



Level



Pressure



Flow



Temperature

Liquid  
Analysis

Registration

Systems  
Components

Services



Solutions

## Technical Information

# Proline t-mass 65F, 65I

## Thermal Mass Flow Measuring System Direct Mass Flow Measurement of Gases



### Application

For measuring the mass flowrate of a wide range of gas types e.g.

- Compressed air
- Natural gas flow to boilers / dryers
- Carbon Dioxide flow in breweries
- Biogas and aeration air in waste water plants
- Gas production (e. g. Ar, N<sub>2</sub>, CO<sub>2</sub>, He, O<sub>2</sub>)
- Leakage detection

Approvals for hazardous area:

- ATEX, FM, CSA

Connection to all common process control systems:

- HART, PROFIBUS DP, MODBUS RS485

### Your benefits

Direct measurement of gas mass flow. Provides temperature as an output.

The **Proline transmitter concept** comprises:

- Modular device and operating concept resulting in a higher degree of efficiency
- Quick setup operating menus for ease of commissioning
- On board software freely allows the selection of up to 20 pure gases and creation of mixed gases with a maximum of 8 components (e. g. Biogas)

The **t-mass sensors** offer:

- Negligible pressure drop or loss
- Wide turndown of up to 100:1
- Insertion version can be programmed for circular pipe or rectangular ducting installation
- Each device individually calibrated and delivered with a traceable certificate
- Can be calibrated with flow conditioner on request.
- Optional cold tap device for insertion allowing ease of removal/replacement for low pressure and non-toxic gas applications.

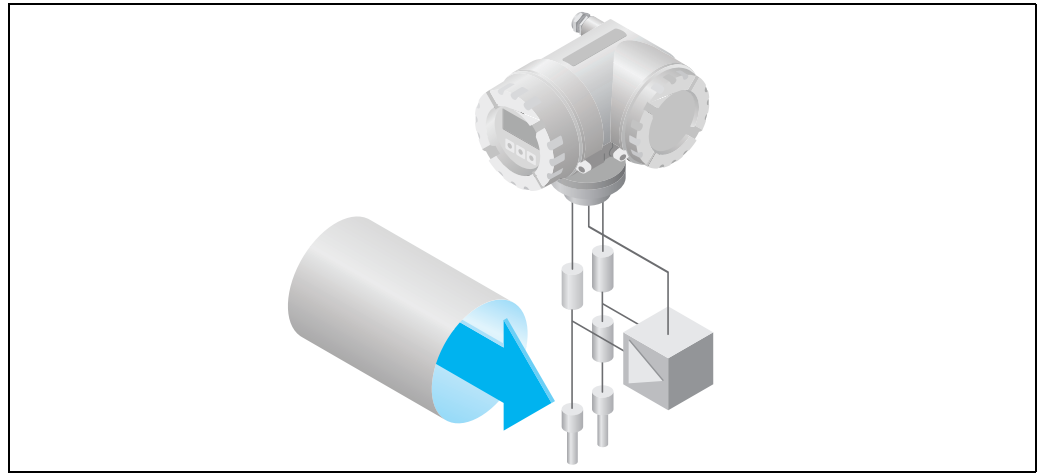
## Function and system design

### Measuring principle

Thermal dispersion principle

The thermal principle operates by monitoring the cooling effect of a gas stream as it passes over a heated transducer (PT100).

Gas flowing through the sensing section passes over two PT 100 RTD transducers one of which is used conventionally as a temperature sensing device, whilst the other is used as a heater. The temperature sensor monitors the actual process values whilst the heater is maintained at a constant differential temperature above this by varying the power consumed by the sensor. The greater the mass flow, the greater the cooling effect and power required to maintain the differential temperature. The measured heater power is therefore a measure of the gas mass flowrate.



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### Measuring system

The measuring system consists of a transmitter and a sensor. Two versions are available:

- Compact version: transmitter and sensor form a single mechanical unit.
- Remote version: transmitter and sensor are mounted physically separate from one another.

