Electricity Meters IEC/MID
Residential

ZxF100Ax

E350 Series 1

User Manual

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Revision History

Index	Date	Comments
	05.10.2004	First edition
a	21.11.2004	Corrections for first release
b	27.04.2005	Release
c	27.10.2006	MID-update
d	15.11.2006	Small corrections
e	19.12.2006	Disconnector and anti-tampering kit added, some text corrections
f	19.06.2007	M13 update, new latching relay warnings and diagram, new larger cover, latching relay replaced by disconnector, new product photography
g	13.07.2007	Minor text corrections
h	03.09.2007	Notes added regarding M13 relevant information, minor corrections
k	16.11.2007	Conn. diagrams corrected
m	05.03.2008	M14 upgrade: 4 tariff registers for active energy, instantaneous current
n	10.06.2009	New branding, new display resolution, text corrections
p	02.09.2016	M15 upgrade: ROM checksum handling

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Table of Contents

0 Introduction

Range of validity

The present manual applies to the following meter versions:

- **ZMF100AC** and **ZMF100AB** according to IEC 62053-21 (three-phase four-wire network), class 1 and 2 (IEC); class A and B (MID)
- **ZFF100AC** and **ZFF100AB** according to IEC 62053-21 (three-phase three-wire network), class 1 and 2 (IEC); class A and B (MID)

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SW-version M13

The ZxF100AB meters with disconnector and the tarifficated export registers are available from Software-version M13 on.

Purpose

The user manual contains all information required for meter applications for the intended purpose. This includes:

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

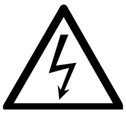
Target group

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

1 Safety

1.1 Safety information

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

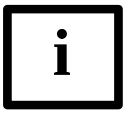


Definition of Danger

For a possibly dangerous situation, which could result in severe physical injury or fatality.

Definition of Warning

For a possibly dangerous situation, which could result in minor physical injury or material damage.



Definition of Note

For general details and other useful information to simplify work.

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

1.2 Responsibilities

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

1. Have read and understood the relevant sections of the user manual.
2. Are sufficiently qualified for the work to be performed.
3. Strictly observe the safety regulations (according to section 1.3) and the operating information in the individual chapters.

In particular, the owner of the meters bears responsibility for the protection of persons, prevention of material damage and the training of personnel. Landis+Gyr Ltd. provides training courses for this purpose on specific equipment; please contact the relevant agent if interested.

1.3 Safety regulations

The following safety regulations must be observed at all times:

- The meter connections must not be under voltage during installation or when opening. Contact with live parts is dangerous to life. The relevant main 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 suitably trained personnel is authorised to install the meters.
- The meters must be held securely during installation. They can cause injuries if dropped.
- Meters, which have fallen, must not be installed, even if no damage is apparent, but must be returned for testing to the service and repair department responsible (or the manufacturer). Internal damage can result in functional disorders or short-circuits.
- The meters must on no account be cleaned with running water or with compressed air devices. Water penetrating can cause short-circuits.

2 Functional Overview

2.1 General view

Fig. 2.1 General view of meter

2.2 Purpose of use

The ZMF100 meters record active energy consumption in all three-phase four-wire networks only. For this purpose, they are directly installed in the supply line by the energy supply company and are read regularly for energy charging purposes.

The ZFF100 meters differ from ZMF meters firstly in the number of measuring elements (2 instead of 3) and secondly in the type of measurement (Aron circuit for three-phase three-wire networks).

The data determined are displayed (LCD) and are also available at the optical interface for data acquisition, with AMR Module also as required via CS, PLC modem, GSM modem, Radio modem, etc. When provided with transmission contacts, the meters can also be used as transmission contact meters for telemetering. The tariffs can be controlled internally or externally with control inputs (on the AMR Module).

With a communication module, the meters can also be used to record counting pulses of other physical media (e. g. water or gas volumes).

Any other application of these meters is regarded as abuse.

2.3 Field of application

Basic version

The basic version provides energy registers for tariffication, a combined infrared test diode/optical interface for meter reading and an interface for various communication forms. This interface is protected against fraud and is independent of the module suppliers. The exchangeable AMR Module is situated outside the calibration liability. The functionality of this meter is suitable for smaller consumers, i.e. for households.

ZXF100AB with disconnector
(SW M13 and higher)

The function of the disconnector is customer specific and is defined by the communication module. Possible uses: anti-tampering (e.g. disconnection in case of tampering with magnets), load limitation (fuse control), remote disconnect (e.g. in case of change of tenant), prepayment. The status of the disconnector is displayed on the communication module and not on the meter, as the disconnector is controlled by the communication module. If you need detailed information on the functionality of your disconnector, please see the user manual of the communication module installed.

Extensions

The basic version can be extended with various AMR Modules for additional functions and communications:

- Double rate import/export with external tariff control
- S0 impulse output
- Communication like PLC, GSM/GPRS.

2.4 Type designation

ZMF 1 20 AC e

Network Type

ZFF 3 phase 3 wire network
ZMF 3 phase 4 wire network

Connection Type

1 Direct connection

Accuracy Class

10 Active energy class 1 (IEC); B (MID)
20 Active energy class 2 (IEC); A (MID)

Additional Functionality

AC Meter with communication interface
AB Meter with communication interface and disconnector

Rates

e 1 rate
d 2 rates
t 4 rates

The AMR Module is not part of this type designation, since it is a complete unit in itself. Users can change it at any time without opening the calibration seal. No hot plug–in (see safety regulations). Every AMR Module has its own user manual.

2.5 Review of main characteristics

The meters have the following basic characteristics:

- Recording of active energy in up to four tariff registers (imported and exported energy)
- Data display with a liquid crystal display (LCD)
- Measuring elements in proven DFS technology (Direct Field Sensor based on Hall effect) with excellent measuring characteristics, including flat load curve, high stability and good protection against interference.
- Compliance with accuracy classes 1 and 2 according to IEC62052-11 and IEC62053-21 as well as MID accuracy classes A and B
- Flexible measuring system through definition of different variables by software (single parametrisation by manufacturer)
- Wide range measurement from starting current to maximum current
- Serial interface with optical input/output for direct readout of meter data
- Storage of event information (e.g. power outages)
- Installation aids
- Measurement of instantaneous values (voltages and currents)

2.6 Measuring principle

2.6.1 Overview

The measuring principle of the meter is briefly described by means of the general block diagram shown in Fig.2.2.

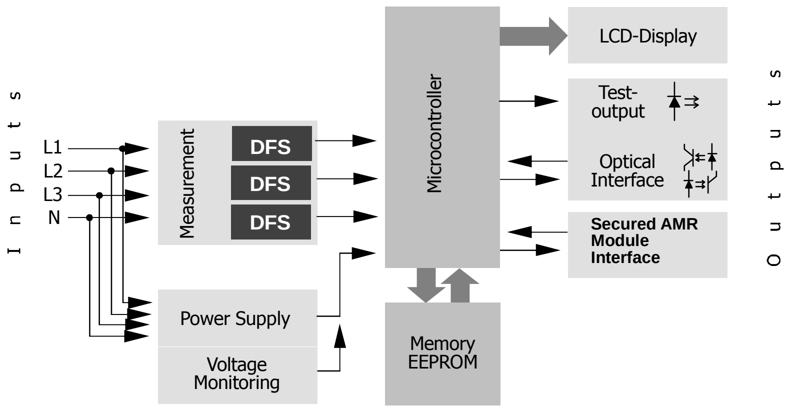


Fig. 2.2 Block schematic diagram for ZMF100AC

Inputs

The main meter inputs are shown on the left.

- Phase connection (L1, L2, L3) and neutral for
  - energy measurement
  - three-phase power supply of the meter
  - L1 for PLC communication with communication modules

Rate control via E1 can take place in two ways:

Normal: If there is no voltage at E1, rate 1 is active (left symbol); if there is voltage at E1, rate 2 is active (right symbol).

Inverted: If there is no voltage at E1, rate 2 is active (right symbol); if there is voltage at E1, rate 1 is active (left symbol).

Outputs

The main meter outputs are shown on the right (also inputs).

- LCD displays the measured amount of energy (simple 7 digit display with additional information for current tariff, visual output (creep indicator) and energy direction)
- Combined infrared diode/optical interface for automatic data readout on site by means of a suitable AMR Module (hand held terminal)
- Secured AMR Interface for automatic data readout through a AMR Module with a PLC, GSM/GPRS, or Radio modem.

Power supply

The supply voltage for the meter electronics is taken from the three-phase system. A voltage monitor circuitry guarantees a safety data storage in the event of a mains voltage failure as well as a correct start-up after the return of the voltage.

Measuring system

Three measuring elements in the proven DSF technology (Direct Field Sensor based on Hall effect) generate signals proportional to the power in each phase from the applied phase voltage and the flowing phase current. This signal is converted to a digital signal for further processing by the microprocessor.

Signal processing

The microprocessor summates the digital signals in the individual phases and forms pulses of fixed energy. It separates these pulses according to the positive and negative energy direction. It then processes them in accordance with the meter constant and feeds them to the relevant tariff register indicated by the tariff control unit. The microprocessor also controls data communication with the display and the serial interface in addition it ensures safe operation in the event of a power failure.

Memory

A non-volatile memory (EEPROM) contains the parameter set of the meter and secures the stored measurements against loss due to power failure.

2.6.2 Signal generation

With its Hall elements the DFS sensor registers the phase current over the magnet field of the current loop and the phase voltage over a resistor divider. The Analog/Digital converters transforms both signals into digital voltage and current data. This data are then multiplied by a digital multiplier to produce an energy proportional value. The resulting value is feed into the microprocessor, which adds the value to the corresponding values of the other phases and the sum is then transferred into the corresponding energy register.

