kamstrup

Data sheet

MULTICAL® 403

- Programmable data logger with AMR
- Configurable M-Bus modules with logger reading
- On site configuration via front keys
- Highly flexible modular design
- Pulse inputs and pulse outputs
- Real-time clock backup
- 16 years' battery lifetime
- IP68 flow sensor

MID

CE M16 0200

EN 1434

DK-BEK 1178

DK 268 16

EN 1434

Contents

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 m^3/h to 15 m^3/h.

Robust and accurate

Due to its robust design and high quality MULTICAL® 403 is practically maintenance free, and its simple set-up 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.

Functionality

Volume is measured using bidirectional ultrasonic technique based on the transit time method, proven a 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.

Energy calculation

MULTICAL® 403 calculates energy on the basis of the formula stated in EN 1434-1, 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 $\Delta\Theta$ x k.

V is the added volume of water

$\Delta\Theta$ is the measured temperature difference

k is the heat coefficient of the water

The calculator always calculates energy in [Wh], which are subsequently converted into the selected measuring unit.

E [Wh] =	V x $\Delta\Theta$ x k x 1000
E [kWh] =	E [Wh] / 1,000
E [MWh] =	E [Wh] / 1,000,000
E [GJ] =	E [Wh] / 277,800

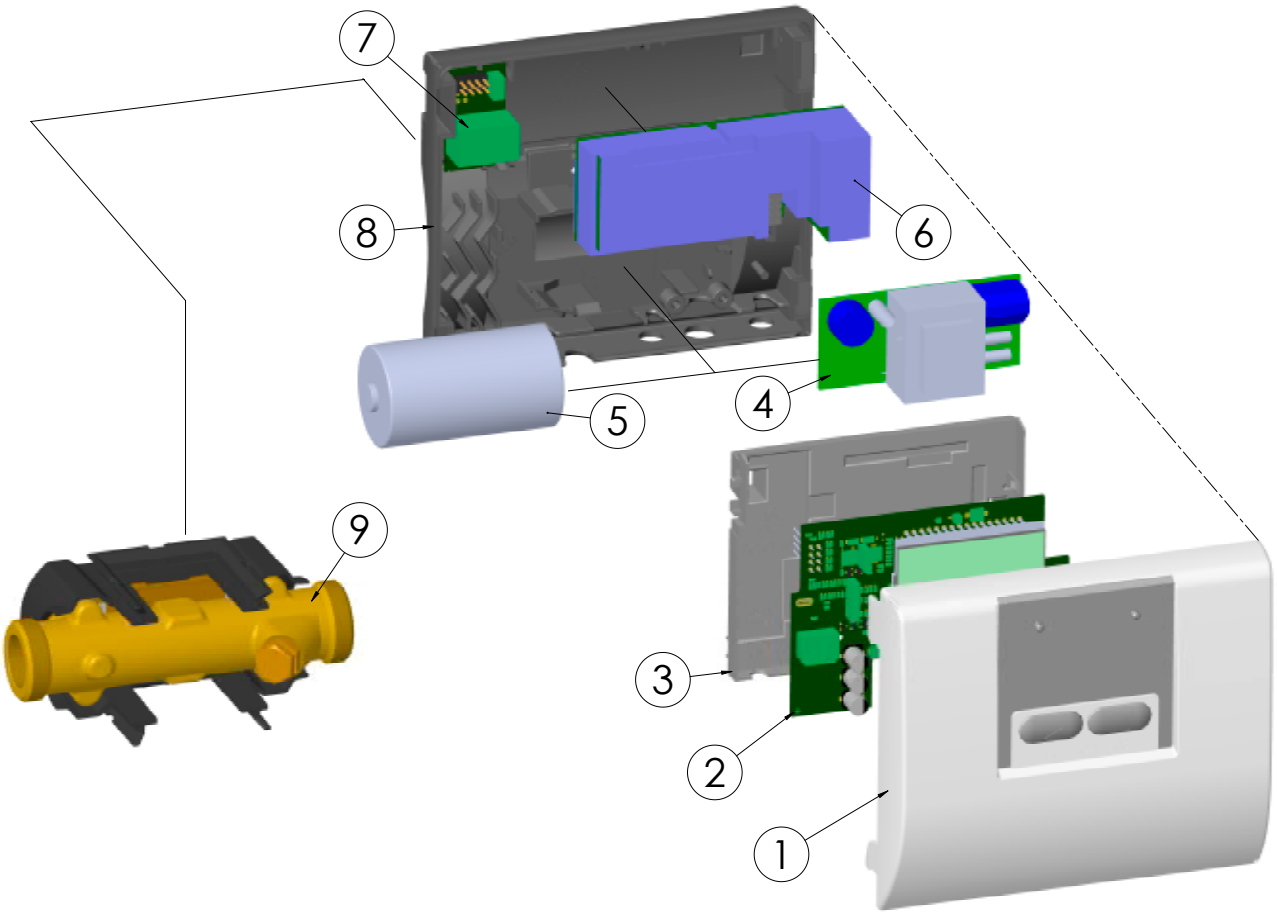
MULTICAL® 403 operates with a number of different energy registers. All energy types are data logged and can be displayed according to configuration. Both in the display and during data reading each energy type is uniquely defined. The energies are calculated as follows:

E1 = V1 x (t1-t2) x k	Heat energy (V1 in inlet or outlet)
E3 = V1 x (t2-t1) x k	Cooling energy (V1 in inlet or outlet)
E8 = V1 x t1	Average temperature (inlet)
E9 = V1 x t2	Average temperature (outlet)
A1 = V1 x (t5-t2) x k_{t2}	Heat energy with discount
A2 = V1 x (t2-t5) x k_{t2}	Heat energy with surcharge

Application Examples

Application A	**Application B**	**Application C**
Closed heating system with one flow sensor	Closed cooling system with one flow sensor	Closed heat/cooling system with one flow sensor
MID approved heat meter: 403-x-xx-2-xx (meter type 2)	TS approved cooling meter: 403-x-xx-5-xx (meter type 5)	MID and TS approved heat/cooling meter: 403-x-xx-3-xx (meter type 3)
Pt500 sensor connection: 403-W-xx-x-xx Pt100 sensor connection: 403-V-xx-x-xx	Pt500 sensor connection: 403-T-xx-x-xx	Pt500 sensor connection: 403-T-xx-x-xx
Heat energy: E1 = V1 x (t1-t2) x k	Cooling energy: E3 = V1 x (t2-t1) x k	Heat energy: E1 = V1 x (t1-t2) x k Cooling energy: E3 = V1 x (t2-t1) x k
Flow sensor in inlet: Configuration of A-code = 3 Flow sensor in outlet: Configuration of A-code = 4	Flow sensor in inlet: Configuration of A-code = 3 Flow sensor in outlet: Configuration of A-code = 4	Flow sensor in inlet: Configuration of A-code = 3 Flow sensor in outlet: Configuration of A-code = 4

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 (IP 68)

Variant structure

MULTICAL® 403 is available in various combinations as required by the customer. First select the required hardware from the type number overview, and next select the required software configuration via the configuration number. Furthermore, a number of data are configured under the country code, e.g. adjustment of clock, primary M-Bus address as well as yearly and monthly target date. Through these selections and configurations MULTICAL® 403 can be adjusted to its current task. The supplied meter has been configured from the factory and is ready for use, however it can also be changed/reconfigured after installation. Before commissioning the meter can be reconfigured via the meter's front keys. After commissioning either METERTOOL HCW or READy must be used.

Type number overview

					Static data 403-XXXXXX Written on the meter's front					Dynamic data XXXXX Shown in display		
MULTICAL® 403				**Type 403-**	□	□□	□	□□	–	□□	□	□□
Sensor connection												
Pt100 Heat meter					V							
Pt500 Heat meter					W							
Pt500 Cooling meter and heat/cooling meter					T							
Flow sensor q_p [m³/h]	**Connection**	**Length [mm]**	**Dynamic range ***									
0.6	G¾B (R½)	110	100:1			10						
0.6	G1B (R¾)	190	100:1			30						
1.5	G¾B (R½)	110	100:1			40						
1.5	G¾B (R½)	165	100:1			50						
1.5	G1B (R¾)	130	100:1			70						
1.5	G1B (R¾)	165	100:1	(130 mm with extension)		80						
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	G1¼B (R1)	260	100:1			D0						
6.0	G1¼B (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							7					
Country code												
Determined by Kamstrup upon receipt of order								XX				
Sensor pair		**Length** [mm]	**Size Ø** [mm]	**Cable length** [m]								
No sensor pair		-	-	-						00		
Short direct temp. sensor pair		27.5		1.5						11		
Short direct temp. sensor pair		27.5		3.0						12		
Pocket sensor pair			5.8	1.5						31		
Pocket sensor pair			5.8	3.0						32		
Supply												
No supply											0	
Battery, 2 x AA-cells											1	
Battery, 1 x D-cell											2	
230 VAC Supply											7	
24 VAC Supply											8	
Modules												
No module												00
Data + 2 pulse inputs (A, B)												10
Data + 2 pulse outputs (C, D)												11
M-Bus, configurable + 2 pulse inputs (A, B)												20
M-Bus, configurable + 2 pulse outputs (C, D)												21
Wireless M-Bus, EU, configurable, 868 MHz + 2 pulse inputs (A, B)												30

* Flow sensors are by default supplied with dynamic range 100:1. Dynamic range 250:1 is available for selected country codes.Please contact Kamstrup for information on the availability of the above MULTICAL® 403 variants on the individual markets.

