Installation and operating instructions

INTEGRA METERING

CALEC® energy master

The benchmark for energy measurement technology

Firmware Version 1.00

VD 3-137e, 11.2017

1 Contents

2 Information and references

2.1 Information

These installation and operating instructions describe the installation and commissioning of a standard device. The chapters describe the topics and tasks in the sequence in which they are needed during commissioning.

- Safety instructions
- Information about the device
- Installation
- Electrical connections
- Operation
- Fault clearance
- Technical data

Always comply with the safety instructions.

2.2 Documents

The installation and operating instructions VD 3-135 vary in scope, depending on the version and items covered by the delivery. The information required for ancillary modules and optional functions is described in additional document extracts (VD 3-136).

Parameterisation software AMBUS Win II

The parameterisation software AMBUS Win II is available for setting the parameters. It can be downloaded free of charge (see below).

Downloads

The current documents and AMBUS Win II are available as free downloads at **www.aquametro.com/downloads**.

3 Safety notices

3.1 Symbols used

Important information

Non-observance can lead to malfunction.

General warning

Non-observance can lead to damage or malfunction.

Warning of dangerous electric voltage

Non-observance can lead to physical injury!

3.2 Intended use

The device is used as an energy calculator for heating, cooling and air conditioning applications in district heating or cooling, in building management services and in industrial energy metering.

It is part of a combined heating/cooling or air conditioning meter, consisting of a calculator, a pair of temperature sensors and a flow meter, or as a transducer for a flow meter.

The environmental conditions described in the technical specifications, as well as the installation and operating instructions must be complied with.

3.3 Inappropriate use

The device must not be used:

- In explosion-risk zones (no ex-risk protection!)
- In a wet environment (condensing, splashing or dripping water)
- Outdoors, without suitable protection
- In environmental conditions (temperature, humidity, vibrations, electromagnetic interference etc.) that do not comply with the technical specifications
- In all other instances that do not conform to its intended use

The device can be dangerous if it is not used as intended, or not in accordance with the installation and operating instructions. In order to avoid this, it is essential that the safety instructions, operating conditions (see technical specifications) and the relevant chapters of these instructions are strictly adhered to.

The manufacturer accepts no liability for damage arising from inappropriate use.

3.4 Installation guidelines

The installation should be performed by authorised, skilled personnel, in compliance with the regulations in force (EN1434 part 6 Regulations and recommendations for installation and operation) and the recommendations of the industry-specific associations (e.g. the AGFW series of leaflets on district heating supplies).

The skilled personnel must have read and understood these instructions. The requirements in the instructions and the applicable regulations on electrical installations must always be observed.

Work on electrical circuits with hazardous voltages (> 24 VAC or >42 VDC) may only be carried out by authorised, skilled people, in compliance with the locally applicable regulations!

4 Pattern approval, versions, marking

4.1 Pattern approval and conformity assessment (Prot)

4.1.1 European conformity assessment for heating applications

For custody transfer, all three component parts of a combined energy calculator must have pattern approval and a conformity assessment. The device with protective housing complies with Directive 2004/22/EC (Measurement Instruments Directive, MID). If the device is approved according to MID, then the conformity assessment replaces the initial calibration, which is the normal procedure for devices with national approval.

The parts of the CE marking have the following meaning:

CE M 08 0102 CE: CE marking

M 08: Metrology mark and year of manufacture

0102: Identification number of the named body that was involved in the conformity assessment (0102: PTB Germany).

A facsimile of the declaration of conformity is shown in chapter 23.

Calibration-relevant data can be changed with an authorisation code. This will result in the invalidation of the calibration, and the action will be entered in the calibration log.

4.1.2 National approval for air-conditioning applications

The device has also a national aaproval for custody transfer according to the german PTB K7.2, (approval no, 22.75/08.01) for:

- Thermal energy metering in air-conditioning applications
- Thermal enegy metering in combined heating and air-conditioning applications (BDE function).
-

4.2 Device identification and labelling

A basic unit consists of a minimum of 4 modules:

- Power supply (24 VDC or 100-240 VAC)
- CPU module with the device-specific function and 2 signal inputs
- Input module with 2 inputs
- Display module

The device can be expanded with additional modules (separate order).
A device is clearly identified by the following details (example):

Art. No.	**Short text**	**Firmware Version (FWV) CPU module**	**Hardware No. (HW_No.) CPU module**
94157	EM-101-Prot-AC[...I]C-T	1.00	1234567

Device type, fabrication number, fabrication date, firmware version, batch no., hardware no. and checksum of the CPU module are displayed in the ***Diagnosis/System*** submenu.

An article number defines a basic device without ancillary modules. The short text indicates the device version and the module assembly at the time of delivery. This short text is printed on the wiring diagram on the inside of the housing cover. If the module assembly is changed in the field, then this identification will no longer correspond to the actual assembly.

Marking	„Prot“ected version	„Mod“ule version	Module
Type plate	On the cover	On the display module	-
Wiring diagram	Inside cover	Enclosed in packaging	On the side of the module
Terminal No.	Above/below the terminals[1)]	Above/below the terminals [1)]	Above/below the terminals [1)]

[1)] The assignment of the signals to the terminals is displayed in the operating menus, on those pages where the settings for the signals are performed.

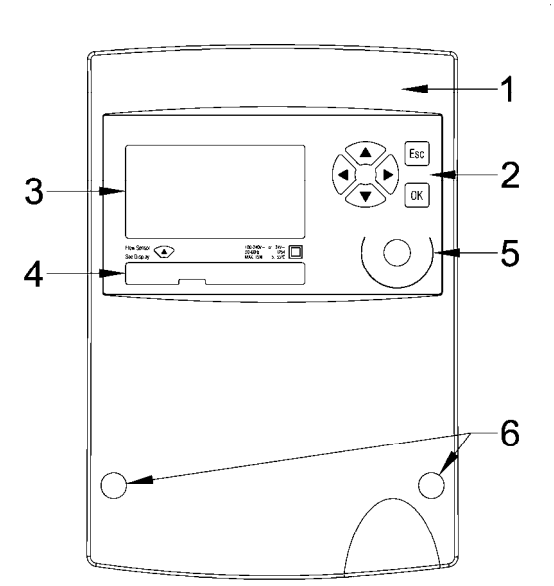
4.3 Short text CALEC® energy master

The table below shows the key for the text used to order the CALEC® energy master:

Example: CALEC® energy master	EM	-	1 0 1		Prot	-	AC	[	M I	]	C - T
CALEC® energy master	EM										
Flow calculator/transducer			1 0 0								
Energy calculator for heating, air conditioning, cooling			1 0 1								
With protective housing („Prot“ected) IP 54	Prot										
Module w/o protective housing („Mod“ule) IP 21	Mod										
Voltage supply											
Supply module 100 - 240 VAC	AC										
Connect module 24 VDC	DC										
All modules in sequence of assembly											
Master Module Input 2xPulse/Analogue	I										
Master Module Input 2xPt100 *	T										
Master Module Output 2xRel.24V/Analogue	O										
Master Module Output 2xRel.240V *	R										
Master Module M-Bus	M										
CPU module with temp. measurement Pt100	C-T										

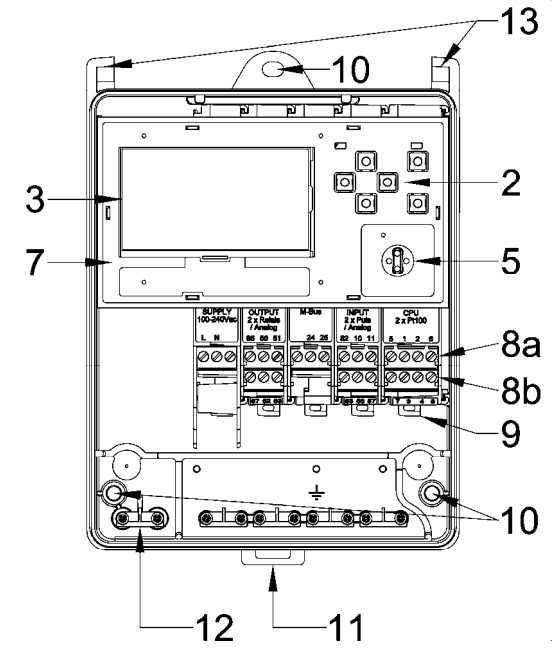
*: Available on request

5 View of device with protective housing



Device with closed protective housing

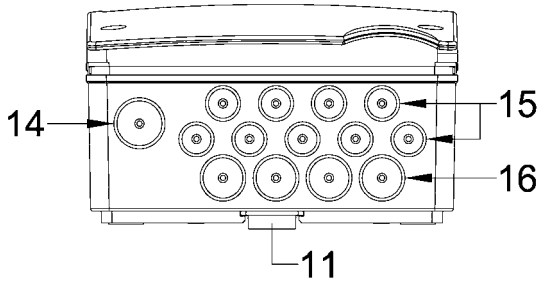
1 Housing cover
2 Operating keys
3 Dot-matrix LCD
4 Type plate with CE marking
5 IR interface on display module
(EN13757-2 / -3 M-Bus)
IrDA interface on CPU module
6 Housing screws, covered by security sealing caps



Device with opened protective housing

2 Operating keys
3 Display, LCD dot matrix
5 IR interface (EN13757-2 / -3 M-Bus)
IrDA interface
7 Display module
8a Upper terminals, plug-in
8b Lower terminals, plug-in
9 Clip-on holder for modules
10 3 Fastening holes for wall mounting
11 Clip-on holder for rail mounting
12 Strain relief
13 Cover hinges

The wiring diagram is on the inside of the housing cover.

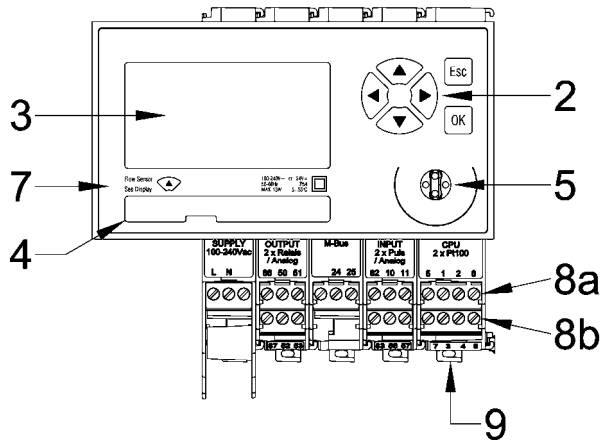


View of the protective housing from below

11 Clip for rail
14 Cable duct supply 14 mm
15 Cable ducts 10 mm
16 Cable ducts 14 mm

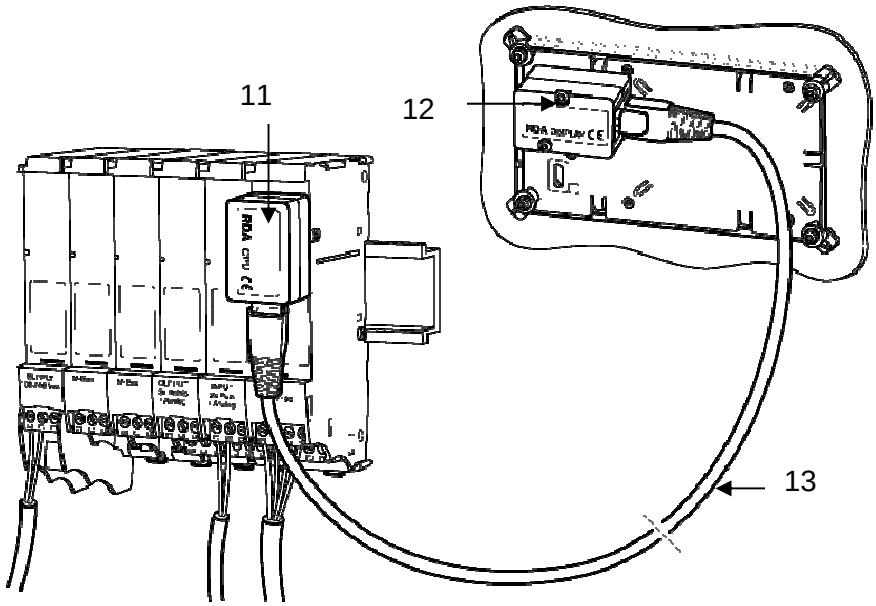
6 View of device without protective housing (Mod)

The following diagram shows the device without protective housing.



2 Operating keys
3 Display, LCD dot matrix
5 IR interface (EN13757-2 / -3 M-Bus)
IrDA interface
7 Display module
8a Upper terminals, plug-in
8b Lower terminals, plug-in
9 Clip-on holder for modules

The Display can be installed at a remote location e.g. in a control panel by using the two Remote Display Adapters:

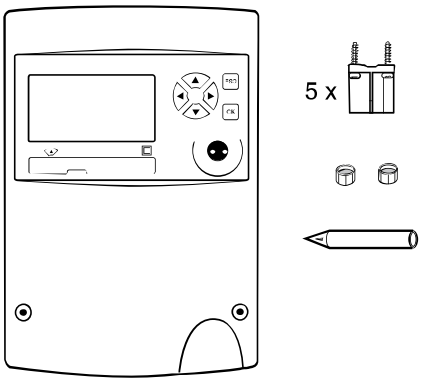


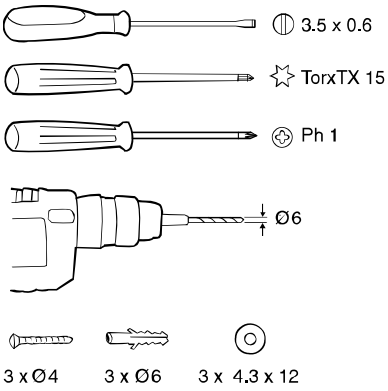
11 Remote Display Adapter RDA/CPU
12 Remote Display Adapter RDA/Display
13 Network cable

7 Mounting the device with protective housing (Prot)

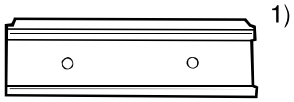
7.1 Scope of supply, tools and mounting material (Prot)

Warning! Precision measuring devices! Protect against heat, humidity, dirt and vibration. Only unpack the device when ready to install. Non-observance can result in damage or malfunction.





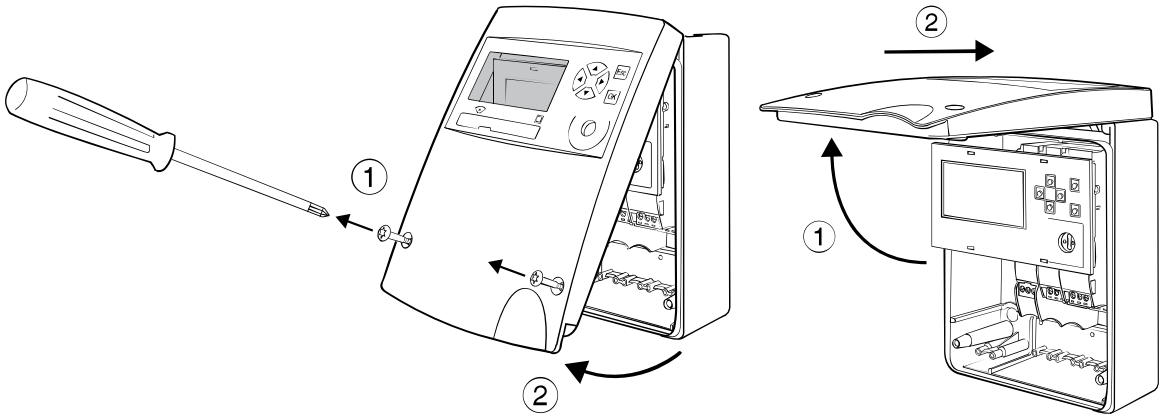
- One Installation and Operating Instructions manual



1) Support rail optional

7.2 Installation (Prot)

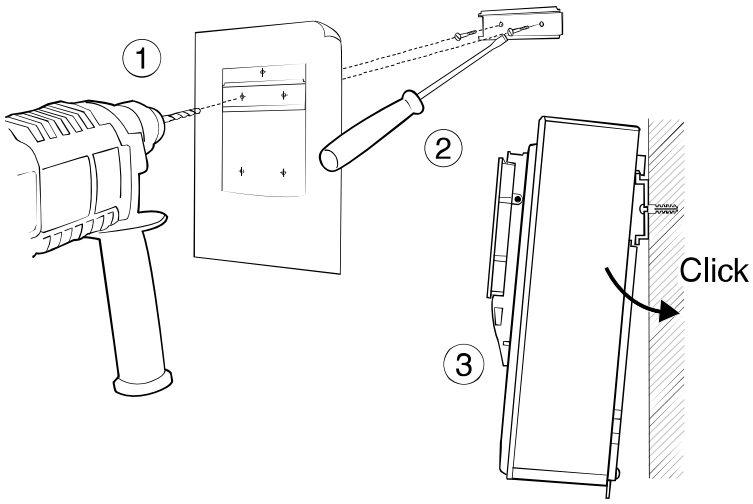
Opening the housing



Mounting on support rail (DIN-EN 50222)

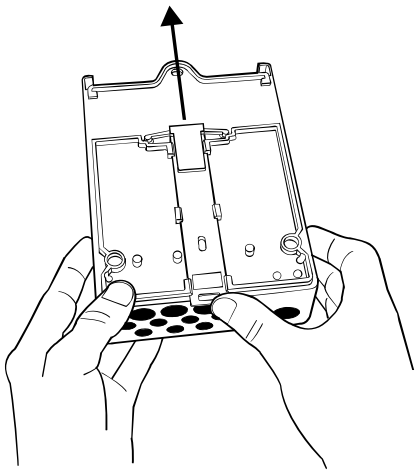
Choose the location for installation

- which is protected against humidity, heat, direct sunlight and damage
- with easy access for reading, operation and installation
- with sufficient distance from sources of electromagnetic interference

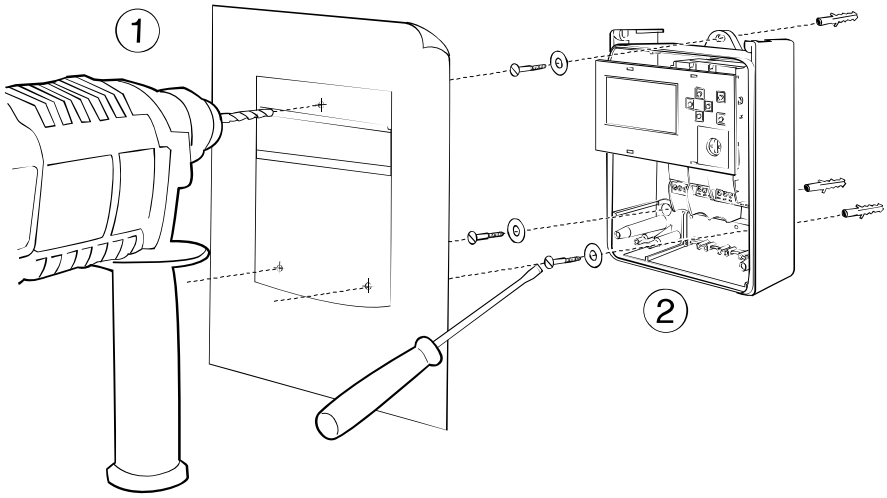


1. Drill holes
2. Screw on support rail
3. Clip device onto support rail

Wall mounting

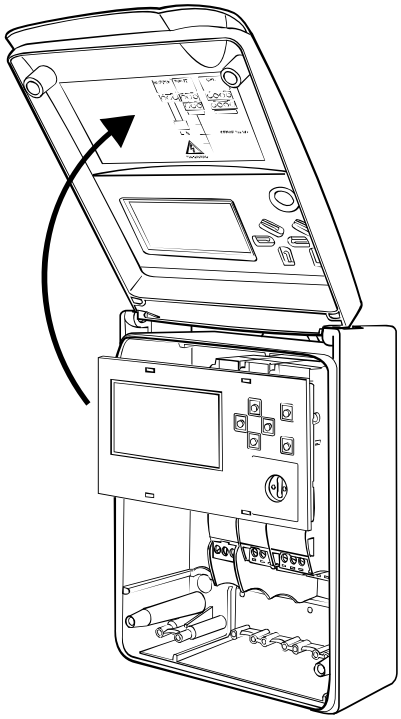


Remove clip-on holder to get a stable support.



