kamstrup

Technical Description

ULTRAFLOW® 54
ULTRAFLOW® 34
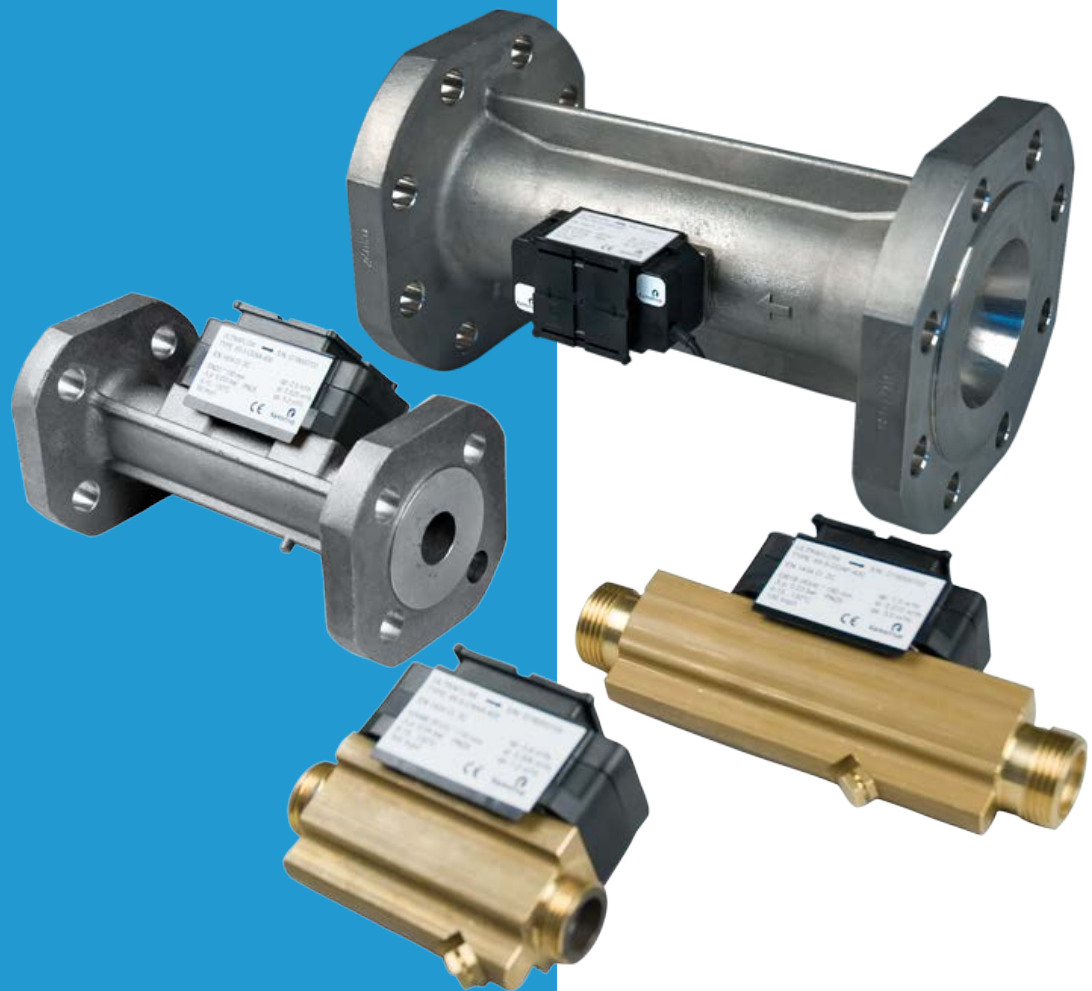
Contents

1   General description

ULTRAFLOW® is a static flow sensor based on the ultrasonic principle. It is primarily used as a volume flow sensor for thermal energy meters such as MULTICAL®. ULTRAFLOW® 54 has been designed for use in heating installations where water is the heat-bearing medium, whereas ULTRAFLOW® 34 has been designed for use in cooling and heat/cooling 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 metres or more, a Pulse Transmitter can be supplied as an accessory. If ULTRAFLOW® is used as pulse generator for other equipment, it must be connected through a Pulse Transmitter. If a different meter factor is required, ULTRAFLOW® is connected through a Pulse Divider. Pulse Transmitter and Pulse Divider have a built-in supply for ULTRAFLOW® and a galvanically separated pulse output.

2   Data

ULTRAFLOW® 54 and 34

2.1   Electrical data

Supply voltage	3.6 VDC ± 0.1 VDC	
Battery (Pulse Transmitter/ Pulse Divider)	3.65 VDC, D-cell lithium	
Replacement interval	6 years @ $t_{BAT} < 30$ °C	For output module (Y=3)
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 SuperCap eliminates interruptions due to short-term power-cuts	
Cable length, flow sensor	Max. 10 m	
Cable length, Pulse Transmitter/ Pulse Divider	Depending on the calculator Max. 100 m when connected to MULTICAL®	
EMC data	Fulfils EN 1434:2007 class C, MID E1 and E2	

2.2   Mechanical data

Metrological class	2 or 3	
Environmental class	Fulfils EN 1434 class C	
Mechanical environment	MID M1	
Ambient temperature	5…55 °C (indoor installation)	
Protection class		
Flow sensor	IP65	When installed properly. See
Pulse Transmitter/ Pulse Divider	IP67	*paragraph 7 Installation*.
Humidity		
ULTRAFLOW® 54	Non-condensing, < 93 % RH	
ULTRAFLOW® 34	Condensing (periodically)	
Temperature of medium		
ULTRAFLOW® 54	15…130 °C or 15…90 °C	At medium temperature above 90 °C, the use of flange meters is recommended.
ULTRAFLOW® 34	2…130 °C or 2…50 °C	At medium temperature above 90 °C or at medium temperature more than 5 °C below ambient temperature ($T_{med} < T_{amb}$ - 5 °C), calculator and Pulse Transmitter/Pulse Divider may not be mounted on the flow sensor. Instead wall mounting is recommended.
Storage and transport temp. empty sensor	-25…60 °C	
Pressure stage	PN16, PS16 and PN25, PS25	

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	1:100	2:1	1.5	0.04	2
1.5	DN15 & DN20	100	1:100	2:1	4.5	0.22	3
2.5	DN20	60	1:100	2:1	7.5	0.03	5
3.5	DN25	50	1:100	2:1	9	0.07	7
6	DN25 & DN32	25	1:100	2:1	18	0.2	12
10	DN40	15	1:100	2:1	30	0.06	20
15	DN50	10	1:100	2:1	45	0.14	30
25	DN65	6	1:100	2:1	75	0.06	50
40	DN80	5	1:100	2:1	90	0.05	80
60	DN100	2.5	1:100	2:1	180	0.03	120
100	DN100 & DN125	1.5	1:100	2:1	300	0.07	200

[1] *The meter factor appears from the meter´s type label.*

[2] *Saturation flow (125 Hz. Max. pulse frequency 128 Hz is maintained at higher flow).*

Table 1. Flow data.

2.4   Materials

Wetted parts

ULTRAFLOW®, q_p 0.6 and 1.5 m³/h

Housing, gland	DZR brass (Dezincification resistant 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 tube	Thermoplastic, PES 30 % GF

ULTRAFLOW®, q_p 2.5 to 100 m³/h

Housing, gland	DZR brass (Dezincification resistant brass)
Housing, flange	Red brass, RG5 or stainless steel, W.no. 1.4308 (see *par. 4 Ordering details*)
Transducer	Stainless steel, W.no. 1.4401
Gaskets	EPDM
Reflectors	Stainless steel, W.no. 1.4301
Measuring tube	Thermoplastic, PES 30 % GF

Electronics housing, ULTRAFLOW®

Base	Thermoplastic, PC 10 % GF
Cover	Thermoplastic, PC 20 % GF

Housing, Pulse Transmitter/Pulse Divider

Base, cover	Thermoplastic, PC 10 % GF

Signal cable

Silicone cable (3 x 0.5 mm²)

Mains supply cable 24/230 VAC (optional for mains supplied Pulse Transmitter/Pulse DIvider)

Cable with PVC-mantle (2 x 0.75 mm²)

3   Type overview

Nom. flow qₚ [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	DN32x260 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. Type overview.

Thread EN ISO 228-1

Flange EN 1092, PN25. Flange facing type B, raised face

4   Ordering details

4.1   ULTRAFLOW® 54

Type number[3)	q_p [m³/h]	q_i [m³/h]	q_s [m³/h]	Connection	PN	Length [mm]	Meter factor [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- CHCC -XXX	6	0.06	12	DN32	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- 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. Type numbers of ULTRAFLOW® 54.

4.2   ULTRAFLOW® 34

Type number[4]	q_p [m³/h]	q_i [m³/h]	q_s [m³/h]	Connection	PN	Length [mm]	Meter factor [imp/l]	CCC (high res.)	Material
65-3- CDAA -XXX	1.5	0.015	3	G¾B (R½)	16	110	100	419 (407)	Brass
65-3- CDAD -XXX	1.5	0.015	3	G1B (R¾)	16	130	100	419 (407)	Brass
65-3- CDAF -XXX	1.5	0.015	3	G1B (R¾)	16	190	100	419 (407)	Brass
65-3- CEAF -XXX	2.5	0.025	5	G1B (R¾)	16	190	60	498 (-)	Brass
65-3- CGAG -XXX	3.5	0.035	7	G5/4B (R1)	16	260	50	451 (436)	Brass
65-3- CHAG -XXX	6	0.06	12	G5/4B (R1)	16	260	25	437 (438)	Brass
65-3- CHCB -XXX	6	0.06	12	DN25	25	260	25	437 (438)	Stainless steel
65-3- CJAJ -XXX	10	0.1	20	G2B (R1½)	16	300	15	478 (483)	Brass
65-3- CJCD -XXX	10	0.1	20	DN40	25	300	15	478 (483)	Stainless steel
65-3- CKCE -XXX	15	0.15	30	DN50	25	270	10	420 (485)	Stainless steel
65-3- CLCG -XXX	25	0.25	50	DN65	25	300	6	479 (-)	Stainless steel
65-3- CMCH -XXX	40	0.4	80	DN80	25	300	5	458 (486)	Stainless steel
65-3- FACL -XXX	60	0.6	120	DN100	25	360	2.5	470 (487)	Stainless steel
65-3- FBCL -XXX	100	1	200	DN100	25	360	1.5	480 (488)	Stainless steel
65-3- FBCM -XXX	100	1	200	DN125	25	350	1.5	480 (488)	Stainless steel

[4] *XXX - code for final assembly, approvals etc. - determined by Kamstrup. A few variants may not be available in national approvals.*

Table 4. Type numbers of ULTRAFLOW® 34.

4.3   Accessories for ULTRAFLOW®

Glands				
Size	Nipple	Union	Type No.	
			1 pc.	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 5. 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
DN32	2210-217
DN40	2210-132
DN50	2210-099
DN65	2210-141
DN80	2210-140
DN100	1150-142
DN125	1150-153

Table 6. Gaskets.

4.4   Pulse Transmitter and Pulse Divider

Pulse Transmitter and Pulse Divider are available with built-in supply for ULTRAFLOW®. The options are battery, 24 VAC or 230 VAC supply.
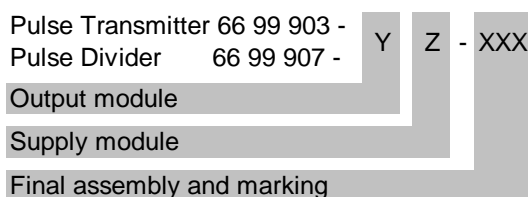
Pulse Transmitter and Pulse Divider are delivered with galvanically separated output module. See *paragraph 4.5.1* below.

Galvanic separation is used in the following situations:

1)   More than 10 metres cable length between MULTICAL® and ULTRAFLOW® is required.

2)   For flow sensor No. 2 in connection with MULTICAL®. If two flow sensors are used together with MULTICAL®, one must be galvanically separated.

      For further info, see *paragraph 7.11 Calculator with two flow sensors*.

3)   ULTRAFLOW® is connected to other equipment/foreign calculators.

Note: Flow-info is not possible if Pulse Transmitter or Pulse Divider is used.

4.5   Type number composition of Pulse Transmitter and Pulse Divider

Pulse Transmitter 66 99 903 - Pulse Divider 66 99 907 -	Y	Z	- XXX
Output module			
Supply module			
Final assembly and marking			

4.5.1   Output module and supply module

Y	Output module	Corresponding supply module
2	Galvanically separated module	0, 7, 8
3	Galvanically separated module, low power	0, 2, 7, 8

Z	Supply module	Corresponding output module
0	No supply	2, 3
2	Battery, D-cell	3
7	230 VAC supply module	2, 3
8	24 VAC supply module	2, 3

Table 7. Output module (Y) and supply module (Z) for Pulse Transmitter and Pulse Divider.

Pulse Transmitter and Pulse Divider are available with one of two different galvanically separated output modules. One output module (Y=2) for use of long cables (up to 100 metres towards MULTICAL®) and one output module (Y=3) for battery supply with a battery lifetime of minimum 6 years. Output module (Y=3) is default.

For further info, see *paragraph 7.7 Electrical connection of Pulse Transmitter and Pulse Divider*.

4.6 Pulse Divider configuration CCC-DD-E-MMM

Pulse Divider is configured for ULTRAFLOW® meter factor (CCC) as well as the required meter factor (DD) and pulse duration (E) for the Pulse Divider according to *Table 8* and *Table 9*.

MMM indicates customer label.

q_p	CCC	Meter factor				Pulse duration				
[m³/h]		[imp/l]	[l/imp]	Divider	DD	[ms]	[ms] (E=4)	[ms] (E=5)	[ms] (E=6)	
0.6	**116**	**300**				**3.9**	-	-	-	**Default**
0.6			1	300	33	-	20	50	100	
0.6			2.5	750	63	-	-	-	100	
1.5	**119**	**100**				**3.9**	-	-	-	**Default**
1.5			1	100	33	-	20	50	100	
1.5			2.5	250	63	-	-	-	100	
1.5			10	1000	34	-	-	-	100	
2.5	**198**	**60**				**3.9**	-	-	-	**Default**
2.5			1	60	33	-	20	50	100	
2.5			2.5	150	63	-	-	-	100	
2.5			10	600	34	-	-	-	100	
3.5	**151**	**50**				**3.9**	-	-	-	**Default**
3.5			1	50	33	-	20	50	-	
3.5			2.5	125	63	-	-	-	100	
3.5			10	500	34	-	-	-	100	
3.5			25	1250	64	-	-	-	100	
6	**137**	**25**				**3.9**	-	-	-	**Default**
6			1	25	33	-	20	50	-	
6			2.5	62.5	63	-	-	-	100	
6			10	250	34	-	-	-	100	
6			25	625	64	-	-	-	100	
10	**178**	**15**				**3.9**	-	-	-	**Default**
10			1	15	33	-	20	50	-	
10			10	150	34	-	-	-	100	
10			25	375	64	-	-	-	100	
15	**120**	**10**				**3.9**	-	-	-	**Default**
15			1	10	33	-	20	-	-	
15			10	100	34	-	-	50	100	
15			25	250	64	-	-	-	100	
15			100	1000	35	-	-	-	100	
25	**179**	**6**				**3.9**	-	-	-	**Default**
25			1	6	33	-	20	-	-	
25			10	60	34	-	-	50	100	
25			25	150	64	-	-	-	100	
25			100	600	35	-	-	-	100	

Table 8. Configuration options as to meter factor (DD) and pulse duration (E) for Pulse Divider when connected to ULTRALFLOW® 54 or 34, q_p 0.6...25.

q_p [m³/h]	CCC	Meter factor				Pulse duration				
		[imp/l]	[l/imp]	Divider	DD	[ms]	[ms] (E=4)	[ms] (E=5)	[ms] (E=6)	
40	**158**	**5**				**3.9**	-	-	-	**Default**
40			10	50	34	-	20	50	-	
40			25	125	64	-	-	-	100	
40			100	500	35	-	-	-	100	
40			250	1250	65	-	-	-	100	
60	**170**	**2.5**				**3.9**	-	-	-	**Default**
60			10	25	34	-	20	50	-	
60			25	62.5	64	-	-	-	100	
60			100	250	35	-	-	-	100	
60			250	625	65	-	-	-	100	
100	**180**	**1.5**				**3.9**	-	-	-	**Default**
100			10	15	34	-	20	50	-	
100			100	150	35	-	-	-	100	
100			250	375	65	-	-	-	100	

Table 9. Configuration options as to meter factor (DD) and pulse duration (E) for Pulse Divider when connected to ULTRALFOW® 54 or 34, q_p 40...100.

Based on a q_p value, a meter factor for the Pulse Divider is chosen in *Table 8* or *Table 9*. The valid possible pulse durations are listed on the same line as the chosen meter factor.

Example: For ULTRAFLOW® 54 q_p 40 m³/h (5 imp/l, CCC=158) a meter factor for the Pulse Divider of 10 l/imp (DD=34) is required. Based on this meter factor one of the pulse durations, 20 milliseconds (E=4) or 50 milliseconds (E=5) is selected.

