Datasheet

Multical 402

(Heating & Cooling)

Supplied by

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kamstrup

Data sheet

MULTICAL® 402

- Up to 16 years' battery lifetime
- Set/reset function
- Pulse outputs for energy and volume
- Pulse inputs for up to two water meters
- Wireless reading via Wireless M-Bus or radio
- IP68 flow sensor for cooling applications

MID-2004/22/EC

CE M15 0200

EN 1434

PTB 22.52 05.04

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Compact meter for heat and cooling with maximum functionality

Application
MULTICAL® 402 is the compact ultrasonic meter which registers the exact consumption due to its supreme measuring accuracy. The meter is maintenance-free and has a long lifetime which guarantees minimum yearly operating costs.

MULTICAL® 402 is used for heat, cooling and combined heat /cooling measurement in all water-based systems with temperatures from 2 to 160 °C. The meter has been developed for measurement of energy consumption in family and multiple occupancy housing, housing associations, blocks of flats and small industry.

Functionality
MULTICAL® 402 consists of calculator, flow sensor and two temperature sensors and is simple to install, read and verify. Our flow sensor range for MULTICAL® 402 comprises of the sizes 0.6 – 15 m^3/h, and the supply options are 230 or 24 VAC mains module, 2xAA-cell battery, or D-cell battery with up to 16 years' lifetime. MULTICAL® 402 is fitted with a connector for the supply and thus, it is easy to change battery or mains supply.

By means of the calculator's two front keys it is easy to adjust date and time or reset operating hour counter and info-event counter. Furthermore, the keys can be used to display log data, incl. yearly or monthly logger.

MULTICAL® 402 receives pulses from up to two connected hot or cold water meters and carries out remote accumulation of energy and volume via pulse outputs. If you change from pulse input to pulse output, the meter is automatically configured for pulse inputs and pulse outputs respectively – without manual reconfiguration.

Wireless reading
The meter is remotely read via Wireless M-Bus or radio module. Consumption data is read, saved and transferred by means of the USB Meter Reader. Furthermore, radio can be read by means of a hand-held terminal or form part of a Kamstrup radio network. The transferred data is used for individual billing, consumption analysis and/or energy optimisation.

Calculator functions

Energy calculation

MULTICAL® 402 calculates energy based on the formula in EN 1434-1:2004, in which the international temperature scale from 1990 (ITS-90) and the pressure definition of 16 bar is used.

The energy calculation can in a simplified way be expressed as:

Energy = V x ΔΘ x k.

V is the supplied water volume

ΔΘ is the temperature difference measured

k is the thermal coefficient of water

The calculator always calculates energy in [Wh], and then it is converted into 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] / 1,163,100

Application types

MULTICAL® 402 operates with four different energy formulas, E1...E9, that are all calculated in parallel in connection with each integration no matter how the meter is configured.

The four energy types are calculated as follows:

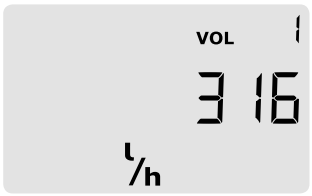
E1=V1(T1-T2)k	Heat energy (V1 in inlet or outlet)
E3=V1(T2-T1)k	Cooling energy (V1 in inlet or outlet)
E8=m^3xT1	(Inlet pipe)
E9=m^3xT2	(Outlet pipe)

This renders MULTICAL® 402 capable of calculating the heat and cooling energy of most applications, both closed and open systems.

All energy types are data logged and can be displayed independent of configuration.

Calculator functions

Flow measurement
MULTICAL® 402 calculates current water flow every 12 seconds or every 4 seconds depending on configuration.

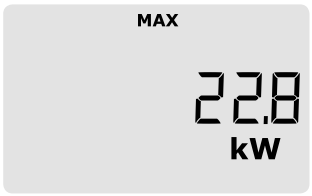


Power measurement
MULTICAL® 402 calculates current power on the basis of current water flow and the temperature difference measured in connection with the latest integration.

Current power is updated in the display every 24 seconds or every 4 seconds depending on configuration.

Min. and max. flow and power
MULTICAL® 402 registers minimum and maximum flow and power on a monthly as well as on a yearly basis. The registrations which can be read via data communication include max. and min. flow and power values, all with date indication.

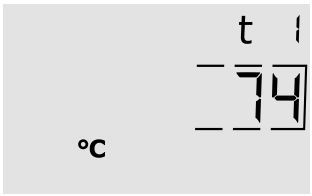
All max. and min. values are calculated as largest and smallest average respectively of a number of current flow or power measurements. The average period used for all calculations is selected in the interval 1...1440 min.



Temperature measurement
MULTICAL® 402 is available in different versions for either Pt100 or Pt500 sensors in a 2-wire version.

