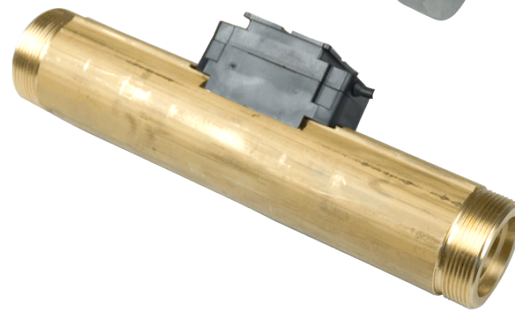
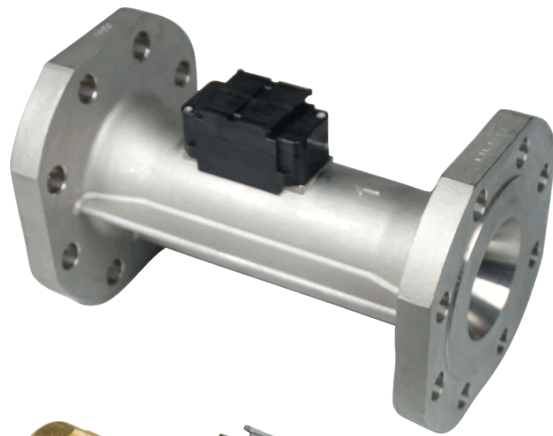


Technical Description

MULTICAL[®] 61

Water Meter



Kamstrup

Kamstrup A/S
Industrivej 28, Stilling
DK-8660 Skanderborg
TEL: +45 89 93 10 00
FAX: +45 89 93 10 01
info@kamstrup.dk
www.kamstrup.dk

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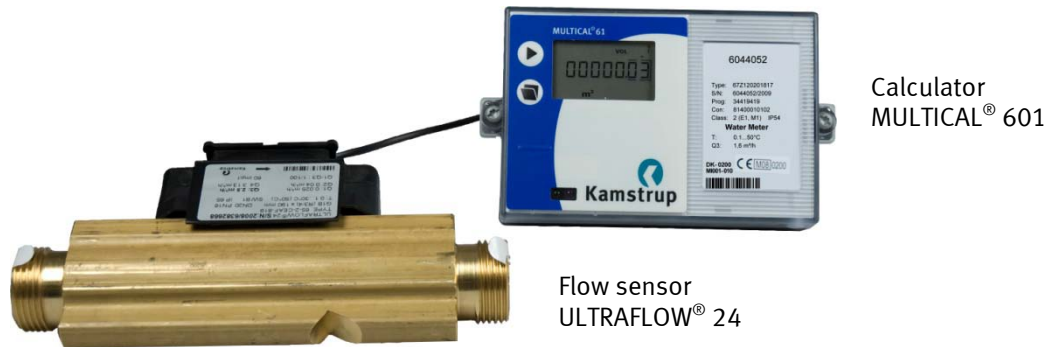
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1 General Description

MULTICAL® 61 is a cold water meter (0,1...50°C) and hot water meter (0,1°C...90°C) and consists of the flow sensor ULTRAFLOW® 24 and the calculator MULTICAL® 601.



MULTICAL® 61 is a static water meter based on the ultrasonic principle. The water meter has been developed on the basis of our experience since 1991 with the development and production of static ultrasonic meters.

The meter, which has been designed to measure the water consumption in "utility room environments", has been subjected to a very comprehensive OIML R 49 type test in order to secure a long-term stable, accurate and reliable meter. One of the water meter's many advantages is the fact that it has no wearing parts, which entails longevity. Furthermore, the starting flow of the meter is only 3 l/h, providing accurate measurement also at low flows.

According to OIML R49 MULTICAL® 61 can be described a "complete water meter". In practice this means that flow sensor and calculator must not be separated.

MULTICAL® 61 employs ultrasonic measuring techniques and microprocessor technology. All circuits for calculation of flow measurements are placed in the calculator base. The flow sensor is without electronics in order to protect it against condensation water. The flow sensor is connected with the calculator base by means of a 2.5 m screened cable.

If flow sensor and calculator have been separated and the seals have therefore been broken, the meter is no longer valid for billing purposes. Furthermore, the factory guarantee no longer applies.

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

The accumulated water consumption is displayed by MULTICAL® 61 in m³ with seven significant digits and the measuring unit. The display has been specially designed to obtain long lifetime and sharp contrast in a wide temperature range.

Other reading options are operating hour counter and current flow, max. and min. flow, information code, customer number and segment test etc. – depending on configuration.

All registers are saved daily in an EEPROM for 460 days. Furthermore, monthly data for the latest three years and yearly data for the latest 15 years are saved.

The water meter is powered by an internal lithium battery with up to 12 years' lifetime. Alternatively the meter can be mains supplied, either by 24 VAC or 230 VAC.

MULTICAL® 61 can be fitted with plug-in modules in both calculator top (top modules) and in connecting base (base modules). Thus, the meter can be adapted to many different applications and data readings.

In addition to the water meter's own data, MULTICAL® 61 has two extra pulse inputs, VA and VB, for collection and remote accumulation of pulses from e.g. water and electricity meters. The pulse inputs are included in the base modules. Pulse inputs VA and VB function independently of the other inputs/outputs.

MULTICAL® 61 is available with communication modules for e.g. radio, M-Bus, LON, 0/4...20 mA and RS232.

MULTICAL® 61 includes data communication ports. An optical eye on the front of the calculator top makes it possible to read consumption data and data logger as well as to establish a serial PC connection for configuration of the water meter. Via plug-in modules it is possible to connect to external communication devices. MULTICAL® 61 can be delivered with communication modules for e.g. radio, M-Bus, LON, 0/4...20 mA and RS232.

1.1 Mechanical construction



Figure 1

1. Transparent top cover with front plate
2. Cabinet for electronics unit
3. Verification cover. The top cover can be dismantled without breaking the verification seal
4. Verification label
5. Meter case
6. Signal case
7. Fitting, also for wall mounting. Screws and rawplugs for wall mounting are enclosed with the meter (item no. 3130-105)
8. Supply: Battery, 24 VAC or 230 VAC. Can be replaced without breaking the verification seal
9. Base module
10. Top module

Optional equipment for cold water meter only:

Strainer (dirt filter) for DN15 and DN40 with gasket

Anti-pollution check valves for DN15 to DN40 with gasket (NF EN 13959)

2 Technical Data

2.1 Approved meter data

Approval	DK-0200-MI001-010	
EU directives	MID (Measuring Instrument Directive 2004/22/EC, MI-001)	
	LVD (Low Voltage Directive 2006/95/EC)	
	EMC (Electromagnetic Compatibility Directive 2004/108/EC)	
	PED (Pressure Equipment Directive 97/23/EC), Category 1,(DN50-DN80)	
Standard	OIML R 49-1(2006), OIML R 49-2(2006)	
	WELMEC guide 8.11 (Issue 1, 2006)	
Mechanical environmental class	M1	
Electromagnetic class	E1	
Environmental class	B	
Accuracy class	2	
Temp. of medium in flow sensor	0.1...50°C	Cold water meter
	0.1...90°C	Hot water meter
Sanitary approval	WRAS (UK)	Water up to 70°C
	VA (DK)	
	DVGW – W421 (KTW + W270) (DE)	Cold water up to 50°C Hot water up to 85°C
	ACS (F)	

2.2 Electrical data

Supply voltage	3.6 V ± 5%
Battery	3.65 VDC, D-cell lithium
Replacement interval	12 years @ $t_{BAT} < 30^{\circ}\text{C}$
Mains supply	230 VAC +15/-30%, 50/60 Hz 24 VAC ±50%, 50/60 Hz
Power consumption mains supply	< 1W
Backup mains supply	Integral SuperCap eliminates interruptions due to short-term power failures
EMC data	Fulfils OIML R 49 class E1

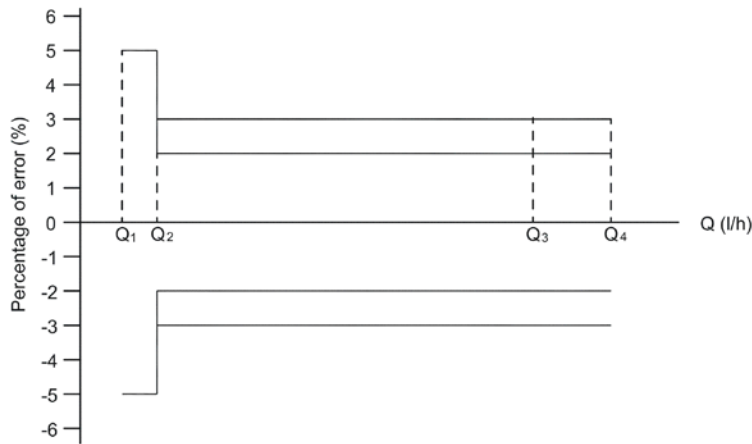
2.3 Mechanical data

Metrological class	2
Environmental class	Fulfils OIML R 49 class B
Mechanical environment	MID class M1
Ambient temperature	5...55°C non-condensing, closed location (installation indoors)
Protection class	Calculator: IP54 Flow sensor: IP65
Temperature of medium	Cold water meter: 0.1...50°C Hot water meter: 0.1...90°C
Storage temperature	-25...60°C (drained flow sensor)
Weight	0.4 kg excl. flow sensor
Pressure stage	Threaded meter: PN16 Flange meter: PN25
Flow sensor cable	2.5 m

2.4 Accuracy

MPE according to OIML R 49 MPE (maximum permissible error range)

Meter approved: 0.1...30°C °C ± 5 % in range $Q_1 \leq Q < Q_2$, ± 2 % in range $Q_2 \leq Q \leq Q_4$
 30...90°C °C ± 5 % in range $Q_1 \leq Q < Q_2$, ± 3 % in range $Q_2 \leq Q \leq Q_4$



Q₁: Minimum flow velocity
 Q₂: Transition flow velocity
 Q₃: Permanent flow velocity
 Q₄: Overload flow velocity

Diagram 1

OIML R 49 requirements to water meters

2.5 Materials

Wetted parts

Case, gland	DZR brass (Dezincification brass)
Case, flange	Stainless steel 1.4408
Transducer	Stainless steel 1.4401
Gaskets	EPDM
Measuring tube	Thermoplastic, PES 30% GF
Reflectors/mirrors	Stainless steel 1.4305, 1.4306, 1.4401

Flow sensor case

Base	Thermoplastic, PBT 30% GF
Cover	Thermoplastic, PC 20% GF
Wall bracket	Thermoplastic, PC 20% GF

Calculator case

Top	Thermoplastic, PC
Base	Thermoplastic, ABS with TPE gaskets (thermoplastic elastomer)
Internal cover	Thermoplastic, ABS

Flow sensor cable

Copper cable with silicone jacket and inner Teflon insulation

3 Type Overview

3.1 Type number, calculator

MULTICAL® 61	67 -	Z	□	□□	□	0	□	□	□□
Top module									
No module			0						
RTC (Real Time Clock)			1						
RTC + data output + hourly data logger			5						
RTC + M-Bus			7						
RTC + 2 pulse outputs for CE and CV + hourly data logger			8						
RTC + 2 pulse outputs for CE and CV + prog. data logger			B						
Base module									
No module				00					
Data + pulse inputs				10					
M-Bus + pulse inputs				20					
RadioRouter + pulse inputs				21					
Prog. data logger + RTC + 4...20 mA inputs + pulse inputs				22					
0/4...20 mA outputs				23					
LonWorks, FTT-10A + pulse inputs				24					
Radio + pulse inputs (internal antenna)				25					
Radio + pulse inputs (connection for external antenna)				26					
M-Bus module with MC-III data package + pulse inputs				29					
Wireless M-Bus Mode C1 + pulse inputs				30					
ZigBee 2.4 GHz int.ant. + pulse inputs				60					
Metasys N2 (RS485) + pulse inputs				62					
Supply									
No supply					0				
Battery, D-cell					2				
230 VAC supply module with transformer					7				
24 VAC supply module with transformer					8				
Flow sensor									
Supplied with one ULTRAFLOW® 24							1		
Meter type									
Hot water meter								7	
Cold water meter								8	
Delivery code (language on label etc.)									XX

3.2 Type number, flow sensor

ULTRAFLOW® 24	Nom. flow Q ₃	Max. flow Q ₄	Min. flow Q ₁	Min. cut off	Max. Cut off	Pressure loss Δp @ Q ₃	Connection on meter	Length	Anti-pollution check valve ¹⁾	Strainer ¹⁾
<i>Type number</i>	[m ³ /h]	[m ³ /h]	[l/h]	[l/h]	[m ³ /h]	[bar]		[mm]		
65-2 -CDAA -XXX	1.6	2.0	16	3	4,5	0.25	G ³ / ₄ B (R ¹ / ₂)	110	-	-
65-2 -CDAC ²⁾ -XXX	1.6	2.0	16	3	4,5	0.25	G ³ / ₄ B (R ¹ / ₂)	165	OK	OK
65-2 -CDA1 -XXX	1.6	2.0	16	3	4,5	0.25	G1B (R3/4)	110	-	-
65-2 -CDAF -XXX	1.6	2.0	16	3	4,5	0.25	G1B (R3/4)	190	OK	OK
65-2 -CEAF -XXX	2.5	3.1	25	6	7,5	0.04	G1B (R3/4)	190	OK	OK
65-2 -CGAG -XXX	4.0	5.0	40	7	9	0.09	G5/4B (R1)	260	OK	OK
65-2 -CHAG -XXX	6.3	7.9	63	12	18	0.22	G5/4B (R1)	260	OK	OK
65-2 -CJAJ -XXX	10	12.5	100	20	30	0.06	G2B (R1 ¹ / ₂)	300	OK	OK
65-2 -CKCE -XXX	16	20	160	30	45	0.16	DN 50	270	-	-
65-2 -CLCG -XXX	25	31.3	250	50	75	0.06	DN 65	300	-	-
65-2 -CMCH -XXX	40	50	400	80	90	0.05	DN 80	300	-	-

Table 1

¹⁾ Anti-pollution check valve and strainer are only valid options for cold water meter.

²⁾ MULTICAL® 61 with flow sensor type 65-2-CDAC (G³/₄B x 165) is only available as cold water meter.

The type number of the flow sensor cannot be changed after factory programming

The delivery code can also be used for:

- Language and approvals on type label
- Marking of PN class

Customer labels (2001-XXX) are integrated in the front label.

3.3 Accessories

3.3.1 Accessories list

66-00-200-100	D-cell battery
66-99-098	Data cable w/USB plug
66-99-099	Infrared optical reading head w/USB plug
66-99-102	Infrared optical reading head w/D-sub 9F
66-99-106	Data cable RS 232, D-sub 9F
59-20-147	USB to serial converter
679xxxxx2xx	External Communication Box
66-99-704	METER TOOL for MULTICAL® 601
66-99-705	METER TOOL LogView for MULTICAL® 601

Please contact Kamstrup A/S for questions concerning further accessories.

3.3.2 Glands incl. gaskets

6561-326	Gland incl. gasket for DN15, (R $\frac{1}{2}$ x G $\frac{3}{4}$)	(2 pcs.)
6561-327	Gland incl. gasket for DN20, (R $\frac{3}{4}$ x G1),	(2 pcs.)
6561-328	Gland incl. gasket for DN25, (R1 x G $\frac{5}{4}$)	(1 pc.)
6561-329	Gland incl. gasket for DN40, (R $\frac{1}{2}$ x G2)	(1 pc.)

3.3.3 Gaskets

<u>Gasket for gland</u>			<u>Gasket for flange</u>		
3130-251	G $\frac{3}{4}$ (R $\frac{1}{2}$)	(2 pcs.)	2210-099	DN50	(1 pc.)
3130-252	G1 (R $\frac{3}{4}$)	(2 pcs.)	2210-141	DN65	(1 pc.)
3130-253	G $\frac{1}{4}$ (R1)	(2 pcs.)	2210-140	DN80	(1 pc.)
3130-254	G2 (R $\frac{1}{2}$)	(2 pcs.)			

