Electricity Meters IEC/MID

Industrial and Commercial

ZMG400AR/CR

E550 Series 2

User Manual

Date: 20.01.2012
File name: D000029783 E550 ZMG400 Series 2 User Manual en.docx

Revision history

Version	Date	Comments
a	17.02.2010	First edition
b	27.07.2010	Section 3.3: new terminal layouts, section 3.4: changed connection diagrams, section 6.2: error messages and explanations updated, entire document re-formatted, typing errors and minor faults corrected.
c	31.01.2011	Firmware version P06 update and a new document template.
d	22.03.2011	Figures updated to firmware version P06.
e	01.12.2011	Power factor monitor event numbers corrected.
f	20.01.2012	New extension boards 060 with 6 output contacts and 240 with 2 control inputs and 4 output contacts.

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About this document

Range of validity

The present user manual applies to the meters specified on the title page.

Purpose

The user manual contains all the information required for application of the meters for the intended purpose. This includes:

- Provision of knowledge concerning characteristics, construction and function of the meters
- Information about possible dangers, their consequences and measures to prevent any danger
- Details concerning the performance of all work throughout the service life of the meters (parameterisation, installation, commissioning, operation, maintenance, shutting down and disposal)

Target group

The contents of this user manual are intended for technically qualified personnel of utilities (energy supply companies) responsible for the system planning, installation and commissioning, operation, maintenance, decommissioning and disposal of the meters.

Reference documents

The technical data and functional description of the meters are explained in separate documents:

- D000029746 "Technical Data E550 Series 2 ZMG400AR/CR"
- D000029785 "Functional Description E550 Series 2"

Conventions

The structure and significance of meter type designations are described in section 1.3 "Type Designation". The following conventions are employed in this user manual for representing type designations:

- The lower case letter "x" can be used as an unknown to indicate different versions (e.g. ZMG410xR for the ZMG410AR and ZMG410CR meters).
- The digit pair "00" can be used to indicate accuracy data (e.g. ZMG400 for the ZMG405 and ZMG410 meters).
- The following collective terms are also sometimes used instead of the type designation:
  - "Active energy meters" for the ZMG400AR meters
  - "Combimeters" for the ZMG400CR meters

1 Description of Unit

This chapter provides you with a brief overview of the design and function of the E550 meters ZMG400xR.

1.1 Field of Application

ZMG400xR meters can be used for transformer connection at all voltage levels (low, medium and high voltage). They are mainly used by medium and large consumers connected to low or medium voltage.

ZMG400xR meters are suitable for applications at the low and medium voltage level.

ZMG400xR meters have a comprehensive tariff structure. This extends from seasonal rates to multiple energy and maximum demand rates.

ZMG400xR meters are designed for connection to current transformers with 5 A or 1 A nominal current.

ZMG400CR combimeters record active and reactive energy, the ZMG410AR active energy meters only in three-phase four-wire networks (low and medium voltage) and from this determine the required electrical measured quantities. For this purpose they are connected to the measuring point via current and possibly voltage transformers:

- **Low voltage**: ZMG400xR with current transformers
- **Medium voltage**: ZMG400xR with current and voltage transformers

The data registered can be displayed (LCD) and are also available at the optical interface for data acquisition. Two interfaces – RS232, RS422, RS485 or CS – are available for remote readout.

When provided with transmission contacts, the energy measured by the meter can be transmitted to external devices (e.g. for load optimisation). The rates can be controlled internally or externally.

1.2 Characteristics

ZMG400xR meters have the following basic characteristics:

- Recording of active, reactive and apparent energy in all four quadrants (ZMG400 CR) or recording of imported and exported active energy (ZMG400 AR)
- Tariff system with energy and maximum demand rates, stored values, load profiles, etc.
- Extended functions such as monitoring functions, sliding maximum demand, etc. (for ZMG400CR additionally power factor cosφ)
- Rate control
  - External
    - via control inputs (ZMG400xR1 and ZMG400xR3)
    - via communication interfaces with formatted commands
  - Internal
    - by integral time switch (ZMG400xR2 and ZMG400xR4) or
    - by event signals based on monitored values such as voltage, current, demand, etc.

  - With remote control signals (formatted commands, dlms) via the communication interface
- Display of data with a liquid crystal display (LCD)
- Accuracy: Compliance with IEC class 1 or 0.5 S and with MID accuracy class B or C for active energy consumption (ZMG400xR) and IEC class 2 or load curve class 1 for reactive energy (ZMG400CR).
- Flexible measuring system through parameterisation (definition of different variables by software)
- Correct measurement even in case of failure of individual phases
- Wide range of measurement from starting current to maximum current
- Long operating lifetime between installation and total failure
- Optical interface according to IEC 62056-21 and dlms (short and logical names)
  - for direct readout of meter data
  - for service functions (e.g. parameterisation)
- Output contacts (solid-state relays) for fixed valency pulses, control signals and status messages or optionally one 5 A relay for load control.
- Instantaneous values concerning active and reactive power, voltages, currents, mains frequency and phase angle
- Installation aids
  - Indication of phase voltages, phase currents, phase angles, phase sequence, direction of energy and warning message
- Storage of event information, e.g. voltage failures, exceeding of thresholds, fraud detection, quality characteristics or error messages. Event information can be read out via the available interfaces. Important events can be communicated to the utility as operational messages (control of an arrow in the display or drive for an output contact).
- One or two independent interfaces for remote data transmission:
  - *Interface 1:* none, RS232, RS485 or RS232 with power on same connector (for power supply to an external modem located under the terminal cover)
  - *Interface 2:* none, CS, RS485 or RS422
  - For more details, see section 1.3 "Type Designation"

1.3 Type Designation

ZMG 4 10 CR 4. 260 b. 43 S2

Network type

ZMG 3-phase 4-wire network (M-circuit)

Connection type

4 Transformer operated

Accuracy class

10 Active energy class 1 (IEC), B (MID)
05 Active energy class 0.5 (IEC), C (MID)

Measured quantities

CR Active and reactive energy
AR Active energy

Tariff functions

1 Energy rates, externally controlled
2 Energy rates, internally controlled with time switch (TOU)
3 Energy and demand rates, externally controlled
4 Energy and demand rates, internally controlled with time switch (TOU)

Number of control inputs / number of output contacts / special functions

000 No control inputs, no output contacts, no special functions
020 2 output contacts
060 6 output contacts
240 2 control inputs, 4 output contacts
260 2 control inputs, 6 output contacts
440 4 control inputs, 4 output contacts
041 No control inputs, 4 output contacts, 1 output relay 5 A

Additional functions

0 none
3 with software events
4 with hardware and software events
7 with load profiles
a with load profiles and software events
b with load profiles, hardware and software events

Interfaces 2 and 1, Series 2

00 No interfaces	40 CS*	60 RS422**	07 Powered RS232***
02 RS232	42 CS and RS232*	62 RS422 and RS232**	37 RS485 and Powered RS232***
03 RS485	43 CS and RS485*	63 RS422 and RS485**	

*) only as .260x.4x or as .440x.4x
**) only as .041x.6x
***) only as .020x.07, .041x.37, .240x.37 or as .060x.37

The designations after AR/CR are not normally specified in the type designation in this user manual, unless necessary for understanding.

Series designation

The hardware version is defined with a series designation. The first hardware generation (Series 1) does not have a series designation. Series 2 is the newest hardware generation. It only supports firmware versions P05 and higher.

Software version

The meter's software version, which determines certain meter characteristics, can be displayed on the LCD e.g. as part of the rolling display (depending on parameterisation) and can be read out in the following two ways:

- meter data readout (depending on parameterisation)
- meter identification readout (see section 5.7 "Data Readout")
- Series 2 meter variants are supported from SW version P05.

1.4 Block Schematic Diagram

This chapter provides an overview of the functions of ZMG400xR meters.

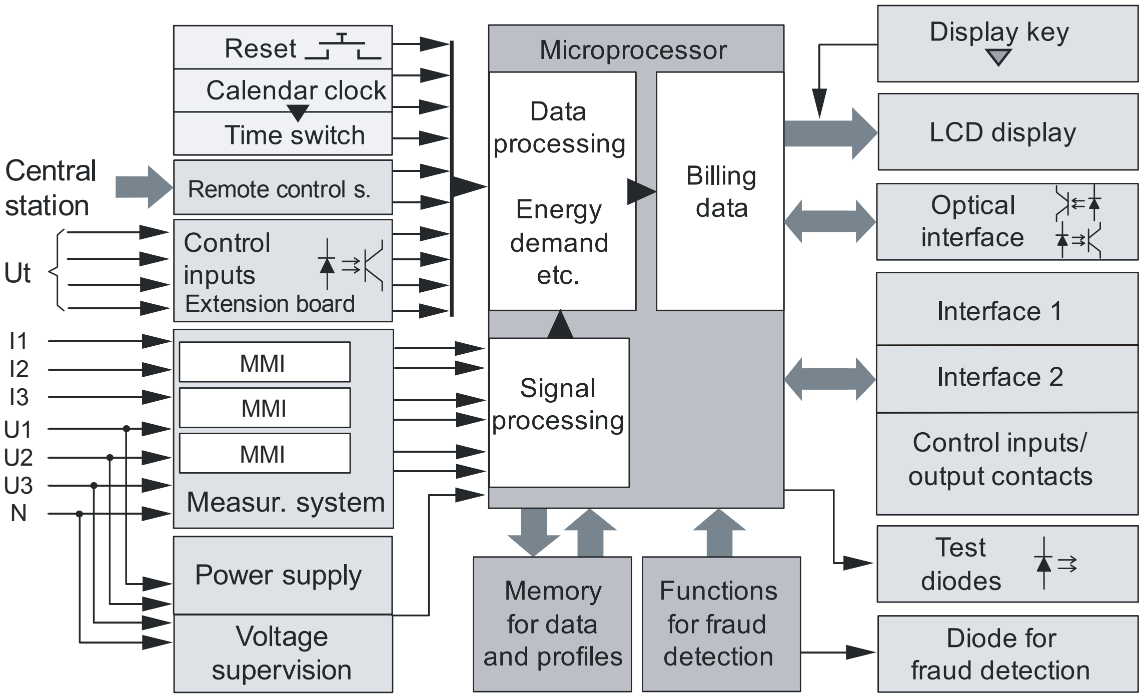


Fig. 1.1 Block diagram ZMG400xR

ZMG400AR active energy meters record the imported and exported active energy, while the ZMG400CR combimeters record the active and reactive energy in all four quadrants.

ZMG400xR meters can be fitted with one or two integrated communication interfaces (of RS232, RS485, RS422 and CS, RS485). See section 1.3 "Type Designation" for possible interfaces.

Inputs

The main inputs to the meter are:

- Connections of phase voltages (U_1, U_2, U_3), phase currents (I_1, I_2, I_3) and neutral conductor N
  - for processing in the measuring system
  - for three-phase power supply to the meter and voltage monitor
- Control inputs U_t (up to 4) for:
  - Changeover of energy and maximum demand rates
  - Demand inhibition
  - Synchronizing the calendar clock

  Opto-couplers protect the following circuit from interference, which could otherwise enter via the control inputs.

- Remote control signals (up to 8) for:
  - rate control
  - retransmission to meter external devices
- Push keys
  - for display control (display key, optical interface)
  - for resetting or service functions (reset key)

Outputs

The meter has the following outputs:

- LCD liquid crystal display with display key for local reading of billing data (single 8-digit display with additional information, such as energy direction, type of energy, presence of phase voltages and identification number)
- Optical test outputs (red, 1 in active energy meters, 2 in combimeters)
- Static relay with freely parameterised signal assignment (up to 6)
- One 5 A relay for load control (optional)
- Optical interface for automatic local data acquisition by suitable acquisition unit (handheld terminal)
- Communication interfaces (interface 1 and 2, for details see section 1.3 "Type Designation")
- Alert diode (diode for fraud detection)

Measuring system

Three measuring elements in the proven DFS technology (Direct Field Sensor based on the Hall effect) generate digital signals per phase from the phase voltage applied and the phase current flowing and multiply these to digital signals proportional to the power in each phase.

Signal processing

The digital voltage, current and power signals are passed to the following signal processor, which generates the digital output signals and mean values over one second:

- Active energy per phase
- Reactive energy per phase (combimeters ZMG400CR only)
- Phase voltages (RMS values)
- Phase currents (RMS values)
- Mains frequency
- Phase angles
- Power factors

Signal utilisation

For signal utilisation in the various registers the microprocessor can calculate the following measured quantities every second (determined by parameterisation):

- Active energy: Sum and individual phases separated according to energy direction
- Phase voltages as RMS values
- Phase currents as RMS values

- Neutral current as RMS value vectorially from the phase currents (with ZMG)
- Phase angles voltage-voltage and voltage-current
- Mains frequency
- Direction of phase sequence
- Total distortion level (TDL in %) per phase and for all phases
- Energy losses (line and transformer)

In addition for the combimeters ZMG400CR:

- Reactive energy: sum and individual phases separated according to energy direction assigned to the 4 quadrants
- Apparent energy: sum and individual phases separated according to energy direction from active and reactive energy or from RMS values
- Power factors cosφ, individual phases and mean value
- Measurement methods for reactive power: $Q^2=S^2-P^2$ (class 2 only) (in firmware version P06)

Rate control

Rate control is performed:

- Externally via control inputs (up to 4)
- Externally via communication interfaces with formatted commands
- Internally by time switch (rate control, demand inhibition) and calendar clock (reset). Combined internal and external control is possible if parameterised accordingly.
- By event signals based on threshold values of the monitoring functions

Data preparation for billing

The following registers are available for evaluation of the individual measured values:

- up to 24 energy registers (firmware version P05) or up to 48 energy registers (Extended Functional range in firmware version P06)
- 12 for total energy
- 3 for total Ah (Ampère hours)
- 8 for running demand mean values
- 8 for maximum demand rates (firmware version P05) or 24 (firmware version P06)
- 2 for power factor cosφ (combimeters ZMG400CR only)
- others for values of voltage and current, mains frequency and phase angles

Memory

A non-volatile memory serves to record a load profile and the event log. It also contains the configuration and parameterisation data of the meter and secures the billing data against loss from voltage failures.

Power supply

The supply voltages for the meter electronics are obtained from the three-phase network, whereby the phase voltage can vary over the entire voltage range (3*58/100 V to 3*277/480 V) without adjustment of the supply voltage. A voltage monitor ensures correct operation and reliable data recovery in the event of a voltage interruption and correct restarting when the voltage is restored.

No auxiliary power supply
No auxiliary power supply is provided in parallel with the normal power supply for ensuring the operation of the meter (e.g. readout) during voltage interruptions longer than 0.5 s.

Fraud detection

If configured, the meter has various fraud detection functions:

- hardware-specific, e.g. terminal cover opened, strong magnetic field present, etc.
- software-specific, e.g. current without voltage, phase failure, etc.

1.5 Measuring Unit

1.5.1 Signal Generation

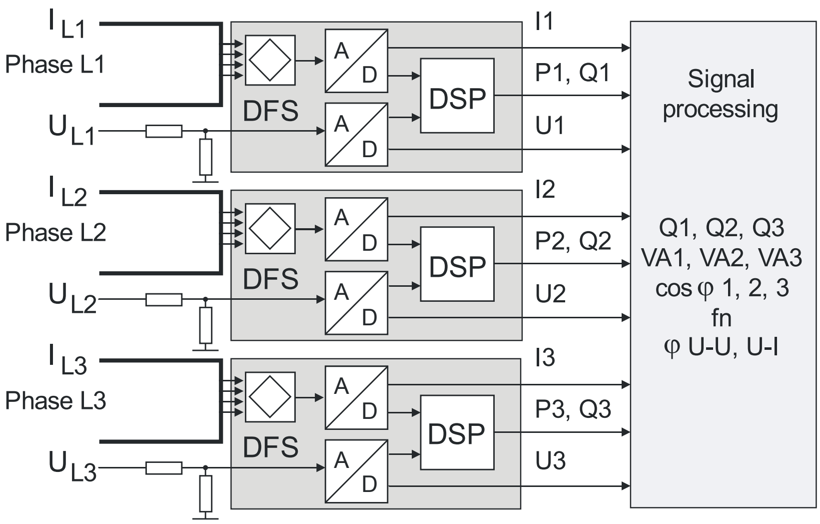


Fig. 1.2 Block schematic diagram of measuring unit

Current sensor

E550 meters utilise the Hall effect directly for current measurement. For this purpose, a corresponding element is incorporated in the measuring chip of the DFS (Direct Field Sensor), which detects the magnetic field of the phase current and from this generates a signal proportional to the current. The magnetic field itself is produced by the current loop through which the phase current flows. The following analogue-digital converter then generates a digital current signal. A magnetic screen protects the measuring system from extraneous fields.

Voltage sensor

The DFS accepts the phase voltage applied from a voltage divider. Its output voltage is similarly immediately converted to a digital voltage signal by the following analogue-digital converter.

Signal generation

The signals proportional to active and reactive power in the individual phases are then generated by the digital signal processor (DSP), which takes as inputs the digital signals of voltage and current. The instantaneous active and reactive powers P_x and Q_x are then fed to the signal processing module, together with the instantaneous values of voltage and current, for further processing. The DSP provides very fast output of the power values, which reduces meter testing times significantly compared with earlier versions.

1.5.2 Signal Processing

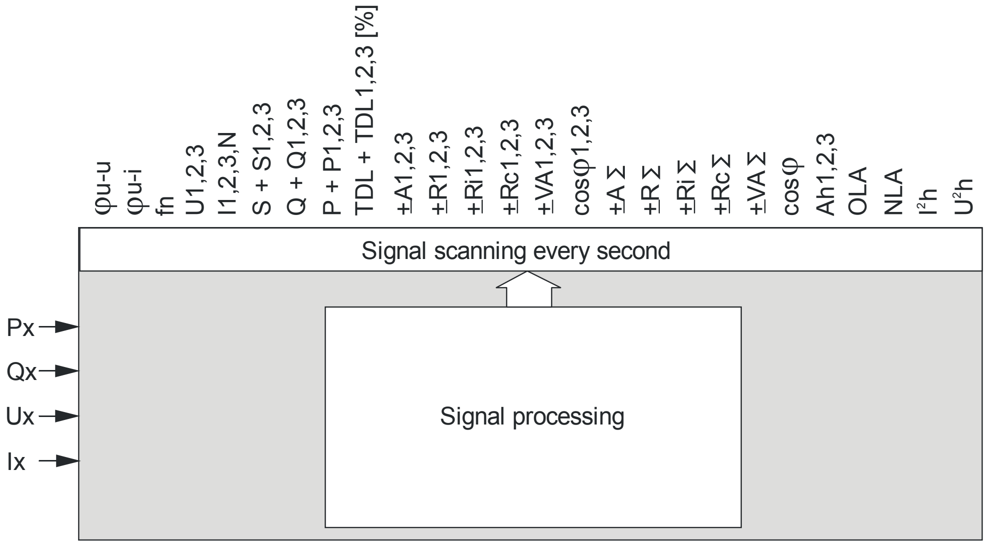


Fig. 1.3 Signal processing

The microprocessor first calculates from active power P_x, reactive power Q_x, voltage U_x and current I_x

- Apparent power Sx,
- True RMS values of voltages U_x and currents I_x,
- Mains frequency f_n
- Phase angles: voltage-voltage and voltage-current

It then forms energy units (pulses) from the powers with fixed clock frequency and variable amplitude proportional to power, and the mean values of the remaining quantities, such as voltage, current, mains frequency, etc. by integration over one second. These form the measured quantities of the meter, from which the measuring values are then obtained.

1.5.3 Measured Quantities

Sum values

The signal processor supplies the following measured quantities:

Active energy	A∑
Active power	instantaneous value P
Reactive energy	R∑
Reactive power	instantaneous value Q
Reactive energy per quadrant	+Ri∑/–Ri∑ and +Rc∑/–Rc∑
Apparent energy	VA∑
Apparent power	instantaneous value S
Power factor	cosφ (mean value of phases)
Line losses of active energy	OLA (firmware version P06)
Transformer losses of active energy	NLA (firmware version P06)
Current square hours	I^2h (firmware version P06)
Voltage square hours	U^2h (firmware version P06)

Values of the individual phases

Active energies	A_1, A_2, A_3
Active power	instantaneous value P_1, P_2, P_3
Reactive energies	R_1, R_2, R_3
Reactive power	instantaneous value Q_1, Q_2, Q_3
Reactive energies per quadrant	+Rix/–Rix and +Rcx/–Rcx
Apparent energies	VA_1, VA_2, VA_3
Apparent power	instantaneous value S_1, S_2, S_3
Power factors	$\cos\varphi_1$, $\cos\varphi_2$, $\cos\varphi_3$
Phase voltages	U_1, U_2, U_3
Phase currents	I_1, I_2, I_3
Neutral current	I_N
Mains frequency	f_n
Phase angles voltage–voltage	$\varphi u_1–u_1$, $\varphi u_1–u_2$, $\varphi u_1–u_3$
Phase angles voltage–current	$\varphi u_1–i_1$, $\varphi u_1–i_2$, $\varphi u_1–i_3$
Ampère hours	Ah_1, Ah_2, Ah_3

The possible measured quantities differ with regard to type of consumption (active only or active and reactive) as shown in the following tables.

Active energy meters ZMG410A..

(Usually measured quantities for active energy)

Measured quantity		ZMG410A..
Active energy import	+A	Sum/Phases
Active energy export	–A	Sum/Phases
Power factor	cosφ	Phases/mean value
Active power	P	Sum/Phases
Phase voltages	U	L_1, L_2, L_3
Phase currents	I	L_1, L_2, L_3
Neutral current	I_N	yes
Mains frequency	f_n	yes
Phase angle voltages	φu–u	$U_1 – U_1/U_2/U_3$
Phase angle voltage–current	φu–i	$U_1 – I_1/I_2/I_3$
Direction of phase sequence		yes
Ampere hours	Ah	L_1, L_2, L_3
Line losses of active energy	OLA	
Transformer losses of active energy	NLA	
Current square hours	I^2h	
Voltage square hours	U^2h	
Total distortion level (TDL)	TDL [%]	Sum/Phases

Combimeters ZMG400C..

(Usually measured quantities for active, reactive and apparent energy)

Measured quantity		ZMG400C..
Active energy import	+A	Sum/Phases
Active energy export	–A	Sum/Phases
Reactive energy positive	+R	Sum/Phases
Reactive energy negative	–R	Sum/Phases
Reactive energy quadrant 1	$+R_i$	Sum/Phases
Reactive energy quadrant 2	$+R_c$	Sum/Phases
Reactive energy quadrant 3	$–R_i$	Sum/Phases
Reactive energy quadrant 4	$–R_c$	Sum/Phases
Apparent energy import	+VA	Sum/Phases
Apparent energy export	–VA	Sum/Phases
Power factor	cosφ	Phases/mean value
Active power	P	Sum/Phases
Reactive power	Q	Sum/Phases

Measured quantity		ZMG400C..
Apparent power	S	Sum/Phases
Phase voltages	U	L_1, L_2, L_3
Phase currents	I	L_1, L_2, L_3
Neutral current	I_N	yes
Mains frequency	f_n	yes
Phase angle voltages	φu–u	U_1 – $U_1/U_2/U_3$
Phase angle voltage–current	φu–i	U_1 – $I_1/I_2/I_3$
Direction of phase sequence		yes
Ampere hours	Ah	L_1, L_2, L_3
Line losses of active energy	OLA	
Transformer losses of active energy	NLA	
Current square hours	I^2h	
Voltage square hours	U^2h	
Total distortion level (TDL)	TDL [%]	Sum/Phases

ZMG400xR

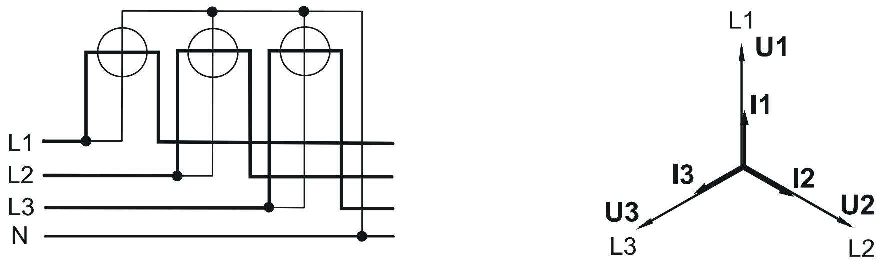


Fig. 1.4 Type of measurement ZMG400xR

Since the ZMG400xR measures the individual phases mutually independently with one measuring element each, it can record the sum of the three phases, the individual phases themselves, the phase angle between voltage and current as well as the angle between voltages U_1–U_2 and U_1–U_3.

The ZMG400xR can be ordered optionally with the capability to be connected to 3-wire networks.

1.5.4 Summation

The E550 features several summation methods:

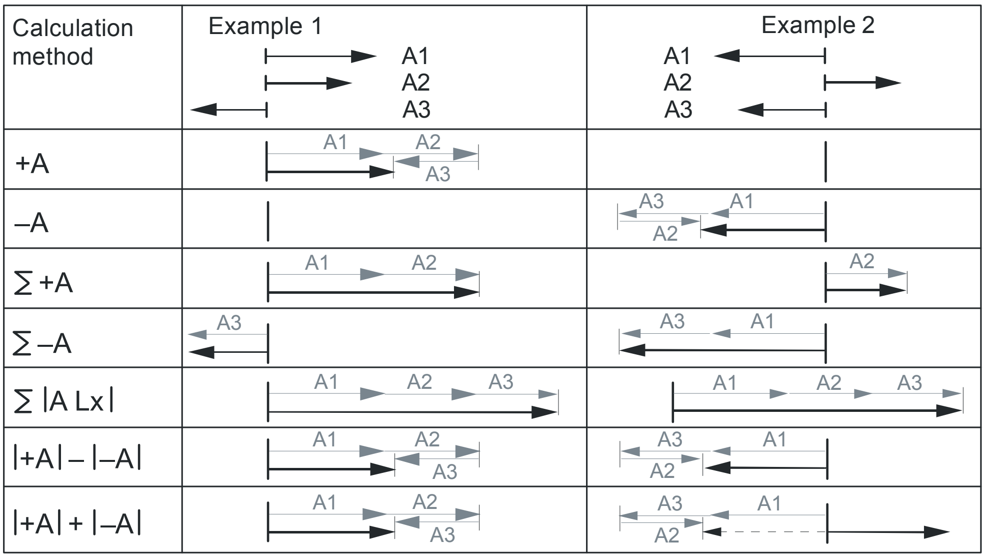


Fig. 1.5 ZMG400xR – Phase summation

By vectors +A/–A

As in Ferraris meters, the meter summates the values of the individual phases taking account of the sign. With differing signs (energy directions), the sum corresponds to the difference between the positive and negative values as shown in the figure above.

By quantity ∑+A/∑–A

Summation by quantity separates the positive from the negative values of the individual phases. Measured quantity ∑+A therefore only includes the positive values (+A_1 and +A3 in example 1), measured quantity ∑–A only the negative values (–A2 in example 1), provided any are present.

In case of a connection error, the meter measures the real import and export energy correctly.

By single quantities ∑ |A Lx|

This method summates the quantity of the individual phases independent of the energy direction. However, a connection error has no effect to the result of measurement.

In case of a real export in one phase, the result of this method is incorrect.

Subtraction |+A| – |–A|

With this method, exported energy is subtracted from imported. Connection errors cannot be detected.

Addition |+A| + |–A|

With this method, the meter adds exported and imported energy. This method only makes sense if the utility is sure there is no energy export. It can be used to ensure that if the meter is tampered with, the inverted energy flow is not subtracted from the import.