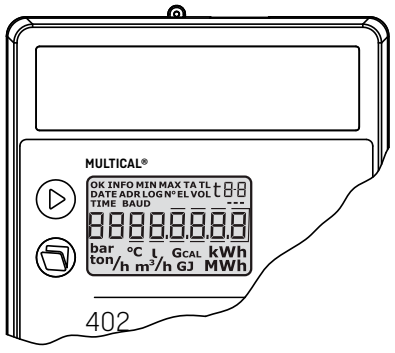
The measuring circuit includes a high resolution analog/digital converter with a temperature range of 0.00 °C...165.00 °C.

In addition to current temperatures for the energy calculation average temperatures on a yearly and monthly basis can also be displayed.



Display functions
MULTICAL® 402 is equipped with a clear LC display including 8 digits, units of measurement and information panel. In connection with energy and volume readings 7 digits and the units of measurement to match are used, whereas 8 digits are used when e.g. meter number is read.

As a starting point the display shows accumulated energy. When the push buttons are activated the display reacts immediately by calling other readings. The display automatically returns to accumulated energy reading 4 minutes after the latest activation of the push buttons.



The upper push button is used to switch between the primary readings. The consumers typically use the first primary readings in connection with self-reading for billing purposes.
The lower push button is used to show secondary information on the selected primary reading.

Calculator functions

Set/reset function
The set/reset function of MULTICAL® 402 makes it possible to change a number of parameters by means of the two buttons on the meter's front.

The following parameters can be changed:

- Date
- Hour
- Input A (preset of register)
- Input B (preset of register)
- Meter no. of Input A
- Meter no. of Input B
- Primary M-Bus address
- Operating hour counter (reset)
- Info-event counter (reset)

As the installation seal is broken, the change can only be made by the energy supplier.

Info codes
MULTICAL® 402 constantly monitors a number of important functions, e.g. power supply and temperature sensors. Should a serious error occur in the measuring system or in the installation, a flashing "INFO" will appear in the display whilst the error exists. The "INFO" panel will automatically disappear when the error has been corrected.

An Info Event Logger indicates how many times the info code has been changed.

The info logger stores the latest 50 changes, of which 36 can be displayed.

Info code	Description	Response time
0	No irrigularities	-
1	Supply voltage has been cut off	-
4	T2 sensor outside range, short-circuited or cut off	< 30 sec.
8	T1 sensor outside range, short-circuited or cut off	< 30 sec.
4096	Flow sensor with weak signal or air	< 30 sec.
16384	Flow sensor with wrong flow direction	< 30 sec.

Calculator functions

Data loggers
MULTICAL® 402 contains a permanent memory (EEPROM), where the results of a number of various data loggers are stored.

The meter contains the following data loggers:

Data logging interval	Data logging depth	Logged value
Yearly logger	15 years	Counter (as seen on the display)
Monthly logger	36 months	Counter (as seen on the display)
Daily logger	460 days	Consumption (increase)/day
Info logger	50 events (36 events can be shown in the display)	Info code and date

Voltage supply
MULTICAL® 402 is available with 2 x AA battery supply (up to a lifetime of 6 years), D-cell battery (up to a lifetime of 16 years incl. Wireless M-Bus), 230 VAC mains module or 24 VAC mains module. The supply modules are exchangeable without breaking the verification seal.

Plug-in modules
Plug-in modules can be added to MULTICAL® 402 such as

- Data
- M-Bus
- Wireless M-Bus
- Radio

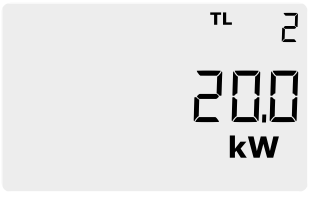
In this way the meter can adapt to various applications and data reading methods.

Programming and verification
METERTOOL for MULTICAL® 402 is a Windows® -based software which includes all facilities for calculator programming. If the software is used together with VERIFICATION EQUIPMENT for MULTICAL® 402, the calculator can be tested and verified.

Tariff functions
MULTICAL® 402 has 2 extra registers TA2 and TA3 to accumulate energy parallelly to the main register based on a programmed tariff condition. No matter which tariff type you select the tariff registers will be displayed as TA2 and TA3.

The main register is always accumulated, irrespective of the selected tariff function, as it is considered the legal billing register.

Tariff conditions TL2 and TL3 are monitored before each integration. If the tariff conditions are fulfilled, the consumed heat energy is accumulated in either TA2 or TA3, as well as the main register.



Pulse outputs and pulse inputs of the modules

Pulse outputs CE and CV

MULTICAL® 402 has pulse outputs for energy and volume pulses respectively. CE on terminals 16-17 releases one pulse per least significant digit of the energy count in the display and CV on terminals 18-19 releases one pulse per least significant digit of the volume count in the display.

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

Pulse inputs VA and VB

MULTICAL® 402 has two extra pulse inputs, VA and VB, to collect and accumulate pulses remotely, e.g from cold-water meters. The pulse inputs are physically placed on the plug-in modules.

The pulse inputs VA and VB function independently of the other inputs/outputs.

