Technical Description

MULTICAL® 801

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

Contents

1 General Description

MULTICAL® 801 is an energy meter with many applications. In addition to being an accurate and reliable mains supplied heat meter MULTICAL® 801 can also be used for:

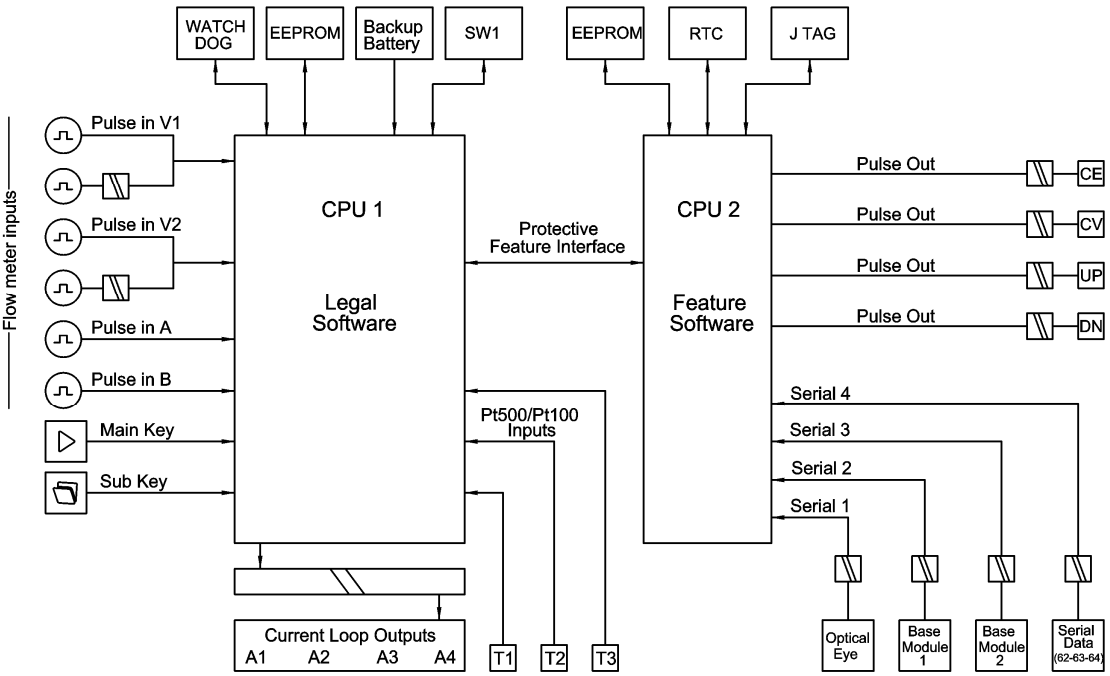
- Energy metering independent of supply voltage interruptions
- Cooling metering in water-based systems
- Bifunctional heat/cooling metering in separate registers
- Leak surveillance of heat and cold water installations
- Power and flow limiter with valve control
- Data logger
- Data communication
- Analog 0/4...20 mA outputs

In designing MULTICAL® 801 we have attached great importance to flexibility through programmable functions and plug-in modules in order to secure optimum use in a wide range of applications. In addition, the construction makes it possible to update previously installed MULTICAL® 801 via the PC-program METERTOOL.

This technical description has been written with a view to enabling operations managers, meter installers, consulting engineers and distributors to utilize all functions comprised in MULTICAL® 801. Furthermore, the description is directed to laboratories performing tests and verification.

MULTICAL® 801 is based on the platform used for MULTICAL® 601. However, many extra facilities such as back illuminated display, back-up of energy metering during power failure, extra communication channels and the option of four analog outputs have been added.

1.1 Block diagram



2 Technical data

2.1 Approved meter data

Approval	DK-0200-MI004-006
Standard	EN 1434:2007 and OIML R75:2002
EU-directives	Measuring Instrument Directive, Low Voltage Directive, Electromagnetic Compatibity Directive
Temperature range Differential range	θ: 2°C...180°C $\Delta\Theta$: 3 K...170 K
Accuracy	$E_C \pm (0.5 + \Delta\Theta_{min}/\Delta\Theta)$ %
Temperature sensors	-Type 67-F and 67-K Pt100 – EN 60 751, 4-wire connection -Type 67-G and 67-L Pt100 – EN 60 751, 4-wire connection
Compatible flow meter types	-ULTRAFLOW® -Electronic meters with active or passive pulse output -Mechanical meters with electronic pick-up -Mechanical meters with reed contact
Flow meter sizes	[kWh] qp 0.6 m^3/h...15 m^3/h [MWh] qp 0.6 m^3/h...15000 m^3/h [GJ] qp 0.6 m^3/h...30000 m^3/h
EN 1434 designation	Environmental class A and C
MID designation	Mechanical environment: Class M1 Electromagnetic environment: Class E1 and E2 Non-condensing environment, closed location 5...55°C (indoors)

2.2 Electrical data

Calculator data

Typical accuracy	Calculator E_C ± (0.15 + 2/ΔΘ) %	Sensor pair: E_T ± (0.4 + 4/ΔΘ) %
Display	LCD – 7 (8) digits with digit heigth 7.6 mm and back illumination	
Resolution	*9999.999 – 99999.99 – 999999.9 – 9999999 - 99999999*	
Energy units	MWh – kWh – GJ – Gcal	
Data logger (Eeprom)	Standard: 460 days, 36 months, 15 years, 50 info codes	
	Standard: Programmable data logger with logging depth 1080 registers	
Clock/calendar	Standard: Clock, calendar, leapyear compensation, target date	
	Standard: Real time clock with battery backup	
	Standard: Battery backup of energy measurement incl. ULTRAFLOW®	
Data communication	Standard: KMP protocol with CRC16 used for optical communication as well as top and base modules	
Power of temperature sensors	< 10 µW RMS	

Mains supply	230 VAC +15/-30%, 50/60 Hz (all types)
	24 VAC ±50%, 50/60 Hz (Type 67-F/G without analog outputs)
	24 VAC ±25%, 50/60 Hz (Type 67-F/G with analog outputs)
Insulation voltage	4 kV
Power consumption	< 3 W without analog outputs < 9 W with analog outputs
Current consumption	Max. 50 mA/230 VAC
	Max. 450 mA/24 VAC

Battery backup	3.65 VDC, 2 batteries A-cell lithium
	(Type No. 66-99-619)
Replacement interval	10 years' normal operation (with mains supply)
Backup period	1 year (without supply)
	The replacement interval is reduced at high ambient temperature

EMC data: Fulfils EN 1434 class A and C (MID class E1 and E2)

Temperature measurement

		T1	T2	T3	T4
-Type 67-F and 67-K 4-W Pt100	Measuring range	0.00…185.00°C	0.00…185.00°C	0.00…185.00°C	N/A
	Preset range	0.01…180.00°C	0.01…180.00°C	0.01…180.00°C	0.01…180.00°C
-Type 67-G and 67-L 4-W Pt100	Measuring range	0.00…185.00°C	0.00…185.00°C	0.00…185.00°C	N/A
	Preset range	0.01…180.00°C	0.01…180.00°C	0.01…180.00°C	0.01…180.00°C

Max. Cable lengths	Pt100, 2-wire	Pt100, 2-wire	Pt100, 4-wire
	2 x 0.25 mm^2: 2.5 m	2 x 0.25 mm^2: 10 m	4 x 0.25 mm^2: 100 m
	2 x 0.50 mm^2: 5 m	2 x 0.50 mm^2: 20 m	-

Flow measurement V1 and V2	-ULTRAFLOW® V1: 9-10-11 and V2: 9-69-11	Reed contacts V1: 10-11 and V2: 69-11	24 V active pulses V1: 10B-11B and V2: 69B-79B
EN 1434 pulse class	IC	IB	(IA)
Pulse input	680 kΩ pull-up to 3.6 V	680 kΩ pull-up to 3.6 V	12 mA at 24 V
Pulse ON	< 0.4 V i > 0.5 msec.	< 0.4 V i > 50 msec.	< 4 V i > 0.5 msec.
Pulse OFF	> 2.5 V i > 10 msec.	> 2.5 V i > 50 msec.	> 12 V i > 10 msec.
Pulse frequency	< 128 Hz	< 1 Hz	< 128 Hz
Integration frequency	< 1 Hz	< 1 Hz	< 1 Hz
Electrical isolation	No	No	2 kV
Max. cable length	10 m	25 m	100 m

Pulse inputs VA and VB VA 65-66 and VB: 67-68	Water meter connection FF(VA) and GG(VB) = 01…40	Electricity meter connection FF(VA) and GG(VB) = 50…60
Pulse input	680 kΩ pull-up to 3.6 V	680 kΩ pull-up to 3.6 V
Pulse ON	< 0.4 V i > 20 msec.	< 0.4 V i > 20 msec.
Pulse OFF	> 2.5 V i > 100 msec.	> 2.5 V i > 100 msec.
Pulse frequency	< 1 Hz	< 3 Hz
Electrical isolation	No	No
Max. cable length	25 m	25 m
Requirements to ext. contact	Leak current at function open < 1 μA	

Pulse outputs CE and CV

Energy (16-17) Volume (18-19)

Type	Open collector (OB)
Pulse duration	Programmable 32, 100 or 247 msec. via METERTOOL
External voltage	5…30 VDC
Current	1…10 mA
Residual stress	$U_{CE} \approx 1$ V at 10 mA
Electrical isolation	2 kV
Max. cable length	25 m

2.3 Mechanical data

Environmental class	Fulfils EN 1434 class A and C
Ambient temperature	5…55°C non-condensing, closed location (installation indoors)
Protection class	IP67
Storage temperature	-20…60°C (drained flow meter)
Weight	1.4 kgs excl. sensors and flow meter
Cable adapters	6 pcs. D 3…6 mm and 3 pcs. D 4…8 mm

2.4 Material

Top cover	PC
Connection base	PC + 10%GF
Sealing cover, top	ABS
Sealing cover, bottom	PC
Prism behind display	PMMA

2.5 Accuracy

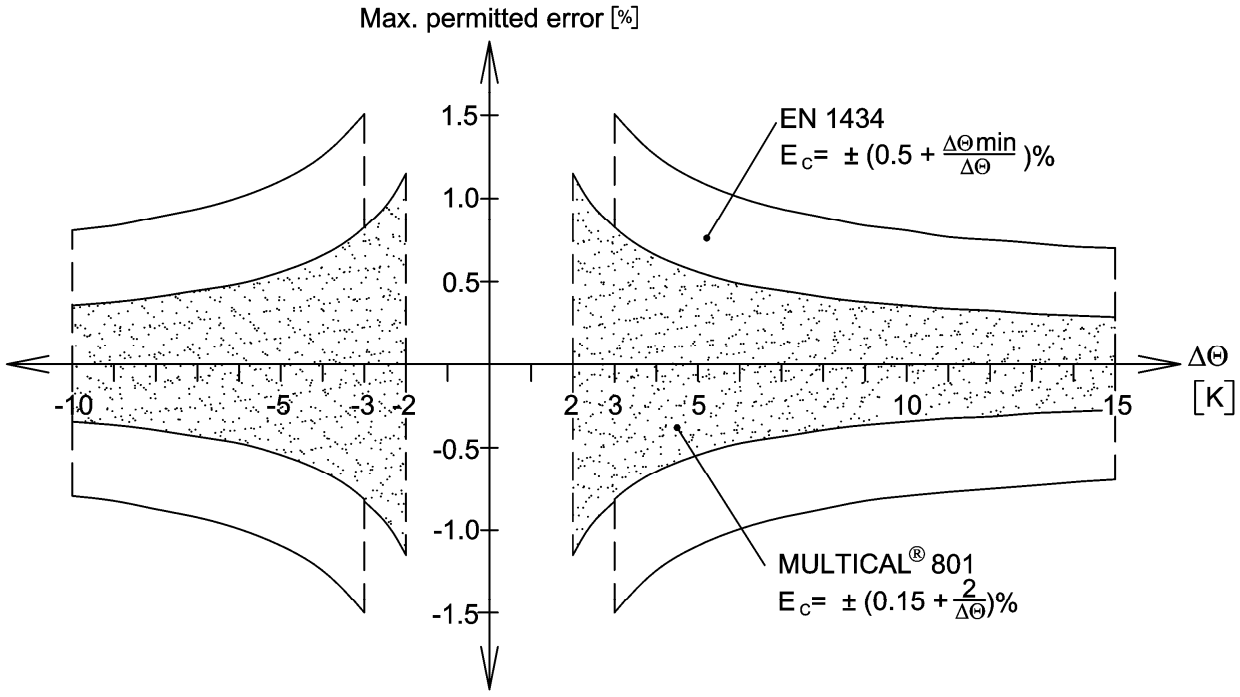


Figure 1

MULTICAL® 801 typical accuracy compared to EN 1434.

3 Type overview

MULTICAL® 801 can be ordered in countless combinations as required by the customer. First you select the required hardware from the type overview. Then select ”Prog”, ”Config” and ”Data” to suit the application in question.

The supplied meter is configured from the factory and ready for use, however it can also be changed/reconfigured after installation.

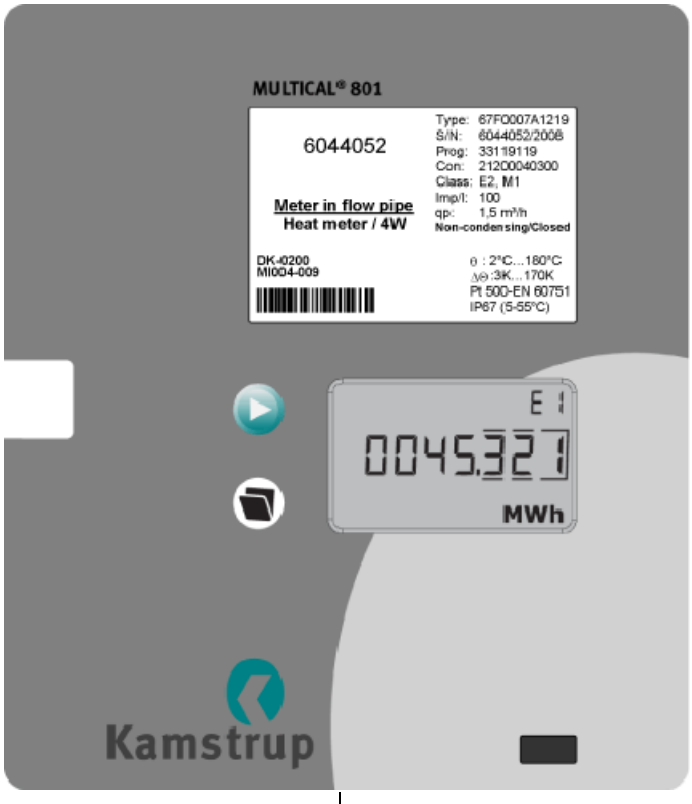
Please note that the points marked “Total prog” cannot be changed without breaking the verification seal. This means that the change must be carried out by an accredited meter laboratory.

We currently develop new functions and modules for MULTICAL® 801. Please contact Kamstrup A/S if your application is not covered by the variants shown.

3.1 Type and programming overview

Type number 67-x-x-xx-xxx-xxx
Choice of calculator, modules, sensor pairs and flow sensor

Total prog



Prog. A-B-CCC-CCC

Config. DDD-EE-FF-GG-M-N

Data

Total prog
Partial prog.
Partial prog.

3.2 Type number composition

MULTICAL® 801 Type 67-			□	□	□□	□	□	□	□	□□
Sensor connection										
Pt100	4-wire (T1-T2-T3)	No analog outputs	**F**							
Pt500	4-wire (T1-T2-T3)	No analog outputs	**G**							
Pt100	4-wire (T1-T2-T3)	4 analog outputs	**K**							
Pt500	4-wire (T1-T2-T3)	4 analog outputs	**L**							
Module 2 *(VA and VB are not available for module position 2)*										
No module				**0**						
M-Bus				**V**						
RadioRouter **)				**W**						
LonWorks, FTT-10A				**Y**						
GSM/GPRS module **)				**Z**						
Module 1 *(VA and VB are available for module position 1)*										
No module					**00**					
M-Bus + pulse inputs					**20**					
RadioRouter + pulse inputs **)					**21**					
Data logger + 4-20 mA inputs + pulse inputs					**22**					
LonWorks, FTT-10A + pulse inputs					**24**					
Supply										
230 VAC supply						**7**				
24 VAC supply						**8**				
Pt500 sensor pair (2-wire sensors)										
No sensor pair							**0**			
Pocket sensor pair with 1.5 m cable							**A**			
Pocket sensor pair with 3.0 m cable							**B**			
Pocket sensor pair with 5 m cable							**C**			
Pocket sensor pair with 10 m cable							**D**			
Short direct sensor pair with 1.5 m cable							**F**			
Short direct sensor pair with 3.0 m cable							**G**			
Set of 3 pocket sensors with 1.5 m cable							**L**			
Set of 3 pocket sensors with 1.5 m cable							**Q3**			
Flow sensor/pick-up unit										
1 ULTRAFLOW® included *)		(specificy type)						**1**		
2 nos. ULTRAFLOW® included *)		(specificy type)						**2**		
Prepared for 1 ULTRAFLOW®		(specificy type)						**7**		
Prepared for 2 nos. (identical) ULTRAFLOW®		(specificy type)						**8**		
Prepared for foreign flowpart with passive/active pulses								**N**		
Meter type										
Heat meter with MID marking									**2**	
Heat meter, closed systems									**4**	
Cooling meter									**5**	
Heat/cooling meter									**6**	
Volume meter, hot water									**7**	
Volume meter, cooling water									**8**	
Energy meter, open systems									**9**	
Delivery code (language on label etc.)										**K1**

*) ULTRAFLOW® is packed in a separate carton which is strapped together with the MULTICAL® 801 carton. The cable between MULTICAL 801 and ULTRAFLOW it not connected from the factory.

**)GSM module and RF module are NOT combinable in one meter (requires further tests).

3.2.1 Accessories

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 RS232 w/D-sub 9F
66-99-106	Data cable RS232, D-sub 9F
66-99-136	Infrared optical reading head for Kamstrup/EVL w/RS232 w/D-sub 9F
66-99-144	Infrared optical reading head for Kamstrup/EVL w/USB plug
66-99-370	Verification unit, Pt100 (to be used with METERTOOL)
66-99-371	Verification unit, Pt500 (to be used with METERTOOL)
66-99-619	Batteri backup (2xA cell lithium battery)
66-99-278	Short circuit pen (for total reset and total programming)
66-99-209	Short circuit jumper (for use with 2-wire temperature sensors)
16-40-080	Jumper for modules
65-56-4x-xxx	Temperature sensor pair with connection head (2/4-wire)
59-20-177	Cable gland wrench 15 mm
59-20-178	Cable gland wrench 19 mm
66-99-103	Q144 dummy cover (144 mm x 144 mm) for blinding in panels/racks
679xxxxxx3xx	External Communication Box
66-99-707	METERTOOL for MULTICAL® 801
66-99-708	LogView for MULTICAL® 801

Contact Kamstrup A/S for questions about further accessories.

3.3 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 laboratory.

The **A-code** states whether flow sensor (V1) is installed in forward or return pipe. As the volume of water increases with temperature, the calculator must correct for the installation form in question. Wrong programming or installation results in measuring errors. Further details concerning installation of flow sensor in flow and return in connection with heat and cooling meters appear from section 5.1.

The **B-code** indicates the measuring unit used for the energy register. GJ, kWh or MWh are the most used units, whereas Gcal are only used in a few countries outside the EEA.

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 about minimum resolution and maximum register overflow are obeyed. The CCC-codes are divided into smaller tables in order to obtain a faster overview.

CCC(V1) states the CCC-code of the flow sensor connected to flow sensor input V1 on terminals 9-10-11 (or 10B-11B). In most applications this is the flow sensor used for energy calculation.

CCC(V2) states the CCC-code of a possible extra flow sensor, which can be connected on terminals 9-69-11 (or 69B-79B). If V2 is not used, CCC(V2) is equal to CCC(V1). For leak surveillance CCC(V2) must be equal to CCC(V1).

Prog. number	**A**	-	**B**	-	**CCC (V1)**	-	**CCC (V1)**
	☐		☐		☐☐☐		☐☐☐
Flow meter position							
k-factor table - Forward (at T1)	3						
k-factor table - Return (at T2)	4						
Measuring unit, Energy							
- x10 GJ			1				
- GJ			2				
- kWh			3				
- MWh			4				
- Gcal			5				
Flow meter coding (CCC-table)					CCC		CCC

3.3.1 CCC-TABLE FOR MULTICAL® 801

The CCC-tables are divided into quick codes (CCC=4XX and 1XX) for electronic meters, e.g. ULTRAFLOW®, and slow codes for e.g. reed contacts (CCC=0XX).

CCC= 4XX Electronic meters with quick and bounce-free pulses as well as info codes for ULTRAFLOW® X4
Max. pulse frequency: 128 Hz

Max. integration frequency: 1 Hz

CCC= 1XX Electronic meters with quick and bounce-free pulses

Max. pulse frequency: 128 Hz

Max. integration frequency: 1 Hz

CCC= 0XX Mechanical meters delivering slow pulses with bounce (flow sensor type "L")

Max. pulse frequency: 1 Hz

Max. integration frequency: 1 Hz

Max. integration frequency is 1 Hz for all types. The CCC-codes have been so composed that qs+20% (or Qmax+20%) does not exceed an integration frequency of 1 Hz.

Example: CCC=107 (applying to a qp 1.5 m^3/h meter) : 1 Hz integration frequency is obtained at q = 3.6 m^3/h.

EN 1434 comprises requirements to the resolution and register size of the energy indication. MULTICAL® 801 fulfils these requirements provided that it is connected to one of the below-mentioned flow sensor sizes:

[kWh]	qp 0.6 m^3/h...15 m^3/h
[MWh]	qp 0.6 m^3/h...15000 m^3/h
[GJ]	qp 0.6 m^3/h...30000 m^3/h

3.3.2 CCC-codes for ULTRAFLOW® X4

			Number of decimals in display											
CCC No.	Pre-counter	Flow factor	kWh	MWh Gcal	GJ	m³ [ton]	l/h	m³/h	kW	MW	Imp./l	qp [m³/h]	Type No.	Flow sensor
416	3000	78642	0	3	2	2	0	-	1	-	300	0.6	65-X-CAAA-XXX	1-2-7-8
													65-X-CAAD-XXX	
													65-X-CAAF-XXX	
484	300	78642	1	-	3	3	0	-	1	-	300	0.6		1-2-7-8
419	1000	235926	0	3	2	2	0	-	1	-	100	1.5	65-X-CDA1-XXX	1-2-7-8
													65-X-CDAA-XXX	
													65-X-CDAC-XXX	
													65-X-CDAD-XXX	
													65-X-CDAE-XXX	
													65-X-CDAF-XXX	
													65-X-CDBA-XXX	
407	100	235926	1	-	3	3	0	-	1	-	100	1.5		1-2-7-8
498	600	393210	0	3	2	2	0	-	1	-	60	2.5	65-X-CEAF-XXX	1-2-7-8
													65-X-CEB/CA-XXX	
451	5000	471852	-	2	1	1	0	-	1	-	50	3.5	65-X-CGAG-XXX	1-2-7-8
													65-X-CGB/CB-XXX	
436	500	471852	0	3	2	2	0	-	1	-	50	3.5		1-2-7-8
437	2500	943704		2	1	1	0		1		25	6	65-X-CHAF-XXX	1-2-7-8
													65-X-CHAG-XXX	
													65-X-CHAH-XXX	
													65-X-CHB/CB-XXX	
438	250	943704	0	3	2	2	0	-	1	-	25	6		1-2-7-8
478	1500	1572840	-	2	1	1	0	-	1	-	15	10	65-X-CJAJ-XXX	1-2-7-8
													65-X-CJB/C2-XXX	
													65-X-CJB/CD-XXX	
483	150	1572840	0	3	2	2	0	-	1	-	15	10		1-2-7-8
420	1000	2359260	-	2	1	1	0	-	1	-	10	15	65-X-CKB/C4-XXX	1-2-7-8
													65-X-CKB/CE-XXX	
485	100	2359260	0	3	2	2	0	-	1	-	10	15		1-2-7-8
479	600	3932100	-	2	1	1	0	-	1	-	6	25	65-X-CLBG-XXX	1-2-7-8
458	5000	471852	-	1	0	0	-	2	0	-	5	40	65-X-CMBH-XXX	1-2-7-8
													65-X-CMBJ-XXX	
486	500	471852	-	2	1	1	-	2	0	-	5	40		1-2-7-8
470	2500	943704	-	1	0	0	-	2	-	3	2.5	60	65-X-FACL-XXX	1-2-7-8
487	250	943704	-	2	1	1	-	2	-	3	2.5	60		1-2-7-8
480	1500	1572840	-	1	0	0	-	2	-	3	1.5	100	65-X-FBCL-XXX	1-2-7-8
488	150	1572840	-	2	1	1	-	2	-	3	1.5	100		1-2-7-8

ULTRAFLOW® high-resolution CCC-codes

3.3.3 CCC-codes for ULTRAFLOW® II, type 65 54 XXX

			Number of decimals in display											
CCC No.	Pre-counter	Flow factor	kWh	MWh Gcal	GJ	m³ [tons]	l/h	m³/h	kW	MW	Imp./l	qp [m³/h]	Type No.	Flow sensor
116	3000	78642	0	3	2	2	0		1		300	0.6	65 54 A8X 65 54 AAX	1-2-7-8
119	1000	235926	0	3	2	2	0		1		100	1.5	65 54 A6X 65 54 A7X 65 54 A1X 65 54 A2X 65 54 A3X	1-2-7-8
136	500	471852	0	3	2	2	0		1		50.0	2.5	65 54 A4X 65 54 ADX	1-2-7-8
151	5000	471852		2	1	1	0		1		50.0	3.5	65 54 B1X 65 54 B7X	1-2-7-8
137	2500	943704		2	1	1	0		1		25.0	6.0 6.0 10 10	65 54 B2X 65 54 B2X 65 54 BGX 65 54 BHX	1-2-7-8
120	1000	2359260		2	1	1	0		1		10.0	15 25	65 54 B4X 65 54 B8X	1-2-7-8
158	5000	471852		1	0	0		2	0		5.0	40	65 54 B9X	1-2-7-8
170	2500	943704		1	0	0		2		3	2.5	60	65 54 BAX	1-2-7-8
147	1000	2359260		1	0	0		2		3	1.0	150	65 54 BBX	1-2-7-8
194	400	5898150		1	0	0		2		3	0.4	400	65 54 BCX	1-2-7-8
195	250	9437040		1	0	0		2		3	0.25	1000	65 54 BKX	1-2-7-8

Current flow indication (l/h or m³/h) is calculated on the basis of volume pulses/10 sec. (see paragraph 6.3)