1.5.5 Formation of Measured Quantities

By reading the mean values of active P and in combimeters also reactive Q powers every second, energy components are produced (Ws or vars) at fixed intervals (every second) and with varying energy magnitudes or demand. These energy components are scaled by the microprocessor corresponding to the meter constant and are then available as measured quantities for selection of measured values. The measured values are fed directly to the following registers to record the energy and the maximum demand (in combimeters also of minimum power factor).

Active power

The active powers in the individual phases ±A1, ±A2 and ±A3 are formed directly from the mean values of active power P1, P2 and P3.

By summating the mean values of active power P1, P2 and P3 the microprocessor calculates the total active power import +A or the total active power export –A.

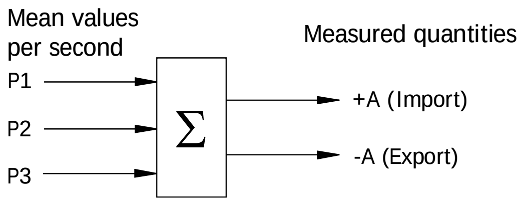


Fig. 1.6 Total active power

Instantaneous power with sign

If the meter is parameterised to calculate instantaneous power as signed values, the following values of power are available:

Active P: + in QI and QIV; - in QII and QIII
Reactive P: + in QI and QII; - in QIII and QIV

Reactive power

The reactive power values of the individual phases ±R1, ±R2 and ±R3 are obtained in the combimeters directly from the mean values of reactive power Q1, Q2 and Q3.

By summating the mean values of reactive power Q1, Q2 and Q3, the microprocessor calculates the total positive reactive power +R or the total negative reactive power -R.

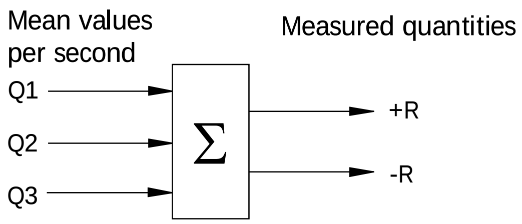


Fig. 1.7 Total reactive power

The microprocessor can allocate the reactive power to the 4 quadrants in the combimeters from the signs of R and A:

- Reactive power in 1st quadrant: +Ri
- Reactive power in 2nd quadrant: +Rc
- Reactive power in 3rd quadrant: –Ri
- Reactive power in 4th quadrant: –Rc

In the same way he can allocate the reactive powers of the individual phases to the 4 quadrants.

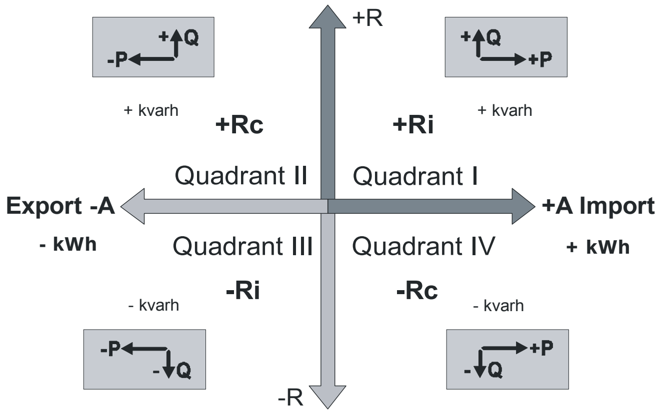


Fig. 1.8 4-quadrant measurement

The quadrants are numbered from top right as 1st quadrant (+A/+Ri) anti-clockwise to the 4th quadrant (+A/–Rc) at bottom right.

Calculated vectorial (not recommended)

The instantaneous value of reactive power is calculated using the values of active power and apparent power. Reactive power is the square root of the square value of apparent power minus the square value of active power:

$$Q = \sqrt{(S^2 - P^2)}$$

This method includes harmonics.

Apparent power

The apparent power is calculated in the combimeters in two ways:

- by geometric addition of the active and reactive power of the individual phases
- by multiplying the rms values of voltage and current of the individual phases

The method of calculation can be parameterised (only one possible in each

Power factor

The power factor cosφ is calculated in combimeters as follows:

$$\cos\varphi = \frac{P}{S}$$

The meter uses the method of calculation employed for calculating the apparent power.

Phase voltages

The rms values of the voltages U_{1rms}, U_{2rms} and U_{3rms} are obtained from the mean values of the squares of the voltages by extracting the root and directly from these the phase voltages U_1, U_2 and U_3.

Phase currents

The rms values of the currents I_{1rms}, I_{2rms} and I_{3rms} are obtained from the mean values of the squares of the currents by extracting the root and directly from these the phase currents I_1, I_2 and I_3.

Neutral current

The neutral current i_0 is calculated by adding the instantaneous phase currents i1, i2 and i3.

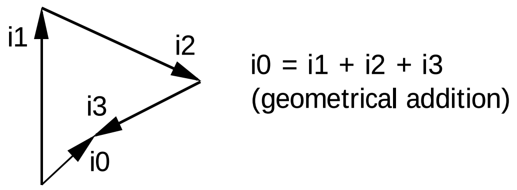


Fig. 1.9 Neutral current I_0

Mains frequency

The signal processor calculates the mains frequency f_n by forming the reciprocal from the time t_{U1-U1} between two zero passages of voltage U_1

Phase angles

The signal processor calculates the phase angles between voltages U1-U2 and U1-U3 from the times t_{U1-U1}, t_{U1-U2} and t_{U1-U3} between zero passages of the various voltages.

The signal processor calculates the phase angle between voltage U_1 and current per phase from the times t_{U1-I1}, t_{U1-I2} and t_{U1-I3} between zero passages of the voltage U_1 and the phase currents.

All voltage and current angles are displayed counter-clockwise with reference to the voltage in phase 1. The values of the angles are always positive and can be from 0 to 360°.

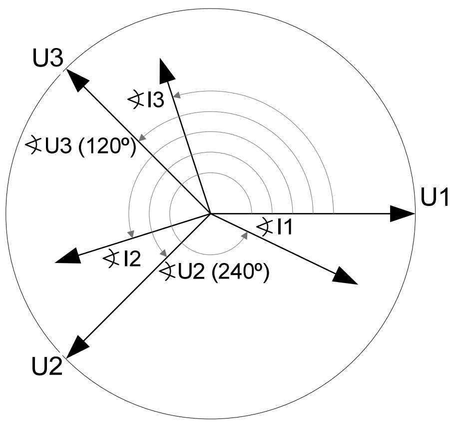


Fig. 1.10 Phase angles

Direction of rotating field

The direction of the rotating field is calculated by the microprocessor based on the phase angle of the 3 voltages. If the direction of rotation corresponds to that specified by the parameterisation, the phase voltage indications L1, L2 and L3 are continuously lit. Otherwise they flash every second.

Total distortion level (TDL)

Total distortion level provides the following functions (in firmware version P06):

- The calculation of the total and per phase values of the distortion level (DIL) in percent.
- Total and per phase diagnostic values can be captured in the load profiles and in the display and readout lists.

In P06 we support the calculation of the total and per phase values of the distortion power level in percentage according to the equation:

Total Power $PTOT = (V * I)$

Distortion Power $PDIS = \sqrt{(V * I)^2 - (P^2 + Q^2)}$

Distortion Level $DIL = PDIS/PTOT * 100$

DIL is only calculated for values >10%.
Zero will be shown for values <10%.

Distortion Level (DIL) indicates the differences in harmonics between the V and I channel. In typical applications, it more or less corresponds to |THD_I − THD_V|. These differences in the harmonics of the measurement channels are typically caused by the end-user, whereas equal harmonics are usually supplied from the mains to a resistive load.

Test conditions fundamental			harmonic				Comparison THD				**DIL**
I [%Ib]	U [%Un]	phi [°]	n [--]	I [%Ib]	V [%Un]	phi [°]	THD_A [%]	THD_I [%]	THD_V [%]	|THD_I-THD_V| [%]	[%]
100	100	0	5	20	20	0	3.8	19.6	19.6	0.0	**0.0**
100	100	0	5	40	0	0	0.0	37.1	0.0	37.1	**40.0**
100	100	0	5	40	10	0	3.8	37.1	10.0	27.2	**28.8**
100	100	0	999	53	0	0	0.0	46.8	0.0	46.8	**53.0**
100	100	0	999	53	5	0	2.6	46.8	5.0	41.8	**46.8**

Total and per phase DIL values are available. They can be captured in the load profiles as well as in the display and readout lists.

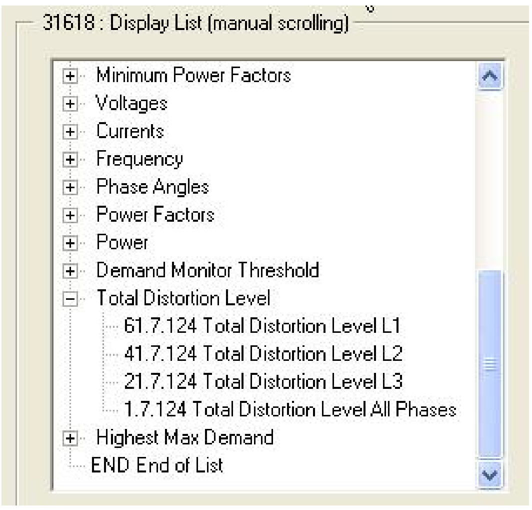


Fig. 1.11 Display list with Total Distortion Level

Losses

Depending on the metering point in the network, the meter does not only measure the net energy that is transferred from the power station to the user but also the line losses (caused by copper resistance R_{Cu}) and the transformer losses (caused by iron resistance R_{Fe}).

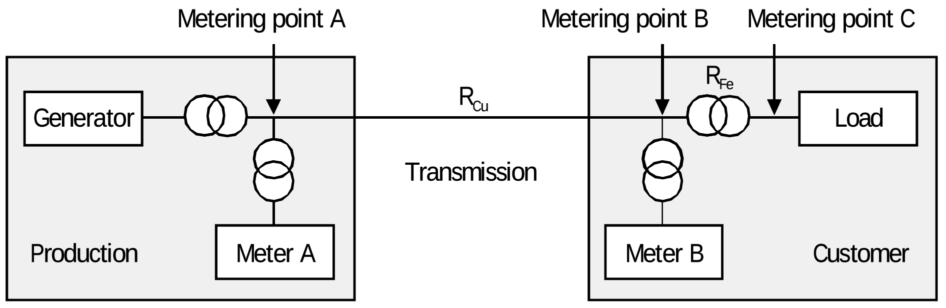


Fig. 1.12 Calculation of losses

Line losses are caused by the copper resistance R_{Cu} of the transmission line. Copper resistance only occurs when there is a load and therefore current is actually flowing.

- On Load Active (OLA) for line losses of active energy

Transformer losses represent all losses of the transformer. They are mainly caused by the iron core of the transformer. Transformer losses (equivalent resistance R_{Fe}) are present whenever the transformer is connected to the network.

- No Load Active (NLA) for transformer losses of active energy

Based on the I_{RMS} and U_{RMS} values, the microprocessor generates the following measured quantities:

OLA	On Load Active. Line (copper) losses of active energy. OLA = $I^2h \times R_{Cu}$. The value of R_{Cu} can be set by parameterisation.
NLA	No Load Active. Transformer (iron) losses of active energy. NLA = U^2h / R_{Fe}. The value of R_{Fe} can be set by parameterisation.
I^2h (Cu)	Ampere square hours (with $R_{Cu} = 1\ \Omega$)
U^2h (Fe)	Voltage square hours (with $R_{Fe} = 1\ M\Omega$)

1.6 Tariffication

1.6.1 Formation of Measuring Values

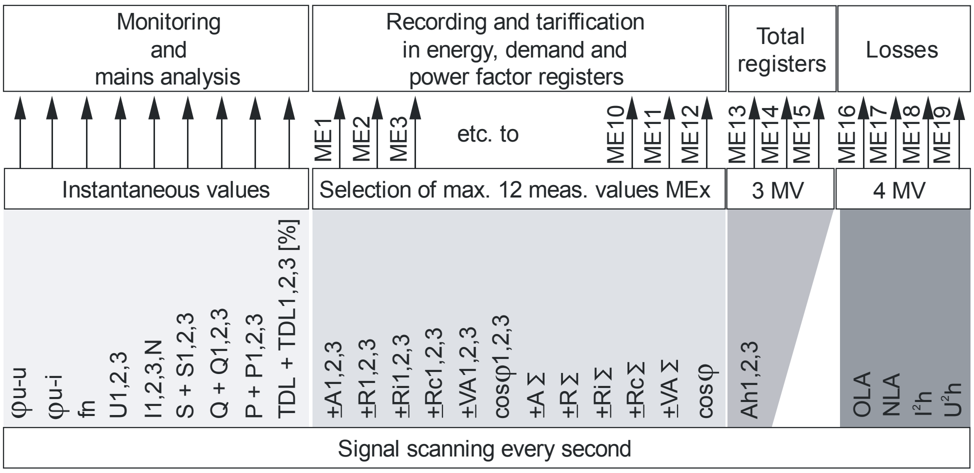


Fig. 1.13 ZMG400xR – Formation of measuring values

A total of 15 (P05) or 19 (P06) measuring values are available for further processing of the energy values from the sums and individual phases:

ME1 to ME12 Can be freely parameterised for active, reactive or apparent energy.

ME13 to ME15 Fixed assignment to Ampère-hours Ah_1, Ah_2, Ah_3.

ME16 to ME19 Fixed assignments for losses (in firmware version P06).

The powers, voltages and currents, mains frequency and the phase angles as instantaneous values form the basis for monitoring and network analysis.

1.6.2 Signal Utilisation

Energy recording

Each of the 15 (P05) or 19 (P06) measuring values ME1 to ME15 (P05 or 19 (P06) has an energy total register.

The measured values ME1 to ME12 are available for the energy tariff structure, but not ME13 to ME15 (P05) or 19 (P06). 24 (firmware version P05) or 48 (firmware version (P06) energy rate registers are available, depending on meter configuration.

Demand recording

The measured values ME1 to ME8 are available for the power tariff structure, but not ME9 to ME15 (P05) or 19 (P06).

- These are fixed assigned to the 8 registers for the running average demand value ($P_{running}$); in addition to $P_{running}$ each has a register for the average demand in the last integrating period.
- The ZMG400 has 24 maximum demand registers for tariffication.

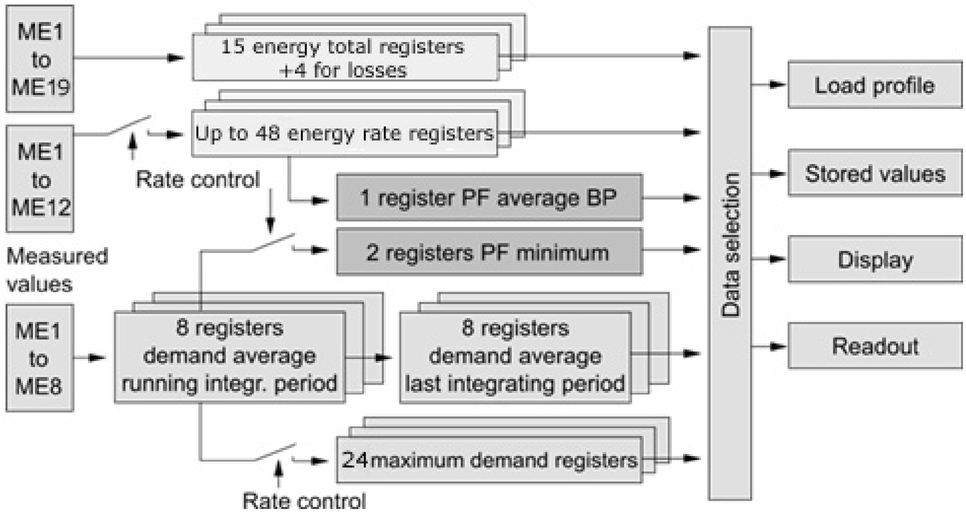


Fig. 1.14 ZMG400xR – Signal utilisation

Power factor

The combimeter can process the power factor in the following two ways:

- from the mean value during the integrating period from the running demand mean values of A and VA, which forms the PF minimum in the two registers similar to the maximum.
- the mean value from the energy advance registers for A and VA during the reset or billing period.

Data selection

The registers can generally be

- represented in the operating display,
- on-site read out in the display or service list,
- read out via the IEC protocol or
- read out individually via DLMS
- stored in the stored value profile per billing period (without average demand values)
- recorded in a load profile per integrating period (only energy total and average demand values during last integrating period)

1.7 Profiles

A profile is used to save the values of various registers at regular intervals. The measured values that are captured in a profile can be selected by parameterisation and may include energy advance, total energy, demand and power factor registers as well as instantaneous values.

Stored values

For optimum memory management the stored values for the ZMG400xR are combined in their own stored value profile. The number of registers using stored values determines the memory width, the number of stored values per register the memory depth.

Load profiles

The meter (firmware version P06) supports two load profiles, e.g., one for billing and one for monitoring purposes. Load profiles are periodic memories that record the quantities determined continuously following every capture period. The time and date are basically only entered at the start of a new day, as well as always for a voltage failure, for the subsequent voltage restoration, for a time shift or for re-parameterisation. Every capture period, however, includes a time entry, various important status details, as well as the individual measuring values. Time entry, status entry and the maximum possible 16 measuring values form the channels.

The capture periods of the load profiles are independent. For meters with demand measurement, one of the capture periods of a load profile always corresponds to the integrating period of the demand measurement.

In firmware version P06, instantaneous values can be captured in either Load Profile 1 or Load Profile 2 depending on parameterisation. In P06, you can specify the display format of instantaneous power (Signed or Unsigned) if the meter is parameterised to calculate instantaneous power as signed values.

The memory depth determines the possible load profile days. It largely depends on

- the duration of the capture period
- the number of measuring values per capture period
- the length of the measuring values

The meter can therefore record 4 measuring values for around 350 days for example with a capture period of 15 minutes.

Load profiles can always be read out via the interfaces. For special applications it can also be shown in the display, whereby like the event log it appears in the display menu under its own menu item.

Standard event log

This event log is an aperiodic memory and records defined events together with time and date, as well as possibly other data. The events of a certain type are denoted by a number, e.g. voltage failure with 23, voltage restoration with 24.

The memory depth depends on the additional data which the utility itself wishes to store, together with the event (status register, energy total register of the defined measuring values).

The contents of the event log can be shown in the display and read out via the interfaces. In the display they appear under their own menu item, normally in the service menu.

List of events

The table below lists all of the events that can be captured in the event log. Depending on the parameterisation, some events may never occur.

Events that can be stored in a dedicated event log are marked in the corresponding column. The marked events are only captured either in the standard event log or in the dedicated event logs, with the exception of event number 135 (front cover opened), which is captured in both logs.

Number	Event	Entry in dedicated event log possible
2	All energy registers cleared	
3	Stored values and/or load profile cleared	
4	Event log profile cleared	
5	Battery voltage low	
7	Battery ok	
8	Billing period reset	
9	Daylight saving time enabled or disabled	
10	Clock adjusted (old time/date)	
11	Clock adjusted (new time/date)	
13	Status of control input changed	
17	Undervoltage L1	x
18	Undervoltage L2	x
19	Undervoltage L3	x
20	Overvoltage L1	x
21	Overvoltage L2	x
22	Overvoltage L3	x
23	Power down	x
24	Power up	x
25	Overcurrent L1	x
26	Overcurrent L2	x
27	Overcurrent L3	x
29	Power factor monitor 1	
30	Power factor monitor 2	
33-38	Demand monitors 1-6	x
45	Error register cleared	
49	Missing voltage L1	x
50	Missing voltage L2	x
51	Missing voltage L3	x
55	Current without voltage L1	x
56	Current without voltage L2	x
57	Current without voltage L3	x

Number	Event	Entry in dedicated event log possible
59	All registers and profiles cleared	
63	Phase sequence reversal	x
66	Invalid clock	
75	Measuring system access error	
76	Time base flag error	
80	MMI board error	
89	Startup sequence invalid	
93	General system error	
94	Communication locked	
95	EEPROM identifier wrong	
104	Count registers cleared	
106	Alert occurred	
121-123	Undercurrent L1-L3	x
128	Energy total and rate register cleared	
135	Front cover opened	x
193	Load profile 2 cleared	

Dedicated event logs

The ZMG400xR can register several events in an own (dedicated) event log for every event. This log memorises per event begin, end and duration, together with further data (energy total registers, instantaneous values) at the beginning as well as at the end of event. It comprises the 10 events with the longest duration as well as the first and the last.

The dedicated event logs can only by read with DLMS.

1.8 Rate Control

The rate control is determined by the tariff structure specified by the utility. In addition to the traditional control of energy and demand rates, it includes further functions such as operating times, transmission of signals via output contacts, display arrows, etc.

The rate control consists of the following elements:

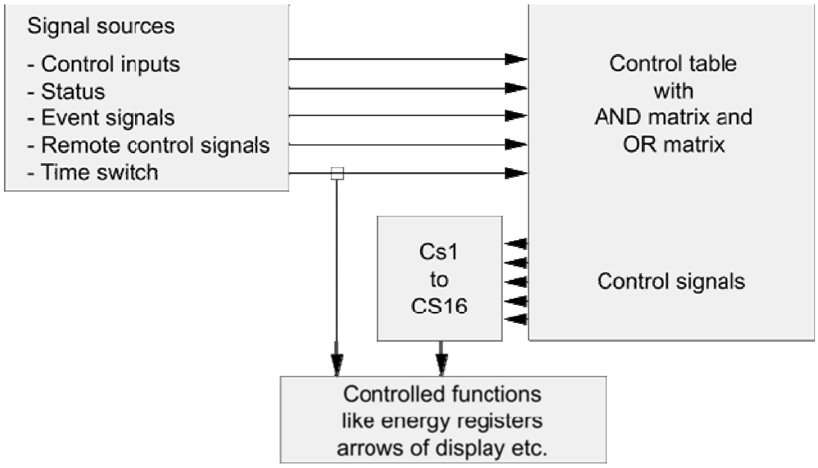


Fig. 1.15 Overview rate control

Signal sources

such as control inputs, internal statuses, event signals, remote control signals, signals from the time switch

Control table with AND and OR matrix for up to 16 control signals CSx

using the AND matrix, logic signals can be represented, which are then linked in the OR matrix to the actual control signals CSx. It serves in particular to link external signals via the control inputs as well as to interconnect signals from various sources.

Controlled objects

These are mainly the energy and maximum demand registers for the current rate control, in addition to the operating times, output contacts, display arrows, etc.

The controlled objects, such as energy registers, operating times, etc. are either assigned to the control signals CSx or to the time switch signals TOUx. With pure time switch operation, they can therefore also be controlled directly by their TOUx signals, since these have the same status for the meter as the control signals CSx.

Output contacts and arrows can be assigned to all other signal sources present, in addition to the control signals. The arrows can also indicate other status, such as reset lock, setting or test mode active, etc., which are not part of the rate control.

Rate control of the ZMG400xR is consistently divided into

- the generation of control signals from the signal sources and
- allocation of the control signals to the functions.

These control signals switch on or off the assigned function(s).

While, for example, one control input switches from one rate to another, these two rates each require their own control signal. These are produced in this case from the two status of the voltage/no voltage control input.

1.9 Clock Structure

The meter-internal clock generates the date and time information which is used:

- for display of the date and time information to be displayed
- to control the time switch TOU
- for the time stamps in the profiles, in the stored value profile, snapshot profile and event log
- for control of the capture period of a load profile

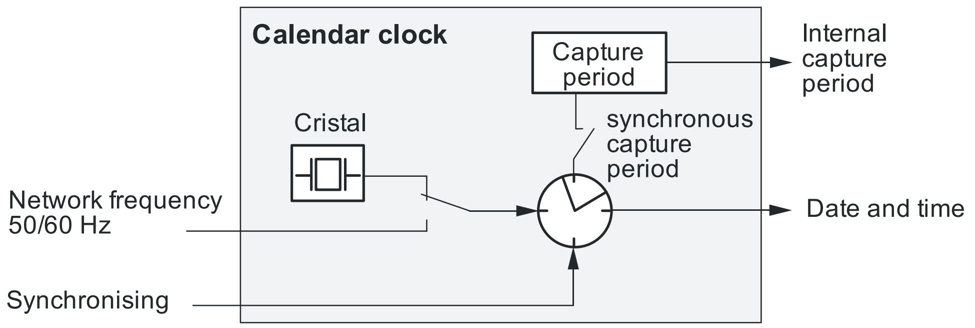


Fig. 1.16 Clock structure

Time base

The calendar clock either uses the internal crystal or the network frequency as time base (depending on parameterisation).

The network frequency (50 Hz or 60 Hz) may be used as time base, provided it is sufficiently accurate. Tuning is then performed after each full wave, i.e. after 20 ms at 50 Hz. If the network frequency happens to vary by more than 5% the calendar clock automatically switches to the crystal time base.

Accuracy

The crystal features a maximum deviation of 0.5 s per day (<6 ppm).

Synchronisation

The calendar clock can be synchronised at regular intervals:

- via communication (e.g. by the central station).
- by an external master clock via synchronisation input Syn

Time-setting

The time and date of the calendar clock can be set:

- via communication
- manually in the set mode in the service menu of the meter

Power reserve

A supercap (capacitor with a very large capacity) provides the power reserve for the calendar clock. The power reserve may be extended using a battery.

- Power reserve without battery: 20 days (only after the meter has been connected to the network for at least 300 hours)
- Power reserve with battery: 10 years

1.10 Monitoring Functions

1.10.1 Event Recognition

E550 meters possess various functions for monitoring operation and fraud detection to help the utility produce bills based on these meters more reliably and accurately.

These functions are:

- Recognition of whether the meter is wrongly connected
- Determination of performance quality features
- Detection of open or short-circuited transformer circuits
- Detection of wrongly connected current and voltage transformers
- Determination of negative energy direction
- Detection of failure of partial functions
- Detection of influence of strong magnetic fields
- Determination of whether case or terminal cover has been opened
- etc.

Event features

E550 meters can also distinguish between the events detected according to type

- Fraud detection
- Mains and power quality
- General events

The events exhibit the following features:

- Their detection can be switched on or off.
- They can be read out via the display and interfaces.
- They can be indicated by a LED and also by a symbol in the display.
- They can trigger a warning with an SMS or output contact.
- The meter can record the events when occurring or when disappearing together with various data.

1.10.2 Assignment of Events

Event type * not complete	Assignment			
	Standard events *	Fraud detection	Power quality	Demand
Strong magnetic field detected		■		
Front cover opened	■	■		
Terminal cover opened		■		
Over-voltage	■		■	
Under-voltage	■		■	
Phase failure (U+I)	■		■	
Power failure	■		■	
Voltage quality			■	
Phase sequence inversed	■	■		
Negative direction of active energy		■		
Current without voltage	■	■		
Transformer open/short-circuited		■		
Missing current	■	■		
Over-current in neutral		■		
Over-current	■			■
Power monitoring	■			■
5/10 highest demand values				■
Access with wrong password	■			
Local or remote parameterisation	■			

Fig. 1.17 Assignment of events

The events depicted here are divided into the groups

- Standard events
- Fraud detection
- Power quality monitoring and
- Demand monitoring

The majority of these are also listed under standard events. This list, however, also contains other events not mentioned here.

Events with two bullets can be assigned to only one of the two groups, thus either the standard events or the other group. The front cover is an exception to this; its opening and closing will always be registered in both the standard and the dedicated event log.

1.10.3 Fraud Detection

If released in the configuration, ZMG400xR meters have the following functions with regard to fraud detection:

- A microswitch on the terminal cover records whether it has been opened and closed during operation.
- A further microswitch on the front cover records whether it has been opened and closed during operation.
  These two switches also operate when no voltage is applied to the meter if battery 1 is inserted.
- A reed switch in the meter records strong magnetic fields in the meter, which could influence the measuring system.

