

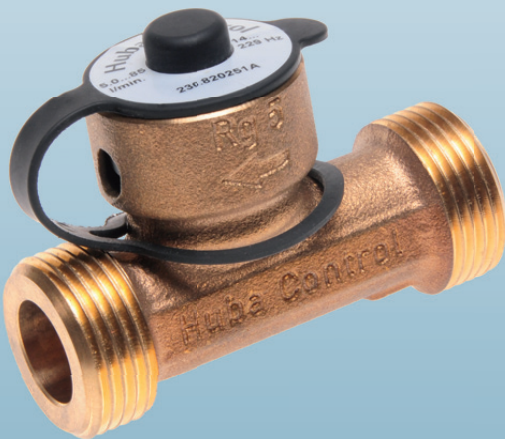


Vortex flow sensor

## Flow sensor for liquid media Type 230

The flow sensor type 230 is based on the Kármán vortex trail. You can choose between various versions as integrated temperature measurement.

The type 230 has a rugged construction of red brass. With no moving parts the flow sensor is not sensitive to debris, has marginal pressure loss and high accuracy.



### Flow range

1.8 ... 150 l/min

### Nominal diameters

DN 10 / 15 / 20 / 25

### Temperature measurement

-40 ... +125 °C

- + Flow measuring with voltage, current, pulse or frequency output
- + Temperature non-sensitive measuring principle
- + Excellent media resistance (measuring element not in contact with the media)
- + Wide application temperature range
- + Marginal loss of pressure
- + Measuring element not sensitive to debris
- + Direct temperature measurement in the medium
- + Drinking water approval KTW, W270, ACS, WRAS

## Technical Overview

### Flow measurement

Measuring principle	Vortex		Piezoelectric sensor element	
Measuring range			1.8 ... 150 l/min	
Nominal diameters			DN 10 / 15 / 20 / 25	
Accuracy at < 50% fs (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	< +125 °C
	Ambient	-15 ... +85 °C
	Ambient (2x 4 ... 20 mA)	-15 ... +65 °C
	Storage	-30 ... +85 °C
Max. pressure and medium temperature	(for lifetime)	12 bar at +40 °C
	(for lifetime)	6 bar at +100 °C
	(for 600 hours)	4 bar at +125 °C
	(for 2 hours)	4 bar at +140 °C
	(max. test pressure)	18 bar at +40 °C
Cavitation	The following equation is valid to prevent cavitation:	$P_{\text{abs.outlet}} / P_{\text{difference}} > 5.5$

### Materials in contact with medium

Sensor paddle	ETFE
Case	Red brass / PA6T/6I (40% GF)
Sealing material	EPDM (perox.) (for drinking water)
	FPM

### Electrical connection

Connector M12x1	Protection standard
	IP 65

Weight	with thread A	with thread L
DN 10	-	~ 230 g
DN 15	~ 240 g	~ 310 g
DN 20	~ 340 g	~ 440 g
DN 25	~ 510 g	~ 600 g

