CALEC® MB

Heat calculator

Contents

1. Advantages and applications

1.1

Applications

- As a versatile and reliable meter for district and local heating, with useful additional features for special applications and tariffs. Thanks to the CALEC® MB calculator there is virtually no limit to the combinations possible with different types of flow meters and temperature sensors.
- For commercial and industrial use, and to monitor systems in energy installations.
- For the middle and upper performance ranges in heat production and distribution.
- Whenever there are demanding requirements for measuring accuracy and stability.
- As a transmitter of heat data for remote processing via the M-Bus communications channel.
- In inspection, testing and calibration systems.

1.2

Advantages

The successor to the well-proven CALEC® MCL and MCP remote heatmeters CALEC® MB complies 100% with the EN 1434 heat meter standard and EMC directives 89/336/EEC (CE certification).
Accuracy and long-term stability thanks to state-of-the-art electronics and high quality engineering. Efficient microprocessor metering system with integral data backup by EEPROM.

Compact modular design
For wall or electrical control panel mounting. Compatible with all commercially available meter boards. Output options can be installed at a later stage without damaging the calibration seal.

Illuminated text display
Since the 8-digit totalizers for energy and flow volume give an enormous metering range, only a few rated capacities are required.
For precise identification of measuring points, the unit has an electronic text display which can also be read by the M-Bus protocol (40-character ASCII string).

Data communications
Fast reading by hand-held terminal or PC via the built-in infrared interface.
Remote reading via the M-Bus interface according to EN 1434-3 at any time.
Functions and parameters which are not relevant to calibration can also be newly entered or modified via the M-Bus interface at a later stage. These can also be partially protected against manipulation.

Datalogger
Energy meter readings can be stored under two freely programmable billing dates, e.g. summer time / winter time billing, or for an intermediate reading.
A built-in **logger function** records energy and flow volume readings, and flow rate and thermal power maxima for 15 different periods. These are programmable to 1 day, 2 days, 7 days, 1/2 month or 1 month, with optional integration time for computing thermal power and flow maxima.

In order to guarantee that the date-dependent datalogger functions correctly, we recommend that the optional realtime clock (2RWC) is installed.

Any errors which occur are stored, together with the duration of the error (in seconds). This means that their significance in relation to measurements can be evaluated retroactively.

The meter is powered from the mains and **needs no battery**. In case of power failure, data are saved in an EEPROM. Data security is thus equivalent to electronic roller counter type meters.
With the realtime clock option, date and time will continue functioning even after a power failure. This option can be retrofitted at any time. The clock has a standby battery which guarantees 10-years operation.

M-Bus interface according to EN 1434
(M-Bus = meter bus)
The standard data communications interface for heat meters allows remote reading, control and calibration via the communications interface. Simultaneous remote reading of other types of meter, such as gas, water or electricity is also possible with M-Bus.

2. Heat metering system design

A heat metering system comprises a flow meter, two paired temperature sensors and the metering unit. Even the best metering unit cannot compensate for errors in sensor dimensioning and installation. It is therefore strongly recommended that great care is taken with the selection and specification of the metering point.

For detailed system layout information, please refer to our general installation guidelines and to heat meter standard EN 1434 Part 6.
Our specialists are at your disposal for system installation planning, thus saving you the unnecessary outlay and expense of subsequent alterations.

2.1

Flow metering

As well as the usual flow meters with a pulse output, option 2AIN also makes it possible to use flow meters with an analogue output such as EM meters or orifice plates. When flow meters with a pulse output are used, the pulse value indicates the volume to which one pulse corresponds. This value should be selected as low as possible, in the interests of high resolution and continuous measurement.

The point of installation is of crucial importance since the volume-to-mass conversion is performed at the temperature specified under "installation location". Because flow/return definitions can lead to misunderstandings, above all in refrigeration systems, the terms "hot side" and "cold side" are used for greater clarity. In heating systems, for example, the return flow loop is the cold side of the heat circuit. Flow meters should preferably be installed in piping sections near room temperature. This makes for greater accuracy and extends service life.

2.2

Temperature measurement

For temperature measurements, the CALEC® MB uses paired platinum temperature sensors (Pt100 to DIN IEC 751). When pairing sensors, the two most similar ones from a large number are chosen to form one pair; the maximum divergence within the pair must not exceed 0.05°C. In conformity with EN 1434-2, sensors can only be paired if they have the same type of installation and the same length.

Careful attention must also be paid to sensor installation and wiring. These are considered in section 3.3 below and in the heat meter standard EN 1434 Parts 2 and 6.

2.3

Heat calculators

Heat calculators are maintenance-free except for recalibration after expiry of the certified period. They must be easily accessible for reading, and protected against heat and electromagnetic interference.

Heat calculators must be clearly marked together with their flow meter and temperature sensor pair. This is extremely important at multiple metering points where confusion can arise.

2.4

Metering concept

Heat meters must be installed according to a systematic concept, depending on whether individual consumers are to be metered or an overall consumption balance is required.

In the latter case, all part - consumers must be metered - extrapolation of unmetered components as a difference in the main measurement is not admissible since it usually causes significant errors.

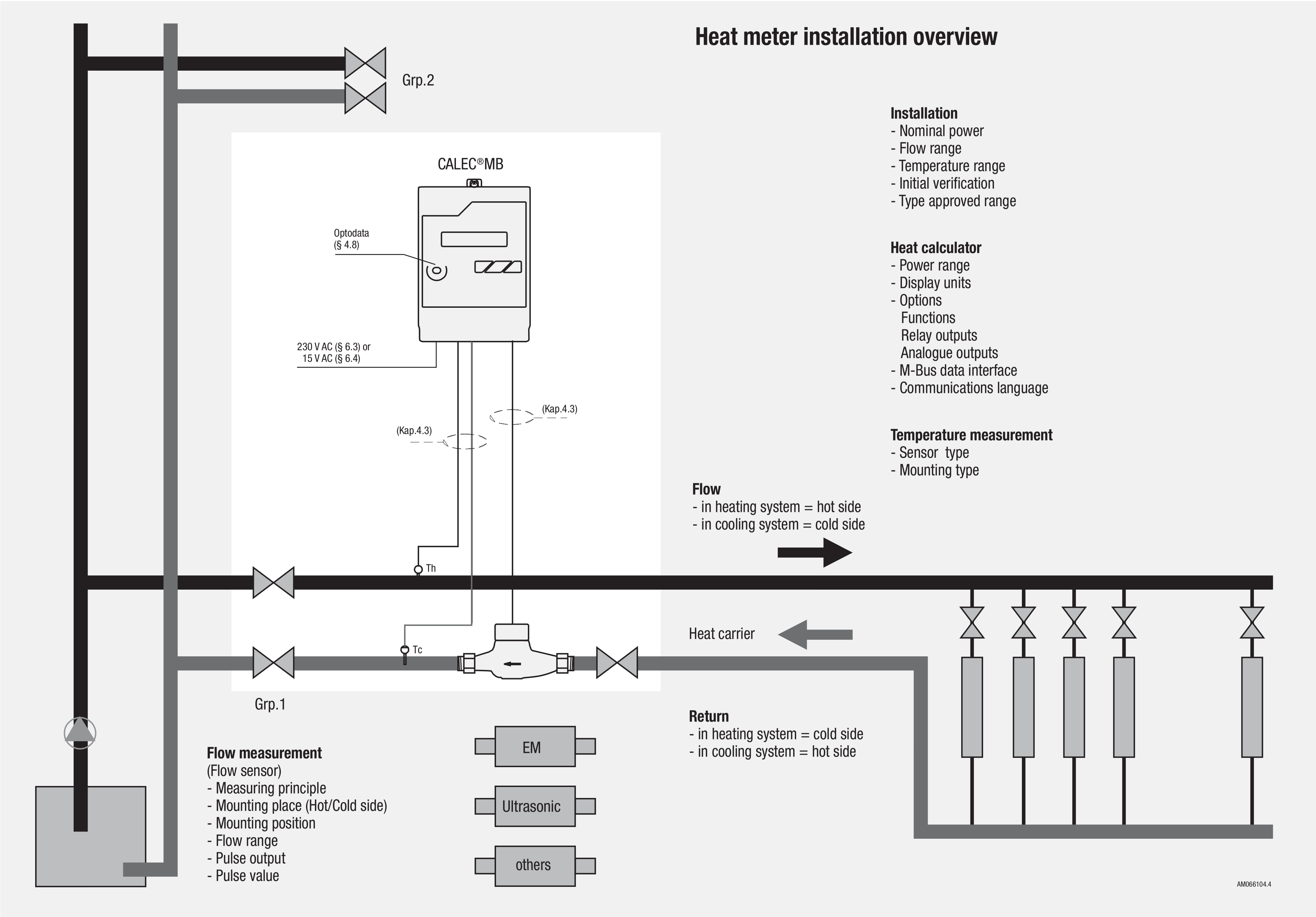
2.5

Installation recommendations

The installation and commissioning of heat meters is a specialists task, demanding the greatest care and expertise. Apart from the recommendations set out here, compliance is also required with EN 1434 Part 6 guidelines and the product operating instructions. Precision requirements can only be met if the meter is installed correctly.

When meters are being installed for the first time, it is already worth remembering that, for reasons of maintenance or verification, all units comprising a system will need exchanging at a future date.

Heat meter installation overview



3. CALEC® MB heat calculator

3.1

Measuring principle

Thermal energy is calculated from the flow rate of the heat carrier, taking into account its physical characteristics (specific heat and density), and the difference between the forward and return flow temperatures.

3.2

Flow inputs

Flow input IN1 (terminals 10/11) allows connection of mechanical or electronical passive/active pulsers and, as an option, current signals of 0/4...20 mA.

Mechanical pulsers (such as reed switches) must be fitted with debouncing filters to prevent double counting. The debounce filter is installed during factory programming and must therefore be specified when placing an order. It limits input frequencies to about 20 Hz, i.e. it requires a minimum volumetric pulse and interval time of 25 ms.

