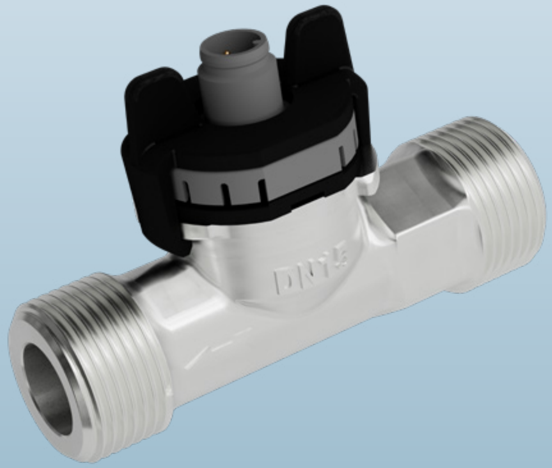
Vortex flow sensor

Huba Control

Flow sensor for liquid media

Type 237



The flow sensors of Type 237 operate based on the vortex principle, which is based on the Kármán vortex street. This non-mechanical measurement method enables precise and wear-free flow measurement without recalibration.

The robust stainless steel construction ensures high long-term stability and reliability, even in demanding environments. The sensor is designed for medium temperatures from -15 to +125 °C and is suitable for applications ranging from cryogenic cooling to high-temperature processes, such as in injection molding systems.

Engineered for OEM applications requiring precise flow measurement in a stainless steel body, the Type 237 provides a maintenance-free solution with proven long-term stability and measurement reliability.

Flow range

1.1 ... 240 l/min

Nominal widths

DN 8 / 10 / 15 / 20 / 25 / 32

Temperature range

-40 ... +125 °C

- Measuring element without media contact for superior resistance
- Direct temperature measurement in medium
- Low pressure loss with high measuring accuracy
- Dirt-resistant measuring element design
- Various output signal variants
- M12x1 electrical connection with IP65

Technical Overview

Flow measurement

Measuring principle		Vortex	Piezoelectric sensor element	
Measuring range			1.1 ... 240 l/m	
Nominal diameters			DN 8 / 10 / 15 / 20 / 25 / 32	
Accuracy at < 50% fs [1] (water)			< 1% fs	
Accuracy at > 50% fs (water)			< 2% measuring value	
Response time	Immediately. Therefore suitable for spigot use	Frequency output (unfiltered)	Signal delay	< 100 ms
			Response time	< 5 ms
		Frequency output (filtered) Analogue output	Signal delay	< 2 s
			Response time	< 500 ms

Operating conditions

Medium	Suitable for heating circuit water with the usual additives Drinking water		other medium on request
Temperature		Media (non freezing)	-15 ... +125 °C
		Ambient	-15 ... +85 °C
		Ambient (2· 4 ... 20 mA)	-15 ... +65 °C
		Storage	-30 ... +85 °C
Max. pressure and medium temperature		(for lifetime)	12 bar bei +40 °C
		(for lifetime)	6 bar bei +100 °C
		(for 600 hours)	4 bar bei +125 °C
		(for 2 hours)	4 bar bei +140 °C
		(max. test pressure)	18 bar bei +40 °C
Cavitation	The following equation is valid to prevent cavitation:	$P_{abs\ outlet} / P_{difference} > 5.5$	

Materials in contact with medium

Sensor paddle	ETFE
Case	Stainless steel
Sealing material	EPDM (perox.) (for drinking water)
	FKM

Electrical connection	**Protection standard**
Connector M12x1	IP 65

Weight	**with thread K**
DN 8 with condensation protection	163 g
DN 10 with condensation protection	175 g
DN 15 with condensation protection	219 g
DN 20 with condensation protection	337 g
DN 25 with condensation protection	552 g
DN 32 with condensation protection	656 g