3.3.4 CCC-codes for ULTRAFLOW® type 65-R/S/T

			Number of decimals in display											
CCC No.	Pre-counter	Flow factor	kWh	MWh Gcal	GJ	m³ [tons]	l/h	m³/h	kW	MW	Imp./l	qp [m³/h]	Type No.	Flow sensor
116	3000	78642	0	3	2	2	0		1		300	0.6	65-X-CAAA-XXX 65-X-CAAD-XXX	1-2-7-8
119	1000	235926	0	3	2	2	0		1		100	1.5	65-X-CDAC-XXX 65-X-CDAD-XXX 65-X-CDAE-XXX 65-X-CDAF-XXX 65-X-CDAA-XXX	1-2-7-8-M
136	500	471852	0	3	2	2	0		1		50.0	3.0	65-X-CFAF-XXX 65-X-CFBA-XXX	1-2-7-8-M
151	5000	471852		2	1	1	0		1		50.0	3.5	65-X-CGAG-XXX 65-X-CGBB-XXX	1-2-7-8-M
137	2500	943704		2	1	1	0		1		25.0	6 6 10 10	65-X-CHAG-XXX 65-X-CHBB-XXX 65-X-C1AJ-XXX 65-X-C1BD-XXX	1-2-7-8-M
178	1500	1572840		2	1	1	0		1		15.0	10	65-X-CJAJ-XXX 65-X-CJBD-XXX	1-2-7-8
120	1000	2359260		2	1	1	0		1		10.0	15	65-X-CKBE-XXX	1-2-7-8-M
179	600	3932100		2	1	1	0		1		6.0	25	65-X-CLBG-XXX	1-2-7-8
120	1000	2359260		2	1	1	0		1		10.0	25	65-X-C2BG-XXX	1-2-7-8-M
158	5000	471852		1	0	0		2	0		5.0	40	65-X-CMBH-XXX	1-2-7-8-M
170	2500	943704		1	0	0		2		3	2.5	60	65-X-FABL-XXX 65-X-FACL-XXX	1-2-7-8-M
180	1500	1572840		1	0	0		2		3	1.5	100	65-X-FBCL-XXX	1-2-7-8
147	1000	2359260		1	0	0		2		3	1.0	150	65-X-FCBN-XXX 65-X-FCCN-XXX	1-2-7-8-M
181	600	3932100		1	0	0		2		3	0.6	250	65-X-FDCN-XXX	1-2-7-8
191	400	589815		1	0	0		1		2	0.4	400	65-X-FEBN-XXX 65-X-FEBR-XXX 65-X-FECN-XXX 65-X-FECP-XXX 65-X-FECR-XXX	1-2-7-8-M
192	250	943704		1	0	0		1		2	0.25	600 600 1000 1000	65-X-FFCP-XXX 65-X-FFCR-XXX 65-X-F1BR-XXX 65-X-F1CR-XXX	1-2-7-8-M
193	150	1572840		1	0	0		1		2	0.15	1000	65-X-FGBR-XXX	1-2-7-8

Current flow indication (l/h or m³/h) is calculated on the basis of volume pulses/10 sec. (see paragraph 6.3)

3.3.5 High-resolution CCC-codes for ULTRAFLOW® (for cooling meters etc.)

			Number of decimals in display											
CCC No.	Pre-counter	Flow factor	kWh	MWh Gcal	GJ	m³ [tons]	l/h	m³/h	kW	MW	Imp./l	qp [m³/h]	Type No.	Flow sensor
184	300	78642	1		3	3	0		1		300	0.6		1-2-7-8
107	100	235926	1		3	3	0		1		100	1.5		1-2-7-8-M
136	500	471852	0	3	2	2	0		1		50.0	3.5		1-2-7-8-M
138	250	943704	0	3	2	2	0		1		25.0	6.0 10		1-2-7-8-M
183	150	1572840	0	3	2	2	0		1		15.0	10		1-2-7-8
185	100	2359260	0	3	2	2	0		1		10.0	15		1-2-7-8-M
186	500	471852		2	1	1		2	0		5.0	40		1-2-7-8-M
187	250	943704		2	1	1		2		3	2.5	60		1-2-7-8-M
188	150	1572840		2	1	1		2		3	1.5	100		1-2-7-8
189	100	2359260		2	1	1		2		3	1.0	150		1-2-7-8-M
191	400	589815		1	0	0		1		2	0.4	400		1-2-7-8-M
192	250	943704		1	0	0		1		2	0.25	600 1000		1-2-7-8-M
193	150	1572840		1	0	0		1		2	0.15	1000		1-2-7-8

Current flow indication (l/h or m³/h) is calculated on the basis of volume pulses/10 sec. (see paragraph 6.3)

3.3.6 CCC-codes for other electronic meters with passive or active output

			Number of decimals in display										
CCC No.	Pre-counter	Flow factor	MWh Gcal	GJ	m³ [tons]	m³/h	kW	MW	l/imp	Imp./l	Qmax [m³/h]	Type	Flow sensor
147	1000	2359260	1	0	0	2		3	1	-	18...75	SC-18	K-M
148	400	5898150	1	0	0	2		3	2.5	-	120...300	SC-120	K-M
149	100	2359260	1	0	0	1	-	2	10	-	450...1200	SC-450	K-M
150	20	1179630 0	1	0	0	1	-	2	50	-	1800...3000	SC-1800	K-M
175	7500	314568	1	0	0	2		3	-	7.5	15...30	DF-15	K-M
176	4500	524280	1	0	0	2		3	-	4.5	25...50	DF-25	K-M
177	2500	943704	1	0	0	2		3	-	2.5	40...80	DF-40	K-M

			Number of decimals in display										
CCC No.	Pre-counter	Flow factor	MWh Gcal	GJ	m³ [tons]	m³/h	MW	l/imp	Imp./l	Qp range [m³/h]	Qs [m³/h]	Type	Flow sensor
201	100	235926	2	1	1	1	2	1	1	10...100	75	FUS380 DN50-65	K-M
202	40	589815	2	1	1	1	2	2.5	0.4	40...200	240	FUS380 DN80-100	K-M
203	400	589815	1	0	0	1	2	2.5	0.4	100...400	500	FUS380 DN125	K-M
204	100	235926	1	0	0	0	1	10	0.1	150...1200	1600	FUS380 DN150-250	K-M
205	20	1179630	1	0	0	0	1	50	0.02	500...3000	3600	FUS380 DN300-400	K-M
206	100	2359260	0	x10	x10	0	1	100	0.01	1400...18000	36000	FUS380 DN500-1200	K-M

Current flow indication (l/h or m³/h) is calculated on the basis of volume pulses/10 sec. (see paragraph 6.3)

3.3.7 CCC-codes for vane-wheel meters with electronic pick-up

			Number of decimals in display											
CCC No.	Pre-counter	Flow factor	kWh	MWh Gcal	GJ	m³ [tons]	l/h	m³/h	kW	MW	Imp./l	qp [m³/h]	Type	Flow sensor
108	1403	168158	0	3	2	2	0		1		140.3	0.6	GWF	F-D-K
109	957	246527	0	3	2	2	0		1		95.7	1.0	GWF	F-D-K
110	646	365211	0	3	2	2	0		1		64.6	1.5	GWF	F-D-K
111	404	583975	0	3	2	2	0		1		40.4	1.5 (2.5)	HM (GWF)	F-D-K
112	502	469972	0	3	2	2	0		1		50.2	1.5 – 2.5*	GWF	F-D-K
113	2350	1003940		2	1	1	0		1		23.5	3.5 - 6*	GWF	F-D-K
114	712	331357		2	1	1	0		1		7.12	10 - 15*	GWF	F-D-K
115	757	311659	0	3	2	2	0		1		75.7	1.0*	GWF	F-D-K
116	3000	78642	0	3	2	2	0		1		300.0	0.6*	GWF	F-D-K
117	269	877048	0	3	2	2	0		1		26.9	1.5	Brunata	F-D-K
118	665	354776	0	3	2	2	0		1		66.5	1.5	Aquastar	F-D-K
119	1000	235926	0	3	2	2	0		1		100.0	0.6	HM	F-D-K
121	294	802469	0	3	2	2	0		1		29.4	1.5 – 2.5		F-D-K
122	1668	141442	0	3	2	2	0		1		166.8	0.6	HM	F-D-K
123	864	273063	0	3	2	2	0		1		86.	0.5 - 1*	HM	F-D-K
124	522	451966	0	3	2	2	0		1		52.	2. (1.5*)	CG (HM)	F-D-K
125	607	388675	0	3	2	2	0		1		60.7	1.5 - 1* 1.5*	HM	F-D-K
126	420	561729	0	3	2	2	0		1		42.0	1.0 (2.5*)	CG (HM)	F-D-K
127	2982	791167		2	1	1	0		1		29.82	2.5 3.5*	HM	F-D-K
128	2424	973292		2	1	1	0		1		24.24	3.5*	HM	F-D-K
129	1854	1272524		2	1	1	0		1		18.54	6*	HM	F-D-K
130	770	3063974		2	1	1	0		1		7.7	10*	HM	F-D-K
131	700	3370371		2	1	1	0		1		7.0	15*	HM	F-D-K
132	365	645665	0	3	2	2	0		1		36.54	2.5	Wehrle	F-D-K
133	604	390154	0	3	2	2	0		1		60.47	1.5	Wehrle	F-D-K
134	1230	191732	0	3	2	2	0		1		123.05	0.6	Wehrle	F-D-K
135	1600	1474538		2	1	1	0		1		16.0	10*	HM	F-D-K
139	256	921586	0	3	2	2	0		1		25.6	1.5 – 2.5	GWF	F-D-K
140	1280	1843172		2	1	1	0		1		12.8	3.5 – 5.0	GWF	F-D-K
141	1140	2069526		2	1	1	0		1		11.4	6	GWF	F-D-K
142	400	589815		2	1	1		2		3	4	10	GWF	F-D-K
143	320	737269		2	1	1		2		3	3.2	10 - 15	GWF	F-D-K
144	1280	1843172		1	0	0		2		3	1.28	25 - 40	GWF	F-D-K
145	640	3686344		1	0	0		2		3	0.64	60	GWF	F-D-K
146	128	18431719		1	0	0		2		3	0.128	125	GWF	F-D-K
152	1194	1975930		2	1	1	0		1		11.94	10	GWF	F-D-K
153	1014	2326686		2	1	1	0		1		10.14	15	GWF	F-D-K
156	594	397182	0	3	2	2	0		1		59.4	1.5	Metron	F-D-K
157	3764	626796		2	1	1	0		1		37.64	2.5	Metron	F-D-K
163	1224	192750	0	3	2	2	0		1		122.4	0.6 – 1.0	GWF/U2	F-D-K
164	852	280064	0	3	2	2	0		1		85.24	1.5	GWF/U2	F-D-K
165	599	393735	0	3	2	2	0		1		59.92	2.5	GWF/U2	F-D-K
168	449	5259161		2	1	1	0		1		4.486	15/25	HM/WS	F-D-K
169	1386	1702208		1	0	0		2	0		1.386	40	HM/WS	F-D-K
173	500	471852		1	0	0		1		2	0.5	80	Westland	F-D-K

Current flow indication (l/h or m³/h) is calculated on the basis of volume pulses/10 sec. (see paragraph 6.3)

3.3.8 CCC-codes for mechanical flow sensors with reed contact

			Number of decimals in display											
CCC No.	Pre-counter	Flow factor	kWh	MWh Gcal	GJ	m³ [tons]	m³/h	l/h	kW	MW	l/imp	Imp./l	Qmax [m³/h]	Flow sensor
010	1	921600	1	-	3	3	-	0	1	-	1	1	≤ 3,0	L
011	1	921600	-	3	2	2	2		0	-	10	0.1	1...30	L
012	1	921600	-	2	1	1	1		-	2	100	0.01	10...300	L
013	1	921600	-	1	0	0	0		-	1	1000	0.001	100...3000	L
020	4	230400	0	3	2	2	2		0	-	2.5	0.4	≤ 6	L
021	4	230400	-	2	1	1	1		-	2	25	0.04	3...60	L
022	4	230400	-	1	0	0	0		-	1	250	0.004	30...600	L

Current flow indication (l/h or m³/h) is calculated on the basis of measured duration between 2 volume pulses. (see paragraph 6.3)

Selecting one of the above-mentioned CCC-codes, both CCC (V1) and CCC (V2) must be selected from this table.

3.4 Display coding

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	Heat meter DDD=210	Heat meter DDD=410	Cooling meter DDD=510	Heat/cooling DDD=610	Heat volume DDD=710	Coolingvolume DDD=810	Heat meter DDD=910
1.0	**Heat energy (E1)**						**1**	**1**		**1**			**1**
		1.1	*Yearly data*			•	*1A*	*1A*		*1A*			
		1.2	*Monthly data*			•	*1B*	*1B*		*1B*			*1A*
2.0	**Cooling energy (E3)**								**1**	**2**			
		2.1	*Yearly data*			•			*1A*	*2A*			
		2.2	*Monthly data*			•			*1B*	*2B*			
3.X		*3.1*	*E2*										
		3.2	*E4*										**2**
		3.3	*E5*										*2A*
		3.4	*E6*										*2B*
		3.5	*E7*										*2C*
		3.6	*E8 (m3*tf)*				**2**	**2**					
		3.7	*E9 (m3*tr)*				*2A*	*2A*					
4.0	**Volume V1**						**3**	**3**	**2**	**3**	**1**	**1**	**3**
		4.1	*Yearly data*			•	*3A*	*3A*	*2A*	*3A*	1A	1A	
		4.2	*Monthly data*			•	*3B*	*3B*	*2B*	*3B*	1B	1B	*3A*
		4.3	*Mass 1*										*3B*
		4.4	*P1*										*3C*
5.0	**Volume V2**												**4**
		5.1	*Yearly data*			•							
		5.2	*Monthly data*			•							*4A*
		5.3	*Mass 2*										*4B*
		5.4	*P2*										*4C*
6.0	**Hour counter**						**4**	**4**	**3**	**4**	**2**	**2**	**5**
7.0	**T1 (Forward)**						**5**	**5**	**4**	**5**			**6**
		7.1	*Year-to-date average*				*5A*	*5A*	*4A*	*5A*			
		7.2	*Month-to-date average*				*5B*	*5B*	*4B*	*5B*			
8.0	**T2 (Return)**						**6**	**6**	**5**	**6**			**7**
		8.1	*Year-to-date average*				*6A*	*6A*	*5A*	*6A*			
		8.2	*Month-to-date average*				*6B*	*6B*	*5B*	*6B*			
9.0	**T1-T2 (Δt) - = cooling**						**7**	**7**	**6**	**7**			**8**
10.0	**T3**												**9**
11.0	**T4 (prog.)**												**10**
12.0	**Flow (V1)**						**8**	**8**	**7**	**8**	**3**	**3**	**11**
		12.1	*This year's max.*			•	*8A*	*8A*	*7A*	*8A*	*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*			•	*8B*	*8B*	*7B*	*8B*	*3B*	*3B*	*11A*
		12.7	*This month's min.*			•							
		12.8	*Min. monthly data*			•	*8C*	*8C*	*7C*	*8C*	*3C*	*3C*	*11B*
13.0	**Flow (V2)**						**9**	**9**			**4**	**4**	**12**
14.0	**Power (V1)**						**10**	**10**	**8**	**9**			**13**
		14.1	*This year's max.*			•	*10A*	*10A*	*8A*	*9A*			
		14.2	*Max. yearly data*			•							
		14.3	*This year's min.*			•							
		14.4	*Min. yearly data*			•							
		14.5	*This month's max.*			•							
		14.6	*Max. monthly data*			•	*10B*	*10B*	*8B*	*9B*			
		14.7	*This month's min.*			•							
		14.8	*Min. monthly data*			•	*10C*	*10C*	*8C*	*9C*			

				Date Stamp	Heat meter DDD=210	Heat meter DDD=410	Cooling meter DDD=510	Heat/cooling DDD=610	Heatvolume DDD=710	Coolingvolume DDD=810	Heat meter DDD=910
15.0	**VA (Input A)**				**11**	**11**	**9**	**10**	**5**	**5**	**14**
		15.1	*Meter No. VA*		*11A*	*11A*	*9A*	*10A*	*5A*	*5A*	*14A*
		15.2	*Yearly data*	•	*11B*	*11B*	*9B*	*10B*	*5B*	*5B*	*14B*
		15.3	*Monthly data*	•	*11C*	*11C*	*9C*	*10C*	*5C*	*5C*	*14C*
16.0	**VB (Input B)**				**12**	**12**	**10**	**11**	**6**	**6**	**15**
		16.1	*Meter No. VB*		*12A*	*12A*	*10A*	*11A*	*6A*	*6A*	*15A*
		16.2	*Yearly data*	•	*12B*	*12B*	*10B*	*11B*	*6B*	*6B*	*15B*
		16.3	*Monthly data*	•	*12C*	*12C*	*10C*	*11C*	*6C*	*6C*	*15C*
17.0	**TA2**				**13**	**13**		**12**			
		17.1	*TL2*		*13A*	*13A*					
18.0	**TA3**				**14**	**14**		**13**			
		18.1	*TL3*		*13A*	*13A*					
19.0	**Info Code**				**15**	**15**	**11**	**14**	**7**	**7**	**16**
		19.1	*Info event counter*		*15A*	*15A*	*11A*	*14A*	*7A*	*7A*	*16A*
		19.2	*Info logger (latest 36 events)*	•	*15B*	*15B*	*11B*	*14B*	*7B*	*7B*	*16B*
20.0	**Customer No. (Nº 1+2)**				**16**	**16**	**12**	**15**	**8**	**8**	**17**
		20.1	*Date*		*16A*	*16A*	*12A*	*15A*	*8A*	*8A*	*17A*
		20.2	*Hour*		*16B*	*16B*	*12B*	*15B*	*8B*	*8B*	*17B*
		20.3	*Target date*		*16C*	*16C*	*12C*	*15C*	*8C*	*8C*	*17C*
		20.4	*Serial no.* **(Nº 3)**		*16D*	*16D*	*12D*	*15D*	*8D*	*8D*	*17D*
		20.5	*Prog. (A-B-CCC-CCC)* **(Nº 4)**		*16E*	*16E*	*12E*	*15E*	*8E*	*8E*	*17E*
		20.6	*Config 1 (DDD-EE)* **(Nº 5)**		*16F*	*16F*	*12F*	*15F*	*8F*	*8F*	*17F*
		20.7	*Config 2 (FF-GG-M-N)* **(Nº 6)**		*16G*	*16G*	*12G*	*15G*	*8G*	*8G*	*17G*
		20.8	*Software edition* **(Nº 10)**		*16H*	*16H*	*12H*	*15H*	*8H*	*8H*	*17H*
		20.9	*Software check sum* **(Nº 11)**		*16I*	*16I*	*12I*	*15I*	*8I*	*8I*	*17I*
		20.10	*Segment test*		*16J*	*16J*	*12J*	*15J*	*8J*	*8J*	*17J*
		20.11	*Module 1* **(Nº 30)**		*16K*	*16K*	*12K*	*15K*	*8K*	*8K*	*17K*
		20.12	*Module 2* **(Nº 40)**		*16L*	*16L*	*12L*	*15L*	*8L*	*8L*	*17L*
		20.13	*Modul 3 (External)* **(Nº 50)**		*16M*	*16M*	*12M*	*15M*	*8M*	*8M*	*17M*

Number of yearly data displayed (1…15)		*2*	*2*	*2*	*2*	*2*	*2*	*2*
Number of monthly data displayed (1…36)		*12*	*12*	*12*	*12*	*12*	*12*	*12*

DDD=210 is the "standard code" of heat meters with meter type 67xxxxxxx2xx. Please contact Kamstrup for other combinations. A DDD-code can contain max. 103 readings, including 4 data logger readings.
A complete overview of existing display codes (DDD) appears from a separate document (5512-593).
Please contact Kamstrup for further details.

Note: One data reading can collect up to 36 monthly data and up to 15 yearly data. The number of yearly and monthly data which can be displayed is determined by the DDD-code.

3.4.1 Energy overview

The above-mentioned energy types E1 to E9 are calculated as follows:

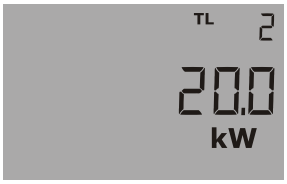
Formula	Example of application	
E1=V1(T1-T2)	Heat energy (V1 in flow or return)	**Legal** Display/Data/Log
E2=V2(T1-T2)	Heat energy (V2 in return)	Display/Data/Log
E3=V1(T2-T1)	Cooling energy (V1 in flow or return)	**Legal** Display/Data/Log
E4=V1(T1-T3)	Forward energy	Display/Data/Log
E5=V2(T2-T3)	Return energy or tap from return	Display/Data/Log
E6=V2(T3-T4)	Tap water energy, separate	Display/Data/Log
E7=V2(T1-T3)	Return energy or tap from flow	Display/Data/Log
E8=m3*T1	(Flow)	Display/Data/Log
E9=m3*T2	(Return)	Display/Data/Log

3.5 ›EE‹ Configuration of MULTI-TARIFF

MULTICAL® 801 has 2 extra registers, TA2 and TA3, which can accumulate heat energy E1 (EE=20 accumulates volume) parallel with the main register based on the limits programmed for tariff limits TL2 and TL3.

Example: EE=11 (Power tariff)

TA2 shows energy consumed... ...above the power limit TL2



EE=	TARIFF TYPE	FUNCTION	Delivery code	Delivery code	Delivery code	Delivery code	Delivery code	Delivery code	Delivery code
00	No active tariff	No function							
11	Power tariff	Energy is accumulated in TA2 and TA3 based on the power limits in TL2 and TL3.	•	•	•				
12	Flow tariff	Energy is accumulated in TA2 and TA3 based on the flow limits in TL2 and TL3.	•	•	•				
13	T1-T2 tariff	Energy is accumulated in TA2 and TA3 based on the Δt-limits in TL2 and TL3.	•	•	•				
14	Flow temperature tariff	Energy is accumulated in TA2 and TA3 based on the tF-limits in TL2 and TL3.	•	•	•				
15	Return temperature tariff	Energy is accumulated in TA2 and TA3 based on the tR-limits in TL2 and TL3.	•	•	•				
19	Time controlled tariff	TL2=Start time for TA2 TL3=Start time for TA3	•	•	•				
20	Heat/cooling volume tariff (TL2 and TL3 are not used)	Volume (V1) is divided into TA2 for heat (T1>T2) and TA3 for cooling (T1<T2). (Recommended for heat/cooling applications)				•	•	•	
21	PQ-tariff	Energy if P>TL2 is saved in TA2 and energy if Q>TL3 is saved in TA3	•	•	•				

See paragraph 6.9 for further details on the tariff registers.

3.6 ›FF‹ Input A (VA), pulse division ›GG‹ Input B (VB), pulse division

MULTICAL® 801 has 2 pulse inputs, VA and VB, which are placed on base module 1 (see paragraph 7.2 for further details). The inputs are individually 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						
FF	Max. input f ≤1Hz	**GG**	Max. input f ≤1 Hz	**Precounter**	**Wh/imp**	**l/imp**	**Measuring unit anddecimal point**	
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 anddecimal 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

3.7 ›MN‹ Configuration of leak limits

When MULTICAL® 801 is used for leak surveillance, the sensivity is determined by the configuration of "M-N".

District heating leak surveillance (V1-V2) Sensivity of leak search		**Cold water leak surveillance (VA)** Constant leakage at no consumption (pulse resolution 10 l/imp)	
M=		**N=**	
0	OFF	0	OFF
1	1.0% qp + 20% q	1	20 l/h 3x10 min. (30 min. without pulses)
2	**1.0% qp + 10% q**	**2**	**10 l/h 6x10 min. (1 hour without pulses)**
3	0.5% qp + 20% q	3	5 l/h 12x10 min. (2 hours without pulses)
4	0.5% qp + 10% q		

Note: M=2 and N=2 are default values when leak surveillance is used. Increased sensivity, e.g. M=4, can only be achieved using METERTOOL.

Info codes for leakage/burst are only active when M > 0 or N > 0 respectively.

3.8 Data for configuration

	Automatic	To be stated when ordering	Default
Series no. (S/N) and year	E.g. 5300000/2009	-	-
Customer No. Display No. 1 = 8 digits MSD Display No. 2 = 8 digits LSD	-	Up to 16 digits Limited to 11 digits depending on PcBase compatibility	Customer number = S/N
Target date	-	MM=1-12 and DD=1-28	Depends on delivery code
TL2	-	5 digits	0
TL3	-	5 digits	0
Average peak time	-	1…1,440 min	60 min.
Max. T1 for cooling metering	-	0.01…180°C	25°C at DDD=5xx and 6xx
T2 prog.		0.01…180°C	-
T3 prog.		0.01…180°C	5°C
T4 prog.		0.01…180°C	0°C
0°C	YYYY.MM.DD/hh.mm.ss GMT+offset according to country code	GMT ± 12.0 hours (30 min. in leaps)	-

Data registers for configuration of modules and functions

qp [l/h]	from CCC-table	-	-
Valve travel	-	20…500 sesec.	300 s.
Hysteresis	-	0.5…5 sek	0.5 s.
Primary data addr.			
Secondary data addr.			
Baud rate			
Reserved			
Reserved			
Reserved			
…..			
Reserved			

Reserved: These registers are prepared for later extensions of the functionality of the modules. Therefore, they have no actual designations yet.

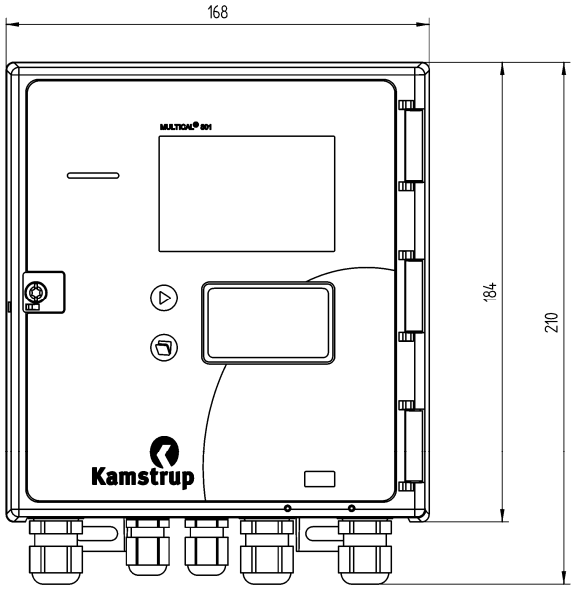
-COUNTRY CODES

Information on country codes see 55 14-170

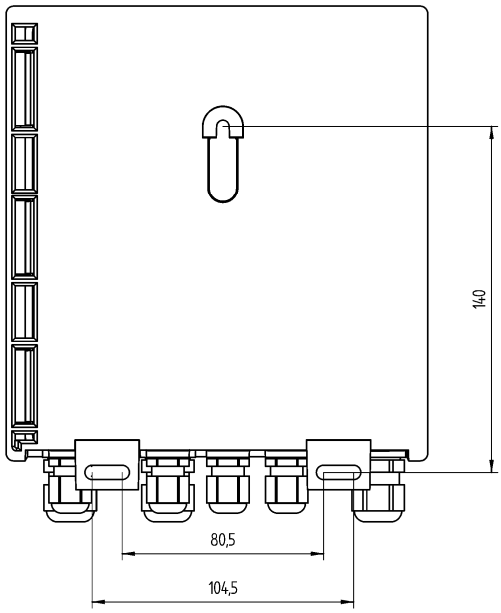
- MAINTENANCE

See instructions no. 55 08-709 concerning update of programming and configuration.