Cabinet design

Power supply/battery

Buttons for changing display

Under the cover the calculator's electronics are sealed by a verification label (security seal)

Plug for power supply/battery

Terminals for temperature sensors

Plug-in module

Approved meter data

EU-direktiver
- Measuring Instrument Directive
- Low Voltage Directive
- Electromagnetic Compatibity Directive
- Pressurised Equipment Directive

Norm	prEN 1434:2009	
Heat meter		
– Approval	DK-0200-MI004-013	
– Temperature range	θ:	2 °C...160 °C
– Differential range	ΔΘ:	3K...150K
Cooling meter		
– Temperature range	θ:	2 °C...50 °C
– Differential range	ΔΘ:	3K...30K
Accuracy		
– Calculator	EC = ± (0.5 + ΔΘmin/ΔΘ) %	
– Flow sensor	Ef = ± (2 + 0.02 qp/q), but not more than ± 5 %	
Dynamic range qi:qp	1:100	
Temperature sensors		
– Type 402-V	Pt100 – EN 60 751, 2-wire connection	
– Type 402-W/T	Pt500 – EN 60 751, 2-wire connection	
EN 1434 designation	Environmental class A =	
MID designation		
– Mechanical environment	class M1	
– Electromagnetic environment	class E1	

The stated minimum temperatures apply to the type approval only. The meter has no cutoff for low temperature and thus measures as low temperatures as 0.01 °C and 0.01 K.

Non condensing, closed location (indoor installation), 5...55 °C

Type number	Nom. flow qp [m³/h]	Min. flow qi [m³/h]	Max. flow qs [m³/h]	Min. cut off [l/h]	Pressure loss Δp @ qp [bar]	Connection meter	Length [mm]
402xxxxxx1xxx	0.6	0.006	1.2	3	0.04	G¾B	110
402xxxxxx3xxx	0.6	0.006	1.2	3	0.04	G1B	190
402xxxxxx4xxx	1.5	0.015	3.0	3	0.22	G¾B	110
402xxxxxx5xxx	1.5	0.015	3.0	3	0.22	G¾B	165
402xxxxxx7xxx	1.5	0.015	3.0	3	0.22	G1B	130
402xxxxxx9xxx	1.5	0.015	3.0	3	0.22	G1B	190
402xxxxxxAxxx	2.5	0.025	5.0	5	0.03	G1B	130
402xxxxxxBxxx	2.5	0.025	5.0	5	0.03	G1B	190
402xxxxxxDxxx	3.5	0.035	7.0	7	0.07	G5/4B	260
402xxxxxxFxxx	6.0	0.06	12	12	0.20	G5/4B	260
402xxxxxxGxxx	6.0	0.06	12	12	0.20	DN25	260
402xxxxxxHxxx	10	0.1	20	20	0.06	G2B	300
402xxxxxxJxxx	10	0.1	20	20	0.06	DN40	300
402xxxxxxKxxx	15	0.15	30	30	0.14	DN50	270

Electrical data

Calculator data

Typical accuracy	
– Calculator	E_C ±[0.15 + 2/ΔΘ] %
– Sensor set	E_T ±[0.4 + 4/ΔΘ] %
Display	LCD – 7 (8) digits with a digit heigth of 7.6 mm
Resolution	9999.999 – 99999.99 – 999999.9 – 9999999
Energy units	MWh – kWh – GJ – Gcal
Data logger (Eeprom)	460 days, 36 months, 15 years, 50 info codes
Clock/calendar	Clock, calendar, leap-year compensation, target date
Data communication	KMP protocol with CRC16 used for optical communication and for base modules
Power in temperature sensors	< 10 µW RMS
Supply voltage	3.6 VDC ± 0.1 VDC

Battery

Replacement interval	3.65 VDC, D-celle lithium	3.65 VDC, 2xAA cell lithium
Mounted on wall	16 years @ t_{BAT} < 30 °C	6 years @ t_{BAT} < 30 °C
Mounted on the flow sensor	12 years @ t_{BAT} < 40 °C	5 years @ t_{BAT} < 40 °C

The replacement interval is reduced by using data modules, at frequent data communication and at high ambient temperature.

Mains supply	230 VAC +15/-30 %, 50/60 Hz 24 VAC ± 50 %, 50/60 Hz
Insulation voltage	4 kV
Power supply	< 1 W
Back-up supply	Integral super-cap eliminates operational stop-down due to short-term power cuts
EMC data	Meets EN 1434 class A (MID class E1)

Electrical data

Temperature measurement

		T1 Inlet temperature	T2 Outlet temperature	ΔΘ(T1-T2) Heat metering	ΔΘ(T2-T1) Cooling metering
402-V 2-W Pt100	Measuring range	0.00…165.00 °C	0.00…165.00 °C	0.01…165.00K	0.01…165.00K
402-W/T 2-W Pt500	Measuring range	0.00…165.00 °C	0.00…165.00 °C	0.01…165.00K	0.01…165.00K