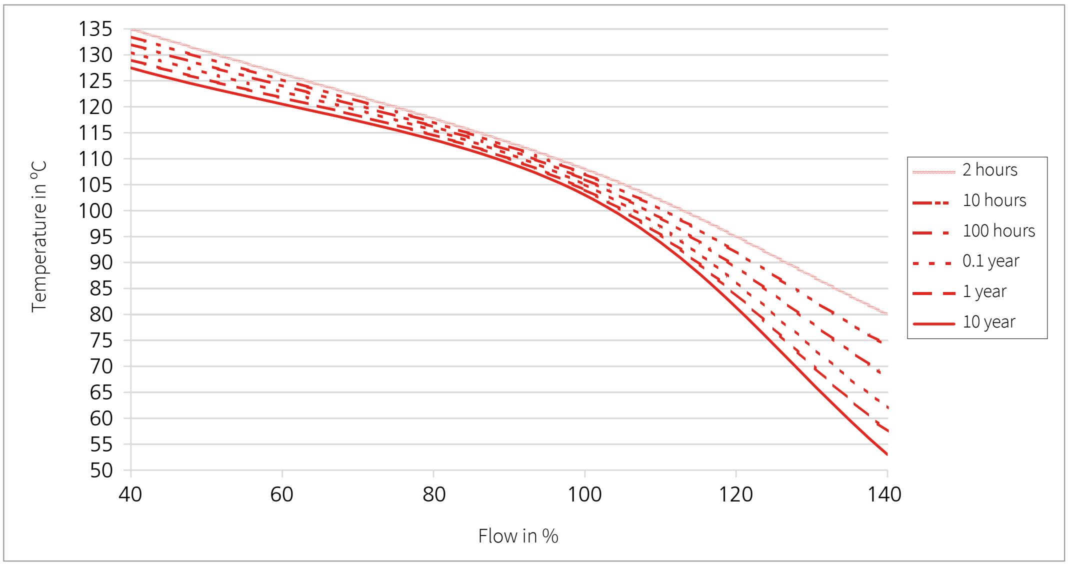
Test / Admissions

Electromagnetic compatibility	CE conformity acc. EN 61326-2-3

Packaging

Single packaging

Minimum life span on high flow rate and high temperature



[1] fs = fullscale

Analogue output - Electrical overview

Temperature measurement

Measuring principle	Resistance		PT1000 Class B DIN EN 60751
PT1000	Measuring range		-40 ... +125 °C
	Accuracy	Class B DIN EN 60751	±0.3°C ± 0.005 · $\Delta T_{0°C}$
0 ... 10 V	Measuring range		-25 ... +125 °C
	Accuracy		±0.5°C ± 0.005 · $\Delta T_{0°C}$
	Calculation temperature		$T\,[°C] = \frac{U_{OUT_T}}{10\,V} \cdot 150°C - 25°C$
4 ... 20 mA	Measuring range		-25 ... +125 °C
	Accuracy		±0.5°C ± 0.005 · $\Delta T_{0°C}$
	Calculation temperature		$T\,[°C] = \frac{I_{OUT_T} - 4\,mA}{16\,mA} \cdot 150\,°C - 25\,°C$

Electronic	Voltage output	Current output	Dual power output
Power supply	11.5 ... 33 VDC	8 ... 33 VDC	10 ... 33 VDC
Output flow (Q)	0 ... 10 V	4 ... 20 mA	4 ... 20 mA
Output temperature (T)	0 ... 10 V	–	4 ... 20 mA
Load agianst GND or IN	< 6 mA / < 100 nF [1]	< (U_{IN} - 8 V) / 20 mA	< (U_{IN} - 10 V) / 20 mA
Current consumption load free (I_{IN})	< 5 mA	–	–
Electrical reliability	Short circuit, reverse voltage and external voltage protected within the admissible supply voltage.		

Analogue output - Nominal diameters dependent variables

DN	Measuring range [l/min]	Flow range [m/s]	Pressure drop P_V in [Pa] [2]	K_U $\left[\frac{l}{V * min}\right]$	K_I $\left[\frac{l}{mA * min}\right]$
8	1.1 ... 15	0.163 ... 2.210	85.00 · Q^2	1.5	0.938
10	1.8 ... 32	0.265 ... 4.716	22.50 · Q^2	3.2	2.000
10	2.0 ... 40	0.295 ... 5.895	22.50 · Q^2	4.0	2.500
15	3.5 ... 50	0.290 ... 4.145	6.70 · Q^2	5.0	3.125
20	5.0 ... 85	0.265 ... 4.509	2.50 · Q^2	8.5	5.313
25	9.0 ... 150	0.283 ... 4.709	0.92 · Q^2	15.0	9.375
32	14.0 ... 240	0.290 ... 4.974	0.25 · Q^2	24.0	15.000