Only mount device on a flat surface!

Wiring diagram



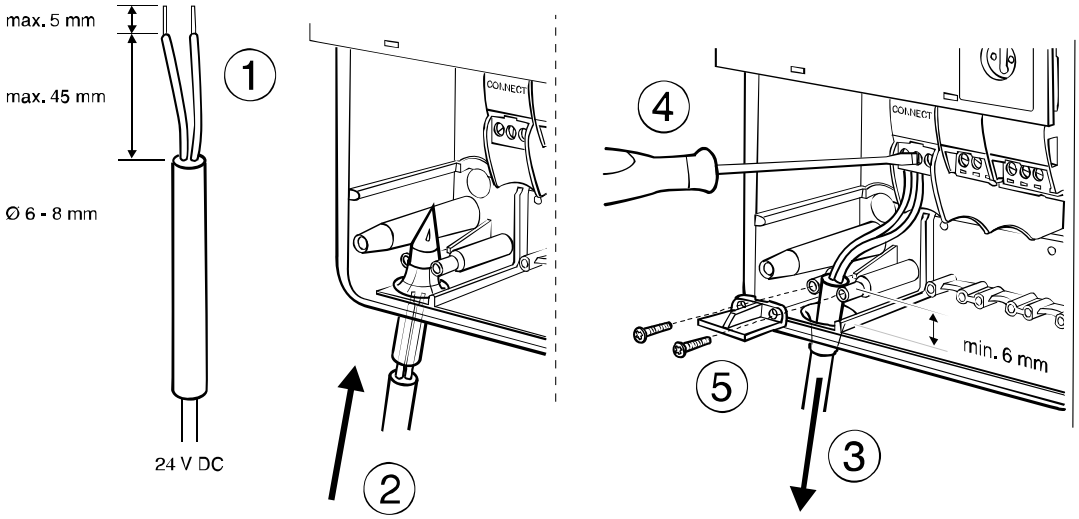
The wiring diagram is on the inside of the housing cover.

Connecting to mains power supply 100 - 240 VAC

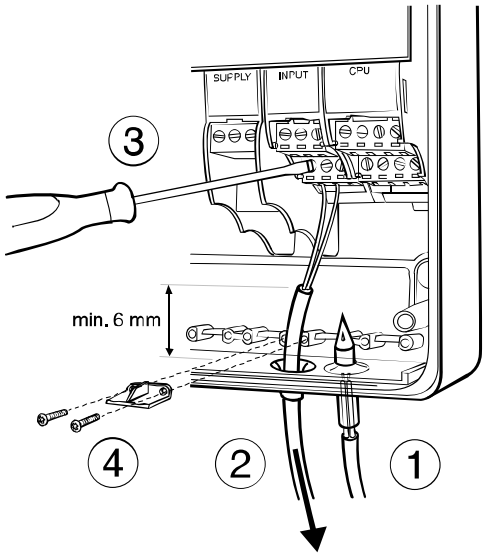
The mains supply must be connected via a two-pole separator and be adequately protected against unauthorised interruption.

	The mains supply 100 - 240 VAC may only be connected to the following terminals:	Terminals L, N (supply module) Terminals 110, 115 (relay module 2x240 VAC)
	The device must be protected by a 10 AT external fuse. The device is fully isolated and requires no grounding connections. Connection to other terminals is extremely dangerous and can permanently damage the instrument!	

Connecting to low voltage supply 24 VDC

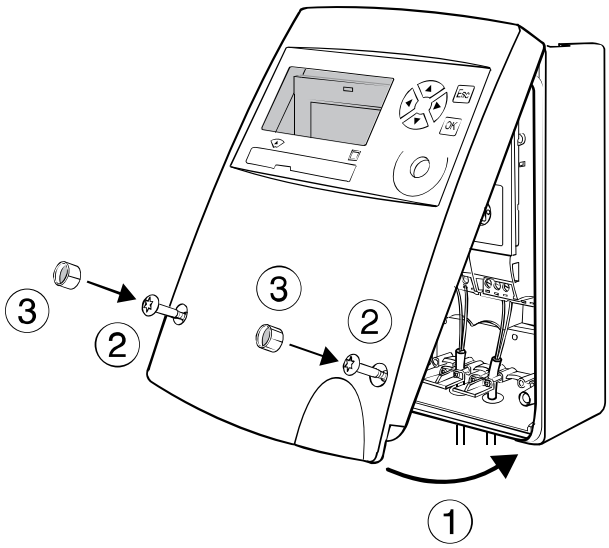


Connecting signal cables



1. Pierce sealing membrane with enclosed awl
2. Insert cable
3. Attach cable to terminal screws according to wiring diagram on the inside cover
4. Affix strain relief clamp

Closing housing



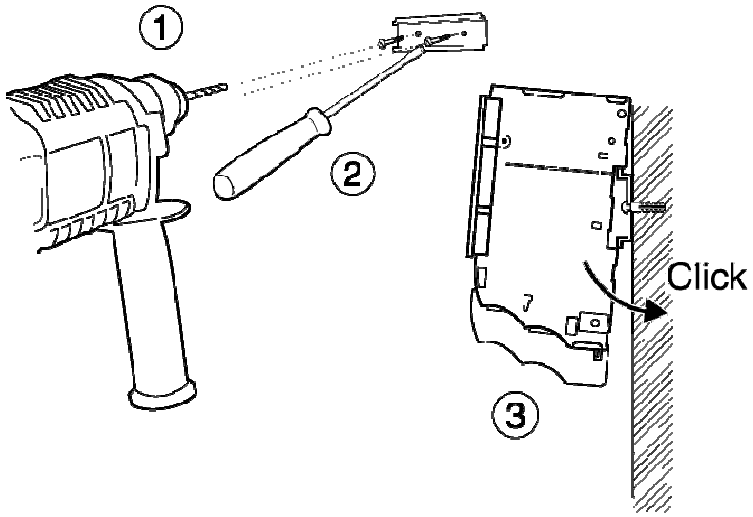
1. Insert the cover into the hinge from above and turn to close
2. Tighten the two fixing screws
3. Engage the **security sealing caps** with the smooth side on the outside.

Once the caps ③ have been fitted, any unauthorised opening of the device can be detected.

Removing the caps: Insert a pointed tool and lever out. The cap is damaged as a result and must be replaced.

8 Mounting the device without protective housing (Mod)

8.1.1 Rail mounting



1. Drill fastening holes
2. Screw on support rail
3. Clip modules onto support rail

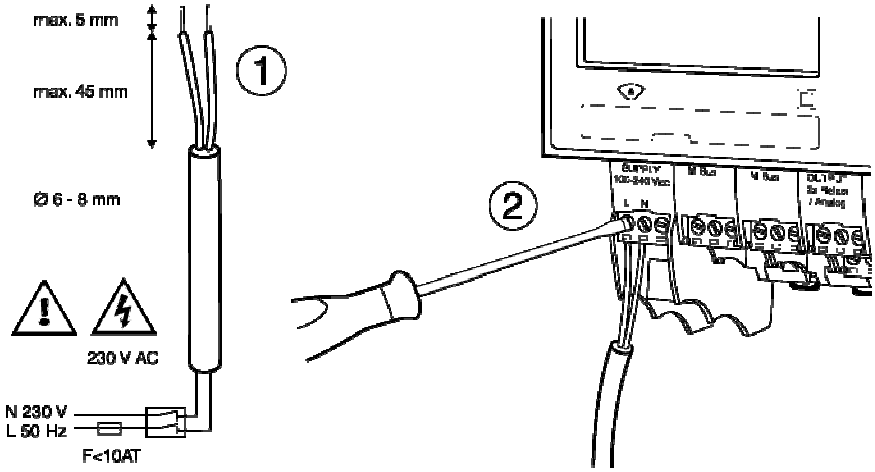
8.1.2 Connecting to mains power supply 230 VAC

Refer to the wiring diagram before starting wiring!

The mains supply may only be connected to terminals L and N!

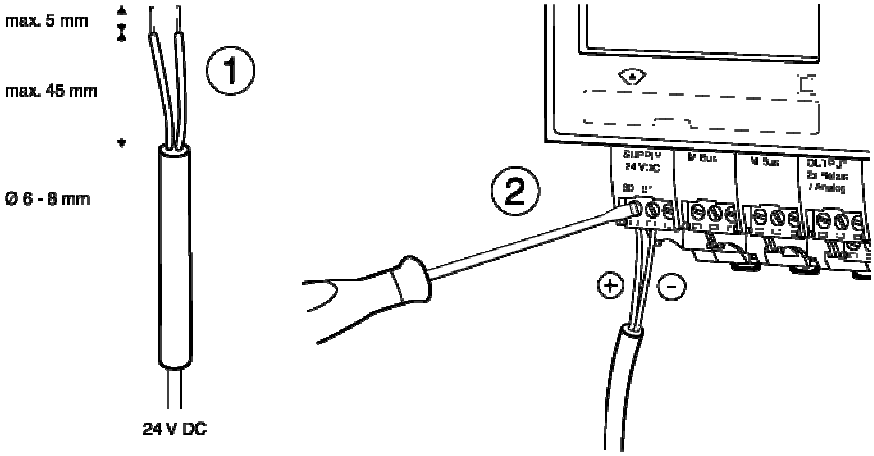
The device is fully isolated and requires no grounding connections.

All other terminals are only for low voltage (<50 V) and measuring signals. Connection to these terminals is extremely dangerous and can permanently damage the instrument!



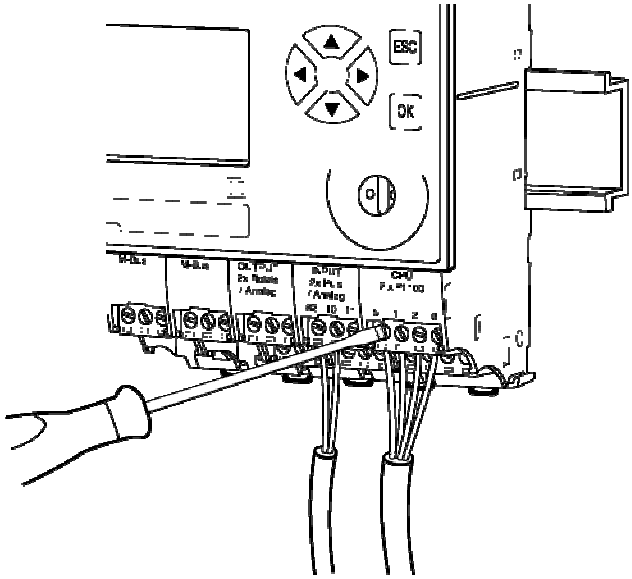
1. Strip the power cable as shown in drawing.
2. Connect power cable to supply module (see enclosed wiring diagram)

8.1.3 Connecting to low voltage supply 24 VDC



1. Strip cable as shown in drawing
2. Attach cable to the connect module (see enclosed wiring diagram)

8.1.4 Connecting signal cables



1. Attach signal cables to terminal screws according to enclosed wiring diagram
2. The terminal blocks can be plugged in.

9 Applications

9.1 Applications for energy calculator

9.1.1 Overview of energy applications

The wiring diagram S-EM1 on the inside of the upper section of the housing summarises all connection variants of the device version for heat meters. The diagram shows the standard assembly with the modules (left to right). The display module is not shown.

- CPU module
- Input module
- Supply or Connect Module (power supply)

Up to four additional input, output or communications modules can be fitted between the supply and input modules.

Applications and the required signals:

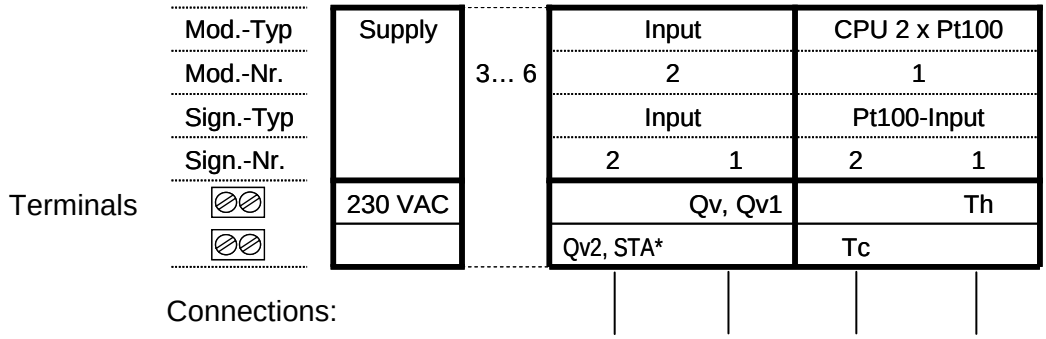
Application	**Connected signals**			
Heat meter		Qv	Tc	Th
Cooling meter		Qv	Tc	Th
Combined cooling/heat meter (BDE)		Qv	Tc	Th
Summer/winter operation	Qv2	Qv1	Tc	Th
Parallel flow meters (TWIN-V)	Qv2	Qv1	Tc	Th
Open systems (Twin-E)	Qv2	Qv	Tc	Th
Flow direction (BDV)	STA	Qv	Tc	Th

Th, Tc: T_{hot}: Temperature hot side, T_{cold}: Temperature cold side

Qv, Qv1, Qv2: Volume signal

STA: Flow direction indicator

These applications are grouped in one single wiring diagram:

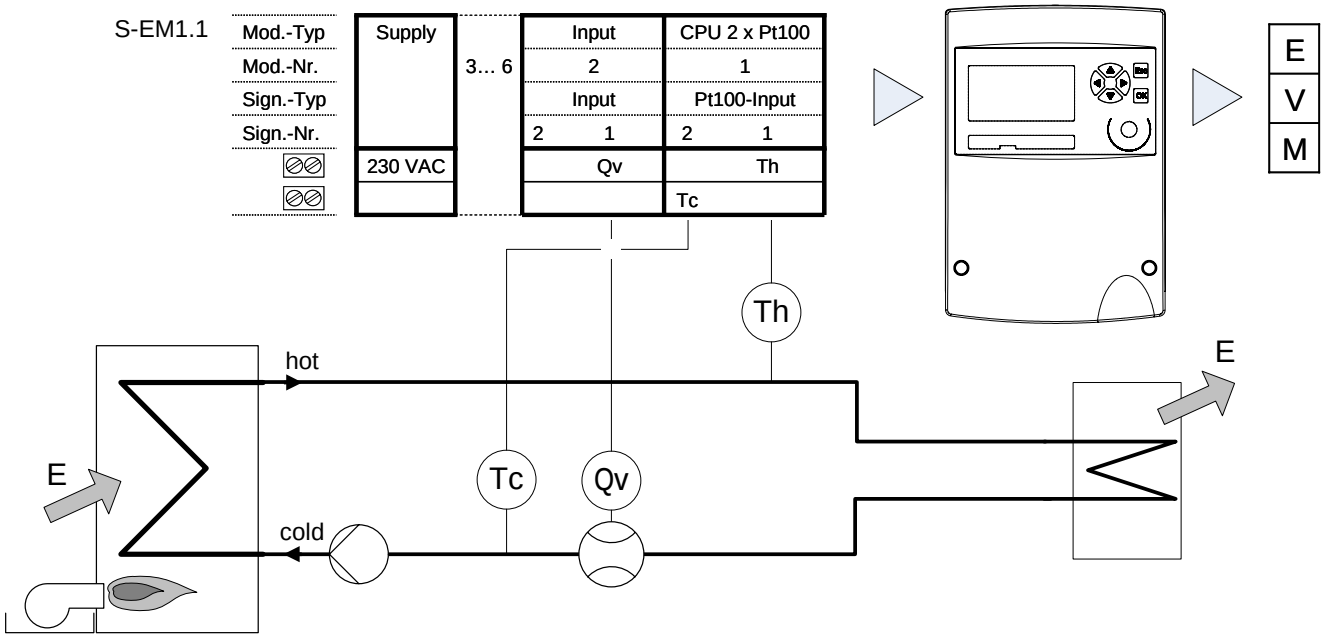


9.1.2 Heat meter application

When used as a heat meter, the transport of energy from a heat source to the consumer is measured in the supply and return flow of a transport duct. This requires signals measuring the supply temperature and the return temperature, and signals from a flow sensor. The flow sensor should, if possible, be mounted on the cold side to reduce thermal effects.

The supply temperature is higher than the return temperature, i.e. Tsupply = Th, Treturn = Tc

The following diagram illustrates the installation with the process signals, the modules with the terminal assignments and the recorded meter readings.



