Huba Control

FOR FINE PRESSURE AND FLOW MEASUREMENT

Flow sensor type 230 for liquid media

Flow range
1.8 ... 150 l/min

Nominal diameters
DN 10 / 15 / 20 / 25

Temperature measurement
-40 ... +125 °C

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 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, WRAS, ACS

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 (unfiltered) 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:	$P_{abs\ outlet} / P_{difference} > 5.5$	

Materials in contact with medium (FDA-conform)

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

Electrical connection	Protection standard
Connector M12x1	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

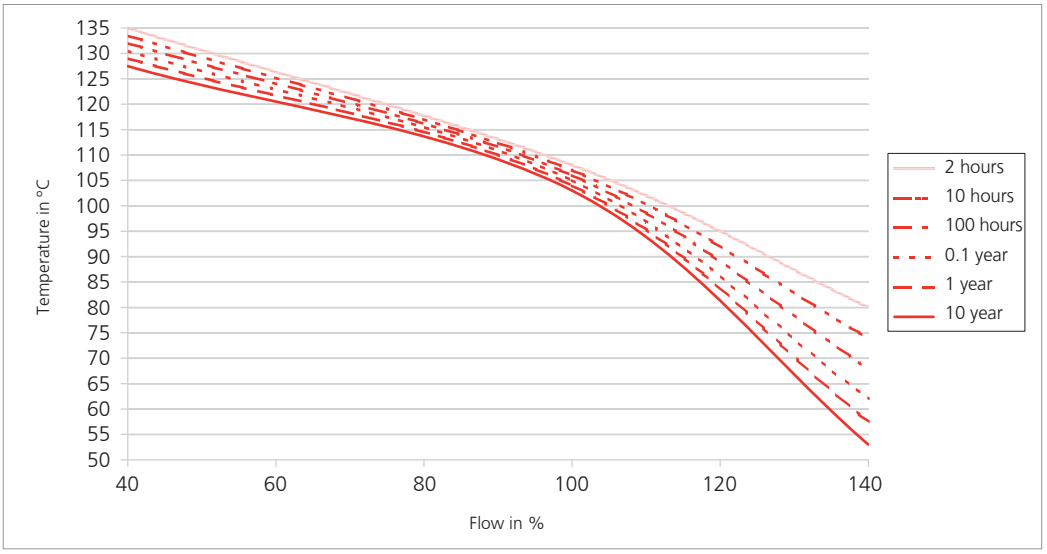
Test / Admissions

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

Packaging

Single packaging

Minimum life span on high flow rate and high temperature



Analogue output - Electrical overview

Temperature measurement (≥ 8 DN)

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

Electronic		Voltage output	Current output	Dual power output
Power supply		11.5 ... 33 VDC	8 ... 33 VDC	10 ... 33 VDC
Output flow (Q)	anaogue signal	0 ... 10 V	4 ... 20 mA	4 ... 20 mA
Output temperature (T)	signal	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 [2),3)]	$K_U \left[\frac{L}{V * min}\right]$	$K_I \left[\frac{L}{mA * min}\right]$
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

Characteristic line formula current output
$Q_V = K_I * (I_{OUT} - 4\ mA)$

Characteristic line formula voltage output
$Q_V = K_U * U_{OUT}$

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]

Analogue output - Order code selection table

			230.	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 (2x 0 ... 10 V)			6			3	5		
	Flow and temperature (2x 4 ... 20 mA)			5			5	5		
Nominal diameters and flow range	DN 10	1.8 ... 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				
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	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 [4]	Fluoro elastomer							2	
Red brass body	Red brass armature outside thread		A (see dimension diagram)							A
			L (see dimension diagram)							L

[1] against GND only
[2] incl. 3xDi inlet and outlet side
[3] Pv in Pa; Q in l/min
[4] No drinking water approval

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	@ 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)	Level height (open collector)	< 0.5 ... > U_{IN} - 0.5 V
Output temperature (T)	Resistant signal	PT1000 class B DIN EN 60751
Load agianst 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 [1),2)]	K_{ff} [(l/min) / Hz] at 0 ... 1000 Hz	Quantity per pulse K_I [ml] (pulse)	Pulse (pulse output) [1/l]
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

