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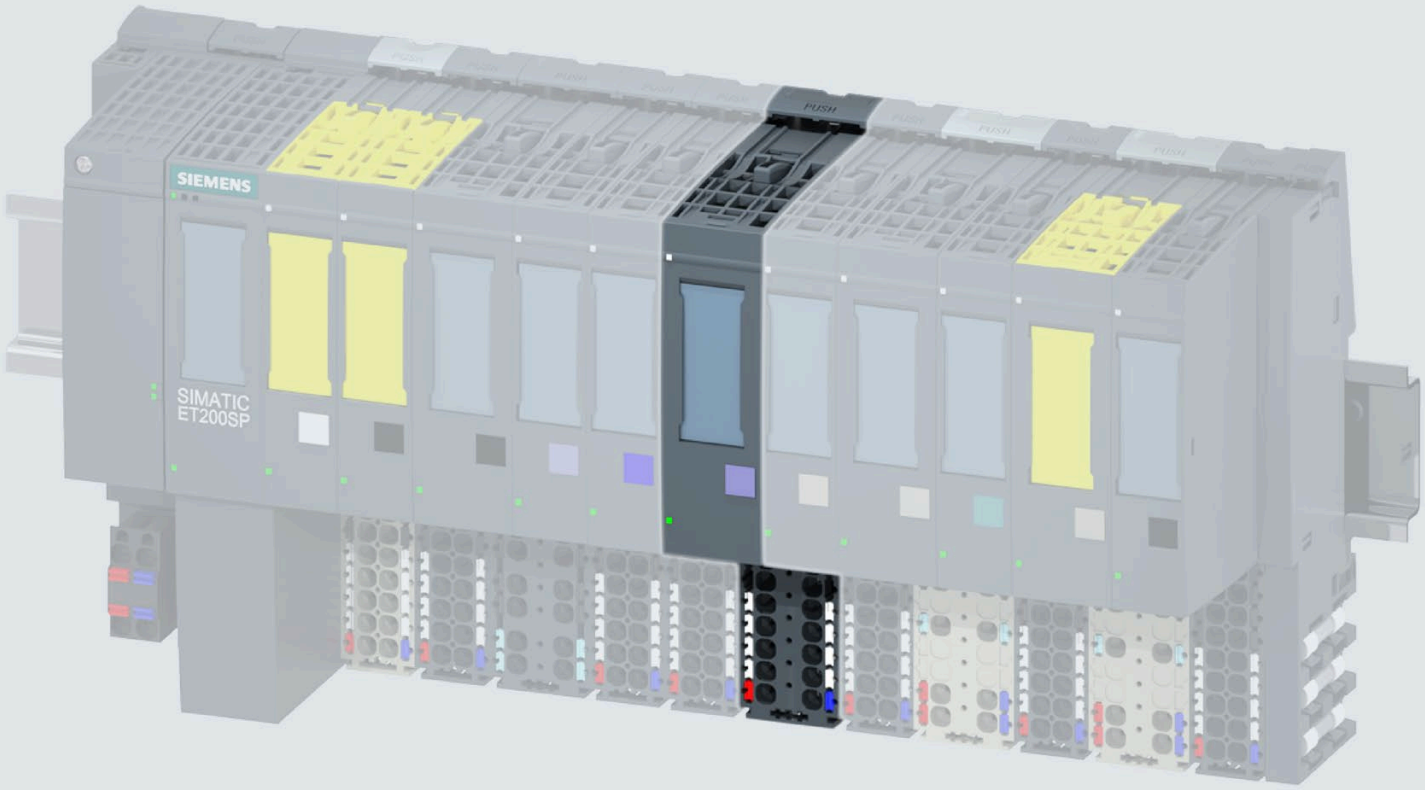

Manual

SIMATIC

ET 200SP

Analog input module
AI Energy Meter 480VAC/CT HF
(6ES7134-6PA00-0CU0)

Edition 03/2021

support.industry.siemens.com

SIEMENS

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ET 200SP
Analog input module
AI Energy Meter 480VAC/CT HF (6ES7134-6PA00-0CU0)

Equipment Manual

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03/2021
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Legal information

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indicates that death or severe personal injury **will** result if proper precautions are not taken.

⚠ WARNING

indicates that death or severe personal injury **may** result if proper precautions are not taken.

⚠ CAUTION

indicates that minor personal injury can result if proper precautions are not taken.

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indicates that property damage can result if proper precautions are not taken.

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Preface

Purpose of the documentation

This manual supplements the system manual ET 200SP distributed I/O system (http://support.automation.siemens.com/WW/view/en/58649293). Functions that generally relate to the system are described in this manual.

The information provided in this manual and in the system/function manuals supports you in commissioning the system.

Conventions

CPU: When the term "CPU" is used in this manual, it applies to the CPUs of the S7-1500 automation system as well as to the CPUs/interface modules of the distributed I/O system ET 200SP.

STEP 7: In this documentation, "STEP 7" is used as a synonym for all versions of the configuration and programming software "STEP 7 (TIA Portal)".

Please also observe notes marked as follows:

Note

A note contains important information on the product described in the documentation, on the handling of the product and on the section of the documentation to which particular attention should be paid.

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To stay informed about product updates, subscribe to the Siemens Industrial Security RSS Feed visit (https://www.siemens.com/industrialsecurity).

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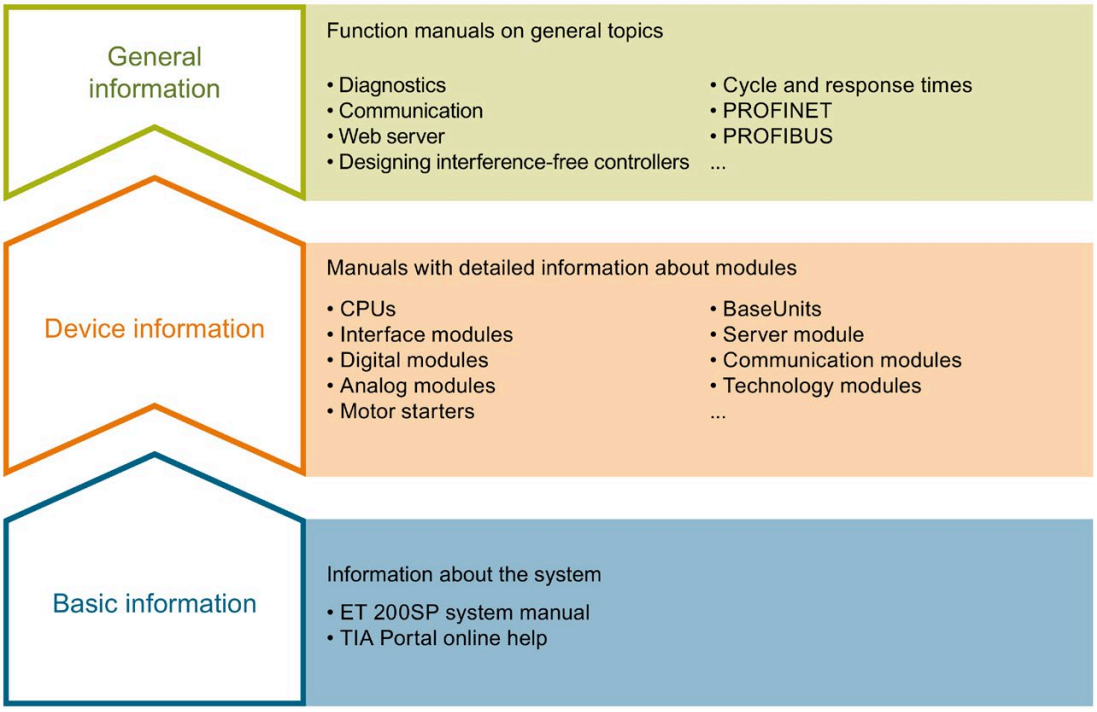
ET 200SP Documentation Guide

1

The documentation for the SIMATIC ET 200SP distributed I/O system is arranged into three areas.
This arrangement enables you to access the specific content you require.



Basic information

The System Manual and Getting Started describe in detail the configuration, installation, wiring and commissioning of the SIMATIC ET 200SP distributed I/O system. The STEP 7 online help supports you in the configuration and programming.

Device information

Product manuals contain a compact description of the module-specific information, such as properties, wiring diagrams, characteristics and technical specifications.

General information

The function manuals contain detailed descriptions on general topics regarding the SIMATIC ET 200SP distributed I/O system, e.g. diagnostics, communication, Web server, motion control and OPC UA.

You can download the documentation free of charge from the Internet (https://support.industry.siemens.com/cs/ww/en/view/109742709).

Changes and supplements to the manuals are documented in a Product Information.

You can download the product information free of charge from the Internet (https://support.industry.siemens.com/cs/us/en/view/73021864).

Manual Collection ET 200SP

The Manual Collection contains the complete documentation on the SIMATIC ET 200SP distributed I/O system gathered together in one file.

You can find the Manual Collection on the Internet (https://support.automation.siemens.com/WW/view/en/84133942).

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With "mySupport", your personal workspace, you make the best out of your Industry Online Support.

In "mySupport", you can save filters, favorites and tags, request CAx data and compile your personal library in the Documentation area. In addition, your data is already filled out in support requests and you can get an overview of your current requests at any time.

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"mySupport" - CAx data

In the CAx data area of "mySupport", you can access the latest product data for your CAx or CAe system.

You configure your own download package with a few clicks.

In doing so you can select:

- Product images, 2D dimension drawings, 3D models, internal circuit diagrams, EPLAN macro files
- Manuals, characteristics, operating manuals, certificates
- Product master data

You can find "mySupport" - CAx data on the Internet (https://support.industry.siemens.com/my/ww/en/CAxOnline).

Application examples

The application examples support you with various tools and examples for solving your automation tasks. Solutions are shown in interplay with multiple components in the system - separated from the focus on individual products.

You will find the application examples on the Internet (https://support.industry.siemens.com/cs/ww/en/ps/ae).

TIA Selection Tool

With the TIA Selection Tool, you can select, configure and order devices for Totally Integrated Automation (TIA).
This tool is the successor of the SIMATIC Selection Tool and combines the known configurators for automation technology into one tool.
With the TIA Selection Tool, you can generate a complete order list from your product selection or product configuration.

You can find the TIA Selection Tool on the Internet (https://support.industry.siemens.com/cs/ww/en/view/109767888).

SIMATIC Automation Tool

You can use the SIMATIC Automation Tool to perform commissioning and maintenance activities simultaneously on various SIMATIC S7 stations as a bulk operation independent of TIA Portal.

The SIMATIC Automation Tool provides a multitude of functions:

- Scanning of a PROFINET/Ethernet system network and identification of all connected CPUs
- Address assignment (IP, subnet, gateway) and station name (PROFINET device) to a CPU
- Transfer of the date and the programming device/PC time converted to UTC time to the module
- Program download to CPU
- RUN/STOP mode switchover
- CPU localization by means of LED flashing
- Reading out of CPU error information
- Reading of the CPU diagnostics buffer
- Reset to factory settings
- Firmware update of the CPU and connected modules

You can find the SIMATIC Automation Tool on the Internet (https://support.industry.siemens.com/cs/ww/en/view/98161300).

PRONETA

SIEMENS PRONETA (PROFINET network analysis) allows you to analyze the plant network during commissioning. PRONETA features two core functions:

- The topology overview automatically scans the PROFINET and all connected components.
- The IO check is a fast test of the wiring and the module configuration of a plant, incl. fail-safe inputs and outputs.

You can find SIEMENS PRONETA on the Internet (https://support.industry.siemens.com/cs/ww/en/view/67460624).

SINETPLAN

SINETPLAN, the Siemens Network Planner, supports you in planning automation systems and networks based on PROFINET. The tool facilitates professional and predictive dimensioning of your PROFINET installation as early as in the planning stage. In addition, SINETPLAN supports you during network optimization and helps you to exploit network resources optimally and to plan reserves. This helps to prevent problems in commissioning or failures during productive operation even in advance of a planned operation. This increases the availability of the production plant and helps improve operational safety.

The advantages at a glance

- Network optimization thanks to port-specific calculation of the network load
- Increased production availability thanks to online scan and verification of existing systems
- Transparency before commissioning through importing and simulation of existing STEP 7 projects
- Efficiency through securing existing investments in the long term and the optimal use of resources

You can find SINETPLAN on the Internet (https://www.siemens.com/sinetplan).

Product overview

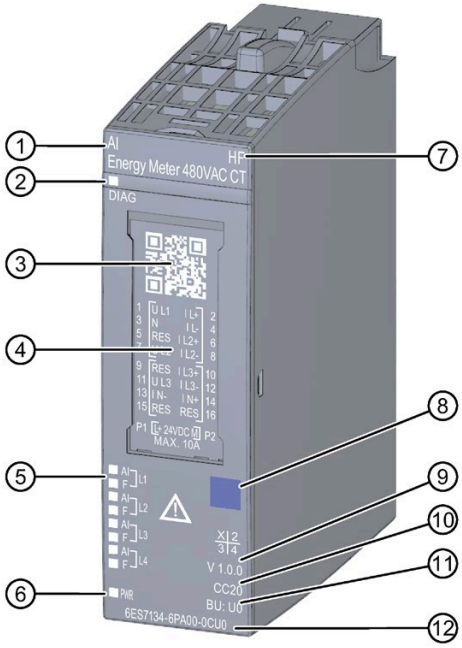
2

2.1 Properties of the AI Energy Meter HF

Article number

6ES7134-6PA00-0CU0

View of the module



① Module type and name
② LED for diagnostics
③ 2D matrix code
④ Wiring diagram
⑤ LEDs for channel status
⑥ LED for supply voltage
⑦ Function class
⑧ Color coding module type
⑨ Function and firmware version
⑩ Color code for selecting the color identification labels
⑪ BU type
⑫ Article number

Figure 2-1 View of the module AI Energy Meter HF

Properties

The module has the following technical properties:

- Measurement of electrical variables from single-phase, two-phase and three-phase supply networks
- Max. nominal voltage between two line conductors 480 V AC
- Retentive storage of the counter values
- Use on frequency converters
- Recording of:
  - Voltages
  - Currents
  - Phase angles
  - Power
  - Energy / electrical work
  - Frequencies
  - Minimum and maximum values with time stamp
  - Power factors
  - Operating hours
  - Limits
  - Power quality data for voltages and currents

The module supports the following functions:

Table 2- 1 Version dependencies of the functions

Function	HW version	FW version	STEP 7	GSD file	
			TIA Portal	PROFINET IO	PROFIBUS DP
Firmware update	FS01	V6.0.0 or higher	V15 or higher with HSP0253	X	---
Calibration in runtime	FS01	V6.0.0 or higher	V15 or higher with HSP0253	---	---
Identification data I&M0 to I&M3	FS01	V6.0.0 or higher	V15 or higher with HSP0253	X	X
Reconfiguration in RUN	FS01	V6.0.0 or higher	V15 or higher with HSP0253	X	X
Diagnostic interrupts	FS01	V6.0.0 or higher	V15 or higher with HSP0253	X	X
Hardware interrupts	FS01	V6.0.0 or higher	V15 or higher with HSP0253	X	---

Note

The AI Energy Meter HF is released as of TIA Portal V15.0.0.2.

Accessories

The following accessories must be ordered separately:

- BaseUnit type U0
- Labeling strips
- Reference identification label

You can find additional information on the accessories in the ET 200SP distributed I/O system (http://support.automation.siemens.com/WW/view/es/58649293) system manual.

2.2 Area of application

Introduction

Energy efficiency is playing an increasingly important role in industry. Rising energy prices, increasing pressure to improve profitability and the growing awareness of climate protection are important factors for reducing energy costs and for introducing an energy data management system.

Where can you use the AI Energy Meter HF?

AI Energy Meter HF is designed for machine-level deployment in an ET 200SP distributed I/O system. AI Energy Meter HF records over 500 different electrical measurement and energy values. It lets you create transparency about the energy requirements of individual components of a production plant even down to the machine level.

You can use the following measurement values supplied by the AI Energy Meter HF for the following applications:

- Energy consumption
- Power consumption
- Power quality
- Forecasts of consumption
- Efficiency

Power consumption measurements are relevant for load management and maintenance. In addition, you can use the measurements for emission reporting and for determining the CO_2 footprint.

Note

Measuring dangerous electrical quantities

The AI Energy Meter HF is not tested according to DIN EN 61010-2-030 and may therefore not be used to verify, measure or monitor protective measures according to DIN EN 61557.

Qualified personnel must ensure through additional measures that no danger ensues for humans and the environment in case of an incorrect display.

TB, TT and IT system

The AI Energy Meter HF can be used in TN, TT and IT systems.

Measuring with AI Energy Meter HF

A typical supply network of a production plant is usually divided into three voltage ranges:

- The infeed of the entire plant
- The subdistribution, for example, to individual lines within the plant
- The end consumers such as the machines in the lines.

The following figure shows the measurement in an electricity supply network:

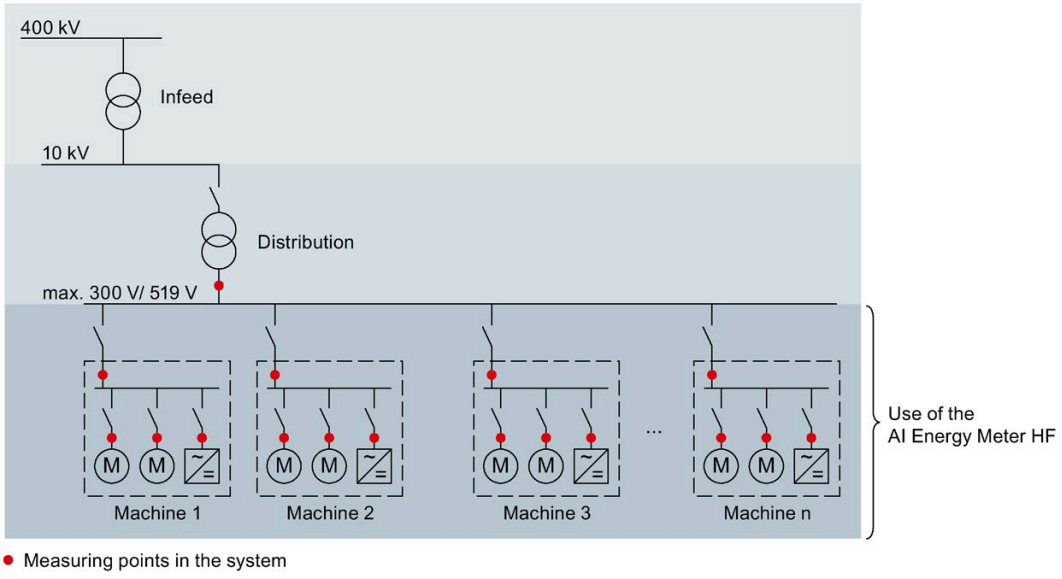


Figure 2-2 Use of the AI Energy Meter CT HF

Advantages of the AI Energy Meter HF

The AI Energy Meter HF has the following advantages:

- Space-saving especially for use in control cabinet
- PROFINET IO or PROFIBUS DP (depending on the interface module in use)
- Multiple modules can be used with one interface module
- Extension of existing stations by components for energy recording

2.3 Special considerations for use on the PROFIBUS DP and PROFINET IO

You can read data records from the module or write them to the module with both PROFIBUS DP and PROFINET IO.

Operation of the module on PROFIBUS DP

Please note that with PROFIBUS DP you can write data records up to a maximum length of 240 bytes to the module or read them from the module.

PROFIBUS DPV 1

If the DP Master supports the DPV1, you can reconfigure in your user program with the parameter data records DS 128, DS 129, DS 130, DS 131 or DS 135. Note that the maximum data record length is 240 bytes for DS 135.

The following applies for the measured value data records:

- DS 142: When you read the data record, the module returns the measured value data record DS 142 in version 2.
- DS 147, DS 148, DS 149: When you read the data record, the module returns the measured value data record in version 0.
- DS 154, DS 155, DS 161, DS 163, DS 164: When you read the data record, the module returns the first 240 bytes of the structure of the measured value data record.
- DS 151: You define the user-defined measured value data record DS 151 in the parameter data record DS 135. If the structure in the measured value data record DS 151 is greater than 240 bytes, the module returns the first 240 bytes of the structure.

  Information on the data record length of data records DS 135 and DS151 can be found in the appendix Structure of the parameter data record 135 for data record mapping (Page 168).

PROFIBUS DPV 0

If the DP Master does **not** support DPV1, you cannot reassign parameters which results in the following restrictions:

- There are no phase-specific parameters. All parameters apply for all three phases and the neutral conductor.
- The connection types und user data variants are limited.
- The voltage transformers are not configurable (default: 1:1).
- The current transformer value range primary current is restricted.
- The low limit for measuring current cannot be adjusted (default: 50 mA).
- Energy metering is performed continuously (the gate is not enabled).
- Min/Max calculation of values is enabled (the gate is not enabled).
- 3P4W can be set in the parameters for the connection type 3P3W.
- 3P4W can be set in the parameters for the connection type 3P3W1.

- Counting of operating hours is enabled (the gate is not enabled).
- The residual current measurement is enabled.
- Limit value monitoring cannot be used.
- Energy meter default cannot be used.
- The user-defined user data interface cannot be used.
- The user-defined data record cannot be used.
- The power quality analysis cannot be used.
- The separate settings for measuring the neutral current cannot be used.
- The measured value data records cannot be used.

Operation of the module on PROFINET IO

When reading data records partially from the module, please note the following:

- Measured value data record DS 142:
  - When you read the data record with a length of 240 bytes or less, the module returns the measured value data record DS 142 in version 2.
  - When you read the data record with a length of more than 240 bytes, the module returns the measured value data record DS 142 in version 3.
- Measured value data records DS 147, DS 148, DS 149:
  - When you read the data record with a length of 240 bytes or less, the module returns the measured value data record in version 0.
  - When you read the data record with a length of more than 240 bytes, the module returns the measured value data record in version 1.

See also

Measured value data records (Page 230)

Wiring

3

3.1 Terminal and block diagram

General safety instructions

WARNING

Danger to life due to electric shock

Touching live parts can lead to death or severe injuries.

Before beginning any work deenergize the system and the AI Energy Meter HF and short-circuit installed transformers.

WARNING

Danger to life, dangerous system conditions and material damage possible

Removing and inserting the AI Energy Meter HF under live voltage is prohibited.

If you remove and insert the AI Energy Meter HF under live voltage during operation, the transformers used can produce dangerous induction voltages and electric arcs and dangerous system conditions can arise.

The AI Energy Meter HF may only be removed and inserted during operation if the measuring voltages supplied to the BaseUnit at terminals U_{L1} , U_{L2}, U_{L3} are disconnected at all poles **and** special current transformer terminals are used that short-circuit the transformer on the secondary side on removal.

Supplying the module

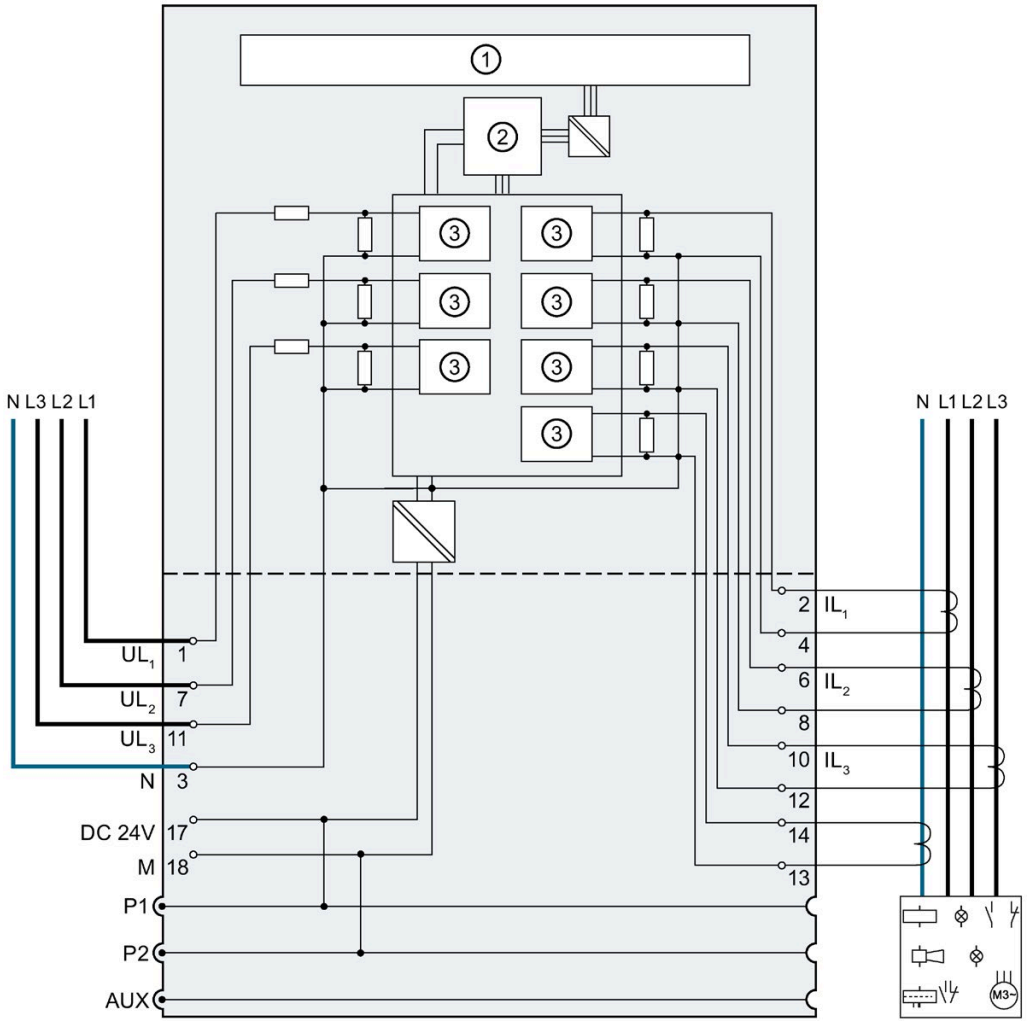
The AI Energy Meter HF receives its supply voltage via terminals 17 (24 V DC) and 18 (M).

