Electricity Meters IEC

High Precision Metering

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Qualigrid ZMQ200, ZFQ200, ZCQ200

E850

Functional Description

Date: 21.12.2011

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Revision history

Version	Date	Comments
a	20.12.2002	First release, for approbation
b	21.03.2003	Updates after review, new Landis+Gyr layout
c	30.06.2003	Updates according to MAP Alpha 4
d	05.04.2004	Updates according to MAP H00
e	30.04.2004	Minor corrections
f	06.10.2004	Update for firmware H01
f	24.02.2005	Layout adaptations for online help
g	04.08.2005	Amendments for firmware version H02/H90 (registration of delta values, demand and power factor, stored billing value profile, IEC60870 subset, transmitting contact test mode)
h	16.12.2008	New Landis+Gyr layout, update for firmware H03 (ABT-tariff for India, additional load profile, new error handling, Persian calendar, communication with limited IEC command set, ...)
h	21.12.2011	New Landis+Gyr template, Layout adaptations for online help

Table of contents

About this document

This document describes the detailed functionality of the Landis+Gyr high-precision meter ZxQ200.

The document serves as functional description and as on-line help of the MAP tool, using the same data source.

- The functional description of the meter is a paper-based document, which can be used for training.
- The **on-line help for the MAP tool** is an electronic document and is an integrated part of the MAP tool.

Firmware version H03 / H90
This document describes the ZxQ meters with firmware H03 and H90 and the MAP tool that is used to parameterise the ZxQ meters with the firmware H03 and H90.

Target group

The target group of this document are persons who perform the following tasks:

- Specification of a metering system
- System integration of the meter in a central system
- Specification of the meter for orders and the processing of orders
- Reparametrisation at the customer's facilities or on site
- Answering customer service requests

The reader must have advanced knowledge of the ZxQ meters and their functionality as well as knowledge of grid metering applications.

Prerequisite

In order to use this document efficiently, the reader must have advanced knowledge of grid metering. A personal computer with the MAP120 tool installed is also necessary.

Referred documents

The following documents complement this Functional Description:

User Manual

Provides information about the installation, commissioning, meter reading, maintenance, decommissioning and disposal of the ZxQ meter.

Technical data

States all technical data of the ZxQ meter.

C.2 and C.7

Versions C.2 and C.7 are described in detail separately in the appendix as they are special versions (meter with software configuration **C.2** need SW-version **H90** instead of H03, **C.7**-versions are exclusively intended for the Indian market).

Conventions

In this manual the following conventions have been made:

Parameters

Parameters are written in italics.

Example: Select *Time of use* as active control source.

Buttons

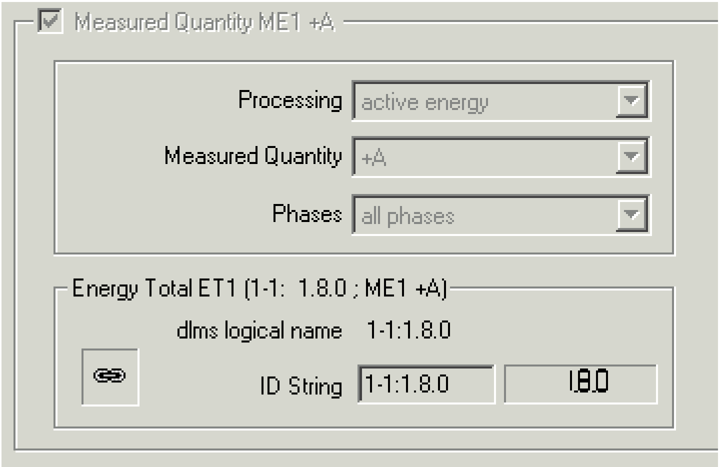
Buttons are written in bold.

Example: Click **Add Season** to add a season.

Functions

Depending on the software configuration of the meter, some functions cannot be activated or deactivated by the customer. In addition, there are selections that are fixed and cannot be altered by parameterisation. In the MAP tool, these functions and selections are shaded.

Example:



The measured quantity ME1 +A is always present (cannot be deactivated) and all relevant parameters are fixed (cannot be altered).

Altering the display code

The display code appears in the code field of the display. By default the display code is identical to the dlms logical name according to the OBIS standard. However, users can set their own display code for each register.

In the MAP tool, the following procedure can be carried out to alter the display code of measured values. The procedure is the same for all measured values that have a display code (e.g. energy registers):

To alter the display code, click  and enter the new display code.

ⓘ

Do not alter the display code
Landis+Gyr strongly recommends not to alter the display code.
In the communication protocols the identification of the measured values is always according to the OBIS standard no matter whether or not it has been altered for the display.

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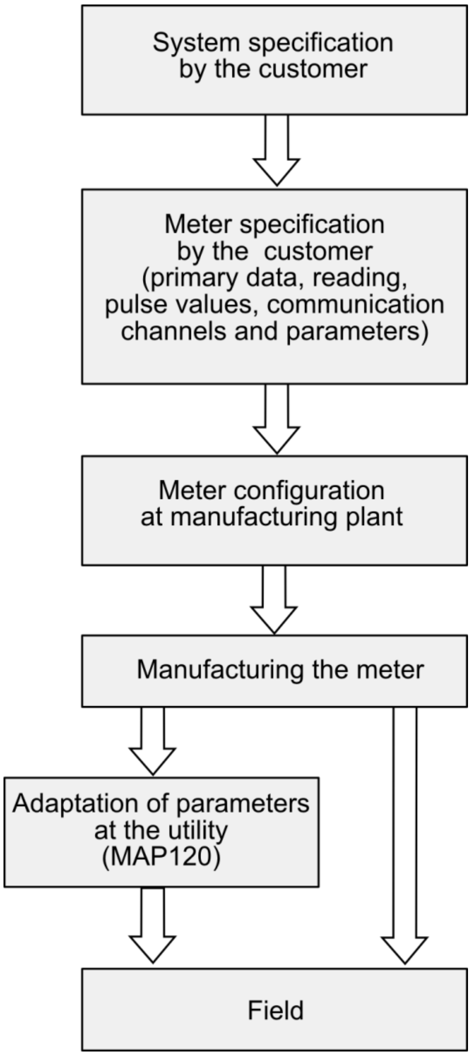
1 Configuration

1.1 Introduction

The configuration of the meter is defined at the manufacturing plant based on the system and meter specification provided by the customer. The hardware and software configuration parameters are set prior to the manufacturing process of the meter in order to specify the process.



Hardware configuration

The hardware configuration parameters specify the physical meter hardware, e.g. the number of measuring elements (M, F, P, C circuit), the accuracy, the transmitting contacts etc.

Software configuration

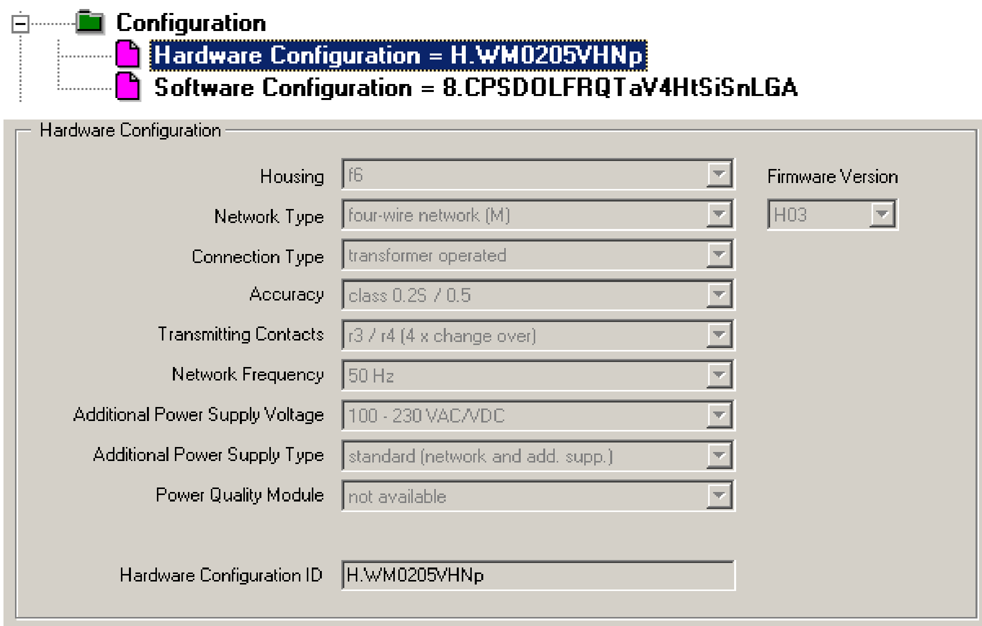
The software configuration parameters define the functional range of the meter, i.e. the various software functions of the meter can be activated or deactivated according to the customer's requirements.

Security System
The configuration of the security system is made at the manufacturing plant based on the order data supplied by the customer. If the customer does not specify the security system when ordering the meters, they are delivered with a standard security system.

1.2 Hardware Configuration Parameters

The hardware configuration parameters describe the meter hardware.

Specify parameters precisely
All meter specifications and parameters that are described in the configuration section can only be set by the manufacturer, i.e. they cannot be altered in the field.



Housing

The type of housing the meter is built in.

f6	Plastic housing for wall mounting
f9	Metal housing for rack or instrument panel mounting, equipped with ESSAILEC connectors

Network Type

The type of mains network the meter is connected to.

- Three-phase four-wire network
- Three-phase three-wire network, Aron circuit
- Single phase network

Special, country-specific network types, e.g. P circuit, are available on request.

Accuracy

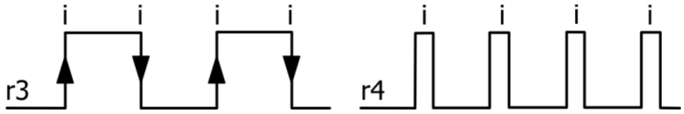
The measuring accuracy of the meter. The first figure represents the accuracy for active energy metering. The second figure after the slash represents the accuracy for reactive energy metering.

0.2S / 0.5	Active energy: Class 0.2 / Reactive energy: Class 0.5
0.2S / 1.0	Active energy: Class 0.2 / Reactive energy: Class 1.0
0.5S / 1.0	Active energy: Class 0.5 / Reactive energy: Class 1.0

Diagnostic values such as current, voltage and power factor are usually registered with class accuracy. Limitations caused by the display resolution are possible, e.g. PF = 0.97.

Transmitting Contacts

Select the transmitting contacts that are used in the meter.

not available	Meter without transmitting contacts
r3 / r4 (4x change-over)	4 changeover transmitting contacts for +A, -A, +R, -R. The distinction between r4 and r3 is made in the software configuration. 
r4a (4 x 2 normally open)	8 normally-open transmitting contacts. The first two contacts are used for +A and -A. The remaining six contacts can be used as pulse output contacts and/or static output contacts for energy flow, load supervision (P_{max}, Q_{max}) and capture period output (tm). If quadrant splitting is selected, the r4a transmitting contacts are used for +A, -A, +Ri, -Ri, +Rc, -Rc. The two remaining contacts can be used e.g. as static output for the capture period (tm(NO), tm(NC)), i.e. a pulse will be generated at the end of an integration period.
r4aa (2 x 4 normally open)	4 normally-open transmitting contacts for +A, -A, +R, -R in 2 groups.

For schematic diagrams see section 3.2 "Terminal Allocation f6 Case" or 3.3 "Terminal Allocation f9 Case".

Selectable pulse width or mark-space ratio of 1
The r4 transmitting contacts send signals with a selectable pulse width of 20 ms, 40 ms or 80 ms while the r3 transmitting contacts send signals with a mark-space ratio of 1 (see section 1.3 "Software Configuration Parameters"). The hardware of the r4 and r3 transmitting contacts is identical. In the rack housing f9, a special connection diagram is needed for the double current output with r3.

Network Frequency

The nominal frequency the meter is connected to.

The selection of the correct frequency is essential because:

- it affects the metering accuracy
- the calendar clock can be synchronised by the network frequency (50 Hz or 60 Hz)
- the frequency is monitored.

Additional Power Supply Voltage

Select the input voltage range of the additional power supply.

Additional Power Supply Type

This parameter defines how the meter is supplied with power.

Standard	The meter is supplied by the measurement voltage and the additional power supply. In the event of a measurement voltage failure, the meter is powered by the additional power supply.
Special	The meter is supplied by the additional power supply. If the additional power supply fails the meter is supplied by the measurement voltage.

Power Quality Recorder

Select whether or not the optional power quality recorder is integrated in the meter. If a power quality recorder is integrated, the serial interface with which it communicates must be selected.

no PQ module	The meter has no power quality recorder.
P2	The power quality recorder communicates via RS232.
P4	The power quality recorder communicates via RS485.

The main characteristics of the power quality recorder are:

- Values according to EN 50160
- Integration period from 1 s to 1 h
- Single harmonics from 1st to 40th in voltage and current
- Recorder triggered by event
- Separate communication line (RS485, RS232) for data read-out by software tool

The analysis of the power quality recorder data is carried out with the analysis software SICARO Q Manager / PQ.

The option power quality recorder is only available for certain markets.

Firmware Version

Select the firmware version that is implemented in the meter.

Meters with the software configurations **C.4 and higher** work with the firmware version **H03** (previous versions: H01, H02). These meters feature the full functionality and dlms communication.

Meters with the software configuration **C.2** work with the firmware version **H90**. These meters have been designed for the connection to the trans-coders FAG/FBC using the IEC60870 subset for communication. Therefore, they feature:

- no tariff control
  - no tariff control inputs
  - no energy tariff registers
- no time switch (time of use) and no control table
- no synchronisation input

Latest firmware version
The latest firmware version is used for new projects and orders. In case of modifications to existing meters, the firmware version of the meters must be selected.

Synchronisation Input Voltage U_{syn}

Select the voltage of the synchronisation input that is used to synchronise the internal clock. If the synchronisation input is not used, there is no need to specify this voltage (see section 4 "Calendar Clock"). A jumper on the supply board must be set accordingly.

Tariff Control Voltage U_d

Select the voltage of the three tariff control inputs that are used to select the required tariff or to enable the bypass feeder operation mode. A jumper on the supply board must be set accordingly.

Notification Input B Voltage

Instead of the tariff control inputs it is possible to use an input to notify the remote metering central station of the bypass feeder operation mode. This mode should only be used if a bypass feeder is present in the switching station.

Chassis

The meters with an f9 housing can be mounted in a 19" rack. The following versions of the chassis are available.

f9.10	19" rack with counter connectors for cable connection. This rack does not include any cables. The required cables have to be ordered separately.
f9.11	19" rack with counter-connector for one meter (direct connection)
f9.12	19" rack with counter-connectors for two meters (direct connection)

Recess

Meters with a f9 housing that are installed in a recess (flush mounting) are delivered with a set of mounting brackets. In addition, the meter is equipped with an earth screw at the back of the housing.

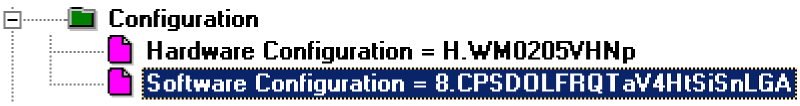
1.2.1 Hardware Configuration ID

The hardware configuration ID is a code that is generated automatically based on the hardware selected.

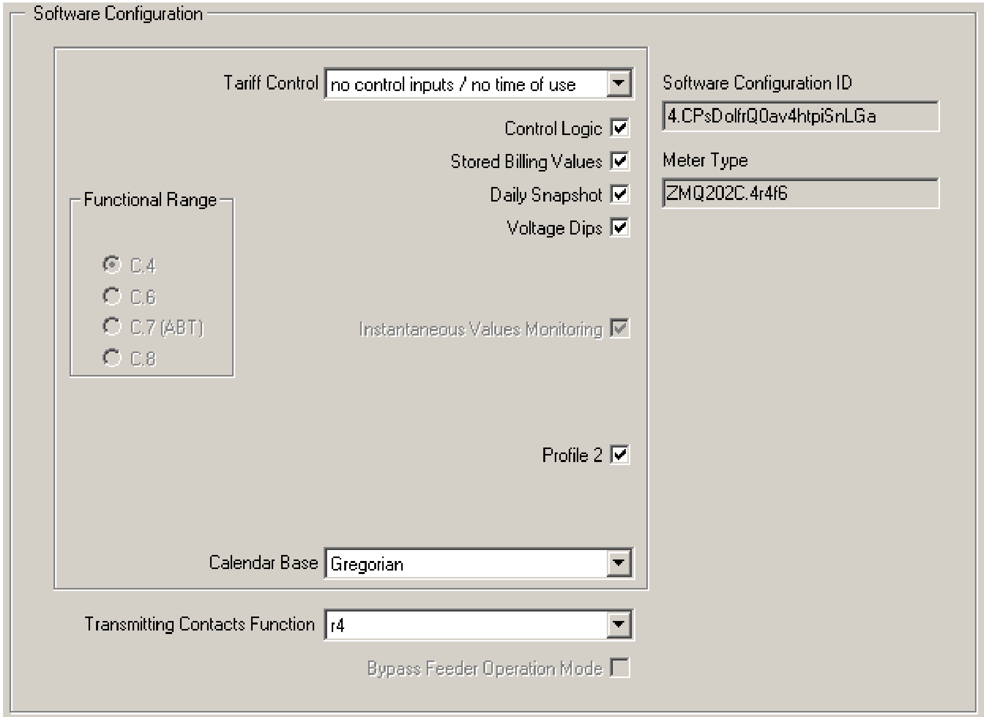
Pos.	Name	Code	Description
1	Device Type	H	ZxQ-meter
	Separator	.	(dot)
2	Housing	W	f6 housing: wall mounted
		R	f9 housing: rack mounted
3	Network Type	M	four-wire network (M-circuit)
		F	three-wire network (F-circuit)
		C	two-wire network (C-circuit)
4-7	Accuracy	0205	class 0.2S / 0.5
		0210	class 0.2S / 1
		0505	class 0.5S / 0.5
		0510	class 0.5S / 1
8	Display Type	V	8-segment
9	Additional Power Supply	H	100 - 230 VAC/VDC
	Voltage (APSVoltage)	L	24 - 125 VAC/VDC
10	Additional Power Supply Type (APSType)	N	standard (powered by network and additional supply)
		S	special (powered by additional power supply only)
	Additional Power Supply Type (APSType) AND Connection Type = voltage direct connection	E	exclusively (only add. supply, no main supply, only for 3 x 400/230 V)
11	Power Quality Recorder	p	not present (standard)
		4	RS485
		2	RS232

1.3 Software Configuration Parameters

The software configuration parameters determine the functional range of the meter. Select a configuration and, depending on the selection, the MAP tree is extended or shortened accordingly.



C.4



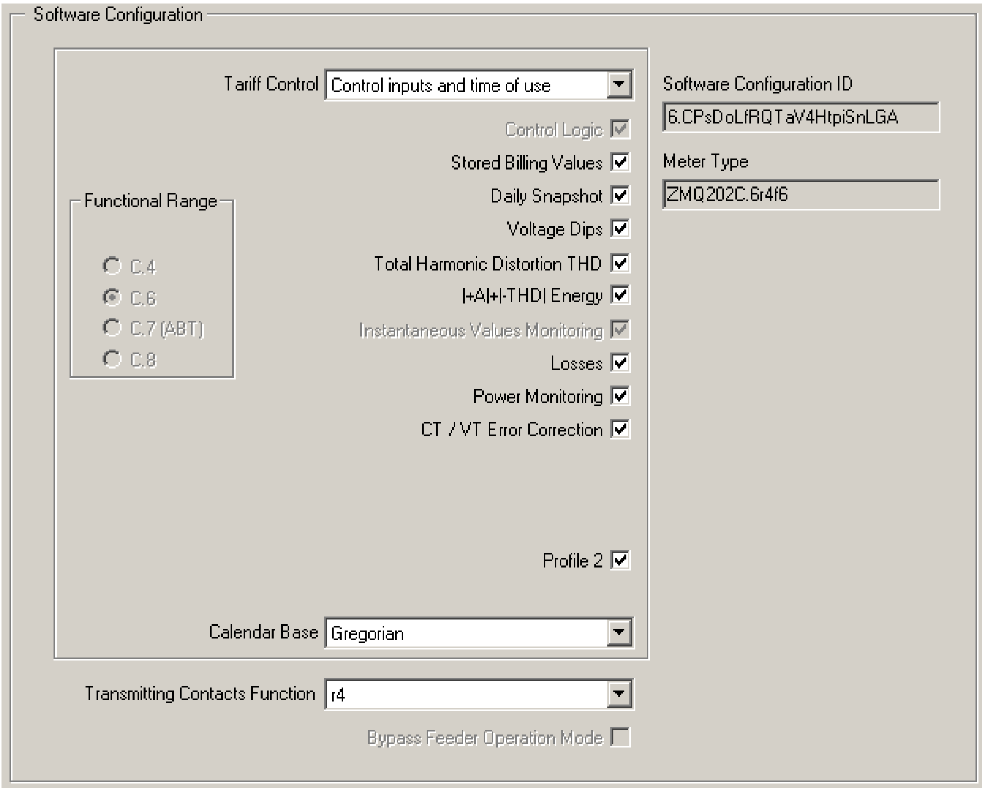
If C.4 is selected, the following meter functions are available:

- All-phase active energy metering +A, -A
- All-phase reactive energy metering +R, -R or +Ri, +Rc, -Ri, -Rc
- Measurement of phase voltages, phase currents and network frequency
- Detection of phase outages
- Phase angle measurement and detection of direction of rotating field
- Time of use
- Control table
- Stored billing values
- Load profile with the possibility to register original meter values and values for energy advance (delta values)
- Second profile
- Event log
- Daily snapshot *
- Voltage dip table *
- Instantaneous value monitoring *

- Customer magnitude adjustment
- Tariff control (option) via real time clock or tariff control inputs. The control signals that are being used for tariff control must be selected.
- Transmitting contact module (option)
- Static output contacts for capture period output (tm)
- Static output contacts for energy flow
- Frequency monitoring
- Bypass feeder operation *

* These features can be activated and deactivated independently. The MAP tree is expanded or shortened accordingly.

C.6

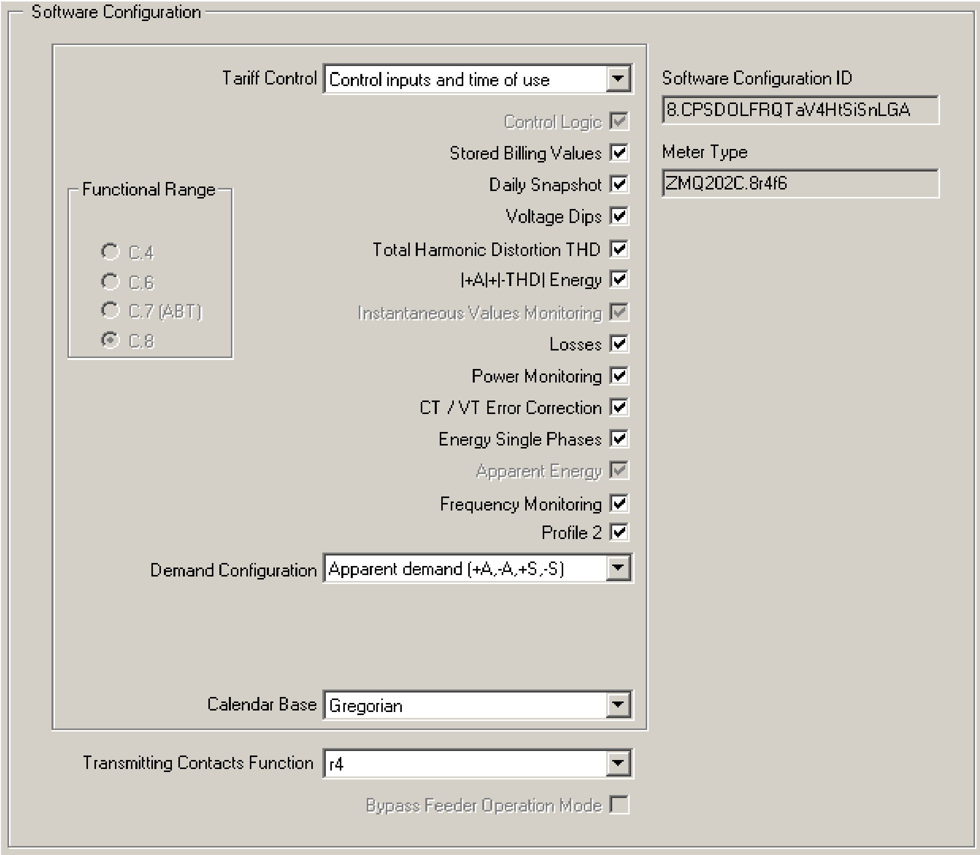


If C.6 is selected, the C.4 meter functions plus the following selection of meter functions are available:

- Loss measurement
- Power monitoring
- CT / VT error correction (option)
- Total harmonic distortion THD
- THD influenced active energy
- Static output contacts for load supervision (P_{max}, Q_{max})

All additional features can be activated and deactivated independently. The MAP tree is expanded or shortened accordingly.

C.8



If C.8 is selected, the C.4 and the C.6 meter functions plus the following selection of meter functions are available:

- Single phase measurement
- Apparent energy measurement
- Demand registration
- Power factor registration
- Stored billing value profile
- Frequency monitoring

All additional features can be activated and deactivated independently. The MAP tree is expanded or shortened accordingly.

1.3.1 Explanations for software configuration

Tariff Control

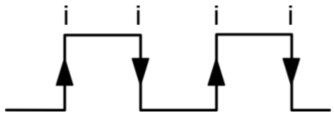
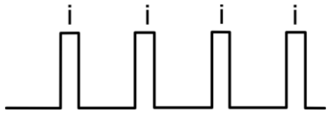
Select the control signals that are available for tariff control.

No control inputs / no time of use	Neither the control inputs nor the time switch is available for tariff control.
Control inputs	The control inputs are available for tariff control. In the control table the time of use signals are not available as control sources. Control inputs for tariff control are usually not used in grid applications.
Control inputs and time of use	The control inputs and the time of use can be used for tariff control.

In grid applications, tariff control is usually not carried out in the meter.

Transmitting Contacts Function

If r3/r4 transmitting contacts have been selected in the hardware configuration, select whether r3 **or** r4 pulses are being transmitted.

r3	Pulses with a mark/space ratio of 1. 
r4 (default)	Pulses with a selectable pulse length (default setting). 

Quadrant Splitting (special)

Select whether or not the meter measures reactive energy split into single quadrants.

+R, -R	The transmitting contact transmits reactive energy in positive and negative direction.
±Ri, ±Rc	The transmitting contact transmits reactive energy split into single quadrants.

Quadrant splitting (±Ri, ±Rc) can only be selected, if either r4a transmitting contacts or no transmitting contacts have been selected in the hardware configuration. Only in quadrant splitting mode does the meter feature rated registers for reactive energy.

Bypass Feeder Operation Mode

The bypass feeder operation mode is used to reroute voltage and current when maintenance work is being performed at a switching station. The meter in the bypass feeder measures the energy during this period of time. The control input B is used to enable and disable the bypass feeder operation mode. The measured values that are acquired while the meter is in the bypass feeder operation mode are marked accordingly.

Set the tick in MAP190 if the meter is used in the *bypass feeder operation mode* rather than for normal metering. If the bypass feeder operation mode is selected all tariff control inputs are disabled.

Calender Base

From firmware version H03 the Persian (Iran) Jalaali calendar is also supported in addition to the Gregorian calendar. This setting is used for all time-based functionalities (clock, TOU, Reset, ...).

Software

This is a code which the MAP Tool generates automatically according to the setting in the Software Configuration window. For details see the following table.

Meter Type

The meter type is derived from the hardware functions requested by the customer.

1.3.2 Software Configuration ID

The software configuration ID is a code that is generated automatically based on the software selection made in this window.

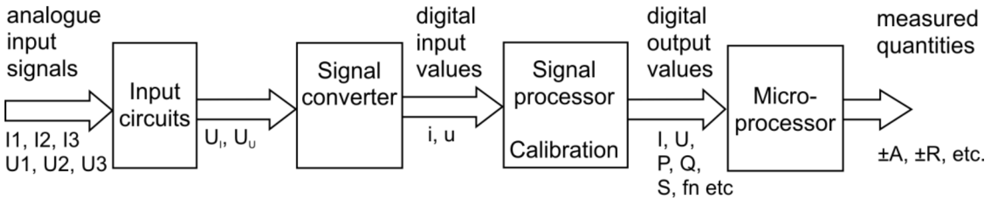
The following table enables you to interpret the software configuration ID.

Pos.	Name	Code	Description
1	Configuration Type (functional range)	2	C.2 (for serial connection to FAG/FBC)
		4	C.4 (basic measurement functions)
		6	C.6 (additionally losses, harmonic distortion and CT/VT correction)
		7	C.7 (specific functionality for India with Availability Based Tariff)
		8	C.8 (additionally apparent energy and single phase measurement, max. demand, Power factor, Monthly billing values)
	Separator	.	. (dot)
2	Control Logic	c	not activated
		C	activated
3	Energy Profile / Stored Billing Values	p	not activated
		P	activated
4	Single Phases	s	not activated
		S	activated
5	Instantaneous Values Monitoring	d	not activated
		D	activated
6	Apparent Energy	o	not activated
		O	activated
7	Losses	l	not activated
		L	activated
8	Frequency Monitoring	f	disabled
		F	enabled
9	Power Monitoring	r	disabled
		R	enabled
10	Voltage DipTable	q	disabled
		Q	enabled
11	Tariff Control	0	no control inputs / no time of use
		I	control inputs
		T	control inputs and time of use
		X	control inputs or time of use
12	Bypass Feeder Operation	a	meter without bypass feeder operation
		A	meter with bypass feeder operation

Pos.	Name	Code	Description
13	CT / VT Error Correction	v	disabled
		V	enabled
14	Transmitting Contacts Function	3	r3
		4	r4
15	Total Harmonic Distortion	h	disabled
		H	enabled
16	Quadrant Splitting	t	+R, -R
		T	±Ri, ±Rc
17	Demand Configuration	p	no demand
		P	Apparent demand and Power Factor
		S	Apparent demand (+A,-A,+S,-S)
		R	Reactive demand (+A,-A,+R,-R)
18	Subset IEC60870 (C.2 only)	i	disabled
		I	enabled
19	Daily Snapshot	s	disabled
		S	enabled
20	Availability Based Tariff (C.7 only)	n	disabled
		N	enabled
21	2nd profile	l	without second profile
		L	with second profile
22	Calender base	G	Gregorian
		J	Jalaali (Persian)
23	THD influenced active energy	a	disabled
		A	enabled

2 Measuring System

2.1 Overview



Input signals

The analogue current values I1, I2, I3 and the analogue voltage values U1, U2, U3 are the input signals to the measuring system of the meter.

Input circuits

Voltage dividers and current transformers reduce the voltages and currents to signals that can be processed in the measuring system.

Signal converter

From the analogue input signals of voltage and current, the signal converter generates instantaneous digital values of voltage and current for each phase. It contains multiplexers, analogue-digital converters and digital filters.

Signal processor

From the instantaneous values of voltage and current in each phase, the signal processor calculates the digital output values. They include the single-phase values of active energy, reactive energy, apparent energy, voltage and current as well as diagnostic values such as the network frequency and phase angles. Information about total harmonic distortion THD is also provided.

Microprocessor

Based on the digital output values provided by the signal processor the microprocessor calculates the measured quantities.

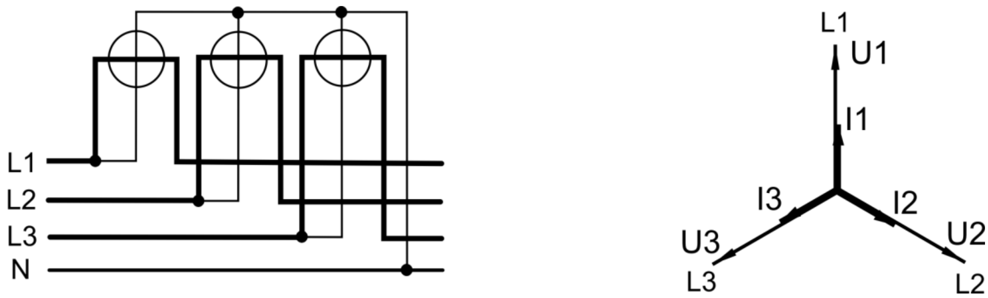
Measured quantities

The output of the measuring system are the measured quantities. They are the "containers" for the measured values. The measured values will finally be displayed on the meter’s display. A complete list of the measured quantities is provided in paragraph 2.5 "Measured Quantities".

2.2 Differences between ZMQ, ZFQ and ZCQ

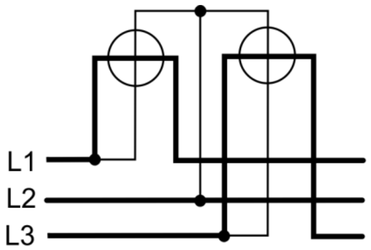
There are three major meter types, the ZMQ, the ZFQ and the ZCQ, which differ in the type of measurement.

ZMQ

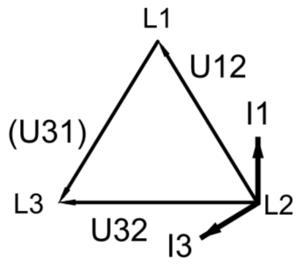


The ZMQ features one measuring element per phase. Because it measures the individual phases independently, it is able to record the individual phases, the sum of the three phases, the phase angle between voltage and current as well as the angle between voltages.

ZFQ

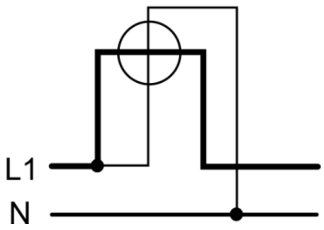


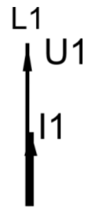
cos φ = 1



The ZFQ with its two measuring elements (Aron circuit) acquires the phase currents I1 and I3 and the corresponding phase-to-phase voltages U1-2 and U3-2. Therefore, it cannot form any single-phase values.

ZCQ





The ZCQ is a single-phase meter and therefore features one measuring element only.

Comparison

Multiplication of voltage and current values of the individual measuring systems are performed according to the following table:

Phase/Measuring system	ZMQ	ZFQ	ZCQ
L1	U1 x I1	U12 x I1	U1 x I1
L2	U2 x I2	—	—
L3	U3 x I3	U32 x I3	—

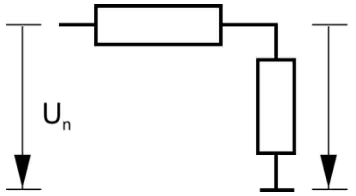
2.3 Input Circuits

Voltage input

High resistance voltage dividers reduce the network voltages U1, U2, U3 applied to the meter to a proportional value of a few mV (U_u) for further processing by the measuring system.

The voltage range of the voltage input spans from $\frac{100V}{\sqrt{3}}$ to $\frac{230V}{\sqrt{3}}$.

Version for direct connection to low voltage network 3 x 400/230 V.



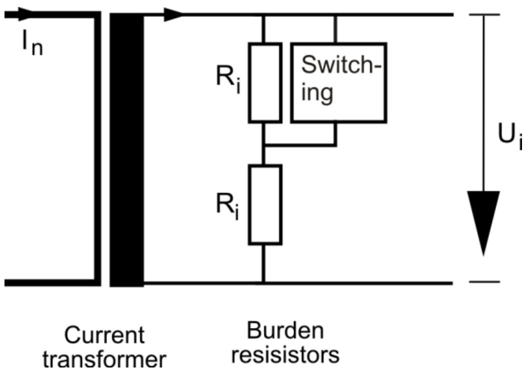
Current input

Compensated current transformers similarly reduce the input currents I1, I2, I3 applied to the meter. The secondary currents of the current transformers develop voltages over burden resistors proportional to the input currents, also of a few mV (U_i).

The nominal currents and current ranges of the meter can be set in MAP120 (Network / Primary Values / Current Ratio).

Nominal currents of the current input are:

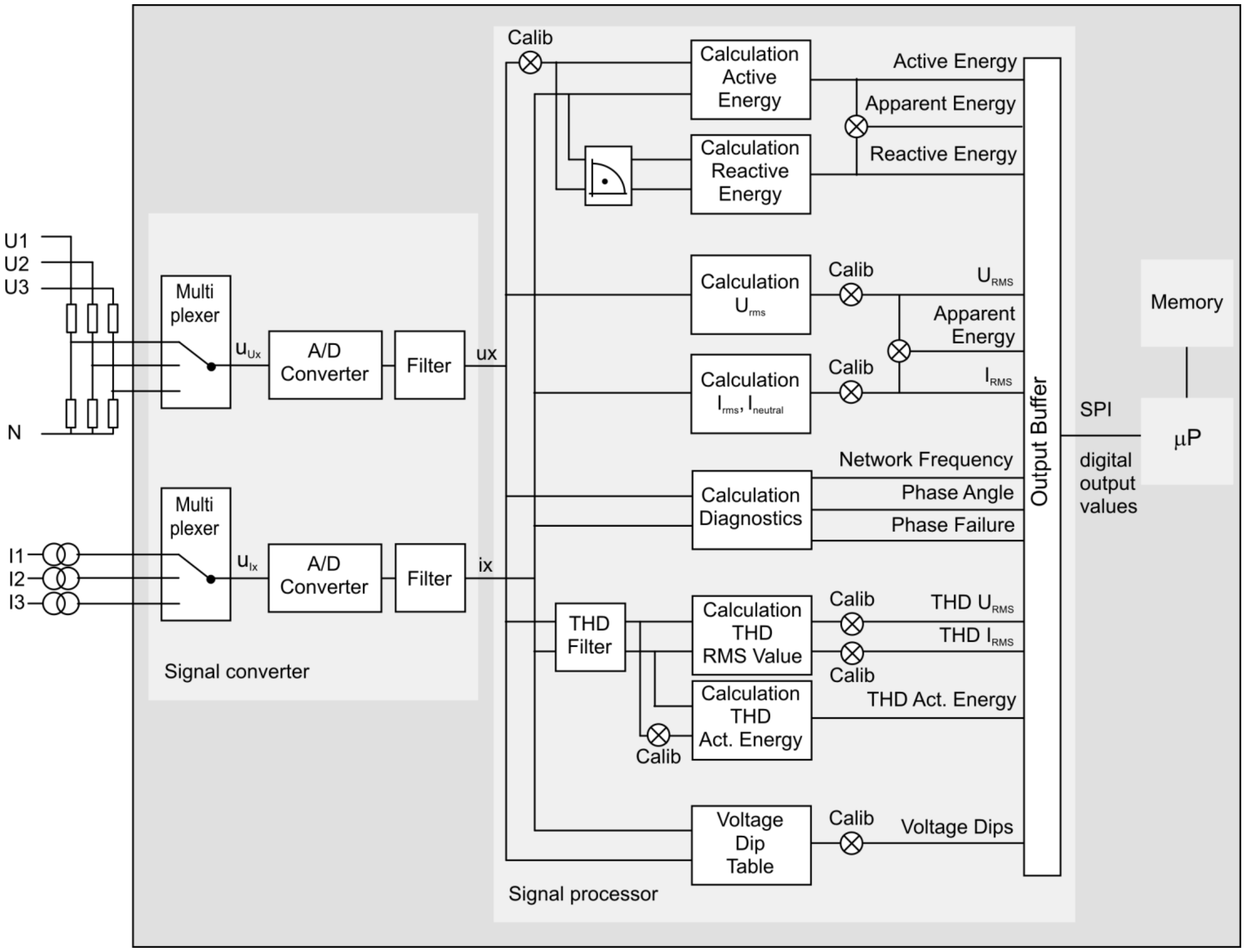
- 1 A (with 120%, 150% or 200% maximum load)
- 2 A (with 120% maximum load)
- 5 A (with 120%, 150% or 200% maximum load)



2.4 Block Diagram

The measuring system consists of:

- the signal converter
- the signal processor
- the microprocessor



2.4.1 Signal Converter

Multiplexer

The multiplexers guide the three analogue single-phase values in a successive order to the analogue-digital converter. There is a multiplexer for the three-phase voltage input and a second multiplexer for the three-phase current input.

Analogue-digital converter

Analogue-digital converters digitise the analogue values of UUX and UIX. Because the analogue signals of the three phases are processed in a successive order, only one analogue-digital converter is necessary for the voltage values and one for the current values.

Filter

Various digital filter stages prepare the signals ux and ix to ensure an error-free processing by the signal processor.

Output

Digital instantaneous values of voltage (ux) and current (ix) for all three phases are then available as intermediate values, ready to be taken over by the signal processor.

2.4.2 Signal Processor

The signal processor scans the single phase, digital input values of voltage (ux) and current (ix) every 0.2 seconds and calculates the digital output values. As a general rule, the measuring system of the ZMQ and the ZCQ produce single-phase data while the ZFQ provides data corresponding to its two measuring elements.

Calibration of meter

The meter is calibrated in the signal processor with small digital correction values.

Output buffer SPI interface

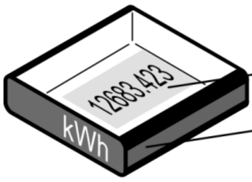
All values calculated by the signal processor are then available as calibrated digital output values. They are stored in the output buffer of the signal processor from where they are transferred to the microprocessor by an SPI interface.

2.4.3 Microprocessor

The microprocessor reads the digital output values from the output buffer of the signal processor every 0.2 seconds. At the output of the measuring system, the measured quantities are available.

2.5 Measured Quantities

The measured quantities are the "containers" for the measured values which will finally be displayed on the meter's display.



Depending on the software configuration, different sets of measured quantities are available:

C.4

With the C.4 meters, the following measured quantities are available:

Measured quantity		**ZMQ**	**ZFQ**	**ZCQ**
Active energy import	+A	Sum	Sum	L1
Active energy export	-A	Sum	Sum	L1
Reactive energy import	+R	Sum	Sum	L1
Reactive energy export	-R	Sum	Sum	L1
Reactive energy in quadrant I	+Ri	Sum	Sum	L1
Reactive energy in quadrant II	+Rc	Sum	Sum	L1
Reactive energy in quadrant III	-Ri	Sum	Sum	L1
Reactive energy in quadrant IV	-Rc	Sum	Sum	L1
Phase voltages (RMS)		U1, U2, U3	U12, U32	U1
Phase currents (RMS)		I1, I2, I3	I1, I3	I1
Network frequency	fn	yes	yes	yes
Phase angle between voltages	φ U	U1-U2 / U1-U3	U12-U32	
Phase angle between voltage and current	φ U-I	U1-I1, U1-I2, U1-I3	U12-I1, U12-I3	
Direction of rotating field		yes	yes	
Phase outage		yes	yes	yes
Voltage dip table		Sum	Sum	L1
Energy flow of active energy	EFA	Sum	Sum	L1
Energy flow of reactive energy	EFR	Sum	Sum	L1

The ZMQ will only measure the phase angles if voltage L1 is present.

The ZFQ will only measure the phase angles if all voltages are present.

C.6

With the C.6 meters, the following measured quantities are available in addition to C.4:

Measured quantity		ZMQ	ZFQ	ZCQ
Active copper losses (line)	OLA	Sum	Sum	L1
Active iron losses (transformer)	NLA	Sum	Sum	L1
Reactive copper losses (line) [1)]	OLR	Sum	Sum	L1
Reactive iron losses (transformer) [1)]	NLR	Sum	Sum	L1
Voltage square hours (internal value only)	U^2h	Sum	Sum	L1
Current square hours (internal value only)	I^2h	Sum	Sum	L1
Primary active power	P	Sum	Sum	L1
Primary reactive power	Q	Sum	Sum	L1
THD of active energy	THD_A	Sum	Sum	L1
THD of phase voltage	THD_U	Sum / Phases	Sum	L1
THD of phase current	THD_I	Sum / Phases	Sum	L1

1) Values for reactive losses are intended for compatibility reasons with third-party products. However, Landis+Gyr do not recommend to measure losses of reactive energy.

C.8

With the C.8 meters, the following measured quantities are available in addition to C.4 and C.6:

Measured quantity		ZMQ	ZFQ	ZCQ
Active energy import	+A	single-phase		
Active energy export	-A	single-phase		
Reactive energy import	+R	single-phase		
Reactive energy export	-R	single-phase		
Reactive energy in quadrant I	+Ri	single-phase		
Reactive energy in quadrant II	+Rc	single-phase		
Reactive energy in quadrant III	-Ri	single-phase		
Reactive energy in quadrant IV	-Rc	single-phase		
Apparent energy import	+S	Sum / Phases	Sum	L1
Apparent energy export	-S	Sum / Phases	Sum	L1

Measured quantity		ZMQ	ZFQ	ZCQ
Apparent energy in quadrant I	+Si	Sum / Phases	Sum	L1
Apparent energy in quadrant II	+Sc	Sum / Phases	Sum	L1
Apparent energy in quadrant III	-Si	Sum / Phases	Sum	L1
Apparent energy in quadrant IV	-Sc	Sum / Phases	Sum	L1
Net/gross active energy in positive direction	+CA	Sum	Sum	L1
Net/gross active energy in negative direction	-CA	Sum	Sum	L1
Net/gross reactive energy in positive direction	+CR	Sum	Sum	L1
Net/gross reactive energy in negative direction	-CR	Sum	Sum	L1
Total losses of active energy in positive direction	+TLA	Sum	Sum	L1
Total losses of active energy in negative direction	-TLA	Sum	Sum	L1
Total losses of reactive energy in positive direction	+TLR	Sum	Sum	L1
Total losses of reactive energy in negative direction	-TLR	Sum	Sum	L1

Due to the different type of measurement of the Aron circuit, data for the individual phases are not provided by the ZFQ.

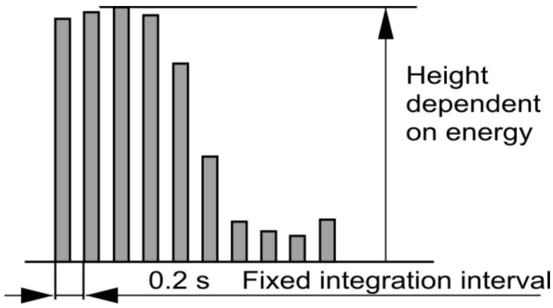
2.6 Calculation of Energy

2.6.1 Calculation of Single Phase Energy

The calculation of the energy per phase is a multi-step procedure:

1. The voltage u and the current i are sampled 1645 times per second.
2. The instantaneous, single phase values of voltage u and current i are multiplied to form the instantaneous, single-phase values of power.
3. The single-phase values of power are then integrated over the integration interval of 0.2 seconds.

The resulting energy values – sampled by the microprocessor – are energy proportions with a fixed period (0.2 seconds) and varying energy (e.g. Wh).

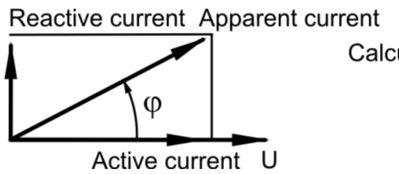


These energy proportions are scaled by the microprocessor according to parametrisation.

The values which are stored in each of the measured quantities are fed to the energy registers to record the energy.

2.6.2 Active Energy

The active power is the product of the voltage U multiplied by the active current component parallel to the voltage.



Calculation per phase of

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

$P = U \cdot I_{Active}$

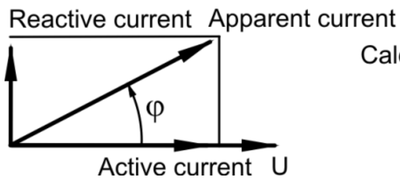
The instantaneous value of active power P is then integrated over the integration interval of 0.2 seconds to form a digital value of active energy.

The microprocessor calculates the total active energy import +A and the total active energy export -A by adding up the values of active energy of L1, L2 and L3.

2.6.3 Reactive Energy

For the instantaneous value of reactive power Q the instantaneous values of voltage U and current I must be rotated by +45° and -45° respectively prior to the multiplication.

The reactive power is the product of the voltage U multiplied by the reactive current component vertical to the voltage.



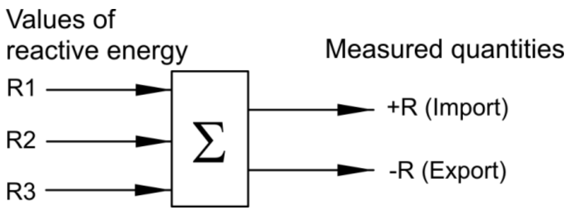
Calculation per phase of

$Q = U \cdot I \cdot \sin \varphi$

$Q = U \cdot I_{Reactive}$

The instantaneous value of reactive power Q is then integrated over the integration interval of 0.2 seconds to form a digital value of reactive energy.

The microprocessor calculates the total reactive energy import +R and the total reactive energy export -R by summating the values of reactive energy of L1, L2 and L3.

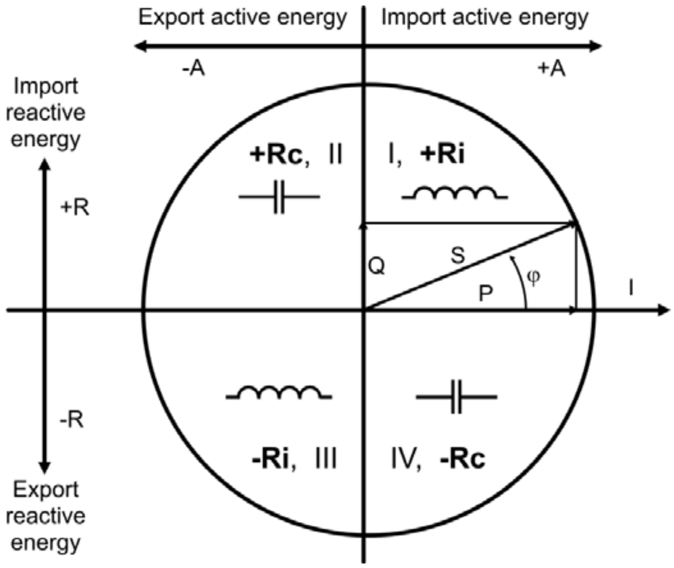


Allocation to the four quadrants

Based on the signs of A and R the microprocessor allocates the reactive energy to the four quadrants.

- Reactive energy in quadrant I: +Ri
- Reactive energy in quadrant II: +Rc
- Reactive energy in quadrant III: -Ri
- Reactive energy in quadrant IV: -Rc

In the same way the microprocessor allocates the reactive energy of the individual phases to the four quadrants.



2.6.4 Apparent Energy

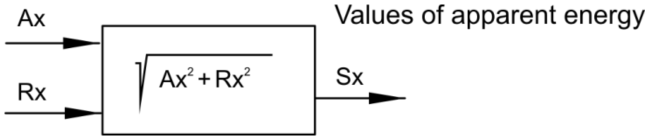
The apparent energy can be calculated in three ways:

- by geometric addition of the active and the reactive energy of the individual phases (standard method)
- by geometric addition of the active and the reactive energy of the individual phases, without the leading reactive energy (special method, only for the Indian market)
- by multiplying the single-phase RMS values of voltage and current (common in the USA)

Which of the principles is used can be selected by parameter setting.

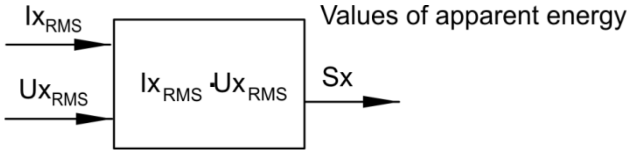
Geometric addition

From the mean values A1 and R1, A2 and R2, A3 and R3, the measuring system calculates the single-phase values of apparent energy S1, S2, S3 according to Pythagoras.

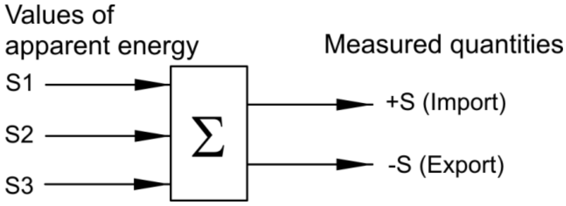


RMS multiplication

From the mean values $U1_{RMS}$ and $I1_{RMS}$, $U2_{RMS}$ and $I2_{RMS}$, $U3_{RMS}$ and $I3_{RMS}$ the measuring system calculates the single-phase values of apparent energy S1, S2, S3 by multiplication.



The microprocessor calculates the total apparent energy import +S and the total apparent energy export -S by summating the values of apparent energy S1, S2 and S3.



These energy components are scaled corresponding to the meter constant (primary data) and are then available as measured quantities.

The total apparent energy as well as its single-phase values are allocated to the four quadrants in the same way as the reactive energy.

2.6.5 Energy Flow

The naming of positive and negative energy flow is different depending on the customer's definition.

Definition According to UCTE

The naming of the energy flow according to UCTE (Union for the Co-ordination of Transmission of Electricity) is as follows:

Energy production

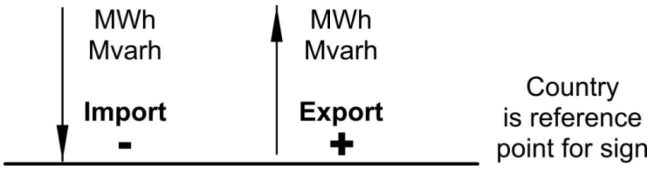
From the energy production point of view, the energy flow is:

- positive if the customer sells/delivers energy.
- negative if the customer buys/receives energy.

Energy exchange

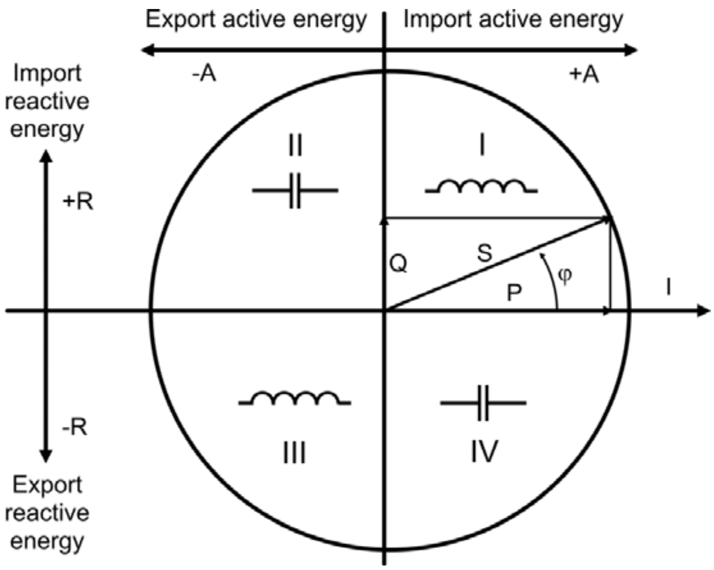
From the energy exchange point of view, the energy flow is:

- positive if energy is being exported.
- negative if energy is being imported.



Definition According to IEC

The naming of the energy flow according to IEC (International Electro-technical Commission) is as follows:



Summary

The table below shows the summary of both definitions. Landis+Gyr uses the IEC definition.

Sign	Naming according to UCTE	Naming according to IEC
+	Export, Selling	Import
–	Import, Buying	Export

2.6.6 Energy of Harmonics

Active energy measurement

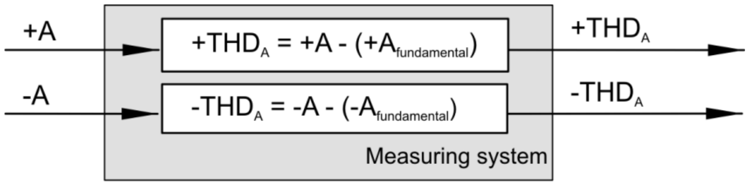
The harmonics are included in the measurement of active energy. The harmonics up to 1 kHz are measured correctly. Higher frequencies are attenuated more and more, i.e. the higher the frequency the smaller the influence to the measurement. Please note also the limited frequency response of the upstream voltage transformer whose limitation starts around 900 Hz.

THD_A

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

The THD information is calculated based on a comparison of the values of the fundamental wave and the harmonics.

The active energy of the harmonics is calculated by subtracting the active energy of the fundamental wave from the total active energy.



Fundamental wave
Because the THD calculation is performed internally by the signal processor, the values for the fundamental wave ($A_{fundamental}$) cannot be used for further processing.

Reactive energy measurement

Due to the measurement principle, the harmonics are strongly attenuated in the measurement of reactive energy. In order to measure reactive energy the voltage must be shifted by 90° and is then multiplied with the current. Due to physical reasons this is only possible for the fundamental wave.

In most applications, the harmonics of reactive energy are neither measured nor billed.

2.7 Calculation of Instantaneous Values

2.7.1 Primary Power

The instantaneous values of active and reactive power are produced by multiplying the instantaneous values of voltage u and current i and the transformer ratio.

2.7.2 Voltage and Current

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}.

Phase voltages

The phase voltages U1, U2 and U3 are obtained from the RMS values $U1_{RMS}$, $U2_{RMS}$, $U3_{RMS}$ and are scaled by the microprocessor according to the voltage transformer ratio. The meter may be parameterised to display the primary phase voltages and/or the secondary phase voltages.

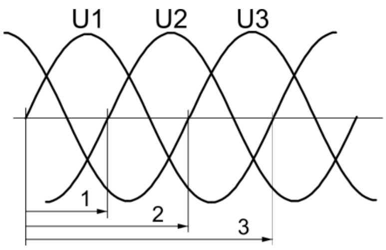
Phase currents

The phase currents I1, I2 and I3 are obtained from the RMS values $I1_{RMS}$, $I2_{RMS}$, $I3_{RMS}$ and are scaled by the microprocessor according to the current transformer ratio. The meter may be parameterised to display the primary phase currents and/or the secondary phase currents.

Voltage square hours
Current square hours

The primary data of voltage square hours and current square hours are calculated by the microprocessor based on the RMS values of voltage and current. These values are the base for the loss calculation.

2.7.3 Network Frequency



Time measurement for rotating field, frequency, phase angles

1 : T_{U1-U2}

2 : T_{U1-U3}

3 : T_{U1-U1} (fn)

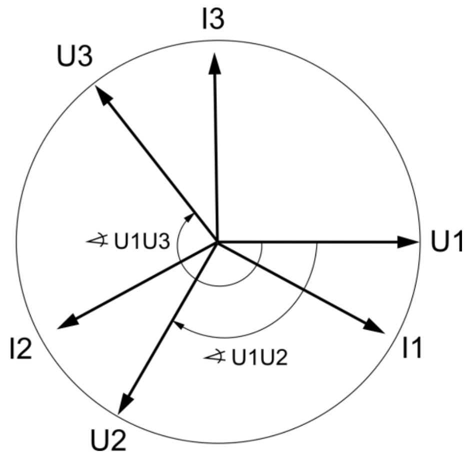
The network frequency is calculated based on the time measured between two zero passages (change from negative to positive value) of voltage U1. The time between two zero passages also serves as a reference to a phase angle of 360°.

2.7.4 Phase Angles

The phase angles are used to check the installation.

Phase angle between voltages (ZMQ)

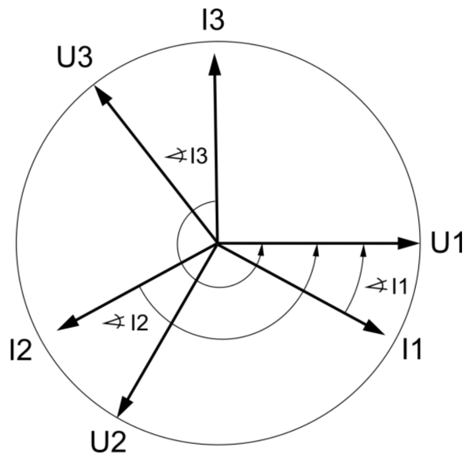
The phase angles between voltages are determined by the times between the zero passage of the phase voltage U1 and those of the other phase voltages U2 and U3. All phase angles are always shown as positive values.



Phase angle between voltage and current (ZMQ)

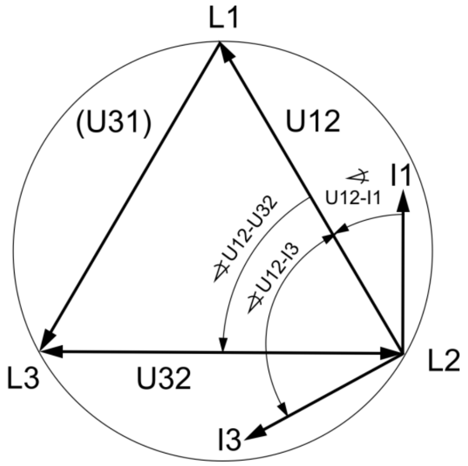
The phase angles between voltage and current are calculated based on the times between the zero passage of the phase voltage and the phase currents.

All phase angles are displayed clockwise using the phase voltage U1 as reference. The values of the angles are always positive and are within 0° and 360°.



Phase angle between voltages (ZFQ)

Due to the Aron circuit the ZFQ is only capable of measuring the angle between voltage U12 and U32.



Phase angle between voltage and current (ZFQ)

For the measurement of the angle between voltage and current the ZFQ always uses the voltage U12 as reference. At cosφ = 1 the angle U12-I1 is -30° (the meter displays 330°) while the angle U12-I3 is 90°.

2.7.5 Power Factor

The meter provides the instantaneous value of the total power factor. The value is refreshed every second. No single-phase values are provided.

The instantaneous power factor value is available on display and via communication.

If the power factor is not measured (e.g. due to the apparent power being too low) the meter shows -.-- as power factor in the display. In the dlms protocol, the power factor is set to the invalid value "2".

2.7.6 Direction of Rotating Field

The direction of rotating field is calculated based on the phase angles between voltages. If the phase angle between the voltages U1 and U2 is smaller than the angle between the voltages U1 and U3, the rotating field has a positive sense of rotation, otherwise the sense of rotation is negative (ZMQ only).

2.8 Calculation of Diagnostic Values

2.8.1 Phase Outages

The measuring system sets the phase outage bit if the corresponding phase voltage drops below the parameterised value (45% U_n is the default value).

Customer specific values 5% and 10% U_n are also possible.

2.8.2 Total Harmonic Distortion (THD)

The measuring system produces information about the total harmonic distortion of the active energy, the voltage and the current of each phase.

For that purpose, the voltage u and the current i are fed through notch filters, which remove the fundamental wave. The harmonics of voltage and current are then sampled 1645 times per second.

The THD information is calculated based on a comparison of the values of the fundamental wave and the harmonics.

THD_{An}

The value THD_{An} shows the all-phase active energy of the harmonics as a percentage of the nominal active energy. The sign shows the direction of the harmonic energy (+ = import, - = export).

$$THD_{An} = \frac{THD_{A}}{An \times 100} \xrightarrow{THD_{An}\,[\%]}$$

THD_{Ax}

The value THD_{Ax} shows the active energy of the harmonics of a single phase as a percentage of the nominal active energy. The sign shows the direction of the harmonic energy (+ = import, - = export).

$$THD_{Ax} = \frac{THD_{ALx}}{An \times 100} \xrightarrow{THD_{Ax}\,[\%]}$$

THD_{U}

For meters with an M-circuit, the THD_{U} value is the ratio between the sum of all harmonic voltages and the triple nominal voltage in percent.

For meters with an F-circuit, the THD_{U} value is the ratio between the sum of all harmonic voltages and the double nominal voltage in percent.

Therefore, the THD_{U} value is an average value over all phases.

$$THD_{U} = \frac{THD_{U1} + THD_{U2} + THD_{U3}}{3 \times Un \times 100} \xrightarrow{THD_{U}\,[\%]} \text{(M-circuit)}$$

$$THD_{U} = \frac{THD_{U12} + THD_{U32}}{2 \times Un \times 100} \xrightarrow{THD_{U}\,[\%]} \text{(F-circuit)}$$

THD_{Ux}

The voltage of the harmonics is calculated by subtracting the voltage of the fundamental wave from the total value of the phase voltage.

$$THD_{Ux} = Ux - (Ux_{fundamental}) \xrightarrow{THD_{Ux}\,[V]}$$

THD_{I}

For meters with an M-circuit, the THD_{I} value is the ratio between the sum of all harmonic currents and the triple nominal current.

For meters with an F-circuit, the THD_{I} value is the ratio between the sum of all harmonic current and the double nominal current.

Therefore, the THD_{I} value is an average value over all phases.

$$THD_{I} = \frac{THD_{I1} + THD_{I2} + THD_{I3}}{3 \times In \times 100} \xrightarrow{THD_{I}\,[\%]} \text{(M-circuit)}$$

$$THD_{I} = \frac{THD_{I1} + THD_{I3}}{2 \times In \times 100} \xrightarrow{THD_{I}\,[\%]} \text{(F-circuit)}$$

THD_{Ix}

The current of the harmonics is calculated by subtracting the current of the fundamental wave from the total value of the phase current.

$$THD_{Ix} = Ix - (Ix_{fundamental}) \xrightarrow{THD_{Ix}\,[A]}$$

2.8.3 Voltage Dips

The measuring system constantly monitors the voltages of each single phase. If a voltage drops below 90% of its nominal value, the measuring system gives information about the duration of the voltage dip and the average voltage during the event. For this purpose, the voltage dip table features various counters (n11 ... n64). The information is refreshed every 0.2 seconds.

Reading example: If there are two voltage dips of 20% with a length of 0.7 seconds the counter n32 is increased by 2 while all other counters remain at the same value. For details please refer to 18 "Voltage Dip Table".

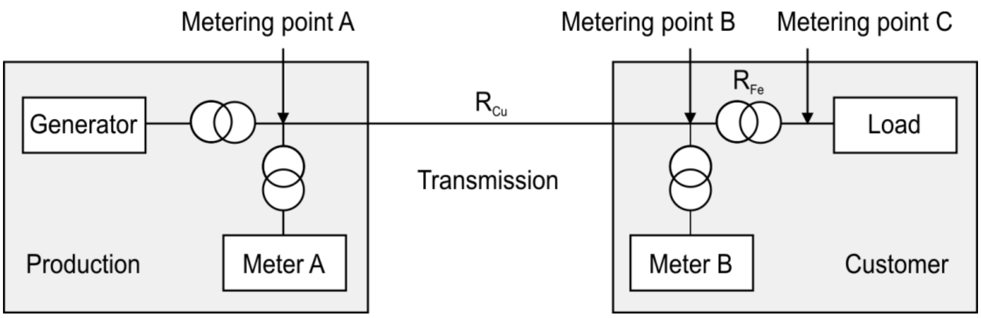
Depth [%]	**% U_n**	**Duration**					
		0.02 ... 0.1s	**0.1 ... 0.5s**	**0.5 ... 1s**	**1 ... 3s**	**3 ... 20s**	**20 ... 60s**
10 ... 15	**85 ... 89.9**	n11	n21	n31	n41	n51	n61
15 ... 30	**70 ... 84.9**	n12	n22	n32	n42	n52	n62
30 ... 60	**40 ... 69.9**	n13	n23	n33	n43	n53	n63
60 ... 95	**5 ... 39.9**	n14	n24	n34	n44	n54	n64

The meter is able to detect voltage drops of 10 ms length. Due to the limited resolution caused by the half-wave (10 ms), a correct registration is only guaranteed from 20 ms onwards. The meter is theoretically able to detect voltage dips smaller than 95%, however, superimposed voltages on the transformer line can distort the measuring result. Therefore, Landis+Gyr has set the threshold to 5% U_n.

2.9 Calculation of Losses

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

Example



The main field of application of loss measurement, however, is the energy transmission between two customers.

Line losses are caused by the copper resistance R_{Cu} of the transmitting line. The copper resistance is only effective if there is a load and therefore current is actually flowing.

- On Load Active OLA for line losses of active energy
- On Load Reactive OLR for line losses of reactive energy

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

- No Load Active NLA for transformer losses of active energy
- No Load Reactive NLR for transformer losses of reactive energy

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

OLA	On load active. Line (copper) losses of active energy. OLA = $I^2h \times R_{Cu}$. The value of R_{Cu} can be set by parameterisation.
NLA	No load active. Transformer (iron) losses of active energy. NLA = U^2h / R_{Fe}. The value of R_{Fe} can be set by parameterisation.
+TLA	Total losses of active energy in positive direction
-TLA	Total losses of active energy in negative direction
OLR [1)]	On load reactive. Line (copper) losses of reactive energy. OLR = $I^2h \times X_{Cu}$. The value of X_{Cu} can be set by parameterisation.
NLR [1)]	No load reactive. Transformer (iron) losses of reactive energy. NLR = U^2h / X_{Fe}. The value of X_{Fe} can be set by parameterisation.
+TLR [1)]	Total losses of reactive energy in positive direction
-TLR [1)]	Total losses of reactive energy in negative direction

[1)] Landis+Gyr does not recommend to measure reactive energy losses.

2.9.1 Calculation of Total Losses

The measured quantities TLA and TLR are used to calculate the total losses i.e. copper losses plus iron losses.

TLA	Total losses of active energy; TLR = NLA + OLA
TLR	Total losses of reactive energy; TLR = NLR + OLR

2.9.2 Calculation of Compensated Energy

Net energy

The measured quantities +CA, -CA, +CR, -CR are used to calculate net (or gross) energy, e.g. active energy minus active energy losses.

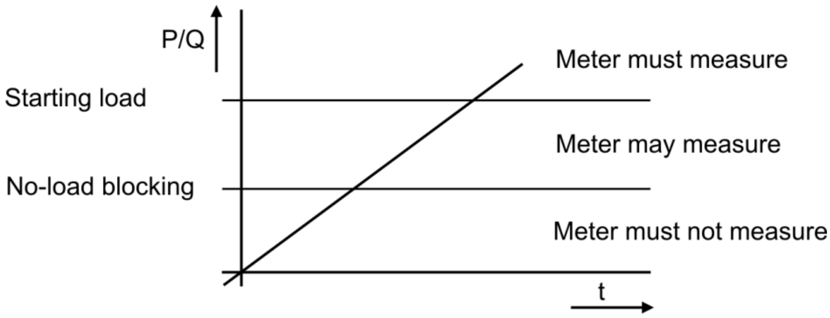
- Gross energy minus losses equals net energy
- Net energy plus losses equals gross energy.

Gross energy
Calculating gross energy (energy plus losses) is possible, yet unusual. The function is only provided for compatibility reasons with the Landis+Gyr Z.V meters.

+CA	Active energy in positive direction (net or gross value depending on sign); +CA = +A ± +TLA
-CA	Active energy in negative direction (net or gross value depending on sign); -CA = -A ± -TLA
+CR	Reactive energy in positive direction (net or gross value depending on sign); +CR = +R ± +TLR
-CR	Reactive energy in negative direction (net or gross value depending on sign); -CR -R ± -TLR

2.10 Starting Load

A minimum energy threshold is defined below which the energy measurement is inhibited. This to make sure that the meter does not measure induced currents and the noise of the measuring system when no load is applied.



2.10.1 Energy Measurement

The measurement of **active energy** starts:

- when the sum of active energy of all phases is above starting load for active energy and
- when at least one phase voltage is above 45% (M-circuit) or above 40% (F-circuit) of its nominal value.
  (It is also possible to parameterise other values.)

The energy of a single phase with a phase voltage below 45% U_n (M-circuit) or below 40% Un (F-circuit) is ignored.

The measurement of **reactive energy** starts:

- when the sum of reactive energy of all phases is above starting load for reactive energy and
- when at least one phase voltage is above 45% (M-circuit) or above 40% (F-circuit) of its nominal value.

(It is also possible to parameterise different values.)

The energy of a single phase with a phase voltage below 45% U_n (M-circuit) or below 40% U_n (F-circuit) is ignored.

The measurement of **apparent energy** starts as soon as the active energy is being measured.

The measurement of the active energy of the **harmonics** (THD_A) starts as soon as the current is above the minimum threshold of 2% I_n.

2.10.2 Voltage and Current Measurement

The measurement of U^2h and of the harmonics THD_U starts as soon as one phase voltage is above 45% of its nominal value.

The measurement of I^2h and of the harmonics THD_I starts:

- when the phase current is above the minimum threshold of 2% I_n and
- when the corresponding phase voltage is above 45% of U_n.
  (It is also possible to parameterise other values.)

Example

For the following examples, the starting load for active energy has been set to 0.05% of nominal power P_n.

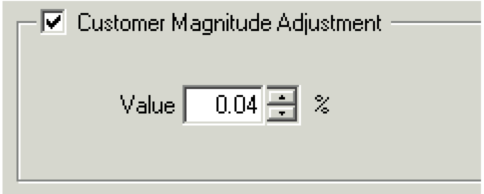
All meters stop measuring the energy and the voltage when the phase voltage drops below 45% of its nominal value.

Example	L1	L2	L3	Does measurement start?
1	0.01% Pn 100% Un	0.01% Pn 100% Un	0.01% Pn 100% Un	**P:** No – The sum of P is below starting load of 0.05%. **U^2h:** Yes on all phases – each phase is above the minimum threshold.
2	0.02% Pn 100% Un	0.01% Pn 100% Un	0.03% Pn 100% Un	**P:** Yes – The sum of P is above starting load. **U^2h:** Yes on all phases – each phase is above the minimum threshold.
3	0.02% Pn 40% Un	0.01% Pn 100% Un	0.03% Pn 100% Un	**P:** No – The energy of phase 1 is cut to 0 (because the voltage on that phase is below 45% Un). Therefore, the sum of P is below starting load. **U^2h:** No on phase 1, yes on phase 2 and 3 – phase 1 is below the minimum threshold.

2.11 Customer Magnitude Adjustment

The customer magnitude adjustment may be used for the adaptation of measurement deviation to a level that is required by the customer.

The magnitude is adjusted by setting a correction value. As a result, the measuring values of the meter are shifted independently of load and magnitude by the same value for all phases.



Range

Class	Cl. 0.2S	Cl. 0.5S
Customer magnitude adjustment	±0.10%	±0.30%
Resolution of adjustment (steps)	0.01%	0.02%

In the display, the arrow "Cal" indicates that a customer magnitude adjustment has been performed, i.e. the compensation value is not zero.

The customer magnitude adjustment is available with all ZxQ meters.

Factory setting
The meters are always shipped with the customer magnitude adjustment set to zero.

2.12 CT / VT Error Correction

The CT/VT Error Correction may be used for the compensation of measurement deviations with external voltage (VT) and current transformers (CT). In this way, the measuring uncertainty in the chain meter – transformer may be reduced. For this, the current measuring deviations of the individual transformers (usually six) must be known with small loads.

It is common to install transformers in new metering points which have sufficiently small measurement deviations.

There are two ways to enter the correction values:

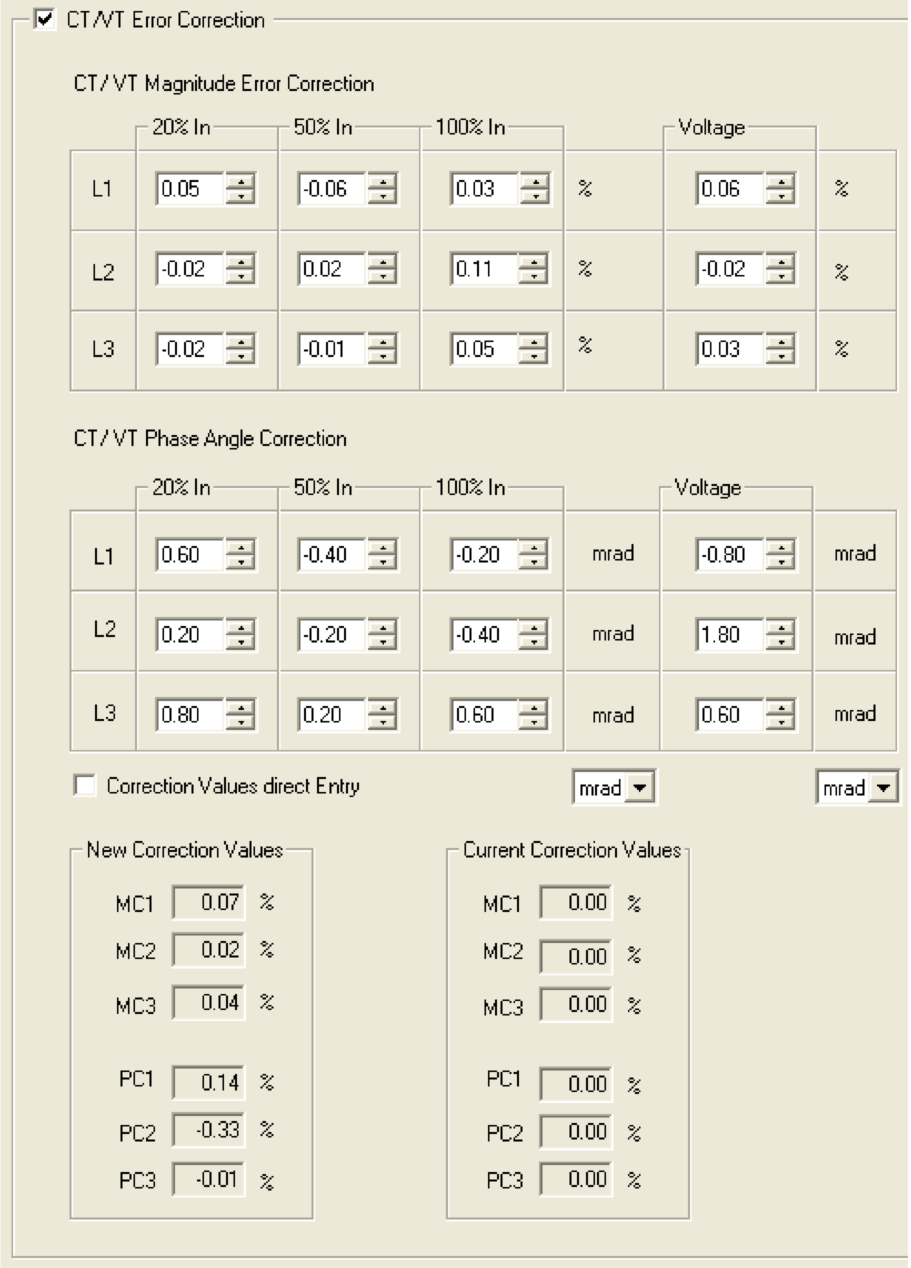
- Input from measurement protocols of the transformers (3 fields per phase).
- Input of correction values as in ZMT (predecessor meter). The compensation values are determined with a special application.