Configuration

The software configuration of MULTICAL® 403 is defined on the basis of the configuration number. Below is an overview of the meter's configuration number. The overview is not complete, it shows a standard configuration. See the technical description on the meter for the complete overview or contact Kamstrup for information on possible meter configurations.

A	B	CCC	DDD	EE	FF	GG	L	N	PP	RR	T	VVVV
Flow sensor position												
Inlet 3												
Outlet 4												
	Measuring unit											
	GJ 2											
	kWh 3											
	MWh 4											
		Flow sensor coding										
		See CCC-code tables below CCC										
			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 m³/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 duration of pulse outputs C and D			
									32 ms 95			
									100 ms (0.1 s) 96			
									Controlled output			
									Controlled output based on data commands 99			
										Data logger profile *		
										Standard data logger profile 10		
											Encryption level	
											Common key 2	
											Individual key 3	
												Customer label *
												Serial number 0000

* See the technical description on the meter for information on other possible configurations or contact Kamstrup for more details.

Configuration

The CCC-code optimises the display resolution for the selected flow sensor size, and at the same time the type approval regulations as to minimum resolution and maximum register overflow are observed. The CCC-codes are divided into two tables for standard resolution and high resolution respectively.

Standard CCC-codes

CCC-codes for MULTICAL® 403									
CCC No.	Number of decimals in display							q_p (m^3/h)	Type 403-xXXxxx-xxxxx
	kWh	MWh	GJ	m^3	l/h	m^3/h	kW		
416	0	3	2	2	0	-	1	0.6	1x-3x
419	0	3	2	2	0	-	1	1.5	4x-5x-7x-8x-9x
498	0	3	2	2	0	-	1	2.5	Ax-Bx
451	-	2	1	1	0	-	1	3.5	Dx
437	-	2	1	1	0	-	1	6.0	Fx-Gx
478	-	2	1	1	0	-	1	10	Hx-Jx
420	-	2	1	1	0	-	1	15	Kx
490	-	1	0	0	0	-	1	15	Kx

CCC-codes with high resolution

If modules with pulse outputs are selected, CCC-codes with high resolutions can reduce the battery lifetime.

CCC-codes for MULTICAL® 403									
CCC No.	Number of decimals in display							q_p (m^3/h)	Type 403-xXXxxx-xxxxx
	kWh	MWh	GJ	m^3	l/h	m^3/h	kW		
484	1	-	3	3	0	-	1	0.6	1x-3x
407	1	-	3	3	0	-	1	1.5	4x-5x-7x-8x-9x
455	1	-	3	2	0	-	1	1.5	4x-5x-7x-8x-9x
454	1	-	3	3	0	-	1	2.5	Ax-Bx
459	1	-	3	2	0	-	1	2.5	Ax-Bx
436	0	3	2	2	0	-	1	3.5	Dx
438	0	3	2	2	0	-	1	6.0	Fx-Gx
483	0	3	2	2	0	-	1	10	Hx-Jx
485	0	3	2	2	0	-	1	15	Kx

Calculator functions

Pulse inputs A and B

MULTICAL® 403 has two extra pulse inputs (A and B), which are placed on selected communication modules. The pulse inputs are used for acquisition and remote accumulation of pulses from e.g. mechanical water meters and electricity meters. The pulse inputs function independently of the meter itself. Therefore, they are not included in any energy calculations. The two pulse inputs are identically constructed and can be individually set up to receive pulses from water meters or electricity meters.

Pulse outputs C and D

MULTICAL® 403 has two extra pulse outputs (C and D), which are placed on selected communication modules. The pulse outputs provide output from selected counter registers determined by the country code. As the meter has two pulse outputs, it is possible to provide output from two of the following counter registers via pulse outputs C and D respectively:

- E1 (Heat energy)
- E3 (Cooling energy)
- V1 (Volume)

Note: As selected counter registers are configured by the country code, the configuration cannot be changed after delivery.

Pulse outputs are by default configured for the following registers:

Meter function	Output C	Output D	Meter type
Heat meter	E1	V1	1, 2, 4
Heat/cooling meter	E1	E3	3, 6
Cooling meter	E3	V1	5
Volume meter	V1	V1	7

The resolutions of pulse outputs always follow the least significant digit in the display, which is determined by the CCC-code e.g. at CCC=119: 1 pulse/kWh and 1 pulse/0.01 m^3.

Data logger

MULTICAL® 403 has a permanent memory (EEPROM), in which the results from various data loggers are saved. The data logger is programmable. The required data logger profile is selected via the RR-code of the configuration number. Unless otherwise stated by the customer the RR-code is set at 10, which is the default data logger profile. This default data logger profile logs the same data logger registers as MULTICAL® 602, but the logging depth is wider (see table below). Both data logger registers and logging depths are programmable, and individual logging profiles can be prepared as required by the customer. Please contact Kamstrup for further details.

