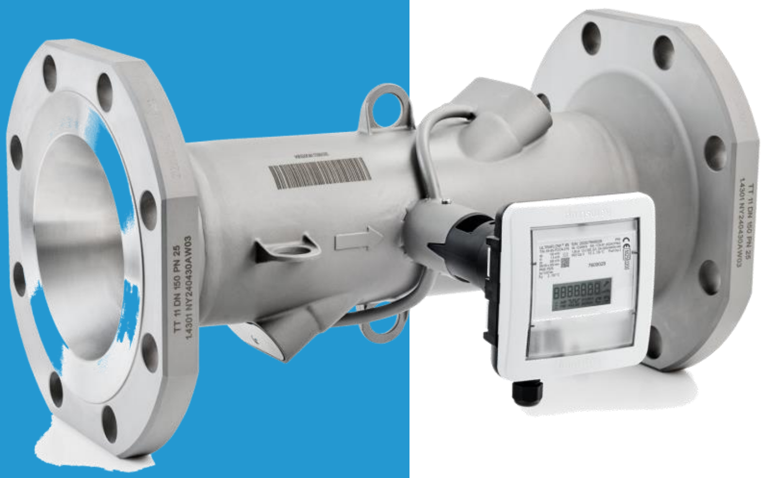
Technical Description

ULTRAFLOW® 85
DN150-300



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Contents

1 Introduction

1.1 Pioneering work and continuous development

Since 1991 Kamstrup has provided static ultrasonic flow sensors for heat meters and is among the pioneering manufacturers of this technology. The stand-alone flow sensors ULTRAFLOW® are the trademark of the Kamstrup static flow sensors based on the ultrasonic measuring principle. The proven long-term accuracy and durability have gained our flow sensors a reputation for reliability and quality. Ongoing development has continuously improved the whole performance of Kamstrup flow sensors. The pressure loss has, for example, been continuously reduced, while the dynamic range could still increase. Furthermore, various smart features like the ability to mount a temperature sensor in the outlet of flow sensors with sizes up to qp 10 m³/h have been added.

1.2 Modular meter set-up for maximum flexibility

ULTRAFLOW® is known as a separate static flow sensor. The modular composition of our heat and cooling meter set-up consisting of separate flow sensor, calculator and temperature sensor set adds degrees of flexibility to your installation, thereby accommodating most needs. In cases where separation of flow sensor and calculator is required during installation, the cable to the calculator can easily be disconnected and connected again. This cable between calculator and flow sensor is in most cases also comparatively easily changeable, underlining the intelligent and easy-to-handle design of Kamstrup products. In addition, you can exchange only one of your sub-assemblies, which minimizes unforeseen costs in case of a calculator upgrade or replacement of either part. The split meter solution allows cable lengths of 2.5 m, 5 m and 10 m as standard and enables even extra-long cables of up to 110 m to MULTICAL®. For further information about our separate calculators MULTICAL® 603 and MULTICAL® 803, please consult the Technical descriptions, Kamstrup doc. no. FILE100002141_EN and FILE100000271_EN (can be found here Link-MC603 and here Link-MC803) .

Whether you choose to install the separate ULTRAFLOW® or the flow sensors connected to our compact calculators, you can be assured by the fact that all our flow sensors are based on the same platform. The ULTRAFLOW® technology has been utilized in the basic design of our other flow sensors integrated in our compact meters like MULTICAL® 303 and MULTICAL® 403 ensuring equally proven accuracy, durability and serviceability. For further information about our compact meters MULTICAL® 303 and MULTICAL® 403, please consult the Technical descriptions, Kamstrup doc. no. FILE100001554_EN and FILE100000166_EN (can be found here Link-MC303 and here Link-MC403).

1.3 General description

ULTRAFLOW® 85 is a static flow sensor based on the ultrasonic measuring principle and has been designed for use in heat and cooling installations where water is used as the heat-bearing medium. It is used primarily as a subassembly of a thermal energy meter in combination with a set of TemperatureSensor 83 and the separate calculators MULTICAL® 603-S, 603-U and 803-A. These types of MULTICAL® support legal measurement of bi-directional flow (forward and reverse flow) with ULTRAFLOW® 85 which can be of benefit e.g. when in some periods thermal energy is consumed and in other periods surplus thermal energy is supplied to the distribution net. In addition, it enables even shorter volume sampling intervals of down to 0.5 s which makes this fast response flow sensor particularly suitable for regulation of industrial processes. These functionalities of ULTRAFLOW® 85 are supported from the following SW revisions of the respective calculators onwards. ULTRAFLOW® 85 is equipped with an indicating device (display) providing different information e.g. about the actual flow, operation state, air in medium, etc. These indications are considered as outside from legal metrological control. This means that the indicating device is not considered crucial for the legitimate use of ULTRAFLOW® 85.

Forward and reverse flow is measured using bidirectional ultrasonic technique based on the transit time method. ULTRAFLOW® 85 employs microprocessor technology. All circuits for calculating and measuring are collected on a single board, providing a compact and rational design in addition to an exceptionally high level of measuring accuracy and proven long-term stability.

A three-wire signal cable is used to connect ULTRAFLOW® 85 to a separate MULTICAL® calculator or other equipment. This cable is used to supply the flow sensor. When connected to MULTICAL® 603-S/603-U/803-A serial communication is facilitated via this cable, which enables measurement of forward and reverse flow in the field. For a correct energy calculation in the calculator, when ULTRAFLOW® 85 is measuring reverse flow, the flow sensor must be mounted in outlet next to t2. When connected to other equipment than MULTICAL® 603-S/603-U/803-A, volume-proportional pulses are emitted from ULTRAFLOW® 85. Measurement of reverse flow in the field is not supported in that case.

If ULTRAFLOW® 85 is used as a flow sensor for equipment different from Kamstrup MULTICAL® calculators, it must be connected through a Pulse Transmitter. If ULTRAFLOW® 85 is connected to another calculator with a different meter factor than the one supplied by ULTRAFLOW® 85, a Pulse Divider is used instead. Pulse Transmitter and Pulse Divider have a galvanically separated pulse output, a built-in supply for ULTRAFLOW® and do not support measurement of reverse flow in the field. If the distance between MULTICAL® and ULTRAFLOW® 85 is more than 10 m, a Pulse Transmitter allows prolongation of the connecting cable (up to 100 m). Alternatively, a Cable Extender Box can be used for this purpose for distances up to 30 m between MULTICAL® and ULTRAFLOW® 85. The Cable extender box does not prohibit measurement of forward and reverse flow in the field.

2 Technical data

ULTRAFLOW® 85 DN150-300

2.1 Approved meter data

MID designation	
Mechanical environment	M1 and M2 (M3 type test also passed)
Electromagnetic environment	E1 and E2
Climatic environment	5…55 °C, condensing, closed location (indoors installation)
Accuracy class	2 and 3
EN 1434 designation	
Environmental class	C
Fast response meter (sub-assembly flow sensor)	Volume sampling interval depends on the connected calculator. Down to 0.5 s with MULTICAL® 603-S/603-U/803-A. Requires mains supply. Otherwise, 1 s.

2.2 Electrical data

Internal supply voltage	3.6 VDC ± 0.1 VDC
Battery	
Display backlight OFF [1)] (MULTICAL® or Pulse Transmitter/ Pulse Divider)	3.65 VDC, D-cell lithium
Battery lifetime (replacement interval)	
ULTRAFLOW® 85 and MULTICAL®	
Serial mode	up to 16 years @ t_{BAT} < 30 °C
Pulse mode	up to 13 years @ t_{BAT} < 30 °C
Pulse Transmitter/Pulse Divider	6-years @ t_{BAT} < 30 °C (Y=3)
Mains supply	
Display backlight ON [2)] (MULTICAL® or Pulse Transmitter/ Pulse Divider)	230 VAC +15/-30 %, 50 Hz or 60 Hz 24 VAC ±50 %, 50 Hz or 60 Hz
Power consumption	< 1 W
Backup supply	Integral capacitor eliminates operational disturbances due to short-term power cuts
Cable length	
Flow sensor	Max 10 m
Pulse Transmitter/Pulse Divider	Depends on calculator. Max 100 m when connected to MULTICAL® (Y=2).
Cable Extender Box	Depends on calculator. Max 30 m when connected to MULTICAL®.
Electromagnetic environment	Fulfils EN 1434 class C, MID E1 and E2
Pulse output	Galvanically connected (ULTRAFLOW®)
Type	Push-Pull
Output impedance	10 kΩ
Pulse duration	2…6 ms
Pause time	Depending on current pulse frequency

[1)] In case of battery supply, backlight ON is not recommended due to the significantly reduced battery lifetime
[2)] In case of mains supply, backlight ON is an option, which can be beneficial in dark installation sites.

2.3 Mechanical data

Accuracy class	2 or 3	
Electromagnetic environment	Fulfils EN 1434 class C, MID E1 and E2	
Mechanical environment	MID M1 and M2	
Ambient conditions	5…55 °C, closed location (indoor installation)	
Protection class		When installed properly. See *6 Installation*.
Flow sensor	IP68	
Cable Extender Box	IP68	
Pulse Transmitter/ Pulse Divider	IP67	
Medium in flow sensor	Water - recommended water quality as in CEN TR 16911 and AGFW FW510	
Temperature of medium θ_q	2…150 °C or narrower range (depending on configuration; see marking)	At medium temperatures above 120 °C ULTRAFLOW® 85 must be insulated. Do not cover the hole of the extension tube, when insulating ULTRAFLOW® 85.
Storage and transport temperature, empty sensor	-25…60 °C	
Pressure stage	PN16, PS16 (DN300) PN25, PS25 or PN16, PS16 (DN150-250); see marking	
Straight inlet requirement	0D (according to EN 1434:2022 and OIML R75:2002) [1)]	
Installation angle	Horizontally, vertically and at an angle [2)]	

[1)] For additional details consult Kamstrup doc. no. FILE100001058_EN (The challenge of correct flow sensor installation with respect to flow disturbances; can be found e.g. here Link-UF85).

[2)] ULTRAFLOW® 85 is typically installed horizontally. In that case, the electronics box should also be oriented horizontally, i. e. pointing to the side, to achieve optimum metrological performance. The ultrasound paths in the flow sensor tube will thus be vertical, which is optimal in connection with possible stratification of the medium. To minimize possible stratification at minimum flow, insulation of ULTRAFLOW® 85 and in particular of the pipes around (before and after the flow sensor) is recommended.

2.4 Flow data

Nom. flow q_p [m³/h]	Meter factor [1)] [p/l]	Dynamic range q_p:q_i	q_s:q_p	Flow@125 Hz [2)] [m³/h]	Min. cut off [l/h]
150	1	100:1	2:1	450	750
250	0.6	100:1	2:1	750	1250
400	0.4	100:1	2:1	1125	2000
600	0.25	100:1	2:1	1800	3000
1000	0.15	100:1	2:1	3000	5000

[1)] *Standard meter factor. Appears from ULTRAFLOW® label. For other meter factors see paragraph 4.*

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

Table 1. Flow data.

For dynamic range q_p:q_i = 100:1 the volume flow stated in m³/h is calculated to a corresponding flow in the measuring pipe according to *Table 2* stated in m/s.

q_i	q_p	q_s	q_i	q_p	q_s	Connection	Length	pipe diameter
[m³/h]			[m/s]			[mm]	[mm]	[mm]
1,5	150	300	0,0368	3,6841	7,3683	DN150	500	120
2,5	250	500	0,0614	6,1402	12,2805			
2,5	250	500	0,0393	3,9298	7,8595	DN200	500	150
4	400	800	0,0629	6,2876	12,5752			
4	400	800	0,0413	4,1336	8,2671	DN250	600	185
6	600	1200	0,0620	6,2003	12,4007			
6	600	1200	0,0368	3,6841	7,3683	DN300	500	240
10	1000	2000	0,0614	6,1402	12,2805			

Table 2. Flow velocities.

2.5 Mechanical design

The basic design principle and main parts are illustrated in the explosion drawing below (*Figure 1*). The components of the electronics casing as well as the extension tube are identical for all flow sensor types ULTRAFLOW® 85. There are 4 flow sensor bodies available in size DN150, DN200, DN250 and DN300. Depending on the size, flanges in either PN16, PS16 (all sizes) or PN25, PS25 (DN150, DN200 and DN250) are welded on the body. The inside geometry does not depend on the pressure stage, i.e. PN25, PS25 flanges have e.g. more material on the outer side to make them more robust. Flanges provide in all cases a conical in- and outlet to the measuring section in the central flow sensor body. For more details of the mechanical design, available spare parts etc. can be found in the Service manual of ULTRAFLOW® 85, Kamstrup doc. no. FILE100005702_EN.

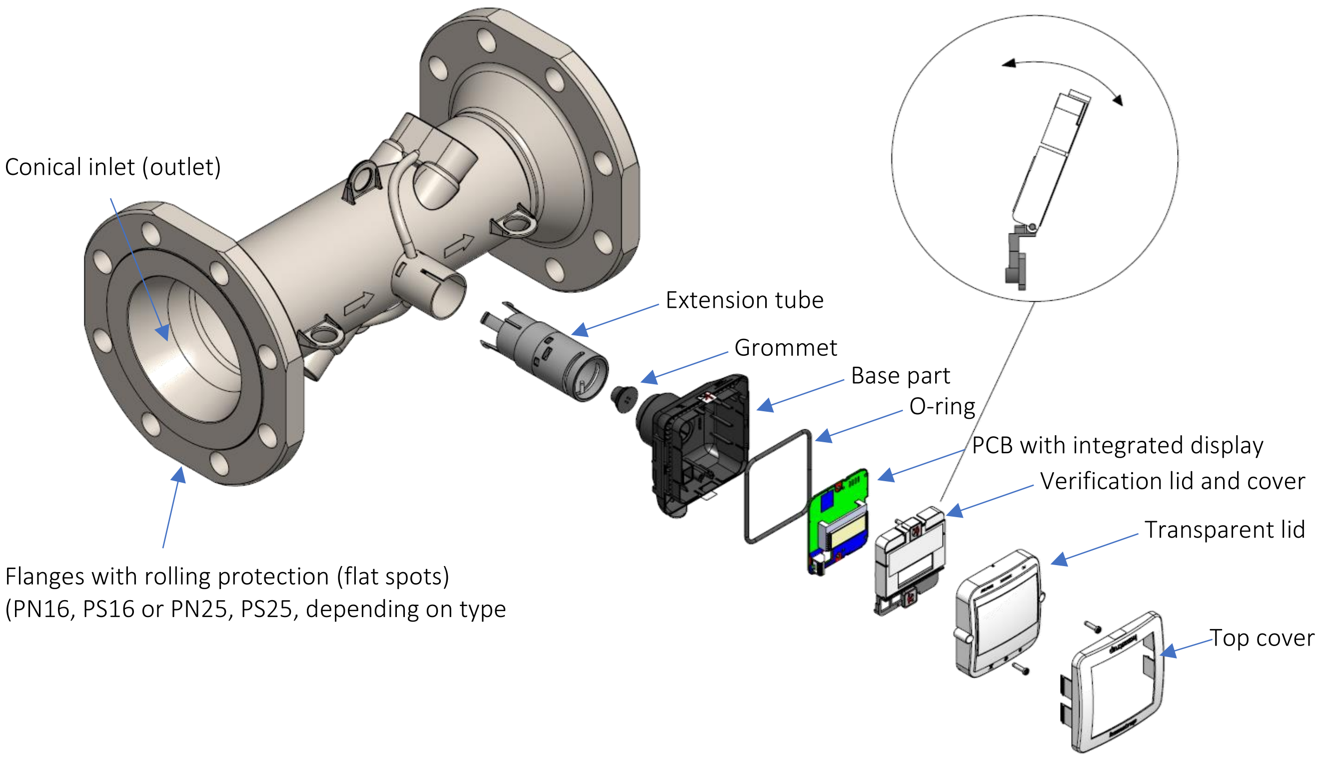


Figure 1. Mechanical design of ULTRAFLOW® 85.

2.6 Materials

Wetted parts

Housing	Stainless steel, W.no. 1.4308
Flanges	Stainless steel, W.no. 1.4301
Transducer	Titanium
Gaskets	Fibre

Electronics box

Extension tube	Thermoplastic, 40 % glass-reinforced Polyphenylenesulfide (PPS)
Base part	Thermoplastic, 10 % glass-reinforced polycarbonate (PC)
Transparent lid	Thermoplastic, Polycarbonate (PC)
Top cover	Thermoplastic, 10 % glass-reinforced polycarbonate (PC)
Calculator mount bracket	Thermoplastic, 10 % glass-reinforced polycarbonate (PC)

Housing, Pulse Transmitter (PT)/Pulse Divider (PD)

Base, cover	Thermoplastic, 10 % glass-reinforced polycarbonate (PC)

Cables

Signal cable Silicone cable (3 x 0.5 mm^2)
(optional for separate ULTRAFLOW® 85 and as accessory for PT/PD and Cable Extender Box)

Mains supply cable 24/230 VAC Cable with Polyvinylchloride (PVC)-mantle (2 x 0.75 mm^2)
(optional when selecting main-supplied Pulse Transmitter/Pulse Divider)

Housing, Cable Extender Box

Base, cover	Thermoplastic, Acrylonitrite butadiene styrene (ABS)

3 Type overview

Nom. flow q_p [m³/h]	Installation dimensions	
150	DN150x500 mm	
250	DN150x500 mm	DN200x500 mm
400	DN200x500 mm	DN250x600 mm
600	DN250x600 mm	DN300x500 mm *
1000	DN300x500 mm *	

Flange facing type B, raised face according to EN 1092-1, PN16 or PN25

* PN16 only

Table 3. Type overview.

4 Ordering details

4.1.1 Type number overview of ULTRAFLOW® 85

The table below shows a list of type numbers for ULTRAFLOW® 85.

Type number	q_p [m³/h]	q_i [m³/h]	q_s [m³/h]	Dynamic range q_p:q_i	Connection [mm]	Length [mm]	PN, PS [bar]
65-85- FCCN -XXX	150	1.5	300	100:1	DN150	500	25, 25
65-85- FDCN -XXX	250	2.5	500	100:1	DN150	500	25, 25
65-85- FDCP -XXX	250	2.5	500	100:1	DN200	500	25, 25
65-85- FECP -XXX	400	4	800	100:1	DN200	500	25, 25
65-85- FECR -XXX	400	4	800	100:1	DN250	600	25, 25
65-85- FFCR -XXX	600	6	1200	100:1	DN250	600	25, 25

Type number	q_p [m³/h]	q_i [m³/h]	q_s [m³/h]	Dynamic range q_p:q_i	Connection [mm]	Length [mm]	PN, PS [bar]
65-85- FCDN -XXX	150	1.5	300	100:1	DN150	500	16, 16
65-85- FDDN -XXX	250	2.5	500	100:1	DN150	500	16, 16
65-85- FDDP -XXX	250	2.5	500	100:1	DN200	500	16, 16
65-85- FEDP -XXX	400	4	800	100:1	DN200	500	16, 16
65-85- FEDR -XXX	400	4	800	100:1	DN250	600	16, 16
65-85- FFDR -XXX	600	6	1200	100:1	DN250	600	16, 16
65-85- FFDS -XXX	600	6	1200	100:1	DN300	500	16, 16
65-85- FGDS -XXX	1000	10	2000	100:1	DN300	500	16, 16

XXX - code for final assembly, approvals etc. - determined by Kamstrup.

Table 4. Type numbers of ULTRAFLOW® 85.

By separate order of ULTRAFLOW® and MULTICAL®, see also the Technical descriptions of MULTICAL® 602/603/801/803 (5512-931_GB/FILE100002141_EN/5512-571_GB/FILE100000271_EN; can be found here Link-MC602, Link-MC603, Link-MC801, Link-MC803) for information on valid CCC codes in the calculator.

4.1.2 Type number details of ULTRAFLOW® 85

Type number details of separate ULTRAFLOW® 85 are given in *Table 5*. Meter types and country codes define the marking of the flow sensor. The meter type defines in particular the (legal) use of the flow sensor. The country code defines in addition language variants of the marking.

Type **65-85**		- X	X	X	X	- X	XX
Dynamic range							
100:1		F					
Flow							
150 m³/h			C				
250 m³/h			D				
400 m³/h			E				
600 m³/h			F				
1000 m³/h			G				
Flange connection							
Flange PN25				C			
Flange PN16				D			
Installation size							
DN150x500mm					N		
DN200x500mm					P		
DN250x600mm					R		
DN300x500mm					S		
Meter type							
Heat flow sensor	MID, module B+D					2	
Heat /cooling flow sensor	MID, module B+D & TS 27.02					3	
Heat flow sensor	National approval/marking					4	
Cooling flow sensor w or w/o approval (incl. volume flow sensor (cold))						5	
Heat/cooling flow sensor w national approval or w/o approval						6	
Volume flow sensor, hot						7	
Country code							
To be defined							XX

Table 5. Type number details of ULTRAFLOW® 85

4.2 Accessories for ULTRAFLOW® 85

ULTRAFLOW® 85 DN150-300, when ordered with MULTICAL®, is supplied with 2.5 m signal cable, optionally 5 or 10 m. The cable is mounted in the ULTRAFLOW® 85 electronics box and in MULTICAL® 603. When ULTRAFLOW® 85 is ordered with MULTICAL® 803, the calculator is supplied separately. Hence the cable is only mounted in the ULTRAFLOW® 85 electronics box.

ULTRAFLOW® 85 DN150-300, when ordered as a separate flow sensor, is optionally available with a signal cable in lengths of 2.5, 5 or 10 m. The cable is mounted in the flow sensor's electronics box.

The pressure stage of enclosed gaskets follows the pressure stage of the flow sensor, i.e. PN16, PS16 or PN25, PS25.

For Pulse Transmitter/Pulse Divider and Cable extender box as accessory for ULTRAFLOW® 85, consult paragraph *4.3 Pulse Transmitter / Pulse Divider and Cable Extender Box*.

Article number	**Description**	**Note**
1150-214	Gasket, DN150 PN16 (1 pc.)	Enclosed (2 pcs.)
1150-215	Gasket, DN200 PN16 (1 pc.)	Enclosed (2 pcs.)
1150-216	Gasket, DN250 PN16 (1 pc.)	Enclosed (2 pcs.)
1150-164	Gasket, DN300 PN16 (1 pc.)	Enclosed (2 pcs.)
1150-140	Gasket, DN150 PN25 (1 pc.)	Enclosed (2 pcs.)
1150-139	Gasket, DN200 PN25 (1 pc.)	Enclosed (2 pcs.)
1150-141	Gasket, DN250 PN25 (1 pc)	Enclosed (2 pcs.)
5000-333	2.5 m silicone cable (3-wire)	Default for ULTRAFLOW® when ordered with MULTICAL® Optional for separate ULTRAFLOW®
5000-259	5 m silicone cable (3-wire)	Optional
5000-270	10 m silicone cable (3-wire)	Optional
3026-1392	Bracket for MULTICAL® 603/803*	Accessory
66-99-036	Cable Extender Box	Accessory
66-99-903-YZ-XXX	Pulse Transmitter	Accessory
66-99-907-YZ-XXX	Pulse Divider	Accessory

* MULTICAL® 803 also requires bracket 30-26-857.

Table 6. Accessories for ULTRAFLOW® 85.

4.3 Pulse Transmitter / Pulse Divider and Cable Extender Box

4.3.1 Introduction

Depending on the installation of ULTRAFLOW®, galvanic separation, adaptation of meter factor to a foreign calculator or a longer cable between ULTRAFLOW® and MULTICAL® can become necessary. Pulse Transmitter, Pulse Divider and Cable Extender Box are electronic equipment that are installed between ULTRAFLOW® and the calculator and provide various technical solutions for these purposes.

Pulse Transmitter and Pulse Divider are available with built-in supply for ULTRAFLOW®. By default, Pulse Transmitter/Pulse Divider is supplied by a built-in battery. Alternatively, Pulse Transmitter/Pulse Divider is externally supplied by 24 VAC or 230 VAC.

Pulse Transmitter and Pulse Divider are available with galvanically separated output module. See paragraph *4.3.3* below.

Galvanic separation can be used in the following situations:

1) If a cable length of more than 10 m is required between MULTICAL® and ULTRAFLOW®
2) For flow sensor no. 2 in connection with MULTICAL®. If two flow sensors are used together with MULTICAL® and an equipotential connection between the two flow sensors cannot be carried out, one (typically V2) should be galvanically separated.

For further information, see paragraph *6.11.4 Calculator with two flow sensors*.

3) If ULTRAFLOW® is connected to other equipment/foreign calculators, ULTRAFLOW® must be galvanically separated.
4) In cases where the electronic signal between ULTRAFLOW® and MULTICAL® is disturbed, galvanic separation in the Pulse Transmitter may in some cases remedy the problem.

Due to the galvanic separation, flow info and bi-directional flow measurement (for ULTRAFLOW® 85) is not available if Pulse Transmitter or Pulse Divider is used.

When mounting the Pulse Transmitter or Pulse Divider between ULTRAFLOW® and MULTICAL®, the cable length can be extended up to 100 m depending on the calculator. See paragraphs *4.3.2 Type number composition of Pulse Transmitter and Pulse Divider*, *4.3.3 Output module and supply module*, and *6.10.3 Cable lengths when using Pulse Transmitter/ Pulse Divider* for more information.

In a case where galvanic separation is not necessary and flow-info and bi-directional flow measurement (for ULTRAFLOW® 85) is required, the Cable Extender Box enables an extension of the cable length between ULTRAFLOW® and MULTICAL® up to max 30 m. For more information see paragraph *4.3.7 Cable Extender Box*.

4.3.2 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				

Table 7. Type number composition of Pulse Transmitter and Pulse Divider

4.3.3 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 8. 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.

Output module (Y=2) is used when extra-long cables are required. When connecting to MULTICAL®, a DC supply is required as shown in *Figure 24* to *Figure 27*. See also the Technical descriptions of MULTICAL®, Flow sensor with active 24 V pulse output. For output module (Y=2), battery supply is not an option.

Output module (Y=3) is intended for battery supply with a minimum battery life of 6 years. Output module (Y=3) is selected by default.

