kamstrup

User guide

# Kamstrup OMNIA® e-meter - direct meters

# Contents

# 1 Revision history

| Rev | Date | Description | Meter software revision |
|---|---|---|---|
| A1 | 2020-06-30 | First release of this user guide. | 50981625 feature pack 2.1 |
| B1 | 2020-10-09 | Added new features and changes to some interval logger defaults. | 50981625 rev. D2 |
| C1 | 2021-04-13 | • Added new features and sections.<br>• The sections about Communication with head-end system 64 and Communication interfaces 71 has been rearranged.<br>• The section about power quality has been split into Power quality 41 and Grid events 48. | 50981625 rev. F7 |
| D1 | 2021-10-05 | • Added new features and sections.<br>• The section about Supply voltage interruption 42 has been moved to the Power quality 41 section. | 50981625 rev. H5 |
| E1 | 2022-03-14 | Added the following sections:<br>• CT ratio 23<br>• Secondary energy values 23<br>• CT ratio change event logger 54<br>• Calculation method change event logger 56<br>• Data quality attribute 39.<br>• Added Min. and Max THD values 25<br>• Accumulated max power values 29.<br>• Selection of access technologies 66.<br>• Temperature supervision 80.<br>• Demand supervision 81.<br><br>Updated the following sections:<br>• Grid Snapshot 62 and HAN interface 71 (both are now configurable). | 50981625 rev. J5 and 50981687 rev. B5 |
| F1 | 2022-10-01 | Added the following:<br>• The number of selectable registers in interval loggers has been increased from 24 to 48 32.<br>• Configuration of display format for energy registers 12.<br>• Support for min./max for P-, Q+ & Q+ per phase 25 .<br>• The number of special days has been extended from 65 to minimum 140 15 due to 2K buffer size.<br>• Calculation of the unbalance is now based on the true definition of unbalance 44.<br>• Cut-off limits 21 are added where relevant.<br>• The section about Selection of access technology 66 has been updated. | 50981625 rev. K3 and 50981687 rev. C3 |
| F2 | 2022-12-02 | No new features. Update of documentation. | 50981625 rev. K4 and 50981687 rev. C4 |

# 2 Introduction

This user guide describes the features and functionality of Kamstrup OMNIA® e-meter.

Kamstrup OMNIA® e-meter is a family of smart electricity meters. The meter is the engine behind an intelligent grid. The Energy Processing Unit (EPU) architecture of the meter makes it capable of processing and analysing energy measurements at a great time resolution. This is the key to absolute voltage quality reporting and the foundation for future analytics applications.

Kamstrup OMNIA® e-meter is available with a variety of communication and functional interfaces. It supports integrated IoT solutions, load control or a specific interface for smart home equipment. The integrated flexibility of the meter enables a fast and easy adaptation to customer and market demands.

### Target group

This user guide is intended for technical users who wish to familiarise themselves with the features of Kamstrup OMNIA® e-meter for the purpose of setting up advanced operations, doing integrations with the meter, evaluating the meter for procurements or similar.

Knowledge of DLMS/COSEM and the DLMS UA "Coloured Books" is recommended, but not required, to read and understand this user guide.

## 2.1 Related documentation

In the following guides you will find additional documentation about Kamstrup OMNIA® e-meter and the DLMS interface:

- Installation guide "Installing Kamstrup OMNIA® e-meter" (doc. 5512-2370).
- Data sheet "Kamstrup OMNIA® e-meter single and three-phase" (doc. 5810-1915).
- Data sheet "Kamstrup OMNIA® e-meter CT" (doc. 5810-1936).
- Technical guide "Kamstrup electricity meter DLMS interface specification" (doc. 5512-2571).
- Technical guide "Kamstrup OMNIA® e-meter single- and three-phase – object list" (doc. 5512-2683).
- "How to verify meter connectivity - a visual guide" (doc. 5512-2694).

# 3 Human interface

The following sections provide an overview of the display, buttons and interfaces of Kamstrup OMNIA® e-meter.

## 3.1 Meter buttons and interfaces

Below you see an overview and descriptions of the meter buttons and interfaces.

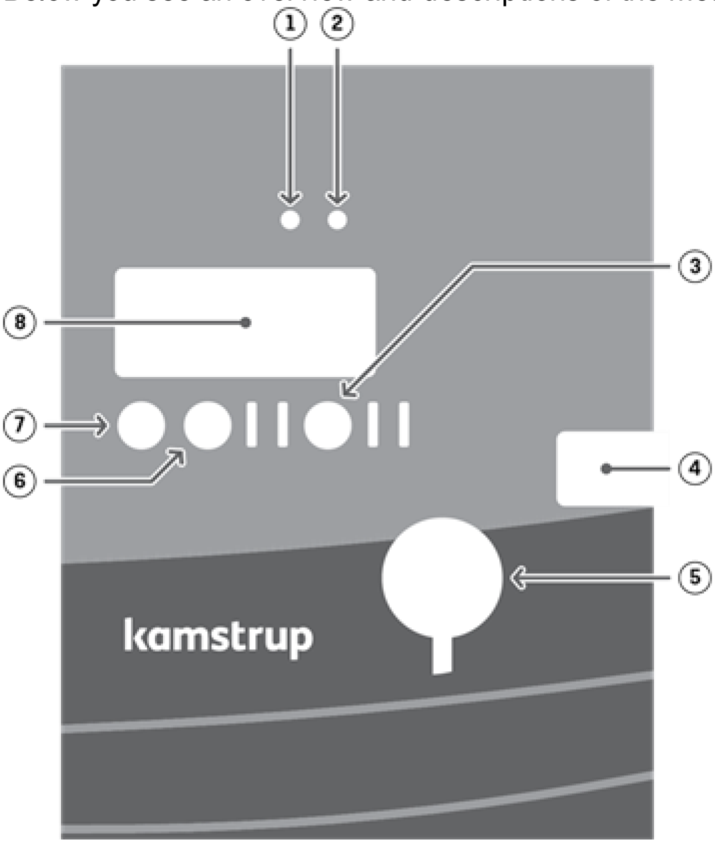



*Figure 1: The buttons and interfaces of Kamstrup OMNIA® e-meter*

| Meter buttons and interfaces | | |
|---|---|---|
| **No.** | **Name** | **Description** |
| 1 | **Meter constant LED** | The **Meter constant LED** blinks (yellow) at a rate reflecting the consumption of active energy. |
| 2 | **Supply switch LED** | The **Supply switch LED** is lit (red) when the internal supply switch is disconnected.<br>If the LED blinks, the supply switch is released for reconnection. |
| 3 | **Infra-red interface** | The **Infra-red interface** is used to connect an infra-red optical head in order to display and change configuration parameters in the meter. |
| 4 | **HAN interface** | The **home area network (HAN) interface** is used to connect compatible smart home equipment.<br><br>**Note** Not all meters have this interface. |
| 5 | **Sealing wheel** | The **Sealing wheel** is used to lock and unlock the terminal cover, secure that the cover is in place and seal the meter. |
| 6 | **Control push button** | The functionality of the **Control push button** depends on the meter configuration.<br><br>On some meters, you can control the internal supply switch by pressing and holding this push button. |
| 7 | **Menu push button** | The **Menu push button** is used to cycle the information shown in the meter display, i.e. 8a-8n in the figure below.<br><br>For descriptions of the meter display, see the table 11 below. |
| 8 | **Meter display** | For descriptions of the meter display, see the table 11 below. |

## 3.2 Meter display

Below you see an overview and descriptions of the meter display.

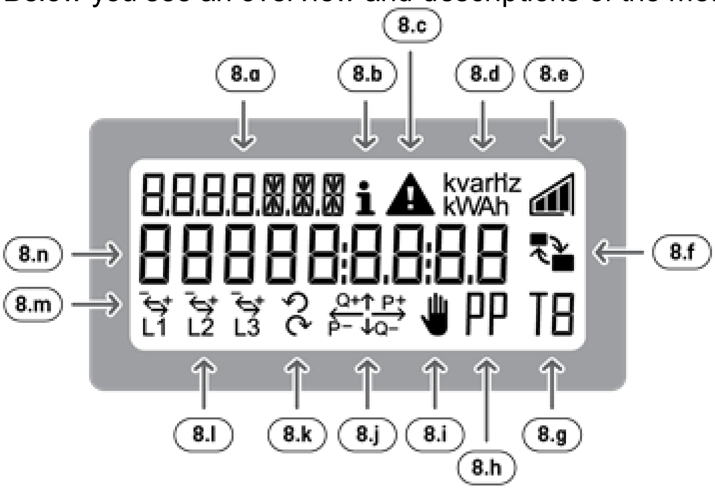
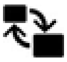



*Figure 2: The display of Kamstrup OMNIA® e-meter*

| Meter display | | | |
|---|---|---|---|
| **No.** | **Symbol** | **Name** | **Description** |
| **8a** | 8.8.8.8.8.8.8 | **Object identification field** | The **Object identification field** uniquely identifies the measurand shown in the **Value** field, e.g. imported or exported energy, active or reactive energy, etc. |
| **8b** | **i** | **Info** | The **Info** symbol indicates that the **Value** field shows data of an informative nature, i.e. not legally relevant data. |
| **8c** |  | **Error** | The **Error** symbol indicates that an internal error has occurred in the meter.<br><br>Can be triggered by:<br>• Error accessing non-volatile data memory, i.e. during data backup or restore.<br>• RAM test failure.<br>• Error in program memory checksum.<br>• Meter is operating in APS mode 75. |
| **8d** | kvarHz<br>kWAh | **Unit** | The **Unit** field shows the unit of the measurand shown in the **Value** field. |
| **8e** |  | **Network** | The **Network** symbol shows the connection quality to the communication network. |
| **8f** |  | **System** | The **System** symbol indicates that there is a verified data connection to the head-end system. |
| **8g** | T8 | **Tariff** | The **Tariff** symbol indicates the tariff that is currently active. |
| **8h** | PP | **Prepayment** | The **Prepayment** symbol indicates that the meter is in prepayment mode. |
| **8i** |  | **Tamper** | The **Tamper** symbol indicates if the meter has been exposed to attempts of physical or magnetic tampering.<br><br>Can be triggered by:<br>• Terminal cover is removed.<br>• Magnetic field is detected. |
| **8j** |  | **Quadrant** | The **Quadrant** symbol indicates the current net load type.<br>This indication is active when the load difference is more than 10 W. |
| **8k** |  | **Phase sequence** | The **Phase sequence** symbols indicate the sequence of the connected phases when all phases are above 50 VAC.<br>•  phase sequence is regular, e.g. L1-L2-L3. |

| Meter display | | | |
|---|---|---|---|
| | | | • ↺ phase sequence is irregular, e.g. L1-L3-L2. |
| **8l** | L1 L2 L3 | **Supply voltage** | The **Supply voltage** symbols are lit when the associated phase input is connected, and the phase voltage is above 160 VAC. |
| **8m** | ⇆ -/+ | **Phase current** | The **Phase current** symbols indicate the direction of the current for each phase.<br>• + energy is imported on the corresponding phase.<br>• - energy is exported on the corresponding phase.<br>Use this to verify the correct sequence of input and output cables.<br>The minimum load limit for the phase current indication is 3 W. |
| **8n** | 88888:8.8:8.8 | **Value** | The **Value** field shows the consumption data value of the measurand. |

### 3.2.1 Resolution for energy registers

The resolution by which all the energy readings are shown in the display can be configured as follows:

| **Resolution for energy registers in OMNIA® e-meter** | |
|---|---|
| **Format Display Energy**<br>**1.1.134.0.116.255** | **Display resolution** |
| 9 | 6.0 (000000) kWh/kvarh |
| 2 | 6.1 (000000.0) kWh/kvarh |
| 3 | 6.3 (000000.000) kWh/kvarh |
| 4 | 7.0 (0000000) kWh/kvarh |
| 6 | 7.1 (0000000.0) kWh/kvarh |
| 5 | 7.2 (0000000.00) kWh/kvarh |

Furthermore, it is possible to select or deselect leading zeroes. The configuration of the leading zeros is done when ordering the meter and cannot be reconfigured afterwards.

All secondary energy registers in OMNIA® e-meter CT are shown with display resolution 5.2 (00000.00) kWh/kvarh.

## 3.3 Start-up sequence

Energizing the Kamstrup OMNIA® e-meter initiates the start-up sequence. The diagram below visualizes the states of the meter display during the start-up sequence.

The meter begins to record energy within 5 seconds from being energized.

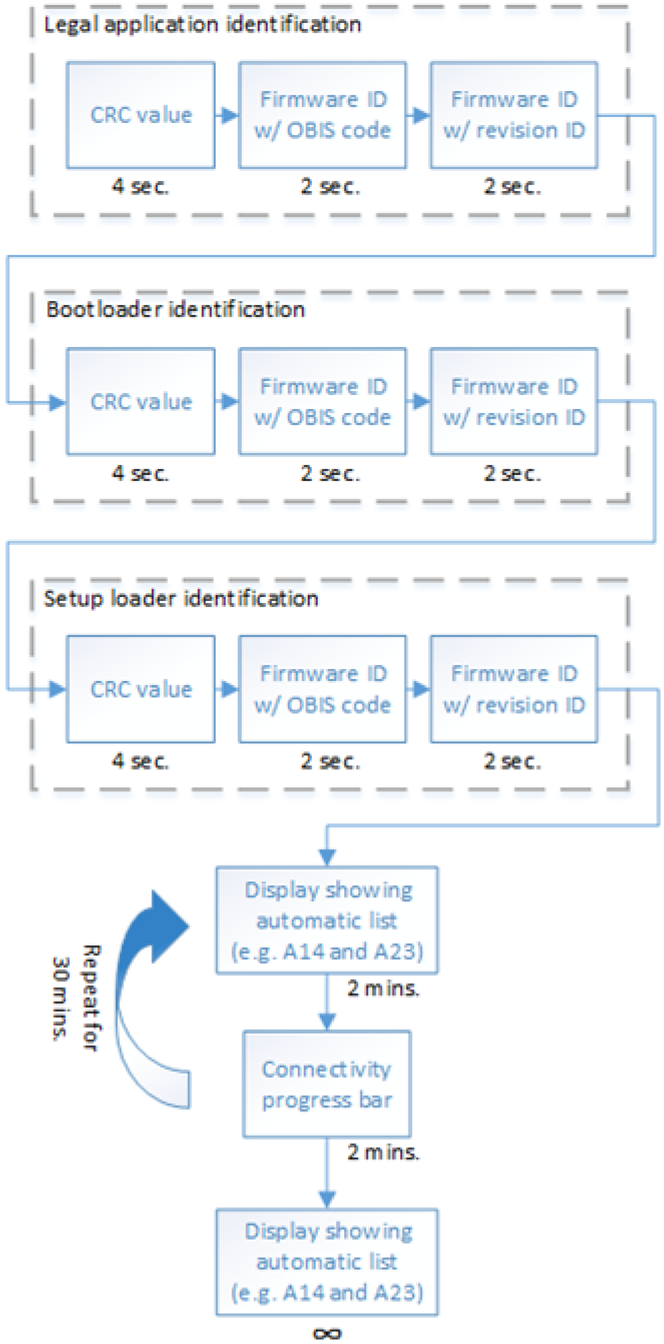



*Figure 3: Meter display states during the start-up sequence*

The meter initiates registration on the cellular network shortly after being energized. Several steps in the connectivity progress bar are often completed when it is shown for the first time.

**Hint** For a visual guide through the start-up sequence, see "How to verify meter connectivity - a visual guide" (doc. 5512-2694).

For details about the connectivity progress bar, see the installation guide "Installing Kamstrup OMNIA® e-meter" (doc. 5512-2370).

# 4 Time management

Time management in Kamstrup OMNIA® e-meter is based on the integrated real-time clock (RTC) and the DLMS Clock class.

## 4.1 Time synchronisation

Network Time Protocol (NTP) is used to retrieve accurate time. Initial NTP synchronisation is executed upon successful meter installation.

The first synchronisation after initial NTP synchronisation will happen at a random time between 0-24 hours. After that, NTP synchronisations will happen every 24 hours.

Any changes to meter time larger than 7 seconds will mark affected interval logger entries using the Data quality attribute 39.

If the meter time is adjusted forward (i.e. to a later point in time), any missing logger entries are automatically generated with identical value as recommended in WELMEC guide 11.2. Any automatically generated entries are marked using the Data quality attribute.

## 4.2 Time keeping without supply voltage

The time continues to be maintained during a supply voltage interruption due to the integrated backup energy storage (either a battery or a rechargeable energy storage unit (supercap)).

## 4.3 Hour counters

An hour counter register keeps track of the number of meter operating hours. As a supplement to the total hour counter, the meter maintains separate counters for all tariffs.

## 4.4 Time zone

The time zone of the meter is selected at order time and the meter display, time stamps, interval loggers, push setups and activity calendars operate in local time.

## 4.5 Daylight saving

Kamstrup OMNIA® e-meter handles daylight saving time. The daylight saving schedule can be programmed in the meter using wildcards through the DLMS Clock class.

Daylight saving can be disabled.

## 4.6 Activity calendar and special days

Kamstrup OMNIA® e-meter uses separate activity calendars for tariffs and load control. An activity calendar can contain up to four different seasons. Each season consists of a week profile built from three day profiles: working days, non-working days and holidays.

A day profile schedules up to 10 actions with a time resolution of 1 minute.

The activity calendar can handle up to four seasons in a year.

The activity calendar can handle a list of 140 user-defined special days (exact days, not wildcards). Special days have the same activity schedule as holidays. The special days table is a shared component for all activity calendars.

# 5 Measuring engine

Kamstrup OMNIA® e-meter measures and calculates a range of electric parameters based on different time intervals.

## 5.1 Instantaneous values

Single-cycle measurements are aggregated into intervals of 1 second duration (instantaneous values). Some instantaneous values, e.g. power values, are calculated and have a refresh rate of 1Hz.

Instantaneous values can be collected remotely by means of on-demand readings.

Kamstrup OMNIA® e-meter can be configured to push a snapshot of instantaneous values to the head-end system when selectable triggers are activated. For a detailed description, see Grid Snapshot 62.

