

General Specifications

ROTAMASS Total Insight Coriolis Mass Flow and Density Meter Intense



GS 01U10B05-00EN-R



Scope of application

- Precise flow rate measurement of fluids and gases, multi-phase fluids and fluids with specific gas content using the Coriolis principle.
- Direct measurement of mass flow and density independent of the fluid's physical properties, such as density, viscosity and homogeneity
- Concentration measurement of solutions, suspensions and emulsions
- Fluid temperatures of -70 – 150 °C (-94 – 302 °F)
- Process pressures up to 260 bar
- ASME process connections, up to two nominal diameters per device meter size
- Connection to common process control systems, such as via HART 7 or Modbus
- Hazardous area approvals: IECEx, ATEX, FM (USA/Canada), NEPSI, INMETRO, PESO, Taiwan Safety Label
- Safety-related applications: PED per AD 2000 Code, SIL 2, secondary containment up to 120 bar
- Marine type approval: DNV GL

Advantages and benefits

- Inline measurement of several process variables, such as mass, density and temperature
- Advanced functions like Net Oil Computing, Batching function and Viscosity function to avoid external dedicated flow computer.
- Adapterless installation due to multi-size flange concept
- No straight pipe runs at inlet or outlet required
- Fast and uncomplicated commissioning and operation of the flow meter
- Maintenance-free operation
- Functions that can be activated subsequently (Features on Demand)
- Total health check (diagnostic function): Self-monitoring of the entire flow meter, including accuracy
- Maximum accuracy due to calibration facility accredited according to ISO/IEC 17025 (for option K5)
- Self-draining installation
- Vibration-resistant due to counterbalanced double tube measurement system and box-in-box design

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1 Introduction

1.1 Applicable documents

For Ex approval specification, refer to the following documents:

- Explosion Proof Type Manual ATEX IM 01U10X01-00__-R¹⁾
- Explosion Proof Type Manual IECEx IM 01U10X02-00__-R¹⁾
- Explosion Proof Type Manual FM IM 01U10X03-00__-R¹⁾
- Explosion Proof Type Manual INMETRO IM 01U10X04-00__-R¹⁾
- Explosion Proof Type Manual PESO IM 01U10X05-00__-R¹⁾
- Explosion Proof Type Manual NEPSI IM 01U10X06-00__-R¹⁾
- Explosion Proof Type Manual KOREA Ex IM 01U10X07-00__-R¹⁾
- Explosion Proof Type Manual EAC Ex IM 01U10X08-00__-R¹⁾

Other applicable User's manuals:

- Protection of Environment (Use in China only) IM 01A01B01-00ZH-R







¹⁾ The "_" symbols are placeholders. Here for example, for the corresponding language version (DE, EN, etc.).

1.2 Product overview

Rotamass Total Insight Coriolis mass flow and density meters are available in various product families distinguished by their applications. Each product family includes several product alternatives and additional device options that can be selected.

The following overview serves as a guide for selecting products.

Overview of Rotamass Total Insight product families

Rotamass Nano		<p>For low flow rate applications</p> <p>Meter sizes: Nano 06, Nano 08, Nano 10, Nano 15, Nano 20</p> <p>Connection sizes:</p> <ul style="list-style-type: none"> ▪ DN15, DN25, DN40 ▪ 1/4", 3/8", 1/2", 3/4", 1", 1 1/2" <p>Maximum mass flow: 1.5 t/h (55 lb/min)</p>
Rotamass Prime		<p>Versatility with low costs for the operator</p> <p>Meter sizes: Prime 25, Prime 40, Prime 50, Prime 80</p> <p>Connection sizes:</p> <ul style="list-style-type: none"> ▪ DN15, DN25, DN40, DN50, DN80 ▪ 3/8", 1/2", 3/4", 1", 1 1/2", 2", 2 1/2", 3" <p>Maximum mass flow: 76 t/h (2800 lb/min)</p>
Rotamass Supreme		<p>Excellent performance under demanding conditions</p> <p>Meter sizes: Supreme 34, Supreme 36, Supreme 38, Supreme 39</p> <p>Connection sizes:</p> <ul style="list-style-type: none"> ▪ DN15, DN25, DN40, DN50, DN65, DN80, DN100, DN125 ▪ 3/8", 1/2", 3/4", 1", 1 1/2", 2", 2 1/2", 3", 4", 5" <p>Maximum mass flow: 170 t/h (6200 lb/min)</p>
Rotamass Intense		<p>For high process pressure applications</p> <p>Meter sizes: Intense 34, Intense 36, Intense 38</p> <p>Connection sizes:</p> <ul style="list-style-type: none"> ▪ 3/8", 1/2", 3/4", 1", 2" <p>Maximum mass flow: 50 t/h (1800 lb/min)</p>
Rotamass Hygienic		<p>For food, beverage and pharmaceutical applications</p> <p>Meter sizes: Hygienic 25, Hygienic 40, Hygienic 50, Hygienic 80</p> <p>Connection sizes:</p> <ul style="list-style-type: none"> ▪ DN25, DN40, DN50, DN65, DN80 ▪ 1", 1 1/2", 2", 2 1/2", 3" <p>Maximum mass flow: 76 t/h (2800 lb/min)</p>
Rotamass Giga		<p>For high flow rate applications</p> <p>Meter sizes: Giga 1F, Giga 2H</p> <p>Connection sizes:</p> <ul style="list-style-type: none"> ▪ DN100, DN125, DN150, DN200 ▪ 4", 5", 6", 8" <p>Maximum mass flow: 600 t/h (22000 lb/min)</p>

2 Measuring principle and flow meter design

2.1 Measuring principle

The measuring principle is based on the generation of Coriolis forces. For this purpose, a driver system (E) excites the two measuring tubes (M1, M2) in their first resonance frequency. Both pipes vibrate inversely phased, similar to a resonating tuning fork.

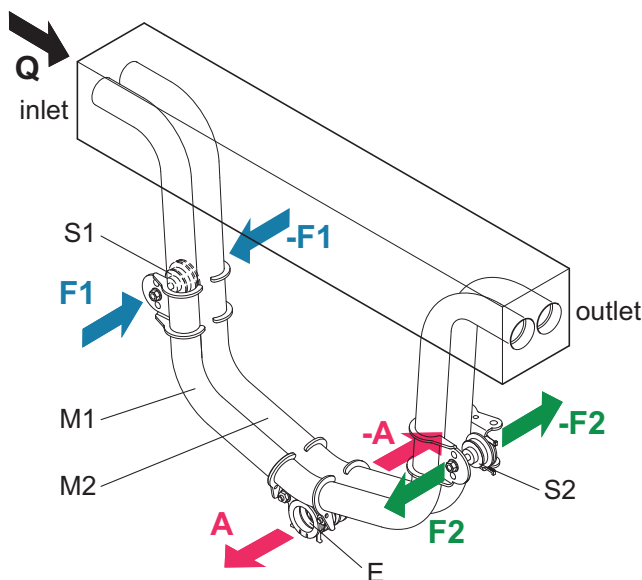


Fig. 1: Coriolis principle

M1, M2	Measuring tubes	E	Driver system
S1, S2	Pick-offs	A	Direction of measuring tube vibration
F1, F2	Coriolis forces	Q	Direction of fluid flow

Mass flow

The fluid flow through the vibrating measuring tubes generates Coriolis forces (F1, -F1 and F2, -F2) that produce positive or negative values for the tubes on the inflow or outflow side. These forces are directly proportional to the mass flow and result in deformation (torsion) of the measuring tubes.

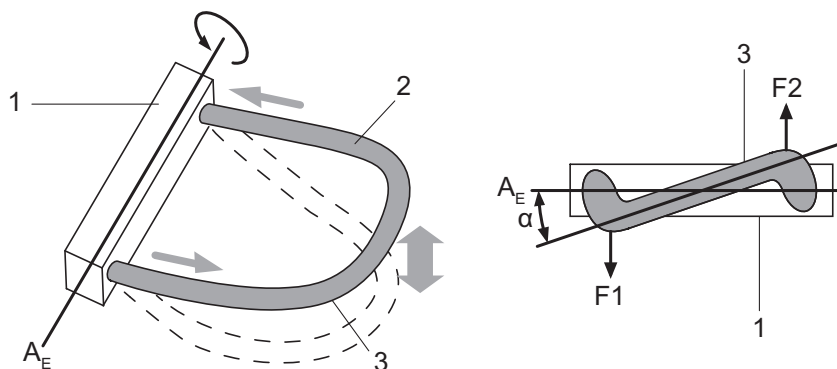


Fig. 2: Coriolis forces and measuring tube deformation

1	Measuring tube mount	A_E	Rotational axis
2	Fluid	F1, F2	Coriolis forces
3	Measuring tube	α	Torsion angle

The small deformation overlying the fundamental vibration is recorded by means of pick-offs (S1, S2) attached at suitable measuring tube locations. The resulting phase shift $\Delta\phi$ between the output signals of pick-offs S1 and S2 is proportional to the mass flow. The output signals generated are further processed in a transmitter.

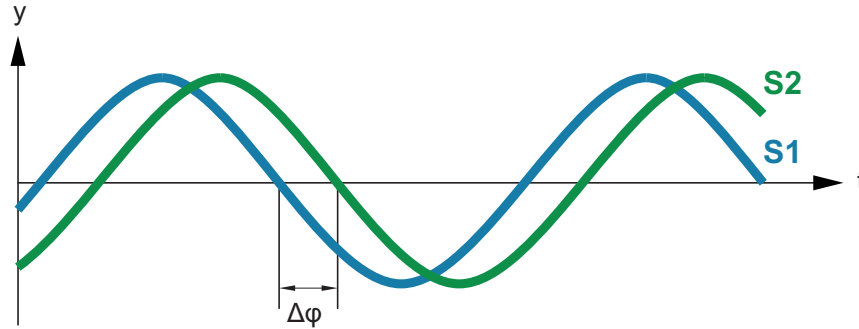


Fig. 3: Phase shift between output signals of S1 and S2 pick-offs

$$\Delta\phi \sim F_c \sim \frac{dm}{dt}$$

- $\Delta\phi$ Phase shift
- m Dynamic mass
- t Time
- dm/dt Mass flow
- F_c Coriolis force

Density measurement

Using a driver and an electronic regulator, the measuring tubes are operated in their resonance frequency f . This resonance frequency is a function of measuring tube geometry, material properties and the mass of the fluid covibrating in the measuring tubes. Altering the density and the attendant mass will alter the resonance frequency. The transmitter measures the resonance frequency and calculates density from it according to the formula below. Device-dependent constants are determined individually during calibration.

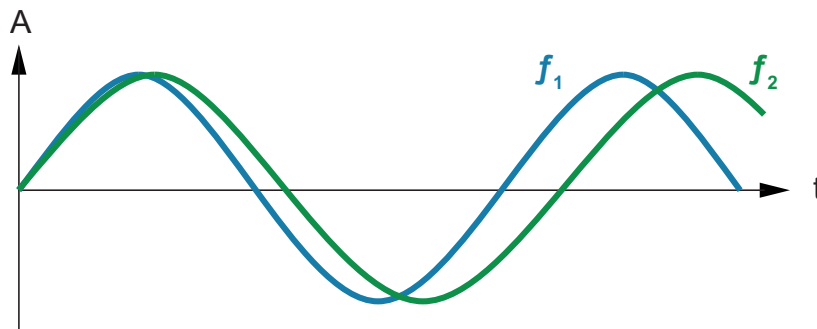


Fig. 4: Resonance frequency of measuring tubes

- A Measuring tube displacement
- f_1 Resonance frequency with fluid 1
- f_2 Resonance frequency with fluid 2

$$\rho = \frac{\alpha}{f^2} + \beta$$

- ρ Fluid density
- f Resonance frequency of measuring tubes
- α, β Device-dependent constants

Temperature measurement

The measuring tube temperature is measured in order to compensate for the effects of temperature on the flow meter. This temperature approximately equals the fluid temperature and is made available as a measured quantity at the transmitter as well.

2.2 Flow meter

The Rotamass Coriolis flow meter consists of:

- Sensor
- Transmitter

When the integral type is used, sensor and transmitter are firmly connected.

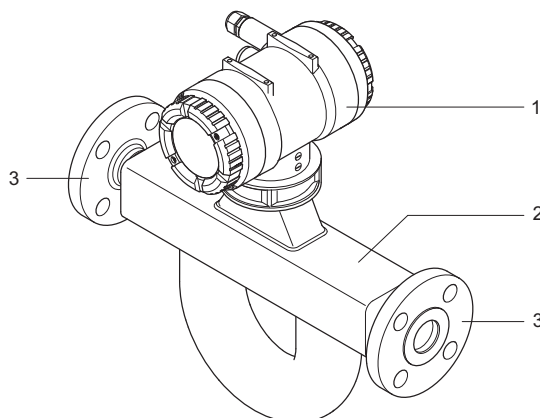


Fig. 5: Configuration of the Rotamass integral type

- | | |
|---|---------------------|
| 1 | Transmitter |
| 2 | Sensor |
| 3 | Process connections |

When the remote type is used, sensor and transmitter are linked via connecting cable. As a result, sensor and transmitter can be installed in different locations.

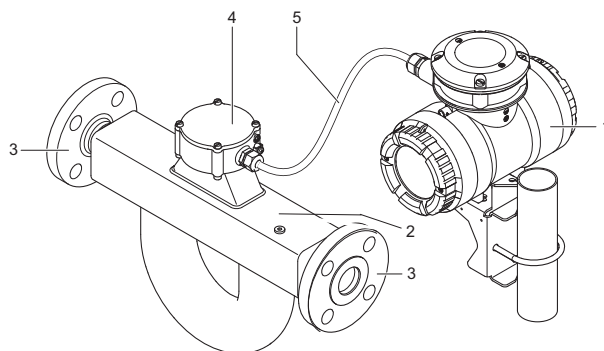


Fig. 6: Configuration of the Rotamass remote type

- | | | | |
|---|---------------------|---|---------------------|
| 1 | Transmitter | 4 | Sensor terminal box |
| 2 | Sensor | 5 | Connecting cable |
| 3 | Process connections | | |

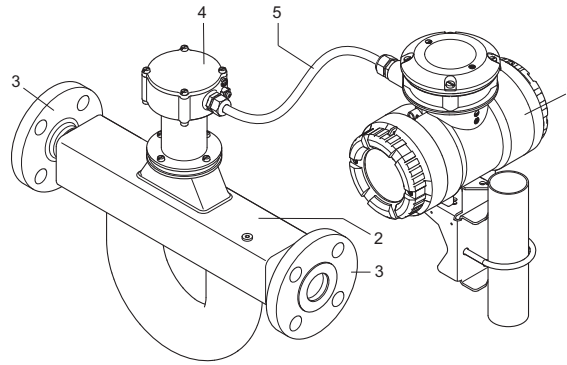


Fig. 7: Configuration of the Rotamass remote type - long neck

- | | | | |
|---|---------------------|---|---------------------|
| 1 | Transmitter | 4 | Sensor terminal box |
| 2 | Sensor | 5 | Connecting cable |
| 3 | Process connections | | |

General specifications

All available properties of the Rotamass Coriolis flow meter are specified by means of a model code.

One model code position may include several characters depicted by means of dashed lines.

The positions of the model code relevant for the respective properties are depicted and highlighted in blue. Any values that might occupy these model code positions are subsequently explained.

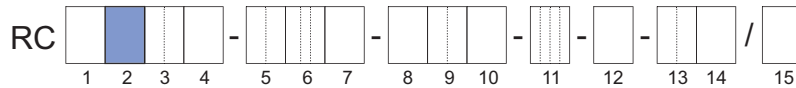


Fig. 8: Highlighted model code positions

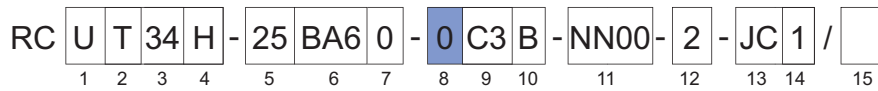
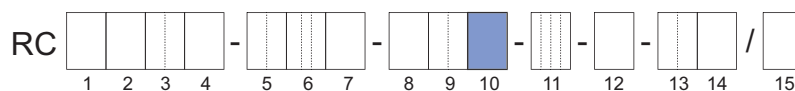


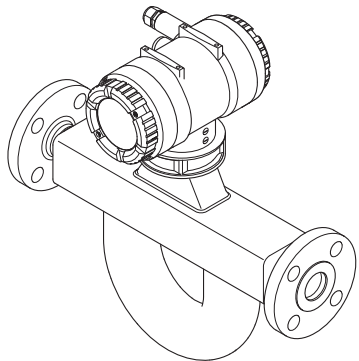
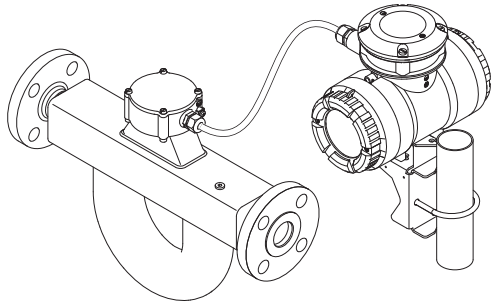
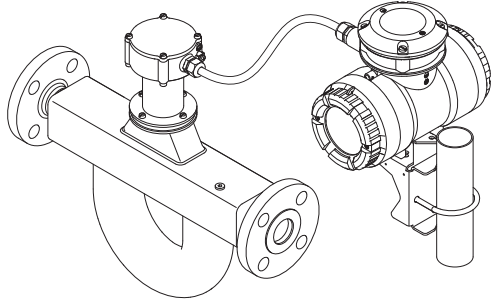
Fig. 9: Example of a completed model code

A complete description of the model code is included in the chapter entitled *Ordering information* [▶ 67].

Type of design

Position 10 of the model code defines whether the integral type or the remote type is used. It specifies further flow meter properties, such as the transmitter coating, see *Design and housing* [84].

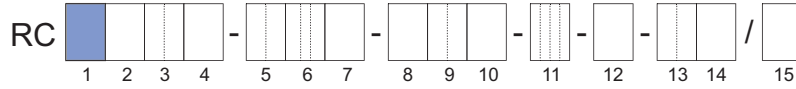




Flow meter	Model code position 10
<p>Integral type</p> 	<p>0, 2</p>
<p>Remote type - standard neck</p> 	<p>A, E, J</p>
<p>Remote type - long neck</p> 	<p>B, F, K</p>

Transmitter overview Two different transmitters can be combined with the sensor: Essential and Ultimate.

Essential transmitter is suitable for general purposes applications and it delivers accurate and precise measurements of flow rate and density.

Ultimate transmitter, thanks to the advanced functions and "Features on Demand", offers dedicated application solutions with a superior accuracy and performances in measuring flow rate, density and concentration.



Transmitter	Properties	Model code position 1
<p>Essential</p> 	<ul style="list-style-type: none"> ▪ Down to 0.15 % mass flow accuracy for liquids ▪ Down to 0.75 % mass flow accuracy for gases ▪ Down to 4 g/l (0.25 lb/ft³) accuracy for density ▪ Total health check (diagnostic function) ▪ Advanced functions: <ul style="list-style-type: none"> - Tube health check (diagnostic function) ▪ HART communication ▪ Modbus communication ▪ Data backup on microSD card 	E
<p>Ultimate</p> 	<ul style="list-style-type: none"> ▪ Down to 0.1 % mass flow accuracy for liquids ▪ Down to 0.5 % mass flow accuracy for gases ▪ Down to 0.5 g/l (0.03 lb/ft³) accuracy for density ▪ Total health check (diagnostic function) ▪ Advanced functions: <ul style="list-style-type: none"> - Net Oil Computing following API standard - Viscosity function - Batching function - Measurement of heat quantity - Tube health check (diagnostic function) ▪ Features on Demand ▪ HART communication ▪ Modbus communication ▪ Data backup on microSD card 	U

3 Application and measuring ranges

3.1 Measured quantities

The Rotamass Coriolis flow meter can be used to measure the following fluids:

- Liquids
- Gases
- Mixtures, such as emulsions, suspensions, slurries

Possible limitations applying to measurement of mixtures must be checked with the responsible Yokogawa sales organization.

The following variables can be measured using the Rotamass:

- Mass flow
- Density
- Temperature

Based on these measured quantities, the transmitter also calculates:

- Volume flow
- Partial component concentration of a two-component mixture
- Partial component flow rate of a mixture consisting of two components (net flow)

In this process, the net flow is calculated based on the known partial component concentration and the overall flow.

3.2 Measuring range overview

	Intense 34	Intense 36	Intense 38	
Mass flow range				
Typical connection size	½"	1"	2"	
Q_{nom}	3 t/h (110 lb/min)	10 t/h (370 lb/min)	32 t/h (1200 lb/min)	[▶ 14]
Q_{max}	5 t/h (180 lb/min)	17 t/h (620 lb/min)	50 t/h (1800 lb/min)	
Maximum volume flow				
(Water)	5 m ³ /h (42 barrel/h)	17 m ³ /h (140 barrel/h)	50 m ³ /h (420 barrel/h)	[▶ 14]
Range of fluid density				
	0 – 5 kg/l (0 – 310 lb/ft ³)			[▶ 14]
Process fluid temperature range				
Standard ¹⁾	-70 – 150 °C (-94 – 302 °F)			[▶ 28]

¹⁾ May be further restricted depending on the design.

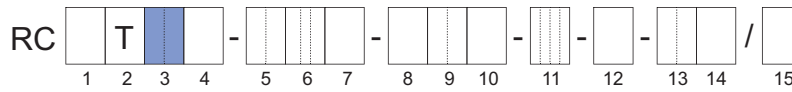
Q_{nom} - Nominal mass flow

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 pressure loss along the flow meter.

3.3 Mass flow

For Rotamass Intense the following meter sizes to be determined using the *Model code* [▶ 81] are available.



Mass flow of liquids

Meter size	Typical connection size	Q _{nom} in t/h (lb/min)	Q _{max} in t/h (lb/min)	Model code position 3
Intense 34	½"	3 (110)	5 (180)	34
Intense 36	1"	10 (370)	17 (620)	36
Intense 38	2"	32 (1200)	50 (1800)	38

Mass flow of gases

When using the Rotamass for measuring the flow of gases, the mass flow is usually limited by the pressure loss generated and the maximum flow velocity. Since these depend heavily on the application, please contact the local Yokogawa sales organization.

3.4 Volume flow

Volume flow of liquids (water at 20 °C)

Meter size	Volume flow (at 1 bar pressure loss) in m³/h (barrel/h)	Maximum volume flow in m³/h (barrel/h)
Intense 34	3 (25)	5 (42)
Intense 36	10 (84)	17 (140)
Intense 38	32 (270)	50 (420)

Volume flow of gases

When using the Rotamass for measuring the flow of gases, the flow rate is usually limited by the pressure loss generated and the maximum flow velocity. Since these depend heavily on the application, please contact the local Yokogawa sales organization.