Passive pulsers, open collector switches and NAMUR transmitters (according to DIN 19234) are powered with 8.0 V, using a current of up to 8 mA from the meter supply. Important: observe the polarity indicated on the wiring diagramme! The minimum admissible pulse and interval time is 2.5 ms, allowing input frequencies of up to 200 Hz for symmetrical pulses.

Active pulsers (current signal >3 mA) are connected via the galvanically isolated optocoupler input. The input current is limited by a constant current circuit to about 3 mA in the voltage range 5 to 30 VDC.
This ensures complete galvanic separation of the flow meter and calculator, and allows an input frequency range of up to 10 kHz with a minimum pulse and interval time of 50 µs.

3.3

Temperature measurement

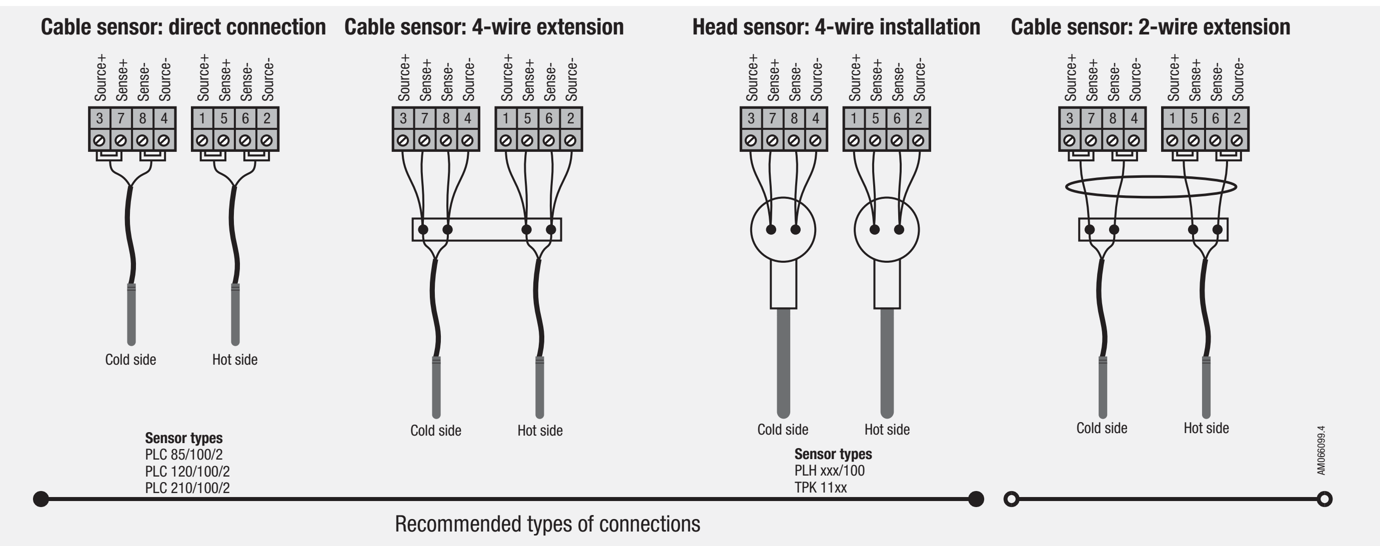
Temperature measurements are made with the well-proven dual slope principle which is extremely reliable. The two sensors (Pt100) receive current pulses in rapid succession. This prevents any intrinsic heating. Sensors can be connected with the 2-wire or preferably with the 4-wire technique.

2-wire circuits
Since the wire resistance is added to the temperature measurement resistance in 2-wire circuits, unequal wire lengths can cause significant errors and unusable results. 2-wire circuits should only be used with wire lengths below 10 m. Extension leads must be exactly the same length and pass through the same cable. In all other cases, only 4-wire circuits ensure adequate precision. Extension leads must have a cross-sectional area of at least 1 mm^2 or preferably 1.5 mm^2.

4-wire sensors
4-wire sensors are not absolutely necessary for a 4-wire circuit. A 4-wire connection between meter and sensor is sufficient, but this requires a 4-pole sensor connection box or head (see wiring diagramme).

For extensions, we recommend paired 0.8 mm Ø twisted telephone cable.
Extension is only admissible to 15 m, with spacing from other cables in compliance with EN 1434-6. Longer extensions are the responsibility of the operator, which must conform with the applicable CE requirements.

Connection of sensor head with threaded connection
All parallel wires (such as at terminals 3 and 7) can be connected together to the sensor head on the same terminal using a cable lug clamp.



3.4

Factory configuration

If the unit is to be used as a verified (calibrated) measuring device, all the parameters relevant to calibration have to be entered during manufacture, after which they must not be modified.
A locking mechanism inside the verification section prevents any further access to these parameters.

Apart from the data used to compute heat consumption, this particularly applies to flow meter parameter changes such as pulse value, debounce filter and point of installation, as well as the capacity range with corresponding display units.

For factory programming, values for the above data to be supplied on the specification form, are therefore mandatory.

3.5

Field configuration

The term "field configuration" is used to cover all the functions which may be modified by the user at any time without affecting the energy calculation.

In order to prevent tampering of the tariff settings by unauthorised persons, additional security is provided by the following protection concept:

Authorised persons	Authorised pers. before verification	Supplier after verification	User after verification
Method of protection (type of locking)	Hardware protection on calculator circuit board, sealed: Lock level 0	HW protection on basic circuit board. Lock level 1	Software without protection Lock level 2
Possibility of setting device function	Settings with CALTOOL-P	Settings with CALTOOL MBUSTOOL	Settings with CALTOOL MBUSTOOL
Heat meterering functions			
Display units			
Entering pulse value	◆		
Installation point of flow sensor	◆		
Switching debounce filter on	◆		
Billing dates 1 and 2	◆	◆	
Registration period	◆	◆	
Integration period	◆	◆	
Text field input	◆	◆	◆
Date-time	as desired	as desired	limited corrections
Baud rate	◆	◆	◆
Bus address	◆	◆	◆
Output option OUT 1...8	◆	◆	◆
Event counter	◆	◆	◆
Smoothing factor	◆	◆	◆
2AIN			
BDE, BDV option			
TWIN E, TWIN V option			
DTF, ISPC option			

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3.6

Menu structure pages 21-25

3.7

Meter displays

The display consists of a 2-line liquid crystal unit which has a capacity of 2 x 20 characters, with alphanumeric 7 x 11 dot matrix presentation.

For mains powered units, the display is switched on by the first key pressed, and shuts off automatically five minutes after the last key has been pressed. The default display is the main window which shows energy and volume totals.

The following displays can be called up:

Display function	**Contents**	**Remarks**	**Variants**
Pulse value Installed side	IPW 1,0000 l/pulse EBS Cold side	as from version 105	
Main display	E....123456.12 MWh V.....1234567.1 m^3	Energy total Volume total	EH 123456.123456 MWh VH 123456.12345 m^3
Second metering unit (option)	E2...123456.12 MWh V2 1234567.8 L or m^3	Other displays for options	
Text field for descriptions	North Central Heating Unit Main Boiler	Maximum 40 characters	
Error message	— Error —	See Error messages	
Billing date values	E 123456.12 MWh Billing date 1 30.04.97	Energy total on billing date 1 Billing date 1	additional display of E2 for options
	E 234567.34 MWh Billing date 2 30.09.97	Energy total on billing date 2 Billing date 2	additional display of E2 for options
Instantaneous values	P 83.34556 MW	Metering power	additional display of P2 and Q2 for options TWIN-E and ISPC
	Q 15.345 m^3/h	Flow rate	
	Temp. DT 63.2 K H 128.3 C 65.1 °C	Temperature difference Temp. hot side/cold side	
	K-fact. 1.112 Wh/l/K Density 1.00498 kg/l	K-factor Density at installation point	
	Date 27.01.98 Time 13.45	Date Time	
	00005815 h	Service hours counter	

Data Logger (History functions)	Periode 1 month Integration time 60 minutes	Recording period Integration period	
Date and number of the period now in progress	Date 27-01-98 00 Enter	Today's date Number of period now in progress	
	Date 2 7-01-98 E 000000.00 MWh	Energy total during period now in progress	
	Date 27-01-98 V 0000000.0 m^3	Volume total during period now in progress	
	Time 04:45 15.01.98 P 2.14984 MW	Time of the maximum power in period 00	
	Time 06:13 15.01.98 Q 35.83210 m^3/h	Time of highest flow rate in period 00	
	Date 31-12-97 01 Enter	Finish date of period 1	
	Date 31-12-97 E 12345.00 MWh	Energy total at end of period 01	
	Date 31-12-97 V 123456.0 m^3	Volume total at end of period 01	
	Time 10:45 24.12.97 P 10.1913 MW	of the maximum output in period 01	
	Time 09:33 16.12.97 Q 37.46610 m^3/h	Time of the highest flow rate in period 01	
Date and number of the penultimate period	Date 30-11-97 02 Enter	Finish date of period 02	
Date and number of period 03	Date 31-10-97 03 Enter	Finish date of period 03	
⇓ continues with 04 .. 13 ⇓			
Date and number of period 14	Date 30-11-96 14 Enter	Finish date of period 14	
	Date 30-11-96 E 000045.00 MWh	Energy total at end of period 14	
	Date 30-11-96 V 000456.0 m^3	Volume total at end of period 14	
	Time 10:45 24.11.96 P 10.1913 MW	Time of the maximum power in period 14	
	Time 09:33 16.11.96 Q 37.46610 m^3/h	Time of the highest flow rate in period 14	