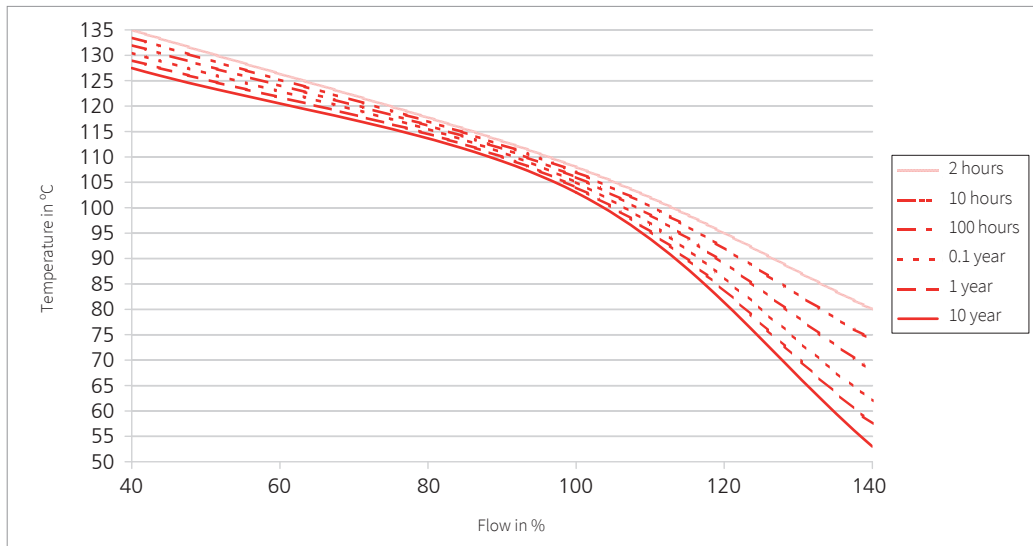
### Test / Admissions

Electromagnetic compatibility	CE conformity acc. EN 61326-2-3
Drinking water approval	WRAS
	ACS
	Plastic parts with KTW and W270 approval

### Packaging

Single packaging	
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## Minimum life span on high flow rate and high temperature



## Analogue output - Electrical overview

### Temperature measurement (≥ 8 DN)

Measuring principle	Resistance			PT1000
	Measuring range			-40 ... +125 °C
PT1000	Accuracy	class B DIN EN 60751	@ T = 0 °C @ T ≠ 0 °C	± 0.3 K ± 0.3 K ± 0.005 * ΔT
	Measuring range			-25 ... +125 °C
0 ... 10 V	Accuracy			± 0.5 K ± 0.005 * ΔT
	Calculation temperature			T (°C) = ±150 °C * U <sub>OUT,T</sub> - 25 °C 10 V
	Measuring range			-25 ... +125 °C
4 ... 20 mA	Accuracy			± 0.5 K ± 0.005 * ΔT
	Calculation temperature			T (°C) = $\frac{I_{OUT,T} - 4 \text{ mA}}{16 \text{ mA}} * 150 \text{ °C} - 25 \text{ °C}$

Electronic	Voltage output	Current output	Dual power output
Power supply	11.5 ... 33 VDC	8 ... 33 VDC	10 ... 33 VDC
Output flow (Q)	anaogue signal	4 ... 20 mA	4 ... 20 mA
Output temperature (T)	signal	-	4 ... 20 mA
Load against GND or IN	< 6 mA / < 100 nF <sup>1)</sup>	< (U <sub>IN</sub> - 8 V) / 20 mA	< (U <sub>IN</sub> - 10 V) / 20 mA
Current consumption load free (I <sub>IN</sub> )	< 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 <sup>2),3)</sup>	K <sub>V</sub> [ $\frac{L}{V * min}$ ]	K <sub>I</sub> [ $\frac{L}{mA * min}$ ]
10	1.8 ... 32	0.265 ... 4.716	22.50*Q <sup>2</sup>	3.2	2.000
10	2.0 ... 40	0.295 ... 5.895	22.50*Q <sup>2</sup>	4.0	2.500
15	3.5 ... 50	0.290 ... 4.145	6.70*Q <sup>2</sup>	5.0	3.125
20	5.0 ... 85	0.265 ... 4.509	2.50*Q <sup>2</sup>	8.5	5.313
25	9.0 ... 150	0.283 ... 4.709	0.92*Q <sup>2</sup>	15.0	9.375

### Characteristic line formula current output

$$Q_V = K_I * (I_{OUT} - 4 \text{ mA})$$

### Characteristic line formula voltage output

$$Q_V = K_U * U_{OUT}$$

### Legend

Q <sub>V</sub>	Volume flow rate	[l/min]
K <sub>V</sub>	Coefficient voltage output	[(l/min) / V]
K <sub>I</sub>	Coefficient current output	[(l/min) / mA]
U <sub>OUT</sub>	Voltage	[V]
I <sub>OUT</sub>	Current	[mA]

## Analogue output - Order code selection table

		1	2	3	4	5	6	7
		230.	X	X	X	X	X	X
Version	Flow	9			3,4	4		
	Flow and temperature (PT1000)	8			3,4	5		
	Flow and temperature (2x 0 ... 10 V)	6			3	5		
	Flow and temperature (2x 4 ... 20 mA)	5			5	5		
Nominal diameters and flow range	DN 10		1	0				L
	DN 10		1	1				L
	DN 15		1	5				
	DN 20		2	0				
	DN 25		2	5				
Output / power supply	Analogue output 0 ... 10 V	9,8,6			3			
	Analogue output 4 ... 20 mA	9,8			4			
	Analogue output 4 ... 20 mA	5			5			
Electrical connection	Connector M12x1 3-pole (with condensation protection)	9			3,4	4		
	5-pole (with condensation protection)	8,6,5				5		
Sealing material	EPDM Ethylene propylene rubber (peroxidically cross-linked)						1	
	FPM <sup>4)</sup> Fluoro elastomer						2	
Red brass body	Red brass armature outside thread							A
								L