When Pulse Transmitter and Pulse Divider are mains-supplied (24 VAC or 230 VAC) and connected via 3-wire cable to MULTICAL®, both output modules can be used. See *Figure 22* and *Figure 23*, respectively.

For further information, see paragraph *6.10.2 Electrical connection of Pulse Transmitter and Pulse Divider*.

4.3.4 Pulse Divider configuration CCC-DD-E-MMM

If ULTRAFLOW® is connected to calculators with different meter factors than the one supplied by ULTRAFLOW®, a Pulse Divider is used.

Pulse Divider must be configured in accordance with *Table 9*, *Table 10* or *Table 11* for ULTRAFLOW® meter factor (CCC), which is unique for the nominal flow q_p. In addition, the desired meter factor (DD) and pulse length (E) of the Pulse Divider is determined by the connected calculator. MMM indicates selection of customer label. Default values in *Table 9*, *Table 10* and *Table 11* indicate meter factors and pulse durations of ULTRAFLOW® X4/X5.

q_p	CCC	Meter factor				Pulse duration				
[m³/h]		[pulse/liter]	[liter/pulse]	Divider	DD	[ms] (E=1)	[ms] (E=4)	[ms] (E=5)	[ms] (E=6)	
0.6	**116**	**300**				**3.9**				**Default**
0.6		1	1	300	33		20	50	100	
0.6		0.4	2.5	750	63				100	
1.5	**119**	**100**				**3.9**				**Default**
1.5		1	1	100	33		20	50	100	
1.5		0.4	2.5	250	63				100	
1.5		0.1	10	1000	34				100	
2.5	**198**	**60**				**3.9**				**Default**
2.5		1	1	60	33		20	50	100	
2.5		0.4	2.5	150	63				100	
2.5		0.1	10	600	34				100	
3.5	**151**	**50**				**3.9**				**Default**
3.5		1	1	50	33		20	50		
3.5		0.4	2.5	125	63				100	
3.5		0.1	10	500	34				100	
3.5		0.04	25	1250	64				100	
6	**137**	**25**				**3.9**				**Default**
6		1	1	25	33		20	50		
6		0.4	2.5	62.5	63				100	
6		0.1	10	250	34				100	
6		0.04	25	625	64				100	
10	**178**	**15**				**3.9**				**Default**
10		1	1	15	33		20	50		
10		0.1	10	150	34				100	
10		0.04	25	375	64				100	
15	**120**	**10**				**3.9**				**Default**
15		1	1	10	33		20			
15		0.1	10	100	34			50	100	
15		0.04	25	250	64				100	
15		0.01	100	1000	35				100	
25	**179**	**6**				**3.9**				**Default**
25		1	1	6	33		20			
25		0.1	10	60	34			50	100	
25		0.04	25	150	64				100	

Table 9. Configuration variants of meter factor (DD) and pulse duration (E) for Pulse Divider for ULTRAFLOW® X4/X5, q_p 0.6...25 m^3/h.

q_p	CCC	Meter factor				Pulse duration				
[m³/h]		[pulse/liter]	[liter/pulse]	Divider	DD	[ms] (E=1)	[ms] (E=4)	[ms] (E=5)	[ms] (E=6)	
40	**158**	**5**				**3.9**				**Default**
40		0.1	10	50	34		20	50		
40		0.04	25	125	64				100	
40		0.01	100	500	35				100	
40		0.004	250	1250	65				100	
60	**170**	**2.5**				**3.9**				**Default**
60		0.1	10	25	34		20	50		
60		0.04	25	62.5	64				100	
60		0.01	100	250	35				100	
60		0.004	250	625	65				100	
100	**180**	**1.5**				**3.9**				**Default**
100		0.1	10	15	34		20	50		
100		0.01	100	150	35				100	
100		0.004	250	375	65				100	

Table 10. Configuration variants of meter factor (DD) and pulse duration (E)
*for Pulse Divider for ULTRAFLOW® X4/X5, q_p 40**…**100 m³/h.*

Based on a q_p-value, one of the meter factor options for the Pulse Divider is selected from *Table 9*, *Table 10* or *Table 11*. The pulse duration options appear from the same line as the selected meter factor.

Examples:

For ULTRAFLOW® X4 with q_p 1.5 m³/h (100 imp/l, CCC=119), a meter factor of 1 liter/pulse (DD=33) for the Pulse Divider is required. Based on this meter factor, you have the option of pulse durations 20 (E=4), 50 (E=5) or 100 (E=6) milliseconds (see *Table 9*).

For ULTRAFLOW® X4 with q_p 100 m³/h (1.5 imp/l, CCC=180), a meter factor of 10 liter/pulse (DD=34) for the Pulse Divider is required. Based on this meter factor, you have the option of pulse durations 20 (E=4) or 50 (E=5) milliseconds (see *Table 10*).

For ULTRAFLOW® X5 with q_p 400 m³/h (0.4 imp/l, CCC=191), a meter factor of 2500 liter/pulse (DD=66) for the Pulse Divider is required. Based on this meter factor, you have the option of pulse durations 20 (E=4), 50 (E=5) or 100 (E=6) milliseconds (see *Table 11*).

q_p	CCC	Meter factor				Pulse duration				
[m³/h]		[pulse/liter]	[liter/pulse]	Divider	DD	[ms] (E=1)	[ms] (E=4)	[ms] (E=5)	[ms] (E=6)	
150	**147**	**1**			**33**	**3.9**				**Default**
150		0.1	10	10	34		20			
150		0.04	25	25	64		20			
150		0.01	100	100	35		20	50	100	
150		0.004	250	250	65		20	50	100	
150		0.001	1000	1000	36		20	50	100	
150		0.0004	2500	2500	66		20	50	100	
250	**181**	**0.6**			**43**	**3.9**				**Default**
250		0.1	10	6	34		20			
250		0.04	25	15	64		20			
250		0.01	100	60	35		20	50	100	
250		0.004	250	150	65		20	50	100	
250		0.001	1000	600	36		20	50	100	
250		0.0004	2500	1500	66		20	50	100	
400	**191**	**0.4**			**63**	**3.9**				**Default**
400		0.01	100	40	35		20	50		
400		0.004	250	100	65		20	50	100	
400		0.001	1000	400	36		20	50	100	
400		0.0004	2500	1000	66		20	50	100	
600	**192**	**0.25**			**14**	**3.9**				**Default**
600		0.01	100	25	35		20	50		
600		0.004	250	62.5	65		20	50		
600		0.001	1000	250	36		20	50	100	
600		0.0004	2500	625	66		20	50	100	
1000	**193**	**0.15**			**24**	**3.9**				**Default**
1000		0.01	100	15	35		20	50		
1000		0.004	250	37.5	65		20	50		
1000		0.001	1000	150	36		20	50	100	
1000		0.0004	2500	375	66		20	50	100	

Table 11. Configuration variants of meter factor (DD) and pulse duration (E) for Pulse Divider for ULTRAFLOW® X4/X5, q_p 150…1000 m³/h.

The MULTICAL® generation 3 only has one CCC-code shared by flow sensors V1 and V2 and thus only the possibility to utilize two ULTRAFLOW® with the same meter factor (pulse/liter) and the same nominal flow (q_p). When utilizing MULTICAL® connected to two ULTRAFLOW® V1 and V2 in relation to open systems it may be beneficial to utilize an ULTRAFLOW®-V2 with a lower nominal flow (q_p) than the nominal flow (q_p) for the utilized ULTRAFLOW®-V1. It is possible to utilize a flow sensor V2 smaller than V1 by including a Pulse Divider for V2 to scale down the meter factor of the ULTRAFLOW®-V2 to match the meter factor of the ULTRAFLOW®-V1. To match the specific requirements of the MULTICAL®-calculator for this specific application a configuration for the ULTRAFLOW® X4/X5 flow sensor according to *Table 12* can be used. For more details about an application with open systems consult e.g. the Technical description of MULTICAL® 603 (Kamstrup doc. no. FILE100002141_EN; Link-MC603).

In some cases, a divider 1 for Pulse Divider might be helpful, e.g. when a simple Pulse Transmitter is effectively needed, but a Pulse Divider is currently available. In those cases, the Pulse Divider can be configured with METERTOOL HCW with a fixed divider 1 (see *Table 13*).

q_p	CCC	Meter factor				Pulse duration				
[m³/h]		[pulse/liter]	[liter/pulse]	Divider	DD	[ms] (E=1)	[ms] (E=4)	[ms] (E=5)	[ms] (E=6)	
0.6	**116**	**300**			**70**	**3.9**				**Default**
0.6		60	0.0167	5	41	3.9				
0.6		50	0.02	6	51	3.9				
0.6		25	0.04	12	12	3.9				
1.5	**119**	**100**			**31**	**3.9**				**Default**
1.5		50	0.02	2	51	3.9				
1.5		25	0.04	4	12	3.9				
1.5		10	0.1	10	32	3.9				
2.5	**198**	**60**			**41**	**3.9**				**Default**
2.5		15	0.0667	4	22	3.9				
2.5		10	0.1	6	32	3.9				
3.5	**151**	**50**			**51**	**3.9**				**Default**
3.5		25	0.04	2	12	3.9				
3.5		10	0.1	5	32	3.9				

Table 12. Configuration variants for meter factor (DD) and pulse length (E) with fixed dividers for MULTICAL® 603 installations with two ULTRAFLOW® X4/X5 of different sizes.

q_p	CCC	Meter factor				Pulse duration				
[m³/h]		[pulse/liter]	[liter/pulse]	Divider	DD	[ms] (E=1)	[ms] (E=4)	[ms] (E=5)	[ms] (E=6)	
0.6	**116**	**300**	0.0033		**70**					
1.5	**119**	**100**	0.01		**31**					
2.5	**198**	**60**	0.0167		**41**					
3.5	**151**	**50**	0.02		**51**					
6	**137**	**25**	0.04		**12**					
10	**178**	**15**	0.0667		**22**					
15	**120**	**10**	0.1		**32**					
25	**179**	**6**	0.1667	**1**	**42**	**3,9**				**Default**
40	**158**	**5**	0.2		**52**					
60	**170**	**2.5**	0.4		**13**					
100	**180**	**1.5**	0.6667		**23**					
150	**147**	**1**	1		**33**					
250	**181**	**0.6**	1.6667		**43**					
400	**191**	**0.4**	2.5		**63**					
600	**192**	**0.25**	4		**14**					
1000	**193**	**0.15**	6.6667		**24**					

Table 13. Configuration variants for meter factor (DD) and pulse length (E) with fixed divider 1 for MULTICAL®. These variants can only be configured via METERTOOL HCW.

4.3.5 Accessories for Pulse Transmitter/Pulse Divider

Please note that not all article numbers can be directly ordered. Some articles must be ordered via Kamstrup service department (service@kamstrup.com).

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 supply cable	Optional
6699-012	Output module (Y=2), galvanically separated 5550-1062	
6699-013	Output module (Y=3), galvanically separated, “Low power” 5550-1219	
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.A	Wall bracket including mounting kit Can also be applied for MULTICAL® 603	Optional

1) Obligatory when changing from mains supply module to battery supply.
2) Including 5000-290.

Table 14. Accessories for Pulse Transmitter and Pulse Divider.

4.3.6 Cables for Pulse Transmitter/Pulse Divider

Pulse Transmitter and Pulse Divider are available with signal cable lengths 2.5; 5 or 10 m. 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.

4.3.7 Cable Extender Box

Cable Extender Box (Type 6699-036) enables a signal cable length of up to 30 m between ULTRAFLOW® and MULTICAL®. The equipment supports flow-info and does not prohibit bi-directional flow measurement (forward and reverse flow) for ULTRAFLOW® 85 but does not provide galvanic separation (see *paragraph 4.3.1*). Cable Extender Box (Type 6699-036) must be ordered separately.

Kamstrup offers signal cables in lengths of 2.5 m (Type 5000-333), 5 m (Type 5000-259) and 10 m (Type 5000-270), which can be ordered separately. In combination with the signal cables, which are typically delivered with ULTRAFLOW®, different total lengths of up to 20 m between ULTRAFLOW® and MULTICAL® can be realized. With signal cables of varying lengths but of the same quality as Kamstrup’s signal cables, it is possible to find individual solutions for cable extensions up to 30 m between ULTRAFLOW® and MULTICAL®. For electrical connections, see *paragraph 6.10.5*.

5 Dimension sketches

5.1 ULTRAFLOW® 85 DN150-300

All measurements are in mm, unless otherwise stated.

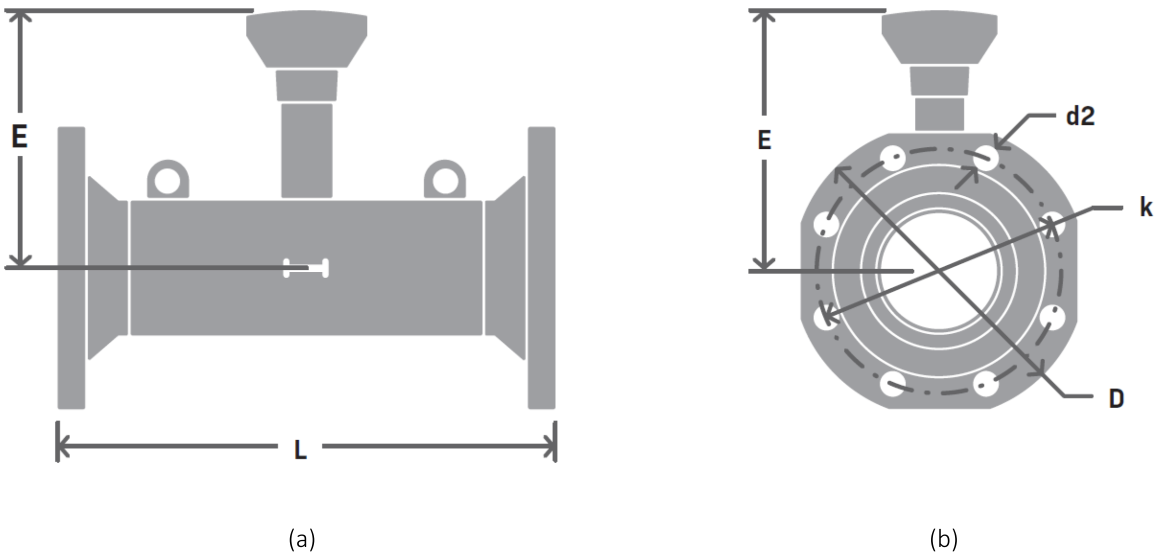


Figure 2. Dimension sketch of ULTRAFLOW® 85 DN150-300: (a) side view and (b) axial view.

Nom. diameter [mm]	PN, PS [bar]	Nom. Flow q_p [m³/h]	L [mm]	D [mm]	k [mm]	Bolts Quantity	Bolts Thread	Bolts d_2 [mm]	E [mm]	Approx. weight [kg]
DN150	16, 16	150 & 250	500	285	240	8	M20	22	264	27
DN200	16, 16	250 & 400	500	340	295	12	M20	22	281	41
DN250	16, 16	400 & 600	600	405	355	12	M24	26	341	67
DN300	16, 16	600 & 1000	500	460	410	12	M24	26	370	80

Nom. diameter [mm]	PN, PS [bar]	Nom. Flow q_p [m³/h]	L [mm]	D [mm]	k [mm]	Bolts Quantity	Bolts Thread	Bolts d_2 [mm]	E [mm]	Approx. weight [kg]
DN150	25, 25	150 & 250	500	300	250	8	M24	26	264	33
DN200	25, 25	250 & 400	500	360	310	12	M24	26	281	53
DN250	25, 25	400 & 600	600	425	370	12	M27	31	341	83

Flange facing type B, raised face according to EN 1092-1

Table 15. Dimensions and weight of ULTRAFLOW® 85 DN150-300.

5.2 Pulse Transmitter and Pulse Divider

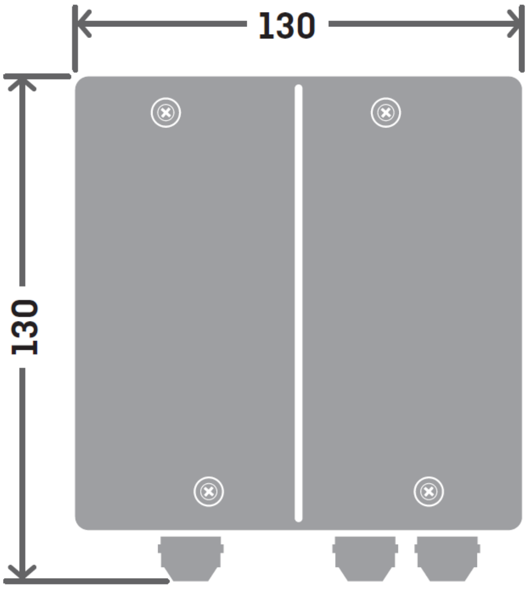


Figure 3. Pulse Transmitter/Pulse Divider seen from the front.

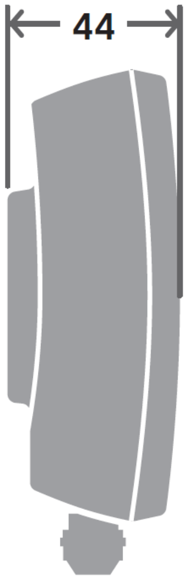


Figure 4. Pulse Transmitter/Pulse Divider seen from the side.

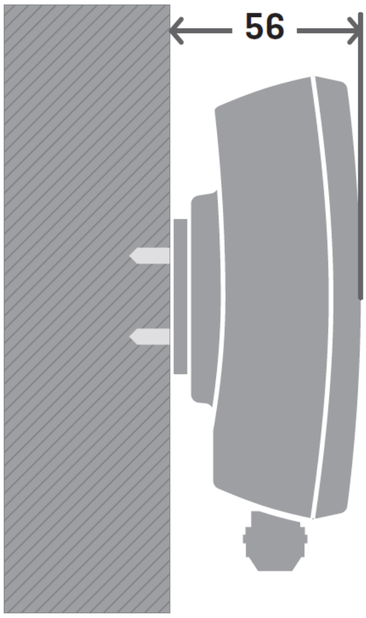


Figure 5. Wall-mounted Pulse Transmitter/Pulse Divider.

5.3 Cable Extender Box

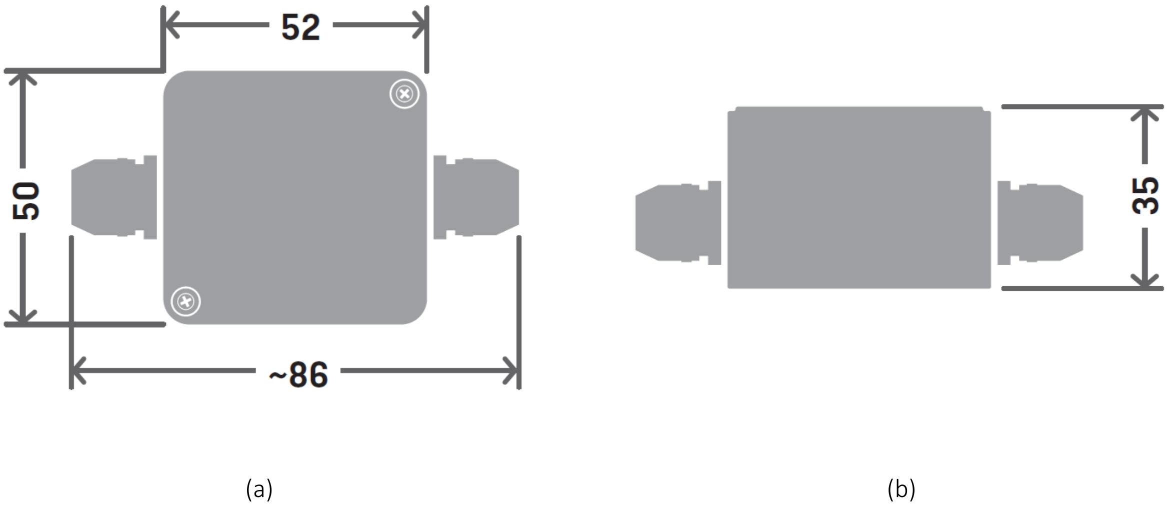


Figure 6. Cable Extender Box seen from the front (a) and from the side (b).

6 Installation

Please read this chapter carefully before installing the energy meter. In case of incorrect mounting, Kamstrup's guarantee obligations no longer apply.

6.1 Guidelines for dimensioning and operating conditions

6.1.1 Introduction

General recommendations for heat and cooling meter installation can be found in EN 1434-6, "Heat meters – Part 6: Installation, commissioning operational monitoring and maintenance" and CEN TR 13582, "Heat meter installation. Instructions in selection, installation and use of heat meters". Due to copyrights, Kamstrup cannot provide you directly with these documents. To acquire CEN TR 13582 (and other EN standards), please refer, for example, to the Danish Standard organization's web shop https://webshop.ds.dk/en-gb/frontpage?CurrencyCode=EUR. Alternatively, you can find your national standardization organization here https://www.iso.org/members.html.

Consider the following general risks and advice:

By connecting to 230 VAC supply, there is a risk of electrical shock.

When working on the flow sensor in the installation, there is a risk of outflow of (hot) water under pressure.

At a media temperature higher than 60 °C, the flow sensor should be shielded from unintended contact.

New fiber gaskets of the original quality must be used.

ULTRAFLOW® 85 must not be lifted on the electronics casing.
Instead lifting rings can be used.

Only use clean water on a damp cloth to clean the meter.

Prior to installation of the flow sensor, the system should be flushed.

Correct flow sensor position (inlet or outlet) appears from the front label or the display of MULTICAL®. The forward flow direction is indicated by an arrow on the flow sensor. For a correct energy calculation in the calculator, when ULTRAFLOW® 85 is measuring reverse flow, the flow sensor must typically be mounted in outlet ( ) next to t2. See *6.3.2 Application no. 1 – reverse flow*.

When the installation has been completed, water flow can be turned on. Carry out an operational check of the complete thermal energy meter after installing the meter and before leaving the installation site.

6.1.2 Dimensioning

Consider, among others, the following aspects when dimensioning the meter:

Pipe dimension: Note that the flow sensor size shall fit the pipe dimension of the installation. However, one dimension up or down in flow sensor size will in general cause no problems. This means that for a pipe dimension of e.g. DN200 in the installation, a flow sensor size of DN 200 is optimum, but DN150 and DN250 are also acceptable. In general, a smooth transition from the installation pipe to the measuring section, where the flow sensor is installed, shall be established. See also Kamstrup doc. nr. FILE100001074_EN_(5811-6554_GB) (The importance of correct flow sensor dimensioning; can be found e.g. here Link-UF85) and *Figure 7*.

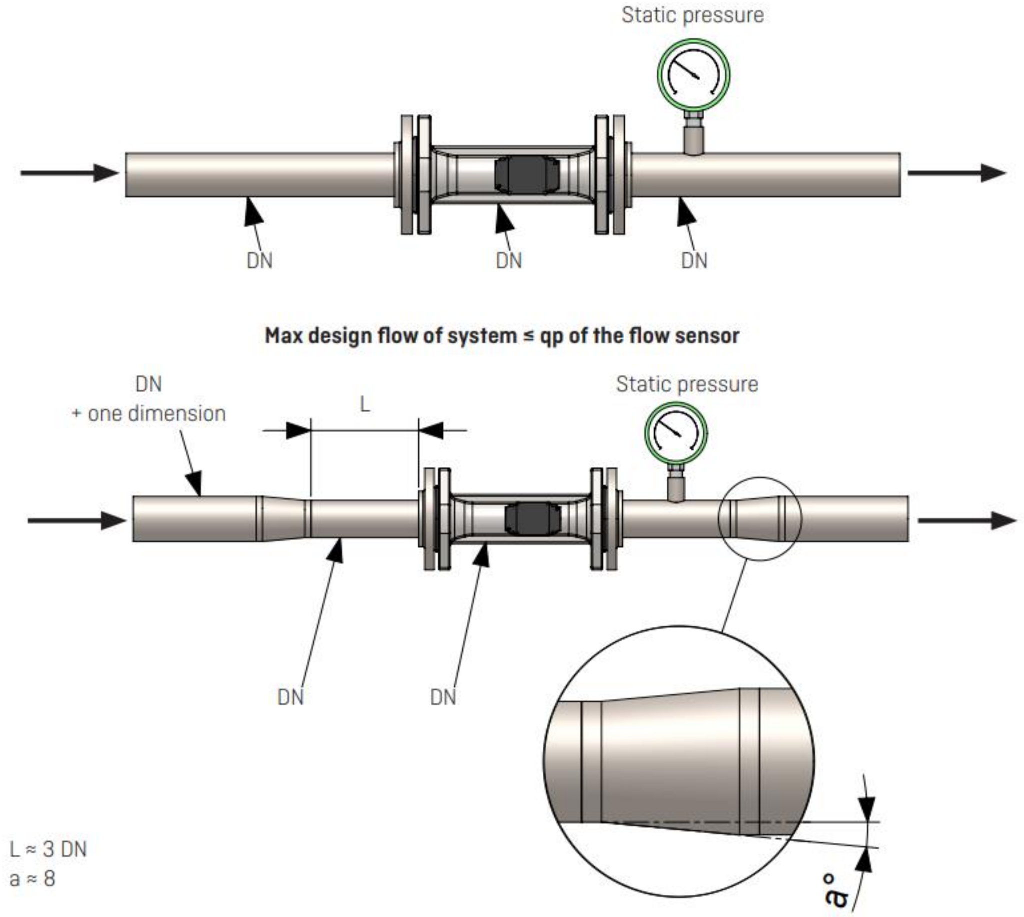


Figure 7. Dimensioning of flow sensors.

Flow: The maximum design flow in the system must in general not exceed the nominal flow q_p of the flow sensor. For further explanation, see *6.1.4 Operating pressure*.

Static pressure: The static pressure at the flow sensor outlet must at all times be above the minimum requirement and in general below the maximum allowable pressure. For further details, see *6.1.4 Operating pressure*.

Meter factor: The meter factor of ULTRAFLOW® and MULTICAL® must be identical (see type label/display). For further details about available meter factors of ULTRAFLOW®, see *Table 1*.