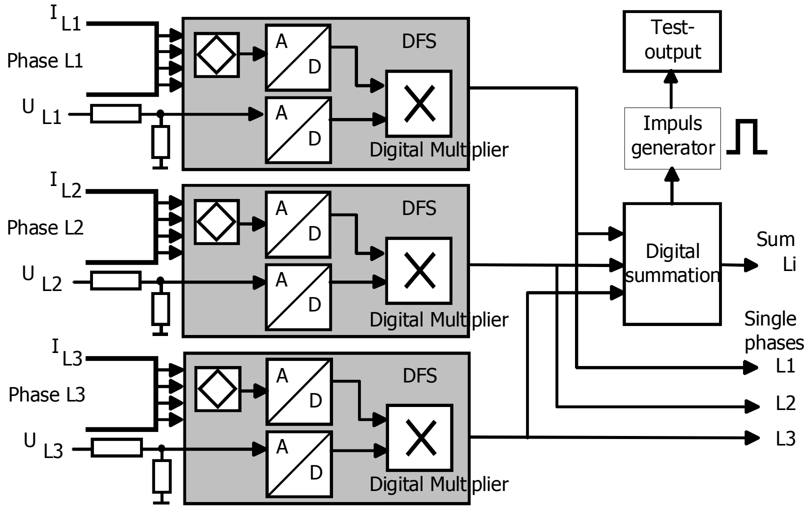


Fig. 2.3 Signal processing diagram for meter ZMF100

The microprocessor generates pulses for the test diode from the digital sum to the meter constant R.

2.6.3 Signal processing

The meter records active energy and can distinguish between energy import and export in up to 4 tariffs (depending on configuration). For this purpose, the microprocessor summates the digitised signals of the sensors and stores the energy consumption in the relevant registers.

Calibration With a calibration function the microprocessor first assesses the signal from the individual sensors on the basis of their deviations. The results determined and stored during the final testing of the meter.

Start detection The microprocessor then compares the power present with the minimum starting power specified. The signals are only passed on for summation when the minimum starting power is exceeded.

Measured quantities The signal +A is formed by summation for imported measured energy. The signal –A is formed by summation for exported measured energy. The combined total is the summation of the absolute value of +A and –A.

Energy register

11 energy registers are available as follows:

Total +A	Total energy import
Total –A	Total energy export
Rate 1 import	Energy import rate 1
Rate 2 import	Energy import rate 2
Rate 3 import	Energy import rate 3 *(SW version M14 and higher)*
Rate 4 import	Energy import rate 4 *(SW version M14 and higher)*
Rate 1 export	Energy export rate 1 *(SW version M13 and higher)*
Rate 2 export	Energy export rate 2 *(SW version M13 and higher)*
Rate 3 export	Energy export rate 3 *(SW version M14 and higher)*
Rate 4 export	Energy export rate 4 *(SW version M14 and higher)*
Combined Total	Sum of absolute value of import and export energy

All registers work internally with 9 digits. The internal valence is Wh (Watt-Hours). They cannot be reset later. At 999999999 a roll over to 0 takes place. Please observe that this is the internal storage format, the display and readout format via optical port may be different.

The Register Combined Total is a virtual register; it does not really exist in the form of an individual register. It is the sum of the absolute import and export totals. This is computed when required.

Rate

The meter is designed in its basic version for one rate. A two-rate and a four-rate version are available upon request. The assignment of the rate registers is done by means of parametrisation and is shown on the faceplate.

Rate control

With the two rate version, the rate switching is operated by the AMR Module directly or by control inputs. The rate switching on the four rate version is operated by the AMR module.

The rate input (Pin 5 on the AMR connector) is activated by application of the required current I_d. The rates can be mapped as follows:

Active rate	**Normal mode**	**Inverted mode**
Rate 1	I_d < 10 µA	I_d > 1 mA
Rate 2	I_d > 1 mA	I_d < 10 µA

The meter can be used for the 3 measurement modes, as mentioned shown below:

Measuring quantities

Active energy/Measuring quantities		Summation
Mode A, vectorial summation, according to Ferraris mode		$(\pm A_{L1})+(\pm A_{L2})+(\pm A_{L3})$
Mode B, Magnitude summation		$+A=\|+A_{Ln}\|, -A=\|-A_{Ln}\|;$ n=1..3
Mode C, Combined Total	Per phase	$+A=\|+A_{Ln}\| + \|-A_{Ln}\|;$ n=1..3

Mode A (vectorial summation):

Mode A simulates the behaviour of a Ferraris meter. As long as the vectorial sum of the three vectors A1, A2, A3 is positive (+A), the energy is added into the import energy register. This means that in Mode A the import energy register is equivalent to a mechanical register with a lock preventing reverse running.

If the vectorial summation of all three vectors is negative, i.e. the energy direction changes from Import (+A) to Export (–A), then the energy will be added to the Total energy export register. If a meter registers in the Total energy export register, either one or more phases have been wrongly connected or energy is exported in one or multiple phases (e.g. solar energy generation).

The test output is triggered in both energy directions.

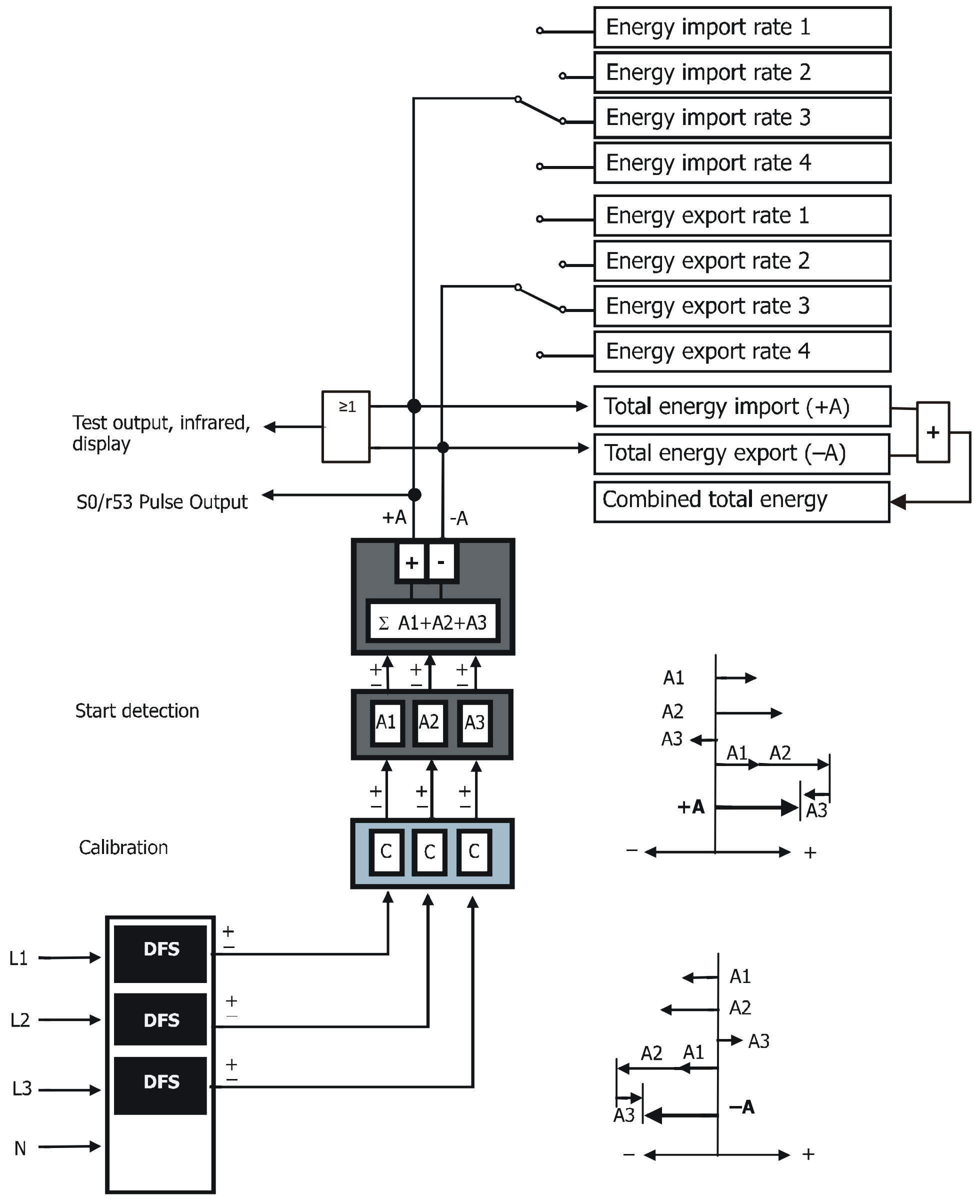


Fig. 2.4 Signal processing for meter ZMF100Ax in Mode A

Mode B (Sign dependent absolute value summation):

In mode B, the meter vectors (A1, A2, A3) are processed considering their sign. This means that vectors with positive signs (Import of energy in dependence of their phase) are added and the sum +A is added into the Total energy import register. The vectors with negative signs are also added and the sum –A is added into the Total energy export register.

Similar to mode A, a registration into the Total energy export register means, that either one or more phases are wrongly installed or that energy is exported (e.g. solar energy).

The test output is triggered only in one direction (import).