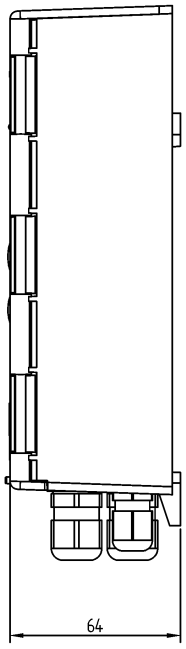
4 Dimensioned sketches



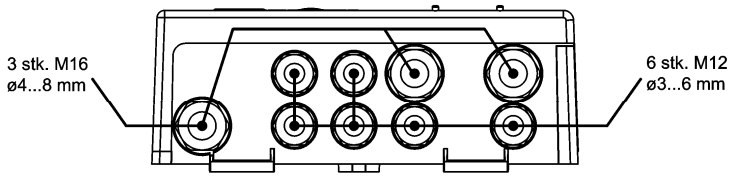
Front measurements of MULTICAL® 801



Installation measurements of MULTICAL® 801



Wallmounted MULTICAL® 801 seen from the side



Cable unions of MULTICAL® 801

All measurements in [mm]

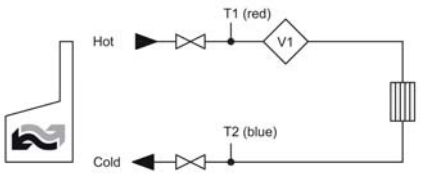
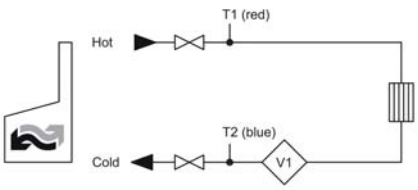
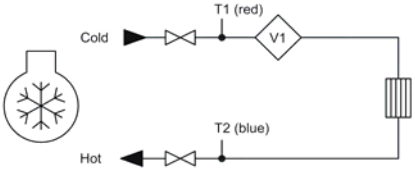
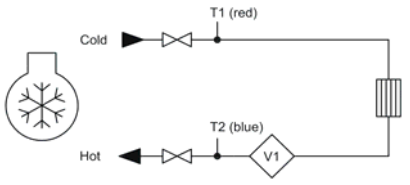
5 Installation

5.1 Mounting in forward or return pipe

Prog. number		A ☐
Flow sensor position		
k-factor table	- Forward (at T1)	3
	- Return (at T2)	4

MULTICAL® 801 is programmed for flow meter mounted in either forward or return pipe. The table below indicates installation conditions for:

- ♦ Heat meters
- ♦ Cooling meters
- ♦ Heat/cooling meters

Formula	k-factor	Prog.	Hot pipe	Cold pipe	Installation:
Heat meter E1=V1(T1-T2)k	k-factor for T1 in Inlet table	A=3 (Flow sensor in forward pipe)	V1 and T1	T2	
	k-factor for T2 in Outlet table	A=4 (Flow sensor in return pipe)	T1	V1 and T2	
Cooling meter E3=V1(T2-T1)k	k-factor for T1 in Outlet table	A=3 (Flow sensor in forward pipe)	T2	V1 and T1	
	k-factor for T2 in Inlet table	A=4 (Flow sensor in return pipe)	V1 and T2	T1	

5.2 EMC conditions

MULTICAL® 801 has been designed and CE-marked according to EN 1434 Class A and Class C (corresponding to Electromagnetic environment: Class E1 and E2 of the Measuring Instruments Directive) and can thus be installed in both domestic and industrial environments.

All control cables must be drawn separately and not parallel to e.g. power cables or other cables with the risk of inducing electromagnetic interference. There must be a distance of min. 25 cm between signal cables and other installations.

5.3 Climatic conditions

MULTICAL® 801 has been designed and approved for indoor installation in non-condensing environments with ambient temperatures from 5…55°C.

Furthermore, MULTICAL® 801 can also be installed in unheated rooms as the instrument is protected by self-heating.

Protection class IP67 allows short-term submergence, provided that all cable unions have been correctly mounted and that the plastic cover has been properly fastened.

5.4 Electrical installations

See paragraph 10

6 Calculator functions

6.1 Energy calculation

MULTICAL® 801 calculates energy on the basis of the formula stated in EN 1434-1:2007, which uses the international temperature scale issued in 1990 (ITS-90) and the pressure definition of 16 bar.

In a simplified form the energy calculation can be expressed as: Energy = V x ΔΘ x k.

The calculator always calculates energy in [Wh], and then converts the value to the selected measuring unit.

E [Wh] =	V x ΔΘ x k x 1000
E [kWh] =	E [Wh] / 1,000
E [MWh] =	E [Wh] / 1,000,000
E [GJ] =	E [Wh] / 277,780
E [Gcal] =	E [Wh] / 1163,100

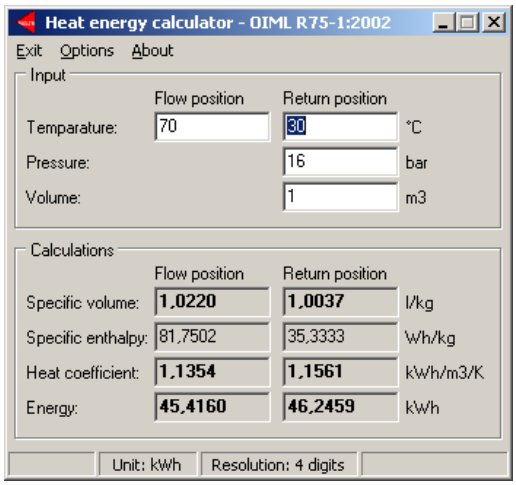
V is the added (or simulated) water volume in m^3. If e.g. the CCC-code = 119 is used, the calculator has been programmed to receive 100 imp./litre. If for instance 10,000 pulses are added, this corresponds to 10,000/100 = 100 litres or 0.1 m^3.

ΔΘ is he measured temperature difference, e.g. ΔΘ = forward temperature – return temperature. Please note that different temperatures are used for the calculation of ΔΘ as MULTICAL® 801 can calculate various different energy types. Both in the display and during data reading each energy type is uniquely defined, e.g.

Heat energy: E1 = V1(T1-T2)k

Cooling energy: E3 = V1 (T2-T1)k

k is the heat coefficient of water which is calculated on the basis of the formula stated in EN 1434-1:2007 (identical with the energy formula of OIML R75-1:2002). For checking the measurement Kamstrup can supply an energy calculator:

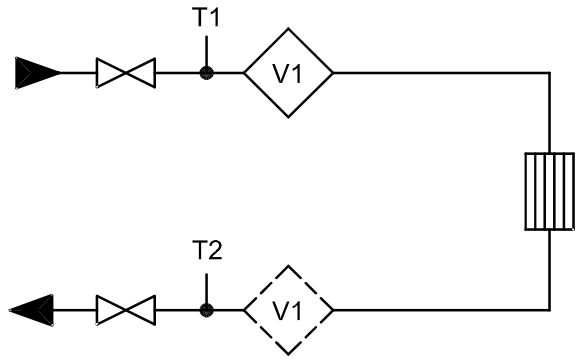


6.2 Application types

MULTICAL® 801 operates with 9 different energy formulas, E1...E9, which are all calculated parallel with each integration, no matter how the meter is configured.

6.2.1 E1...E7

Energy types E1...E7 are described by application examples below.



Application no. 1

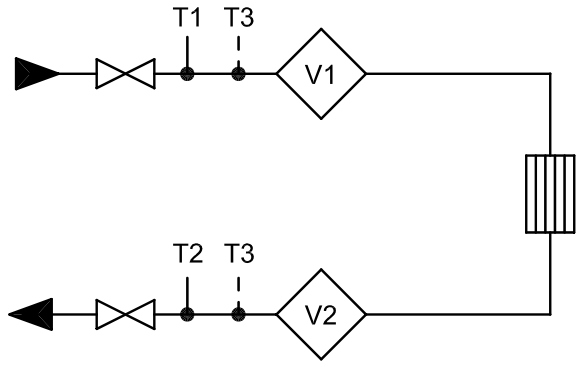
Closed thermal system with 1 flow meter

Heat energy: E1 = V1(T1-T2)$k_{T1:Forward\ or\ T2:Return}$

Cooling energy: E3 = V1(T2-T1)$k_{T1:Forward\ or\ T2:Return}$

Flow meter V1 is placed in flow or return as selected during PROG.

Mass: M1 = V1 (Kmass t1) or
Mass: M1 = V1 (Kmass t2) depending on Flow/Return programming.



Application no. 2

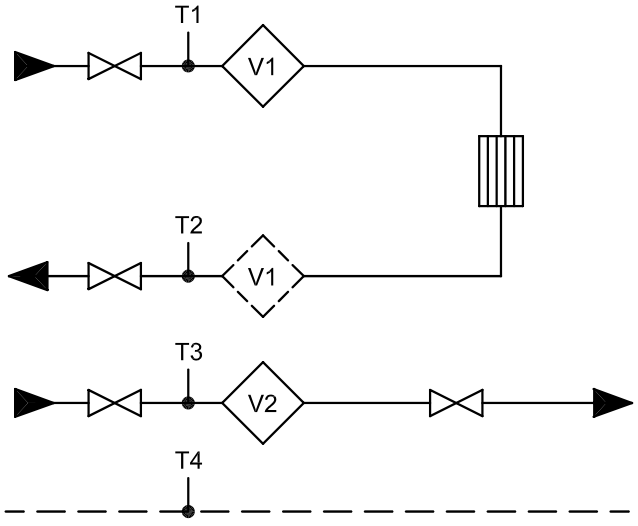
Closed thermal system with 2 identical flow meters

Billing energy: E1 = V1(T1-T2)$k_{T1:Flow}$

Control energy: E2 = V2 (T1-T2)$k_{T2:Return}$

T3 can be used for checking the measurement of either forward for return temperature, but T3 is not used for calculation.

Mass: M1 = V1 (Kmass t1)
Mass: M2 = V2 (Kmass t2)



Application no. 3

2-string system with 2 flow meters

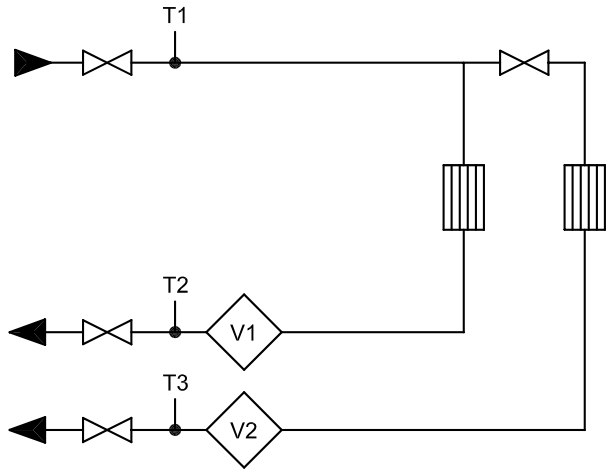
Heat energy: E1 = V1(T1-T2)$k_{T1:Forward\ or\ T2:Return}$

Tap water energy: E6 = V2 (T3-T4)$k_{T3:Flow}$

T3 is measured or programmed
T4 is programmed

Flow meter V1 is placed in flow or return as selected during PROG.

Mass: M1 = V1 (Kmass t1) or
Mass: M1 = V1 (Kmass t2) depending on flow/return programming.Mass: M2 = V2 (Kmass t3)*



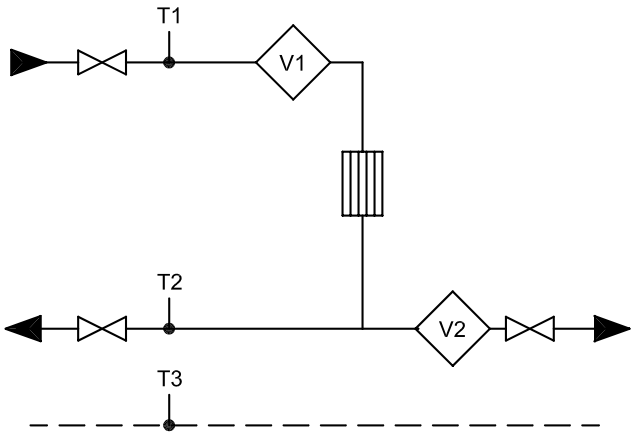
Application no. 4

2 heating circuits with joint forward pipe

Heat energy #1: $E1 = V1(T1-T2)k_{T2:Return}$

Heat energy #2: $E7 = V2(T1-T3)k_{T3:Return}$

T3 is measured or programmed
Mass: M1 = V1 (Kmass t1)
Mass: M2 = V2 (Kmass t3)*



Application no. 5

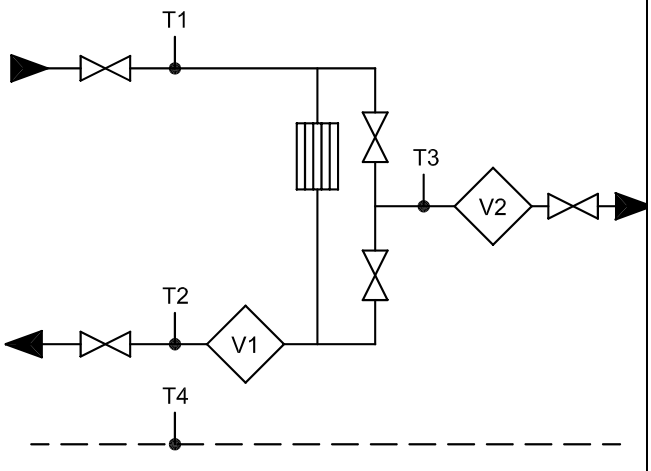
Open system with tapping from return pipe

Heat energy: $E1 = V1(T1-T2)k_{T1:Flow}$

Tap water energy: $E5 = V2\ (T2-T3)k_{T2:Flow}$

T3 is measured or programmed

Mass: M1 = V1 (Kmass t1)
Mass: M2 = V2 (Kmass t2)



Application no. 6

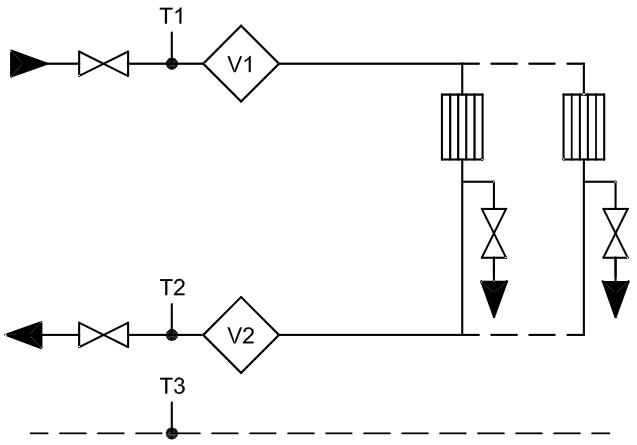
Open system with separate flow meter for tapping

Heat energy: $E1 = V1(T1-T2)k_{T2:Return}$

Tap water energy: $E6 = V2\ (T3-T4)k_{T3:Flow}$

T3 is measured or programmed
T4 is programmed

Mass: M1 = V1 (Kmass t1)
Mass: M2 = V2 (Kmass t3)*



Application no. 7

Open system with 2 flow meters

Forward energy: E4 = V1 (T1-T3)$k_{T1:Flow}$

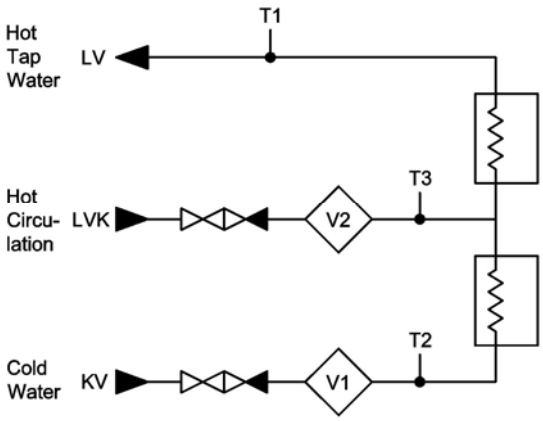
Return energy: E5 = V2 (T2-T3)$k_{T2:Flow}$

(ΔE = E4-E5 cannot be calculated by MULTICAL® 801)

Heat energy: E2 = V2 (T1-T2)$k_{T2:Return}$

T3 is measured or programmed

Mass: M1 = V1 (Kmass t1)
Mass: M2 = V2 (Kmass t2)

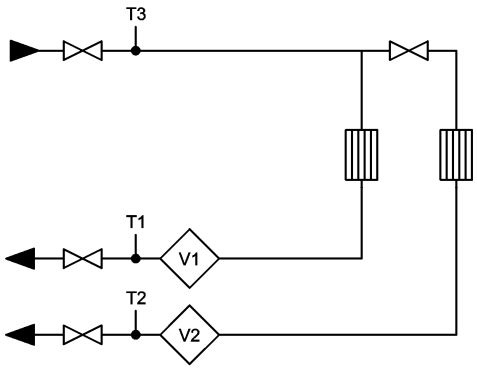


Application no. 8

Hot water boiler with circulation

Total consumption E1 = V1(T1-T2)$k_{T2:Return}$

Circulated consumption: E7 = V2(T1-T3)$k_{T3:Return}$



Application no. 9

2 cooling circuits with joint forward pipe

Cooling energy #1: E4 = V1 (T1-T3)$k_{T1:Flow}$

Cooling energy #2: E5 = V2 (T2-T3)$k_{T2:Flow}$

* M2 = V2 (Kmass t3)* only with delivery codes (930…939)!

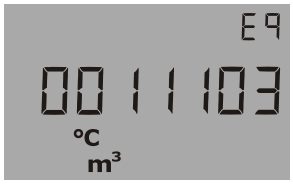
6.2.2 E8 and E9

E8 and E9 is used as a basis for calculation of volume-based average temperatures in forward and return pipes respectively. With every integration (every 0.01 m^3 for qp 1.5 m^3/h) the registers are accumulated by the product of $m^3 \times °C$, which makes E8 and E9 a suitable basis for calculation of volume-based average temperatures.

E8 and E9 can be used for average calculation during any period of time as long as the volume register is read at the same time as E8 and E9.

E8= $m^3 \times$ tF E8 is accumulated by the product of $m^3 \times tF$

E9= $m^3 \times$ tR E9 is accumulated by the product of $m^3 \times tR$



Resolution of E8 and E9

E8 and E9 depend on the resolution of volume (m^3)

Volume resolution	Resolution of E8 and E9
0000.001 m^3	$m^3 \times °C \times 10$
00000.01 m^3	$m^3 \times °C$
000000.1 m^3	$m^3 \times °C \times 0{,}1$
0000001 m^3	$m^3 \times °C \times 0{,}01$

Example 1 After a year a heating installation has consumed 250.00 m^3 district heating water and the average temperatures have been 95°C for flow and 45°C for return.
E8 = 23750 and E9 = 11250.

Example 2 The average temperatures must be measured together with the yearly reading.,Therefore E8 and E9 are included in the yearly reading.

Date of reading	Volume	E8	Average of forward pipe	E9	Average of return pipe
2003.06.01	534.26 m^3	48236		18654	
2002.06.01	236.87 m^3	20123		7651	
Yearly consumption	297.39 m^3	28113	28113/297.39 **= 94.53°C**	11003	11003/297.39 **= 36.99°C**

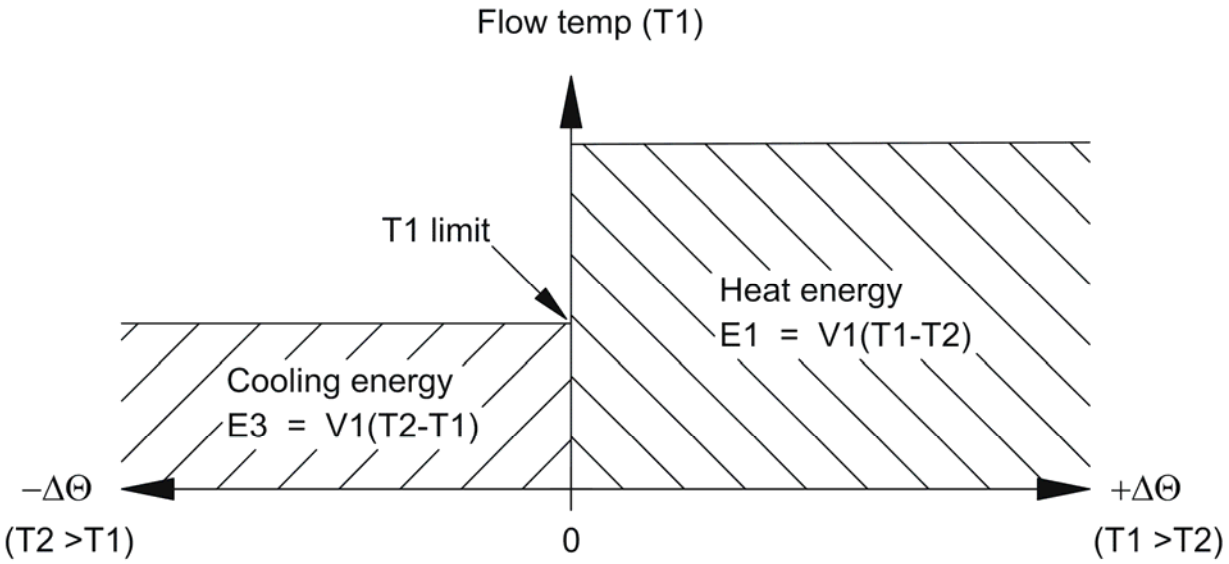
Table 1

6.3 Combined heat/cooling metering

MULTICAL® 801 is available as heat meter (meter type 2xx), cooling meter (meter type 5xx) or combined heat/cooling meter (meter type 6xx).

Meter type	
Heat meter, closed systems (MID)	2
Heat meter, closed systems	4
Cooling meter	5
Heat/cooling meter	6
Volume meter, hot water	7
Volume meter, cooling water	8
Energy meter, open systems	9
Delivery code (language on label etc.)	XX

If MULTICAL® 801 has been supplied as a combined heat/cooling meter, heat energy (E1) is measured at positive temperature difference (T1 › T2) whereas cooling energy (E3) is measured at negative temperature difference (T2 › T1). Temperature sensor T1 (with a red type sign) must be installed in the hydraulic forward pipe whereas T2 is installed in the return pipe.



The temperature point “T1 limit” is used as a ”filter” for cooling measurement in the way that only cooling is measured when the current forward temperature T1 is below T1 limit.

T1 limit is configurable in the temperature range 0.01...180.00°C.

In combined heat/cooling meters T1 limit ought to correspond to the highest occurring forward temperature in connection with cooling, e.g. 25°C. If the meter is to be used for ”purchase and sale of heat”, T1 limit is adjusted to 180.00°C, which cancels the T1 limit function.

The change between heat and cooling measurement involves no hysteresis (ΔT1 limit = 0.00K).

6.4 Flow measurement V1 and V2

MULTICAL® 801 calculates current water flow according to two different principles depending on the connected flow meter type:

• Quick volume pulses (CCC > 100)

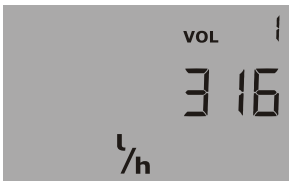
The current water flow for quick volume pulses, without average determination, is calculated as the number of volume pulses per 10 sec. multiplied by the scaling factor.

q = (Imp./10 sec. x flow factor)/65535 [l/h] or [m³/h]

Example:

- ULTRAFLOW qp 1.5 m³/h with 100 imp./l (CCC=119), flow factor = 235926
- Current water flow = 317 l/h, corresponding to 88 Imp./10 sec.

q = (88 x 235926)/65535 = 316.8 which is displayed as 316 [l/h]



Current water flow in V1

• Slow volume pulses (CCC = 0XX)

The current water flow of slow volume pulses (typically from flow meters with reed contact) is calculated without average determination as a scaling factor divided by the duration between two volume pulses.

q = flow factor/(256 x period of time in sec.) [l/h] or [m³/h]

Example:

- Mechanical flow meter Qn 15 qp m³/h with 25 l/imp. (CCC=021), flow factor = 230400
- Current water flow = 2.5 m³/h, which corresponds to 36 sec. of the duration between 2 pulses
  q = 230400 /(256 x 36) = 25 which is displayed as 2.5 [l/h]

V1 and V2 must be the same type (either quick (CCC › 100) or slow (CCC=0XX)) but can have different qp-codings (CCC).

6.5 Power measurement, V1

MULTICAL® 801 calculates current power based on the current water flow and the temperature difference measured at the latest integration on the basis of the following formula:

P = q (T1 – T2) x k [kW] or [MW]

"k" being the heat coefficient of water, which is currently calculated by MULTICAL® 801 according to EN 1434:2007.

Example:

- Current water flow, q = 316 l/h and flow meter mounted in return pipe
- T1 = 70.00°C and T2 = 30.00°C, k-factor is calculated at 1.156 kWh/m^3/K

P = 0.316 (70-30) x 1.156 = 14.6 [kW]

Current power in V1

Both heat and cooling power is displayed numerically (without signs)

6.6 Min. and max. flow and power, V1

MULTICAL® 801 registers minimum and maximum flow and power on both monthly and 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. registrations include the following flow and power 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 of a number of current flow or power measurements respectively. 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.

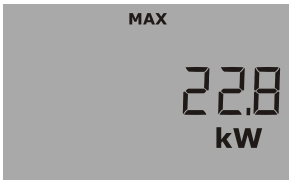
At the end of a year and a month the max. and min. values are saved in the data logger, and the current max. and min. registers are "reset" according to the selected target date and the meter's internal clock and calendar.

"Reset" is made by setting the max. value to zero and the min. value to 10000,0 kW at e.g. CCC=119.

If the max. or min. registration is used for accounting purposes, we recommend that the clock setting is checked in connection with the installation as well as once a year. Furthermore, the back-up battery of MULTICAL® 801 ought to be replaced at intervals of max. 10 years.

Date of year-to-date max.

Value of year-to-date max.



Date of this month's min.

Value of this month's min.

6.7 Temperature measurement

MULTICAL® 801 is fitted with a high-resolution analog/digital converter which measures the temperatures T1, T2 and T3 with a resolution of 0.01°C. The same measuring circuit is used for all three temperature inputs in order to obtain the lowest possible measuring error of the temperature difference. Prior to each temperature measurement the internal measuring circuit is automatically adjusted on the basis of built-in reference resistors at 0°C and 100°C respectively. Very accurate measurements and an almost immeasurable long-term stability is hereby obtained.

Current T1

MULTICAL® 801 measures all temperatures every 10 seconds if supply voltage is connected. If the supply voltage is disconnected and the meter is driven by the backup battery, temperature measurements are carried out with every integration (energy calculation), not at shorter intervals than 10 sec. however.

The temperature range of the measuring circuit is 0.00°C...185.00°C. For disconnected temperature sensor 200.00°C is shown and for short-circuited temperature sensor 0.00°C is displayed. In both cases the info code for sensor error will appear.

In order to reduce the influence of hum which can e.g. be picked up in long sensor cables, double measurements with a timing difference of half a period of time are carried out, and the average of the two measurements is the temperature measurement used for calculation and the one displayed. The hum suppression is optimized to either 50 Hz or 60 Hz depending on the selected country code.

6.7.1 Measuring current and power

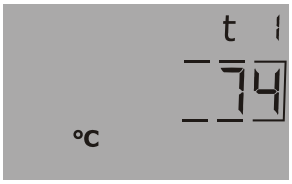
Measuring current is only sent through the temperature sensors during the short duration of the temperature measurement. The effective power which is deposited in the sensor elements is thus very small, and its influence on the self-heating of the temperature sensors is typically less than 1/1000 K.

	Pt100	Pt500
Measuring current	< 3 mA	< 0.5 mA
Peak power	< 1.5 mW	< 0.2 mW
RMS influence	< 10 µW	< 1 µW

6.7.2 Average temperatures

MULTICAL® 801 currently calculates the average temperatures of forward and return pipes (T1 and T2) in °C without decimals, and the background calculations E8 and E9 (m^3 x T1 and m^3 x T2) are carried out with every energy calculation (e.g. with every 0.01 m^3 if the meter size is qp 1.5), whereas the display is updated every 24 hours. The average temperatures are thereby volume weighted and can therefore be used for check purposes directly.

