CAN-EZ3
CAN ENERGY METER

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Safety requirements

All installation and wiring work on the controller must only be carried out in a zero volt state. The opening, connection and commissioning of the device may only be carried out by competent personnel. While doing so, they must observe all local safety requirements.

This device is state of the art and meets all necessary safety regulations. It may only be used in accordance with the technical data and the safety requirements and regulations listed below. When using the device, also observe the statutory and safety regulations apposite to the particular use. Any other use will automatically void all warranty rights.

- The device must only be installed in a dry interior room.
- In accordance with local regulations, it must be possible to isolate the 230 V cable to the energy meter from the mains using an omnipolar isolating facility (connector/socket or 2-pole isolator).
- Never interchange the safety low voltage connections (e.g. sensor connections) with the 230 V connections. Destruction and life threatening voltages at the device and the connected sensors may occur.
- Safe operation is no longer possible if the controller or connected equipment exhibits visual damage, no longer functions or has been stored for lengthy periods in unsuitable conditions. If this is the case, disable the controller and equipment and secure against unintentional use.
- Heat-sensitive system components (e.g. plastic pipes) must be equipped with safety devices (e.g. thermal high limit safety cut-out for underfloor heating), which prevent overheating in the event of a fault in the controller or another system component.

Maintenance

If treated and used correctly, the device will not require any maintenance. Use a cloth moistened with mild alcohol (such as methylated spirits) to clean. Never use corrosive cleaning agents or solvents such as chloroethylene or trichloroethylene.

No components relevant to long term accuracy are subject to loading if the device is used correctly. Consequently long term drift is extremely low. The device therefore cannot be calibrated. Thus applying any compensation is impossible.

The design characteristics of the device must not be changed during repairs. Spare parts must correspond to the original spare parts and must be used in accordance with the build version.

Disposal
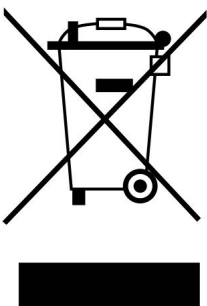
- Devices no longer in use or beyond a state of repair must be disposed of in an environmentally responsible manner by an authorised collection point. They must never be treated as ordinary household waste.
- We can undertake the environmentally responsible disposal of devices sold by the Technischen Alternative company upon request.
- Packaging material must be disposed of in an environmentally responsible manner.
- Incorrect disposal may result in considerable damage to the environment, as many of the materials used require professional handling.

Function description

The main purpose of the **CAN-EZ3** energy meter is energy management in conjunction with several **EHS(-R)** electric immersion heaters and other actuators, as well as metering energy and heat.

Energy management primarily includes current measurement in the building and the corresponding control of immersion heaters (and other consumers) for the use of surplus energy yields in the form of DHW storage, instead of exporting it to the mains, which can be less profitable.

As the CAN-EZ3 has the full functionality of the x2 series and multiple sensor inputs, other tasks such as heat and energy metering are also possible. However, only specific functions are used for the actual purpose of the energy meter and these are described in these instructions.

For tasks such as heat metering, 4 analogue inputs for temperature sensors, 2 inputs for VSG flow rate transducers or FTS flow sensors and a DL bus interface for DL sensors are available.

The CAN-EZ3 is programmed either with **TAPPS2**, directly via the display and buttons on the energy meter or remotely via the UVR16x2 controller, the CAN-MTx2 CAN monitor or the C.M.I.

Input values, system values from electrical measuring and results of the metering and functions can be relayed to other devices via the CAN bus.

The same applies to values from inputs that are not used for any metering (e.g. in the case of a CAN I/O module).

The CAN-EZ3 has **no** outputs.

The CAN-EZ3 is not calibrated and consequently may not be used for billing purposes.

Installation and connection

The CAN-EZ3 is installed in a meter box in accordance with local regulations. It can be snapped on to a top-hat rail (DIN support rail TS35 to EN 50022).

The 2-pole connectors of the current transformers are connected to the CAN-EZ3 and folded over the cores. When doing this, pay attention to the correct assignment (I1 - I3) in accordance with the voltage connections and a positive phase sequence.

Caution! The surfaces of the current transformer ferrite cores must be completely clean. Even tiny dust particles or greasy films can severely affect the measuring result. These surfaces must therefore be cleaned with a clean, lint-free cloth or clean fingers before closing.

For voltage measuring, the required wires are connected to the voltage terminals in the CAN-EZ3.

The connection of sensors, and CAN and DL buses is carried out using the supplied connectors

Power supply

The CAN-EZ3 is supplied with power via the voltage measuring connection **U1** (first phase).

Time stamp

The CAN-EZ3 has a real time clock and, as node 1 in the CAN bus network, can therefore transmit the time and date to other devices.

General connection of the CAN-EZ3

The CAN-EZ3 must always be connected by qualified personnel, taking into account the conditions on site and local safety regulations. The safety requirements on page 5 must also be observed.

The following diagram is only an example of the installation of a CAN-EZ3 in a typical TN-S system with surplus power supply.

NZHS	Normal supply main switches
HAS	Grid connection fuses
ENS	Device for grid monitoring with associated switching element
FI	Residual current device
MCB	Miniature circuit breaker
Wh	Electricity meter of the energy supplier
	Device is internally fused; only the supply cable to the device must be fused
	Appropriate fuse protection by the MCB (A) should be selected according to the cable diameter.

Sensor, DL bus and CAN bus connections

AN1 - AN4	Sensor inputs **1-4** Parameterisation in the **Inputs** (1-4) menu Connection of sensors between AN1/2/3/4 and sensor earth ⊥

VT1 & VT2	Special connection for **FTS** flow sensors (excl. DL) and other DL sensors
	 Parameterisation: **Inputs** menu
	     Inputs **5-6** for temperature (sensor PT1000)
	     Inputs **7-8** for flow rate and selection of the sensor (DN) **or** digital signals (S0)
	
	 Connection between each sensor Sx and earth GND.
	 The earth connection (GND) is looped.

CAN bus (C-L, C-H +12 V, GND)	CAN-Low, CAN-High, +12 V, earth The principles of bus cabling are described extensively in the manuals for the freely programmable controllers and must be observed.
Modbus	Interface for Modbus RTU485 (as master or slave)
DL bus	DL bus interface for DL sensors (e.g. FTS-DL (with intermediate board)) Parameterisation: **DL bus** menu (any **analogue** input) Connection between DL and GND ⊥
Ext. connection Antenna	No screws should be used to secure the antenna cable – press and pull to connect and terminate. The antenna itself is intended for mounting outside the meter box. The antenna should not be fitted directly on metal (e.g. meter box).
S0 output	The connection for S0 signals is located on the device's lower terminal strip (graphic on page 11). This output can emit pulses with **max. 20 Hz** and a pulse duration of at least **25 ms**. Either power drawn from grid or power exported to grid is issued; adjustable in the standard settings.

Sensor connection FTS... to VT1 or VT2

A flow rate sensor can be connected directly to the CAN-EZ3 without an intermediate board. For this, a ribbon cable, which is available separately, is adjusted to the required length on site. This is done by pressing the 2nd plug onto the cable according to the following drawing.
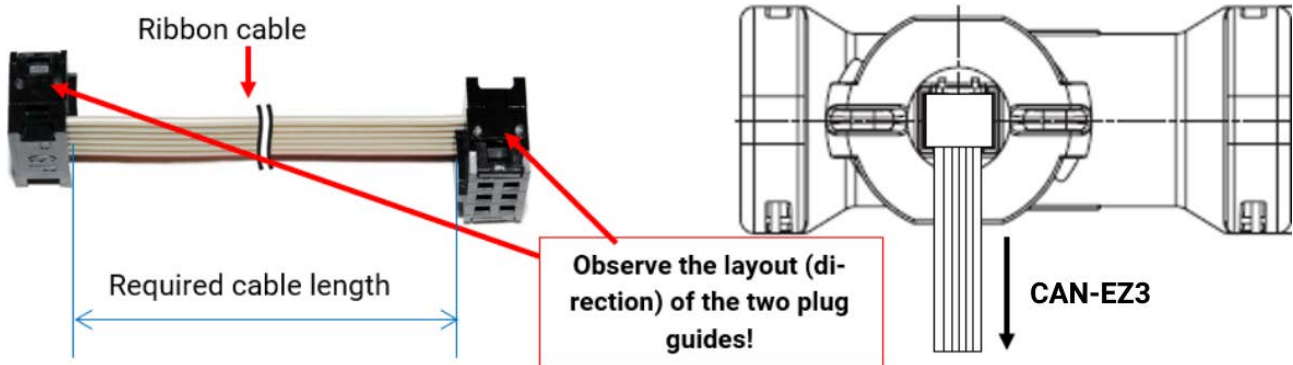
Electrical measuring
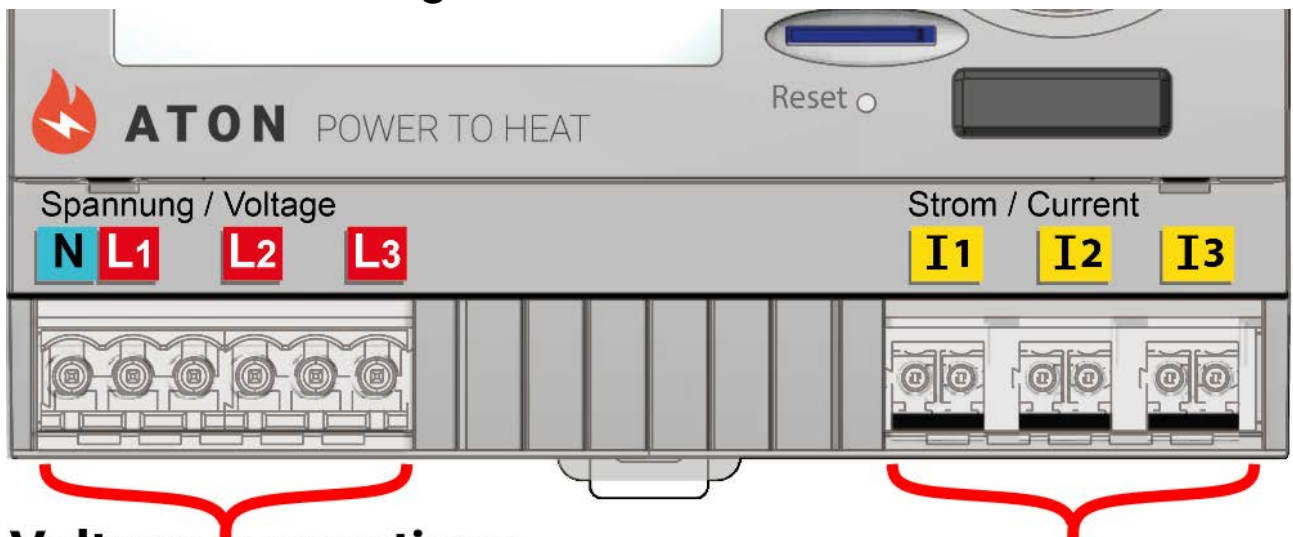
3-phase measuring

All 3 phase conductors (**L1 - L3**) are connected to voltage terminals **L1-L3** and the neutral conductor to the **N** terminal. The 3 external hinged current transformers are connected to terminals **I1 − I3** in the correct sequence and folded over the wires to be measured.

For **single** measurements, it is possible to set the **"Phase simulation"** parameter in the **General settings** to "**Yes**". In this case, the values (voltage / cos phi / output) for **L2** and **L3** are simulated internally using **L1**. Phase simulation is based on a clockwise rotating field, therefore a clockwise rotating field must also be observed for current measurement at **I2** and **I3**.

This results in **less precise** measuring. When phase simulation is activated, phases L2 and L3 are output as 0. When phase simulation is deactivated, the high-resistance voltage input may result in random values being displayed at **L2** and **L3** due to interference effects. This can be eliminated by additionally routing the neutral conductor **N** to voltage inputs **L2** and **L3**.

1-phase measuring

Only the phase conductor (to voltage terminal L1) and the neutral conductor N are connected. An external hinged current transformer is connected to terminal **I1** and folded over the wire to be measured.

The **"Phase simulation"** parameter is irrelevant for this.

External hinged current transformers

Ensure that the current transformers are assigned correctly (**I1** to **L1**, **I2** to **L2** and **I3** to **L3**) and that the energy direction is observed.

PLEASE NOTE: Before snapping the current transformer onto the phase conductors, they must already be connected to the CAN-EZ3. Otherwise the current transformers can be damaged.

Each external current transformer is labelled with "**K** —–> **L**", whereby the **energy direction must be from K to L** for positive metering.

The poles of the cable connecting the electricity sensor and the energy meter must not be swapped. The white cable must be on the left and the black cable on the right.
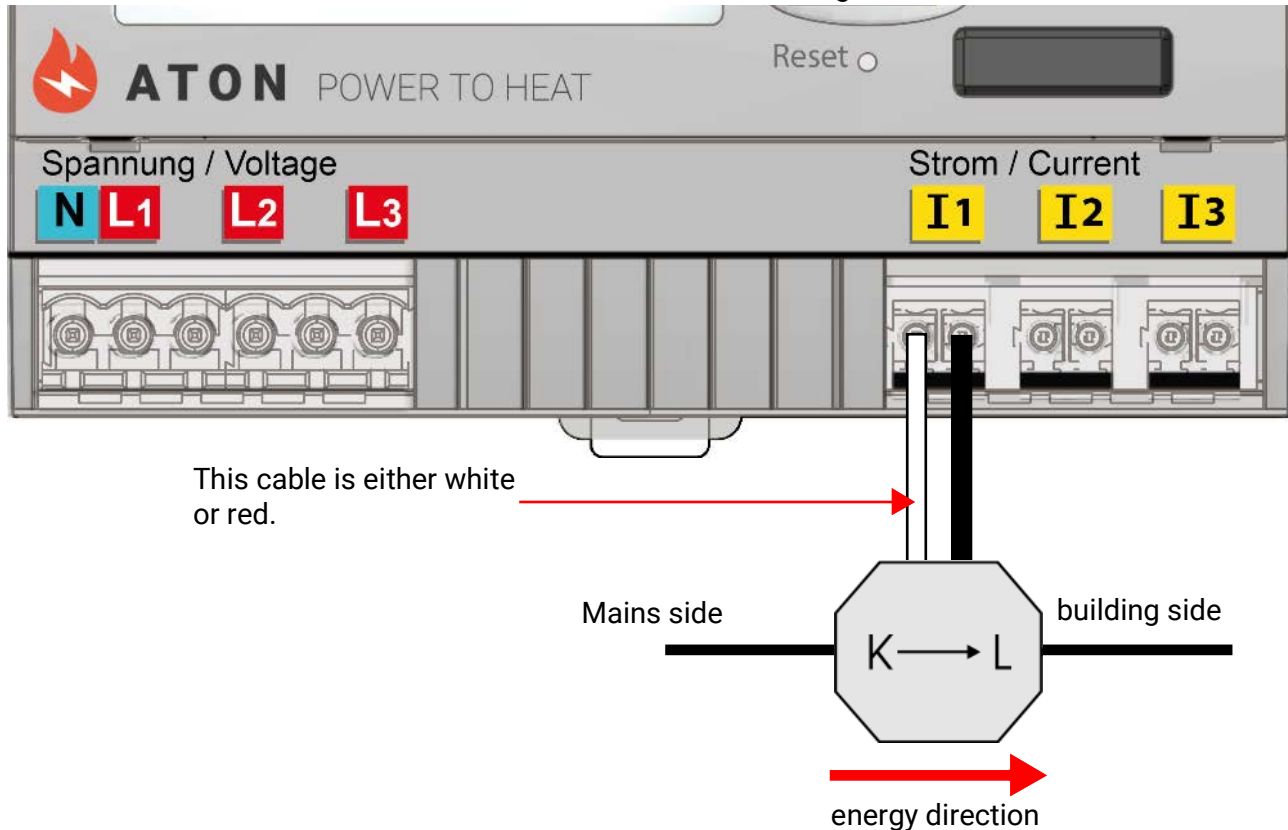
Each current transformer must be closed carefully by clicking the snap fastener securely into place. If the energy direction is changed, the energy meter counts in the negative.

Sensor installation

Correct arrangement and installation of the sensors is extremely important for correct functioning of the system. To this end, also ensure that they are completely inserted in their sensor wells. The cable fittings provided serve as strain relief. When used outdoors, no water must be allowed to penetrate the sensor wells (risk of frost). The contact sensors must be insulated well to protect them from being influenced by the ambient temperature.

Fundamentally, sensors should not be exposed to moisture (such as condensation) since this can diffuse through the cast resin and damage the sensor. If this happens, heating the sensor to 90 °C for an hour may help. When using sensor wells in stainless steel cylinders or swimming pools, particular attention must be given to their corrosion resistance.

· **Collector sensor (grey lead with junction box):** Either insert into a pipe which is brazed or riveted directly to the absorber and protrudes from the collector housing, or insert a tee into the flow manifold of the outermost collector into which the sensor well, together with the brass cable fitting (= protection against moisture), can be inserted; then insert the sensor. To protect against lightning damage, the junction box has a surge protection (voltage dependent resistor) which is clamped in parallel between the sensor and the extension cable.

· **Boiler sensor (boiler flow):** This sensor is either inserted into a sensor well in the boiler or fitted to the flow line as close to the boiler as possible.

· **DHW cylinder sensor:** The sensor required for the solar thermal system should be used with a sensor well for finned tube heat exchangers just above the exchanger or, if integrated smooth tube heat exchangers are used, in the lower third of the exchanger or the exchanger's return outlet so that the sensor well protrudes into the heat exchanger tube. The sensor monitoring the heating of the DHW cylinder by the boiler is installed at a level corresponding to the amount of domestic hot water required during the heating season. The supplied cable fitting acts as strain relief. Installation below the associated coil or heat exchanger is not permissible under any circumstances.

· **Buffer sensor:** The sensor required for the solar thermal system is fitted in the lower section of the cylinder just above the solar indirect coil using the sensor well supplied. The supplied cable fitting acts as strain relief. As the reference sensor for the heating system hydraulics, it is recommended to insert the sensor into the sensor well between the centre and upper third of the buffer cylinder, or positioned against the cylinder wall underneath the insulation.

· **Pool sensor (swimming pool):** Fit a tee into the suction line immediately on the pool outlet and insert the sensor with a sensor well. In the process, ensure the material used is corrosion-resistant. A further option would be to fit the sensor as a contact sensor with appropriate thermal insulation against ambient influences.

· **Contact sensor:** Use scroll springs, pipe clips, etc.to attach the contact sensor to the respective line. Ensure the material used is suitable (corrosion, temperature resistance, etc.). Then insulate the sensor thoroughly so that the pipe temperature is captured accurately and ambient temperatures cannot falsify the result.

· **DHW sensor:** A rapid reaction to changes in the water volume is extremely important when using the controller in systems that generate domestic hot water by means of an external heat exchanger and variable speed pump (freshwater module). Therefore fit the DHW sensor directly on the heat exchanger outlet. This ultra-quick sensor (special accessory, type MSP ...) should protrude into the output with the aid of a tee sealed in with an O-ring. The heat exchanger should be installed upright with the DHW outlet at the top.

· **Radiation sensor:** The parallel collector orientation is important in order to obtain a measurement that corresponds to the collector position. Consequently it should be secured to the sheet steel covering or adjacent to the collector on an extension of the mounting rail. To this end, the sensor casing has a blind hole that can be opened at any time. The sensor is also available as a wireless version.

- **Room sensor:** This sensor is intended for installation in the living space (reference room). Do not install the room sensor near a heat source or window. By simply replugging a jumper inside the sensor, each room sensor can also be used exclusively as a remote adjuster (no room temperature influence). It is only suitable for operation in dry rooms. The sensor is also available as a wireless version.
- **Outside temperature sensor:** This sensor is installed on the coldest wall (usually facing north) some two meters above the ground. Avoid temperature influences from nearby air shafts, open windows, cable ways, etc. It must not be subjected to direct insolation.

Sensorleitungen

All sensor leads with a cross-section of 0.5 mm2 can be extended to up to 50 metres. With this lead length and a PT1000 temperature sensor, the measuring error is approximately +1 K. A correspondingly larger cross-section is required for longer leads or a lesser measuring error. In order to prevent measurement fluctuations and ensure perfect signal transmission, sensor leads must not be subjected to external negative influences. When using non-screened cables, route sensor leads and 230 V cables either in separate cable conduits or with a minimum clearance of 5 cm. If screened cables are used, the screen must be connected to the sensor earth.

Data link for DL bus

The DL bus has only 2 wires: **DL** and **GND** (sensor earth). The DL bus itself supplies the power supply for the DL bus sensors.

Cables can be routed with a star topology or in series (from one device to the next).

Any cable with a cross-section of 0.75 mm² up to 30 m in length can be used as a **data link**. Over 30 m, the use of a shielded cable is recommended, increasing the permissible cable length to 100 m.

Long cable conduits routed closely next to each other for mains and data links result in faults being induced into the data link from the mains. We therefore recommend a minimum clearance of 20 cm between two cable conduits or the use of screened cables.

Use separate, screened cables when capturing data from two controllers with a single datalogger. Never run the data link together with a CAN bus cable in the same conduit.

Bus load from DL sensors

A 2-pole cable provides **both** the power supply and the signal transfer from DL bus sensors. An additional power supply by means of an external power supply unit (such as with the CAN bus) is not possible.

Take the "**bus load**" into consideration as sensors have a relatively high current demand:

The CAN-EZ3 energy meter provides a maximum bus load of **100 %**. The bus loads of the electronic sensors are listed in the technical data of the relevant sensors.

Example: The FTS4-50DL electronic sensor has a bus load of **25 %**. Consequently, up to four FTS4-50DL sensors can be connected to the DL bus.