Protecting the connection cables

To protect the connection cables at U_{L1}, U_{L2} and U_{L3}, make sure there is adequate cable protection, especially after cross-section transitions.

If the cables are routed with short-circuit protection according to IEC 61439-1:2009, for example, in a pipe or in separate cable ducts, there is no need for separate cable protection for the AI Energy Meter HF.

Terminal and block diagram



①	Microcontroller	UL_n	Connection of voltage transformers
②	Backplane bus interface	IL_n	Connection of current transformers
③	Analog-to-digital converter (ADC)	N	Neutral
P1, P2, AUX	Internal self-assembling voltage buses Connection to left (dark-colored BaseUnit) Connection to left interrupted (light-colored BaseUnit)		

Figure 3-1 Block diagram of the AI Energy Meter HF

Useable BaseUnits

You can use the following BaseUnits:

- Type BU type U0 dark-colored
- Type BU type U0 light-colored

A potential group opened with a light-colored BU type U0 must contain no dark-colored BaseUnit of BU type A0 or A1.

Connection types

The AI Energy Meter HF supports the following connection types:

- 3P4W1, 3 phases, 4 conductors, balanced load
- 3P4W, 3 phases, 4 conductors
- 2P3W, 2 phases, 3 conductors
- 1P2W, 1 phase, 2 conductors
- 3 x 1P2W, 3 x 1 phase, 2 conductors
- 3P3W, 3 phases, 3 conductors
- 3P3W1, 3 phases, 3 conductors, balanced load
- 3P4WI, 3 phases, 4 conductors (only for current measurement)

The input circuit of the module must correspond to one of the listed connection types. Select the appropriate connection type for the intended use.

You will find examples of connections in the section Connection examples (Page 23).

Information on the selection of a current transformer is available in the section Current transformer selection data (Page 28).

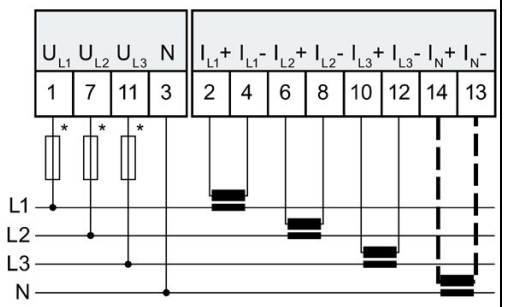
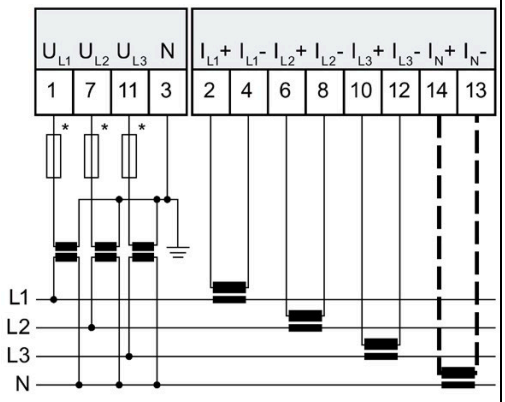
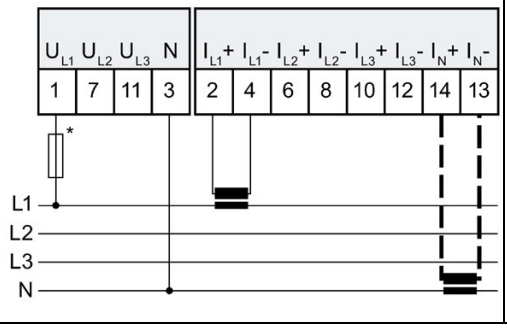
Note

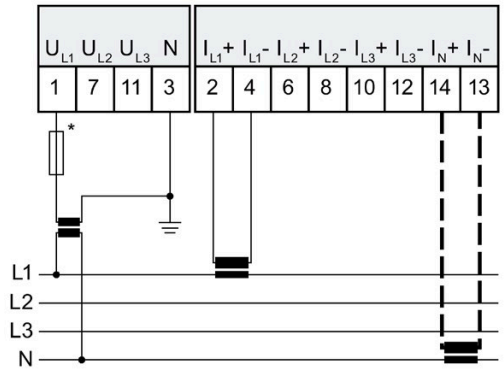
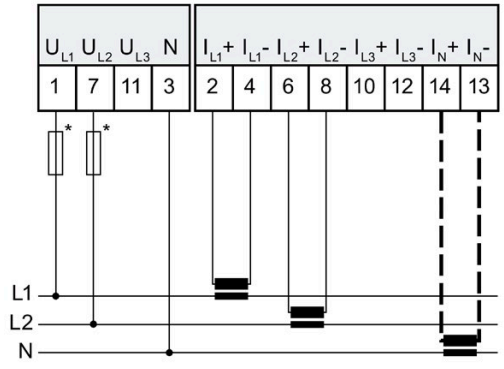
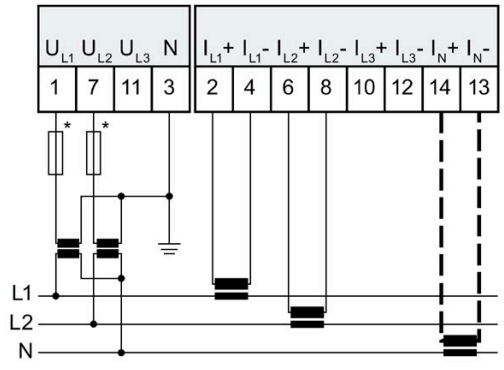
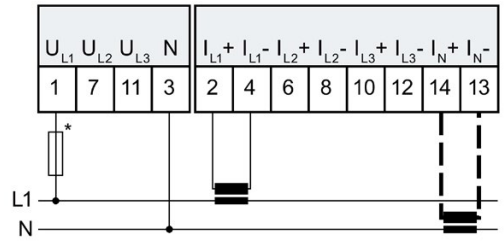
Measurement of other currents

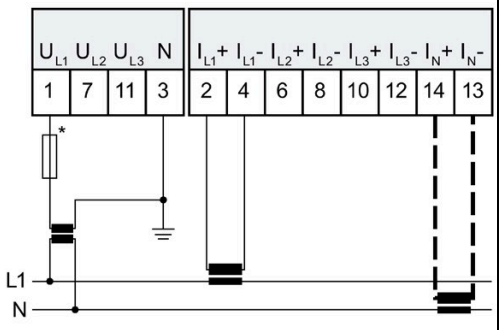
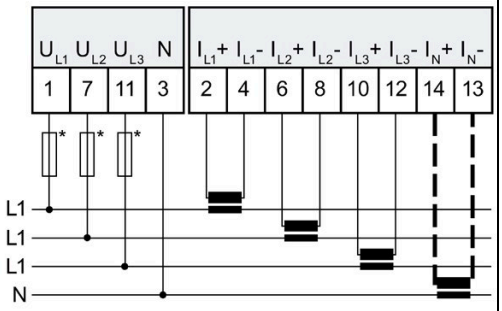
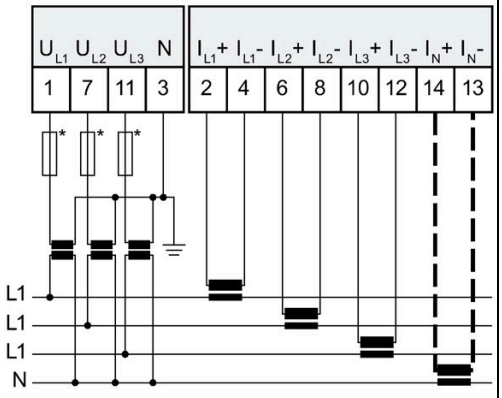
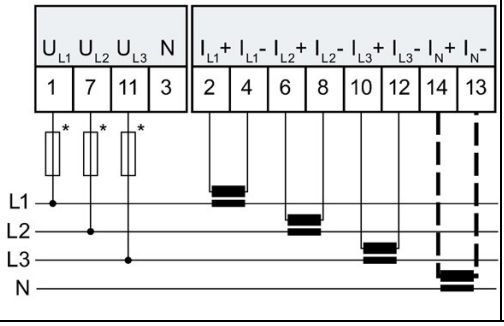
You can also use the connection for measurement of the neutral current for measuring other currents.

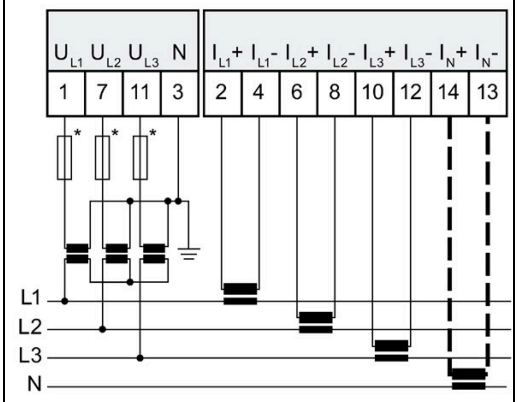
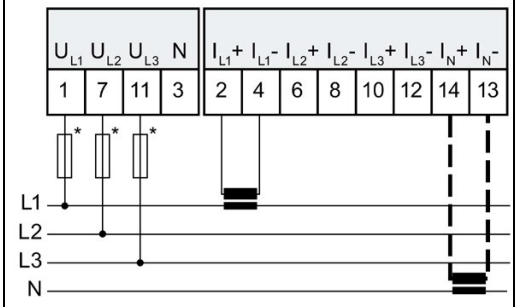
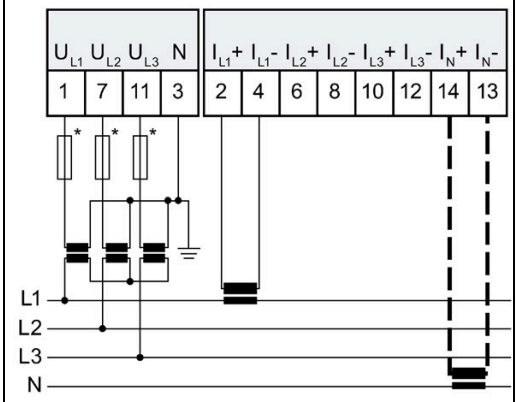
3.2 Connection examples

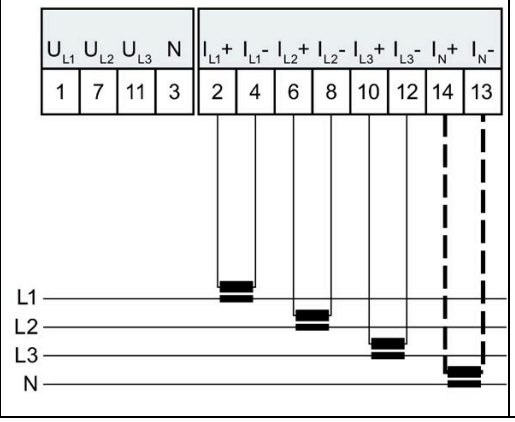
The following figures show the connection of the AI Energy Meter HF for three-phase, two-phase and single-phase measurements. Note that the AI Energy Meter HF must always be connected via a current transformer. The use of voltage transformers is optional.

Connection type	Wiring diagram	Comment
3P4W Three-phase measurement, 4 wires		Any load Connection with three current transformers
3P4W Three-phase measurement, 4 wires		Any load Connection with three current transformers and three voltage transformers.
3P4W1 Three-phase measurement, 4 wires		Balanced load Connection with one current transformer

Connection type	Wiring diagram	Comment
3P4W1 Three-phase measurement, 4 wires		Balanced load Connection with one current transformer and one voltage transformer.
2P3W Two-phase measurement, 3 conductors		Any load Connection with two current transformers AI Energy Meter HF supplies the value "0" for all measured values of Phase 3 as well as for some cross-phase measured values.
2P3W Two-phase measurement, 3 conductors		Any load Connection with two current transformers and two voltage transformers. AI Energy Meter HF supplies the value "0" for all measured values of Phase 3 as well as for some cross-phase measured values.
1P2W Single-phase measurement, 2 conductors		Measurement in an AC network with a current transformer. AI Energy Meter HF supplies the value "0" for all measured values of Phase 2 and 3 as well as for some cross-phase measured values.

Connection type	Wiring diagram	Comment
1P2W Single-phase measurement, 2 conductors		Measuring the load in an AC network with one current transformer and one voltage transformer. AI Energy Meter HF supplies the value "0" for all measured values of Phase 2 and 3 as well as for some cross-phase measured values.
3 x 1P2W 3 x single-phase measurement		Measurement with three current transformers for any three loads that are each connected to one of the three phases.
3 x 1P2W 3 x single-phase measurement		Measurement with three current transformers and three voltage transformers for any three loads that are each connected to one of the three phases.
3P3W Three-phase measurement		Any load Connection with three current transformers

Connection type	Wiring diagram	Comment
3P3W Three-phase measurement		Any load Connection with three current transformers and three voltage transformers.
3P3W1 Three-phase measurement		Balanced load Connection with one current transformer
3P3W1 Three-phase measurement		Balanced load Connection with one current transformer and one voltage transformer.

Connection type	Wiring diagram	Comment
3P4WI Three-phase measurement (only for current measurement)		Connection with three current transformers

If the cables are routed with short-circuit protection according to IEC 61439-1:2009, for example, in a pipe or in separate cable ducts, there is no need for separate cable protection for the AI Energy Meter HF.

Current transformer connection requirements

DIN VDE 0100-557 and IEC 60364-5-55 require the following for the connection of current transformers:

- The secondary circuits of current transformers must not be grounded.
- Guards must not be used in the secondary circuits of current transformers.
- The insulation of the secondary cables of transformers must be designed for the highest voltage of all active components, or the secondary cables must be installed in such a way that their insulation cannot touch any active components, such as busbars.
- Connection points must be provided for temporary measurements.

3.3 Current transformer selection data

Introduction

Connection via a current transformer is always required for the current measurement. Use toroids with an accuracy class of 0.5, 1 or 3.

Dimensioning of the current transformer

The correct dimensioning of the current transformer is important for the following reasons:

- You achieve correct results from the measurements and
- You do not overload or damage the current transformers.

Selecting a current transformer

Use current transformers with a burden capacity 1.5 to 2 times greater than the power dissipation in the terminal circuit (consisting of resistance of the connection cables and burden of the AI Energy Meter HF). 1.5 times the power loss is required in order to prevent the transformer from overloading. 2 times the power dissipation is important to ensure the current limiting in case of a short-circuit. The burden capacity of the terminal circuit, in turn, must be at least 25% of the rated burden of the transformer on the working point. This is the only way for you to operate the transformer with the specified accuracy.

Maximum length of the connection cable

To avoid overloading or damaging the current transformer, the burden Z_n specified on the data sheet of the current transformer (in VA) must not be exceeded. To prevent this being exceeded, the entire burden resistance (consisting of the resistance of the connection cable and the internal resistance of the AI Energy Meter HF (see figure below) must be below a certain resistance value (depending on Z_n and I_{max}).

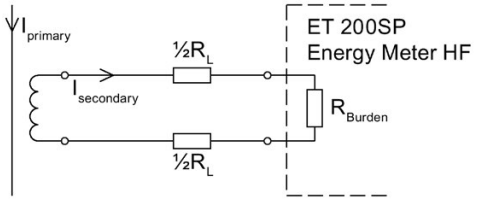


Figure 3-2 Maximum length of the connection cable

The maximum value of the resistance of the connection cable is obtained with the following formula:

$$R_{L,\,max} = \frac{Z_n}{I_{max}^{\,2}} - R_{burden}$$

R_L	Cable resistance in ohms	I_{max}	Secondary current of the current transformer
Z_n	Rated burden current transformer in VA	R_{burden}	Resistance of the AI Energy Meter HF (25 mΩ)

Figure 3-3 Maximum value for the resistance of the connection cable

Based on the maximum cable resistance in ohms, you then calculate the maximum length of the connection cable. To do this, check the data sheet of the connection cable you are using.

Note

The length of the connection cable (outwards and return) must not exceed the value of 200 meters.

Example: Usage of a current transformer 500/5 A

You use a current transformer with a transmission ration of 500/5 A that has a rated burden Z_n of 5 VA according to the data sheet.

The maximum primary current in the application amounts to 400 A. This means that the maximum secondary current $I_{max.}$ amounts to 4 A. The burden of the AI Energy Meter HF including connection resistance amounts to R_{Burden} = 25 mΩ.

The maximum value of the resistance of the connection cable (outgoing and incoming line) is obtained using the following formula:

$$R_{L,\,max} = \frac{Z_n}{I_{max}^{\,2}} - R_{Burden} = \frac{5\ AV}{16\ A^2} - 25\ m\Omega = 312.5\ m\Omega - 25\ m\Omega = 287.5\ m\Omega$$

The maximum cable resistance between the transformer and the terminals of the AI Energy Meter HF may not exceed 287.5 mΩ in this case. The corresponding cable length (outgoing and incoming line) depends on the cross-section used of the copper line and can be determined by using the following table.

The following table shows the resistance values of copper cables for typical cross-sections with $\rho = 0.017857\ \Omega \times mm^2/m$

Estimating the length for a connection cable

The value in the table must be less than the calculated terminal resistance $R_{L\ max}$ of the cable. For the resistance R_{Lmax} of 287.5 mΩ used in the above example it is possible to use a connection cable (outgoing and incoming line) with a length of 10 m from a cross-section of 0.75 mm² upward.

Cross-section	AWG	Cable overview for copper				
		0.5 m	1 m	5 m	10 m	50 m
0.25 mm²	24	35.7 mΩ	71.4 mΩ	357.1 mΩ	714.3 mΩ	3571.4 mΩ
0.34 mm²	22	26.3 mΩ	52.5 mΩ	262.6 mΩ	525.2 mΩ	2626.0 mΩ
0.5 mm²	21	17.9 mΩ	35.7 mΩ	178.6 mΩ	357.1 mΩ	1785.7 mΩ
0.75 mm²	19/20	11.9 mΩ	23.8 mΩ	119.0 mΩ	238.1 mΩ	1190.5 mΩ
1.0 mm²	18	8.9 mΩ	17.9 mΩ	89.3 mΩ	178.6 mΩ	892.9 mΩ
1.5 mm²	16	6.0 mΩ	11.9 mΩ	59.5 mΩ	119.0 mΩ	595.2 mΩ
2.5 mm²	14	3.6 mΩ	7.1 mΩ	35.7 mΩ	71.4 mΩ	357.1 mΩ

Checking the ratio of burden load and power loss

The rated burden of the transformer must be 1.5 to 2 times greater than the power loss in the connection circuit to ensure that the transformer is not overloaded and that the current limitation is ensured during a short-circuit.

At a maximum secondary current of 4 A the power loss in the connection circuit is calculated in accordance with the following formula for a connection cable (outgoing and incoming line) with a length of 10 m and a cross-section of 1.0 mm² and a burden resistance of the AI Energy Meter HF of 25 mΩ:

$$P_{Connection\ circuit} = (R_{Connection\ cable} + R_{Burden}) \times I^2_{Max.\ secondary}$$

$$P_{Connection\ circuit} = (178.6\ m\Omega + 25\ m\Omega) \times 4^2\ A^2 3.26\ W$$

The ratio of the rated burden and the power loss in the connection circuit thus amounts to:

$$\frac{Z_{N\ rated\ burden}}{P_{Connection\ circuit}} = \frac{5\ VA}{3.26\ W} = 1.54$$

The required ratio of rated burden and power loss in the connection circuit lies within the required range. The transformer is dimensioned sufficiently large.

See also

Technical specifications (Page 140)

Configuration / address space

4

4.1 Configuring

Introduction

To configure the AI Energy Meter HF after connecting it, use configuration software such as STEP 7 (TIA Portal). In addition, you can also change numerous parameters of the AI Energy Meter HF in RUN via the user program.

Configuring

You configure the AI Energy Meter HF with:

- STEP 7 (TIA Portal) as of V15 and HSP0253
- GSD file for PROFIBUS or PROFINET

Note

Consistency check of the parameter assignment only with STEP 7

If you configure the AI Energy Meter HF using STEP 7 (TIA Portal), STEP 7 (TIA Portal) already checks the various parameters for consistency while they are being entered.

If you configure the AI Energy Meter HF using a GSD file, a consistency check is not carried out. The module does not recognize incorrect entries until after the parameter data record has been transferred. If the module recognizes an invalid parameter, the module rejects the complete data record.

Preferably use STEP 7 (TIA Portal) to configure the AI Energy Meter HF.

The following instructions show the theoretical procedure for configuring the AI Energy Meter HF with STEP 7 (TIA Portal) V15 or higher with HSP0253.

1. Select the ET 200SP distributed I/O system you are using in the hardware catalog.
2. Insert the module into your station.
3. Open the device view of the ET 200SP and insert the AI Energy Meter HF.
4. Configure the AI Energy Meter HF to suit your requirements.

   Once the configuration has been compiled without errors, you can download the configuration to the CPU and commission the ET 200SP station while the AI Energy Meter HF is running.

4.2 Selecting the module versions

Introduction

The AI Energy Meter HF has different module versions.

During the configuration you use the selection of the module version to specify which measured values can be read.

Each module version supplies quality information via the input user data.

With the exception of the module version "2 I / 2 Q" you can read the measured values as user data cyclically from the process image. At each module version you have the option to read measured value records from the AI Energy Meter HF by using the RDREC instruction asynchronously.

Influence of the module version on the address space

Note

Influence of the AI Energy Meter HF on the maximum configuration of the ET 200SP

The available address space of the ET 200SP is influenced by the following factors:

- CPU or interface module
- Plugged I/O modules

The address space made **additionally** available by the AI Energy Meter HF is essentially influenced by the length of the user data supplied. The module version determines the length of the user data, which can be supplied by the AI Energy Meter HF at maximum.

4.2.1 Module versions at configuration with STEP 7

Module versions with fixed user data assignment

Module version	User data	Address space	Comment
2 I / 2 Q	No cyclic user data. Access to measured values through "Read data record".	2-byte inputs 2-byte outputs	Information about the structure of the 2 I / 2 Q module version is available in the appendix Module version "2 I / 2 Q" (Page 198).
EE@Industry E0	User data in accordance with EE@Industry measurement data profiles	12-byte inputs / 20-byte outputs	Information about the structure of the EE@Industry measured data profiles is available in the appendix Module version "EE@Industry measurement data profile E0 / E1 / E2 / E3" (Page 209).
EE@Industry E1		4-byte inputs / 20-byte outputs	
EE@Industry E2		12-byte inputs / 20-byte outputs	
EE@Industry E3		104-byte inputs / 20-byte outputs	

Module versions with selectable user data variants

Module version	User data	Address space	Comment
32 I / 20 Q	User data selectable through defined user data variants	32-byte inputs / 20-byte outputs	You can change over the user data variant during operation. Information about the structure of the 32 I / 20 Q module version is available in appendix Module version "32 I / 20 Q" (Page 201). Information about the user data variants at 32 I / 20 Q is available in appendix User data variants (Page 211).
User-specific	User data selectable through user data mapping or through defined user data variant	variable* / 20-byte outputs	You have to activate the check box "User data-mapping" in STEP 7 to use the module version user-specifically. You can change over the user data variant during operation. Information about the structure of the user-specific module version is available in the appendix "User-specific" module version (Page 207).

* 16 ... 256 bytes in steps of 16 bytes, depending on the mapped measured values

4.2.2 Module versions at configuration with GSD file

Module versions with fixed user data assignment

Module version	User data	Address space	Comment
2 I / 2 Q	No cyclic user data. Access to measured values through "Read data record".	2-byte inputs 2-byte outputs	Information about the structure of the 2 I / 2 Q module version is available in the appendix Module version "2 I / 2 Q" (Page 198).
E0	User data in accordance with EE@Industry measurement data profiles	12-byte inputs / 20-byte outputs	Information about the structure of the EE@Industry measured data profiles is available in the appendix Module version "EE@Industry measurement data profile E0 / E1 / E2 / E3" (Page 209).
E1		4-byte inputs / 20-byte outputs	
E2		12-byte inputs / 20-byte outputs	
E3		104-byte inputs / 20-byte outputs	

Module versions with selectable user data variants

Module version	User data	Address space	Comment
32 I / 20 Q	User data selectable through user data variants or through user-specific user data*	32-byte inputs / 20-byte outputs	You can change over the user data variant during operation. If you use user-specific user data, you write your measured value profile into the AI Energy Meter HF with the data record 130. To do this use the WRREC instruction. Information about the structure of data record 130 is available in appendix Structure of the parameter data records 130/131 for user-data mapping (Page 165).
64 I / 20 Q		64-byte inputs / 20-byte outputs	
128 I / 20 Q		128-byte inputs / 20-byte outputs	
256 I / 20 Q		256-byte inputs / 20-byte outputs	

*Ensure that the user data do not exceed the size of the address space of the module version. If necessary, use a module version with a larger address space

4.2.3 Changing over the user data variant during operation

Introduction

You change the user data variant in the output data of each user data variant in Byte 0.