<sup>1)</sup> against GND only

<sup>2)</sup> incl. 3xDi inlet and outlet side

<sup>3)</sup> Pv in Pa; Q in l/min

<sup>4)</sup> No drinking water approval

## Frequency output (filtered) and pulse output - Electrical overview

### Temperature measurement

Measuring principle	Resistance	PT1000 class B DIN EN 60751		
	Measuring range	-40 ... +125 °C		
PT1000	Accuracy	Class B DIN EN 60751	@ T = 0 °C	± 0.3 K
			@ T ≠ 0 °C	± 0.3 K ± 0.005 * ΔT
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)	< 0.5 ... > U <sub>IN</sub> - 0.5 V	Level height (open collector)	< 0.5 ... > U <sub>IN</sub> - 0.5 V
Output temperature (T)	Resistant signal		PT1000 class B DIN EN 60751
Load against GND or IN	> 1 kΩ / < 10 kΩ		
Current consumption load free (I <sub>m</sub> )	< 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 <sup>1),2)</sup>	K <sub>ff</sub> [(l/min) / Hz] at 0 ... 1000 Hz	Quantity per pulse K <sub>i</sub> [ml] (pulse)	Pulse (pulse output) [1/l]
10	1.8 ... 32	0.265 ... 4.716	22.50*Q <sup>2</sup>	0.032	0.50	2000
10	2.0 ... 40	0.295 ... 5.895	22.50*Q <sup>2</sup>	0.04	0.50	2000
15	3.5 ... 50	0.290 ... 4.145	6.70*Q <sup>2</sup>	0.05	1.00	1000
20	5.0 ... 85	0.265 ... 4.509	2.50*Q <sup>2</sup>	0.085	1.00	1000
25	9.0 ... 150	0.283 ... 4.709	0.92*Q <sup>2</sup>	0.15	1.25	800

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

$$Q_v = K_{ff} * f$$

### Pulse

$$l/min = \frac{pulse}{s} * K_i * \frac{60}{1000}$$

### Legend

Q <sub>v</sub>	Volume flow rate	[l/min]
K <sub>ff</sub>	Coefficient frequency output filtered	[(l/min) / f]
f	Frequency	[Hz]

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

		1	2	3	4	5	6	7
		230. X X X X X X X						
Version	Flow	9				4		
	Flow and temperature (PT1000)	8				5		
Nominal diameters and flow range	DN 10 1.8 ... 32 l/min.		1	0				L
	DN 10 2.0 ... 40 l/min.		1	1				L
	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				
Output / power supply	Frequency output (filtered)				6			
	Pulse output				7			
Electrical connection	Connector M12x1 3-pole (with condensation protection)	9				4		
	5-pole (with condensation protection)	8				5		
Sealing material	EPDM Ethylene propylene rubber (peroxidically cross-linked)							1
	FPM <sup>3)</sup> Fluoro elastomer							2
Red brass body	Red brass armature outside thread A (see dimension diagram)							A
	L (see dimension diagram)							L