**Note** Objects representing RMS currents are unsigned, i.e. they hold absolute values with no indication of current flow direction.

| OBIS code | Description |
|---|---|
| 1.1.1.7.0.255 | Active power P14 |
| 1.1.2.7.0.255 | Active power P23 |
| 1.1.3.7.0.255 | Reactive power Q12 |
| 1.1.4.7.0.255 | Reactive power Q34 |
| 1.1.9.7.0.255 | Apparent power S14 |
| 1.1.10.7.0.255 | Apparent power S23 |
| 1.1.13.7.0.255 | Power factor total |
| 1.1.14.7.0.255 | Frequency |
| 1.1.21.7.0.255 | Active power P14 of phase 1 |
| 1.1.41.7.0.255 | --- of phase 2 |
| 1.1.61.7.0.255 | --- of phase 3 |
| 1.1.22.7.0.255 | Active power P23 of phase 1 |
| 1.1.42.7.0.255 | --- of phase 2 |
| 1.1.62.7.0.255 | --- of phase 3 |
| 1.1.23.7.0.255 | Reactive power Q12 of phase 1 |
| 1.1.43.7.0.255 | --- of phase 2 |
| 1.1.63.7.0.255 | --- of phase 3 |
| 1.1.24.7.0.255 | Reactive power Q34 of phase 1 |
| 1.1.44.7.0.255 | --- of phase 2 |
| 1.1.64.7.0.255 | --- of phase 3 |
| 1.1.29.7.0.255 | Apparent power S14 of phase 1 |
| 1.1.49.7.0.255 | --- of phase 2 |
| 1.1.69.7.0.255 | --- of phase 3 |
| 1.1.30.7.0.255 | Apparent power S23 of phase 1 |
| 1.1.50.7.0.2551 | --- of phase 2 |

| OBIS code | Description |
|---|---|
| 1.1.70.7.0.255 | --- of phase 3 |
| 1.1.31.7.0.255 | RMS current of phase 1 |
| 1.1.51.7.0.255 | --- of phase 2 |
| 1.1.71.7.0.255 | --- of phase 3 |
| 1.1.31.7.3.255 | 3rd harmonic RMS current of phase 1 |
| 1.1.51.7.3.255 | --- of phase 2 |
| 1.1.71.7.3.255 | --- of phase 3 |
| 1.1.31.7.5.255 | 5th harmonic RMS current of phase 1 |
| 1.1.51.7.5.255 | --- of phase 2 |
| 1.1.71.7.5.255 | --- of phase 3 |
| 1.1.31.7.7.255 | 7th harmonic RMS current of phase 1 |
| 1.1.51.7.7.255 | --- of phase 2 |
| 1.1.71.7.7.255 | --- of phase 3 |
| 1.1.31.7.11.255 | 11th harmonic RMS current of phase 1 |
| 1.1.51.7.11.255 | --- of phase 2 |
| 1.1.71.7.11.255 | --- of phase 3 |
| 1.1.31.7.124.255 | THD current of phase 1 |
| 1.1.51.7.124.255 | --- of phase 2 |
| 1.1.71.7.124.255 | --- of phase 3 |
| 1.1.32.7.0.255 | RMS voltage of phase 1 |
| 1.1.52.7.0.255 | --- of phase 2 |
| 1.1.72.7.0.255 | --- of phase 3 |
| 1.1.32.7.3.255 | 3rd harmonic RMS voltage of phase 1 |
| 1.1.52.7.3.255 | --- of phase 2 |
| 1.1.72.7.3.255 | --- of phase 3 |
| 1.1.32.7.5.255 | 5th harmonic RMS voltage of phase 1 |
| 1.1.52.7.5.255 | --- of phase 2 |
| 1.1.72.7.5.255 | --- of phase 3 |
| 1.1.32.7.7.255 | 7th harmonic RMS voltage of phase 1 |
| 1.1.52.7.7.255 | --- of phase 2 |
| 1.1.72.7.7.255 | --- of phase 3 |
| 1.1.32.7.11.255 | 11th harmonic RMS voltage of phase 1 |
| 1.1.52.7.11.255 | --- of phase 2 |
| 1.1.72.7.11.255 | --- of phase 3 |
| 1.1.32.7.124.255 | THD voltage of phase 1 |
| 1.1.52.7.124.255 | --- of phase 2 |
| 1.1.72.7.124.255 | --- of phase 3 |
| 1.1.33.7.0.255 | Power factor of phase 1 |
| 1.1.53.7.0.255 | --- of phase 2 |
| 1.1.73.7.0.255 | --- of phase 3 |

### 5.1.1 Aggregation across multiple phases

In a multi-phase meter, the instantaneous power values per phase can be aggregated into instantaneous power totals. The aggregation is based on one of the calculation methods below and is selectable at ordering.

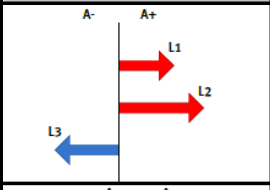
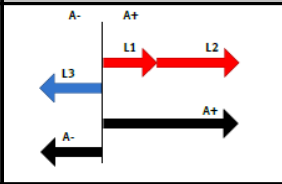
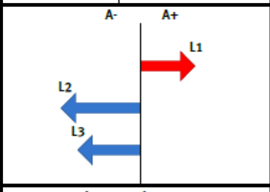
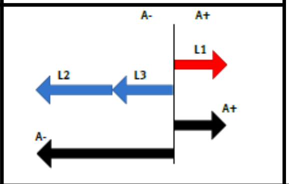
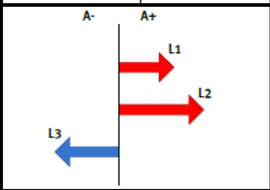
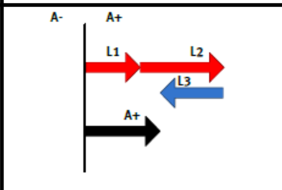
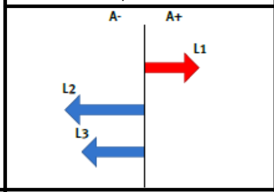
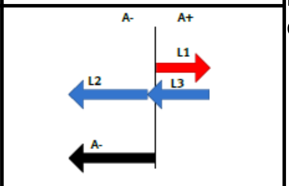
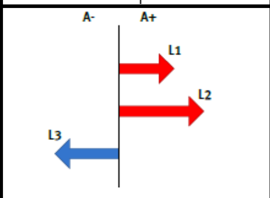
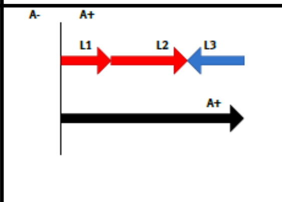
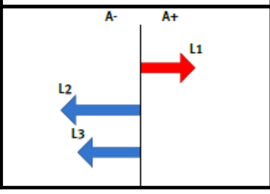
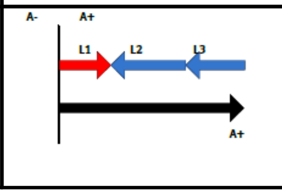
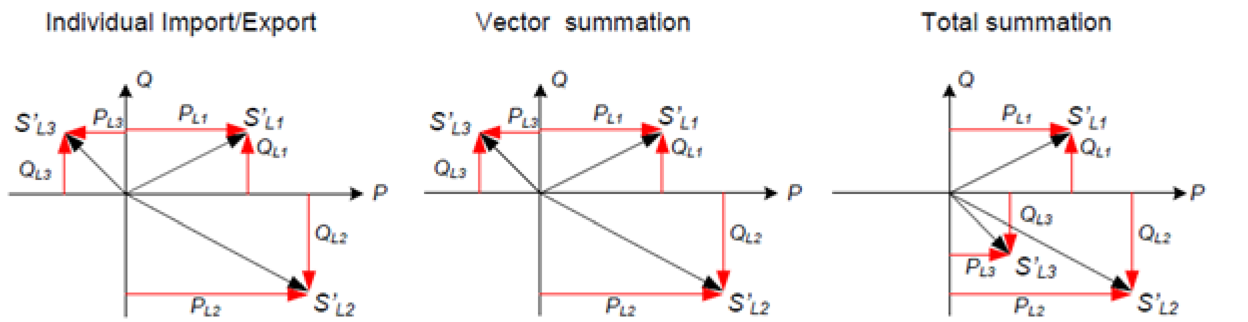
| Calculation method | Active energy examples | | Description |
|---|---|---|---|
| | Per phase contribution | Aggregated total | |
| **Individual import/export** |  |  | The individual import/export calculation method has one register for the positive contributions and one for the negative contributions. |
| |  |  | |
| **Vector summation** |  |  | When using the vector summation calculation, the positive contributions are added and the negative contributions are subtracted in the same way as by electromechanical meters.<br>Contributions from e.g. solar energy installations will be set off in the total energy calculation. |
| |  |  | |
| **Total summation** |  |  | The total summation calculation adds all contributions to the positive register whether one or more phases contribute with negative energy. |
| |  |  | |

*Figure 4: Simple view of aggregation of power across multiple phases, taking only active energy into consideration*

A detailed view on multi-phase aggregation showing the effect on reactive power is shown below using the diagrammed example of complex powers $S'_{L1}$, $S'_{L2}$ and $S'_{L3}$

**Note** The complex powers should not be confused with the apparent powers $S_{L1}$, $S_{L2}$ and $S_{L3}$ given by the relation $S_{Ln} = |S'_{Ln}|$.

In *total summation*, any complex power in the negative active power regime ($S'_{L3}$ in the example), is translated to the positive active power regime as the first step of the aggregation.




| | | | | | |
|---|---|---|---|---|---|
| P+ | $= P_{L1} + P_{L2}$ | P+ | $= P_{L1} + P_{L2} - P_{L3}$ | P+ | $= P_{L1} + P_{L2} + P_{L3}$ |
| P- | $= P_{L3}$ | P- | = 0 | P- | = 0 |
| Q+ | $= Q_{L1} + Q_{L3}$ | Q+ | $= Q_{L1} + Q_{L3} - Q_{L2}$ | Q+ | = 0 |
| Q- | $= Q_{L2}$ | Q- | = 0 | Q- | $= Q_{L3} + Q_{L2} - Q_{L1}$ |
| S+ | $= S_{L1} + S_{L2}$ | S+ | $= S_{L1} + S_{L2}$ | S+ | $= S_{L1} + S_{L2} + S_{L3}$ |
| S- | $= S_{L3}$ | S- | $= S_{L3}$ | S- | = 0 |
| A+ | $= A_{L1} + A_{L2}$ | A+ | $= A_{L1} + A_{L2} - A_{L3}$ | A+ | $= A_{L1} + A_{L2} + A_{L3}$ |
| A- | $= A_{L3}$ | A- | = 0 | A- | = 0 |
| R+ | $= R_{L1} + R_{L3}$ | R+ | $= R_{L1} + R_{L3} - R_{L2}$ | R+ | = 0 |
| R- | $= R_{L2}$ | R- | = 0 | R- | $= R_{L3} + R_{L2} - R_{L1}$ |
| E+ | $= E_{L1} + E_{L2}$ | E+ | $= E_{L1} + E_{L2}$ | E+ | $= E_{L1} + E_{L2} + E_{L3}$ |
| E- | $= E_{L3}$ | E- | $= E_{L3}$ | E- | = 0 |
| R1 | $= R_{L1}$ | R1 | $= R_{L1}$ | R1 | $= R_{L1}$ |
| R2 | $= R_{L3}$ | R2 | $= R_{L3}$ | R2 | = 0 |
| R3 | = 0 | R3 | = 0 | R3 | = 0 |
| R4 | $= R_{L2}$ | R4 | $= R_{L2}$ | R4 | $= R_{L2} + R_{L3}$ |

*Figure 5: Detailed view of aggregation of power across multiple phases, covering both active, reactive and apparent power*

### 5.1.2 Power factor

Kamstrup OMNIA® e-meter calculates the true power factor (TPF) from the ratio between active power and apparent power. The instantaneous values of power factor per phase are calculated from the active and apparent power per phase:

Power factor of phase n = active power of phase n / apparent power of phase n

where active and apparent power can be any combination of import (P14, S14) or export (P23, S23) depending on the electrical load.

In a multi-phase meter, the instantaneous power factors per phase are aggregated into an instantaneous power factor total:

Power factor total = active power total / apparent power total

where active and apparent power totals are aggregated across phases based on the vector sum calculation method. This aggregation method is independent of the global power aggregation method selected for the meter.

**Note** Objects representing power factor are unsigned, i.e. they hold absolute values with no indication of power flow direction.

### 5.1.3 Harmonic voltage and current distortion

Kamstrup OMNIA® e-meter measures harmonic content of voltage and current at individual harmonic frequencies. This feature complements the total harmonic distortion (THD) by providing additional details of which harmonic frequencies are dominating and their levels.

The meter records individual harmonic content of both voltage and current. A selected set is presented in individual harmonic content objects. All individual harmonic content objects operate per phase and are available as instantaneous values and as mean values.

The harmonic current has a cut-off limit of 0.6 A.

Additionally, the meter calculates the total harmonic distortion of both voltage (THDU) and current (THDI). The calculations of THDU and THDI include each harmonic frequency up to the 50th harmonic.

The definition of THDU is given below as a function of the relative amplitudes (uh) which is the harmonic voltage related to the fundamental voltage where h is the order of the harmonic.

$$THDU = \sqrt{\sum_{h=2}^{50} (u_h)^2}$$

*Figure 6: THDU definition*

## 5.2 Accumulated values

Accumulated values are incremented each time the corresponding instantaneous value is refreshed.

Example:

Each time P14 is refreshed, the active energy A14 is incremented by P14 x Δt.

| OBIS code | Description |
|---|---|
| 0.1.96.8.0.255 | Hour counter |
| 1.1.0.1.0.255 | Billing period counter |
| 1.1.1.8.0.128 | Active energy A14 (high resolution for verification purposes only) |
| 1.1.1.8.0.255 | Active energy A14 |
| 1.1.1.8.x.255 | Active energy A14 for tariff x (1=x=8) |
| 1.1.2.8.0.128 | Active energy A23 (high resolution for verification purposes only) |
| 1.1.2.8.0.255 | Active energy A23 |
| 1.1.2.8.x.255 | Active energy A23 for tariff x (1=x=8) |
| 1.1.3.8.0.128 | Reactive energy R12 (high resolution for verification purposes only) |
| 1.1.3.8.0.255 | Reactive energy R12 |

| OBIS code | Description |
|---|---|
| 1.1.3.8.x.255 | Reactive energy R12 for tariff x (1=x=8) |
| 1.1.4.8.0.128 | Reactive energy R34 (high resolution for verification purposes only) |
| 1.1.4.8.0.255 | Reactive energy R34 |
| 1.1.4.8.x.255 | Reactive energy R34 for tariff x (1=x=8) |
| 1.1.5.8.0.128 | Reactive energy R1 (high resolution for verification purposes only) |
| 1.1.5.8.0.255 | Reactive energy R1 |
| 1.1.5.8.x.255 | Reactive energy R1 for tariff x (1=x=8) |
| 1.1.6.8.0.128 | Reactive energy R2 (high resolution for verification purposes only) |
| 1.1.6.8.0.255 | Reactive energy R2 |
| 1.1.6.8.x.255 | Reactive energy R2 for tariff x (1=x=8) |
| 1.1.7.8.0.128 | Reactive energy R3 (high resolution for verification purposes only) |
| 1.1.7.8.0.255 | Reactive energy R3 |
| 1.1.7.8.x.255 | Reactive energy R3 for tariff x (1=x=8) |
| 1.1.8.8.0.128 | Reactive energy R4 (high resolution for verification purposes only) |
| 1.1.8.8.0.255 | Reactive energy R4 |
| 1.1.8.8.x.255 | Reactive energy R4 for tariff x (1=x=8) |
| 1.1.9.8.0.255 | Apparent energy E14 |
| 1.1.9.8.x.255 | Apparent energy E14 for tariff x (1=x=8) |
| 1.1.10.8.0.255 | Apparent energy E23 |
| 1.1.10.8.x.255 | Apparent energy E23 for tariff x (1=x=8) |
| 1.1.15.8.0.255 | Active energy A1234 |
| 1.1.16.8.0.255 | Active energy net (\|A14\| - \|A23\|) |
| 1.1.21.8.0.255 | Active energy A14 of phase 1 |
| 1.1.41.8.0.255 | --- of phase 2 |
| 1.1.61.8.0.255 | --- of phase 3 |
| 1.1.22.8.0.255 | Active energy A23 of phase 1 |
| 1.1.42.8.0.255 | --- of phase 2 |
| 1.1.62.8.0.255 | --- of phase 3 |
| 1.1.23.8.0.255 | Reactive energy R12 of phase 1 |
| 1.1.43.8.0.255 | --- of phase 2 |
| 1.1.63.8.0.255 | --- of phase 3 |
| 1.1.24.8.0.255 | Reactive energy R34 of phase 1 |
| 1.1.44.8.0.255 | --- of phase 2 |
| 1.1.64.8.0.255 | --- of phase 3 |
| 1.1.29.8.0.255 | Apparent energy E14 of phase 1 |
| 1.1.49.8.0.255 | --- of phase 2 |
| 1.1.69.8.0.255 | --- of phase 3 |
| 1.1.30.8.0.255 | Apparent energy E23 of phase 1 |
| 1.1.50.8.0.255 | --- of phase 2 |
| 1.1.70.8.0.255 | --- of phase 3 |

### 5.2.1 CT ratio

A CT meter is connected to the electrical grid through current transformers. The CT ratio is what relates the energy measured by the meter to the energy at the primary side of the current transformer (i.e. the energy actually imported or exported). It must be selected to match the current transformers used in the installation.

The CT ratio is selected at order time and can be changed subsequently if the current transformers in the installation should be exchanged. Any changes to the CT ratio trigger an entry in the CT ratio change event logger 54.

The CT ratio is expressed as a ratio (e.g. 5:1 or 120:1) and can take values from 1:1 to 600:1 (in steps of 1).

### 5.2.2 Secondary energy values

Special to Kamstrup OMNIA® e-meter CT is the energy values as measured on the secondary side of the current transformer. These are referred to as the secondary energy values.

Since a CT meter is, by definition, connected through current transformers, secondary energy values are what the meter really measures. Primary energy values are calculated from the secondary energy values multiplied by the CT ratio 23.

| OBIS code | Description |
|---|---|
| 1.1.1.8.0.129 | Active secondary energy A14 |
| 1.1.1.8.x.129 | Active secondary energy A14 for tariff x (1=x=8) |
| 1.1.2.8.0.129 | Active secondary energy A23 |
| 1.1.2.8.x.129 | Active secondary energy A23 for tariff x (1=x=8) |
| 1.1.3.8.0.129 | Reactive secondary energy R12 |
| 1.1.3.8.x.129 | Reactive secondary energy R12 for tariff x (1=x=8) |
| 1.1.4.8.0.129 | Reactive secondary energy R34 |
| 1.1.4.8.x.129 | Reactive secondary energy R34 for tariff x (1=x=8) |
| 1.1.5.8.0.129 | Reactive secondary energy R1 |
| 1.1.5.8.x.129 | Reactive secondary energy R1 for tariff x (1=x=8) |
| 1.1.6.8.0.129 | Reactive secondary energy R2 |
| 1.1.6.8.x.129 | Reactive secondary energy R2 for tariff x (1=x=8) |
| 1.1.7.8.0.129 | Reactive secondary energy R3 |
| 1.1.7.8.x.129 | Reactive secondary energy R3 for tariff x (1=x=8) |
| 1.1.8.8.0.129 | Reactive secondary energy R4 |
| 1.1.8.8.x.129 | Reactive secondary energy R4 for tariff x (1=x=8) |
| 1.1.9.8.0.129 | Apparent secondary energy E14 |
| 1.1.9.8.x.129 | Apparent secondary energy E14 for tariff x (1=x=8) |
| 1.1.10.8.0.129 | Apparent secondary energy E23 |
| 1.1.10.8.x.129 | Apparent secondary energy E23 for tariff x (1=x=8) |

## 5.3 Mean values

Kamstrup OMNIA® e-meter calculates the mean value of several measurands. For each time frame, the mean value is calculated and the mean value register is refreshed.