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Display function	Contents		Remarks	Variants
Factory configuration	Serial number Man. date	04848109 30 .06 .96	Serial number Date of manufacture	
	CALEC MB. Heat calculator	Ver. 200	Type and version number Designation	Option designation, such as BDE / ISPC etc.
	Fluid-Nr. 000 Water		Heat carrier no. 000 Fluid designation	Other fluids availabe
	Temp. sensor T	Pt100 0 ... 200°C	Sensor type Sensor range	
	IN1 Term. 10/1	Impuls passiv Enter	Volume input E1 Connection terminals	
	Pulse value Max. frequency	1.00 l 20 Hz	Debounce filter switched on	
	Flow sensor location	 cold side	Installation location of the volume- tric flow sensor, programmed for:	
	Inhibition of low DT	 0.00 °C	Minimum temperature difference for energy calculation	additional displays for options TWIN-V, TWIN-E, ISPC, DTF, BDV, 2AIN
Field configuration Output 1	OUT 1 Term. 50/51	Relay Enter	Output assignment Connection terminals	
	Pulse Pulse value	Energy1 1000. Wh	Function and assignment of its size and unit	
			Event counter	
Output 2	OUT 2 Term. 52/53	Relay Enter	Output assignment Connection terminals	
	Alarm	Inverse	Function and assignment	
	Alarm 12345678	Inverse s	Event counter	
Output 3	OUT 3 Term. 70/71	Analogue output Enter	Output assignment Connection terminals	
	Current3 Q1 0-30.0	0...20mA m^3/h	Current range Measuring range	
	Current3 16.08	0...20mA mA	Control field for output current	
Output 4	OUT 4 Term. 72/73	Analogue output Enter	Output assignment Connection terminals	
	Current4 P1 0-150	4...20mA kW	Current range Measuring range	
	Current4 12.8	4...20mA mA	Control field for output current	
Output 5 and soon	OUT 5 Term. —/ —	Event Enter	virtual counter without terminals	
	Limit Q1 25.00	 m^3/h	Function and assignment of its size and unit	
	Limit 01853420	 s	Event counter, duration for which limit value is exceeded	
M-Bus	M-Bus Baud = 2400 Term. 24/25 Adr. 000		Baud rate 2400 Terminals + M-Bus address	
Language	Language	English Change Enter	Language selection	
	Deutsch			
	Français			
	Italiano			
Status test	IN1 f = 4.88 Hz t = 00000000 s		Vol. pulse frequency at IN1 Time since last pulse	Additional display for IN2 for options TWIN-V, TWIN-E, ISPC, DTF, BDV, 2AIN
	Lock Level 1 MBus access 00004371		Lock level status Access counter	
Display test	################################ ################################			

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N.B. The listed parameters and values are by way of example only and do not necessarily represent standard settings.

Error messages on the display

On the main display, errors are indicated alternately on line 1 and line 2. The error menu provides a more detailed plain text description. The table which follows contains a selection of possible error types:

HW Temp Alarm (Cold)	Sensor error, cold side (short circuit, breakage, jumpers missing)
HW Temp Alarm (Hot)	Sensor error, hot side (short circuit, breakage, jumpers missing)
Delta-T Alarm	Temperature difference outside of range -10 ... +200°C
SW Temp Alarm (Cold)	Temperature alarm, cold side (value outside of the measuring range)
SW Temp Alarm (Hot)	Temperature alarm, hot side (value outside of the measuring range)
Relay overflow (as from version 105)	Relay switching frequency exceeded
Option Alarm	Programming does not match hardware
Overflow Alarm	Power or flow capacity exceeded
Undervoltage Alarm	Supply voltage is too low, e.g. for bus supply
Overvoltage Alarm	Supply voltage is too high
Namur breakage	Namur pulser is faulty or broken, I<0.2 mA
Analogue input	Analogue input card (2AIN) is not available or is faulty

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M-Bus error messages

The M-Bus protocol contains error messages in coded form.

3.8

M-Bus communications interface

The CALEC® MB incorporates the standardised M-Bus interface (in conformity with EN 1434-3), featuring variable data format which enables all the parameters to be read out. The same interface can also be used to program the enabled auxiliary functions and options with the help of the Aquametro-CALTOOL and MBUSTOOL software.
Bidirectional optocouplers are used to isolate the bus with the interface from the unit. The M-Bus connection is made to terminals 24 / 25, regardless of polarity.

The optical interface conforms electrically and mechanically with the ZVEI standard, IEC 1107 (EN61107), but it supports the M-Bus protocol in conformity with EN 1434.

3.9

Auxiliary power output

An 18 VDC auxiliary power supply, galvanically isolated from the calculator, is available on terminals 64 (+) and 65 (-) with current capacity up to 100 mA. This is intended e.g. for powering 4 analogue outputs or one 2-wire flow sensor with pulse output.

4. Options

Slots are provided on the base circuit board for option cards which, when inserted, have no effect on the calibrated part of the meter.
The unit recognizes each option card inserted and indicates the type and terminal allocation on the display.

Socket No.	Output	Terminals	Output	Terminals
Socket 1	OUT 1	No. 50 / 51	OUT 2	No. 52 / 53
Socket 2	OUT 3	No. 70 / 71	OUT 4	No. 72 / 73
Socket 3	OUT 5	No. 74 / 75	OUT 6	No. 76 / 77
Socket 4	OUT 7	No. 78 / 79	OUT 8	No. 80 / 81

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4.1

Relay card 2RNC

This incorporates two switching contacts to which any parameters can be allocated via the interface.
These solid state relays have a switching capacity of up to 100 mA AC or DC at 50 V .
Function allocations can be modified at any time via the M-Bus interface.

The following programming options are available:

- Pulse functions: as output contact for adjustable energy and flow volume pulses. Pulse duration is about 1 second. For fast pulse trains, the pulse duration is decreased to the max. pulse frequency of 16 Hz with equal pulse and interval times (see "Relay overflow" error message).
- Status functions: as limiting value (GW) relay for monitoring flow (Q), power (P), inflow and outflow temperatures (H or C) or temperature difference (D). Limits can be selected with or without switching hysteresis. If a hysteresis (GH) function with separate reswitching value (smaller) is selected, this must be specified additionally.
- Alarm function: as alarm contact for signalling a heat meter error, optionally as closing (AE) or opening (AA) alarm contact.

4.2

Relay card with realtime clock 2RWC

The function of this card is identical to relay card 2RNC except that it has an additional battery-powered clock module for data and time recording (without automatic switchover between winter and summer time) making it mains power failure proof. The battery is soldered onto the card and lasts about ten years. The date and time are set via the M-Bus interface.

Time deviations without change of date can be corrected once per month with the keypad on the front panel (e.g. summer/winter time changeover). Only one clock card can be inserted per meter.
The card (including battery) can be installed and removed without damaging the calibration seals.

4.3

Analogue output card 2AOU

This card incorporates two current outputs (galvanically isolated from the heat meter), which are freely programmable.
These outputs require a **separate** voltage supply, and are available in either active or passive versions. The passive version requires a current supply (internal or external) connected to the terminals. In active mode the internal auxiliary power supply is loaded at 25 mA per channel.

The maximum load resistance depends on the supply voltage.
If the internal auxiliary power supply is used, the maximum load resistance is 600 Ohm.

Technical specifications	
Voltage range (passive)	5...25 VDC from external auxiliary source 18 V from internal auxiliary source
Current range Maximum load Resolution	4...20 mA (0...20 mA with limitations [1]) R_L(Ohm) max. = (Us - 5)/0,02 A 12 bits
Max. converter error	0.15% of actual value + 0.15% of full scale
Measured variable	Power, flow rate, temperature H, C, D Additional parameters for the options TWIN E, ISPC

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1) Operation with 0 to 20 mA (e.g. for generating a 0 to 10 V output on a 500 Ohm resistor) is possible but subject to one limitation: Due to residual current requirements of the output circuit, the minimum current cannot be less than 200μA, thus raising the zero point.

Parameters and ranges can be programmed at any time via the interface. These are not subject to verification.

4.4

Double analogue input 2AIN

Application
To process analogue current signals from flow and pressure sensors for heat measurement.
The unit has two independent 0/4 .. 20 mA inputs and is accommodated in the cover (together with the calculator circuit board). Of all the hardware options, this is the only one which cannot be retrofitted.

Required information
When ordering, please supply the following information for each input:
- Zero point of the range (0 or 4 mA)
- Unit of measurement (flow rate in m³/h, t/h)
- Measuring range 0/4 mA corresponds to 0 m³/h, 20 mA corresponds to........................
- Flow rate at which signals should be suppressed ≤ .... m³/h

Technical data
The accuracy requirements for energy measurements are defined in the Heat Meter Standard, EN 1434:1997 as a function of the declared minimum temperature difference. It is assumed there that the volume input to the calculator is error-free, although this is only true for weighted pulses (litres per pulse).
The analogue signal represents a flow rate (volume per unit of time) which has to be converted into volume units by the calculator. The error which occurs as a result of this, and the inaccuracy of the current measurements, are transferred to the calculator as additional errors. These must not cause the permissible error of the calculator to be exceeded.

Because of the measuring uncertainty of the A/D converter, a short circuited or opened input can also be registered as (low) flow. Such errors can be prevented with the flow rate suppression cut-off option mentioned above. If no value is indicated, a default of 0.75% Q_{max} is programmed.

Current range
0/4 .. 20 mA
Software is used to make the adaptation to 4 - 20 mA.
Linear signal characteristic.

Measuring error
0.005% of actual value + 0.005% of full scale.

Input resistance
This is designed so that the maximum voltage drop across the input is less than 3V (Ri≤120 Ohm + 0.6 V)
No galvanic isolation: The analogue input is not galvanically isolated from the basic unit. The negative wire is connected to the unit's earth.

Calibration
Software is used to perform the calibration. For analogue values 0/4 mA and 20 mA, the corresponding digital values for both channels are stored in an EEPROM on the analogue input card.

Overload protection
The inputs are protected against overloads in the range from -5 V to +40 mA.

Initial Verification
The initial verification is always performed in conjunction with the calculator.
Because the unit is contained in the same cover as the calculator circuit board, sealing protects the settings against manipulation.

4.5

Control and tariff input DTF

Parallel energy metering can take place on a second counter E2 if a 5 to 30 VDC supply is connected to the control input IN2. For example, control input IN2 can be activated by an external tariff signal, or by an internally programmed threshold value which is dependent on a time value or a limit value via an output signal from the plug-in relay card. The main meter E1 is not affected by this function.

