Technical Description

ULTRAFLOW® 54

Kamstrup

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Contents

1 General Description

ULTRAFLOW® 54 is a static flow sensor based on the ultrasonic principle. It is primarily used as a volume flow sensor for heat meters such as MULTICAL®. ULTRAFLOW® has been designed for use in heating installations where water is the heat-bearing medium.

ULTRAFLOW® employs ultrasonic measuring techniques and microprocessor technology. All calculating and measuring circuits are collected on one single board, providing a compact and rational design in addition to exceptionally high measuring accuracy and reliability.

The flow is measured using bidirectional ultrasonic technique based on the transit time method, proven a long-term stable and accurate measuring principle. Two ultrasonic transducers are used to send the sound signal both against and with the flow. The ultrasonic signal travelling with the flow reaches the opposite transducer first. The time difference between the two signals can be converted into flow velocity and thereby also volume.

A three-wire pulse cable is used to connect ULTRAFLOW® to the calculator. The cable supplies the flow sensor and also transfers the signal from sensor to calculator. A signal corresponding to the flow – or more correctly, a number of pulses proportional to the water volume flowing through - is transmitted.

Where ULTRAFLOW® is to be used as a flow sensor with built-in supply, e.g. if the distance between MULTICAL® and ULTRAFLOW® is 10 m or more, a Pulse Transmitter can be supplied as an accessory. If ULTRAFLOW® 54 is used as pulse generator for other equipment, it must be connected through a Pulse Transmitter. The Pulse Transmitter has a built-in supply for ULTRAFLOW® and a galvanically separated pulse output.

2 Data

ULTRAFLOW® 54

2.1 Electrical data

Supply voltage	3.6 V ± 0.1 V
Battery (Pulse Transmitter/ Pulse Divider)	3.65 VDC, D-cell lithium
Replacement interval	6 years @ t_{BAT}< 30°C
Mains supply (Pulse Transmitter/ Pulse Divider)	230 VAC +15/-30%, 50 Hz 24 VAC ±50%, 50 Hz
Power consumption mains supply	< 1 W
Back-up mains supply	Integral super-cap eliminates interruptions due to short-term power-cuts
Cable length, flow meter	Max. 10 m
Cable length, Pulse Transmitter/ Pulse Divider	Depending on the calculator
EMC data	Meets DS/EN 1434:2007 class C, MID E1 and E2

2.2 Mechanical data

Metrological class	2 or 3	
Environmental class	Meets DS/EN 1434 class C	
Ambient temperature	5…55°C (indoors)	
Protection class		
Flow sensor	IP65	
Pulse Transmitter/ Pulse Divider	IP54	
Humidity	93% RF non-condensing	
Mechanical environment	MID M1	
Temperature of medium	15…130°C or 15…90°C	At medium temperatures above 90°C use of flange meters is recommended. Additionally, MULTICAL® calculator or Pulse Transmitter/Pulse Divider should be wall-mounted
Storage temp. empty sensor	-25…70°C, 60°C at mounted/enclosed battery	
Pressure stage	PN16 and PN25	

2.3 Flow data

Nom. flow q_p [m³/h]	Nom. diameter [mm]	Meter factor [1)] [imp/l]	Dynamic range q_i:q_p	q_s:q_p	Flow @125 Hz [2)] [m³/h]	Δp @ q_p [bar]	Min. Cutoff [l/h]
0.6	DN15 & DN20	300	1:50 & 1:100	2:1	1,5	0.04	2
1.5	DN15 & DN20	100	1:50 & 1:100	2:1	4,5	0.22	3
2.5	DN20	60	1:50 & 1:100	2:1	7,5	0.03	5
3.5	DN25	50	1:50 & 1:100	2:1	9	0.07	7
6	DN25 & DN32	25	1:50 & 1:100	2:1	18	0.2	12
10	DN40	15	1:50 & 1:100	2:1	30	0.06	20
15	DN50	10	1:50 & 1:100	2:1	45	0.14	30
25	DN65	6	1:50 & 1:100	2:1	75	0.06	50
40	DN80	5	1:50 & 1:100	2:1	90	0.05	80
60	DN100	2.5	1:50 & 1:100	2:1	180	0.03	120
100	DN100	1.5	1:50 & 1:100	2:1	300	0.07	200
100	DN125	1.5	1:50 & 1:100	2:1	300	0.1	200

[1)] *The pulse figure appears from the meter´s type label.*
[2)] *Saturation flow (125 Hz. Max. pulse frequency 128 Hz is maintained at higher flow).*

Table 1

2.4 Material

Wetted parts

ULTRAFLOW® 54, q_p 0.6 and 1.5 m³/h

Housing, gland	DZR brass (Dezincification proof brass)
Housing, flange	Stainless steel, W.no. 1.4308
Transducer	Stainless steel, W.no. 1.4401
Gaskets	EPDM
Reflectors	Thermoplastic, PES 30% GF and stainless steel, W.no. 1.4301
Measuring pipe	Thermoplastic, PES 30% GF

ULTRAFLOW® 54, q_p 2.5 to 100 m³/h

Housing, gland	DZR brass (Dezincification proof brass)
Housing, flange	Red brass, RG5 or stainless steel, W.no. 1.4308 (see Order specification)
Transducer	Stainless steel, W.no. 1.4401
Gaskets	EPDM
Measuring pipe	Thermoplastic, PES 30% GF
Reflectors	Stainless steel, W.no. 1.4301

Electronics housing

Base	Thermoplastic, PBT 30% GF
Lid	Thermoplastic, PC 20% GF

Connecting cable

Silicone cable (3x0.5mm²)

3 Type overview

Nom. flow q_p [m³/h]	Installation dimensions						
0.6	G¾Bx110 mm	G1Bx130 mm	*(G1Bx190 mm)*				
1.5	G¾Bx110 mm	G¾Bx165 mm	G1Bx130 mm	G1Bx190 mm	*(G1Bx110 mm)*	*(G1Bx165 mm)*	*(DN20x190 mm)*
2.5	G1Bx190 mm	DN20x190 mm	*(G1Bx130 mm)*				
3.5	G5/4Bx260 mm	DN25x260 mm					
6	G5/4Bx260 mm	DN25x260 mm	*(G1½Bx260 mm)*				
10	G2Bx300 mm	DN40x300 mm	(DN40x250 mm)				
15	DN50x270 mm	*(DN50x250 mm)*					
25	DN65x300 mm						
40	DN80x300 mm	*(DN80x350 mm)*					
60	DN100x360 mm	*(DN100x400 mm)*					
100	DN100x360 mm	DN125x350 mm					

(...) Country specific variants

Table 2

Thread ISO 228-1

Flange EN 1092, PN25

4 Ordering details

Below is a list of type numbers for ULTRAFLOW® 54.

Type number[3)]	q_p [m³/h]	q_i [m³/h]	q_s [m³/h]	Connection	PN	Length [mm]	Pulse figure [imp/l]	CCC (high res.)	Material
65-5- CAAA -XXX	0.6	0.006	1.2	G¾B (R½)	16	110	300	416 (484)	Brass
65-5- CAAD -XXX	0.6	0.006	1.2	G1B (R¾)	16	130	300	416 (484)	Brass
(65-5- CAAF -XXX)	0.6	0.006	1.2	G1B (R¾)	16	190	300	416 (484)	Brass
(65-5- CDA1 -XXX)	1.5	0.015	3	G1B (R¾)	16	110	100	419 (407)	Brass
65-5- CDAA -XXX	1.5	0.015	3	G¾B (R½)	16	110	100	419 (407)	Brass
65-5- CDAC -XXX	1.5	0.015	3	G¾B (R½)	16	165	100	419 (407)	Brass
65-5- CDAD -XXX	1.5	0.015	3	G1B (R¾)	16	130	100	419 (407)	Brass
(65-5- CDAE -XXX)	1.5	0.015	3	G1B (R¾)	16	165	100	419 (407)	Brass
65-5- CDAF -XXX	1.5	0.015	3	G1B (R¾)	16	190	100	419 (407)	Brass
(65-5- CDCA -XXX)	1.5	0.015	3	DN20	25	190	100	419 (407)	Stainless steel
(65-5- CEAD -XXX)	2.5	0.025	5	G1B (R¾)	16	130	60	498 (-)	Brass
65-5- CEAF -XXX	2.5	0.025	5	G1B (R¾)	16	190	60	498 (-)	Brass
65-5- CECA -XXX	2.5	0.025	5	DN20	25	190	60	498 (-)	Stainless steel
65-5- CGAG -XXX	3.5	0.035	7	G5/4B (R1)	16	260	50	451 (436)	Brass
65-5- CGCB -XXX	3.5	0.035	7	DN25	25	260	50	451 (436)	Stainless steel
65-5- CHAG -XXX	6	0.06	12	G5/4B (R1)	16	260	25	437 (438)	Brass
(65-5- CHAH -XXX)	6	0.06	12	G1½B (R5/4)	16	260	25	437 (438)	Brass
65-5- CHCB -XXX	6	0.06	12	DN25	25	260	25	437 (438)	Stainless steel
65-5- CJAJ -XXX	10	0.1	20	G2B (R1½)	16	300	15	478 (483)	Brass
(65-5- CJB2 -XXX)	10	0.1	20	DN40	16	250	15	478 (483)	Red brass
65-5- CJCD -XXX	10	0.1	20	DN40	25	300	15	478 (483)	Stainless steel
(65-5- CKC4 -XXX)	15	0.15	30	DN50	25	250	10	420 (485)	Stainless steel
65-5- CKCE -XXX	15	0.15	30	DN50	25	270	10	420 (485)	Stainless steel
65-5- CLCG -XXX	25	0.25	50	DN65	25	300	6	479 (-)	Stainless steel
65-5- CMCH -XXX	40	0.4	80	DN80	25	300	5	458 (486)	Stainless steel
(65-5- CMCJ -XXX)	40	0.4	80	DN80	25	350	5	458 (486)	Stainless steel
65-5- FACL -XXX	60	0,6	120	DN100	25	360	2,5	470 (487)	Stainless steel
(65-5- FAD5 -XXX)	60	0.6	120	DN100	16	400	2.5	470 (487)	Stainless steel
65-5- FBCL -XXX	100	1	200	DN100	25	360	1.5	480 (488)	Stainless steel
65-5- FBCM -XXX	100	1	200	DN125	25	350	1.5	480 (488)	Stainless steel

3) XXX - code for final assembly, approvals etc. - determined by Kamstrup. A few variants may not be available in national approvals.

(…) Country specific variants

Table 3

4.1 Accessories

Glands				
Size	Nipple	Union	Type no.	(2 pcs.)
DN15	R½	G¾	-	6561-323
DN20	R¾	G1	-	6561-324
DN25	R1	G5/4	6561-325	-
DN32	R5/4	G1½	6561-314	-
DN40	R1½	G2	6561-315	-

Table 4. Glands including gaskets (PN16).

Gaskets for glands	
Size (union)	Type no.
G¾	2210-061
G1	2210-062
G5/4	2210-063
G1½	2210-064
G2	2210-065

Gaskets for flange meters PN25	
Size	Type no.
DN20	2210-147
DN25	2210-133
DN40	2210-132
DN50	2210-099
DN65	2210-141
DN80	2210-140
DN100	1150-142
DN125	1150-153

Table 5. Gaskets.

4.2 Pulse Transmitter

Type No. 66-99-603. The Pulse Transmitter is available with built-in supply for ULTRAFLOW®. The options are battery, 24 VAC or 230 VAC supply. Please specify when placing the order.

Note: Flow-info not possible.

4.3 Pulse Divider

Type No. 66-99-607. The Pulse Divider is available with built-in supply for ULTRAFLOW®. The options are battery, 24 VAC or 230 VAC supply. Please specify when placing the order.

Note: Flow-info not possible.

The pulse division for Pulse Divider must also be specified when placing the order, see *Table 6*, *Table 7* and *Table 8* for possible pulse divisions.

ULTRAFLOW®		Pulse Divider, pulselength 100 ms							
q_p [m³/h]	Meter factor [Pulses/l]	Meter factor [l/Pulse]	Divider	Meter factor [l/Pulse]	Divider	Meter factor [l/Pulse]	Divider	Meter factor [l/Pulse]	Divider
0.6	300	1	300	2.5	750				
1.5	100	1	100	2.5	250	10	1000		
2.5	60	1	60	2.5	150	10	600		
3.5	50	2.5	125	10	500	25	1250		
6	25	10	250	25	625				
10	15	10	150	25	375				
15	10	10	100	25	250	100	1000	250	2500
25	6	10	60	25	150	100	600	250	1500
40	5	25	125	100	500	250	1250		
60	2.5	100	250	250	625				
100	1.5	100	150	250	375				

Table 6. Pulse division (pulse duration 100 ms).

ULTRAFLOW®		Pulse Divider, pulselength 20 ms		Pulse Divider, pulselength 50 ms	
q_p [m³/h]	Meter factor [Pulses/l]	Meter factor [l/Pulse]	Divider	Meter factor [l/Pulse]	Divider
0.6	300	1	300	1	300
1.5	100	1	100	1	100
2.5	60	1	60	1	60
3.5	50	1	50	1	50
6	25	1	25	1	25
10	15	1	15	1	15
15	10	1	10	10	100
25	6	1	6	10	60
40	5	10	50	10	50
60	2.5	10	25	10	25
100	1.5	10	15	10	15

Table 7. Pulse division (pulse duration 20 ms and 50 ms).

ULTRAFLOW®		Pulse Divider & 11EVL (pulselength 50 ms)		Pulse Divider & 11EVL (pulselength 100 ms)	
q_p [m³/h]	Meter factor [Pulses/l]	Meter factor [l/Pulse]	Divider	Meter factor [l/Pulse]	Divider
0.6	300	1	300	2.5	750
1.5	100	1	100	2.5	250
2.5	60	1	60	2.5	150
3.5	50	1	50	2.5	125
6	25	1	25	25	625
10	15	1	15	25	375
15	10	10	100	25	250
25	6	10	60	25	150
40	5	10	50	25	125
60	2.5	10	25	250	625
100	1.5	10	15	250	375

Table 8. Table on the use together with Kamstrup EVL.