**Note** Objects representing RMS currents are unsigned, i.e. they hold absolute values with no indication of current flow direction.

| OBIS code | Description | Time frame |
|---|---|---|
| 1.1.1.25.0.255 | Average active power P14 | Load profile 1 capture period |
| 1.1.2.25.0.255 | Average active power P23 | Load profile 1 capture period |
| 1.1.3.25.0.255 | Average reactive power Q12 | Load profile 1 capture period |
| 1.1.4.25.0.255 | Average reactive power Q34 | Load profile 1 capture period |
| 1.1.9.25.0.255 | Average apparent power S14 | Load profile 1 capture period |
| 1.1.10.25.0.255 | Average apparent power S23 | Load profile 1 capture period |
| 1.1.13.25.0.255 | Average power factor total | Analysis logger capture period |
| 1.1.14.25.0.255 | Average frequency | 10 seconds |
| 1.1.21.25.0.255 | Average active power P14 of phase 1 | Analysis logger capture period |
| 1.1.41.25.0.255 | --- of phase 2 | Analysis logger capture period |
| 1.1.61.25.0.255 | --- of phase 3 | Analysis logger capture period |
| 1.1.22.25.0.255 | Average active power P23 of phase 1 | Analysis logger capture period |
| 1.1.42.25.0.255 | --- of phase 2 | Analysis logger capture period |
| 1.1.62.25.0.255 | --- of phase 3 | Analysis logger capture period |
| 1.1.23.25.0.255 | Average reactive power Q12 of phase 1 | Analysis logger capture period |
| 1.1.43.25.0.255 | --- of phase 2 | Analysis logger capture period |
| 1.1.63.25.0.255 | --- of phase 3 | Analysis logger capture period |
| 1.1.24.25.0.255 | Average reactive power Q34 of phase 1 | Analysis logger capture period |
| 1.1.44.25.0.255 | --- of phase 2 | Analysis logger capture period |
| 1.1.64.25.0.255 | --- of phase 3 | Analysis logger capture period |
| 1.1.29.25.0.255 | Average apparent power S14 of phase 1 | Analysis logger capture period |
| 1.1.49.25.0.255 | --- of phase 2 | Analysis logger capture period |
| 1.1.69.25.0.255 | --- of phase 3 | Analysis logger capture period |
| 1.1.30.25.0.255 | Average apparent power S23 of phase 1 | Analysis logger capture period |
| 1.1.50.25.0.255 | --- of phase 2 | Analysis logger capture period |
| 1.1.70.25.0.255 | --- of phase 3 | Analysis logger capture period |
| 1.1.31.25.0.255 | Average RMS current of phase 1 | Analysis logger capture period |
| 1.1.51.25.0.255 | --- of phase 2 | Analysis logger capture period |
| 1.1.71.25.0.255 | --- of phase 3 | Analysis logger capture period |
| 1.1.31.25.3.255 | 3rd harmonic average RMS current of phase 1 | Analysis logger capture period |
| 1.1.51.25.3.255 | --- of phase 2 | Analysis logger capture period |
| 1.1.71.25.3.255 | --- of phase 3 | Analysis logger capture period |
| 1.1.31.25.5.255 | 5th harmonic average RMS current of phase 1 | Analysis logger capture period |
| 1.1.51.25.5.255 | --- of phase 2 | Analysis logger capture period |
| 1.1.71.25.5.255 | --- of phase 3 | Analysis logger capture period |
| 1.1.31.25.7.255 | 7th harmonic average RMS current of phase 1 | Analysis logger capture period |

| OBIS code | Description | Time frame |
|---|---|---|
| 1.1.51.25.7.255 | --- of phase 2 | Analysis logger capture period |
| 1.1.71.25.7.255 | --- of phase 3 | Analysis logger capture period |
| 1.1.31.25.11.255 | 11th harmonic average RMS current of phase 1 | Analysis logger capture period |
| 1.1.51.25.11.255 | --- of phase 2 | Analysis logger capture period |
| 1.1.71.25.11.255 | --- of phase 3 | Analysis logger capture period |
| 1.1.31.24.124.255 | Average THD current of phase 1 | Analysis logger capture period |
| 1.1.51.24.124.255 | --- of phase 2 | Analysis logger capture period |
| 1.1.71.24.124.255 | --- of phase 3 | Analysis logger capture period |
| 1.1.32.25.0.255 | Average RMS voltage of phase 1 | Analysis logger capture period |
| 1.1.52.25.0.255 | --- of phase 2 | Analysis logger capture period |
| 1.1.72.25.0.255 | --- of phase 3 | Analysis logger capture period |
| 1.1.32.25.3.255 | 3rd harmonic average RMS voltage of phase 1 | Analysis logger capture period |
| 1.1.52.25.3.255 | --- of phase 2 | Analysis logger capture period |
| 1.1.72.25.3.255 | --- of phase 3 | Analysis logger capture period |
| 1.1.32.25.5.255 | 5th harmonic average RMS voltage of phase 1 | Analysis logger capture period |
| 1.1.52.25.5.255 | --- of phase 2 | Analysis logger capture period |
| 1.1.72.25.5.255 | --- of phase 3 | Analysis logger capture period |
| 1.1.32.25.7.255 | 7th harmonic average RMS voltage of phase 1 | Analysis logger capture period |
| 1.1.52.25.7.255 | --- of phase 2 | Analysis logger capture period |
| 1.1.72.25.7.255 | --- of phase 3 | Analysis logger capture period |
| 1.1.32.25.11.255 | 11th harmonic average RMS voltage of phase 1 | Analysis logger capture period |
| 1.1.52.25.11.255 | --- of phase 2 | Analysis logger capture period |
| 1.1.72.25.11.255 | --- of phase 3 | Analysis logger capture period |
| 1.1.32.24.124.255 | Average THD voltage of phase 1 | Analysis logger capture period |
| 1.1.52.24.124.255 | --- of phase 2 | Analysis logger capture period |
| 1.1.72.24.124.255 | --- of phase 3 | Analysis logger capture period |
| 1.1.33.25.0.255 | Average power factor of phase 1 | Analysis logger capture period |
| 1.1.53.25.0.255 | --- of phase 2 | Analysis logger capture period |
| 1.1.73.25.0.255 | --- of phase 3 | Analysis logger capture period |

## 5.4 Minimum and maximum values

Kamstrup OMNIA® e-meter registers the extremes (minimum and maximum values) of several measurands. During the extreme value time frame, the mean value is continuously compared to the latest extreme value. If the new value exceeds the latest extreme value, it replaces it. At the end of the extreme value time frame, the minimum and maximum value registers are reset.

**Note** Objects representing RMS currents are unsigned, i.e. they hold absolute values with no indication of current flow direction.

Objects holding minimum and maximum values include a time stamp of the time when that minimum or maximum was recorded. Adding both value and time stamp to an interval logger takes up two “slots”.

| OBIS code | Description | Averaging time frame | Extreme value time frame |
|---|---|---|---|
| 1.1.1.6.0.255 | Max active power P14 | Load profile 1 capture period | Debiting 1 logger capture period |
| 1.1.1.6.x.255 | Max active power P14 for tariff x (1=x=8) | Load profile 1 capture period | Debiting 1 logger capture period |
| 1.1.2.6.0.255 | Max active power P23 | Load profile 1 capture period | Debiting 1 logger capture period |
| 1.1.2.6.x.255 | Max active power P23 for tariff x (1=x=4) | Load profile 1 capture period | Debiting 1 logger capture period |
| 1.1.3.6.0.255 | Max reactive power Q12 | Load profile 1 capture period | Debiting 1 logger capture period |
| 1.1.3.6.x.255 | Max reactive power Q12 for tariff x (1=x=4) | Load profile 1 capture period | Debiting 1 logger capture period |
| 1.1.4.6.0.255 | Max reactive power Q34 | Load profile 1 capture period | Debiting 1 logger capture period |
| 1.1.4.6.x.255 | Max reactive power Q34 for tariff x (1=x=4) | Load profile 1 capture period | Debiting 1 logger capture period |
| 1.1.9.6.0.255 | Max apparent power S14 | Load profile 1 capture period | Debiting 1 logger capture period |
| 1.1.9.6.x.255 | Max apparent power S14 for tariff x (1=x=8) | Load profile 1 capture period | Debiting 1 logger capture period |
| 1.1.10.6.0.255 | Max apparent power S23 | Load profile 1 capture period | Debiting 1 logger capture period |
| 1.1.21.3.128.255 | Min. active power P14 of phase 1 | Instantaneous value | Analysis logger capture period |
| 1.1.41.3.128.255 | --- of phase 2 | Instantaneous value | Analysis logger capture period |
| 1.1.61.3.128.255 | --- of phase 3 | Instantaneous value | Analysis logger capture period |
| 1.1.21.6.128.255 | Max active power P14 of phase 1 | Instantaneous value | Analysis logger capture period |
| 1.1.41.6.128.255 | --- of phase 2 | Instantaneous value | Analysis logger capture period |
| 1.1.61.6.128.255 | --- of phase 3 | Instantaneous value | Analysis logger capture period |
| 1.1.22.3.128.255 | Min. active power P23 of phase 1 | Instantaneous value | Analysis logger capture period |
| 1.1.42.3.128.255 | --- of phase 2 | Instantaneous value | Analysis logger capture period |
| 1.1.62.3.128.255 | --- of phase 3 | Instantaneous value | Analysis logger capture period |
| 1.1.22.6.128.255 | Max active power P23 of phase 1 | Instantaneous value | Analysis logger capture period |

| OBIS code | Description | Averaging time frame | Extreme value time frame |
|---|---|---|---|
| 1.1.42.6.128.255 | --- of phase 2 | Instantaneous value | Analysis logger capture period |
| 1.1.62.6.128.255 | --- of phase 3 | Instantaneous value | Analysis logger capture period |
| 1.1.23.3.128.255 | Min. active power Q12 of phase 1 | Instantaneous value | Analysis logger capture period |
| 1.1.43.3.128.255 | --- of phase 2 | Instantaneous value | Analysis logger capture period |
| 1.1.63.3.128.255 | --- of phase 3 | Instantaneous value | Analysis logger capture period |
| 1.1.23.6.128.255 | Max active power Q12 of phase 1 | Instantaneous value | Analysis logger capture period |
| 1.1.43.6.128.255 | --- of phase 2 | Instantaneous value | Analysis logger capture period |
| 1.1.63.6.128.255 | --- of phase 3 | Instantaneous value | Analysis logger capture period |
| 1.1.24.3.128.255 | Min. active power Q34 of phase 1 | Instantaneous value | Analysis logger capture period |
| 1.1.44.3.128.255 | --- of phase 2 | Instantaneous value | Analysis logger capture period |
| 1.1.64.3.128.255 | --- of phase 3 | Instantaneous value | Analysis logger capture period |
| 1.1.24.6.128.255 | Max active power Q34 of phase 1 | Instantaneous value | Analysis logger capture period |
| 1.1.44.6.128.255 | --- of phase 2 | Instantaneous value | Analysis logger capture period |
| 1.1.64.6.128.255 | --- of phase 3 | Instantaneous value | Analysis logger capture period |
| 1.1.29.3.128.255 | Min. apparent power S14 of phase 1 | Instantaneous value | Analysis logger capture period |
| 1.1.49.3.128.255 | --- of phase 2 | Instantaneous value | Analysis logger capture period |
| 1.1.69.3.128.255 | --- of phase 3 | Instantaneous value | Analysis logger capture period |
| 1.1.29.6.128.255 | Max apparent power S14 of phase 1 | Instantaneous value | Analysis logger capture period |
| 1.1.49.6.128.255 | --- of phase 2 | Instantaneous value | Analysis logger capture period |
| 1.1.69.6.128.255 | --- of phase 3 | Instantaneous value | Analysis logger capture period |
| 1.1.31.3.128.255 | Min. RMS current of phase 1 | Instantaneous value | Analysis logger capture period |
| 1.1.51.3.128.255 | --- of phase 2 | Instantaneous value | Analysis logger capture period |
| 1.1.71.3.128.255 | --- of phase 3 | Instantaneous value | Analysis logger capture period |

| OBIS code | Description | Averaging time frame | Extreme value time frame |
|---|---|---|---|
| 1.1.31.6.128.255 | Max RMS current of phase 1 | Instantaneous value | Analysis logger capture period |
| 1.1.51.6.128.255 | --- of phase 2 | Instantaneous value | Analysis logger capture period |
| 1.1.71.6.128.255 | --- of phase 3 | Instantaneous value | Analysis logger capture period |
| 1.1.31.3.132.255 | Min. THD current of phase 1 | Instantaneous value | Analysis logger capture period |
| 1.1.51.3.132.255 | --- of phase 2 | Instantaneous value | Analysis logger capture period |
| 1.1.71.3.132.255 | --- of phase 3 | Instantaneous value | Analysis logger capture period |
| 1.1.31.6.132.255 | Max THD current of phase 1 | Instantaneous value | Analysis logger capture period |
| 1.1.51.6.132.255 | --- of phase 2 | Instantaneous value | Analysis logger capture period |
| 1.1.71.6.132.255 | --- of phase 3 | Instantaneous value | Analysis logger capture period |
| 1.1.32.3.128.255 | Min. RMS voltage of phase 1 | Instantaneous value | Analysis logger capture period |
| 1.1.52.3.128.255 | --- of phase 2 | Instantaneous value | Analysis logger capture period |
| 1.1.72.3.128.255 | --- of phase 3 | Instantaneous value | Analysis logger capture period |
| 1.1.32.3.130.255 | Min. daily RMS voltage of phase 1 | Instantaneous value | Daily (at midnight local time) |
| 1.1.52.3.130.255 | --- of phase 2 | Instantaneous value | Daily (at midnight local time) |
| 1.1.72.3.130.255 | --- of phase 3 | Instantaneous value | Daily (at midnight local time) |
| 1.1.32.6.129.255 | Max RMS voltage of phase 1 | Instantaneous value | Analysis logger capture period |
| 1.1.52.6.129.255 | --- of phase 2 | Instantaneous value | Analysis logger capture period |
| 1.1.72.6.129.255 | --- of phase 3 | Instantaneous value | Analysis logger capture period |
| 1.1.32.6.131.255 | Max daily RMS voltage of phase 1 | Instantaneous value | Daily (at midnight local time) |
| 1.1.52.6.131.255 | --- of phase 2 | Instantaneous value | Daily (at midnight local time) |
| 1.1.72.6.131.255 | --- of phase 3 | Instantaneous value | Daily (at midnight local time) |
| 1.1.32.3.133.255 | Min. THD voltage of phase 1 | Instantaneous value | Analysis logger capture period |
| 1.1.52.3.133.255 | --- of phase 2 | Instantaneous value | Analysis logger capture period |

| OBIS code | Description | Averaging time frame | Extreme value time frame |
|---|---|---|---|
| 1.1.72.3.133.255 | --- of phase 3 | Instantaneous value | Analysis logger capture period |
| 1.1.32.6.133.255 | Max THD voltage of phase 1 | Instantaneous value | Analysis logger capture period |
| 1.1.52.6.133.255 | --- of phase 2 | Instantaneous value | Analysis logger capture period |
| 1.1.72.6.133.255 | --- of phase 3 | Instantaneous value | Analysis logger capture period |

### 5.4.1 Accumulated maximum power values

Each time a billing period is reset, either by user interaction or automatically at end of month, the maximum power values of the billing period that just ended are added to the accumulated maximum power values. These values can be used to track maximum power values in situations with several irregular billing period resets.

**Hint** Maximum power values are also known as maximum demand.

| OBIS code | Description |
|---|---|
| 1.1.1.2.0.255 | Accumulated max active power P14 |
| 1.1.1.2.x.255 | Accumulated max active power P14 for tariff x (1=x=2) |
| 1.1.2.2.0.255 | Accumulated max active power P23 |
| 1.1.2.2.x.255 | Accumulated max active power P23 for tariff x (1=x=2) |
| 1.1.3.2.0.255 | Accumulated max reactive power Q12 |
| 1.1.4.2.0.255 | Accumulated max reactive power Q34 |

### 5.4.2 Values coinciding with min. and max supply voltage

The following instantaneous values are captured at the time of minimum and maximum RMS phase voltage resetting synchronously to the Analysis logger capture period.

**Hint** For details about the behavior and reset time of minimum and maximum values, see Minimum and maximum values 25.

| OBIS code | Description | Capture trigger |
|---|---|---|
| 1.1.21.7.128.255 | Active power P14 at the time of the min. RMS voltage of phase 1 | 1.1.32.3.128.255 |
| 1.1.41.7.128.255 | --- of phase 2 | 1.1.52.3.128.255 |
| 1.1.61.7.128.255 | --- of phase 3 | 1.1.72.3.128.255 |
| 1.1.21.7.129.255 | Active power P14 at the time of the max RMS voltage of phase 1 | 1.1.32.6.129.255 |
| 1.1.41.7.129.255 | --- of phase 2 | 1.1.52.6.129.255 |
| 1.1.61.7.129.255 | --- of phase 3 | 1.1.72.6.129.255 |
| 1.1.29.7.128.255 | Apparent power S14 at the time of the min. RMS voltage of phase 1 | 1.1.32.3.128.255 |
| 1.1.49.7.128.255 | --- of phase 2 | 1.1.52.3.128.255 |

| OBIS code | Description | Capture trigger |
|---|---|---|
| 1.1.69.7.128.255 | --- of phase 3 | 1.1.72.3.128.255 |
| 1.1.29.7.129.255 | Apparent power S14 at the time of the max RMS voltage of phase 1 | 1.1.32.6.129.255 |
| 1.1.49.7.129.255 | --- of phase 2 | 1.1.52.6.129.255 |
| 1.1.69.7.129.255 | --- of phase 3 | 1.1.72.6.129.255 |
| 1.1.31.7.128.255 | RMS current at the time of the min. RMS voltage of phase 1 | 1.1.32.3.128.255 |
| 1.1.51.7.128.255 | --- of phase 2 | 1.1.52.3.128.255 |
| 1.1.71.7.128.255 | --- of phase 3 | 1.1.72.3.128.255 |
| 1.1.31.7.129.255 | RMS current at the time of the max RMS voltage of phase 1 | 1.1.32.6.129.255 |
| 1.1.51.7.129.255 | --- of phase 2 | 1.1.52.6.129.255 |
| 1.1.71.7.129.255 | --- of phase 3 | 1.1.72.6.129.255 |

The following instantaneous values are captured at the time of minimum and maximum RMS phase voltage resetting daily at midnight local time.

**Hint** For details about the behavior and reset time of minimum and maximum values, see Minimum and maximum values 25.

| OBIS code | Description | Capture trigger |
|---|---|---|
| 1.1.21.7.130.255 | Active power P14 at the time of the min. **daily** RMS voltage of phase 1 | 1.1.32.3.130.255 |
| 1.1.41.7.130.255 | --- of phase 2 | 1.1.52.3.130.255 |
| 1.1.61.7.130.255 | --- of phase 3 | 1.1.72.3.130.255 |
| 1.1.21.7.131.255 | Active power P14 at the time of the max **daily** RMS voltage of phase 1 | 1.1.32.6.131.255 |
| 1.1.41.7.131.255 | --- of phase 2 | 1.1.52.6.131.255 |
| 1.1.61.7.131.255 | --- of phase 3 | 1.1.72.6.131.255 |
| 1.1.29.7.130.255 | Apparent power S14 at the time of the min. **daily** RMS voltage of phase 1 | 1.1.32.3.130.255 |
| 1.1.49.7.130.255 | --- of phase 2 | 1.1.52.3.130.255 |
| 1.1.69.7.130.255 | --- of phase 3 | 1.1.72.3.130.255 |
| 1.1.29.7.131.255 | Apparent power S14 at the time of the max **daily** RMS voltage of phase 1 | 1.1.32.6.131.255 |
| 1.1.49.7.131.255 | --- of phase 2 | 1.1.52.6.131.255 |
| 1.1.69.7.131.255 | --- of phase 3 | 1.1.72.6.131.255 |
| 1.1.31.7.130.255 | RMS current at the time of the min. **daily** RMS voltage of phase 1 | 1.1.32.3.130.255 |
| 1.1.51.7.130.255 | --- of phase 2 | 1.1.52.3.130.255 |
| 1.1.71.7.130.255 | --- of phase 3 | 1.1.72.3.130.255 |
| 1.1.31.7.131.255 | RMS current at the time of the max **daily** RMS voltage of phase 1 | 1.1.32.6.131.255 |
| 1.1.51.7.131.255 | --- of phase 2 | 1.1.52.6.131.255 |

| OBIS code | Description | Capture trigger |
|---|---|---|
| 1.1.71.7.131.255 | --- of phase 3 | 1.1.72.6.131.255 |

## 5.5 Tariff/TOU registers

The use of tariff or time-of-use (TOU) registers enable time segmentation of the total energy consumption. The available tariff/TOU registers are listed in the sections Accumulated values 21 and Minimum and maximum values 25.

