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Application

MULTICAL® 403 is a static heat meter, cooling meter or combined heat/cooling meter based on the ultrasonic principle. The meter is intended for energy measurement in almost all types of thermal installations where water is used as the energy-conveying medium.

MULTICAL® 403 consists of a calculator, a flow sensor and two temperature sensors. MULTICAL® 403 has been developed for measurement of energy consumption in flats, single-family and multi-family houses, housing associations, blocks of flats and small industry. The meter is simple to install, and it has a temperature range of 2 ...180 °C and a meter programme with nominal flow from q_p 0.6 m³/h to 15 m³/h.

Due to its robust design and high quality, MULTICAL® 403 is practically maintenance-free, and its simple setup makes it easy to configure via the meter's front keys.

MULTICAL® 403 has been optimised compared to earlier generations. The total dynamic range has been increased to 1600:1 from saturation to start-up and the meter has an approved dynamic range of 250:1. It is thereby secured that every conceivable consumption is measured with the same well-known Kamstrup precision.

The meter can be powered by mains or battery supply as required. You can choose between a small battery without transport restrictions or a more powerful battery with 16 years' lifetime. No matter which solution you choose, the power consumption of MULTICAL® 403 is low.

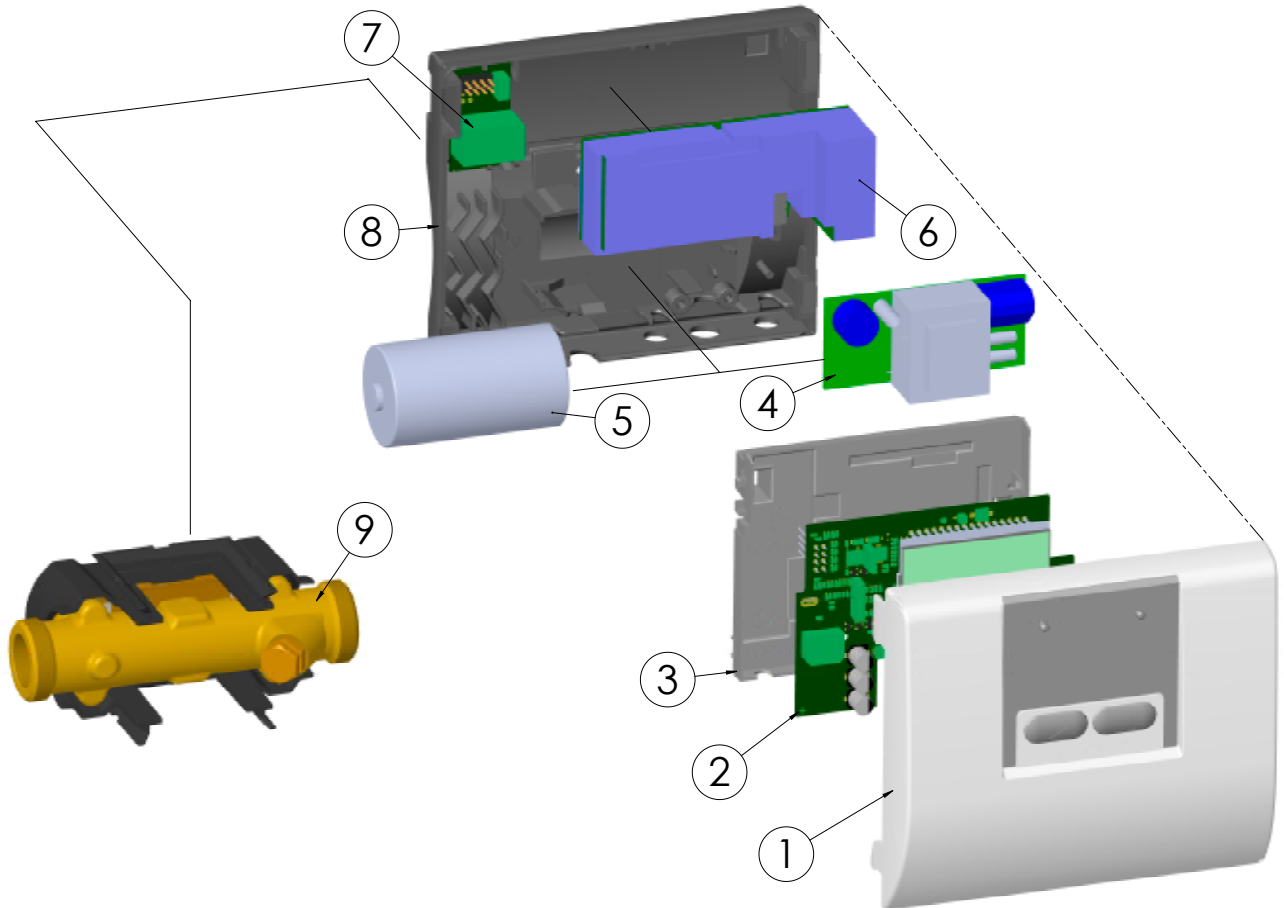
Volume is measured using bidirectional ultrasonic technique based on the transit time method, a proven long-term stable and accurate measuring principle.