3.3.4 Strainer for flow sensor inlet ¹⁾

6556-484	Strainer DN15 for G $\frac{3}{4}$ B (R $\frac{1}{2}$), 10 strainers, not for 110 mm housing
6556-485	Strainer DN20 for G1B (R $\frac{3}{4}$), 10 strainers
6556-499	Strainer DN25 for G $\frac{1}{4}$ B (R1), 10 strainers
6556-500	Strainer DN40 for G2B (R $\frac{1}{2}$), 10 strainers

3.3.5 Anti-pollution check valve (EN 13959) for flow sensor return, incl. PE gasket ¹⁾

6556-480	Anti-pollution check valve DN15 for G $\frac{3}{4}$ B, incl. strainer and two PE gaskets, not for 110 mm housing
6556-481	Anti-pollution check valve DN20 for G1B, incl. strainer and two PE gaskets
6556-482	Anti-pollution check valve DN25 for G $\frac{1}{4}$ B, incl. PE gasket
6556-483	Anti-pollution check valve DN40 for G2B, incl. PE gasket

(PE = Polyethylene)

3.3.6 PE gasket for strainer and anti-pollution check valve ¹⁾

6556-494	DN15	(10 pcs.)
6556-495	DN20	(10 pcs.)
6556-496	DN25	(10 pcs.)
6556-497	DN40	(10 pcs.)

3.3.7 Pulse Transmitter (Cable extension set)

6699-618.0	Pulse Transmitter, without cable
6699-618.2	Pulse Transmitter, incl. 10 m cable

¹⁾ Anti-pollution check valves, strainers and PE- gaskets are only valid options for cold water meter.

4 Programming

MULTICAL® 61 can be ordered in countless combinations as required by the customer. First select the required hardware from the type overview. Then select "Prog", "Config" and "Data" to suit the application in question.

The "Prog" and "Config" codes are printed on the front label and can be read out via the display or via METERTOOL. It is only possible to read out "Data" via METERTOOL.

The supplied meter is configured from the factory and ready for use, but can also be changed/reconfigured after installation. However, this does not apply to type number and "prog"(CCC-code), which cannot be changed unless the verification seal is broken. This requires that changes must be made by an accredited meter laboratory.

4.1 PROG (A-B-CCC-CCC)

The meter's legal parameters are determined by the "Prog", which cannot be changed without breaking the verification seal. This means that the change must be made by an accredited meter laboratory.

Prog. number	A	-	B	-	CCC	-	CCC
	3		4		□□□		□□□
Flow meter position	Internal value						
Measuring unit	Internal value						Internal value
Flow sensor coding	(CCC-table)				CCC		CCC

4.1.1 >A< and >B<

The A- and B-codes are always 3 and 4, respectively, for MULTICAL® 61.

4.1.2 >CCC< CONFIGURATION OF FLOW METER TYPE

The **CCC-code** states the calculator's adaption to a specific flow sensor type to the effect that calculating speed and display resolution are optimized for the selected flow sensor at the same time as type approval regulations as to minimum resolution and maximum register overflow are obeyed.

The "Internal value CCC-code" must be identical with the selected CCC-code.

4.1.3 Standard CCC-codes

CCC-table for MULTICAL® 61									
CCC No.	Pre-counter	Flow factor	Number of decimals in display			Pulse output CV [m³]	Imp./l	Q₃ [m³/h]	Type
			m³	l/h	m³/h				
419	1000	235926	2	0	-	0,01	100	1.6	65-2-CDxx-xxx
407	100	235926	3	0	-	0,001	100	1.6	65-2-CDxx-xxx
498	600	393210	2	0	-	0,01	60	2.5	65-2-CExx-xxx
451	5000	471852	1	0	-	0,1	50	4	65-2-CGxx-xxx
436	500	471852	2	0	-	0,01	50	4	65-2-CGxx-xxx
437	2500	943704	1	0	-	0,1	25	6.3	65-2-CHxx-xxx
438	250	943704	2	0	-	0,01	25	6.3	65-2-CHxx-xxx
478	1500	1572840	1	0	-	0,1	15	10	65-2-CJxx-xxx
483	150	1572840	2	0	-	0,01	15	10	65-2-CJxx-xxx
420	1000	2359260	1	0	-	0,1	10	16	65-2-CKxx-xxx
485	100	2359260	2	0	-	0,01	10	16	65-2-CKxx-xxx
479	600	3932100	1	0	-	0,1	6	25	65-2-CLxx-xxx
458	5000	471852	0	-	2	1	5	40	65-2-CMxx-xxx
486	500	471852	1	-	2	0,1	5	40	65-2-CMxx-xxx

Current flow indication (l/h or m³/h) is calculated on the basis of volume pulses/10 sec. (See paragraph 8.1)



4.2 CONFIG (DDD-EE-FF-GG-MN)

4.2.1 >DDD< CONFIGURATION OF DISPLAY

Display code "DDD" indicates the active readings of each meter type.

"1" is the first primary reading, whereas e.g. "1A" is the first secondary reading.

The display automatically returns to reading "1" after 4 minutes.

				Date stamp	Volume Hot DDD=710	Volume Hot DDD=714	Volume Cold DDD=810	Volume Cold DDD=814
4.0	Volume V1				1	1	1	1
	4.1	Yearly data	•	1A	1A	1A	1A	1A
	4.2	Monthly data	•	1B	1B	1B	1B	1B
6.0	Hour counter				2	2	2	2
12.0	Flow (V1)				3	3	3	3
	12.1	This year's max.	•	3A	3A	3A	3A	3A
	12.2	Max. yearly data	•					
	12.3	This year's min.	•					
	12.4	Min. yearly data	•					
	12.5	This month's max.	•					
	12.6	Max. monthly data	•	3B	3B	3B	3B	3B
	12.7	This month's min.	•					
	12.8	Min. monthly data	•	3C	3C	3C	3C	3C
13.0	Flow (V2)				4		4	
15.0	VA (Input A)				5		5	
	15.1	Meter No. VA		5A		5A		
	15.2	Yearly data	•	5B		5B		
	15.3	Monthly data	•	5C		5C		
16.0	VB (Input B)				6		6	
	16.1	Meter No. VB		6A		6A		
	16.2	Yearly data	•	6B		6B		
	16.3	Monthly data	•	6C		6C		
19.0	Info Code				7	4	7	4
	19.1	Info event counter		7A	4A	7A	4A	
	19.2	Info logger (36 latest events)	•	7B	4B	7B	4B	
20.0	Customer number (N° 1+2)				8	5	8	5
	20.1	Date		8A	5A	8A	5A	
	20.2	Hour		8B	5B	8B	5B	
	20.3	Target date		8C	5C	8C	5C	
	20.4	Serial no. (N° 3)		8D	5D	8D	5D	
	20.5	Prog. (A-B-CCC-CCC) (N° 4)		8E	5E	8E	5E	
	20.6	Config 1 (DDD-EE) (N° 5)		8F	5F	8F	5F	
	20.7	Config 2 (FF-GG-M-N) (N° 6)		8G	5G	8G	5G	
	20.8	Software edition (N° 10)		8H	5H	8H	5H	
	20.9	Software check sum (N° 11)		8I	5I	8I	5I	
	20.10	Segment test		8J	5J	8J	5J	
	20.11	Top module type (N° 20)		8K	5K	8K	5K	
	20.12	Base module type (N° 30)		8L	5L	8L	5L	

DDD = 714 is the "standard code" for hot water meter type 67-Z-xxxx017xx, whereas DDD = 814 is the "standard code" for cold water meter type 67-Z-xxxx018xx. Contact Kamstrup for other combinations.

A data reading can include up to 36 pieces of monthly data and up to 15 pieces of yearly data; the number is determined by the DDD-code.

See paragraph 8.3.2 for more info on display structure.

4.2.2 >EE< Configuration

The EE-code is not used for MULTICAL® 61 in connection with ULTRAFLOW® 24 and is always “00”

4.2.3 >FF< Input A (VA), pulse division >GG< Input B (VB), pulse division

MULTICAL® 61 has two extra optional pulse inputs, VA and VB, which are placed on the base modules (see paragraph 9.8 for further details). The inputs can be configured via the FF and GG codes as shown in the table below. In the absence of other information from the customer the inputs will be configured as FF=24 and GG=24.

Input A Terminal 65-66		Input B Terminal 67-68		Precounter	Wh/imp.	l/imp.	Measuring unit and decimal position	
FF	Max. input f ≤ 1 Hz	GG	Max. input f ≤ 1 Hz				vol A/vol B (m³)	000000.0
01	100 m³ h	01	100 m³ h	1	-	100	vol A/vol B (m³)	000000.0
02	50 m³ h	02	50 m³ h	2	-	50	vol A/vol B (m³)	000000.0
03	25 m³ h	03	25 m³ h	4	-	25	vol A/vol B (m³)	000000.0
04	10 m³ h	04	10 m³ h	10	-	10	vol A/vol B (m³)	000000.0
05	5 m³ h	05	5 m³ h	20	-	5.0	vol A/vol B (m³)	000000.0
06	2.5 m³ h	06	2.5 m³ h	40	-	2.5	vol A/vol B (m³)	000000.0
07	1 m³ h	07	1 m³ h	100	-	1.0	vol A/vol B (m³)	000000.0
24	10 m³ h	24	10 m³ h	1	-	10	vol A/vol B (m³)	00000.00
25	5 m³ h	25	5 m³ h	2	-	5.0	vol A/vol B (m³)	00000.00
26	2.5 m³ h	26	2.5 m³ h	4	-	2.5	vol A/vol B (m³)	00000.00
27	1 m³ h	27	1 m³ h	10	-	1.0	vol A/vol B (m³)	00000.00
40	1,000 m³ h	40	1,000 m³ h	1	-	1000	vol A/vol B (m³)	0000000
FF	Max. Input f ≤ 3 Hz	GG	Max. Input f ≤ 3 Hz	Precounter	Wh/imp.	l/imp.	Measuring unit and decimal position	
50	2500 kW	50	2500 kW	1	1000	-	EL A/EL B (kWh)	0000000
51	150 kW	51	150 kW	60	16.67	-	EL A/EL B (kWh)	0000000
52	120 kW	52	120 kW	75	13.33	-	EL A/EL B (kWh)	0000000
53	75 kW	53	75 kW	120	8.333	-	EL A/EL B (kWh)	0000000
54	30 kW	54	30 kW	240	4.167	-	EL A/EL B (kWh)	0000000
55	25 kW	55	25 kW	340	2.941	-	EL A/EL B (kWh)	0000000
56	20 kW	56	20 kW	480	2.083	-	EL A/EL B (kWh)	0000000
57	15 kW	57	15 kW	600	1.667	-	EL A/EL B (kWh)	0000000
58	7.5 kW	58	7.5 kW	1000	1.000	-	EL A/EL B (kWh)	0000000
59	750 kW	59	750 kW	10	100	-	EL A/EL B (kWh)	0000000
60	1250 kW	60	1250 kW	2	500	-	EL A/EL B (kWh)	0000000
70	25000 kW	70	25000 kW	1	10000	-	EL A/EL B (MWh)	00000.00

MULTICAL® 61 has no pulse output possibility via the base modules, only via the top modules. See paragraph 11.1

4.2.4 >MN< Configuration of leak limits

When MULTICAL® 61 is used for leak surveillance, the sensitivity is determined by the configuration of "MN". See paragraph 8.6

M=		Leak surveillance (V1)	
		Leakage sensitivity (at 0.01 m³ resolution in display)	
0	OFF	N=	0
			OFF
			1
			20 l/h (30 min. without counting in display)
			2
			10 l/h (1 hour without counting in display)
			3
			5 l/h (2 hours without counting in display)

Note: M=0 and N=2 are default values when leak surveillance is used. Increased sensitivity, e.g. N=3, can only be achieved by means of METERTOOL.

Info codes for leakage (info code 64) are only active when M = 0 and N > 0 respectively.

NB: Input VA of MULTICAL® 61 cannot be used for leak surveillance.

4.3 DATA for configuration

	Automatic	To be stated when ordering	Default
Serial no. (S/N) as well as	E.g. 6000000/2006	-	-
Customer No.	-	Up to 16 digits	Customer number = S/N
Display No. 1 = 8 digits MSD		Limited to 11 digits depending on PcBase compatibility	
Display No. 2 = 8 digits LSD			
Target date	-	MM=1-12 and DD=1-28	Depends on delivery code
TL2	-	N/A	N/A
TL3	-	N/A	N/A
Average peak time	-	1...1440 min.	60 min.
Max. T1 for cooling metering	-	N/A	N/A
T2 prog.		N/A	N/A
T3 prog.		N/A	N/A
T4 prog.		N/A	N/A
Date/time	YYYY.MM.DD/hh.mm.ss GMT+offset acc. to delivery code	GMT ± 12.0 hours (in 30 min. steps)	-

-DELIVERY CODES

Information on delivery codes see no. 5511-352

- MAINTENANCE

See instructions no. 5508-721 concerning update of programming, configuration and delivery codes.

5 Dimensioned Sketches

MULTICAL® 61

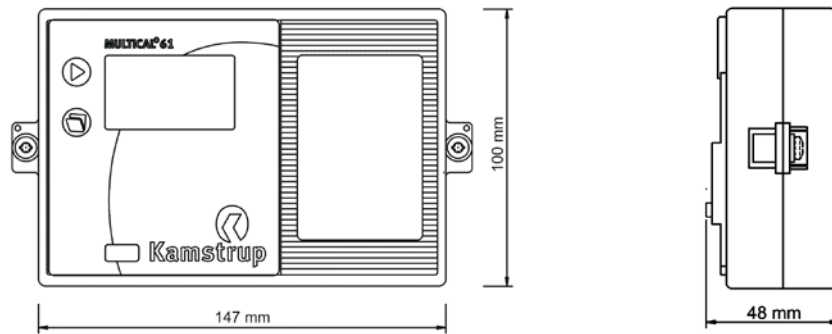


Figure 2 Physical measurements of the electronics unit

ULTRAFLOW® 24, G³/₄B and G1B

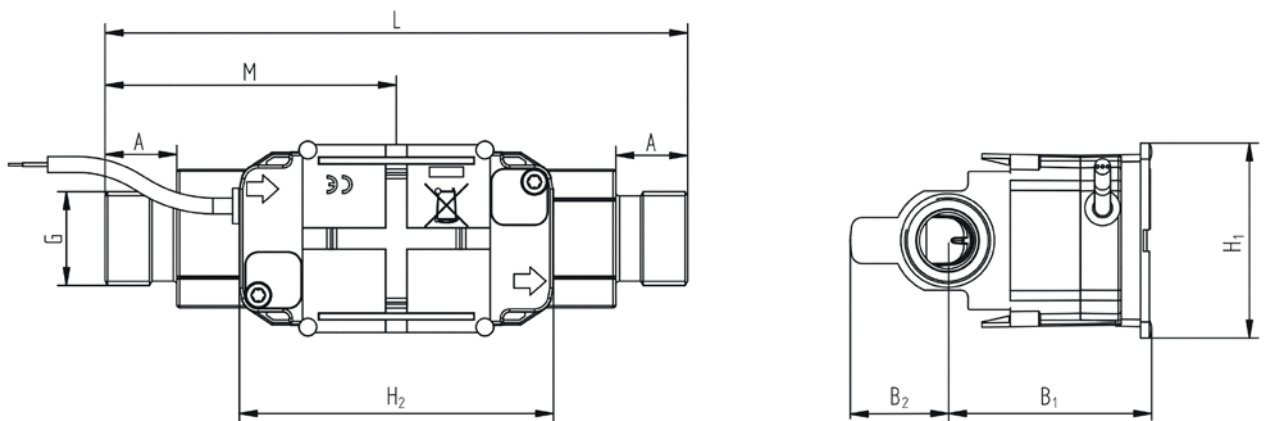


Figure 3 Flow sensor with G³/₄B and G1B threaded connection

Thread ISO 228-1

Q ₃ [m ³ /h]	Thread	L [mm]	M [mm]	H ₂ [mm]	A [mm]	B ₁ [mm]	B ₂ [mm]	H ₁ [mm]	Approx. weight [kg]
1.6	G ³ / ₄ B	110	L/2	89	10.5	58	28	55	0.8
1.6	G ³ / ₄ B	165	L/2	89	20.5	58	28	55	1.2
1.6	G1B	110	L/2	89	10.5	58	28	55	0.9
1.6	G1B	190	L/2	89	20.5	58	28	55	1.4
2.5	G1B	190	L/2	89	20.5	58	29	55	1.3