For older types of ULTRAFLOW® (e.g. ULTRAFLOW® type 65), where the correlation between q_p and meter factor (CCC) is not ambiguous, the correct configuration is made by using the flow sensor's meter factor [imp/l].

Default values in *Table 8* and *Table 9* are meter factor and pulse duration values for ULTRAFLOW® 54 and 34.

4.7   Accessories for Pulse Transmitter and Pulse Divider

Please note that not all article numbers in *Table 10* can be directly ordered. Some article numbers must be ordered via Kamstrup service department

Article number	Description	Note (when ordering Pulse Transmitter/Pulse Divider)
65-000-000-2000	D-cell lithium battery with two-pole connector	
3026-477 [1]	Fitting for D-cell battery	Enclosed if battery supply or "No supply" is selected
1650-157 [1]	Plug for cable connection	Enclosed if battery supply or "No supply" is selected
65-000-000-7000 [2]	230 VAC supply module	
65-000-000-8000 [2]	24 VAC supply module	
5000-290	Cable between supply module and output module	Enclosed if supply module is selected
5000-286	24/230 VAC power cable	Optional
66-99-012	Output module (Y=2), galvanically separated	
66-99-013	Output module (Y=3), galvanically separated, "Low power"	
5000-333	2.5 m silicone cable (3-wire)	Optional
5000-259	5 m silicone cable (3-wire)	Optional
5000-270	10 m silicone cable (3-wire)	Optional
3026-207	Bracket for wall munting	Optional

[1] *Obligatory when changing from mains supply module to battery supply.*

[2] *Including 5000-290.*

Table 10. Accessories for Pulse Transmitter and Pulse Divider.

4.7.1   Cables

Pulse Transmitter and Pulse Divider are optionally available with signal cable in lengths of 2.5, 5 or 10 metres. The signal cable is mounted from the factory.

If 24/230 VAC supply module is selected, Pulse Transmitter and Pulse Divider are optionally available with mains supply cable. The cable is mounted from the factory.

5 Dimensional sketches

All measurements are in mm, unless otherwise stated.
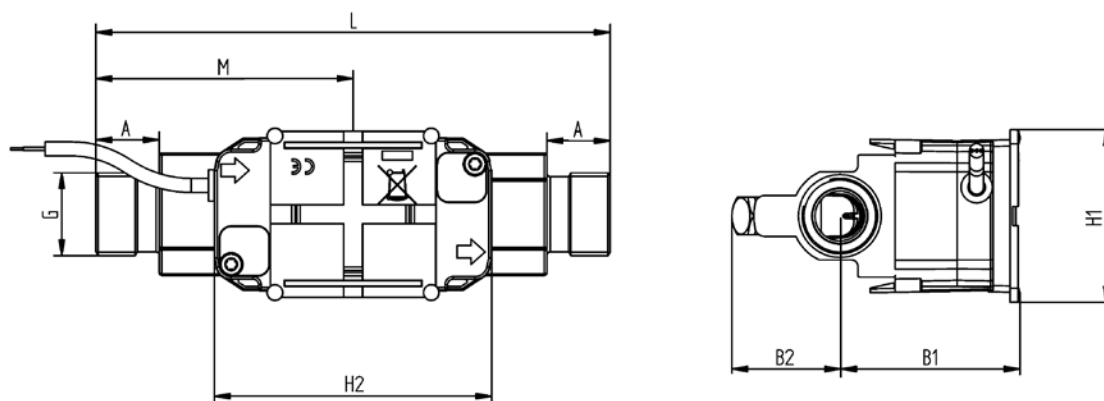
5.1 ULTRAFLOW®

ULTRAFLOW®, G¾B and G1B

Figure 1

Thread EN ISO 228-1

Thread	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 11

ULTRAFLOW®, G5/4B, G1½B and G2B
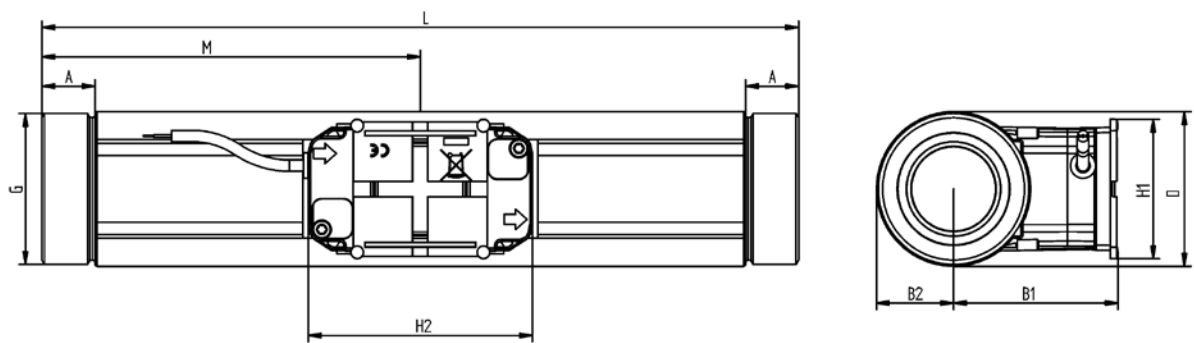
Figure 2

Thread EN ISO 228-1

Thread	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 12

ULTRAFLOW®, DN20 to DN50
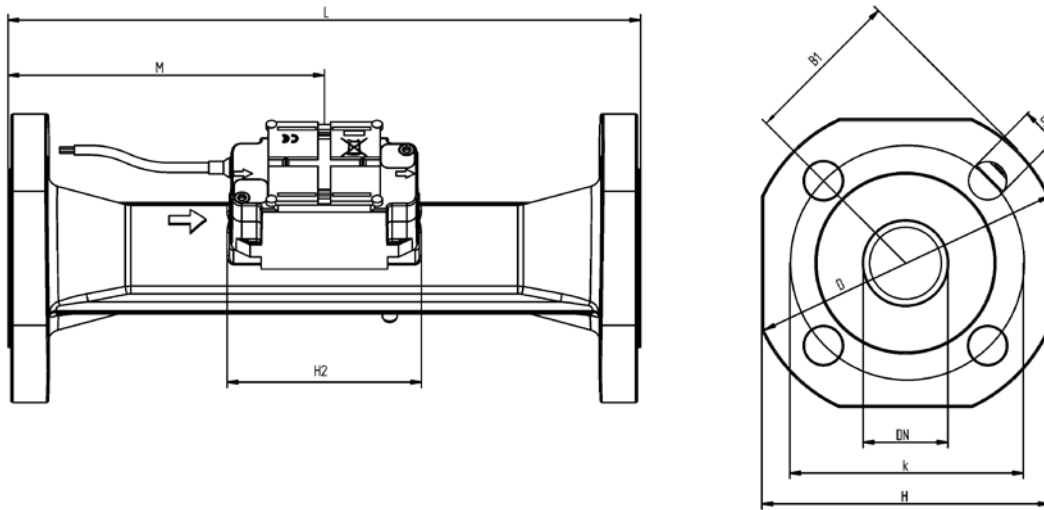
Figure 3

Flange EN 1092, PN25. Flange facing type B, raised face

Nom. diameter	L	M	H2	B1	D	H	k	Bolts Number	Thread	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
DN32	260	L/2	89	58	140	128	100	4	M16	18	5.2
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 13

ULTRAFLOW®, DN65 to DN125
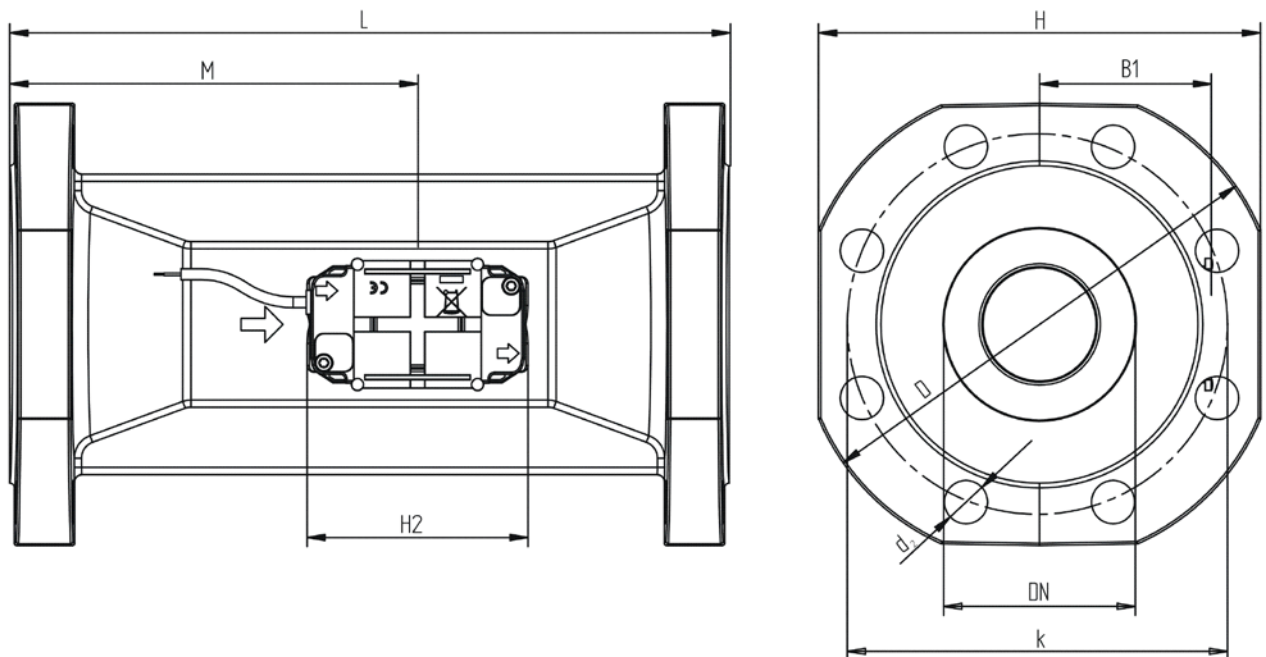
Figure 4

Flange EN 1092, PN25. Flange facing type B, raised face

Nom. Diameter	L	M	H2	B1	D	H	k	Bolts			Approx. weight
								Number	Thread	d_2	[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 14

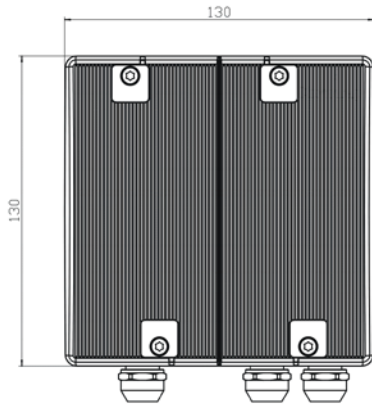## 5.2   Pulse Transmitter and Pulse Divider

Figure 5. Pulse Transmitter/Pulse Divider front view.

Figure 6. Pulse Transmitter/Pulse Divider side view.
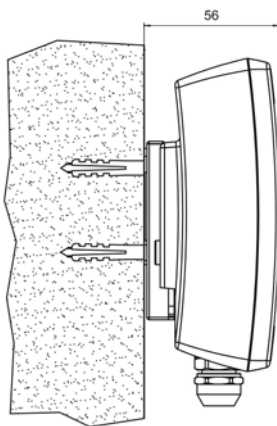

Figure 7. Wall mounted Pulse Transmitter/Pulse Divider.
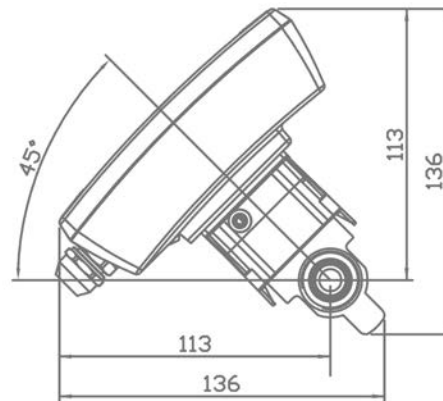

Figure 8. Pulse Transmitter/Pulse Divider mounted on ULTRAFLOW®.

6   Pressure loss

The pressure loss in a flow sensor is stated as the maximum pressure loss at q_p. According to EN 1434 the maximum 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 & DN125	373	187

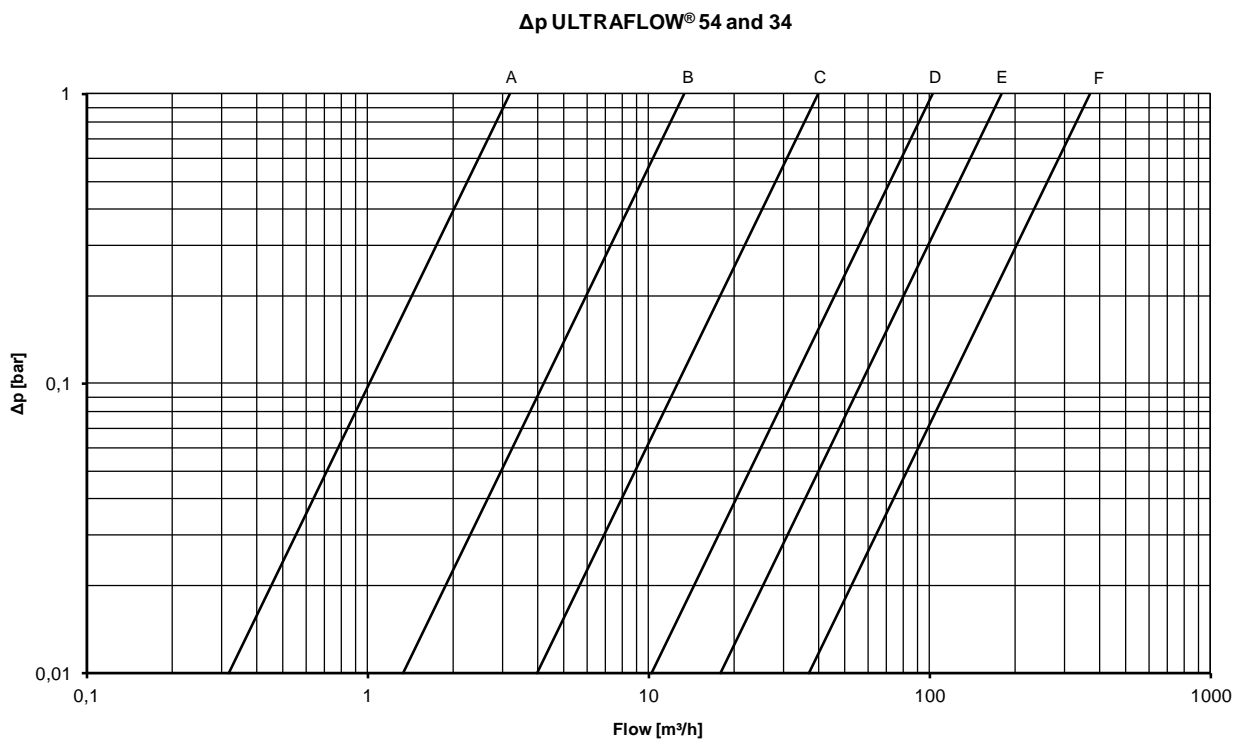*Table 15. Pressure loss table.*

Δp ULTRAFLOW® 54 and 34

Figure 9. Pressure loss chart for ULTRAFLOW® 54 and 34.

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 *Figure 16*, page 26.

Pressure stage of ULTRAFLOW®: 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.

Temperature of medium, ULTRAFLOW® 34: 2…130 °C/2…50 °C, see marking.

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

Electromagnetic environment: E1 and E2 (housing/light industry). The meter's signal 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). However, ULTRAFLOW® 34 may be installed in environments with periodically condensing humidity.

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.

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

It is permissible to replace the supply and change the supply type in Pulse Transmitter/Pulse Divider. For battery supply a lithium battery with connector from Kamstrup A/S must be used. Lithium batteries must be correctly handled and disposed of (see Kamstrup document 5510-408, "Lithium batteries - Handling and disposal").

It is also permissible to replace the output module in Pulse Transmitter/Pulse Divider

Other repairs require subsequent re-verification in an accredited laboratory.

Note: Please make sure that the meter factor is identical on flow sensor and calculator.

At medium temperature above 90 °C, the use of flange meters is recommended.

At medium temperature above 90 °C or at medium temperature more than 5 °C below ambient temperature (T_{med} ‹ T_{amb} - 5 °C), calculator and Pulse transmitter/Pulse divider may not be mounted on the flow sensor. Instead wall mounting is recommended.

In order to prevent cavitation the back pressure (the pressure at the flow sensor outlet) 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).

ULTRAFLOW® 54 should not be insulated or enclosed as the natural ventilation around the meter is prevented.

ULTRAFLOW® 34 should not be insulated or enclosed as condensation around the meter will be trapped.

If, after careful consideration, ULTRAFLOW® is insulated anyway, the electronics housing must remain uninsulated.

