MULTICAL® 302

DATA SHEET

- On-site configurable as to inlet and outlet
- PN25 metal flow sensor, approved up to 130 °C
- Small pressure loss, all flow sizes below 0.1 bar
- Dynamic range up to 1:1600 from start to saturation flow – 1:250 (q_i:q_p)

All-round heat and cooling meter, easy to install and easy to use

Application

The minimal dimensions of MULTICAL® 302 allow this compact all-round heat and cooling meter to be installed anywhere. The meter can be turned during installation, in very compact systems too, enabling you to obtain optimal reading of the display at all times.

The robust metal flow sensor endures up to 130 ˚C permanently, is effectively protected against condensation and can be used in both PN16 and PN25 systems.

The flow sensor has been designed with Kamstrup's unique ultrasound technique, which ensures extremely long lifetime – also in magnetite-containing heating systems.

Functionality

MULTICAL® 302 consists of a flow sensor based on ultrasound, an electronic display unit and a Pt500 sensor pair. These components are separately calibrated and subsequently assembled into a heat, cooling or combined heat/cooling meter which must not be separated.

The meter comprises an integral data logger, which saves all relevant registers for the latest 960 hours, 460 days, 24 months and 15 years.

During installation the meter can be configured for installation of flow sensor in either inlet or outlet pipe. Furthermore, unit and resolution as well as date/time and M-Bus address can be selected merely by pressing a button, no special tools needed.

Wired or Wireless M-Bus

MULTICAL® 302 is available with M-Bus and 1.5 m factory mounted cable or with Wireless M-Bus in either mode C1 or T1 OMS according to EN 13757-3.

The M-Bus communication is galvanically separated and comprises auto-select 300/2400 Baud, primary/secondary addressing and collision detection. The current consumption of the master is lower than 1 unit load, and separate registers for heat and cooling energy are read.

The wireless data communication, Wireless M-Bus, follows the European standard EN 13757-4, and the data telegram is configurable for either mode C1 or mode T1 OMS.
Data communication, including 128 bit AES encryption .

MID-2004/22/EC

CE M14 0200

PTB K 7.2

22.72

13.04

product design award

2014

Kamstrup

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Energy calculation

MULTICAL® 302 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.

V is the added volume of water

ΔΘ 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 ΔΘ x k x 1,000
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® 302 operates with 4 different energy formulas, E1, E3, E8 and E9, which are all calculated parallel with each integration no matter the configuration of the meter.

The four energy types are calculated as follows,

E1=V1(T1-T2)k Heat energy (V1 in inlet or outlet)

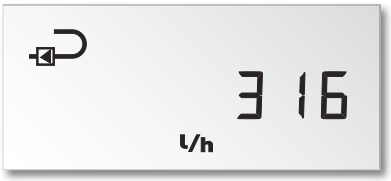
E3=V1(T2-T1)k Cooling energy (V1 in inlet or outlet)

E8=m^3xT1 Average temperature (inlet)

E9=m^3xT2 Average temperature (outlet)

This enables MULTICAL® 302 to calculate heat and cooling energy in most applications. All energy types are data logged and can be displayed dependent on configuration.

Flow measurement



MULTICAL® 302 calculates current water flow every four seconds or every two seconds determined by configuration.

Power measurement

MULTICAL® 302 calculates current power based on current water flow and the temperature difference measured at the latest integration.

Current power is updated in the display every 32 or every 8 seconds dependent on configuration.

Maximum flow and power

MULTICAL® 302 registers maximum flow and maximum power values on a yearly as well as a monthly basis. The registrations can be read via data communication or from the display in "TECH mode".

All maximum values are calculated as the highest average of a number of current flow or power measurements. The average period used for all calculations is selected within the interval of 1...1440 min.

Calculator functions

Temperature measurement

Inlet and outlet temperatures are measured by means of an accurately matched Pt500 sensor set in two-wire version.

The measuring circuit comprises a high-resolution analogue-to-digital converter with a temperature range of 0.00 °C to 155.00 °C.

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

Display functions

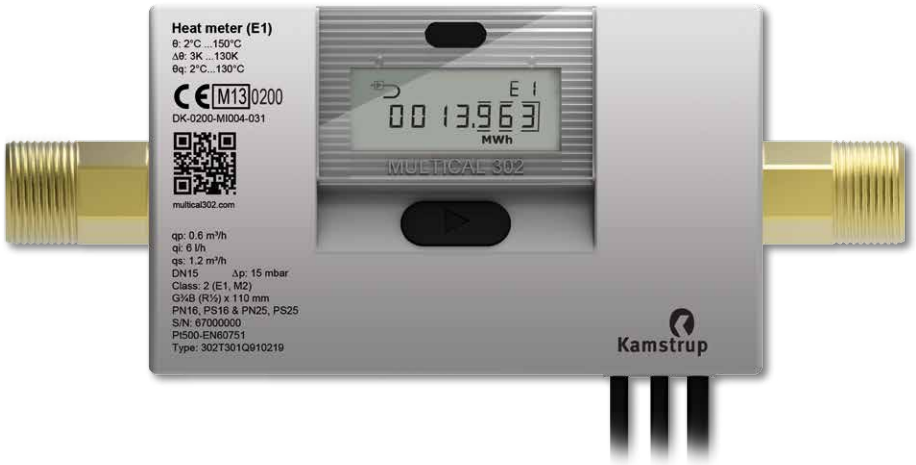
MULTICAL® 302 is fitted with an easily readable LC-display comprising 8 digits, measuring units and an information field. Energy and volume readings use 7 digits plus corresponding measuring units, whereas 8 digits are used to display e.g. the meter number.