Pulse inputs VA and VB VA: 65-66 and VB: 67-68 via module	**Water meter connection FF(VA) and GG(VB) = 01…40**
Pulse input	680 kΩ pull-up to 3.6 V
Pulse ON	< 0.4 V for > 30 msec.
Pulse OFF	> 2.5 V for > 1.1 sec.
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 CE and CV Energy (16-17) Volume (18-19) via module	**The pulse outputs can be configured for heat or cooling energy**
Type	Open collector (OB)
Pulse length	Programmable 32 msec. or 100 msec.
External voltage	5…30 VDC
Current	1…10 mA
Residual voltage	U_{CE} ≈ 1 V at 10 mA
Electrical isolation	2 kV
Max. cable length	25 m

Mechanical data

Environment class	Meets EN 1434 class A (MID class E1)
Ambient temperature	5…55 °C, non condensing, closed location (indoor installation)
Protection class	
– Calculator	IP54
– Flow sensor heat, 402-V/W	IP65
– Flow sensor cooling, 402-T	IP68
Media temperature	
– Heat meters, 402-V/W	15…130 °C
– Cooling meters, 402-T	2…50 °C
– Heat/cooling meters, 402-T	2…130 °C
– Media in flow sensor	Water
Storage temperature	-20…60 °C (drained flow meter)
Pressure step (with thread)	PN16
Pressure step (with flanges)	PN25
Weight	From 1.8 to 12 kg depending on the size of the flowpart
Flow sensor cable	1.5 m (the cable cannot be removed)
Connection cables	ø3.5…6 mm
Supply cable	ø5…10 mm

At medium temperatures over 90 °C in the flow sensor, we recommend using flange meters and mounting the calculator on the wall.

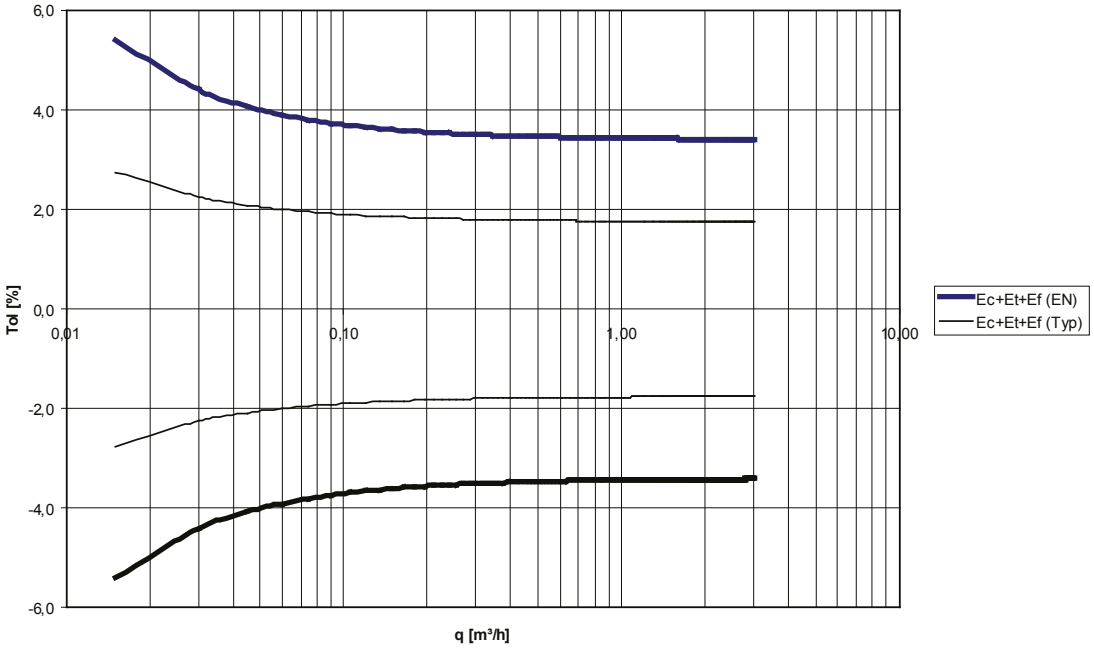
Materials

Wetted parts	
Housing, gland	DZR brass (dezincification resistant)
Housing, flange	Stainless steel, W.no. 1.4308
Transducers	Stainless steel, W.no. 1.4401
Gaskets	EPDM
Measuring tube	Thermoplastic, PES 30 % GF
Reflectors	Thermoplastic, PES 30 % GF and Stainless steel, W.no. 1.4301
Flow sensor housing	
Top/wall brackets	Thermoplastic, PC 20 % GF
Calculator casing	
Top cover	Thermoplastic, PC
Base unit	Thermoplastic, ABS with TPE gaskets (thermoplastic elastomer)
Internal cover	Thermoplastic, ABS
Flow sensor cable	Silicone cable with internal teflon insulation

Accuracy

Sub-units of the heat meter	MPE according to EN 1434-1	MULTICAL® 402, typical accuracy
Flow sensor	Ef = ± (2 + 0.02 qp/q) %	Ef = ± (1 + 0.01 qp/q) %
Calculator	Ec = ± (0.5 +ΔΘmin/ΔΘ) %	Ec = ± (0.15 + 2/ΔΘ) %
Sensor set	Et = ± (0.5 + 3ΔΘmin/ΔΘ) %	Et = ± (0.4 + 4/ΔΘ) %