1.10.4 Voltage Monitor

The voltage monitor provides the following functions:

- Display and readout
- Recording in load profile
- Testing for voltage failure in each phase
- Testing for voltage failure in all phases
- Testing for over- and undervoltages
- Determination of voltage quality

1.10.5 Current Monitor

The current monitor provides the following functions:

- Display and readout
- Recording in load profile
- Testing for missing current
- Testing for overcurrents

1.10.6 Demand Monitor

The demand monitor provides the following functions:

- Display and readout of total active power and active power of individual phases and in combimeters also of total reactive power and reactive power of individual phases
- Testing of running mean value $P_{running}$ or
- Testing of final mean value P_{last} with respect to exceeding of demand.

1.11 Communication

Landis+Gyr E550 meters have an optical interface for on-site communication via a reading head and, if required, via an integrated communication interface or, from firmware version P05, via two integrated communication interfaces, for remote reading of the meter (RS232, RS422, RS485 or CS as selected).

Access to the communication interfaces is password protected for certain access levels by the meter's security system. The meter can monitor passwords entered. In case monitoring has been activated with the corresponding parameterisation, communication is interrupted in both communication interfaces for a selectable time (max. 24 hours) if a wrong password was entered several times. The number of invalid entries, after which the communication is interrupted, can be specified (max. 15).

1.11.1 Visual Interfaces

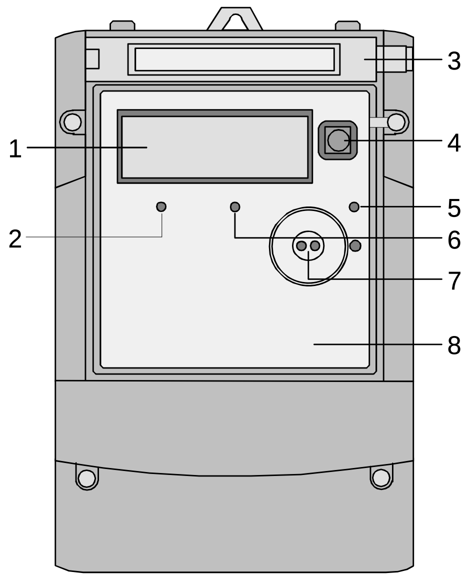


Fig. 1.18 Visual interfaces

E550 meters include the following visual interfaces:

1 Display
2 Optical test output reactive energy (combimeters ZMG400CR only)
3 Reset key (behind hinged cover)
4 Display key
5 Alert diode (fraud detection)
6 Optical test output active energy
7 Optical interface
8 Faceplate

The reset key and batteries are fitted behind the hinged cover and are protected by the utility seal. The service menu is obtained using the reset key to gain access to security level 3 (under utility seal).

The faceplate is situated behind the front cover, which is secured by the certification seal. This provides access to the security switches and therefore to security level 4 (under certification seal).

1.11.2 Data Display

E550 meters have a liquid crystal display (LCD) with the following features:

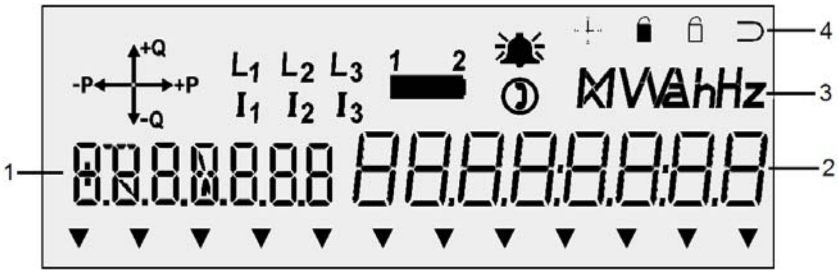


Fig. 1.19 Display of data

1 Identification number to OBIS
2 Value of item displayed
3 Unit of item displayed
4 Reserved for special applications

The various data appear in the display

- menu-controlled
  with a freely accessible display menu and a protected service menu
- with lists for free parameterisation (up to 200 values)
  - operating display (fixed value or several values rolling)
  - display list (freely accessible)
  - service list (under utility seal, for installation check)
  - set list (e.g. time and date)
- Display of load profile data
- Display of events (e.g. standard events, fraud detection, mains quality)
- Display without power
  With battery 1 it is possible to show data on the display in case of a power cut.

1.11.3 Optical Interface

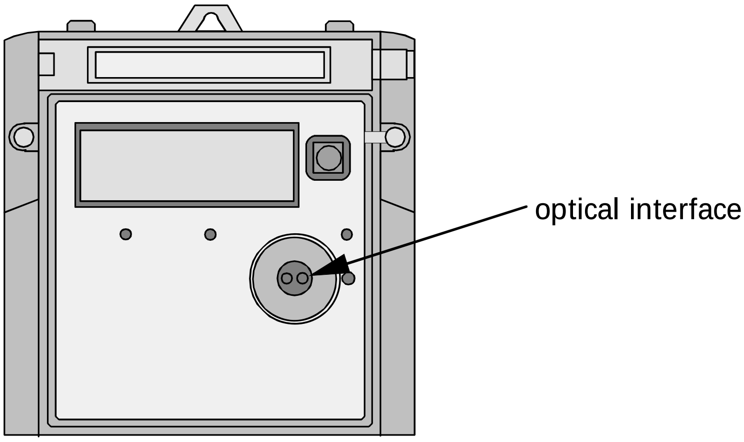


Fig. 1.20 Optical interface

The optical interface is provided for local communication with the meter, including automatic readout of data, performance of service functions, reparameterisation, etc. The user employs a suitable device for this purpose, such as handheld terminal or laptop and a suitable reading head. The interface has the following characteristics:

- Physical characteristics according to IEC 62056-21
- Opening of communication always with starting speed of 300 bps
- Start protocol always according to IEC 62056-21 (mode C)
- As "optical key", i.e. as receiver of a light signal, e.g. generated by a flashlight acting like the "down" display key (see also section 5.1.2 "Control of Display via Optical Interface")
- Also supports DLMS, changeover performed at start
- Maximum transmission speed 19'200 bps

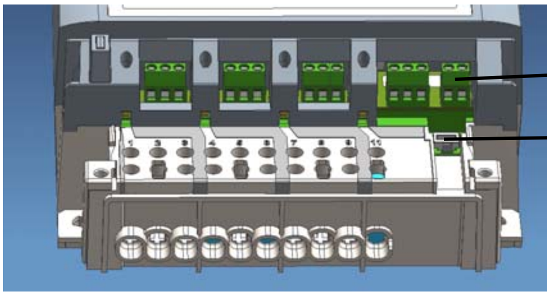
Parallel readout

For ZMG400xR meters, the utility can perform readout via the optical interface or also via the two electrical interfaces independently, since they use separate internal interfaces.

Readout without power

With battery 1, it is possible to read the meter out even in case of a power cut.

1.11.4 Electrical interface



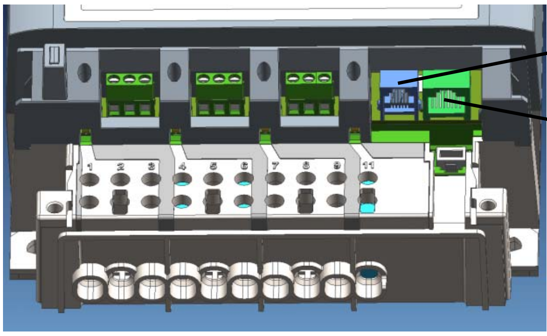


Fig. 1.21 Electrical interfaces (top: previous version and Series 2, below: Series 2 only)

E550 prior to Series 2 (also available for Series 2)
Channel 1: RS232 or RS485 interface with RJ12-connector
Channel 2: CS-interface with 2 terminal screws

E550 Series 2 only
Position 1: powered RS232 or RS422
Position 2: RS485 or RS422
for possible interfaces see section 1.3 "Type Designation")

Versions

In addition to the optical interface always present, E550 meters can be fitted with one or two additional interfaces for remote readout. The available versions are listed in section 1.3 "Type Designation".

Transparent RS232 requires external connection of an intelligent modem, which checks the connection regularly via the telephone system.

The intelligent RS232 interface permits external connection of any desired (transparent) modem. The interface itself regularly checks the connection via the telephone system.

The powered RS232 interface permits the connection of an external GSM/GPRS modem (under the terminal cover) and provides the necessary power supply over the same RJ45 connector.

The characteristics of the electrical interface are:

- starting speed 300 to 38'400 bps (bits per second)
- automatic recognition of start protocol
- maximum transmission speed
  - CS 2400 to 9600 bps
  - RS232/RS485/RS422 2400 to 38'400 bps

38,400 bps can only be set on one interface (1 or 2), the others to 9600 bps.

19,200 bps can only be set on 2 interfaces; the third can be set to 9600 bps.

Parallel readout

E550 meters can be read out by the utility via the electrical or the optical interface. These interfaces can be used independently.

Further information

More detailed information about Landis+Gyr Dialog communication solutions can be found in the following documents:

- **Overview** of communication applications D000011226
- **Basic information** for communication applications H 71 0200 0145 en

These documents as well as customer support are available from your local Landis+Gyr representative.

RS485 interface

The RS485 interface is a serial bi-directional half-duplex interface.

Up to 32 locally installed meters can be connected via the RS485 interface (daisy chain network) to a bus system and then centrally to a modem, in order to read out the meter data or perform service functions (such as setting starting values, time/date, etc.).

RS422 interface

The RS422 interface is a serial bi-directional full-duplex interface.

Up to 10 locally installed meters can be connected via the RS422 interface (daisy chain network) to a bus system and then centrally to a modem. 60 Ω line terminations and cross-over cables may be needed depending on the application.

CS interface

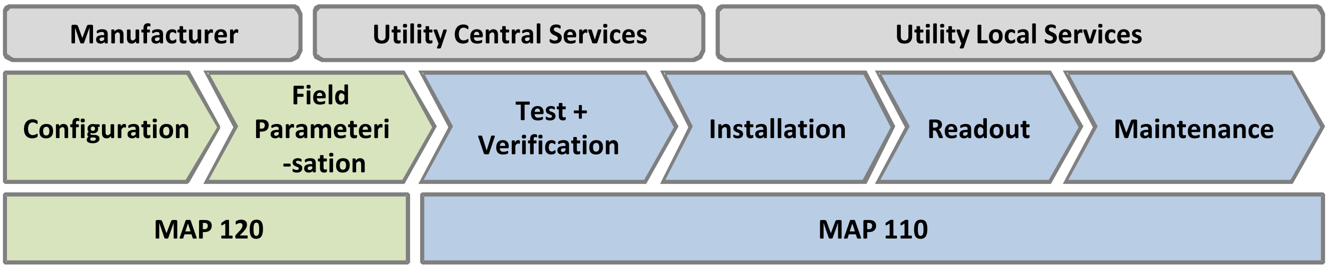
The CS interface is a serial, bi-directional, passive current interface (current loop).

A maximum of 4 locally installed meters can be connected to a bus system and then centrally to a modem, in order to read out the meter data or perform service functions (such as setting starting values, time/date, etc.).

1.12 MAP Software Tools

There are two software tools available for the parameterisation of the E550 meter and for communication with the meter: MAP110 and MAP120.

Areas of application



MAP110

The MAP110 Service Tool covers all the following applications normally required for meter installation and in the service sector:

- Billing data readout
- Readout and export of profiles (load profiles, stored values and event log)
- TOU (Time of Use) readout and modification
- Billing period reset
- Register and profile resets
- Setting of certain parameter ranges such as primary data, time switch, etc.
- Communication input settings
- Communication settings for Landis+Gyr communication units readout and modification
- GSM installation aid for Landis+Gyr communication units (field strength indicators, telephone number information, PIN-code handling)
- Test SMS message transmission
- Analysis and diagnostic functions

MAP120

The Landis+Gyr MAP120 software is used to reparameterise the meter and the communication unit, i.e. it is possible to read out and modify all device parameters.

2 Safety

This section describes the safety information used in this manual, outlines the responsibilities and lists the safety regulations to be observed.

2.1 Safety Information

Attention is drawn as follows in the individual chapters of this user manual to the relevant danger level, i.e. the severity and probability of any danger:

Danger
Identifies an extraordinarily great and immediate danger that could lead to serious physical injury or death.

Warning
Indicates a potentially hazardous situation that may result in minor physical injury or material damage.

Note
Indicates general details and other useful information to help you with your work.

In addition to the danger level, all safety information also describes the type and source of the danger, its possible consequences and measures to counteract the danger.

2.2 Responsibilities

The owner of the meters – normally the utility – is responsible that all persons engaged on work with meters:

1. Are competent and qualified in accordance with national regulations (see ISSA "Guideline for Assessing the Competence of Electrically Skilled Persons").
2. Have read and understood the relevant sections of the user manual.
3. Strictly observe the safety regulations (according to section 2.3) and the operating information in the individual chapters.

In particular, the owner of the meters bears responsibility

- for the protection of persons,
- prevention of material damage,
- and the training of personnel.

Landis+Gyr AG provides training courses for this purpose on specific equipment; please contact the relevant agent if interested.

2.3 Safety Regulations

The following safety regulations must be observed at all times:

- The conductors to which the meter will be connected must not be under voltage during installation or change of the meter. Contact with live parts is dangerous to life. The relevant preliminary fuses should therefore be removed and kept in a safe place until the work is completed, so that other persons cannot replace them unnoticed.
- Local safety regulations must be observed. Installation of the meters must be performed exclusively by technically qualified and suitably trained personnel.
- Secondary circuits of current transformers must be short-circuited (at the test terminal block) without fail before opening. The high voltage produced by an interrupted current transformer is dangerous to life and destroys the transformer.
- Transformers in medium or high voltage systems must be earthed on one side or at the neutral point on the secondary side. Otherwise they can be statically charged to a voltage which exceeds the insulation strength of the meter and is also dangerous to life.
- The meters must be held securely during installation. They can cause injuries if dropped.
- Meters which have fallen must not be installed, even if no damage is apparent. They must be returned for testing to the service and repair department responsible (or the manufacturer). Internal damage can result in functional disorders or short-circuits.
- The meters must on no account be cleaned with running water or with high pressure devices. Water penetration can cause short-circuits.

2.4 Radio interference

Possible radio interference in residential environments
This meter is a class B product. Therefore, it provides reasonable protection against interference with communication devices in a typical residential environment.

3 Mechanical Construction

This section describes the mechanical construction of the E550 ZMG400xR meter and shows the most common connection diagrams.

The internal construction of the meters is not described here, since they are protected following verification and official certification on delivery by a manufacturer seal and a certification seal. It is not permitted to open the meters after delivery. The hinged cover secured with a utility seal can be opened sideways to operate the reset key or change the batteries.

3.1 Front View

The following drawing shows the meter components visible from outside.

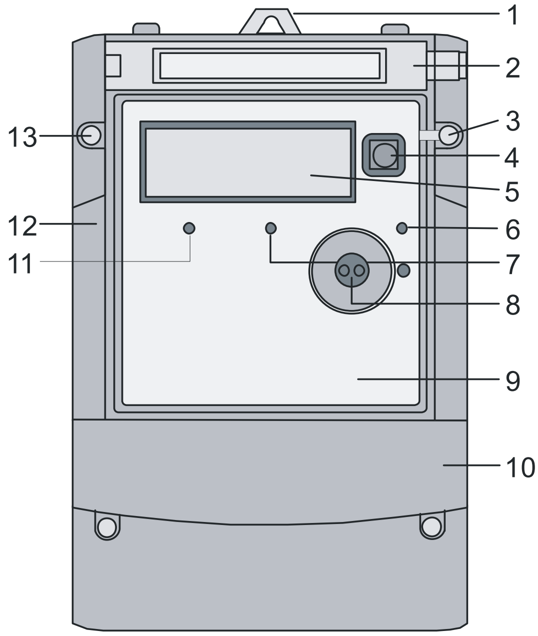


Fig. 3.1 ZMG400xR – Front view

1 Combined suspension hanger (open or concealed)
2 Hinged cover opening to the left, with utility seal right (provides access to the reset key and to the battery compartment)
3 Screw with certification seal (secures the front cover with faceplate and provides access to the security switch without having to open the meter)
4 Display key
5 Display (LCD)
6 Warning diode
7 Optical test output active energy
8 Optical interface
9 Front cover with faceplate
10 Terminal cover with utility seals
11 Optical test output reactive energy
12 Upper part of case
13 Screw with utility or verification seal for upper part of case

Case

The meter case is made of antistatic plastic (polycarbonate). The upper part of the case is provided with a transparent plastic front cover, affording a view of the face plate. The lower part of the case is additionally glass fibre reinforced.

Front cover

The front cover with the face plate is secured on the upper right side with a certification seal, while the upper part of the case is secured on the upper left side with a manufacturer seal (warranty) or a second certification seal.

Terminal cover

The terminal cover is available in various lengths in order to ensure the required free space for the connections.

Hinged cover

The hinged cover opening sideways is secured with a utility seal. The battery compartment and reset key are underneath.

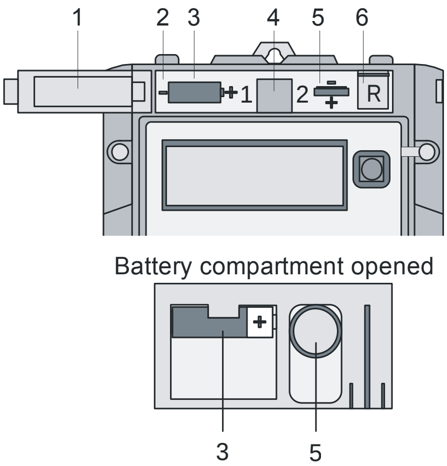


Fig. 3.2 Meter with hinged cover open

1 Hinged cover open (sideways to left)
2 Battery compartment
3 Battery 1 for calendar clock, display and readout
4 Grip recess for withdrawing battery compartment
5 Battery 2 for calendar clock, if battery 1 is not inserted in or empty
6 Reset key

In order to actuate the reset key the utility seal must be removed and the hinged cover opened sideways. This permits

- manual resetting or
- access to the service menu (level 3 of the security system)

3.2 Faceplate

All relevant meter data can be found on the customer specific faceplate.

The faceplate is situated under the front cover, which is secured by a certification seal. A recess permits operation of the display key.

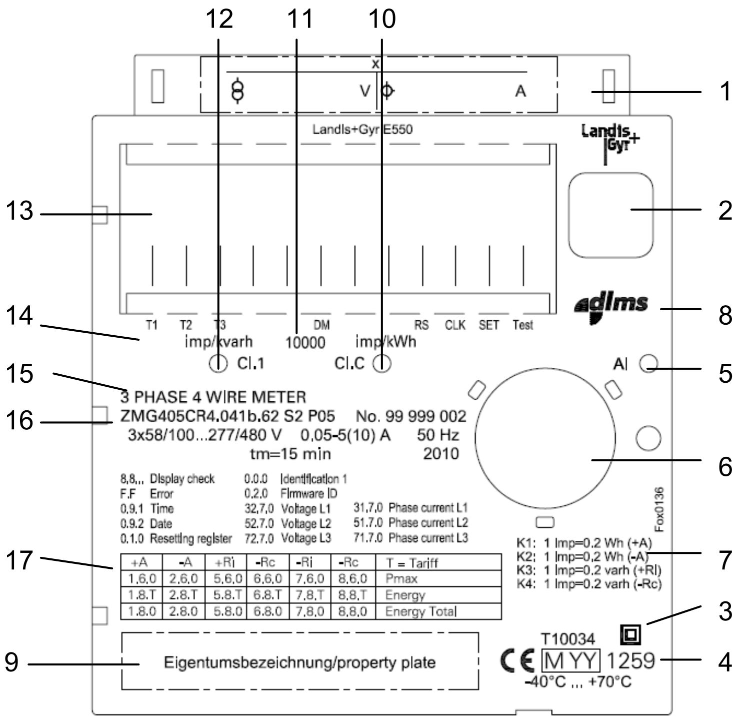


Fig. 3.3 Face plate (example ZMG405CR)

1 Transformer label for the ZMG400
2 Opening for display key
3 Symbol for double protective insulation according to IEC 61010
4 Approval symbol
5 Warning diode (Alert)
6 Opening for optical interface
7 Data of output contacts
8 dlms Symbol: meter with IEC and DLMS protocol
9 Field for property designation
10 Optical test output active energy with accuracy class
11 Meter constant
12 Optical test output reactive energy with accuracy class (combimeters only)
13 Opening for LCD
14 Status information (together with arrows in display) with regard to active rates, set mode, time/date invalid, etc.
15 Connection type (three-phase four-wire meter)
16 Meter data with type designation, serial number, nominal values, year of construction, etc.
17 Legend for codes of values displayed

The detailed configuration depends on national regulations and customer specifications.

The operating elements and displays are described more fully in section 5 "Operation".

3.3 Connections

The terminal block with all meter connections is situated under the terminal cover. Two utility seals in the fixing screws of the terminal cover prevent unauthorised access to the phase connections and therefore prevent unrecorded energy consumption.

Terminal layout (example ZMG400xR with CS interface)

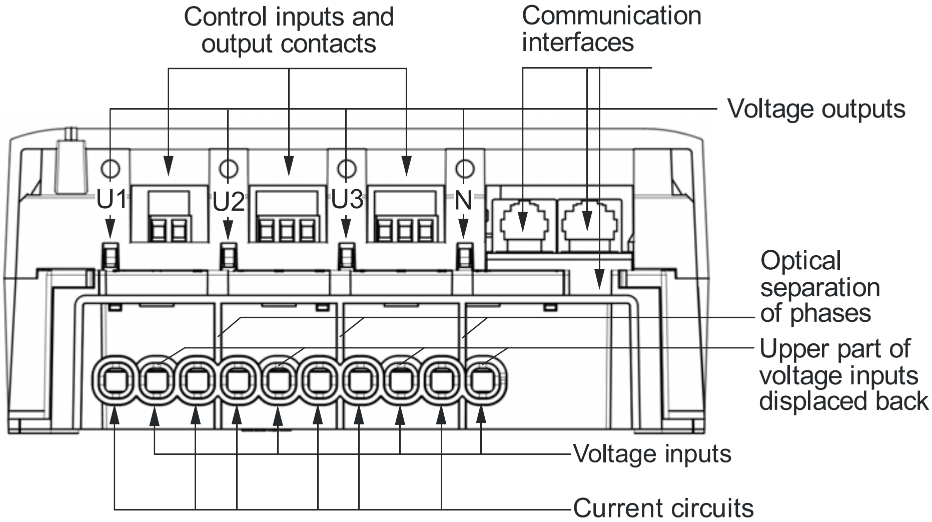


Fig. 3.4 Terminal layout ZMG400xR with CS interface

The top row of terminals consists of screw terminals and comprises

- Voltage outputs U_1, U_2, U_3 and N, tapped from the relevant phase input. These outputs may carry a maximum current of 1 A.
- Control inputs for external rate control and reset, if the meter is configured for external control.
- Output contacts for transferring fixed valency pulses, control signals or statuses
- Communication interfaces
  - CS interface with screw terminals
  - RS232 or RS485 interface with RJ12 jack (not visible here since on base board)

The lower row of terminals comprises the phase connections with input and output of the circuit for each phase with the voltage connection in between and neutral conductor at far right.

Terminal layout (example ZMG400xR without CS interface)

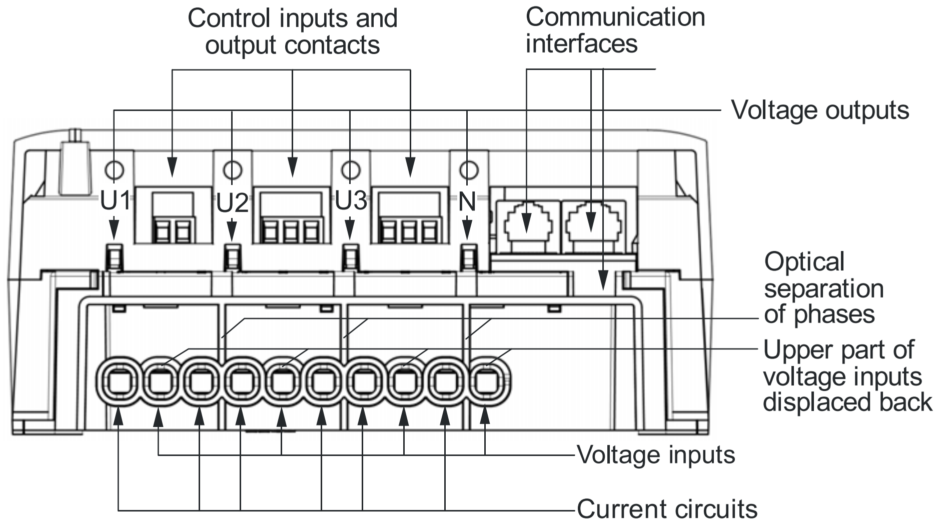


Fig. 3.5 Terminal layout ZMG400xR without CS interface

The top row of terminals consists of screw terminals and comprises

- Voltage outputs U_1, U_2, U_3 and N, tapped from the relevant phase input. These outputs may carry a maximum current of 1 A.
- Electromechanical output contact (output relay 5 A)
- Output contacts for transferring fixed valency pulses, control signals or statuses
- Communication interfaces
  - on the left RS422 or RS485 interface (RJ12 jack)
  - on the right RS422 interface (RJ12 jack) or powered RS232 interface (RJ45 jack)
  - on the base board RS232 or RS485 interface (RJ12 jack, not visible here)

The lower row of terminals comprises the phase connections with input and output of the circuit for each phase with the voltage connection in between and neutral conductor at far right.

Input terminals

The input terminals of ZMG400xR meters have two features, which optically distinguish the functions of the individual terminals:

- Vertical struts separate the individual phases.
- A retracted flank of the voltage input distinguishes this from the current input left and output right.

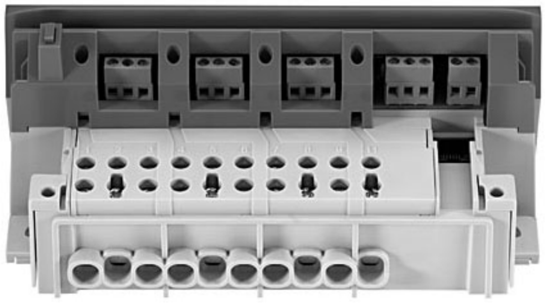


Fig. 3.6 Terminals of ZMG400xR with visual separation of individual phases. The top part of the voltage inputs has been set back for identification. A transparent terminal top is available for the 60 mm terminal block.

Current and voltage terminals ZMG400xR

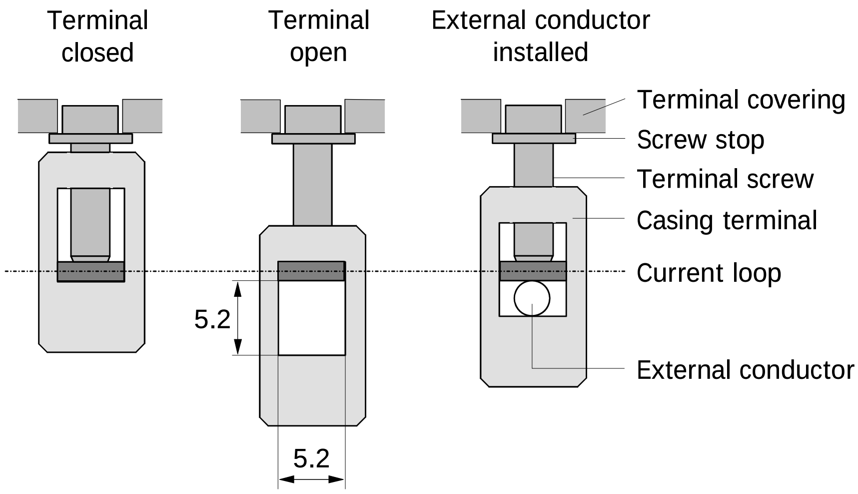


Fig. 3.7 Current and voltage terminals ZMG400xR

The ZMG400xR uses a cage type terminal instead of the former pillar type terminal, in which the outer conductor is pressed against the internal conductor of the meter from above. This presses the outer conductor against the internal conductor from below by means of the terminal screw as shown in the above picture. This ensures a satisfactory contact for every outer conductor cross-section.