The default data logger profile (RR-code = 10) includes the following six data loggers with allocated depths:

Data logging interval	Default data logging depth (RR = 10)
Yearly logger	20 years
Monthly logger	36 months
Daily logger	460 days
Hourly logger	1400 hours
Minute logger 1-60 min.	0
Minute logger 1-60 min.	0

Calculator functions

Integration mode

MULTICAL® 403 uses time-based integration, which means that calculations of accumulated volume and energy are carried out at fixed time intervals. The time interval is configurable via the L-code and is independent of the water flow. Please be aware that choice of integration mode in combination with selected power supply defines the meter's battery lifetime.

The meter has six optional integration modes; three modes, in which the meter's display remains switched on and three modes, in which the meter's display is switched off 4 min. after the latest registered activation of a front key. During periods with the display switched off a dot flashes (heart beat indication) at intervals of 30 seconds to indicate that the meter is active.

Integration mode	L-code	
	Display on	Display off
Adaptive mode (4-64 s)	1	5
Normal mode (32 s)	2	6
Fast mode (4 s)	3	7

- **Adaptive mode (4-64 s)**
  Adaptive mode is the meter's intelligent integration mode, in which the time interval is continuously adjusted. This mode combines the long battery lifetime obtained in Normal mode with the high measuring and calculation resolution obtained in Fast mode.
  Thus, in adaptive mode MULTICAL® 403 measures at high resolution during periods with changes in the system requiring accurate measurements and saves battery power during stable periods.
  Adaptive mode is recommended for all systems including those with tap water exchanger.
- **Normal mode (32 s)**
  In normal mode the integration interval is set at 32 seconds, which means that the meter calculates accumulated volume and energy every 32 seconds.
  Normal mode is recommended for systems with hot water tank and similar systems.
- **Fast mode (4 s)**
  In fast mode the integration interval is set at 4 seconds, which means that the meter calculates accumulated volume and energy every 4 seconds. Fast mode is recommended for all systems including those with tap water exchanger.

Tariffs

MULTICAL® 403 has 3 extra tariff registers TA2, TA3 and TA4, which can accumulate heat energy or cooling energy (EE=20 accumulates volume) parallel with the main register based on preprogrammed tariff conditions (to be included in the order). Irrespective of the selected tariff type, the tariff registers are named TA2, TA3 and TA4 in the display.

As the main register is considered the legal billing register, it is accumulated no matter the selected tariff function. Tariff conditions TL2, TL3 and TL4 are monitored at every integration. If the tariff conditions are fulfilled, consumed heat energy, cooling energy or volume is accumulated in either TA2, TA3 or TA4 parallel with the main register.

Calculator functions

Coefficient of performance (CP) of a heat pump

In houses with heat pumps with single output it is expedient to measure both the released thermal energy and the gained electrical energy, based on which the coefficient of performance (COP or CP) can be calculated. COP is the abbreviation of "Coefficient Of Performance".

The calculation is based on simple proportional numbers between calculated thermal energy (E1) and electrical energy, which is measured via pulse input B (Input B):

$$CP = \frac{\text{Thermal energy [E1]}}{\text{Electrical energy [Input B]}}$$

Electrical energy (Input B) is always registered in kWh, whereas thermal energy (E1) is either registered in kWh, MWh or in GJ depending on the selected B-code. No matter which unit you choose the meter calculates CP correctly. The CP value is displayed with one decimal and is a value in the interval 0.0...19.9.

CP can also be used for measurement in gas-fired systems, CP being expressed as kWh/Nm^3 gas.

Configurable M-Bus modules

In the module bay of MULTICAL® 403 a communication module can be mounted, adapting the meter to various applications. The M-Bus module is powered 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 a digital isolator providing galvanic separation between M-Bus and meter. The module supports both primary, secondary and enhanced secondary addressing. The module can communicate at communication speeds of 300, 2400, 9600 or 19200 baud and automatically detects the speed used.

The output data package can be configured to include various register combinations by means of the programs METERTOOL HCW and READy Manager.

The module can be read at intervals of 10 seconds without the battery lifetime being influenced.

Calculator functions

Info codes

MULTICAL® 403 constantly monitors a number of important functions. If a serious error occurs in measuring system or installation, a flashing "INFO" will appear in the display. The "INFO" field keeps flashing as long as the error is present no matter which reading you choose. The "INFO"-field is automatically switched off when the error has been corrected.

In addition to the "INFO"-field the current info code can be displayed. In MULTICAL® 403 each digit of the info code is dedicated to one of the meter's elements. The below table shows the info code structure together with an example of the info code.

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	

* This parameter of the info code does not appear from the current info code as it is only active when the meter is without supply. The info code is saved in the info log, and thus it will appear from the info log that the meter has been without power supply.