When the installation has been completed, water flow can be turned on. The valve on the inlet side must be opened first.
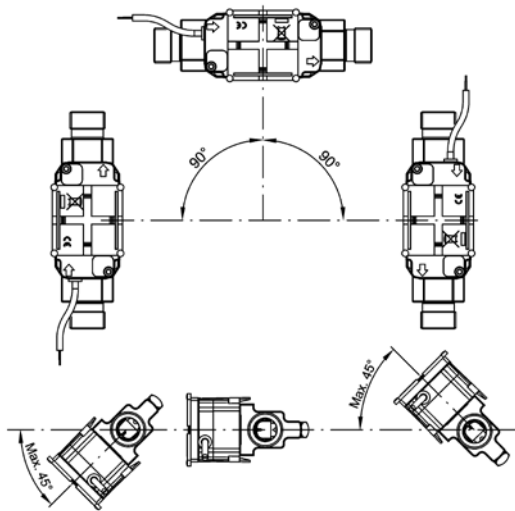
7.1　Installation angle for ULTRAFLOW®

Figure 10

ULTRAFLOW® 54 and 34 may be installed horizontally, vertically or at an angle.

Important!

For ULTRAFLOW® 54 and 34 the electronics housing must be placed on the side (when installed horizontally).

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

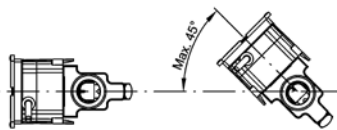*Figure 11*

ULTRAFLOW® 34 may be turned up to +45° around the pipe axis as shown in *Figure 11*.

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:
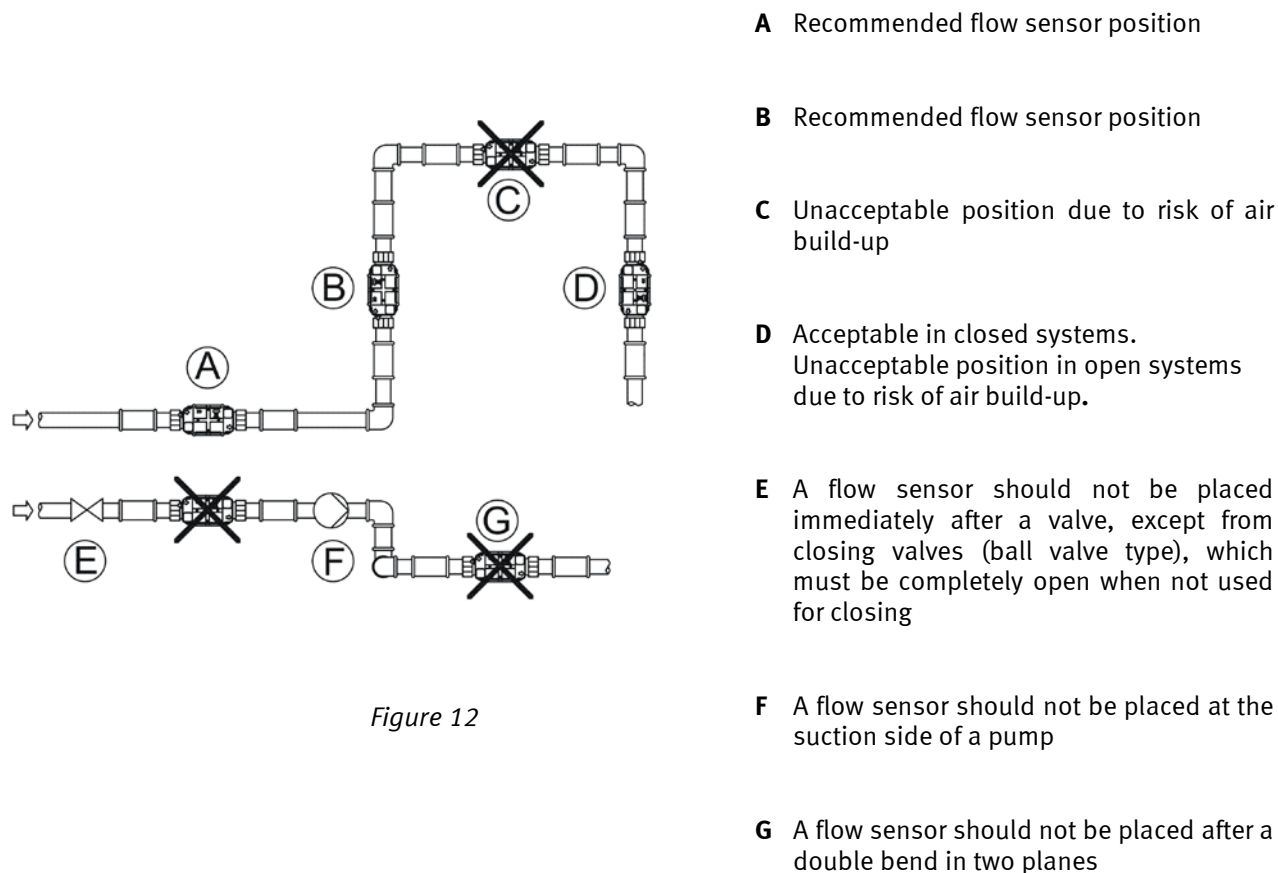

Figure 12

A Recommended flow sensor position

B Recommended flow sensor position

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 sensor should not be placed immediately after a valve, except from closing valves (ball valve type), which must be completely open when not used for closing

F A flow sensor should not be placed at the suction side of a pump

G A flow sensor should not be placed after a double bend in two planes

For general information concerning installation see CEN report *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 (the pressure at the flow sensor outlet) 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° around the pipe axis as shown in *Figure 13* below.
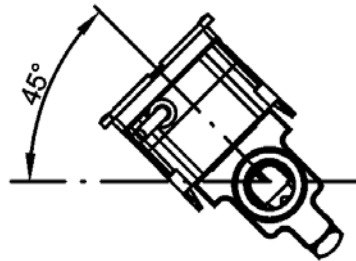
Figure 13

ULTRAFLOW® 34 can be installed in environments with periodically condensing humidity, but ought neither to be insulated nor wrapped as condensation water on the meter is thereby entrapped.

Furthermore, wires/cables must in general hang freely downwards after cable connections to form a drip nose for drainage of water and condensation.

7.4.1   Orientation of Pulse Transmitter and Pulse Divider

Mounting the Pulse Transmitter and Pulse Divider, the cable connections must always be horizontally or downwards oriented in order to avoid the risk of water and condensation being led into the box via the cables.

This is specially important in moist environments.

Furthermore, wires/cables must in general hang freely downwards after the cable connections to form a drip nose for drainage of water and condensation.
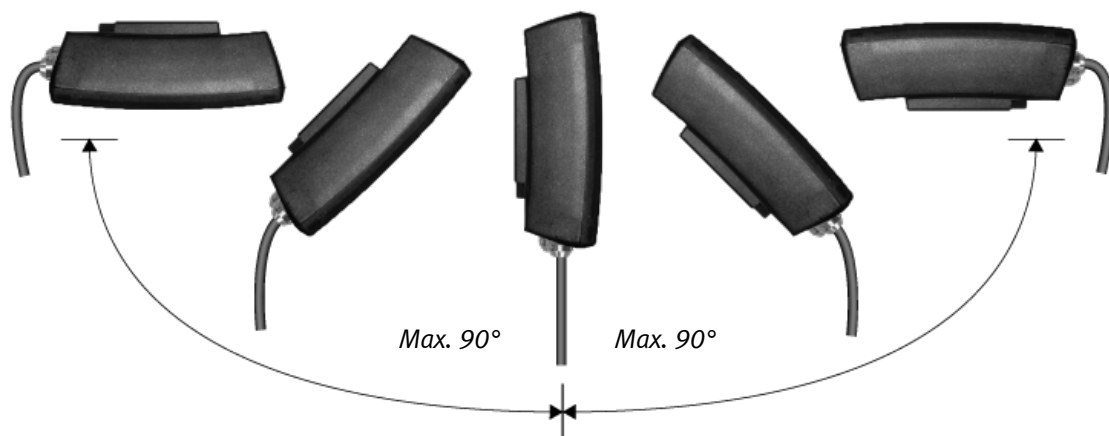
Figure 14. Orientation of Pulse Transmitter/Pulse Divider.
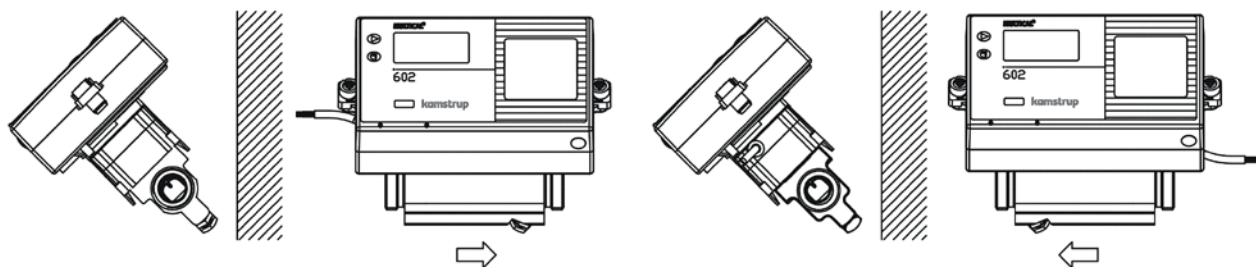
7.5 Installation examples

Figure 15. Threaded meter with MULTICAL® mounted on ULTRAFLOW®.

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 sensor can be used in both PN16 and PN25 installations and can be supplied marked either PN16 or PN25 as desired.
Supplied glands, if any, can only be used for PN16. For PN25 installations shall be used suitable PN25 glands.

In connection with G¾Bx110 mm and G1Bx110 mm, it must be checked that 10 mm thread run-out is sufficient. See *Figure 16* below.
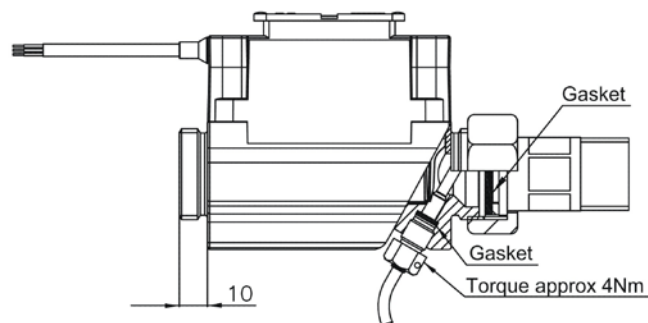

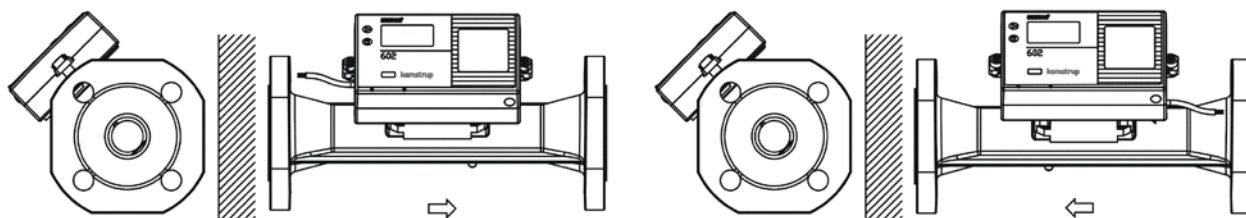*Figure 16. ULTRAFLOW® with gland and short direct sensor.*

Figure 17. Flange meter with MULTICAL® mounted on ULTRAFLOW®.
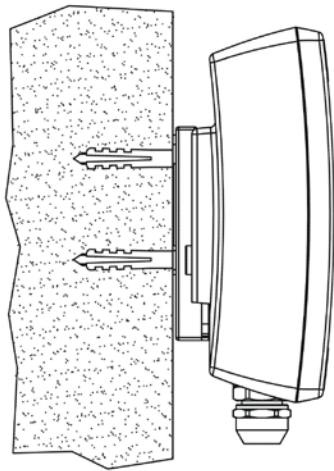
Figure 18. Wall mounted Pulse Transmitter/Pulse Divider.
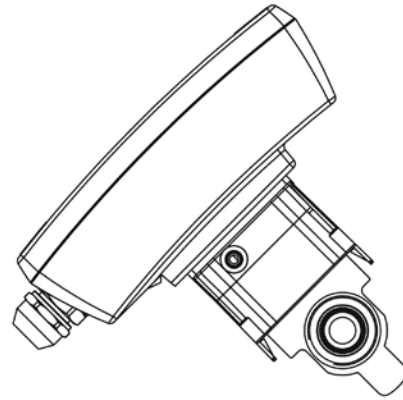
Figure 19. Pulse Transmitter/Pulse Divider mounted on ULTRAFLOW®.

Note: At medium temperature above 90 °C or at medium temperature more than 5 °C below ambient temperature ($T_{med} < T_{amb}$ - 5 °C), calculator and Pulse transmitter/Pulse divider may not be mounted on the flow sensor. Instead wall mounting is recommended.

7.6   Electrical connection of ULTRAFLOW® and MULTICAL®

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

Table 16. Connecting ULTRAFLOW® and MULTICAL®.

Please note that using long signal cables requires careful consideration 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   Electrical connection of Pulse Transmitter and Pulse Divider

If ULTRAFLOW® and MULTICAL® are connected via a Pulse Transmitter, ULTRAFLOW® is galvanically separated from MULTICAL®.

Note: Flow-info is not possible if Pulse Transmitter is used.

If ULTRAFLOW® is connected to other equipment than MULTICAL®, always connect ULTRAFLOW® via Pulse Transmitter or Pulse Divider.

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

Table 17. Connecting ULTRAFLOW® and MULTICAL® via Pulse Transmitter/Pulse Divider.
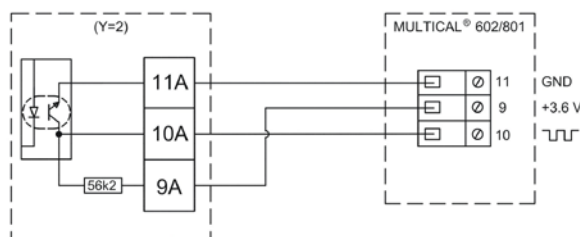**) Pulse Divider is not normally used together with MULTICAL®.*

Figure 20. Three-wire connection of Pulse Transmitter with output module (Y=2)
to MULTICAL® 602/801. Cable length up to 25 metres.
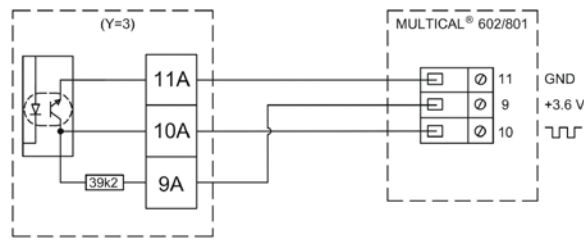
Figure 21. Three-wire connection of Pulse Transmitter with output module (Y=3) to MULTICAL® 602/801. Cable length up to 25 metres.
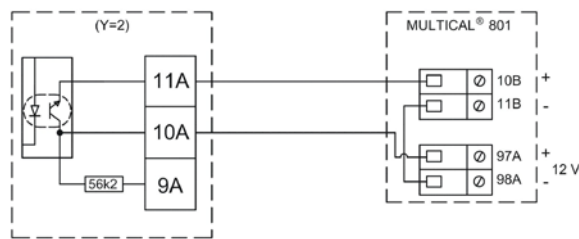
Figure 22. Two-wire connection of Pulse Transmitter with output module (Y=2) to MULTICAL® /801. Cable length up to 100 metres.

Figure 23. Two-wire connection of Pulse Transmitter with output module (Y=2) to MULTICAL® 602-D and external 24 VDC supply. Cable length up to 100 metres.
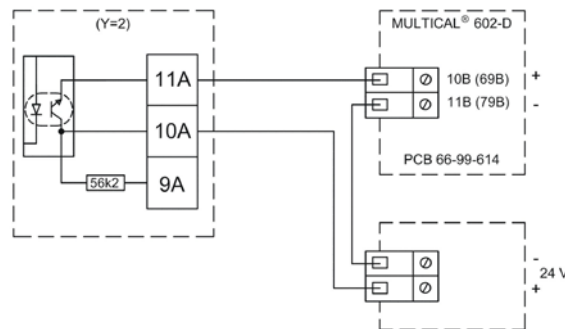
See *paragraph 7.10 Example of connecting Pulse Transmitter*.

For connection of Pulse Transmitter and Pulse Divider to other calculators please see *paragraph 8.9 Pulse output of Pulse Transmitter and Pulse Divider*.

7.7.1   Cable length

Maximum allowable cable length between Pulse Transmitter/Pulse Divider and MULTICAL® depends on the output module used in Pulse Transmitter/Pulse Divider as well as how the MULTICAL® calculator is connected.

Pulse Transmitter/Pulse Divider output module	MULTICAL® 601/602/801	
	2-wire connection	3-wire connection
Y=2	< 100 m *)	< 25 m
Y=3	N/A	< 25 m

*) MULTICAL® 601/602 must have sensor connection type D and external 24 VDC supply.

Table 18. Maximum cable length between Pulse Transmitter/
Pulse Divider and MULTICAL®.

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

7.8   Connection of power supply

If ULTRAFLOW® is connected via Pulse Transmitter or Pulse Divider, ULTRAFLOW® is powered by the supply module/battery in the Pulse Transmitter/Pulse Divider.

