Electricity Meters IEC/MID

Industrial and Commercial

SMA300AR/CR

S650 Series 3

User Manual

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Revision history

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a	26.09.2012	First edition

Table of contents

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 metering applications for the intended purpose. This includes:

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

Target group

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

Reference documents

The following documents provide further information related to the subject of this document:

- D000045770 "S650 SMA300AR/CR Series 3 Technical Data"
- D000030112 "E650 ZxD/S650 SxA Series 3 Functional Description"

Conventions

The structure and significance of meter type designations are described in section 2.3 "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. SMA310xR for the SMA310AR and SMA310CR meters).
- The following collective terms are also sometimes used instead of the type designation:
  - "Active energy meters" for the SMA300AR meters
  - "Combi-meters" for the SMA300CR meters

1 Safety

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

1.1 Safety information

The following symbols are used to draw your attention to the relevant danger level, i.e. the severity and probability of any danger, in the individual sections of this document.

Warning
Used to indicate a dangerous situation that could cause bodily injury or death.

Caution
Used to indicate a situation/ action that could result in material damage or loss of data.

Note
Used to indicate general guidelines and other useful information.

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

1.2 Responsibilities

The owner of the meters – usually the utility company – is responsible for ensuring that all persons working with meters:

- Have read and understood the relevant sections of the user manual.
- Are appropriately qualified for the work to be performed.
- Strictly observe the safety regulations (laid down in section 1.3) and the operating instructions as specified in the individual sections.

In particular, the owner of the meters bears responsibility for the protection of persons, prevention of material damage and the training of personnel.

For this purpose, Landis+Gyr provides training on a variety of products and solutions. Please contact your local Landis+Gyr representative if interested.

1.3 Safety regulations

The following safety regulations must be observed at all times:

- The meter connections must be disconnected from all voltage sources during installation or when opening.
- Contact with live parts can be fatal. The relevant supply 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. Only technically qualified and appropriately trained personnel are authorised to install the meters.
- Only appropriate tools shall be used for the job. This means, e.g. that the screwdriver must be of the correct size for the screws, and the handle of the screwdriver must be insulated.
- The meters must be held securely during installation. They can cause injuries if dropped.
- Meters that have been dropped must not be installed, even if no damage is apparent, but must be returned to the service and repair department (or the manufacturer) for testing. Internal damage may result in malfunctions or short-circuits.
- The meters must never be cleaned under running water or with compressed air. Water ingress can cause short-circuits.

2 Device description

This section provides you with a brief overview of the design and function of the S650 SMA300AR/CR meters (smart grid terminals).

2.1 Field of application

SMA300xR meters can be used for direct connection at the low voltage level. They are primarily used by medium consumers.

SMA300xR meters have a comprehensive tariff structure. This extends from seasonal tariffs to multiple energy and demand tariff rates.

SMA300xR meters are well suited for street light applications with embedded astronomical clock and combinations of control saving signals coming from light sensors, measurements or other digital inputs.

SMA300CR combi-meters record active and reactive energy consumption, SMA300AR active energy meters only the active energy in three-phase four-wire networks on low voltage, and from this determine the required electrical measured quantities. They are connected directly to the phase conductors at the measuring point.

The data determined are displayed (LCD) and are also available at the optical interface for data acquisition, with an appropriate interface board as selected also as required via RS232, RS422, RS485 or CS. When provided with transmission contacts, the meters can also be used as transmitting meters for telemetering. The tariff rates can be controlled internally or externally.

SMA300xR meters can be combined easily with data concentrator DC450 through RS485, if option selected.

2.2 Characteristics

SMA300xR meters have the following basic characteristics:

- Recording of active, reactive and apparent energy in all four quadrants (SMA300CR)
- Tariff system with energy and demand tariff rates, stored values, load profiles etc.
- Astronomical clock generating 2 energy saving signals to control 2 relays outputs, if option selected
- Extended functions such as monitoring functions, sliding maximum demand, (for SMA300CR additionally power factor and displacement power factor), voltage/current unbalance
- Tariff control
  - External
    - via control inputs (SMA300xR21 and SMA300xR41)
    - via communication interfaces using formatted commands
  - Internal
    - by integral time switch (SMA300xR24 and SMA300xR44)
    - by event signals based on monitored values, such as voltage, current demand etc.
- Display of data on a liquid crystal display (LCD)

- Active and reactive power per phase and true RMS values of voltages and currents by means of digital signal processing (DSP) chips
- Accuracy: Compliance with IEC class 1 and with MID accuracy class B for active energy consumption (SMA310xR) and IEC class 1 for reactive energy (SMA310CR).
- Flexible measuring system through parameterisation (definition of different variables by software)
- Correct measurement even with failure of individual phases, or when used in two- or single-phase networks
- Wide range of measurement from starting current to maximum current
- Optical interface according to IEC 62056-21 and dlms
  - for direct readout of meter data
  - for service functions of the meter, extension board and interface board (e.g. parameterisation)
- Output contacts (solid-state relays) for fixed valence pulses, control signals and status messages
- Output contacts (relays) for control signals and status messages
- Input contact for real time TCP/IP alarm capabilities through DC450, if RS485 interface board selected
- Installation aids
  - Indication of phase voltages, phase angles, rotating field and direction of energy
- Storage of event information, e.g. voltage failures, exceeding of thresholds or error messages. Event information can be read out via the available interfaces. Important events can be communicated to the energy supply company as operational messages (sending of advanced SMS messages, control of an arrow in the display, drive for an output contact, etc.).
- Interfaces such as RS232, RS422, RS485 or CS for remote transmission of data (interface board)
- Auxiliary power supply for communication with the meter if no measuring voltage is present

2.3 Type designation

Type designation SMA 3 10 C R 44 4207 .c1 S3

Network type

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

Connection type

3 Direct connection

Accuracy class

10 Active energy class 1 (IEC), B (MID)

Measured quantities

C Active and reactive energy
A Active energy

Construction

R With integrated interface

Tariffication

21 Energy rates, external rate control via control inputs
24 Energy rates, internal rate control via time switch (additionally possible via control inputs)
41 Energy and demand rates, external rate control via control inputs
44 Energy and demand rates, internal rate control via time switch (additionally possible via control inputs)

All versions with 3 control inputs and 2 output contacts

Additional functions

000x No extension board
060x 6 outputs
240x 2 control inputs, 4 outputs
326x 3 control inputs. 2 relays outputs, auxiliary power supply 12–24 VDC
420x 4 control inputs, 2 outputs
045x 4 outputs, auxiliary power supply 100–240 VAC/VDC
046x 4 outputs, auxiliary power supply 12–24 VDC

xxx0 No additional functions
xxx7 Load profile

Integrated interface (R-types only)

c1 RS232 interface
c2 RS485 interface
c3 CS interface
c6 RS422 interface

Series 3

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

Series designation S3 (Series 3) represents the newest hardware generation.

Firmware version

The firmware version and firmware checksum stored in the meter can be shown on the display or read out as IEC readout list, if parameterised accordingly (see section 5.7 "Data readout"). Specific meter characteristics are present or not depending on the firmware version.

2.4 Block schematic diagram

This section provides an overview of the function of SMA300xR meters based on a block schematic diagram.

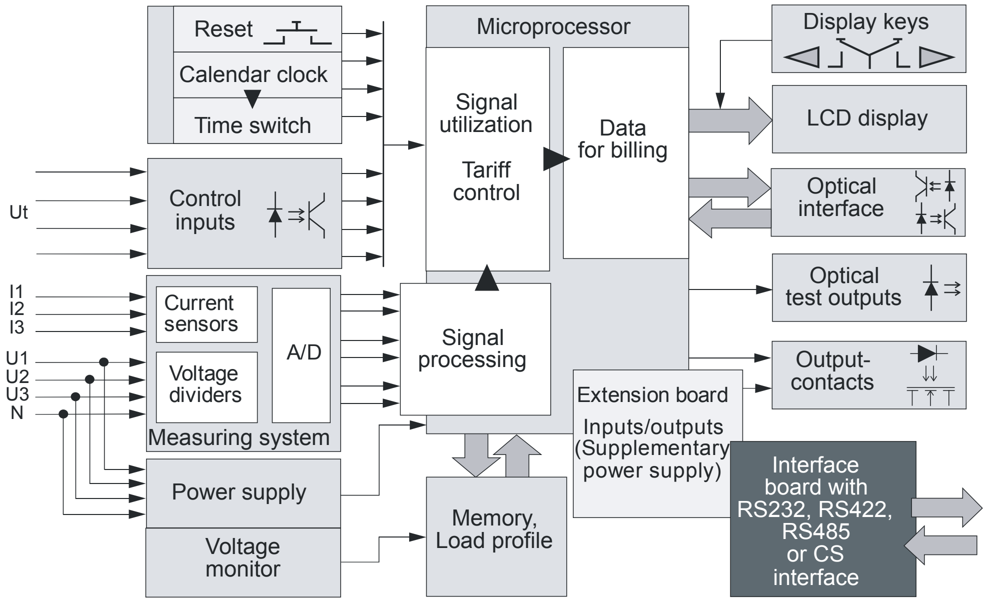


Figure 1 Block schematic diagram SMA300xR

The SMA300AR active energy meters record the imported and exported active energy consumption, while the SMA300CR combi-meters record the active and reactive energy consumption in all four quadrants.

The SMA300xR meters can be fitted with a maximum of one integrated communication interface (RS232, RS422, RS485 or CS) on the interface board.

Inputs

The main meter inputs are:

- Connections of phase voltages (U1, U2, U3), phase currents (I1, I2, I3) and neutral conductor N
  - for processing in the measuring system
  - for the three-phase power supply to the meter and voltage monitor
- Control inputs U_t (3 fixed, plus up to 4 others on extension board) for:
  - Changeover of energy and demand tariff rates
  - Resetting
  - Demand inhibition
  - Synchronizing

  Opto-couplers protect the internal circuitry from interference, which could otherwise enter via the control inputs.
- Keys
  - for display control (display keys, optical interface)
  - for resetting or service functions (reset key)

Outputs

The meter has the following outputs:

- LCD display with keys for local reading of billing data (single 8-digit display with additional information, such as energy direction, energy type, presence of phase voltages and identification number)
- Optical test outputs (red, 1 in active energy meters, 2 in combi-meters)
- Optional alert LED (red) to indicate alerts on the front face of the meter
- Static relay with freely parameterised signal assignment (2 fixed, plus up to 6 others on the extension board)
- Relay outputs with limited parameterised signal assignment due to limited life expectancy (up to 2 on the extension board)
- Optical interface for automatic local data acquisition by a suitable acquisition unit (handheld terminal)
- Communication interfaces of various kinds on the interface board (see also section 2.7 "Communication)

Measuring system

The input circuits (voltage dividers and current shunts with voltage transformer) record voltage and current in the individual phases. Analogue-digital converters digitise these values and feed them as instantaneous digital values via calibration stages to a signal processor.

Signal processing

The signal processor determines the following measured quantities from the instantaneous digital values of voltage and current for each phase and forms their mean value over one second:

- Active power per phase
- Reactive power per phase (combi-meters SMA300CR only)
- Phase voltages
- Phase currents
- Network (mains) frequency
- Phase angles

Signal utilisation

For signal utilisation in the various registers, the microprocessor scans the measured quantities every second to determine the following values:

- Active energy (sum and individual phases, separated according to energy direction, if required in the combi-meters SMA300CR also assigned to the 4 quadrants)
- Reactive energy (only for combi-meters SMA300CR, sum and individual phases, separated according to energy direction, assigned to the 4 quadrants)
- Apparent energy (only for combi-meters SMA300CR, sum and individual phases, separated according to energy direction)
- Power factor and displacement power factor cosφ (only for combi-meters SMA300CR, individual phases and mean value)
- Phase voltages
- Phase currents and neutral current
- Voltage and current unbalance
- Active and reactive power

- Direction of rotating field
- Total harmonic distortions of active energy, voltage and current

Rate control

Rate control is performed:

- Externally via control inputs (3 fixed, plus up to 4 others on the extension board)
- Externally via communication interfaces using formatted commands
- Internally by time switch and calendar clock
- 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:

- 32 for energy rates
- 27 for total energy
- 10 for running mean demand values
- 24 for demand rates
- 2 for power factors (combi-meters SMA300CR only)
- Up to 41 diagnostic registers
- Others for values of voltage and current, network frequency and phase angles

Memory

A non-volatile flash memory serves to record data profiles and also contains the configuration and parameterisation data of the meter and secures the billing data against loss due to 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 without the supply voltage having to be adjusted. A voltage monitor ensures correct operation and reliable data recovery in the event of a power failure and correct restarting when the voltage is restored.

Auxiliary power supply

For medium or high-voltage applications in particular, the measuring voltage can be switched off. Since the meter normally obtains its supply from the measuring voltage, it is also switched off and cannot be read. The auxiliary power supply connected in parallel with the normal power supply ensures operation of the meter free from interruption, so that it can be read at any time. The auxiliary power supply is situated on an extension board.

Extension board

The extension board is fitted inside the meter and is secured by the certification seals. It cannot be exchanged. It can have the following components:

- Up to 4 control inputs in combination with
- Up to 6 output contacts (solid-state relays)
- Up to 2 relays outputs
- An auxiliary power supply

Interface board

The interface board present in the SMA300xR meters is permanently fitted in the meter and therefore secured by the certification seal. Depending on the version, it contains:

- an RS232 interface,
- an RS422 interface,
- an RS485 interface or
- a CS interface

2.5 Measuring system

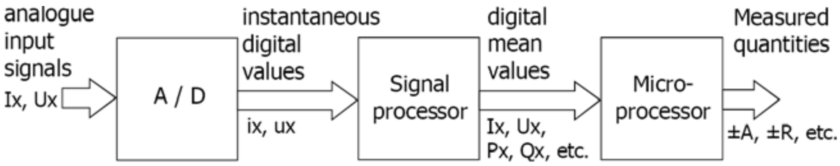


Figure 2 Block schematic diagram of measuring system

2.5.1 Input signals

The meter has the analogue current values I1, I2 and I3 and analogue voltage values U1, U2 and U3 available as input signals.

SMA300xR

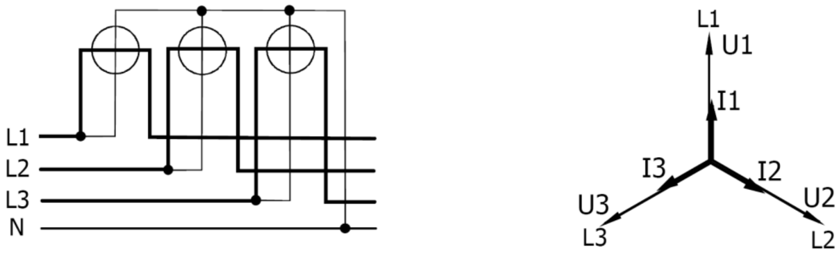


Figure 3 Type of measurement SMA300xR

Since the SMA300xR 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 U1–U2 and U1–U3.

Voltage input

High resistance voltage dividers reduce the voltages U1, U2 and U3 (58 to 240 V) applied to the meter to a proportionate amount of a few mV (U_U) for further processing.

Current input

Internal current transformers reduce the input currents I1, I2 and I3 to the meter (0 to 120 A) for further processing. The secondary currents of these current transformers develop voltages proportional to the input currents across resistors, also of a few mV (U_I).

2.5.2 Signal processor

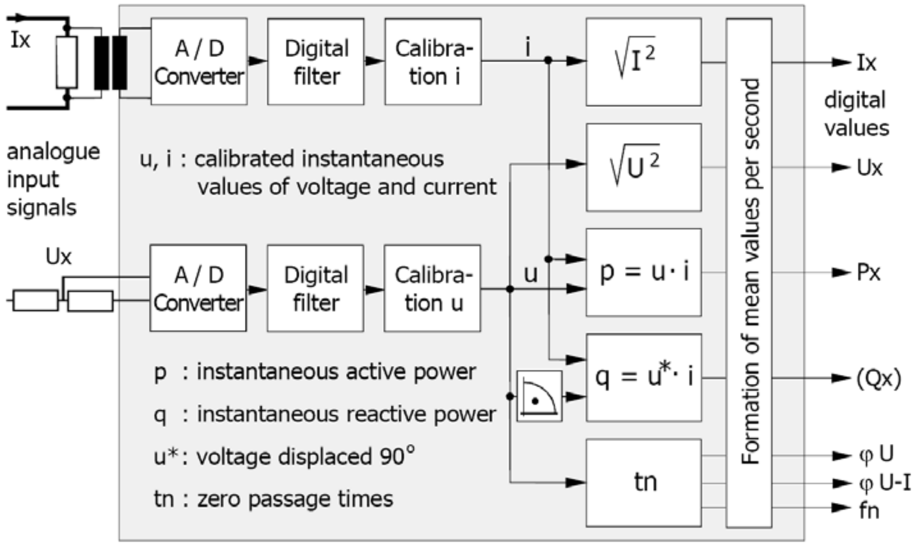


Figure 4 Principle of signal processor

SMA300AR active energy meters do not measure reactive energy.

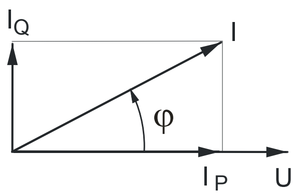
Digitizing

The analogue signals Ux and Ix are digitised in Sigma-Delta converters (analogue-digital converters with highest resolution) with a sample rate of 1.6 kHz and then filtered. A following calibration stage compensates for the natural errors of the voltage divider or current transformer, so that no further adjustment is necessary in the subsequent processing.

Calibrated digital instantaneous values of voltage (u) and current (i) for all three phases are then available as intermediate values for the formation of the required values in the signal processor.

Calculation of active power

The instantaneous value of active power p is produced by multiplying the instantaneous values of voltage u and current i (the active component corresponds to the product of voltage component with the current component parallel to the voltage). Thereby the harmonics up to 1 kHz are measured correctly.



Calculation per phase of

$$P = U \cdot I \cdot \cos\varphi$$

Figure 5 Active power calculation

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

Calculation of reactive power

There are two possibilities to calculate the instantaneous value of reactive power (SMA300Cx combi-meters only):

Measured:

For the instantaneous value of reactive power q the instantaneous value of voltage u must be rotated by 90° before multiplication (the reactive component is the product of the voltage component with the current component vertical to the voltage). Thereby no harmonics are measured since only the fundamental wave is rotated through 90°.

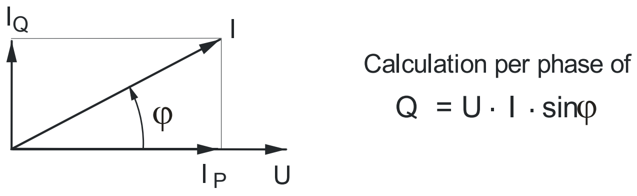


Figure 6 Reactive power calculation (method: measured)

Calculated vectorial (not recommended):

The instantaneous value of reactive power is calculated using the values of active power and apparent power.

The reactive power is the square root of the square value of apparent power minus the square value of active power. This method includes the harmonics.