6.1.3 Operating conditions

The meter must be suitable for the foreseeable operating conditions in the installation:

Pressure stage: PN16, PS16 or PN25, PS25, see marking. The marking of the flow sensor also covers accessories included such as gaskets.

Medium temperature [1]: 2…150 °C or narrower range, see marking.

[1] At medium temperature higher than 60 °C the flow sensor should be shielded against unintentional contact. At medium temperatures above 120 °C the flow sensor must be insulated. See also *6.4 Insulation*.

Mechanical environment: **MID M1** – applies to instruments used in locations with vibration and shocks of low significance, e.g. for instruments fastened to light supporting structures subject to negligible vibrations and shocks transmitted from local blasting or pile-driving activities, slamming doors, etc.– **and M2** – applies to instruments used in locations with significant or high levels of vibration and shock, e.g. transmitted from machines and passing vehicles in the vicinity or adjacent to heavy machines, conveyor belts, etc. (Note that ULTRAFLOW® 85 has passed successfully the M3 type test.)

Electromagnetic environment: **MID E1** – applies to instruments used in locations with electromagnetic disturbances corresponding to those likely to be found in residential, commercial and light industrial buildings. – **and E2** – applies to instruments used in locations with electromagnetic disturbances corresponding to those likely to be found in other industrial buildings. **EN 1434 class C** (high electrical and electromagnetic conditions).
⚠ **The meter's cables must be drawn at min. 25 cm distance from other installations.**

Ambient conditions: The ambient temperature must be within 5…55 °C. Installation must be in closed locations (indoors).

Static pressure: To minimize the risk of measuring errors as a result of cavitation or air in the water it is recommended to keep a sufficient static pressure at the flow sensor outlet of min 1.5 bar at q_p and min 2.5 bar at q_s. This applies to temperatures up to approx. 80 °C. It is particularly recommended to follow this advice during meter calibration. In absence of cavitation, the flow sensor is typically functioning at lower operating pressure. See also *6.1.4 Operating pressure.*

Pressure loss: Consider the pressure loss of the installed flow sensor for dimensioning of pumps in your installation. For further details, see *6.1.5 Pressure loss.*

Protection class [1] /		
Climatic conditions:	Flow sensor:	IP68 [2]
[1] acc. to EN 60529	Cable Extender Box:	IP68 [2]
	Pulse Transmitter/	
	Pulse Divider:	IP67

[1] IP**6**X means that persons handling the instrument are protected against access to hazardous parts even when dealing with a thin wire of 1.0 mm diameter. In addition, the inside of the instrument is protected against ingress of dust (**dust-tight**).

[3] IPX**8** means that ingress of water in quantities causing harmful effects are not possible even when the enclosure of the instrument is **continuously immersed** in water **as specified by the manufacturer**.

For the flow sensor ULTRAFLOW® 85 this means that it is well protected and durable in **permanently wet conditions**. However, to avoid long-term effects of possible water ingress in cooling installations, we recommend not rotating the electronics box pointing downwards (see *Figure 16*).

For the Cable Extender Box, this means that the IP class is significantly higher than required by EN 1434 for other enclosures, which are not to be installed in pipe work. Note that it is the responsibility of the installer to ensure proper mounting of the cable screw connections as otherwise the IP classification is not valid.

[2] IPX**7** means that ingress of water in quantities causing harmful effects are not possible even when the enclosure of the instrument is **temporarily immersed** in water.

For the Pulse Transmitter/Pulse Divider, this means that it is well protected and durable in periodically wet conditions. It withstands being submerged for max 30 min, but only in case of proper mounting of the cable screw connections. It is the responsibility of the installer to ensure proper mounting of the cable screw connections as otherwise IP classification is not valid (see *6.10.4.4 Cable screw connections*). When the electronics box is wall-mounted or mounted via the bracket 3026-1392 on ULTRAFLOW® 85 it is even well protected and durable in permanently wet conditions.

When installing a thermal energy meter, the installation recommendations of all three sub-assemblies, i.e. flow sensor, temperature sensor set and calculator, must be considered. This applies in particular when a calculator is mounted directly on a flow sensor.

6.1.4 Operating pressure

To minimize the risk of measuring errors as a result of cavitation or air in the water, it is recommended to keep a sufficient static pressure at the flow sensor outlet of min 1.5 bar at q_p and min = 2.5 bar at q_s. This applies to temperatures up to approx. 80 °C. It is particularly recommended to follow this advice during meter calibration. In absence of cavitation, the flow sensor is typically functioning at lower operating pressure.

It is not necessarily cavitation in the sensor itself but also bubbles from cavitating pumps and regulating valves mounted before the sensor. It can take some time until such bubbles have been dissolved in the water. Furthermore, water can include air which is dissolved in the water. The amount of air which can be dissolved in water depends on pressure and temperature. This means that air bubbles can be formed due to a decrease in pressure, e.g. caused by a velocity rise in a pipe contraction or in the sensor. The risk of these factors affecting accuracy is reduced by maintaining a suitable pressure in the system.

In relation to the recommended static pressure, the steam pressure at the current temperature must also be considered. The recommended static pressure applies to temperatures up to approx. 80 °C.

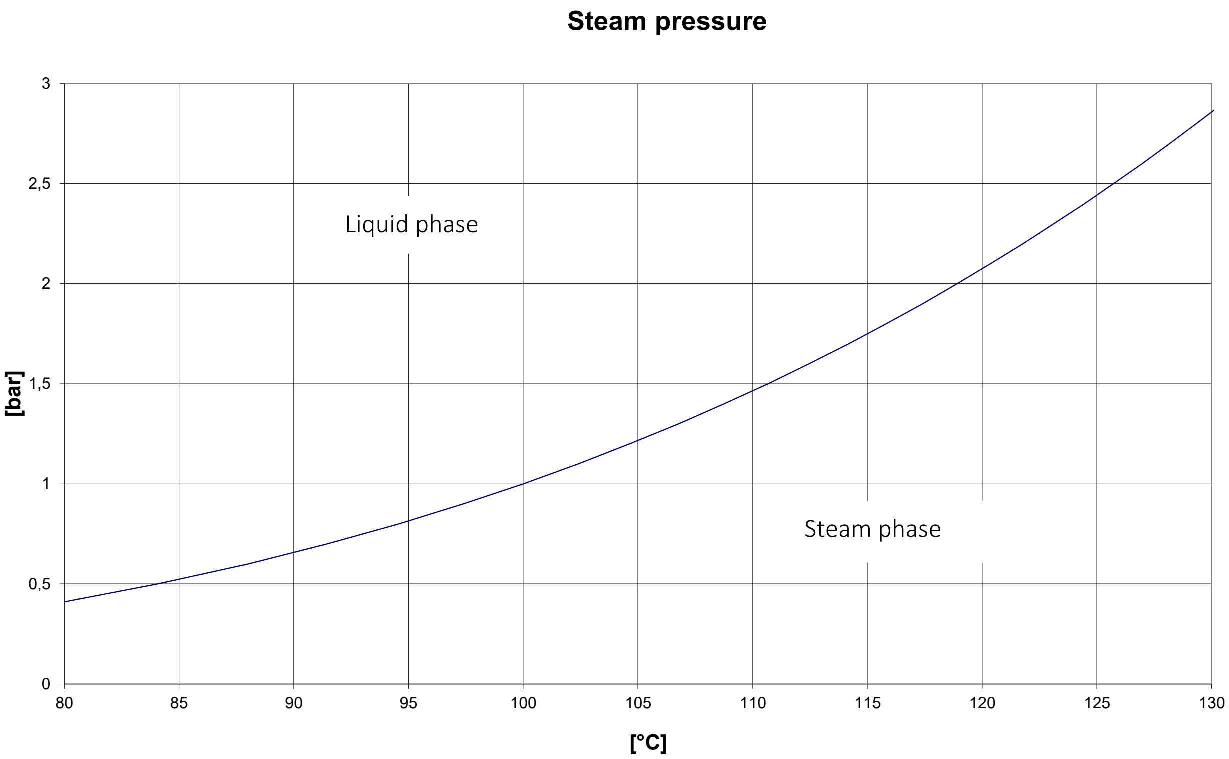


Figure 8. Steam pressure of water. At low temperature and high pressure, water is in the liquid phase. At high temperature and low pressure, water is in the steam phase. The blue curve characterizes the equilibrium of the liquid and steam phases.

The steam pressure is the pressure where steam and liquid are in equilibrium at the current temperature (boiling point at a given pressure). At low temperature and high pressure, water is in the liquid phase. At high temperature and low pressure, water is in the steam phase. The blue curve (the steam pressure curve) in *Figure 8* thus characterizes the equilibrium of the liquid and steam phases. This means that the static pressure in water must be increased at a given temperature to avoid the steam phase that is shown in the lower right corner of the graph in *Figure 8.*

Furthermore, it must be taken into account that the above static pressure is lower after a contraction than before (e.g. at cones). This means that the static pressure – when measured elsewhere in the installation– might be different from the pressure at the flow sensor outlet.

This can be explained by combining Bernoulli’s equation and the continuity equation. Based on Bernoulli's equation, the total pressure of the flow will be the same for any cross section. It can be reduced to:

$p_{stat.} + p_{dynam.} = p_{stat.} + \frac{1}{2}\rho v^2 = constant$ (Bernoulli's equation)

$p_{stat.}$ is the static pressure. $\left[Pa = \frac{N}{m^2} = \frac{kg}{s^2 \cdot m}\right]; 1\ bar = 10^5 \frac{N}{m^2}$

$p_{dynam.}$ is the dynamic pressure. $[Pa = \frac{N}{m^2} = \frac{kg}{s^2 \cdot m}]; 1\ bar = 10^5 \frac{N}{m^2}$

ρ is the water density. $[\frac{kg}{m^3}]$

v is the water flow rate. $[\frac{m}{s}]$

The continuity equation determines that the product of pipe cross sectional area A and average flow velocity v, which corresponds to the volume flow rate passing through, is constant for an incompressible fluid like e.g. water. Therefore, the flow velocity is increased in a contraction and the static pressure decreases.

$q = A_1 \cdot v_1 = A_2 \cdot v_2 = \cdots = A_i \cdot v_i = constant$ (Continuity equation)

When dimensioning a flow sensor, you must take the above into consideration, especially if the sensor is used within the scope of EN 1434 between q_p and q_s, and in case of major pipe contractions. In general, the maximum design flow in the system must NOT exceed the nominal flow q_p of the flow sensor.

6.1.5 Pressure loss

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

The pressure loss in a meter increases with the square of the flow and is usually stated as a direct proportionality between the flow and the square root of the pressure loss:

$$\Delta p = \frac{1}{k_v^2} q^2 \Leftrightarrow q = k_v \times \sqrt{\Delta p}$$

where:

q = volume flow rate $[q] = \frac{m^3}{h}$

k_v = volume flow rate at 1 bar pressure loss $[k_v] = \frac{m^3}{h \cdot \sqrt{bar}}$

Δp = pressure loss $[\Delta p] = bar;\ 1\ bar = 10^5 Pa$

Graph	Nom. flow q_p [m³/h]	Type number [1)]	Nom. diameter [mm]	Length [mm]	$\Delta p@q_p$ [bar]	k_v	q@0.25 bar [m³/h]
A	150	65-85- FCxN -XXX	DN150	500	0.02	1100	550
	250	65-85- FDxN -XXX			0.06		
B	250	65-85- FDxP -XXX	DN200	500	0.02	1945	973
	400	65-85- FExP -XXX			0.04		
C	400	65-85- FExR -XXX	DN250	600	0.02	2940	1470
	600	65-85- FFxR -XXX			0.04		
D	600	65-85- FFDS -XXX	DN300	500	0.01	5900	2950
	1000	65-85- FGDS -XXX			0.03		

1) *XXX - code for final assembly, approvals etc. - determined by Kamstrup. A few variants may not be available in national approvals. x = C (PN25) or x = D (PN16).*

Table 16. Pressure loss table.

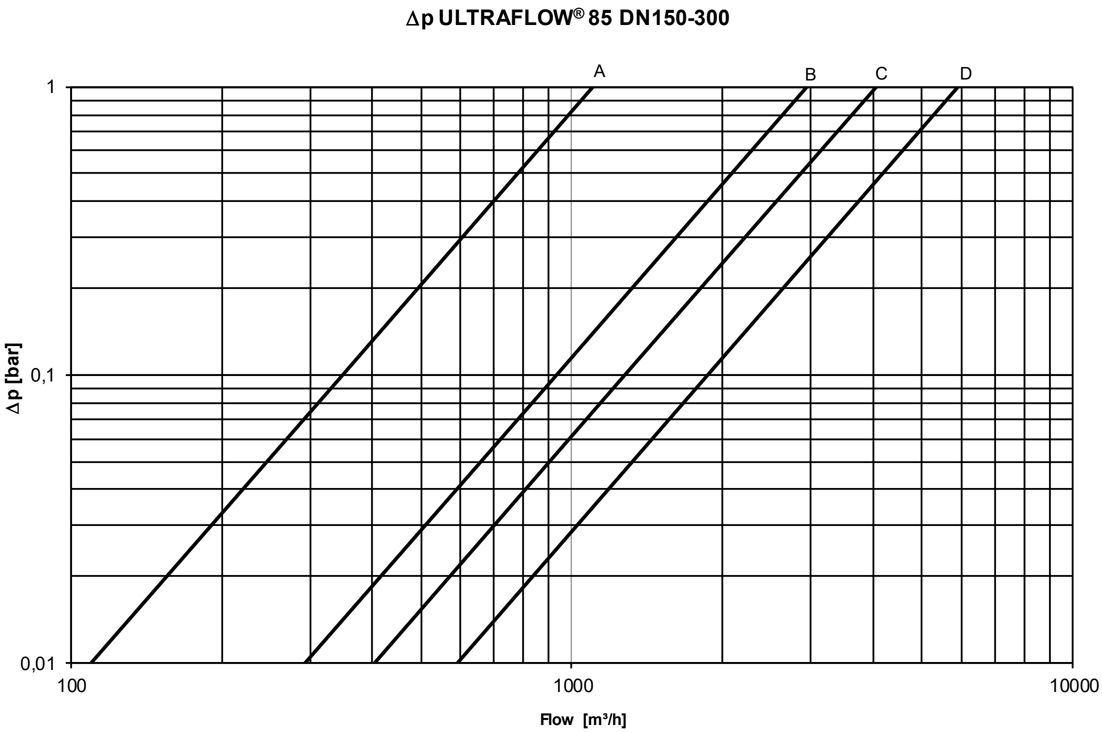


Figure 9. Pressure loss diagram.

6.2 Connection to calculator and cable lengths

Figure 10 illustrates the most common connections between ULTRAFLOW® 85 and MULTICAL®. See also *Table 17* for cable lengths and recommended cable cross sections. In case that, the 3-wire cable is not yet mounted in ULTRAFLOW® 85 from factory, consult paragraph *6.11.1 Mounting of 3-wire cable in ULTRAFLOW® 85*.

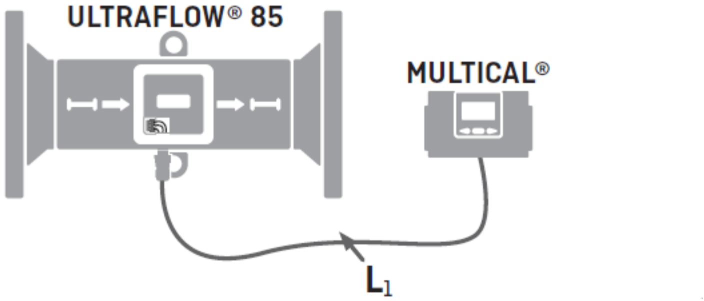
(a) Direct connection of ULTRAFLOW® is only permitted to Kamstrup MULTICAL® calculators on terminals 11-9-10 with a cable length of L1 ≤ 10 m (see also *6.10.1 Electrical connection of ULTRAFLOW® and MULTICAL®*).
Connection to other calculator types requires galvanic separation between ULTRAFLOW® and the calculator, which is provided by a galvanically separated output module in Pulse Transmitter. Check that the meter factor is the same on the flow sensor and the calculator or connect a Pulse Divider with proper coding in between, if this is not the case.
ULTRAFLOW® 85 can be provided with a signal cable length of 2.5 m, 5 m or 10 m. If necessary in your installation, the signal cable length can be shortened. In these cases, we recommend using cable end sleeves and crimping them.

(b) Connection of ULTRAFLOW® 85 via Cable extender box to Kamstrup MULTICAL® calculators allows a cable length between ULTRAFLOW® and MULTICAL® of maximum 30 m.
Cable extender box provides flow-info and does not prohibit bi-directional flow measurement (forward and reverse flow) for ULTRAFLOW® 85 but does not provide galvanic separation. Consult chapter *6.10.5 Electrical connection of Cable Extender Box* for additional details about the electrical connection of the cable extender box.

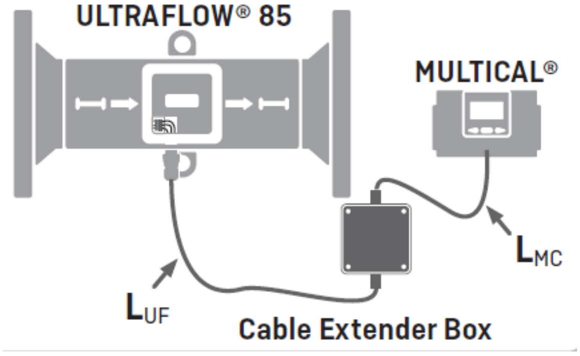
(c) Cable lengths of more than 30 m between ULTRAFLOW® and the calculator requires galvanic separation from the Pulse Transmitter (Pulse Divider). Consult paragraphs *6.10.2 Electrical connection of Pulse Transmitter and Pulse Divider* and *6.10.3 Cable lengths when using Pulse Transmitter/ Pulse Divider* for additional details about the electrical connection and cable lengths when using of Pulse Transmitter and Pulse Divider

L_1	≤ 10 m	3 x ø 0.5 mm²
L_2	≤ 10 m	3 x ø 0.5 mm²
L_3	≤ 10 m	3 x ø 0.5 mm²
L_3	≤ 100 m	2 x ø 0.5 mm²
L_{UF}	≤ 29 m	3 x ø 0.5 mm²
L_{MC}	≤ 1 m	3 x ø 0.5 mm²

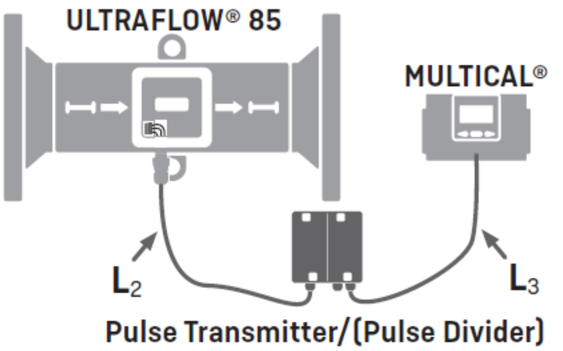
Table 17. Maximum allowable cable length and recommended cable cross section for the 3-wire cable between ULTRAFLOW® and MULTICAL®.



(a)



(b)



(c)

Figure 10. Examples for the connection of ULTRAFLOW® 85 to MULTICAL®.
(a) Direct connection, (b) connection via Cable extender box, and (c) via Pulse Transmitter/ Pulse Divider.

6.3 Flow sensor position (Inlet/Outlet)

Correct flow sensor position of (inlet or outlet) appears from the front label or display of MULTICAL® where indicates the position in inlet and indicates the position in outlet. When ULTRAFLOW® is connected to another calculator, ULTRAFLOW® can be used for both inlet and outlet. Crucial is the coding of the calculator. The forward flow direction of ULTRAFLOW® is indicated by arrows on the flow sensor.

6.3.1 Application no. 1 – forward flow

Figure 11 illustrates as an example application no. 1 (closed thermal system with 1 flow sensor). The flow direction of the district heating/cooling water is clockwise oriented. ULTRAFLOW® 85 is measuring in this case flow in forward direction. The measured volume increase is in this case registered in the V1 register of MULTICAL®. Temperature sensors are mounted downstream, i.e. after the flow sensor. The k-factor (k_{t1} or k_{t2}) depends on the coding of the calculator, which determines the requested flow sensor position in inlet or outlet.

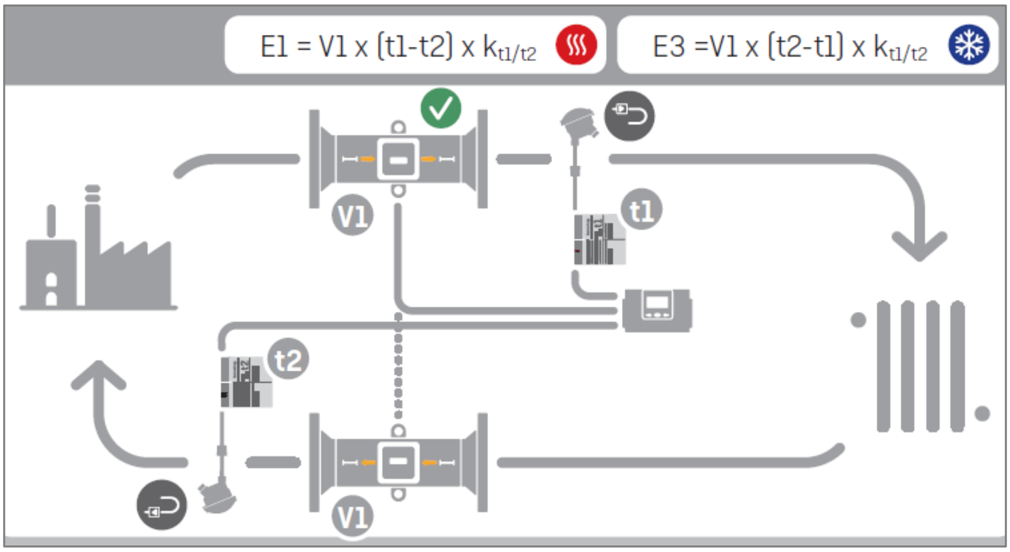


Figure 11. Application no. 1: Closed thermal system with 1 flow sensor.

6.3.2 Application no. 1 – reverse flow

Figure 12 illustrates an example for measuring reverse flow with ULTRFOW® 85. In comparison to the application shown in *Figure 11*, the former consumer of heat energy is now providing surplus heat energy and has become a producer. In addition, the flow direction of the district heating water is counterclockwise, which requires measuring of reverse flow in the existing installation of the flow sensor. The measured volume increase is in case of reverse flow always registered in the V2 register of MULTICAL®.

⚠ The volume registration in the V2 register for reverse flow is processed internally in e.g. MULTICAL® 603-S/-U and must not be confused with the physical connection of the 3-wire cable in MULTICAL®. For an application with one flow sensor the V1 screw terminals in MULTICAL® are used to physically connect the flow sensor.

⚠ Due to limitations in the possible coding of the current MULTICAL®-calculators, the acceptable flow sensor position in inlet or outlet is also limited. In the example shown below, E2 can only be calculated with k_{t2}. Thus, for a correct energy calculation in the calculator, when ULTRAFLOW® 85 is measuring reverse flow, the flow sensor must be mounted in outlet ( ) next to t2. Consult the technical description of the connected calculator for additional energy registers, which take the volume register V2 into account. Crucial for the position of the flow sensor is the k-factor used for energy calculation (k_{t1}, k_{t2} or k_{t3}).

⚠ The energy calculation in additional energy registers like e.g. E2, E7 and E12 is technically correct, i.e. accurate with identical tolerances known from registers for heat (E1) and cooling (E3), but the additional energy registers are not approved under MID and not verified. When using these energy registers for billing, national requirements for approved and verified registers must be obeyed. Alternatively, an agreement between equal parties can be made.

In general, mounting of any flow disturbing obstacles before a flow sensor (upstream) is not recommended. However, when measuring both forward flow and reverse flow as input for the measurement of thermal energy, it is impossible to avoid upstream mounting of the temperature sensor in both cases. The diameter of typical temperature sensors or pockets is though comparatively small in comparison to the diameter of the flow sensors ULTRAFLOW® 85 (≥ DN150). It has therefore been judged that approximately 30 cm distance[1] can be considered as a good compromise of having a sufficient reduction of any significant influence of flow disturbances from the temperature sensors on the performance of the flow measurement of ULTRAFLOW® 85 and still using a correct temperature for the k-factor. Correct means that it corresponds to the position of the flow sensor, where the water volume is measured. When pipes are insulated, the distance of the temperature sensor might be chosen larger.

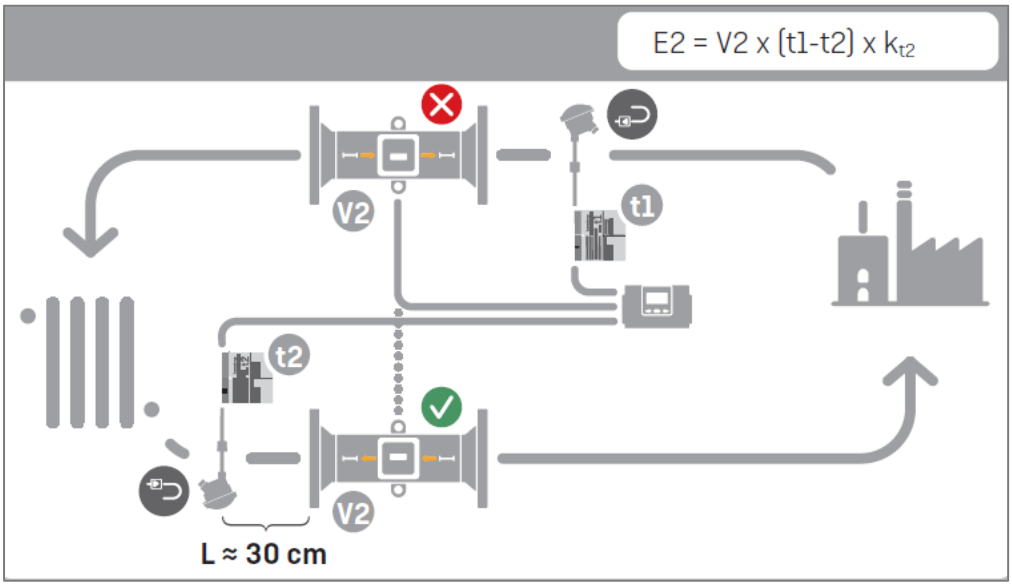


Figure 12. Application no. 1: Closed thermal system with 1 flow sensor measuring reverse flow.