Variants/special cases:

When installing the flow sensor on the hot side, the installation side of the flow sensor should be set to *Side Q Hot side* in the ***Basic settings/input*** sub-menu,

The device provides the following meter readings:

E: Cumulative energy

V: Cumulative volume

M: Cumulative mass

9.1.3 Cooling meter application

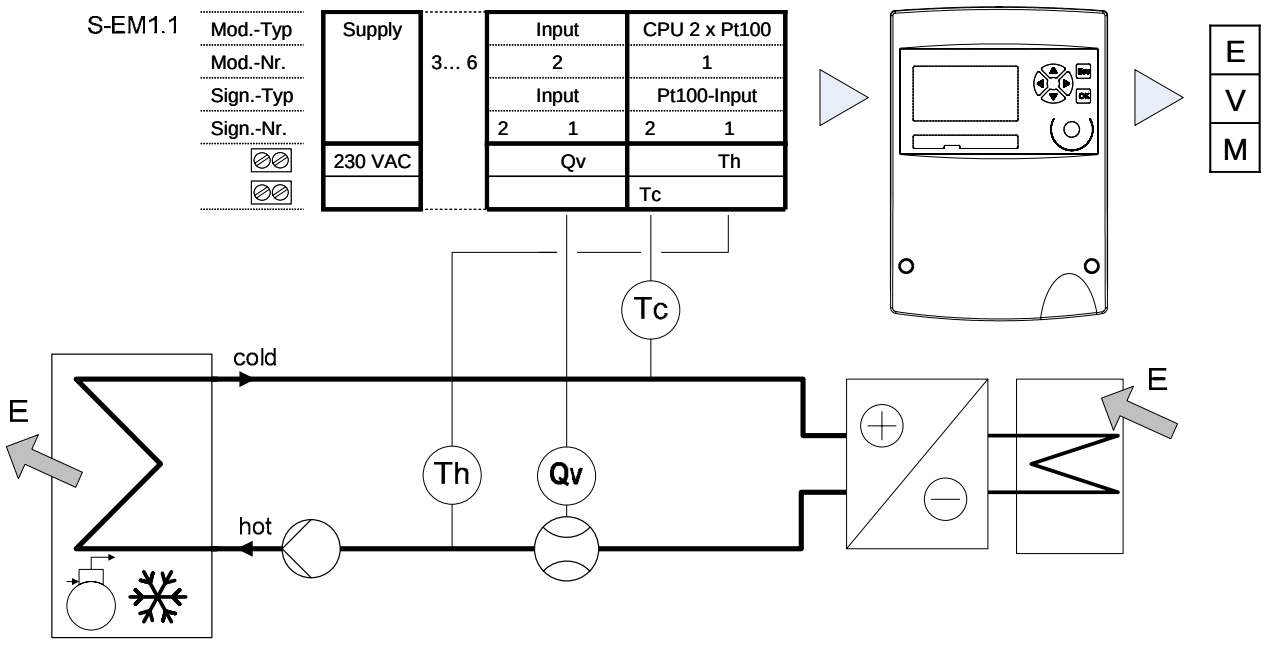
The following characteristics differentiate the cooling meter application from the heat meter application:

- The supply temperature is lower than the return temperature, i.e. Tsupply = Tc, Treturn = Th.
- The temperature difference is in the range of 1 … 15 K. This means that, for the same energy consumption, the flow rate is markedly higher than in heating applications.
- There is a risk of water condensing on the flow sensor, i.e. the sensor should be adequately protected against ingress of water (e.g. IP 67).
- If the supply temperature is < approx. 3 °C, pure water cannot be used as the heat transfer medium. The device is available with a selection of standard commercial heat transfer liquids for this application.

With cooling meters, it is preferable to mount the flow sensor on the hot side in order to reduce thermal effects. The installation side should be set correspondingly. In terms of sensor location, this corresponds to installation in the return flow pipe.

Furthermore, suitable temperature sensors must be used. This can affect the test points, the moisture resistance of the sensors and the cable sheath and the use of heat transfer barriers.

Required measuring signals: Supply and return temperature, flow rate signal.



The device provides the following **meter readings**:

E: Cumulative energy

V: Cumulative volume

M: Cumulative mass

9.1.4 Flow meter application

As a flow meter/calculator, the signals from the flow sensors are converted into current values and cumulative volumes. The measured liquid is also called a ‘heat transfer medium’ in this function, although only the flow rate is measured.

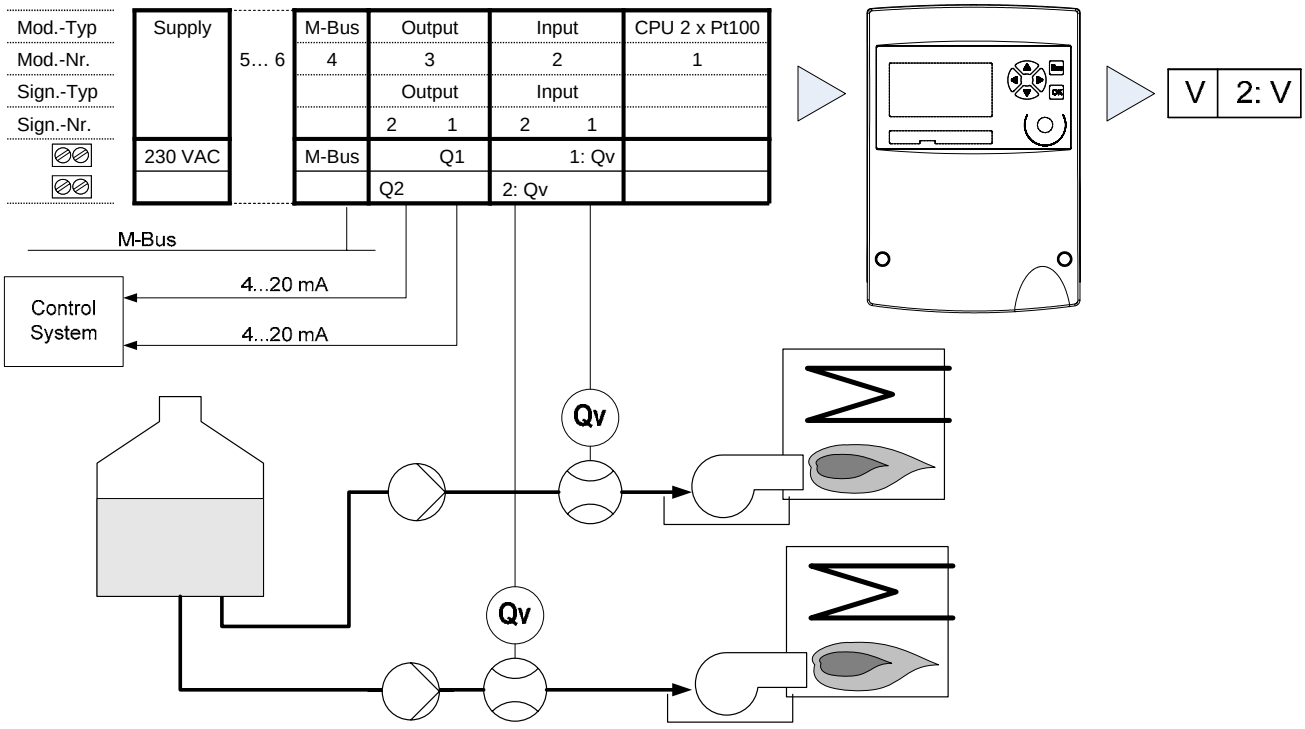
A flow meter can be realised in each logical calculator. Up to three flow sensors can be connected per device. The **example** below shows a flow meter application.

The volume of liquid and the current flow rate in two water pipes are transmitted via the M-Bus interface to a billing system. The flow rate values are also transmitted as analogue signals to a building services management control system.

The following table summarises the input and output signals:

Signal transmitter	Signal	Physical variable	Output control system	Billing system
Water meter 1	Pulse	Volume flow: 1: Qv	4 ... 20 mA	M-Bus
Water meter 2	Pulse	Volume flow: 2: Qv	4 ... 20 mA	M-Bus

This produces the following application diagram:



This example can be implemented with one device, using calculators 1 and 2, which are both configured as flow meters.

Meter readings

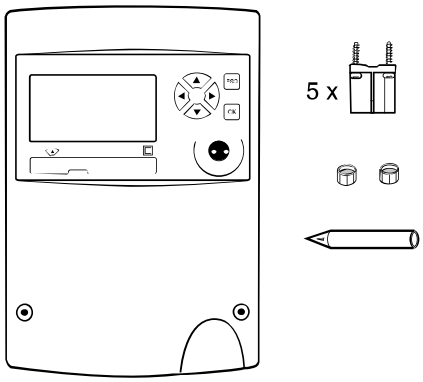
The device records the following meter readings.

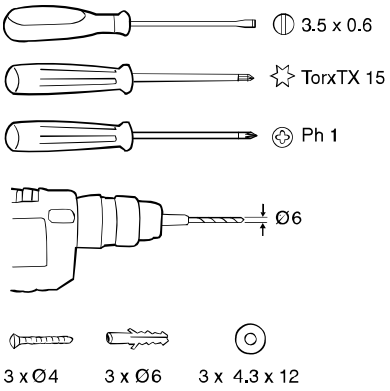
Calculator 1	Calculator 2
V Cumulative volume flow	2: V Cumulative volume flow

10 Mounting the device with protective housing (Prot)

10.1 Scope of supply, tools and mounting material (Prot)

Warning! Precision measuring devices! Protect against heat, humidity, dirt and vibration. Only unpack the device when ready to install. Non-observance can result in damage or malfunction.



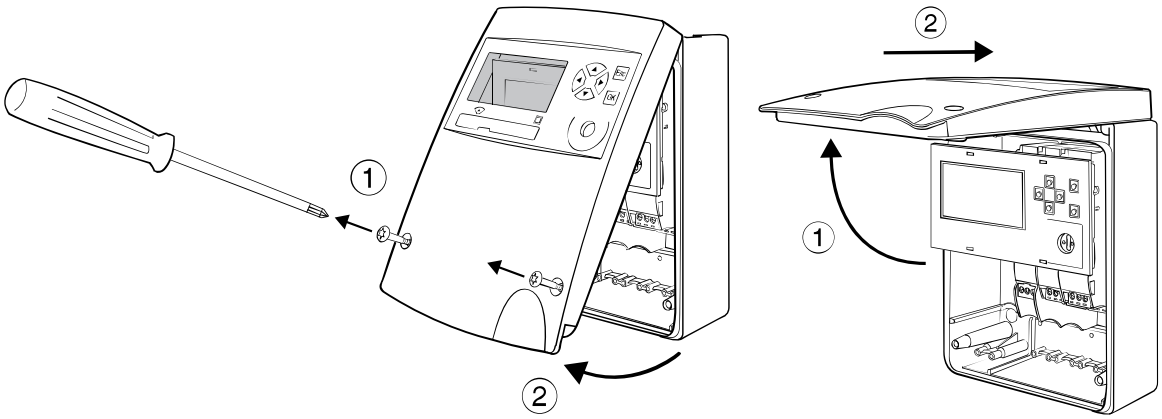


- One Installation and Operating Instructions manual

1) Support rail optional

10.2 Installation (Prot)

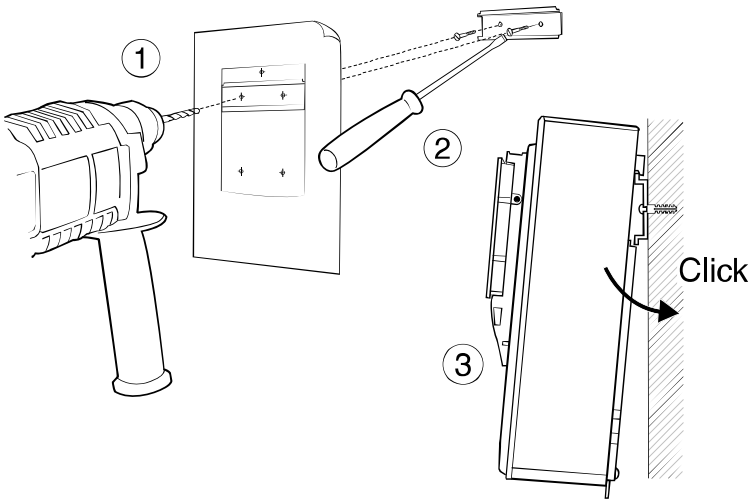
Opening the housing



Mounting on support rail (DIN-EN 50222)

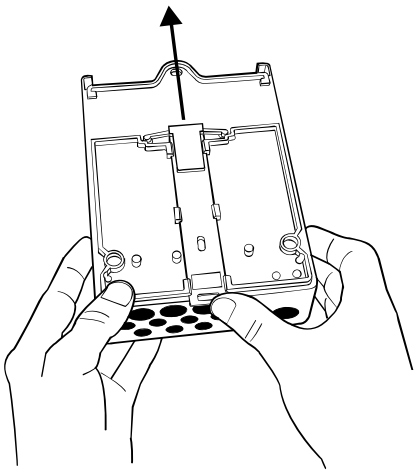
Choose the location for installation

- which is protected against humidity, heat, direct sunlight and damage
- with easy access for reading, operation and installation
- with sufficient distance from sources of electromagnetic interference

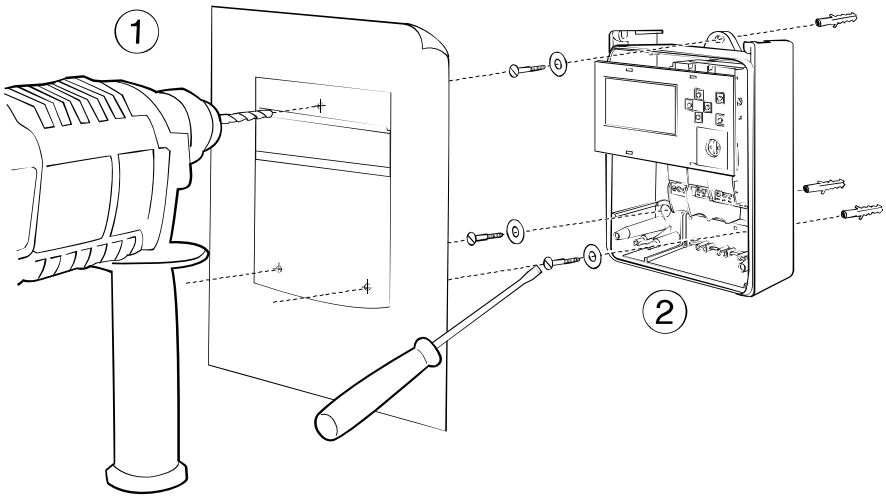


1. Drill holes
2. Screw on support rail
3. Clip device onto support rail

Wall mounting

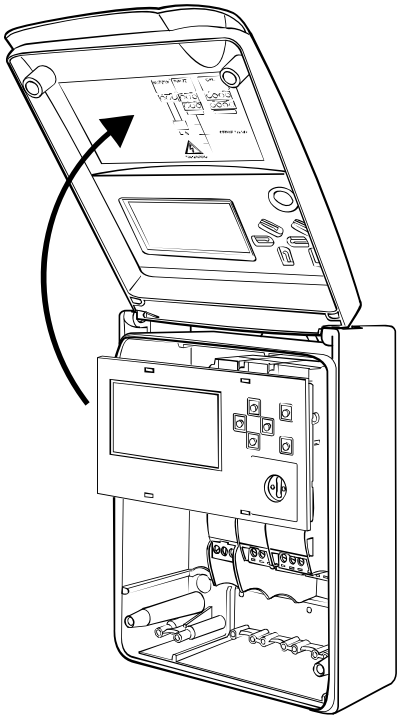


Remove clip-on holder to get a stable support.



Only mount device on a flat surface!

Wiring diagram



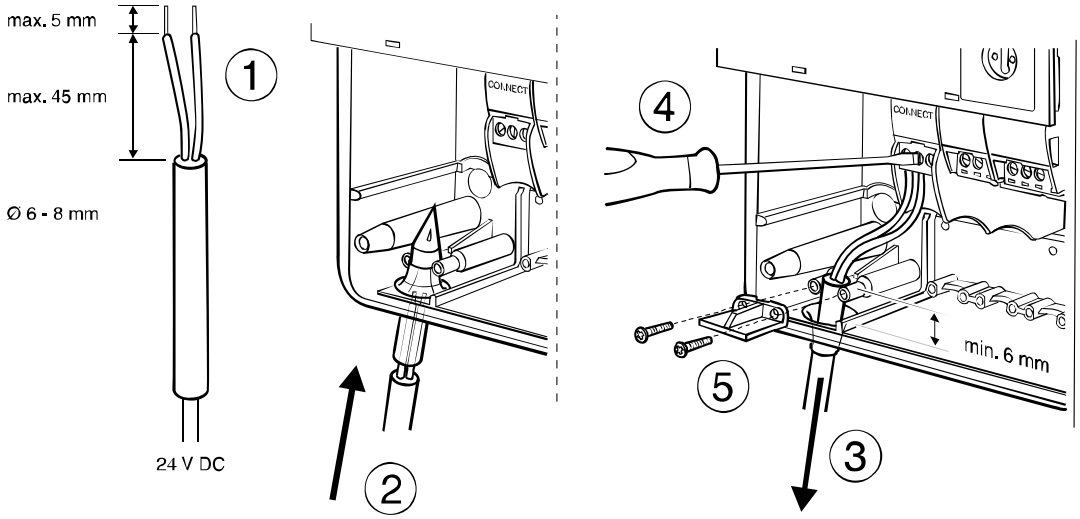
The wiring diagram is on the inside of the housing cover.

Connecting to mains power supply 100 - 240 VAC

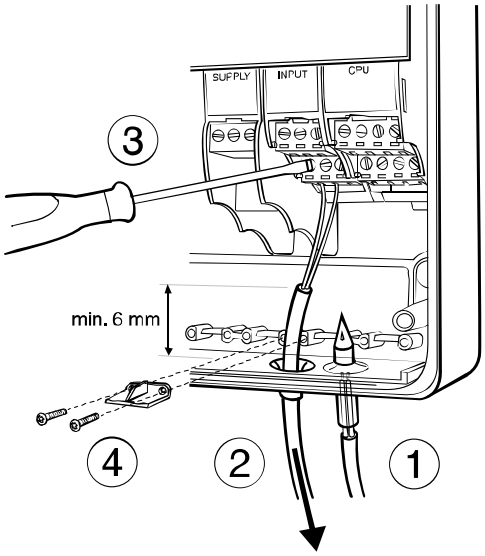
The mains supply must be connected via a two-pole separator and be adequately protected against unauthorised interruption.

⚠	The mains supply 100 - 240 VAC may only be connected to the following terminals:	Terminals L, N (supply module) Terminals 110, 115 (relay module 2x240 VAC)
	The device must be protected by a 10 AT external fuse. The device is fully isolated and requires no grounding connections. Connection to other terminals is extremely dangerous and can permanently damage the instrument!	

Connecting to low voltage supply 24 VDC

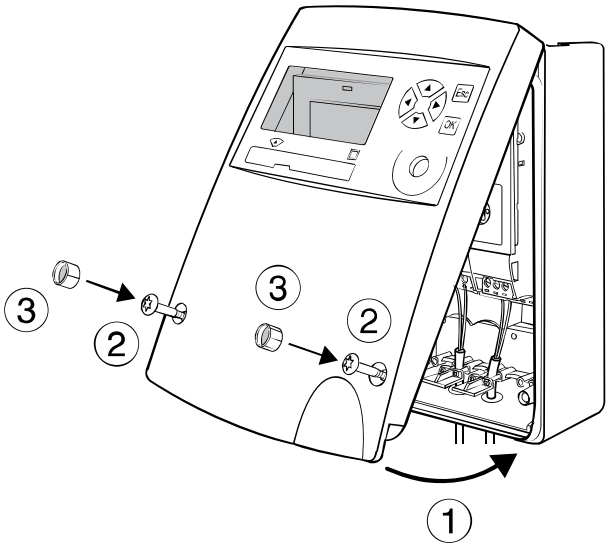


Connecting signal cables



1. Pierce sealing membrane with enclosed awl
2. Insert cable
3. Attach cable to terminal screws according to wiring diagram on the inside cover
4. Affix strain relief clamp

Closing housing



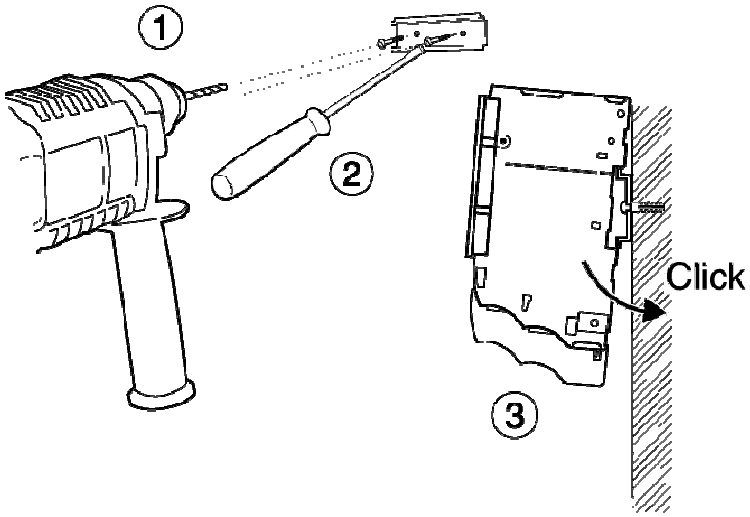
1. Insert the cover into the hinge from above and turn to close
2. Tighten the two fixing screws
3. Engage the **security sealing caps** with the smooth side on the outside.