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_V	Volume flow rate	[l/min]
K_{ff}	Coefficient frequency output filtered	[(l/min) / f]
f	Frequency	[Hz]

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

230. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| | 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)		4.75 ... 33 VDC						6				
	Pulse output		4.75 ... 33 VDC						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 [3)]	Fluoro elastomer									2		
Red brass body	Red brass armature outside thread		A (see dimension diagram)										A
			L (see dimension diagram)										L

[1)] incl. 3xDi inlet and outlet side [2)] Pv in Pa; Q in l/min [3)] No drinking water approval

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	@ 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)		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 [1),2)]	Quantity per pulse @50% fs [ml]	Frequency range unfiltered [Hz]	Q_0 [l/min]	K_f [(l/min) / f]
10	L	1.8 ... 32	0.265 ... 4.716	22.50 * Q^2	1.378	24 ... 385	-0.2	0.0858
10	L	2.0 ... 40	0.295 ... 5.895	22.50 * Q^2	1.381	26 ... 480	-0.2	0.0858
15	A	3.5 ... 50	0.290 ... 4.145	6.70* Q^2	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^2	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^2	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]

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

Legend

Q_V	Volume flow rate	[l/min]
Q_0	Axis intercept	[l/min]
K_f	Coefficient frequency output	[(l/min) / f]
f	Frequency	[Hz]
$\frac{\text{Quantity}}{\text{Pulse}}$	Quantity per pulse	$\frac{\text{litres}}{\text{pulse}}$

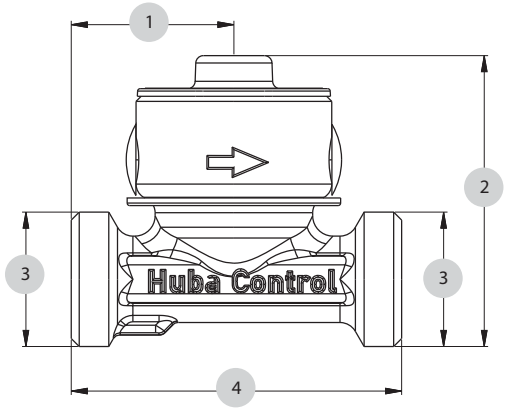
Frequency output (unfiltered) - Order code selection table

			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 [3)]	Fluoro elastomer						2	
Red brass body	Red brass armature outside thread	A (see dimension diagram)							A
		L (see dimension diagram)							L

[1)] incl. 3xDi inlet and outlet side [2)] Pv in Pa; Q in l/min [3)] No drinking water approval