Kamstrup OMNIA® e-meter supports the following methods for controlling tariffs/TOU registers:

1. The active tariff can be set on request.
2. Tariffs can be controlled using an activity calendar.
3. Tariffs disabled.

**Note** For a detailed description, see the section Activity calendar and special days 15 or refer to the technical guide "Kamstrup electricity meter DLMS interface specification" (doc. 5512-2571).

# 6 Interval loggers

Kamstrup OMNIA® e-meter maintains several interval loggers.

Each interval logger is based on the DLMS Profile Generic class for flexibility in configurations.

The interval loggers are synchronous profiles triggered on a regular basis at the end of the capture period, which is individually selectable per interval logger. The debiting 1 logger can also operate asynchronously, e.g. be triggered remotely by a head-end system.

Each interval logger has a capture object list that defines which capture objects (values or registers) are stored when the interval logger is triggered. The capture object list always has five fixed objects: Log ID, time stamp, log status, log data quality 39 and primary energy scaler. In addition to these five, each interval logger can capture up to 48 capture objects.

**Note** For details about the five fixed objects, refer to the section "Profile Generic class" in the technical guide "Kamstrup electricity meter DLMS interface specification" (doc. 5512-2571).

The primary energy scaler is selected at order time from kWh (or kvarh) with either two or three decimals.

Secondary energy values 23 are always stored in 0.1 Wh resolution.

Changing the configuration of load profile 1, load profile 2 or debiting 1 logger triggers an entry in the load profile change event logger 55.

In case of power outage or time adjustment, the load profile loggers automatically copy the last logged values to all missing entries. This is done in order to avoid missing entries in the interval logger.

**Note** Entries are not generated if the logger was empty or if the RTC was invalid.

Entries are only generated if the total amount of logs to be created is less than 3024.

In the following sections, each interval logger is described with factory settings for default capture period and default capture objects.

**Note** Single-phase meters do not include per-phase registers for phase 2 and 3 as default captured objects.

## 6.1 Load profile 1 (1.1.99.1.0.255)

| | |
|---|---|
| **Capture periods:** | 0, 5, 10, 15, 30, 60 minutes. |
| **Default capture period:** | Selected at order time. |
| **Default captured objects:** | Selected at order time. |

**Note** When the capture period is set to 0 minutes, the interval logger is disabled and will not trigger.

The capture object list of this logger always contains - as a minimum - either average powers or energy totals corresponding to the measuring accuracy verification printed on the meter front.

### Capacity at default captured objects

| Capture period (examples) / Captured objects | 5 min. | 15 min. | 30 min. | 60 min. |
|---|---|---|---|---|
| A14 / A23 / R12 / R34 | 60 days | 180 days | 361 days | 722 days |
| A14 / A23 / R12 / R34 / R1 / R2 / R3 / R4 | 40 days | 122 days | 245 days | 491 days |

**Important** The WELMEC guide 11.2 defines a suitable profile capacity in days as a factor 2.5 multiplied by the duration of the billing period. If the meter is used for billing based on interval data, Kamstrup A/S recommends that the definitions of WELMEC are complied with when configuring load profile 1.

## 6.2 Load profile 2 (1.1.99.2.0.255)

| | |
|---|---|
| **Capture periods:** | 0, 5, 10, 15, 30, 60, 1440 minutes. |
| **Default capture period:** | 15 minutes. |
| **Default captured objects:** | Active energy A14 of phase 1 (1.1.21.8.0.255) |
| | Active energy A14 of phase 2 (1.1.41.8.0.255) |
| | Active energy A14 of phase 3 (1.1.61.8.0.255) |
| | Active energy A23 of phase 1 (1.1.22.8.0.255) |
| | Active energy A23 of phase 2 (1.1.42.8.0.255) |
| | Active energy A23 of phase 3 (1.1.62.8.0.255) |

**Note** When the capture period is set to 0 minutes, the interval logger is disabled and will not trigger.

When the capture period is set to 1440 minutes, the interval logger triggers at midnight local time.

Single-phase meters do not include per-phase registers for phase 2 and 3 as default captured objects.

### Capacity at default captured objects

| Capture period (examples) / Captured objects | 5 min. | 15 min. | 30 min. | 60 min. |
|---|---|---|---|---|
| Default captured objects | 22 days | 67 days | 134 days | 268 days |

## 6.3 Debiting 1 logger (1.1.98.1.0.255)

| | |
|---|---|
| **Capture periods:** | 1 month. |
| **Default capture period:** | 1 month. |
| **Default captured objects:** | Active energy A14 (1.1.1.8.0.255) |
| | Active energy A23 (1.1.2.8.0.255) |
| | Reactive energy R12 (1.1.3.8.0.255) |
| | Reactive energy R34 (1.1.4.8.0.255) |
| | Active energy A14 for tariff x (1≤x≤4) (1.1.1.8.x.255) |
| | Active energy A23 for tariff x (1≤x≤4) (1.1.2.8.x.255) |
| | Max active power P14 (1.1.1.6.0.255) |

**Note** This logger is synchronously triggered by a single action schedule; hence the capture period attribute always returns "0".

### Capacity at default captured objects

| Capture period (examples) | 1 month |
|---|---|
| **Captured objects** | |
| Default captured objects | 108 months |

The debiting 1 logger can be triggered asynchronously on request from a head-end system by a maximum demand reset. The monthly trigger occurs at midnight local time on the 1st of the month.

## 6.4 Debiting 2 logger (1.1.98.2.0.255)

| | |
|---|---|
| **Capture periods:** | Daily. |
| **Default capture period:** | Daily. |
| **Default captured objects:** | Active energy A14 (1.1.1.8.0.255) |
| | Active energy A14 for tariff 1 (1.1.1.8.1.255) |
| | Active energy A14 for tariff 2 (1.1.1.8.2.255) |
| | Active energy A23 (1.1.2.8.0.255) |
| | Active energy A23 for tariff 1 (1.1.2.8.1.255) |
| | Active energy A23 for tariff 2 (1.1.2.8.2.255) |
| | Reactive energy R12 (1.1.3.8.0.255) |
| | Reactive energy R12 for tariff 1 (1.1.3.8.1.255) |
| | Reactive energy R12 for tariff 2 (1.1.3.8.2.255) |
| | Reactive energy R34 (1.1.4.8.0.255) |

| | |
|---|---|
| | Reactive energy R34 for tariff 1 (1.1.4.8.1.255) |
| | Reactive energy R34 for tariff 2 (1.1.4.8.2.255) |

**Note** This logger is synchronously triggered by a single action schedule; hence the capture period attribute always returns "0".

### Capacity at default captured objects

| **Capture period (examples)** | **Daily** |
|---|---|
| **Captured objects** | |
| Default captured objects | 496 days |

The daily capture period triggers at midnight local time.

## 6.5 Analysis logger (1.1.99.1.1.255)

| | |
|---|---|
| **Capture periods:** | 0, 5, 10, 15, 30, 60 minutes. |
| **Default capture period:** | 10 minutes. |
| **Default captured objects:** | Average frequency (1.1.14.25.0.255) |
| | Average RMS current of phase 1 (1.1.31.25.0.255) |
| | Average RMS current of phase 2 (1.1.51.25.0.255) |
| | Average RMS current of phase 3 (1.1.71.25.0.255) |
| | Average RMS voltage of phase 1 (1.1.32.25.0.255) |
| | Average RMS voltage of phase 2 (1.1.52.25.0.255) |
| | Average RMS voltage of phase 3 (1.1.72.25.0.255) |

**Note** When the capture period is set to 0 minutes, the interval logger is disabled and will not trigger.

Single-phase meters do not include per-phase registers for phase 2 and 3 as default captured objects.

### Capacity at default captured objects

| **Capture period (examples)** | **5 min.** | **10 min.** | **30 min.** | **60 min.** |
|---|---|---|---|---|
| **Captured objects** | | | | |
| Default captured objects | 24 days | 49 days | 148 days | 296 days |

## 6.6 Occurrence counter logger (1.1.99.98.17.255)

| | |
|---|---|
| **Capture periods:** | Daily. |
| **Default capture period:** | Daily. |
| **Default captured objects:** | VQ_Counter_F1 (1.1.133.0.1.255) 41 |
| | VQ_Counter_F2 (1.1.133.0.2.255) 41 |
| | VQ_Counter_F3 (1.1.133.0.3.255) 41 |
| | VQ_Counter_F4 (1.1.133.0.4.255) 41 |
| | VQ_Counter_F5 (1.1.133.0.5.255) 41 |
| | VQ_Counter_F6 (1.1.133.0.6.255) 41 |
| | VQ_Counter_F7 (1.1.133.0.7.255) 41 |
| | VQ_Counter_F8 (1.1.133.0.8.255) 41 |
| | VQ_Counter_VoltageVariation_Low1 (1.1.133.0.9.255) 42 |
| | VQ_Counter_VoltageVariation_Low2 (1.1.133.0.10.255) 42 |
| | VQ_Counter_VoltageVariation_High (1.1.133.0.11.255) 42 |
| | VQ_Counter_RapidVoltageChanges (1.1.133.0.12.255) 44 |
| | VQ_Counter_Voltage_Unbalance (1.1.133.0.13.255) 44 |
| | VQ_Counter_Interupts_Long (1.1.133.0.14.255) 43 |
| | VQ_Counter_Interupts_Short (1.1.133.0.15.255) 43 |
| | VQ_Counter_THD_U_L1 (1.1.133.0.16.255) 45 |
| | VQ_Counter_THD_U_L2 (1.1.133.0.17.255) 45 |
| | VQ_Counter_THD_U_L3 (1.1.133.0.18.255) 45 |
| | VQ_Counter_THD_I_L1 (1.1.133.0.21.255) 45 |
| | VQ_Counter_THD_I_L2 (1.1.133.0.22.255) 45 |
| | VQ_Counter_THD_I_L3 (1.1.133.0.23.255) 45 |
| | Number of voltage sags in phase L1 (1.0.32.32.0.255) 47 |
| | Number of voltage sags in phase L2 (1.0.52.32.0.255) 47 |
| | Number of voltage sags in phase L3 (1.0.72.32.0.255) 47 |
| | Number of voltage swells in phase L1 (1.0.32.36.0.255) 47 |
| | Number of voltage swells in phase L2 (1.0.52.36.0.255) 47 |
| | Number of voltage swells in phase L3 (1.0.72.36.0.255) 47 |

**Note** The capture object list of the occurrence counter logger is not configurable.

This logger is synchronously triggered by a single action schedule; hence the capture period attribute always returns "0".

### Capacity at default captured objects

| Capture period (examples) | Daily |
|---|---|
| **Captured objects** | |
| Default captured objects | 60 days |

The daily capture period triggers at midnight local time.

The table below lists an example readout of the occurrence counter logger with a daily capture period. With this information, it is possible to calculate the total percentage of time that conditions have been outside the limits given in EN 50160. The table shows these calculations in the column to the right. In the example, it can be seen that the THDU_L2 is above the requirements (THDU higher than 8% for more than 5% of the time in a week). The example assumes a 10-minutes window is used for average THD calculations.

<u>Example snippet of the occurrence counter logger</u>:

| OBIS Code | Log ID (Daily) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | No. of events in a week | Total time in a week |
|---|---|---|---|---|---|---|---|---|---|---|
| | **RTC** *(example with daily capture period)* | 20/1 2020 | 21/1 2020 | 22/1 2020 | 23/1 2020 | 24/1 2020 | 25/1 2020 | 26/1 2020 | | |
| 1.1.133.0.14.255 | VQ_Counter_Interupts_Long | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 1.1.133.0.15.255 | VQ_Counter_Interupts_Short | 0 | 0 | 0 | 1 | 2 | 0 | 0 | 3 | |
| 1.1.133.0.16.255 | VQ_Counter_THD_U_L1 | 2 | 3 | 1 | 2 | 3 | 2 | 2 | 15 | 1.5 % |
| 1.1.133.0.17.255 | VQ_Counter_THD_U_L2 | 9 | 8 | 12 | 8 | 14 | 7 | 10 | 68 | 6.7 % |
| 1.1.133.0.18.255 | VQ_Counter_THD_U_L3 | 1 | 1 | 4 | 3 | 1 | 2 | 1 | 13 | 1.3 % |
| ... | ... | | | | | | | | | |

## 6.7 GSM diagnostics logger (0.0.99.98.18.255)

The GSM diagnostics logger stores attributes from the DLMS GSM diagnostics class, relevant for analysing the operation of the cellular network.

**Hint** The *status* attribute indicates the network registration status of the modem, i.e. GMM attach state.

The *ps_status* attribute indicates the active access technology, i.e. GPRS, LTE cat. M or NB-IoT.

The *cell information* attribute contains cell information, i.e. information about the network and signal quality.

The *LTE_quality_of_service* attribute contains information on quality of service for LTE cat. M1 and NB-IoT, i.e. signal quality and enhanced coverage level.

| | |
|---|---|
| **Capture periods:** | Triggered by single action schedule (0.153.15.0.0.255) |
| **Default capture period:** | 60 minutes. |
| **Default captured objects:** | GSM diagnostic status (0.0.25.6.0.255 : 3) |
| | GSM diagnostic ps_status (0.0.25.6.0.255 : 5) |
| | GSM diagnostic cell information (0.0.25.6.0.255 : 6) |
| | LTE monitoring LTE_quality_of_service (0.0.25.11.0.255 : 3) |

**Note** Besides the listed default captured objects, the GSM diagnostics logger only captures three of the five fixed objects described in Interval loggers 32, namely Log ID, time stamp and log status.

### Capacity at default captured objects

| Capture period (examples) / Captured objects | 15 min. | 30 min. | 60 min. |
|---|---|---|---|
| Default captured objects | 2 days | 4 days | 8 days |

## 6.8 Data quality attribute

The data quality attribute is included in each interval logger entry. It tells if the values of that logger entry coincide with any of the following events, which could influence how the data should be interpreted.

| Event marking | Description |
|---|---|
| **Clock set between 7-15 seconds** | Set if the meter time is adjusted within the capture period, either by a user or autonomously during time synchronisation.<br><br>The interval is fixed and cannot be changed. |
| **Clock set between 15-60 seconds** | Set if the meter time is adjusted within the capture period, either by a user or autonomously during time synchronisation.<br><br>The interval is fixed and cannot be changed. |
| **Clock set between 60-180 seconds** | Set if the meter time is adjusted within the capture period, either by a user or autonomously during time synchronisation.<br><br>The interval is fixed and cannot be changed |
| **Clock set more than 180 seconds** | Set if the meter time is adjusted within the capture period, either by a user or autonomously during time synchronisation.<br><br>The interval is fixed and cannot be changed |
| **Clock set forward** | Set together with one of the above intervals. Identifies if the meter time is changed forward (to a later point in time).<br><br>Any logger entries created by automatic filling and the first subsequent entry are marked. |

| Event marking | Description |
|---|---|
| **Clock set backward** | Set together with one of the above intervals. Identifies if the meter time is changed backward (to an earlier point in time).<br><br>Any logger entries time stamped “ahead of time” are marked. |
| **Legal parameter error** | Set when a memory CRC error is detected when restoring data during start-up sequence.<br><br>This flag is not cleared. All following logger entries are marked. |
| **Overvoltage** | Set when the voltage on any phase exceeds 265V. The threshold is fixed and cannot be changed.<br><br>This flag is cleared when the phase voltage returns below the threshold. Any logger entries during the overvoltage are marked. |
| **Undervoltage** | Set when the voltage on any phase drops below 184V. The threshold is fixed and cannot be changed.<br><br>This flag is cleared when the phase voltage returns above the threshold. Any logger entries during the undervoltage are marked. |
| **Power outage** | Set when the meter powers up after a supply voltage interruption acting on all phases for longer than 180 seconds.<br><br>Any logger entries created by automatic filling and the first subsequent entry are marked. |

# 7 Power quality

Kamstrup OMNIA® e-meter is equipped with a power quality assessment tool. It is based on the requirements in EN 50160 regarding power quality delivered from utilities.

The power quality assessment in Kamstrup OMNIA® e-meter is based on events, i.e. information is only registered if a parameter exceeds its limits. Power quality events are logged in the Power quality event logger 52.

Additionally, the Occurrence counter logger 37 captures a set of counter registers, which are incremented when the limits of EN 50160 are exceeded.

All power quality-related features run down to 50 V.

## 7.1 Power frequency

Kamstrup OMNIA® e-meter measures a 10-seconds mean value of the line frequency and compares this value with the limits given in EN50160. Each occurrence of this 10-seconds mean value that exceeds the limits is registered in one of the following occurrence counters.

| OBIS code | Parameter | Description |
|---|---|---|
| 1.1.133.0.1.255 | VQ_Counter_F1 | Incremented when (fn - 2%) ≤ avg. frequency < (fn - 1%). |
| 1.1.133.0.2.255 | VQ_Counter_F2 | Incremented when (fn + 1%) < avg. frequency ≤ (fn + 2%). |
| 1.1.133.0.3.255 | VQ_Counter_F3 | Incremented when (fn - 15%) ≤ avg. frequency < (fn - 6%). |
| 1.1.133.0.4.255 | VQ_Counter_F4 | Incremented when (fn + 4%) < avg. frequency ≤ (fn + 15%). |
| 1.1.133.0.5.255 | VQ_Counter_F5 | Incremented when (fn - 6%) ≤ avg. frequency < (fn - 2%). |
| 1.1.133.0.6.255 | VQ_Counter_F6 | Incremented when (fn + 2%) < avg. frequency ≤ (fn + 4%). |
| 1.1.133.0.7.255 | VQ_Counter_F7 | Incremented when avg. frequency < (fn - 15%). |
| 1.1.133.0.8.255 | VQ_Counter_F8 | Incremented when (fn + 15%) < avg. frequency. |

## 7.2 Overvoltage and undervoltage

Kamstrup OMNIA® e-meter calculates the mean values of phase voltages in consecutive windows of selectable duration and compares each mean value with user-defined limits. If either limit is exceeded, the "undervoltage Ln" or "overvoltage Ln" event for the corresponding phase is triggered.