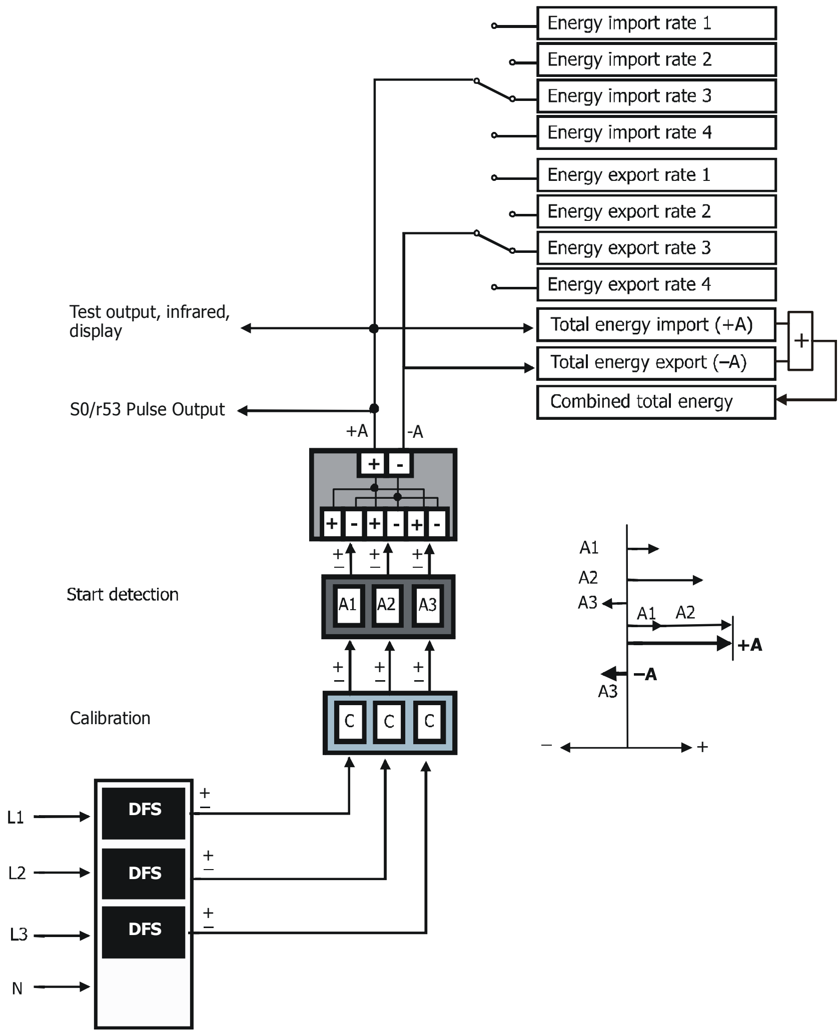


Fig. 2.5 Signal processing for meter ZMF100Ax in Mode B

Mode C (Combined Total):

In mode C the meter vectors (A1, A2, A3) are processed and their sign is considered. This means that vectors with positive signs (import of energy in dependence of their phase) are added and the sum +A is added into the Total energy import register. The vectors with negative signs are also added and the sum –A is added into the Total energy export register. Then the absolute values of sum –A and sum +A are added and shown as Combined Total.

This mode is mainly used where energy fraud is expected and where energy export is impossible.

If energy is registered in the Total energy export register, somebody has manipulated the meter installation.

In the Mode-C, the test output and the r53 (SO-output) are triggered in both energy directions.

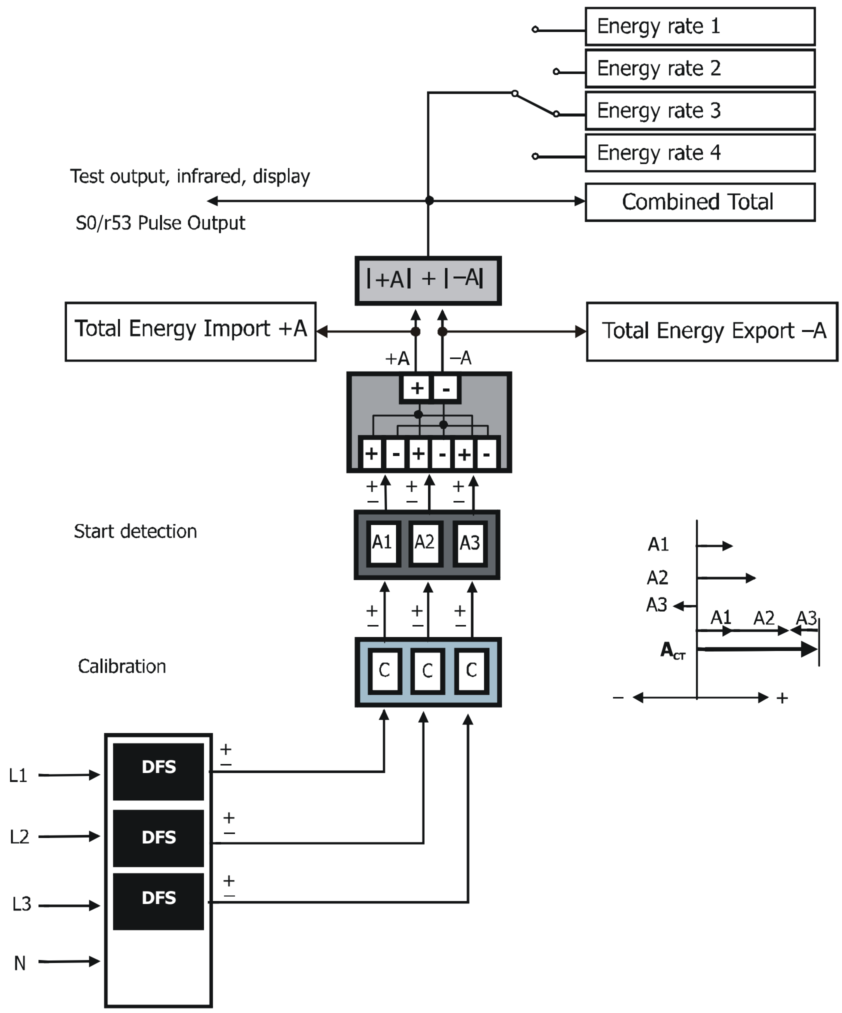


Fig. 2.6 Signal processing for meter ZMF100Ax in Mode C

2.7 Instantaneous values

2.7.1 Voltage Measurement

Voltage measurement is updated every 5 seconds. The start threshold is 50 V, the maximum voltage is 370 V. The resolution is 1 V.

Accuracy	50 V to 370 V:	±1%

2.7.2 Current Measurement

Current measurement is updated every 5 seconds. The start threshold is at 0.2 A, the maximum current is 99.99 A. Two decimal points are required (0.01 A).

Accuracy	0.05 to 0.10 I_b:	±5%	(I_b = 5 A)
	0.10 I_b to I_{max}:	±2.5%	(I_{max} = 100 A)

2.8 Disconnector (SW-version M13 and higher)

Upon request, the ZxF100 meter is available with a disconnector which is controlled via the communication module. Various functions can be implemented:

- disconnection if credit has been used up
- change to minimum power mode if credit has been used up
- disconnection if maximum power has been exceeded over a specified time
- others

3 Mechanical Description

3.1 Housing

The internal construction of the meter will not be described in detail here, since the meter is sealed after calibration and verification at points 3.

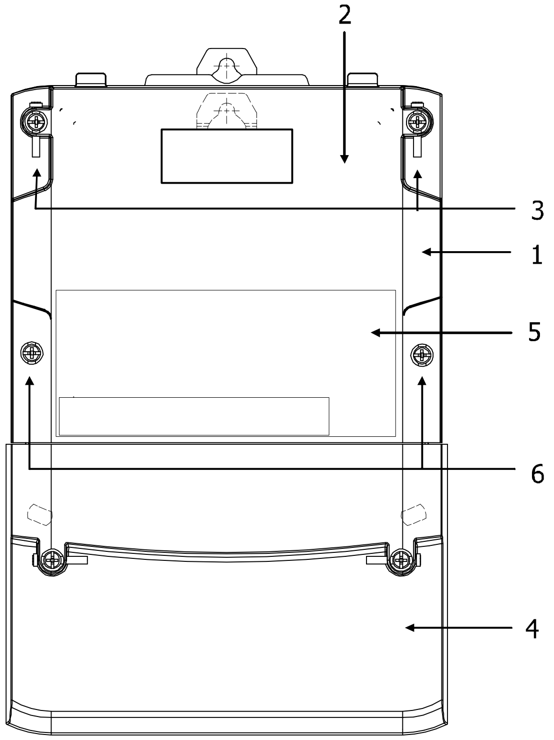


Fig. 3.1 Front view of meter

1 Upper part of case
2 Face plate (for details see Fig. 3.2)
3 Sealing point (manufacturer and /or verification seal)
4 Terminal cover
5 AMR Module compartment
6 MR Module Sealing point manufacturer and/or utility seal)

A terminal block with all connecting terminals for the meter is located under the terminal cover. On the terminal cover, a sealing point for a utility seal prevents unauthorised access to the phase connections. Unrecorded power consumption can be prevented in this way.

3.2 Face Plate

The face plate is configured according to customer specific data. It contains all relevant information of the meter. The window provides a clear view to the LCD (Liquid Crystal Display) and to the combined test diode (optical interface for testing and automatic readout of meter data).

