

Installation and User Guide

MULTICAL® 402

Cooling meter



MULTICAL® 402

Allowed operation conditions/measuring ranges

Complete cooling meter with national Danish cooling approval (TS 27.02 005):

Calculator	θ : 2 °C...50 °C	$\Delta\theta$: 3K...40K
Flow meter (medium temperature)	θ : 2 °C...50 °C	

Combined heat/cooling meter with national Danish cooling and MID approval (TS 27.02 005 and DK-0200-MI004-013):

Calculator	θ : 2 °C...160 °C	$\Delta\theta$: 3K...150K
Flow meter (medium temperature)	θ : 2 °C...130 °C	

Mechanical environment

M1 (fixed installation with minimum vibration).

Electromagnetic environment

E1 (housing/light industry). The meter's control cables must be drawn at min. 25 cm distance to other installations.

Climatic environment

Must be installed in environments with non-condensing humidity as well as in closed locations (indoors). The ambient temperature must be within 5...55 °C.

Maintenance and repair

The energy supplier can replace communication module, battery and temperature sensors. Flow sensor and calculator must not be separated. Other repairs require subsequent reverification in an accredited laboratory. MULTICAL® 402-T requires connection of temperature sensors type Pt500.

Battery for replacement

Kamstrup type 402-000-2000-000 [D-cell] or 402-000-1000-000 [2 x AA-cells].

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1 General information



Read these instructions before you install the meter.

In case of incorrect mounting Kamstrup's guarantee obligations no longer apply.

Please note that the following installation conditions must be obeyed:

- Pressure stage: PN16/PN25, see marking. The flow sensor marking does not apply to enclosed accessories.
- Pressure stage, Kamstrup sensor set type DS: PN16
- Pressure stage, Kamstrup stainless steel sensor pockets: PN25

At a medium temperature above 90 °C we recommend the use of flange sensors as well as wall mounting of the calculator.

2 Mounting of temperature sensors

The temperature sensors used for measuring forward and return temperatures respectively, constitute a matched sensor pair, which must never be separated. Temperature sensors are usually mounted in the calculator from the factory. According to EN 1434/OIML R75 the cable length must not be changed. Should replacement be necessary, both sensors must be replaced.

The sensor marked with a red sign is to be installed in the flow pipe. The other sensor, marked with a blue sign, is to be installed in the return pipe. For mounting in the calculator, see the paragraph "Electrical connection".

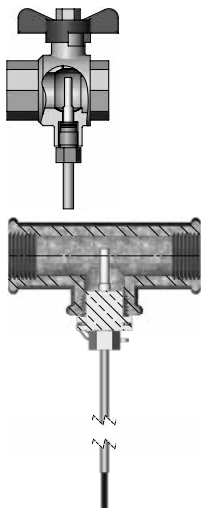
Note: The sensor cables must neither be exposed to jerking nor pulling.

Please be aware of this when binding the cables, and be careful not to pull the binders unnecessarily tight as this may damage the cables.

Please also note that temperature sensors must be mounted from below in cooling or heat/cooling installations.

2.1 Direct sensors

The short, direct sensors up to DN25 can be mounted in special ball valves with built-in M 10 socket for the short direct sensor. They can also be mounted in installations with standard angle tee-pipes. Kamstrup supply R $\frac{1}{2}$ and R $\frac{3}{4}$ brass nipples, which fit our short, direct sensor. The short direct sensor can also be direct mounted in all Kamstrup flow sensors with G $\frac{3}{8}$ B and G1B thread on the meter case. Fasten the sensors' brass unions lightly (approx. 4 Nm) using a 12 mm face wrench and seal the sensors with seal and locking wire.



2.2 Pocket sensors

The sensor pockets can be mounted in e.g. a welding sleeve or in a 45° lateral Y-piece. The tip of the sensor pocket must at least reach the center of the flow pipe. Push the temperature sensors as deep as possible into the pockets. If a short response time is required, "nonhardening" thermally conductive paste can be used. Push the plastic sleeve on the sensor cable into the sensor pocket and secure the cable by means of the enclosed M4 sealing screw. Fasten the screw with your fingers only. Seal the pockets using seal and locking wire.