The following figure shows to which user data you can change over at various module versions during operation.

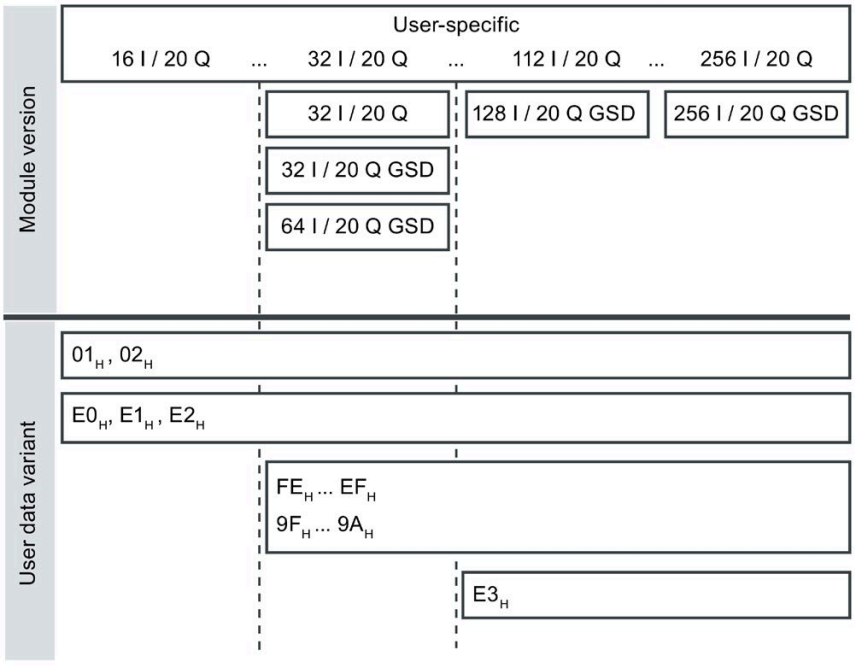


Figure 4-1 Possible user data variants

Requirement

- User program has been created.
- AI Energy Meter HF is configured as one of the module versions mentioned in the figure above.
- The start address of the module is known in the process image output.

Procedure

1. Create one constant with the data type BYTE per user data variant.
2. Enter the user data ID as a value in each case.
3. Write the constant to the start address of the module in the process image output.

Result

The user data variant is switched with the next cycle.

Note
Information about user data changeover

The parameterized user data variant is set in the following cases:

- A "0" is written in byte 0 in the output data of a user data variant.
- Byte 0 in the output data of a user data variant contains an invalid value:
  - Coding of the user data variant not available
    or
  - Available address space is not sufficient for the selected user data variant.

4.2.4 Recommendations for selecting the module version

The following table shows which module version is suitable for a given purpose.

Module version	Application	Note
2 I / 2 Q	• Use of many AI Energy Meter HF in an ET 200SP or little address space is available	• Read the measured values solely via the RDREC instruction from a measured value data record. • Quality information about the measured values is always available.
EE@Industry measurement data profile E0 / E1 / E2 / E3	• Cyclic measurement per phase • Supplied measured values in accordance with the EE@Industry measured data profile	• Available measured values depend on the configured measurement data profile. • The user data are fixed and cannot be changed dynamically. Alternatively, read the measured values acyclically from a measured value data record via the RDREC instruction. • No quality information
32 I / 20 Q	• Cyclic measurement per phase • Flexibility by switching predefined user data variants	• Quality information about the measured values is always available. • Depending on the user data variant, you must convert the measured values in the CPU to physical values using the supplied scaling factor. • One cycle elapses for each user data changeover. Measured values from the next user data variant are thus supplied with a slight time offset. Alternatively, read the measured values acyclically from a measured value data record via the RDREC instruction. Consistent measured values of a measuring cycle are supplied.
User-specific With GSD configuration • 32 I / 20 Q • 64 I / 20 Q • 128 I / 20 Q • 256 I / 20 Q	• Cyclic measurement of up to 64 measured values configurable • Flexibility by switching predefined user data variants	

4.3 Applicable modules

Configuring with STEP 7

The following table shows with which controllers the different module versions can be configured with STEP 7.

Table 4- 1 Module versions configured with STEP 7

Controller	Module version						
	2 I / 2Q	32 I / 20 Q	User-specific	EE@Industry measurement data profile			
				E0	E1	E2	E3
IM 155-6 PN ST	V3.3 or higher						
IM 155-6 PN HF *	V3.1 or higher						
IM 155-6 PN BA	V3.2 or higher		---	V3.2 or higher			---
IM 155-6 PN HS	V4.0 or higher		---	V4.0 or higher			
IM 155-6 DP HF	V3.0 or higher		---	V3.0 or higher			---
CPU 1510SP-1 PN**	V1.6 or higher		V1.6 or higher*** V2.0 or higher	V1.6 or higher			V2.0 or higher
CPU 1510SP F-1 PN**	V1.7 or higher		V1.7 or higher*** V2.0 or higher	V1.7 or higher			V2.0 or higher
CPU 1512SP-1 PN**	V1.6 or higher		V1.6 or higher*** V2.0 or higher	V1.6 or higher			V2.0 or higher
CPU 1512SP F-1 PN**	V1.7 or higher		V1.7 or higher*** V2.0 or higher	V1.7 or higher			V2.0 or higher
CPU 1515SP PC**	V1.7 or higher		V1.7 or higher*** V2.0 or higher	V1.7 or higher			V2.0 or higher

** Function setting the time as of V4.2

** Time setting function is not possible

*** Up to a max. of 32 bytes input

Configuring with GSD file

The following table shows with which controllers the different module versions can be configured using a GSD file.

Table 4- 2 Module versions configuring with GSD file

Controller	Module version						
	2 I / 2Q	32 I / 20 Q	64 I / 20 Q 128 I / 20 Q 256 I / 20 Q	EE@Industry measurement data profile			
				E0	E1	E2	E3
IM 155-6 PN ST	V3.3 or higher						---
IM 155-6 PN HF	V3.1 or higher						---
IM 155-6 PN BA	V3.2 or higher		---	V3.2 or higher			---
IM 155-6 PN HS	V4.0 or higher		---	V4.2 or higher			---
IM 155-6 DP HF	v4.2 or higher		---	v4.2 or higher			---

Quick start

5

Introduction

This section shows you how to read and view your first measured values on the AI Energy Meter HF in a particularly quick and easy way.

Requirement

You have already connected the AI Energy Meter HF to your network with one of the connection types shown in the section Wiring (Page 20). The AI Energy Meter HF has already been integrated in your configuration tool (such as STEP 7), or the AI Energy Meter HF has been integrated in your hardware catalog of your configuration tool with the GSD file.

Procedure

1. Configure an ET 200SP station

   Configure an ET 200SP station with a CPU 151xSP or an IM 155-6.

2. Plug module in ET 200S station

   Plug the AI Energy Meter HF into the ET 200SP station and use the module version with 32-byte inputs and 20-byte outputs.

3. Set the module parameters

   Set the following parameters for the AI Energy Meter HF:

   – Connection type that you have used for the AI Energy Meter HF (e.g. 3P4W)
   – Voltage measuring range
   – Frequency of your network (for example 50 Hz)
   – Nominal value current and nominal value voltage for the phases
   – Primary and secondary current of the used current transformer (e.g. 100 A and 1 A)
   – Primary and secondary voltages of the used voltage transformer (e.g. 230 V and 230 V)

   Leave all other parameters at their default settings and do not change them.

4. Load configuration

   Switch on the ET 200SP station and download the configuration to the CPU.

Result

After being switched on, the AI Energy Meter HF supplies the measured values for the "Total power L1L2L3" user data variant with the ID 254 or FE_H.

Read and check the measured values provided by the AI Energy Meter HF in the input data.

The table below shows the structure of the user data variant, the measured variables and the data type of the measured values in STEP 7 (TIA Portal) that are stored in the 32 bytes of output data of the module. Each measured variable is referenced via the measured value ID. An overview of all the measured variables with their measured value IDs is provided in the section Measured variables for connection type (Page 171).

Table 5- 1 Total power L1L2L3

Byte	Allocation	Data type	Unit	Value range	Measured value ID
0	User data variant	BYTE	-	254 (FE_H)	-
1	Quality information = QQ_1 I_3 U_3 I_2 U_2 I_1 U_1	BYTE	Bit string	qq xx xx xx	-
2 ... 3	Current L1	UINT	1 mA	0 ... 65535	66007
4 ... 5	Current L2	UINT	1 mA	0 ... 65535	66008
6 ... 7	Current L3	UINT	1 mA	0 ... 65535	66009
8 ... 9	Active power L1L2L3	INT	1 W	-32768 ... 32767	66034
10 ... 11	Reactive power Qtot L1L2L3	INT	1 var	-32768 ... 32767	66038
12 ... 13	Apparent power L1L2L3	INT	1 VA	-32768 ... 32767	66036
14 ... 17	Total active energy L1L2L3 (Int32)	DINT	1 Wh	-2147483647 to +2147483647	225
18 ... 21	Total reactive energy L1L2L3 (Int32)	DINT	1 varh	-2147483647 to +2147483647	226
22	Reserved	BYTE	-	0	-
23	Power factor λ L1L2L3	USINT	0.01	0 ... 100	66037
24	Scaling current L1	USINT	-	0 ... 255	-
25	Scaling current L2	USINT	-	0 ... 255	-
26	Scaling current L3	USINT	-	0 ... 255	-
27	Scaling active power L1L2L3	USINT	-	0 ... 255	-
28	Scaling reactive power L1L2L3	USINT	-	0 ... 255	-
29	Scaling apparent power L1L2L3	USINT	-	0 ... 255	-
30	Scaling total active energy L1L2L3	USINT	-	0 ... 255	-
31	Scaling total reactive energy L1L2L3	USINT	-	0 ... 255	-

Additional information

If you require further information about the evaluation and interpretation of the measured values, please refer to the section Reading and processing measured values (Page 41).

Reading and processing measured values

6

6.1 Basics for reading measured values

Introduction

The AI Energy Meter HF provides the measured values and variables through the following methods:

- Cyclic: User data
- Acyclic: Measured value data records

User data

User data provide pre-defined or user-defined measured values depending on the configured user data variant. The supplied measured values are cyclically written to the process image of the CPU. With some user data variants, the measured values are supplied as raw data, which you have to convert to the corresponding physical values using a supplied scaling factor.

Measured value data records

Each measured value data record supplies physical values that you can further process immediately. You read the values of a measured value data record acyclically with the RDREC instruction in a PLC tag. You need a corresponding PLC tag for each measured value data record to be read. It is also possible to create the corresponding structure in the static variables of an FB or store this structure in a DB.

You can display the read measured values in a watch table in STEP 7.

Note

If you are using CPUs other than S7-1200 or S7-1500, convert 64-bit measured values to 32-bit measured values. Note the conversion can cause loss of accuracy.

For more information, read FAQ: Processing 64-bit-floating-point numbers in S7-300/400 (https://support.industry.siemens.com/cs/ww/en/view/56600676)

Validity of the measured values

After turning on the 24 V DC supply voltage, the first measured values are available at terminal 17 after approximately 2 seconds. In the input user data, the content of byte 0 is set to the selected user data variant. You can use this change in byte 0 as a trigger event.

As soon as the module has valid measured values, the value of this byte changes to a value within the value range.

Initial module startup

After the first startup or restart of the module, the parameters are transferred to the module. You can preset a user data variant in the parameters of the hardware configuration. This remains in effect until a different user data variant is selected in the output data (byte 0). This allows input user data to be modified dynamically according to the requirements of the process.

The user data variant defined in parameter data record 128 or configuration tool is used under the following conditions:

- A "0" is written in byte 0 in the output data of a user data variant.
- Byte 0 in the output data of a user data variant contains an invalid value:
  - Coding of the user data variant not available, or
  - Available address space is not sufficient for the selected user data variant.

  See "Selecting the module versions (Page 32)".

Current measured values become "0"

The current and all other measured values based on it are suppressed (or set to "0") in the data records and in the user data in the following cases:

- The fed-in current of the current transformer is less than the configured "Low limit for measuring current in relation to nominal value current [0.1%]" parameter.
- Fed-in secondary current at the channel is higher than 12 A.

Among others, the following measured values and derived measured variables of the phase involved become "0":

- Effective current value
- Active power
- Reactive power
- Apparent power
- Phase angle
- Power factor

A floating mean value is formed from the power values. These only become "0" after a corresponding time. The operating hours counter and the energy counter for active, reactive and apparent energy of the reset phase stops counting.

General reset

With module versions with 20 bytes of output data you can reset some measured values and counter levels.

An edge change of 0 -> 1 at the bit for the general reset has the following effect:

- Counters for energy, operating hours and limits start at "0" again.
- Results of the power quality analysis are deleted.
- Minimum and maximum value calculation starts again with initial values.

For the general reset, set bit 7 in byte 16 of the output user data. (Page 201)

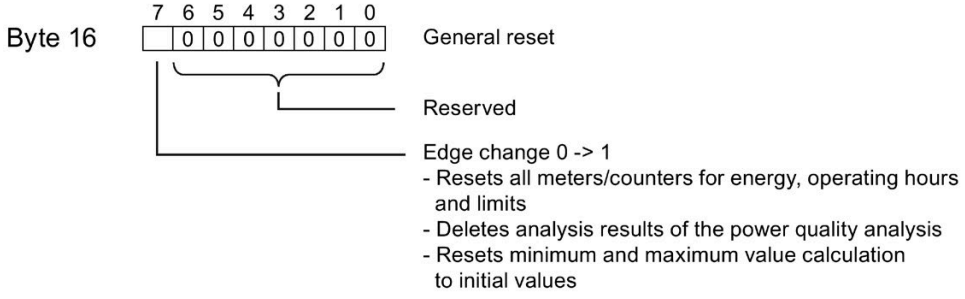


Figure 6-1 Control byte 16 in the output user data for general reset

Substitute value behavior

The substitute values for input values of the AI Energy Meter HF amount to "0".

See also

Reading measured values from user data cyclically (Page 50)

6.2 Quality information

Use the quality information to evaluate the status for currents, voltage, operating quadrants and the rotating field.

The AI Energy Meter HF provides quality information:

- In byte 1 of the user data
- In measured value IDs 65500 to 65503
- In the power quality analysis Qualifier ID 65496 (Page 94)

See also

Module version "32 I / 20 Q" (Page 201)

6.2.1 Quality information in byte 1 of the user data

For all user data variants, the module provides brief quality information in an 8-bit field in byte 1 for:

- Currents (I_{L1}, I_{L2}, I_{L3})
- Voltages (U_{L1}, U_{L2}, U_{L3})
- Operating quadrant for a phase

Please note that quality information assignment with user data variants for phase-specific measurement (ID 154 to ID 159) is different from user data variant assignment for 3-phase measurement (ID 244 to ID 254).

Quality information in byte 1 of the user data for 3-phase measurement

The quality information for 3-phase measurement is provided by the module in user data variants ID 244 to ID 254.

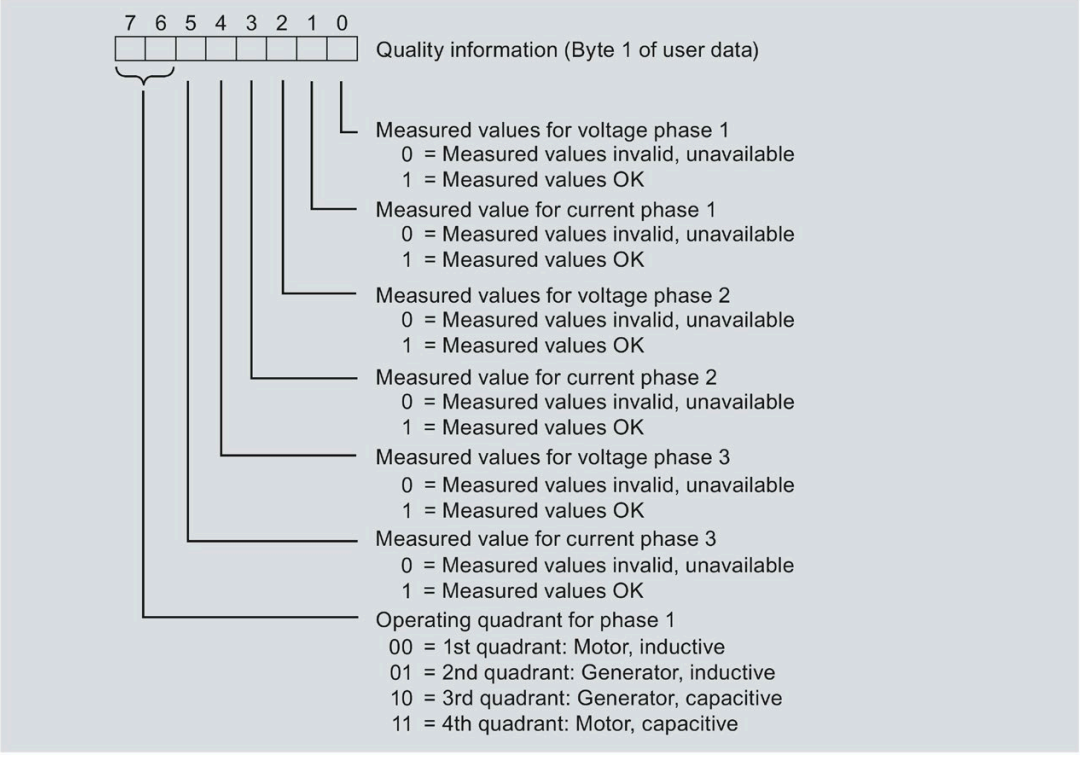


Figure 6-2 Assignment of byte 1 for user data variants ID 224 to ID 254

Quality information in byte 1 for phase-specific measurement

The quality information for phase-specific measurement is provided by the module in user data variants ID 154 to ID 159.

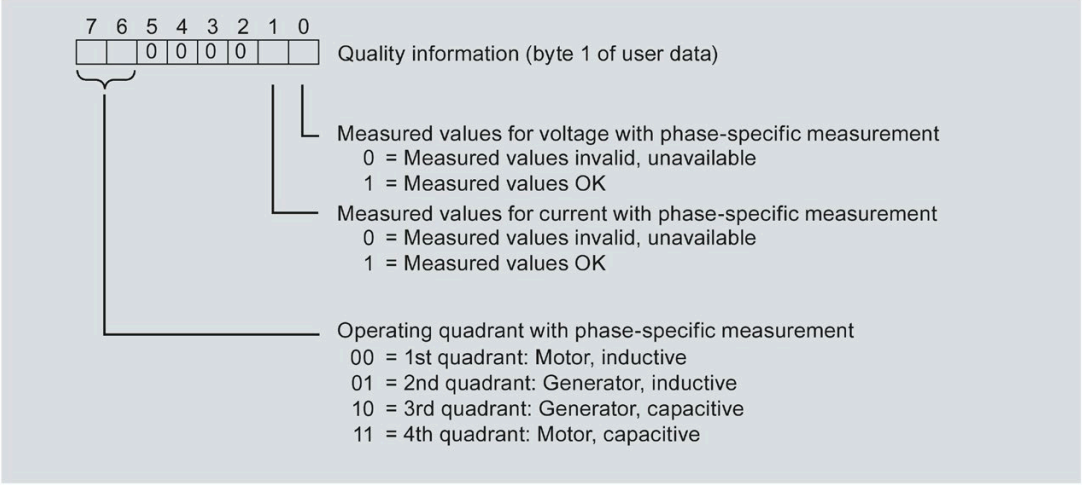


Figure 6-3 Byte 1 assignment for user data variants ID 154 to ID 159

6.2.2 Quality information with measured value IDs

Complete quality information is provided by the module in a 16-bit field with measured value IDs 65500 to 65503.

- Measured value ID 65503 for 3-phase measurement
- Measured value ID 65500, 65501 or 65502 for phase-specific measurement in phase 1, phase 2 or phase 3

Quality information with measured value ID 65503 for 3-phase measurement

The quality information for 3-phase measurement is provided by the module with:

- User data variant "Basic variables quality values three-phase measurement (ID 240 or $F0_H$)
- User data (measured value ID 66503)
- Measured value data record 150

The measured value ID 65503 provides information on:

- Currents (I_{L1}, I_{L2}, I_{L3})
- Voltages (U_{L1}, U_{L2}, U_{L3})
- Operating quadrants for all 3 phases
- Rotating field for the 3-phase system

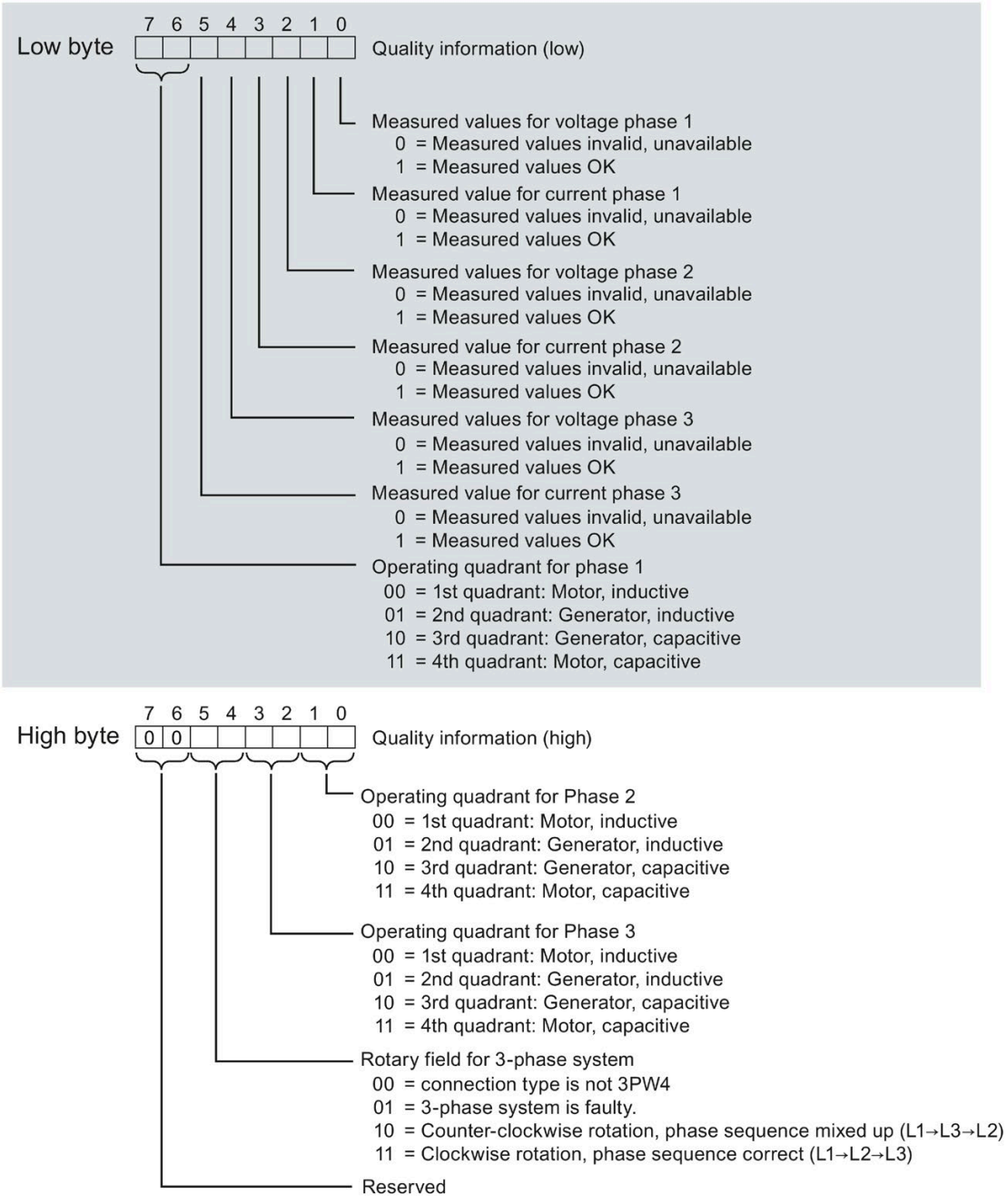


Figure 6-4 Quality information for low and high byte of the measured value ID 65503

Quality information with measured value ID 65500, 65501 or 65502 for phase-specific measurement

The module provides quality information for phase-specific measurement in phase 1, phase 2 or phase 3 with:

- User data (with measured value ID 65500, 65501 or 65502)
- Measured value data record DS 147, 148 or 149

Measured value IDs 65500, 65501 and 65502 provide information on:

- Current of the phase in question
- Voltage of the phase in question
- Operating quadrant of the phase in question

In contrast to the assignment for measured value ID 65503 (figure above), measured value IDs 65500, 65501 and 65502 only contain the phase-specific information for current, voltage and operating quadrant. The information about the other phases and the rotating field have the value 0.