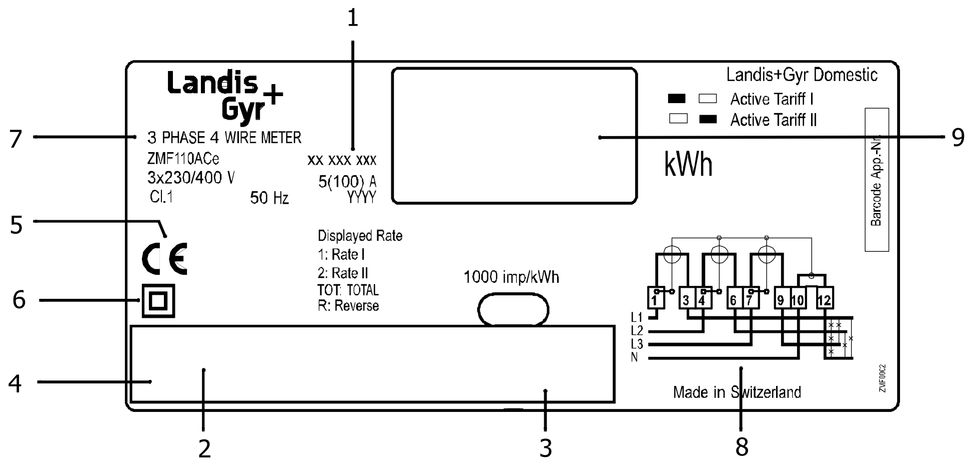


Fig. 3.2 Basic layout of face plate

1. *Manufacturers serial number*
2. *Ownership designation*
3. *Approval symbol*
4. *Customer No./Barcode*
5. *CE Conformity symbol*
6. *Double protection insulation symbol*
7. *Meter data*
8. *Meter circuit diagram*
9. *Active rate*

The control elements and display are fully described in chapter 5.

3.3 Connection diagrams

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Where to find relevant diagrams

The following connection diagrams are only examples. Only the connection diagrams printed on the face plate are relevant for the installation.

3.3.1 ZMF110AC/ZMF120AC

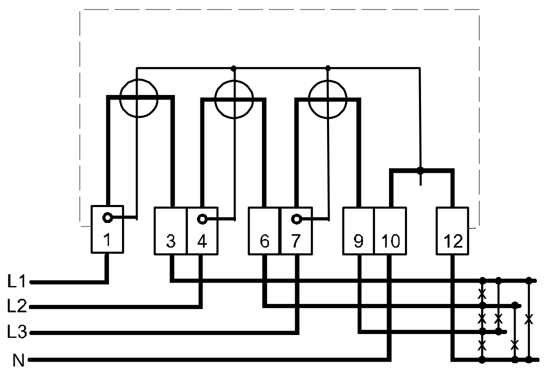


Fig. 3.3 Circuit diagram ZMF100AC (M-Connection)

3.3.2 ZMF110AB/ZMF120AB (with disconnector)

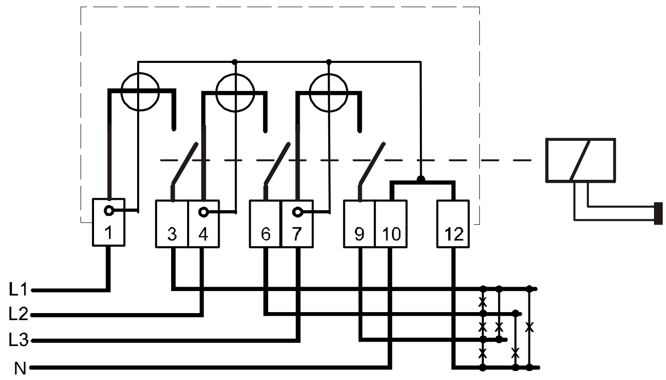


Fig. 3.4 Circuit diagram ZMF100AB (M-Connection)

3.3.3 ZFF110AC/ZFF120AC

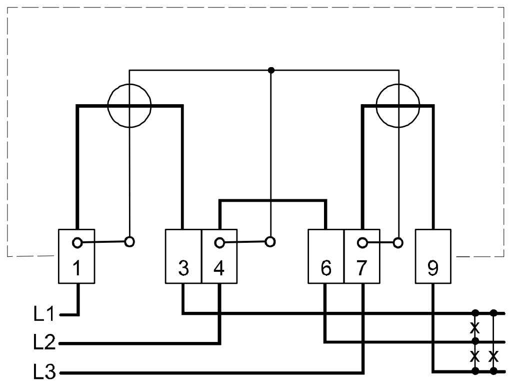


Fig. 3.5 Connection diagram ZFF100AC (Aron-Connection)

3.3.4 ZFF110AB/ZFF120AB (with disconnector)

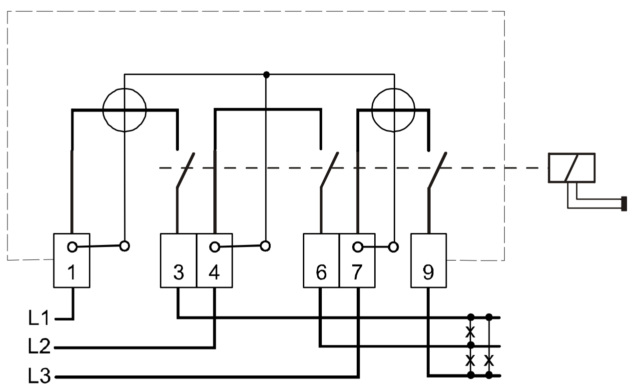


Fig. 3.6 Connection diagram ZFF100AC (Aron-Connection)

3.4 Dimensions

3.4.1 ZMF110AC/ZMF120AC (without disconnector)

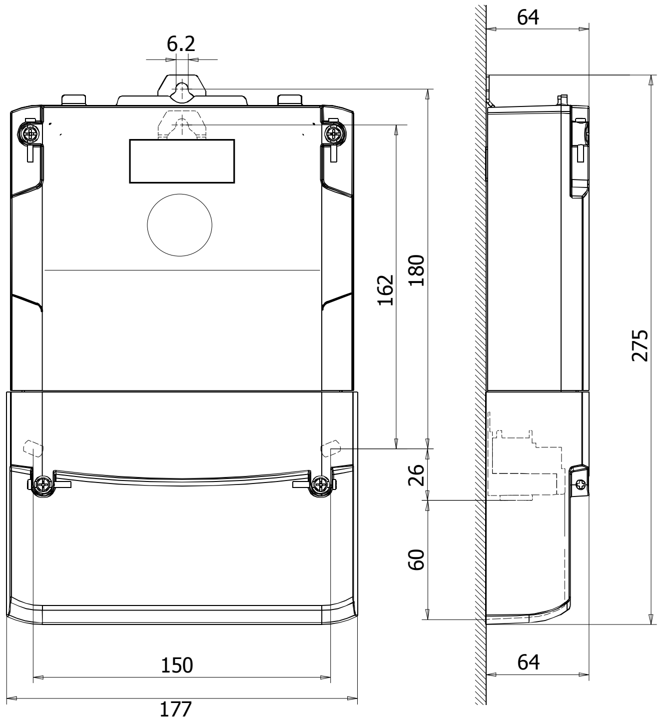


Fig. 3.7 Meter dimensions without disconnector

Extended terminal cover

The meter is optionally available with an extended terminal cover and an additional terminal screws flap. This execution offers increased safety during installation as the terminal screws cannot be touched when the communication module is connected.

The meter dimensions are identical with both terminal covers.

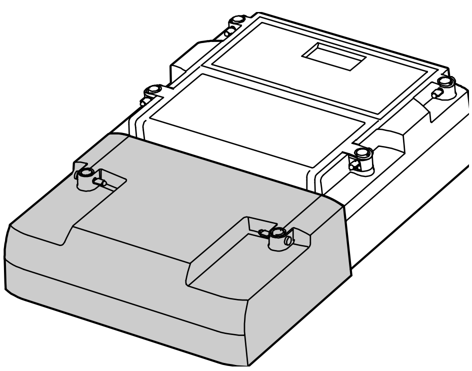


Fig. 3.8 ZMF meter with extended terminal cover

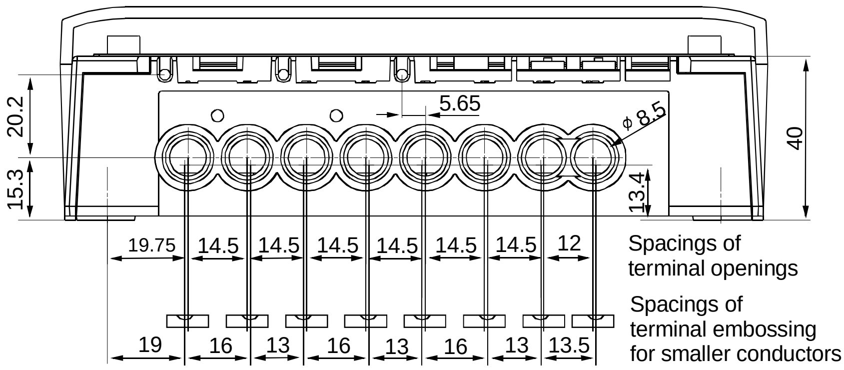


Fig. 3.9 Normal terminal layout and dimensions

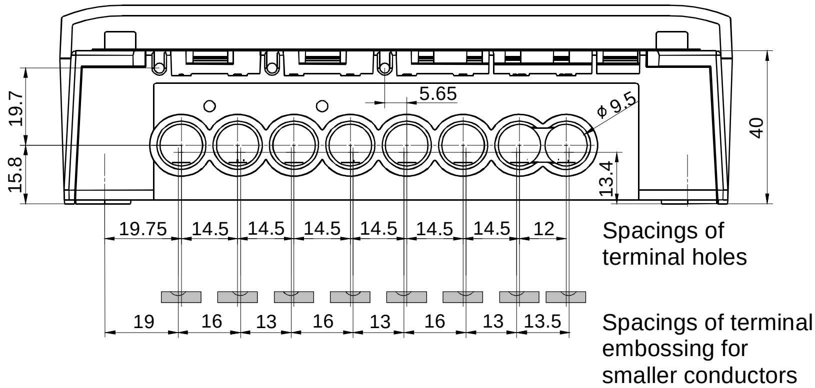


Fig. 3.10 Terminal layout and dimensions with terminal opening diameter of 9.5 mm