Input from measurement protocols of the transformers

The correction values can be entered individually per phase for value and angle. As the measurement deviation in current transformers depends on the current, there are three fields to cover the measurement range (20% I_n, 50% I_n und 100% I_n). MAP120 uses the entered values to calculate the values to be stored in the meter.

Input of already known values (direct input)

Values already known from a former application (from predecessor meter ZMT) can be entered directly. If a ZMQ meter is exchanged, the "current correction values" can be transferred from the old to the new meter. It is therefore not necessary to consult the measurement protocols of the 6 transformers.



Range

Correction	Range	Resolution
CT/VT Magnitude Error Correction	±2.0%	0.01%
CT/VT Phase Angle Correction	±9 mrad (±1.55%)	0.2 mrad

To fulfil customer requirements, the range was chosen very wide. In practice, only about a tenth of the range is actually used.

In the display, the arrow "Cal" indicates that a CT / VT error correction has been performed, i.e. the compensation values are not zero.

If activated in the software configuration, the CT / VT error correction is available with all ZxQ meters apart of C.4.

Factory setting
The meters are always shipped with the CT/VT error correction set to zero.

2.13 Optical Test Output

Two LEDs on the front of the meter are used as optical test output. Depending on the operating mode the LEDs signal different measured quantities.

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

Losses are shown on the LEDs in normal mode if the "losses" menu was selected by pressing the scroll button.

Primary and secondary data

If the meter is parameterised for primary data, the test output signals primary data. If the meter is parameterised for secondary data, the meter signals secondary data.

Active and reactive energy

For active and reactive energy, the meter constant of the optical test output is stated on the face plate of the meter (e.g. 0.025 imp/kWh).

Losses

For line and transformer losses, the power or the parameterised equivalent resistances upon which the calculation is based on, are stated on the face plate of the meter.

Meter constant

The following table applies for meters with a nominal voltage U_n of:

$3 \times \frac{100 ... 120\,\text{V}}{\sqrt{3}}$ or 3 x 100 ... 120 V (M, F and C circuits)

Nominal current I_n	Load capacity	Meter constant imp/kWh, imp/kvarh
1 A	120%, 150%	100'000
2 A	120%	50'000
5 A	120%, 150%	20'000
1 (2) A	200%	50'000
5 A	200%	10'000

The following table applies for meters with a nominal voltage U_n of:

$3 \times \frac{190 \ldots 230\ V}{\sqrt{3}}$ or 3 x 190 … 230 V (M, F and C circuits)

Nominal current I_n	**Load capacity**	**Meter constant imp/kWh, imp/kvarh**
1 A	120%, 150%	50'000
2 A	120%, 150%	25'000
5 A	120%, 150%	10'000
1 (2) A	200%	25'000

Line losses OLA

The table below shows the meter constants of the optical test output for the active line losses OLA. For the optical test output, the meter uses the copper resistance R_{Cu} or the power loss that is parameterised (see section 2.14.4 "Losses").

Nominal current I_n	**Load capacity**	**Meter constant imp/kWh**
1 A	120%, 150%	7'200'000
2 A	120%, 150%	1'800'000
5 A	120%, 150%	288'000
1 (2) A	200%	1'800'000
5 A	200%	72'000

Transformer losses NLA

The table below shows the meter constants of the optical test output for the active transformer losses NLA. For the optical test output, the meter uses the iron resistance R_{Fe} or the power loss that is parameterised (see section 2.14.4 "Losses").

Nominal voltage U_n	**Meter constant imp/kWh**
100 V (57,7 V x √3)	2'000'000'000
200 V (115 V x √3)	500'000'000

As meters are only executed with losses in primary data, these meter constants are only used for meter testing purposes.

2.14 Measuring System Parameters

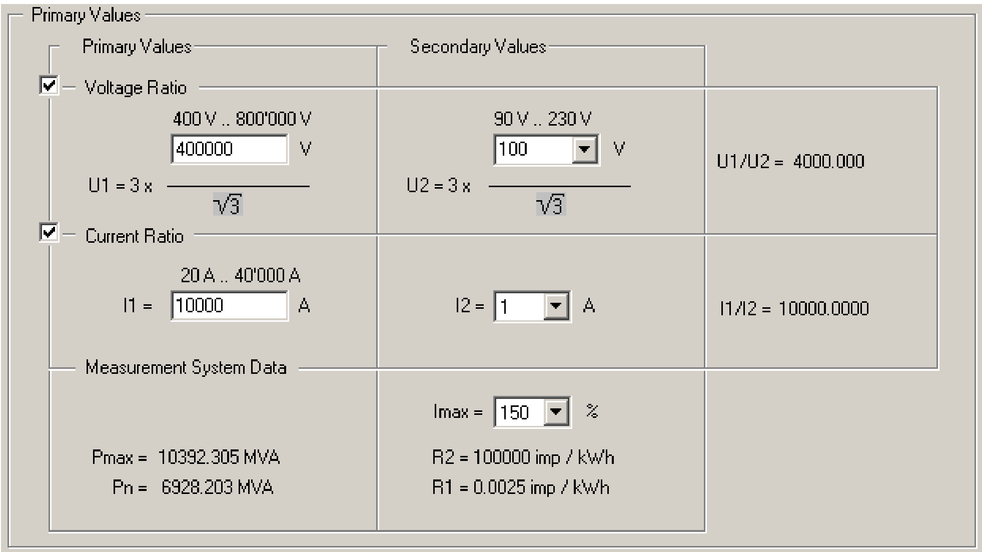
2.14.1 Primary and Secondary Data

The primary value adaptation parameters describe the primary and secondary values of the voltage and current transformers the meter is connected to.

These parameters are determined by the external transformer installation as well as by the meter itself and must be entered precisely in accordance to the hardware.

Primary values according to transformers
The primary values must be entered according to the information given on the name plate of the current and voltage transformers.

Primary Values



To select primary values:

- Set the tick for *Voltage Ratio*.
- Enter a value for the primary voltage U1 between 400 V and 800 kV. The primary power must not exceed 2600 MVA.
- For the secondary voltage U2 select a value from the pull-down list or enter a value between 90 V and 230 V.

For M and F circuits, the entered values represent the phase-to-phase voltage. To get the phase voltage, the nominal voltage must be divided by √3.

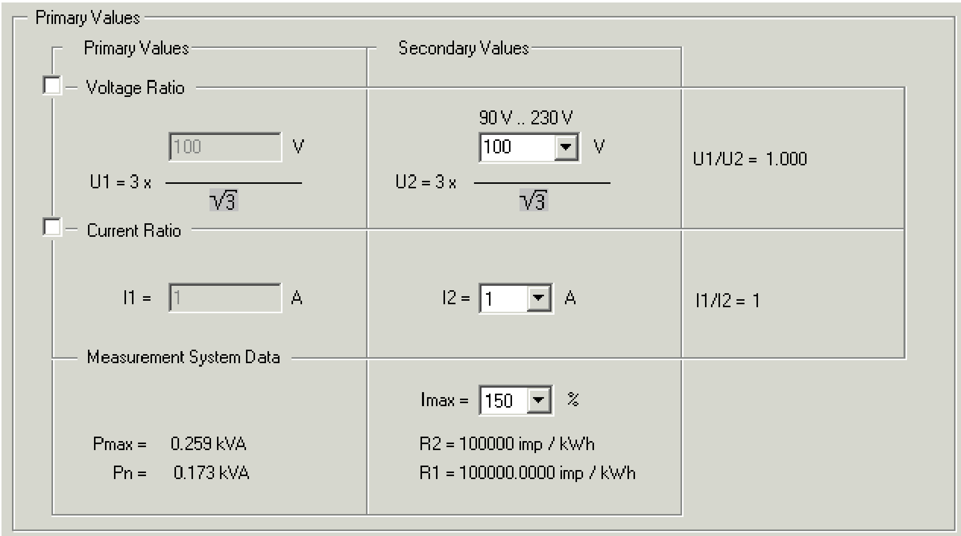
For single-phase applications, the entered value is the phase voltage.

- Set the tick for *Current Ratio*.

- Enter a value for the primary current I1 between 20 A and 40'000 A. The primary power must not exceed 2600 MVA.
- For the secondary current I2 select a value from the pull-down list between 1 A and 5 A.

No primary values for C.7: only secondary values selectable
With C.7, it is not possible to enter primary values.

Secondary Values



To select secondary values:

- Remove the tick for *Voltage Ratio*.
- For the secondary voltage U2 select a value from the pull-down list or enter a value between 90 V and 230 V.
- Remove the tick for *Current Ratio*.
- For the secondary current I2 select a value from the pull-down list between 1 A and 5 A.

Maximum Current

From the pull-down list, select the maximum current in percent of the nominal value of the secondary current.

2 A transformers with 120% load are only used in Scandinavia. For the 2 A current transformers the maximum current is limited to 120% of the nominal value.

Meter Constants R1 and R2

The primary meter constant R1 and the secondary meter constant R2 cannot be selected by the user but are calculated by the MAP tool after the voltage and current data entries have been completed. The secondary meter constants are set by the MAP tool according to the tables below.

The following table applies for meters with a nominal voltage U_n of:

$3 \times \frac{100 \ldots 120\,\text{V}}{\sqrt{3}}$ or 3 x 100 ... 120 V (M, F and C circuits)

Nominal current I_n	Load capacity	Meter constant R imp/kWh, imp/kvarh	Pulse value i Wh/imp, varh/imp
1 A	120%, 150%	100'000	0.02
2 A	120%	50'000	0.02
5 A	120%, 150%	20'000	0.1
1 (2) A	200%	50'000	0.02
5 A	200%	10'000	0.1

The following table applies for meters with a nominal voltage U_n of:

$3 \times \frac{190 \ldots 230\ \mathrm{V}}{\sqrt{3}}$ or 3 x 190 ... 230 V (M, F and C circuits)

Nominal current I_n	Load capacity	Meter constant R imp/kWh, imp/kvarh	Pulse value i Wh/imp, varh/imp
1 A	120%, 150%	50'000	0.05
2 A	120%, 150%	25'000	0.05
5 A	120%, 150%	10'000	0.2
1 (2) A	200%	25'000	0.05

The primary values are calculated with the formulas below:

$$\text{primary meter constant R} = \frac{\text{secondary meter constant R}}{\text{transformer ratio K}}$$

primary pulse value i = seondary pulse value i x transformer ratio K

Primary Data Meter and Secondary Data Meter

Although the meter is always connected to voltage and current transformers, the meter may be parameterised as a primary or as a secondary data meter.

If the meter is parameterised as a primary data meter, all displayed and communicated registers and values show primary data (except for the installation menu which always displays secondary data).

If the meter is parameterised as secondary data meter, all displayed and communicated registers and values show secondary data.

Measurement System Data

The measurement system data is calculated on the basis of your entries of the primary and secondary data.

After the voltage and current data entries have been completed the software calculates the transformer ratios, the nominal and maximum primary power as well as the meter constant.

If primary values have been provided the primary meter constant R1 is calculated. If no primary values have been provided the primary meter constant R1 is identical to the secondary meter constant R2.

2.14.2 Register Resolution

All energy registers (total, rated, original meter values, delta values) have a total of 8 digits each, 5 of which can be decimal places (kWh only).

The demand registers have a total of 5 digits each, 4 of which can be decimal places.

The resolution of the registers depends on the nominal power applied to the meter and on the minimum time until a register overflow occurs that is required for the application (at least 1'500 h).

The relation between the nominal power and the register resolution is shown in the tables below. The resolution printed in **bold** is the default resolution suggested by the MAP tool.

Register Resolution for Secondary Data Meters

Energy (original meter values), Losses, THD

Nominal power (Load capacity 120% and 150%)	Nominal power (Load capacity 200%)	Register resolution Cumulative energy A, R, S	Register resolution Losses, THD
0 .. 320 W	0 .. 160 W	000.00000 kWh **0000.0000 kWh**	**000.00000 kWh**
>320 W .. 3200 W	>160 W .. 1600 W	0000.0000 kWh **00000.000 kWh**	000.00000 kWh **0000.0000 kWh**

Delta Energy and Demand

Nominal power (Load capacity 120% and 150%)	Nominal power (Load capacity 200%)	Register resolution Delta energy A, R, S	Register resolution Demand
0 .. 320 W	0 .. 160 W	**000.00000 kWh** 0000.0000 kWh	0.0000 kWh 00.000 kWh 000.00 kWh 0000.0 kWh
>320 W .. 3200 W	>160 W .. 1600 W	000.00000 kWh **0000.0000 kWh** 00000.000 kWh	0.0000 kWh 00.000 kWh 000.00 kWh 0000.0 kWh

Register Resolution for Primary Data Meters

Energy (original meter values), Losses, THD

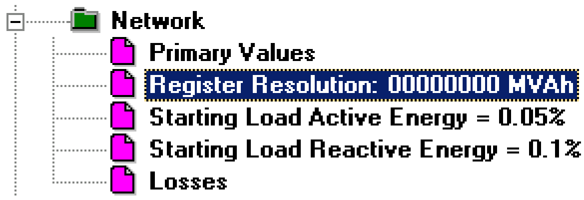
Nominal power (Load capacity 120% and 150%)	Nominal power (Load capacity 200%)	Register resolution Cumulative energy A, R, S	Register resolution Losses, THD
>3.2 kW .. 32 kW	>1.6 kW .. 16 kW	**00000.000 kWh** 000000.00 kWh	**0000.0000 kWh** 00000.000 kWh
>32 kW .. 320 kW	>16 kW .. 160 kW	00000.000 kWh **000000.00 kWh** 0000000.0 kWh	0000.0000 kWh **00000.000 kWh** 000000.00 kWh
>320 kW .. 3200 kW	>160 kW .. 1600 kW	000000.00 kWh **0000000.0 kWh** 00000000 kWh	00000.000 kWh **000000.00 kWh** 0000000.0 kWh
>3.2 MW .. 32 MW	>1.6 MW .. 16 MW	0000000.0 kWh **00000000 kWh** 0000.0000 MWh **00000.000 MWh** 000000.00 MWh	000000.00 kWh **0000000.0 kWh** 000.00000 MWh **0000.0000 MWh** 00000.000 MWh
>32 MW .. 320 MW	>16 MW .. 160 MW	00000.000 MWh **000000.00 MWh** 0000000.0 MWh	0000.0000 MWh **00000.000 MWh** 000000.00 MWh
>320 MW .. 2600 MW	>160 MW .. 1600 MW	000000.00 MWh **0000000.0 MWh** 00000000 MWh	00000.000 MWh **000000.00 MWh** 0000000.0 MWh

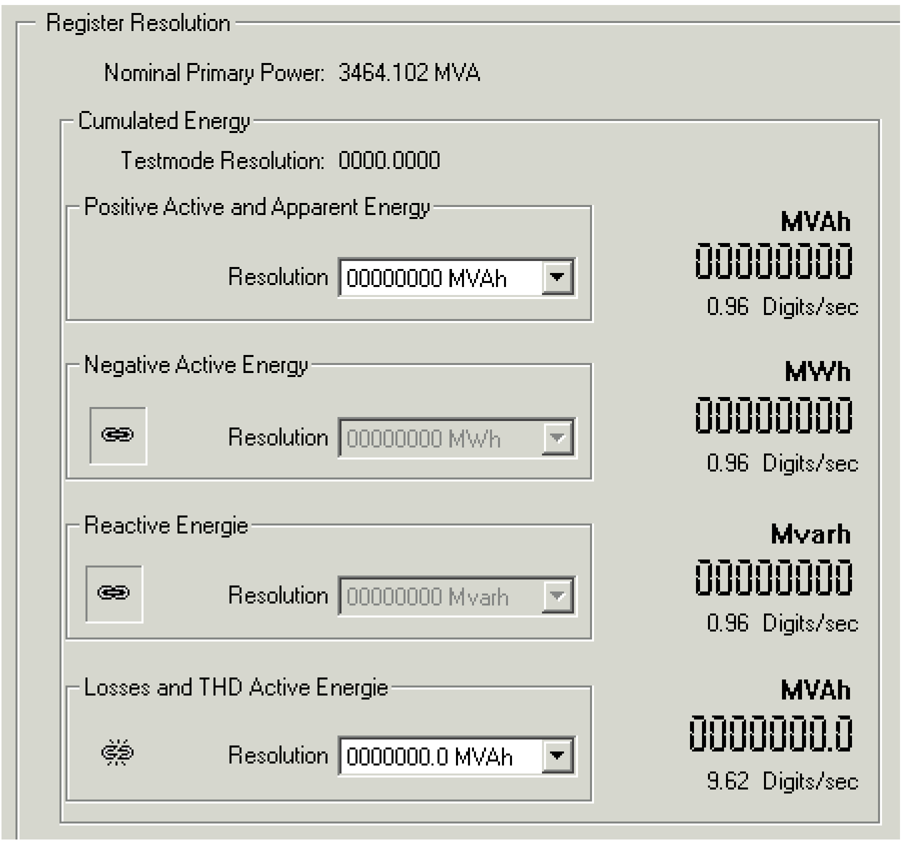
Delta Energy and Demand

Nominal power (Load capacity 120% and 150%)	Nominal power (Load capacity 200%)	Register resolution Delta energy A, R, S	Register resolution Demand
>3.2 kW .. 32 kW	>1.6 kW .. 16 kW	**0000.0000 kWh** 00000.000 kWh 000000.00 kWh	0.0000 kWh 00.000 kWh 000.00 kWh 0000.0 kWh
>32 kW .. 320 kW	>16 kW .. 160 kW	0000.0000 kWh **00000.000 kWh** 000000.00 kWh 0000000.0 kWh	0.0000 kWh 00.000 kWh 000.00 kWh 0000.0 kWh
>320 kW .. 3200 kW	>160 kW .. 1600 kW	00000.000 kWh **000000.00 kWh** 0000000.0 kWh 00000000 kWh	0.0000 kWh 00.000 kWh 000.00 kWh 0000.0 kWh

Nominal power (Load capacity 120% and 150%)	Nominal power (Load capacity 200%)	Register resolution Delta energy A, R, S	Register resolution Demand
>3.2 MW .. 32 MW	>1.6 MW .. 16 MW	000000.00 kWh **0000000.0 kWh** 00000000 kWh 000.00000 MWh **0000.0000 MWh** 00000.000 MWh 000000.00 MWh	0.0000 kWh 00.000 kWh 000.00 kWh 0000.0 kWh 0.0000 MWh 00.000 MWh 000.00 MWh 0000.0 MWh
>32 MW .. 320 MW	>16 MW .. 160 MW	0000.0000 MWh **00000.000 MWh** 000000.00 MWh 0000000.0 MWh	0.0000 MWh 00.000 MWh 000.00 MWh 0000.0 MWh
>320 MW .. 2600 MW	>160 MW .. 1600 MW	00000.000 MWh **000000.00 MWh** 0000000.0 MWh 00000000 MWh	0.0000 MWh 00.000 MWh 000.00 MWh 0000.0 MWh

Selecting the resolution





Resolution

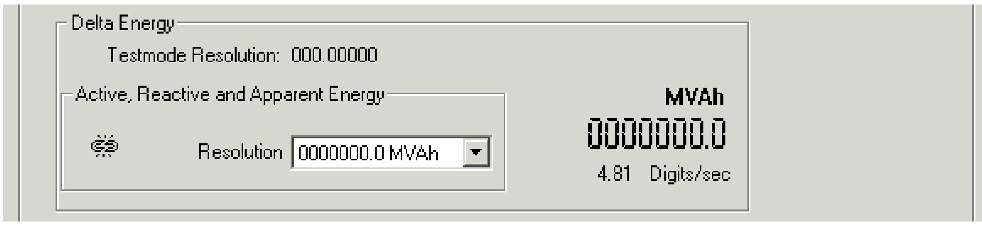
For positive active and apparent energy, select the resolution from the pull-down list according to the table above.

By default, the resolution is set identically for negative active and for reactive energy. For losses and THD_A, the resolution may be set as required.

Click  to select the resolution.

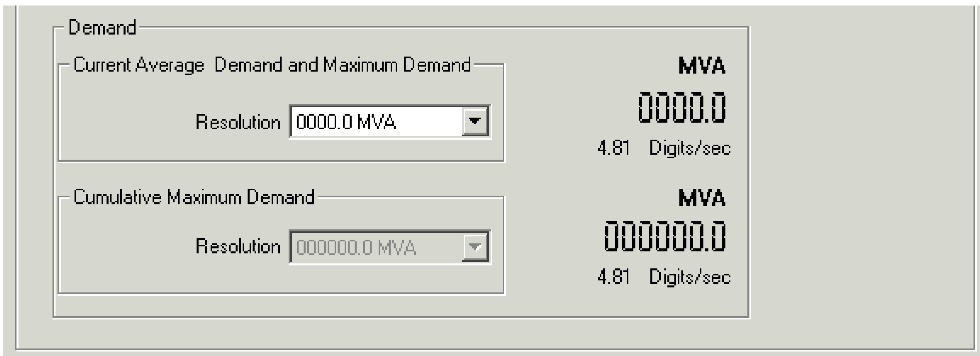
Resolution in test mode (only used in Central Europe)
According to VDEW, the resolution of the energy registers in the test mode is automatically set to 4 decimal points. The unit selected with the resolution parameter remains unchanged.

Delta registers



For the delta energy registers, select the resolution from the pull-down list.

Demand registers

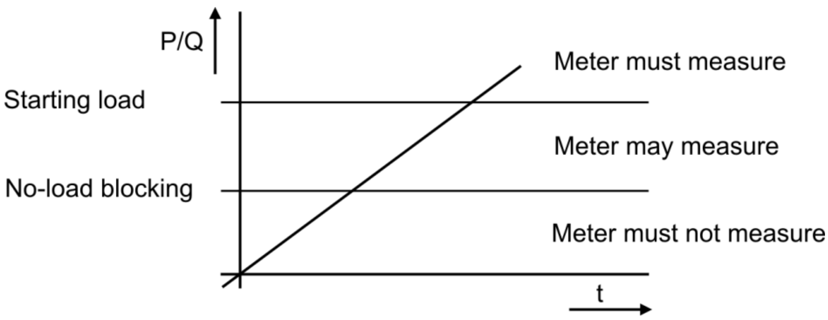


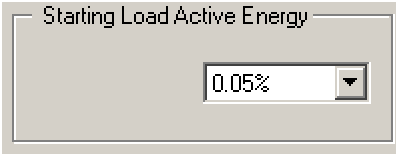
For the current average and maximum demand registers, select the resolution from the pull-down list.

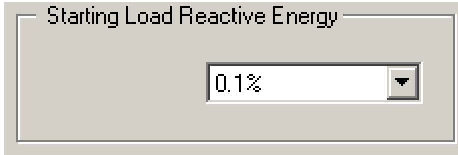
The registers for cumulative maximum demand are not used in the ZxQ.

2.14.3 Starting Load

The starting load defines the threshold above which the meter must measure the energy.



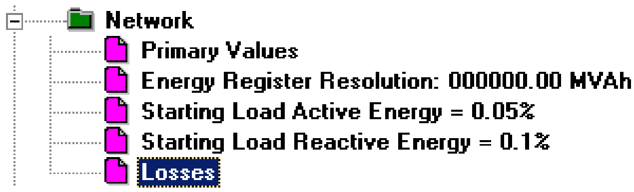


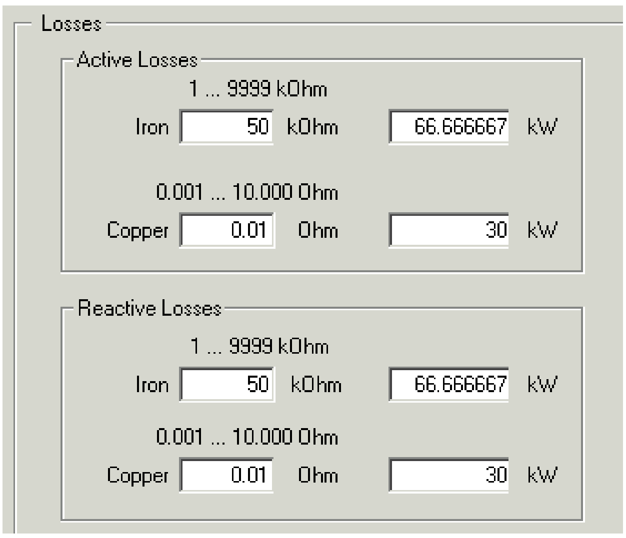


For M and F circuits, select the starting load according to table below. For C circuits double the starting load to a maximum of 0.4% P_n.

	Load capacity	Starting load (default)	Starting load (user defined)
Active	120%, 150% I_{max}	0.05% P_n	0.1%, 0.2% P_n
Active	200% I_{max}	0.1% P_n	0.2% P_n
Reactive	120%, 150% I_{max}	0.1% Q_n	0.2%, 0.4% Q_n
Reactive	200% I_{max}	0.2% Q_n	0.4% Q_n
Apparent	120%, 150% I_{max}	0.1% I_n	
U^2h	all	45% U_n	
I^2h	120%, 150% I_{max}	2% I_n	

2.14.4 Losses





If the meter only has secondary values and the „Losses" measurement is activated, no losses data is specified on the information shield. If necessary, the meter constants from table in section to 2.13 "Optical Test Output" can be used for testing purposes.

If the registration of losses is activated with primary values and no losses data have been passed on with the order, the setting is always 1 %PCu and 0,2 %PFe.

Prior to the installation of the meter in the metering point, the corresponding losses data has to be entered. Additional shields can be used for a correct notification on the meter.

Active Losses

In order to calculate the losses as accurately as possible, the equivalent resistance for the transmission line (copper) and the transformer (iron) must be entered.

For the iron resistance, values between 1 kΩ and 9999 kΩ are possible. For the copper resistance, values between 0.001 Ω and 10 Ω are possible. The MAP tool calculates the power losses based on the nominal primary power and the equivalent iron and copper resistance.

Usually, the power losses are entered. In that case the equivalent resistances are calculated.

If only the line losses are to be measured, set the iron resistance to 9999 kΩ.

Reactive Losses (not recommended)

For reactive losses, the same entries must be made as for active losses. Landis+Gyr do not recommend to measure losses of reactive energy. To ensure that the calculation of the losses of reactive energy is disabled, we recommend setting the iron resistance to 9999 kΩ and the copper resistance to 0.001 Ω.

2.14.5 Measured Quantities

All measured quantities that must be available on display, on communication, on transmitting contact or for tariffication must be enabled in the list of measured quantities. In the MAP tool, each measured quantity is represented by an ME number. You may select a maximum of 46 quantities to be processed in the meter (depending on the software configuration).

Some of the measured quantities have a fixed allocation to an ME number and cannot be switched off while others have a fixed allocation, but can be deactivated if not required.

MEx fix	Fixed allocation, cannot be switched off
MEx	Fixed allocation but can be switched off if not required
variable	The measured quantity can be allocated to any ME number that is not occupied by a fixed allocation.
—	Not available with this software configuration

Active energy

The measured quantities +A and -A are allocated to ME1 and ME2 respectively.

Allocation		
	Measured quantity	**all ZxQ versions**
+A	Active energy in positive direction (import)	ME1 fix
-A	Active energy in negative direction (export)	ME2 fix

Reactive energy without quadrant splitting

The measured quantities +R and -R are allocated to ME3 and ME4 respectively.

Allocation		
	Measured quantity	**all ZxQ versions**
+R	Reactive energy in positive direction (import)	ME3 fix
-R	Reactive energy in negative direction (export)	ME4 fix

Reactive energy with quadrant splitting

The measured quantities +Ri, -Ri, +Rc and -Rc are activated if quadrant splitting is selected.

Allocation		
	Measured quantity	**all ZxQ versions**
+R	Reactive energy in positive direction (import)	ME3 fix
-R	Reactive energy in negative direction (export)	ME4 fix
+Ri	Reactive energy in quadrant I	ME5 fix
-Ri	Reactive energy in quadrant II	ME6 fix
+Rc	Reactive energy in quadrant III	ME7 fix
-Rc	Reactive energy in quadrant IV	ME8 fix

Apparent energy

The measured quantities for apparent energy are only available with C.7 and C.8, whereby +S is assigned to ME35 and -S to ME36. The other apparent energy values can be allocated to an ME number between ME23 and ME34. Apparent energy measurement must be activated in the software configuration.

Allocation		
	Measured quantity	**C.7, C.8**
+S	Apparent energy in positive direction (import)	ME35
-S	Apparent energy in negative direction (export)	ME36
+Si	Apparent energy in quadrant I	variable
+Sc	Apparent energy in quadrant II	variable
-Si	Apparent energy in quadrant III	variable
-Sc	Apparent energy in quadrant IV	variable

Single phase values

With the C.7 and C.8 meters single phase values of active, reactive and apparent energy and losses can be measured. The measured quantities for single phase values can be allocated to the ME numbers ME23 to ME34. Single phase measurement must be activated in the software configuration.

Total harmonic distortion THD

Allocation		
	Measured quantity	**C.6, C.7, C.8**
$+THD_A$	Energy of the harmonics of +A	ME21
$-THD_A$	Energy of the harmonics of -A	ME22

Energy flow

The energy total registers EFA and EFR are derived from the measured quantities |+A| - |-A| and |+R| - |-R| respectively. They are solely used to drive the energy flow contacts and are only implemented to ensure compatibility with earlier products.

Allocation		
	Measured quantity	**all ZxQ versions**
EFA	Energy flow of active energy	ME19 fix
EFR	Energy flow of reactive energy	ME20 fix

Losses

Loss measurement must be activated in the software configuration. If activated, the following measured quantities are available:

Allocation				
	Measured quantity	**C.2**	**C.6**	**C.7, C.8**
NLA	Active iron losses (transformer)	ME9	variable	variable
OLA	Active copper losses (line)	ME10	variable	variable
NLR*	Reactive iron losses (transformer)	—	ME11	ME11
OLR*	Reactive copper losses (line)	—	ME12	ME12
+TLA	Total losses of active energy in positive direction	ME13	variable	ME13
-TLA	Total losses of active energy in negative direction	ME14	variable	ME14
+TLR*	Total losses of reactive energy in positive direction	—	variable	ME15
-TLR*	Total losses of reactive energy in negative direction	—	variable	ME16
I^2h	Current square hours (only internal value)	—	—	ME17
U^2h	Voltage square hours (only internal value)	—	—	ME18

*) Landis+Gyr do not recommend to measure losses of reactive energy.

Total losses

The measured quantities TLA and TLR are used to calculate the total losses, i.e. copper losses plus iron losses.

In order to calculate the total losses the relevant loss values must be available, i.e. their measured quantities must be activated. When activating a measured quantity for total losses, the MAP tool will prompt you to activate all measured quantities that are necessary for the calculation of the total losses. For details please refer to 2.14.8 "Measured Quantities for Total Losses and Compensated Energy").

The total losses are only available with the C.6 and C.8 and are allocated to the measured quantities ME41 and ME42.

Allocation			
	Measured quantity	**C.2, C.4, C.6, C.7**	**C.8**
TLA	Total active energy losses, NLA and OLA must be activated.	—	ME41
TLR	Total reactive energy losses, NLR and OLR must be activated.	—	ME42

Net and gross energy

These measured quantities are used to calculate net (or gross) energy, e.g. active energy minus active energy losses.

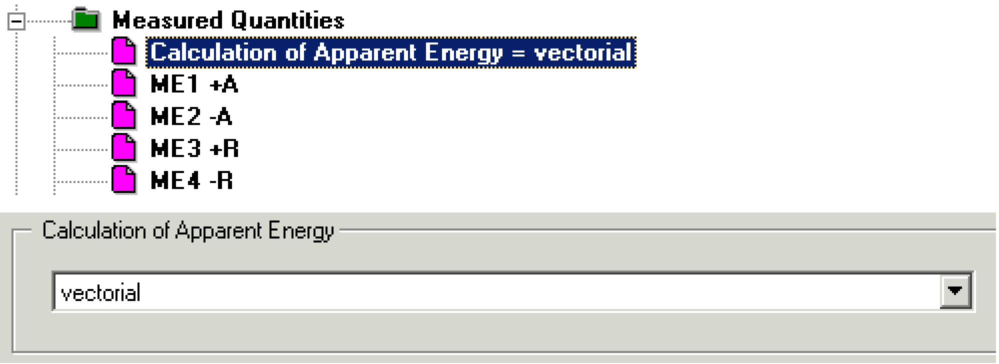
In order to calculate net energy the relevant energy and loss values must be available, i.e. their measured quantities must be activated. When activating a measured quantity for net energy, the MAP tool will prompt you to activate all measured quantities that are necessary for the calculation of net energy values. For details please refer to 2.14.8 "Measured Quantities for Total Losses and Compensated Energy".

The net energy calculation is only available with the C.8 and the values are allocated to the measured quantities ME43 to ME46.

Allocation			
	Measured quantity	**C.2, C.4, C.6, C.7**	**C.8**
+CA	Net (gross) active energy in positive direction +A and +TLA must be activated.	—	ME43
-CA	Net (gross) active energy in negative direction -A and -TLA must be activated.	—	ME44
+CR	Net (gross) reactive energy in positive direction +R and +TLR must be activated.	—	ME45
-CR	Net (gross) reactive energy in negative direction -R and -TLR must be activated.	—	ME46

Calculating gross energy (energy plus losses) is possible yet unusual. The function is provided for compatibility reasons with the Landis+Gyr Z.V meters.

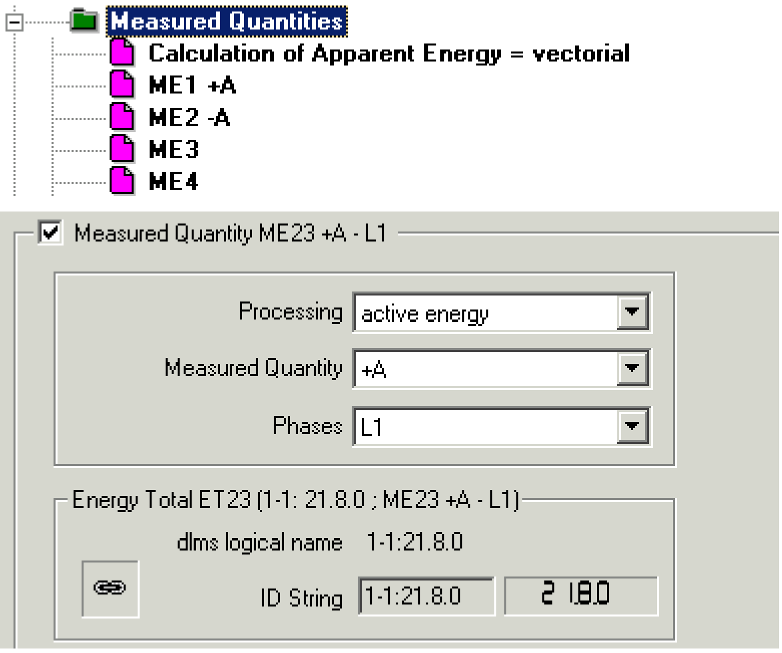
2.14.6 Apparent Energy Calculation



Select which calculation method is to be used for the apparent energy:

- **vectorial:** geometric addition of the active and the reactive energy of the individual phases (standard setting)
- **vectorial, ignore leading reactive:** geometric addition of the active and the reactive energy of the individual phases, ignoring the leading reactive energy
- **true RMS:** multiplying the single-phase RMS values of voltage and current (common in the USA)

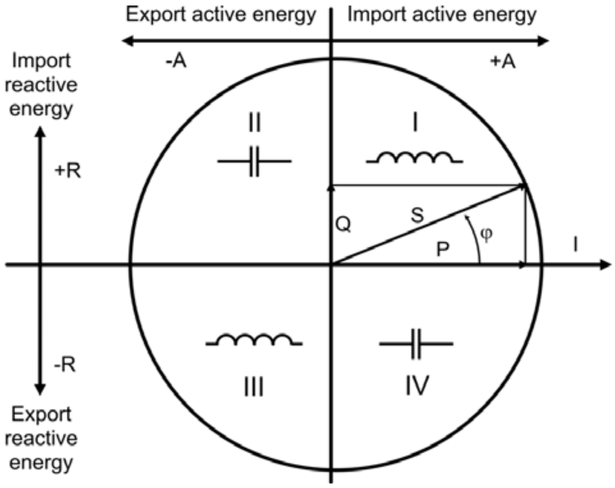
2.14.7 Defining a Measured Quantity



To define a measured quantity, set a tick at the required ME number to activate it and set the following parameters:

Processing From the pull-down list, select the type of energy to be processed.

Measured Quantity From the pull-down list, select the measured quantity.

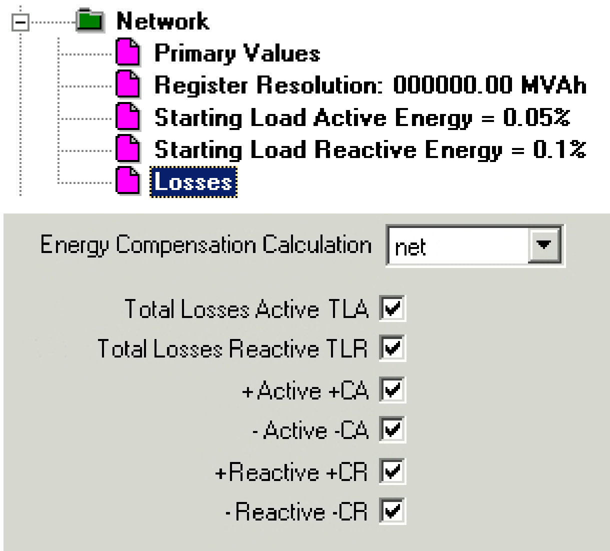


Phases From the pull-down list, select which phase(s) are taken into consideration for this measured quantity.

dlms logical name The dlms logical name is a numerical code that serves as identification of the measured quantity according to the OBIS standard. When defining a measured quantity it is allocated automatically.

Display Code The display code appears in the code field of the display. By default the display code is identical to the dlms logical name according to the OBIS standard. However, the user can set his own display code for each register.

2.14.8 Measured Quantities for Total Losses and Compensated Energy



To activate a measured quantity for total losses and compensated energy, set the required tick. The selected measured quantities are added to the list of measured quantities (ME41 to ME46).

Activate all required measured quantities
These measured quantities are the sum of or the difference between two measured quantities. Therefore, you will be prompted to activate all measured quantities that are required to calculate the measured quantities for total losses and compensated energy.

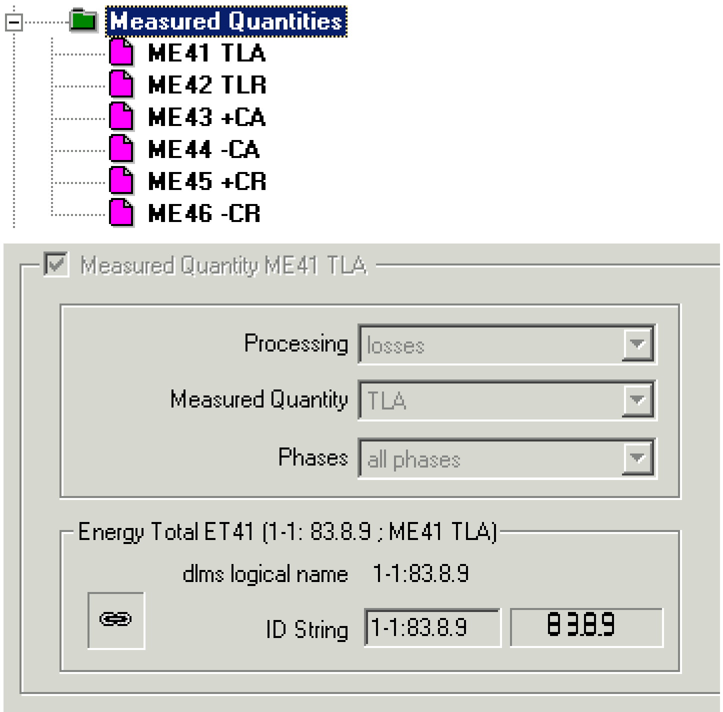
In order to calculate net energy the relevant energy and loss values must be available, i.e. their measured quantities must be activated. When activating a measured quantity for net energy, the MAP tool will prompt you to activate all measured quantities that are necessary for the calculation of net energy values.

Energy Compensation Calculation

For +CA, -CA, +CR and -CR, select whether the losses are added to or subtracted from the energy value.

net	The losses are subtracted from the energy value.
gross	The losses are added to the energy value.

Parameters for Total Losses and Compensated Energy



All relevant parameters except for the display code are fixed and cannot be altered by the customer.

dlms logical name

The dlms logical name is a numerical code that serves as identification of the measured quantity according to the OBIS standard. When defining a measured quantity it is allocated automatically.

Display Code

The display code appears in the code field of the display. By default the display code is identical to the dlms logical name according to the OBIS standard. However, users can set their own display code for each register.

3 Transmitting Contacts

3.1 Overview

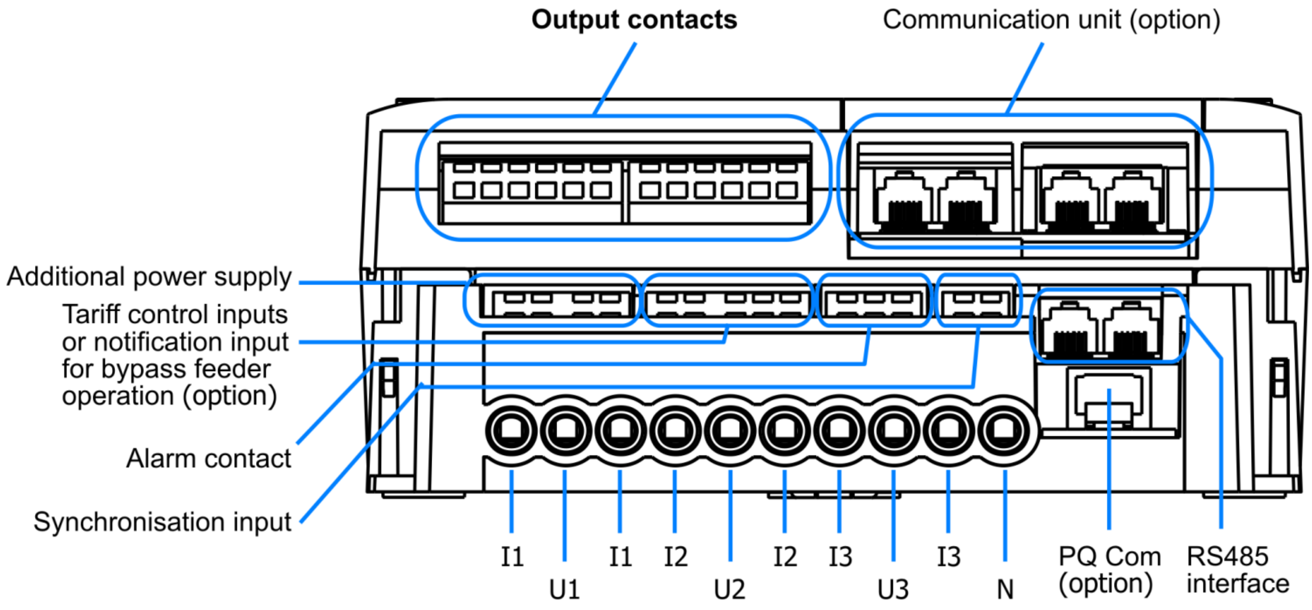
The transmitting contacts of the ZxQ are used to transmit information to external devices by means of pulses and static signals.

Various parameters define the behaviour of the transmitting contacts of the meter. The transmitting contacts can be used as:

- pulse output contacts for active energy, reactive energy and losses
- static output contacts to indicate:
  – the energy flow
  – the primary power exceeding the upper limit (load supervision)
  – the end of the capture period (t_m)

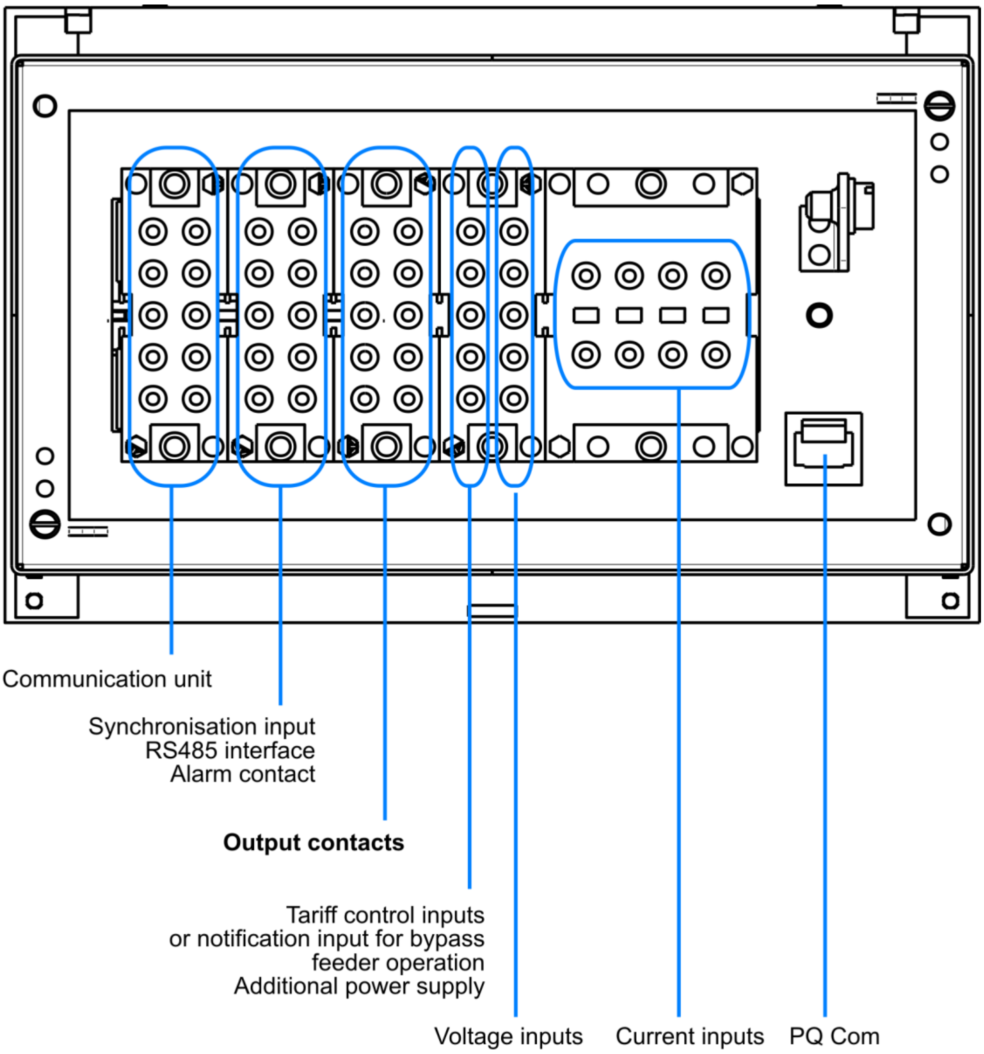
Selectable function
The output contacts for pulses and static signals are physically the same contacts. The customer can select which signal should be available on which contact.

3.1.1 Terminals of the f6 Case



All options
The illustration shows the standard terminal layout of an f6 meter with all options.

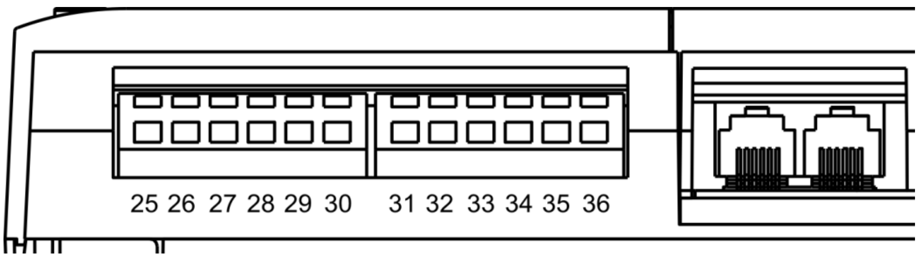
3.1.2 Terminals of the f9 Case



All options
The illustration shows the standard terminal layout of an f9 meter with all options.

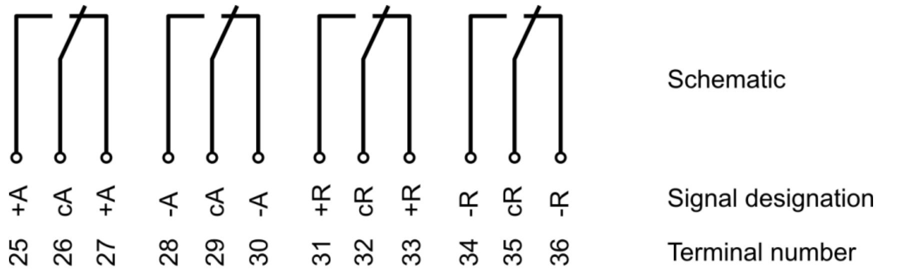
3.2 Terminal Allocation f6 Case

With the exception of the transmitting contact terminals, all ZxQ meters with an f6 case have the same terminal allocation.



Depending on the selection of transmitting contacts made in the hardware configuration menu, one of the following terminal allocations applies.

r3 / r4 transmitting contact

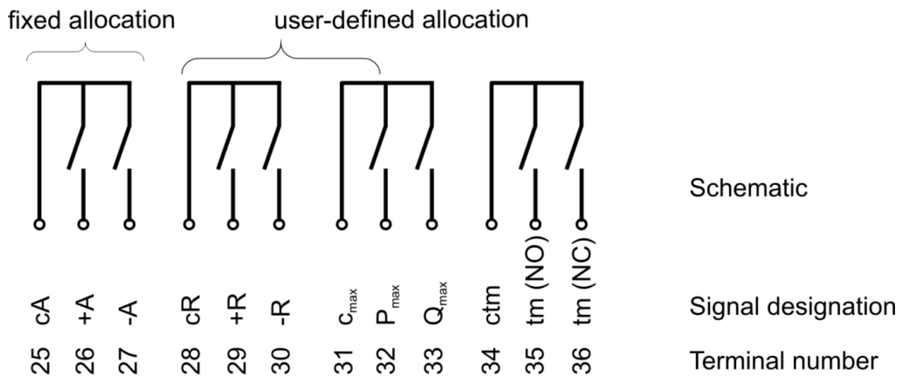


cA	Common of pulse output contacts, active energy
+A	Pulse output contact, active energy in positive direction
-A	Pulse output contact, active energy in negative direction
cR	Common of pulse output contacts, reactive energy
+R	Pulse output contact, reactive energy in positive direction
-R	Pulse output contact, reactive energy in negative direction

r4a transmitting contact

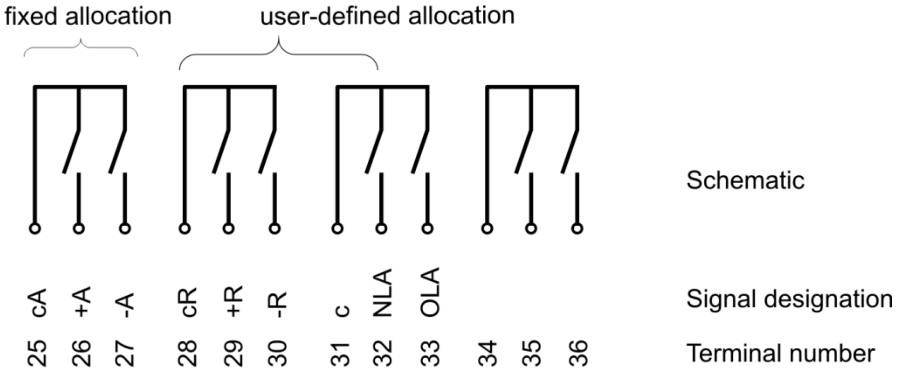
The r4a transmitting contacts consist of two groups of contacts. The first group has a fixed signal allocation while the signal allocation for the second group can be defined by the user. Four examples of r4a transmitting contacts are given below:

Example 1: r4a transmitting contacts with load supervision and capture period output contacts



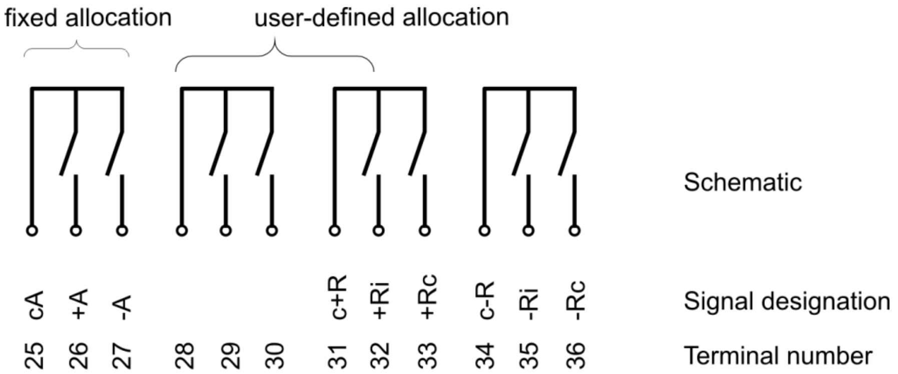
cA	Common of pulse output contacts, active energy
+A	Pulse output contact, active energy in positive direction
-A	Pulse output contact, active energy in negative direction
cR	Common of pulse output contacts, reactive energy
+R	Pulse output contact, reactive energy in positive direction
-R	Pulse output contact, reactive energy in negative direction
C_{max}	Common of static output contacts for load supervision
P_{max}	Static output contact for load supervision (primary active power too high)
Q_{max}	Static output contact for load supervision (primary reactive power too high)
ctm	Common of static output contact for capture period output
tm (NO)	Static output contact for capture period output (normally open)
tm (NC)	Static output contact for capture period output (normally closed)

Example 2: r4a transmitting contacts for losses



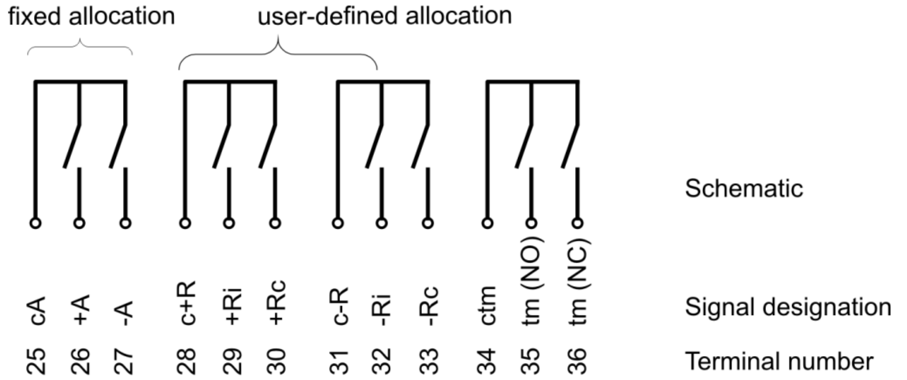
cA	Common of pulse output contacts, active energy
+A	Pulse output contact, active energy in positive direction
-A	Pulse output contact, active energy in negative direction
cR	Common of pulse output contacts, reactive energy
+R	Pulse output contact, reactive energy in positive direction
-R	Pulse output contact, reactive energy in negative direction
c	Common of pulse output contacts, active losses
NLA	Pulse output contact, active iron losses
OLA	Pulse output contact, active copper losses

Example 3: r4a transmitting contacts with quadrant splitting



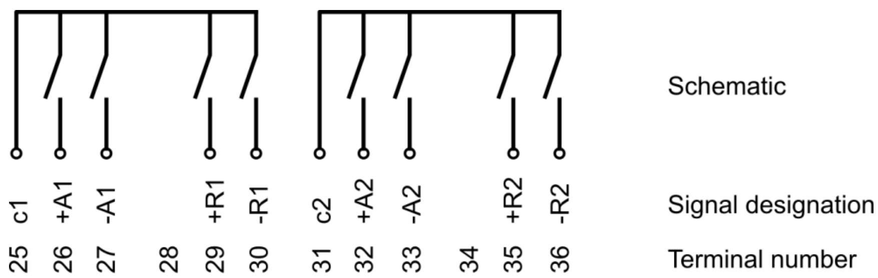
cA	Common of pulse output contacts, active energy
+A	Pulse output contact, active energy in positive direction
-A	Pulse output contact, active energy in negative direction
c+R	Common of pulse output contacts, reactive energy in pos. direction
+Ri	Pulse output contact, inductive, reactive energy in positive direction
+Rc	Pulse output contact, capacitive, reactive energy in positive direction
c-R	Common of pulse output contacts, reactive energy in neg. direction
-Ri	Pulse output contact, inductive, reactive energy in negative direction
-Rc	Pulse output contact, capacitive, reactive energy in negative direction

Example 4: r4a transmitting contacts with quadrant splitting and capture period output contacts



cA	Common of pulse output contacts, active energy
+A	Pulse output contact, active energy in positive direction
-A	Pulse output contact, active energy in negative direction
c+R	Common of pulse output contacts, reactive energy in pos. direction
+Ri	Pulse output contact, inductive, reactive energy in positive direction
+Rc	Pulse output contact, capacitive, reactive energy in positive direction
c-R	Common of pulse output contacts, reactive energy in neg. direction
-Ri	Pulse output contact, inductive, reactive energy in negative direction
-Rc	Pulse output contact, capacitive, reactive energy in negative direction
ctm	Common of static output contact for capture period output
tm (NO)	Static output contact for capture period output (normally open)
tm (NC)	Static output contact for capture period output (normally closed)

r4aa transmitting contact (twin)

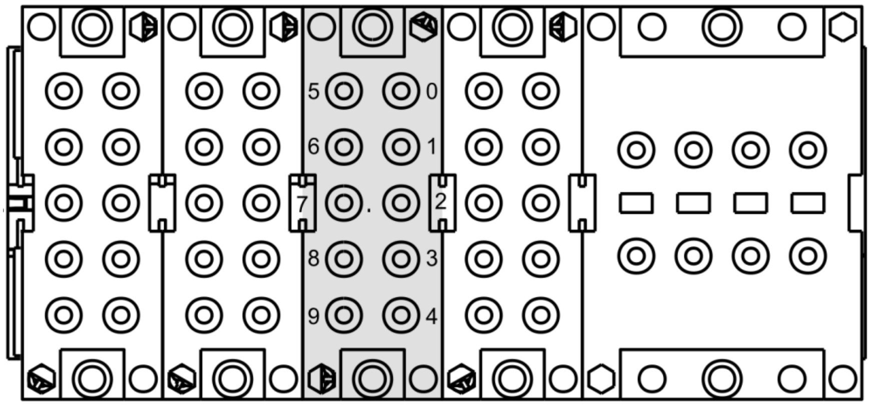


c1	Common of pulse output contacts, group 1
+A1	Pulse output contact, active energy in positive direction, group 1
-A1	Pulse output contact, active energy in negative direction, group 1
+R1	Pulse output contact, reactive energy in positive direction, group 1
-R1	Pulse output contact, reactive energy in negative direction, group 1
c2	Common of pulse output contacts, group 2

+A2	Pulse output contact, active energy in positive direction, group 2
-A2	Pulse output contact, active energy in negative direction, group 2
+R2	Pulse output contact, reactive energy in positive direction, group 2
-R2	Pulse output contact, reactive energy in negative direction, group 2

3.3 Terminal Allocation f9 Case

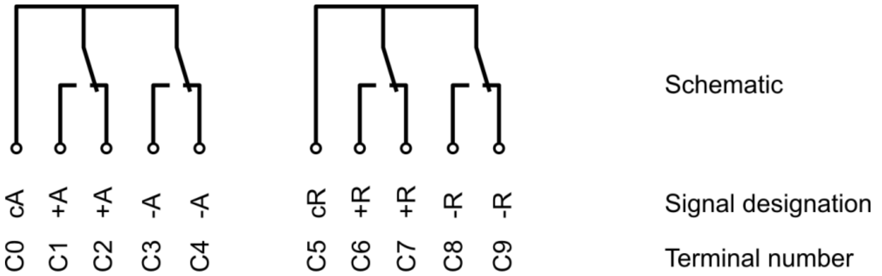
With the exception of the transmitting contact terminals, all ZxQ meters with an f9 case have the same terminal allocation.



Connector C

Depending on the selection of transmitting contacts made in the hardware configuration menu, one of the following terminal allocations applies.

r3 / r4 transmitting contact

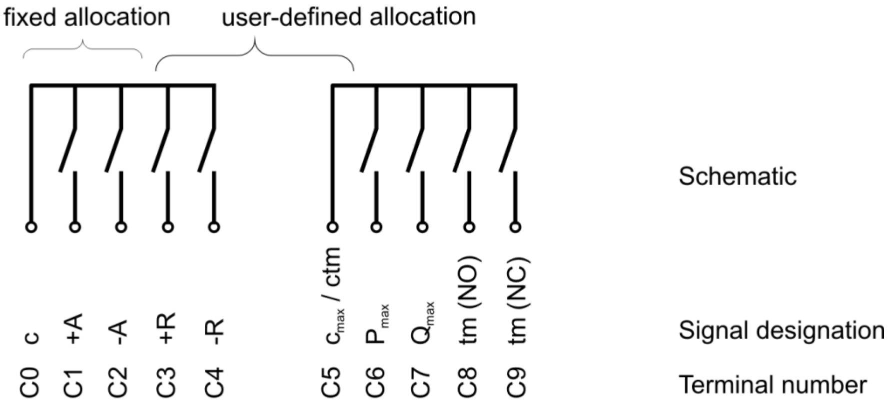


cA	Common of pulse output contacts, active energy
+A	Pulse output contact, active energy in positive direction
-A	Pulse output contact, active energy in negative direction
cR	Common of pulse output contacts, reactive energy
+R	Pulse output contact, reactive energy in positive direction
-R	Pulse output contact, reactive energy in negative direction r4aa transmitting contact (twin)

r4a transmitting contact

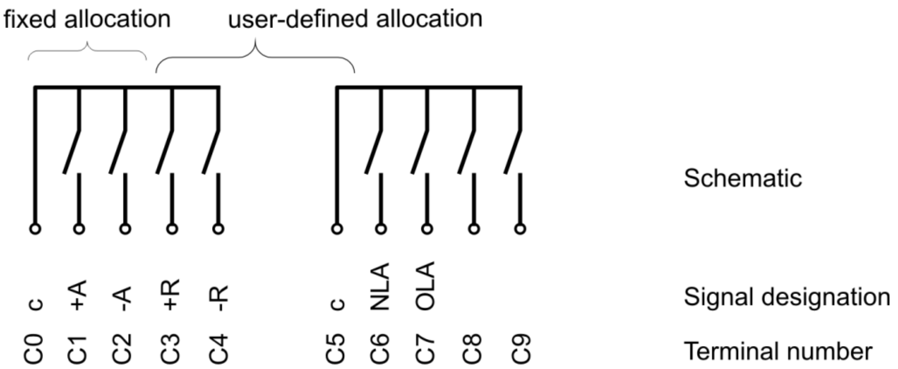
The r4a transmitting contacts consist of two groups of contacts. The first group has a fixed signal allocation while the signal allocation for the second group can be defined by the user. Four examples of r4a transmitting contacts are given below:

Example 1: r4a transmitting contacts with load supervision and capture period output contacts



c	Common of pulse output contacts for active and reactive energy
+A	Pulse output contact, active energy in positive direction
-A	Pulse output contact, active energy in negative direction
+R	Pulse output contact, reactive energy in positive direction
-R	Pulse output contact, reactive energy in negative direction
Cmax / ctm	Common of static output contacts for load supervision and Common of static output contact for capture period output
Pmax	Static output contact for load supervision (primary active power too high)
Qmax	Static output contact for load supervision (primary reactive power too high)
tm (NO)	Static output contact for capture period output (normally open)
tm (NC)	Static output contact for capture period output (normally closed)

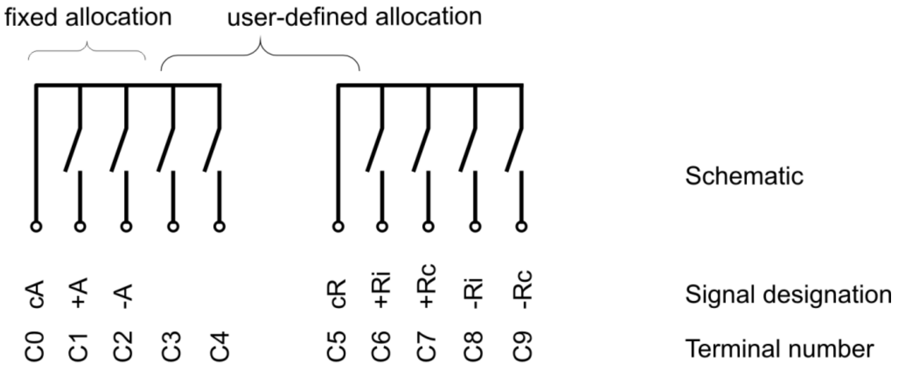
Example 2: r4a transmitting contacts for losses



c	Common of pulse output contacts, active and reactive energy
+A	Pulse output contact, active energy in positive direction
-A	Pulse output contact, active energy in negative direction
+R	Pulse output contact, reactive energy in positive direction
-R	Pulse output contact, reactive energy in negative direction

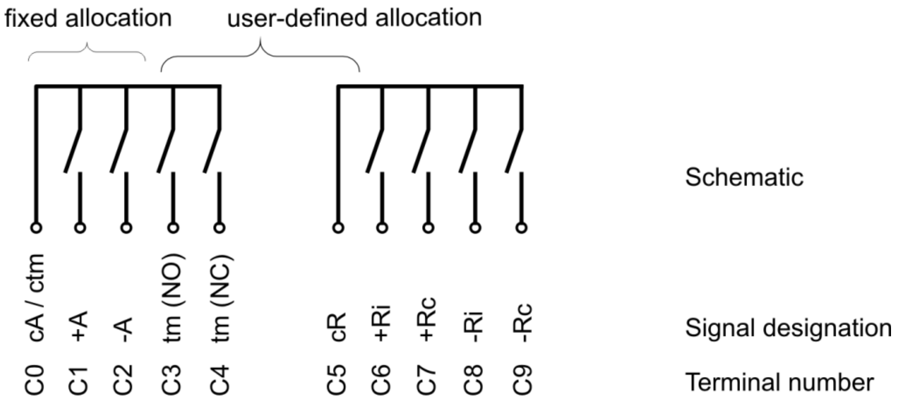
c	Common of pulse output contacts, losses
NLA	Pulse output contact, active iron losses
OLA	Pulse output contact, active copper losses

Example 3: r4a transmitting contacts with quadrant splitting



cA	Common of pulse output contacts, active energy
+A	Pulse output contact, active energy in positive direction
-A	Pulse output contact, active energy in negative direction
cR	Common of pulse output contacts, reactive energy
+Ri	Pulse output contact, inductive, reactive energy in positive direction
+Rc	Pulse output contact, capacitive, reactive energy in positive direction
-Ri	Pulse output contact, inductive, reactive energy in negative direction
-Rc	Pulse output contact, capacitive, reactive energy in negative direction

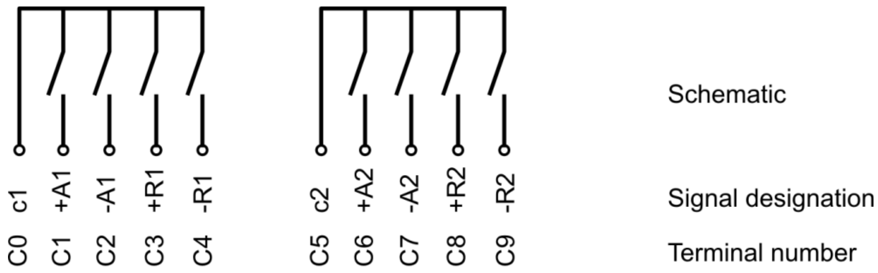
Example 4: r4a transmitting contacts with quadrant splitting and capture period output contact



cA / ctm	Common of pulse output contacts, active energy and Common of static output contact for capture period output
+A	Pulse output contact, active energy in positive direction
-A	Pulse output contact, active energy in negative direction
tm (NO)	Static output contact for capture period output (normally open)
tm (NC)	Static output contact for capture period output (normally closed)

cR	Common of pulse output contacts, reactive energy
+Ri	Pulse output contact, inductive, reactive energy in positive direction
+Rc	Pulse output contact, capacitive, reactive energy in positive direction
-Ri	Pulse output contact, inductive, reactive energy in negative direction
-Rc	Pulse output contact, capacitive, reactive energy in negative direction

r4aa transmitting contact (twin)



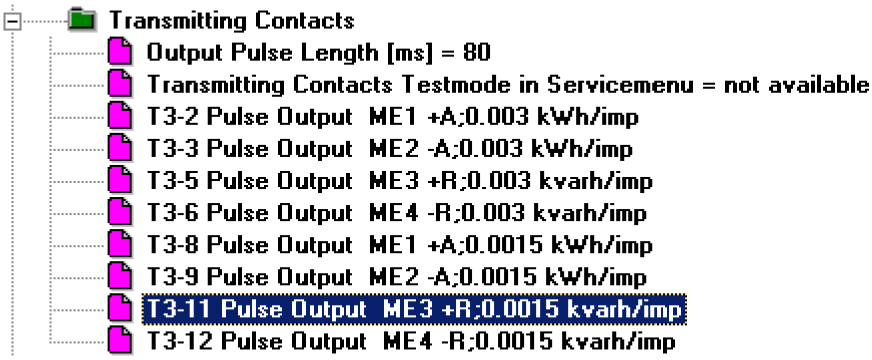
c1	Common of pulse output contacts, group 1
+A1	Pulse output contact, active energy in positive direction, group 1
-A1	Pulse output contact, active energy in negative direction, group 1
+R1	Pulse output contact, reactive energy in positive direction, group 1
-R1	Pulse output contact, reactive energy in negative direction, group 1
c2	Common of pulse output contacts, group 2
+A2	Pulse output contact, active energy in positive direction, group 2
-A2	Pulse output contact, active energy in negative direction, group 2
+R2	Pulse output contact, reactive energy in positive direction, group 2
-R2	Pulse output contact, reactive energy in negative direction, group 2

Z.U compatible transmitting contacts

Transmitting contacts with signal allocations which are compatible with existing Z.U applications are possible on request.

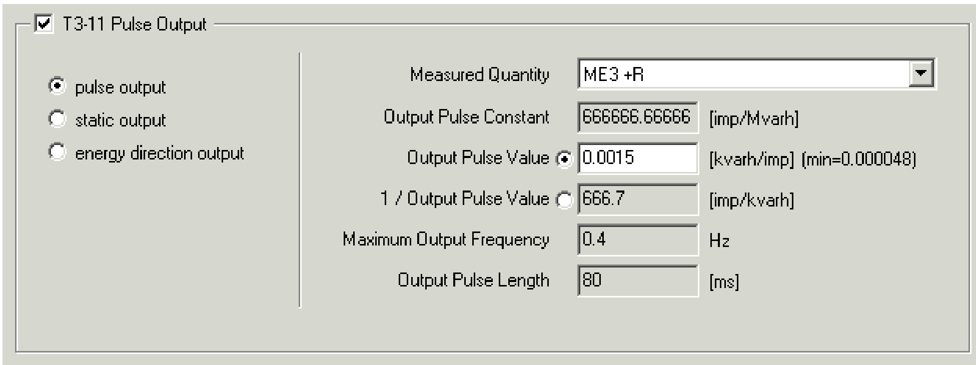
3.4 Transmitting Contact Parameters

3.4.1 Pulse Output



To define a transmitting contact as pulse output:

1. Select the contact you intend to define as pulse output.
2. Select *pulse output*.
3. Define the parameters below.



Measured Quantity

Select the measured quantity that is transmitted via the contact (unless the allocation is fixed). Active, reactive and apparent energy as well as compensated energy and losses can be selected.

Output Pulse Value

Enter the pulse value of the transmitting contact output pulses. Pulse values with up to 6 decimal points are possible.

To select an appropriate output pulse value, the maximum primary power and the maximum acceptable frequency of the transmitting contacts must be taken into consideration.

The output pulse value of the transmitting contact is:

$$i\left[\frac{\mathrm{kWh}}{\mathrm{imp}}\right] = \frac{P1_{max}[\mathrm{kW}]}{f_{max}[\mathrm{Hz}] * 3600}$$

i: primary output pulse value

$P1_{max}$: maximum primary power

f_{max}: maximum frequency of the transmitting contact

Minimum of 2'777 pulses per capture period
According to the IEC standards, class 0.2S meters must send a minimum of 2'777 pulses per capture period at nominal load. This is to provide an adequate resolution.

Check the selected output pulse value as follows:
Minimal frequency at nominal load = 2777 / capture period in seconds

Example: capture period of 15 minutes (900 s)
Minimal frequency at nominal load = 2777 / 900 s = 3.1 Hz
Minimal frequency at maximum load (120%) = 3.1 Hz x 1.2 = 3.72 Hz

1 / Output Pulse Value

The reciprocal value of the output pulse value in imp/kWh. This value can only be entered for meters with secondary data.

Output Pulse Constant

The reciprocal value of the output pulse value in imp/MWh. This value cannot be altered but can be added to the display lists (see section 20.5.1 "Selection of Entries in each Display List").

The following table illustrates the dependency between the primary power, the selected output pulse constant and the resulting frequency of the transmitting contacts.

Nominal power P_n Load capacity 120% and 150%	Nominal power P_n Load capacity 200%	Output pulse value i [.Wh(.varh)/imp]	Fr_{max} @ P_{max} 120%	Fr_{max} @ P_{max} 150%	Fr_{max} @ P_{max} 200%
>1.3 MW … 2.6 MW		0.2 kWh	2.2 .. 4.3 Hz	5.4 Hz	
>2.6 MW … 6.5 MW	>1.6 MW … 4 MW	0.5 kWh	1.7 .. 4.3 Hz	5.4 Hz	1.8 .. 4.4 Hz
>6.5 MW … 13 MW	>4 MW … 8 MW	1 kWh	2.2 .. 4.3 Hz	5.4 Hz	2.2 .. 4.4 Hz
>13 MW … 26 MW	>8 MW ... 16 MW	2 kWh	2.2 .. 4.3 Hz	5.4 Hz	2.2 .. 4.4 Hz
>26 MW … 65 MW	>16 MW … 40 MW	5 kWh	1.7 .. 4.3 Hz	5.4 Hz	1.8 .. 4.4 Hz
>65 MW … 130 MW	>40 MW … 80 MW	10 kWh	2.2 .. 4.3 Hz	5.4 Hz	2.2 .. 4.4 Hz
>130 MW … 260 MW	>80 MW ... 160 MW	20 kWh	2.2 .. 4.3 Hz	5.4 Hz	2.2 .. 4.4 Hz
>260 MW … 650 MW	>160 MW … 400 MW	50 kWh	1.7 .. 4.3 Hz	5.4 Hz	1.8 .. 4.4 Hz
>650 MW … 1300 MW	>400 MW … 800 MW	100 kWh	2.2 .. 4.3 Hz	5.4 Hz	2.2 .. 4.4 Hz
>1300 MW ... 2600 MW	>800 MW ... 1600 MW	200 kWh	2.2 .. 4.3 Hz	5.4 Hz	2.2 .. 4.4 Hz

Maximum Output Frequency

The MAP tool calculates the maximum output frequency based on the output pulse value and the primary power. If the frequency is above a certain limit you are prompted to select a shorter pulse length (r4 contacts) or a higher pulse value.

Pulse length	Max. frequency
80 ms	6 Hz
40 ms	11 Hz
20 ms	22 Hz

When r3 has been selected in the software configuration, the frequency stated by the MAP tool means changeovers per second. For example, if the frequency is displayed as 10 Hz, there are 10 changeovers per second which results in a real frequency of 5 Hz. With r3 contacts, a maximum of 50 changeovers per second are possible (25 Hz).

Exceeding the maximum output frequency on the testing station
In normal grid applications, the reactive load will never reach 100%. Therefore, the output pulse value for reactive energy can be set to optimise the output frequency at low reactive loads.

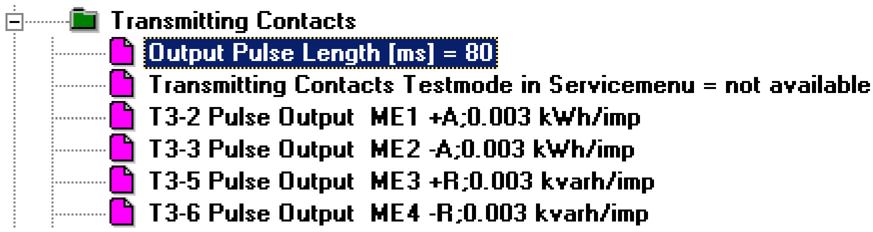
As a result, the maximum output frequency is exceeded when the meter is tested at 100% reactive load on the testing station.

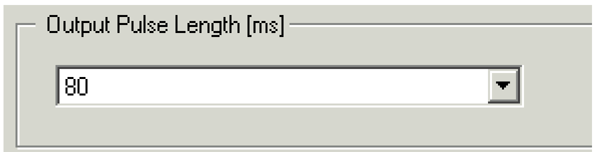
If the pulse values are set so that the maximum frequency is exceeded at 100% load, the pulse values on the information plate of the meter are marked with Q_{max}.