6.3.3 Application with 2 flow sensors ULTRAFLOW® 85

In general, when 2 flow sensors shall be used in an application, consider the recommendations in paragraph *6.11.4 Calculator with two flow sensors*.

When ULTRAFLOW® 85 is connected correctly at V1 screw terminals[2] in MULTICAL® 603-S/-U or MULTICAL® 803 (from SW 14890801 (H1) on) with CCC-codes 4xx, 5xx or 8xx, ULTRAFLOW® 85 will be in serial operation state, enabling among others bi-directional flow measuring, and the screw terminals for V2 in the MULTICAL®-calculators will in that case be blocked internally. To avoid blocking of the V2 screw terminals in these MULTICAL®-calculators, the calculator must be configured with a CCC-code 1XX or 2XX for "Electronic meters with quick and bounce-free pulses". In that case ULTRAFLOW® 85 will operate in pulse operation state and 2 flow sensors ULTRAFLOW® 85 can be connected to the calculator, one at V1 and the second one at V2, both emitting volume proportional pulses to the calculator.

In case that ULTRAFLOW® 85 is operating in pulse operation state, e.g. in combination with Pulse Transmitter/Pulse Divider[3] or MULTICAL® 603-A/-B/-C/-D/-E/-F/-G/-H, 2 flow sensors ULTRAFLOW® 85 can be connected to the calculator, one at V1 and the second one at V2, both emitting volume proportional pulses to the calculator. The CCC-code of the connected MULTICAL®-calculators will in that case typically be either 4xx/5xx (for "Electronic meters with quick and bounce-free pulses as well as data for info codes for ULTRAFLOW® X4/X5) or 8xx (for Electronic meters with quick and bounce-free pulses as well as data for info codes for ULTRAFLOW® X4 and Auto Detect).

For additional details about CCC-codes and the possibility of changing these, consult the Technical descriptions for MULTICAL® 603 and MULTICAL® 803 (Link-MC603, Link-MC803).

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[1] Flow disturbances are considered being sufficiently decayed after approximately 10 times the diameter of the disturbing obstacle (diameter of temperature sensor or pocket diameter).
[2] When connected wrongly at V2 screw terminals, ULTRAFLOW® 85 will operate in pulse operation state, and emit volume proportional pulses to the calculator.
[3] When in rare cases Pulse Transmitter (PT) or Pulse Divider (PD) is connected between ULTRAFLOW® and MULTICAL®, a CCC-code 1xx or 2xx is recommended for MULTICAL®. When using CCC-codes 4xx, 5xx or 8xx, an info code error will be registered in MULTICAL® due to galvanic separation from PT/PD.

6.4 Insulation

Insulation of pipes utilized for transmitting thermal energy conveying liquids is in general always recommended, because the insulation reduces losses of valuable heat energy or avoids heating of the medium, which is utilized for cooling. Thus, insulation optimizes the supply of thermal energy with thermal energy conveying liquids. To further optimize the supply, insulation of flow and temperature sensors, which are both in direct contact with the thermal energy conveying liquid, must also be addressed. Insulation of both sub-assemblies will reduce heat dissipation errors for temperature sensors and reduce stratification effects in the flow sensor and optimize thereby the metrological performance in installations with a large temperature gradient between pipes and the environment. To avoid stratification effects insulation of upstream pipes is at minimum equally important as insulation of the flow sensor. As the calculator of a heat/cooling meter is not in direct contact with the thermal energy conveying liquid, insulation of the calculator as such is not applicable. However, due to the possibility of mounting the calculator directly on the flow sensor, installation recommendations for the calculator must be considered depending on the temperature of the medium and the environment.

Insulation has the effect that all parts under the insulation might reach temperatures up to the temperature of the thermal energy conveying liquid as thermal balance to the environment is prohibited. This might be critical to some components, in particular to sensitive electronics. Predominantly in cooling installations, humidity from the warm environment will condense on comparatively colder pipes. This is why they are often permanently wet. Insulation therefore requires temperature stability of the insulated parts within the approved range of the medium temperature as well as waterproof encapsulation of sensitive electronic components in cooling installations in warm and humid environments. Finally, note that local rules concerning insulation of pipes might apply.

The following general rules apply for installing heat/cooling meters:

- Calculators must in general be wall-mounted at medium temperatures higher than 90 °C to protect sensitive electronics inside.[4]

- Calculators usually have a lower IP-class than the connected flow sensor and must therefore NOT be mounted on the flow sensor in cooling installations to avoid condensation and water penetration into the calculator. Note that condensation is induced from the flow sensor itself but can also come from other parts of the installation. This becomes even more critical in warm and humid environments.[5]

- Cable connections must always point downwards, and cables must in general hang freely downwards to form a drip nose for drainage of condensation.

⚠ Kamstrup flow sensors are only designed for water as the thermal energy conveying medium.

[4] Due to the mechanical design of ULTRAFLOW® 85 with an extension tube, MULTICAL® 603 might still be mounted on the calculator mount bracket 3026-1392 as this provides sufficient distance to the pipe.
[5] Due to the mechanical design of ULTRAFLOW® 85 with an extension tube, MULTICAL® 603 might still be mounted on the calculator mount bracket 3026-1392 as this provides sufficient distance to the pipe.

Table 18 gives a general overview of the insulation recommendations for Kamstrup flow and temperature sensors. *Figure 21* illustrate specifically the insulation of ULTRAFLOW® 85 DN150-300.

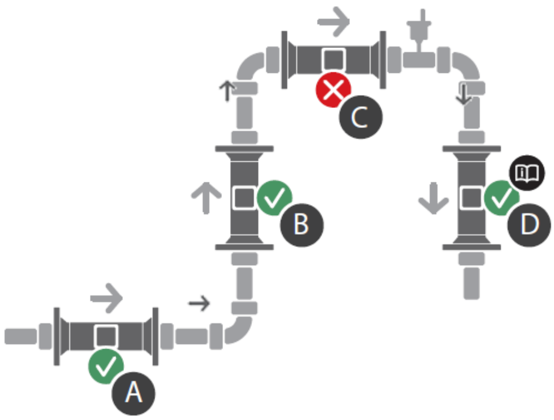
<table>
<tr><th rowspan="2">Flow sensor</th><th>Cooling</th><th colspan="3">Heat</th></tr>
<tr><th>T_{medium} < ambient</th><th>T_{medium} < 110 °C</th><th>T_{medium} > 110 °C</th><th>T_{medium} > 120 °C</th></tr>
<tr><td>MULTICAL® 303</td><td colspan="2" rowspan="3">YES – recommended</td><td colspan="2" rowspan="3">YES – recommended
(except the plastic casing)</td></tr>
<tr><td>MULTICAL® 403</td></tr>
<tr><td>ULTRAFLOW® 44
DN15-125</td></tr>
<tr><td>ULTRAFLOW® 54
DN15-125</td><td>N/A</td><td colspan="3">YES – recommended
(except the plastic casing)</td></tr>
<tr><td rowspan="2">ULTRAFLOW® 85
DN150-300</td><td colspan="3">YES – recommended
(except the plastic casing)</td><td>YES –
REQUIRED</td></tr>
<tr><td colspan="4">The hole of the extension tube must NOT be covered</td></tr>
<tr><td>TemperatureSensor 63 & 83</td><td colspan="4">YES</td></tr>
</table>

Table 18. Overview of insulation recommendations for different flow sensors and for TemperatureSensor 63 & 83.

6.5 Inlet prerequisites

ULTRAFLOW® 85 DN150-300 requires neither straight inlet nor straight outlet to meet the Measuring Instruments Directive (MID) 2014/32/EU, OIML R75:2002 and EN 1434. A straight inlet section is only necessary in case of heavy flow disturbances before the meter. It is recommended to follow the guidelines in *CEN TR 13582, Heat meter installation. Instructions in selection, installation and use of heat meters*. See also Kamstrup doc. no. FILE100001058_EN_(5811-6595_GB) (The challenge of correct flow sensor installation with respect to flow disturbances; can be found e.g. here Link-UF85).

Optimal position can be obtained if you take the below installation recommendations into consideration:

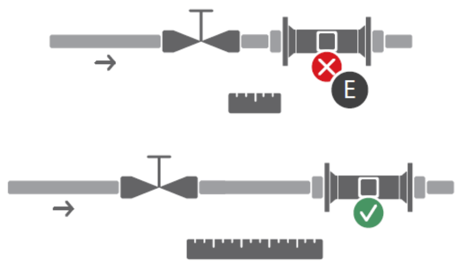


A Recommended position – horizontally mounted.

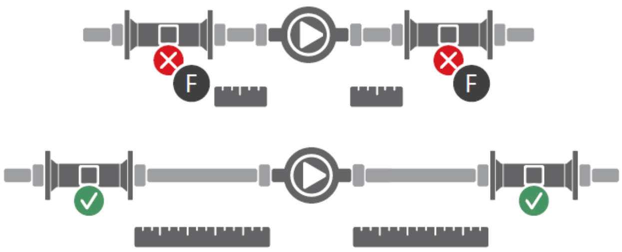
B Recommended position – vertically mounted with flow pipe upwards.

C Unacceptable position due to risk of air build-up.

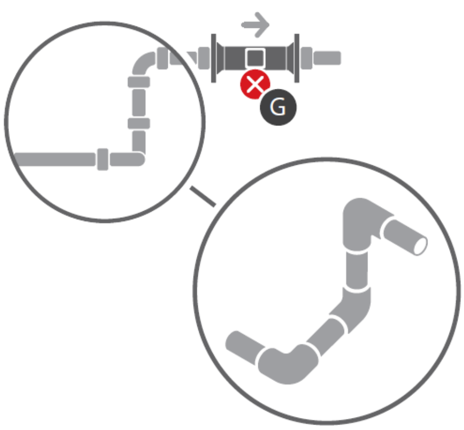
D Acceptable position in closed systems – vertically mounted with flow pipe downwards.
Unacceptable position in open systems due to risk of air build-up in the system.



E A flow sensor ought not to be placed immediately after a valve, with the exception of shut-off valves (full bore ball valve type), which must be fully open when not used for shutting off.



F A flow sensor ought not to be placed immediately before (on the inlet side) or immediately after (on the pressure side) a pump.



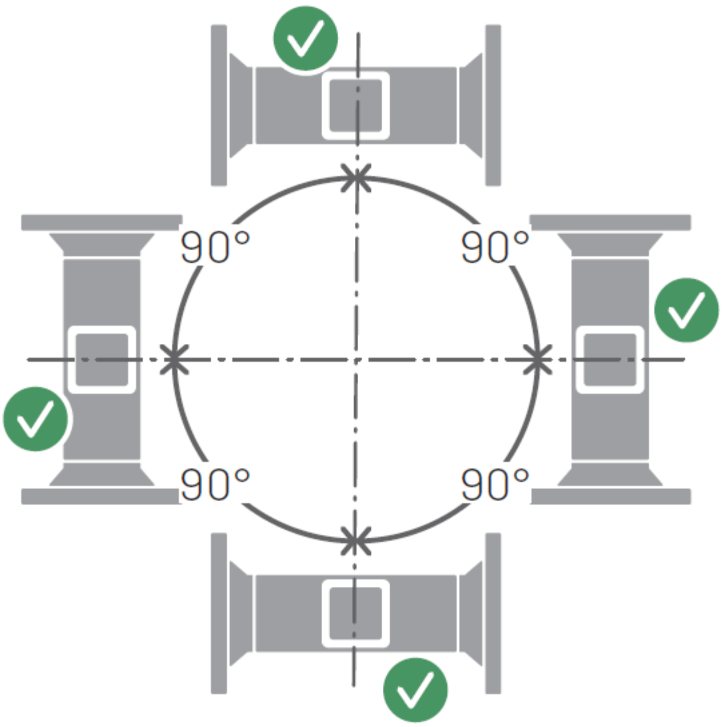
G A flow sensor ought not to be placed immediately after a double bend in two planes.

Figure 13. General installation recommendations for flow sensors.

6.6 Orientation of Kamstrup's flow sensors

The recommended orientation of the flow sensor in an installation takes into account the metrological sensitivity of the flow sensor to orientation, for example because of orientation-dependent flow profiles; poor water quality of district heating water, e.g. dirt, which can accumulate in the flow sensor; air in the system and finally because of environmental requirements, for example in case of condensation. The recommendations may vary for each of the types because of their diversity in the design.

6.6.1 General recommendations



Kamstrup's flow sensors can be mounted vertically, horizontally or at an angle.

If Kamstrup flow sensors are vertically mounted, they can be turned ±360° around the pipe axis.

For readability of the display see *6.9.2 Rotation of the display*.

The plastic box should preferentially be placed on the side (at horizontal mounting). See below for additional details.

Figure 14. Separate mounting of Kamstrup flow sensors. Vertically, horizontally or at an angle.

At horizontal mounting, Kamstrup's flow sensors can be turned around the pipe axis. Acceptable angles of rotation for the various types of Kamstrup flow sensors can be found in *Figure 15* and *Figure 16*.

At medium temperatures above 90 °C and below ambient temperature, i.e. for cooling installations, calculator and Pulse Transmitter/Pulse Divider must not be mounted on the flow sensor except from ULTRAFLOW® 85. Instead wall-mounting is recommended. The orientation of the flow sensor in a cooling installation does therefore not need to take the readability of the calculators display into account and can thereby be limited to the optimum orientation of the flow sensor only.

To obtain optimal metrological performance it is recommended to mount ULTRAFLOW® 85 with the electronics box placed on the side, when mounted horizontally. The ultrasound paths in the flow sensor tube will thus be vertical, which is optimal in connection with possible stratification of the medium, which might occur at low flow. In addition, we recommend insulating both ULTRAFLOW® 85 and pipes before and after to minimize possible stratification.

6.6.2 Recommendations for heat, cooling and bi-functional heat/cooling installations

The general recommendations apply for heat, cooling and bi-functional heat/cooling installations. However, acceptable positioning of the electronics box is depending on the medium temperature. See *Figure 15* and *Figure 16* for further information.

6.6.2.1 Recommendations for heat installations – UF85

Figure 15 shows acceptable orientations for ULTRAFLOW® 85 around the pipe axis, when horizontally mounted in a heat installation.

To obtain optimal metrological performance it is recommended to mount ULTRAFLOW® 85 with the electronics box placed on the side, when mounted horizontally. The ultrasound paths in the flow sensor tube will thus be vertical, which is optimal in connection with possible stratification of the medium, which might occur at low flow. In addition, we recommend insulating both ULTRAFLOW® 85 and pipes before and after to minimize possible stratification.

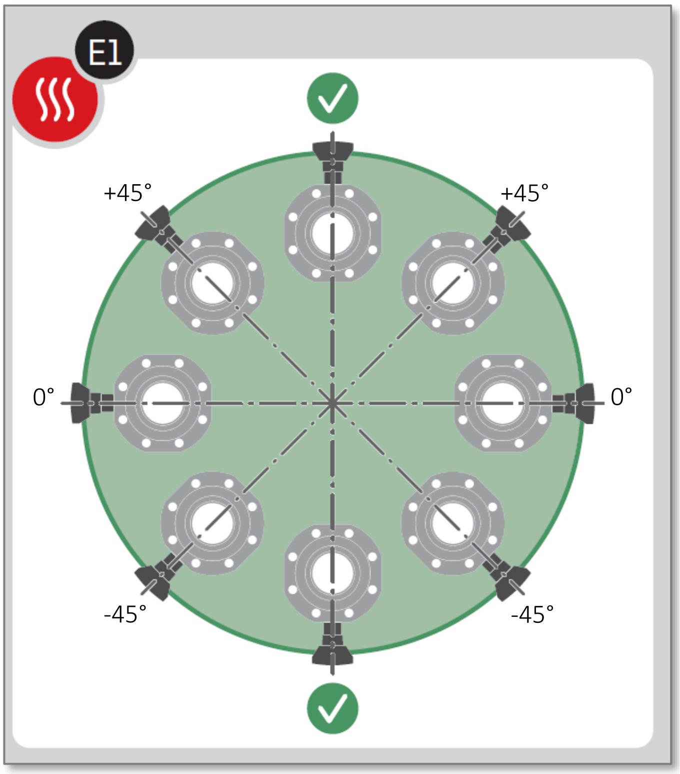


Figure 15: Acceptable orientations around pipe axis, when mounted horizontally in a heat installation.
All orientations are accepted in a heat installation.

6.6.2.2 Recommendations for cooling and combined heat/cooling installations – UF85

Figure 16 shows acceptable orientations for ULTRAFLOW® 85 around the pipe axis, when horizontally mounted in a cooling or combined heat/cooling installation.

To obtain optimal metrological performance it is recommended to mount ULTRAFLOW® 85 with the electronics box placed on the side, when mounted horizontally. The ultrasound paths in the flow sensor tube will thus be vertical, which is optimal in connection with possible stratification of the medium, which might occur at low flow. In addition, we recommend insulating both ULTRAFLOW® 85 and pipes before and after to minimize possible stratification.

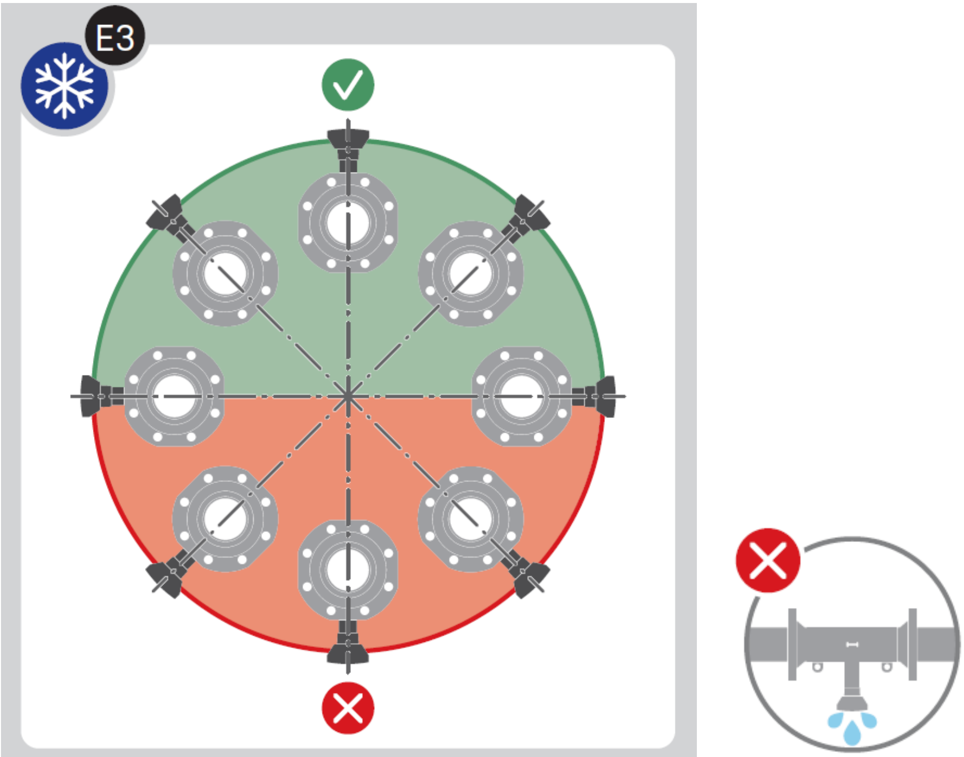


Figure 16: Acceptable orientations around pipe axis, when mounted horizontally in a cooling or combined heat/cooling installation. The electronics box must not be positioned downwards in a cooling installation due to the risk of permanent water stream over the electronics box from condensing water.

6.6.3 Recommendations for directly mounted temperature sensors

When mounting a temperature sensor directly in the outlet of the flow sensor, acceptable orientations for the temperature sensor must be taken into account. For heating installations (*Figure 17 (a)*), the orientation of a temperature sensor is not important as long as a homogeneous temperature distribution can be assumed, i.e. all orientations can be accepted. For cooling installations (*Figure 17 (b)*), water penetration into the sensor element must be avoided. Therefore, a temperature sensor is mounted ideally from the bottom pointing with its tip upwards and can be rotated up to a horizontal position.

(a) (b)

Figure 17. Acceptable orientation of a temperature sensor in (a) a heating and (b) a cooling installation.

6.7 Mounting of Cable Extender Box

Cable Extender Box is lightweight and can therefore hang freely as an integrated part of the signal cable from the ULTRAFLOW® flow sensor to the calculator. Alternatively, Cable Extender Box can be wall-mounted. The base part of Cable Extender Box contains 2 holes for this purpose, which are prepared for mounting screws.

6.8 Maintenance and service during operation

The flow sensor is verified separately and can, therefore, be separated from the calculator. Consult the sealing instructions of the connected calculator such as MULTICAL® 603 (FILE100002141_EN; Technical description can be found here Link-MC603) or MULTICAL® 803 (FILE100000271_EN (55122360); Technical description can be found here Link-MC803). In case this should become necessary, top cover and transparent lid can be exchanged in the field, due to the protection level of an installation seal only (see *Figure 61* and *Figure 62*).

Due to the sealing levels of Pulse Transmitter/Pulse Divider (see *Figure 65*), it is also permitted to replace the supply and exchange the supply type in Pulse Transmitter/Pulse Divider while ULTRAFLOW® is installed in the installation. For battery supply of Pulse Transmitter/Pulse Divider, a lithium battery with connector from Kamstrup A/S must be used. Lithium batteries must be correctly handled and disposed of (see paragraph *12 Disposal*). It is also permissible to replace output modules of Pulse Transmitter/Pulse Divider.

The cable length between ULTRAFLOW® and the MULTICAL® calculator may be extended under certain installation conditions, for example by use of Cable Extender Box, up to max 30 m (see *Figure 32*).

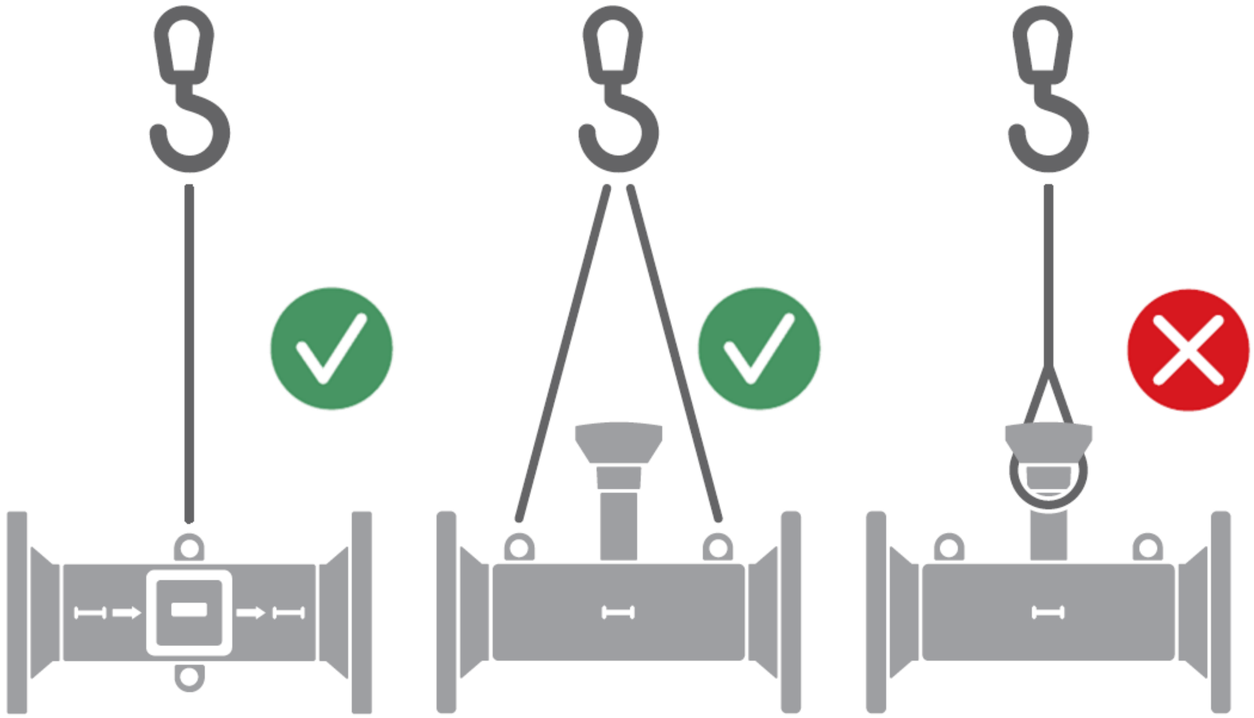
Other repairs of ULTRAFLOW® and Pulse transmitter/Pulse Divider require subsequent reverification on accredited laboratory.

6.9 Installation examples (mechanical)

6.9.1 Mounting ULTRAFLOW® 85 by means of lifting rings

ULTRAFLOW® 85 can be mounted hanging from the available lifting rings as shown with examples in *Figure 18*.

⚠ Do NOT lift the flow sensor on the base part. The base part or extension tube will break.



(a) (b) (c)

Figure 18. Lifting of ULTRAFLOW® 85 with lifting rings.

6.9.2 Rotation of the display

To support the readability of the display in different installations, the top of ULTRAFLOW® 85 including the display can be rotated by 270° (see *Figure 19*).