Terminal diagram, DL bus data link
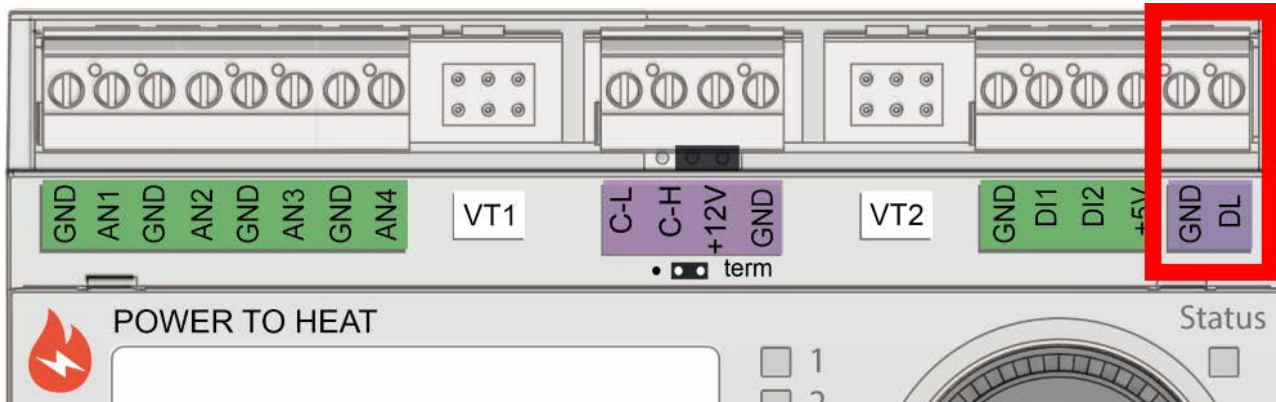
CAN Bus network

Terminal diagram, CAN Bus cable
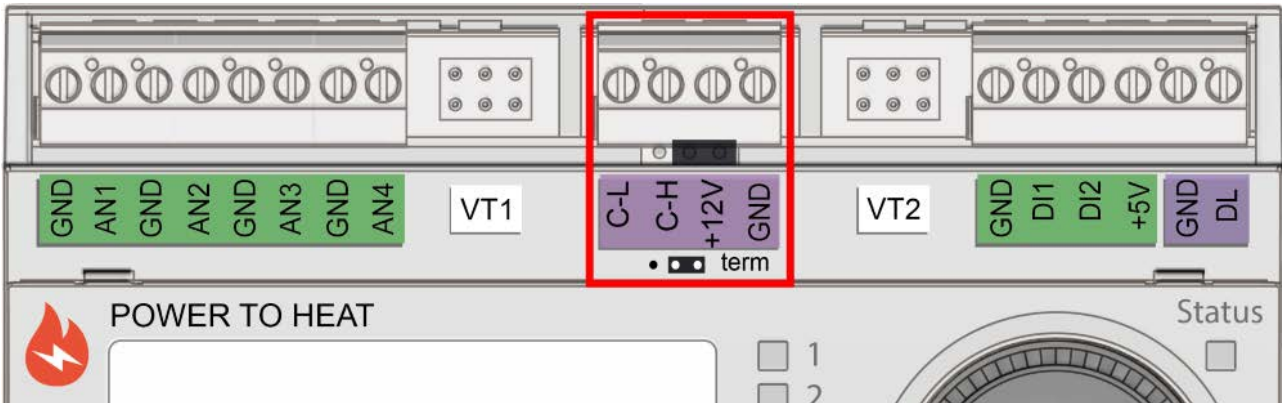
Guidelines for the topology of CAN networks

Technical principles
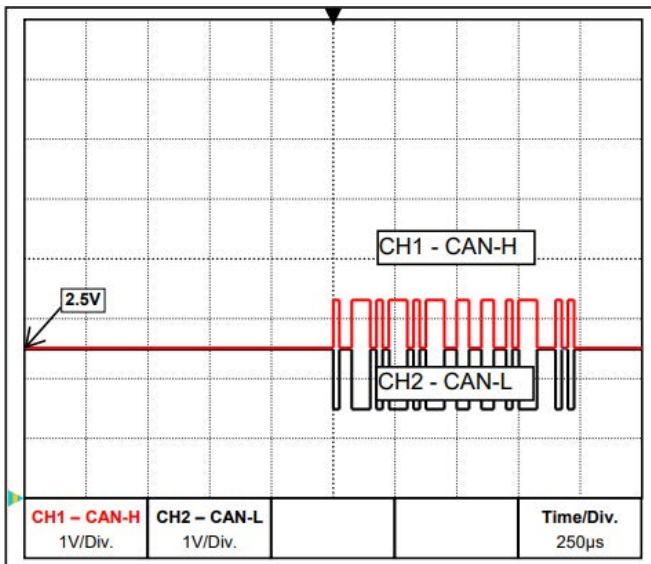
CAN-H and CAN-L data signals

The CAN bus comprises the cables CAN-High, CAN-Low, GND and one +12 V supply cable for bus components without their own power supply. The combined total load of all devices with 12 V and 24 V supply must not exceed 6 W.

Design CAN networks in a linear fashion and set a terminator at each network termination. This is ensured by the termination of the end devices.

In the case of larger networks (covering several buildings), problems can occur through electromagnetic interference and potential differences.

To avoid or to the greatest extent manage such problems, take the following measures:

- **Cable screening**
  The bus cable screen must be connected well at every node to provide continuity. For larger networks we recommend including the screen in the equipotential bonding, in line with the examples shown.
- **Equipotential bonding**
  As low an ohm connection as possible to the earth potential is particularly important. Where cables enter buildings, ensure that the cable entries are in the same location where possible and that all are connected to the same equipotential bonding system (SingleEentryPoint principle). The purpose is to create potentials that are as similar as possible, in order to achieve the smallest possible potential difference to adjacent lines in case one line suffers a voltage surge (lightning strike). Also ensure a corresponding clearance between the cable and lightning protection systems.
  The equipotential bonding also has positive properties to counteract interferences emitted from linked cables.

- **Avoiding earth loops**

  Where a bus cable is routed between several buildings, ensure that earth loops are avoided. The reason for this is that buildings actually have different potentials compared to the earth potential. An earth loop is created when connecting one cable screen in each building directly with the equipotential bonding system. In other words, a current flows from the higher to the lower potential.

  For example, if lightning strikes near one of the buildings, the potential of that building will briefly be raised by several kV.

  In this case, the equalizing current flows to earth via the bus screen and causes an extreme electromagnetic input which can result in the destruction of the bus components.

Lightning protection

Efficient lighting protection is highly dependent on good building earthing that meets the relevant regulations.

An external lightning protection system offers protection against a direct lightning strike.

In order to protect against voltage surges in the 230 V mains supply cable (indirect lightning strike), appropriate lightning conductors and surge arresters compliant with local regulations must be fitted in the upstream distribution systems.

In order to protect the individual components of a CAN network against indirect lightning strike, we recommend the use of surge arresters specifically developed for bus systems.

Example: CAN bus surge arresters CAN-UES from Technische Alternative

Gas discharge arrester for indirect earthing EPCOS N81-A90X

Examples of different network versions

Key to symbols:

     ... device with its own power supply (RSM610, UVR16x2, UVR67 etc.)

     ... device is supplied by the bus (CAN-I/O 45, CAN-MTx2 etc.)

term   ... terminated (end devices)   open   ... open termination

     ... gas discharge arrester for indirect earthing
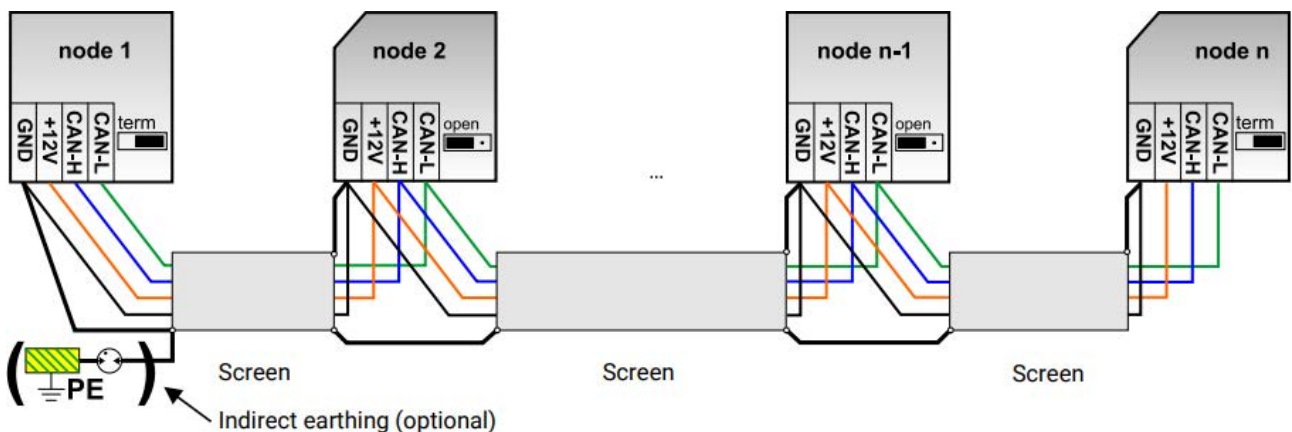
Max. cable length: 1000 m at 50 kbit/s

The screen must be continued at each network node and be connected to the device earth (GND).

The screen earthing or GND must only be implemented **indirectly** via a gas discharge arrester.

Ensure that no unintentional **direct** connection of earth or screen and the earth potential is created (e.g. via sensors and the earthed pipework).

Cable selection and network topology

Screened twisted pairs have proven useful in CANopen networks. These are cables with twisted pairs of conductors and a shared external screen. Such cables are relatively resistant to EMC interference and can still carry 50 kbit/s for up to 1000 m. The CANopen recommendations (CiA DR 303-1) for cable cross-sections are given in the table below.

Bus length [m]	Resistance in terms of length [mΩ/m]	Cross-section [mm^2]
0...40	70	0,25...0,34
40...300	< 60	0,34...0,60
300...600	< 40	0,50...0,60
600...1000	< 26	0,75...0,80

The maximum cable length also depends on the number of nodes [n] linked with the bus cable and the cable cross-section [mm²].

Cable cross-section [mm^2]	Maximum length [m]	
	n=32	n=63
0,25	200	170
0,50	360	310
0,75	550	470

Bus rate

In the CAN bus / CAN settings menu of the UVR16x2, the bus rate can be set to between 5 and 500 kbit/s, whereby lower bus rates enable longer cable networks. However, in this case, the cable cross-section must be increased accordingly.

The standard bus rate of the CAN network is 50 kbit/s (50 kBaud), which is specified for many CAN bus devices.

Important: All devices in the CAN bus network must have the same transfer rate in order to be able to communicate with each other.

Bus rate [kbit/s]	Maximum permissible total bus length [m]
5	10.000
10	5.000
20	2.500
50 (standard)	1.000
125	400
250	200
500	100

Recommendations

A 2x2-pole, screened twisted pair (twist CAN-L with CAN-H or +12 V with GND) with a cable cross-section of at least 0.5 mm² and a conductor-to-conductor capacity of no more than 60 pF/m and a nominal impedance of 120 ohms. The standard bus speed of the UVR16x2 is 50 kbit/s. This recommendation corresponds, for example, to cable type **Unitronic®-BUS CAN 2x2x0.5** supplied by **Lapp Kabel** for permanent installation **in buildings or conduits.** Theoretically this would enable a bus length of approx. 500 m to guarantee reliable transmission.

For **direct** routing **underground,** earth cable **2x2x0.5** mm² supplied by **HELUKABEL,** part no. 804269, or earth cable **2x2x0.75** mm² supplied by **Faber Kabel,** part no. 101465, would be suitable.

Wiring

A CAN BUS network should never have a star topology. Rather, the correct topology is a line from the first device (with terminator) to the second, third and so forth. The last bus device has the termination jumper again.
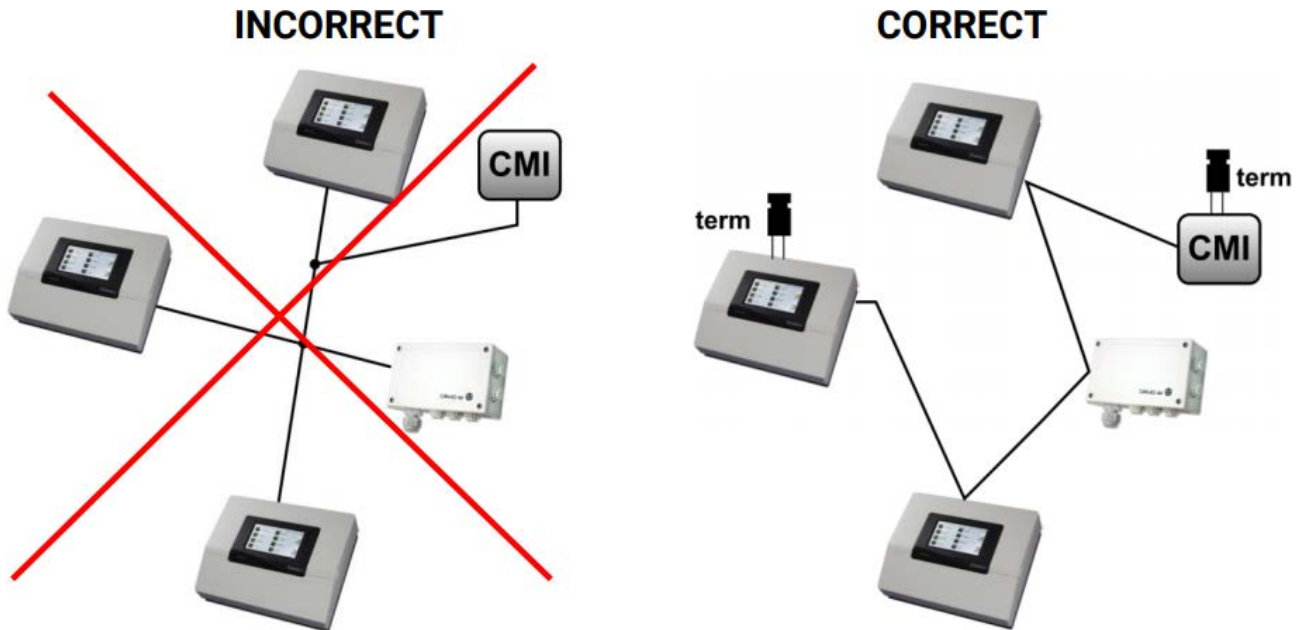
Example: Connection of three network nodes (NWN) with a 2x2-pole cable and **termination** of the terminal network nodes (network inside one building)
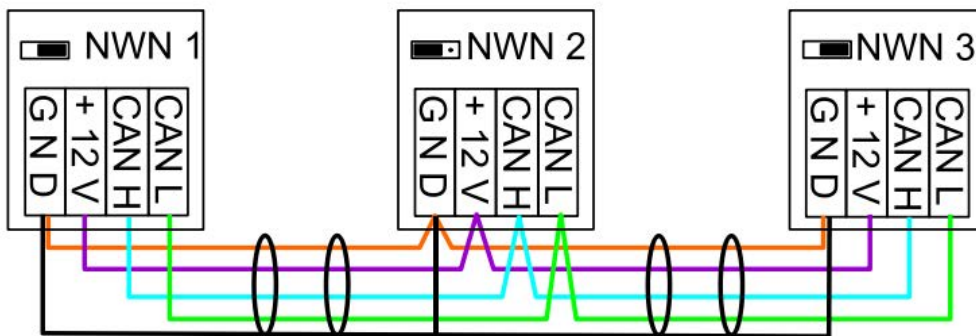
Each CAN network is to be provided with a 120 ohm BUS terminator at the first and last network subscriber (= **termination**). This is achieved with a plug-in jumper **at the back of the controller.** Each CAN network therefore always has two terminators (one at each end). Branch cables or a star topology are not permissible for CAN wiring.
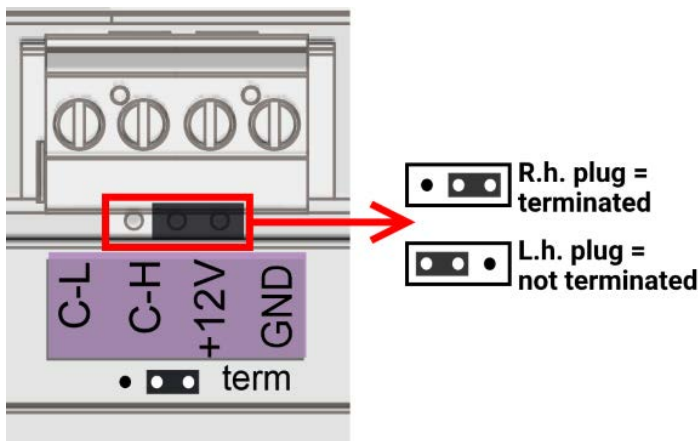
Wireless system (CORA)

Principles

The wireless system comprises multiple CORA devices (e.g. CAN-EZ3 and EHS), which communicate with one another, exchange data or transfer firmware. This functionality cannot fully replace the CAN bus.

For the wireless system, the CAN-EZ3 has an external antenna. The antenna itself is intended for mounting outside the meter box. The antenna should not be fitted directly on metal (e.g. meter box).

The wireless range is around 1000 m outdoors, and typically 30 m in buildings (through approx. 2 walls/ceilings, depending on thickness and material). Up to 3 additional wireless devices can be used as a bridge to enable data to be exchanged under deviating conditions.

A CAN-EZ3 can be paired with maximum **12** CORA devices.

RCV-DL, GBS-F and RAS-F devices **cannot** be used.

Wireless system settings can be found in the main menu item **CORA devices.**

Pairing CORA devices

In the **ATON** set, the included **CAN-EZ3A** energy meter and the **EHS-R** immersion heater are already paired at the factory.

In the main menu, under "**CORA devices**", a **New CORA device** is selected. Once the device type has been selected, additional setting options appear.

Switch to device parameters

Pairing status

Wireless or cable connection

Specify CORA ID from target device...

...and select **Pair**

The target device must have **Allow pairing** enabled. Information about this can be found in the operating instructions for the relevant device.

To pair an additional device, navigate back to the **Devices** menu and create another **New device**.

If **Manual mode** is set to **ON**, the item **Output** appears under it. Here, you can adjust the set output for manual mode.

If **Connect automatically** is set to **Yes**, when the wireless signal is lost, the system automatically attempts to restore the connection.

Relaying wireless signals

CORA devices can relay signals from other devices. All required settings for this are carried out at the device, which transmits the signal to be relayed. Pairing with devices that simply relay signals is not required.

During parameterisation of the CORA device, simply enter the CORA ID of the relaying devices under the items **HOP1-3** (depending on how many relays should occur).

RCV-DL, GBS-F and RAS-F devices **cannot** be used.

Example: The **CORA 1** device should control the **CORA 3** wirelessly, but cannot reach it due to the local conditions. However, **CORA 1** can reach **CORA 2**, and **CORA 2** can reach **CORA 3**.

During parameterisation on **CORA 1** (= pairing with **CORA 3**), the CORA ID of **CORA 3** is entered under **CORA ID**, and the CORA ID of **CORA 2** is entered under **HOP1**.

No settings are required on **CORA 2**. This device relays the signals independently.

No settings are required on **CORA 3** either.

The only change to the pairing process is that CORA IDs are entered under **HOP1-3**.

To enable additional devices to relay the signal, they should be specified in the corresponding order under **HOP2** and then under **HOP3**. A data packet is sent by the transmitter to HOP1, HOP2, HOP3 and then to the target device (= "CORA ID"), where defined.

The entry **00000000** means that no relaying will occur.

Deleting a pairing

Under the tab **FiD** is the item **Delete CORA device**.

CORA-DL (cable instead of wireless)

From version **1.08,** CORA devices can also be connected to the CAN-EZ3 via a cable. This replaces all functions of the wireless system. A CORA device **cannot be run with a wireless and a cabled connection at the same time.**

Anbindung

CORA-DL

CORA ID

00000000

For use with a cable, set "**Connection**" to **CORA-DL** in the parameters of the set CORA device.

Under **"CORA ID",** enter the ID of the device to be connected. This can usually be found on a label on the device.

Installation

To use a CORA device via CORA-DL, connect it to the DL bus of the CAN-EZ3.
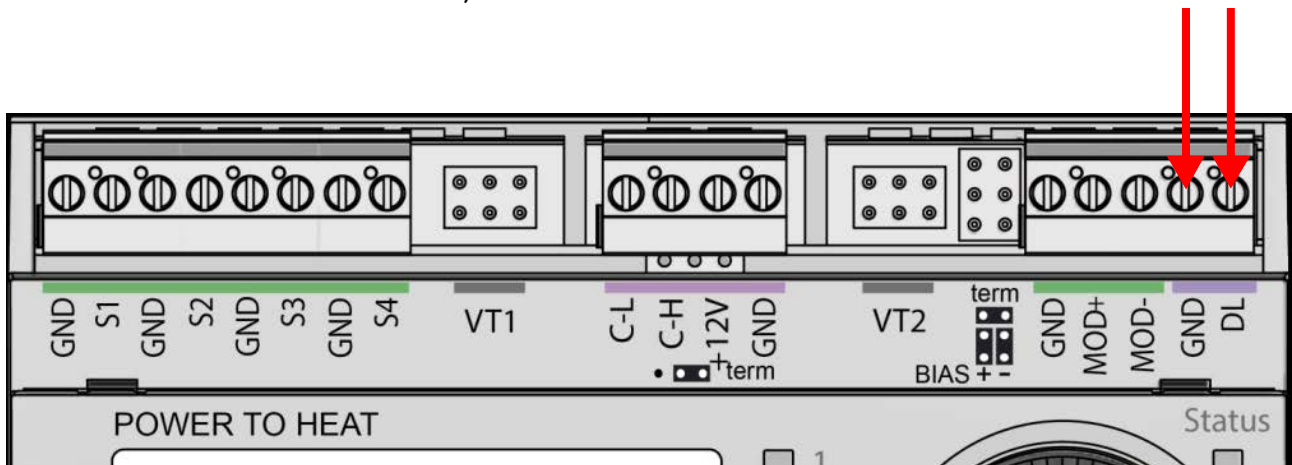
Devices connected via CORA-DL do not affect the DL bus load.

Operation and programming

The CAN-EZ3 is operated via the integral display and the rotary dial and buttons. Programming can be carried out entirely on the device, but the PC software **TAPPS2** is recommended.

Operation of the CAN-EZ3 and menu navigation are described in more detail in the "**Operation**" instructions.

Inputs

The energy meter has **8 inputs** for analogue measurements, digital signals (ON/OFF) or pulses.

Type	I 1	I 2	I 3	I 4	I 5	I 6	I 7	I 8
					VT1	VT2	VT1	VT2
Digital	x	x	x	x			x	x
Analogue (all measured variables and sensor types)	x	x	x	x				
Analogue (measured variable: temp.; sensor: FTS)					x	x		
Pulse (all measured variables) (e.g. sensor VSG) S0 signals (max 20 Hz)							x	x
Pulse (measured variable: flow rate)							x	x

Default settings

The CAN-EZ3 CAN energy meter is delivered with the following default settings. This programming can of course be supplemented or replaced with your own programming.