Caution: This option cannot be used at the same time as the ISPC option described below.

4.6

Pulse counter input ISPC

(ISPC = independent secondary pulse counter)
Input IN2 serves in this version for counting pulses from a second source independent of the main meter. The reading can be displayed on the meter itself or via the M-Bus, and is designated "flow 2" with unit l.

Application: as separate meter for water, gas, electricity, etc. for remote reading.

The pulse input can be connected to the following pulsers:

Contact pulsers
Reed or relay contacts (switches). The maximum pulse frequency is 50 Hz.

Namur or open collector pulsers
Here too, the maximum input frequency is 50 Hz but, if necessary, a 64:1 divider can be switched on during factory configuration. In this case, the maximum frequency is limited to 200 Hz by a filter. The divider has no influence on the metering result, but it does degrade the resolution.

Active pulser, frequency pulser
(galvanically isolated via optocoupler)
The 64:1 divider is always switched on and the maximum frequency is 1000 Hz.

For remote signalling of an alarm that is independent of the heat meter, the signal status of input IN2 can be monitored and transmitted instead of using it as a counter.
Application: for remote monitoring and alarm signalling of other devices in AMBUS® systems.

4.7

Enthalpy and density data for other heat carriers, FLX / FLU

If other heat carriers are used instead of water their enthalpies and densities must be known so that the configuration data can be adapted accordingly. At the present time data for more than 130 heat carriers in various mixtures are available in our database. Information is available upon request.

Heat meters for heat carriers other than water cannot be officially calibrated.

Designation:
FLU = heat carrier included in existing database.
Art. No. 81'625
FLX = heat carrier must be newly calculated and added to database.
Art. No. 81'626

For new heat carriers, data for specific heat (enthalpy) and density (specific weight) must be specified for at least 4 temperatures within the designated operating temperature range.

4.8

RS232 Communications interface

This optional module requires a free socket on the basic circuit board. It supports 300 to 9600 baud. The interface is powered by the auxiliary supply (loading 25 mA) and therefore galvanically isolated from the basic unit.

The signals for GND, TXD and RXD are available at the connection terminals. A signal of +10V (which can be used as DTR or RTS) is applied at a fourth connection terminal. Half-duplex communication is used; however, transmission and reception use separate channels.
The protocol used is identical to the M-Bus protocol defined in EN 1434-3:1997 and IEC 870-5.

Example
RS232 in socket 1

Socket 1	Term. 50	Term. 51	Term. 52	Term. 53
RS232	TXD	RXD	GND	+10V

4.9

RS485 Communications interface

This optional module requires a free socket on the basic circuit board. It supports 300 to 9600 baud.
The interface is powered by the auxiliary supply (loading 50 mA) and it is galvanically isolated from the calculator.
Half-duplex communication is used. Transmission and reception use the same channel.
The protocol used is identical to the M-Bus protocol defined in EN 1434-3:1997 and IEC 870-5.

Example
RS485 in socket 4

Socket 4	Term. 78	Term. 79	Term. 80	Term. 81
RS485	B +	B -	•	•

4.10

Bidirectional measurements, BDE (dependent on temperature difference)

If a heat transport circuit with one direction of flow is used to heat as well as to cool, positive and negative temperature differences will occur alternately. The cooling energy (prefixed with a negative sign) is calculated in the same way as for the heating energy. When the prefixed sign changes ($\Delta T<0K$), the calculator switches over to an additional energy metering register, E-. For monitoring purposes, the volume is also registered as V- during the negative phase.

Applications
Measurement of energy exchange (draw / supply) for interlinked networks, accumulators, etc.; geothermal heat, latent heat accumulators, air conditioning supply

4.11

Bidirectional measurements, BDV (dependent on direction of flow)

To measure energy in circuits with an alternating direction of flow.
The flow must be recorded with a sensor which recognises the forward and reverse directions. In addition to the volume signal output, this sensor must be fitted with one additional direction signal output. Example: EM and ultrasonic flow sensors.

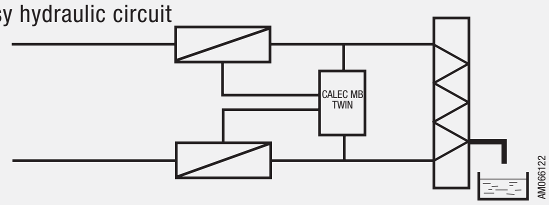
Application
Measurement of energy exchange (draw / supply) for interlinked networks, charging / discharging in heat accumulators (loading boilers, earth accumulators, ice accumulators, latent heat accumulators, air conditioning convectors and heat exchangers)

4.12

Twin calculator TWIN E

Double heat meter with two separate heat calculators using the same temperature values for both calculations.
This variant can be a cost effective way of replacing a second heat meter if two different flow sensors are installed in one common heat circuit.
The TWIN E-calculator cannot be officially calibrated (in Germany). For applications which are subject to mandatory calibration, it is therefore necessary to use separate heat meters.

Application
Energy and flow measurements
in a lossy hydraulic circuit

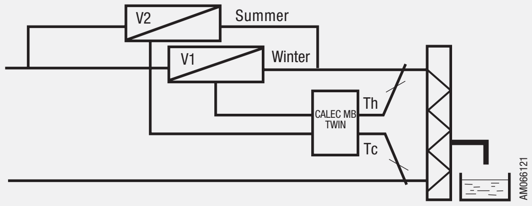


4.13

Twin calculator TWIN V

The TWIN V is used so that two parallel operating flow sensors with identical or different designs, sizes and pulse values, can be connected to one heat meter with common temperature measurement points (one pair of sensors). This is done in order to extend the flow rate range (for example: summer / winter operation).
Individual installation of the two flow sensors on the cold or hot side is possible.

Application example



4.14

Combination of options

Options RS232, RS485, 2AOU, 2RNC and 2RWC each require one socket. The extent to which they can be combined is therefore limited by the number of sockets.

The following rules also apply:
- the maximum number of interface cards is one
- the maximum number of analogue output cards is two at the same time, or one analogue output card and one interface card
- the maximum number of relay cards is three of which no more than one may have a clock component.

On the terminals, the current available at the auxiliary voltage output is:
- 100 mA
- 75 mA with RS232 card installed
- 50 mA with RS485 card installed

5. Technical data

Heat meter calculator	
Temperature measurement range	T 0°C ... 200°C
Temperature difference range	ΔT 0 ... 200 K
Pattern approved operating range	T 5°C ... 180°C
Pattern approved temperature difference range	ΔT 3 ... 175 K
Temperatur sensor type, Connection style Sensor cable length	Pt100 according to IEC 751, two or four-wire Tested to 15 m
Energy display units Display capacity	kWh - MWh I MJ - GJ 99'999'999
Maximum thermal power	30'000 MW / GJ/h
Volume display units Display capacity	m^3 or Ml (Megaliter) 99'999'999
Measuring and calculation time interval	~ 2 sec.
Time between inspections	10 years
Accuracy class Measuring and calculation error	EN 1434-1 / OIML Cl. 4 ≤ 0.5% at ΔT ≥ 3K

Power supply and interfaces	
Mains supply	230 V (+10-15%) 50 Hz, 15 VA, fully isolated
Supply via AMBUS®-network	16...24 V DC or 12...18 V AC 50/60Hz
Communications interface on the calculator front panel	Optical interface acc. to EN1434-3 with M-Bus protocol IEC 870-5
Communications interface at the M-Bus terminals	M-Bus protocol according to EN 1434-3 (IEC 870-5), galvanic isolation

Flow rate input	
Flow pulse input for - Contact pulser - Open collector pulser - Namur pulser (DIN 19234) - Active pulsers via optocoupler input Programmable pulse values	 Duration of pulse ≥ 25 ms Duration of pulse ≥ 2.5 ms Duration of pulse ≥ 2.5 ms Duration of pulse ≥ 50 µs, max. 10 kHz, 5...30 V, ≥ 5 mA 0.001 ml ... 100 m^3 with a resolution of 0.001 ml
Analogue input for flow rate (option)	0...20 mA or 4...20 mA, linear signal progression Input resistor 120 Ω, no galvanic isolation
Maximum flow rate	100'000 m^3/h
Flow transmitter mounting position	Cold or hot side

2nd Flow rate or control input (optional)		
Control input	ON OFF	with active signal via the optocoupler input 5...30 V, ≥ 5 mA with closed contact no active signal with open contact
Flow pulse input for - Contact pulser - Open collector pulser - Namur pulser (DIN 19234) - Active pulsers via optocoupler input Programmable pulse values		 max. 50 Hz, no debounce filter max. 50 Hz, with 64:1 divider max. 200 Hz max. 50 Hz, with 64:1 divider max. 200 Hz Duration of pulse ≥ 50 µs, max. 1 kHz, 5...30 V, ≥ 5 mA 0.001 ml ... 100 m^3 with a resolution of 0.001 ml
Analogue input for flow rate (option)		0...20 mA or 4...20 mA, linear signal progression Input resistor 120 Ω, no galvanic isolation
Flow sensor mounting position		Cold or hot side (with option Twin E only)

Output functions (optional)	
Relay output card 2RWC, 2RNC	two solid state contacts, potential-free max. values 50 V AC/DC, 100 mA, R_{ON} ≤ 20 Ω, R_{OFF} ≥ 1 MΩ
Analogue output card 2AOU	galvanically isolated, to be operated actively or passively, output current 0...4 mA or 4...20 mA Supply 5...24 VDC, R_L max at 24 V = 950 Ω
Interface card RS232	300...9600 baud half duplex, max. cable length 15 m
Interface card RS485	300...9600 baud half duplex, max. cable length 1200 m

Housing, environmental conditions	
Wall mounting	for installation on DIN rail (35 mm) or by three screw fixture
Protection class	IP 54
Ambient temperature range, Environmental class	5 ... 55°C, EN 1434 Class "C"
Storage temperature range	-20 ... 65°C

3-168-e3

5.1

Heat calculator

The CALEC® MB heat calculator is completed as a combined heat meter with water as the heat conveying liquid by adding the subassemblies of two separately matched and approved platinum temperature sensors and a separately verified flow sensor.