Output Pulse Length

With a pulse length of 80 ms, the maximum allowed frequency is 6 Hz. If the resulting frequency exceeds this value, you will be prompted to either select a shorter pulse length or a higher pulse value.

Pulse lengths of 80 ms, 40 ms and 20 ms can be selected. With a pulse length of 40 ms a maximum frequency of 11 Hz, with 20 ms a maximum of 22 Hz are possible.

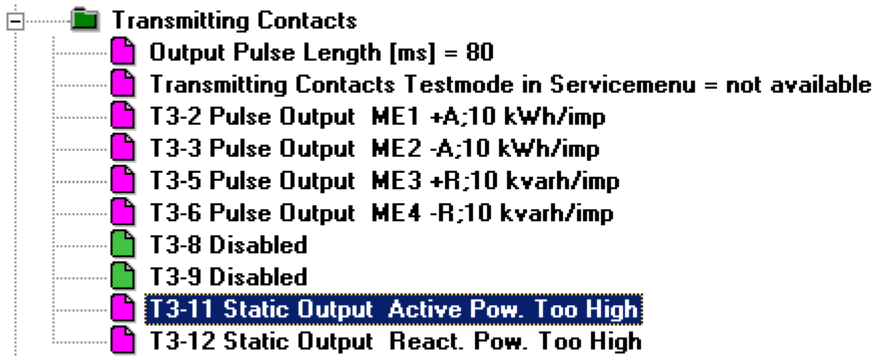




The selected output pulse length applies for all output contacts.

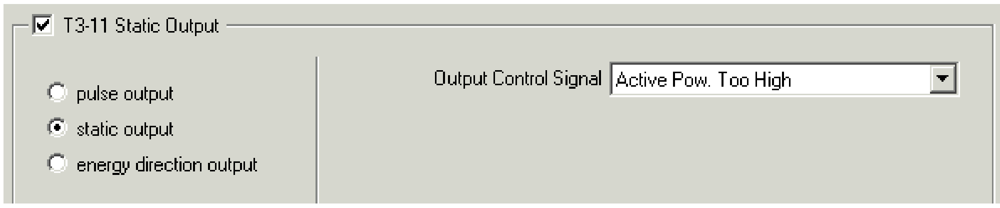
3.4.2 Static Output

r4a required
The static output contacts are only available with r4a transmitting contacts.



To define a transmitting contact as static output:

1. Select the contact you intend to define as static output.
2. Select *static output*.
3. Define the parameter below.

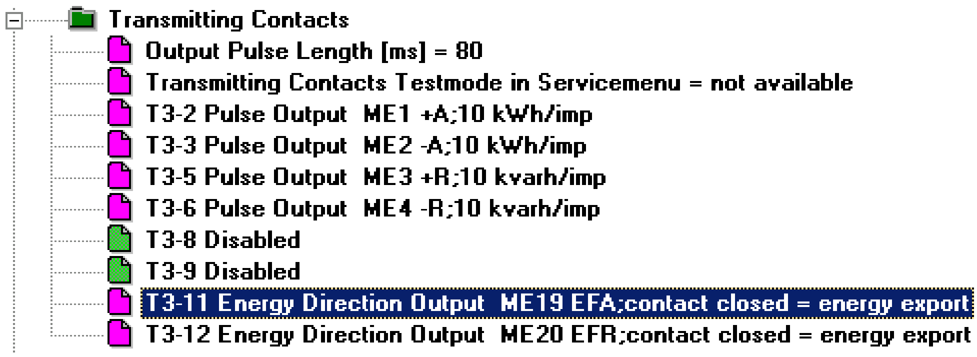


Output Control Signal Select the control signal that drives the static contact:

Active power too high Reactive power too high	Indicates that the active or reactive power is above the set limit. In order to select these control signals, the power monitor must be activated (see section 1.3 "Software Configuration Parameters") and its thresholds must be set (see section 17.8.7 "Power Monitor (Load Supervision)"). The power monitor is available with the software configurations C.6 and C.8 only.
Capture period output	Indicates the end of the capture period. Select whether the contact is open during the capture period and closes to indicate the end of the period or vice versa. *Only capture period tm1 can be shown on the contacts.* tm2 cannot be shown.

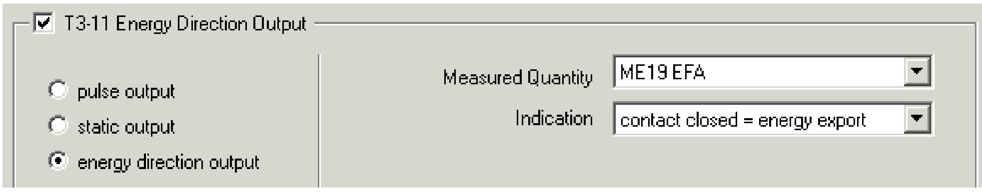
3.4.3 Energy Flow Contact

r4a required
The energy flow contacts are only available with r4a transmitting contacts.



To define a transmitting contact as energy flow contact:

1. Select the contact you intend to define as energy flow output.
2. Select *energy direction output*.
3. Define the parameters below.



Measured Quantity

Select whether the direction of active or reactive energy is indicated with this contact.

EF_A: Indicates the direction of active energy.

EF_R: Indicates the direction of reactive energy.

Indication

Select whether a closed contact indicates positive energy (import) or negative energy (export).

3.4.4 Transmitting Contact Test Mode

The transmitting contact test mode may be used to test the wiring of the transmitting contacts during installation. While in the transmitting contact test mode the meter sends pulses with a frequency of 1 Hz to the pulse receiver no matter the load that is applied to the meter.

The transmitting contact test mode is only available with meters with the software configurations C.4, C.6 and C.8.

Select whether or not the transmitting contact test mode can be activated in service menu.

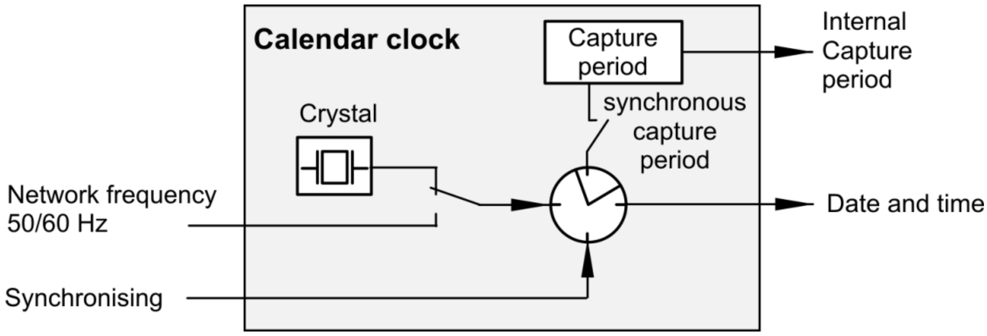
Approved only in some countries
The use of the transmitting contact test mode is permitted only in a few countries for calibration reasons. See country regulation for details.

4 Calendar Clock

4.1 Characteristics

The internal calendar clock of the ZxQ generates the date and time information, which is used:

- for the date and time information to be displayed
- to control the time switch TOU
- for the time stamps in the load profile, stored billing value profile, daily snapshot and event log
- to control the capture/integration period



Time base

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

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

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

Adjustment

The calendar clock can be adjusted:

- via the synchronisation input Syn
- via communication
- in the set mode

Daylight saving time

If activated, the changeover to daylight saving time (summer time) and back to normal time is performed automatically. Start and end of daylight saving time can be set according to the European standard or users may define their own specification.

Validity

The calendar clock is designed to generate valid calendar data (including leap years) until the year 2060.

Power reserve

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

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

- Power reserve with battery: 10 years (at a storage temperature of 25°C)

Display and communication

The following calendar clock information is available on the display and via communication:

- Current time of the day
- Current date
- Day of the week (1: Monday, 7: Sunday)
- Status information

4.2 Adjustment of the Calendar Clock

The calendar clock can be adjusted:

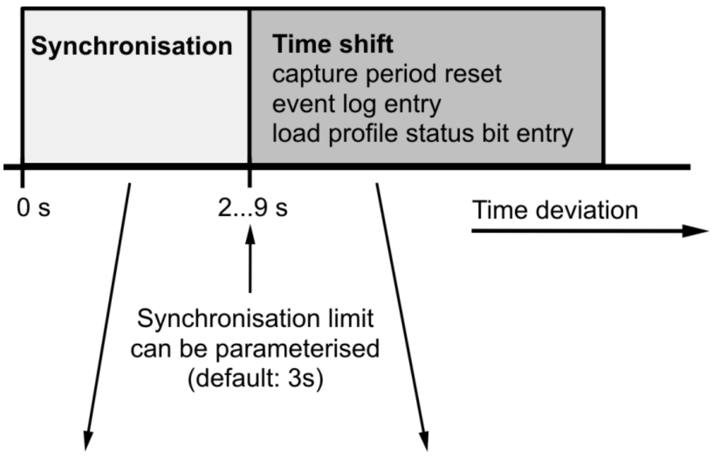
- via the synchronisation input Syn
- via communication
- in the set mode

The time information received is compared with the local time of the meter. The reaction of the meter depends on the deviation (see section 4.2.1 "Handling the Deviations").

4.2.1 Handling the Deviations

Depending on the time deviation of the internal clock, the adjustments have different effects on the calendar clock. The following cases are possible:

- The time deviation is shorter than 2 to 9 seconds (depending on parameter setting). This results in a synchronisation.
- The time deviation is longer than 2 to 9 seconds (depending on parameter setting). This results in a time shift.



It has to be taken into account for synchronisation that in some cases the resolutions of the readout central station are limited.

	Deviation < synch limit	Deviation > synch limit	Remark
Control input Syn	Synchronisation	Time shift Capture period reset Event log entry Load profile status bit set	The second synchronisation signal within the same synchronisation interval is ignored.
Communication	Synchronisation	Time shift Capture period reset Event log entry Load profile status bit set	Adjusting the time a second time within the same capture period results in a time shift, no matter how small the deviation.
Set mode	Synchronisation	Time shift Capture period reset Event log entry Load profile status bit set	Adjusting the time a second time within the same capture period results in a time shift, no matter how small the deviation.

4.2.2 Adjusting the Calendar Clock via the Synchronisation Input Syn

The calendar clock can be adjusted by an external master clock (e.g. GPS receiver), which sends synchronisation pulses at regular intervals.

There are three possibilities of adjusting the calendar clock using the external synchronisation signal:

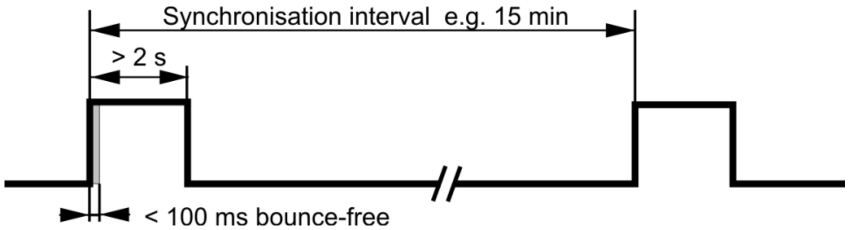
- The synchronisation takes place several times per day
  - To the minute or
  - To the capture period
- The synchronisation takes place once per day at a selectable time of the day (standard in grid applications)

Use only one type of synchronisation
Only one type of synchronisation can be used at a time, either several times per day **or** once per day.

C.2 has no synchronisation input
Meters with the software configuration C.2 have no synchronisation input Syn.

Several times per day

The "several times per day" synchronisation takes place at regular intervals. The interval is defined by parameter setting.



The synchronisation signal sets the time of the calendar clock to either the begin of or the end of the synchronisation interval.

It sets back the time to the start of the synchronisation interval, if the signal was received during the first half of the interval. It advances the time to the end of the synchronisation interval, if the signal was received in the second half of the interval.

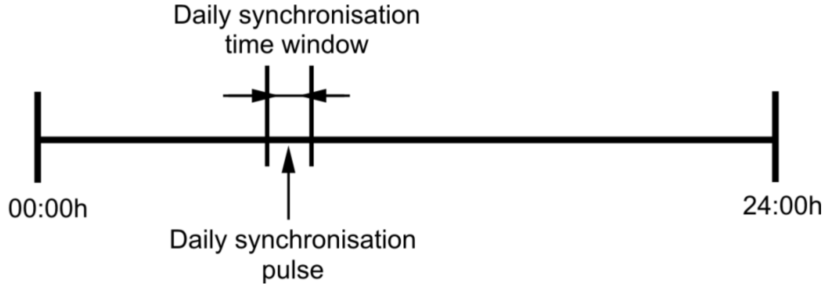
The reaction of the meter to the synchronisation signal depends on the detected deviation (see section 4.2.1 "Handling the Deviations").

The meter will accept the synchronisation pulse any time but only once within one synchronisation interval.

Ignoring second synchronisation pulse
A second synchronisation pulse within the same synchronisation interval will be ignored.

Once per day

With the daily synchronisation, the meter allows one time window per day within which the synchronisation pulse must be sent to the meter. The time of the day (e.g. 04:00h) and the width (e.g. one minute) of the window can be defined by parameter setting.



If the "time of the day" parameter is e.g. set to 04:00h and the meter receives a synchronisation signal within the defined window, the calendar clock is synchronised to 04:00h. The reaction of the meter to the synchronisation signal depends on the deviation (see section 4.2.1 "Handling the Deviations").

The meter does not accept any synchronisation pulses outside the time window and the signal will therefore have no effect.

Example

In this example, the synchronisation interval has been set to "One day" (Synchronisation Time: 00:00, Time Window: ±1 min) and the capture period to 15 minutes.

If, for instance, the meter receives the synchronisation pulse at 00:01:30, nothing happens because the pulse arrives outside of the specified time window. If the meter receives the synchronisation pulse at 00:00:37, the clock is reset to 00:00, i.e. to the start time of the capture period. The aborted capture period is declared as invalid and a new capture period will immediately be initiated.

If the meter receives the synchronisation pulse at 23:59:44, the clock is advanced to the end of the capture period (00:00). The aborted (shortened) capture period is declared as invalid and a new capture period is initiated at 00:00.

4.2.3 Adjusting the Calendar Clock via Communication

The calendar clock can be adjusted:

- by the central station, which sends the time information to the meter via the selected communication interface.
- with the MAP tool and a laptop computer which is connected to the meter via the optical interface.

The time information received is compared with the local time of the meter. The reaction of the meter to the time information depends on the deviation (see section 4.2.1 "Handling the Deviations").

Via communication, the time may be adjusted only once per capture period.

Adjusting the time twice within capture period
If the time is adjusted a second time within the same capture period, the capture period is reset no matter how small the deviation.
This is to prevent multiple adjustments with small time shifts resulting in a large time shift that, if made in one single approach, would have reset the capture period.

4.2.4 Adjusting the Calendar Clock via Set Mode

The time of the calendar clock can be set manually in the set mode.

The time information received is compared with the local time of the meter. The reaction of the meter to the time information depends on the deviation (see section 4.2.1 "Handling the Deviations").

Adjusting the time twice within capture period
If the time is adjusted a second time within the same capture period, the capture period is reset no matter how small the deviation.

4.3 Time Stamp

Whenever data is stored in the meter or commands are performed that are time relevant a time stamp will also be stored. The time stamp is stored in local time and consists of:

- date and time
- the calendar clock status information

4.3.1 Format of the Time Stamp

The time stamp consists of the following information:

year	month	day of month	hour	minute	second	clock status

4.3.2 Clock Status Information

In dlms protocols a clock status byte is included whose bits indicate the current status of the calendar clock.

Bit 0	Invalid time	The time could not be recovered after an incident.
Bit 1	doubtful time	The time could be recovered after an incident but the value cannot be guaranteed.
Bit 2	Clock source (time base)	Indicates whether the clock source (time base) is the same as parameterised. For instance, this bit is set when the calendar clock temporarily switches to crystal operation because the network frequency has not been accurate enough.
Bit 3	Invalid clock status	Indicates (when set to 1) that the present clock status is invalid.
Bit 4	Reserved	not used
Bit 5	Reserved	not used
Bit 6	Reserved	not used
Bit 7	Daylight saving active	Indicates (when set to 1) that the time is deviated from the normal due to daylight saving time.

4.4 Battery Status Information

In addition to the supercap, an optional battery can provide the back up power for the calendar clock. It is therefore important to monitor the battery status. The battery status information consists of the following information:

- Operating time of battery
- Battery low indicator in the display
- Battery voltage
- Operational indication F.F 0100 0000

There are no parameters to be set, but the user may select where the status information is used (e.g. display, event log entry, trigger an alarm etc).

Operating time of battery

The register "operating time of battery" indicates for how long the battery has been in the meter.

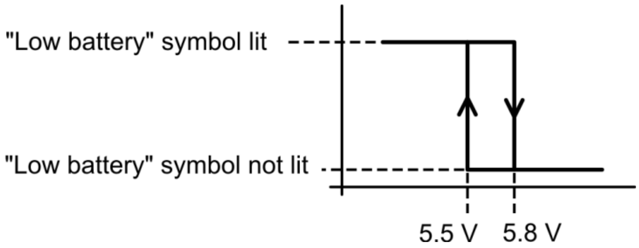
In the communication protocol, the operating time is specified in minutes while it is shown in hours on the display.

The register must be reset when the battery is replaced.

Using the MAP tool, the battery operating time information can be added to the display list and/or the service list of the meter (see section 20.5.1 "Selection of Entries in each Display List").

Battery low indicator

The battery voltage remains stable during about 90% of its life expectancy. The meter constantly measures the voltage and if the voltage drops below 5.5 V (nominal value 6.0 V) the "low battery" symbol in the display is lit and the operational indication F.F 0100 000 is generated.



Battery voltage

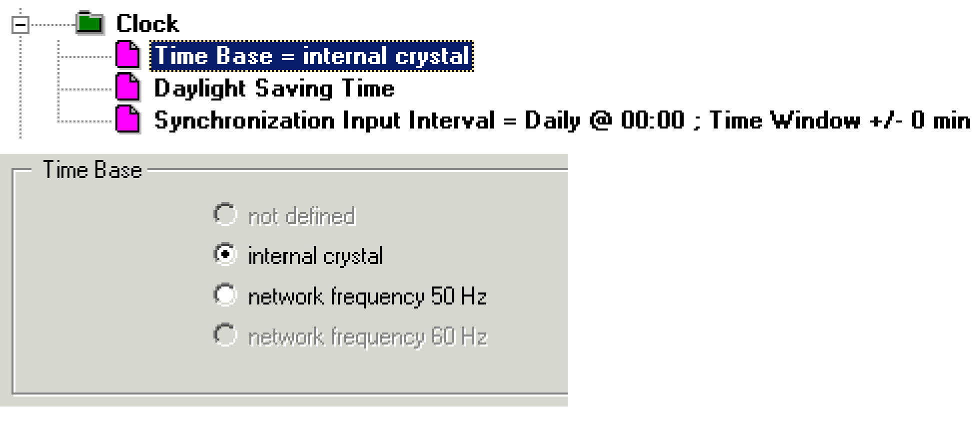
The battery voltage is constantly measured and the value is stored to a register.

Using the MAP tool, the battery voltage register can be added to the display list and/or the service list of the meter (see section 20.5.1 "Selection of Entries in each Display List").

Do not judge battery state by the voltage only
The charge state of the battery cannot only be judged by the charge voltage as low temperatures can temporarily cause the battery voltage to drop.

4.5 Calendar Clock Parameters

4.5.1 Time Base



Select whether the network frequency or the internal crystal is used as a time base of the calendar clock.

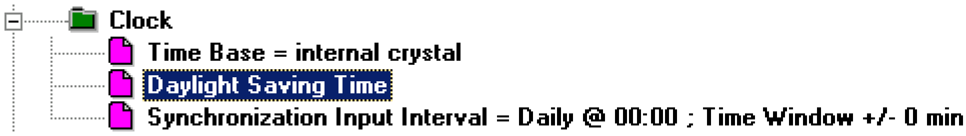
Crystal operation
If the network frequency appears to vary more than 5% from its nominal value (compared with the crystal time base), the calendar clock automatically switches temporarily to crystal operation.
In this case, bit 2 of the clock status byte (clock source) is set.

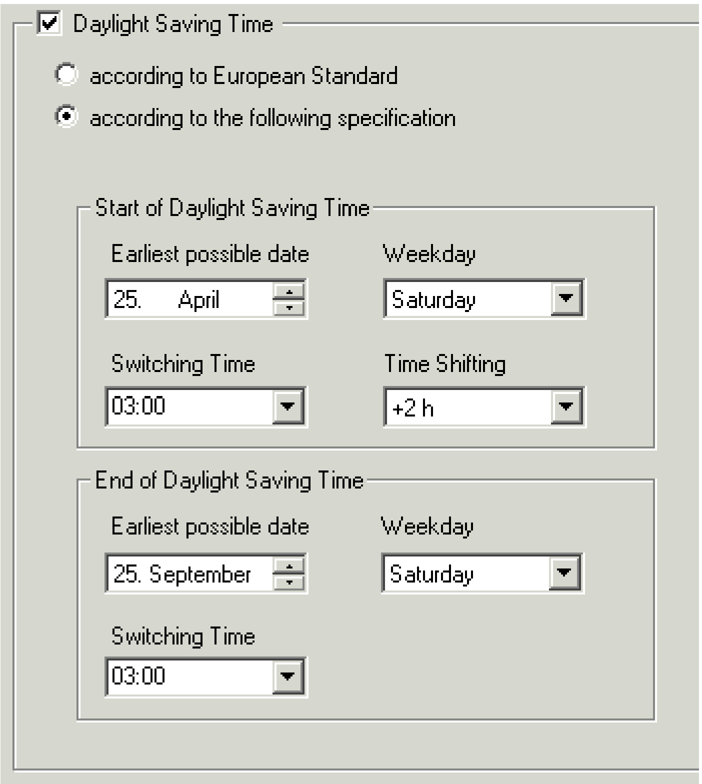
Synchronous to network frequency
If the network frequency is used as time base the calendar clock runs synchronously to the network frequency.
In this case, the calendar clock must **not** be synchronised using the synchronisation inputs.

Load profile
In some countries outside of the European Union, the network frequency may not be as stable as the internal crystal.
If this is the case, the network frequency is not suitable as time base for meters with a load profile. As a result, select the internal crystal as time base for meters with a load profile.
If the network frequency is at least as stable as the internal crystal, select the network frequency as time base.

4.5.2 Daylight Saving Time

Select whether the daylight saving time is used and whether it starts and ends according to the European standard or according to your own specification.





Daylight Saving Time Tick this box if daylight saving time is to be used, either according to the European standard or according to the customer's specification.

According to European Standard

Tick this box if the daylight saving time should start and end according to the European standard.

According to the European standard, daylight saving time starts on Sunday the 25th of March or on the first Sunday after the 25th of March. On that day the clock is advanced from 02:00h to 03:00h.

Daylight saving time ends on Sunday the 25th of October or on the first Sunday after the 25th of October. On that day the clock is set back from 03:00h to 02:00h.

According to the following Specification

Tick this box to make your own specification of the start and end time of the daylight saving time.

Start of Daylight Saving Time	Enter the month, the weekday and the earliest possible day on which the daylight saving time must be activated. Also enter the switching time and the time shift (usually +1h).
End of Daylight Saving Time	Enter the month, the weekday and the earliest possible day on which the daylight saving time must be deactivated. Also enter the switching time. The time shift is the same as defined for activating the daylight saving but in the opposite direction.

Example

In the example in the above screenshot, daylight saving time starts and ends according to a customer specific setting:

Start

On Saturday the 25th of April or on the first Saturday after the 25th of April. On that day, the clock is advanced from 03:00h to 05:00h.

End

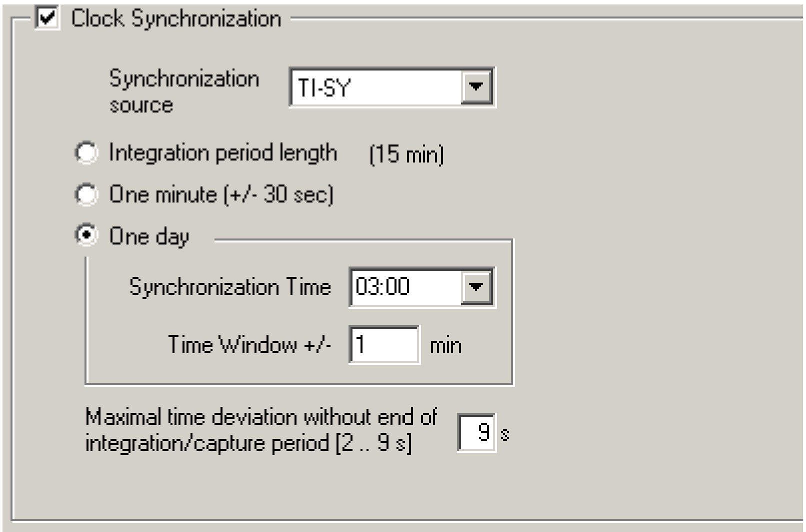
On Saturday the 25th of September or on the first Saturday after the 24th of September. On that day, the clock is set back from 03:00h to 01:00h.

4.5.3 Clock Synchronisation

There are three possibilities to synchronise the clock using the synchronisation signal:

- The synchronisation takes place to the minute
- The synchronisation takes place to the capture period
- The synchronisation takes place once per day (standard in grid applications)

Select one of the above type of synchronisation and set the parameter accordingly.



Synchronisation Source	Select the control input that is used as synchronisation source (TI-SY).
Synchronisation Interval	Select whether the meter is synchronised every minute, every integration period or once per day.
Daily Synchronisation Time	Select the time at which the daily synchronisation takes place, e.g. 03:00h (daily synchronisation only).
Time Window	Define the time window within which the daily synchronisation pulse must be sent to the meter (daily synchronisation only). The meter will not accept a synchronisation pulse outside the time window and the signal will therefore not have any effect.
Maximum Time Deviation without End of Integration/Capture Period	Select the maximum allowed deviation (2 … 9 seconds) that does not trigger a restart of the capture period but results in a time synchronisation. Deviations exceeding that limit do trigger a restart of the capture period and an event log entry.

5 Time of Use

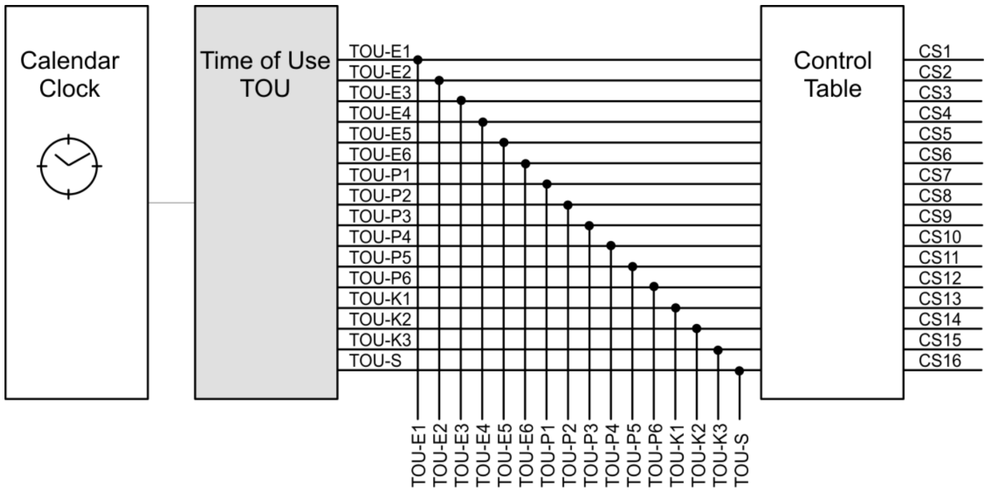
5.1 Overview

The meter features a time switch (time of use, TOU), which uses the calendar clock as time base. The time switch drives 16 output signals and their on and off times can be set with the help of day tables, season tables and special day tables.

The output signals of the time switch can directly be used for tariff control, i.e. to activate and deactivate registers and the arrows in the display.

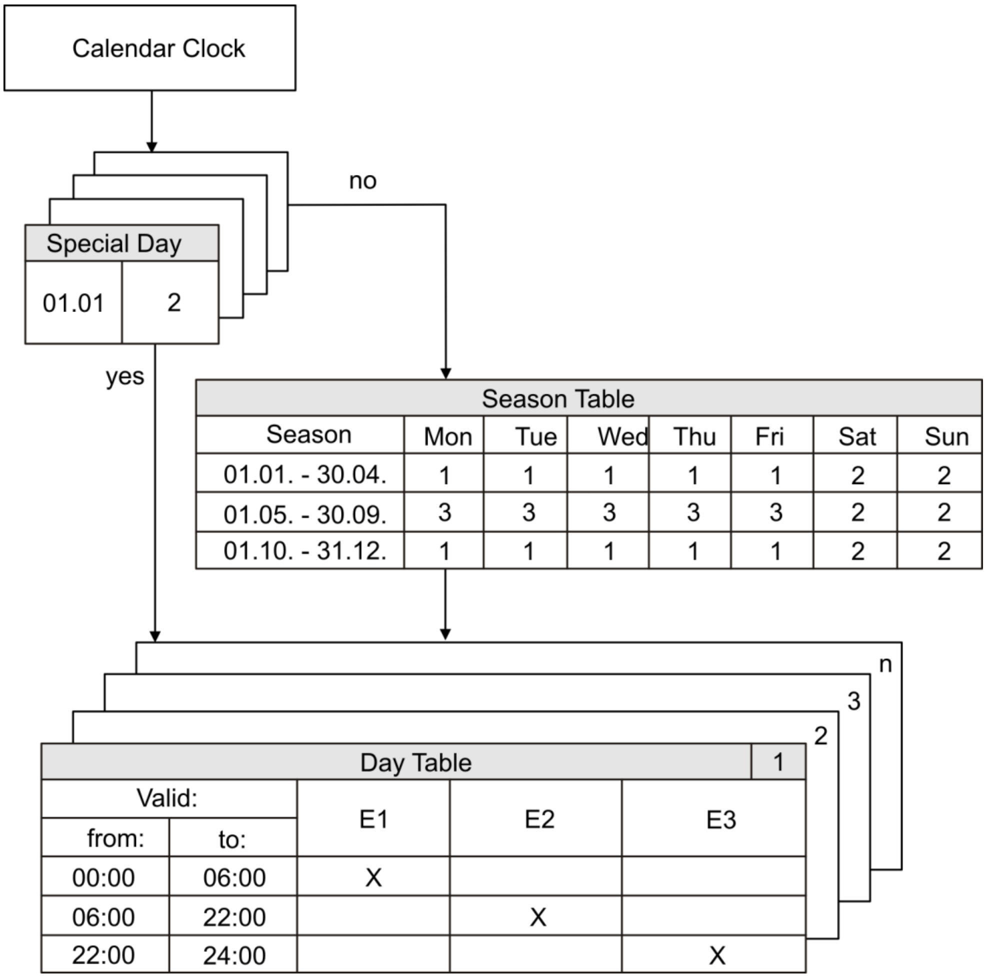
They can also be taken over by the control table where logic operations are performed. The control table then drives the 16 control signals CS1 to CS16.

With the TOU parameters the on/off times of the 16 output signals of the time switch can be defined. The on/off times can be defined depending on the daytime, the weekday, the season and on special days.



5.2 Switching Tables

The switching tables consist of the special day table, the season table and of up to eight day tables. All switching tables are controlled by the calendar clock.



The day table in the above example has external tariff inputs. It can also be operated with the internal timer and 16 inputs. The use of tariffs in day tables is not common.

5.2.1 Day Table

In the day table, the user defines which output signals are switched on at what time of the day. Each line in the day table represents one switching state with its start and end time and the activated output signals in that period of time. The first entry starts at 00:00h and the last entry ends at 24:00h.

5.2.2 Season Table

The season table defines the weekly and the seasonal on/off pattern of the output signals.

Week

To define the weekly on/off pattern, the user enters the number of the day table which is applicable at a particular day of the week. As soon as all days of the week are allocated with a day table, the week table is completed.

Season

In the season column, the user defines the period of the year the week table applies for.

5.2.3 Special Day Table

A special day might be used to define a tariff that applies on a particular day of the year only e.g. New Year, Easter or public holidays.

To define a special day, the user enters the date and selects the day table that is valid on that day. If the date includes the year, the special day is valid for the specified year only (e.g. Easter). If the date does not include the year, the special day is valid every year thereafter (e.g. New Year).

At each change of the date, the time switch checks whether or not the following day is a special day and selects the day table accordingly.

5.2.4 Emergency Settings

The meter can activate one or more output signals of the time switch if time and date are invalid, i.e. if the power reserve of the calendar clock is exhausted and the corresponding status flag has been set.

In the emergency settings, the customer selects which output signals are activated if the internal clock fails.

5.2.5 Active and Passive Switching Tables

There are two complete sets of switching tables:

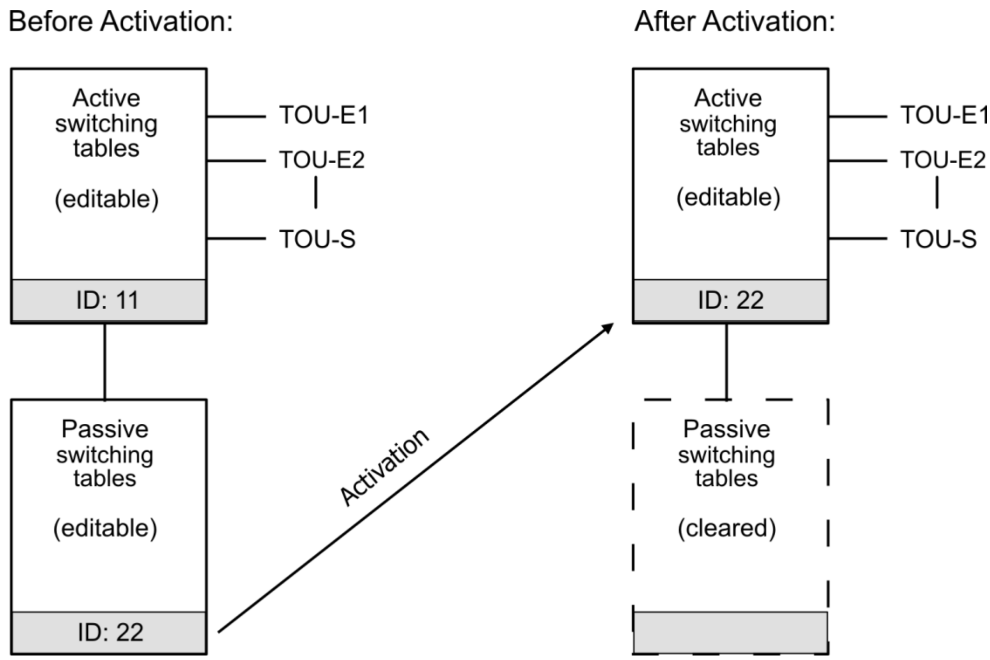
- **Active switching tables:** The active switching tables are the ones that are currently being used.

Active switching tables can now also be directly edited
Active switching tables are immediately updated in case of a modification.

- **Passive switching tables:** The passive switching tables are not yet used. They can be prepared in the background for a later use.

Each set of switching tables bears an ID code with which it is clearly identified. The ID code consists of a maximum of 7 characters and can be set with the MAP tool. The ID code can be displayed and read via communication interface.

When activating the passive switching tables, the currently active switching tables are overwritten and the passive switching tables are cleared.



Activation date
The passive switching tables are activated, if the current date is newer than the activation date. In order to activate passive switching tables you can either enter the current or an earlier activation date or modify the active switching table directly.

Special day settings
There are no passive special day settings. Therefore, a special day setting becomes active immediately after completing its definition.

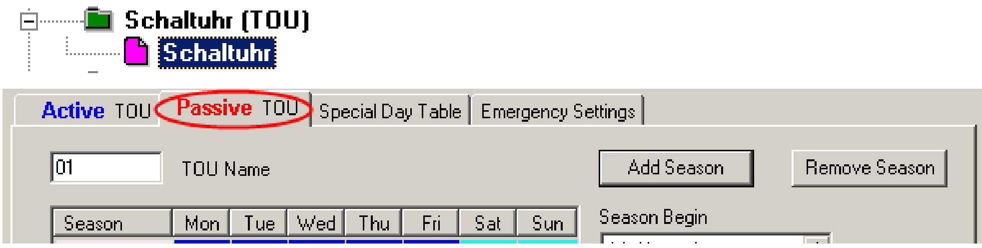
5.3 Time of Use Parameters

For a complete TOU definition you have to:

- Create a new set of (passive) switching tables and enter the following data:
  - the TOU name for the new set of switching tables
  - the start and end times of the required seasons (season table)
  - the on/off times within a day (day table)
- Define special days if required
- Define the emergency settings
- Activate the passive switching tables

5.3.1 Creating a New Set of Switching Tables

Start



1. Click the tab **Passive TOU**. Passive TOU is used to prepare a set of switching tables for a later download to the meter.

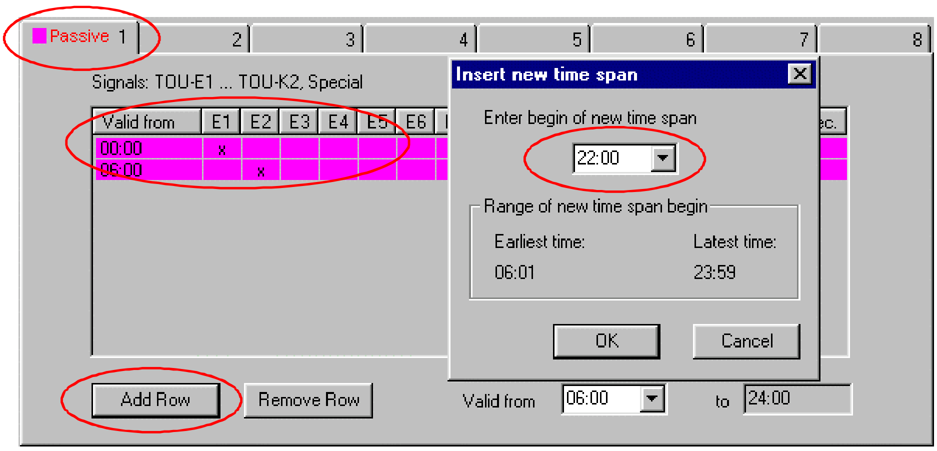
TOU Name

The TOU name is an ID code with which the set of switching tables is clearly identified. A maximum of 7 characters can be used.

2. Enter the TOU name.

Day Table

The day table defines which output control signal is on at what time of the day.

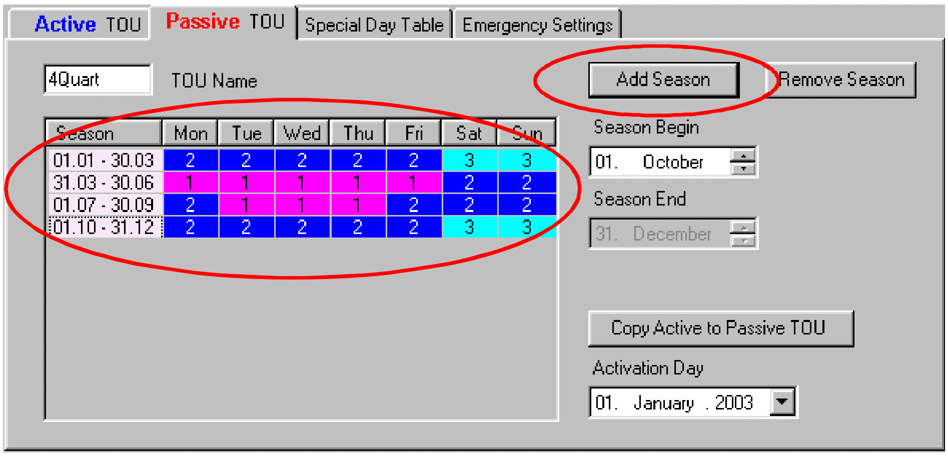


3. Click the first tab (Passive 1 to 8) to prepare a new day table.
4. Click **Add Row** to add a time period that spans from 00:00 to 24:00.
5. Click **Add Row** for any further time period within the day and define its start time. Click **OK** or press **Enter**.
6. Select which output signal (E1, E2, E3 etc.) is to be switched on during which time period by clicking the corresponding field. An X will appear for each activated output signal.

Up to eight different day tables can be defined.

Season Table

The season table defines which day table is used at what day of the year.

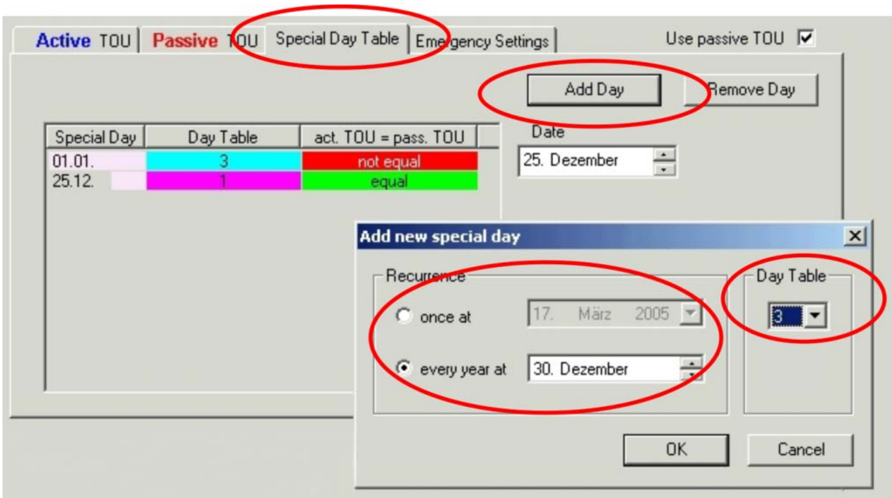


7. Click **Add Season** to add a season that spans from January 1st to December 31st.
8. Click **Add Season** for any further season within the year and define its start date.
9. Select which day table applies to which day of the week within a season by clicking the corresponding field. Click the same field again to allocate another day table.

Up to twelve different seasons can be defined.

5.3.2 Defining a Special Day

A special day is a single day within a year with an exceptional day table.



1. Click the tab **Special Day Table**.
2. Click **Add Day**.
3. Select whether the special day is recurrent every year or non-recurrent.
4. Select the day table that applies to the special day.
5. Enter the date and click **OK**.
6. Click **Add Day** for any further special day.

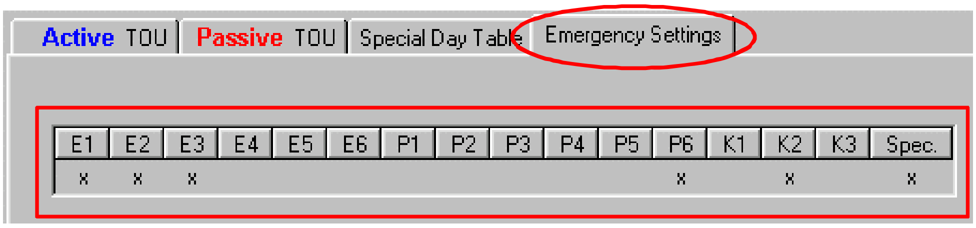
Special day settings
There is an active special day setting only. Therefore, a special day setting becomes active immediately after re-parameterisation of the meter.
The day numbers in the special day settings refer to **active** day numbers!

You are prompted with the red message "not equal" if the new special day setting (Active TOU) differs from the day table that is prepared in the passive TOU.

Up to 100 special days can be defined.

5.3.3 Defining the Emergency Settings

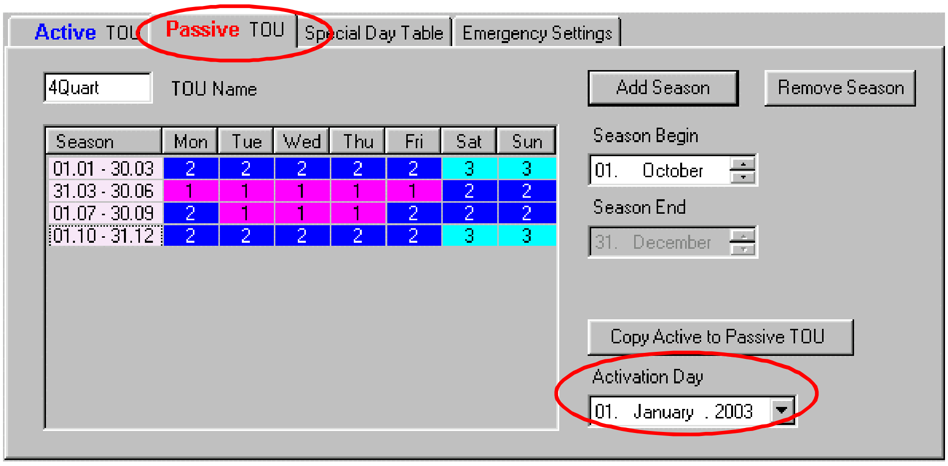
The output signals selected in the emergency settings are triggered if time and date are invalid, i.e. if the power reserve is exhausted and the corresponding status flag has been set.



1. Click the tab **Emergency Settings**.
2. Click the output signal(s) which must be on if time and date are invalid. An X will appear for each activated output signal.

5.3.4 Activating the Passive TOU Settings

To activate the passive TOU settings they must be moved to the active TOU settings.



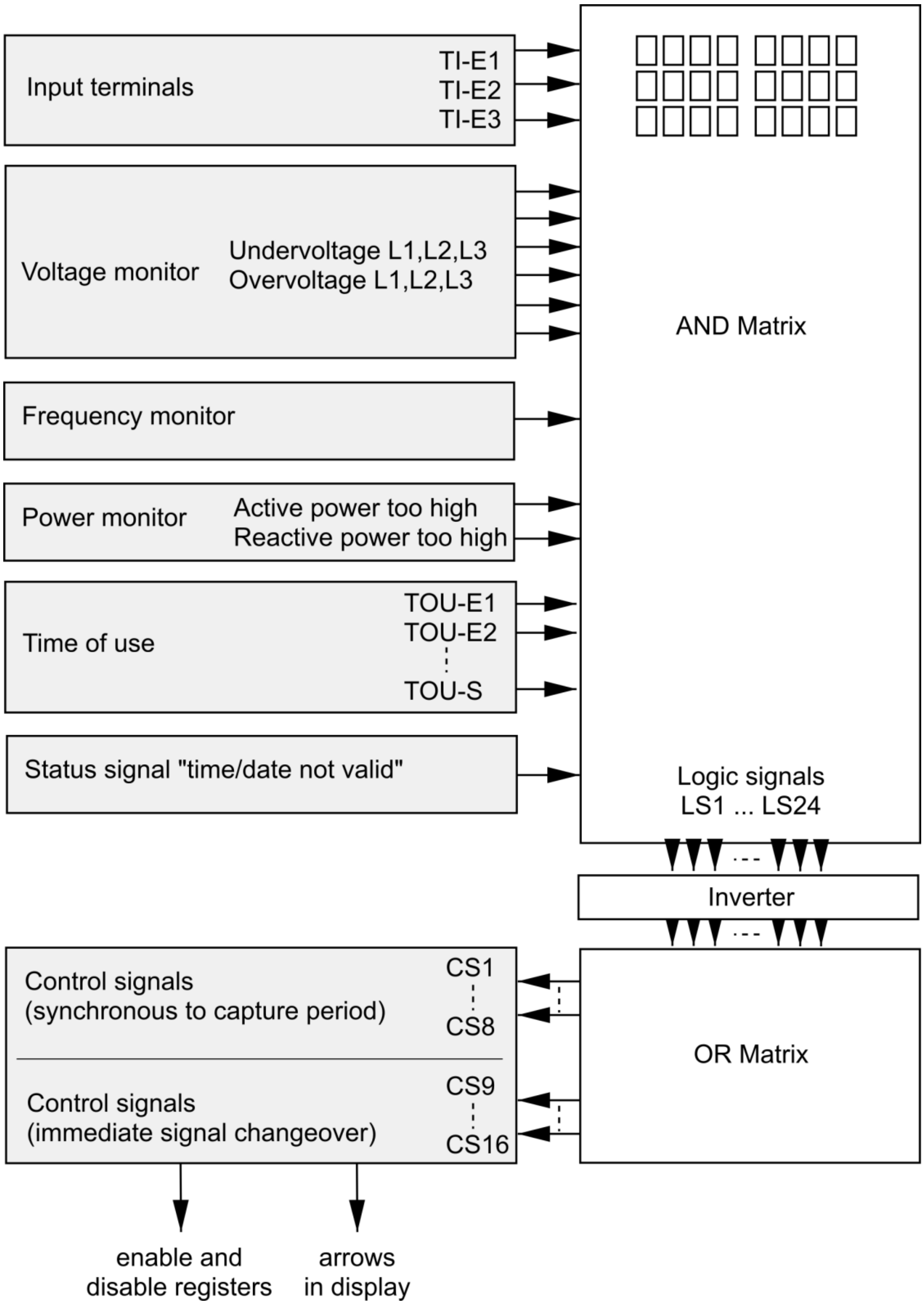
1. Click the tab **Passive TOU**.
2. Enter the date from which the passive settings should be active. An activation date set in the past or today immediately activates the settings.

6 Control Table

6.1 Overview

The control table is a fully programmable switching matrix with which control signals are generated. The control signals of the control table are used for tariff control (i.e. to enable and disable the various energy registers) and to control the arrows in the display.

Various signal sources can be used to form logic signals in the AND matrix. The logic signals (LS) are then taken over by the OR matrix in order to generate the control signals (CS1 to CS16).



6.2 Signal Sources

Various signal sources (internal or external) can be used as input signals for the control table.

Input terminals The control inputs E1, E2, E3

Voltage monitor The event signals due to over/undervoltage in phases L1, L2 or L3.

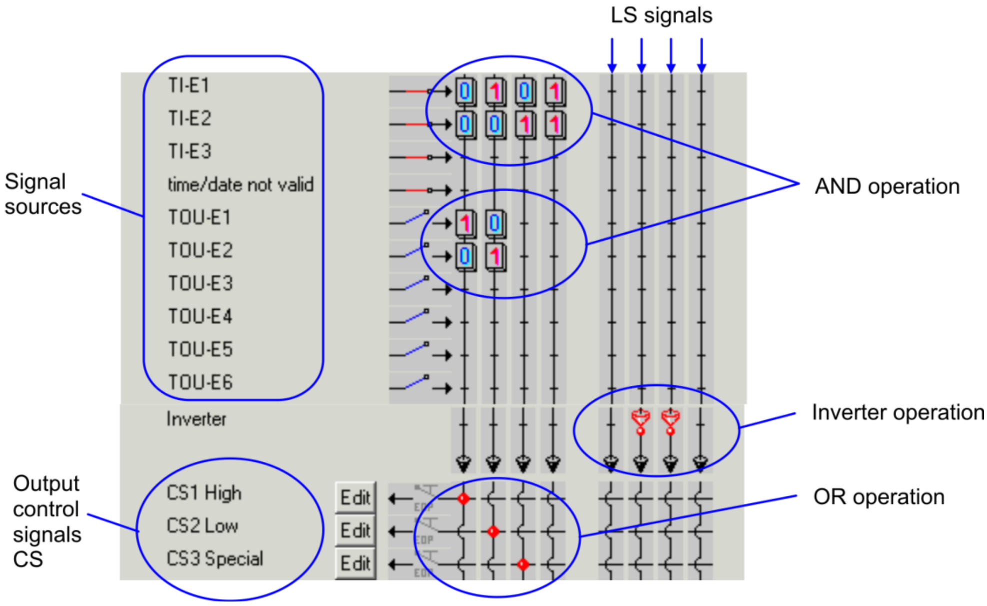
Frequency monitor The event signals due to the network frequency being too high or too low.

Power monitor The event signals due to the primary active or reactive power being too high.

Time of use The 16 output signals of the time switch TOU-E1, TOU-E2 … TOU-S.

Status signal The status signal "time/date not valid".

6.3 Logic Operations



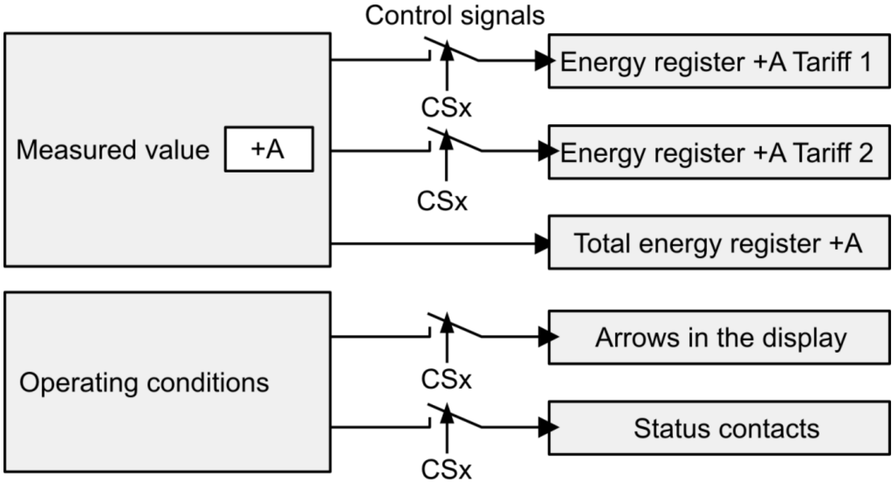
AND operation With the AND operation, the user defines the condition of the signal sources under which a particular LS signal must be logic high. Up to 24 different conditions (i.e. AND operations) can be defined.

Inverter The output signal of the AND operation (LS signal) can be inverted if necessary.

OR operation The OR operation collects all the conditions (LS signals) that influence one particular CS signal.

6.4 Control Signals

The control table features 16 control signals (CS1 to CS16), eight of which may be used for tariff control (CS1 to CS8). This is done by enabling and disabling the energy registers depending on the state of the CS signals (see also section 8 "Energy Registration").

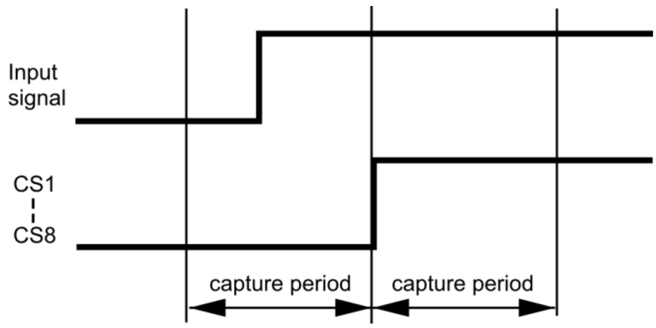


There are two groups of control signals:

Synchronous to end of capture period

The control signals CS1 to CS8 switch synchronously to the end of the capture period. When an input signal changes its state sometime during a capture period and this causes the control signal to change, it will do so at the end of the capture period only. As a result, there is a delay between the input signal change and the control signal change.

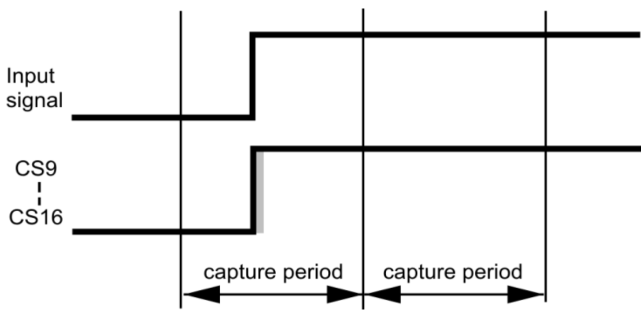
Synchronous control signals are mainly used for tariff control.



Immediate changeover

The control signals CS9 to CS16 change their state immediately after the input signal change.

Control signals with immediate changeover are mainly used for monitoring applications (overvoltage monitor, power monitor etc.). They cannot be used for tariff control.



6.5 Control Table Parameters

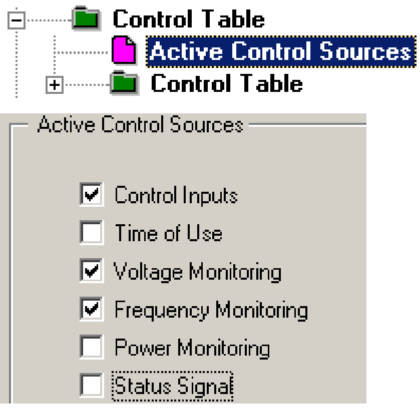
6.5.1 How to Set Up the Control Table for Tariff Control

To set up the control table for tariff control you must:

- decide how many tariffs are required
- decide which energy registers and display arrows must be active with each tariff
- decide which control signals CS1 to CS8 are used to activate each tariff (synchronous or immediate switching)
- decide which signal sources are to control the tariffs (e.g. E1, E2, E3)
- decide which logic state the signal sources must have to activate the individual tariffs
- set up the control table accordingly
- select the control signals that enable and disable the various energy registers (see section 8 "Energy Registration")
- select the control signals that enable the arrows in the display (see section 20.3 "Arrows in Display")

6.5.2 Active Control Sources

Select which signal sources (internal or external) are used as input signals for the control table.



The signal sources can be enabled and disabled as a group only i.e. all control inputs E1, E2, E3 are enabled or none. A single control input (e.g. E1) cannot be enabled.

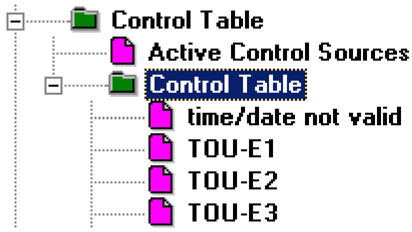
Control Inputs	Control inputs TI-E1, TI-E2, TI-E3
Time of Use	Output signals of the time switch TOU-E1, TOU-E2 … TOU-S
Voltage Monitor	Event signals due to over- or undervoltage (exceeding a set limit) in phases L1, L2 or L3.
Frequency Monitor	Event signals due to the network frequency being out of range
Power Monitor	Event signals due to the primary active or reactive power being too high
Status Signal	The status signal "time/date not valid"

In order to use the monitors as signal source, the relevant monitors must be activated and their thresholds must be set (see section 17.8 "Monitoring Function Parameters").

Available control sources
Only the control sources that have been activated in the software configuration menu can be selected here.

6.5.3 Control Table

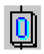
The control table is used to define the logic operations. Define which signal sources must have which logic state in order to produce an output signal (CS1 to CS16) to be logic high.

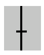


AND operation

Define which conditions (logic state of signal sources) must be fulfilled for a particular LS signal to be logic high.

 The input signal must be logic high

 The input signal must be logic low

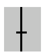
 The input signal state does not matter

In the line of the corresponding signal source, click the symbol to change to the required logic state.

Inverter operation

Define whether or not the LS signal must be inverted before it enters the OR operation.

 The LS signal is inverted

 The LS signal will not be inverted

In the Inverter line, click the symbol to toggle it.

OR operation

Define which of the LS signals (if they are logic high) lead to a CS signal being logic high.

 The LS signal does affect the CS signal

 The LS signal does not affect the CS signal

In the line of the required CS signal, click the symbol to toggle it.

Control signal names

A maximum of 16 control signals (CS1 to CS16) can be used.

Synchronous or immediate changeover
The control signals CS1 to CS8 switch to their new state synchronously to the capture period (i.e. with the beginning of the next capture period) while CS9 to CS16 *immediately* switch after the input signal change. The control signals CS9 to CS16 cannot be used for tariff control.

When naming the control signals make sure to select the control signals accordingly.

1. Click **Edit** at the required control signal to name and activate it.

The control signals can only be used for control if they are activated and given a name.

6.5.4 Example

This example demonstrates how to set up the control table for a meter with the following specification:

Specification

- Active and reactive energy (+A, -A, +R, -R)
- Double tariff for active energy, single tariff for reactive energy

Preparation

To be able to set up the control table, the following questions must be answered:

1. How many tariffs are required?
   – Two. Tariff I and tariff II
2. Which energy registers must be active with each tariff and which control signals (CS signals) are used to activate each tariff?

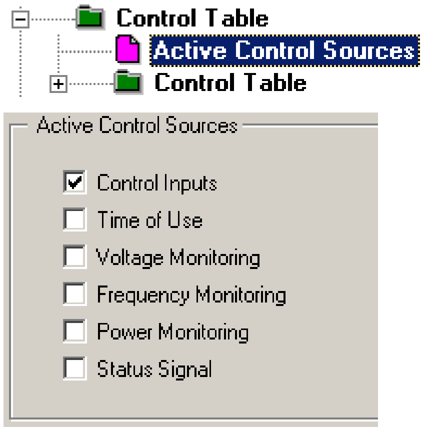
+A	Positive active energy tariff I	CS1
+A	Positive active energy tariff II	CS2
-A	Negative active energy tariff I	CS1
-A	Negative active energy tariff II	CS2
+R	Total positive reactive energy	always
-R	Total negative reactive energy	always

3. Which signal sources are used to control the tariffs?
   – The tariffs for the active energy shall be controlled by the control input E1.
4. Which logic state of the signal sources is needed to activate the individual tariffs?
   – The control input signal shall be logic high to activate tarif I.

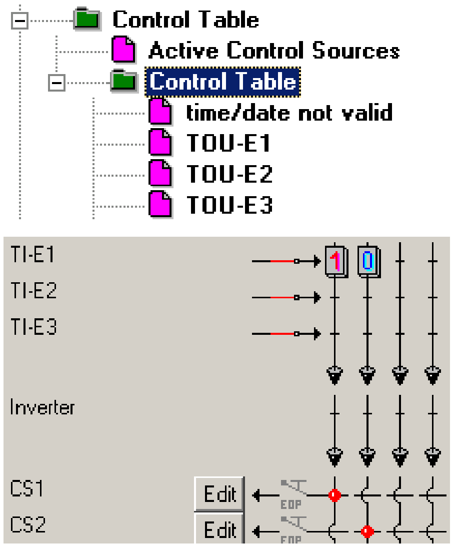
Setting up control table

Now the control table can be set up.

1. Enable the control source *Control Inputs*.



2. Define the logic operations in the AND / OR matrix.



To activate tariff I, the input signal E1 must be logic high. Tariff II is activated as soon as the input signal E1 is low (second column).

3. Activate and name (click **Edit**) control signal CS1 (tariff I) and CS2 (tariff II).

Completing the setup

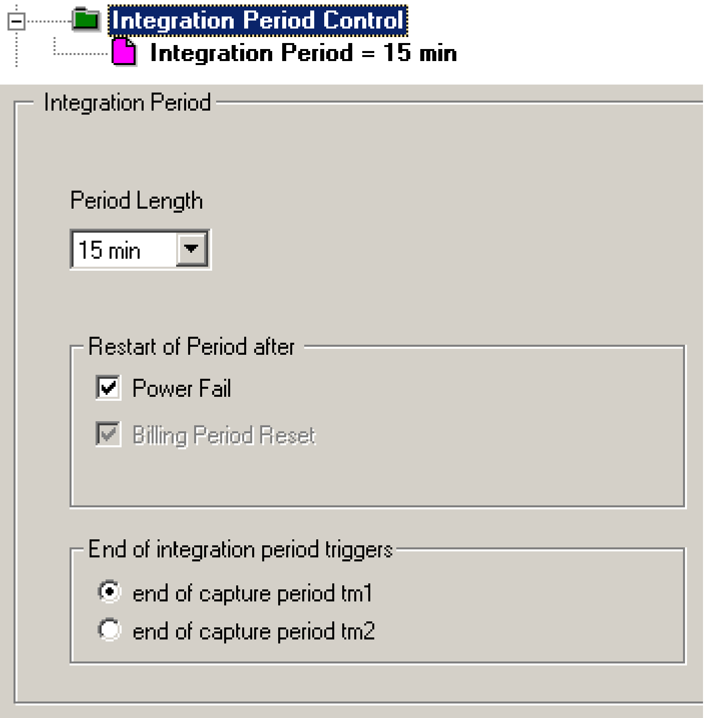
To complete the tariff setup you also have to select the control signals that enable and disable the various energy registers accordingly (see also section 8 "Energy Registration").

Positive active energy tariff I	CS1
Positive active energy tariff II	CS2
Negative active energy tariff I	CS1
Negative active energy tariff II	CS2
Total positive reactive energy	always active
Total negative reactive energy	always active

7 Integration Period Control

7.1 Settings

The integration period control is only used in configurations which register demand in a profile. The capture period of this profile is defined by the integration period. If a second profile is implemented, its capture period can be freely selected, as no demand can be stored in this profile. The integration period control is not available in configurations which do not feature demand registration.



Period Length

This setting defines the length of the integration period for demand registration. The capture period of the profile to which this period length is assigned in "End of integration period..." cannot be changed in the respective setting of the profile (the capture period length appears shaded).

Restart of Period after

This setting determines whether an integration period is restarted after a power fail.

End of integration period triggers

The setting "end of integration period..." determines which capture period (tm1 or tm2) is synchronised with the integration period (i.e. which profile can be used for demand registration). This is the profile e.g. used for operation control purposes. The other profile is then used for billing purposes.

8 Energy Registration

8.1 Rated Energy Registers and Total Energy Registers

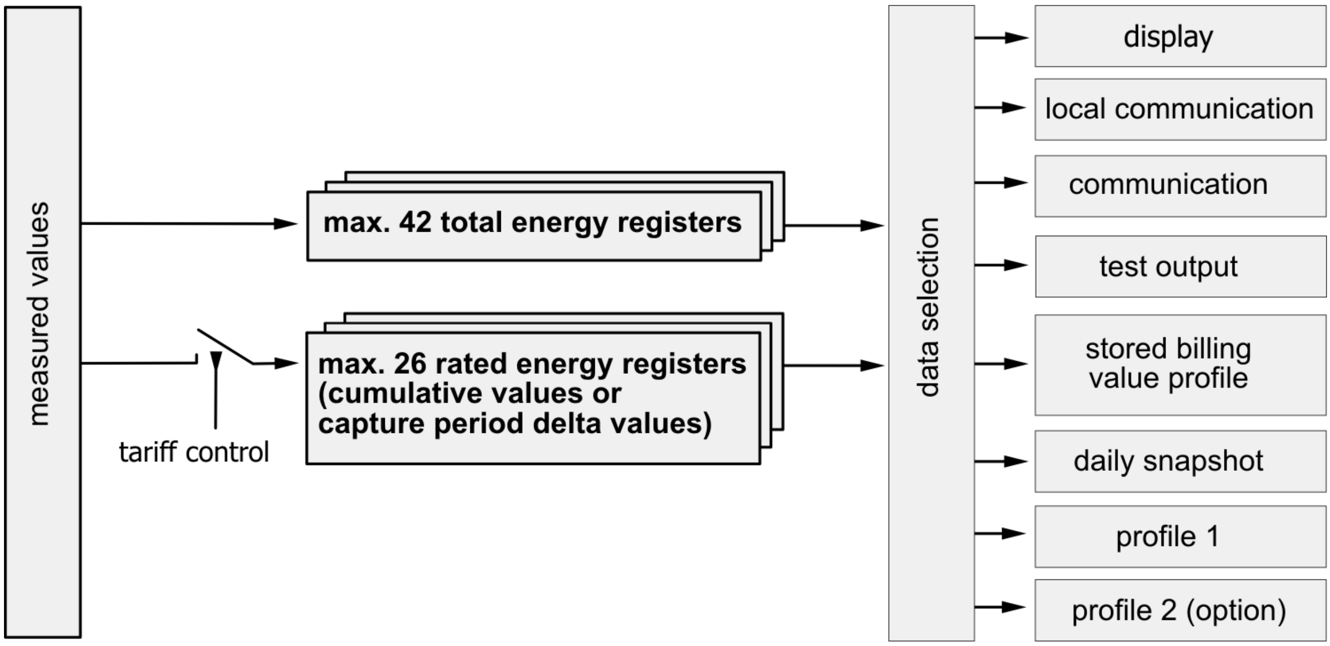
The measuring unit provides 42 measured quantities. The user can select the measured quantities whose values must be displayed and transmitted via the communication interface.

The content of the selected measured quantities (the measured values) can be registered as follows:

- as original meter values in the total energy registers
- as original meter values in the energy registers (rated registers)
- as capture period delta values in the energy registers (rated registers)
- as billing period delta value in the energy registers (rated registers)

The ZxQ combimeters feature 42 total energy registers and 26 rated energy registers for energy registration.

Six of the total of 42 measured quantities are reserved for calculated values such as total losses (see section 2.14.8 "Measured Quantities for Total Losses and Compensated Energy").

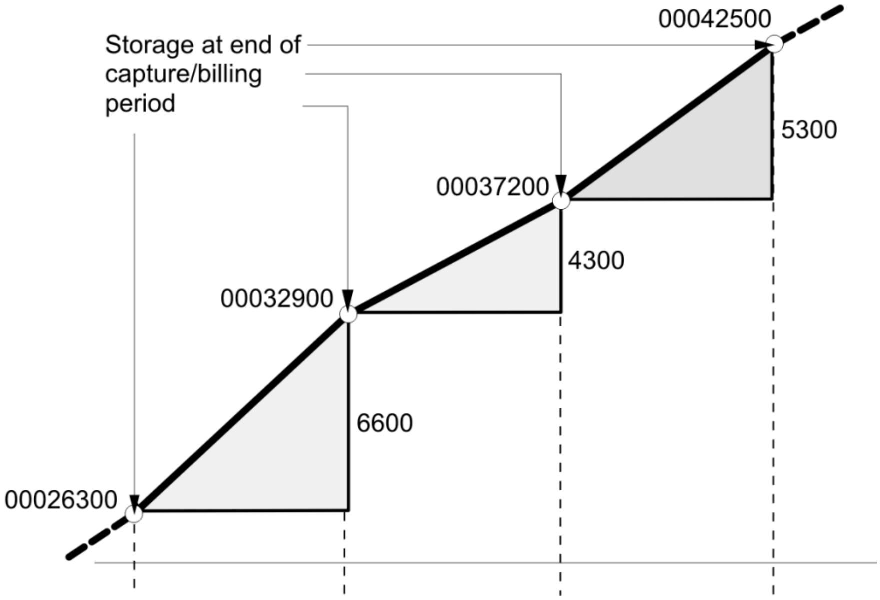


8.2 Methods of Energy Registration

Original meter values

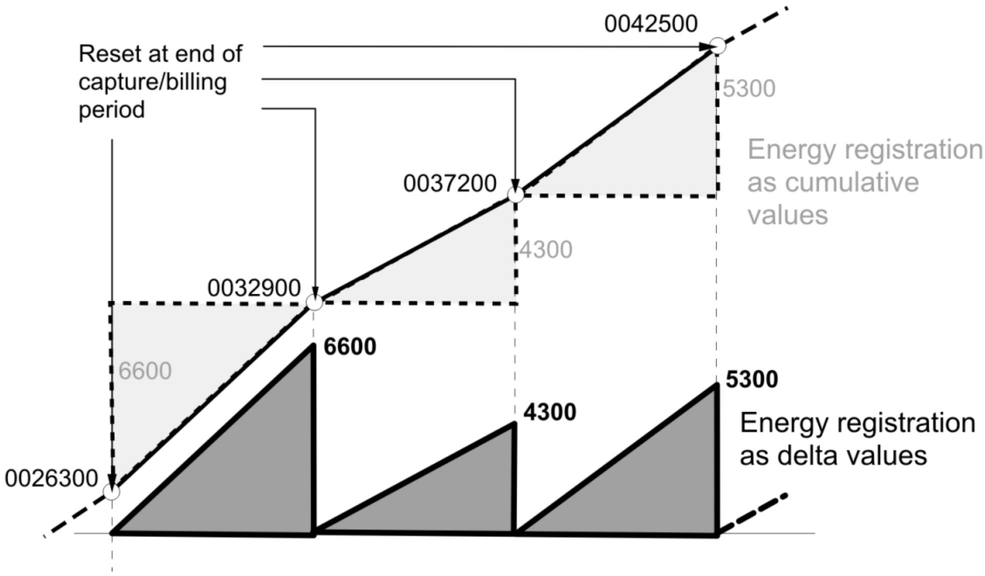
The energy is registered as original meter values i.e. the memory continuously replaces the old value of energy with the new value.

The consumption during a period is obtained from the difference between the new and the old value. Calculation of the energy consumption is made after every reading at the data processing department of the customer.



Capture period delta values

To register the energy advance during a capture period, the procedure is as follows: At the end of a capture period, the meter saves the content of the energy register to the load profile (but not to the stored billing value profile) and clears the content of the energy register. During the following capture period, the meter registers the energy consumption beginning with a meter reading of 0 and, at the end of the period, the value is again saved and the register cleared.



Load profiles

Delta values per capture period are only calculated to be stored in the load profiles. One of the 24 energy registers is required for every measured value to be stored as energy advance (delta value) in the load profiles.

No tariffication
The registers for capture period delta values do not allow tariffication.

Residual value processing

If the meter registers energy as delta values, it only stores the value that is visible in the display to the stored value profile or to the load profile. The remainder is not displayed but is retained in the memory and will be included in the next billing or capture period. As a result, the sum of delta values in the load profile always corresponds with the original meter values of the total energy registers.

8.3 Tariff Control

Tariff control is realised by selecting which energy register(s) take over the measured values at a given time. The maximum of 42 measured values may be allocated to up to 24 rated energy registers, to permit a convenient tariff structure.

Landis+Gyr recommend using a maximum of three rates for active energy and a maximum of two rates for reactive energy.

If the meter is used in the bypass feeder operation (see section 1.3 "Software Configuration Parameters") the tariff control inputs E2 and E3 are disabled.

8.4 Format of the Energy Registers

Register size

The rated energy registers and the total energy registers have a total of 8 digits each, 5 of which can be decimal places.

Register resolution

The resolution of the energy registers depends on the nominal power applied to the meter and on the minimum time until a register overflow occurs that is required for the application (at least 1'500h).

For details please refer to 2.14.2 "Register Resolution".

8.5 Display

Display format

8 digits are shown in the value field of the liquid crystal display, 5 of which can be decimal places. Decimal places and units appear in the display as defined by the register resolution parameter.

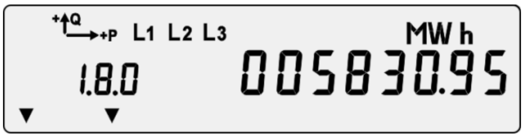
Test mode

A test mode is provided for test purposes, which provides a higher resolution of the registers and therefore reduces the testing time accordingly.

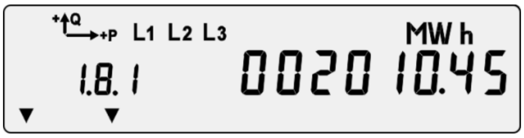
The resolution of the energy registers in the test mode is automatically set to 4 decimal points. The unit selected with the resolution parameter remains unchanged.

Display examples

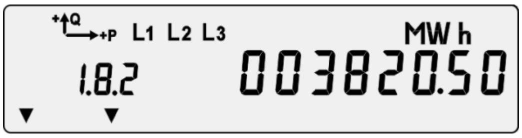
Some examples of energy register displays are given below. The identification figures for the individual data correspond to the energy data identification system OBIS.



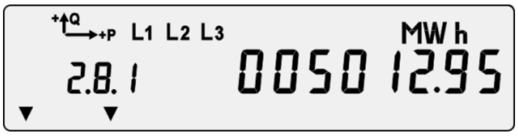
Active energy import (1)
Original meter value (8)
Total energy register (0)



Active energy import (1)
Original meter value (8)
Tariff 1

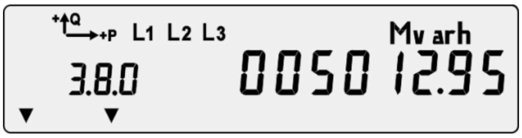


Active energy import (1)
Original meter value (8)
Tariff 2

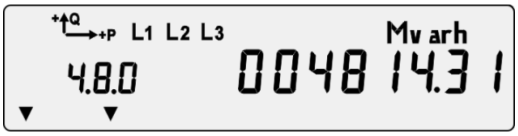


Active energy export (2)
Original meter value (8)
Tariff 1

Active energy export (2)
Original meter value (8)
Tariff 2



Reactive energy import (3)
Original meter value (8)
Total energy register (0)



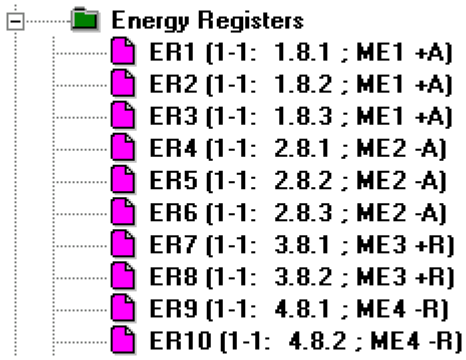
Reactive energy export (4)
Original meter value (8)
Total energy register (0)

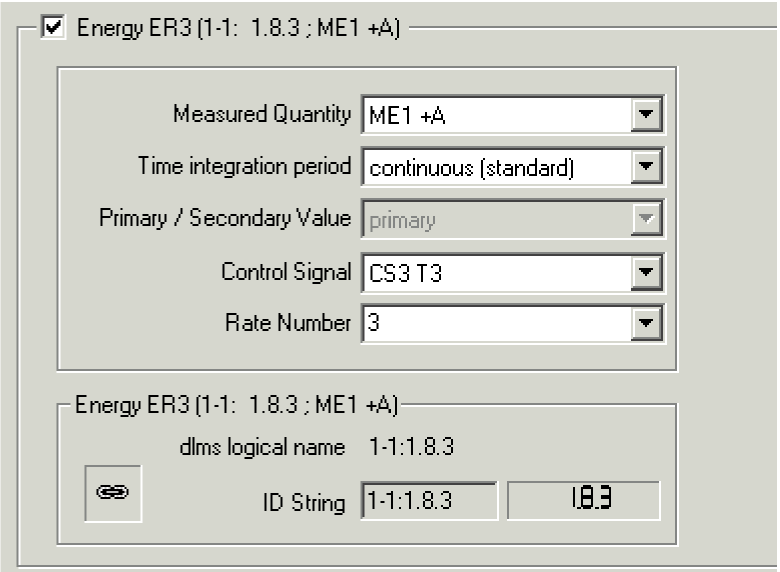
Active energy import in phase L1 (21)
Original meter value (8)
Total energy register (0)

8.6 Energy Register Parameters

8.6.1 Energy Register Definition

To define an energy register, click the corresponding ER number.