5 Dimensioned sketches

All measurements are in mm, unless otherwise stated.

ULTRAFLOW® 54, G¾B and G1B

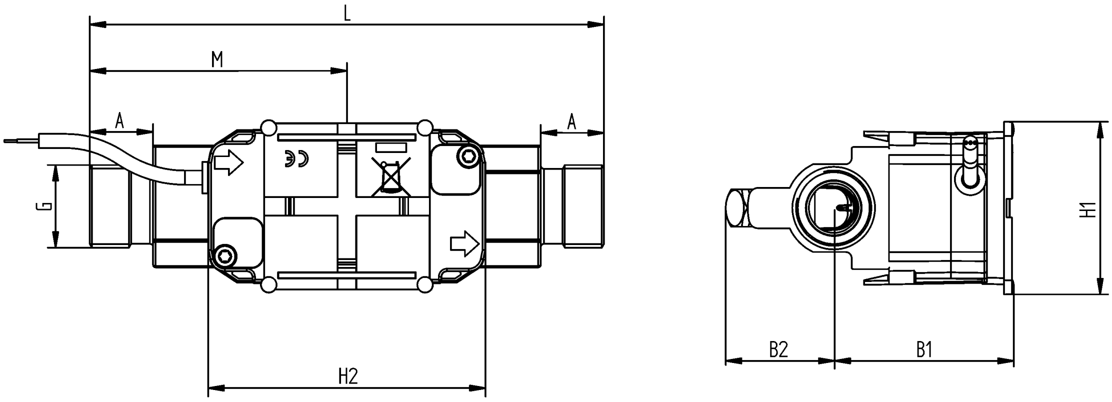


Figure 1

Thread ISO 228-1

Threads	L	M	H2	A	B1	B2	H1	Approx. weight [kg]
G¾B	110	L/2	89	10.5	58	35	55	0.8
G1B	110	L/2	89	10.5	58	35	55	0.9
G1B (q_p 0.6;1.5)	130	L/2	89	20.5	58	35	55	1.1
G1B (q_p 2.5)	130	L/2	89	20.5	58	35	55	0.9
G¾B	165	L/2	89	20.5	58	35	55	1.2
G1B	165	L/2	89	20.5	58	35	55	1.2
G1B (q_p 0.6;1.5)	190	L/2	89	20.5	58	35	55	1.5
G1B (q_p 2.5)	190	L/2	89	20.5	58	36	55	1.3

Table 9

ULTRAFLOW® 54, G5/4B, G1½B and G2B

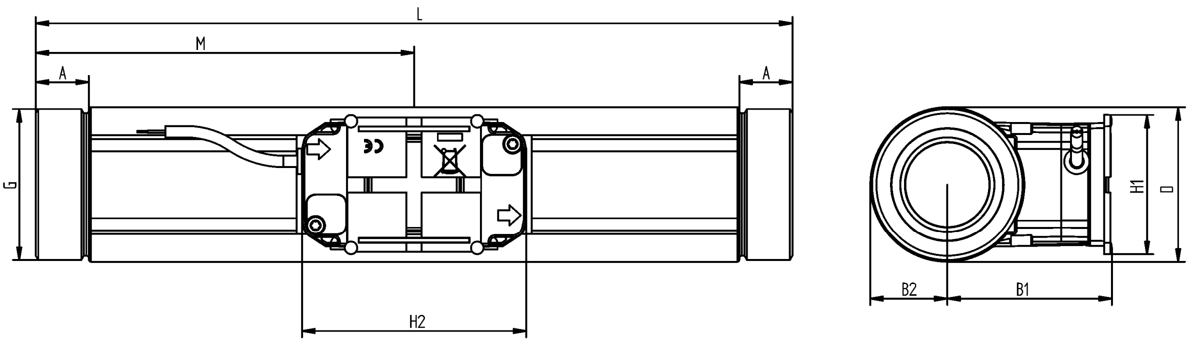


Figure 2

Thread ISO 228-1

Threads	L	M	H2	A	B1	B2	H1	D	Approx. weight [kg]
G5/4B	260	L/2	89	17	58	22	55	ø43	2.3
G1½B	260	L/2	89	30	58	37	55	ø61	4.5
G2B	300	L/2	89	21	65	31	55	ø61	4.5

Table 10

ULTRAFLOW® 54, DN20 to DN50

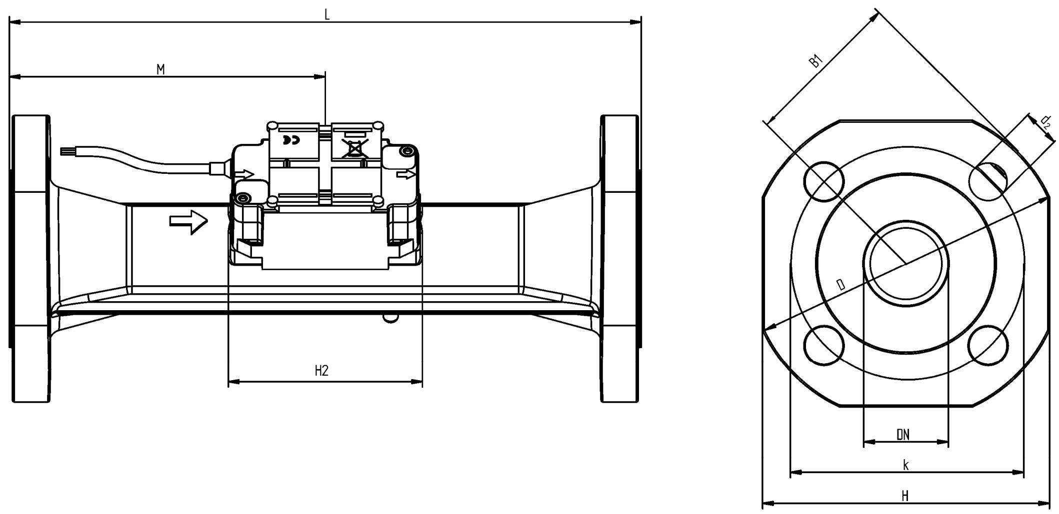


Figure 3

Flange EN 1092, PN25

Nom. diameter	L	M	H2	B1	D	H	k	Bolts Number	Threads	d_2	Approx. weight [kg]
DN20	190	L/2	89	58	105	95	75	4	M12	14	2.9
DN25	260	L/2	89	58	115	106	85	4	M12	14	5.0
DN40	250	L/2	89	<D/2	150	136	110	4	M16	18	7.9
DN40	300	L/2	89	<D/2	150	136	110	4	M16	18	8.3
DN50	250	155	89	<D/2	165	145	125	4	M16	18	9.8
DN50	270	155	89	<D/2	165	145	125	4	M16	18	10.1

Table 11

ULTRAFLOW® 54, DN65 to DN125

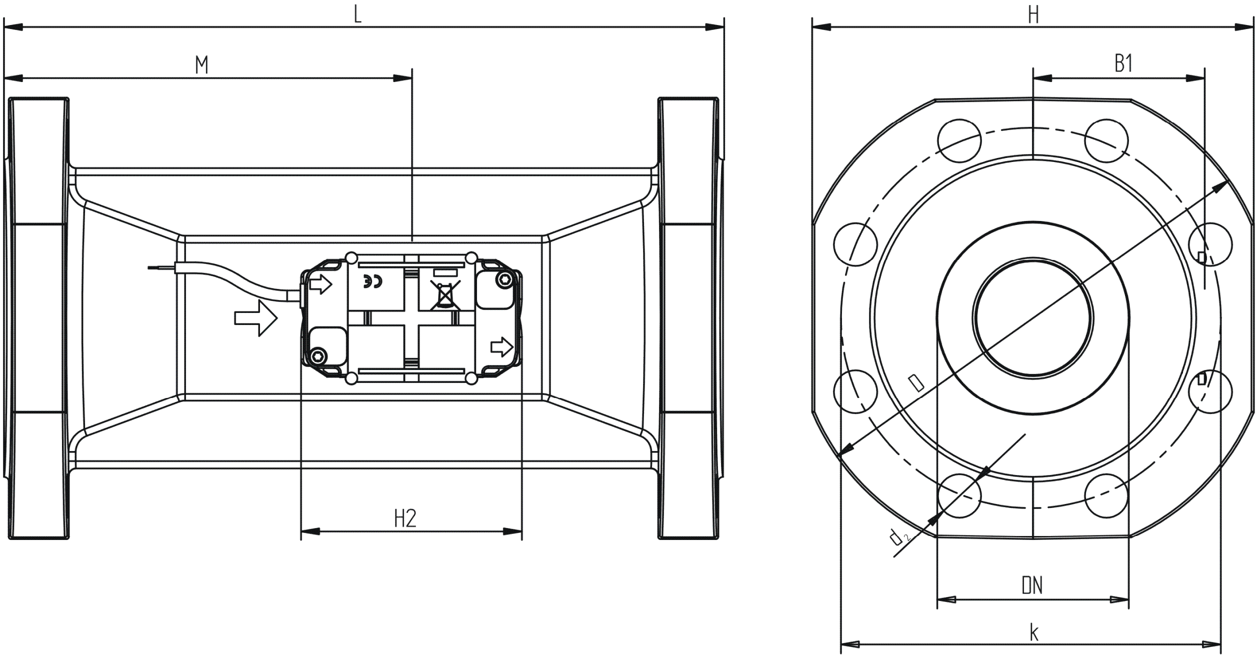


Figure 4

Flange EN 1092, PN25

Nom. Diameter	L	M	H2	B1	D	H	k	Bolts Number	Bolts Threads	Bolts d_2	Approx. weight [kg]
DN65	300	170	89	<H/2	185	168	145	8	M16	18	13.2
DN80	300	170	89	<H/2	200	184	160	8	M16	18	16.8
DN80	350	170	89	<H/2	200	184	160	8	M16	18	18.6
DN100	360	210	89	<H/2	235	220	190	8	M20	22	21.7
DN100	400	210	89	<H/2	220	210	180	8	M16	18	22.8
DN125	350	212	89	<H/2	270	260	220	8	M24	28	28.2

Table 12

6 Pressure loss

The pressure loss in a flow sensor is stated as the max. pressure loss at q_p. According to EN 1434 the max. pressure loss must not exceed 0.25 bar, unless the energy meter includes a flow controller or functions as pressure reducing equipment.

The pressure loss in a sensor increases with the square of the flow and can be stated as:

$$Q = kv \times \sqrt{\Delta p}$$

where:

Q =volume flow rate [m³/h]

kv=volume flow rate at 1 bar pressure loss

Δp=pressure loss [bar]

Graph	q_p [m³/h]	Nom. diameter [mm]	kv	Q@0.25 bar [m³/h]
A	0.6 & 1.5	DN15 & DN20	3.2	1.6
B	2.5 & 3.5 & 6	DN20, DN25 & DN32	13.4	6.7
C	10 & 15	DN40 & DN50	40	20
D	25	DN65	102	51
E	40	DN80	179	90
F	60 & 100	DN100	373	187
G	100	DN125	316	158

Table 13. Pressure loss table.

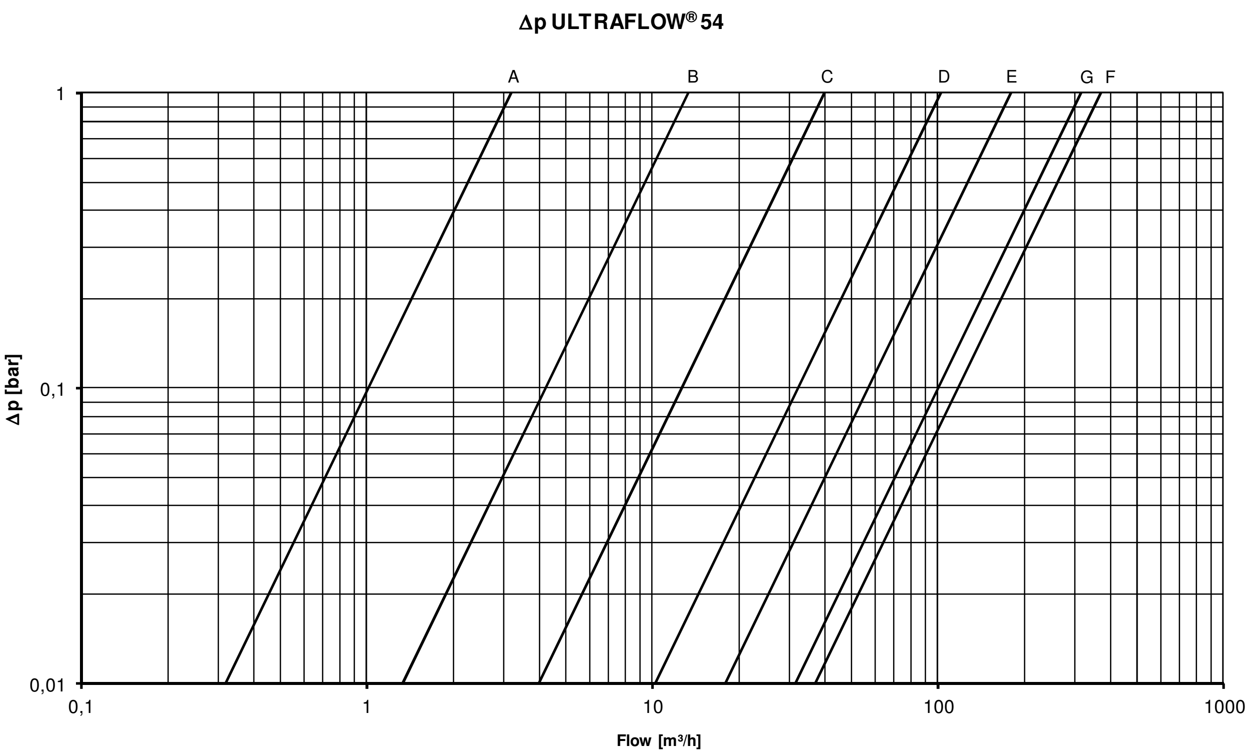


Diagram 1. Pressure loss chart.