The amount of water flowing is recorded by means of volume proportional pulses or flow rate proportional analogue signals (0/4...20mA). It is converted into mass units by the calculator using the temperature of the water in the flow sensor.

From the resistance values of the temperature sensors and the heat carrier properties, the enthalpy difference is calculated and multiplied by the previously determined mass. The result is stored in a data-secured memory (EEPROM) and at the same time appears on the 8-digit LC display as total energy consumption in kWh, MWh or MJ, GJ.

The calculator is equipped as standard with a galvanically isolated M-Bus interface, complying with the EN 1434-3 (IEC 870-5 protocol) standard, which is available both on the housing cover as an infra-red transmitter and on connecting terminals.

5.2

Voltage supply

According to choice, voltage can be supplied to the CALEC® MB either at 230V AC, or via the AMBUS® network. Both types of supply may be provided at the same time. The display, the auxiliary voltage, and the RS232 and RS485 options cannot be supplied over the AMBUS® network.

Operation via the AMBUS® network is not permissible when the device is subject to mandatory calibration.

5.3

Connection of flow sensor

Flow input IN1 (terminals 10/11) allows connection of passive or active pulsers. Units are configured according to order.

To a limited extent, the input variants can be selected on site.
The necessary information is given in the operating instructions.

5.4

Connection of temperature sensors

2-wire connections
The temperature sensor wires are connected to terminals 7/8 (cold side) or terminals 5/6 (hot side).

Important: The four metal jumpers on the sensor terminals must be connected according to the wiring diagramme, otherwise temperature measurements cannot be made.

4-wire connections
The temperature sensor wires are connected to terminals 3+7/4+8 (cold side) or terminals 1+5/2+6 (hot side). The metal jumpers on the sensor terminals must be removed and individual wires connected to all 8 sensor terminals.
Reversal of the "source" and "sense" wires on the same side of the sensor has no detrimental effect.

5.5

Installation modes

The following standard installation modes are available:
- Wall mounting with supplied DIN rail
- Wall mounting directly with screws
- Wall mounting on existing CALEC® bracket
- Panel mounting with panel mounting bracket
- Panel mounting as replacement for CALEC® MCL/MCP

6. Testing / calibration

6.1

Testing

For testing and verification purposes the meter is fitted with a high-resolution display for total energy and flow. By pressing the "UP" and "DOWN" keys simultaneously, the display changes to high-resolution mode, with four extra digits corresponding to an additional factor of 10000. Pressing any key returns the display to standard mode.

Testing can also take place via the optical interface on the housing cover or terminals 24/25 using the M-Bus protocol according to EN 1434-3. In both cases the M-Bus interface is galvanically isolated and free of any electrical feedback.

6.2

Sealing and verification points

The verification mark is placed on the front panel of the meter (outer surface of cover).
The calibration seal prevents unauthorized access to the verified part of the meter by covering the interior cover fixing screws.

Factory seals protect the connection zone of the meter after commissioning by covering the access screws on the outside of the cover.

6.3

Official calibration approval

The CALEC® MB has been approved according to EN 1434.
In Switzerland and Germany, it has been authorised for commercial use in applications requiring mandatory calibration.

Options BDE, BDV, TWIN E and TWIN V cannot be officially calibrated in Germany. EN 1434 does not cover applications of this sort.
If an official test is nevertheless required, a special test can be carried out by the responsible calibration authority which, in practical terms, is equivalent to a calibration.

Approval testing also covers all currently valid safety and electromagnetic compatibility requirements. The meter is therefore designated with the CE mark.

6.4

Note regarding official calibration requirements

Verified heat meters are subject to supervision by national calibration authorities and must be re-verified before expiry of the calibration validity period (usually 5 years).
In some countries (such as Germany and Switzerland) large-scale meters >10 MW are exempted from calibration.

Verification covers all units comprising a heat meter, i.e. the calculator unit, flow sensor and both temperature sensors.
The heat meter operator is responsible for complying with recalibration requirements.

7. Miscellaneous

7.1

Accessories

- Installation accessories according to order list (section 8).
- Temperature sensors, sensor immersion sleeves, sensor connection sockets according to separate documentation.
- Flow sensors for heat meters according to separate documentation.
- Reading heads and units (HHU) including software.
- Accounting software available on request.
- M-Bus communications software for reading and parameterizing by PC.
- MBUSTOOL, CALTOOL

7.2

Guarantee and operating life

The period for which a CALEC® MB can be used until the first inspection is 10 years. Even heat meters which are not subject to mandatory calibration should be checked after a 5-year period in use since, in particular, wear and contamination of the flow sensor can cause substantial measuring errors. The information about the periods of use is based on experience.
Warranty is according to the general terms of delivery.

8. Ordering data

Ordering data for CALEC® MB heat calculator.

8.1

Basic unit

CALEC® MB	Power supply	Temp. sensors	Output options	Type designation	Order No.
MB-2S	230 V AC or AMBUS®	Pt100	2 sockets	MB 2S	93360
MB-4S	230 V AC or AMBUS®	Pt100	4 sockets	MB 4S	93361

3161e-7

The basic unit does not include any relays !

8.2

Hardware options (as additional order items)

Outputs	Cards	2 Relays with clock	2RWC	81620
		2 Relays without clock	2RNC	81621
		RS232C interface	RS232	81668
		RS485 interface	RS485	81669
		2 analogue outputs	2AOU	81622
Analogue inputs		2 analogue inputs	2AIN	81667
Mounting accessories		Mounting kit for front panel	MPM	81627
		Conversion kit, wall CALEC® MCL/MCP to MB	CWM	81628
		Conversion kit, front panel CALEC® MCL/MCP to MB	CPM	81629
Optical head		Optical reading head	OCI 9600	93376

3161e-8

- Only 1 card with clock is possible per unit

8.3

Software options (additional order items)

Functions	Control and tariff input	DTF	81623
	Pulse collector input	ISPC	81624
	Heat carrier other than water	FLU	81625
	New heat carrier: to be programmed	FLX	81626
	Bidirectional measurement (ΔT-dependent)	BDE	81663
	Bidirectional measurement (dependent on direction of flow)	BDV	81664
	Double calculator (2 flow sensors)	TWIN-E	81665
	Double calculator (volume totalisation)	TWIN-V	81666
PC software	Reading and programming software	CALTOOL	81648
	ditto, with Lock level 0 functions	CALTOOL-P	81657

3161e-9

All other device and programming data must be indicated on the CALEC® MB specification form.

Standard

Mainmenu / Sub-menu

IN1 / EBS display

Mainmenu (Display on pulse input)		Sub-menu (Display on current input (opt.))
IN1 1.000 L/Imp EBS cold side	or =	IN1current 0...20 mA EBS cold side

↑

Mainmenu		Sub-menu
E 00002216. kWh V 000259.42 m3	↑+↓	EH 0002216.1608 kWh VH 00259.425303 m3

↓

Textfield

↓

Error message Enter →

	Display on error only	Display on error only	Display on error only	Display on error only
no fault Exit Enter	HW temp. alarm (hot) Exit Enter	Option Alarm Exit Enter	Overflow Alarm Exit Enter	xxxxxxx Alarm Exit Enter

↓

Billing date Enter →

E 00002216. kWh Bill date 1 30.06.--	E 00002216. kWh Bill date 2 30.12.--	Exit Enter

↓

Instantaneous values Enter →

P 3.759526 MW Q 18.247 m3/h	Temp. ΔT 175.04 K H 180.0 C 4.9 °C	k-Fact 1.1770 Wh/l/K Density 1.00068 kg/l	Date 11.05.98 Time 10.25	Total working time xxxxxxxx h	Exit Enter
			10.25 11.05.98 Edit: Up, Down		

↓

Data Logger Enter →

Period monthly Integr.lap 15 min	Date xx.xx.xx 00 Enter	Date xx.xx.xx 01 Enter	Date xx.xx.xx 02 Enter	Date xx.xx.xx 03 Enter	Date xx.xx.xx 04 Enter	Date xx.xx.xx 05 Enter	Date xx.xx.xx 06 Enter	Date xx.xx.xx 07 Enter	Date xx.xx.xx 08 Enter	Date xx.xx.xx xx Enter	Date xx.xx.xx 14 Enter	Exit Enter
	4 Infofield	4 Infofield	4 Infofield	4 Infofield	4 Infofield	4 Infofield	4 Infofield	4 Infofield	4 Infofield	4 Infofield	Date xx.xx.xx E 00002216. kWh	
											Date xx.xx.xx V 000259.42 m3	
											Time 00:00 xx.xx.xx P 3.759526 MW	
											Time 00:00 xx.xx.xx Q 18.247 m3/h	
											Exit Enter	

↓

Factory config. Enter →

				on pulse input only	on current input only (opt.)		on current input only (opt.)		
Serial Nr. 03784829 Man. date 31.05.97	CALEC MB Ver. 200 Heat calculator	Fluid number 000 water	Temp.sensor Pt100 T 0...200°C	IN1 pulse xxxxxxx Kl. 10/11 Enter	IN1 current 0...20mA Kl. 10/11 Enter	Flow sensor location cold side	inhibition of low Q 0.000 m3/h	inhibition of low ΔT 0.00 °C	Exit Enter
				pulse value 1.0000 l max.frequency200 Hz	20mA->30.000 m3/h linear				

↓

Field configuration Enter →

OUT1 xxxxxx Kl. 50/51 Enter	OUT2 xxxxxx Kl. 52/53 Enter	OUT3 xxxxxx Kl. 70/71 Enter	OUT4 xxxxxx Kl. 72/73 Enter	OUT5 xxxxxx Kl. 74/75 Enter	OUT6 xxxxxx Kl. 76/77 Enter	OUT7 xxxxxx Kl. 78/79 Enter	OUT8 xxxxxx Kl. 80/81 Enter	OUT9 Time count Kl. --/-- Enter	OUT10 Time count Kl. --/-- Enter	M-Bus BAUD = 2400 Kl. 24/25 Adr. 000	Language English Aendern Enter	Exit Enter
Function	Function	Function	Function	Function	Function	Function	Function	Function	Function		Deutsch Exit Enter	
											English Exit Enter	
											Français Exit Enter	
											Italiano Exit Enter	
											Exit Enter	