3.4 Connection Diagrams

Binding connection diagrams
The following connection diagrams should be considered examples. The connection diagrams, provided on the inside of the terminal cover and visible when this is opened, are always binding for the installation.

3.4.1 Three-phase three-wire connection with ZMG400

ZMG400xR for three-phase three-wire networks

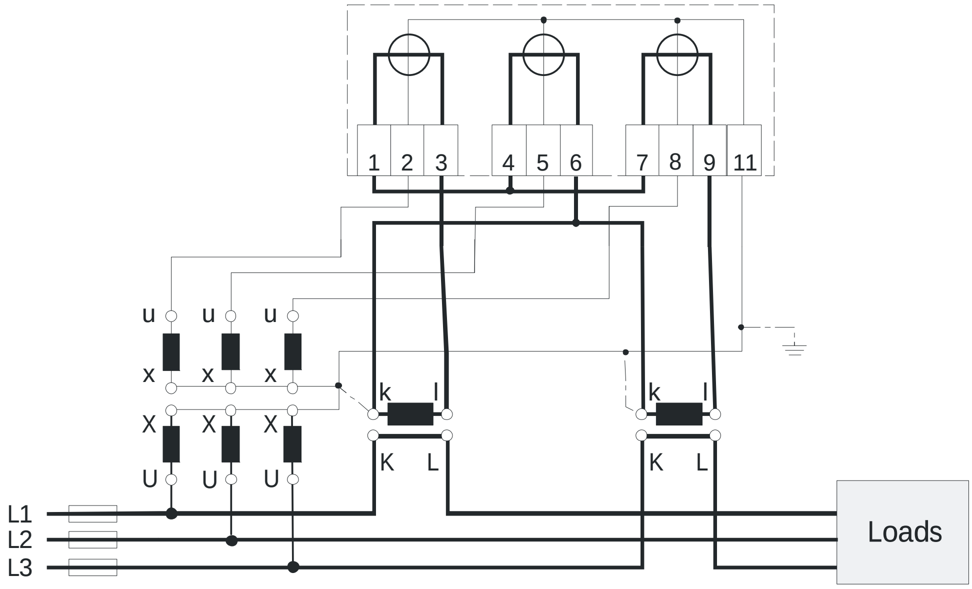


Fig. 3.8 Connection diagram of ZMG400xR for three-wire network

3.4.2 M-connection

ZMG400xR for three-phase four-wire networks

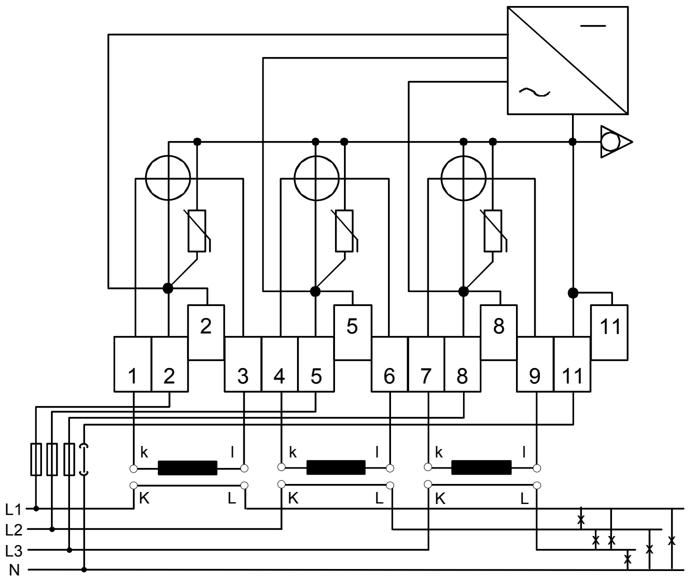


Fig. 3.9 Connection diagram of ZMG400xR with current transformers

ZMG400xR for medium voltage networks

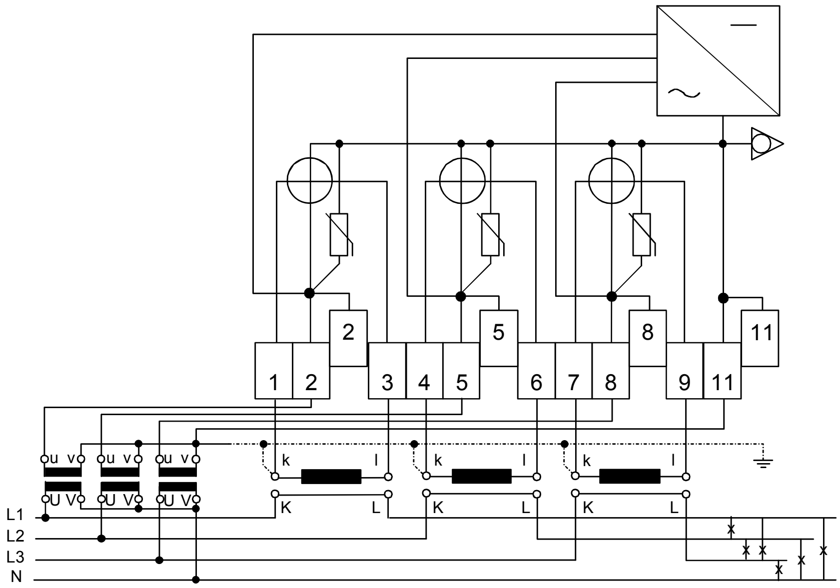


Fig. 3.10 Connection diagram of ZMG400xR with current and voltage transformers at medium voltage level

3.4.3 Inputs and outputs

For a complete list of possible I/O variants see section 1.3 "Type Designation" or the datasheet of the meter.

4 control inputs / 4 output contacts / RS485 / CS

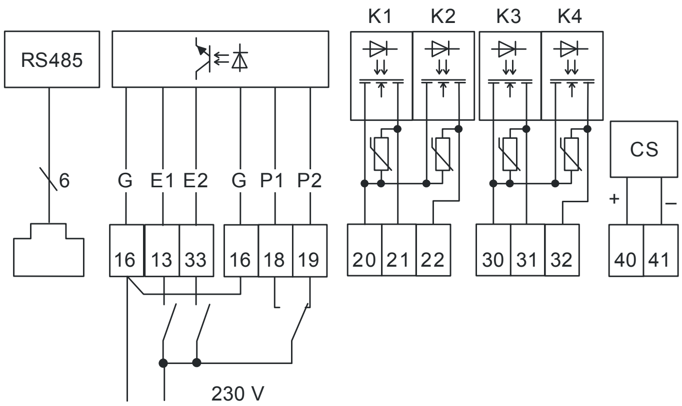


Fig. 3.11 Connection diagram 4 control inputs, 4 output contacts (example) with RS485 and CS interface (only one active)

4 output contacts / 1 relay output / RS 485 / RS 232 powered

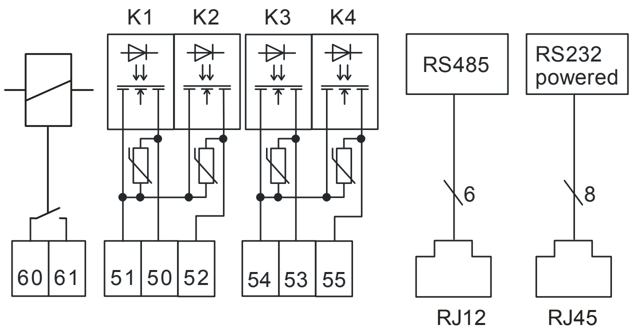


Fig. 3.12 Connection diagram 4 output contacts, 1 relay output, RS 485 and RS232 interface (powered)

2 control inputs / 4 output contacts / RS 485 / RS 232 powered

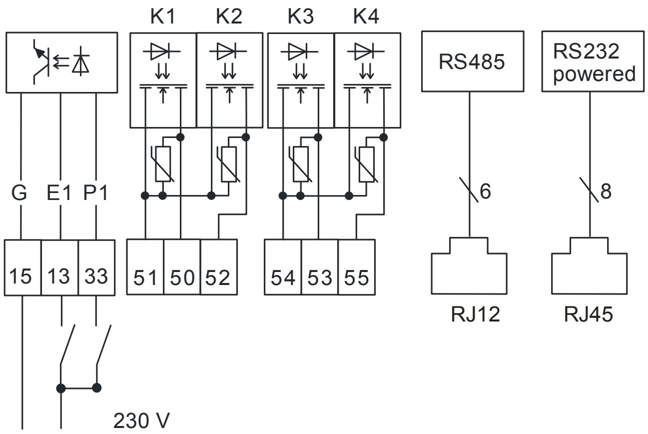


Fig. 3.13 Connection diagram 2 control inputs, 4 output contacts, RS 485 and RS232 interface (powered)

4 output contacts / 1 relay output / RS 422

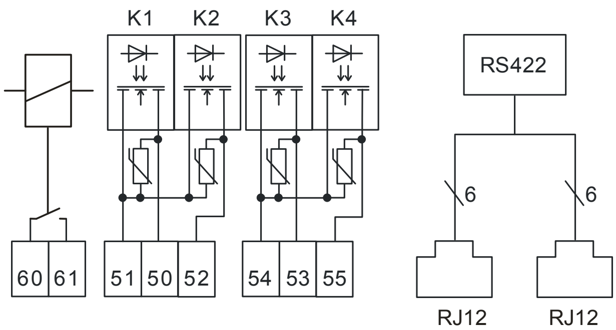


Fig. 3.14 Connection diagram 4 output contacts, 1 relay output, RS 422

6 output contacts / RS 485 / RS 232 powered

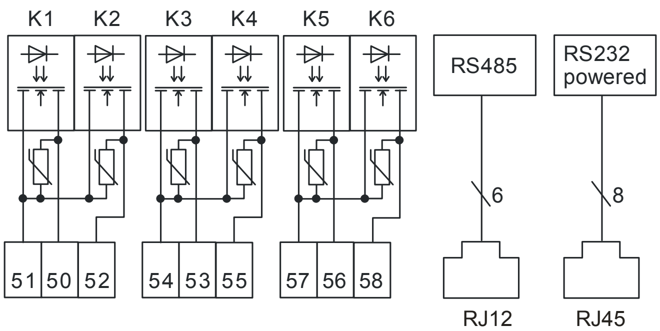


Fig. 3.15 Connection diagram 6 output contacts, RS 485 and RS232 interface (powered)

2 control inputs / 6 output contacts / RS232 / CS

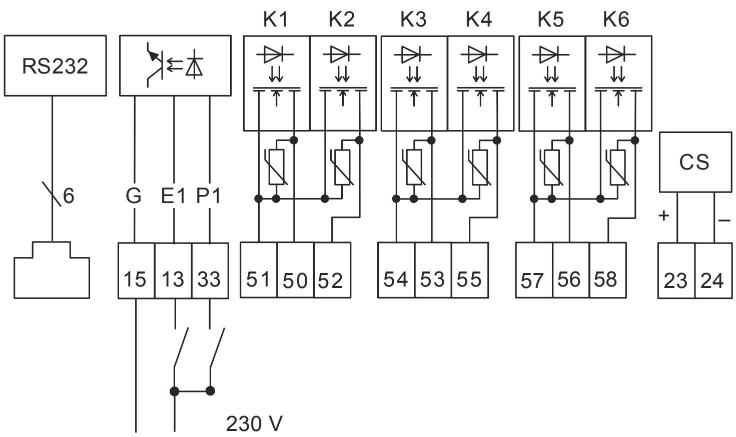


Fig. 3.16 Connection diagram 2 control inputs/6 output contacts (example) with RS232 and CS interface (only one active)

3.5 Dimensions

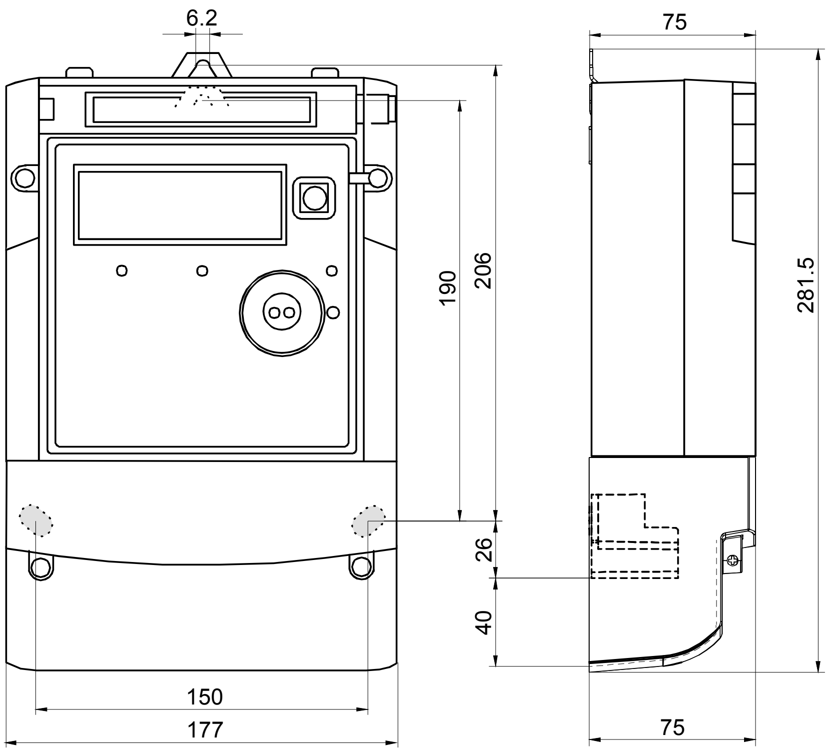


Fig. 3.17 Meter dimensions (standard terminal cover)

4 Installing and Removing Meters

This chapter describes the installation and connection of meters for transformer connection. In addition, the necessary steps for checking the connections, commissioning of the meter and the final functional check are described as well as the de-installation.

Dangerous voltage
Dangers can arise from live electrical installations to which the meters are connected. Touching live parts is dangerous to life. All safety information should therefore be strictly observed without fail.

4.1 Basic Information for Connecting Meter

It is recommended to use the following connections whenever possible for connecting the meter to the various voltage levels.

4.1.1 Connection to Low Voltage with Current Transformers

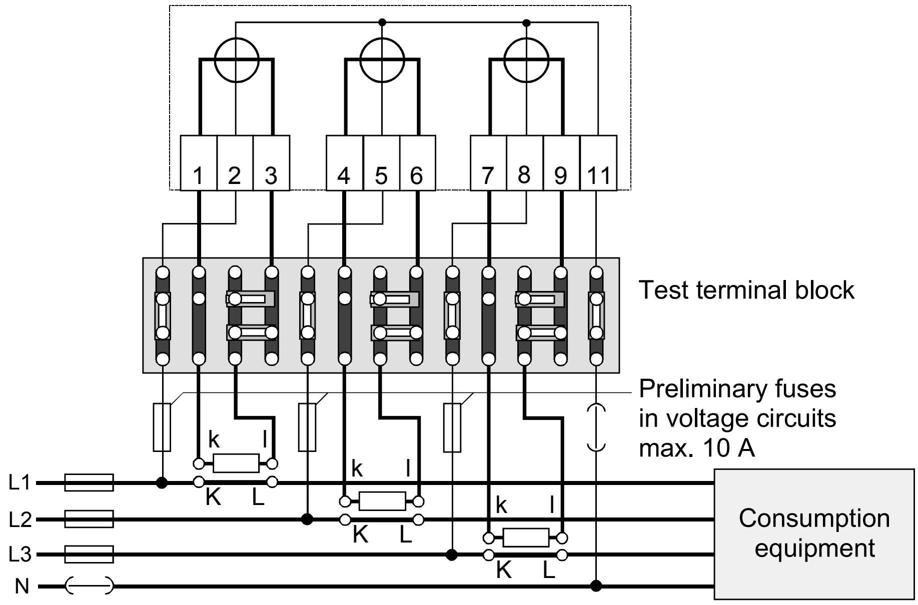


Fig. 4.1 Connection to low voltage with current transformers

Test terminal block The secondary circuit of a current transformer must always be closed when current is flowing in the primary. Opening of the secondary circuit can destroy the transformer. The test terminal block shown above allows the secondary circuits to be short-circuited and the voltage circuits to be opened in order to change the meter without interrupting operation.

Preliminary fuses The preliminary fuses in the voltage circuit (max. 10 A) protect against short-circuits in the measuring circuitry. The voltage circuits are connected directly to the primary and would only be protected by the main fuses of 100 A or more if the preliminary fuses were not fitted. A short-circuit would certainly destroy the measuring device.

4.1.2 Connection to Medium Voltage

Aron measuring circuit

This connection type is used by various suppliers for medium voltage (3 to 30 kV) but hardly ever for high voltage (> 30 kV).

It is also recommended to connect a test terminal block between the transformers and the measuring device (i.e. the meter). This enables a fast exchange without interrupting operation. Pre-fuses are not needed in the circuits as the voltage transformers cannot generate high currents on their secondary side.

Grounding

In medium and high voltage, the secondary sides of all transformers must be grounded. Otherwise, dangerous potentials may be generated.

Aron-connection with ZMG400xR

The supplier can use a ZMG400xR 3-phase 4-wire meter. The following connections are possible:

- with 2 voltage transformers and open neutral point at the meter
- with 2 voltage transformers and star point connected
- with 3 voltage transformers and star point connected

ZMG400xR with transformers in Aron-connection

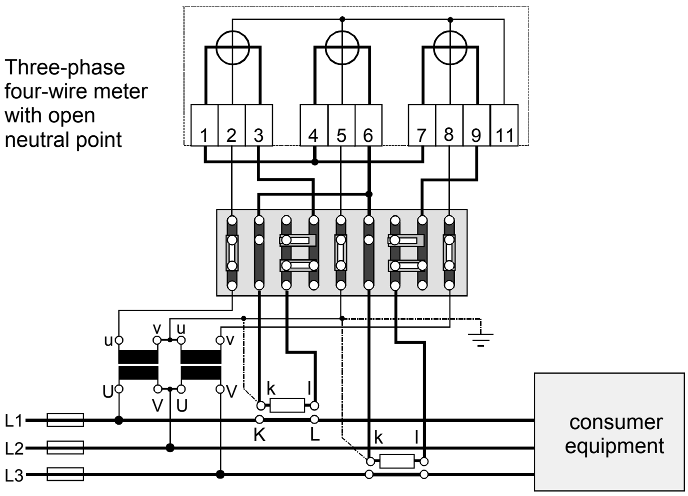


Fig. 4.2 Connection of ZMG400xR to medium voltage with 2 transformers in Aron connection

ZMG400xR (star point connected at meter)

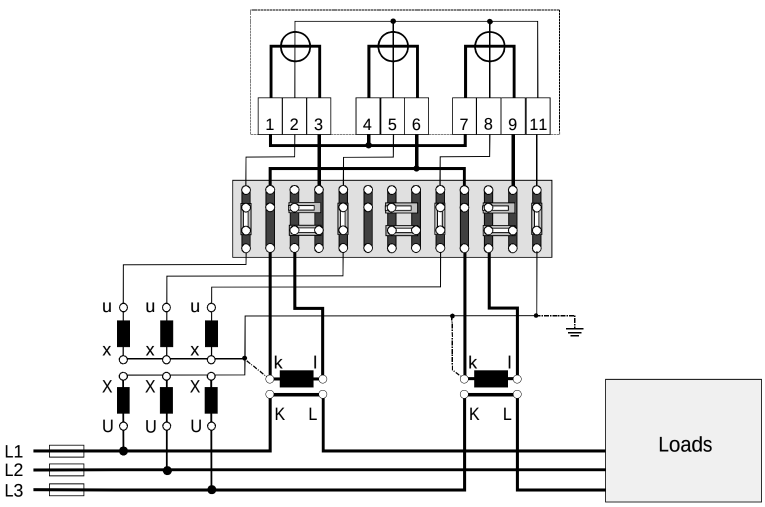


Fig. 4.3 Connection of ZMG400xR to medium voltage with star point connected

Three-phase four-wire connection

This connection type is increasingly used in medium voltage (3 to 30 kV) by electricity suppliers instead of the Aron connection. It is the standard connection for high voltage (above 30 kV).

ZMG400xR with 3 transformers each

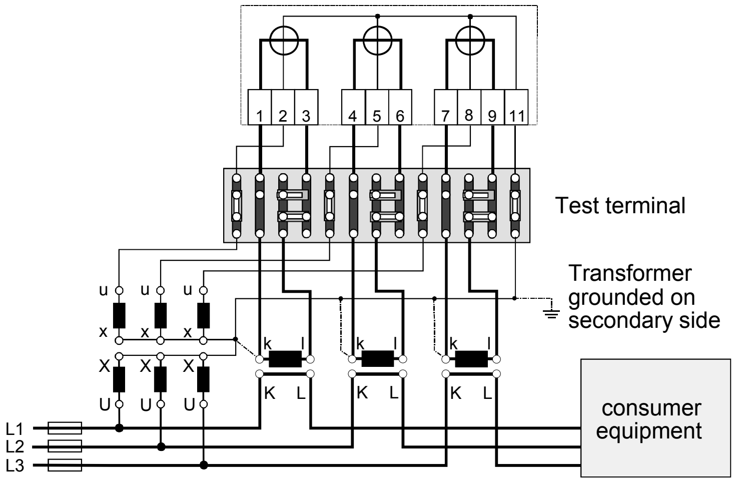


Fig. 4.4 Connection of ZMG400xR to medium voltage with 3 transformers each

4.2 Mounting the Meter

Dangerous voltage on conductors
The connecting conductors at the point of installation must be voltage-free for installation of the meter. Contact with live components is dangerous to life. The relevant preliminary fuses should therefore be removed and kept in a safe place until finishing work, so that they cannot be re-inserted unnoticed by other persons.

Dangerous voltage on current transformers
The current transformer secondary circuits must not be opened when current is flowing in the primary. This would produce a dangerous voltage at the terminals of several thousand volts and the insulation of the transformer would be destroyed.

To install the meter, short-circuit the secondary of the current transformer on the test terminal block (e.g. TVS14). For this purpose, release the screws of the relevant short-circuiting jumpers with an insulated screw-driver, move the jumpers away over the terminals on the meter side and then re-tighten the screws. The circuit on the meter side can then be opened without danger.
If no test terminal block is available, the primary voltage must be interrupted, i.e. the system switched off.

The meter should be mounted as follows on the meter board or similar device provided for this purpose:

1. Find the correct meter position for mounting the meter.
2. Determine the desired form of fixing (open/covered meter mounting or extended suspension hook for 230 mm suspension triangle height). If holes for a suspension triangle height of 230 mm are already present, use the **optional extended suspension hook** depicted below. This hook can be ordered with the part number 74 109 0072 0 (minimum order quantity 50) from:

   Landis+Gyr AG
   Service & Repair
   Theilerstrasse 1
   CH-6301 Zug
   Switzerland

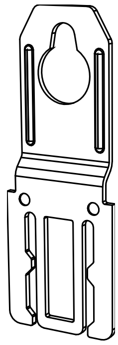


Fig. 4.5 Extended suspension hook for 230 mm suspension triangle height

3. Either set the meter suspension hook in the relevant position as shown below or replace the suspension hook with the extended hook by lifting the latch slightly and pulling out the shorter hook. Insert the extended hook into the grooves in the same way the shorter hook was inserted (bent towards rear) and push it down until it clicks in place.

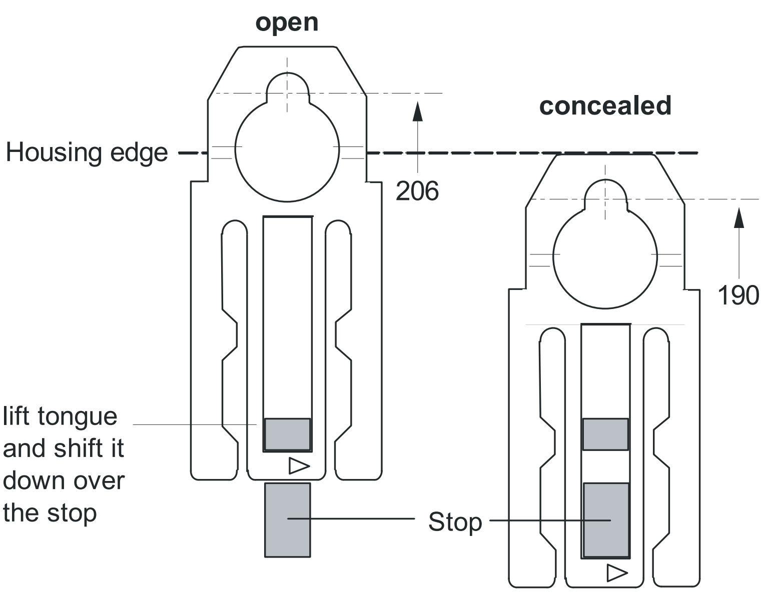


Fig. 4.6 Meter suspension eyelet

4. Check with a phase tester or universal measuring instrument whether the connecting wires are live. If so, remove the corresponding preliminary fuses and keep them in a safe place until installation is completed, so that they cannot be replaced unnoticed by anyone. Open the voltage connections at the test terminal block with an insulated screwdriver and check whether the short-circuit jumpers of the circuit are closed.

5. Mark the three fixing points (suspension triangle as in the following illustration) on the mounting surface provided:
   - horizontal base of suspension triangle = 150 mm
   - height of suspension triangle for open mounting = 206 mm
   - height of suspension triangle for concealed mounting = 190 mm

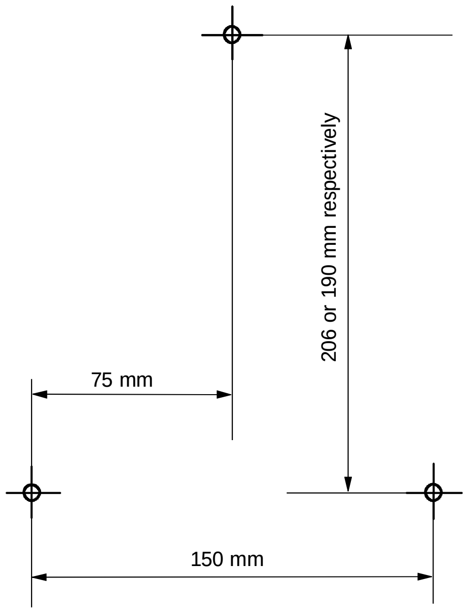


Fig. 4.7 Drilling plan

6. Drill the three holes for the fixing screws.
7. Unscrew the meter terminal cover.
8. Fit meter with the 3 fixing screws on the mounting surface provided.

4.3 Connecting Meter

Dangerous voltage on conductors
The connecting conductors at the point of installation must be voltage-free for the meter installation. Contact with live components is dangerous to life. The relevant preliminary fuses should therefore be removed and kept in a safe place until finishing work, so that they cannot be re-inserted unnoticed by other persons.
The jumpers in the voltage connections must also be opened at the test terminal block (e.g. TVS14). For this purpose release the two screws of each jumper with an insulated screwdriver and move the jumpers away from the terminal on the meter side.
If no test terminal block is available, the primary voltage must be interrupted, i.e. the system switched off.