7 Installation

Prior to installation of the flow sensor, the system should be flushed and protection plugs/plastic diaphragms removed from the flow sensor.

Correct position of the flow sensor (flow or return) appears from the front label of MULTICAL®. The flow direction is indicated by an arrow on the side of the flow sensor.

Glands and gaskets are mounted as shown in the drawings overleaf.

Pressure stage of ULTRAFLOW® 54: PN16/PN25, see marking. Flow sensor marking does not cover included accessories.

Temperature of medium, ULTRAFLOW® 54: 15…130°C/15…90°C, see marking.

Mechanical environment: M1 (fixed installation with minimum vibration).

Electromagnetic environment: E1 and E2 (housing/light industry). The meter's control cables must be drawn at min. 25 cm distance from other installations.

Climatic environment: Installation must take place in environments with non-condensing humidity as well as in closed locations (indoors).

The ambient temperature must be within 5…55°C.

Maintenance and repair: The flow sensor is verified separately and can, therefore, be separated from the calculator. Battery for replacement: Kamstrup type 66-00-200-100. Other repairs require subsequent reverification in an accredited laboratory.

ULTRAFLOW® can only be connected direct to Kamstrup's calculators on terminals 11-9-10, as shown in *paragraph 7.6*. Connection to other types of calculators requires the use of a Pulse Transmitter.

Note: Please make sure that "pulse/litres" is identical on flow meter and calculator

At medium temperatures above 90°C use of flange meters is recommended. Additionally, MULTICAL® calculator or Pulse Transmitter should be wall-mounted.

In order to prevent cavitation the back pressure at ULTRAFLOW® must be min. 1.5 bar at q_p and min. 2.5 bar at q_s. This applies to temperatures up to approx. 80°C.

ULTRAFLOW® must not be exposed to pressure lower than the ambient pressure (vacuum).

When the installation has been completed, water flow can be turned on. The valve on the inlet side must be opened first.

7.1 Installation angle for ULTRAFLOW® 54

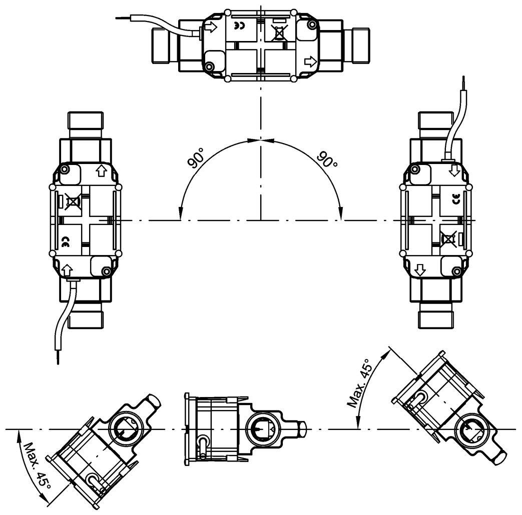


Figure 5

ULTRAFLOW® 54 may be installed horizontally, vertically, or at an angle.

Important!

For ULTRAFLOW® 54 the electronics/plastic case must be placed on the side (when installed horizontally).

ULTRAFLOW® 54 may be turned up to ±45° in relation to the pipe axis.

7.2 Straight inlet

ULTRAFLOW® 54 requires neither straight inlet nor straight outlet to meet the Measuring Instruments Directive (MID) 2004/22/ EC, OIML R75:2002 and EN 1434:2007. A straight inlet section will only be necessary in case of heavy flow disturbances before the meter. We recommend following the guidelines of CEN CR 13582.

Optimal position can be obtained if you take the below-mentioned installation methods into consideration:

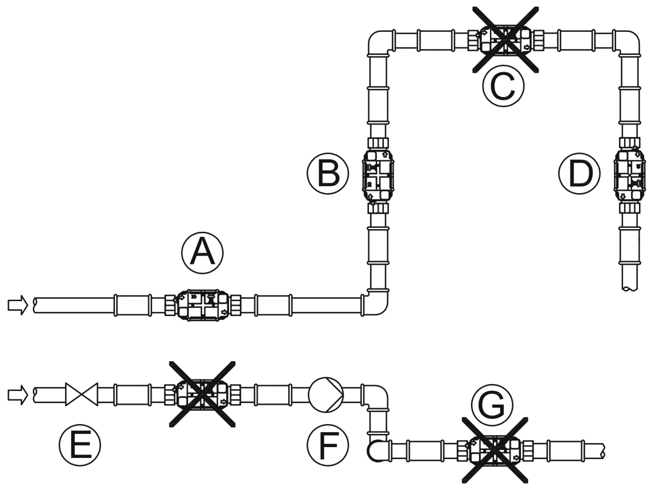


Figure 6

A Recommended position of flow meter

B Recommended position of flow meter

C Unacceptable position due to risk of air build-up

D Acceptable in closed systems. Unacceptable position in open systems due to risk of air build-up.

E A flow meter ought not to be placed immediately after a valve, except from closing valves (ball check valve type), which must be completely open when not used for closing

F Never place a flow meter on the inlet side of a pump

G A flow meter ought not to be placed after a double bend, in two levels

For general information concerning installation see CEN report *DS/CEN/CR 13582, Heat meter Installation. Instructions in selection, installation and use of heat meters*.

7.3 Operating pressure

In order to prevent cavitation the back pressure at ULTRAFLOW® must be min. 1.5 bar at q_p and min. 2.5 bar at q_s. This applies to temperatures up to approx. 80°C. ULTRAFLOW® must not be exposed to pressure lower than the ambient pressure (vacuum). For further information on operating pressure, see *paragraph 8.7 Guidelines for dimensioning ULTRAFLOW®*

7.4 Humidity and condensation

If ULTRAFLOW® is installed in moist environments, it must be turned 45° compared to the pipe axis as shown in the drawing below.

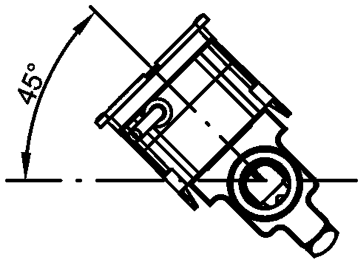


Figure 7

7.5 Installation examples

Gland meter with MULTICAL®/Pulse Transmitter fitted on ULTRAFLOW®.

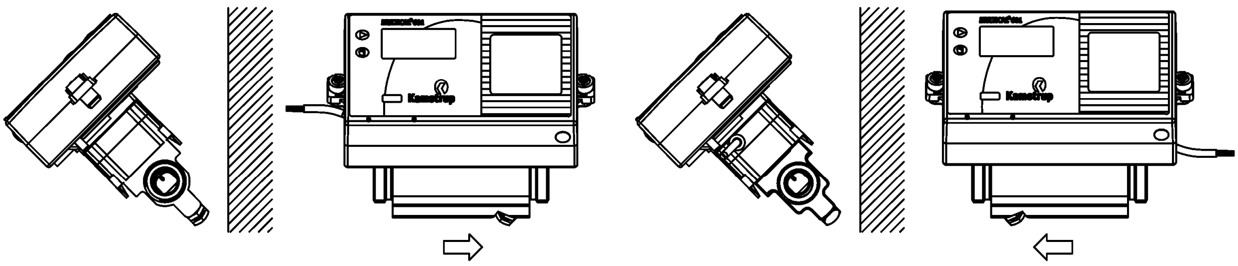


Figure 8

Glands and short direct sensor fitted into ULTRAFLOW® (only G¾B (R½) and G1B (R¾)).

The short direct sensor from Kamstrup can only be mounted in PN16 installations. The blind plug mounted in the ULTRAFLOW® flow part can be used in connection with both PN16 and PN25.
The flow meter can be used in both PN16 and PN25 and can be supplied marked either PN16 or PN25 as desired. Possibly supplied glands can only be used for PN16. For PN25 installations shall be used suitable PN25 glands.

In connection with G¾Bx110 mm and G1Bx110 mm, it shall be checked that 10 mm thread run-out is sufficient. See *Figure 9* below.

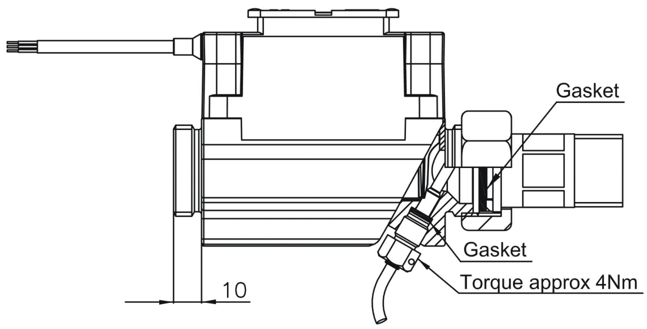


Figure 9

Flange meter with MULTICAL®/Pulse Transmitter fitted on ULTRAFLOW®

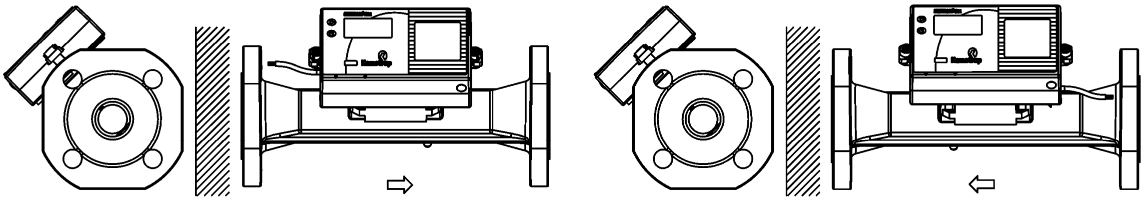


Figure 10

7.6 Electrical connection

ULTRAFLOW®	→	MULTICAL®
Blue (ground)/11A	→	11
Red (supply)/9A	→	9
Yellow (signal)/10A	→	10

Table 14. Connecting ULTRAFLOW® and MULTICAL®.

3.65 VDC Supply [5)]	→	Pulse Transmitter/ Pulse Divider
Red (+)	→	60
Black (-)	→	61

[5)] From battery or supply module

Table 15. Connection of supply in Pulse Transmitter/Pulse Divider.

ULTRAFLOW®	→	Pulse Transmitter/ Pulse Divider		→	MULTICAL®
		In	Out		
Blue (ground)/11A	→	11	11A	→	11
Red (supply)/9A	→	9	9A	→	9
Yellow (signal)/10A	→	10	10A	→	10

Table 16. Connecting via Pulse Transmitter/Pulse Divider.

Please note that use of long signal cables requires thoughtfulness in connection with installation. There must be a distance of **min.** 25 cm between signal cables and all other cables to prevent electrical disturbance.

7.7 Example of connecting ULTRAFLOW® and MULTICAL®

ULTRAFLOW® 54

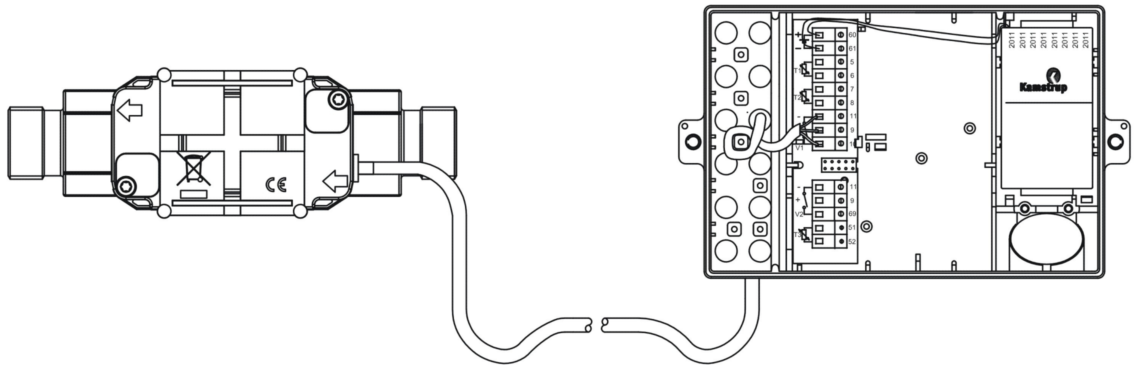


Figure 11

7.8 Calculator with two flow sensors

MULTICAL® 602 can be used in various applications with two flow sensors, e.g. leak surveillance or open systems. When two ULTRAFLOW® are direct connected to one MULTICAL® 602, a close electric coupling between the two pipes ought to be carried out as a main rule. If the two pipes are installed in a heat exchanger, close to the flow sensors, however, the heat exchanger will provide the necessary electric coupling.

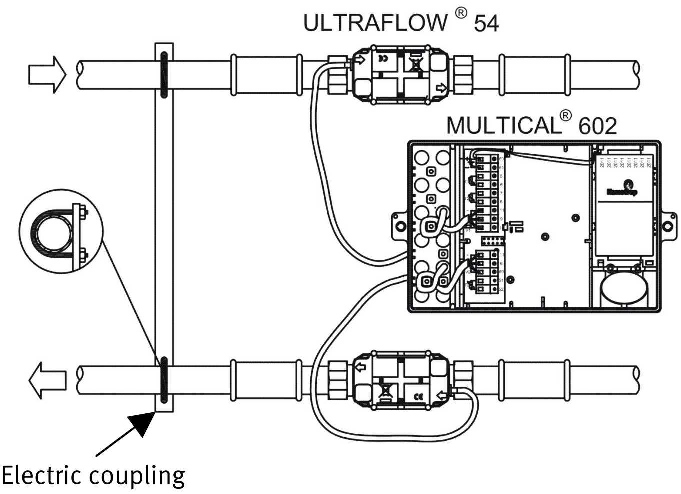


Figure 12

- Forward and return pipes are closely electrically coupled
- No welded joints occur

In installations where the electric coupling cannot be carried out, or where welding in the pipe system can occur, the cable from one ULTRAFLOW® must be routed through a Pulse Transmitter with galvanic separation before the cable enters MULTICAL® 602.