Measured Quantity

Select the measured quantity whose values must be captured in this energy register.

The example below shows a possible setup of energy registers.

ER1: +A, tariff I

ER2: +A, tariff II

ER3: +A, tariff III

ER4: -A, tariff I

ER5: -A, tariff II

ER6: -A, tariff III

ER7: +R, tariff I

ER8: +R, tariff II

ER9: -R, tariff I

ER10: -R, tariff II

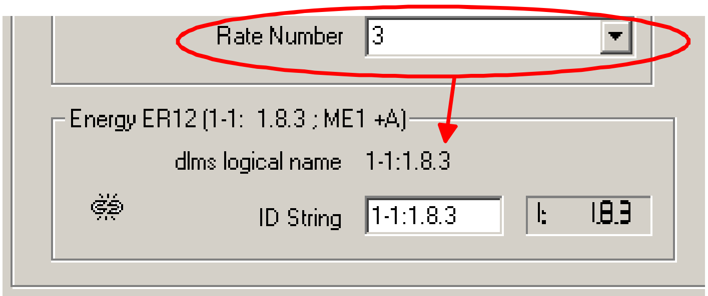
Time Integration Period

Select the method of energy registration. If the energy register is to show original meter values, select *continuous*. If the energy register is to show delta values, either select *billing period delta value, capture period delta value (tm1) or capture period delta value (tm2)*. The OBIS-code changes to correspond to the setting.

Control Signal

Select whether the energy register is always active or which control signal is used to activate it (tariff control).

Rate Number



Enter the rate number that is used to indicate the currently active tariff. The rate number is added as suffix to the dlms logical name (OBIS field E). Usually "1" is used to indicate tariff 1, "2" to indicate tariff 2 etc.

dlms logical name

The dlms logical name is the identification of the energy register according to the OBIS standard. The central station uses the identification code to automatically identify each measured value.

When defining an energy register it is allocated automatically.

Display Code

The display code appears in the code field of the display. By default the display code is identical to the dlms logical name according to the OBIS standard. However, users can set their own display code for each register.

9 Demand Registration

9.1 Overview

C.7 and C.8 only
Demand registers are only available in meters with the software configuration C.7 or C.8 and if the demand and power factor measurement is activated (see section 1.3 "Software Configuration Parameters").

The ZxQ meters may register the demand of the all-phase active energy (+A, -A) and the all-phase apparent energy (+S, -S).

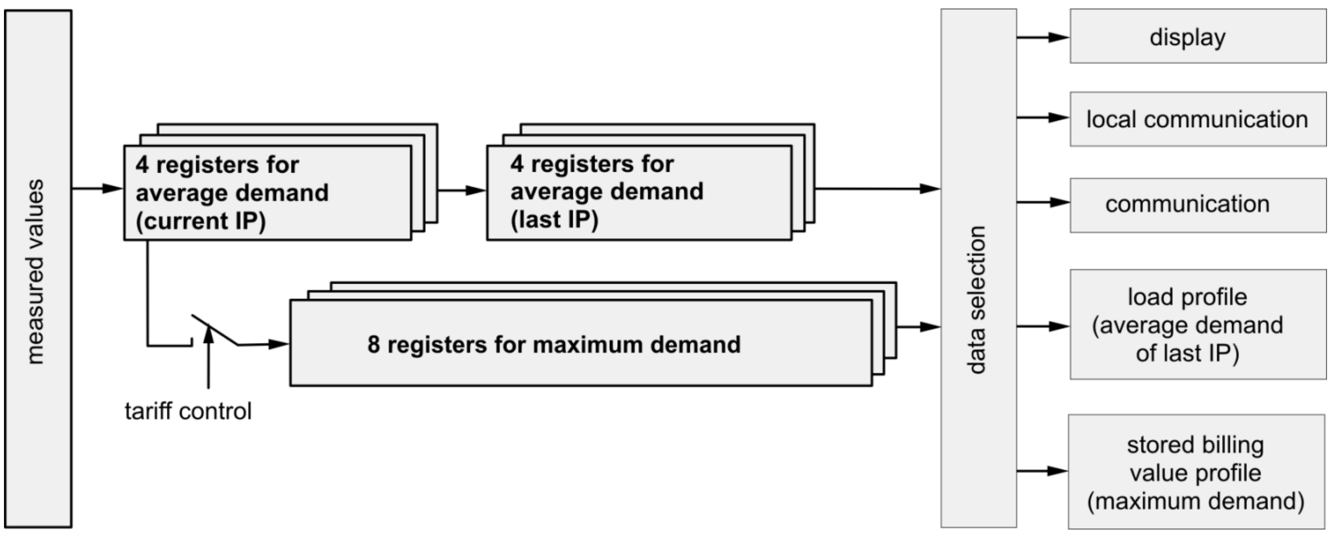
The demand of these measured quantities can be registered in the demand registers as:

- average demand
- maximum demand

9.2 Demand Registers

For demand registration, the ZxQ meter features the following registers:

- 4 registers for average demand values of the current integration period (1 register per measured value)
- 4 registers for average demand values of the last integration period (1 register per measured value)
- 8 maximum demand registers.



9.3 Integration Period

The integration period is the regular period of time during which the demand is measured and continuously integrated. At the end of the integration period the average value of the demand is available.

The integration period defines the capture period of the profile which is used for demand registration. In case two profiles are present, it defines capture period tm1 or tm2, the other capture period can be freely selected. See also section 7 "Integration Period Control".

9.3.1 Controlling the Integration Period

Internal, synchronous

The integration period is synchronised with the time-of-day, so that it always starts on the hour (e.g. integration periods of 15 minutes starting at 10:00, 10:15, 10:30, 10:45, 11:00, 11:15 etc.).

New start of integration period

A new start of the integration period causes the capture period assigned to the integration period in "Integration period control" (tm1 or tm2) to be restarted. (If there is only one profile, tm2 is not present).

9.4 Average Demand

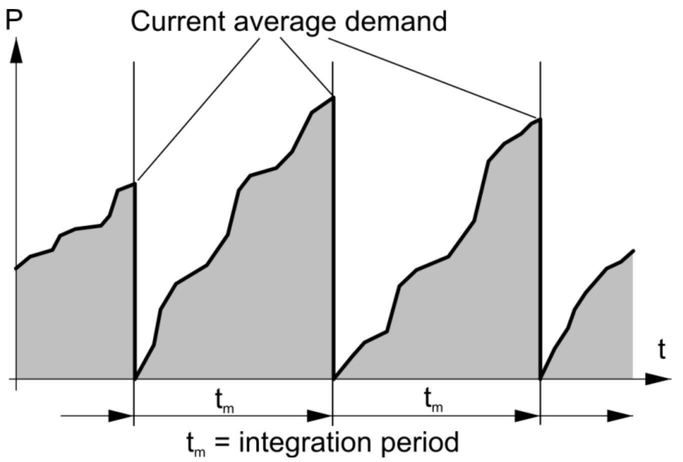
For each of the measured quantities +A, -A, +S and -S, there is a register for the average demand of the current integration period and a register for the average demand of the last integration period.

The allocation of the demand register to the corresponding measured quantity is fix and cannot be altered by parameterisation.

9.4.1 Current Average Demand

Each demand register sums up the corresponding measured values during one integration period. At the end of the integration period the average demand of the current integration period is available for further processing with the maximum demand registers.

Several maximum demand registers may access the same average demand register (different tariffs).



If the energy consumption varies, the average demand may fluctuate considerably from one integration period to the next.

9.4.2 Average Demand of the Last Integration Period

At the end of every integration period the average values are stored to the register for the average values of the last integration period (freeze function). The values are then available for display and readout during the following integration period. These values may also be stored in one of the two profiles. After saving the values, the registers for the current integration period are cleared.

9.4.3 Residual Value Processing

At the end of the integration period only the part of the average demand of the current integration period that is visible in the display is stored to the register for the last integration period.

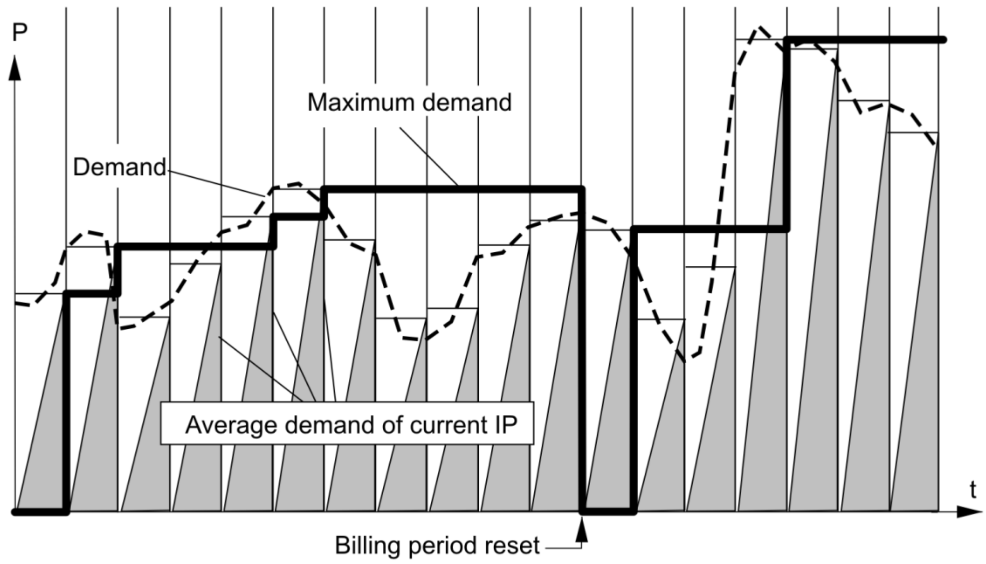
The residual value remaining in the value register is taken into account in the next integration period.

9.4.4 Profile Entries

The average demand of the last integration period can be stored to the profile at the end of every integration period. In this case, the sum of the integration periods corresponds to the cumulated status of the total energy registers.

9.5 Maximum Demand

The highest average value of demand determined during the entire billing period is very important for tariff control.



At the end of each integration period, the meter compares the current average value of demand with the previously highest average value of demand for the current billing period. The comparison is only made if the corresponding tariff is active.

- If the current average value is less than the highest average value, the maximum demand remains unchanged.
- If the current average value is equal or greater than the highest average value, the meter stores the current average value as new maximum demand and simultaneously records the time (date and time-of-day) at which the new maximum occurred.

Therefore, the meter determines a large number of average demand values during the entire billing period, but normally only registers the highest value. All other values are lost.

Maximum demand registers

Each maximum demand register comprises a memory for the current maximum value (within the current billing period). In addition, there are up to 40 memories in the stored billing value profile.

Various demand values can be registered in the 8 maximum demand registers for tariff control. Any of the 4 average values of demand can be assigned as input quantity to each maximum demand register. Several maximum demand registers can also access the same average value of demand to form various tariffs.

Billing period reset

At the end of the billing period the reset signal stores the current maximum demand value together with date and time in the stored billing value profile.

Up to 40 stored values of successive billing periods remain stored. Every time a new stored value is stored, the oldest stored value is overwritten.

Tariff control

Tariff control is realised by selecting which maximum demand register(s) take over the measured values at a given time.

9.6 Format of the Demand Registers

Register size

The average and maximum demand registers have a size of 5 digits. A maximum of 4 decimal places are possible.

Register resolution

The resolution of the demand registers (significance of last visible digit) depends on the maximum power applied to the meter. A register overflow must not occur.

For details please refer to 2.14.2 "Register Resolution".

9.7 Display and Readout

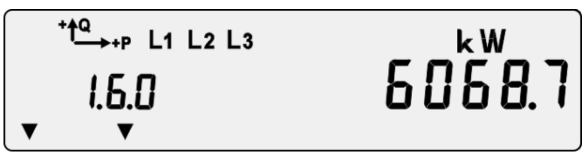
Values available

The following demand values are available for display and readout depending on the parameterisation:

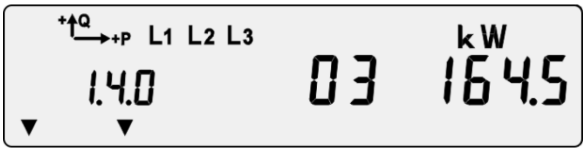
- average demand values of the current integration period with the status of the integration period
- average demand values of the last integration period
- current demand maximum values during the current billing period with date and time of occurrence
- maximum demand values of preceding billing periods as stored values with date and time

Display examples

Some examples are given below of demand register displays. The identification codes for the individual data correspond to the energy data identification system OBIS.



Active power import (1)
Maximum demand (6)



Active power import (1)

Average demand value of current integration period (4)

Minute of the current integration period (03)

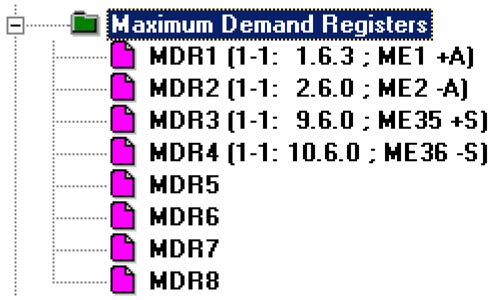
9.8 Demand Register Parameters

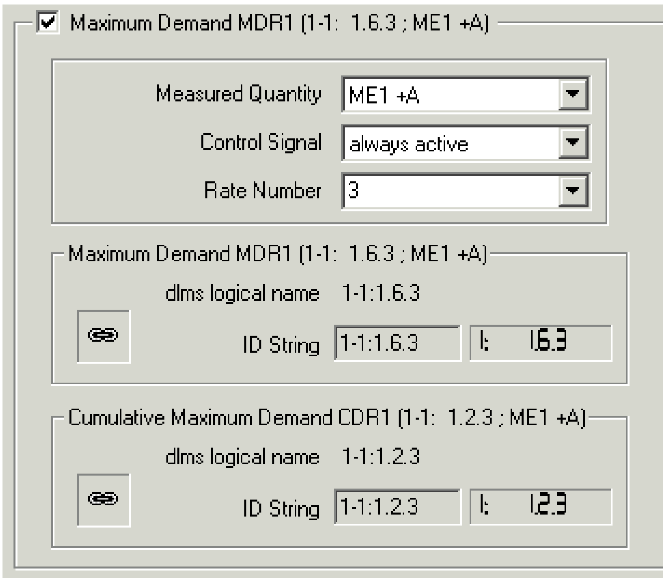
9.8.1 Register Definition for Average Demand

For the register definition for average values of demand (current and last integration period), please refer to 2.14.7 "Defining a Measured Quantity".

9.8.2 Register Definition for Maximum Demand

Each maximum demand register defined with the following parameters has also a register for cumulative maximum demand.



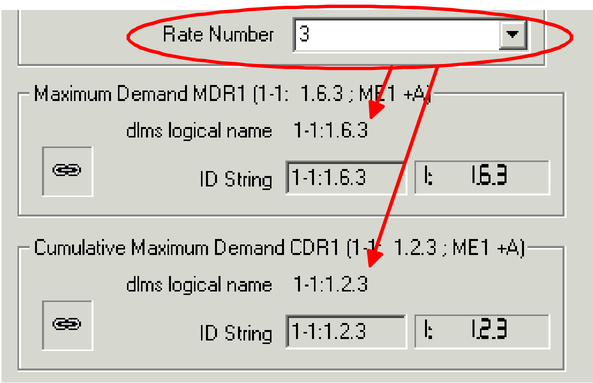


To define a maximum demand register, click the corresponding MDR number and set the following parameters:

Measured Quantity Select the measured quantity whose values must be captured in this maximum demand register.

Control Signal Select whether the maximum demand register is always active or which signal is used to activate it (tariff control).

Rate Number



Enter the rate number that is used to indicate the currently active tariff. The rate number is added as suffix to the dlms logical name (field E). Usually "1" is used to indicate tariff 1, "2" to indicate tariff 2 etc.

dlms logical name

The dlms logical name is the identification of the maximum demand register according to the OBIS standard. The central station uses the identification code to automatically identify each measured value.

When defining a maximum demand register it is allocated automatically.

Display Code

The display code appears in the code field of the display. By default the display code is identical to the dlms logical name according to the OBIS standard. However, users can set their own display code for each register.

Cumulative maximum demand
The registers for cumulative maximum demand are not used in the ZxQ.

9.8.3 Defining the Integration Period

The Integration Period Control is described in section 7 "Integration Period Control".

9.8.4 Demand Register Resolution

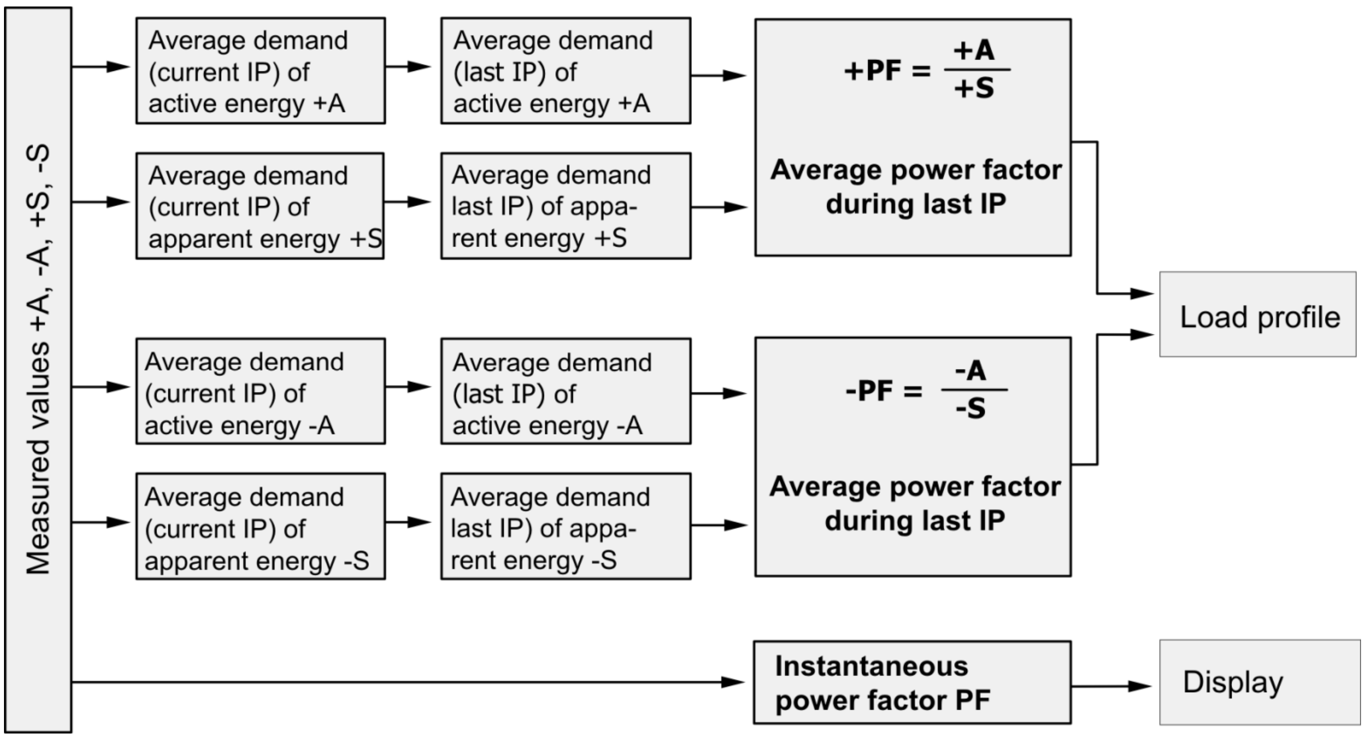
Define the resolution of the demand registers according to 2.14.2 "Register Resolution".

10 Power Factor Registration

10.1 Overview

C.7 and C.8 only
The average power factors are only available with meters with the software configuration C.7 or C.8 and if the demand and power factor measurement is activated (see section 1.3 "Software Configuration Parameters").

The ZxQ meter is capable of registering power factors (PF). The power factors are calculated based on the values of active and apparent energy.



Average power factor during the integration period IP

The average power factors during the integration period are calculated based on the average values of demand of active and apparent energy during the last integration period (positive sum of all three phases).

The average power factors of the last integration period can be stored to the profile.

Instantaneous power factor

The meter provides the instantaneous value of the total power factor. The value is refreshed every second. No single-phase values are provided.

The instantaneous power factor is available on display and via communication.

10.2 Average Power Factor during the Integration Period

Meters with the software configuration C.8 and activated demand registration can form the average power factor during the integration period.

+PF

To calculate the power factor of energy import +PF the meter uses the average demand of the last integration period of the two measured values

- All-phase active energy import +A,
- All-phase apparent energy import +S.

-PF

To calculate the power factor of energy export -PF the meter uses the average demand of the last integration period of the two measured values

- All-phase active energy export -A,
- All-phase apparent energy export -S.

The value of both power factors is always positive and between 0 and 1.

If the power factor cannot be determined for some reason (e.g. +S = 0), the power factor is set to 1. This allows searching for the minimum power factor in the profile no matter the measuring conditions.

Load profile entries

The example below shows the load profile entries for +PF and -PF when the energy flow changes from import to export.

Energy flow	Time stamp	Status	+A	+S	-A	-S	+PF	-PF
No energy	00:00	xy	0	0	0	0	2 or -.--	2 or -.--
Energy import only	00:15	xy	8 MWh	10 MWh	0	0	0.8	1
Change from import to export	00:30	xy	1MWh	5MWh	2MWh	5MWh	0.2	0.4
Energy export only	00:45	xy	0	0	3MWh	5MWh	1	0.6

Automatic allocation
If the demand and power factor measurement has been activated in the software configuration, the measured quantities +S and -S are automatically allocated to the measured quantities ME35 and ME36.

10.3 Instantaneous Power Factor

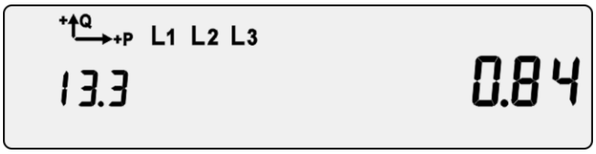
The meter provides the instantaneous value of the total power factor. The value is refreshed every second. No single-phase values are provided.

The instantaneous power factor value is always within -1 and +1 depending on the energy direction. The value is available on display and via communication.

If the power factor is not measured (e.g. due to the apparent power being zero) the meter shows -.-- as power factor in the display. In the dlms protocol the power factor is set to the invalid value "2".

10.4 Display

On the display, only the instantaneous value of the total power factor (all-phase value) is available.



Total power factor
Instantaneous value

10.5 Power Factor Register Parameters

For the power factor registration no parameters have to be set.

11 Status Registers

11.1 Overview

The meter features several registers to show the current status of the meter and its inputs and outputs. The following status information is available:

- Terminal status information
- Internal control signal status information
- Event status information

As ZxQ has specific network operational indicators the following status information should only be used in special cases.

11.2 Terminal Status Information

The terminal status information shows the current status of the input and output terminals of the meter. The information may be added to the display and readout lists.

For details about the designation and the allocation of the terminals, please refer to 3 "Transmitting Contacts".

Input terminals

C.3.1 Control Input States Base Meter. These bits indicate the status of the input terminals of the base meter. The following terminal numbers show the standard terminal allocation.

Bit #	Description	Terminal f6	Terminal f9
Bit 0	Control input E1	43	B6
Bit 1	Control input E2	44	B7
Bit 2	Control input E3	45	B8
Bit 3	Synchronisation input	21	D9
Bit 4-7	not used		

Output terminals

C.3.2 Control Output States Base Meter. These bits indicate the status of the output terminals of the base meter.

Bit #	Description	Terminal f6	Terminal f9
Bit 0	Alarm contact	52, 54	D1, D2
Bit 1-7	not used		

11.3 Internal Control Signal Status Register

Keys and switches

C.3.3 Keys and Switches Base Meter. The internal control signal register shows the current status of the parameterisation switches 1 and 2.

The information may be added to the display and readout lists.

Bit #	Description	State definition
Bit 0	**Parameterisation switch 2:** The bit indicates the status of the parameterisation switch 2.	0 = off 1 = on
Bit 1	**Parameterisation switch 1:** The bit indicates the status of the parameterisation switch 1.	0 = off 1 = on
Bit 2-7	not used	

11.4 Event Status Register

The event status register shows whether the phase currents and phase voltages are present. The presence of the additional power supply is also indicated.

Single phase outages

C.4.0 Missing Voltage Status. These bits indicate that the phase voltage is below 45% U_n (standard setting) or below 5 or 10% U_n (special cases) and the phase current is below 2% I_n.

Bit #	Description	State definition
Bit 0	Single phase outage L1	0 = U and I above threshold 1 = U and I below threshold
Bit 1	Single phase outage L2	0 = U and I above threshold 1 = U and I below threshold
Bit 2	Single phase outage L3	0 = U and I above threshold 1 = U and I below threshold
Bit 3-7	not used	

Voltage without current

C.4.1 Missing Current Status. These bits indicate that the phase current is below 2% I_n while the phase voltage is above 45% U_n.

Bit #	Description	State definition
Bit 0	Voltage without current L1	0 = I above threshold 1 = I below threshold
Bit 1	Voltage without current L2	0 = I above threshold 1 = I below threshold
Bit 2	Voltage without current L3	0 = I above threshold 1 = I below threshold
Bit 3-7	not used	

Current without voltage

C.4.2 Current without Voltage Status. These bits indicate that the phase current is above the minimum threshold of 1% I_n while the phase voltage is below 45% U_n.

Bit #	Description	State definition
Bit 0	Current without voltage L1	0 = I below threshold 1 = I above threshold
Bit 1	Current without voltage L2	0 = I below threshold 1 = I above threshold
Bit 2	Current without voltage L3	0 = I below threshold 1 = I above threshold
Bit 3-7	not used	

Additional power supply

C.4.3 Missing Additional Supply Status. This bit indicates that the additional power supply failed.

Bit #	Description	State definition
Bit 0	Missing additional power supply	0 = Us present 1 = Us absent
Bit 1-7	not used	

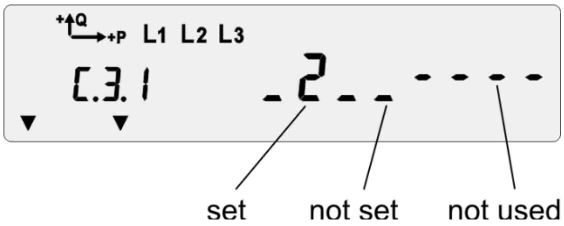
11.5 Display and Communication

Possible states

The individual status bits may be:

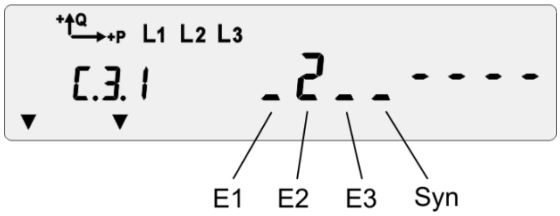
- set
- not set or
- not used.

In the display the status bits are displayed as follows:



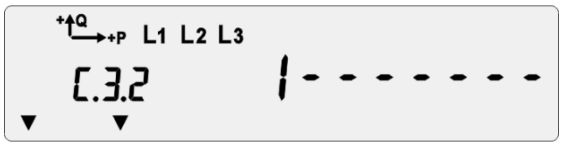
Display examples

The following examples show the terminal status registers of the base meter and the event status register for single phase outages.



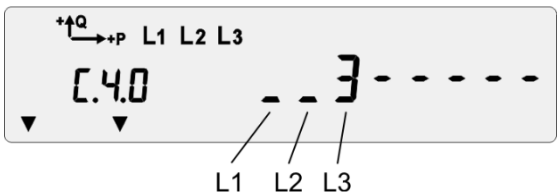
C.3.1: control input states

_: Control input E1 off (inactive)
2: Control input E2 on (active)
_: Tariff input E3 off (inactive)
_: Synch. signal Syn inactive
–: not used



C.3.2: control output states

1: Alarm contact closed
-: not used



C.4.0: Single phase outages

_: Phase 1 is present
2: Phase 2 is present
3: Phase 3 failed
–: not used

dlms protocol

In the dlms protocol the status information is included as two integer numbers between 0 and 255 which represent the binary status of the eight bits of a status register. One number states which status bits are used while the other number states which status bits are currently set.

If, for instance, a status register is displayed as _23----- the dlms protocol contains the numbers 224 and 096:

Status bits (display):	_	2	3	–	–	–	–	–	
Used status bits (dlms):	1	1	1	0	0	0	0	0	**224**
Set status bits (dlms):	0	1	1	0	0	0	0	0	**096**
Valency of the bits:	128	64	32	16	8	4	2	1	

12 Daily Snapshot

12.1 Overview

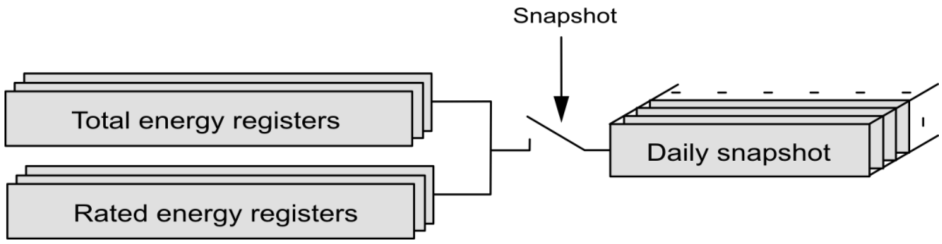
Not available for C.2.

Application

In grid metering applications, the daily snapshot is used to store the energy values on a daily basis. The daily values may then be transmitted for further processing and for comparative purposes.

Snapshot

When taking a snapshot, the contents of the selected rated energy registers and of the selected total energy registers are stored in the daily snapshot profile.



12.2 Structure of the Daily Snapshot

Each daily snapshot entry consists of the snapshot counter, the time stamp and a selectable number of measured values.

Date/time	Snapshot counter	Measured value 1	Measured value 2	…
02-11-25 / 00:00:00	01	1234567.1	1233567.1	…
02-11-26 / 00:00:00	02	1234579.4	1233584.5	…
02-11-27 / 00:00:00	03	1234586.7	1233598.7	…
…	…	…	…	…

A maximum of 40 entries with a maximum of 36 captured objects each can be stored to the energy profile. The most recent value appears first in the energy profile. The oldest entry will always be overwritten by the most recent one.

The 2-digit snapshot counter counts up to 99 and then starts at 00 again. It is used to identify the value in the energy profile.

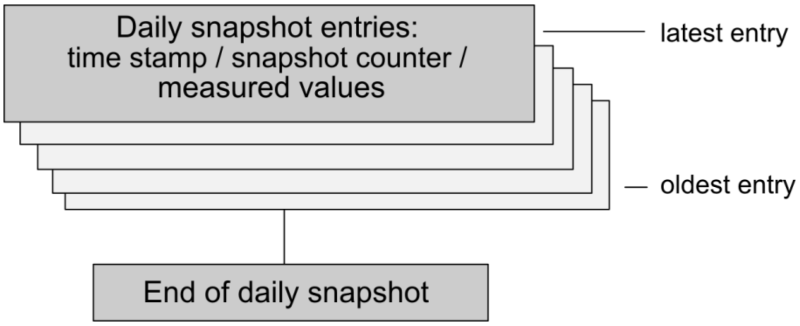
12.3 Snapshot Interval

The daily snapshot is initiated internally by the calendar clock. By default, the snapshot takes place at midnight but it may be set to any full hour of the day. See also section 12.5.2 "Snapshot Time".

12.4 Display

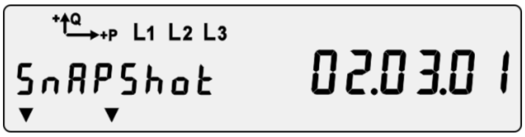
12.4.1 Display Structure

Each entry in the daily snapshot consists of the time stamp, the snapshot counter and the selected measured values. The most recent entry is shown first.

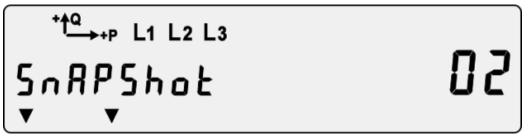


12.4.2 Display Examples

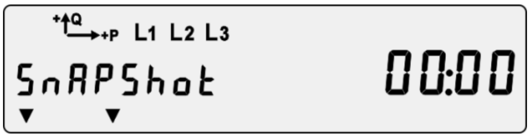
Some examples of displays are given below.



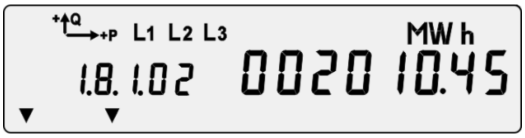
Date of daily snapshot entry
1st March, 2002



Snapshot counter



Time-of-day of snapshot



Active energy import (1)
Original meter value (8)
Tariff 1 (1)
Snapshot counter (02)

12.5 Daily Snapshot Parameters

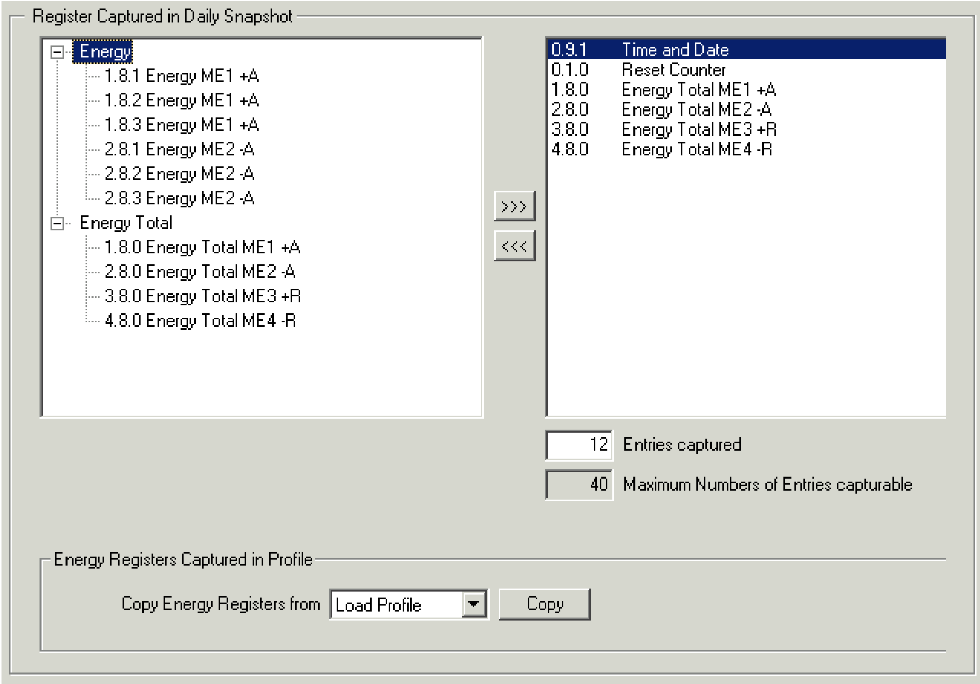
12.5.1 Registers Captured in the Daily Snapshot

Register Selection

Select which registers (objects) are stored to the daily snapshot.

1. Click the register you wish to add to the daily snapshot.
2. Click **>>>** to add it.

A maximum of 36 objects (time stamp, snapshot counter, energy registers etc.) can be captured in the daily snapshot.



Energy Registers Captured in Profile

You can copy energy registers from the profile (first profile in case two profiles are configured) or the event log to the daily snapshot.

To do this proceed as follows:

1. Choose if you would like to use the same energy registers as in the load profile **or** in the event log.
2. Click on **Copy** to copy the registers.

12.5.2 Snapshot Time

By default the daily snapshot takes place at midnight but it may be set to any full hour of the day.

13 Stored Billing Value Profile

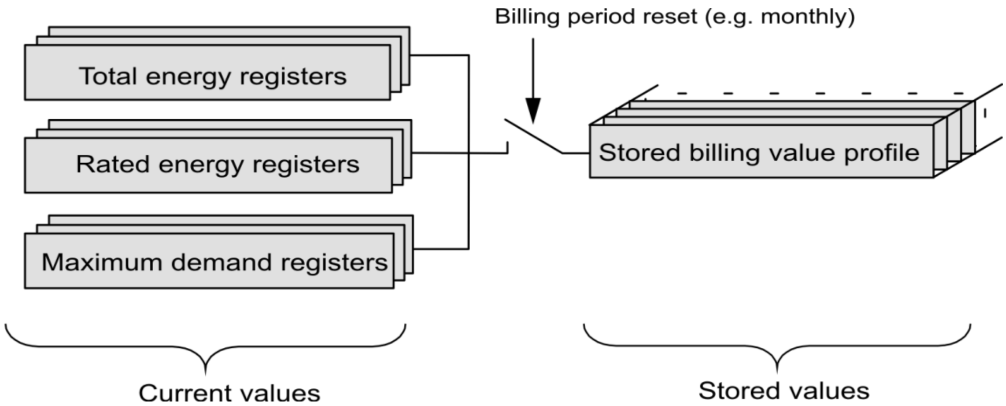
13.1 Overview

Stored billing value profile not available with C.2
The stored billing value profile is available with all meters apart from meters with the software configuration C.2 (see section 1.3 "Software Configuration Parameters").

The stored billing value profile is used to register billing relevant values such as energy and maximum demand.

Billing period

At the end of the billing period, the contents of the selected rated energy registers, of the selected total energy registers and of the selected maximum demand registers are stored in the stored billing value profile.



13.2 Current Values and Stored Values

Current values

Current values are the contents of the energy registers (see also section 8 "Energy Registration").

Stored values

At the end of the billing period, the billing period reset signal triggers the storing of the current values into the stored billing value profile.

The stored billing value profile is organised as a circular buffer. Once the buffer is full, the oldest entry is always overwritten by the most recent one.

13.3 Structure of the Stored Billing Value Profile

Each stored billing value profile entry consists of the stored billing value counter, the time stamp and a selectable number of measured values.

Date/time	**Stored billing value counter**	**Measured value 1**	**Measured value 2**	**…**
02-11-25 / 00:00:00	01	1234567.1	1233567.1	…
02-11-26 / 00:00:00	02	1234579.4	1233584.5	…
02-11-27 / 00:00:00	03	1234586.7	1233598.7	…
…	…	…	…	…

A maximum of 40 entries with a maximum of 36 captured objects each can be stored in the stored billing value profile. The most recent value appears first in the profile. The oldest entry will always be overwritten by the most recent one.

The 2-digit stored billing value counter counts up to 99 and then starts at 00 again. It is used to identify the value in the profile.

13.4 Billing Period

The billing period is the regular period of time after which an entry to the stored billing value profile is made.

13.4.1 Billing Period Reset

The billing period reset is initiated internally by the calendar clock. It may also be initiated by a dlms command or manually by selecting "Cumulate" in the service menu.

C.7 limitations
In C.7, the billing period reset is always executed daily at 00:00 h and cannot be changed. Moreover, it is not possible to trigger a reset manually with the reset button or via a formatted command.

According to parameter setting, it may take place:

- daily (daily snapshot to be preferred)
- on a specific day every week
- at the begin of the month (default setting)
- at selectable day(s) within a month
- at selectable day(s) within a calendar year
- at the begin and at the end of daylight saving time

Selectable time of the day
The time of day at which the billing period reset takes place can be selected for all billing periods (except for daylight saving begin and end).

13.4.2 Reset Lockout

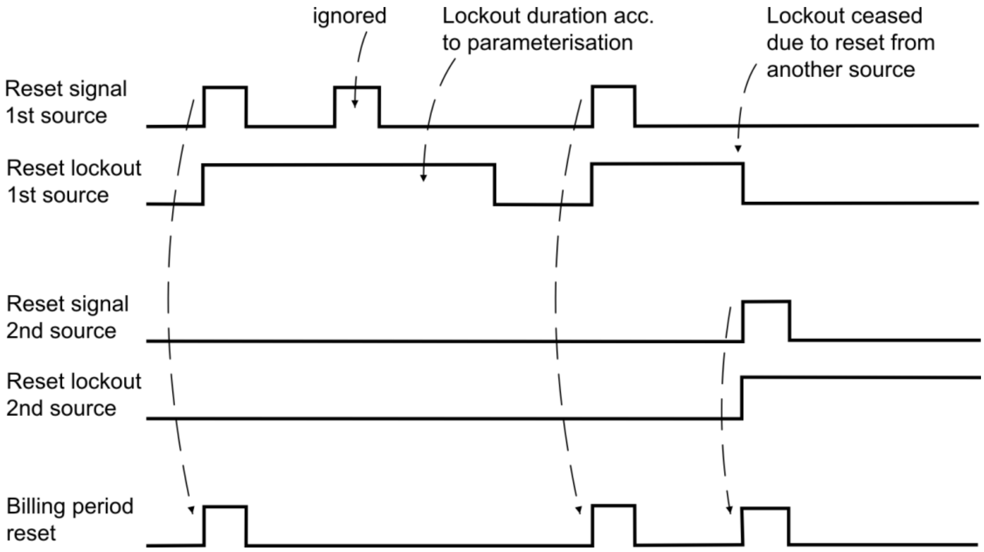
At every billing period reset, regardless how it was initiated, a time window is started during which no further reset is possible (reset lockout). The duration of the reset lockout can be parameterised from 0 minutes (no lockout) to several hours.

3 kinds of reset sources

There are three kinds of reset sources. The reset lockout only applies to the kind of reset that initiated the billing period reset. The three reset sources are:

- Manual reset by selecting "Cumulate" in the service menu
- External reset via communication interface (electrical, optical, communication unit)
- Internal reset via calendar clock

Behaviour of reset lockout



The reset lockout only applies to the source that initiated the billing period reset. Reset commands from other sources will not be locked.

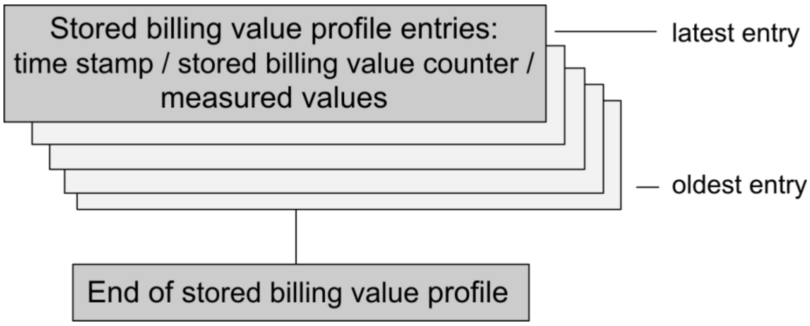
If a reset is triggered during a lockout of one source by another source, the inhibition of the first source ceases, i.e. a new reset at the first is executed.

A voltage interruption deactivates the reset lockout which can be particularly useful for testing.

13.5 Display

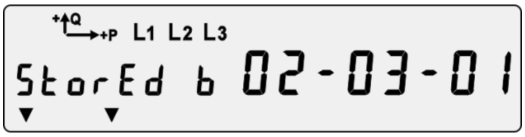
13.5.1 Display Structure

Each energy profile entry consists of the time stamp, the stored billing value counter, the time stamp and the selected measured values. The most recent entry is shown first.

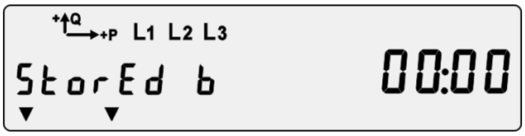


13.5.2 Display Examples

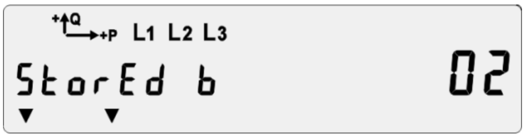
Some examples of displays are given below.



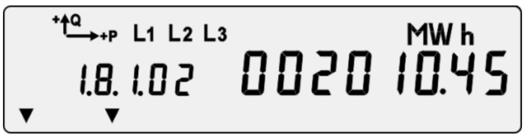
Date of stored billing value profile entry
1st March, 2002



Time-of-day of stored billing value profile entry



Stored billing value counter

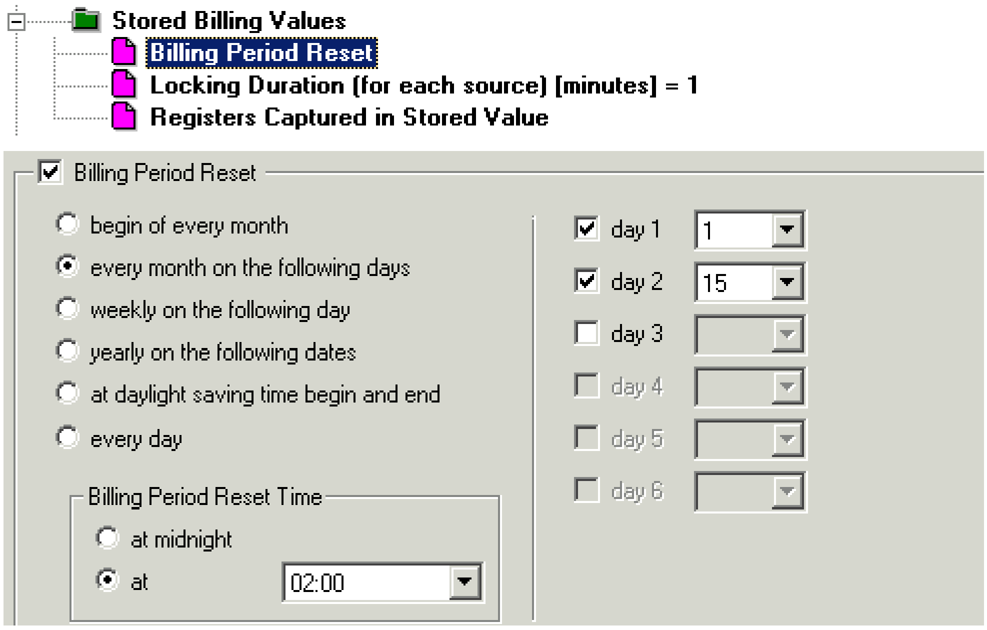


Active energy import (1)
Original meter value (8)
Tariff 1 (1)
Stored billing value counter (02)

13.6 Stored Billing Value Profile Parameters

13.6.1 Billing Period Reset

Set the length of the billing period by defining the time when the billing period reset takes place.

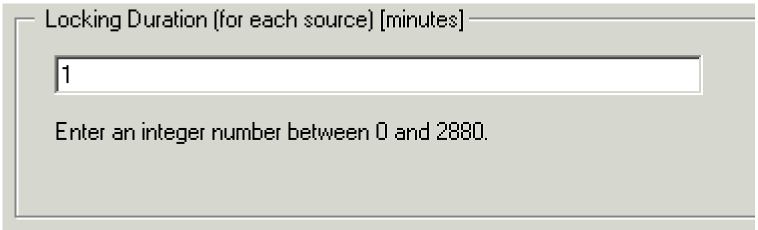


Begin of every month	The billing data is stored on the first day of the month.
Every month on the following days	Select the day(s) of the month on which the billing data must be stored (1 to 31). A maximum of six days can be entered.
Weekly on the following days	Select the day of the week on which the billing data must be stored.
Yearly on the following dates	Select the date(s) within a calendar year on which the billing data must be stored. A maximum of six dates can be selected.
At daylight saving time begin and end	The billing data is stored at begin and at the end of daylight saving time. To define begin and end time see section 4 "Calendar Clock".
Every day (standard setting)	The billing data is stored daily (not used in grid applications, see section 12 "Daily Snapshot").

Billing period reset time

Select at midnight or enter the time of day at which the billing data is stored. The selected time applies for all billing period selections made above. When at midnight is selected, the billing data are stored at 00:00h.

13.6.2 Reset Lockout Duration



Select the duration of the reset lockout. Enter a duration between 0 minutes (no reset lockout) and 2'880 minutes. This setting applies for all reset signal sources.

If, for instance, a reset lockout of 10 minutes is selected, the actual lockout duration is between 9 and 10 minutes. This is because the reset source is asynchronous to the internal clock.

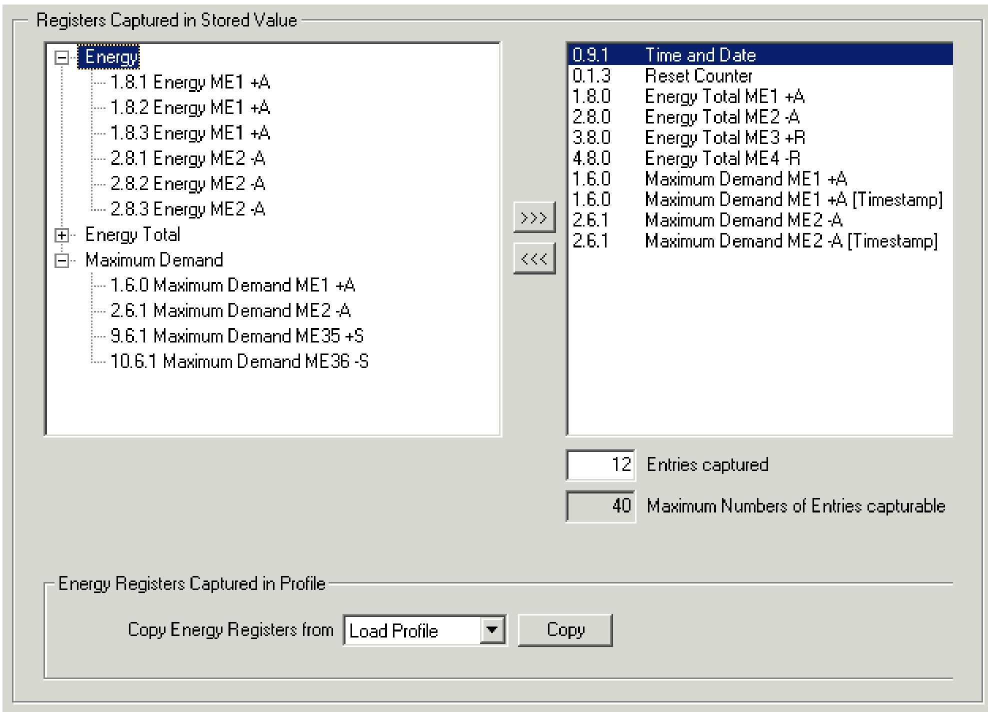
13.6.3 Registers Captured in the Stored Billing Value Profile

Register Selection

Select which registers (objects) are stored to the stored billing value profile at the end of a billing period.

1. Click the register you wish to add to the stored billing value profile.
2. Click **>>>** to add it.

A maximum of 36 objects (time stamp, stored billing value counter, energy registers etc.) can be captured in the stored billing value profile.



Energy Registers Captured in Profile

You may also capture the same registers in the energy profile as in the load profile or as in the event log.

To do so, do the following:

1. Select whether you want to add the same registers as in the load profile or as in the event log.
2. Click **Copy** to take over the registers.

14 Energy Profile (H01 and H90 only)

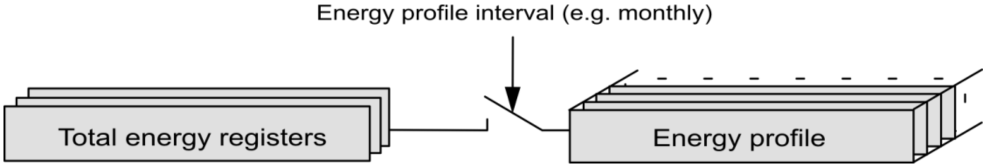
14.1 Overview

Availability
The energy profile is available with C.2 meters with the firmware version H90 and with all C.4, C.6 and C.8 meters with firmware version H01.

The energy profile is used to register the energy values on a regular basis.

Energy profile interval

At the end of the energy profile interval, the contents of the selected total energy registers are stored in the energy profile.



14.2 Current Values and Energy Profile

Current values

Current values are the contents of the energy registers (see also section 8 "Energy Registration").

Stored values

At the end of the energy profile interval, the reset signal triggers the storing of the current values into the energy profile.

The energy profile is organised as a circular buffer. Once the buffer is full, the oldest entry is always overwritten by the most recent one.

14.3 Structure of the Energy Profile

Each energy profile entry consists of the snapshot counter, the time stamp and a selectable number of measured values.

Date/time	Snapshot counter	Measured value 1	Measured value 2	…
02-11-25 / 00:00:00	01	1234567.1	1233567.1	…
02-11-26 / 00:00:00	02	1234579.4	1233584.5	…
02-11-27 / 00:00:00	03	1234586.7	1233598.7	…
…	…	…	…	…

A maximum of 40 entries with a maximum of 36 captured objects each can be stored to the energy profile. The most recent value appears first in the profile. The oldest entry will always be overwritten by the most recent one.

The 2-digit snapshot counter counts up to 99 and then starts at 00 again. It is used to identify the value in the profile.

14.4 Energy Profile Interval

The energy profile interval is the regular period of time after which an entry to the energy profile is made.

14.4.1 Energy Snapshot

The energy snapshot is initiated internally by the calendar clock. According to parameter setting, it may take place:

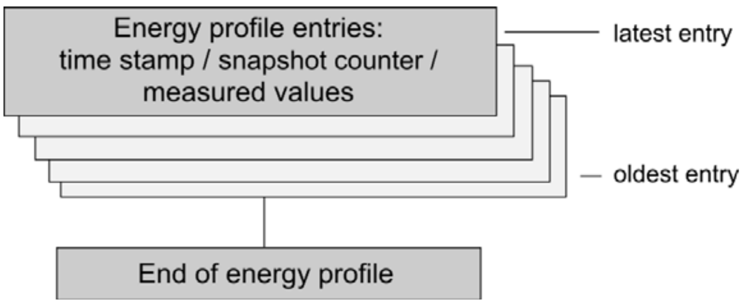
- daily (standard setting)
- on a specific day every week
- at the begin of the month
- at selectable day(s) within a month
- at selectable day(s) within a calendar year
- at the begin and at the end of daylight saving time

Selectable time of the day
The time of day at which the entries to the energy profile take place can be selected for all energy profile intervals (except for daylight saving begin and end).

14.5 Display

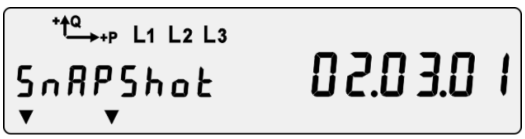
14.5.1 Display Structure

Each energy profile entry consists of the time stamp, the snapshot counter, the time stamp and the selected measured values. The most recent entry is shown first.

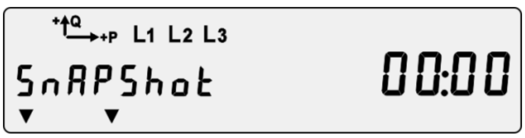


14.5.2 Display Examples

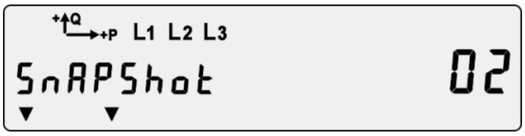
Some examples of displays are given below.



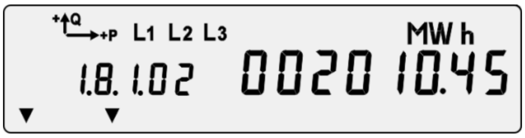
Date of energy profile entry
1st March, 2002



Time-of-day of energy profile entry



Snapshot counter

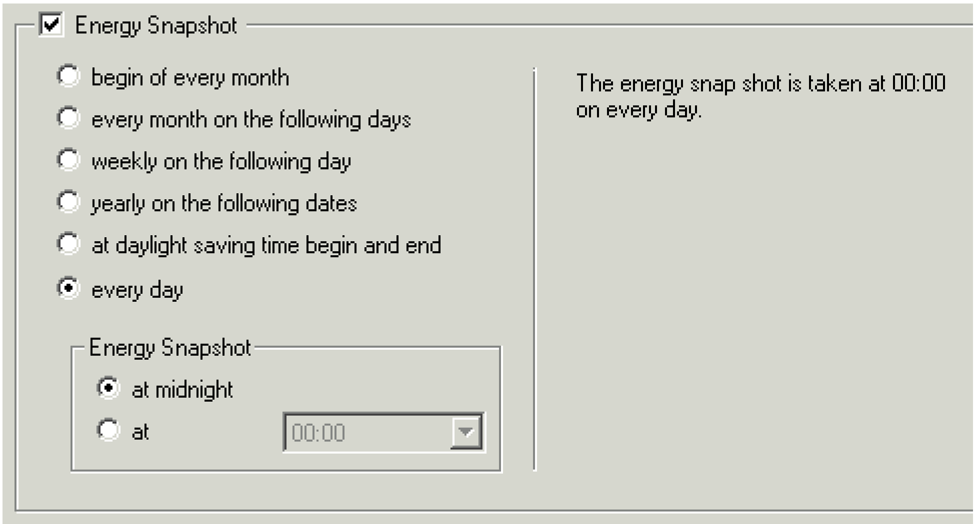


Active energy import (1)
Original meter value (8)
Tariff 1 (1)
Snapshot counter (02)

14.6 Energy Profile Parameters

14.6.1 Energy Snapshot

Define the time when the energy snapshot takes place.



Begin of every month	The data is stored on the first day of the month.
Every month on the following days	Select the day(s) of the month on which the data must be stored (1 to 31). A maximum of six days can be entered.
Weekly on the following day	Select the day of the week on which the data must be stored.
Yearly on the following dates	Select the date(s) within a calendar year on which the data must be stored. A maximum of six dates can be selected.
At daylight saving time begin and end	The data is stored at begin and at the end of daylight saving time. To define begin and end time see section 4 "Calendar Clock".
Every day	The data is stored daily (standard setting).

Energy Snapshot

Select at midnight or enter the time of day at which the billing data is stored. The selected time applies for all billing period selections made above. When at midnight is selected, the billing data is stored at 00:00h.

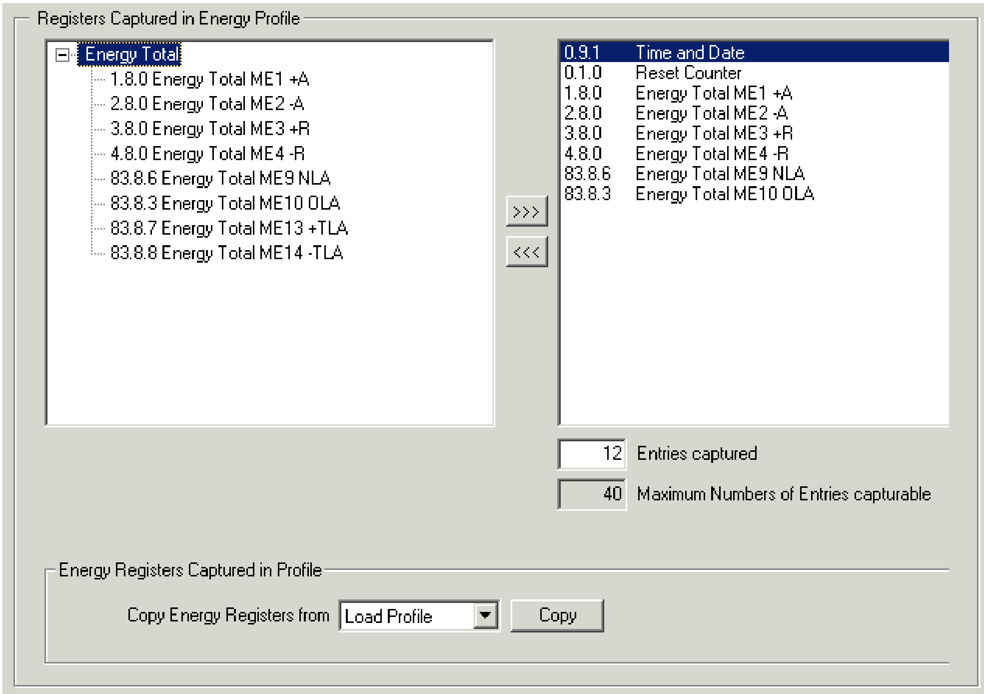
14.6.2 Registers Captured in the Energy Profile

Register Selection

Click the register you wish to add to the energy profile.

1. Click the register you wish to add to the energy profile.
2. Click **>>>** to add it.

A maximum of 36 objects (time stamp, snapshot counter, energy total registers) can be captured in the energy profile.



Energy Registers Captured in Profile

You may also capture the same registers in the energy profile as in the load profile or as in the event log.

To do so, do the following:

1. Select whether you want to add the same registers as in the load profile **or** as in the event log.
2. Click **Copy** to take over the registers.

15 Profile

15.1 Overview

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

15.2 Profile 1 and Profile 2

A second profile can be activated in the configurations C.4, C.6 and C.8.

Profile 1

The first profile is generally used for billing purposes. It has a capture time range of 1...60 min., the standard value is 15 min. This profile also contains detailed status information for data processing in central stations.

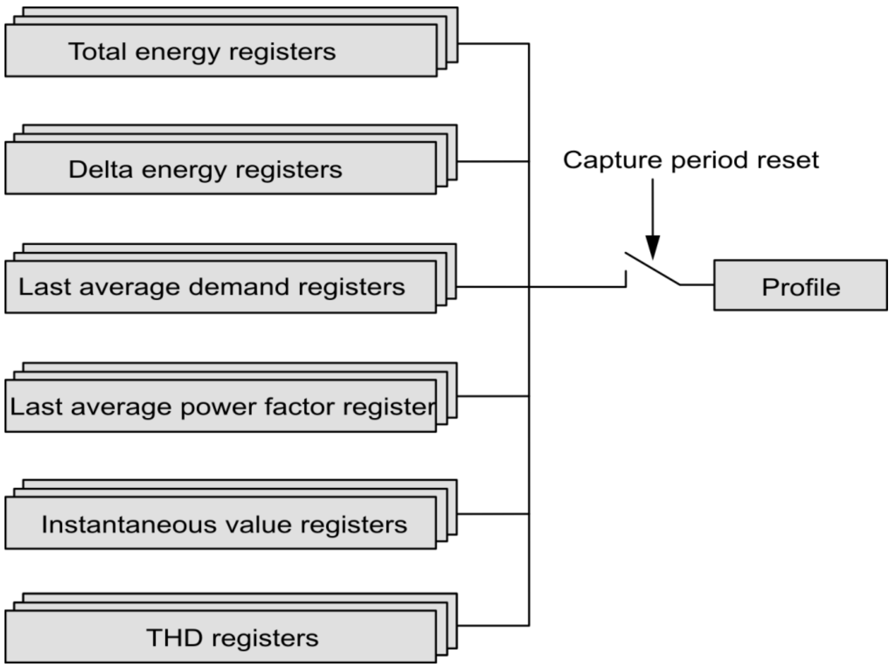
Profile 2

The second profile can either be used for operation control (SCADA supervision, with a short capture period of 1 to 5 min.) or for billing (with a capture period of 1 h for countries which have not yet changed to the standard capture period of 15 min.). This makes it possible to change from a capture period of 1 h to 15 min. without a modification of the capture period parametrisation (sealed).

If two profiles are used and demand is registered, the integration period has to be specified for the demand registration and it has to be defined which profile is used for demand registration. For details see section 7 "Integration Period Control".

15.3 Capture Period

The capture period is the regular period of time after which a profile entry (the current values of various registers are saved to the profile) is made.



15.3.1 Controlling the Capture Period

The capture period is controlled by the internal clock. It is synchronised with the time of day, so that it always starts on the hour (e.g. a capture period of 15 minutes begins at 10:00, 10:15, 10:30, 10:45, 11:00, 11:15, etc.).

The following capture periods are possible: 1 min, 3 min, 5 min, 10 min, 15 min, 30 min and 60 min.

15.4 Capacity

Each profile entry consists of a time stamp of 5 bytes, a status code of 4 bytes and of the measured values (8 bytes each).

The ZxQ meter features two profile memories of 2.88 MB each.

The table below shows the number of days that are covered by the profile depending on the number of registers captured and the length of the capture period.

	60’	**30’**	**15’**	**10’**	**5’**	**3’**	**1’**
4 registers	800	800	681	545	227	136	45
8 registers	800	789	394	263	131	78	26
12 registers	800	555	277	185	92	55	18
16 registers	800	428	214	142	71	42	14
20 registers	697	348	174	116	58	34	11
24 registers	588	294	147	98	49	29	9
28 registers	508	254	127	84	42	25	8
32 registers	447	223	111	74	37	22	7
36 registers	400	200	100	66	33	20	6

A minimum of 100 days is guaranteed with 36 captured registers and a capture period of 15 minutes.

A maximum of 800 days can be covered no matter how long the capture period and how few registers are captured.

Circular buffer
The profile is organised as a circular buffer, i.e. once the buffer is full the oldest entry will always be overwritten by the most recent one.

15.5 Structure of Entries

Each profile entry consists of the time stamp, the status code and a maximum of 36 measured values.

Date/time	**Status code**	**Measured value 1**	**Measured value 2**	**…**
02-09-15 / 00:00:00	0080 0000	00785147.9	00254838.2	…
02-09-15 / 00:00:15	0080 0000	00785153.2	00254849.4	…
02-09-15 / 00:00:30	0080 0000	00785164.3	00254856.3	…
…	…	…	…	…

15.5.1 Time Stamp

Time and date information is stored with every profile entry. The time stamp is stored in local time.

15.5.2 Measured Values

With the MAP tool, the user selects the measured values to be captured in the profile (see section 15.11.2 "Registers Captured in the Profile"). The following measured values may be captured in the profile:

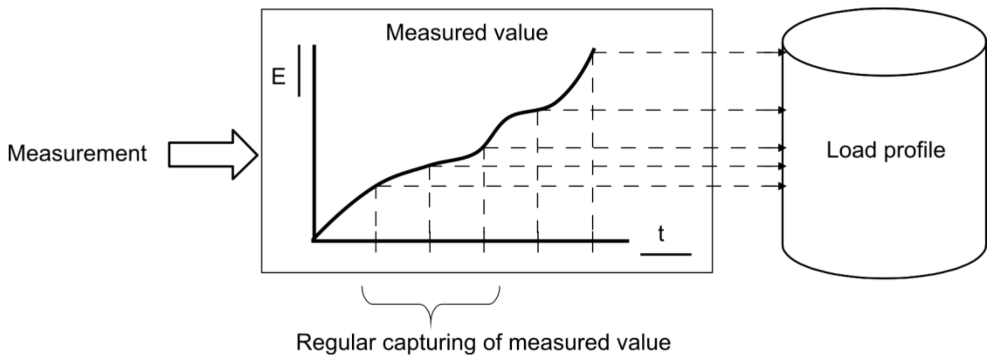
- total energy
- capture period delta values (energy advance)
- Last average demand
- Last average power factor
- Instantaneous values (voltage, current, power, frequency as average values over the capture period)
- Total harmonic distortion of active energy, voltage and current

The measured values are captured at regular intervals i.e. at the end of the capture period or due to a special event that causes the capture period to restart.

The value with the midnight time stamp (00:00h / new date) is the last value of the previous day.

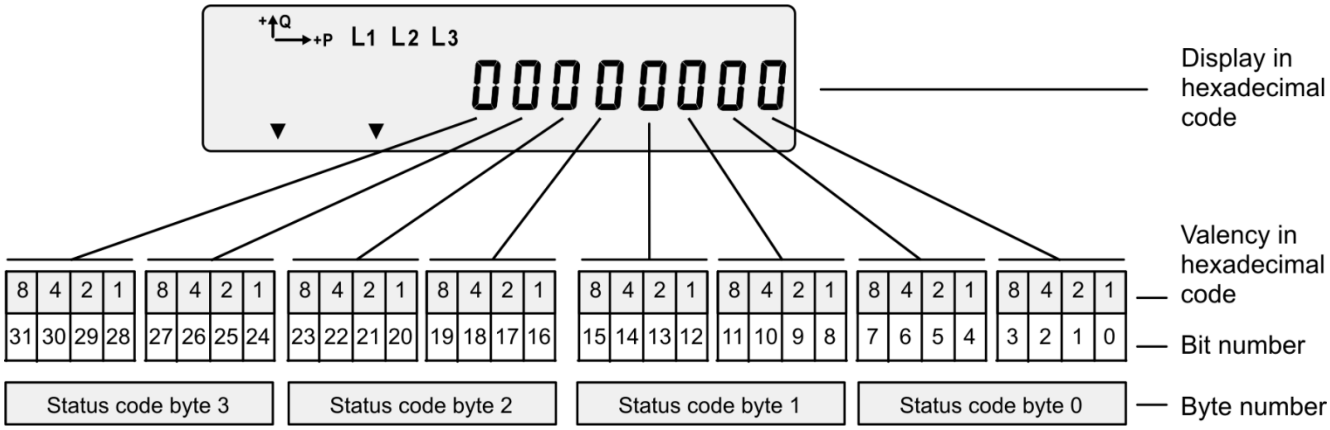
Average values are stored to the profile as average values over the capture period.

Each measured value occupies 8 Bytes in the profile.



15.5.3 Status Code

In both profiles, a status code is stored with every profile entry. It contains information about the current status of the meter and of the network the meter is connected to. The status code has a size of 4 bytes (32 bits).



Status code byte 3

Bit 31-26		not used
Bit 25 *	Event	**Voltage without current:** This bit indicates that there is no current flowing in one or several phases although voltage is applied to all three phases (3-phase operation). When this bit is set, bit 2 will also be set. The bit will not be set if the incident occurs on all phases simultaneously.
Bit 24	Event	**Current without voltage:** This bit indicates that there is current flowing in one or several phases although there is no voltage in the relevant phase. When this bit is set, bit 2 will also be set. The bit will not be set if the incident occurs on all phases simultaneously.

Status code
The bits marked with * will only be set in the profile status code if the relevant events have been selected to trigger an event log entry (see also section 16.8.1 "Event Log Entries").

Status code byte 2

Bit 23	Status	**End of interval, regular, internal:** This bit indicates that the capture period was terminated and the profile entry was made due to an internally generated regular EOI.
Bit 22		Not used
Bit 21	Event	**Energy registers cleared:** This bit indicates that individual or all energy registers have been cleared. When this bit is set, bit 2 will also be set.
Bit 20	Event	**End of interval EOI:** This bit indicates that the capture period was terminated and the profile entry was made due to an unsynchronised tariff switching.

Bit 19	Event	**Start of interval SOI:** This bit indicates the start of the capture period.
Bit 18	Status	**Bypass feeder operation mode:** This bit indicates that the bypass feeder operation mode is activated. When this bit is set, bit 2 will also be set.
Bit 17 *	Status	**All-phase measurement voltage failure:** When set to 1 this bit indicates that an all-phase measurement voltage failure occurred.
Bit 16 *	Status	**Single-phase measurement voltage failure:** When set to 1 this bit indicates that the measurement voltage of one phase failed. When this bit is set, bit 2 will also be set.

Status code
The bits marked with * will only be set in the profile status code if the relevant events have been selected to trigger an event log entry (see also section 16.8.1 "Event Log Entries").

Status code byte 1

Bit 15	Status	**Status before last adjustment of clock:** This bit marks the profile entry containing the time immediately before the time is adjusted. It should be followed by an entry that has bit 5 set (Clock adjusted).
Bit 14	Event	**Load profile cleared:** When set to 1 this bit indicates that the load profile memory was cleared during the previous capture period.
Bit 13	Event	**Control input change pos.:** This bit marks the occurrence of a positive slope at the control input.
Bit 12	Event	**Control input change neg.:** This bit marks the occurrence of a negative slope at the control input.
Bit 9-11		Not used
Bit 8	Event	**Parameterisation changed:** When set to 1 this bit indicates that one of the following parameters have been changed: - primary data adaptation - output pulse values of the transmitting contacts - register resolution When this bit is set, bit 2 will also be set.

Status code byte 0

Bit 7	Event	**Power down:** This bit is set to indicate that a 3-phase power failure occurred (measurement voltage **and** additional power supply). This bit may mark the profile entry containing the power down time or (together with the power up bit) it may mark the first entry after a short power failure.
Bit 6	Event	**Power up:** This bit is set to indicate that a power up has occurred. This bit may mark the profile entry containing the power up time or (together with the power down bit) it may mark the first entry after a short power failure.

Bit 5	Event	**Clock adjusted:** The bit is set when the time/date has been adjusted. The time that is stored in the profile entry is the new time after the setting.
Bit 4	Event	**Billing period reset:** When set to 1, this bit indicates that an energy snapshot (billing period reset) has occurred taken during the capture period.
Bit 3	Status	**Summer/Winter:** Indicates the current season. When set to 1 the current season is summer, when 0 the season is winter.
Bit 2	Status	**Invalid measured value:** Incomplete measurement because the capture period length deviates from its nominal length by more than 1% due to time setting, power failure, unsynchronised energy snapshot or tariff switching. The bit is also set when one of the bits 0, 8, 16, 17, 18, 21, 24 or 25 is set.
Bit 1	Status	**Invalid time:** The power reserve of the calendar clock is exhausted. The time is declared as invalid.
Bit 0	Status	**Fatal error:** A serious error such as a checksum error of the ROM or backup memory has occurred. When this bit is set, bit 2 will also be set.

15.6 Status Code Entries

This section describes which status code is stored in the load profile under certain special conditions.

15.6.1 Season Change

Winter to summer

The example shows a 15-minute profile containing a season change from winter to summer.

Date/time	Bit 23 EOI regular internal	Bit 19 SOI	Bit 3 Season	Status code (hex)
27-03-02 / 01:30	1	0	0	0080 0000
27-03-02 / 01:45	1	0	0	0080 0000
27-03-02 / 02:00	1	0	0	0080 0000
27-03-02 / 03:00	0	1	1	0008 0008
27-03-02 / 03:15	1	0	1	0080 0008
27-03-02 / 03:30	1	0	1	0080 0008

Summer to winter

The example shows a 15-minute profile containing a season change from summer to winter.

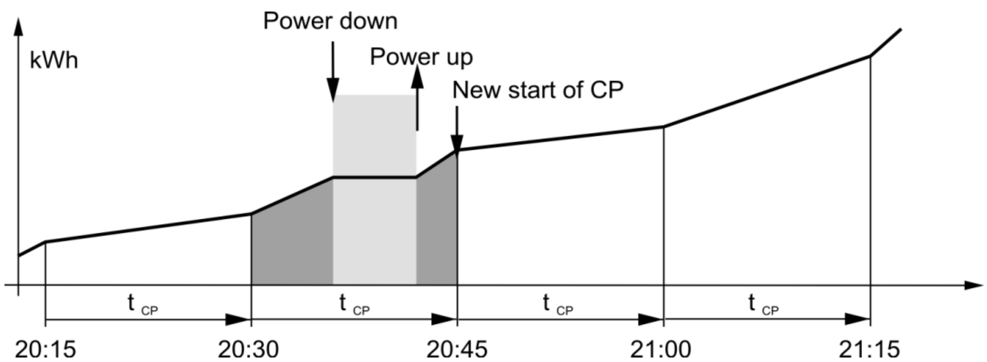
Date/time	Bit 23 EOI regular internal	Bit 19 SOI	Bit 3 Season	Status code (hex)
27-10-02 / 02:30	1	0	1	0080 0008
27-10-02 / 02:45	1	0	1	0080 0008
27-10-02 / 03:00	1	0	1	0080 0008
27-10-02 / 02:00	0	1	0	0008 0000
27-10-02 / 02:15	1	0	0	0008 0000
27-10-02 / 02:30	1	0	0	0008 0000

15.6.2 Power Down

Power down within a capture period

If, after a power down, the voltage is restored within the capture period (CP), the meter continues with the measurement and terminates the capture period normally.

Parameter Setting
With the parameter Period restart after power fail (see section 15.11.1 "Capture Period Control"), the user may select that the capture period is terminated and restarted after a measurement voltage failure.



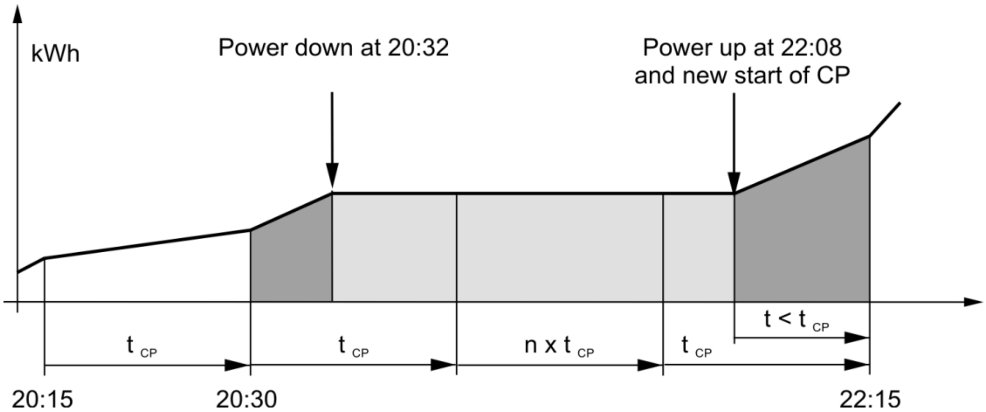
The following example shows a 15-minute profile containing a short power failure that does not span the EOI (from 20:32 to 20:35). The meter is parameterised not to make an entry for every power failure.