Accumulated heat energy and/or cooling energy can be displayed in kWh, MWh or GJ, all in the form of seven or eight significant digits. The display has been specially designed with a view to obtaining longevity.

A wide range of parameters are configurable via the front keys of MULTICAL® 403: Flow sensor position in inlet or outlet, energy unit, primary M-Bus address, radio on/off, target dates, etc. Configuration can be carried out on site, thus contributing to a reduction of stocks and installation time.

MULTICAL® 403 is available with communication modules for Wireless M-Bus, M-Bus and RS232. The modules are available with either pulse inputs or pulse outputs. In addition to reading current values, the programmable data loggers of MULTICAL® 403 can be read via M-Bus.

Mechanical design



- 1 Top cover with front keys and laser engraving
- 2 PCB with micro-controller, flow-ASIC, display, etc.
- 3 PCB cover (may only be opened at an authorised laboratory)
- 4 Either a power supply module can be mounted
- 5 Or a battery can be mounted
- 6 Data module, e.g. M-Bus
- 7 Connection of temperature sensors
- 8 Bottom cover
- 9 Flow sensor (IP68)

Mechanical data

Weight	From 0.9 to 8.6 kgs depending on flow sensor size
Ambient temperature	5...55 °C. Non-condensing, closed location (indoor installation)
Protection class	
– Calculator	IP54
– Flow sensor	IP68
Medium temperatures	
– Heat meters 403-V/W	2...130 °C
– Cooling meters 403-C	2...50 °C
– Heat/cooling meters 403-T	2...130 °C
Medium in flow sensor	Water (district heating water as described in CEN TR 16911 and AGFW FW510)
Storage temperature	-25...60 °C (drained flow sensor)
Pressure stage	PN16/PN25
Flow sensor cable	1.5 m (cable non-demountable)
Connection cables	∅ 3.5...6 mm
Supply cables	∅ 5...8 mm

At medium temperature below ambient temperature or above 90 °C, we recommend wall-mounting of calculator.

Materials

Wetted parts

Case, coupling	Hot-pressed dezincification proof brass (CW 602N)
Case, flange	Stainless steel, material no. 1.4308
Transducer	Stainless steel, material no. 1.4404
O-rings	EPDM
Measuring tube	Thermoplastic, PES 30 % GF
Reflectors	Thermoplastic, PES 30 % GF and stainless steel, material no. 1.4306

Flow sensor case

Top/wall bracket	Thermoplastic, PC 20 % GF
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Calculator case

Top and base	Thermoplastic, PC 10 % GF with TPE (thermoplastic elastomer)
Internal cover	Thermoplastic, PC 10 % GF