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

U_{RMS}, I_{RMS} calculation

The square values of voltage and current are obtained by multiplying the instantaneous values of voltage and current by themselves. From these values the signal processor forms the corresponding single-phase RMS values U_{RMS} and I_{RMS}.

Time measurement

The network frequency can be calculated from the time measured between two zero passages (change from negative to positive value of voltage U1). The times between zero passage of the phase voltage U1 and those of the other phase voltages U2 and U3 serves to determine the phase angle between the voltages and of the rotating field.

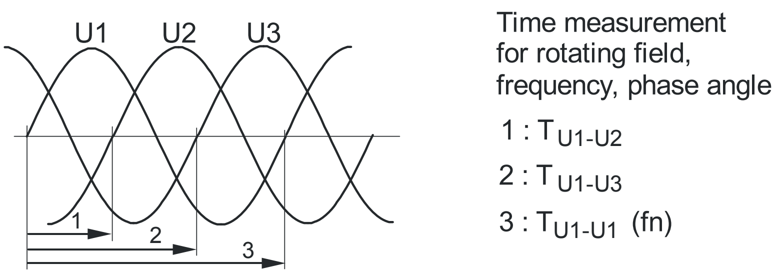


Figure 7 Time measurement

The phase angle between voltage and current is determined by the times between zero passage of the phase voltage U1 and those of the phase currents I1, I2 and I3.

Mean value formation

For further processing of the individual signal, the signal processor generates mean values over one second, which the following microprocessor scans at intervals of one second.

2.5.3 Measured quantities

Measured quantity		SMA300
Active energy in quadrant I	A (QI)	Sum / Phases
Active energy in quadrant II	A (QII)	Sum / Phases
Active energy in quadrant III	A (QIII)	Sum / Phases
Active energy in quadrant IV	A (QIV)	Sum / Phases
Active energy import	+A (QI+QIV)	Sum / Phases
Active energy export	–A (QII+QIII)	Sum / Phases
Active energy, absolute value	|+A|+|-A|	Sum / Phases
Active energy, absolute value	|+A|-|-A|	Sum / Phases
Active energy import summation	Σ +A	Sum
Active energy export summation	Σ -A	Sum
Active energy by single quantity	Σ |ALx|	Sum
Reactive energy in quadrant I	R (QI)	Sum / Phases
Reactive energy in quadrant II	R (QII)	Sum / Phases
Reactive energy in quadrant III	R (QIII)	Sum / Phases
Reactive energy in quadrant IV	R (QIV)	Sum / Phases
Reactive energy import	+R (QI+QII)	Sum / Phases
Reactive energy export	–R (QIII+QIV)	Sum / Phases
Reactive energy import	+R (QI+QIV)	Sum / Phases
Reactive energy export	–R (QII+QIII)	Sum / Phases
Reactive energy, combined	R (QI+QIII)	Sum / Phases
Reactive energy, combined	R (QII+QIV)	Sum / Phases
Reactive energy, absolute value	|+R|+|-R|	Sum / Phases
Reactive energy, absolute value	|+R|-|-R|	Sum / Phases
Reactive energy import summation	Σ +R	Sum
Reactive energy export summation	Σ -R	Sum
Apparent energy import	+S (QI+QIV)	Sum / Phases
Apparent energy export	-S (QII+QIII)	Sum / Phases
Phase voltages (RMS)		U1, U2, U3
Phase voltages (RMS)		U12, U23, U31
Phase currents (RMS)		I1, I2, I3
Neutral current	I0	yes
Network frequency	fn	yes
Active power	±P	Sum / Phases
Reactive power	±Q	Sum / Phases
Phase angle between voltages	φ U	U1-U2 / U1-U3*
Phase angle between voltage and current	φ U-I	U1-I1, U1-I2, U1-I3 * or U1-I1, U2-I2, U3-I3

Measured quantity		SMA300
Power factor	PF	Sum / Phases
Displacement power factor	cosφ	Sum / Phases
Voltage unbalance	Δ U	yes
Current unbalance	Δ I	yes
Direction of rotating field		yes
THD of active energy import	$+THD_A$	Sum
THD of active energy export	$-THD_A$	Sum
THD of active energy (percent)	THD_A [%]	Sum
THD of phase voltages (absolute)	THD_U	Phase 1, 2, 3
THD of voltage (percent)	THD_U [%]	Sum
THD of phase currents (absolute)	THD_I	Phase 1, 2, 3
THD of current (percent)	THD_I [%]	Sum

** Only if U1 is present.*

2.5.4 Formation of measured quantities

By scanning the mean values of active power P, and in combi-meters also reactive power Q 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 the measured values. The measured values are fed directly to the following registers to record the energy and the maximum demand (in combi-meters also of minimum power factor).

Active energy

The active energy 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 energy A1, A2 and A3 the micro-processor calculates the total active energy import +A or the total active energy export -A.

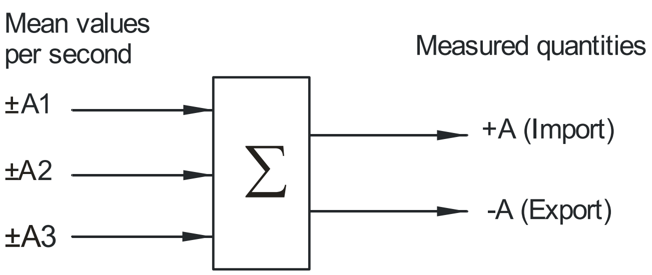


Figure 8 Total active energy

Reactive energy

The reactive energy values of the individual phases ±R1, ±R2 and ±R3 are obtained in the combi-meters directly from the mean values of reactive power Q1, Q2 and Q3. The reactive energy can therefore also be calculated vectorially (see 2.5.2).

By summating the mean values of reactive energy R1, R2 and R3, the microprocessor calculates the total positive reactive energy +R or the total negative reactive energy -R.

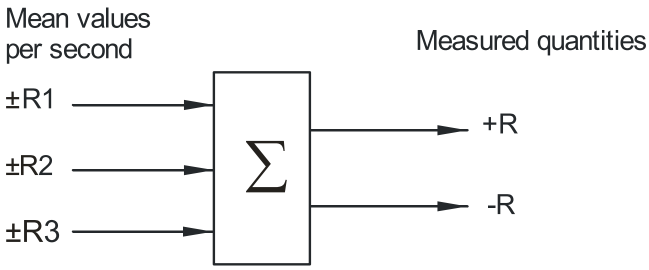


Figure 9 Total reactive energy

The microprocessor can allocate the reactive energy to the 4 quadrants in the combi-meters from the signs of R and A:

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

In the same way it can allocate the reactive energy of the individual phases to the 4 quadrants.

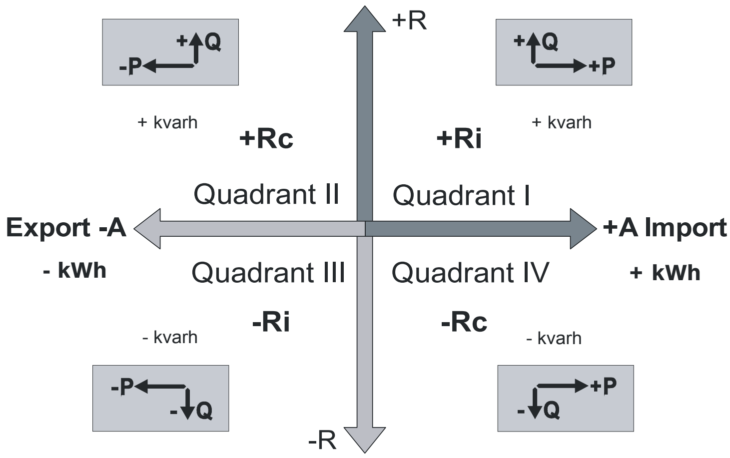


Figure 10 4-quadrant measurement

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

Apparent energy

The apparent energy is calculated in the combi-meters in two ways:

- by vectorial addition of the active and reactive energy 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 case).

Calculation method 1 (vectorial addition)

From the mean values A1, A2 and A3 and R1, R2 and R3 the microprocessor calculates the apparent energy of the individual phases ±S1, ±S2 and ±S3 as well as the total apparent energy ±S.

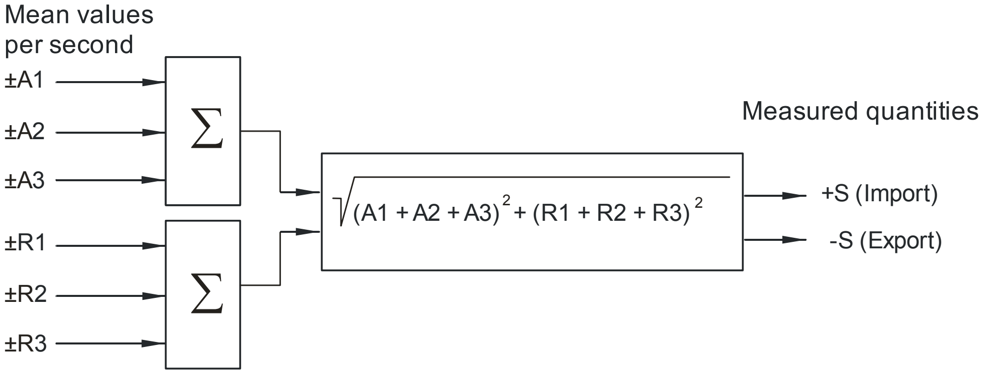


Figure 11 Total apparent energy according to calculation method 1

Only fundamental wave considered for reactive energy
Only the fundamental wave is considered for the calculation of the reactive energy share; possible harmonics are not taken into account.

Calculation method 2 (from rms values)

From the mean values $U1_{rms}$, $U2_{rms}$, $U3_{rms}$ and $I1_{rms}$, $I2_{rms}$, $I3_{rms}$ the microprocessor calculates by multiplication the apparent power of the individual phases ±VA1, ±VA2 and ±VA3 and summates these for the total apparent power ±VA.

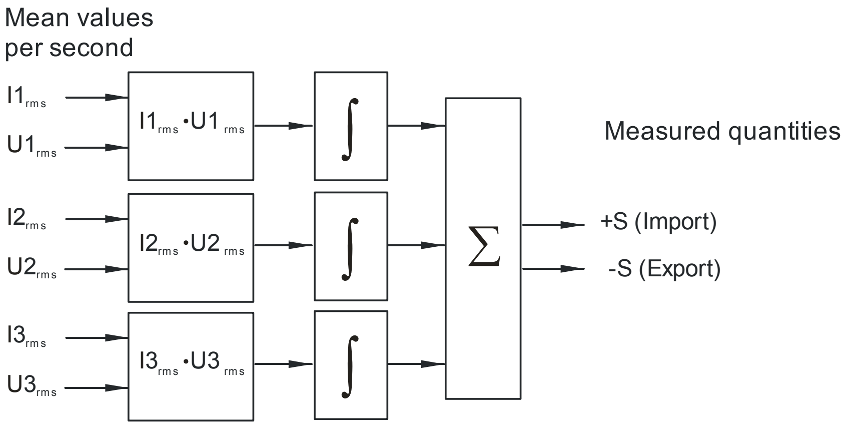


Figure 12 Total apparent power according to calculation method 2 (SMA300Cx combi-meters only)

Harmonics considered for reactive energy
As RMS values are used for the calculation of the apparent energy with calculation method 2, not only the fundamental wave but also the harmonics are taken into account. Therefore, if harmonics are present, the measured values are greater than those of calculation method 1.

Summation channels

The values of two measurement quantities can be added.

Power factor

The power factor (PF) is calculated in combi-meters as follows:

$$PF = \frac{P}{S}$$

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

The PF calculation includes harmonics versus the displacement power factor cosφ.

In case of high harmonic perturbations, the difference between PF and cosφ can be significant.

For instance, THD I ~50% involves PF 10% lower than cosφ.

Displacement power factor cosφ

The displacement power factor (dPF) cosφ is calculated in combi-meters as follows:

$$dPF_{Lxf} = \frac{P_{50hz}}{U_{50hz} I_{50hz}}$$

It takes into account only the fundamental wave versus PF that includes rms values.

Phase voltages

The rms values of the voltages $U1_{rms}$, $U2_{rms}$ and $U3_{rms}$ are obtained from the mean values of the squares of the voltages by extracting the root and directly from these the phase voltages U1, U2 and U3.

U12, U23 and U31 voltages are computed from U1, U2 and U3.

Voltage unbalance

The voltage unbalance is computed according to the ratio of the maximum difference between phase voltage maximum and averaged 3 phase voltage.

$$Voltage\ unbalance = \frac{Max(|U_{LxLy} - U_{AV}|)}{U_{AV}} * 100$$

$$U_{AV} = \frac{U_{L1L2} + U_{L2L3} + U_{L3L1}}{3}$$

Phase currents

The rms values of the currents $I1_{rms}$, $I2_{rms}$ and $I3_{rms}$ are obtained from the mean values of the squares of the currents by extracting the root and directly from these the phase currents I1, I2 and I3.

Current unbalance

The current unbalance is computed according to the maximum difference between maximum phase current and averaged 3 phase current.

$$Current\ unbalance = \frac{Max(|I_{Lx} - I_{AV}|)}{I_{AV}} * 100$$

$$I_{AV} = \frac{I_{L1} + I_{L2} + I_{L3}}{3}$$

Neutral current

The signal processor calculates the instantaneous neutral current i0 by adding the instantaneous phase currents i1, i2 and i3.

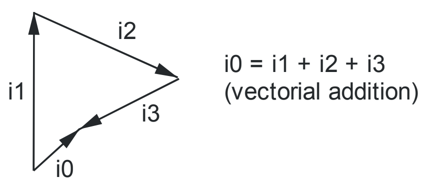


Figure 13 Neutral current I_0

Network frequency

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

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 U1 and current per phase from the times t_{U1-I1}, t_{U1-I2} and t_{U1-I3} between zero passages of the voltage U1 and the phase currents.

2 forms of representation are available for displaying the phase angle. These can be selected by parameterisation.

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

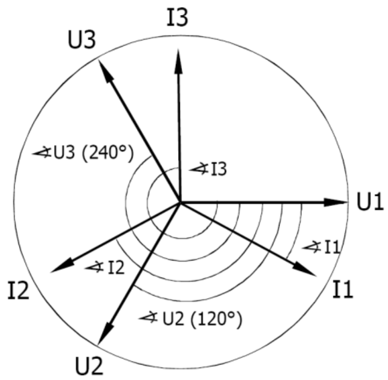


Figure 14 Phase angle case 1

Case 2: The voltage angles are displayed as in case 1. The angles of the currents are displayed, however, with reference to the associated phase voltage and can have values between -180° and +180°.

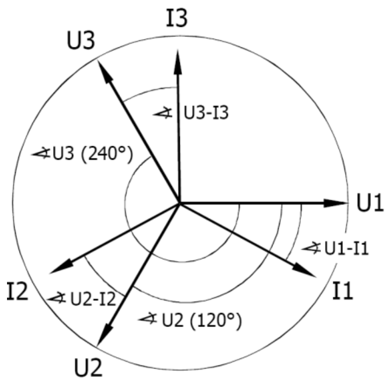


Figure 15 Phase angle case 2

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 harmonic distortion

The measuring system produces information about the total harmonic distortion of the active energy.

For that purpose, the voltages are fed through notch filters, which remove the fundamental wave.

Figure 16 Calculation of total harmonic distortion

In addition, the following absolute and relative THD values available:

- THD of active energy (relative to the nominal active energy)
- THD of phase voltages (absolute)
- THD of voltage (relative to the nominal voltage)
- THD of phase currents (absolute)
- THD of phase current (relative to the nominal current)

2.5.5 Summation channels

The values of two measurement quantities can be added. The added quantities must be of the same energy type (active, reactive or apparent). The sum is stored in a total energy register.

Energy registers which contain the summation of two measured quantities (summation channels) cannot be used for tariffication.

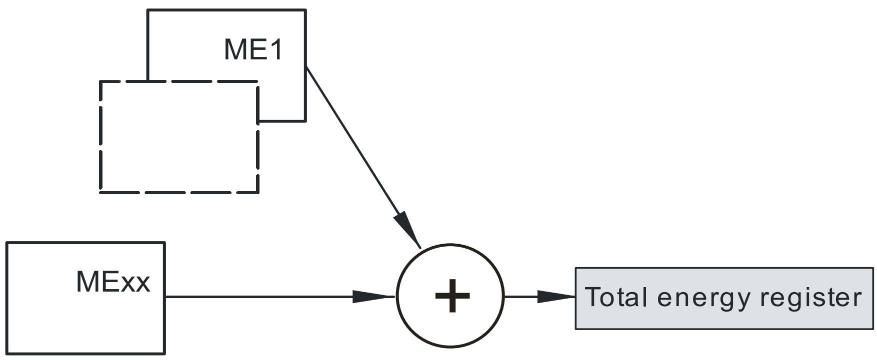


Figure 17 Summation channels

2.6 Data profile

A non-volatile memory (FLASH memory) contains the data of:

- the stored value profile
- the load profile 1
- the load profile 2 (optional)
- the event log
- the three groups of dedicated event logs

The flash memory stores data without data loss in case of voltage failures. No battery is required for this purpose.

The total size of the available memory for the stored billing value profile, the load profile(s), the event log and the dedicated event logs is 1.8 MB.

2.6.1 Stored value profile

At the end of the billing period, the meter stores the current value of the registers to the stored value profile. Which energy registers and/or demand registers are stored to the stored billing value profile can be selected by parameterisation.

Memory organisation The stored value profile is organised as a circular buffer, i.e. the oldest entry will be overwritten by the most recent entry. The memory capacity which is available for the stored value profile depends on parameterisation.

2.6.2 Load profile 1 and load profile 2 (option)

The load profiles are used to save the values of various registers at regular intervals. The measured values that are captured in the load profile can be selected by parameterisation.

Load profile 2 is optional
The second load profile is optional.
Please consult your sales representative for further details.

Profile 1 The first load profile is generally used for billing purposes. Its capture period has a range of 1...60 min. This load profile may also contain instantaneous values and detailed status information for data processing in central stations.

Profile 2 The second load profile can be used to store instantaneous values over a period which differs from the period of the first load profile. Apart from the differing capture period, the second load profile is identical with the first load profile.

Memory organisation The load profile is organised as a circular buffer, i.e. the oldest entry will be overwritten by the most recent entry. The memory capacity which is available for the load profile(s) depends on parameterisation. If both load profiles are activated, they share the memory capacity which is allocated to the load profile(s).

2.6.3 Event log

Events that occur sporadically are stored in the event log. The user may select which events trigger an entry in the event log. The event log is used to analyse the behaviour of the network as well as to supervise the correct function of the meter.

Memory organisation

In the event log, a maximum of 500 event entries can be stored. The individual entries consist of the time stamp and the event number. Additional information such as the error register or energy total registers can also be stored with every event.

The event log is organised as a circular buffer, i.e. the oldest entry will be overwritten by the most recent entry.

Dedicated event log

Network quality events, can be stored in the dedicated event log. The dedicated event log consists of three groups of logs.