3.5 Pressure loss

The pressure loss along the flow meter is heavily dependent on the application. The pressure loss of 1 bar at nominal mass flow Q_{nom} also applies to water and is considered the reference value.

3.6 Density

Meter size	Measuring range of density
Intense 34	0 – 5 kg/l (0 – 310 lb/ft³)
Intense 36	
Intense 38	

Rather than being measured directly, density of gas is usually calculated using its reference density, process fluid temperature and process pressure.

3.7 Temperature

The process fluid temperature measuring range is limited by:

- Design type (integral or remote)
- Process connection size and type
- Ex approvals

Maximum measuring range: -70 – 150 °C (-94 – 302 °F)

4 Accuracy

In this chapter, maximum deviations are indicated as absolute values.



All accuracy data are given in \pm values.

4.1 Overview

Achievable accuracies for liquids

The value D_{flat} specified for accuracy of mass flow applies for flow rates exceeding the mass flow limit Q_{flat} . If the flow rate is less than Q_{flat} , other effects have to be considered.

The following values are achieved at calibration conditions when the device is delivered, see *Calibration conditions* [▶ 23]. Depending on the product version selected, specifications may not be as accurate, see *Mass flow and density accuracy* [▶ 83].

Measured quantity		Accuracy for transmitters	
		Essential	Ultimate
Mass flow ¹⁾	Accuracy ²⁾ D_{flat}	0.15 % of measured value	0.1 % of measured value
	Repeatability	0.08 % of measured value	0.05 % of measured value
Volume flow (water) ¹⁾	Accuracy ²⁾ D_v	0.43 % of measured value	0.12 % of measured value
	Repeatability	0.22 % of measured value	0.06 % of measured value
Density	Accuracy ²⁾	4 g/l (0.25 lb/ft ³)	0.5 g/l (0.03 lb/ft ³)
	Repeatability	2 g/l (0.13 lb/ft ³)	0.3 g/l (0.02 lb/ft ³)
Temperature	Accuracy ²⁾	0.5 °C (0.9 °F)	0.5 °C (0.9 °F)

¹⁾ Based on the measured values of the pulse output. This means that the flow accuracy and repeatability considers the combined measurement uncertainties including sensor, electronic and pulse output interface.

²⁾ Best accuracy per transmitter type.

The connecting cable may influence the accuracy. The values specified are valid for connecting cables \leq 30 m (98.4 ft) long.

Achievable accuracies for gases

Measured quantity		Accuracy for transmitters	
		Essential	Ultimate
Mass flow / standard volume flow ¹⁾	Accuracy ²⁾ D_{flat}	0.75 % of measured value	0.5 % of measured value
	Repeatability	0.6 % of measured value	0.4 % of measured value
Temperature	Accuracy ²⁾	0.5 °C (0.9 °F)	0.5 °C (0.9 °F)

¹⁾ Based on the measured values of the pulse output. This means that the flow accuracy and repeatability considers the combined measurement uncertainties including sensor, electronic and pulse output interface.

²⁾ Best mass flow accuracy per transmitter type.

In the event of fluid temperature jumps, a delay is to be expected in the temperature being displayed due to low heat capacity and heat conductivity of gases.

The connecting cable may influence the accuracy. The values specified are valid for connecting cables \leq 30 m (98.4 ft) long.

4.2 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)
Intense 34	0.15 (0.33)
Intense 36	0.5 (1.1)
Intense 38	1.6 (3.5)

4.3 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* [21].

Use the following formulas to calculate the maximum deviation D :

$$Q_m \geq Q_{\text{flat}} \rightarrow D = D_{\text{flat}}$$

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

D Maximum deviation in %

Q_m Mass flow in kg/h

D_{flat} Maximum deviation for high flow rates in %

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

a, b Constants

Meter size	Model code position 9	D_{flat} in %	Q_{flat} in kg/h	a in kg/h	b in %
Intense 34	E7	0.2	150	0.38	-0.05
	D7	0.15	200	0.21	0.043
	C2, C3	0.1	300	0.17	0.044
	70	0.75	150	0.25	0.583
	50	0.5	300	0.17	0.444
Intense 36	E7	0.2	500	1.3	-0.05
	D7	0.15	667	0.71	0.043
	C2, C3	0.1	1000	0.56	0.044
	70	0.75	500	0.83	0.583
	50	0.5	1000	0.56	0.444
Intense 38	E7	0.2	1600	4	-0.05
	D7	0.15	2130	2.3	0.043
	C2, C3	0.1	3200	1.8	0.044
	70	0.75	1600	2.7	0.583
	50	0.5	3200	1.8	0.444

4.3.1 Sample calculation for liquids

Accuracy using water at 20 °C as an example

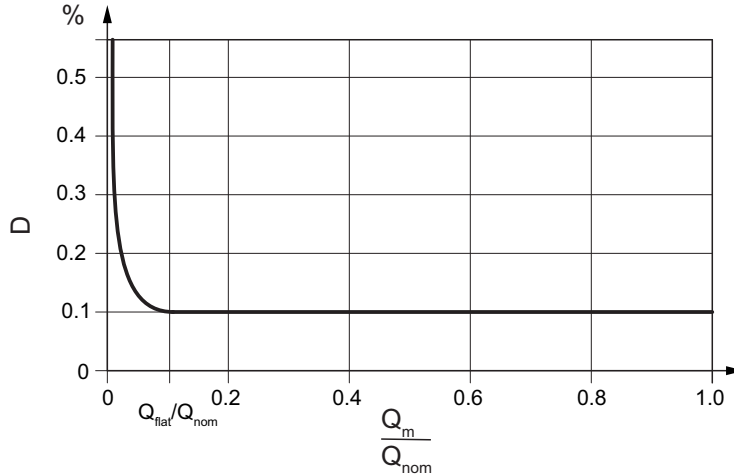


Fig. 10: Schematic dependency of the maximum deviation on the mass flow

D Maximum deviation in % Q_m Mass flow in kg/h
 Q_{nom} Nominal mass flow in kg/h Q_{flat} Mass flow above which D_{flat} applies, in kg/h

Turn down $Q_m:Q_{nom}$	Maximum deviation D	Water pressure loss
1:100	0.6 %	≈ 0 mbar (0 psi)
1:40	0.3 %	0.7 mbar (0.01 psi)
1:10	0.1 %	10 mbar (0.15 psi)
1:2	0.1 %	250 mbar (3.62 psi)
1:1	0.1 %	1000 mbar (14.50 psi)

Example

RC U T 34 H - 25 BA6 0 - 0 C3 B - NN00 - 2 - JC 1 /

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

Fluid: Liquid
 Maximum deviation D_{flat} : 0.1 %
 Q_{flat} : 300 kg/h
 Constant a : 0.17 kg/h
 Constant b : 0.044 %
 Value of mass flow Q_m : 75 kg/h

Calculation of flow rate condition:

Check whether $Q_m \geq Q_{flat}$:

$Q = 75 \text{ kg/h} < Q_{flat} = 300 \text{ kg/h}$

As a result, accuracy is calculated using the following formula:

$$D = \frac{a \times 100 \%}{Q_m} + b$$

Calculation of accuracy:

$D = 0.17 \text{ kg/h} \times 100 \% / 75 \text{ kg/h} + 0.044 \%$

$D = 0.27 \%$

4.3.2 Sample calculation for gases

The maximum deviation in the case of gases depends on the product version selected, see also *Mass flow and density accuracy* [► 83].

Example

RC

U	T	34	H
1	2	3	4

 -

25	BA6	60
5	6	7

 -

0	50	B
8	9	10

 -

NN00
11

 -

2
12

 -

JC	1
13	14

 /

15

Fluid:	Gas
Maximum deviation D_{flat} :	0.5 %
Q_{flat} :	300 kg/h
Constant a :	0.17 kg/h
Constant b :	0.444 %
Value of mass flow Q_m :	30 kg/h

Calculation of the flow rate condition:

Check whether $Q_m \geq Q_{\text{flat}}$:

$$Q_m = 30 \text{ kg/h} < Q_{\text{flat}} = 300 \text{ kg/h}$$

As a result, the accuracy is calculated using the following formula:

$$D = \frac{a \times 100 \%}{Q_m} + b$$

Calculation of accuracy:

$$D = 0.17 \text{ kg/h} \times 100 \% / 30 \text{ kg/h} + 0.444 \%$$

$$D = 1.01 \%$$

4.4 Accuracy of density

4.4.1 For liquids

Meter size	Transmitter	Maximum deviation of density ¹⁾ in g/l (lb/ft ³)
Intense 34	Essential	Down to 4 (0.25)
Intense 36		
Intense 38		
Intense 34	Ultimate	Down to 0.5 (0.03)
Intense 36		
Intense 38		

¹⁾ Deviations possible depending on product version (meter size, type of calibration)

The maximum deviation depends on the product version selected, see also *Accuracy of mass flow and density according to the model code* [▶ 21].

4.4.2 For gases

In most applications, density at standard conditions is fed into the transmitter and used to calculate the standard volume flow based on mass flow.

If gas pressure is a known value, after entering a reference density, the transmitter is able to calculate gas density from temperature and pressure as well (while assuming an ideal gas).

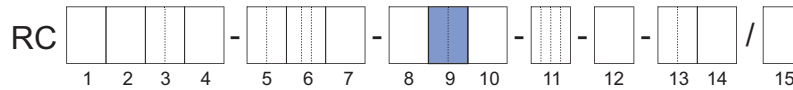
Alternatively, there is an option for measuring gas density. In order to do so, it is necessary to adapt the lower density limit value in the transmitter.

For most applications the direct measurement of the gas density will have insufficient accuracy.

4.5 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.

4.5.1 For liquids



Essential

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 %		
			Intense 34	Intense 36	Intense 38
E7	4	0.3 – 5	0.2	0.2	0.2
D7	4	0.3 – 5	0.15	0.15	0.15

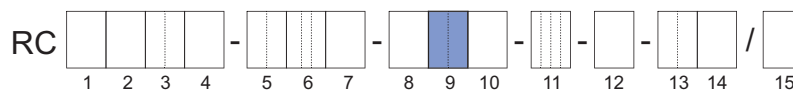
¹⁾ Specified maximum deviation is achieved within the applicable measuring range for density.

Ultimate

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 %		
			Intense 34	Intense 36	Intense 38
C3	1	0.3 – 5	0.1	0.1	0.1
C2	0.5	0.3 – 2.5	0.1	0.1	0.1

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

4.5.2 For gases



Essential

Maximum deviation D_{flat} of mass flow in %	Model code position 9
0.75	70

Ultimate

Maximum deviation D_{flat} of mass flow in %	Model code position 9
0.5	50

4.6 Volume flow accuracy

4.6.1 For liquids

The following formula can be used to calculate the accuracy of liquid volume flow:

$$D_V = \sqrt{D^2 + \left(\frac{\Delta\rho}{\rho} \times 100\%\right)^2}$$

- D_V Maximum deviation of volume flow in %
- $\Delta\rho$ Maximum deviation of density in kg/l
- D Maximum deviation of mass flow in %
- ρ Density in kg/l

4.6.2 For gases

Accuracy of standard volume flow for gas with a fixed composition equals the maximum deviation D of the mass flow.

$$D_V = D$$



In order to determine the standard volume flow for gas, it is necessary to input a reference density in the transmitter. The accuracy specified is achieved only for fixed gas composites. Major deviations may appear if the gas composition changes.

4.7 Accuracy of temperature

Various process fluid temperature ranges are specified for Rotamass Intense:

- Integral type: -50 – 150 °C (-58 – 302 °F)
- Remote type: -70 – 150 °C (-94 – 302 °F)

Accuracy of temperature depends on the sensor temperature range selected (see *Process fluid temperature range* [▶ 28]) and can be calculated as follows:

$$\Delta T = 0.5 \text{ °C} + 0.005 \times |T_{pro} - 20 \text{ °C}|$$

- ΔT Maximum deviation of temperature
- T_{pro} Process fluid temperature in °C

Formula for temperature specification Standard

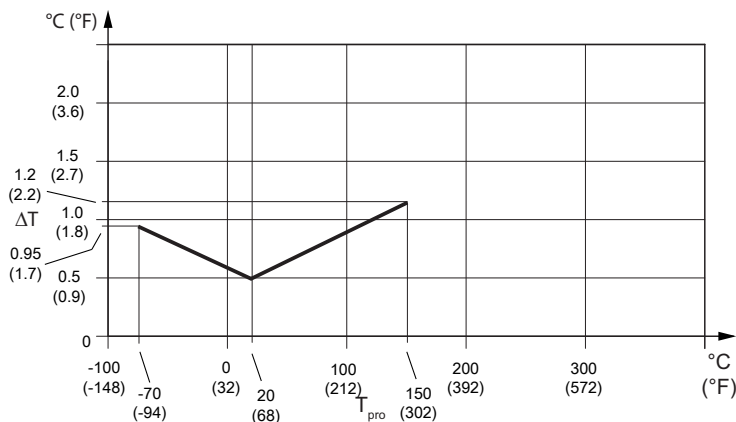


Fig. 11: Presentation of temperature accuracy

Example

RC

U	T	34	H
1	2	3	4

 -

25	BA6	0
5	6	7

 -

0	C3	B
8	9	10

 -

NN00
11

 -

2
12

 -

JC	1
13	14

 /

15

The sample model code specifies the Standard temperature range.

Process fluid temperature T_{pro} : 50 °C

Calculation of accuracy:

$$\Delta T = 0.5 \text{ °C} + 0.005 \times |50 \text{ °C} - 20 \text{ °C}|$$

$$\Delta T = 0.65 \text{ °C}$$

4.8 Repeatability**For liquids**

When using default damping times, the specified repeatability of mass flow, density and temperature measurements equals half of the respective maximum deviation.

$$R = \frac{D}{2}$$

R Repeatability

D Maximum deviation

For gases

In deviation hereto, the following applies to mass and standard volume flow of gases:

$$R = \frac{D}{1.25}$$

4.9 Calibration conditions**4.9.1 Mass flow calibration and density adjustment**

All Rotamass are calibrated in accordance with the state of the art at Rota Yokogawa. Optionally, the calibration can be performed according to a method accredited by DAkkS in accordance with DIN EN ISO/IEC 17025 (Option K5, see *Certificates* [91]).

Each Rotamass device comes with a standard calibration certificate.

Calibration takes place at reference conditions. Specific values are listed in the standard calibration certificate.

	Reference conditions
Fluid	Water
Density	0.9 – 1.1 kg/l (56 – 69 lb/ft ³)
Fluid temperature	10 – 35 °C (50 – 95 °F) Average temperature: 22.5 °C (72.5 °F)
Ambient temperature	10 – 35 °C (50 – 95 °F)
Process pressure (absolute)	1 – 2 bar (15 – 29 psi)

The accuracy specified is achieved at as-delivered calibration conditions stated.

4.9.2 Density calibration

Density calibration is performed for maximum deviation of 0.5 g/l (0.03 lb/ft³), (model code pos. 9 _2).

Density calibration includes:

- Determination of calibration constants for fluid densities at 0.7 kg/l (44 lb/ft³), 1 kg/l (62 lb/ft³) and 1.65 kg/l (103 lb/ft³) at 20 °C (68 °F) fluid temperature
- Determination of temperature compensation coefficients at 20 – 80 °C (68 – 176 °F)
- Check of results for fluid densities at 0.7 kg/l (44 lb/ft³), 1 kg/l (62 lb/ft³) and 1.65 kg/l (103 lb/ft³) at 20 °C (68 °F) fluid temperature
- Special flow meter configuration:
 - Specific insulation of temperature sensors
 - Preaging for long-term stability
- Creation of density calibration certificate

4.10 Process pressure effect

Process pressure effect is defined as the change in sensor flow and density deviation due to process pressure change away from the calibration pressure. This effect can be corrected by dynamic pressure input or a fixed process pressure.

Tab. 1: Process pressure effect, wetted parts stainless steel 1.4404/ 316L and Ni alloy C-22/ 2.4602

Meter size	Material	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
Intense 34	1.4404/316L	-0.0005	-0.00003	-0.066	-0.0046
	C-22/2.4602	-0.0005	-0.00003	-0.076	-0.0052
Intense 36	1.4404/316L	-0.0024	-0.00017	-0.193	-0.0133
	C-22/2.4602	-0.0023	-0.00016	-0.192	-0.0132
Intense 38	1.4404/316L	-0.0034	-0.00023	-0.378	-0.0261
	C-22/2.4602	-0.0035	-0.00024	-0.381	-0.0263

4.11 Process fluid temperature effect

For mass flow and density measurement, process fluid temperature effect is defined as the change in sensor flow and density accuracy due to process fluid temperature change away from the calibration temperature. For temperature ranges, see *Process fluid temperature range* [▶ 28].

Temperature effect on Zero

Temperature effect on Zero of mass flow can be corrected by zeroing at the process fluid temperature.

Temperature effect on mass flow

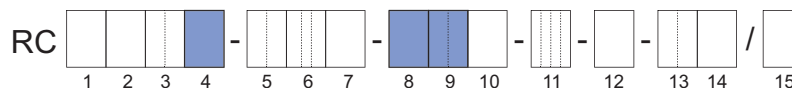
The process fluid temperature is measured and the temperature effect compensated. However due to uncertainties in the compensation coefficients and in the temperature measurement an uncertainty of this compensation is left. The typical rest error of Rotamass Total Insight temperature effect on mass flow is:

Tab. 2: All models

Temperature range	Uncertainty of flow
Standard	±0.0011 % of rate / °C (±0.0006 % of rate / °F)

The temperature used for calculation of the uncertainty is the difference between process fluid temperature and the temperature at calibration condition. For temperature ranges, see *fluid temperature range* [▶ 28].

Temperature effect on density measurement (liquids)



Process fluid temperature influence:

Formula for metric values

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

Formula for imperial values

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

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)

Tab. 3: Constants for particular meter size and model code position (see also *Process fluid temperature range* [▶ 28] and *Mass flow and density accuracy* [▶ 83])

Meter size	Model code position 4	Model code position 8	Model code position 9	k in g/l × 1/°C (lb/ft ³ × 1/°F)	
Intense 34	S	0	C3, D7, E7	0.150 (0.0052)	
	H			0.170 (0.0059)	
	S		C2	0.068 (0.0024)	
	H			0.027 (0.0009)	
Intense 36	S		C3, D7, E7	C3, D7, E7	0.110 (0.0038)
	H				0.090 (0.0031)
	S		C2	C2	0.034 (0.0012)
	H				0.019 (0.0007)
Intense 38	S		C3, D7, E7	C3, D7, E7	0.070 (0.0024)
	H				0.060 (0.0021)
	S		C2	C2	0.028 (0.0010)
	H				0.018 (0.0006)

5 Operating conditions

5.1 Location and position of installation

Rotamass Coriolis flow meters can be mounted horizontally, vertically and at an incline. The measuring tubes should be completely filled with the fluid during flow measurement as accumulations of air or formation of gas bubbles in the measuring tube may result in errors in measurement. Straight pipe runs at inlet or outlet are usually not required.

Avoid the following installation locations and positions:

- Measuring tubes as highest point in piping when measuring liquids
- Measuring tubes as lowest point in piping when measuring gases
- Immediately in front of a free pipe outlet in a downpipe
- Lateral positions

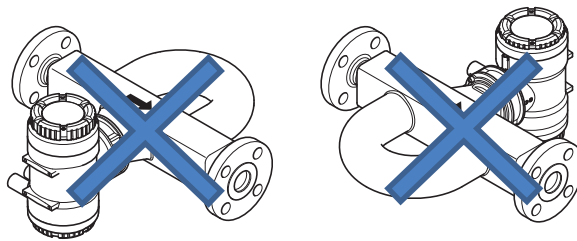
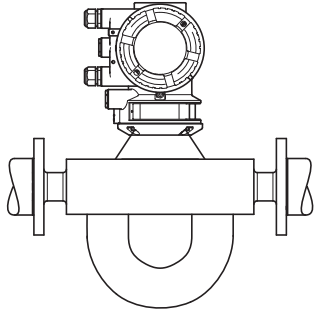
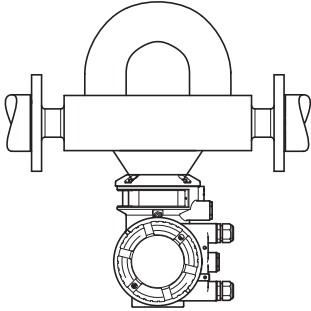
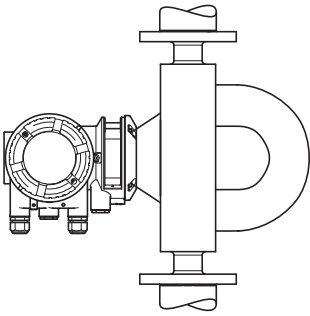


Fig. 12: Installation position to be avoided: Flow meter in sideways position

5.1.1 Sensor installation position

Sensor installation position as a function of the fluid

Installation position	Fluid	Description
Horizontal, measuring tubes at bottom 	Liquid	The measuring tubes are oriented toward the bottom. Accumulation of gas bubbles is avoided.
Horizontal, measuring tubes at top 	Gas	The measuring tubes are oriented toward the top. Accumulation of liquid, such as condensate is avoided.

Installation position	Fluid	Description
Vertical, direction of flow towards the top (recommended) 	Liquid/gas	The sensor is installed on a pipe with the direction of flow towards the top. Accumulation of gas bubbles or solids is avoided. This position allows for complete self-draining of the measuring tubes.

5.2 Installation instructions

The following instructions for installation must be observed:

1. Protect the flow meter from direct sun irradiation in order to avoid exceeding the maximum allowed temperature of the transmitter.
2. In case of installing two sensors of the same kind back-to-back redundantly, use a customized design and contact the responsible Yokogawa sales organization.
3. Avoid installation locations susceptible to cavitation, such as immediately behind a control valve.
4. Avoid installation directly behind rotary and gear pumps to prevent fluctuations in pressure from interfering with the resonance frequency of the Rotamass measuring tubes.
5. In case of remote installation: When installing the connecting cable between sensor and transmitter, keep the cable temperature above $-10\text{ }^{\circ}\text{C}$ ($14\text{ }^{\circ}\text{F}$) to prevent cable damage from the installation stresses.

5.3 Process conditions



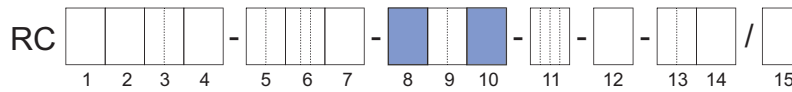
The pressure and temperature ratings presented in this section represent the design values for the devices. For individual applications (e.g. marine applications with option MC_) further limitations may apply according to the respective applicable regulations. For details see chapter *Marine Approval* [▶ 95].