1. Loosen the screw on the side
2. Rotate the top cover
3. Fasten the screw again

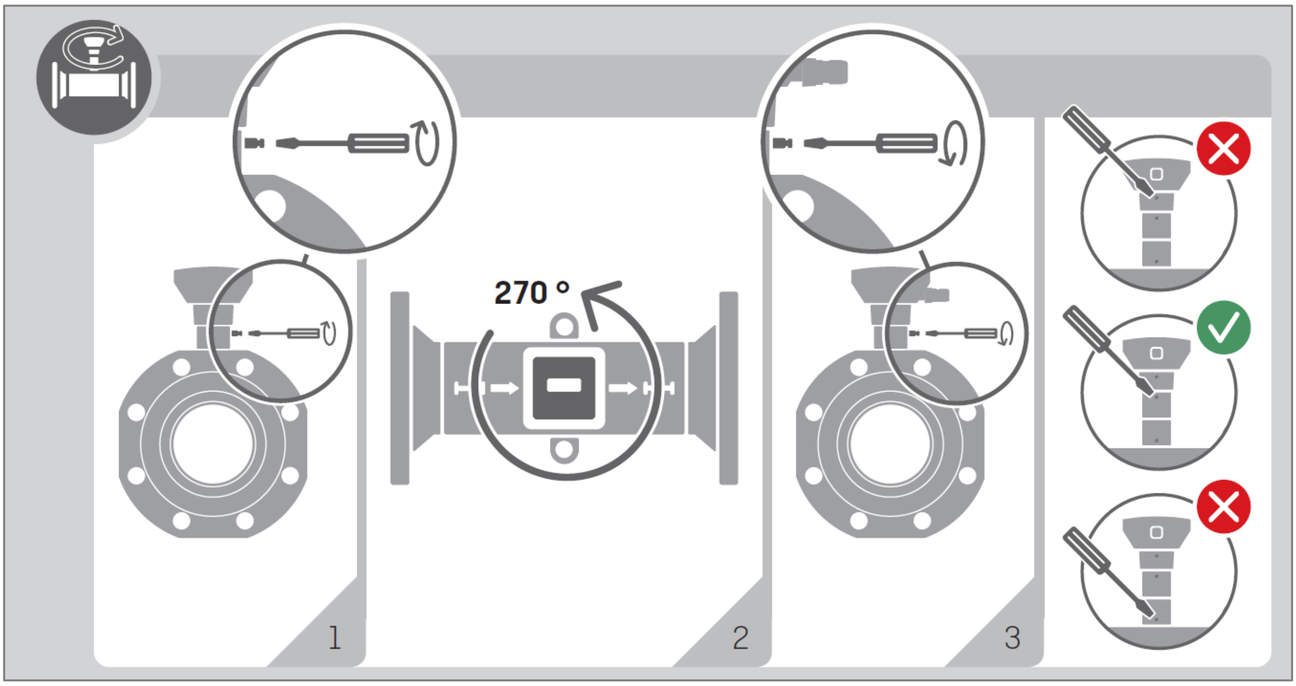


Figure 19. Rotation of top up to 270 °.

ULTRAFLOW® 85 with calculator mount bracket 3026-1392 allows the direct mounting of MULTICAL® 603/803 on the top cover of ULTRAFLOW® 85. The bracket 3026-1392 allows also direct mounting of Pulse Transmitter/ Pulse Divider on the flow sensor. MULTICAL® 803 requires in addition bracket 3026-857.

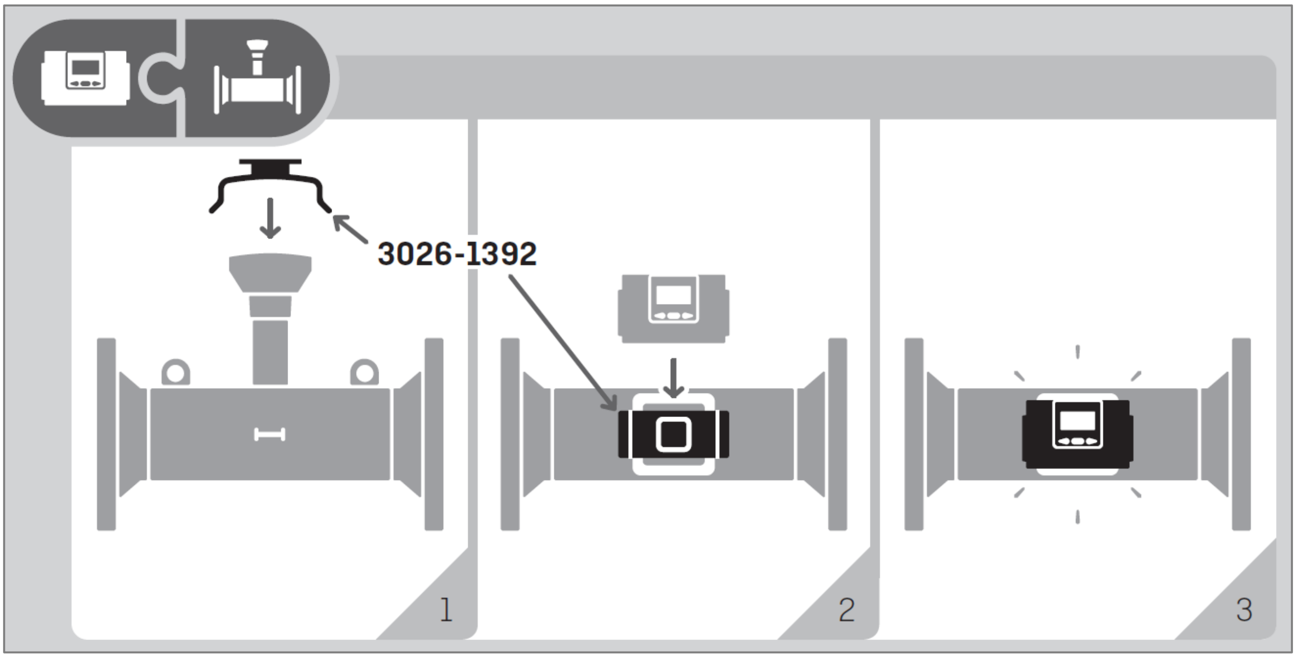


Figure 20. Mounting of calculator or Pulse Transmitter/ Pulse Divider on ULTRAFLOW® 85.

6.9.3 Insulation of ULTRAFLOW® 85 (DN150-300)

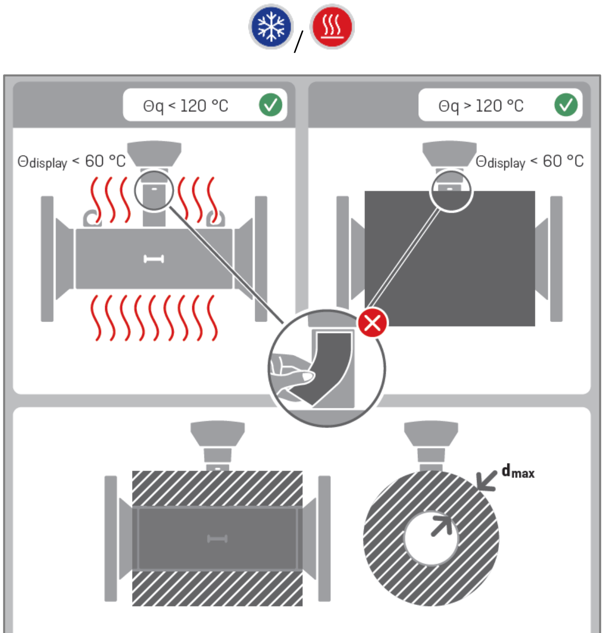
The electronics of ULTRAFLOW® 85 DN150-300 is placed in a separate electronics box (within top cover and base part) connected to the meter housing via an extension tube made of composite material.

The flow part (meter housing) may in general be insulated. However, the electronics box must NOT be insulated and the hole in the extension tube must NOT be covered. **This applies to both cooling and heat installations.**

⚠ At medium temperature below room temperature in a humid environment, the display of ULTRAFLOW® 85 (DN150-300) **must not** be positioned downwards (see *Figure 16*).

⚠ At medium temperature above 120 °C, the flow part of ULTRAFLOW® 85 (DN150-300) **must** be insulated.

The insulation will shield the electronics box from excessive heat radiation from the pipe. This becomes necessary because the temperature inside the electronics box of above 60 °C will lead to degradation of the display.



DN	d_{max}
DN150	80 mm
DN200	80 mm
DN250	120 mm
DN300	120 mm

Figure 21. Insulation examples for ULTRAFLOW® 85: The hole in the extension tube must not be covered. To avoid covering of the hole in the extension tube the stated max thickness of the insulation must be followed.

6.10 Electrical connection

Consult also paragraph *6.3.3 Application with 2 flow sensors ULTRAFLOW® 85* to learn how the operation state of ULTRAFLOW® 85 is depending on the type and CCC-code of the MULTICAL®-calculator and the connection (V1 or V2).

6.10.1 Electrical connection of ULTRAFLOW® and MULTICAL®

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

Table 19. Connection of ULTRAFLOW® and MULTICAL®.

⚠ Using long control cables, careful consideration is required in connection with installation. With a view to EMC, there must be a distance of **at least 25 cm** between control cables and all other cables.

6.10.2 Electrical connection of Pulse Transmitter and Pulse Divider

If ULTRAFLOW® and MULTICAL® are connected via Pulse Transmitter, ULTRAFLOW® is galvanically separated from MULTICAL® and the cable length between ULTRAFLOW® and MULTICAL® can be extended up to 110 m.

⚠ Flow-info is not possible if Pulse Transmitter/Pulse Divider is used and bi-directional flow measurement (forward and reverse flow) is not supported for ULTRAFLOW® 85.

If ULTRAFLOW® is connected to other equipment than MULTICAL®, always connect ULTRAFLOW® via Pulse Transmitter or Pulse Divider. For connection of Pulse Transmitter and Pulse Divider to other calculators, see paragraph *7.3.3 Pulse output of Pulse Transmitter and Pulse Divider.*

ULTRAFLOW®	→	Pulse Transmitter/ Pulse Divider [1]		→	MULTICAL®
		Input	Output		
Blue (ground)	→	11	11A	→	11
Red (supply)	→	9	9A	→	9
Yellow (signal)	→	10	10A	→	10

Table 20. Connection of ULTRAFLOW® and MULTICAL® via Pulse Transmitter/Pulse Divider.
[1] Pulse Divider is normally not used together with MULTICAL®.

6.10.3 Cable lengths when using Pulse Transmitter/ Pulse Divider

The 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.

PT/PD output module	MULTICAL® 602/603/801/803	
	2-wire connection	3-wire connection
Y=2	< 100 m *)	< 10 m
Y=3	N/A	< 10 m

*) *MULTICAL ® 602 must have sensor connection type D and external 24 VDC supply.*
MULTICAL ® 603 must have sensor connection type G and external 24 VDC supply.
MULTICAL ® 801 features 12 VDC auxiliary supply.
MULTICAL ® 803 features auxiliary supply via PCB 66-99-045.

Table 21. Maximum allowable cable length depends on the output module in Pulse Transmitter / Pulse Divider and how the MULTICAL® calculator is connected.

⚠ Using long signal cables, careful consideration is required in connection with installation. With respect to EMC, there must be a distance of **at least** 25 cm between signal cables and all other cables. Recommended cable cross section for the signal cable is 2 x 0.5 mm2.

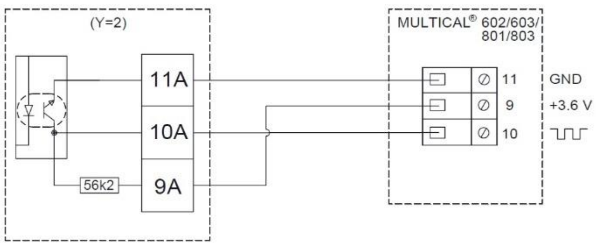


Figure 22. Three-wire connection of Pulse Transmitter with output module (Y=2) to MULTICAL® 602/603/801/803. Cable length < 10 m.

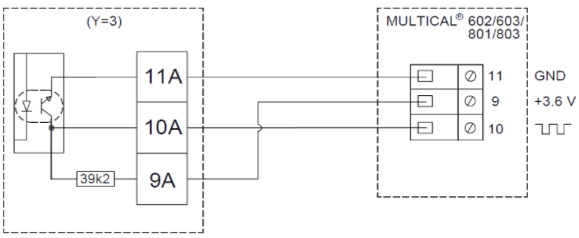


Figure 23. Three-wire connection of Pulse Transmitter with output module (Y=3) to MULTICAL® 602/603/801/803. Cable length < 10 m.

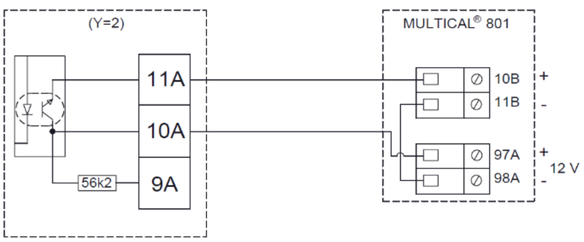


Figure 24. Two-wire connection of Pulse Transmitter with output module (Y=2) to MULTICAL® 801. Note the 12 VDC auxiliary supply in MULTICAL® 801. Cable length < 100 m.

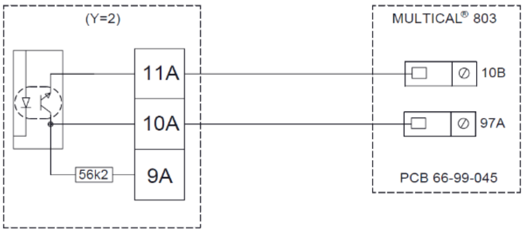


Figure 25. Two-wire connection of Pulse Transmitter with output module (Y=2) to MULTICAL® 803. Note the auxiliary supply in MULTICAL® 803 via PCB 66-99-045. Cable length < 100 m.

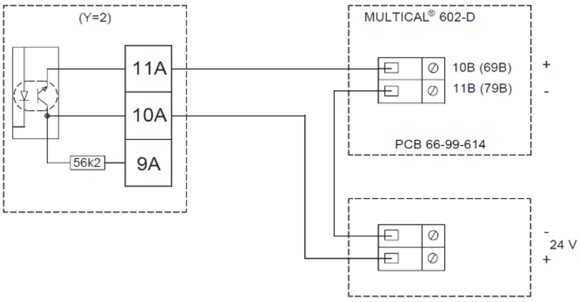


Figure 26. Two-wire connection of Pulse Transmitter with output module (Y=2) to MULTICAL® 602-D and external 24 VDC supply 1). Cable length < 100 m.

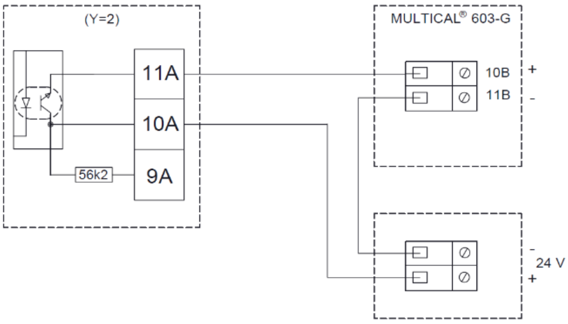


Figure 27. Two-wire connection of Pulse Transmitter with output module (Y=2) to MULTICAL® 603-G and external 24 VDC supply 1). Cable length < 100 m.

1) External 24 VDC supply is not part of the calculator.

Examples of connection of Pulse Transmitter appear from paragraph *6.10.2 Electrical connection of Pulse Transmitter and Pulse Divider.*

6.10.4 Connection of power supply

In case that ULTRAFLOW® is connected galvanically coupled to a MULTICAL® calculator, ULTRAFLOW® is supplied by MULTICAL®. If ULTRAFLOW® is connected via Pulse Transmitter or Pulse Divider, ULTRAFLOW® is supplied by the supply module/battery mounted in Pulse Transmitter/Pulse Divider.

6.10.4.1 Battery supply

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

Optimal battery lifetime is obtained by keeping the battery temperature below 30 °C, e.g. by wall-mounting of 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 must be replaced by a corresponding lithium battery with connector from Kamstrup A/S. Used batteries must be handed in for approved destruction, e.g. to Kamstrup A/S (see paragraph *12 Disposal*).

6.10.4.2 Mains supply modules

The mains supply modules are protection class II and are connected to the interface module via a short two-wire cable with connector. The modules are powered via a two-wire mains supply cable (without earth connection) through the cable connector of 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 *6.10.4.4*).

Max permitted fuse: 6 A.

230 VAC

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

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 V installation in the main electrical panel must be carried out by an authorized electrician.

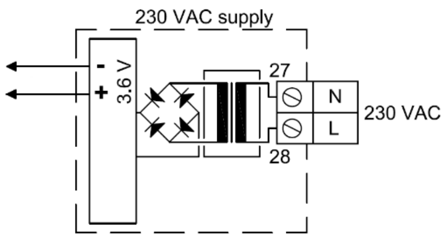


Figure 28. 230 VAC supply module for Pulse Transmitter/Pulse Divider

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 V safety transformer in the main electrical panel. The module includes a double-chamber safety transformer, which fulfils double insulation requirements when the cover is mounted on Pulse Transmitter/Pulse Divider. Power consumption is less than 1 W or 1 VA.

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 V installation in the main electrical panel must be carried out by an authorized electrician.

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

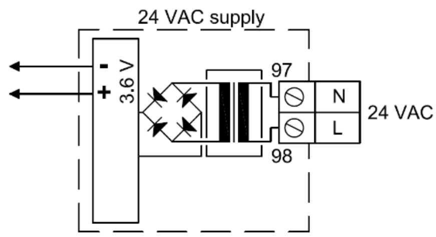


Figure 29. 24 VAC supply module for Pulse Transmitter/Pulse Divider

230/24 VAC safety transformer

The 24 VAC module is especially suited for installation together with a 230/24 VAC safety transformer, e.g. type 6699-403, which can be installed in the main electrical panel before 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 30. 230/24 VAC safety transformer

6.10.4.3 Mains supply cable

Pulse Transmitter/Pulse Divider is available with mains supply cable H03 VV-F for either 24 VAC or 230 VAC (l=1.5 m).

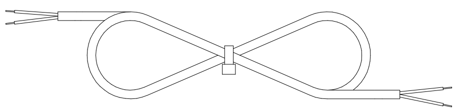


Figure 31. Mains supply cable (2 x 0.75 mm²), max 6 A fuse

"H03 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.

6.10.4.4 Cable screw connections

Cable dimension of control cable connections: 2…6 mm

Cable dimension of mains cable connections: 4.5…10 mm

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

In connection with battery supply, the unused cable connection must be sealed off as shown in *Figure 35*.

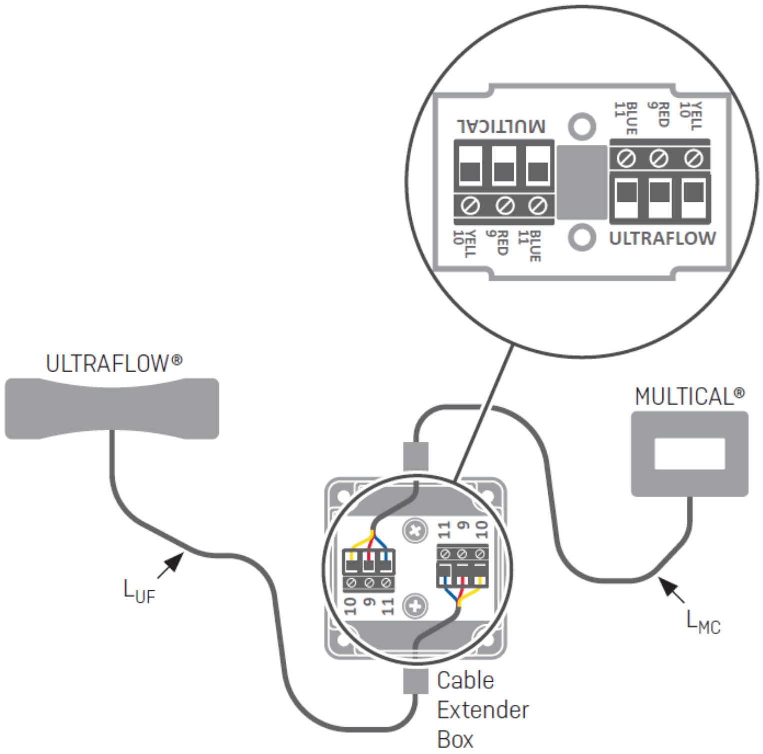
6.10.5 Electrical connection of Cable Extender Box

The Cable Extender Box includes transient transorb diodes, making it possible to extend the cable between ULTRAFLOW® and MULTICAL® with up to 30 m in total, while the cable length without the Cable Extender Box can be maximum up to 10 m.

The Cable Extender Box can e.g. be mounted on the wall. Connect the 3 wires of the cable from ULTRAFLOW® to the indicated terminal in Cable Extender Box. In case of ULTRAFLOW® 54 (DN150-300) and ULTRAFLOW® 85 (DN150-300), a 3-wire cable with at least 3 x 0.5 mm^2 wire cross section and of the same quality as the cable from the respective ULTRAFLOW® might equally be used.

Connect a 3-wire cable with 3 x 0.5 mm^2 wire cross section and of the same quality as the cable from the respective ULTRAFLOW® between Cable Extender Box and MULTICAL®. Use the following combination when connecting the wires: 10: Yellow, 9: Red and 11: Blue. This color and number combination applies to both ULTRAFLOW®, Cable Extender Box and terminal V1 in MULTICAL®.

Perform a function check and complete the installation by sealing the Cable Extender Box with the included void-labels or the sealing labels of the utility.



ULTRAFLOW®	L_{UF}	L_{MC}
ULTRAFLOW® 85	max 29 m	max 1 m
ULTRAFLOW® 44/54	max 10 m	max 27.5 m
L_{UF} + L_{MC}	max 30 m	

Figure 32. Electrical connection of ULTRAFLOW® to MULTICAL® via Cable Extender Box. The cable length L_{UF} between ULTRAFLOW® and Cable Extender Box as well as the cable length L_{MC} between Cable extender box and MULTICAL® depends on the type of ULTRAFLOW®. In total, a cable length of L_{UF} + L_{MC} = max 30 m between ULTRAFLOW® and MULTICAL® can be achieved.

6.11 Installation examples (electrical)

6.11.1 Mounting of 3-wire cable in ULTRAFLOW® 85

(1) Remove the top cover and (2) unscrew the transparent lid.

(1), (2) Guide the signal cable through the cable screw connection and (3) mount the 3-wire cable in the screw terminal as indicated.

(1) Remount the transparent lid and with respect to the IP class of the flow sensor (IP68) pay special attention to the quality and correct positioning of the O-ring. (2) Mount the top cover.

(1), (2) With respect to the IP class of the flow sensor (IP68) the cable screw connection must be tightened properly around the cable (ca. 1.5 Nm are recommended).

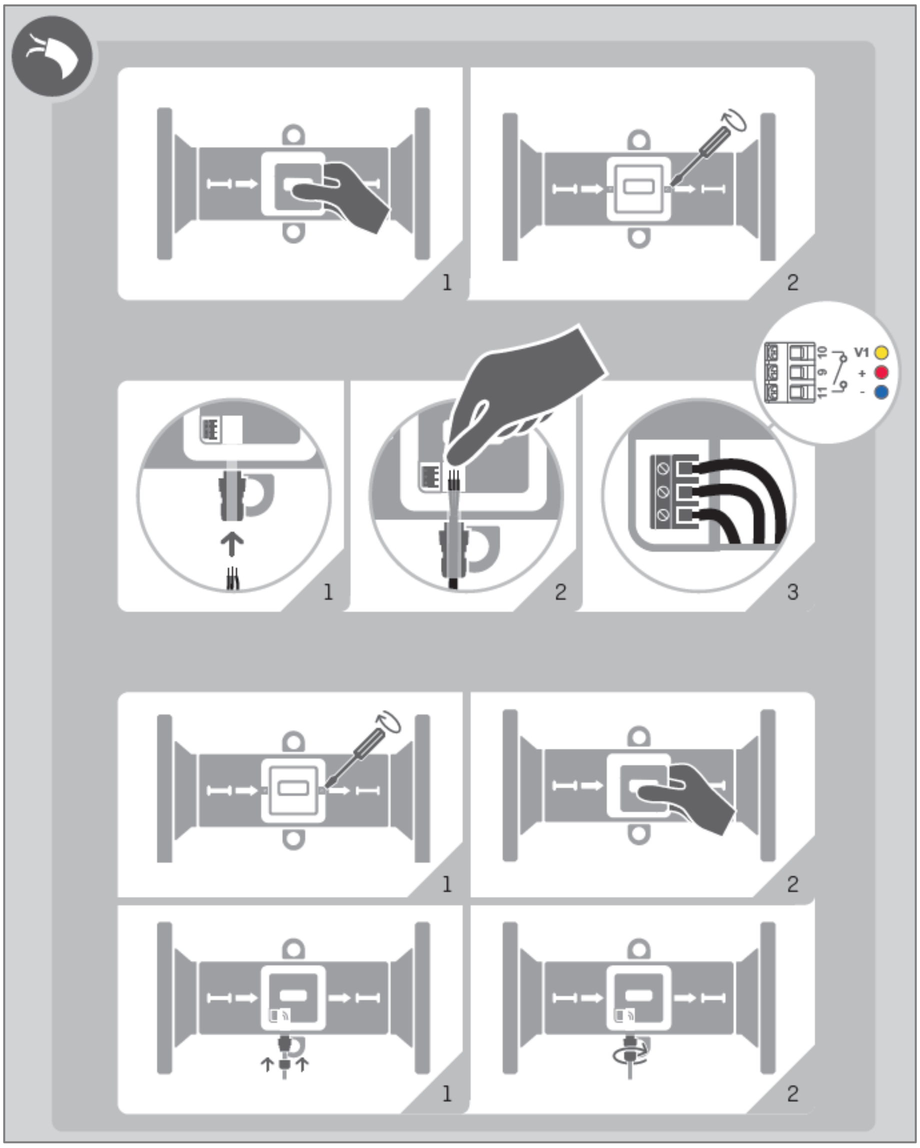


Figure 33. Mounting the three-wire cable to ULTRAFLOW® 85 in the field.