Once the caps ③ have been fitted, any unauthorised opening of the device can be detected.

Removing the caps: Insert a pointed tool and lever out. The cap is damaged as a result and must be replaced.

11 Mounting the device without protective housing (Mod)

11.1.1 Rail mounting



1. Drill fastening holes
2. Screw on support rail
3. Clip modules onto support rail

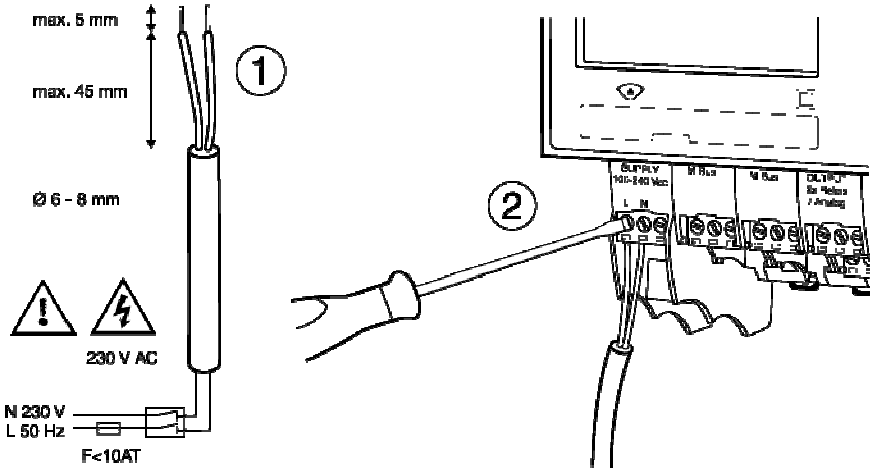
11.1.2 Connecting to mains power supply 230 VAC

Refer to the wiring diagram before starting wiring!

The mains supply may only be connected to terminals L and N!

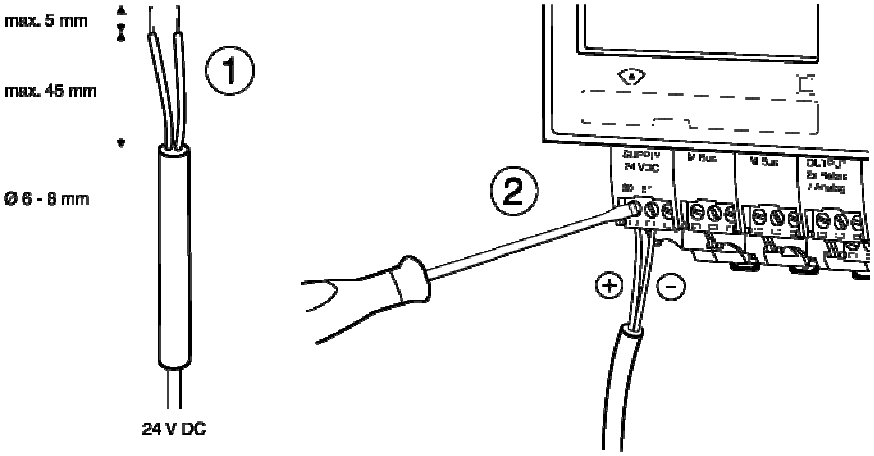
The device is fully isolated and requires no grounding connections.

All other terminals are only for low voltage (<50 V) and measuring signals. Connection to these terminals is extremely dangerous and can permanently damage the instrument!



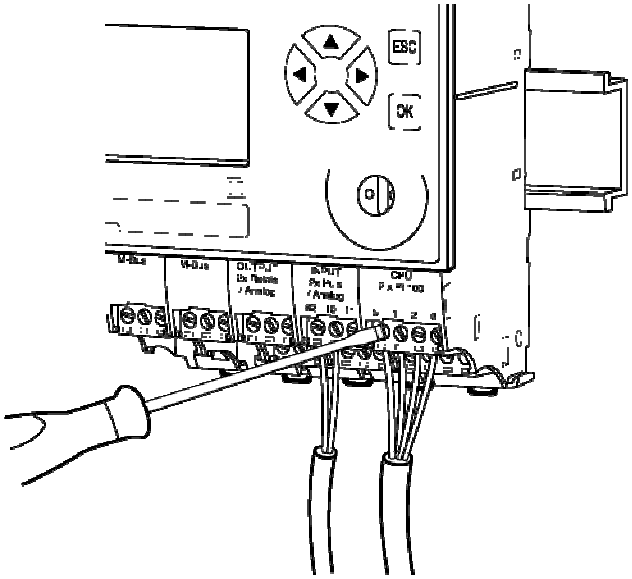
1. Strip the power cable as shown in drawing.
2. Connect power cable to supply module (see enclosed wiring diagram)

11.1.3 Connecting to low voltage supply 24 VDC



1. Strip cable as shown in drawing
2. Attach cable to the connect module (see enclosed wiring diagram)

11.1.4 Connecting signal cables



1. Attach signal cables to terminal screws according to enclosed wiring diagram
2. The terminal blocks can be plugged in.

12 Electrical connections

12.1 Connection instructions

Devices with 100 - 240 VAC connections must have a safety fuse with a max. 10 AT, and must be capable of being made voltage-free by means of an isolating element!

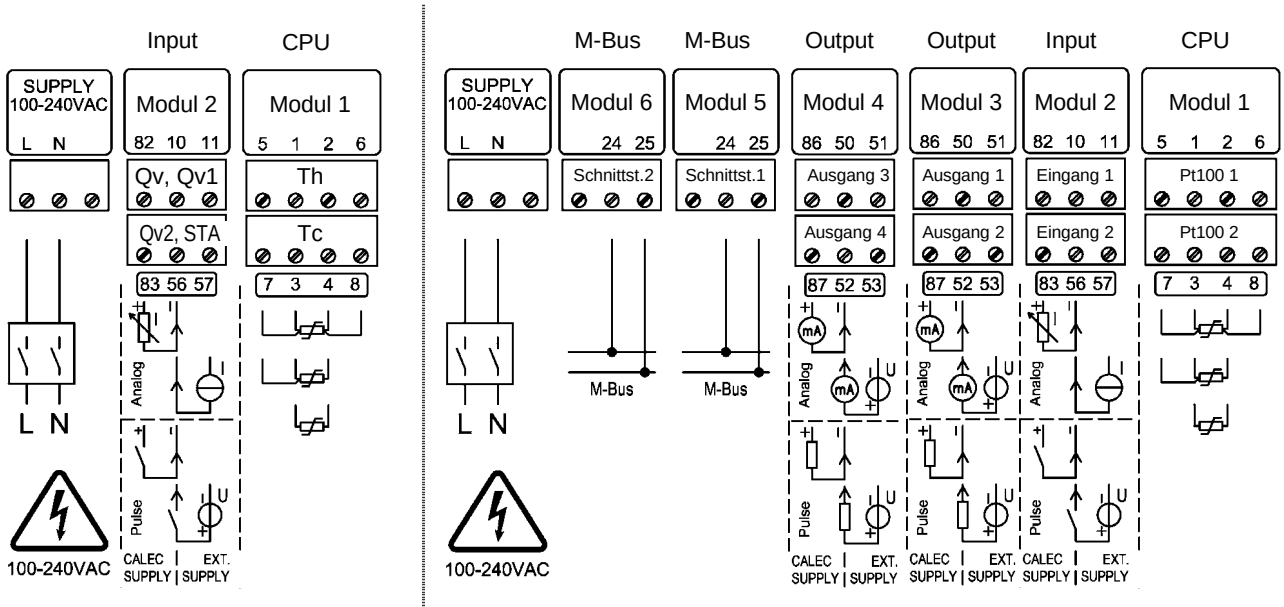
The device must be connected to the same electric circuit and the same fusing, switching and isolating elements as the corresponding heating or cooling system.

If the device is additionally connected via fusing, switching and isolating elements, then these must be protected against unauthorised access (e.g. by security seals), so that the device cannot be put out of operation by unauthorised persons.

12.2 Wiring diagram, module and signal numbers

Below are two examples of wiring diagrams in which the module numbers and signal numbers or signal designations are shown:

Basic unit with 3 modules (right to left): M-101-Prot-AC[I]-CT	Fully assembled unit with 7 modules (right to left): EM-101-Prot-AC[MMOOI]-CT
• CPU module 2 x Pt100 • Input module for flow signal • Mains power supply (supply module)	• CPU module 2 x Pt100 • Input module for flow signal • 2 output modules for 4 analogue output signals, e.g. for a building services management system • 2 M-Bus modules for data reading with 2 M-Bus master units • Mains power supply (supply module)
• Designation: • Module numbers • Signal designation according to standard diagram of the application	• Designation: • Signal numbers, without signal designation • Signal designation according to the standard diagram of the application



Note on input module: Left-hand pair of terminals: Power via calculator
Right-hand pair of terminals: External supply

12.3 Numbering rules

Basic rule: The signals are numbered from right to left and from the top down.

This table shows the elements that have a number, and their maximum number.

Element	Display/number	Explanation
Module	Mod-No.1… 6 (Prot) * Mod-No.1…15 (Mod) *	Numbers according to assembly from right to left No. 1 is the CPU module The module for power supply has no number
Input	Input 1…8	Pulse, current or frequency signal
Pt100 input	Pt100 No.1…6	Pt100 inputs for temperature measurement
Output	Output 1…8 (Prot) * Output 1…12 (Mod)	Output 1 …8, (short designation e.g. A1) Output 9 …12 can be used virtually
Terminals	Trm.No. 82-10-11	See terminal marking
Tariff register	R1 … R4	4 tariff registers per active calculator Display example: R 1 A2+ Tariff register 1 is active when output 2 is switched on.
Interfaces	Interface 1 … 5	1 Internal bus between the modules 2 Optical M-Bus interface in the display module 3 IrDA interface in the CPU module 4 M-Bus module 1 5 M-Bus module 2

*: Prot: Device version with protective housing

Mod: Device version without protective housing

13 Commissioning a measuring point

An energy measuring point consists of the following peripheral equipment:

- Calculator
- Temperature sensor pair
- Flow sensor (fm)

These are matched to each other and must not be exchanged. Temperature sensors with two wires must not be shortened or lengthened.

Procedure during commissioning: (see EN 1434-6:2007)

Tempera-ture sensor	Visual check	• Does the installation of the sensors comply with the installation instructions? The sensor tip should extend at least to the middle of the pipe. • Are the sensors and the sensor pockets waterproof? • Are the sensor version and the sensor pockets compatible? Is the the sensor pair correctly matched (same serial no.)? • Is the sensor type (e.g. Pt100) suitable for the calculator version? • Is the installation side (hot, cold side) correct? • Do the sensor heads have a 4-wire connection?
Flow sensor (fm)	Visual check	• Is the flow sensor mounted in a permitted position? • Does the flow direction correspond to the symbol on the flow sensor? • Does the measuring range correspond to the system flow in operation? • Have all electrical connections been made correctly? • Does the installation side (hot or cold side) correspond to the installation side set in the calculator? • Does the output signal correspond to the input signal set in the calculator (e.g. pulse value, current range etc.)?
Calculator	Visual check	• Do the mounting and operating locations conform to the permissible environmental conditions? • Are all cables correctly connected, and the strain relief clamps fitted correctly? - Temperature sensor (2-/4-wire connection) - Flow sensor - Power supply
	Functional test	• Start up calculator (switch on power supply) • Compare the flows displayed on the device and the flow sensor (if there are two displays) • Check temperature values (e.g. Th > Tc) Check type of connection in the ***Basic settings / Pt100-input*** submenu and set correctly if necessary • Check date / time, set if necessary • Check and set additional functions (billing dates, logger functions etc.)

Protecting the measuring point

If a measuring point is used in commercial transactions, then the peripherals must be protected against manipulation. This is done by means of a sealing wire, adhesive seal and, for the calculator, with a protected password and security caps for the screws.

14 Operation

14.1 PC-Software AMBUS Win II

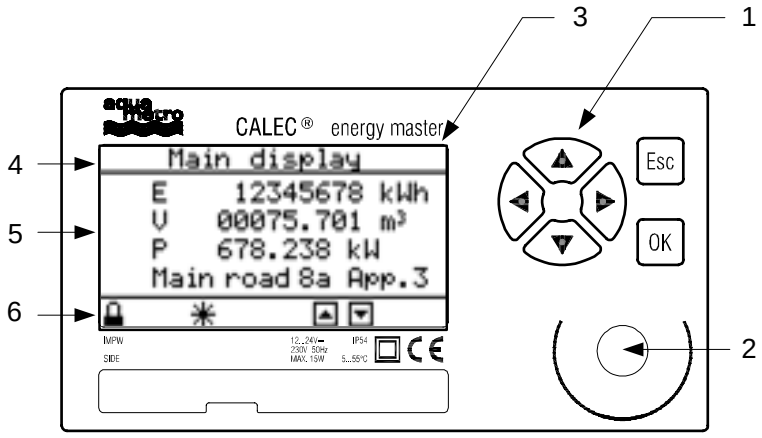
The parameters of the device can be set both via keys and display and via one of the data interfaces with the PC parameterising software AMBUS Win II.

With AMBUS Win II, the meter reading data can be saved, and parameter settings that have to be executed repeatedly can be stored as macros, which can then be reloaded and run. AMBUS Win II and the associated operating instructions can be downloaded free of charge at www.aquametro.com. The use of AMBUS Win II offers advantages if:

- large data records have to be read,
- several devices require identical or similar parameter settings,
- complex applications with inputs/outputs are to be parameterized.

AMBUS Win II and instructions are available as free downloads at www.aquametro.com.

14.2 Display



1 Operating keys
see section 0
Key functions.

2 IR interface, M-Bus

3 LCD display, dot matrix 128 x 64 (see section 18.3)

4 Title for display window

5 Display field, up to 4 values with identification and units

6 Status bar

Symbols on the status bar

	Currently available keys
✳	A flow signal is being detected
EDIT	Edit mode active, input possible
, , no lock	Protection level (see section 0) user, service, programming mode

14.2.1 Key functions

Keys	Function in display mode	Function in edit mode
▲ ▼	Move line/image up or down	Setting of figures and/or characters Selection from a preset list
◀ ▶	No function in the main menu Change channel / input / output Change billing date / logger period	Select setting position in the edit window Change list inside a double-list

Keys	Short (< 0.5 s)	Long (> 0.5 s)	Key operation
OK	Confirm	Activate/deactivate the 3 additional decimal points in the meter settings	Accept set value Accept selected value Finish edit mode
Esc	Back to a previous level, abort process	Back to the standard display	Abort input / selection In double list: finish process

14.3 Right of access, security levels

The parameters for the device can be set entirely via the keys or via the interfaces. The security level (lock level) determines which parameters can be altered. At the time of delivery, the devices are in user mode.

Symbol	Security level	Settings	Code	At delivery
🔒	User mode	Only operating language		
🔓	Service mode	All values that are not relevant for calibration, e.g. initial parameter settings, date/time, measuring point designation etc.	S-Code	1111
no lock	Programming mode	All parameters can be set, e.g. initial settings, resetting/synchronising of meter readings etc.	P-Code	3132

The codes can be changed in the ***Basic setting/System*** submenu.

In EU-compliant devices, activating programme mode will result in the invalidation of the calibration! The date and time will be recorded in the calibration log and the device displays an error.

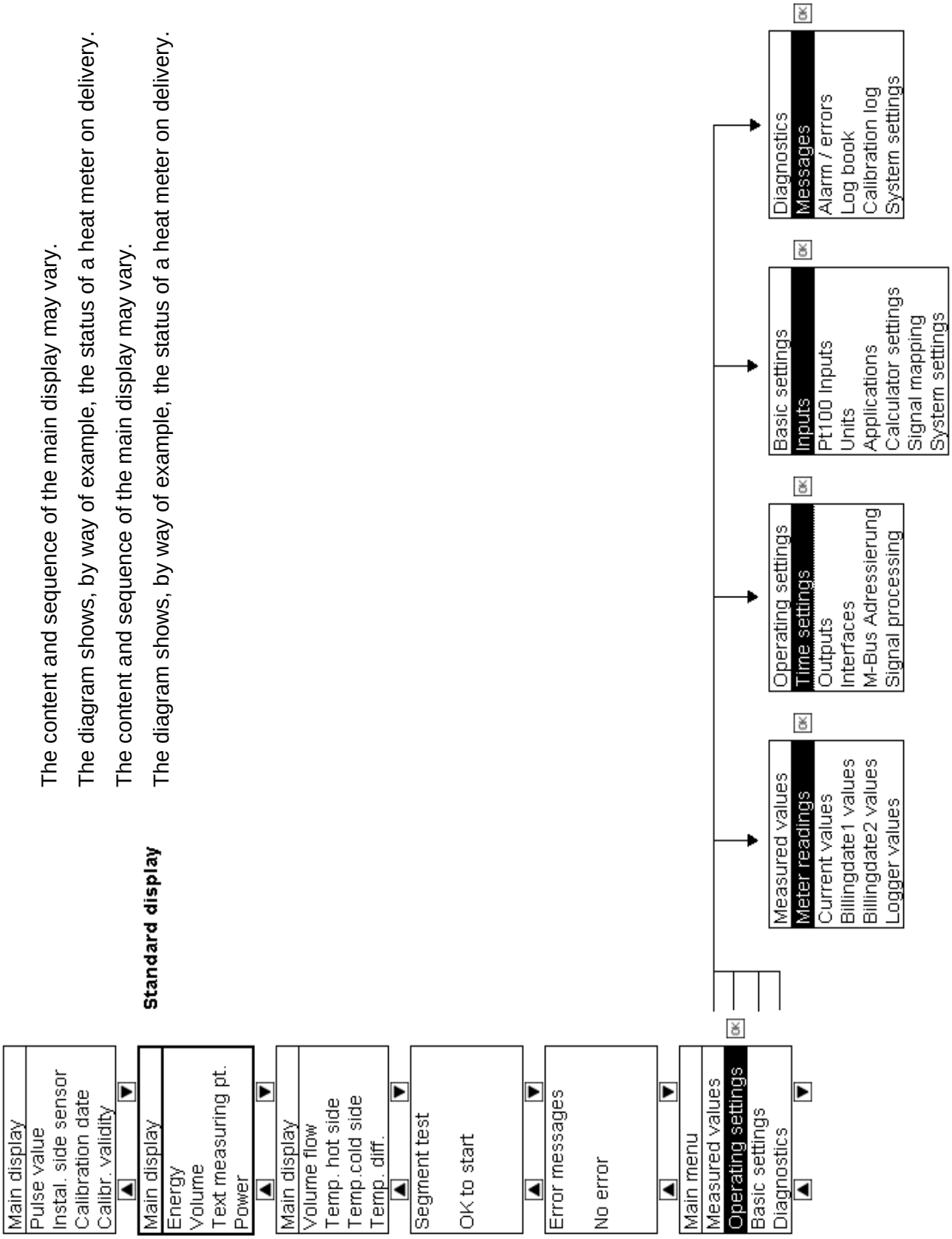
Warning: If you change a code, make sure that you keep it in a safe place. If the code ist lost, reprogramming is necessary by a service technician on site or in the factory.