Date/time	Bit 23 EOI regular internal	Bit 19 SOI	Bit 7 Power down	Bit 6 Power up	Bit 2 Invalid meas' value	Status code (hex)
02-11-15 / 20:15	1	0	0	0	0	0080 0000
02-11-15 / 20:30	1	0	0	0	0	0080 0000

Date/time	Bit 23 EOI regular internal	Bit 19 SOI	Bit 7 Power down	Bit 6 Power up	Bit 2 Invalid meas' value	Status code (hex)
02-11-15 / 20:45	1	0	1	1	0	0080 00C0
02-11-15 / 21:00	1	0	0	0	0	0080 0000
02-11-15 / 21:15	1	0	0	0	0	0080 0000

Power down beyond a capture period

If, after a power down, the voltage interruption continues beyond the capture period, the currently running capture period is terminated normally. The next capture period starts after the voltage has returned but it is terminated with the next (synchronous) capture period reset. Therefore, it is shorter than a normal period.

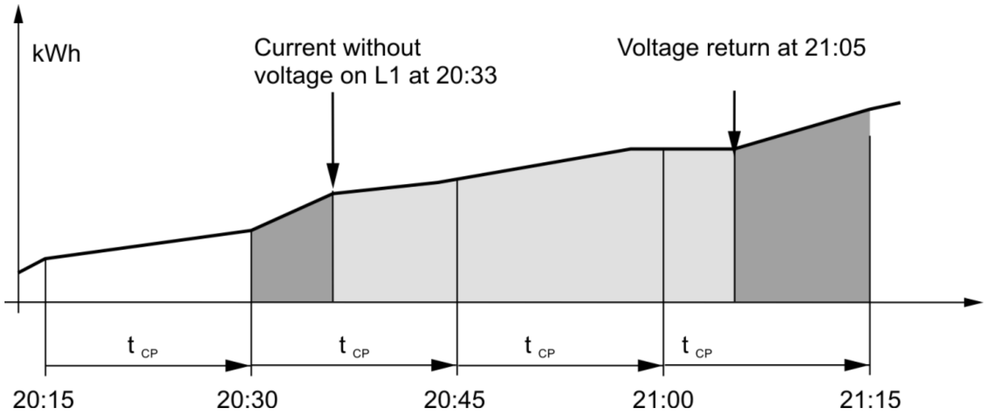


The following example shows a 15-minute profile containing a power down that spans the EOI (from 20:32 to 22:08).

Date/time	Bit 23 EOI regular internal	Bit 19 SOI	Bit 7 Power down	Bit 6 Power down	Bit 2 Invalid meas' value	Status code (hex)
02-11-15 / 20:15	1	0	0	0	0	0080 0000
02-11-15 / 20:30	1	0	0	0	0	0080 0000
02-11-15 / 20:45	0	0	1	0	1	0000 0084
02-11-15 / 21:00	0	1	0	1	0	0008 0040
02-11-15 / 21:15	1	0	0	0	1	0080 0004
02-11-15 / 21:30	1	0	0	0	0	0080 0000
02-11-15 / 21:45	1	0	0	0	0	0080 0000

Current without voltage on phase 1

When current is flowing in an individual phase but no voltage is present at the same time, the fuse of the corresponding voltage transformer must be defective. The affected profile entries are marked accordingly.



The following example shows a 15-minute profile containing a "current without voltage" situation on phase L1 that lasts from 20:33 to 21:05.

Date/time	Bit 24 Current without voltage	Bit 23 EOI regular internal	Bit 19 SOI	Bit 2 Invalid meas' value	Status code (hex)
02-11-15 / 20:15	0	1	0	0	0080 0000
02-11-15 / 20:30	0	1	0	0	0080 0000
02-11-15 / 20:45	1	1	0	1	0180 0040
02-11-15 / 21:00	1	1	0	1	0180 0040
02-11-15 / 21:15	1	1	0	1	0180 0040
02-11-15 / 21:30	0	1	0	0	0080 0000

Bit 24
The bit 24 will only be set in the profile status code if the event has been selected to trigger an event log entry (see also section 16.8.1 "Event Log Entries").

Voltage without current in an individual phase

When voltage is applied but at the same time no current is flowing in an individual phase, the affected profile entries are marked accordingly.

The status code entry will be as described for the "current without voltage" event but bit 25 is set instead of bit 24.

Phase outage

When an individual phase fails the affected profile entries are marked accordingly.

The status code entry will be as described for the "current without voltage" event but bit 16 is set instead of bit 24.

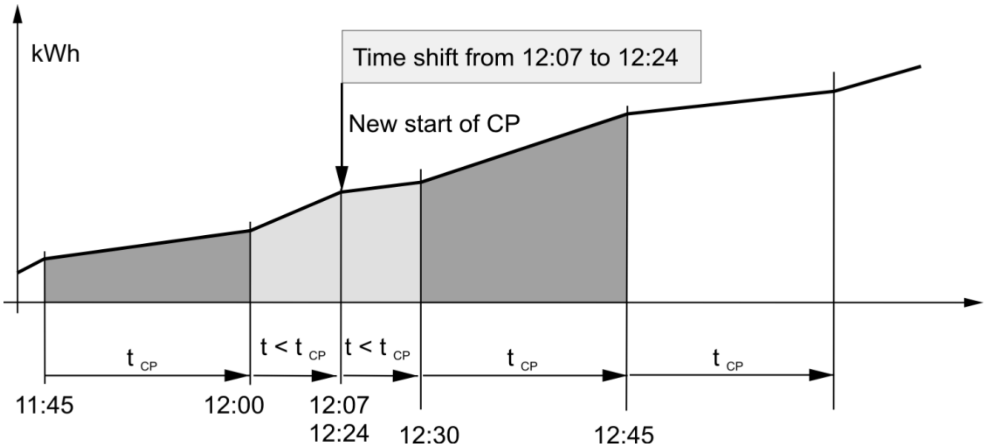
15.6.3 Setting Time/Date

Two profiles
If two profiles are used, the same rules also apply to Profile 2.

Advancing the time

A forward time shift would cause the capture period (CP) to become too short. It is therefore necessary to restart the capture period and to trigger a profile entry after a time shift.

If the time shift, however, is smaller than 2 to 9 seconds (depending on parameter setting) no new start is triggered.



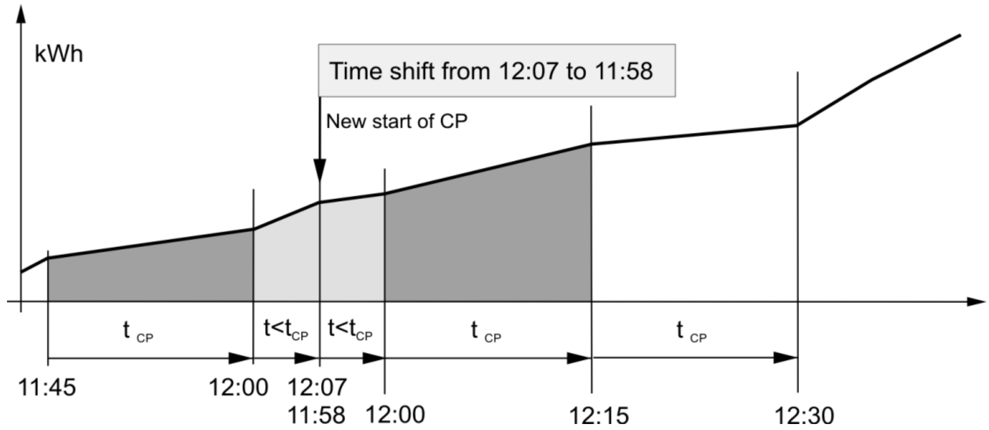
The following example shows a 15-minute profile where the time is adjusted from 12:07 to 12:24.

Date/time	Bit 23 EOI regular interval	Bit 19 SOI	Bit 15 Status before last adjust-ment of clock	Bit 5 Clock adjusted	Bit 2 Invalid meas' value	Status code (hex)
02-11-15 / 11:45	1	0	0	0	0	0080 0000
02-11-15 / 12:00	1	0	0	0	0	0080 0000
02-11-15 / 12:07	0	0	1	0	1	0000 8004
02-11-15 / 12:24	0	1	0	1	0	0008 0020
02-11-15 / 12:30	1	0	0	0	1	0080 0004
02-11-15 / 12:45	1	0	0	0	0	0080 0000

Setting back the time

A backward time shift would cause the capture period (CP) to become too long. It is therefore necessary to restart the capture period and to trigger a profile entry after a time shift.

If the time shift, however, is smaller than 2 to 9 seconds (depending on parameter setting) no new start is triggered.



The following example shows a 15-minute profile where the time is adjusted from 12:07 to 11:58.

Date/time	Bit 23 EOI regular interval	Bit 19 SOI	Bit 15 Status before last adjust-ment of clock	Bit 5 Clock adjusted	Bit 2 Invalid meas' value	Status code (hex)
02-11-15 / 11:45	1	0	0	0	0	0080 0000
02-11-15 / 12:00	1	0	0	0	0	0080 0000
02-11-15 / 11:58	0	0	1	0	1	0008 0020
02-11-15 / 12:00	1	0	0	0	1	0080 0004
02-11-15 / 12:15	1	0	0	0	0	0080 0000
02-11-15 / 12:30	1	0	0	0	0	0080 0000

When setting back the time it is possible that there are two entries with the same time stamp.

Clearing the profile
Several profile entries with identical time stamps cannot be handled properly.
Therefore, it is highly recommended to backup the data and to clear the profile after setting back the time.

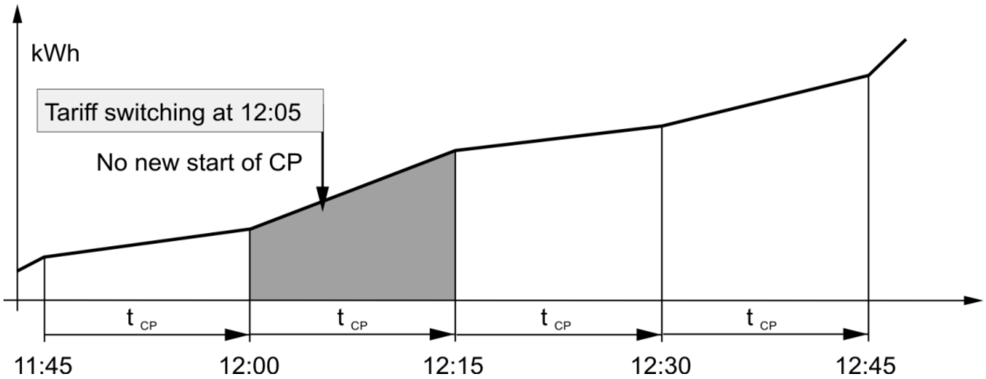
Synchronising the time

Synchronising the time has the same effect on the status code as setting the time, i.e. the effect only depends on the detected deviation (see also section 4.2 "Adjustment of the Calendar Clock").

15.6.4 Changing Energy Tariff

Synchronous tariff switching

The meter delays the tariff switching internally to the end of the current capture period. This means that the current capture period is terminated normally and no extra entries are made to the profile.



The following example shows a 15-minute profile where a tariff switching occurs at 12:05. The meter is parameterised to synchronise to the next end of the capture period EOI.

Date/time	Bit 23 EOI regular internal	Bit 20 EOI tariff switching	Bit 2 Invalid meas' value	Status code (hex)
02-11-15 / 11:45	1	0	0	0080 0000
02-11-15 / 12:00	1	0	0	0080 0000
02-11-15 / 12:15	1	1	0	0090 0000
02-11-15 / 12:30	1	0	0	0080 0000
02-11-15 / 12:45	1	0	0	0080 0000
02-11-15 / 13:00	1	0	0	0080 0000

15.6.5 Midnight Time Stamp

The following example shows the entries of a 15-minute profile around midnight.

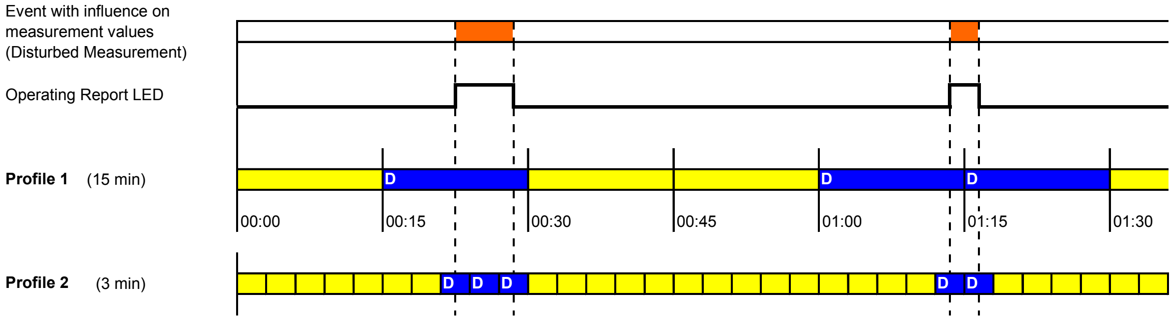
Date/time	Bit 23 EOI regular internal	Bit 19 SOI	Status code (hex)
02-11-15 / 23:30	1	0	0080 0000
02-11-15 / 23:45	1	0	0080 0000
02-11-16 / 00:00	1	0	0080 0000
02-11-16 / 00:00	0	1	0008 0000
02-11-16 / 00:15	1	0	0080 0000
02-11-16 / 00:30	1	0	0080 0000

15.6.6 Two profiles: Invalid values handling

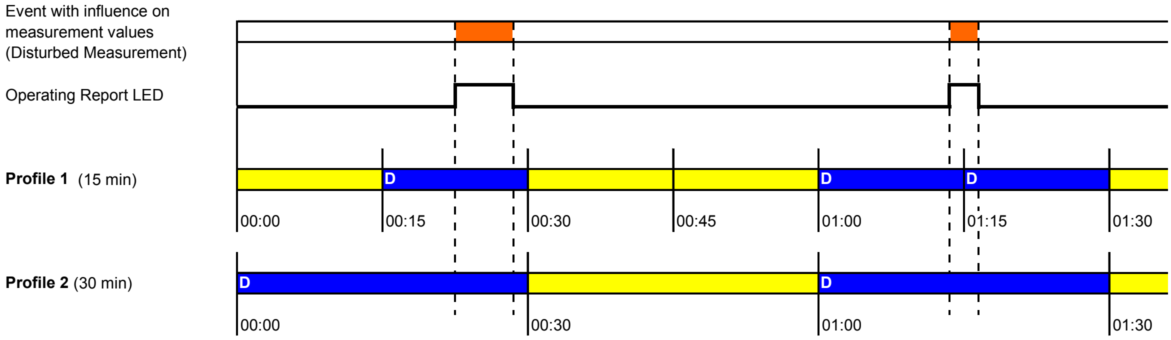
Special attention must be paid to the handling of invalid values, i.e. "Disturbed values" as well as to the "EOI" & "SOI", since they are capture period dependant. In the following examples, the profile entries with invalid data are dark (blue) and marked with "D" (Disturbed values). "EOI" & "SOI" events are different for the 1st and 2nd profile.

Single phase outage

1. Capture period of profile 2 is smaller than the capture period of profile 1

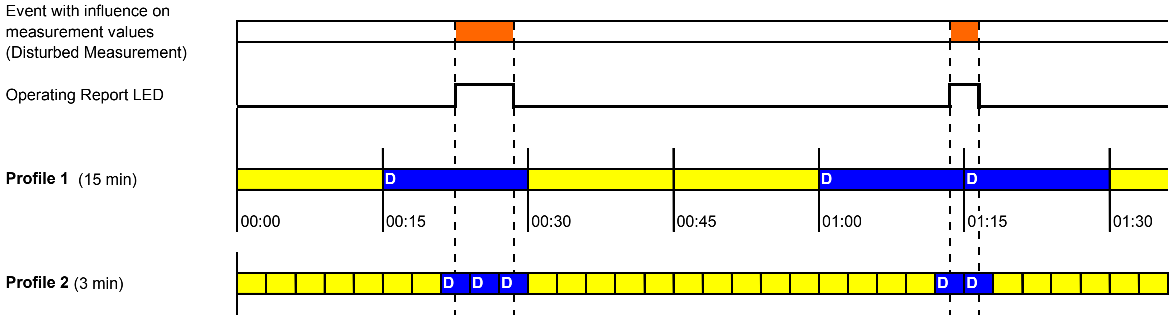


2. Capture period of profile 2 is longer than the capture period of profile 1

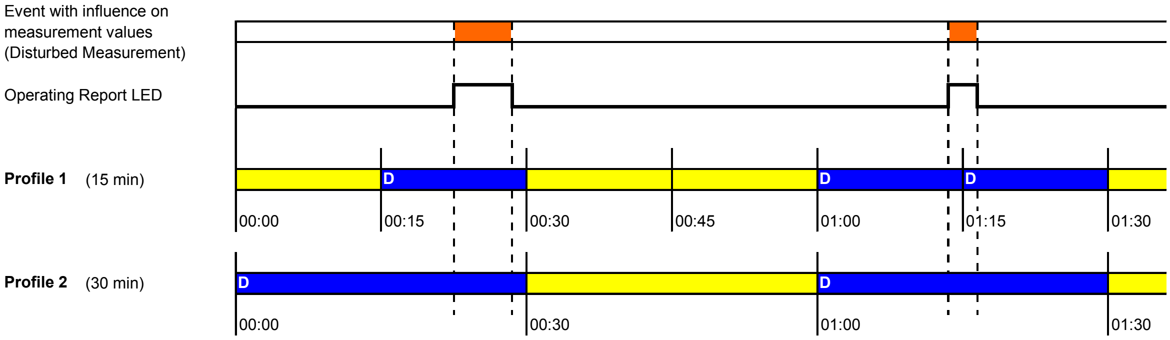


Current without voltage

1. Capture period of profile 2 is smaller than the capture period of profile 1

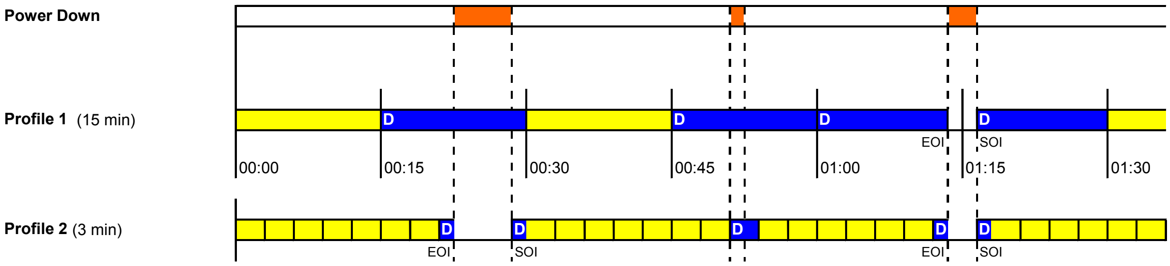


2. Capture period of profile 2 is longer than the capture period of profile 1

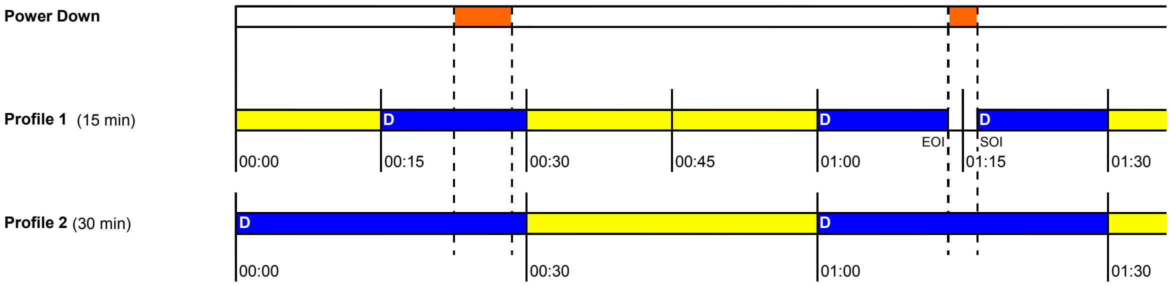


Power down without restart of capture period

1. Capture period of profile 2 is smaller than the capture period of profile 1

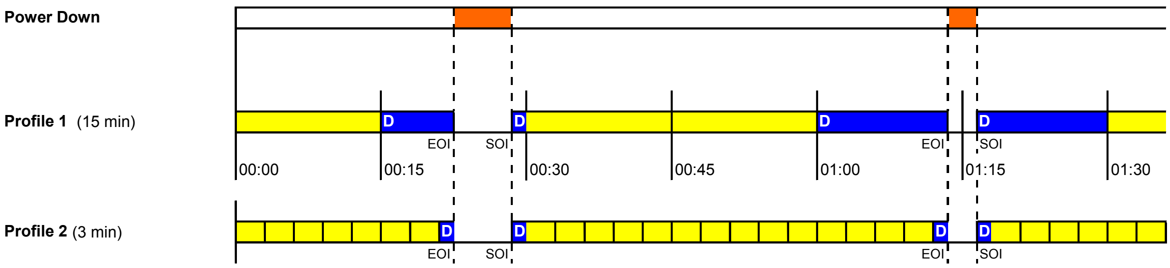


2. Capture period of profile 2 is longer than the capture period of profile 1

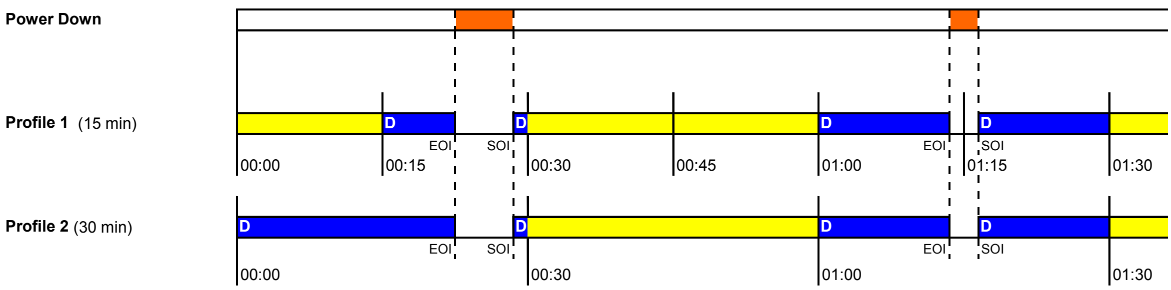


Power down with restart of capture period

1. Capture period of profile 2 is smaller than the capture period of profile 1

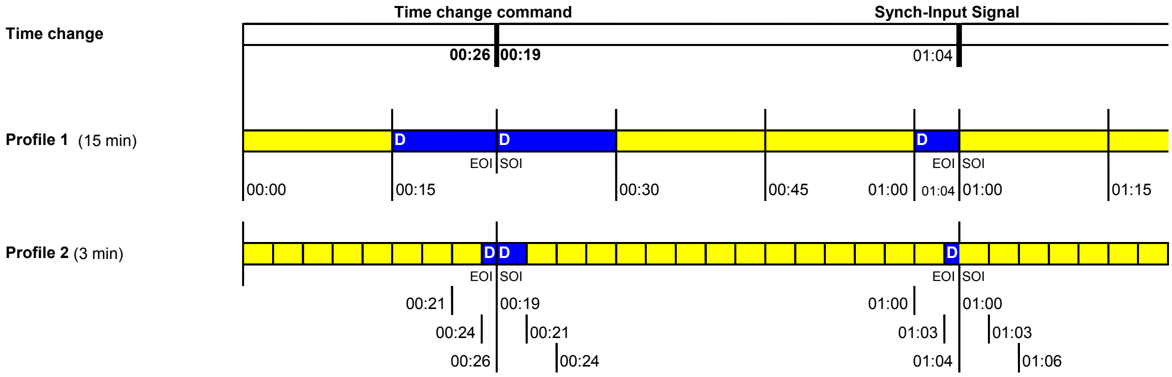


2. Capture period of profile 2 is longer than the capture period of profile 1

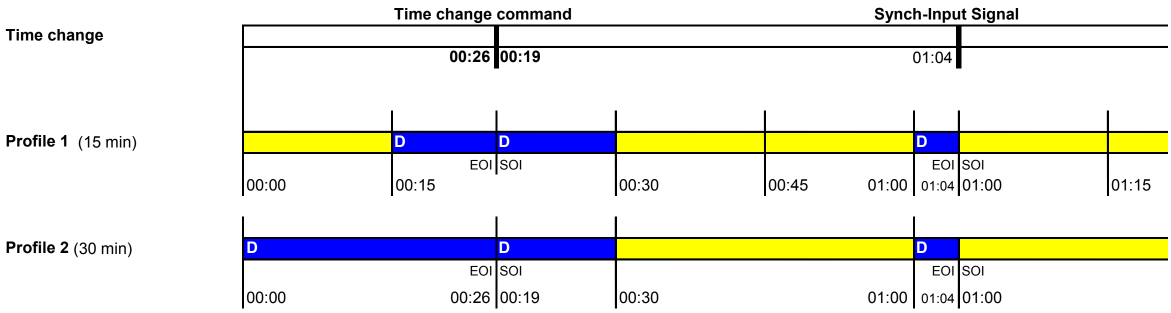


Time change backward

1. Capture period of profile 2 is smaller than the capture period of profile 1

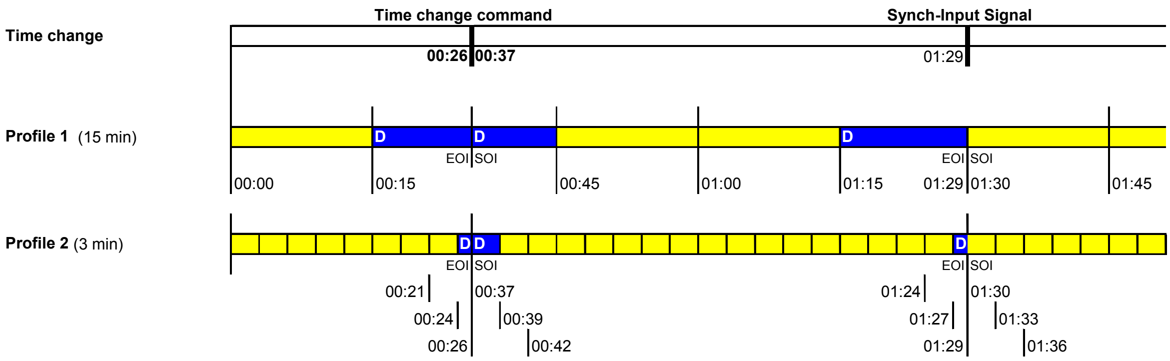


2. Capture period of profile 2 is longer than the capture period of profile 1

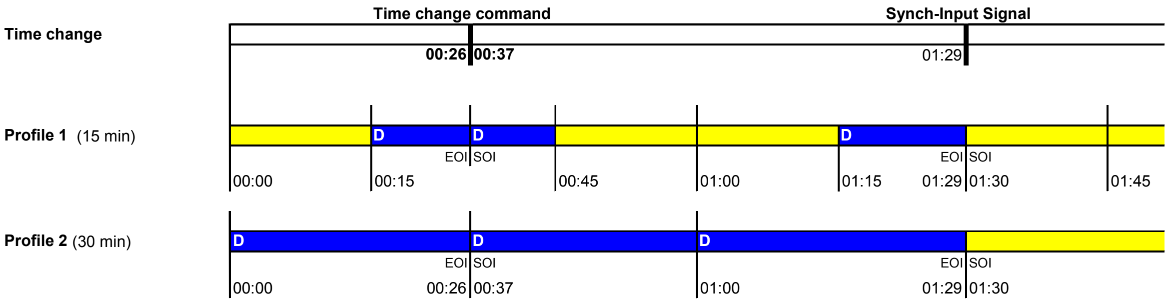


Time change forward

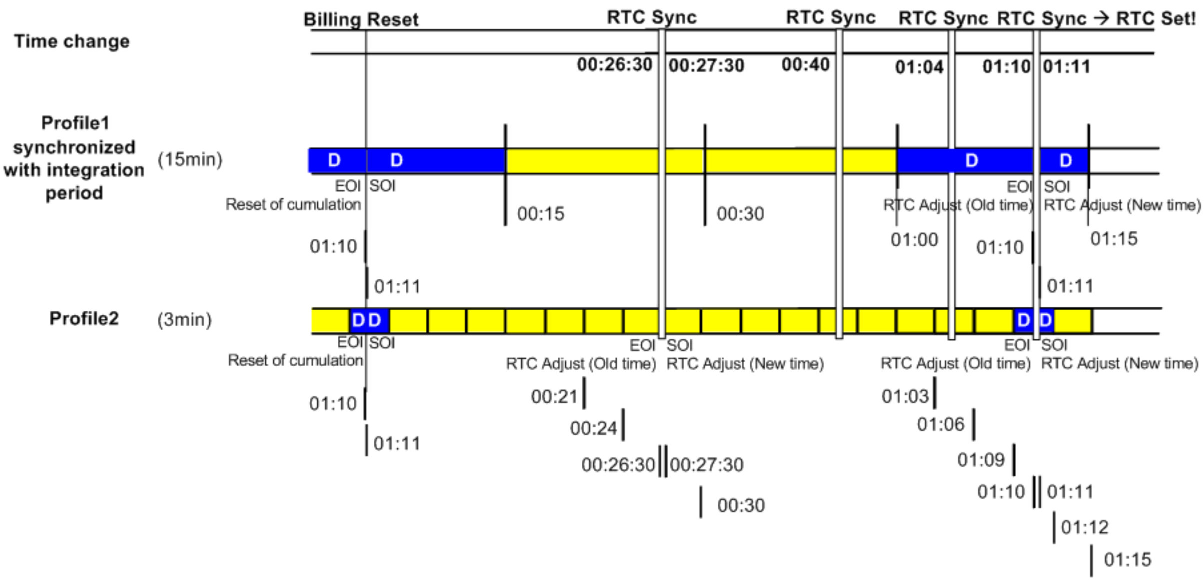
1. Capture period of profile 2 is smaller than the capture period of profile 1

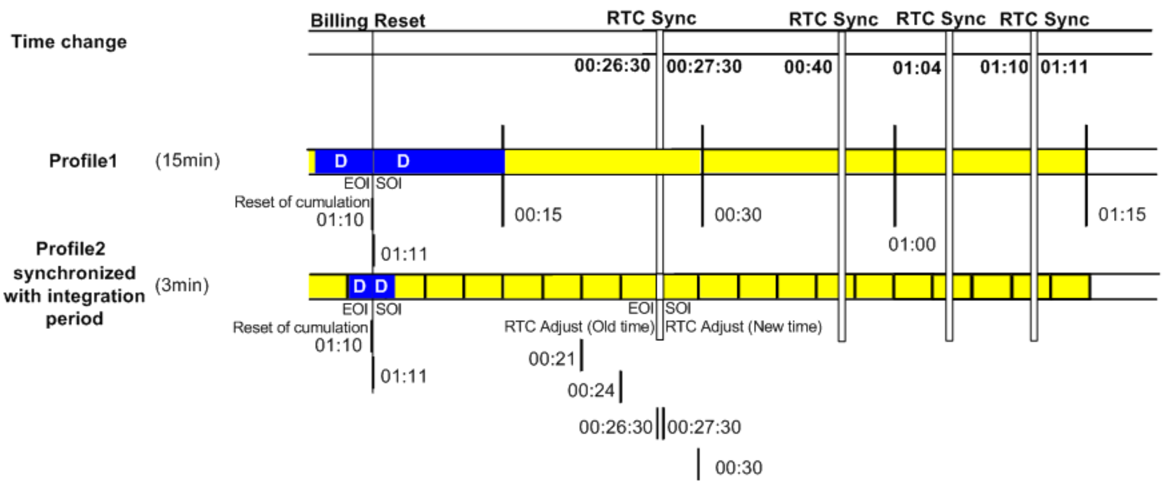


2. Capture period of profile 2 is longer than the capture period of profile 1



Time change and billing reset with regard to integration period synch





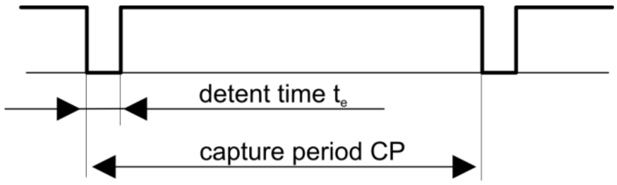
15.7 Capture Period Output

Capture period

The duration of the capture period tm1 can be transmitted to external equipment via a transmitting contact of the meter. Please note that capture period tm2 cannot be transmitted via an output contact.

The contact is closed during the capture period. At the beginning of the capture period, the contact is opened during 1 % of the capture period (detent time t_e), i.e. 9 seconds with a capture period of 15 minutes.

In order to signal the duration of the capture period, a transmitting contact must be defined as static output and "capture period output" must be selected as output control signal (see section 3.4.2 "Static Output").



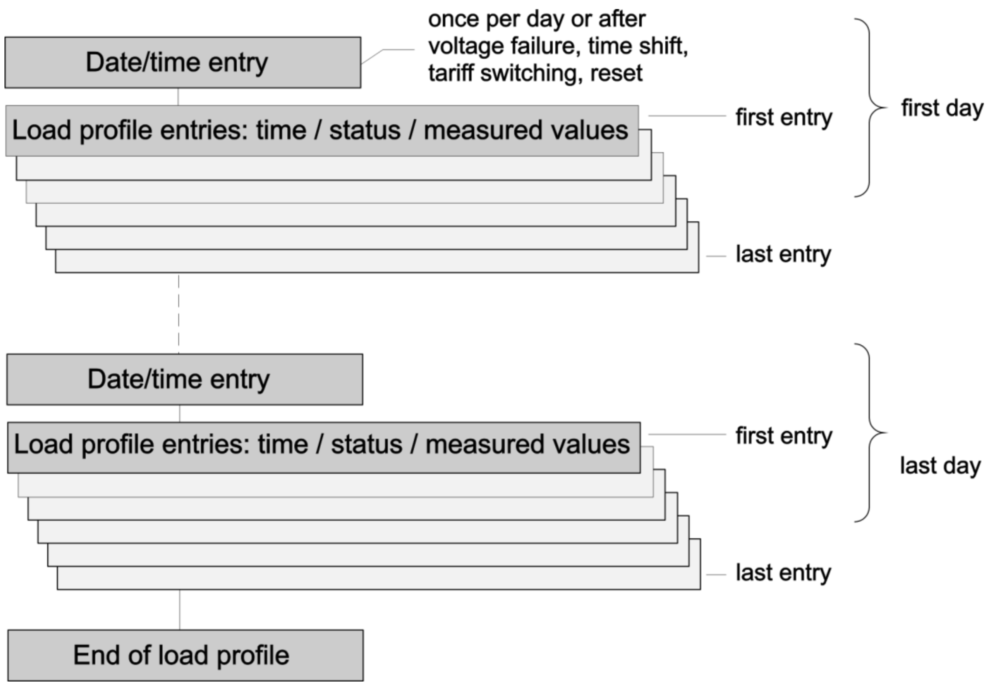
Inverted signal

The output signal for the capture period can be inverted so that the contact is open during the capture period and closed to signal the end of the capture period (see section 3.4.2 "Static Output").

15.8 Display

15.8.1 Structure of Display

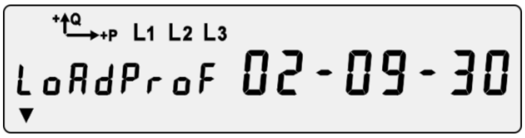
Profile 1 may be viewed in the operating menu. The following information can be retrieved:



Only profile 1 on display
The optional profile 2 cannot be shown on the meter's display.

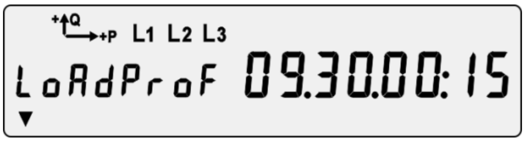
15.8.2 Display Examples

Date of entry



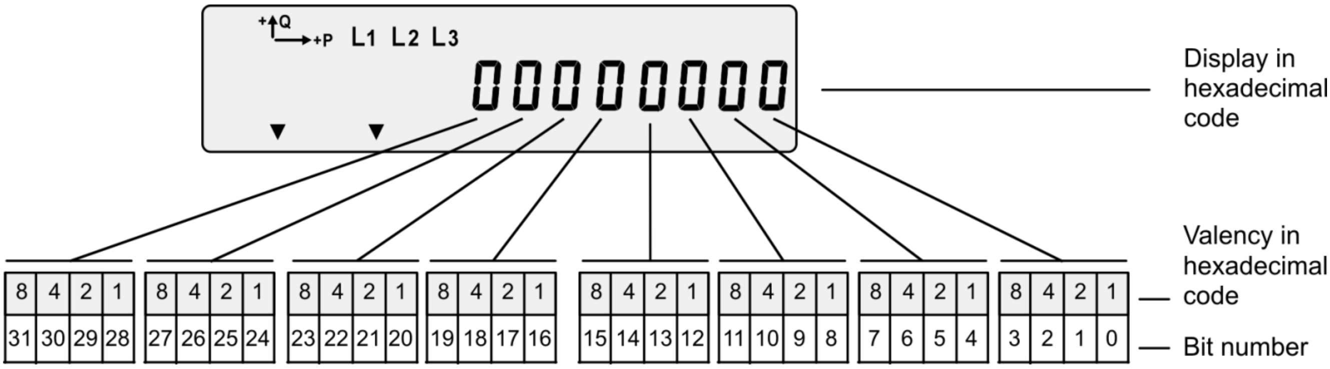
Example:
30. September 2002
(Year, month, day)

Time of entry



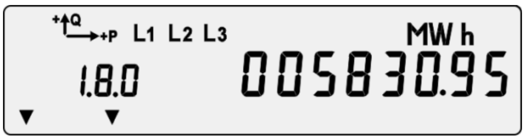
Example:
30. September, 00:15h
(Month, day, hour, minute)

Status code



Each figure can have a value between 0 (no bit set) and F (all four bits set).

Measured values



Example:
Active energy import +A

15.9 Communication

The data of the profiles can be read via communication. The customer may read entire profiles or parts of it. An IEC readout is not possible.

The format of the profile data in display and in communication is identical.

15.9.1 Profile Readout

The customer can either read entire profiles or only parts of it.

dlms parameterised access

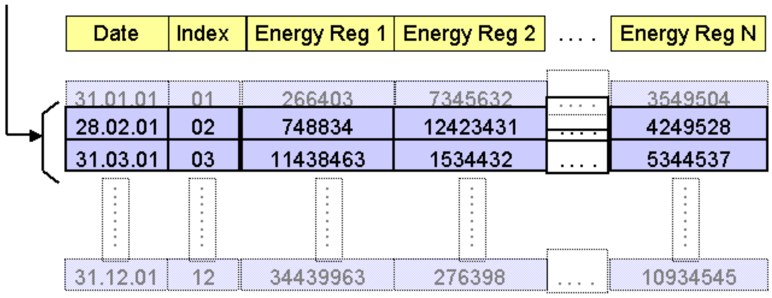
When only parts of a profile are to be read, the customer selects whether only certain rows or certain columns are read or a combination of both. Rows and columns can be selected using the dlms parameterised access.

Date selection (row selection)

To read profile entries within a specific period, enter the start date from where the data is read and the end date until which the data is read.

The meter then searches the start date beginning at the oldest entry of the profile. Once the start date is found the meter looks for the end date beginning at the most recent entry of the profile.

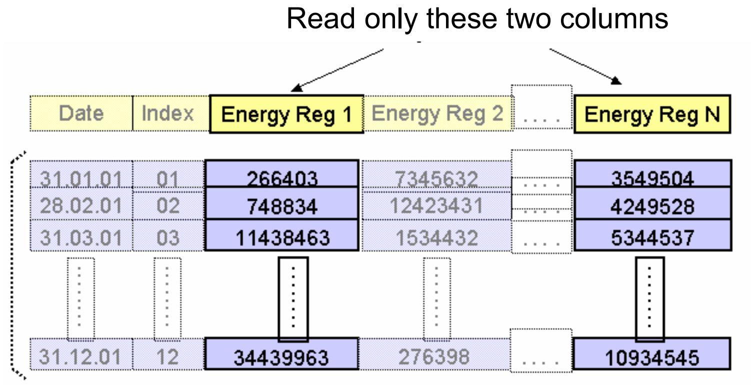
Read from 15.02.01 to 04.04.01



Special attention must be paid if the profile contains entries where the time has been set back, e.g. due to time-setting or an exhausted power reserve.

Register selection (column selection)

To read only certain registers of the profile entries (column selection) define which registers are to be read.



15.10 Resetting the Profile Data

Resetting the profile data is only possible in accordance with national laws and/or regulations.

Profile data can be reset automatically as well as manually. The DNV flag is set in the first entry after the reset as the length of the period is shorter than the capture period.

Automatic reset

An automatic reset is performed as soon as the profile data structure is modified (e.g. the number of captured objects, length of the capture period, etc.) by writing to the capture period or capture object list.

Save profile data in case of structure changes
Read out the profile data before you modify the profile structure as the data are lost.

Manual reset

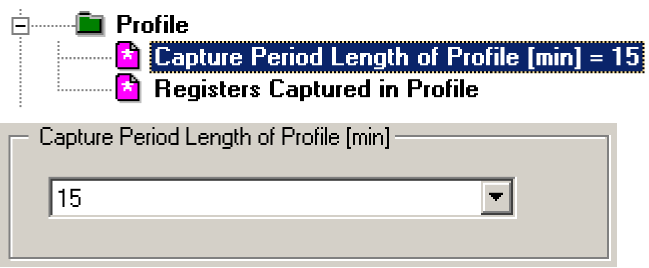
A manual reset of a profile object during normal operation can be done via communication by invoking the reset method in MAP110 and MAP120. For this, the appropriate security level needs to be used. This reset is only possible for a specific profile, i.e. if all profiles need to be deleted, the reset method has to be used for each profile (also for stored values etc.).

Backward time shift
Landis+Gyr strongly recommends resetting the profile after a backward time shift.

15.11 Profile Parameters

15.11.1 Capture Period Control

Capture Period



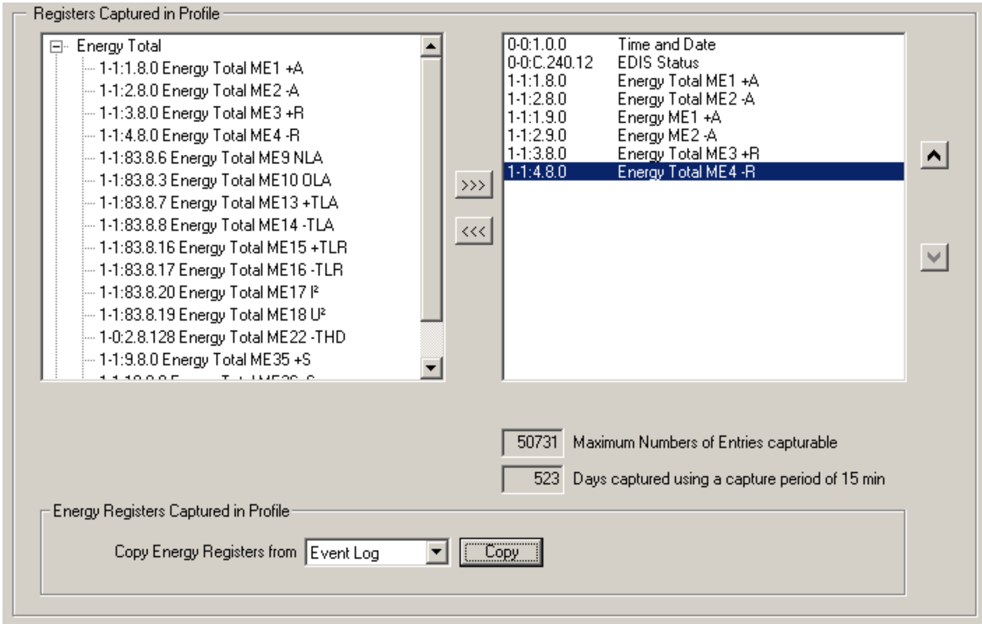
The following capture periods are possible:
1 min, 3 min, 5 min, 10 min, 15 min, 30 min and 60 min.

Integration period determines Capture Period Length setting
If the parameter "End of integration period triggers..." in Integration Period Control is set to a particular profile, this profile's Capture Period Length is set to the integration period and cannot be changed in the Profile window (shaded out).

15.11.2 Registers Captured in the Profile

Select which registers are stored in the profile at the end of a capture period.

1. Click the energy register you wish to add to the profile.
2. Click **>>>** to add it.



Only registers which have been activated in the software configuration and selected under 2.14.5 "Measured Quantities" can be captured in the profile.

Energy Registers Captured in Profile

You may also capture the same registers in the profile as in the stored billing value profile or as in the event log. To do so, do the following:

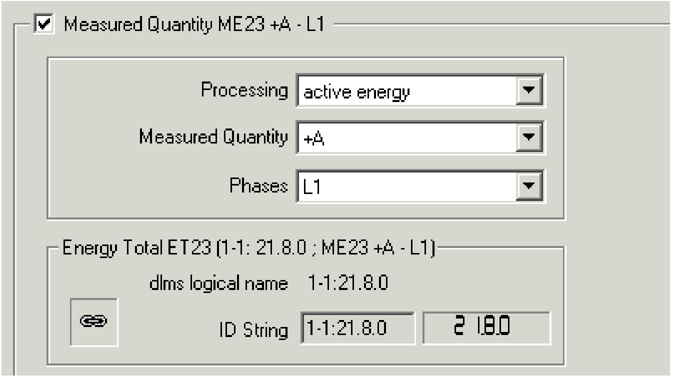
1. Select whether you want to add the same registers as in the stored billing value profile **or** as in the event log.
2. Click **Copy** to copy the registers.

Profile depth
The profile depth (the number of days captured in the profile) depends on the capture period length and the number of registers captured in the profile.
A minimum of 100 days is guaranteed with 36 captured registers and a capture period of 15 minutes.

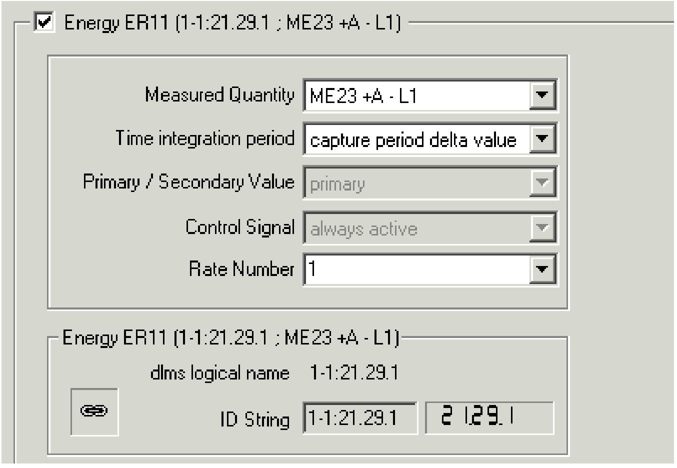
15.11.3 Setting up the Profile for Delta Values

If you intend to store registers for energy advance (capture period delta values) to the profile do the following:

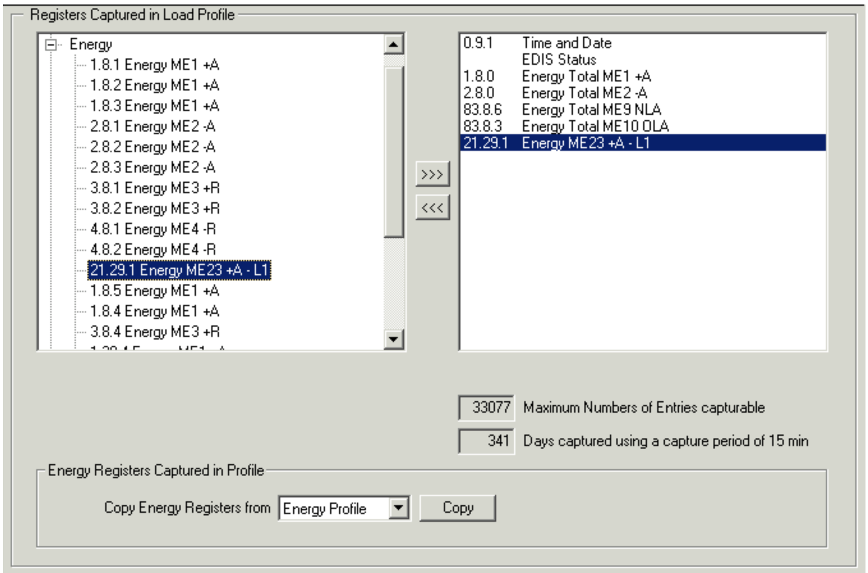
1. Define the required measured quantity (see section 2.14.7 "Defining a Measured Quantity").



2. Define a rated energy register. Select the above measured quantity and set the parameter Time integration period to capture period delta value (see section 8.6.1 "Energy Register Definition").



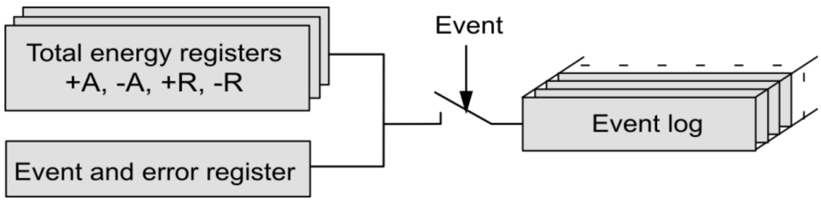
3. Select the above energy register to be captured in the profile (see section 15.11.2 "Registers Captured in the Profile").



16 Event Log

16.1 Overview

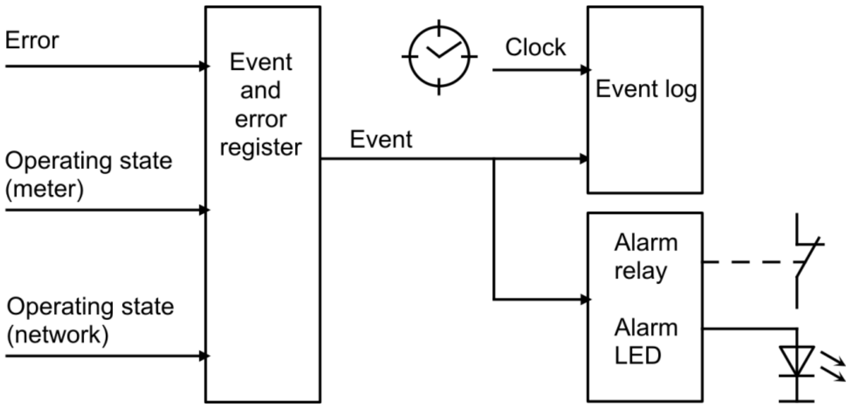
The event log is an aperiodic memory in which irregular events are captured that may occur in the meter or in the network the meter is connected to.



16.2 Characteristics

All events are collected in the event and alarm register of the meter. From this register, event log entries are triggered. Each entry consists of a time stamp, an event number which describes the event and the current status of the four most important energy registers.

Depending on the severity of the event it may also trigger an alarm or an operational indication.



The event log entries can be displayed and read via communication.

16.3 Structure of an Event Log Entry

Each event log entry consists of the following data:

Date/time	Event number	Register +A	Register -A	Register +R	Register -R
02-09-01 01:32:07	18	0052813.1	0023621.2	0019234.2	0016458.7
02-09-30 16:00:17	18	0052856.9	0023666.8	0019268.5	0016472.6
02-10-27 08:50:42	9	0052895.3	0023699.7	0019283.4	0016484.2
…	…	…	…	…	…

A maximum of 256 entries with the above structure can be stored to the event log. The oldest entry will always be overwritten by the most recent one (circular buffer).

The most recent entry appears first in the event log (on display and in the communication protocol).

If quadrant splitting is activated (see section 1.3 "Software Configuration Parameters") only the energy registers +A and -A are stored to the event log.

Event number

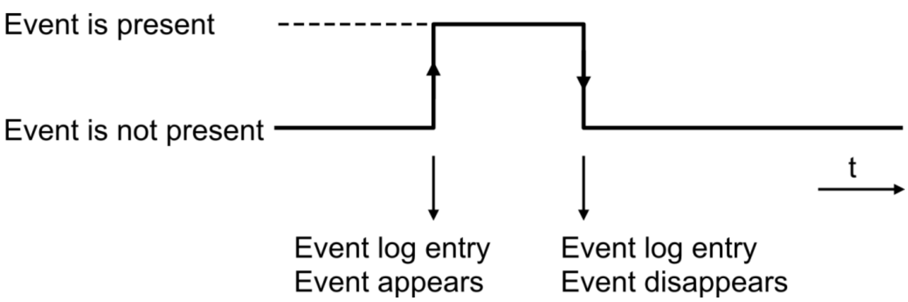
The event number describes the event that has occurred. For details see section 16.4.3 "Event and Error Register".

16.4 Triggers

16.4.1 Appearance and Disappearance of Events

Some events trigger an event log entry when they appear and/or when they disappear.

- When an event **appears** (occurs) the relevant bit in the event and alarm register is set and the status change of the bit triggers the event log entry "Event appears".
- When an event **disappears** (vanishes) the relevant bit in the event and alarm register is cleared. The status change of the bit triggers an event log entry "Event disappears".



The user may select which events (i.e. the change of which bits) trigger an event log entry upon appearance and which events trigger an event log entry upon disappearance.

Activation delay
The activation delay for the event log entries is set separately from the activation delay of the relays. Default value is 3 seconds.

16.4.2 Error Types

Depending on the severity of the event it may cause the meter to stop (fatal error) or it may trigger an alarm or an operational indication. See also section 19.3 "Degree of severity of errors".

Error type	Display	Alarm LED	Alarm contact	Event log entry
Fatal error	FF and error code (replaces the operating display)	Off	Closed (OK = contact open)	Not possible
Alarm	FF and error code	On	Closed (for 1..9 s or until the alarm is cleared, depending on parameterisation)	Yes, if activated by parameter setting.
Operational indication	FF and error code in rolling display (with some operational indications)	Blinking (if activated by parameter setting)	Closed, while the event is present (if activated by parameterisation)	Yes, if activated by parameter setting.

Fatal error

A fatal error causes the meter to stop and the corresponding error message appears in the display instead of the normal operating display. The meter will not operate any longer and must be replaced. As fatal errors occur during start-up the alarm LED cannot be lit. The alarm contact remains closed due to the start-up sequence not being completed. Fatal errors cannot be stored in the event log because the meter is not functioning any longer.

Alarm

The alarm LED is lit and the alarm contact is closed according to parameterisation (see also section 16.8.2 "Displaying Alarms and Operational Indications"). An event log entry is only made if the corresponding alarm is selected to trigger an entry.

Operational indication

The alarm LED flashes and the alarm contact is closed for as long as the event persists. Which of the events actually activate the alarm LED and the alarm contact can be selected (see also section 16.8.2 "Displaying Alarms and Operational Indications"). An event log entry is only made if the corresponding operational indication is selected to trigger an entry.

16.4.3 Event and Error Register

Each event is given a number. If the corresponding event occurs (or disappears) and the event is selected to trigger an entry in the event log, the event is added to the event log.

The table below lists all events that can be selected to trigger an event log entry.

Some events may never occur
The event log is capable of capturing all listed events. Depending on the software configuration of the meter, some events may never occur.

Trigger

The symbol in the trigger column indicates that an event log entry can be made when the event appears.

The symbol in the trigger column indicates that an event log entry can be made when the event appears and disappears. The event number is the same when the event appears and when it disappears.

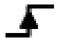
The user may select which of these events trigger an event log entry upon appearance and disappearance.

Error type

In the "Error Type" column it is indicated whether the event triggers an operational indication, an alarm or even a fatal error (see also section 16.4.2 "Error Types").

Where the column "Error Type" is left empty neither the alarm LED nor the alarm contact can be activated by parameter setting.

No.	Name	Description	Trigger	Error Type
1	Parameterisation changed	Indicates that the primary adaptation parameters or the output pulse value of the transmitting contacts or the register resolution have been changed.		
2	Tariff registers cleared	Indicates that the energy tariff registers were cleared.		
3	Profile 1 and/or energy profile cleared	Indicates that profile 1 and/or the energy profile was cleared.		
4	Event log cleared	Indicates that the event log was cleared.		
5	Battery low	Indicates that the battery voltage dropped to a level below a set threshold.		Operational indication
7	Battery ok	Indicates that the battery voltage returned to a level above a set threshold.		
8	Billing period reset	Indicates that the billing period has been reset.		
9	Daylight saving time enabled or disabled	Indicates the change from and to daylight saving time. The time stamp shows the time before the changeover.		
10	Clock adjusted (old date/time)	Indicates that the date/time has been adjusted. The time that is stored in the event log is the old time before adjusting the time.		
11	Clock adjusted (new date/time)	Indicates that the date/time has been adjusted. The time that is stored in the event log is the new time after adjusting the time.		
17	Undervoltage L1	Indicates that an undervoltage on phase 1 occurred. If a phase failure (event no. 125) occurs within one second, this event is suppressed.		
18	Undervoltage L2	Indicates that an undervoltage on phase 2 occurred. If a phase failure (event no. 126) occurs within one second, this event is suppressed.		
19	Undervoltage L3	Indicates that an undervoltage on phase 3 occurred. If a phase failure (event no. 127) occurs within one second, this event is suppressed.		
20	Overvoltage L1	Indicates that an overvoltage on phase 1 occurred.		

No.	Name	Description	Trigger	Error Type
21	Overvoltage L2	Indicates that an overvoltage on phase 2 occurred.		
22	Overvoltage L3	Indicates that an overvoltage on phase 3 occurred.		
23	Power down	Measurement and supply voltage U_S have failed.		
24	Power up	Measurement and supply voltage U_S have returned.		
25	Overcurrent L1	Indicates that an overcurrent on phase 1 has occurred.		
26	Overcurrent L2	Indicates that an overcurrent on phase 2 has occurred.		
27	Overcurrent L3	Indicates that an overcurrent on phase 3 has occurred.		
43	EOI Rate Switching	Rate switching at end of integration period (clears itself after capturing).		
44	Corrupt measure-ment	The length of the measurement period is incorrect. Normally this means the period is too short (clears the event itself after capturing).		
45	Clearing of Error Register	Make an event log entry to indicate that some error bits were cleared (clears the event itself after cap-turing).		
47	Bypass feeder operation	Indicates that the meter is in the bypass feeder operation mode.		
55	Current without voltage L1	Indicates that the current I1 is above the minimum threshold of 1% I_n while the voltage U1 is below 45% U_n. If the event occurs on all three phases si-multaneously, i.e. within 600 ms, the bit will not be set.		Opera-tional indication
56	Current without voltage L2	Indicates that the current I2 is above the minimum threshold of 1% I_n while the voltage U2 is below 45% U_n. If the event occurs on all three phases si-multaneously, i.e. within 600 ms, the bit will not be set.		Opera-tional indication
57	Current without voltage L3	Indicates that the current I3 is above the minimum threshold of 1% I_n while the voltage U3 is below 45% U_n. If the event occurs on all three phases si-multaneously, i.e. within 600 ms, the bit will not be set.		Opera-tional indication
58	Missing additional power supply	Indicates that the additional power supply is miss-ing.		Opera-tional indication
61	Active power too high	Indicates that the active power is above the set threshold.		Opera-tional indication
62	Reactive power too high	Indicates that the reactive power is above the set threshold.		Opera-tional indication

No.	Name	Description	Trigger	Error Type
66	Date/time invalid	FF 02000000 (see section 19.4.1 "Time-Base Errors (Clock)"		Opera-tional indication
73	Main Memory (RAM)	Internal RAM check fails at startup.		Fatal
75	Measuring system access error	FF 00040000 (see section 19.4.2 "Read/Write Access Errors")		
76	Time base error (CTS)	FF 00080000 (see section 19.4.2 "Read/Write Access Errors")		
77	Data profile mem-ory error (FLASH)	FF 00100000 (see section 19.4.2 "Read/Write Access Errors")		Alarm
79	Communication unit error	FF 00400000 (see section 19.4.2 "Read/Write Access Errors")		Opera-tional indication
82	Backup data checksum error (EEPROM)	FF 00000200 (see section 19.4.3 "Checksum Errors")		Alarm
83	Parameter data checksum error (FLASH)	FF 00000400 (see section 19.4.3 "Checksum Errors")		Critical Error / Alarm
84	Load profile data checksum error (FLASH)	FF 00000800 (see section 19.4.3 "Checksum Errors")		
85	Internal Profile Data	Checksum of Internal Profile Data failed		Alarm
87	Calibration Data	Checksum of Calibration Data failed		Alarm
88	2nd Profile	Checksum of 2nd profile failed		
89	Start-up sequence invalid	FF 00000001 (see section 19.4.4 "Other Errors")		
93	General system error	FF 00000010 (see section 19.4.4 "Other Errors")		
94	Communication locked (wrong PW)	Indicates illegal communication access (wrong password used repeatedly)		Opera-tional indication
108	All-phase outage	Indicates that all phase voltages are below 45% U_n (C.7: below 70%, value parametrisable) and all phase currents are below 2% I_n.		
109	Missing measure-ment current on all phases	An event entry is triggered if the current on all phases drops below a parameterised threshold within a defined time window.		
110	Undervoltage on all phases	Undervoltage occurred on all phases. In the event of an all-phase failure (event no. 108), the bit will not be set.		

No.	Name	Description	Trigger	Error Type
124	Compensation values changed	Indicates that either an error correction of the current or voltage transformers or a costumer magnitude adjustment has been performed.		
125	Single-phase outage L1	Phase voltage U1 is < 45% U_n and the phase current I1 is < 2% I_n. If the event occurs on all three phases simultaneously, i.e. within 600 ms, the bit will not be set.		Operational indication
126	Single-phase outage L2	Phase voltage U2 is < 45% U_n and the phase current I2 is < 2% I_n. If the event occurs on all three phases simultaneously, i.e. within 600 ms, the bit will not be set.		Operational indication
127	Single-phase outage L3	Phase voltage U3 is < 45% U_n and the phase current I3 is < 2% I_n. If the event occurs on all three phases simultaneously, i.e. within 600 ms, the bit will not be set.		Operational indication
128	Energy register cleared	Some or all energy registers were cleared.		
132	I without U on all phases	An event entry is triggered if the voltage on all phases drops below a parameterised threshold value within a defined time window.		
159	Clearing of profile 1 or energy values profile	Clearing of profile 1 or energy values profile (clears the event itself after capturing).		
189	Active power too high disappears	C.7: Linked to event 61		
190	Reactive power too high disappears	C.7: Linked to event 62		
191	Average voltage high	C.7 only: Average voltage higher than set threshold		
192	Average voltage low	C.7 only: Average voltage lower than set threshold		
193	Clearing of profile 2	Clearing of profile 2		
195	Current unbalanced	When the difference between the min. and max. current value of i1-3 is more than e.g. 30% (parametrisable) in normal conditions (UL1-3>45%)		
196	Voltage unbalanced	When the difference between the min. and max. voltage value is more than e.g. 20% (parametrisable) and the activation delay of e.g. 10 seconds (parametrisable) has elapsed.		
197	Frequency high	When the network frequency rises above e.g. 102% of f_n.		
198	Frequency low	When the network frequency falls below e.g. 98% of f_n.		

Frequency supervision is **not recommended** in European UCTE countries.

16.5 Setting Events and Triggering Operational Indications

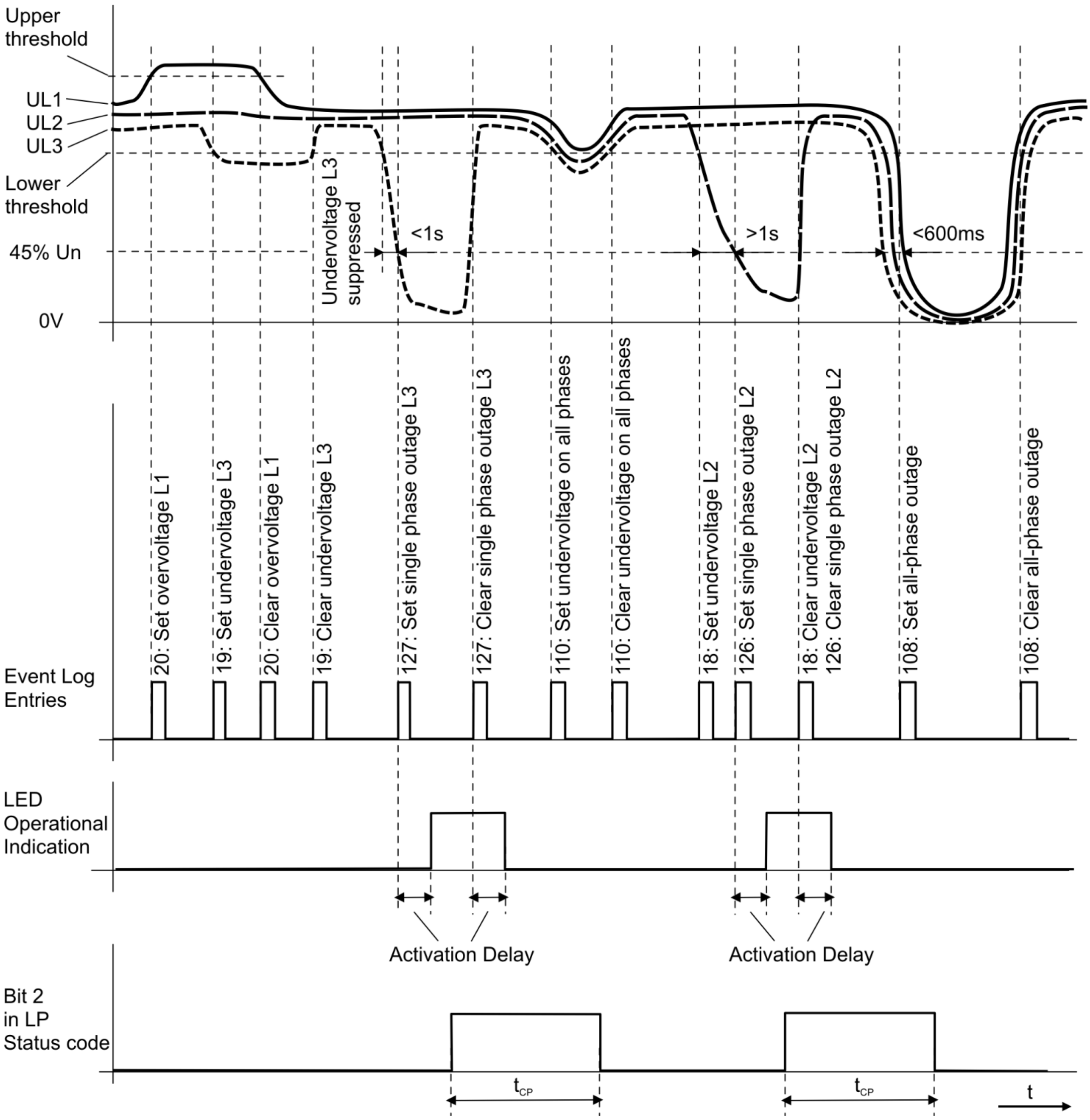
The following graphics illustrate how the meter sets events and triggers operational indications after specific incidents occurred.

16.5.1 Overvoltage, Undervoltage, Phase Outages

In this example, the meter is parameterised to make an event log entry upon appearance and disappearance of the events.

All events are set and cleared with a delay of 600 ms.

The default value for the activation delay of operational indications is 14 s.



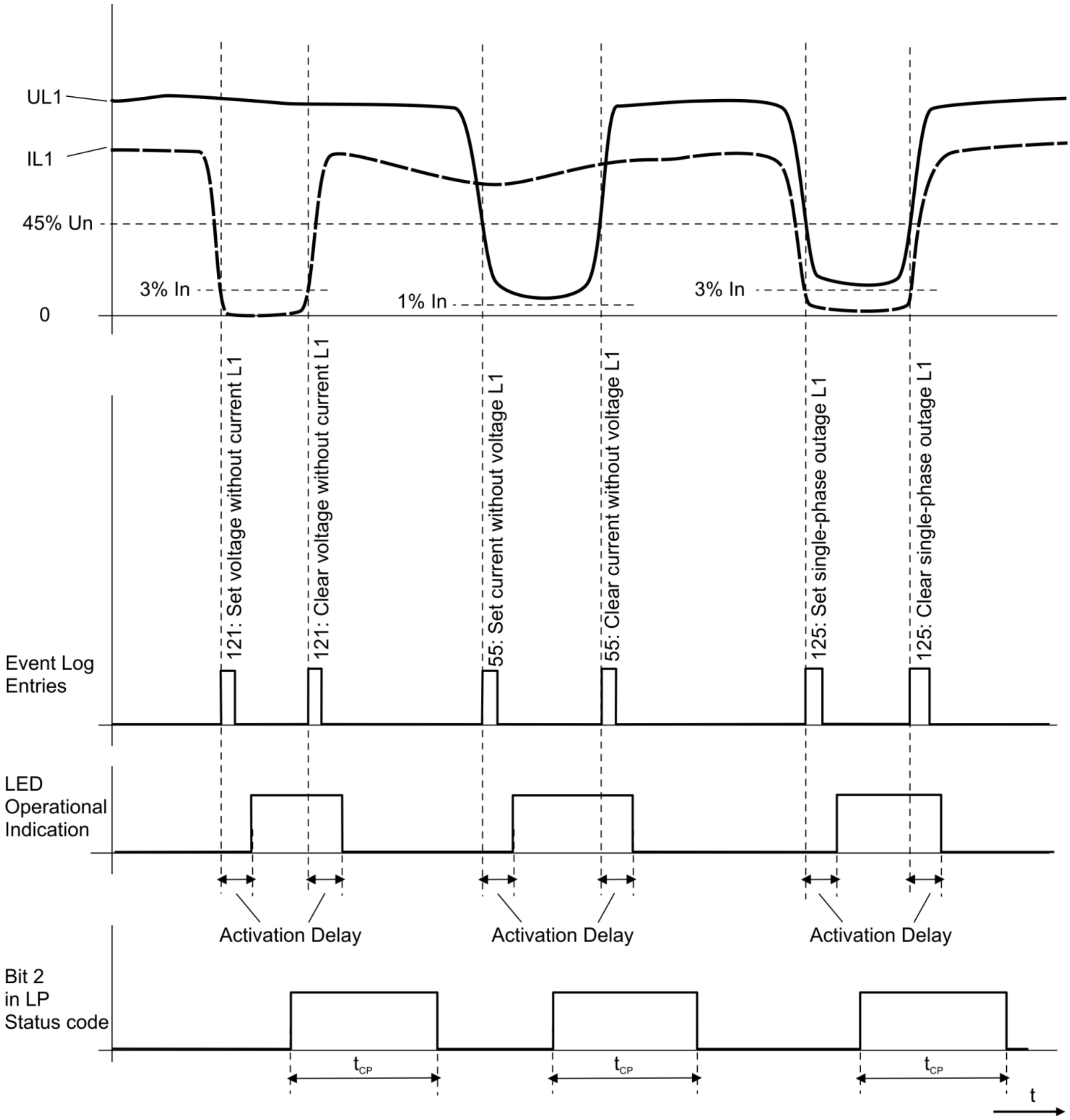
The bit 2 of the load profile status code is set for as many capture periods as the operational conditions persists.

16.5.2 Voltage without Current, Current without Voltage

In this example, the meter is parameterised to make an event log entry upon appearance and disappearance of the events.

All events are set and cleared with a delay of 600 ms.

The default value for the activation delay of operational indications is 14 s.

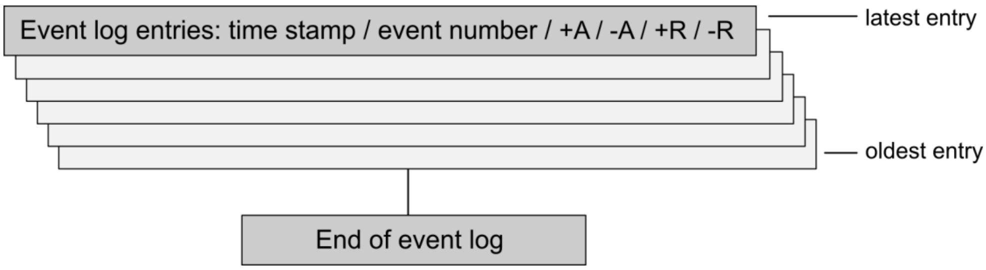


The bit 2 of the load profile status code is set for as many capture periods as the operational conditions persists.

16.6 Display

16.6.1 Structure of Display

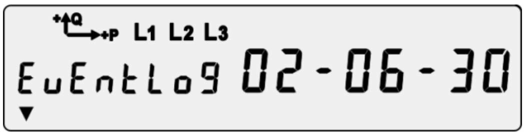
Each event log entry consists of the time stamp, the event number and the four energy registers +A, -A, +R, -R. The most recent entry is shown first.



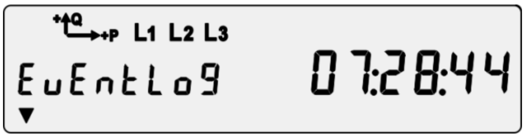
If quadrant splitting is activated (see section 1.3 "Software Configuration Parameters" only the energy registers +A and -A are stored to the event log.

16.6.2 Display Examples

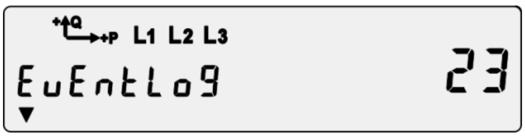
The event log may be viewed in the display menu. The following information can be retrieved:



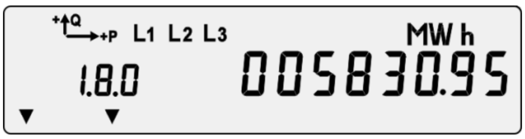
Date of entry



Time of entry



Event number
(example: power down)



Energy registers +A, -A, +R, -R
(example: +A)

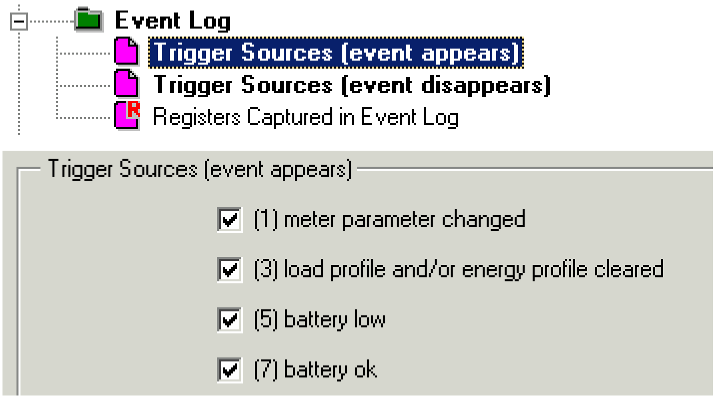
16.7 Communication

The data of the event log cannot be read via communication.

16.8 Event Log Parameters

16.8.1 Event Log Entries

Trigger Sources (event appears)



Set a tick for each event that triggers an entry in the event log saying that the event has occurred.

Trigger Sources (event disappears)

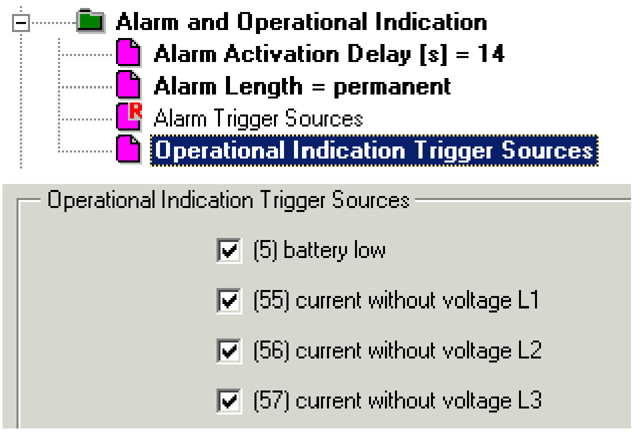
Set a tick for each event that triggers an entry in the event log saying that the event has disappeared.

16.8.2 Displaying Alarms and Operational Indications

The alarm contact and the alarm LED are used to indicate that an alarm or an operational indication has occurred.

The following parameters define the behaviour of the alarm contact and the alarm LED in such an event.

Operating Report Trigger Sources



Set a tick for each event that is to trigger an operational indication.

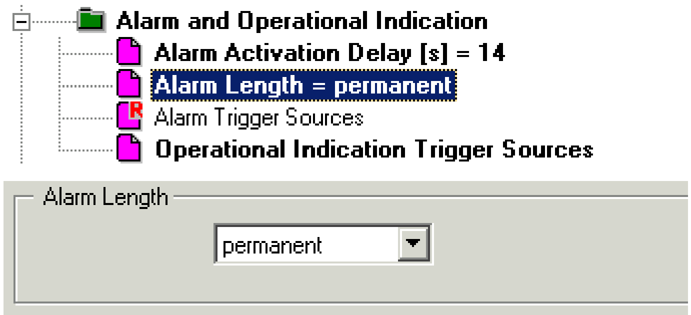
Operational indications cause the alarm contact to close and the alarm LED to flash.

By default, the event numbers 5, 55, 56, 57, 58, 125, 126 and 127 are selected to trigger an operational indication.