Type of registration	*Average*	*Yearly data*	*Monthly data*
Year-to-date average (since latest target date)	•	•	
Month-to-date average (since latest target date)	•		•



Year-to-date average for T1

(Current date with a stipulated line under year or month is shown immediately BEFORE this reading)

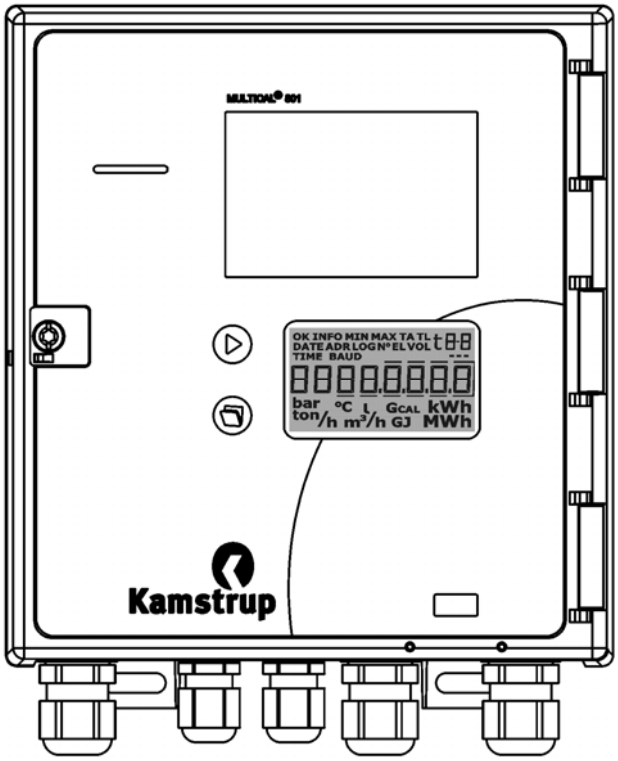
6.7.3 Preprogrammed temperatures

Temperatures T3 and T4 can be programmed into the calculator's memory, whereby these temperatures can be used for energy calculation with fixed temperature reference, as used in the calculations of the energy types E4, E5, E6 and E7 (see application drawings in paragraph 6.2)

The temperatures can be entered from the factory or by means of METERTOOL, in the range 0.01…180°C, after installation.

6.8 Display functions

MULTICAL® 801 is fitted with an easily readable LC-display, including 8 digits, measuring units and information field. For energy and volume indication 7 digits (8 digits, however, for programming the biggest flow meter types) and the corresponding measuring units are used, whereas 8 digits are used for indication of e.g. meter number and serial number.
Basically accumulated energy is displayed. Activating the pushbuttons the display reacts at once by calling up other indications. The display automatically returns to energy indication 4 minutes after the latest activation of the pushbuttons.



6.8.1 Primary and secondary indications

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

The bottom pushbutton is used to collect secondary information on the primary indication selected.

Example: If the selected primary indication is "heat energy", the secondary indications will be yearly data and monthly data for heat energy.

Heat energy E1 in MWh

Yearly data, date of LOG1 (latest yearly reading)

Yearly data, value of LOG1 (latest yearly reading)

Monthly data, date of LOG1 (latest monthly reading)

6.8.2 Display structure

The below-mentioned diagram shows the display structure with up to 20 primary readings as well as a series of secondary readings under most primary indications. The number of secondary readings in connection with yearly and monthly data has been determined under the DDD-code. In the absence of other information with the order, readings will consist of 2 yearly data and 12 monthly data. The target date will be the standard date applying to the delivery code used.

As the display is configured to the customer's need (selecting the DDD-code) the display will most frequently include much fewer indications than listed below.

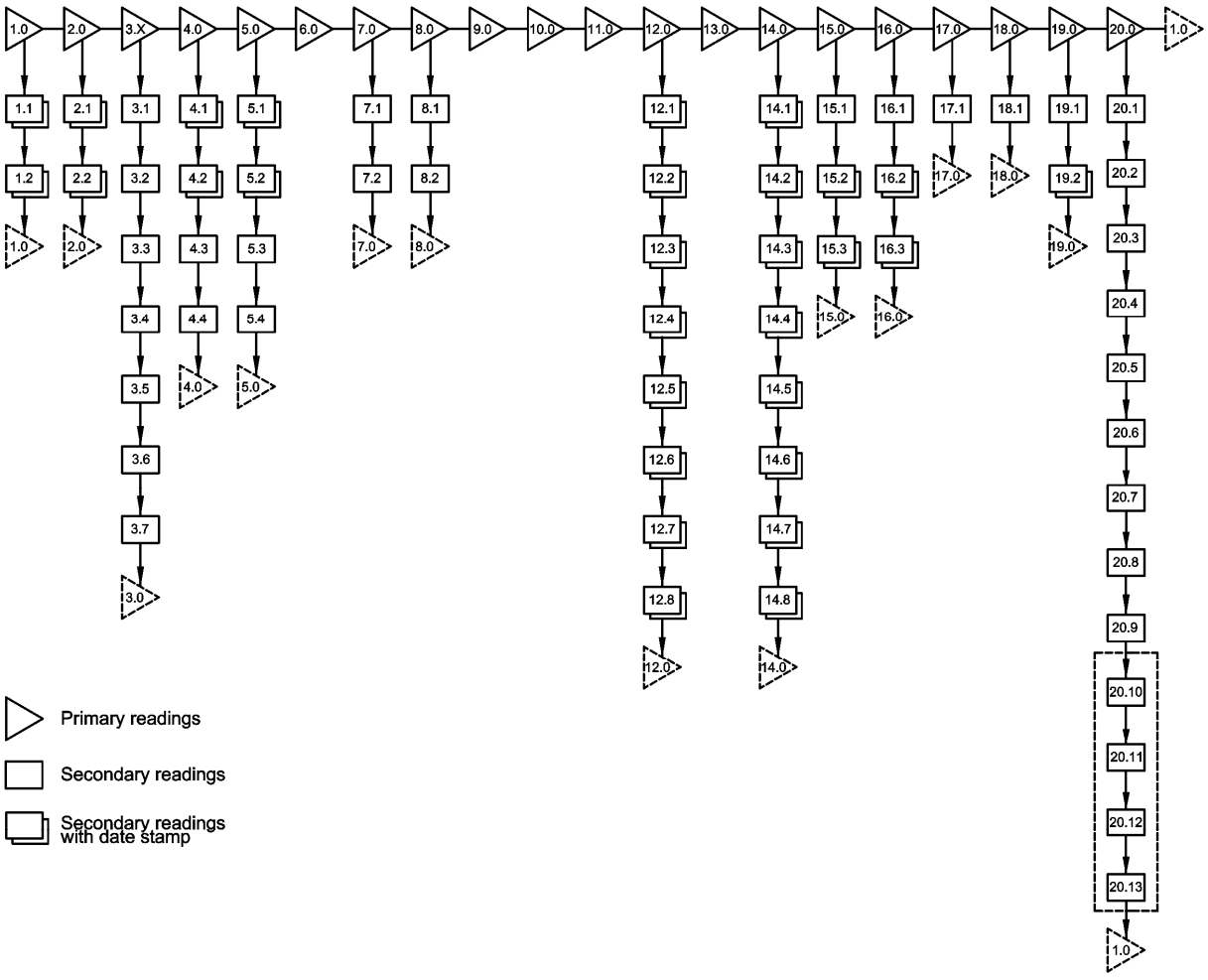


Figure 2

6.8.3 Display grouping

MULTICAL® 801 can be configured for many different applications, which creates the need for different display groups. The table below includes possible indications [•] of heat meters, cooling meters etc., indications supported by date stamp as well as the indications, to which the display automatically reverts 4 min. after the latest activation of the pushbuttons [1•]. (The paragraph is only used for creation of DDD-codes).

				Date Stamp	Heat meter DDD=4xx	Cooling meter DDD=5xx	Heat/cooling DDD=6xx	Heatvolume DDD=7xx	Cold volume DDD=8xx	Heat meter DDD=9xx
1.0	**Heat energy (E1)**				**1 •**		**1 •**			•
		1.1	*Yearly data*	•	•		•			•
		1.2	*Monthly data*	•	•		•			•
2.0	**Cooling energy (E3)**					**1 •**	•			•
		2.1	*Yearly data*	•		•	•			•
		2.2	*Monthly data*	•		•	•			•
										•
3.X	**Other energy types**	*3.1*	*E2*							•
		3.2	*E4*							•
		3.3	*E5*							•
		3.4	*E6*							•
		3.5	*E7*							•
		3.6	*E8 (m3*tf)*		•					•
		3.7	*E9 (m3*tr)*		•					•
4.0	**Volume V1**				•	•	•	**1 •**	**1 •**	•
		4.1	*Yearly data*	•	•	•	•	•	•	•
		4.2	*Monthly data*	•	•	•	•	•	•	•
		4.3	*Mass 1*		•	•	•	•	•	•
		4.4	*P1*		•	•	•	•	•	•
5.0	**Volume V2**							•	•	•
		5.1	*Yearly data*	•				•	•	•
		5.2	*Monthly data*	•				•	•	•
		5.3	*Mass 2*					•	•	•
		5.4	*P2*					•	•	•
6.0	**Hour counter**				•	•	•	•	•	•
7.0	**T1 (Flow)**				•	•	•			•
		7.1	*Year-to-date average*		•	•	•			•
		7.2	*Month-to-date average*		•	•	•			•
8.0	**T2 (Return)**				•	•	•			•
		8.1	*Year-to-date average*		•	•	•			•
		8.2	*Month-to-date average*		•	•	•			•
9.0	**T1-T2 (Δt) - = cooling**				•	•	•			•
10.0	**T3**				•	•	•			•
11.0	**T4 (prog.)**									•
12.0	**Flow (V1)**				•	•	•	•	•	•
		12.1	*This year's max.*	•	•	•	•	•	•	•
		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*	•	•	•	•	•	•	•
		12.7	*This month's min.*	•	•	•	•	•	•	•
		12.8	*Min. monthly data*	•	•	•	•	•	•	•
13.0	**Flow (V2)**				•			•	•	•
14.0	**Power (V1)**				•	•	•			•
		14.1	*This year's max.*	•	•	•	•			•
		14.2	*Max. yearly data*	•	•	•	•			•
		14.3	*This year's min.*	•	•	•	•			•
		14.4	*Min. yearly data*	•	•	•	•			•
		14.5	*This month's max.*	•	•	•	•			•
		14.6	*Max. monthly data*	•	•	•	•			•
		14.7	*This month's min.*	•	•	•	•			•
		14.8	*Min. monthly data*	•	•	•	•			•

				Date Stamp	Heat meter DDD=4xx	Cooling meter DDD=5xx	Heat/cooling DDD=6xx	Heatvolume DDD=7xx	Cold volume DDD=8xx	Heat meter DDD=9xx
15.0	**VA (Input A)**				•	•	•	•	•	•
		15.1	*Meter No. VA*		•	•	•	•	•	•
		15.2	*Yearly data*	•	•	•	•	•	•	•
		15.3	*Monthly data*	•	•	•	•	•	•	•
16.0	**VB (Input B)**				•	•	•	•	•	•
		16.1	*Meter No. VB*		•	•	•	•	•	•
		16.2	*Yearly data*	•	•	•	•	•	•	•
		16.3	*Monthly data*	•	•	•	•	•	•	•
17.0	**TA2**				•	•	•			
		17.1	*TL2*		•	•				
18.0	**TA3**				•	•	•			
		18.1	*TL3*		•	•				
19.0	**Info Code**				•	•	•	•	•	•
		19.1	*Info event counter*		•	•	•	•	•	•
		19.2	*Info logger (36 latest events)*	•	•	•	•	•	•	•
20.0	**Customer No. (N° 1+2)**				•	•	•	•	•	•
		20.1	*Date*		•	•	•	•	•	•
		20.2	*Hour*		•	•	•	•	•	•
		20.3	*Target date*		•	•	•	•	•	•
		20.4	*Serial no.* **(N° 3)**		•	•	•	•	•	•
		20.5	*Prog. (A-B-CCC-CCC)* **(N° 4)**		•	•	•	•	•	•
		20.6	*Config 1 (DDD-EE)* **(N° 5)**		•	•	•	•	•	•
		20.7	*Config 2 (FF-GG-M-N)* **(N° 6)**		•	•	•	•	•	•
		20.8	*Software edition* **(N° 10)**		•	•	•	•	•	•
		20.9	*Software check sum* **(N° 11)**		•	•	•	•	•	•
		20.10	*Segment test*		•	•	•	•	•	•
		20.11	*Module 1* **(N° 30)**		•	•	•	•	•	•
		20.12	*Module 2* **(N° 40)**		•	•	•	•	•	•
		20.13	*Module 3 (External)* **(N° 50)**		•	•	•	•	•	•

Display example showing the PROG number.

A total survey of existing display codes (DDD) appear from a separate document.
Please contact Kamstrup for further details.

6.9 Info codes

MULTICAL® 801 constantly monitors a series of important functions. If there is a serious error in measuring system or installation, a flashing “info” will appear in the display until the error has been corrected. The ”Info” field flashes 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.

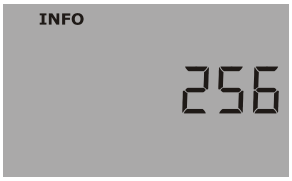
6.9.1 Examples of info codes in the display

Example: 1

Flashing ”info”

If the information code exceeds 000, a flashing “info” will appear in the information field.

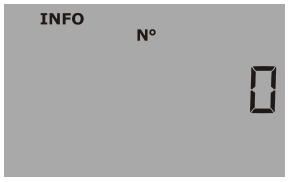
Example: 2



Current information code

Activating the top (primary) pushbutton several times, the current information code is displayed

Example: 3



Info event counter

- shows how many times the information code has been changed.

Example: 4

Info logger

Pushing the bottom pushbutton once more, the data logger for iinormation code is shown.
First the date of the latest change is shown...

...then the information code set on this date is displayed. In this case it has been a ”burst alarm” on 4 January 2006.

The data logger saves the latest 50 changes. 3The latest 36 changes can be displayed. All 50 changes can be read by means of METERTOOL. Alle 50 ændringer kan aflæses med METERTOOL.

Furthermore the info code is saved in the programmable logger, in the daily logger, in the monthly logger and in the yearly logger for diagnosis purposes.

6.9.2 Info code types

Info Code	Description	Response time
0	No irregularities	-
1	Supply voltage has been interrupted	-
8	Temperature sensor T1 outside measuring range	1…10 min
4	Temperature sensor T2 outside measuring range	1…10 min
32	Temperature sensor T3 outside measuring range	1…10 min
64	Leak in cold water system	24 hours
256	Leak in heating system	24 hours
512	Burst in heating system	120 s.

	ULTRAFLOW® X4 info (must be activated CCC=4XX)	
16	Flow meter V1 communication error, signal too weak or wrong flow direction	After reset and 24 hours (at 00:00)
1024	Flow meter V2 communication error, signal too weak or wrong flow direction	After reset and 24 hours (at 00:00)
2048	Flow meter V1 wrong pulse figure	After reset and 24 hours (at 00:00)
128	Flow meter V2 wrong pulse figure	After reset and 24 hours (at 00:00)
4096	Flow meter V1, signal too weak (air)	After reset and 24 hours (at 00:00)
8192	Flow meter V2, signal too weak (air)	After reset and 24 hours (at 00:00)
16384	Flow meter V1 wrong flow direction	After reset and 24 hours (at 00:00)
32768	Flow meter V2 wrong flow direction	After reset and 24 hours (at 00:00)

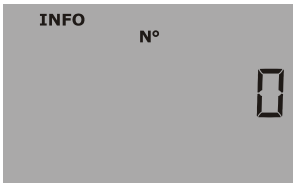
If several info codes appear at the same time, the sum of the info codes is displayed. If e.g. both temperature sensors are outside measuring range, info code 12 is displayed.

During factory configuration the individual info codes are set active or passive, meaning that a standard heat meter which does not use T3 cannot set info code 32.

6.9.3 Transport mode

When the meter leaves the factory it is in transport mode, whereby 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. When the meter has accumulated the volume register the first time after the installation, the info code automatically becomes active.

6.9.4 Info event counter



Info event counter

Increment with each change of the info code.

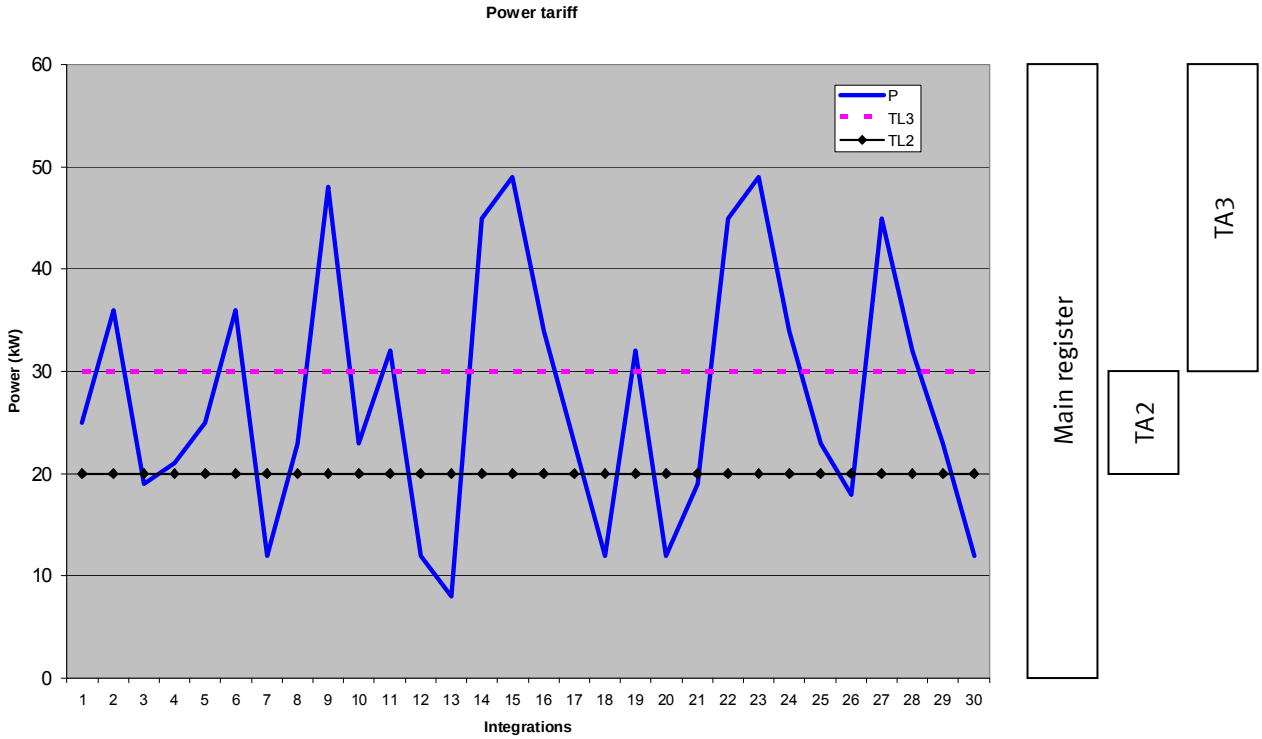
The info event counter of a new meter will be 0 as "transport mode" prevents counting during transportation.

Info code	"info" in display	Registration in info, daily, monthly or yearly logger	Counting of Info event
1	Yes	Yes	With each "main power" On/Off
4, 8, 32	Yes	Yes	When Info 4, 8, 32 is set or removed. Max. 1 per temperature measurement
64, 256	Yes	Yes	When Info is set and when Info is deleted. Max. once a day
512	Yes	Yes	When Info is set and when Info is deleted. Max. once every 120 s.
16, 128, 1024, 2048, 4096, 8192, 16384, 32768	Yes	Yes	When Info is set and when Info is deleted. Max. once a day

6.10 Tariff functions

MULTICAL® 801 has 2 extra registers TA2 and TA3, which can accumulate heat energy (EE=20 accumulates volume) parallel with the main register, based on a programmed tariff condition. Irrespective of the selected tariff form, the tariff registers are named TA2 and TA3 in the display. The tariff function can only be used for heat energy (E1).

The main register is always accumulated as it is considered legal billing register, no matter the selected tariff function. Tariff conditions TL2 and TL3 are monitored with each integration. If the tariff conditions are fulfilled, consumed heat energy is accumulated in either TA2 or TA3 parallel with the main register.

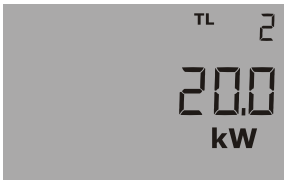


2 tariff conditions, TL2 and TL3, which are always used in the same tariff type, are connected to each tariff function. However, it is not possible to “mix” 2 tariff types.

Example: EE=11 (Power tariff)

TA2 shows energy consumed...

...above power limit TL2 (but below TL3)



6.10.1 Tariff types

The below-mentioned table lists the tariff types, for which MULTICAL® 801 can be configured:

EE=	TARIFF TYPE	FUNCTION
00	No active tariff	No function
11	Power tariff	Energy is accumulated in TA2 and TA3 on the basis of the power limits programmed for TL2 and TL3.
12	Flow tariff	Energy is accumulated in TA2 and TA3 on the basis of the flow limits programmed for TL2 and TL3.
13	T1-T2 tariff	Energy is accumulated in TA2 and TA3 on the basis of the Δt-limits programmed for TL2 and TL3.
14	Flow temperature tariff	Energy is accumulated in TA2 and TA3 on the basis of the tF-limits programmed for TL2 and TL3.
15	Return temperature tariff	Energy is accumulated in TA2 and TA3 on the basis of the tR-limits programmed for TL2 and TL3.
19	Time controlled tariff	TL2=Start time for TA2 TL3=Start time for TA3
20	Heat/cooling volume tariff (TL2 and TL3 are not used)	Volume (V1) is divided into TA2 for heat (T1>T2) and TA3 for cooling (T1<T2) provided that T1 is below T1 limit.
21	PQ-tariff	Energy if P>TL2 is saved in TA2 and energy if Q>TL3 is saved in TA3

EE=00 No active tariff

If not the tariff function is going to be used, select the setup EE=00.

The tariff function can, however, at a later stage be made active by means of reconfiguration with METERTOOL for MULTICAL® 801. See section 14 METERTOOL.

EE=11 Power controlled tariff

If the current power exceeds TL2 but is lower than or equal to TL3, heat energy is counted in TA2 parallel to the main register. If the current power exceeds TL3, heat energy is counted in TA3 parallel to the main register.

P < TL2	Accumulation in main register only	TL3 > TL2
TL3 ≥ P > TL2	Accumulation in TA2 and main register	
P > TL3	Accumulation in TA3 and main register	

Setting up data TL3 must always include a higher value than TL2. The power controlled tariff is e.g. used as a basis for the individual heat consumer's connection fee. Furthermore, this tariff type can provide valuable statistical data if the heating station considers new construction activities.

EE=12 Flow controlled tariff

If the current water flow exceeds TL2 but is lower than or equal to TL3, heat energy is counted in TA2 parallel to the main register. If the current water flow exceeds TL3, heat energy is counted in TA3 parallel to the main register. Setting up data TL3 must always include a higher value than TL2.

q < TL2	Accumulation in main register only	TL3 > TL2
TL3 ≥ P > TL2	Accumulation in TA2 and main register	
q > TL3	Accumulation in TA3 and main register	

The flow controlled tariff is e.g. used as a basis for the individual heat consumer's connection fee. Furthermore, this tariff type can provide valuable statistical data if the heating station considers new construction activities.

If either power or flow tariff is used you obtain an overview of the total consumption compared to the part of the consumption used above tariff limit.

EE=13 T1-T2 tariff (Δt)

If the current T1-T2 (Δt) is lower than TL2 but exceeds TL3, heat energy is counted in TA2 parallel to the main register. If the current cooling falls below or is equal to TL3, heat energy is counted in TA3 parallel with the main register.

Δt > TL2	Accumulation in main register only	TL3 < TL2
TL3 < Δt < TL2	Accumulation in TA2 and main register	
Δt ≤ TL3	Accumulation in TA3 and main register	

Setting up tariff limits TL3 must always be lower than TL2.

The T1-T2 tariff can be used as a basis for weighted user charge. Low Δt (small difference between forward and return temperatures) is uneconomical for the heat supplier.

EE=14 Forward tariff

If the current forward temperature (T1) exceeds TL2 but is lower than or equal to TL3, heat energy is counted in TA2 parallel to the main register. If the current forward temperature exceeds TL3, heat energy is counted in TA3 parallel to the main register.

T1 < TL2	Accumulation in main register only	TL3 > TL2
TL3 ≥ P > TL2	Accumulation in TA2 and main register	
T1 > TL3	Accumulation in TA3 and main register	

Setting up data TL3 must always include a higher value than TL2.

The forward temperature tariff can be used as a basis for billing consumers who are guaranteed a certain forward temperature. If the "guaranteed" minimum temperature is entered as TL3, the payable consumption is accumulated in TA3.

EE=15 Return temperature tariff

If the current return temperature (T2) exceeds TL2 but is lower than or equal to TL3, heat energy is counted in TA2 parallel to the main register. If the current return temperature exceeds TL3, heat energy is counted in TA3 parallel to the main register.

T2 < TL2	Accumulation in main register only	TL3 > TL2
TL3 ≥ T2 > TL2	Accumulation in TA2 and main register	
T2 > TL3	Accumulation in TA3 and main register	

Setting up data TL3 must always be bigger than TL2.

The return temperature tariff can be used as a basis for weighted user charge. A high return temperature indicates insufficient heat utilization which is uneconomical for the heat supplier.

EE=19 Time-controlled tariff

The time-controlled tariff is used for time division of the heat consumption. If TL2 = 08:00 and TL3 = 16:00, the daily consumption from 8 a.m. to 4 p.m. is accumulated in TA2, whereas the consumption during the evening and night from 16:01 to 07:59 will be accumulated in TA3.

TL2 must include a lower hour value than TL3.

TL 3 ≥ Clock ≥ TL2	Accumulation in TA2 and main register	TL3 > TL2
TL 2 > Clock > TL3	Accumulation in TA3 and main register	

The time tariff is suitable for billing in housing areas close to industrial areas with large district heating consumption as well as billing industrial customers.

The adjustment of the clock ought to be checked in order to secure correct time as a basis for the time tariff.

EE=20 Heat/cooling volume tariff

Heat/cooling volume tariff is used for division of volume into heat and cooling consumption. TA2 accumulates the volume consumed together with E1 (heat energy) and TA3 accumulates the volume consumed together with E3 (cooling energy).

T1 ≥ T2	Volume is accumulated in TA2 and V1	TL2 and TL3 are not used
T2 > T1 and T1 < T1 limit	Volume is accumulated in TA3 and V1	
T2 > T1 and T1 > T1 limit	Volume is accumulated in TA2 and V1	

For combined heat/cooling metering the total volume is accumulated in the register V1, whereas heat energy is accumulated in E1 and cooling energy in E3. The heat/cooling tariff is used for dividing the consumed volume into heat and cooling volume.

EE=20 ought always to be selected together with heat/cooling meters, type 67-xxxxxx-6xx.

EE=21 PQ tariff

The PQ tariff is a combined power and flow tariff. TA2 functions as power tariff and TA3 functions as flow tariff.