Table 2 Total weight excl. packing

ULTRAFLOW® 24, G1¼B and G2B

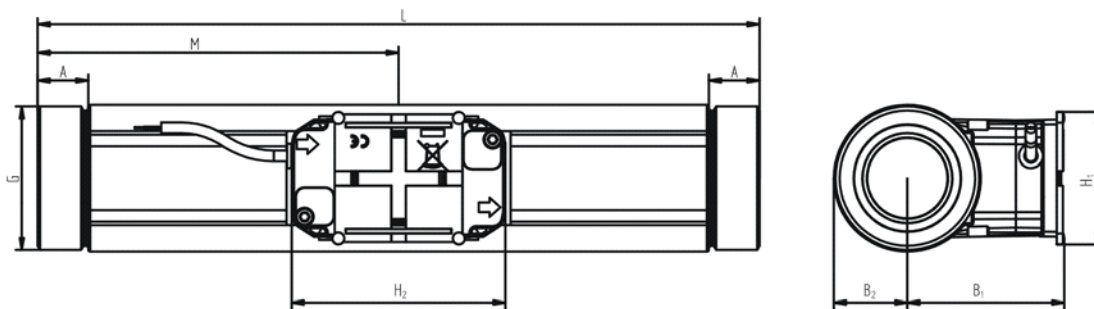


Figure 4 Flow sensor with G1¼B and G2B threaded connection

Thread ISO 228-1

Q ₃ [m³/h]	Thread	L [mm]	M [mm]	H ₂ [mm]	A [mm]	B ₁ [mm]	B ₂ [mm]	H ₁ [mm]	Approx. weight [kg]
4.0 6.3	G1¼B	260	L/2	89	17	58	22	55	2.3
10	G2B	300	L/2	89	21	65	31	55	4.5

Table 3

ULTRAFLOW® 24, DN50

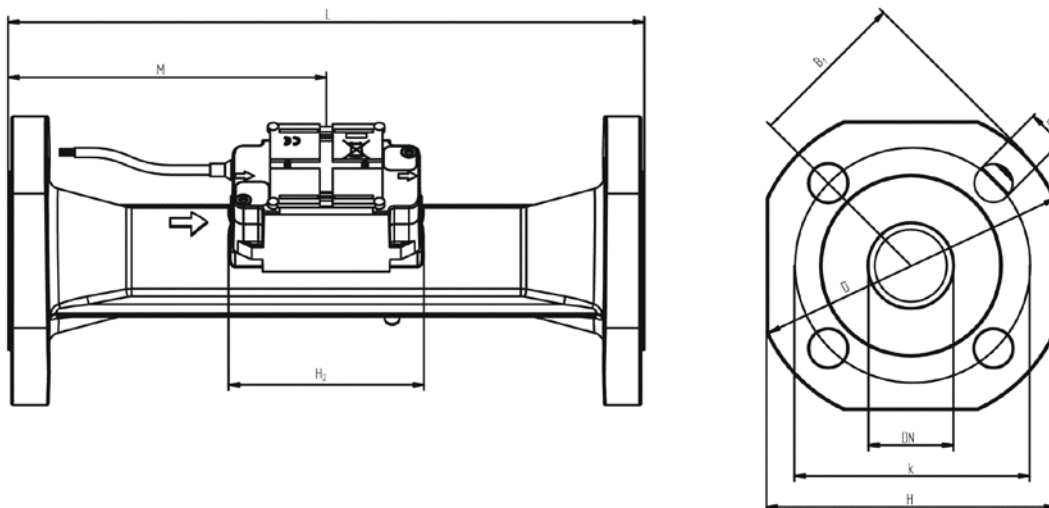


Figure 5 Flow sensor with DN50 flange connection

Flange EN 1092-3, PN25

Q ₃ [m³/h]	Nom. diameter	L [mm]	M [mm]	H ₂ [mm]	B ₁ [mm]	D [mm]	H [mm]	k [mm]	Number [units]	Bolts Thread	d ₂ [mm]	Approx. weight [kg]
16	DN50	270	155	89	65	165	145	125	4	M16	18	10.1

Table 4

ULTRAFLOW® 24, DN65 and DN80

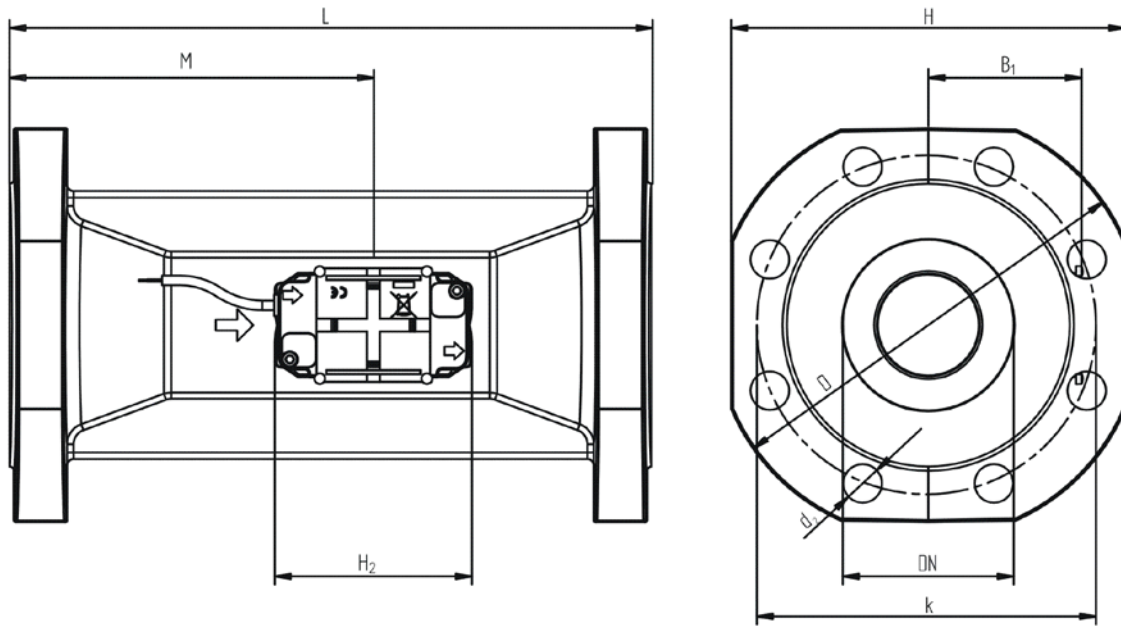


Figure 6 Flow sensor with DN65 and DN80 flange connection

Flange EN 1092-3, PN25

Q_3 [m ³ /h]	Nom. diameter	L [mm]	M [mm]	H ₂ [mm]	B ₁ [mm]	D [mm]	H [mm]	k [mm]	Number [units]	Bolts Thread	d ₂ [mm]	Approx. weight [kg]
25	DN65	300	170	89	72	185	168	145	8	M16	18	13.2
40	DN80	300	170	89	80	200	184	160	8	M16	18	16.8

Table 5

6 Pressure Loss

According to OIML R 49 the maximum pressure loss must not exceed 0.63 bar in range Q₁ up to and incl. Q₃ and max. 1.0 bar at Q₄ respectively. The pressure loss is without anti-pollution check valve.

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

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

where:

Q = volume flow rate [m³/h]

kv = volume flow rate at 1 bar pressure loss [m³/h]

Δp = pressure loss [bar]

Graph	Q ₃ [m ³ /h]	Nom. diameter [mm]	kv	Q @ 0.63 bar [m ³ /h]
A	1.6	DN15 & DN20	3.2	2.5
B	2.5 & 4 & 6.3	DN20 & DN25	13.4	10.6
C	10 & 16	DN40 & DN50	40	32
D	25	DN65	102	81
E	40	DN80	179	142

Table 6 Pressure loss table

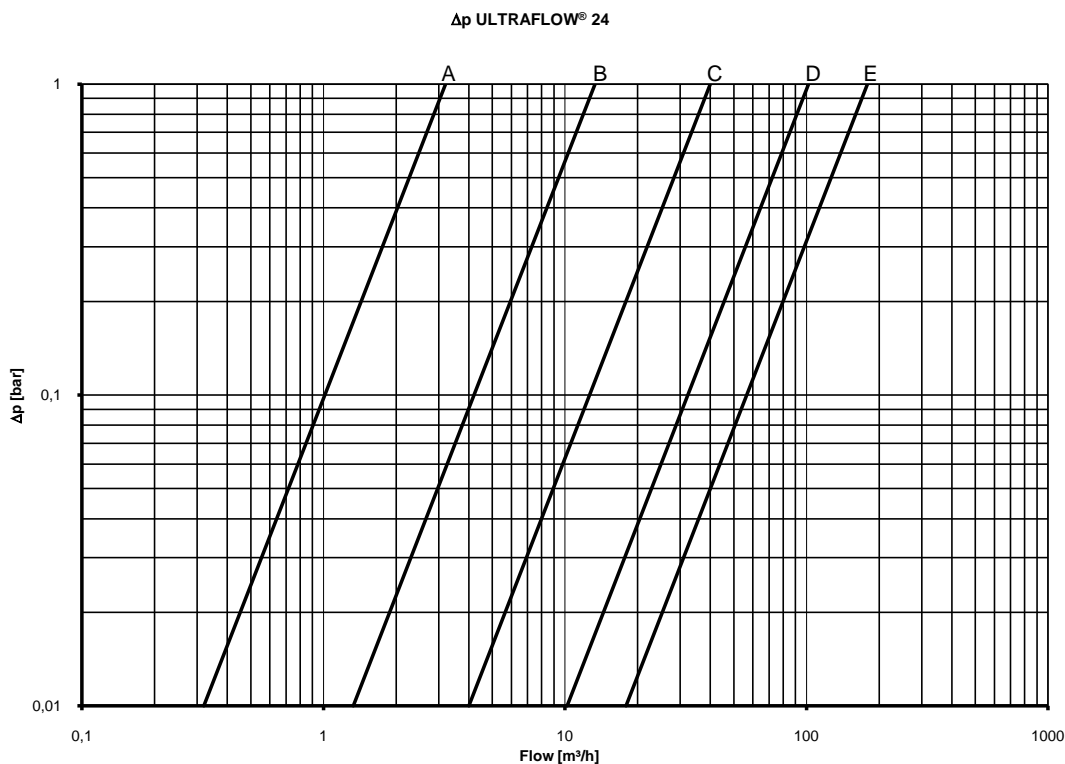


Diagram 2 Pressure loss chart

7 Installation

7.1 Installation requirements

Prior to installing the flow sensor ULTRAFLOW® 24 the installation ought to be flushed while a fitting piece is replacing the meter. Remove the adhesive wafers from the meter's inlet and outlet and mount the flow sensor with glands. You must always use new gaskets in original quality.

The flow sensor must be correctly placed according to the drawings overleaf. See paragraph 7.2

The flow direction is indicated by an arrow on each side of the flow sensor.

Mounting the sensor you must make sure that the threaded length of the glands does not prevent proper tightening of the sealing surface and that PN10 or glands/gaskets are used (PN16 glands/gaskets can be used).

Using strainer and/or anti-pollution check valve (only to be used in cold water meters) the enclosed thicker PE gaskets must be used to avoid damaging strainer or anti-pollution check valve.

When mounting the sensor's connection cables please make sure that condensation water cannot penetrate the sensor.

Permissible operating conditions

Ambient temperature: 5...55°C non-condensing, closed location (installation indoors)

Temperature of medium: 0.1...50°C Cold water meter

0.1...90°C Hot water meter

System pressure: 1.5...16 bar (See paragraph 7.5)

EMC conditions

MULTICAL® 61 has been designed for installation in housing and in light industrial environments. The meter is CE-marked on the basis of OIML R 49 type test class E1 and the Low Voltage Directive.

The meter's control cables must be routed at min. 25 cm distance from other installations.

Electrical installations

MULTICAL® 61 is available for both 24 VAC and 230 VAC mains supply. The mains connection consists of a two-wire cable without safety ground.

Use a strong connection cable with an outer diameter of max. 7 mm and ensure correct cable relief for the meter.

National regulations for electric installations must be observed, including e.g. the cable cross section used in relation to the installation's fuse size (short circuit current). Max. fuse 6 A.

Installation in Denmark is subject to an SIK announcement 27/09 from The Danish Safety Technology Authority concerning "Installations for mains supplied equipment for consumption registration" (See paragraph 10.6) for both direct 230 VAC supplied meters and 24 VAC meters which are powered via a safety transformer.

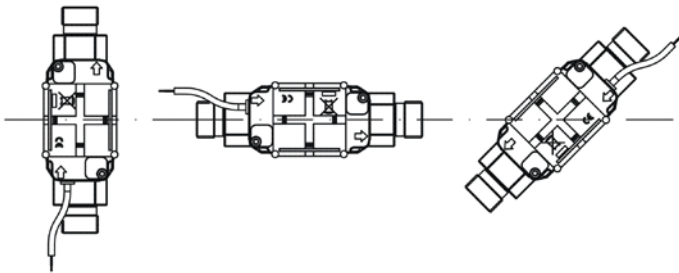
Service

When the meter has been mounted in the system neither welding nor freezing is allowed. Dismount the meter from the system and switch off the mains supply to the meter, if any, before starting the work.

In order to facilitate replacement of the meter, shut-off valves ought to be mounted on both sides of the meter.

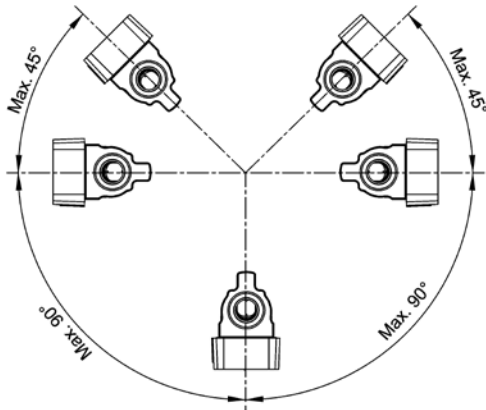
Under normal operating conditions no pipe strainer is required in front of the meter.

7.2 Installation angle for ULTRAFLOW® 24



ULTRAFLOW® 24 can be mounted vertically, horizontally or at an angle.

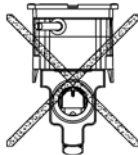
Figure 7



Important!

ULTRAFLOW® 24 may be turned upwards to max. 45° and downwards to max. 90° in relation to the pipe axis.

Figure 8



The plastic housing must **not** face upwards.

Figure 9

7.3 Straight inlet

ULTRAFLOW® requires neither straight inlet nor outlet to meet the Measuring Instruments Directive (MID) 2004/22/EC and OIML R 49. Only in case of heavy flow disturbances before the meter a straight inlet section is necessary.

7.4 Installation example

The calculator can be mounted on top of the flow sensors plastic housing, it must then be advised as shown in Figure 10.

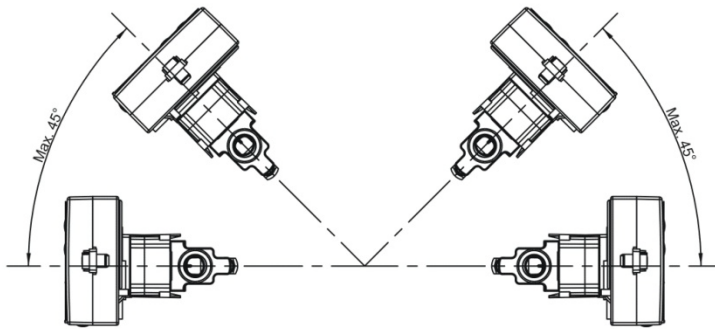


Figure 10

Is the flow sensor mounted with plastic housing facing down, the calculator must then be wall mounted as shown in Figure 11. Alternatively, the calculator can be mounted on the flow sensor with an angle fitting as shown in Figure 12.

