Technical
Information
TI 030D/06/en
No. 50068989

# Coriolis Mass Flow Measurement System *promass 63*

## Simultaneous measurement of mass, density and temperature for a broad range of applications For liquids and gases

**Flexible system**
- The system can be customised to each application
- Wide choice of materials for process connections and measuring tubes, compatible to the fluid
- Simple and cost-effective installation
- Transmitter housing can be rotated to fit the orientation

**Easy to operate**
- Menu-driven dialogue for all parameters
- Two-line illuminated display
- Touch Control: remote operation without special equipment (protection not violated)

**Accurate measurement**
- Measurement accuracy for liquids:
  – Mass flow ± 0.1%
  – Volume flow ± 0.15%
- Measurement accuracy for gases:
  – Mass flow ± 0.5%
- 1000:1 operable flow range
- Excellent repeatability

**Safe operation**
- Self-emptying measuring tubes
- Secondary containment vessel as standard
- High electromagnetic compatibility (EMC)
- Self-monitoring with alarm function
- EEPROM stores data on power failure (no batteries required)
- ISO 9001 manufacturer, quality assured

**Install anywhere**
- Compact design
- Insensitive to plant vibration
- Rugged and shock-proof surfaces resistant to acids and alkalis
- IP 67 protection for compact and remote versions
- Measurement independent of fluid characteristics
- High performance: simultaneous measurement of more than one process variable, special density evaluation functions, etc.

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# Technical Data

## Application

| | |
|---|---|
| *Instrument name* | Flow measuring system “Promass 63” |
| *Instrument function* | Mass and volumetric flow measurement of liquids and gases in closed pipings. |

## Function and system design

*Measuring principle*

Mass flow measurement according to the Coriolis measuring principle (see page 3)

*Measuring system*

Instrument family “Promass 63” consisting of:
Transmitter: Promass 63
Sensors: Promass A, I, F and M

- Promass A — DN 1, 2, 4 and DN 2, 4 (high pressure version)
  Single tube system in SS or Alloy C-22
- Promass I — DN 8, 15, 25, 40, 50 (completely welded version)
  Straight single tube system in titanium

  DN 15 “FB”, DN 25 “FB”, DN 40 “FB”:
  Full bore versions of Promass I with a higher full scale value (see table below)
- Promass F — DN 8, 15, 25, 40, 50, 80, 100 (completely welded version)
  Two slightly curved measuring tubes in SS (DN 8...100) or Alloy C-22 (DN 8...80)
- Promass M — DN 8, 15, 25, 40, 50, 80 (two straight measuring tubes in titanium). Containment vessel up to 100 bar.
  DN 8,15, 25 high pressure version for operating pressures up to 350 bar

Two versions are available:
- Compact version
- Remote version (max. 20 m)

## Input variables

*Measured variables*

- Mass flow rate (is proportional to the phase difference between two sensors on the measuring tube which detect differences in its oscillation)
- Fluid density (is proportional to the resonance frequency of the measuring tubes)
- Fluid temperature (is measured with temperature sensors)

*Measuring range*

Range of full scale values

| DN [mm] | Liquid $\dot{m}_{min\,(L)} \dots \dot{m}_{max\,(L)}$ |
|---|---|
| 1 | 0... 20.0 kg/h |
| 2 | 0...100.0 kg/h |
| 4 | 0...450.0 kg/h |
| 8 | 0... 2.0 t/h |
| 15 | 0... 6.5 t/h |
| 15* | 0... 18.0 t/h |
| 25 | 0... 18.0 t/h |
| 25* | 0... 45.0 t/h |
| 40 | 0... 45.0 t/h |
| 40* | 0... 70.0 t/h |
| 50 | 0... 70.0 t/h |
| 80 | 0...180.0 t/h |
| 100 | 0...350.0 t/h |

Gas $\dot{m}_{min\,(G)} \dots \dot{m}_{max\,(G)}$

The full scale depends on the density of the gas. The full scale value can be determined with the following formula:

$$\dot{m}_{max(G)} = \frac{\dot{m}_{max(L)} \cdot \rho_{(G)}}{x \cdot 1.6}$$

$\dot{m}_{max(G)}$ = Full scale value gas [t/h]

$\dot{m}_{max(L)}$ = Full scale value liquid [t/h] (value from table)

$\rho_{(G)}$ = gas density [kg/m$^3$] (at operating conditions)