Basically accumulated energy is displayed. Activating the push-button the display immediately switches to other readings. The display automatically returns to energy reading four minutes after the latest activation of the push-button, and after four more minutes without activation the display switches off in order to save current.

The meter uses four different loops for four different user situations:

- User loop
- Tech loop
- Setup loop
- Test loop

Only one loop can be displayed at a time.



Calculator functions

User loop

User loop is the primary loop, which is accessible when the meter has been installed and is in normal operation. The loop includes legal and most used readings. User loop is primarily intended for the user of the meter.

Tech loop

Tech loop is primarily for technicians and other persons who are interested in viewing further data. Tech loop displays all legal registers, other important registers as well as logged data.

Setup loop

Setup loop comprises everything that can be changed in the meter. In Setup loop selected configurations in the meter can be changed:

- Customer No.
- Date
- Time
- Target date
- Flow sensor installation (inlet/outlet)
- Energy unit/resolution
- Primary M-Bus address
- Max average peak time
- Heat/cooling-switching
- Radio (on/off)

Test loop

Test loop is intended for laboratories and others who are to calibrate or verify the meter.

Calculator functions

Info codes

MULTICAL® 302 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 exists no matter which reading you choose. The "INFO" field automatically disappears when the reason for the error has been removed.

An info-event counter shows how many times the information code has been changed.

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

Info code	Description	Response time
0	No irregularities	-
1	Supply voltage has been interrupted	-
4	Temperature sensor T2 outside measuring range	< 32 sec.
8	Temperature sensor T1 outside measuring range	< 32 sec.
32	Temperature difference has wrong polarity	< 32 sec. and 0.05 m^3
128	Supply voltage too low	< 10 sec.
16	Flow sensor with weak signal or air	< 32 sec.
2	Flow sensor with wrong flow direction	< 32 sec.

Data loggers

MULTICAL® 302 has a permanent memory (EEPROM), in which the values of many different data loggers are saved. The meter includes the following data loggers:

Data logging interval	Data logging depth	Data logged value
Yearly logger	15 years	Counter register
Monthly logger	24 months	Counter register
Daily logger	460 days	Counter register
Hourly logger	960 hours	Counter register
Info logger	50 events (36 events can be displayed)	Info code and date
Config. logger	25 config. changes	New config. and date

Power supply

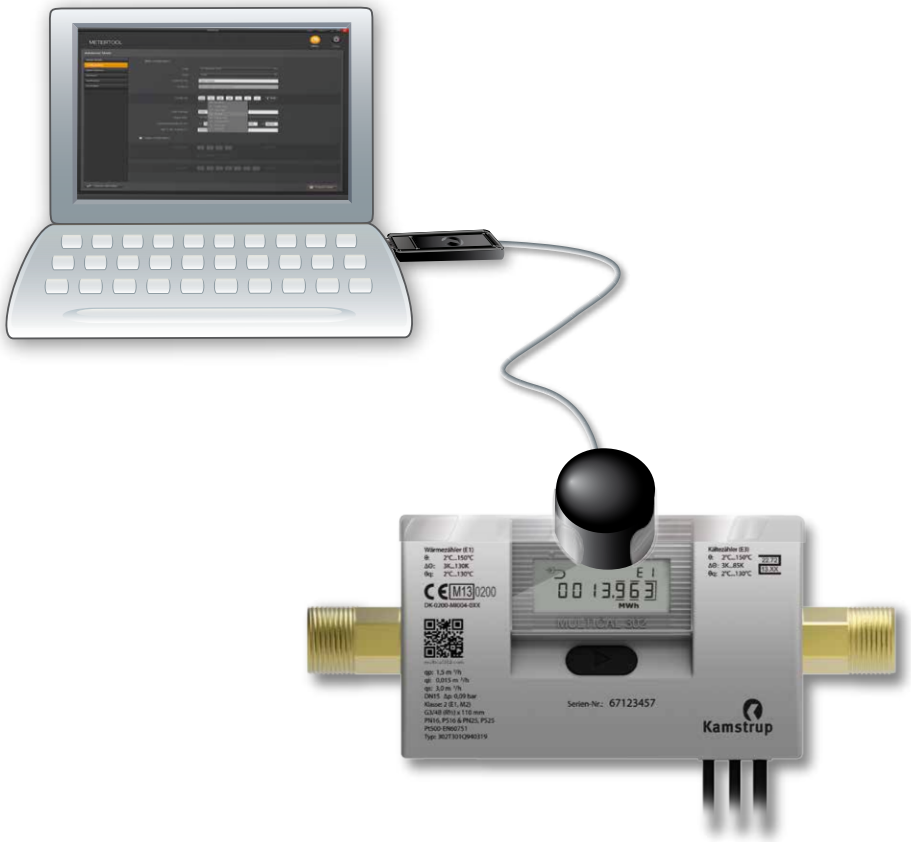
MULTICAL® 302 is available with 1 or 2 built-in A-cell batteries,

1 x A-cell lithium battery is sufficient to power MULTICAL® 302 for an operating period of 6 years.