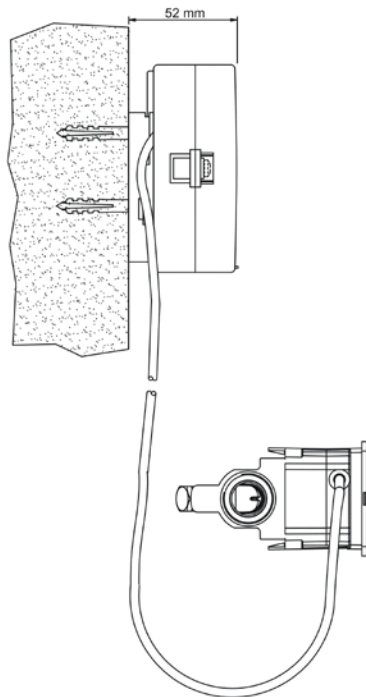


Figure 11

MULTICAL® 61 mounted on a wall

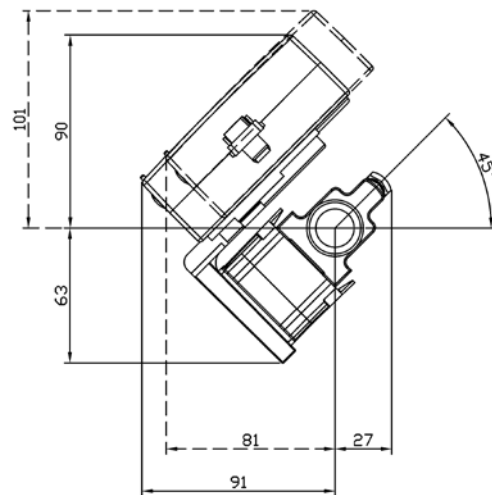


Figure 12

MULTICAL® 61 mounted on ULTRAFLOW® 24, by means of angle fitting 3026-252

7.5 Operating pressure

In order to prevent cavitation the operating pressure at ULTRAFLOW® 24 must be min. 1.5 bar at Q_3 and min. 2.5 bar at Q_4 . ULTRAFLOW® 24 must not be exposed to pressure lower than the ambient pressure (vacuum).

7.6 Mounting of Pulse Transmitter 66-99-618

See installation instructions 5512-587 DK-GB-DE

8 The Calculator

8.1 Flow measurement and calculation

MULTICAL® 61 calculates the current water flow of quick volume pulses without average determination as the number of volume pulses per 10 sec. multiplied by the scaling factor.

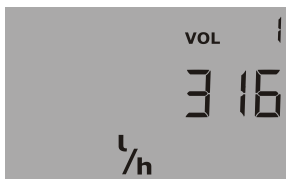
$$Q = (\text{Imp./10 s.} \times \text{flow factor}) / 65535 \quad [\text{l/h}] \text{ or } [\text{m}^3/\text{h}]$$

Example:

$$Q_3 = 1.6 \text{ m}^3/\text{h} \text{ with } 100 \text{ imp./l (CCC=419), flow factor} = 235926$$

Current water flow = 317 l/h, corresponding to 88 Imp./10 s.

$$q = (88 \times 235926) / 65535 = 316.8 \text{ which is displayed as } 316 \text{ [l/h]}$$



Current water flow of V1

8.2 Min. and max. flow, V1

MULTICAL® 61 can register both minimum and maximum flow on monthly as well as yearly basis. The complete registration can be read via data communication. Furthermore, a few monthly and yearly registers can be read from the display, depending on the selected DDD-code.

The min. and max. registration includes the following flow values with indication of date:

Type of registration	Max. data	Min. data	Yearly data	Monthly data
Max. this year (since latest target date)	•		•	
Max. yearly data, up to latest 15 years	•		•	
Min. this year (since latest target date)		•	•	
Min. yearly data, up to latest 15 years		•	•	
Max. this month (since latest target date)	•			•
Max. monthly data, up to latest 36 months	•			•
Min. this month (since latest target date)		•		•
Min. monthly data, up to latest 36 months		•		•

All max. and min. values are calculated as biggest and smallest average respectively of a number of current flow measurements. The average period used for all calculations can be selected in the interval 1...1440 min. in 1 min. leaps. (1,440 min. = 24 hours).

Average period and target date must be stated in the order, or be reconfigured by means of METERTOOL. In the absence of other information with the order, the average period is set to 60 min. and the target date to the standard value applying to the delivery code used.

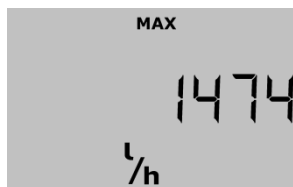
At the end of a year or a month the max. and min. values are saved in the data logger, and the current max. and min. registers are “reset” according to the selected target date and the meter’s internal clock and calendar.

”Reset” is made by setting the max. value to zero and the min. value to a high value (e.g. 100000 l/h at CCC=419).

If the max. or min. registration is used for billing purposes, we recommend mounting a top module with real time clock and battery backup in MULTICAL® 61.



Date of max. flow this year



Value of max. flow this year

8.3 Display functions

MULTICAL® 61 is fitted with an easily readable LCD-display including 8 digits, measuring units and information field. Volume readings use 7 digits and the corresponding measuring units, whereas 8 digits are used for display of e.g. meter number.

Basically the accumulated volume is displayed. Activating the pushbuttons the display reacts at once by calling up other readings. The display automatically returns to volume reading four minutes after the latest activation of the pushbuttons.

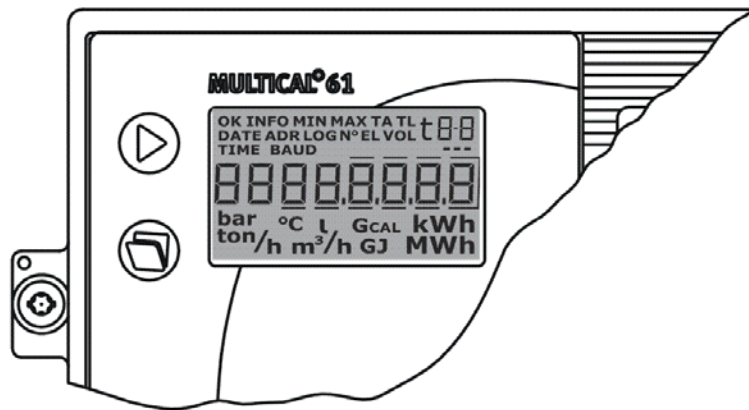


Figure 13

8.3.1 Primary and secondary readings

The top pushbutton is used to change between readings of the primary register. Consumers normally use the first primary reading in connection with self-reading for billing purposes.

The lower pushbutton is used to display readings of the secondary register with additional information on the selected primary reading.

Example: If the selected primary reading is "Volume", the secondary readings will be yearly data and monthly data for volume.

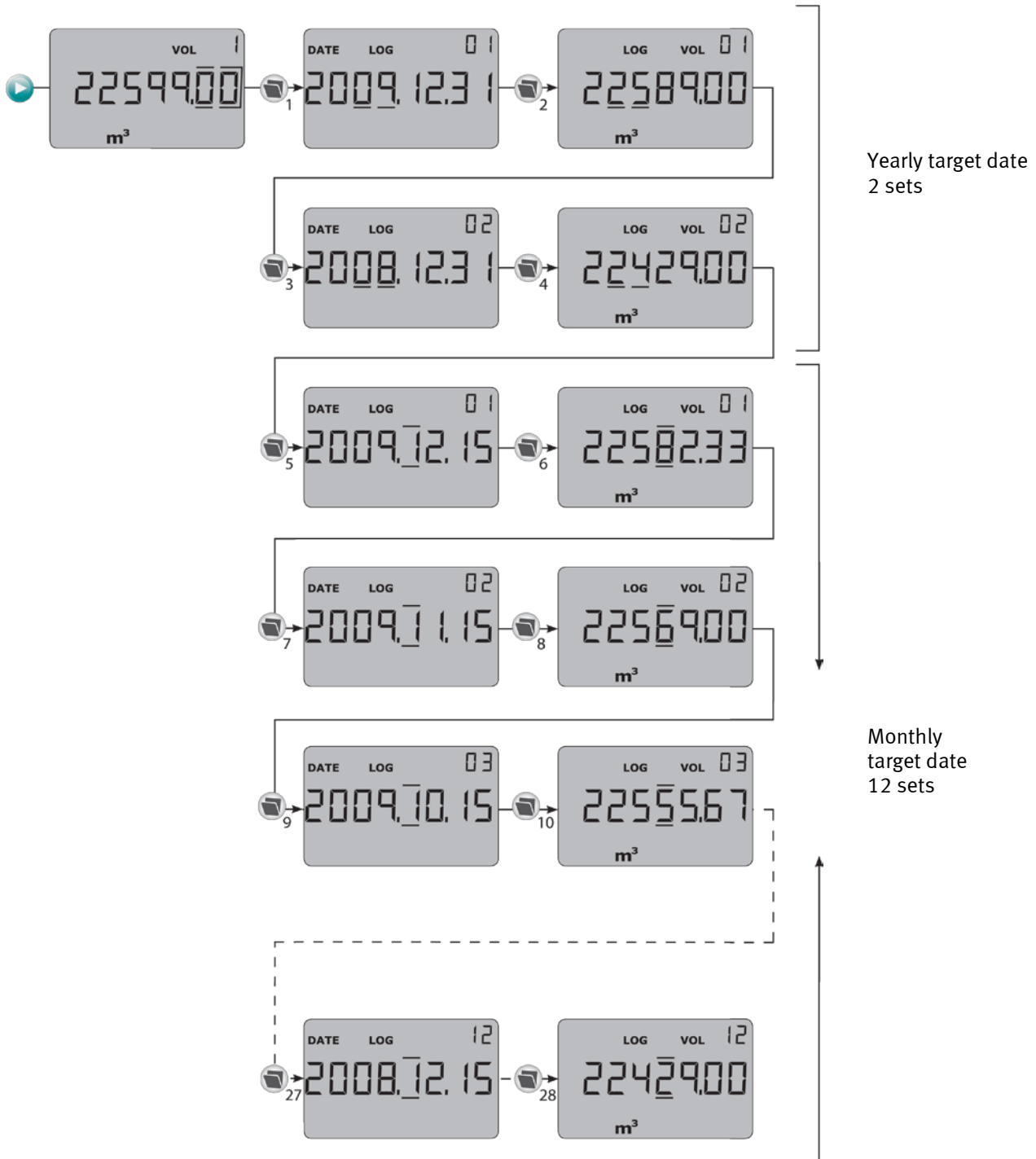


Figure 14

8.3.2 Display structure

The below-mentioned diagram shows the display structure of DDD=814 with 5 primary readings and a number of secondary readings under most primary readings. The number of secondary readings in connection with yearly and monthly data has been determined under the DDD-code. If not specified when ordering the water meter,, secondary readings will consist of 2 yearly data sets and 12 monthly data sets. The target date will be the standard date applying to the delivery code used.

The contents of both main and submenus (primary and secondary registers) are determined by the selected configuration of the meter (see paragraph 4.2.1 *Configuration of display*). The MULTICAL® 61 display includes both a main menu and a submenu. The main menu includes accumulated volume, flow readings, operating hour counter and info codes (error codes).

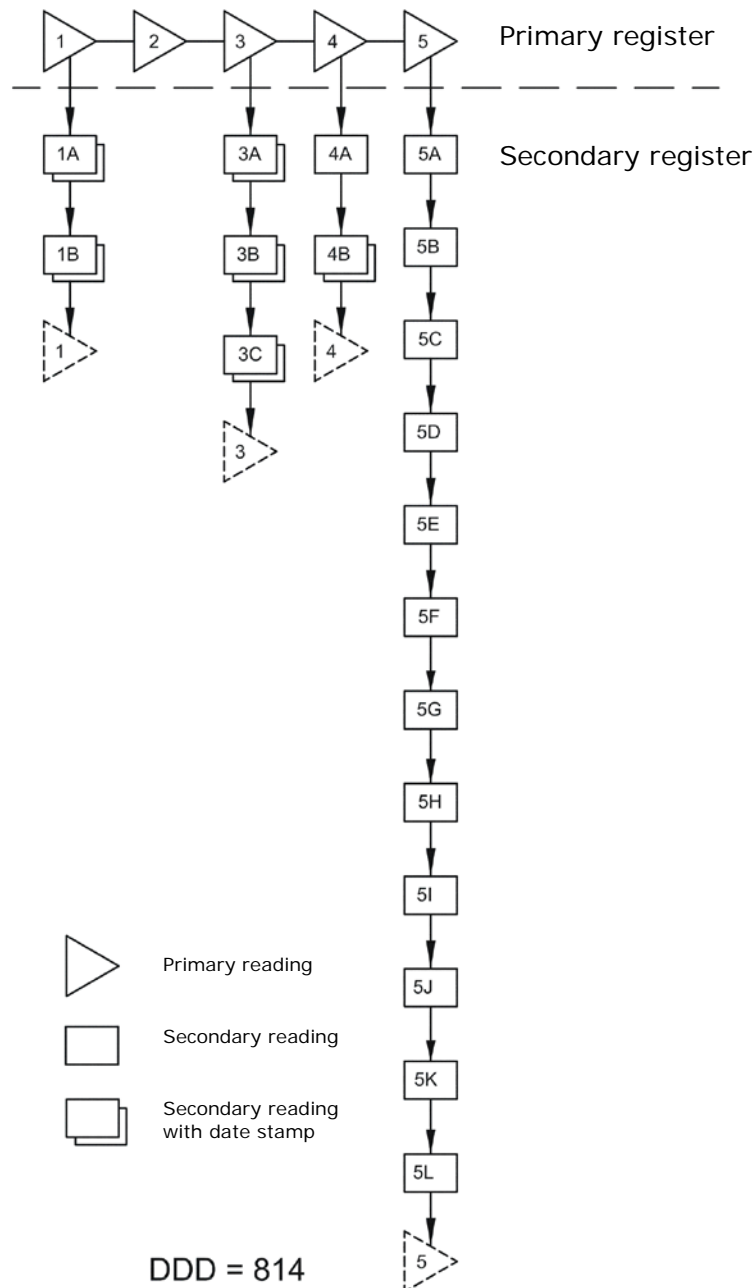


Figure 15

8.4 Information Codes "Info"

MULTICAL® 61 constantly monitors a number of important functions. If there is a serious error in measuring system or installation, a flashing "info" will appear in the display. The "Info" field will flash as long as the error exists no matter which reading you choose. The "Info" field automatically disappears when the reason for the error has been removed.

When the first permanent information code appears it is saved in the EEPROM after a response time together with the date and the volume registers at the time the error occurred.

Furthermore, the info code is saved in the hourly logger (if a top module with hourly logger is mounted), the daily logger, the monthly logger and the yearly logger for diagnosis purposes.



8.4.1 Info code types

info	Description	Response time
0	No irregularities	-
1	Supply voltage has been interrupted	-
16	Flow meter V1, communication error, signal too weak or wrong direction	After reset (e.g. cover off and on) as well as automatically after max. 24 hours (at 00:00)
64	Leak in water installation	24 hours
2048	Flow meter V1, wrong pulse figure	After reset (e.g. cover off and on) as well as automatically after max. 24 hours (at 00:00)
4096	Flow meter V1, signal too weak (air)	
16384	Flow meter V1, wrong flow direction	

If several info codes appear at a time, the sum of the info codes is displayed.

Example: E2064 = E16 + E2048.

8.4.2 Transport mode

When the meter leaves the factory it is in transport mode, i.e. the info codes are active in the display only, not in the data logger. This prevents "infoevent" from counting during transportation and non-relevant data from appearing in the info logger. The first time the meter totalizes the volume register after the installation, the info code automatically becomes active.

8.5 Data loggers

MULTICAL® 61 includes a permanent memory (EEPROM), in which the values of various data loggers are saved. The meter includes the following data loggers:

Data logging interval	Data logging depth	Logged value
Yearly logger	15 years	Counter register •
Monthly logger	36 months	Counter register •
Daily logger	460 days and nights	Consumption (increase)/day ♦
Hourly logger (Top module)	1392 hours	Consumption (increase)/hour ♦
Info logger	50 Events (36 events can be displayed)	Info code and date

The loggers are static and the register types can therefore not be changed, the same applies to the logging intervals. When the EEPROM is full the oldest data will be overwritten.