Overview of TAPPS2 programming
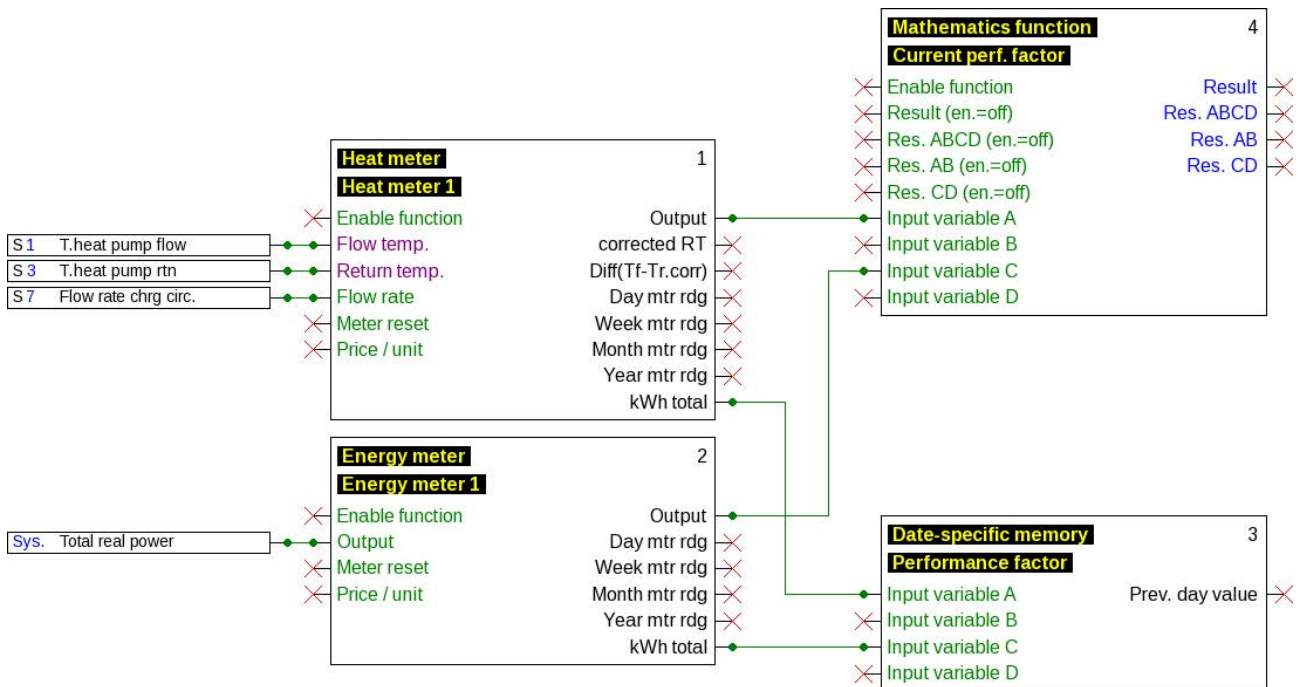
Inputs

S1	T.heat pump flow	Analogue	PT1000
S3	T.heat pump rtn	Analogue	PT1000
S5	Flow rate charging circuit	Analogue	FTS2-32 DN10

Datalogging

The following values are logged in data record "Analogue values"; data record "Digital values" is un-used

Analogue values	Digital values	General
ANALOGUE 1	Input 1: T.heat pump flow - Measurement	
ANALOGUE 2	Input 2: unused - Measurement	
ANALOGUE 3	Input 3: T.heat pump rtn - Measurement	
ANALOGUE 4	Input 4: unused - Measurement	
ANALOGUE 5	Input 5: unused - Measurement	
ANALOGUE 6	Input 6: unused - Measurement	
ANALOGUE 7	Input 7: Flow rate chrg circ. - Measurement	
ANALOGUE 8	Input 8: unused - Measurement	
ANALOGUE 9	Function: Heat meter 1 - Output	
ANALOGUE 10	Function: Heat meter 1 - Kilowatt hours total	
ANALOGUE 11	System value: Electrical power - Total real power	
ANALOGUE 12	Function: Energy meter 1 - Kilowatt hours total	
ANALOGUE 13	Function: Current perf. factor - Result	

Datalogging on SD card is deactivated at the factory.

Functions

Heat meter - Heat meter 1 ✕

Input variables | **Parameters** | Output variables

Des. group	General
Designation	Heat meter
Des. index	1
Frost protection	0,0 %
Flow rate	I.V.
Price per unit	0,20000
Reversing block	No
Total meter reading	0,0 kWh
Sum total	0,00

OK   Cancel

Mathematics function - Current perf. factor ✕

Input variables | **Parameters** | Output variables

Des. group	General
Designation	Current perf. factor
Des. index	
Function quantity	Performance factor
Result (enable = off)	0,00
Result ABCD (en.=off)	0,00
Result AB (en.=off)	0,00
Result CD (en.=off)	0,00
Formula: ((A + B) : (C x D))	
Function	
Input variable A	I.V.
Operator 1	+
Input variable B	0,00000
Operator 2	:
Input variable C	I.V.
Operator 3	x
Input variable D	1,00000

OK   Cancel

Energy meter - Energy meter 1 ✕

Input variables | **Parameters** | Output variables

Des. group	General
Designation	Energy meter
Des. index	1
Output	I.V.
Price per unit	0,20000
Factor	1
Total meter reading	0,0 kWh
Sum total	0,00

OK   Cancel

Date-specific memory - Performance factor ✕

Input variables | **Parameters** | Output variables

Des. group	General
Designation	Performance factor
Des. index	
Mode	Differential
Function quantity	Performance factor
Formula: ((ΔA + ΔB) : (ΔC x ΔD))	
Function	
Input variable A	I.V.
Operator 1	+
Input variable B	0,00000
Operator 2	:
Input variable C	I.V.
Operator 3	x
Input variable D	1,00000

OK   Cancel

The date-specific memory records the values of the heat meter and energy meter, totals them and stores them in differential mode.

The mathematics function uses output variable **Result** to offer a display value for the totalled current output of the heat meter and energy meter.

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Functions

All functions of the UVR16x2 controller are available. You can choose from **43** different functions and can create up to **128** functions. Functions can also be applied multiple times.

In the following, only those functions are described that are relevant for the actual task of the CAN-EZ3.

Descriptions of all other functions can be found in the corresponding controller **manuals** (UVR16x2/RSM610/UVR610/CAN-I/O45), which can be downloaded from ta.co.at.

Definitions

COP value (COP= Coefficient of Performance)

Ratio of the output heat power (kW) to the consumed electrical operating power incl. auxiliary energy **under test conditions** (defined temperature conditions, defined time points).

$$COP = Q_{WP} / P_{el}$$

The COP value also includes the power of auxiliary units (thawing energy, fraction of pump capacity for heating, brine or groundwater heat pumps).

Consequently the COP value is a good criterion for heat pumps.

Test institutes determine this value according to a defined measuring method (DIN EN 255).

However performance number and COP value do not allow any energy-based evaluation of the overall system. They are only a snapshot of certain heat pump (HP) type under favourable operating conditions (e.g. at 35°C flow temperature). The (yearly) performance factor is much more meaningful for a **system.**

Performance factor β

The performance factor is the actual COP during operation.

It is the ratio of the heat energy yield (kWh) to the consumed operating and auxiliary power kWh) over a given time period:

$$β = W_{Useful} / W_{el}$$

The more important performance factor for the efficiency of a system is therefore the (annual) performance factor ß.

This is the result of measurements at the electricity meter for the supplied electrical energy (compressor, heat source pump) and at the heat meter (output thermal energy of the heat pump) over a given time interval. If the interval is one year, then the annual performance factor or annual COP is referred to.

Energy manager

Function description

The energy manager manages up to 12 output control functions. The (usually) available surplus output measured and calculated by the CAN-EZ3 is divided between the **output controls** involved due to various parameters and user defined priorities.

Input variables

Enable	General enabling of the function (digital value ON/OFF)
Power from grid	Power currently being drawn from the grid • Negative when power is being exported to the grid • Positive when power is being drawn from the grid
Set value	Set value for power drawn from the grid

- Via the "**Power drawn from grid**" input variable, the function provides an overview of the power drawn from the grid by the entire system – if this value is negative, this corresponds to power exported to grid.
    - In standard application scenarios, this input variable is linked to the *system value* "**Total active power**" of the energy meter used.
- The set value (factory setting: -500 W) makes it possible to prevent power being drawn from the grid for brief periods (= tolerance value).

  Without this kind of tolerance value, a set output level may be specified for the consumer that cannot be generated by the system (any longer), with the result that power is briefly drawn from the grid to meet the set output level. By specifying a negative value, power is exported to the grid instead.
- All input variables related to power can be given values in the units **W** or **kW**. The unit is recognised automatically.

Parameters

No. of involved functions	No. of involved output control functions
Involved functions	Click once and then you can specify the involved output control functions.
Priority	Priorities can be assigned here to the output control functions that are set as involved. When surplus power is available, it is first used by the output control with priority 1 (= highest priority). The function with the next highest priority does not become active until the first function's **max. consumer output** is reached. If two power output controls are assigned the same priority level, the one with the lower function number (as programmed) has priority.

- It is not necessary to establish a link to the output control functions. Instead, the **Involved functions** parameter is used.

Output variables

Residual power	Amount of available power not used
Power used	Amount of available power used

- These output variables are only used for display purposes, e.g. in a function overview. The consumers are linked to the output variables of the involved output control functions.

Example of a standard diagram

Energy manager with **output control**
CAN-EZ3 and **EHS(-R)**

Sys.	Total real power

Energy manager   1
Energy manager 1
Power from grid
Included functions
Output control 1

Output control   2
Output control 1
Participating device
Immersion heater 1

EHS immersion heater   1
Immersion heater 1
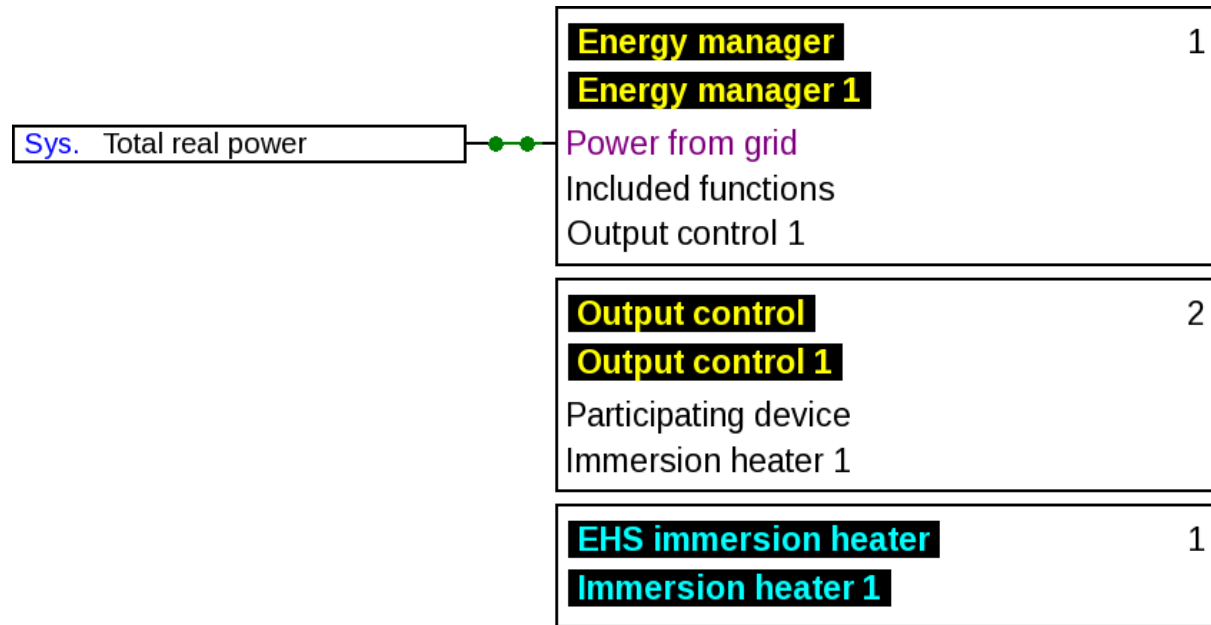
Output control

Standard diagram

See **Energy manager** function description.

Function description

The output control function is used to control loads (e.g. **EHS** immersion heater or **LST** output controller) according to the specifications of the **energy manager** function, or by means of forced operation.

When used with an **energy manager** function, output control is specified in this function's parameters as an **involved function**. Up to 12 output controls can be managed by one energy manager.

For use without an **energy manager** function, the **forced operation** and **forced operation output** input variables are used. The output can then be specified manually or by any other control event.

With the **Participating CORA device** parameter, **Output control** makes it possible to control a device using the **"CORA"** wireless system. Further information on this wireless system can be found in the installation instructions for the corresponding devices.

Input variables

Enable	General enabling of the function (digital value ON/OFF)
Minimum output	Upper and lower limits of the output to be consumed
Maximum output	
Start differential	The consumer is not activated until the **minimum output + start differential** is reached.
	The consumer is deactivated again when the output falls below **minimum output**.
	Operation proceeds, taking account of the **minimum runtime, stop delay** and **blocking time** parameters.
Forced operation	The consumer is enabled without taking account of the specifications of the energy manager (digital value ON/OFF).
Forced operation output	Set output when **forced operation** is active.

- When used in conjunction with an energy manager, the set output comes from that function; otherwise from the **forced operation output** input variable.
  - Forced operation takes precedence over the specifications of the energy manager function.
- The value of the **maximum output** input variable should not exceed the maximum output of the consumer (e.g. 3 kW for an EHS immersion heater).
- All input variables related to power can be given values in the units **W** or **kW**. The unit is recognised automatically.
- If a non-regulated consumer is to be switched, the **minimum power** and **maximum power** must be set to the same value. The start differential continues to have an effect with this setting.
- Percentage values can also be applied to the input variables **minimum power** and **forced operation output**. These refer to the maximum power (100 % = maximum power).

Parameters	
Cycle time	Specifies the cycle in which the calculation of the output control should occur. Delayed responses of consumers can be compensated. This parameter also affects the higher ranking energy manager.
Minimum runtime	If the consumer is activated, it may only be deactivated again after this time has elapsed.
Run-on time	If the consumer is to be deactivated, it continues to run for this time until it is actually deactivated.
Pause time	If the consumer is deactivated, it may only be reactivated after this time has elapsed.
Involved network node (display only for devices with x2 wireless)	If the function is to control a device via x2 wireless, this is defined here. A link must first be established with the device in the **Network node** menu. The CORA device involved should only be present once in the programming.

- **Cycle time:** If the values of the output control are transmitted, for example, via the CAN bus to a controller, which switches the consumer, the calculation of the function is much quicker than values can be transferred via the CAN bus. This can have a negative impact on delayed responses of the control characteristics (system starts to oscillate). The **cycle time** should be matched to the transfer time of the bus.
- The **minimum runtime, run-on time** and **pause time** parameters also apply to **forced operation**.

Output variables	
Correcting variable	Selection of an analogue output for consumer output modulation Displays the percentage of modulated output specified for the selected analogue output (0-100 %) • 0 % corresponds to 0 W • 100 % corresponds to the set maximum output
Status	Selection of the switching output of the consumer Display ON/OFF
Effective set output	Output to be consumed at the moment (specified by the **energy manager** function)
Minimum runtime meter	Meter for the remaining **minimum runtime** (see Parameters)
Run-on time meter	Meter for the remaining **run-on time** (see Parameters)
Pause time meter	Meter for the remaining **pause time** (see Parameters)
Cycle timer	Meter for the remaining **cycle time** (see Parameters)

- The **effective set output** and the **meters** are for display only.

Example: Actuation of an EHS-R by PWM

Output control function	
Minimum output parameter	0,05 kW
Maximum output parameter	3,00 kW
Start differential parameter	0,01 kW

Connected analogue output	
Input value 1	0
Target value 1	10,0 %
Input value 2	1000
Target value 2	90,0 %

Energy meter

Function description
The energy meter takes the **analogue** value for **energy output** from other sources (e.g. CAN energy meter CAN-EZ) and meters the energy according to that value.

Input variables	
Enable	General enabling of the function (digital value ON/OFF)
Output	Analogue value specifying the energy output in kW (to two decimal places)
Meter reset	Digital input signal, ON/OFF, to reset the meter
Price / unit	Input of a price per unit (1 kWh)

- When the energy output value is adopted, note that two decimal places must be included. **Example:** A dimensionless number 413 will be adopted as 4.13 kW.
- If the energy output values are negative, note that the metering will be negative as well, i.e. the metered values can also become negative.
- The **meter reset** is carried out by means of a digital ON pulse or manually from the parameter menu. It will delete **all** meter readings, in other words also those from previous periods.
- When the **Price / unit** is transferred from a source, note that five decimal places must be included. **Example:** A dimensionless number without a decimal point such as 413 will be adopted as 0.00413. If the source is a **Fixed value,** the unit used should not be a currency (Euro or Dollar) but rather **Dimensionless (.5).**

Parameters	
Function quantity	Selection: **Energy kWh, litres** or **cubic metres**
Factor	Optional: enter an integral factor (a whole number) for the multiplication of the input value
Delete meter reading	Pressing this button opens a confirmation prompt, followed by a reset of all meter readings, including those from previous periods.

Output variables	
Output	The energy output, with the factor applied
Day meter reading	Meter readings
Prev. day meter reading	
Week meter reading	
Prev. week meter reading	
Month meter reading	
Prev. month meter reading	
Year meter reading	
Prev. year meter reading	
Kilowatt hours total	
Day sum	Display of yield in the set currency
Previous day sum	
Week sum	
Prev. week sum	
Month sum	
Prev. month sum	
Year sum	
Prev. year sum	
Sum total	

- **PLEASE NOTE:** The meter readings from the Energy meter function module are saved to the internal memory every hour. Therefore, in the event of a power failure, no more than 1 hour of metering can be lost.
- When loading function data, you will be prompted whether you want to apply the saved meter readings (see the Programming Part 1: General information manual).
- The changeover of the Week meter occurs on **Sundays at 24:00 h.**
- The meter readings can also be deleted manually in the parameter menu.

Heat meter

Standard diagram
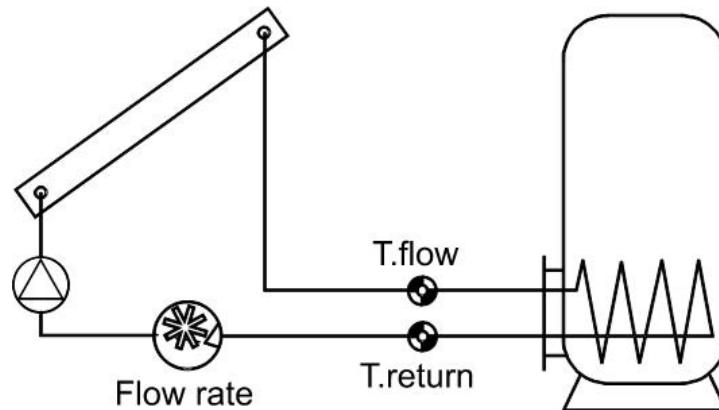
Function description

Calculation of thermal output and metering of thermal energy via the temperature differential T.flow - T.return and the flow rate, and allowing for the antifreeze component in the heat transfer medium.

Input variables

Enable	General enabling of the function (digital value ON/OFF)
Flow temperature	Analogue input signal for the flow temperature
Return temperature	Analogue input signal for the return temperature
Flow rate	Analogue input signal for the flow rate
Meter reset	Digital **pulse** input signal, ON/OFF, to reset the meter
Specific heat capacity	**Optional**: Analogue value specifying the heat capacity of the fluid in the measured system
Price / unit	A price per kWh for yield calculations

- The **BFPT1000 5x60MM** sensors fitted in the **KH ball valve** from Technische Alternative are particularly suitable for temperature measurement. The sensors can be removed with little effort for the calibration process.

- With a solar thermal system, the collector sensor can also be used as the flow sensor. For that to be possible, it must be installed in a sensor well at the flow outlet of the collector header. However, the captured amount of heat will then also include the losses in the solar flow line.

- Entering *User* as the source in the **Flow rate** input variable allows a fixed value to be entered as the flow rate instead the flow rate captured by a flow sensor.

- The **meter reset** is carried out by a digital ON pulse or manually in the parameter menu. It will delete **all** meter readings, in other words also those from previous periods. The meter will be blocked as long as this input variable is set to ON. The meter reset also works when Enable = Off.

- **Specific heat capacity:** This optional specification must be entered as a multiple of the unit **0.01 kJ/l*K** as a **dimensionless** number. **Example:** Pure water has a heat capacity of 4.18 kJ/l*K at 20 °C, so a dimensionless value of 418 must be entered for this heat capacity (at 20 °C).

  N.B.: The heat capacity of fluids is temperature-dependent. The value entered should therefore be a variable value dependent on the temperature (e.g. from the Curve function).

Parameters	
Frost protection (shown only if the Specific heat capacity input variable is **unused)**	Specification of the antifreeze component in %
Reversing lock	Available for selection: *Yes* / *No*
Status Calibration value	Display: *Not calibrated* or *Calibrated* Display of the differential T.flow − T.return measured during the calibration process (in **Not calibrated** status this value must be 0.0 K)
Start calibration	Select to start the calibration process (Note the section **Calibration process**!)
Delete calib. values	This can be used to **undo** the calibration. It resets the calibration value to 0.
Delete meter reading	Button for deleting all meter readings

- **Antifreeze component (frost protection):** An average has been calculated from the product specifications of all the major manufacturers and tabulated in relation to the mixing ratio. Under typical conditions this method results in an additional error of **no more than** one percent.
- **Reversing lock:** Entering *No* permits **negative** metering; entering *Yes* means that the heat meter will only be able to meter **positive** values.
- The tolerance of sensors and measuring device can sometimes lead to substantial errors in the calculation of the differential temperature. The device has a **calibration process** to compensate this error.
- After selecting **Start calibration,** the user is prompted to confirm. If the calibration was performed by mistake or incorrectly, the result can be undone with **Delete calib. values** and/or corrected by means of a new calibration.

Calibration process

By simultaneously measuring the **same** temperature with both sensors, the deviation of the sensors from each other can be ascertained and included as a correction factor in future calculations.

The calibration affects only the sensor values in the Heat meter function and is not factored into other functions.

During the calibration process, it is very important that both sensors (flow and return) capture the same temperatures. This is achieved by binding the two sensor tips together with a piece of tape or wire. Both sensors should also be fitted now with the lead extensions which will be used later, so that the electrical resistances of the leads are included. If the collector sensor is being used, the required lead length should be estimated and integrated. The sensors must be connected to the two **programmed** inputs for flow and return and are immersed together in hot water (so that both are exposed to the same temperature).

Calibration process:

1. Immerse the sensors in the water.
2. Start the calibration process and confirm.
   Status display: *Calibrated.*
3. The calibration values displayed in the parameters and the corrected return temperature is included in the output variables.

Notes on accuracy

The accuracy of all measured energies and energy flows depends on many factors and is to be subject to closer consideration here.

- PT1000 **class B** temperature sensors have an accuracy of +/- 0.55 K (at 50 °C).
- Errors in temperature capture by the X2 device are typically +/- 0.4 K per channel.

For an assumed spread of 10 K, these two measuring errors result in a **maximum** measuring error between the flow and return of +/- 1.90 K = **+/- 19.0 %** for class B and +/- 13.0 % for class A.

- At a lower spread, the percentage measuring error **increases**
- The accuracy of the FTS 4-50DL flow sensor is approx. **+/- 1.5 %**

In the **worst case** scenario, the maximum overall measuring error for heat metering therefore equals:

$$1.19 \times 1.015 = 1.208$$

This means heat metering accuracy of **+/- 20.8 %** in the **worst case scenario** (at 10 K spread, **without calibrating** the temperature sensors), although all measuring errors would then skew the results to the **same** extent.

Experience has shown that a worst case scenario **never** actually occurs and in an unfavorable scenario, half of this value can be expected. However, even 10.4 % is not justifiable.

After **calibrating** the temperature sensors (see above), the measuring error of the overall temperature measurement reduces to a maximum 0.3 K. Relative to the spread of 10 K as assumed above, this equals a measuring error of 3 %.