- Over-voltage events
- Under-voltage events
- Missing voltage events

In the dedicated event logs, important information can be stored per entry such as:

- duration of the events
- extreme values of the events (not for missing voltage).
- instantaneous values
- maximum three energy registers

Additional information can be read from the header of the event logs, such as the longest entry, the shortest entry, the total number of occurrence and the total duration of the event.

Memory organisation

The dedicated event logs are organised as circular buffers, i.e. the oldest entry will be overwritten by the most recent entry.

List of events

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

Events which can be stored in the dedicated event log are marked in the corresponding column.

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)	
17	Under-voltage L1	x
18	Under-voltage L2	x

Number	Event	Entry in dedicated event log possible
19	Under-voltage L3	x
20	Over-voltage L1	x
21	Over-voltage L2	x
22	Over-voltage L3	x
23	Power down	
24	Power up	
25	Over-current L1	
26	Over-current L2	
27	Over-current L3	
28	Over-current neutral	
31	Power factor monitor 1	
32	Power factor monitor 2	
33-40	Demand monitors 1-8	
45	Error register cleared	
49	Missing voltage L1	x
50	Missing voltage L2	x
51	Missing voltage L3	x
55	Current without voltage L1	
56	Current without voltage L2	
57	Current without voltage L3	
58	Missing additional power supply	
59	All registers and profiles cleared	
63	Wrong phase sequence	
64	Correct phase sequence	
66	Invalid clock	
74	Backup memory access error	
75	Measuring system access error	
76	Time device access error	
77	Load profile memory access error	
79	Communication unit access error	
80	Display board access error	
81	Program checksum error	
82	Backup data checksum error	
83	Parameter checksum error	
84	Load profile checksum error	
85	Stored values checksum error	
86	Event log checksum error	
87	Calibration data checksum error	
88	Load profile 2 checksum error	

Number	Event	Entry in dedicated event log possible
89	Invalid start-up sequence	
93	Expired watchdog (general system error)	
94	Communication locked	
96	Wrong extension board identification	
104	Count registers cleared	
105	SMS delivery to GSM failed	
106	Alert occurred	
124	Compensation values changed	
128	Energy total and rate register cleared	
133	Terminal cover removed	
187	Terminal cover mounted	
193	Load profile 2 cleared	
201	Under-voltage L12	x
202	Under-voltage L23	x
203	Under-voltage L31	x
204	Over-voltage L12	x
205	Over-voltage L23	x
206	Over-voltage L31	x
207	Voltage unbalance	
208	Voltage unbalance disappeared	
209	Current unbalance	
210	Current unbalance disappeared	
211	Control input 1 set	
212	Control input 1 reset	
213	Control input 2 set	
214	Control input 2 reset	
215	Control input 3 set	
216	Control input 3 reset	
217	Control input 4 set	
218	Control input 4 reset	
219	Control input 5 set	
220	Control input 5 reset	
221	Control input 6 set	
222	Control input 6 reset	
223	Control input 7 set	
224	Control input 7 reset	

2.7 Communication

The SMA300xR meters have an optical interface for local communication via a readout head and, if required, via an integrated communication interface on the interface board for remote reading and for remote tariff control of the meter (RS232, RS422, RS485 or CS as selected).

Access via the communication interfaces is protected for specific access levels using the meter security system by means of passwords. If the monitoring is activated by corresponding parameterisation, communication is inhibited for a selected time (max. 24 h) after a selected number of password attempts with an incorrect password (max. 15). Monitoring takes place independent of all access levels with password protection and for the IEC W5 password.

The interface board is permanently fitted in the meter and cannot therefore be fitted retroactively or exchanged.

Versions

The following versions of interface boards are available in SMA300xR meters:

- **Interface board c1** with RS232 interface
- **Interface board c2** with RS485 interface
- **Interface board c3** with CS interface
- **Interface board c6** with RS422 interface

Optical interface

The optical interface to IEC 62056-21 is a serial, bi-directional interface. It is situated at top right on the main face plate (see also section 3 "Mechanical construction") and serves:

- for automatic local data recording by means of a suitable acquisition unit (hand-held terminal) (see section 5.7 "Data readout")
- for performing service functions, e.g. to input formatted commands (see section 5.8 "Input of formatted commands")
- 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 5.2.2 "Control of display via optical interface")
- for communication with a Landis+Gyr .MAP110 service tool or a Landis+Gyr MAP120 parameterisation tool.

RS232 interface

The RS232 interface on the interface board c1 is an asymmetric, serial, asynchronous, bi-directional interface. It serves:

- for the connection of an external modem (intelligent or transparent), e.g. for remote reading of meter data or performance of service functions from a central station
- for the provision of a direct connection to the RS232 interface of a computer.

The RS232 interface on the interface board c1 is only available as a version without control lines, and is for connection of an external modem with sufficient intelligence of its own.

RS485 interface

The RS485 interface on the interface board c2 is a serial bi-directional 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 initial values, time/date, etc.).

RS422 interface

The RS422 interface on the interface board c6 is a serial, symmetrical, asynchronous bi-directional interface according to ISO-8482.

Up to 10 locally installed meters can be connected via the RS422 interface (parallel 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 initial values, time/date, etc.).

CS interface

The CS interface on the c3 interface board 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 initial values, time/date, etc.).

Further information sources

More detailed information about Landis+Gyr communication solutions as well as advisory services are available from authorised Landis+Gyr representatives.

2.8 MAP software tools

There are two software tools available for parameterisation of the S650 meter and for communication with the meter: .MAP110 and MAP120

Areas of application

Figure 18 Application of MAP software tools

.MAP110

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

- Billing data readout
- Readout and export of profiles (load profile(s), stored values and event log, dedicated event logs)
- 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, communication parameters etc.
- Communication input settings
- Test SMS message transmission
- Analysis and diagnostic functions

MAP120

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

2.9 Anti-tampering feature

The following anti-tampering feature is available for SMA310xR meters:

- Terminal cover detection for the detection of situations when the terminal cover has been opened. This feature is a retrofit solution.

2.9.1 Terminal cover detection

Installed SMA300 meters can be equipped with a terminal cover detection unit. For this, they need to be parameterised and the unit – consisting of a switch which detects the removal of the terminal cover – has to be installed.

Whenever the retrofit terminal cover is removed, it detects the switch status change via control input 1 and enters event 211 in the event log with date and time. When the terminal cover is mounted again, event 212 is entered in the event log with date and time.

Please order terminal cover detection units – part number 74 766 0163 0 (minimum order quantity 10) – from:

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

For installation of the unit see section 4.6 "Installation of terminal cover detection".

3 Mechanical construction

This section describes the mechanical construction of the SMA300xR meter and shows the most common connection diagrams.

3.1 Housing

The internal construction of the meters is not described here, since they are protected following calibration and official certification on delivery by a manufacturer and certification seal. It is not permitted to open the meters after delivery. The front door is only secured with a utility seal and can be opened to operate the reset key, to change the battery and to exchange the tariff face plate with connection diagram.

The following drawing shows the meter components visible from outside.

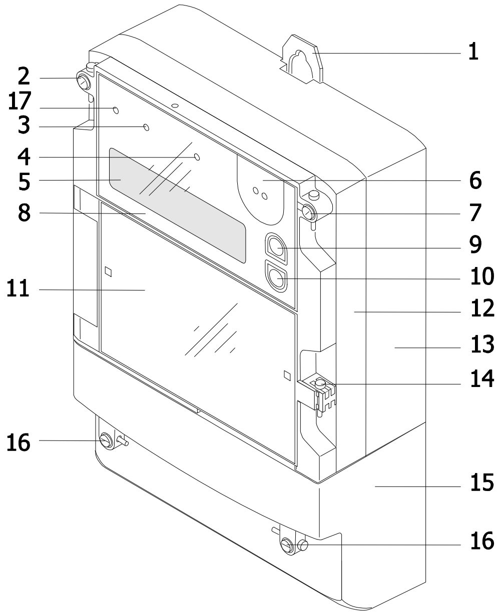


Figure 19 Meter SMA300xR

1	*Combined suspension hanger (open or concealed)*	*10*	*Display key "down"*
2	*Screw with manufacturer seal*	*11*	*Front door with tariff face plate*
3	*Optical test output reactive energy consumption (red), SMA300CR only*	*12*	*Upper part of case*
4	*Optical test output active energy consumption (red)*	*13*	*Lower part of case*
5	*Liquid crystal display (LCD)*	*14*	*Utility seal for front door*
6	*Optical interface*	*15*	*Terminal cover*
7	*Screw with certification seal*	*16*	*Terminal cover screws with plate utility seals*
8	*Front section with main face plate*	*17*	*Alert LED (optional)*
9	*Display key "up"*		

Case

The meter case is made of antistatic plastic (polycarbonate). The upper part of the case is provided with two transparent plastic viewing windows, affording a view of the main face plate (top) and the tariff face plate (bottom). The lower part of the case is additionally glass-fibre reinforced.

Viewing window

The upper viewing window with the main 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.

The lower viewing window is in the form of a hinged front door, secured with an utility seal. The tariff face plate with the connection diagram on the rear side, the battery compartment and the reset key are situated behind this front door.

Terminal cover

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

Front door

The front door must be opened to give access to the battery compartment, reset key and tariff face plate.

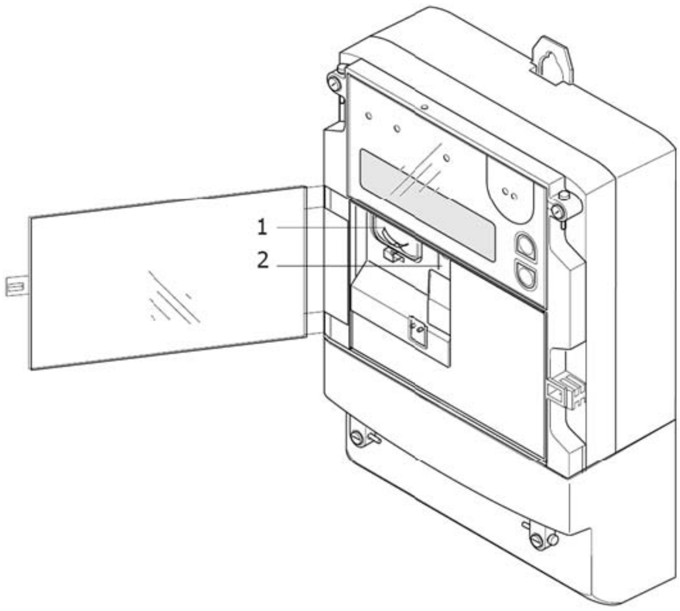


Figure 20 Meter with front door open

1	*Battery compartment*
2	*Reset key R*

Seal component

An additional component, which is easy to install, allows the use of a standard padlock instead of a utility seal.

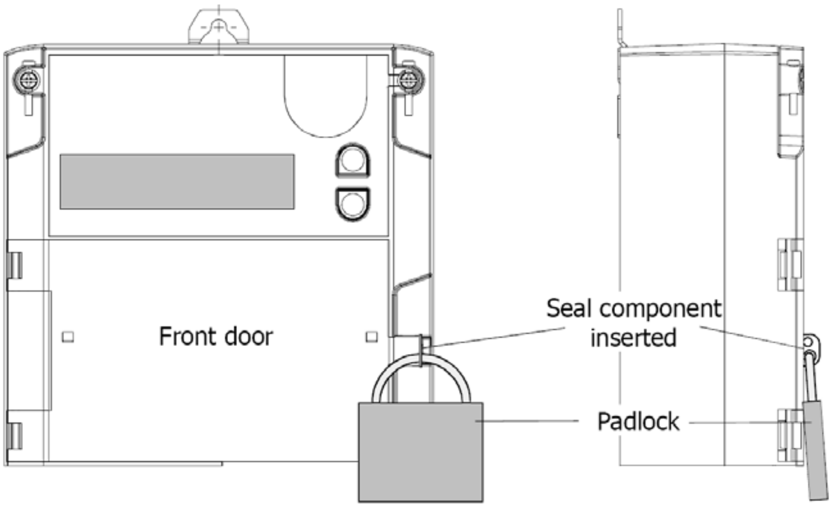


Figure 21 Front door sealing using a padlock

The seal component is stowed away in a holder under the front door when not in use.

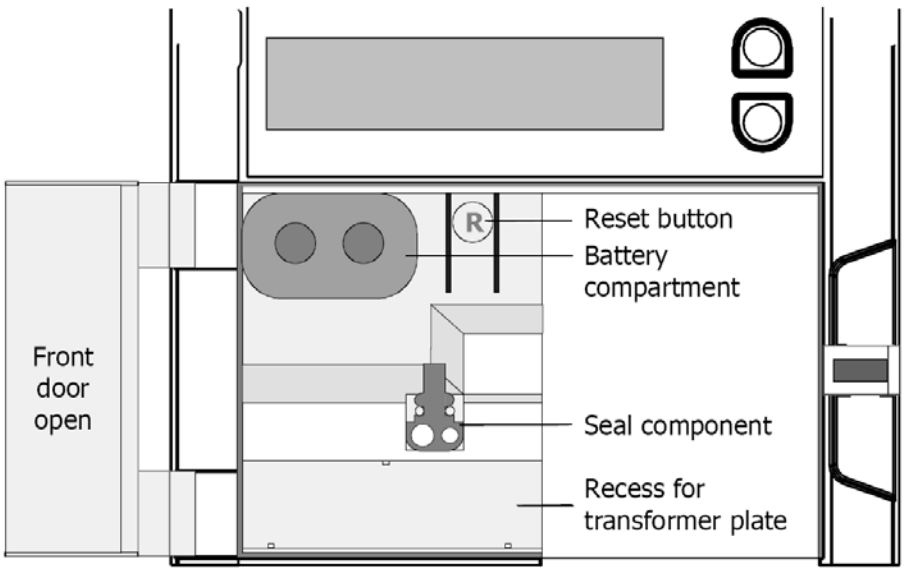


Figure 22 Stowage of seal component when not in use

The seal component is installed as follows:

- Slide the seal component into the vertical slot at an angle, as shown, (position 1) until it contacts the rear wall.
- Now turn the seal component until it is horizontal and slide it down into position 2 as illustrated. The two bulges firmly fix the seal component into the lateral grooves.

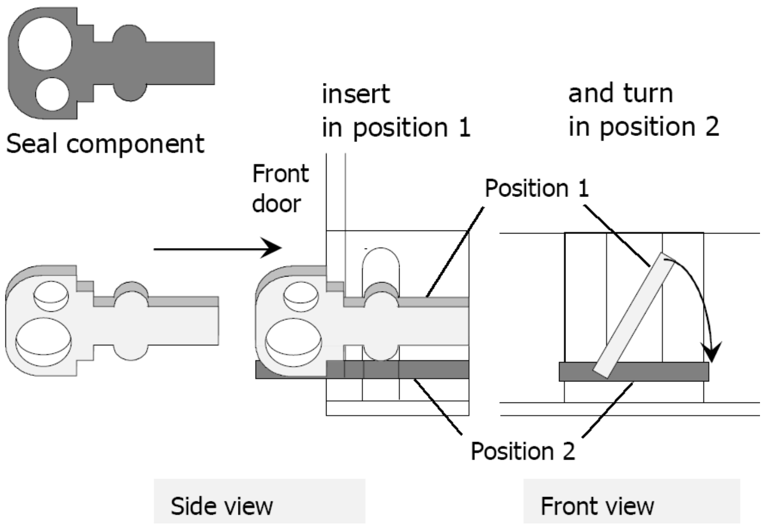


Figure 23 Seal component for use with padlock

3.2 Face plates

The face plate is divided into two parts and is designed to customer specifications. It contains all relevant data about the meter.

Main face plate

The main face plate is situated behind the plastic viewing window, which is secured by a certification seal. Recesses permit operation of the display keys "down" and "up" for control of the liquid crystal display.

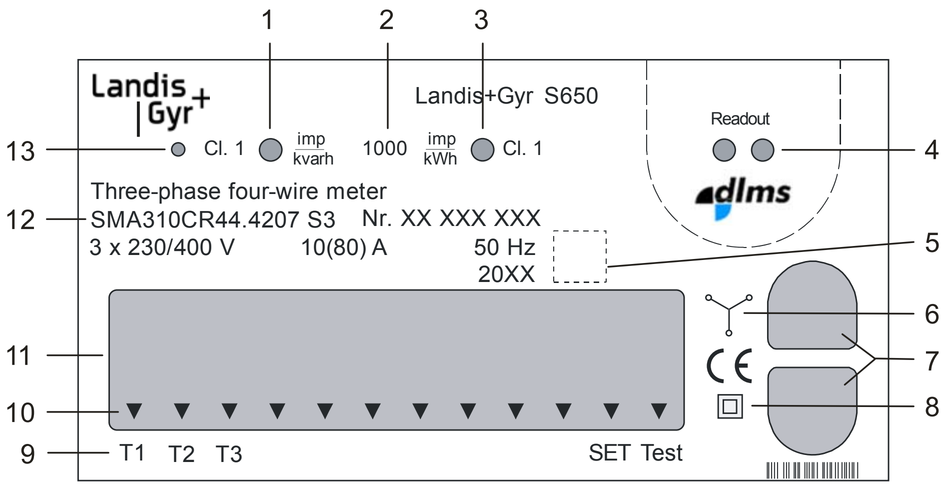


Figure 24 Main face plate (example SMA310CR)

1 Optical test output reactive energy (with accuracy class – SMA300CR only)
2 Meter constant R1 (referred to primary values) or R2
3 Optical test output active energy (with accuracy class)
4 Optical interface
5 Approval symbol
6 Type of connection
7 Display key "up"/Display key "down"
8 Symbol for double protective insulation
9 Status indication
10 Arrows for present status indication
11 Liquid crystal display (LCD)
12 Meter data (type designation, serial number, rated values, year of construction)
13 Alert LED (optional)

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

Tariff face plate

The tariff face plate is placed in the front door, which can be swung out sideways to the left and is secured by a utility seal. The connection diagram of the meter is shown on the back of the face plate and is therefore visible with the front door open.