5.3.1 Process fluid temperature range



Allowed process fluid and ambient temperature ranges in hazardous areas depend on classifications defined by applications, refer to *Temperature specification in hazardous areas* [▶ 34].

For Rotamass Intense the following process fluid temperature ranges are available:



Temperature range	Model code position 8	Process fluid temperature in °C (°F)	Design type	Model code position 10
Standard	0	-50 – 150 (-58 – 302)	Integral type	0, 2
		-70 – 150 (-94 – 302)	Remote type	A, B, E, F, J, K

5.3.2 Density

Meter size	Measuring range of density
Intense 34	0 – 5 kg/l (0 – 310 lb/ft³)
Intense 36	
Intense 38	

Rather than being measured directly, density of gas is usually calculated using its reference density, process fluid temperature and process pressure.

5.3.3 Pressure

The maximum allowed process pressure depends on the selected process connection and its surface temperature.

The given process connection temperature and process pressure ranges are calculated and approved without corrosion or erosion effects.

The following diagrams shows the process pressure as a function of process connection temperature as well as the process connection used (type and size of process connection).

**ASME class 900
suitable for
process connection
ASME B16.5**

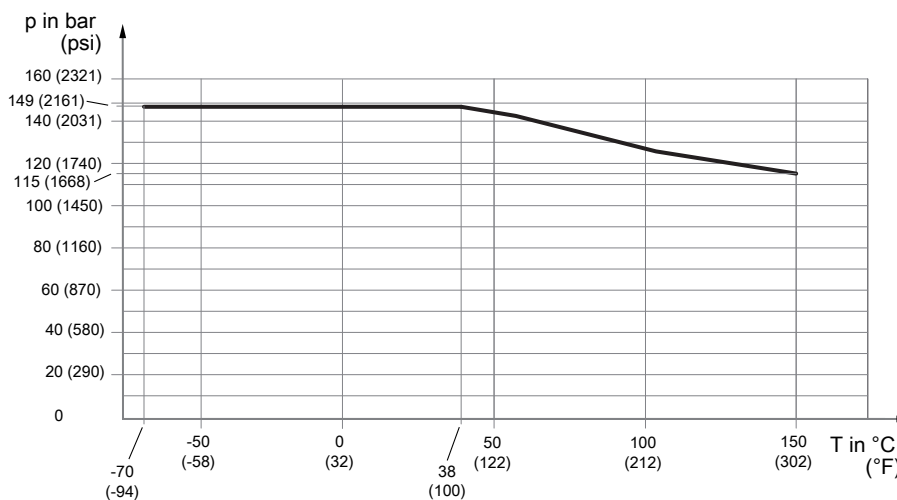


Fig. 13: Allowed process pressure as a function of process connection temperature

**ASME class 1500
suitable for process
connection
ASME B16.5
Intense 34**

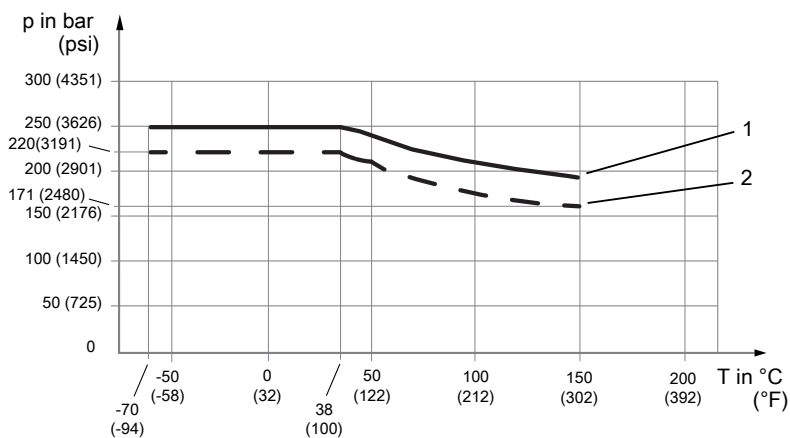


Fig. 14: Allowed process pressure as a function of process connection temperature

- 1 Process connection suitable for ASME B16.5 class 1500:
Intense with meter size 34, material wetted parts S or H (without ASME compliance);
Intense with meter size 34, material wetted parts H and ASME compliance(option P15)
- 2 Process connection suitable for ASME B16.5 class 1500:
Intense with meter size 34, material wetted parts S and ASME compliance(option P15)

Process connection with internal thread G and NPT

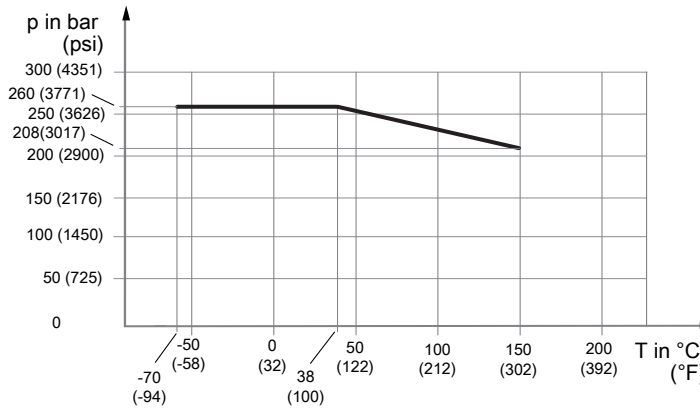


Fig. 15: Allowed process pressure as a function of temperature

Rupture disc

The rupture disc is located on the sensor housing. It is available as an option, see *rupture disc* [► 93]. The rupture disc's bursting pressure is 20 bar. In the case of big nominal diameters and high pressures, it is not possible to ensure that the entire process pressure is released across the rupture disc. In the event this is necessary, it is possible to request a customized design from the responsible Yokogawa sales organization. In the event of a burst pipe, the rupture disc provides an acoustic signal in applications with gases.

5.3.4 Mass flow

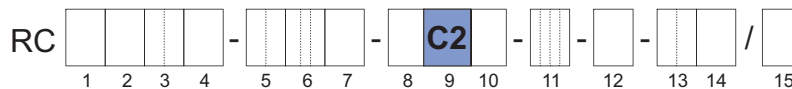
For **liquids** the preferred measuring range is 10 % - 80 % of Q_{nom} , see *Mass flow* [► 14].

For **gases**, as a result of low gas density, the maximum mass flow Q_{max} is usually not reached in gas measurements. In general, the maximum flow velocity should not exceed 33 % of the sonic velocity of the fluid.

5.3.5 Effect of temperature on accuracy

Effect of process fluid temperature

The specified accuracy of the density measurement (see *Mass flow and density accuracy* [► 83]) applies at calibration conditions and may deteriorate if process fluid temperatures deviate from those conditions. The effect of temperature is minimal for the product version with model code position 9, value _2.



For further description of process fluid temperature effect, see *Process fluid temperature effect* [► 25].

5.3.6 Secondary containment

Some applications or environment conditions require secondary containment retaining the process pressure for increased safety. All Rotamass Total Insight have a secondary containment filled with inert gas. The rupture pressure typical values of the secondary housing are defined in the table below.

Typical rupture pressure

Rupture pressure in bar (psi)			
Intense 34S	Intense 34H	Intense 36S	Intense 38S
120 (1740)			

5.4 Ambient conditions

Rotamass Total Insight can be used at demanding ambient conditions.

In doing so, the following specifications must be taken into account:

As ambient temperature is intended the air surrounding the device.

Allowed ambient and storage temperature of Rotamass Total Insight depends on the below components and their own temperature limits:

- Sensor
- Transmitter
- Connecting cable between sensor and transmitter (for remote design type)

Ambient temperature

Maximum ambient temperature range ¹⁾		
integral type:		-40 – 60 °C (-40 – 140 °F)
remote type		
with standard cable (option L _{...}):	Sensor ²⁾ :	-50 – 80 °C (-58 – 176 °F)
	Transmitter:	-40 – 60 °C (-40 – 140 °F)
with fire retardant cable ³⁾ (option Y _{...}):	Sensor ²⁾ :	-35 – 80 °C (-31 – 176 °F)
	Transmitter:	-35 – 60 °C (-31 – 140 °F)

¹⁾ If the device is operating outdoors be sure that the solar irradiation does not increase the surface temperature of the transmitter higher than the allowed maximum ambient temperature. Transmitter display has limited legibility below -20 °C (-4 °F)

²⁾ Check derating for high fluid temperature, see *Process fluid temperature range* [▶ 28], *Process conditions* [▶ 28] and *Allowed ambient temperature for sensor* [▶ 32]

³⁾ Lower temperature specification valid for fixed installation only

Storage temperature

Maximum storage temperature range		
integral type		-40 – 60 °C (-40 – 140 °F)
remote type		
with standard cable (option L _{...}):	Sensor:	-50 – 80 °C (-58 – 176 °F)
	Transmitter:	-40 – 60 °C (-40 – 140 °F)
with fire retardant cable (option Y _{...}):	Sensor:	-35 – 80 °C (-31 – 176 °F)
	Transmitter:	-35 – 60 °C (-31 – 140 °F)

Further ambient conditions

Ranges and specifications	
Relative humidity	0 – 95 %
IP code	IP66/67 for transmitters and sensors when using the appropriate cable glands
Allowable pollution degree in surrounding area acc.: EN 61010-1	4 (in operation)
Resistance to vibration acc.: IEC 60068-2-6 (not with option T _{...})	Transmitter: 10 – 500 Hz, 1g Sensor: 25 – 100 Hz, 4g

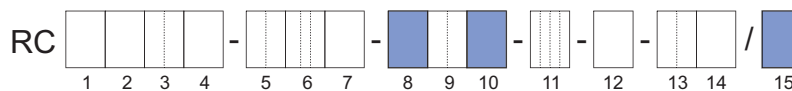
Ranges and specifications	
Electromagnetic compatibility (EMC) <ul style="list-style-type: none"> ▪ IEC/EN 61326-1, Table 2 ▪ IEC/EN 61326-2-3 ▪ NAMUR NE 21 recommendation ▪ DNVGL-CG-0339, chapter 14 This includes <ul style="list-style-type: none"> ▪ Surge immunity acc.: <ul style="list-style-type: none"> – EN 61000-4-5 for lightning protection ▪ Emission acc.: <ul style="list-style-type: none"> – IEC/EN 61000-3-2, Class A – IEC/EN 61000-3-3, Class A – NAMUR NE 21 recommendation – DNVGL-CG-0339, chapter 14 	Immunity assessment criterion: The output signal fluctuation is within $\pm 1\%$ of the output span.
Maximum altitude	2000 m (6600 ft) above mean sea level (MSL)
Overvoltage category acc.: IEC/EN 61010-1	II

5.4.1 Allowed ambient temperature for sensor

As ambient temperature is intended the temperature of the air surrounding the device. If the device is operating outdoors be sure that solar irradiation does not increase the surface temperature higher than the allowed maximum ambient temperature.

The allowed ambient temperature depends on the following product properties:

- Process fluid temperature, see *Process fluid temperature range* [▶ 28]
- Design type
 - Integral type
 - Remote type
- Connecting cable type (options L_{xxx} and Y_{xxx})



The allowed combinations of process fluid and ambient temperature for the sensor are illustrated as gray areas in the diagrams below.



Allowed process fluid and ambient temperature ranges in hazardous areas depend on classifications defined by applications, refer to *Temperature specification in hazardous areas* [▶ 34].

Temperature specification Standard, integral type

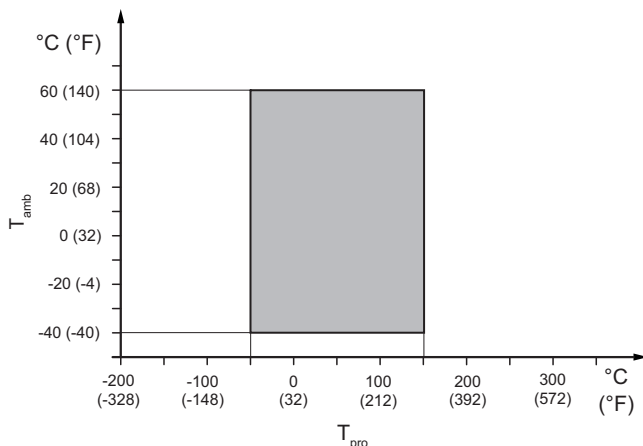


Fig. 16: Allowed process fluid and ambient temperatures, integral type

T_{amb} Ambient temperature
 T_{pro} Process fluid temperature

Temperature specification Standard, remote type

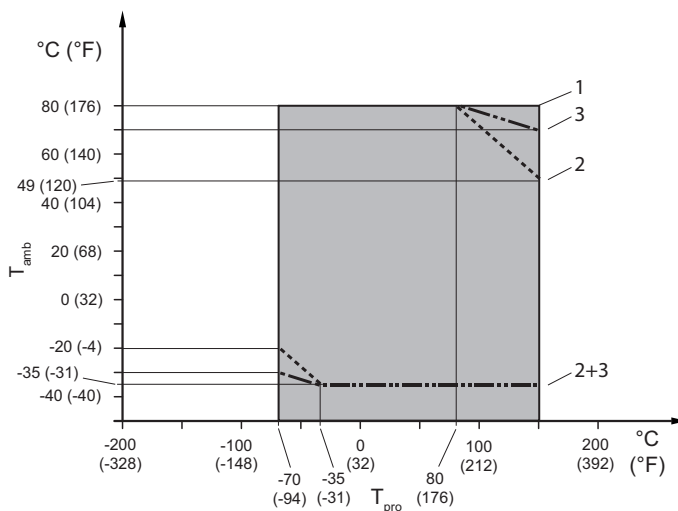


Fig. 17: Allowed process fluid and ambient temperatures, remote type

- 1 Standard cable option L_{_____}
- 2 Limitation for fire retardant cable option Y_{_____} for standard neck
- 3 Limitation for fire retardant cable option Y_{_____} for long neck

5.4.2 Temperature specification in hazardous areas

The maximum ambient and process fluid temperatures depending on explosion groups and temperature classes can be determined via the model code or via the model code together with the Ex code (see the corresponding Explosion Proof Type Manual).

Model code:

Pos. 2: T

Pos. 8: 0

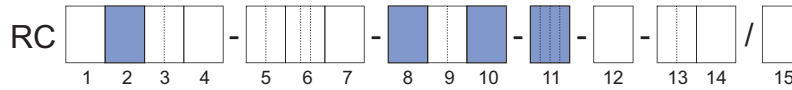
Pos. 10: 0, 2

Pos. 11: _F21, FF11

Ex code:

6.85.86.87.54.10

The following figure shows the relevant positions of the model code:



Tab. 4: Temperature classification

Temperature class	Maximum ambient temperature in °C (°F)	Maximum fluid temperature in °C (°F)
T6	43 (109)	66 (150)
T5	58 (136)	82 (179)
T4	60 (140)	118 (244)
T3	60 (140)	150 (302)
T2	60 (140)	150 (302)
T1	60 (140)	150 (302)

Model code:

Pos. 2: T

Pos. 8: 0

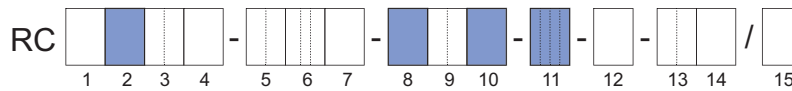
Pos. 10: 0, 2

Pos. 11: _F22, FF12

Ex code:

2.78.79.81.54.10

The following figure shows the relevant positions of the model code:



Tab. 5: Temperature classification

Temperature class	Maximum ambient temperature in °C (°F)	Maximum fluid temperature in °C (°F)
T6	59 (138)	59 (138)
T5	60 (140)	75 (167)
T4	60 (140)	112 (233)
T3	60 (140)	150 (302)
T2	60 (140)	150 (302)
T1	60 (140)	150 (302)

Model code:

Pos. 2: T

Pos. 8: 0

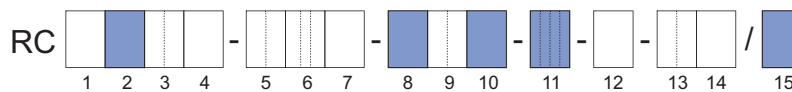
Pos. 10: A, E, J

Pos. 11: _F21, FF11

Ex code:

6.85.86.87.54.10

The following figure shows the relevant positions of the model code:



Tab. 6: Temperature classification

Temperature class	Maximum ambient temperature in °C (°F)		Maximum fluid temperature in °C (°F)
	Option L_...	Option Y_...	
T6	41 (105)	41 (105)	66 (150)
T5	56 (132)	56 (132)	82 (179)
T4	80 (176)	62 (143)	118 (244)
T3	78 (172)	49 (120)	150 (302)
T2	78 (172)	49 (120)	150 (302)
T1	78 (172)	49 (120)	150 (302)

Option Y_... not with model code pos. 11: FF11

Model code:

Pos. 2: T

Pos. 8: 0

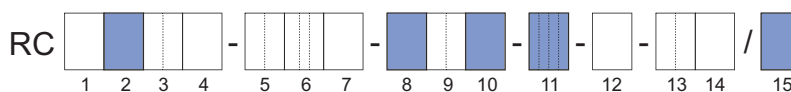
Pos. 10: A, E, J

Pos. 11: _F22, FF12

Ex code:

2.78.79.81.54.10

The following figure shows the relevant positions of the model code:



Tab. 7: Temperature classification

Temperature class	Maximum ambient temperature in °C (°F)		Maximum fluid temperature in °C (°F)
	Option L_	Option Y_	
T6	59 (138)	59 (138)	59 (138)
T5	75 (167)	75 (167)	75 (167)
T4	80 (176)	65 (149)	112 (233)
T3	78 (172)	49 (120)	150 (302)
T2	78 (172)	49 (120)	150 (302)
T1	78 (172)	49 (120)	150 (302)

Option Y_ not with model code pos. 11: FF12

Model code:

Pos. 2: T

Pos. 8: 0

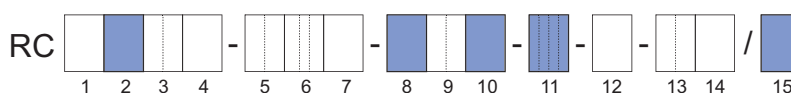
Pos. 10: B, F, K

Pos. 11: _F21, FF11

Ex code:

6.85.86.87.54.10

The following figure shows the relevant positions of the model code:



Tab. 8: Temperature classification

Temperature class	Maximum ambient temperature in °C (°F)		Maximum fluid temperature in °C (°F)
	Option L_	Option Y_	
T6	47 (116)	47 (116)	66 (150)
T5	62 (143)	62 (143)	82 (179)
T4	80 (176)	74 (165)	118 (244)
T3	80 (176)	70 (158)	150 (302)
T2	80 (176)	70 (158)	150 (302)
T1	80 (176)	70 (158)	150 (302)

Option Y_ not with model code pos. 11: FF11

Model code:

Pos. 2: T

Pos. 8: 0

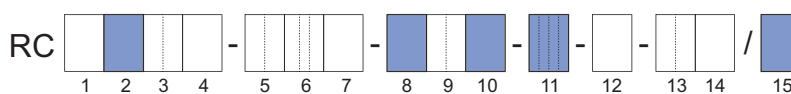
Pos. 10: B, F, K

Pos. 11: _F22, FF12

Ex code:

2.78.79.81.54.10

The following figure shows the relevant positions of the model code:



Tab. 9: Temperature classification

Temperature class	Maximum ambient temperature in °C (°F)		Maximum fluid temperature in °C (°F)
	Option L_	Option Y_	
T6	59 (138)	59 (138)	59 (138)
T5	75 (167)	75 (167)	75 (167)
T4	80 (176)	74 (165)	112 (233)
T3	80 (176)	70 (158)	150 (302)
T2	80 (176)	70 (158)	150 (302)
T1	80 (176)	70 (158)	150 (302)

Option Y_ not with model code pos. 11: FF12

6 Mechanical specification

6.1 Design

The Rotamass Intense flow meter is available with two design types:

- Integral type, sensor and transmitter are firmly connected
- Remote type
 - Standard neck
 - Long neck

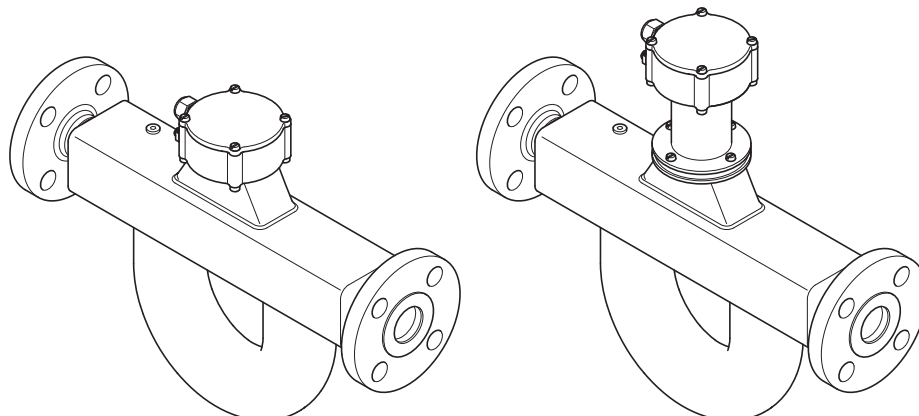
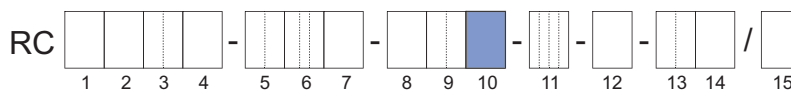


Fig. 18: Remote type sensor with standard and long neck



Design type	Design version	Process fluid temperature range	Model code position 10
Integral type	Direct connection	Standard	0, 2
Remote type	Standard neck		A, E, J
	Long neck		B, F, K



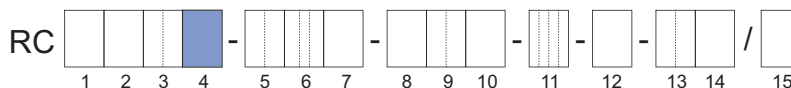
The design influences the temperature specification for Ex-approved Rotamass, see Explosion Proof Type Manual (IM 01U10X_--00EN-R).

6.2 Material

6.2.1 Material wetted parts

The wetted parts of Rotamass Intense are available in two material versions.

For corrosive fluids, use of a corrosion-resistant nickel alloy (nickel alloy C-22/2.4602) is recommended for wetted parts.

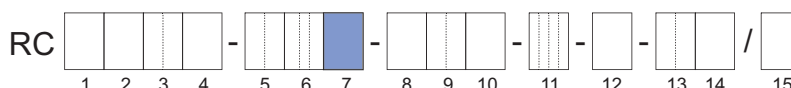


Material	Model code position 4
Stainless steel 1.4404/316L	S
Nickel alloy C-22/2.4602	H

6.2.2 Non-wetted parts

Housing material of sensor and transmitter are specified via model code position 7 and position 10.