8.5.1 Yearly, monthly, daily and hourly loggers

The following registers are logged every year and every month on target date as counter values. Furthermore, the day and hour increases are logged at midnight.

Register type	Description	Yearly logger	Monthly logger	Daily logger	Hourly logger
Date (YY.MM.DD)	Year, month and day of logging time	•	•	♦	♦
V1	Volume register for Volume 1	•	•	♦	♦
VA	Extra water or electricity meter connected to Input A	•	•	♦	♦
VB	Extra water or electricity meter connected to Input B	•	•	♦	♦
INFO	Information code	•	•	♦	♦
DATE FOR MAX. FLOW V1	Date stamp for max. flow during period	•	•	-	-
MAX. FLOW V1	Value of max. flow during period	•	•	-	-
DATE FOR MIN. FLOW V1	Date stamp for min. flow during period	•	•	-	-
MIN. FLOW V1	Value of min. flow during period	•	•	-	-

8.5.2 Info logger

Every time the information code changes, date and info codes are logged. Thus, it is possible to data read the latest 50 changes of the information code as well as the date the change was made.

Register type	Description
Date (YY.MM.DD)	Logging time, year, month and day
info	Information code on above date

When the info logger is read from the display, only the latest 36 changes including dates can be read. All 50 changes can be read via METERTOOL.

8.6 Leak surveillance

Water installation

MULTICAL® 61 can monitor the water consumption. Possible running cisterns, leaky heating spirals of tap water tanks or other leakages will result in water flow being registered from the water meter 24 hours a day.

If MULTICAL® 61 does not detect for example at least 1 continuous hour / day without pulses from the water meter, this may be the sign of a leak in the water system. "Info" will be displayed (info code 64), and will be sent an alarm via remote communication.

If MULTICAL® 61 does not example detect. At least 1 continuous hour / day without pulses from the water meter, then this is indication of a leak in the water system, and there will be sent an alarm by remote communication.

Leak surveillance (v1)	
N=	Leakage sensitivity at 0.01 m³ resolution in display
0	OFF
1	20 l/h (30 min. without counting in display)
2	10 l/h (1 hour without counting in display)
3	5 l/h (2 hours without counting in display)

Note: N=2 is default value in connection with leak surveillance. Increased sensitivity, e.g. N=3, can only be achieved by means of METERTOOL.

Users must be aware that water consumption can occur during the night too in connection with lavatory visits in households with many residents. Thus, hours without counting may not occur, and MULTICAL® 61 will therefore set an alarm for this day. Users and water works should therefore not be uncritical towards the leakage alarm of MULTICAL® 61. The alarm will be deleted automatically after 24 hours with at least one hour without counting (at N=2), and after this the event will only appear from the info logger.

When the leak function is activated in MULTICAL® 61 (N>0), input VA of the base module cannot be used, and therefore it is only possible to connect one extra meter (e.g. an electricity meter to input VB). If the function is inactive, it is thus possible to connect two extra meters (e.g. an electricity meter and a water meter).

Receipt of alarm messages

When the meter has registered a leakage, it can send an alarm message to a receiving station where incoming alarms are processed according to an encoded action pattern determined for each customer. E.g. starting with an SMS message to the customer's mobile phone parallel with the person on guard receiving the message. Regular data readings from MULTICAL® 61 to receiving station/control centre ensure that defective remote reading, if any, is detected.

Max. flow

MULTICAL® 61 makes it possible to keep an eye on the max. flow on a monthly basis. The max. flow is a measure of the maximum water flow in the system at a given consumption pattern. If the max. flow decreases over time, this may indicate a leakage in the residential service pipe.

8.7 Reset Function

Resetting the hour counter

The operating hour counter can be reset in connection with e.g. replacement of battery.

As the hour counter is often used to check whether the meter has been in operation during the whole billing period (e.g. 1 year = 8760 hours) the utility or waterworks must always be informed, in which meters the hour counter has been reset.



In order to reset the operating hour counter you must first break the calculator seals, remove the calculator top from the connecting base and wait until the display goes blank.

Remount the calculator top on the connecting base at the same time activating the top pushbutton for minimum 10 s. until e.g. volume is displayed.



The operating hour counter has been reset.

Resetting data loggers

Separate reset of data loggers, info loggers, max. & min. logger (without resetting the legal registers) is only possible by means of METERTOOL.

Resetting all registers

All legal and non-legal registers, including all data loggers, info logger, max. & min. logger can be reset by means of METERTOOL or via NOWA if the verification seal is broken and the internal "total programming lock" is short-circuited. As the verification seal is broken, this can only be done by an accredited laboratory.

The following registers are reset:

All legal and non-legal registers, including all data loggers, info logger, max. and min. logger (max. values are set to zero, whereas min. values are set to 100000).

"Date" is after reset set to 2000.01.01

Via METERTOOL current date/time are changed from the PC used for the task Therefore, do not forget to check correct date/time (technical normal time = "winter time") of the PC before starting the reset function.

9 The Flow Sensor

9.1 Ultrasound combined with piezo ceramics

Flow sensor manufacturers have been working on alternative techniques to replace the mechanical principle. Research and development at Kamstrup has 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.

9.2 Principles

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

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 very similar to the effect you experience when a car drives by. The sound (the frequency) decreases when the car passes by.

9.3 Transient time method

The transit time method used in ULTRAFLOW® 24 utilizes the fact that it takes an ultrasonic signal emitted in the opposite direction of the flow longer to travel from sender to receiver than a signal sent in the same direction as the flow.

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.

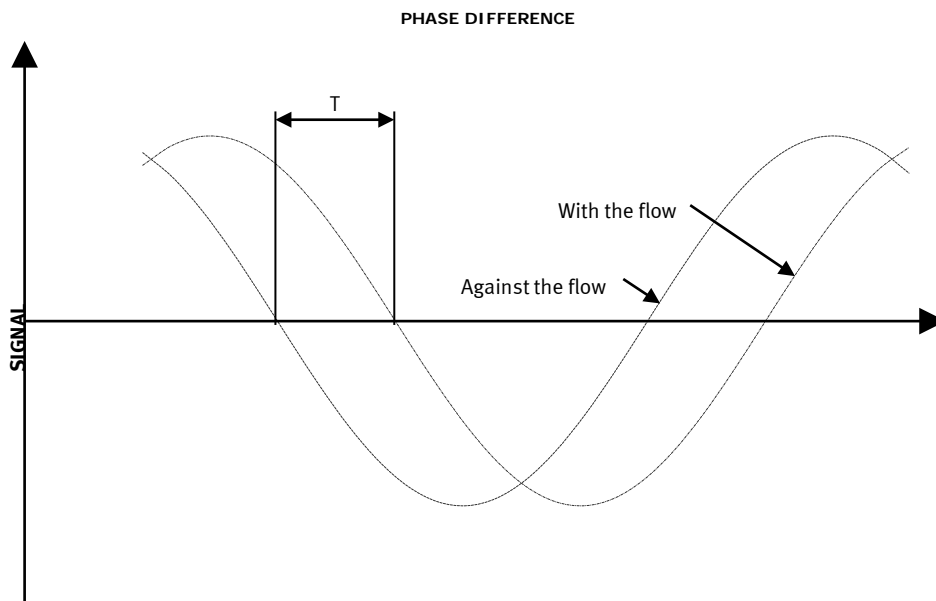


Diagram 3

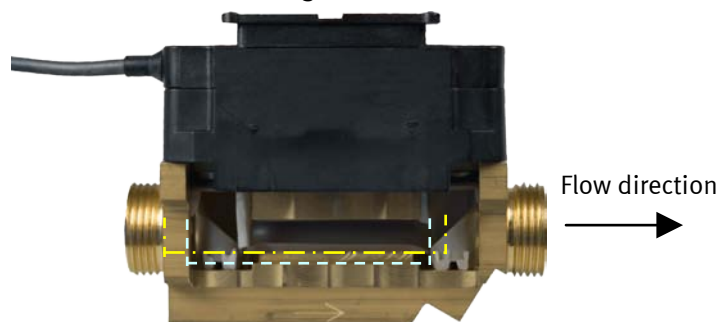


Figure 16

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

$$Q = F \times A$$

where:

Q is the flow

F is the flow velocity

A is the area of the measuring pipe

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

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

where:

L is the measuring distance

V is the sound propagation velocity

T is the time

The phase difference can be expressed as:

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

In connection with ultrasonic flow sensors the velocities up- and downstream, V_1 and V_2 respectively, can be stated as:

$$V_1 = C - F \quad \text{and} \quad V_2 = C + F$$

where: C is the velocity of sound in water

Using the above formula you get:

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

which can also be written as:

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

As $C^2 \gg F^2$ it is reasonable to omit F^2 and the formula is reduced as follows:

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

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

9.4 Signal paths



Q₃: 1.6 m³ h

2 parallel tracks

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



Q₃: 2.5...40 m³/h

Triangle

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

Figure 17

Measuring sequences

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

The routines of normal mode are listed in the table below.

Time [s]	Operation
0	Phase difference and absolute time measurement with and against the flow as well as pulse emission
1	Pulse emission
2	Pulse emission
3	Phase difference and absolute time measurement with and against the flow, reference measurement and pulse emission
4	Pulse emission
5	Pulse emission
6	Phase difference and absolute time measurement with and against the flow as well as pulse emission
7	Pulse emission
8	Pulse emission
9	Phase difference and absolute time measurement with and against the flow as well as pulse emission
10	Pulse emission
11	Pulse emission
12	Phase difference and absolute time measurement with and against the flow as well as pulse emission

Table 7

The routines are the same in test mode, but with 1 sec. intervals between measurements instead of 3 sec. as in normal mode.

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

Function

In the meter’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 below diagram shows an example of the connection between flow and pulse frequency for ULTRAFLOW® 61 ($Q_3 = 1.6 \text{ m}^3/\text{h}$). See *Diagram 4*.

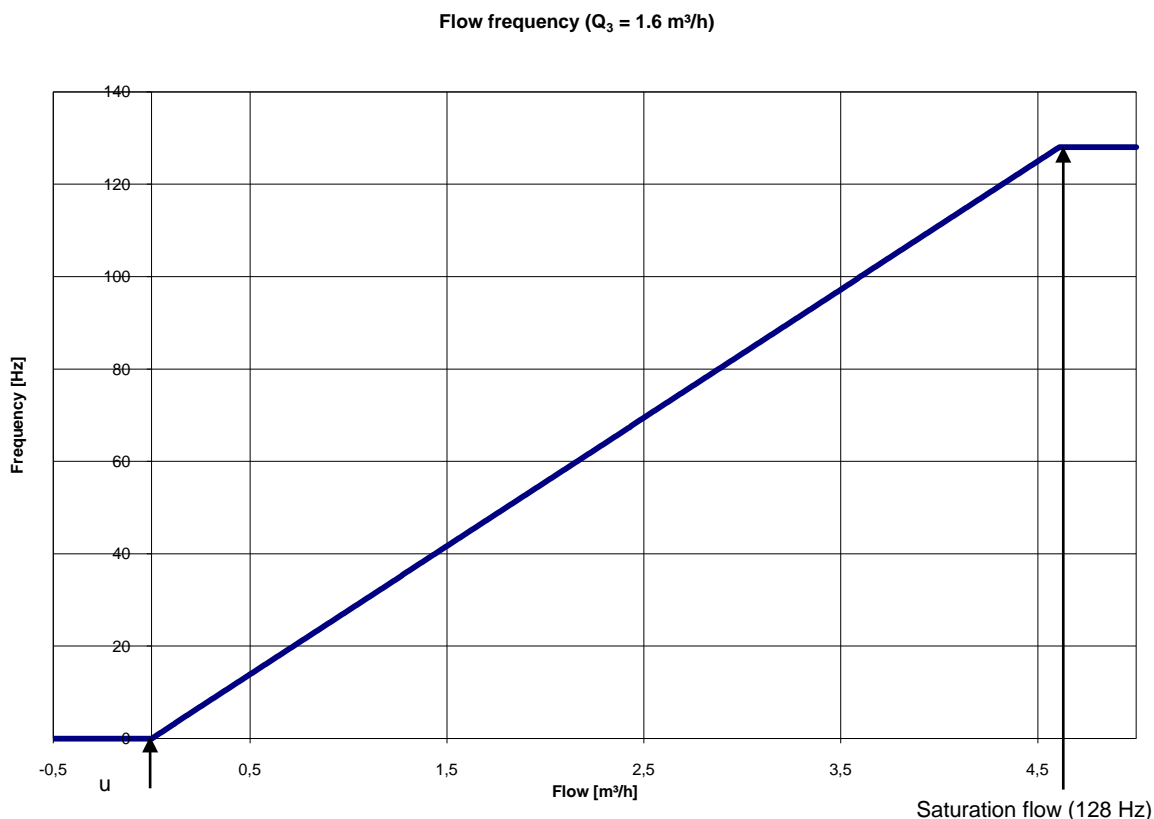


Diagram 4

If the flow is lower than min. cut off or negative, ULTRAFLOW® 24 will not send out pulses. (See *Diagram 4*).

At flows above the saturation flow, corresponding to pulse emission with a max. pulse frequency of 128 Hz, the max. pulse frequency will be maintained. (See *Diagram 4*). *Table 8* shows the saturation flow (flow at 128 Hz) of the various flow sizes/pulse figures.

Q_3 [m³/h]	Pulse figure [imp./l]	Flow at 128 Hz [m³/h]
1.6	100	4.61
2.5	60	7.68
4	50	9.22
6.3	25	18.4
10	15	30.7
16	10	46.1
25	6	76.8
40	5	92.2

Table 8

9.5 Flow limits

In the meter’s working range from min. cut-off and far beyond Q_4 there is a linear connection between the flow rate and the measured water flow.

In practice the highest possible water flow through the sensor will be limited by the pressure in the system or cavitation due to too low back pressure.

If the flow is lower than min. cut-off or negative, ULTRAFLOW® 24 does not measure any flow.

According to OIML R 49 the upper flow limit Q_4 is the highest flow, at which the flow sensor may operate for short periods of time without exceeding maximum permissible error. ULTRAFLOW® 24 has no functional limitations while operating above Q_4 . Please note, however, that high flow velocities $> Q_4$ involve the risk of cavitation, especially at low static pressures.

9.6 Guidelines for dimensioning ULTRAFLOW® 24

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

Nominal flow Q_3 [m ³ /h]	Recommended minimum operating pressure [bar]	Max. flow Q_4 [m ³ /h]	Recommended operating pressure [bar]
1.6	1.5	2	2.5
2.5	1	3.1	2
4	1	5	2
6.3	1.5	7.9	2.5
10	1	12.5	2
16	1.5	20	2.5
25	1	31	2
40	1.5	50	2.5

Table 9

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

It is not necessarily cavitation in the sensor itself, but also bubbles from cavitating pumps or regulating valves mounted before the sensor.

In addition, the water may contain air in the form of small bubbles or air in the water.

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

Furthermore, it must be taken into consideration that the above-mentioned pressure is the pressure at the sensor and that the pressure is lower after a contraction than before one (e.g. cones). This means that pressure measured elsewhere in the system may be different from the pressure at the sensor.

This can be explained by combining the continuity equation and Bernoulli’s equation. The total energy from the flow will be the same at any cross section. It can be reduced to: $P + \frac{1}{2} \rho v^2 = \text{constant}$, where P is the pressure, ρ is the density of water and v is the flow velocity.

Dimensioning the flow sensor the above must be taken into consideration, especially if the sensor is used within the scope of OIML R 49 between Q_3 and Q_4 , and in case of strong contractions of the pipe.