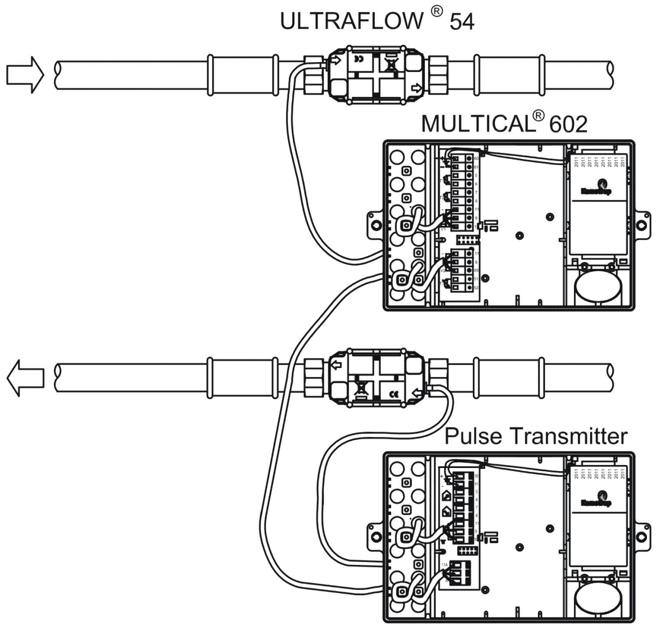


Figure 13

- Forward and return pipes are not necessarily closely coupled
- Electric welding *) can occur

*) Electric welding must always be carried out with the earth pole closest to the welding point. Damage to meters due to welding is **not** comprised by our factory guarantee.

8 Functional description

8.1 Ultrasound combined with piezo ceramics

Flow sensor manufacturers have been working on alternative techniques to replace the mechanical principle. Research and development at Kamstrup has proved that ultrasonic measuring is the most viable solution. Combined with microprocessor technology and piezo ceramics, ultrasonic measuring is not only accurate but also reliable.

8.2 Principles

The thickness of a piezo ceramic element changes when exposed to an electric field (voltage). When the element is influenced mechanically, a corresponding electric charge is generated. In this way the piezo ceramic element can function either as a sender or a receiver or both.

Within ultrasonic flow measuring there are two main principles: the transit time method and the Doppler method.

The Doppler method is based on the frequency shifting which is generated when sound is reflected by a moving particle. This is very similar to the effect you experience when a car drives by. The sound (the frequency) decreases when the car passes by.

8.3 Transient time method

The transient time method used in ULTRAFLOW® utilizes the fact that it takes an ultrasonic signal emitted in the opposite direction of the flow longer time to travel from sender to receiver than a signal sent in the same direction as the flow.

The transient time difference of a flow sensor is very small (nanoseconds). Therefore, the time difference is measured as a phase difference between the two 1 MHz sound signals to obtain the necessary accuracy.

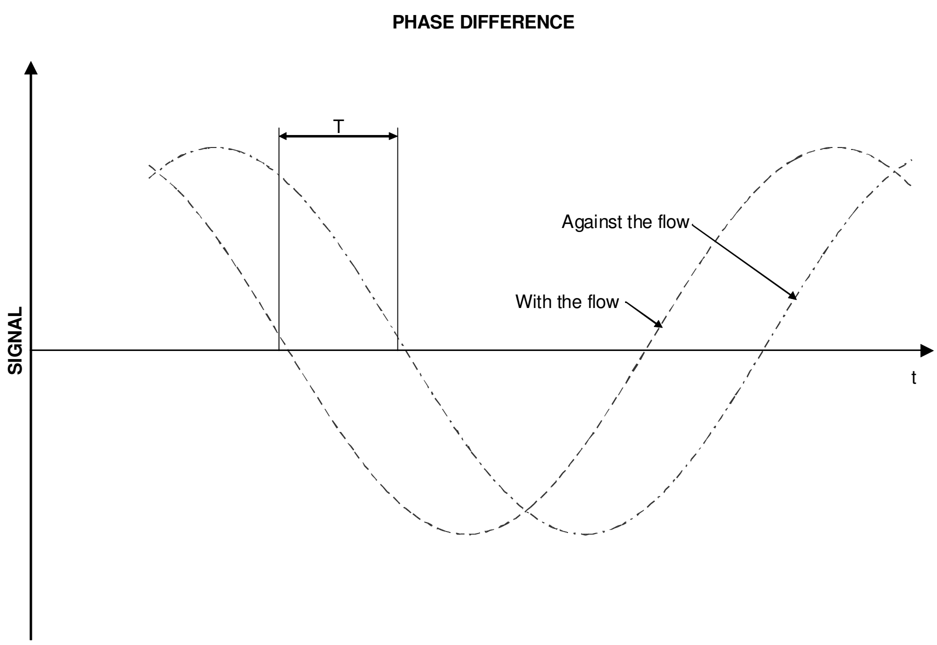


Diagram 2

In principle, flow is determined by measuring the flow velocity and multiplying it by the area of the measuring pipe:

$$Q = F \times A$$

where:

Q is the flow

F is the flow velocity

A Is the area of the measuring pipe

The area and the length, which the signal travels in the sensor, are well-known factors. The length which the signal travels can be expressed as $L = T \times V$, which can also be written as:

$$T = \frac{L}{V}$$

where:

L is the measuring distance

V is the sound propagation velocity

T is the time

The time can be expressed as the difference between the signal sent with the flow and the signal sent against the flow.

$$\Delta T = L \times \left(\frac{1}{V_1} - \frac{1}{V_2} \right)$$

In connection with ultrasonic flow sensors the velocities V_1 and V_2 can be stated as:

$V_1 = C - F$ And $V_2 = C + F$ respectively

where:

C is the velocity of sound in water

Using the above formula you get:

$$\Delta T = L \times \frac{1}{C - F} - \frac{1}{C + F}$$

which can also be written as:

$$\Delta T = L \times \frac{(C + F) - (C - F)}{(C - F) \times (C + F)}$$

$$\Downarrow$$

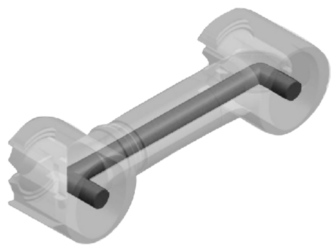
$$\Delta T = L \times \frac{2F}{C^2 - F^2}$$

As $C \rangle\rangle F$, F^2 can be omitted and the formula reduced as follows:

$$F = \frac{\Delta T \times C^2}{L \times 2}$$

To minimize the influence from variations of the velocity of sound in water it is measured. The velocity of sound in water is measured by means of the built-in ASIC. For this purpose a number of absolute time measurements between the two transducers are made. These measurements are subsequently converted into the current velocity of sound, which is used in connection with flow calculations.

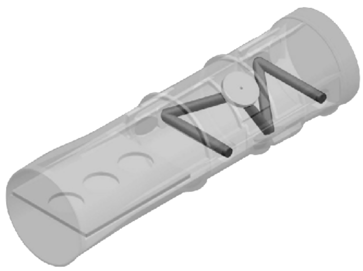
8.4 Signal paths



q_p 0.6...1.5 m³/h

Parallel

The sound path is parallel to the measuring pipe and sound is sent from the transducers via reflectors.



q_p 2.5...100 m³/h

Triangle

The sound path covers the measuring pipe in a triangle and sound is sent from the transducers round the measuring pipe via reflectors.

8.5 Measuring sequences

During flow measuring ULTRAFLOW® passes through a number of sequences, which are repeated at fixed intervals. Deviations only occur when the meter is in test mode and connecting the supply during initialization/start-up.

The difference between the main routines in normal and verification mode is the frequency of the measurements, on which pulse emission is based.

It may take up to 16 seconds to obtain correct function after a power cut.

8.6 Function

In the meter's working area from min. cut-off to saturation flow there is a linear connection between the water volume flowing through and the number of pulses being emitted. An example of the connection between flow and pulse frequency for ULTRAFLOW® q_p 1.5 m³/h is shown below (*Diagram 3)*.

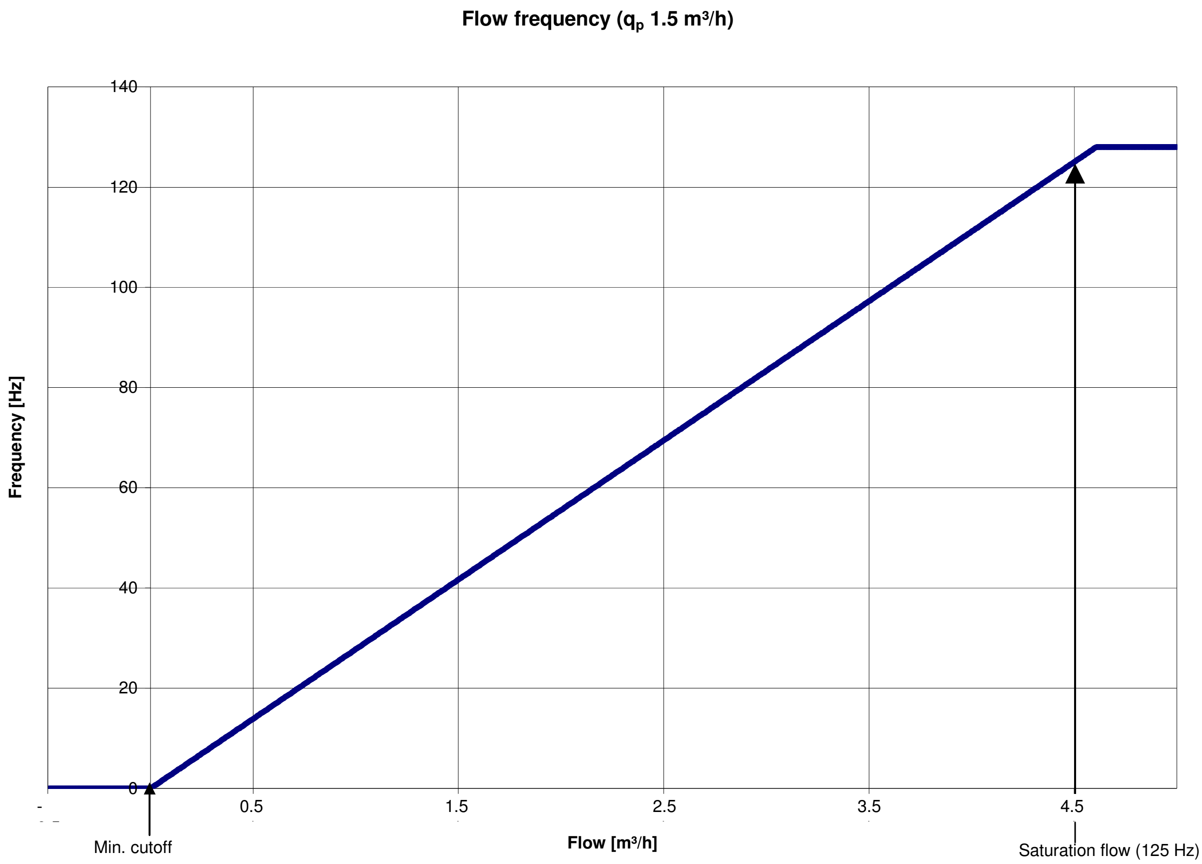


Diagram 3

If the flow is lower than min. cut-off or negative, ULTRAFLOW® emits no pulses.

At flows above the flow corresponding to pulse emission at a max. pulse frequency of 128 Hz, the max. pulse frequency will be maintained. *Table 17* overleaf shows the flow at max. pulse frequency 128 Hz for the various flow sizes/pulse figures.

q_p [m³/h]	Meter factor [imp/l]	Flow at 128 Hz [m³/h]
0.6	300	1.54
1.5	100	4.61
2.5	60	7.68
3.5	50	9.22
6	25	18.4
10	15	30.7
15	10	46.1
25	6	76.8
40	5	92.2
60	2.5	184.3
100	1.5	307.2

Table 17. Flow at max. pulse frequency (128 Hz).

According to DS/EN 1434 the upper flow limit q_s is the highest flow at which the flow sensor may operate for short periods of time (<1h/day, <200h/year) without exceeding max. permissible errors. ULTRAFLOW® has no functional limitations during the period when the meter operates above q_p. However, please note that high flow velocities may cause cavitation, especially at low static pressure.

8.7 Guidelines for dimensioning ULTRAFLOW®

In connection with installations it has proved to be practical to work with larger pressures than the ones stated below:

Nominal flow q_p [m³/h]	Recommended back pressure [bar]	Max. flow q_s [m³/h]	Recommended back pressure [bar]
0.6	1	1.2	2
1.5	1.5	3	2.5
2.5	1	5	2
3.5	1	7	2
6	1.5	12	2.5
10	1	20	2
15	1.5	30	2.5
25	1	50	2
40	1.5	80	2.5
60	1	120	2
100	1.5	200	2.5

Table 18

The purpose of recommended back pressure is to avoid measuring errors as a result of cavitation or air in the water.

It is not necessarily cavitation in the flow sensor itself, but also bubbles from cavitating pumps or regulating valves mounted before the sensor. It can take some time for these bubbles to dissolve in the water.

In addition, the water may contain air, which is dissolved in the water. The amount of air which can be dissolved in water depends on the pressure and the temperature. This means that air bubbles can be formed because of a drop of pressure e.g. due to an absolute speed rise in a contraction or over the meter.

The risk of these factors affecting accuracy is reduced by maintaining a fair pressure in the installation.

In relation to above table, the steam pressure at current temperature must also be considered. *Table 18* applies to temperatures up to approx. 80°C. Furthermore, it must be considered that the above-mentioned pressure is the back pressure at the sensor and that the pressure is lower after a contraction than before one (e.g. cones). This means that the pressure – when measured elsewhere - might be different from the pressure at the sensor.

This can be explained by combining the continuity equation and Bernoulli's equation. The total energy from the flow will be identical at any cross section. It can be reduced to: $P + \frac{1}{2}\rho v^2 = \text{constant}$.

When dimensioning the flow sensor, this must be taken into consideration, especially if the sensor is used within the scope of EN 1434 between q_p and q_s, and in case of heavy contractions of the pipe.