Dangerous voltage on current transformers
The current transformer secondary circuits must not be opened when current is flowing in the primary. This would produce a dangerous voltage at the terminals of several thousand volts and the insulation of the transformer would be destroyed.
To install the meter, short-circuit the secondary of the current transformer on the test terminal block (e.g. TVS14): Release the screws of the relevant short-circuiting jumpers with an insulated screwdriver, move the jumpers away over the terminals on the meter side and then re-tighten the screws. The circuit on the meter side can then be opened without danger.
If no test terminal block is available, the primary voltage must be interrupted, i.e. the system switched off.

Preliminary work

It is assumed that the transformers and test terminal blocks have already been correctly fitted, the current transformers are short-circuited and the voltage connections opened.

Earthing
When using voltage transformers, the secondary star-point (or centre point in Aron circuit) of the transformer is earthed. The secondary circuits of the current transformers are also earthed on one side (connection k).
Preliminary fuses must be used with direct voltage connection. The current transformers must not be earthed on the secondary side in this case, see connection diagram.

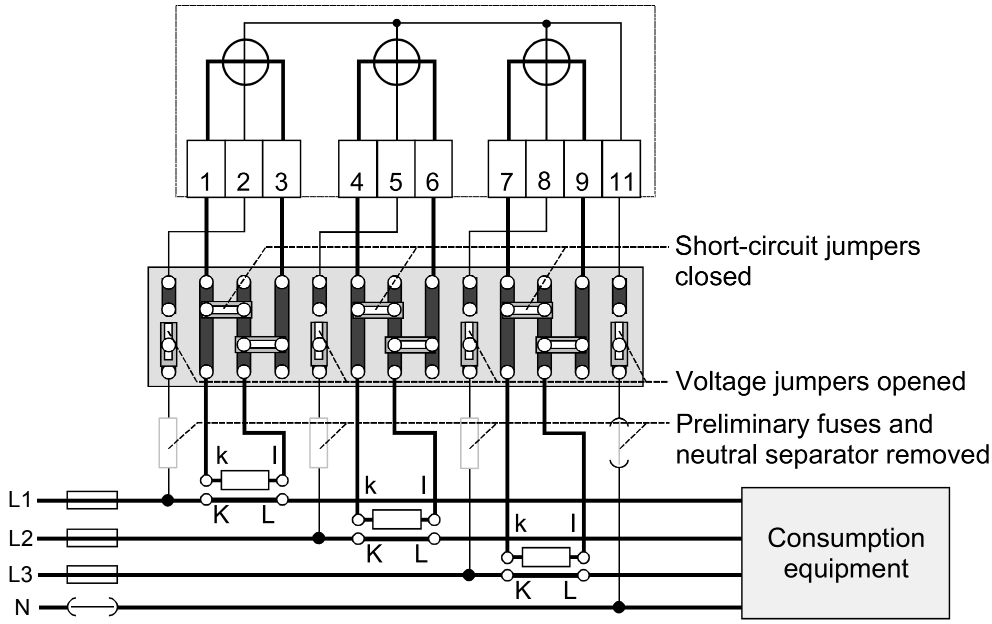


Fig. 4.8 Test terminal block status before installing the meter

Connecting

The electrical connections to the meter should be made as follows according to the connection diagram:

1. Check whether the preliminary work described above has been performed. If not, complete this work (test terminal blocks should only be touched with an insulated screwdriver).
2. Check with a phase tester or universal measuring instrument whether the connecting wires are live. If so, remove the corresponding preliminary fuses and keep them in a safe place until installation is completed, so that they cannot be replaced by anyone unnoticed.

Connecting the phase connection lines

Bare end of connecting wire must not be too long
The insulation of the connecting line must extend as far as the terminal indentation. Touching live parts is dangerous to life. The stripped part of the connecting wire should be shortened if necessary.

Artificial star point
With the three-wire circuit, the artificial star point (terminal 11) must not be externally wired.

1. Shorten the phase connecting wires to the required length and then strip them. If stranded wire is used, it is recommended to use ferrules for connection.
2. Insert the phase connecting wires in the relevant terminals (the terminals are numbered as shown in the connection diagram) and tighten the terminal screws firmly (torque 1.5 to 2 Nm).

   The cage type terminal used in the ZMG400xR presses the connecting conductor against the internal conductor to ensure a secure connection even with small conductor cross-sections.

It is recommended to identify the beginning and end of the relevant conductors with a suitable test unit (e.g. buzzer) to ensure that the right consumer is connected to the meter output.

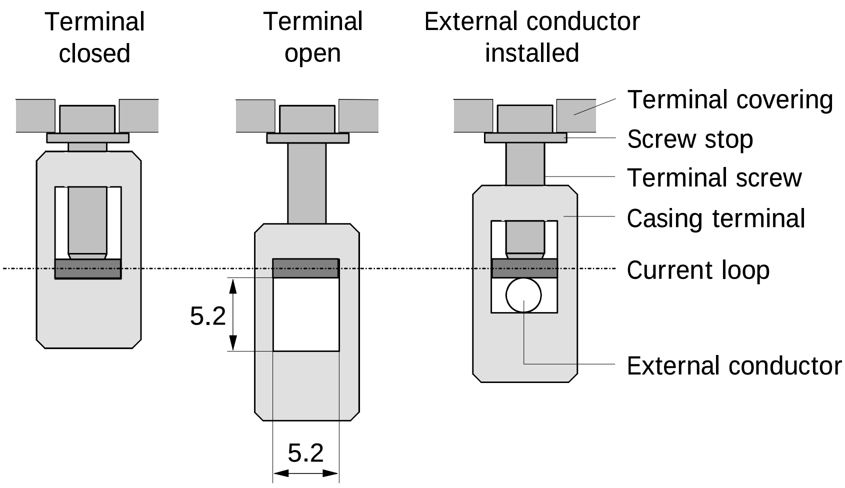


Fig. 4.9 Cage type terminal of the ZMG400xR

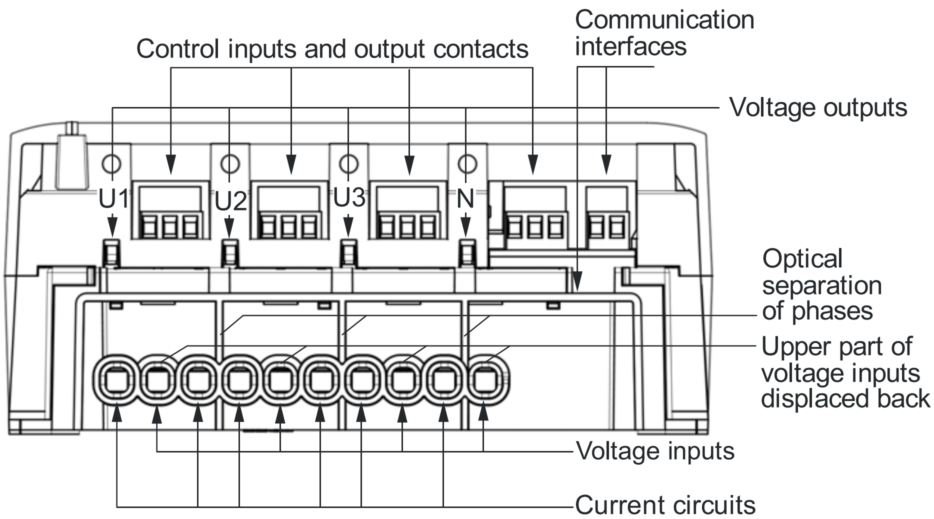


Fig. 4.10 Meter connections (example ZMG400xR)

Connecting the signal inputs and outputs

Maximum current at auxiliary terminals
The circuits connected to the auxiliary terminals must be built in such a way that the maximum current is never exceeded, as this might damage the meter.
Maximum current of the voltage outputs: 1 A.
Maximum current of the output contacts: 100 mA.

Use fuses or protective relays between external and internal circuits to avoid defects and possible exchange of the meter.

1. Shorten the connecting wires of the signal inputs and outputs to the required length and strip them for approx. 4 mm (wires and strands up to 2.5 mm² can be connected).

Ferrules for stranded wire
If stranded wire is used, it is recommended to provide it with ferrules for connection.

2. Connect the connecting wires of the signal inputs and outputs to the corresponding screw terminals (the terminals are numbered as shown on the connection diagram).

4.3.1 Connection of RS485 interface

Use an RS485 splitter connected directly to the meter to connect two RS485 cables. Never dismantle the shielded cables, e.g. to connect the individual wires to a terminal block, as this increases electromagnetic interference.

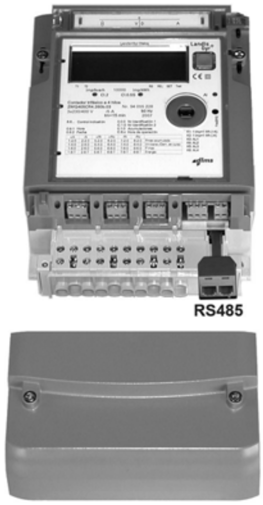


Fig. 4.11 RS485 splitter connected to meter

External wiring of RS485
From Series 2, RS485 operation with either 3 wires or 2 wires (without Common GND) is supported. It is therefore no longer necessary to use a RS485 repeater between a 2-wire modem and the meters.

4.4 Check of Connections

Effects of connection errors
Only a properly connected meter measures correctly!
Every connection error results in a financial loss for the power company!

Before putting into operation check again whether all meter connections are connected correctly according to the connection diagram.

4.5 Commissioning, Functional Check and Sealing

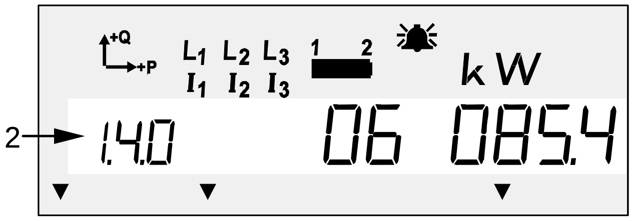
Dangerous voltage on conductors
The preliminary fuses must be re-inserted or the jumpers of the voltage circuits in the test terminal block re-closed before commissioning and functional check of the meter.
If the terminal cover is not screwed tight, there is a danger of contact with the connection terminals. Contact with live components is dangerous to life. The relevant preliminary fuses should therefore be removed before making any modifications to the installation and these kept in a safe place until completing the work to prevent anyone re-inserting them unnoticed. The jumpers in the test terminal block of the voltage circuits should again be opened and secured.

Dangerous voltage on current transformers
The current transformer circuits must be closed before commissioning and functional check of the meter. Opening the jumpers short-circuiting the secondary sides of the transformers permits the transformer current to flow through the meter. Opening of the short-circuit jumper must never interrupt the circuit.

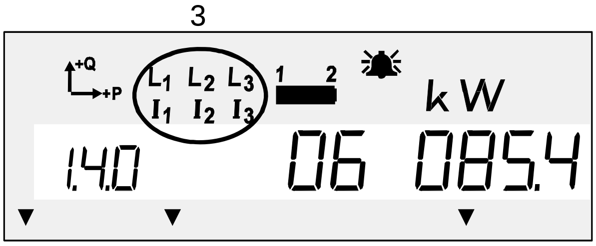
Prerequisites for commissioning and functional check
The functional check requires voltage to be applied and load applied to all phases. If export is possible, determine first the energy direction present.
If no mains voltage is present, commissioning and functional check must be performed at a later date.
Via the test terminal blocks you can also supply the meter from suitable auxiliary sources on the secondary side with the system switched off. Repeat the functional check later with the system switched on.

The installed meter should be put into service and checked as follows:

1. Close the jumpers of the voltage paths in the test terminal block with an insulated screwdriver and re-insert the preliminary fuses. The meter will be switched on after max. 5 seconds. If there were some resettings before start up, the duration of start-up could be longer than 5 seconds.
2. Check whether the operating display appears correctly (no error message).

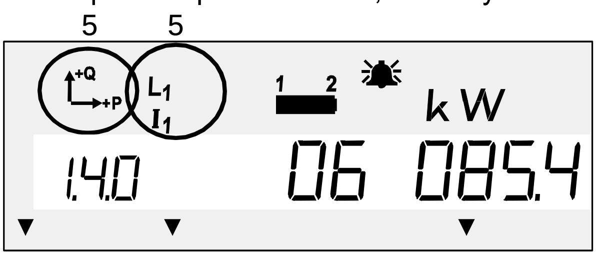


3. Check on the display whether the phases L_1, L_2 and L_3 are indicated and show the right phase sequence.
   - If one phase is not present, the relevant symbol is absent. This is also the case if the voltage is less than 20 V.
   - With the normal phase sequence L_1– L_2– L_3 the symbols are displayed continuously.
   - If, however, the meter is connected with reversed phase sequence (e.g. L_2– L_1– L_3) the symbols flash. The direction of phase sequence (clockwise or anticlockwise) is determined by the parameterisation. This has no influence, however, on the measuring behaviour of the meter.
   - The current symbols Ix appear, if the power of the corresponding phase exceeds the creep threshold.



4. Open the short-circuit jumper of phase 1 and the voltage jumpers of phases 2 and 3 in the test terminal block with an insulated screwdriver.
5. Check the display of the energy direction: +P to right, +Q up with inductive load and the phase current I1. If the energy direction arrow P points to the left, this indicates is a connection error, if there is no export. If the meter displays no energy direction despite connected load, the voltage jumper is open, the preliminary or main fuse is defective or the neutral is not connected.

   First repair the possible error, before you check the further points.



6. Close the short-circuit jumper of phase 1 in the test terminal block again with an insulated screwdriver.
7. Repeat the same test for the other phases as in points 4 to 6 by closing the voltage jumper and opening the short-circuit jumper.
8. Then open the short-circuit jumpers and close the voltage jumpers of all phases in the test terminal block with an insulated screwdriver.

   Instead of opening the voltage jumpers, the preliminary fuses can also be removed and replaced.

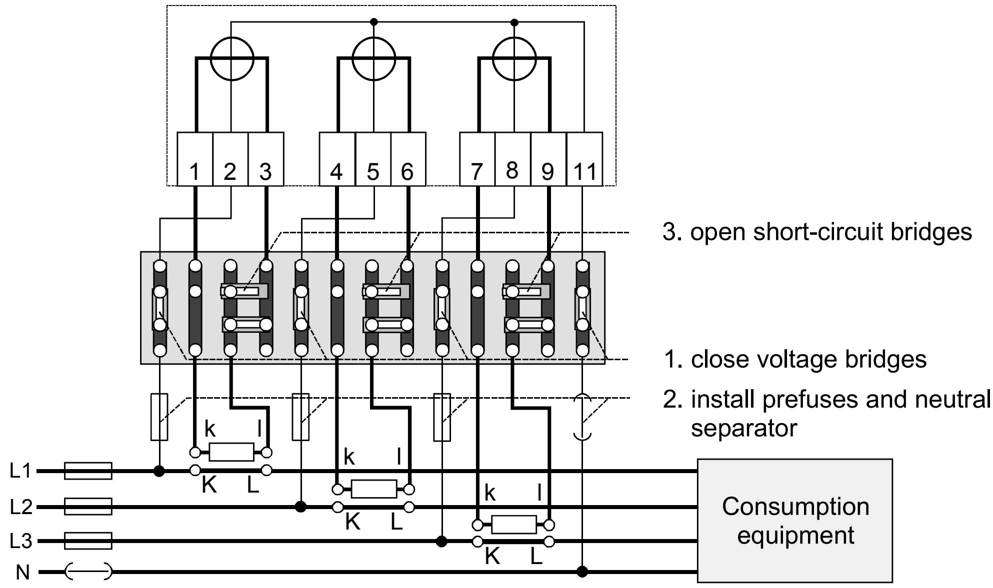
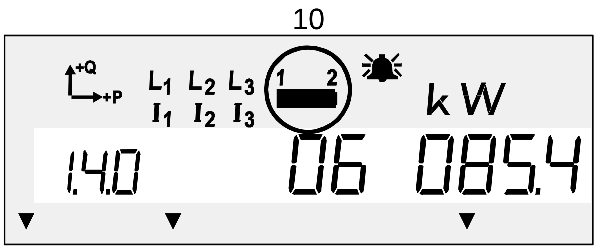
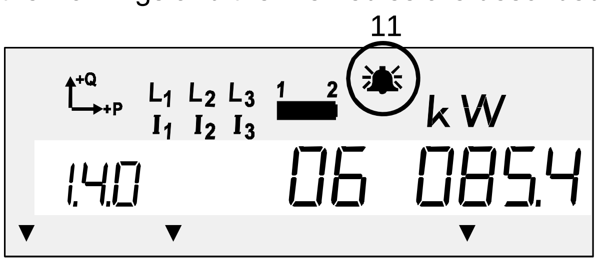


Fig. 4.12 Test terminal blocks status after commissioning

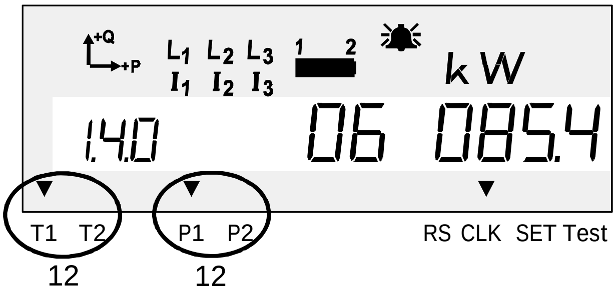
9. Further values can be checked in the service list obtained via the service menu if parameterised: phase voltages, angles, currents, etc.
10. Check the condition of the batteries if fitted. The figures by the battery symbol must not flash.



11. Ensure that no warning is displayed (symbol flashing). The meaning of the warnings and their remedies are described in section 6 "Service".

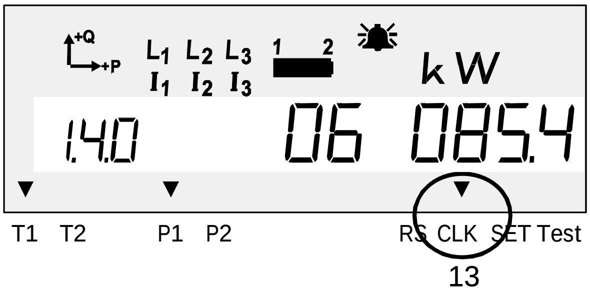


12. Check the rate displays with the control inputs with external control or with the time switch. The arrow symbols of the rate display must change.
    - With external control, the voltage at the control inputs should be switched on and off. E1 and E2 control the energy rates Tx, P1 and P2 the maximum demand rates Px, provided rates are present.
    - With internal control by the time switch, the time-of-day should be set, so that the time switch is brought to the different switching states.



13. Check the correct date and time-of-day. If the arrow above "CLK" flashes, the time and date are wrong. This is also apparent from the error message F.F 02000000.
    When the meter is powered up, the time and date are either set to
    – 00-01-01 (1.1.2000) and 00:00:00 or to
    – the point in time when the voltage failure occurred which caused the power reserve to be used up.

    Set the time-of-day and date manually (section 5.9) or by formatted command (section 5.8).



14. If the meter is connected to a meter readout system via the electrical interface, the data communication system should be checked.
15. Screw on the terminal cover if the meter is operating correctly. Otherwise first locate and eliminate the error.
16. Seal the terminal cover with two utility seals.
17. Enter the primary values of the transformer connected on the transformer label, in addition to the read factor.
18. Close the hinged cover and seal it.

4.6 Removing Meter

Dangerous voltage on conductors
The connecting conductors at the point of installation must be voltage-free for de-installation of the meter. Contact with live components is dangerous to life. The relevant preliminary fuses should therefore be removed and kept in a safe place until finishing work, so that they cannot be re-inserted by other persons unnoticed.
The jumpers in the voltage connections must also be opened at the test terminal block (e.g. TVS14). For this purpose release the two screws of each jumper with an insulated screwdriver and move the jumpers away from the terminal on the meter side.
If no test terminal block is available, the primary voltage must be interrupted, i.e. the system switched off.

Dangerous voltage on current transformers
The current transformer secondary circuits must not be opened when current is flowing in the primary. This would produce a dangerous voltage at the terminals of several thousand volts and the insulation of the transformer would be destroyed.
To de-install the meter, short-circuit the secondary of the current transformer on the test terminal block (e.g. TVS14). For this purpose, release the screws of the relevant short-circuiting jumpers with an insulated screwdriver, move the jumpers away over the terminals on the meter side and then re-tighten the screws. The circuit on the meter side can then be opened without danger.
If no test terminal block is available, the primary voltage must be interrupted, i.e. the system switched off.

The meter should be removed as follows:

1. Short-circuit the current transformer with the short-circuit jumpers in the test terminal block using an insulated screwdriver and interrupt the voltage connections with the jumpers in the test terminal block.
2. Remove the two utility seals on the screws of the terminal cover.
3. Release the two screws of the terminal cover and remove it.
4. Check that the connecting wires are not live using a phase tester or universal measuring instrument. If not, check the condition of the test terminals again according to the figure below. Remove the relevant preliminary fuses if necessary and ensure that they cannot be reinserted unnoticed by anyone before completing the de-installation.

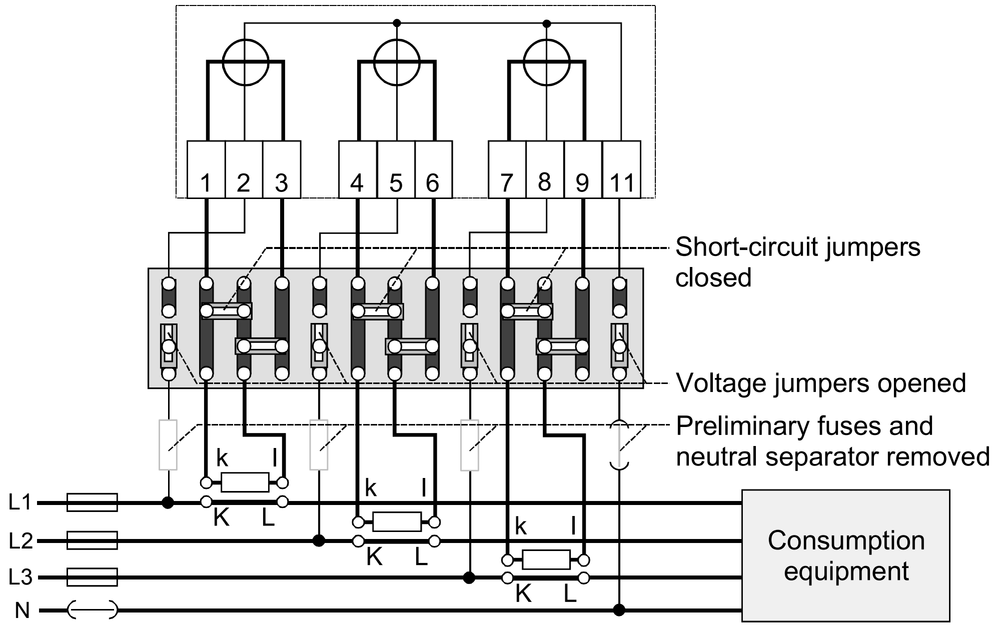


Fig. 4.13 Condition of test terminal block before removing meter

5. Remove the connecting wires of the signal inputs and outputs from the screw terminals.
6. Release the terminal screws 1 to 11 of the phase connecting wires with a suitable screwdriver and withdraw the phase connecting wires from the terminals.
7. Fit a substitute meter as described in section 4.3 "Connecting Meter" and the following chapters.

5 Operation

This chapter describes the location and function of all operating elements and displays of the meters, as well as operating sequences.

Illustrations
The illustrations of the faceplate and display in this section always show the ZMG400CR combimeter (with additional optical test output for reactive energy, together with direction of reactive power and quadrant display).

5.1 Operating Elements

The following parts are the basic operating elements:

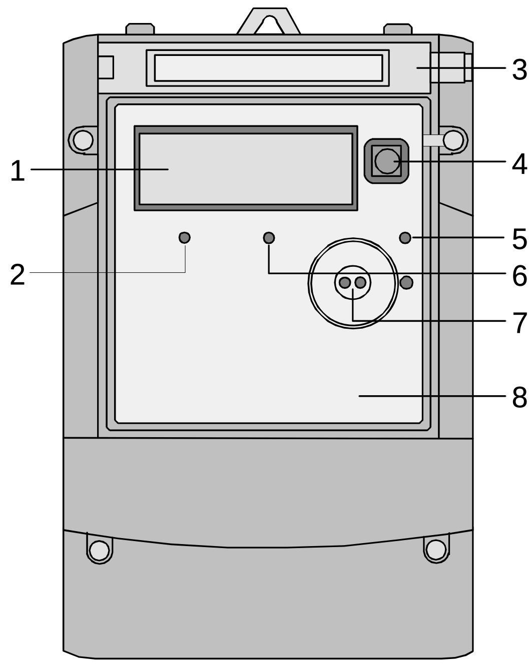


Fig. 5.1 Operating elements ZMG400xR

1. Display
2. Optical test output reactive energy (combimeters ZMG400CR only)
3. Reset key (under hinged cover)
4. Display key
5. Warning diode
6. Optical test output active energy
7. Optical interface
8. Faceplate

E550 meters have a display key and a reset key as conventional operating elements. The display can also be controlled with the aid of a light source via the optical interface.

5.1.1 Display Key

The display key is placed on the face plate on the right of the liquid crystal display.

By pressing the display key, the display changes to the next value in the list. It also has further functions (see also section 5.3.2 "Display Control").

5.1.2 Control of Display via Optical Interface

All E550 meters have an "optical key" in addition to the display key. The optical interface serves to receive a light signal, e.g. generated by a torch. The light signal acts like the display key and controls the display in one direction from one value to the next. This type of display control only functions when voltage is supplied to the meter.

The reader can also control the display at a distance from the meter depending on the light intensity from the source, e.g. through a protective glass disc in front of the meter.

Control of the display via the optical interface can only be used if the meter is connected to the supply voltage and switched on.

Torch
The optical interface reacts to infrared light. Use therefore only a torch equipped with a bulb as a light source. Torches with LEDs (light emitting diodes) are not suitable because they do not produce infrared radiation.

5.1.3 Display Control without Voltage

The battery compartment can accommodate two batteries.

- Battery 1 on the left serves as primary power reserve for the calendar clock and for display control and readout via the optical interface without voltage. This permits the necessary data to be read from the meter without having to apply voltage.
- Battery 2 on the right serves as power reserve for the calendar clock if no battery 1 is built in or if it is discharged.

5.1.4 Reset Key

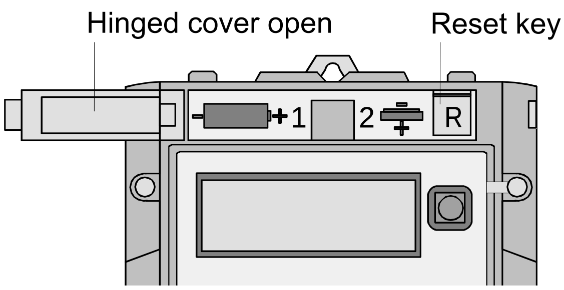


Fig. 5.2 Reset key under hinged cover

The reset key is situated in the battery compartment on the right under the hinged cover. To permit operation of the reset key the hinged cover must be opened and therefore the utility seal removed.

The reset key is normally used to perform a manual reset. If the display check is displayed, however, pressing of the reset key produces the service menu (see also section 5.5 "Service Menu").

Reset lock

If the reset key is pressed to reset the meter, it normally releases a reset lock with a duration of up to several minutes. An arrow appears in the display above the abbreviation "RL", if the meter is parameterised to activate the arrow. During the reset lock a further manual reset is not possible.

Take note that the meter can also lock an internal or external controlled reset depending on the parameterisation.

5.2 Display

5.2.1 Introduction

E550 meters are provided with a liquid crystal display (LCD).