3.4.2 Dimensions with disconnector

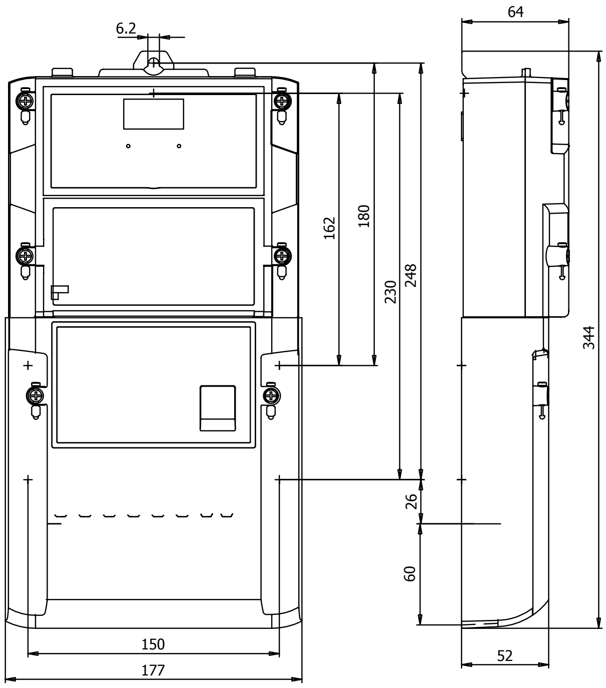


Fig. 3.11 Meter dimensions with disconnector

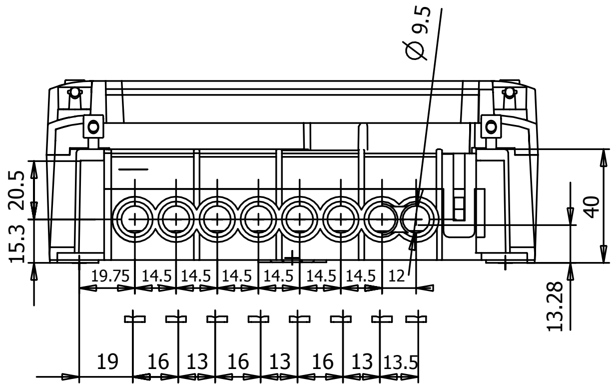


Fig. 3.12 Disconnector version: Terminal dimensions with terminal opening diameter of 9.5 mm

4 Installation/De-installation

Do not touch live parts

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 Mounting the meter

Keep main fuses removed before connecting

The connecting wires at the place of installation must not be live when fitting the meter. Touching live parts is dangerous to life. The corresponding main fuses should therefore be removed and kept in a safe place until work is completed, so that they cannot be replaced by anyone unnoticed.

The meter should be mounted as follows on the meter board or similar device provided for this purpose (see also section 3.4 “Dimensions”):

1. Find the correct position for the meter.
2. Define the desired form of fixing (open or covered meter mounting).
3. Set the meter suspension eyelet in the relevant position. It can be moved up or down over the stop as illustrated below.
4. Check with a phase tester or universal measuring instrument whether the connecting wires are live. If so, remove the corresponding main fuses and keep them in a safe place until installation is completed, so that they cannot be replaced by anyone unnoticed.
5. 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 = 180 mm
   – height of suspension triangle for covered mounting = 162 mm

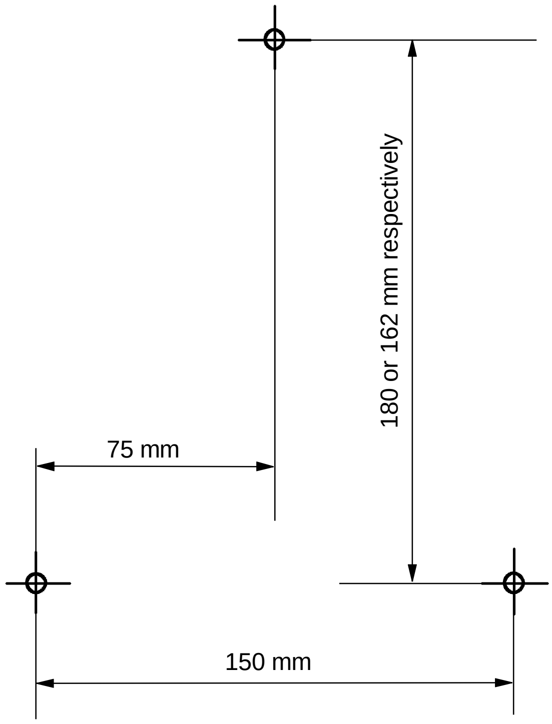


Fig. 4.1 Drilling plan

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

4.2 Connecting meter

Remove main fuses before connecting

The connecting wires at the place of installation must not be live when fitting the meter. Touching live parts is dangerous to life. The corresponding main fuses should therefore be removed and kept in a safe place until work is completed, so that they cannot be replaced by anyone unnoticed.

*For ZXF100AB meters: **Do not use the disconnector as a main switch for installation or maintenance purposes!** The meter remains connected to the mains! Touching live parts is dangerous to life.*

No overcurrent protection and automatic disconnection

As the meter has no internal overcurrent protection and no method of disconnection from the mains, this must be provided by the end installation.

Disconnector has to be protected against overcurrent

For ZXF100AB meters: As the disconnector is not equipped with a thermal and/or short circuit protection device, it needs to be protected with an external fuse or overload switch.

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 max. 3 Nm). ***Note:*** *Always connect* ***phase 1*** *as this is the phase used by modules for plc-communication.*

With small conductor cross-sections (e.g. 4 mm^2) 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.

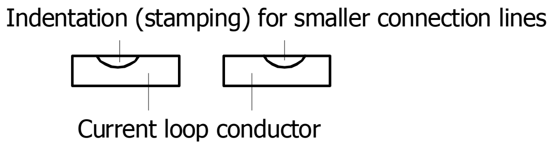


Fig. 4.2 Cross-section through current loop conductor

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

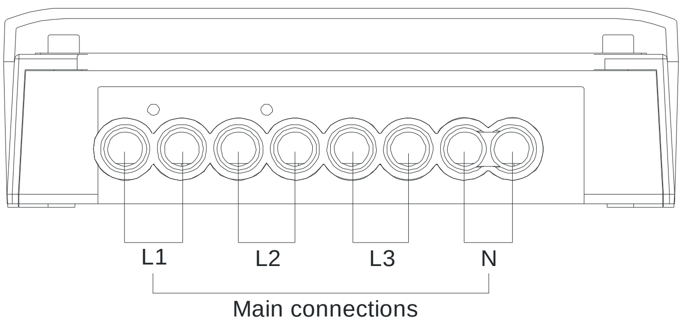


Fig. 4.3 Meter connections

3. Fix screws at the phase connection tightly.

Insufficiently tightened screws

Insufficiently tightened screws of the 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 6.4 W at 80 A!

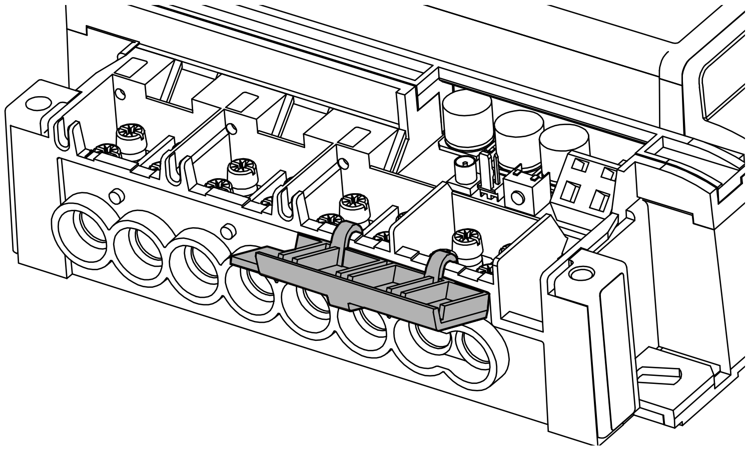
Insulate to correct length

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. Touching live parts is dangerous to life. The stripped part of the connecting wire should be shortened if necessary.

Do not withdraw connecting wires with closed terminals

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

4. Meters with extended terminal cover: swivel the terminal cover flap onto the terminal screws.



5. If needed, connect the cables to the communication module.

4.3 Check of connections

Secure proper connection

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

Before putting into operation the following points must be checked again and corrected if necessary:

1. Has the correct meter (identification number) been installed at the measuring point of the relevant consumer?
2. Is the calibration connection closed (voltage jumper between phase and voltage circuit) (no contact pin inserted to lift the contact spring)?
3. Are all thrust screws for the phase connections and neutral tightened sufficiently?
4. Are the inputs and outputs for each phase connected correctly? The conductor from the house connection or from the consumer fuse must be present at the input (terminals 1, 4, 7), those of the meter to the consumer at the output (terminals 3, 6, 9).
5. Is the neutral conductor connected to terminals 10 and 12? Interchanging of a phase with the neutral would destroy the meter.
6. Mount the terminal cover after a successful check of the connections, tighten its screws and seal it.

4.4 Commissioning and functional check

Do not touch live parts

The main fuses must be replaced to put the meter into operation and for the functional check. While the terminal cover remains unscrewed there is a danger of contact with the connecting terminals. Touching live parts is a danger to life. For any modifications to the installation therefore the main fuses must always be removed again and kept in a safe place until completion of work, so that they cannot be replaced by anyone unnoticed.

Absence of mains voltage

If no mains voltage is yet present, commissioning and functional check must be performed later.

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

1. Insert the main fuses removed before installation. The meter is on.
2. Check whether the operating display appears correctly (no error message) and with no load connected that the visual output is permanently on (creep indicator).
3. Connect a load and check whether the visual output starts flashing.
4. Check whether the disconnector (if present) works according to the functionality specified for your application.