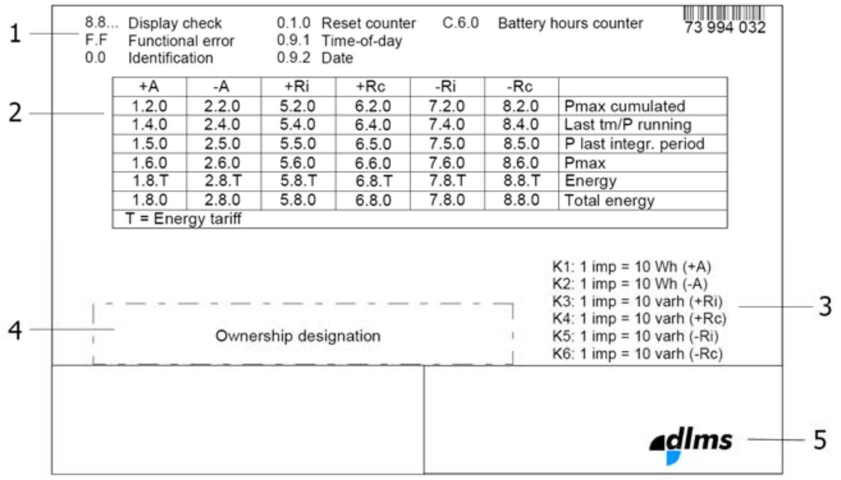


Figure 25 Tariff face plate (example SMA310CR)

1 General data appearing in the display
2 Measured quantities
3 Output contact data
4 Ownership designation
5 dlms symbol (if interface IEC and dlms supported)

3.3 Connections

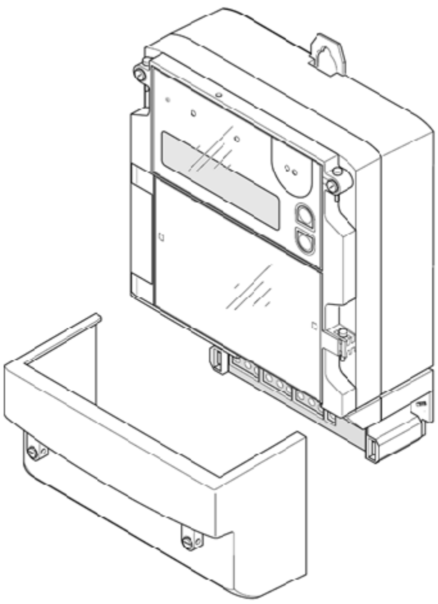


Figure 26 Meter with terminal cover removed (example SMA300CR)

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

Terminal layout (example SMA300xR)

The top row of terminals (level 1) consists of spring-loaded terminals and comprises

- Extension board terminals on the left
  Depending on the version, up to 4 control inputs or 6 output contacts, 3 digital inputs and 2 relays outputs or a combination of these with maximum 6 inputs and outputs, or voltage connections for a separate supply.
- Interface board connections on the right – if present.
  There is either a spring-loaded terminal (CS interface) or an RJ12 double jack (RS232, RS422 or RS485 interface). If no interface is present, a dummy circuit board provides dust protection.

The centre row of terminals (level 0) likewise consists of spring-loaded terminals and comprises

- Voltage outputs U1, U2, U3 and N, tapped from the relevant phase input
- 3 fixed control inputs with a common return line G (electrically isolated)
- 2 output contacts for transferring fixed valence pulses or control signals (electrically isolated)

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.

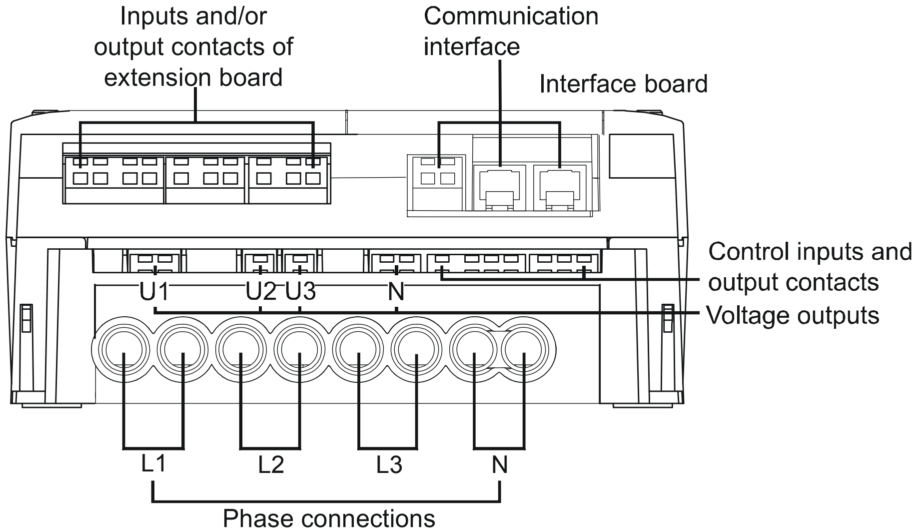


Figure 27 Terminal layout SMA300xR

3.4 Connection diagrams (examples)

Binding connection diagrams
The following connection diagrams should be considered examples. The connection diagrams provided at the rear of the front door and visible when the door is open are always binding for the installation.

SMA300xR for three-phase four-wire networks

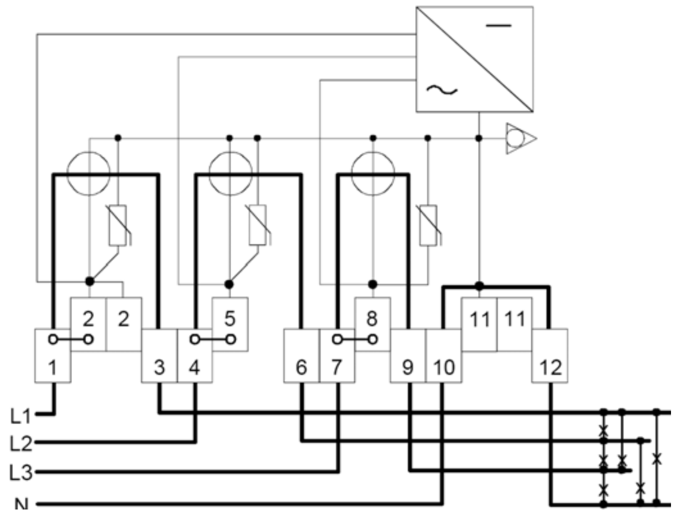
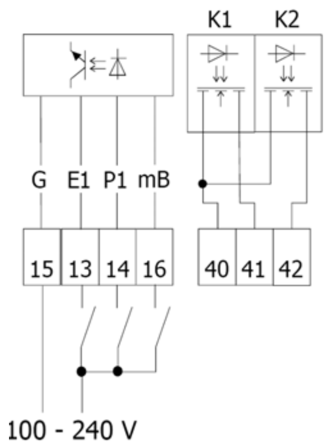


Figure 28 Connection diagram of measuring unit SMA300xR

Control inputs / output contacts



Basic version:

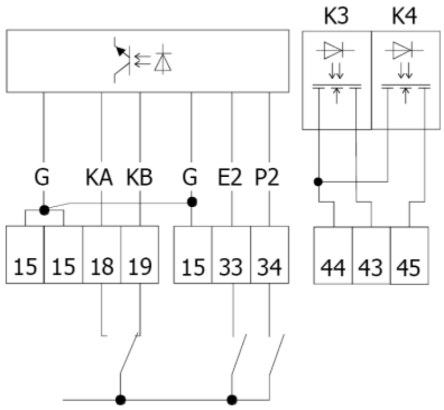
3 control inputs

2 output contacts (solid-state relays)

Signal allocation and numbering of terminals for free parameterisation

Figure 29 Connection diagram fixed control inputs/output contacts

Extension board 4200



Extension board 4200:

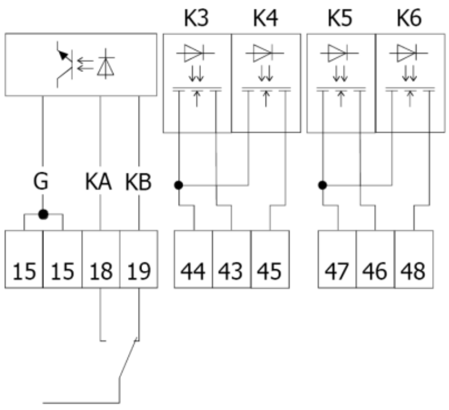
4 control inputs

2 output contacts (solid-state relays)

Signal allocation and numbering of terminals for free parameterisation

Figure 30 Connection diagram extension board with 4 control inputs and 2 output contacts

Extension board 2400



Extension board 2400:

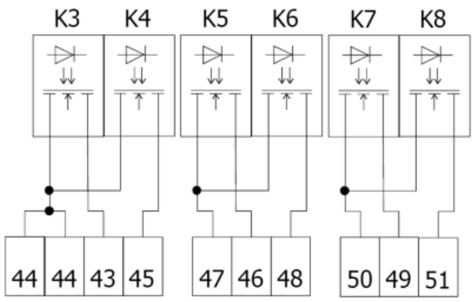
2 control inputs

4 output contacts (solid-state relays)

Signal allocation and numbering of terminals for free parameterisation

Figure 31 Connection diagram extension board with 2 control inputs and 4 output contacts

Extension board 0600



Extension board 0600:

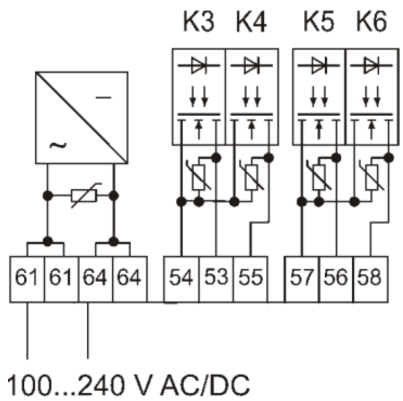
no control inputs

6 output contacts (solid-state relays)

Signal allocation and numbering of terminals for free parameterisation

Figure 32 Connection diagram extension board with 6 output contacts

Extension board 0450



Extension board 0450:

with auxiliary power supply

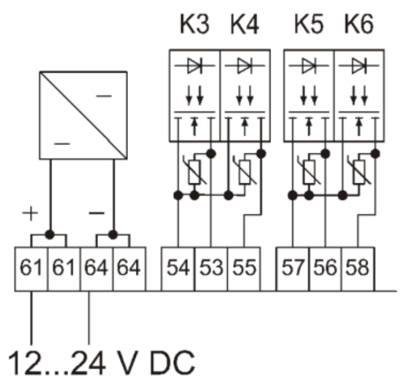
no control inputs

4 output contacts (solid-state relays)

Signal allocation and numbering of terminals for free parameterisation

Figure 33 Connection diagram extension board with auxiliary power supply and 4 output contacts

Extension board 0460



Extension board 0460:

with auxiliary power supply

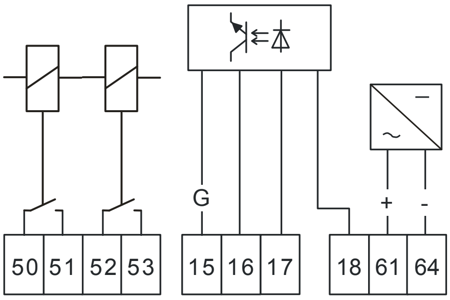
no control inputs

4 output contacts (solid-state relays)

Signal allocation and numbering of terminals for free parameterisation

Figure 34 Connection diagram extension board with auxiliary power supply and 4 output contacts

Extension board 3260



Extension board 3260:

with auxiliary power supply

3 control inputs

2 relay outputs (8 A)

Signal allocation and numbering of terminals for free parameterisation

Figure 35 Connection diagram extension board with auxiliary power supply, 3 control inputs and 2 relay outputs

Interface boards

No schematic symbol is shown on the connection diagram for the following interface boards:

- Type c1 (RS232)
- Type c2 (RS485)
- Type c6 (RS422)

The following schematic symbol is shown for type c3 (CS) interface boards on the connection diagram:

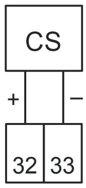


Figure 36 Schematic symbol of CS interface (example)

Ground terminal connection
Please note that the Ground terminal (G) of the control inputs on the extension boards is NOT internally connected to the Ground terminal on the base. If the Ground level is the same, then an external wire must be connected between the two Ground terminals.

3.5 Dimensions

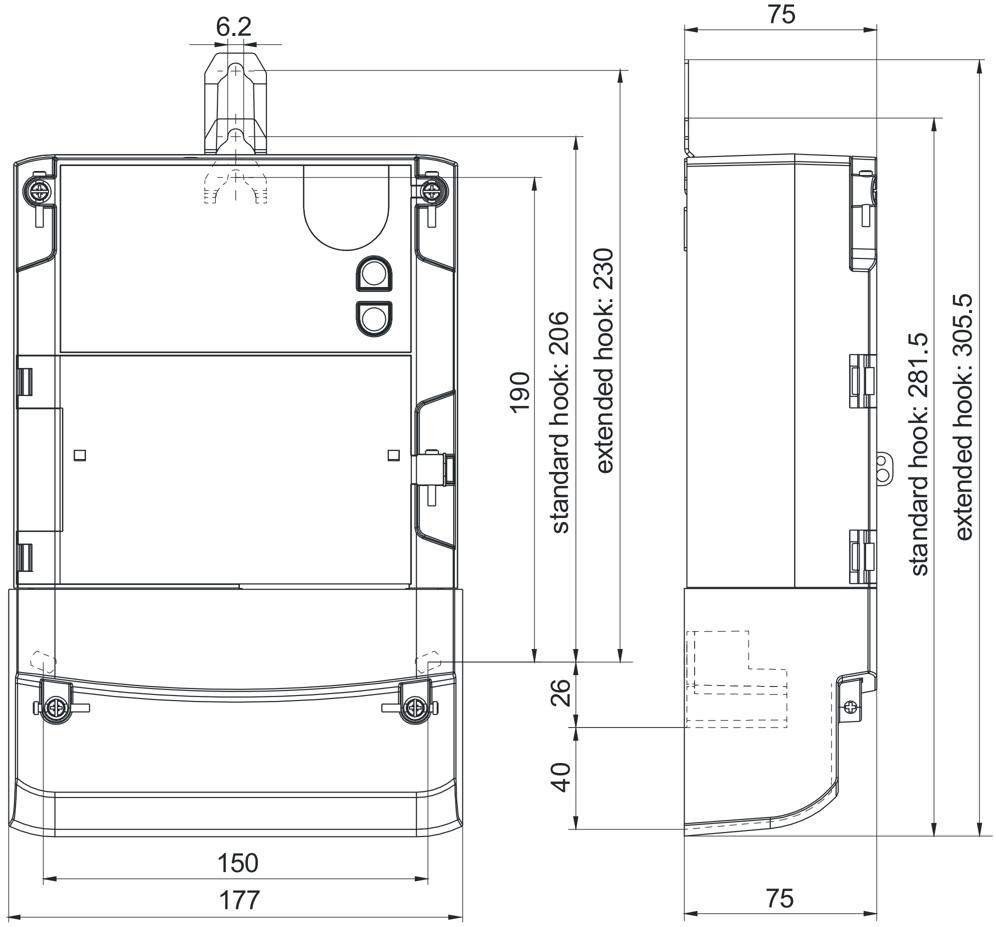


Figure 37 Meter dimensions (Standard terminal cover)

4 Installation and de-installation

This section describes the installation and connection of meters for direct 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 circuits whenever possible for connecting the meter to the various voltage levels.

4.1.1 Connection with 3 phases and neutral

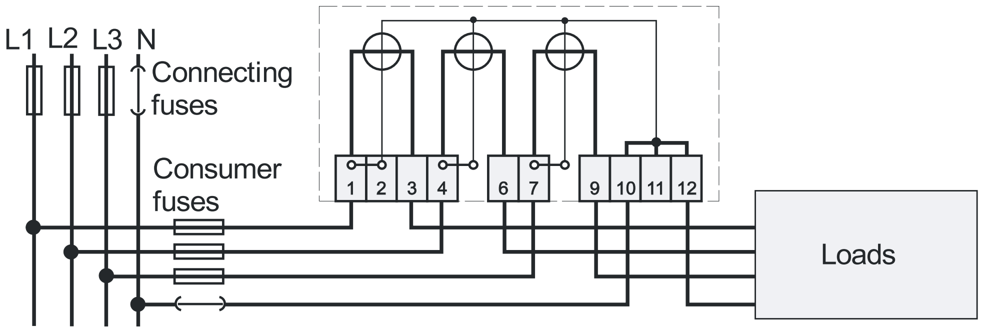


Figure 38 Connection with 3 phases and neutral

Neutral

The neutral is normally looped through terminals 10 and 12. Some power supply companies, however, make a simple connection between terminal 10 or 12 and the neutral. This avoids possible contact errors in the neutral conductor.

4.1.2 Connection with 3 phases without neutral (Aron circuit)

A version SFA300xR for the rarely encountered three-phase networks without neutral with 3 x 230 V is not available.

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 supply 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.

When you have identified the correct meter position for mounting the meter, it should be mounted as follows on the meter board or similar device provided for this purpose:

1. 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

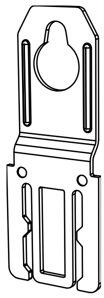


Figure 39 Extended suspension hook for installations with 230 mm suspension triangle height

2. 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 into place.

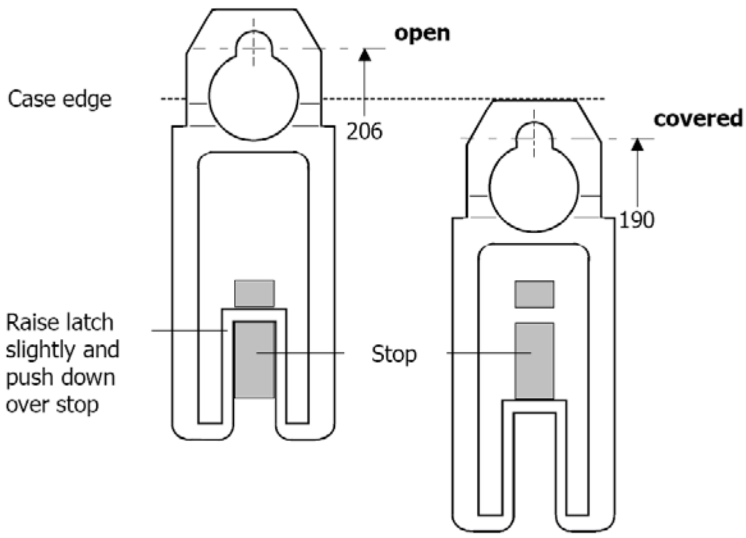


Figure 40 Positioning of meter suspension eyelet

3. Check with a phase tester or universal measuring instrument whether the connecting wires are live. If so, remove the corresponding supply fuses and keep them in a safe place until installation is completed, so that they cannot be replaced by anyone unnoticed. 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.
4. In case there are no holes provided, e.g. as in the case with the 230 mm suspension triangle: Mark the three fixing points (suspension triangle as in 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 covered mounting = 190 mm

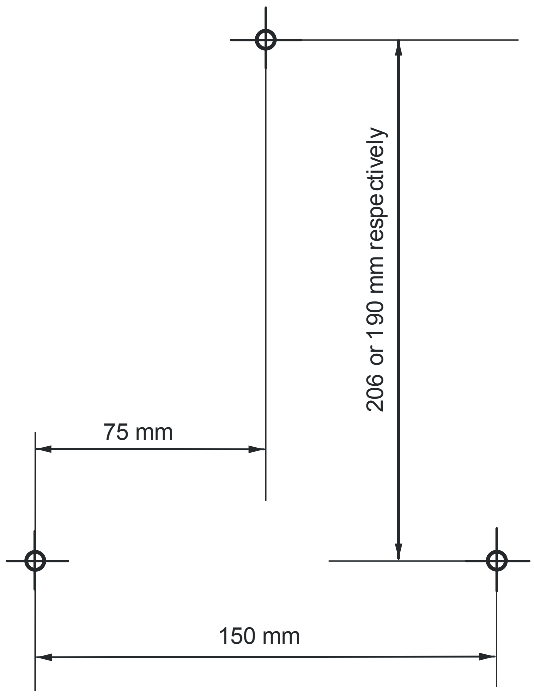


Figure 41 Drilling plan

5. Drill the three holes for the fixing screws.
6. Unscrew the meter terminal cover.
7. Fit the meter with the three 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 installation of the meter. Contact with live components is dangerous to life. The relevant supply 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.