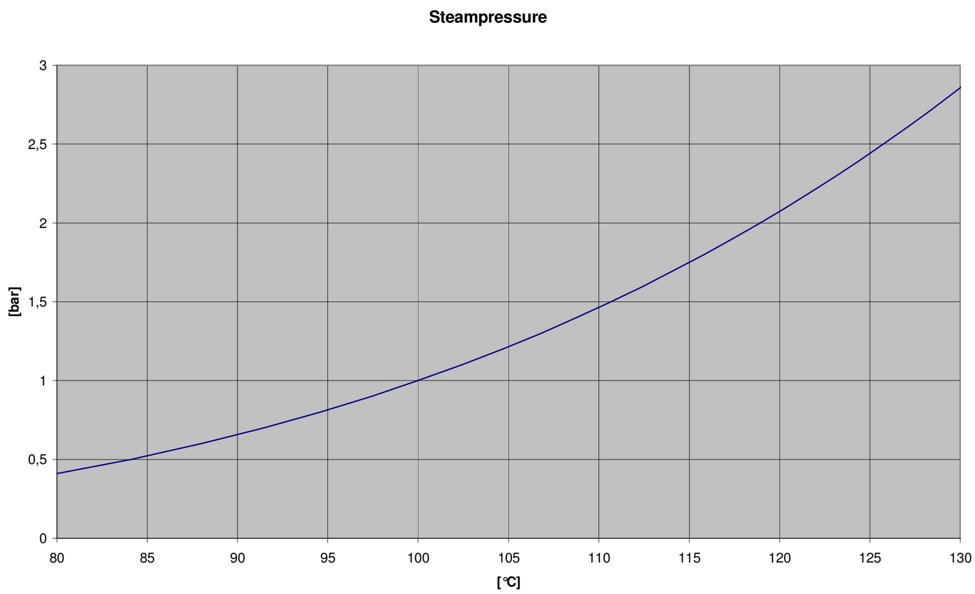


Diagram 4

8.8 Pulse output

ULTRAFLOW® 54

Type	Push-Pull
Output impedance	~10 kΩ
Pulse duration	2…5 ms
Pause	Depending on current pulse frequency

See also block diagram below.

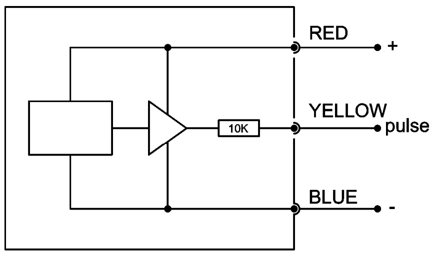


Figure 14. Block diagram ULTRAFLOW®.

8.9 Pulse Transmitter/Pulse Divider

Type	Open collector. Can be connected as two-wire or as three-wire by means of the integral pull-up resistance of 33 kΩ
Output impedance	~2 kΩ
I_{max}	0.2 mA
Supply (9A)	3…10 VDC
Pulse duration (Pulse Transmitter)	2…5 ms
Pulse duration (Pulse Divider)	100 ms (standard)
Pause	Depending on the actual pulse frequency

Note: Flow-info not possible.

See also block diagram below.

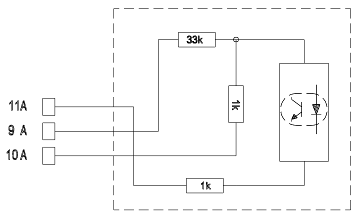


Figure 15. Block diagram Pulse Transmitter/Pulse Divider (standard configuration).

8.10 Pulse emission

Pulses are emitted at intervals of 1 sec. The number of pulses to be emitted is calculated every second. Pulses are emitted in bursts with a pulse duration of 2…5 ms and pauses depending on the current pulse frequency. The duration of the pauses between the individual bursts is approx. 30 ms.

The transmitted pulse signal is the average determination of a series of flow measurements. This means that during start-up there will be a transient phenomenon until correct flow signal has been obtained. Furthermore, this brings about a pulse tail of up to 8 s. in case of sudden hold.

8.11 Accuracy

ULTRAFLOW® 54 is a volume flow sensor specially developed for use with heat meters according to DS/EN 1434. Permitted tolerances in DS/EN 1434 for flow sensors with a dynamic range of 1:100 (q_i:q_p) are shown in the diagram below. The tolerances are defined for classes 2 and 3 with following formulas:

Class 2: $2 + 0.02 \times \frac{q_p}{q}$ but max. 5 %

Class 3: $3 + 0.05 \times \frac{q_p}{q}$ but max. 5%

DS/EN 1434 defines following dynamic ranges (q_i:q_p): 1:10, 1:25, 1:50, 1:100 and 1:250.

In connection with accuracies the range from q_p to q_s is defined as max. flow short-term, where tolerances are adhered to. There are no requirements as to the relationship between q_p and q_s. See *Table 1* for information on q_s for ULTRAFLOW®.

To ensure that the sensors meet the tolerance requirements, DS/EN 1434-5 specifies calibration requirements in connection with verification of sensors. The requirements for flow sensors are that they have to be tested at following 3 points:

q_i…1.1 x q_i, 0.1 x q_p..0.11 x q_p and 0.9 x q_p…q_p

During testing the water temperature must be 50°C ±5°C.

Further requirements are that the tolerance of the equipment used to perform the test must be less than 1/5 MPE (Max. Permissible Error) in order for the acceptance limit to be equal to MPE. If the equipment does not meet this standard, the acceptance limit must be reduced by the tolerance of the equipment.

ULTRAFLOW® 54 will typically do better than half of the permitted tolerance according to DS/EN 1434 cl. 2.

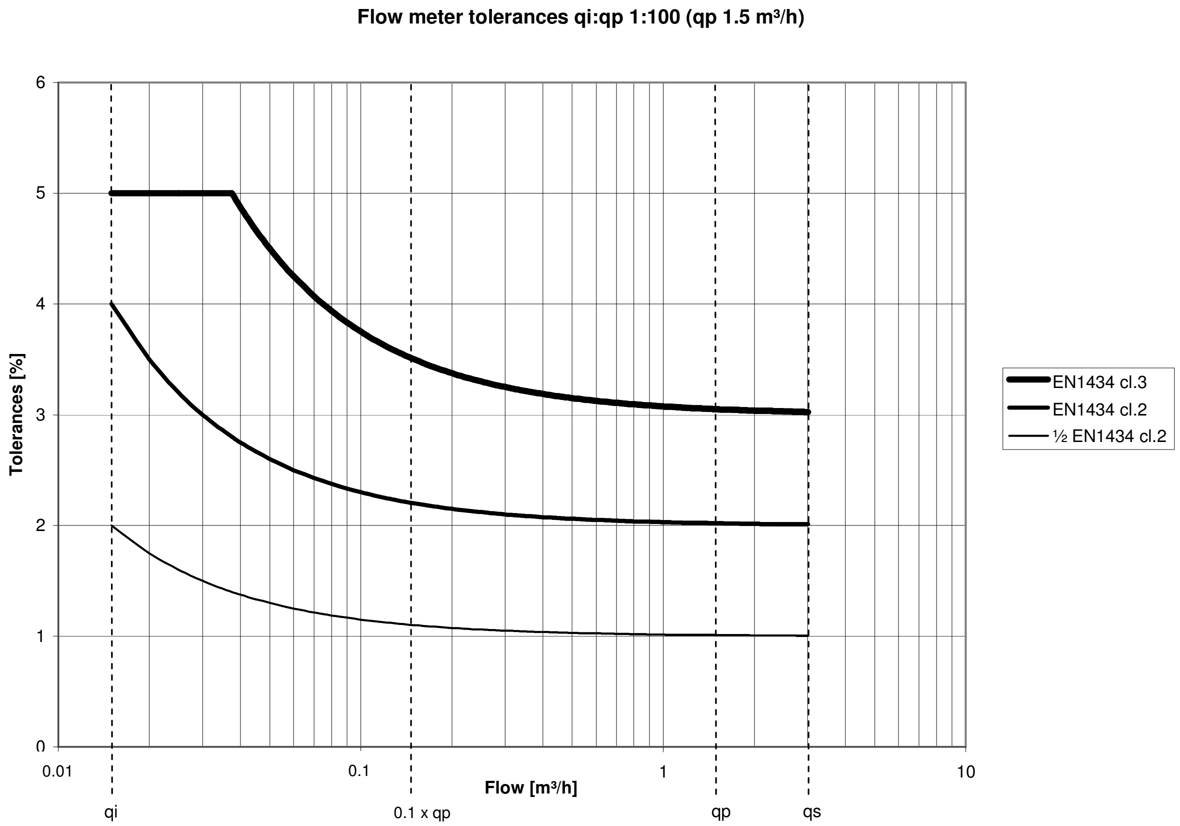


Diagram 5

8.12 Power consumption

The power consumption of ULTRAFLOW® is as follows:

Max. average	50 µA
Max. current	7 mA (max. 40 ms)

8.13 Interface plug/serial data

ULTRAFLOW® 54 is fitted with a four-pole plug under the cover. Thus, it is not possible to access this plug without breaking the seal. On delivery, the cover will be sealed with a factory seal and in connection with verified sensors it will be a laboratory seal (legal seal).

The plug is used for:

- Programming meters, including adjusting the correction graph by means of METERTOOL
- Setting the sensor to test mode
- Reading accumulated water quantity in connection with calibration
- External control of start/stop in connection with calibration

The interface plug is built up as *Figure 16*.

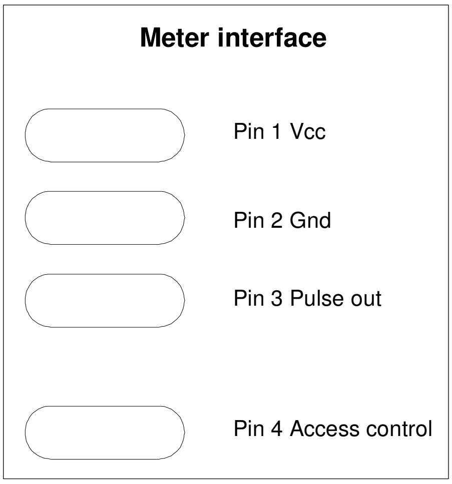


Figure 16. Interface plug.

8.14 Test mode

To minimize the time spent on calibration, ULTRAFLOW® 54 can be switched into test mode. In test mode (verification mode) the measuring routines only take one fourth of the time they take in normal mode.

ULTRAFLOW® 54 is put into test mode by connecting pin 4 of the internal connector to frame (*Figure 16*) and subsequently connect the supply. After approx. 1 sec. the sensor goes into test mode and the connection between pin 4 and frame is disconnected.

Test mode is ended by disconnecting the supply to the sensor.

Note: An ULTRAFLOW® 54 in test mode uses approx. 3 times as much power as in normal mode. However, this does not influence the total battery lifetime of the energy meter.

8.15 Externally controlled start/stop

In connection with calibration by means of serial data, e.g. in connection with NOWA, ULTRAFLOW® 54 can be monitored by an external signal when it is in verification mode (see *paragraph 8.14)*. This is done by grounding pin 4 of the internal connector when starting the test and removing it when the test has been completed. The volume of water that has been accumulated during the test can be read serially.

The accumulation is based on the same data as those used for calculating the number of pulses to be emitted.

In addition to accumulating water volume during test, the sensor corrects for the excess quantity measured in connection with start as well as the quantity lacking in connection with stop. These deviations occur because the sensor measures flow at regular intervals, as illustrated in *Figure 17* below.

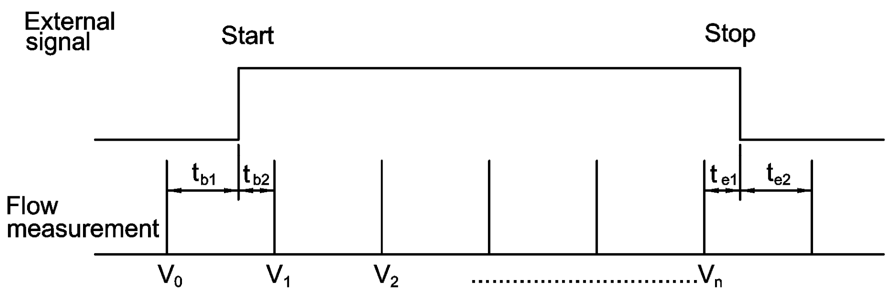


Figure 17

The excess water quantity in connection with start is the water volume that runs through the sensor during the time t_{b1} before the first accumulation V_1 within the test period. In the same way the water quantity for the period t_{e1} from the last accumulation V_n until end of test is added.

The volume accumulated during the test can be stated as:

$$\sum \frac{V_1 \times t_{b2}}{t_{b1} + t_{b2}} + V_2 ... + V_n + \frac{V_n \times t_{e1}}{t_{e1} + t_{e2}}$$

8.16 Course of calibration by means of serial data and externally controlled start/stop

The routine for calibrating ULTRAFLOW® 54 using serial data is outlined below.

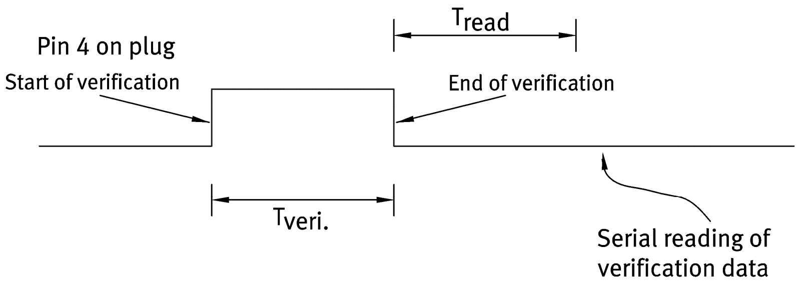


Figure 18

The sensor must be in test mode (verification mode).