Cables

Silicone cable with inner Teflon insulation

Approved meter data

Approvals

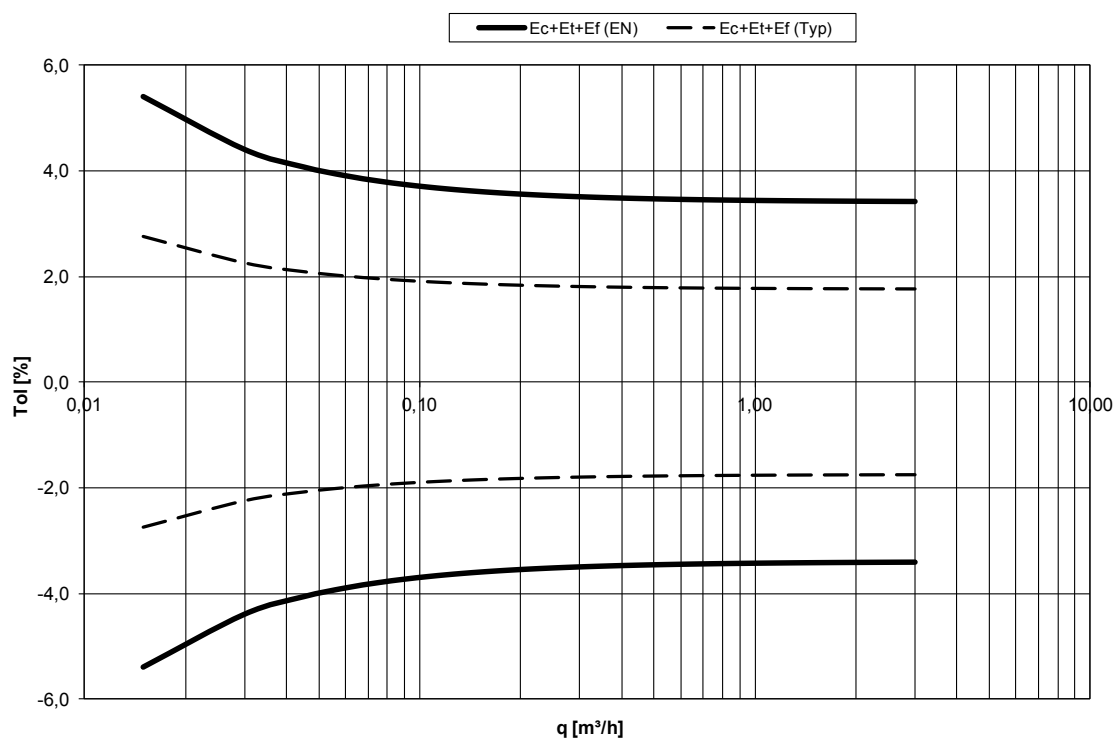
- Heat meter	DK-0200-MI004-037	The stated minimum temperatures are related to the type approval. The meter has no cut-off for low temperature and thus measures down to 0.01 °C and 0.01 K.
- Temperature range	θ : 2 °C...180 °C	
- Differential range	$\Delta\theta$: 3 K...178 K	
- Cooling meter	TS 27.02 009	
- Temperature range	θ : 2 °C...180 °C	
- Differential range	$\Delta\theta$: 3 K...178 K	
- Bifunctional heat/cooling meter	Marked with DK-0200-MI004-037 and TS 27.02 009 as well as the yearly mark of MID	
- Temperature range	θ : 2 °C...180 °C	
- Differential range	$\Delta\theta$: 3 K...178 K	
Standard	EN 1434:2015	
EU directives	Measuring Instruments Directive Low Voltage Directive Electromagnetic Compatibility Directive Radio Equipment Directive RoHS Directive Pressurised equipment Directive	
EN 1434 designation	Environmental class A	
MID designation		
- Mechanical environment	Class M1 and M2	
- Electromagnetic environment	Class E1 5...55 °C. Non-condensing, closed location (indoor installation)	
Temperature sensor connection		
- Type 403-V	Pt100 – EN 60751, 2-wire connection	
- Type 403-W/C/T	Pt500 – EN 60751, 2-wire connection	

Accuracy

Heat meter components	MPE according to EN 1434-1	MULTICAL® 403, typical accuracy
Calculator	$E_c = \pm [0.5 + \Delta\Theta \text{ min}/\Delta\Theta] \%$	$E_c = \pm [0.15 + 2/\Delta\Theta] \%$
Flow sensor	$E_f = \pm [2 + 0.02 q_p/q]$, but not exceeding $\pm 5 \%$	$E_f = \pm [1 + 0.01 q_p/q] \%$
Sensor pair	$E_t = \pm [0.5 + 3 \Delta\Theta \text{ min}/\Delta\Theta] \%$	$E_t = \pm [0.4 + 4/\Delta\Theta] \%$

Total typical accuracy of MULTICAL® 403 compared to EN 1434-1.