Sensor housing material

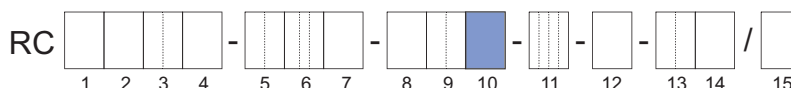


Housing material	Model code position 7
Stainless steel 1.4301/304, 1.4404/316L	0
Stainless steel 1.4404/316L	1

Transmitter housing, coating and bracket material

The transmitter housing is available with different coatings:

- Standard coating
Urethane-cured polyester powder coating
- Corrosion protection coating
Three-layer coating with high chemical resistance (polyurethane coating on two layers of epoxy coating)



Housing material	Coating	Design type	Model code position 10	Bracket material
Aluminum Al-Si10Mg(Fe)	Standard coating	Integral type	0	—
		Remote type	A, B	Stainless steel 1.4301/304
	Corrosion protection coating	Integral type	2	—
		Remote type	E, F	Stainless steel 1.4301/304
Stainless steel CF8M	—	Remote type	J, K	Stainless steel 1.4404/316L
	—			

See also *Design and housing* [▶ 84].

Nameplate

For stainless steel transmitter the nameplates are made of stainless steel 1.4404/316L. Aluminum transmitter nameplates are made of foil.

In case of sensor housing material stainless steel 1.4404/316L (Model code position 7, value 1), nameplates of sensor are made of stainless steel 1.4404/316L. With other sensor housing material and with process fluid temperature range standard the sensor nameplates are made of foil, for other temperature ranges the nameplates are made of stainless steel 1.4404/316L.

6.3 Process connections, dimensions and weights of sensor

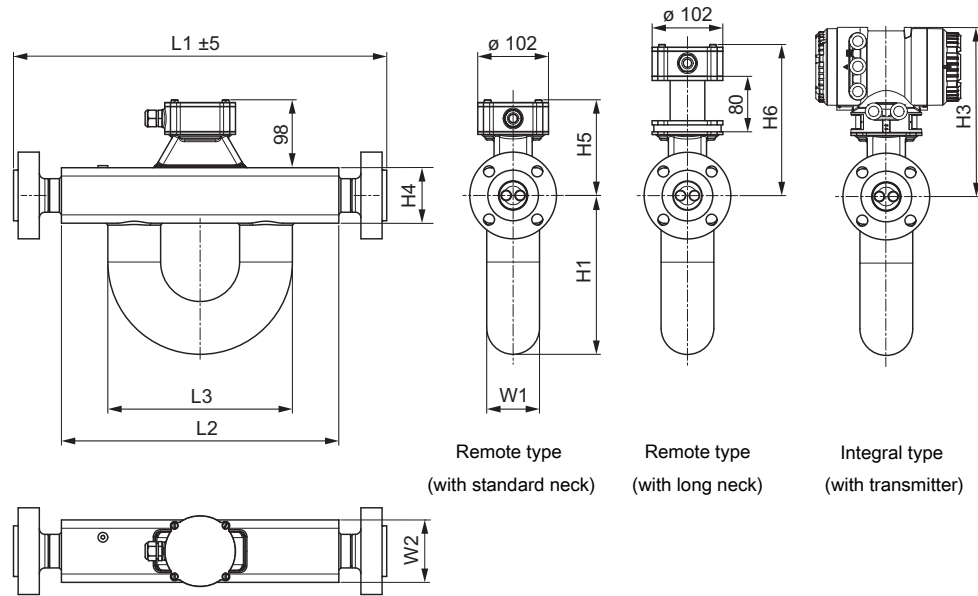


Fig. 19: Dimensions in mm

Tab. 10: Dimensions without length L1

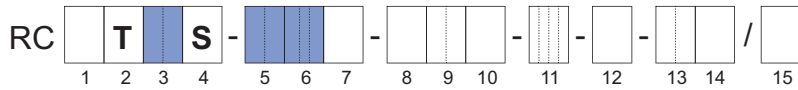
Meter size	L2	L3	H1	H3	H4	H5	H6	W1	W2
	in mm (inch)								
Intense 34	272 (10.7)	212 (8.3)	177 (7)	279 (11)	80 (3.1)	138 (5.4)	218 (8.6)	60 (2.4)	80 (3.1)
Intense 36	400 (15.7)	266 (10.5)	230 (9.1)	279 (11)	80 (3.1)	138 (5.4)	218 (8.6)	76 (3)	90 (3.5)
Intense 38	490 (19.3)	267 (10.5)	268 (10.6)	289 (11.4)	100 (3.9)	148 (5.8)	228 (9)	89 (3.5)	110 (4.3)

Overall length L1 and weight

The overall length of the sensor depends on the selected process connection (type and size of flange). The following tables list the overall length and weight as functions of the individual process connection.

The weights in the tables are for the remote type with standard neck. Additional weight for the remote type with long neck: 1 kg (2.2 lb). Additional weight for the integral type: 3.5 kg (7.7 lb).

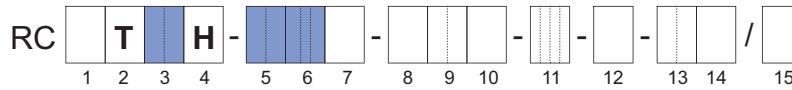
Process connections suitable for ASME B16.5



Tab. 11: Overall length L1 and weight of sensor (process connections: ASME, wetted parts: stainless steel)

Process connections	Model code position		Intense 34		Intense 36		Intense 38	
	5	6	L1 in mm (inch)	Weight in kg (lb)	L1 in mm (inch)	Weight in kg (lb)	L1 in mm (inch)	Weight in kg (lb)
ASME 1/2" class 900, raised face (RF)	15	BA5	400 (15.7)	12.6 (28)	-	-	-	-
ASME 1/2" class 900, ring joint (RJ)		CA5	400 (15.7)	12.8 (28)	-	-	-	-
ASME 1/2" class 1500, raised face (RF)		BA6	400 (15.7)	12.6 (28)	-	-	-	-
ASME 1/2" class 1500, ring joint (RJ)		CA6	400 (15.7)	12.8 (28)	-	-	-	-
ASME 1" class 900, raised face (RF)	25	BA5	450 (17.7)	16.4 (36)	540 (21.3)	20.2 (45)	-	-
ASME 1" class 900, ring joint (RJ)		CA5	450 (17.7)	16.6 (37)	540 (21.3)	20.4 (45)	-	-
ASME 1" class 1500, raised face (RF)		BA6	450 (17.7)	16.4 (36)	-	-	-	-
ASME 1" class 1500, ring joint (RJ)		CA6	450 (17.7)	16.6 (37)	-	-	-	-
ASME 2" class 900, raised face (RF)	50	BA5	-	-	660 (26)	35.2 (78)	720 (28.3)	43 (95)
ASME 2" class 900, ring joint (RJ)		CA5	-	-	660 (26)	35.6 (78)	720 (28.3)	43.4 (96)

Meaning of "-": not available

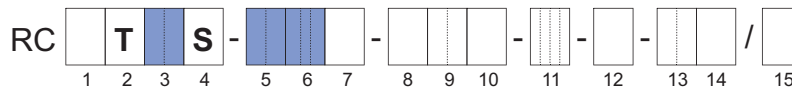


Tab. 12: Overall length L1 and weight of sensor (process connections: ASME, wetted parts: Ni alloy C-22/2.4602)

Process connections	Model code position		Intense 34		Intense 36		Intense 38	
	5	6	L1 in mm (inch)	Weight in kg (lb)	L1 in mm (inch)	Weight in kg (lb)	L1 in mm (inch)	Weight in kg (lb)
ASME 1" class 900, raised face (RF)	25	BA5	400 (15.7)	16.2 (36)	-	-	-	-
ASME 1" class 1500, raised face (RF)		BA6	400 (15.7)	16.2 (36)	-	-	-	-

Meaning of "-": not available

Process connections with internal thread
G

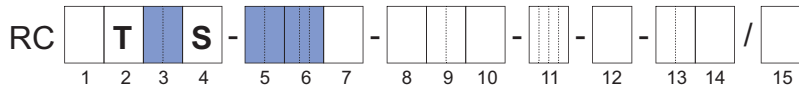


Tab. 13: Overall length L1 and weight of sensor (process connections: G thread, wetted parts: stainless steel)

Process connections	Model code position		Intense 34		Intense 36		Intense 38	
	5	6	L1 in mm (inch)	Weight in kg (lb)	L1 in mm (inch)	Weight in kg (lb)	L1 in mm (inch)	Weight in kg (lb)
G 3/8"	08	TG9	390 (15.4)	9.4 (21)	-	-	-	-
G 1/2"	15		390 (15.4)	9.4 (21)	-	-	-	-
G 3/4"	20		390 (15.4)	9.4 (21)	-	-	-	-

Meaning of "-": not available

Process connections with internal thread NPT



Tab. 14: Overall length L1 and weight of sensor (process connections: NPT thread, wetted parts: stainless steel)

Process connections	Model code position		Intense 34		Intense 36		Intense 38	
	5	6	L1 in mm (inch)	Weight in kg (lb)	L1 in mm (inch)	Weight in kg (lb)	L1 in mm (inch)	Weight in kg (lb)
NPT 3/8"	08	TT9	390 (15.4)	9.4 (21)	-	-	-	-
NPT 1/2"	15		390 (15.4)	9.4 (21)	-	-	-	-
NPT 3/4"	20		390 (15.4)	9.4 (21)	-	-	-	-

Meaning of "-": not available

6.4 Transmitter dimensions and weights

Transmitter dimensions

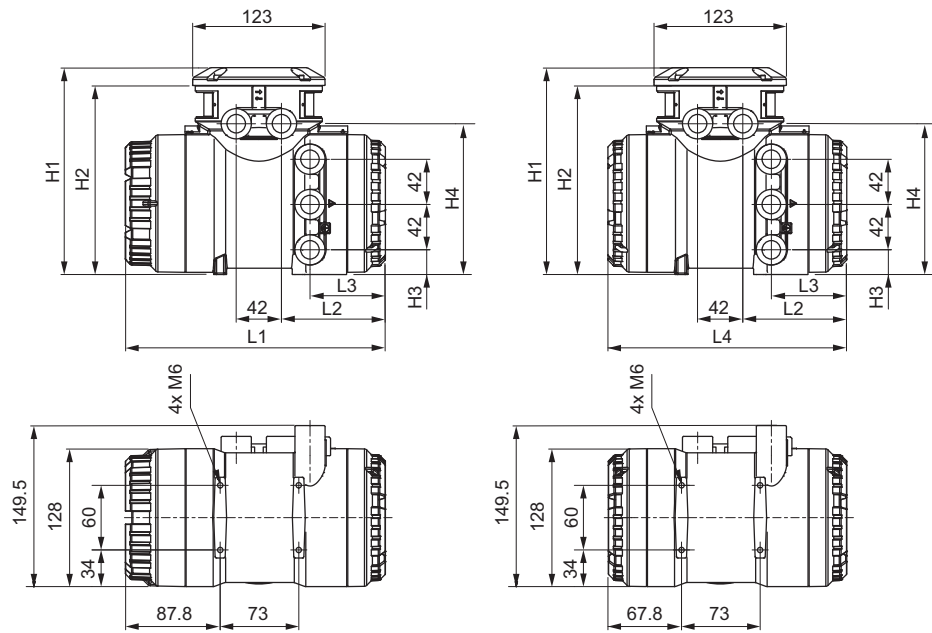


Fig. 20: Dimensions of transmitter in mm (left: transmitter with display, right: transmitter without display)

Tab. 15: Overall length L1 - L4 and height H1 - H4 of transmitter (material: stainless steel, aluminum)

Material	L1 in mm (inch)	L2 in mm (inch)	L3 in mm (inch)	L4 in mm (inch)	H1 in mm (inch)	H2 in mm (inch)	H3 in mm (inch)	H4 in mm (inch)
Stainless steel	255.5 (10.06)	110.5 (4.35)	69 (2.72)	235 (9.25)	201 (7.91)	184 (7.24)	24 (0.94)	150.5 (5.93)
Aluminum	241.5 (9.51)	96.5 (3.8)	70 (2.76)	221 (8.7)	192 (7.56)	175 (6.89)	23 (0.91)	140 (5.51)

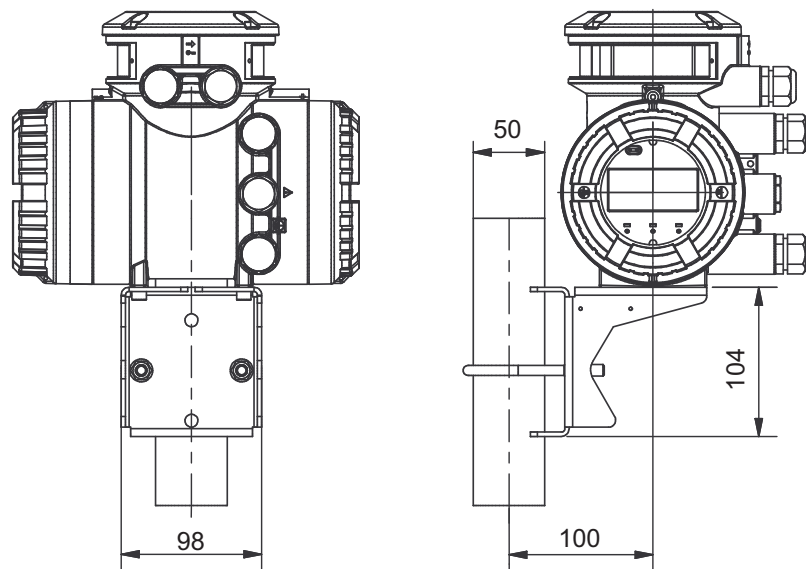
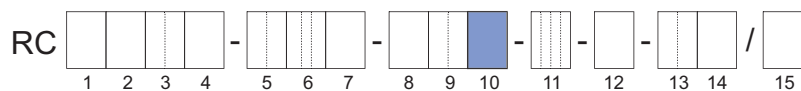


Fig. 21: Dimensions of transmitter in mm, attached by sheet metal console (bracket)

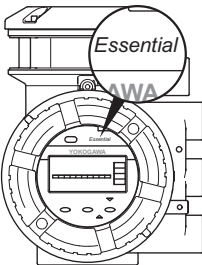
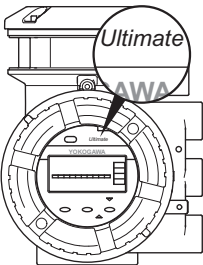


Transmitter weights

Model code (pos. 10)	Design type	Housing material of transmitter	Weight in kg (lb)
A, B, E, F	Remote	Aluminum	4.2 (9.3)
J, K		Stainless steel	12.5 (27.6)

7 Transmitter specification

Overview of functional scope of the Rotamass transmitter

Functional scope	Transmitter	
	Essential	Ultimate
		
Model code (position 1)	E	U
4-line Dot-Matrix display	●	●
Universal power supply (V_{DC} and V_{AC})	●	●
microSD card	●	●
Installation		
Integral type	●	●
Remote type	●	●
Features on Demand	–	●
Special functions		
Wizard	●	●
Event management	●	●
Total health check ¹⁾ (diagnostic function)	●	●
Dynamic pressure compensation ²⁾	–	●
Advanced functions		
Measurement of heat quantity ²⁾	–	●
Net Oil Computing following API standard	–	●
Tube health check (diagnostic function)	●	●
Batching function	–	●
Viscosity function ²⁾	–	●
Inputs and outputs		
Analog output	●	●
Pulse/frequency output	●	●
Status output	●	●
Analog input	–	●
Status input	●	●
Communication		
HART	●	●
Modbus	●	●

meaning of "–": not available;
 meaning of "●": available

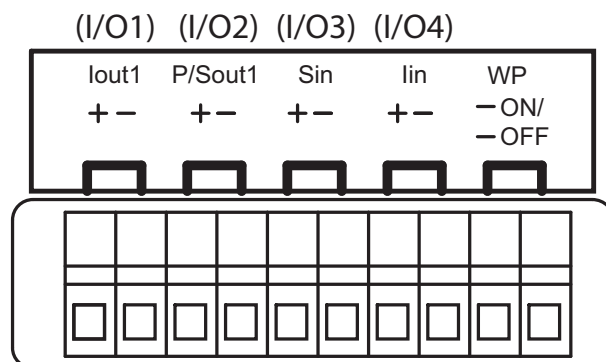
¹⁾ Function is based on external software (FieldMate)

²⁾ Only in combination with an analog input

7.1 Inputs and outputs

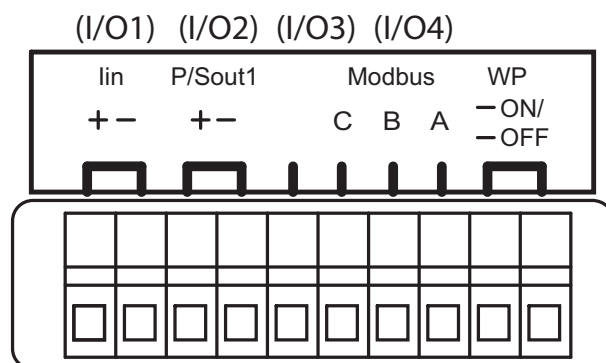
Depending on the flow meter specification, there are different configurations of the connection terminal. Following are configuration examples of the connection terminal (value JK and M7 on model code position 13 - see *Communication type and I/O* [85] for details):

HART



- I/O1: lout1 Current output (active/passive)
- I/O2: P/Sout1 Pulse or status output (passive)
- I/O3: Sin Status input
- I/O4: lin Current input (active/passive)
- WP: Write-protect bridge

Modbus



- I/O1: lin Current input (passive)
- I/O2: P/Sout1 Pulse or status output (passive)
- I/O3-I/O4: Modbus RS485 input/output
- WP: Write-protect bridge

7.1.1 Output signals

Galvanic isolation All circuits for inputs, outputs and power supply are galvanically isolated from each other.

Active current output *lout* One or two current outputs are available depending on model code position 13. Depending on the measured value, the active current output delivers 4 – 20 mA.

It may be used for output of the following measured values:

- Flow rate (mass, volume, net partial component flow of a mixture)
- Density
- Temperature
- Pressure
- Concentration

For HART communication devices, it is supplied on the current output *lout1*. The current output may be operated in compliance with the NAMUR NE43 standard.

	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
Additive maximum deviation	8 μA
Additive output deviation for deviation from 20 °C ambient temperature	0.8 μA/ °C

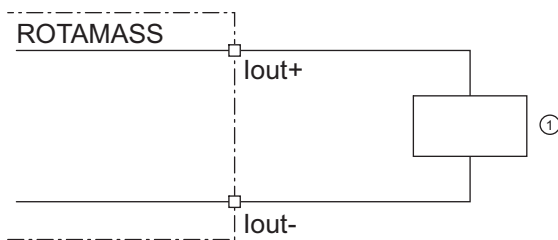


Fig. 22: Active current output connection *lout* HART

① Receiver

Passive current output *I_{out}*

	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
Additive maximum deviation	8 μA
Additive output deviation for deviation from 20 °C ambient temperature	0.8 μA/ °C

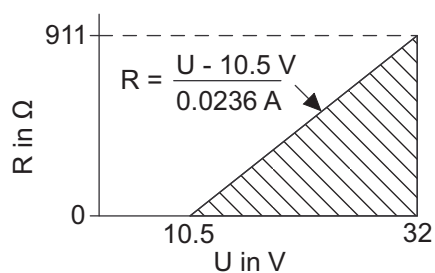


Fig. 23: Maximum load resistance as a function of an external power supply voltage

R Load resistance
 U External power supply voltage

The diagram shows the maximum load resistance R as a function of voltage U of the connected voltage source. Higher load resistances are allowed with higher power supply values. The usable zone for passive power output operation is indicated by the hatched area.

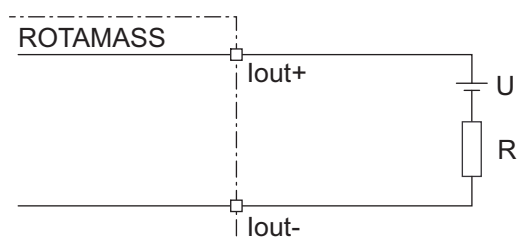


Fig. 24: Passive current output connection *I_{out}*

Active pulse output P/Sout

Connection of an electronic counter

Maximum voltage and correct polarity must be observed for wiring.

	Value
Load resistance	> 1 kΩ
Internal power supply	24 V _{DC} ±20 %
Maximum pulse rate	10000 pulses/s
Frequency range	0 – 12.5 kHz

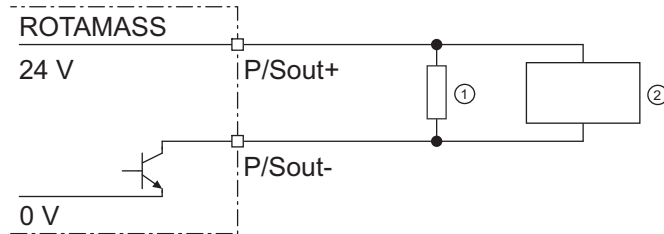


Fig. 25: Active pulse output connection P/Sout

- ① Load resistance
- ② Electronic counter

Connection of an electromechanical counter

	Value
Maximum current	150 mA
Average current	≤ 30 mA
Internal power supply	24 V _{DC} ±20 %
Maximum pulse rate	2 pulses/s
Pulse width	20, 33, 50, 100 ms

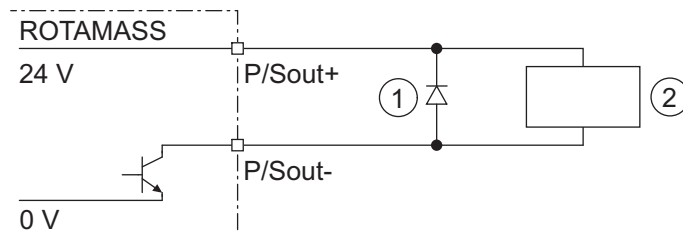


Fig. 26: Active pulse output P/Sout connection with electromechanical counter

- ① Protective diode
- ② Electromechanical counter

Active pulse output P/Sout with internal pull-up resistor

	Value
Internal power supply	24 V _{DC} ±20 %
Internal pull-up resistor	2.2 kΩ
Maximum pulse rate	10000 pulses/s
Frequency range	0 – 12.5 kHz

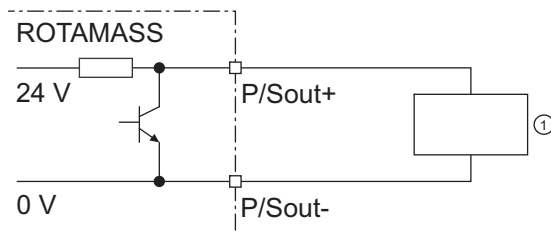


Fig. 27: Active pulse output P/Sout with internal pull-up resistor

- ① Electronic counter

Passive pulse output P/Sout

Maximum voltage and correct polarity must be observed for wiring.