6.2.3 Operating quadrant

The figure below shows the quality information of the operating quadrants.

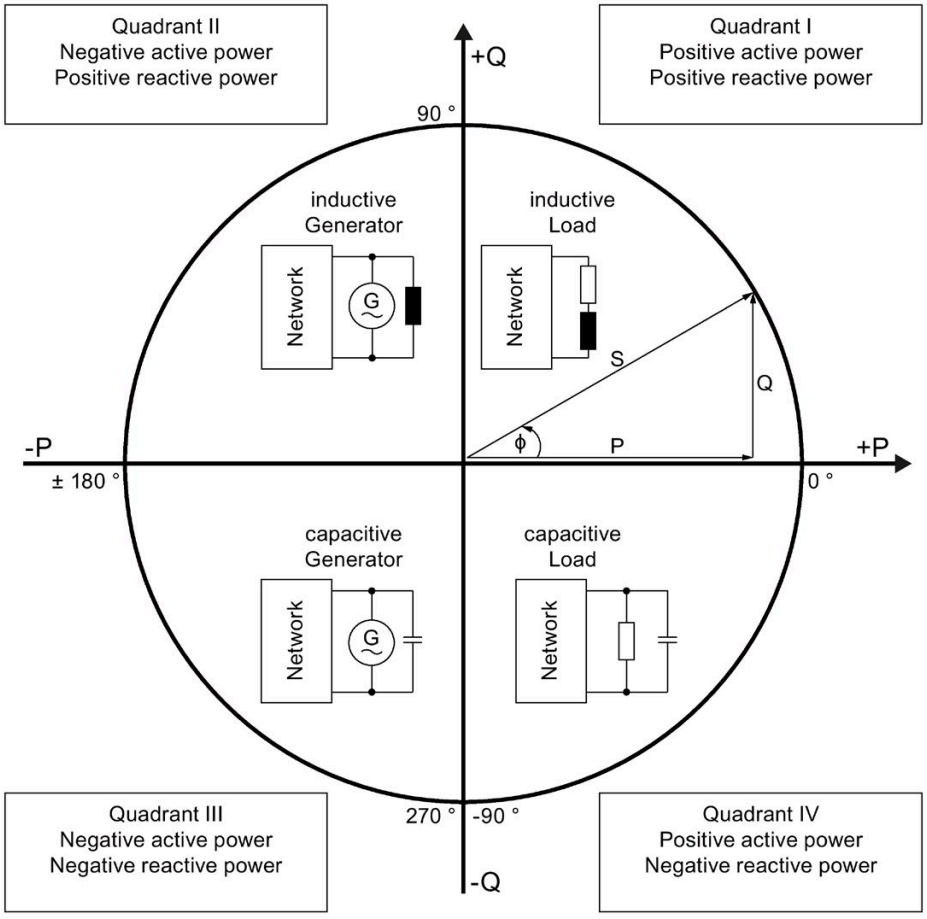


Figure 6-5 Quadrant in the quality bits

6.2.4 Notes for the detection of wiring errors and incorrect rotating field

A variety of quality information is available to evaluate the correct wiring of the Energy Meter and the applied rotary field.

In byte 1 of the payload, section 7.2.1 or measured value IDs 65500-65503, section 7.2.2

Information on the validity of the measured currents and voltages is encoded in bits 0 to 5.

Information on the operating quadrants is encoded in the bits 6 to 7, see section 7.2.3 (Page 44)

Phase angle between voltages and currents, measured value phase angle Ln

Based on the phase angle, you can recognize whether the flow direction of the current is correct and whether the voltage or current connections have been swapped. You cannot recognize, however, which phases are swapped and how. If the wiring is correct, the phase angle for the consumer must be in the range from 270° to 359° or -0° to -90°. For generators, the phase angle with correct wiring is in the range from 90° to 270° or -180° to -90°.

Angle between the voltages, measured value phase angle ULx-ULy

Based on the phase angle between the voltages, you can check the correct phase sequence and detect an unwanted same-phase connection.

In a symmetrical three-phase network, the angle between the phase voltages is +120°(-240°) or -120°(+240°).

Angle between currents, measured value phase angle ILx-ILy

Based on the phase angle between the currents, you can check the correct phase sequence and flow direction as well as detect an unwanted same-phase connection.

For a symmetrical load, the phase angles between the currents are identical to those between the voltages.

Line-to-line voltage, measured value ULx-ULy

You can detect an unwanted same-phase connection using the line-to-line voltage whose calculation takes into account the angles between the voltage phases.

See also

How you can use this information to detect specific faulty wiring, is explained in a separate FAQ (https://support.industry.siemens.com/cs/ww/de/view/109755917).

6.3 Reading measured values from user data cyclically

Requirement

- STEP 7 is open.
- The AI Energy Meter HF Is configured.

Scaling of measured values in the user data

Since the value range of 16-bit values is often smaller than the value range of the physical value, a scaling factor is supplied together with the basic value in the user data for the respective measured or calculated values. You determine the actual value of the measured variable with the following formula:

Actual value of measured quantity = measured value in the user data x $10^{\text{scaling factor}}$

Procedure

To read measured values from the user data cyclically, proceed as follows:

1. Read the relevant measured value from the input data.
2. Observe the scaling factor at scaled measured values and convert the read measured value using the scaling factor.

Example

The user data variant 254 (FE_H) "Total power L1L2L3" is configured on the AI Energy Meter HF. The measured value for "Current L1" should be read.

Table 6- 1 Total power L1L2L3

Byte	Allocation	Data type	Unit	Value range	Measured value ID
0	User data variant	BYTE	-	254 (FE_H)	-
1	Quality information = QQ_1 I_3 U_3 I_2 U_2 I_1 U_1	BYTE	Bit string	qq xx xx xx	-
2 ... 3	Current L1	UINT	1 mA	0 ... 65535	66007
4 ... 5	Current L2	UINT	1 mA	0 ... 65535	66008
6 ... 7	Current L3	UINT	1 mA	0 ... 65535	66009
8 ... 9	Active power L1L2L3	INT	1 W	-32768 ... 32767	66034
10 ... 11	Reactive power Qtot L1L2L3	INT	1 var	-32768 ... 32767	66038
12 ... 13	Apparent power L1L2L3	INT	1 VA	-32768 ... 32767	66036
14 ... 17	Total active energy L1L2L3 (Int32)	DINT	1 Wh	-2147483647 to +2147483647	225
18 ... 21	Total reactive energy L1L2L3 (Int32)	DINT	1 varh	-2147483647 to +2147483647	226
22	Reserved	BYTE	-	0	-
23	Power factor λ L1L2L3	USINT	0.01	0 ... 100	66037
24	Scaling current L1	USINT	-	0 ... 255	-
25	Scaling current L2	USINT	-	0 ... 255	-
26	Scaling current L3	USINT	-	0 ... 255	-
27	Scaling active power L1L2L3	USINT	-	0 ... 255	-
28	Scaling reactive power L1L2L3	USINT	-	0 ... 255	-
29	Scaling apparent power L1L2L3	USINT	-	0 ... 255	-
30	Scaling total active energy L1L2L3	USINT	-	0 ... 255	-
31	Scaling total reactive energy L1L2L3	USINT	-	0 ... 255	-

In the user data variant FE_H (254) the measured value for the current L1 is stored in Byte 2 + 3. The current is supplied by the module as a 16-bit-fixed-point number in the value range from 0 to 65535 in the unit 1 mA. In addition the scaling factor for the current L1 has to be considered additionally. The module supplies the related scaling factor in Byte 24.

The actual value for current L1 is calculated as follows:

Actual value for current L1 = Current L1 x $10^{\text{Scaling current L1}}$

See also

Basics for reading measured values (Page 41)

6.4 Read out measured values acyclically using data records

With all module versions you can read out the measured values using data records.

An overview of all measured value data records and exact information about the structure is available in the appendix Overview of all measured value data records (Page 230).

Requirement

In the STEP 7 project you have created a PLC data type that has an identical structure to the data record you want to evaluate.

Example of the structure of a data record

The following overview shows the structure of the data record DS 142.

Byte	Measured variable	Data type	Unit	Value range	Measured value ID
0	Version = 2	UINT8	-	-	-
1	Reserved	UINT8	-	-	-
2...5	Voltage UL1-N	REAL	V	0.0 ... 1000000.0	1
6...9	Voltage UL2-N	REAL	V	0.0 ... 1000000.0	2
10...13	Voltage UL3-N	REAL	V	0.0 ... 1000000.0	3
14...17	Voltage UL1-L2	REAL	V	0.0 ... 1000000.0	4
18...21	Voltage UL2-L3	REAL	V	0.0 ... 1000000.0	5
22...25	Voltage UL3-L1	REAL	V	0.0 ... 1000000.0	6
26...29	Current L1	REAL	A	0.0 ... 100000.0	7
30...33	Current L2	REAL	A	0.0 ... 100000.0	8
34...37	Current L3	REAL	A	0.0 ... 100000.0	9
:		:	:	:	:
210...213	Neutral current IN	REAL	A	0.0 ... 100000.0	61149

Procedure

1. Read the desired data record with the RDREC instruction.

   The measured values are in the target range of the data block which you specified with the RDREC instruction.

2. Evaluate the measured values for the desired measured variables.

Note

If you want to read or write several data records at the same time in the user program, note that the number of active jobs that you started with the RDREC or WRREC instruction is limited by the resources of the CPU used.

See also

Measured value data record for base measurements (DS 142) (Page 231)

6.5 Time-of-day synchronization and time stamp

The AI Energy Meter HF supports time-of-day synchronization and time stamp.

Time-of-day synchronization is only supported by IM 155-6 PN HF as of firmware version V4.2.

Time stamps are used to date the exact occurrence of information. You can find time information in the measured value data records "Measured value data record for maximum values with time stamp (DS 154)" and "Measured value data record for minimum values with time stamp (DS 155)", for example, or the power quality analysis data records DS160, DS161 and DS163. In addition, time information is required for the evaluation of the "Power failure analysis" function (see section Power failure analysis).

For the time on the AI Energy Meter CT HF to correspond to the current system time, the clock must be synchronized externally. Information on this and additional requirements can be found in the application example. In the absence of time-of-day synchronization, the internal time stamp of the AI Energy Meter CT HF starts at 01.01.1970, 0:00.

Structure of the time stamp

The table below shows the structure of the time stamp:

Byte	PNIO Time	Format	Length
0	Status 0: Synchronization from system time master available 1: Local synchronization available 2: No synchronization available	UINT16	2 bytes
2	Seconds high	UINT16	2 bytes
4	Seconds low	UINT32	4 bytes
8	Nanoseconds	UINT32	4 bytes

The start value (initial value) is 01.01.1970, 0:00.

Note

If you use the implementation from the FAQ, the status is always 2.

See also

Application example (http://support.automation.siemens.com/WW/view/en/109754890)

Energy counters

7

Introduction

The AI Energy Meter HF provides several energy and overflow counters that detect both line-based and phase-based energy values, e.g.:

- Active energy (total, outflow, inflow)
- Reactive energy (total, outflow, inflow)
- Apparent energy (total)

Retentivity

The AI Energy Meter HF stores all counter values retentively. After an interruption (e.g. Power System Off), the energy counting resumes with the retentively stored values.

Functions

The energy meters provide the following basic functions:

- Measured values for infinite and periodical counting can be read out

  End values for periodic counting: 10^3, 10^6, 10^9, 10^{12} and 10^{15} can be selected with overflow counters
- Measuring ranges can be changed in RUN
- Starting and stopping counters via gate is possible
- Preset and apply start values in RUN
- Measured variables can be evaluated via data records and user data.

7.1 Evaluate measured values for energy

There are two ways of evaluating the measured values:

- Reading measured values using the instruction "RDREC".
- Reading measured values from the user data variants (not for module versions with 2 bytes of input data).

Data records for energy meters

You can read out measured values for energy and overflow counters in the following data records.

The evaluation of measured data using data records is described in section Read out measured values acyclically using data records (Page 52).

Name of the data record	Number of the data record	Comment
Data record for basic measured values (Page 231)	Data record 142	Measured values of the total energy L1L2L3
Data record for energy meter (Page 236)	DS 143	Measured values of energy and overflow counters for phases L1, L2 and L3
Data record for phase-specific measured values L1 (Page 252)	DS 147	Measured values of the phase-specific energy meters L1
Data record for phase-specific measured values L2 (Page 255)	DS 148	Measured values of the phase-specific energy meters L2
Measured value data record for phase-specific measured values L3 (Page 258)	DS 149	Measured values of the phase-specific energy meters L3

User data variants for energy meters

You can read out measured values for energy and overflow meters in the following user data variants.

The evaluation of measured data using user data variants is described in section Reading measured values from user data cyclically (Page 50).

Name of the user data variant	Number of the user data variant	Comment
Total energy L1 L2 L3 (Page 216)	ID 249 or F9H	Measured values of the total energy L1L2L3
Energy L1 (Page 217)	ID 248 or F8H	Measured values of the phase-specific energy meters L1
Energy L2 (Page 218)	ID 247 or F7H	Measured values of the phase-specific energy meters L2
Energy L3 (Page 218)	ID 246 or F6H	Measured values of the phase-specific energy meters L3
Basic variable quality measurement three-phase measurement (Page 219)	ID 240 or F0H	Status on the overflow of the energy meters for phases L1, L2 and L3
Basic variables energy meter measurement (periodic) L1L2L3 (Page 221)	ID 239 or EFH	Number of counter overflows for energy of phases L1, L2 and L3
EE@Industry measurement data profile E3 (Page 222)	ID 227 or E3H	Measured values for total active energy and total reactive energy L1L2L3
EE@Industry measurement data profile E2 (Page 222)	ID 226 or E2H	Measured values for total active energy L1L2L3
Basic variables for phase-specific measurement L1 (Page 224)	ID 159 or 9FH	Measured values for phase-specific active, reactive and apparent energy for phase L1
Basic variables for phase-specific measurement L1a (Page 225)	ID 158 or 9EH	Measured values for phase-specific active, reactive and apparent energy for phase L1
Basic variables for phase-specific measurement L2 (Page 226)	ID 157 or 9DH	Measured values for phase-specific active, reactive and apparent energy for Phase L2
Basic variables for phase-specific measurement L2a (Page 227)	ID 156 or 9CH	Measured values for phase-specific active, reactive and apparent energy for Phase L2
Basic variables for phase-specific measurement L3 (Page 228)	ID 155 or 9BH	Measured values for phase-specific active, reactive and apparent energy for Phase L3
Basic variables for phase-specific measurement L3a (Page 229)	ID 154 or 9AH	Measured values for phase-specific active, reactive and apparent energy for Phase L3
User-defined user data variant	ID 1 or 01H and ID 2 or 02H	Measured variables for energy can be selected in a user-defined manner

7.2 Preset and apply start values for energy and overflow counters

At the beginning of a new work order, it may be useful to start the energy and overflow counter with new start values.

Define the new start values for the energy and overflow counter in data record DS 143.

Note

Pre-set start values for counters

If you have not yet transferred any start values to the CPU using the data record DS 143, then start the counters with the value 0.

With **all** the module versions there are two ways of applying the start values:

- Transfer start values from data record DS 143 and apply them **immediately**
- Transfer start values from data record DS 143 and only apply them after setting a special bit (DQ bit for counter reset)

Both options are described in the following sections.

General reset

With module versions with 20 bytes of output data you can reset the energy and overflow counters. With a general reset, you cannot preset any start values; the start values for energy and overflow counters are always zero with a general reset.

You can find additional information on the general reset in the section Basics for reading measured values (Page 41).

See also

Structure for energy counters (DS 143) (Page 236)

7.2.1 Preset start values for the energy meters

Define the start values for the energy and overflow meters in data record DS 143.

Introduction

You have created a PLC data type that has an identical structure to data record DS 143.

Structure of data record DS 143

The following overview shows the structure of the data record DS 143 in simplified form.

More detailed information about the structure of data record DS 143 is available in section Structure for energy counters (DS 143) (Page 236).

Byte	Measured variable	Data type	Unit	Value range	Measured value ID
0	Version	BYTE	-	1	-
1	Reserved	BYTE	-	0	-
2	Control byte 1 - L1	BYTE	Bit string	-	-
3	Control byte 2 - L1	BYTE	Bit string		
4	Control byte 1 - L2	BYTE	Bit string		
5	Control byte 2 - L2	BYTE	Bit string		
6	Control byte 1 - L3	BYTE	Bit string		
7	Control byte 2 - L3	BYTE	Bit string		
8...15	Start value for active energy inflow L1	LREAL	Wh	You will find the exact assignment in the section Structure for energy counters (DS 143) (Page 236).	61180
16...23	Initial value active energy outflow L1	LREAL	Wh		61181
:	:	:	:		:
128...129	Start value for overflow counters active energy inflow L1	UNIT	-		61190
130...131	Start value for overflow counter active energy outflow L1	UNIT	-		61191
:	:	:	:		

Assignment of data record DS 143

Byte 0 and Byte 1: Version of the data record

Header information for the version of the data record.

Byte 2 ... Byte 7: Control bytes for energy and overflow counter

When data record 143 is written with the WRREC instruction, Bytes 2 to 7 are used as phase-specific control information for energy meters, overflow counters and operating hours counters. The length of the control information amounts to 2 bytes for each phase.

Byte 8 ... Byte 127: Start values for the individual energy meters

The start values for energy meters in data record 143 are 64-bit floating point numbers. The format corresponds to the data type LREAL in S7-1200 and in S7-1500.

Byte 128 ... Byte 157: Initial values for overflow counters

The initial values for overflow counters in data record 143 are 16-bit integers. The format corresponds to the data type UINT in S7-1200 and in S7-1500.

7.2.2 Apply start values from data record DS 143 immediately

It is possible to apply the start values for energy counters and overflow counters for each **individual** phase separately by active, reactive and apparent energy.

Requirement

In your STEP 7 project you have created a PLC data type that has an identical structure to data record DS 143 and you have entered the start values.

Procedure for all module versions

1. In control byte 2 of the DS 143 (bytes 3, 5 and 7), for each phase set the category of the energy meters (active, reactive, apparent energy) for which you want to set the start values.

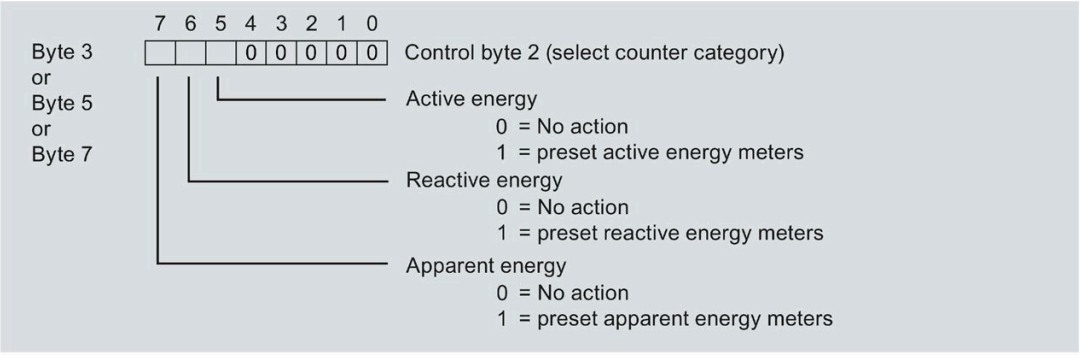


Figure 7-1 Assignment of control byte 2 in DS 143

2. In control byte 1 of DS 143 (bytes 2, 4 and 6), for each phase define whether you want to apply the start values for energy or overflow counters.

   Applying depends on the category selection from control byte 2.

   – Set Bit 0 if you want to apply the start values for the overflow counters.

   – Set Bit 2 if you want to apply the start values for the energy meters.

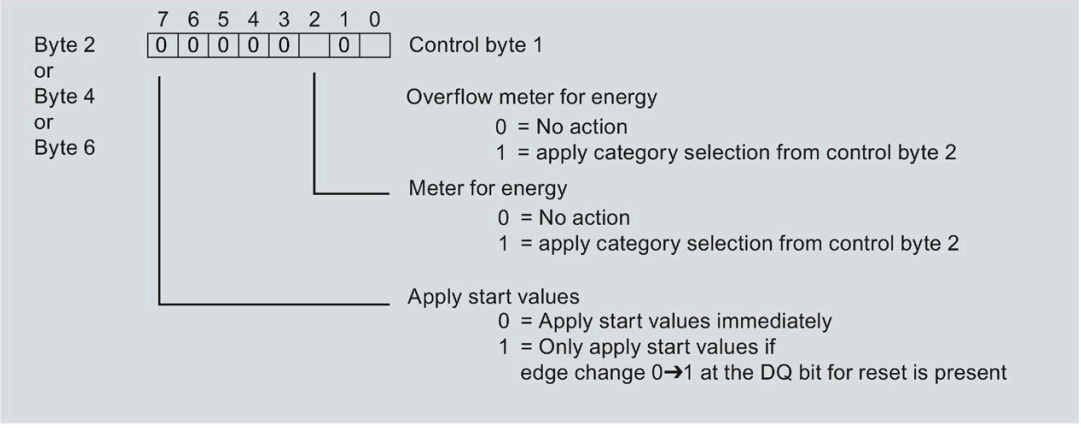


Figure 7-2 Assignment of control byte 1 in DS 143

3. In control byte 1 of DS 143 define that you want to immediately apply the start values.

   – Set Bit 7 to 0 so that the start values are immediately applied after writing the data record.

4. Transfer the data record with the WRREC instruction to the CPU.

7.2.3 Apply start values from data record DS 143 with DQ bit

Due to the differing lengths of the output data, setting of the start values for the energy counters and overflow counters depends on the configured module version.

Module versions with 20 bytes of output data

If you use module versions with 20 bytes of output data, you can:

- Apply start values for energy counters and overflow counters for **all** phases separately by active, reactive and apparent energy.
- Apply start values for energy counters and overflow counters for each **individual** phase separately by active, reactive and apparent energy.

Module version with 2 bytes of output data

If you use the module version with 2 bytes of output data, then you always apply the start values for **all** the energy counters and overflow counters simultaneously.

Requirement

- In your STEP 7 project you have created a PLC data type that has an identical structure to data record DS 143 and have entered the start values.

  Applying depends on the category selection from control byte 2.

  – Set Bit 0 if you want to apply the start values for the overflow counters.

  – Set Bit 2 if you want to apply the start values for the energy meters.
- In control byte 1 of the DS 143 you have set Bit 7 to "1" (apply start values via DQ bit)
- You have transferred the data record DS 143 with new start values to the CPU. The assignment of the data record can be found in Structure for energy counters (DS 143) (Page 236)

Note

Pre-set start values for counters

If you have not yet transferred any start values to the CPU using the data record DS 143, then start the counters with the value 0.

Procedure for module version with 20 bytes of output data

Apply start values for energy counters and overflow counters for all three phases

1. In Byte 2 of the output data, select the categories for which you want to apply start values.
   - Set bit 5 for active energy counters.
   - Set bit 6 for reactive energy counters.
   - Set bit 7 for apparent energy counters.

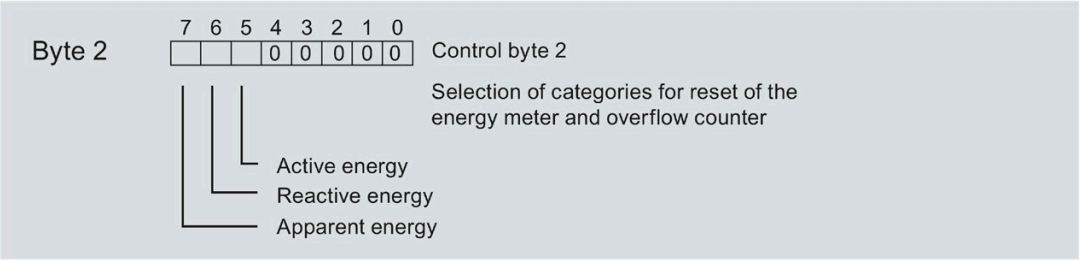


Figure 7-3 Selection of categories for reset

2. Set the reset bit (Bit 7) in byte 1 of the output data.

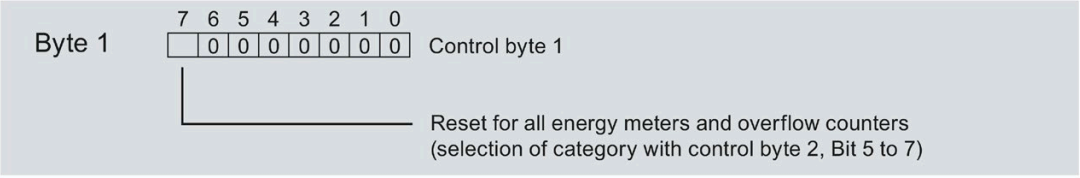


Figure 7-4 Reset bit for energy and overflow counter

If there is an edge change of the reset bit from 0 -> 1, the module resets the energy and overflow counters that you previously selected in byte 2 to their start values.