Connecting conductor cross-section
SMA310CR meters with a maximum current of 100 or 120 A require connecting conductors of 35 mm² cross-section. Owing to the terminal opening of 9.5 mm, only cable is possible.

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

1. Check with a phase tester or universal measuring instrument whether the connecting wires are live. If so, remove the corresponding supply fuses and keep them in a safe place until installation is completed, so that they cannot be replaced by anyone unnoticed.

4.3.1 Connecting the phase connection lines

1. Shorten the phase connecting wires to the required length and then strip them.
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 3 to 5 Nm).

   With small conductor cross-sections (e.g. 4 mm²) the connecting line must be placed in the indentation (stamping) of the current loops, so that it cannot shift sideways when tightening the terminal screws. Ensure that the connecting line remains in the indentation when tightening.

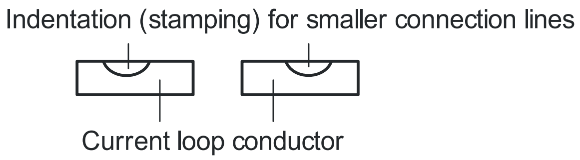


Figure 42 Cross-section through current loop conductor

If smaller connection lines are used, it's possible to adapt the cable section with terminal holes using "assembling aids" or "centering parts" in order to have a safe connection:

- P000225650 (x100 pcs) – 8.5 mm
- P000172980 (x100 pcs) – 9.5 mm

Please contact your sales representative for ordering.

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.

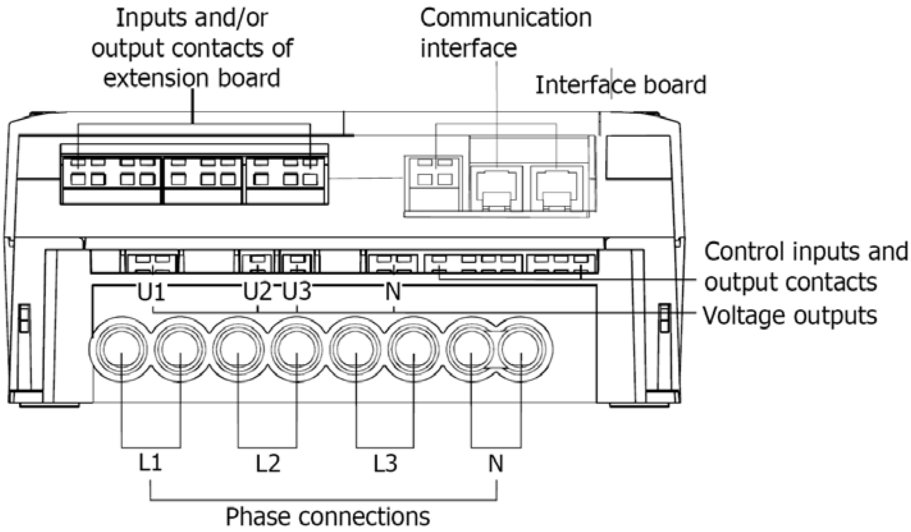


Figure 43 Meter connections (example SMA300xR)

Power losses at the terminals
Insufficiently tightened screws at the phase connections can lead to increased power losses at the terminals and therefore to undesirable heating. A contact resistance of 1 mΩ causes a power loss of 10 W at 100 A!

4.3.2 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 a 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).

Use ferrules with stranded wires
If stranded wire is used, provide it with ferrules for connection.

2. Connect the connecting wires of the signal inputs and outputs as follows to the screwless spring-loaded terminals (the terminals are numbered as shown on the connection diagram):
   - Insert a size 1 screwdriver in the upper opening and insert it turning slightly upwards (figure 44 A).
   - Now place the stripped connecting wire in the lower opening and hold it there securely (figure 44 B).
   - Withdraw the screwdriver. The connecting wire is then firmly fixed (figure 44 C).

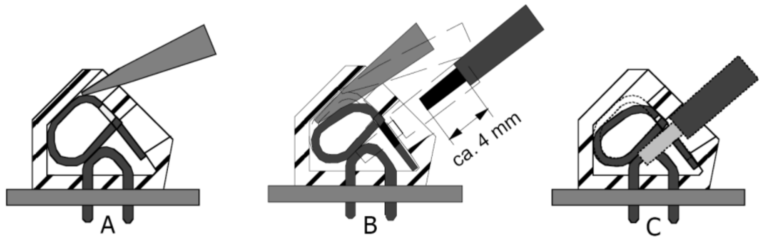


Figure 44 Connection in screwless spring-loaded terminals

Bare end of connecting wire must not be too long
The insulation of the connecting line must extend as far as the terminal indentation, i.e. there must be no further bare part of the connecting line visible above the terminal edge (as shown in figure 44 C). Touching live parts is dangerous to life. The stripped part of the connecting wire should be shortened if necessary.

Only one wire or ferrule per terminal
Only one wire or ferrule with strand(s) may be connected in screwless spring-loaded terminals. The terminal could otherwise be damaged or the contact not properly made.

If a connecting wire must be disconnected again for any reason, this is performed in the reverse sequence:

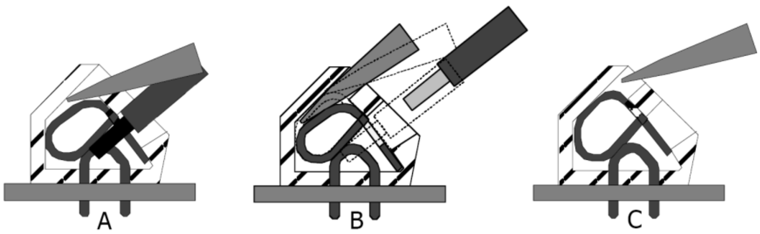


Figure 45 Releasing connection from spring-loaded terminal

Damage to terminals
Never withdraw connecting wires with the terminal closed, since this could damage the terminal.

4.3.3 Connecting the RS485 interface

If you connect the RS485 interface you must not strip back the shielded cables, e.g. to connect the individual wires to an external terminal block (see figure below), as this considerably increases the likelihood of interference.

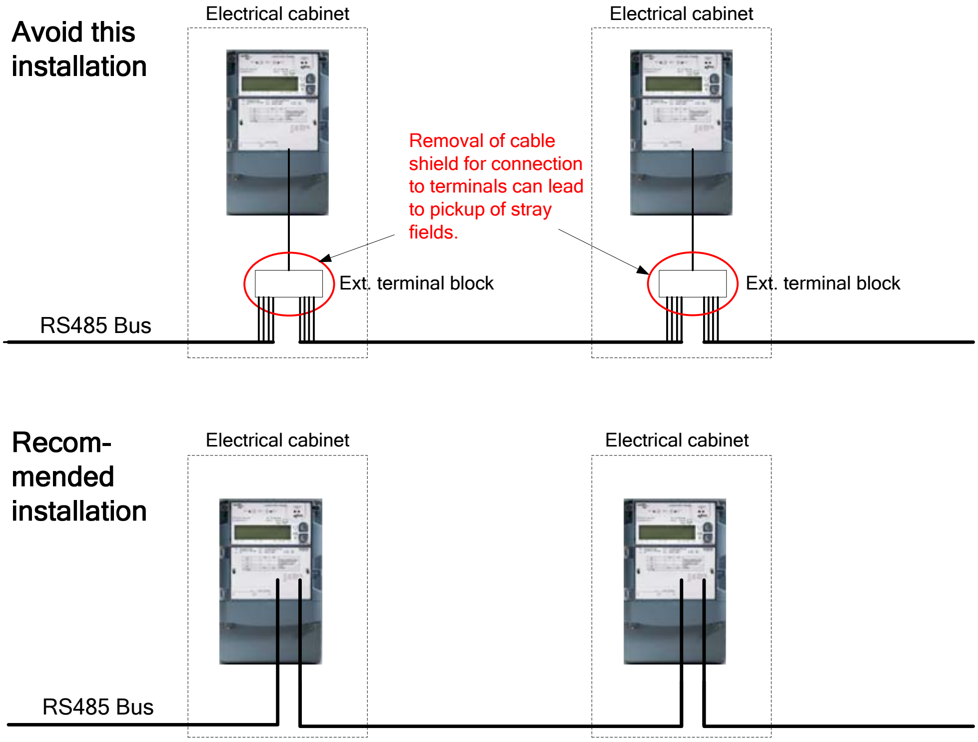


Figure 46 How to connect RS485 correctly

It is also possible to use RS485 distributors instead of connecting the RS485 cables directly to the meter.

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 supply fuses must be re-inserted 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 supply 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.

Prerequisites for commissioning and functional check
If no mains voltage is present, commissioning and functional check must be performed at a later date.

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

1. Insert the supply fuses removed for installation. The meter is switched on.
2. Check whether the operating display is correct (no error message).
3. Check on the display whether all three phases L1, L2 and L3 are indicated and show the right phase sequence.
   - If one phase is not present or less than 20 V, then the relevant symbol is absent.
   - With the normal phase sequence L1-L2-L3 the symbols are displayed continuously.
   - If, however, the meter is connected with reversed phase sequence (e.g. L2-L1-L3) the symbols flash. The direction of field rotation (clockwise or anticlockwise) is determined by the parameterisation. This has no influence on the measuring behaviour of the meter.

Figure 47 Phase sequence indication

4. Remove all supply fuses.
5. Insert the supply fuse of phase 1 and check the display of the energy direction: +P to right. If the energy direction arrow P points to the left, the input and output of phase 1 are interchanged. If the meter displays no energy direction, the calibration link is open, the supply fuse is defective or the neutral is not connected.
6. Remove the supply fuse of phase 1 again.
7. Repeat the same test for the other phases as in points 5 and 6.
8. You can now check further values such as phase voltages. This is preferably done with .MAP110 or, if parameterised, via the service list, which you can reach via the service menu.
9. Check the tariff displays and switch the control voltages to the tariff inputs on and off. The arrow symbols of the tariff display must change.

10. If the meter is connected to a meter readout system via the electrical interface, check the data transmission.
11. If a DC450 is connected to the meter through RS485, the alarm transmission function should be checked by simulating an alarm and check the HES takes into account.
12. Mount the terminal cover if the meter is operating correctly. Otherwise first locate and eliminate the error.
13. Seal the terminal cover with two utility seals.
14. Set the current date and time with the relevant formatted command (see section 5.8 "Input of formatted commands") or in the set mode (see section 5.9 "Set time and date, ID numbers, battery time").
15. Close the front door.
16. Re-seal the front door.

4.6 Installation of terminal cover detection

1. Ensure that control input 1 has been parameterised for this function.
2. Connect cables 1 and 2 to terminal according to the figure below.

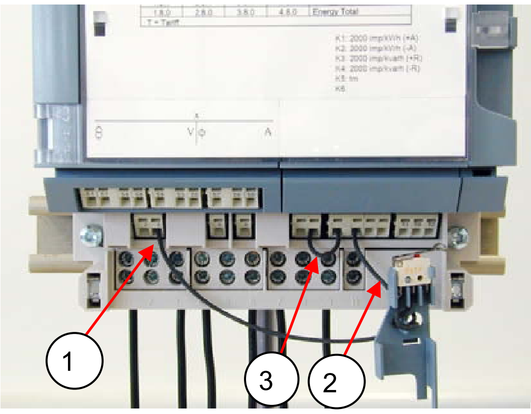


Figure 48 Connection of cables of cover detection unit

3. Fix terminal cover detection unit to meter. See figure below.

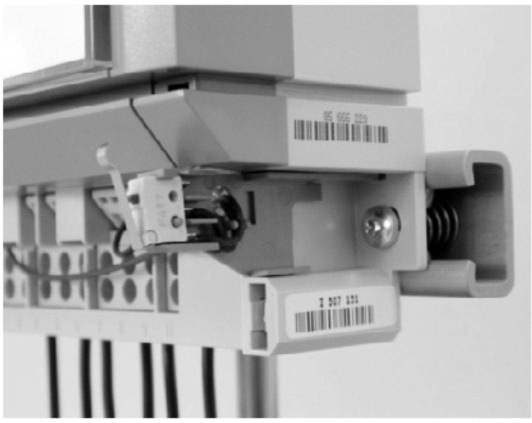


Figure 49 Fixing of cover detection unit to meter

4. Connect cable 3 as shown above.

4.7 De-installation

Dangerous voltage on conductors
The connecting wires at the place of installation must not be live when removing the meter. Touching of live parts is dangerous to life. Remove the corresponding supply fuses and keep these in a safe place until work is completed, so that they cannot be replaced by anyone unnoticed.

The meter should be removed as follows:

1. Remove the two utility seals at the screws of the terminal cover.
2. Release the two screws of the terminal cover and remove it.
3. Check that the connecting wires are not live using a phase tester or universal measuring instrument. If they are live, remove the corresponding supply fuses and keep these in a safe place until work is completed, so that they cannot be replaced by anyone unnoticed.
4. Remove the connecting wires of the signal inputs and outputs from the screwless spring-loaded terminals as follows:
   – Place a size 1 screwdriver in the upper opening and insert it turning slightly upwards (figure 50 A).
   – Then draw the wire from the lower opening (figure 50 B).
   – Withdraw the screwdriver (figure 50 C).

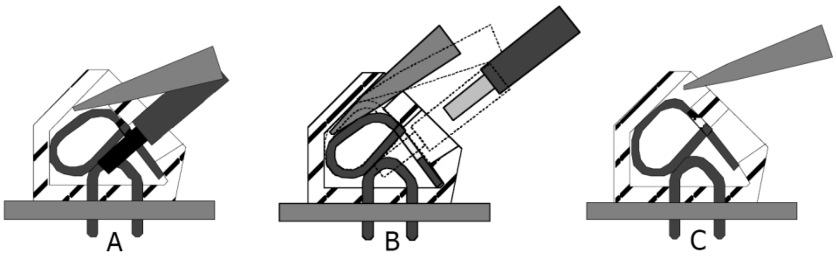


Figure 50 Removing connections in screwless spring-loaded terminals

Damage to terminals
Never withdraw connecting wires from closed terminals. The terminals could be damaged.

5. Release the terminal screws 1, 3, 4, 6, 7, 9, 10 and 12 of the phase connecting wires with a suitable screwdriver and withdraw the phase connecting wires from the terminals.
6. Fit a substitute meter as described in section 4.3 "Connecting meter" and the following sections.

5 Operation

This section describes the location and function of all operating elements and displays of the S650 SMA300xR meters as well as operating sequences.

Illustrations
The illustrations of the face plate and display in this section always show the SMA300CR combimeter (with additional optical test output for reactive energy, together with direction of reactive power and quadrant display).

5.1 Operation with auxiliary power supply

Meters equipped with an auxiliary power supply which is supplied with electricity (see section 3.4 "Connection diagrams (examples)") are completely functional even in case of a power cut. Despite missing voltage at the terminals they can be read out via display, remote readout etc. and parameterised, if desired.

Connect the auxiliary power supply as follows:

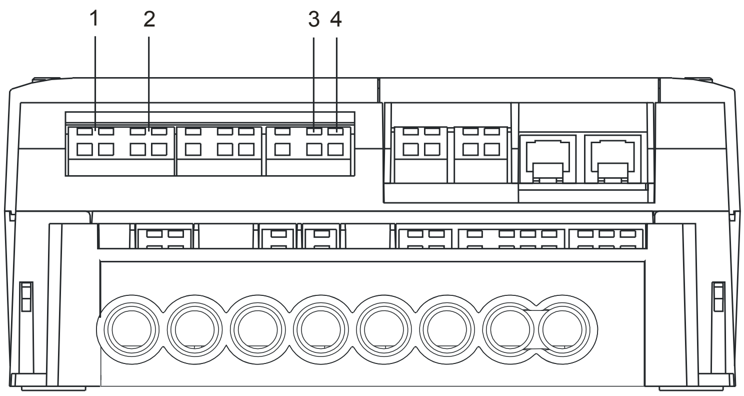


Figure 51 Auxiliary power supply connections
Type 045x: 1 and 2: 100–240 V AC/DC
Type 046x: 1: + (12–24 V DC)
Type 046x: 2: – (12–24 V DC)
Type 326x: 3: + (12–24 V DC)
Type 326x: 4: – (12–24 V DC)

5.2 Control elements

S650 meters have the two display keys "down" and "up" 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.

5.2.1 Display keys

The two display keys "down" and "up" are placed on the main face plate (top) on the right of the liquid crystal display.

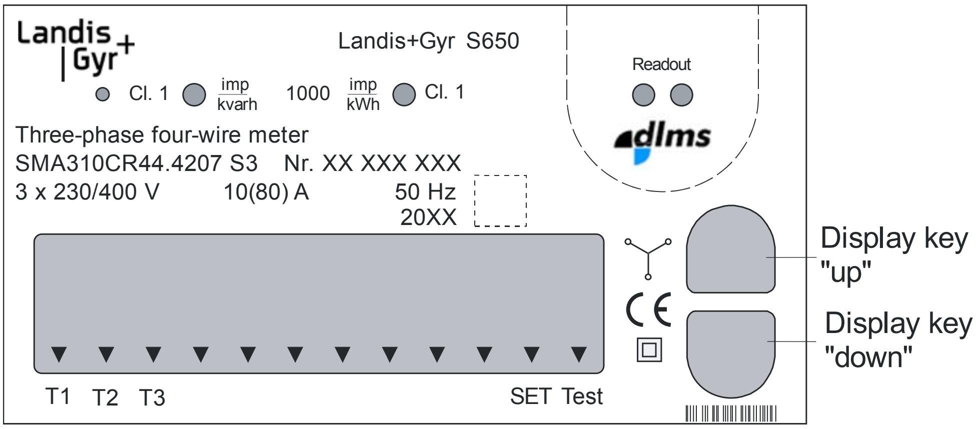


Figure 52 Display keys

By pressing the lower display key "down", the display changes to the next value in the list. By pressing the upper display key "up", the display changes to the previous value (see also section 5.4.2 "Display menu").

5.2.2 Control of display via optical interface

All S650 meters have an "optical key" in addition to the "up" and "down" display keys. The optical interface serves to receive a light signal, e.g. generated by a torch (works only with warm light, i.e. LED torches cannot be used for this). The light signal acts like the "down" 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 in front of the meter.

5.2.3 Reset key

The reset key is situated to the right of the battery compartment behind the front door. To permit operation of the reset key the front door must be opened and therefore the utility seal be removed.

The reset key can be used to perform a manual reset. If the display check is displayed (after operation of a display key), however, pressing the reset key produces the service menu (see also section 5.4.3 "Service menu").