Characteristic line formula voltage output 0 ... 10 V

$Q_V = K_U \cdot U_{OUT}$

Characteristic line formula current output 4 ... 20 mA

für $Q_{max} \geq Q \geq Q_{min}$ [l/min]

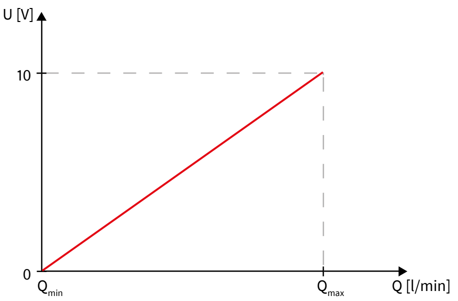
$Q_V = K_I \cdot (I_{OUT} - 4\,mA)$

To avoid signal saturation with highly viscous media, the characteristic can be adjusted accordingly on request.

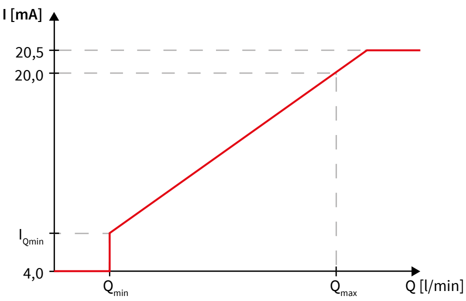
Legend

Q_V	Volume flow rate	[l/min]
K_U	Coefficient voltage output	[(l/min) / V]
K_I	Coefficient current output	[(l/min) / mA]
U_{OUT}	Voltage	[V]
I_{OUT}	Current	[mA]

Voltage output 0 ... 10 V



Current output 4 ... 20 mA



Analogue output - Order code selection table

		237.	1 X	2 X	3 X	4 X	5 X	6 X	7 X
Version	Flow		9			3,4	4		
	Flow and temperature(PT1000)		8			3,4	5		
	Flow and temperature (2· 0 ... 10 V)		6			3	5		
	Flow and temperature(2· 4 ... 20 mA)		5			5	5		
Norminal diameters and flow range	DN 8	1.1 ... 15 l/min		0	8				
	DN 10	1.8 ... 32 l/min		1	0				
	DN 10	2.0 ... 40 l/min		1	1				
	DN 15	3.5 ... 50 l/min		1	5				
	DN 20	5.0 ... 85 l/min		2	0				
	DN 25	9.0 ... 150 l/min		2	5				
	DN 32	14.0 ... 240 l/min		3	2				
Ouput / power supply	Analogue output 0 ... 10 V	11.5 ... 33 VDC	9,8,6			3			
	Analogue output 4 ... 20 mA	8 ... 33 VDC	9,8			4			
	Analogue output 4 ... 20 mA	10 ... 33 VDC	5			5			
Electrical connection	Connector M12x1 2- oder 3-pole	(with condensation protection)	9				4		
	4- oder 5-pole	(with condensation protection)	8,6,5				5		
Sealing material	EPDM Ethylene propylene rubber (peroxidically cross-linked)	O-rings mounted						1	
	FKM Fluoro elastomer	O-rings mounted						2	
Tube connection	Stainless steel with outside thread	K (DN 8, 10 - G ½; DN 15 - G ¾; DN 20 - G 1; DN 25 - G 1 ¼; DN 32 - G 1 ½)							K

[1] against GND only [2] incl. 3 x DN inlet and outlet side [3] Q in l/min

Frequency output (filtered) and pulse output - Electrical overview

Temperature measurement

Measuring principle	Resistance		PT1000 Class B DIN EN 60751
PT1000	Measuring range		-40 ... +125 °C
	Accuracy	Class B DIN EN 60751	±0.3°C ± 0.005 · $\Delta T_{0°C}$
Temperature influences		Self-heating at temperature sensor	1 K/mW
		Conduction resistance to connector	0.8 Ω

Electronic

Power Supply		4.75 ... 33 VDC
Output flow (Q)	Level height (open collector)	< 0.5 ... > U_{IN} - 0.5 V
Output temperature (T)	Resistant signal	PT1000 Class B DIN EN 60751
Load agiangst GND or IN		> 1 kΩ / < 10 kΩ
Current consumption load free (I_{IN})		< 3 mA
Electrical reliability	Short circuit, reverse voltage and external voltage protected within the admissible supply voltage.	