2 x A-cell lithium battery must be selected for MULTICAL® 302 if 12 years' battery lifetime is required.

Programming and verification

METERTOOL for MULTICAL® 302 is Windows-based software that includes facilities for programming the calculator. Furthermore, it is possible to test and verify the calculator. Please contact Kamstrup A/S for further information.



Communication

MULTICAL® 302 offers two different forms of communication, namely wired M-Bus or Wireless M-Bus.

Wired M-Bus

If the meter is supplied with built-in wired M-Bus, M-Bus protocol according to EN 13757-3:2013 is used.

Connection to the M-Bus master is established via the fixed 1.5 m 2-wire cable. Connection is independent of polarity and the M-Bus interface is galvanically separated from the rest of the meter.

Communication speed with automatic baud rate detection is 300 or 2400 Baud. Both primary and secondary addressing are supported. Current consumption: 1 unit load (1.5 mA).

The following data can be read via M-Bus:

M-Bus data header	Current data	Target data*)	Meter data
M-Bus ID	Heat energy E1	Heat energy E1	Serial number
Producer ID	Cooling energy E3	Cooling energy E3	Customer number 1
Version	Energy m^3 x T1= E8	Energy m^3 x T1= E8	Customer number 2
Device type	Energy m^3 x T2 = E9	Energy m^3 x T2 = E9	Config. number 1
Access counter	Volume V1	Volume V1	Config. number 2
Status	Hour counter	Max. power	Meter type
Configuration	Error hour counter	Max. flow	SW revision
	T1	Target date	
	T2		
	T1-T2		
	Current power		
	Max. power this month*		
	Actual flow		
	Max. flow this month*		
	Info code		
	Date/time		

**) Monthly data is transmitted by default. Change to yearly data possible by means of an M-Bus command. For further details we refer to Technical description on M-Bus for MULTICAL® 302.*

Communication

Wireless M-Bus

If the meter has built-in wireless M-Bus, you can choose between Mode C1 or Mode T1 OMS.

Mode C1 is used in connection with Kamstrup's reading systems and for drive-by meter reading in general.

Mode T1 OMS is used in connection with OMS-based stationary networks. The meter has an internal antenna.

Mode C1

Protocol according to EN 13757-4:2013. Transmission interval: 16 sec. Individual 128 bit AES encryption.

Data packets Mode C1

Heat meter HH = 01 or 02	Heat meter HH = 11 or 12	Cooling meter	Heat/cooling meter
Header	**Header**	**Header**	**Header**
Producer ID	Producer ID	Producer ID	Producer ID
Serial number	Serial number	Serial number	Serial number
Version	Version	Version	Version
Status	Status	Status	Status
Hour counter	Hour counter	Hour counter	Hour counter
Current data	**Current data**	**Current data**	**Current data**
Heat energy E1	Heat energy E1	Cooling energy E3	Heat energy E1
Volume V1	Info code	Volume V1	Cooling energy E3
Power		Power	Power
Info code		Info code	Info code
Target data*)	**Target data*)**	**Target data*)**	**Target data*)**
Date	Date	Date	Date
Heat energy E1 last month	Heat energy E1	Cooling energy E3 last month	Heat energy E1 last month
or	Volume V1	or	Cooling energy E3 last month
Heat energy E1 last year	Energy m^3*T1= E8	Cooling energy E3 last year	or
	Energy m^3*T2= E9		Heat energy E1 last year
	Last month or last year*		Cooling energy E3 last year

**) Monthly or yearly data depends on HH configuration.*
For further details we refer to Technical description for MULTICAL® 302.

Communication

Mode T1 OMS

Protocol according to EN13757-4:2013 and OMS Specification Volume 2 issue 3.0.1.
Transmission interval 900 sec. Individual 128 bit AES encryption.

Data packets Mode T1 OMS

Heat meter	Cooling meter	Heat/cooling meter
Header	**Header**	**Header**
Device type	Device type	Device type
Producer ID	Producer ID	Producer ID
Serial number	Serial number	Serial number
Version	Version	Version
Status	Status	Status
Current data	**Current data**	**Current data**
Heat energy E1	Cooling energy E3	Heat energy E1
Volume V1	Volume V1	Cooling energy E3
Power	Power	Volume V1
Flow	Flow	Power
T1	T1	Flow
T2	T2	T1
Hour counter	Hour counter	T2
Date	Date	Hour counter
Info code	Info code	Date
		Info code
Target data*)	**Target data*)**	**Target data*)**
Heat energy E1 last month	Cooling energy E3 last month	Heat energy E1 last month
Volume V1 last month	Volume V1 last month	Cooling energy E3 last month
or	or	Volume V1 last month
Heat energy E1 last year	Cooling energy E3 last year	or
Volume V1 last year	Volume V1 last year	Heat energy E1 last year
Target date	Target date	Cooling energy E3 last year
		Volume V1 last year
		Target date

**) Monthly or yearly data depends on HH configuration.*
For further details we refer to Technical description for MULTICAL® 302.