	Value
Maximum load current	≤ 200 mA
Power supply	≤ 30 V _{DC}
Maximum pulse rate	10000 pulses/s
Frequency range	0 – 12.5 kHz

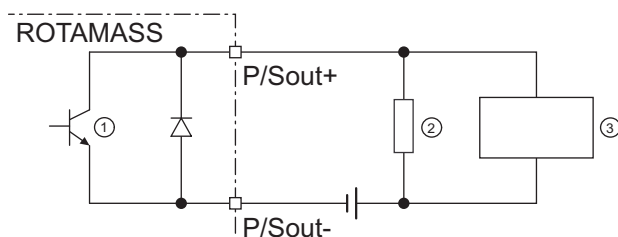


Fig. 28: Passive pulse output connection P/Sout with electronic counter

- ① Passive pulse or status output
- ② Load resistance
- ③ Electronic counter

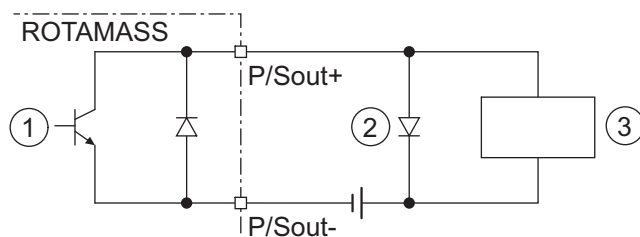


Fig. 29: Passive pulse output P/Sout connection with electromechanical counter

- ① Passive pulse or status output
- ② Protective diode
- ③ Electromechanical counter

Active status output P/Sout

Since this is a transistor contact, maximum allowed current as well as polarity and level of output voltage must be observed during wiring.

	Value
Load resistance	> 1 kΩ
Internal power supply	24 V _{DC} ±20 %

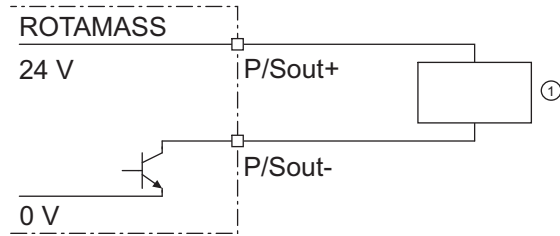


Fig. 30: Active status output connection P/Sout

① External device with load resistance

Active status output P/Sout with internal pull-up resistor

	Value
Internal pull-up resistor	2.2 kΩ
Internal power supply	24 V _{DC} ±20 %

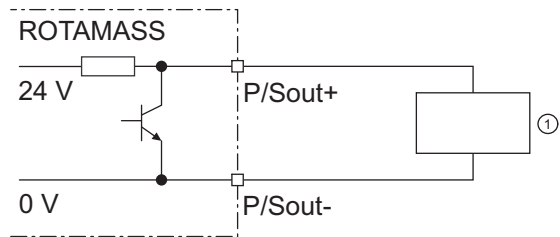


Fig. 31: Active status output P/Sout with internal pull-up resistor

① External device

Passive status output P/Sout or Sout

	Value
Output current	≤ 200 mA
Power supply	≤ 30 V _{DC}

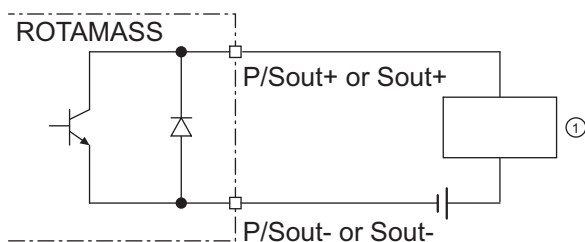


Fig. 32: Passive status output connection P/Sout or Sout

- ① External device

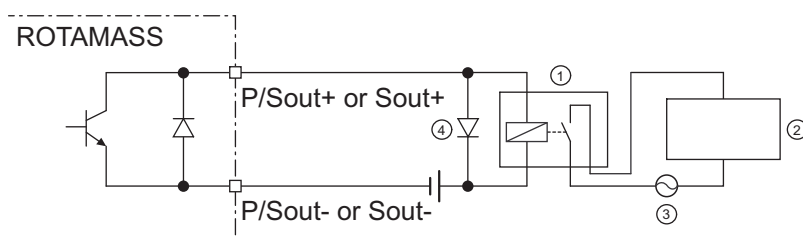


Fig. 33: Passive status output connection P/Sout or Sout for solenoid valve circuit

- ① Relay
- ② Solenoid valve
- ③ Magnetic valve power supply
- ④ Protective diode

A relay must be connected in series to switch alternating voltage.

Passive pulse or status output P/Sout (NAMUR)

Output signals according to EN 60947-5-6 (previously NAMUR, worksheet NA001):

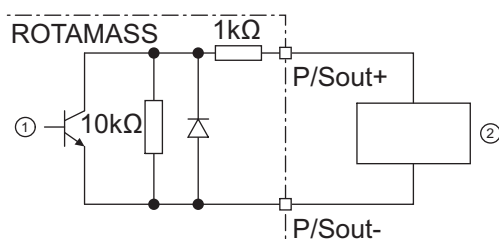


Fig. 34: Passive pulse or status output with switching amplifier connected in series

- ① Passive pulse or status output
- ② Switching amplifier

7.1.2 Input signals

Active current input *lin*

An individual analog power input is available for external analog devices.

The active current input *lin* is provided for connecting a two-wire transmitter with an output signal of 4 – 20 mA.

	Value
Nominal input current	4 – 20 mA
Maximum input current range	2.4 – 21.6 mA
Internal power supply	24 V _{DC} ±20 %
Internal load resistance Rotamass	≤ 160 Ω

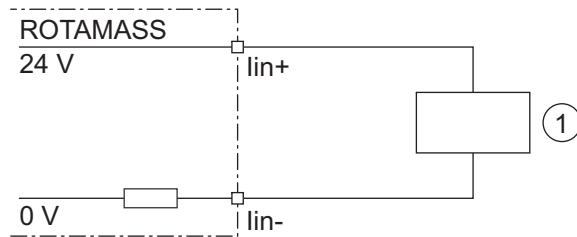


Fig. 35: Connection of external device with passive current output

① External passive current output device

Passive current input *lin*

The passive current input *lin* is provided for connecting a four-wire transmitter with an output signal of 4 – 20 mA.

	Value
Nominal input current	4 – 20 mA
Maximum input current range	2.4 – 21.6 mA
Maximum input voltage	≤ 32 V _{DC}
Internal load resistance Rotamass	≤ 160 Ω

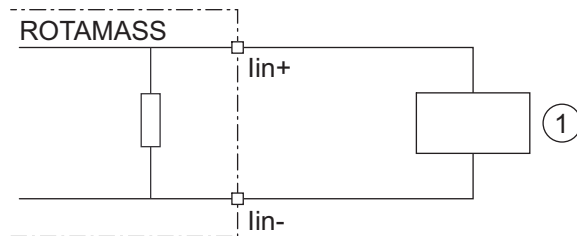


Fig. 36: Connection of external device with active current output

① External active current output device

Status input *Sin*

Do not connect a signal source with electric voltage.

The status input is provided for use of voltage-free contacts with the following specification:

Switching status	Resistance
Closed	< 200 Ω
Open	> 100 k Ω

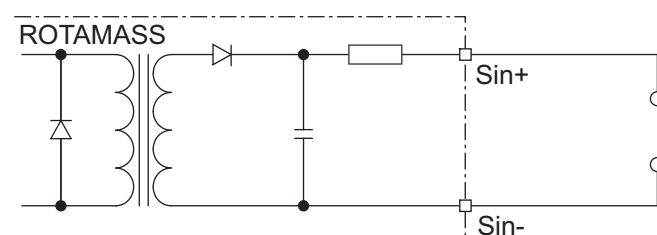


Fig. 37: Status input connection

7.2 Power supply**Power supply**

Alternating voltage (rms):

- Power supply¹⁾: 24 V_{AC} +20 % -15 % or 100 – 240 V_{AC} +10 % -20 %
- Power frequency: 47 – 63 Hz

Direct-current voltage:

- Power supply¹⁾: 24 V_{DC} +20 % -15 % or 100 – 120 V_{DC} +8,3 % -10 %

¹⁾ for option MC_ (DNV GL approval) supply voltage is limited to 24 V

Power consumption

$P \leq 10$ W (including sensor)

Power supply failure

In the event of a power failure, the flow meter data are backed up on a non-volatile internal memory. In case of devices with display, the characteristic sensor values, such as nominal diameter, serial number, calibration constants, zero point, etc. and the error history are also stored on a microSD card.

7.3 Cable specification

With the remote type, the original connecting cable from Rota Yokogawa must be used to connect the sensor with the transmitter. The connecting cable included in the delivery may be shortened. An assembly set along with the appropriate instructions are enclosed for this purpose.

The connecting cable can be ordered as option in various lengths as a standard type (device options L_...) or as marine approved fire retardant cable (device options Y_...), see chapters *Connecting cable type and length* [▶ 89] and *Marine Approval* [▶ 95] for details.

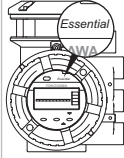
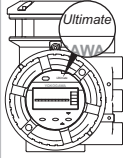


The maximum cable length to keep the specification is 30 m (98.4 ft). Longer cables must be ordered as a separate item, refer to *Connecting cable type and length* [▶ 89].

8 Advanced functions and Features on Demand (FOD)

Rotamass Total Insight includes many dedicated application and maintenance functions that can be ordered simultaneously with the device or can be purchased and activated in a second time (only with the Ultimate transmitter).

Advanced functions

Functional scope	Transmitter		Communication type and I/O		
	Essential	Ultimate	Available type		Mandatory I/O
			HART	Modbus	
Model code (pos. 1 and 13)	E	U	J_	M_	
Net Oil Computing following API standard	-	•	•	•	Not needed
Tube health check	•	•	•	•	
Batching function	-	•	•	-	1 status output for one-stage batching 2 status outputs for two-stage batching
Viscosity function	-	•	•	-	1 analog input
Measurement of heat quantity	-	•	•	•	1 analog input

meaning of "-": not available;
meaning of "•": available

8.1 Concentration and petroleum measurement

Petroleum measurement function NOC (option C52)

"NOC" is an abbreviation for the "Net Oil Computing" function that provides real-time measurements of water cut and includes "API" (American Petroleum Institute) correction according to API MPMS Chapter 11.1.

Oil sometimes contains entrained gas. Rotamass Total Insight measures the density of the emulsion oil and gas that result to be lower than the oil density. If the measured density is used to calculate volume flow of oil, the result would not be correct. Therefore NOC function (option C52) includes also a Gas Void Fraction function (GVF). GVF may reduce the error in oil volume flow calculation at a minimum recognizing the occurrence of gas in the oil and using the oil density to calculate the volume flow.

Oil properties can be selected using Oil type's pre-settings or using "Alpha 60".

Oil and water types predefined in the functions	
Oil types	Water types
<ul style="list-style-type: none"> ▪ Crude ▪ Refined Products: Fuel, Jet Fuel, Transition, Gasoline ▪ Lubricating ▪ Custom Oil 	<ul style="list-style-type: none"> ▪ Standard Mean Ocean Water ▪ UNESCO 1980 ▪ Fresh water density by API MPMS 11.4 ▪ Produced water density by API MPMS 20.1 Appendix A.1 ▪ Brine water density by El-Dessouky, Ettouy (2002) ▪ Custom

In addition to water cut, the function can calculate: Net oil mass flow, net water mass flow, net oil volume flow, net water volume flow and net corrected oil volume flow.

For details about the ordering information, see *Concentration and petroleum measurement* [▶ 90].

8.2 Batching function

Batching and filling processes are typical applications in different industries as food and beverage, cosmetic, pharmaceutical, chemical and oil & gas.

Rotamass Total Insight offers an integrated “Batching function” to automatize the task. A “self-learning” algorithm optimizes the process and allows high accurate results.

The function supports two filling modes:

- one-stage mode with single valve
- two-stage mode to control two valves for accurate filling

Without using an external flow computer, data related to the process can be transmitted via communication protocol. The error management function allows the user to set alarms and warnings accordingly the application needs.

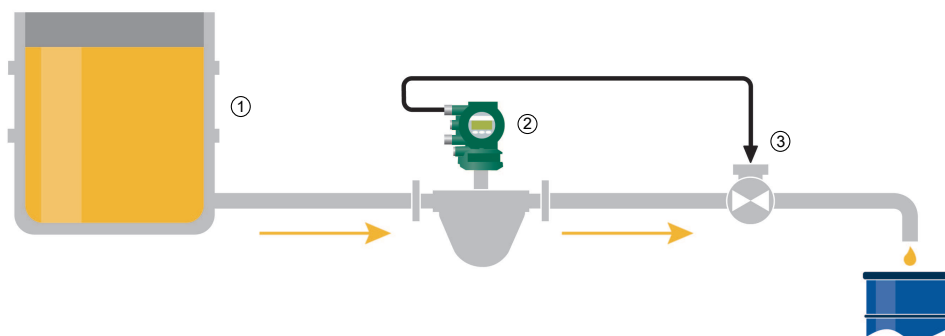


Fig. 38: One-stage mode (The above diagram illustrates the fundamental functionality for one of several combination possibilities)

- | | | | |
|---|------------------------|---|-------|
| ① | Storage tank | ③ | Valve |
| ② | Rotamass Total Insight | | |

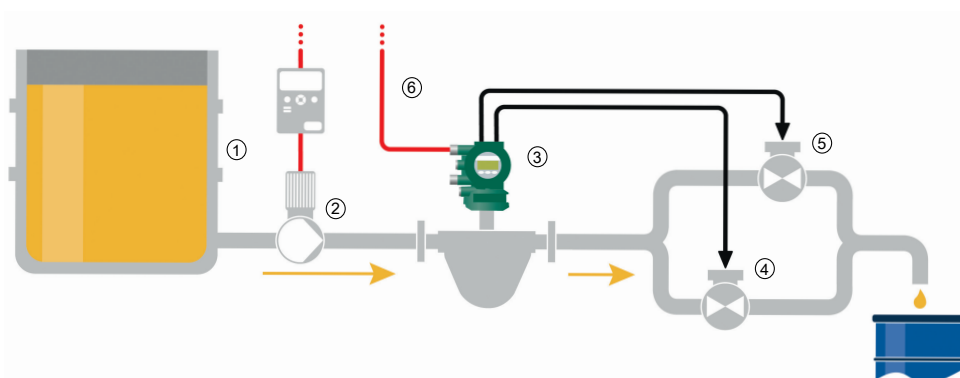


Fig. 39: Two-stage mode (The above diagram illustrates the fundamental functionality for one of several combination possibilities)

- | | | | |
|---|------------------------|---|-----------|
| ① | Storage tank | ④ | Valve "A" |
| ② | Pump | ⑤ | Valve "B" |
| ③ | Rotamass Total Insight | ⑥ | HART |

For details about the ordering information, see *Batching function* [▶ 90].

8.3 Viscosity function

Viscosity function allows the user to have an estimation of the viscosity of the fluid.

The function can be used as redundant viscosity control or as reference value to activate other processes like for instance fluid heating systems.

The viscosity estimation is calculated based on a comparison between measured pressure loss Δp and a “calculated” Δp_{cal} between two points of the pipe nearby the flow meter (refer to related instruction manual for the correct installation).

In order to use the function a pressure measurement device (separate order) directly connected to the analog input of the Rotamass Total Insight is necessary. Based on iteration process, Rotamass Total Insight finds the value of viscosity μ that returns a Δp_{cal} closed to the measured Δp .

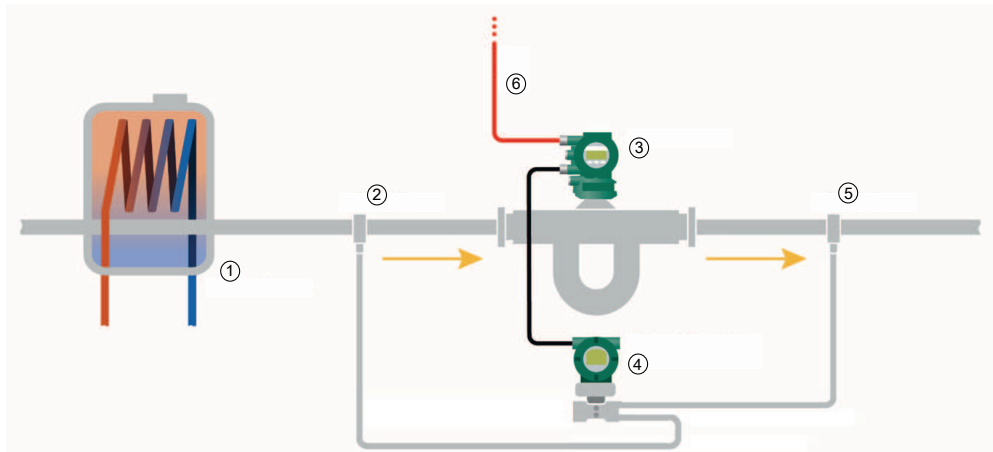


Fig. 40: Viscosity function returns a reference value used to activate a heating system (The above diagram illustrates the fundamental functionality for one of several installation possibilities)

- | | |
|--------------------------|-------------------------------------|
| ① Heat exchanger | ④ Differential pressure transmitter |
| ② Pressure tap 1 | ⑤ Pressure tap 2 |
| ③ Rotamass Total Insight | ⑥ HART |

For details about the ordering information, see *Viscosity function* [▶ 90].

8.4 Tube health check

Tube health check function is a valuable diagnostic function that returns the status of the measuring tubes of the Rotamass Total Insight giving the possibility to set up a real predictive maintenance system or to detect corrosion or clogging of the measuring tubes.

The function is able to measure periodically the change of the stiffness of the measuring tubes. Storage of the values in the internal microSD card is available for HART communication type.

Measurement values can be also transmitted via HART or Modbus protocol and therefore integrated in the customers condition monitoring system.

An alarm or an external event can be activated directly from Rotamass Total Insight in case the measured value exceeds a threshold defined by the user.

Thanks to the PC based software FieldMate, the single measurements can be plotted in a diagram and printed in a report for quality and maintenance documentation.

For details about the ordering information, see *Tube health check* [▶ 94].

8.5 Measurement of heat quantity

The function allows to evaluate the total fuel calorific value of the measured fluid.

The function can work with a constant value of the calorific value of the fluid, but in order to have a precise evaluation we suggest to use an additional device like a gas chromatograph (not included in the supply). The external device that supplies the instantaneous calorific value is connected with the current input of the transmitter (model code position 13: from JH to JN). Based on the mass flow, the total calorific energy of the fluid is calculated as below:

Formula for total calorific energy

$$\Sigma E_{cal} = \Sigma (Q_m \times H_i \times \Delta t)$$

E_{cal} Calorific energy

Q_m Mass flow rate

H_i Calorific value variable

Δt Time interval between two measurements

Other formula based on volume and corrected volume are included in the function and can be set using the display or the configuration PC software FieldMate.

For details about the ordering information, see *Measurement of heat quantity* [▶ 94].

8.6 Features on Demand (FOD)

In combination with the “Ultimate” transmitter, the functions can be purchased and activated later as “Features on Demand”.

After the order, the user receives a KeyCode for input in the transmitter. To activate the desired functions, refer to related software instruction manual (IM01U10S0_-00_-R).

The options of FOD functions for Rotamass Total Insight are shown below.

To order these functions refer to the related general specifications for FOD functions (GS01U10B20-00_-R).

Option category	Options	Description	Valid from main SW rev. ¹⁾	
			Modbus	HART
Concentration and petroleum measurement	C52	Net Oil Computing (NOC) following API standard	R1.01.01	
Batching function	BT	Batching and filling function	-	R3.01.01
Viscosity function	VM	Viscosity computing function for liquids		
Measurement of heat quantity	CGC	Measurement of the total transported energy content of a fuel in connection with a sensor for determining the fuel's calorific value (e.g. a gas chromatograph, not included in scope of delivery).	R1.01.01	R1.01.02
Tube health check	TC	Tube health check	R1.01.01	R1.01.02 ²⁾

¹⁾ Main software revision is given by the transmitter for which the FODs are intended for. For details refer to software instruction manual (IM01U10S0_-00_-R).

²⁾ From software rev. R3.01.01 tube health check includes trend line report (by FieldMate) and the possibility to store the data on microSD card.

Please be sure that your device is compatible with the selected function and in case of doubts please contact Yokogawa Service Department providing the serial number or the model code of the device where you want activate the function.

9 Approvals and declarations of conformity

CE marking	The Rotamass Total Insight meets the statutory requirements of the applicable EU Directives. By attaching the CE mark, Rota Yokogawa confirms conformity of the field instrument with the requirements of the applicable EU Directives. The EU Declaration of Conformity is enclosed with the product on a data carrier.
RCM	Rotamass Total Insight meets the EMC requirements of the Australian Communications and Media Authority (ACMA).
Ex approvals	All data relevant for explosion protection are included in separate Explosion Proof Type Manuals.
NACE	Chemical composition of wetted materials 316L/316/1.4404/1.4401/1.4435 and Ni-Alloy C-22/2.4602 are conform to: <ul style="list-style-type: none"> ▪ ANSI / NACE-MR0175 / ISO15156-2 ▪ ANSI / NACE-MR0175 / ISO15156-3 ▪ NACE MR0103 <p>For details please see Rota Yokogawa declaration about NACE conformity 8660001.</p>
Pressure equipment approvals	The Rotamass Total Insight is in compliance with the statutory requirements of the applicable EU Pressure Equipment Directive (PED). <p>The customer is fully responsible of selecting proper materials which withstand corrosive or erosive conditions. In case of heavy corrosion and/or erosion the instrument may not withstand the pressure and an incident may happen with human and/or environmental harm. Yokogawa will not take any liability regarding damage caused by corrosion or erosion. If corrosion or erosion may happen, the user has to check periodically if the necessary wall thickness is still in place.</p>
Functional safety	The Rotamass Total Insight with HART communication type complies with the relevant safety management requirements of IEC 61508:2010 SIL3. The Rotamass Total Insight product families can be used to implement a SIL 2 safety function (with HFT = 0) or a SIL 3 safety function (with HFT = 1) with all its 4 – 20 mA outputs. The available number of outputs depends on the model code. For further information please contact Yokogawa sales department or look here http://www.exida.com/SAEL-Safety/yokogawa-electric-corporation-rotamass-ti-series

Tab. 16: Approvals and certifications

Type	Approval or certification
ATEX	EU Directive 2014/34/EU ATEX approval: DEKRA 15ATEX0023 X CE ₀₃₄₄ II2G or II2(1)G or II2D or II2(1)D Applied standards: <ul style="list-style-type: none"> ▪ EN 60079-0 +A11 ▪ EN 60079-1 ▪ EN 60079-7 ▪ EN 60079-11 ▪ EN 60079-31
	Remote transmitter (depending on the model code): Ex db [ia Ga] IIC T6 Gb or Ex db e [ia Ga] IIC T6 Gb or Ex db [ia Ga] IIB T6 Gb or Ex db e [ia Ga] IIB T6 Gb Ex db [ia Ga] [ia IIC Ga] IIB T6 Gb or Ex db e [ia Ga] [ia IIC Ga] IIB T6 Gb or Ex tb [ia Da] IIIC T75 °C Db Note: The marking on the product may be changed from Ex e to Ex eb based on statutory requirements.
	Remote sensor (depending on the model code): Ex ib IIC T6...T1 Gb or Ex ib IIB T6...T1 Gb Ex ib IIIC T150 °C Db or Ex ib IIIC T220 °C Db or Ex ib IIIC T350 °C Db
	Integral type (depending on the model code): Ex db ib IIC T6...T1 Gb or Ex db e ib IIC T6...T1 Gb or Ex db ib IIB T6...T1 Gb or Ex db e ib IIB T6...T1 Gb or Ex db ib [ia Ga] IIC T6...T1 Gb or Ex db e ib [ia Ga] IIC T6...T1 Gb or Ex db ib [ia IIC Ga] IIB T6...T1 Gb or Ex db e ib [ia IIC Ga] IIB T6...T1 Gb Ex ib tb IIIC T150 °C Db or Ex ib tb [ia Da] IIIC T150 °C Db Note: The marking on the product may be changed from Ex e to Ex eb based on statutory requirements.