The maximum overall measuring error for the performance factor therefore equals:

$$1.03 \times 1.015 = 1.045$$

At a **10 K spread** and **with calibrated** temperature sensors, heat metering accuracy therefore improves for the **worst case scenario** to **+/- 4.5 %.**

Output variables	
Output	Display of the current thermal output in kW (to two decimal places)
Corrected return temperature	Display of the return temperature corrected by the calibration process
Differential (Tflow-Trtn corr)	Display of the current temperature differential between the flow and corrected return temperature, which is critical for the heat meter
Day meter reading	
Prev. day meter reading	
Week meter reading	
Prev. week meter reading	
Month meter reading	Meter readings
Prev. month meter reading	
Year meter reading	
Prev. year meter reading	
Kilowatt hours total	
Day sum	
Previous day sum	
Week sum	
Prev. week sum	
Month sum	Display of yield in the set currency
Prev. month sum	
Year sum	
Prev. year sum	
Sum total	

- **ATTENTION:** The meter readings from the Heat meter function module are saved to the internal memory every hour. Therefore, in the event of a power failure, no more than 1 hour of metering can be lost.
- When loading function data, you will be asked whether you want to apply the saved counter readings (see manual Programming Part 1: General information).
- If the flow temperature is lower than the return temperature, the meter will count **negative** energy if the reversing lock is set to **No.** The meter reading will be **reduced** as a result.
- The changeover of the Week meter occurs on Sundays at 24:00 h.

Date-specific memory

Function description

The date-specific function enables daily, monthly and annual recording of meter readings.

The 2 different versions allow either the total meter readings for specific times, or the values for a time period (day, month, year) to be established.

The integral mathematics function can, for example, calculate the performance factor of a heat pump.

Input variables

Input variables A - D	Analogue input signal for the value to be saved

Parameters

Mode	Selection: **Differential**, **Value**
Function quantity	A wide range of function quantities are available, which are applied together with their unit and their decimal places.

- **Differential mode:** The **differentials** of the calculated values between beginning and end of the day, month and year are saved. This version is suitable, for example, for calculating the daily, monthly and annual performance factor of a heat pump.

   Example: Daily value
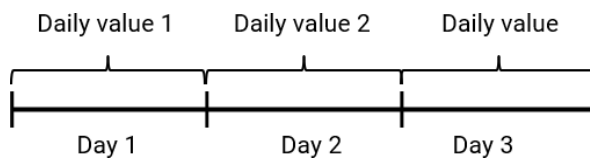
- **Value mode:** The calculated values (e.g. meter readings) **for the respective point in time** (end of day, end of month, end of year) are recorded.

   Example: Daily value
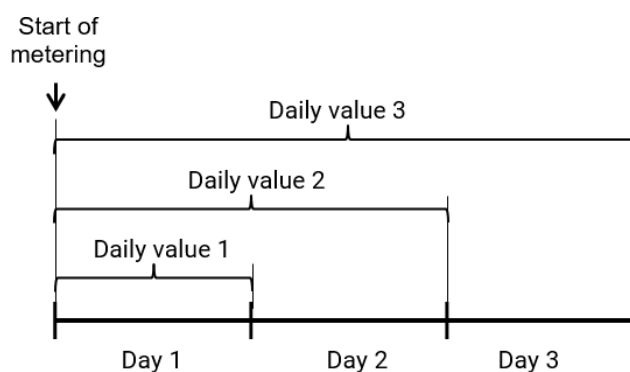
Calculation

With the help of the integral mathematics function, the input variables A - D can be linked mathematically.

If only one input variable is available, variables B to D remain on value 1 and the operators on "multiplication". The result of the calculation is therefore identical to input variable A.

The result of the calculation is then saved in accordance with the mode

View on display

[ ] ((A [] B) [] (C [] D))

Function		Operator 2	×
Input variable A	1.00000	Input variable C	1.00000
Operator 1	×	Operator 3	×
Input variable B	1.00000	Input variable D	1.00000

View in TAPPS2

Formula: $((\Delta A \times \Delta B) \times (\Delta C \times \Delta D))$

Function	
Input variable A	1,00000
Operator 1	x
Input variable B	1,00000
Operator 2	x
Input variable C	1,00000
Operator 3	x
Input variable D	1,00000

The arithmetic operation is performed according to the following formula:

$$\boxed{Function}((\mathbf{A} \boxed{Operator\ 1} \mathbf{B})\ \boxed{Operator\ 2}\ (\mathbf{C} \boxed{Operator\ 3} \mathbf{D}))$$

- The first field **Function** can remain empty, in which case it has no effect on the arithmetic operation. In this field, a function can be selected which will be applied to the result of the arithmetic calculation that follows:
    - Absolute value **abs**
    - Square root **sqrt**
    - Trigonometric functions **sin**, **cos**, **tan**
    - Inverse trigonometric functions **arcsin**, **arccos**, **arctan**
    - Hyperbolic functions **sinh**, **cosh**, **tanh**
    - Exponential function e^x **exp**
    - Natural and common logarithms **ln** and **log**
- The fields marked Operator 1 - 3 are for selecting the arithmetic operation::
    - Addition **+**
    - Subtraction **−**
    - Multiplication **x**
    - Division **:**
    - Modulo **%** (remainder from a division)
    - Exponentiation **∧**
- The brackets must be observed in accordance with mathematical rules.
- In the "**differential**" version, these mathematical calculations therefore allow the daily, monthly and annual performance factors to be calculated by dividing the heat amount (thermal energy) by electrical energy and stored on a daily, monthly and annual basis.

Daily values **Monthly values** **Yearly values**	The stored values are displayed by selecting these buttons
Delete history	Selecting this button deletes the stored values after a confirmation prompt.

Output variables

Previous day value	Display of the stored previous day value

Mathematics function

Function description
The Mathematics function applies various mathematical calculations and functions to four values of analogue input variables to produce four different calculated results. The results can be assigned to selected function quantities.

Input variables	
Enable	General enabling of the function (digital value ON/OFF)
Result (enable = off)	Analogue value for the **Result** output variable when Enable is OFF
Result ABCD (enable = off)	Analogue value for the **Result ABCD** output variable when Enable is OFF
Result AB (enable = off)	Analogue value for the **Result AB** output variable when Enable is OFF
Result CD (enable = off)	Analogue value for the **Result CD** output variable when Enable is OFF
Input variable A - D	Analogue values for the mathematical calculations (to five decimal places)

- If the function is blocked (Enable = Off), it issues values which are either defined by the user with Result (enable = off) or which come from a specific source. Enable can therefore be used to switch between analogue values.

  As the function produces four different results, there are also four input variables for those results when Enable is OFF.

- If the source of an input variable is set to *User*, the user can specify an adjustable numeric value.

- As the mathematical calculations can be carried out either using all four input variables or using two of them, appropriate selection of the unused input variables is important for a correct result.

Parameters	
Function quantity	Selection of the required function quantity. A wide range of function quantities are available, which are applied together with their unit and their decimal places.

- As it truncates (cuts off) the decimal places, the dimensionless function quantity (= without decimal places) is usually inappropriate when functions are used. For precise calculations, dimensionless function quantities with decimal places are available (e.g. Dimensionless (.5) with five decimal places).

View in TAPPS2

Formula: ((A x B) x (C x D))	
Function	
Input variable A	1,00000
Operator 1	x
Input variable B	1,00000
Operator 2	x
Input variable C	1,00000
Operator 3	x
Input variable D	1,00000

View on display:

[ ] ((A [] B) [] (C [] D))

Function	
Input variable A	1.00000
Operator 1	×
Input variable B	1.00000

Operator 2	×
Input variable C	1.00000
Operator 3	×
Input variable D	1.00000

The arithmetic operation is performed according to the following formula:

$$\boxed{Function}((\mathbf{A} \; \boxed{Operator\ 1} \; \mathbf{B}) \; \boxed{Operator\ 2} \; (\mathbf{C} \; \boxed{Operator\ 3} \; \mathbf{D}))$$

- The first field **Function** can remain empty, in which case it has no effect on the arithmetic operation. In this field, a function can be selected which will be applied to the result of the arithmetic calculation that follows:
  - Absolute value **abs**
  - Square root **sqrt**
  - Trigonometric functions **sin, cos, tan**
  - Inverse trigonometric functions **arcsin, arccos, arctan**
  - Hyperbolic functions **sinh, cosh, tanh**
  - Exponential function e^x **exp**
  - Natural and common logarithms **ln** and **log**
- The fields marked Operator 1 - 3 are for selecting the arithmetic operation::
  - Addition **+**
  - Subtraction **−**
  - Multiplication **x**
  - Division **:**
  - Modulo **%** (remainder from a division)
  - Exponentiation **∧**
- The brackets must be observed in accordance with mathematical rules.

Output variables	
Result	The result of the calculation **including** any function calculation
Result ABCD	The result of the calculation for all four variables A, B, C and D **without** any function calculation
Result AB	The result of the calculation for the two variables A and B **without** any function calculation
Result CD	The result of the calculation for the two variables C and D **without** any function calculation

- The results are produced with the selected function quantity (unit) and the decimal places **specified by it,** and can be used as input variables for other functions, for example.
- The results are **not** mathematically rounded. The decimal places not displayed are **discarded.**
- If the **Dimensionless (.5)** function quantity is used in the calculation, the result will have five decimal places. The **Scaling function** can then be used to convert that result into a value with any other function quantity, with truncation removing any decimal places that are not required.

Notes on accuracy

The accuracy of all measured energies and energy flows depends on many factors and is to be subject to closer consideration here.

- PT1000 **class B** temperature sensors have an accuracy of +/- 0.55 K (at 50 °C).
- Errors in temperature capture by the x2 device are typically +/- 0.4 K per channel.

For an assumed spread of 10 K, these two measuring errors result in a **maximum** measuring error between the flow and return of +/- 1.90 K = **+/- 19.0 %** for class B and +/- 13.0 % for class A.

- At a lower spread, the percentage measuring error **increases**
- The accuracy of the FTS 4-50DL flow sensor is approx. **+/- 1.5 %**
- The measuring error of electrical energy capture is +/- 3 % (at cos phi = 0.6)

In the **worst case** scenario, the maximum overall measuring error for heat metering therefore equals:

$$1.19 \times 1.015 = 1.208$$

This means heat metering accuracy of **+/- 20.8 %** in the **worst case scenario** (at 10 K spread, **without calibrating** the temperature sensors), although all measuring errors would then skew the results to the **same** extent.

Experience has shown that a worst case scenario **never** actually occurs and in an unfavourable scenario, half of this value can be expected. However, even 10.4 % is not justifiable.

After **calibrating** the temperature sensors (see above), the measuring error of the overall temperature measurement reduces to a maximum 0.3 K. Relative to the spread of 10 K as assumed above, this equals a measuring error of 3 %.

The maximum overall measuring error for the performance factor therefore equals:

$$1.03 \times 1.015 = 1.045$$

At a **10 K spread** and **with calibrated** temperature sensors, heat metering accuracy therefore improves for the **worst case scenario** to **+/- 4.5 %.**

Reset

Pressing the reset button **briefly** (with a narrow-tip pen) restarts the energy meter (= reset).

Total reset: pressing **and holding down** the button triggers a continuous tone, then a single high beep, followed by a total reset.

A **total reset** deletes all function modules, the parameter settings for all inputs and outputs, bus inputs and outputs, fixed values, system values and the CAN bus settings.

Reset button
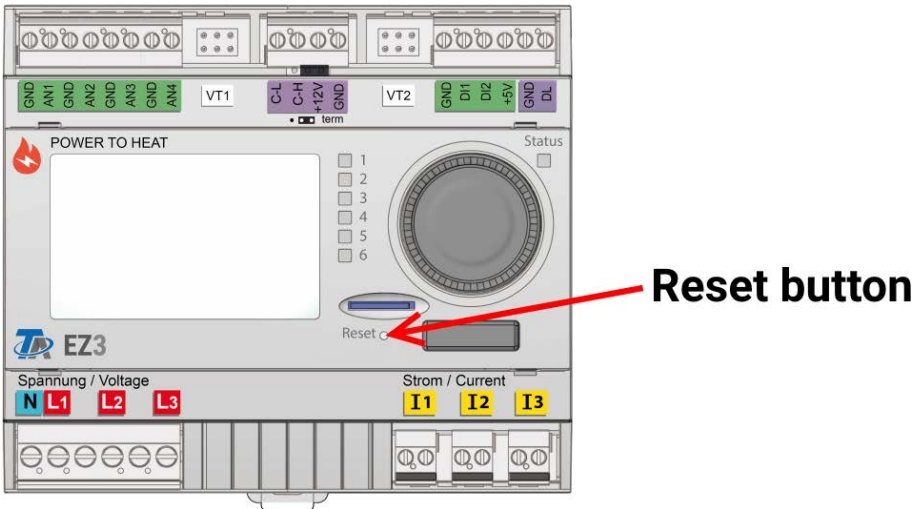
LED status indicators

Status LED
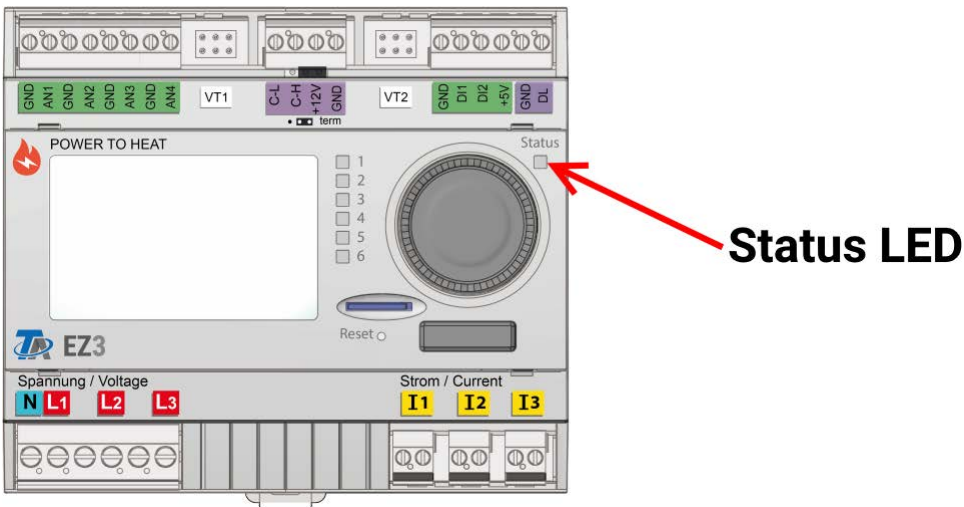
LED indicators at device start-up

Control indicator	Explanation
Flashing green light	After start-up and hardware initialisation, the CAN-EZ3 waits about 30 seconds to receive all the information necessary for function (sensor values, network inputs)
Steady green light	Normal CAN-EZ3 operation

Basics

This section is designed as a guide to programming directly on the device, but also provides important information about the elements required for programming with the TAPPS 2 programming software (functions, inputs and outputs, etc.).

Programming with TAPPS2 is always recommended. It enables the programmer to draw (= program) all program operations in the form of a graphical flow chart and to define parameters for them accordingly.

Nevertheless it is important to know how to use the "programming mechanisms" on the device itself in order to be able to make changes on site.

Device overview
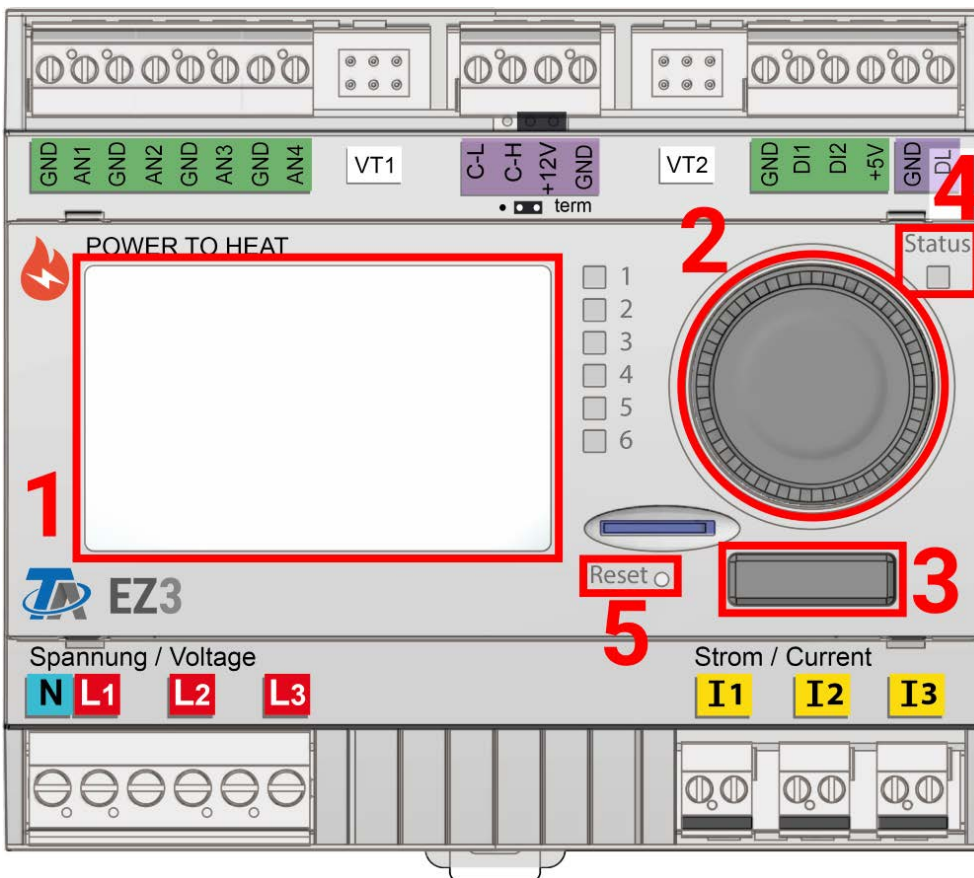
The display **(1)** on the front shows information about sensor measurements, menu position, parameters and such.

The wheel **(2)** to the right of the menu serves to navigate through menus. Twisting it clockwise navigates downwards in a menu, twisting it counter-clockwise navigates upwards.

Pushing the wheel **(2)** down opens the currently selected menu/enables changing the currently selected value/parameter. (= Enter button)

Pushing the button **(3)** left of the wheel leaves the current menu. (= Back button)

Pushing the „Enter button" or the „Back button" is related to the value/menu point that's framed.

The **"Status"** LED **(4)** above right of the rotary dial provides information on the status of the device. Green flashing means the energy meter is starting up. A continuous green light shows normal operation. Orange means there is a "message", for example concerning a collector over-temperature shutdown. Red means there is a "fault", such as a DL sensor failure.

At a short push of the Reset button **(5)**, the device reboots. To carry out a total reset of the device, push the button until the status LED **(4)** stops rapidly flashing orange and begins slowly flashing in red.

LED indicator light
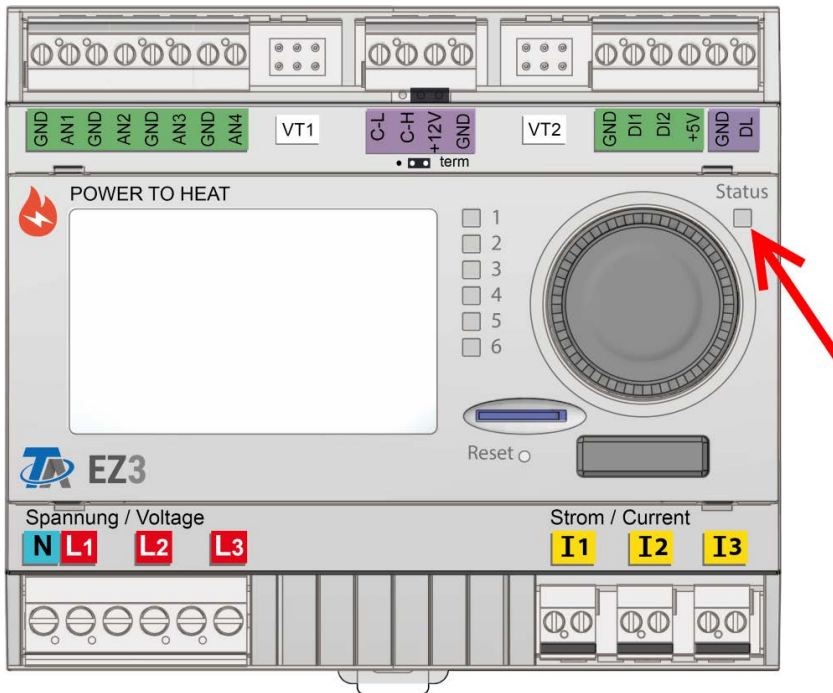
The indicator light can indicate a variety of statuses by means of three colours.

Indications at controller start

| Indicator light	Explanation
Steady red light	The controller is booting up (= start routine after switching on, resetting or updating) or
Steady orange light	Hardware is initialising after booting up
Flashing green light	After hardware initialisation, the controller waits about 30 seconds to receive all the information necessary for a function (sensor values, network inputs)
Steady green light	Normal operation of the controller

An active **message** can be displayed by a change in the LED indicator light. This can be set in the **Parameter menu** of the "**Message**" function.

General information on programming parameters

for inputs, outputs, fixed values, functions, default settings, and CAN and DL inputs and outputs.

Every entry must be finished by selecting $\boxed{\checkmark}$ **.**

If you want to discard your entries, select $\boxed{X}$.

Example:

```
New password

    128

  [✓]  [X]  [←]
```

Entering numeric values

A keypad is displayed for entering numeric values.

```
Value
-273.2 -      ←————— Name of the numeric value, entry range
2000.0 °C

      20.0 °C ←————— Current numeric value
```
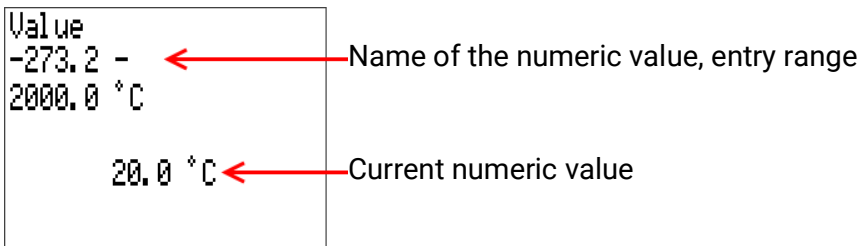
The current value is shown (example: 22.0 °C).

The top line shows the entry range (example: -273.2 – 2000.0 °C).

The value is entered by turning the rotary dial. As there are no symbols for confirming or rejecting a value, the entry is confirmed by pressing the dial or rejected by using the back button.

Designations

All elements can be designated by selecting a predefined designation from various designation groups or from the user defined designations.

You can also assign a number from 1 to 16 to every designation.

In the "General settings" menu, all user defined designations from the technician or expert level can be created, changed or deleted globally.