MULTICAL® 403 $q_p 1.5 \text{ m}^3/\text{h}$ @ $\Delta\Theta 30\text{K}$

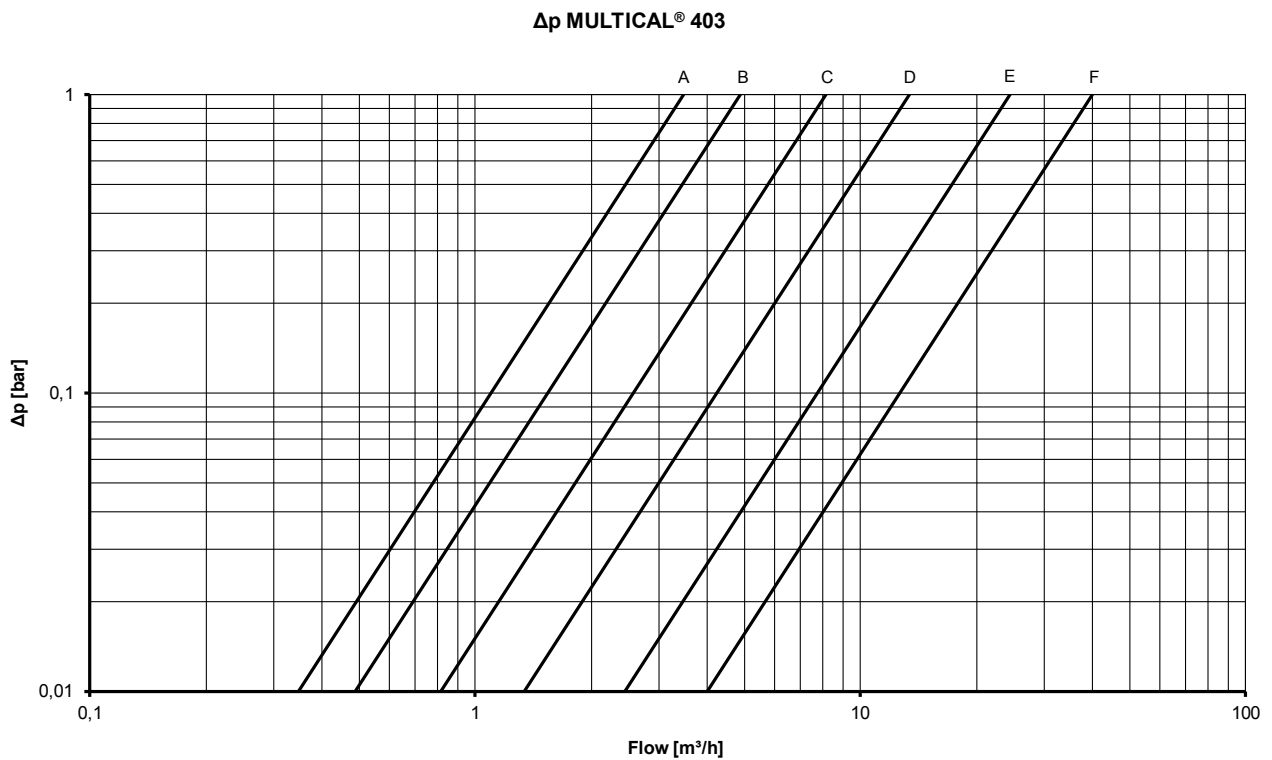


Pressure loss

Pressure loss in a flow sensor is stated as max pressure loss at q_p .
According to EN 1434, maximum pressure must not exceed 0.25 bar.

Graph	Nom. flow q_p [m ³ /h]	Max flow q_s [m ³ /h]	Min. flow q_i^* [l/h]	Min. flow cut-off [l/h]	Saturation flow [m ³ /h]	Nom. diameter [mm]	$\Delta p@q_p$ [bar]	k_v	$q@0.25$ bar [m ³ /h]
A	0.6	1.2	6	3	1.5	DN15/DN20	0.03	3.46	1.7
B	1.5	3.0	15	3	4.6	DN15/DN20	0.09	4.89	2.4
C	2.5	5.0	25	5	7.6	DN20	0.09	8.15	4.1
D	3.5	7.0	35	7	9.2	DN25	0.07	13.42	6.8
E	6	12	60	12	18	DN25	0.06	24.5	12.3
F	10	20	100	20	30	DN40	0.06	40.83	20.4
F	15	30	150	30	46	DN50	0.14	40.09	20.1