$x$ = constant [kg/m$^3$]
Promass A: x = 20
Promass I, M, F: x = 100

* DN 15, 25, 40 “FB” = Full bore version of Promass I

*(continued on next page)*

| **Input variables (continued)** | |
|---|---|
| *Measuring range (continued)* | Example for calculating a gas full scale value:<br><br>Sensor:<br>Promass F → x = 100<br>Nominal diameter DN 50 → 70.0 t/h (full scale value from table on page 26)<br><br>Gas: Air with a density of 60.3 kg/m³ (at 20°C and 50 bar)<br><br>$\dot{m}_{max(G)} = \frac{\dot{m}_{max(L)} \cdot \rho_{(G)}}{x \cdot 1.6} = \frac{70.0 \cdot 60.3}{100 \cdot 1.6} = 26.4$ t/h |
| *Operable flow range* | up to 1000 : 1<br>This enables totalizer values to be accurately determined even in pulsating systems e.g. with reciprocating pumps. |
| *Auxiliary input (with "RS 485" board only)* | U = 3...30 V DC, $R_i$ = 1.8 kΩ, pulsed or level mode<br>Configurable for: totaliser reset, batching, zero point adjustment, zero point selection, positive zero return or full scale switching |
| **Output variables** | |
| *Output signal* | • *Relay output 1*<br>max. 60 V AC / 0.5 A or max. 30 V DC / 0.1 A<br>Either NC or NO via a jumper available (factory setting: NO)<br>Configurable for error message (failure), empty pipe detection, full scale switching, batch precontact, flow direction, limit value<br><br>• *Relay output 2*<br>max. 60 V AC / 0.5 A or max. 30 V DC / 0.1 A<br>Either NC or NO via a jumper available (factory setting: NC)<br>Configurable like relay 1 except error messages<br><br>• *Current output 1/2*<br>0/4...20 mA, also acc. to NAMUR recommendations;<br>$R_L$ < 700 Ω; freely assignable to different measured values, time constant freely selectable (0.01...100.00 s), full scale value selectable, temperature coefficient typ. 0.005% o.f.s./°C<br>HART protocol via current output 1 only<br><br>o.f.s. = of full scale<br><br>• *Pulse/Frequency output*<br>freely assignable to one flow variable,<br>active/passive selectable,<br>active: 24 V DC, 25 mA (250 mA during 20 ms), $R_L$ > 100 Ω<br>passive: 30 V DC, 25 mA (250 mA during 20 ms)<br><br>– *Frequency output:* $f_{End}$ selectable up to 10 kHz<br>On/off ratio 1:1, pulse width max. 10 s<br><br>– *Pulse output:* pulse weighting adjustable, pulse polarity adjustable, pulse width adjustable (50 ms...10 s)<br>Above a frequency of $^1/_{(2 \text{ x pulse width})}$ the on/off ratio is 1:1 |
| *Signal on alarm* | The following applies until the fault has been cleared:<br>• Current output: failure mode selectable<br>• Pulse/Frequency output: failure mode selectable<br>• Relay 1: de-energised if configured to "FAILURE".<br>• Relay 1/2: de-energised on power supply failure. |
| *Load* | $R_L$ < 700 Ω (current output) |
| *Creep suppression* | Switch points for low flow selectable. Hysteresis: –50 % |

**Accuracy**

*Reference conditions*

Error limits based on ISO / DIS 11631:
- 20...30 °C; 2...4 bar
- Calibration rig based on national standards
- Zero point calibrated under operating conditions
- Field density calibration carried out (or special density calibration)

*Measured error*

- *Mass flowrate (liquids):*
  Promass
  A, M, F ± 0.10% ± [(zero stability / flow rate) x 100]% of rate
  I ± 0.15% ± [(zero stability / flow rate) x 100]% of rate

- *Mass flowrate (gas):*
  Promass
  A, I, M, F ± 0.50% ± [(zero stability / flow rate) x 100]% of rate

- *Volume flowrate (liquids):*
  Promass
  A, M ± 0.25% ± [(zero stability / flow rate) x 100]% of rate
  I ± 0.50% ± [(zero stability / flow rate) x 100]% of rate
  F ± 0.15% ± [(zero stability / flow rate) x 100]% of rate

  zero stability → see table below

Note!
- The values above refer to the pulse/frequency output.
- Additional measuring error of the current output: ± 5 µA (typical)

| Diameter DN | Max. full scale [kg/h] or [l/h] | Zero stability Promass A, M, F [kg/h] or [l/h] | Zero stability Promass I [kg/h] or [l/h] |
|---|---|---|---|
| 1 | 20 | 0.0010 | — |
| 2 | 100 | 0.0050 | — |
| 4 | 450 | 0.0225 | — |
| 8 | 2000 | 0.100 | 0.200 |
| 15 | 6500 | 0.325 | 0.650 |
| 15 * | 18000 | — | 1.800 |
| 25 | 18000 | 0.90 | 1.800 |
| 25 * | 45000 | — | 4.500 |
| 40 | 45000 | 2.25 | 4.500 |
| 40 * | 70000 | — | 7.000 |
| 50 | 70000 | 3.50 | 7.000 |
| 80 | 180000 | 9.00 | — |
| 100 | 350000 | 14.00 | — |