Approved meter data

EU directives	Measuring Instruments Directive Low Voltage Directive Electromagnetic Compatibility Directive Pressurised Equipment Directive
Standards	EN 1434:2007, prEN 1434:2013 and PTB TR K7.2
Heat meter	Approval: DK-0200-MI004-031 Temperature range θ: 2 °C…150 °C Differential range $\Delta\Theta$: 3 K…130 K
Cooling meter	Approval: PTB TR K7.2 (22.72/13.XX) Temperature range θ: 2 °C…150 °C Differential range $\Delta\Theta$: 3 K…85 K
Accuracy	Calculator: $E_c \pm (0.5 + \Delta\Theta_{min}/\Delta\Theta)$ % Flow sensor: $E_q \pm (2 + 0.02\ q_r/q_i)$, but not exceeding ± 5 %
Dynamic range q_i:q_p	1:250 and 1:100
Temperature sensors	Type 302-T: Pt500 – EN 60 751, 2-wire, hard-wired connection
EN 1434 designation	Accuracy class 2 and 3 / Environmental class A
MID designation	Mechanical environment: Class M1 and M2 Electromagnetic environment: Class E1

The stated minimum temperatures are only 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.

Type number	Nom. flow q_p [m^3/h]	Max. flow q_s [m^3/h]	Min. flow cutoff [l/h]	Saturation flow [m^3/h]	Pressure loss Δp @ q_p [bar]	Threaded connection on meter	Length [mm]
302Txxxxx10xxx	0.6	1.2	3	3.0	0.02	G¾B	110
302Txxxxx11xxx	0.6	1.2	3	3.0	0.02	G¾B	130
302Txxxxx12xxx	0.6	1.2	3	3.0	0.02	G¾B	165
302Txxxxx40xxx	1.5	3.0	3	5.0	0.09	G¾B	110
302Txxxxx41xxx	1.5	3.0	3	5.0	0.09	G¾B	130
302Txxxxx42xxx	1.5	3.0	3	5.0	0.09	G¾B	165
302Txxxxx70xxx	1.5	3.0	3	5.0	0.07	G1B	130
302Txxxxx71xxx	1.5	3.0	3	5.0	0.07	G1B	190
302Txxxxx72xxx	1.5	3.0	3	5.0	0.07	G1B	220
302TxxxxxA0xxx	2.5	5.0	5	7.0	0.09	G1B	130
302TxxxxxA1xxx	2.5	5.0	5	7.0	0.09	G1B	190
302TxxxxxA2xxx	2.5	5.0	5	7.0	0.09	G1B	220

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 (8) digits with digit height 6 mm
Resolution	9999.999 – 99999.99 – 999999.9 – 9999999
Energy units	MWh – kWh – GJ
Data logger (EEPROM)	960 hours, 460 days, 24 months, 15 years, 50 Info Events, 25 config. logs
Clock/calendar	Clock, calendar, leap year compensation, target date
Data communication	KMP protocol with CRC16 used for optical communication
Wired M-Bus	Protocol according to EN 13757-3:2013, 300 and 2400 Baud communication speed with automatic baud rate detection. Current consumption: 1 unit load (1.5 mA). 1.5 m fixed 2-wire cable. Polarity independent.
wM-Bus	Mode C1 protocol according to EN 13757-4:2013. Individual 128 bit AES encryption. Transmission interval: 16 sec. Transmission frequency: 868.95 MHz Mode T1 OMS protocol according to EN13757-4:2013 and OMS Specification Volume 2 issue 3.0.1. Individual 128 bit AES encryption. Transmission interval: 15 min. Transmission frequency: 868.95 MHz
Power of temperature sensors	< 0.5 µW RMS
Supply voltage	3.6 VDC ± 0.1 VDC
EMC data	Fulfills EN 1434 class A (MID class E1)

Temperature measurement				
2-Wire Pt500	T1 Inlet temperature	T2 Outlet temperature	ΔΘ (T1-T2) Heat metering	ΔΘ (T2-T1) Cooling metering
Measuring range	0.00…155.00 °C	0.00…155.00 °C	0.01…155.00 K	0.01…155.00 K

Battery	3.65 VDC, 1 x A-cell lithium	3.65 VDC, 2 x A-cell lithium
Replacement interval	6 years	12 years
Lithium content	0.96 g	2 x 0.96 g
Transport class	Not subject to dangerous goods regulations	
Outside the USA	Non-restricted to transport/Non-assigned to Class 9	
Within the USA	Belonging to the category of "small primary lithium cells"	

Mechanical data

Environmental class: Fulfils EN 1434 class A and MID class E1and M2

	Protection class	Ambient temperature	Environmental class	
Calculator	IP65	5…55 °C	Non-condensing	Indoors (closed position)
Flow sensor and temp. sensor pair	IP68		Condensing	

Medium temperatures

Heat meters 302-T	2…130 °C
Cooling meters 302-T	2…130 °C
Heat/cooling meters 302-T	2…130 °C

At medium temperatures below 15 °C the calculator must be wall mounted in order to prevent condensation.