3 Information Codes "INFO"

MULTICAL® 402 constantly monitors a number of important functions. In case of a serious error in measuring system or installation, "INFO" flashes in the display and an info-code can be read by activating the top front key until „INFO" is displays . The info code disappears when the error has been remedied, unless the meter has been specially configured for "manual reset of info codes". When the error condition has existed for more than an hour, the error code is saved in the info log.

Info code	Description	Response time
0	No irregularities	-
1	Supply voltage has been interrupted	-
8	Temperature sensor T1 outside measuring range	< 30 s.
4	Temperature sensor T2 outside measuring range	< 30 s.
4096	Flow sensor V1, signal too weak (air)	< 30 s.
16384	Flow sensor with wrong flow direction	< 30 s.

If various info codes appear at the same time, the sum of info codes is displayed. E.g. the info code will be 12 if both temperature sensors are outside measuring range.

4 Mounting of flow sensor

Prior to installation of the flow sensor, the system should be flushed and protection plugs/plastic diaphragms removed from the flow sensor.

Correct flow sensor position (inlet or outlet) appears from the front label of MULTICAL® 402. The flow direction is indicated by an arrow on the side of the flow sensor.

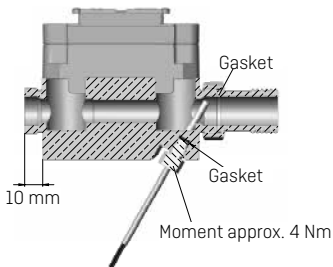
4.1 Mounting of couplings as well as short direct sensor mounted in MULTICAL®402 flow sensor

The short direct sensor from Kamstrup may be mounted in PN16 installations only, whereas the blind plug which is mounted in the MULTICAL® 402 flow sensor from the factory may be used in connection with both PN16 and PN25 installations.

The flow sensor may be used in both PN16 and PN25 installations and is available marked either PN16 or PN25 as required.

Enclosed couplings, if any, are only intended for PN16. Suitable PN25 couplings must be used in PN25 installations.

In connection with G3/4x110 mm and G1x110 mm it must be checked that 10 mm thread run-out is sufficient. See the figure to the right.



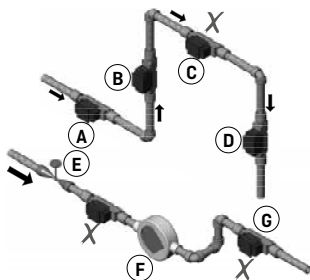
Glands and gaskets are mounted as shown in the above drawing.

Straight inlet: MULTICAL® 402 requires neither straight inlet nor straight outlet to meet the Measuring Instruments Directive (MID) 2014/32/EU, OIML R75:2002 and EN 1434:2007.

A straight inlet section will only be necessary in case of heavy flow disturbances before the meter. We recommend you to follow the guidelines described in CEN CR 13582.

For systems that lack temperature intermixture and systems with temperature stratification respectively we recommend a straight inlet of 10 x DN.

- A** Recommended flow sensor position
- B** Recommended flow sensor position
- C** Unacceptable position due to risk of air build-up
- D** Acceptable in closed systems. Unacceptable position in open systems due to risk of air build-up in the system
- E** A flow sensor ought not to be placed immediately after a valve, with the exception of block valves (ball valve type) which must be fully open when not used for blocking.
- F** A flow sensor must never be placed on the inlet side of a pump
- G** A flow sensor ought not to be placed after a double bend in two levels.



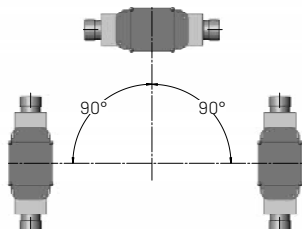
In order to prevent cavitation the operating pressure at MULTICAL® 402 must be min. 1.5 bar at q_p and min. 2.5 bar at q_s . This applies to temperatures up to approx. 80 °C.

MULTICAL® 402 must not be exposed to pressure below the ambient pressure (vacuum).