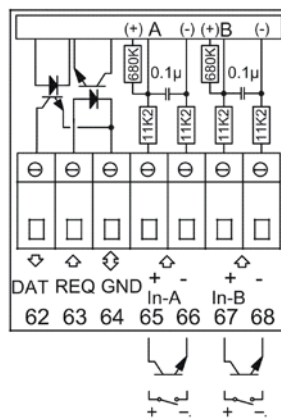
9.7 Pulse Transmitter (Cable extension set) 66-99-618

The pulse transmitter is used in connection with reading at large distances (up to 10 metres). Installation instructions: 5512-587



9.8 Pulse inputs VA and VB

In addition to pulse input V1, to which ULTRAFLOW® 24 is connected, MULTICAL® 61 has two extra pulse inputs, VA and VB, for collection and remote accumulation of pulses from e.g. electricity meters or another flow meter. The pulse inputs are physically placed on the base modules, e.g. the "data/pulse input module", which can be mounted in the connection base, but accumulation and data logging of values is carried out by the calculator. Please be aware that pulse inputs VA and VB function independently of the other inputs/outputs. Therefore their values are not included in any kind of volume calculation.



Pulse inputs VA and AB

The two pulse inputs are identically constructed and can be individually set up to receive pulses from water meters of max. 1 Hz, or pulses from electricity meters of max. 3 Hz.

Correct pulse value is configured from the factory on the basis of order information, or by means of METERTOOL. See paragraph 4.2.3 concerning configuration of VA (FF-codes) and VB (GG-codes).

MULTICAL® 61 registers the accumulated consumption of the meters, which are connected to VA and VB, and saves the counter values every month and every year on target date. In order to facilitate the identification during data reading it is also possible to save the meter numbers of the two meters connected to VA and VB. Programming is carried out with METERTOOL.

The registration, which can both be read from the display (selecting a suitable DDD-code) and via data communication, includes the following as well as date indication of yearly and monthly data:

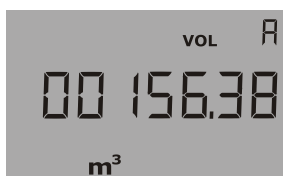
Type of registration	Counter value	Identification	Yearly data	Monthly data
VA (accumulated register)	•			
Meter number VA		•		
Yearly data, up to latest 15 years			•	
Monthly data, up to latest 36 months				•
VB (accumulated register)	•			
Meter number VB		•		
Yearly data, up to latest 15 years			•	
Monthly data, up to latest 36 months				•

Counter values VA and VB can be preset to the values of the connected meters at the time of commissioning by means of METERTOOL.

Display example, VA

In the example below VA is configured as FF=24, which matches 10 litres/pulse and a max. flow of 10 m³/h. The meter connected to VA has meter no. 75420145 which has been saved in the internal memory of MULTICAL® 61 by means of METERTOOL.

1



Accumulated register of VA (Input A)

2



Meter no. of VA (max. 8 digits)

3



Yearly data, date of LOG1 (latest target date)

4



Yearly data, value of LOG1 (latest yearly reading)

This is the accumulated volume registered on 1 January 2006

10 Power Supply

MULTICAL® 61 must be internally powered by 3.6 VDC (± 5%) on terminals 60(+) and 61(-). This is obtained using one of the following supply modules:

MULTICAL® 61	Type 67-	Z	□	□□	□	0	□	□	□□
Supply									
Battery D-cell						2			
230 VAC supply module with transformer						7			
24 VAC supply module with transformer						8			

The three above-mentioned supply modules are included in the comprehensive type test, to which MULTICAL® 61 has been subjected. Within the framework of the type approval, the CE-declaration and the manufacturer's guarantee no other types of power supplies than the ones listed above can be used.

ULTRAFLOW® 24 will be powered by the same supply.

10.1 Built-in D-cell lithium battery

When supplied by a battery MULTICAL® 61 uses a lithium D-cell (Kamstrup type 66-00-200-100). The battery is mounted in the right side of the connection base with the red wire connected to terminal 60(+) and the black wire to terminal 61(-). The battery is easily replaced using a screwdriver.



The battery lifetime depends on the temperature, to which the battery is exposed, as well as the selected application for the meter.

Application (temperature)	Battery lifetime
MULTICAL® 61 mounted on a wall (battery temperature < 30°C)	12 years
MULTICAL® 61 mounted on flow sensor (battery temperature < 45°C)	10 years

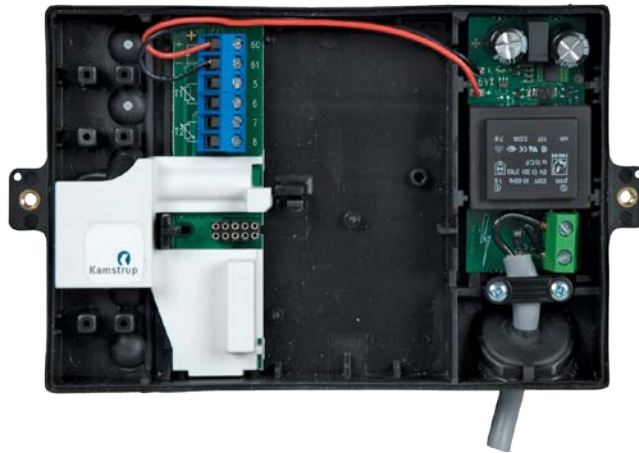
The above-mentioned battery lifetimes apply to standard installations. The battery lifetime is reduced by:

- Warm ambient temperature
- Connection of data modules
- Frequent data communication

Please contact Kamstrup A/S for further information.

10.2 Supply Module 230 VAC

This PCB module is galvanically separated from the mains voltage and is suitable for direct 230 V mains installation. The module includes a double-chamber safety transformer, which fulfils the double-isolation requirements when the calculator top is mounted. The power consumption is less than 1 VA/1 W.



National regulations for electric installations must be observed. The 230 VAC module can be connected/disconnected by the utility's personnel, whereas the fixed 230 V installation into the meter panel must be carried out by an authorized electrician.

10.3 Supply Module 24 VAC

This PCB module is galvanically separated from the 24 VAC mains supply and is both suitable for industrial installations with joint 24 VAC supply and individual installations, which are supplied by a separate 230/24 V safety transformer in the meter panel. The module includes a double-chamber safety transformer, which fulfils the double-isolation requirements when the calculator top is mounted. The power consumption is less than 1 VA/1W.



National regulations for electric installations must be observed. The 24 VAC module can be connected/disconnected by the utility's personnel, whereas the fixed 230/24 V installation into the meter panel must be carried out by an authorized electrician.

The module is specially suited for installation together with a 230/24 V safety transformer, e.g. type 66-99-403, which can be installed in the meter panel before the safety relay. When the transformer is used the power consumption of the total meter incl. the 230/24 V transformer will be lower than 1.7 W .



10.4 Change of supply unit

The supply unit for MULTICAL® 61 can be changed from mains supply to battery or visa versa as the needs of the utility change. Thus, it can be an advantage to change mains supplied meters to battery supplied meters in buildings under construction where the mains supply can be unstable or periodically missing.

The change from battery to mains supply or visa versa does not require reprogramming as MULTICAL® 61 does not include an information code for worn out battery.

However, mains supply must not be changed to battery if MULTICAL® 61 is fitted with one of the following base modules:

	MULTICAL® 61	Type 67-	Z	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	0	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Base module										
RadioRouter + pulse inputs					<input checked="" type="checkbox"/>					
Prog. data logger + RTC + 4...20 mA inputs + pulse inputs					<input checked="" type="checkbox"/>					
0/4...20 mA outputs					<input checked="" type="checkbox"/>					
LonWorks, FTT-10A + pulse inputs					<input checked="" type="checkbox"/>					
ZigBee 2.4 GHz int.ant. + pulse inputs					<input checked="" type="checkbox"/>					
Metasys N2 (RS485) + pulse inputs					<input checked="" type="checkbox"/>					

See paragraph 11.1.3 concerning supply options for top and base modules

10.5 Mains cables

MULTICAL® 61 is available with mains cables H05 VV-F for either 24 V or 230 V (l=1.5 m):

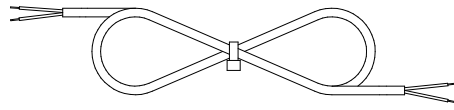


Figure 18

Mains cable, type 5000-286 (2x0.75 mm²), max. 6 A fuse

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

10.6 Danish regulations for the connection of mains operated meters

Installation of mains connected equipment for registration of consumption (www.sik.dk, safety notification electric services no. 27/09, February 2009).

The consumption of energy and resources (electricity, heat, gas and water) of the individual consumer is to an increasing extent registered by electronic meters, and often equipment for remote reading and remote control of both electronic and non-electronic meters is used.

General regulations for carrying out installations must be observed. However, the following modifications are permitted:

- If meter or equipment for remote reading or remote control is double-isolated, it is not necessary to run the protective conductor all the way to the connection point. This also applies if the connection point is a plug socket provided that it is placed in a canning which is sealable or can be opened with key or tool only.

If meter or equipment used for remote reading and remote control is connected to a safety transformer mounted in the panel and direct connected to the branch conductor, no on-off switch or separate overcurrent protection in either primary or secondary circuit is required, provided that the following conditions are fulfilled:

- The safety transformer must either be inherently short-circuit-proof or fail-safe
- The conductor of the primary circuit must either be short-circuit protected by the overcurrent protection of the branch conductor or short-circuit safely run.
- The conductor of the secondary circuit must have a cross section of at least 0.5 mm² and a current value which exceeds the absolute maximum current deliverable by the transformer
- It must be possible to separate the secondary circuit, either by separators, or it must appear from the installation instructions that the secondary circuit can be disconnected at the transformer’s terminals

General information

Work on the fixed installation, including any intervention in the group panel, must be carried out by an authorized electrician.

It is not required that service work on equipment comprised by this notification as well as connection and disconnection of the equipment outside the panel is carried out by an authorized electrician. These tasks can also be carried out by persons or companies, who professionally produce, repair or maintain equipment if only the person carrying out the work has the necessary expert knowledge.

11 Plug-in Modules

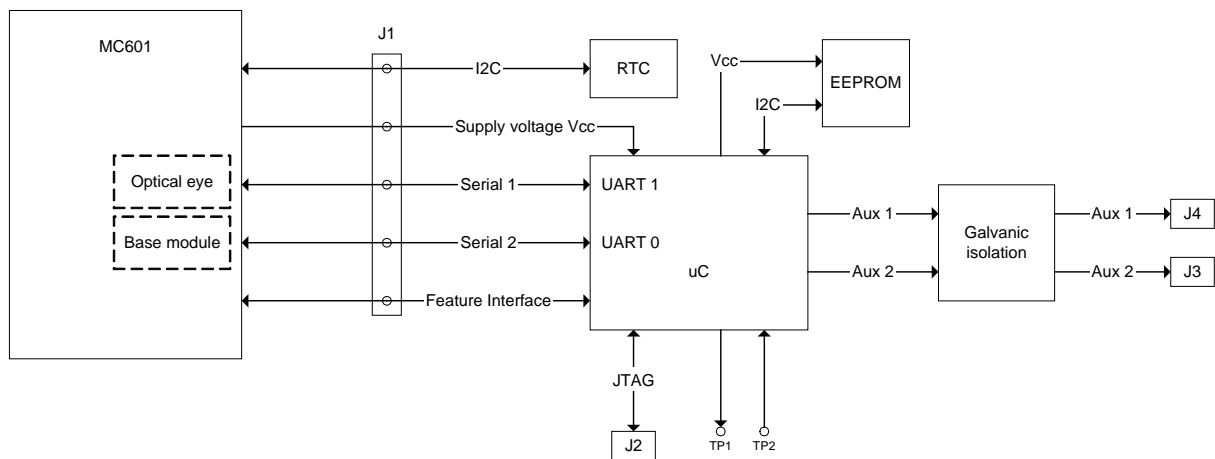
MULTICAL® 61 can be fitted with plug-in modules in both calculator top (top modules) and connection base (base modules) which adapt the meter to various applications.

In reading systems like MULTITERM Pro and PcBase, MULTICAL® 61 will appear as MULTICAL® 601.

All plug-in modules are included in the comprehensive type test, to which MULTICAL® 61 has been subjected. Within the framework of the type approval, the CE-declaration and the manufacturer’s guarantee no other types of plug-in modules than the ones listed below can be used.

11.1 Top modules

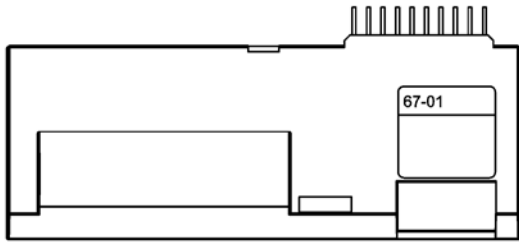
	MULTICAL® 61	Type 67-	Z	□	□□	□	0	□	□	□□
Top module										
No module				0						
RTC (Real Time Clock)				1						
RTC + data output + hourly data logger				5						
RTC + M-Bus				7						
RTC + pulse output for CV + hourly data logger				8						
RTC + pulse output for CV + prog. data logger				B						



Block diagram for top module

The top modules have been constructed according to the above-mentioned common hardware platform. The microcontroller’s application program and the tooling vary according to the task in question.

11.1.1 Overview of top modules



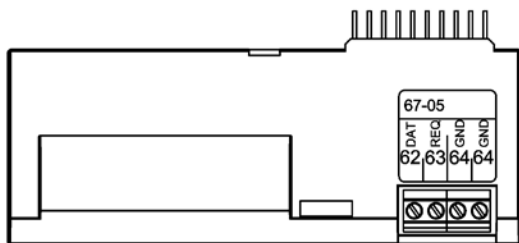
Type 67-01: RTC, Real Time Clock

The top module consists of real time clock and battery backup. When the MULTICAL® 61 calculator top is placed in the connection bracket, thereby being powered, the top module transfers current date and time to the calculator.

The top module is recommended for applications where correct date/time in data loggers as well as time controlled tariffs is important.

Real time clock and battery backup are included in all other top modules.

The connection terminals are not used in this module.



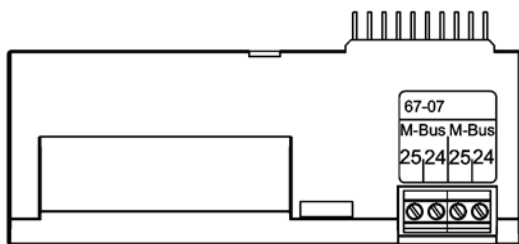
Type 67-05: RTC + data output + hourly data logger

The module has a galvanically separated data port which functions with the KMP protocol. The data output can be used for e.g. connection of external communication units or other hardwired data communication which it is not expedient to carry out via the optical communication on the meter's front.

62: DATA (brown) – 63:REQ (white) – 64: GND (green). Use data cable type 66-99-106 with 9-pole D-sub or type 66-99-098 with USB connector.

Furthermore the module includes an hourly data logger.

Only current and accumulated data can be read. Hourly/daily/monthly/yearly data loggers cannot be read through the data port of top module 67-05.



Type 67-07: RTC + M-Bus

M-Bus can be connected in star, ring and bus topology. Depending on M-Bus Master and cable length/cross section, up to 250 meters with primary addressing can be connected, and even more using secondary addressing.

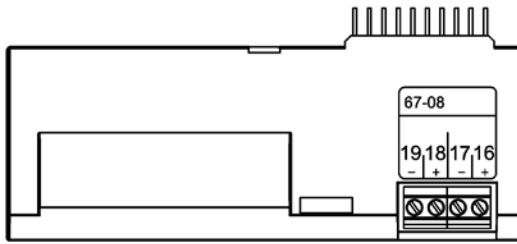
Cable resistance in network: < 29 Ohm

Cable capacity in network: < 180 nF

The connection polarity of terminals 24-25 is unimportant.

This module is only to be used in mains supplied meters.

Unless otherwise stated in the order, the primary address consists of the last three digits of the customer number, but it can be changed via the PC program METERTOOL.



Type 67-08: RTC + pulse output for CV + hourly data logger

This top module has a configurable pulse output, which is suitable for volume pulses for water meters.