Type	Approval or certification
IECEX	IECEx approval: IECEx DEK 15.0016X Applied standards: <ul style="list-style-type: none"> ▪ IEC 60079-0 ▪ IEC 60079-1 ▪ IEC 60079-7 ▪ IEC 60079-11 ▪ IEC 60079-31
	Remote transmitter (depending on the model code): Ex db [ia Ga] IIC T6 Gb or Ex db e [ia Ga] IIC T6 Gb or Ex db [ia Ga] IIB T6 Gb or Ex db e [ia Ga] IIB T6 Gb Ex db [ia Ga] [ia IIC Ga] IIB T6 Gb or Ex db e [ia Ga] [ia IIC Ga] IIB T6 Gb or Ex tb [ia Da] IIIC T75 °C Db Note: The marking on the product may be changed from Ex e to Ex eb based on statutory requirements.
	Remote sensor (depending on the model code): Ex ib IIC T6...T1 Gb or Ex ib IIB T6...T1 Gb Ex ib IIIC T150 °C Db or Ex ib IIIC T220 °C Db or Ex ib IIIC T350 °C Db
IECEX	Integral type (depending on the model code): Ex db ib IIC T6...T1 Gb or Ex db e ib IIC T6...T1 Gb or Ex db ib IIB T6...T1 Gb or Ex db e ib IIB T6...T1 Gb or Ex db ib [ia Ga] IIC T6...T1 Gb or Ex db e ib [ia Ga] IIC T6...T1 Gb or Ex db ib [ia IIC Ga] IIB T6...T1 Gb or Ex db e ib [ia IIC Ga] IIB T6...T1 Gb Ex ib tb IIIC T150 °C Db or Ex ib tb [ia Da] IIIC T150 °C Db
	Note: The marking on the product may be changed from Ex e to Ex eb based on statutory requirements.

Type	Approval or certification
FM (CA/US)	<p>FM approvals:</p> <ul style="list-style-type: none"> ▪ US Cert No. FM16US0095X ▪ CA Cert No. FM16CA0031X <p>Applied standards:</p> <ul style="list-style-type: none"> ▪ Class 3600 ▪ Class 3610 ▪ Class 3615 ▪ Class 3810 ▪ Class 3616 ▪ NEMA 250 ▪ ANSI/IEC 60529 ▪ CSA-C22.2 No. 0-10 ▪ CSA-C22.2 No. 0.4-04 ▪ CSA-C22.2 No. 0.5-1982 ▪ CSA-C22.2 No. 94.1-07 ▪ CSA-C22.2 No. 94.2-07 ▪ CAN/CSA-C22.2 No. 60079-0 ▪ CAN/CSA-C22.2 No. 60079-11 ▪ CAN/CSA-C22.2 No. 61010-1-04 ▪ CSA-C22.2 No. 25-1966 ▪ CSA-C22.2 No. 30-M1986 ▪ CSA-C22.2 No. 60529
	<p>Remote transmitter (depending on the model code): CL I, DIV 1, GP ABCD, CL II/III, DIV 1, GP EFG; CL I ZN 1 GP IIC; Associated Apparatus CL I/II/III DIV 1, GP ABCDEFG; CL I ZN 0 GP IIC Entity Temperature class T6 or CL I, DIV 1, GP ABCD, CL II/III, DIV 1, GP EFG; CL I ZN 1 GP IIC; Associated Apparatus CL I/II/III DIV 1, GP ABCDEFG; CL I ZN 0 GP IIC Temperature class T6; Associated Apparatus CL I/II/III DIV 1, GP ABCDEFG; CL I ZN 0 GP IIC Entity Temperature class T6 or CL I, DIV 1, GP CD, CL II/III, DIV 1, GP EFG; CL I ZN 1 GP IIB; Associated Apparatus CL I/II/III DIV 1, GP CDEFG; CL I ZN 0 GP IIB Entity Temperature class T6 or CL I, DIV 1, GP CD, CL II/III, DIV 1, GP EFG; CL I ZN 1 GP IIB; Associated Apparatus CL I/II/III DIV 1, GP CDEFG; CL I ZN 0 GP IIB Temperature class T6; Associated Apparatus CL I/II/III DIV 1, GP ABCDEFG; CL I ZN 0 GP IIB Entity Temperature class T6</p> <p>Remote sensor (depending on the model code): IS CL I/II/III, DIV 1, GP ABCDEFG; CL I, ZN 0, GP IIC Temperature class T* or IS CL I/II/III, DIV 1, GP ABCDEFG; CL I, ZN 0, GP IIB Temperature class T*</p>

Type	Approval or certification
FM (CA/US)	<p>Integral type (depending on the model code): CL I, DIV 1, GP ABCD, CL II/III, DIV 1, GP EFG; CL I ZN 1 GP IIC Temperature class T*</p> <p>or</p> <p>CL I, DIV 1, GP ABCD, CL II/III, DIV 1, GP EFG; CL I ZN 1 GP IIC Associated Apparatus CL I/II/III DIV 1 GP ABCDEFG; CL I ZN 0 GP IIC Entity Temperature class T*</p> <p>or</p> <p>CL I, DIV 1, GP CD, CL II/III, DIV 1, GP EFG; CL I ZN 1 GP IIB Temperature class T*</p> <p>or</p> <p>CL I, DIV 1, GP CD, CL II/III, DIV 1, GP EFG; CL I ZN 1 GP IIB Associated Apparatus CL I/II/III DIV 1 GP ABCDEFG; CL I ZN 0 GP IIC Entity Temperature class T*</p>
INMETRO (BR)	<p>INMETRO approval: DEKRA 16.0012X</p> <p>Applied standards:</p> <ul style="list-style-type: none"> ▪ ABNT NBR IEC 60079-0 ▪ ABNT NBR IEC 60079-1 ▪ ABNT NBR IEC 60079-7 ▪ ABNT NBR IEC 60079-11 ▪ ABNT NBR IEC 60079-31
	<p>Remote transmitter (depending on the model code): Ex db [ja Ga] IIC T6 Gb or Ex db e [ja Ga] IIC T6 Gb or Ex db [ja Ga] IIB T6 Gb or Ex db e [ja Ga] IIB T6 Gb Ex db [ja Ga] [ja IIC Ga] IIB T6 Gb or Ex db e [ja Ga] [ja IIC Ga] IIB T6 Gb or Ex tb [ja Da] IIIC T75 °C Db</p>
	<p>Remote sensor (depending on the model code): Ex ib IIC T6...T1 Gb or Ex ib IIB T6...T1 Gb Ex ib IIIC T150 °C Db or Ex ib IIIC T220 °C Db or Ex ib IIIC T350 °C Db</p>
	<p>Integral type (depending on the model code): Ex db ib IIC T6...T1 Gb or Ex db e ib IIC T6...T1 Gb or Ex db ib IIB T6...T1 Gb or Ex db e ib IIB T6...T1 Gb or Ex db ib [ja Ga] IIC T6...T1 Gb or Ex db e ib [ja Ga] IIC T6...T1 Gb or Ex db ib [ja IIC Ga] IIB T6...T1 Gb or Ex db e ib [ja IIC Ga] IIB T6...T1 Gb Ex ib tb IIIC T150 °C Db or Ex ib tb [ja Da] IIIC T150 °C Db</p>

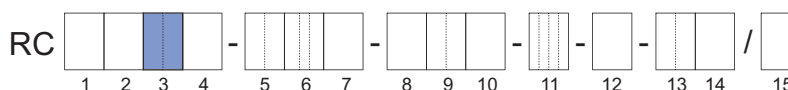
Type	Approval or certification
NEPSI (CN)	<p>Applied standards:</p> <ul style="list-style-type: none"> ▪ GB3836.1 ▪ GB3836.2 ▪ GB3836.3 ▪ GB3836.4 ▪ GB3836.19 ▪ GB3836.20
	<p>Remote transmitter (depending on the model code): Ex db [ia Ga] IIC T6 Gb or Ex db e [ia Ga] IIC T6 Gb or Ex db [ia Ga] IIB T6 Gb or Ex db e [ia Ga] IIB T6 Gb Ex db [ia Ga] [ia IIC Ga] IIB T6 Gb or Ex db e [ia Ga] [ia IIC Ga] IIB T6 Gb or Ex [iaD 20] tD A21 IP6X T75°C</p> <p>Note: The marking on the product may be changed from Ex e to Ex eb based on statutory requirements.</p>
	<p>Remote sensor (depending on the model code): Ex ib IIC T6...T1 Gb or Ex ib IIB T6...T1 Gb Ex ibD 21 IP6X T150°C or Ex ibD 21 IP6X T220°C or Ex ibD 21 IP6X T350°C</p>
	<p>Integral type (depending on the model code): Ex db ib IIC T6...T1 Gb or Ex db e ib IIC T6...T1 Gb or Ex db ib IIB T6...T1 Gb or Ex db e ib IIB T6...T1 Gb or Ex db ib [ia Ga] IIC T6...T1 Gb or Ex db e ib [ia Ga] IIC T6...T1 Gb or Ex db ib [ia IIC Ga] IIB T6...T1 Gb or Ex db e ib [ia IIC Ga] IIB T6...T1 Gb Ex ibD 21 tD A21 IP6X T150°C or Ex [iaD 20] ibD 21 tD A21 IP6X T150°C</p> <p>Note: The marking on the product may be changed from Ex e to Ex eb based on statutory requirements.</p>

Type	Approval or certification
PESO (IN)	<p>PESO approval: PESO approval is based on ATEX certification by DEKRA Certificate Number: DEKRA 15ATEX0023 X</p> <p>PESO approval is only valid for type of protection “d” flameproof enclosure. Option Q11 must be ordered for conformity of device with PESO requirements.</p> <p>PESO Equip. Ref. No. P4...:</p> <p>P400958/_ P400964/_ P400966/_ P400967/_ P400969/_ P400970/_ P400971/_ P400972/_ P400973/_</p> <p>Applied standards:</p> <ul style="list-style-type: none"> ▪ EN 60079-0 +A11 ▪ IS/IEC 60079-1 ▪ EN 60079-11
	<p>Remote transmitter (depending on the model code): Ex db [ia Ga] IIC T6 Gb or Ex db [ia Ga] IIB T6 Gb or Ex db [ia Ga] [ia IIC Ga] IIB T6 Gb</p>
	<p>Remote sensor (depending on the model code): Ex ib IIC T6...T1 Gb or Ex ib IIB T6...T1 Gb</p>
	<p>Integral type (depending on the model code): Ex db ib IIC T6...T1 Gb or Ex db ib IIB T6...T1 Gb or Ex db ib [ia Ga] IIC T6...T1 Gb or Ex db ib [ia IIC Ga] IIB T6...T1 Gb</p>

Type	Approval or certification
Safety Label (TW)	Please refer to IECEx approval for specifications. A device with IECEx approval (model code position 11, value: SF2_) must be ordered to comply with Safety Label requirements. For export to Taiwan and to get the Safety Label the Yokogawa representative in Taiwan must be contacted in advance.
Ingress protection	IP66/67 and NEMA 4X
EMC	EU directive 2014/30/EU per EN 61326-1 Class A Table 2 and EN 61326-2-3
	NAMUR NE21
	RCM in Australia/New Zealand
	KC mark in Korea
	TR CU 020 in EAC area
Korea Ex EAC Ex	For further information please contact your Yokogawa representative
LVD	EU directive 2014/35/EU per EN 61010-1 and EN 61010-2-030
	TR CU 004 in EAC area
PED	EU directive 2014/68/EU per AD 2000 Code
	TR CU 032 in EAC area
Marine	DNV GL Type approval according to DNVGL-CP-0338 for options MC2 and MC3
RoHS	EU directive 2011/65/EU per EN 50581
WEEE	EU directive 2012/19/EU (Waste Electrical and Electronic Equipment) is only valid in the European Economic Area.
	This instrument is intended to be sold and used only as a part of equipment which is excluded from the WEEE directive, such as large-scale stationary industrial tools, a large-scale fixed installation etc., and therefore it is in principle fully compliant with WEEE directive. The instrument should be disposed of in accordance with applicable national legislations or regulations, respectively.
SIL	Exida Certificate per IEC61508:2010 Parts 1-7 SIL 2 @ HFT=0; SIL 3 @ HFT =1
NAMUR	NAMUR NE95 compliant
Metrological Regulations	Rotamass Total Insight is registered as a measuring instrument in the following countries: <ul style="list-style-type: none"> ▪ China ▪ Russia
	Please contact your Yokogawa representative regarding respective "Pattern Approval Certificate of Measuring Instruments" and export to these countries.
ASME	ASME B31.3 compliance

10 Ordering information

10.1 Overview model code Intense 34

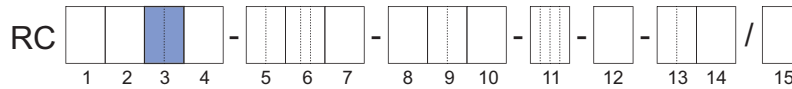


Model code position	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	Description	Restriction
Transmitter	E														Essential (base function)	not with accuracy C2, C3, 50 not with communication type and I/O JH, JJ, JK, JL, JM, JN, M2, M7 not with option CGC, C52, BT, VM
	U														Ultimate (high function)	not with accuracy E7, D7, 70 not with display 0
Sensor	T														Intense	–
Meter size	34														Nominal mass flow : 3 t/h (110 lb/min) Maximum mass flow: 5 t/h (180 lb/min)	not with option FE
Material wetted parts	S														Stainless steel 1.4404/316L	–
	H														Ni alloy C-22/2.4602	not with option RT, RTA, MC_, P2_
Process connection size	08														3/8"	–
	15														1/2"	
	20														3/4"	
	25														1"	
Process connection type	BA5														ASME flange class 900, suitable for ASME B16.5, raised face (RF)	see tables on page [39]
	CA5														ASME flange class 900, suitable for ASME B16.5, ring joint (RJ)	
	BA6														ASME flange class 1500, suitable for ASME B16.5, raised face (RF)	
	CA6														ASME flange class 1500, suitable for ASME B16.5, ring joint (RJ)	
	TG9														Process connection with internal thread G	not with option WPA, RTA, PTA, P2_
	TT9														Process connection with internal thread NPT	see tables on page [40]
Sensor housing material	0														Stainless steel 1.4301/304, 1.4404/316L	–
	1														Stainless steel 1.4404/316L	not with option SA
Process fluid temperature range	0														Standard, integral type: -50 – 150 °C (-58 – 302 °F), remote type: -70 – 150 °C (-94 – 302 °F)	–
Mass flow and density accuracy	E7														Liquid: 0.2 % maximum mass flow deviation D_{flat} , 4 g/l density deviation	not with transmitter U
	D7														Liquid: 0.15 % maximum mass flow deviation D_{flat} , 4 g/l density deviation	
	C3														Liquid: 0.1 % maximum mass flow deviation D_{flat} , 1 g/l density deviation	not with transmitter E
	C2														Liquid: 0.1 % maximum mass flow deviation D_{flat} , 0.5 g/l density deviation	not with option RT, RTA, P2_
	70														Gas: 0.75 % maximum mass flow deviation D_{flat}	not with transmitter U not with option VM
	50														Gas: 0.5 % maximum mass flow deviation D_{flat}	not with transmitter E not with option C52, VM

Model code position	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	Description	Restriction
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 aluminum transmitter housing		
											A			Remote type with "urethane-cured polyester powder coating" coated aluminum transmitter housing and standard neck sensor	not with option RB	
											B			Remote type with "urethane-cured polyester powder coating" coated aluminum transmitter housing and long neck sensor		
											E			Remote type with "corrosion protection coating" coated aluminum transmitter housing and standard neck sensor		
											F			Remote type with "corrosion protection coating" coated aluminum transmitter housing and long 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	
											K			Remote type stainless steel transmitter and long 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 not with option Q11	
											KF21			ATEX, explosion group IIC and IIIC	not with design and housing J, K	
											KF22			ATEX, explosion group IIB and IIIC	–	
											SF21			IECEX, explosion group IIC and IIIC	not with design and housing J, K 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, K 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 not with option Y____, Q11	
											FF12			FM, groups C, D, E, F, G	not with process connection type TG9, TT9	
											UF21			INMETRO, explosion group IIC and IIIC	not with design and housing J, K not with option Q11	
											UF22			INMETRO, explosion group IIB and IIIC	– not with option Q11	
											NF21			NEPSI, explosion group IIC and IIIC	not with design and housing J, K 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, K 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		

Model code position	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	Description	Restriction
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	
													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	
	Communication type and I/O													JP		
													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	
													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	
Display													0		No display	not with transmitter U
													1		With display	–

10.2 Overview model code Intense 36

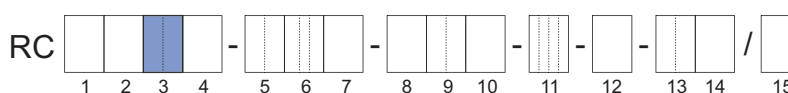


Model code position	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	Description	Restriction
Transmitter	E														Essential (base function)	not with accuracy C2, C3, 50 not with communication type and I/O JH, JJ, JK, JL, JM, JN, M2, M7 not with option CGC, C52, BT, VM
	U														Ultimate (high function)	not with accuracy E7, D7, 70 not with display 0
Sensor	T														Intense	-
Meter size	36														Nominal mass flow : 10 t/h (370 lb/min) Maximum mass flow: 17 t/h (620 lb/min)	-
Material wetted parts	S														Stainless steel 1.4404/316L	-
Process connection size	25														1"	-
	50														2"	-
Process connection type	BA5														ASME flange class 900, suitable for ASME B16.5, raised face (RF)	see tables on page [39]
	CA5														ASME flange class 900, suitable for ASME B16.5, ring joint (RJ)	
Sensor housing material	0														Stainless steel 1.4301/304, 1.4404/316L	-
	1														Stainless steel 1.4404/316L	not with option SA
Process fluid temperature range	0														Standard, integral type: -50 – 150 °C (-58 – 302 °F), remote type: -70 – 150 °C (-94 – 302 °F)	-
Mass flow and density accuracy	E7														Liquid: 0.2 % maximum mass flow deviation D_{flat} , 4 g/l density deviation	not with transmitter U
	D7														Liquid: 0.15 % maximum mass flow deviation D_{flat} , 4 g/l density deviation	
	C3														Liquid: 0.1 % maximum mass flow deviation D_{flat} , 1 g/l density deviation	not with transmitter E
	C2														Liquid: 0.1 % maximum mass flow deviation D_{flat} , 0.5 g/l density deviation	
	70														Gas: 0.75 % maximum mass flow deviation D_{flat}	not with transmitter U not with option VM
	50														Gas: 0.5 % maximum mass flow deviation D_{flat}	not with transmitter E not with option 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 aluminum transmitter housing	
	A														Remote type with "urethane-cured polyester powder coating" coated aluminum transmitter housing and standard neck sensor	not with option RB
	B														Remote type with "urethane-cured polyester powder coating" coated aluminum transmitter housing and long neck sensor	
	E														Remote type with "corrosion protection coating" coated aluminum transmitter housing and standard neck sensor	
	F														Remote type with "corrosion protection coating" coated aluminum transmitter housing and long 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
K														Remote type stainless steel transmitter and long neck sensor	not with Ex approval KF21, SF21, GF21, UF21, NF21, PF21 not with option RB	

Model code position	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	Description	Restriction	
Ex approval											11.	12.	13.	14.	NN00	None	not with communication type and I/O JP, JQ, JR, JS not with option Q11
															KF21	ATEX, explosion group IIC and IIIC	not with design and housing J, K
															KF22	ATEX, explosion group IIB and IIIC	–
															SF21	IECEX, explosion group IIC and IIIC	not with design and housing J, K 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, K 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 not with option Y____, Q11
															FF12	FM, groups C, D, E, F, G	not with process connection type TG9, TT9
															UF21	INMETRO, explosion group IIC and IIIC	not with design and housing J, K not with option Q11
															UF22	INMETRO, explosion group IIB and IIIC	– not with option Q11
															NF21	NEPSI, explosion group IIC and IIIC	not with design and housing J, K 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, K 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	

Model code position	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	Description	Restriction
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	
													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	
	Communication type and I/O													JP		
													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	
													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	
Display													0		No display	not with transmitter U
													1		With display	-