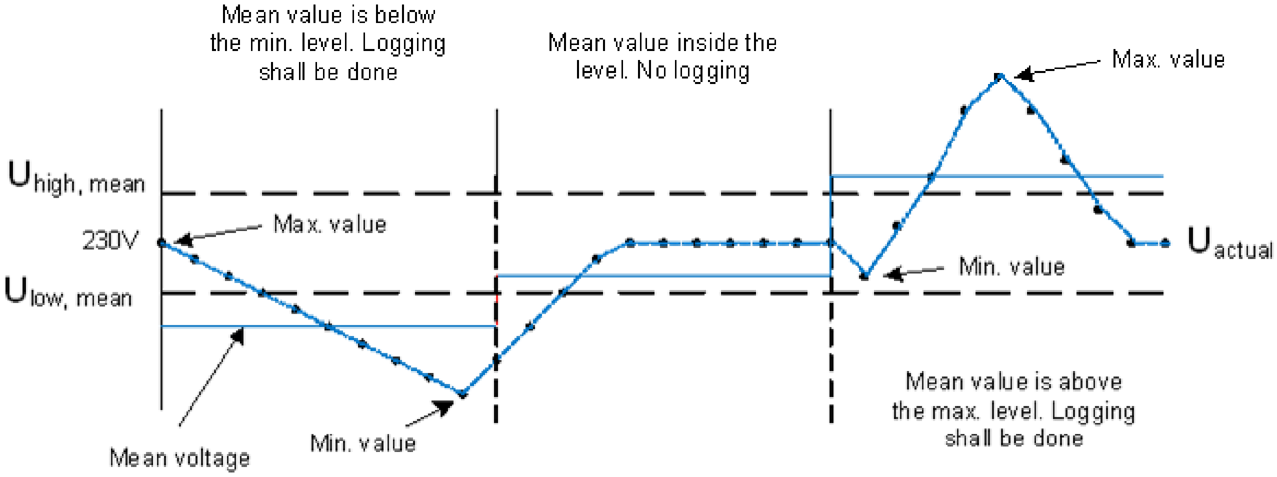



*Figure 7: Examples of detection of undervoltage and overvoltage*

Each occurrence of this mean value exceeding the limits is registered in an occurrence counter.

| OBIS code | Parameter | Description | Min. | Max | Default |
|---|---|---|---|---|---|
| 1.1.12.35.0.255 | $U_{high,mean}$ | Limit for triggering "overvoltage Ln" event (limit in % of nominal voltage). | 1% | 20% | 10% |
| 1.1.12.31.0.255 | $U_{low,mean}$ | Limit for triggering "undervoltage Ln" event (limit in % of nominal voltage). | - 20% | -1% | -10% |
| 1.1.12.44.0.255 | $U_{time-period,mean}$ | Duration of the window for mean voltage calculation (duration in seconds). | 10 sec. | 1800 sec. | 600 sec. |
| 1.1.133.0.9.255 | VQ_Counter_VoltageVariation_Low1 | Incremented when avg. voltage of any phase < (Un - 10%). | | | |
| 1.1.133.0.10.255 | VQ_Counter_VoltageVariation_Low2 | Incremented when avg. voltage of any phase < Ulow,mean. | | | |
| 1.1.133.0.11.255 | VQ_Counter_VoltageVariation_High | Incremented when avg. voltage of any phase > Uhigh,mean. | | | |

## 7.3 Supply voltage interruption

Kamstrup OMNIA® e-meter detects all supply voltage interruptions.

### 7.3.1 Acting on a subset of connected phases

The detection limit is selectable when the supply voltage interruption occurs on a subset of connected phases, i.e. the meter is still powered. In this scenario, if the detection limit and time threshold are exceeded, the "missing voltage Ln" event for the corresponding phase(s) is triggered.

In general, "missing voltage Ln" events suppress "undervoltage Ln" events. Depending on the setting of the time threshold, it is possible to observe an "undervoltage Ln" event followed by a “missing voltage Ln” event, even if the phase voltage actually dropped instantly from Un to 0V.

Example:

The phase voltage of Ln drops to 0V halfway through the undervoltage evaluation window and the "undervoltage Ln" event is triggered. The time threshold for "missing voltage Ln" is set at 10 minutes and the positive evaluation of this event exceeds the undervoltage evaluation window. The result is an "undervoltage Ln" event followed by a "missing voltage Ln" event.

**Note** In desktop testing scenarios, in case a single-phase voltage is looped to all three-phase inputs of a meter, and the test sequence includes disconnecting at least one phase input, that phase input must be loaded with a load to neutral of at least 0.5 W or alternatively shorted to neutral.

### 7.3.2 Acting on all connected phases

When the supply voltage interruption acts on all connected phases, the detection is based on a hardware signal. In this scenario, the "power down" event is triggered.

No time threshold applies to the "power down" event and the actual event logging is done when power is restored to the meter. The time stamp of the event identifies the beginning of the all-phase supply voltage interruption.

**Note** In case of a supply voltage interruption acting on all connected phases, the "missing voltage Ln" events are suppressed and will not trigger.

A last gasp enabled meter can push a last gasp message to the head-end system when an all-phase supply voltage interruption occurs. For details, see Last gasp 61.

Independent of the number of affected phases, each occurrence of supply voltage interruption is registered in one of two occurrence counters, depending on the duration of the interruption. According to EN 50160, supply voltage interruptions are divided into short interruptions (=3 minutes) and long interruptions (>3 minutes). The occurrence counters count all supply voltage interruptions and are thus not filtered by $U_{outage,timethreshold}$

| OBIS code | Parameter | Description | Min. | Max | Default |
|---|---|---|---|---|---|
| 1.0.12.39.0.255 | $U_{outagelevel}$ | Limit for triggering "missing voltage Ln" event and for incrementing occurrence counters (limit in volts). | 50 V | 160 V | 50 V |
| 1.0.12.45.0.255 | $U_{outage,timethreshold}$ | Time threshold for triggering "missing voltage Ln" event (duration in seconds) | 1 sec. | 1800 sec. | 10 sec. |
| 1.1.133.0.14.255 | VQ_Counter_Interupts_Long | Incremented when a supply voltage interruption longer than or equal to 3 minutes is detected on any phase. This object is not filtered by $U_{outage,timethreshold}$ | | | |
| 1.1.133.0.15.255 | VQ_Counter_Interupts_Short | Incremented when a supply voltage interruption shorter than 3 | | | |

| OBIS code | Parameter | Description | Min. | Max | Default |
|---|---|---|---|---|---|
| | | minutes is detected on any phase. This object is not filtered by $U_{outage,timethreshold}$ | | | |

## 7.4 Rapid voltage change

Kamstrup OMNIA® e-meter detects a rapid voltage change when two consecutive instantaneous values of "RMS voltage of phase n" differ by 5% of $U_n$ or more, i.e. ΔV ≥ 11.5 V in a 230 V system.

If the "RMS voltage of phase n" exceeds the detection limits for voltage dips or swells, the event is characterized as a voltage dip/swell rather than a rapid voltage change.

**Note** Instantaneous values are characterized by a refresh rate of 1 second. For further details, see the section Instantaneous values 17.

Each occurrence of rapid voltage change is registered in the following occurrence counter.

| OBIS code | Parameter | Description |
|---|---|---|
| 1.1.133.0.12.255 | VQ_Counter_RapidVoltageChanges | Incremented when a rapid voltage change is detected. |

## 7.5 Supply voltage unbalance

Kamstrup OMNIA® e-meter calculates the mean supply voltage unbalance in consecutive windows of 10 minutes.

Supply voltage unbalance is a measure of the balance between the three phase voltages, taking both magnitude and phase shift into account. If either is unequal across the three phases, the system is said to have an unbalance. As an example, supply voltage unbalance can occur in sections of the distribution grid where one of the phases sees a significantly higher load than the two others.

**Note** This feature only applies to multi-phase meters and works as intended only when all three phases and neutral are connected.

The calculation of the unbalance is based upon the true definition of unbalance.

Each occurrence of the mean supply voltage unbalance exceeding 2% (the limit defined in EN 50160) is registered in the following occurrence counter.

| OBIS code | Parameter | Description |
|---|---|---|
| 1.1.133.0.13.255 | VQ_Counter_Voltage_Unbalance | Incremented when supply voltage unbalance exceeds 2%. |

## 7.6 Total harmonic distortion

Kamstrup OMNIA® e-meter compares instantaneous values of total harmonic distortion voltage (THDU) and current (THDI) per phase to user-defined limits. If either of the detection limits and the time threshold is exceeded, the "THDU high Ln" or "THDI high Ln" event for the corresponding phase is triggered.

**Note** Instantaneous values are characterised by a refresh rate of 1 second. For further details, see the section Instantaneous values 17.

For details about total harmonic distortion, see Harmonic voltage and current distortion 21.

Additionally, the meter calculates the mean values of total harmonic distortion voltage (THDU) and current (THDI) per phase in consecutive windows of 10 minutes duration. Each occurrence of this 10-minutes mean THDU or THDI exceeding 8% (the limit defined in EN 50160) is registered in one of the following occurrence counters.

| OBIS code | Parameter | Description | Min. | Max | Default |
|---|---|---|---|---|---|
| 1.0.12.31.124.255 | THDU limit | Limit for triggering “THDU high Ln” event (limit in percent). | 1% | 15% | 8% |
| 1.0.12.44.124.255 | THDU time threshold | Time threshold for triggering "THDU high Ln" and "THDU high Ln ended" events (duration in seconds). | 10 sec. | 1800 sec. | 600 sec. |
| 1.0.11.31.124.255 | THDI limit | Limit for triggering “THDI high Ln” event (limit in percent). | 1% | 15% | 8% |
| 1.0.11.44.124.255 | THDI time threshold | Time threshold for triggering "THDI high Ln" and "THDI high Ln ended" events (duration in seconds). | 10 sec. | 1800 sec. | 600 sec. |
| 1.1.133.0.16.255 | VQ_Counter_THD_U_L1 | Incremented when avg. THDU of phase 1 > 8%. | | | |
| 1.1.133.0.17.255 | VQ_Counter_THD_U_L2 | Incremented when avg. THDU of phase 2 > 8%. | | | |
| 1.1.133.0.18.255 | VQ_Counter_THD_U_L3 | Incremented when avg. THDU of phase 3 > 8%. | | | |
| 1.1.133.0.21.255 | VQ_Counter_THD_I_L1 | Incremented when avg. THDI of phase 1 > 8%. | | | |
| 1.1.133.0.22.255 | VQ_Counter_THD_I_L2 | Incremented when avg. THDI of phase 2 > 8%. | | | |
| 1.1.133.0.23.255 | VQ_Counter_THD_I_L3 | Incremented when avg. THDI of phase 3 > 8%. | | | |

## 7.7 Supply voltage sags and swells

Kamstrup OMNIA® e-meter detects supply voltage sags and swells of a duration down to 20 milliseconds.

For every period of nominal frequency, the voltage on each phase is compared to the user-defined thresholds for sag and swell. If either detection limit or the time limit is exceeded, a sag or swell is recorded as illustrated below.

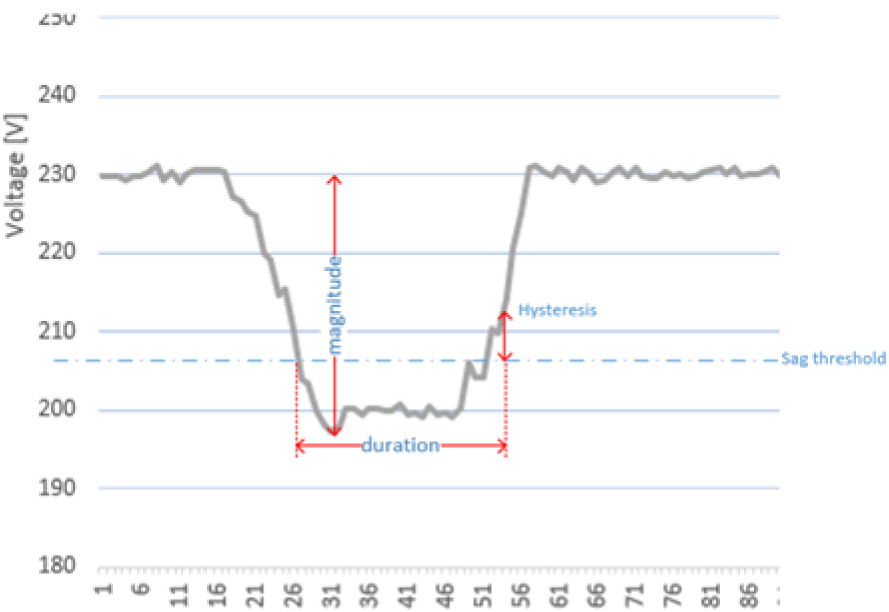



*Figure 8: Example of a voltage sag showing the recorded parameters and configuration parameters*

**Hint** A sag/swell ends when the voltage is above/below the corresponding detection limit +/- a hysteresis. The hysteresis is fixed at 2% of the nominal voltage.

A sag/swell of a longer duration than 60 seconds is not considered a sag/swell and is not recorded.

Each occurrence of a voltage sag or swell is registered in one of the following occurrence counters and the duration and magnitude of the last occurring sag or swell is available in the relevant objects listed below.

| OBIS code | Parameter | Description | Min. | Max | Default |
|---|---|---|---|---|---|
| 1.0.12.31.0.255 | Threshold for voltage sag | Limit for recording voltage sag (limit in $10^{-1}$ volts) | 11.5 V | 216.0 V | 207.0 V |
| 1.0.12.43.0.255 | Time threshold for voltage sag | Time threshold for recording voltage sag (duration in $10^{-2}$ seconds). | 20 millisec. | 60 sec. | 20 millisec. |
| 1.0.12.35.0.255 | Threshold for voltage swell | Limit for recording voltage swell (limit in $10^{-1}$ volts). | 253.0 V | 288.0 V | 253.0 V |
| 1.0.12.44.0.255 | Time threshold for voltage swell | Time threshold for recording voltage swell (duration in $10^{-2}$ seconds). | 20 millisec. | 60 sec. | 20 millisec. |

| OBIS code | Parameter | Description | Min. | Max | Default |
|---|---|---|---|---|---|
| 1.0.32.32.0.255 | Number of voltage sags in phase L1 | Incremented when a voltage sag in phase L1 is detected. | | | |
| 1.0.52.32.0.255 | Number of voltage sags in phase L2 | Incremented when a voltage sag in phase L2 is detected. | | | |
| 1.0.72.32.0.255 | Number of voltage sags in phase L3 | Incremented when a voltage sag in phase L3 is detected. | | | |
| 1.0.32.33.0.255 | Duration of last voltage sag in phase L1 | Duration of the last occurring voltage sag in phase L1 (duration in $10^{-2}$ seconds). | | | |
| 1.0.52.33.0.255 | Duration of last voltage sag in phase L2 | Duration of the last occurring voltage sag in phase L2 (duration in $10^{-2}$ seconds). | | | |
| 1.0.72.33.0.255 | Duration of last voltage sag in phase L3 | Duration of the last occurring voltage sag in phase L3 (duration in $10^{-2}$ seconds). | | | |
| 1.0.32.34.0.255 | Magnitude of last voltage sag in phase L1 | Magnitude of the last occurring voltage sag in phase L1 (magnitude in $10^{-1}$ volts). | | | |
| 1.0.52.34.0.255 | Magnitude of last voltage sag in phase L2 | Magnitude of the last occurring voltage sag in phase L2 (magnitude in $10^{-1}$ volts). | | | |
| 1.0.72.34.0.255 | Magnitude of last voltage sag in phase L3 | Magnitude of the last occurring voltage sag in phase L3 (magnitude in $10^{-1}$ volts). | | | |
| 1.0.32.36.0.255 | Number of voltage swells in phase L1 | Incremented when a voltage swell in phase L1 is detected. | | | |
| 1.0.52.36.0.255 | Number of voltage swells in phase L2 | Incremented when a voltage swell in phase L2 is detected. | | | |
| 1.0.72.36.0.255 | Number of voltage swells in phase L3 | Incremented when a voltage swell in phase L3 is detected. | | | |
| 1.0.32.37.0.255 | Duration of last voltage swell in phase L1 | Duration of the last occurring voltage swell in phase L1 (duration in $10^{-2}$ seconds). | | | |
| 1.0.52.37.0.255 | Duration of last voltage swell in phase L2 | Duration of the last occurring voltage swell in phase L2 (duration in $10^{-2}$ seconds). | | | |
| 1.0.72.37.0.255 | Duration of last voltage swell in phase L3 | Duration of the last occurring voltage swell in phase L3 (duration in $10^{-2}$ seconds). | | | |
| 1.0.32.38.0.255 | Magnitude of last voltage swell in phase L1 | Magnitude of the last occurring voltage swell in phase L1 (magnitude in $10^{-1}$ volts). | | | |
| 1.0.52.38.0.255 | Magnitude of last voltage swell in phase L2 | Magnitude of the last occurring voltage swell in phase L2 (magnitude in $10^{-1}$ volts). | | | |
| 1.0.72.38.0.255 | Magnitude of last voltage swell in phase L3 | Magnitude of the last occurring voltage swell in phase L3 (magnitude in $10^{-1}$ volts). | | | |

# 8 Grid events

Kamstrup OMNIA® e-meter detects events in the electric distribution grid. A grid event is characterised by (and differs from power quality monitoring in that) the root cause typically being a disconnected or broken conductor.

Grid event are logged in the Standard event logger 49 or in the Power quality event logger 52.

## 8.1 Neutral fault

Kamstrup OMNIA® e-meter detects when a neutral wire in the low voltage distribution grid is disconnected or broken by monitoring the instantaneous values of phase voltages and comparing them to user-defined limits. When at least one phase voltage exceeds the upper limit and at least one other phase voltage exceeds the lower limit, the "missing neutral" event is triggered.

**Note** This feature only applies to multi-phase meters and works as intended only when all three phases and neutral are connected.

| OBIS code | Parameter | Description | Min. | Max | Default |
|---|---|---|---|---|---|
| 1.1.132.0.13.255 | Neutral fault upper limit | Upper limit for triggering "missing neutral" event (limit in volts) | 240 V | 270 V | 260 V |
| 1.1.132.0.12.255 | Neutral fault lower limit | Lower limit for triggering "missing neutral" event (limit in volts) | 50 V | 230 V | 210 V |
| 1.1.132.0.15.255 | Neutral fault time threshold | Time threshold for triggering "missing neutral" and "missing neutral ended" events (duration in seconds). | 1 sec. | 900 sec. | 60 sec. |

## 8.2 Phase asymmetry

Kamstrup OMNIA® e-meter detects when a phase wire in the medium voltage grid is disconnected or broken by monitoring the instantaneous values of phase voltages and comparing them to user-defined limits. When exactly two phase voltages are within a range defined by an upper and a lower limit and the third phase voltage is above this range, the "phase asymmetry" event is triggered.

**Note** This feature only applies to multi-phase meters and works as intended only when all three phases and neutral are connected.

| OBIS code | Parameter | Description | Min. | Max | Default |
|---|---|---|---|---|---|
| 1.1.132.0.11.255 | Asymmetry fault upper limit | Upper limit for triggering “phase asymmetry” event (limit in volts) | 50 V | 230 V | 170 V |
| 1.1.132.0.10.255 | Asymmetry fault lower limit | Lower limit for triggering “phase asymmetry” event (limit in volts) | 50 V | 230 V | 90 V |
| 1.1.132.0.16.255 | Asymmetry fault time threshold | Time threshold for triggering "phase asymmetry" and "phase asymmetry ended" events (duration in seconds) | 1 sec. | 900 sec. | 180 sec. |

# 9 Event loggers

Kamstrup OMNIA® e-meter continuously monitors the electrical grid as well as its own state of operation. Deviations from normal, trigger an event in one of the event loggers.

Each event logger is based on the DLMS Profile Generic class and each entry is registered with a time stamp.