↓

Status check Enter →

on pulse input only	on current input only (opt.)		
IN 1 f = 5.06 Hz t = 00000000 s	IN1 I = 03.56 mA	Lock level 1 M-Bus access 0002134	Exit Enter

↓

Mainmenu		Sub-menu
################ ################		Keys up + down OK Exit Enter

Optional fields

Option DTF

Mainmenu		Sub-menu
Display on pulse input: IN1 1.000 L/Imp / EBS cold side	or =	Display on current input (opt.): IN1current 0...20 mA / EBS cold side
↑		
E 00002216. kWh / V 000259.42 m3	↑+↓	EH 0002216.1608 kWh / VH 00259.425303 m3
↓		
Et 00002216. kWh / Vt 000153.87 m3		EHt 002216.1608 kWh / VHt 0153.873500 m3
↓		
Textfield		
↓		

Error message Enter →

	Display on error only	Display on error only	Display on error only	Display on error only
no fault / Exit Enter	HW temp. alarm (hot) / Exit Enter	Option alarm / Exit Enter	Overflow alarm / Exit Enter	xxxxxxx Alarm / Exit Enter

↓

Billing date Enter →

E 00000321. kWh / Bill date 1 30.06.97	Et 00000026. kWh / Bill date 1 30.06.97	E 00001216. kWh / Bill date 2 30.12.97	Et 000000104. kWh / Bill date 2 30.12.97	Exit / Enter

↓

Instantaneous values Enter →

P 3.759526 MW / Q 18.247 m3/h	Temp. ΔT 175.04 K / H 180.0 C 4.9 °C	k-Fact 1.1770 Wh/l/K / Density 1.00068 kg/l	Date 11.05.98 / Time 10.25	Total working time / xxxxxxxx h	Exit / Enter
			10.25 11.05.98 / Edit: Up, Down		

↓

Data Logger Enter →

Period monthly / Integr.lap 15 min	Date xx.xx.xx / 00 Enter	Date xx.xx.xx / 01 Enter	Date xx.xx.xx / 02 Enter	Date xx.xx.xx / 03 Enter	Date xx.xx.xx / 04 Enter	Date xx.xx.xx / 05 Enter	Date xx.xx.xx / 06 Enter	Date xx.xx.xx / 07 Enter	Date xx.xx.xx / 08 Enter	Date xx.xx.xx / xx Enter	Date xx.xx.xx / 14 Enter	Exit / Enter
	4 Infofield	4 Infofield	4 Infofield	4 Infofield	4 Infofield	4 Infofield	4 Infofield	4 Infofield	4 Infofield	4 Infofield	Date xx.xx.xx / E 00002216. kWh	
											Date xx.xx.xx / Et 0000942. kWh	
											Time 00:00 xx.xx.xx / P 3.759526 MW	
											Time 00:00 xx.xx.xx / Q 5.942 m3/h	
											Exit / Enter	

↓

Factory config. Enter →

				on pulse input only	on current input only (opt.)			on current input only (opt.)		
Serial Nr. 03784829 / Man. date 31.05.97	CALEC MB Ver. 200 / Tarif calculator	Fluid number 000 / water	Temp.sensor Pt100 / T 0...200°C	IN1 pulse xxxxxxx / Kl. 10/11 Enter	IN1 current 0...20mA / Kl. 10/11 Enter	Flow sensor location / cold side	IN2 pulse xxxxxxx / Kl. 56/57 Enter	inhibition of low / Q 0.000 m3/h	inhibition of low / ΔT 0.00 °C	Exit / Enter
				pulse value 1.0000 l / max.frequency200 Hz	20mA->30.000 m3/h / linear		Pulse value --/-- / Tarif switch			

↓

Field configuration Enter →

OUT1 xxxxxx / Kl. 50/51 Enter	OUT2 xxxxxx / Kl. 52/53 Enter	OUT3 xxxxxx / Kl. 70/71 Enter	OUT4 xxxxxx / Kl. 72/73 Enter	OUT5 xxxxxx / Kl. 74/75 Enter	OUT6 xxxxxx / Kl. 76/77 Enter	OUT7 xxxxxx / Kl. 78/79 Enter	OUT8 xxxxxx / Kl. 80/81 Enter	OUT9 Time count / Kl. --/-- Enter	OUT10 Time count / Kl. --/-- Enter	M-Bus BAUD = 2400 / Kl. 24/25 Adr. 000	Language English / Aendern Enter	Exit / Enter
Function	Function	Function	Function	Function	Function	Function	Function	Function	Function		Deutsch / Exit Enter	
											English / Exit Enter	
											Français / Exit Enter	
											Italiano / Exit Enter	
											Exit / Enter	

↓

Status check Enter →

on pulse input only	on current input only (opt.)			
IN 1 f = 5.06 Hz / t = 00000000 s	IN1 I = 03.56 mA	Tarif2: on/off / t = 00000358 s	Lock level 1 / M-Bus access 0002134	Exit / Enter

↓

################ / ################ → Keys up + down OK / Exit Enter

Optional fields

Option ISPC

Mainmenu / **Sub-menu**

Mainmenu		Sub-menu												
Display on pulse input: IN1 1.000 L/Imp EBS cold side	or =	Display on current input (opt.): IN1current 0...20 mA EBS cold side												
E1 00002216. kWh V1 000259.42 m3	↑+↓	EH1 002216.1608 kWh VH1 0259.425303 m3												
V2 000153.87 m3		VH2 0153.873500 m3												
Textfield														
Error message Enter	→	no fault Exit Enter	Display on error only: HW temp. alarm (hot) Exit Enter	Display on error only: Option alarm Exit Enter	Display on error only: Overflow alarm Exit Enter	Display on error only: xxxxxxx Alarm Exit Enter								
Billing date Enter	→	E1 00000321. kWh Bill date 1 30.06.97	V2 00000026. m3 Bill date 1 30.06.97	E1 00001216. kWh Bill date 2 30.12.97	V2 000000104. kWh Bill date 2 30.12.97	Exit Enter								
Instantaneous values Enter	→	P 3.759526 MW Q 18.247 m3/h	Q2 6.735 m3/h	Temp. ΔT 175.04 K H 180.0 C 4.9 °C	k-Fact 1.1770 Wh/l/K Density 1.00068 kg/l	Date 11.05.98 Time 10.25	Total working time xxxxxxxx h	Exit Enter						
						10.25 11.05.98 Edit: Up, Down								
Data Logger Enter	→	Period monthly Integr.lap 15 min	Date xx.xx.xx 00 Enter	Date xx.xx.xx 01 Enter	Date xx.xx.xx 02 Enter	Date xx.xx.xx 03 Enter	Date xx.xx.xx 04 Enter	Date xx.xx.xx 05 Enter	Date xx.xx.xx 06 Enter	Date xx.xx.xx 07 Enter	Date xx.xx.xx 08 Enter	Date xx.xx.xx xx Enter	Date xx.xx.xx 14 Enter	Exit Enter
			4 Infofield	4 Infofield	4 Infofield	4 Infofield	4 Infofield	4 Infofield	4 Infofield	4 Infofield	4 Infofield	4 Infofield	Date xx.xx.xx E1 00002216. kWh	
													Date xx.xx.xx V1 000059.42 m3	
Factory config. Enter	→	Serial Nr. 03784829 Man. date 31.05.97	CALEC MB Ver. 200 ISPC calculator	Fluid number 000 water	Temp.sensor Pt100 T 0...200°C	on pulse input only: IN1 pulse xxxxxxx Kl. 10/11 Enter	on current input only (opt.): IN1 current 0...20mA Kl. 10/11 Enter	Flow sensor location cold side	IN2 pulse xxxxxxx Kl. 56/57 Enter	on current input only (opt.): inhibition of low Q 0.000 m3/h	inhibition of low ΔT 0.00 °C	Exit Enter	Time 00:00 xx.xx.xx P 3.759526 MW	
						pulse value 1.0000 l max.frequency200 Hz	20mA->30.000 m3/h linear		pulse value 1.0000 l max.frequency 50 Hz				Time 00:00 xx.xx.xx Q 18.247 m3/h	
													Exit Enter	
Field configuration Enter	→	OUT1 xxxxxx Kl. 50/51 Enter	OUT2 xxxxxx Kl. 52/53 Enter	OUT3 xxxxxx Kl. 70/71 Enter	OUT4 xxxxxx Kl. 72/73 Enter	OUT5 xxxxxx Kl. 74/75 Enter	OUT6 xxxxxx Kl. 76/77 Enter	OUT7 xxxxxx Kl. 78/79 Enter	OUT8 xxxxxx Kl. 80/81 Enter	OUT9 Time count Kl. --/-- Enter	OUT10 Time count Kl. --/-- Enter	M-Bus BAUD = 2400 Kl. 24/25 Adr. 000	Language English Aendern Enter	Exit Enter
		Function	Function	Function	Function	Function	Function	Function	Function	Function	Function		Deutsch Exit Enter	
													English Exit Enter	
													Français Exit Enter	
													Italiano Exit Enter	
													Exit Enter	
Status check Enter	→	on pulse input only: IN 1 f = 5.06 Hz t = 00000000 s	on current input only (opt.): IN1 I = 03.56 mA	IN 2 f = 0.00 Hz t = 00000358 s	Lock level 1 M-Bus access 0002134	Exit Enter								
################ ################		Keys up + down OK Exit Enter												