7.8.1   Battery supply

Pulse Transmitter/Pulse Divider is fitted with a D-cell lithium battery with connector. The battery plug is connected to the output module.

Optimal battery lifetime is obtained by keeping the battery temperature below 30 °C, e.g. by wall mounting the Pulse Transmitter/Pulse Divider.

The voltage of a lithium battery is almost constant throughout the lifetime of the battery (approx. 3.65 V). Therefore, it is not possible to determine the remaining capacity of the battery by measuring the voltage.

The battery cannot and must not be charged and must not be short-circuited.

The battery supply may only be replaced by a corresponding lithium battery with connector from Kamstrup A/S. Used batteries must be handed in for approved destruction, e.g. at Kamstrup A/S. (See Kamstrup document 5510-408, "Lithium batteries - Handling and disposal").

7.8.2   Mains supply modules

The mains supply modules are protection class II and are connected to the output module via a small two-wire cable with plugs. The modules are powered via a two-wire mains supply cable (without earth connection) through the cable connector of the Pulse Transmitter/Pulse Divider. Use supply cable with an outer diameter of maximum 10 mm and ensure correct stripping of insulation as well as correct tightening of cable connection (see *paragraph 7.8.4*).

Max. permitted fuse: 6 A

230 VAC

This PCB module is galvanically separated from the mains supply and is suitable for direct 230 VAC mains installation. The module includes a double-chamber safety transformer, which fulfils double-isolation requirements when the cover is mounted on the Pulse Transmitter/Pulse Divider. Power consumption is less than 1 VA or 1 W.

National regulations for electric installations must be observed. The 230 VAC module can be connected/disconnected by the district heating station's personnel, whereas the fixed 230 VAC installation to the main electrical panel must be carried out by an authorized electrician.

Figure 24

24 VAC

This PCB module is galvanically separated from the 24 VAC mains supply and is both suitable for industrial installations with joint 24 VAC supply and individual installations, which are supplied by a separate 230/24 VAC safety transformer in the main electrical panel. The module includes a double-chamber safety transformer, which fulfils double-isolation requirements when the cover is mounted on the Pulse Transmitter/Pulse Divider. Power consumption is less than 1 VA or 1 W.

National regulations for electric installations must be observed. The 24 VAC module can be connected/disconnected by the district heating station's personnel, whereas the fixed 230/24 VAC installation in the main electrical panel must only be carried out by an authorized electrician.
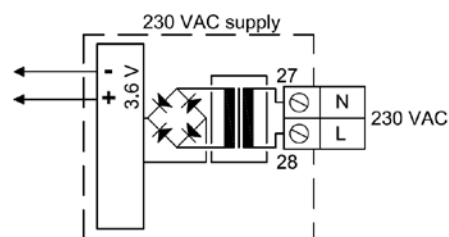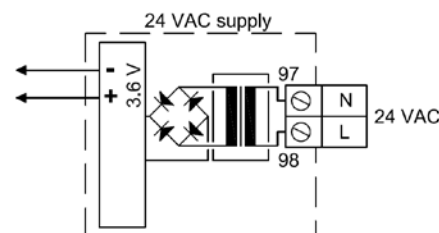

Figure 25

Note: This module cannot be supplied by 24 VDC (direct current).

230/24 VAC safety transformer

The 24 VAC module is specially suited for installation together with a 230/24 VAC safety transformer, e.g. type 66-99-403, which can be installed in the main electrical panel <u>before</u> the safety relay. When the transformer is used, the total power consumption of the meter incl. the 230/24 VAC transformer will not exceed 1.7 W.

Figure 26

7.8.3 Mains supply cable

Pulse Transmitter/Pulse Divider is available with mains supply cable H05 VV-F for either 24 V or 230 V (l=1.5 m):
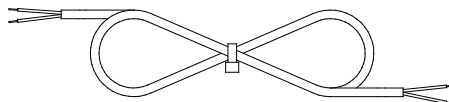

Figure 27. Mains cable (2 x 0.75 mm²), max. 6 A fuse.

"H05 VV-F" is the designation of a strong PVC mantle, which withstands max. 70 °C. Therefore, the mains cable must be installed with sufficient distance to hot pipes etc.

7.8.4 Cable connections

Cable dimension in connections for signal cable: 2…6 mm

Cable dimension in connections for mains supply cable: 4.5…10 mm

Tightening torque: Maximum 4 Nm (cable strain relief minimum 40 N according to EN 61558)

Please note: When supplied by battery the unused cable connection must be sealed off as shown in *Figure 29*, page 33.

7.8.5 Change of supply unit

The supply unit of Pulse Transmitter/Pulse Divider can be changed from mains supply to battery or visa versa as the needs of the supply company change. Thus, it can be an advantage to temporarily change mains supplied Pulse Transmitter/Pulse Divider to battery supplied, e.g. in case of buildings under construction where the mains supply can be unstable or periodically missing.

Please note that for Pulse Transmitter/Pulse Divider the supply type appears from the label. If the original supply type is changed, it will no longer be in accordance with the label.

7.9   Example of connecting ULTRAFLOW® and MULTICAL®
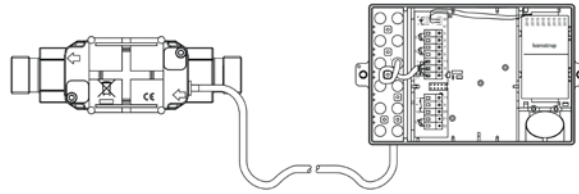
Figure 28. ULTRAFLOW® 54 connected to MULTICAL® 602.

See *paragraph 7.6* for electrical wiring.

7.10   Example of connecting Pulse Transmitter
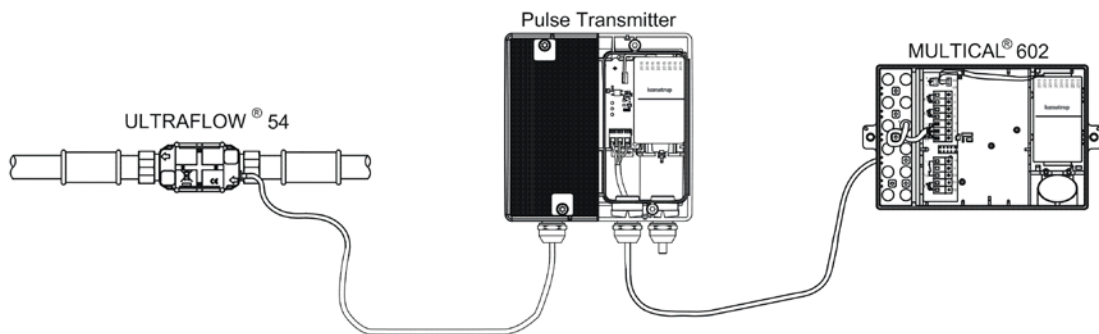
Figure 29. ULTRAFLOW® 54 connected to battery supplied Pulse Transmitter. MULTICAL® 602 connected to the Pulse Transmitter's output module (Y=3).

Please note: If battery supplied, the right cable connection of the Pulse Transmitter is plugged.
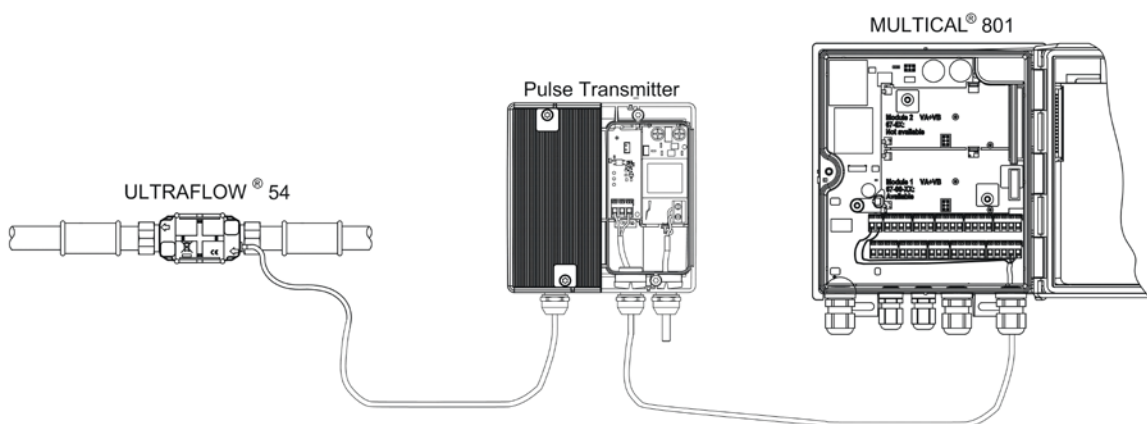
Figure 30. ULTRAFLOW® 54 connected to Pulse Transmitter with 230 VAC supply. MULTICAL® 801 is connected to the Pulse Transmitter's output module (Y=2).

See *paragraph 7.7* for electrical wiring.

7.11 Calculator with two flow sensors

MULTICAL® 602 and 801 can be used in various applications with two flow sensors, e.g. leak surveillance and open systems. When two ULTRAFLOW® are direct connected to one MULTICAL®, 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.
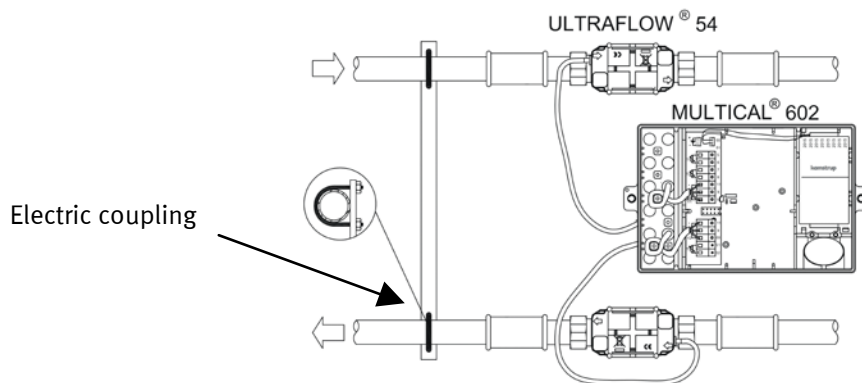
Figure 31. Forward and return pipes are closely electrically coupled.
No welded joints occur.

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®.
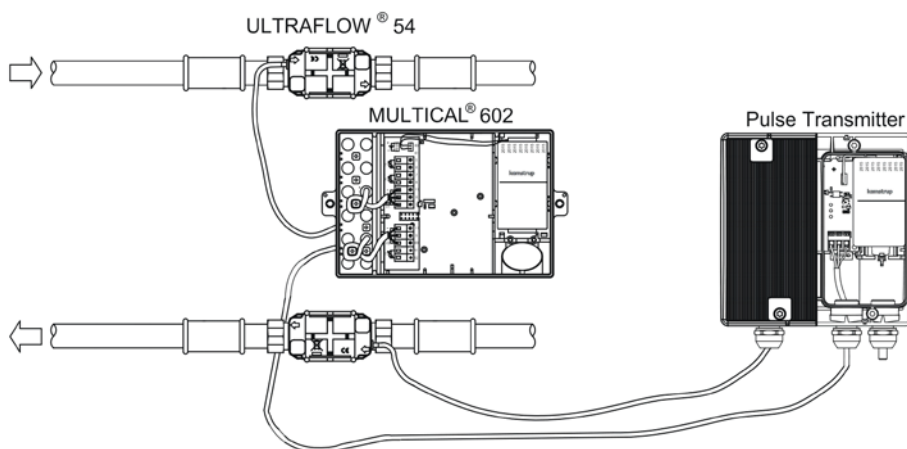
*Figure 32.*Forward and return pipes are not necessarily closely coupled.
Electric welding [*)] can occur.

[*)] 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 Kamstrup's factory guarantee.

7.12 Operational check

Carry out an operational check when the complete meter (flow sensor and calculator) has been installed and connected. Open thermoregulators and valves to establish water flow through the installation. Activate the top key of the calculator and check that the displayed values for temperatures and water flow are credible values.

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.

PHASE DIFFERENCE
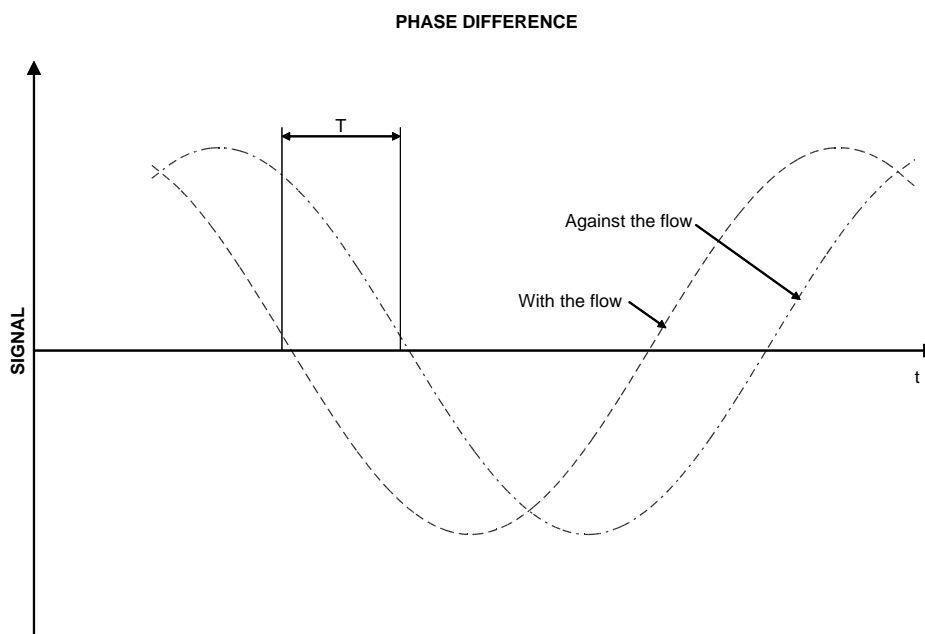
Figure 33

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:

$$\Delta T = L \times \frac{(C + F) - (C - F)}{(C - F) \times (C + F)} \quad \Rightarrow \quad \Delta T = L \times \frac{2F}{C^2 - F^2}$$

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

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

In order to minimize the influence from variations of the velocity of sound in water, the velocity is measured via a number of absolute time measurements between the two transducers. These measurements are subsequently, in the built-in ASIC, converted into the current velocity of sound which is used in connection with flow calculations.

8.4 Signal paths

Figure 34. 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.

Figure 35. 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 range 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 (*Figure 36*).

Flow frequency (q_p 1.5 m³/h)
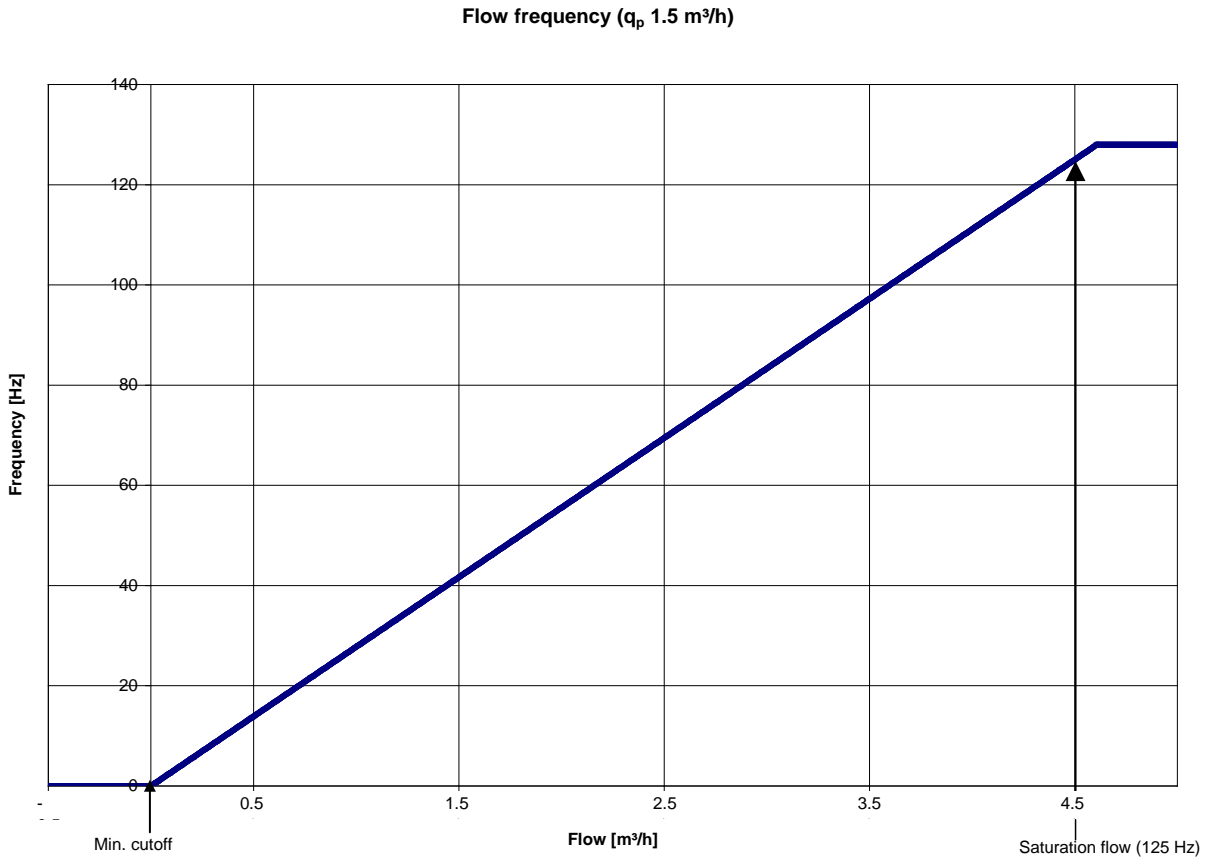
Figure 36. Flow frequency q_p 1.5 m³/h.