<sup>1)</sup> incl. 3xDI inlet and outlet side

<sup>2)</sup> Pv in Pa; Q in l/min

<sup>3)</sup> No drinking water approval

## Frequency output (unfiltered) - Electrical overview

### Temperature measurement

Measuring principle	Resistance	PT1000 class B DIN EN 60751		
	Measuring range	-40 ... +125 °C		
PT1000	Accuracy	Class B DIN EN 60751	@ T = 0 °C @ T ≠ 0 °C	± 0.3 K ± 0.3 K ± 0.005 * ΔT
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 (push-pull)	< 0.5 ... > U <sub>N</sub> - 0.5 V	
Output temperature (T)	Resistant signal	PT1000 class B DIN EN 60751	
Load against GND or IN	< 1 mA / < 100 nF		
Current consumption load free (I <sub>N</sub> )	< 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 <sup>1),2)</sup>	Quantity per pulse @50% fs [ml]	Frequency range unfiltered [Hz]	Q <sub>0</sub> [l/min]	K <sub>f</sub> [(l/min) / f]
10	L	1.8 ... 32	0.265 ... 4.716	22.50 * Q <sup>2</sup>	1.378	24 ... 385	-0.2	0.0858
10	L	2.0 ... 40	0.295 ... 5.895	22.50 * Q <sup>2</sup>	1.381	26 ... 480	-0.2	0.0858
15	A	3.5 ... 50	0.290 ... 4.145	6.70 * Q <sup>2</sup>	2.998	20 ... 277	-0.2	0.1813
	L				2.975	21 ... 279		0.1799
20	A	5.0 ... 85	0.265 ... 4.509	2.50 * Q <sup>2</sup>	6.109	14 ... 231	-0.2	0.3691
	L				6.057	14 ... 233		0.3660
25	A	9.0 ... 150	0.283 ... 4.709	0.92 * Q <sup>2</sup>	12.114	13 ... 206	-0.2	0.7288
	L				12.143			0.7305

### Characteristic line formula frequency output unfiltered

$$Q_v = K_f * f + Q_0$$

### Formula quantity per pulse [litres/pulse]

$$\text{Quantity} = \frac{K_f * Q_v}{60 * (Q_v - Q_0)}$$

### Legend

Q <sub>v</sub>	Volume flow rate	[l/min]
Q <sub>0</sub>	Axis intercept	[l/min]
K <sub>f</sub>	Coefficient frequency output	[(l/min) / f]
f	Frequency	[Hz]
Quantity	Quantity per pulse	litres
Pulse		pulse

## Frequency output (unfiltered) - Order code selection table

		1	2	3	4	5	6	7
		230.						
		X	X	X	X	X	X	X
Version	Flow	9				4		
	Flow and temperature (PT1000)	8				5		
Nominal diameters and flow range	DN 10 1.8 ... 32 l/min.		1	0				L
	DN 10 2.0 ... 40 l/min.		1	1				L
	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				
Output / power supply	Frequency output (unfiltered) 4.75 ... 33 VDC				2			
Electrical connection	Connector M12x1 2- or 3-pole (condensation protection)	9				4		
	4- or 5-pole (condensation protection)	8,6				5		
Sealing material	EPDM Ethylene propylene rubber (peroxidically cross-linked)						1	
	FPM <sup>3)</sup> Fluoro elastomer						2	
Red brass body	Red brass armature outside thread A (see dimension diagram)							A
	L (see dimension diagram)							L

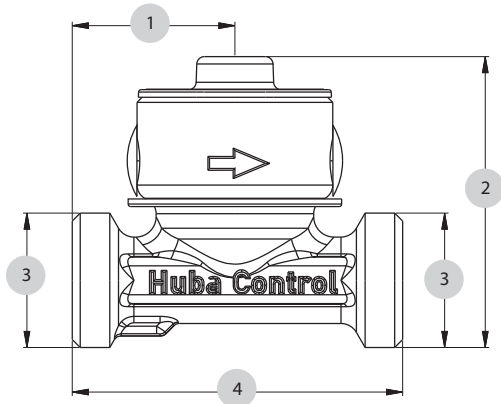
<sup>1)</sup> incl. 3xDI inlet and outlet side

<sup>2)</sup> Pv in Pa; Q in l/min

<sup>3)</sup> No drinking water approval

Accessories <i>(supplied loose)</i>				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				115024