Alarm Trigger Sources

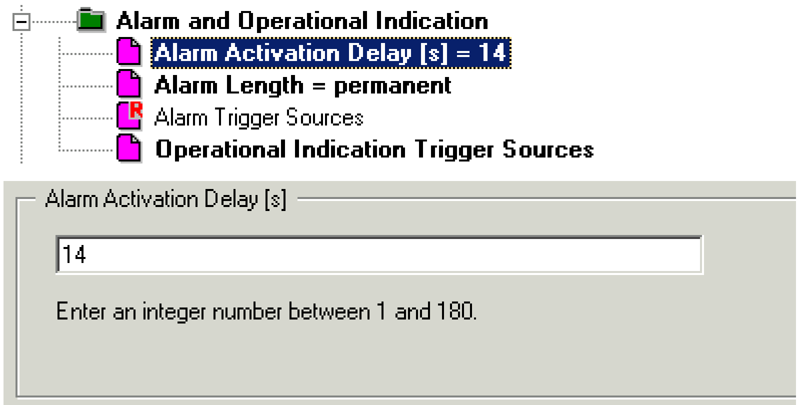
The selection of events that trigger an alarm is fixed and cannot be altered by the customer. Alarms cause the alarm contact to close and the alarm LED to be lit continuously.

Alarm Length



Select a time between 1 and 9 seconds after which the alarm contact opens again. If permanent is selected, the alarm contact remains closed until the cause of the alarm is not present any longer.

Alarm Activation Delay



Select the delay in seconds before the operational indication is triggered after it was registered by the meter.

When the operational indication is cleared, the same delay applies until the operational indication is deactivated.

This delay only applies for the following operational indications concerning the network monitoring:

55	Current without voltage L1
56	Current without voltage L2
57	Current without voltage L3
61	Active power too high
62	Reactive power too high
121	Voltage without current L1
122	Voltage without current L2
123	Voltage without current L3
125	Single phase outage L1
126	Single phase outage L2
127	Single phase outage L3

ZxU compatibility
Select an alarm activation delay of 14s to set up the ZxQ compatible with the ZxU.

17 Monitoring Functions

17.1 Overview

The ZxQ meters monitor various measured values and generate event signals if specific limits are exceeded for a preset period of time.

The events are counted in event registers and entered in the event log. The event signals may be used for tariff control and can be transmitted via the transmitting contacts (primary power monitor only).

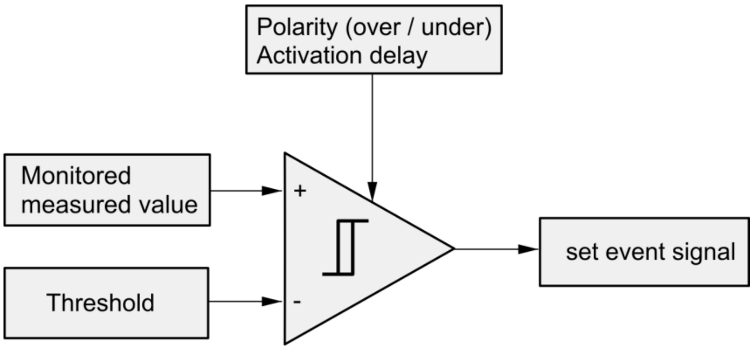
The ZxQ meters can monitor the following values:

- Phase voltages (failure, over- and undervoltage, voltage unbalance)
- Phase currents (missing current, overcurrent, current unbalance)
- Primary power (e.g. transmission line overload)
- Network frequency (e.g. for special tariff functions)

17.2 Working Principle

Each value to be monitored is given a threshold. If the monitored value exceeds the threshold this is recorded as a corresponding event. The user can define most limits.

Event entries are subject to an activation delay. The event entry is only made if the condition of exceeding a limit persists for a certain time. This is to prevent an over-sensitive reaction. The activation delay can be defined independently for each value to be monitored.



17.2.1 Thresholds

The monitored measured value (e.g. a phase voltage) is compared with the corresponding threshold every second.

Value exceeds the thresholds

If the monitored value exceeds the upper or lower threshold, an event signal is generated after the time defined by the activation delay has elapsed.

The event signal can be used for various purposes, e.g. tariff switching, depending on the control table settings (see section 6 "Control Table").

Value within thresholds

If the monitored measured value lies within the upper and the lower threshold, no event is generated.

Value within clear thresholds

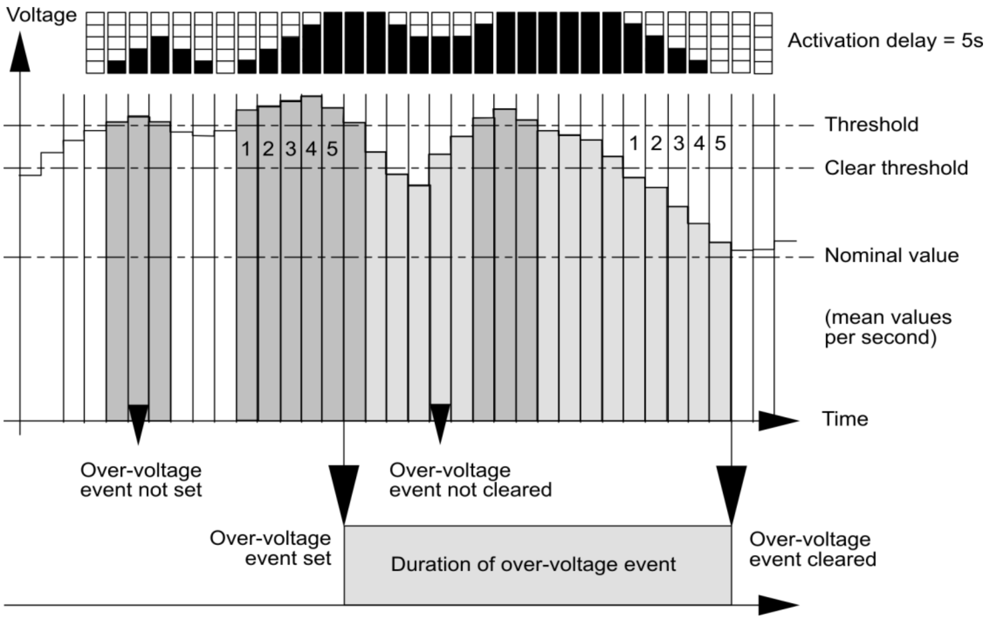
If an event is currently set and the monitored measured value returns to a value that lies within the clear threshold, the event is cleared after the time defined by the activation delay has elapsed.

Communication

There is a dlms logical name for each threshold. The threshold values can be read via communication.

17.2.2 Activation Delay

The diagram below illustrates the effect of the activation delay with the example of the voltage being monitored with an activation delay of 5 seconds.



Example

The overvoltage event is set with a delay of 5 seconds during which the value has been exceeding the threshold. This is because the activation delay counter only reaches its limit after 5 seconds of overvoltage.

To clear the overvoltage event, the voltage must be below the clear threshold for at least 5 seconds, since the activation delay counter only returns to zero after the voltage has been below the clear threshold for 5 seconds.

If the voltage exceeds the threshold for less than 5 seconds, no overvoltage event is set. If an overvoltage event is currently set and the voltage drops below the clear threshold for less than 5 seconds, the overvoltage event will not be cleared.

Range of activation delay

The customer can set the "sensitivity" as required with the activation delay value (1 = immediate response the first time the limit is exceeded, 3600 = response only after the value has been exceeding the limit for one hour).

17.3 Monitoring Applications

If the meter has registered an event and this is released in the control table, the corresponding event signal can be used as follows:

Tariff control

Each monitor event signal (except the current monitor signals) can be used as input signal of the control table in order to perform a tariff switching. For example, the phase voltage or network frequency could set the meter to another tariff if the corresponding value exceeds a specific limit.

Entry in event log

The monitor may also capture the time and date at which the event occurred. In this case an event log entry is triggered with a time stamp and the corresponding event number.

Transmitting contact The event can also be transmitted to external devices via a transmitting contact (primary power monitor only).

Operational indication The event can also be transmitted as an operational indication via the alarm contact.

17.4 Voltage Monitor

The voltage monitors check for the following incidents:

- Voltage failure in each individual phase
  The following standard values are used:

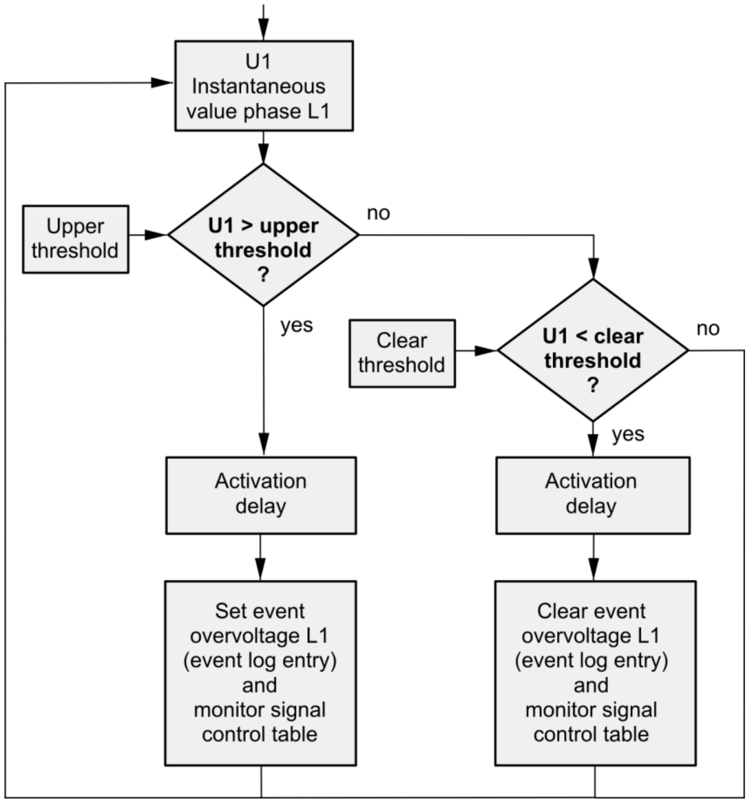
  ZMQ / ZCQ: 45% U_n to set the event, 50% U_n to clear the event

  ZFQ: 40% U_n to set the event, 45% U_n to clear the event Overvoltage in each individual phase (parameterised threshold)
- Overvoltage in each individual phase (parameterised threshold)
- Undervoltage in each individual phase (parameterised threshold)
- Voltage unbalance (parameterised threshold)

The monitoring functions only available in C.7 are described in section 25.3 "Voltage Monitoring".

17.4.1 Measurement Overvoltage

The meter checks the phase voltages for overvoltages. For this purpose, the customer sets an upper threshold.

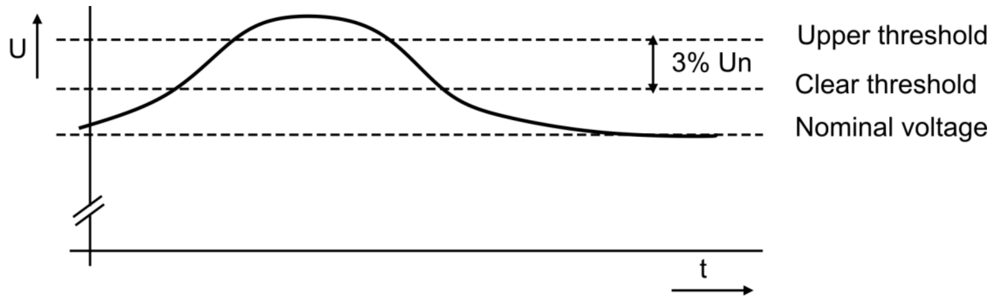


If a phase voltage exceeds the upper threshold, the meter sets the event signal "Overvoltage" for the relevant phase after the time defined by the activation delay has elapsed.

When the phase voltage drops below the clear threshold, the event signal is cleared after the time defined by the activation delay has elapsed.

The upper threshold and the activation delay can be set by the customer. The clear threshold is automatically calculated according to the formula below. It cannot be altered by the customer.

$$U_{\text{clear threshold}} = U_{\text{upper threshold}} - 0.03 \times U_n$$

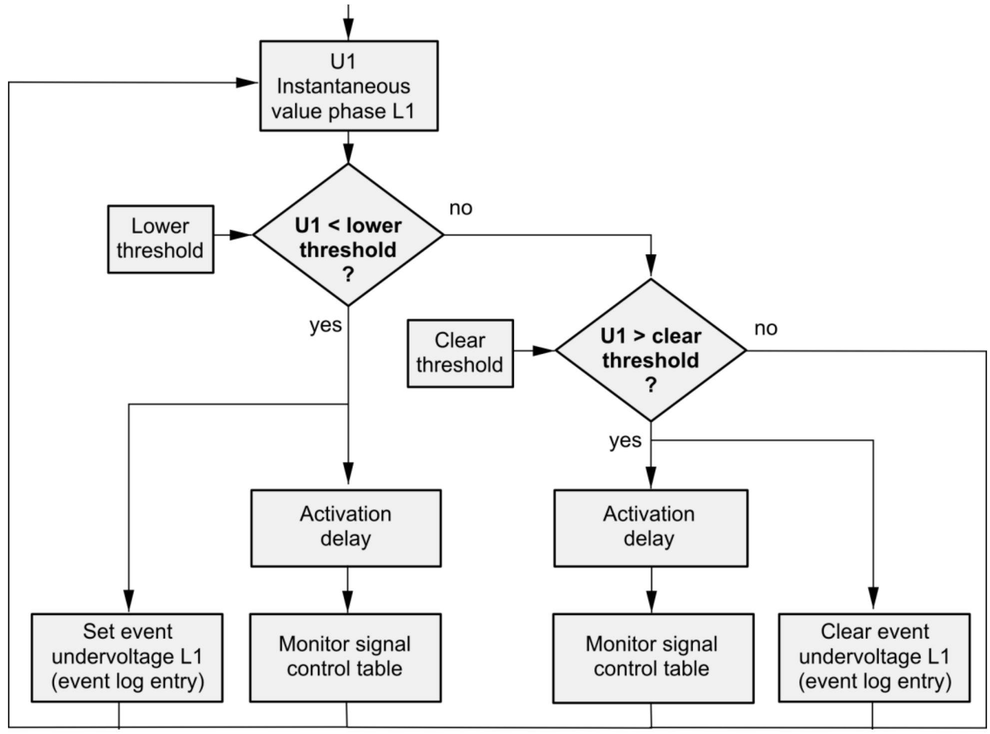


The overvoltage monitor signals are used to form the events:

- Overvoltage (event no. 20, 21, 22)

17.4.2 Measurement Undervoltage

The meter checks the phase voltages for undervoltages. For this purpose the customer sets a lower limit.

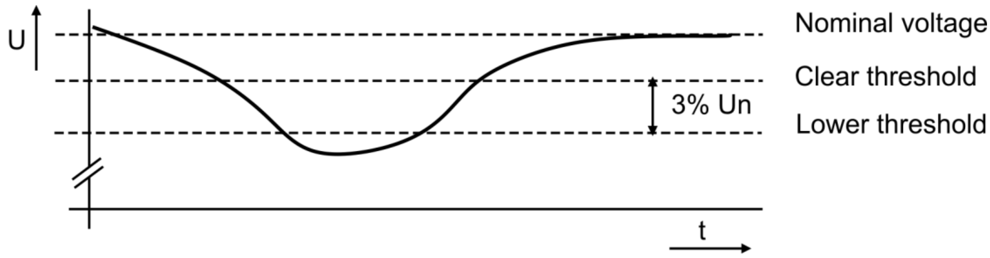


If a phase voltage drops below the lower threshold, the meter immediately sets the event signal "Undervoltage" for the relevant phase. The monitor signal for the control table is set after the time defined by the activation delay has elapsed.

When the phase voltage exceeds the clear threshold, the event signal is immediately cleared. The monitor signal for the control table is cleared after the time defined by the activation delay has elapsed.

The lower threshold and the activation delay can be set by the customer. The clear threshold is automatically calculated according to the formula below. It cannot be altered by the customer.

$$U_{\text{clear threshold}} = U_{\text{lowerthreshold}} + 0.03 \times U_n$$



The undervoltage monitor signals are used to form the events:

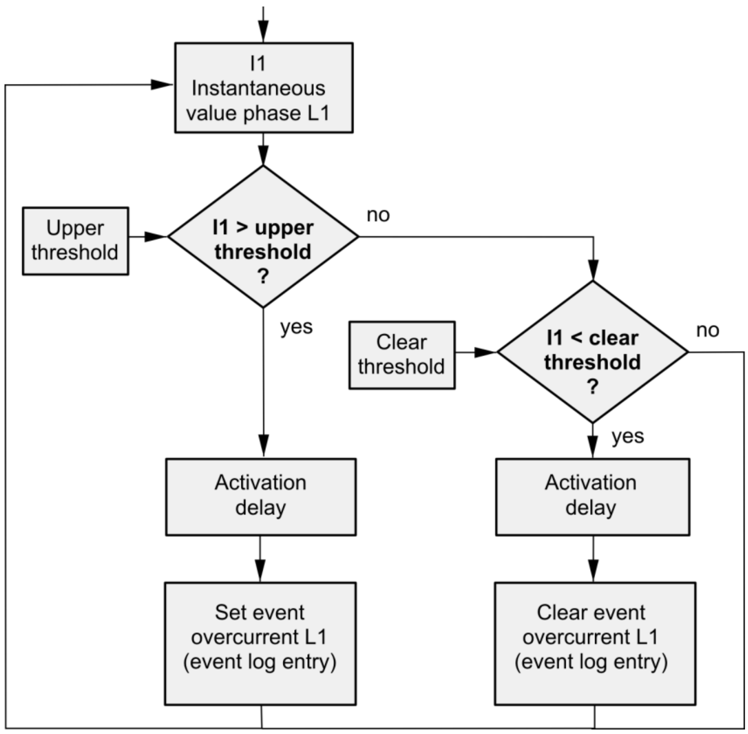
- All-phase outage (event no. 108)
- Undervoltage (event no. 17, 18, 19)
- Current without voltage (event no. 55, 56, 57)
- Undervoltage on all phases (event no. 110)
- Single phase outage (event no. 125, 126, 127)

17.5 Current Monitor

The current monitors check for the following incidents:

- Missing current in each individual phase (fixed thresholds)
  2% I_n to set the event, 5% I_n to clear the event. This corresponds to the event "voltage without current" (event no. 109).
- Overcurrent in each individual phase (parameterised threshold)
- Current unbalance (parameterised threshold)

17.5.1 Overcurrent



If a phase current exceeds the threshold, the meter sets the event signal "Overcurrent" for the relevant phase after the time defined by the activation delay has elapsed.

When the phase current drops below the clear threshold, the event signal is cleared after the time defined by the activation delay has elapsed.

The threshold and the activation delay can be set by the customer. The clear threshold is automatically calculated according to the formula below. It cannot be altered by the customer.

$$I_{\text{clear threshold}} = I_{\text{threshold}} - 0.03 \times I_n$$

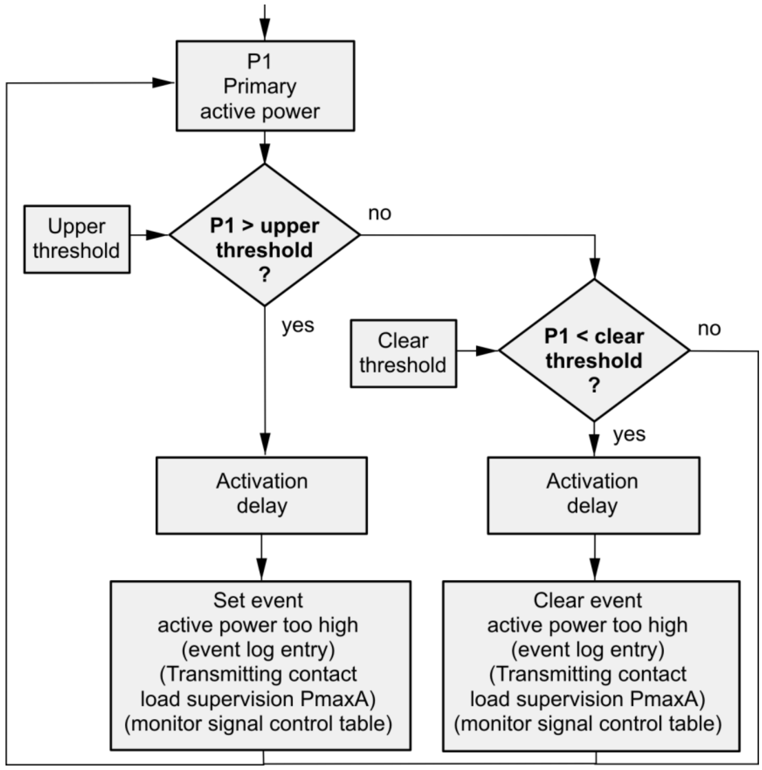
The overcurrent monitor signals are used to form the events:

- Overcurrent (event no. 25, 26, 27)

17.6 Power Monitor (Load Supervision)

The power monitor checks the active and the reactive primary power for overload. The customer can set the power limit by parameterisation.

The power monitor can be used to supervise the load of power lines and transformers.



If the (primary) active power exceeds the set limit, the meter sets the event signal "Active power too high" and activates the corresponding transmitting contact after the time defined by the activation delay has elapsed.

When the (primary) power drops below the clear threshold, the meter clears the event signal "Active power too high" and deactivates the transmitting contact after the time defined by the activation delay has elapsed.

The threshold and the activation delay can be set by the customer. The clear threshold is automatically calculated according to the formula below. It cannot be altered by the customer.

$$P_{\text{clear threshold}} = P_{\text{threshold}} - 0.05 \times P_n$$

The same principles apply for active and for reactive power monitoring.

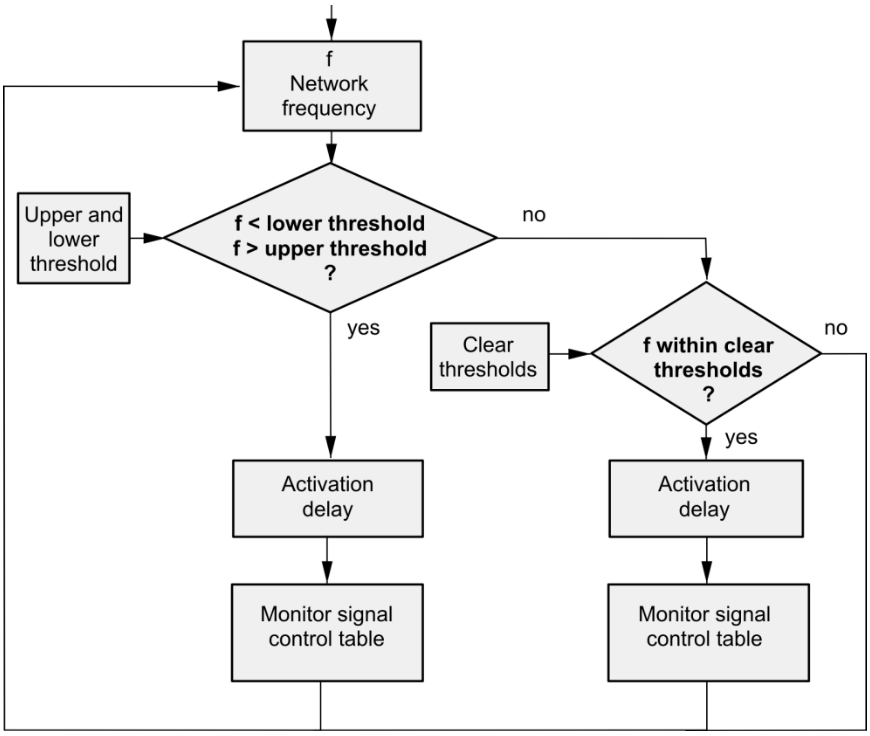
The power monitor signals are used to form the events:

- Active power too high (event no. 61)
- Reactive power too high (event no. 62)

Select r4a
To transmit the power monitor overload signals the transmitting contact "r4a" must be selected and parameterised accordingly (see section 3.4.2 "Static Output").

17.7 Frequency Monitor

The meter continuously measures the time between two zero passages of the reference voltage UL1 and from this it calculates the network frequency. This information is available for display and can be read via communication.



If the network frequency drops below the lower threshold or exceeds the upper threshold, the meter activates the corresponding control table input signal after the time defined by the activation delay has elapsed.

When the network frequency returns to a value within the clear thresholds, the control table input signal is cleared after the time defined by the activation delay has elapsed.

The upper and lower threshold, as well as the activation delay, can be set by the customer. The clear thresholds are automatically calculated according to the formula below. It cannot be altered by the customer.

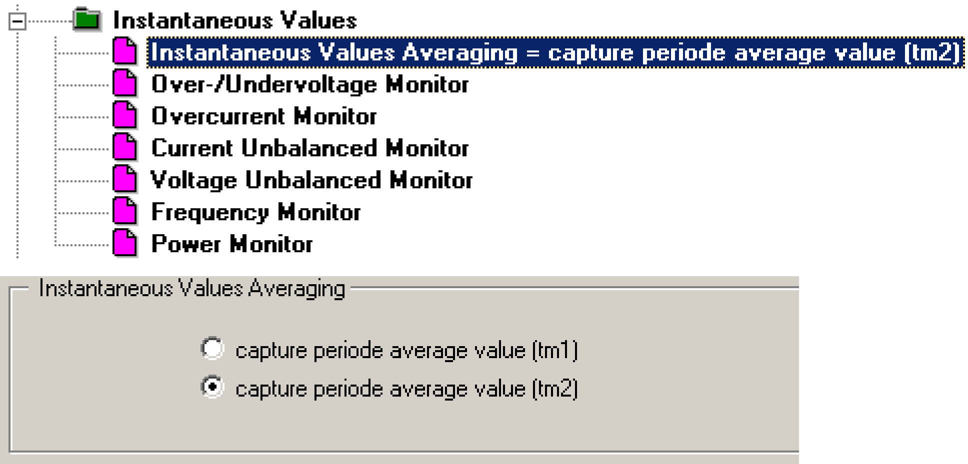
$$f_{\text{upper clear threshold}} = f_{\text{upper threshold}} - 0.1\,\text{Hz}$$

$$f_{\text{lower clear threshold}} = f_{\text{lower threshold}} + 0.1\,\text{Hz}$$

Activation of frequency monitoring
Only select Frequency Monitor if the frequency fluctuation is considerable in your network and you would like to record it specifically. Otherwise, the event log will contain many unnecessary entries.

17.8 Monitoring Function Parameters

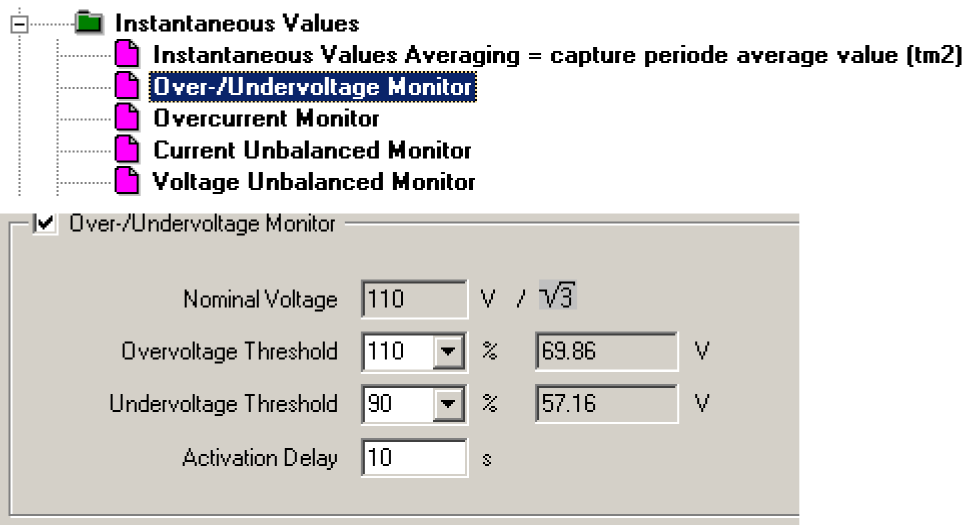
17.8.1 Instantaneous Values Averaging



Select whether the averages of the instantaneous values (voltages, currents) are calculated in relation to capture period 1 or 2 (default value).

17.8.2 Over-/Undervoltage Monitor

Undervoltage monitoring
The Dip Table is more suitable for the registration of undervoltages. See section 18 "Voltage Dip Table".



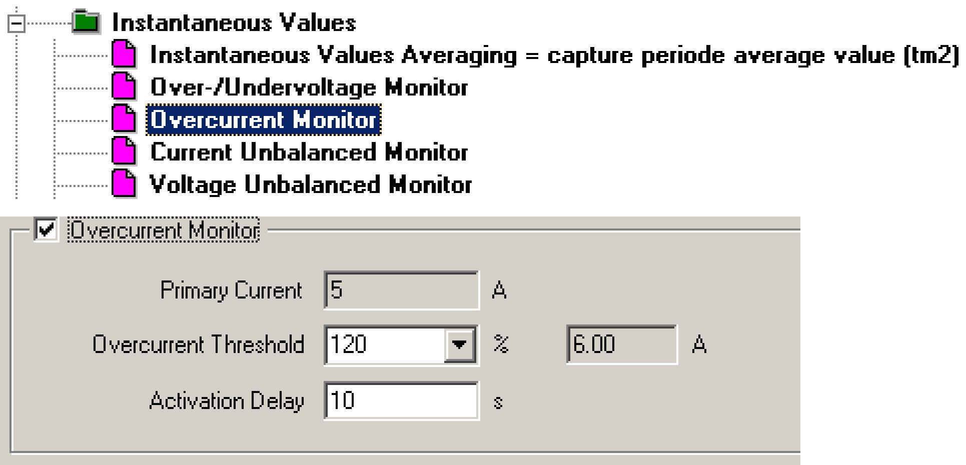
Thresholds Set the upper and lower limits in percent. The resulting deviation in absolute values is displayed but cannot be altered.

Activation Delay Set the activation delay to between 1 and 3600 seconds after which the event is triggered or cleared.

Undervoltage monitor without any delay
The activation delay only applies for the overvoltage monitor but not for the undervoltage monitor. The undervoltage events are set immediately.

17.8.3 Overcurrent Monitor

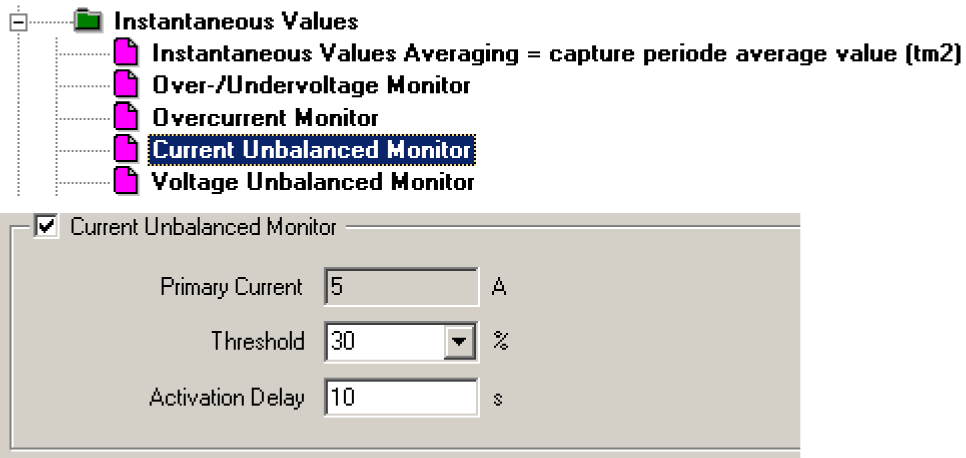
Select this function only if current monitoring is not performed by a protection device.



Threshold For the current monitor set the upper limit in percent of the nominal value. This value applies to all three phases.

Activation Delay Set the activation delay to between 1 and 3600 seconds after which the event is triggered or cleared.

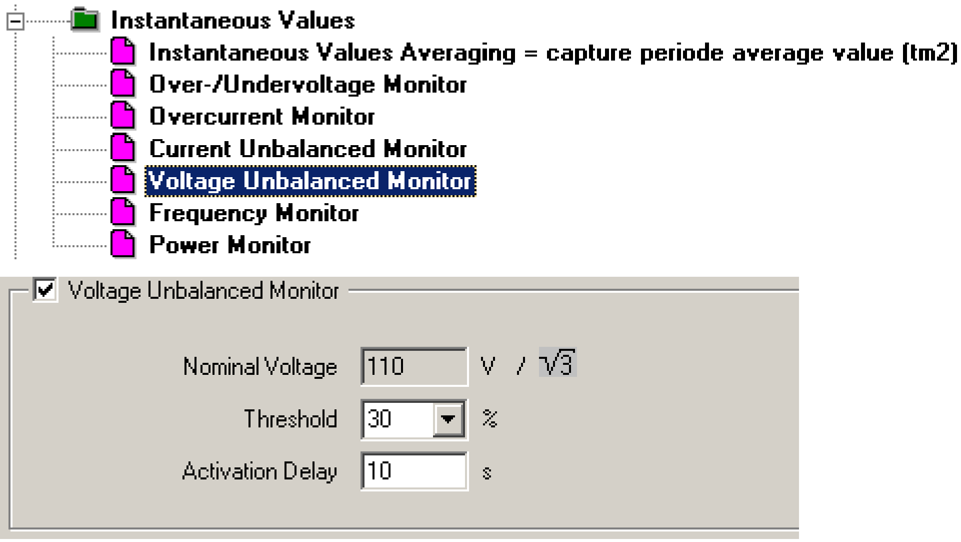
17.8.4 Current Unbalanced Monitor



Threshold The asymmetry of the currents – the difference between the highest and lowest instantaneous current in relation to the highest current: $(I_{max}-I_{min})/I_{max}$ – can be monitored. Select the threshold in percent of the nominal value.

Activation Delay Set the activation delay to between 1 and 3600 seconds after which the event is triggered or cleared.

17.8.5 Voltage Unbalanced Monitor



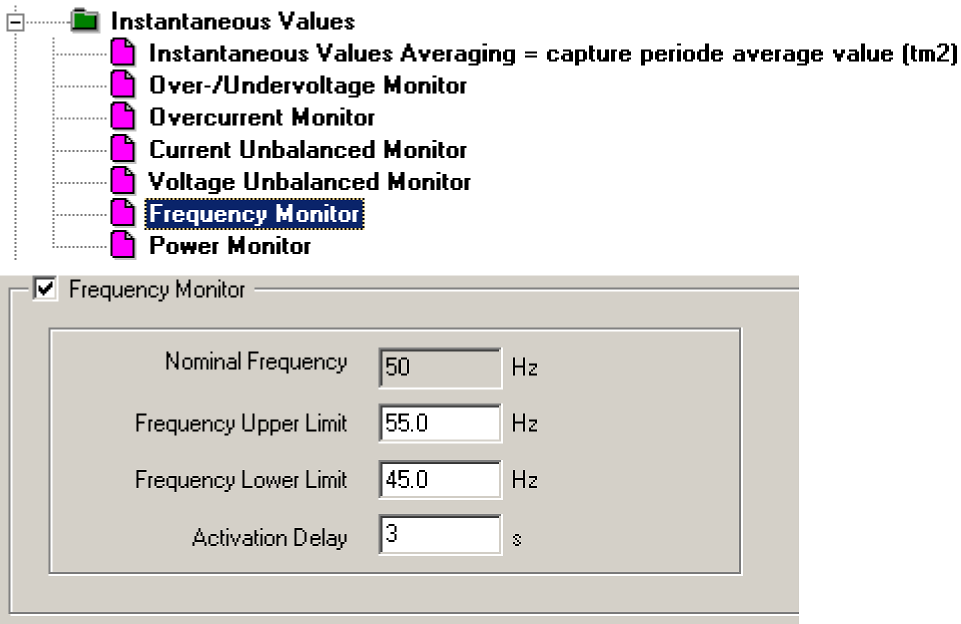
Threshold

The asymmetry of the voltages – difference between the highest and the lowest voltage in relation to the highest voltage: $(U_{max}-U_{min})/U_{max}$ – can be monitored. Select the threshold in percent of the nominal value. The usual value is 10% to 15%.

Activation Delay

Set the activation delay to between 1 and 3600 seconds after which the event is triggered or cleared.

17.8.6 Frequency Monitor



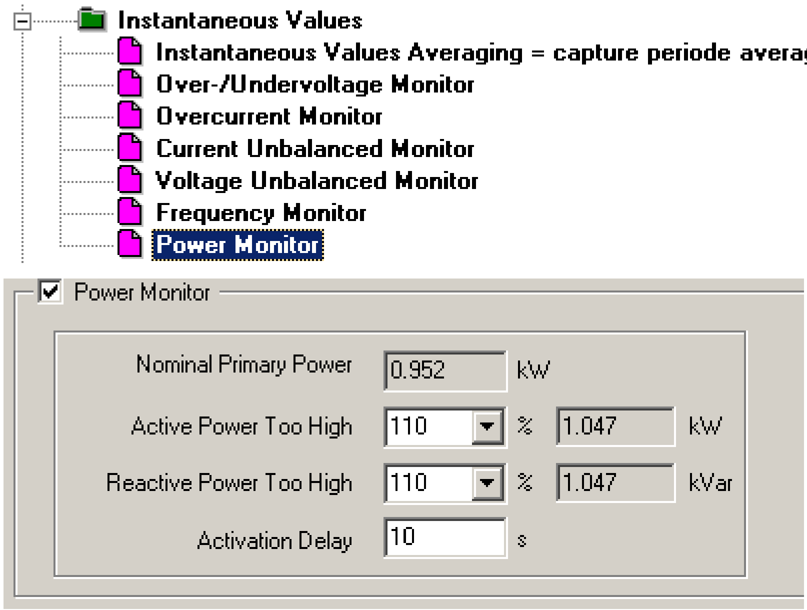
Thresholds

Set the upper and lower limit in absolute values.

Activation Delay

Set the activation delay to between 1 and 3600 seconds after which the event is triggered or cleared.

17.8.7 Power Monitor (Load Supervision)



Thresholds

For the power monitor, set the upper limit for the active and reactive power in percent. The resulting limits in absolute values are displayed but cannot be altered.

Activation Delay

Set the activation delay to between 1 and 3600 seconds after which the event is triggered or cleared.

18 Voltage Dip Table

18.1 Overview

The measuring system constantly monitors the voltages of each single phase. If a voltage drops below 90% of its nominal value, the measuring system gives information about the duration of the voltage dip and the average voltage during the event. The information is refreshed every 0.2 seconds.

18.2 Working Principle

The single-phase voltage values obtained from the measuring system are compared with four different thresholds. If a phase voltage drops below a threshold for a certain period of time, one of the 24 counters in the voltage dip table (n11 ... n64) is increased by 1.

Counters

The counters do not overflow but stop at the maximum value of 65535. The entries in the voltage dip table are kept until a manual reset is performed.

Reading the voltage dip table

The voltage dip table can only be read via communication. Each counter is allocated a dlms logical name with which it is clearly identified (see table below). The voltage dip table cannot be displayed on the meter's display.

Structure

Depth [%]	% U_n		Duration					
			0.02 s <0.1 s	**0.1 s <0.5 s**	**0.5 s <1 s**	**1 s <3 s**	**3 s <20 s**	**20 s <60 s**
10<15	**<89.9≥85**	**counter number**	n11	n21	n31	n41	n51	n61
		dlms logical name	12.32.00	12.32.01	12.32.02	12.32.03	12.32.04	12.32.05
15<30	**<84.9≥70**	**counter number**	n12	n22	n32	n42	n52	n62
		dlms logical name	12.32.10	12.32.11	12.32.12	12.32.13	12.32.14	12.32.15
30<60	**<69.9≥40**	**counter number**	n13	n23	n33	n43	n53	n63
		dlms logical name	12.32.20	12.32.21	12.32.22	12.32.23	12.32.24	12.32.25
6<95	**<39.9**	**counter number**	n14	n24	n34	n44	n54	n64
		dlms logical name	12.32.30	12.32.31	12.32.32	12.32.33	12.32.34	12.32.35

Reading example

Situation: There were two voltage dips of 20% (i.e. the voltage dropped to 80% of its nominal value) with a length of 0.7 seconds.

Consequence: The counter n32 (with the dlms logical name: 12.32.12) is increased by 2, while all other counters remain the same.

Time of dip

There are no time stamps in the voltage dip tables.

18.2.1 Resetting the Voltage Dip Table

Resetting the counters is only possible via communication. If the meter is re-parameterised, the counters are also cleared. When a voltage dip table reset takes place, all counters are cleared, i.e. resetting single counters is not possible.

18.2.2 Registering the Voltage Dip Data

Depending on the number of dips that occur at the same time the voltage dip table registers the incidents differently:

A single dip occurs

If a single dip occurs in one phase only, one entry is made according to the depth and duration of the dip.

Several dips occur at the same time

If several dips occur in several phases at the same time, two cases are possible:

The duration of all simultaneous dips is within 10%:

In this case one entry is made with the depth of the deepest dip and the average duration of all simultaneous dips. Therefore, in case of an all-phase de-energisation, only one dip table entry is made.

The duration of the simultaneous dips differs more than 10%:

In this case separate entries are made for all dips with the depth and duration of each dip.

18.2.3 Uncertainty of Duration Measurement

The uncertainty of the dip duration measurement depends on the duration of the dip.

If a dip lasts up to 10 half cycles (one half cycle equals 10ms at 50Hz) the uncertainty of the time measurement is 10 ms.

If a dip lasts longer than 10 half cycles (100ms) the uncertainty of the time measurement is within ±10%.

18.2.4 Analysis of Voltage Dip Table Data

The voltage dip table data can be analysed using the MAP110 tool (Excel-format).

18.3 Voltage Dip Table Parameters

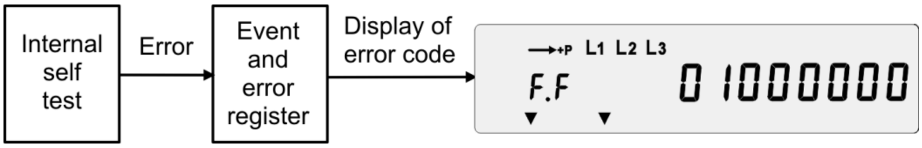
The voltage dip table must be activated in the software configuration (see section 1.3 "Software Configuration Parameters").

It is recommended to activate the table as this has no impact on other parameters.

19 Error Handling

19.1 Overview

The meter regularly performs an internal self-test which checks the correct function of all vital parts of the meter.



In the event of an error, an entry to the event and error register is made and the meter displays an error code. The error code appears in the display as an F.F followed by an 8-digit figure. The error code is always included in the readout log (e.g. error code F.F 0000 0000 = no error).

19.2 Structure of the Error Code

The error code is split up in four groups of two digits each.

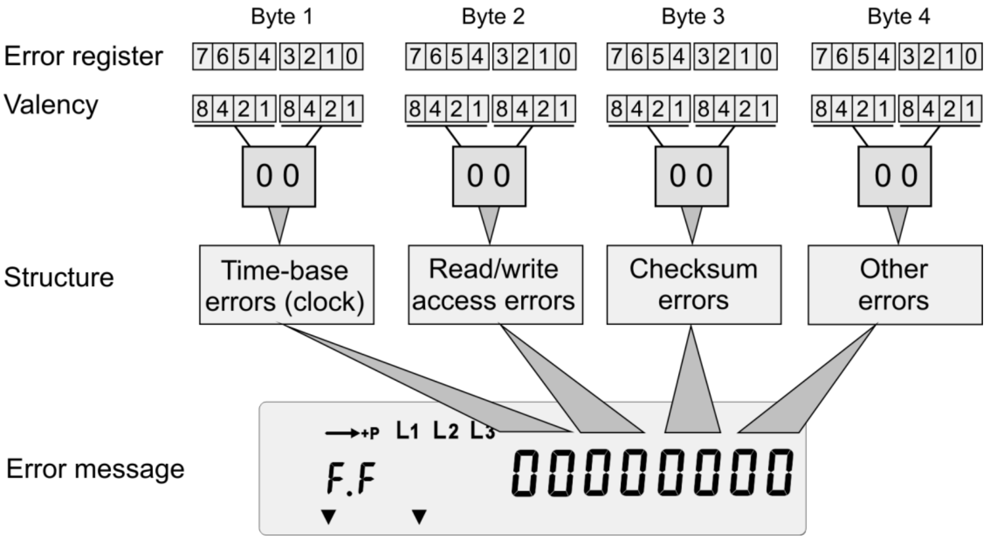
The four groups represent the four error types (i.e. time base errors, read/write errors, checksum errors and other errors).

Each digit of the error code represents four error messages (i.e. four bits of the error register). The status of the four bits is displayed in hexadecimal code i.e. the single digits may display values between 0 (no error message set) and F (all four error messages set).

Error codes are added
As all errors are displayed in hexadecimal code a single error message can appear in the display in various ways depending on the presence of other error messages.

Example:

Two errors are displayed as:	FF **01**00**02**00
Another two errors occur:	FF **02**00**08**00
The display reads:	FF **03**00**0A**00



19.3 Degree of severity of errors

From firmware version H03 on, the degree of severity of an error occurring is assessed as follows (up to and including firmware version H02 there are only fatal and non-critical errors):

Fatal errors

A fatal error indicates a severe problem which prevents the meter from operating, e.g. a defective hardware component. As fatal errors occur during start-up, the alarm LED cannot be lit.

The alarm contact remains closed because the start-up sequence has not been completed. The meter stops its operation and the error code is displayed permanently. **The meter must be exchanged immediately.**

Critical errors

A critical error indicates a severe problem, despite which the meter continues to function and measurement is still possible. The data is stored in the memory and suitably marked in case of doubt.

If the meter is equipped with an alarm system, each critical error is linked to an alarm. If an alarm is reset, the critical error is also cleared and vice versa.

After a critical error, the error code is displayed and the alarm LED is lit until the error is acknowledged with the display key or the error register is reset, e.g. via the electrical interface. The alarm contact is closed until the error is reset or a timeout period has elapsed. The error can be read out via communication or displayed in the manual display list.

Depending on the type of error, it can reoccur, since with the acknowledgement the error cause has not been eliminated.
The meter must be exchanged as soon as possible.

Non-critical errors

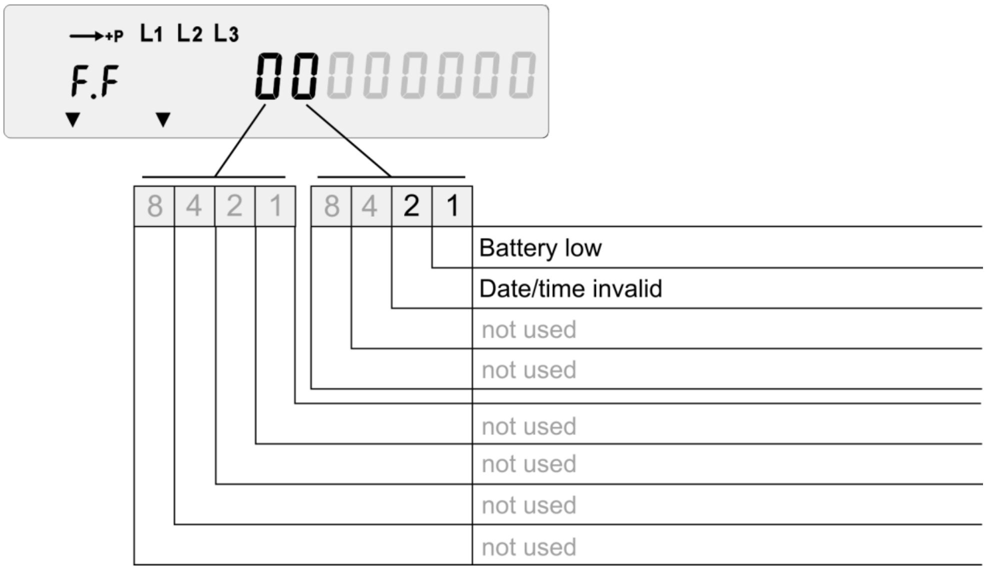
Non-critical errors can influence the meter functions (temporarily or permanently). These errors are recorded in the error register. If parameterised accordingly, the alarm LED flashes.

The alarm contact is closed until the error is cleared. The meter remains serviceable and generally **does not have to be exchanged**.

Reset of errors
Country and customer specific regulations may prohibit the reset of an error at the metering point. In this case, the meter has to be recalibrated according to local regulations.

19.4 Error Groups

19.4.1 Time-Base Errors (Clock)



F.F 01 00 00 00 **Battery low (event no. 5)**

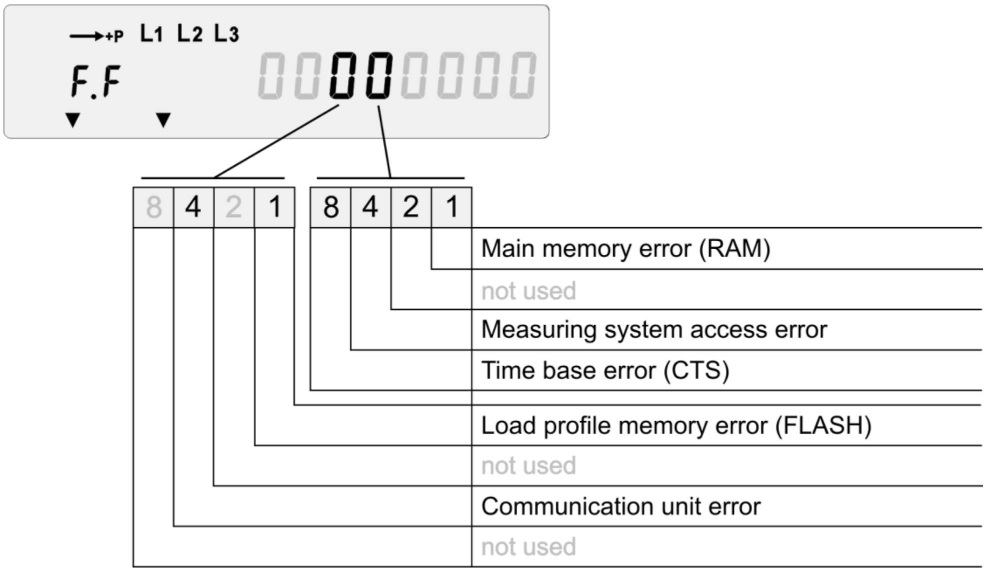
Purpose:	Indicates a discharged or removed battery
Checked:	Continuously, several times per minute
Set:	If the voltage drops below a certain level or the battery is removed
Meter reaction:	Battery indicator on the LCD is lit, alarm-LED is flashing (if parameterised)
Severity:	Non-critical
Consequence:	None as long as the meter is powered correctly. If the supercap is discharged, the time/date is lost (see error 02 00 00 00).
Rectification:	If the voltage reaches a certain level or a new battery is installed

This error message only appears if the battery check is activated (bat …. 1 in the service menu). Otherwise no battery condition check is performed.

F.F 02 00 00 00 **Date/time invalid (event no. 66)**

Purpose:	Indicates an invalid time/date
Checked:	Event driven
Set:	If the power reserve is exhausted during power down with low battery
Meter reaction:	The clock arrow is displayed, alarm-LED is flashing (if parameterised)
Severity:	Non-critical
Consequence:	After power up, the clock runs again but shows incorrect time/date (1.1.2000 00:00h). Entries in the profiles will be marked with wrong time stamps.
Rectification:	The error is automatically cleared when the clock is set (and the battery has been replaced, if necessary).

19.4.2 Read/Write Access Errors



Communication problem
Read/write errors indicate a communication problem between the microprocessor and the various components.

F.F 00 01 00 00 **Main memory error (RAM, event no. 73)**

Purpose:	Indicates an internal RAM check failure
Checked:	On power-up
Set:	On power-up if RAM access fails several times
Meter reaction:	The software is restarted (loop if RAM check fails again)
Severity:	Fatal
Consequence:	The meter may contain incorrect data
Rectification:	The meter must be replaced

This error can only occur at start-up and stops the meter in the start-up process. Therefore, the alarm LED cannot be lit and no event log entry is possible. The alarm contact remains active.

F.F 00 04 00 00 **Measuring system access error (event no. 75)**

Purpose:	Indicates measuring system access failures
Checked:	On each access to the measuring system
Set:	If access to measuring system failed several times. The error may occur if meters are installed with a completely discharged supercap which causes an incorrect start-up.
Meter reaction:	none
Severity:	Non-critical
Consequence:	The meter may contain incorrect measurement data
Rectification:	Power-up meter and wait for a short time, then clear error via communication. If the error reoccurs, replace the meter

F.F 00 08 00 00 **Time base error (RTC) (event no. 76)**

Purpose:	Indicates that the real time clock was without power and the clock has lost its time
Checked:	On power-up
Set:	After repeated failures of the internal time base test
Meter reaction:	The clock arrow is displayed
Severity:	Non-critical
Consequence:	The calendar clock may display incorrect/invalid time/date
Rectification:	Clear error via communication. If it occurs repeatedly, the meter must be replaced.

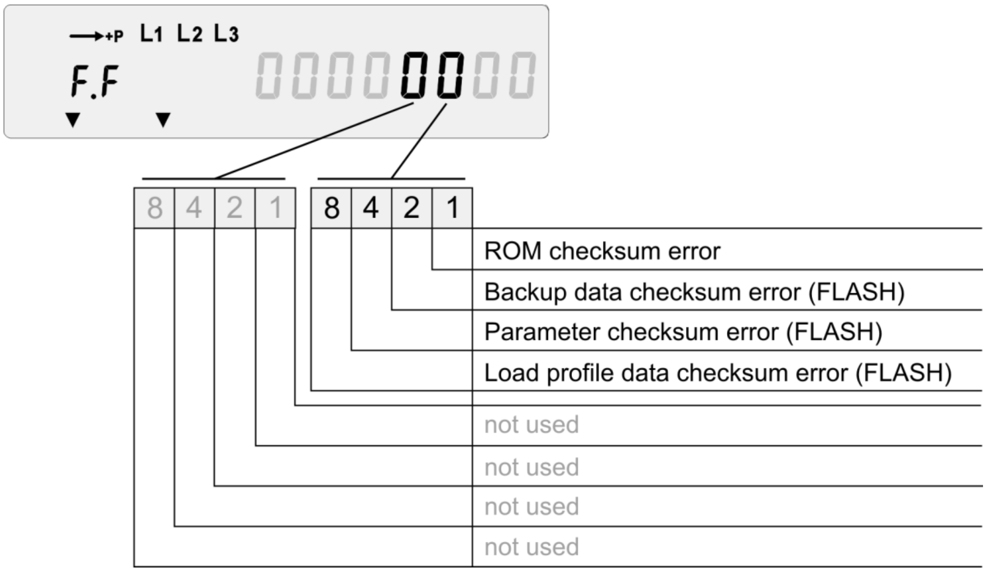
F.F 00 10 00 00 **Profile memory error (event no. 77)**

Purpose:	Indicates profile memory access failures
Checked:	At each read/write access
Set:	After repeated failures to access the internal memory
Meter reaction:	Profile data will be marked in the status code, alarm-LED is on
Severity:	Critical
Consequence:	It may be impossible to access the profile or it may contain incorrect data
Rectification:	By pressing the alarm reset button or via communication

F.F 00 40 00 00 **Communication unit access error (event no. 79)**

Purpose:	Indicates a failure to access the communication unit
Checked:	At each read/write access
Set:	After repeated failures of the internal CU test
Meter reaction:	The meter may stop to communicate with the CU, alarm-LED is flashing (if parameterised)
Severity:	Non-critical
Consequence:	Communication via the CU may not work or is slow
Rectification:	Clear error via communication or by pressing the alarm reset button. If it occurs repeatedly, replace CU first, check function and if the error reoccurs, replace meter.

19.4.3 Checksum Errors



F.F 00 00 01 00 **ROM checksum error (event no. 81)**

Purpose:	Indicates a microprocessor ROM code checksum failure
Checked:	On power-up
Set:	On power-up if the ROM checksum test fails
Meter reaction:	The software is restarted (loop if ROM check fails again)
Severity:	Fatal
Consequence:	The meter will no longer work
Rectification:	The meter must be replaced

This error can only occur at start-up and stops the meter in the start up process. Therefore, the alarm LED cannot be lit and no event log entry is possible. The alarm contact remains active.

F.F 00 00 02 00 **Backup data checksum error (FLASH) (event no. 82)**

Purpose:	Indicates a backup data checksum failure
Checked:	On start-up
Set:	Temporarily set after a faulty checksum test
Meter reaction:	Profile data will be marked in the status code, alarm-LED is on
Severity:	Critical
Consequence:	Meter may contain incorrect data
Rectification:	The meter needs to be replaced

F.F 00 00 04 00 **Parameter data checksum error (FLASH) (event no. 83)**

Purpose:	Indicates a parameter data checksum failure
Checked:	On power-up and every 24 hours
Set:	Set after a faulty checksum test
Meter reaction:	Profile data is marked in the status code, alarm-LED is on
Severity:	Critical
Consequence:	Meter may contain incorrect data
Rectification:	The meter must be replaced

F.F 00 00 08 00 **Profile data checksum error (FLASH) (event no. 84)**

Purpose:	Indicates a profile data checksum failure
Checked:	Continuously (page by page)
Set:	After repeated failures of the profile data checksum test
Meter reaction:	Profile data of the page concerned will be marked in the status code
Severity:	Non-critical
Consequence:	Pages affected may contain faulty data but the measuring system works correctly
Rectification:	Reset the profile and then the error via communication. If it occurs repeatedly, the meter must be replaced.

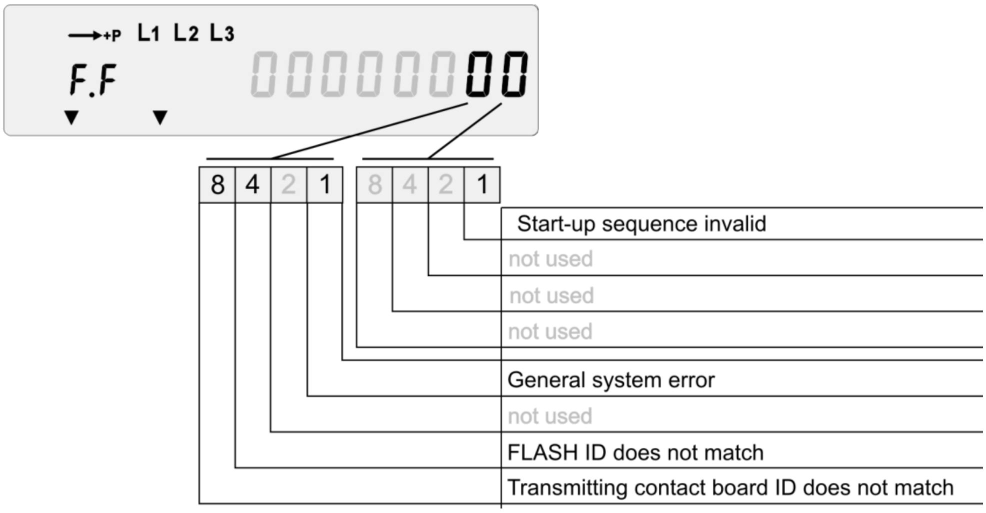
F.F 00 00 40 00 **Calibration data checksum error (event no. 87)**

Purpose:	Indicates a calibration data checksum failure
Checked:	Continuously
Set:	After repeated failures of the profile data checksum test
Meter reaction:	The meter might not measure accurately
Severity:	Critical
Consequence:	The meter might contain incorrect data
Rectification:	The meter must be replaced

F.F 00 00 80 00 **2nd Profile data checksum error (event no. 88)**

Purpose:	Indicates a profile data checksum failure
Checked:	Continuously (page by page)
Set:	After repeated failures of the profile data checksum test
Meter reaction:	Profile data of the page concerned will be marked in the status code
Severity:	Non-critical
Consequence:	Pages affected may contain faulty data but the measuring system works correctly
Rectification:	Reset profile 2 and then the error via communication. If it occurs repeatedly, the meter must be replaced.

19.4.4 Other Errors



F.F 00 00 00 01 **Start-up sequence invalid (event no. 89)**

Purpose:	Indicates an invalid start-up sequence
Checked:	On power-up
Set:	If the power up procedure detects that no valid power down took place
Meter reaction:	none
Severity:	Non-critical
Consequence:	The meter might have lost data since the last storage (storage every 24 h and at power down of the meter)
Rectification:	By pressing the alarm reset button or via communication. If it occurs repeatedly, contact Landis+Gyr Customer Services.

F.F 00 00 00 10 **General system error (event no. 93)**

Purpose:	Indicates a fatal system failure within the microprocessor
Checked:	Event driven
Set:	If the microprocessor was restarted due to a disturbance (e.g. lightning)
Meter reaction:	The software is restarted
Severity:	Non-critical
Consequence:	All actual data (since the last storage – storage takes place every 24 h and at power down of the meter) is lost
Rectification:	By pressing the alarm reset button or via communication. If it occurs repeatedly, contact Landis+Gyr Customer Services.

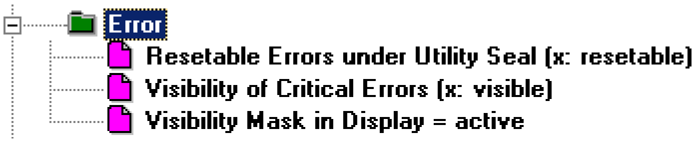
F.F 00 00 00 20 **Communication locked (event no. 94)**

Purpose:	Indicates access attempts with a wrong password via the communication interface
Checked:	At every access via communication
Set:	After using wrong passwords several times
Meter reaction:	Access to the meter via communication at levels requiring passwords will be locked for a parameterised time, but maximum until midnight. An alert can be triggered, alarm-LED is flashing (if parameterised)
Severity:	Non-critical
Consequence:	No access at levels requiring passwords will be possible until the inhibition time expires
Rectification:	Wait until expiration of the inhibition time

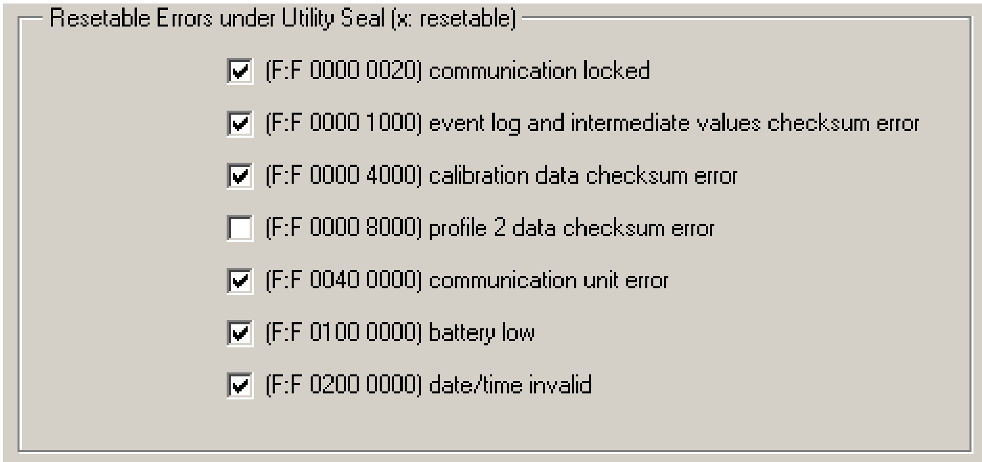
F.F 00 00 00 40 **Wrong EEPROM/Flash (event no. 95)**

Purpose:	Indicates that an incorrect EEPROM/Flash is installed
Checked:	On power-up
Set:	If reference identification of the firmware is different from the one stored in the EEPROM/Flash memory
Meter reaction:	The error code is displayed and the meter will stop
Severity:	Fatal
Consequence:	Meter will no longer work
Rectification:	The meter must be replaced

19.5 Error Handling Parameters

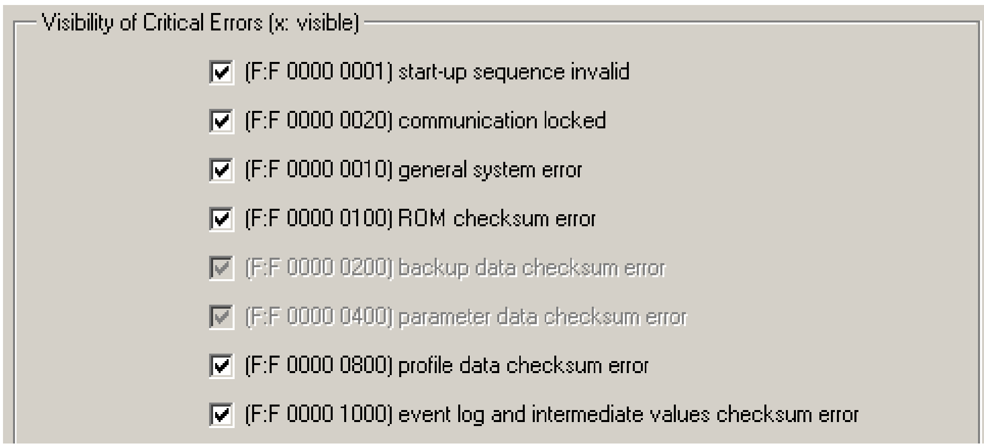


Resettable Errors under Utility Seal



Select which error messages can be cleared by pressing the reset button under the utility seal.

Visibility of Critical Errors



Select which critical errors are to be displayed in the auto-scroll display. In the manual display list, all errors are shown and cannot be suppressed.

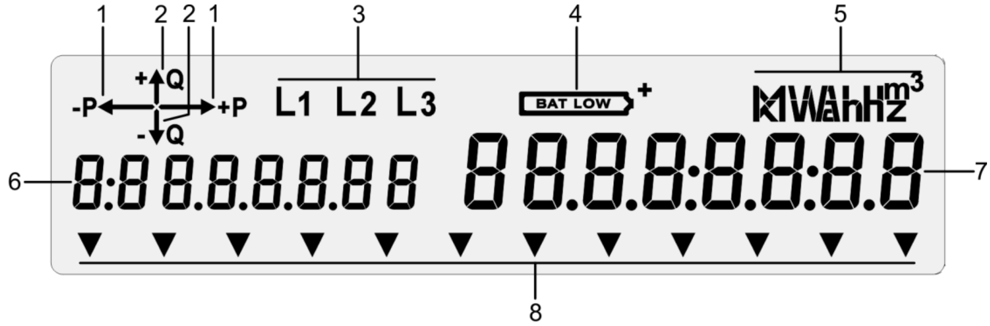
Visibility Mask in Display

Select whether or not the above selection applies.

20 Display

20.1 Display Characteristics

The display of the ZxQ meter comprises the following elements:



1. Direction of active energy (+P = import, -P = export)
2. Direction of reactive energy
   Together with the symbols for the active energy flow, the relevant quadrant is indicated. (+Q = import, -Q = export)
3. Presence of phase voltages
4. Battery status
5. Units field
6. Code field (maximum 8 digits)
7. Value field (8 digits)
8. 12 arrow symbols for status information

Background illumination

The LCD (liquid crystal display) is provided with background lighting for easier reading. The lighting is switched on with the first press of a display button and automatically switched off after a while when no button has been pressed.

Reading without voltage

With the battery fitted, the display can also be operated even if no voltage is applied to the meter (neither measurement voltage nor the additional power supply). Pressing one of the display buttons activates the display. The background lighting, however, remains switched off.

Reading without voltage several times decreases the capacity of the battery and reduces its service life. The power reserve of at least 10 years includes no more than 2 readings per year.

Display check

When the meter shows the operating display and a display button is pressed, all segments of the display are illuminated (display check).

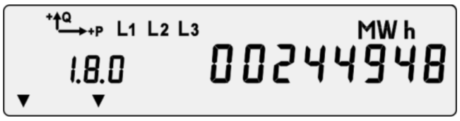
20.2 Display Menus

The meter uses the following display menus:

- Operating display
- Operating menu
- Service menu

20.2.1 Operating Display

The operating display is shown unless one of the two display buttons is pressed.



The operating display also appears

- after a fixed time in the operating menu without pressing a button
- after a fixed time in the service menu without pressing a button (unless the completion of the task is essential)
- by simultaneously pressing both display buttons within the operating or service menu
- by continuously pressing the button at the end of the display menu or service menu

Rolling display

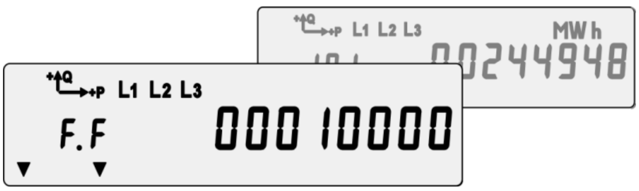
The operating display is a rolling display i.e. several values are displayed in succession at a fixed interval. By default, the following registers are part of the rolling operating display. More registers can be added by parameterisa-tion.

Error code	Error code (F.F 0000 0000 if no error is present)
Time	Current time
Date	Current date
+A	Active energy, positive direction (import)
-A	Active energy, negative direction (export)
+R	Reactive energy, positive direction (import)
-R	Reactive energy, negative direction (export)

Certified values
In some countries, only certified values may be displayed in the rolling dis-play.

Error message

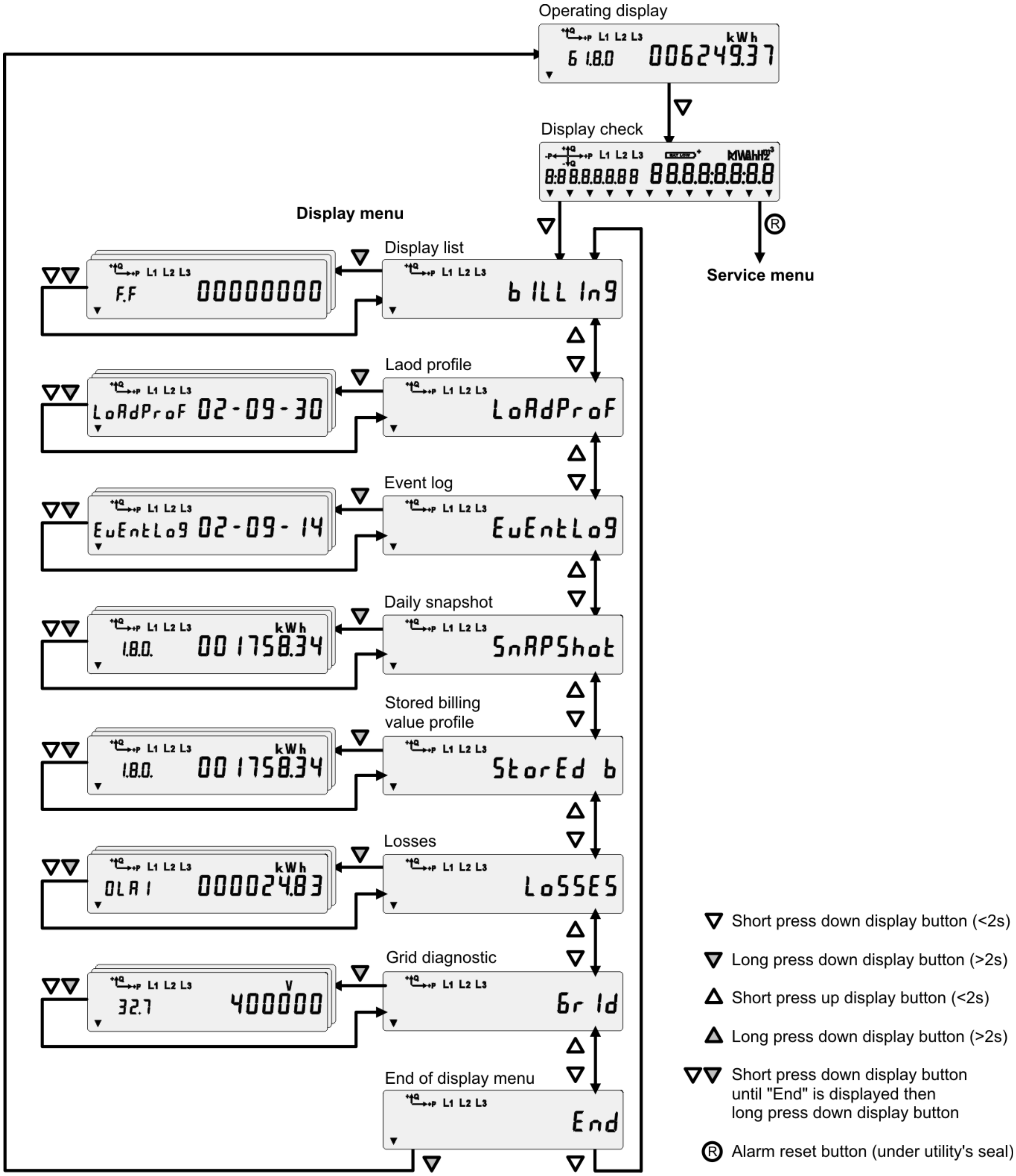
The meter can generate error messages on the basis of the regular internal self-test. In the event of a fatal error, the error message appears and replaces the operating display.



20.2.2 Display Menu

The display menu displays information according to the diagram below (example, depending on parameterisation).

It is accessed using the display buttons.



Billing	**Billing data:** Displays all energy registers and total energy registers that are used for billing. By default, the following registers are part of the billing data list. More registers can be added by parameterisation (see section 20.5.1 "Selection of Entries in each Display List").	

Error code	Error code (F.F 0000 0000 if no error is present)
ID1	Identification number 1
+A	Active energy in positive direction (import)
-A	Active energy in negative direction (export)
+R	Reactive energy in positive direction (import)
-R	Reactive energy in negative direction (export)
Time	Current time
Date	Current date

Loadprof

Profile: The profile display lists all the measured values that are captured in profile 1 with time/date and the status code in chronological order (see section 15.11.2 "Registers Captured in the Profile"). Profile 2 cannot be displayed.

Eventlog

Event log: The event log display lists all events that are captured in the event log (see section 16.8.1 "Event Log Entries"). For each event log entry the following information can be retrieved:

Date	Event date
Time	Event time
Event	Number that describes the event
+A	Active energy in positive direction (import)
-A	Active energy in negative direction (export)
+R	Reactive energy in positive direction (import)
-R	Reactive energy in negative direction (export)

Reactive energy in negative direction (export) If quadrant splitting is activated only the measured quantities +A and -A are stored to the event log.

Snapshot

Daily snapshot (C.4, C.6, C.8): The daily snapshot display lists the daily snapshots of the selected energy registers in chronological order together with date/time and the snapshot counter (see section 12.5.1 "Registers Captured in the Daily Snapshot").

Energy profile (C.2): The energy profile display lists the energy snapshots of the selected total energy registers in chronological order together with date/time and the snapshot counter (see section 14.6.2 "Registers Captured in the Energy Profile").

Stored_b

Stored billing value profile: The stored billing value profile display lists the stored billing values of the selected energy and demand registers in chronological order together with date/time and the stored billing value counter (see section 13.6.3 "Registers Captured in the Stored Billing Value Profile"). The stored billing value profile is available with the C.8 with demand measurement only.

Losses

Energy losses: The losses display lists all loss values that have been selected by parameterisation in a successive order (see section 20.5.1 "Selection of Entries in each Display List").

Grid

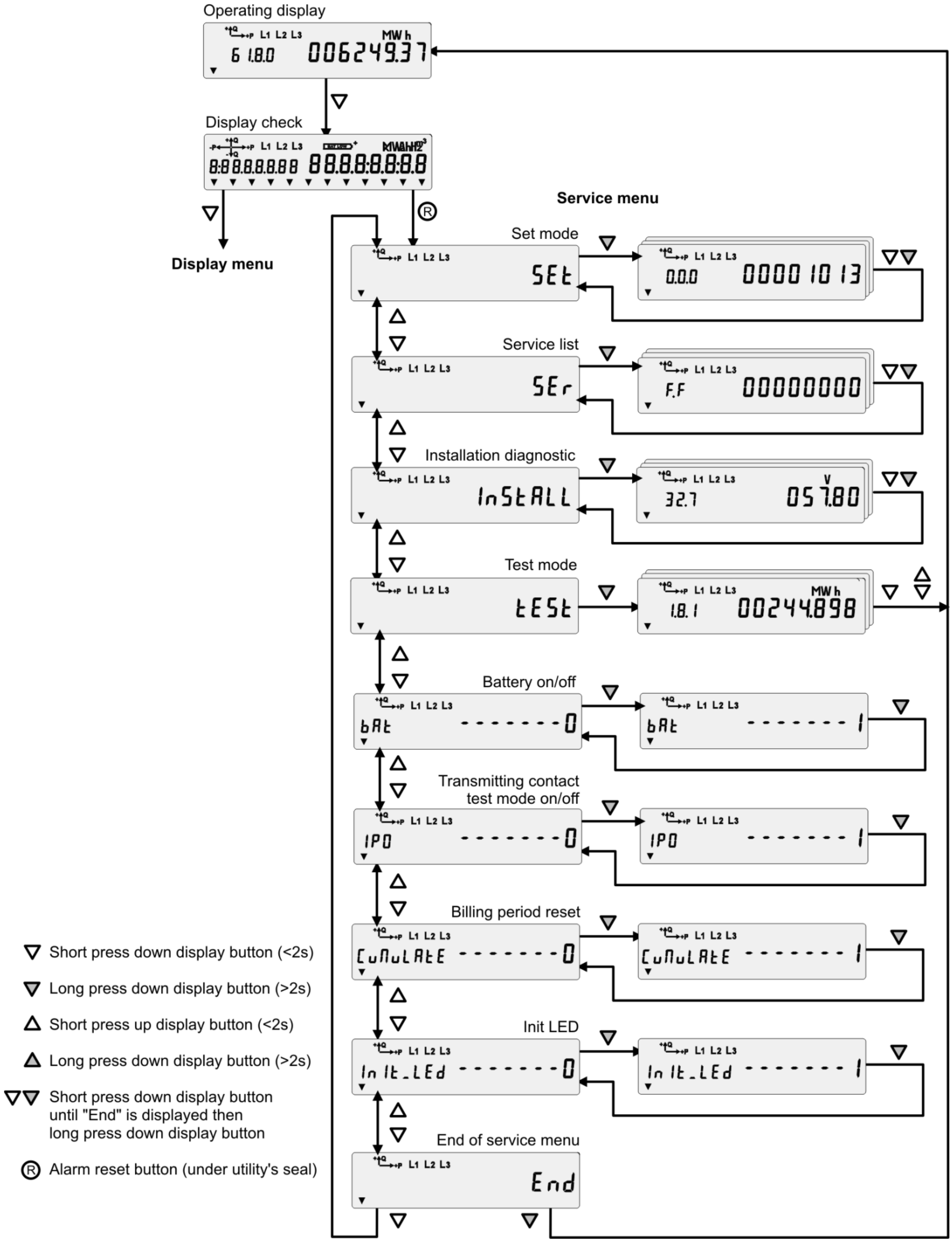
Grid diagnostic: The grid diagnostic displays the following list of instantaneous values. Primary values are always displayed if primary values have been parameterised.