Apply start values for energy counters and overflow counters for phase-specific counting

You can also reset the energy and overflow counters on a phase-specific basis using the output data.

Follow the procedure as described in "Applying start values for energy counters and overflow counters for all three phases", as applicable.

1. In bytes 7, 9 and 11 of the output data, select the categories for which you want to apply the phase-specific start values.
   - Set Bit 5 for active energy counters.
   - Set Bit 6 for reactive energy counters.
   - Set Bit 7 for apparent energy counters.

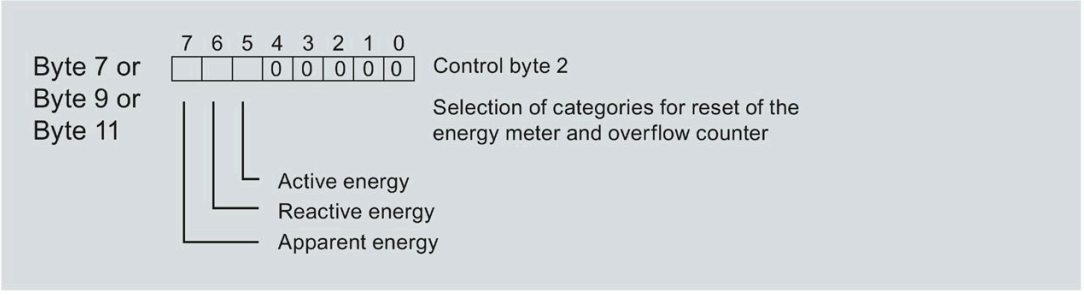


Figure 7-5 Selection of category

2. In bytes 6, 8 and 10 of the output data, set the reset bits (Bit 7) for the phase-specific start values.

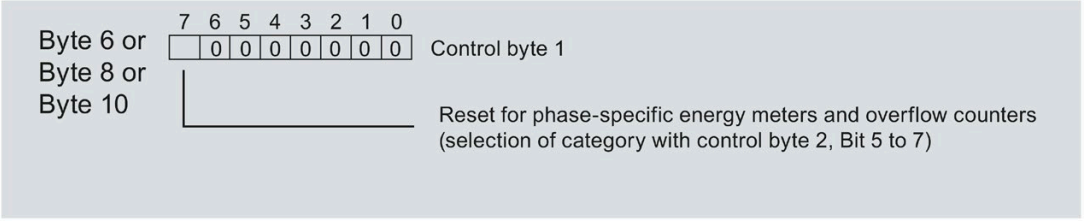


Figure 7-6 Reset bit for phase-specific energy and overflow counters

If there is an edge change of the phase-specific reset bit from 0 -> 1, the module resets the energy and overflow counters that you previously selected in bytes 7, 9 and 11 to their start values.

Procedure for module version with 2 bytes of output data

If you use the module version with 2 bytes of output data, always apply the start values **for all** the energy counters and overflow counters.

- Set the reset bit (Bit 7) in byte 1 of the output data.

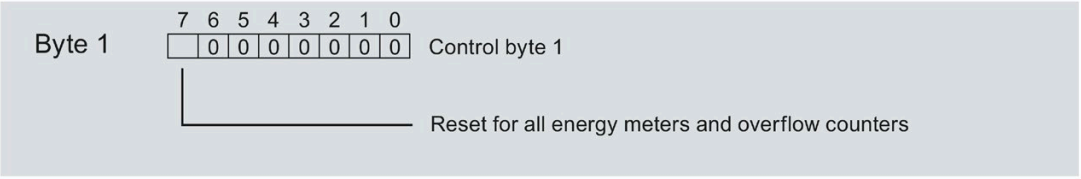


Figure 7-7 Reset bit for all energy and overflow counters

If there is an edge change of the reset bit from 0 -> 1, the module resets **all** energy and overflow counters to their start values.

7.3 Starting and and stopping energy meters

There are two ways of starting or stopping measurement with the energy meter AI Energy Meter HF:

- Counting with gate

  The module starts counting when you set the DQ bit for the counter gate in the output data using an edge change from 0 -> 1. If you reset the DQ bit using an edge change from 1 -> 0, the counter stops.

- Counting without gate

  The module starts counting immediately as soon as the module is switched on. Counting cannot be stopped.

Both options are described in the following sections.

Counting with gate

Requirements:

The current value is higher than the configured "Low limit for measuring current in relation to nominal value current [0.1%]".

Procedure

If you wish to start counting using the gate, proceed as follows:

1. Activate the parameter "Enable energy meter gate" in the parameter assignment of the module.
2. Set the DQ bit for the counter gate (Bit 6) in control byte 1 in the output data.

The module starts counting as soon as there is an edge change from 0 -> 1 at the DQ bit for the counter gate.

If you wish to stop the counting again, then reset Bit 6 in control byte 1 in the output data. Counting stops at an edge change from 1 -> 0.

The "Enable gate control for the energy counter" parameter and the DQ bit for the "counter date" behave like the parallel connection of contacts.

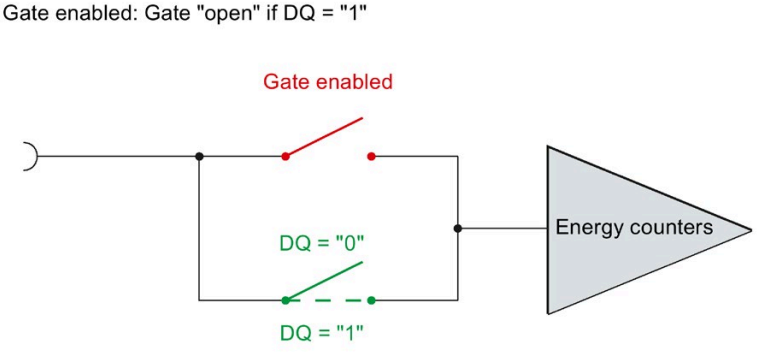


Figure 7-8 Gate enabled

Counting without gate

Requirement

The current value is higher than the configured "Low limit for measuring current in relation to nominal value current [0.1%]".

Procedure

Deactivate the parameter "Enable energy meter gate" in the parameter assignment of the module.

The module starts counting as soon as the module is started. The counter continues to count.

Gate disabled: Gate is always "open" (signal path closed)

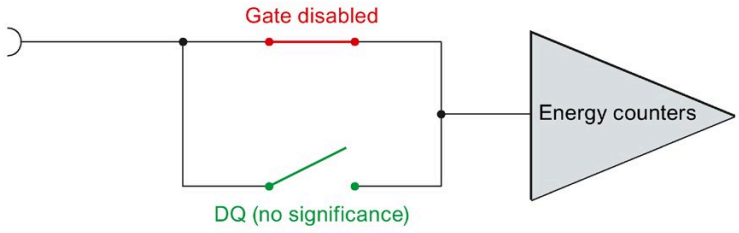
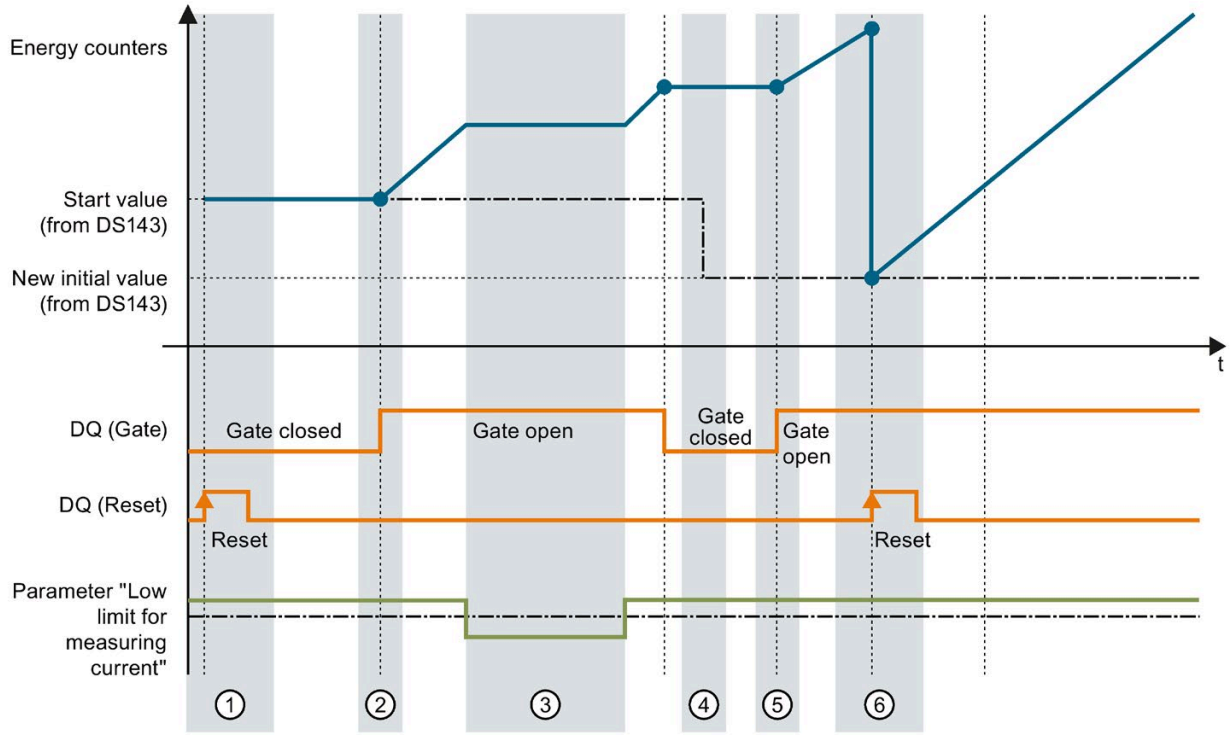


Figure 7-9 Gate disabled

7.4 Example of measuring and resetting an energy meter

The following figure shows resetting and starting/stopping with activated gating using the energy meter as an example:



① The counter is reset to the value specified in the configuration. The gate is closed. The counter does not count.

② The gate is opened via the control byte 1 in the output data of the user data variant. The counter counts.

③ The configured current low limit has been violated. The counter does not count.

④ The gate is closed. The counter does not count. A new start value is written to the measured value data record 143 (Page 236) with the WRREC instruction.

⑤ The gate is opened again via the control byte 1 in the output data of the user data variant. The counter counts with the new start value.

⑥ The counter is reset via the control byte 1 in the output data of the user data variant. The counter counts from the new start value that was transferred via the measured value data record 143.

Figure 7-10 Example of an energy meter

7.5 What is the structure of the control and feedback interface for DS 143?

Introduction

Bytes 2 to 7 of data record 143 (Page 236) form the phase-based control and feedback interface for the data record DS 143.

- Bytes 2 and 3: Control and feedback interface for phase 1
- Bytes 4 and 5: Control and feedback interface for phase 2
- Bytes 6 and 7: Control and feedback interface for phase 3

Status information

When data record 143 is read with the RDREC instruction, Bytes 2 to 7 supply phase-specific status information for energy counters, overflow counters and operating hours counters.

The status information enables you can see which counters are returning their values in the data record 143. If energy counters return their values in the status byte 1, you can determine the type of energy counter with status byte 2.

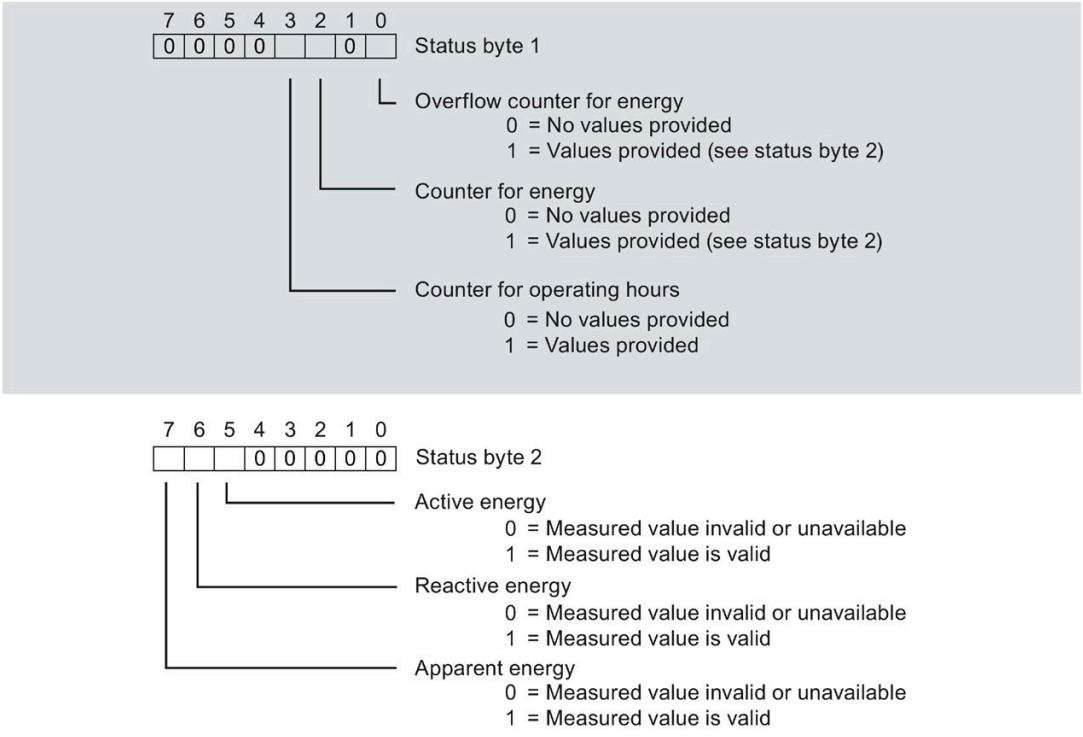


Figure 7-11 Status information DS 143 (read access)

Control information

When data record 143 is written with the WRREC instruction, Bytes 2 to 7 are used as phase-specific control information for energy meters, overflow counters and operating hours counters. The length of the control information amounts to 2 bytes for each phase:

- In control byte 1 you determine which counter you want to preset and the time at which counters are to be preset.

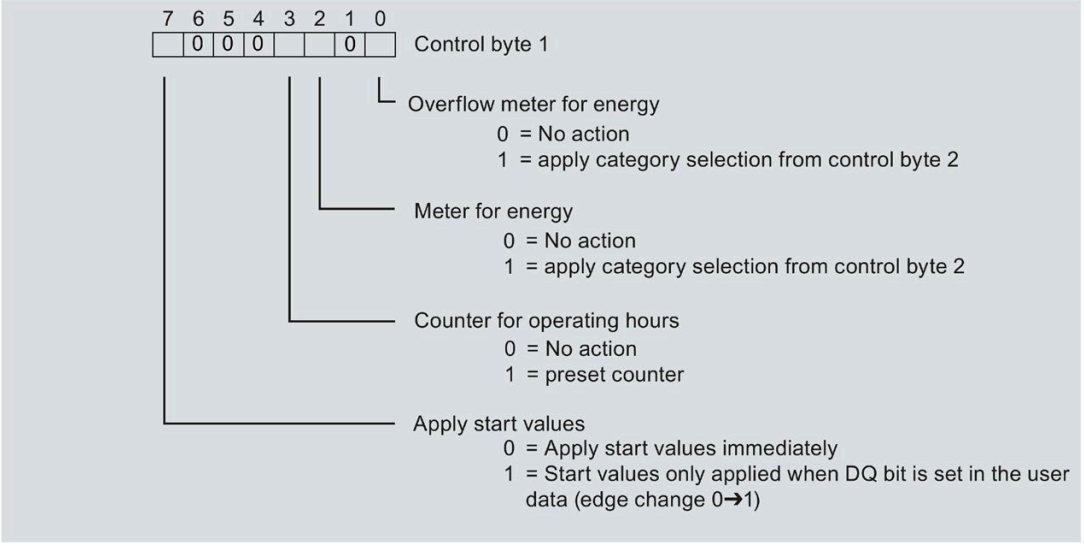


Figure 7-12 Control information DS 143, control byte 1 (write access)

- In control byte 2 you determine which energy meter categories you want to preset.

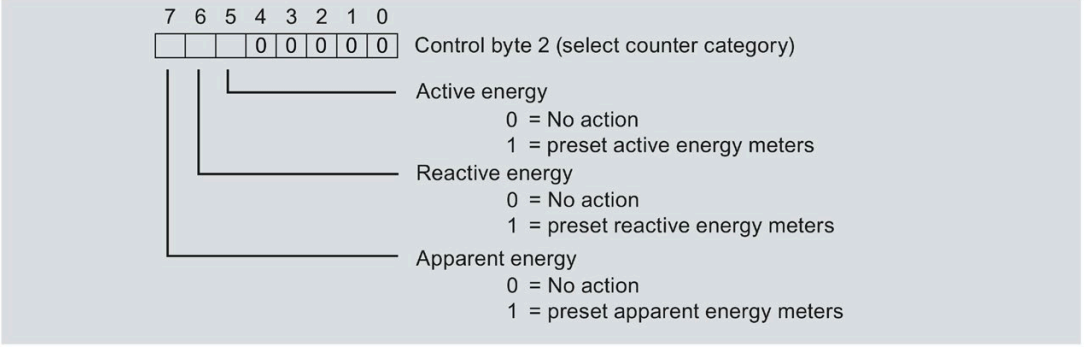


Figure 7-13 Control information DS 143, control byte 2 (write access)

Operating hours counter

8

Introduction

The AI Energy Meter HF provides four operating hours counters which count the operating hours of the connected consumers:

- Three phase-specific operating hours counters
- 1 operating hours counter which displays the value of the largest phase-specific operating hours counter.

Retentivity

The AI Energy Meter HF stores all counter values retentively. After an interruption (e.g. Power System Off), counting resumes with the retentively stored values.

Functions

The operating hours counters provide the following basic functions:

- Measuring ranges from 0 to 3.4 x 10^{38} hours.
- Starting and stopping operating hours counters via gate
- Preset and apply start values in RUN
- Evaluating counter states using data records and user data

8.1 Evaluating operating hours counters

There are two ways of evaluating the operating hours counters:

- Reading counter states using data records with the instruction RDREC.
- Reading counter states from the user-defined user data variants.

Data records for operating hours counter

You can read out measured values for operating hours in the following data records.

The evaluation of measured data using data records is described in section Reading and processing measured values (Page 41).

Name of the data record	Number of the data record	Comment
Data record for energy meter (Page 236)	DS 143	Phase-specific operating hours counter for phase L1, phase L2, phase L3 and largest phase-specific operating hours counter L1L2L3
Measured value data record for advanced measurement and status values (Page 261)	DS 150	
Measured value data record of user-defined data record (Page 262)	DS 151	Operating hours counters can be selected in a user-defined manner

User data variants for operating hours counters

You can read out measured values for operating hours in the following user data variants.

The evaluation of measured data using user data variants is described in section User data variants (Page 211).

Name of the user data variant	Number of the user data variant	Comment
User-defined user data variant	ID 1 or 01_H and ID 2 or 02_H	Operating hours counters can be selected in a user-defined manner

8.2 Preset and apply start values for operating hours counters

Introduction

At the beginning of a new work order, it may be useful to start counting of the operating hours counters with new start values.

Define the new start values for the operating hours counters in data record DS 143.

Note

Pre-set start values for counters

If you have not yet transferred any start values to the CPU using the data record DS 143, then start the counters with the value 0.

With **all** the module versions there are two ways of applying the start values:

- Transfer start values from data record DS 143 and apply them **immediately**
- Transfer start values from data record DS 143 and only apply them after setting a special bit (DQ bit for operating hours counter reset)

Both options are described in the following sections.

General reset

With module versions with 20 bytes of user data you can reset the operating hours counters. With a general reset, you cannot preset any start values; the start values for operating hours counters are always zero with a general reset.

You can find additional information on the general reset in the section Basics for reading measured values (Page 41).

8.2.1 Preset start values for operating hours counters

Define the start values for operating hours counters using data record DS 143.

Introduction

You have created a PLC data type that has an identical structure to data record DS 143.

Structure of data record DS 143

The following overview shows the structure of the data record DS 143 in simplified form.

More detailed information about the structure of data record 143 is available in section Structure for energy counters (DS 143) (Page 236).

Byte	Measured variable	Data type	Unit	Value range	Measured value ID
0	Version	BYTE	-	1	-
1	Reserved	BYTE	-	0	-
2	Control byte 1 - L1	BYTE	Bit string	-	-
3	Control byte 2 - L1	BYTE	Bit string		
4	Control byte 1 - L2	BYTE	Bit string		
5	Control byte 2 - L2	BYTE	Bit string		
6	Control byte 1 - L3	BYTE	Bit string		
7	Control byte 2 - L3	BYTE	Bit string		
8...15	Start value for active energy inflow L1	LREAL	Wh	You will find the exact assignment in the section Structure for energy counters (DS 143) (Page 236).	61180
16...23	Initial value active energy outflow L1	LREAL	Wh		61181
:	:	:	:		:
158...161	Start value operating hours L1	REAL	h		65505
162...165	Start value operating hours L2	REAL	h		65506
166...169	Start value operating hours L3	REAL	h		65507

Assignment of data record DS 143

Byte 0 and Byte 1: Version of the data record

Header information for the version of the data record.

Byte 2 ... Byte 7: Control bytes for energy and overflow counter

When data record 143 is written with the WRREC instruction, Bytes 2 to 7 are used as phase-specific control information for energy meters, overflow counters and operating hours counters. The length of the control information amounts to 2 bytes for each phase.

Byte 8 ... byte 157: Start values for the individual energy meters and overflow counters

The start values for energy counters in data record 143 are 64-bit floating point numbers. The format corresponds to the data type LREAL in S7-1200 and in S7-1500.

The initial values for overflow counters in data record 143 are 16-bit integers. The format corresponds to the data type UINT in S7-1200 and in S7-1500.

Byte 158 ... byte 169: Start values for operating hours counter

The start values for operating hours counters in data record 143 are 32-bit integers. The format corresponds to the data type REAL in S7-1200 and in S7-1500.

8.2.2 Apply start values from data record DS 143 immediately

Applying the start values for each separate operating hours counter is possible.

Requirement

In your STEP 7 project you have created a PLC data type that has an identical structure to data record DS 143 and you have entered the start values.

Procedure for all module versions

1. In Control byte 1 of DS 143 (bytes 2, 4 and 6), for each phase, define that you want to immediately apply the start values for operating hours counters.
   - Set the Bit 3 to 1 so that the start values for the operating hours counters are preset.
   - Set the Bit 7 to 0 so that the module **immediately** applies the start values after writing the data record.

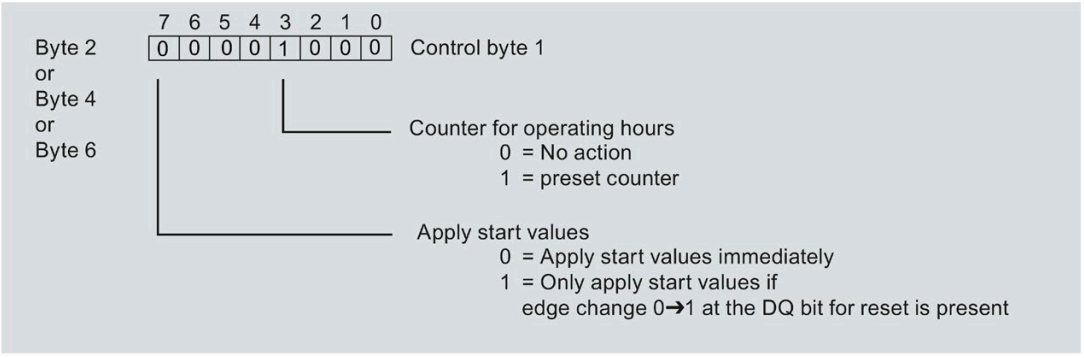


Figure 8-1 Allocation of the control bytes in DS 143 for operating hours

2. Transfer the data record with the WRREC instruction to the CPU.

8.2.3 Apply start values from data record DS 143 with DQ bit

Due to the differing lengths of the output data, setting of the start values for the operating hours counters depends on the configured module version.

Module versions with 20 bytes of output data

If you use module versions with 20 bytes of output data, you can:

- Apply start values for **all** operating hours counters.
- Apply start values for **individual** operating hours counters separately.

Module version with 2 bytes of output data

If you use the module version with 2 bytes of output data, apply the start values for **all** operating hours counters simultaneously.

Requirement

- In your STEP 7 project you have created a PLC data type that has an identical structure to data record DS 143 and have entered the start values.
- Set the Bit 3 to 1 so that the start values for the operating hours counters are preset.
- In control byte 1 of DS 143 you have set Bit 7 to "1" (apply start values via DQ bit). (see previous figure)
- You have transferred the data record DS 143 with new start values to the CPU. The assignment of the data record can be found in Structure for energy counters (DS 143) (Page 236)

Note

Pre-set start values for counters

If you have not yet transferred any start values to the CPU using the data record DS 143, then start the counters with the value 0.