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				115024

Dimension diagram DN 10, 15, 20, 25

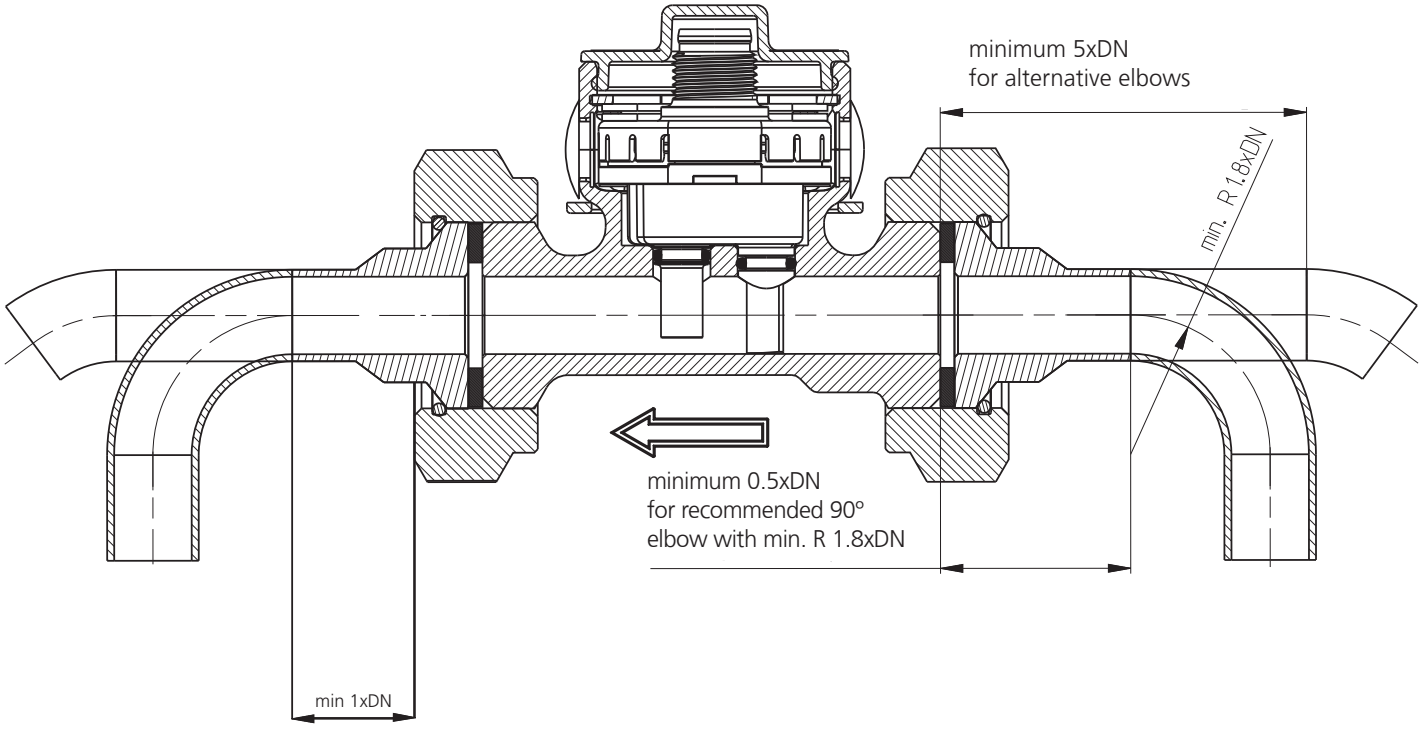


		1	2	3	4
DN10	L	32	57.22	G ¾	65
DN15	A	40	59.22	G ¾	75
DN15	L	40	62.65	G 1	75
DN20	A	49	64.62	G 1	86
DN20	L	49	68.95	G 1¼	86
DN25	A	70	71.45	G 1¼	109
DN25	L	70	74.40	G 1½	109

Tube mounting instructions

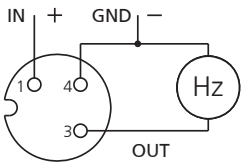
Consider the following to ensure the correct function of the sensor.

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

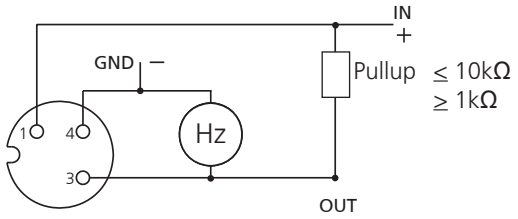


Electrical connection

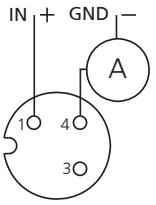
Connector M12x1 without temperature measurement 1