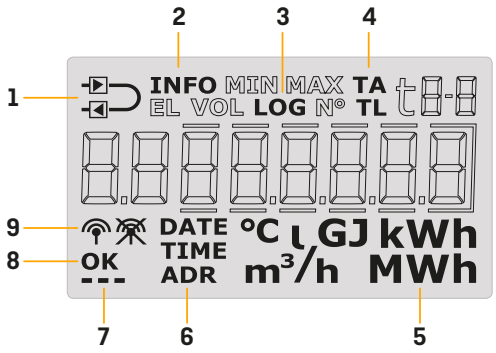
** The info code for leakage at pulse input B, must be actively selected.

Note: Info codes are configurable. Therefore, it is not certain that all above-mentioned parameters are available in a given MULTICAL® 403. This depends on the selected country code.

An info logger saves the info code every time the info code is changed. The latest 50 changes are saved. The 50 changes plus the corresponding date can be read from the display.

Display

MULTICAL® 403 has a bright and clear display including 7 or 8 digits (depending on configuration) as well as a number of symbols for e.g. measuring units, info, inlet and outlet, radio on/off etc. The display is switched on by pressing either the primary or the secondary key on the meter's front. The display reverts to energy indication 4 minutes after the latest activation of a front key. Depending on the L-code the display switches off after 4 more minutes, but switches on again at the activation of a front key.



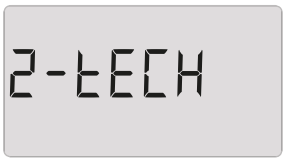
1 The meter is configured as inlet or outlet meter
2 Flashes at active info code
3 Historical readings
4 Tariff registers/tariff limits
5 Measuring unit
6 Date, time and address
7 "Heart beat"-indication shows that both meter and display are active
8 "OK" is displayed when a changed value has been saved
9 The meter's radio communication is switched on or off

By means of the meter's primary key you can choose from and switch between the meter's four display loops. When delivered the meter is in transport state, which means that USER, TECH and SETUP loops are available. Depending on country code, SETUP loop can be locked in transport state and is thereby not available on delivery. TEST loop can only be accessed if the test seal is broken.

The meter's four display loops are intended for four different usage situations.

- **USER loop**
  The meter's configurable display loop, which is intended for the user. The readings in this loop can be adjusted to the user's requirements via the DDD-code.

- **TECH loop**
  This loop is intended for technicians and is not configurable. In this loop all the meter's readings are shown. The loop comprises readings such as serial number, date, time, config no., software revision, segment test. TECH loop also comprises a number of fixed module readings as well as a number of module readings, which depend on the module.



- **SETUP loop**
  This loop is intended for the technician too. In this loop the technician can configure the meter via the front keys. In general (unless otherwise informed by the customer) the loop is open in transport state. When the first integration has been carried out by the meter, SETUP loop is locked and it is no longer possible to access SETUP loop unless the installation seal is broken.

- **TEST loop**
  Used by certified laboratories for reverification of the meter. This loop is not available unless the meter's test seal is broken.

Approved meter data

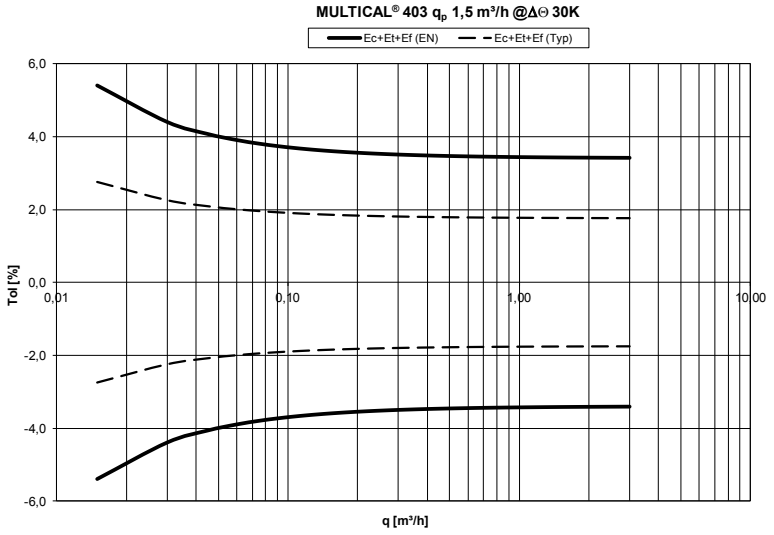
Approvals	DK-0200-MI004-037, heat meter TS 27.02 009, cooling meter and heat/cooling meter
Standards	EN 1434:2007 and EN 1434:2015
EU directives	Measuring Instruments Directive, Low Voltage Directive, Electromagnetic Compatibility Directive, Pressurised equipment Directive
Heat meter Temperature range Differential range	DK-0200-MI004-037 θ: 2 °C...180 °C $\Delta\Theta$: 3 K...178 K
Cooling meter and heat/cooling meter Temperature range Differential range	TS 27.02 009 θ: 2 °C...180 °C $\Delta\Theta$: 3 K...178 K
Temperature of medium	θ: 2 °C...130 °C
Accuracy - Calculator - Flow sensor	 $E_C = \pm (0.5 + \Delta\Theta_{min}/\Delta\Theta)$ % $E_f = \pm (2 + 0.02\ q_p/q)$, but not exceeding ±5 %
Temperature sensor connection -Type 403-V -Type 403-W/T	 Pt100 – EN 60751, 2-wire connection Pt500 – EN 60751, 2-wire connection
EN 1434 designation	Environmental class A
MID designation	Mechanical environment: Class M1 and M2 Electromagnetic environment: Class E1 Non-condensing environment, closed location (indoors), 5...55 °C