If the flow is lower than min. cut-off or negative (reverse flow), 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 19 overleaf shows the flow at max. pulse frequency 128 Hz for the various flow sizes and meter factors.

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

According to 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.

Please note, however, that high flow velocities may cause cavitation, especially at low static pressure. See *paragraph 8.7 Guidelines for dimensioning ULTRAFLOW®*.

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 20. Recommended minimum back pressure (pressure at the flow sensor outlet).

The purpose of recommended back pressure is to avoid measuring errors due to 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 20* 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 <u>after</u> a contraction than <u>before</u> 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: $P + \frac{1}{2}\rho v^2 = constant$.

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.
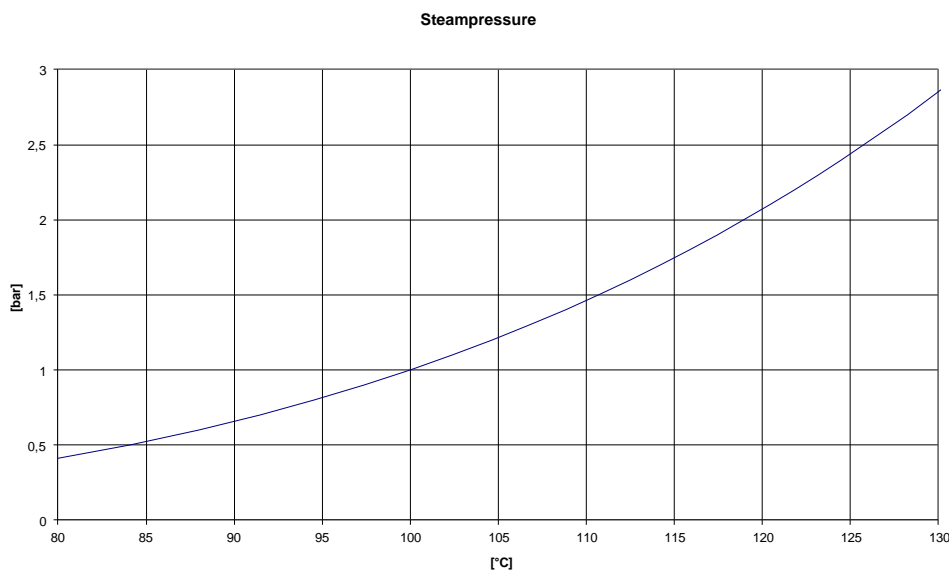
Figure 37. Steam pressure.

8.8   Pulse output of ULTRAFLOW®

ULTRAFLOW® 54 and 34

Type	Push-Pull
Output impedance	~10 kΩ
Pulse duration	2...5 ms
Pause	Depending on current pulse frequency
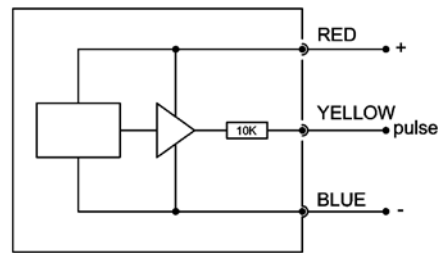
Figure 38. Block diagram for ULTRAFLOW®.

8.9   Pulse output of Pulse Transmitter and Pulse Divider

8.9.1   Galvanically separated output module (Y=2)

Pulse Transmitter/Pulse Divider is powered by the built-in supply module (Z=7 or 8).

Cable length to Pulse Transmitter/Pulse Divider depends on the calculator. When connected to MULTICAL® maximum cable length is 100 metres.

To calculator:

Type:	Open collector.
Connection:	Can be connected as two-wire or as three-wire via the built-in 56.2 kΩ pull-up.

Module Y=2	OC and OD	(OB) Kam
Max input voltage	6 V	30 V
Max input current	0,1 mA	12 mA
ON condition	U ≤ 0,3 V @ 0,1 mA	U_{CE} ≤ 2,5 V @ 12 mA
OFF condition	R ≥ 6 MΩ	R ≥ 6 MΩ

Table 21

Concerning meter factor and pulse duration, see *paragraph 4.6 Pulse Divider configuration CCC-DD-E-MMM.*

Figure 39. Block diagram for galvanically separated output module (Y=2).
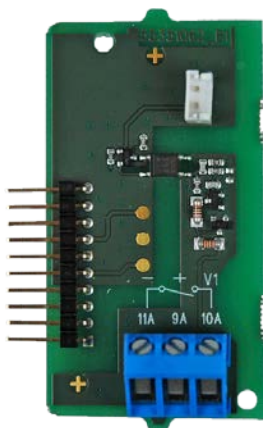
Figure 40. Galvanically separated output module (Y=2).

8.9.2   Galvanically separated output module (Y=3)

Pulse Transmitter/Pulse Divider is powered by the built-in supply module (Z=2, 7 or 8).

Cable length to Pulse Transmitter/Pulse Divider depends on the calculator. When connected to MULTICAL® maximum cable length is 25 metres.

To calculator:

Type:	Open collector.
Connection:	Can be connected as three-wire via the built-in 39.2 kΩ pull-up.

Module Y=3	OC and OD
Max input voltage	6 V
Max input current	0,1 mA
ON condition	U ≤ 0,3 V @ 0,1 mA
OFF condition	R ≥ 6 MΩ

Table 22

Concerning meter factor and pulse duration, see *paragraph 4.6 Pulse Divider configuration CCC-DD-E-MMM*.

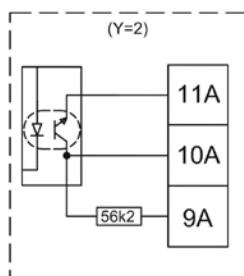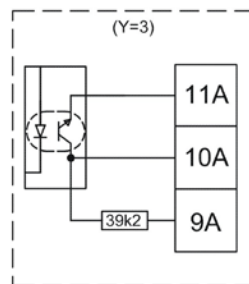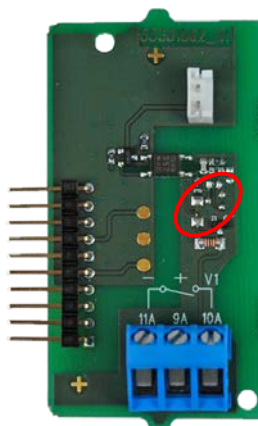*Figure 41. Block diagram for galvanically separated output module (Y=3).*

Figure 42. Galvanically separated output module (Y=3). Note the omitted components in the encircled area compared to output module (Y=2).

8.10 Pulse emission

Pulses are emitted at intervals of 1 second. 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 seconds in case of sudden hold.

8.11 Accuracy

ULTRAFLOW® 54 and 34 have been developed as a volume flow sensor for use with energy meters according to EN 1434. Permitted tolerances in EN 1434 for flow sensors with a dynamic range of 1:100 (q_i:q_p) are shown in *Figure 43*. The tolerances are defined for classes 2 and 3 with following formulas:

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

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

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, 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 for ULTRAFLOW® as a heat meter.

For ULTRAFLOW® as a cooling meter the water temperature must be 15 °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® will typically do better than half of the permitted tolerance according to EN 1434 class 2.

Flow sensor tolerances qi:qp 1:100 (qp 1.5 m³/h)
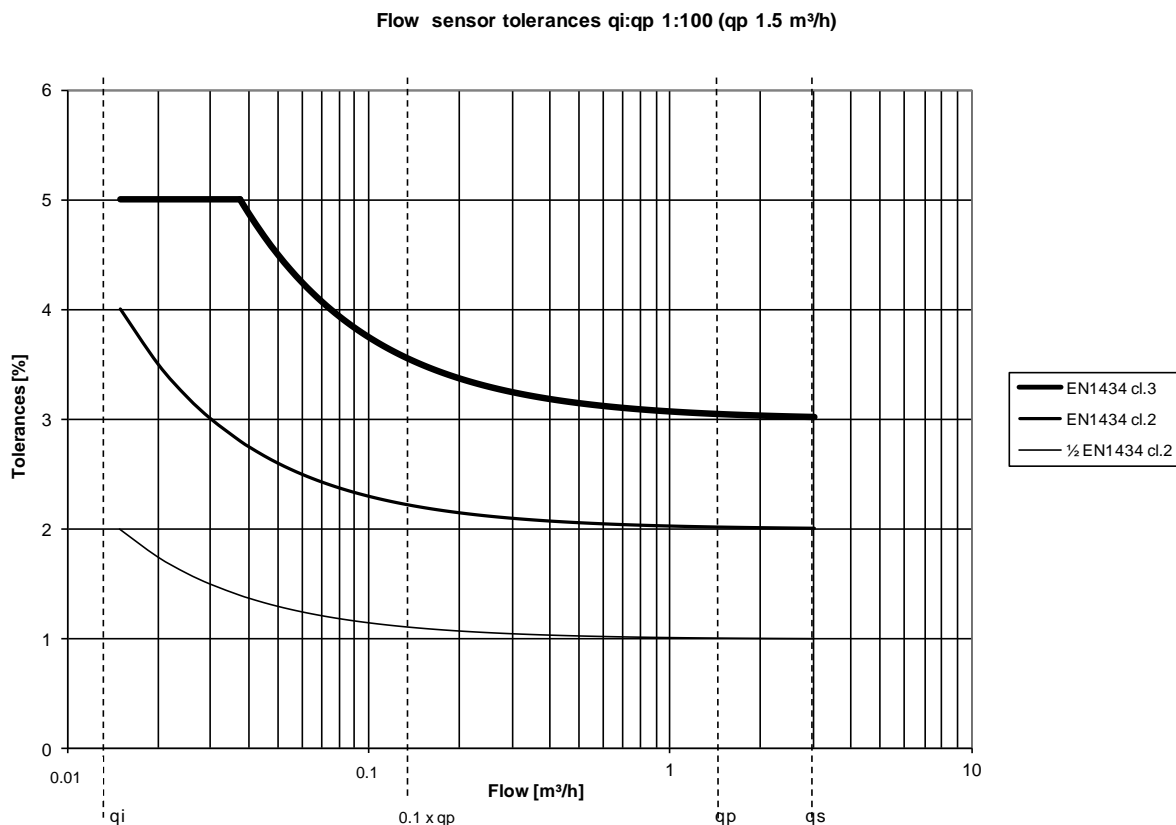
Figure 43. Flow sensor tolerances $q_i:q_p$ 1:100 for q_p 1.5 m³/h.

8.12 Power consumption

The current consumption of ULTRAFLOW® is as follows:

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

8.13 Interface connector/serial data

ULTRAFLOW® 54 and 34 is fitted with a four-pole connector under the cover. Thus, it is not possible to access this connector 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 connector is used for:

- Programming sensor, including adjusting the flow curves 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 connector is constructed as shown in *Figure 44*.

Meter interface

Pin 1 Vcc

Pin 2 Gnd

Pin 3 Pulse out

Pin 4 Access control
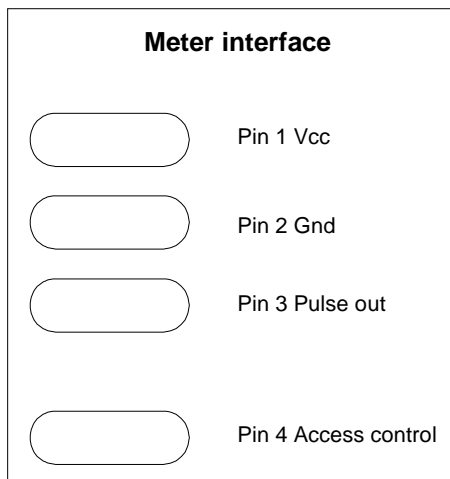
Figure 44. Interface connector.
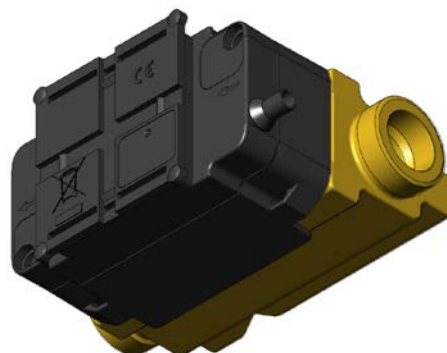
Figure 45. Drilling marking on ULTRAFLOW® 34 cover.

The electronics are encapsulated in ULTRAFLOW® 34, and, thus, the four-pole connector is not directly available. In order to gain access to pin 4 an adapter with four-pole connector is used (see *Figure 61, page 61*). Before clicking the adapter onto the electronics housing, a hole is drilled in the cover of the electronics housing at the marking (ø2 mm, max. drilling depth 10 mm). (See *Figure 45*.) Subsequently the signal cable is connected to the terminals of the adapter. (See *paragraph 7.6*.)

8.14 Test mode

To minimize the time spent on calibration, ULTRAFLOW® 54 and 34 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® is put into test mode by connecting pin 4 of the internal connector to ground (*Figure 44*) and subsequently connect the supply. After approx. 1 second the sensor goes into test mode and the connection between pin 4 and ground is disconnected.

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

Note: An ULTRAFLOW® 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 and 34 can be monitored by an external signal when it is in test mode (see *paragraph 8.14 Test mode*). 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 46* below.
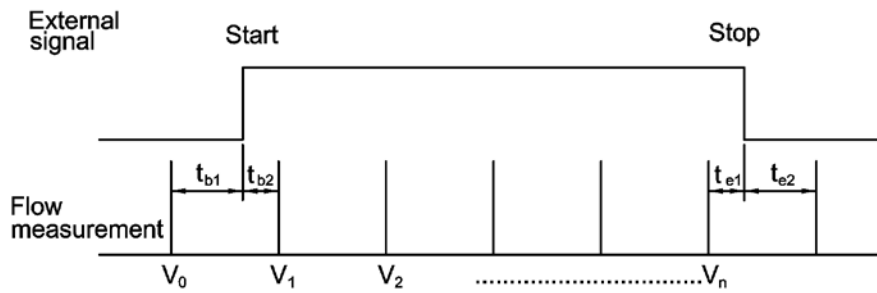
Figure 46

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 lacking quantity in connection with stop is the water volume passing through the sensor during the time t_{e1} from the last accumulation V_n until stop

The volume accumulated during the test can be stated as:

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

8.16 Calibration using serial data and externally controlled start/stop

The routine for calibrating ULTRAFLOW® using serial data is outlined below.
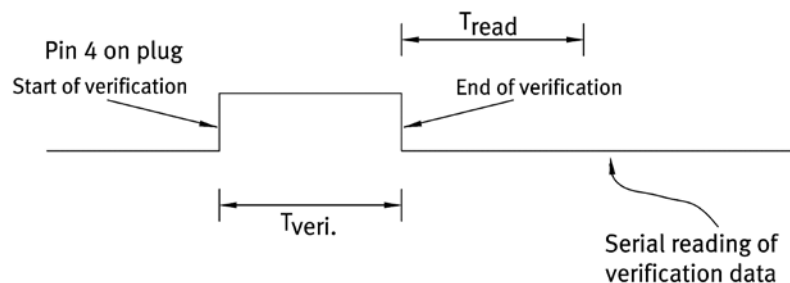
Figure 47

The sensor must be in test mode (see *paragraph 8.14 Test mode*).

Calibration is started by connecting the 4th pin of the internal plug (see *Figure 47*), 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, minimum 2 seconds 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 second.

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®. See the restrictions in *paragraph 7 Installation*. Also see *paragraph 9.9 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 23. Output signal.

Output ULTRAFLOW®

Type	Push-Pull
Output impedance	~10 kΩ
Pulse duration	2...5 ms
Pause	Depending on current pulse frequency
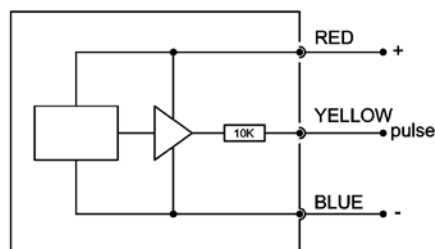
Figure 48. Block diagram for ULTRAFLOW®.

9.3   Connection

Connection via three-wire cable from ULTRALFOW®

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

Output when using Pulse Transmitter/Pulse Divider with galvanically separated output module (Y=2)

Type   Open collector. Can be connected as two-wire or three-wire via the built-in pull-up resistance of 56.2 kΩ.