15 Menu overview

15.1 Main display and main menu

The content and sequence of the main display may vary.

The diagram shows, by way of example, the status of a heat meter on delivery.

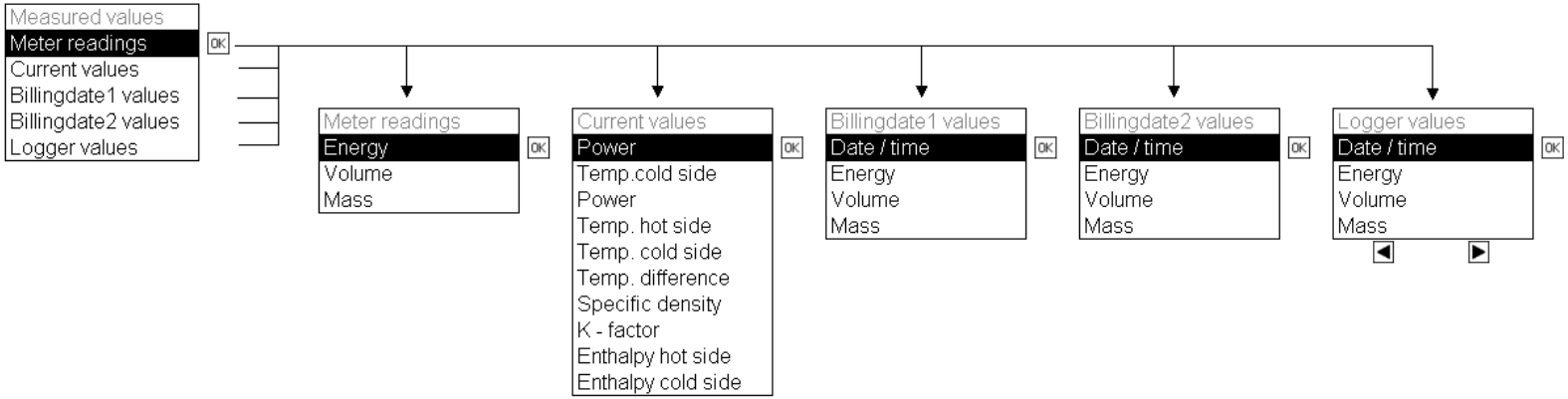


The content and sequence of the main display may vary.

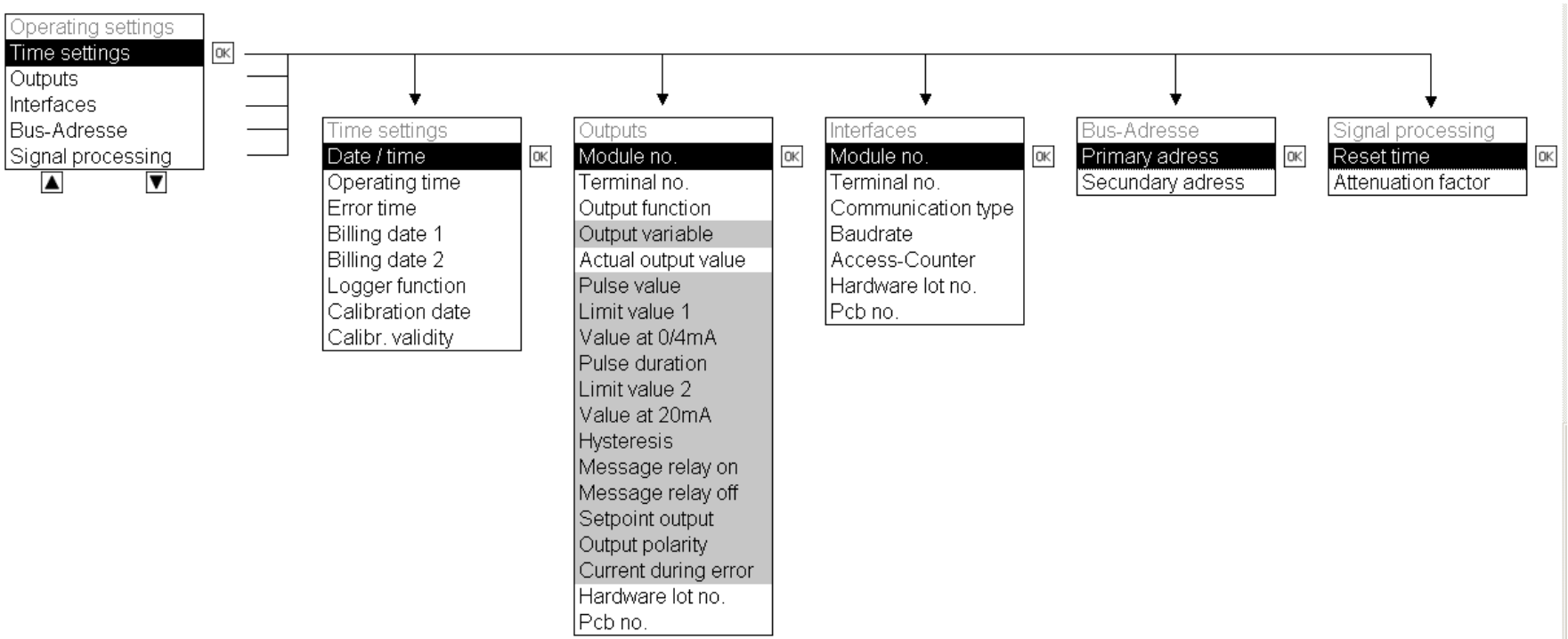
The diagram shows, by way of example, the status of a heat meter on delivery.

15.2 Submenus

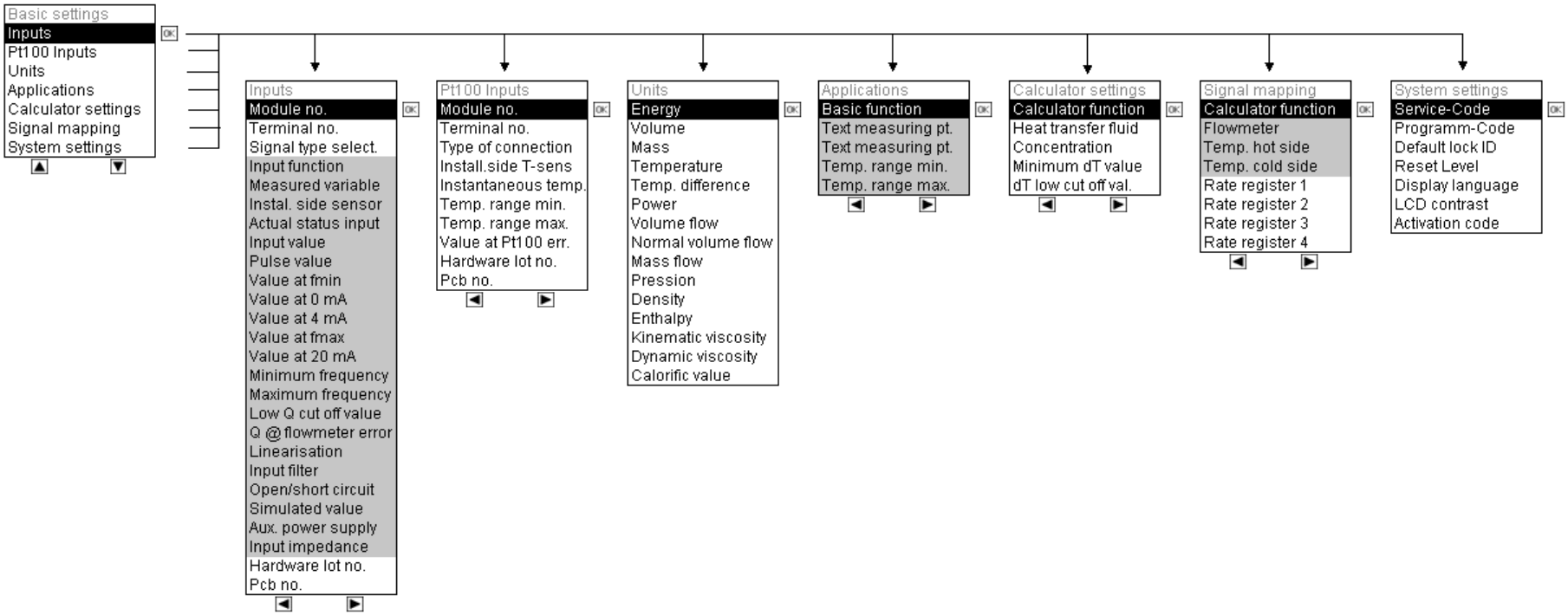
Overview Submenu ***Measured values***



Overview Submenu ***Operating mode***

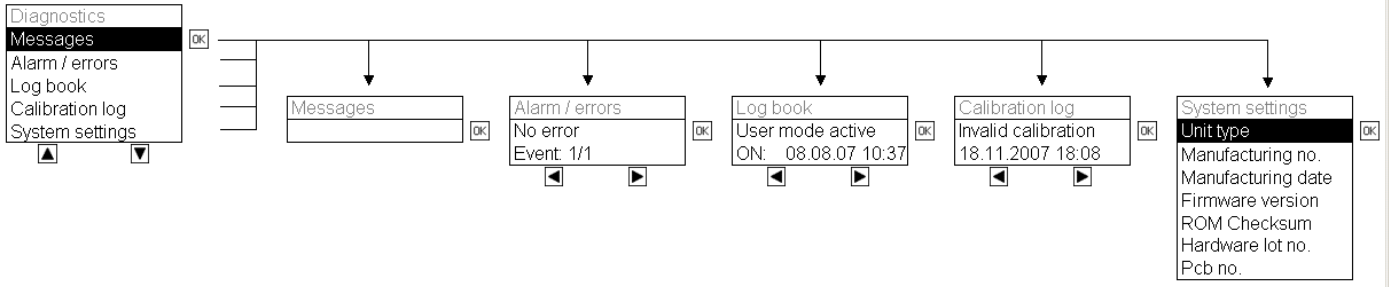


Overview Submenu ***Basic setting***



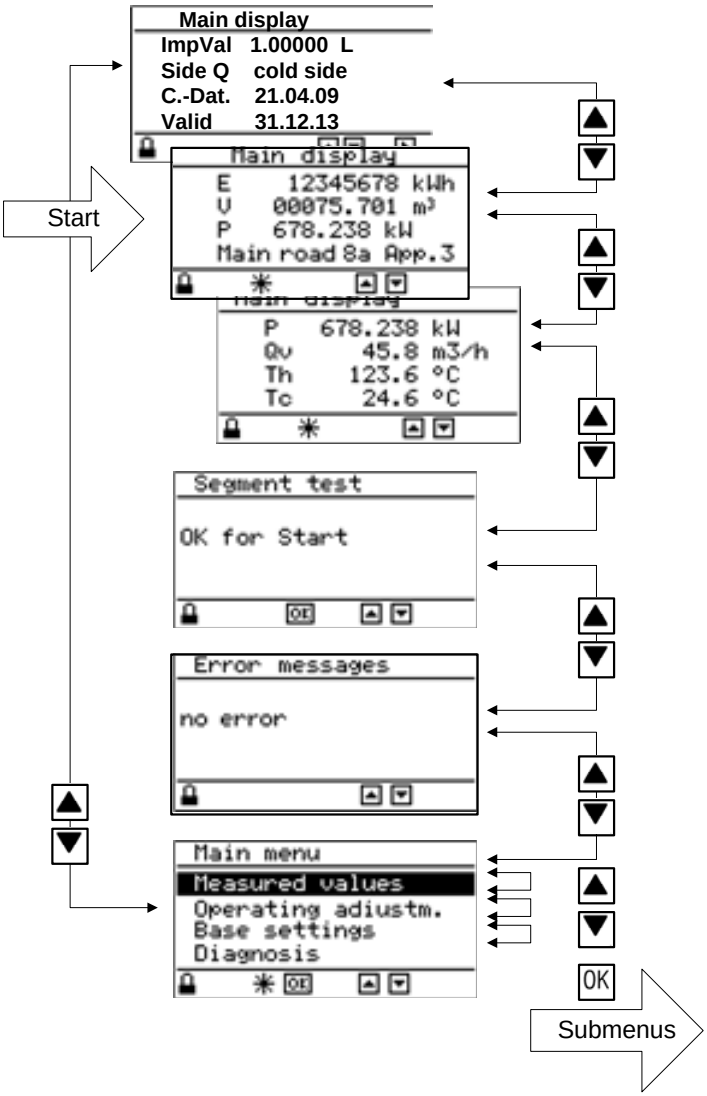
These parameters are only displayed if they are relevant for the selected function

Overview Submenu ***Diagnosis***



16 Use under operating conditions

16.1 The main display



After switching on the device, the page marked ‘start’ of the main display appears.

The arrow keys can be used to move between a maximum of 4 pages of the main display:

- ▲ 1: Calibration-relevant data
  2: Meter readings and designation
- ▼ 3: Current values
- ▼ 4: other values, if configured
- ▼ Segment test (display test)
- ▼ Error display
- ▼ Main menu

The segment test shows a chequerboard pattern to test the display.

In the error message window, an error message is displayed if an error occurs

In the main menu, the submenus can be selected and displayed to show or set further values.

If no operation is carried out for approx. 5 min., the device will display the main menu page marked ‘Start’.

Notes:

The content of the main display depends on the device version. The main display can contain up to four pages with up to four values (i.e. up to 16 values). In standard CALEC® energy master devices, only three pages are displayed with the values shown above.

The display values of the main display are predefined at delivery. These values and their sequence can be altered in a non-CE conformity assessed device using the software AMBUS Win II.

16.2 The measured values submenu

16.2.1 Measured values

Measured values	
Meter readings	Meter readings for energy, volume (mass)
Current values	Current values: temperatures, volume/mass flow rates, power
Billing date 1 values	Meter readings on the set billing dates
Billing date 2 values	
Logger values	Meter readings per calculator at the set times

16.2.2 Meter readings

Meter	Display calc1, calc2 and 3			Explanation
Energy	E E	2: E 2: E-	3: E 3: E-	Energy meter reading, positive Energy meter reading negative, in options BDE / BDV
Volume	V, V-	2: V, 2: V-	3: V, 3: V-	Volume meter reading, E, E- respectively
Mass	M, M-	2: M, 2: M-	3: M, 3: M-	Mass meter reading E, E- respectively

16.2.3 Current values

Current value	Display	Explanation
Power	P	Thermal power
Volume flow	Qv	Volume flow rate
Mass flow	Qm	Mass flow rate
Temperatures	Th, Tc	Temperature of the heat transfer medium hot / cold side
Temp. difference	dT	Temperature difference: dT = Th - Tc
Density	Den	Density of the heat transfer medium (Den: Density)
K-factor	K-F	Heat coefficient
Enthalpy	Hh, Hc	Enthalpy of the heat transfer medium hot / cold side

Current values of calc2 and 3, or with a negative prefix, are displayed similarly (2: P or P-).
If a current value exceeds 999 999 (6 digits), Overflow is displayed

16.2.4 Billing date values

Shows the meter readings saved on the two set billing dates. The billing dates can be set under ***Operating settings/time settings/Billing*** and ***Billing2.*** The meter readings are saved at 23:59 each time.

16.2.5 Logger values

In version 1.0, only the meter readings can be recorded.

Logger values 1	
Date/T	01.05.08
E	24.567 MWh
V	1000.12 m3
M	982.1 t
M	982.1 t

1. Logger value, select with keys ◀ ▶
Date/time when the value was chosen
Energy meter reading at this time
Volume meter reading at this time
Mass meter reading at this time
Mass meter reading at the displayed time

The time interval for the logger function can be set under ***Operating settings/ Time settings/Logger***.

17 Settings on commissioning

17.1 General settings

The device parameters can be set with the keys. The level of protection determines which parameters can be changed (see section 0). On delivery, the device is in user mode. See section 10.1 on how to use the parameterisation software.

17.1.1 Display language

The operating language can be set in user mode in the ***Basic setting / system*** menu:

System	
S-Code	
P-Code	
D-Lock	
Reset	Abort
Lang.	English
…	

Keys	Parameter
	Input field unlocking code for service mode
	Input field unlocking code for programming mode
	Protection level after approx. 4 min. without operation (default lock)
OK	Select: Deutsch, English, Français, Italiano

17.1.2 Date and time

Date, time ander other timing parameters can be set in service mode 🔓 under:
Operating mode / time settings / Date/Ti DD.MM.YY hh:mm

Time settings	
Date/ti h:mm	DD.MM.YY
...	

	Note
	Date and time: **DD.MM.YY hh:mm,** Enter character by character

17.1.3 Baud rate optical interface

The baud rate of the optical interface can be set in service mode 🔓 under
Operating adjustm. / Interfac

Interfac 2	
Mod-No.	IR EN60870-5
T-Nr.	IR EN60870-5
Type	IR EN60870-5
Bd	9600 Bps
Access	123
…	

Keys	Parameter
◀ ▶	Click on ◀ ▶ to select interface 2
	IR interface on CPU module
OK ▼ ▲	Set baud rate
	Number of calls from the M-Bus master

17.1.4 M-Bus address

Addressing type, i.e. collective or single address, and the M-Bus addresses (M-Bus modules and the infrared interface according to EN60870-5) can be set in service mode :

M-Bus primary and secondary address under ***Operating mode / M-Bus addressing***:

M-Bus Addressing 1
Pri 2
Sec 1534

Entry	Parameter
	Click on ◀ ▶ to select interface, from No. 4
◀ ▶ ▼ OK	Enter primary address, 0 to 255
◀ ▶ ▲ OK	Enter secondary address with max. 8 characters (000 0000 to 9999 9999). At delivery, the secondary address corresponds to the serial number.

17.2 Settings for the calculator function

17.2.1 Standard applications

The devices are delivered with preset basic settings; when commissioning standard applications, the following values should be set:

- Interface parameters (address, baud rate…)
- Operating settings: output signals, billing dates and logger parameters
- Individual calculator parameters: Limiting values dT and Cut alarm

17.2.2 Do not change settings in programming mode

Changing settings in programming mode is only useful in exceptional cases, and is only possible with devices without CE conformity assessment. Please consult your customer service advisor.

Warning: Only activate programming mode if the consequences are known!

If the basic settings are faulty, the device will not function correctly, or will cease to function!

An alteration of the basic setting in conformity-assessed (calibrated) devices will invalidate the calibration!

17.2.3 How does one recognize devices with CE conformity assessment?

Devices with CE conformity assessment can be recognized by:

1. the CE mark on the type plate (see section 4.1),
2. the indicated values for the calibration date and calibration validity.