Frequency output (filtered) and pulse output - Nominal diameters dependent variables

DN	Measuring range [l/min]	Flow range [m/s]	Pressure drop P_V in [Pa] [1), 2)]	K_{ff} [(l/min) / Hz] bei 0 ... 1000 Hz	Quantity per pulse K_I [ml] (Impuls)	Pulse (pulse output) [1/l]
8	1.1 ... 15	0.163 ... 2.210	85.00 · Q^2	0.015	0.20	5000
10	1.8 ... 32	0.265 ... 4.716	22.50 · Q^2	0.032	0.50	2000
10	2.0 ... 40	0.295 ... 5.895	22.50 · Q^2	0.04	0.50	2000
15	3.5 ... 50	0.290 ... 4.145	6.70 · Q^2	0.05	1.00	1000
20	5.0 ... 85	0.265 ... 4.509	2.50 · Q^2	0.085	1.00	1000
25	9.0 ... 150	0.283 ... 4.709	0.92 · Q^2	0.15	1.25	800
32	14.0 ... 240	0.290 ... 4.974	0.25 · Q^2	0.24	2.00	500

Characteristic line formula frequency output filtered *(0 ... 1000 Hz, other frequency on request)*

$Q_V = K_{ff} \cdot f$

Pulse

$$Q_V = \frac{Puls}{s} \cdot K_I \cdot \frac{60}{1000}$$

Legend

Q_V	Volume flow rate	[l/min]
P_V	Pressure drop	[Pa]
K_{ff}	Coefficient frequency output filtered	[(l/min) / Hz]
f	Frequency	[Hz]

Frequency output (filtered) and pulse output - Order code selection table

				1	2	3	4	5	6	7
			237.	X	X	X	X	X	X	X
Version	Flow			9				4		
	Flow and temperature (PT1000)			8				5		
Nominal diameters and flow range	DN 8	1.1 ... 15 l/min			0	8				
	DN 10	1.8 ... 32 l/min			1	0				
	DN 10	2.0 ... 40 l/min			1	1				
	DN 15	3.5 ... 50 l/min			1	5				
	DN 20	5.0 ... 85 l/min			2	0				
	DN 25	9.0 ... 150 l/min			2	5				
	DN 32	14.0 ... 240 l/min			3	2				
Output / power supply	Frequency output (filtered)	4.75 ... 33 VDC					6			
	Pulse output	4.75 ... 33 VDC					7			
Electrical connection	Connector M12x1 2- oder 3-pole	(with condensation protection)		9				4		
	Connector M12x1 4- oder 5-pole	(with condensation protection)		8				5		
Sealing material	EPDM	Ethylene propylene rubber (peroxidically cross-linked)	O-rings mounted						1	
	FKM	Fluoro elastomer	O-rings mounted						2	
Tube connection	Stainless steel with outside thread	K (DN 8, 10 - G ½; DN 15 - G ¾; DN 20 - G 1; DN 25 - G 1 ¼; DN 32 - G 1 ½)								K

1) incl. 3x DN inlet and outlet side 2) Q in l/min

Frequency output (unfiltered) - Electrical overview

Temperature measurement

Measuring principle	Resistance		PT1000 Class B DIN EN 60751
PT1000	Measuring range		-40 ... +125 °C
	Accuracy	Class B DIN EN 60751	±0.3°C ± 0.005 · $\Delta T_{0°C}$
Temperature inluences		Self-heating at temperature sensor	1 K/mW
		onduction resistance to connector	0.8 Ω

Electronic

Power Supply		4.75 ... 33 VDC
Output flow (Q)	Level height (push-pull)	< 0.5 ... > U_{IN} - 0.5 V
Output temperature (T)	Resistant signal	PT1000 Class B DIN EN 60751
Load agianst GND or IN		< 1 mA / < 100 nF
Current consumption load free (I_{IN})		< 2 mA
Electrical reliability	Short circuit, reverse voltage and external voltage protected within the admissible supply voltage.	