Procedure for applying the start values of all operating hours counters

Applying the start values for all operating hours counters with the module versions with 2 bytes and 20 bytes of output data is identical.

1. Set the reset bit for operating hours counters (Bit 5) in Byte 1 in the output data.

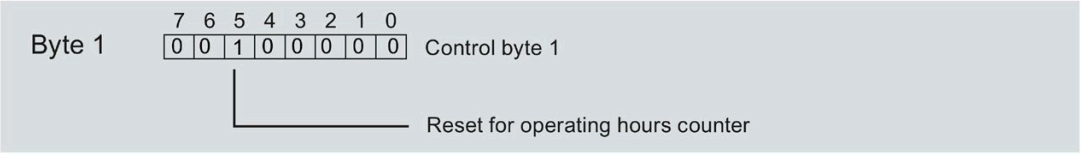


Figure 8-2 Control byte 1 Reset for all operating hours counters

If there is an edge change of the reset bit from 0 to 1, the module applies the start values for all operating hours counters.

Procedure for applying the start values of individual operating hours counters

Note

Applying the start values for phase-specific operating hours counters

Applying the start values for phase-specific operating hours counters does not differ from the procedure described above. In the output data, select the reset bits for the phase-specific operating hours counters in bytes 6, 8 and 10.

8.3 Starting and stopping operating hours counters

There are two ways of starting or stopping counting with the operating hours counter AI Energy Meter HF:

- Counting with gate

  The module starts counting when you set the DQ bit for the counter gate in the output data using an edge change from 0 -> 1. If you reset the DQ bit for the counter gate using an edge change from 1 -> 0, the counter stops.

- Counting without gate

  The module starts counting immediately as soon as the module is switched on. Counting cannot be stopped.

Both options are described in the following sections.

Counting with gate

Requirements:

The current value is higher than the configured "Low limit for measuring current in relation to nominal value current [0.1%]".

Procedure

If you wish to start counting using the gate, proceed as follows:

1. Activate the parameter "Enable operating hours counter gate" in the parameter assignment of the module.
2. Set the DQ bit for the counter gate (Bit 4) in control byte 1 in the output data.

The module starts counting as soon as there is an edge change from 0 -> 1 at the DQ bit for the counter gate.

If you wish to stop the counting again, then reset Bit 4 in control byte 1 in the output data. Counting stops at an edge change from 1 -> 0.

The "Enable operating hours counter gate" parameter and the DQ bit for the "counter date" behave like the parallel connection of contacts.

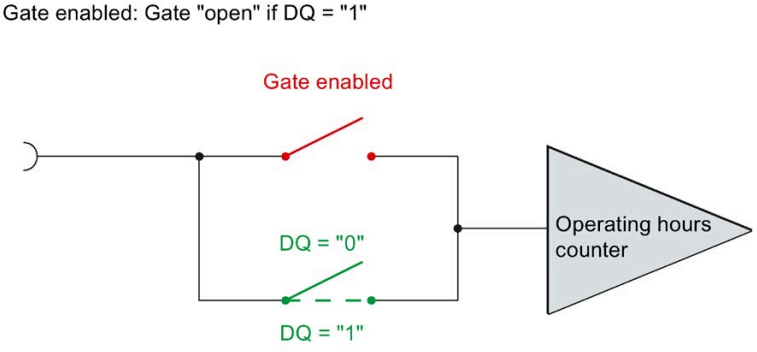


Figure 8-3 Gate enabled

Counting without gate

Requirement

The current value is higher than the configured "Low limit for measuring current in relation to nominal value current [0.1%]".

Procedure

Deactivate the parameter "Enable operating hours counter gate" in the parameter assignment of the module.

The module starts counting as soon as the data record has been applied by the CPU.

The counter continues to count.

Gate disabled: Gate is always "open" (signal path closed)

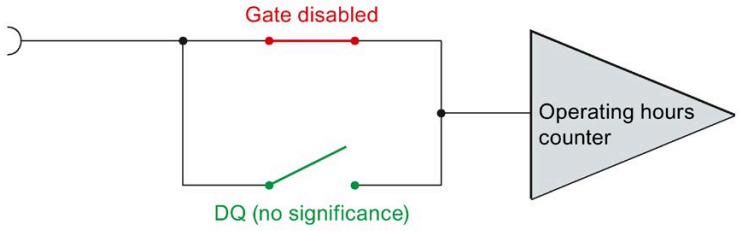


Figure 8-4 Gate disabled

Limit monitoring

9

9.1 How limit monitoring works

Introduction

The AI Energy Meter HF supports monitoring of parameterizable low **or** high limits for up to 16 analog measured or calculated variables.

You can also specify multiple limits for each measured or calculated variable, in order to define a high or low value range.

The measured value data record 150 returns the current status of limit violations and one counter per limit that displays the number of limit violations. In addition, a hardware interrupt may be generated for each limit violation.

The status of the limit violations can also be evaluated in the user data variant 240 ($F0_H$) or via the user-defined user data variant or the user-defined data record via the measured value ID 65509.

Benefits

With activated limit monitoring you can already detect any irregularities in the measured value acquisition already in field level.

Retentivity

All the counter states are stored retentively in the AI Energy Meter HF. After an interruption (e.g. Power System Off), the counting resumes with the retentively stored values.

Configuring

You configure the following limit monitoring settings in STEP 7:

- Measured variable that is to be monitored.
- Activate / Deactivate limit monitoring.
- Activate / deactivate gate limit monitoring.
- High or low limit values.
- Delay time and hysteresis for each limit.
- Activate / Deactivate hardware interrupts at limit violation.
- Measured value that is subject to limit monitoring.

Hardware interrupt at a limit violation

The hardware interrupt provides the following information:

- Measured value ID of the monitored measured or calculated variable
- Number of the limit (0 = Limit 1. 15 = Limit 16)
- Information on whether limit was exceeded or fallen below

For more detailed information, refer to section Hardware interrupts (Page 117).

Changing properties in RUN

The following table shows the supported control information:

Control information	Default value	Available in
Enable/disable monitoring per limit[1]	Disabled	Module version with 20 bytes of output data
Reset number of total limit violations	0	Module version starting at 2 bytes of output data

[1] Effective only with enabled gate

9.2 Influence of hysteresis and delay time on limit monitoring

Delay time and hysteresis

In order to prevent the triggering of limit violations with small fluctuations, you have the following configuration options in STEP 7:

- Delay time in seconds (0 to 10 s)

  With the delay time, you filter faults and thereby prevent limit value monitoring from triggering too frequently. The limit violation is counted only when the limit violation is present for longer than the configured delay time. The delay time is also taken into consideration with an outgoing limit violation, directly after a high or low limit has been violated in the permitted range. If the measured variable lies between limit violation and hysteresis after the limit violation has been corrected again, the delay time expires also without leaving the hysteresis.

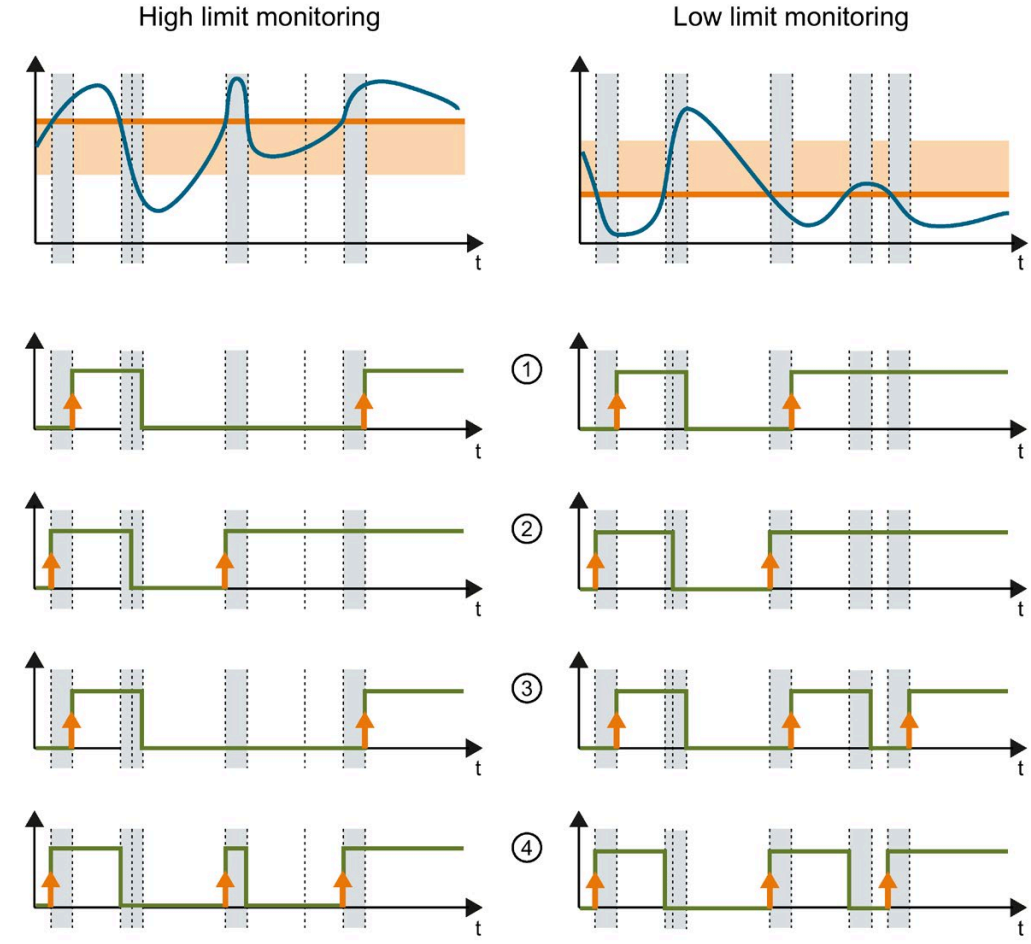
- Hysteresis as a percentage (0 to 20%)

  With the hysteresis, you suppress fluctuations around the limit. The hysteresis is a tolerance range that you define as a percentage deviation of the configured limit. The limit violation is considered to be corrected only when the monitored value leaves the tolerance range.

Note

You can get information about underflow and overflow from the calculation of minimum (Page 246) and maximum values (Page 241) of selected measured variables.

The following figure shows the value-over-time for two measured values using the example of a high and low limit as well as the influence of hysteresis and delay time on the counting of the limit violations.



- Configured limit.
- Configured delay time. Is taken into consideration during coming and going.
- Hysteresis range. Only considered for outgoing.
- Value-over-time for which the limit is monitored.
- Edge change. Counter for limit violations is incremented by 1. If parameterized, a hardware interrupt is triggered.
- Signal wave
- ① Limit monitoring with hysteresis and delay time
- ② Limit monitoring with hysteresis, but without delay time
- ③ Limit monitoring without hysteresis, but with delay time
- ④ Limit monitoring without hysteresis and delay time

Figure 9-1 Influence of hysteresis and delay time on the limit

See also

How limit monitoring works (Page 79)

9.3 Reset, activate and deactivate counters for limit violation

Introduction

At the beginning of a new work order, it can be useful to reset or also enable/disable the counters for limit violations of the AI Energy Meter HF.

Resetting here means that the counters for limit violations are reset to 0.

Due to the differing lengths of the output data resetting of the counters for limit violations depends on the configured module version.

Resetting at module version with 20 bytes of output data

1. Select the counters for limit violations that you want to reset in control bytes 3 and 4; see "Enabling/disabling the counters for limit violations".
2. In control byte 1, set the rest bit (bit 3) with an edge change from 0 to 1; see "Resetting the counters for limit violations".

Resetting for module version with 2 bytes of output data

Set the reset bit (Bit 3) in Control byte 1 from 0 to 1 through an edge change. Resetting acts globally on all the configured counters for limit violation.

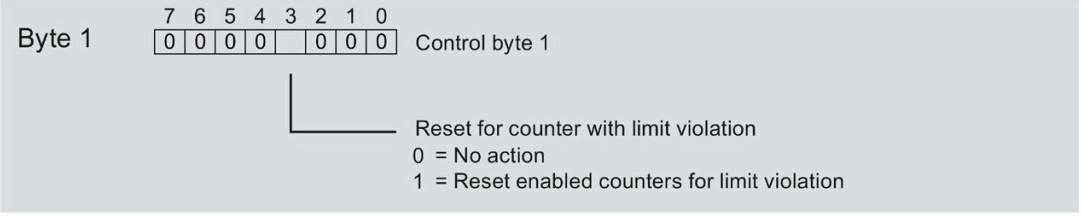


Figure 9-2 Resetting of the counters for limit violations

Activating / Deactivating counters for limit violations

Activating/deactivating of the counters for limit violations is only possible for module versions with 20 bytes of output data.

Requirements: "Gate for limit value monitoring" was parameterized during configuration of the module using STEP 7 or by writing the data record DS 128.

Select the counters for limit violations that you want to activate / deactivate in Control bytes 3 and 4.

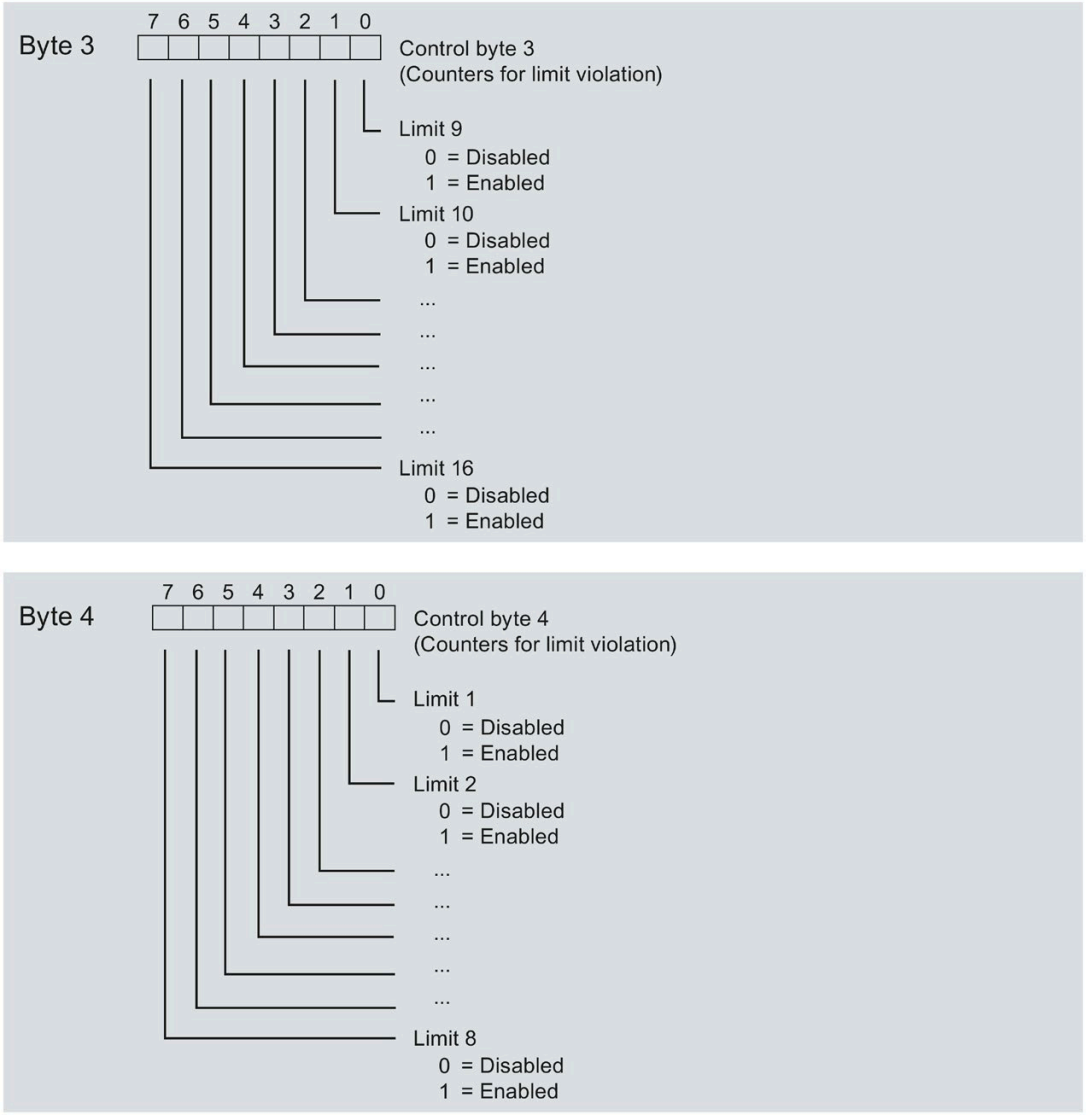


Figure 9-3 Activating / deactivating of the counters for limit violations

9.4 Measured variables for limit monitoring

You can use measured variables from the section Measured variables (Page 171) for limit value monitoring.

The value range of the parameter "Limit x" is -3.0E+09 ... +3.0E+09.

The table below shows you which measured variables are not available for limit monitoring.

Measured value ID	Measured variables
220	Active energy inflow L1L2L3 (Int32)
221	Active energy outflow L1L2L3 (Int32)
222	Reactive energy inflow L1L2L3 (Int32)
223	Reactive energy outflow L1L2L3 (Int32)
224	Apparent energy L1L2L3 (Int32)
225	Total active energy L1L2L3 (Int32)
226	Total reactive energy L1L2L3 (Int32)
61136	Neutral current maximum value
61137	Neutral current minimum value
62110	Active energy inflow L1 (Int32)
62111	Active energy outflow L1 (Int32)
62112	Reactive energy inflow L1 (Int32)
62113	Reactive energy outflow L1 (Int32)
62114	Apparent energy L1 (Int32)
62115	Total active energy L1 (Int32)
62116	Total reactive energy L1 (Int32)
62132	Voltage L1 instantaneous value
62135	Current L1 instantaneous value
62136	Fundamental cos φ active factor L1 (SINT8)
62210	Active energy inflow L2 (Int32)
62211	Active energy outflow L2 (Int32)
62212	Reactive energy inflow L2 (Int32)
62213	Reactive energy outflow L2 (Int32)
62214	Apparent energy L2 (Int32)
62215	Total active energy L2 (Int32)
62216	Total reactive energy L2 (Int32)
62232	Voltage L2 instantaneous value
62235	Current L2 instantaneous value
62236	Fundamental cos φ active factor L2 (SINT8)
62310	Active energy inflow L3 (Int32)
62311	Active energy outflow L3 (Int32)
62312	Reactive energy inflow L3 (Int32)
62313	Reactive energy outflow L3 (Int32)
62314	Apparent energy L3 (Int32)
62315	Total active energy L3 (Int32)
62316	Total reactive energy L3 (Int32)
62332	Voltage L3 instantaneous value
62335	Current L3 instantaneous value

Measured value ID	Measured variables
62336	Fundamental cos φ active factor L3 (SINT8)
65496	Power quality analysis qualifier
65497	Current module time
65500	Qualifier L1
65501	Qualifier L2
65502	Qualifier L3
65503	Qualifier L1L2L3
65508	Status of energy counter overflows
65509	Status of limit violations 1...16
66001	Voltage L1-N
66002	Voltage L2-N
66003	Voltage L3-N
66004	Voltage L1-L2
66005	Voltage L2-L3
66006	Voltage L3-L1
66007	Current L1
66008	Current L2
66009	Current L3
66010	Apparent power L1
66011	Apparent power L2
66012	Apparent power L3
66013	Active power L1
66014	Active power L2
66015	Active power L3
66016	Reactive power Qn L1
66017	Reactive power Qn L2
66018	Reactive power Qn L3
66019	Power factor λ L1
66020	Power factor λ L2
66021	Power factor λ L3
66030	Frequency (Uint8)
66031	Frequency (Uint16)
66034	Active power L1L2L3
66035	Reactive power Qn L1L2L3
66036	Apparent power L1L2L3
66037	Power factor λ L1L2L3
66038	Reactive power Qtot L1L2L3

Minimum and maximum values 10

10.1 Minimum and maximum values

Introduction

The AI Energy Meter HF determines the respective highest and lowest measured or calculated value for a series of measured and calculated values. The values are stored retentively in the module and can be read using measured value data records DS 144 (Page 241), DS 145 (Page 246), DS 154 (Page 243) and DS 155 (Page 248).

Benefits

Using the stored minimum and maximum values, for example, you can detect further irregularities in addition to limit monitoring.

Calculation of minimum and maximum values

Minimum and maximum values are only calculated for the phases in accordance with the configured connection type. Existing minimum and maximum values that have not been calculated are assigned initial values. If faults such as under or overcurrent occur during operation, new minimum and maximum values are calculated.

The measured and calculated values are initialized as follows during commissioning of the AI Energy Meter HF so that the first calculation of minimum and maximum values supplies a plausible result:

- Maximum values for measured and calculated values: Minimum values
- Minimum values for measured and calculated values: Maximum values

Minimum and maximum values are determined as "slave pointer procedures" from the start of calculation. Start is effective as of activation of the function or after a reset. The module uses the current actual value as the start value.

Output of the measurement values

For technical reasons, after plugging in or switching on the load voltage, the module returns the minimum and maximum values delayed by approx. 2 s.

Configuring

You configure the following settings in STEP 7:

- Enable calculation of minimum and maximum values
- Enable minimum and maximum value calculation gate

Changing properties in RUN

The following table shows the supported control information:

Control information	Default value	Available in
Reset saved maximum values	0	Module version starting at 2 bytes of output data
Reset saved minimum values	0	Module version starting at 2 bytes of output data

Note

Automatic reset

If you change the parameters for current or voltage transformers, the minimum and maximum values are reset automatically to their initial values.

10.2 Resetting minimum and maximum values

Description

At the beginning of a new work order, it may be useful to reset the minimum and maximum values of the AI Energy Meter HF. Resetting means that the minimum and maximum values are reset to their initial values. Initial values are described, see section Measured value data record for maximum values (DS 144) version 1 (Page 241), Measured value data record for minimum values (DS 145) version 1 (Page 246), Measured value data record for maximum values with time stamp (DS 154) (Page 243) and Measured value data record for minimum values with time stamp (DS 155) (Page 248).

Minimum and maximum values are only reset using a Reset via output data (DQ bit).

Due to the differing lengths of the output data resetting of the minimum and maximum values depends on the configured module version. If you use module versions with 20 bytes of output data, you can:

- Reset the minimum and maximum values for **all** phases.
- Reset minimum and maximum values for each **individual** phase.

If you use the module version with 2 bytes of output data, you always reset **all** the minimum and maximum values simultaneously.

Time stamps are set to initial values (01.01.1970, 0:00) on reset.

Procedure for module version with 20 bytes of output data

Resetting the minimum and maximum values for all 3 phases.

1. Select the categories of minimum and maximum value that you want to reset in byte 2.
   - Set bit 0 for voltage and frequency.
   - Set bit 1 for current and power factor.
   - Set bit 2 for active power.
   - Set bit 3 for reactive power.
   - Set bit 4 for apparent power.
   - Set bit 5 for active energy.
   - Set bit 6 for reactive energy.
   - Set bit 7 for apparent energy.

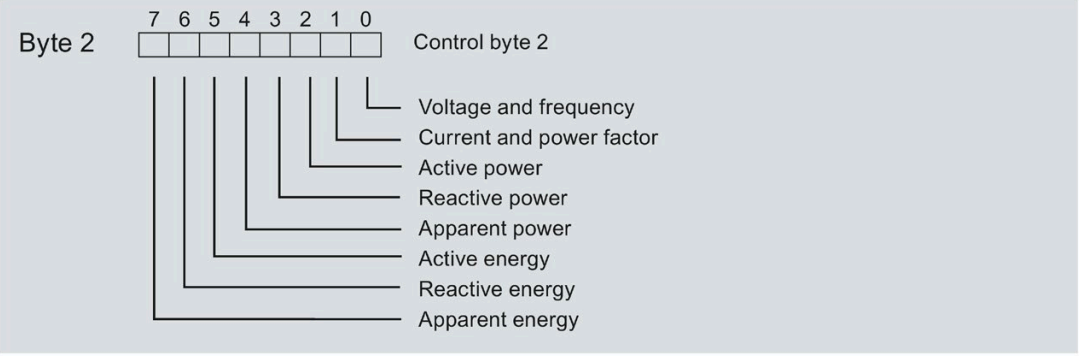


Figure 10-1 Selection of minimum and maximum value category

2. In Byte 1, set reset bit 0 for minimum values or reset bit 1 for maximum values.
   If there is an edge change of the reset bits from 0 to 1, the module resets the selected minimum or maximum values for all 3 phases that you previously selected in Byte 2.



Figure 10-2 Reset bit for minimum and maximum values

Resetting minimum and maximum values for phase-specific measurement

You can also reset the minimum and maximum values on a phase-specific basis using the output data.

Follow the procedure for "Resetting minimum and maximum values for all 3 phases" as applicable.

1. Select the categories of minimum and maximum value that you want to reset on a phase-specific basis.
   - In byte 7, set the bits for the category of minimum and maximum values in phase 1.
   - In byte 9, set the bits for the category of minimum and maximum values in phase 2.
   - In byte 11, set the bits for the category of minimum and maximum values in phase 3.
2. Set the reset bit (bit 0 and bit 1) for minimum or maximum values.
   - in byte 6 for phase 1
   - in byte 8 for phase 2
   - in byte 10 for phase 3

If there is an edge change of the phase-specific reset bits from 0 to 1, the module resets the minimum or maximum values for the given phase.