<b>Transmitter</b>	
<p><b>t-mass 65</b></p> <p style="text-align: right; font-size: small;">a0003671</p>	<ul style="list-style-type: none"> <li>■ Two-line liquid-crystal display</li> <li>■ Configuration using push button operation</li> </ul>
<b>Sensor</b>	
<p><b>F</b></p> <p style="text-align: right; font-size: small;">a0005137</p>	<ul style="list-style-type: none"> <li>■ Flanged version</li> <li>■ Nominal diameters DN 15 to 100</li> <li>■ Sensor body material:                             <ul style="list-style-type: none"> <li>- 1.4404, 316L</li> <li>- CF3M</li> </ul> </li> <li>■ Transducer body material:                             <ul style="list-style-type: none"> <li>- 1.4404, 316L, Alloy C22</li> </ul> </li> </ul>
<p><b>I</b></p> <p style="text-align: right; font-size: small;">a0005138</p>	<ul style="list-style-type: none"> <li>■ Insertion version</li> <li>■ Sensor length 235/335/435/608 for DN 80 to 1500</li> <li>■ Sensor body material:                             <ul style="list-style-type: none"> <li>1.4404, 316/316L</li> </ul> </li> <li>■ Transducer body material:                             <ul style="list-style-type: none"> <li>1.4404/316L, Alloy C22</li> </ul> </li> </ul>

## Input

<b>Measured variable</b>	Mass flow Gas temperature
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### Measuring range (air at ambient conditions)

The measuring range is dependant on the gas selection, line size and use of flow conditioner. Each meter is individually calibrated on air and mathematically converted to suit the customer specific gas, where required. The tables below define the ranges available for air without flow conditioner. Please refer to your Endress+Hauser contact or to Applicator, the selection tool, for other gases and process conditions.

Measuring range for the DIN (EN) / JIS flanged version, metric units:

DN	kg/h		Nm <sup>3</sup> /h at 0°C, 1.013 bar a		scf/min. at 15°C, 1.013 bar a	
	min.	max.	min.	max.	min.	max.
15	0.5	53	0.38	41	0.23	25
25	2	200	1.5	155	1.0	96
40	6	555	4.6	429	3.0	266
50	10	910	7.7	704	5.0	436
80	20	2030	15.5	1570	10	974
100	38	3750	29	2900	18	1800

Measuring range for the ANSI flanged version, US units:

DN	lb/h		Sm <sup>3</sup> /h at 59 °F, 14.7 psi a		scf/min. at 59 °F, 14.7 psi a	
	minimum	maximum	minimum	maximum	minimum	maximum
½"	1.1	116	0.4	42	0.23	25
1"	4.4	440	1.6	160	1.0	96
1 ½"	13.2	1220	4.8	450	3.0	266
2"	22	2002	8	740	5.0	436
3"	44	4466	16	1656	10	974
4"	84	8250	30	3060	18	1800

Measuring range for the insertion version, metric units:

DN	kg/h		Nm <sup>3</sup> /h at 0°C, 1.013 bar a		scf/min. at 15°C, 1.013 bar a	
	min.	max.	min.	max.	min.	max.
80	20	2030	15.5	1570	9.6	974
100	38	3750	29.0	2900	18	1800
150	50	7500	38	5800	24	3600
200	80	12500	62	9666	38	6000
250	120	20000	93	15468	58	9600
300	180	28000	139	21655	86	13440
400	300	50000	232	38670	144	24000
500	500	80000	386	61870	240	38400
600	700	115000	540	88940	336	55200
700	900	159000	696	122970	432	76300
1000	2000	320000	1546	247846	960	153600
1500	2500	720000	1933	556844	1200	345600

In order to achieve optimum performance it is recommended that under operating conditions the maximum velocity is limited to a value below 70 m/sec.

#### Caution!

The flowrates shown are representative of the calibrated conditions only and do not necessarily reflect what the meter can measure under operating conditions and actual internal pipe dimensions found on site. To correctly size and select a meter, it is recommended that you either contact your local Endress+Hauser representative or refer to the Endress+Hauser software package Applicator.