Frequency output (unfiltered) - Nominal diameters dependent variables

DN	Tube connection	Measuring range [l/min]	Flow range [m/s]	Pressure drop P_V in [Pa] 1), 2)	Quantity per pulse @50% FS [ml]	Frequency range unfiltered [Hz]	Q_0 [l/min]	K_f [(l/min) / Hz]
8	K	1.1 ... 15	0.163 ... 2.210	85.00 · Q^2	0.578	31 ... 427	-0.1	0.0368
10	K	1.8 ... 32	0.265 ... 4.716	22.50 · Q^2	1.416	23 ... 374	-0.1	0.0852
10	K	2.0 ... 40	0.295 ... 5.895	22.50 · Q^2	1.419	26 ... 467	-0.1	0.0852
15	K	3.5 ... 50	0.290 ... 4.145	6.70 · Q^2	3.036	20 ... 273	-0.1	0.1854
20	K	5.0 ... 85	0.265 ... 4.509	2.50 · Q^2	6.173	14 ... 229	-0.3	0.3820
25	K	9.0 ... 150	0.283 ... 4.709	0.92 · Q^2	12.201	13 ... 205	-0.2	0.7413
32	K	14.0 ... 240	0.290 ... 4.974	0.25 · Q^2	27.513	9 ... 145	-0.5	1.6710

Characteristic line formula frequency output unfiltered

$Q_V = K_f \cdot f + Q_0$

Formula quantity per pulse [litres/pulse]

$$\frac{\text{Liter}}{\text{Puls}} = \frac{K_f \cdot Q_V}{60 \cdot (Q_V - Q_0)}$$

Legend

Q_V	Volume flow rate	[l/min]
P_V	Pressure drop	[Pa]
Q_0	Axis intercept	[l/min]
K_f	Coefficient frequency output	[(l/min) / Hz]
f	Frequency	[Hz]

Frequency output (unfiltered) - Order code selection table

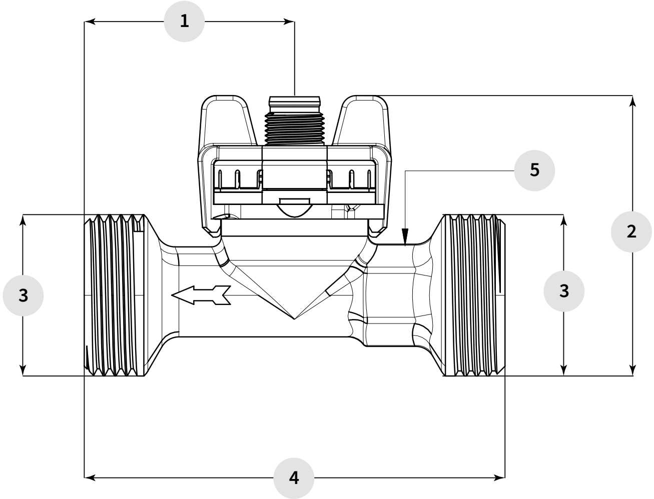
	237.	1 X	2 X	3 X	4 X	5 X	6 X	7 X
Version	Flow	9				4		
	Flow and temperature (PT1000)	8				5		
Nominal diameters and flow range	DN 8 1.1 ... 15 l/min		0	8				
	DN 10 1.8 ... 32 l/min		1	0				
	DN 10 2.0 ... 40 l/min		1	1				
	DN 15 3.5 ... 50 l/min		1	5				
	DN 20 5.0 ... 85 l/min		2	0				
	DN 25 9.0 ... 150 l/min		2	5				
	DN 32 14.0 ... 240 l/min		3	2				
Output / power supply	Frequency output (unfiltered) 4.75 ... 33 VDC				2			
Electrical connection	Connector M12x1 2- oder 3-pole (with condensation protection)	9				4		
	Connector M12x1 4- oder 5-pole (with condensation protection)	8				5		
Sealing material	EPDM Ethylene propylene rubber (peroxidically cross-linked) O-rings mounted						1	
	FKM Fluoro elastomer O-rings mounted						2	
Tube connection	Stainless steel with outside thread K (DN 8, 10 - G ½; DN 15 - G ¾; DN 20 - G 1; DN 25 - G 1 ¼; DN 32 - G 1 ½)							K