Calibration is started by connecting the 4th pin of the internal plug (see *Figure 18*), simultaneously with starting the test. E.g. this might take place at the same time as the master meter is started or at the same time as the diverter to the weight is being changed. ULTRAFLOW® accumulates the water volume until you disconnect pin 4 and terminate the test. Subsequently, the volume accumulated during the test can be read with respect to start and stop. From the test has been completed until the accumulated quantity of water can be read, min. 2 sec. must pass (Tread). No communication must take place with ULTRAFLOW® during testing.

Pulse emission stops when pin 4 is disconnected. The read water quantity and the number of emitted pulses may differ as the pulse emission is controlled at intervals of 1 s.

9 Calibrating ULTRAFLOW®

Calibration can be based on:

- Pulses in standard mode
- Pulses in test mode
- Pulses using PULSE TESTER type 66-99-279
- Serial data with the meter in test mode (e.g. used in connection with NOWA)

9.1 Installation

The installation angle must be taken into account installing ULTRAFLOW® 54. See the restrictions in *paragraph 7 Installation*. See *paragraph 10.1 Optimization in connection with calibration*.

9.2 Technical data for ULTRAFLOW®

q_p [m³/h]	Meter factor [imp/l]	Flow at 128 Hz [m³/h]
0,6	300	1,54
1,5	100	4,61
2,5	60	7,68
3,5	50	9,22
6	25	18,4
10	15	30,7
15	10	46,1
25	6	76,8
40	5	92,2
60	2,5	184,3
100	1,5	307,2

Table 19. Output signal.

Output ULTRAFLOW® 54

Type	Push-Pull
Output impedance	~10 kΩ
Pulse duration	2...5 ms
Pause	Depending on current pulse frequency

See also block diagram next page.

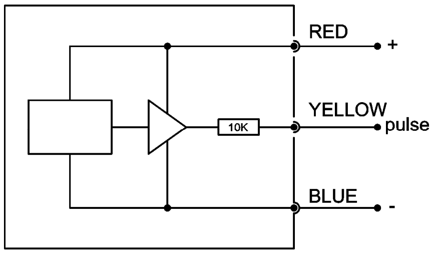


Figure 19. Block diagram ULTRAFLOW®.

Connection via three-wire cable

Yellow	Signal
Red	Supply
Blue	Ground
Supply	3.6 VDC ± 0.1 V

Output when using Pulse Transmitter

Type	Open collector. Can be connected as two-wire or three-wire via the built-in pull-up resistance of 33 kΩ.
Output impedance	~2 kΩ
I_{max}	0.2 mA
Supply (9A)	3…10 VDC
Pulse duration	2…5 ms
Pause	Depending on the actual pulse frequency.

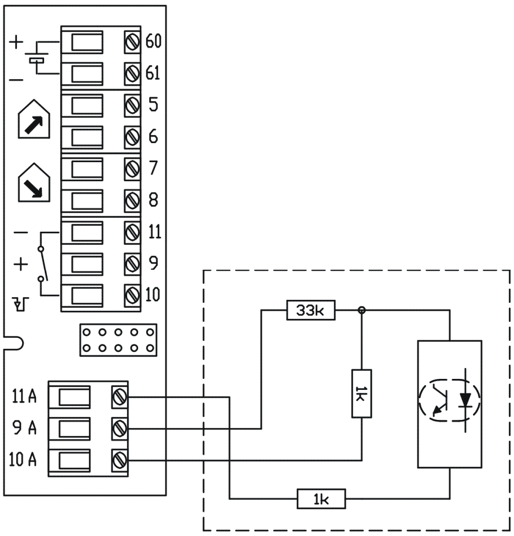


Figure 20. Block diagram Pulse Transmitter.

9.3 Start-up

16 seconds must elapse from start-up to calibration in order to allow a true reading to be reached.

9.4 Measuring flow

To obtain correct flow measurement, the duration of calibration must be min. 2 minutes.

9.5 Evacuation

ULTRAFLOW® must NOT be evacuated (subjected to vacuum).

9.6 Suggested test points

Nom. flow	Meter factor	Test point			Test duration			Test quantities		
q_p		q_p	q_i	$0.1xq_p$	q_p	q_i	$0.1xq_p$	q_p	q_i	$0.1xq_p$
[m³/h]	[impulses/l]	[m³/h]	[m³/h]	[m³/h]	[min]	[min]	[min]	[kg]	[kg]	[kg]
0.6	300	0.6	0.006	0.06	3	20	6	30	2	6
1.5	100	1.5	0.015	0.15	3	20	4	75	5	10
2.5	60	2.5	0.025	0.25	3	20.2	4.8	125	8.4	20
3.5	50	3.5	0.035	0.35	3	17.1	6	175	10	35
6	25	6	0.06	0.6	3	20	4	300	20	40
10	15	10	0,1	1	3	20.4	6	500	34	100
15	10	15	0.15	1.5	3	20	6	750	50	150
25	6	25	0.25	2.5	3	20.2	6	1250	84	250
40	5	40	0.4	4	3	15	6	2000	100	400
60	2.5	60	0.6	6	3	20	6	3000	200	600
100	1.5	100	1	10	3	20	6	5000	333	1000

Table 20. Table showing ULTRAFLOW® including suggested test points, test durations, and test quantities.

The suggested test parameters are based on EN 1434-5 and q_i:q_p 1:100.

The test set-ups have been selected on the basis of the following requirements:

Min. test duration of 3 minutes

Water volumes of q_i and $0.1xq_p$ of min. 10% of the water volume per hour

Water volume of $0.1xq_p$ corresponding to min. 1000 pulses

Water volume of q_i corresponding to min. 500 pulses

These suggested test points can be optimized for each rig as well as for the test purpose.

10 Sealing

ULTRAFLOW® is sealed from the factory. If the sensor is verified, it will be supplied with laboratory marks and a year mark as shown in *Figure 21*.

If the seal of a verified sensor is broken, the sensor must be verified before being installed in a location demanding verification.

Below sealing is shown on:

ULTRAFLOW® 54

Pulse Transmitter

On the drawings the sealing is divided into following groups:

H	Verification year
E	Laboratory mark/seal
B	Installation seal

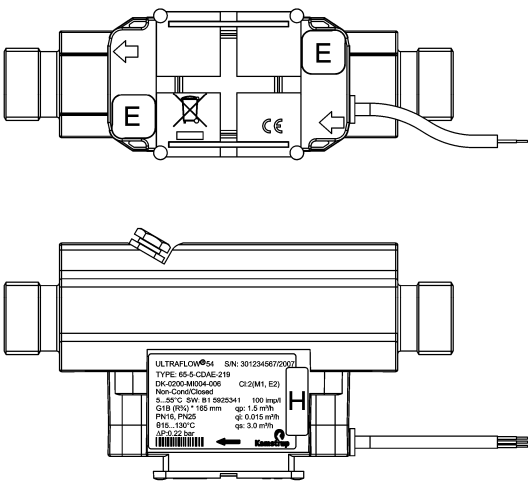


Figure 21. Sealing of ULTRAFLOW® 54.

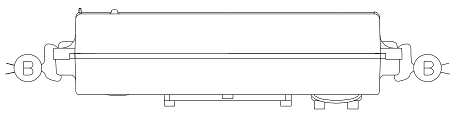


Figure 22. Sealing of Pulse Transmitter.

Note! Sealing requirements may vary as a consequence of national regulations.

10.1 Optimization in connection with calibration

To make a rational test of ULTRAFLOW® it must be possible to reproduce test results. This is also very important if the sensors tested are to be adjusted.

Experience shows that ULTRAFLOW® operates with standard deviations of 0.3...0.4% at q_i and 0.2...0.3% at q_p. This is standard deviations at 300...500 pulses at q_i, 3000...5000 at q_p , and flying start/stop.

In connection with optimization of calibration the following aspects should be taken into account:

Pressure: Optimal working pressure is 4...6 bar of static pressure. This minimizes the risk of air and cavitation.

Temperature: Calibration temperature according to DS/EN 1434-5 is 50°C ± 5°C.

Water quality: No requirements

Installation - mechanical conditions:

To avoid flow disturbances inlet pipes and distance pieces must have the same nominal diameter as the sensors (see *Table 21*). There should be min. 5 x DN between the sensors. With bends etc. there should be a min. distance of 10 x DN. If tests are made at low flow through a bypass at right angles to the pipe, it would be an advantage to mount an absorber of pressure fluctuations due to the angle of the inlet pipe. This can be a flexible tube on the bypass. In addition, it would be advantageous to fit a flow straightener before the first distance piece. Flow disturbances such as pulsations, e.g. pump fluctuations must be minimized. In connection with calibration, a code of practice concerning distance pieces has been made on the basis of years of experience:

The length of the distance piece must be 10 x DN.

The diameter of the distance piece must be:

Connection	Distance piece	Gland
G¾ (R½) DN15	ø15	ø14
G1 (R¾) DN20	ø20	ø19,5
DN20	ø20	
G5/4 (R1) DN25	ø25	ø25,5
DN25	ø25	
G1½ (R5/4) DN32	ø32	ø32
G2 (R1½) DN40	ø40	ø39
DN40	ø40	
DN50	ø50	
DN65	ø65	
DN80	ø80	
DN100	ø100	
DN125	ø125	

Table 21. Distance pieces.

Installation - electrical conditions:

To avoid external disturbances and to achieve an electrical interface as that of MULTICAL®, we recommend that you use a PULSE TESTER.

10.2 PULSE TESTER

During a calibration process it is often practical to use PULSE TESTER type 66-99-279 with the following functions:

Galvanically separated pulse outputs

Integral supply for ULTRAFLOW®

LCD-display with counter

Externally controlled ”Hold” function

Can be fitted directly on a MULTICAL® base unit

10.3 Technical data for PULSE TESTER

Pulse inputs (M1/M2)

Counter inputs	Max. frequency: 128 Hz
Active signal	Amplitude: 2.5 - 5 Vpp
Pulse duration	>1 msec.
Passive signal	Internal pull-up 680 kΩ
Internal supply	3.65 V lithium battery

Note! There are one or two pulse inputs/outputs depending on the choice of base unit

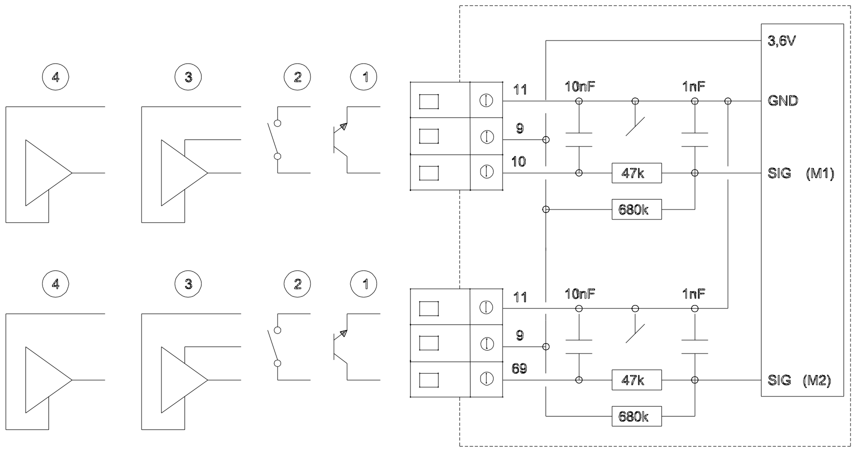


Figure 23

1 **Flow sensor with transistor output**

The transmitter is normally an optocoupler with FET or transistor output to be connected to terminals 10 and 11 for water meter M1 or terminals 69 and 11 for water meter M2.

The leak current of the transistor must not exceed 1 µA in off-state, and U_{CE} in on-state must not exceed 0.5 VDC.

2 **Flow sensor with relay or reed contact output**

The transmitter is a reed contact, which is normally mounted on vane wheel and Woltmann meters, or the relay output from e.g. MID-meters. This type of transmitter should not be used as the quick pulse input may cause bounce problems.

3 **Flow sensor with active pulse output, supplied from the pulse tester**

This connection is used together with either Kamstrup's ULTRAFLOW® or Kamstrup's electronic pick-up for vane wheel meters.

Connection (M1)	9: Red (9A)	10: Yellow (10A)	11: Blue (11A)
Connection (M2)	9: Red (9A)	69: Yellow (10A)	11: Blue (11A)

Table 22

4 **Flow sensor with active output and integral supply**

Flow sensors with active signal output must be connected as shown in *Figure 24*. The signal level must be between 3.5 and 5 V. Higher signal levels can be connected via a passive voltage divider, e.g. of 47 kΩ/10 kΩ at a signal level of 24 V.

Pulse outputs (M1/M2)

Two-wire connection:

Voltage <24 V
Load >1.5Ω

Three-wire connection

Voltage 5...30 V
Load >5 kΩ

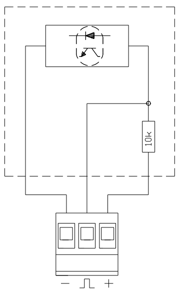


Figure 24

The outputs are galvanically separated and protected against overvoltage and reversed polarity.

Max. counter capacity before overflow is 9,999,999 counts.

10.4 Hold function

When the Hold input is activated (high level supplied to input), counting stops.

When the Hold signal is removed (low level supplied to input), counting restarts.

The counters can also be reset by pressing the right key on the front panel (Reset).

Input	Galvanically isolated
Input protection	Against reversed polarity
“Open input”	Count (see *Figure 25*)

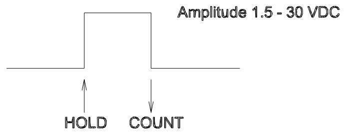


Figure 25

10.5 Push-button functions

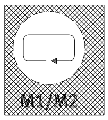


Figure 26. The left push button shifts between readings/counts of the two flow sensor inputs. In the display M1 and M2 respectively indicate the currently displayed flow sensor inputs/counters.

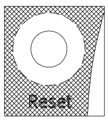


Figure 27. *The right push-button resets both counters (M1 and M2).*

10.6 Using the PULSE TESTER

The PULSE TESTER can be used in the following ways:

Standing start/stop of flow sensor using the integral pulse counters.

Standing start/stop of flow sensor using the pulse outputs for external test equipment.