Procedure for module version with 2 bytes of output data

If you use the module version with 2 bytes of output data, you always reset **all** the minimum and maximum values simultaneously.

Set the reset bit (Bit 0 or Bit 1) in Control byte 1 from 0 to 1 through an edge change.



Figure 10-3 Resetting the minimum and maximum values at module version with 2 bytes of output data

10.3 Gate

Note

Module version with 2 bytes of output data

The gate is not available for the module version with 2 bytes of output data.

There are two ways of starting or stopping the calculation of the minimum and maximum values:

- Calculation of the minimum and maximum values with gate

  The module starts the calculation when you set the DQ bit for the gate in the output data (output data byte 1, bit 2 = "1") using an edge change from 0 -> 1. If you reset the DQ bit using an edge change from 1 -> 0, the calculation stops.

- Calculation of the minimum and maximum values without gate

  The module starts the calculation as soon as the module is started. The calculation cannot be stopped.

Both options are described in the following sections.

Calculation of the minimum and maximum values with gate

Procedure

If you wish to start calculating using the gate, proceed as follows:

1. Activate the parameter "Enable minimum and maximum value calculation" in the parameter assignment of the module.
2. Set the DQ bit of the gate for minimum and maximum value calculation (Bit 2) in control byte 1 in the output data.

The module starts calculating as soon as there is an edge change from 0 -> 1 at the DQ bit for the gate.

If you wish to stop the calculating again, then reset Bit 2 in control byte 1 in the output data. Calculating stops at an edge change from 1 -> 0.

The "Enable minimum and maximum value calculation" parameter and the DQ bit for the "gate" behave like the parallel connection of contacts.

Gate enabled: Gate "open" if DQ = "1"

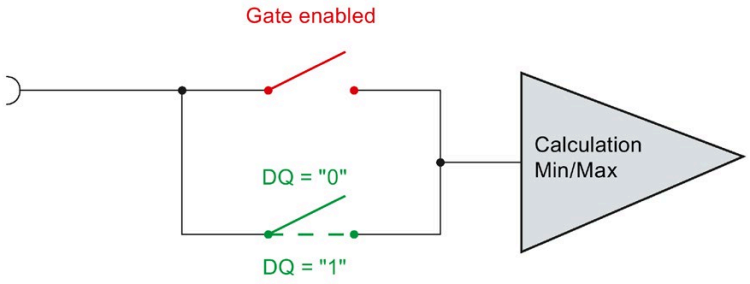


Figure 10-4 Gate enabled

Note

Module-global/phase-granular PLC

If you are using the gate control for all three phases simultaneously, use the control byte 1 at output address 1. For a phase-specific resolution of the gate control, use the addresses 6 (Phase1), 8 (Phase2) or 10 (Phase3) as control byte 1. The resolution of a module-global PLC overrules a phase-granular resolution.

Calculation of the minimum and maximum values without gate

Procedure

Deactivate the parameter "Enable minimum and maximum value calculation gate" in the parameter assignment of the module.

The module starts calculating as soon as the module is started. The calculating cannot be stopped.

Gate disabled: Gate is always "open" (signal path closed)

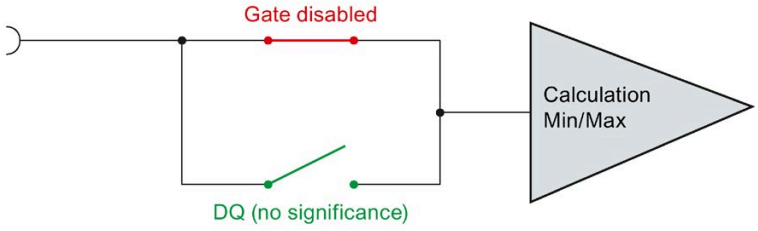


Figure 10-5 Gate disabled

Power quality analysis functions 11

Introduction

Power quality analysis functions are used as an aid to evaluate the quality of the supply network. In a three-phase system, many of these functions only make sense or can be executed if a functioning symmetrical three-phase supply system is available, the detection sensors of the three phases are identical in design and the nominal values current or voltage of the phases have the same values.

The AI Energy Meter HF provides you with the following power quality analysis functions in accordance with IEC 6100-4-30 for monitoring the power quality in your power network:

- Measure the neutral current
- Perform residual current analysis
- Determine active and power factor
- Carry out reactive power compensation
- Analyze fundamental values three-phase (voltage, current, power)
- Analyze the harmonics up to the 40th harmonic
- Determine the total harmonic distortion THD+N current/voltage for all three phases
- Detect voltage dip and voltage swell
- Detect overcurrent
- Detect peak value for current and voltage

The power quality analysis only returns useful results if some basic requirements are met. These include:

- Accuracy of the line frequency (50 Hz or 60 Hz) is maintained according to IEC 61557-12.
- Wiring was done correctly and the correct rotating filed is generated (see Notes for the detection of wiring errors and incorrect rotating field (Page 48)).

Delete the results of the power quality analysis

Delete the results of the power quality analysis by setting the corresponding bits in Byte 12 of the output range (Page 206) for at least 100 ms to "1".

Deletion has the following effects:

- Deletion of the result values and status bits for
  - Peak values of the instantaneous values for voltage and current
  - Overcurrent of the current half value
  - Voltage dip and voltage swell of the voltage half-wave value
- Any pending diagnostics "External fault" is deleted.

Harmonic

Harmonics are superimposed vibrations deviating from the fundamental frequency of the supply network (50 Hz or 60 Hz) with an integer multiple of the fundamental frequency. Harmonics are generated by equipment with a non-linear current–voltage characteristic such as transformers, gas discharge lamps and power electronics devices.

Harmonic component THD (Total Harmonic Distortion)

The THD defines the ratio of the power of the harmonics to the power of the fundamental and provides information about the power quality. The value is dimensionless and is stated as a percentage [%].

The AI Energy Meter HF returns THD+N (Noise) and considers the entire current signal (DS 163) or voltage signal (DS 161). Interference in the network is not filtered out.

Output of the measurement values

For technical reasons, after plugging in or switching on the load voltage, the module returns the following measured values delayed by approx. 2 s.

- Frequency
- Harmonic distortion THD+N current
- Harmonic distortion THD+N voltage

11.1 Power quality analysis status

Information about the power quality status can be found in the measured value "Power quality analysis qualifier" with the measured value ID 65496.

The bits 0 to 4 in byte 1 to 3 show in status "1" that information has been available since the last reset, which can be retrieved. The bits 5 to 7 in byte 1 to 3 in status "1" show that the event is currently active. If the event is not active, "0" is displayed.

The measured value "Network analysis qualifier" has the following structure:

Address	Content	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 0	Power quality analysis qualifier module	Reserved	Reserved	Status of harmonics analysis: 0_D: No data, no start 1_D ... 62_D: running 63_D: Completed, data is available					
Byte 1	Power quality analysis qualifier phase L1	**Overcurrent** Event currently active	**Voltage swell** Event currently active	**Voltage dip** Event currently active	**Overcurrent** Event occurred, data available	**Peak value current** Event occurred, data available	**Voltage peak** Event occurred, data available	**Voltage swell** Event occurred, data available	**Voltage dip** Event occurred, data available
Byte 2	Power quality analysis qualifier phase L2								
Byte 3	Power quality analysis qualifier phase L3								

11.2 Harmonics analysis

The AI Energy Meter HF can determine the effective values for current and voltage up to the 40th harmonic of the fundamental.

The harmonics of the voltage are stored in the data record DS 161 (Page 265).

The harmonics of the current are stored in the data record DS 163 (Page 268).

In addition, you can incorporate the results on IDs with the parameter data records DS 130/DS 131 (Page 165) in the user-defined user data and DS 135 (Page 168) in the user-defined data record DS 151 (Page 262).

The calculation of the harmonics takes several cycles. To determine whether calculation is completed, evaluate the Bits 0 to 5 in the power quality analysis data record DS 160 (Page 263) in Byte 218. If the value 63 is in the Bits 0 to 5, the calculation is completed and the measured values are available.

Note

While the calculation is in progress, you cannot read the data records DS 161 and DS 163.

Note

While the calculation is in progress, quick measured value acquisition (e.g. for controlling reactive-power compensation) is not possible.

Requirement

- The parameter "Power quality analysis function" is activated.
- The parameter "Analyse harmonics" for the corresponding phase must be released.

Voltage and current are always analyzed simultaneously for the enabled phases.

Control via data outputs

The harmonics analysis starts by setting the DQ bit 6 "Power quality analysis Start/Stop L1L2L3" in Byte 12 of the output data. The results of a previous analysis of harmonics are deleted in the process. Results of non-selected channels are "0". If channels which have not yet been analyzed are added, the data are not plausible at the start of the analysis.

If the DQ bit is reset during an ongoing analysis, the analysis stops.

11.3 Reactive power compensation

Use the power factor of the fundamental for the reactive power compensation.

When you activate the power quality analysis function, the power factor of the fundamental is available in the measured value data record DS 160 (Page 263) or in the user data.

See also

User data variants (Page 211)

11.4 Detection of residual current

For the residual current analysis (function "Tamper Detect" = Detection of unauthorized interventions), the total current must be determined:

Isum L1L2L3 (t) = IL1 (t) + IL2 (t) + IL3 (t)

The instantaneous residual current If is obtained by subtracting the results of the current neutral current In from the total current:

If = Isum L1L2L3 − In

Analysis starts immediately after parameter assignment. The measured value "Total current IL1+IL2+IL3-IN" (ID = 61153) returns the residual current. It is contained in DS 160, for example. You can monitor a threshold relevant for your application for a limit value (see function Limit monitoring (Page 79)).

Requirements

- "3P4W" or "3P4WI" is parameterized as the connection type.
- The same current transformers are connected to all three phases.
- The parameter "Reverse current direction" is parameterized identically for all three phases.
- The neutral current is parameterized with "Measuring".
- The residual current analysis is activated in the parameter assignment.

11.5 Active factor and power factor

The AI Energy Meter HF returns the active and power factor individually for each phase and as an aggregate.

Active factor

The active factor is defined as follows:

cos φ (active factor, signed, fundamental oscillation): cos φ = P1 / S1

φ = phase shift angle of fundamental oscillation

P1 = active power of fundamental oscillation

S1 = apparent power of fundamental oscillation

Power factor

The power factor λ = cos Φ is the ratio of active power (P) to the total apparent power (S) over the fundamental oscillation and all harmonics (total):

λ (power factor, unsigned, total): λ = cos Φ = |P| / S

11.6 Neutral current In

The module can measure or calculate the neutral current.

For measuring, you have to connect a current transformer to neutral. The behavior "measuring or calculating" can be set for each parameter. The main application of the measured value "Neutral current IN" (ID: 61149) are three-phase networks with existing 4th conductor, neutral: The neutral current usually shows incorrectly flowing currents. In an ideal three-phase network, the neutral current = 0.

An additional possible application is measuring any 4th current on this channel. Please note that in this case the measured value "Neutral current IN" displays this 4th current and not the actual neutral current.

Additional values in conjunction with the neutral current is set to 0.

The calculation of the neutral current and the comparison of calculated and measured neutral current (used for residual current analysis) is only possible in the operating modes "3P4W" and "3P4WI".

The determination of the neutral current is not subject to current suppression.

Parameter assignment options

If there a neutral in a connection type, the following parameters are available:

- Neutral current measurement deactivated
- Calculate the neutral current measurement
- Measure the neutral current measurement

If there is no neutral in a connection type, the following parameters are available:

- Do not use current channel
- Measure current channel

Display via channel LED

Neutral exists for connection type	calculate	measuring	Error	Channel LED
Yes	Yes	Yes	No	Green
Channel disabled	---	---	---	Off
No	No	Yes	No	Green

11.7 Monitoring the instantaneous or half-wave values

You can enable the following functions:

- Voltage swell (Page 123)
- Voltage dip (Page 125)
- Voltage peaks (Page 128)
- Current peak value (Page 135)
- Overcurrent value (Page 137)

The results are mapped in the phase-specific data records DS 147 (Page 252), DS 148 (Page 255) and DS 149 (Page 258) and in the power quality analysis data record DS 160 (Page 263).

In addition, you can incorporate the results using IDs in the measured value data record of the user-defined data record DS 151 (Page 262) and in the user data variants 1/2.

You can monitor the results for limits (Page 79) and generate hardware interrupts.

Phase-based measured values

12

Introduction

The AI Energy Meter HF makes the measured values of individual phases available.

- Through the user data variants
  - Phase-specific measurement Phase L1 with user data variants 158 ($9E_H$) and 159 ($9F_H$)
  - Phase-specific measurement Phase L2 with user data variants 156 ($9C_H$) and 157 ($9D_H$)
  - Phase-specific measurement Phase L3 with user data variants 154 ($9A_H$) and 155 ($9B_H$)
- Via measured value data records
  - Phase-specific measurement for the phases L1, L2 and L3 with data record 142
  - Phase-specific measurement for phase L1 with data record 147
  - Phase-specific measurement for phase L2 with data record 148
  - Phase-specific measurement for phase L3 with data record 149

User data variants

Through the user data variants 154 ($9A_H$) to 159 ($9F_H$) you can evaluate the following measured values for each phase of an AC / three-phase network:

- Quality information
- Current and voltage
- Active, reactive and apparent power
- Active, reactive and apparent energy
- Power factor

You can find the structure of the user data variants in appendix User data variants (Page 211).

Measured value data records

Through the measured value data records DS 142, DS 147, DS 148 and DS 149 you can evaluate the following measured values for each phase of an AC / three-phase network:

- Quality information
- Current and voltage
- Minimum current and minimum voltage
- Maximum current and maximum voltage
- Active, reactive and apparent power
- Minimum active, reactive and apparent power
- Maximum active, reactive and apparent power
- Active, reactive and apparent energy
- Power factor
- Minimum power factor
- Maximum power factor
- Harmonic distortion for voltage and current including minimum/maximum values
- Voltage dip
- Voltage swell
- Peak value for voltage and current
- Overcurrent value

You can find the structure of the measured value data records in appendix Measured value data record for phase-based measured values L1 (DS 147) version 1 (Page 253).

See also

Measured value data record for phase-based measured values L2 (DS 148) version 1 (Page 256)

Measured value data record for phase-based measured values L3 (DS 149) version 1 (Page 259)

Parameters 13

13.1 Parameters

Parameters of the AI Energy Meter HF

You will usually configure the AI Energy Meter HF with STEP 7 (TIA Portal, if necessary with HSP). In this case, STEP 7 (TIA Portal) checks the configured properties for plausibility during configuration.

You can also assign parameters to the module using a GSD file and STEP 7 or the configuration software of any provider. In this case, the module checks the validity of the configured properties only after the configuration has been downloaded. Note that some parameters depend on the selected connection type of the AI Energy Meter HF. For example in the connection type 1P2W for measurements in single-phase AC network it does not make sense to enter parameters for Phases 2 and 3. This is not checked by the system if the GSD file is used.

The effective range of the parameters that can be set using a GSD file depends on the type of bus system used:

- Distributed operation on PROFINET IO in an ET 200SP system
- Distributed operation with PROFIBUS DP in an ET 200SP system

In addition you can change the parameterized properties via the user program in RUN mode. When you assign parameters in the user program, the "WRREC" instruction transfers the parameters to the module using data records (see appendix Configuration via parameter data records (Page 147)).

The following table summarizes all the configurable parameters with STEP 7 (GSD file).

Table 13- 1 Parameters AI Energy Meter HF (GSD file)

Parameters	Value range	Default setting
Hardware interrupt	• Disable • Enable	Disable
Inputs		
Diagnostics: Missing supply voltage L+	• Disable • Enable	Disable
Connection type	• Disabled • 1P2W - 1 phase, 2 conductors • 3P4W - 3 phase current measurement, 4 conductors • 3P4W1, 3 phases, 4 conductors, balanced load • 3P4W - 3 phases, 4 conductors • 3x1P2W - 3 x 1 phase, 2 conductors each • 2P3W - 2 phases, 3 conductors • 3P3W, 3 phases, 3 conductors • 3P3W1, 3 phases, 3 conductors, balanced load	3P4W - 3 phases, 4 conductors
Voltage measuring range	• 100 V • 110 V • 115 V • 120 V • 127 V • 190 V • 200 V • 208 V • 220 V • 230 V • 240 V • 277 V	230 V
Line frequency	• 50 Hz • 60 Hz	50 Hz
Energy meter gate enabled	• Disable • Enable	Disable

Parameters	Value range	Default setting
End value energy meter	• No end value (infinite counting) • Count periodically to 10^3 • Count periodically to 10^6 • Count periodically to 10^9 • Count periodically to 10^{12} • Count periodically to 10^{15}	No end value (infinite counting)
User data variant	See the table Overview of the user data variants (Page 211)	Total power L1L2L3 (W#16#FE)
Minimum and maximum value calculation	• Disable • Enable	Disable
Minimum and maximum value calculation gate	• Disable • Enable	Disable
Power quality analysis functions	• Disable • Enable	Disable
Residual current analysis	• Disable • Enable	Disable
Neutral: Current transformer primary current [A]	• 0 = Disabled • 1 ... 99999 = measuring • 4294967295 = Calculating	0
Neutral: Current transformer secondary current [A]	• 1 • 5	1
Voltage dip limit value in relation to nominal value voltage [0.1%]	• 10 ... 1000	100
Voltage swell limit value in relation to nominal value voltage [0.1%]	• 10 ... 10000	100
Threshold overcurrent in relation to nominal value current [0.1%]	• 10 ... 60000	100
Number of cycles for voltage swell and dip analysis	• 4 ... 32767	10
Diagnostics power quality	• Disable • Enable	Disable
Diagnostics overflow current	• Disable • Enable	Disable
Diagnostics overflow voltage	• Disable • Enable	Disable
Diagnostics underflow voltage	• Disable • Enable	Disable
Diagnostics overflow cumulative values	• Disable • Enable	Disable

Parameters	Value range	Default setting
Detect voltage swell and dip	• Disable • Enable	Disable
Detect peak value current	• Disable • Enable	Disable
Detect peak value voltage	• Disable • Enable	Disable
Detect overcurrent	• Disable • Enable	Disable
Analyse harmonics	• Disable • Enable	Disable
Nominal value current [A]	• 0 ... 99999	1
Tolerance factor overcurrent in relation to nominal value current [0.1%]	• 10 ... 60000	100
Tolerance time overcurrent [ms]	• 0 ... 60000	40000
Low limit current measurement in relation to nominal value current [0.1%]	• 0 ... 200	10
Enable operating hours counter	• Disable • Enable	Disable
Enable gate of operating hours counter	• Disable • Enable	Disable
Current transformer primary current [A]	• 1 ... 99999 A	1 A
Current transformer secondary current	• 1 A • 5 A	1 A
Reverse current direction	• Disabled • Reverse current direction	Disabled
Nominal value voltage [V]	• 1 ... 999999	230 V
Tolerance factor overvoltage/undervoltage [0.1%]	• 10 ... 500	100
Voltage transformer primary voltage [V]	• 1 ... 999999 V	230 V
Voltage transformer secondary voltage [V]	• 1 ... 500 V	230 V
Limits		
Number of limits	• 0 ... 16	0
Limit monitoring	• Disable • Enable	Disable
Measured variable	• Measured value ID see Measured value data records (Page 230)	None

Parameters	Value range	Default setting
Enable limit monitoring gate	• Disable • Enable	Disable
Hardware interrupt	• Disable • Enable	Disable
Limit	• depending on the selected measured variable	0.0000
Type	• High limit • Low limit	High limit
Hysteresis for limit monitoring [0.1%]	• 0 ... 200 [0.1%]	1%
Delay time for limit monitoring [s]	• None • 1 ... 10 s	None
User data mapping I/II		
Number of measured values	• 0 ... 64	0
Measured variable	• Measured value ID see AUTOHOTSPOT	None
Data record mapping		
Number of measured values	• 0 ... 150 • 0 ... 125 with STEP 7 (TIA Portal) V15 with HSP0253	0
Measured variable	• Measured value ID see AUTOHOTSPOT	None

* Reconfiguration in RUN is not possible.

13.2 Description of parameters

Hardware interrupt

Enable the hardware interrupt for the entire module here.

Diagnostics: Missing supply voltage L+

Activate the diagnostics No supply voltage L+. If there is no voltage or too little voltage at terminal 17, the message "No supply voltage" is output and a diagnostic interrupt is triggered.

Connection type

Specify the connection type you used for the AI Energy Meter HF.

For more detailed information, refer to "Connection examples (Page 23)".

Voltage measuring range

Here you set the voltage measuring range in which the system connected to the AI Energy Meter HF works.

Line frequency

Here you set the line frequency in which the system connected to the AI Energy Meter HF works.

Enable gate energy counter

Enable the gate for the energy counter When the gate is enabled, the energy counter only counts when the corresponding output data bit (DQ bit) is set to "1".

End value energy counter

Select the end value for the periodic counting of the energy counter. You can also specify that the energy counter is to count without a full-scale value (infinite counting). The calculated energy counter values are stored retentively in the module.

User data variant

Select user data variant with which the module is to operate once it is started up.

Minimum and maximum value calculation

Enable calculation of the minimum and maximum values. The minimum and maximum value are calculated from the start of the measurement. The values determined are stored retentively in the AI Energy Meter HF together with the time stamp.

Minimum and maximum value calculation gate

Enable the gate for minimum and maximum value calculation. When the gate is enabled, the energy counter only counts when the corresponding output data bit (DQ bit) is set to "1".

Power quality analysis function

Enable the power quality analysis function for the entire module.

Residual current analysis

Enable the residual current analysis for the entire module. The residual current analysis is only available in the connection types 3P4W or 3P4WI and the concurrently activated parameter "Neutral current measurement".

Neutral current measurement

Defines whether the neutral current is measured or calculated.

This parameter does not apply to parameter assignment with GSD file.

Neutral conductor: Current transformer primary current [A]

To determine the current transformer ratio, enter the primary current. The transformer ratio is calculated from the primary and secondary current.

The following applies to parameter assignment with GSD file:

- 0 = Neutral function deactivated
- 1 ... 99999 = measure neutral current
- 4294967295 (0xFFFF) = calculate neutral current

Neutral conductor: Current transformer secondary current [A]

To determine the current transformer ratio, enter the secondary current. The transformer ratio is calculated from the primary and secondary current.

Voltage dip limit value in relation to nominal value voltage [0.1%]

Further information can be found under Voltage dip of the voltage half-wave value (Page 125).

Voltage swell limit value in relation to nominal value voltage [0.1%]

Further information can be found under Voltage swell of the voltage half-wave value (Page 123).

Threshold overcurrent in relation to nominal value current [0.1%]

Further information can be found under Overcurrent of the current half value (Page 137).

Number of cycles for voltage swell and dip analysis

Further information can be found under Voltage swell of the voltage half-wave value (Page 123) and Voltage dip of the voltage half-wave value (Page 125).

Diagnostics power quality

Depending on the enable of the individual functions the diagnostics are triggered when a voltage swell, voltage dip or overcurrent event has occurred.

Diagnostics overflow current

The measured current is monitored after expiry of the "Tolerance time" for "Overcurrent [0.1 A] tolerance value". Exceeding the value generates the diagnostics "overflow current".

Diagnostics overflow voltage

The nominal values voltage are monitored for tolerance. An overflow triggers a diagnostic interrupt.

Diagnostics underflow voltage

The nominal values voltage are monitored for tolerance. An underflow triggers a diagnostic interrupt.

Diagnostics overflow cumulative values

A cumulative overflow in the calculated variables is displayed. The values stop at the high or low limit. A violation triggers a diagnostic interrupt.

Detect voltage swell and dip

Activates the detection of voltage swell and dip. Further information can be found under Diagnostics: Overflow/underflow (Page 121).

Detect peak value current

Activates the detection of current peak values. Further information can be found under Peak values of the instantaneous values for current (Page 135).

Detect peak value voltage

Activates the detection of voltage peak values. Further information can be found under Peak values of the instantaneous values for voltage (Page 128).

Detect overcurrent

Activates the detection of overcurrent. Further information can be found under Overcurrent of the current half value (Page 137).

Analyse harmonics

Activates harmonics analysis

Nominal value current [A]

Enter the nominal value for the current. This is the "operating point" in your application.

Tolerance factor overcurrent in relation to nominal value current [0.1%]

Further information can be found under Diagnostics: Overload (Page 131).

Tolerance time overcurrent [ms]

Further information can be found under Diagnostics: Overload (Page 131).

Low limit current measurement in relation to nominal value current [0.1%]

The configurable low limit for measuring current refers to the nominal value and is used to avoid incorrect calculations in the case of very low currents. Incorrect measurements of very low currents in particular are a cause of inaccuracies in the current transformer used. Set the low limit for the current measurement to the required value depending on your process.

Note

Tip: If you want to find the low limit for the current measurement experimentally, set it to a lower value. Then, feed in a very precise low current and determine the measurement error that can no longer be tolerated. Afterwards, set the low limit for the current measurement to the limit value you have determined.