 Displayed in Technician or Expert mode only
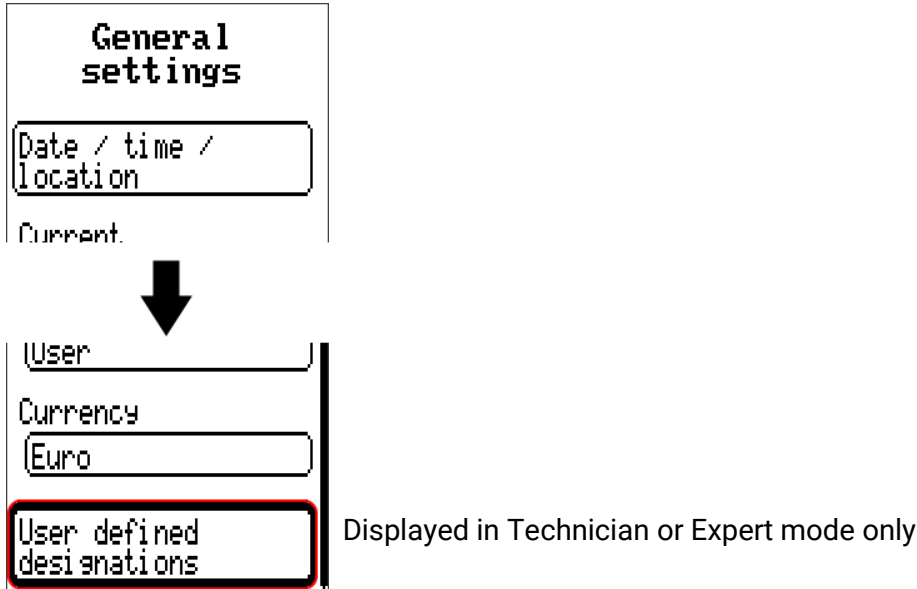
View with designations defined previously
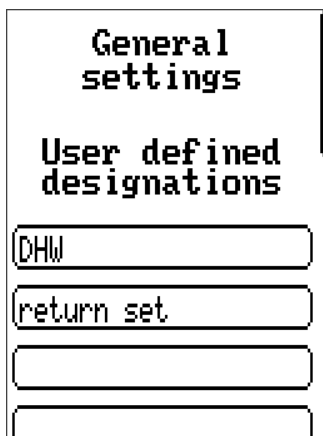
Entries are made up of letters, numbers and symbols entered consecutively.
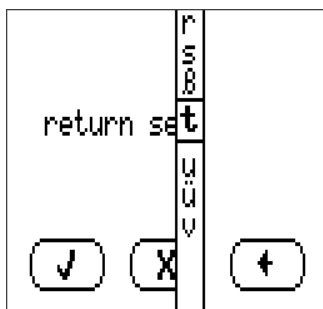
Up to 100 different designations can be defined by the user. The maximum number of characters per designation is **23.**

Designations defined previously are available for all elements (inputs, outputs, functions, fixed values, bus inputs and outputs).

Date / time / location

```
    General
    settings

 Date / time /
 location

 Current
```

The entry **Date / Time / Location** can be found under general settings.

```
 Date / time /
    location

 Time zone
 01:00

 Automatic
 time change
 Yes

 Summertime
  Yes

 Date
 03.09.2021

 Time
 09:20

 GPS latitude
 48.836500 °

 GPS longitude
 15.080000 °

 Sunrise
  06:18

 High sun
  12:59

 Sunset
  19:40

 Solar altitude
  28.7 °

 Direction of the
 sun
  113.0 °
```

The system value parameters are displayed first.

•**Time zone** – 01:00 means the time zone "**UTC + 1 hour**". UTC stands for "Universal Time Coordinated", also known as GMT (= Greenwich Mean Time).

•**Automatic time change** – If "**Yes**", the time will switch over automatically to summertime according to the specifications of the European Union.

•**Summertime** – "**Yes**" if summertime is active. Can only be changed if the "Automatic time change" is set to "No".

•**Date** – The current date (dd.mm.yy).

•**Time** – The current time

•**GPS latitude** – Geographical latitude according to GPS (= global positioning system)

•**GPS longitude** – Geographical longitude according to GPS

•**Sunrise** – time

•**High sun** – time

•**Sunset** – time

•**Solar altitude** – Specified in ° as measured from the geometric horizon (0°), zenith = 90°

•**Direction of the sun** – Specified in ° as measured from the north (0°)

  North = 0°   East = 90°   South = 180°   West = 270°

The values for geographical latitude and longitude are used to determine the location-specific solar data. That data can be used in functions (e.g. shading function).

The factory default settings for the GPS data are for the location of Technische Alternative in Amaliendorf, Austria.

Value summary

In this menu, the sensor inputs, DL bus inputs and analogue/digital CAN bus inputs can be clearly displayed.

```
Value summary
┌─────────────────────┐
│█████ Inputs ████████│
├─────────────────────┤
│       DL BUS        │
├─────────────────────┤
│  CAN bus analogue   │
├─────────────────────┤
│   CAN bus digital   │
```
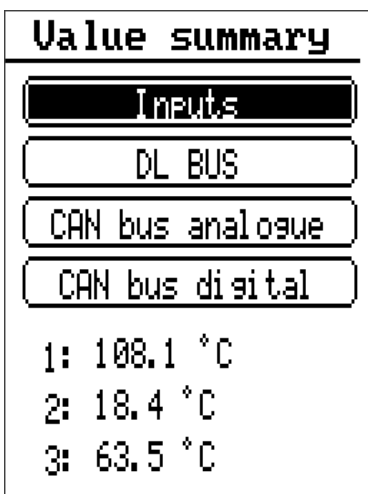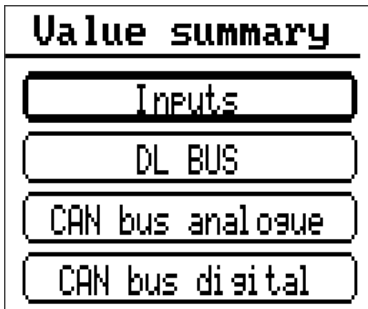
If an entry is selected, the corresponding values are listed below.

```
Value summary
┌─────────────────────┐
│██████ Inputs ███████│
├─────────────────────┤
│       DL BUS        │
├─────────────────────┤
│  CAN bus analogue   │
├─────────────────────┤
│   CAN bus digital   │
└─────────────────────┘

  1: 108.1 °C
  2: 18.4 °C
  3: 63.5 °C
```

Inputs

The energy meter has 8 inputs for analogue (measurements), digital (ON/OFF) signals or pulses.

Typ	S1	S2	S3	S4	S5 VT1	S6 VT2	S7 VT1	S8 VT2
Digital	x	x	x	x	x	x	x	x
Analogue (all measured variables and sensor types)	x	x	x	x	x	x		
Analogue (measured variable: temp.; sensor: FTS)					x	x		
Pulse (all measured variables) (e.g. VSG sensor) S0 signals (max 20 Hz)							x	x
Pulse (measured variable: flow rate)							x	x

This menu displays the inputs with their designation and the current measurements or status.

Example of a programmed system; input 4 is still unused:

Programming the parameters

Sensor type and measured variable

Once the required input is selected, the sensor type can be defined.

First, you must specify the basic type of input signal.

- **Digital**
- **Analogue**
- **Pulse**

Digital

Select the **measured variable:**

- **Off / On**
- **No / Yes**
- **Off / On (inverse)**
- **No / Yes (inverse)**

Analogue

Select the **measured variable:**

- **Temperature**
- Select the sensor type: **KTY** (2 kΩ/25°C = formerly Technische Alternative's standard type), **PT 1000** (= current standard type), room sensors: **RAS**, **RASPT**, **THEL** thermocouple, **KTY** (1 kΩ/25°C), **PT 100, PT 500, Ni1000, Ni1000 TK5000**
- **Solar radiation** (sensor type: GBS01)
- **Voltage** (inputs 4-5: **max. 10V DC**)
- **Resistance**
- **Humidity** (sensor type: **RFS**)
- **Rain** (sensor type: **RES**)

Also select the **process variable** for the measured variables **Voltage** and **Resistance:**

- **Dimensionless**
- **Dimensionless (,1)**
- **Performance factor**
- **Dimensionless (,5)**
- **Temperature °C**
- **Global radiation**
- **CO2 content (ppm)**

- **Percent**
- **Absolute humidity**
- **Pressure bar, mbar, Pascal**
- **Litre**
- **Cubic metre**
- **Flow rate (l/min, l/h, l/d, m³/min, m³/h, m³/d)**

- **Output**
- **Voltage**
- **Amperage mA**
- **Amperage A**
- **Speed km/h**
- **Speed m/s**
- **Degree (angle)**

Then you must use scaling to define the value range.

Example Voltage/Global radiation:

```
Scaling

Input value 1
0.00 V

Target value 1
0 W/m²

Input value 2
10.00 V

Target value 2
1500 W/m²
```

0.00 V equates to 0 W/m^2, 10.00 V yields 1500 W/m^2.

Pulse input

Inputs **7 - 8** can detect pulses with **max. 20 Hz.** Inputs **1 - 6** can detect pulses with max. **10 Hz** and at least **50 ms** pulse duration.

Select the measured variable

```
    Input 6

Type
(Pulse            )

Measured variable
┌─────────────────┐
│Wind speed]      │
│Flow rate        │
│Pulse            │
│User defined     │
└─────────────────┘
```

Wind speed

A quotient must be entered for the "Wind speed" measured variable. This is the signal frequency at 1 km/h.

Example: The WIS01 wind sensor issues one pulse (=1Hz) per second at a wind speed of 20 km/h. Therefore the frequency at 1 km/h equals 0.05 Hz.

```
Quotient
(0.05 Hz          )
```

Setting range: 0.01 – 1.00 Hz

Flow rate

A quotient must be entered for the "Flow rate" measured variable. This is the flow rate in litres per pulse.

```
Quotient
(0.5 l/Imp        )
```

Setting range: 0.1 – 100.0 l/pulse

Pulse

This measured variable is used as the input variable for the "Meter/Counter" function, as a pulse counter with "Pulses" as its unit.

User defined

For the "User defined" measured variable, both the quotient and the unit must be entered.

```
Quotient
(0.50000 l/Imp    )

Unit
(l                )

Time unit
(/h               )
```

```
Quotient
(0.00125 kWh/Imp  )

Unit
(kW               )
```

Setting range for quotient: 0.00001 – 1000.00000 units/pulse (5 decimal places)

Units: l, kW, km, m, mm, m³.

For l, mm and m³ the unit of time must be selected as well. For km and m the units of time are pre-defined and cannot be changed.

Example: For the "Energy meter" function, the unit "kW" can be used. In the example above, 0.00125 kWh/pulse was selected, which equates to 800 pulses /kWh.

Designation

Enter the input designation by selecting a predefined designation from various designation groups or from the user defined designations.

Sensor type Analogue / Temperature:

- General
- Generator
- Consumer
- Line
- Climate
- User (user defined designations)

You can also assign a number from 1 to 16 to every designation.

Sensor correction

The option of sensor correction is available for the measured variables Temperature, Solar radiation, Humidity and Rain. The corrected value is utilized for all calculations and displays.

Example: PT1000 temperature sensor

```
Sensor
(PT 1000

Sensor correction
(0.2 K
```

Average

```
Average
(1.0s
```

This setting refers to the average of the measurements over time.

Averaging over 0.3 seconds leads to extremely rapid reactions on the part of the display and the unit. However, this can be expected to cause fluctuations of the value.

A large average value leads to inertia and is only recommended for sensors for the heat meter.

For simple measuring tasks, around 1 - 3 seconds should be selected. For hygienic domestic hot water heating with the ultra-fast sensor, 0.3 - 0.5 seconds should be selected.

Sensor check for analogue sensors

```
┌─────────────────────┐
│ Sensor check        │
│ (Yes                │
└─────────────────────┘

  Short circuit
  threshold
  (Standard    )

  Short circuit value
  (Standard    )
```

```
              ↓
  Lead break
  threshold
  (Standard    )

  Lead break value
  (Standard    )
```
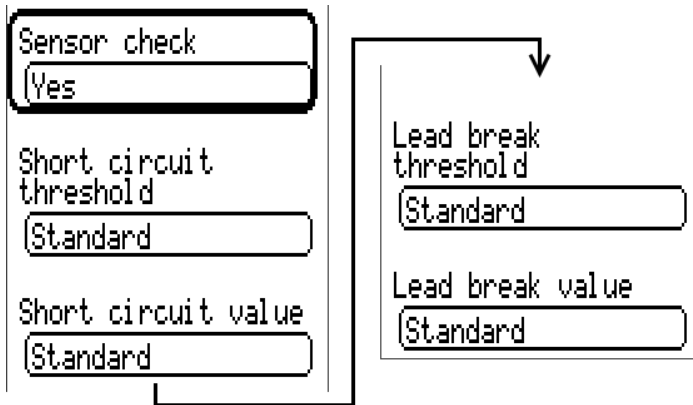
When "Sensor check" is active (setting: "Yes"), a short circuit or a lead break will automatically generate a fault message.

Example:

```
┌─────────────────────┐
│      Inputs         │
├─────────────────────┤
│ 1: T.collector 1    │
│         -9999.9 °C   │
└─────────────────────┘
```

Sensor error

When "**Sensor check**" is active, **Sensor error** is available as an input variable for functions: status "**No**" for a sensor that is working correctly and "Yes" for a defect (short circuit or lead break). This allows the controller to react to the failure of a sensor, for example.

In System values / General, a sensor error for all inputs is available.

If the **Standard** thresholds are selected, a short circuit will be indicated if the value falls below the lower **measurement limit** and a lead break will be indicated if the value exceeds the upper **measurement limit.**

The **Standard** values for temperature sensors are -9999.9 °C for a short circuit and 9999.9 °C for a lead break. Those values are utilised in the internal calculations in the event of an error.

By selecting the thresholds and values appropriately, a fixed value can be specified for the controller in the event of sensor failure, in order to allow a function to continue operating in emergency mode.

Example: If the temperature value falls below the threshold of -40 °C (= "Threshold value"), a value of 0.0 °C (= "Output value") is issued and displayed for that sensor (fixed hysteresis: 1.0 °C). At the same time the "Sensor error' status is set to "**Yes**".

The short circuit threshold must be defined below the lead break threshold.

```
┌─────────────────────┐
│ Sensor check        │
│ (Yes                │
└─────────────────────┘

  Short circuit
  threshold
  (User defined)

  Threshold value
  (-40.0 °C    )
```

```
              ↓
  Short circuit value
  (User defined)

  Output value
  (0.0 °C      )
```
→
```
┌─────────────────────┐
│      Inputs         │
├─────────────────────┤
│ 1: T.collector 1    │
│           0.0 °C     │
└─────────────────────┘
```
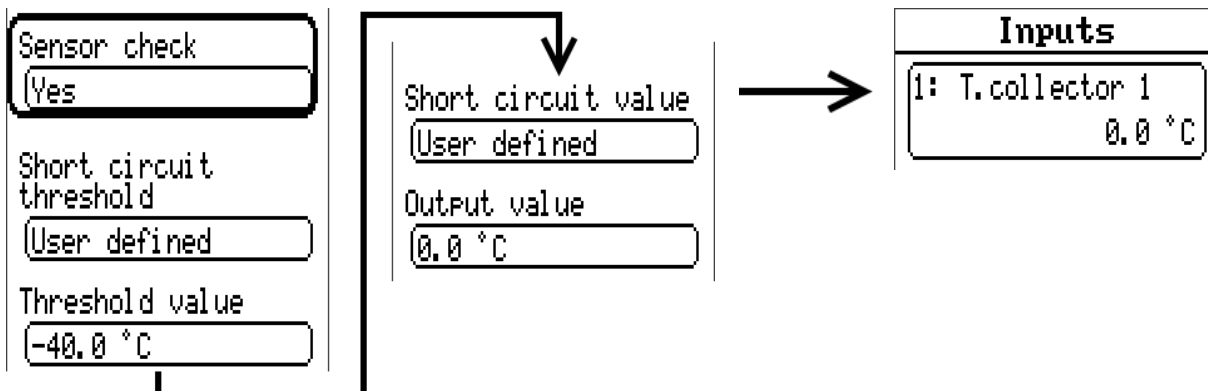
Example: Sensor 1 has fallen below -40 °C, so 0 °C is issued as the measurement, and a sensor error is displayed at the same time.

Assignment of the possible sensor types to the inputs

	PT1000, KTY (2kΩ), KTY (1kΩ), PT100, PT500, Ni1000, Ni1000TK5000, NTC	Digital (ON/OFF)	THEL, GBS01, RFS, RES01	Voltage 0 – 3,3 V DC	Resistance 1 – 100 kOhm	Pulses max 10 Hz	Pulses (S0) max. 20 Hz	Temperature of an FTS sensor
Inputs 1 - 4	x	x	x	x	x	x		
Inputs 5 - 6	x	x	x	x	x	x		x
Inputs 7 - 8		x					x	x

In the case of **voltage measurements** (max. 3.3V), note that the internal resistance of the **voltage source** must not exceed 100 ohms otherwise the accuracy will be less than that specified in the technical data.

Resistance measurement: If the process variable is set to "Dimensionless", measurement is only possible up to 30 kΩ. If the process variable is set to "Resistance" and the resistances being measured are >15 kΩ, the averaging time should be increased as the values will fluctuate slightly.

Resistance table for various sensor types

Temp. [°C]	0	10	20	25	30	40	50	60	70	80	90	100
PT1000 [Ω]	1000	1039	1078	1097	1117	1115	1194	1232	1271	1309	1347	1385
KTY (2kΩ) [Ω]	1630	1772	1922	2000	2080	2245	2417	2597	2785	2980	3182	3392
KTY (1kΩ) [Ω]	815	886	961	1000	1040	1122	1209	1299	1392	1490	1591	1696
PT100 [Ω]	100	104	108	110	112	116	119	123	127	131	135	139
PT500 [Ω]	500	520	539	549	558	578	597	616	635	654	674	693
Ni1000 [Ω]	1000	1056	1112	1141	1171	1230	1291	1353	1417	1483	1549	1618
Ni1000 TK5000 [Ω]	1000	1045	1091	1114	1138	1186	1235	1285	1337	1390	1444	1500

The standard type used by Technische Alternative is **PT1000.**

KTY (2 kΩ) was the factory-fitted standard type until 2010/2011.

PT100, PT500: As these sensors are more susceptible to external interference, their sensor leads must be **screened** and the **Average time** should be increased. Nevertheless the accuracy specified in the technical data for PT1000 sensors **cannot be guaranteed.**

NTC sensors

```
Sensor
[NTC        ]

R25
[1.00 kΩ    ]

Beta
[1000       ]
```

For evaluating the NTC sensors, the R25 value and the beta value must be specified.

The nominal resistance R25 is always based on 25 °C.

The beta value refers to the characteristic of an NTC sensor in relation to 2 resistance values.

Beta is a material constant and can be calculated from the manufacturer's resistance table using the following formula:

$$B = \frac{\ln \dfrac{R1_{(NT)}}{R2_{(HT)}}}{\dfrac{1}{T1_{(NT)}} - \dfrac{1}{T2_{(HT)}}}$$

As the beta value is not a constant over the total temperature curve, the anticipated limits of the measuring range must be determined (e.g. for a cylinder sensor from +10 °C to +100 °C or for an outside sensor from -20 °C to +40 °C).

All temperatures in the formula must be given as **absolute temperatures in K** (Kelvin) (e.g. +20 °C = 273.15 K + 20 K = 293.15 K)

ln	Natural logarithm
$R1_{(NT)}$	Resistance at the minimum temperature of the temperature range
$R2_{(HT)}$	Resistance at the maximum temperature of the temperature range
$T1_{(NT)}$	Minimum temperature of the temperature range
$T2_{(HAT)}$	Maximum temperature of the temperature range

PTC sensors

```
Sensor
[PTC         ]

R25
[1.00 kΩ     ]

Alpha (x10^-3)
[7.95000      ]

Beta (x10^-6)
[19.50000     ]
```

The R25 value is also required for the evaluation of PTC sensors. The nominal resistance R25 is based on 25 °C.

In addition, the **Alpha (x10^-3)** and **Beta (x10^-6)** values are required. The **Alpha** and **Beta** values are normally taken from the PTC sensor datasheet and entered after applying the adjacent formula.

To calculate the **Alpha** and **Beta** values, any two resistance values and their associated temperatures are selected according to the resistance table of the respective PTC sensor.

R_1 ... Resistance value 1 (Ohm)	T_1 ... Temperature at resistance R_1 (°C)	$\Delta T_1 = T_1 - 25$ °C
R_2 ... Resistance value 2 (Ohm)	T_2 ... Temperature at resistance R_2 (°C)	$\Delta T_2 = T_2 - 25$ °C

Beta should be calculated first, as that value is necessary to calculate **Alpha**.

Fixed value

```
Value summary
Inputs
┌─────────────┐
│Fixed values │
└─────────────┘
Functions
```

In this menu you can define up to 64 fixed values, which can be used as input variables for functions, for example.

When this item is selected in the main menu, the fixed values already defined are displayed together with their designation and their current value or status.

Example:

```
   Fixed values
┌──────────────────┐
│1: Minimum        │
│temperature       │
│           0.0 °C │
└──────────────────┘
2: Maximum
temperature
           20.0 °C

3: unused
```

Programming the parameters

Example: Fixed value 1

```
       ⚏
 Fixed value 1

 Type
 (unused
```

Fixed value type

Once the required fixed value is selected, the fixed value type can be defined.

- • Digital
- • Analogue
- • Pulse

Digital

Select the measured variable:

- • Off / On
- • No / Yes

Select whether the status can be changed via a selection box or simply by a click

```
 Changeover
 Selection box
 Click
```

Changing a digital fixed value

Tapping a button with a light background allows you to change the fixed value either via a selection box or by tapping ("Click"). If the status does not appear on a light background, that status cannot be changed from the logged-in user level.

Example: Changeover from ON to OFF via a selection box

```
  Fixed values

 1: Enable
          ON
```

↓

```
  Fixed values

 1: Enable
         OFF
         ON
```

↓

```
  Fixed values

 1: Enable
         OFF
```

Analogue

Select from a wide range of function quantities

```
Type
(Analogue          )

Function quantity
┌──────────────────┐
│dimensionless     │
└──────────────────┘
  Dimensionless
D (.1)
  Performance
```

● ● ●
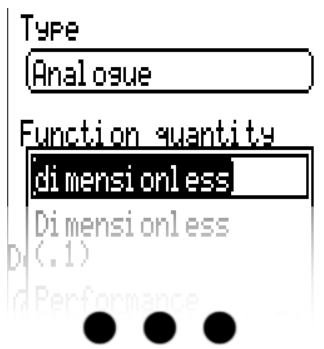
For fixed values, the function quantity "Time" (shown as: 00:00) is also available.

After assigning the designation, you must define the permitted limits and the current fixed value. The value can be adjusted in the menu within those limits.