Go to page 1 of the main display (start window and ▲).

Without conformity assessment	With conformity assessment
ImpVal 1.000 L Side Q Cold side	ImpVal 1.000 L Side Q Cold side E-Date. 30.06.2008 Valid 30.06.2013
Settings can be changed in programming mode.	Calibration-relevant settings must not be changed otherwise the calibration will be invalidated.

17.2.4 Calculator settings: Heat and cooling calculator

Warning! The following parameters can only be set in programming mode. With conformity-assessed devices, the activation of programming mode invalidates the calibration.

Parameters for the flow sensor

If a device is supplied as part of a measuring point (e.g. a combined heat meter), then the flow sensor parameters have already been set correctly.

The corresponding parameters can be checked in the ***Basic settings / input 1*** submenu (example for pulse input Namur 200 Hz):

Input 1		Settable?	Parameter
			Select input with the ◄ ► keys
Mod-No. 2		No	Module number
T-Nr..	82-10-11	No	Terminal numbers
Signal	ID Namur 200 Hz	Yes	Signal type
Funct.	Pulse	Yes	Function (status, pulse or frequency)
Meas.var.	Volume	Yes	Measured variable (e.g. volume, mass…)
Side Q	cold side	Yes	Installation side of flow sensor (hot/ cold side) *
Status	0.000 Hz	No	Pulse frequency at input
ImpVal	1.000 L	Yes	Pulse value
…			Other parameters, not settable
FWV	V01.00.05	No	Firmware version number of the module

*: with the cooling meter application, Side Q = hot side is preferable (default setting).

Parameters for temperature sensors

The following parameters are available in the ***Basic settings/Pt100-Input*** operating menu:

The type of connection can be set in service mode .

Pt100-Input 1		Settable?	Parameter
			Select input with the ◀ ▶ keys
Mod-No.	1	No	Module number, here the CPU module on the right
Trm.No.	5-1-2-6	No	Terminal numbers
Conn.	4-wire	Yes	Type of connection Pt100 (2-, 3-, 4-wire)
Side T	Hot side	No	Temperature sensor installation hot side
T inst	21.5 °C	No	Instantaneous temperature at input
T min	-50.0 °C	No	Lowest measurable temperature
T max	550.0 °C	No	Highest measurable temperature
T err	999.9 °C	Yes	Displayed temperature if an error occurs in the input
Lot No.	807	No	Production batch number of the module
HW_No.	12345678	No	Hardware version module number
FWV	V01.00.05	No	Firmware version module number

Pt100 input 2 has identical parameters with the exception of: Side T Cold side.

Calculator parameters

With the calculator function Energy calculator, the following parameters can be set in service mode in the submenu ***Basic settings / application / Fct. :***

Application 1		Settable?	Parameter
			Select calculator with the ◀ ▶ keys
Fct. Energy calc.		Yes	Function/applications Energy calculator
<text1>			Text to describe device/measuring point
<text2>			
T min	0.0 °C		Lower limit of temperature measureing range
T max	200,0 °C		Upper limit of temperature measureing range

Parameters for outputs and interfaces

The settings for the output signals and the communication interfaces should be made according to the device fittings and the system connections.

17.2.5 Time settings: date, billing dates, logger etc.

The submenu ***Operating setting / time settings*** groups various settings connected to time settings:

Time settings	Settable?	Parameter
Date/ti 30.06.08 12:34	Yes	OK ▼▲ ▶ ▼▲ etc. OK Date and time, enter character by character
Bil d 1 30.06.--	Yes	Date for billing date 1 enter character by character
Bil d 2 31.12.--	Yes	Date for billing date 2 enter character by character
Logger daily	Yes	Inactive: Logger is switched off. The logger is activated when an interval is selected: Monthly, 15 days, daily, hourly, 30 minutes, 15 minutes. The readings of the 3 registers (E, M, V) are recorded
C-Dat. 25.06.08	No	If date display: 'calibration date', calibration valid If 0 is shown: calibration invalid
Valid. 1	No	1: Calibration valid; 0: calibration invalid
T oper 123 h	No	Operating hours
T-Err1 2 h	No	Error hours, time during which at least one error was identified

17.2.6 Settings of calculator function for measuring transducer

The main settings in the ***Basic settings*** submenu are:

Menu point	Display	Note
Application 1	Fct. Energy calculator	
Application 2	2: Fct. Energy calculator	Select calculator with the ◀ ▶ keys
Calculator setting 1	Fct. Flow calculator Wtr Water	
Calculator setting 2	2: Fct Flow calculator 2: Wtr Water	Select calculator with the ◀ ▶ keys
Assignment table 1	Fct Flow calculator Sig Input 1	Signal from flow meter 1 to pulse input 1
Assignment table 2	2: Fct Flow calculator 2: Sig Input 2	Signal from flow meter 2 to pulse input 2

18 Troubleshooting

18.1 Messages

Messages are triggered by the events set out in the following table.

In case of a fault or alarm, the backlight of the display will flash, and a message will appear in the ***Error messages*** menu in the main display.

The table shows triggered events, display and actions to be taken in relation to the messages:

Event type	**Trigger**	**Entry in**	**Display red**	**M-Bus status byte**	**Action**
Error	Device error	Logbook	X	Error	Repair or replace device
Alarm	Unauthorised operating mode	Logbook	X	Error	Return to authorised operating mode (self-healing)
	Configuration error				Change parameters or assemble modules (create valid configuration)
Calibration-relevant events	Activate programming mode, change calibration data	Calibration log	X	Error	Recalibrate device
Other events	Change protection level	Logbook	-	-	-
	Change switching status of an output 1)	Logbook	-	-	-

1) User-programmed messages

18.2 Error message in the main display

If the device is in error status (flashing red backlight), the error message is accessed in the main display by pressing the ▼ key repeatedly.

Error messages
No error

Display during normal operation

Error message 1
error Th CPU module

Display of an error message (example). In case of several error messages, use the ◀ ▶ keys to move back and forth.

18.3 Diagnosis submenu

Diagnosis
Messages
Alarm / error
Log book
Calibration log

Additional information which could be useful for the operation and the error search is shown in the Diagnosis submenu.

18.3.1 Message submenu

In this submenu, all messages are displayed for approx. 5 seconds.

Messages

Display during normal operation.

Messages
Limit value Th < 50°C

Example of a user-programmed message.

18.3.2 Alarm / error submenu

This message is also available as a copy in the main menu (see section18.2)

Alarm / Error
No error
Event : 1/1

Display in normal operation

Alarm / Error 1
Error Tc CPU module
Event 1/2

Display of a message (example) In case of several error messages, use the ◀ ▶ keys to move forward and back.

18.3.3 Logbook submenu

All errors, alarms, calibration-relevant events, device manipulations and system messages are recorded in the logbook with a key word and date / time. Up to 100 entries can be made. If this number is exceeded, the oldest entry will be removed to make space for a new entry.

In case of several entries, these can be selected with the ◀ ▶ keys.

Example: Error in the hot side temperature

Log book 4
Th error CPU module
On : 05.03.08 11:16

Occurred on 05.03.2008 at 11:16 a.m.

Log book 2
Th error CPU module
Off : 05.03.08 11:56

Reset on 05.03.2008 at 11:56 a.m.

18.3.4 Calibration log menu

The events in the calibration log can be selected with the ◀ ▶ keys.

Calibration log 9
Invalid calibration
No entry

*: No event, “no entry” is shown

Calibration log 9
Invalid calibration
05.03.08 10:05

The calibration became invalid on 05.03.2008

The calibration log records 10 entries with a time stamp, which are relevant for maintaining metrological CE-conformity.

Title/Number	Calibration event	Time stamp	Note
Calibration log 1	Device calibrated	DD.MM.YY hh:mm	Date of last 'calibration'
Calibration log 2	Calibration invalid	DD.MM.YY hh:mm	By activating programming mode, the calibration was invalidated
Calibration log 2	Reset meter readings	DD.MM.YY hh:mm	Resetting the meter readings deletes the consumption values!
Calibration log 4	E1 Counter overflow	DD.MM.YY hh:mm	After a counter overflow, the meter reading is lower than previously. This can be corrected when calculating consumption, and will still result in correct consumption values
Calibration log 5	2: E1 Counter overflow	DD.MM.YY hh:mm	
Calibration log 6	3: E1 Counter overflow	DD.MM.YY hh:mm	
Calibration log 7	E2 Counter overflow	DD.MM.YY hh:mm	
Calibration log 8	2: E2 Counter overflow	DD.MM.YY hh:mm	
Calibration log 9	3: E2 Counter overflow	DD.MM.YY hh:mm	

18.4 Error messages

Note: X:… represents calculator No. X (X = 2 or 3)

X is only displayed if calculators 2 and 3 are activated.

Message	Description/possible cause	Comment/action to take
E1,E2 Counter overflow X: E1,E2 Counter overflow	Overflow of the counter on display	Taken into account during billing
Calibration invalid	Message if calibration seal was destroyed	Only possible in programming mode
Th Error CPU module Tc Error CPU module	Measured value outside the measuring range, temperature sensor missing/defective, or setting of 2- / 3- / 4-wire connection incorrect	Connect sensor correctly Replace sensor Check setting of 2-, 3-, 4-wire connection
Th >< Range error Tc >< Range error	Temperature on hot/cold side outside the permitted range	Device fault or sensor defect
Th >< Range calc X Tc >< Range calc X	Temperature on hot/cold side is outside the permitted range for calculator X	Device fault or sensor defect
dT < dTmin-value calc X	Temperature difference is smaller than dTmin-value	Tc > Th: When installation idle: error will disappear when running Temperature sensors switched: exchange temperature sensors.
Configuration error Config. error: calc X	Device configuration in the ***Basic settings*** submenu is incorrect or incomplete.	Correct the configuration
Memory error EEPROM	Error when saving a parameter or a meter reading	Risk of data loss Device faulty, repair
Error real-time clock	The real-time clock cannot be accessed	Device fault, repair Billing data and logger values no longer being saved
Error Display module	Display module gives error message	Replace or repair display module
No module present	No module was found between CPU	Device incomplete

Message	Description/possible cause	Comment/action to take
	module and the mains unit	Check module assembly
Too many modules	The number of modules is too great, or the address assignation failed	Check module assembly
Module missing	An expected module (shown in the saved list) between CPU module and mains unit was not found.	Assemble module or adapt configuration to the existing assembly
Internal bus error	Communication on the internal bus is faulty	Check connection of the individual modules, device defective, repair
Code is invalid	Entered release code incorrect	Request correct code from manufacturer and enter
Assignment error	Assignment in the ***Basic settings*** submenu is faulty or incomplete	Correct the assignment
Faulty meter reading	CRC-error of a meter	Replace device or send for repair
IN 1…8 value too large	Value at input 1…8 too large - Frequency greater/equal to 10.5 kHz - Current greater/equal to 21 mA	Check signal
IN 1…8 Value too small	Value at input X too small - 4 … 20 mA: Current <= 3.6 mA - 0 … 20 mA: Current > 0 mA	Check signal
IN 1…8 Interruption	Signal interruption at input X (U < 50mV / I < 50 µA)	Only with NAMUR setting if SC det = on
IN 1…8 Short circuit	Signal short circuit at input X (U > 7.28 V / R ext < 100 Ω)	Only with NAMUR setting if SC det = on
IN 1…8 power supply < 20V	internal 24V voltage < 20 V	Check voltage
OUT 1…12 power supply < 20V	internal 24V voltage < 20 V	Only output and relay module
Error ADC CPU module	The ADC in the CPU-module cannot be accessed	Faulty device, repair
Error ADC Parameter	Error when setting parameters of the ADC in the CPU module.	Faulty device, repair

19 Maintenance, recalibration, disposal

19.1 Maintenance and recalibration

The following components need regular maintenance:

The backup battery in the CPU module must be replaced in the factory after 10 years.
The contacts of the electromechanical relay in the output module 2 x 240 VAC must, depending on the load, be checked after 5-10 years and, if necessary, replaced.

Furthermore, periodic recalibration is prescribed by national calibration regulations for devices in commercial use.

	Devices in commercial use	**Devices without conformity assessment**
Maintenance interval	Calibration period as per national regulations. For energy calculators, normally 5 years	10 years
Tasks	Recalibration	Works test
	Functionality test, replacement of obsolete components After 10 years, replacement of the internal battery in the CPU module (soldered button cell)	

*. If desired, the counter readings can be reset to zero during recalibration. This must be taken into account when calculating bills.

19.2 Dispatch

The modules to be recalibrated can be sent to the supplier, i.e.:

3. The CPU module
4. All input modules that process calibration-relevant signals.

The device to be transported should be packed in a suitable protective packaging, preferably in its original packing.

Repairs may only be carried out by your supplier's service organisation. You will find a list of the service network on the address page of these operating instructions.

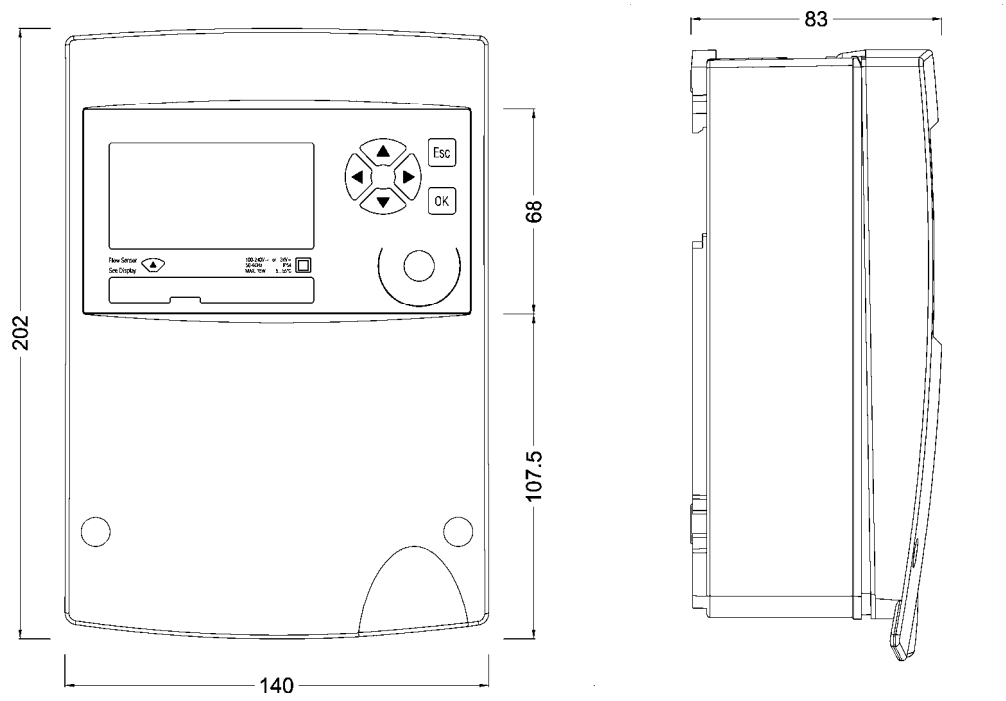
When repairs are required, please always enclose a description of the error (observations, type of malfunction, external circumstances etc.).

19.3 Disposal

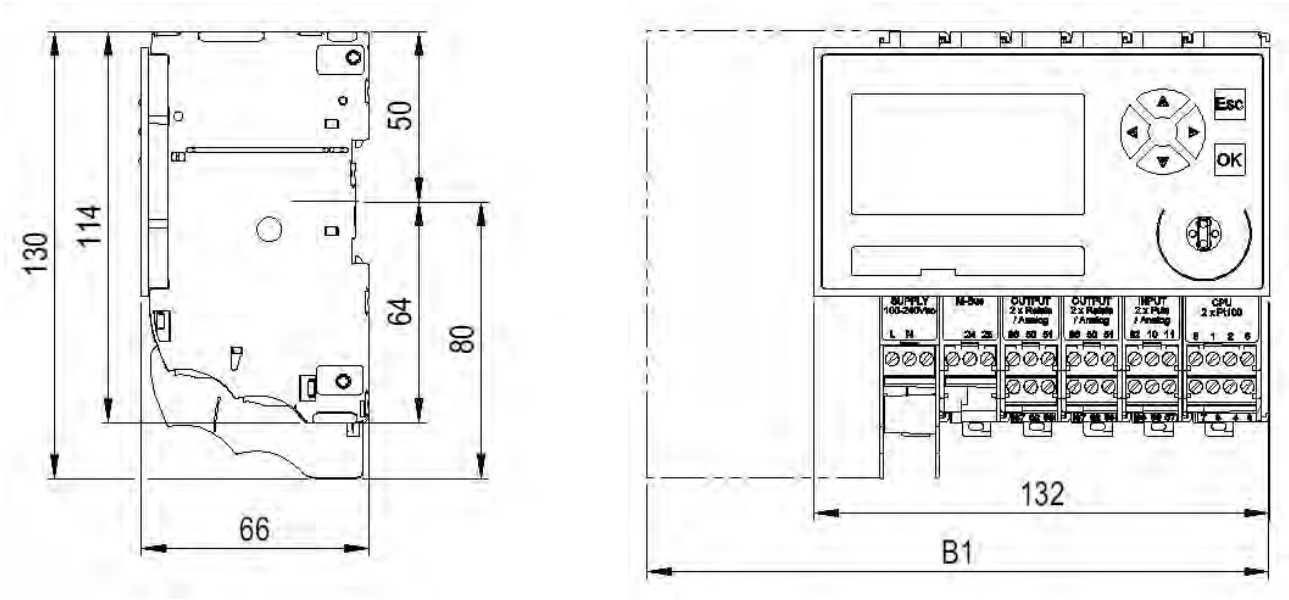
The device contains electronic components and must therefore be disposed of as electronic waste. Aquametro takes back its old devices and will dispose of them. Please also note your local regulations in this respect.