P ≤ TL2 and q ≤ TL3	Accumulation in main register only	TL2 = power limit (P) TL3 = flow limit (q)
P > TL2	Accumulation in TA2 and main register	
q > TL3	Accumulation in TA3 and main register	
P > TL2 and q > TL3	Accumulation in TA2, TA3 and main register	

The PQ tariff can e.g. be used for customers paying a fixed charge based on max. power and max. flow.

6.11 Data loggers

MULTICAL® 801 includes a permanent memory (EEPROM), in which the values from 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 ♦
Programmable data logger	1080 loggings (e.g. 45 days' hour loggings or 11 days' 15 min. loggings)	Counter register • *and* Current value #
Info logger	50 Events (36 Events can be displayed)	Info code and date

The loggers are static ones and the register types can therefore not be changed, the same applies to the logging intervals. When the last record has been written into the EEPROM the oldest one will be overwritten.

6.11.1 Yearly, monthly, daily loggers

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

Register type	Description	Yearlylogger	Monthly logger	Daily logger	Prog. logger
Date (YY.MM.DD)	Year, month and day for logging time	•	•	♦	•
E1	E1=V1(T1-T2) Heat energy	•	•	♦	•
E2	E2=V2(T1-T2) Heat energy	•	•	♦	•
E3	E3=V1(T2-T1) Cooling energy	•	•	♦	•
E4	E4=V1(T1-T3) Forward energy	•	•	♦	•
E5	E5=V2(T2-T3) Return energy or tap from return	•	•	♦	•
E6	E6=V2(T3-T4) Tap water energy, separate	•	•	♦	•
E7	E7=V2(T1-T3) Tap water energy from flow	•	•	♦	•
E8	E8=m3*T1 (flow)	•	•	♦	•
E9	E9=m3*T2 (return)	•	•	♦	•
TA2	Tariff register 2	•	•	-	
TA3	Tariff register 3	•	•	-	
V1	Volume register for Volume 1	•	•	♦	•
V2	Volume register for Volume 2	•	•	♦	•
VA	Extra water or electricity meter connected to Input A	•	•	♦	•
VB	Extra water or electricity meter connected to Input B	•	•	♦	•
M1	Mass corrected V1	-	-	♦	•
M2	Mass corrected V2	-	-	♦	•
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 MAX. FLOW V1	Date stamp for min. flow during period	•	•	-	
MIN. FLOW V1	Value for min. flow during period	•	•	-	
DATE FOR MAX. POWER V1	Date stamp for max. power during period	•	•	-	
MAX. POWER V1	Value of max. power during period	•	•	-	
DATE FOR MAX. POWER V1	Date stamp for min. flow during period	•	•	-	
MIN. POWER V1	Value for min. power during period	•	•	-	
T1avg	Time average of T1	-	-	♦	
T2avg	Time average of T2	-	-	♦	
T3avg	Time average of T3	-	-	♦	
P1avg	Time average of P1	-	-	♦	
P2avg	Time average of P2	-	-	♦	

dE (dV)	Differential energy (differential volume)	-	-	-	
cE (eV)	Check energy (Check volume)	-	-	-	
Operating hour counter	Accumulated number of operating hours	-	-	-	•
T1	Current value of T1	-	-	-	#
T2	Current value of T2	-	-	-	#
T3	Current value of T3	-	-	-	#
T4	Current value of T4	-	-	-	#
T1-T2 (Δt)	Current differential value	-	-	-	#
Flow (V1)	Current water flow of V1	-	-	-	#
Flow (V2)	Current water flow of V2	-	-	-	#
Power (V1)	Actual power	-	-	-	#
P1	Current pressure of flow	-	-	-	#
P2	Current pressure of return	-	-	-	#

6.11.2 Info logger

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

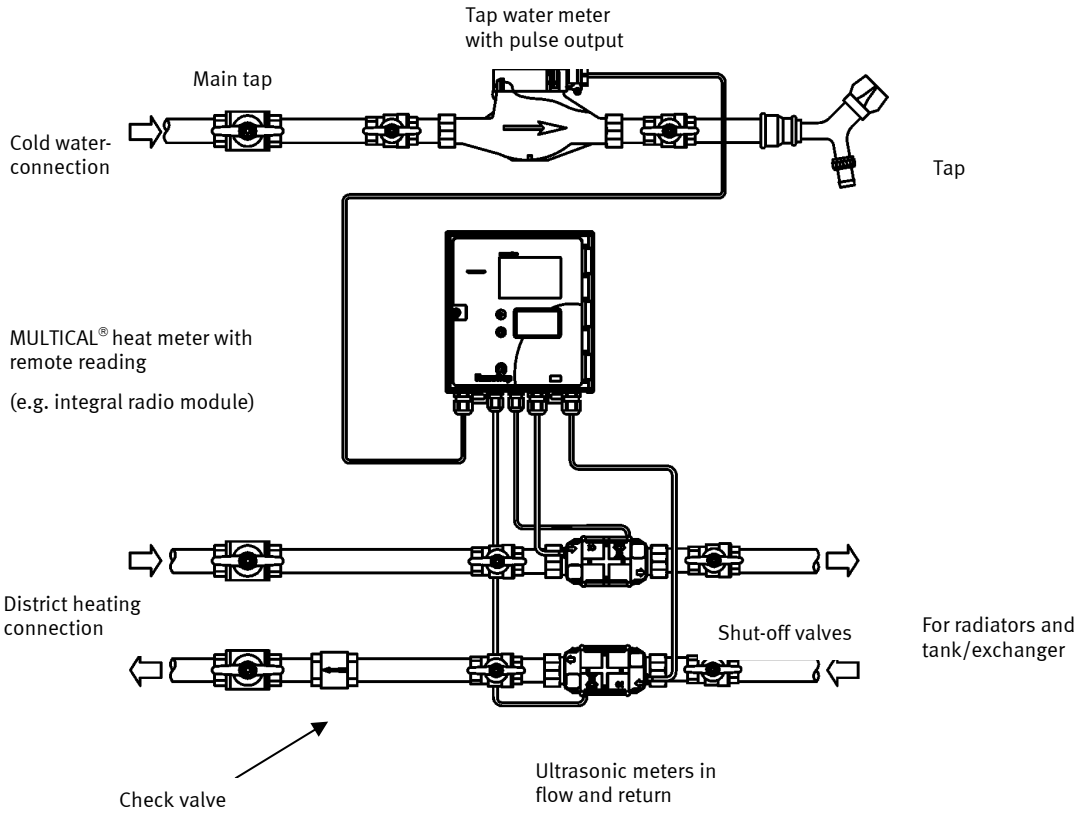
Register type	Description
Date (YY.MM.DD)	Year, month and day of logging time
info	Information code on above date

When the info logger is read in the display the latest 36 changes including dates can be read.

6.12 Leak surveillance

6.12.1 District heating system

The leak surveillance system is primarily used for direct connected district heating systems, i.e. systems without exchangers between the district heating network and the heating system of the house. The surveillance equipment consists of two ultrasonically based water meters placed in forward and return pipe respectively as well as temperature sensors in both pipes. Furthermore the electronics unit MULTICAL® 801, which calculates the heat energy and monitors the mass difference (temperature corrected volume) which can be found between forward and return pipe.



If a difference that exceeds 20% of the measuring range (corresponding to 300 l/h for a single-family house) is registered, an alarm will be sent within 120 sec. via remote communication.

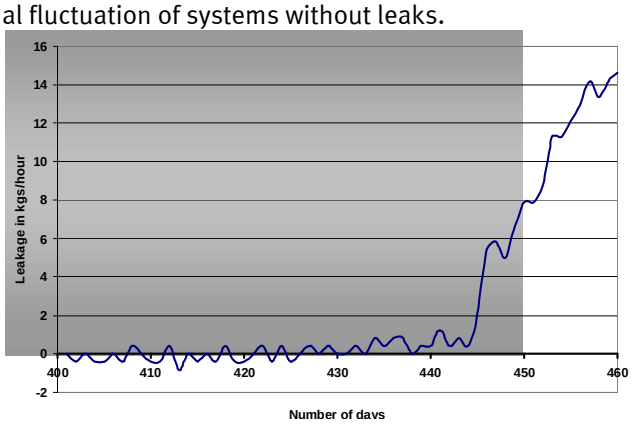
Small leaks from 15 kgs/h and upwards for qp 1.5 m^3/h are monitored on the basis of daily average in order to exclude erroneous alarms due to air pockets and quick flow changes from e.g. hot water exchangers.

District heating leak surveillance (V1-V2)	
M=	Sensivity of leak search
0	OFF
1	1.0% qp + 20% q
2	**1.0% qp + 10% q**
3	0.5% qp + 20% q
4	0.5% qp + 10% q

Note: M=2 is the default value when leak surveillance is used. Increased sensivity, e.g. M=4, can only be achieved by means of METERTOOL.

Info codes for leakage/burst are only active when M › 0 or N › 0 respectively.

Example: The below graph illustrates the difference between Mass V1 and Mass V2 during 60 days before the leakage of an under-floor heating pipe caused a leak alarm. During the first 43 days there is fluctuation of approx. ± 1 kg/h, which is the normal fluctuation of systems without leaks.



6.12.2 District heating burst

Every 30 seconds the current flow of the forward pipe is compared to that of the return pipe. If the difference exceeds 20% of the nominal flow at four successive measurements (120 sec.), info = 00512 is set and a "burst alarm" is sent via remote communication.

6.12.3 Cold water systems

In addition to the above-mentioned functions MULTICAL® 801 can be connected to the pulse signal from the cold water meter of the house. It can thus monitor the cold water consumption. Possible running cisterns, untight heating spirals of tap water tanks or other untightnesses will cause pulses to be received from the cold water meter 24 hours a day.
If MULTICAL® 801 does not register e.g. at least one continuous hour/day without pulses from the water meter, this implies a leakage in the water system and an alarm will be sent via remote communication.

Cold water leak surveillance (VA)	
N=	Constant leakage at no consumption (pulse resolution 10 l/imp)
0	OFF
1	20 l/h (30 min. without pulses)
2	**10 l/h (1 hour without pulses)**
3	5 l/h (2 hours without pulses)

Note: N=2 is the default value in connection with leak surveillance. Increased sensivity, e.g. N=3, can only be achieved by means of METERTOOL. Info codes for leakage/burst are only active when M > 0 eller N > 0 respectively.

6.12.4 Receipt of alarm messages

When the meter has registered a leak or burst it sends an alarm message to a receiving station, where incoming alarms are processed according to an encoded action pattern which is determined for each customer, e.g. starting with an SMS message to the customer's mobile phone parallel with the heating station on guard receiving the message. Regular data readings from MULTICAL® 801 to receiving station/control centre ensure that defective remote readings, if any, are detected.

6.12.5 Surveillance, but no automatic blocking

The leak surveillance system is based on installation at a big number of private district heating customers. Normally the individual district heating stations install and maintain leak surveillance as an integral part of the compulsory heat metering of all district heating customers in their area. Therefore, the individual private district heating customers need not take care of maintenance or other task of technical character in connection with the installed leak surveillance system, and the surveillance system must not involve increased risk of erroneous closing, which may lead to frost burst. Due to this fact the stability and reliability of the complete system must make 12 years operation without further maintenance possible. As neither thermically or electrically activated closing valves can be expected to have so long a lifetime it is not possible to use automatic closing.

6.12.6 First day after reset

The first day after the installation (the meter having been without supply voltage) no info codes will be sent or alarms set in case of a calculated district heating or cold water leak.

This limitation has been introduced in order to avoid erroneous alarms due to the installation and the shortened measuring period.

The alarm function can be tested via remote communication by pressing both pushbuttons at a time until "Call" is displayed.

6.13 Reset functions

6.13.1 Resetting the hour counter

The operating hour counter can be reset in connection with e.g. change of backup 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 district heating supplier must always be informed, inwhich meters the hour counter has been reset

In order to reset the operating hour counter switch off the supply voltage and disconnect the backup battery, then wait until the display goes blank.

Connect the backup battery whilst activating the top pushbutton for min. 10 sec. until e.g. energy is displayed.
Do not forget to switch on the supply voltage again. The operating hour counter has been reset.

Note: Resetting the hour counter involves that the meter's internal clock is initialized to 00:00:00 and 2000:01:01, and it is therefore necessary subsequently to adjust the clock by means of hand-held terminal or PC with METERTOOL.

6.13.2 Resetting data loggers

Separate reset of data loggers, info loggers, max. & min. logger (without resetting the legal registers) can only be carried out by means of METERTOOL. See paragraph 14 for further information.

6.13.3 Reset of all registers (total reset)

All legal and non-legal registers, including all data loggers, info logger, max. & min. logger can be reset by means of METERTOOL or a short-circuit pen if the verification seal is broken and the internal "total programming lock" is short-circuited.
Important! As the verification seal is broken, this reset must be carried out by competent laboratories/utility companies with authorization to reseal the meter!

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).

Note: "Date" is after reset set to 2000.01.01 and subsequently changed to current date/time 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 via METERTOOL.

6.13.4 Reset of all registers (with short-circuit pen)

The supply voltage (230 VAC or 24 VAC) is switched off, but the backup battery must be in working order. A short-circuit pen (type: 66-99-278) is used to break the seal and short-circuit the two contact points for approx. 10 sec., until CLR is displayed.

Figure 3
The short-circuit pen functions in ›back-up mode‹ as "Total reset" and ›with supply voltage‹ as "Total Prog"

Do not forget to switch on the supply voltage again.

Note: "Date" is after reset set to 2000.01.01. Therefore, do not forget to adjust date/time via hand-held terminal or PC with METERTOOL if correct time is important for the application in question.

7 Flow meter connection

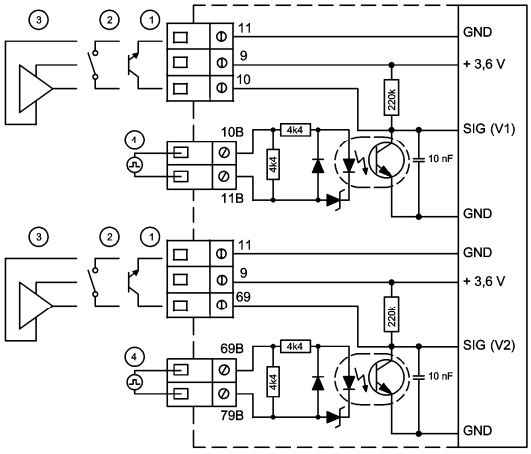
MULTICAL® 801 can be used with up to 4 pulse inputs, of which V1 and V2 are used for energy calculation and leak surveillance, whereas VA and VB are used to accumulating pulses from e.g. cold water meters and electricity meters.

V1 and V2 can either be used for quick pulses (CCC > 100) or slow pulses (CCC = 0XX). Quick and slow pulses cannot be used at a time.

7.1 Volume inputs V1 and V2

MULTICAL® 801 can be connected with one or two flow meters, depending on the required application. Typical heating installations with one flow meter is always connected to V1, no matter if this flow meter is installed in forward or return pipe.

Almost all available flow meter types with pulse output can be connected as the standard connection circuit can receive pulses from both electronic and mechanical meters.



Flow meter with transistor or FET output ①

The signal transmitter is normally an optocoupler with transistor or FET output. V1 is connected to terminals 10(+) and 11(-), V2 is connected to terminals 69(+) and 11(-). Terminal 9 is not used in this application.

The leak current of transistor or FET output must not exceed 1μA in OFF-state and it must be max. 0.4 V in ON-state.

A suitable CCC-kode with the same number of imp./litre as the flow sensor must be selected and for this flow meter type the CCC-code must be CCC > 100.

Example: CCC=147 is suitable for an electronic meter with 1 imp./litre and qp 150 m^3/h.

7.1.1 Flow meter with reed contact output ②

The transmitter is a reed contact, which is normally mounted on vane wheel and Woltmann meters, or a relay output from e.g. a magnetic inductive flow sensor. V1 is connected to terminals 10(+) and 11(-), V2 is connected to terminals 69(+) and 11(-). Terminal 9 is not used in this application.

The leak current must not exceed 1μA in OFF-state and it must be max. 10 kΩ in ON-state.

A suitable CCC-kode with the same number of litres/imp. as the flow sensor must be selected and for this flow meter type the CCC-code must be in the area 010 ≤ CCC ≤ 022.

Example: CCC=012 is suitable for a mechanical flow meter with 100 litres/imp. Flow meters with Qmax. in the range of 10...300 m^3/h can use this CCC-code.

7.1.2 Flow meter with active output, supplied through MULTICAL® ③

This connection is used together with both Kamstrup's ULTRAFLOW and Kamstrup's electronic pick-up units for vane wheel meters. The current consumption of these units is very low and furthermore adapted to the battery lifetime of MULTICAL®.

A suitable CCC-kode with the same number of imp./litre as the flow sensor must be selected and for this flow meter type the CCC-code must be CCC > 100.

Example: CCC=119 suits an electronic meter with 100 imp./litre and normally qp 1.5 m^3/h.

V1 and V2 is connected as shown in the table below.

	V1	V2
Red (3.6 V)	9	9
Yellow (signal)	10	69
Blue (GND)	11	11

Table 2

7.2 Flow meter with active 24 V pulse output ④

MULTICAL® 801 can be direct connected to "industrial" flow sensors with 24 V active pulse output on terminals 10B and 11B for V1 and terminals 69B and 79B for V2. If the only output of the flow meter used is a passive one, MULTICAL® 801's internal auxiliary supply on terminals 97A and 98A is used.

Technical data for the optoisolated pulse inputs

Pulse input voltage	12...32 V
Pulse current	Max. 12 mA at 24 V
Pulse frequency	Max. 128 Hz
Pulse duration:	Min. 3 msec.
Cable length V1 and V2	Max. 100 m (drawn with min. 25 cm distance to other cables)
Galvanic isolation	Inputs V1 (10B and 11B) and V2 (69B and 79B) are both individually isololated and isolated from MULTICAL®
Insulation voltage	2 kV

7.2.1 Connection examples

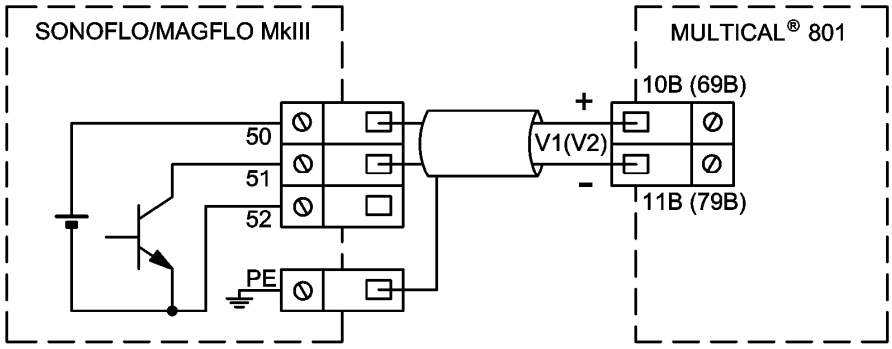


Figure 4

The active pulse output is direct connected to the galvanically separated flow sensor input. This permits a cable length of up to 100 m between flow sensor and calculator.

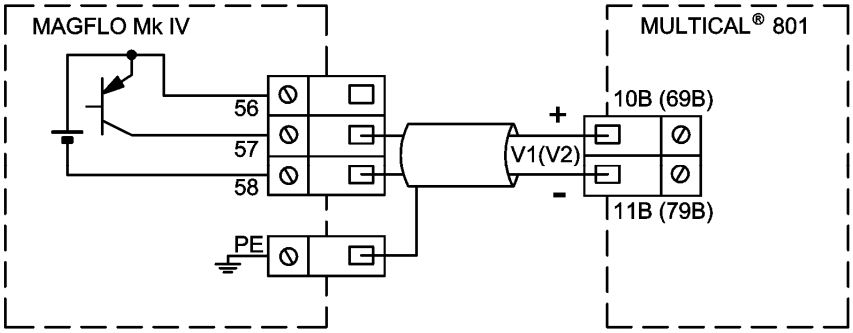
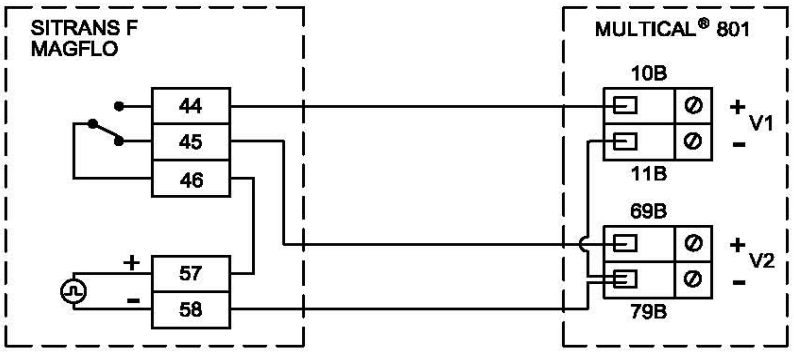


Figure 5

The active pulse output is direct connected to the galvanically separated flow sensor input. This permits a cable length of up to 100 m between flow sensor and calculator.



	Heat energy	Cooling energy
Same ΔΘ polarity	E2 = V2 (T1-T2)	E1 = V1 (T1-T2)
Changed ΔΘ polarity	E2 = V2 (T1-T2)	E3 = V1 (T2-T1)

Figure 6

The active pulse output is direct connected to the galvanically separated flow sensor input. This permits a cable length of up to 100 m between flow sensor and calculator.

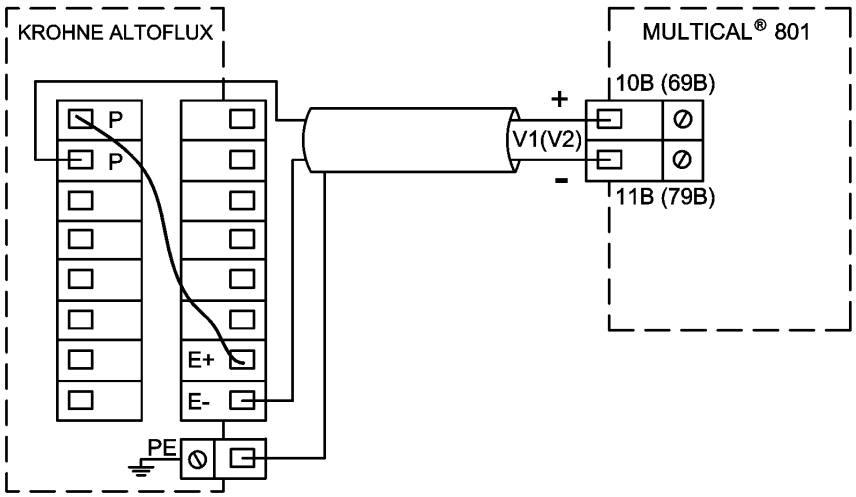


Figure 7

Auxiliary voltage from E+ and E- is added to the passive contact output P before the signal is connected to the galvanically separated flow sensor input. This permits a cable length of up to 100 m between flow sensor and calculator.

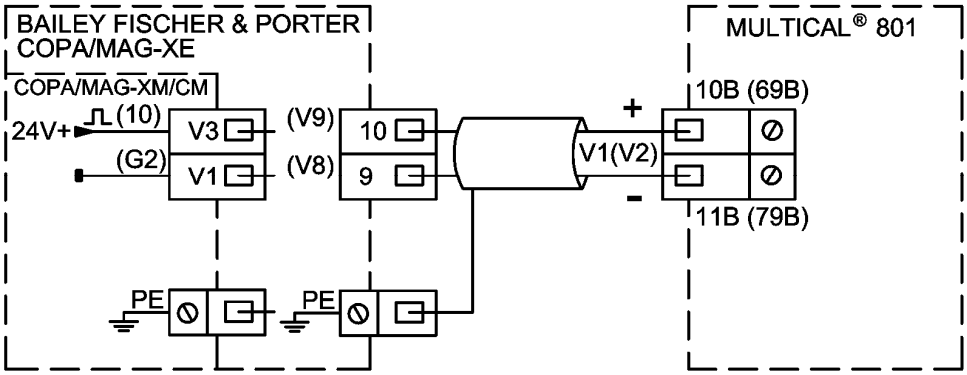


Figure 8

The active pulse output is direct connected to the galvanically separated flow sensor input. This permits a cable length of up to 100 m between flow sensor and calculator.

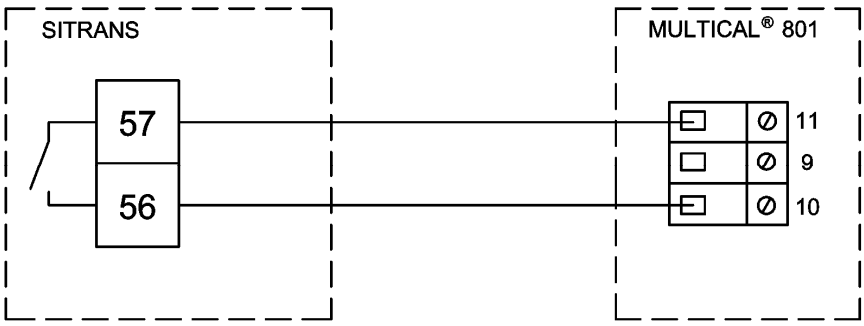


Figure 9

The passive contact output on terminals 56 and 57 is direct connected to the not galvanically separated flow meter input. This permits a cable length of max. 10-20 m between flow sensor and calculator.

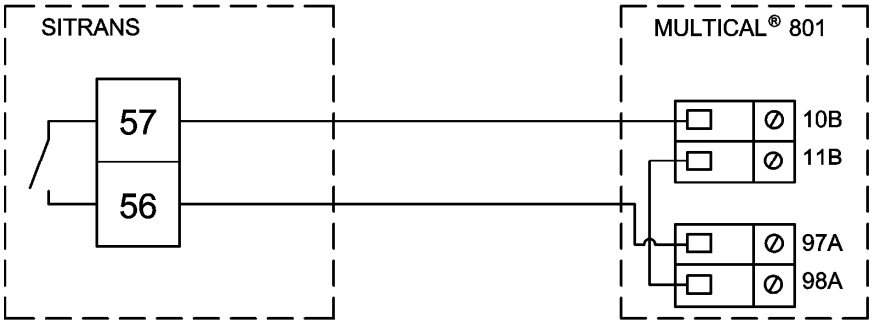


Figure 10

Auxiliary voltage from terminals 97A and 98A is added to the passive contact output on terminals 56 and 57 before the signal is connected to the galvanically separated flow sensor input. This permits a cable length of up to 100 m between flow sensor and calculator.

7.2.2 Flow meter coding

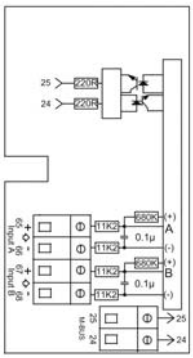
Installing the meter it is important that both flow sensor and MULTICAL® are correctly programmed. The below-mentioned table lists the most frequently used flow meter codes:

			Number of decimals in display										
CCC No.	Pre-counter	Flow factor	MWh Gcal	GJ	m³ [ton]	m³/h	MW	l/imp	Imp./l	Qp range [m³/h]	Qs [m³/h]	Type	Flow sensor
201	100	235926	2	1	1	1	2	1	1	10…100	75	FUS380 DN50-65	K-M
202	40	589815	2	1	1	1	2	2.5	0.4	40…200	240	FUS380 DN80-100	K-M
203	400	589815	1	0	0	1	2	2.5	0.4	100…400	500	FUS380 DN125	K-M
204	100	235926	1	0	0	0	1	10	0.1	150…1200	1600	FUS380 DN150-250	K-M
205	20	1179630	1	0	0	0	1	50	0.02	500…3000	3600	FUS380 DN300-400	K-M
206	100	2359260	0	x10	x10	0	1	100	0.01	1400…18000	36000	FUS380 DN500-1200	K-M

Table 3

7.3 Pulse outputs VA and VB

In addition to pulse inputs V1 and V2, MULTICAL® 801 has two extra pulse inputs, VA and VB, for collection and remote accumulation of pulses from e.g. cold water meters and electricity meters. The pulse inputs are physically placed in "Module 1" like e.g. in "M-Bus + pulse inputs" which can be placed in the connection bracket, but accumulation and data logging of values is carried out by the calculator.