### Dimension diagram DN 10, 15, 20, 25

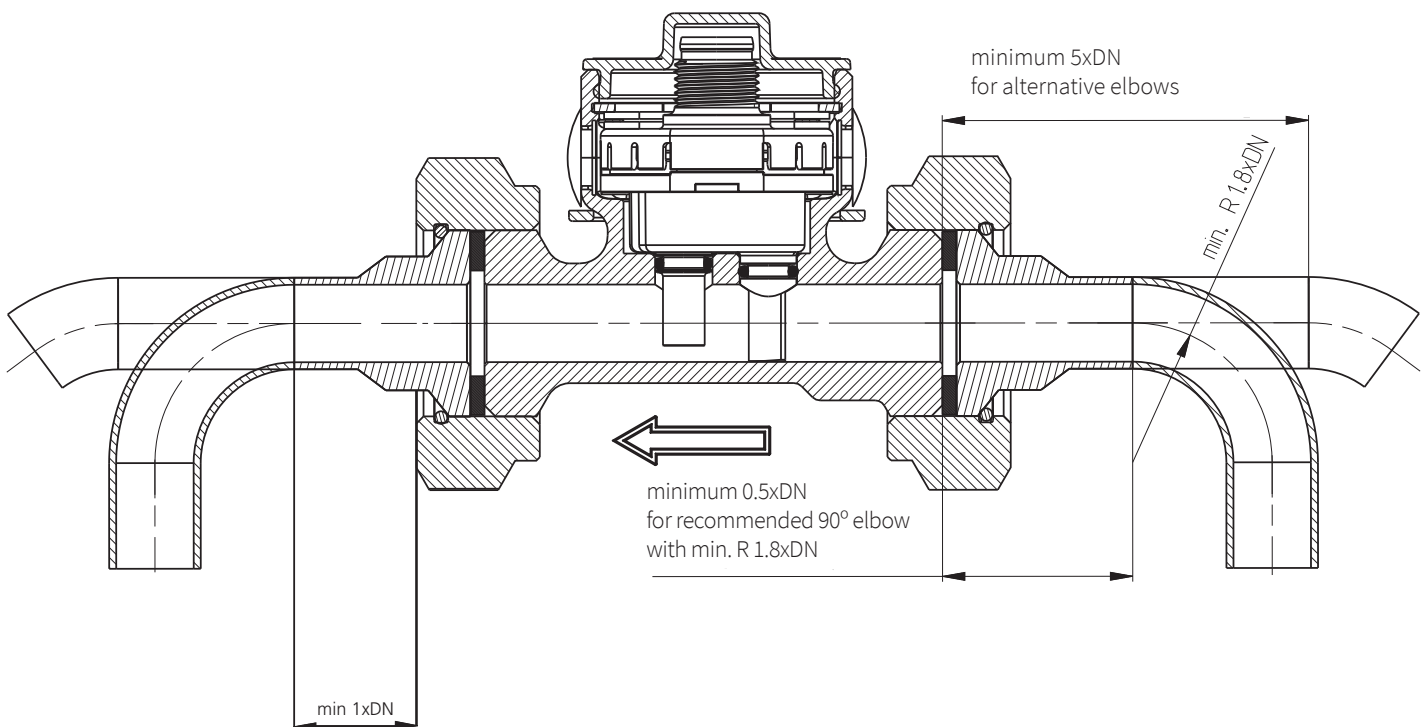


		1	2	3	4
DN10	L	32	57.22	G 3/4	65
DN15	A	40	59.22	G 3/4	75
DN15	L	40	62.65	G 1	75
DN20	A	49	64.62	G 1	86
DN20	L	49	68.95	G 1 1/4	86
DN25	A	70	71.45	G 1 1/4	109
DN25	L	70	74.40	G 1 1/2	109

### Tube mounting instructions

Consider the following to ensure the correct function of the sensor.

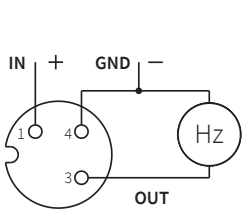
- Only diameter changes from large to small are allowed.
- Avoid repeated elbows in the same level at entryside