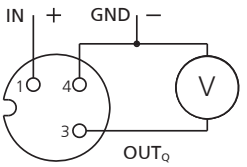
Frequency output
unfiltered



Frequency output filtered
Pulse output

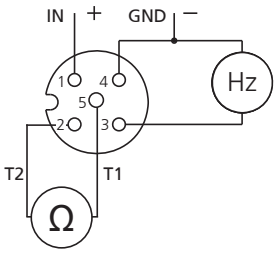


Current output

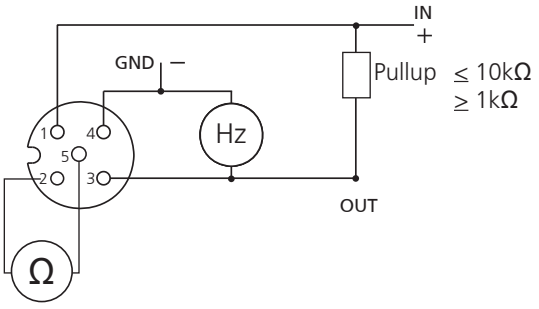


Voltage output

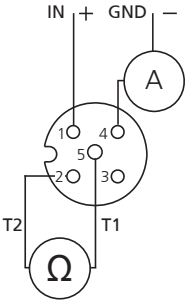
Connector M12x1 with temperature measurement 2



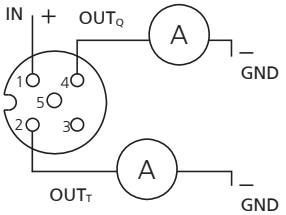
frequency output with
temperature measurement
PT1000



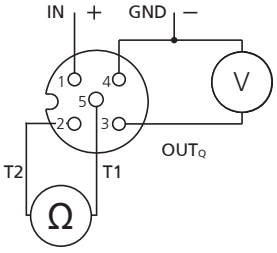
Frequency output filtered
Pulse output



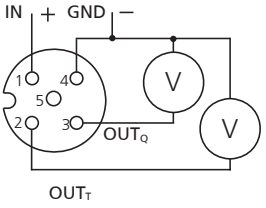
Current output
with temperature
measurement
PT1000



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



Voltage output with
temperature measurement
PT1000



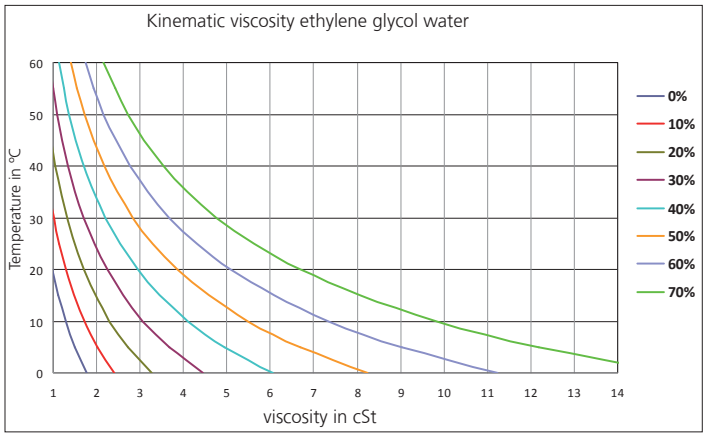
Voltage output with temperature
measurement 0 ...10 V

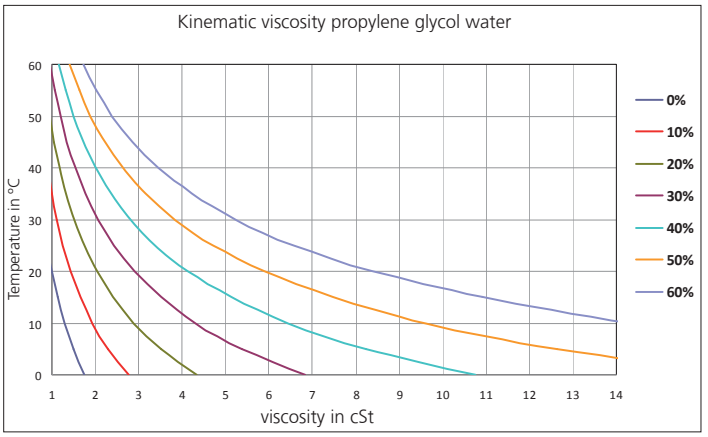
Pin		Colour
1	1	brown
3		blue
4		black
1	2	brown
2		white
3		blue
4		black
5		gray