UL1	Primary voltage phase 1
UL2	Primary voltage phase 2
UL3	Primary voltage phase 3
IL1	Primary current phase 1
IL2	Primary current phase 2
IL3	Primary current phase 3
P1	Primary active power (all phases)
Q1	Primary reactive power (all phases)

This display makes it possible to check the situation of the measured network at all times with the meter.

20.2.3 Service Menu

The service menu displays information according to the diagram below (example, depending on parameterisation. It is accessed by pressing the alarm reset button when the display check is displayed.



Set	**Set mode:** In the set mode the user may set/reset the following values and parameters (for details see User Manual):	

ID	The user-defined identification numbers 1.1, 1.2, 1.3, 1.4, 2.1 and 2.2 may be set
Time	The current time may be set
Date	The current date may be set
Battery operating time	The battery operating time may be reset

Ser

Service list: The service list provides the billing data extended by various registers. The additional registers are useful when performing maintenance or service tasks. The registers to be displayed in the service list are selected by parameterisation (see section 20.5.1 "Selection of Entries in each Display List").

Install

Installation check: The installation check displays the following list of secondary instantaneous values. The list is fixed and cannot be altered by parameterisation.

As the installation check display of the ZxQ provides all information necessary for meter installation, it replaces the multimeter of the meter installer.

Depending on the network type of the meter, the following values are displayed:

ZMQ

UL1	Secondary voltage phase 1
UL2	Secondary voltage phase 2
UL3	Secondary voltage phase 3
IL1	Secondary current phase 1
IL2	Secondary current phase 2
IL3	Secondary current phase 3
Angle UL1	Angle between UL1 and UL1 (must read 0)
Angle UL2	Angle between UL1 and UL2
Angle UL3	Angle between UL1 and UL3
Angle IL1	Angle between UL1 and IL1
Angle IL2	Angle between UL1 and IL2
Angle IL3	Angle between UL1 and IL3
Frequency	Network frequency

ZFQ

UL12	Secondary voltage phase 1 to phase 2
UL32	Secondary voltage phase 3 to phase 2
IL1	Secondary current phase 1
IL3	Secondary current phase 3
Angle UL12	Angle between UL12 and UL12 (must read 0)
Angle UL33	Angle between UL12 and UL32
Angle IL1	Angle between UL12 and IL1
Angle IL3	Angle between UL12 and IL3
Frequency	Network frequency

ZCQ

UL1	Secondary voltage phase 1
IL1	Secondary current phase 1
Angle UL1	Angle between UL1 and UL1 (must read 0)
Angle IL1	Angle between UL1 and IL1
Frequency	Network frequency

Test

Test mode: The test mode provides energy registers with a higher resolution in order to shorten testing time. The same registers as the operating display are available but without the auto-scrolling function. Therefore, the step from one register to the next has to be performed manually by pressing one of the display buttons.

If the meter is parameterised to measure losses, the test mode may also provide loss registers if the scrolling display contains them.

In the test mode, the optical test outputs can also signal U2h and I2h.

Register on display	Test output reactive	Test output active
Any register	|R|	|A|
Active energy	|R|	|A|
Reactive energy	|A|	|R|
Losses (internal values)	U^2h	I^2h
Losses (internal values)	I^2h	U^2h
Any other registers not mentioned	|R|	|A|

Bat

Battery on/off: The battery on/off menu is used to switch on and off the battery monitoring (see User Manual). If the battery monitoring is switched off, the low battery indicator and the corresponding error message (F.F. 0100 0000) will not appear when the battery is low or removed.

It is not recommended to disable battery monitoring if there is a battery in the meter.

IPO

Transmitting contact test mode on/off: This menu is used to switch on and off the transmitting contact test mode. With the transmitting contact test mode switched on the meter sends pulses with a frequency of 1 Hz to the pulse receiver no matter the load that is applied to the meter (C.4, C.6 and C.8 only).

ctr_res

Counter reset: This menu is used to reset the counters of the three IEC60870 communication commands freeze, send and respond (C.2 only).

Cumulate

Billing period reset: With every change from 0 to 1 and from 1 to 0 the billing period is reset manually and an entry to the stored billing value profile is made (C.8 with demand measurement only).

Init_LED

Initialise LED: This function is reserved for special service cases.

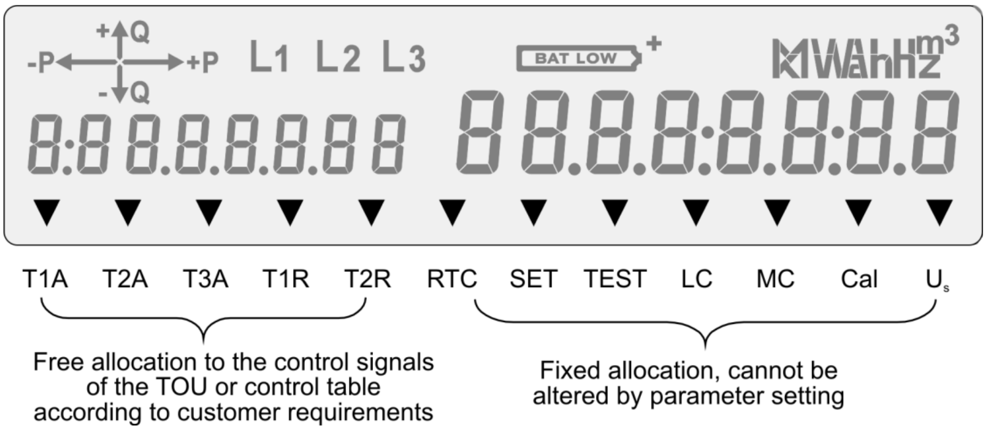
20.3 Arrows in Display

The arrow symbols in the display are used to give status information according to the face plate.

Example

The twelve arrows may be used to indicate:

the active tariff for active energy	T1A, T2A, T3A
the active tariff for reactive energy	T1R, T2R
that the time/date (Real Time Clock) is invalid	RTC
that the meter is in the set mode	SET
that the meter is in the test mode	TEST
that the meter communicates locally using the optical interface or the internal RS485 interface (arrow blinks) (local communication mode)	LC
that the meter communicates with the master station using an interface of the CU (master communication mode). The arrow is constantly on when the meter is equipped with a CU. The arrow blinks when the meter communicates.	MC
that a customer magnitude adjustment and/or a CT/VT correction has been made	Cal
the voltage for the additional power supply U_S is present	U_S

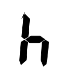
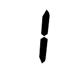
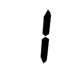
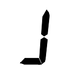
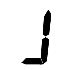
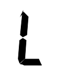
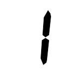
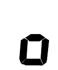
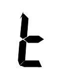
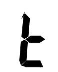


20.4 Display Character Set

Because of the use of a 7-segment display the meter cannot show all characters of the 7-bit ASCII character set.

The following figures and characters can be shown. Unknown characters are shown as <SPACE>.

Hex	Dez	ASCII	LCD		Hex	Dez	ASCII	LCD
20	32	<SPACE>						
2D	45	- (minus)	-					
5F	95	_ (underscore)	_					
30	48	0	0					
31	49	1	1					
32	50	2	2					
33	51	3	3					
34	52	4	4					
35	53	5	5					
36	54	6	6					
37	55	7	7					
38	56	8	8					
39	57	9	9					
41	65	A	A		61	97	a	A
42	67	B	8		62	98	b	b
43	67	C	C		63	99	c	c
44	68	D	d		64	100	d	d

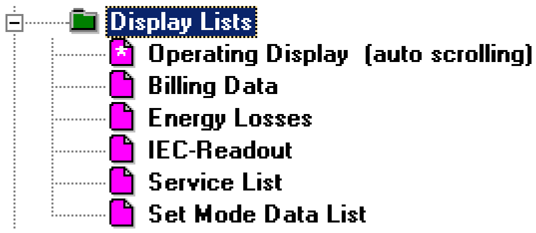
Hex	Dez	ASCII	LCD		Hex	Dez	ASCII	LCD
45	69	E			65	101	e	
46	70	F			66	102	f	
47	71	G			67	103	g	
48	72	H			68	104	h	
49	73	I			69	105	i	
4A	74	J			6A	106		
4C	76	L			6C	108		
4D	77	M			6D	109	m	
4E	78	N			6E	110	n	
4F	79	O			6F	111	o	
50	80	P			70	112	p	
52	82	R			72	114	r	
53	83	S			73	115	s	
54	84	T			74	116	t	
55	85	U			75	117	u	
59	89	Y			79	121	y	
5A	90	Z			7A	122	z	

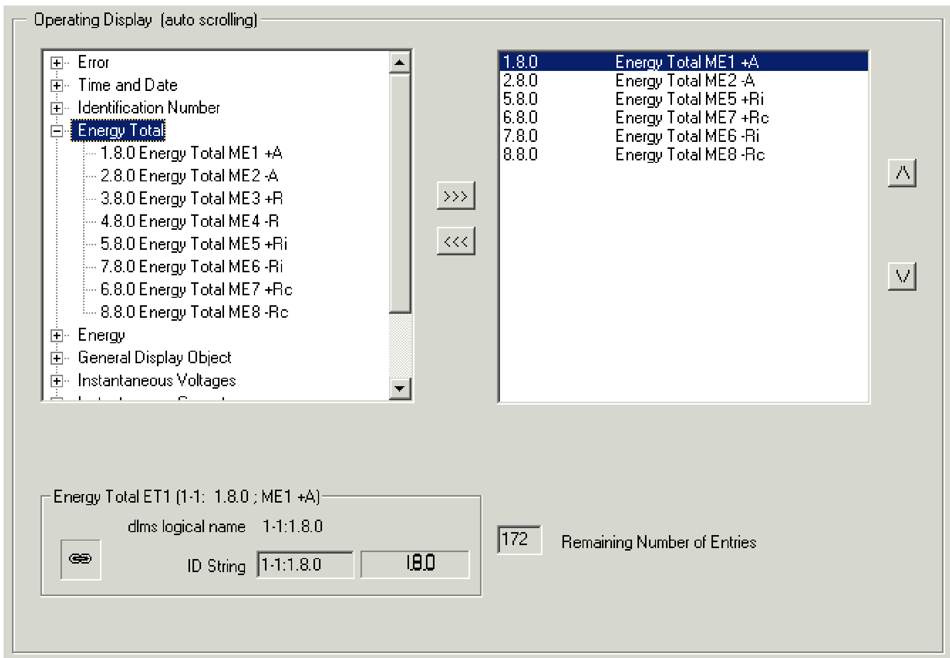
20.5 Display Parameters

20.5.1 Selection of Entries in each Display List

For the following display lists the customer can select the registers that are displayed in the corresponding list.

- Operating Display (auto scrolling)
- Billing Data
- Energy Losses
- IEC-Readout (limited functionality)
- Service List
- Set Mode Data List





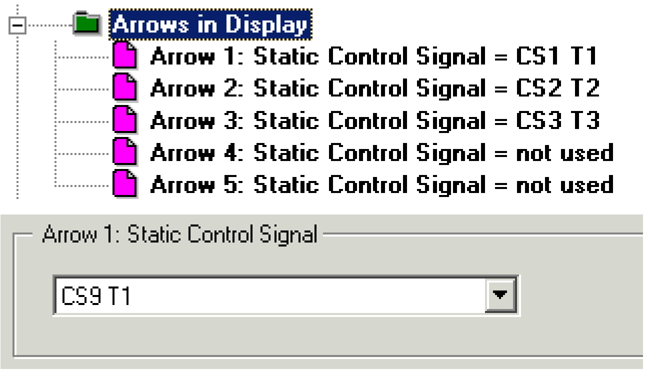
1. Select the display list you wish to edit.
2. Click the register you wish to add to the list.
3. Click **>>>** to add it.

Register display
Each register may be displayed in several lists.

Display Code

The display code appears in the code field of the display. By default the display code is identical to the dlms logical name according to the OBIS standard. However, users can set their own display code for each measured quantity.

20.5.2 Arrows in Display



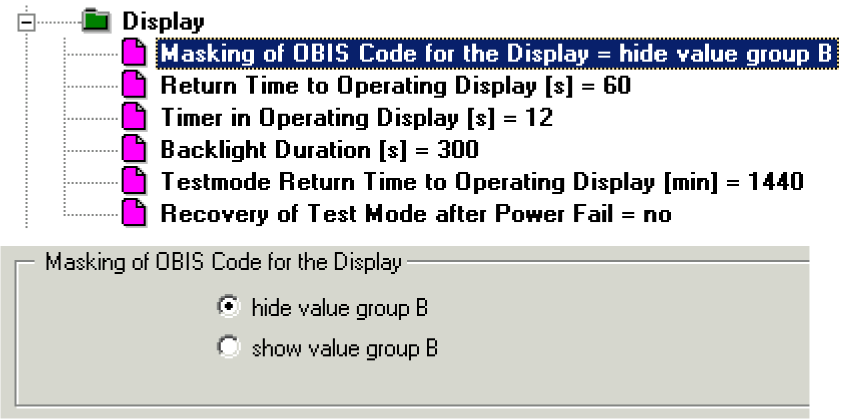
The first five arrows from the left can be activated independently by a control signal (CS1 … CS16 or TOU-E1 … TOU-S). They may be used to indicate the currently active tariffs for active and reactive energy.

The remaining seven arrows in the display give information about the current operating condition of the meter. Their function cannot be altered.

Static Control Signal Select which control signal or which status switches on the arrow.

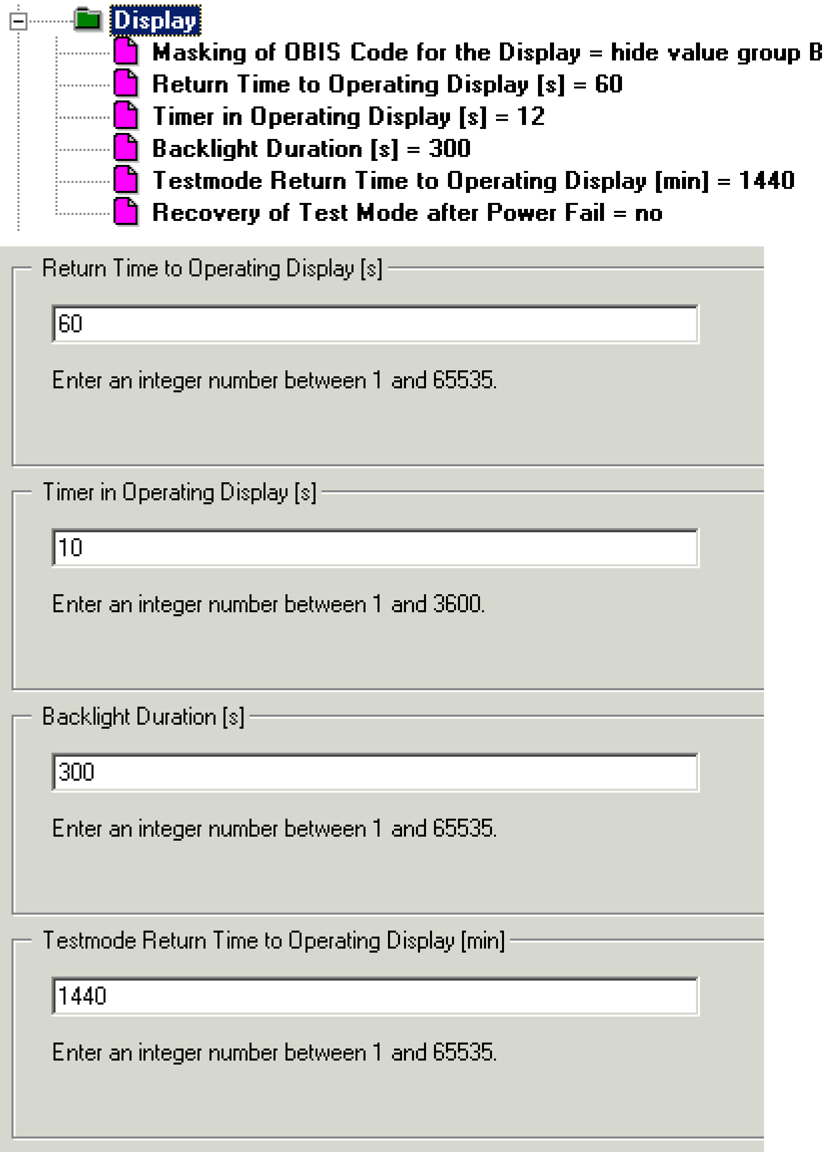
20.5.3 Identification Code Format

Masking of OBIS Code for Display



Select whether or not the channel number B of the OBIS code is included in the identification code on the display. Default setting is hide.

20.5.4 Display Timers



Return Time to Operating Display
Enter the time after which the meter returns to the operating display from any list in the display menu or service menu when no button has been pressed.

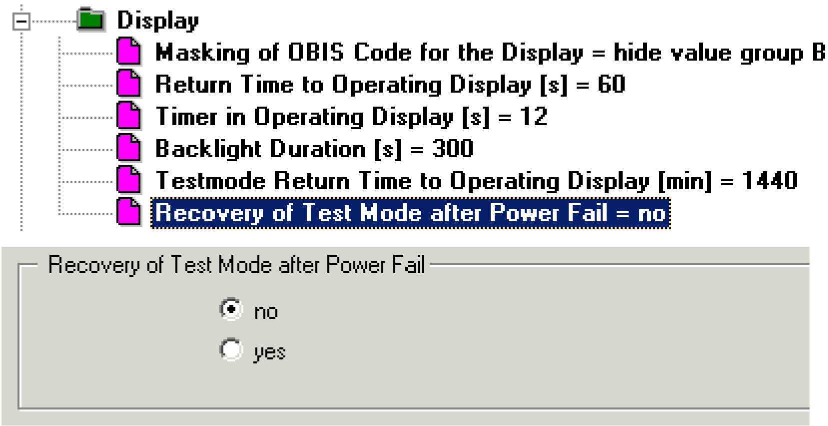
Timer in Operating Display (Autoscroll)
Enter the time interval at which the display scrolls to the next measured value (in the operating display only).

Backlight Duration
Enter the time after which the backlight is switched off when no button has been pressed.

Test Mode Return Time to Operating Display
Enter the time after which the meter returns from the test mode to the operating display (normal mode) when no button has been pressed.

20.5.5 Test Mode

Recovery of Test Mode after Power Failure



Select whether or not the meter returns to the test mode after a power failure has occurred while in the test mode. If "no" is selected the meter returns to the normal operating mode at start-up.

21 Communication

21.1 Overview

Communication with the meter can be established via two different communication channels:

- the optical interface
- the RS485 serial interface

Use a communication unit for additional channels
Further communication channels can be added to the meter by means of optional communication units.

21.2 Communication via the Optical Interface

The optical interface is a serial, bi-directional interface. It is located at the top right corner of faceplate.

The optical interface is defined by the following IEC standards:

- IEC 62056-21: Optical and mechanical definitions
- IEC 62056-42: dlms physical layer
- IEC 62056-46: dlms link layer (HDLC definitions)
- IEC 62056-53: dlms application layer (COSEM)

The optical interface is used:

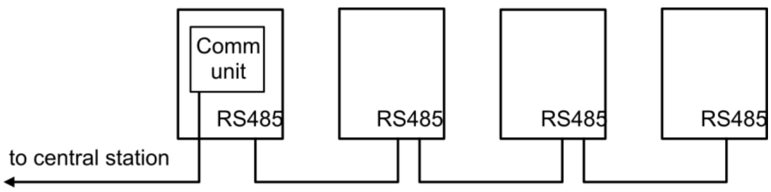
- to communicate with the Landis+Gyr MAP tool
- for local data acquisition by means of a data acquisition device
- to perform service functions, e.g. to enter formatted commands
- as an optical switch. A light beam, e.g. from a torch, has the same function as the Down display button. This makes readings possible without access to the display buttons, e.g. through a protective glass screen in front of the meter.

21.3 Communication via RS485 Interface

The internal RS485 interface of the ZxQ meters is a serial, bi-directional interface according to ISO-8482. It is used to establish communication between the meters as several meters can be connected in a daisy-chain network.

dlms

When using the dlms protocol one meter of the daisy-chain network is connected to the central station. For that purpose, that meter must be equipped with a communication unit.



For details about the RS485 interface please refer to the ZxQ Technical Data.

21.3.1 Addressing the Meters

As several meters are linked in a network, the individual meters must be addressed by a unique identification.

Physical HDLC Device Address

Every meter can be clearly identified by the Physical HDLC Device Address. Landis+Gyr recommends to use the last four figures of the meter's device number plus 1'000.

Example

Meter serial number	76 256	6837
		<u>1000</u>
Physical HDLC Device Address		7837

Therefore, the device address can be a number between 1000 (0000+1000) and 10999 (9999+1000).

Default setting
This is the default setting and meters are shipped with default settings unless ordered otherwise.

Customers may adapt the device addresses according to their requirement. However, the range of numbers which can be used for the physical HDLC device addresses is limited. Only the numbers between 16 and 16381 can be used.

21.4 Communication via Communication Unit

For the ZxQ meter the following communication units (CU) are available:

- B4 (RS232 / RS485)
- M22/V34b (PSTN / RS485)
- E22 (TCP/IP)
- Q22 IEC60870 (RS485 / RS485), only for special applications
- Q22 dlms (RS485 / RS485)
- G22 (GSM / RS485)
- P22 (GPRS/GSM / RS485)
- G32 (GSM / RS485)
- P32 (GPRS/GSM / RS485)

CU-adapter ADP1 needed for f9
Modules with an antenna cannot be used in the metal rack housing. Instead, they have to be connected to f9 ZxQ-meters with a CU-adapter ADP1. This applies to the following CUs: G22, P22, G32, P32.

For details about the communication units please refer to the relevant product documentation.

21.5 Password Input Monitoring

ZxQ200 meters are provided with a password input monitor for the optical and electronic interfaces which can be activated or deactivated. With the input monitor activated, every defined password is individually monitored every time it is entered.

Every wrong password entered sets a flag in a 16-bit status word (bit 1 for password 1, bit 2 for password 2, etc.). The flag is reset when the correct password is entered, provided communication is not yet inhibited.

While a flag is set, all further wrong inputs of all passwords are counted. If the parameterised number of permitted wrong inputs (max. 15) is exceeded, communication is inhibited in all channels for a specific time (max. 24 h).

Inhibition of communication

- sets the error message F.F 00000020,
- can be shown in the display with an arrow and
- can be recorded in the standard event log (event 94).

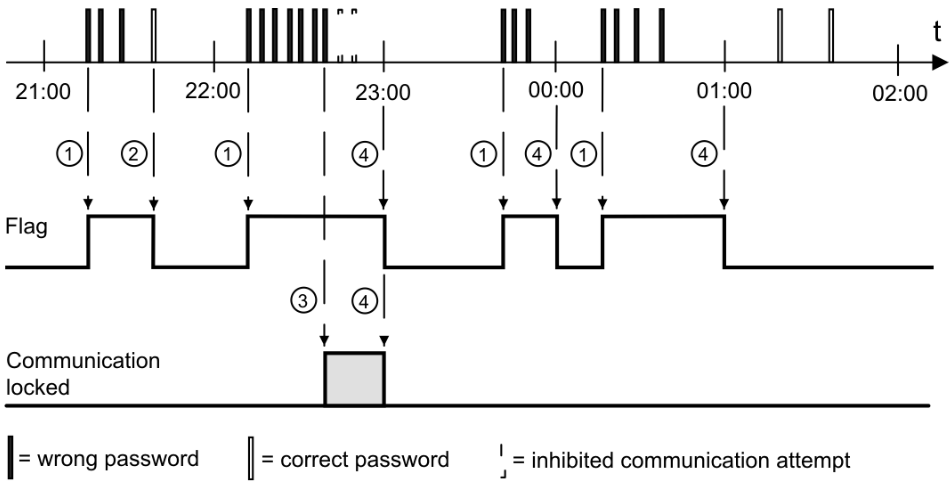
The flags and counters are reset and inhibition cancelled,

- when the voltage in all phases and the supplementary voltage are disconnected or
- if the next full hour (e.g. 01:00, 02:00, etc.) is reached before expiration of the parameterised inhibition time or
- *for versions prior to H03:* if the date changes (at midnight).

The first of these events to occur causes resetting of flags and counters, in addition to cancellation of the communication inhibition.

Example 1

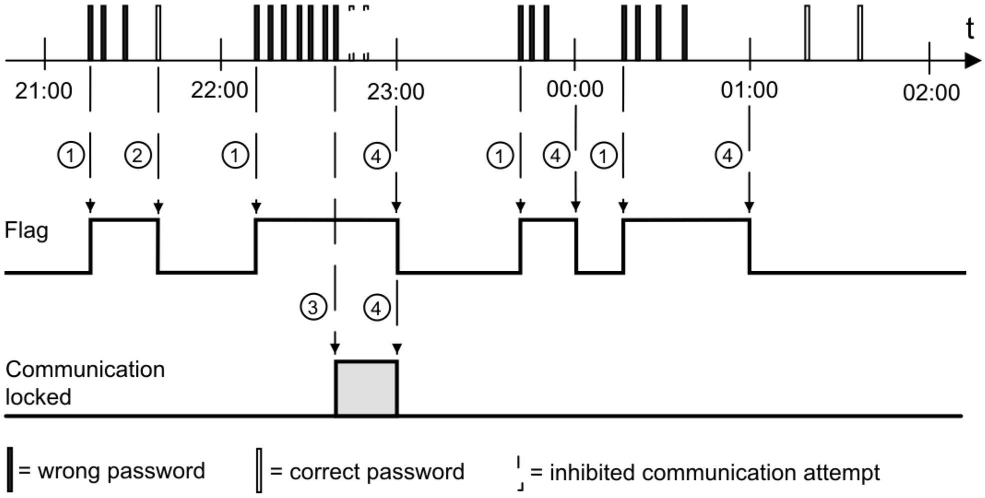
The diagrams below show the method of operation of the input monitor with a parameterised inhibition time of 1 h and with 7 permitted wrong password inputs before inhibition of communication. All accesses are made via the same channel and at the same access level.



① 1st wrong password sets flag and starts counter
② Correct password resets flag and counter as long as count < 7
③ 7th wrong password starts inhibition (count = 7)
④ Next full hour resets flag, counter and inhibition

Example 2

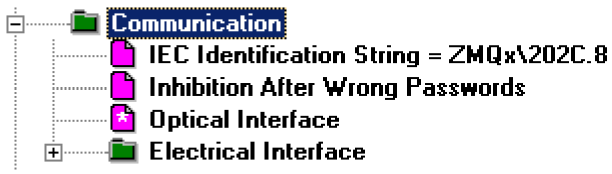
The diagrams below show the method of operation of the input monitor with a parameterised inhibition time of 2 h and with 5 permitted wrong password inputs before inhibition of communication. All accesses are made via the same channel and at the same access level.



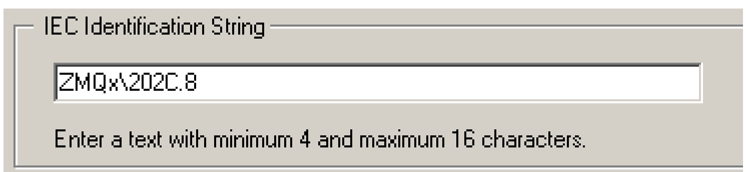
① 1st wrong password sets flag and starts counter
② Correct password resets flag and counter as long as count < 7
③ 7th wrong password starts inhibition (count = 7)
④ Next full hour resets flag, counter and inhibition

21.6 Communication Parameters

21.6.1 General Communication Parameters

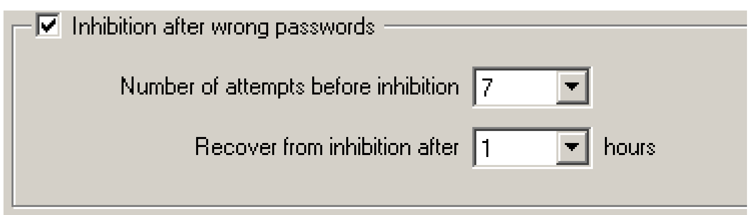


IEC Identification String



Enter the IEC identification string.

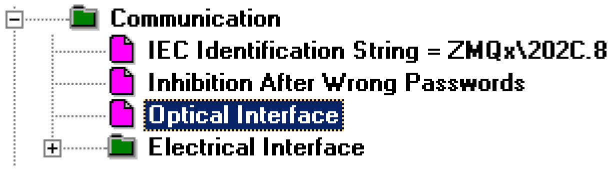
Inhibition after wrong passwords



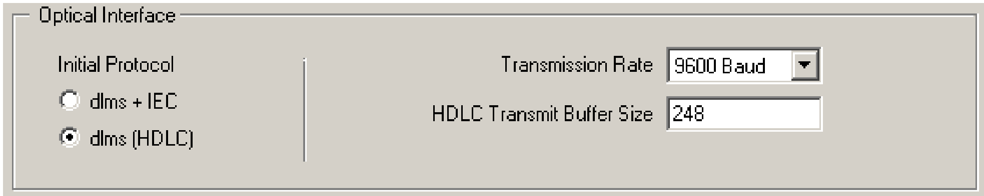
Select the number of wrong password inputs permitted before communication is inhibited (maximum 15, default 7).

Select the duration of communication inhibition following too many wrong password inputs (range 1 to 24 h, default 1 h).

21.6.2 Optical Interface (dlms)



Initial Protocol

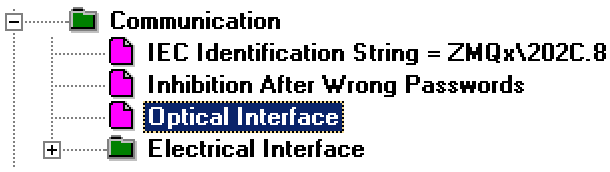


Select the protocol to be used for communication. dlms (HDLC) is the standard setting.

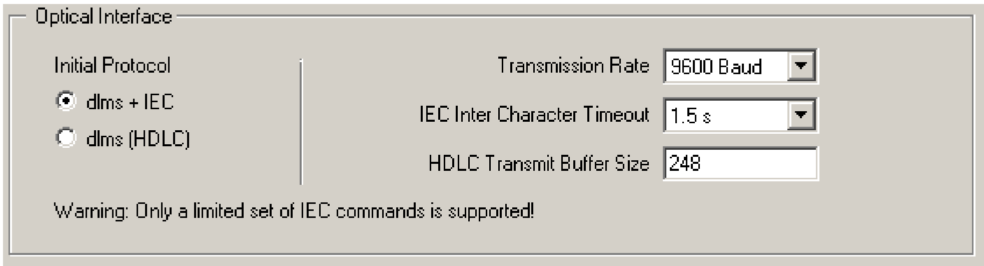
Transmission Rate Select the transmission rate of the interface (maximum 9'600 Baud).

HDLC Transmit Buffer Size Enter the size of the transmit buffer for the dlms-communication (62 ... 248 bytes). The normal size is 248 bytes. Landis+Gyr recommends to reduce the buffer size only in case of communication problems.

21.6.3 Optical Interface (dlms + IEC)



Initial Protocol



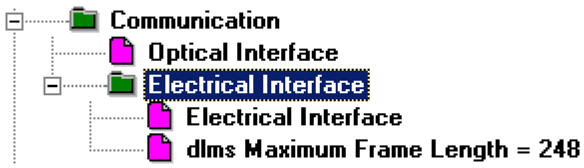
Select the protocol to be used for communication. "dlms (HDLC)" is the standard setting. In special cases, IEC can be used. Please note that only a limited set of commands is available. For more details see section 21.7 "IEC command set (IEC 62056-21, formerly IEC 1107)".

Transmission Rate Select the transmission rate of the interface (maximum 9'600 Baud). The start transmission rate of the optical interface in "dlms + IEC" mode is 300 bps.

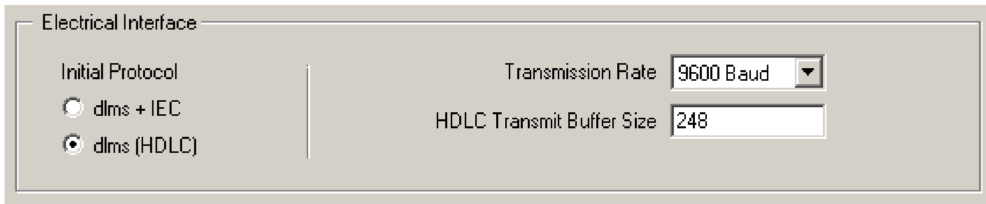
IEC Inter Character Timeout After expiration of this time, the transmission is automatically ended if no further data is transmitted. This parameter only applies to the IEC protocol, i.e. it is not displayed if "dlms" has been selected as start protocol. The standard time delay according to IEC standard is 1.5 s.

HDLC Transmit Buffer Size Enter the size of the transmit buffer for the dlms-communication (62 ... 248 bytes). The normal size is 248 bytes. Landis+Gyr recommends to reduce the buffer size only in case of communication problems.

21.6.4 Electrical Interface (dlms)



Initial Protocol



Select the protocol to be used for communication. dlms (HDLC) is the standard setting.

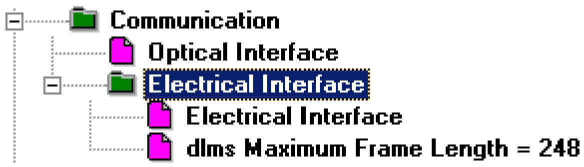
Transmission Rate

Select the transmission rate of the interface (maximum 57'600 Baud).

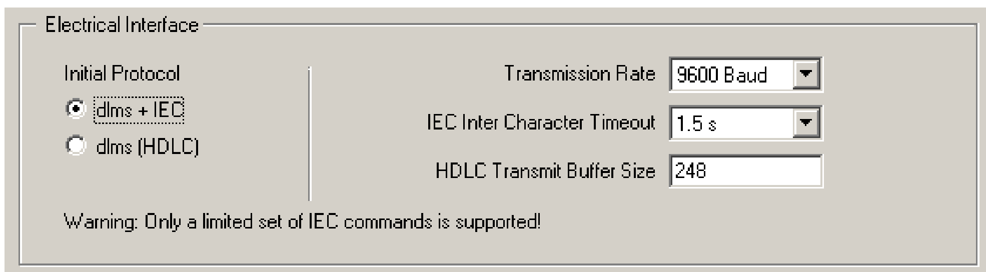
HDLC Transmit Buffer Size

Enter the size of the transmit buffer for the dlms-communication (62 ... 248 bytes). The normal size is 248 bytes. Landis+Gyr recommends to reduce the buffer size only in case of communication problems.

21.6.5 Electrical Interface (dlms + IEC)



Initial Protocol



Select the protocol to be used for communication. "dlms (HDLC)" is the standard setting. In special cases, IEC can be used. Please note that only a limited set of commands is available. For more details see section 21.7 "IEC command set (IEC 62056-21, formerly IEC 1107)".

Transmission Rate

Select the transmission rate of the interface (maximum 57'600 Baud).

IEC Inter Character Timeout

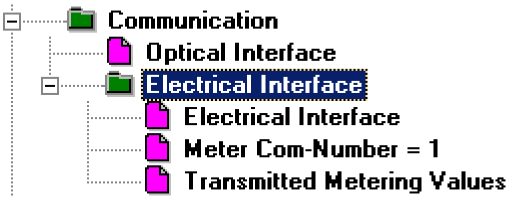
After expiration of this time, the transmission is automatically ended if no further data is transmitted. This parameter only applies to the IEC protocol, i.e. it is not displayed if "dlms" has been selected as start protocol. The standard time delay according to IEC standard is 1.5 s.

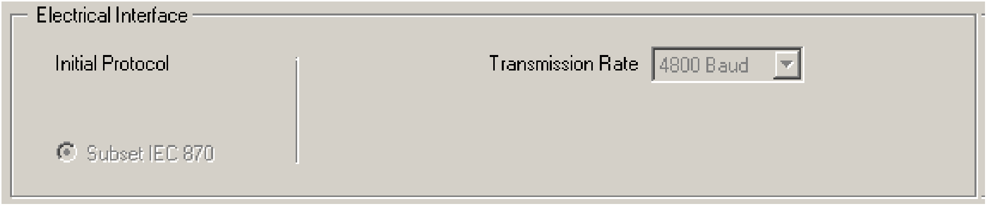
HDLC Transmit Buffer Size

Enter the size of the transmit buffer for the dlms-communication (62 ... 248 bytes). The normal size is 248 bytes. Landis+Gyr recommends to reduce the buffer size only in case of communication problems.

21.6.6 Electrical Interface (IEC60870 Subset; C.2 only)

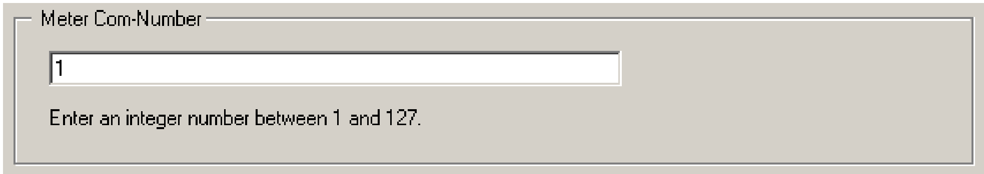
Electrical Interface





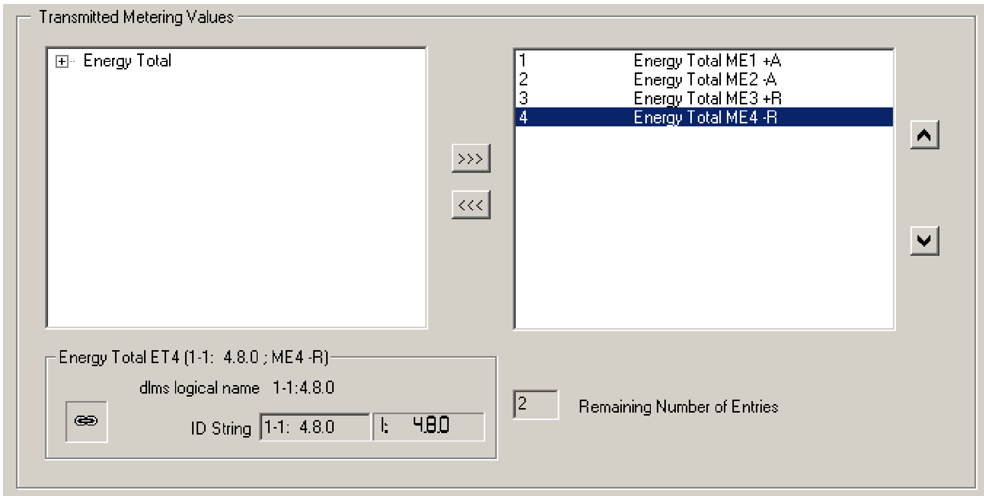
For the communication with the IEC60870 subset the transmission rate of the electrical interface is fixed to 4800 Baud.

Meter Com-Number



Select the communication number of the meter. Make sure that no meter within the same daisy-chain network carries the same communication number.

Transmitted Metering Values



Select the measured values that are transmitted from this meter to the transcoder. A maximum of six measured values may be selected.

1. Click the total energy register you wish to add to the list of transmitted values.
2. Click **>>>** to add it.

21.7 IEC command set (IEC 62056-21, formerly IEC 1107)

The H03 firmware enables the use of a limited set of IEC commands with the configurations C.4, C.6 and C.8 (only available for Germany, Austria and Switzerland). The following table lists the available commands.

Register	IEC or OBIS (for VDEW)	ZxQ200 – H03
Identification numbers		
ID 1		R (only in readout list)
ID 2		R (only in readout list)
Software identification	FF01	R2
Time / Date Information		
Time / date	C001 (YYMMDDHHMMSSWWN)	W2, R2
Time / date / season	C003 (YYMMDDHHMMSSWWNZ)	W2, R2
Registers		
Energy registers		R (only in readout list)
Demand registers		R (only in readout list)
Energy and demand registers		R (only in readout list)
Reset all registers and total registers (energy and demand)	A0F0 (0000)	W2
Billing period reset (cumulation)		
Billing period reset	0001	E2
Billing period counter	C100 (n+)	W2, R2
Diagnostics		
Error code	C150 or C150 (0000)	W2, R2
Reset error code (masked)	C150 (n+)	W2
Communication		
IEC Device Address	D110 (n+)	R (only in readout list)
Test mode		
Enable test mode (high resolution)	0101	E2
Disable test mode (high resolution)	0102	E2

The following commands are **not** available:

- All W4 (formatted block write) commands
- All W5 commands
- Read and reset commands for profiles (R5, R6)
- IEC readout in C.7

21.8 Reference Documentation

- Basic Information for Communication Applications H 71 0200 0146 en
- Application Instructions for Multiple Connections with RS485 Interfaces H 71 0200 0154 en

This documentation gives extensive information about the meaning of all parameters involved and the procedure of setting up a communication using the RS485 interface. It is available from all Landis+Gyr representatives.

22 Identification Numbers

22.1 Description

Identification numbers can be used for several purposes. Some of them can be set by the customer (e.g. the customer IDs). Other identification numbers are the result of an action or clearly identify a status of the meter (e.g. the calibration ID or the firmware ID).

Identification numbers are alphanumerical strings that can be read via communication and, in some cases, viewed on the display. All identification numbers are given a display code according to the OBIS standard.

Settable identification numbers may be set using the MAP tool or in the set mode of the meter.

Display of an identification number

Do not use letters
The identification number may contain letters. Some letters, however, cannot be displayed on the 7-segment display (see also section 20.4 "Display Character Set").
Landis+Gyr recommend not to use letters for the identification numbers.

Name	Description	Availability	OBIS Code
Customer IDs 1-1 1-2 1-3 1-4 2-1 2-2	The customer IDs can be used by the customer to store any identification (e.g. the meter device number). These IDs can be set by the customer. A maximum of 8 figures per ID is allowed.	display, communication	ID1-1 = 0.0.0 ID1-2 = 0.0.1 ID1-3 = 0.0.2 ID1-4 = 0.0.3 ID2-1 = C.1.0 ID2-2 = C.1.1
Firmware ID	The Firmware ID identifies the firmware version of the meter (e.g. 00, H01, H02, H90, H03).	display, communication read only	0.2.0
Parameterisation ID	The Parameterisation ID identifies the current parameterisation of the meter. Can be used as a reference by the customer to quickly check the current parameterisation. The ID can be set by the customer.	display, communication	0.2.1
Date/Time of last Parameterisation	A time stamp is stored every time the meter is (re)parameterised.	display, communication read only	C.2.1

Name	Description	Availability	OBIS Code
Parameterisation counter	The Parameterisation counter is increased by 1 after every write access to the meter every time the meter is (re)parameterised.	communication read only	C.2.0
TOU Active ID	The TOU Active ID identifies the active TOU switching tables. The ID can be set by the customer.	display, communication	0.2.2
TOU Passive ID	The TOU Passive ID identifies the passive TOU switching tables. The ID can be set by the customer.	display, communication	0.2.7
Configuration ID	The Hardware Configuration ID is calculated based on the hardware configuration that has been selected with the MAP tool.	display, communication read only	C.90
Connection ID	The Connection ID identifies the connection diagram of the meter according to DIN43856. Can be used as installation aid.	display, communication	0.2.4
dlms device ID	The dlms device ID is a world-wide unique address that is used to clearly identify the meter. The dlms device ID is part of the communication protocol and consists of the letters "LGZ" and the 8-digit meter device number.	communication read only	42.0.0
Physical HDLC device address	When communicating with the RS485 interface, the Physical HDLC Device Address clearly identifies every meter. By default, it consists of the last four figures of the meter's device number plus 1'000.	communication	C.90.2
Date/Time of last Calibration	A time stamp is stored when the meter is calibrated at the manufacturing plant.	display, communication read only	C.2.5
Date/time of last synchronisation	A time stamp is stored when the clock is synchronised.	display, communication read only	C.2.12
Metering Code ID	The Metering Code ID is a 33-character alphanumerical string that is unique to each meter world-wide. The ID contains information about the country and the customer and is set by the customer.	communication	C.1.10

22.2 Identification Number Parameters

Where possible, enter the identification numbers as required.

Apart from entering the identification numbers themselves, no parameters must be set.

23 Security System

23.1 Introduction

The data and parameters of the ZxQ meters are protected against unintended or improper access by a flexible, multi-stage security system. It is very similar to the one in computer systems and consists of several access levels (users) with different access rights.

Defining the security system
The security system should be defined according to the requirements of the customer and the national regulations when ordering the meter. There are only limited changing possibilities in the field and special tools are required.

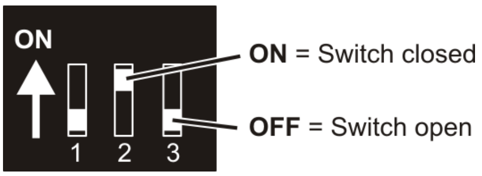
All meters, for which no specific security system has been defined, are delivered with a standard security system. It is the customer's responsibility to ensure the security system conforms to national regulations.

23.2 Security Attributes

For each access level, various security attributes can be defined that must be fulfilled to gain access.

23.2.1 Switches Protected by the Verification Seal

Under the main face plate, above the display and protected by the verification seal, there is a block of hardware switches. Their positions must be defined in order to gain access to a particular level:



S1: must always be open (OFF)

S2: Parameterisation switch used for parameterisations. If this switch is closed (ON), flashing arrows appear in the display.

S3: not used

S4: not used (f9 meters only)

To change the position of the switches, remove the cover (f6 meters) or remove the metal housing (f9 meters) from the meter. In either case, the verification seal must be opened.

The position required is defined for each level and is checked by the meter in any case. The status "OFF" is equal to "does not care". The setting of the switch is ignored if status "OFF" is required. In former firmware releases the status "does not care" is not implemented and it is mandatory to open the switch to gain access.

Unless ordered otherwise, all meters are delivered with open switches (OFF = all switches in the down position).

23.2.2 Entering the Service Menu Protected by the Utility Seal

It may be defined that access to a certain level will only be granted from the service menu. To enter the service menu the utility seal must be opened.

23.2.3 Passwords

A password may be defined for some access levels. Either a static 8-character password or a coded 7-character password can be used.

If a static password is used, the user needs to know the password. It is checked by the meter and access is granted if the passwords match.

If a coded password is used, the user not only needs to know the password but also an encryption algorithm. Due to the encryption a Landis+Gyr tool is required to access such a level.

For the passwords only the characters '0' to '9' and 'A' to 'F' are allowed.

23.2.4 Communication Channels

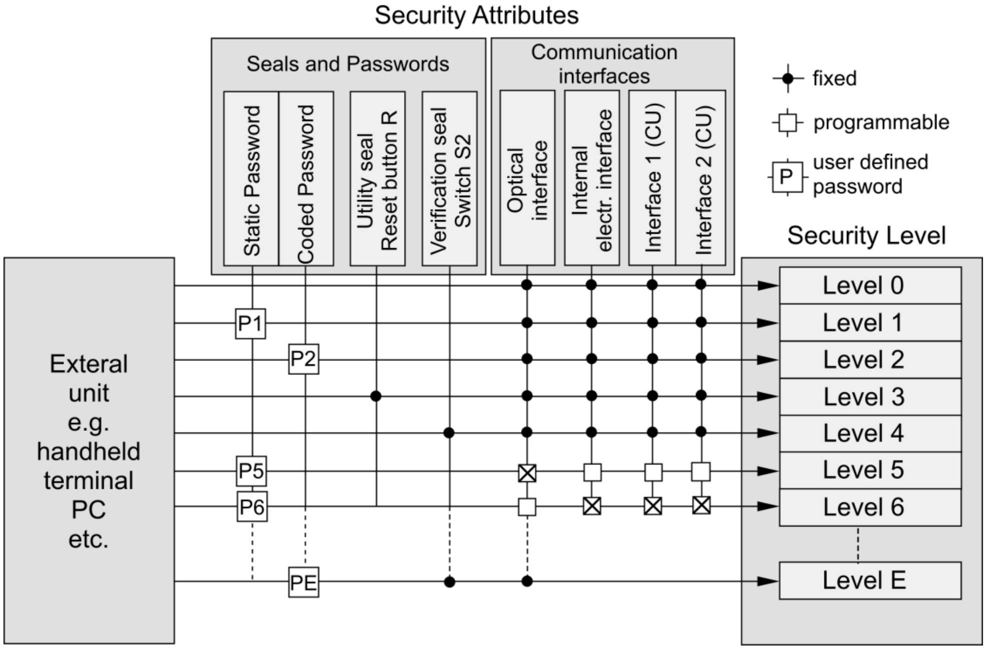
The access to a certain level may be restricted so that it is only granted via selected communication channels.

Independent access is possible via the optical interface, the integrated RS485 interface and both communication channels of the communication unit.

23.3 Access Levels

The ZxQ meters feature 15 different access levels (level 0 to 9, A to E) with different access rights each. For groups of registers and parameters, it can be defined which level is required to read and which level to write.

Each access level is protected by security attributes which must be fulfilled to gain access.



All levels are strictly independent i.e. a higher level does not automatically bear all rights of the lower levels.

23.3.1 Access Levels and their Application

The table below describes all levels with the required security attributes and their typical application. The access rights themselves are defined by the customer when ordering the meter. They depend on the customer's needs and on national regulations.

The UID (user identification) is used in dlms communication to select the access level.

Level	Security attributes	Access rights and typical application examples
0 Public Access UID = 16	no password no seal all channels	This access level is always available. All dlms meters can be accessed on this level. All data can be read but there is no write access.
1 Data Collection UID = 32	with static password without breaking a seal channels selectable	Readout of billing data by means of a handheld terminal or possibly by a central station. All billing data is readable. Limited write access possible, e.g. time/date.
2 Customer Field Service UID = 48	with coded password without breaking a seal Landis+Gyr Tool required because of coded password	Installation or maintenance tasks in the field. All parameters and all billing data are readable. Limited write access to uncritical data is possible, e.g. device addresses, identification numbers, phone numbers etc.
3 Customer Service UID = 64	no password breaking the utility seal necessary all channels	Installation or maintenance work by customer. All parameters and all billing data are readable. Limited write access possible, e.g. battery operating time, switching tables etc.
4 Extended Service by customer UID = 80	no password breaking the verification seal necessary all channels	Parameterisation by customer. All parameters and all billing data are readable. Write access to all data and parameters is granted, e.g. parameterisation, register clearing, password setting etc. After the access, a verification is needed.
5 Extended Consumer UID = 17	with static password without breaking a seal channels selectable	Write access for the end user. All parameters and most billing data are readable. Write access to user data is granted, e.g. monitor thresholds.
6 Remote Data Collection UID = 18	with static password without breaking a seal no access via optical interface	Readout of billing data by a central station. All billing data are readable. Limited write access is possible, e.g. time/date.
7 Remote Service UID = 19	with static password without breaking a seal no access via the optical interface	Installation or maintenance work in connection with a central station. All parameters and all billing data are readable. Limited write access is granted, e.g. switching tables, device addresses, identification numbers, phone numbers etc.

Level	Security attributes	Access rights and typical application examples
8,9,A,B		Reserved for future expansion.
C Read Administrator UID = 96	with static password without breaking a seal no access via the optical interface	Allocation of read access rights All parameter and all billing data are readable. Read access rights for all lower levels (0 to B) can be allocated.
D Customer Administrator UID = 97	with coded password breaking the verification seal necessary access via optical interface only Landis+Gyr Tool required because of coded password	Same as level 4. In addition, changes in the customer security system are possible. Read and write access rights can be adapted and all password can be changed. After the access, a verification is required.
E Distributor Service UID = 100	with coded password breaking the verification seal necessary access via optical interface only Landis+Gyr Tool required because of coded password	Service access of the distributor. Identical to level D. In addition, changing the access rights and the password of the customer's administrator is possible. After the access, a verification is required.

23.4 Security System Parameters

When ordering the meter, the whole security system must be defined according to customer requirements and national regulations.

23.4.1 Security Attributes

Most of the security attributes have been fixed. Nevertheless, some of them can be changed if required. In the table below you find a detailed description of all access levels with the associated settings.

The following syntax is used:

Value can be changed at ordering time
Value is fixed

Description	Value	Remark
Public Access (Level 0)		**read access only**
Password		not used
Password Type	*no password*	no password
Service Menu (Utility Seal)	*not required*	
Switch Under Verification Seal	*not required*	
Optical Interface	*Access allowed*	
Internal Electrical Interface	*Access allowed*	
Communication Channel 1 (CU only)	*Access allowed*	
Communication Channel 2 (CU only)	*Access allowed*	

Description	**Value**	**Remark**
Data Collection (Level 1)		
Password	00000000	Default password
Password Type	*static password*	
Service Menu (Utility Seal)	*not required*	
Switch Under Verification Seal	*not required*	
Optical Interface	*Access allowed*	
Internal Electrical Interface	Access allowed	Default value
Communication Channel 1 (CU only)	Access allowed	Default value
Communication Channel 2 (CU only)	Access allowed	Default value

Customer Field Service (Level 2)		
Password	1234567	Default password
Password Type	*coded password*	
Service Menu (Utility Seal)	*not required*	
Switch Under Verification Seal	*not required*	
Optical Interface	*Access allowed*	
Internal Electrical Interface	Access allowed	Default value
Communication Channel 1 (CU only)	Access allowed	Default value
Communication Channel 2 (CU only)	Access allowed	Default value

Customer Service (Level 3)		
Password		not used
Password Type	*no password*	no password
Service Menu (Utility Seal)	*required*	
Switch Under Verification Seal	*not required*	
Optical Interface	*Access allowed*	
Internal Electrical Interface	*Access allowed*	
Communication Channel 1 (CU only)	*Access allowed*	
Communication Channel 2 (CU only)	*Access allowed*	

Extended Customer Service (Level 4)		
Password		not used
Password Type	*no password*	no password
Service Menu (Utility Seal)	*not required*	
Switch Under Verification Seal	*required*	
Optical Interface	*Access allowed*	
Internal Electrical Interface	*Access allowed*	
Communication Channel 1 (CU only)	*Access allowed*	
Communication Channel 2 (CU only)	*Access allowed*	

Description	Value	Remark
Extended Consumer (Level 5)		
Password	55555555	Default password
Password Type	*static password*	
Service Menu (Utility Seal)	*not required*	
Switch Under Verification Seal	*not required*	
Optical Interface	Access allowed	Default value
Internal Electrical Interface	Access allowed	Default value
Communication Channel 1 (CU only)	Access allowed	Default value
Communication Channel 2 (CU only)	Access allowed	Default value
Remote Data Collection (Level 6)		
Password	66666666	Default password
Password Type	*static password*	
Service Menu (Utility Seal)	*not required*	
Switch Under Verification Seal	*not required*	
Optical Interface	no access	
Internal Electrical Interface	Access allowed	Default value
Communication Channel 1 (CU only)	Access allowed	Default value
Communication Channel 2 (CU only)	Access allowed	Default value
Remote Service (Level 7)		
Password	77777777	Default password
Password Type	static password	Default value
Service Menu (Utility Seal)	*not required*	
Switch Under Verification Seal	*not required*	
Optical Interface	no access	
Internal Electrical Interface	Access allowed	Default value
Communication Channel 1 (CU only)	Access allowed	Default value
Communication Channel 2 (CU only)	Access allowed	Default value
Read Administrator (Level C)		
Password	CDEF123	Default password
Password Type	*coded password*	
Service Menu (Utility Seal)	*not required*	
Switch Under Verification Seal	*not required*	
Optical Interface	*Access allowed*	
Internal Electrical Interface	*Access allowed*	
Communication Channel 1 (CU only)	*Access allowed*	
Communication Channel 2 (CU only)	*Access allowed*	

Description	**Value**	**Remark**
Customer's Administrator (Level D)		
Password	DEF1234	Default password
Password Type	*coded password*	
Service Menu (Utility Seal)	*not required*	
Switch Under Verification Seal	*required*	
Optical Interface	*Access allowed*	only local access possible
Internal Electrical Interface	*no access*	
Communication Channel 1 (CU only)	*no access*	
Communication Channel 2 (CU only)	*no access*	

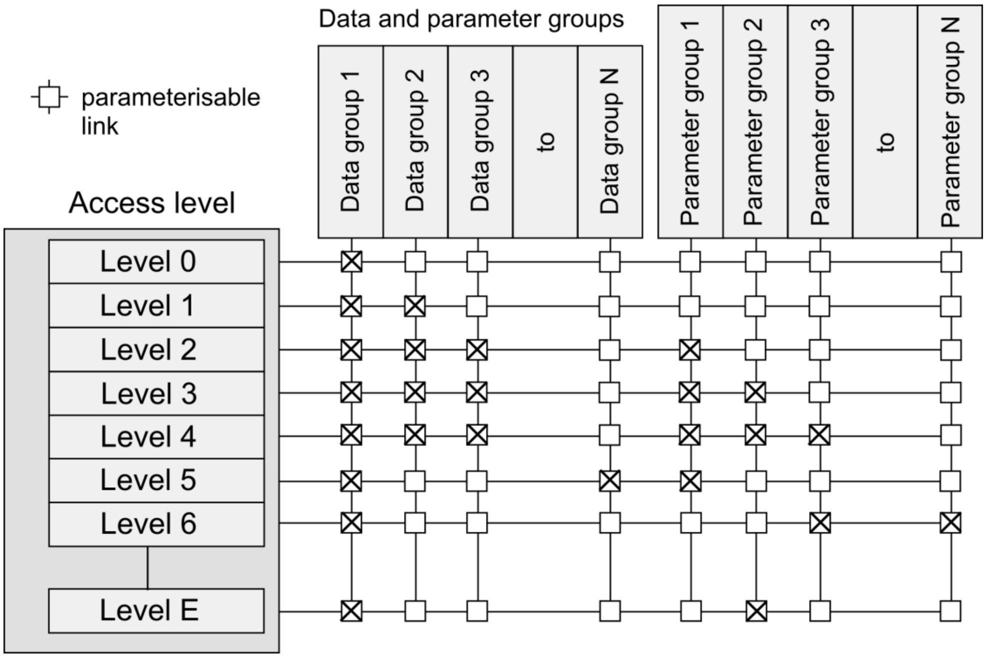
Distributor Service (Level E)		
Password	EF12345	Default password
Password Type	*coded password*	
Service Menu (Utility Seal)	*not required*	
Switch Under Verification Seal	*required*	
Optical Interface	*Access allowed*	only local access possible
Internal Electrical Interface	*no access*	
Communication Channel 1 (CU only)	*no access*	
Communication Channel 2 (CU only)	*no access*	

Handling of passwords
All meters are delivered with standard passwords as listed above. It is in the responsibility of the customer to change these passwords. If you order the meters with customer specific passwords Landis+Gyr is not able to guarantee the secrecy of such passwords throughout the whole manufacturing process.

23.4.2 Allocation of Access Rights to Data and Parameter Groups

In order to simplify the handling of the access rights, all registers and parameters have been grouped.

Read and write access for every group can be allocated to the individual access levels.



The allocation is defined by the customer application and by national approval regulations.

In the tables below a list of all data and parameter groups is given.

23.4.3 Data Groups (Registers and Profiles)

No.	Name	Content
00	Error Code	Error code of the device
01	Identification Number 1	Identification numbers 1.1 to 1.4
02	Identification Number 2	Identification numbers 2.1 to 2.2
03	HDLC Device Addresses	Physical HDLC device address used to address the device in dlms communication protocols.
04	Parameterisation ID, Timestamp and Counter	Parameterisation ID, time of last parameterisation and number of parameterisations.
05	Snapshot Counter (Counter and Timestamp)	Content of the billing period counter and the timestamps of all billing period resets.
06	Energy Total Registers	Content of all energy total registers.
07	Energy Registers	Content of all energy registers without total registers.
08	Time and Date	Date, time and status of the clock.

No.	Name	Content
10	Battery (Time, Voltage and Symbol)	Battery related items as battery operating time register, battery voltage and enabling/disabling of the battery low symbol.
11	Connection ID	Connection ID to identify the type of connection.
13	Power Factor	Content of the power factor registers
14	Event Log	Content of the event log profile
15	Energy Profile (Stored Values)	Content of the stored value profile
70	Maximum Demand Registers	Content of the maximum demand registers
71	Cumulative Maximum Demand Registers	Content of the cumulative maximum demand registers
73	Load Profile	Content of the load profile
83	Voltage DIP Table	Content of the voltage dip table
84	Installation and Network Values	Content of the Installation Check and Grid Diagnostic registers
16	All other Registers	All registers not listed in the table elsewhere, e.g. phase fail counter.

Read access to data

Usually all users have access to all data. In liberalised markets different users may have different access rights. If you want to change parameters in an access level it is absolutely necessary to have read access to the data as well as write access to the parameters.

Write or reset access to data

It is not possible to give write or reset access to registers or profiles in level 0.

There is no difference between write and reset access to a register or a profile.

23.4.4 Parameter Groups

No.	Name	Content
W09	Clock (Synchronisation, Daylight Saving)	Configuration of clock: Clock base, synchronisation source and interval, daylight saving time
W20	Pulse Output Configuration	Configuration of output contacts (type and linked parameters)
W21	Primary Values (Transformer Ratio)	All items related to primary data adaptation: Primary voltage and current, pulse length and pulse constant of transmitting contacts
W22	Power Factor Configuration	Threshold and control signal for power factor registration and power factor monitoring

No.	Name	Content
W23	Event Log Configuration	Trigger sources and registers captured in event log
W24	Snapshot Control (Reset Tables)	Date and time of billing period reset (energy snapshot)
W25	Energy Register Format	Assignment of measured quantity, type of register and register resolution of all energy and energy total registers, display code
W26	Demand Register Format	Assignment of measured quantity, and register resolution of all kind of demand registers, display code
W27	Display Lists	Content of all display lists and the set mode list. The display code of every entry with exception of the energy registers can be changed.
W28	Control Table	Settings of the control table as well as the activation source of registers, outputs and arrows
W68	Customer Magnitude Adjustment	Settings of the customer magnitude adjustment
W69	CT / VT Error Correction	Settings of the current and voltage transformer error correction
W72	Energy Profile (Stored Value) Configuration	Registers captured in stored value profile
W74	Monitor Thresholds	Threshold and activation delay of under and over voltage monitors and over current monitors
W77	Integration / Capture Period	Type and duration of the integration and the capture period
W78	Load Profile Configuration	Registers captured in load profile
W79	TOU and Special Day Table	Passive TOU and special day table, emergency settings. Active TOU is always read only.
W80	Communication Parameters	dlms communication settings of the optical interface with exception of the device address
W82	Communication Parameters RS485	dlms communication settings of the internal electrical interface with exception of the device address
W85	Losses: Iron and Copper Resistor	Setting for the equivalent resistance of the transmission line (copper) and the transformer (iron) used for loss calculation
W29	All other Parameters	All parameters not listed in the table elsewhere

For parameters read access is always possible, only the write access can be selected.

It is not possible to give write access to parameters in level 0.

23.4.5 Access to Commands

Please note that the security concept is based on protection of data and not on protection of commands, i.e. the data itself is protected not the command.

No.	Name	Content
W30	Register Reset	Reset command to all energy and demand registers. The registers are only cleared if the necessary reset access is reached.

23.4.6 Modification of Passwords

Please observe the hints in section 23.4.1 "Security Attributes".

Passwords cannot be read from the meter.

No.	Name	Content
W33	Password 1	Static password of level 1. This is used in dlms communication protocols.
W34	Password 2	Coded password of level 2. This is used in dlms communication protocols.
W37	Password 5	Static password of level 5.
W38	Password 6	Static password of level 6.
W39	Password 7	Coded or static password of level 7.
W44	Password C	Coded password of level C.
W45	Password D	Coded password of level D.
W46	Password E	Coded password of level E.

Usually every level is allowed to change its own password. Make sure that at least one administrator access is available to reset the passwords.

23.5 High Level Security System Example

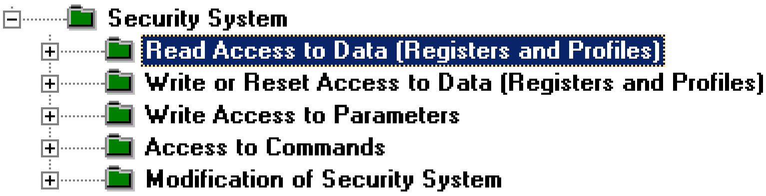
In this section an example of a high level security system is given. All changes that have any influence on the billing require a new verification of the device.

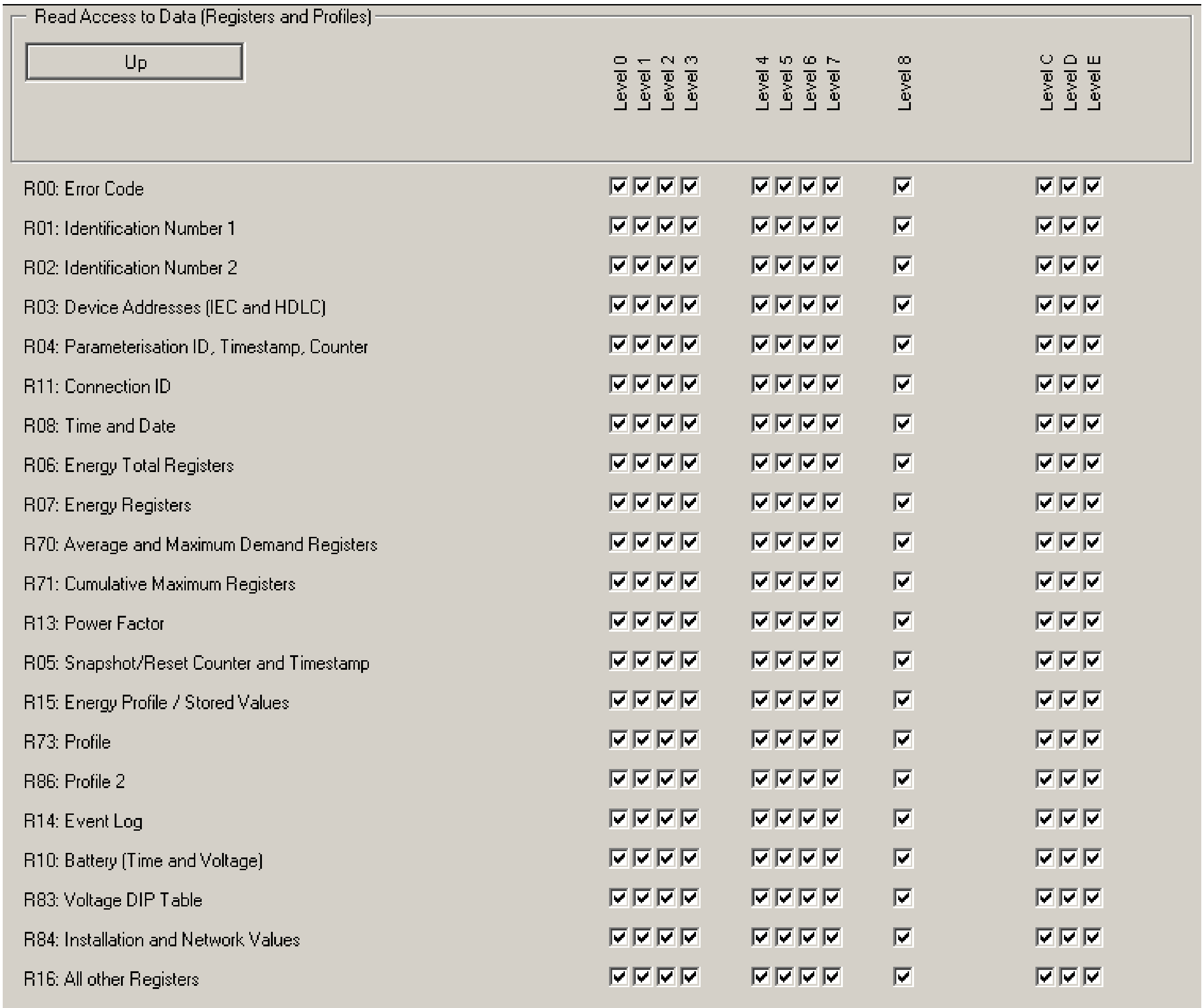
The levels are used as described in section 23.3.1 "Access Levels and their Application".

23.5.1 Security Attributes

As defined in 23.4.1 "Security Attributes".

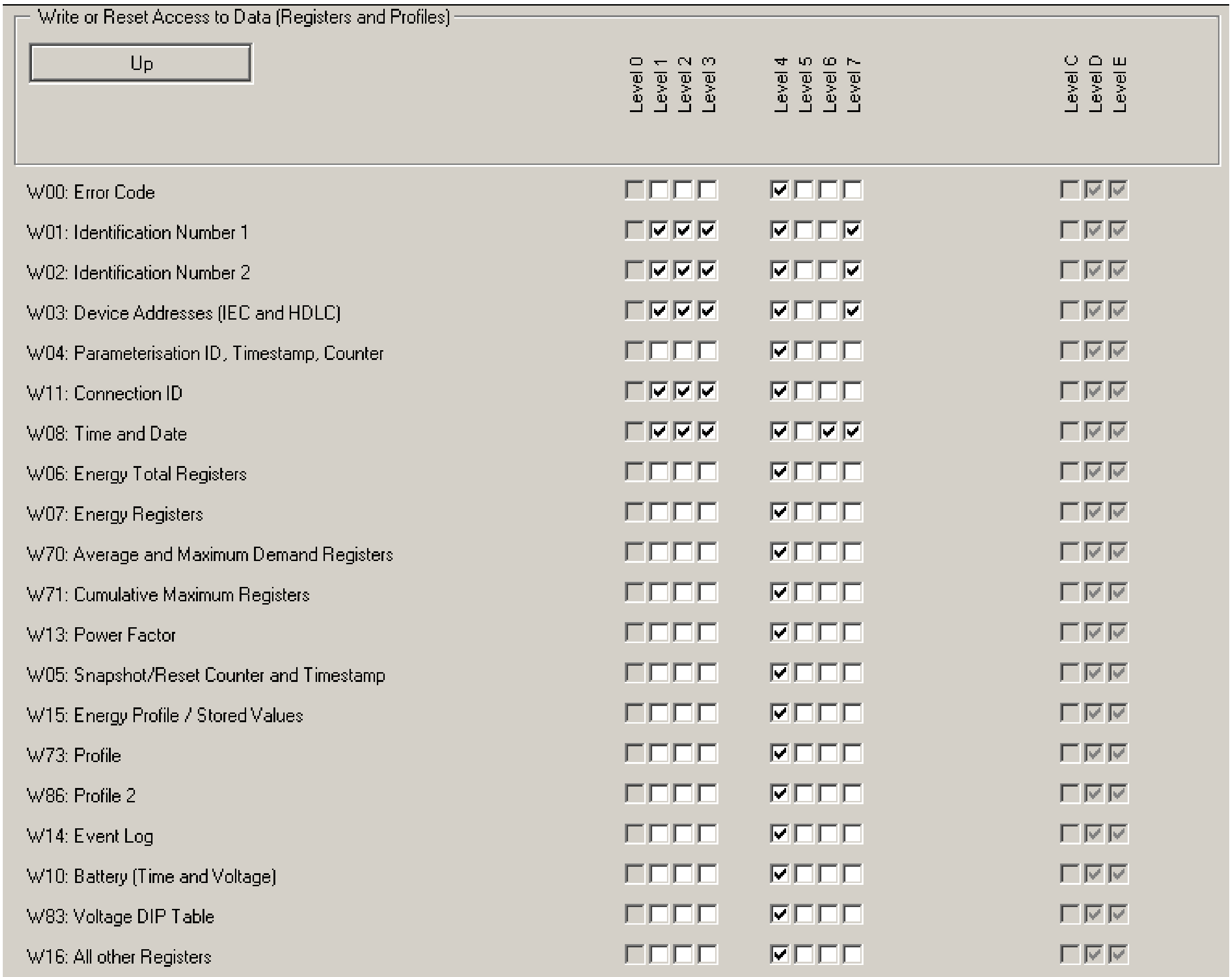
23.5.2 Read Access to Data (Registers and Profiles)





All users have unlimited access to all data.

23.5.3 Write Access to Data (Registers and Profiles)


Write or Reset Access to Data (Registers and Profiles)

Up

	Level 0	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7	Level C	Level D	Level E
W00: Error Code					✓					✓	✓
W01: Identification Number 1		✓	✓	✓	✓			✓		✓	✓
W02: Identification Number 2		✓	✓	✓	✓			✓		✓	✓
W03: Device Addresses (IEC and HDLC)		✓	✓	✓	✓			✓		✓	✓
W04: Parameterisation ID, Timestamp, Counter					✓					✓	✓
W11: Connection ID		✓	✓	✓	✓					✓	✓
W08: Time and Date		✓	✓	✓	✓		✓	✓		✓	✓
W06: Energy Total Registers					✓					✓	✓
W07: Energy Registers					✓					✓	✓
W70: Average and Maximum Demand Registers					✓					✓	✓
W71: Cumulative Maximum Registers					✓					✓	✓
W13: Power Factor					✓					✓	✓
W05: Snapshot/Reset Counter and Timestamp					✓					✓	✓
W15: Energy Profile / Stored Values					✓					✓	✓
W73: Profile					✓					✓	✓
W86: Profile 2					✓					✓	✓
W14: Event Log					✓					✓	✓
W10: Battery (Time and Voltage)					✓					✓	✓
W83: Voltage DIP Table					✓					✓	✓
W16: All other Registers					✓					✓	✓

On levels 4, D and E it is possible to change or reset all registers. At installation time the ID 1 and ID 2, the communication addresses, date and time as well as the connection ID can be set.

For remote reading levels 1 or 6 are possible. Therefore, time and date can be changed on these levels. Level 7 is intended for remote parameterisation.

23.5.4 Parameter Write Access

- Security System
  - Read Access to Data (Registers and Profiles)
  - Write or Reset Access to Data (Registers and Profiles)
  - Write Access to Parameters
  - Access to Commands
  - Modification of Security System

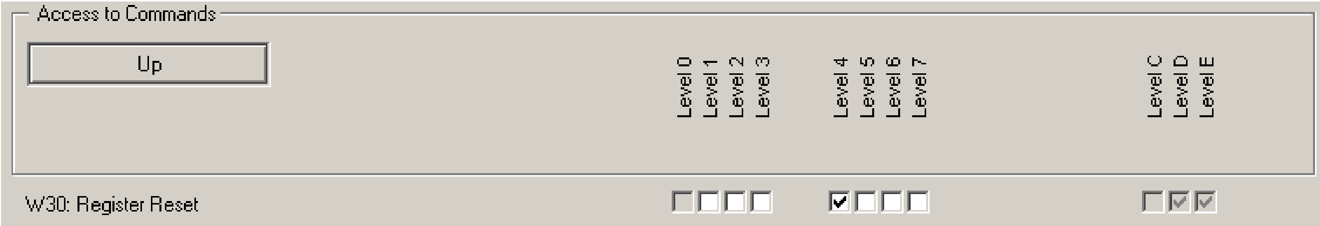
Write Access to Parameters

Up

	Level 0	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7	Level C	Level D	Level E
W21: Primary Values (Transformer Ratio)					✓					✓	✓
W20: Pulse Output Configuration					✓					✓	✓
W09: Clock (Synchronization, Daylight Saving)				✓	✓			✓		✓	✓
W79: TOU, Specials Days and Communication Inputs				✓	✓					✓	✓
W28: Control Table					✓					✓	✓
W77: Integration / Capture Period					✓					✓	✓
W25: Energy Register Format					✓					✓	✓
W26: Demand Register Format					✓					✓	✓
W22: Power Factor Configuration					✓					✓	✓
W24: Snapshot Control (Reset Tables)					✓			✓		✓	✓
W72: Energy Profile Configuration (Stored Value Configuration)					✓					✓	✓
W78: Profile Configuration					✓					✓	✓
W87: Profile 2 Configuration					✓					✓	✓
W23: Event Log Configuration					✓					✓	✓
W74: Monitor Thresholds		✓	✓	✓	✓			✓		✓	✓
W27: Display Lists					✓					✓	✓
W80: Communication Parameters				✓	✓					✓	✓
W82: Communication Parameter RS485				✓	✓					✓	✓
W68: Customer Magnitude Adjustment					✓					✓	✓
W69: CT / VT Error Correction					✓					✓	✓
W85: Losses: Iron and Copper Resistor				✓	✓					✓	✓
W29: All other Parameters					✓					✓	✓

On levels 4, D and E it is possible to change all parameters. The TOU, the clock settings and the communication parameters can be changed remotely or locally on level 3. Various thresholds which are not relevant for billing can be changed in the field.