At medium temperatures above 90 °C in the flow sensor the calculator must be wall mounted in order to prevent too high temperature, especially in relation to display and battery lifetime.

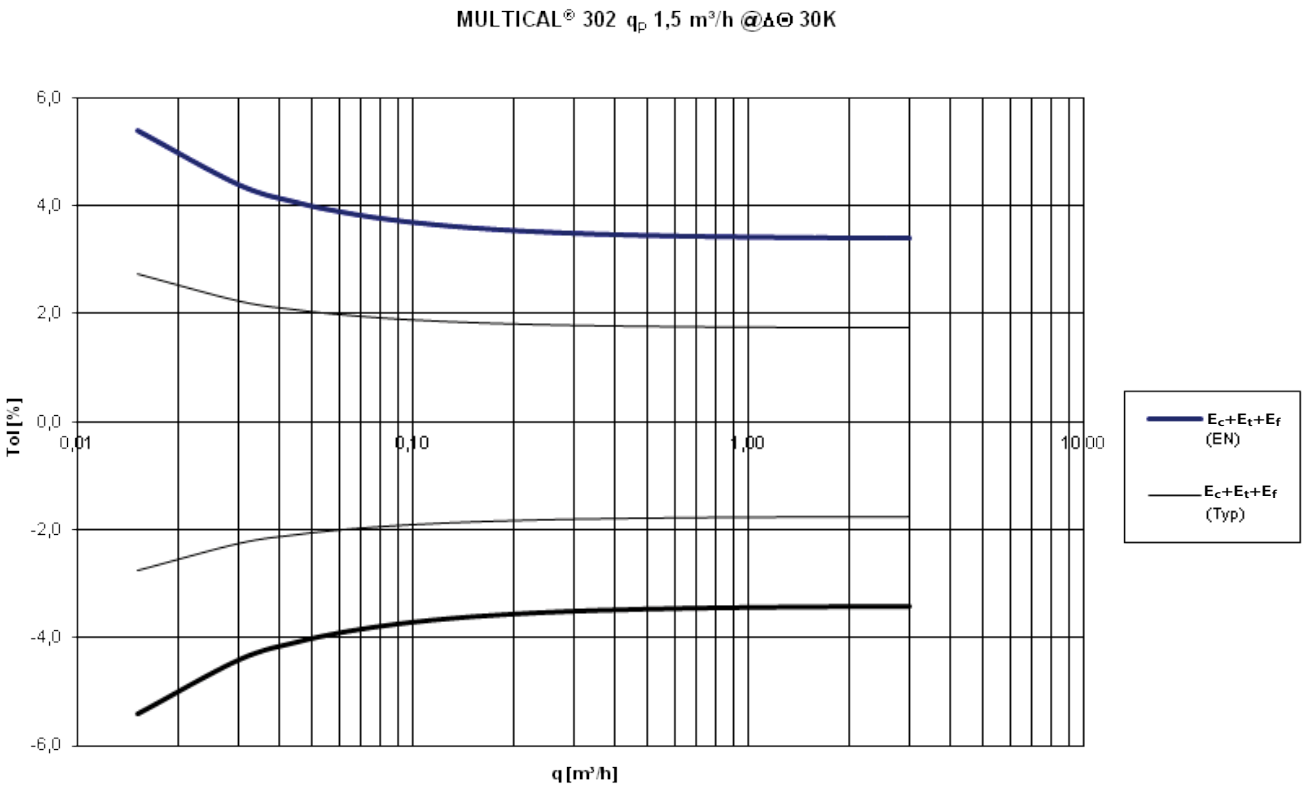
Medium in flow sensor	Water
Storage temperature	-25…60 °C (drained flow sensor)
Pressure stage (with thread)	PN16 and PN25
Weight	From 0.7 to 1.1 kg depending on flow meter size and extension piece
Flow sensor cable	1.2 m (non demountable cable)
Temperature sensor cables	1.5 m (non demountable cables)

Material

Wetted parts	Flow sensor case	Hot dezincification proof brass (CW 602N)
	Diaphragms	Stainless steel, W.no. 1.4404
	O-rings	EPDM
	Measuring tube	Thermoplastic, PES 30 % GF
	Reflectors	Thermoplastic, PES 30 % GF and stainless steel, W.no. 1.4306
Flow sensor cover	Thermoplastic, PC 20 % GF	
Wall bracket	Thermoplastic, PC 20 % GF	
Calculator case	Top	Thermoplastic, PC 10 % GF
	Base	Thermoplastic, ABS with TPE gaskets (thermoplastic elastomer)
Cables	Flow sensor	Silicone cable with inner Teflon insulation
	Temperature	Silicone cable with inner Teflon insulation
	M-Bus	Silicone cable with inner Teflon insulation