The display is provided with background lighting for easier reading especially when there is insufficient lighting. This is switched on by pressing the display key and is extinguished automatically after a short time if the key is no longer pressed.

5.2.2 Basic Layout

The basic layout shows all the indication possibilities of the LCD.

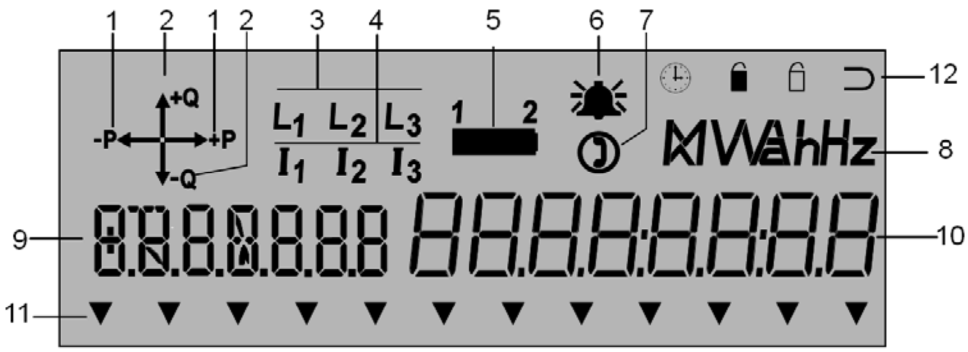
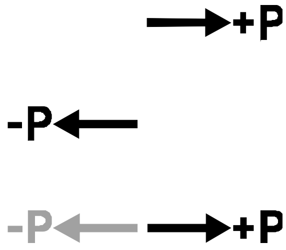


Fig. 5.3 Basic layout of the liquid crystal display (LCD)

1	Active energy direction	+P = import; –P = export
2	Reactive energy direction	+Q = positive; –Q = negative combimeter ZMG400CR only
3	Presence of phase voltages	flashing with reversed phase sequence
4	Presence of phase currents	
5	Battery indication	1 = Battery 1 2 = Battery 2
	Symbol flashing, if battery voltage too low (battery discharged)	
6	Display of a warning	appears flashing
7	Communication running	
8	Units field	
9	Index field	maximum 7 digits
10	Value field	maximum 8 digits
11	12 arrow symbols	for status indications as rates
12	Reserved for special applications	

Energy direction



+P = positive active energy (from utility to consumer)

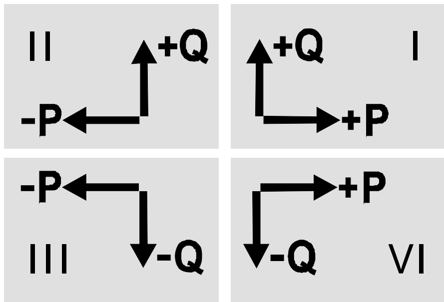
-P = negative active energy (from consumer to utility)

One or two phases are reversed in direction compared with the sum (here negative opposite positive). The second arrow flashes.

The active energy arrow P continuously displays the sum of the individual phases.

Quadrants

combimeter ZMG310CR only

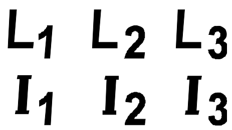


The meter continuously indicates the quadrants in which it measures the active and reactive energy.

+Q = positive reactive energy

–Q = negative reactive energy

Voltages and currents

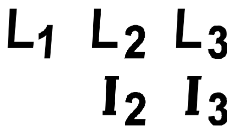


Presence of phase voltages (L_1, L_2, L_3) and phase currents (I_1, I_2, I_3).

The symbols L_1, L_2, L_3 flash if the phase sequence is reversed. The correct phase sequence (clockwise or counter-clockwise) can be parameterised.

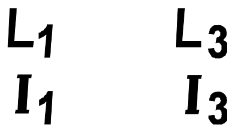
The current symbols Ix appear if the power of the corresponding phase exceeds the creep threshold.

Examples of irregularities:

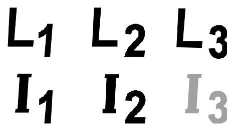


Current I_1 of phase L_1 missing

Warning symbol can flash



Phase L_2 failure (Warning symbol can flash) or current without voltage in phase L_3 (Warning symbol flashes simultaneously)



Symbol I_3 flashes:
Negative energy direction in this phase

Warning symbol can flash

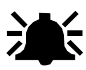
Battery condition

The relevant number flashes if the charging voltage of the battery concerned is too low (provided battery monitoring is parameterised in the meter).

1 = Battery 1 for power reserve of calendar clock and for display and readout

2 = Battery 2 for calendar clock (power reserve) if battery 1 is missing or if it is discharged

Warning



The symbol appears if the meter has generated a warning due to an internal or external fault (e.g. current without voltage in a phase).

Communication running

The symbol appears as soon as a readout or communication starts via one of the interfaces.

Units field

The following units are shown:
W, var, VA, k..., M..., ...h, V, A, h, Hz,
(var and VA only for combimeters)

Index field

Up to 7-digit indices are displayed, which define the value in the value field.

Value field

Up to 8-digit values are displayed.

Arrow symbols

▼ ▼ ▼ ▼

An arrow symbol is an additional status indication for rates, reset lock, test mode, etc. The arrow points to a status description on the face plate.

Anti-tampering symbols

Special symbols for anti-tampering. Reserved for future applications.

5.2.3 Index System

All values shown in the display have a clear identification number based on an index system to identify the value together with the unit if necessary.

With the 7-digit index field, all identification number systems used up to now can be obtained in principle, e.g. to DIN, LG, VEOe, etc. Landis+Gyr recommends the use of the index system according to OBIS, however, so that the identification numbers of the display and readout according to IEC 62056-21 correspond to those under DLMS.

Identification numbers according to OBIS (Object Identification System) have the following structure:

A Defines the **medium**, i.e. whether the value displayed refers to electricity, gas, water, heating systems, etc. For E550 meters, it always concerns electrically related values (1) so that the value group A is omitted.

B Defines the **channel number**, i.e. the number of the input of a metering equipment having several inputs for the measurement of energy of the same or different types (e.g. in data concentrators, registration units). This enables data from different sources to be identified. ZMG400xR meters have only one channel, so that the value group B is normally also omitted.

C Defines the **measured quantity**, i.e. abstract or physical data items related to the information source concerned, e.g. active power, reactive power, apparent power, power factor, current or voltage.

D Defines the **type of measurement**, i.e. the result of the processing of physical quantities according to various specific algorithms. The algorithms can deliver energy and demand quantities, instantaneous values, etc.

E Defines the **rate**, i.e. further processing of measurement results to rate registers, according to the rates in use. For abstract data or for measurement results for which rates are not relevant, this value group can be used for further classification.

F Defines the **stored value**, i.e. storage of data according to different billing periods. Where this is not relevant, this value group can be used for further classification.

A	B	C	D	E	F	Value group
M -	KK :	GG .	AA .	R *	VV	according VDEW

A	M	Medium	1 ... 9	not necessary to use when 1 medium only
	-	Separating sign		
B	KK	Channel	1 ... 64	not necessary to use when 1 channel only
	:	Separating sign		
C	GG	Measured quantity	1 ... 99	must always be used
	.	Separating sign		
D	AA	Measuring type	1 ... 99	must always be used
	.	Separating sign		
E	R	Rate	1 ... 9	
	*	Separating sign (also &)		
F	VV	Stored value	01 ... 99	

Fig. 5.4 Index system according to OBIS

To simplify the reading in the index field, individual parts of the OBIS code can be omitted. The abstract or physical data C and type of data D must be shown.

Example

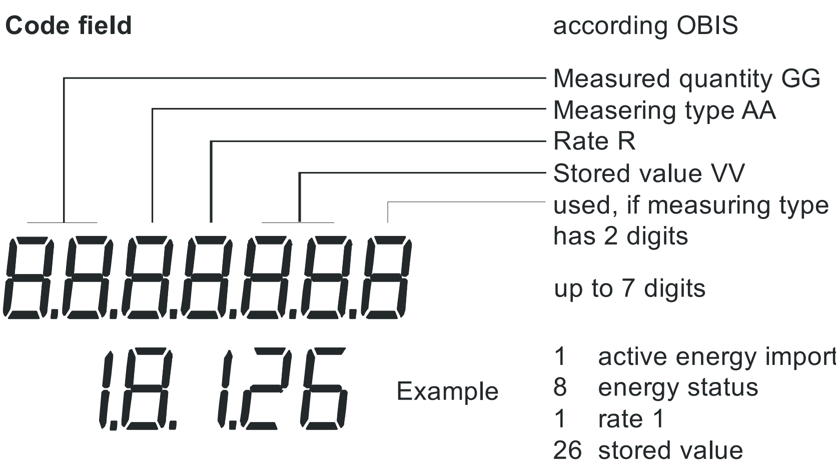


Fig. 5.5 Index system according to OBIS

Reference is made for examples to the following display list and the readout protocol (see section 5.7 "Data Readout").

5.3 Types of Display

E550 meters have the following three types of display:

Operating display

This is displayed while the display key is not pressed. It can include one or more values. If the meter is stopped within a list of the display or service menu, the display returns automatically to the operating display after a defined interval (e.g. 2 minutes).

Display menu

By pressing the display key the display check is activated and from there the user reaches the display menu by again pressing the display key. From the display menu values of the display list, the load profiles, the event log, etc. can be accessed. The display list, for example, comprises all values which appear in the display after pressing a key. The values themselves and also the sequence can be parameterised. The display keys permit scrolling down in the lists.

Service menu

The user reaches the service menu by pressing the reset key instead of the display key starting from the display check. From the service menu values of the service list, the event log, the set mode, etc. can be accessed. The service list for example is an extended display list with additional values.

5.3.1 Operating Display

The values always displayed are considered the operating display. This can be parameterised as fixed display (only one value present, e.g. the present rate) or as rolling display (several values alternate at a fixed rate, e.g. every 15 seconds).

Fixed display

One value continuously displayed

e.g. running average
P running with status
of integrating period

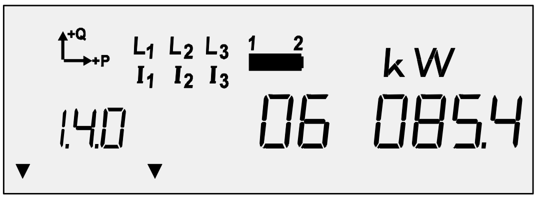


Fig. 5.6 Example of a fixed operating display

Rolling display

several values appear
one after the other
in a fix sequence,
e.g. all 15 seconds

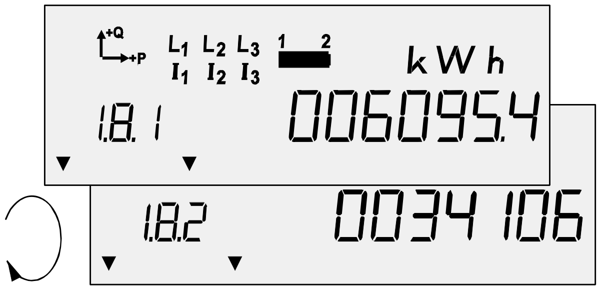


Fig. 5.7 Example of a rolling operating display

Error message

The meter performs self-checks, above all when starting, but also during operation, which run automatically in the background. If the meter detects an error, it generates the appropriate error message. In the event of a fatal error it appears in the display, where it replaces the operating display, and the meter no longer operates.

Example:

Checksum error in ROM

Fig. 5.8 Display with fatal error (example)

In case of an error message the procedure described in section 6.2 should be followed.

5.3.2 Display Control

Starting from the operating display, the display check appears after the first operation of the display key. Branching is possible from here

- to the **display menu**,
  by pressing the display key again, or
- to the **service menu**,
  by pressing the reset key R under the hinged cover.

These menus also appear if only one menu item is present.

Both menus have an "End" position. Return to the operating display is made from here by pressing the display key longer.

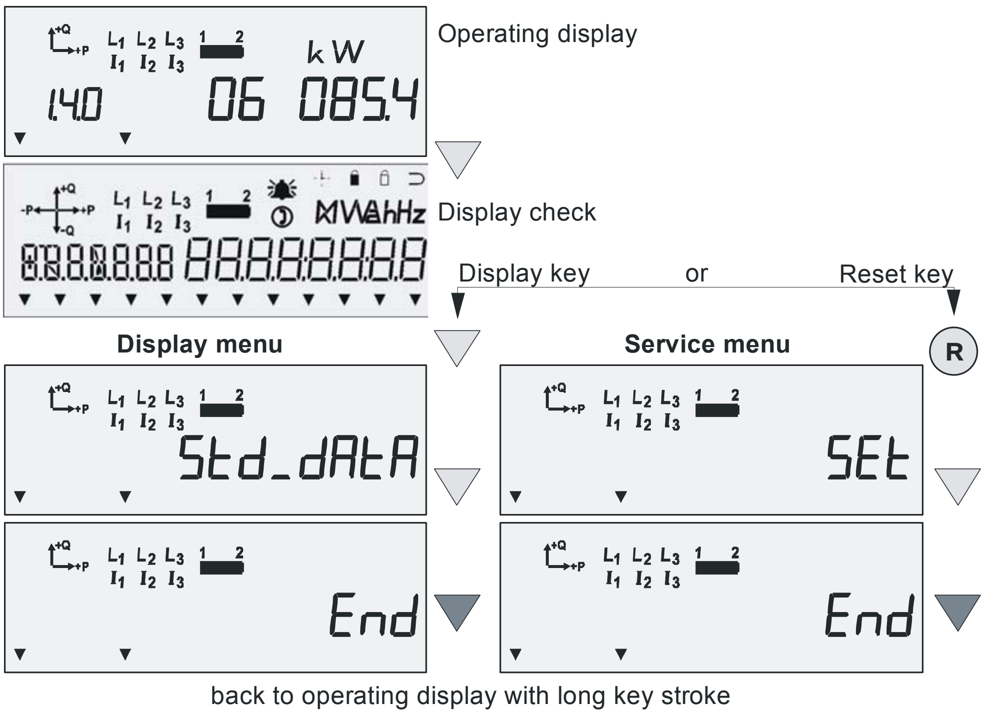


Fig. 5.9 Display control

To open a menu item, e.g. to enter the display list, the display key must be pressed (more than 2 seconds) until the first value of the menu item, e.g. the display list, appears.

5.4 Display Menu

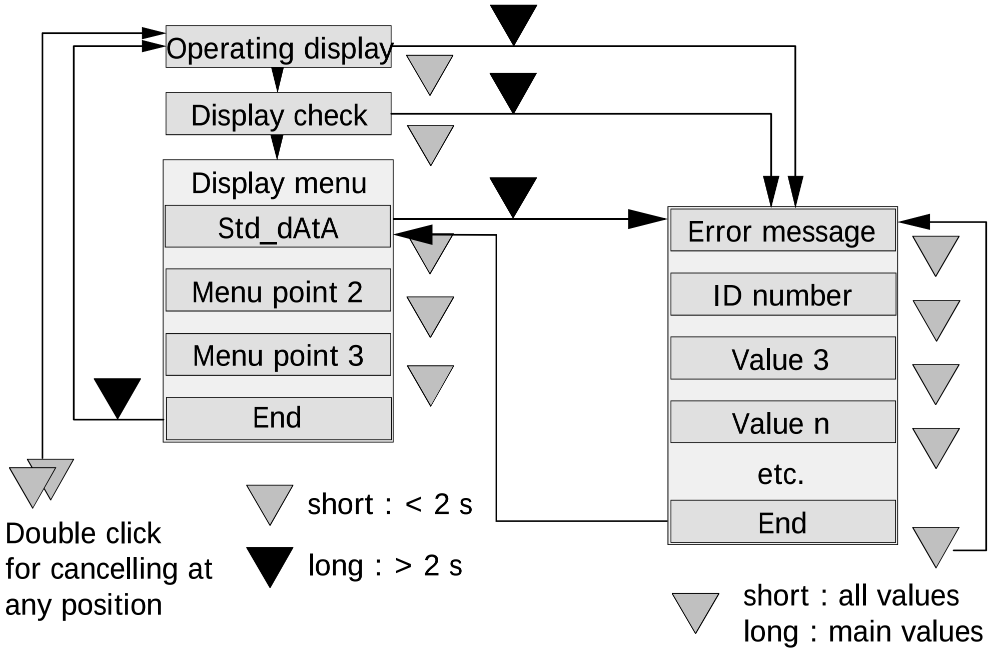


Fig. 5.10 Display menu overview

The display menu always contains the display list under menu item "Std_dAtA". Further menu items are possible, e.g. a load profile.

The display list can be found under menu item "Std_dAtA" in the display menu starting from the operating display by pressing the display key twice briefly (via display check).

The other menu items can all be obtained by briefly pressing a key.

To enter the display list, press the display key (> 2 seconds) until the first value of the display list appears, normally the error message.

The display list can also be directly reached

- starting from the operating display by pressing the display key once (> 2 seconds) until the first value of the display list appears
- starting from the display check by pressing the display key once (> 2 seconds) until the first value of the display list appears

Within the display list

- brief key operation displays all values,
- longer key operation only the main values, i.e. no stored values.

If the display key is continuously pressed, the display rolls at one second intervals from main value to main value (rapid traverse).

Exit from the display list is made either

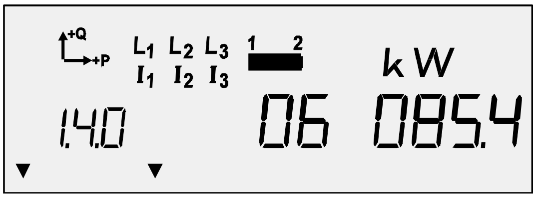
- by longer key operation at the end of the list ("End" position) until the menu item "Std_dAtA" re-appears, or
- by pressing the key twice (within 0.3 second) direct to the operating display (interruption).

5.4.1 Display List

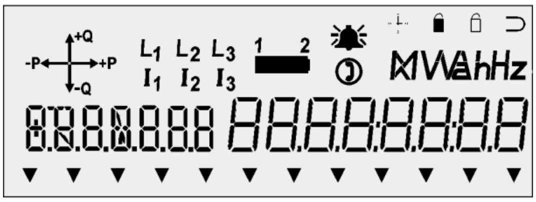
The display list comprises a number of values determined by the parameterisation in a similarly defined sequence. It can vary considerably depending on version, tariff structure, country, etc. Starting point, however, is always the operating display.

Display check

Brief operation (< 2s) of the display key causes change of the operating display, e.g.:



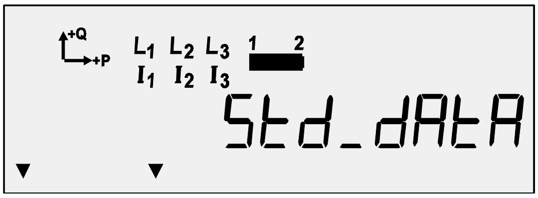
to the display check:



All segments of the display are operated here. The index and value fields should be checked each time for missing segments. This can prevent incorrect readings.

Display menu

Pressing the display key again **briefly** changes to the display menu. The first menu item appears, e.g. "Display list" with the designation Std_dAtA (standard data):



The menu item also appears if only one menu item is present.

The next menu item appears for every further brief operation of the display key, e.g. "Load profile", "Event log", etc. The first menu item appears again after the last item "End".

Opening list

The first value of the list associated with the present menu is displayed by pressing the display key for longer (at least 2 seconds), normally the error message:

The next list value appears for every further brief operation of the display key. The sequence of values in the list is determined by the parameterisation.

A **longer** key operation (at least 2 seconds) jumps past any stored values. Continuously pressing the display key starts rapid traverse from main value to main value.

Typical display list

Examples of values in a display list:

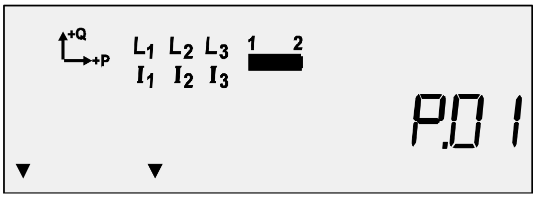
Display code	Display value	Meaning
0.0.0	83721033	Identification number
0. 1.0	26	Reset counter
0. 1.2.26	05-07-01	Date of reset number 26 (end of June)
0. 1.2.26	00:00	Time-of-day of reset number 26 (midnight)
1.2. 1	00335.9	Active energy import P_{max} cumulated, Rate 1
1.6. 1	074.2	Active energy import current P_{max}, Rate 1
1.6. 1	05-07-14	Date of current P_{max}
1.6. 1	11:45	Time-of-day of current P_{max}
1.6. 1.26	082.6	P_{max} of previous month Stored value 26
1.6. 1.26	05-06-24	Date of P_{max} of previous month
1.6. 1.26	10:45	Time-of-day of P_{max} of previous month
1.8. 1	00055927	Active energy import energy status, Rate 1
1.8. 1.26	00053816	Energy status at end of previous month
1.8.2	00031806	Active energy import energy status, Rate 2
1.8.2.26	00030095	Energy status at end of previous month
5.8. 1	00022487	Reactive energy inductive energy status, Rate 1
5.8. 1.26	00019982	Energy status at end of previous month
5.8.2	00017067	Reactive energy inductive energy status, Rate 2
5.8.2.26	00015883	Energy status at end of previous month
0.9. 1	14:49:42	Current time-of-day
0.9.2	05-07-18	Current date (18 July 2005)
	End	End of display list

The display list is left either

- by a longer key press at the end of the list ("End" position) until the menu item "Std_dAtA" re-appears, or
- by pressing the key twice (within 0.3 s) direct to the operating display (interruption).

5.4.2 Load Profiles

If a load profile is contained in the display menu, it appears under the menu item P.01:



The latest date with entries in a load profile, normally the present day, is displayed by pressing the display key for **longer** (at least 2 seconds).

Display control of a load profile

After opening a load profile by longer key operation, the list of stored days starting with the latest date is obtained. The desired day (date) is selected and opened by longer key operation. The first item appears in the display, i.e. the first integrating period (00:15 for an integrating period of 15 minutes). The display simultaneously starts to roll from value to value for this integrating period (approx. 2 seconds interval). The desired integrating period for which the values are required is then selected with the display key.

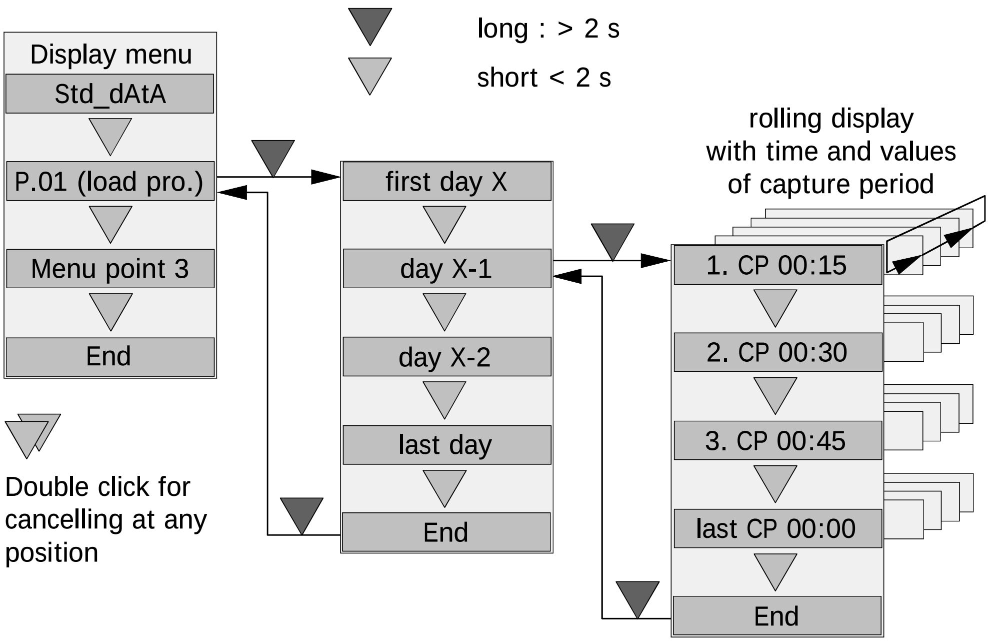


Fig. 5.11 Display control of a load profile

5.5 Service Menu

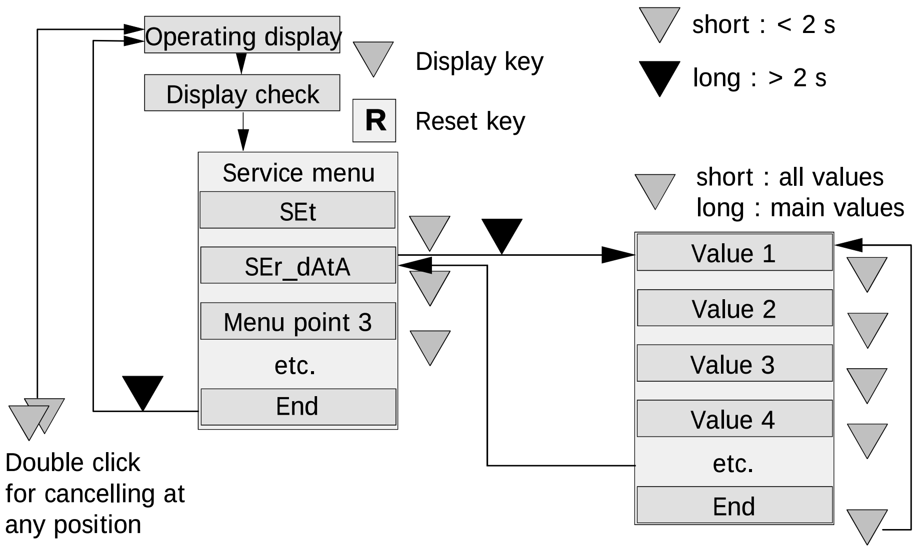
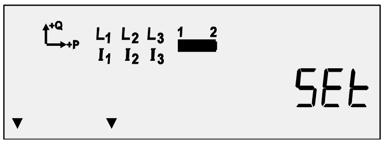


Fig. 5.12 Service menu overview

Pressing the reset key during the display check changes the display to the service menu. The first menu item appears, normally the "set mode" (SEt):

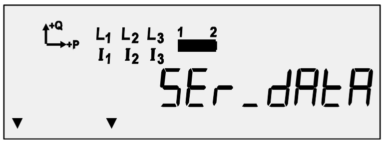
Set mode



Values can be changed in the value display of the set mode with the aid of the reset key and the display key (for setting time and date, identification numbers, battery hours counter, etc.). The procedure is described in section 5.9 "Changing Values in Set Mode".

Service list

With every further brief operation of the display key, the next menu item appears, e.g. "Service list", "Event log", "Test mode on/off", etc. The service list appears under the designation "SEr_dAtA":



Value display

The first value of the list associated with the present menu is displayed by pressing the display key for **longer** (at least 2 s, as for the display list).

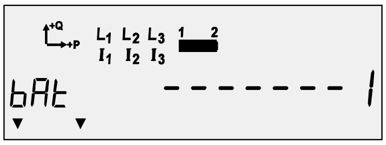
The next list value appears for every further **brief** operation of the display key. The sequence of values in the list is determined by the parameterisation.

A rapid run is started by holding down the display key for **longer** (at least 2 seconds). The main values of the list are then displayed while the display key remains pressed, but no stored values.

To return to the menu level from the list at the end of the display list press the display key for **longer** (at least 2 seconds).

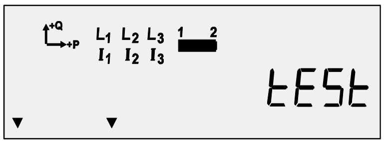
To return to the operating display from the list, press the display key **twice briefly** (double-click).