Flying start/stop of flow sensor using the integral counters controlled by external equipment (Sample & Hold).

Flying start/stop of flow sensor using the pulse outputs controlled by external equipment (Sample & Hold).

10.7 Spare parts

Description	Type No.
Battery D-cell	66-00-200-100
Cable retainer (secures the battery)	1650-099
2-pole plug (female)	1643-185
3-pole plug (female)	1643-187
PCB (66-R)	5550-517

Table 23

10.8 Changing the battery

If the PULSE TESTER is used continuously we recommend that the battery be replaced once a year.

Connect the battery to the terminals marked ”batt.”, the red wire to + and the black one to -.

Current consumption:

Power consumption with no sensors connected	400 µA
Max. power consumption with two ULTRAFLOW® connected	1.5 mA

Note! If the base unit is fitted with battery or externally supplied, the PULSE TESTER's integral supply must be disconnected (the plug must be removed).

11 METERTOOL

11.1 Introduction

METERTOOL is a collection of programs for servicing Kamstrup heat meters.

”METERTOOL for ULTRAFLOW® X4” is a Windows®-based software. In combination with a PC and interface the software makes it possible to adjust ULTRAFLOW® X4.

METERTOOL has been developed to provide laboratories a simple and effective access to programming/adjusting ULTRAFLOW® X4. Furthermore, It is used for programming the Pulse Divider incl. printing of label for same.

11.2 System Requirements for PC

METERTOOL requires minimum Windows XP SP3, Windows Vista or Windows 7 (32 or 64 bits) or newer as well as Microsoft Internet Explorer 5.01.

Minimum requirements:

Pentium 4 or equivalent (Atom processor/netbooks/mini PC’s are not supported)

2 GB RAM

10 GB HD

Display resolution 1024 x 768

USB as well as CD-ROM drive

Printer installed

Administrator rights to the PC are required in order to install and use the program.
The programs must be installed under the login to be subsequently used for the programs.

11.2.1 Interface

The following interfaces can be used:

ULTRAFLOW® 54	type 66-99-141	USB port for connection to PC and four-pole plug for flow sensor
ULTRAFLOW® 14/24	type 66-99-002	Adapter for connecting ULTRAFLOW® 14/24 (mounted on 66-99-141)
Pulse Divider	type 66-99-140	COM port for connection to PC and eight-pole plug for Pulse Divider

In order to print a label for the Pulse Divider a printer must be installed and connected.

NOTE: The supply to ULTRAFLOW® and/or Pulse Divider, if any, must be disconnected during programming. The sensors are powered via the connected programming interface.

The USB Interface includes a converter box which secures galvanic separation of the supply to the flow sensor.

In order to mount the plug in the flow sensor, the sealing cover must be removed. If the sensor is used where verification is required, an authorised laboratory must re-verify and reseal the sensor before it is remounted. The positions of laboratory labels and year marks appear from *Figure 21* and *Figure 22*.

Figure 28. Location of the four-pole plug in ULTRAFLOW® 54.

Figure 29. Location of the four-pole plug incl. ULTRAFLOW® 14 adapter in ULTRAFLOW® 14/24 (MULTICAL® 61/62).

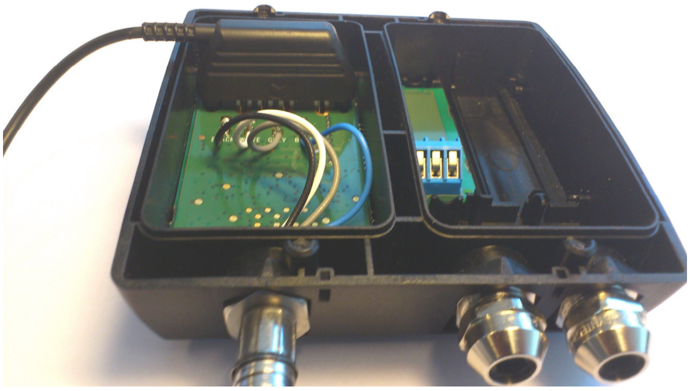


Figure 30. Location of the four-pole plug in ULTRAFLOW® 54 DN150…250.

11.2.2 Installation

Check that system requirements are fulfilled.

Close other open programs before starting the installation.

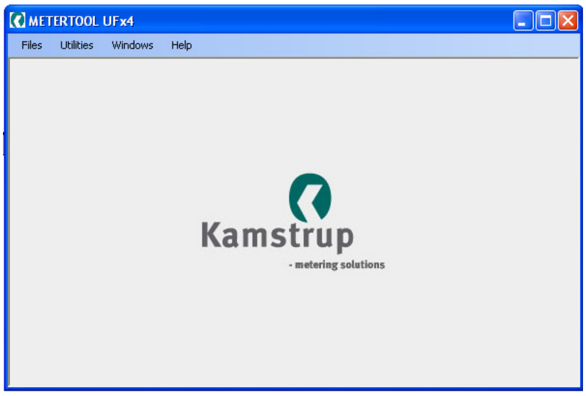
Insert the CD in the drive and follow the program's directions during the installation.

NOTE: The files used for installation must be saved on a CD or in a local folder in the PC. Installation is not possible using files from a USB-stick or an external drive.If the installation program does not start automatically, the installation can be started by typing "D:\CD\launch.exe" under "Run" in the Start menu (provided that the drive specification of the CD is "D").

When the installation has been completed, the icon "KAMSTRUP METERTOOL" will appear from the Start menu and as a link on the desktop. Click on the new icon "KAMSTRUP METERTOOL" for the list of "METERTOOL" programs selected during installation to be displayed. Double-click on "METERTOOL UFx4" in order to start the program METERTOOL for ULTRAFLOW® X4.

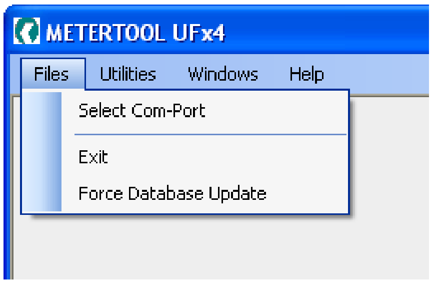
11.3 METERTOOL for ULTRAFLOW® X4

The menu structure of METERTOOL for ULTRAFLOW® X4 is as follows:



11.3.1 Files

The menu ”Files” includes:



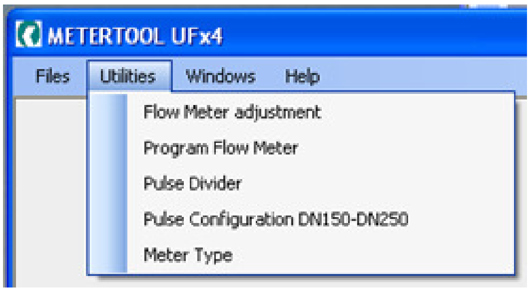
Select Com-Port: Setup of COM port for interface of flow sensor/Pulse Divider.

Exit: Terminates METERTOOL.

Force Database Update: Online-update of flow sensor database.

11.3.2 Utilities

The menu ”Utilities” includes:



Flow Meter Adjustment: Reading and correction of flow curve.

Program Flow Meter: Programming standard flow curve for flow sensor.

Pulse Divider: Programming Pulse Divider.

Pulse Configuration DN150...250: To be used by specially trained personnel only.

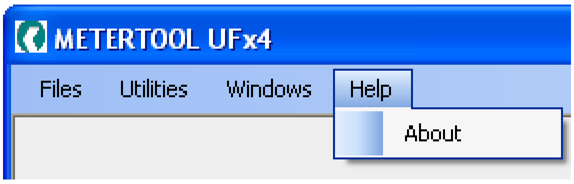
Meter Type: Information on flow sensor and equipment.

11.3.3 Windows

The function makes it possible to change between the open dialog boxes of the program.

11.3.4 Help

About: Includes program numbers and revisions of the various components of the installed version.



11.4 Application

Flow sensor adjustment.

Before adjusting a sensor you must make sure that the sensor operates satisfactorily in the flow rig in question. See *paragraph 9 Calibrating ULTRAFLOW®*.

If it is necessary to adjust the sensor more than a few percent, the sensor is probably defective, or has a different error, and should not be adjusted.

11.4.1 COM-port selection

Open ”Select Com Port”:

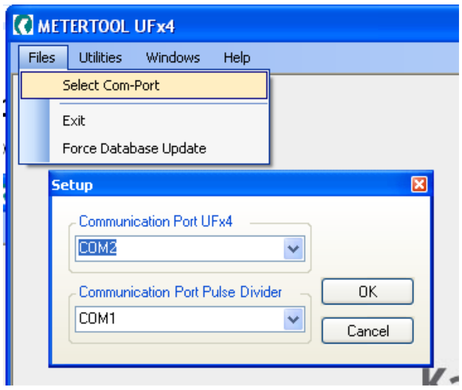
Select a COM-port for ULTRAFLOW® X4.

The USB driver must be installed before connecting the interface.

The related COM port will not appear from the list until the USB interface has been connected.

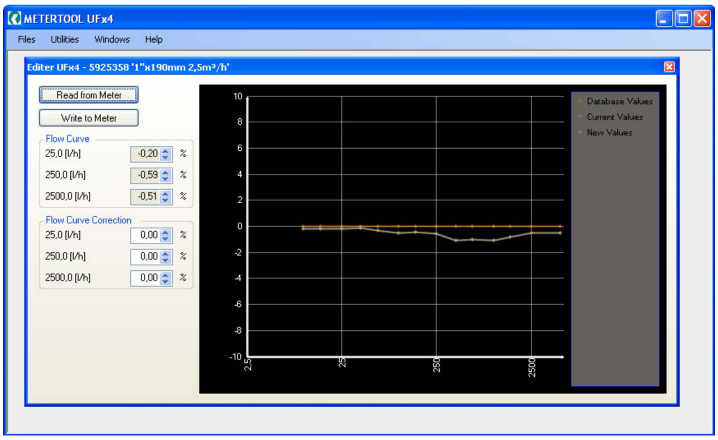
Select COM port for Pulse Divider.

Activate ”OK” in order to save the selected ports.



11.4.2 Flow meter adjustment

Open ”Flow Meter Adjustment”:



”Read from Meter”: Reads data from the connected flow sensor.

Flow curve number - 5945357 - and meter dimensions appear from the heading. This number will also appear from the meter’s label.

The field “Flow Curve” shows the values of the sensor in question compared to the standard curve. These values are also shown in the form of a graph.

The required correction of q_i, $0.1xq_p$ and q_p can be entered into the field ”Flow Curve Correction”.

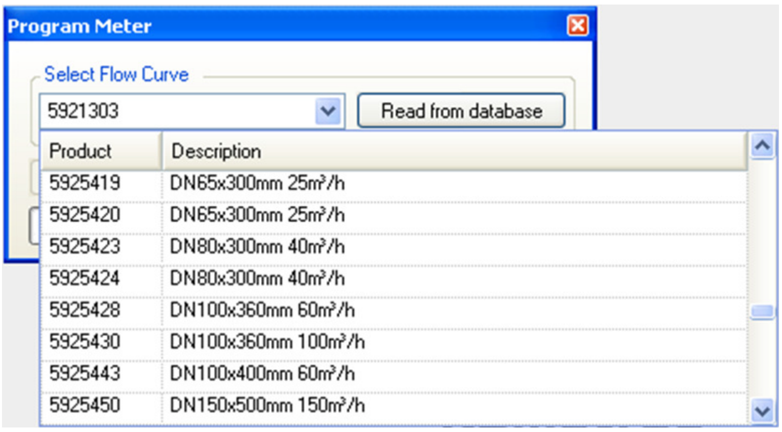
”Write to Meter”: Writes the correction to the connected flow sensor.

After the adjustment the flow sensor is ready for renewed test.

11.4.3 Programming of standard flow curve

Open ”Flow Meter Adjustment”:

The 59xxxxx no. appears from the sensor's type label.



”Read from database”: Enters the selected standard flow curve into the program.

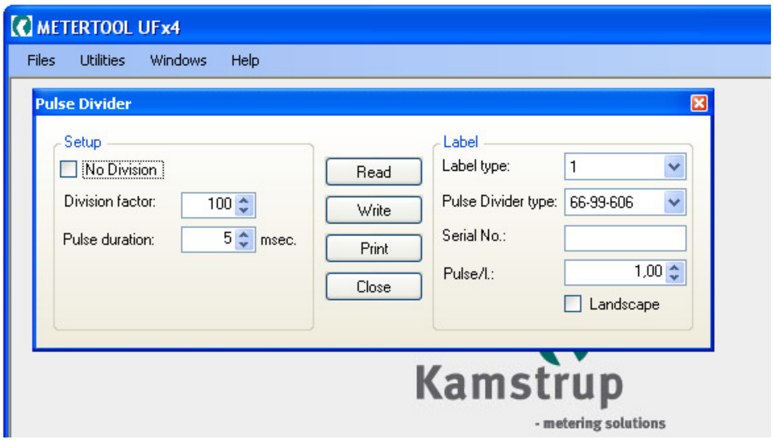
”Write to Meter”: Programs the flow sensor with the entered standard flow curve.

The flow sensor is now ready for test.

11.4.4 Pulse Divider

Setup and programming of Pulse Divider. A Pulse Divider is used for adapting flow signals to calculators, e.g. if a "foreign" calculator is connected to Kamstrup ULTRAFLOW® and the codings (number of pulses CCC or pulse duration) do not correspond.

Open "Pulse Divider":



"Read": Reads the current coding of the Pulse Divider.
"Write": Programs the Pulse Divider with the entered data.
"Label type": Makes it possible to select position on Kamstrup label sheet.
"Print": Prints Pulse Divider Label on the standard printer selected in the PC.
"Close": Terminates Pulse Divider.