6.11.2 Example of connection of ULTRAFLOW® 85 and MULTICAL®

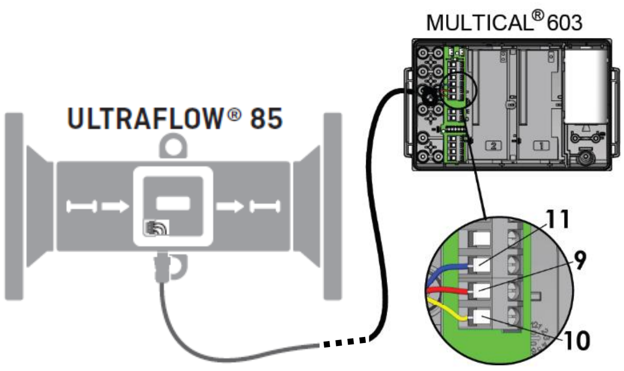


Figure 34. ULTRAFLOW® 85 connected to MULTICAL® 603.

6.11.3 Example of connection of Pulse Transmitter

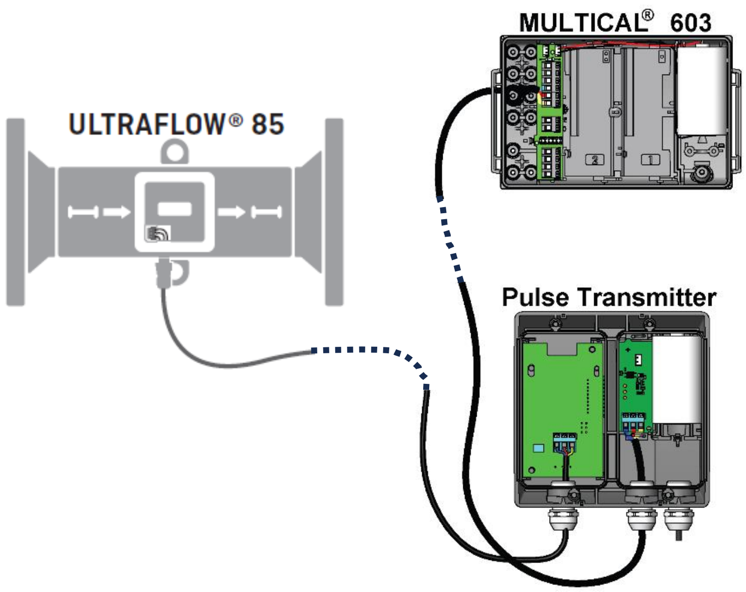


Figure 35. ULTRAFLOW® 85 connected to Pulse Transmitter with battery supply.
MULTICAL® 603 is connected to the Pulse Transmitter's output module (Y=3).

If battery-supplied, the right cable screw connection of Pulse Transmitter is plugged.

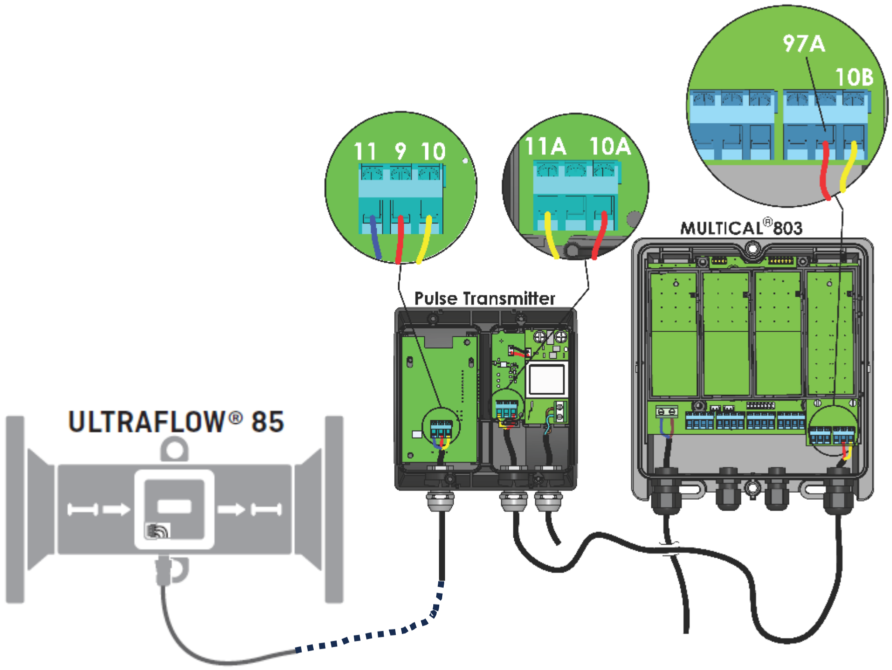


Figure 36. ULTRAFLOW® 85 connected to Pulse Transmitter with 230 VAC supply.
MULTICAL® 803 is connected via a two-wire connection to the Pulse Transmitter's output module (Y = 2)

6.11.4 Calculator with two flow sensors

MULTICAL® 602/603/801/803 can be used in various applications with two flow sensors, e.g. for leak monitoring or in open systems. When two ULTRAFLOW® sensors are directly connected to one MULTICAL®, an equipotential connection (electric low impedance connection) between the two pipes should be carried out as a main rule to protect the meter electronics against transients and potential differences. If the two pipes are installed in a heat exchanger, close to the flow sensors, however, the heat exchanger will provide the necessary electric connection.

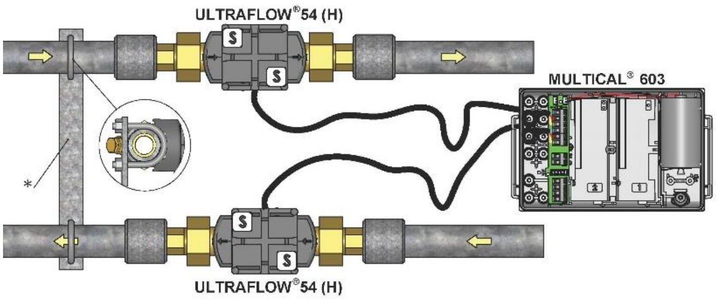


Figure 37. Direct electric connection of two ULTRAFLOW® flow sensors to MULTICAL® in an installation with equipotential connection (electric low impedance connection) between the pipes.*

In installations where an equipotential connection cannot be carried out, one ULTRAFLOW® flow sensor (typically V2) shall pass through a Pulse Transmitter with galvanic separation before the cable enters MULTICAL®. ULTRAFLOW® has in this case its own supply.

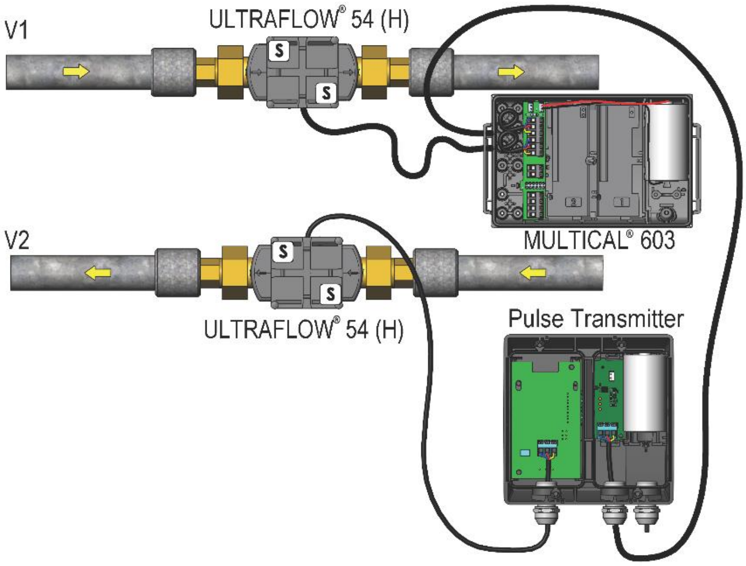


Figure 38. Installation of Pulse Transmitter for galvanic separation of one ULTRAFLOW® flow sensor (typically V2) in installations where an equipotential connection cannot be carried out.

For ULTRAFLOW® 85 consult also paragraph *6.3.3 Application with 2 flow sensors ULTRAFLOW® 85*.

6.11.5 Electric welding

If electric welding is performed, the signal cable from ULTRAFLOW® must always be disconnected from the MULTICAL® calculator terminal blocks while the welding is being performed. For meters with two ULTRAFLOW® flow sensors connected to the calculator, both ULTRAFLOW® signal cables must be disconnected.

⚠ 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.

6.12 Operational check

Carry out an operational check when the complete meter (flow sensor, temperature sensors and calculator) has been installed and connected. Open thermostats and valves so that water flows in the system and check that there are credible values for temperatures and water flow in the calculator display.

The display of ULTRAFLOW® 85 provides additional information, which is particularly beneficial during commissioning. See explanations for display symbols "AIR" and "> qp" in *7.7.1 Display symbols during field operation*.

7 Functional description

Within the heat, cooling and water meter industry, producers have been working on alternative techniques for the replacement of flow sensors based on the mechanical principle. Research and development at Kamstrup have proven that ultrasonic measuring is the most viable solution. Combined with microprocessor technology and piezo ceramics, ultrasonic measuring is not only accurate but also reliable.

7.1 Flow measurement with ultrasound

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 change which occurs when sound is reflected by a moving particle. This is the effect you experience when a car drives by. The sound (the frequency) decreases when the car passes by. The transit time method used in ULTRAFLOW® utilizes the fact that it takes an ultrasonic signal, sent in the opposite direction of the flow, longer to travel from transmitter to receiver than a signal sent in the same direction as the flow.

A piezo-ceramic element is used for transmitting and receiving ultrasound. The thickness of the element changes when exposed to an electric field (voltage) and thereby it functions as a transmitter of ultrasound. When the element is mechanically influenced, it generates a corresponding electric voltage and thus functions as a receiver of ultrasound.

7.2 Signal path, flow calculation and flow profiles

As proven by the calculations below, the average flow velocity is directly proportional to the transit time difference of ultrasound signals which are sent with or against the flow. *Figure 39* shows as an example the U-shaped signal path and corresponding measuring tube assembly utilized in flow sensors of MULTICAL® 303 and MULTICAL® 403 (q_p 0.6…2.5 m³/h) as well as ULTRAFLOW® 44 (q_p 1.5…2.5 m³/h) and ULTRAFLOW® 54 (type 65-5-XXHX-XXX, q_p 0.6…2.5 m³/h): Piezo-electric elements transmit and receive the ultrasound signal, which is reflected into and through the measuring tube to the receiver via reflectors. Due to superposition of velocities of water and sound signal, ultrasound propagates faster with the flow than against the flow.

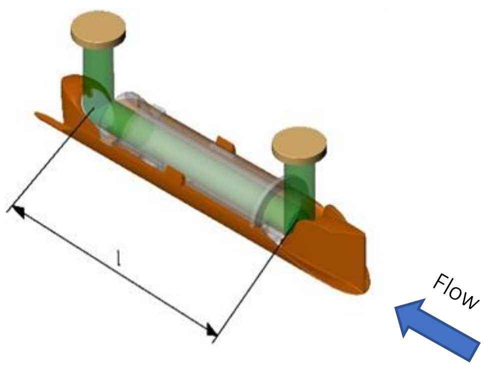


Figure 39. U-shaped signal path. Sound signals are transmitted by the transducers via 2 reflectors. The signal's transit times with and against the flow vary for the significant sound path distance (parallel with the measuring tube).

For the calculation of the transit time difference, the signal path along the flow is crucial, and the transit time to the measuring distance is calculated as:

$$t = \frac{l}{c \pm v}$$

where:

t is the transit time from sender to receiver of the sound signal along the measuring distance l. [s]

l is the measuring distance. [m]

c is the sound propagation velocity in stagnant water. [m/s]

v is the average flow velocity of water. [m/s]

The transit time difference can be expressed as the difference between the absolute time of the signal sent against the flow (-) and the signal sent with the flow (+).

$$\Delta t = \frac{l}{c-v} - \frac{l}{c+v}$$

which can also be written as:

$$\Delta t = l\frac{(c+v)-(c-v)}{(c-v)\cdot(c+v)} \Rightarrow \Delta t = l\frac{2v}{c^2-v^2}$$

As $c^2 \gg v^2$, v^2 can be omitted and the formula reduced as follows:

$$v = \frac{\Delta t \cdot c^2}{2l}$$

Thus, we know the basic connection between the average flow velocity and the transit time difference.

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

Furthermore, the influence of the temperature of the sound velocity of water must be taken into account. In ULTRAFLOW®, the velocity of ultrasound c is measured by means of a number of absolute time measurements between the two transducers. As the geometry of the flow sensor is known, the measured speed of the ultrasound is thus a scale for the water temperature, which is further used in the built-in ASIC in connection with the flow calculations.

The flow (volume flow rate) is then determined by measuring the transit time difference, calculate the average flow velocity and multiply it by the area of the measuring tube:

$$q = v \cdot A$$

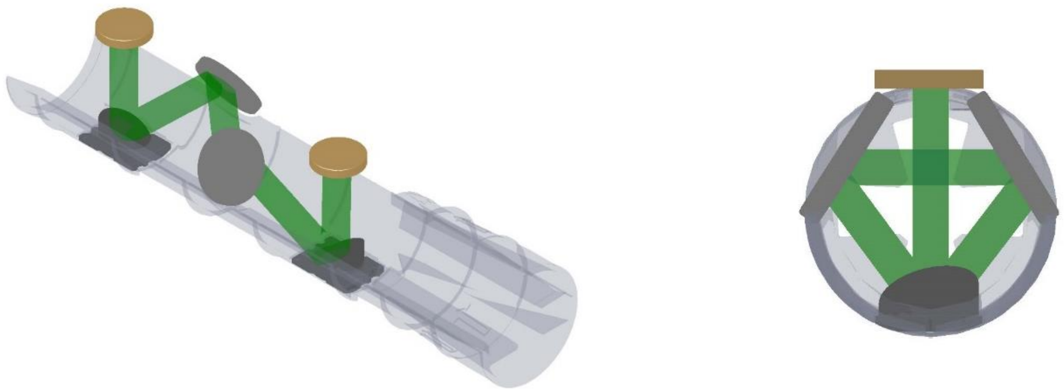
where:

q is the flow (volume flow rate). $[\frac{m^3}{h}]$

A is the area of the measuring pipe. $[m^2]$

The volume V passing through is finally calculated as a time integration over the flow (multiplication of (cross section constant) flow by time).

The calculation above is simplified since it does not take into account the flow profiles. In general, flow profiles influence the measurement, which in our case is the transit time difference. Flow sensors are thus adjusted properly according to the different Reynolds numbers that characterize the flow, i.e. in practice for different flows (volume flow) and temperatures. To cover the various flow profiles in the best possible way with the ultrasound signal, Kamstrup uses a triangle sound path, as illustrated in *Figure 40* from two perspectives, for large MULTICAL® 403, ULTRAFLOW® 44 and ULTRAFLOW® 54 flow sensors (q_p 3.5…100 m^3/h).



(a) (b)

Figure 40. Triangular signal path shown from the side (a) and when looking into the measuring tube (b). Sound signals are transmitted by the transducers via 4 reflectors along the triangular path.

ULTRAFLOW® 85 DN150-300 utilizes finally two parallel sound paths at a slant as shown in *Figure 41*.

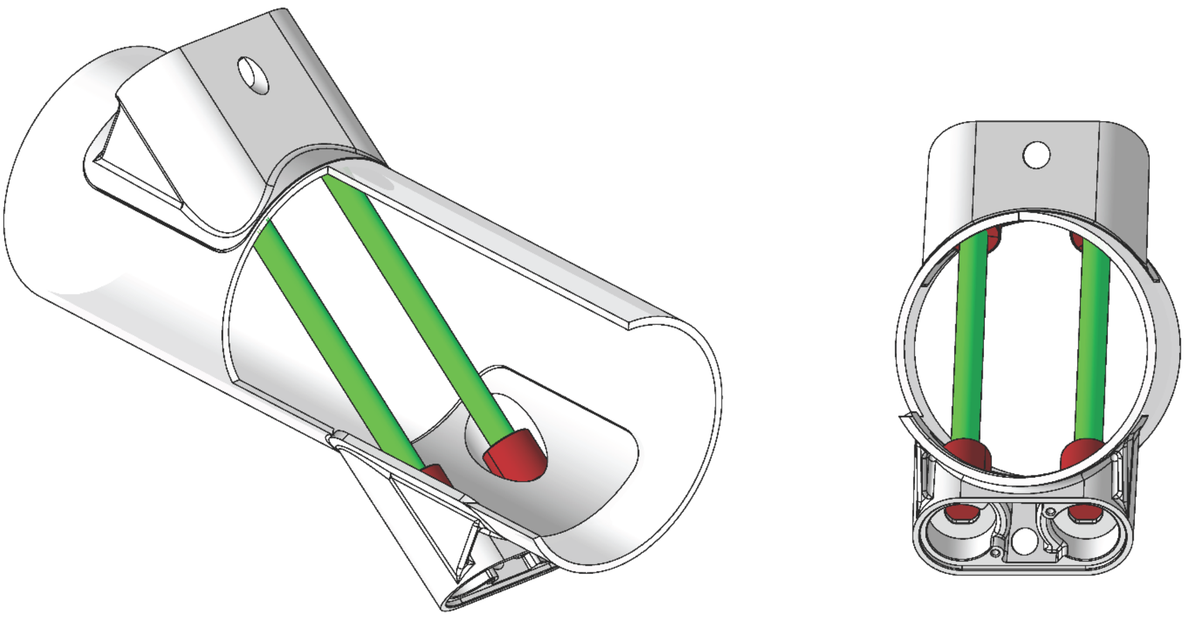


Figure 41. ULTRAFLOW® 85 (q_p 150…1000 m³/h). Two parallel sound paths at a slant in the measuring pipe.

7.3 Function of ULTRAFLOW® 85

ULTRAFLOW® 85 can operate as a standalone flow sensor. When connected and supplied by Pulse Transmitter/Pulse Divider or e.g. a MULTICAL® 601/602 or 603-A/-B/-C/-D/-E/-F/-G/-H calculator, it will operate in pulse operation mode. This means that the flow sensors will emit volume proportional pulses to the calculator. When specifically connected to e.g. MULTICAL® 603-S/603-U (from SW revision 18420501 (E1) onwards) or MULTICAL® 803-A (from SW revision 14890801 (H1) onwards), ULTRAFLOW® 85 will operate in serial operation mode. This means that flow sensor and calculator operate together like a compact meter, where flow measuring is initiated by the calculator and serial data communication between flow sensor and calculator is established. For connection of 2 flow sensors ULTRAFLOW® 85 and to learn how the operation state of ULTRAFLOW® 85 is depending on the type and CCC-code of the MULTICAL®-calculator and the connection (V1 or V2).consult also paragraph *6.3.3 Application with 2 flow sensors ULTRAFLOW® 85*.

⚠ Bi-directional flow measuring (forward and reverse flow) in the field and the highest sampling rates for volume requires serial operation state and thereby connection to MULTICAL® 603-S/603-U or MULTICAL® 803-A.

⚠ For a correct energy calculation in the calculator, when ULTRAFLOW® 85 is measuring reverse flow, the flow sensor must typically be mounted in outlet ( ) next to t2 (see *6.3.2 Application no. 1 – reverse flow*).

7.3.1 Pulse operation mode

During a flow measurement in pulse operation mode, ULTRAFLOW® passes through a number of sequences, which are repeated at fixed intervals. Deviations only occur when the flow sensor is in verification mode and when the supply is connected during initialization/start-up. The difference between the main routines in normal mode and verification mode is the frequency of the measurements on which pulse emission is based. In connection with Power Down, it may take up to 16 seconds to start with proper functioning.

In the flow sensor's working range from min. cut off to saturation flow, there is a linear connection between the flow rate and the number of pulses being emitted. The diagram below shows an example of the connection between flow and pulse frequency for ULTRAFLOW® q_p 150 m³/h (*Figure 42*).

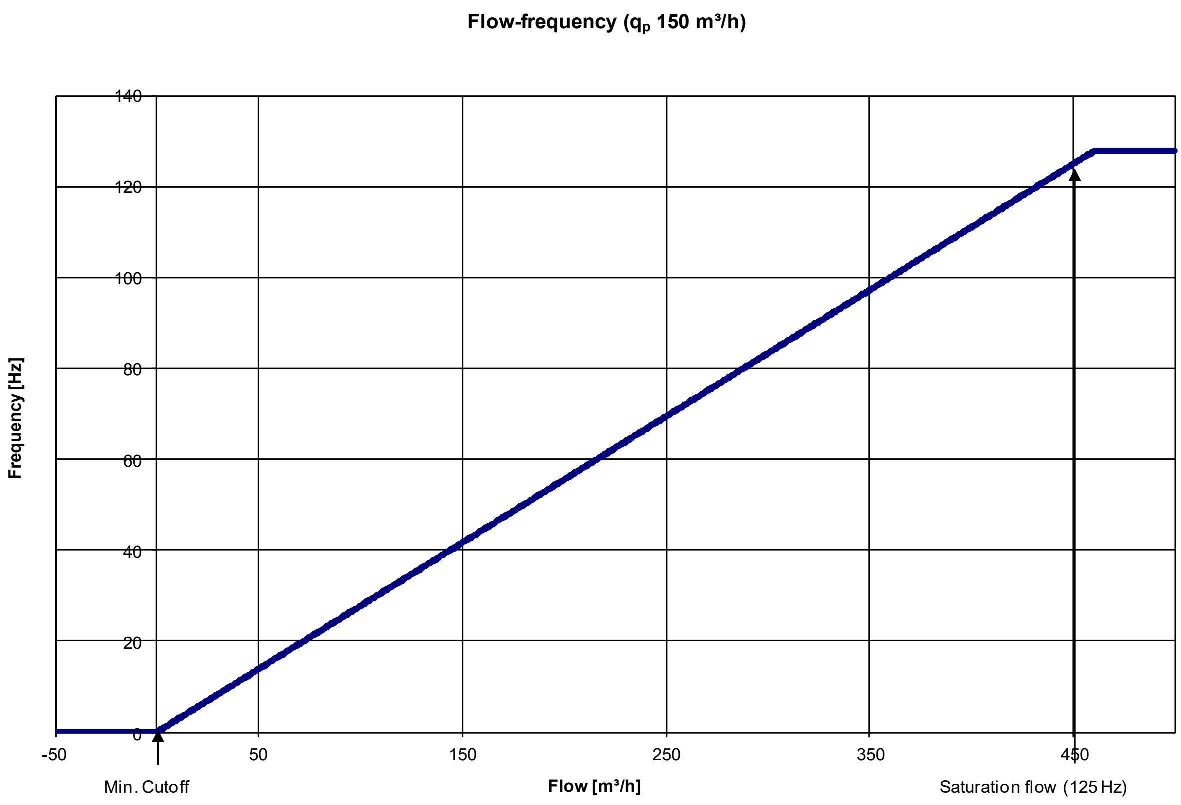


Figure 42. Pulse frequency as a function of flow q_p 150 m³/h.

If the flow is lower than min. cut off or negative (reverse flow), ULTRAFLOW® does not emit pulses, except from being set into a different pulse operation state for testing purposes. Consult *Table 26* for additional details about the pulse operation states of ULTRAFLOW® 85. At flows exceeding the flow corresponding to pulse emission at max pulse frequency, the max pulse frequency will be maintained. *Table 22* shows the saturation flow at a pulse frequency of 125 Hz for the different flow sizes and meter factors.

q_p [m³/h]	Meter factor [p/l]	Flow at 125 Hz [m³/h]
150	1	450
250	0.6	750
400	0.4	1125
600	0.25	1800
1000	0.15	3000

Table 22. Flow rate at saturation flow (125 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, <200 h/year), without exceeding max. permissible error. ULTRAFLOW® has no functional limitations during the period when the flow sensor operates above q_p. Please note, however, that high flow velocities may cause cavitation, especially at low static pressure. See paragraph *6.1.4 Operating pressure*.

Pulses are emitted at 1-second intervals. The number of pulses to be emitted is calculated every second. Pulses are emitted evenly distributed to estimate the flow with a pulse duration of 2**…**6 ms and pauses depending on the current pulse frequency. The transmitted pulse signal is the average determination of a series of flow measurements. This means that there will be a transient phenomenon until correct flow signal has been obtained during start-up. Furthermore, this brings about a pulse tail in case of sudden hold.

7.3.2 Pulse output of ULTRAFLOW® 85

Galvanically coupled pulse output. ULTRAFLOW® 85 is powered by MULTICAL® or Pulse Transmitter/Pulse Divider.

Cable length ULTRAFLOW® to MULTICAL® Max. 10 m

Type	Push-Pull
Output impedance	~10 kΩ
Pulse duration	2…6 ms
Duration of pause	Depends on the actual pulse frequency

Concerning meter factor and pulse durations, see paragraph *4.3.4 Pulse Divider configuration CCC-DD-E-MMM*

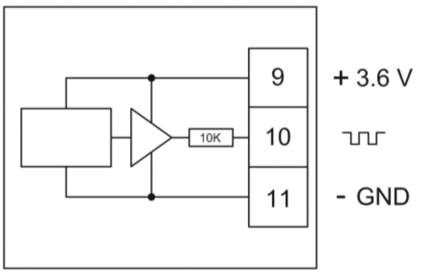


Figure 43. Block diagram of galvanically coupled output in ULTRAFLOW® 85.

7.3.3 Pulse output of Pulse Transmitter and Pulse Divider

Galvanically separated output module (Y=2)

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

The cable length to Pulse Transmitter/Pulse Divider depends on the calculator.

To calculator:

Type: Open collector.

Connection: Can be connected as two-wire or 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 23. Output (Y=2).

Concerning meter factors and pulse durations, see paragraph *4.3.4 Pulse Divider configuration CCC-DD-E-MMM*.

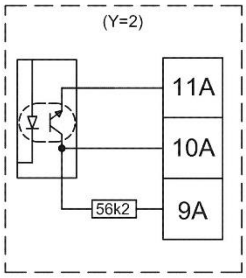


Figure 44. Block diagram for galvanically separated output module (Y=2).

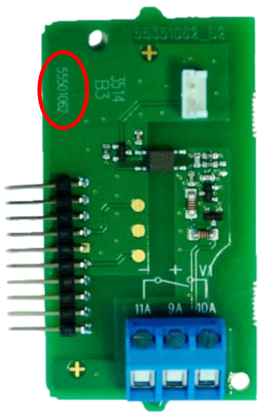


Figure 45. Galvanically separated output module (Y=2).
Note the PCB number 5550-1062 in the encircled area.