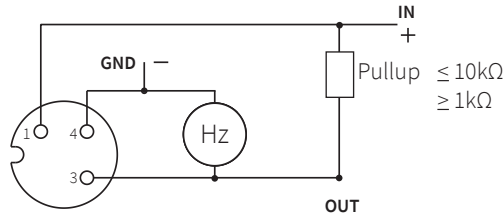
## Electrical connection

Connector M12x1 without temperature measurement

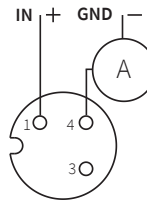
1



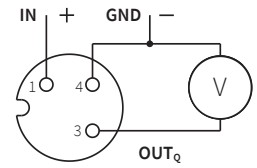
Frequency output unfiltered



Frequency output filtered  
Pulse output



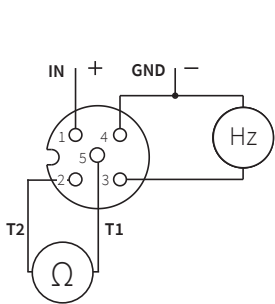
Current output



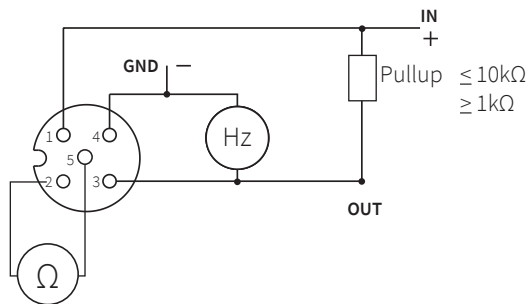
Voltage output

Connector M12x1 with temperature measurement

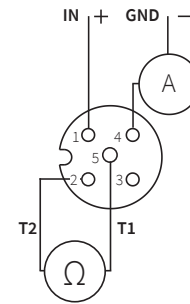
2



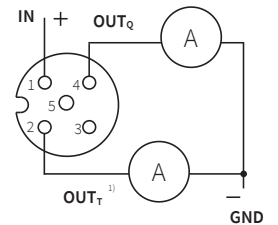
frequency output with temperature measurement  
PT1000



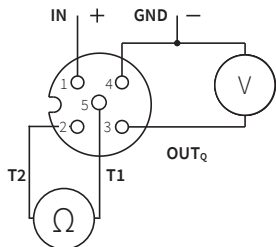
Frequency output filtered  
Pulse output



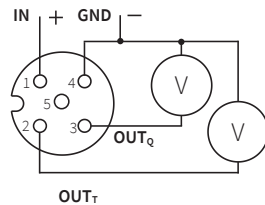
Current output with temperature measurement  
PT1000



Current output with temperature measurement  
4 ... 20 mA



Voltage output with temperature measurement  
PT1000



Voltage output with temperature measurement  
0 ... 10 V

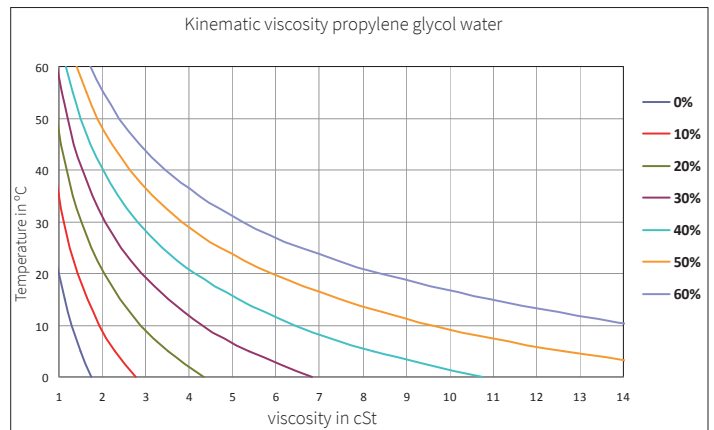
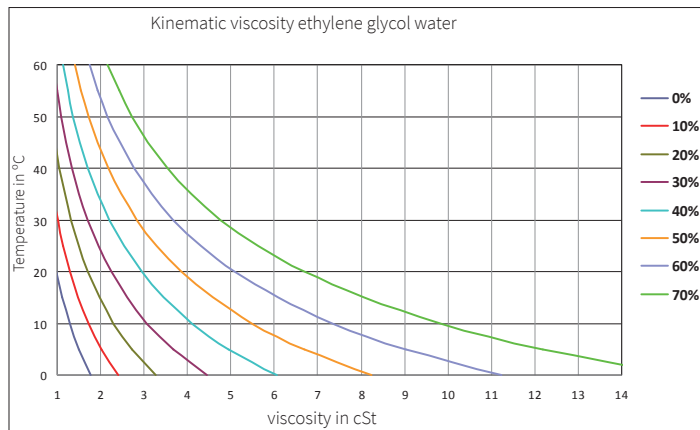
Pin	Colour
1	brown
3	blue
4	black
1	
1	brown
2	white
3	blue
4	black
5	gray
2	