* DN 15, 25, 40 "FB" = Full bore versions Promass I

Example for calculating the measured error:
Promass F ± 0.10% ± [(zero stability / flow rate) x 100]% of rate
DN 25; Flowrate = 3.6 t/h = 3600 kg/h

$$\text{Measured error} \rightarrow \pm 0.10\% \pm \frac{0.9\ \text{kg/h}}{3600\ \text{kg/h}} \cdot 100\% = \pm 0.125\%$$

- *Density (liquid):*
  Standard calibration:
  Promass A, I, M ± 0.02 g/cc (1 g/cc = 1 kg/l)
  Promass F ± 0.01 g/cc

  Special density calibration (optional):
  (calibration range = 0.8...1.8 g/cc, 5...80°C)
  Promass A, M ± 0.002 gccl
  Promass I ± 0.004 g/cc
  Promass F ± 0.001 g/cc

  Density calibration in the field:
  Promass A, M ± 0.0010 g/cc
  Promass I ± 0.0020 g/cc
  Promass F ± 0.0005 g/cc

- *Temperature:*
  Promass A, I, M, F ± 0.5 °C ± 0.005 x T (T = fluid temp. in °C)

| Accuracy (continued) | |
|---|---|
| *Repeatability* | • *Mass flowrate (liquids):*<br>Promass A, I, M, F<br>± 0.05% ± [$^1/_2$ x (zero stability / flow rate) x 100]% of rate<br><br>• *Mass flowrate (gas):*<br>Promass A, I, M, F<br>± 0.25% ± [$^1/_2$ x (zero stability / flow rate) x 100]% of rate<br><br>• *Volume flowrate (liquids):*<br>Promass<br>A, M ± 0.10% ± [$^1/_2$ x (zero stability / flow rate) x 100]% of rate<br>I ± 0.20% ± [$^1/_2$ x (zero stability / flow rate) x 100]% of rate<br>F ± 0.05% ± [$^1/_2$ x (zero stability / flow rate) x 100]% of rate<br><br>Zero stability → see table on page 28<br><br>Example for calculating the repeatability:<br>Promass F ± 0.05% ± [(zero stability / flow rate) x 100]% of rate<br>DN 25; Flowrate = 3.6 t/h = 3600 kg/h<br>Repeatabilitity → $\pm 0{,}05\% \pm {}^1/_2 \cdot \frac{0{,}9\ kg/h}{3600\ kg/h} \cdot 100\% = \pm 0{,}0625\%$ |
| | • *Density measurement (liquids):*<br>Promass A, M ± 0.00050 g/cc (1 g/cc = 1 kg/l)<br>Promass I ± 0.00100 g/cc<br>Promass F ± 0.00025 g/cc |
| | • *Temperature measurement:*<br>Promass A, I, M, F ± 0.25 °C ± 0.0025 x T (T = fluid temp. in °C) |
| *Process effects* | • *Process temperature effect:*<br>The below value represents the zero point error due to changing process temperature away from temperature at which a zero point adjustment was carried out:<br>Promass A, I, M, F typical = ± 0,0002% of full scale / °C<br><br>• *Process pressure effect:*<br>The below defined values represent the effect on accuracy of mass flow due to changing process pressure away from calibration pressure (values in % of rate / bar). |

| DN [mm] | Promass A flow rate % o.r.** / bar | Promass I flow rate % o.r.** / bar | Promass M flow rate % o.r.** / bar | Promass MP flow rate % o.r.** / bar | Promass F flow rate % o.r.** / bar |
|---|---|---|---|---|---|
| 1 | none | — | — | — | — |
| 2 | none | — | — | — | — |
| 4 | none | — | — | — | — |
| 8 | — | 0.006 | 0.009 | 0.006 | none |
| 15 | — | 0.004 | 0.008 | 0.005 | none |
| 15 * | — | 0.006 | — | — | — |
| 25 | — | 0.006 | 0.009 | 0.003 | none |
| 25 * | — | none | — | — | — |
| 40 | — | none | 0.005 | — | –0.003 |
| 40 * | — | 0.006 | — | — | — |
| 50 | — | 0.006 | none | — | –0.008 |
| 80 | — | — | none | — | –0.009 |
| 100 | — | — | — | — | –0.012 |

* DN 15, 25, 40 “FB” = Promass I mit vollem Nennweitenquerschnitt
** o.r. = of rate