4.5 Disconnecting meters

Remove main fuses before disconnecting

The connecting wires at the place of installation must not be live when removing the meter. Touching live parts is dangerous to life. The corresponding main fuses should be removed and kept in a safe place until work is completed, so that they cannot be replaced by anyone unnoticed.

For ZXF100AB: ***Do not use the disconnector as a main switch for disconnecting purposes!*** *The meter remains connected to the mains!*

Remove the meter from the network as follows:

1. Switch off the voltage. The display goes off.
2. Remove the seal at the terminal cover.
3. Release and remove the terminal cover.
4. Ensure with a phase checker that the connecting lines have no voltage. If there is voltage, remove the main fuses and keep them separately so nobody can insert them unnoticed.
5. Remove the connecting wires of the AMR Module, if available.
6. Release the terminal screws of the phase and neutral connecting wires with a suitable screwdriver and withdraw the phase and neutral connecting wires from the terminals.
7. Fit a substitute meter as described in section 4.2 "Connecting meter" and the following chapters.

5 Operation

5.1 Control elements

The **ZXF100AC** meter has no control elements in the normal sense. The only operating function, data acquisition, is made either by reading the display or automatic readout via the optical interface. For this purpose, the optical head is placed on the marked position on the plastic window of the meter and readout is performed with a handheld terminal (refer to chapter 5.5 “Data readout”).

The **ZXF100AB** meter has a push button for the operation of the disconnector. All other features correspond to that of the ZXF100AC meter.

5.2 Liquid crystal display (LCD)

Meters are provided with a simple liquid crystal display (LCD).

5.2.1 Basic Layout

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

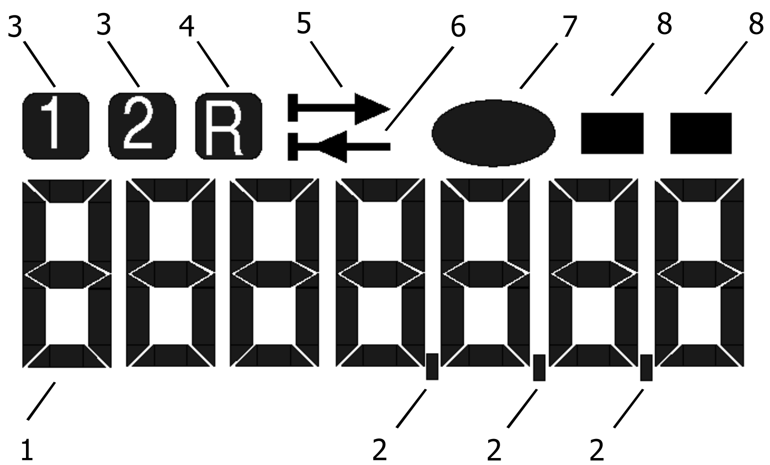


Fig. 5.1 Basic layout of liquid crystal display (LCD)

1 7 segment digits
2 Decimal point
3 Rate indicator
4 Export total register display
5 Energy direction Import
6 Energy direction Export
7 Visual output (creep indicator, flashes if meter registers energy)
8 Active rate indicator

5.2.2 Explanations to LCD display

- The 7 segment digits are able to display numeric data or limited alpha numeric text.
- The decimal points are used to show decimal places.
- The visual output indicator (creep indicator) is switched on after start up as well as each time the used energy is below the No Load Threshold.
- As soon as the No Load Treshold is exceeded and the meter registers energy, the visual output starts flashing proportionally to the measured power. The flashing is limited to max. 1 Hz, i.e. with higher powers the flashing simply indicates that the meter registers energy.

Display Indicators

There are eight indicators on the display. Some of these are used to identify a displayed register and some are status indicators. Their usage is described in the sections below. The exceptions are the test displays where they are either all off or all on.

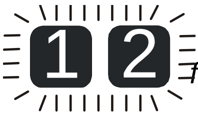
Rate Register Identification Indicators

These two indicators are used to identify a rate register when it is been displayed. Only one may be shown at any time.

Rate register 1 is being displayed.

Rate register 2 is being displayed.

Rate register 3 is being displayed.



flashing

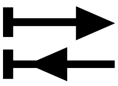
Rate register 4 is being displayed.

Reverse Register Identification Indicator

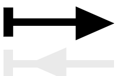
This indicator shows that the reverse total register is being displayed.

Energy Flow Status Indicators

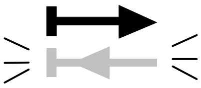
These indicators are used to show the current energy flow. The top indicator represents import energy flow and the bottom indicator represents export energy flow. These can be seen on any display. They are updated once per second.



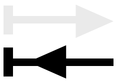
If the meter is in creep, these indicators are off.



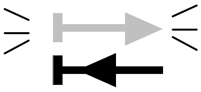
If the energy flow is import only, the top indicator is on as shown beneath.



For the 4-wire connection only, if the total energy flow is import but at least one phase has export energy flow, the top indicator is on and the bottom indicator flashes.

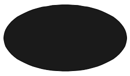


If the energy flow is export only, the bottom indicator is on as shown beneath.



For the 4-wire connection only, if the total energy flow is export but at least one phase has import energy flow, the bottom indicator is on and the top indicator flashes.

Visual Output (Creep Indicator)



This indicator is used for two different purposes. It can visibly show energy pulses and it can show creep status. Its use as creep indicator can be enabled or disabled in the meter configuration.

Enable Creep test

This indicator is displayed with all display sequence items.

Use as a creep indicator

Initially after power-up it indicates creep.

Use as an energy registering pulse

As a pulse indicator, it shows when the meter registers energy. It is on for half a second when the meter registers a whole Wh of energy. It then stays off for at least half a second until the next Wh is registered. At high energy consumption rates, its frequency is limited to 1 Hz.

Active Rate Register Status Indicators

These indicators are used to show the active rate.

Left indicator on: **rate 1** is active
Right indicator on: **rate 2** is active
Both indicators on: **rate 3** is active
Both indicators are flashing: **rate 4** is active.

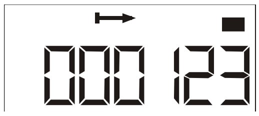
5.2.3 Display definitions

There are a number of different displays, which can be shown by the meter. The following section details how they will appear.

Note: Some displays, such as the error message display, only appear in special circumstances, e.g. when an error occurs. Any additional displays needed during the production process of the meter are not defined here.

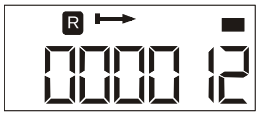
Import energy total

This display shows the value of the Import Total register. It can be placed in either display sequence. The example below shows a value of 123 kWh. In this case the displayed value is parametrised for 6 digits. The leading zeros are not suppressed. The arrow shows that energy is imported.



Export energy total

This display shows the value of the Reverse Total register. The example below shows a value of 12 kWh. In this case the displayed value is parametrised for 6 digits. The arrow shows that energy is imported.

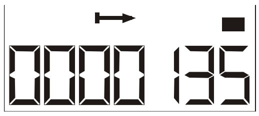


Combined Total

The display below shows the value of the Combined Total register. It can be placed in either display sequence. The example shows a value of 135 kWh.

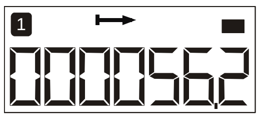
Attention: It is not foreseen that this display is shown in the same display sequence with display Import total.

The arrow shows that energy is imported. The register is parametrised for seven digits. The leading zeros are not suppressed.



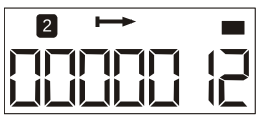
Rate 1 import

This display shows the value of Rate 1 register. The example below shows a value of 56,2 kWh. Furthermore, the import arrow is shown. Rate 1 is shown, rate 2 is active.



Rate 2 import

This display shows the value of the currently active Rate 2 import register. The example below shows a value of 12 kWh. In this case, the displayed value is parametrised for 7 digits and the leading zeros are not suppressed.

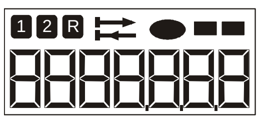


Blank display test

For this test all segments are turned off.

All Segment On Test

For this test all segments of the LCD display are turned on. It is used to check for missing segments. The display looks like this:



Error display

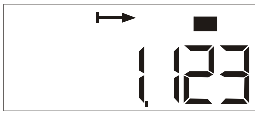
This display is only generated when an error occurs. It cannot be entered in a display sequence, it automatically turns up in case of a malfunction.

ROM Checksum

The ROM checksum is displayed at the end of the display sequence.

Dial test

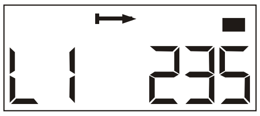
This display is used for meter testing only. It shows the last 4 digits of the import total register, whereby the entire display flashes at 1 Hz. It is used for accelerated product certification which can now be done with 0,5 kWh in about 2 minutes. The display shows a value of 1,123 kWh. This display should only be used in the start-up mode.