10.3 Overview model code Intense 38

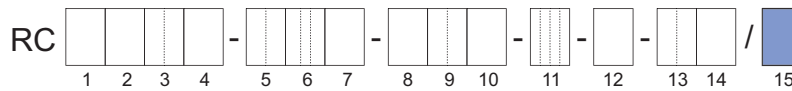


Model code position	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	Description	Restriction
Transmitter	E														Essential (base function)	not with accuracy C2, C3, 50 not with communication type and I/O JH, JJ, JK, JL, JM, JN, M2, M7 not with option CGC, C52, BT, VM
	U														Ultimate (high function)	not with accuracy E7, D7, 70 not with display 0
Sensor	T														Intense	-
Meter size	38														Nominal mass flow : 32 t/h (1200 lb/min) Maximum mass flow: 50 t/h (1800 lb/min)	-
Material wetted parts	S														Stainless steel 1.4404/316L	-
Process connection size	50														2"	-
Process connection type	BA5														ASME flange class 900, suitable for ASME B16.5, raised face (RF)	see tables on page [39]
	CA5														ASME flange class 900, suitable for ASME B16.5, ring joint (RJ)	
Sensor housing material	0														Stainless steel 1.4301/304, 1.4404/316L	-
	1														Stainless steel 1.4404/316L	not with option SA
Process fluid temperature range	0														Standard, integral type: -50 – 150 °C (-58 – 302 °F), remote type: -70 – 150 °C (-94 – 302 °F)	-
Mass flow and density accuracy	E7														Liquid: 0.2 % maximum mass flow deviation D_{flat} , 4 g/l density deviation	not with transmitter U
	D7														Liquid: 0.15 % maximum mass flow deviation D_{flat} , 4 g/l density deviation	
	C3														Liquid: 0.1 % maximum mass flow deviation D_{flat} , 1 g/l density deviation	not with transmitter E
	C2														Liquid: 0.1 % maximum mass flow deviation D_{flat} , 0.5 g/l density deviation	
	70														Gas: 0.75 % maximum mass flow deviation D_{flat}	not with transmitter U not with option VM
	50														Gas: 0.5 % maximum mass flow deviation D_{flat}	not with transmitter E not with option 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 aluminum transmitter housing	
	A														Remote type with "urethane-cured polyester powder coating" coated aluminum transmitter housing and standard neck sensor	not with option RB
	B														Remote type with "urethane-cured polyester powder coating" coated aluminum transmitter housing and long neck sensor	
	E														Remote type with "corrosion protection coating" coated aluminum transmitter housing and standard neck sensor	
	F														Remote type with "corrosion protection coating" coated aluminum transmitter housing and long 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
K														Remote type stainless steel transmitter and long neck sensor	not with Ex approval KF21, SF21, GF21, UF21, NF21, PF21 not with option RB	

Model code position	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	Description	Restriction
Ex approval											NN00				None	not with communication type and I/O JP, JQ, JR, JS not with option Q11
											KF21				ATEX, explosion group IIC and IIIC	not with design and housing J, K
											KF22				ATEX, explosion group IIB and IIIC	–
											SF21				IECEX, explosion group IIC and IIIC	not with design and housing J, K 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, K 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 not with option Y_..., Q11
											FF12				FM, groups C, D, E, F, G	not with process connection type TG9, TT9
											UF21				INMETRO, explosion group IIC and IIIC	not with design and housing J, K not with option Q11
											UF22				INMETRO, explosion group IIB and IIIC	– not with option Q11
											NF21				NEPSI, explosion group IIC and IIIC	not with design and housing J, K 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, K 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 1/2" NPT	–
												4		ISO M20x1.5	not with Ex approval FF11 or FF12	

Model code position	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	Description	Restriction
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	
													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	
	Communication type and I/O													JP		
													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	
													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	not with transmitter E, not with option PS, BT, VM	
												M7		Modbus output, 1 passive pulse or status output, 1 passive current input		
Display													0		No display	not with transmitter U
													1		With display	–

10.4 Overview options



Option category	Options	Description	Restriction
Additional nameplate information	BG	Nameplate with customer device location identification	–
Presetting of customer parameters	PS	Presetting according to customer parameters	not with communication type and I/O M ₁
Country-specific delivery	PJ	Delivery to Japan	not with option QR
	CN	Delivery to China	
	KC	Delivery to Korea	–
	VE	Delivery to EAC area	–
	VR	Delivery to EAC area and Russia Pattern Approval marking	–
Country-specific application	Q11	PESO approval delivery	only with Ex proof KF2 ₁
	QR	Primary calibration valid in Russia, including certificate	only with option VE or VR
Concentration and petroleum measurement	C52	Net Oil Computing (NOC) following API standard	not with transmitter type E not with mass flow and density accuracy 70, 50
Rupture disc	RD	Rupture disc	–
Mass flow calibration	K2	Customer-specific 5-point mass flow calibration with factory calibration certificate (mass flow or volume flow of water). A table listing the desired calibration points must be supplied with the order.	–
	K5	Customer-specific 10-point mass flow calibration with DAkkS calibration certificate (mass flow or volume flow of water). A table listing the desired calibration points must be supplied with the order.	
Accordance with terms of order	P2	Declaration of compliance with the order 2.1 according to EN 10204	not with option P10, P11, P12, P13, P21, P22
	P3	Quality Inspection Certificate (Inspection Certificate 3.1 according to EN 10204)	
Material certificates	P6	Certificate of Marking Transfer and Raw Material Certificates (Inspection Certificate 3.1 according to EN 10204)	not with option P10, P11, P12, P13, P21, P22
Pressure testing	P8	Hydrostatic Pressure Test Certificate (Inspection Certificate 3.1 according to EN 10204)	not with option P10, P12, P13, P14, P21
Surfaces free of oil and grease	H1	Degreasing of wetted surfaces according to ASTM G93-03 (Level C), including test report	–

Option category	Options	Description	Restriction
Welding certificates	WP	WPS according to DIN EN ISO 15609-1	not with option P13, P14, P15, P2_
		WPQR according to DIN EN ISO 15614-1	
		WQC according to DIN EN 287-1 or DIN EN ISO 6906-4	
	WPA	Welding procedures and Certificate according to ASME IX	only with process connection type BA_ or CA_ not with option P12, P13, P14, P2_
X-ray inspection of flange weld seam	RT	X-ray inspection of flange weld seam according to DIN EN ISO 17636-1/B Evaluation according to AD 2000 HP 5/3 and DIN EN ISO 5817/C, including certificate	not with material wetted parts H not with Intense 34 for mass flow and density accuracy C2, C3 not with option P15, P2_
	RTA	X-ray test according to ASME V	not with material wetted parts H not with Intense 34 for mass flow and density accuracy C2, C3 only with process connection type BA_ or CA_ not with option P12, P13, P14, P2_
Dye penetration test of weld seams	PT	Dye penetration test of process connection weld seams according to DIN EN ISO 3452-1, including certificate	not with option P12, P13, P15, P2_
	PTA	Dye Penetrant test of flange welding according to ASME V	only with process connection type BA_ or CA_ not with option P12, P13, P14, P2_
Ferrite testing	FE	Ferrite test for flange welding acc. DIN EN ISO 8249	not with meter size 34
Transmitter housing rotated 180°	RB	Alignment of transmitter housing rotated 180°	not with design and housing A, B, E, F, J, K
Measurement of heat quantity	CGC	Measurement of the total transported energy content of a fuel in connection with a sensor for determining the fuel's calorific value (e.g. a gas chromatograph, not included in scope of delivery)	not with transmitter type E only with communication type and I/O JH, JJ, JK, JL, JM, JN, M2, M7

Option category	Options	Description	Restriction
Connecting cable type and length	L000	without standard connecting cable	not with design and housing 0, 2 not with option MC_
	L005	5 meter (16.4 ft) remote connecting cable terminated std. gray / Ex blue	
	L010	10 meter (32.8 ft) remote connecting cable terminated std. gray / Ex blue	
	L015	15 meter (49.2 ft) remote connecting cable terminated std. gray / Ex blue	
	L020	20 meter (65.6 ft) remote connecting cable terminated std. gray / Ex blue	
	L030	30 meter (98.4 ft) remote connecting cable terminated std. gray / Ex blue	
Connecting cable type and length	Y000	without fire retardant connecting cable	not with design and housing 0, 2 not with Ex approval FF11, FF12
	Y005	5 meter (16.4 ft) remote fire retardant connecting cable not terminated	
	Y010	10 meter (32.8 ft) remote fire retardant connecting cable not terminated	
	Y015	15 meter (49.2 ft) remote fire retardant connecting cable not terminated	
	Y020	20 meter (65.6 ft) remote fire retardant connecting cable not terminated	
	Y030	30 meter (98.4 ft) remote fire retardant connecting cable not terminated	
Marine Approval	MC2	Marine approval according to DNV GL piping class 2	not with material wetted parts H, design and housing 0, 2, communication type and I/O JP, JQ, JR, JS
	MC3	Marine approval according to DNV GL piping class 3	only with option Y_... in case of thermal oil applications option RT or RTA is mandatory
Combined certificate	P10	Combination of: <ul style="list-style-type: none"> ▪ P3: Quality Inspection Certificate ▪ P6: Certificate of Marking Transfer and Raw Material Certificates ▪ P8: Hydrostatic Pressure Test Certificate 	not with option P3, P6, P8
	P11	Combination of: <ul style="list-style-type: none"> ▪ P3: Quality Inspection Certificate ▪ P6: Certificate of Marking Transfer and Raw Material Certificates ▪ PM: Positive Material Identification of wetted parts 	not with option P3, P6, PM

Option category	Options	Description	Restriction
Combined certificate	P12	Combination of: <ul style="list-style-type: none"> ▪ P3: Quality Inspection Certificate ▪ P6: Certificate of Marking Transfer and Raw Material Certificates ▪ PT: Dye penetration test according to DIN EN ISO 3452-1 ▪ P8: Hydrostatic Pressure Test Certificate 	not with option P3, P6, P8, P15, PT, WPA, RTA, PTA
	P13	Combination of: <ul style="list-style-type: none"> ▪ P3: Quality Inspection Certificate ▪ P6: Certificate of Marking Transfer and Raw Material Certificates ▪ PT: Dye penetration test according to DIN EN ISO 3452-1 ▪ PM: Positive Material Identification of wetted parts ▪ P8: Hydrostatic Pressure Test Certificate ▪ WP: Welding certificates 	not with option P3, P6, P8, P15, WP, PM, PT, WPA, RTA, PTA
	P14	Combination of: <ul style="list-style-type: none"> ▪ PM: Positive Material Identification of wetted parts ▪ P8: Hydrostatic Pressure Test Certificate ▪ WP: Welding certificates 	not with option P8, P15, WP, PM, WPA, RTA, PTA
	P20	Combination of: <ul style="list-style-type: none"> ▪ PTA: Dye Penetrant test of flange welding according to ASME V ▪ WPA: Welding procedures and Certificates according to ASME IX ▪ RTA: X-ray test according to ASME V 	not with material wetted parts H not with meter size 34 for mass flow and density accuracy C3, C2 only with process connection type BA_ or CA_ not with option WP, WPA, RT, RTA, PT, PTA
	P21	Combination of: <ul style="list-style-type: none"> ▪ P3: Quality Inspection Certificate ▪ P6: Certificate of Marking Transfer and Raw Material Certificates ▪ P8: Hydrostatic Pressure Test Certificate ▪ PTA: Dye Penetrant test of flange welding according ASME V ▪ WPA: Welding procedures and Certificates according to ASME IX ▪ RTA: X-ray test according to ASME V 	not with material wetted parts H not with meter size 34 for mass flow and density accuracy C3, C2 only with process connection type BA_ or CA_ not with option P3, P6, P8, WP, WPA, RT, RTA, PT, PTA

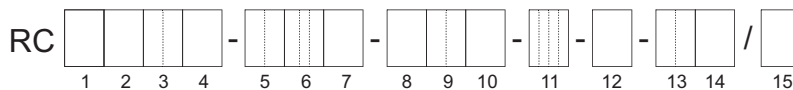
Option category	Options	Description	Restriction
Combined certificate	P22	Combination of: <ul style="list-style-type: none"> ▪ P3: Quality Inspection Certificate ▪ P6: Certificate of Marking Transfer and Raw Material Certificates ▪ PM: Positive Material Identification of wetted parts ▪ PTA: Dye Penetrant test of flange welding according ASME V ▪ WPA: Welding procedures and Certificates according to ASME IX ▪ RTA: X-ray test according to ASME V 	not with material wetted parts H not with meter size 34 for mass flow and density accuracy C3, C2 only with process connection type BA_ or CA_ not with option P3, P6, WP, WPA, RT, RTA, PM, PT, PTA
Positive Material Identification of wetted parts	PM	Positive Material Identification of wetted parts, including certificate (Inspection Certificate 3.1 according to EN 10204)	not with option P11, P13, P14, P22
Tube health check	TC	Tube health check	–
ASME B31.3 compliance	P15	ASME B31.3 compliance NORMAL FLUID SERVICE	only with process connection type BA_ or CA_ not with option WP, RT, PT, P12, P13, P14, T_
Batching function	BT	Batching and filling function	not with transmitter type E only with communication type and I/O J_
Viscosity function	VM	Viscosity computing function for liquids	not with transmitter type E not with mass flow and density accuracy 70, 50 only with communication type and I/O JH, JJ, JK, JL, JM, JN

10.5 Model code

The model code of the Rotamass Total Insight is explained below.

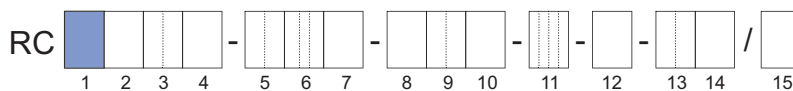
Items 1 through 14 are mandatory entries and must be specified at the time of ordering.

Device options (item 15) can be selected and specified individually by separating them with slashes.



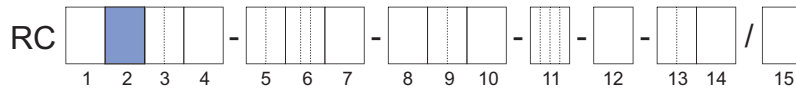
1. Transmitter
2. Sensor
3. Meter size
4. Material wetted parts
5. Process connection size
6. Process connection type
7. Sensor housing material
8. Process fluid temperature range
9. Mass flow and density accuracy
10. Design and housing
11. Ex approval
12. Cable entries
13. Communication type and I/O
14. Display
15. Options

10.5.1 Transmitter



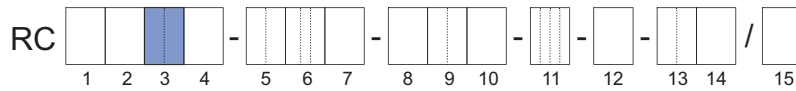
Model code position 1	Transmitter
E	Essential
U	Ultimate

10.5.2 Sensor



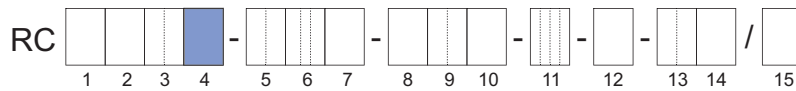
Model code position 2	Sensor
T	Intense

10.5.3 Meter size



Model code position 3	Meter size	Nominal mass flow in t/h (lb/min)	Maximum mass flow in t/h (lb/min)
34	34	3 (110)	5 (180)
36	36	10 (370)	17 (620)
38	38	32 (1200)	50 (1800)

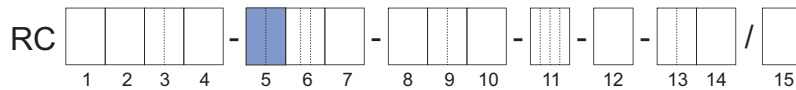
10.5.4 Material wetted parts



Model code position 4	Material wetted parts
S	Stainless steel 1.4404/316L
H	Ni alloy C-22/2.4602 (only available for meter size 34)

Non-wetted parts of the process connection are generally made of stainless steel 1.4404/316L.

10.5.5 Process connection size

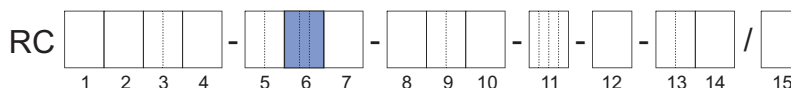


Model code position 5	Process connection size
08	3/8"
15	1/2"
20	3/4"
25	1"
50	2"



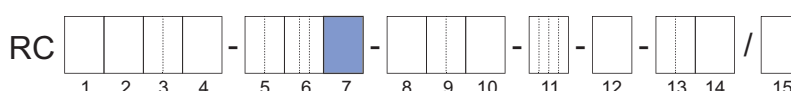
Available sizes depend on the actual process connection, see also chapter *Process connections, dimensions and weights of sensor* [▶ 38].

10.5.6 Process connection type



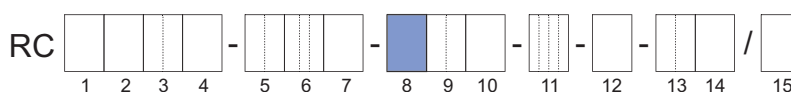
Model code position 6	Type	Process connections
BA5	Flanges suitable for ASME B16.5	ASME flange class 900, raised face (RF)
CA5		ASME flange class 900, ring joint (RJ)
BA6		ASME flange class 1500, raised face (RF)
CA6		ASME flange class 1500, ring joint (RJ)
TG9	Process connections with internal thread	Process connection with internal thread G
TT9		Process connection with internal thread NPT

10.5.7 Sensor housing material



Model code position 7	Housing material
0	Stainless steel 1.4301/304, 1.4404/316L
1	Stainless steel 1.4404/316L

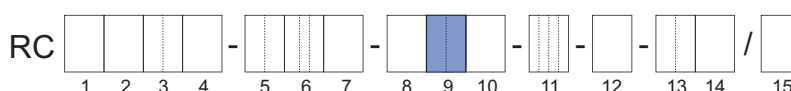
10.5.8 Process fluid temperature range



Model code position 8	Temperature range	Process fluid temperature range
0	Standard	Integral type: -50 – 150 °C (-58 – 302 °F) Remote type: -70 – 150 °C (-94 – 302 °F)

For temperature range limits, see chapter *Process fluid temperature range* [28].

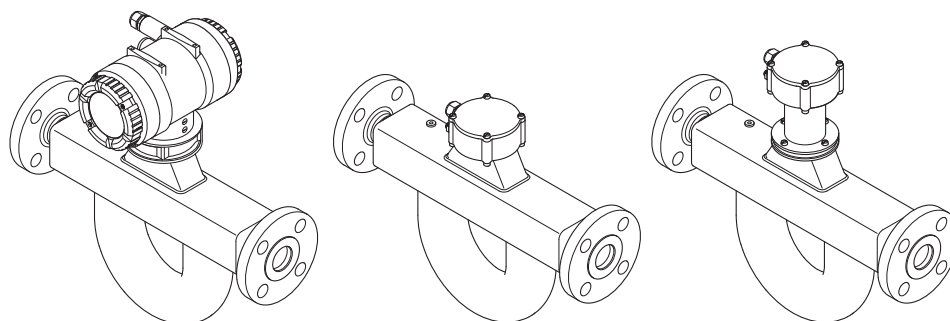
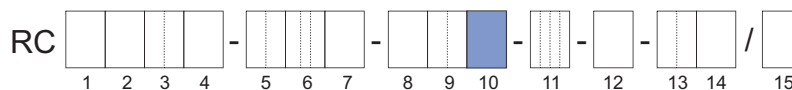
10.5.9 Mass flow and density accuracy



Fluid	Model code position 9	Maximum deviation		Model code position 1
		Mass flow D_{flat} in %	Density in g/l	
Liquid	E7	0.2	4	E
	D7	0.15	4	E
	C3	0.1	1	U
	C2		0.5	U
Gas	70	0.75	–	E
	50	0.5	–	U

Devices with value _2 in model code position 9 receive an additional density calibration with a corresponding certificate.

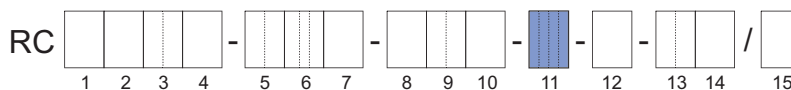
10.5.10 Design and housing



Model code position 10	Design type	Transmitter housing material	Transmitter housing coating	Sensor terminal box material	Long neck
0	Integral type	Aluminum	Standard coating	-	-
2			Corrosion protection coating		
A	Remote type	Aluminum	Standard coating	Stainless steel	No
B			Corrosion protection coating		Yes
E			Corrosion protection coating		No
F		Stainless Steel	Yes		
J		Stainless Steel	-		No
K	Stainless Steel	-	Yes		

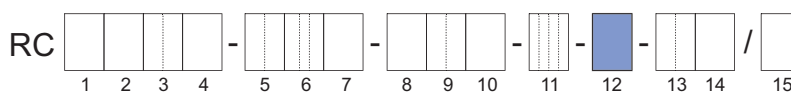
The remote type requires a connecting cable to connect sensor and transmitter. It can be selected in various lengths as a device option, see *Connecting cable type and length* [89].

10.5.11 Ex approval



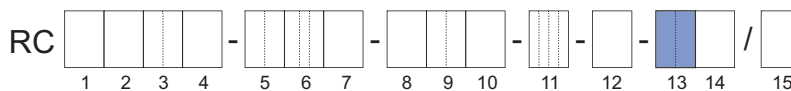
Model code position 11	Ex approval
NN00	None
KF21	ATEX, explosion group IIC and IIIC
KF22	ATEX, explosion group IIB and IIIC
SF21	IECEX, explosion group IIC and IIIC
SF22	IECEX, explosion group IIB and IIIC
FF11	FM, group A, B, C, D, E, F, G
FF12	FM, group C, D, E, F, G
GF21	EAC Ex, explosion group IIC and IIIC
GF22	EAC Ex, explosion group IIB and IIIC
UF21	INMETRO, explosion group IIC and IIIC
UF22	INMETRO, explosion group IIB and IIIC
NF21	NEPSI, explosion group IIC and IIIC
NF22	NEPSI, explosion group IIB and IIIC
PF21	Korea Ex, explosion group IIC and IIIC
PF22	Korea Ex, explosion group IIB and IIIC

10.5.12 Cable entries



Model code position 12	Cable entries
2	ANSI 1/2" NPT
4	ISO M20x1.5

10.5.13 Communication type and I/O



HART I/O

Model code position 13	Connection terminal assignment				
	I/O1 +/-	I/O2 +/-	I/O3 +/-	I/O4 +/-	WP
JA	Iout1 Active	P/Sout1 Passive	–	–	Write-protect
JB	Iout1 Active	P/Sout1 Passive	P/Sout2 Passive	Iout2 Active	Write-protect
JC	Iout1 Active	P/Sout1 Passive	Sin	Iout2 Active	Write-protect
JD	Iout1 Active	P/Sout1 Passive	Sout Passive	P/Sout2 Passive	Write-protect
JE	Iout1 Active	P/Sout1 Passive	Sin	P/Sout2 Passive	Write-protect

Model code position 13	Connection terminal assignment				
	I/O1 +/-	I/O2 +/-	I/O3 +/-	I/O4 +/-	WP
JF	lout1 Active	P/Sout1 Passive	Sin	P/Sout2 Active Internal pull-up resistor	Write-protect
JG	lout1 Active	P/Sout1 Passive	Sin	P/Sout2 Active	Write-protect
JH	lout1 Active	P/Sout1 Passive	lout2 Passive	lin Active	Write-protect
JJ	lout1 Active	P/Sout1 Passive	P/Sout2 Passive	lin Active	Write-protect
JK	lout1 Active	P/Sout1 Passive	Sin	lin Active	Write-protect
JL	lout1 Active	P/Sout1 Passive	lout2 Passive	lin Passive	Write-protect
JM	lout1 Active	P/Sout1 Passive	P/Sout2 Passive	lin Passive	Write-protect
JN	lout1 Active	P/Sout1 Passive	Sin	lin Passive	Write-protect

- lout1 Analog current output with HART communication
- lout2 Analog current output
- lin Analog current input
- P/Sout1 Pulse or status output
- P/Sout2 Pulse or status output
- Sin Status input
- Sout Status output

HART I/O, intrinsically safe

Model code position 13	Connection terminal assignment				
	I/O1 +/-	I/O2 +/-	I/O3 +/-	I/O4 +/-	WP
JP	lout1 Passive	P/Sout1 Passive	lout2 Passive	–	Write-protect
JQ	lout1 Passive	P/Sout1 Passive	lout2 Passive	P/Sout2 Passive	Write-protect
JR	lout1 Passive	P/Sout1 Passive NAMUR	lout2 Passive	–	Write-protect
JS	lout1 Passive	P/Sout1 Passive NAMUR	lout2 Passive	P/Sout2 Passive NAMUR	Write-protect

- lout1 Analog current output with HART communication
- lout2 Analog current output
- P/Sout1 Pulse or status output
- P/Sout2 Pulse or status output

Intrinsically safe outputs are only available in combination with selecting Ex approval of the device, see chapter *Ex approval* [▶ 85].