1) incl. 3· DN inlet and outlet side   2) Q in l/min

Accessories *(Accessories supplied loose)* — Order number

Straight-wire box for connector M12x1 with cable	3-pole	200 cm		114605
Corner-wire box for connector M12x1 with cable	3-pole	200 cm		114604
Straight-wire box for connector M12x1 with cable	5-pole	200 cm	(with temperature)	114564
Corner-wire box for connector M12x1 with cable	5-pole	200 cm	(with temperature)	114563
Straight-wire box for connector M12x1 screwing terminal	5-pole			115024

Dimension diagram



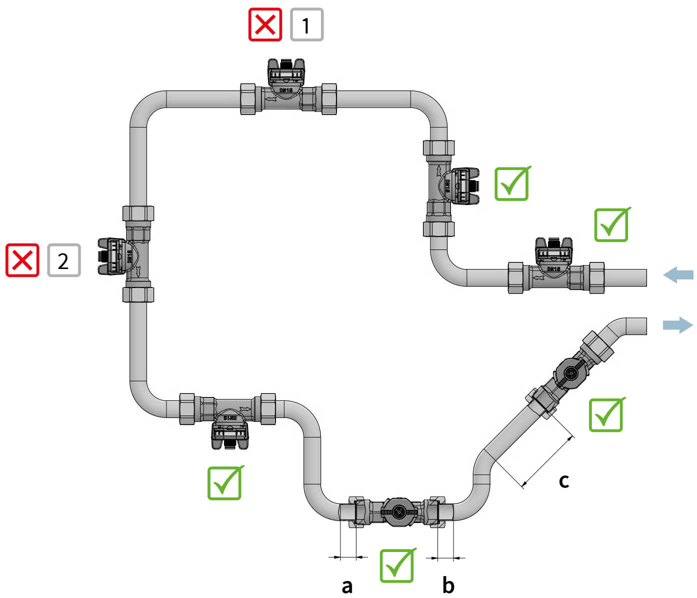
	1	2	3	4	5
DN8	33.3	52.9	G ½	77	15
DN10	43.0	51.1	G ½	86	19
DN15	41.6	55.9	G ¾	87	22
DN20	40.6	61.3	G 1	105	27
DN25	50.0	68.1	G 1¼	120	34
DN32	50.0	74.9	G 1½	134	41

Installation instructions

The following instructions must be observed for correct functioning of the sensor:

- Ensure that the internal diameter of the connection tubes on the sensor is never smaller than the internal diameter of the measuring tube
- Avoid repeated elbows in the same level at entry-side

✓	✗ 1	✗ 2
• Any air bubbles can escape upwards • Low risk of dirt deposits	• Any air bubbles can accumulate (as highest point of the system) • Danger of idling (measuring tube only part. filled)	• Possible rising of air bubbles from below • Danger of idling

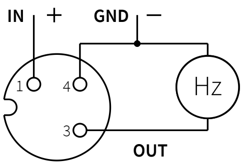


The following minimum distances must be maintained:

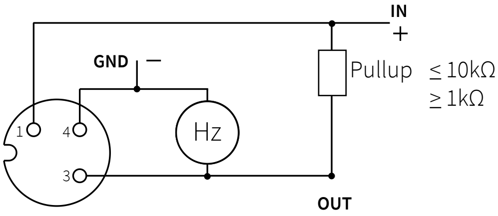
a	b	c
≥ 1 · DN for recommended elbow with ≥ R1.8 · DN	≥ 1 · DN	≥ 5 · DN for alternative elbows

Electrical connection

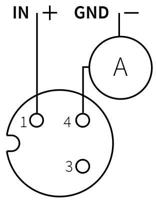
Connector M12x1 without temperature measurement 1