Battery symbol on/off



This function allows directly switching on or off the battery symbol in the display, but also the battery supervision. By pressing the display key for **longer** (at least 2 seconds), the displayed digit to the right changes from "0" (battery symbol off) to "I" (battery symbol on) and vice versa.

Test mode



This function allows switching on the test mode by pressing the display key for **longer** (at least 2 seconds).

For further information concerning the test mode see section 7.1.2.

Following the last menu item "End" the first item appears again. To return to the operating display from the service menu, press the display key **twice briefly** (double-click).

5.6 Optical Test Output

The optical test outputs – one for active energy in all meters and a second for reactive energy in combimeters – are fitted in the face plate below the liquid crystal display.

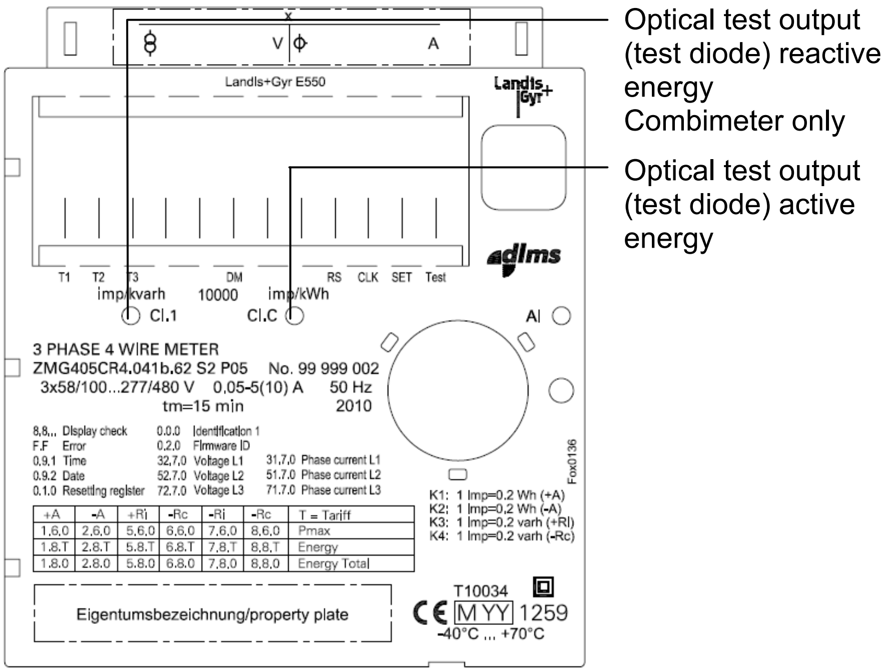


Fig. 5.13 Optical test outputs

The optical test outputs are used for testing the meter (see also section 7.1). They transmit pulses in the visible red range with a frequency proportional to the power corresponding to the meter constant.

5.7 Data Readout

The utility can record the data stored in the meter on site at any time in two ways:

- Reading the liquid crystal display of the meter. Only those data can be recorded which appear in the rolling operating display or can be selected with the display key.
- Automatic data readout via the optical interface with the aid of a hand held terminal or other readout device (e.g. laptop) . Further data are then accessible depending on the parameterisation.

ⓘ **Readout data**
For readout to IEC 62056-21 all data determined by the parameterisation are read out in the specified sequence.
For readout according to DLMS (Device Language Message Specification) the data requested by the readout unit are read out.

If the meter is fitted with the appropriate RS232, RS485 RS422 or CS interface, remote reading of the meter data is also possible.

Procedure for data readout via optical interface

1. Start the hand held terminal (according to the details in the associated operating instructions).
2. Connect the cable of the reading head to the hand held terminal.
3. Place the reading head in the "Readout" indentation of the optical interface on the front cover of the meter. The reading head cable must point towards the terminal cover (when mounted vertically downwards). The reading head is held magnetically.
4. Start the data readout on the hand held terminal (according to the details in the associated operating instructions).
5. Remove the reading head from the meter again after completing the readout.

5.7.1 Readout without Voltage

The battery compartment of E550 meters can accommodate two batteries, battery 2 on the right as power reserve for the calendar clock, battery 1 on the left for display control without voltage. This permits the necessary data to be read via the optical interface from the meter without having to apply voltage. Press the reset key before starting the readout.

Start readout

The procedure is the same as described above. However, press the display key before readout (step 4).

This battery also permits display control without voltage.

5.7.2 Readout to IEC 62056-21

The data read out according to IEC 62056-21 are recorded in the form shown below. The scope and sequence of values in the protocol is determined by the parameterisation.

Meter identification

/LGZ5\2ZMG410426b.Pxx	Identification of meter (reply on transmit request) does not appear in the protocol

xx: Software version

Example	Significance	
F.F (00000000)	Error message	
0.0.0 (417242)	1st identification number	
0.1.0 (28)	Number of resets	
0.1.2.04 (05-05-01 00:00)	Time of last reset	
1.2.1 (26068.7*kW)	P_{max} cumulated	Rate 1
1.2.2 (15534.8*kW)	P_{max} cumulated	Rate 2
1.6.1 (192.4*kW)(05-05-06 10:45)	Current P_{max}	Rate 1
1.6.1*04 (202.4)(05-04-22 09:30)	with April stored value	Rate 1
1.6.2 (086.7*kW)(05-05-04 22:30)	Current P_{max}	Rate 2
1.6.2*04 (100.9)(05-04-14 23:00)	with April stored value	Rate 2
1.8.1 (0244948*kWh)	Active energy (import)	Rate 1
1.8.1*04 (0234520)	with April stored value	Rate 1
1.8.2 (0082520*kWh)	Active energy (import)	Rate 2
1.8.2*04 (0078197)	with April stored value	Rate 2
5.8.1 (0106103*kvarh)	Reactive energy (inductive)	Rate 1
5.8.1*04 (0100734)	with April stored value	Rate 1
5.8.2 (0039591*kvarh)	Reactive energy (inductive)	Rate 2
5.8.2*04 (0036152)	with April stored value	Rate 2
1.8.0 (0327468*kWh)	Total active energy import	
2.8.0 (0000000*kWh)	Total active energy export	
5.8.0 (0145694*kvarh)	Total reactive energy (inductive)	
8.8.0 (0001452*kvarh)	Total reactive energy (capacitive)	
0.9.1 (14:18:06)	Time-of-day of readout	
0.9.2 (05-05-20)	Date of readout	
C.2.1 (05-03-26)	Date of last parameterisation	
!	End of protocol	

Stored values

The hyphen following the identification number and the rate (1.6.1) denotes the type of resetting:

e.g. 1.6.1*04	*04	Resetting made internally or remote controlled
e.g. 1.6.1&04	&04	Resetting performed manually or with reset key R

Meter identification

The utility can select by parameterisation between a standard identification and its own identification. The standard identification has the following structure:

/**LGZ**...	Manufacturer	(Landis+Gyr)
/LGZ **5**...	Transmission speed	5 = 9600 Baud
/LGZ5 **\2**...	Extended communication possibility	2 = DLMS-compatible meter
/LGZ5\2 **ZMG410**...	Meter	Type of measuring unit
/LGZ5\2ZMG410 **4**...		Basic version tariff section
/LGZ5\2ZMG4104 **26**...		Number of inputs/outputs
/LGZ5\2ZMG410426 **b**..		Additional functions
/LGZ5\2ZMG4104100 .**Pxx**		Software version

Identification by the utility itself uses an identification number. ID1.1 (designation of ownership by the utility), ID1.2 (any desired number) or ID2.1 (serial number) are available. The identification is comprised as follows in this case:

/**LGZ**...	Manufacturer	(Landis+Gyr)
/LGZ **5**...	Transmission speed	5 = 9600 Baud
/LGZ5 **2**...	Extended communication possibility	2 = DLMS-compatible meter
/LGZ5\2 @**Pxx**...	Meter	Software version
/LGZ5\2@P05 **12345678**	Identification number specified by parameterisation (maximum 8 characters)	

5.7.3 Readout to DLMS

While the readout according to IEC 62056-21 uses a protocol determined in advance, readout to DLMS enables the utility to configure the values to be read out individually. The utility therefore has systematic access to specific values without being influenced by other values not required.

DLMS specification

Various meter manufacturers – including Landis+Gyr – together with related organisations, have compiled the language specification DLMS (Device Language Message Specification) and undertaken to use this in their equipment (meters, tariff units, systems, etc.).

Objective

The objective of DLMS is to use a common language for data exchange in the energy measurement and other sectors. In addition to end units such as meters, tariff units, etc. dlms also describes the interfaces, transmission channels and system software.

Principle

DLMS can be compared to sending a letter: the sender writes the address of the recipient on the letter and hands it to the post office for transport. The way in which the postal department transports the letter is of no consequence to the sender and receiver. The only important thing is that the address of the recipient is clearly shown and that the letter is received, read and it can be seen from whom the letter originates.

Units with DLMS operate in a similar way. They provide the values – termed objects – required by the receiver (e.g. central station) and pass them via interface to the transport medium (channel). How the values reach the recipient is immaterial for both parties.

DLMS objects

DLMS is an object-oriented language. The dlms objects

- have an unique name in the form of the OBIS identification number
- contain the value in an exactly defined form and
- are configured in a similarly exactly defined format.

Objects of this kind include number of resets with date and time, cumulative maxima, rolling mean values, maxima, energy statuses, associated stored values, etc.

The sender feeds these objects to a transport medium, e.g. the telephone network. This transmits them to the receiver, so that the objects are received in the same form as supplied by the sender.

Short/logical names

E550 meters support short names as well as logical names for readout. The logical names always consist of the full OBIS address and allow the utility to directly access the desired objects. In this way, a complete data readout can be avoided and the readout is much faster.

5.8 Formatted Commands

Formatted commands serve to modify operating data or meter characteristics. The user of formatted commands, however, must have the necessary access authorisation according to the security system.

The following commands can be used according to both IEC 62056-21 and DLMS:

- Set time/date
- Set identification numbers
- Initiation of reset via interface
- Neutralise reset inputs KA/KB
- Set/reset reset counter
- Set/reset energy registers
- Set/reset energy total registers
- Set/reset maximum demand registers
- Set/reset power factor registers
- Reset stored values
- Reset battery hours counter of battery 1
- Reset voltage failures registers
- Switch on/off increased resolution of energy registers (test mode); additional parameter determines whether the optical test output for active energy sends out impulses for active or reactive energy in test mode.
- Select the measured value ME1 to ME12 (P05) or ME15 (P06) for the middle test output in the test mode, if the test output is parameterised for this.
- Delete error messages
- Change passwords P1,P2 and W5
- Reset load profile

- Reset event log
- Activate remote control signals (communication inputs)

The following commands can only be executed with DLMS:

- Reset battery hours counter of battery 2
- Reset event register
  - Under- and overvoltages
  - Demand monitor
  - Current monitor
  - Power factor monitor
- Set thresholds for monitoring functions
- Reset Load Profile 2
- Reset dedicated event logs (one by one or all at once)

Formatted commands are transferred to the meter with a suitable aid (hand held terminal or laptop) via the optical interface or via an electrical interface.

5.9 Changing Values in Set Mode

In set mode, some values (date and time, identification numbers and battery hour counter) can be changed with the aid of the display key and the reset key, without the use of auxiliary aids such as hand-held terminal or laptop.

5.9.1 Set Time and Date

The time and date can be wrong particular on first installation under certain conditions. This is the case if no backup battery is fitted for the calendar clock and the power reserve of the internal buffer capacitor (supercap) has been consumed following a long period of storage.

This can be recognised from the following ways:

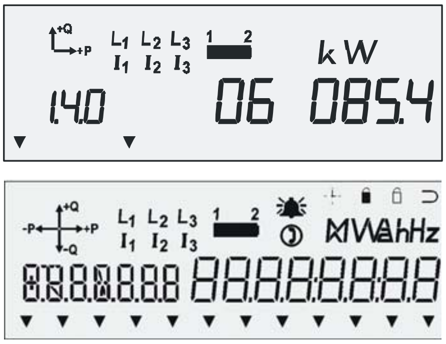
- The arrow above the "CLK" symbol flashes.
- The error message in the display list shows F.F 02000000
- The meter has either reset the date to 1.1.2000 (shown as **00-01-01** or **01.01.2000**) and the time to **00:00:00** or has used time and date of the last voltage failure.

It is absolutely necessary to set the time and date correctly to prevent incorrect time data in the meter. This should be performed either with the corresponding formatted command or manually, as shown below.

5.9.2 Set the Time Manually

Procedure:

1. Remove the hinged cover seal.
2. Open the hinged cover, so that the reset key is accessible.
3. Ensure that the operating display appears. Press the display key briefly. The display changes from operating display to display check.



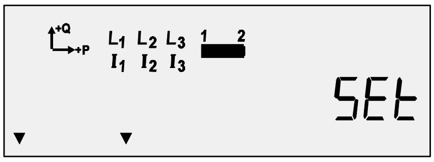
Operating display

Display key short

Display check

4. Press the reset key. The display changes to the service menu with the first menu item, normally set mode "Set".
Otherwise press the display key as many times briefly, until the menu item "Set mode" (SEt) is displayed.

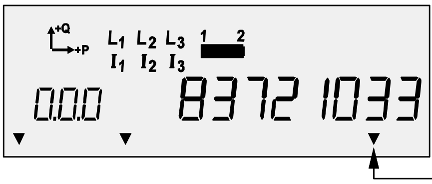
R Reset key



Set mode

5. Press the display key for longer (at least 2 seconds), until the first value for setting is displayed.

Display key long

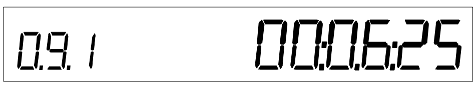


first line for setting
1. identification number

Set mode active

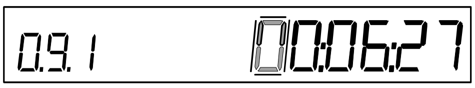
The arrow above the "SEt" symbol appears and remains until exit from the set mode.

6. Select the value to be changed with the display key, e.g. the time-of-day 0.9.1.



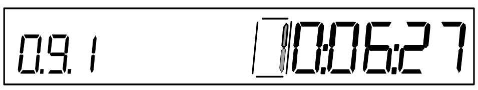
Running day time

7. Press the reset key. The first digit of the value to be changed flashes.

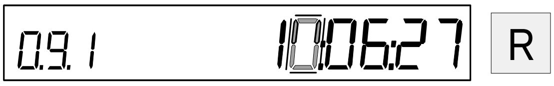


R

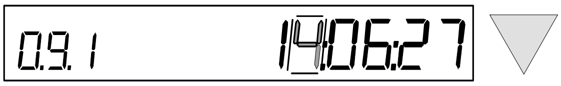
8. Change the digit by pressing the display key, which increases the digit by 1 each time up to the desired value.

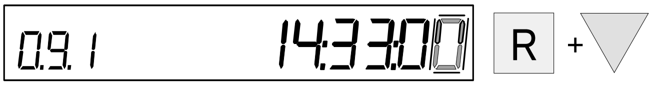


9. Press the reset key. The next digit of the value to be changed flashes.

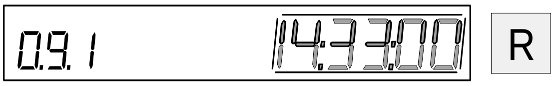


10. Repeat steps 8 and 9 for all digits of the value to be changed, up to the last digit.

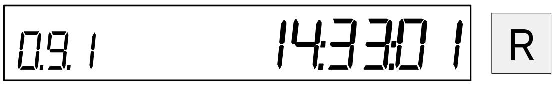




11. Press the reset key. The entire line flashes.



12. Ensure that the value set is correct.
    - **If not**, press the display key to correct the value. The original time-of-day appears again and a start must be made from step 7.
    - **If yes**, wait for the time set and then press the reset key.



13. The set time is stored and begins to run. The arrow above the symbol "CLK" disappears and the error message is deleted (F.F 00000000).
14. The next value to be changed can then be processed. The procedure is the same as described above.
15. To end the set mode, press the display key **twice briefly** (double-click). The operating display appears again.
16. Close the hinged cover.
17. Re-seal the hinged cover.

5.9.3 Set the Date Manually

Format of date

To show the date in the display and readout according to IEC, one of the two following formats can be parameterised:

- Year – Month – Day YY-MM-DD

Example:

Year Month Day

or

- Day . Month . Year DD.MM.YYYY

Example:

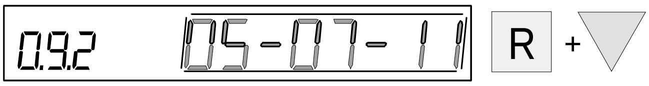
Day Month Year

1. In set mode select the date with the display key 0.9.2.

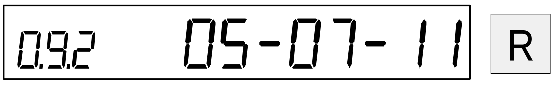
Running date (1.1.2000)

2. Press the reset key. The first digit of the value to be changed flashes.

3. Change the individual digits by pressing the display key and reset key until the entire date is set correctly.



4. Press the reset key, to save the date set.



Structure

Note that the date always begins with the two-digit year number, followed by month and day. The above date 05-07-11 is therefore 11 July 2005.

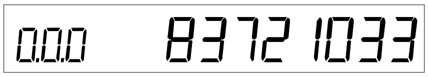
ⓘ **Do not set a future date**
Never set a date in the future, i.e. a date later than the present day. For meters with load profiles, readout of the load profile would be disturbed.

If a date in the future has accidentally been set in a meter with load profiles, the load profile must be deleted immediately after setting the correct date.

5.9.4 Set Identification Number Manually

The 1st identification number (ID1) basically belongs to the meter and is not normally changed. If the number is nevertheless to be changed, the following procedure should be adopted as for setting the time:

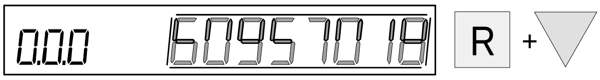
1. In set mode select with the display key the identification number to be changed, e.g. 0.0.0.



Identification number

2. Press the reset key. The first digit of the value to be changed flashes.

3. Change the individual digits by pressing the display key and reset key, until the entire number is set correctly.



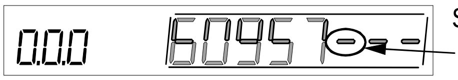
4. Press the reset key, to save the number set.

For the identification number two further characters can also be selected in addition to the digits 0 to 9:

- the hyphen "-" as termination for a short number
- the subscript line "_" as position holder for a space

This makes it possible to enter a number with 7 digits or less right-aligned with "-" or left-aligned with "_", as shown in the following examples.

Number with 5 digits right-aligned, before saving



Short number closed to the right
symbol for closing

and after saving

Number is saved

Number with 5 (visible) digits left-aligned, before saving

Short number closed to the left
symbol for space

and after saving

Number is saved

6 Service

This chapter describes the necessary servicing work after the appearance of operating faults or error messages.

6.1 Operating Faults

If the liquid crystal display is illegible or the data readout does not function, the following points should first be checked:

1. Is the mains voltage present (preliminary fuses intact and test terminals closed)?
2. Is the maximum permissible ambient temperature exceeded?
3. Is the plastic viewing window over the face plate clean (not scratched, painted over, misted over or soiled in any way)?

Danger of short-circuits
Never clean soiled meters under running water or with high pressure devices. Water penetration can cause short-circuits. If the meter is heavily soiled, it should be dismantled if necessary and sent to an authorised service centre, so that a new plastic viewing window can be fitted.

If none of the points listed is the cause of the fault, the meter should be disconnected, removed and sent to an authorised service centre (see section 6.4 "Repairing Meters").

6.2 Error Messages

The meters regularly perform an internal self-test. This checks the correct function of all important parts.

If a severe error (fatal or critical error according to the following severity code classification) has been detected, the meters display a corresponding error message. Depending on the parameterisation and significance of the error the error message appears as an eight-digit figure together with "F.F" or "FF" in the display. The error message is always included in the readout protocol. F.F(00000000) means no error.

Severity code classification

Severe problems are classified as fatal and critical errors.

A **fatal error** indicates a severe problem which prevents the microcontroller from maintaining its measuring processes. This can e.g. be a hardware defect. The meter stops working and displays the error code permanently. The meter has to be replaced.

A **critical error** indicates a severe problem which normally does not prevent the microcontroller from measuring. Data is stored in the memory and, in case of doubt, marked accordingly. After a critical error, the error code is displayed until the display button is pressed or the error register is reset, e.g. via the electrical interface. The meter must be replaced as soon as possible.

Non-critical errors can have an impact on the meter’s functionality (temporary or permanent). These errors are stored in the error register. Generally, the meter can still be used and does not have to be exchanged.

Delete error message

If nothing else is specified in the following description of the error group, the error messages can only be deleted with formatted commands (see section 5.8). The majority of errors require the meter to be removed and returned to an authorised service centre (see section 6.4 "Repairing Meters").

6.2.1 Structure of an Error Message

An error message has the following form:

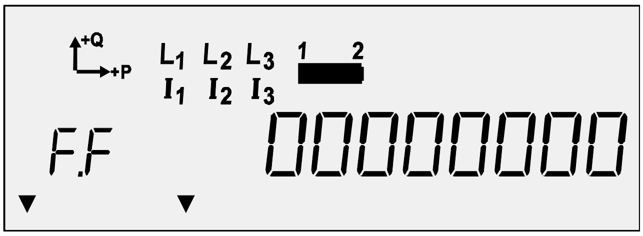


Fig. 6.1 Error message on E550

E550 meters all use the same format for error messages. This consists of four groups of 2 digits each, whereby the groups have the following significance:

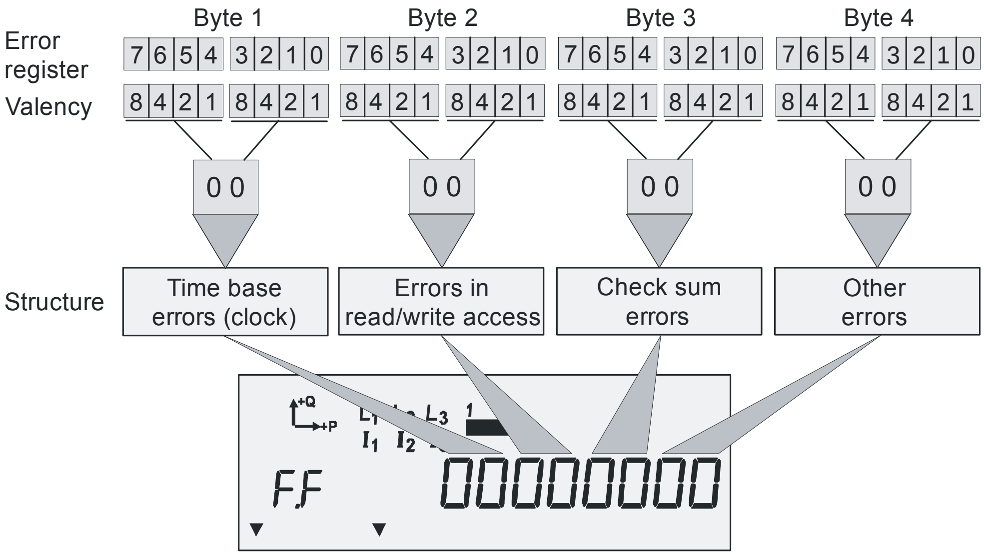


Fig. 6.2 Significance of error message

Each group has two digits written in hexadecimal notation and can therefore have the values 0 to 9 and letters A to F. Both digits each form the sum of the individual values of 4 possible types of error as shown in the following diagrams.

6.2.2 Error Groups

Time-base errors (clock)

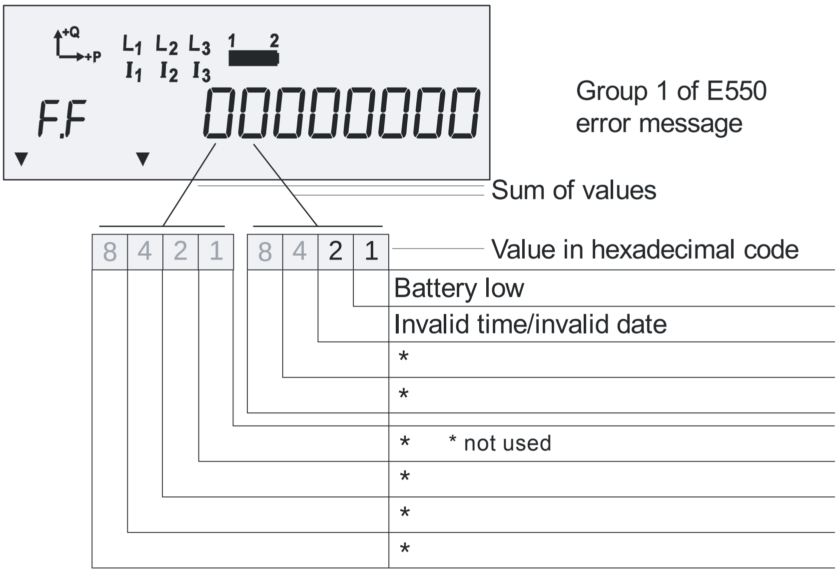


Fig. 6.3 Group 1 of error message

The first digit in the first group has no significance, since no error messages are assigned to it.

The second digit can have values between 0 (no error message) and 3 (both error messages set). Significance:

F.F **01** 00 00 00

Battery low

This is a non-critical error. The battery is missing or discharged. The calendar clock will stop when the supercap is discharged following separation from the mains.

The error is deleted automatically when the battery voltage has again reached a sufficient value (e.g. after inserting a new battery according to *7.2* "*Changing the Battery*").

This error message only appears if the meter is parameterised as "fitted with battery". Otherwise there is no check of the battery condition.

F.F **02** 00 00 00

Invalid time/invalid date

This is a non-critical error. The meter has discovered that the calendar clock has stopped at some time. The clock is running but shows the wrong time or date.

The error is deleted automatically when the time and date have been set correctly by the relevant formatted command or manually in the set mode (see section *5.8* "*Formatted Commands*" or *5.9* "*Changing Values in Set Mode").*

Errors for write/read access

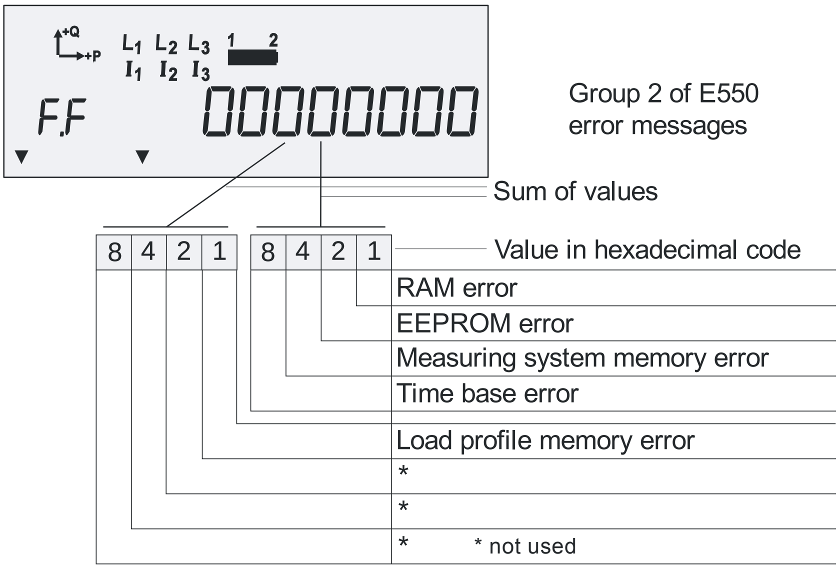


Fig. 6.4 Group 2 of error message

The first digit in the second group can have the value 0 (no error message) or 1 (error message set).