Module Y=2	OC and OD	(OB) Kam
Max input voltage	6 V	30 V
Max input current	0,1 mA	12 mA
ON condition	U ≤ 0,3 V @ 0,1 mA	U_{CE} ≤ 2,5 V @ 12 mA
OFF condition	R ≥ 6 MΩ	R ≥ 6 MΩ

Table 24
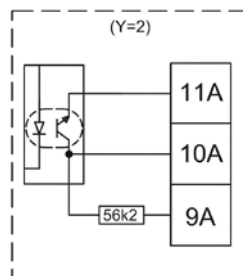
Figure 49. Block diagram for galvanically separated output module (Y=2).

Output when using Pulse Transmitter/Pulse Divider with galvanically separated output module (Y=3)

Type   Open collector. Can be connected as three-wire via the built-in pull-up resistance of 39.2 kΩ.

Module Y=3	OC and OD
Max input voltage	6 V
Max input current	0,1 mA
ON condition	U ≤ 0,3 V @ 0,1 mA
OFF condition	R ≥ 6 MΩ

Table 25
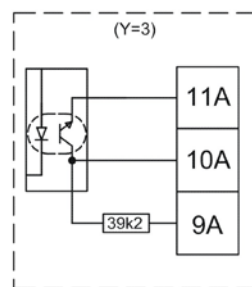
Figure 50. Block diagram for galvanically separated output module (Y=3).

9.4   Start-up

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

9.5   Measuring flow

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

9.6   Evacuation

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

9.7 Suggested test points

Nom. flow	Meter factor	Test point			Test duration			Test quantities		
q_p [m³/h]	[imp/l]	q_p [m³/h]	q_i [m³/h]	$0.1xq_p$ [m³/h]	q_p [min]	q_i [min]	$0.1xq_p$ [min]	q_p [kg]	q_i [kg]	$0.1xq_p$ [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 26. Table for 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:

Minimum test duration of 3 minutes

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

Water volume of $0.1xq_p$ corresponding to minimum 1000 pulses

Water volume of q_i corresponding to minimum 500 pulses

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

9.8   Sealing

ULTRAFLOW® is sealed from the factory. Verified sensor will be supplied with laboratory marks and a year mark as shown in *Figure 51*.

If the seal of a verified sensor is broken, the sensor must be verified before being installed in a location demanding verification.
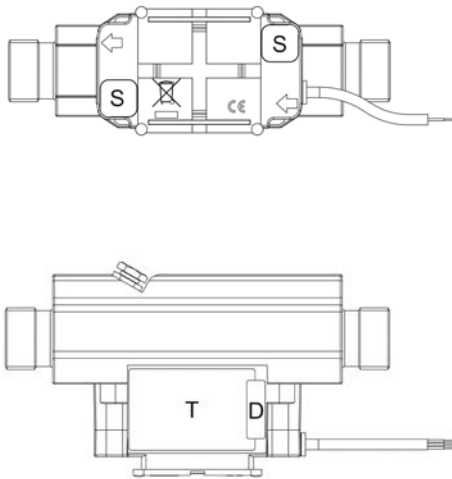
Figure 51. MID sealing of ULTRAFLOW®.
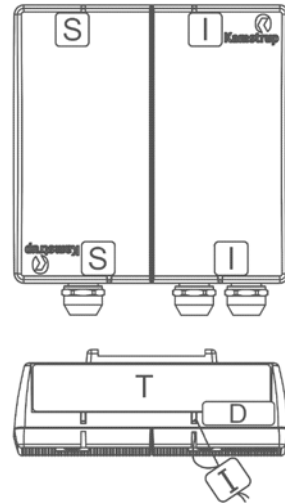
Figure 52. MID sealing of Pulse Divider.

On the drawings the sealing is divided into following groups:

        D   Module D/F label or security seal (depending on type label).

        S   Security seal. Covering screws.

        T   Type label (as void label or with security seal D).

        I   Installation seal (wire and seal or sealing label).

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

9.9   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 EN 1434-5 is 50 °C ± 5 °C for heat meters and 15 °C ± 5 °C for cooling meters.

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 27*). There should be minimum 5 x DN between the sensors. With bends etc. there should be a minimum 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 27. 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. See *paragraph 9.10*.

9.10 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 in a MULTICAL® base unit

9.10.1 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 ms
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
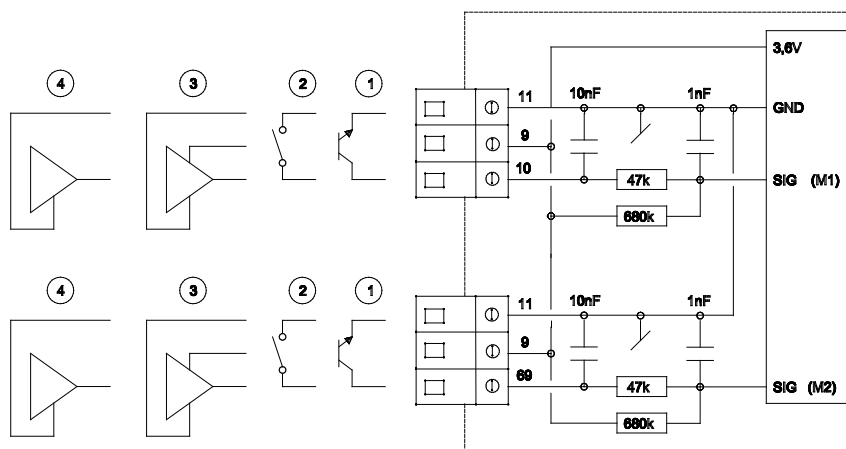
Figure 53

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-switch output**

The transmitter is a reed-switch, 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, powered by 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 28

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

Flow sensors with active signal output must be connected as shown in *Figure 54*. 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   > 1.5 kΩ

Three-wire connection

Voltage   5...30 V

Load   > 5 kΩ
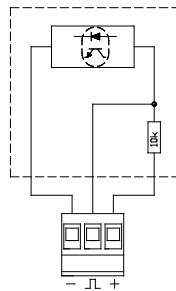
Figure 54

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

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

9.10.2 Hold function

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

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

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

Hold input	Galvanically isolated
Input protection	Against reversed polarity
"Open input"	Count (see *Figure 55*)
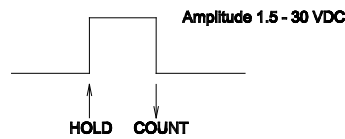
Figure 55

9.10.3 Push-button functions
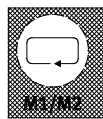
Figure 56. The left push button shifts between readings/counts of the two flow sensor inputs. In the display M1 and M2 respectively indicate the currently displayed flow sensor inputs/counters.

Figure 57. The right push-button resets both counters (M1 and M2).

9.10.4 Using the PULSE TESTER

The PULSE TESTER can be used as follows:

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).

9.10.5 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 29. Spare parts for PULSE TESTER.

9.10.6 Changing the battery

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

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

Current consumption:

    Curent consumption with no sensors connected   400 µA
    Max. current 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).

10 METERTOOL

10.1 Introduction

METERTOOL is a collection of programs used 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 for ULTRAFLOW® X4" has been developed to provide laboratories a simple and efficient access to programming/adjusting ULTRAFLOW® X4. Furthermore, It is used for programming the Pulse Divider.

10.2 System requirements for PC

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

Minimum requirements:

> Pentium 4 or equivalent (Atom processor/netbooks/mini PCs 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 programs.
The programs must be installed under the login to be subsequently used for the programs.

10.2.1 Interface

The following interfaces can be used:

Interface for	Type No.	Description
ULTRAFLOW® 54	66-99-141	Cable with USB connection to PC and 4-pole plug for ULTRAFLOW® 54 and Pulse Divider 66-99-907.
ULTRAFLOW® 54	66-99-024	Cable with USB connector for PC and 4-pole plug for ULTRAFLOW® 54 (H).
ULTRAFLOW® 14/24	66-99-002	Adapter for connecting ULTRAFLOW® 14/24. Plugged onto 66-99-141.
ULTRAFLOW® 34	66-99-006	Adapter for connecting ULTRAFLOW® 34. Plugged onto 66-99-141.
Pulse Divider	66-99-140	Cable with serial plug for PC and 8-pole plug for Pulse Divider 66-99-607.

Table 30. Communication interfaces.

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

The USB Interface (66-99-141 and 66-99-024) 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 reverify and reseal the sensor before it is remounted. The positions of laboratory labels and year marks appear from *Figure 51* and *Figure 52*.

Figure 58. Location of the four-pole connector in ULTRAFLOW® 54.

Figure 59. Location of the four-pole connector in ULTRAFLOW® 54 (H).

Figure 60. Location of the four-pole connector incl. ULTRAFLOW® 14 adapter in ULTRAFLOW® 14/24 (MULTICAL® 61/62).
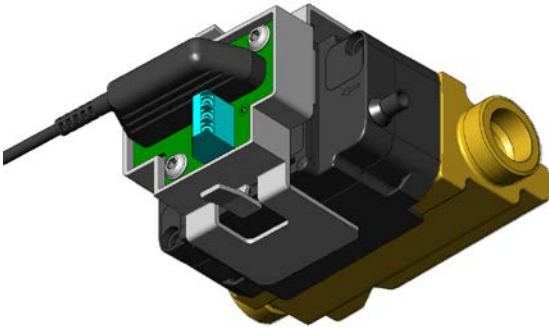
Figure 61. Location of the four-pole connector including ULTRAFLOW® 34 adapter on ULTRAFLOW® 34.

Figure 62. Location of the four-pole connector in ULTRAFLOW® 54 DN150...250.
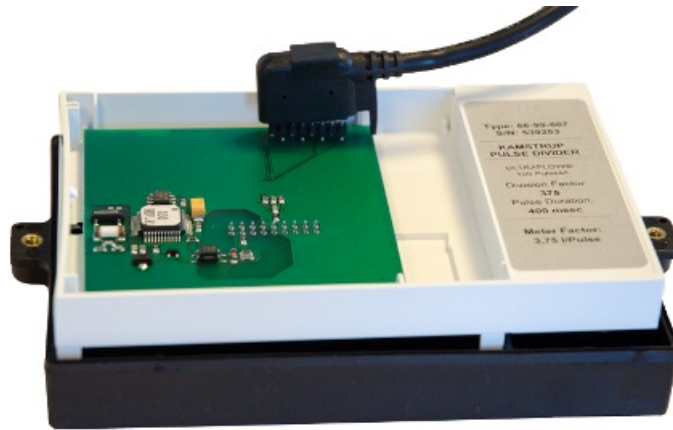
Figure 63. Location of the eight-pole connector in Pulse Divider 66-99-607.

Figure 64. Location of the four-pole connector in Pulse Divider 66-99-907.

10.2.2 Installation

Check that system requirements are fulfilled.

Close other open programs before starting the installation.

Insert the CD into the drive and follow the program's instructions 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.

10.3 METERTOOL for ULTRAFLOW® X4

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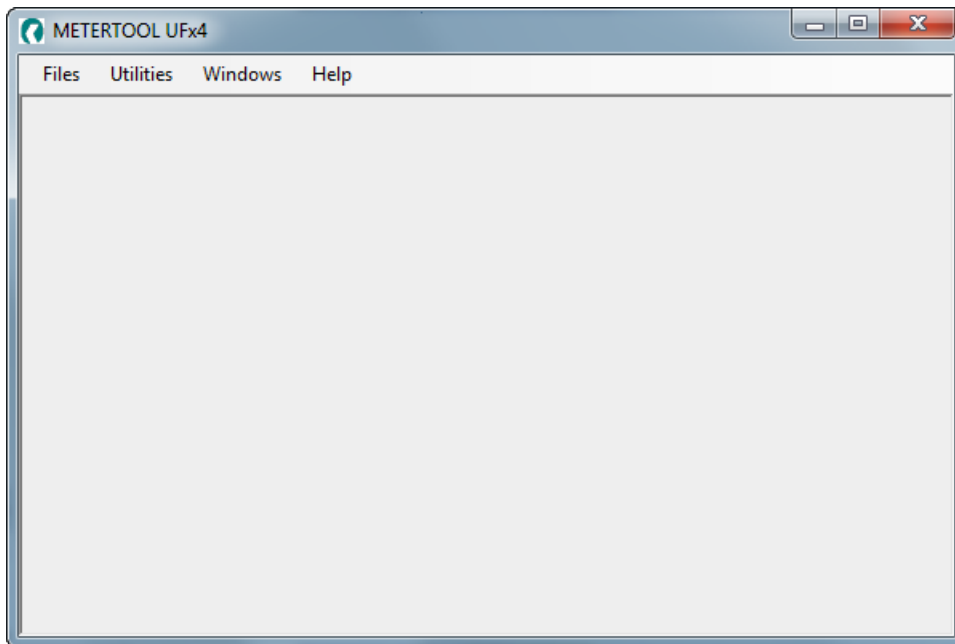
10.3.1 Files

The menu "Files" includes:

Setup:	Update of program and database (internet connection required) and setup of COM-port for interface for flow sensor and Pulse Divider.
Exit:	Terminates METERTOOL.
Force Database Update:	Forced online-update of flow sensor database.
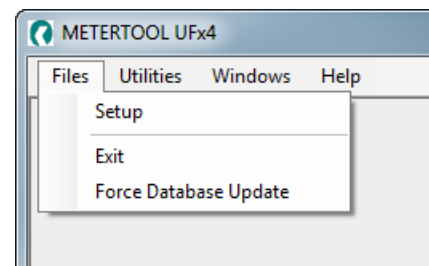
10.3.2 Utilities

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 of Pulse Divider 66-99-607.
Pulse Configuration DN150-DN250:	Programming of meter factor and pulse duration for ULTRAFLOW® 54 DN150...250.
Meter Type:	Information on flow sensor and equipment.
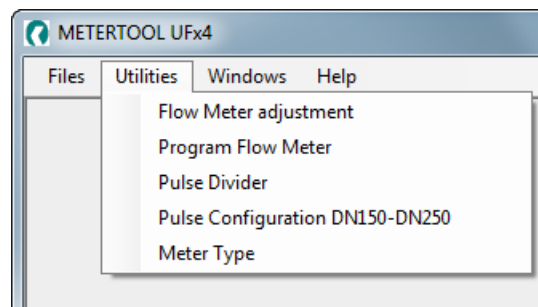
10.3.3 Windows

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

10.3.4 Help

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

User manual: Opens web browser to Kamstrup's website with technical descriptions for heat and cooling meters, water meters and flow sensors.

(Internet connection required)
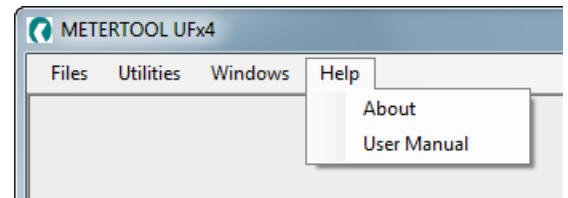
10.4 Application

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 per cent, the sensor is probably defective, or has a different error, and should not be adjusted.

10.4.1 COM-port selection

Open "Setup"

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 "Save" in order to save the selected ports.
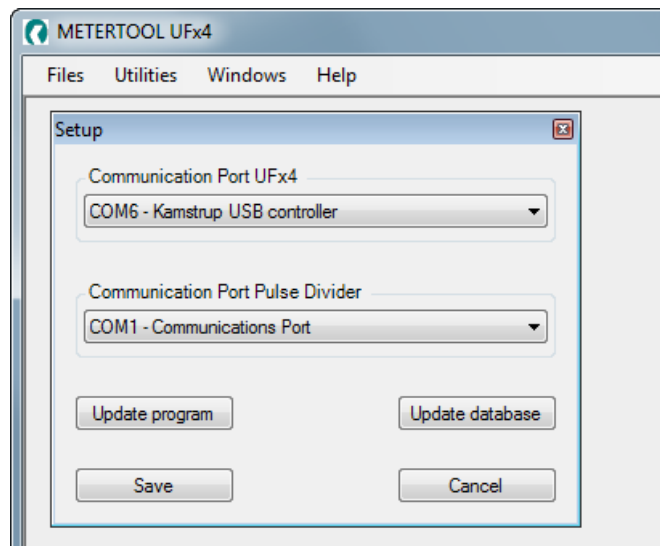
10.4.2 Flow meter adjustment

Open "Flow Meter Adjustment"
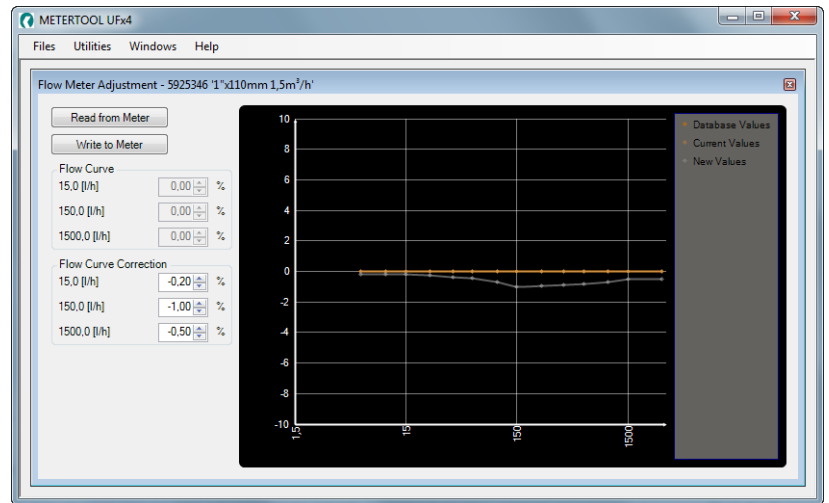
"Read from Meter":   Reads data from the connected flow sensor.