## 9.1 Standard event logger (0.0.99.98.0.255)

Kamstrup OMNIA® e-meter has a standard event logger which contains information about the meter status events. A registration in the logger can be triggered by the following events:

| Event ID | Event | Description |
|---|---|---|
| 1 | Power down | A complete power down of the device. |
| 2 | Power up | The device is powered again after a complete power down. |
| 4 | Clock adjusted (old date/time) | The clock has been adjusted. The date/time that is stored in the event logger is the old date/time before adjusting the clock. |
| 5 | Clock adjusted (new date/time) | The clock has been adjusted. The date/time that is stored in the event logger is the new date/time before adjusting the clock. |
| 6 | Clock invalid | The clock may be invalid, i.e. if the power reserve of the clock has exhausted. It is set at power-up. |
| 12 | Program memory error | A physical or logical error in the program memory. |
| 13 | RAM error | A physical or logical error in the RAM. |
| 14 | NV memory error | A physical or logical error in the non-volatile memory which is either the EEPROM or the flash memory. |
| 17 | Firmware ready for activation | The firmware is ready for activation. |
| 18 | Firmware activated | The firmware has been successfully activated. |
| 47 | One or more parameters changed | A change has been made to the meter configuration, either locally or remotely. |
| 88 | Phase sequence reversal | Indicates wrong mains connection. Usually indicates fraud or wrong installation.<br><br>**Note** For poly-phase connection only. |
| 89 | Missing neutral | Indicates that the neutral connection from the supplier to the meter is interrupted (but the neutral connection to the load prevails). The phase voltages measured by the meter may differ from their nominal values. |
| 230 | Missing neutral ended | Indicates that the neutral connection from the supplier to the meter has been restored. |
| 222 | High processor temperature | Indicates that the processor temperature has exceeded the threshold. |
| 448 | High processor temperature ended | Indicates that the processor temperature is within normal limits again. |
| 223 | Firmware uploaded | The firmware has been uploaded. |
| 224 | Firmware activating | The activation of the uploaded firmware has been started. |
| 225 | No phase current | No phase current has been detected by the meter for a specific period of time. |

| Event ID | Event | Description |
|---|---|---|
| 226 | Firmware activation failed | The activation of the firmware failed. |
| 426 | APS activated | The supply voltage on all connected phases is interrupted and the meter is powered from the auxiliary power supply input (APS). |
| 427 | APS input deactivated | The supply voltage has been restored and the meter is no longer powered from the auxiliary power supply (APS). |
| 444 | Current without voltage | Indicates the measurement of current on a phase without simultaneous detection of voltage. This is typically related to a hardware malfunction.<br>The event is triggered if measured supply voltage drops below 50V RMS and the measured current is above 50mA RMS for 30 consecutive seconds. |
| 213 | Current limit L1 exceeded | Indicates that the current threshold is exceeded on phase L1. |
| 214 | Current limit L2 exceeded | Indicates that the current threshold is exceeded on phase L2. |
| 215 | Current limit L3 exceeded | Indicates that the current threshold is exceeded on phase L3. |
| 449 | Current limit L1 restored | Indicates that the current in L1 is within limits again. |
| 450 | Current limit L2 restored | Indicates that the current in L2 is within limits again. |
| 451 | Current limit L3 restored | Indicates that the current in L3 is within limits again. |
| 452 | Power factor L1 minimum limit reached | Indicates that the power factor minimum limit has been reached on phase L1. |
| 454 | Power factor L2 minimum limit reached | Indicates that the power factor minimum limit has been reached on phase L2. |
| 456 | Power factor L3 minimum limit reached | Indicates that the power factor minimum limit has been reached on phase L3. |
| 453 | Power factor L1 minimum limit cleared | Indicates that the power factor on phase L1 is within limits again. |
| 455 | Power factor L2 minimum limit cleared | Indicates that the power factor on phase L2 is within limits again. |
| 457 | Power factor L3 minimum limit cleared | Indicates that the power factor on phase L3 is within limits again. |
| 458 | Total demand limit exceeded | Indicates that the total demand threshold is exceeded. |
| 459 | Total demand limit restored | Indicates that the total demand is within limits again. |
| 460 | Demand limit L1 exceeded | Indicates that the demand threshold is exceeded on phase L1. |
| 461 | Demand limit L2 exceeded | Indicates that the demand threshold is exceeded on phase L2. |
| 462 | Demand limit L3 exceeded | Indicates that the demand threshold is exceeded on phase L3. |
| 463 | Demand limit L1 restored | Indicates that the demand in L1 is within limits again. |
| 464 | Demand limit L2 restored | Indicates that the demand in L2 is within limits again. |
| 465 | Demand limit L3 restored | Indicates that the demand in L3 is within limits again. |

The standard event logger is a circular buffer with a capacity of 270 entries. When full, a new entry will overwrite the oldest entry.

## 9.2 Fraud detection event logger (0.0.99.98.1.255)

Kamstrup OMNIA® e-meter has a fraud detection logger. A registration in the logger can be triggered by the following events:

| Event ID | Event | Description |
|---|---|---|
| 40 | Terminal cover removed | The terminal cover has been removed. |
| 41 | Terminal cover closed | The terminal cover has been closed. |
| 42 | Strong DC field detected | A strong magnetic DC field has been detected. |
| 43 | No strong DC field anymore | A strong magnetic DC field has disappeared. |
| 49 | Decryption or authentication failure | A communication attempt with incorrect encryption keys was detected. |
| 50 | Replay attack | A communication attempt with incorrect frame counter was detected. |
| 91 | Current reversal | The current flow is reversed. |
| 447 | General signing failed | The validation of signature failed either due to wrong credentials, missing signature or malformed general signing header. |

The fraud detection event logger is a circular buffer with a capacity of 270 entries. When full, a new entry will overwrite the oldest entry.

## 9.3 Disconnect control event logger (0.0.99.98.2.255)

Kamstrup OMNIA® e-meter includes a logger that registers all events related to the supply control functionality. For each event (either a disconnection, a release or a reconnection), the meter logs an ID, a time stamp, the disconnect state and the connection feedback.

| Event ID | Event | Description |
|---|---|---|
| 59 | Released for connection | The breaker is released for manual connection using the push button on the meter front. |
| 60 | Disconnected by push button | The breaker is manually disconnected using the push button on the meter front. |
| 61 | Connected by push button | The breaker is manually connected using the push button on the meter front. |
| 62 | Disconnected by remote command | The breaker is remotely disconnected by a system command. |
| 63 | Connected by remote command | The breaker is remotely connected by a system command. |
| 64 | Disconnected by smart disconnect | The breaker is automatically disconnected by smart disconnect. |
| 68 | Connect/Disconnect failed | An attempt to connect or disconnect has failed. |
| 69 | Connected by smart disconnect | The breaker is automatically connected by smart disconnect. |

The disconnect control event logger is a circular buffer with a capacity of 270 entries. When full, a new entry will overwrite the oldest entry.

## 9.4 Power quality event logger (0.0.99.98.4.255)

Kamstrup OMNIA® e-meter has a power quality event logger, which is used for registration of voltage events like overvoltage, undervoltage and supply voltage interruptions.

| Event ID | Event | Description |
|---|---|---|
| 76 | Undervoltage L1 | Indicates that undervoltage was detected on at least L1 phase. |
| 77 | Undervoltage L2 | Indicates that undervoltage was detected on at least L2 phase. |
| 78 | Undervoltage L3 | Indicates that undervoltage was detected on at least L3 phase. |
| 406 | Undervoltage L1 ended | Indicates that voltage on phase L1 is within normal limits again after undervoltage. |
| 407 | Undervoltage L2 ended | Indicates that voltage on phase L2 is within normal limits again after undervoltage. |
| 408 | Undervoltage L3 ended | Indicates that voltage on phase L3 is within normal limits again after undervoltage. |
| 79 | Overvoltage L1 | Indicates that overvoltage was detected on at least L1 phase. |
| 80 | Overvoltage L2 | Indicates that overvoltage was detected on at least L2 phase. |
| 81 | Overvoltage L3 | Indicates that overvoltage was detected on at least L3 phase. |
| 403 | Overvoltage L1 ended | Indicates that voltage on phase L1 is within normal limits again after overvoltage. |
| 404 | Overvoltage L2 ended | Indicates that voltage on phase L2 is within normal limits again after overvoltage. |
| 405 | Overvoltage L3 ended | Indicates that voltage on phase L3 is within normal limits again after overvoltage. |
| 82 | Missing voltage L1 | Indicates that the voltage on at least L1 phase has fallen below the threshold for longer than the time delay. |
| 83 | Missing voltage L2 | Indicates that the voltage on at least L2 phase has fallen below the threshold for longer than the time delay |
| 84 | Missing voltage L3 | Indicates that the voltage on at least L3 phase has fallen below the threshold for longer than the time delay |
| 400 | Missing voltage L1 restored | Indicates that voltage on phase L1 is within normal limits again after missing phase. |
| 401 | Missing voltage L2 restored | Indicates that voltage on phase L2 is within normal limits again after missing phase. |
| 402 | Missing voltage L3 restored | Indicates that voltage on phase L3 is within normal limits again after missing phase. |
| 90 | Phase asymmetry | Indicates phase asymmetry due to large unbalance of loads connected |
| 428 | Phase asymmetry ended | Indicates phase asymmetry conditions has ended. |
| 431 | THDU high L1 | Indicates that THDU (total harmonic distortion voltage) on phase L1 has exceeded the set limit. |
| 432 | THDU high L2 | Indicates that THDU (total harmonic distortion voltage) on phase L2 has exceeded the set limit. |
| 433 | THDU high L3 | Indicates that THDU (total harmonic distortion voltage) on phase L3 has exceeded the set limit. |
| 434 | THDU high L1 ended | Indicates that THDU (total harmonic distortion voltage) on phase L1 is within the set limit again. |
| 435 | THDU high L2 ended | Indicates that THDU (total harmonic distortion voltage) on phase L2 is within the set limit again. |

| Event ID | Event | Description |
|---|---|---|
| 436 | THDU high L3 ended | Indicates that THDU (total harmonic distortion voltage) on phase L3 is within the set limit again. |
| 437 | THDI high L1 | Indicates that THDI (total harmonic distortion current) on phase L1 has exceeded the set limit. |
| 438 | THDI high L2 | Indicates that THDI (total harmonic distortion current) on phase L2 has exceeded the set limit. |
| 439 | THDI high L3 | Indicates that THDI (total harmonic distortion current) on phase L3 has exceeded the set limit. |
| 440 | THDI high L1 ended | Indicates that THDI (total harmonic distortion current) on phase L1 is within the set limit again. |
| 441 | THDI high L2 ended | Indicates that THDI (total harmonic distortion current) on phase L2 is within the set limit again. |
| 442 | THDI high L3 ended | Indicates that THDI (total harmonic distortion current) on phase L3 is within the set limit again. |

The power quality event logger is a circular buffer with a capacity of 270 entries. When full, a new entry will overwrite the oldest entry.

For details about the detection mechanics for each power quality event, see the section Power quality 41.

Each power quality event has a complementary "...ended" event, which is triggered when the event condition is no longer fulfilled.

Example:

"undervoltage L1" is logged as the voltage drops below the threshold for longer than the time threshold. As the voltage exceeds the threshold for longer than the time threshold, "undervoltage L1, event inactive" is logged.

**Note** An "...ended" event can only be triggered following a corresponding event and only once per event.

## 9.5 Communication event logger (0.0.99.98.5.255)

The communication event logger registers events related to the communication module. It also contains events related to the WAN communication status.

| Event ID | Event | Description |
|---|---|---|
| 146 | PDP context established | Indicates that the packet data protocol (PDP) context has been established. |
| 147 | PDP context destroyed | Indicates that the packet data protocol (PDP) context has been destroyed from the network side. |
| 148 | PDP context failure | Indicates that the meter was not able to re-establish the packet data protocol (PDP) context. |
| 149 | Modem SW reset | Indicates that the modem was restarted by a software reset. |
| 768 | NTP sync success | Indicates that the NTP client has received a time response from the NTP server. |
| 769 | NTP sync failed | Indicates that there is no time response from the NTP server after a predefined number of retries. |

| Event ID | Event | Description |
|---|---|---|
| 770 | HES connection established | Indicates that the head-end system (HES) communication is established. |
| 771 | HES connection destroyed | Indicates that the head-end system (HES) connection could not be established. |
| 772 | Event rate limit reached | Indicates missing communication events because the logging maximum rate has been reached. |
| 773 | Access technology changed to Cat. M1 | Indicates that the modem was previously registered using another radio access technology (RAT), and is now registered to the network using Cat. M1. |
| 774 | Access technology changed to Cat. NB1 | Indicates that the modem was previously registered using another radio access technology (RAT), and is now registered to the network using Cat. NB1. |
| 775 | Access technology changed to GPRS | Indicates that the modem was previously registered using another radio access technology (RAT), and is now registered to the network using GPRS. |
| 776 | Access technology changed to Cat. NB2 | Indicates that the modem was previously registered using another radio access technology (RAT), and is now registered to the network using Cat. NB2. |

The communication event logger is a circular buffer with a capacity of 270 entries. When full, a new entry will overwrite the oldest entry.

## 9.6 Access event logger (0.0.99.98.128.255)

The access event logger registers events that relate to communication to the meter. Both remote and local attempts are detected and logged in the access event logger.

| Event ID | Event | Description |
|---|---|---|
| 26 | Communication start on remote interface | The communication was started on the remote interface. |
| 27 | Communication end on remote interface | The communication has ended on the remote interface. |
| 28 | Communication started on local interface | The communication was started on the local interface. |
| 29 | Communication ended on local interface | The communication has ended on the local interface. |
| 212 | Successful reading attempt | A reading request was successfully executed. |

The access event logger is a circular buffer with a capacity of 270 entries. When full, a new entry will overwrite the oldest entry.

## 9.7 CT ratio change event logger (1.1.99.98.9.255)

The CT ratio change event logger registers changes to the CT ratio 23. Any changes to the CT ratio trigger a time stamped entry in this logger with the following values.

**Hint** Only Kamstrup OMNIA® e-meter CT has the CT ratio change event logger.

| OBIS code | Description |
|---|---|
| 0.1.96.8.0.255 | Hour counter |
| 1.1.0.4.2.1 | CT ratio before change |
| 1.1.0.4.2.255 | CT ratio new |
| 1.1.1.8.0.255 | Active energy A14 |
| 1.1.1.8.0.129 | Active secondary energy A14 |
| 1.1.1.8.x.255 | Active energy A14 for tariff x (1=x=8) |
| 1.1.2.8.0.255 | Active energy A23 |
| 1.1.2.8.0.129 | Active secondary energy A23 |
| 1.1.2.8.x.255 | Active energy A23 for tariff x (1=x=8) |
| 1.1.3.8.0.255 | Reactive energy R12 |
| 1.1.3.8.0.129 | Reactive secondary energy R12 |
| 1.1.3.8.x.255 | Reactive energy R12 for tariff x (1=x=8) |
| 1.1.4.8.0.255 | Reactive energy R34 |
| 1.1.4.8.0.129 | Reactive secondary energy R34 |
| 1.1.4.8.x.255 | Reactive energy R34 for tariff x (1=x=8) |
| 1.1.5.8.0.255 | Reactive energy R1 |
| 1.1.5.8.0.129 | Reactive secondary energy R1 |
| 1.1.8.8.0.255 | Reactive energy R4 |
| 1.1.8.8.0.129 | Reactive secondary energy R4 |

The CT ratio change event logger is a circular buffer with a capacity of 10 entries. When full, a new entry will overwrite the oldest entry.

## 9.8 Load profile change event logger (1.1.99.98.10.255)

The load profile change event logger registers changes to the configuration of load profile 1, load profile 2 and the debiting 1 logger.

| Event ID | Event | Description |
|---|---|---|
| 1 | Capture object list of load profile 1 has been changed | A change has been made to the objects captured by load profile 1. |
| 2 | Load profile 1 has been cleared following a change applied to the capture object list | Load profile 1 has been cleared automatically following a change in the captured objects. |
| 4 | Load profile 1 has been cleared by command (only possible in Kamstrup factory) | Load profile 1 has been cleared by command in Kamstrup's factory. |
| 5 | Capture period of load profile 1 has been changed | A change has been made to the capture period of load profile 1. |
| 6 | Load profile 1 has been disabled | Load profile 1 has been disabled. |
| 7 | Load profile 1 has been enabled | Load profile 1 has been enabled. |
| 12 | Capture object list of debiting 1 logger has been changed | A change has been made to the objects captured by debiting 1 logger. |

| Event ID | Event | Description |
|---|---|---|
| 13 | Load profile 2 has been cleared | Load profile 2 has been cleared, either following a change in the captured objects or by command in Kamstrup's factory. |
| 14 | Capture period of load profile 2 has been changed | A change has been made to the capture period of load profile 2. |

The load profile change event logger is a circular buffer with a capacity of 291 entries. When full, a new entry will overwrite the oldest entry.

## 9.9 Calculation method change event logger (0.0.99.98.131.255)

The calculation method change event logger registers changes to the multi-phase energy aggregation method 19 (also known as the calculation method). Any changes to the calculation method trigger a time stamped entry in this logger with the following values.

**Hint** Only Kamstrup OMNIA® e-meter CT has the secondary energy values 23.

| OBIS code | Description |
|---|---|
| 0.1.96.8.0.255 | Hour counter |
| 1.1.134.0.113.255 | The calculation method before change.<br><br>Can take the following values:<br>0: Individual import/export<br>1: Vector summation<br>2: Total summation |
| 1.1.134.0.111.255 | Calculation method new.<br><br>Can take the following values:<br>0: Individual import/export<br>1: Vector summation<br>2: Total summation |
| 1.1.1.8.0.255 | Active energy A14 |
| 1.1.1.8.0.129 | Active secondary energy A14 |
| 1.1.1.8.x.255 | Active energy A14 for tariff x (1=x=8) |
| 1.1.2.8.0.255 | Active energy A23 |
| 1.1.2.8.0.129 | Active secondary energy A23 |
| 1.1.2.8.x.255 | Active energy A23 for tariff x (1=x=8) |
| 1.1.3.8.0.255 | Reactive energy R12 |
| 1.1.3.8.0.129 | Reactive secondary energy R12 |
| 1.1.3.8.x.255 | Reactive energy R12 for tariff x (1=x=8) |
| 1.1.4.8.0.255 | Reactive energy R34 |
| 1.1.4.8.0.129 | Reactive secondary energy R34 |
| 1.1.4.8.x.255 | Reactive energy R34 for tariff x (1=x=8) |
| 1.1.5.8.0.255 | Reactive energy R1 |
| 1.1.5.8.0.129 | Reactive secondary energy R1 |
| 1.1.8.8.0.255 | Reactive energy R4 |
| 1.1.8.8.0.129 | Reactive secondary energy R4 |

The calculation method change event logger is a circular buffer with a capacity of 10 entries. When full, a new entry will overwrite the oldest entry.

# 10 Alarms

Kamstrup OMNIA® e-meter can push alarms triggered by specific events. The alarm is pushed from the meter immediately after the event is registered in one of the event loggers.

All alarms are disabled per default and can be enabled by setting the corresponding bit in the alarm filter objects listed below. Alarm filter objects can be managed from a head-end system.

Alarms are transmitted through the communication network with priority before conventional data push.