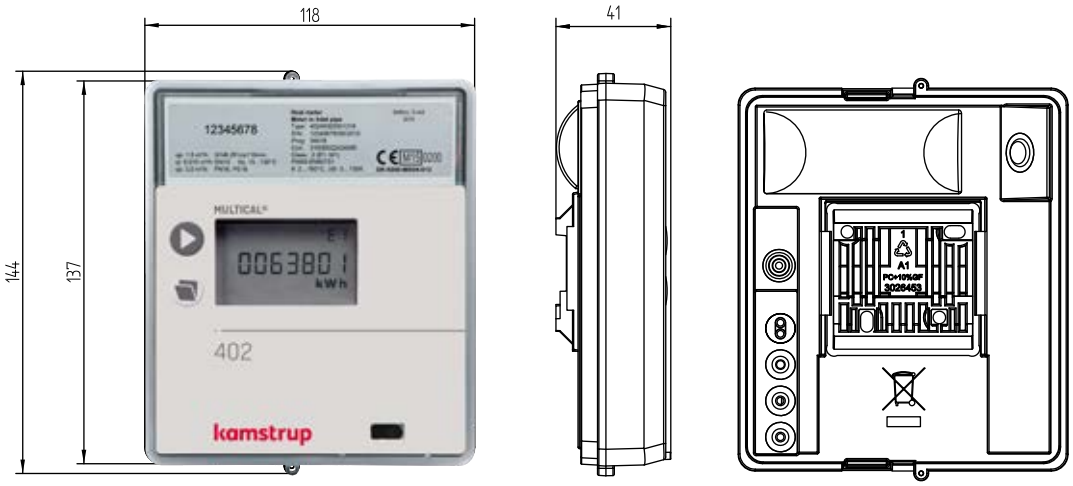
MULTICAL® 402 qp 1.5 m³/h @ ΔΘ 30K



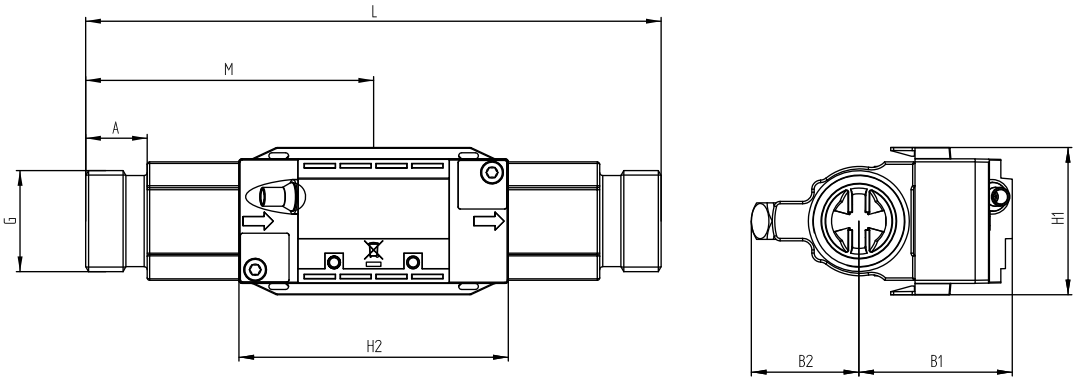
Order specifications

MULTICAL® 402	Type 402	□	□□	□	□□	□	□	□□
Sensor connection								
Pt100		V						
Pt500		W						
Pt500 (with condensation protected flow sensor for cooling)		T						
Modules								
No module			00					
Data + 2 pulse inputs (VA, VB)			10					
Data + 2 pulse outputs (CE, CV)			11					
M-Bus + 2 pulse inputs (VA, VB)			20					
M-Bus + 2 pulse outputs (CE, CV)			21					
M-Bus + 2 pulse inputs (VA, VB), MULTICAL® III Data Package			29					
Wireless M-Bus, EU, 868 MHz, Mode C1			30					
Wireless M-Bus, EU, 868 MHz, Mode C1 (Individual key), alternative registers, +VA, VB			35					
Wireless M-Bus, EU, 868 MHz, Mode T1 (Common key)			37					
Radio, EU, 434 MHz, int. ant., NET0			40					
Radio, EU, 434 MHz, int. ant., NET1			41					
Radio, EU, 434 MHz, int.+ext. ant., NET0 + 2 pulse inputs (VA, VB)			42					
Radio, EU, 434 MHz, int.+ext. ant., NET0 + 2 pulse outputs (CE, CV)			43					
Radio, EU, 434 MHz, int.+ext. ant., NET1 + 2 pulse inputs (VA, VB)			44					
Radio, EU, 434 MHz, int.+ext. ant., NET1 + 2 pulse outputs (CE, CV)			45					
Radio, SE, 444 MHz, int. ant., NET0 + 2 pulse inputs (VA, VB)			50					
Radio, SE, 444 MHz, int. ant., NET1 + 2 pulse inputs (VA, VB)			52					
Radio, SE, 444 MHz, ext. ant., NET0 + 2 pulse inputs (VA, VB)			54					
Radio, SE, 444 MHz, ext. ant., NET1 + 2 pulse inputs (VA, VB)			56					
Supply								
No module				0				
Battery, 2 x AA				1				
Battery, D-cell				2				
230 VAC supply module				7				
24 VAC supply module				8				
Pt500 sensor set								
No sensor set					00			
Pocket sensor set with 1.5 m cable					0A			
Pocket sensor set with 3.0 m cable					0B			
Short direct sensor set with 1.5 m cable					0F			
Short direct sensor set with 3.0 m cable					0G			
Flow sensor								
qp [m³/h]	**Connection**	**Length [mm]**						
0.6	G¾B (R½)	110				1		
0.6	G1B (R¾)	190				3		
1.5	G¾B (R½)	110				4		
1.5	G¾B (R½)	165				5		
1.5	G1B (R¾)	130				7		
1.5	G1B (R¾)	190				9		
2.5	G1B (R¾)	130				A		
2.5	G1B (R¾)	190				B		
3.5	G5/4B (R1)	260				D		
6.0	G5/4B (R1)	260				F		
6.0	DN25	260				G		
10	G2B (R1½)	300				H		
10	DN40	300				J		
15	DN50	270				K		
Meter type								
Heat meter (MID: module B+D)							2	
Heat meter (MID: module B+D, only MULTICAL® 402 T)							3	
Heat meter							4	
Cooling meter (only MULTICAL® 402 T)							5	
Heat/cooling meter (only MULTICAL® 402 T)							6	
Volume meter (hot)							7	
Volume meter (cold, only MULTICAL® 402 T)							8	
Energy meter							9	
Country code (language on lable etc.)								XX