Examples (in metric units):

Line Size	Gas	Process pressure	Temperature	Max. Flowrate
DN		bar a	°C	kg/h
50	Air	1	25	910
50	Air	3	25	3300
50	CO <sub>2</sub>	1	25	1300
50	CO <sub>2</sub>	3	25	3950
50	Methane	1	25	795
50	Methane	3	25	1500

## Input signal

### Status input (auxiliary input) for HART version:

U = 3 to 30 V DC,  $R_i = 5 \text{ k}\Omega$ , galvanically isolated; switch level:  $\pm 3$  to  $\pm 30$  V DC  
Configurable for: totalizer reset, positive zero return, zero point adjustment

### Status input (auxiliary input) for MODBUS RS485 version:

U = 3 to 30 V DC,  $R_i = 3 \text{ k}\Omega$ , galvanically isolated; switch level:  $\pm 3$  to  $\pm 30$  V DC, independent of polarity  
Configurable for: totalizer reset, positive zero return, zero point adjustment

### Current input:

Active/passive selectable, galvanically isolated, resolution: 2  $\mu\text{A}$

- Active: 4 to 20 mA,  $R_i \leq 150 \Omega$ ,  $U_{\text{out}} = 24 \text{ V DC}$ , short-circuit proof
- Passive: 0/4 to 20 mA,  $R_i \leq 150 \Omega$ ,  $U_{\text{max}} = 30 \text{ V DC}$

## Output

## Output signal

### Current output:

Active/passive selectable, galvanically isolated, time constant selectable (0.0 to 100.0 s), full scale value selectable, temperature coefficient: typically 0.005% o.r./°C, resolution: 0.5  $\mu\text{A}$

- Active: 0/4 to 20 mA,  $R_L < 700 \Omega$  (at HART:  $R_L \geq 250 \Omega$ )
- Passive: 4 to 20 mA,  $R_i \geq 150 \Omega$ ,  $U_{\text{max}} = 30 \text{ V DC}$

Note!

If the current output is used as a temperature output, please observe the following information:  
Class B according to EN 6075

### Pulse/frequency output:

Active: 24 V DC, 25 mA (max. 250 mA during 20 msec),  $R_L > 100 \Omega$

Passive: open collector, 30 V DC, 250 mA, galvanically isolated.

- Frequency output: full scale frequency 2 to 1000 Hz ( $f_{\text{max}} = 1250 \text{ Hz}$ ), on/off ratio 1:1, pulse width max. 2s, time constant selectable (0.0 to 100.0 s)
- Pulse output: pulse value and pulse polarity can be selected, pulse width adjustable (0.5 to 2000 ms).

### PROFIBUS DP interface:

- PROFIBUS DP in accordance with IEC 61158, galvanically isolated
- Profile version 3.0
- Data transmission rate: 9.6 kBaud to 12 MBaud
- Automatic data transmission rate recognition
- Signal encoding: NRZ-Code
- Function blocks: 3 x Analog Input, 2 x Totalizer
- Output data: Mass flow, Corrected volume flow, Temperature, Totalizer 1 to 2
- Input data: Positive zero return (ON/OFF), Zero point adjustment, Totalizer control and Pressure display value
- Bus address can be set at the measuring device via miniature switches or using local display (optional)

**MODBUS RS485 interface:**

- MODBUS device type: slave
- Address range: 1 to 247
- Bus address can be set at the measuring device via miniature switches or the on-site display (optional)
- Supported function codes: 03, 04, 06, 08, 16, 23
- Broadcast: supported with the function codes 06, 16, 23
- Physical interface: RS485 in accordance with EIA/TIA-485 standard
- Supported baudrate: 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 Baud
- Transmission mode: RTU or ASCII
- Response times:
  - Direct data access = typically 25 to 50 ms
  - Auto-scan buffer (data block) = typically 3 to 5 ms

**Signal on alarm****Current output:**

Failsafe mode selectable (e.g. in accordance with NAMUR Recommendation NE 43)

**Current input:**

Failsafe value selectable

**Pulse/frequency output:**

Failsafe mode selectable

**Status output:**

“Non conductive” in the event of fault or power supply failure.

**Relay output:**

“De-energized” in the event of fault or power supply failure.

**PROFIBUS DP:**

Status and alarm messages in accordance with PROFIBUS Profile Version 3.0.

**MODBUS RS485:**

If an error occurs, the value NaN (not a number) is output for the measured values.

**Load**

see “Output signal”

**Low flow cut off**

Switch points for low flow cut off are programmable

**Galvanic isolation**

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

**Switching output****Relay output:**

Normally closed (NC) or normally open (NO) contacts available  
 (factory setting: relay 1 = NO, relay 2 = NC), max. 30 V / 0.5 A AC; 60 V / 0.1 A DC, galvanically isolated.  
 Configurable for: error messages, limit values

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