## 10.1 Alarm filter 1 (0.0.97.98.10.255)

| Bit | Alarm name | Trigger event |
|---|---|---|
| 0 | Clock invalid | Std 6 |
| 8 | Program memory error | Std 12 |
| 9 | RAM error | Std 13 |
| 10 | NV memory error | Std 14 |

## 10.2 Alarm filter 2 (0.0.97.98.11.255)

| Bit | Alarm name | Trigger event |
|---|---|---|
| 0 | Power down | Std 1 |
| 1 | Power up | Std 2 |
| 2 | Missing voltage L1 | PQ 82 |
| 3 | Missing voltage L2 | PQ 83 |
| 4 | Missing voltage L3 | PQ 84 |
| 9 | Phase asymmetry | PQ 90 |
| 10 | Current reversal | Fraud 91 |
| 11 | Phase sequence reversal | Std 88 |
| 31 | Connect/disconnect failed | Disc 68 |

## 10.3 Alarm filter 3 (0.0.97.98.12.255)

| Bit | Alarm name | Trigger event |
|---|---|---|
| 0 | Disconnector ready for manual reconnection | Disc 59 |
| 1 | Manual disconnection | Disc 60 |
| 2 | Manual connection | Disc 61 |
| 3 | Remote disconnection | Disc 62 |
| 4 | Remote connection | Disc 63 |
| 5 | Local disconnection | Disc 64 |
| 6 | Local reconnection | Disc 69 |

| Bit | Alarm name | Trigger event |
|---|---|---|
| 17 | Firmware activated | Std 18 |
| 18 | Firmware activation failed | Std 226 |
| 19 | Replay attack | Fraud 50 |
| 20 | Decryption or authentication failure | Fraud 49 |
| 21 | One or more parameters changed | Std 47 |
| 22 | General signing failed | Fraud 447 |
| 26 | Current without voltage | Std 444 |
| 27 | APS activated | Std 426 |
| 28 | APS input deactivated | Std 427 |

## 10.4 Alarm filter 4 (0.0.97.98.13.255)

| Bit | Alarm name | Trigger event |
|---|---|---|
| 8 | Undervoltage L1 | PQ 76 |
| 9 | Undervoltage L2 | PQ 77 |
| 10 | Undervoltage L3 | PQ 78 |
| 11 | Overvoltage L1 | PQ 79 |
| 12 | Overvoltage L2 | PQ 80 |
| 13 | Overvoltage L3 | PQ 81 |
| 14 | Phase asymmetry ended | PQ 428 |
| 15 | No phase current | Std 225 |
| 16 | Missing neutral | Std 89 |
| 17 | Missing neutral ended | Std 230 |
| 18 | Strong DC field detected | Fraud 42 |
| 19 | No strong DC field anymore | Fraud 43 |
| 20 | Terminal cover removed | Fraud 40 |
| 21 | Terminal cover closed | Fraud 41 |
| 22 | Missing voltage L1 restored | PQ 400 |
| 23 | Missing voltage L2 restored | PQ 401 |
| 24 | Missing voltage L3 restored | PQ 402 |
| 25 | Overvoltage L1 ended | PQ 403 |
| 26 | Overvoltage L2 ended | PQ 404 |
| 27 | Overvoltage L3 ended | PQ 405 |
| 28 | Undervoltage L1 ended | PQ 406 |
| 29 | Undervoltage L2 ended | PQ 407 |
| 30 | Undervoltage L3 ended | PQ 408 |

## 10.5 Alarm filter 5 (0.0.97.98.14.255)

| Bit | Alarm name | Trigger event |
|---|---|---|
| 0 | AccessTechM1 | Com 773 |

| Bit | Alarm name | Trigger event |
|---|---|---|
| 1 | AccessTechNB1 | Com 774 |
| 2 | AccessTechGPRS | Com 775 |
| 3 | AccessTechNB2 | Com 776 |
| 18 | High processor temperature | Std 222 |
| 19 | High processor temperature ended | Std 448 |
| 20 | THDU high L1 | PQ 431 |
| 21 | THDU high L2 | PQ 432 |
| 22 | THDU high L3 | PQ 433 |
| 23 | THDU high L1 ended | PQ 434 |
| 24 | THDU high L2 ended | PQ 435 |
| 25 | THDU high L3 ended | PQ 436 |
| 26 | THDI high L1 | PQ 437 |
| 27 | THDI high L2 | PQ 438 |
| 28 | THDI high L3 | PQ 439 |
| 29 | THDI high L1 ended | PQ 440 |
| 30 | THDI high L2 ended | PQ 441 |
| 31 | THDI high L3 ended | PQ 442 |

## 10.6 Alarm filter 6 (0.0.97.98.15.255)

| Bit | Alarm name | Trigger event |
|---|---|---|
| 0 | Current limit L1 exceeded | Std 213 |
| 1 | Current limit L2 exceeded | Std 214 |
| 2 | Current limit L3 exceeded | Std 215 |
| 3 | Current limit L1 restored | Std 449 |
| 4 | Current limit L2 restored | Std 450 |
| 5 | Current limit L3 restored | Std 451 |
| 6 | Total demand limit exceeded | Std 458 |
| 7 | Total demand limit restored | Std 459 |
| 8 | Demand limit L1 exceeded | Std 460 |
| 9 | Demand limit L2 exceeded | Std 461 |
| 10 | Demand limit L3 exceeded | Std 462 |
| 11 | Demand limit L1 restored | Std 463 |
| 12 | Demand limit L2 restored | Std 464 |
| 13 | Demand limit L3 restored | Std 465 |
| 14 | Power factor L1 minimum limit reached | Std 452 |
| 15 | Power factor L2 minimum limit reached | Std 454 |
| 16 | Power factor L3 minimum limit reached | Std 456 |
| 17 | Power factor L1 minimum limit cleared | Std 453 |
| 18 | Power factor L2 minimum limit cleared | Std 455 |
| 19 | Power factor L3 minimum limit cleared | Std 457 |

# 11 Last gasp

Kamstrup OMNIA® e-meter is available with a last gasp feature. A last gasp capable meter can push a message to the head-end system when an all-phase supply voltage interruption occurs. Last gasp is triggered by the same hardware signal informing the processor to initiate a shutdown when a supply voltage interruption occurs acting on all connected phases. The last gasp message is pushed immediately after detection.

The last gasp message payload contains a time stamp of the beginning of the all-phase supply voltage interruption.

**Note** For details on the last gasp message, see the technical guide "Kamstrup electricity meter DLMS interface specification" (doc. 5512-2571).

The last gasp feature is disabled by default when the meter leaves Kamstrup's factory and can be enabled from the head-end system on relevant meters.

**Important** Not all meters are last gasp capable. The feature requires additional energy storage in the meter, which must be selected at order time.

# 12 Grid snapshot (0.0.99.98.130.255)

Kamstrup OMNIA® e-meter can push a snapshot of instantaneous values when triggered.

Grid snapshot is based on the DLMS Profile Generic class and modeled as an event logger. It has a capture object list that defines which capture objects (values or registers) are stored when a trigger occurs. Grid snapshot can capture up to 24 capture objects. The captured objects can be selected using the captured objects attribute. The default list is given in the table below.

Grid snapshot operates asynchronously, i.e. it is triggered by an event. When a trigger event occurs, a snapshot is taken of the captured objects. Any new snapshots are pushed to the head-end system according to the push setup. Grid snapshot has a circular buffer with a capacity of at least 100 snapshots.

The list of trigger events is selectable from any event in the meter using Grid snapshot event filters. All snapshots contain a Log ID, Log status, time stamp and an event ID identifying which event triggered the snapshot.

| OBIS code | Description |
|---|---|
| 1.1.134.0.120.255 | Grid snapshot event filter 1 |
| 1.1.134.0.121.255 | Grid snapshot event filter 2 |
| 1.1.134.0.122.255 | Grid snapshot event filter 3 |
| 1.1.134.0.123.255 | Grid snapshot event filter 4 |
| 1.1.134.0.124.255 | Grid snapshot event filter 5 |
| 1.1.134.0.125.255 | Grid snapshot event filter 6 |

**Note** The Grid snapshot event filters are identical in mapping to the alarm filters. See the section Alarms 58 for mapping of Grid snapshot event filters, i.e. how to enable an event as a trigger event.

Snapshots are transmitted through the communication network with priority after conventional data push.

The default captured objects and trigger events are listed in the table below:

| | |
|---|---|
| **Default trigger events:** | Overvoltage L1 |
| | Overvoltage L2 |
| | Overvoltage L3 |
| | Missing voltage L1 |
| | Missing voltage L2 |
| | Missing voltage L3 |
| **Default captured objects:** | RMS current of phase 1 (1.1.31.7.0.255) |
| | RMS current of phase 2 (1.1.51.7.0.255) |
| | RMS current of phase 3 (1.1.71.7.0.255) |
| | RMS voltage of phase 1 (1.1.32.7.0.255) |

| | |
|---|---|
| | RMS voltage of phase 2 (1.1.52.7.0.255) |
| | RMS voltage of phase 3 (1.1.72.7.0.255) |
| | Active power P14 (1.1.1.7.0.255) |
| | Active power P23 (1.1.2.7.0.255) |
| | Frequency (1.1.14.7.0.255) |

# 13 Communication with head-end system

## 13.1 Push setups

The general read out of conventional meter data, consisting of both interval loggers and event loggers, is based on a reliable push schedule from the meter to the head-end system. It means that the meter is responsible for pushing all conventional data at regular intervals, which is handled by push setups.

Push setups are based on the DLMS Push Setup class.

A push setup operates synchronously and is triggered on a regular basis defined by the push interval. The push interval is selectable and intervals up to 24 hours are valid. The minimum push interval is 5 minutes. Default push intervals are listed in the table below.

Each push setup has a push object list that defines which objects (values or registers) are pushed when the push setup is triggered. The push object list is individually selectable per push setup.

Each push setup has a randomization window to prevent all meters from pushing data sets at the same time, e.g. at midnight.

Examples:
A meter with a push setup configured for daily push interval and 2 hours randomization window will trigger (will push data) at a randomized time between 00:00 and 02:00.

A meter with a push setup configured for 15 minutes push interval and 15 minutes randomization window will trigger (will push data) at a randomized time between hh:00 and hh:15, and again between hh:15 and hh:30 and so on, but always with 15 minutes interval between each trigger.

A meter with a push setup configured for 8 hours push interval, 6 hours randomization window and 2 hours offset will trigger (will push data) at a randomized time between 02:00 and 08:00, and again between 10:00 and 16:00, and again between 18:00 and 00:00, but always with 8 hours interval between each trigger.

The default settings for push setups are listed below.

| Push setup | Default pushed objects | Default push interval | Default randomization window | Offset |
|---|---|---|---|---|
| 0.128.25.9.0.255 | Meter registration message | Daily | 18 hours | 4 hours |
| **Interval loggers** | | | | |
| 0.129.25.9.0.255 | All objects in<br>Load profile 1 (1.1.99.1.0.255) | 2 hrs. | 2 hrs. | - |
| 0.162.25.9.0.255 | All objects in<br>Load profile 2 (1.1.99.2.0.255) | 4 hrs. | 4 hrs. | - |
| 0.134.25.9.0.255 | All objects in<br>Debiting 1 logger (1.1.98.1.0.255) | Daily | 2 hours | - |
| 0.132.25.9.0.255 | All objects in<br>Debiting 2 logger (1.1.98.2.0.255) | Daily | 2 hours | - |
| 0.131.25.9.0.255 | All objects in | 4 hours | 4 hours | - |

| Push setup | Default pushed objects | Default push interval | Default randomization window | Offset |
|---|---|---|---|---|
| | Analysis logger (1.1.99.1.1.255) | | | |
| 0.133.25.9.0.255 | All objects in Occurrence counter logger (1.1.99.98.17.255) | Daily | 6 hours | 2 hours |
| 0.153.25.9.0.255 | All objects in GSM diagnostics logger (0.0.99.98.18.255) | 8 hours | 6 hours | 2 hours |
| **Event loggers** | | | | |
| 0.151.25.9.0.255 | All objects in Standard event logger (0.0.99.98.0.255) | Daily | 6 hours | - |
| 0.152.25.9.0.255 | All objects in Fraud detection event logger (0.0.99.98.1.255) | Daily | 6 hours | - |
| 0.156.25.9.0.255 | All objects in Disconnect control event logger (0.0.99.98.2.255) | Daily | 6 hours | - |
| 0.159.25.9.0.255 | All objects in Power quality event logger (0.0.99.98.4.255) | Daily | 6 hours | - |
| 0.158.25.9.0.255 | All objects in Communication event logger (0.0.99.98.5.255) | Daily | 18 hours | 4 hours |
| 0.160.25.9.0.255 | All objects in Grid snapshot (0.0.99.98.130.255) | Default not pushed | - | - |

**Note** All objects of interval loggers are pushed per default with the exception of the primary energy scaler attribute.

For details about configuration of push setups, see the technical guide "Kamstrup electricity meter DLMS interface specification" (doc. 5512-2571).

In case the connection between meter and head-end system is interrupted, the meter is responsible for storing the push data in a "queuing" system, waiting for network connection to be reestablished. When the network connection is restored, the meter ensures "catch-up" by pushing data in "queue" until acknowledgement is received from the head-end system.

## 13.2 On-demand requests

In addition to data push, it is possible to read data from the meters using on-demand requests from the head-end system. This provides the possibility to access data asynchronously or to access data not included in a push setup.

## 13.3 Selection of access technology

Kamstrup OMNIA® e-meter is available with several cellular access technologies. The meter can autonomously select the best suited.

When ordering a meter with multiple access technologies, the priorities of these must be selected. If the meter is unable to register to the cellular network using the primary access technology, it changes to the secondary instead. The meter has differentiated timeouts depending on the selected primary access technology.

- If the primary access technology is LTE Cat. M1 and the meter is unable to register, it changes to the secondary access technology after 5 minutes (default).
- If the primary access technology is NB-IoT and the meter is unable to register, it changes to the secondary access technology after 20 minutes (default).

If connected using the secondary access technology, the meter will retry the primary access technology with exponentially increasing intervals starting at a default of 24 hours and with a maximum interval of 8 days (default).

It is possible to order the meter limited to just a single access technology. In that case, the meter will only connect using that technology.

If the meter is able to register to the cellular network using the primary access technology, but under poor radio condition, it changes to the secondary instead and adverse. The meter has differentiated (per access technology) signal thresholds that define the poor radio condition.

- If the primary access technology is LTE Cat. M1 and the meter is able to register, but RSRP is below -120 dBm (default) AND SINR is below -5 dB (default), it changes to the secondary access technology.
- If the primary access technology is NB-IoT and the meter is able to register, but RSRP is below -150 dBm (default) AND SINR is below -20 dB (default), it changes to the secondary access technology.

All the above parameters are configurable when ordering the meters.

# 14 Firmware upgrade

The complete firmware in the meter is divided into the following four sub-images.

- **Legal meter firmware**: This includes all features related to legal energy measurement, data handling and specific meter features. The firmware number and firmware revision are shown in the meter display during the power-up sequence.
- **Communication firmware**: This handles all communication related tasks using the integrated cellular module in the meter.
- **Bootloader firmware**: This is used for firmware image validation and upgrade. The meter has two bootloader slots for robustness to power failures during firmware upgrade. The firmware number and revision of the bootloader is shown in the meter display during the start-up sequence.
- **Setup loader firmware**: The setup loader selects the active bootloader slot during start-up and provides a secure boot swap functionality when the bootloader is replaced.

It is possible to upgrade new legal meter firmware, communication firmware and bootloader firmware remotely. This functionality is compliant to the guidelines of the WELMEC Software guide 7.2 and is approved in accordance with the MID type approval of the meter.

Any firmware upgrade session is recorded in the standard event logger and in one of three audit loggers.

## 14.1 Audit loggers

Kamstrup OMNIA® e-meter has three audit loggers for successful, failed and legally non-relevant firmware upgrade activity.

Besides the fixed attributes Log ID, time stamp and log status, all three audit loggers capture the same information as listed below.

| Object | Description |
|---|---|
| SoftwareUploadInformationPart (1.1.96.54.2.255) | Which firmware component was target of the firmware upgrade job.<br><br>Can take the following values:<br>0: Nothing<br>1: Boot loader<br>2: Legal application<br>3: Setup loader<br>5: Legally non-relevant application |
| Upload_SoftwareVariantRevision _old (1.1.96.54.3.255) | The revision of the firmware component being replaced. |
| Upload_SoftwareVariantRevision _new (1.1.96.54.11.255) | The revision of the new firmware component. |
| Upload_StartUploadInterface (1.1.96.54.6.255) | From which interface was the firmware upgrade job initiated.<br><br>Can take the following values: |

| Object | Description |
|---|---|
| | 0: Reserved for future use<br>1: Reserved for future use |
| OriginatorID<br>(1.1.96.54.4.255) | The originator ID received in a firmware activate command. |
| Upload_SoftwareVariantNumber_old<br>(1.1.96.54.12.255) | The software number of the firmware component being replaced. |
| Upload_SoftwareVariantNumber_new<br>(1.1.96.54.13.255) | The software number of the new firmware component. |
| Upload_Result<br>(1.1.96.54.14.255) | The result of the firmware upgrade job.<br><br>Can take the following values:<br>0: Success<br>1: Update not completed<br>2: Invalid request CRC<br>3: Invalid image header<br>4: Invalid image header CRC<br>5: Invalid image external CRC<br>6: Invalid image internal CRC<br>7: Invalid image type<br>8: Invalid image memory map<br>9: Invalid image sequence<br>10: Invalid compatibility<br>11: Invalid image signature<br>12: Erase internal image failed<br>13: Vector table programming failed<br>14: Vector table verification failed<br>15: Copy image from external to internal memory failed<br>16: Invalid result CRC |

### 14.1.1 Audit logger success (1.1.99.98.13.255)

A firmware upgrade job triggers an entry in this logger when the result is successful and the target firmware component is legally relevant, e.g. legal application, bootloader or setup loader.

The logger capacity is 100 entries and the logger is not circular in order to hold the full trace of successful upgrade jobs.

### 14.1.2 Audit logger fail (1.1.99.98.14.255)

A firmware upgrade job triggers an entry in this logger when the result is not successful and the target firmware component is legally relevant, e.g. legal application, bootloader or setup loader.

The logger is a circular buffer with a capacity of 100 entries. When full, a new entry will overwrite the oldest entry.

### 14.1.3 Audit logger non-legal (1.1.99.98.18.255)

A firmware upgrade job triggers an entry in this logger when the target firmware component is not legally relevant, independent of job success.

The logger is a circular buffer with a capacity of 25 entries. When full, a new entry will overwrite the oldest entry.

# 15 Data security

Kamstrup OMNIA® e-meter is protected by encryption on all communication interfaces. The security architecture is built around role-based access with each role having a separate level of privilege. The encryption method is AES-GCM 128 and it is implemented according to DLMS/COSEM security suite 0.

**Note** Due to the typical use cases and processes of distribution system operators (DSOs), the home area network (HAN) interface is unencrypted.

For details about the security suite, see the technical guide "Kamstrup electricity meter DLMS interface specification" (doc. 5512-2571).

The encryption covers readout of all consumption/production data, read and write possibilities of configuration parameters and control commands like disconnect/reconnect of the internal supply control switch.

## 15.1 Digital signature of supply control switch commands

Kamstrup OMNIA® e-meter can be ordered with an option for digital signature support for supply control switch (SCS) state change commands. The head-end system (HES) then needs to digitally sign all SCS state change commands using its HES signing certificate in addition to encrypt the commands using the meter specific symmetric keys. This adds an additional layer of protection to these commands.

If the meter cannot verify the digital signature, the General signing failed 51 event is triggered in the Fraud detection event logger 51.

# 16 Communication interfaces

## 16.1 Cellular interface

Kamstrup OMNIA® e-meter is available with an integrated cellular communication interface acting as the primary communication interface towards a head-end system.

**Note** The characteristics of the cellular interface and supported technologies are described in the data sheet "Kamstrup OMNIA® e-meter" (doc. 5810-1915).

## 16.2 Optical interface

An optical interface is available on the meter front for local communication with the meter, e.g. using a field tool. The optical interface conforms to the physical properties defined in IEC/EN 62056-21.