Pulse inputs VA and VB function independently of the other inputs/outputs and are therefore not included in any energy calculation either.

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

Configuration for correct pulse value has been carried out from the factory on the basis of order information or is configured by means of METERTOOL. See paragraph 3.6 concerning configuration of VA (FF-codes and VB (GG-codes).

MULTICAL® 801 registers the accumulated consumption of the meters 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, by means of METERTOOL, be preset to the value of the connected meters at the time of commissioning.

7.3.1 Display example, VA

In the example below VA is configured as FF=24, which matches 10 litres/pulse and a max. flow of 10 m^3/h. The meter connected to VA has meter no. 75420145 which is saved in the internal memory of MULTICAL® 801 by means of METERTOOL.

Accumulated register of VA (Input A)

Meter no. of VA (max. 8 digits

Yearly data, date of LOG1 (latest target date)

Yearly data, value of LOG1 (latest yearly reading)

This is the accumulated volume registered on 1 January 2006

8 Temperature sensors

MULTICAL® 801 uses either Pt100 or Pt500 temperature sensors according to EN 60751 (DIN/IEC 751). A Pt100 or Pt500 temperature sensor respectively is a platinum sensor, of which the nominal ohmic resistance is 100.000 Ω and 500,000 Ω at 0.00°C and 138.506 Ω and 692,528 Ω at 100.00°C respectively. All ohmic resistance values are determined in the international standard IEC 751, applying to Pt100 temperature sensors. The ohmic resistance values of Py500 sensors are five times higher. The tables below include resistance values for each degree celcius in [Ω] for both Pt100 and Pt500 sensors:

Pt100										
°C	0	1	2	3	4	5	6	7	8	9
0	100,000	100,391	100,781	101,172	101,562	101,953	102,343	102,733	103,123	103,513
10	103,903	104,292	104,682	105,071	150,460	105,849	106,238	106,627	107,016	107,405
20	107,794	108,182	108,570	108,959	109,347	109,735	110,123	110,510	110,898	111,286
30	111,673	112,060	112,447	112,835	113,221	113,608	113,995	114,382	114,768	115,155
40	115,541	115,927	116,313	116,699	117,085	117,470	117,856	118,241	118,627	119,012
50	119,397	119,782	120,167	120,552	120,936	121,321	121,705	122,090	122,474	122,858
60	123,242	123,626	124,009	124,393	124,777	125,160	125,543	125,926	126,309	126,692
70	127,075	127,458	127,840	128,223	128,605	128,987	129,370	129,752	130,133	130,515
80	130,897	131,278	131,660	132,041	132,422	132,803	133,184	133,565	133,946	134,326
90	134,707	135,087	135,468	135,848	136,228	136,608	136,987	137,367	137,747	138,126
100	138,506	138,885	139,264	139,643	140,022	140,400	140,779	141,158	141,536	141,914
110	142,293	142,671	143,049	143,426	143,804	144,182	144,559	144,937	145,314	145,691
120	146,068	146,445	146,822	147,198	147,575	147,951	148,328	148,704	149,080	149,456
130	149,832	150,208	150,583	150,959	151,334	151,710	152,085	152,460	152,835	153,210
140	153,584	153,959	154,333	154,708	155,082	155,456	155,830	156,204	156,578	156,952
150	157,325	157,699	158,072	158,445	158,818	159,191	159,564	159,937	160,309	160,682
160	161,054	161,427	161,799	162,171	162,543	162,915	163,286	163,658	164,030	164,401
170	164,772	165,143	165,514	165,885	166,256	166,627	166,997	167,368	167,738	168,108

Pt100, IEC 751 Amendment 2-1995-07

Table 4

Pt500										
°C	0	1	2	3	4	5	6	7	8	9
0	500,000	501,954	503,907	505,860	507,812	509,764	511,715	513,665	515,615	517,564
10	519,513	521,461	523,408	525,355	527,302	529,247	531,192	533,137	535,081	537,025
20	538,968	540,910	542,852	544,793	546,733	548,673	550,613	552,552	554,490	556,428
30	558,365	560,301	562,237	564,173	566,107	568,042	569,975	571,908	573,841	575,773
40	577,704	579,635	581,565	583,495	585,424	587,352	589,280	591,207	593,134	595,060
50	596,986	598,911	600,835	602,759	604,682	606,605	608,527	610,448	612,369	614,290
60	616,210	618,129	620,047	621,965	623,883	625,800	627,716	629,632	631,547	633,462
70	635,376	637,289	639,202	641,114	643,026	644,937	646,848	648,758	650,667	652,576
80	654,484	656,392	658,299	660,205	662,111	664,017	665,921	667,826	669,729	671,632
90	673,535	675,437	677,338	679,239	681,139	683,038	684,937	686,836	688,734	690,631
100	692,528	694,424	696,319	698,214	700,108	702,002	703,896	705,788	707,680	709,572
110	711,463	713,353	715,243	717,132	719,021	720,909	722,796	724,683	726,569	728,455
120	730,340	732,225	734,109	735,992	737,875	739,757	741,639	743,520	745,400	747,280
130	749,160	751,038	752,917	754,794	756,671	758,548	760,424	762,299	764,174	766,048
140	767,922	769,795	771,667	773,539	775,410	777,281	779,151	781,020	782,889	784,758
150	786,626	788,493	790,360	792,226	794,091	795,956	797,820	799,684	801,547	803,410
160	805,272	807,133	808,994	810,855	812,714	814,574	816,432	818,290	820,148	822,004
170	823,861	825,716	827,571	829,426	831,280	833,133	834,986	836,838	838,690	840,541

Pt100, IEC 751 Amendment 2-1995-07

Table 5

8.1 Sensor types

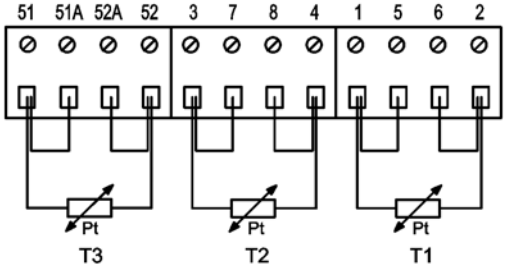
MULTICAL® 801 **Type 67-** □ □ □□ □ □

Pt500 sensor pair (2-wire sensors)	
No sensor pair	**0**
Pocket sensor pair with 1.5 m cable	**A**
Pocket sensor pair with 3.0 m cable	**B**
Pocket sensor pair with 5 m cable	**C**
Pocket sensor pair with 10 m cable	**D**
Short direct sensor pair with 1.5 m cable	**F**
Short direct sensor pair with 3.0 m cable	**G**
Set of 3 pocket sensors with 1.5 m cable	**L**
Set of 3 short direct sensors with 1.5 m cable	**Q3**

8.2 Cable influence and compensation

8.2.1 Two-wire sensor pair

MULTICAL® 801 is in standard version fitted with 4-wire sensor inputs for all three inputs, T1-T2-T3. Mostly only relatively short temperature sensor lengths are needed for small and medium-size heat meters, which means that 2-wire sensor sets can be used with advantage.



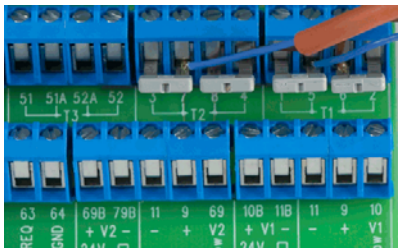


Figure 11

Connection of 2-wire sensors by means of jumpers (type: 66-99-209)

Cable lengths and cross sections of the two sensors which are used as temperature sensor pair for a heat meter must always be identical, and cable sensors must neither be shortened nor extended.

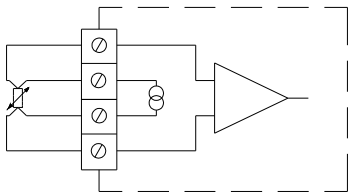
The limitations connected to the use of 2-wire sensor sets according to EN 1434-2 appear from the table below. Kamstrup supply Pt500 sensor sets with up to 10 m cable (2 x 0.25 mm²)

Cable cross section [mm²]	**Pt100 sensors**		**Pt500 sensors**	
	Max. cable length [m]	Temperature increase [K/m] *Copper @ 20 °C*	Max. cable length [m]	Temperature increase [K/m] *Copper @ 20 °C*
0,22	2,5	0,450	12,5	0,090
0,50	5,0	0,200	25,0	0,040
0,75	7,5	0,133	37,5	0,027
1,50	15,0	0,067	75,0	0,013

Table 6

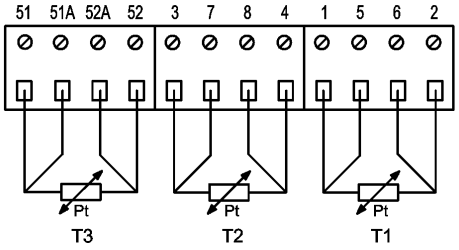
8.2.1 4-wire sensor pair

For installations requiring longer cables than listed in the table above we recommend the use of 4-wire sensor sets.

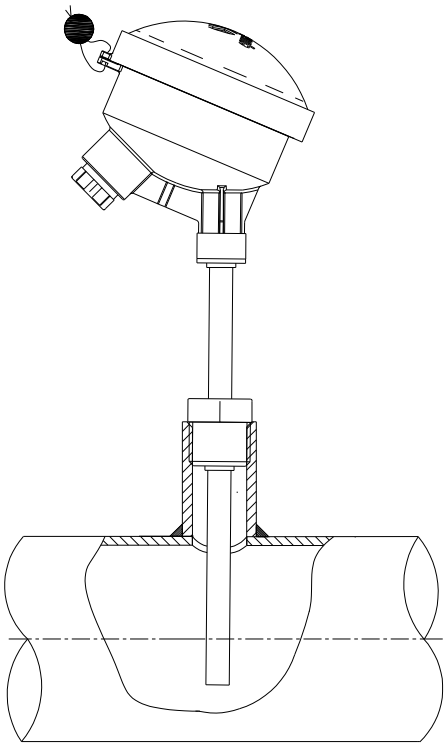


MULTICAL® 801 has a "real" 4-wire construction, which uses two conductors for measuring current and the two conductors for measuring signal, which means that the construction is in theory uninfluenced by long sensor cables. In practice cables ought not to be longer than 100 m and we recommend the use of 4 x 0.25 mm².

The connection cable ought to have an outer diameter of 5-6 mm in order to obtain optimum tightness of both MULTICAL® 801 and the screw-joint for the 4-wire sensor. The isolation material/cover of the cable ought to be selected on the basis of the maximum temperature in the installation. PVC cables are normally used up to 80°C and for higher temperatures silicone cables are often used.



Kamstrup's 4-wire sensor pair has a replaceable sensor insert and is available in lengths of 90, 140 and 180 mm.



8.3 Pocket sensors

The Pt500 cable sensor is constructed with 2-wire silicone cable and closed with a D 5.8 mm shrunk on stainless steel tube which protects the sensor element.

The steel tube is mounted in a sensor pocket (immersion pipe) which has an inner diameter of 6 mm and an outer diameter of 8 mm. Sensor pockets are available with R½ (conical ½") connection in stainless steel i lengths of 65, 90 and 140 mm. The sensor construction with separate immersion pipe permits replacement of sensors without having to switch off the flow. Furthermore, the wide range of immersion pipe lengths ensures that the sensors can be mounted in all existing pipe dimensions.

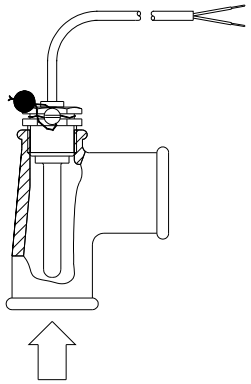


Figure 12

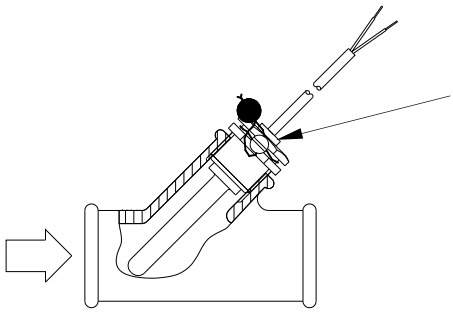


Figure 13

The stainless steel pockets can be used for mounting in PN25 systems!

8.4 Pt500 short direct sensor pair

The Pt500 short direct sensor has been constructed according to the European heat meter standard EN 1434-2. The sensor has been designed for direct mounting in the measuring medium, i.e. without sensor pocket, whereby a very fast response to temperature changes from e.g. domestic water exchangers is obtained.

The sensor is based on two-wire silicone cable. The sensor pipe is made of stainless stell and has a diameter of 4 mm at the point where the sensor element is placed. Furthermore, it can be direct mounted in many flow sensor types which reduces the installation costs.

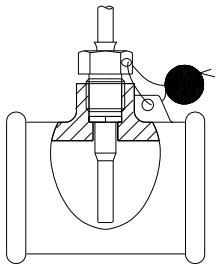


Figure 14

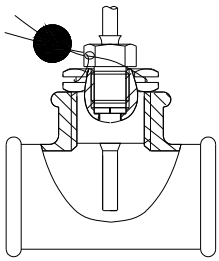


Figure 15

The sensor can be mounted in special T-sections which are available for ½", ¾" and 1" pipe installations.

In addition, the short direct sensor can be mounted by means of a R½ or R¾ for M10 nipple in a standard 90° tee.

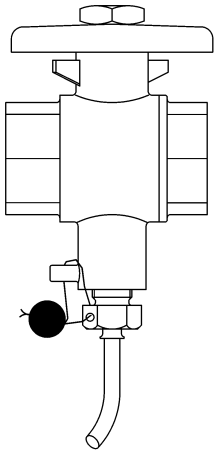


Figure 16

To obtain the best serviceability during meter replacement, the short direct sensor can be placed in a ball valve with a sensor connecting piece.

Ball valves with sensor connecting piece are available in G½, G¾ and G1

No.	6556-474	6556-475	6556-476
	G½	G¾	G1

Max. 130°C and PN16

9 Other connections

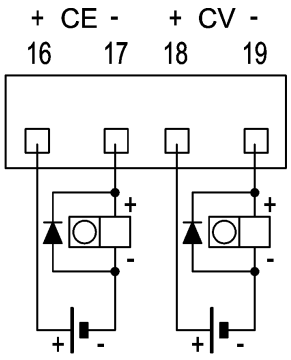
9.1 Pulse outputs CE and CV [16-19]

MULTICAL® 801 has pulse outputs for energy and volume pulses respectively. CE on terminals 16-17 releases one pulse per least significant digit in the energy count of the display and CV on terminals 18-19 releases one pulse per least significant digit in the volume count of the display.

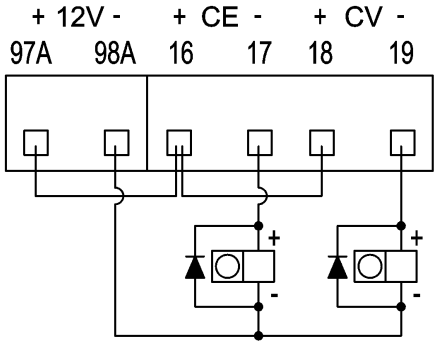
For CCC codes with 8-digit counter (e.g. CCC=206) energy pulses (GJ) and volume pulses (m3) will be generated with every least significant digit but one.

If a higher resolution of pulse outputs is required, a high resolution CCC code must be selected.

The pulse outputs are passive, optoisolated and tolerate 30 VDC and 10 mA. If active pulse outputs are required, the internal supply on terminals 97A-98A can be used.



Passive pulse outputs connected via external supply



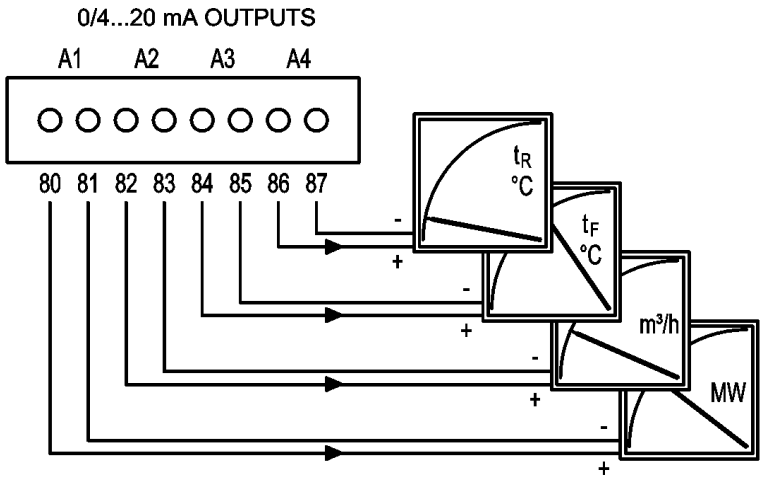
Active pulse outputs connected via internal supply

By means of the PC-programm METERTOOL you can choose between 32, 100 and 247 msec. in addition to the option of pulses for combined heat/cooling measurement (CE- and CV-).

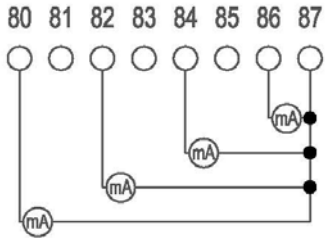
9.2 Analog outputs [80-87]

MULTICAL® 801 is available with 4 analog outputs. The outputs are active 0-20 mA or 4-20 mA, can be loaded with 0...500 Ω and are optoisolated in relation to the supply. The 4 analog outputs, however, are not mutually isolated.

Example of configuration of the analog outputs:



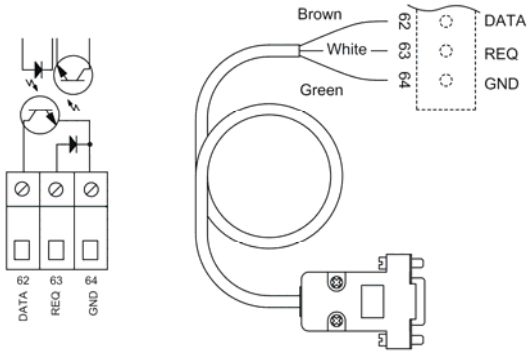
The analog outputs can be configured as power, flow (V1, V2), T1, T2, T3 or T1-T2, and also the measuring range can be configured. All relevant configurations can be set up from the factory or on site by means of METERTOOL.



The analog outputs can also be coupled with common frame.

9.3 Data connection [62-64]

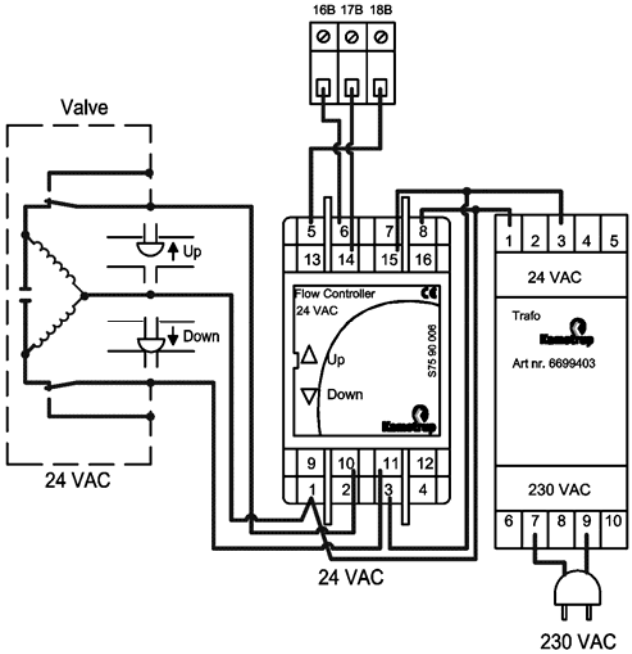
MULTICAL® 801 has data connection on terminals 62-63-64. The data connection is passive and optoisolated, as shown in the block diagram below. Adaption to RS 232 level is possible via data cable type 66-99-106. Adaption to USB is possible via data cable 66-99-098.



The data connection uses the KMP protocol. Please contact Kamstrup for further details on the KMP protocol.

9.4 Valve control [16B-18B]

MULTICAL® 801 has a built-in valve control, which makes it possible to automatically restrict power, flow, differential or return temperature to a preprogrammed limit.

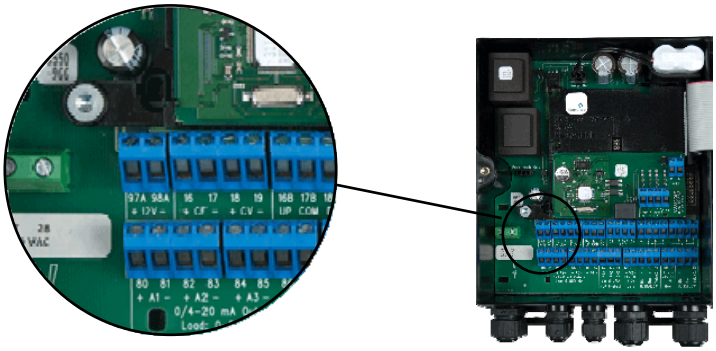


For further details about installation and setup you can order installation instructions 5512-497 .

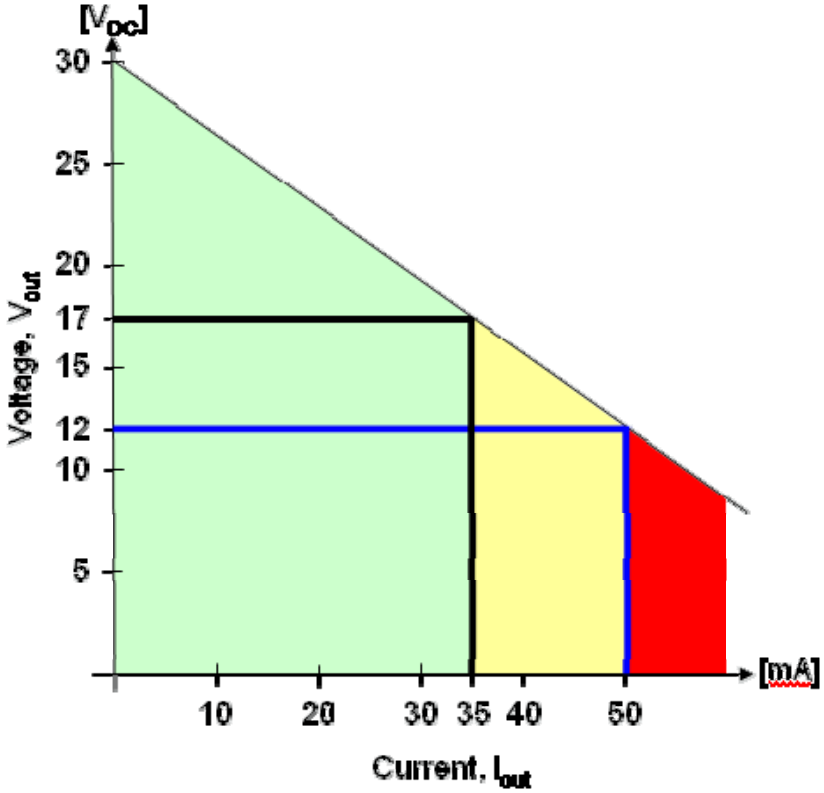
9.5 Auxiliary supply [97A-98A]

MULTICAL® 801 comprises a built-in auxiliary supply on terminals 97A-98A. The auxiliary supply is based on an unstabilized power supply. This means that the output voltage varies depending on load.
The output current must not exceed 50 mA and the nominal output current is 35 mA.

The auxiliary supply is suitable for e.g. supplying a Lon-module or a passive flow meter output.



The built in auxiliary supply is available on terminals 97A-98A.



The voltage on terminals 97A-98A varies according to load.

10 Power supply

MULTICAL® 801 is available for 24 VAC or 230 VAC supply voltage.

MULTICAL® 801	Type 67- □	□	□□	□
Supply				
230 VAC supply				**7**
24 VAC supply				**8**

As the connection PCB of MULTICAL® 801 is equipped with either a 24 VAC or a 230 VAC transformer, it is not possible to change the supply voltage of a previously supplied meter.

10.1 Built in battery backup

The built-in backup battery maintains all basic energy meter functions, including flow meter supply on terminal

11-**9**-10 (V1) as well as terminal 11-**9**-69 (V2) during power failure. The much current consuming functions such as back illumination of display and analog outputs are not supported by the battery backup.

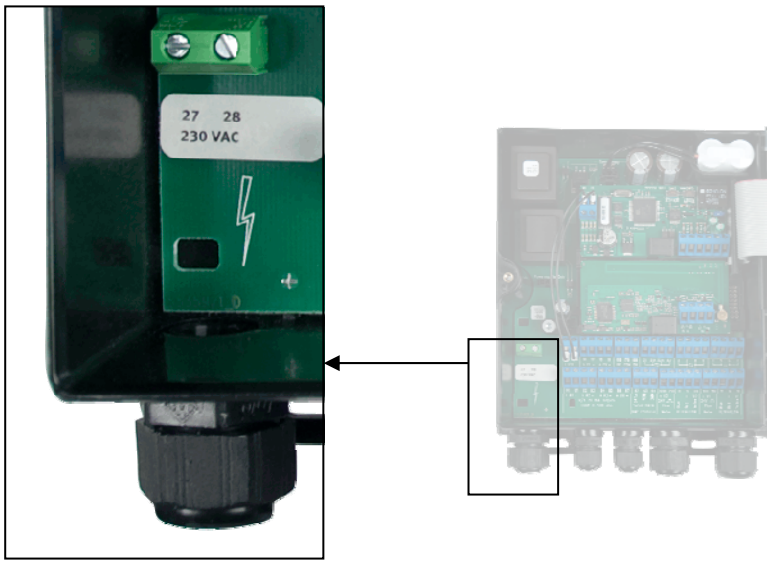
The type number of the backup battery is 66-99-619 (2xA lithium battery with plug)

The lifetime of the backup partly depends on how long MULTICAL® 801 remains without mains supply and partly of the temperature, to which the battery is exposed.

	Backup, expected lifetime	
	With supply	**Without supply**
MULTICAL® 801	10 years	1 year

10.2 230 VAC supply

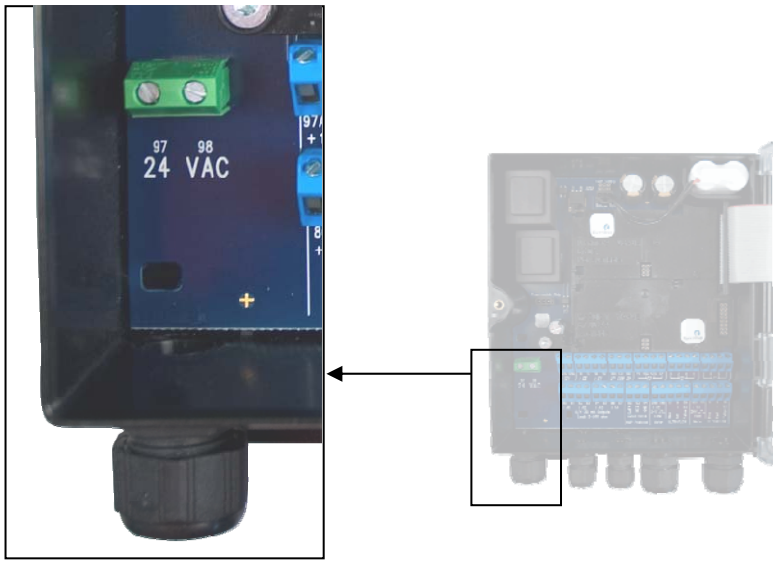
Includes a double-chamber safety transformer which fulfils the requirements to double-isolation. The power consumption is lower than 3 W (without analog outputs) or less than 9 W with analog outputs.