20 Dimensional drawings and technical specifications

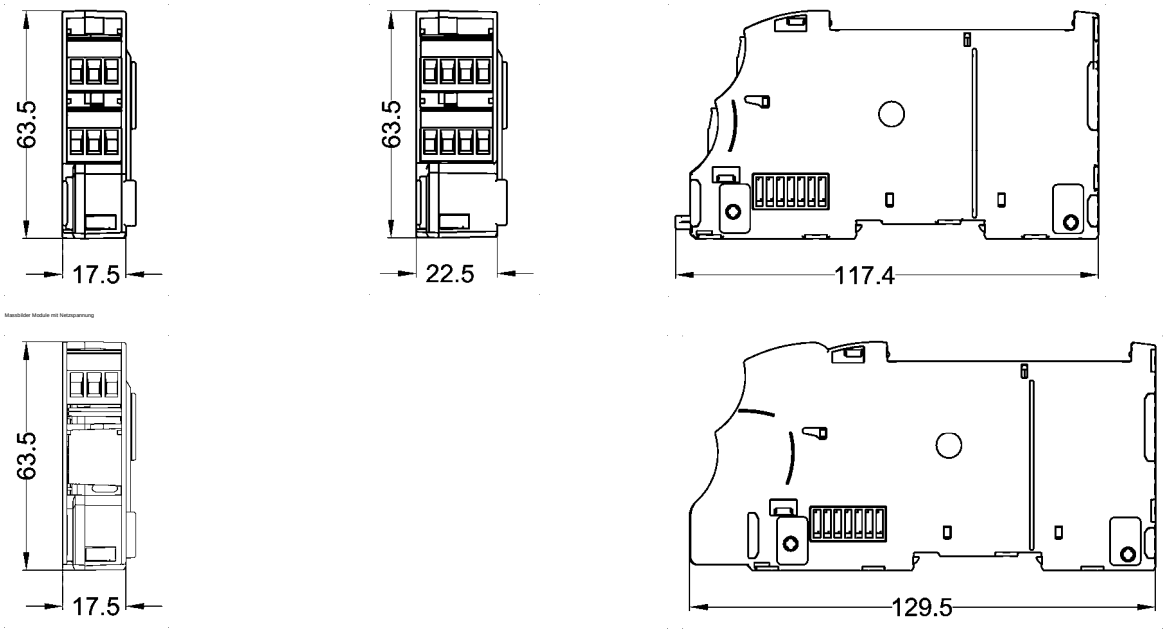
20.1 Dimensional drawings of device with protective housing Prot



20.2 Drawings of device without protective housing (Mod)



Dimensional drawings of modules with low voltage

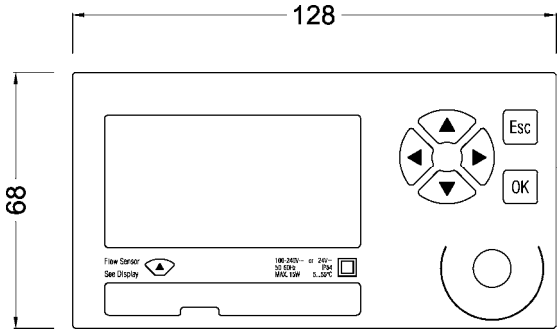


In supply module 100-240 VAC and output module 2 x relays 240 VAC, the terminals are protected against accidental contact by two lateral partition walls.

Dimensional drawing of display module

The dimensions in the diagram refer to the size of the section.

Dimensions of the module are:
W x H x D: 132 x 72 x 7.8 mm



20.3 Technical specifications

Standards	
CE Directives	2014/32/EU (MID) Measuring Instruments Directive 2014/30/EU (EMC) Electromagnetic compatibility 2014/35/EU (LVD) Low voltage directive
Standards	EN 1434, EN 61000-6-2, EN 61000-6-3, EN 60950
Approvals for custody transfer	
Heating	EC comformity assessment module B, DE-07-MI004-PTB029
Air-conditioning + combined	National german approval according to PTB K7.2, approval no, 22.75/08.01

Housing, modules	**With protective housing**	**Without protective housing**
Mounting	On support rail or wall	On support rail
Protective housing size W x H x D	140 x 202 x 83 mm	
Module housing size W x H x D		3 poles: 17.5 x 117.4 x 63.5 mm 3 poles: 240 V: 17.5 x 129.5 x 63.5 mm 4 poles: 22.5 x 117.4 x 63.5 mm
Type of ingress protection accord-	IP54	IP20

Housing, modules	With protective housing	Without protective housing
ing to EN60529		
Maximum number of modules	6 – 7, including 1 CPU and 1 supply module, max. 2 communications modules	16, including 1 CPU and 1 supply module, max. 2 communications modules

Environmental conditions	
Ambient temperature during operation	+ 5… +55 °C, EN 1434 class C
Storage temperature	0 °C … 60 °C
Humidity	Max. 95% rel. humidity, without producing condensation
Cable cross-sections	
Power supply	0.8 …2.5 mm^2
Pulses, frequency, analogue	0.35 …2.5 mm^2
Pt100	0.8 … 2.5 mm^2 (preferably large)

Power supply	Supply module 100-240VAC
Nominal voltage	100 … 240 VAC, 50 … 60 Hz
Operating voltage	86 … 265 VAC, 47 … 63 Hz
Current input	Max. 300 mA
Protection class	II
Isolat.-voltage primary/secondary	3000 VAC
additional approvals	UL 60950, EN 60950 (via CSA-NRTL/C)

CPU module 2*Pt100			
Accuracy of energy calculation	Energy error in % Ec <= 20 mK / ΔT (mK) Significantly below EN 1434-1: Ec <= 0.5% + (ΔT/ΔTmin)		
	ΔT [K]	Ec CALEC energy master	Ec EN 1434-1
	3	0.7%	1.5%
	6	0.3%	1%
	20	0.07%	0.65%
	100	0.02%	0.53%
Data backup in case of power failure	EEPROM > 10 years		
Backup battery (button cell)	Lithium 3 V, 48 mAh, Type CR1225, soldered		
Life of backup battery	Typically >10 years in normal operation (T < 45 °C) Typically > 6 years without mains supply		
Data logger	100 values of all meter readings with time stamp in the ring memory Logger interval: 15 min.., 30 min., 1 hr., 1 day, 15 days, 1 month		
Billing dates	2 billing dates, dates adjustable		
Optical interface	IrDA V1.0 with 57600 baud and M-Bus protocol, max. distance 70 m		
Measuring and calculating cycle	1 second		

Temperature measurement	**CPU-module 2*Pt100 and Input-module 2*Pt100**
Temperature range Temperature deviation	-50 … +550 °C according to MID/EN1434: 1 … 200 °C < ± 10 mK
Temperature differential range Deviation ΔT (Ta = 5 … 55°C)	0 … 550 K according to MID/EN1434: 3 … 198 K < ± 15 mK
Temperature sensor type	Pt 100 (IEC751, paired according to EN1434), 2-, 3- or 4-wire cable
Resolution ADC	24 Bit

Display module	
Dimensions W x H x D	132 x 72 x 7.8 mm
Dimension of cut-out W x H	128 x 68 mm
Display	Alphanumeric LCD, 128 x 64 pixel
Backlight	White, flashes red when fault occurs
Display	Title bar, 4 lines each of 21 characters, status line
Language	Settable: German, English, French, Italian
Keys	6 keys: 4 arrow keys for navigation, OK, Esc
Detachable display module	Max 100 m with Remote Display Adapters (RDA)
Optical interface (Display module)	IEC 870-5, 300, 2400 or 9600 baud, M-Bus protocol

Input-Module 2*Pulse/frequency/Analogue	
Number of inputs	2
Pulse input	Pulse input: 0.003 … 12.5 kHz Min. pulse width 40 µs Types settable according to EN 1434, see below
Frequency input	Frequency input 0 … 10 kHz (PFM) Measuring error: typ. < 0.1%
Analogue input	Measuring range 0 or 4 … 20 mA absolute measuring range 0 … 22 mA Accuracy 0.025% full scale, drift 15ppm / K Load 50 Ω Measuring transducer power supply 24V
Measuring transducer power supply	6, 8 or 24 VDC, settable, max. 25 mA, short-circuit proof
Error detection	Short circuit and interruption (settable)

Pulse input type according to EN 1434

	Max. pulse freq.	**Pulse length**	**Input resistance Ri**	**Meas. transducer power supply**
Class IB	5Hz	≥ 100 ms	100 kΩ	6 V
Class IC	200 Hz	≥ 2 ms	100 kΩ	6 V
Class ID	200 Hz	≥ 2 ms	1 kΩ	8 V
Class IE	12.5 kHz	≥ 0.04 ms	1 kΩ	8 V
PFM	12.5 kHz	≥ 0.04 ms	150 Ω	24 V

Switching level: low < 1.5 V, high > 2.1 V, 0.6 V Hysteresis

Output module 2*relays 24V, analogue	
Number of outputs	Two
Output type settable	Relay functions: Pulse / status / limit value / limit value 2 Analogue functions: 0 … 20 mA / 4 … 20 mA Test functions: Relay test / analogue test
Relay output (solid state relay)	Max. contact voltage: 24 VDC Max. current: 100 mA Frequency: max. 50 Hz at * * Pulse width: 10 ms, 50 ms, 250 ms, 1 s settable Duty cycle: 50% Normal state: Contact closed or open, settable Leak current: < 30 µA corresp. to > 800 kOhm at 24 VDC
Analogue output	Current range 0 … 20 mA or 4 … 20 mA Accuracy 0.1% full scale, drift 50 ppm / K Max. loadR = (Uext - 4V) / 22 mA
Galvanic isolation	50 V
Measuring transducer power supply	24 VDC, max. 25 mA, short-circuit proof

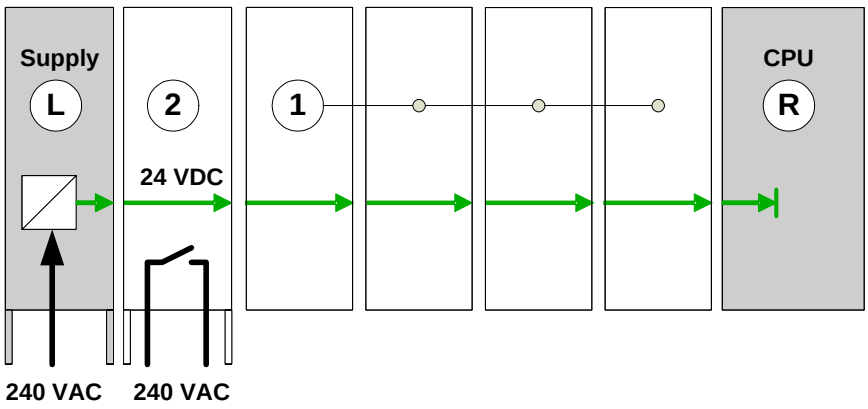
M-Bus module	**M-Bus interface EN1434-3, 2007**
Transmission rate	300, 2400, 9600 Baud
Current requirements	1.5 mA (1 M-Bus load)
Addressing	Point-to-point, primary address, secondary address One address per active calculator (max. 3)
Galvanic isolation	Max. 50 V

21 The module system

21.1 Arrangement and connection of the modules

Thanks to its modular design, the device is flexible and can be adapted to different requirements. The units are fitted in the factory with the modules that were ordered. Additional modules can be retrofitted in the field, or those not needed can be removed.

The diagram below shows the principle of the electrical connections and how the modules are arranged:



L: Left terminal module, power supply, electrical contacts right-hand side

R: Right terminal module, CPU, electrical contacts left-hand side

1: Input, output or communications modules, electrical contacts, both sides

2: Relay module 240 VAC, electrical contacts both sides

External power supply, e.g. 240 VAC

Internal power supply

The modules are electrically connected via lateral contacts for energy supply and signal exchange. The modules for the power supply (Supply and Connect modules) only have contacts on the right side, the CPU module only on the left, so they form the terminal modules of the internal connection. The display module can be fitted on the front.

21.2 Number of modules in the protective housing

The number of modules in the protective housing is restricted to:

- A maximum of 7 modules or
- Up to 6 modules, if at least one 2xPt100 input module is used.

22 The CALEC® master modules

22.1 The supply module 100-240 VAC

22.1.1 Safety instructions

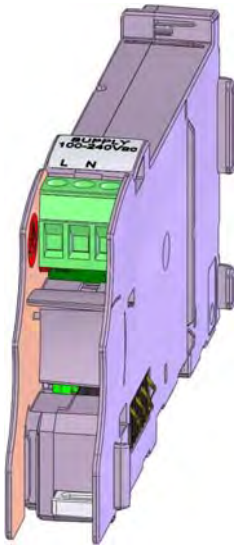
The terminals are protected against accidental contact by lateral partition walls. This also prevents the mixing up of terminals for mains and low voltage supplies.

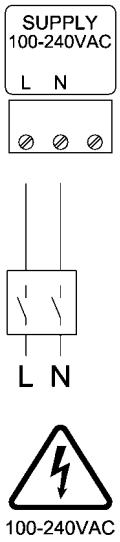
Caution: dangerous electric voltage!

Misuse can lead to physical injury!

The input cable must be protected with an external fuse F<10 AT.

22.1.2 Function and connections



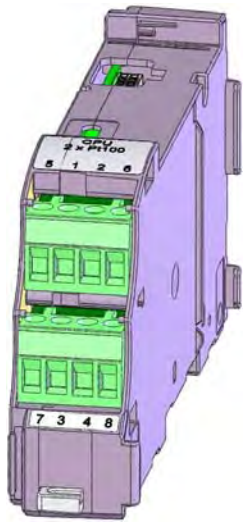


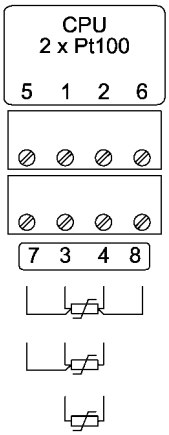
The supply module supplies the power for the device. Voltages of 100 … 240 VAC can be connected. It is always assembled as the left-side terminal module.

The supply voltage is connected to terminals L and N of the 3-pole plug-in screw-type terminal via a double-pole separator.

22.2 The CPU module 2 x Pt100

22.2.1 Function and connections





Signal and terminal assignments:

Upper terminals (5 - 1 - 2 - 6):
Pt100-input 1
Temperature hot side

Lower terminals (7 - 3 - 4 - 8):
Pt100-input 2
Temperature cold side

The CPU module with the central processor for the calculating, control and memory functions has the following features:

- Real-time clock with buffer battery for mains-independent time display
- IrDA-interface with M-Bus protocol for reading and parameter setting
- Two Pt100-inputs for temperature measurement with 2, 3 or 4-wire connections. EEPROM for secure data storage
- Communication with the modules via the internal bus. Automatic module recognition
- Communication with the display module
- Non-reactive plug-in connection for the display module. The display module can be fitted on the CPU module or mounted in split version with the remote display adapter set.

22.2.2 Settings

All device parameters are stored in the CPU module. Depending on the application and module assembly, this comprises the following settings:

- Application and calculator function for one to three calculators
- Units and resolution of the meter readings and current values
- Assignment of the input signals (assignment table, e.g. Q1 = Input 1, Th = Pt100 Input 1, Tc = Pt100 Input 2)
- Specification of the output variables for the output signals
- Setting of the input and output signals (e.g. pulse value, Pt100 hot side, Pt100 cold side)
- Other settings such as date, time, memory functions, output functions, interface parameters etc.

The procedure to be followed for commissioning or changing settings is described in the chapters on operation and commissioning.

22.2.3 Ordering a CPU module as spare

When ordering a CPU module as spare, please order the version that corresponds to the device concerned. The corresponding module can be distinguished by its desiganation as shown in the example below:

Device designation	CPU-Module designation
EM-101-Prot-AC[...I]C-T	Master Module CPU EM-101 2xPt100
EM-100-Prot-AC[...I]C-T	Master Module CPU EM-100 2xPt100

22.2.4 IrDA interface

The IrDA interface on the CPU module can be used for temporary communication with a PC, e.g. for reading the meter data or service operations. The IrDA interface can also be used with a mounted display enclosed in the protective housing.

22.2.5 Pt100 inputs

Platinum resistance temperature sensors with 2, 3 or preferably 4 wire systems can be connected to the Pt100 inputs. The temperature measurement is made via a 24 bit AD converter of high accuracy and measuring consistency. Only a short current pulse flows through the measuring resistors, which keeps the self-heating of the measuring resistor negligibly small.

Important! Paired Pt100 sensors according to EN1434 must be used for measuring the temperature difference.

The settings of the Pt100 inputs are effected via the submenu ***Basic setting/Pt100 input***:

Display	Settable?	Note
Pt100-Input 1	Yes	Select the Pt100-input with keys ◀ ▶
Mod-No. 1	No	Module No. is displayed. Module 1 = CPU module
T-No. 5 - 1 - 2 - 6	No	Terminal No. is displayed
Conn. 4-wire	Yes	Type of connection: 2-wire 3-wire 4-wire inactive (input without function)
Side T Hot side	No	Sensor installation side: hot side
T inst. 83.245 °C	No	Currently measured temperature of the hot side
T min -50.0 °C	No	min. temperature: -50.0 °C
T max 550.0 °C	No	max. temperature: 550.0 °C
T err 999.9 °C	Yes	Temperature in case of a fault: 999.9 °C (Standard value)

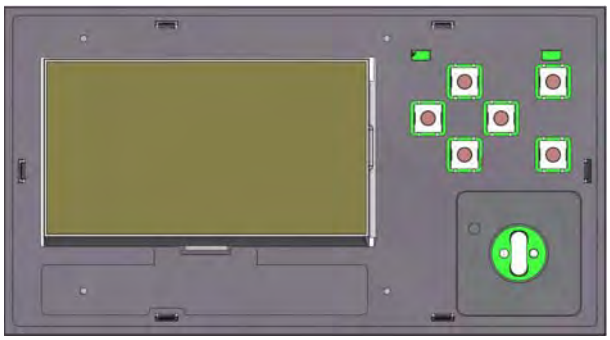
22.3 The display module

22.3.1 Function

The display module can be fitted on the CPU module or mounted separately with the RDA set, e.g. on a control panel. The display module consists of:

- A dot-matrix display (128 * 64 pixel) with a white backlight.
  In case of a device fault or alarm, the backlight flashes red.
- Six keys
- An optical M-Bus interface (interface 2, independent of other M-Bus interfaces)
- A connector for communicating with the CPU module.

For devices with protective housings (Prot), the protective foil is fitted on the cover, not on the display module.



For the version without protective housing (Mod), the display module is delivered with protective foil

22.3.2 Settings

Setting	Submenu
Language of the display text	***Basic setting / system / interface 2 / language***
Baud rate of the optical M-Bus interface	***Operating setting / interface / interface 2 / Bd***
Contrast of the display	***Basic setting / system / interface 2 / contr.***
Segment test	***Main display***

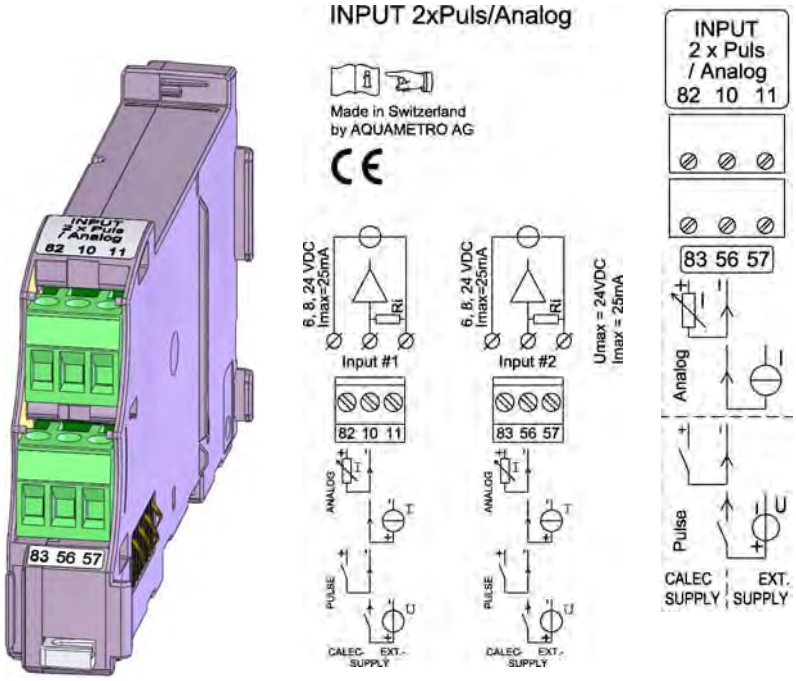
22.3.3 Contents of the main display

The values shown in the main display may vary, depending on the device version or device function. In devices with conformity assessment, this list must not be changed.