## 16.3 Home area network (HAN)

Kamstrup OMNIA® e-meter is available with a home area network (HAN) interface accessible on the meter front.

### 16.3.1 Physical interface (HAN)

The HAN interface connector type is RJ12 and the meter holds a female connector; the external device connects via standard RJ12 male plug.

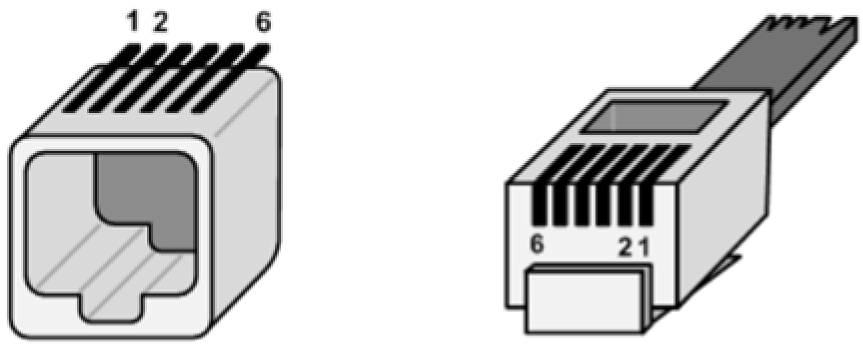



*Figure 9: Physical connectors pin-out*

The HAN interface pin assignment is detailed in the table below:

| Pin # | Signal name | Description | Remark |
|---|---|---|---|
| 1 | +5V | +5V power supply | Power supply line |
| 2 | Data request | Data request | Input |
| 3 | Data GND | Data ground | |
| 4 | n.c. | Not connected | |
| 5 | Data | Data line | Output. Open collector |

| Pin # | Signal name | Description | Remark |
|---|---|---|---|
| 6 | Power GND | Power ground | Power supply line |

This physical interface conforms to the properties defined in DSMR v. 5.0.2 P1 companion standard, with the following exception: The HAN interface fulfills the electrical requirements of overvoltage category III, which is the level generally applicable to electricity smart meters.

**Note** The meter is available in a version without the +5V power supply output (DSMR P1 Lite) to the external device. This is selected when ordering and indicated in the meter type number as shown below.

684-2-xxP-xxx1xxxx-xxxxxxx OMNIA® e-meter three-phase (DSMR P1 Lite)

684-2-xxP-xxx2xxxx-xxxxxxx OMNIA® e-meter three-phase (DSMR P1)

### 16.3.2 "Data" line specification

The "Data" line is an Open Collector output.

The "Data" line is logically inverted.

The voltage range for LOW level for "Data" line must be between 0 VDC and 1.0 VDC.

### 16.3.3 “Data Request” line specification

The HAN interface is activated (starts sending data) by setting "Data Request" line high (to +5 VDC). While receiving data, the requesting external device must keep the "Data Request" line activated (set to +5 VDC).

To stop receiving data, the external device needs to drop "Data Request" line (set it to "high impedance" mode). In such case, data transfer will stop immediately.

The voltage range for HIGH level for "Data Request" line must be between 4.0 VDC and 5.5 VDC.

### 16.3.4 Protocol description (HAN)

The HAN interface protocol is based on the current IEC standard for local data exchange with electricity meters, IEC 62056-21 Mode D. The data is represented in ASCII format for easy interpretation in the receiving device and the transfer rate (Baud rate) is 115200 Baud.

Due to the typical use cases and processes of electricity distribution system operators (DSOs), the HAN interface is unencrypted.

### 16.3.5 Data telegram (HAN)

The push interval is selectable from 1 to 10 seconds through the capture period attribute of object 0.0.21.0.0.255. The HAN data telegram is disabled per default, i.e. the capture period object is set to 0 seconds.

The default push list contains the data objects below.

**Hint** The default push list content meets the recommendations of the Swedish industry “Branschrekommendation för lokalt kundgränssnitt för elmätare v 2.0”.

| OBIS code | Description |
|---|---|
| 0-0:1.0.0 | Date and time |
| 1-0:1.8.0 | Active energy A14 |
| 1-0:2.8.0 | Active energy A23 |
| 1-0:3.8.0 | Reactive energy R12 |
| 1-0:4.8.0 | Reactive energy R34 |
| 1-0:1.7.0 | Active power P14 |
| 1-0:2.7.0 | Active power P23 |
| 1-0:3.7.0 | Reactive power Q12 |
| 1-0:4.7.0 | Reactive power Q34 |
| 1-0:21.7.0 | Active power P14 of phase 1 |
| 1-0:41.7.0 | --- of phase 2 |
| 1-0:61.7.0 | --- of phase 3 |
| 1-0:22.7.0 | Active power P23 of phase 1 |
| 1-0:42.7.0 | --- of phase 2 |
| 1-0:62.7.0 | --- of phase 3 |
| 1-0:23.7.0 | Reactive power Q12 of phase 1 |
| 1-0:43.7.0 | --- of phase 2 |
| 1-0:63.7.0 | --- of phase 3 |
| 1-0:24.7.0 | Reactive power Q34 of phase 1 |
| 1-0:44.7.0 | --- of phase 2 |
| 1-0:64.7.0 | --- of phase 3 |
| 1-0:32.7.0 | RMS voltage of phase 1 |
| 1-0:52.7.0 | --- of phase 2 |
| 1-0:72.7.0 | --- of phase 3 |
| 1-0:31.7.0 | RMS current of phase 1 |
| 1-0:51.7.0 | --- of phase 2 |
| 1-0:71.7.0 | --- of phase 3 |

## 16.4 Hot swap extension interface

Kamstrup OMNIA® e-meter is available with a hot swap extension interface accessible under the terminal cover. The hot swap interface is a hot pluggable module interface for retrofitting modules extending or replacing functionality in the meter.

A hot swap module is fixed to the inside of a terminal cover, and the connection between the meter and the module is made by attaching the terminal cover to the meter.

**Important** The interface is placed on a hazardous live voltage potential (HLV). Never touch or measure the interface without appropriate measures.

**Note** Not all meters are equipped with the hot swap interface. The feature requires additional circuitry in the meter, which must be selected at order time.

### 16.4.1 Compatible modules

Kamstrup does not yet offer any modules compatible with the hot swap interface in Kamstrup OMNIA® e-meter.

An integrators guide to the hot swap interface will be released in the near future.

# 17 Auxiliary power supply (APS) input

Kamstrup OMNIA® e-meter is available with an auxiliary power supply (APS) input connector for bypassing external circuit switches. When connected, the meter will remain powered when an external circuit switch, located upstream in relation to the meter, is disconnected.

The APS connector accepts only a single line of AC voltage at $U_n$. It is a precondition that the neutral line remains connected to the meter terminals and is not disconnected by the external supply switch.

**Note** APS is available only in Kamstrup OMNIA® e-meter three-phase.

For details on wiring to the APS connector, see the installation guide "Installing Kamstrup OMNIA® e-meter " (doc. 5512-2370).

When all phase voltages are missing for longer than 10 seconds and the meter remains powered from the APS connector, it is said to operate in APS mode. In APS mode the meter assumes that an external upstream circuit switch has been disconnected, but the electrical grid is operating normally. Hence, any power quality related events associated with the missing phase voltages are suppressed, such as “missing voltage Ln” events or “last gasp”.

When operating in APS mode, the meter continues to push data and it is possible to request data from the meter or upgrade the firmware. It is not possible to operate the supply control switch in APS mode.

**Note** When operating in APS mode, the error symbol 11 in the meter display is turned on.

# 18 Supply control switch

Kamstrup OMNIA® e-meter variants for direct connection are available with an internal supply control switch for disconnecting and reconnecting the consumer's supply.

The supply control switch is bistable, i.e. it maintains its state (connected/disconnected) during a power outage.

**Important** The supply control switch must not be used for safety disconnection, i.e. disconnecting the electrical installation in relation to maintenance work or similar.

## 18.1 Remote on-demand disconnect

The internal supply control switch can be operated (disconnect, release and reconnect) remotely from a head-end system. Operating the supply control switch remotely requires authentication of the operator using an encryption key with the correct level of privilege.

The control mode is selectable and can be manual or automatic.

- **In manual control mode** (default), a head-end system can release the supply control switch for manual reconnection using the meter push button.
- **In automatic control mode**, a head-end system can reconnect the supply control switch with no manual interaction.

The red LED blinks when the supply control switch is released by the head-end system. To reconnect, press and hold the control push button (the right-most of the two push buttons) for 3 seconds.

**Note** For a description of digital signature on supply control switch commands from the head-end system, see Digital signature of supply control switch commands 70.

## 18.2 Manual disconnect

The internal supply control switch can be operated manually using the control push button (the right-most of the two push buttons).

To operate, press and hold the control push button (the right-most of the two push buttons) for 3 seconds.

**Note** The manual disconnect functionality can be disabled at order time or from a head-end system, but it is always possible to reconnect the supply control switch when it is released by the head-end system.

When disconnected manually, the internal supply control switch can be reconnected using the control push button, independent of the selected control mode (manual or automatic).

## 18.3 Overvoltage disconnect

The internal supply control switch can be set to disconnect automatically when the phase voltage of any phase exceeds a limit. The meter calculates the mean values of phase voltages in consecutive windows of selectable duration and compares each mean value with the user-defined limit. If the limit is exceeded, the supply control switch is disconnected.

Similarly, when all phase voltages return below a different user-defined limit, the supply control switch is reconnected. The disconnect and reconnect controls have independent and selectable window durations.

**Note** The overvoltage disconnect control is disabled by default and must be enabled, e.g. from a head-end system.

| OBIS code | Parameter | Description | Min. | Max | Default |
|---|---|---|---|---|---|
| 1.1.128.0.19.255 | Overvoltage disconnect threshold | Limit for triggering automatic overvoltage disconnect (limit in volts). | 260 V | 320 V | 285 V |
| 1.1.128.0.20.255 | Overvoltage sample time for disconnect | Duration of the window for mean voltage calculation for automatic overvoltage disconnect (duration in seconds). | 1 sec. | 3600 sec. | 1 sec. |
| 1.1.128.0.21.255 | Overvoltage reconnect threshold | Limit for triggering automatic reconnect following an overvoltage disconnect (limit in volts). | 250 V | 270 V | 265 V |
| 1.1.128.0.22.255 | Overvoltage sample time for reconnect | Duration of the window for mean voltage calculation for automatic reconnect following an overvoltage disconnect (duration in seconds). | 1 sec. | 3600 sec. | 60 sec. |

# 19 Load control switch

Kamstrup OMNIA® e-meter is available with one or two integrated load control switches for managing (on/off) external electrical loads. Each load control relay can be individually controlled.

**Note** The characteristics of the load control relay are described in the data sheet "Kamstrup OMNIA® e-meter" (doc 5810-1915).

Load control relays can be operated in several modes selected by the corresponding mode selector object. One relay can operate in one mode while the other operates in a different mode.

**Note** For details about how to configure load control modes, see the technical guide "Kamstrup electricity meter DLMS interface specification" (doc. 5512-2571).

The load control switches may change state during a supply voltage interruption, but will return to the correct state when power is restored to the meter.

## 19.1 On-demand mode

The load control relay is operated on-demand from a head-end system.

In this mode, no random delay applies to the relay operation.

## 19.2 Activity calendar mode

The load control relay is operated by the associated activity calendar. Each relay has its own activity calendar.

**Note** For a detailed description of activity calendars, see the section Activity calendar and special days 15.

In this mode, a random delay applies when the relay changes state to connected. The purpose of this is to distribute in time the load change seen by the electrical grid when a number of meters operate relays simultaneously. The limits of the random delay is selectable.

## 19.3 Active tariff mode

The load control relay operates synchronous with tariff/TOU changes.

Example:
Relay 1 operates in active tariff mode and is configured to switch off when T1 is the active tariff and switch on when T2 is the active tariff.

**Note** For a detailed description of tariffs/TOU, see the section Tariff/TOU registers 31.

In this mode, a random delay applies when the relay changes state to connected. The purpose of this is to distribute in time the load change seen by the electrical grid when a number of meters operate relays simultaneously. The limits of the random delay is selectable.

# 20 Unconnected phase detection

The multi-phase variant of Kamstrup OMNIA® e-meter is designed for use in 1x, 2x or 3x phase installations. The meter automatically detects which phase inputs are connected and which are not, and uses this information to suppress false positive events of Undervoltage Ln or Missing phase Ln. The phase voltage of an unconnected phase will read 0V.

The detection executes during the first start-up sequence of the meter and is updated each time the terminal cover is re-attached. Additionally, the detection continuously monitors if any phase input, initially identified as unconnected, is suddenly connected (not the other way around) even without the terminal cover being removed.

Detection during the first start-up sequence is triggered when the terminal cover is attached. Alternatively, if the terminal cover is not attached (or was never removed) within 15 minutes from the meter is energized, the detection is triggered by a timer. This time-out trigger only applies during the first start-up sequence.

The first start-up sequence is identified by an internal flag and cannot be reset when the meter has left the assembly line in Kamstrup's factory. Until detection has executed for the first time, all phases are assumed to be connected. However, phase related events can only trigger when the first detection has completed.

**Hint** There are three triggers to detect unconnected phases:
(1) timed trigger during first start-up sequence
(2) when terminal cover is re-attached
(3) continuous monitoring of inactive phases turning active (only one-way state change allowed).

**Note** Supply voltage interruptions do not cause the detection to update.

In desktop testing scenarios, in case only a single-phase voltage is looped to one or several phase inputs of the meter, any unconnected phases should be loaded with at least 0.5 watt or connected to neutral to prevent unintentional floating voltage levels.

It is possible to query a meter for which phases are detected and categorized as unconnected. The unconnected phases register (1.1.134.0.112.255) represents each phase with one bit; a value of '0' means connected and '1' means unconnected.

| Bit position in object 1.1.134.0.112.255 | Interpretation of bit value |
|---|---|
| Bit 0 (LSB) | 0: phase 1 is connected<br>1: phase 1 is unconnected |
| Bit 1 | 0: phase 2 is connected<br>1: phase 2 is unconnected |
| Bit 2 | 0: phase 3 is connected<br>1: phase 3 is unconnected |

# 21 Temperature supervision

Kamstrup OMNIA® e-meter continuously monitors the temperature internally in the meter processor. The internal temperature is affected by conditions such as power conducted through the meter terminals, power sourced to an external device and the ambient temperature. A too high internal temperature can be an indicator of unintended use of the meter, such as too high current or insufficient tightening of terminals, or it could be a malfunction internally in the meter.

The temperature is measured internally in the main processor of the meter and compared to a user-defined limit.

If the detection limit and time threshold are exceeded, the "High processor temperature” event is triggered.

| OBIS code | Parameter | Description | Min. | Max | Default |
|---|---|---|---|---|---|
| 1.1.137.35.0.255 | ProcessorTemperatureHighThreshold | Limit for triggering "high processor temperature" event (limit in °C). | 0 °C | 100 °C | 85 °C |
| 1.1.137.44.0.255 | ProcessorTemperatureHighTimeThreshold | Time threshold for triggering "high processor temperature" event (duration in seconds) | 0 sec. | 65.535 sec. | 600 sec. |

# 22 Demand supervision

Kamstrup OMNIA® e-meter continuously monitors the demand (or load) at the metering point. Each of the monitored values are compared to user-defined limits and trigger an event when that limit is exceeded.

It is possible to enable alarms for each of the demand supervision events.

## 22.1 Current supervision

Instantaneous values of RMS current per phase are continuously compared to a user-defined limit.

If the detection limit and time threshold are exceeded, the "Current limit Ln exceeded" event for the corresponding phase is triggered.

When the measured RMS current falls below the threshold again for longer than the time threshold, the "Current limit Ln restored" event for the corresponding phase is triggered.

| OBIS code | Parameter | Description | Min. | Max | Default |
|---|---|---|---|---|---|
| 1.1.11.35.0.255 (in direct meter) | CurrentMaxThreshold | Limit for triggering "current limit Ln exceeded" event (limit in ampere). | 0 A | 100 A | 100 A |
| 1.1.11.35.0.255 (in CT meter) | CurrentMaxThresholdCT | Limit for triggering "current limit Ln exceeded" event (limit in ampere). | 0 A | 6000 A | 6000 A |
| 1.1.11.44.0.255 | CurrentMaxTimeThreshold | Time threshold for triggering "current limit Ln exceeded" event (duration in seconds) | 0 sec. | 65.535 sec. | 600 sec. |

## 22.2 Power supervision

Instantaneous values of imported active power (P14), total and per phase, are continuously compared to user-defined limits.

If the detection limit and time threshold are exceeded, the "Total demand limit exceeded" event or the "Demand limit Ln exceeded" event for the corresponding phase is triggered.

When the measured active power falls below the threshold again for longer than the time threshold, the "Total demand limit restored" event or the "Demand limit Ln restored" event for the corresponding phase is triggered.

| OBIS code | Parameter | Description | Min. | Max | Default |
|---|---|---|---|---|---|
| 1.1.1.35.0.255 (in direct meter) | TotalDemandLimitThreshold | Limit for triggering "total demand limit exceeded" event (limit in watts). | 0 W | 72 kW | 72 kW |
| 1.1.1.35.0.255 (in CT meter) | TotalDemandLimitThresholdCT | Limit for triggering "total demand limit exceeded" event (limit in watts). | 0 W | 4.3 MW | 4.3 MW |
| 1.1.1.44.0.255 | TotalDemandLimitTimeThreshold | Time threshold for triggering "total demand limit exceeded" event (duration in seconds) | 0 sec. | 65.535 sec. | 600 sec. |

| OBIS code | Parameter | Description | Min. | Max | Default |
|---|---|---|---|---|---|
| 1.2.1.35.0.255 (in direct meter) | DemandLimitThreshold | Limit for triggering “demand limit Ln exceeded” event (limit in watts). | 0 W | 24 kW | 24 kW |
| 1.2.1.35.0.255 (in CT meter) | DemandLimitThresholdCT | Limit for triggering “demand limit Ln exceeded” event (limit in watts). | 0 W | 1.4 MW | 1.4 MW |
| 1.2.1.44.0.255 | DemandLimitTimeThreshold | Time threshold for triggering “demand limit Ln exceeded” event (duration in seconds) | 0 sec. | 65.535 sec. | 600 sec. |

## 22.3 Power factor supervision

Instantaneous values of power factor per phase are continuously compared to a user-defined limit.

If the detection limit and time threshold are exceeded, the “Power factor Ln minimum limit reached” event for the corresponding phase is triggered.

When the power factor rise above the threshold again for longer than the time threshold, the “Power factor Ln minimum limit cleared” event for the corresponding phase is triggered.

| OBIS code | Parameter | Description | Min. | Max | Default |
|---|---|---|---|---|---|
| 1.1.13.31.0.255 | PowerFactorThreshold | Limit for triggering "power factor Ln minimum limit reached" event (arbitrary unit). | 0 | 0.9 | 0.1 |
| 1.1.13.43.0.255 | PowerFactorTimeThreshold | Time threshold for triggering "power factor Ln minimum limit reached" event (duration in seconds) | 0 sec. | 65.535 sec. | 600 sec. |

# 23 Disposal of worn out meters

Kamstrup offers to handle disposal of worn out products when contractually agreed. When worn out meters are scrapped by Kamstrup, approximately 80 % of their weight is being recycled.

Any scrapping of worn out meters, handled by Kamstrup or by any other party, must be completed in accordance with local regulations.

Worn out products must not be disposed of as regular waste.