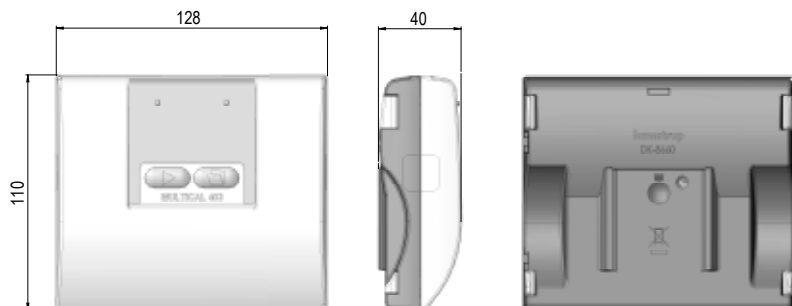
* Dynamic range $q_p:q_i = 100:1$



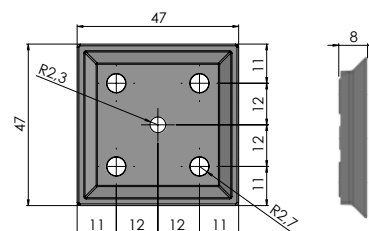
Dimensioned sketches

All measurements in [mm]

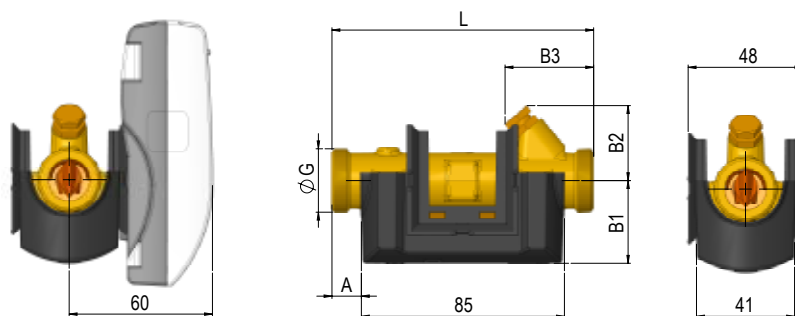
Mechanical measurements for calculator



Bracket for wall mounting



Flow sensor with G^{3/4} and G1 thread connection



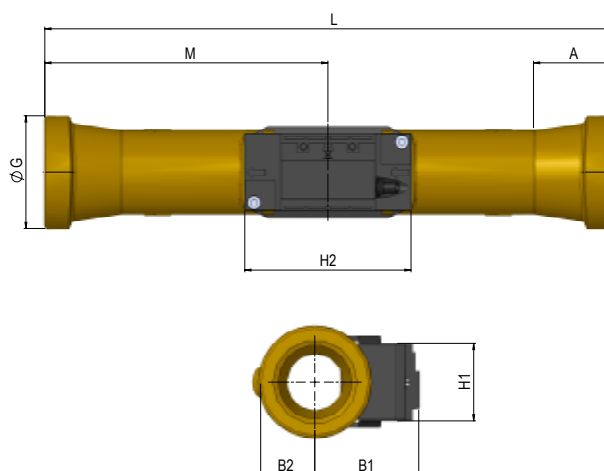
Nominal flow q_p [m ³ /h]	Thread G	L	A	B1	B2	B3	Approx. weight [kg] *
0.6 + 1.5	G ^{3/4} B	110	12	35	32	38	0.9
1.5	G ^{3/4} B	165	12	35	32	65	1.0
1.5	G1B	130	22	38	32	48	1.0
2.5	G1B	130	22	38	38	48	1.0
0.6 + 1.5	G1B	190	22	38	38	78	1.1
2.5	G1B	190	22	38	38	78	1.2

* Weight of calculator, flow sensor, 3 m sensor pair excl. packing

Dimensioned sketches

All measurements in [mm]

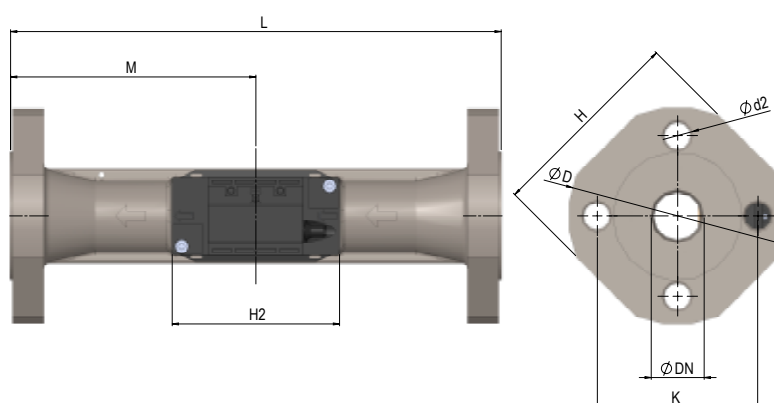
Flow sensor with G5/4 and G2 threaded connection