23.5.5 Access to Commands

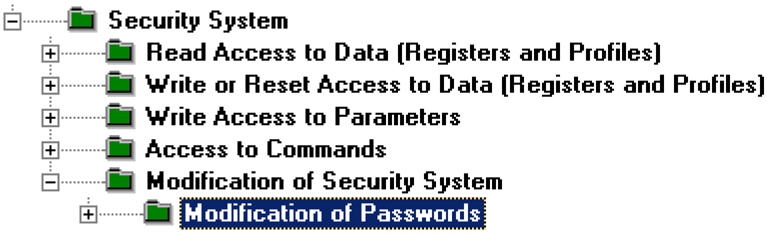


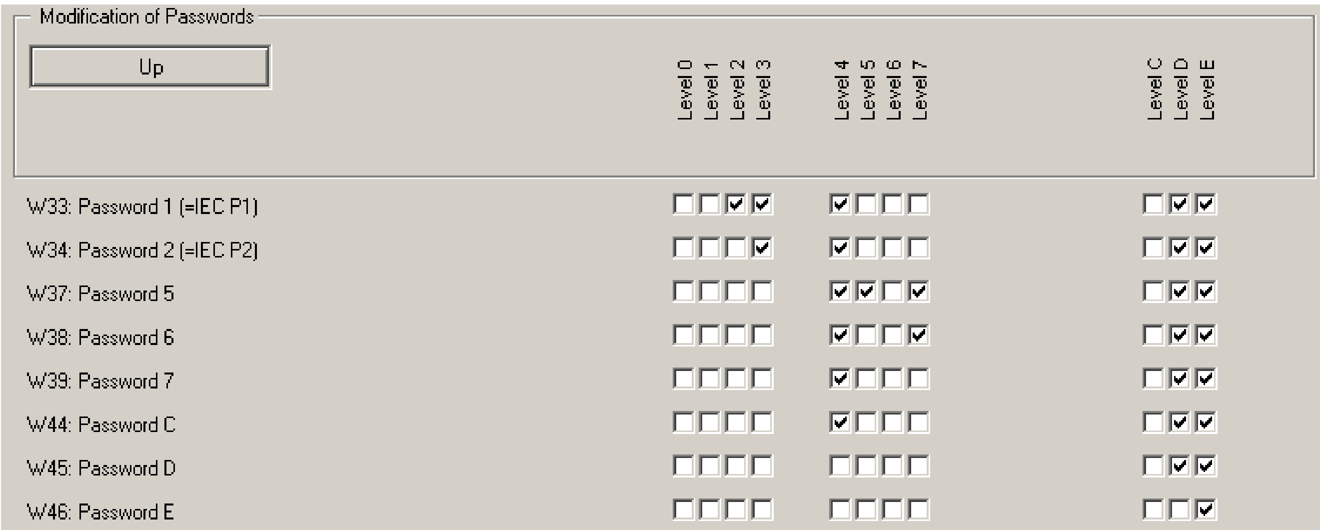
Access to Commands

	Level 0	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7	Level C	Level D	Level E
W30: Register Reset					✓					✓	✓

Register Reset is only possible on levels 4, D and E.

23.5.6 Modification of Passwords





Modification of Passwords

	Level 0	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7	Level C	Level D	Level E
W33: Password 1 (=IEC P1)			✓	✓	✓					✓	✓
W34: Password 2 (=IEC P2)				✓	✓					✓	✓
W37: Password 5					✓	✓		✓		✓	✓
W38: Password 6					✓			✓		✓	✓
W39: Password 7					✓					✓	✓
W44: Password C					✓					✓	✓
W45: Password D										✓	✓
W46: Password E											✓

The change of passwords is very restricted and implemented in a hierarchical way. The users cannot modify their own password, at least the next superior level is needed to do so. On levels 4, D and E all passwords can be changed.

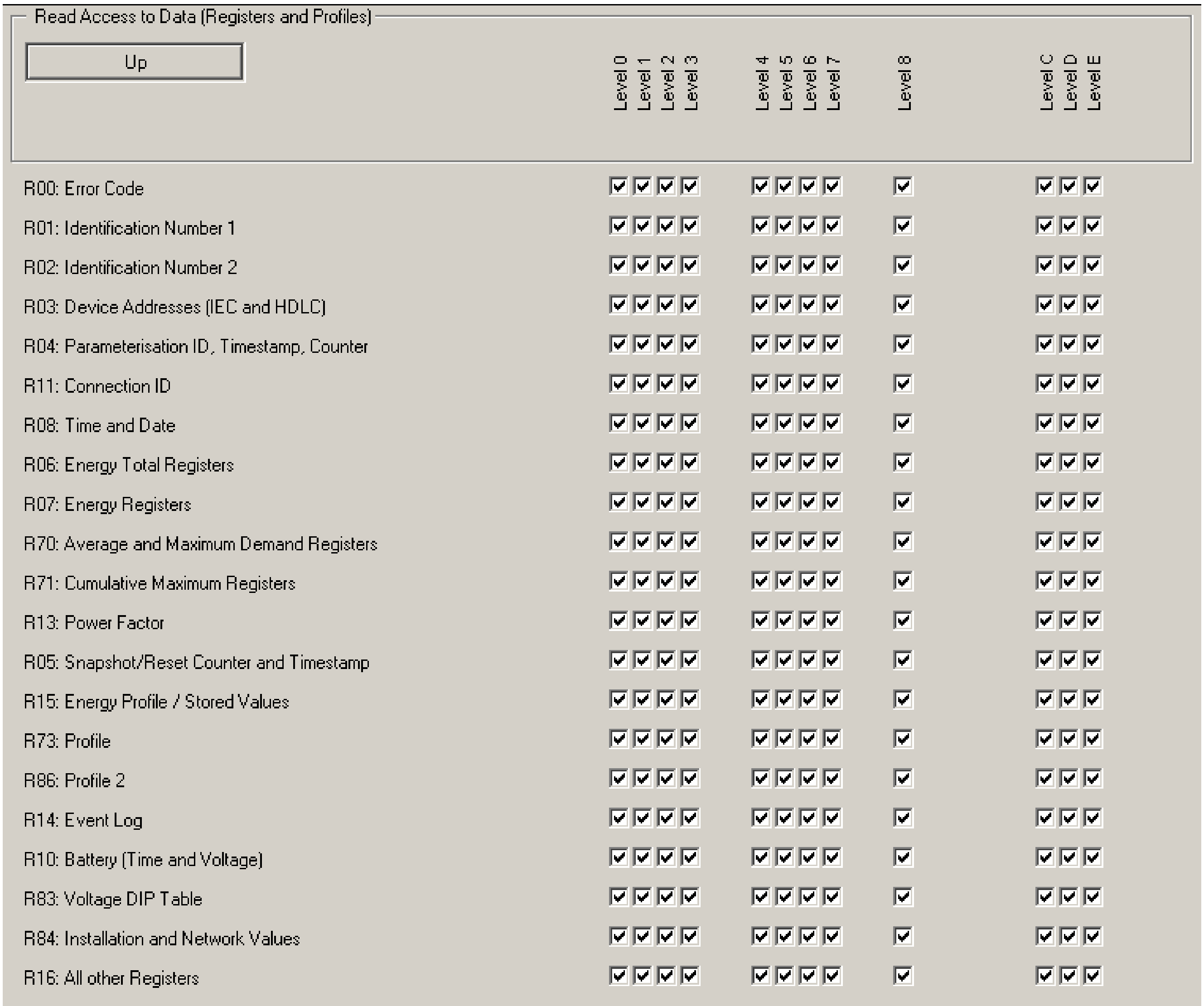
23.6 Middle Level Security System Example

In this section, an example of a middle level security system is given. A lot of changes are possible without breaking the verification seal. The main access is protected by the utility seal.

23.6.1 Security Attributes

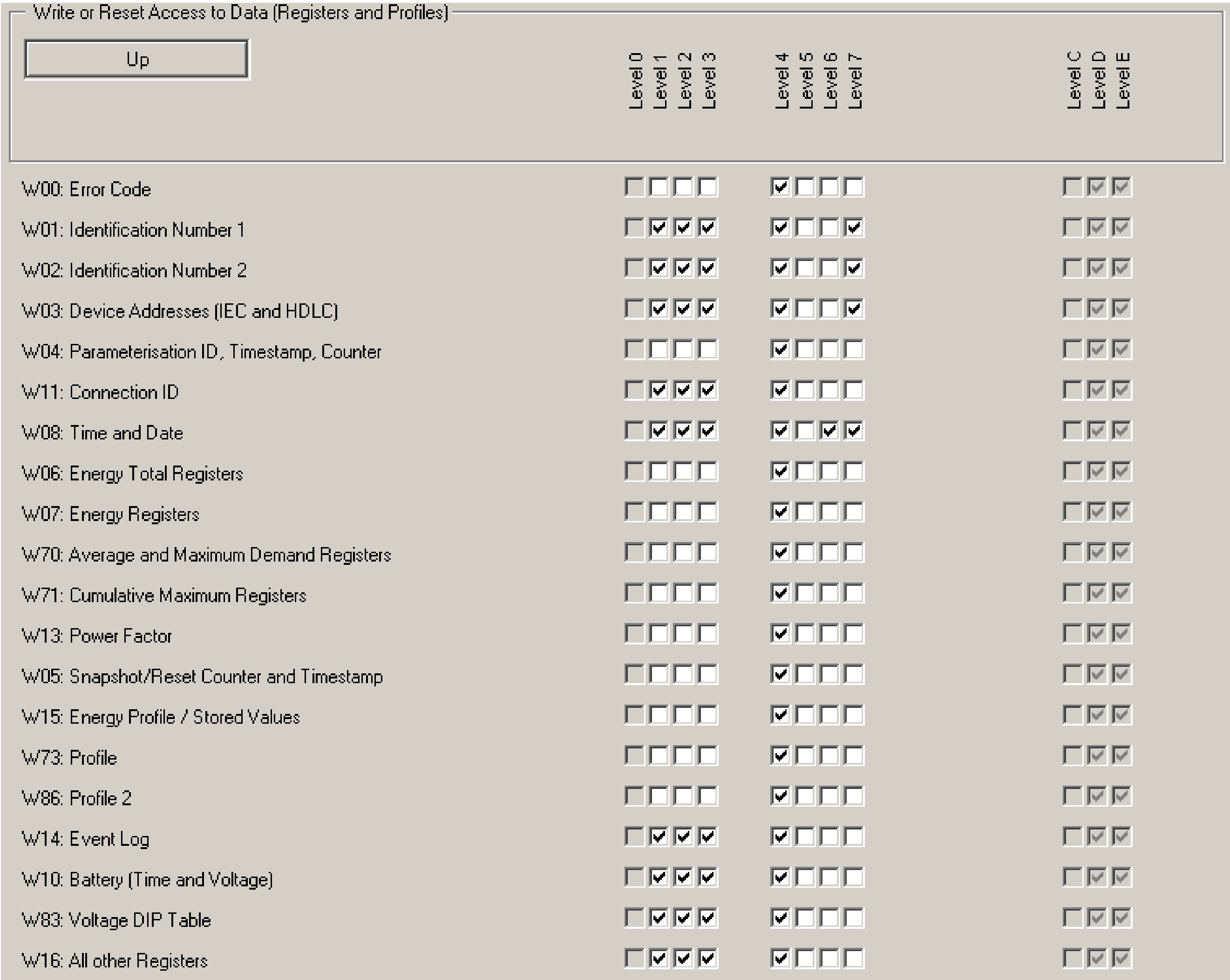
As defined in 23.4.1 "Security Attributes".

23.6.2 Read Access to Data (Registers and Profiles)



All users have unlimited access to all data.

23.6.3 Write Access to Data (Registers and Profiles)

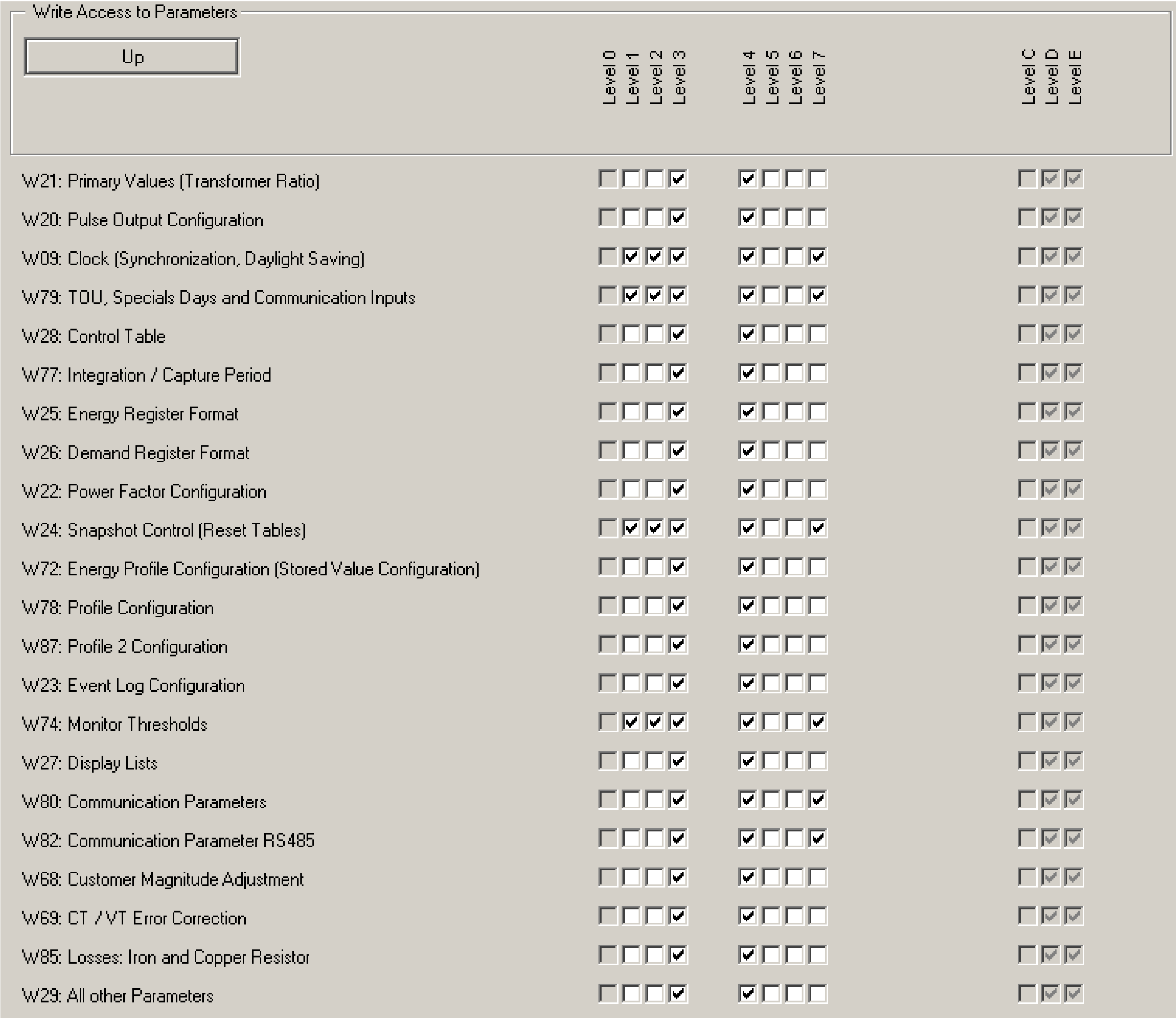


	Level 0	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7	Level C	Level D	Level E
W00: Error Code	☐	☐	☐	☐	☑	☐	☐	☐	☐	☑	☑
W01: Identification Number 1	☐	☑	☑	☑	☑	☐	☐	☑	☐	☑	☑
W02: Identification Number 2	☐	☑	☑	☑	☑	☐	☐	☑	☐	☑	☑
W03: Device Addresses (IEC and HDLC)	☐	☑	☑	☑	☑	☐	☐	☑	☐	☑	☑
W04: Parameterisation ID, Timestamp, Counter	☐	☐	☐	☐	☑	☐	☐	☐	☐	☑	☑
W11: Connection ID	☐	☑	☑	☑	☑	☐	☐	☐	☐	☑	☑
W08: Time and Date	☐	☑	☑	☑	☑	☐	☑	☑	☐	☑	☑
W06: Energy Total Registers	☐	☐	☐	☐	☑	☐	☐	☐	☐	☑	☑
W07: Energy Registers	☐	☐	☐	☐	☑	☐	☐	☐	☐	☑	☑
W70: Average and Maximum Demand Registers	☐	☐	☐	☐	☑	☐	☐	☐	☐	☑	☑
W71: Cumulative Maximum Registers	☐	☐	☐	☐	☑	☐	☐	☐	☐	☑	☑
W13: Power Factor	☐	☐	☐	☐	☑	☐	☐	☐	☐	☑	☑
W05: Snapshot/Reset Counter and Timestamp	☐	☐	☐	☐	☑	☐	☐	☐	☐	☑	☑
W15: Energy Profile / Stored Values	☐	☐	☐	☐	☑	☐	☐	☐	☐	☑	☑
W73: Profile	☐	☐	☐	☐	☑	☐	☐	☐	☐	☑	☑
W86: Profile 2	☐	☐	☐	☐	☑	☐	☐	☐	☐	☑	☑
W14: Event Log	☐	☑	☑	☑	☑	☐	☐	☐	☐	☑	☑
W10: Battery (Time and Voltage)	☐	☑	☑	☑	☑	☐	☐	☐	☐	☑	☑
W83: Voltage DIP Table	☐	☑	☑	☑	☑	☐	☐	☐	☐	☑	☑
W16: All other Registers	☐	☑	☑	☑	☑	☐	☐	☐	☐	☑	☑

On levels 3, 4, D and E it is possible to change or reset all registers. At installation time the ID 1 and ID 2, the communication addresses, date and time as well as the connection ID can be set. Event log, battery and operating time are not used for billing and can be changed on almost on every level.

For remote reading levels 1 or 6 are possible. Therefore, time and date can be changed on these levels. Level 7 is intended for remote parameterisation and service.

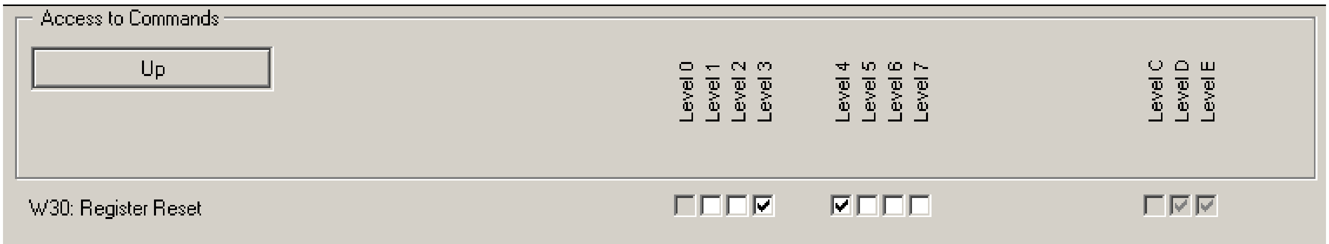
23.6.4 Parameter Write Access



	Level 0	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7	Level C	Level D	Level E
W21: Primary Values (Transformer Ratio)	☐	☐	☐	☑	☑	☐	☐	☐	☐	☑	☑
W20: Pulse Output Configuration	☐	☐	☐	☑	☑	☐	☐	☐	☐	☑	☑
W09: Clock (Synchronization, Daylight Saving)	☐	☑	☑	☑	☑	☐	☐	☑	☐	☑	☑
W79: TOU, Specials Days and Communication Inputs	☐	☑	☑	☑	☑	☐	☐	☑	☐	☑	☑
W28: Control Table	☐	☐	☐	☑	☑	☐	☐	☐	☐	☑	☑
W77: Integration / Capture Period	☐	☐	☐	☑	☑	☐	☐	☐	☐	☑	☑
W25: Energy Register Format	☐	☐	☐	☑	☑	☐	☐	☐	☐	☑	☑
W26: Demand Register Format	☐	☐	☐	☑	☑	☐	☐	☐	☐	☑	☑
W22: Power Factor Configuration	☐	☐	☐	☑	☑	☐	☐	☐	☐	☑	☑
W24: Snapshot Control (Reset Tables)	☐	☑	☑	☑	☑	☐	☐	☑	☐	☑	☑
W72: Energy Profile Configuration (Stored Value Configuration)	☐	☐	☐	☑	☑	☐	☐	☐	☐	☑	☑
W78: Profile Configuration	☐	☐	☐	☑	☑	☐	☐	☐	☐	☑	☑
W87: Profile 2 Configuration	☐	☐	☐	☑	☑	☐	☐	☐	☐	☑	☑
W23: Event Log Configuration	☐	☐	☐	☑	☑	☐	☐	☐	☐	☑	☑
W74: Monitor Thresholds	☐	☑	☑	☑	☑	☐	☐	☑	☐	☑	☑
W27: Display Lists	☐	☐	☐	☑	☑	☐	☐	☐	☐	☑	☑
W80: Communication Parameters	☐	☐	☐	☑	☑	☐	☐	☑	☐	☑	☑
W82: Communication Parameter RS485	☐	☐	☐	☑	☑	☐	☐	☑	☐	☑	☑
W68: Customer Magnitude Adjustment	☐	☐	☐	☑	☑	☐	☐	☐	☐	☑	☑
W69: CT / VT Error Correction	☐	☐	☐	☑	☑	☐	☐	☐	☐	☑	☑
W85: Losses: Iron and Copper Resistor	☐	☐	☐	☑	☑	☐	☐	☐	☐	☑	☑
W29: All other Parameters	☐	☐	☐	☑	☑	☐	☐	☐	☐	☑	☑

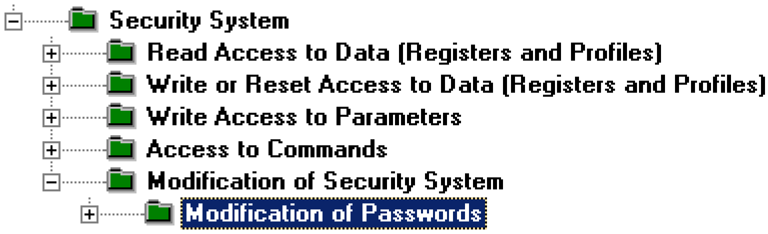
On levels 3, 4, D and E it is possible to change all parameters. The TOU, the clock settings, the reset tables and the communication parameters can be changed locally or remotely on levels 1 and 7 respectively. Various thresholds which are not relevant for billing can be changed in the field.

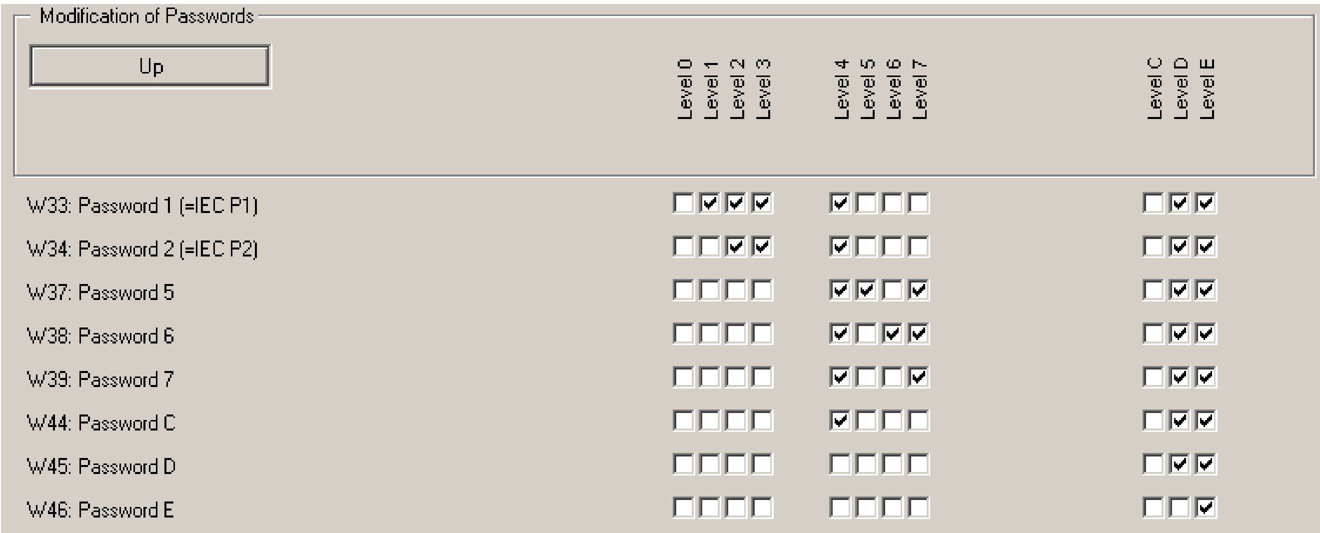
23.6.5 Access to Commands



Register Reset is possible on levels 3, 4, D and E.

23.6.6 Modification of Passwords





The change of passwords is implemented in a hierarchical way. The users can modify their own password and at least the next superior level is also allowed to do so. On levels 4, D and E all passwords can be changed.

23.7 Defining Your Security System

Because the security system cannot be changed in the field after delivery of the device it is very important that you define the security system before ordering the meters.

Please find some hints to observe when you start defining your security system:

Make a list of all potential users in your environment, e.g. verification office, meter installer, service and repair centre, data provider, etc. Do not forget your data collection system if available.

Write down the requirements of all these users. As mentioned before it is in the responsibility of the customer to know and follow all legal restrictions.

Group all users with the same requirements to user groups and assign each group to a security level.

Define the access rights for every user group according to your needs and according to the legal restrictions. Disable the access rights of unused groups.

Test some sample meters in your environment especially if you use a remote reading system.

24 Appendix 1: Version C.2

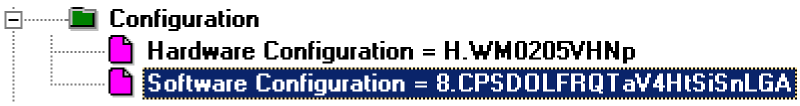
This chapter describes the characteristics of the ZxQ200C.2.

Software configuration

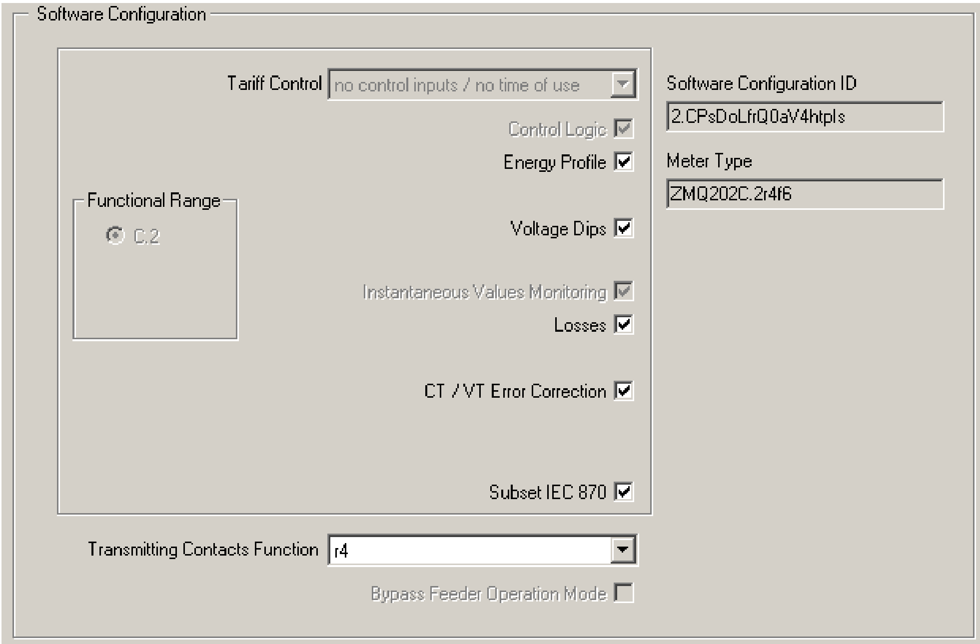
Unlike all other ZxQ200 meters, the C.2 can communicate using the IEC60870 subset.

24.1 Software Configuration Parameters

The software configuration parameters determine the functional range of the meter. Select a configuration and, depending on the selection, the MAP tree is extended or shortened accordingly.



C.2



Meters with the software configuration C.2 are intended for the communication with the IEC60870-5-102 subset.

The software configuration C.2 is available with meters with firmware version **H90** only. It provides the following functions:

- All-phase active energy metering +A, -A
- All-phase reactive energy metering +R, -R or +Ri, +Rc, -Ri, -Rc
- Measurement of phase voltages, phase currents and network frequency (readout with dlms only)
- Loss measurement *
- CT/VT Error Correction *
- Load profile
- Event log
- Energy profile *
- Voltage dip table (readout with dlms only) *

- Instantaneous value monitoring
- Customer magnitude adjustment
- Transmitting contact module
- Current and voltage transformer correction CT/VT (option)
- Static output contacts for energy flow
- Communication with the IEC60870 subset *
- Bypass feeder operation *

  * These features can be activated and deactivated independently. The MAP tree is expanded or shortened accordingly.

No tariff control
The C.2 meters have no tariff control.
As a result, these meters have:
– no tariff control inputs
– no energy tariff registers
– no time switch (time of use) and no control table
Furthermore, the C.2 meters have no synchronisation input.

24.2 Measured Quantities

With the C.2 meters, the following measured quantities are available:

Measured quantity		ZMQ	ZFQ	ZCQ
Active energy import	+A	Sum	Sum	L1
Active energy export	-A	Sum	Sum	L1
Reactive energy import	+R	Sum	Sum	L1
Reactive energy export	-R	Sum	Sum	L1
Reactive energy in quadrant I	+Ri	Sum	Sum	L1
Reactive energy in quadrant II	+Rc	Sum	Sum	L1
Reactive energy in quadrant III	-Ri	Sum	Sum	L1
Reactive energy in quadrant IV	-Rc	Sum	Sum	L1
Active copper losses (line)	OLA	Sum	Sum	L1
Active iron losses (transformer)	NLA	Sum	Sum	L1
Total losses of active energy in positive direction	+TLA	Sum	Sum	L1
Total losses of active energy in negative direction	-TLA	Sum	Sum	L1
Phase voltages (RMS)		U1, U2, U3	U12, U32	U1
Phase currents (RMS)		I1, I2, I3	I1, I3	I1
Network frequency	fn	yes	yes	yes

Measured quantity		ZMQ	ZFQ	ZCQ
Phase angle between voltages	φ U	U1-U2 / U1-U3	U12-U32	
Phase angle between voltage and current	φ U-I	U1-I1, U1-I2, U1-I3	U12-I1, U12-I3	
Direction of rotating field		yes	yes	
Phase outage		yes	yes	yes
Voltage dip table		Sum	Sum	L1
Energy flow of active energy	EFA	Sum	Sum	L1
Energy flow of reactive energy	EFR	Sum	Sum	L1

Meters with quadrant splitting provide the measured quantities +R and -R as well as +Ri, +Rc, -Ri and -Rc.

The ZMQ will only measure the phase angles if voltage L1 is present.

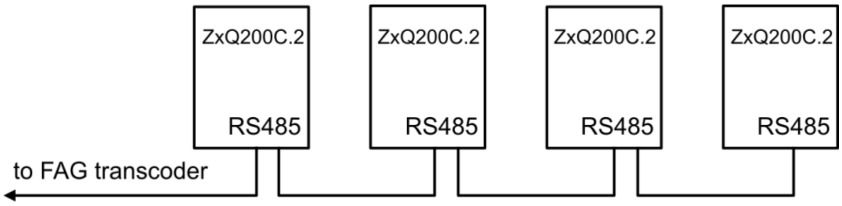
The ZFQ will only measure the phase angles if all voltages are present.

A maximum of six of the above measured quantities may be transmitted to the transcoder using the IEC60870 subset.

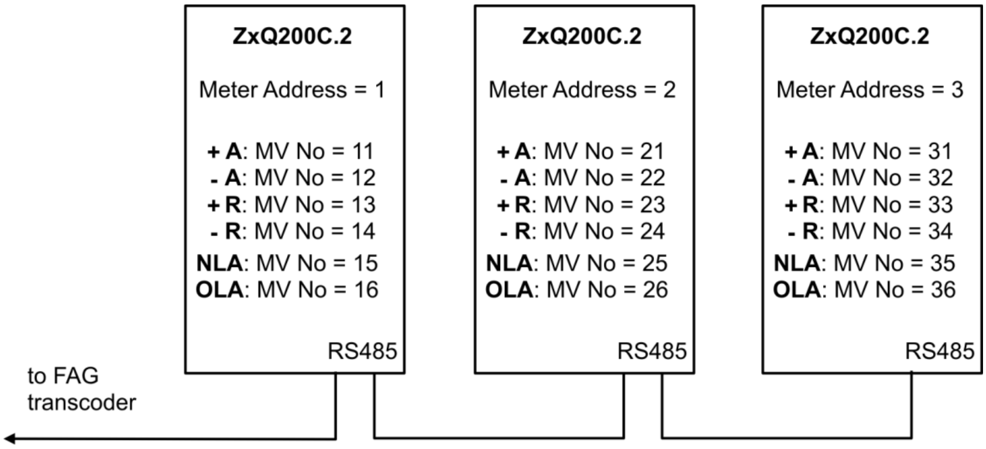
24.3 Communication Using the IEC60870 Subset

The ZxQ meters with the software configuration C.2 are capable of communicating using the IEC60870 subset. These meters are particularly suited for the replacement of previous IEC60870 meters such as the Landis+Gyr ZMU. As a result, the ZxQ C.2 is predestined to be used in existing telemetering systems with transcoders such as the Landis+Gyr FAG.

For this, one meter of the daisy-chain network is connected to a transcoder via the local RS485 interface.



The transcoder requests the meter every minute to send the current data.



Meter Address

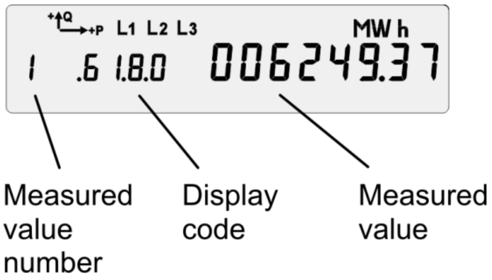
Each meter has a unique meter address (communication number) between 1 and 127 with which the meter is identified within the daisy-chain network.

Measured Value Number (MV No)

In addition to the display code, the measured values (energy/loss) also have a number (MV No) between 1 and 255 with which the value is clearly identified by the transcoder. All measured values of the various meters connected to the same transcoder must have a unique MV No.

Display

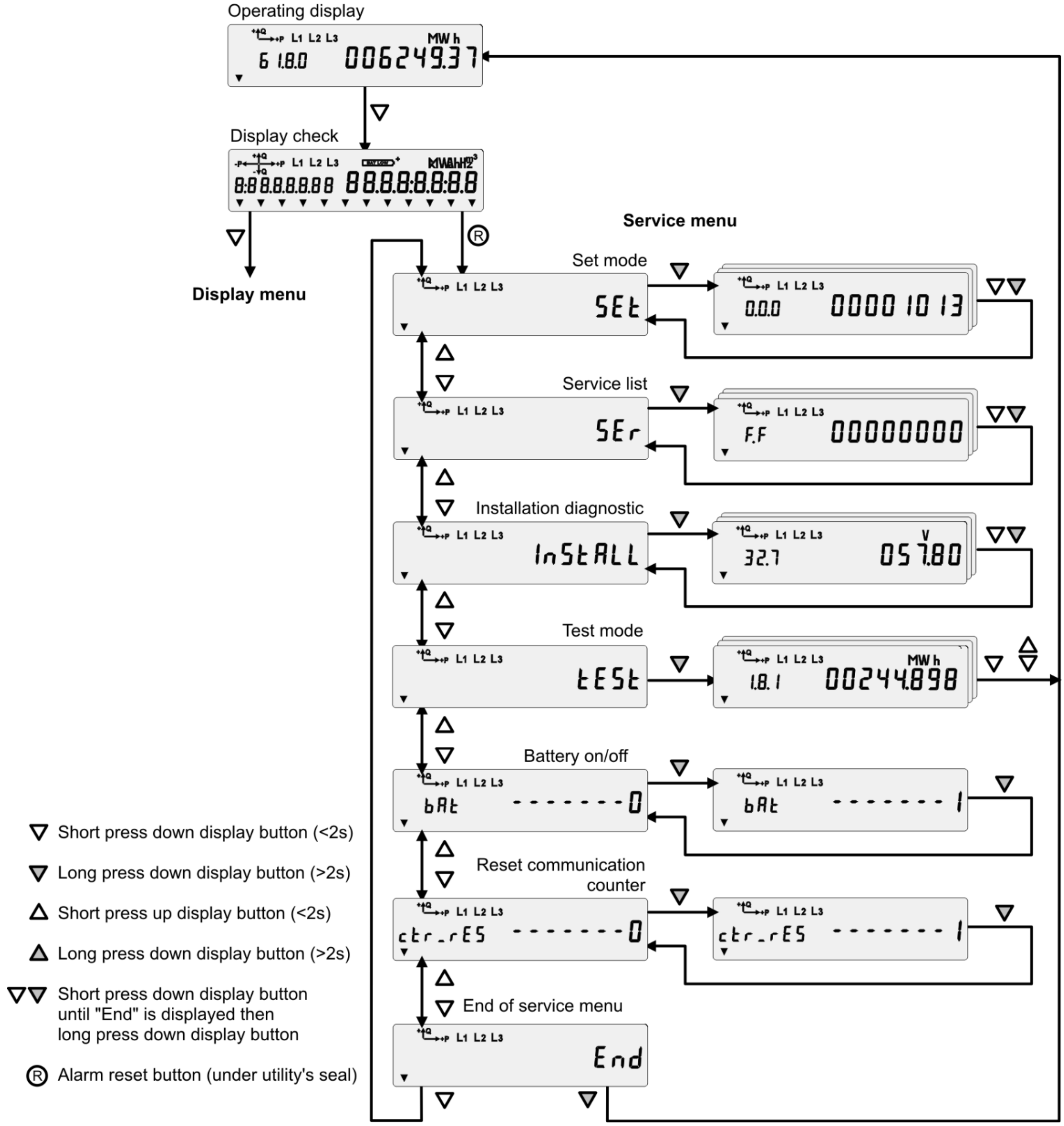
The measured value number is shown in the display of the C.2 meters in addition to the measured value itself and the display code (OBIS code).



Parameter setting

When setting the parameters for the ZxQ200C.2, a meter address must be defined for every meter and a measured value number must be defined for every measured value.

24.4 Service Menu



Install

Installation check: In addition to the instantaneous values displayed in the installation check list in every meter, the C.2 meters also show the meter address and the communication counters. The list is fixed and cannot be altered by parameterisation.

Depending on the network type of the meter, the following values can be displayed:

ZMQ

Meter_no	Meter address used for IEC60870 communication (C.2 only)

Free_Ctr	Counter of the freeze command (IEC60870, C.2 only)
Send_Ctr	Counter of the send command (IEC60870, C.2 only)
Resp_Ctr	Counter of the respond command (IEC60870, C.2 only)
UL1	Secondary voltage phase 1
UL2	Secondary voltage phase 2
UL3	Secondary voltage phase 3
IL1	Secondary current phase 1
IL2	Secondary current phase 2
IL3	Secondary current phase 3
Angle UL1	Angle between UL1 and UL1 (must read 0)
Angle UL2	Angle between UL1 and UL2
Angle UL3	Angle between UL1 and UL3
Angle IL1	Angle between UL1 and IL1
Angle IL2	Angle between UL1 and IL2
Angle IL3	Angle between UL1 and IL3
Frequency	Network frequency

ZFQ

Meter_no	Meter address used for IEC60870 communication (C.2 only)
Free_Ctr	Counter of the freeze command (IEC60870, C.2 only)
Send_Ctr	Counter of the send command (IEC60870, C.2 only)
Resp_Ctr	Counter of the respond command (IEC60870, C.2 only)
UL12	Secondary voltage phase 1 to phase 2
UL32	Secondary voltage phase 3 to phase 2
IL1	Secondary current phase 1
IL3	Secondary current phase 3
Angle UL12	Angle between UL12 and UL32
Angle IL1	Angle between UL12 and IL1
Angle IL3	Angle between UL12 and IL3
Frequency	Network frequency

ZCQ

Meter_no	Meter address used for IEC60870 communication (C.2 only)
Free_Ctr	Counter of the freeze command (IEC60870, C.2 only)
Send_Ctr	Counter of the send command (IEC60870, C.2 only)
Resp_Ctr	Counter of the respond command (IEC60870, C.2 only)
UL1	Secondary voltage phase 1
IL1	Secondary current phase 1
Angle IL1	Angle between UL1 and IL1
Frequency	Network frequency

ctr_res

The service menu of the C.2 meter is extended by the command ctr_res which is used to reset the counters of the three IEC60870 communication commands freeze, send and respond.

For details on how to read and reset the communication counters please refer to the User Manual.

24.5 Error Messages

If the IEC60870 subset is used to communicate between meter and transcoder all meter types that can communicate using this protocol can be utilized (e.g. ZxU, ZxV, ZxQ200C.2).

All these meter types generate different operational indications and alarms.

The table below provides a cross-reference of the error messages of the ZxU/ZxV and the ZxQ.

Message ZxU/ZxV	Message ZxQ	Event No ZxQ
System restart	Energy register cleared	128
Coldstart	General system error	93
Program error	ROM checksum error	(81, fatal error)
Parameter error	Parameter data checksum error (FLASH)	83
Parameter error M, D	Measuring system access error	75
Data error	Main memory error (RAM)	(73, fatal error)
Current without voltage phase Lx	Current without voltage Lx	55-57
Outage Phase Lx	Single-phase outage Lx	125-127
Parameter change [1)]	Parameterisation changed	1
Bypass feeder operation [1)]	Bypass feeder operation	47
Power outage [1)]	Power down	23
Set register value [1)]	[2)]	[2)]
Register overflow [1)]	[2)]	[2)]

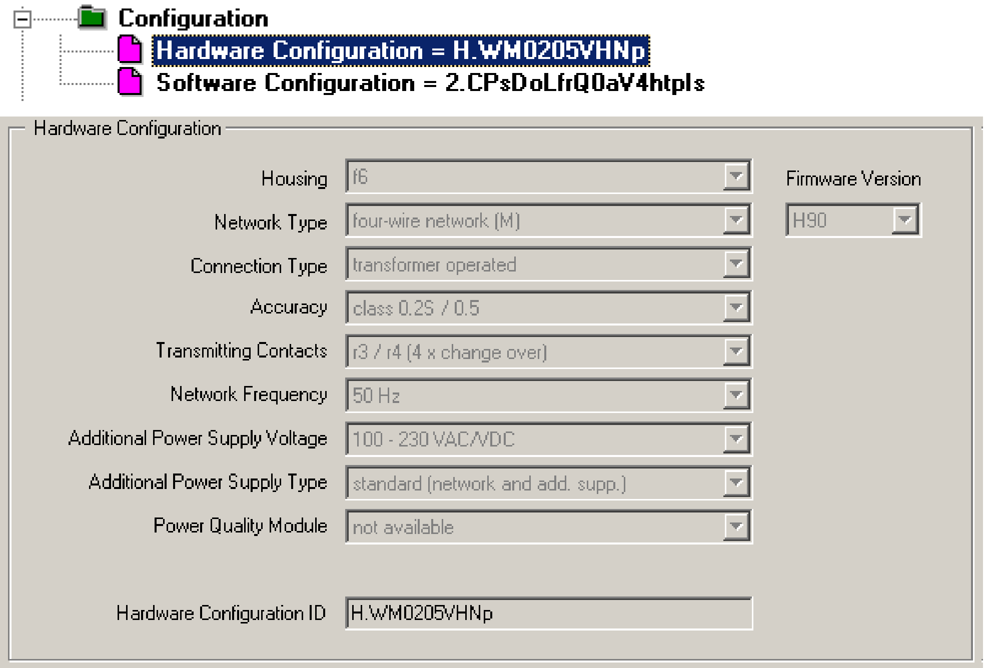
[1)] These messages do not appear in the display of the ZxU/ZxV. However, they are transmitted to the transcoder using the IEC60870 subset.

[2)] These events do not trigger an event log entry at the ZxQ. However, the events are transmitted to the transcoder using the IEC60870 subset.

24.6 Setting up the C.2 Meter for IEC60870 Communication

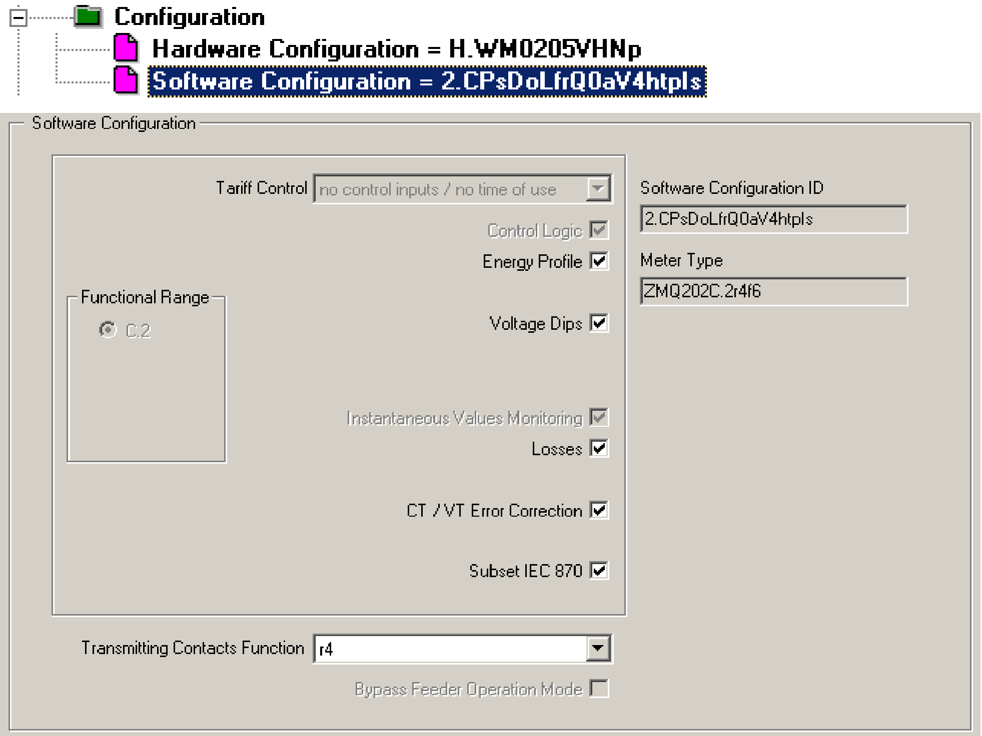
This section explains the setting of all parameters that are related to the communication using the IEC60870 subset.

24.6.1 Hardware Configuration



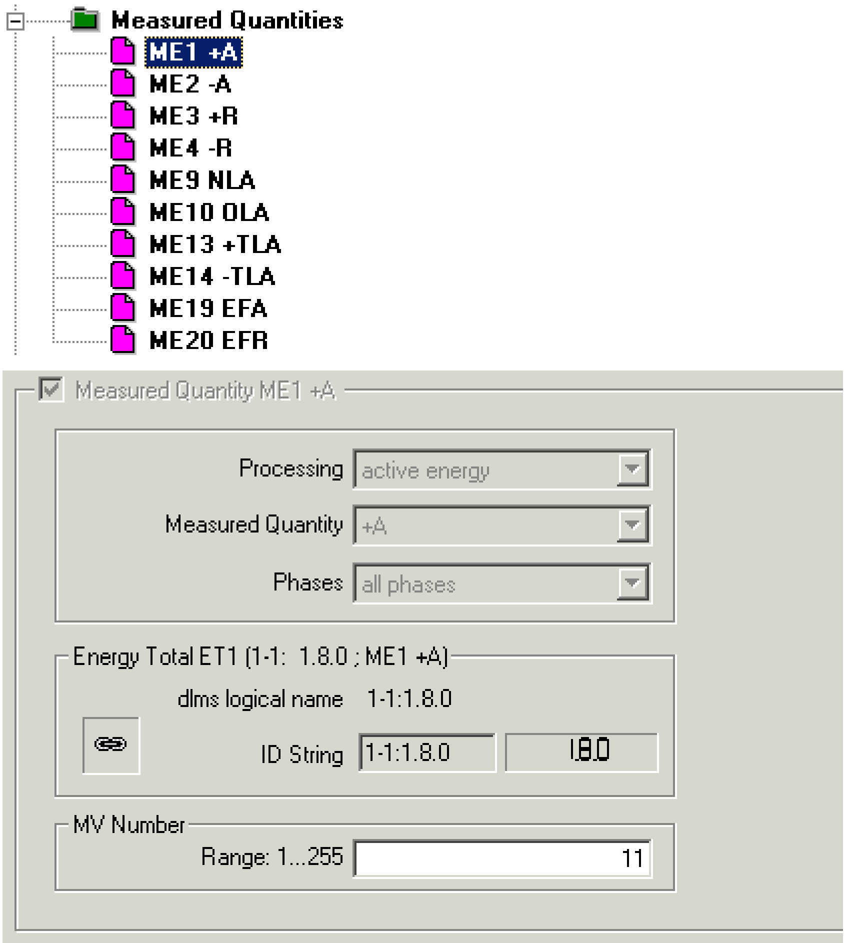
Firmware Version Make sure your meter has firmware version H90.

24.6.2 Software Configuration



Subset IEC60870 Set the tick for *Subset IEC870*.

24.6.3 Measured Quantities



MV Number

Define an MV number between 1 and 255 for each measured quantity. It is recommended to use identical groups of numbers for each of the meters.

Example:

Meter 1: MV number 11 to 16

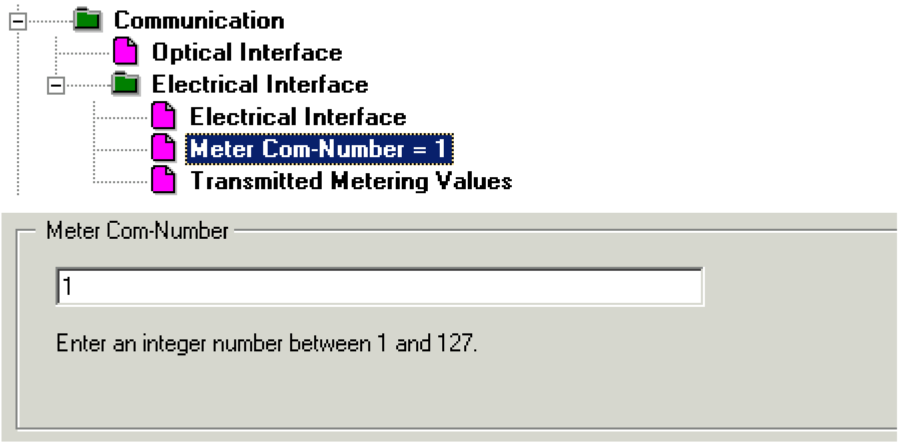
Meter 2: MV number 21 to 26

Meter 3: MV number 31 to 36

etc.

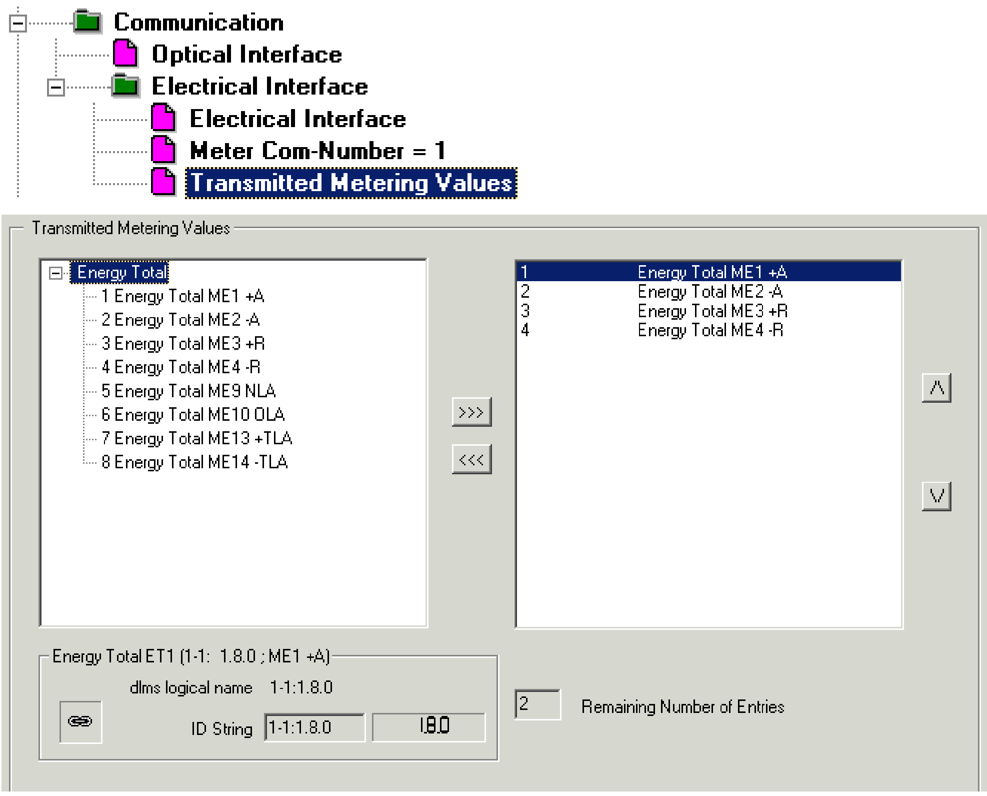
24.6.4 Electrical Interface

Meter Com-Number



Define the meter communication number between 1 and 127.

Transmitted Metering Values



Select a maximum of 6 registers that are transmitted to the transcoder FAG using the IEC60870 subset.

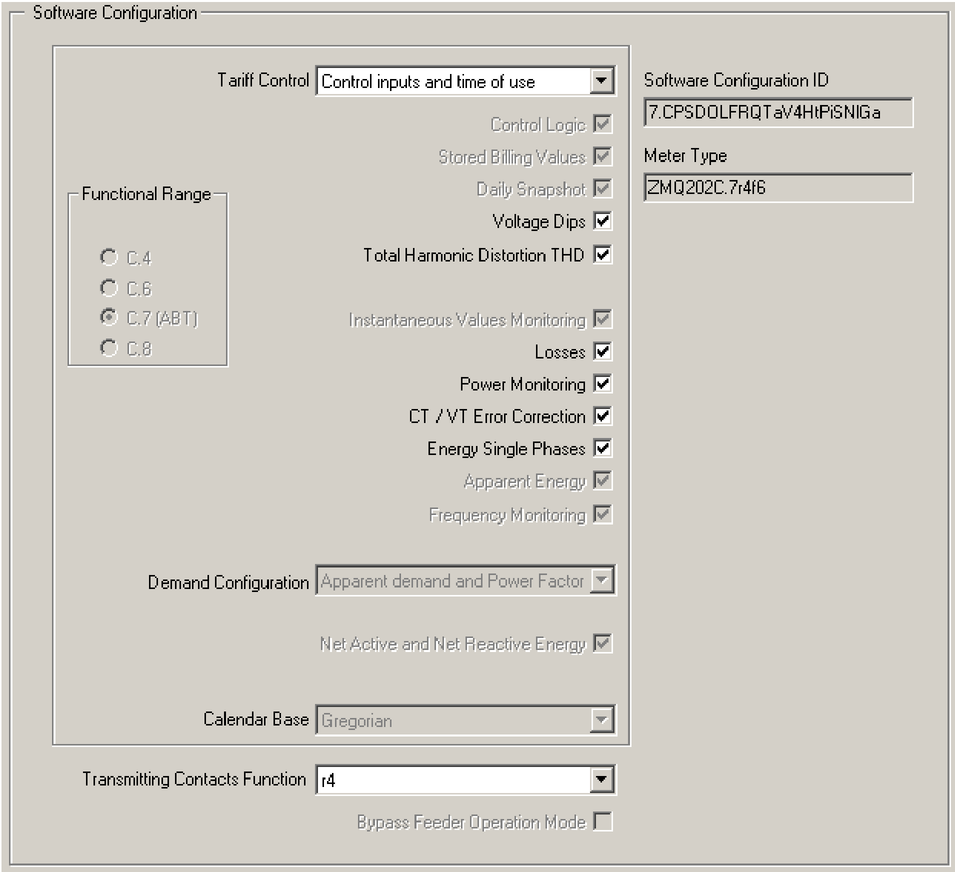
Quadrant splitting
If quadrant splitting has been activated in the software configuration the selection of registers that are transmitted is fixed to +A, -A, +Ri, -Ri, +Rc, -Rc.
If quadrant splitting has been disabled the registers +A, -A, +R and -R are fixed while two of the four loss values may be added to the list.

25 Appendix 2: Version C.7

This appendix describes the functions of the special version C.7 which is only intended for the Indian market.

25.1 Software Configuration Parameters

C.7



If C.7 is selected, the C.4 and the C.6 meter functions plus the following selection of meter functions are available:

- Single phase measurement
- Apparent energy measurement
- Demand registration (the configuration is set to "Apparent demand and Power Factor" and cannot be changed.)
- Power factor registration
- Stored billing value profile
- Frequency monitoring
- ABT (availability based tariff: Indian tariff structure based on network quality)

The THD influenced active energy and the second profile are not available in C.7.

Certain features (Voltage Dips, THD, Losses, Power Monitoring, CT/VT Error Correction, Energy Single Phases) can be activated and deactivated independently. The MAP tree is expanded or shortened accordingly.

Only secondary values
Only secondary values are available in C.7. Primary values are not available.

25.2 Measured quantities

With the C.7 meters, the following measured quantities are available in addition to those found in C.4 and C.6:

Measured quantity		ZMQ	ZFQ	ZCQ
Active energy import	+A	single-phase		
Active energy export	-A	single-phase		
Reactive energy import	+R	single-phase		
Reactive energy export	-R	single-phase		
Reactive energy in quadrant I	+Ri	single-phase		
Reactive energy in quadrant II	+Rc	single-phase		
Reactive energy in quadrant III	-Ri	single-phase		
Reactive energy in quadrant IV	-Rc	single-phase		
Apparent energy import	+S	Sum / Phases	Sum	L1
Apparent energy export	-S	Sum / Phases	Sum	L1
Apparent energy in quadrant I	+Si	Sum / Phases	Sum	L1
Apparent energy in quadrant II	+Sc	Sum / Phases	Sum	L1
Apparent energy in quadrant III	-Si	Sum / Phases	Sum	L1
Apparent energy in quadrant IV	-Sc	Sum / Phases	Sum	L1
Net/gross active energy in positive direction	+CA	Sum	Sum	L1
Net/gross active energy in negative direction	-CA	Sum	Sum	L1
Net/gross reactive energy in positive direction	+CR	Sum	Sum	L1
Net/gross reactive energy in negative direction	-CR	Sum	Sum	L1
Total losses of active energy	TLA	Sum	Sum	L1
Total losses of reactive energy	TLR	Sum	Sum	L1

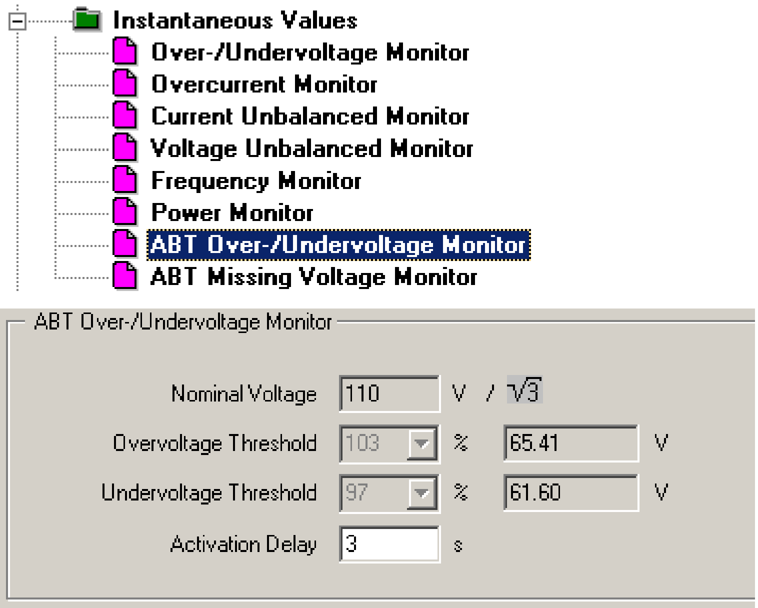
Due to the different type of measurement of the Aron circuit, data for the individual phases are not provided by the ZFQ.

In C.7, vectorial calculation is always used to calculate apparent energy, the leading reactive energy is not taken into account.

25.3 Voltage Monitoring

In C.7 meters, there is an additional over-/undervoltage monitor with preset values and a Missing Voltage Monitor with a parametrisable threshold. These additional functions can be used for tariff control. They are described in the following two sections.

25.3.1 ABT Over-/Undervoltage Monitor

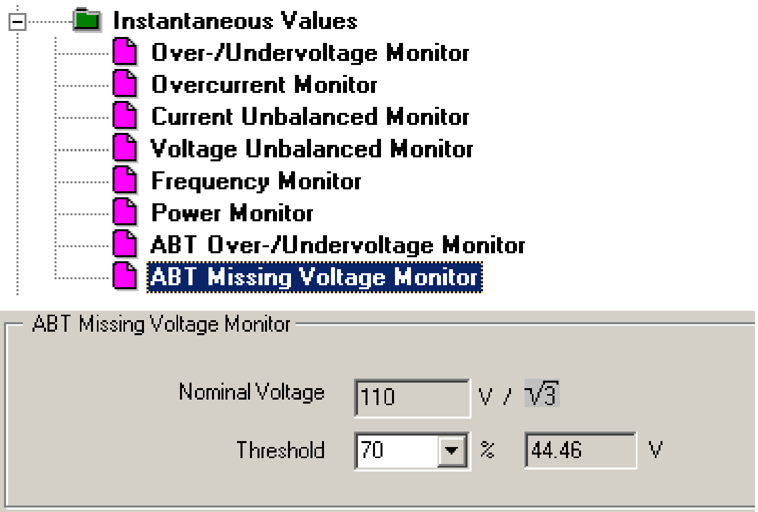


This monitor can be used to control tariffs.

Thresholds The thresholds are preset and cannot be altered.

Activation Delay Set the activation delay to between 1 and 3600 seconds after which the event is triggered or cleared.

25.3.2 ABT Missing Voltage Monitor



This monitor can be used to control tariffs.

Threshold Define the Threshold in percent of the nominal value. If the voltage crosses this threshold, the event is triggered accordingly without delay. The Threshold range is 55% to 90% in 5% steps.

26 Appendix 3: OBIS Identification Codes

26.1 General Description

For OBIS (Object Identification System) the structure A-B:C.D.E.F applies, whereby the individual groups have the following significance:

A Defines the medium, i.e. the characteristic of the data item to be identified, e.g. abstract data, electricity-, gas-, heat- or water-related data.

B Defines the channel number, i.e. the number of the input of a metering equipment having several inputs for the measurement of energy of the same or different types (e.g. in data concentrators, registration units). This enables data from different sources to be identified.

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

D Defines 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 tariffs 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 the reading in the code field, individual groups of the OBIS code can be omitted. The abstract or physical data C and type of data D must be shown. **A full specification of the OBIS identification number system can be found in standard IEC 62056-61 (European standard EN13757-1).**

Only the values of interest to meters are explained below with a collection of examples.

Group A

Group A of the OBIS identification can theoretically have values in the range between 0 and 15. Only the values

0 (abstract objects) and

1 (electricity related objects)

appear in the Landis+Gyr MAP120 Service Tool.

Group B

Group B of the OBIS identification can theoretically have values in the range between 0 and 255. Only the values

0 (no channel specified)

1 (channel 1) and

2 (channel 2)

appear in the Landis+Gyr MAP120 Service Tool.

Group C

Group C of the OBIS identification can have values in the range between 0 and 255. The individual values are differently assigned depending on the value of group A. The values for abstract items (group A = 0) are of no interest at this point, since they are largely specific to either context, country or manufacturer. On the other hand, the values for items related to electricity are listed in the following table.

Value	Application
0	General purpose objects
1	Sum of all phases: active energy import (+A)
2	Sum of all phases: active energy export (-A)
3	Sum of all phases: reactive energy import (+R)
4	Sum of all phases: reactive energy export (-R)
5	Sum of all phases: reactive energy quadrant I (+Ri)
6	Sum of all phases: reactive energy quadrant II (-Rc)
7	Sum of all phases: reactive energy quadrant III (-Ri)
8	Sum of all phases: reactive energy quadrant IV (+Rc)
9	Sum of all phases: apparent energy import (+S)
10	Sum of all phases: apparent energy export (-S)
11	Any phase: current
12	Any phase: voltage
13	Average power factor (cosφ)
14	Mains frequency (fn)
15	Sum of all phases: active energy quadrant I+IV+II+III
16	Sum of all phases: active energy quadrant I+IV-II-III
17	Sum of all phases: active energy quadrant I
18	Sum of all phases: active energy quadrant II
19	Sum of all phases: active energy quadrant III
20	Sum of all phases: active energy quadrant IV
21	Phase 1: active energy import
22	Phase 1: active energy export
23	Phase 1: reactive energy import
24	Phase 1: reactive energy export
25	Phase 1: reactive energy quadrant I
26	Phase 1: reactive energy quadrant II
27	Phase 1: reactive energy quadrant III
28	Phase 1: reactive energy quadrant IV
29	Phase 1: apparent energy import
30	Phase 1: apparent energy export
31	Phase 1: current

Value	Application
32	Phase 1: voltage
33	Phase 1: power factor
34	Phase 1: frequency
35	Phase 1: active energy quadrant I+IV+II+III
36	Phase 1: active energy quadrant I+IV-II-III
37	Phase 1: quadrant I
38	Phase 1: quadrant II
39	Phase 1: quadrant III
40	Phase 1: quadrant IV
41…60	Phase 2: same as 21…40
61…80	Phase 3: same as 21…40
81	Phase angles
82	Unitless quantity (pulses or pieces)
83...90	Losses, ...
91	Neutral current
92	Neutral voltage
93...95	Not used
96	Electricity-related service entries
97	Electricity-related error messages
98	Electricity-related list objects
99	Data profiles
100...127	Reserved
128...254	Manufacturer-specific definitions Landis+Gyr: 130 = Sum of all phases: reactive energy quadrant I+IV+II+III 131 = Sum of all phases: reactive energy quadrant I+II-III-IV 132 = Sum of all phases: reactive energy quadrant I+IV 133 = Sum of all phases: reactive energy quadrant II+III 150 = Phase 1: reactive energy quadrant I+IV+II+III 151 = Phase 1: reactive energy quadrant I+II-III-IV 152 = Phase 1: reactive energy quadrant I+IV 153 = Phase 1: reactive energy quadrant II+III 170 = Phase 2: reactive energy quadrant I+IV+II+III 171 = Phase 2: reactive energy quadrant I+II-III-IV 172 = Phase 2: reactive energy quadrant I+IV 173 = Phase 2: reactive energy quadrant II+III 190 = Phase 3: reactive energy quadrant I+IV+II+III 191 = Phase 3: reactive energy quadrant I+II-III-IV 192 = Phase 3: reactive energy quadrant I+IV 193 = Phase 3: reactive energy quadrant II+III
255	Reserved

Group D

Group D of the OBIS identification can have values in the range between 0 and 255. The individual values are differently assigned depending on the value of group A and C, but are not described here.

Group E

Group E of the OBIS identification can have values in the range between 0 and 255. In the Landis+Gyr MAP120 Service Tool for group E for electricity-related items (group A = 1) the values corresponding to the number of tariffs specified mainly appear (0 = total of all tariffs, 1 = tariff 1, 2 = tariff 2, etc.). Other values apply for specific values of group C, but these are not described here.

Group F

Group F of the OBIS identification can have values in the range between 0 and 255. In the Landis+Gyr MAP120 Service Tool group F is not used and is therefore always set to 255.

26.2 Examples

The following table shows a selection of OBIS identification numbers and explains their significance.

Identification numbers used in several meters
The following table contains OBIS identification numbers which are used in numerous meters (ZxQ, ZxD etc.). As a result, it is possible that some OBIS codes are not used with your meter.

OBIS code (decimal)	OBIS code (hex) A B C D E F	Description
0-0:0.9.1	00 00 01 00 00 FF	Clock
0-0:42.0.0	00 00 2A 00 00 FF	dlms device identification
0-0:C.1.0	00 00 60 01 00 FF	Identification number 2.1
0-0:C.1.1	00 00 60 01 01 FF	Identification number 2.2
0-0:C.2.0	00 00 60 02 00 FF	Number of parameterisations
0-0:C.2.1	00 00 60 02 01 FF	Date and time of last parameterisation
0-0:C.2.2	00 00 60 02 02 FF	Activation date TOU
0-0:C.2.12	00 00 60 02 0C FF	Date and time of last synchronisation
0-0:C.240.0	00 00 60 F0 00 FF	EEPROM identification
0-0:C.240.13	00 00 60 F0 0D FF	Hardware ID
0-0:C.3.1	00 00 60 03 01 FF	Input terminal states base meter
0-0:C.3.2	00 00 60 03 02 FF	Output terminal states base meter
0-0:C.3.3	00 00 60 03 03 FF	Keys and switches base meter
0-0:C.4.0	00 00 60 04 00 FF	Internal control signal states (Missing voltage status)
0-0:C.4.1	00 00 60 04 01 FF	Missing current status
0-0:C.4.2	00 00 60 04 02 FF	Current without voltage status
0-0:C.4.3	00 00 60 04 03 FF	Missing additional supply status
0-0:C.5.0	00 00 60 05 00 FF	Internal operating state

OBIS code (decimal)	OBIS code (hex) A B C D E F	Description
0-0:C.6.0	00 00 60 06 00 FF	Operating time of battery
0-0:C.6.3	00 00 60 06 03 FF	Battery voltage
0-0:C.7.0	00 00 60 07 00 FF	Number of phase fails L1..L3
0-0:C.7.1	00 00 60 07 01 FF	Number of phase fails L1
0-0:C.7.2	00 00 60 07 02 FF	Number of phase fails L2
0-0:C.7.3	00 00 60 07 03 FF	Number of phase fails L3
0-0:C.8.0	00 00 60 08 00 FF	Total operating time
0-0:C.8.t	00 00 60 08 t FF	Operating time (t = tariff number)
0-0:C.90	00 00 60 5A FF FF	Configuration ID
0-0:C.90.1	00 00 60 5A 01 FF	Physical IEC device address
0-0:C.90.2	00 00 60 5A 02 FF	Physical HDLC device address
1-0:C.2.7	00 00 60 02 07 FF	Activation date passive TOU
0-0:F.F.0	00 00 61 61 00 FF	Error code register
0-0:L.1.0*126	00 00 62 01 00 7E	Stored values
0-0:240.1.0	00 00 F0 01 00 FF	Meter functions
0-0:240.15	00 00 F0 0F FF FF	Customer Magnitude Adjustment
0-1:C.2.5	00 01 60 02 05 FF	Date and time of last calibration
0-1:C.240.8	00 01 60 F0 08 FF	Hardware ID of base meter
0-1:C.3.1	00 01 60 03 01 FF	Input terminal states extension board
0-1:C.3.2	00 01 60 03 02 FF	Output terminal states extension board
0-2:C.240.8	00 02 60 F0 08 FF	Hardware ID of extension board
0-2:C.240.9	00 02 60 F0 09 FF	Reference hardware ID of extension board
1-0:0.0.0	01 00 00 00 00 FF	Identification number 1.1
1-0:0.0.1	01 00 00 00 01 FF	Identification number 1.2
1-0:0.0.2	01 00 00 00 02 FF	Identification number 1.3
1-0:0.0.3	01 00 00 00 03 FF	Identification number 1.4
1-0:0.1.0	01 00 00 01 00 FF	Reset counter
1-0:0.1.2	01 00 00 01 02 FF	Time and date of last billing period reset
1-0:0.2.0	01 00 00 02 00 FF	Software ID
1-0:0.2.1	01 00 00 02 01 FF	Parameterisation ID
1-0:0.2.3	01 00 00 02 03 FF	Ripple control receiver ID
1-0:0.2.4	01 00 00 02 04 FF	Connection ID
1-0:0.2.7	01 00 00 02 07 FF	Passive TOU ID
1-0:0.3.6	01 00 00 03 06 FF	Meter constant I^2h
1-0:0.3.7	01 00 00 03 07 FF	Meter constant U^2h

OBIS code (decimal)	OBIS code (hex) A B C D E F	Description
1-0:0.9.5	01 00 00 09 05 FF	Weekday
1-0:C.99.8	01 00 60 69 08 FF	Display and IEC readout ID
1-0:P.1.0	01 00 63 01 00 FF	Load profile
1-0:P.98.0	01 00 63 62 00 FF	Event log
1-1:0.3.0	01 01 00 03 00 FF	Meter constant active energy
1-1:0.3.1	01 01 00 03 01 FF	Meter constant reactive energy
1-1:0.3.3	01 01 00 03 03 FF	Output pulse constant 1
1-1:0.4.0	01 01 00 04 00 FF	Scale factor for demand display
1-1:0.4.1	01 01 00 04 01 FF	Scale factor for energy display
1-1:0.4.2	01 01 00 04 02 FF	Current transformer ratio
1-1:0.4.3	01 01 00 04 03 FF	Voltage transformer ratio
1-1:0.6.0	01 01 00 06 00 FF	Secondary voltage
1-1:0.6.1	01 01 00 06 01 FF	Secondary current
1-1:13.0.0	01 01 0D 00 00 FF	Average billing period power factor
1-1:13.3.n	01 01 0D 03 n FF	Power factor minimum (n = number)
1-1:13.31.n	01 01 0D 23 n FF	Power factor threshold (n = number)
1-1:13.35.n	01 01 0D 23 n FF	Power factor monitor threshold (n = number)
1-1:13.5.0	01 01 0D 00 00 FF	Last average power factor
1-1:13.7.0	01 01 0D 07 00 FF	Total power factor
1-1:14.7.0	01 01 0E 07 00 FF	Mains frequency
1-1:16.7.0	01 01 10 07 00 FF	Active energy
1-1:31.7.0	01 01 1F 07 00 FF	Current L1
1-1:31.35.0	01 01 1F 23 00 FF	Overcurrent threshold L1
1-1:32.7.0	01 01 20 07 00 FF	Voltage L1
1-1:32.31.0	01 01 20 1F 00 FF	Undervoltage threshold L1
1-1:32.35.0	01 01 20 23 00 FF	Overvoltage threshold L1
1-1:33.7.0	01 01 21 07 00 FF	Power factor L1
1-1:51.7.0	01 01 33 07 00 FF	Current L2
1-1:51.35.0	01 01 33 23 00 FF	Overcurrent threshold L2
1-1:52.7.0	01 01 34 07 00 FF	Voltage L2
1-1:52.31.0	01 01 34 1F 00 FF	Undervoltage threshold L2
1-1:52.35.0	01 01 34 23 00 FF	Overvoltage threshold L2
1-1:53.7.0	01 01 35 07 00 FF	Power factor L2
1-1:71.7.0	01 01 47 07 00 FF	Current L3
1-1:71.35.0	01 01 47 23 00 FF	Overcurrent threshold L3

OBIS code (decimal)	OBIS code (hex) A B C D E F	Description
1-1:72.7.0	01 01 48 07 00 FF	Voltage L3
1-1:72.31.0	01 01 48 1F 00 FF	Undervoltage threshold L3
1-1:72.35.0	01 01 48 23 00 FF	Overvoltage threshold L3
1-1:73.7.0	01 01 49 07 00 FF	Power factor L3
1-1:81.7.0	01 01 51 07 00 FF	Angle U(L1) to U(L1)
1-1:81.7.1	01 01 51 07 01 FF	Angle U(L2) to U(L1)
1-1:81.7.2	01 01 51 07 02 FF	Angle U(L3) to U(L1)
1-1:81.7.3	01 01 51 07 04 FF	Angle I(L1) to U(L1)
1-1:81.7.4	01 01 51 07 05 FF	Angle I(L2) to U(L1)
1-1:81.7.5	01 01 51 07 06 FF	Angle I(L3) to U(L1)
1-1:91.7.0	01 01 5B 07 00 FF	Neutral current
1-1:131.7.0	01 01 83 07 00 FF	Reactive energy
1-1:m.2.0	01 01 m 02 00 FF	Cumulative maximum demand (m = measured quantity)
1-1:m.4.0	01 01 m 04 00 FF	Current average demand (m = measured quantity)
1-1:m.6.t	01 01 m 06 t FF	Maximum demand register (m = measured quantity, t = tariff number)
1-1:m.8.0	01 01 m 08 00 FF	Total energy register (m = measured quantity)
1-1:m.8.t	01 01 m 08 t FF	Energy register (cumulative) (m = measured quantity, t = tariff number)
1-1:m.9.t	01 01 m 09 t FF	Energy register (billing period delta value) (m = measured quantity, t = tariff number)
1-1:m.29.t	01 01 m 1D t FF	Energy register (registration period delta value) (m = measured quantity, t = tariff number)
1-1:m.35.n	01 01 m 23 n FF	Demand register monitor threshold (m = measured quantity, n = number)
1-2:0.3.3	01 02 00 03 03 FF	Output pulse constant 2
1-3:82.8.0	01 03 52 08 00 FF	Counter S0 pulses input 2
1-3:0.3.3	01 03 00 03 03 FF	Output pulse constant 3
1-4:0.3.3	01 04 00 03 03 FF	Output pulse constant 4
1-4:0.6.0	01 04 00 06 00 FF	Primary voltage
1-4:0.6.1	01 04 00 06 01 FF	Primary current
1-5:0.3.3	01 05 00 03 03 FF	Output pulse constant 5
1-6:0.3.3	01 06 00 03 03 FF	Output pulse constant 6
1-7:0.3.3	01 07 00 03 03 FF	Output pulse constant 7
1-8:0.3.3	01 08 00 03 03 FF	Output pulse constant 8

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