Dimentional sketches



Mechanical measurements of the electronics unit

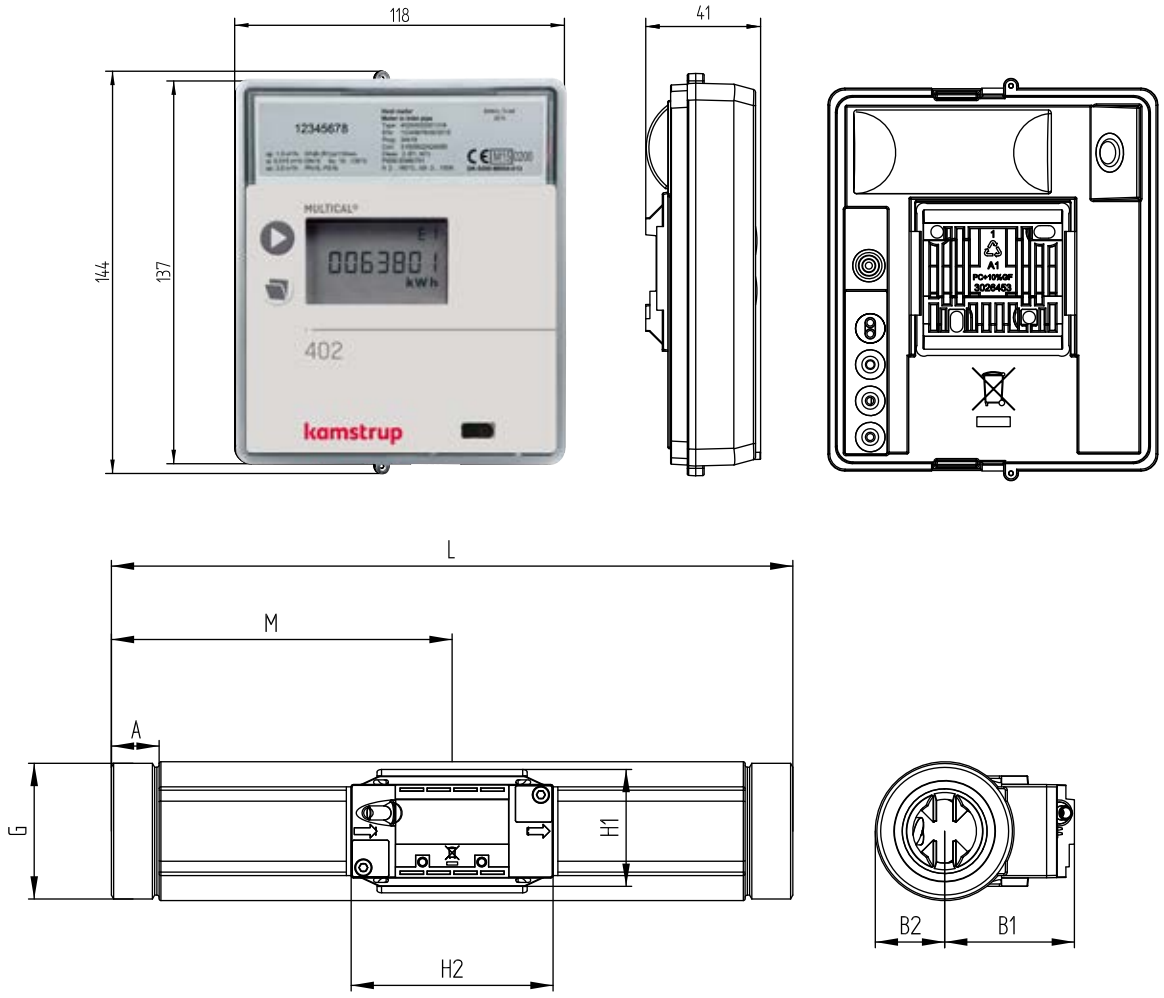


Flow sensor with G¾ and G1 thread connection. Thread ISO 228-1.