The stated minimum temperatures are related to the type approval. The meter has no cutoff for low temperature and thus measures down to 0.01 °C and 0.01 K.

Accuracy

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

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

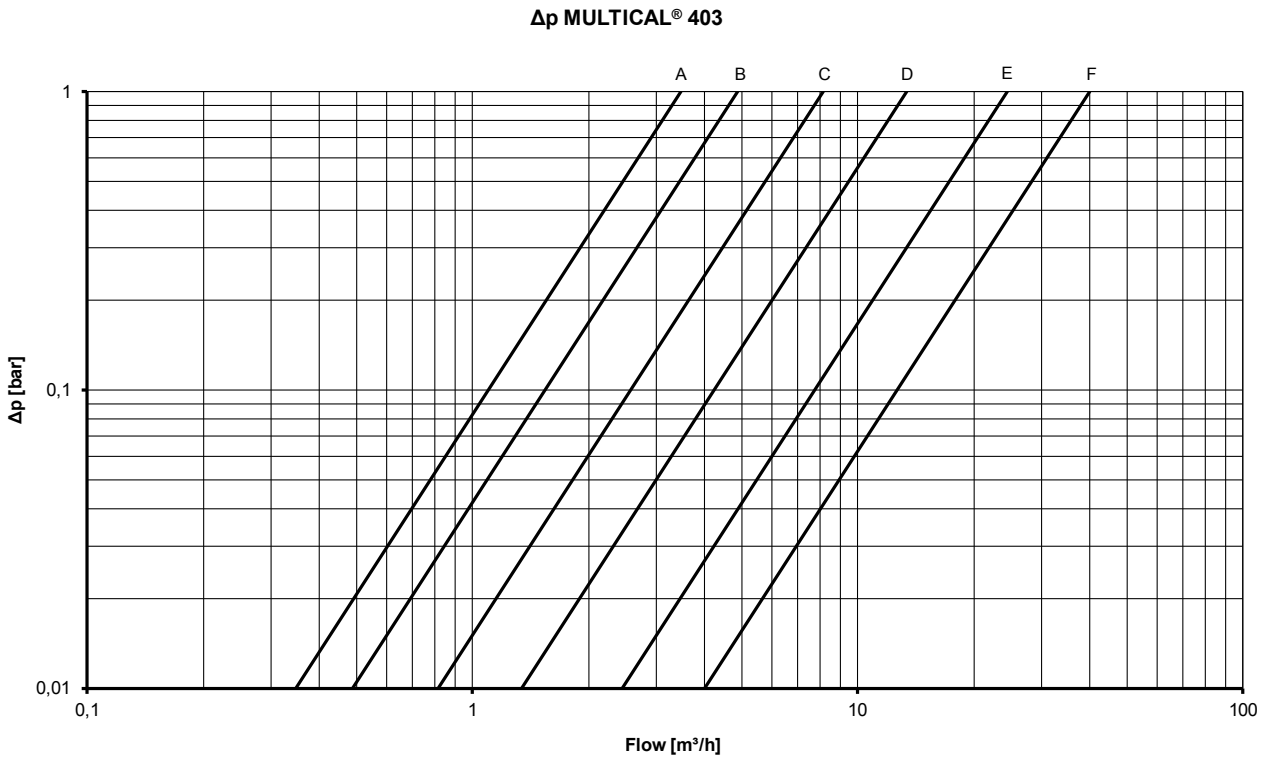


Pressure loss

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 [m³/h]	Max flow q_s [m³/h]	Min. flow q_i * [l/h]	Min. flow cut-off [l/h]	Saturation flow [m³/h]	Nom. diameter [mm]	Δp@q_p [bar]	k_v	q@0.25 bar [m³/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



Electrical data

Calculator data

Typical accuracy	Calculator: $E_C \pm (0.15 + 2/\Delta\Theta)$ % Sensor pair: $E_t = \pm (0.4 + 4/\Delta\Theta)$ %
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)	Logging intervals: From one minute to one year
Programmable	Logging content: All registers can be selected Standard logger profile: 20 years, 36 months, 460 days, 1400 hours
Info logger (Eeprom)	50 info codes
Clock/calender (with backup battery)	Clock, calendar, leap year compensation, target date
Summer/winter time	Programmable under country code The function can be disabled so that "technical normal time" is used
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, 2xAA-cells lithium
Wall mounted	16 years @ t_{BAT} < 30 °C	8 years @ t_{BAT} < 30 °C
Mounted on flow sensor	14 years @ t_{BAT} < 40 °C	7 years @ t_{BAT} < 40 °C

Please note that the battery lifetime will be reduced if the integration mode "Fast mode" is selected.
See Technical Description for further details.