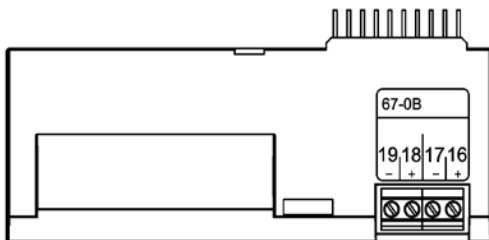
The pulse resolution follows the display (fixed in the CCC-code). E.g. CCC=419 ($Q_3 = 1.6 \text{ m}^3/\text{h}$): 1 pulse/ 0.01 m^3 .

The pulse output is optoisolated and is able to withstand 30 VDC and 10 mA.

Normally volume (CV) is connected on 18-19, but it is also possible to use 16-17, as both outputs are identical. (The outputs are identically configured when the module is used in MULTICAL® 61)

Via the PC program METERTOOL the pulse width can be set at either 32 or 100 ms.

The module also comprises an hourly data logger, including registers as daily logger (see paragraph 8.5 Data loggers).



Type 67-0B: RTC + pulse output for CV + prog. data logger

The RTC and pulse output functions of this top module are identical with the functions described for top module 67-08.

The top module is prepared for use in a Kamstrup radio network together with the Radio Router base module 6700210003xx, read data being transferred to the system software via the network unit RF Concentrator.

11.1.2 Mounting and dismounting the top module

The top module is released by pressing the middle of the plastic item in the left side down and at the same time pushing the top module to the left.

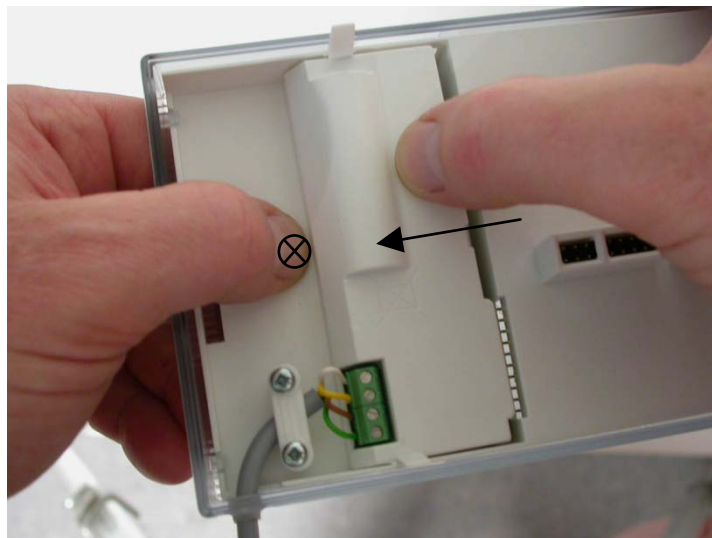


Figure 19

11.1.3 Supply options for top and base modules

Top ⇒ Base ↓	67-01 RTC	67-05 RTC + Data + Hour Log	67-07 RTC + M-Bus	67-08 RTC + pulse output +prog.hour log.	67-0B RTC + pulse output +prog.hour log.
67-00-10 Data+p/i	Battery/mains supply	Battery/mains supply	Mains supply only	Battery/mains supply	Battery/mains supply
67-00-20/29 M-Bus+p/i	Battery/mains supply	Battery/mains supply	Mains supply only	Battery/mains supply	Battery/mains supply
67-00-21 RadioRouter +pulse input	Mains supply only	Mains supply only	Mains supply only	Mains supply only	Mains supply only
67-00-22 4...20 Input	Mains supply only	Mains supply only	Mains supply only	Mains supply only	Mains supply only
67-00-23 0/4...20 input	Mains supply only	Mains supply only	Mains supply only	Mains supply only	Mains supply only
67-00-24 LonWorks +pulse input	Mains supply only	Mains supply only	Mains supply only	Mains supply only	Mains supply only
67-00-25 RF+p/i	Battery/mains supply	Battery/mains supply	Mains supply only	Battery/mains supply	Battery/mains supply
67-00-26 RF+p/i	Battery/mains supply	Battery/mains supply	Mains supply only	Battery/mains supply	Battery/mains supply
67-00-30 wM-Bus + pulse inp.	Battery/mains supply	Battery/mains supply	Mains supply only	Battery/mains supply	Battery/mains supply
67-00-60 ZigBee + pulse inp.	Mains supply only	Mains supply only	Mains supply only	Mains supply only	Mains supply only
67-00-62 Metasys N2 + pulse inp.	Mains supply only	Mains supply only	Mains supply only	Mains supply only	Mains supply only

Overview for top module 67-05 with external communication unit

Top ⇒ Ext. box ↓	67-05 RTC + Data + Hour Log	Comments/limitations in use
67-00-10	N/A	
67-00-20/29	N/A	
67-00-21 RadioRouter +pulse input	Mains supply only	The module type of the external communication unit cannot be displayed by MC61. Only current and accumulated data can be read. Hourly/daily/monthly/yearly data loggers are not readable through the data port of top module 67-05. RadioRouter must always be mains supplied.
67-00-22	N/A	
67-00-23	N/A	
67-00-24 LonWorks +pulse input	Mains supply only	The module type of the external communication unit cannot be displayed by MC61. Only current and accumulated data can be read. Hourly/daily/monthly/yearly data loggers are not readable through the data port of top module 67-05. LONWorks must be mains supplied.
67-00-25 RF+ pulse input	Battery/mains supply	The module type of the external communication unit cannot be displayed by MC61. Only current and accumulated data can be read. Hourly/daily/monthly/yearly data loggers are not readable through the data port of top module 67-05.
67-00-26 RF+ pulse input	Battery/mains supply	The module type of the external communication unit cannot be displayed by MC61. Only current and accumulated data can be read. Hourly/daily/monthly/yearly data loggers are not readable through the data port of top module 67-05.
67-00-30	N/A	
67-00-60	N/A	
67-00-62	N/A	

Note: Pulse inputs VA and VB (terminals 65-66-67-68) are not connected if the module is used in an external communication unit.

11.2 Base modules

The base modules for MULTICAL® 61 can be divided into two groups:

67-00-2X	Modules which have been specially developed for MULTICAL® 61 and the KMP protocol
67-00-1X	Modules with simple functions and without microprocessors

	MULTICAL® 61	Type 67-	Z	□	□□	□	0	□	□	□□
Base modules										
Data + pulse inputs										10
M-Bus + pulse inputs										20
RadioRouter + pulse inputs										21
Prog. data logger + RTC + 4...20 mA inputs + pulse inputs										22
0/4...20 mA outputs										23
LonWorks, FT1-10A + pulse inputs										24
Radio + pulse inputs (internal antenna)										25
Radio + pulse inputs (connection for external antenna)										26
M-Bus module with MC-III data package + pulse inputs										29
Wireless M-Bus Mode C1 + pulse inputs										30
ZigBee 2.4 GHz int.ant. + pulse inputs										60
Metasys N2 (RS485) + pulse inputs										62

11.2.1 Data + pulse inputs (67-00-10)

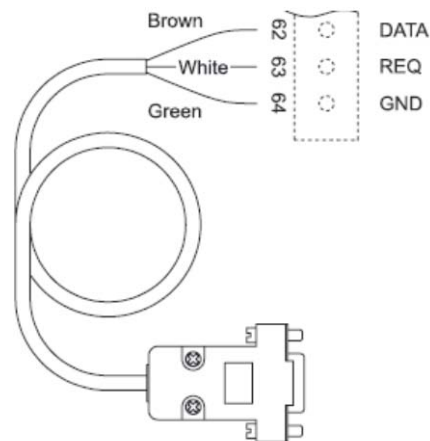
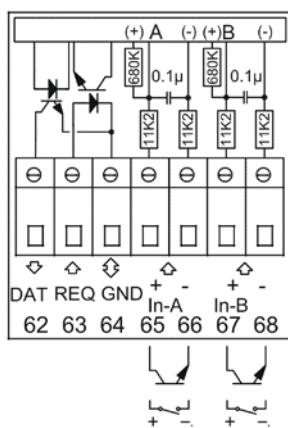
The module has a galvanically separated data port which functions with the KMP protocol. The data output can be used for e.g. connection of external communication units or other hardwired data communication which it is not expedient to carry out via the optical communication on the meter's front.

See paragraph 9.8 Pulse inputs VA and VB concerning the function of the pulse inputs.

The module includes data connection, which can e.g. be used for the external reading plug designed for Kamstrup's hand-held terminal or hardwiring of PC connection.

The data connection is galvanically isolated with optocouplers, which makes it necessary to use data cable type 6699-105 or 6699-106 in order to adapt the signal to RS232 level, which suits PC and Kamstrup's hand-held terminal.

See section 12 *Data Communication* for information on data sequences and protocols. If the computer does not have a COM-port, data cable with USB type 6699-098 can be used.

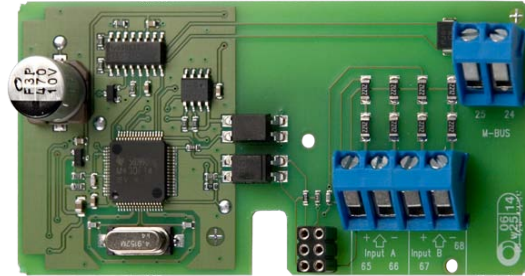


11.2.2 M-Bus + pulse inputs (67-00-20)

The M-bus module is supplied through the M-bus network and is thus independent of the meter’s internal supply. Two-way communication between M-bus and water meter is carried out via optocouplers providing galvanic separation between

M-bus and meter. The module supports both primary, secondary and enhanced secondary addressing.

The M-Bus module has two extra inputs. See paragraph 9.8 concerning the function of pulse inputs VA and VB.



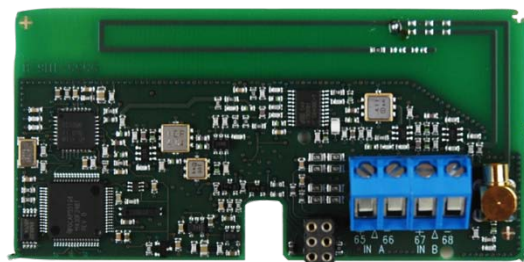
11.2.3 RadioRouter + pulse inputs (67-00-21)

The radio module is available for operation at both licence-free and licence demanding frequencies. The module is available with internal antenna as well as connection for external antenna.

The radio module is prepared to form part of a Kamstrup radio network, the read data being automatically transferred to system software via the network component/network unit, RF Concentrator.

The radio module has two extra inputs. See paragraph 9.8 concerning the function of pulse inputs VA and VB.

The RadioRouter module (67-00-21) must be used with mains supply.

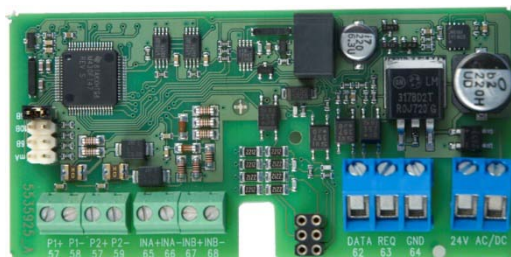


11.2.4 Prog. data logger + RTC + 4...20 mA inputs + pulse inputs (67-00-22)

The module has connection possibility for two pressure transmitters on terminals 57, 58 and 59 and can be adjusted for current reading or pressure ranges of 6, 10 or 16 bar.

The module is prepared for remote reading, data from meter/module being transferred to the system software via the connected external GSM/GPRS modem on terminals 62, 63 and 64.

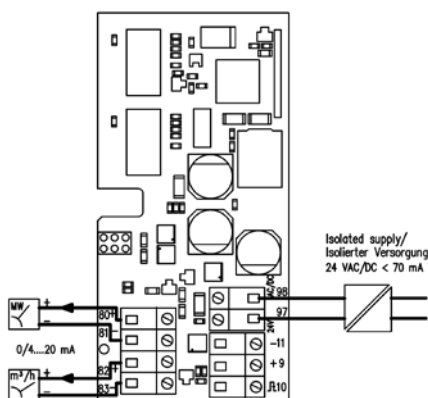
Furthermore the module has two extra pulse inputs, see paragraph 9.8 concerning the function of pulse inputs VA and VB. The module must be powered by 24 VAC.



11.2.5 0/4...20 mA outputs (67-00-23)

The module has two active analog outputs, which can be individually configured at 0...20 mA or 4...20 mA. Furthermore, the outputs can be configured for a specific measuring value as well as the required range scaling.

All output values are updated every 10 seconds.



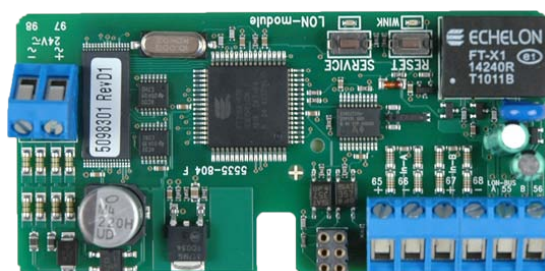
The module must be mounted in MULTICAL® 61 and is powered by 24 VAC. Configuration to be carried out via the "Base module" menu of METERTOOL.

11.2.6 LonWorks, FT-10A + pulse inputs (67-00-24)

The LonWorks module is used for data transfer from MULTICAL® 61 either for data reading/registration or regulation purposes via the Lon-Bus.

See paragraph 9.8 concerning the function of pulse inputs VA and VB. The module must be powered by 24 VAC.

A list of network variables (SNVT) and further details about the LonWorks module appear from data sheet 5810-510. GB version 5810-511 and DE version 5810-512. Regarding mounting we refer to installation instructions 5512-396.

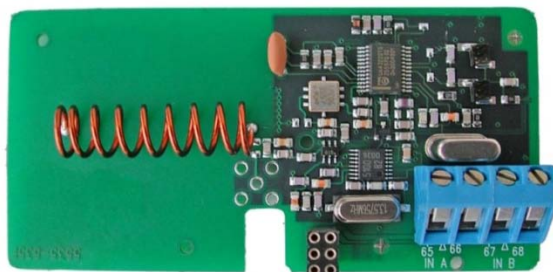


11.2.7 RadioRouter + pulse inputs (67-00-25/26)

The standard version of the radio module is for operation in licence-free frequency bands, but it is also available for other licence demanding frequencies.

The radio module is prepared to form part of a Kamstrup radio network, the read data being automatically transferred to system software via the network components RF Router and RF Concentrator.

The radio module has two extra inputs. See paragraph 9.8 concerning the function of pulse inputs VA and VB.



67-00-25: Internal antenna
67-00-26: External antenna connection

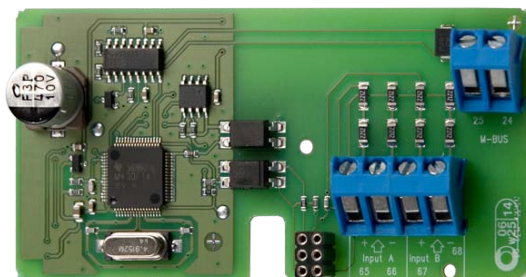
11.2.8 M-Bus module with MC-III data package + pulse inputs (67-00-29)

The M-Bus module 670029 comprises the same data packet as M-Bus module 6604 for MC III/66-C and module 660S for MCC/MC 401.

The module can e.g. be used together with the old M-Bus master with display, old regulators and old reading systems not supporting the newer M-Bus modules.

In order to function correctly in a MC61, minimum program version E1, released in June 2011, is required.

See paragraph 9.8 “Pulse inputs VA and VB” describes how the pulse inputs function.



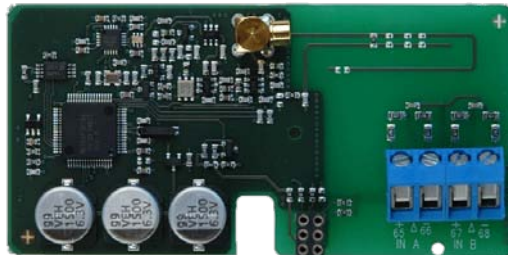
11.2.9 Wireless M-Bus + 2 pulse inputs (67-00-30)

The radio module has been designed to form part of Kamstrup's hand-held Wireless M-Bus Reader systems, which operate within the unlicensed frequency band in the 868 MHz area.

The module fulfils the C-mode specifications of prEN13757-4 and can thus form part of other systems using Wireless M-Bus C-mode communication.