Influence of glycol

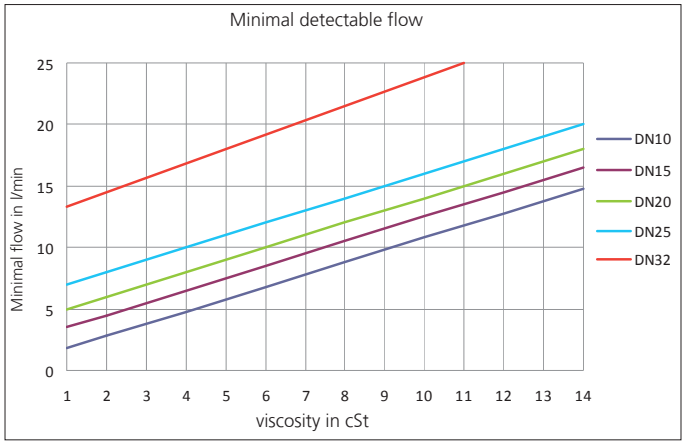
With the following definitions we are able to correct the influence of media with higher viscosity than water (= media viscosity > 1.8 cST) in order to reach a measuring accuracy of 3% fs in the range of 1.8 - 4 cST and of 4% in the range of 4 - 14 cSt (υ = viscosity in cSt).

Definition of viscosity of glycol-water-compound

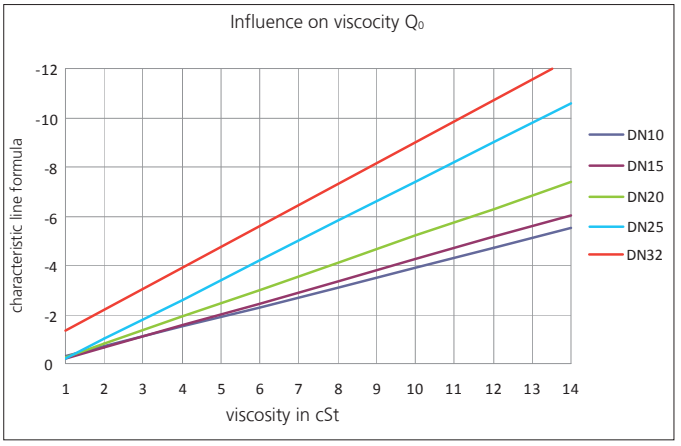




Definition of respond threshold Q_{min}



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

Formula characteristic line for $Q \geq Q_{min}$ in l/min
< DN 10 not possible
Frequency output (unfiltered):
DN10: $Q = K_f * f - 0.40\upsilon + 0.20$
DN15: $Q = K_f * f - 0.45\upsilon + 0.25$
DN20: $Q = K_f * f - 0.55\upsilon + 0.25$
DN25: $Q = K_f * f - 0.80\upsilon + 0.60$

Frequency output (filtered):
DN10: $Q = 0.032 * f - 0.40\upsilon + 0.40$
DN15: $Q = 0.050 * f - 0.45\upsilon + 0.45$
DN20: $Q = 0.080 * f - 0.55\upsilon + 0.55$
DN25: $Q = 0.150 * f - 0.80\upsilon + 0.80$

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

Voltage output 0 ...10 V:
DN10: $Q = 3.2 * U_{out} - 0.40\upsilon + 0.40$
DN15: $Q = 5.0 * U_{out} - 0.45\upsilon + 0.45$
DN20: $Q = 8.5 * U_{out} - 0.55\upsilon + 0.55$
DN25: $Q = 15.0 * U_{out} - 0.80\upsilon + 0.80$

Current output 4 ... 20 mA (I in mA):
DN10: $Q = 2.000 * (I - 4\ mA) - 0.40\upsilon + 0.40$
DN15: $Q = 3.125 * (I - 4\ mA) - 0.45\upsilon + 0.45$
DN20: $Q = 5.313 * (I - 4\ mA) - 0.55\upsilon + 0.55$
DN25: $Q = 9.375 * (I - 4\ mA) - 0.80\upsilon + 0.80$

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