With non-EC conformity tested devices, the displayed values of the main display can be changed using the AMBUS Win II software

22.4 The input module 2x pulse/analogue

22.4.1 Function and connections



Signal and terminal assignments

Upper terminal row

Active transmitter:	10 - 11
Passive transmitter:	82 -10

Lower terminal row:

Active transmitter:	56 - 57
Passive transmitter:	83 - 56

The input signals are numbered
- from right to left
- from top to bottom

The module has two universal inputs e.g. for flow, temperature or pressure sensors with the following output signals:

- Pulse transmitters of different types, incl. classes IB, IC, ID, IE according to EN 1434
- Frequency signals 0 … 10 kHz
- Analogue current signals 0 or 4 – 20 mA

Each of the two input signals is connected via a 3-pole plug-in terminal.
Active and passive transmitters must be connected differently:

Active transmitters are transmitters with their own power supply

Passive transmitters are transmitters that are powered by the module

The integrated output power supply is short-circuit-proof and can be loaded with 25mA per output. The module recognises an overload of the power supply.

The inputs are not galvanically isolated, i.e. they possess a common ground for active transmitters. Observe polarity! Do not connect negative voltages!

22.4.2 Settings

The parameters of the inputs can only be set in programming mode.
In EC conformity assessed devices, changes will invalidate the calibration!

The settings for input signals in the basic setting / input submenu differ, depending on type of signal. The values can be divided into three groups:

	Main parameters
Input 1	Select the input with the ◀ ▶ keys
Mod-No 2	Display of the module number
T-No. 82-10-11	Display of the terminal numbers
Signal ID Namur 200Hz	Input signal type, see table above
Funct. Impulse	Only for digital signals: Status, pulse or frequency
MeaVar Volume	Information on the measured variable
…	Function-dependent parameters; description depends on the corresponding signal type

	Parameters that can only be changed with signal type = Special
Filter Off	Input filter (against contact bouncing)
SC-int On	Short-circuit / interrupt detection
U aux 6VDC	Voltage of the auxiliary supply
Z Inp. 100k Ohm	Input impedance

	Identification details of the input module
Lot- no. 96370508	Production batch number
HW_No. 1804169	Hardware version number
FWV V 01.00.03	Firmware version number

22.4.3 Signal types

The table below shows the signal types and their use:

Group	**Signal type**	**Application**	**Comment**
	Inactive	Input without function	
Analogue signals	Current 0 – 20mA	analogue current signal	Current value, e.g. for flow rate, pressure
	Current 4 – 20mA	analogue current signal	Temperature etc.
Digital signals	IB pulse 5Hz	slow pulse transmitter	Potential free contacts, reed transmitters
	IC pulse 200Hz	fast pulse transmitter	Open collector, optocoupler
	ID Namur 200Hz	NAMUR pulse transmitter	
	IE pulse 10kHz	very fast pulse transmitters or frequency transmitters	
	PFM 10kHz		For transmitters with pulse-frequency-modulation
	Special	For simulation, setting of fixed values and special electrical characteristics	Changes in the electrical properties of the input. Other signal types have fixed configurations

22.4.4 Digital signal types

Most signal transmitters can be used with the signal types IB… IE and PFM:

Transmitter types	IB	IC	ID (Namur)	IE	PFM
Potential free contact, Reed	possible		+		
Open collector up to 200 Hz			+	+	
Open collector up to 10 kHz					
NAMUR up to 200 Hz			+		
NAMUR up to 10 kHz				+	
Kamstrup 'slow'	+				
PFM					+

For the above-cited signal types, the input signals must meet the following requirements:

Pulse input characteristic	IB	IC	ID (Namur)	IE	PFM
Supply voltage	6 V	6 V	8 V	8 V	24V
Input resistance	100 kOhm	100 kOhm	1 kOhm	1 kOhm	150 Ohm
Low/high level	1.5 / 2.1 V	1.5 / 2.1 V	1.5 / 2.1 mA	1.5 / 2.1 mA	9 / 14mA
Pulse length (typical)	≥ 100 ms	≥ 2 ms	≥ 2 ms	≥ 0.04 ms	≥ 0.04 ms
Min. pulse frequency	0.003 Hz	0.003 Hz	0.003 Hz	0.003 Hz	0.003 Hz
Max. pulse frequency	5 Hz	200 Hz	200 Hz	12.5 kHz	12.5 kHz
Transmitter classes (EN1434)	OC (OA)	OC, OD	OA, OB	OB	PFM

22.4.5 Functions for digital input signals

The following functions can be selected for the signals in the digital group (see table above). Other functions are also available under the Special setting option.

Function	Application	Comment
Status	Status signal	e.g. flow direction signal, tariff switching etc.
Pulse	Pulse signal	e.g. volume pulses
Frequency	Frequency signal	e.g. flow-rate proportional frequency signals (not possible with signal “IB Imp.” 5Hz)

Digital signal ‘status’ function

The status function evaluates the status of a digital signal. This allows evaluating the direction signal of a flow sensor (flow reversal), for example, or the switching of a tariff.

Input 2		
…		
Signal	IB Imp. 5Hz	Signal type: Class IB pulse 5Hz acc. to EN 1434
Funct.	Status	Set to status input
MeaVar.	Norm.closed	Effect: Norm closed: Contact closed, if status ‘on’ Norm open: Contact opened, if status ‘on’
Status	Open	Status at input: In the example, the contact is open, so status ‘off’
…		

Select an input with the ◀ ▶ keys

Digital signal ‘pulse’ function

The pulse function allows metering via a pulse signal

Input 1		
…		Select the input with the ◀ ▶ keys
Signal ID Namur 200Hz	Signal type	e.g. Class ID Namur 200Hz acc. to EN 1434
Funct. Pulse	Pulse function	metering using pulse signals as input
MeaVar Volume	Physical quantity	Energy, volume, mass, HCA
Side Q Q Cold side	Sensor installation side	Hot side / cold side: for energy measurement Not relevant: for flow measurement
Status 0.000 Hz	Status at input	Frequency measured at input
ImpVal 1.00000 L	Pulse value	Input range: 0.00001 to 999999 Units (see below)
…		

Digital signal ‘frequency’ function

The frequency function allows the evaluation of a frequency signal, e.g. from a flow sensor.

Input 1	Note	Select the input with the ◀ ▶ keys
…		
Signal IE Imp**.** 10kHz	Signal type	Signal type: IE up to 10 kHz. The function is not available with signal type IB Imp. 5Hz
Function Frequency		Frequency measurement
MeaVar Volume-flow	Measured variable	Available measured variables: power, volume flow, mass flow, frequency, temperature, pressure, density
Side Q Cold side	Sensor install. side	Settable as: not relevant, hot side, cold side
Status 0.000 Hz	Status at input	Frequency measured at input
V fmin 0.00 m3/h	Value at f min	Value of the measured variable at f min
V fmax 1000 m3/h	Value at f max	Value of the measured variable at f max
f min 0.000 Hz		Lower limit of the frequency measuring range
f max 10000.0 Hz		Upper limit of the frequency measuring range
Lco Q 0.00 %	Low cut-off value	0.00 – 20.00 % of maximum flow value
Q Err 0.00 m3/h	Display in case of error	This value is displayed in case of an input error, and used for the calculation.
…		
LinFct None		Parameter/function not yet implemented

The units of the measured variable correspond to those of the current value in the submenu ***Basic settings / units***.

22.4.6 Units of the pulse function

The unit of the output pulse value depends on the unit of the corresponding meter. If, for instance, an energy meter reading in kWh is connected with a pulse output signal, the unit of the pulse value is Wh/pulse. The table shows the relationships:

Meter	Unit	Input signal	Unit	Note
Energy	kWh, MWh MJ, GJ kcal kBtu, MBtu therm	Energy pulse	Wh, kWh kJ, MJ kcal P/Btu therm	 Pulses per Btu
Volume	L, m^3 ft^3 USgal UKgal	Volume pulse	L, m^3 ft^3 P/USgal P/UKgal	 Pulses per US gallon Pulses per UK gallon
Mass	kg, t ton	Mass pulse	g, kg ton	

22.4.7 Analogue signal types

With this setting, analogue signals 0 – 20 mA or 4 - 20 mA can be processed. The table shows the display for the signal type Current 0-20 mA:

Input 1		
… Signal Current 0 – 20mA*	Signal type	Input signal 0 – 20mA
MeaVar Vol. flow	Measured variable	Available measured variables: Power, volume flow, mass flow, frequency, temperature, pressure, density
Side Cold side	Sensor installation side	Settable as: not relevant, hot side, cold side
Status 0.000 mA	Status at input	Measured current at input
0 mA 0.00 m3/h **	Value at 0 mA	Input range 0.00 to 999999
20 mA 1000 m3/h	Value at 20 mA	Units (see below)
Lco Q 0.00 %	Low cut-off value	0.00 – 20.00 % of maximum flow value
LinFct None		Parameter/function not yet implemented
Q Err 0.00 m3/h …	Display in case of error	This value is displayed in case of an input error, and used for the calculation.

Note	Select the input with the ◀ ▶ keys

*: For the 4-20 mA signal type, the display shows: Signal current 4 – 20 mA.

**: For the 4-20 mA signal type, the display shows: 4 mA 0.00 m^3/h.

The units of the measured variables correspond to the units of the current values in the ***Basic settings / units*** submenu. These can only be set in programming mode.

22.4.8 ‘Special’ signal type

The signal type ‘Special’ allows:

- inputting constant, virtual input variables, e.g. a reference temperature
- adapting the electrical characteristics of the input switch for special signals

The table shows the settable parameters:

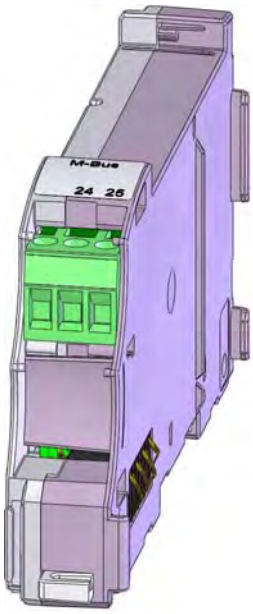
Input 2		
…		
Signal Special		Signal type: Special
Funct. Impulse		Settings: Status, Impulse, frequency, 0 – 20mA, 4 – 20mA, Status virtual, analogue virtual
MeaVar Temperature	Measured variable	e.g. temperature (selectable)
Side Q Cold side	Sensor install.side	Settings: not relevant, hot side, cold side
Status 0.000 Hz	Status at input	measured frequency at input
Filter Off		Input filter (against contact bouncing)
SC-int Off		Short-circuit / interrupt detection
U aux 24VDC		Voltage level of the auxiliary supply
Z Inp. 100k Ohm		Input impedance
Lco Q 0.00 %	Low cut-off value	0.00 – 20.00 % of maximum flow value
Q Err 0.00 m3/h	Display value in case of error	This value is displayed in case of an input error, and used for the calculation.
…		

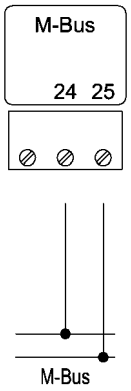
	Select the input with the ◀ ▶ keys

22.5 The M-Bus module

22.5.1 Function and connections

The M-Bus module can communicate as an M-Bus slave with an M-Bus master via an M-Bus network according to EN 1434-3 (Single Master Bus). Up to two M-Bus modules can be operated per device. The M-Bus interface can be used for remote reading of the data or for setting the device parameters.





Connections interchangeable

The M-Bus is connected to terminals 24 and 25 of the 3-pin plug-in terminal, the connections being interchangeable. The M-Bus interface is galvanically isolated from the device.

22.5.2 M-Bus addressing

The M-Bus addresses (M-Bus module and the infrared interface according to EN60870-5) can be set in service mode 🔓:

M-Bus primary and secondary address under ***Operating setting / M-Bus addressing:***

	Input	Parameter
M-Bus addressing 1		If single addressing select calculator with ◀ ▶
Pri 2	◀ ▶ ▼ OK	Enter primary address, 0 to 255
Sec 1534	◀ ▶ ▲ OK	Enter secondary address with max. 8 digits (000 0000 to 9999 9999). On delivery, the secondary address corresponds to the serial number.

22.5.3 Other settings

For each M-Bus module, service mode can be used to set the M-Bus interface parameters in the menu ***Operating settings / interface***:

	Settable?	Parameter
Interface 4	Yes	Select interface 4 and 5 with the ◀ ▶ keys
Mod-No. 3	No	Module number, displayed automatically
T-No. 24-25	No	Terminal numbers, displayed automatically
Type M-Bus module	Yes	Interface type = M-Bus module; Other interface types: Interface 1: internal bus Interface 2: IR EN6870-5 Interface 3: IrDA Interface 4 / 5: No module if not assembled
Bd 2400 Bps	Yes	Baud rates: 300, 2400 or 9600 Bps
Access 123	No	Number of communication accesses to the interface
Lot-No. 1234	No	Production batch number of the module
HW_No. 120045	No	Hardware version number of the module
FWV V 01.00.02	No	Firmware version number of the module

Konformitätserklärung
Declaration of conformity
Déclaration de conformité
Dichiarazione di conformità

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erklärt, dass das Produkt declares that the product déclare que le produit dichiara che i prodotti	**Energie-Rechenwerk** **Energy calculator** **Calculateur d'énergie** **Calcolatore d'energia**	**CALEC® energy master**

mit den Vorschriften folgender Richtlinien übereinstimmt :
conforms with the regulations of the following European Council Directives :
est conforme aux prescriptions et directives Européennes suivantes :
è conforme alle seguenti prescrizioni e direttive Europee :

CE-Konformität

Richtlinie **Directive** **Directive** **Direttiva** CE	**Beurteilungsverfahren** **Method of assessment** **Méthode d'évaluation** **Metodo di valutazione**	**Benannte Stelle** **Notified body** **Organisme notifié** **Organizzazione notificata**	
LVD 2014/35/EU Niederspannungsrichtlinie Low voltage directive Directive sur la tension basse Direttiva bassa tensione	Report: **08-EL-0061**	Electrosuisse Luppmenstr.1 CH – 8320 Fehraltdorf	
EMC 2014/30/EU EMV Richtlinie EMC directive Directive CEM Direttiva CEM	Report: **15298**	Montena EMC SA CH – 9403 Goldbach	
MID 2014/32/EU Messgeräterichtlinie Measurement Instruments Directive Directive sur les instruments de métrologie Strumenti di misura direttiva	Modul B: **DE-07-MI004-PTB029** PTB, Berlin	Modul D: METAS-Cert 1259 Lindenweg 50 CH-3003 Bern-Wabern	Modul F: N/A

Weitere Konformitäten

Richtlinie **Directive** **Directive** **Direttiva**	**Beurteilungsverfahren** **Method of assessment** **Méthode d'évaluation** **Metodo di valutazione**	**Benannte Stelle** **Notified body** **Organisme notifié** **Organizzazione notificata**
Mess- und Eichverordnung – MessEV vom 11.12.2014	Modul B: Bauartzulassung K7.2 **22.75/08.01** PTB Berlin	Modul D: Physikalisch-Technische Bundesanstalt (0102) Bundesallee 100 D - 38116 Braunschweig

Therwil, 07.04.2017

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Management des produits
Management del prodotto

24 Appendix

24.1 Terms, abbreviations, formula symbols

24.1.1 Terms

Term	Meaning
Installation side	Density and specific heat capaicity are functions of temperature. It is therefore of significance for the calculation which temperature measuring value is used. The installation side (hot or cold side) determines this.
Paired temperature sensors	Two temperature sensors are selected during production in such a way that the measuring errors in the temperature difference measurement are below the stipulated limiting values.
Combined cooling/heating meter	Energy meter which, in the heating operation (T supply > T return) or in the cooling operation (T return > T supply) cumulates the energy in separate meters. See also 'BDE'.
Combined heat meter	Heat meter comprising separate components: flow sensor, pair of temperature sensors and calculator. The components can be separately replaced, altered and recalibrated.
Conformity assessment	Legally binding declaration of metrological EC conformity Corresponds to devices with domestic pattern/type approval of the initial calibration
Current value	Momentary value of, e.g. temperature, flow rate
Supply / return flow	Part of a hydraulic circuit in which the medium flows into/out of a heat exchanger. In heating or cooling circuits, the flow sensor should always be installed in the return pipe, since effects resulting from temperature and condensation are less there, both in heating and cooling systems.
Meter reading	Energy, volume or mass, resulting from totalising a current value. As a rule, a meter reading does not get smaller

24.1.2 Abbreviations

Abbreviation	Meaning
BDE	Bi-directional energy measurement: If Ts > Tr , then meter E is incremented If Tr > Ts , then meter E- is incremented
BDV	Bi-directional volume measurement, energy calculation for reverse flow: for forward flow, meter E is incremented, for reverse flow, meter E-
CALEC® EM	CALEC® energy master
fm	Flow sensor, measures the flow and supplies a flow signal
Limit	Limiting value
IR	Infrared
IrDA	Infrared interface according to the Standard of the Infrared Data Association (IrDA)
Class IA…IE	Classification of pulse inputs according to EN 1434
Class OA…OE	Classification of pulse transmitters according to EN 1434
SC det	Short-circuit/interrupt detection; when activated, short-circuiting and power cuts are detected and displayed as errors
Mod	Device version without protective housing ("Mod"ule)
Prot	Device version with protective housing ("Prot"ected)
Pt100	Platinum resistance temperature sensors according to DIN IEC 60751, R = 100 Ohm at 0°C
PFM	Pulse-frequency modulation or pulse/frequency modulated signal A measured value is transmitted as frequency from 0 – 10 kHz
RDA	Remote Display Adapter, 2 adapters for operation of the detached display module
calc 1 … 3	Calculator 1 to 3

Abbreviation	Meaning
Lco T	Cut-off at small temperature difference. Can be activated to suppress energy measurement during irregular system statuses (e.g. gravitational circulation when pump is switched off)
Lco Q	Low flow cut-off
STA	Status signal pulse input
TWIN-E	Measurement in open systems with 2 flow sensors. Used where heat transfer medium between forward and return pipe is removed from the system
TWIN-V	Flow measurement with 2 parallel fitted flow sensors, e.g. for summer / winter operation

24.1.3 Symbols

Symbol	Meaning
E, E-	Thermal energy of heat transfer, meter reading E-: computed as negative energy (Th < Tc and Qv > 0 or Th>Tc and Qv < 0)
E 1 … E 8	Energy, meters 1 to 8
F	Frequency
Hc	Enthalpy cold side
Hh	Enthalpy hot side
HCA	Units for heating cost meter (Heat Cost Allocator)
K-F	K – factor (heat coefficient)
M, M-	Mass with flow direction indicator, meter reading
p	Pressure
P	Power
Qm	Mass flow rate, mass flow
Qv	Volume flow rate, volume flow
R 1… R 4	Tariff register 1 to 4
Rho	Density
STA	Status signal, pulse input
t	Time / metric ton
T, Tc, Th	Temperature, Tc: Temperature cold side, Th: Temperature hot side
dT	Temperature difference
Ts, Tr	Supply temperature, return temperature
V, V-	Volume with flow direction indicator, meter reading