ULTRAFLOW®		Pulse Divider							
q_p [m³/h]	Pulse fig. [imp/l]	Pulse fig. [l/imp]	Divider	Pulse fig. [l/imp]	Divider	Pulse fig. [l/imp]	Divider	Pulse fig. [l/imp]	Divider
0,6	300	1	300	2,5	750				
1.5	100	1	100	2,5	250	10	1000		
2.5	60	1	60	2,5	150	10	600		
3	50	1	50	2,5	125	10	500		
3.5	50	2.5	125	10	500	25	1250		
6	25	10	250	25	625				
10	25	10	250	25	625				
10	15	10	150	25	375				
15	10	10	100	25	250	100	1000	250	2500
25	10	10	100	25	250	100	1000	250	2500
25	6	10	60	25	150	100	600	250	1500
40	5	25	125	100	500	250	1250		
60	2.5	100	250	250	625				
100	1.5	100	150	250	375				
150	1	100	100	250	250	1000	1000	2500	2500
250	0.6	100	60	250	150	1000	600	2500	1500
400	0.4	250	100	1000	400	2500	1000		
600	0.25	1000	250	2500	625				
1000	0.25	1000	250	2500	625				

Table 24. Pulse division table (pulse duration divided pulses std. 100 ms).

ULTRAFLOW®		Pulse Divider & 11EVL (pulse duration 50 ms)		Pulse Divider & 11 EVL (pulse duration 100 ms)	
q_p [m³/h]	Pulse figure [imp/l]	Pulse figure [l/Pulse]	Divider	Pulse figure [l/Pulse]	Divider
0.6	300	1	300	2.5	750
1.5	100	1	100	2.5	250
2.5	60	1	60	2.5	150
3	50	1	50	2.5	125
3.5	50	1	50	2.5	125
6	25	1	25	25	625
10	25	1	25	25	625
10	15	1	15	25	375
15	10	10	100	25	250
25	10	10	100	25	250
25	6	10	60	25	150
40	5	10	50	25	125
60	2,5	10	25	250	625
100	1,5	10	15	250	375
150	1	100	100	250	250
250	0.6	100	60	250	150
400	0.4	100	40	250	100
600	0.25	100	25	2500	625
1000	0.25	100	25	2500	625

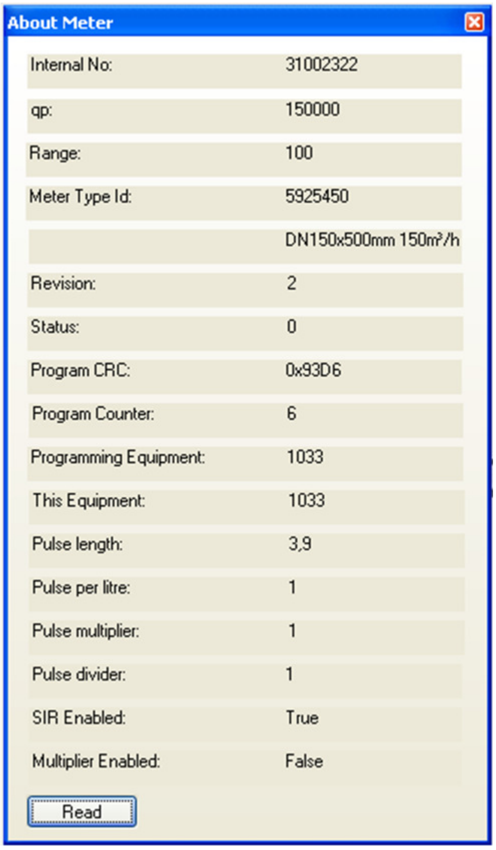
Table 25. Pulse division table for use together with Kamstrup EVL.

For other variants, please see installation guide for Pulse Divider No. 5511-727.

11.4.5 Meter type

Open ”Meter type”:

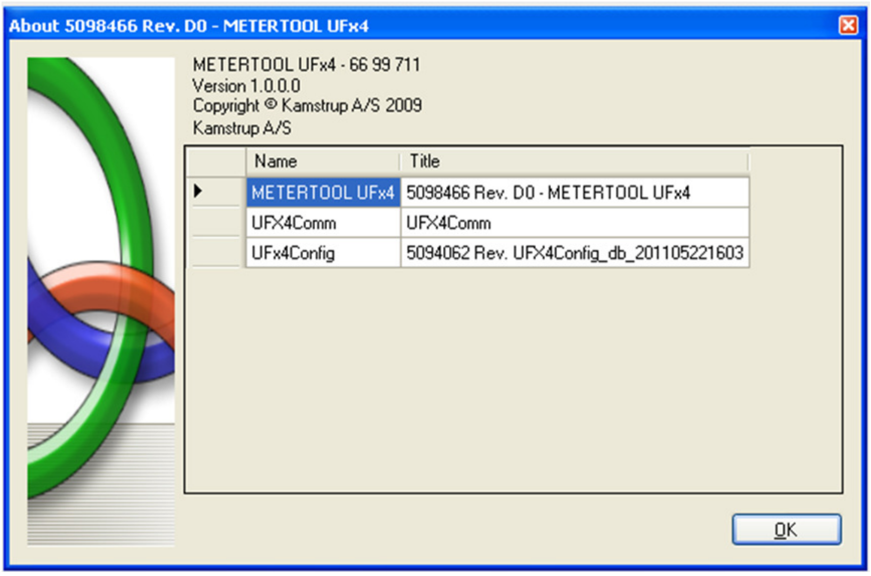
”Read”: Reads flow sensor information.



11.4.6 Help

Open ”About”:

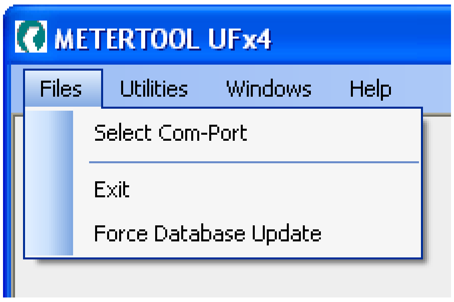
Displays: Revision numbers.



11.5 Update

The program includes a database comprising data of the variants released at the time the program was produced.

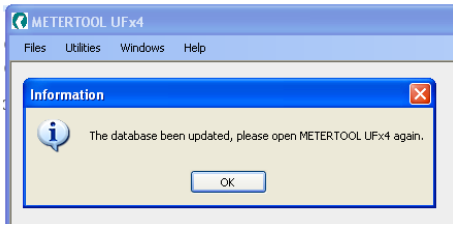
Open "Force Database Update".



The METERTOOL database is updated by connecting the PC to the Internet and activating "Force Database Update". The program now connects to a Kamstrup server and downloads the newest database.

After update the following message appears:

The database has been updated, please open METERTOOL UFx4 again.



12 Approvals

12.1 The Measuring Instrument Directive

ULTRAFLOW® 54 is supplied with a CE-marking according to MID (2004/22/EC). The certificates have the following numbers:

B-module:	DK-0200-MI004-008
D-module:	DK-0200-MIQA-001

Please contact Kamstrup A/S for further details on type approval and verification.

12.2 CE marking

ULTRAFLOW® 54 is marked according to the following directives:

EMC directive	2004/108/EC
LV directive	2006/95/EC (together with Pulse Transmitter or Pulse Divider)
PE directive	97/23/EC (DN50…DN125) category I

12.3 Declaration of conformity

Declaration of Conformity

Overensstemmelseserklæring
Déclaration de conformité
Konformitätserklärung
Deklaracja Zgodnosci
Declaración de conformidad
Declaratie de conformitate

We
Vi
Nous
Wir
My
Nosotros
Noi

Kamstrup A/S
Industrivej 28, Stilling
DK-8660 Skanderborg
Denmark
Tel: +45 89 93 10 00

declare under our sole responsibility that the product(s):
erklærer under eneansvar, at produkt(erne):
déclarons sous notre responsabilité que le/les produit(s):
erklären in alleiniger Verantwortung, dass/die Produkt(e):
deklarujemy z pełną odpowiedzialnoscią że produkt(y):
Declaramos, bajo responsabilidad propia que el/los producto
declaram pe proprie raspundere ca produsul/produsele:

Instrument	Type	Type No.:	Classes	Type Approval Ref.:
Heat Meter	MULTICAL® 401	66-V and 66-W	Cl 2/3,M1,E1	DK-0200-MI004-001
Heat Meter	MULTICAL® 402	402-V, 402-W, 402-T	Cl 2/3,M1,E1	DK-0200-MI004-013
Temperature Sensors	PL and DS	65-00-0A/B/C/D 66-00-0F/G 65-00-0L/M/N/P 66-00-0Q3/4 65-56-4	M1	DK-0200-MI004-002
Flow Sensor	ULTRAFLOW® qp 0.6...400 m³/h	65-S/R/T	Cl 3, M1, E1	DK-0200-MI004-003
Flow Sensor	ULTRAFLOW® qp 0.6...40 m³/h and qp 150...400 m³/h	65-S/R/T	Cl 2/3, M1, E1	DK-0200-MI004-003
Calculator	MULTICAL® 601 MULTICAL® 601+ MULTICAL® 602 SVM S6 MULTICAL® 801	67-A/B/C/D 67-E 602-A/B/C/D S6-A/B/C/D 67-F/G/K/L	M1, E1/E2 M1, E1/E2 M1, E1/E2 M1, E1/E2 M1, E1/E2	DK-0200-MI004-004 DK-0200-MI004-004 DK-0200-MI004-020 DK-0200-MI004-020 DK-0200-MI004-009
Flow Sensor	ULTRAFLOW® 54/34 qp 0.6...100 m³/h qp 150...1000 m³/h	65-5/65-3	Cl 2/3 M1, E1/E2 M1/M2, E1/E2	DK-0200-MI004-008
Water Meter	MULTICAL® 21 MULTICAL® 41 MULTICAL® 61 MULTICAL® 62	021-66 66-Z 67-Z 62-Z	Cl 2, M1, E1/E2 Cl 2, M1, E1 Cl 2, M1, E1, B Cl 2, M1, E1, B	DK-0200-MI001-015 DK-0200-MI001-003 DK-0200-MI001-010 DK-0200-MI001-016

are in conformity with the requirements of the following directives:
er i overensstemmelse med kravene i følgende direktiver:
sont conforme(s) aux exigences de la/des directives:
mit den Anforderungen der Richtlinie(n) komform ist/sind:
są zgodne z wymaganiami następujących dyrektyw:
es/son conformes con los requerimientos de las siguintes directivas:
este/sunt in conformitate cu cerintele urmatoarelor directive:

Measuring Instrument Directive	2004/22/EC
EMC Directive	2004/108/EC
LVD Directive	2006/95/EC
PE-Directive (Pressure)	97/23/EC
R&TTE	1999/5/EC

Notified Body, Module D Certificate:
Force Certification A/S
EC Notified Body nr. 0200
Park Alle 345, 2605 Brøndby
Denmark

Date: 2012-04-16

Sign.:

Lars Bo Hammer
Quality Assurance Manager

5518-050,Rev.: V1, Kamstrup A/S, DK8660 Skanderborg, Denmark

13 Troubleshooting

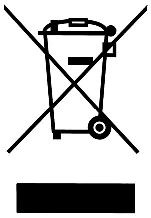
Before sending in the sensor to be repaired or checked, please use the error detection table below to help you clarify the possible cause of the problem.

Symptom	Possible cause	Proposal for correction
No updating of display values	No power supply	Replace battery or check mains supply
No display function (blank display)	No voltage supply and backup	Replace back-up cell. Replace battery or check mains supply
No accumulation of m³	No volume pulses Incorrect connection Flow sensor is inverted Air in sensor/cavitation Flow sensor error	 Check flow sensor connection (Check with PULSE TESTER, if necessary) Check flow sensor direction Check installation angle. Check if there is air in the system or cavitation from valves and pumps. If possible, try to increase the static pressure. Replace the flow sensor/Send meter for repair
Erroneous accumulation of m³	Erroneous programming Air in sensor/cavitation Flow sensor error	Check that meter factors of calculator and flow sensor correspond Check the installation angle. Check if there is air in the system or cavitation from valves and pumps. Increase the static pressure, if possible Replace the flow meter/send sensor for repair

14 Disposal

Kamstrup A/S holds an environmental certification according to ISO 14001, and as part of Kamstrup's environmental policy only materials which can be recovered environmentally correctly are used to the greatest possible extent.

Kamstrup A/S has climate accounts (Carbon footprint) for all meter types.



As of August 2005 heat meters from Kamstrup are marked according to the EU directive 2002/96/EEA and the standard EN 50419.

The purpose of the marking is to inform our customers that the heat meter cannot be disposed of as ordinary waste.

- **Disposal by Kamstrup A/S**

  Kamstrup accepts worn-out meters for environmentally correct disposal according to previous agreement. The disposal is free of charge to our customers, except for the cost of transportation to Kamstrup.

- **The customer sends for disposal**

  The meters must not be disassembled prior to dispatch. The complete meter is handed in for approved national/local disposal. Enclose a copy of this page in order to inform the recipient of the contents.

Please note that lithium cells and meters containing lithium cells must be shipped as dangerous goods. Please see Kamstrup document 5510-408, "Lithium batteries - Handling and disposal".

Meter part	Material	Recommended disposal
Lithium cells in Pulse Transmitter/ Pulse Divider (D-cell)	Lithium and thionyl chloride > UN 3091 < D-cell: 4.9 g lithium	Approved deposit of lithium cells
PCBs in Pulse Transmitter, Pulse Divider and ULTRAFLOW®	Coppered epoxy laminate, components soldered on	PCB scrap for concentration to noble metals
Flow sensor cables	Copper with silicone mantle	Cable recycling
Plastic parts, cast	PES, PBT and PC. See material data	Plastic recycling
ULTRAFLOW® meter case	DZR brass/red brass/stainless steel	Metal recycling
Packing	Recycled cardboard and EPS	Cardboard recycling (Resy) and EPS recycling

Please direct any questions you may have concerning environmental matters to:

Kamstrup A/S
FAO: Environmental and quality assurance department
Fax.: +45 89 93 10 01
info@kamstrup.com

15 Documents

	Danish	English	German	Russian
Technical Description	5512-384	5512-385	5512-575	5512-576
Data sheet	5810-588	5810-589	5810-590	5810-593
Installation instructions	5512-951	5512-952	5512-953	5512-956

Table 26