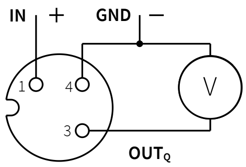
Frequency output
unfiltered



Frequency output filtered
Pulse output

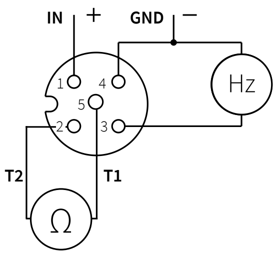


Current output

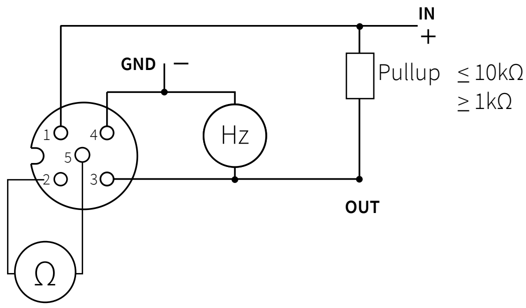


Voltage output

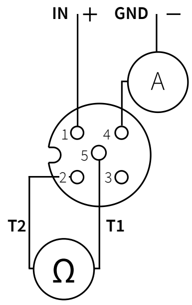
Connector M12x1 with temperature measurement 2



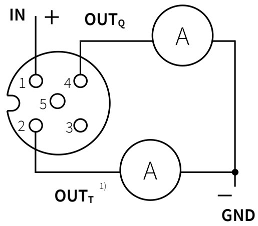
frequency output with
temperature measurement
PT1000



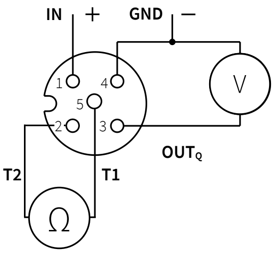
Frequency output filtered
Pulse output



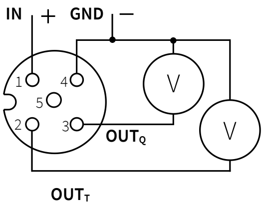
Current output
with temperature
measurement
PT1000



Current output with
temperature measu-
rement 4 ... 20 mA



Voltage output with temperature
measurement PT1000



Voltage output with temperature
measurement 0 ... 10 V

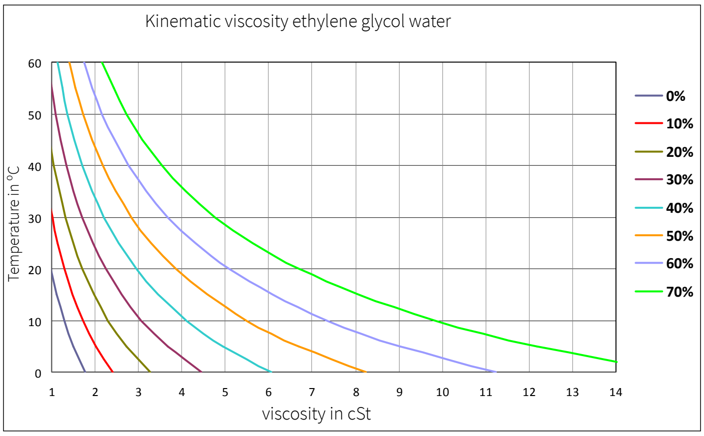
Pin		Colour
1	1	brown
3		blue
4		black
1	2	brown
2		white
3		blue
4		black
5		gray

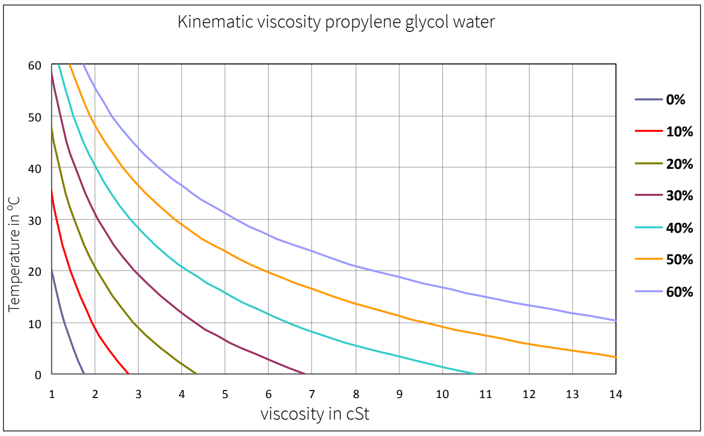
[1] «OUT_T» is only in operation if «OUT_Q» is connected