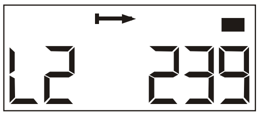


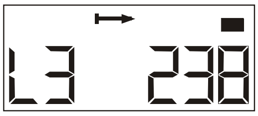
Line voltages

The line voltages can only be displayed in the start-up display sequence. They are shown with an 'L' followed by the phase number. This depends on whether the meter is wired in a 4-wire or 3-wire connection.
Examples of each voltage display are shown below:

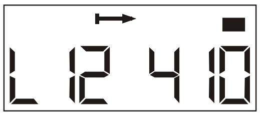
4-wire connection

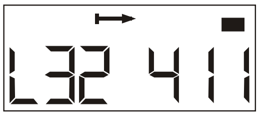




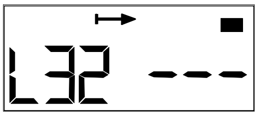


3-wire connection

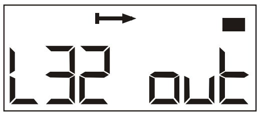




Failed phases



(SW version M13 and higher)

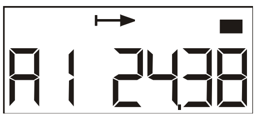


(Up to SW version M12)

Line current
(from SW M14 on)

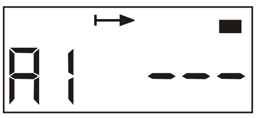
The line currents can only be displayed in the start-up display sequence. They are shown with an 'A' followed by the phase number.

Normal operation



Current too low

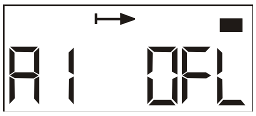
If the measured current is below 0.2 A, "---" is displayed instead.



Current too high

If the measured current exceeds the maximum measurable current

(99.99 A), “OFL” (overflow) is displayed instead.



Display sequence

The previous section shows in detail the possible displays. The display sequence shown on any specific customer’s meter are set through parametrisation at the factory.

There are two different display sequences:

- Start-up sequence
- Normal display sequence

The start-up sequence allows tests to be carried out by allowing higher start-up resolution of the registers when the meter first powers up. Since there are no buttons on the meter, the start-up sequence is performed after each voltage interruption when the meter is powered up again. The transition time from the start-up sequence is active for 30 min or 1 hour and is determined by parametrisation.

The start-up sequence as well as the normal display sequence can consist up to 21 display items. The meter displays the first display in a sequence for a set time (which can be defined by parametrisation individually for each display between 1 sec. and 32 sec.) before moving on to the next display. After the last display in sequence, it starts again.

Parameters which have an influence on the display sequence must be defined in the configuration process.

These items are:

- Leading zeros can be enabled/disabled for registers
- Energy register display can be defined with 6 or 7 digits
- Energy-register display (kWh) with 0 or 1 decimal place
  (in special cases with 2 decimal places)
- Active rate indication can be enabled or disabled
- Flashing decimal point to indicate that the meter is in the start-up display mode

Display Sequence Example

The following tables show a simple meter display sequence configuration. The value of the Import Total register is assumed to be 000123456 Wh in this example. The start-up sequence is active for 1 hour and the registers are set to show 6 digits and 1 decimal place. The leading zeros are not suppressed.

Start-up Sequence	
(1 decimal place)	
Import Total	10 s
Display Test	1 s

Normal Sequence	
(no decimal place)	
Import Total	8 s
Display Test	1 s
Import Total	8 s
Display Blank	1 s

After power-up the start-up sequence is used. The meter first shows the Import Energy total register as 000123.4 kWh for 10 seconds, followed by all segments on for 1 second. This sequence is repeated until the normal display sequence becomes active one hour later.

The Import Total Register is now displayed as 0000123 kWh for 8 seconds followed by all segments on for 1 second. The Import Energy Total is now displayed again for 8 seconds, followed by a blank display for 1 second. This sequence repeats until the meter is powered down.

5.3 Optical Test Output

The test diode is used for meter testing. It transmits infrared pulses equivalent to the currently measured value. The number of pulses per time unit depends on the meter constant (as stated on the face plate) and on the measured power.

The test diode, combined with the optical port, transmits infrared pulses with a pulse width of 2 ms. The test diode works in both energy directions depending on the mode A/B/C.

5.4 Optical interface

All meters have an optical communications port. If the AMR module supports this function, both meter and module can be accessed via optical port. In this case, the AMR module has to be addressed.

Data readout

Reading the meter's registers and identity in the field using a HHT (Hand Held Terminal). The readout list is in full accordance with the provisions of IEC62056-21. The optical port is normally closed, a wake up string is sent to the meter, which activates the readout list.

Test output

Additionally, it serves as a test output. In this capacity, it transmits infrared pulses for meter testing purposes (see chapter 5.3).

5.5 Data readout

The power supply company can record the data stored in the meter, particularly the energy consumption, on the spot at any time in two ways:

- Reading the display of the meter. However, only the data shown on the scrolling operating display can be recorded.
- Automatic data readout via the optical interface with the aid of a AMR Module (e.g. hand held terminal T3000). Further data are then accessible depending on the parametrisation (total registers etc.). Log corresponds to the provisions of IEC62056-21 (old IEC 61107), a communication standard for meters.

5.5.1 IEC 62056-21 mode C

The meter supports IEC 62056-21 mode C-a. This enables the reading of data from the meter in the Data Readout Mode. After an initial sign-on sequence, the meter transmits its data to the HHT. This consists of a number of items which are set in the configuration. Each item is sent in ASCII with OBIS (IEC 62056-61) identifiers. Each identifier is on a separate line (separated by carriage return and line feed characters $^{C}{}_{R}{}^{L}{}_{F}$) and follows the format *Identifier (value*units).*

The maximum transmission rate is 9600 bps. The response message identifies the software version and the IEC 62056-21 baud rate mode used.

5.5.2 Readout Configuration

The items which can be read out by the HHT are specified in the configuration. The items that are read, their order in the list, along with the number of decimal places for the registers, can be specified. The register sizes are fixed at 6 or 7 digits, regardless of decimal place value. The number of decimal places can be 0, 1, or 2. This is independent of the display configuration.

The readout list (which is similar to a display sequence) consists of a number of specified items. The customer specifies the readout sequence. This sequence is set at the factory. All items are identified with OBIS codes when read out.

These are the items that can be placed in the readout list (in any order except for 1. Error code, 2. Meter serial number, 3. Customer serial number, 4. Manufacturer ID):

Readout items

OBIS	Items
F.F	*Error Code*
C.1.0	*Meter ID (Serial number) (8 char)*
0.0	*Customer ID (16 char)*
C.1.1	*Manufacturer ID (Serial number) (8 char)*
1.8.1	Energy import tariff 1
1.8.2	Energy import tariff 2
1.8.3	Energy import tariff 3
1.8.4	Energy import tariff 4
2.8.1	Energy export tariff 1
2.8.2	Energy export tariff 2
2.8.3	Energy export tariff 3
2.8.4	Energy export tariff 4
1.8.0	Import Energy Total
2.8.0	Export Energy Total
15.8.0	Combined total
C.7.0	Total number of power losses
32.7	Line voltage L1 or L12
52.7	Line voltage L2
72.7	Line voltage L3 or L32
31.7	Instantaneous current A1
51.7	Instantaneous current A2
71.7	Instantaneous current A3
C.5.0	Status flag (operation state)
	End of list

5.5.3 Status flag (C.5.0)

The status register C.5.0 consists of 8 bits and describes the following:

Bit number	**Allocation**
0	Export detect
1	Creep flag (set on product initialisation and cleared when meter first registers energy)
2	L1 phase fail flag
3	L2 phase fail flag
4	L3 phase fail flag
5	AR = Active rate
6, 7	Used for factory tests

5.5.4 Data readout procedure via optical interface or AMR Module

1. Start the Hand Held Terminal (acc. to associated manual).
2. Connect the cable of the reader head to the Hand Held Terminal.
3. Place the reader head in the marked position on the plastic viewing window of the meter. The reader head is held magnetically.
4. Start the data readout with the Hand Held Terminal (according to the details in the associated operating instructions).
5. Remove the reader head from the meter again after the readout.

Readout list (example)

The data read out are recorded in the form shown below. The scope and sequence of values in the readout list is determined by parametrisation.

Info flow	Readout list	Significance
--->>>	/?! $^{C}_{R}{}^{L}_{F}$	Opening string (initial sign on)
<<<---	/LGZ5ZMF100AC.MXX$^{C}_{R}{}^{L}_{F}$	Unit recognition for the specific manufacturer (no identification of data; MXX: SW version)
--->>>	<ACK>000 $^{C}_{R}{}^{L}_{F}$	Acknowledgement
<<<---	<STX> F.F(00)$^{C}_{R}{}^{L}_{F}$	Start of text, Error message
<<<---	C.1.0(0000000074892473) $^{C}_{R}{}^{L}_{F}$	Meter serial number
<<<---	1.8.0(000065.3*kWh) $^{C}_{R}{}^{L}_{F}$	Energy import Total
<<<---	2.8.0(000003.5*kWh)$^{C}_{R}{}^{L}_{F}$	Energy export Total
<<<---	1.8.1(000021.5*kWh)$^{C}_{R}{}^{L}_{F}$	Energy import tariff 1
<<<---	1.8.2(00043.8*kWh)$^{C}_{R}{}^{L}_{F}$	Energy import tariff 2
<<<---	2.8.1(000001.5*kWh)$^{C}_{R}{}^{L}_{F}$	Energy export tariff 1
<<<---	2.8.2(00000.0*kWh)$^{C}_{R}{}^{L}_{F}$	Energy export tariff 2
<<<---	C.5.0(03)$^{C}_{R}{}^{L}_{F}$	Status flag (export detect flag)
<<<---	<ETX><BCC>	End of text, Checksum

Fig. 5. 2 Example of readout list

<ACK>, <CR>, <LF>, <STX>, <ETX>, <BCC> ASCII character not visualised in the Data Readout list.

6 Service

6.1 Operating faults

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

1. Is the mains voltage present (main fuses intact)?
2. Is the maximum permissible ambient temperature not exceeded?
3. Is the plastic viewing window over the dial clean (not scratched, painted over, misted over or soiled in any way)?