Nominal flow q_p [m ³ /h]	Thread G	L	M	H2	A	B1	B2	H1	Approx. weight [kg] *
3.5	G5/4B	260	130	88	16	51	20	41	2.0
6	G5/4B	260	130	88	16	53	20	41	2.1
10	G2B	300	150	88	40.2	55	29	41	3.0

* Weight of calculator, flow sensor, 3 m sensor pair excl. packing

Flow sensor with DN25, DN40 and DN50 flange connection



Nominal flow q_p [m ³ /h]	Nom. diameter DN	L	M	H2	D	H	K	Bolts			Approx. weight [kg] *
								Qty	Thread	d2	
6	DN25	260	130	88	115	106	85	4	M12	14	4.6
10	DN40	300	150	88	150	140	110	4	M16	18	7.5
15	DN50	270	155	88	165	145	125	4	M16	18	8.6

* Weight of calculator, flow sensor, 3 m sensor pair excl. packing

Electrical data

Calculator data

Display	LCD – 7 or 8 digits, digit height 8.2 mm
Resolutions	9999.999 – 99999.99 – 999999.9 – 9999999 99999.999 – 999999.99 – 9999999.9 – 99999999
Energy units	MWh – kWh – GJ
Data logger (EEPROM)	Programmable
– Log content	All registers can be selected
– Logging interval	From 1 minute to 1 year
– Logging depth	Default: 20 years, 36 months, 460 days, 1400 hours
Info logger (EEPROM)	50 info codes (50 latest are shown on the display)
Clock/calender (with backup battery)	Clock, calendar, leap year compensation, target date
Daylight saving time/wintertime (DST)	Programmable The function can be disabled so that “technical normal time” is used
Clock accuracy	Without external adjustment: Less than 15 min./year With external adjustment every 48 hours: Less than 7 s from legal time
Data communication	KMP protocol with CRC16 used for optical communication as well as for modules
Power in temperature sensors	< 10 µ W RMS
Power supply	3.6 VDC ± 0.1 VDC

Battery

Replacement interval	3.65 VDC, D-cell lithium	3.65 VDC, 2 x A-cells lithium
Wall-mounted	16 years @ $t_{BAT} < 30\text{ °C}$	9 years @ $t_{BAT} < 30\text{ °C}$
Mounted on flow sensor	14 years @ $t_{BAT} < 40\text{ °C}$	8 years @ $t_{BAT} < 40\text{ °C}$

Note: Depends on the meter and module configuration

Backup battery (for real-time clock)	3.0 VDC, BR-cell lithium
Mains supply	230 VAC +15/-30 %, 50/60 Hz 24 VAC ±50 %, 50/60 Hz
Insulation voltage	3.75 kV
Power consumption	< 1 W
Backup supply	Integral SuperCap eliminates interruptions due to short-term power failures (only supply modules type 7 and 8)

Electrical data

Temperature measurement	t1 Inlet temperature	t2 Outlet temperature	$\Delta\Theta$ (t1-t2) Heat measurement	$\Delta\Theta$ (t2-t1) Cooling measurement	t5 Preset for A1 and A2
Measuring range 2-wire, Pt100 [403-V] 2-wire, Pt500 [403-W/C/T]	0.01...185.00 °C				
Offset adjustment	± 0.99 K				

Max cable lengths (max \varnothing 6 mm cable)	Pt100, 2-wire	Pt500, 2-wire
	2 x 0.25 mm ² : 2.5 m 2 x 0.50 mm ² : 5 m 2 x 1.00 mm ² : 10 m	2 x 0.25 mm ² : 10 m 2 x 0.50 mm ² : 20 m

Pulse inputs In-A/In-B	Elektronical contact	Reed contact
Pulse input	680 k Ω pull-up for 3.6 V	680 k Ω pull-up for 3.6 V
Pulse ON	< 0.4 V for > 30 ms	< 0.4 V for > 500 ms
Pulse OFF	> 2.5 V for > 30 ms	> 2.5 V for > 500 ms
Pulse frequency	< 3 Hz	< 1 Hz
Electrical isolation	No	No
Max cable length	25 m	25 m
Requirements for external contact	Leakage current at function open < 1 μ A	