Accuracy

Heat meter components	MPE according to EN 1434-1	MULTICAL® 302, typical accuracy
Flow sensor	$E_f = \pm (2 + 0.02\ q_p/q)$ %	$E_f = \pm (1 + 0.01\ q_p/q)$ %
Calculator	$E_c = \pm (0.5 + \Delta\Theta_{min}/\Delta\Theta)$ %	$E_c = \pm (0.15 + 2/\Delta\Theta)$ %
Sensor pair	$E_t = \pm (0.5 + 3\ \Delta\Theta_{min}/\Delta\Theta)$ %	$E_t = \pm (0.4 + 4/\Delta\Theta)$ %



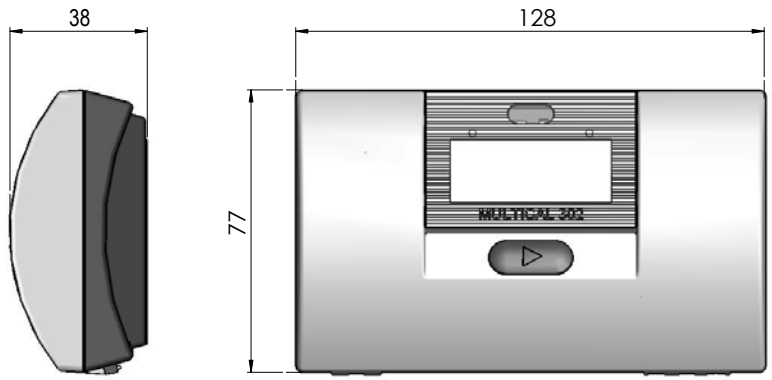
Ordering details

MULTICAL® 302	Type 302	☐	☐☐	☐	☐☐	☐☐	☐	☐☐
Sensor connection								
Pt500 (with condensation protected flow sensor)		T						
Communication								
No communication			00					
M-Bus (comes with 1.5 m factory mounted cable)			20					
Wireless M-Bus, 868 MHz (configurable mode C1 or T1 OMS)			30					
Supply								
6 year battery, Normal Response meter				1				
12 year battery, Normal Response meter				2				
6 year battery, Quick Response meter				3				
Temperature sensors								
Pt500, ø 5.2 mm temperature sensors with cable length 1.5 m					Q9			
Flow sensor								
q_p [m³/h]	**Connection**	**Length [mm]**						
0.6	G¾B (R½)	110				10		
	DN 15		With extension to 130 mm			11		
			With extension to 165 mm			12		
1.5	G¾B (R½)	110				40		
	DN 15		With extension to 130 mm			41		
			With extension to 165 mm			42		
1.5	G1B (R¾)	130				70		
	DN 20		With extension to 190 mm			71		
			With extension to 220 mm			72		
2.5	G1B (R¾)	130				A0		
	DN 20		With extension to 190 mm			A1		
			With extension to 220 mm			A2		
Meter type								
Heat meter		MID approved as heat meter	θ_{hc}= OFF				2	
Heat meter/cooling meter		MID approved as heat meter	θ_{hc}= OFF				3	
Heat meter		With national approval	θ_{hc}= OFF				4	
Cooling meter		E.g. PTB approved as cooling meter	θ_{hc}= OFF				5	
Heat/cooling meter		Without approval marking	θ_{hc}= ON				6	
Country code (language on label etc.) Letters can also be used.								XX

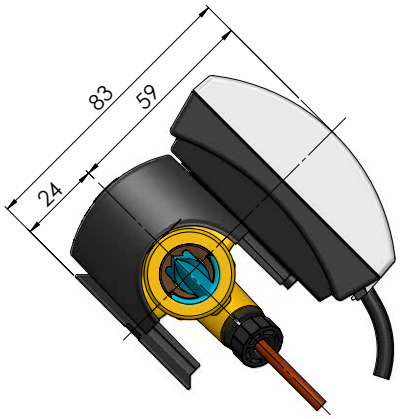
Dimensioned sketches

All measurements in [mm]

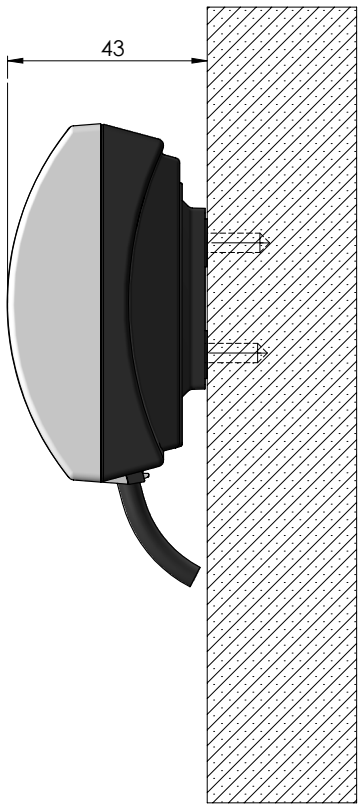
Calculator



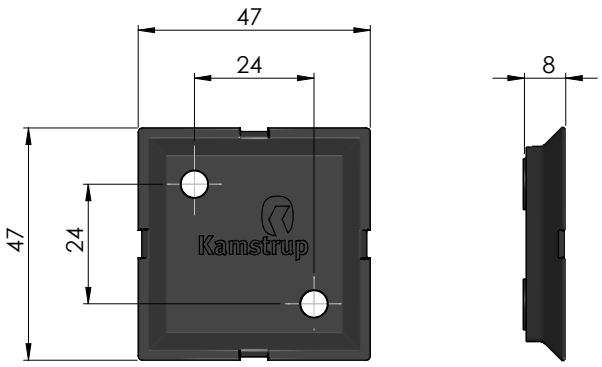
MULTICAL® 302 with calculator mounted on flow sensor