Flow curve number - e.g. 5925346 - 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.

"Write to Meter":   Writes the correction to the connected flow sensor. The required correction of q_i, $0.1xq_p$ and q_p can be entered into the field "Flow Curve Correction".

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

10.4.3 Programming of standard flow curve

Open "Program Flow Meter"

The 59xxxxx number appears from the sensor's type label.

"Write to Meter":   Programs the flow sensor with the selected standard flow curve. *)
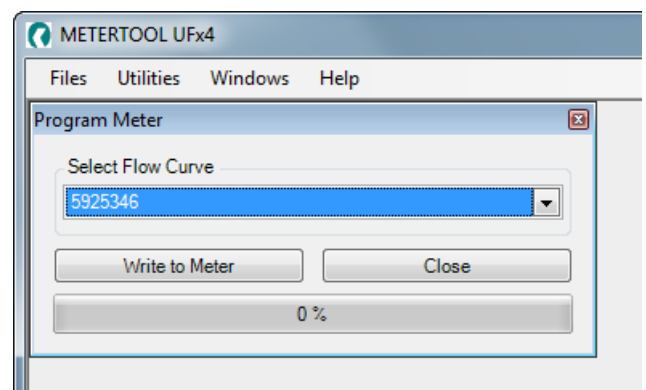
The flow sensor is now ready for test.

*) METERTOOL automatically configures ULTRAFLOW® 54 DN150…250 to Kamstrup default meter factor (*Table 33*, page 71). If an alternative meter factor is required, please refer to *paragraph 10.4.6 Pulse Configuration DN150-DN250*.

10.4.4 Pulse Divider type No. 66-99-607

Setup and programming of Pulse Divider type No. 66-99-607. A Pulse Divider is used for adapting flow signals to calculators, e.g. if a "foreign" calculator is connected to Kamstrup ULTRAFLOW® and the coding (number of pulses CCC or pulse duration) does not correspond.

Open "Pulse Divider"
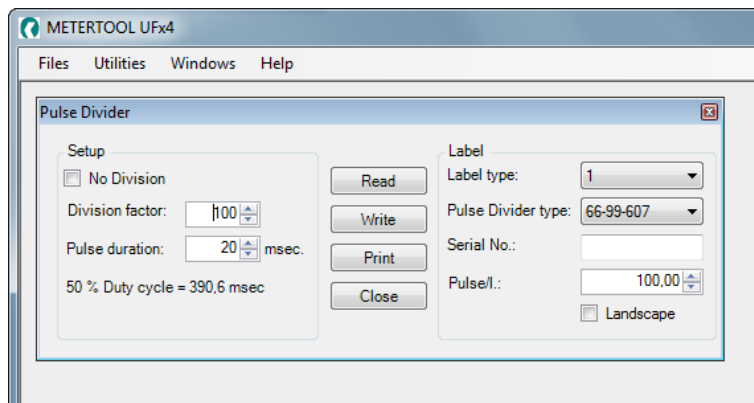
"Read":   Reads the current coding of the Pulse Divider.

"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]	Meter factor [imp/l]	Meter factor [l/imp]	Divider	Meter factor [l/imp]	Divider	Meter factor [l/imp]	Divider	Meter factor [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 31. 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]	Meter factor [imp/l]	Meter factor [l/imp]	Divider	Meter factor [l/imp]	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 32. Pulse division table for use together with Kamstrup EVL.

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

10.4.5 Pulse Divider type No. 66-99-907

Readout and programming of Pulse Divider type No. 66-99-907 is not supported by the existing version of METERTOOL UFx4 (rev. M1).

Instead we refer to a new version of METERTOOL, "METERTOOL HCW". See *paragraph 11*.

10.4.6 Pulse Configuration DN150-DN250

Programming of meter factor and pulse duration for ULTRAFLOW® 54 DN150...250. ”Pulse Configuration DN150-DN250” is used to change meter factor and pulse duration to match calculator and other equipment. E.g. if ULTRAFLOW® is connected to a calculator which does not support Kamstrup's fast pulses. See *Table 33* for valid programming options.

Open ”Pulse Configuration DN150-DN250”

”qp”:	Based on the programmed standard flow curve.
”Meter factor”:	Only the valid meter factors are available.
”Pulse duration”:	Only the valid pulse durations are available.
”Write”:	Programs ULTRAFLOW® 54 DN150...250 according to the selected values.
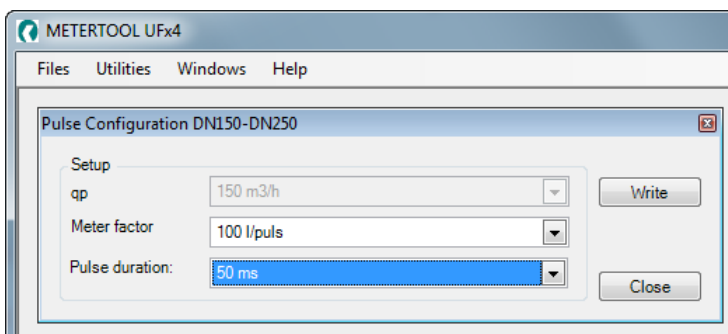
q_p [m³/h]	Meter factor [imp/l]	Meter factor [l/pulse]	CC	Pulse duration [ms] (E=1)	[ms] (E=4)	[ms] (E=5)	[ms] (E=6)	
150	**1**		**33**	**3.9**	-	-	-	**Default**
150		10	34	-	20	-	-	
150		25	64	-	20	-	-	
150		100	35	-	20	50	100	
150		250	65	-	20	50	100	
150		1000	36	-	20	50	100	
150		2500	66	-	20	50	100	
250	**0.6**		**43**	**3.9**	-	-	-	**Default**
250		10	34	-	20	-	-	
250		25	64	-	20	-	-	
250		100	35	-	20	50	100	
250		250	65	-	20	50	100	
250		1000	36	-	20	50	100	
250		2500	66	-	20	50	100	
400	**0.4**		**63**	**3.9**	-	-	-	**Default**
400		100	35	-	20	50	-	
400		250	65	-	20	50	100	
400		1000	36	-	20	50	100	
400		2500	66	-	20	50	100	
600	**0.25**		**14**	**3.9**	-	-	-	**Default**
600		100	35	-	20	50	-	
600		250	65	-	20	50	-	
600		1000	36	-	20	50	100	
600		2500	66	-	20	50	100	
1000	**0.15**		**24**	**3.9**	-	-	-	**Default**
1000	(0.25)	4	14	3.9	-	-	-	*)
1000		100	35	-	20	50	-	
1000		250	65	-	20	50	-	
1000		1000	36	-	20	50	100	
1000		2500	66	-	20	50	100	

*) Spare part for ULTRAFLOW® type 65-S/R/T. Configured 65-5-FGCR. No flow info.

Table 33. Programming options as to meter factor (CC) and pulse duration (E) for ULTRAFLOW® 54 DN150...250.

Based on a q_p value a meter factor in *Table 33* is chosen. The valid pulse durations are listed in the same line as the chosen meter factor.

Example: For ULTRAFLOW® 54 with q_p of 400 m³/h a meter factor of 100 l/pulse (CC=35) is required. Based on this meter factor one of the pulse durations, 20 milliseconds (E4) or 50 milliseconds (E5) is selected.

Default values in *Table 33* are programming values for ULTRAFLOW® 54 DN150...250 when connected to a Kamstrup MULTICAL® calculator.

10.4.7 Meter type

Open ”Meter type”

Reads out flow sensor information.

Internal No.	4294967295
qp	150 [m³/h]
Dynamic range	1:100
Meter Type Id	5925450 DN150x500mm 150m³/h
Revision	41
Status	0
Program CRC	0x15F1
Program Counter	1
Meter programmed by User ID	1420
METERTOOL User ID	1420
Meter factor	1 [Pulse per litre]
Pulse duration	3,9 [ms]
Pulse multiplier	1
Pulse divider	1
Flow info enabled	True
Pulse config enabled	False

10.5 Update

The program includes a database comprising data of the variants released at the time the program was produced. Both program and database are updated regularly.

Open "Setup"

Select "Update program"

"Update":   If a new version of METETOOL is available on Kamstrup's server it is possible to update the program online.

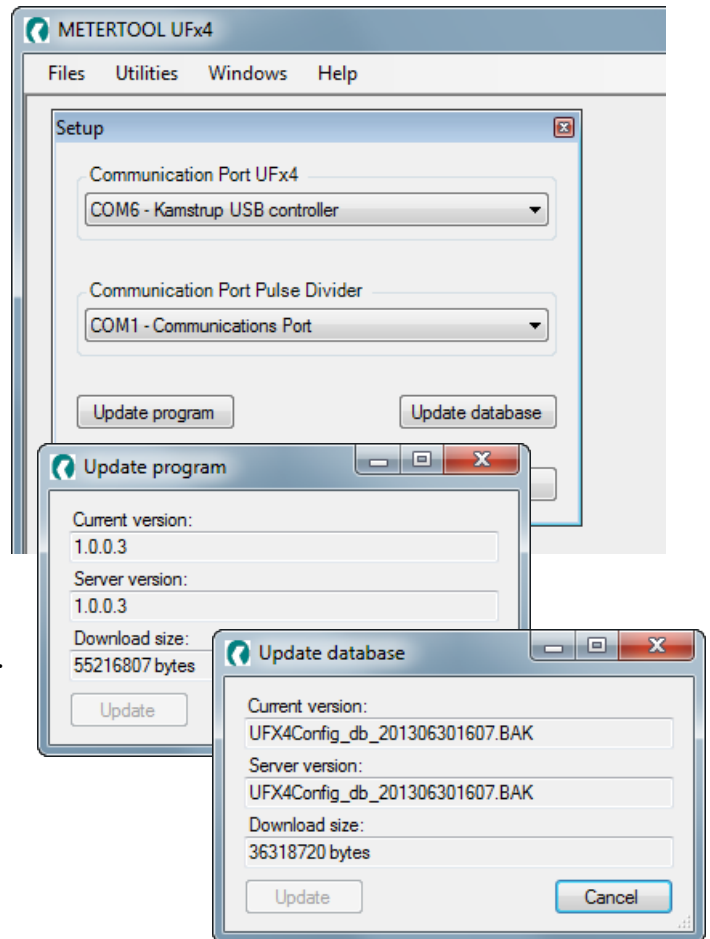(Internet connection required)

Choose "Update database"

"Update":   The database at Kamstrup is updated daily. If a newer version is available, the database can be updated online from Kamstrup's server.
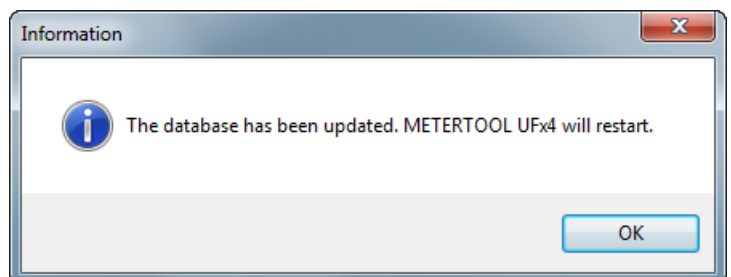
(Internet connection required)

When update is completed METERTOOL will restart.

Open "Force Database Update"

Forced update of the database. When update is completed METERTOOL will restart.

11 METERTOOL HCW

11.1 Introduction

Kamstrup's software product "METERTOOL HCW" (66-99-724) is used for configuration of Kamstrup heat, cooling and water meters.

The following instructions are based on version 1.0.3.0

11.1.1 System requirements

METERTOOL requires minimum Windows XP SP3, Windows 7, Home Premium SP1 or newer as well as Windows Internet Explorer 5.01 or newer.

Minimum:	1 GB RAM	**Recommended:**	4 GB RAM
	10 GB HD		20 GB HD
	Display resolution 1366 x 768		1920 x 1080
	USB		
	Printer installed		

Administrator rights to the PC are required in order to install and use the programs. The programs must be installed under the log-on of the person who is to use the programs.

11.1.2 Interface

See *paragraph 10.2.1*

11.1.3 Installation

Check that system requirements are fulfilled.

Close other open programs before starting the installation.

Download the METERTOOL-software from Kamstrup's FTP-server and follow the program's directions.

During the installation of the METERTOOL program the USB-driver is automatically installed if it has not been installed already.

When the installation has been completed, the icon "METERTOOL HCW" will appear in the menu "All Programs" under 'KAMSTRUP METERTOOL' (or from the menu "Start" for Windows XP) and as a link on the desktop. Double-click on link or icon in order to start the program.

11.2 How to use METERTOOL HCW for Pulse Divider 66-99-907

11.2.1 General information

It is important to be familiar with the Pulse Divider's functions before starting programming.

Kamstrup's software product "METERTOOL HCW" (6699-724) is used for Pulse Divider 6699-907. For Pulse Divider 6699-607 see *paragraph*.

Before running the program, the interface cable with USB and 4-pole connector must be connected to a USB-port in the PC and the 4-pole connector in the Pulse Divider.

Note: The supply to the Pulse Divider must be disconnected during programming. The Pulse Divider is powered through the connected interface cable.

Start METERTOOL HCW and click on „Connect" in METERTOOL HCW. It is not important whether the program is in basic or advanced mode.
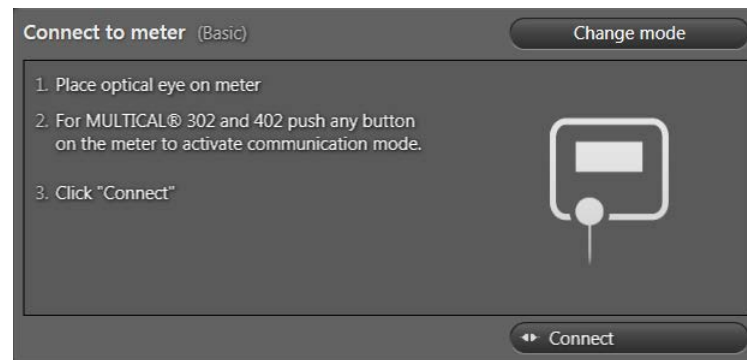
Figure 65. Connect to meter.

11.2.2 Meter details

Having clicked on **"Connect"**, METERTOOL HCW opens a new window showing a picture of the Pulse Divider with information on S/W revision.
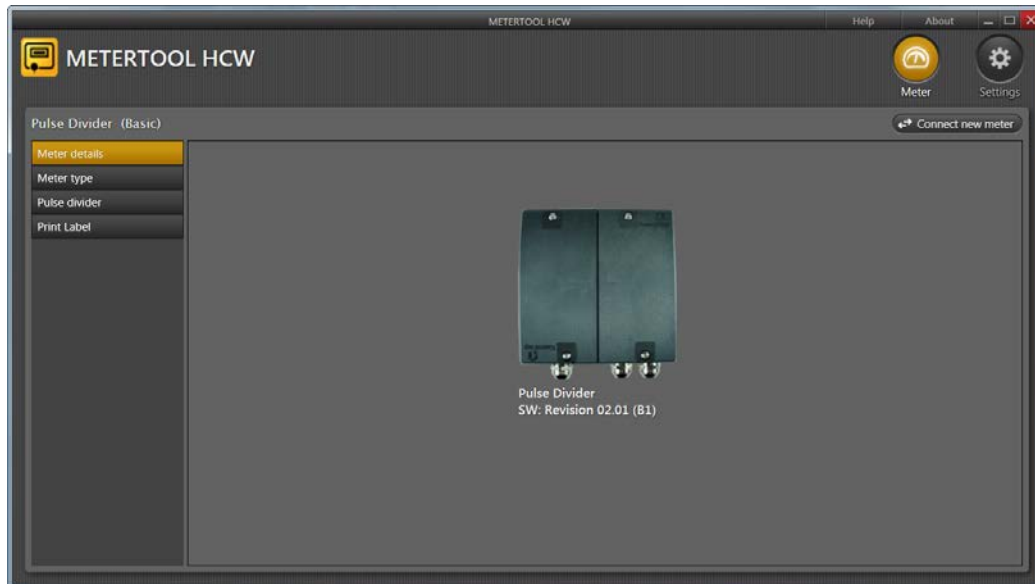
Figure 66. Meter details.

The menu in the left side of the screen includes a number of different options, which are described in detail below.