The second digit can have values between 0 (no error message) and F (all four error messages set). Significance:

F.F 00 **x1** 00 00

RAM error

This appears in the display as **critical error** when starting the meter if the RAM test fails.

The meter may contain erroneous data and must be replaced as soon as possible.

The same applies to messages: F.F .. x3/x5/x7/x9/xB/xD/xF

F.F 00 **x2** 00 00

EEPROM error

The meter supplies this message in the event of a repeated memory test failure. This is a **critical error**.

The meter may contain erroneous data and must be replaced as soon as possible.

The same applies to messages: F.F .. x3/x6/x7/xA/xB/xE/xF

F.F 00 **x4** 00 00

Measuring system memory error

The meter supplies this message for repeated failure of the measuring system test. The meter may contain erroneous data or fail. This is a **critical error**.

The meter may contain erroneous data and must be replaced as soon as possible.

The same applies to messages: F.F .. x5/x6/x7/xC/xD/xE/xF

F.F 00 **x8** 00 00

Time base error

The meter sets this message for repeated failure of the time base test. The calendar clock may display an invalid time/date. This is a **critical error**.

The error is reset via communication according to IEC 62056-21 or dlms. If it occurs repeatedly, the meter must be replaced as soon as possible.

The same applies to messages: F.F .. x9/xA/xB/xC/xD/xE/xF

F.F 00 **1x** 00 00

Load profile memory error

This message is displayed as a **critical error** in case the memory test was failed repeatedly.

Load profile data are marked in the status code (invalid measuring value and severe error).

The meter may contain incorrect data and must therefore be replaced as soon as possible.

This also applies for the messages: F.F .. 3x/5x/7x/9x/Bx/Dx/Fx.

Checksum errors

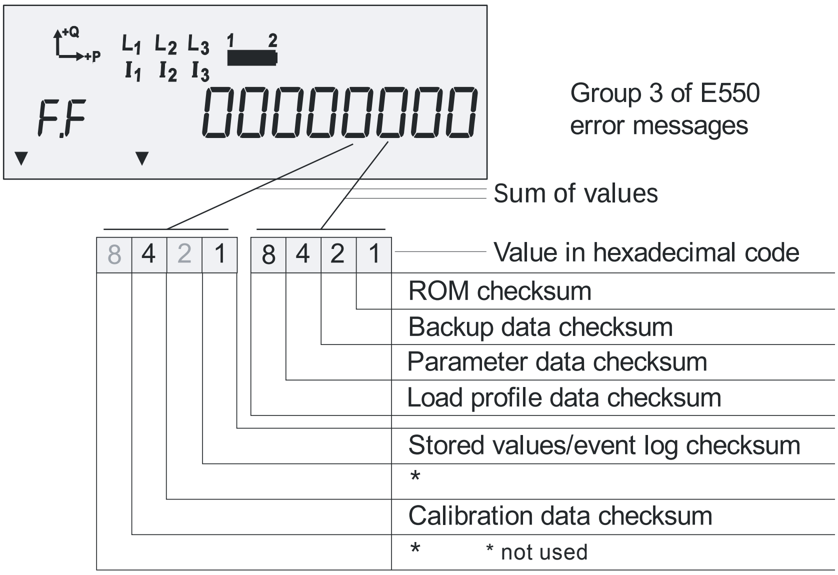


Fig. 6.5 Group 3 of error message

The first digit in the third group can have the value 0 (no error message) or 1, 4 or 5 (error messages set).

The second digit can have values between 0 (no error message) and F (all four error messages set). Significance:

F.F 00 00 **x1** 00

ROM checksum error

This appears on the display as a so-called **fatal error** if the relevant test fails.

The meter does not operate and must be replaced.

The same also applies to messages F.F .. .. x3/x5/x7/x9/xB/xD/xF.

F.F 00 00 **x2** 00

Backup data memory checksum error

This appears on the display as a so-called **critical error** if the relevant test fails. Load profile data are marked in the status code (invalid measuring value and severe error).

The meter probably does not operate and must be replaced as soon as possible.

The same also applies to messages F.F .. .. x3/x6/x7/xA/xB/xE/xF.

F.F 00 00 **x4** 00

Parameter memory checksum error

This appears on the display as a so-called critical error if the relevant test fails.

Load profile data are marked in the status code (invalid measuring value and severe error).

The meter probably does not operate and must be replaced as soon as possible.

The same applies to messages F.F .. .. x5/x6/x7/xC/xD/xE/xF.

F.F 00 00 **x8** 00

Load profile memory checksum error

This message is displayed as a **non-critical error** in case the load profile memory test fails repeatedly.

Load profile data of the defective memory area are marked in the status code (invalid value).

The error is reset via communication according to IEC 62056-21 or dlms. If it occurs repeatedly, the meter must be replaced as soon as possible.

F.F 00 00 **1x** 00

Stored values and event log checksum error

This message is displayed as a **critical error** in case the checksum test for the stored values or event log fails repeatedly.

Load profile data are marked in the status code (severe error).

The error is reset via communication according to IEC 62056-21 or dlms. If it occurs repeatedly, the meter must be replaced as soon as possible.

The same applies to messages F.F .. .. 5x.

F.F 00 00 **4x** 00

Calibration data checksum error

The meter sets this message for repeated failure of a checksum test for the calibration data. This is a **critical error**.

The meter can carry out an incorrect measurement and must therefore be replaced.

The same applies to messages F.F .. .. 5x.

Other errors

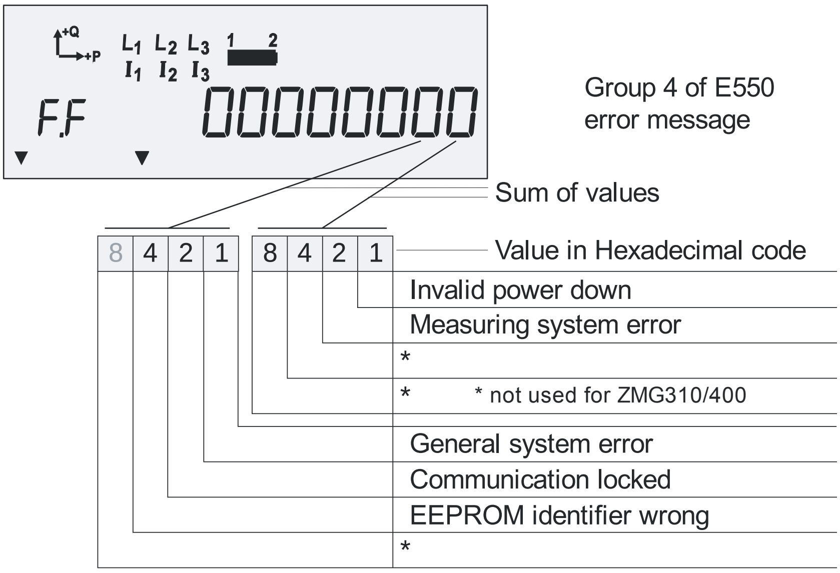


Fig. 6.6 Group 4 of error message

The first digit in the fourth group can have values between 0 (no error message) and 7 (error messages set).

The second digit can have values between 0 (no error message) and 3 (both error messages set). Significance:

F.F 00 00 00 **x1** Invalid start-up sequence

The meter has detected that the last data storage was not performed correctly. The meter may contain incorrect data. The error is reset via communication according to IEC 62056-21 or dlms.

F.F 00 00 00 **x2** Measuring system error (overflow or no activity of the measuring system)

The meter has detected an error in the data processing, e.g. part of the energy has not been measured.

The meter must therefore be replaced.

F.F 00 00 00 **1x** General system error (in microprocessor)

The meter loses all data determined since the last storage, i.e. for 24 hours maximum. The error is reset via communication according to IEC 62056-21 or dlms.

F.F 00 00 00 **2x** Communication locked

Communication is locked, e.g. after an unauthorised access via the communication interfaces. The error is automatically deleted after the inhibition time, via communication (according to IEC 62056-21 or dlms) or at midnight.

F.F 00 00 00 **4x** EEPROM identifier wrong (wrong FLASH detected)

The reference identification differs from the FLASH-ID, e.g. a wrong FLASH was installed. This is a **fatal error**.

The meter does not operate and must be changed.

The same applies to messages F.F .. .. .. 5x/6x/7x.

6.3 Changing or Inserting the Face Plate

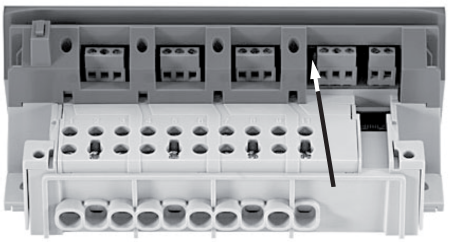
Certification of meter necessary
The faceplate is fitted under the front cover of the meter, which is sealed with the verification seal top right. If the face plate has to be inserted or changed, re-certification of the meter is normally necessary.

If the meter was supplied without faceplate fitted or the faceplate must be changed, e.g. due to re-parameterisation, proceed as follows:

1. Remove the certification seal at top right of the meter.

Plastic seals
Cut plastic seals carefully to avoid injuries caused by flying parts.
Wear protective goggles!

2. Release the screw at the top right of the meter.
3. Push the front cover latch with a suitable tool to unlock the cover.



4. Take off the front cover and remove the old faceplate, if a new face-plate is to be fitted.
5. Insert the new faceplate in the front cover and insert the front cover in the meter.
6. Tighten the screw again at top right of the meter.
7. Carry out the certification according to the local regulations.
8. Reseal the screw at top right of the meter with a certification seal.

6.4 Repairing Meters

Meters must only be repaired by an authorised service centre (or manufacturer).

The following procedure should be adopted if a meter repair is necessary:

1. If installed, remove the meter as described in section 4.6 and fit a substitute meter.
2. Describe the error found as exactly as possible and state the name and telephone number of the person responsible in case of inquiries.
3. Pack the meter to ensure it can suffer no further damage during transport. Preferably use the original packing if available. Do not enclose any loose components.
4. Send the meter together with the detailed error description to the responsible service and repair centre.

7 Maintenance

This chapter describes the necessary maintenance work.

7.1 Meter Testing

Meter tests should be performed at periodic intervals according to the valid national regulations (either on all meters or on specific random samples). In principle the meters should be dismantled for this purpose according to the instructions in section 4.6 "Removing Meter" and replaced by a substitute meter. The meter test can also be performed on site in certain circumstances.

7.1.1 Installation of a meter on a testing device

For testing the meter, it should be connected to a testing device specially provided for this purpose.

The meter uses a voltage jumper similar to the series ZxB meters. A spring contact connects the voltage circuit of the meter to the phase terminal (see left-hand side of the following figure).

Procedure:

1. Connect the meter to the terminals of the testing device as shown in the connection diagram on the dial and according to the usual testing methods.
2. To connect the test voltage use connecting cable with a contact pin of 2.5 mm diameter and approx. 40 mm long (between 39 and 41 mm). This contact pin is inserted in the circular opening provided in the terminal cover above the measuring terminals. The pin lifts the spring from the contact tip of the current loop and therefore breaks the connection.

Keep voltage cable free from supply voltage when inserting
The voltage cables must always be free from voltage when inserting. Touching live contact pins can be fatal.

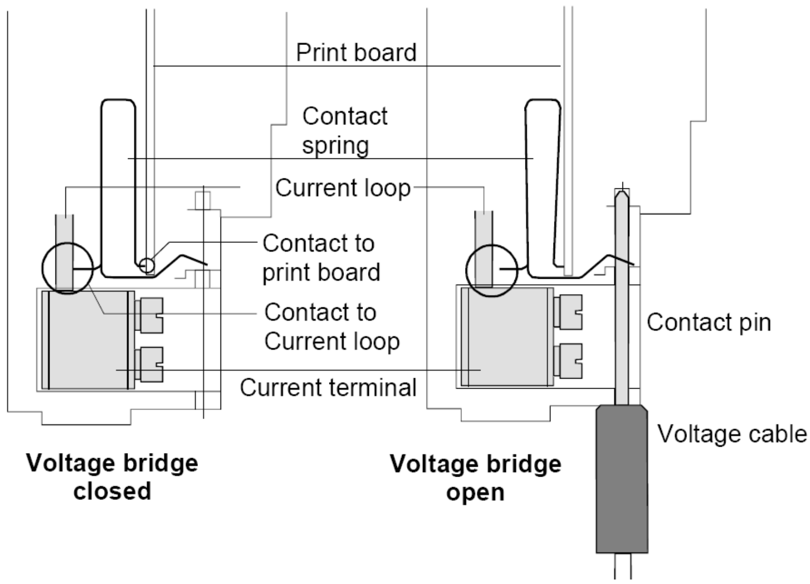


Fig. 7.1 Voltage jumper – closed at left, open at right

3. After testing, withdraw the cable with the contact pins (not under voltage) from the terminal cover. The spring closes the current loop contact and therefore the voltage jumper automatically.

Avoid unsuitable tools
Do not use tools such as screwdrivers or cables which could bend or damage the springs in any way.

7.1.2 Test Mode

The test mode increases the resolution of the energy registers by 1 to 4 digits. This allows the utility to carry out the so-called register test in a sufficiently short time.

In test mode the normal rolling operating display changes to manual control with the same values, but with high resolution in the energy registers.

The energy registers comprise a total of 12 digits with 4 decimal places. A maximum of 8 digits, however, is shown on the display. The effective number of digits shown and the number of decimal places are determined by the parameterisation. For the test mode more decimal places are normally parameterised (maximum 4) to permit a quicker test of the transmission to the energy registers.

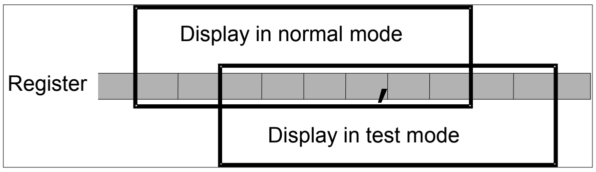


Fig. 7.2 Display changeover normal mode – test mode

Changeover from normal to test mode and back is made by a formatted command (see section 5.8 "Formatted Commands") or manually in the service menu in sub-menu "tESt".

Optical test output in test mode

In test mode, the optical test output for active energy (LED in the middle) can also provide other energy pulses if parameterised accordingly.

The switchover can be performed with a formatted command via the optical or electrical interface. By this means, it is possible to select any parameterised measured value ME1 to ME12. This also allows an automatic test procedure without manual interaction.

This allows the utility to check all recorded values such as active, reactive or apparent energy, sum or individual phase values, etc. with only one reading head for all values in the meter.

7.1.3 Measuring Times

For technical reasons greater measuring deviations can occur during short-term measurements. It is therefore recommended to use sufficiently long measuring times in order to achieve the required accuracy.

ZMG400xR with I_n = 5 A

Table of measuring times required:
(**3 P** = balanced load, **1 P** = single-phase load):

Measuring uncertainty 0.2%

U_n = 230 V (ZMG400)

I_n = 5 A

	Active energy			Reactive energy		
Current [% I_n]	3 P cosφ=1	1 P 1	3 P 0,5	3 P sinφ=1	1 P 1	3 P 0,5
1	5 s	–	–	–	–	–
2	3 s	–	5 s	3 s	–	–
5	3 s	3 s	5 s	3 s	3 s	3 s
10	3 s	3 s	3 s	3 s	3 s	3 s
20	3 s	3 s	3 s	3 s	3 s	3 s
50	3 s	3 s	3 s	3 s	3 s	3 s
100	3 s	3 s	3 s	3 s	3 s	3 s
200	3 s	3 s	3 s	3 s	3 s	3 s

Measuring uncertainty 0.1%

U_n = 230 V (ZMG400)

I_n = 5 A

	Active energy			Reactive energy		
Current [% I_n]	3 P cosφ=1	1 P 1	3 P 0,5	3 P sinφ=1	1 P 1	3 P 0,5
1	17 s	–	–	–	–	–
2	7 s	–	17 s	7 s	–	–
5	6 s	6 s	7 s	6 s	6 s	7 s
10	6 s	6 s	6 s	6 s	6 s	6 s
20	6 s	6 s	6 s	6 s	6 s	6 s
50	6 s	6 s	6 s	6 s	6 s	6 s
100	6 s	6 s	6 s	6 s	6 s	6 s
200	6 s	6 s	6 s	6 s	6 s	6 s

Measuring uncertainty 0.05%

U_n = 230 V (ZMG400)

I_n = 5 A

	Active energy		
Current [% I_n]	3 P cosφ=1	1 P 1	3 P 0,5
1	64 s	–	–
2	20 s	–	64 s
5	12 s	14 s	16 s
10	12 s	12 s	12 s
20	12 s	12 s	12 s
50	12 s	12 s	12 s
100	12 s	12s	12 s
200	12 s	12 s	12 s

ZMG400xR with I_n = 1 A

Table of measuring times required:
(**3 P** = balanced load, **1 P** = single-phase load):

Measuring uncertainty 0.2%

U_n = 230 V (ZMG400)

I_n = 1A

	Active energy			Reactive energy		
Current [% I_n]	3 P cosφ=1	1 P 1	3 P 0,5	3 P sinφ=1	1 P 1	3 P 0,5
1	–	–	–	–	–	–
2	5 s	–	–	5 s	–	–
5	3 s	3 s	4 s	5 s	3 s	4 s
10	3 s	3 s	3 s	5 s	3 s	3 s
20	3 s	3 s	3 s	3 s	3 s	3 s
50	3 s	3 s	3 s	3 s	3 s	3 s
100	3 s	3 s	3 s	3 s	3 s	3 s
200	3 s	3 s	3 s	3 s	3 s	3 s
500*)	3 s	3 s	3 s	3 s	3 s	3 s
600*)	3 s	3 s	3 s	3 s	3 s	3 s

3 P = balanced load 1 P = single-phase load

*) Only valid for 5//1 A.

Measuring uncertainty 0.1%

U_n = 230 V (ZMG400)

I_n= 1 A

	Active energy			Reactive energy		
Current [% I_n]	3 P cosφ=1	1 P 1	3 P 0,5	3 P sinφ=1	1 P 1	3 P 0,5
1	–	–	–	–	–	–
2	16 s	–	–	16 s	–	–
5	6 s	9 s	11 s	6 s	9 s	11 s
10	6 s	6 s	6 s	6 s	6 s	6 s
20	6 s	6 s	6 s	6 s	6 s	6 s
50	6 s	6 s	6 s	6 s	6 s	6 s
100	6 s	6 s	6 s	6 s	6 s	6 s
200	6 s	6 s	6 s	6 s	6 s	6 s
500*)	6 s	6 s	6 s	6 s	6 s	6 s
600*)	6 s	6 s	6 s	6 s	6 s	6 s

3 P = balanced load 1 P = single-phase load

*) Only valid for 5//1 A.

7.1.4 Optical Test Output

The optical test outputs on the meter below the LCD should be used for meter testing. These supply pulses at a frequency dependent on the meter constant R, whereby the rising edge is always decisive for the test.

Note that the digital signal processing provides a delay of 2 seconds between the instantaneous power at the meter and the appearance of the pulses at the optical test outputs. No pulses are lost.

The number of pulses per second for the desired power is obtained by multiplying the meter constant R by the power in kW divided by 3600.

Example: Meter constant R = 10'000

Power P = 3.5 kW

f-test output = R x P / 3600 = 10'000 x 3.5 / 3600 = 10 imp/s

The optical test outputs are continuously lit at creep.

Test mode

Depending on the parameter setting of the behaviour of the pulse LED, test mode allows you to select which measuring value (active, reactive, I^2, U^2) is shown on the optical test output.

In the display, values for active, reactive and apparent energy are available. Depending on the parameter setting, the resolution of the display register can be increased for faster testing. In the test mode, the resolution is increased by one decimal point compared to the normal mode. A maximum of 4 decimal points is possible.

The measured values are displayed on the optical test outputs as shown in the following table:

Mode	Register on display	Test output reactive	Test output active
Normal mode	Any register	|R|	|A|
	Losses	I^2h	U^2h
Test mode	Active energy (A)	|R|	|A|
	Reactive energy (R)	|A|	|R|
	Losses (NLA)	I^2h	U^2h
	Losses (OLA)	U^2h	I^2h
	Any other registers not mentioned	|R|	|A|

7.1.5 Creep Test

A test voltage U_p of 1.15 U_n is used for the creep test (no-load test) to IEC 62053-21 (e.g. U_p = 265 V with U_n = 230 V).

Procedure:

1. Disconnect the meter from the mains for at least 10 seconds.
2. Then switch on the test voltage U_p and wait approx. 10 seconds. After this time the energy direction arrows must disappear. The red optical test outputs are permanently "lit".
3. The optical test outputs must not switch off.
4. Switch on test mode (high resolution).
5. Check the energy levels for changes in test mode. They must not increase by more than the value of one pulse during a specified time.

7.1.6 Starting Test Active Part

Procedure:

1. Apply a load current of 0.02% of the nominal current I_n (IEC-meters) or 0.02% of the reference current I_{ref} (MID-meters) – e.g. 1 mA with I_n= I_{ref} = 5 A – and the voltage U_n (3-phase in each case) and **cosφ = 1**. The meter must remain in creep.
2. For ZMG410xR: Increase the load current to 0.2% I_n (IEC-meters) or 0.2% I_{ref} (MID-meters) – e.g. 10 mA with I_n = I_{ref} = 5 A.

For ZMG405xR: Increase load current to 0.1% I_n (=0.1% I_{ref} for MID). The energy direction arrow "P" must appear within 10 seconds.

The optical test output for active energy consumption is no longer permanently "lit".

7.1.7 Starting Test Reactive Part

Procedure:

1. Apply a load current of 0.04% of the nominal current I_n (e.g. 2 mA with I_n = 5 A) and the voltage U_n (three-phase in each case) and **sinφ = 1**. The meter must remain in creep.
2. Increase the load current to 0.4% I_n (i.e. 20 mA with I_n = 5 A). The energy direction arrow "Q" must appear within 10 s. The optical test output for reactive energy consumption is no longer permanently "lit".

7.1.8 Accelerated no-load and starting tests

No-load and starting test via optical test output

No-load is indicated by "continuously lit" at the optical test output. The status of the optical test output cannot, however, be assessed by the eye, since it is infrared light. For automated testing the optical scanner must be able to detect static conditions. The following points must be tested:

"No-load" current

With this no-load current, the optical test output must change to "continuously lit". The "no-load" current is 30% of the starting current for class 2 meters defined in IEC 62053-21.

Starting current

With this load current, the optical test output must be dark. The test is specified at 90% of the starting current defined by IEC 62053-21

The following settings must be made for the active energy test:

- cosφ = 1 resp. sinφ = 1
- Voltage $U = U_n$
- No-load current and starting current according to the following table

Version	Class	No-load current	Starting current
5 A	2.0	1 mA	20 mA
	1.0	1 mA	10 mA
	0.5	1 mA	5 mA
1 A	2.0	0.2 mA	4 mA
	1.0	0.2 mA	2 mA

The minimum waiting times before a status (standstill or start) is positively indicated are set as follows:

- Waiting time for standstill: 12 s
- Waiting time for starting: 10 s

No-load and starting test with LCD

No-load is indicated by the display when the energy direction arrows are not visible. If the meter has started, at least one energy direction arrow appears. This test can only be performed visually and is therefore suitable above all for on-site diagnoses in existing installations. The precondition for this is that the energy direction arrows have been parameterised in the meter. Procedure, load point setting and waiting times correspond to the above data.

No-load and starting test by readout

The current internal operating statuses are recorded in the register internal operating status (code number C.5.0) according to DIN 43863-3. If this register has been parameterised for the display or service list of the meter, the status of bit b7 ("Start active") and bit b6 ("Start reactive") of the 2nd byte of the register can be checked. This test can be automated very well. The test station must only have a device for reading via the optical interface. Procedure, load point setting and waiting times correspond to the above data.

7.2 Changing the Battery

The E550 can accommodate two batteries: battery 1 on the left side of the battery compartment for the power reserve of the calendar clock and for the display and readout; battery 2 on the right for the power reserve of the calendar clock if battery 1 is missing or discharged. The meter monitors the voltage and activates the battery symbol in the display if the voltage falls below a specific value. Monitoring only takes place, however, if the meter is parameterised as provided with battery.

The relevant battery should be changed if one of the following events occurs:

- The relevant figure flashes in the symbol in the liquid crystal display: 1 for battery 1; 2 for battery 2.
- The relevant battery has been in the meter for more than 10 years (preventive servicing). It is recommended to note the date of insertion on the battery. The 10 years depend on the product and on the age of the battery when inserting it into the meter.
- The battery operating hours counter indicates over 100,000 hours (can be read under code C.6.0 in service mode).

Meters with or without battery
Only meters with parameterised battery supervision have the 2 figures in the symbol and the battery operating hours counter.

Battery compartment protects against touching the contacts
The contacts in the battery compartment may have mains voltage applied. The open battery compartment protects against direct touching of the contacts. Do not use any metal tools when changing the battery.

Replacement battery
Do not touch the batteries with bare hands. Perspiration and dirt change the battery surface and can lead to contact problems.

Battery 1: Only use a lithium battery with a nominal voltage of 3.6 V and the same construction as the original battery for replacement.
Battery 2: Only use a lithium battery with a nominal voltage of 3 V and the same construction as the original battery for replacement.

Make sure that the battery is inserted in the correct position with regard to polarity (plus to the right for battery 1, to the bottom for battery 2). A wrongly inserted battery is not dangerous for the meter, but will be discharged in a short time.

Procedure:

1. Remove the hinged cover seal.
2. Open the hinged cover (1).
3. Withdraw the battery compartment with the grip recess (2). The compartment folds down obliquely.

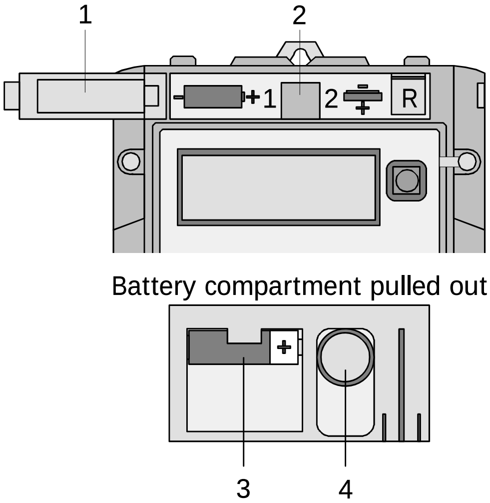


Fig. 7.3 Battery compartment

4. Remove the battery concerned.
5. Mark the current date on the new battery.
6. Insert the new battery.
7. Reset the battery hours counter to zero with the relevant formatted command (see section 5.8) or in the set mode (see section 5.9). The corresponding figure stops flashing after the reset.

   A reset of the battery hour counter can also be made if the meter is out of voltage from battery 1.
8. Close the hinged cover.
9. Re-seal the hinged cover.
10. Dispose of the old battery as hazardous waste in accordance with local regulations.

Checking time-of-day and date
After inserting the battery, check the time-of-day and date without power applied and set these values again if necessary.

Never short-circuit batteries or expose them to high temperatures
Never short-circuit batteries, even if they are discharged, and never expose them to high temperatures (over 80 °C). Danger of exploding batteries!

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8 Disposal

Based on the data specified in environmental certificate ISO 14001, the components used in meters are largely separable and can therefore be taken to the relevant disposal or recycling point.

Disposal and environmental protection regulations
For the disposal of meters observe the local disposal and environmental protection regulations in effect without fail.

Components	Disposal
Printed circuit boards, LCD, LEDs	Electronic waste: disposal according to local regulations.
Batteries	Hazardous waste: disposal according to local regulations.
Metal parts	Sorted and taken to collective materials disposal point.
Plastic components	Sorted and taken to recycling (regranulation) plant or if no other possibility to refuse incineration.

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