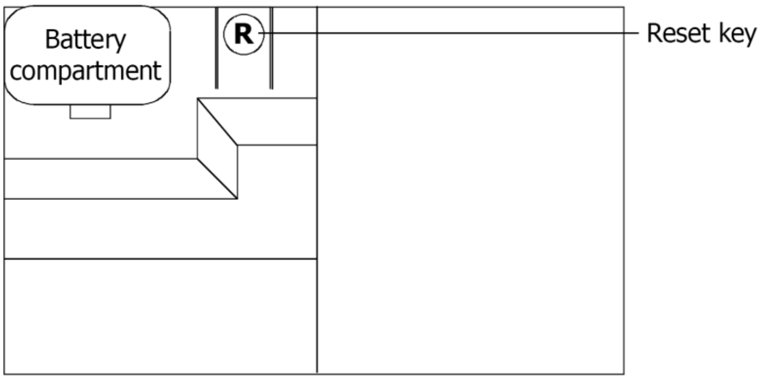


Figure 53 Reset key behind front door

5.3 Display

5.3.1 Introduction

S650 meters are provided with a liquid crystal display (LCD).

The display can be provided with background lighting for easier reading (optional). This is switched on by pressing one of the display keys and is extinguished automatically after a short time if no further key is pressed.

5.3.2 Basic layout

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

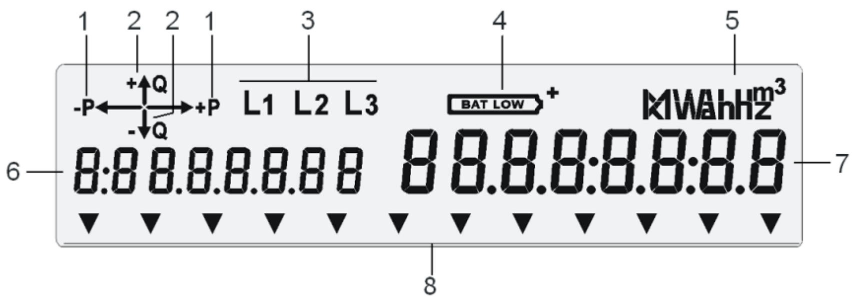


Figure 54 Basic layout of the liquid crystal display (LCD)

1 Active power direction (+P: import, -P: export)
2 Reactive power direction (not used with SMA300AR)
3 Phase voltages (flash if rotating field reversed)
4 Battery status (charge voltage)
5 Units field
6 Index field (8 digits)
7 Value field (8 digits)
8 12 arrow symbols for status information (e.g. tariffs)

Active power direction	Shows always the sum of the three phases:	
	→+P	positive active energy direction (imported from power company)
	-P←	negative active energy direction (exported to power company)
	-P← →+P	negative active energy direction of individual phases (second arrow flashes).
Reactive power direction	Indicates for combimeters SMA300CR always the sum of the three phases (not used for active energy meters SMA300AR).	
	+↑Q	positive reactive energy direction
	-↓Q	negative reactive energy direction
Quadrant display	Indicates for combi-meters SMA300CR in which quadrants the present measurement is made (not used for active energy meters SMA300AR):	
	↑Q →+P	1st quadrant
	-P← +↑Q	2nd quadrant
	-P← -↓Q	3rd quadrant
	↓Q →+P	4th quadrant
Phase voltages	L1 L2 L3	Indication of presence of phase voltages. If the rotating field corresponds to the parameterised, symbols L1, L2 and L3 are continuously lit. Otherwise they flash every second.
Battery condition	BAT LOW +	The symbol appears if the charge voltage of the battery fitted is too low (provided the meter is parameterised as "fitted with battery").
Units field	kMWAhHz m³	The following units are shown: W, var, VA, k..., M..., ...h, V, A, h, Hz, m³ (var and VA only for combimeters)
Index field	8:8 8.8.8.8.8 8	Up to 8-digit indices are displayed, which define the value in the value field.
Value field	8 8.8.8:8.8:8.8	Up to 8-digit values are displayed.
Arrow symbols	▼ ▼ ▼ ▼	An arrow symbol is an additional status indication for tariff rates, reset block, test mode, etc. The arrow points to a status description on the face plate.

5.3.3 Index system

The information concerning which data are shown in the display is made with an index system and is supported by the unit over the value field.

The 8-digit index field permits all currently known index systems such as DIN, LG, VEOe, OBIS, etc.

The **B:C.D.E.F** structure applies to OBIS (Object Identification System):

B Defines the channel number, i.e. the number of the input of a metering device 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.

C Defines the abstract or physical data items related to the information source concerned, e.g. active power, reactive power, apparent power, cosφ, current or voltage.

D Defines types, or the result of the processing of physical quantities according to various specific algorithms. The algorithms can deliver energy and demand quantities as well as other physical quantities.

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

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

To simplify reading of 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.

For further details about OBIS code see Appendix 1 "OBIS code".

Examples

1.8.0: 1 = Active energy import (all phases); 8 = Status; 0 = Total

0.9.1: Local time

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

5.4 Types of display

The SMA300xR has the following three types of display:

Operating display

The values specified by the parameterisation are shown as a rolling display in the operating display. The display is always in operating mode when the display keys are not operated. The meter returns automatically from the display list to the operating display after a defined time. This display can consist of one or more values.

Display menu

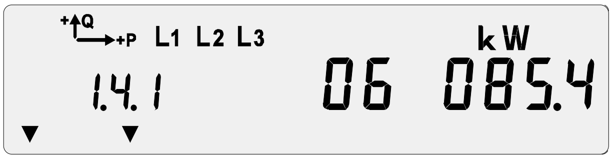
By pressing the display key, the display check is activated, and from there the user reaches the display menu by pressing the display key again. From the display menu, values of the display list, the load profile(s), the event log etc. can be accessed. The values of the display list and also the sequence can be parameterised. The display keys permit scrolling up and down in the list.

Service menu

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

5.4.1 Operating display

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



running average demand value with status of integrating period

Figure 55 Example of a fixed display

Error message

The meter can generate an error message on the basis of self-tests. According to parameterisation, this can be permanently included in the operating display. In the event of a serious error (fatal or critical error), it replaces the normal operating display. After a fatal error, the meter no longer operates and must be replaced. In case of a critical error, the error message can be acknowledged with the display key.

Figure 56 Example of an error message (insufficient battery voltage)

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

5.4.2 Display menu

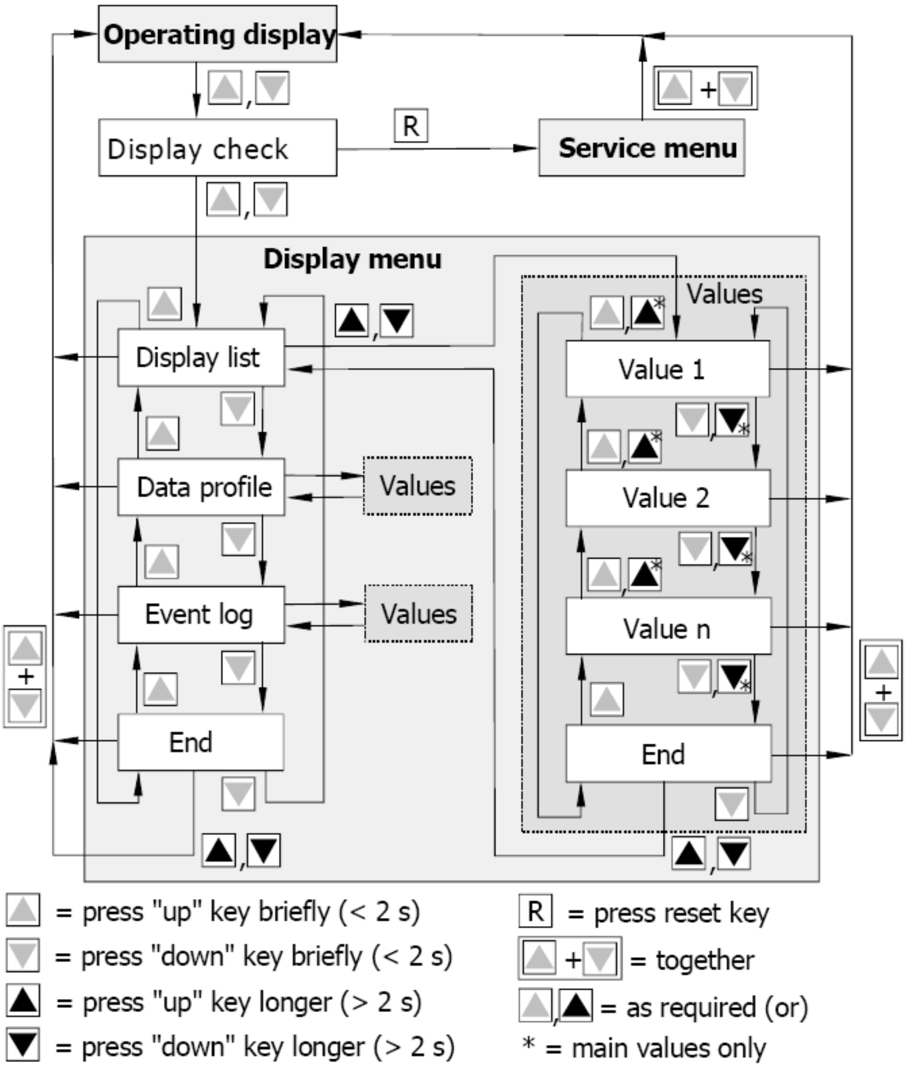
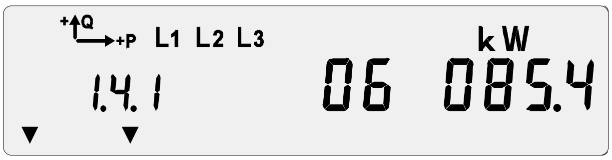


Figure 57 Display menu overview

Display check

Brief operation (< 2s) of the display key "down" or "up" causes a change of the operating display, e.g.:

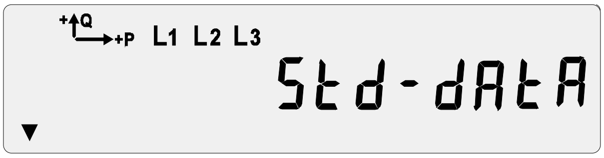


to the display check:

All segments of the display are active 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 "down" or "up" again **briefly**, changes to the display menu or directly to the display list. The first menu item appears, e.g. "Display list" (standard data):



The menu item only appears when several menu items exist. Otherwise direct entry is made to the display list.

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

The preceding menu item is displayed again by **briefly** pressing the "up" display key.

Both display keys ("down" and "up") must be pressed **simultaneously** to return to the operating display from any display menu.

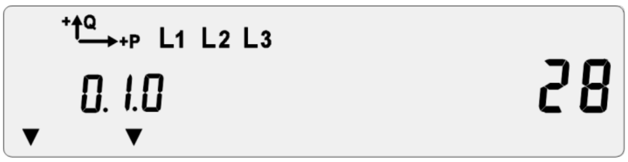
Value display

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

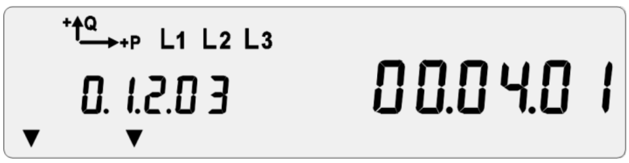
The next list value appears for every further brief operation of the "down" display key. **Brief** operation of the "up" key again displays the preceding value. The sequence of values in the list is determined by the parameterisation.

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

Examples of values in a display list:



Reset counter



Date of resetting

stored value 03 (March)

Cumulated maximum demand

active power

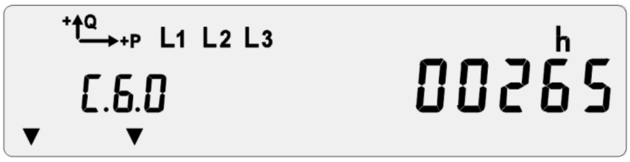
rate 1

Active energy

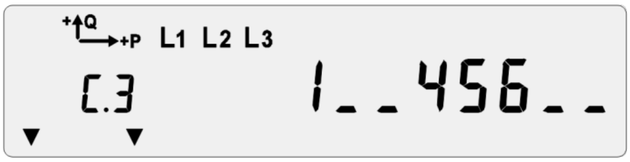
present status

rate 1

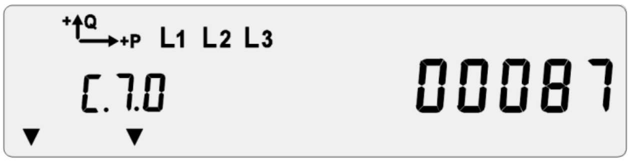
Reactive energy present status rate 1



Battery hours counter



Status of signals at control terminals

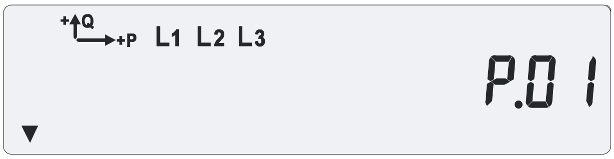


Number of total voltage failures

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

Load profile 1

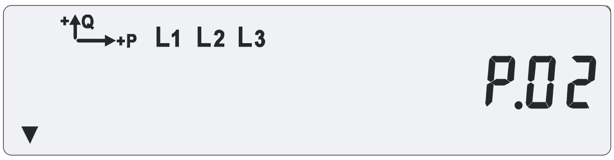
The load profile 1 menu item for selection in the display menu (denoted P.01) is shown as follows:



The first value of the load profile 1 is displayed by pressing the display key "down" or "up" for **longer** (at least 2 seconds).

Load profile 2

The load profile 2 menu item for selection in the display menu (denoted P.02) is shown as follows:



The first value of the load profile 2 is displayed by pressing the display key "down" or "up" for **longer** (at least 2 seconds).

Event log

The event log menu item for selection in the display menu (denoted P.98) is shown as follows:

The first entry in the event log is displayed by pressing the display key "down" or "up" for **longer** (at least 2 seconds).

5.4.3 Service menu

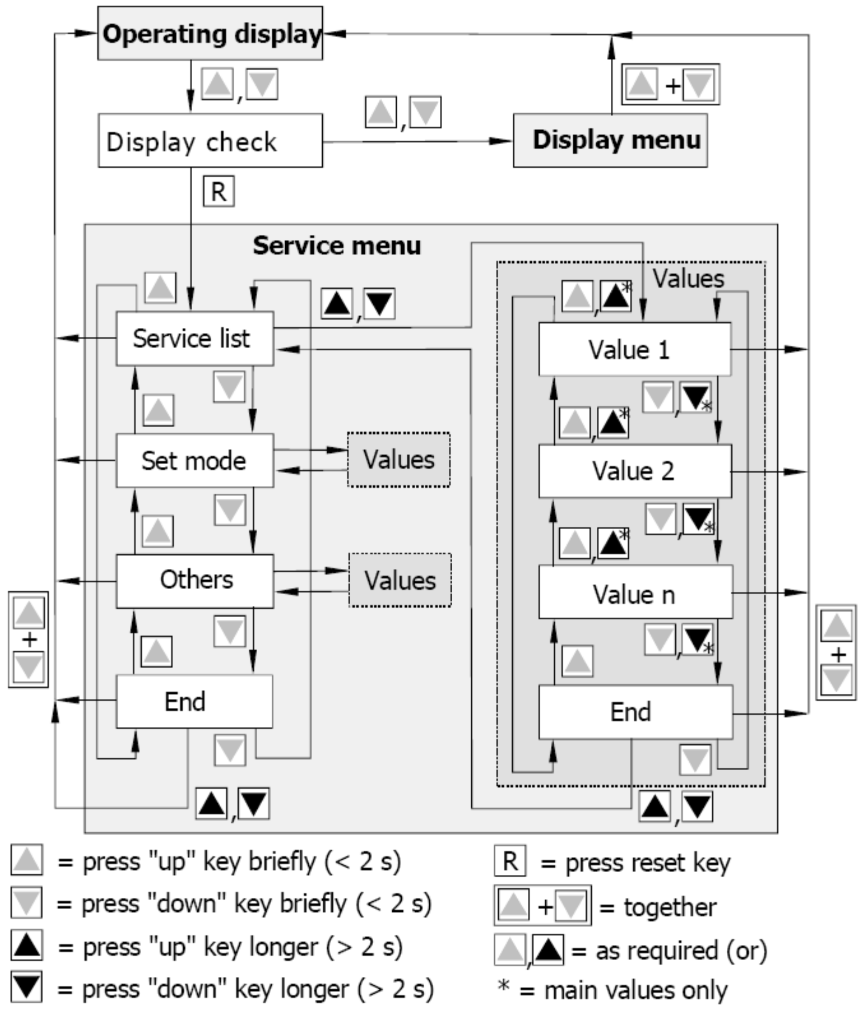
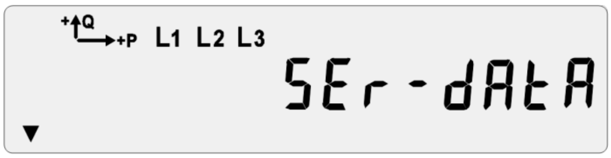


Figure 58 Service menu overview

Service menu

Pressing the reset key during the display check changes the display to the service menu or directly to the service list. The first menu item appears, e.g. the service list:



The menu item only appears if there are several items present. Otherwise pressing the reset key directly leads to the values of the service list.

The next menu item appears for every further **brief** operation of the "down" display key, e.g. "Set mode", "Test mode on/off", etc. The first item appears again following the last menu item "End".

The preceding menu item appears again by pressing the "up" key **briefly**.

Both display keys ("down" and "up") must be pressed **simultaneously** to return to the operating display from the service menu.

Value display

The first value of the list associated with the present menu is displayed by pressing the display key "down" or "up" for **longer** (at least 2 seconds).

The next list value appears for every further brief operation of the "down" display key. **Brief** operation of the "up" key again displays the preceding value. The sequence of values in the list is determined by the parameterisation.

A rapid run is started by holding down the display key "down" or "up" for **longer** (at least 2 seconds). The main values of the list are then displayed while the 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 "down" or "up" for **longer** (at least 2 seconds).

Both display keys ("down" and "up") must be pressed **simultaneously** to return to the operating display from the list.

Set mode

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

5.5 Alert LED

The red alert LED (optional) on the main face plate indicates that certain event(s) have occurred. Which event(s) trigger the alert LED can be set by parameterisation.