Optional fields

Option BDE and BDV

Mainmenu		Sub-menu
Display on pulse input IN1 1.000 L/Imp EBS cold side	or =	Display on current input (opt.) IN1current 0...20 mA EBS cold side
↑		
E+ 00002216. kWh V+ 000259.42 m3	↑+↓	EH+ 02216.1608 kWh VH+ 0259.425303 m3
↓		
E- 00002216. kWh V- 000153.87 m3		EH- 02216.1608 kWh VH- 0153.873500 m3
↓		
Textfield		

Error message Enter →

	Display on error only	Display on error only	Display on error only	Display on error only
no fault Exit Enter	HW temp. alarm (hot) Exit Enter	Option alarm Exit Enter	Overflow alarm Exit Enter	xxxxxxx Alarm Exit Enter

Billing date Enter →

E+ 00000321. kWh Bill date 1 30.06.97	E- 00000026. kWh Bill date 1 30.06.97	E+ 00001216. kWh Bill date 2 30.12.97	E- 00000104. kWh Bill date 2 30.12.97	Exit Enter

Instantaneous values Enter →

P 3.759526 MW Q 18.247 m3/h	Temp. ΔT 175.04 K H 180.0 C 4.9 °C	k-Fact 1.1770 Wh/l/K Density 1.00068 kg/l	Date 11.05.98 Time 10.25	Total working time xxxxxxxx h	Exit Enter
			10.25 11.05.98 Edit: Up, Down		

Data Logger Enter →

Period monthly Integr.lap 15 min	Date xx.xx.xx 00 Enter	Date xx.xx.xx 01 Enter	Date xx.xx.xx 02 Enter	Date xx.xx.xx 03 Enter	Date xx.xx.xx 04 Enter	Date xx.xx.xx 05 Enter	Date xx.xx.xx 06 Enter	Date xx.xx.xx 07 Enter	Date xx.xx.xx 08 Enter	Date xx.xx.xx xx Enter	Date xx.xx.xx 14 Enter	Exit Enter
	4 Infofield	4 Infofield	4 Infofield	4 Infofield	4 Infofield	4 Infofield	4 Infofield	4 Infofield	4 Infofield	4 Infofield	Date xx.xx.xx E+ 00002216. kWh	
											Date xx.xx.xx E- 0000942. kWh	
											Time 00:00 xx.xx.xx P 3.759526 MW	
											Time 00:00 xx.xx.xx P- 1.238545 MW	
											Exit Enter	

Factory config. Enter →

				on pulse input only	on current input only (opt.)			on current input only (opt.)		
Serial Nr. 03784829 Man. date 31.05.97	CALEC MB Ver. 200 BDE calculator	Fluid number 000 water	Temp.sensor Pt100 T 0...200°C	IN1 pulse xxxxxxx Kl. 10/11 Enter	IN1 current 0...20mA Kl. 10/11 Enter	Flow sensor location cold side	**IN2 pulse xxxxxxx Kl. 56/57 Enter**	inhibition of low Q 0.000 m3/h	inhibition of low ΔT 0.00 °C	Exit Enter
	or BDV calculator			pulse value 1.0000 l max.frequency200 Hz	20mA->30.000 m3/h linear		**Pulse value --/-- Tarif switch**			

Field configuration Enter →

OUT1 xxxxxx Kl. 50/51 Enter	OUT2 xxxxxx Kl. 52/53 Enter	OUT3 xxxxxx Kl. 70/71 Enter	OUT4 xxxxxx Kl. 72/73 Enter	OUT5 xxxxxx Kl. 74/75 Enter	OUT6 xxxxxx Kl. 76/77 Enter	OUT7 xxxxxx Kl. 78/79 Enter	OUT8 xxxxxx Kl. 80/81 Enter	OUT9 Time count Kl. --/-- Enter	OUT10 Time count Kl. --/-- Enter	M-Bus BAUD = 2400 Kl. 24/25 Adr. 000	Language English Aendern Enter	Exit Enter
Function	Function	Function	Function	Function	Function	Function	Function	Function	Function		Deutsch Exit Enter	
											English Exit Enter	
											Français Exit Enter	
											Italiano Exit Enter	
											Exit Enter	

Status check Enter →

on pulse input only	on current input only (opt.)			
IN 1 f = 5.06 Hz t = 00000000 s	IN1 I = 03.56 mA	**Flow : positiv t = 00000358 s**	Lock level 1 M-Bus access 0002134	Exit Enter

**################
################**

Keys up + down OK Exit Enter

Optional fields

Display on option BDV only

Option Twin E and Twin V

Mainmenu / **Sub-menu**

IN1 / EBS
- Display on pulse input: IN1 1.000 L/Imp / EBS cold side
- or = Display on current input (opt.): IN1current 0...20 mA / EBS cold side

E1 / V1 (↑ + ↓)
- E1 00002216. kWh / V1 000259.42 m3
- EH1 02216.1608 kWh / VH1 0259.425303 m3

E2 / V2
- E2 00002216. kWh / V2 000153.87 m3
- EH2 02216.1608 kWh / VH2 0153.873500 m3

Textfield

Error message (Enter) →
- no fault / Exit Enter
- Display on error only: HW temp. alarm (hot) / Exit Enter
- Display on error only: Option alarm / Exit Enter
- Display on error only: Overflow alarm / Exit Enter
- Display on error only: xxxxxxx Alarm / Exit Enter

Billing date (Enter) →
- E1 00000321. kWh / Bill date 1 30.06.97
- E2 00000026. kWh / Bill date 1 30.06.97
- E1 00001216. kWh / Bill date 2 31.12.97
- E2 00000104. kWh / Bill date 2 31.12.97
- Exit / Enter

Instantaneous values (Enter) →
- P 3.759526 MW / Q 18.247 m3/h
- P2 0.975246 MW / Q2 4.682 m3/h
- Temp. ΔT 175.04 K / H 180.0 C 4.9 °C
- k-Fact 1.1770 Wh/l/K / Density 1.00068 kg/l
- Date 11.05.98 / Time 10.25 — (10.25 11.05.98 / Edit: Up, Down)
- Total working time / xxxxxxxx h
- Exit / Enter

Data Logger (Enter) →
- Period monthly / Integr.lap 15 min — 4 Infofield
- Date xx.xx.xx / 00 Enter — 4 Infofield
- Date xx.xx.xx / 01 Enter — 4 Infofield
- Date xx.xx.xx / 02 Enter — 4 Infofield
- Date xx.xx.xx / 03 Enter — 4 Infofield
- Date xx.xx.xx / 04 Enter — 4 Infofield
- Date xx.xx.xx / 05 Enter — 4 Infofield
- Date xx.xx.xx / 06 Enter — 4 Infofield
- Date xx.xx.xx / 07 Enter — 4 Infofield
- Date xx.xx.xx / 08 Enter — 4 Infofelder
- Date xx.xx.xx / xx Enter — 4 Infofelder
- 4 Infofelder
- 4 Infofield — 4 Infofelder
- Date xx.xx.xx / 14 Enter
  - Date xx.xx.xx / E1 00002216. kWh
  - Date xx.xx.xx / V 00000942. m3 (Option Twin-V only)
  - Date xx.xx.xx / E2 00000942. kWh (Option Twin-E only)
  - Time 00:00 xx.xx.xx / P1 3.759526 MW
  - Time 00:00 xx.xx.xx / Q 1.238545 m3/h (Option Twin-V only)
  - Time 00:00 xx.xx.xx / P2 1.238545 MW (Option Twin-E only)
  - Exit / Enter
- Exit / Enter

Factory config. (Enter) →
- Serial Nr. 03784829 / Man. date 31.05.97
- CALEC MB Ver. 200 / Twin-E calculator (or Twin V calculator)
- Fluid number 000 / water
- Temp.sensor Pt100 / T 0...200°C
- on pulse input only: IN1 pulse xxxxxxx / Kl. 10/11 Enter — pulse value 1.0000 l / max.frequency200 Hz
- on current input only (opt.): IN1 current 0...20mA / Kl. 10/11 Enter — 20mA->30.000 m3/h / linear
- Flow sensor location / cold side
- IN2 pulse xxxxxxx / Kl. 56/57 Enter — pulse value 1.000 l / max.frequency 50 Hz
- on current input 2 only (opt.): IN2 current 0...20mA / Kl. 56/57 Enter — 20mA->24.000 m3/h / linear
- on current input 2 only (opt.): inhibition of low / Q 1.000 m3/h
- on current input 2 only (opt.): inhibition of low / Q2 0.000 m3/h
- inhibition of low / ΔT 0.00 °C
- Exit / Enter

Field configuration (Enter) →
- OUT1 xxxxxx / Kl. 50/51 Enter — Function
- OUT2 xxxxxx / Kl. 52/53 Enter — Function
- OUT3 xxxxxx / Kl. 70/71 Enter — Function
- OUT4 xxxxxx / Kl. 72/73 Enter — Function
- OUT5 xxxxxx / Kl. 74/75 Enter — Function
- OUT6 xxxxxx / Kl. 76/77 Enter — Function
- OUT7 xxxxxx / Kl. 78/79 Enter — Function
- OUT8 xxxxxx / Kl. 80/81 Enter — Function
- OUT9 Time count / Kl. --/-- Enter — Function
- OUT10 Time count / Kl. --/-- Enter — Function
- M-Bus BAUD = 2400 / Kl. 24/25 Adr. 000
- Language English / Aendern Enter
  - Deutsch / Exit Enter
  - English / Exit Enter
  - Français / Exit Enter
  - Italiano / Exit Enter
  - Exit / Enter
- Exit / Enter

Status check (Enter) →
- on pulse input only: IN 1 f = 5.06 Hz / t = 00000000 s
- on current input only (opt.): IN1 I = 12.16 mA
- IN 2 f = 0.00 Hz / t = 00000358 s
- on current input 2 only (opt.): IN2 I = 7.12 mA
- Lock level 1 / M-Bus access 0002134
- Exit / Enter