Example:

```
Minimum
(50.0 °C          )

Maximum
(65.0 °C          )

Value
(0.0 °C           )
```
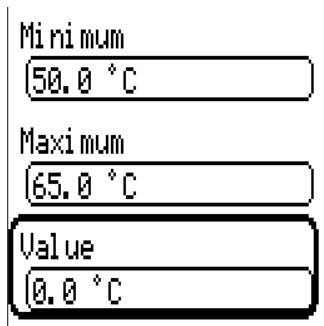
Changing an analogue fixed value

Tapping the button allows you to change the fixed value via the dial. If the value does not appear on a light background, that status cannot be changed from the logged-in user level.

```
1: Set temperature
(         50.0 °C )

        ↓

1: Set temperature
50.0 -
65.0 °C

        50.0 °C
```
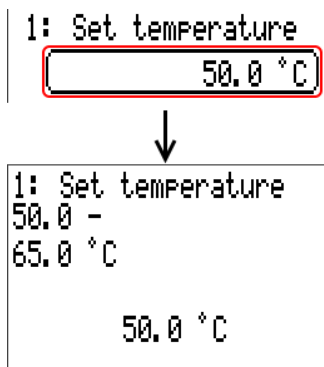
Pulse

A fixed value of this type allows short pulses to be generated by tapping it in the menu "Fixed values".

```
┌─────────────────────────┐
│  Fixed values           │
├─────────────────────────┤
│ 1: Start                │
│   ┌─────────────────┐   │
│   │            OFF  │   │
│   └─────────────────┘   │
└─────────────────────────┘
```

A pulse can also be triggered in the menu of the fixed value by tapping.

Function quantity

```
┌─────────────────────────┐
│  Fixed value 1          │
│                         │
│ Type                    │
│ (Pulse          )       │
│                         │
│ Function quantity       │
│ │ON pulse │             │
│ │OFF pulse│             │
└─────────────────────────┘
```
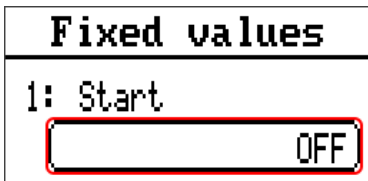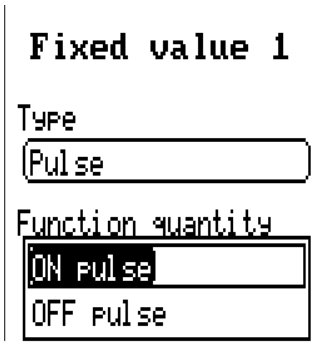
Select the function quantity: When activated, either an ON pulse (from OFF to ON) or an OFF pulse (from ON to OFF) will be generated, depending on the selection made here.
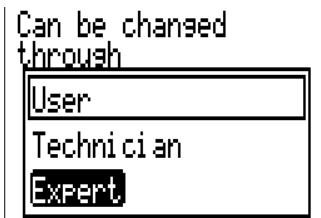
Designation

Enter the fixed value designation by selecting a predefined designation or one of the user defined designations.

You can also assign a number from 1 to 16 to every designation.

Restriction of change authority

For all fixed values, you can set the user level from which the fixed value can be changed:

```
┌─────────────────────────┐
│ Can be changed          │
│ through                 │
│ │User      │            │
│ │Technician│            │
│ │Expert    │            │
└─────────────────────────┘
```

Functions

Functions are created, programmed and linked in this menu. This section only describes how functions and links are created. For more detailed information on the various function modules, see the **Programming: functions** instructions of the freely programmable controllers.

Functions
New function

Creating a new function

Type

| Analogue function |
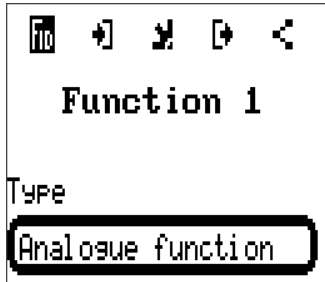
Under **Type** you select which function is to be created.

The line at the top of the menu provides access to **fiD** (type and designation), **input variables, parameters, output variables** and **links.**

Function 1

The menu whose symbol is highlighted in black is displayed.

Example: linking the "collector temperature" input variable to an input

Solar

| Enable |
ON

| Collector temperature |
0.0 °C
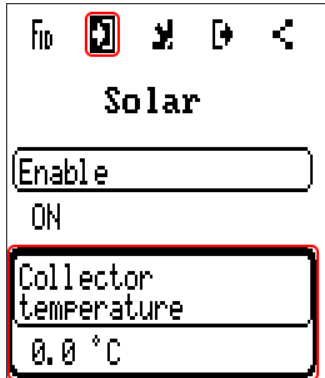
Selecting the symbol for **input variables**

Selecting the required input variable

Solar

Collector temperature

| Inputs |

| 1: T.collector |

| Measurement |

114.6 °C
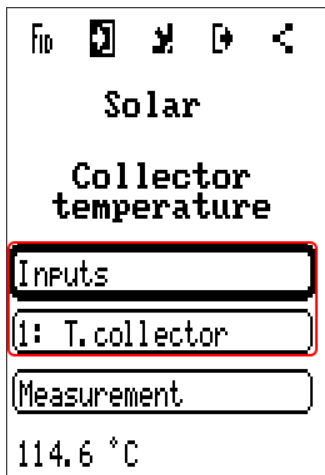
The first entry shows various sources for values; **Inputs** is selected

The required input is selected

Messages

This menu item displays activated messages.

```
┌─────────────────────┐
│ Value summary       │
│ Inputs              │
│ Fixed values        │
│ Functions           │
│(Messages           )│
│ CAN BUS             │
│ DL DUC              │
└─────────────────────┘
```

⬇

Example: A message is active.

```
┌─────────────────────┐
│      Messages       │
├─────────────────────┤
│(2: Excess          )│
│ temperature         │
│          03.09.2021 │
│              11:57  │
└─────────────────────┘
```

CAN bus

The CAN network allows communication between CAN bus devices. When analogue or digital values are sent via CAN outputs, other CAN bus devices can utilise those values as CAN inputs.

This menu contains all of the information and settings needed to set up a CANopen network. Up to 62 CAN bus devices can be operated in one network.

Every CAN bus device must be given its own node number in the network.

The cable topology of a CAN bus network is described in the installation instructions.

```
Value summary
Inputs
Fixed values
Functions
Messages
CAN BUS
DL BUS
Modbus
```

```
CAN BUS
Datalogging
CAN settings
CAN analogue
inputs
CAN digital
inputs
CAN analogue
outputs
CAN digital
outputs
```

Datalogging

This menu is not visible in the User mode.
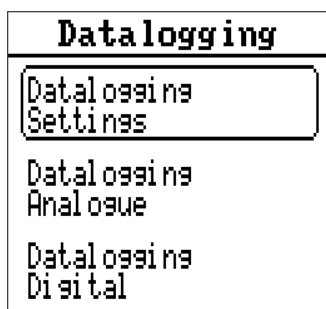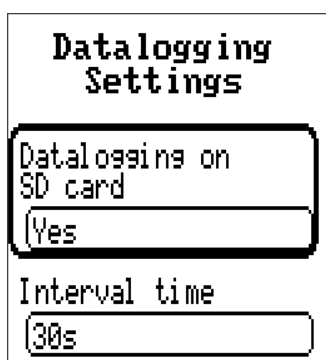
```
Datalogging
┌─────────────┐
│Datalogging  │
│Settings     │
└─────────────┘
Datalogging
Analogue

Datalogging
Digital
```

In this menu, the settings for datalogging are defined via CAN bus or on the SD card of the controller for analogue and digital values.

Datalogging Settings

```
  Datalogging
    Settings

┌─────────────┐
│Datalogging on│
│SD card      │
│┌───────────┐│
││Yes        ││
│└───────────┘│

Interval time
┌───────────┐
│30s        │
└───────────┘
```

Here, you can define whether the logging values are stored on the SD card for the controller and if so, at what intervals.

The logged daily log files are stored in the LOG/year folder. Logging only takes place when the SD card is inserted.

If the memory available on the SD card falls below 50 MB, the oldest daily log files will be automatically deleted. The logged values can be read out using Winsol software on the SD card (see Winsol manual).

Datalogging Analogue/Digital

The settings apply to both datalogging on the SD card for the controller and for CAN datalogging with the C.M.I.

Each controller can issue a maximum of 64 digital and 64 analogue values that are defined in this sub-menu.

The sources for the logged values can be inputs, outputs, function output variables, fixed values, system values, and DL and CAN bus inputs.

Note: Digital inputs must be defined within the range of **digital** values.

Any number of counter functions (but a maximum of 64 analogue values) can be logged. Like all other analogue values, the counter values to be logged are entered into the "Analogue datalogging" list.

CAN datalogging requires at least version 1.25 on the C.M.I. datalogger and a Winsol version of at least 2.06.

CAN datalogging is only possible with the C.M.I. datalogger. In contrast to data recording via the DL bus, the data to be logged via the CAN-bus can be freely selected. There is no constant data output. When requested by a C.M.I., the controller saves the current values to a logging buffer and locks it to prevent it from being overwritten (when requests are received from another C.M.I.) until the data is read out and the logging buffer has been enabled again.

The settings required on the C.M.I. for datalogging via CAN bus are described in the C.M.I.'s online help.

CAN settings

```
CAN settings

Node
1

Designation
CAN-EZ3

BUS rate
50 kbit/s
(standard)
```

Node

Define a unique CAN node number for the device (setting range: 1 – 62). The device with node number 1 provides the time stamp for all other CAN bus devices.

Designation

Every controller can be given its own designation.

Bus rate

The standard bus rate of the CAN network is 50 kbit/s (50 kBd), which is specified for most CAN bus devices.

Important: All devices in the CAN bus network must have the **same** transfer rate in order to be able to communicate with each other.

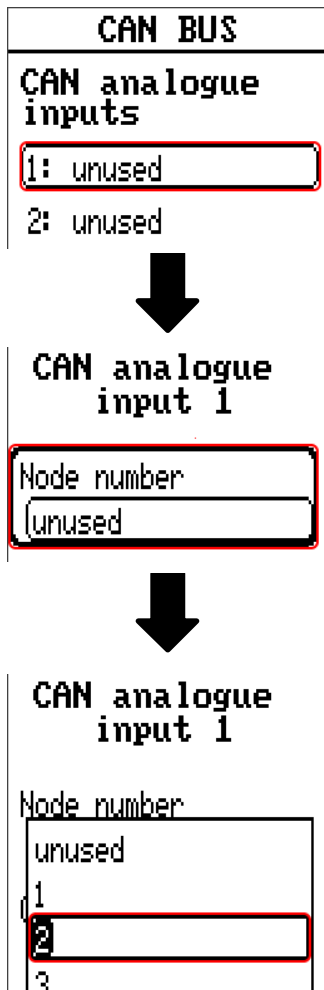The bus rate can be set to between 5 and 500 kbit/s, with lower bus rates allowing longer cable networks.

Bus rate [kbit/s]	Maximum permissible total bus length [m]
5	10.000
10	5.000
20	2.500
50 (standard)	1.000
125	400
250	200
500	100

In the event of a total reset from the "Data admin" menu, the settings for the node number and bus rate are retained.

CAN analogue inputs

Up to 64 CAN analogue inputs can be programmed. They are defined by specifying the transmission node number and the number of the transmission node's CAN output.

```
        CAN BUS
  CAN analogue
  inputs

 [1: unused          ]

  2: unused
```

⬇

```
  CAN analogue
     input 1

 [Node number        ]
 [unused             ]
```

⬇

```
  CAN analogue
     input 1

 Node number
  unused
  1
 [2                  ]
  3
```

Node number

After the node number of the **transmission node** is entered, the other settings can be specified. The number of a CAN analogue output is taken from the device with that node number and applied here.

Example: On CAN analogue **input 1,** the output number applied is that of CAN analogue **output 1 from** the device with node number 2.

```
  CAN analogue
     input 1

 Node number
 [2                  ]

 Output number
 [1                  ]
```
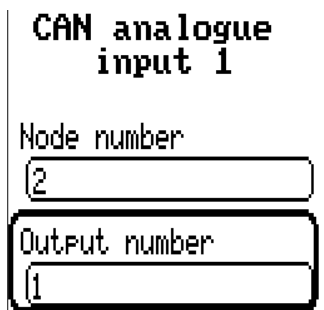
Designation

Every CAN input can be given its own designation. The designation can be selected from various designation groups or can be user defined, as for the other controller inputs.

Beispiel:

```
Designation

┌─────────────────────┐
│ Temperature actual  │
│ value               │
└─────────────────────┘
┌─────────────────────┐
│ T.collector         │
└─────────────────────┘
┌─────────────────────┐
│ 1                   │
└─────────────────────┘
```

CAN bus timeout

Define the timeout time for the CAN input (minimum value: 5 minutes).

```
┌─────────────────────┐
│ CAN BUS timeout     │
│ 5m                  │
└─────────────────────┘
```

As long as the information continues to be read from the CAN bus, the **network error** for the CAN input will be "**No**".

If the value has not been updated for longer than the set timeout, the **network error** changes from "No" to "**Yes**". You can then define whether the controller should issue the last value transmitted or a definable substitute value (only when the measured variable is set to **User**).

The **network error** can be selected as the source of a function input variable, which allows the controller to react appropriately to a failure of the CAN bus or transmission node.

In **System values** / General, a network error for **all** CAN inputs is available.

Sensor check

If you set "Sensor check" to "Yes", the sensor error of the sensor supplying the CAN input is available as an input variable for a function.

```
┌─────────────────────┐
│ Sensor check        │
│ Yes                 │
└─────────────────────┘
```

Measured variable

If "Measured variable" is set to "**Automatic**", the unit of measurement specified by the transmission node will be applied in the controller.

```
┌─────────────────────┐
│ Measured variable   │
│ Automatic           │
└─────────────────────┘
```

If you select "**User**", you can select a unit of your own, a sensor correction and, if sensor check is active, a monitoring function.

```
┌─────────────────────┐
│ Measured variable   │
│ ┌─────────────────┐ │
│ │ Automatic       │ │
│ └─────────────────┘ │
│ ┌─────────────────┐ │
│ │ User defined    │ │
│ └─────────────────┘ │
└─────────────────────┘
```

Every CAN input is assigned its own unit, which can differ from the unit used by the transmission node. A range of units is available to choose from.
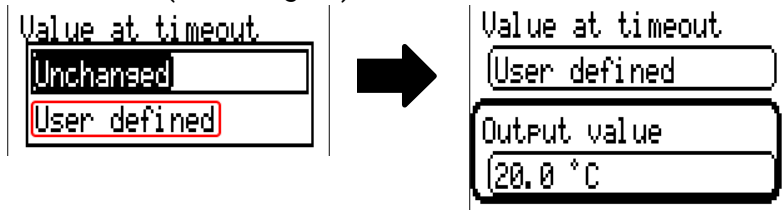
```
┌─────────────────────┐
│ Unit                │
│ Temperature °C      │
└─────────────────────┘
```
This setting is only displayed if "Measured variable" is set to "**User**".

Value at timeout

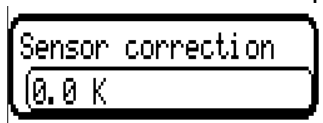This setting is only displayed if "Measured variable" is set to "User".

If the timeout time is exceeded, you can define here whether the controller should issue the last value transmitted ("Unchanged") or a definable substitute value.

```
Value at timeout        Value at timeout
Unchanged               User defined
User defined
                        Output value
                        20.0 °C
```
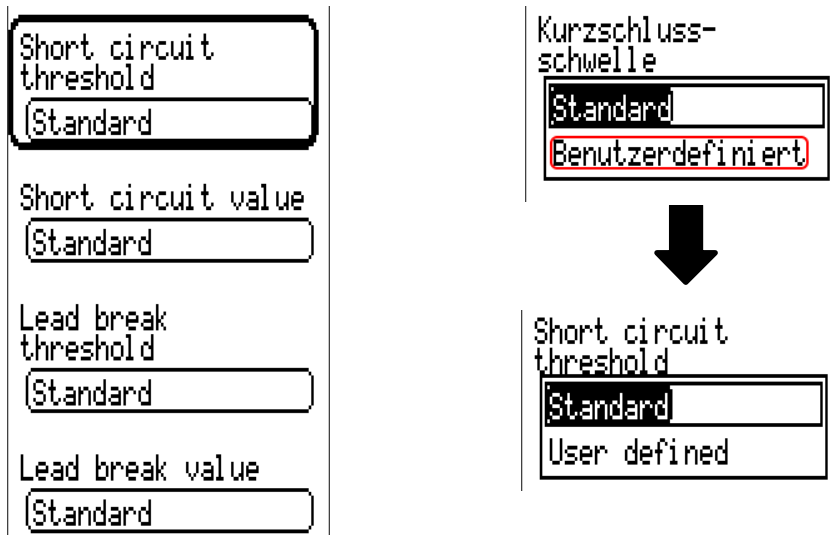
Sensor correction

This setting is only displayed if "Measured variable" is set to "User".

The value of the CAN input can be corrected by applying a fixed value.

```
Sensor correction
0.0 K
```

Sensor error

```
Short circuit            Kurzschluss-
threshold                schwelle
Standard                 Standard
                         Benutzerdefiniert
Short circuit value
Standard
                               ↓
Lead break
threshold                Short circuit
Standard                 threshold
                         Standard
Lead break value         User defined
Standard
```

This setting is only displayed if **sensor check is active and** "Measured variable" is set to "**User**".

When "**Sensor check**" is active, the **sensor error** of a CAN input is available as an input variable for functions: status "**No**" for a sensor that is working correctly and "**Yes**" for a defect (short circuit or lead break). This allows the controller to react to the failure of a sensor, for example.

If the **Standard** thresholds are selected, a short circuit will be indicated if the value falls below the **measurement limit** and a lead break will be indicated if the value exceeds the **measurement limit.**

The **Standard** values for temperature sensors are -9999.9 °C for a short circuit and 9999.9 °C for a lead break. Those values are utilised in the internal calculations in the event of an error.

By selecting the thresholds and values for short circuit and lead break appropriately, a fixed value can be specified for the controller in the event of sensor failure at the transmission node, in order to allow a function to continue operating in emergency mode (fixed hysteresis: 1.0 °C).

The short circuit threshold must be defined below the lead break threshold.

In **System values** / General, a sensor error for **all** inputs, CAN inputs and DL inputs is available.

CAN digital inputs

Up to 64 CAN digital inputs can be programmed. They are defined by specifying the transmission node number and the number of the transmission node's CAN output.

Their parameters are programmed in almost exactly the same way as for the CAN analogue inputs.

Under Measured variable / User the Display for the CAN digital input can be changed from Off / On to No / Yes and you can define whether the controller should issue the last status transmitted ("Unchanged") or a definable substitute status when the timeout time is exceeded.
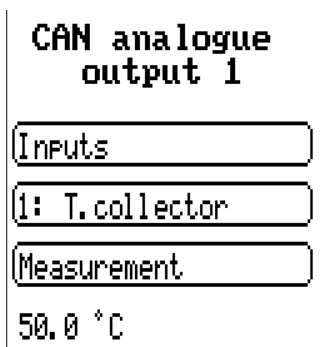
CAN analogue outputs

Up to 32 CAN analogue outputs can be programmed. They are defined by specifying the source in the controller.
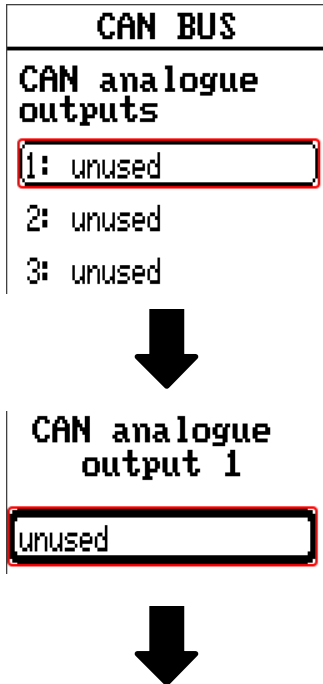
Specify the source in the controller which supplies the value for the CAN output.

- **Inputs**   • **System values**
- **Functions**   • **DL bus**
- **Fixed values**

Example: Source, Input 1

68

Designation

Every CAN analogue output can be given its own designation. The designation can be selected from various designation groups or can be user defined, as for the inputs.

Example:

```
Designation

 Temperature actual
 value

 T.collector

 1
```

Transmission condition

Example:

```
Transmission
condition

If change >
 1.0 K

Blocking time
 10s

Interval time
 5m
```

If change > 1.0 K	If the current value has changed by more than 1.0 K compared to the last transmitted value, a new transmission is made. The unit used by the source is applied to the output value (minimum setting: 0.1 K).
Blocking time 10 s	If the value changes by more than 1.0 K within 10 seconds of the last transmission, the value is nevertheless only transmitted again after 10 seconds (minimum setting: 1 sec.).
Interval time 5 m	The value is transmitted every 5 minutes even if it has not changed by more than 1.0 K since the last transmission (minimum setting: 1 minute).

CAN digital outputs

Up to 32 CAN digital outputs can be programmed. They are defined by specifying the source in the controller.

Their parameters are programmed in exactly the same way as for the CAN analogue outputs except for the transmission conditions.

Designation and transmission condition

Every CAN digital output can be given its own designation. The designation can be selected from various designation groups or can be user defined, as for the inputs.

Example:

```
Designation
(Output general    )
(Heat pump demand  )
(1                 )
```

Transmission condition
Example:

```
Transmission
condition

If change
(No                )

Blocking time
(10s               )

Interval time
(5m                )
```

If change Yes/No	Transmission of the value if a status change occurs
Blocking time 10 s	If the value changes within 10 seconds of the last transmission, the value is nevertheless only transmitted again after 10 seconds (minimum setting: 1 sec.).
Interval time 5 m	The value is transmitted every 5 minutes even if it has not changed since the last transmission (minimum setting: 1 minute).

Active CAN nodes

```
32: CAN-EZ3

1: CMI
```

If Back is pressed in the main menu view, the network overview opens. All active CAN nodes with node number and device designation are displayed here. Select an x2 device to be able to access it.

This view shows a CAN-EZ3 with node number 32 in the CAN bus network, and a C.M.I. with node number 1. To return to the menu of the energy meter, select the energy meter itself (e.g.: **32: CAN-EZ3**) in this overview.

DL-Bus

> The DL bus acts as a bus cable for various sensors and/or for datalogging by C.M.I. or D-LOGG.
>
> The DL bus is a bidirectional data link and is only compatible with products from Technische Alternative. The DL bus network operates independently of the CAN bus network.

This menu contains all of the information and settings needed to set up a DL bus network.

The cable topology of a DL bus network is described in the controller's installation instructions.

```
Value summary
Inputs
Fixed values
Functions
Messages
CAN BUS
DL BUS
Modbus
CORA devices
```

```
    DL BUS
DL settings
DL input
DL output
```

DL settings

```
  DL settings

Data output
No
Yes
```

You can use this button to activate or deactivate data output for datalogging via the DL bus and for display on the RAS-PLUS room sensor. The C.M.I. can be used for DL datalogging. Only the input and output values and the 2 heat meters are included in the data output; the values of the network inputs are not included.

DL input

Sensor values from DL bus sensors are transferred via a DL input.

Up to 32 DL inputs can be programmed.