<sup>1)</sup> «OUT T» is only in operation if «OUT Q» is connected

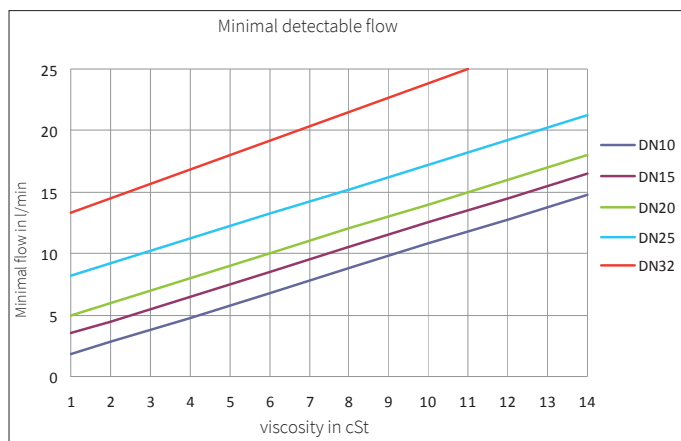
## Influence of glycol

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 ( $\nu$  = viscosity in cSt).

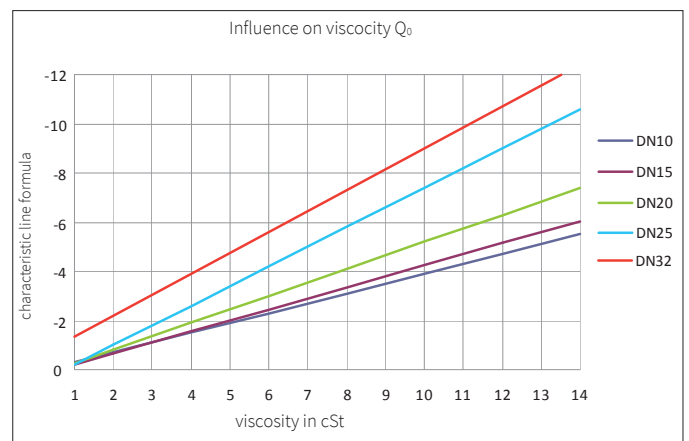
### Definition of viscosity of glycol-water-compound



### Definition of respond threshold $Q_{min}$



### Definition of characteristic line formula $Q_v = k_f * f + Q_0$



#### Formula respond threshold $Q_{min}$ in l/min

< DN 10 not possible

DN10:	$Q_{min} = \nu + 0.8$
DN15:	$Q_{min} = \nu + 2.5$
DN20:	$Q_{min} = \nu + 4$
DN25:	$Q_{min} = \nu + 8$

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

< DN 10 not possible

Frequency output (unfiltered):

DN10:	$Q = K_f * f - 0.40\nu + 0.20$
DN15:	$Q = K_f * f - 0.45\nu + 0.25$
DN20:	$Q = K_f * f - 0.55\nu + 0.25$
DN25:	$Q = K_f * f - 0.80\nu + 0.60$

Frequency output (filtered):

DN10:	$Q = 0.032 * f - 0.40\nu + 0.40$
DN15:	$Q = 0.050 * f - 0.45\nu + 0.45$
DN20:	$Q = 0.080 * f - 0.55\nu + 0.55$
DN25:	$Q = 0.150 * f - 0.80\nu + 0.80$

Impulse output:

DN10:	$Q = 0.030 * \#Pulse/s - 0.40\nu + 0.40$
DN15:	$Q = 0.060 * \#Pulse/s - 0.45\nu + 0.45$
DN20:	$Q = 0.060 * \#Pulse/s - 0.55\nu + 0.55$
DN25:	$Q = 0.075 * \#Pulse/s - 0.80\nu + 0.80$

Voltage output 0 ... 10 V:

DN10:	$Q = 3.2 * U_{out} - 0.40\nu + 0.40$
DN15:	$Q = 5.0 * U_{out} - 0.45\nu + 0.45$
DN20:	$Q = 8.5 * U_{out} - 0.55\nu + 0.55$
DN25:	$Q = 15.0 * U_{out} - 0.80\nu + 0.80$

Current output 4 ... 20 mA (I in mA):

DN10:	$Q = 2.000 * (I - 4 \text{ mA}) - 0.40\nu + 0.40$
DN15:	$Q = 3.125 * (I - 4 \text{ mA}) - 0.45\nu + 0.45$
DN20:	$Q = 5.313 * (I - 4 \text{ mA}) - 0.55\nu + 0.55$
DN25:	$Q = 9.375 * (I - 4 \text{ mA}) - 0.80\nu + 0.80$

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