If none of the points listed is the cause of the fault, the meter should be disconnected, removed and sent to the responsible Landis+Gyr service centre (according to section Repairing meters 6.3 “Repairing meters”).

6.2 Error Messages

Errors are shown as „Err nn“ where nn is the error number. The error code is also included in the readout list (see section 5.2.3 “Display definitions”).

The assigned error numbers are:

Error	**Persistent** up to M12	**Persistent** M13, M14	**Persistent** M15	**Description**
01	No	Yes	Yes	Reading from or writing to EEPROM has failed at least three times.
02	No	No	No	Power save structure corrupt. Registered energy since last power down is set to zero.
03	Yes	Yes	Yes	Calibration values are corrupt, default values are used instead. Measured data are inaccurate.
04	Yes	Yes	Yes	Energy registers contain corrupted values. Measured energy is invalid.
05	No	No	No	Checksum of current energy registers is invalid. Latest valid copy is restored instead.
06	No	No	No	Communication with measuring chip failed 8 times successively.
07	No	Yes	Yes	Measurement chip parameters are incorrect and cannot be restored.
08	No	n/a	n/a	Power supply control structure CRC incorrect - using default.
09	n/a	n/a	Yes	ROM checksum error. At each power up, the ROM checksum will be calculated over the entire ROM and compared with the release depended reference checksum. If the calculated checksum does not match with the reference checksum, the appropriate error flag will be set.

Non-persistent error messages are reset at the next readout. Persistent error messages cannot be reset in the field. A meter showing a persistent error message must be considered unsafe for further use. A different meter must be used instead. Any meter showing an error message must be sent to a Landis+Gyr Service Centre (see chapter 6.3).

6.3 Repairing meters

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

1. If installed, remove the meter (see section 4.5) 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. Please also state serial no. and complete type designation no.
3. Pack the meter to ensure it is not damaged during transport. Use the original packing, if available. Do not enclose any loose components.
4. Send the meter to an authorised service centre.

7 Maintenance

The meter does not require any kind of maintenance. The following points should be checked on the meters periodically (e.g. with every data readout):

- Is the meter dry and clean (particularly display and optical interface)?
- Is the meter in operation and serviceable (operating display present and reasonable)?
- Are all calibration and company seals undamaged?
- Is there an error recorded based on periodical internal self tests since the previous check (check on the display or readout list)?
- Have the values of the energy registers changed within reasonable limits since the last data readout (no unauthorised manipulations made to the installation)?

Continue as described in chapter 6.3 “Repairing meters" if errors or irregularities are found.

7.1 Meter testing

The meters are calibrated during the manufacturing process. A recalibration by external means later during the lifetime of the meter is not possible. Meter tests should be performed at periodic intervals according to the valid national regulations (either on all meters or on specific random samples). For this purpose, the meters must be removed as described in section 4.5 “Disconnecting meters” and replaced by a substitute meter for the duration of the test.

7.1.1 Test mode

As described in chapter 5.2.3 “Display Sequence” there are two display sequences available, the start-up mode sequence and the normal mode display sequence. The start-up mode sequence allows test to be carried out by allowing higher resolution of the registers to be displayed when the meter powers up.

In the dial test mode the display shows the last 3 digits of the import total register (i.e. 1.234 Wh resolution). It is normally only used for accelerated product certification. This can now be done with 0.5 kWh in about 2 minutes. Only 4 digits are shown and the entire display flashes at 1 Hz.

The transition time from the start-up sequence to the normal one is controlled by a configuration parameter. It can be set to either 30 minutes or 1 hour. After this time, the meter changes to the normal display sequence.

If the supply voltage is disconnected, the meter will enter the start-up sequence again after power-up for the pre-programmed time span.

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:

ZMF
U_n=230 V

	Measuring uncertainty 0.2%			Measuring uncertainty 0.1%		
Current [A]	3 P cosφ=1	1 P 1	3 P 0.5	3 P cosφ=1	1 P 1	3 P 0.5
0.2	25 s	70 s	90 s	90 s	4.5 min	6 min
0.5	5 s	12 s	15 s	16 s	45 s	60 s
1	4 s	8 s	4 s	8 s	16 s	8 s
2	4 s	8 s	4 s	8 s	16 s	8 s
5	4 s	8 s	4 s	8 s	16 s	8 s
10	4 s	8 s	4 s	8 s	16 s	8 s
20	4 s	8 s	4 s	8 s	16 s	8 s
50	4 s	8 s	4 s	8 s	16 s	8 s
100	4 s	8 s	4 s	8 s	16 s	8 s

3 P = universal
1 P = single-phase

ZFF
U_n =230 V

	Measuring uncertainty 0.2%			Measuring uncertainty 0.1%		
Current [A]	3 P cosφ=1	1 P 1	3 P 0.5	3 P cosφ=1	1 P 1	3 P 0.5
0.2	42 s	3 min	3 min	3 min	12 min	11 min
0.5	8 s	30 s	27 s	30 s	2 min	2 min
1	3 s	8 s	8 s	9 s	30 s	30 s
2	1.5 s	3 s	3 s	4 s	9 s	9 s
5	1.1 s	1.3 s	1.3 s	2.3 s	3 s	3 s
10	1.1 s	1.1 s	1.1 s	2.1 s	2.3 s	2.3 s
20	1.0 s	1.0 s	1.0 s	2.0 s	2.1 s	2.1 s
50	1.0 s	1.0 s	1.0 s	2.0 s	2.0 s	2.0 s
100	1.0 s	1.0 s	1.0 s	2.0 s	2.0 s	2.0 s

7.1.3 Test diode

The infrared test diode used for meter testing purposes is incorporated in the optical interface. It supplies pulses with a value of 1 Wh of the import energy measured. This corresponds to a meter constant of 1’000 imp/kWh. For meter testing purposes, only the rising edge is decisive.

7.1.4 Connection to a meter testing device

To test the meter, connect it to a testing device specially provided for this purpose.

The meter uses a voltage jumper whereby a spring contact connects the voltage circuit of the meter to the phase terminal. By inserting a contact pin of 2.5 mm diameter, the voltage and current circuits of the meter are separated. At the same time, the test voltage is connected via the contact pin. See Fig. 7.1.

Procedure:

1. Connect the meter to the terminals of the testing device as shown in the meter connection diagram and according to the usual testing methods. Remove the small lid of the cover, in order to gain access to the holes for the voltage connection.
2. To connect the test voltage, use a connecting cable with a contact pin of 2.5 mm diameter and approx. 40 mm length (between 39 and 41 mm). This is the standard cable used to test other Landis+Gyr meters. This contact pin is inserted in the circular opening provided on the front side of the terminal block, right above the measuring terminals. The pin lifts the spring off the current loop, breaks the connection and at the same time connects the test voltage.

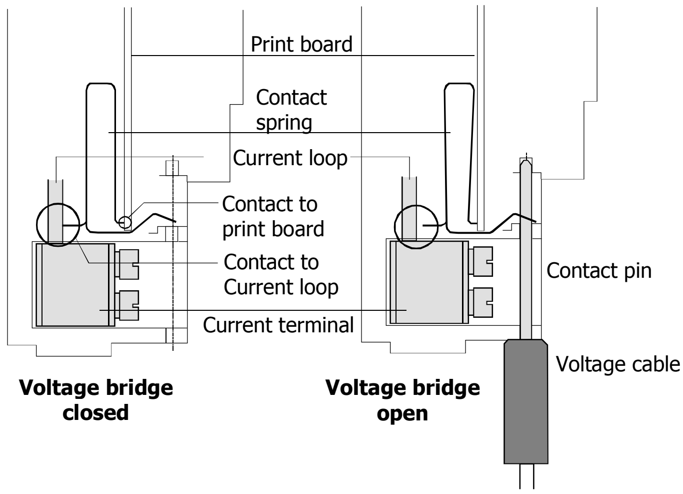
Keep voltage cables free from voltage when inserting

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

3. After testing, remove the cable (not under voltage) from the terminal cover. The spring closes the current loop contact and therefore the voltage is automatically connected again. Assemble the plastic lid with a sealing screw and seal the meter according to your demand.

Do not use unsuitable tools

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



7. 1 Voltage jumper with test voltage connection

7.1.5 Creep test

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

Procedure:

1. Disconnect the meter from the mains for at least 10 seconds.
2. Then switch on the test voltage U_p and wait approx. 10 seconds. The visual output must now be shown. It remains permanently on.

7.1.6 Starting test

Procedure:

1. Apply a load current of 0.1% of the base current I_b or, in the case of MID-meters, of the reference current I_{ref}, e.g. 10 mA with I_b=I_{ref}=10 A, and the voltage U_n (three-phase in each case). The meter must remain in creep.
2. Increase the load current to 0.5% I_b (for MID: to 0.5% I_{ref}) (i.e. 50 mA with I_b = I_{ref} = 10 A). The energy direction arrow must appear within 10 seconds. The visual output starts to flash.

7.2 Cleaning

Avoid running water or high pressure when cleaning soiled meters

Never clean soiled meters under running water or with high pressure devices. Penetrating water can cause short-circuits. A damp cleaning cloth is sufficient to remove normal dirt such as dust. If the meter is more heavily soiled, it should be dismantled if necessary and sent to the responsible service and repair centre.

8 Decommissioning, Disposal

This chapter explains the disconnection of the meter from the system and its correct disposal.

8.1 Decommissioning

The procedure for disconnecting and removing the meter from the mains is described in chapter 4.5.

8.2 Disposal

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

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Disposal and environmental protection regulations

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

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

9 Parameter setting

The meters can be parametrised, i.e. specific parameters can be set with software, so that the meters can be supplied according to the specific wishes of the relevant utility.

Retroactive modification of the parameters is not possible.

The parameters stored in the meter are protected against unauthorised overwriting.