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4.2 Mounting of flow sensor

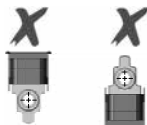
The flow sensor can be mounted horizontally, vertically, or at an angle.



The flow sensor may be turned up to $\pm 45^\circ$ in relation to the horizontal axis.



The plastic case must neither point upwards nor downwards.

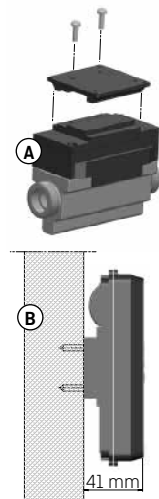


5 Mounting the calculator

The following installation guidelines must be observed.

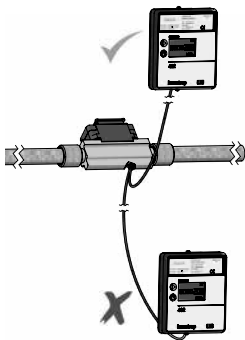
5.1 Wall mounting

MULTICAL® 402 can be mounted on an even wall by means of the enclosed fitting. The fitting is mounted on the flow sensor from the factory. Remove the fitting from the flow sensor (A), use the fitting as a template to mark and drill two 6 mm holes in the wall, and mount the calculator on the fitting (B).



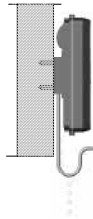
5.2 Mounting position of calculator

When MULTICAL® 402 is used as a cooling meter and the flow sensor is thus installed in humid or condensing environment, the calculator must be placed higher than the flow sensor.



5.3 Cabling

Because of the humid and condensing environment correct cabling is important. Below you see examples of correct and incorrect cabling.



Front, vertical.

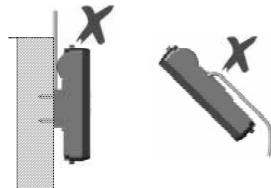


Front, at an angle between horizontal and vertical.



Front, horizontal.

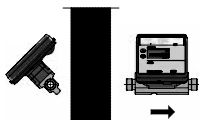
Note: The cable **must** be inserted from the bottom



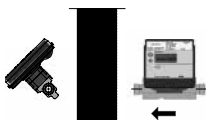
5.4 Application at medium temperature, which is less than 5 °C lower than the ambient temperature

At medium temperatures below ambient temperature, MULTICAL® 402 must be wall mounted and the condensation-proof version, type 402-T, must be used.

Calculator mounted on threaded meter:



Flow from left to right

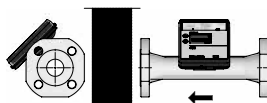


Flow from right to left

Calculator mounted on flange meter:



Flow from left to right



Flow from right to left

6 Power supply

MULTICAL® 402 can be powered by a built-in lithium battery or an integral 24 VAC or 230 VAC mains module.

The two cables from battery or mains module are mounted in the calculator's two-pin plug.

6.1 Battery supply

MULTICAL® 402 is connected to a lithium battery, D-cell or 2 x AA-cells.

Optimal battery lifetime is obtained by keeping the battery temperature below 30 °C, e.g. by wall mounting.

The voltage of a lithium battery is almost constant throughout the lifetime of the battery (approx. 3.65 V). Therefore, it is not possible to determine the remaining capacity of the battery by measuring the voltage.

The battery must neither be charged nor shortcircuited. Used batteries must be handed in for approved destruction.

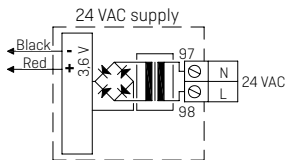
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6.2 Mains modules

MULTICAL® 402 is available with supply modules for either 24 VAC or 230 VAC.

The modules are protection class II and are connected via a two-wire cable (without earth) through the big cable bush, in the top left of the connecting base. Use connecting cable with an outer diameter of 5-10 mm and ensure correct stripping of the cable as well as correct mounting of cable relief.