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

10.3 24 VAC supply

Includes a double-chamber safety transformer which fulfils the double-isolation requirements. The power consumption is lower than 3 W (without analog outputs) or less than 9 W with analog outputs.



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

MULTICAL® 801 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 in front of the safety relay. When the transformer is used the power consumption will be lower than 3 W (without analog outputs) or lower than 9 W with analog outputs, for the complete meter incl. 230/24 V transformer.

Note: The safety transformer 66-99-403 is marked with 0.2 A, but in practice it can supply much more. When MULTICAL® 801, with maximum consumption, is connected with the transformer, the transformer will experience a temperature increase of approx. 20K.

10.4 Danish regulations for the connection of mains operated meters

Installation to mains connected equipment for registration of consumption (Text from The Danish National Safety Board, 2004-12-06)

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 are double-isolated it is not necessary to draw 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 for remote reading and remote control, which is connected to a safety transformer mounted in the panel and direct connected to the branch conductor, is used, 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 be either short-circuit-protected by the overcurrent protection of the branch conductor or short-circuit safely drawn.
- 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 by separators or it must appear form 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 message as well as connection and disconnection of the equipment outside the panel is carried out by an authorized electrician. These task 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.

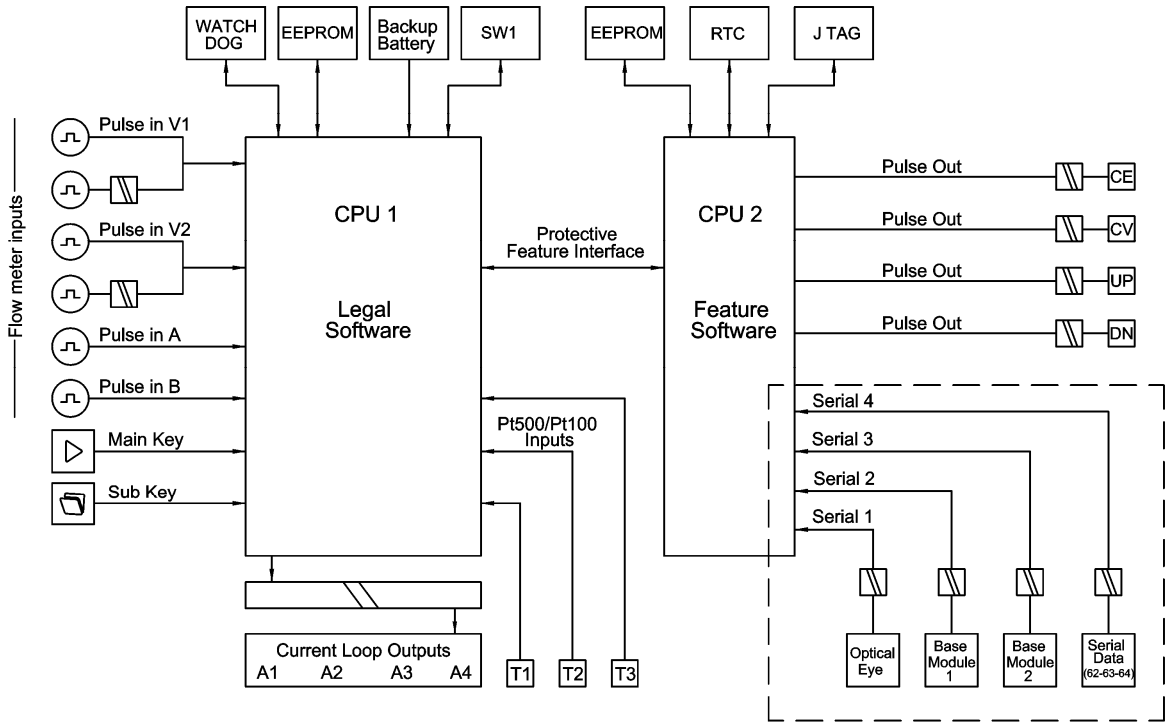
11 Plug-in modules

Two plug-in modules can be mounted in the connection base of MULTICAL® 801, in this way the meter can be adapted to various applications.

All plug-in modules are included in the comprehensive type test, to which MULTICAL® 801 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 Plug-in modules

MULTICAL® 801 Type 67-	□	□	□□	□	□	□	□	□□
Module 2 *(VA and VB are not available in module position 2)*								
No module		**0**						
M-Bus		**V**						
RadioRouter **)		**W**						
LonWorks, FTT-10A		**Y**						
GSM/GPRS module		**Z**						
Module 1 *(VA and VB are available in module position 1)*								
No module			**00**					
M-Bus + pulse inputs			**20**					
RadioRouter + pulse inputs			**21**					
Data logger + 4-20 mA inputs + pulse inputs			**22**					
LonWorks, FTT-10A + pulse inputs			**24**					



Possible combinations of module 1 and module 2

2 ⇒ **1 ⇓**		**67-0V** M-Bus	**67-0W** RadioRouter	**67-0Y** LonWorks	**67-0Z** GSM/GPRS
67-00-20 M-Bus+p/i		**OK**	**OK**	**OK**	**OK**
67-00-21 RadioRouter +pulse input		**OK**	**N/A**	**OK**	**N/A**
67-00-22 0/4-20 Input		**OK**	**OK**	**OK**	**OK**
67-00-24 LonWorks +pulse input		**OK**	**OK**	**OK**	**OK**

Options of external communication unit connected to data output (62-63-64)

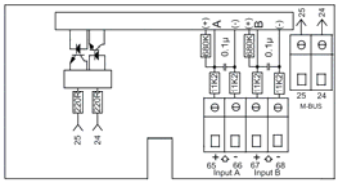
Ext. box ⇓		**Serial DATA** **62-63-64**		**Comments/limitations in use**
67-0V M-Bus				**No limitations**
67-0W RadioRouter				**No limitations**
67-0Y LonWorks				**No limitations**
67-0Z GSM/GPRS				**Supply unit for GSM/GPRS module must be included in the external communication unit**

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

11.1.1 M-Bus + pulse inputs (67-00-20) (67-0V)

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 energy 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 which can only be used if modules are mounted in module position 1. See paragraph "7.3 Pulse inputs VA and VB" concerning the function of the pulse inputs.



Limitations
The maximum register value of the M-Bus Protocol is "2147483647", with the following main units: "10xm3", "10xkWh" and "10xMJ".
This means that energy meters with 8-digit energy register in MWh or GJ can not be read through the M-Bus. This applies, e.g. for MULTICAL® 801 with CCC code 206.

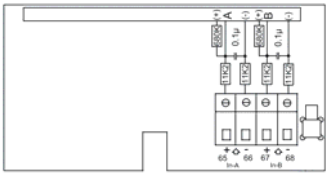
11.1.2 RadioRouter + pulse inputs (67-00-21) (67-0W)

The radio module is available for operation in licence-free frequency bands and also for licence demanding frequencees. 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 which can only be used if modules are placed in module area 1. See paragraph "7.3 Pulse inputs VA and VB" concerning the function of the pulse inputs.

The RadioRouter module must be used with mains supply.

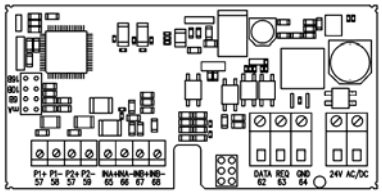


11.1.3 Prog. data logger + RTC + 4...20 mA inputs + pulse inputs (67-00-22)

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.

The module has two extra pulse inputs which can only be used, however, if modules are mounted in module position 1, see paragraph 7.2: Pulse inputs VA and VB as to function. The module must be powered by 24 VAC.

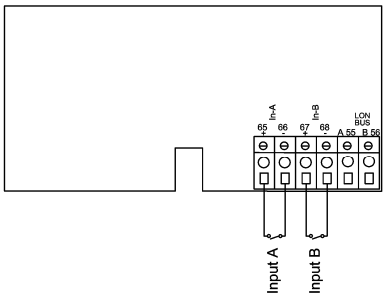


11.1.4 LonWorks, FTT-10A + pulse inputs (67-00-24) (67-0Y)

The LonWorks module is used for data transfer from MULTICAL®801 either for data reading/registration or regulation purposes via the Lon-Bus.

Furthermore the module has two extra pulse inputs which can only be used, however, if modules are mounted in module position 1, see paragraph 7.2: Pulse inputs VA and VB as to function. The module must be powered by 24 VAC/DC or 12 VDC from terminals 97A-98A.

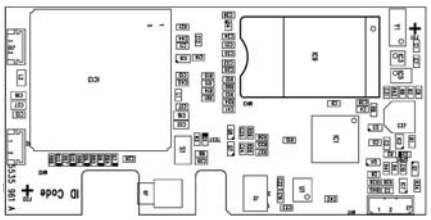
A list of network variables (SNVT) and further details about the LonWorks module appear from data sheet 5810-510, GB-version 5810-511, DE-version 5810-512.
Regarding mounting we refer to installation instructions 5512-396.



11.1.5 GSM/GPRS (67-0Z)

The GSM/GPRS module functions as transparent communication path between reading software and MULTICAL®801 and is used for data reading. The module includes an external dual-band GSM antenna which must always be used. The module itself includes a line of light emitting diodes indicating signal strength which are very useful during installation.

Further details about the GSM/GPRS module appear from data sheet 5810-627. GB-version 5810-628, DE-version 5810-629, SE-version 5810-630.
Regarding mounting we refer to installation instructions DK-version 5512-686, GB-version 5512-687, DE-version 5512-688.

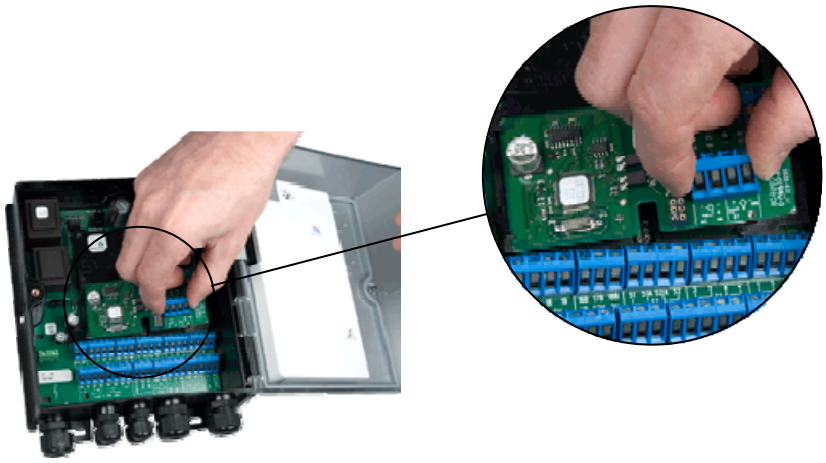


11.2 Retrofitting modules

Modules for MULTICAL® 801 are also supplied separately for retrofitting. The modules are configured and ready for installation from the factory. However, some of the modules need individual configuration after installation which is possible by means of METERTOOL.

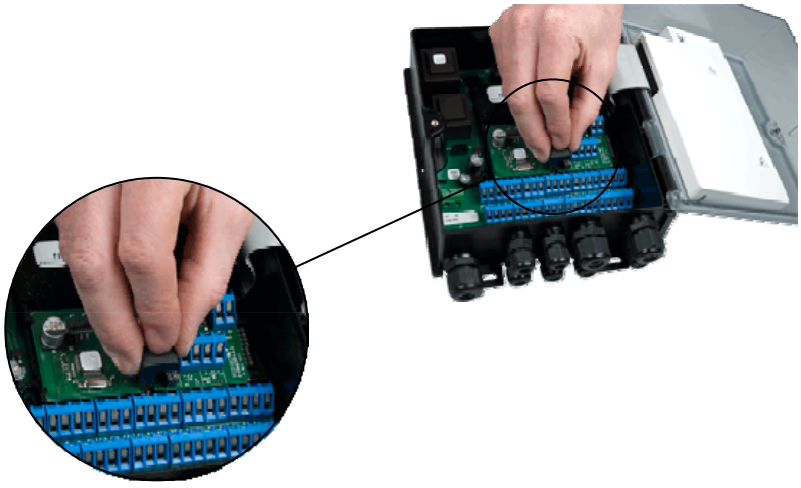
Module 1 (Module 2)			Possible configuration after installation
M-Bus + pulse inputs	20	(V)	Pulse values of VA and VB are changed via METERTOOL. Primary and secondary M-Bus addresses can be changed via METERTOOL or M-Bus. Furthermore, monthly logger data can be selected instead of yearly logger data via M-bus.
RadioRouter + pulse inputs	21	(W)	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.
GSM/GPRS	-	(Z)	No configuration
LonWorks, FTT-10A + pulse inputs	24	(Y)	Pulse values of VA and VB are changed via METERTOOL. All other configurations are made via LonWorks.

Data modules are retrofitted by placing the module in the PCB holder in the left side of the meter and "clicking" on the module.



Insert module

Module and meter are electrically connected using a 6-pole jumper:



Add jumper

12 Data communication

12.1 MULTICAL® 801 Data Protocol

Internal data communication in MULTICAL® 801 is based on the Kamstrup Meter Protocol (KMP) which partly provides a quick and flexible reading structure and partly 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 on the optical eye and via plug pins for the modules. Thus, modules with e.g. M-bus interface use the KMP protocol internally and the M-bus protocol externally.

The KMP protocol has been constructed to handle point to point communication in a master/slave system (e.g. a bus system) and is used for data reading of Kamstrup energy 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 synchroneous 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 value range.

12.1.1 The register IDs of MULTICAL® 801

ID	Register	Description
1003	DATE	Current date (YYMMDD)
60	E1	Energy register 1: Heat energy:
94	E2	Energy register 2: Control energy:
63	E3	Energy register 3: Cooling energy:
61	E4	Energy register 4: Forward energy:
62	E5	Energy register 5: Return energy:
95	E6	Energy register 6: Tap water energy:
96	E7	Energy register 7: Heat energy Y
97	E8	Energy register 8: [m^3 • T1]
110	E9	Energy register 9: [m^3 • T2]
64	TA2	Tariff register 2
65	TA3	Tariff register 3
68	V1	Volume register V1
69	V2	Volume register V2
84	VA	Input register VA
85	VB	Input register VB
72	M1	Mass register V1
73	M2	Mass register V2
1004	HR	Operating hour counter
113	INFOEVENT	Info event counter
1002	CLOCK	Current hour (hhmmss)
99	INFO	Info code register, current
86	T1	Current forward temperature
87	T2	Current return temperature
88	T3	Current temperature T3
122	T4	Current temperature T4
89	T1-T2	Current differential temperature
91	P1	Pressure in flow
92	P2	Pressure in return
74	FLOW1	Current forward flow
75	FLOW2	Current return flow
80	POWER1	Current power calculated on the basis of V1-T1-T2.
123	MAX FLOW1DATE/YEAR	Date of this year's min.
124	MAX FLOW1DATE/YEAR	This year's max. value
125	MIN FLOW1DATE/YEAR	Date of this year's min.
126	MIN FLOW1/YEAR	This year's min. value
127	MAX POWER1DATE/YEAR	Date of this month's max.
128	MAX POWER1/YEAR	This year's max. value
129	MIN POWER1DATE/YEAR	Date of this year's min.
130	MIN POWER1/YEAR	This year's min. value
138	MAX FLOW1DATE/MONTH	Date of this month's max.
139	MAX FLOW1/MONTH	This month's max. value
140	MIN FLOW1DATE/MONTH	Date of this month's min.
141	MIN FLOW1/MONTH	This month's min. value
142	MAX POWER1DATE/MONTH	Date of this month's max.
143	MAX POWER1/MONTH	This month's max. value
144	MIN POWER1DATE/YEAR	Date of this month's min.
145	MIN POWER1/MONTH	This month's min. value
146	AVR T1/YEAR	Year-to-date average for T1
147	AVR T1/YEAR	Year-to-date average for T2
149	AVR T1/MONTH	Month-to-date average for T1
150	AVR T2/MONTH	Year-to-date average for T2
66	TL2	Tariff limit 2
67	TL3	Tariff limit 3
98	XDAY	Target date (reading date)
152	PROG NO	Prog. no. ABCCCCCC
153	CONFIG NO 1	Config no. DDDEE
168	CONFIG NO 2	Config. no. FFGGMN
1001	SERIAL 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 check sum
155	HIGH RES	High-resolution energy register for test purposes
157	TOP MODULE ID	ID number of top module
158	BOTMODULE ID	ID number of base module

12.1.2 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® 66-CDE compatible data

Not included in MC801

13 Calibration and verification

13.1 High-resolution energy reading

Should you need high-resolution energy reading during test and verification, it can be initialized as follows:

- Switch off the supply voltage and remove the plug from the backup battery. Wait until the display is blank
- Press both pushbuttons at a time whilst connecting the supply voltage (or the plug of the backup battery) and keep pressing both buttons until the display becomes active
- The display now shows energy with 0.1 [Wh] resolution until one of the pushbuttons is activated

The above display example showing 345.4 [Wh] corresponds to the amount of energy accumulated at flow = 43.00°C and return = 40.00°C as well as a return volume of 0.1 m^3.

The high-resolution energy reading is displayed in Wh at a volume resolution of 0.01 m^3 (qp 1,5 m^3/h). For bigger meters the energy indication must be multiplied by 10 or 100.

m^3	Wh
0.001	x 0.1
0.01	**x 1**
0.1	x 10
1	x 100

The high-resolution energy can be used for both heat energy (E1) and cooling energy (E3).

Note: Hour counter and info event counter are always reset when HighRes is provoked by pressing both buttons in connection with reset.

13.1.1 Data reading of high-resolution energy

The register "HighRes" can be data read with ID = 155.

In connection with data reading measuring unit and value will be correct irrespective of meter size.

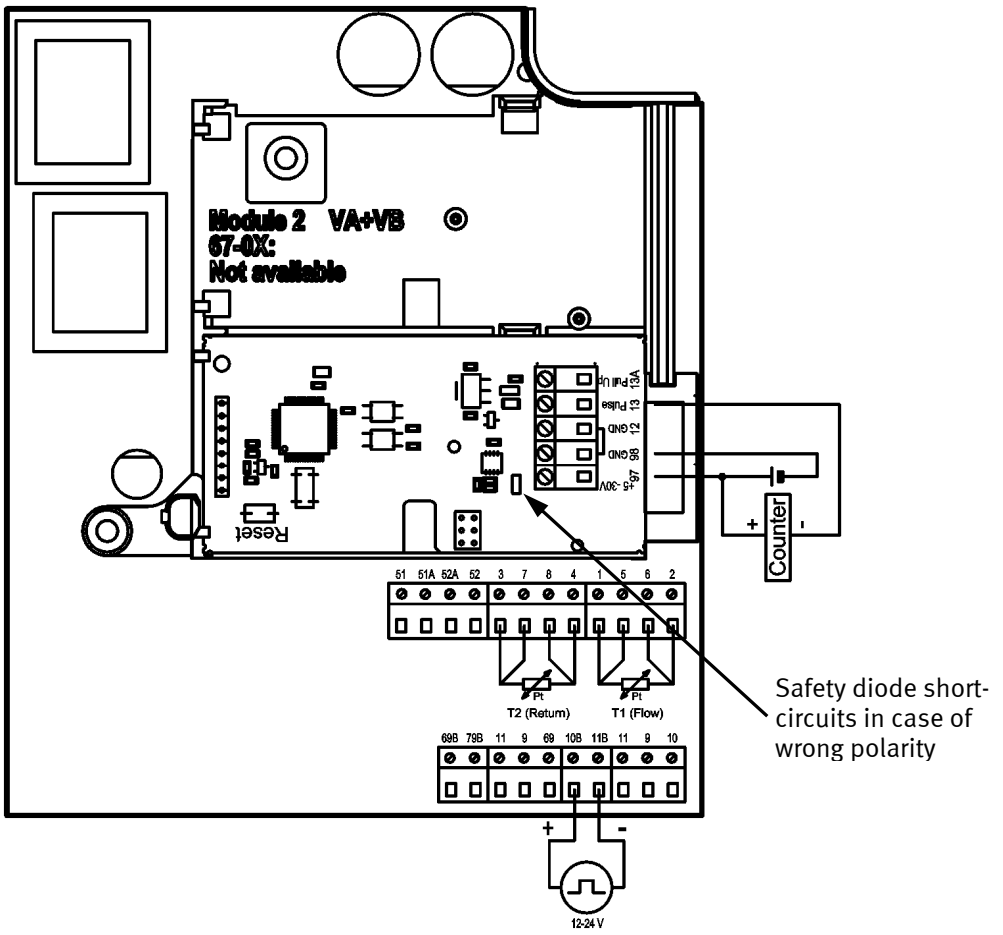
13.2 Pulse interface

During test and verification of MULTICAL® 801, where high-resolution energy pulses are required verification adapter type 5550-888, placed as module 1, can be used.

The pulse interface collects serial data from MULTICAL® 801 every 7 sec. and converts these high-resolution data to high-resolution energy pulses with the same resolution as the high-resolution register of the display (see section 12.1)

The pulse interface must be voltage supplied on terminals 97-98 from en external supply with 5…30 VDC and the current consumption is max. 5 mA. You might use MULTICAL® 801's auxiliary supply on terminals 97A and 98A.

The high-resolution energy pulses are transmitted as an open collector signal on terminals 13-12, whereas an internal pull-up resistance of 10 kOhm can be connected to the external pulse supply via terminal 13A.



Pulse interface 5550-888 placed as module 1 in MULTICAL® 801

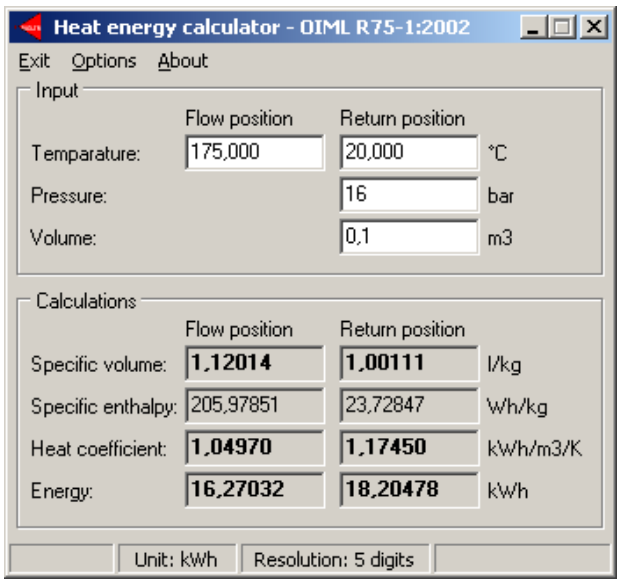
13.2.1 Technical data

Power supply (97-98):	5...30 VDC
Current consumption:	Max. 5 mA
Volume simulation:	Max. 128 Hz for CCC=1xx and 4xx (ULTRAFLOW®) Max. 1 Hz for CCC=0xx (Reed contact)
HF-energy output (13-12):	Open collector, 5...30 VDC max. 15 mA
Pulse frequency (13-12):	Max. 32 kHz as burst per integration
Data interval:	About 7 s.
Time-out in case of missing data:	About 35 s.

13.3 True energy calculation

During test and verification the heat meter's energy calculation is compared to the "true energy" calculated according to the formula of EN 1434-1:2004 or OIML R75:2002.

The PC-program METERTOOL from Kamstrup includes an energy calculator which is suitable for the purpose:



The true energy at the most frequently used verification points is indicated in the table below.

T1 [°C]	T2 [°C]	ΔΘ [K]	Flow [Wh/0.1 m³]	Return [Wh/0.1 m³]
42	40	2	230,11	230,29
43	40	3	345,02	345,43
53	50	3	343,62	344,11
50	40	10	1146,70	1151,55
70	50	20	2272,03	2295,86
80	60	20	2261,08	2287,57
160	40	120	12793,12	13988,44
160	20	140	14900,00	16390,83
175	20	155	16270,32	18204,78

14 METERTOOL for MULTICAL® 801

14.1 Introduction

METERTOOL for MULTICAL® 801 consists of two separate programs:

"METERTOOL MULTICAL® 801" is configuration and verification software for reconfiguration and test/verification of MULTICAL®801 (item no. 66-99-707).

"LogView MULTICAL® 801" for reading of logging data as well as carrying out interval logging. The read data can be used for analysis and diagnostic test of the heating installation. Data can be presented as table and graphics. Tables can be exported direct to "Microsoft Office Excel" (item no. 66-99-708).

14.1.1 System requirements

METERTOOL/LogView requires minimum Windows 2000 SP3 or Windows XP SP2 or newer as well as Explorer 5.01.

Minimum:	Pentium III or equivalent	**Recommended:**	Pentium 4 or equivalent
	256 MB RAM		512 MB RAM
	1 GB HD		10 GB HD
	Display resolution 1024 x 768		
	USB and CD-ROM drive		
	Printer installed		

Administrator rights to the PC are required in order to install and use the programs.

The programs must be installed under the logon of the person who is to use the programs.

14.1.2 Interface

The following interfaces can be used:

Verification equipment	Item no.	66-99-370	Verification of 67-F/K (4-W/Pt100) and total/partial reconfiguration
Verification equipment	Item no.	66-99-371	Verification of 67-G/L (4-W/Pt500) and total/partial reconfiguration
Data cable w/USB	Item no.	66-99-098	Total/partial reconfiguration
Optical eye USB	Item no.	66-99-099	Partial reconfiguration
Optical eye COM port	Item no.	66-99-102	Partial reconfiguration

Using equipment with Kamstrup USB, the USB driver must be installed before connection.

14.1.3 Installation

Check that system requirements are fulfilled.

Close other open programs before starting the installation.

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

When the installation is completed, the icon "METERTOOL MULTICAL® 801" and/or "LogView MULTICAL® 801" will appear from the menu "start" as a link on the desktop. For METERTOOL MULTICAL®801" double-click on link or icon in order to terminate the installation and establish connection to the SQL-database, the installation has now been completed.

Subsequently double-click on link or icon of the required program in order to start the program.

14.2 METERTOOL MULTICAL® 801

14.2.1 General information

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

There are two programming options "Partial programming" and "Total programming".

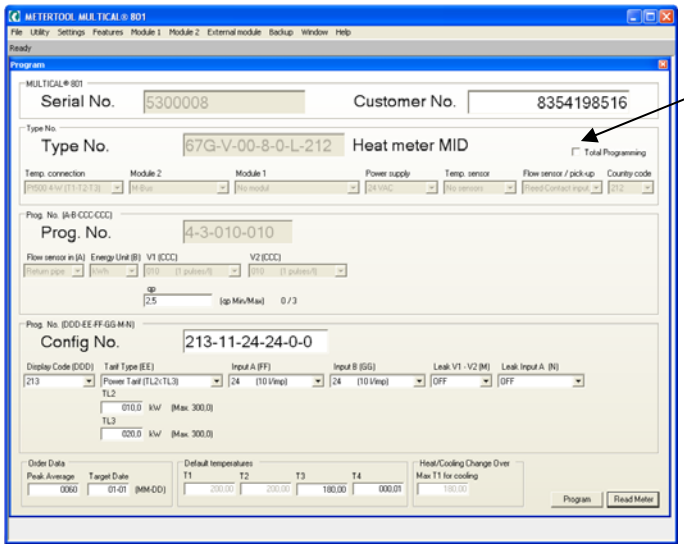
"Partial programming" does not allow change of coding which is important to energy calculation, e.g. Type number and Program number.