Galvanically separated output module (Y=3)

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

The cable length to Pulse Transmitter/Pulse Divider depends on the calculator.

To calculator:

Type: Open collector.

Connection: Three-wire connection is possible 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 24. Output (Y=3).

Concerning meter factors and pulse durations, see paragraph *4.3.4 Pulse Divider configuration CCC-DD-E-MMM*.

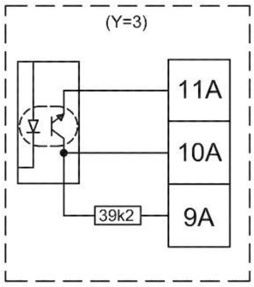


Figure 46. Block diagram for galvanically separated output module (Y=3).

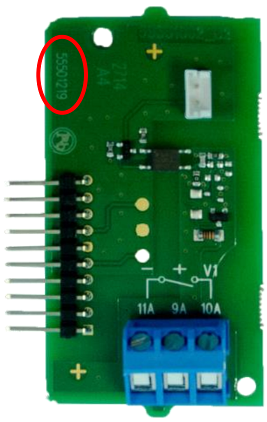


Figure 47. Galvanically separated output module (Y=3).
Note the PCB number 5550-1219 in the encircled area.

7.3.4 Serial operation mode

ULTRAFLOW® 85 can operate in serial mode, where flow measurements are performed upon request from the calculator, i.e. the flow sensor acts as a slave for the calculator. No pulse output is generated. ULTRAFLOW® 85 acts like a pure bi-directional flow sensor without any volume integration. The integration is instead handled in the calculator. For additional details about the calculators MULTICAL® 603-S/-U and MULTICAL® 803 supporting serial operation state consult the Technical descriptions Kamstrup doc. no. FILE100002141_EN (Link-MC603) and FILE100000271_EN (Link-MC803).

If no measurement is requested by the calculator for ~16 seconds, the flow sensor will reset and return to normal pulse operating state, where it can be used in combination with other types of MULTICAL®-calculators or in combination with a Pulse Transmitter/ Pulse Divider with 3rd party calculators.

7.4 Supply and power consumption of ULTRAFLOW®

Normally, ULTRAFLOW® is supplied by the connected MULTICAL® calculator. When ULTRAFLOW® is supplied in any other way, for example via direct connection in a flow bench, the following applies:

Internal supply voltage of ULTRAFLOW®:

3.6 VDC ±0.1 VDC

The current consumption of ULTRAFLOW® 85:

Typical average ca. 60 µA @ 1 s (volume) sampling rate (Backlight OFF)

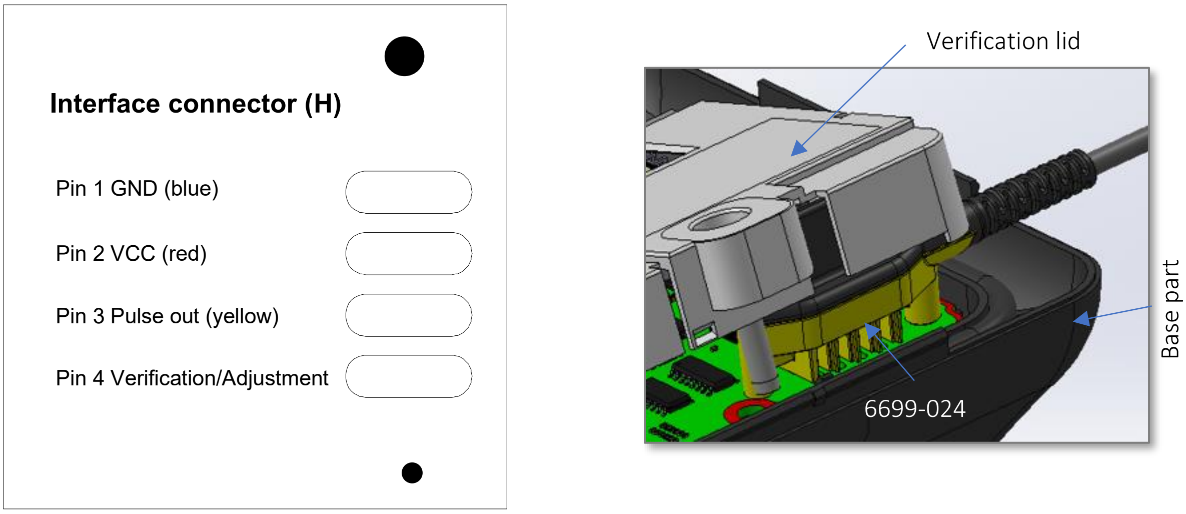
7.5 Interface connector/serial data

ULTRAFLOW® 85 is fitted with a four-pole connector under the verification lid. The verification lid is protected by a security seal "S" by factory, which is covering a screw. Thus, it is not possible to access the connector without breaking this security seal.

The connector is used for:

- Bringing the flow sensor into different operation states e.g. by means of LabTool (see *Table 26*)
- External control of start/stop in connection with calibration
- Reading accumulated water quantity in connection with calibration
- Meter programming, including adjustment of correction curve e.g. by means of LabTool

The interface connector is constructed as shown in *Figure 48* (a) and can be connected e.g. by the Interface cable with USB type 6699-024 shown in *Figure 48* (b).



(a) (b)

Figure 48. Interface connector.

7.6 Accuracy

ULTRAFLOW® as been developed as a flow sensor for energy meters according to EN 1434. The tolerances permitted for flow sensors according to EN 1434 with a dynamic range of 100:1 (q_p:q_i) are shown in *Figure 49*. The tolerances are defined for class 2 and class 3 with the following formulas:

Class 2: $\pm 2 + 0.02 \times \frac{q_p}{q}$ %, however max. ±5 %

Class 3: $\pm 3 + 0.05 \times \frac{q_p}{q}$ %, however max. ±5 %

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

In connection with accuracies the range from q_p to q_s is defined as max. flow, where the meter must short-term (< 1 h/day; < 200 h/ year) be functioning and tolerances are adhered to. There are no requirements to the relation between q_p and q_s. See *Table 1* for information on q_s for ULTRAFLOW®.

To render probable that the sensors meet the tolerance requirements, EN 1434-5 specifies calibration requirements in connection with verification of sensors. It is required that flow sensors are tested at the 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 test 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 (Maximum Permissible Error) to permit the acceptance limit to be equal to MPE. If the equipment does not observe 1/5 MPE, 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, documented with DANAK-accredited certificates at flow qi, 0.1 qp and qp.

For further information regarding allowable test conditions such as water temperature and flow of the individual ULTRAFLOW®, see the approval of ULTRAFLOW® (see paragraph *10 Approvals*).

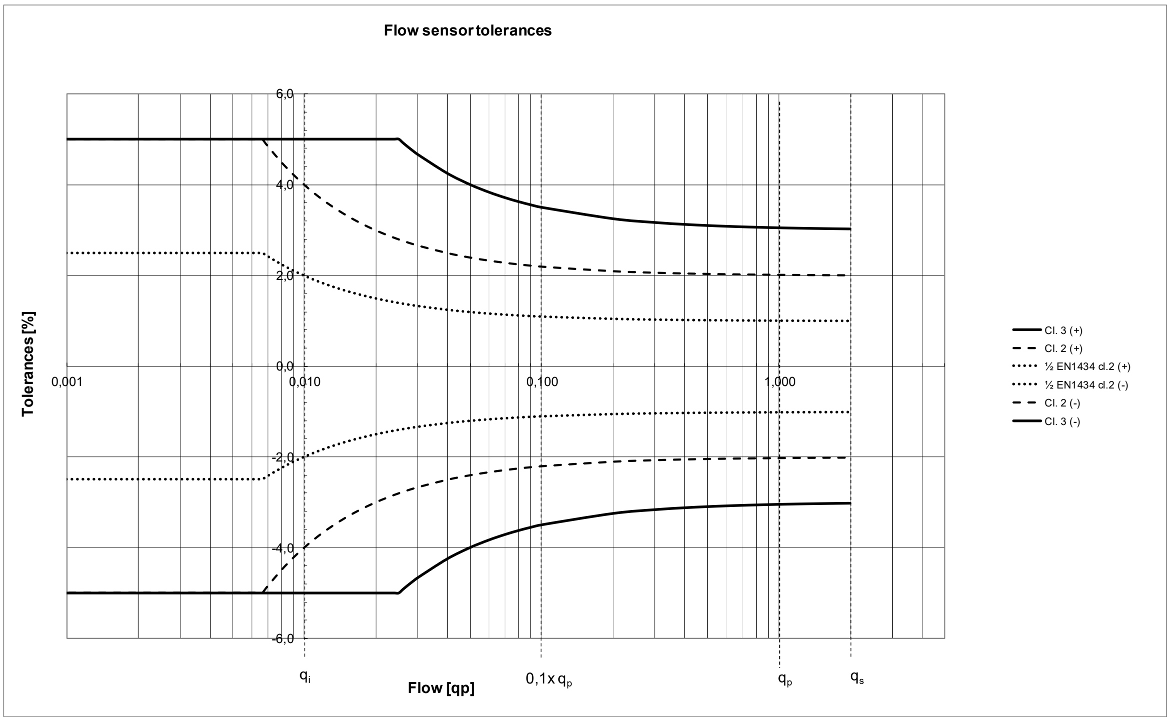


Figure 49. Flow sensor tolerances specified as an example for a flow sensor with q_p:q_i = 100:1 and q_p:q_s = 1:2.

7.7 Display of ULTRAFLOW® 85

ULTRAFLOW® 85 contains an indicating device, providing different information e.g. about the actual flow, operation state, air in medium, etc. These indications are considered as outside from legal metrological control. This means that the indicating device is not considered crucial for the legitimate use of ULTRAFLOW® 85.

The display contains a backlight, which can be switched on or off by factory, with ON/OFF meaning always on or always off. There is for the time being no possibility to switch the display backlight state from ON to OFF or vice versa after production.

⚠ To maintain the supply of ULTRAFLOW® 85 for a sufficient period of time, e.g. a typical verification period of several years, backlight ON is due to the high current consumption NOT recommended in case of battery supply of the flow sensor. The battery lifetime would otherwise be significantly reduced.

7.7.1 Display symbols during field operation

Figure 50 indicates possible icons during field operation of ULTRAFLOW® 85. The actual flow is always indicated in m^3/h with one decimal. Reverse flow is indicated with a minus symbol. Note that reverse flow is measured and indicated, irrespectively whether pulses are emitted or not. The operation state of ULTRAFLOW® 85 depends in the field on the connected calculator and can be either serial operation state or pulse operation state. In pulse operation mode (normal mode), no pulses are emitted for reverse flow (in the field).

Figure 50. Possible display symbols during field operation of ULTRAFLOW® 85.

The flow sensor indicates, when the actual flow is above 1.25 x qp with the symbol "> qp". This info message can be used during installation of the flow sensor. Ensure sufficient static pressure in the outlet of the flow sensor (≥ 1.5 bar @ qp and ≥ 2.5 bar @ qs) to avoid cavitation and consider general advice during dimensioning (see paragraph *6.1.2 Dimensioning*). The icon is not shown anymore, after the flow has been reduced below the threshold value of 1.25 x qp.

The error message "AIR" is indicated in the display in case of air or other obstacles blocking the propagation of ultrasound in the ultrasonic path. The error message is actualized with each flow measurement and can therefore be used during installation e.g. to test all operation conditions of the installation with respect to the risk of air and possible cavitation.

The heartbeat indicator is finally toggling between on/off for each flow measurement performed. It corresponds therefore with the volume sampling time.

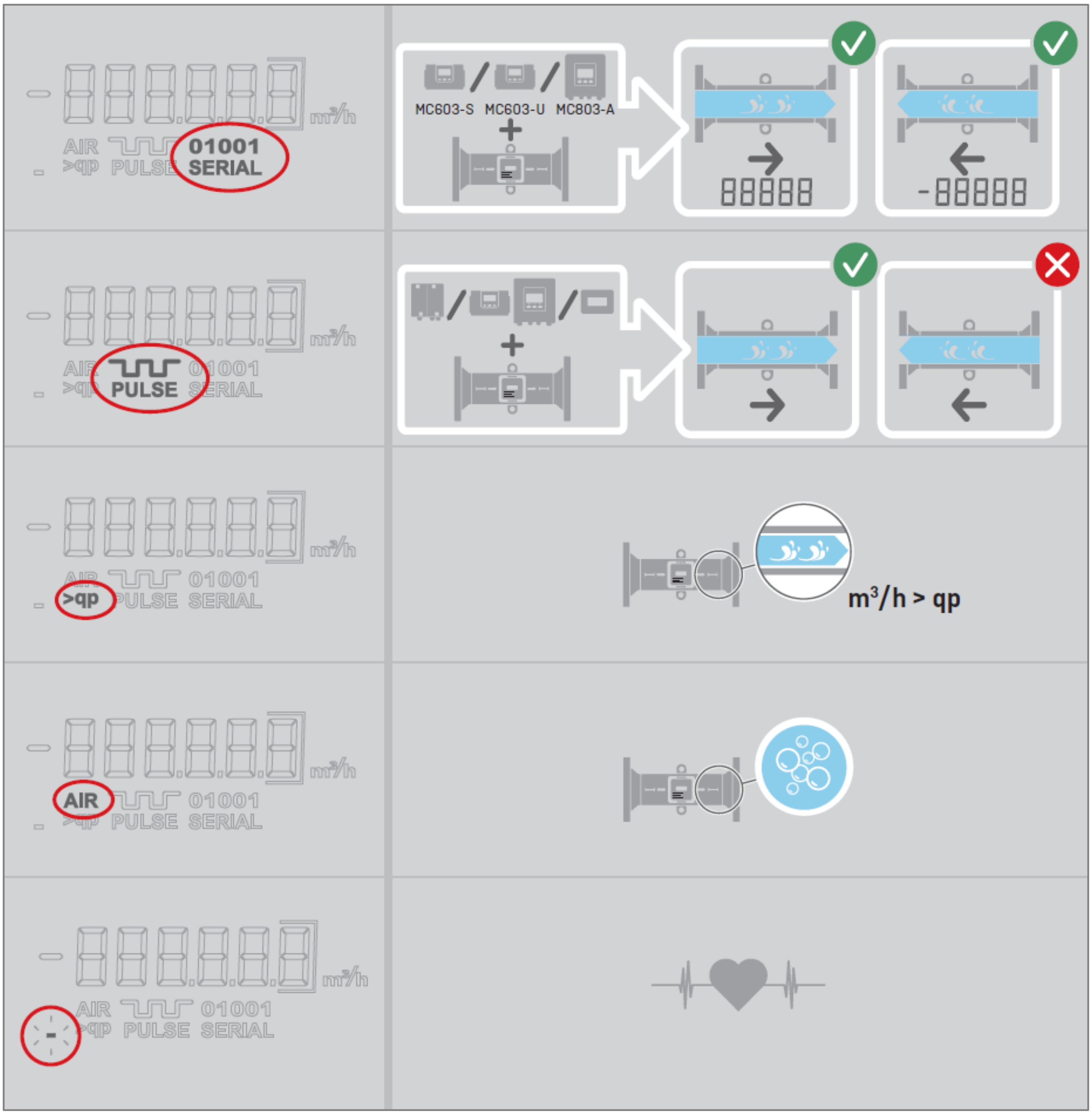


Figure 51. Possible display symbols during field operation of ULTRAFLOW® 85.

7.7.2 Additional display symbols during laboratory operation

To support e.g. test of reverse flow with pulses in laboratories, additional operation states of ULTRAFLOW® 85 are possible, which are also indicated by a combination of (additional) icons in the display as outlined below in *Figure 52*. During programming, e.g. with cable 66-99-024, the control pin is set to ground. The display symbols, which indicate an operation state, depend on whether the control pin is set to ground or not (any longer). Therefore, an operation state of ULTRAFLOW® 85 is typically indicated differently during programming compared to during testing in external laboratories, when the control pin is normally not set to ground. Note that indication of operation states in the approvals for ULTRAFLOW® 85 (EU-Type examination certificate DK-0200-MI004-048 and TS 27.02 019 national Danish cooling certificate) are with the control pin NOT set to ground, i.e. as normally for testing ULTRAFLOW® 85 with pulses coming directly from the 3-wire cable out of ULTRAFLOW® 85 or a Pulse Transmitter. Consult also paragraph *8 Calibration, adjustment and sealing of ULTRAFLOW® 85* for additional details about how to calibrate ULTRAFLOW® 85.

Figure 52. Possible display symbols during laboratory operation of ULTRAFLOW® 85. In addition to field operation, the dot – indicated with red circle – and the clockwise/counterclockwise arrow can be shown.

Icon			PULSE		SERIAL	01001	(DOT)
Operation state – Control pin **NOT** shortened							
Normal			X	X			
Normal_Reverse		X	X	X			
Verification	X		X				
Verification_Reverse		X	X				
Serial					X	X	
Operation state – Control pin shortened							
Normal					X		X
Normal_Reverse [1)]		X			X		X
Verification	X				X		X
Verification_Reverse [1)]		X			X		X
Serial					X		X

[1)] Difference is visible by the toggling frequency (ON/OFF) of the heartbeat indicator.

Table 25. Display icons, which are shown in the display, to indicate different operation states of ULTRAFLOW® 85, respectively.

8 Calibration, adjustment and sealing of ULTRAFLOW® 85

Calibration in external laboratories can be based on:

- Volume proportional pulses from ULTRAFLOW® 85 in different pulse operation states as outlined in *Table 26*.
- Volume proportional pulses from MULTICAL®-calculator by means of pulse interface 66-99-143 (only for testing forward flow) as outlined e.g. in the technical descriptions of MULTICAL® 603 (FILE100002141_EN; Link-MC603) or MULTICAL® 803 (FILE100000271_EN; Link-MC803). ULTRAFLOW® 85 can either be in pulse operation state or in serial operation state, when testing with pulse interface 66-99-143.

When testing ULTRAFLOW® with pulses coming directly from the 3-wire cable of the flow sensor, Pulse Tester type 66-99-279 can be used. See paragraph *8.6 Pulse Tester* for additional details about the Pulse Tester.

8.1 Operation states of ULTRAFLOW® 85

In field operation ULTRAFLOW® 85 is only emitting volume proportional pulses for forward flow (Normal). Even though the flow sensor measures reverse flow, no pulse emission is occurring, when ULTRAFLOW® 85 is in normal mode (pulse operation state). To test ULTRAFLOW® in external flow laboratories with pulses with (1.) higher volume sampling rates and (2.) for reverse flow, the flow sensor can be set by means of e.g. LabTool HCW 66-99-726 into different pulse operation modes as outlined in *Table 26* below.

⚠ ULTRAFLOW® 85 can be taken out of these different pulse operation mode in 2 ways:

- It is strongly recommended to set ULTRAFLOW® 85 manually with LabTool HCW 66-99-726 back to normal mode.
- Alternatively, after power has been applied continuously for 20 hours, it will automatically revert to normal mode.

For a description of symbols in the display of ULTRAFLOW® 85, please consult paragraph *7.7 Display of ULTRAFLOW® 85*.

Symbol	Name	Description
Pulse operation states (control pin NOT set to ground)		
	Normal	Pulse operation mode for pulse emission during forward flow – indicated with arrows on the flow sensor – and normal volume sampling rate defined by the flow sensor.
	Normal reverse	Pulse operation mode for pulse emission during reverse flow – opposite to the arrows on the flow sensor – and normal volume sampling rate defined by the flow sensor. Used e.g. for testing reverse flow with pulses in laboratories. Not for permanent field operation. Set with e.g. with LabTool HCW 66-99-726, which can be required from laboratories with partnership with Kamstrup from Kamstrup A/S. After 20 hours constant supply, the flow sensor will automatically return to Normal mode.
	Verification	Pulse operation mode for forward flow direction – indicated with arrows on the flow sensor – and high volume sampling rate defined by the flow sensor. Used e.g. for testing forward flow with pulses in laboratories. Not for permanent field operation. Set with e.g. with LabTool HCW 66-99-726, which can be required from laboratories with partnership with Kamstrup from Kamstrup A/S. After 20 hours constant supply, the flow sensor will automatically return to Normal mode.
	Verification reverse	Pulse operation mode for reverse flow direction – opposite to the arrows on the flow sensor – and high volume sampling rate defined by the flow sensor. Used e.g. for testing reverse flow with pulses in laboratories. Not for permanent field operation. Set with e.g. with LabTool HCW 66-99-726, which can be required from laboratories with partnership with Kamstrup from Kamstrup A/S. After 20 hours constant supply, the flow sensor will automatically return to Normal mode.
Pulse operation states (control pin set to ground)		
See *Table 25*	Unlock and enable serial	When the control pin is set to ground, the pulse output is disabled. The flow sensor is also unlocked and ready for serial communication. Can be used for testing in Normal, Normal reverse Verification and Verification reverse state without pulse emission. Instead of collecting pulses the volume register in the flow sensor for forward or reverse flow is read-out via serial data telegrams, respectively. Only available for Kamstrup A/S.

Symbol	Name	Description
Serial operation state		
	Serial	Serial mode, where each flow measurement is requested by the calculator. If no command is executed for ~16 seconds, the flow sensor will automatically return to Normal mode. Supported by e.g. MULTICAL® 603-S/603-U and MULTICAL® 803-A in the field.

Table 26. Operation states of ULTRAFLOW® 85.

During programming or test of ULTRAFLOW® 85 the control pin, which is protected by a security seal, can be set to ground. In that case the pulse output of ULTRAFLOW® 85 is disabled and the flow sensor is unlocked and ready for serial communication. This operation state “Unlock and enable serial” can be used for testing in Normal, Normal reverse Verification and Verification reverse state without pulse emission. Instead of collecting pulses the volume register in the flow sensor for forward or reverse flow is read-out via serial data telegrams, respectively. For the time being only available in Kamstrup’s flow laboratory.

8.2 Pulse output from ULTRAFLOW®

ULTRAFLOW® 85 can emit flow-proportional pulses according to *Table 1*. If ULTRAFLOW® is connected to equipment other than MULTICAL® calculators, for example a flow bench, it is recommended to use galvanic separation via Pulse Transmitter (or Pulse Divider).

Output ULTRAFLOW®

Type	Push-Pull
Output impedance	~10 kΩ
Pulse duration	2…6 ms
Duration of pause	Depending on the actual pulse frequency
Internal supply	3.6 VDC ±0.1 VDC

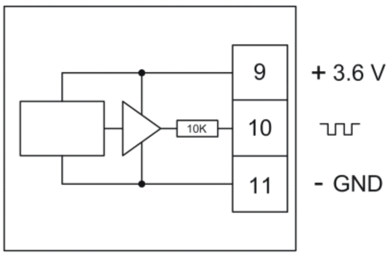


Figure 53. Block diagram for ULTRAFLOW® 85

From start-up, it takes up to a minimum of 16 seconds until true flow reading has been reached and calibration can start. The calibration duration depends on different parameters like e.g. a sufficient test volume and number of pulses, stable flow conditions etc., but a minimum test time of 3 minutes is in any case recommended. See paragraph *8.4 Suggested test points* for further information about suggested test points.

8.3 Electrical connection

Connection via 3-wire cable from ULTRAFLOW®

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

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

Type Open collector. Two-wire or three-wire connection is possible via the built-in 56.2 kΩ pull-up resistor.

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 27. Output (Y=2).

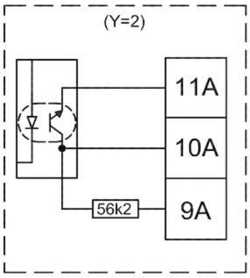


Figure 54. Block diagram for galvanically separated output module (Y=2).

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

Type Open collector. Three-wire connection via the built-in 39.2 kΩ pull-up resistor.

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 28. Output (Y=3)

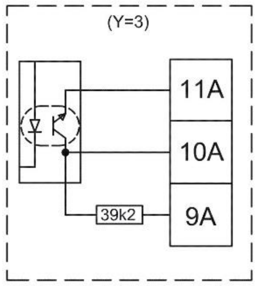


Figure 55. Block diagram for galvanically separated output module (Y=3).

8.4 Suggested test points

Nom. flow	Meter factor	Test points			Test duration			Test quantities		
q_p		q_p	q_i	$0.1xq_p$	q_p	q_i	$0.1xq_p$	q_p	q_i	$0.1xq_p$
[m³/h]	[pulses/l]	[m³/h]	[m³/h]	[m³/h]	[min]	[min]	[min]	[kg]	[kg]	[kg]
150	1	150	1.5	15	3	20	6	7500	500	1500
250	0.6	250	2.5	25	3	20	6	12500	833	2500
400	0.4	400	4	40	3	19	6	20000	1250	4000
600	0.25	600	6	60	3	20	6	30000	2000	6000
1000	0.15	1000	10	100	3	20	6	50000	3400	10000

Table 29. Table for ULTRAFLOW® including suggested test points, test durations and test quantities.

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

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

- Minimum test duration of 3 minutes
- Water volumes at q_i and 0.1 x q_p of minimum 10 % of the water volume per hour
- Water volume at 0.1 x q_p corresponding to minimum 1000 pulses
- Water volume at q_i corresponding to minimum 500 pulses

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

8.5 Optimization in connection with calibration

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

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

In connection with optimization of calibration, the following subcomponents can be considered:

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.

For further information regarding allowable test conditions such as water temperature and flow of the individual ULTRAFLOW®, see the approval of ULTRAFLOW® (see *paragraph 10 Approvals).*

Water quality: Recommended water quality as described in CEN TR 16911 and AGFW FW510

Installation (mechanical conditions):

To avoid flow disturbances, the inlet pipes and distance pieces must have the same nominal diameter as the sensors. There should be min. 5 x DN between the sensors. In connection with bends, etc., there should be a minimum distance of 10 x DN. If tests are made at low flow with a bypass at right angles to the pipe, it will be an advantage to mount an absorber of pressure fluctuations due to the perpendicular inlet. This can be a flexible tube on the bypass. In addition, it will be an advantage to mount 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 for distance pieces has been made on the basis of many years' experience:

The lengths of the distance pieces must be 10 x DN.