Back-up 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
Back-up supply	Integral SuperCap eliminates interruptions due to short-term power failures (only supply modules type 7 and 8)
EMC data	Fulfil EN 1434 class A (MID class E1)

Electrical data

Temperature measurement	**t1 Inlet temperature**	**t2 Outlet temperature**	**ΔΘ (t1-t2) Heat measurement**	**ΔΘ (t2-t1) Cooling measurement**	**t5 Preset for A1 and A2**
Measuring range 402-V 2-W Pt100 402-W/T 2-W Pt500	0.01...185.00 °C				
Offset adjustment	± 0.99 K				

Max. cable lengths (Max. ø6 mm cable)	**Pt100, 2-wire**	**Pt500, 2-wire**
	2 x 0.25 mm²: 2.5 m 2 x 0.50 mm²: 5 m 2 x 1.00 mm²: 10 m	2 x 0.25 mm²: 10 m 2 x 0.50 mm²: 20 m

Pulse inputs **Terminal connection: In-A 65-66 and In-B: 67-68 via module**	**Water meter connection**
Pulse input	680 kΩ pull-up for 3.6 V
Pulse ON	< 0.4 V for > 30 ms
Pulse OFF	> 2.5 V for > 1.1 s
Pulse frequency	< 0.5 Hz
Electrical isolation	No
Max. cable length	25 m
Requirements to external contact	Leakage current at function open < 1 µA

Pulse outputs **Terminal connection: Out-C: 16-17 and Out-D: 18-19 via module**	
Pulse value	Heat meter: E1 and V1 Cooling meter: E3 and V1 Heat/cooling meter: E1 and E3
Type	Open collector (OB)
Pulse duration	Optionally 32 ms or 100 ms
External voltage	5...30 VDC
Current	1...10 mA
Residual stress	U_{CE} ≈ 1 V at 10 mA
Electrical isolation	2 kV
Max. cable length	25 m

Mechanical data

Environment class	Fulfils EN 1434 class A (MID class E1)
Ambient temperature	5…55°C, non-condensing, closed location (installation indoors)
Protection class – Calculator – Flow sensor	 IP54 IP68
Medium temperatures – Heat meters 402-V/W – Cooling meters 402-T – Heat/cooling meters 402-T	 2…130 °C 2…130 °C 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 (with thread)	PN16 with DS temperature sensor with fibre gasket PN25 with blind plug with O-ring gasket PN25 with DS temperature sensor with O-ring gasket
Pressure stage (with flanges)	PN25
Weight	From 0.9 to 8.6 kgs depending on flow sensor size
Flow sensor cable	1.5 m (cable undemountable)
Connection cables	ø 3.5…6 mm
Supply cables	ø 5…10 mm

At medium temperature above 90°C we recommend wall-mounting of calculator.

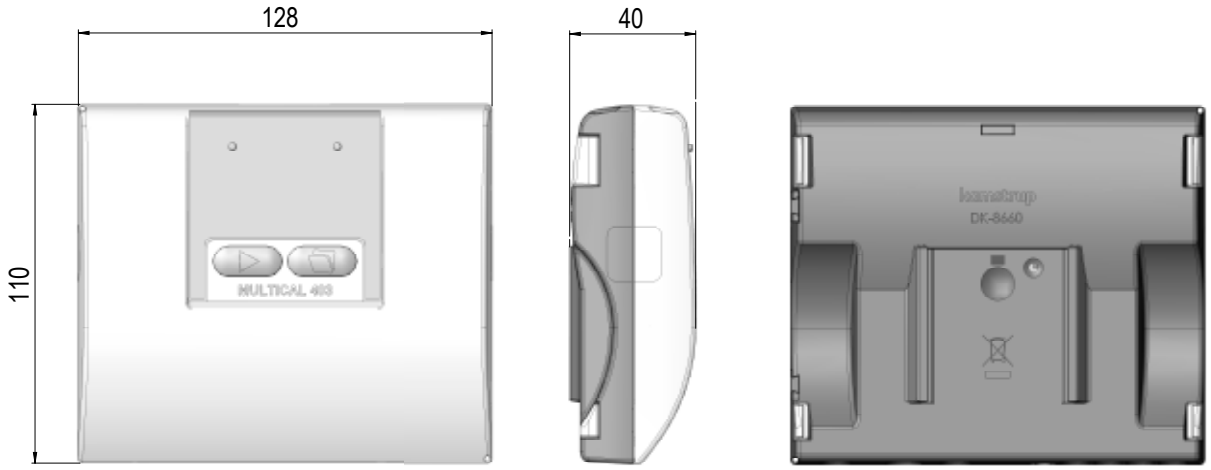
Materials

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
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