By means of "Total programming" it is possible to change the remaining values too. Programming is only possible if the internal programming lock is closed (short-circuit pen 66-99-278).

In order to carry out verification the jumper connection must remain the same throughout the verification.

It is not possible to change the serial number as it is a unique number allocated to the meter during production.

"V2(CCC)", "T1", "T2" and "Max T1 for cooling" can be disabled, depending on the meter type in question.



Partial/Total programming

The program is self-explanatory as to most coding numbers (see text in "combo-boxes"), further details can be found in the respective paragraphs of the technical description.

14.2.2 File

The menu "File" includes printer setup as well as printout possibility of new meter label or test certificate.

Exit	Closes METERTOOL
Certificate	Initiates printout of test certificate
Print Label	Initiates printout of meter label
Select Label Printer	Printer setup

14.2.3 Utility

The menu "Utitily" includes the following configuration and test points:

Configuration	Overall view which is used during reading and programming (see examples at top of page)
Preset VA/VB	Presets the register values of the two extra pulse inputs for water and electricity meters.
Time/Date	Transfer of date and time to **MULTICAL®801 calculator and top module.**
Info code setup	Change Info code setup between UF65 and UF54 as active info codes.
Reset	Normal reset, i.e. reset of data logger and total reset. Do not forget to check the date and time after reset.
Meter Type	Reads the meter's type, software revision and CRC check sum.
Verification	See separate paragraph, 14.3 Verification.

14.2.4 Settings

COM port Setup of COM port for interface of calculator/equipment

Verification unit settings Input and maintenance of verification data of connected verification equipment See separate paragraph **14.3 Verification with METERTOOL MULTICAL® 801**.

Verification unit calibration Used for changing between temperature set points during calibration

14.2.5 Features

The menu "Features" includes configuration of extra functions included in MULTICAL® 801.

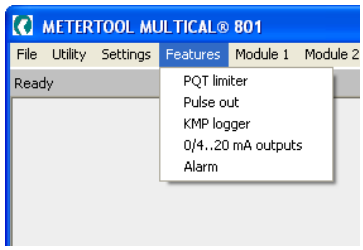
PQT limiter

Pulse out

KMP logger

0/4....20 mA outputs

Alarm



14.2.6 Module 1

The menu "Module 1" is used for configuration of module data for modules mounted in module position 1. See paragraph 11.2 Retrofitting of modules.

14.2.7 Module 2

The menu "Module 2" is used for reconfiguration of module data for modules mounted in module position 2.

See paragraph 11.2 Retrofitting of modules.

Note! Input A and Input B are not supported in module position 2.

14.2.8 External Module

The menu "External Module" is used for configuration of module data for externally mounted modules connected to MULTICAL® 801 via RS232 data connection.

See paragraph 11.1 Plug-in modules.

Note! Input A and Input B are not supported in modules mounted as external modules.

14.2.9 Backup

Used for exporting/importing a backup file of saved verification data.

14.2.10 Windows

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

14.2.11 Help

Output Opens the communication log which is used in connection with troubleshooting in the program

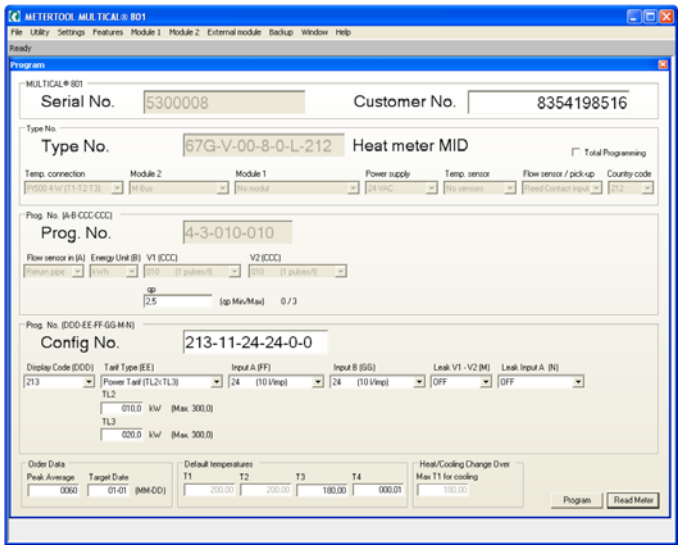
Contact Mail address for registration as METERTOOL user as well as for questions on subjects related to METERTOOL

About Includes program numbers and revisions of the various components of the installed version. In connection with error reports on METERTOOL software we ask you to e-mail us a screen dump of "About"

14.2.12 Application

Double-click on link or icon in order to start the program.

Activate “Configuration” under “Utility” in order to start meter configuration.



Enter the present configuration by activating ”Read meter”.

Enter the required changes of coding and activate ”Program” in order to carry out the changes in the meter.

If USB interface is used, it must be connected before the program is opened.

Note! Do not forget to set up the COM port the first time the program is used.

14.3 Verification with METERTOOL MULTICAL®801

14.3.1 General information

Verification of MULTICAL® 801 requires verification equipment and verification data must be entered into the METERTOOL program.

14.3.2 Verification equipment

Verification equipment, e.g. item no. 66-99-370 for verification of 67-F/K (4-W/Pt100) or item no. 66-99-371 for verification of 67-G/L(4-W/Pt500) is used for verification of calculator MULTICAL®801. The verification includes energy verification of "E1" and "E3", test of volume inputs "V1", "V2", "VA" and "VB" as well as test of temperature input "T3".

Different temperatures are simulated for the two sensor inputs "T1" and "T2". Together with the volume simulation (autointegration) these temperatures form the basis of the verification of the energy calculation.

The equipment was primarily constructed for use in laboratories, which test and verify heat meters, but can also be used for performance testing the meter.

The computer program "METERTOOL MULTICAL® 801" item no. 66-99-707 is used for configuration, test and verification.

In order to carry out verification the programming lock must be closed throughout the verification (see paragraph 14.2.1 General)

The verification equipment for MULTICAL® 801 includes USB interface (item no. 66-99-098) as well as corresponding driver software. During installation this interface creates a virtual COM port which figures as an optional COM port of the METERTOOL MULTICAL®801 software in the computer. As the virtual COM port only exists when the equipment is connected, the verification equipment *must* be connected to the computer before the program "METERTOOL MULTICAL® 801" is started. Furthermore, the verification equipment requires mains supply via the included mains adapter.

Verification does no apply to temperature and flow sensor(s).

The verification equipment is available in three different types, depending on the MULTICAL® 801 type used and the temperature points to be tested.

66-99-370 Standard (EN1434/MID) Type 67-F/K (4-wire Pt100)	T1 [°C] 160 80 43	T2 [°C] 20 60 40	T3 [°C] 5
66-99-371 Standard (EN1434/MID) Type 67-G/L (4-wire Pt500)	T1 [°C] 160 80 43	T2 [°C] 20 60 40	T3 [°C] 5

For other equipment variants (types or temperature points), please contact Kamstrup A/S.

14.3.3 Function

Verification equipment, e.g. item no. 66-99-370 or 66-99-371 is mounted in a standard MULTICAL® base and includes battery, verification PCB with connection terminals, interface for calculator, microprocessor, control relays and precision resistors.

The connection between verification equipment and MULTICAL® 801 consists of a 14-pole test connector.

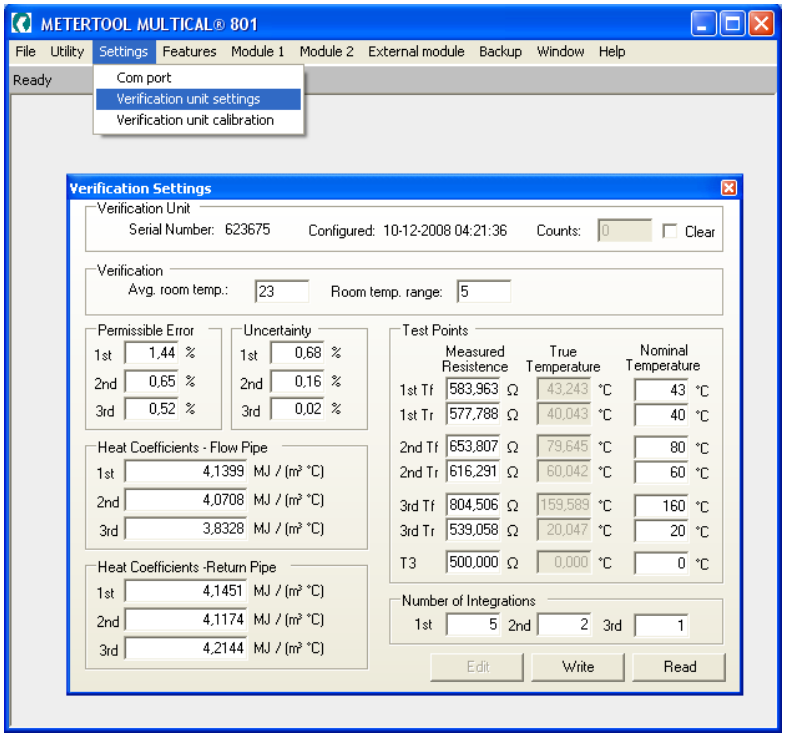
During test the calculator is supplied by the meter's main supply. The verification PCB is powered with 12 VDC by the enclosed external mains adapter. The microprocessor simulates volume based on pulse frequency and the number of pulses per test point selected in the computer program. Temperature simulation is obtained by means of fixed precision resistors, which are automatically changed via relays controlled by the microprocessor.

After the test the computer reads registers in the calculator and compares the values to the calculated values.

The calibration result in percentage for each test point can be stored in the computer under the serial number of the tested MULTICAL® 801 to be printed out later on a test certificate.

14.3.4 Verification data

The first time METERTOOL and the verification equipment is used a number of calibration data must be entered into the menu ”Verification” under ”Settings” in the METERTOOL program. Calibration data is electronically included in the verification equipment (also enclosed with the verification equipment as a certificate on paper). In order to transfer calibration data from the equipment to the program select ”Verification” from the menu ”Settings” and activate ”Read”. Calibration data is now transferred to and saved in the METERTOOL program.



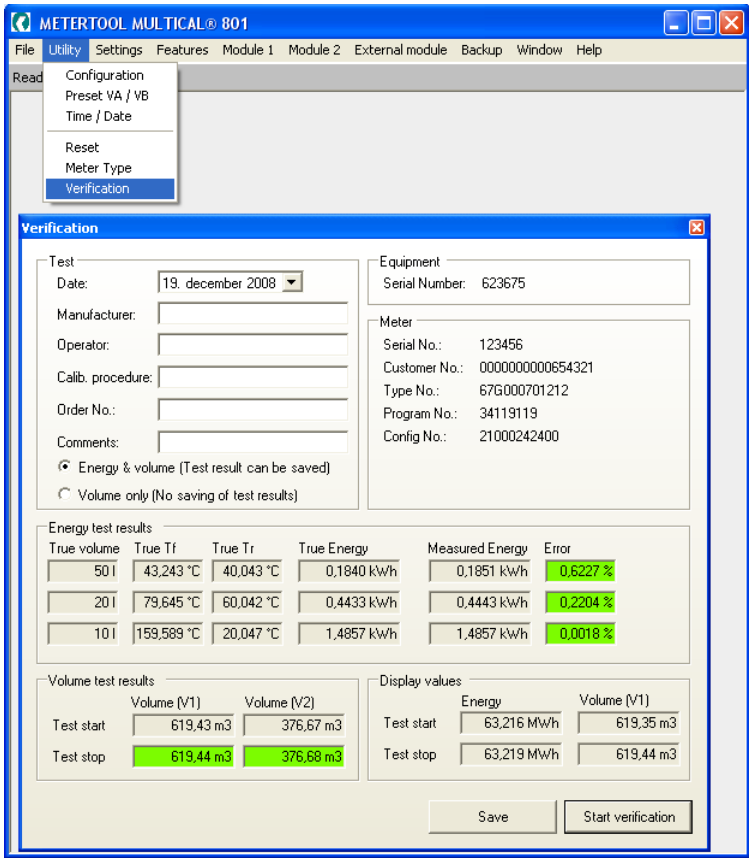
The calibration data of the equipment and the program verification data are compared every time verification equipment is connected in order to secure that verification data is updated if the calibration data of the equipment have been changed. For instance this can be due to recalibration of verification equipment. Calibration data of the verification equipment can be maintained by changing verification data in the program METERTOOL and clicking on “Write” these new data into the equipment. In order to avoid unintentional change of calibration data ”Write” is protected by a password, which can be obtained from Kamstrup A/S.

Calibration data include test points, permissible error, uncertainty, ambient temperature (fixed value) and number of integrations per test.

Having entered verification data, the program automatically calculates the true k-factor in accordance with the formula of EN 1434 and OIML R75:2002.

14.3.5 Verification

The verification program menu is opened by activating ”Verification” in the menu ”Utility”.

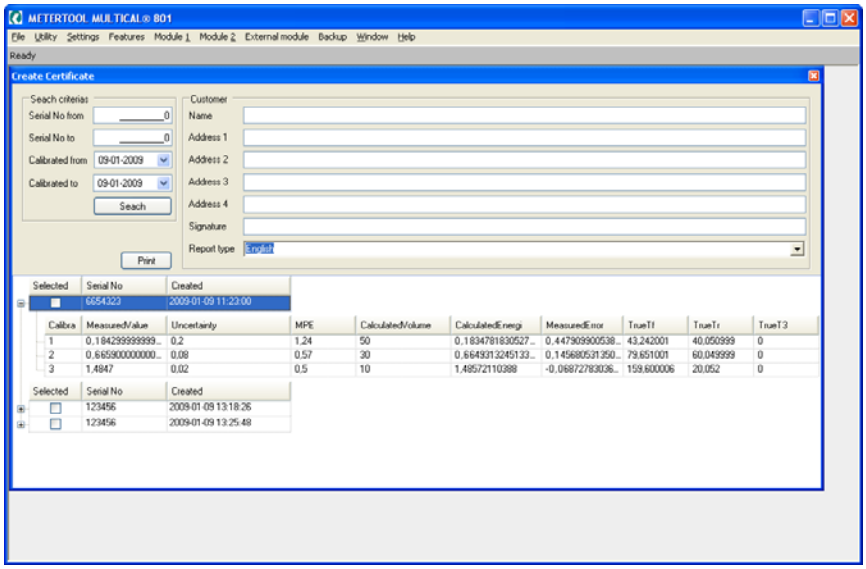


Click on ”Start verification” in order to begin test/verification.

When the test has been completed, the result will be displayed. If the result can be approved, click on “Save”. The result is now saved in the database under the serial number of the calculator. You can save several results under one serial number without overwriting earlier results.

14.3.6 Certificate

If you want to print a certificate with saved results, select “Certificate” in the menu “File”. The test/verification result can subsequently be found according to serial number and the certificate can be printed.



14.4 LogView MULTICAL®801

14.4.1 Introduction, Interface and installation

Regarding "Introduction", "Interface" and "Installation" see paragraph **13.1 Introduction METERTOOL.**

14.4.2 General information

"LogView MULTICAL® 801" is used for read-out of logging data from MULTICAL® 801 calculator and modules (e.g. "Prog. data logger + RTC + 4...20 mA inputs + pulse inputs" (67-00-22)), as well as carrying out interval logging. The read data can be used for analysis and diagnostic test of the heating installation. Data can be presented as table and graphics. Tables can be exported direct to "Microsoft Office Excel" (item no. 66-99-708).

For available logger data see paragraph **6.10 Data loggers.**

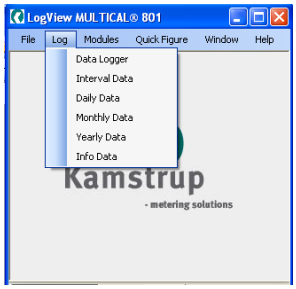
14.4.3 File

Settings Setup of COM port for interface of calculator/equipment. **Note!** Do not forget to connect the USB interface before starting the program LogView.

Exit Exit LogView

14.4.4 "Log"

Select the required data function.



Data logger "Internal KMP Logger" makes it possible to read data from the "Programmable KMP logger", which saves data in the calculator.

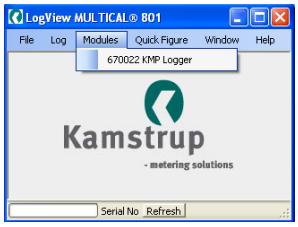
Interval Data enables interval read-out of the current counter values in MULTICAL® 801 at optional intervals from 1 to 1440 minutes as well as an optional number of repetitions of the reading from 1 to 9999 times.

For read-out of "current" counter values select interval 1 and repetition 1. Thereby you obtain one instantaneous reading.

Daily Data, Monthly Data and Yearly Data enables reading of logged data from MULTICAL® 801 including optional data period and values.

Info Data makes it possible to read-out the latest 50 info events from MULTICAL® 801, the read-out includes date and info code of the info event.

14.4.5 Modules - ("Module 1", "Module 2" or "External Module")



Are used for read-out of logging data collected in the KMP logger module.

Reading is carried out by direct connection to the module. Module logger data cannot be read via the MULTICAL® 801 calculator.

14.4.6 "Window"

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

14.4.7 "Quick Figure"

Quick Figure reads the energy register during verification and calculates the related Quick figure.

14.4.8 Help

Contact Mail address for registration as LogView user as well as requests on LogView related subjects.

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

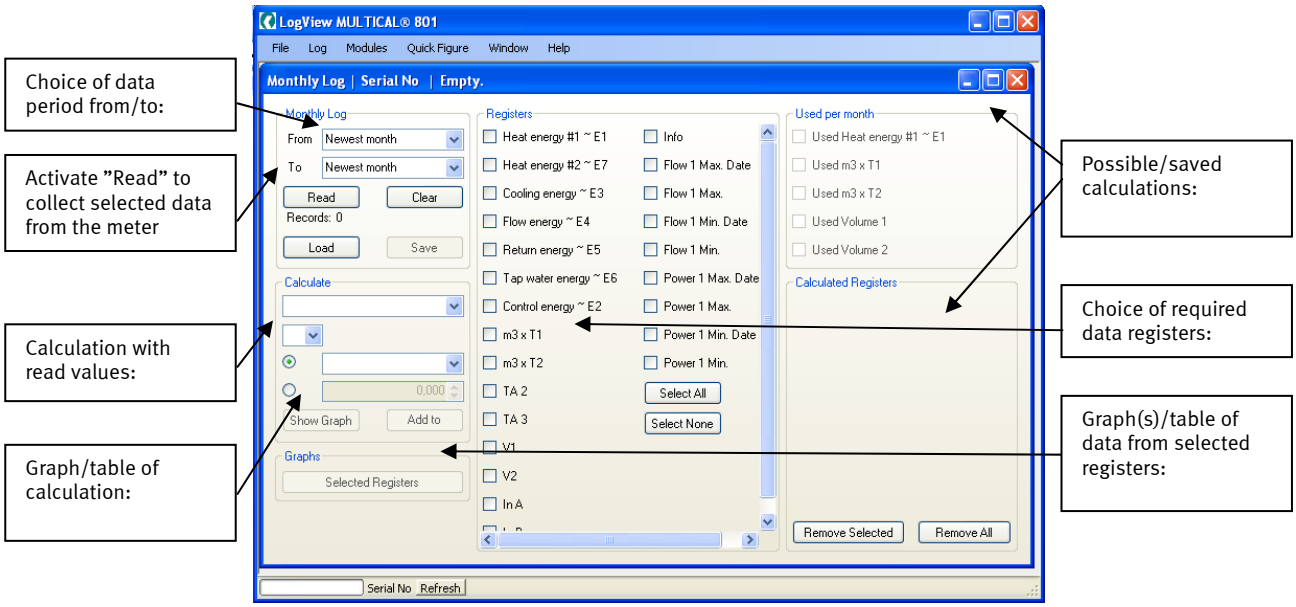
In connection with error reports on LogView software we ask you to e-mail us a screen dump of "About".

14.4.9 Application

Double click on link or icon for "LogView MULTICAL® 801" in order to start the program and select the required data function.

Note! Do not forget to set up the COM port the first time the program is used.

"**Daily Data**" is used as an example:



After read-out non-selected data registers become grey and cannot be used for further processing/analysis. In order to read all data, select all values by clicking on "Select All" .

When read-out has been completed the program automatically asks whether the data should be saved. We recommend you to save the read-outs to make it possible to reopen the data later for further analysis or documentation.

Additional functions can now be selected for the read data. By means of "**Calculation**" individual calculations can be carried out, and graphs/tables with the values appear by activating "Show Graph". If you want to save the calculation forms for reuse, select "Add to" and the function is added to "Calculated Registers".

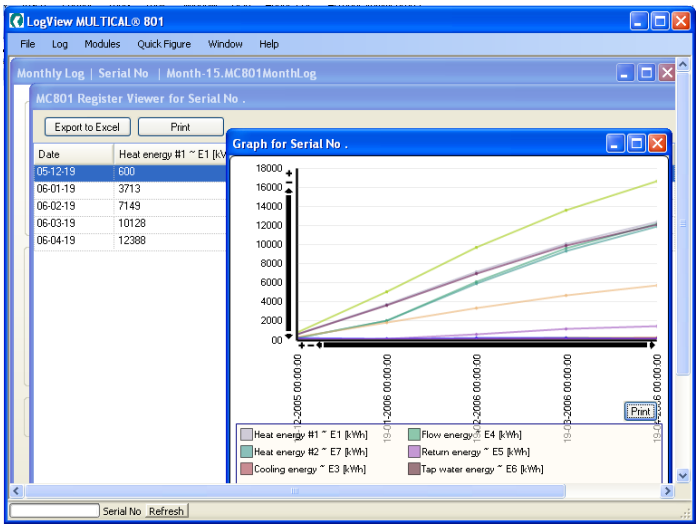
In order to carry out a new data reading activate "Clear", and select a new period and new data registers.

If "Selected Registers" are chosen under "Graphs", graph(s)/table with the marked registers are displayed.

The table can be exported to "Microsoft Excel" or printed.

Activate (**+**) to zoom in, activate (**-**) to zoom out on the axes.

The arrows (↑↓→←) on the axes are used for manoeuvring in the graph area.



15 Approvals

15.1 Type approvals

MULTICAL® 801 has been type approved on the basis of EN 1434-4:2007 and OIML R75:2002.
The test report, project A530573, has been prepared by DELTA and forms the basis of the MID approval.

15.2 The Measuring Instrument Directive

MULTICAL® 801 is supplied with marking according to MID (2004/22/EF). The certificates have the following numbers:

B-module: DK-0200-MI004-006

D-module: DK-0200-MIQA-001

Declaration of Conformity

Overensstemmelseserklæring
Déclaration de conformité
Konformitätserklärung
Deklaracja Zgodnosci
Declaración de conformidad

We
Vi
Nous
Wir
My
Nosotros

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

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

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

is/are in conformity with the requirements of the following directive(s):
er i overensstemmelse med kravene i følgende direktiv(er):
est/sont conforme(s) aux exigences de la/des directive(s):
mit den Anforderungen der Richtlinie(n) komform ist/sind:
jest/są zgodne z wymaganiami następujących dyrektyw:
es/son conforme(s) con los requerimientos de la(s) siguinte(s) directiva(s):

Measuring Instrument Directive	2004/22/EC
EMC Directive	89/336/EEC
LVD Directive	2006/95/EEC
PE-Directive (Pressure)	97/23/EC
R&TTE	1999/5/EC

Date: 2009-06-08 **Sign.:**

Kurt Stochholm
Quality Assurance Manager

5518-050,Rev.: M1, Kamstrup A/S, DK8660 Skanderborg, Denmark

16 Troubleshooting

MULTICAL® 801 has been constructed with a view to quick and simple installation as well as long and reliable operation at the consumer.

Should, however, an operating problem with the meter occur, the table below can be used for troubleshooting.

Repairing the meter, if needed, we recommend only to replace battery, temperature sensors 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
No function in the display (empty display)	Power supply missing	Change backup battery or check mains supply
No energy accumulation (e.g. MWh) and volume (m^3)	Read "info" in the display	Check the error indicated by the info code (see paragraph 6.8)
	If "info" = 000 ⇒	Check that the flow direction matches the arrow on the flow sensor
	If "info" = 004, 008 or 012 ⇒	Check the temperature sensors. If defective, replace the sensor pair.
Accumulation of volume (m^3), but not of energy (e.g. MWh)	Flow and return sensors have been interchanged either in the installation or at the connection	Mount the sensors correctly
No accumulation of volume (m^3)	No volume pulses	Check that the flow direction matches the arrow on the flow sensor Check the flow sensor's connection
Incorrect accumulation of volume (m^3)	Erroneous programming	Check that the pulse figure on the flow sensor matches the calculator
Incorrect temperature reading	Defective temperature sensor Insufficient installation	Replace the sensor pair Check the installation
Temperature indication a little too low, or accumulation of energy (e.g. MWh) slightly too low	Bad thermic sensor contact Heat dissipation Too short sensor pockets	Place the sensors at the bottom of the sensor pockets Insulate the sensor pockets Replace by longer pockets

17 Environmental declaration

Kamstrup A/S holds an environmental certification according to ISO 14001, and as part of our environment policy we use materials which can be recovered environmentally correct to the greatest possible extent.

17.1 Disposal

Kamstrup accept worn-out MULTICAL® 801 for environmentally correct disposal according to previous agreement. The disposal arrangement is free of charge to the customer, except for the cost of transportation to Kamstrup A/S or the nearest disposal system.

The meters should be disassembled as described below. The separate parts should be sent for approved destruction. The batteries must not be exposed to mechanical impact and the lead-in wires must not be short-circuited during transport.

Item	Material	Recommended disposal
Lithium cells in MULTICAL® 801 (Backup battery, type: 66-99-619)	Lithium and thionyl chloride, 2 pcs. A-cell lithium 0.96 g lithium each	Approved deposit of lithium cells
PCBs in MULTICAL® 801 (LC-display is removed)	Coppered epoxy laminate, soldered on components	PCB scrap for metal recovery
LC display	Glass and liquid crystals	Approved processing of LC-displays
Cables for flow sensor and sensors	Copper with silicone mantle	Cable recovery
Transparent top cover and sealing cover, bottom	PC	Plastic recovery
Connection bracket	PC + 10% glass	Plastic recovery
Sealing cover, top	ABS	Plastic recovery
Prism behind display	PMMA	Plastic recovery
Packing	Polystyrene	EPS recovery

17.2 Transport restrictions

MULTICAL® 801 can be transported without restrictions (not dangerous goods). The built-in backup battery fulfils the requirements of both EN 50020 ”Intrinsic safety transport” and IEC 86-4 ”Safety standard”.

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

Kamstrup A/S
Att.: Miljø- og kvalitetsafd.
Fax.: +45 89 93 10 01
info@kamstrup.dk

18 Documents

	Danish	English	German
Technical Description	5512-570	5512-571	5512-572
Data sheet	5810-624	5810-625	5810-626
Installation and User's guide	5512-602	5512-603	5512-604