Volume Flow (Fixed Density)	Output 2: Mass Flow
Pulse output type															0				No output	
															1				Open collector pulse (standard)	
															2				Voltage pulse	
Communication interface																1			HART communication (Hybrid Bell 202)	
																4			Modbus communication (RS-485) and HART communication (Hybrid Bell 202)	
Explosion-proof rating																	2		ATEX, IECEx	
																	4		CSA	
Explosion-proof temperature class ❶																		3	Sensor unit: Temperature class T3 (separately-mounted transmitter only)	
																		4	Sensor unit: Temperature class T4	

1. Explosion-proof specification has restrictions on temperature class.
2. If fluid temperature exceeds 176°F (80°C), separately-mounted transmitter must be used.
3. Remote Communication cable is included. Length is 5 meters. This is the only length available.
4. If "Volume Flow (Fixed Density)" is selected for analog and/or pulse outputs, the volume rate calculation will be based on the fixed (not live) density value.
5. "Volume Flow (Fixed Density)" and "Volume Flow (Live Density)" cannot be used simultaneously on analog and/or pulse outputs. User must choose one or the other.

PRODUCT INQUIRY FORM

PLEASE SUPPLY THE FOLLOWING INFORMATION WHEN YOU INQUIRE

Complete the following form (to the extent possible) by filling in the blanks and checking the applicable boxes. Additional information will be provided during your personal consultation.

1. Model code	CC _____	
2. Process fluid[1]	Name: _____ Density: _____ Viscosity: _____	
3. Flow range	Maximum _____ Normal _____ Minimum _____ Unit _____ (lbm/hr, bbl/hr, etc.)	
4. Fluid temperature	Maximum _____ Normal _____ Minimum _____ Unit _____ (˚F or ˚C)	
5. Operating pressure	Maximum _____ Normal _____ Minimum _____ Unit _____ (psi, barg, kPa, kg/cm2)	
6. Ambient temperature	Maximum _____ Normal _____ Minimum _____ Unit _____ (˚F or ˚C)	
7. Fluid flow direction	☐ Left to Right ☐ Right to Left ☐ Bottom to Top ☐ Top to Bottom (Orientation: See page A-9)	
8. Nominal size	_____in. or _____mm	
9. Required accuracy	±_____% of reading ±_____% of full scale	
10. Process connection	☐ Flange type/rating _____ ☐ Threaded ☐ Ferrule	
11. Explosion-proof	☐ CSA ☐ ATEX ☐ IECEx ☐ Not required	
12. Power supply	☐ AC ☐ DC _____ Volts	
13. Output specifications	Pulse output	Output Form: ☐ Active voltage ☐ Open collector
		Output 1: ☐ Mass rate ☐ Volume rate Output 2: ☐ Mass rate ☐ Volume rate
		Output 1_____ Pulses per _____ Output 2_____ Pulses per _____
	Analog output	Output 1: ☐ Mass rate ☐ Volume rate ☐ Temperature ☐ Density Output 2: ☐ Mass rate ☐ Volume rate ☐ Temperature ☐ Density
		Output 1: 4mADC = _____ 20mADC = _____ Output 2: 4mADC = _____ 20mADC = _____
	Flow damping	_____ seconds (selectable from 0 to 200 seconds; default is 0.8 seconds)
	Slug flow alarm output	Low = _____ (g/ml, SG, lbm/ft3, etc.) Default is 0.3 g/ml. High = _____ (g/ml, SG, lbm/ft3, etc.) Default is 2.0 g/ml.
14. Communication protocol	☐ HART ☐ Modbus (Slave Address: _____)	
15. Transmission length	Distance from sensor to transmitter (if remote mounted) _____ Unit _____ (ft or m) Distance from transmitter to receiving device _____ Unit _____ (ft or m)	
16. Receiving device	☐ Totalizer ☐ Indicator ☐ Recorder ☐ Flow controller ☐ Batch controller ☐ Density computer ☐ Computer ☐ Other _____	
17. Interconnect cable length	Remote-mount transmitter is available only with a 5-meter interconnect cable length	
18. Remote mount bracket	☐ Remote mount bracket for wall mount or 2" pipe mount (for remote mount transmitters only)	
19. Number of units required		
20. Application		
21. Other considerations		

1. Special fluids, such as high viscosity fluids or slurries, should be stated precisely and in detail.

This page is intentionally blank.

MEASUREMENT SYSTEMS

HOUSTON HEAD OFFICE **1.281.582.9500**

ASIA PACIFIC **+603.7954.0145**
ms-kl@c-a-m.com

CANADA **1.403.291.4814**
ms-canada@c-a-m.com

EUROPE, CASPIAN, RUSSIA & S. AFRICA **+44.1892.518000**
ms-uk@c-a-m.com

INDIA **91.982.2431686**
ms-ind@c-a-m.com

LATIN AMERICA **+55.21.2172.9714**
ms-latinamerica@c-a-m.com

MIDDLE EAST & N. AFRICA **971.4802.7700**
ms-me@c-a-m.com

UNITED STATES **1.800.654.3760**
ms-us@c-a-m.com

www.c-a-m.com/measurement

CAMERON