To obtain optimal metrological performance it is recommended to mount ULTRAFLOW® 85 with the electronics box placed on the side (0°-position in *Figure 15*), when mounted horizontally. The ultrasound paths in the flow sensor tube will thus be vertical, which is optimal in connection with possible stratification of the medium, which might occur at low flow. The electronics box can also be positioned +45° upwards (see *Figure 15*).

In addition, we recommend insulating both ULTRAFLOW® 85 and pipes before and after to minimize possible stratification.

Installation (electrical conditions):

To avoid interference from the outside as well as to obtain an electrical interface to MULTICAL®, it is recommended to use a Pulse Tester (see paragraph *8.6* Pulse Tester) or to connect a Pulse Transmitter (see paragraph *4.3 Pulse Transmitter / Pulse Divider and Cable Extender Box*) between ULTRAFLOW® and the relevant test equipment that count pulses to achieve galvanic separation.

8.6 Pulse Tester

During a calibration process it is often practical to use Pulse Tester type No. 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 mounted directly in a MULTICAL® base unit (type 66- and 602-)

8.6.1 Technical data of 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

Please note: Depending on the connecting base used there are one or two pulse inputs/outputs.

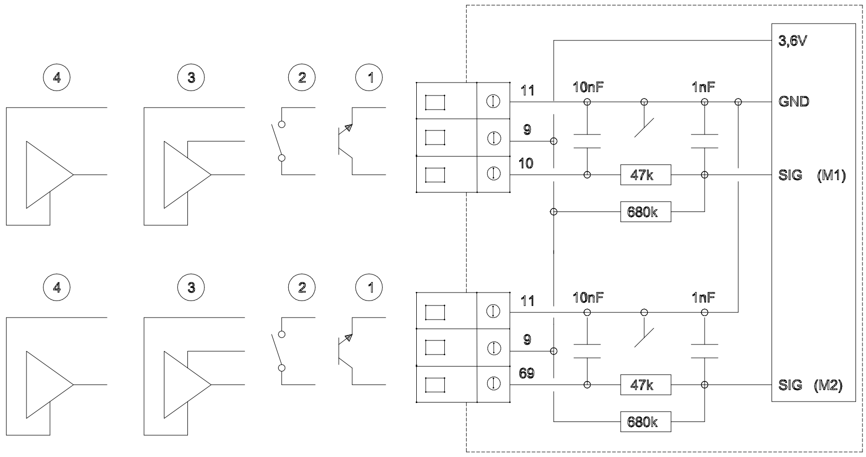


Figure 56. Electric diagram of Pulse Tester

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 of e.g. MID-meters. This type of transmitter should not be used as the quick pulse input of the Pulse Tester may regard bounce from the transmitter as pulses.

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 30. M1/M2 connection in Pulse Tester

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

Flow sensors with active signal output are connected as shown in *Figure 56.* The signal level must be between 3.5 V 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)

Pulse duration > 4 ms

Duration of pause Depending on the actual pulse frequency

Two-wire connection:

Voltage < 24 V

Load > 1.5 kΩ

Three wire connection:

Voltage 5...30 V

Load > 5 kΩ

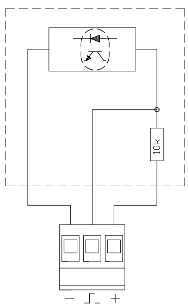


Figure 57. Flow sensor with active output and integral supply

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

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

8.6.2 Hold-function

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

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 separated
Input protection	Against reversed polarity
“Open input”	Count (see *Figure 58*)

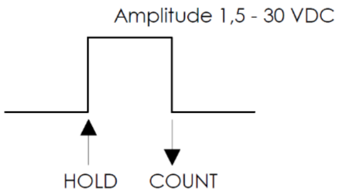


Figure 58. Hold-function

8.6.3 Push-button functions

Figure 59. 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 60. The right push-button “Reset”.

8.6.4 Using 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).

8.6.5 Spare parts

Description	Type No.
Battery D-cell	1606-064
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 31. Spare parts for Pulse Tester.

8.6.6 Battery replacement

If the Pulse Tester is used continuously, we recommend that the battery is replaced once a year.

Remove the battery plug from the battery and strip the cable insulation before connecting the battery to the terminals marked ”Batt”, the red wire to + and the black one to -.

Current consumption:

Current consumption with no sensors connected	400 µA
Max. current consumption with two ULTRAFLOW® connected	1.5 mA

If the base unit is fitted with battery or externally supplied, the Pulse Tester’s integral supply must be disconnected (unplugged).

8.7 Adjustment of ULTRAFLOW® flow sensors with Kamstrup software

Adjusting of ULTRAFLOW® flow sensors is supported by Kamstrup for authorized laboratories. The adjustment is performed through LabTool HCW 6699-726. Please contact the Kamstrup Product Service in Denmark (service@kamstrup.com) for additional information.

To prevent any attempt of fraud, LabTool is exclusively distributed to workshops/laboratories with national legal authorization and partnership with Kamstrup.

8.8 Sealing and marking

ULTRAFLOW® is factory sealed, i.e. verified flow sensors will be supplied with security seals (S) and a year mark (D). Security seals are identical to metrological seals defined in WELMEC 13.3:2021.

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

⚠ According to WELMEC 13.3:2021 installation sealing is advisable. The shown methods for installation sealing are examples, but other securing measures for the installation may be equally suitable. National requirements concerning installation sealing shall be taken into account.

Sealing of ULTRAFLOW® 85 is shown below but crucial are the requirements as stated in the type approval certificates for ULTRAFLOW® 85 (see paragraph *10 Approvals*).

In the drawings, sealing is divided into the following groups/protection levels:

- D Module D/F marking (depending on type label) as an integrated part of the type label.
- S Security seals. Void label covering screws or anti-tamper seal, which must be destroyed to be unlocked.
- T Type label (void label)
- I Installation seals (void label)
- A Alternative approval marking as an integrated part of the type label.
(e.g. DK268 mark or DK268 mark and year mark)
- R Re-verification marking, if required; suggested position

The following illustrations specify the place(s) where a security seal “S” must be applied. ULTRAFLOW® is delivered sealed from factory.

Installation sealing is advisable, and the installation seals can be ordered to be mounted from factory, or the sealing is performed onsite with e.g. specific installation seals of the respective district heating/cooling suppliers.

Side view A

I – Sealing of top cover

S – Sealing label (covering screw, which is locking the base part, or transducer lid)

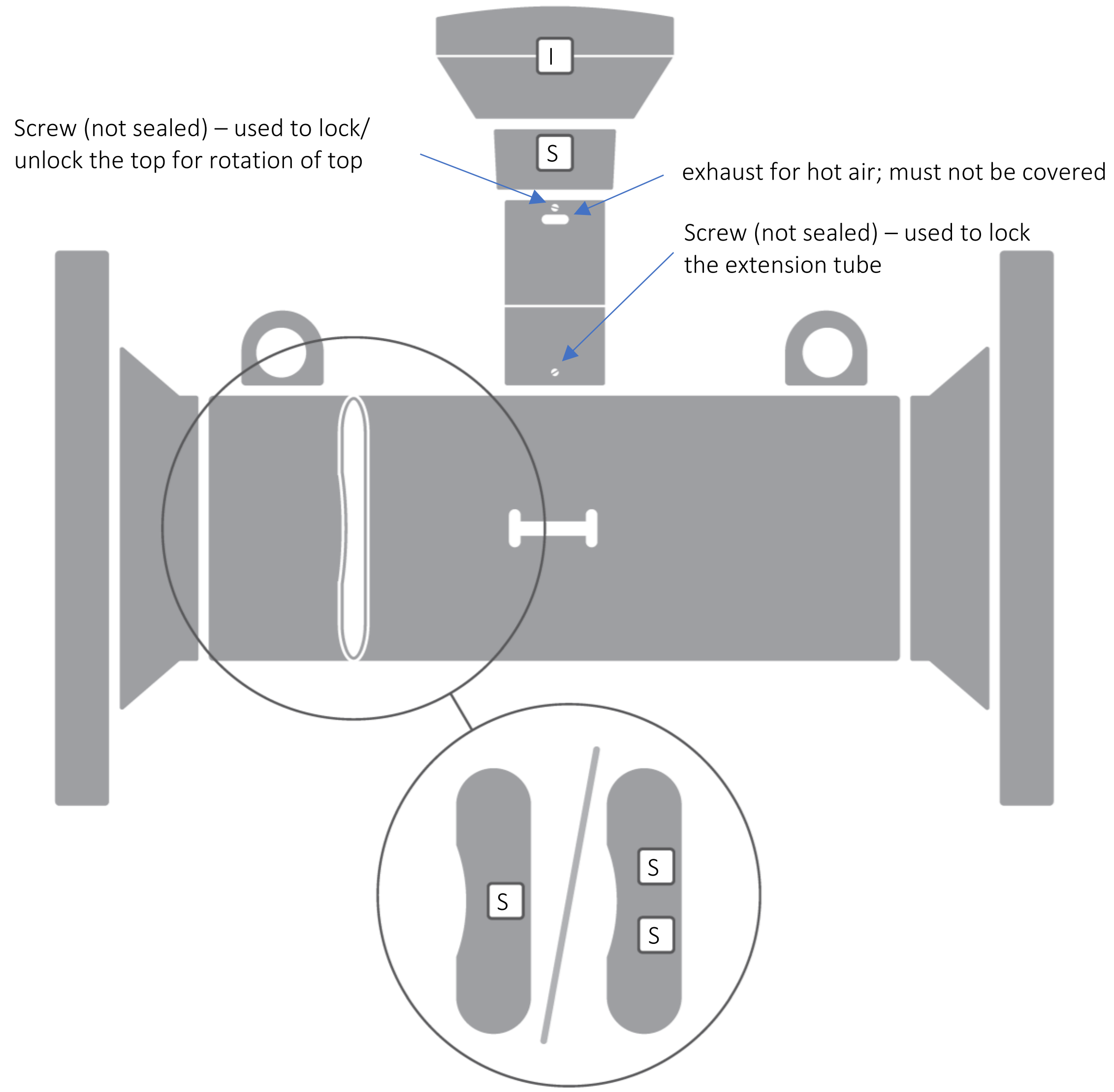


Figure 61. Sealing of ULTRAFLOW® 85 – Side view A.

Side view B

I – Sealing of top cover

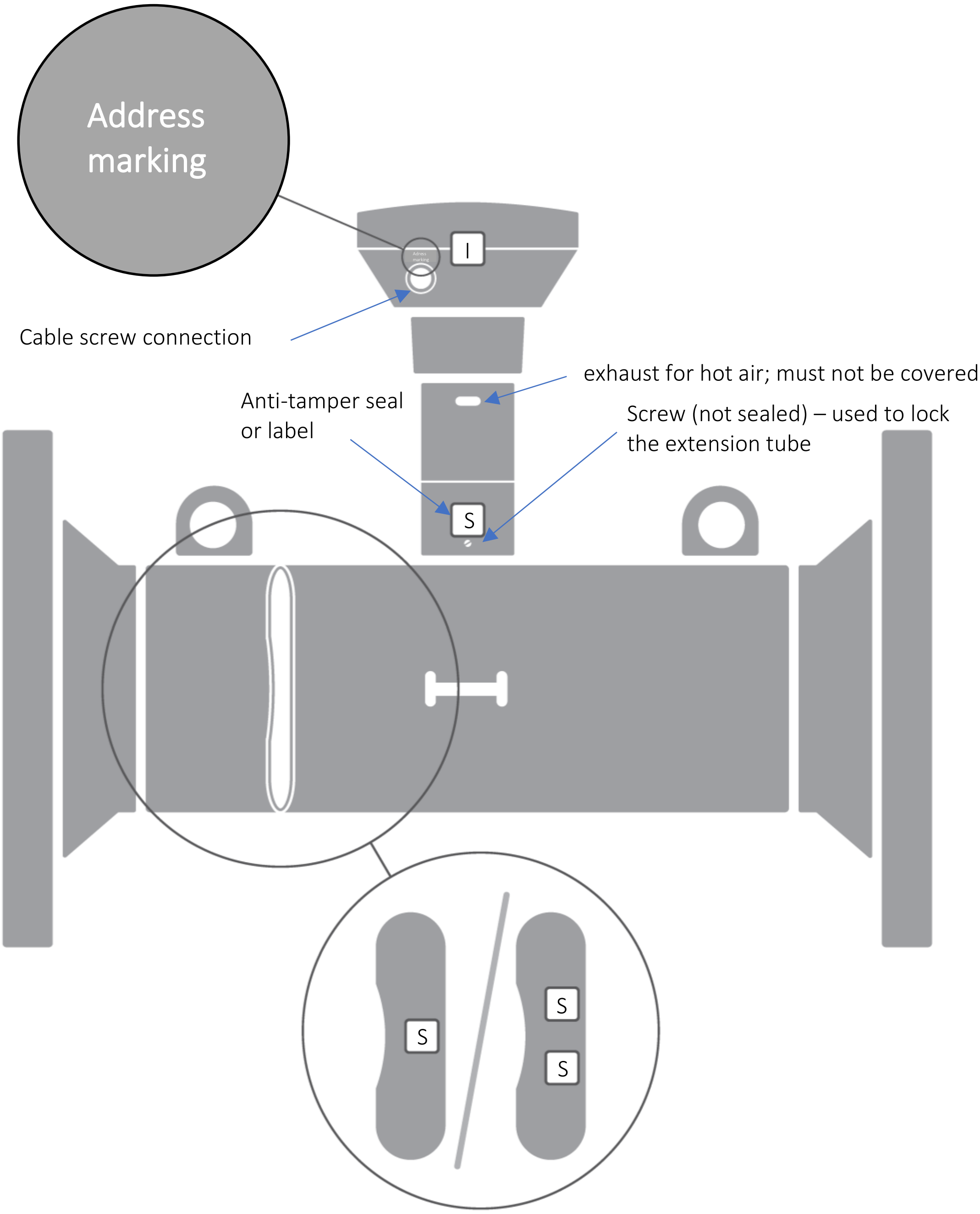


Figure 62. Sealing of ULTRAFLOW® 85 – Side view B.

Top view (top cover and transparent lid are removed)

S – Sealing label covering screws of verification lid/cover

T – Type label (void)

A – Alternative approval marking as integrated part of the type label

D – Module D/F marking (depending on type label) as integrated part of the type label

R – Re-verification marking; suggested position

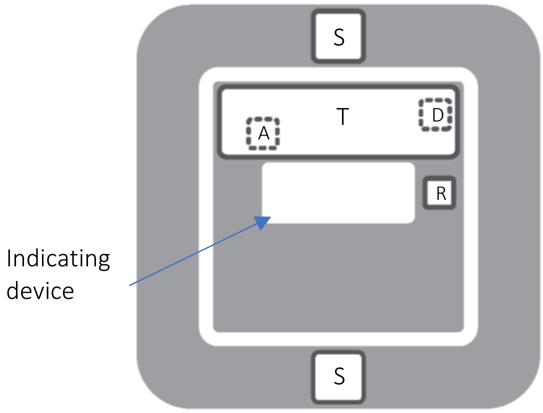


Figure 63. Sealing of ULTRAFLOW® 85 – Top view (top cover and transparent lid are removed).

Cable extender box (Type 66-99-036)

Type label does not need to be a void label.

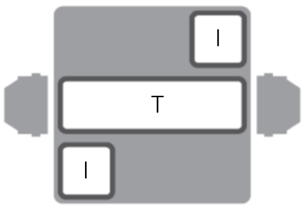


Figure 64. Sealing of Cable extender box.

Pulse Transmitter (Type 66-99-903-YZ-XXX)/Pulse Divider (Type 66-99-907-YZ-XXX)

Pulse Transmitter (Type 66-99-903-YZ-XXX)

Type label does not need to be a void label.

Marking of output (Y)/supply (Z) module can be adapted, when changing the output/supply module.

Pulse Divider (Type 66-99-907-YZ-XXX)

Marking of output (Y)/supply (Z) module can be adapted, when changing the output/supply module.

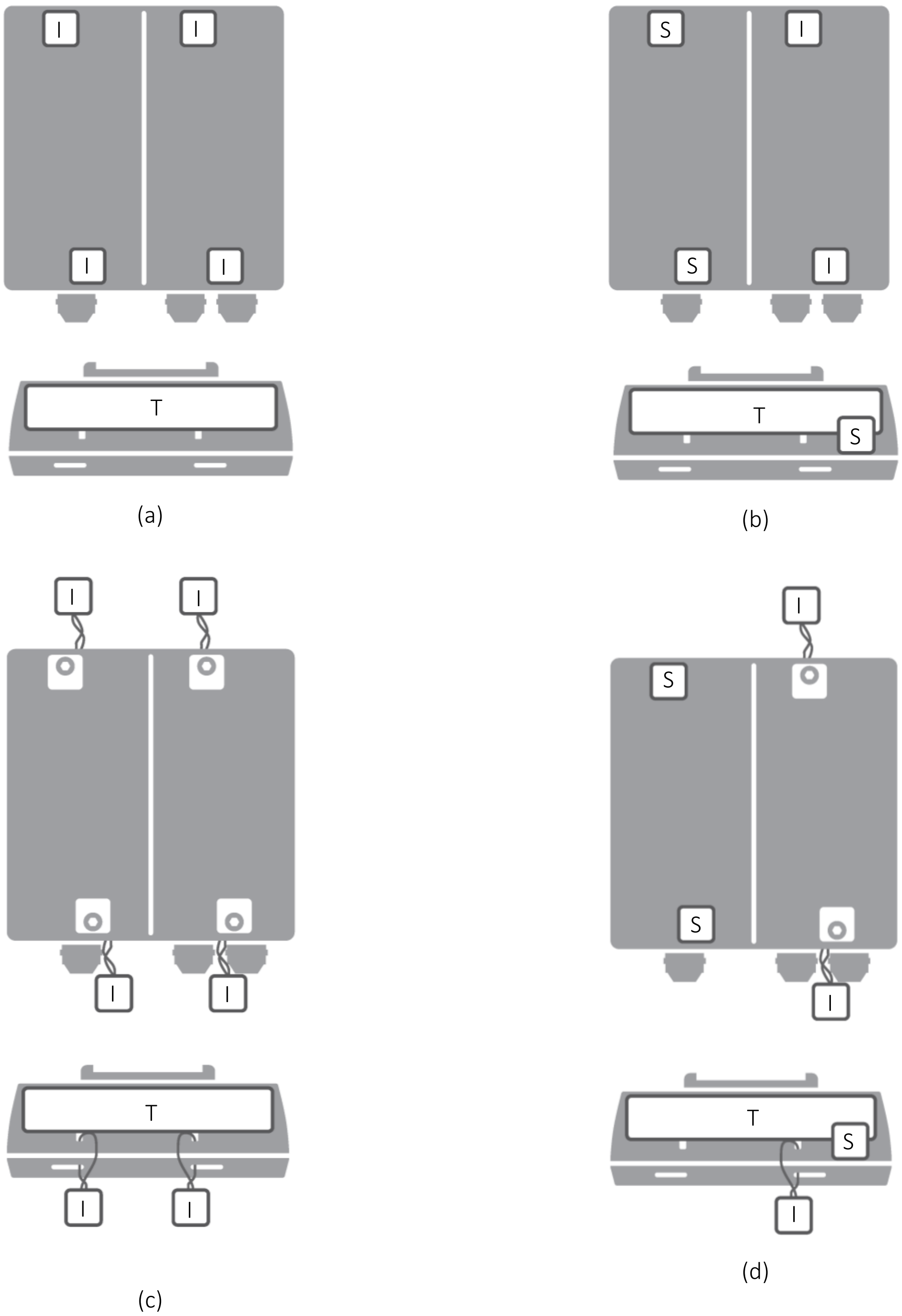


Figure 65. Sealing examples of (a) Pulse Transmitter and (b) Pulse Divider with void labels covering screws (and type label), (c) Pulse Transmitter with seal and wire and (d) Pulse Divider with void labels covering screws (and type label) and seal and wire.

9 Software for Kamstrup heat/cooling meters

Adjusting of ULTRAFLOW® flow sensors is supported by Kamstrup for authorized laboratories. The adjustment is performed through Kamstrup's software LabTool. Please contact the Kamstrup Product Service in Denmark (service@kamstrup.com) for additional information.

To program Pulse Divider and to configure pulses in ULTRAFLOW® 54 DN150-300, the software METERTOOL HCW 6699-724 is used. For more information, see the Technical description of METERTOOL HCW (FILE100002360_EN_(5512-2097_GB)).

To adjust ULTRAFLOW® 85, see *8.7 Adjustment of ULTRAFLOW® flow sensors with Kamstrup software*.

10 Approvals

10.1 MID and DK-BEK 1178 – 06/11/2014

ULTRAFLOW® 85 is available as a flow sensor for heating installations with CE-marking according to MID (2014/32/EU). The certificates have the following numbers:

EC-Type Examination certificate (B-Module):	DK-0200-MI004-048
MID-certificate acc. to Module D:	DK-0200-MID-D-001

ULTRAFLOW® 85 is approved as a cooling flow sensor in accordance with DK-BEK 1178 – 06/11/2014:

System designation:	TS 27.02 019
Verification:	DANAK accreditation 268

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

Standard and documents:

EN 1434:2022

OIML R75:2002

WELMEC 7.3:2023 (May 2024).

10.2 CE-Marking

In addition, ULTRAFLOW® 85 is marked according to the following directives, where necessary:

EMC directive	2014/30/EU
LV directive	2014/35/EU (when fitted with 230 VAC supply module)
PE directive	2014/68/EU (DN150…DN300) category I or II

10.3 Declaration of Conformity (EU)

With each ULTRAFLOW® 85 DN150-300 delivered from Kamstrup, an EU Declaration of Conformity is provided. See Kamstrup documentation no. 5512-1996 (Link-UF85).

11 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.

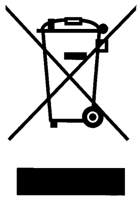
Symptom	Possible cause	Proposal for correction
No update of display values	No power supply	Replace battery or check mains supply
No display function (blank display)	No power supply and backup	Replace back-up cell. Replace battery or check mains supply
No accumulation of m^3	No volume pulses Incorrect connection	Check flow sensor connection. (Check with Pulse Tester, if necessary)
	Flow sensor 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. The signal path might also be blocked by other obstacles.
	Flow sensor error	Replace flow sensor/send sensor for repair
Erroneous m^3 accumulation	Erroneous programming	Check consistency between meter factor of calculator and flow sensor
	Air in sensor/cavitation	Check installation angle. Check if there is air in the system or cavitation from valves and pumps. Increase the static pressure, if possible. The signal path might also be blocked by other obstacles.
	Flow sensor error	Replace flow sensor/Send sensor for repair

Table 32. Troubleshooting for heat and cooling meters.

12 Disposal

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

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



Kamstrup's heat meters are marked according to EU Directive 2012/19/EU 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 A/S 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 A/S.

- **The customer sends for disposal**

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

Lithium cells and meters including lithium cells must be packed, marked and forwarded as dangerous goods (see also Kamstrup document 5510-408, "Lithium batteries - Handling and disposal"). Batteries must NOT be subject to mechanical shock and the cables must NOT be able to be short circuited during transport.

Meter part	Material	Recommended disposal
Lithium cell (D-cell)	Lithium and thionyl chloride > UN 3091 < D-cell: 4.9 g lithium	Approved deposit of lithium cells
PCB	Coppered epoxy laminate, components soldered on	PCB scrap for concentration of metals
Signal cable for flow sensor	Copper with silicone mantle	Cable recycling
Supply cable	Copper with PVC mantle	Cable recycling
ULTRAFLOW® 85 base part, top cover, and calculator mount bracket; base and cover of Pulse Transmitter/ Pulse Divider	Thermoplastic, PC 10% GF	Plastic recycling
ULTRAFLOW® 85 extension tube	Thermoplastic, PPS 40% GF	Plastic recycling
Housing, Cable Extender Box	Thermoplastic, ABS	Plastic recycling
ULTRAFLOW® 85 sensor housing	Stainless steel, W.no. 1.4308	Metal recycling
Flanges	Stainless steel, W.no. 1.4301	Metal recycling
Transducer	Titanium	Metal recycling
Packing	Wooden pallets	Reuse or recycling

Table 33. Recommended disposal for single parts.

Please send any questions you may have regarding environmental matters to:

Kamstrup A/S
Att.: Quality and environmental dept.
Fax: +45 89 93 10 01
info@kamstrup.com

13 Technical documentation

	Danish	English	German
Technical description			
ULTRAFLOW® 54 DN15-125	FILE100001275_DK (5512-2463)	FILE100001282_EN (5512-2464)	FILE100001285_DE (5512-2465)
ULTRAFLOW® 44 DN15-125	FILE100000272_DK (5512-2589)	FILE100000287_EN (5512-2599)	FILE100000290_DE (5512-2600)
ULTRAFLOW® 85 DN150-300	-	FILE100005701_EN	-
Data sheet			
ULTRAFLOW® 54 DN15-125	FILE100000563_DA (5810-1546)	FILE100000564_EN (5810-1547)	FILE100000565_DE (5810-1548)
ULTRAFLOW® 44 DN15-125	FILE100001166_DA (5810-1753)	FILE100001165_EN (5810-1751)	FILE100001519_DE (5810-1754)
ULTRAFLOW® 85 DN150-300	FILE100005703_DK	FILE100005503_EN	FILE100005704_DE
Installation guide			
ULTRAFLOW® & MULTICAL® 603	- 5512-2231	FILE100002838_EN 5512-2231	- 5512-2231
ULTRAFLOW® & MULTICAL® 803	- 5512-2408	FILE100002839_EN 5512-2408	- 5512-2408
ULTRAFLOW® 85 DN150-300	- 5512-3517	FILE100005542_EN 5512-3517	- 5512-3517
Pulse Transmitter/Pulse Divider	5512-1387	5512-1421	5512-1422
Cable Extender Box	5512-2008	5512-2008	5512-2008

Table 34. Technical documentation for ULTRAFLOW®.

14 List of figures

15 List of tables