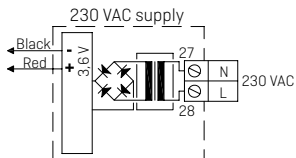
If connecting to 230 VAC, it is important to make sure that the whole installation complies with current regulations. The supply cable to the meter must not be pre-fused by a bigger fuse than permitted, see examples below.



24 VAC

E.g. transformer 230/24V, type 66-99-403, can be used.

Note! MULTICAL® 402 cannot be powered by 24 VDC.



230 VAC

This module is used in connection with direct mains connection.

Note! External supply may only be connected to the supply module.

Supply cable	Max. Fuse
2 x 0,75 mm ² [accessory from Kamstrup A/S]	6 A
2 x 1,0 mm ²	10 A

In connection with other types of installations or requirements for bigger pre-fuses than the ones listed above, it is necessary to consult a certified electrician for an individual evaluation of how the type of installation in question should be carried out.

7 Testing the function

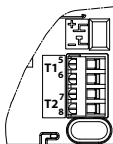
Carry out an operational check when the energy meter has been fully mounted. Open thermoregulators and cocks to establish water flow through the heating system. Activate the top key of MULTICAL® 402 and check that the displayed values for temperatures and water flow are credible values.

8 Electrical connection

The two matched 2-wire temperature sensors are mounted in terminals nos. 5 and 6 (T1) and terminals nos. 7 and 8 (T2). The polarity of temperature sensors T1 and T2 is unimportant.

Please see position of terminals below:

	Terminal no.	Standard heat and cooling measurement
T1	5-6	Sensor in inlet pipe (red)
T2	7-8	Sensor in outlet pipe (blue)



9 Plug-in modules

MULTICAL® 402 can be extended by a wide range of extra functions if plug-in modules are added. The individual modules are briefly described below.

9.1 Pulse inputs

Pulse inputs [VA] and [VB] are used for connection of extra water meters with either Reed-switch output or passive electronic pulse output. Min. pulse duration is 30 ms. and max. pulse frequency is 0.5 Hz.

65 + [VA] Pulse input
66 -

67 + [VB] Pulse input
68 -

If a module with pulse inputs is mounted in MULTICAL® 402, the meter will automatically be configured for pulse inputs.

Please note that the pulse figure [litres/pulse] must match the extra water meters and the configuration of VA and VB. After delivery the configuration of VA and VB (config FF and GG) can be changed by means of the PC program METERTOOL.

9.2 Pulse outputs

Pulse outputs for energy [CE] and volume [CV] have Darlington optocouplers and are available with many of the plug-in modules. Max. voltage and current are 30 VDC and 10 mA.

16 + [CE] Pulse output for energy
17 -

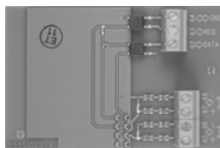
18 + [CV] Pulse output for volume
19 -

If a module with pulse outputs is mounted in MULTICAL® 402, the meter will automatically be configured for pulse outputs. The pulse duration was ordered at 32 msec. or 0.1 sec. After delivery the pulse duration can be changed by means of the PC program METERTOOL.

The resolutions of the pulse outputs always follow the least significant digit displayed for energy and volume respectively.

9.3 Data + pulse inputs, type 402-0-10

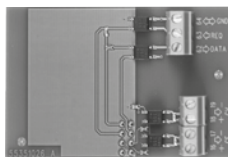
The data terminals are used for connection of e.g. a PC. The signal is passive and galvanically separated by means of optocouplers. Conversion into RS232 level requires connection of data cable 66-99-106 [D-Sub 9F] or 66-99-098 [USB] with the following connections:



62	Brown	[DAT]
63	White	[REQ]
64	Green	[GND]

9.4 Data + pulse inputs, type 402-0-11

The data terminals are used for connection of e.g. a PC. The signal is passive and galvanically separated by means of optocouplers. Conversion into RS232 level requires connection of data cable 66-99-106 [D-Sub 9F] or 66-99-098 [USB] with the following connections:



62	Brown	[DAT]
63	White	[REQ]
64	Green	[GND]

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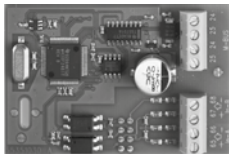
9.5 M-Bus + pulse inputs, type 402-0-20

M-Bus module with primary, secondary and enhanced secondary addressing.