Example: Programming the parameters of DL input 1

```
        DL BUS
 DL input
 ┌─────────────────┐
 │1: unused        │
 └─────────────────┘
  2: unused

  3: unused
```

⬇

```
     DL input 1

 Type
 ┌─────────────────┐
 │unused           │
 │Digital          │
 │Analogue         │
 └─────────────────┘
```

Select: Analogue or digital

```
     DL input 1

 Type
 ┌─────────────────┐
 │Analogue         │
 └─────────────────┘

 DL bus address
 ┌─────────────────┐
 │1                │
 └─────────────────┘

 DL bus index
 ┌─────────────────┐
 │1                │
 └─────────────────┘
```

DL bus address and DL bus index

Every DL sensor must have its own DL bus address. Setting the address of a DL sensor is described in the sensor's datasheet.

Most DL sensors can measure various different values (e.g. flow rate and temperatures). Every value measured must be given its own index number. The applicable index number can be found in the DL sensor's datasheet.

Designation

Every DL input can be given its own designation. The designation can be selected from various designation groups or can be user defined, as for the other controller inputs.

Example:

```
Designation
 Temperature actual
 value
 T.solar flow
 1
```

DL bus timeout

As long as the information continues to be read from the DL bus, the network error for the DL input will be "No".

If the controller scans the DL sensor value three times and no value is transmitted, the network error changes from "No" to "Yes". You can then define whether the controller should issue the last value transmitted or a definable substitute value (only when the measured variable is set to User).

The network error can also be selected as the source of a function input variable, which allows the controller to react appropriately to a failure of the DL bus or DL sensor.

In System values / General, a network error for all DL inputs is available.

Sensor check

```
Sensor check
 Yes
```

If you set "Sensor check" to "Yes", the sensor error of the sensor supplying the DL input is available as an input variable for a function.

Measured variable

```
Measured variable
 Automatic
```

If "Measured variable" is set to "Automatic", the unit of measurement specified by the DL sensor will be applied in the controller.

If you select "User", you can select a unit of your own, a sensor correction and, if sensor check is active, a monitoring function.

```
Measured variable
 Automatic
 User defined
```

Every DL input is assigned a unit, which can differ from the unit used by the DL sensor. A wide range of units is available to choose from.

```
Unit
 Temperature °C
```

This setting is only displayed if "Measured variable" is set to "User".

Value at timeout

This setting is only displayed if "Measured variable" is set to "User".

If a timeout is set, you can define here whether the controller should issue the last value transmitted ("Unchanged") or a definable substitute value.

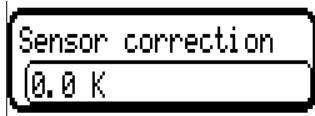```
Value at timeout
 Unchanged
 User defined
```
➡
```
Value at timeout
 User defined

 Output value
 0.0 °C
```
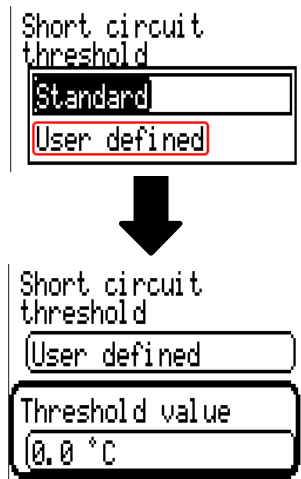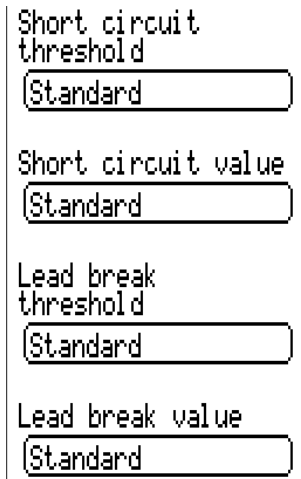
## Sensor correction

This setting is only displayed if "Measured variable" is set to "User".

The value of the DL input can be corrected by applying a fixed differential value.

```
Sensor correction
0.0 K
```

Sensor error

```
Short circuit
threshold
Standard

Short circuit value
Standard

Lead break
threshold
Standard

Lead break value
Standard
```

```
Short circuit
threshold
Standard
User defined
```

⬇

```
Short circuit
threshold
User defined

Threshold value
0.0 °C
```

This setting is only displayed if sensor check is active and "Measured variable" is set to "User".

When "Sensor check" is active, the sensor error of a DL input is available as an input variable for functions: status "No" for a sensor that is working correctly and "Yes" for a defect (short circuit or lead break). This allows the controller to react to the failure of a sensor, for example.

If the Standard thresholds are selected, a short circuit will be indicated if the value falls below the measurement limit and a lead break will be indicated if the value exceeds the measurement limit.

The Standard values for temperature sensors are -9999.9 °C for a short circuit and 9999.9 °C for a lead break. Those values are utilised in the internal calculations in the event of an error.

By selecting the thresholds and values for short circuit and lead break appropriately, a fixed value can be specified for the controller in the event of sensor failure at the transmission node, in order to allow a function to continue operating in emergency mode (fixed hysteresis: 1.0 °C).

The short circuit threshold must be defined below the lead break threshold.

In System values / General, a sensor error for all inputs, CAN inputs and DL inputs is available.

DL digital inputs

The DL bus is configured for the transfer of digital values as well as analogue. However, there is not yet any use for this at present.

The parameters are programmed in almost exactly the same way as for the DL analogue inputs.

Under Measured variable / User the Display for the DL digital input can be changed to No / Yes.

Bus load of DL sensors

A 2-pole cable provides both the power supply and the signal transfer for DL sensors. An additional power supply by means of an external power supply unit (such as with the CAN bus) is not possible.

As the DL sensors have a relatively high power demand, the "bus load" must be considered:

The CAN-EZ3 energy meter provides a maximum bus load of **100 %**. The bus loads of the DL sensors are listed in the technical data of the relevant DL sensors.

Example: The DL sensor FTS4-50DL has a bus load of 25%. Consequently up to four FTS4-50DL sensors can be connected to the DL bus.

DL output

Analogue and digital values can be transmitted to the DL bus network via a DL output. For example, a digital command to activate an O2-DL O_2 sensor can be output.

Example: Programming the parameters of DL output 1

```
      DL BUS
 DL output
 [1: unused        ]
  2: unused
  3: unused
```

▼

```
   DL output 1
 [unused           ]
```

Indication of the source in the energy meter from which the value for the DL output stems.

- **Inputs**
- **Outputs**
- **Functions**
- **Fixed values**
- **System values**
- **CAN bus analogue**
- **CAN bus digital**

Example: Digital value; source: the result of a logic function

```
   DL output 1
 [Functions        ]
 [2: Logic         ]
 [Result           ]
 OFF
```

Designation and destination address

Specify the designation and the destination address of the DL sensor to be activated.
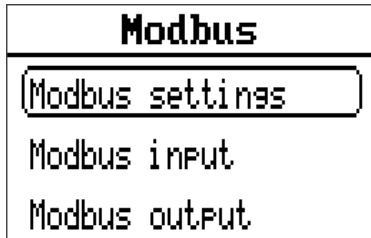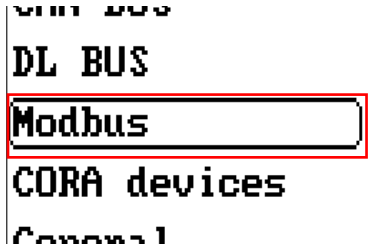
For the activation of the O2 sensor, the index has no effect and can be ignored.

Examples:

```
Designation
[User defined      ]
[O2 sensor         ]
[                  ]
```

```
Destination address
 DL bus address
 [1                ]
 DL bus index
 [1                ]
```
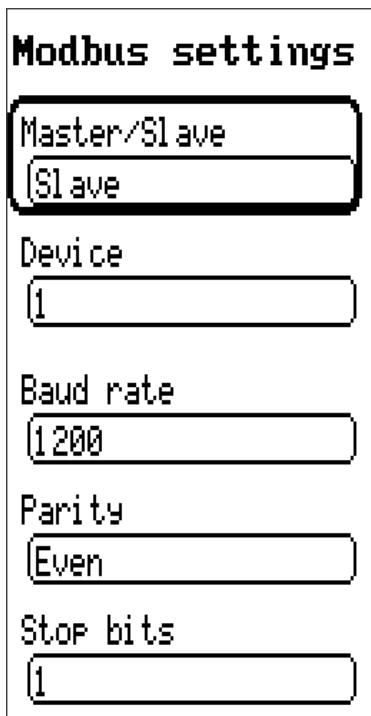
Modbus

(from version **1.09** and serial number **003600**)

The CAN-EZ3 can be used as master or slave for Modbus RTU485. In this menu, all settings for Modbus functionality are made and the inputs/outputs are programmed.

Only the **Modbus RTU485** protocol is supported.

Modbus settings

Controller programmed as **master** or **slave**

Device number 1-247 (only shown if programmed as slave)

Baud rate

Parity (Even/Odd/None)

Stop bits (1 or 2)

Modbus input

Inputs can be programmed as **analogue** (numerical value) or **digital** (On/Off or Yes/No).

Modbus input 1

Type
[Analogue]

Device
[1]

Function
[3 - Read holding register]

Address
[0]

Data type
[8-bit signed integer]

Byte order
[Big-endian]

Designation
[Temperature actual value]
[T.collector]
[1]

Interval time
[10s]

Divisor
[1]

Factor
[1]

Unit
[Temperature °C]

Unit
[Temperature °C]

Sensor correction
[0.0 K]

Start value
[0.0 °C]

Value at timeout
[Unchanged]

Sensor check
[Yes]

Short circuit threshold
[Standard]

Short circuit value
[Standard]

Lead break threshold
[Standard]

Lead break value
[Standard]

Exception Code
No Respond

Type
Select Analogue/Digital

Device/function/address
Master mode: Details about the Modbus device (slave) from which the values are applied.
Slave mode: The device's own number is specified in the device settings. The function is defined by the input type selected. The address of the module is issued automatically and counts upwards irrespective of the input number and type.

Data type/byte sequence
Only for analogue values: Details about the data type of the device from which the value is applied.

Designation
Every Modbus input can be given its own designation. The designation can be selected from various designation groups or can be user defined, as for the other inputs.

Interval time
The readout intervals can be set from 10 seconds to 30 minutes (only possible in master mode).

Divisor/factor
Only for analogue values: Input of a divisor or factor for adjusting the applied value to the actual variable (e.g. correct position of the decimal point).

Unit
Every Modbus input must be assigned a unit, as the transmitted data is dimensionless. A wide range of units is available to choose from.

Sensor correction
The value of the Modbus input can be corrected by applying a fixed differential value.

Start value
Definition of a start value which is shown after the bus converter is restarted until a new value is applied by the Modbus.

Sensor check
The sensor check can only be activated for analogue Modbus inputs.
If you set the sensor check to "Yes", the sensor error of the Modbus value is available as a digital input variable for a function.
This application is only useful if user defined threshold and output values are specified for the sensor error.

Short-circuit threshold/ value; lead break threshold/value
These 4 values can be changed from Standard to User defined, which opens an additional value input field.
If the value falls below the short-circuit threshold, the short-circuit value is output.
If the value exceeds the lead break threshold, the lead break value is output.

Exception code
Fault code for retrieval problems with the slave device. The code is not refreshed until the interval time has expired.

Modbus output

Outputs can be programmed as **analogue** (numerical value) or **digital** (On/Off or Yes/No).

```
          ⛟

Modbus output 1

Functions

1: Solar 1

Solar circuit

OFF

Type
Analogue

Designation

Temperature actual
value

T.solar flow

1

Device
1

Function
6 - Preset single
register

Address
1

Data type
8-bit signed
integer

Byte order
Big-endian

Divisor
1

Factor
1
```
⬇

First, select the value to be transmitted (function, fixed value, system value, DL bus, CAN bus). The two following entries depend on your selection.
The current value is displayed.

Type
Select Analogue/Digital

Designation
Every Modbus output can be given its own designation. The designation can be selected from various designation groups or can be user defined, as for the other inputs.

Device/function/address
Master mode: These details relate to the target device (slave) and are therefore only available in master mode.
Slave mode: The device's own number is specified in the device settings. The function is defined by the input type selected. The address of the module is issued automatically and counts upwards irrespective of the input number and type.

Data type/byte sequence
Only for analogue values: Details about the data type of the output value in the bus converter (matched to the target device).

Divisor/factor
Only for analogue values: Input of a divisor or factor for

```
Byte order
Big-endian

Divisor
1

Factor
1

Transmission
condition

If change >
1

Blocking time
10s

Send in intervals
No


Transmission
condition

If change
Yes

Blocking time
10s

Send in intervals
No

Exception Code
 No Respond
```

adjusting the output value to the target device. Only whole numbers without a unit can be output to the Modbus. Example: 37.5 °C is output as "375". If only "37" is to be output, enter 10 as the divisor.

Transmission condition
Analogue:
If change > 1.0 K:
If the current value has changed by more than 1.0 K compared to the last transmitted value, a new transmission is made. The unit used by the source is applied (minimum value: 0.1 K).
Blocking time 10 s:
If the value changes by more than 1.0 K within 10 seconds of the last transmission, the value is still only retransmitted after 10 seconds (minimum value: 1 second).
Interval time 5 m:
The value is transmitted every 5 minutes even if it has not changed by more than 1.0 K since the last transmission (minimum value: 1 minute).
Digital:
If change Yes/No:
The message is sent whenever the status changes.
Blocking time 10 s:
If the value changes within 10 seconds of the last transmission, the value is still only retransmitted after 10 seconds (minimum value: 1 second).
Interval time 5 m:
The value is transmitted every 5 minutes even if it has not changed since the last transmission (minimum value: 1 minute).

Exception code
Fault code for retrieval problems with the slave device. The code is not refreshed until the interval time has expired.

CORA devices

*For more information about the wireless system, see chapter **Wireless system** in the installation instructions.*
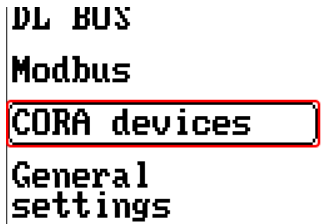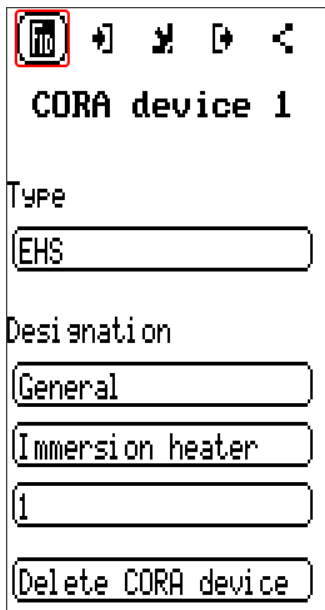
This menu allows other devices to be paired and programmed wirelessly, and transmitted values to be imported.
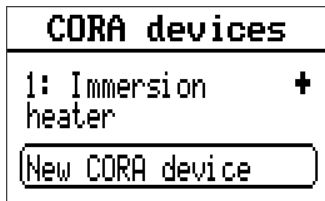
To create a new CORA device, select **New CORA device**.

fiD sub-menu

After creating a CORA device, select that node:

Type determines the device type with which a connection is to be established (currently only "EHS" is available).

To assign a **designation**, first select a designation group, then the designation itself. An index number from 1-16 can also be assigned.
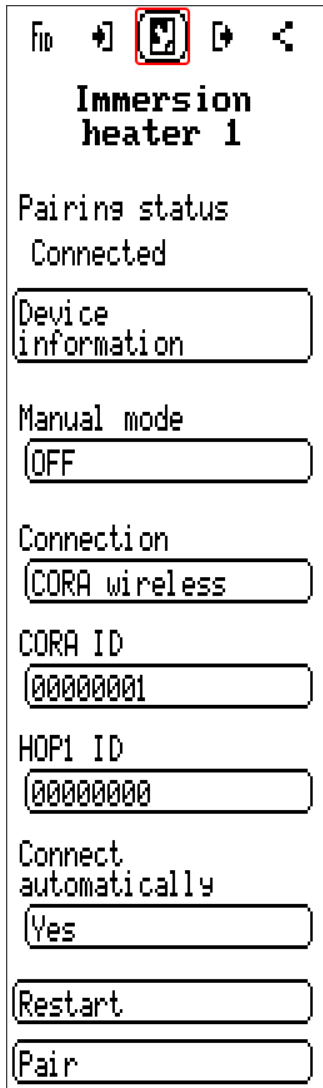
To **delete** an entry

Input variables

Variables that are sent to the wireless device (currently empty for EHS).

Parameters

Pairing status indicates whether the wireless connection with the device is established.

Device information opens a menu similar to the **Version** menu of the paired device, in addition to displaying the date and time of the last packet received wirelessly.

Manual mode On/Off

Specifies the **CORA ID** of the device to which the connection is to be made

HOP1 ID: Gives a wireless ID for forwarding signals (see chapter **"Wireless signal forwarding"** in the installation instructions)

Connect automatically: If this parameter is set to **Yes**, attempts will be made at increasingly long intervals to (re-)establish a connection to the target device.

Pair: Make a single manual attempt at pairing

With **Connect automatically** (if set to **Yes**), the command to connect may be issued with a time delay if an especially large amount of data is being sent wirelessly. Manual operation of the **Pair** button always issues the command **immediately**.
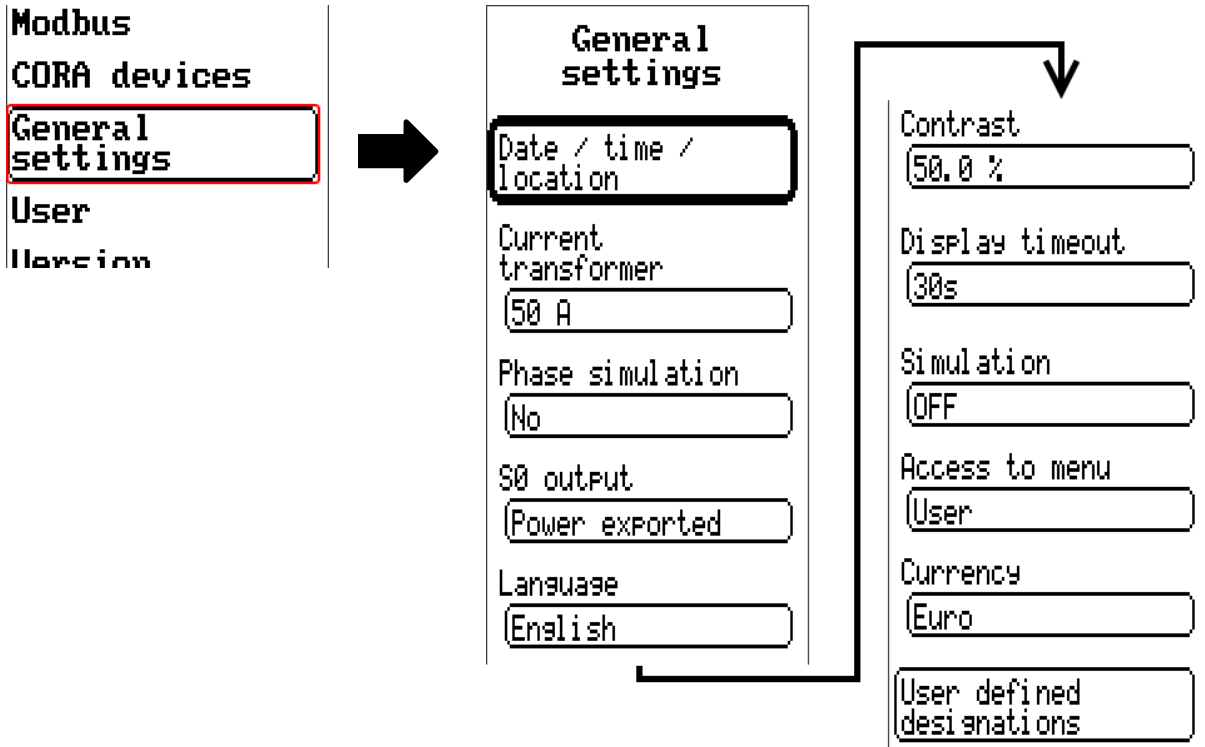
Output variables
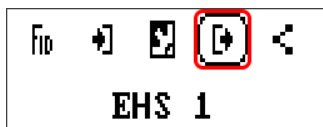
Variables received by the wireless device.

Example: The EHS immersion heater issues the following variables:

- x2 wireless timeout (yes for timeout)
- Current output
- Higher output level
- Lower output level
- Temperature 1 (sensor input 1)
- Temperature 2 (sensor input 2)
- HLSC temperature
- Electronics temperature
- Fault code

General settings

Some menu items are only displayed in expert and/or technician mode.

This menu serves to input settings which then take effect for all other menus and displays.

Current transformer

Choice between a standard current transformer (50 A) or current transformer up to 100 A (special accessory).

Phase simulation

See chapter "Electrical measurement" in the installation instructions.

SO output

Choice of whether power drawn from grid, power exported to grid or nothing should be issued at S0 output. If S0 output is active, a field appears below it for adjusting the value of the output.

Language

Select the display language

Contrast

Select the contrast of the display to match the surroundings (setting range: 45.0 – 75.0%)

Display timeout

The display will be switched off if the user does not do anything for the period of time set here.

Tapping the touchscreen surface re-activates the display (setting range: 5 seconds to 30 minutes)

Status LED

If this option is set to "Auto switch off", the LED is switched off automatically together with the display (see display timeout). However, the LED is only switched off if no message, warning, fault, etc. activates the LED (via message function or otherwise).

Return to start page automatically

If this option is set to "Yes", a field appears underneath for entering the return time.

If the controller is not operated for the duration of the return time, the view returns to the start page.

Simulation

Option of activating the simulation mode (only possible in Expert mode):

- No averaging of the outside temperature in heating circuit control.
- All temperature inputs are measured as PT1000 sensors, even if a different sensor type is
- defined.
- The RAS features of room sensors are ignored.

Select from: **OFF**

Analogue – Simulation with the EWS16x2 development set

CAN SIM board – Simulation with SIM-BOARD-USB-UVR16x2 for simulation in a system
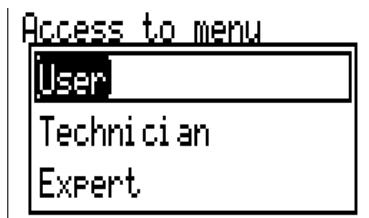
The simulation mode is ended automatically when you exit the Expert level.

Currency

Select the currency for yield metering

Access to menu

Definition of the user levels from which access to the main menu is permitted

```
Access to menu
┌─────────────────────┐
│ User                │
│ Technician          │
│ Expert              │
└─────────────────────┘
```
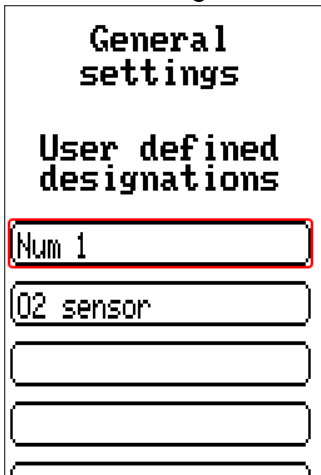
If only technicians or experts are permitted to access the menu, the relevant password must be entered to reach the main menu.
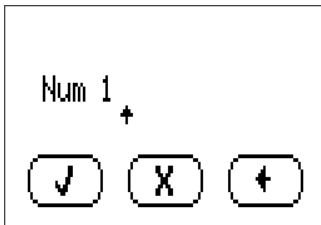
User defined designations

In this menu, you can enter, change or delete user defined designations **for all elements of the con-troller.** This menu can only be selected from within the Technician or Expert level.

View with designations defined previously

```
    General
    settings

    User defined
    designations

  [Num 1]
  [O2 sensor]
  [         ]
  [         ]
  [         ]
```

Entries are made up of letters, numbers and symbols entered consecutively.