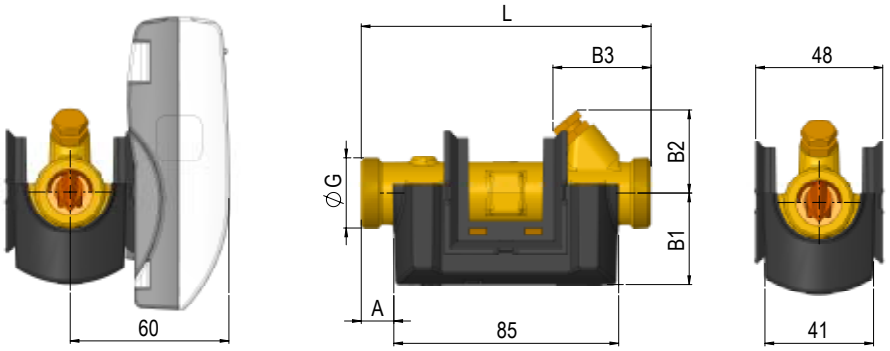
Dimensioned sketches

All measurements in [mm]

Mechanical measurements for calculator



Flow sensor with G¾ and G1 thread connection



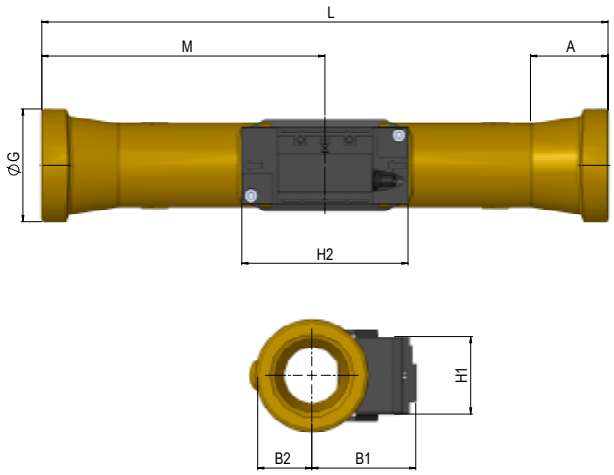
Nominal flow q_p [m³/h]	Thread G	L	A	B1	B2	B3	Approx. weight [kg] *
0.6 + 1.5	G¾	110	12	35	32	38	0.9
1.5	G¾	165	12	35	32	65	1.0
1.5	G1	130	22	38	32	48	1.0
2.5	G1	130	22	38	38	48	1.0
0.6 + 1.5	G1	190	22	38	38	78	1.1
2.5	G1	190	22	38	38	78	1.2

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

Dimensioned sketches

All measurements in [mm]

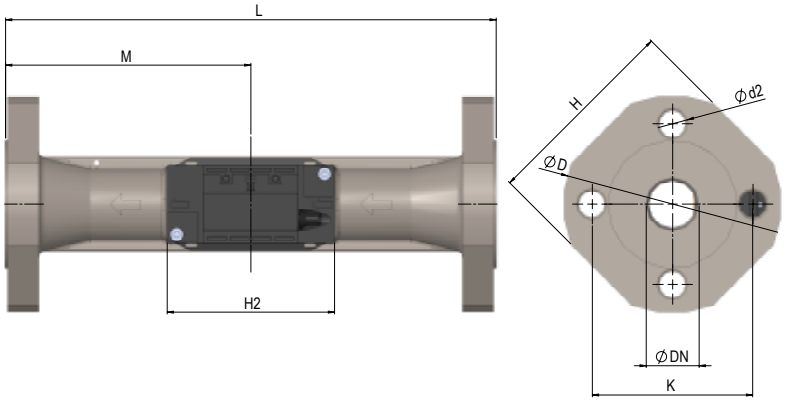
Flow sensor with G5/4 and G2 threaded connection



Nominal flow q_p [m³/h]	Thread G	L	M	H2	A	B1	B2	H1	Approx. weight [kg] *
3.5	G5/4	260	130	88	16	51	20	41	2.0
6	G5/4	260	130	88	16	53	20	41	2.1
10	G2	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 [m³/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

Accessories

Article number	Type
HC-993-01	Battery module with two AA-cells
HC-993-02	Battery module with one D-cell
HC-993-07	230 VAC supply module
HC-993-08	24 VAC supply module
6699-099	Infrared optical reading head w/USB plug
3026-810	Holder for infrared optical reading head
3026-655	Wall bracket
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)
6699-724	METERTOOL HCW
6699-725	LogView HCW
5915-413	Module configuration connector, 10-pin w/USB plug

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