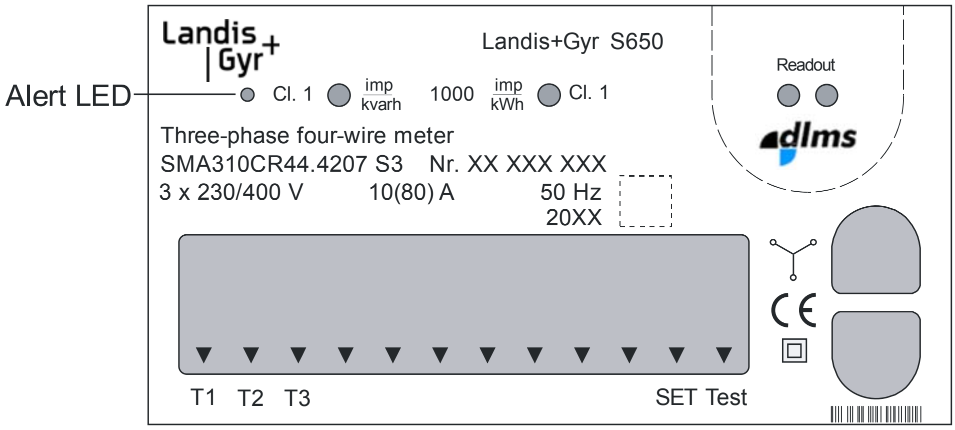


Figure 59 Alert LED

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 main face plate above the liquid crystal display.

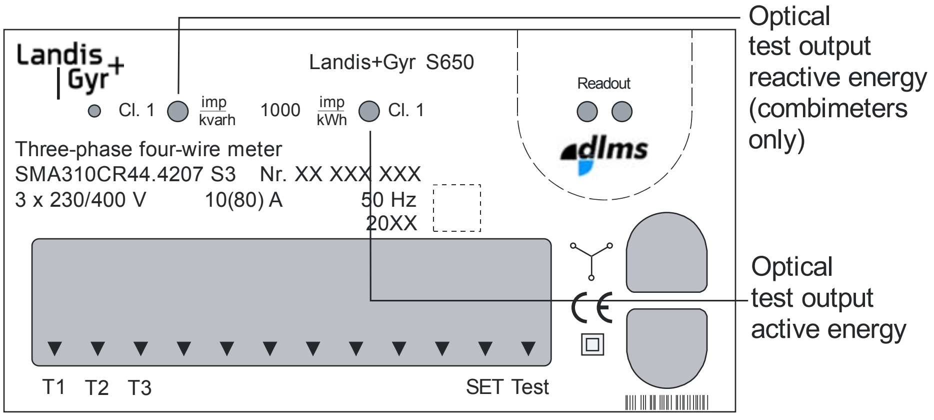


Figure 60 Optical test outputs

The optical test outputs are used for testing the meter (see also section 7.1 "Meter testing"). They transmit visible red pulses corresponding to the current measured values (active and reactive energy).

5.7 Data readout

The energy supply company can record the data stored locally in the meter at any time in two ways:

- Reading the liquid crystal display of the meter. The displayed data is defined by parameterisation.
- Automatic data readout via the optical interface with a readout device (e.g. laptop).

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 communication device remote readout of the meter data is also possible.

Procedure for data readout via optical interface

1. Start the readout device (according to the details in the associated operating instructions).
2. Connect the cable of the reading head to the readout device.
3. Place the reading head in the "Readout" indentation on the plastic viewing window 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 readout device (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 to IEC 62056-21

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

Log example	Significance	
/LGZ4\2SMA3104100	Designation of meter (reply on transmit request)	
F.F (00000000)	Error message	
0.0.1 (417242)	1st identification number	
0.1.0 (28)	Number of resets	
0.1.2.04 (98-05-01 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)(00-05-06 10:45)	P_{max} present	Rate 1
1.6.1*04 (202.4)(00-04-22 09:30)	with April stored value [1)]	Rate 1
1.6.2 (086.7*kW)(00-05-04 22:30)	P_{max} present	Rate 2
1.6.2*04 (100.9)(00-04-14 23:00)	with April stored value [1)]	Rate 2
1.8.1 (0244948*kWh)	Active energy (import)	Rate 1
1.8.1*04 (0234520)	with April stored value [1)]	Rate 1
1.8.2 (0082520*kWh)	Active energy (import)	Rate 2
1.8.2*04 (0078197)	with April stored value [1)]	Rate 2
5.8.1 (0106103*kvarh)	Reactive energy (inductive)	Rate 1
5.8.1*04 (0100734)	with April stored value [1)]	Rate 1
5.8.2 (0039591*kvarh)	Reactive energy (inductive)	Rate 2
5.8.2*04 (0036152)	with April stored value [1)]	Rate 2
1.8.0 (0327468*kWh)	Total active energy	
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 (00-05-20)	Date of readout	
C.7.0 (00087)	No. of voltage failures of all phases	
C.72.0 (00157)	Number of under-voltages	
C.73.0 (00000)	Number of over-voltages	
C.74.0 (00306)	Number of over-loads (over-current)	
C.3.0 (500)	Active pulse constant	
C.3.1 (500)	Reactive pulse constant	
C.2.1 (00-03-26)	Date of last parameterisation	
!	End of log	

[1)] If the sequence is parameterised as month.

Notes

The energy supply company can select by parameterisation between a standard identification or its own identification. The standard identification has the following structure:

/**LGZ...**	Manufacturer	(Landis+Gyr)
/LGZ **4...**	Transmission rate 4 = 4800 bps	
/LGZ4 **\2...**	Extended communication possibility 2 = dlms-compatible meter	
/LGZ4\2 **SMA310...**	Meter	Type of measuring unit
/LGZ4\2SMA310 **41...**		Basic version tariff section
/LGZ4\2SMA31041 **00...**		Additional functions (auxiliary power supply)
/LGZ4\2SMA3104100 **.B32**		Firmware version
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

The identification by the energy supply company itself uses an identification number. ID1.1 (designation of ownership by the energy supply company), 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 **4...**	Transmission rate 4 = 4800 bps	
/LGZ4 **2...**	Extended communication possibility 2 = dlms-compatible meter	
/LGZ4\2 **B32...**	Meter	Firmware version
/LGZ4\2\B32 **12345678**		Identification number specified by parameterisation (maximum 8 characters)

5.7.2 Readout to dlms

While the readout according to IEC 62056-21 uses a predefined protocol, readout to dlms enables the power supply company to read out values individually. The company therefore has systematic access to specific values without being influenced by other values that are not required.

dlms specification

Various meter manufacturers – including Landis+Gyr – together with related organisations, have compiled the language specification dlms (Device Language Message Specification).

Objective

The objective of dlms is to use a common language for data exchange in energy measurement and other sectors. In addition to end units such as meters, tariff units, etc. dlms also defines 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. control centre) and pass them via interface to the transport medium (channel). How the values reach the recipient is again immaterial for both parties.

dlms items

dlms is an object-oriented language. The dlms objects

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

Examples are number of resets with date and time, cumulative maxima, rolling mean values, maxima, energy status, 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.

5.8 Input of formatted commands

The following operating data or meter characteristics can be modified by the input of formatted commands. The user of formatted commands, however, must have the necessary access authorisation according to the security system.

The following commands can be used both according to IEC 62056-21 and also with dlms:

- Set time/date
- Set identification numbers for the energy supply company and for the manufacturer (by line).
- Reset
- Neutralise reset inputs KA/KB
- Set/reset reset counter
- Control tariff rates via interface
- Set/reset energy registers
- Set/reset total energy registers
- Set/reset demand maximum registers
- Set/reset power factor registers
- Reset stored values
- Reset battery hours counter
- Reset voltage failures registers
- Switch on/off increased resolution (test mode) of energy registers
- Define by additional parameters whether the optical test output for active energy in test mode supplies active or reactive energy pulses
- Delete error messages
- Change passwords P1,P2 and W5
- Reset load profile 1 / load profile 2
- Reset event log
- Reset dedicated event log groups

The following commands can only be executed with dlms:

- Reset event register
  - Under- and over-voltages
  - Demand messages
  - Current messages
  - Power factor messages
- Set thresholds for messages

Formatted commands are transferred to the meter with a suitable device via the optical or serial interface.

5.9 Set time and date, ID numbers, battery time

The following values can be changed at any time from the service menu (set mode):

- Date and time
- Identification numbers
- Operating time of battery

Below is an example on how to set the date and time.

			6 1.8.0 006249.37 MWh	Operating display
1.	▽	All segments of the display are lit	8:88.8.8.8.8.8 88.8.8:8.8:8.8 kWAh	Display check
2.	Ⓡ	Enter service menu	SEt	Set mode
3.	▼	Enter set mode	0.0.0 00001013	Identification number
4.	▽	Select required setting	0.9.2 02-09-29	Date, old value
5.	Ⓡ	Select digit to be changed	0.9.2 02-09-29	Digit flashes
6.	▽	Change digit value	0.9.2 02-09-20	Digit flashes
7.	Ⓡ	Select digit to be changed	0.9.2 02-09-20	Next digit flashes
8.		Repeat steps 5 – 7 for all digits to be changed.		All digits flash
9.	Ⓡ	Confirm new setting	0.9.2 02-09-30	Date, new value
10.		Repeat steps 4 – 9 for all settings to be changed.		
11.	▽	Advance display until **End**	End	End of set mode
12.	▼	Back to service menu	SEt	Service menu
13.	▽	Advance display until **End**	End	End of service menu
14.	▼	Back to operating display	6 1.8.0 006249.37 MWh	Operating display
15.		Close and re-seal the front door.		

6 Service

This section 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 network voltage present (supply 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 de-installed if necessary and sent to an authorised service and repair 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 the responsible service and repair centre (according to section 6.3 "Repairing meters").

6.2 Error messages

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

In case of a serious error detected (fatal or critical error according to classification in the following degrees of severity), the meters displays an error code. This error code appears as an eight-digit number together with "F.F" or "FF" in the display (error code F.F 00000000 = no error).

Classification of degree of severity

The degree of severity of an error occurring is assessed as follows:

A **fatal error** indicates a severe problem, which prevents the meter maintaining measuring operation, e.g. a defective hardware component. The meter stops its operation and the error code is displayed permanently. The meter must be exchanged.

A **critical error** indicates a severe problem, but with which the meter continues to function and measurement is still possible. The data are stored in the memory and suitably marked in case of doubt. After a critical error, the error code is displayed until acknowledged with the display key or until the error register is reset, e.g. via the electrical interface. Depending on the type of the error this can cyclically occur again, since with the acknowledgement the error cause is usually not repaired. The meter must in this case be exchanged as soon as possible.

Non-critical errors can influence the meter functions (temporarily or permanently). These errors are recorded in the error register. The meter remains serviceable and normally needs not to be exchanged.

Deleting error messages

If nothing else is specified in the following description of the error groups, the error messages can only be deleted with formatted commands (see section 5.8 "Input of formatted commands"). If the error occurs again, the meter should be removed and sent to the responsible service and repair centre (according to section 6.3 "Repairing meters").

6.2.1 Structure of an error message

An error message has the following form:

Figure 61 Error message on S650 meters

All S650 meters use the same format for error messages. It consists of four groups of 2 digits each, whereby the groups have the following significance:

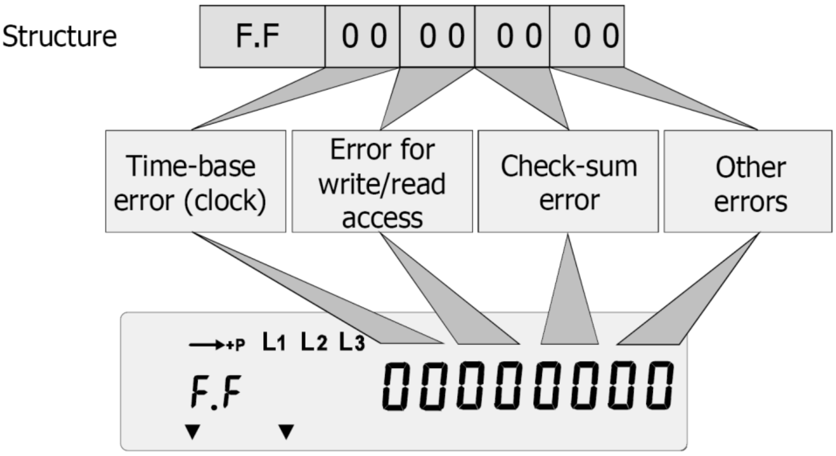


Figure 62 Significance of error message

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)

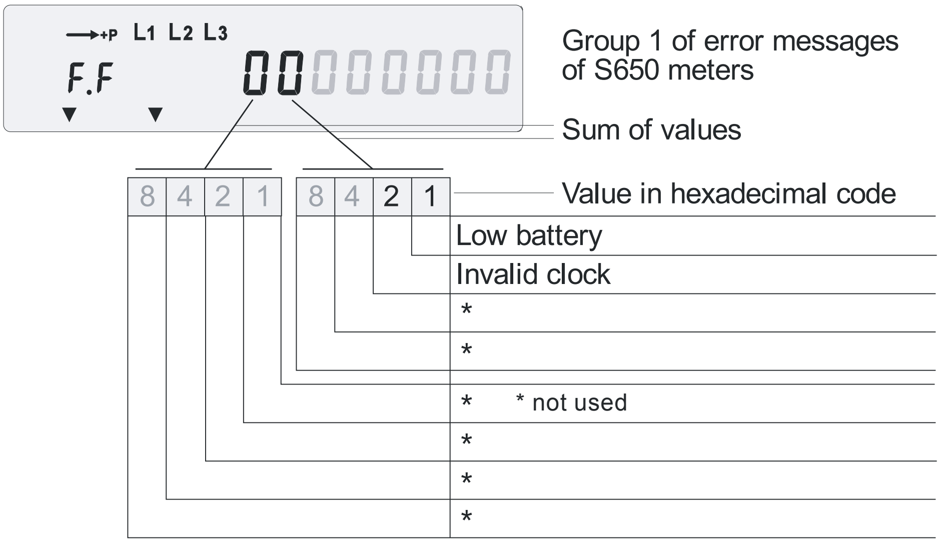


Figure 63 Group 1 of error messages

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

Low battery (non-critical error)

The battery is missing or discharged. If there is no mains voltage at the meter and the internal supercap is discharged (after about 3 weeks) then the calendar clock will stop.

The error is deleted automatically when the battery voltage has again reached a sufficient value (e.g. after inserting a new battery as described in section 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.

The same applies to messages where the bit is set:
F.F 03 .. .. ..

F.F **02** 00 00 00

Invalid clock (non-critical error)

The meter has found that the calendar clock has stopped at some time, e.g. due to insufficient power reserve (battery low). The clock is running, but shows the wrong time and/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 "Input of formatted commands"). or section 5.9 "Set time and date, ID numbers, battery time"). If necessary, replace the battery.

The same applies to messages where the bit is set:
F.F 03 .. .. ..

Errors for write/read access

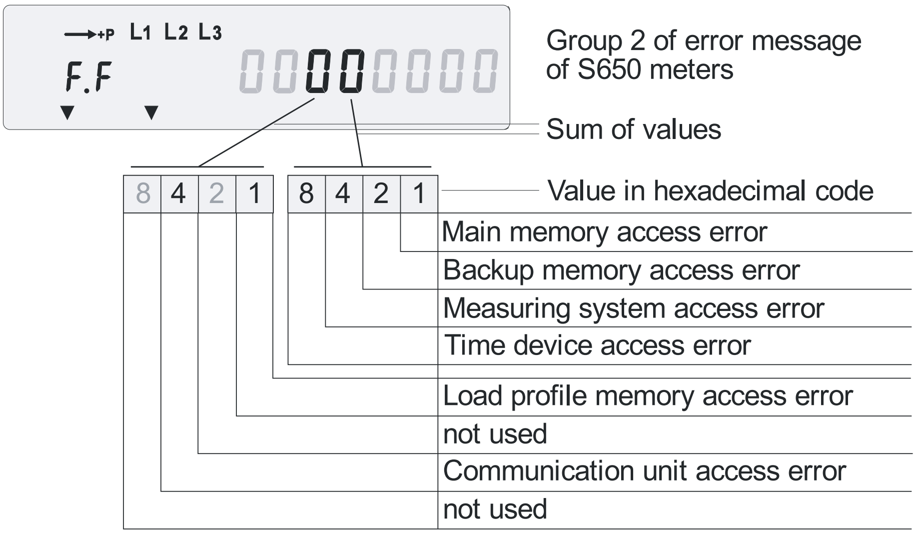


Figure 64 Group 2 of error messages

In the second group both digits can have values between 0 (no error message) and F (all four error messages set). Significance:

F.F 00 **x1** 00 00

Main memory access error (fatal error)

This error message appears if the main memory could not be accessed several times during the start-up of the meter.

The meter may contain incorrect data and must be exchanged.

The same applies to messages where the bit is set:
F.F .. x3/x5/x7/x9/xB/xD/xF .. ..

F.F 00 **x2** 00 00

Backup memory access error (non-critical error)

This error message appears if the backup memory could not be accessed several times.

The meter may contain incorrect data and must be exchanged.

The same applies to messages where the bit is set:
F.F .. x3/x6/x7/xA/xB/xE/xF .. ..

F.F 00 **x4** 00 00

Measuring system access error (non-critical error)

This error message appears in case of repeated failures when accessing the measuring system, possibly because of a completely discharged supercap, which causes an incorrect start-up behaviour.

Power-up meter and wait for a short time, then clear error via communication. If the error does not reoccur, it is recommended to equip the meter with a battery. If the error reoccurs, replace the meter.

The same applies to messages where the bit is set:
F.F .. x5/x6/x7/xC/xD/xE/xF .. ..

F.F 00 **x8** 00 00

Time device access error (non-critical error)

The meter sets this message in the event of repeated failures when accessing the time device. The calendar clock may display an invalid time or date.

The error can be reset via communication. If it occurs repeatedly, the meter must be exchanged.

The same applies to messages where the bit is set:
F.F .. x9/xA/xB/xC/xD/xE/xF .. ..

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

Load profile memory access error (critical error)

This error message appears in case of repeated failures when accessing the load profile memory.

Load profile data will be marked in the status code (bit 2 "corrupted measurement" and bit 0 "critical error" set).

It may not be possible to access the load profile memory. The memory may contain incorrect data. **The meter must be exchanged.**

The same applies to messages where the bit is set: F.F .. 5x .. ..

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

Communication unit access error (non-critical error)

The meter sets this message in the event of repeated failures to access the communication unit. Communication fails or is slow.

The error can be reset via communication. If it reoccurs, replace first the communication unit, check the function again. If the error still occurs, the meter must be exchanged.

The same applies to messages where the bit is set: F.F .. 5x .. ..