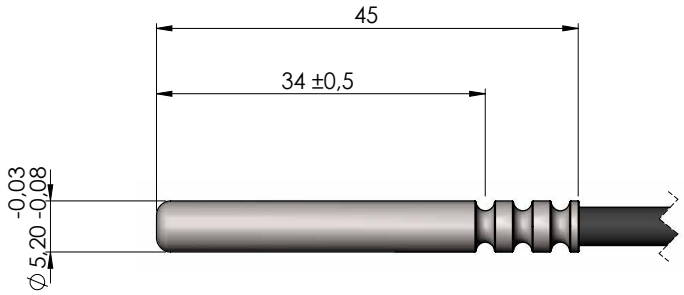
Wall-mounted calculator



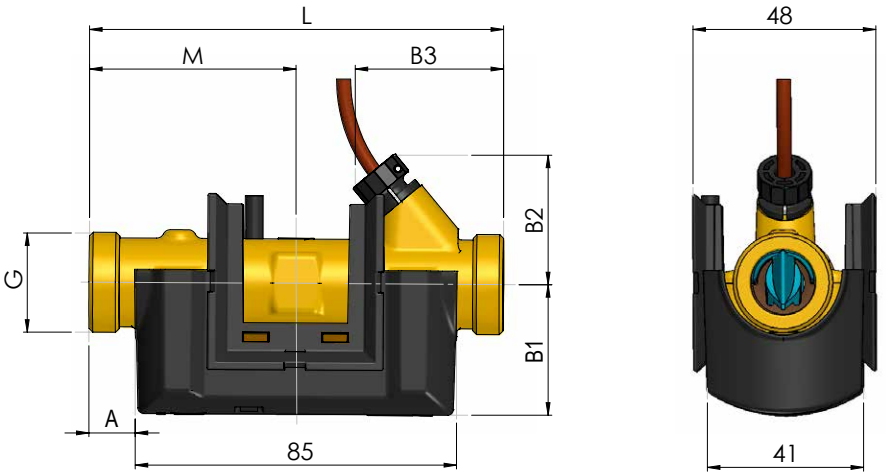
Wall fitting for calculator



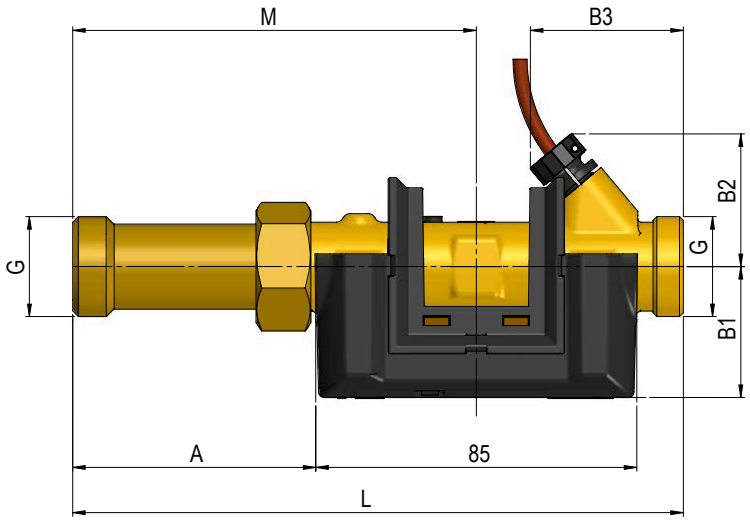
Temperature sensor



Dimensioned sketches



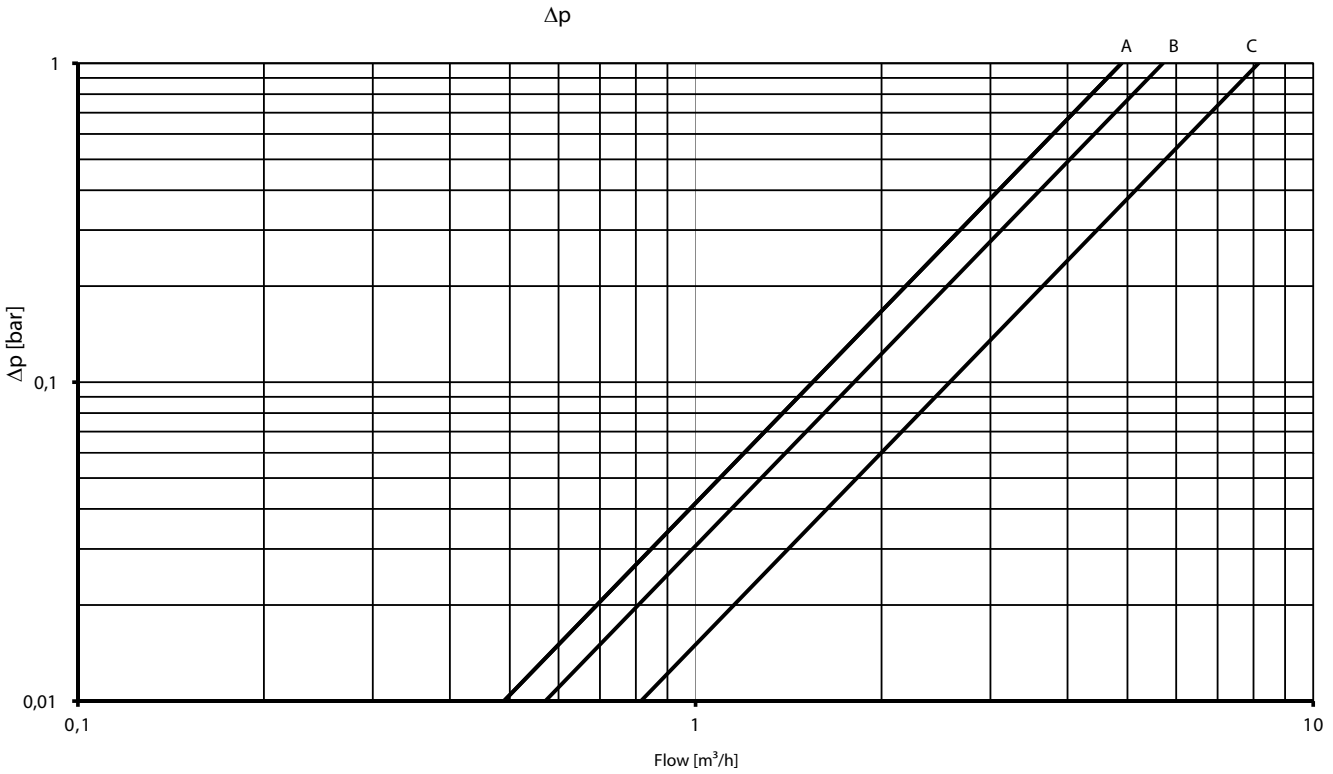
Thread	L [mm]	A [mm]	B1 [mm]	B2 [mm]	B3 [mm]	Approx. weight [kg] *)
G¾B (R½)	110	12	35	35	40	0.7
G1B (R¾)	130	22	38	38	50	0.8



Thread	L [mm]	M [mm]	A [mm]	B1 [mm]	B2 [mm]	B3 [mm]	Approx. weight [kg] *)
G¾B (R½)	130	73	30	35	35	40	0.8
G¾B (R½)	165	109	66	35	35	40	0.8
G1B (R¾)	190	124	81	38	38	50	1.0
G1B (R¾)	220	154	111	38	38	50	1.1

**) The weight indication comprises the whole meter incl. flow sensor, calculator, sensor pair and 2 x A batteries. Enclosed accessories such as couplings, nipples and sensor pockets, if any, as well as packing are not included in the weight indication.*

Pressure loss



Graph	q_p [m³/h]	Size	Nom. diameter [mm]	Δp@q_p [bar]	kv	Q@0.25 bar [m³/h]
A	0.6	G¾B x 110 mm	DN15	0.02	4.89	2.4
A	1.5	G¾B x 110 mm	DN15	0.09	4.89	2.4
B	1.5	G1 x 130 mm	DN 20	0.07	5.71	2.9
C	2.5	G1 x 130 mm	DN 20	0.09	8.15	4.1

Accessories

3026-655.A	Wall bracket (LEXAN 3412R black)
6561-346	Holder for optical reading head
3130-262	Blind plug for temperature sensor in flow sensor (copper-alloyed brass, CW614N)