Thread	L	M	H2	A	B1	B2	H1	Approx. weight [kg]
G¾	110	L/2	89	10.5	50.5	35	48.5	1.4
G1 (qp 1.5)	130	L/2	89	20.5	50.5	35	48.5	1.5
G1 (qp 2.5)	130	L/2	89	20.5	50.5	35	48.5	1.4
G¾	165	L/2	89	20.5	50.5	35	48.5	1.8
G1 (qp 1.5)	190	L/2	89	20.5	50.5	35	48.5	2.0
G1 (qp 2.5)	190	L/2	89	20.5	50.5	35	48.5	1.9

Weight includes a 3 m Short direct sensor set, but is excluding packing.

Dimentional sketches

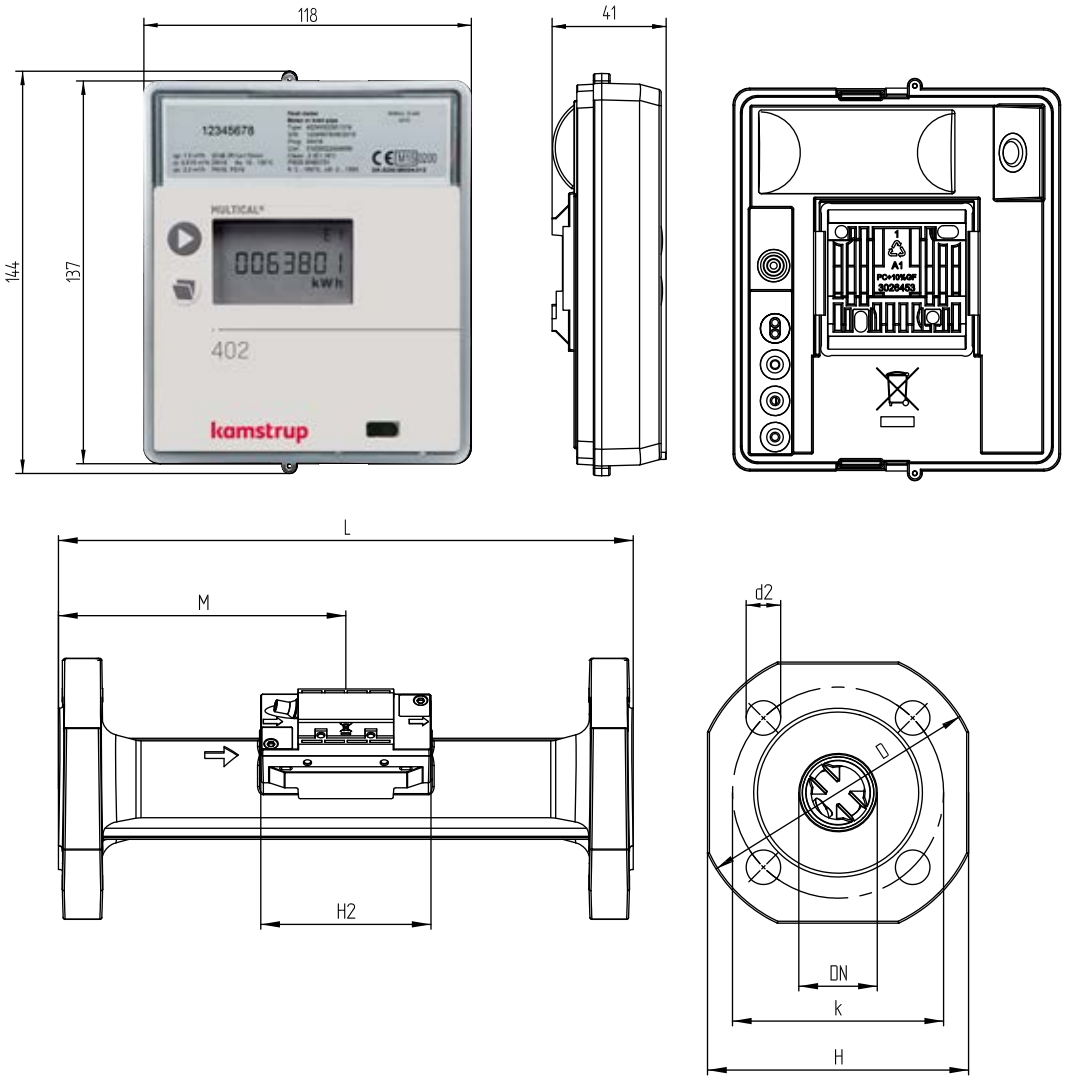


Flow sensor with G5/4 and G2 thread connection. Thread ISO 228-1.