11.2.3 Meter type

"Read":   Reads out information from the Pulse Divider.
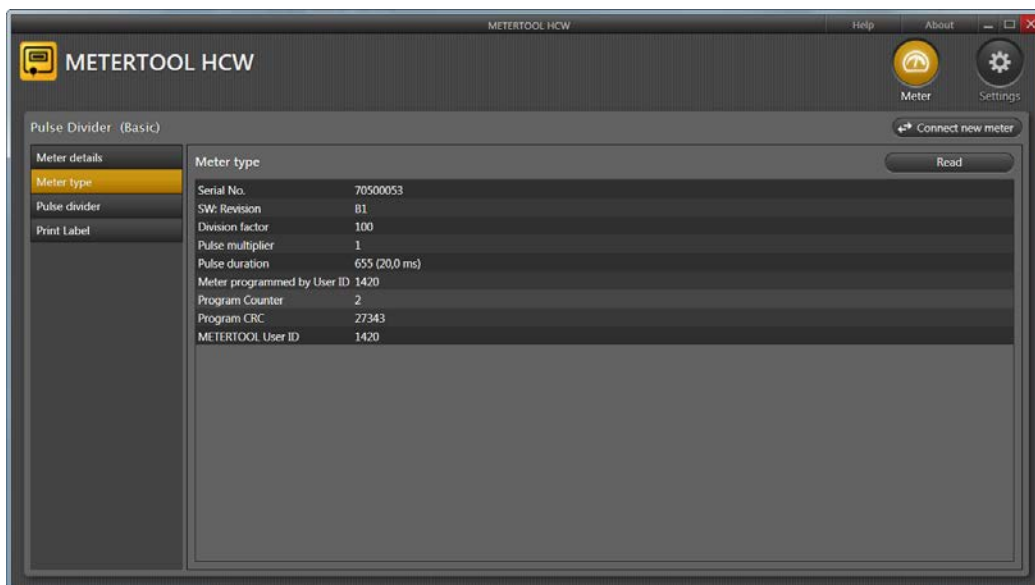
Figure 67. Meter type.

11.2.4 Pulse Divider

Configuration of Pulse Divider is used for adapting flow signals to calculators, e.g. if ULTRAFLOW® is connected to a "foreign" calculator, which does not support Kamstrup's quick pulses.

"ULTRAFLOW® pulse factor (CCC)":   Based on ULTRAFLOW® pulse factor. Appears from ULTRAFLOW® type label.

"Pulse Divider pulse factor (DD)":   Only valid pulse factors can be selected.

"Pulse duration (E)":   Pulse Divider pulse duration. Only valid pulse durations can be selected.

"Write":   Programs the Pulse Divider with the selected data.

Figure 68. Pulse Divider.

See *Table 34* and *Table 35* for valid configuration variants.

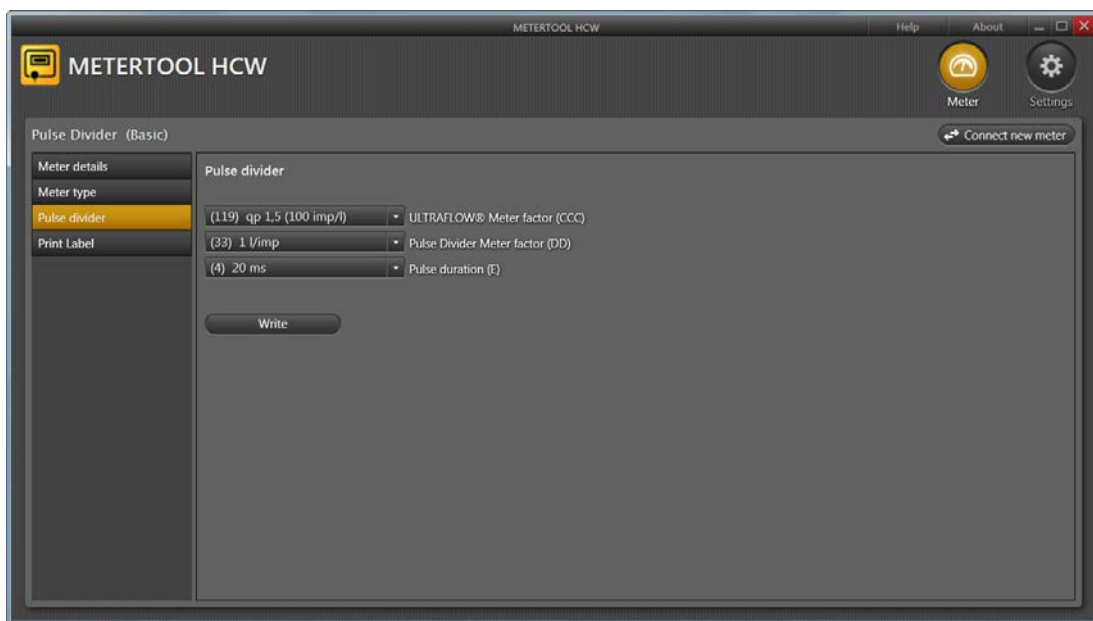| q_p	CCC	Meter factor				Pulse duration				
[m³/h]		[imp/l]	[l/imp]	Divider	DD	[ms]	[ms] (E=4)	[ms] (E=5)	[ms] (E=6)	
0.6	**116**	**300**				**3.9**	-	-	-	**Default**
0.6			1	300	33	-	20	50	100	
0.6			2.5	750	63	-	-	-	100	
1.5	**119**	**100**				**3.9**	-	-	-	**Default**
1.5			1	100	33	-	20	50	100	
1.5			2.5	250	63	-	-	-	100	
1.5			10	1000	34	-	-	-	100	
2.5	**198**	**60**				**3.9**	-	-	-	**Default**
2.5			1	60	33	-	20	50	100	
2.5			2.5	150	63	-	-	-	100	
2.5			10	600	34	-	-	-	100	
3.5	**151**	**50**				**3.9**	-	-	-	**Default**
3.5			1	50	33	-	20	50	-	
3.5			2.5	125	63	-	-	-	100	
3.5			10	500	34	-	-	-	100	
3.5			25	1250	64	-	-	-	100	
6	**137**	**25**				**3.9**	-	-	-	**Default**
6			1	25	33	-	20	50	-	
6			2.5	62.5	63	-	-	-	100	
6			10	250	34	-	-	-	100	
6			25	625	64	-	-	-	100	
10	**178**	**15**				**3.9**	-	-	-	**Default**
10			1	15	33	-	20	50	-	
10			10	150	34	-	-	-	100	
10			25	375	64	-	-	-	100	
15	**120**	**10**				**3.9**	-	-	-	**Default**
15			1	10	33	-	20	-	-	
15			10	100	34	-	-	50	100	
15			25	250	64	-	-	-	100	
15			100	1000	35	-	-	-	100	
25	**179**	**6**				**3.9**	-	-	-	**Default**
25			1	6	33	-	20	-	-	
25			10	60	34	-	-	50	100	
25			25	150	64	-	-	-	100	
25			100	600	35	-	-	-	100	

Table 34. Configuration variants of meter factor (DD) and pulse duration (E)
for Pulse Divider for ULTRAFLOW® 54 and 34, qp 0.6…25.

q_p	CCC	Meter factor				Pulse duration				
[m³/h]		[imp/l]	[l/imp]	Divider	DD	[ms]	[ms] (E=4)	[ms] (E=5)	[ms] (E=6)	
40	**158**	**5**				**3.9**	-	-	-	**Default**
40			10	50	34	-	20	50	-	
40			25	125	64	-	-	-	100	
40			100	500	35	-	-	-	100	
40			250	1250	65	-	-	-	100	
60	**170**	**2,5**				**3.9**	-	-	-	**Default**
60			10	25	34	-	20	50	-	
60			25	62.5	64	-	-	-	100	
60			100	250	35	-	-	-	100	
60			250	625	65	-	-	-	100	
100	**180**	**1,5**				**3.9**	-	-	-	**Default**
100			10	15	34	-	20	50	-	
100			100	150	35	-	-	-	100	
100			250	375	65	-	-	-	100	

*Table 35. Configuration variants of meter factor (DD) and pulse duration (E)
for Pulse Divider for ULTRAFLOW® 54 and 34, qp 40…100.*

Based on a q_p-value one of the meter factor options for the Pulse Divider is selected from *Table 34* or *Table 35*. The pulse duration options appear from the same line as the selected meter factor.

Example: For ULTRAFLOW® 54 with q_p 40 m³/h (5 imp/l, CCC=158) a meter factor of 10 l/pulse (DD=34) for the Pulse Divider is required. Based on this meter factor the options of pulse duration 20 (E=4) or 50 (E=5) milliseconds are available.

For older types of ULTRAFLOW® (e.g. ULTRAFLOW® type 65) which do not have the same direct and unique connection between q_p and meter factor (CCC), correct configuration can be ensured by starting from the meter factor of the flow sensor [imp/l].

Default values in *Table 34* or *Table 35* indicate meter factors and pulse durations of ULTRAFLOW® 54 and 34.

11.2.5 Print out labels

This menu point enables you to print new type labels for Pulse Divider.

|	
”Country code”:	Select country code for Pulse Divider. Appears from Pulse Divider type label.
”Module”:	Select output module. Appears from Pulse Divider type label.
”Power supply”:	Select power supply. Appears from Pulse Divider type label.
”ULTRAFLOW® pulse factor (CCC)“:	Select ULTRAFLOW® pulse factor. Appears from Pulse Divider type label.
”Pulse Divider pulse factor (DD)”:	Select pulse factor of Pulse Divider. Appears from Pulse Divider type label.
”Pulse duration (E)”:	Select pulse duration of Pulse Divider. Appears from Pulse Divider type label.
”SW: Revision”:	Pulse Divider software revision. Appears from Pulse Divider type label.
”Serial number”:	Pulse Divider serial number: Appears from Pulse Divider type label.
”Year”:	Pulse Divider production year: Appears from Pulse Divider type label.
”Offset X”:	Horizontal offset for printing of label (positive value: Offset to the right).
”Offset Y”:	Vertical offset for printing of label (positive value: Offset downwards).
”Example”:	Shows examples of Pulse Divider type label with selected values.
”Print”:	Prints type label on selected printer.
”Select label printer”:	Select printer.
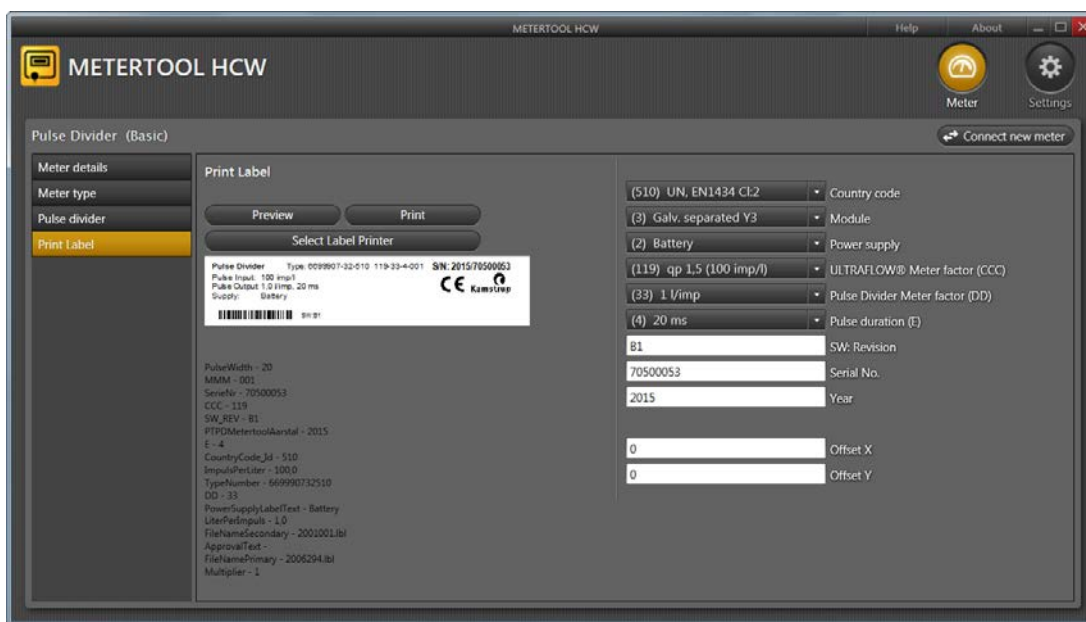
Figure 69. Print label.

Please note: Replacing type label of Pulse Divider, legal marking requirements must be taken into account.

11.3 Settings

Clicking on the button "Settings" the following parameters can be changed:

"Select language": The program language can be changed to 6 different languages: Danish, German, English, French, Polish and Russian.

Figure 70. Select language.

"Select COM-port": The COM-port can be selected manually instead of the automatically selected default setting.

Figure 71. Select COM-port.

"Update program": The METERTOOL program can be updated online if a newer revision is available on Kamstrup's FTP-server.
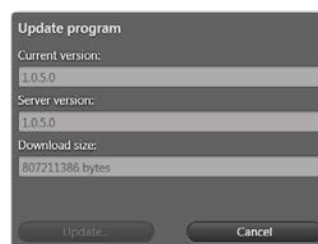
Figure 72. Update program.

"Update database": The METERTOOL databases can be updated online if newer revisions are available on Kamstrup's FTP-server.

Figure 73. Update database.

"Save or restore databases": This function is not used for Pulse Divider.

"Install the USB-driver": This function enables (re)installation of the USB-driver, which is used for the interface cable.

11.3.1 Help button

”Contact”:   Links to Kamstrup's website and mailbox.

”Output”:   Opens a window showing the latest used functions in the program.

”User Manual”:   Links to technical descriptions on Kamstrup's website.

11.3.2 About button

List of METERTOOL program versions and revision numbers as well as all sub-programs including type numbers and revision numbers for the entire METERTOOL HCW.

12 Approvals

12.1 The Measuring Instruments Directive

ULTRAFLOW® 54 and 34 are 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 and 34 are marked according to the following directives:

EMC directive   2004/108/EC

LV directive   2006/95/EC (when connected to mains supplied 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	**Kamstrup A/S**	declare under our sole responsibility that the product(s):
Vi	Industrivej 28, Stilling	erklærer under eneansvar, at produkt(erne):
Nous	DK-8660 Skanderborg	déclarons sous notre responsabilité que le/les produit(s):
Wir	Denmark	erklären in alleiniger Verantwortung, dass/die Produkt(e):
My	Tel: +45 89 93 10 00	deklarujemy z pe³n¹ odpowiedzialnosci¹ ¿e produkt(y):
Nosotros		Declaramos, bajo responsabilidad propia que el/los producto
Noi		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		DK-0200-MI004-013
Heat Meter	MULTICAL® 302	302-T	Cl 2/3,E1,M1,M2	DK-0200-MI004-031
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 MULTICAL® 6L2 SVM S6 MULTICAL® 801	67-A/B/C/D 67-E 602-A/B/C/D 6L2-F 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 M1, E1/E2	DK-0200-MI004-004 DK-0200-MI004-004 DK-0200-MI004-020 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 ULTRAFLOW® 54	65-5/65-3 65-5	Cl 2/3 M1, E1/E2 M1/M2, E1/E2 M1/M2, E1/E2	DK-0200-MI004-008 DK-0200-MI004-033
Water Meter	MULTICAL® 21 MULTICAL® 41 MULTICAL® 61 MULTICAL® 62 flowIQTM 2101 flowIQTM 3100	021 66-Z 67-Z 62-Z 021 031	Cl 2, M1, E1/E2 Cl 2, M1, E1 Cl 2, M1, E1, B Cl 2, M1, E1, B Cl 2, M1, E1/E2 Cl 2, M1, E1/E2	DK-0200-MI001-015 DK-0200-MI001-003 DK-0200-MI001-010 DK-0200-MI001-016 DK-0200-MI001-015 DK-0200-MI001-017

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:
s¹ zgodne z wymaganiami nastêpuj¹cych 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, Module D	Notified Body, Module D Certificate:
EMC Directive	2004/108/EC	Force Certification A/S
LVD Directive	2006/95/EC	EC Notified Body nr. 0200
PE-Directive (Pressure)	97/23/EC, Module A1	Park Alle 345, 2605 Brøndby
R&TTE	1999/5/EC	Denmark
RoHS II Directive	2011/65/EU	

Date: 2015/02/05   Sign.:

Lars Bo Hammer
Quality Assurance Manager

5518-050,Rev.: AA1, Kamstrup A/S, DK8660 Skanderborg, Denmark

13 Troubleshooting

Before sending in the sensor for repair or testing, 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	Check flow sensor connection (Check with PULSE TESTER, if necessary)
	Flow sensor is inverted	Check flow sensor direction
	Air in sensor/cavitation	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
	Flow sensor error	Replace the flow sensor/Send meter for repair
Erroneous accumulation of m³	Erroneous programming	Check that meter factors of calculator and flow sensor correspond
	Air in sensor/cavitation	Check the installation angle. Check if there is air in the system or cavitation from valves and pumps. Increase the static pressure, if possible
	Flow sensor error	Replace the flow meter/send sensor for repair

14 Disposal

Kamstrup A/S holds an environmental certification according to EN ISO 14001, and as part of Kamstrup's environment policy 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 <u>not</u> 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 and PC. See material data	Plastic recycling
ULTRAFLOW® meter case	DZR brass and stainless steel	Metal recycling
Packing	Recycled cardboard and EPS	Cardboard recycling (Resy) and EPS recycling

Please direct any questions 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 instruction	5512-951	5512-952	5512-953	5512-956

Table 36