6556-511	R½ x M10 nipple (copper-alloyed brass, CW614N)
6556-512	R¾ x M10 nipple (copper-alloyed brass, CW614N)
5920-257	G½ ball valve with M10x1 sensor socket, 48 mm
5920-271	G¾ ball valve with M10x1 sensor socket, 54 mm
6557-302	G½ sensor pocket 35 mm (copper-alloyed brass, CW614N)
6699-099	Infrared optical reading head w/USB plug
6699-102	Infrared optical reading head RS232 w/D-sub 9F
6699-304	Infrared optical reading head for NOWA
6699-016	Kamstrup NOWA KAS software
6699-724	METERTOOL for MULTICAL® 302
6699-725	METERTOOL LogView for MULTICAL® 302

Note: Ball valves with M10x1 socket (type: 6556-474, -475 and -476) are not suitable for sensors with O-ring seal as they are intended for flat gaskets.

Accessories

Couplings (PN16)

Order code	Size	Nipple	Coupling
6561-323	DN15	R½	G¾
6561-324	DN20	R¾	G1

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

Gaskets for couplings

Order code	Size (coupling)
3130-126	G¾
3130-127	G1

Material: Reinz AFM30

Extension pieces

Order code	Description	Length [mm]	Total length [mm]
6556-505	Extension piece G¾B	20	130
6556-506	Extension piece G¾B	55	165
6556-507	Extension piece G1B	60	190
6556-508	Extension piece G1B	90	220

Material: copper-alloyed brass (CW614N)