Influence of glycol

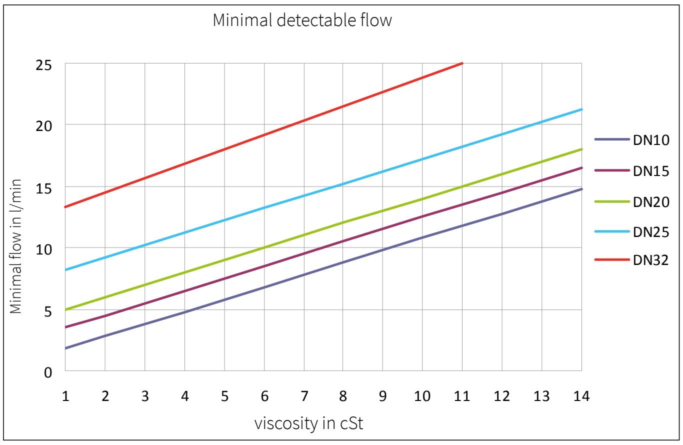
With the following definitions we are able to correct the influence of media with higher viscosity than water (= media viscosity > 1.8 cST) in order to reach a measuring accuracy of 3% fs in the range of 1.8 - 4 cST and of 4% in the range of 4 - 14 cSt (v = viscosity in cSt).

Definition of viscosity of glycol-water-compound





Definition of respond threshold Q_{min}



Formula respond threshold Q_{min} in l/min

< DN 10 not possible

DN 10: $Q_{min} = v + 0.8$
DN 15: $Q_{min} = v + 2.5$
DN 20: $Q_{min} = v + 4.0$
DN 25: $Q_{min} = v + 8.0$
DN 32: $Q_{min} = v + 13.0$

Formula characteristic line for $Q \geq Q_{min}$ in l/min

< DN 10not possible

Frequency output (unfiltered):
DN 10: $Q = K_f \cdot f - 0.40v + 0.3$
DN 15: $Q = K_f \cdot f - 0.45v + 0.35$
DN 20: $Q = K_f \cdot f - 0.55v + 0.25$
DN 25: $Q = K_f \cdot f - 0.80v + 0.60$
DN 32: $Q = K_f \cdot f - 0.85v + 0.35$

Frequency output (filtered):
DN 10: $Q = 0.032 \cdot f - 0.40v + 0.40$
DN 15: $Q = 0.050 \cdot f - 0.45v + 0.45$
DN 20: $Q = 0.080 \cdot f - 0.55v + 0.55$
DN 25: $Q = 0.150 \cdot f - 0.80v + 0.80$
DN 32: $Q = 0.240 \cdot f - 0.85v + 0.85$

Pulse output:
DN 10: $Q = 0.030 \cdot \text{Pulse/s} - 0.40v + 0.40$
DN 15: $Q = 0.060 \cdot \text{Pulse/s} - 0.45v + 0.45$
DN 20: $Q = 0.060 \cdot \text{Pulse/s} - 0.55v + 0.55$
DN 25: $Q = 0.075 \cdot \text{Pulse/s} - 0.80v + 0.80$
DN 32: $Q = 0.120 \cdot \text{Pulse/s} - 0.85v + 0.85$

Voltage output 0 ... 10 V:
DN 10: $Q = 3.2 \cdot U_{Out} - 0.40v + 0.40$
DN 15: $Q = 5.0 \cdot U_{Out} - 0.45v + 0.45$
DN 20: $Q = 8.5 \cdot U_{Out} - 0.55v + 0.55$
DN 25: $Q = 15.0 \cdot U_{Out} - 0.80v + 0.80$
DN 32: $Q = 24.0 \cdot U_{Out} - 0.85v + 0.85$

Current output 4 ... 20 mA (I in mA):
DN 10: $Q = 2.000 \cdot (I - 4\text{ mA}) - 0.40v + 0.40$
DN 15: $Q = 3.125 \cdot (I - 4\text{ mA}) - 0.45v + 0.45$
DN 20: $Q = 5.313 \cdot (I - 4\text{ mA}) - 0.55v + 0.55$
DN 25: $Q = 9.375 \cdot (I - 4\text{ mA}) - 0.80v + 0.80$
DN 32: $Q = 15.000 \cdot (I - 4\text{ mA}) - 0.85v + 0.85$

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