Checksum errors

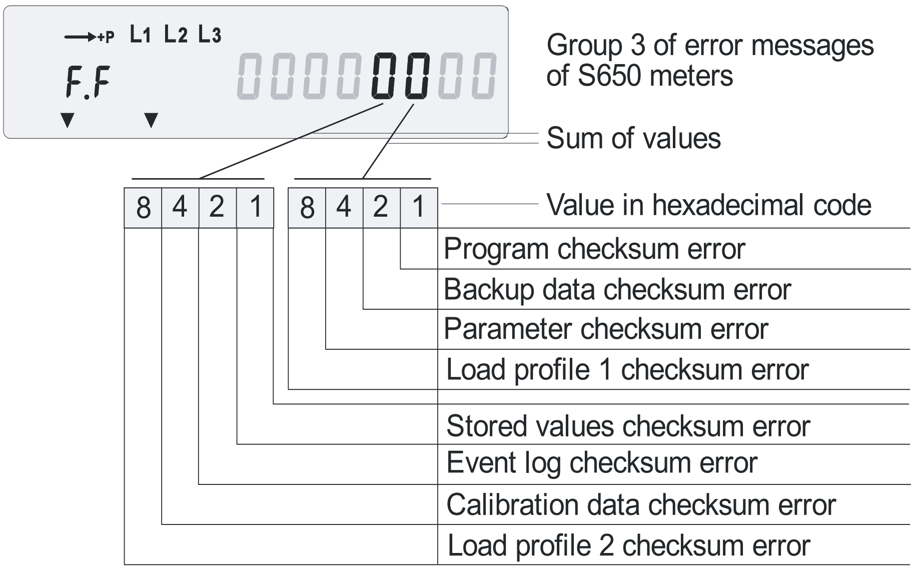


Figure 65 Group 3 of error messages

The first digit in the third 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 00 **x1** 00

Program checksum error (fatal error)

The meter does not operate and must be exchanged.

The same applies to messages where the bit is set:
F.F .. .. x3/x5/x7/x9/xB/xD/xF ..

F.F 00 00 **x2** 00

Backup data checksum error (critical error)

This error message appears when the backup data checksum test fails.

Load profile data will be marked in the status code (bit 2 "corrupted measurement" and bit 0 "critical error" set). **The meter may contain incorrect data and must be exchanged.**

The same applies to messages where the bit is set:
F.F .. .. x3/x6/x7/xA/xB/xE/xF ..

F.F 00 00 **x4** 00

Parameter checksum error (critical error)

This error message appears when the parameter checksum test fails.

Load profile data will be marked in the status code (""bit 0 "critical error" set). **The meter may contain incorrect data and must be exchanged.**

The same applies to messages where the bit is set:
F.F .. .. x5/x6/x7/xC/xD/xE/xF ..

F.F 00 00 **x8** 00

Load profile 1 checksum error (non-critical error)

Load profile 1 data of the defective memory area will be marked in the status code (bit 2 "corrupted measurement" set).

The error can be reset via communication. Reset the load profile first and then the error. If it occurs repeatedly, the meter must be replaced as soon as possible.

The same applies to messages where the bit is set:
F.F .. .. x9/xA/xB/xC/xD/xE/xF ..

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

Stored values checksum error (critical error)

Data in the defective memory area will be marked in the status code (bit 0 "critical error" set).

The error can be reset via communication. If it occurs repeatedly, the meter must be replaced as soon as possible.

The same applies to messages where the bit is set:
F.F .. .. 3x/5x/7x/9x/Bx/Dx/Fx ..

F.F 00 00 **2x** 00

Event log checksum error (non-critical error)

Data in the defective memory area will be marked in the status code (bit 0 set).

The error can be reset via communication. If it occurs repeatedly, the meter must be replaced as soon as possible.

The same applies to messages where the bit is set:
F.F .. .. 3x/6x/7x/Ax/Bx/Ex/Fx ..

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

Calibration data checksum error (critical error)

Data in the defective memory area will be marked in the status code (bit 0 "critical error" set).

The meter must be replaced as soon as possible.

The same applies to messages where the bit is set:
F.F .. .. 5x/6x/7x/Cx/Dx/Ex/Fx ..

F.F 00 00 **8x** 00

Load profile 2 checksum error (non-critical error)

Load profile 2 data of the defective memory area will be marked in the status code.

The error can be reset via communication. Reset the load profile first and then the error. If it occurs repeatedly, the meter must be replaced as soon as possible.

The same applies to messages where the bit is set:
F.F .. .. 9x/Ax/Bx/Cx/Dx/Ex/Fx ..

Other errors

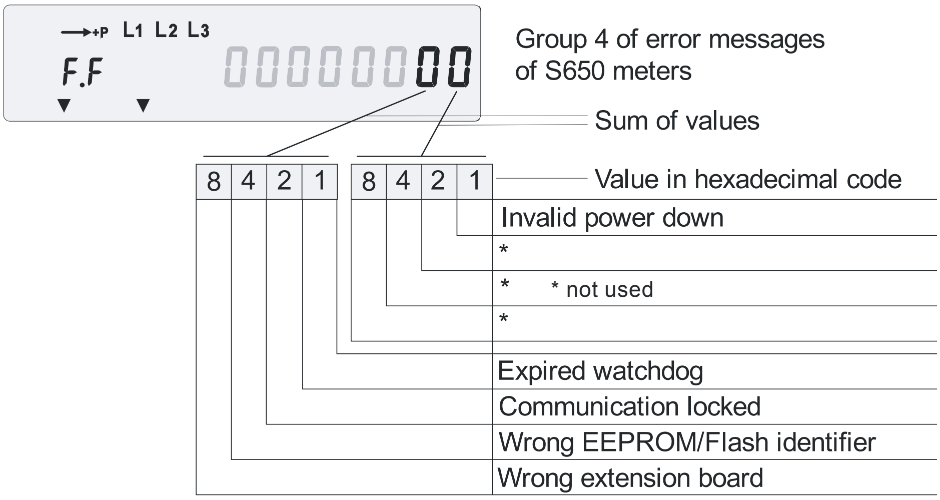


Figure 66 Group 4 of error messages

The first digit in the fourth group can have the values 0 to F.

The second digit can have values between 0 (no error message) and 1 (Invalid power down). Significance:

F.F 00 00 00 **x1**

Invalid power down (non-critical error)

The meter has detected that the last data storage was not performed correctly. The meter may contain incorrect data or may have lost data since the last storage, i.e. for 24 hours maximum.

The error can be reset via communication. If it occurs repeatedly, contact Landis+Gyr Customer Services.

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

Expired watchdog (non-critical error)

The microprocessor was restarted due to a disturbance (e.g. lightning). The meter may lose all data recorded since the last storage, i.e. for 24 hours maximum.

The error can be reset via communication. If it occurs repeatedly, contact Landis+Gyr Customer Services.

The same applies to messages where the bit is set:
F.F 3x/5x/7x/9x/Bx/Dx/Fx

F.F 00 00 00 **2x**

Communication locked (non-critical error)

This error indicates access attempts via the communication interface with wrong passwords.

The error is automatically deleted after the inhibition time or at midnight.

The same applies to messages where the bit is set:
F.F 3x/6x/7x/Ax/Bx/Ex/Fx

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

Wrong EEPROM/Flash (fatal error)

Incorrect EEPROM/ Flash memory is installed in meter.

The meter does not operate and must be exchanged.

The same applies to messages where the bit is set:
F.F 5x/6x/7x/Cx/Dx/Ex/Fx

F.F 00 00 00 **8x**

Wrong extension board (non-critical error)

Identification of extension board differs from that parameterised in the meter.

The meter might not have the required functions such as data profile, control inputs or output signals. **The meter has to be exchanged**.

The same applies to messages where the bit is set:
F.F 9x/Ax/Bx/Cx/Dx/Ex/Fx

6.3 Repairing meters

Meters must only be repaired by the responsible service and repair centre (or manufacturer).

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

1. If the meter is installed, remove the meter as described in section 4.7 "De-installation" 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 to the responsible service and repair centre.

7 Maintenance

This section 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 de-installed for this purpose according to the instructions in section 4.7 "De-installation" and replaced by a substitute meter. The meter test can also be performed on the spot in certain circumstances.

7.1.1 Test mode

The test mode permits increasing the resolution of the energy registers by 1 to 5 digits. This allows the energy supply company to carry out the so called measuring unit test in a reasonably short time.

In test mode, the same registers shown as a rolling list in the operating display are always displayed, but with high resolution and not rolling.

The energy registers comprise a total of 12 digits. 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 5) to permit a quicker test of the transmission to the energy registers.

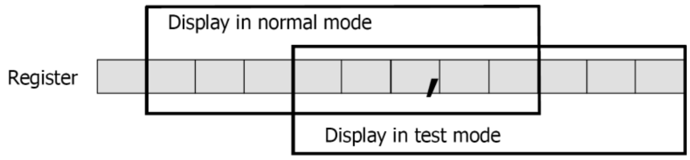


Figure 67 Display changeover normal mode – test mode

Changeover from normal to test mode and back is made by formatted commands (see section 5.8 "Input of formatted commands") or manually in the service menu.

In test mode, the optical test output for active energy can also provide reactive energy pulses depending on the parameterisation. Reactive energy pulses are supplied to this test output if the register shown on the display represents a reactive energy register. Active energy pulses are supplied for all other measured values shown as in normal operating mode. Formatted commands can also be used to define whether the optical test output for active energy in test mode should supply active or reactive energy pulses, independent of the type of register shown on the display. This permits changeover without manual intervention.

7.1.2 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.

Table of measuring times required at the optical test output:

SMA300xR

U_n = 230 V
I_b = 5 A

	Measuring uncertainty 0.1 %		
Current [% I_b]	3 P cosφ=1	1 P 1	3 P 0,5
5	40 s	40 s	90 s
10	20 s	20 s	40 s
20	10 s	10 s	20 s
50	8 s	8 s	10 s
100	6 s	6 s	8 s
1000	6 s	6 s	6 s
2000	6 s	6 s	6 s
2400	6 s	6 s	6 s

3 P = universal
1 P = single-phase

7.1.3 Optical test output

The red optical test outputs on the meter above 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 = 1000

Power P = 35 kW

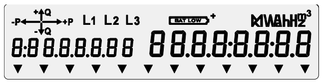
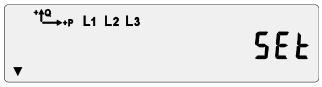
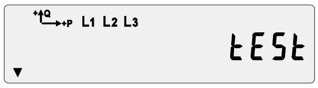
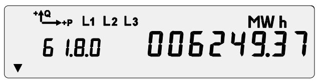
f-test output = R x P / 3600 = 1000 x 35 / 3600 = 10 imp/s

The optical test outputs are continuously lit at creep.

Test mode

The test mode enables you to select which measuring value (active, reactive) is shown on the optical test output.

In the display, values for active, reactive and apparent energy are available. Depending on 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 with the normal mode. A maximum of 5 decimal points is possible.

				Operating display
1.	▽	All segments of the display are lit		Display check
2.	(R)	Enter service menu		Set mode
3.	▽	Select test mode		Test mode
4.	▼	Enter test mode		First value
5.	▽	Select required value		Value x
6.		Repeat step 3 for all values to be tested		
7.	△▽	Exit test mode		Operating display

Examples
First value and value x are examples. The real values are defined in the parameter settings and are the same as the operating display.

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

Mode	Register on Display	Test output reactive	Test output active
Normal mode	Some sort of register	|R|	|A|
Test mode	Reactive energy register	|A|	|R|
	Active energy register or one of not mentioned registers in this table.	|R|	|A|

7.1.4 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 network 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. Switch on test mode (high resolution).
4. The meter must not deliver more than one pulse during the creep test. Check the energy levels for changes in test mode. They must not increase by more than the value of one pulse (see face plate).

7.1.5 Starting test active part

Procedure:

1. Apply a load current of 0.1% of the base current I_b (IEC-meters) or 0.1% of the reference current I_{ref} (MID-meters) – e.g. 5 mA with I_b=I_{ref}= 5 A – and the voltage U_n (three-phase in each case) and **cosφ = 1**. The meter must remain in creep.
2. Increase the load current to 0.4% I_b (IEC-meters) or 0.4% I_{ref} (MID-meters) – e.g. 20 mA with I_b= I_{ref} = 5 A. The energy direction arrow "P" must appear within 10 seconds. The optical test output for active energy consumption is no longer permanently "lit".

7.1.6 Starting test reactive part

Procedure:

1. Apply a load current of 0.1% of the basic current I_b (e.g. 5 mA with I_b = 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_b (i.e. 20 mA with I_b = 5 A). The energy direction arrow "Q" must appear within 10 seconds. The optical test output for active energy consumption is no longer permanently "lit".

7.2 Changing the battery

If the meter is provided with a battery, this must be changed if one of the following events occurs:

- The BAT LOW + symbol appears on the display.
- The 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 80,000 hours (can be read under code C.6.0 in service mode).
- The battery charge indicates less than 4.8 V (can be read under code C.6.1 in service mode).

Meters with or without battery
Only meters parameterised as "fitted with battery" have the BAT LOW + symbol and the battery operating hours counter.

Dangerous voltage on contacts in the battery compartment
The contacts in the battery compartment may have mains voltage applied. Therefore only remove the battery with the existing battery holder and insert the new battery only with the battery holder. Ensure that the contacts are never touched.

Replacement battery
As a replacement, use only a lithium battery with a rated voltage of 6 V and the same construction as the original battery.

Procedure:

1. Remove the front door seal.
2. Open the front door.
   The battery compartment is on the left below the liquid crystal display.

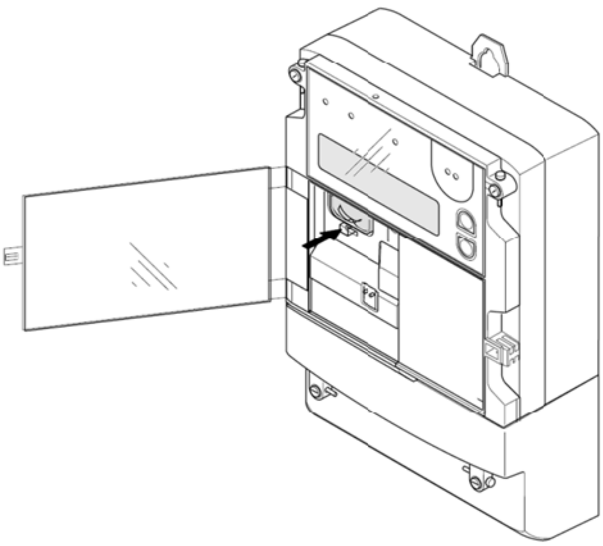


Figure 68 Battery compartment

3. Press on the latch of the plastic battery holder until it releases and then withdraw the battery holder with the old battery.

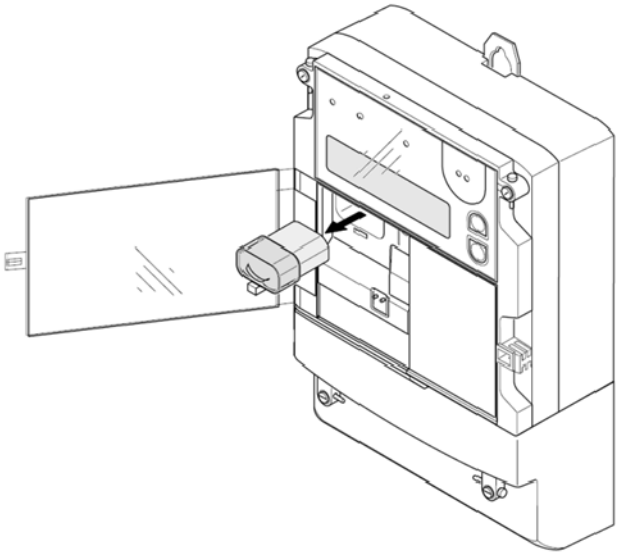


Figure 69 Removing the battery

4. Mark the current date on the new battery.
5. Withdraw the old battery from the holder and insert the new battery.
6. Push the battery holder with battery into the battery compartment until the latch engages.
7. Reset the battery hours counter to zero with the relevant formatted command (see section 5.8 "Input of formatted commands") or in the set mode (see section 5.9 "Set time and date, ID numbers, battery time").
8. Close the front door.
9. Re-seal the front door.
10. Dispose of old batteries 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.

8 Disposal

Electronic waste treatment
This product must not be disposed of in regular waste. Use a professional electronic waste treatment process.

The components used to manufacture the device can, in the main, be broken down into constituent parts and sent to an appropriate recycling or disposal facility. When the product is removed from use, the whole product must be sent to a professional electronic waste treatment process. The waste treatment and disposal plants must be approved by local regulatory authorities.

The end processing of the product and recycling of its components must always be carried out in accordance with the rules and regulations of the country where the end processing and recycling are done.

On request, Landis+Gyr will provide more information about the environmental impact of the product.

Disposal and environmental protection regulations
The following are general guidelines and should NOT take priority over local disposal and environmental policies which should be adhered to without compromise.

Components	Disposal
Printed circuit boards, LEDs, LCD display	Delivered to recycling plants
Metal components	Sorted and delivered to metal recycling plants
Plastic components	Sorted and delivered to re-granulation if at all possible
Batteries	Removed from meter and delivered to specialised recycling plants

9 Index

Appendix 1 OBIS code

Object Identification System

The OBIS code (Object Identification System) is structured as follows:

A	B	C	D	E	F	Value group
M-	KK:	GG.	AA.	T	W	According to VDEW

A: Medium
[1 … 9]

Defines the medium used. If only one medium is used it does not have to be specified. The Values represent the following objects:

1 Electricity

2, 3 not used

4 Heating costs

5 Cooling system

6 Heating system

7 Gas

8 Cold water

9 Hot water

B: Channel
[1 … 64]

Defines the channel number, i.e. the number of the input of a metering equipment with 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. If only one channel (only one meter) is used, it does not have to be specified.

C: Measured quantity
[1 … 99]

Defines the abstract or physical data items related to the information source concerned, e.g. active power, reactive power, apparent power, cosφ, current or voltage.

General data		0			
Active energy	**+ (import)**	**∑Li** 1	**L1** 21	**L2** 41	**L3** 61
	– (export)	2	22	42	62
Reactive energy	**+**	3	23	43	63
	–	4	24	44	64
	QI (quadrant I)	5	25	45	65
	QII	6	26	46	66
	QIII	7	27	47	67
	QIV	8	28	48	68
Apparent energy	**+ (import)**	9	29	49	69
	– (export)	10	30	50	70
Current		11	31	51	71
Voltage		12	32	52	72
Power factor		13	33	53	73
Frequency		14			
Service data		C			
Error message		F			
Profile data		P			

D: Measuring type
[1 ... 73, F, P]

Defines types, or the result of the processing of physical quantities according to various specific algorithms. The algorithms can deliver energy and demand quantities as well as other physical quantities.

The following list is an excerpt.

Capture period	1	2	3
Cumulated minimum	1	11	21
Cumulated maximum	2	12	22
Minimum	3	13	23
Running average	4	14	24
Last average	5	15	25
Maximum	6	16	26
Instantaneous value	7		
Time integral 1 (energy status)	8		
Time integral 2 (energy consumption)	9		
Time integral 3 (excess consumption)	10		
...			
Test average	55		
Test time integral 4	58		
...			
Error message	F		
Load profile	01		

E: Tariff
[1 ... 9]

Defines the further processing of measurement results to tariff registers, according to the tariffs in use. Total values are marked with ‘0’. For abstract data or for measurement results for which tariffs are not relevant, this value group can be used for further classification.

F: Stored value
[01 ... 99]

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

Display code

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

Examples

1.8.0 1 = all-phase active power in positive direction
8 = cumulative value (meter reading)
0 = total energy (no tariffs)

0.9.1 Local time

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manage energy better