The radio module comes with internal antenna and external antenna connection as well as two pulse inputs (VA + VB). Paragraph 9.8 "Pulse inputs VA and VB" describes how the pulse inputs function.

The Wireless M-Bus radio transmitter is switched off before dispatch from the factory. It switches on automatically when one litre of water has run through meter. The radio transmitter can also be switched on by making a forced call (keep both front keys activated for approx. 5 sec. until CALL is displayed).

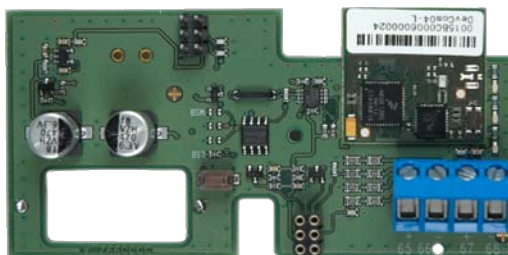


11.2.10 ZigBee + 2 pulse inputs (67-00-60)

The ZigBee module is mounted direct in the meter and is powered by the meter's supply. The module operates within the 2.4 GHz area and is ZigBee Smart Energy certified. The certification secures that the meter can form part of other ZigBee networks, e.g. reading several meter types from different meter suppliers.

To be able to offer a compact solution the module uses an internal antenna.

See paragraph 9.8 "Pulse inputs VA and VB" describes how the pulse inputs function.

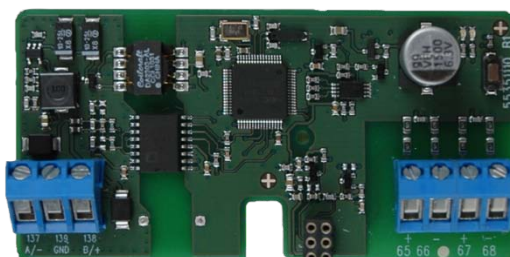


11.2.11 Metasys N2 (RS485) + 2 pulse inputs (VA, VB) (67-00-62)

The N2 module is used for data transfer from MULTICAL® heat and cooling meters to an N2 Master in a Johnson Controls System. The N2 module transfers accumulated energy and volume, current temperatures, flow and power from the heat or cooling meter to an N2 Master. N2 Open from Johnson Controls is a widespread and established field bus protocol used within building automation. The N2 module for MULTICAL® ensures simple integration from Kamstrup's heat and cooling meters to N2 Open based systems. Address area is 1-255 determined by the last three digits of the meters customer number.

See paragraph 9.8 concerning the function of pulse inputs VA and VB.

Further details about the Metasys N2 module appear from data sheet 5810-925, GB-version.



11.3 Retrofitting modules

Both top modules and base modules for MULTICAL® 61 can be supplied separately for retrofitting. The modules are configured and ready for installation from the factory. Some of the modules require individual configuration after installation which is possible by means of METERTOOL.

Top module

Top module		Possible configuration after installation
RTC (Real Time Clock)	1	Clock adjustment
RTC + data output + hourly data logger	5	Clock adjustment
RTC + M-Bus	7	Clock adjustment. Primary and secondary M-Bus addresses can be changed via METERTOOL or M-Bus. Furthermore, monthly logger data can be selected instead of yearly logger data via M-bus.
RTC + pulse output for CV + hourly data logger	8	Clock adjustment. Configuration of pulse output. (Configured from the factory according to customer requirements)
RTC + pulse output for CV + prog. data logger	B	Clock adjustment. Configuration of pulse output.

Base module

Data + pulse inputs	10	Pulse values of VA and VB are changed via METERTOOL.
M-Bus + pulse inputs	20	Pulse values of VA and VB are changed via METERTOOL. Primary and secondary M-Bus addresses can be changed via METERTOOL or M-Bus. Furthermore, monthly logger data can be selected instead of yearly logger data via M-bus.
RadioRouter + pulse inputs	21	Pulse values of VA and VB are changed via METERTOOL.
Prog. data logger + RTC + 4...20 mA inputs + pulse inputs	22	Clock adjustment. Pulse values of VA and VB are changed via METERTOOL.
0/4...20 mA outputs	23	Config data must be programmed into the calculator by means of METERTOOL after retrofitting. Furthermore, all parameters can be changed via METERTOOL.
LonWorks, FTT-10A + pulse inputs	24	Pulse values of VA and VB are changed via METERTOOL. All other configurations are made via LonWorks.
Radio + pulse inputs (internal antenna)	25	Pulse values of VA and VB are changed via METERTOOL.
Radio + pulse inputs (connection for external antenna)	26	Pulse values of VA and VB are changed via METERTOOL.
M-Bus module with medium data package + pulse inputs	29	Pulse values of VA and VB are changed via METERTOOL. Primary and secondary M-Bus addresses can be changed via METERTOOL or M-Bus.
Wireless M-Bus + pulse inputs	30	Pulse values of VA and VB are changed via METERTOOL
ZigBee 2.4 GHz internal antenna + pulse inputs	60	Pulse values of VA and VB are changed via METERTOOL
Metasys N2 (RS485) + pulse inputs	62	Pulse values of VA and VB are changed via METERTOOL

12 Data Communication

12.1 MULTICAL® 61 Data Protocol

Internal data communication in MULTICAL® 61 is based on the Kamstrup Meter Protocol (KMP) which both provides a quick and flexible reading structure and fulfils future requirements to data reliability.

The KMP protocol is used in all Kamstrup consumption meters launched in 2006 and later. The protocol is used for the optical eye and via plug pins for the base module. Thus, base modules with e.g. M-bus interface use the KMP protocol internally and the M-bus protocol externally.

The KMP protocol has been designed to handle point to point communication in a master/slave system (e.g. a bus system) and is used for data reading of Kamstrup consumption meters.

Software and parameter protection

The meter’s software is implemented in a ROM and cannot be changed, neither deliberately nor by mistake. The legal parameters cannot be changed via data communication without breaking the legal seal and short circuiting the "total programming lock".

Software conformity

Software checksum based on CRC16 is available via data communication and in the display.

Integrity and authenticity of data

All data parameters include type, measuring unit, scaling factor and CRC16 checksum. Every produced meter includes a unique identification number.

Two different formats are used in the communication between master and slave. Either a data frame format or an application acknowledgement format.

- A request from master to slave is always sent in a data frame.
- The response from the slave can either be sent in a data frame or as an application acknowledgement.

The data frame is based on the OSI model using the physical layer, the data link layer and the application layer.

Number of bytes in each field	1	1	1	0-?	2	1
Field designation	Start byte	Destination address	CID	Data	CRC	Stop byte
OSI – layer			Application layer			
	Data link layer					
	Physical layer					

The protocol is based on half duplex serial asynchronous communication with setup: 8 data bits, no parity and 2 stop bits. The data bit rate is 1200 or 2400 baud. CRC16 is used in both request and response.

Data is transferred byte for byte in a binary data format, of which the 8 data bits represent one byte of data.

Byte Stuffing is used for extending the data value range.

12.1.1 MULTICAL® 61 Register IDs for water meter

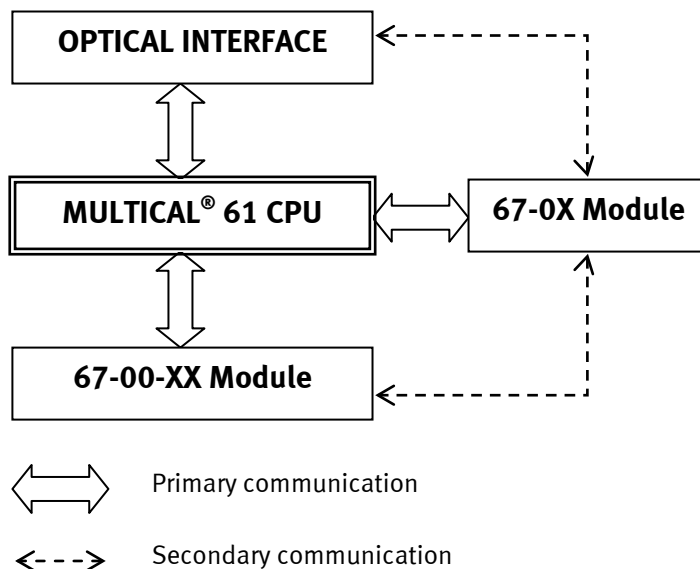
ID	Register	Description
1003	DATE	Current date (YYMMDD)
68	V1	Volume register V1
84	VA	Input register VA
85	VB	Input register VB
1004	HR	Operating hour counter
113	INFOEVENT	Info event counter
1002	CLOCK	Current hour (hhmmss)
99	INFO	Info code register, current
74	FLOW1	Current flow
123	MAX FLOW1DATE/ÅR	Date of this year's max.
124	MAX FLOW1/ÅR	This year's max. value
125	MIN FLOW1DATE/ÅR	Date of this year's min.
126	MIN FLOW1/ÅR	This year's min. value
138	MAX FLOW1DATE/MÅNED	Date of this month's max.
139	MAX FLOW1/MÅNED	This month's max. value
140	MIN FLOW1DATE/MÅNED	Date of this month's min.
141	MIN FLOW1/MÅNED	This month's min. value
98	XDAY	Target date (reading date)
152	PROG NO	Program no. ABCCCCC
153	CONFIG NO 1	Config no. DDDEE
168	CONFIG NO 2	Config. no. FFGGMN
1001	SERIE NO	Serial no. (unique number of each meter)
112	METER NO 2	Customer number (8 most significant digits)
1010	METER NO 1	Customer number (8 least significant digits)
114	METER NO VA	Meter no. of VA
104	METER NO VB	Meter no. of VB
1005	METER TYPE	Software edition
154	CHECK SUM 1	Software checksum
155	HIGH RES	High-resolution energy register for test purposes
157	TOPMODUL ID	ID number of top module
158	BOTMODUL ID	ID number of base module

Open data protocol

Companies who want to develop their own communication driver for the KMP protocol can order a demonstration program with "open source code" in C# (.net based) as well as a detailed protocol description (in English language).

12.2 MULTICAL® 61 Communication paths

Physically the possibility of direct communication has been implemented as shown below. Data communication can be routed internally between modules and calculator via destination addresses.



12.3 Optical eye

For data communication via the optical interface an optical eye can be used. The optical eye must be located at the front of the calculator, just above the IR-diode as shown on the photo below. Please note that the optical eye contains a very powerful magnet that should be protected with the magnet protector when not in use.

Different variants of the optical eye can be found in the list of accessories (see chapter 3.3.1).



13 Approvals

13.1 Type approvals

MULTICAL® 61 has been MID approved on the basis of OIML R 49-1:2006 and R 49-2:2006, with FORCE Certification as notified body. Please contact Kamstrup A/S for further details on type approvals and verification.

13.2 CE-Marking

MULTICAL® 61 is CE-marked in accordance with the following directives:

EMC directive	2004/108/EC
LV directive	2006/95/EC (together with Pulse Transmitter)
PE directive	97/23/EF (DN50...DN80) category 1

13.3 Measuring Instrument Directive (MID)

MULTICAL® 61 is available with CE-marking according to MID (2004/22/EC). The certificates have the following numbers:

B-module:	DK-0200-MI001-010
D-module:	DK-0200-MIQA-001

13.4 Declaration of Conformity



Declaration of Conformity
Overensstemmelseserklæring
Déclaration de conformité
Konformitätserklärung
Deklaracja Zgodności
Declaración de conformidad
Declaratie de conformitate

**We
Vi
Nous
Wir
My
Nosotros
Noi**

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

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

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

are in conformity with the requirements of the following directives:

er i overensstemmelse med kravene i følgende direktiver:

sont conforme(s) aux exigences de la/des directives:

mit den Anforderungen der Richtlinie(n) konform ist/sind:

są zgodne z wymaganiami następujących dyrektyw:

es/son conformes con los requerimientos de las siguientes directivas:

este/sunt în conformitate cu cerințele următoarelor directive:

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

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

Date: 2011-10-10

Sign.:

Lars Bo Hammer
Quality Assurance Manager

5518-050, Rev.: T1, Kamstrup A/S, DK8660 Skanderborg, Denmark

14 Troubleshooting

MULTICAL® 61 with flow sensor ULTRAFLOW® 24 is designed for quick and simple installation as well as long and reliable operation at the water consumer.

Should you, however, experience an operating problem, the table below can be used for troubleshooting.

Repairing the meter, if needed, we recommend only to replace parts like battery and communication modules. Alternatively the whole meter ought to be replaced.

Major repairs must be made by Kamstrup A/S.

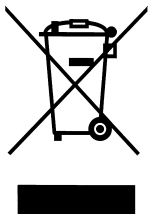
Before sending in the sensor for repair or check, please use the error detection table below to help you clarify the possible cause of the problem.

Symptom	Possible reason	Proposal for correction
The display value is not updated	Power supply missing	Change battery or check mains supply
No display function (empty display)	Power supply missing	Change battery or check mains supply. Is there 3.6 VDC on terminals 60(+) and 61 (-)?
If "info" = 1	Supply voltage has been interrupted	The info code is corrected automatically
No accumulation of volume (m ³)	Read "info" in the display	Check the error indicated by the info code
If "info" = 16	Communication error or signal too weak or wrong flow direction	There is air in the flow sensor? Bleed the system and check the meter again. Check that the flow direction matches the arrow on the flow sensor
If "info" = 2048	Flow sensor programmed with wrong pulse figure	Please contact Kamstrup A/S
If "info" = 4096	Signal too weak	There is air in the flow sensor? Bleed the system and check the meter again.
If "info" = 16384	Flow sensor mounted in wrong direction	Check that the flow direction matches the arrow on the flow sensor

15 Disposal

Kamstrup A/S is environmentally certified according to ISO 14001, and as far as possible and as part of our environmental policy we use materials that can be recycled in an environmentally correct way.

Kamstrup A/S has calculated carbon footprint of all meters.



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

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

- **Disposal by Kamstrup A/S**

Kamstrup accepts worn-out meters for environmentally correct disposal according to previous agreement. The disposal is free of charge to the customer, 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 chapter in order to inform the recipient of the contents.

Please note that lithium cells, and meters containing lithium cells must be shipped as dangerous goods. Please see Kamstrup document 5509-682 “Shipping of battery powered heat meters and lithium batteries”

Item	Material	Recommended disposal
Lithium cell in MULTICAL® 61	Lithium and Thionylchloride >UN 3090< D-cell: 4.9 g lithium	Approved deposit of lithium cells
PCBs in MULTICAL® 61 (Remove LCD-display)	Coppered epoxy laminate, components soldered on	PCB scrap for metal recovery
LCD-display	Glass and liquid crystals	Approved processing of LCD-displays
Cable for flow sensor	Copper cable, silicone jacket, FEP insulation	Cable recovery
Transparent top cover	Thermoplastic, PC	Plastic recovery
Black connection base	Thermoplastic, ABS with TPE gaskets	Plastic recovery
Internal cover	Thermoplastic, ABS	Plastic recovery
Other plastic parts, cast moulding	Thermoplastic, PC + 20% GF	Plastic recovery
Meter housing (threaded meter)	DZR brass	Metal recovery
Meter housing (flange meter)	Stainless steel 1.4408	Metal recovery
Signalhousing (top)	Thermoplastic, PC 20% GF	Plastic recovery
Signalhousing (bottom), plug holder	Thermoplastic, PBT 30% GF	Plastic recovery
Clamping plate incl. screws	Stainless steel 1.4301	Metal recovery
Flowpipe, reflector	Thermoplastic, PES 30% GF	Plastic recovery
Reflector plate, mirror, transducer	Stainless steel 1.4305, 1.4306, 1.4401	Metal recovery
Gaskets	EPDM	Plastic recovery
Packing	Environmental cardboard	Cardboard recycling
Packing	Polystyrene	EPS recovery

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

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

16 Documents

	Danish	English	German	SNG
Technical description	5512-621	5512-622	5512-623	5512-756
Data sheet	5810-642	5810-643	5810-644	5810-713
Installation and user's guide	5512-676	5512-697	5512-700	5512-793

Terms and expressions used in this document are explained at www.kamstrup.dk