Pulse outputs Out-C/Out-D	HC-003-11 HC-003-21 and -31 (before 2017-05) (before 2018-04)	HC-003-11 HC-003-21 and -31 (after 2017-05) (after 2018-04)
Pulse output type	Open collector (OB)	Opto FET
External voltage	5...30 VDC	1...48 VDC/VAC
Current	< 10 mA	< 50 mA
Residual stress	$U_{CE} \approx 1$ V t 10 mA	$R_{ON} \leq 40 \Omega$
Electrical isolation	2 kV	2 kV
Max cable length	25 m	25 m

Product variants

				Static data Written on the meter's front 403-X XX X XX				Dynamic data Shown on display XX X XX				
MULTICAL® 403				Type 403-	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sensor connection												
Pt100 heat meter				V								
Pt500 heat meter				W								
Pt500 cooling meter				C								
Pt500 cooling meter and heat/cooling meter				T								
Flow sensor	Connection	Length	Dynamic									
q _p [m ³ /h]		[mm]	range									
0.6	G½B (R½)	110	100:1	10								
0.6	G1B (R¾)	190	100:1	30								
1.5	G½B (R½)	110	100:1	40								
1.5	G¾B (R¾)	165	100:1	50								
1.5	G1B (R¾)	110	100:1	60								
1.5	G1B (R¾)	130	100:1	70								
1.5	G1B (R¾)	165	100:1	80 (130 mm with extension)								
1.5	G1B (R¾)	190	100:1	90								
2.5	G1B (R¾)	130	100:1	A0								
2.5	G1B (R¾)	190	100:1	B0								
3.5	G5/4B (R1)	260	100:1	D0								
6.0	G5/4B (R1)	260	100:1	F0								
6.0	DN25	260	100:1	G0								
10	G2B (R1½)	300	100:1	H0								
10	DN40	300	100:1	J0								
15	DN50	270	100:1	K0								
Meter type												
Heat meter (MID module B)				1								
Heat meter (MID modules B+D)				2								
Heat/cooling meter (MID modules B+D & TS+DK268)				3								
Heat meter (national approvals)				4								
Cooling meter (TS+DK268)				5								
Heat/cooling meter				6								
Volume meter, hot				7								
Volume meter, cold				8								
Country code												
Determined by Kamstrup upon receipt of order				XX								

Note: The flow sensor is approved for the dynamic areas q_p:q_i 250:1 and 100:1, but is, by default, delivered as q_p:q_i 100:1.

Product variants

	Static data Written on the meter's front 403-X XX X XX -				Dynamic data Shown on display XX X XX			
MULTICAL® 403	Type 403-				-			
Temperature sensor set								
Supplied without temperature sensors								00
2-wire Pt500 temperature sensors								
Direct short temperature sensors, 2 pcs.	DS 27.5 mm		1.5 m - 3 m					1x
Direct short temperature sensors, 2 pcs.	DS 38 mm		1.5 m - 3 m					2x
Pocket temperature sensors, 2 pcs.	PL ø5.8 mm		1.5 m - 10 m					3x
2-wire Pt100 temperature sensors								
Direct short temperature sensors, 2 pcs.	DS 27.5 mm or DS 38 mm		2 m					Jx
Supply								
No supply								0
Battery, 1 x D-cell								2
230 VAC supply								7
24 VAC supply								8
Battery, 2 x A-cells								9
Modules								
No module								00
Data Pulse, inputs (In-A, In-B)								10
Data Pulse, outputs (Out-C, Out-D)								11
Wired M-Bus, inputs (In-A, In-B)								20
Wired M-Bus, outputs (Out-C, Out-D)								21
Wired M-Bus, Thermal Disconnect								22
Wireless M-Bus, inputs (In-A, In-B), 868 MHz								30
Wireless M-Bus, outputs (Out-C, Out-D), 868 MHz								31
linkIQ/wM-Bus, inputs (In-A, In-B), EU								32
linkIQ/wM-Bus, outputs (Out-C, Out-D), EU								33
wM-Bus, inputs (In-A, In-B), 912,5/915/918,5 MHz								34
Analog outputs 2 x 0/4...20 mA								40
PQT Controller								43
Low Power Radio, inputs (In-A, In-B), 434 MHz								50
Low Power Radio GDPR, inputs (In-A, In-B), 434 MHz								51
BACnet MS/TP, inputs (In-A, In-B)								66
Modbus RTU, inputs (In-A, In-B)								67

* The meter must be mains-supplied.

Contact Kamstrup for further information about product variants.