The module is connected to the M-Bus Master on terminals 24 and 25 by means of twisted-pair cable.

The polarity is unimportant.

The module is powered by the connected master.



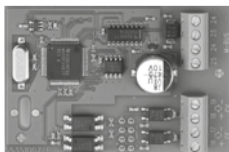
9.6 M-Bus + pulse outputs, type 402-0-21

M-Bus module with primary, secondary and enhanced secondary addressing.

The module is connected to the M-Bus Master on terminals 24 and 25 by means of twisted-pair cable.

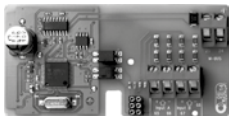
The polarity is unimportant.

The module is powered by the connected master.



9.7 M-Bus module with MULTICAL® III data packet + pulse inputs, type 402-0-29

M-Bus module 402029 includes the same data packet as M-Bus module 6604 for MULTICAL® III/66-C and module 660S for MULTICAL® Compact/MULTICAL® 401.

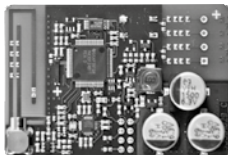


The module can be used together with e.g. the old M-Bus Master with display, old regulators and old reading systems which do not support the newest M-Bus modules.

9.8 Wireless M-Bus, type 402-0-30, 402-0-35 + 402-0-37*

The radio module has been designed to form part of Kamstrup's hand-held Wireless M-Bus Reader system, which operates within the licence-free frequency band in the 868 MHz area.

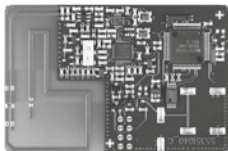
The module is equipped with an internal antenna as well as a connector for external antenna.




9.9 Radio, type 402-0-40 and 402-0-41*

These radio modules are your first choice for reading via Kamstrup's hand-held reading systems, e.g. the USB Meter Reader and the hand-held terminal MULTITERM Pro, which operate within the unlicensed frequency band in the 434 MHz area.

The radio module is supplied with internal antenna.



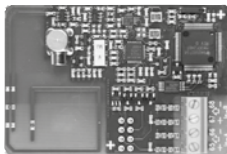
*  Mounting an external antenna it must be secured that the antenna cable does not become caught between the PCB and the stay of the cover.

Replacing or mounting modules the meter must be without current. The same applies when mounting an external antenna.

9.10 Radio, type 402-0-42 and 402-0-44*

The radio modules have been optimised to form part of Kamstrup's radio network systems, which operate within the unlicensed frequency band in the 434 MHz area, but can also be used for the hand-held reading systems in the same frequency range.

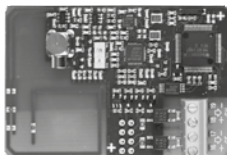
The module is equipped with an internal antenna as well as a connector for external antenna.




9.11 Radio, type 402-0-43 and 402-0-45*

The radio modules have been optimised to form part of Kamstrup's radio network systems, which operate within the unlicensed frequency band in the 434 MHz area, but can also be used for the hand-held reading systems in the same frequency range.

The module comes with internal antenna as well as a connector for external antenna and two pulse outputs.



*  Mounting an external antenna it must be secured that the antenna cable does not become caught between the PCB and the stay of the cover.

Replacing or mounting modules the meter must be without current. The same applies when mounting an external antenna.