################ / ################
- Keys up + down OK / Exit Enter

Optional fields

Display on option Twin E only

10. Programming sheet

Customer ____________________

Object ____________________ for description on packaging

Order-No. ____________ Date ____________ indication on display

Measuring point ____________________

Distributor ____________________ indication on display

Salesman ____________ Date ____________ indication on nameplate

Remarks ____________________

Date of delivery____________________

CALEC® MB 2S	Pcs Part No. 93360.00	
CALEC® MB 4S	Pcs Part No. 93361.00	
2 RWC	Pcs Part No. 81620.00	max. 1 p/CALEC® [1])
2 RNC	Pcs Part No. 81621.00	max. 3 p/CALEC® [1])
2AOU	Pcs Part No. 81622.00	max. 2 p/CALEC® [1])
RS232	Pcs Part No. 81668.00	max. 1 p/CALEC® [1])
RS485	Pcs Part No. 81669.00	max. 1 p/CALEC® [1])
2AIN	Pcs Part No. 81667.00	max. 1 p/CALEC® [1])
DTF	Pcs Part No. 81623.00	
ISPC	Pcs Part No. 81624.00	
FLU	Pcs Part No. 81625.00 Temp. Min	No. Max
FLX	Pcs Part No. 81626.00	
BDE	Pcs Part No. 81663.00	
BDV	Pcs Part No. 81664.00	
TWIN E	Pcs Part No. 81665.00	
TWIN V	Pcs Part No. 81666.00	
MPM	Pcs Part No. 81627.01	front panel
MS Wall	Pcs Part No. 81628.00	MCP/L => MB
MS Rack	Pcs Part No. 81629.01	MCP/L => MB

[1]) for possible combinations see technical information VD 3-161

Heat carriers ❒ water ❒ others:

Approval ❒ D ❒ CH ❒ D/CH ❒ A ❒ others

Initial verification ❒ no ❒ yes

Adress M-Bus ❒ standard 000 ❒ (1-250) ____________

❒ pulses ❒ Reed ❒ open collector, NAMUR (passive)
❒ active (5-30 V/ 5 mA)
pulse value ____________ ❒ m³ ❒ l ❒ ml

❒ frequency (active 5-30 V / 5 mA)
range Fmin ____________ - Fmax ____________ Hz
corresponding Q = ____________ to ____________ m³/h

❒ current signal ❒ 0...20 mA ❒ 4...20 mA
corresponding Q = ____________ to ____________ m³/h
surpression of Q at ≤ ____________ m³/h

Mounting place of flow meter
❒ cold side ❒ hot side

Input 2 (Please specify in case of TWIN E, TWIN V and ISPC)
❒ pulses ❒ Reed ❒ open collector, NAMUR (passive)
❒ active (5-30 V/ 5 mA)
pulse value ____________ ❒ m³ ❒ l ❒ ml

❒ frequency (active 5-30 V / 5 mA, max 1000 Hz)
range Fmin ____________ - Fmax ____________ Hz
corresponding Q = ____________ to ____________ m³/h

❒ current Signal ❒ 0...20 mA ❒ 4...20 mA (not with ISPC)
corresponding Q = ____________ to ____________ m³/h
surpression of Q at ≤ ____________ m³/h

Mounting place of second flow meter (programming for TWIN E only)
❒ cold side ❒ hot side

Language

Nameplate	❒ D	❒ E	❒ F	❒ I	❒ other:
Display text	❒ D	❒ E	❒ F	❒ I	____________

Energy: power range and display units

				2nd display Twin E
❒ up to	30 MW	00000000▪	kWh	❒
❒ up to	30 MW	00000▪000	MWh	❒
❒ up to	30'000 MW	00000000▪	MWh	❒
❒ up to	30 GJ/h	00000000▪	MJ	❒
❒ up to	30 GJ/h	00000▪000	GJ	❒
❒ up to	30 TJ/h	00000000▪	GJ	❒

Flow: flow rate range and display units

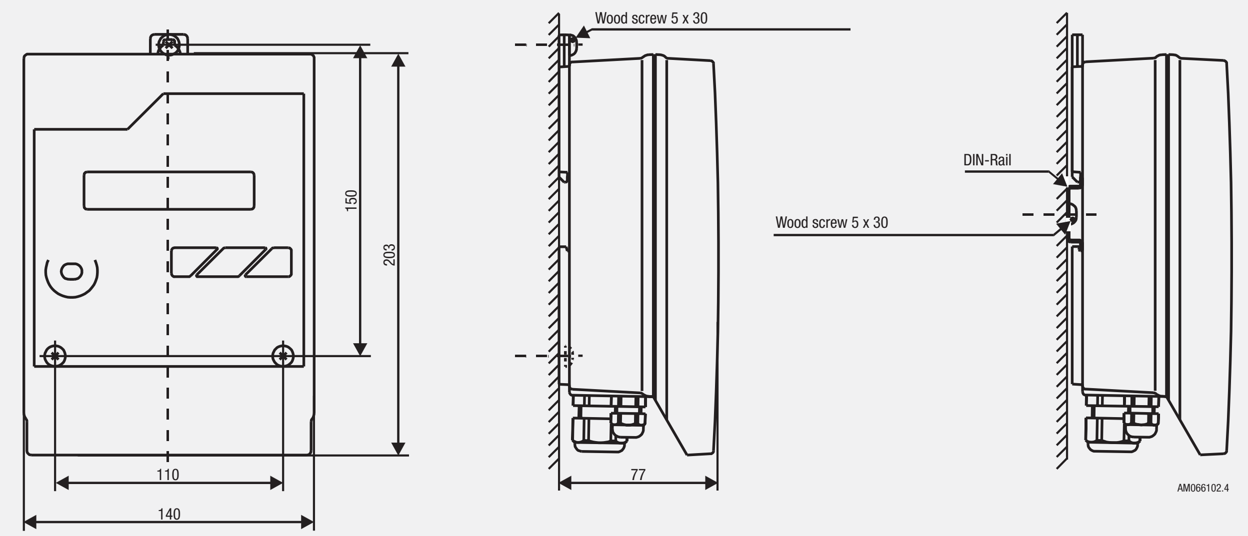
❒ up to	300 m³/h	000000▪00	m³
❒ up to	3'000 m³/h	0000000▪0	m³
❒ up to	30'000 m³/h	00000000▪	m³

Billing date 1 ❒ 30.06. ❒ 31.12. ❒ ____________
Billing date 2 ❒ 30.06. ❒ 31.12. ❒ ____________
Datalogger period ❒ none
❒ 1 day ❒ 2 days ❒ 7 days ❒ 14 days ❒ 1 month
Peak value acquisition integration time
❒ 15 min ❒ 30 min ❒ 60 min ❒ 120 min

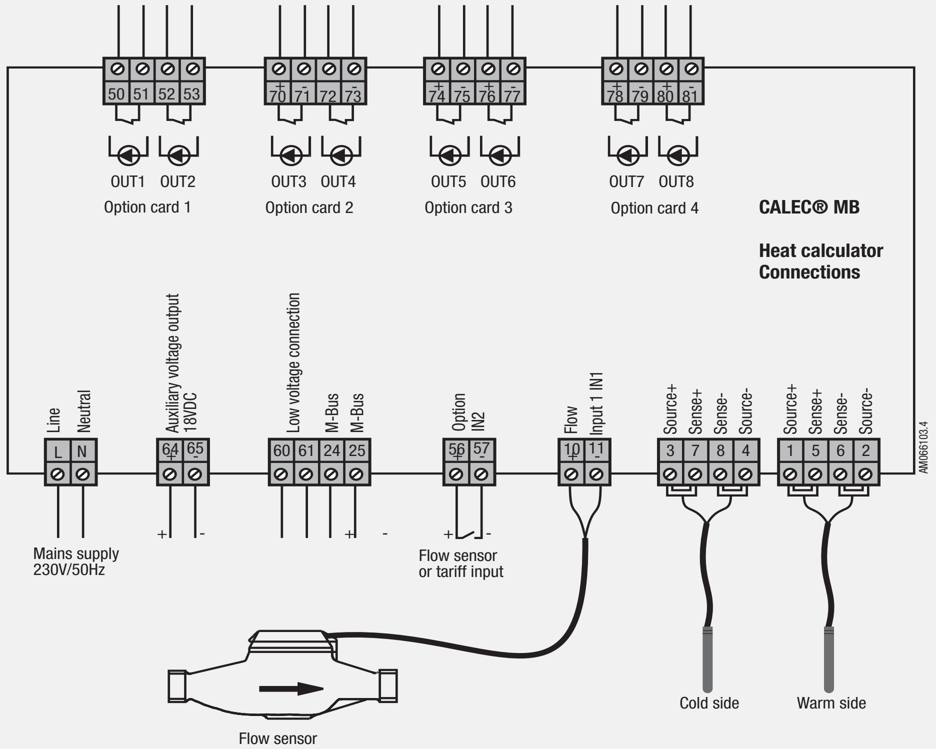
Relay outputs	Relay	Pulses			Limiting value with hysteresis = GH		Limiting value without hysteresis = GW			Alarm
		E = Energy V = Volume			meas. variable:	P=Power Q=Flow rate H=Temp. hot side C=Temp. cold side D=Temp. difference				AA = off by alarm AE = on by alarm
	2RNC 2RWC	E / V	Pulse value	Units	Function GW / GH	Inst. value	On value GH and GW	Off value GH only	Units	Function AA or AE
Socket No.										
Socket No.										
Socket No.										

Analogue outputs	Instantaneous value functions						
	Measured variables: P=Power Q=Flow rate H=Temp. hot side C=Temp. cold side D=Temp. difference						
	Analogue	Output signal 0-20 / 4-20 mA	Output active=A / passive=P	Meas. variable	0 or 4 mA corresponds to	20 mA corresponds to	Units
Socket	2AOU	-20 mA	❒ A ❒ P				
No.							
Socket	2AOU	-20 mA	❒ A ❒ P				
No.							
	Analogue outputs reaction time	❒ 2 sec (standard)	❒ 15 sec	❒ 30 sec	❒ 1 min	❒ 3 min	❒ 20 min
Socket No.	Communication options	❒ RS232	❒ RS485				

11. Device dimensions



12. Connections



aqua metro

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