```
  Num 1 .
        +

  (√)  (X)  (+)
```

Up to 100 different designations can be defined by the user. The maximum number of characters per designation is **23.**

Designations defined previously are available for all elements (inputs, outputs, functions, fixed values, bus inputs and outputs).

User

```
CUNM devices
General
settings
┌─────────────────┐
│User             │
└─────────────────┘
Version
Data admin
```

Current user

```
┌─────────────────┐
│      User       │
├─────────────────┤
│      User       │
│                 │
│   Technician    │
│  ┌───────────┐  │
│  │  Expert   │  │
│  └───────────┘  │
└─────────────────┘
```

Select whether the user is an **Expert, Technician** or **User.**

To enter the Technician or Expert level a password must be entered, which can be set by the programmer.

When function data is loaded from the Expert or Technician level, the controller returns to the User level and applies the programmed passwords.

When the controller is started, the controller is always in the User level.

Changing the password

```
┌─────────────────┐
│      User       │
├─────────────────┤
│      User       │
│                 │
│   Technician    │
│  ┌───────────┐  │
│  │  Expert   │  │
│  └───────────┘  │
│ ┌─────────────┐ │
│ │Change technician│
│ │password     │ │
│ │             │ │
│ │Change expert│ │
│ │password     │ │
│ └─────────────┘ │
└─────────────────┘
```

An **Expert** can change the passwords for Technician and Expert. A **Technician** can only change the Technician password.

There are no restrictions regarding the length of the password or the type of characters that can be used.

To change a password, you must first enter the old password.

List of permitted actions

User level	Displays and permitted actions
User	• **Function overview** with options for control • **Access to main menu** only if enabled for **"User"** in the "General settings" • **Summary of values** • **Inputs:** display only, no access to the parameters • **Fixed values:** changes to the value or status of the fixed values enabled for User, no access to the parameters • **Functions:** display of the function status, no access to the parameters • **Messages:** display of active messages, hiding and deleting messages • **CAN and DL bus:** no access to the parameters • **General settings:** language, brightness and display timeout can be altered • **User:** change of user (with password entry) • **System values:** setting the date, time, location data, display of System values
Technician	**All of the above plus:** • **Access to main menu** only if enabled for **Technician** or **User** in the "General settings" • Changes to the parameters for **inputs** (except for type and measured variable), no creation of new ones • Changes to the parameters for **outputs** (except for type; status only if enabled for User or Technician), no creation of new ones • Changes to the parameters for **fixed values** (except for type and measured variable; value and status only if enabled for User or Technician), no creation of new ones • **General settings:** Changes to **user defined designations** and creation of new ones, selecting the currency • **Functions:** changes to user defined input variables and parameters; output variables are visible • All settings in the **CAN** and **DL** bus menus • **Data administration** actions
Expert	**All** actions and **all** displays are accessible.

Automatic changeover

Normally, the controller automatically switches back to **user mode** 30 minutes **after login** as an expert or technician.

For programming or test purposes, this automatic changeover can be switched off. To do so, an expert selects "Change expert password", first enters the old password, then enters **nothing** (not "0" either) and confirms this with the tick.

The same can be done for the Technician password.

When new programming is loaded, the controller returns to the User level and the Expert password set by the programmer will apply.

Version and serial number

This menu displays the serial number, internal production data and the name of the current function data.

```
General
settings

User

┌─────────────────┐
│Version          │
└─────────────────┘

Data admin

System values
```

⬇

```
       Version
Version: V
1.08Beta-A

Serial number:
EZ3-000000 E

CORA ID: 02000001

Date of
manufacture:
0.1.1900

Hardware (cover):
04S Funk

Rev: A1756

Current function
data: tmp.dat

Internal ID:
00000000

       [QR code]
```

The serial number is also visible on the controller's rating plate (upper side panel).

Data administration

Can only be operated in technician or expert mode

You can perform the following actions in this menu:

- Save, load or delete function data
- Load firmware
- Load or delete a function overview
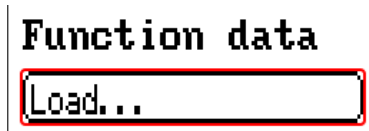- Display the status of the data transfer
- Restart the controller

```
User
Version
Data admin
System values
```

Function data

```
    Data admin
Function data
Load...
Save...
Carry out
total reset
Current function
data: tmp.dat
Firmware
Load...
    Status
Successful!
Restart
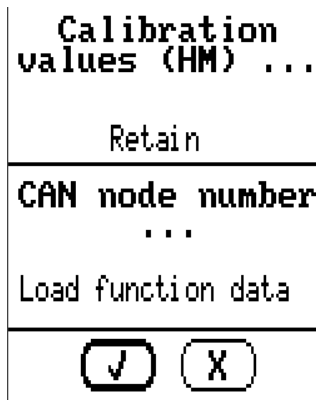```

Name of the current function data
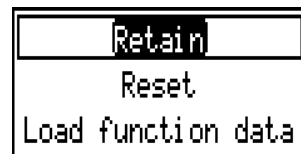
# Load…

**Function data**

**Load..**

Function data can be loaded from the SD card onto the controller or other x2 devices. Multiple function data files can be saved to the SD card.

The data transfer is only possible after a technician or expert password has been entered for the target device.

After selecting the function data required (*.dat file), you will be prompted to specify how the meter readings and the heat meter's calibration values should be treated.

**Calibration values (HM) …**

Retain

**CAN node number**

…

Load function data

✓  X

You can choose from the following actions:

Retain
Reset
Load function data

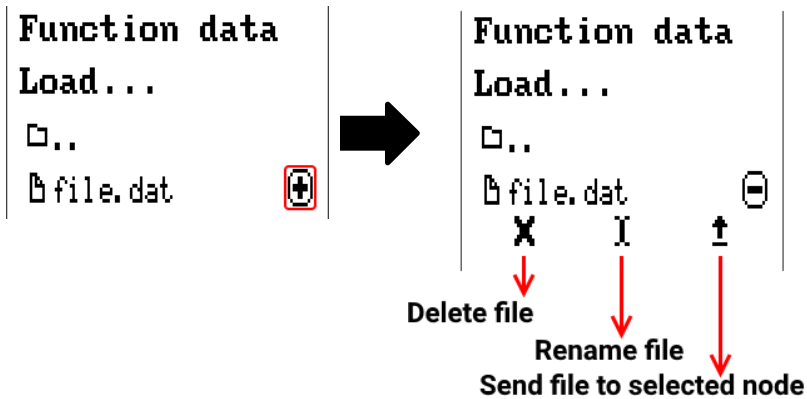| Retain | The meter readings and calibration values in the controller will be applied. |
| --- | --- |
| | Example of use: After programming is changed using TAPPS2 |
| Reset | The meter readings and calibration values will be reset to zero |
| Load function data | The meter readings and calibration values applied will be taken from the function data being loaded onto the controller. |
| | **Example of use:** Replacement of a controller. The function data is taken from the old controller and its meter readings are to be loaded onto the new controller. |

Selecting ✓ loads the new function data; X cancels the action.

If function data is loaded onto the controller, a _Backup.dat file is created on the SD card with the old function data.

**Once the function data is loaded, the controller returns to the User level.**

# Deleting, renaming and sending saved files

In order to rename or delete saved files, tap the plus symbol. The following options then appear for selection:

```
Function data          Function data
Load...                Load...
 □..                    □..
 ▯ file.dat    ⊞         ▯ file.dat      ⊟
                        X      I      ↑
```

```
              Delete file
                     Rename file
              Send file to selected node
```

Return from this selection by tapping the icon again.

Delete file

A confirmation prompt appears, which you can confirm by tapping (√) .
Tapping (X) cancels the action.

Rename file

The file name can be changed using a keyboard (Umlauts are not possible). The file name must be no longer than 63 characters with no dots or accents.

Send file to selected nodes

This allows you to send function data to other CAN bus subscribers with x2 technology (e.g. RSM610, CANEZ2, CAN-I/O45).

```
Do you really want
to send the file to
the selected node?
     "file.dat"

Please select
         X
```
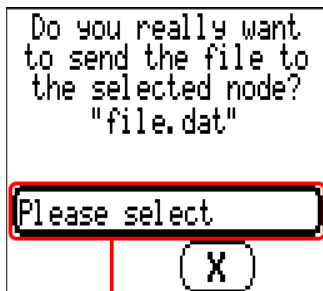
Select the node number and then tap (√).

(see above)

Save...

Save...

The current function data can be saved to the SD card.

You can give the function data a name of your own. More than one set of function data can be saved.

Example:

Function data
Save...
□..
🗋 +++   ✦
🗋 file.dat

In this example there are already several sets of function data saved on the SD card.

🗋 +++   ✦ | If you want to save the function data under a new name, tap on the button. You can then enter a new name and save the file (umlauts cannot be entered). The file name must be no longer than 63 characters with no dots or accents.

🗋 +++   ⊞ | Tap the plus symbol to load function data from a different x2 device onto the controller SD card.

🗋 +++   − ↓ | When the button expands, tap on the green arrow.

Now a node query appears and it is possible to enter a new file name.

Do you really want
to save the function
data from the
selected node?
"+++"

Please select
X

Firmware Load...

```
Firmware
Load...
```

Firmware (= operating system, file ***.bin**) can be loaded from the SD card onto the controller or other x2 devices (Except: other UVR16x2) on the CAN bus. More than one operating system version may be saved on the SD card.

The data transfer is only possible after a **technician** or **expert password** has been entered for the target device.

As when loading function data, the saved firmware files can be deleted, renamed or loaded onto other x2 devices.

```
Firmware
Load...
🗀..
🗎 UVR610_V100.bin ⊟
    ✗      I      ↑
```

Delete file
Rename file
Send file to selected node

Return from this selection by tapping the icon again.

Function overview

TA-Designer min. version **1.25**, CAN-EZ3 min. firmware version **1.27**

```
Function
overview

Load...

Delete

Current function
overview:
```

From the SD card, the function overview (*.tfo file) can be loaded onto the device or deleted on the device. Multiple files can be saved to the SD card.

When you select the file a confirmation prompt will appear, as the function overview currently on the device will be overwritten.

"Delete..." deletes the function overview saved on the device. When you select the file a confirmation prompt will appear.

Answer the confirmation prompt by tapping either (✓) (= Yes) or (✗) (= No).
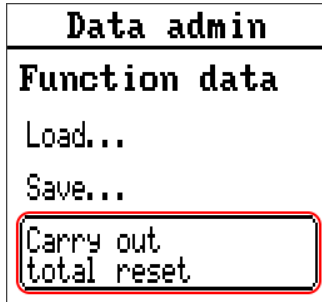
Status

```
     Status
Successful!
```

This indicates whether a data administration transfer of data from the SD card to the energy meter or vice versa was successful.

This status display does not apply to data transfers from another controller, a C.M.I. or a CAN monitor

Total reset

```
┌─────────────────────┐
│   Data admin        │
├─────────────────────┤
│ Function data       │
│ Load...             │
│ Save...             │
│┌───────────────────┐│
││Carry out          ││
││total reset        ││
│└───────────────────┘│
└─────────────────────┘
```
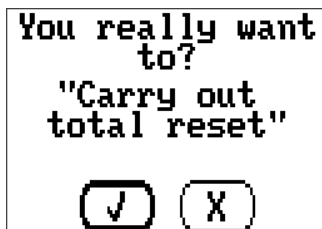
A total reset can only be carried out from the Technician or Expert level and requires confirmation when prompted.

A **total reset** deletes the function modules, the parameter settings of all inputs and outputs, bus inputs and outputs, fixed values and system values.

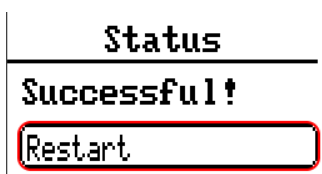The settings for the CAN node number and the CAN bus rate are retained.

After tapping the screen you will be asked to confirm that you want a total reset to be carried out.

```
┌─────────────────────┐
│ You really want     │
│       to?           │
│   "Carry out        │
│  total reset"       │
│                     │
│    ( √ )  ( X )     │
└─────────────────────┘
```
Answer by tapping either (√) (= Yes) or (X) (= No).

If a total reset is carried out, a _Backup.dat file is created on the SD card with the old function data.

Restart

```
┌─────────────────────┐
│     Status          │
├─────────────────────┤
│ Successful!         │
│┌───────────────────┐│
││Restart            ││
│└───────────────────┘│
└─────────────────────┘
```

At the end of the "Data admin" menu, there is an option to restart the controller following a confirmation prompt, without disconnecting the controller from the network.

Reset

Pressing the reset button on the front of the controller briefly (with a narrow-tip pen) and releasing it before the beep ends will restart the controller (= reset).
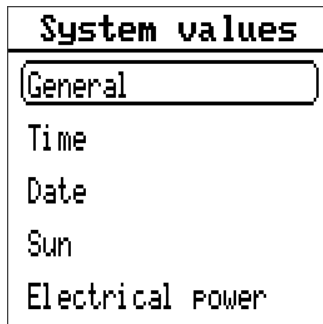
Change-Log

Every change in the energy meter is recorded with the exact time in the CHANGE.LOG file on the energy meter SD card and can therefore be traced.

System values

This menu displays the status of system values that are available for selection as the source for function input variables and CAN and DL outputs.

```
User
Version
Data admin
System values
```
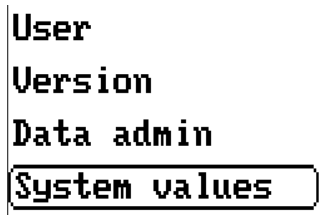
The system values are divided into **5 groups:**

```
  System values
 General
 Time
 Date
 Sun
 Electrical power
```

General system values

When programmed accordingly, these system values allow monitoring of the controller system.

- **Controller start**
- **Sensor error inputs/CAN/DL**
- **Network error CAN/DL**
- **Mains frequency**
- **CAN node**
- **CAN connection**
- **Message (type: message/warning/fault/error)**
- **Serial number**

Controller start generates a 20 second pulse 40 seconds after the device is switched on or reset, and is used for monitoring the controller starts (e.g. after power failures) in the datalogging feature. The interval time in datalogging should be set to 10 seconds for these starts.

The **sensor errors** and **network errors** are global digital values (No/Yes) which are not connected to the error status of a specific sensor or network input.

If any one of the sensors or network inputs has an error, the status of the corresponding group changes from **No** to **Yes.**

Time system values
- **Second** (seconds of the current time)
- **Minute** (minutes of the current time)
- **Hour** (hour of the current time)
- **Second pulse**
- **Minute pulse**
- **Hour pulse**
- **Summertime** (digital value OFF/ON)
- **Time** (hh:mm)

Date system values
- **Day**
- **Month**
- **Year** (without the century)
- **Day of the week** (starting with Monday)
- **Calendar week**
- **Day of the year**
- **Day pulse**
- **Month pulse**
- **Year pulse**
- **Week pulse**

The pulse values generate a single pulse per time unit.

Sun system values

- **Sunrise** (time)
- **Sunset** (time)
- **Minutes until sunrise** (on the same day, does not go beyond midnight)
- **Minutes since sunrise**
- **Minutes until sunset**
- **Minutes since sunset** (on the same day, does not go beyond midnight)
- **Solar altitude** (see Shading function)
- **Direction of the sun** (see Shading function)
- **Solar altitude > 0°** (digital value yes/no)
- **High sun** (time)

Electrical power system values

- **Total apparent power** (kW)
- **Apparent power L1, L2, L3** (kW)
- **Total real power** (kW)
- **Real power L1, L2, L3** (kW)
- **Total reactive power** (kW)
- **Reactive power L1, L2, L3** (kW)
- **Voltage L1, L2, L3** (Volt)
- **Total amperage** (Ampere)
- **Amperage L1, L2, L3** (Ampere)
- **Total cos phi power factor**
- **Cos phi power factor L1, L2, L3**
- **Total phi phase shift**
- **phi phase shift L1, L2, L3**
- **Positive phase sequence** (Yes/No)

Technical data

Important information about the measuring limits of the electrical energy meter:

1. If the effective power value is available as kW only, then cos phi must be observed.
2. The consumer load must lie within the specified power limits.
3. As the power consumption of heat pumps with frequency converters (inverters) is not sinusoidal, there is a risk of over control of the measuring movement resulting in a measurement error. The actual peak current must never exceed 70 A for 50 A current transformers, 140 A for 100 A current transformers and 430 A for 400 A current transformers.

Rated voltage consumer	3 x 400/230V 50 Hz
Power range with 1- or 3-phase connected consumer	Max. **10 kVA** per phase for **50 A** current transformers Max. **20 kVA** per phase for **100 A** current transformers Max. **70 kVA** per phase for **400 A** current transformers
Resolution	10 VA
Maximum cable diameter for current transformers:	10 mm Ø for standard current transformers (50 A) 16 mm Ø for special version of current transformers (100 A)
Accuracy of power measurement	± (**10 W + 3 %** of current power) for **50 A** current transformers ± (**20 W + 3 %** of current power) for **100 A** current transformers ± (**80 W + 3 %** of current power) for **400 A** current transformers
Current transformer cable length	1 m
Sensor inputs 1-4	Temperature sensors of type PT1000, KTY (2 kΩ/25 °C), KTY (1 kΩ/25 °C), PT100, PT500, Ni1000, Ni1000TK5000 and room sensors RAS or RASPT, radiation sensor GBS01, thermocouple THEL-MV (without DL), humidity sensor RFS, rain sensor RES01, pulses **max. 10 Hz** (e.g. for flow rate transducer VSG), voltage **up to 3.3 V DC,** resistance (1-100 kΩ), and as a digital input (caution: potential-free)
Sensor inputs 5, 6 (via VT1 and VT2)	Inputs for temperature from FTS flow sensors
Sensor inputs 7, 8 (via VT1 and VT2)*	Inputs for flow rate from FTS flow sensors (pulses)
Sensor inputs 7, 8 (via DI1 and DI2)*	Inputs for analogue flow sensors (type FTS) or pulse flow sensors (type VSG) S0 up to max. 20 Hz
Frequency of wireless system	868.5 MHz
DL bus interface	For electronic sensors via DL-bus
DL bus load	100%
SD card	Micro SD with FAT32 formatting
Dimensions W x H x D	107 x 95 x 64 mm
Max. ambient temperature	0°C bis 45°C
IP rating	IP10
Protection class	II - double insulated

* Connections <u>VT1 and DI1</u> (= input 7) and <u>VT2 and DI2</u> (= input 8) cannot be used at the same time (e.g. the use of <u>VT1 and DI2</u> is possible).

Subject to technical modifications as well as typographical and printing errors. This manual is only valid for devices with the corresponding firmware version. Our products are subject to constant technical advancement and further development. We therefore reserve the right to make changes without

prior notice.

EU Declaration of conformity

Document- No. / Date: TA19001, 19.07.2019
Company / Manufacturer: Technische Alternative RT GmbH
Address: A-3872 Amaliendorf, Langestraße 124

This declaration of conformity is issued under the sole responsibility of the manufacturer.

Product name: CAN-EZ3, CAN-EZ3A
Product brand: Technische Alternative RT GmbH
Product description: CAN energy meter

The object of the declaration described above is in conformity with Directives:

2014/35/EU   Low voltage standard
2014/30/EU (11/09/2018)   Electromagnetic compatibility
2011/65/EU (01/10/2022)   RoHS Restriction of the use of certain hazardous substances

Employed standards:

EN 60730-1:2021-06	Automatic electrical controls - Part 1: General requirements
EN IEC 61000-6-3:2022-06	Electromagnetic compatibility (EMC) - Part 6-3: Generic standards - Emission standard for equipment in residential environments
EN IEC 61000-6-2:2019-11	Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity standard for industrial environments
EN IEC 63000:2019-05	Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances
EN 300220-2:2018-09	Short Range Devices (SRD) operating in the frequency range 25 MHz to 1 000 MHz - Part 2: Harmonised Standard for access to radio spectrum for non specific radio equipment
EN 301489-1:2020-06	ElectroMagnetic Compatibility (EMC) standard for radio equipment and services - Part 1: Common technical requirements - Harmonised Standard for ElectroMagnetic Compatibility
EN 301489-3:2019-08	ElectroMagnetic Compatibility (EMC) standard for radio equipment and services - Part 3: Specific conditions for Short-Range Devices (SRD) operating on frequencies between 9 kHz and 246 GHz
EN 62479:2011-09	Assessment of the compliance of low power electronic and electrical equipment with the basic restrictions related to human exposure to electromagnetic fields (10 MHz to 300 GHz)

Position of CE - label: On packaging, manual and type label

$$C\!E$$

Issuer: Technische Alternative RT GmbH
                               A-3872 Amaliendorf, Langestraße 124

This declaration is submitted by

Dipl.-Ing. Andreas Schneider, General manager,
19.07.2019

This declaration certifies the agreement with the named standards, contains however no warranty of characteristics

The security advices of included product documents are to be considered.

Warranty conditions

Note: The following guarantee conditions do not in any way limit the legal right to warranty, but rather expand your rights as a consumer.

1. The company Technische Alternative RT GmbH provides a one-year warranty from the date of purchase for all the devices and parts which it sells. Defects must be reported immediately upon detection and within the guarantee period. Technical support knows the correct solution for nearly all problems. In this respect, contacting us immediately will help to avoid unnecessary expense or effort in troubleshooting.

2. The warranty includes the free of charge repair (but not the cost of on site fault-finding, removal, refitting and shipping) of operational and material defects which impair operation the event that a repair is not, for reasons of cost, worthwhile according to the assessment of Technische Alternative, the goods will be replaced.

3. Not included is damage resulting from the effects of over-voltage or abnormal ambient conditions. Likewise, no warranty liability can be accepted if the device defect is due to: transport damage for which we are not responsible, incorrect installation and assembly, incorrect use, non-observance of operating and installation instructions or incorrect maintenance.

4. The warranty claim will expire, if repairs or actions are carried out by persons who are not authorised to do so or have not been so authorised by us or if our devices are operated with spare, supplementary or accessory parts which are not considered to be original parts.

5. The defective parts must be sent to our factory with an enclosed copy of the proof of purchase and a precise description of the defect. Processing is accelerated if an RMA number is applied for via our home page www.ta.co.at A prior clarification of the defect with our technical support is necessary.

6. Services provided under warranty result neither in an extension of the warranty period nor in a resetting of the warranty period. The warranty period for fitted parts ends with the warranty period of the whole device.

7. Extended or other claims, especially those for compensation for damage other than to the device itself are, insofar as a liability is not legally required, excluded.

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