Thread	L	M	H2	A	B1	B2	H1	Approx. weight [kg]
G5/4	260	L/2	88.7	17	50.5	22	48.5	2.9
G2	300	L/2	88.7	21	50.5	31	48.5	5.1

Weight includes a 3 m Short direct sensor set, but is excluding packing.

Dimentional sketches

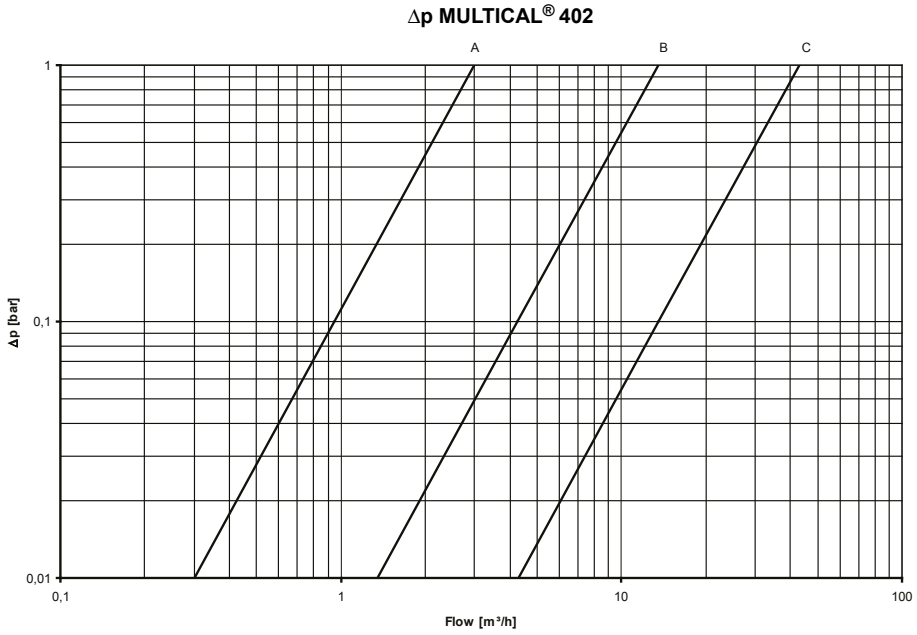


Flow sensor with DN25 to DN50 flange connection. Flange EN 1092, PN25.

Nom. diameter							Bolts			Approx. weight [kg]
	L	M	H2	D	H	k	Number	Thread	d2	
DN25	260	L/2	92.5	115	106	85	4	M12	14	5.6
DN40	300	L/2	92.5	150	136	110	4	M16	18	8.9
DN50	270	155	92.5	165	145	125	4	M16	18	10.7

Weight includes a 3 m Short direct sensor set, but is excluding packing.

Pressure loss



Graph	qp [m³/h]	Nom. diameter [mm]	kv	Q@0,25 bar [m³/h]
A	0.6 & 1.5	DN15 & DN20	3	1.5
B	2.5 & 3.5 & 6	DN20 & DN25	13.5	6.8
C	10 & 15	DN40 & DN50	43	21.7

Accessories

Description	Type number
Battery module 2 pcs. AA-cell	402-000-1000-000
D-cell battery	402-000-2000-000
230 VAC supply module	402-000-7000-000
24 VAC supply module	402-000-8000-000
USB cable with galvanic separation	66-99-097
Infra-red optical reading head with USB plug	66-99-099
Infra-red optical reading head RS232 with D-sub 9F	66-99-102
Data cable RS232, D-sub 9F	66-99-106
Pc-Interface cable RS232 for MULTICAL®	66-99-108
Pt500 (Heat) Verification Equipment for MULTICAL® 402 (used with METERTOOL)	66-99-372
Pt500 (Cooling) Verification Equipment for MULTICAL® 402 (used with METERTOOL)	66-99-373
METERTOOL for MULTICAL® 402	66-99-712
METERTOOL LogView for MULTICAL® 402	66-99-713

Accessories

Glands including gaskets (PN16)
Material: copper-alloyed brass, CW617N (fitting). Copper-alloyed brass, CW602N (union nut)

Size	Nipple	Union	Type No.	2 pcs
DN15	R½	G¾		65-61-323
DN20	R¾	G1		65-61-324
DN25	R1	G5/4	65-61-325	
DN40	R1½	G2	65-61-315	

Gaskets for glands
Material: Reinz AFM30

Size (Union)	Type No.
G¾	2210-061
G1	2210-062
G5/4	2210-063
G2	2210-065

Gaskets for flange meters PN25
Material: copper-alloyed brass (CW614N)

Size	Type No.
DN20	2210-147
DN25	2210-133
DN40	2210-132
DN50	2210-099

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Kamstrup A/S
Industrivej 28, Stilling
DK-8660 Skanderborg
T: +45 89 93 10 00
F: +45 89 93 10 01
info@kamstrup.com
kamstrup.com