Meter configuration

	A	B	CCC	DDD	EE	FF	GG	L	N	PP	RR	T	VVV
Flow sensor position													
Inlet		3											
Outlet		4											
Measuring unit													
GJ		2											
kWh		3											
MWh		4											
Flow sensor coding													
7-digit CCC-codes			4xx										
8-digit CCC-codes			5xx										
Display													
Heat meter				210									
Heat/cooling meter				310									
Cooling meter				510									
Tariffs													
No active tariff					00								
Power tariff					11								
Flow tariff					12								
t1-t2 tariff					13								
Inlet tariff					14								
Outlet tariff					15								
Time-controlled tariff					19								
Heat/cooling volume tariff					20								
PQ tariff					21								
Pulse inputs A and B													
10 l/imp, pre-counter 1 (<10 m ³ /h)						24	24						
Integration mode													
Adaptive mode (4-64 s)									1				
Normal mode (32 s)									2				
Fast mode (4 s)									3				
Cold water leak detection (input A)													
OFF												0	
30 min. without pulses												1	
1 hour without pulses												2	
2 hours without pulses												3	
Pulse outputs Out-C/Out-D													
Out-C: V1/4			5.0 ms										73
Out-C: V1/1			3.9 ms										82
Out-C: V1/4			22 ms										83
E1 and V1 or E3 and V1			32 ms										95
E1 and V1 or E3 and V1			100 ms (0.1 s)										96
Controlled output based on data commands													99
Data logger profile													
Standard data logger profile													10
Encryption level													
Individual key													3
Customer label													
Serial number													0000

Contact Kamstrup A/S for further information about meter configuration.

Info codes in display

Display digit								Description
1	2	3	4	5	6	7	8	
Info	t1	t2	0	V1	0	In-A	In-B	
1								No voltage supply
2								Low battery level
9								External alarm (e.g. via KMP)
	1							t1 above measuring range or switched off
		1						t2 above measuring range or switched off
	2							t1 below measuring range or short-circuited
		2						t2 below measuring range or short-circuited
	9	9						Invalid temperature difference (t1-t2)
				3				V1 air
				4				V1 wrong flow direction
				6				V1 > q _s for more than an hour
						8		Pulse input A Leakage in system
						9		Pulse input A External alarm
							8	Pulse input B Leakage in system
							9	Pulse input B External alarm

Example:

1	0	2	0	0	0	9	0	
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Note: Info codes are configurable. Therefore, it is not certain that all the above parameters are available in a given MULTICAL® 403.

An info logger saves the info code every time the info log is changed. It is possible to read the latest 50 changes of the info code and the date of the change.

Accessories

Article number	Description
HC-993-09	Battery module with two A-cells
HC-993-02	Battery module with one D-cell
HC-993-07	230 VAC supply module
HC-993-08	24 VAC supply module
3026-517	Sealing cap for temperature sensors, blue 2 pcs.
3026-518	Sealing cap for temperature sensors, red 2 pcs.
3026-655.A	Wall bracket
3026-902	Bracket for mounting MULTICAL® 403 on wall bracket for MULTICAL® 402
3026-909	Holder for optical readout head
3026-961	Disassemble tool base
3026-962	Disassemble tool bracket
3130-262	Blind plug with O-ring
3130-269	Cable clamp with screws
5000-337	Module cable, 2 m (2 x 0.25 mm ²)
6699-035	USB module configuration cable
6699-042	Metal plate for optical read-out head (20 pcs)
6699-043	Accessory bag with sealing buds
6699-047	Supply label MULTICAL® 403/603, 10 pcs. (2006-681)
6699-099	Infrared optical reading head w/USB plug
6699-403	230/24 VAC safety transformer 5 VA
6699-404	230/24 VAC safety transformer 10 VA
6699-405	230/12/24 VAC safety transformer 63 VA
6699-447.E	Internal antenna for Kamstrup radio, 434 MHz
6699-448	Mini Triangle antenna for Wireless M-Bus and 2G/4G Network Module
6699-482.E	Internal antenna for Wireless M-Bus 868 MHz
6699-724	METERTOOL HCW
6699-725	LogView HCW

Calibration units

Article number	Description
6699-367	Verification unit for MULTICAL® 403, Pt100, heat/cooling (used with METERTOOL HCW)
6699-366	Verification unit for MULTICAL® 403, Pt500, heat/cooling (used with METERTOOL HCW)

Find more information on ULTRAFLOW®, temperature sensors and ball valves on products.kamstrup.com.

Contact Kamstrup A/S for information about further accessories.

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