9.12 Module overview

MULTICAL® 402 communication modules

Type No.	Description	Module no.
402-0-10	Data + 2 pulse inputs (VA, VB)	5550-1025
402-0-11	Data + 2 pulse outputs (CE, CV)	5550-1026
402-0-20	M-Bus + 2 pulse inputs (VA, VB)	5550-1030
402-0-21	M-Bus + 2 pulse outputs (CE, CV)	5505-1007
402-0-29	M-Bus + 2 pulse inputs - MULTICAL® III compatible data	5505-1140
402-0-30	Wireless M-Bus, C1, encrypted, 868 MHz, internal and external antenna	5550-1029
402-0-35	Wireless M-Bus, C1, alternative registers, encrypted, 868 MHz, internal and external antenna, pulse input	5550-1203
402-0-37	Wireless M-Bus, EU, 868 MHz, Mode T1, common key, internal antenna	5550-1075
402-0-40	Radio, EU, 434 MHz, int. ant., NET0	5550-1040
402-0-41	Radio, EU, 434 MHz, int. ant., NET1	5505-1040
402-0-42	Radio, EU, 434 MHz, int. ant., NET0 + 2 pulse inputs (VA, VB)	5550-1072
402-0-43	Radio, EU, 434 MHz, int. ant., NET0 + 2 pulse outputs (CE, CV)	5550-1072
402-0-44	Radio, EU, 434 MHz, int. + ext. ant., NET1 + 2 pulse inputs (VA, VB)	5550-1072
402-0-45	Radio, EU, 434 MHz, int. + ext. ant., NET1 + 2 pulse outputs (CE, CV)	5550-1074


10 Setup via front keys

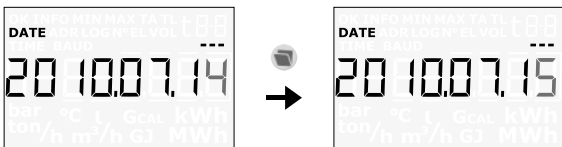
Date, time and primary M-Bus address can be adjusted by means of the keys on the calculator's front.


- 1 In the display you select the reading you want to change
- 2 Disconnect the supply plug from the meter
- 3 Wait until the meter has shut down (up to 2.5 minutes). Do not press any keys
- 4 Keep pressing the main key  while connecting the supply plug to the meter until the display is free from lines.
- 5 The setup menu is now active.

When the setup menu has been activated the value selected to be changed is displayed, the digit furthest to the right flashing:






The value of the flashing digit can be changed by pressing the sub-key . The digit is increased by one each time the key is pressed, and passing 9 it starts from 0:



Pressing the main key  you go to the next digit from right to left:



The active digit flashes and this digit can now be changed by pressing the sub-key . You go to the first digit on the right by means of the main key .

When the value of the reading has been changed you quit by pressing the main key  continuously for 5-6 seconds.

It should be checked if the value is valid for the reading in question. If so, the value is saved and the new value is displayed together with the "OK" symbol. If not, the old value is displayed without the "OK" symbol.

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Consumed cooling energy in MWh.

E3 = legal cooling energy.



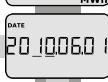
Latest target date.

Water consumption of V1.



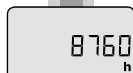
Energy count on latest target date.

Followed by monthly counts.



Latest target date.

Number of operating hours.



Volume count on latest target date.

Followed by monthly counts.

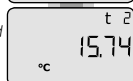
Current inlet temperature.

[] Activate  to view yearly and monthly average values.*



Current outlet temperature.


[] Activate  to view yearly and monthly average values.*

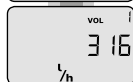


Current differential temperature.




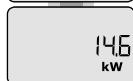
Actual flow.

[] Activate  to see this year's max. value as well as yearly and monthly logging values.*



Current cooling capacity.

[] Activate  to see this year's max. value as well as yearly and monthly logging values. Followed by accumulated water consumption on inputs A and B.*



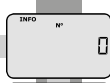


Current information code.

(Contact your supply company if the value differs from "0").



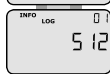
Reading of number of INFO code events.



Data logger shows the date...



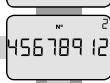
... and then the INFO codes of the latest 36 events.



The eight most significant digits of the customer number.



The eight least significant digits of the customer number. In this example the customer number is 12345678912.



Current date.



Current time.



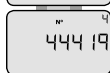
Target date displayed as month and day. In this example 1st June.



The calculator's serial number.



The calculator's program number. In this example: Flow sensor in outlet pipe, MWh and 100 imp/l.



Followed by the calculator's configuration number and software edition.



Display test.

DDD = 510

Furthermore, see interactive user's guides at www.kamstrup.com.