Modbus I/O

Model code position 13	Connection terminal assignment						
	I/O1 +/-	I/O2 +/-	I/O3 +	I/O3 -	I/O4 +	I/O4 -	WP
M0	–	P/Sout1 Passive	–	Modbus C	Modbus B	Modbus A	Write-protect
M2	lin Active	P/Sout1 Passive	–	Modbus C	Modbus B	Modbus A	Write-protect
M3	P/Sout2 Passive	P/Sout1 Passive	–	Modbus C	Modbus B	Modbus A	Write-protect
M4	P/Sout2 Active	P/Sout1 Passive	–	Modbus C	Modbus B	Modbus A	Write-protect
M5	P/Sout2 Active Internal pull-up resistor	P/Sout1 Passive	–	Modbus C	Modbus B	Modbus A	Write-protect
M6	lout1 Active	P/Sout1 Passive	–	Modbus C	Modbus B	Modbus A	Write-protect
M7	lin Passive	P/Sout1 Passive	–	Modbus C	Modbus B	Modbus A	Write-protect

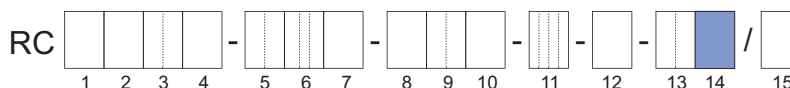
lout Analog current output, no HART

lin Analog current input

P/Sout1 Pulse or status output

P/Sout2 Pulse or status output

10.5.14 Display



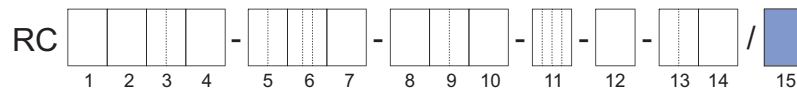
The display unit includes a slot for the microSD card.

Model code position 14	Display
0	Without display
1	With display

Devices without a display are available for Essential transmitters only (value E in model code position 1).

10.6 Options

Additional device options that can be combined may be selected; they are listed sequentially in model code position 15. In this case, each device option is preceded by a slash.



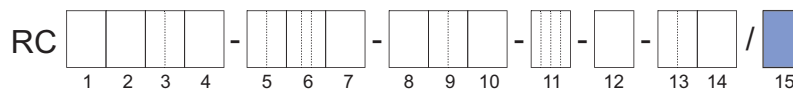
The following device options are possible:

- Connecting cable length, see chapter *Connecting cable type and length* [▶ 89].
- Customer-specific adaptation of the nameplate, see chapter *Additional nameplate information* [▶ 89].
- Flow meter presetting with customer parameters, see chapter *Presetting of customer parameters* [▶ 89].
- Concentration and petroleum measurement, see chapter *Concentration and petroleum measurement* [▶ 90].
- Batching function, see chapter *Batching function* [▶ 90].
- Viscosity function, see chapter *Viscosity function* [▶ 90].
- Certificates to be supplied, see chapter *Certificates* [▶ 90], e.g.:
 - Positive Material Identification of wetted parts, see chapter *Certificates* [▶ 91].
 - X-ray inspection of flange weld seam, see chapter *Certificates* [▶ 91].
 - Ferrite testing, see chapter *Certificates* [▶ 91].
- Country -specific delivery *Country-specific delivery* [▶ 93].
- Country -specific application *Country-specific application* [▶ 93].
- Rupture disc, see chapter *Rupture disc* [▶ 93].
- Tube health check, see chapter *Tube health check* [▶ 94].
- Transmitter housing rotated 180°, see chapter *Transmitter housing rotated 180°* [▶ 94].
- Measurement of heat quantity, see chapter *Measurement of heat quantity* [▶ 94].
- Marine type approval, see chapter *Marine Approval* [▶ 95].

10.6.1 Connecting cable type and length

When ordering the remote type it is mandatory to select one of the below shown connecting cable lengths.

It is possible to order cables with higher length than the maximum cable length and termination kits separately. For this purpose please check the "Customers Maintenance Parts List" (Ref.: CMPL 01U10B00-00EN-R) or consult our Service team.



Options	Specification
L000	without standard connecting cable ¹⁾
L005	5 meter (16.4 ft) remote connecting cable terminated std. gray / Ex blue
L010	10 meter (32.8 ft) remote connecting cable terminated std. gray / Ex blue
L015	15 meter (49.2 ft) remote connecting cable terminated std. gray / Ex blue
L020	20 meter (65.6 ft) remote connecting cable terminated std. gray / Ex blue
L030	30 meter (98.4 ft) remote connecting cable terminated std. gray / Ex blue
Y000	without fire retardant connecting cable ¹⁾
Y005	5 meter (16.4 ft) remote fire retardant connecting cable, not terminated
Y010	10 meter (32.8 ft) remote fire retardant connecting cable, not terminated
Y015	15 meter (49.2 ft) remote fire retardant connecting cable, not terminated
Y020	20 meter (65.6 ft) remote fire retardant connecting cable, not terminated
Y030	30 meter (98.4 ft) remote fire retardant connecting cable, not terminated

¹⁾ Even without cables, it is necessary to select this option, because the device name plate shows the allowed ambient temperature depending on the selected cable type (see chapter [32]).

Fire retardant cable is mandatory for DNV GL type approval (Options MC2 and MC3). The minimum permissible ambient temperature for the two cable types differs (see chapter *Allowed ambient temperature for sensor* [32]). The cable type intended to be used needs to be indicated (with option L000 or Y000) even if connecting cable is ordered separately.

10.6.2 Additional nameplate information

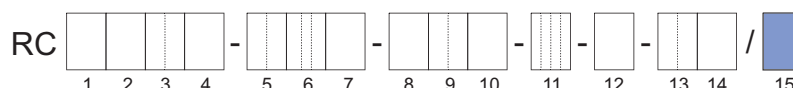


Options	Specification
BG	Nameplate with customer device location identification

This marking (Tag No.) must be provided by the customer at the time the order is placed.

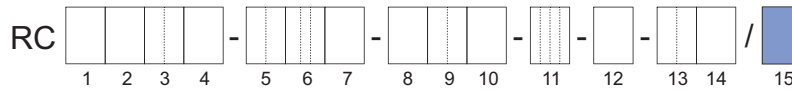
10.6.3 Presetting of customer parameters

Rotamass flow meters can be preconfigured with customer-specific data.



Options	Specification
PS	Presetting according to customer parameters.

10.6.4 Concentration and petroleum measurement



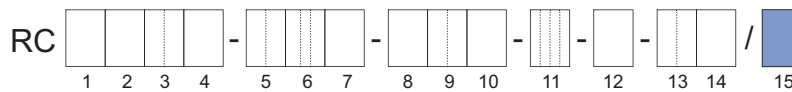
Options	Specification
C52	Net Oil Computing (NOC) following API standard

Device option C52 is not available in combination with gas measurement devices (model code position 9 with the values: 70 or 50).

Options with C52 are available only for Ultimate transmitters (value U in model code position 1).

For details about the device function refer to *Concentration and petroleum measurement* [▶ 54].

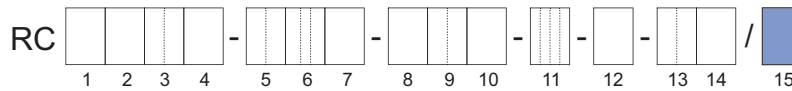
10.6.5 Batching function



Options	Specification
BT	Batching and filling function

For details about the device function refer to *Batching function* [▶ 55].

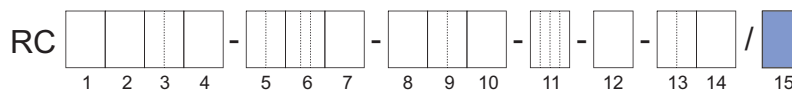
10.6.6 Viscosity function



Options	Specification
VM	Viscosity computing function for liquids

For details about the device function refer to *Viscosity function* [▶ 56].

10.6.7 Certificates



Accordance with terms of order

Options	Specification
P2	Declaration of compliance with the order 2.1 according to EN 10204
P3	Quality Inspection Certificate (Inspection Certificate 3.1 according to EN 10204)

Material certificates

Options	Specification
P6	Certificate of Marking Transfer and Raw Material Certificates (Inspection Certificate 3.1 according to EN 10204)

Dye penetration test of weld seams

Options	Specification
PT	Dye penetrant test of process connection weld seams according to DIN EN ISO 3452-1, including certificate
PTA	Dye penetrant test of flange welding according to ASME V

Positive Material Identification of wetted parts	Options	Specification
	PM	

Pressure testing	Options	Specification
	P8	

Welding certificates	Options	Specification	
	WP		Welding certificates: <ul style="list-style-type: none"> ▪ WPS according to DIN EN ISO 15609-1 ▪ WPQR according to DIN EN ISO 15614-1 ▪ WQC according to DIN EN 287-1 or DIN EN ISO 6906-4
	WPA		Welding procedures and Certificate according to ASME IX

Only for the butt welding seam between the process connection and the flow divider.

Mass flow calibration	Options	Specification	
	K2		Customer-specific 5-point mass flow calibration with factory calibration certificate (mass flow or volume flow of water). A table listing the desired calibration points must be supplied with the order.
	K5		Customer-specific 10-point mass flow calibration with DAkkS calibration certificate (mass flow or volume flow of water). A table listing the desired calibration points must be supplied with the order.

Water is used as fluid for calibrating the Rotamass.

Surfaces free of oil and grease	Options	Specification
	H1	

X-ray inspection of flange weld seam	Options	Specification	
	RT		X-ray inspection of flange weld seam according to DIN EN ISO 17636-1/B Evaluation according to AD 2000 HP 5/3 and DIN EN ISO 5817/C, including certificate
	RTA		X-ray test according to ASME V

This device option is not available for devices with wetted parts made of Ni alloy C-22/2.4602.

Ferrite testing	Options	Specification
	FE	

Determination of ferrite content is possible for flange weld seams according to DIN EN ISO 8249 and ANSI/AWS A4.2. The pass criterion is a ferrite number < 30. An inspection certificate is delivered with the device.

Combined certificates

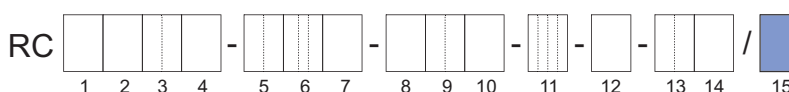
Options	Specification
P10	Combination of: <ul style="list-style-type: none"> ▪ P3: Quality Inspection Certificate ▪ P6: Certificate of Marking Transfer and Raw Material Certificates ▪ P8: Hydrostatic Pressure Test Certificate
P11	Combination of: <ul style="list-style-type: none"> ▪ P3: Quality Inspection Certificate ▪ P6: Certificate of Marking Transfer and Raw Material Certificates ▪ PM: Positive Material Identification of wetted parts
P12	Combination of: <ul style="list-style-type: none"> ▪ P3: Quality Inspection Certificate ▪ P6: Certificate of Marking Transfer and Raw Material Certificates ▪ PT: Dye penetration test according to DIN EN ISO 3452-1 ▪ P8: Hydrostatic Pressure Test Certificate
P13	Combination of: <ul style="list-style-type: none"> ▪ P3: Quality Inspection Certificate ▪ P6: Certificate of Marking Transfer and Raw Material Certificates ▪ PT: Dye penetration test according to DIN EN ISO 3452-1 ▪ PM: Positive Material Identification of wetted parts ▪ P8: Hydrostatic Pressure Test Certificate ▪ WP: Welding certificates
P14	Combination of: <ul style="list-style-type: none"> ▪ PM: Positive Material Identification of wetted parts ▪ P8: Hydrostatic Pressure Test Certificate ▪ WP: Welding certificates
P20	Combination of: <ul style="list-style-type: none"> ▪ PTA: Dye Penetrant test of flange welding according to ASME V ▪ WPA: Welding procedures and Certificates according to ASME IX ▪ RTA: X-ray test according to ASME V
P21	Combination of: <ul style="list-style-type: none"> ▪ P3: Quality Inspection Certificate ▪ P6: Certificate of Marking Transfer and Raw Material Certificates ▪ P8: Hydrostatic Pressure Test Certificate ▪ PTA: Dye Penetrant test of flange welding according to ASME V ▪ WPA: Welding procedures and Certificates according to ASME IX ▪ RTA: X-ray test according to ASME V

Options	Specification
P22	Combination of: <ul style="list-style-type: none"> ▪ P3: Quality Inspection Certificate ▪ P6: Certificate of Marking Transfer and Raw Material Certificates ▪ PM: Positive Material Identification of wetted parts ▪ PTA: Dye Penetrant test of flange welding according to ASME V ▪ WPA: Welding procedures and Certificates according to ASME IX ▪ RTA: X-ray test according to ASME V

ASME B31.3 compliance

Options	Specification
P15	ASME B31.3 compliance NORMAL FLUID SERVICE

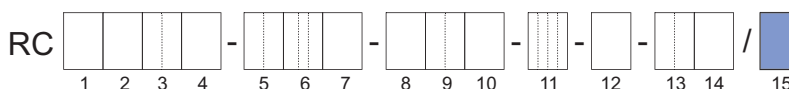
10.6.8 Country-specific delivery



Options	Specification
PJ	Delivery to Japan ¹⁾
CN	Delivery to China
KC	Delivery to Korea
VE	Delivery to EAC area
VR	Delivery to EAC area and Russia Pattern Approval marking

¹⁾ Delivery with SI units pre-setting of transmitter and Quality Inspection Certificate (English/Japanese)

10.6.9 Country-specific application

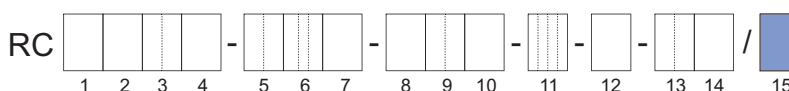


Options	Specification
Q11	PESO approval delivery
QR	Primary calibration valid in Russia, including certificate

10.6.10 Rupture disc

In the event of a measuring tube break, complete release of process pressure via the rupture disc cannot be ensured in every case.

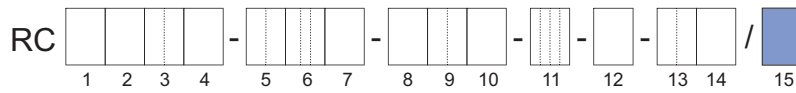
The rupture disc's bursting pressure is 20 bar (291 psi), the nominal diameter 8 mm (0.315 inch). If a larger nominal diameter is required, the Yokogawa sales organization may be contacted with regard to customized designs.



Options	Specification
RD	Rupture disc

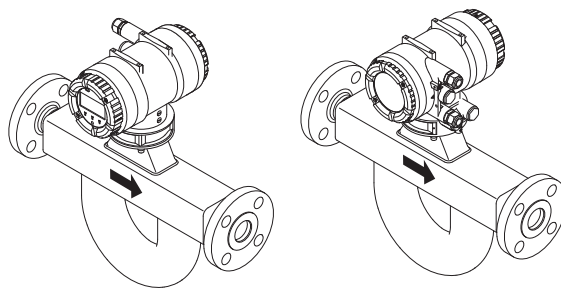
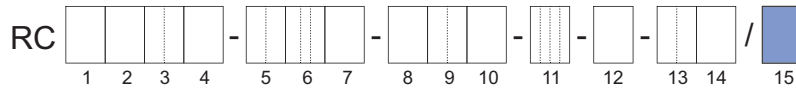
10.6.11 Tube health check

By way of the tube health check, the transmitter can determine whether the tube properties were altered due to corrosion or deposits and whether they could impact accuracy as a result.



Options	Specification
TC	Tube health check

10.6.12 Transmitter housing rotated 180°

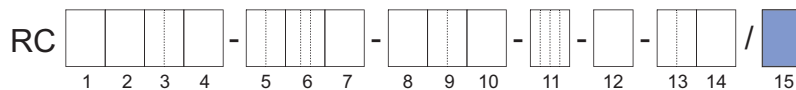


Standard

Option RB

Options	Specification
RB	Alignment of transmitter housing rotated 180°

10.6.13 Measurement of heat quantity

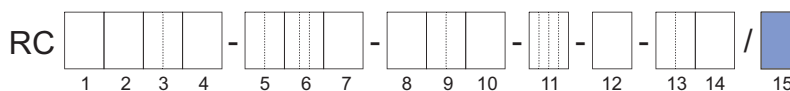


Options	Specification
CGC	Measurement of the total transported energy content of a fuel in connection with a sensor for determining the fuel's calorific value (e.g. a gas chromatograph, not included in scope of delivery). This option is available only together with model code position 13 JH to JN.

For details about the device function refer to *Measurement of heat quantity* [▶ 57].

10.6.14 Marine Approval

By ordering options MC2 and MC3 the device will carry a type approval mark by DNV GL. Ordering of fire retardant cable (Y_...) is mandatory with this option. In case of thermal oil applications option RT or RTA is mandatory. Please note that DNV GL has additional requirements regarding the process conditions as reproduced in the table below. The complete requirements can be found in the classification society's rules concerning the respective use case. Marine approval is not available for all device variants, for details see exclusions in *Overview options [76]*.



	Option			
	MC2		MC3	
Piping system for	Class II ¹⁾		Class III ¹⁾	
	p in bar	T _D in °C	p in bar	T _D in °C
Steam	≤ 16	≤ 300	≤ 7	≤ 170
Thermal oil	≤ 16	≤ 300	≤ 7	≤ 150
Fuel oil, lubricating oil, flammable oil	≤ 16	≤ 150	≤ 7	≤ 60
Other media²⁾	≤ 40	≤ 300	≤ 16	≤ 200

p : Design pressure

T_D : Design temperature

¹⁾ both specified conditions (p and T_D) shall be met

²⁾ Cargo oil pipes on oil carriers and open ended pipes (drain overflows, vents, boiler escape pipes etc.) independently of the pressure and temperature, are pertaining to class III.

Options	Specification
MC2	Marine approval according to DNV GL piping class 2
MC3	Marine approval according to DNV GL piping class 3

10.6.15 Customer specific special product manufacture



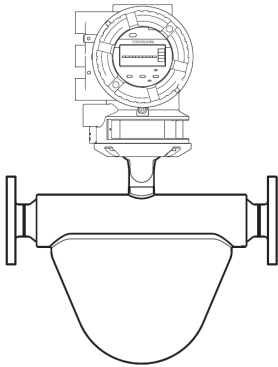
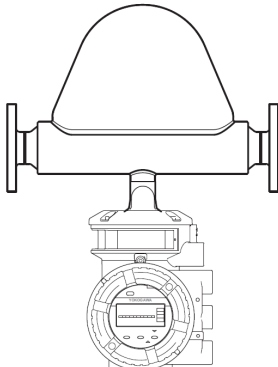
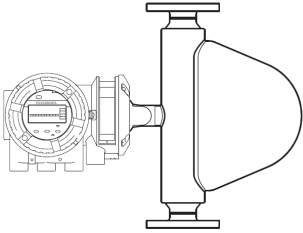
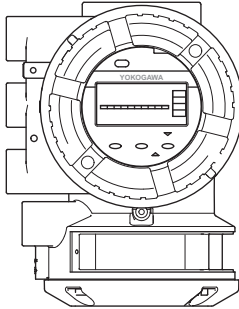
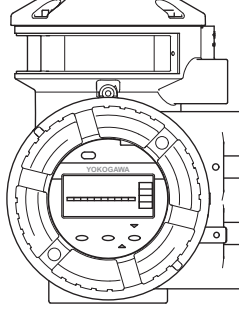
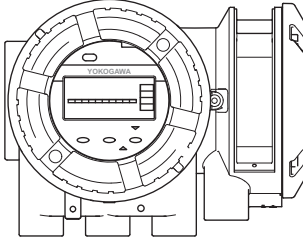
Options	Specification
Z	Deviations from the specifications in this document are possible.

10.7 Ordering Instructions

Specify the following information when ordering a product:

- Model code
- Fluid name
- Language of the quick reference instruction manual:
 - English
 - French
 - German
 - Japanese
 - Russian
 - Korean
 - Chinese
- Display language and language pack (Display only present for value 1 on position 14 of the model code):
 - EN-Pack1 - English
 - DE-Pack1 - German
 - FR-Pack1 - French
 - PT-Pack1 - Portuguese
 - JA-Pack1 - Japanese
 - IT-Pack1 - Italian
 - EN-Pack2 - English
 - DE-Pack2 - German
 - RU-Pack2 - Russian
 - PL-Pack2 - Polish
 - KZ-Pack2 - Kazakh
 - EN-Pack3 - English
 - DE-Pack3 - German
 - FR-Pack3 - French
 - PT-Pack3 - Portuguese
 - IT-Pack3 - Italian
 - ES-Pack3 - Spanish
 - CN-Pack3 - Chinese

- Orientation of the display (Display only present for value 1 on position 14 of the model code):

	Orientation 1	Orientation 2	Orientation 3
Integral type	Horizontal installation - tubes down 	Horizontal installation - tubes up 	Vertical installation 
Remote type			



In the above the figure, the case of the Prime sensor is shown. The design of sensor depend on the each series.



The parameter "Installation Orientation" in transmitter must be set by the customer according to the installation direction of the sensor.

- Tag No. to be engraved on the nameplate (option BG, up to 16 characters length)
- Software Tag No. (both short and long):
 - HART Tag No. (short): up to 8 characters length (Capital letters only)
 - HART Tag No. (long): up to 32 characters length

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