If current falls below the low limit for the current measurement, the following measured values and derived variables of the affected phase are reset.

- Effective current value
- Neutral current
- Active power
- Reactive power
- Apparent power
- Phase angle
- Power factor

A moving mean value is formed from the power values and they only become "0" after a corresponding time. The energy counters for active, reactive and apparent energy as well as the operating hours counters do not count any longer.

Further information can be found under Low limit for measuring current undershot (Page 133).

Enable operating hours counter

Enable the operating hours counter. The counting starts from the configurable low limit of the current measurement. The counter can be reset or pre-assigned using data record or output bit.

Enable gate of operating hours counter

Enable the gate for the operating hours counter. When the gate is activated, the operating hours counter only counts when the corresponding output data bit (DQ bit) is set to "1".

Current transformer primary current

Enter the nominal value for the primary current of the current transformer used. The transformer ratio is calculated from the primary and secondary current.

Current transformer secondary current

Enter the nominal value for the secondary current (1 A or 5 A) of the current transformer used. The transformer ratio is calculated from the primary and secondary current.

Reverse current direction

Setting to determine whether or not to reverse the direction of current.

In the event of inadvertent incorrect connection, this parameter can be used to correct the measured values, thus saving the hassle of rewiring. The direction of the current is only evident from the power measurement values. The current measurement value is an rms value.

Nominal value voltage [V]

Enter the nominal value for the voltage. This is the "operating point" in your application.

Tolerance factor overvoltage/undervoltage [0.1%]

Enter the tolerance factor overvoltage/undervoltage here in increments of 0.1%. You can find additional information under Diagnostics: Overflow/underflow (Page 121).

Voltage transformer primary voltage [V]

Enter the nominal value for the primary voltage of the voltage transformer used. The transformer ratio is calculated from the primary and secondary voltage.

Voltage transformer secondary voltage [V]

Enter the nominal value for the secondary voltage of the voltage transformer used. The transformer ratio is calculated from the primary and secondary voltage.

Number of limits

Enter the number of measured values that you want to monitor for limits.

Limit monitoring

Enable the monitoring of the limit for a freely definable measured value here. Limit violations are counted and the count values stored retentively.

Measured variable

Enter the measured value ID that you want to use for limit monitoring.

Enable limit monitoring gate

Enable the limit monitoring gate. When the gate is enabled, the limit monitoring is only started when the corresponding bit of the associated output user data is set to "1".

Hardware interrupt

Enable the hardware interrupt. The hardware interrupt is triggered if a high or low limit is violated. Without activation of a hardware interrupt, a limit violation is only displayed in the user data and in DS 150.

Limit

Enter the limit that is to trigger a limit violation when exceeded or fallen below. Limit violations are displayed in the user data and in DS 150.

Type

Select whether it is a high or low limit. Depending on this selection, the limit violation or hardware interrupt is triggered when a value exceeds (high limit) or falls below (low limit) the limit.

Hysteresis for limit monitoring [0.1%]

Enter the hysteresis for limit in percent.

The hysteresis band is below the high limit or above the low limit. The parameter in % refers to the configured limit. If a measured value fluctuates around the limit but does not leave the hysteresis band, a new limit violation is not triggered.

Delay time for limit monitoring [s]

Select the delay time for limit violation. The delay refers to the time that must elapse before an occurrence of a limit violation is reported. Faults can be filtered out by selection of the delay time. The deceleration time is also taken into consideration during outgoing of the limit violation.

Number of measured values

Specify the number of measured values/variables that you want to use for the user-specific user data mapping.

Measured variable

Select the measured variable (with the measured value ID) that you want to use for the user-specific user data mapping.

Number of measured values

Specify the number of measured values/variables that you want to use for the user-specific data record mapping.

Measured variable

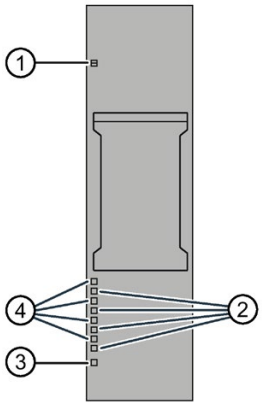
Select the measured variable (with the measured value ID) that you want to use for the user-specific data record mapping.

Interrupts/diagnostic alarms

14

14.1 Status and error display

LED display



① DIAG (green/red)
② Error (red)
③ PWR (green)
④ Status (green)

Figure 14-1 LED display

Meaning of the LED displays

The following table explains the meaning of the status and error displays. Remedial measures for diagnostic alarms can be found in the section Diagnostic alarms (Page 119).

DIAG LED

Table 14- 1 Meaning of the DIAG LED

DIAG	Meaning
Off	Supply voltage of the ET 200SP not OK
Flashes	Module not ready for operation (no parameters assigned)
On	Module parameters assigned and no module diagnostics
Flashes	Module parameters assigned and module diagnostics

Status LED

Table 14- 2 Meaning of the Status LED

Status	Meaning
Off	Channel disabled
On	Channel activated and no error

see also Neutral current In (Page 97)

Error LED

Table 14- 3 Meaning of the Error LED

Status	Meaning
Off	Channel is OK
On	Channel is faulty

PWR LED

Table 14- 4 Meaning of the PWR LED

PWR	Meaning
□ Off	Line voltage missing
■ On	Line voltage available

14.2 Interrupts

The analog input module AI Energy Meter HF supports hardware and diagnostic interrupts.

14.2.1 Hardware interrupts

Hardware interrupts

The module generates a hardware interrupt at the following events:

- Violation of low limit 1 to 16
- Violation of high limit 1 to 16

You can find detailed information on the event in the hardware interrupt organization block with the "RALARM" (read additional interrupt information) instruction and in the STEP 7 online help.

The module channel that triggered the hardware interrupt is entered in the start information of the organization block. The following figure shows the assignment of the local data double word 8 by the start information of the hardware interrupt organization block.

Note

When configuring with a GSD file, you operate the AI Energy Meter CT HF downstream of an S7-1500 CPU. For the correct OB start information to become visible for evaluation by the hardware interrupt, disable the optimized block access at the alarm OB.

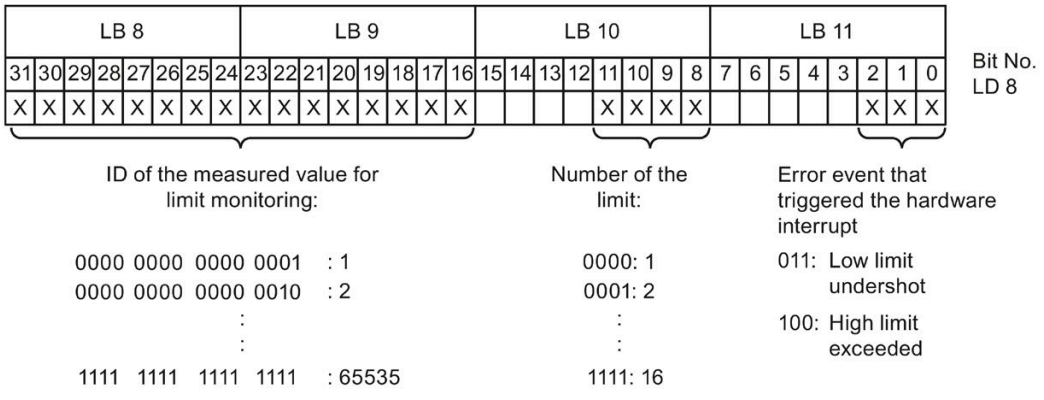


Figure 14-2 Start information of the organization block

14.2.2 Diagnostics interrupt

Diagnostic interrupt

The module generates a diagnostic error interrupt at the following events:

- Power quality
- Channel is temporarily unavailable
- Hardware interrupt lost
- Error
- Supply voltage missing
- Parameter assignment error
- Underflow voltage (tolerance for supply voltage) violated
- Overflow voltage (tolerance for supply voltage) exceeded
- Overload (current measurement > 12 A or tolerance overcurrent exceeded after expiry of the tolerance time)
- Overflow of the calculated values (measured or calculated values screen exceed the representable range of values)

14.3 Diagnostic alarms

Note

Assignment channel in diagnostic message ⇔ Phase

In the diagnostic messages the channels are counted from Channel "0" on, in the AI Energy Meter HF from phase "1" on.

Note the following assignment:

- Channel "0" ⇔ Phase "1"
- Channel "1" ⇔ Phase "2"
- Channel "2" ⇔ Phase "3"

Table 14- 5 Error types

Diagnostic message	Error code	Meaning	Solution
Undervoltage	2H	Line voltage (measuring range) is monitored for tolerance. Violation leads to voltage overflow/underflow	Observe the line voltage range
Overvoltage	3H		
Overload	4H	• The measured current is monitored after the "Tolerance time" for "Tolerance value overcurrent [0.1A]" has expired. Exceeding this results in overflow current. • The maximum value of the secondary current (12 A) has been exceeded.	Observe the current range
Error	9H	Internal module error (diagnostic alarm on channel 0 applies to the entire module).	Replace the module
Parameter assignment error	10H	• The module cannot evaluate parameters for the channel. • Incorrect parameter assignment.	Correct the parameter assignment
Load voltage missing	11H	Missing or insufficient line voltage at terminal 17	Check supply
External fault	1AH	Voltage swell/dip and overcurrent	see: • Voltage swell of the voltage half-wave value (Page 123) • Voltage dip of the voltage half-wave value (Page 125) • Overcurrent of the current half value (Page 137)
Channel is temporarily unavailable	1FH	Firmware upgrade is being performed. Channel 0 applies to the entire module. The module is currently not performing any measurements.	--
		A user calibration is being executed at the channel.	Complete the user calibration

14.4 Diagnostics response

Diagnostics response

This section describes the response of the AI Energy Meters HF when diagnostics information is reported.

Measured values in the case of diagnostics

Even in the case of diagnostics, measured values continue to be displayed as long as they can still be acquired. If measured values cannot be measured or calculated, "0" is displayed.

Low limit for current measurement undershot (zero suppression)

If the supplied current is less than the configured "Low limit for current measurement" parameter, the current measurement and all dependent variables are suppressed and set to "0".

If current falls below the low limit for the current measurement, the following measured values and derived variables of the affected phase are reset.

- Effective current value
- Active power
- Reactive power
- Apparent power
- Phase angle
- Power factor

A moving mean value is formed from the power values and they only become "0" after a corresponding time. The energy meters for active, reactive and apparent energy as well as the operating hours counters do not count any longer.

If the secondary current fed in at the channel is higher than 12 A, the module changes to limitation and the current measured value of the current and all dependent variables are set to "0".

Input data to "0"

If the AI Energy Meter HF is no longer recognized by the interface module (for example, because it is defective or not plugged in), all input data are set to "0".

14.4.1 Voltage diagnostics

14.4.1.1 Diagnostics: Overflow/underflow

Introduction

You use the parameter "Tolerance factor overvoltage/undervoltage" to define a tolerance range around the set nominal value voltage at the operating point. If the effective value of the primary voltage exceeds this tolerance range, the module reports the diagnostics "overflow" or "underflow".

Calculation of tolerance value measuring voltage

The tolerance value measuring voltage is calculated with the following formula:

Tolerance value measuring voltage = "Nominal value voltage" ± ("Tolerance factor overvoltage/undervoltage [%]" × "Nominal value voltage")

The "Nominal value voltage" is the primary voltage at the operating point.

Parameter assignment

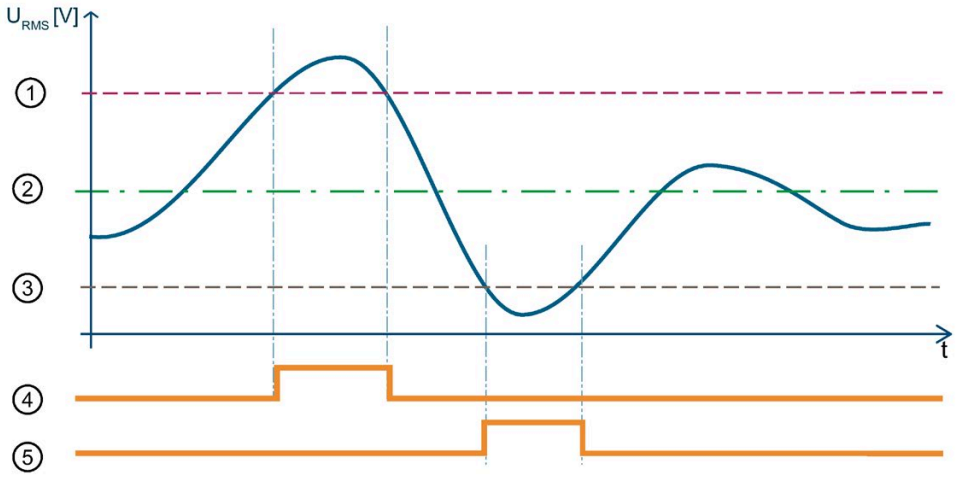
The following table shows the necessary parameters:

Table 14- 6 Parameter assignment

Parameter	
Power quality analysis functions	Enable
Diagnostics overflow	Enable
Diagnostics underflow	Enable
Nominal value voltage	1 ... 999999 V
Voltage transformer primary voltage	1 ... 999999 V
Voltage transformer secondary voltage	1 ... 500 V
Tolerance factor overflow/underflow	10 ... 50%

Example

The following figure is a schematic diagram of the principle of operation:



① Upper tolerance value measuring voltage
② Nominal voltage
③ Lower tolerance value measuring voltage
④ Diagnostics "overflow"
⑤ Diagnostics "underflow"

Figure 14-3 "Overflow/Underflow" diagnostics of the effective voltage value

The following table shows the parameter assignment for the example:

Table 14- 7 Parameter assignment

Parameter	
Power quality analysis functions	Enable
Diagnostics overflow	Enable
Diagnostics underflow	Enable
Nominal value voltage	230 V
Voltage transformer primary voltage	1000 V
Voltage transformer secondary voltage	500 V
Tolerance factor overflow/underflow	20%

In this example you define a tolerance range of ± 20%. The tolerance range corresponds to an effective value of primary voltage of ± 46 V.

In the figure the effective value of the primary voltage first exceeds the tolerance range. As long as the effective value of the primary voltage exceeds the tolerance range the module reports the diagnostics "overflow".

The effective value of the primary voltage then exceeds the tolerance range. As long as the effective value of the primary voltage exceeds the tolerance range the module reports the diagnostics "underflow".

14.4.1.2 Voltage swell of the voltage half-wave value

Introduction

Voltage swells are short-term increases in the line voltage which can occur, for example, when switching off large consumers.

With the parameter "Number of cycles for analysis" you define how many measuring cycles the voltage swell must apply at until the module reports the voltage swell. The module reports the diagnostics "Power quality". The module also sets the qualifier bit 6 for the respective phase in data record DS 160 (Page 263). If the voltage lies below the limit for voltage swell again, the module sets the diagnostics "Power quality" again and resets the qualifier bit 6 again.

The AI Energy Meter HF returns the maximum value and the duration of the voltage swell, e.g. in data record 160. The duration is determined exactly to ± 2 cycles.

In the event of voltage swell again, only the diagnostics "Power quality" is reported again and the duration, and if applicable, the maximum voltage swell value is updated.

For technical reasons, if the process value for the voltage goes to "0", then the module shows a slightly longer time for a voltage swell.

Calculation of voltage swell limit value

The Voltage swell limit value is the value from which level of voltage the AI Energy Meter HF recognizes a voltage swell.

The "Voltage swell limit value" is calculated by the following formula:

Voltage swell limit = "Nominal value voltage" + ("Voltage swell limit [%]" × "Nominal value voltage")

The "Nominal value voltage" is the primary voltage at the operating point.

Parameter assignment

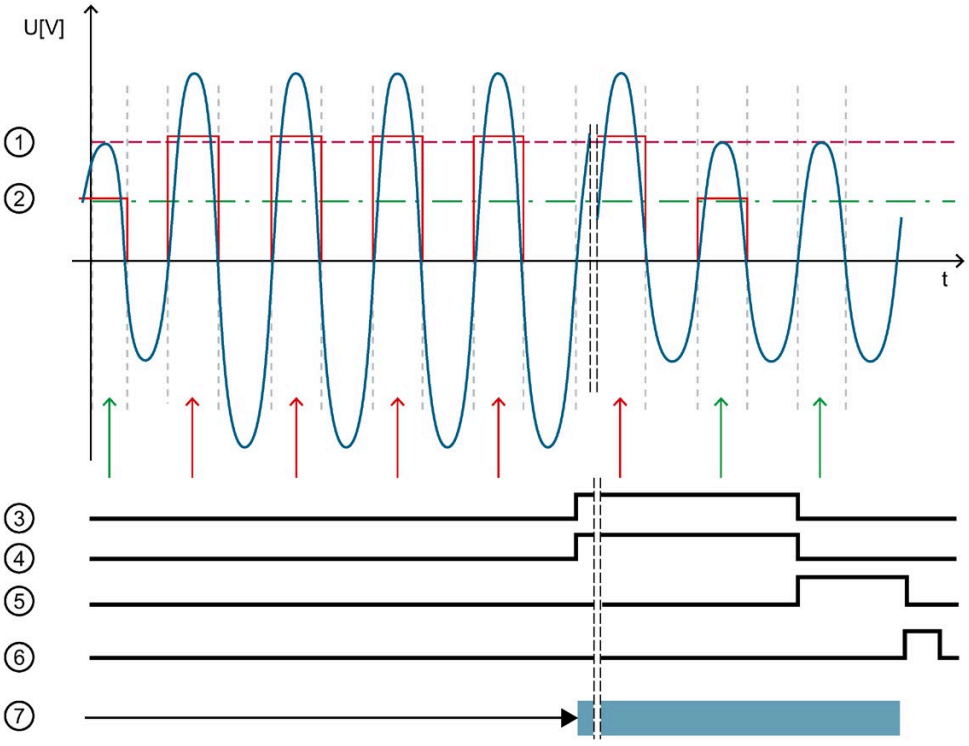
The following table shows the necessary parameters:

Table 14- 8 Parameter assignment

Parameter	
Power quality analysis functions	Enable
Number of cycles for analysis	4 ... 32767
Diagnostics power quality	Enable
Determination of voltage swell and dip	Enable
Nominal value voltage	1 ... 999999 V
Voltage swell limit	1 ... 1000%

Example

The following figure is a schematic diagram of the principle of operation:



① Voltage swell limit
② Nominal voltage
③ Diagnostics "power quality"
④ Qualifier Bit 6
⑤ Status "Power quality voltage swell"
⑥ Bit "Reset status "power quality""
⑦ Min. voltage swell (half-wave) and duration can be read

Figure 14-4 Example of principle of operation

The following table shows the parameter assignment for the example:

Table 14- 9 Parameter assignment

Parameter	
Power quality analysis functions	Enable
Number of cycles for analysis	4
Diagnostics power quality	Enable
Determination of voltage swell and dip	Enable
Nominal value voltage	230 V
Voltage swell limit	20%

If the module detects that the "Voltage swell limit value" has been exceeded:

- The module reports the diagnostics "Power quality" from "Number of cycles for analysis" as long as there is a voltage swell.
- The module sets the qualifier bit 6 from "Number of cycles for analysis" as long as there is a voltage swell.
- After the module has reset the diagnostics "Power quality" and reset the qualifier bit again, Bit 1 is set.

As long as Bit 1 is set, the module returns the maximum value and the duration of the voltage swell, e.g. in data record 160.

You reset Bit 1 with the bit "reset status "power quality"".

14.4.1.3 Voltage dip of the voltage half-wave value

Introduction

Voltage dips are short-term decreases in the line voltage which can occur, for example, when switching on large consumers.

With the parameter "Number of cycles for analysis" you define how many measuring cycles the voltage dip must be present until the module reports the voltage dip. If the voltage lies above the "Voltage dip limit" again, the module sets the diagnostics "Power quality" and resets the qualifier bit 5 again.

The AI Energy Meter HF returns the maximum value and the duration of the voltage dip, e.g. in data record DS 160 (Page 263). The duration is determined exactly to ± 2 cycles.

In the event of voltage dip, the module reports a "Power quality" diagnostic. The module also sets the qualifier bit 5 for the respective phase in data record DS 160. In the event of voltage dip again, only the "Power quality" diagnostics is reported again and the duration, and if applicable, the minimum voltage dip value is updated.

For technical reasons, if the process value for the voltage goes to "0", then the module shows a slightly longer time for a voltage dip.

Calculation of voltage dip limit

The voltage dip limit is the value from which level of voltage the AI Energy Meter HF detects a voltage dip.

The voltage dip limit is calculated by the following formula:

Voltage dip limit = "Nominal value voltage" - ("Voltage dip limit [%]" × "Nominal value voltage")

The "Nominal value voltage" is the primary voltage at the operating point.

Parameter assignment

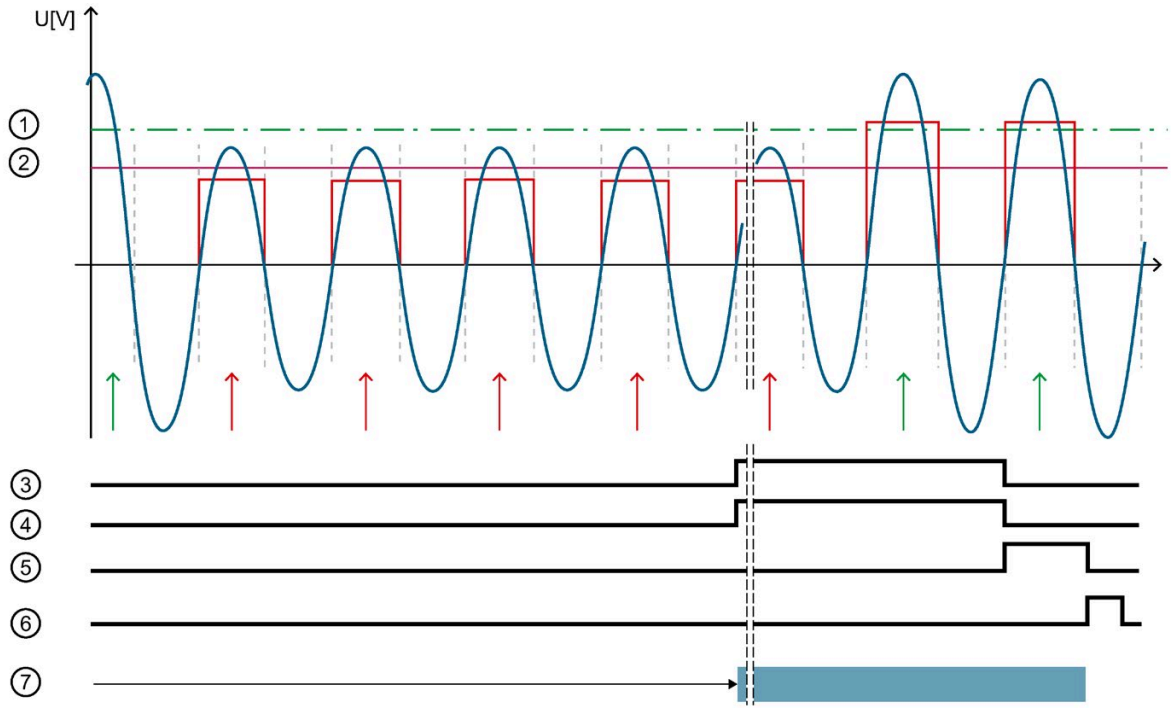
The following table shows the necessary parameters:

Table 14- 10 Parameter assignment

Parameter	
Power quality analysis functions	Enable
Number of cycles for analysis	4 ... 32767
Diagnostics power quality	Enable
Determination of voltage swell and dip	Enable
Nominal value voltage	1 ... 999999 V
Voltage dip limit	1 ... 100%

Example

The following figure is a schematic diagram of the principle of operation:



① Nominal voltage
② Voltage dip limit
③ Diagnostics "power quality"
④ Qualifier Bit 0
⑤ Status "Power quality voltage dip"
⑥ Bit "Reset status "power quality""
⑦ Min. voltage dip (half-wave) and duration can be read

Figure 14-5 Example of principle of operation

The following table shows the parameter assignment for the example:

Table 14- 11 Parameter assignment

Parameter	
Power quality analysis functions	Enable
Number of cycles for analysis	4
Diagnostics power quality	Enable
Determination of voltage swell and dip	Enable
Nominal voltage	230 V
Voltage dip limit	50%

If the module detects that the "Voltage dip limit" has been undershot:

- The module reports the diagnostics "Power quality" from "Number of cycles for analysis" as long as there is a voltage dip.
- The module sets the qualifier bit 5 from "Number of cycles for analysis" as long as there is a voltage dip.
- After the module has reset the diagnostics "Power quality" and reset the qualifier bit again, bit 0 is set.

As long as bit 0 is set, the module returns the minimum value and the duration of the voltage dip, e.g. in data record 160.

You reset Bit 0 with the bit "Reset status "power quality"".

14.4.1.4 Peak values of the instantaneous values for voltage

Introduction

The AI Energy Meter HF determines the maximum instantaneous value for the voltage for up to three phases.

The function "Detect peak value voltage" returns the largest voltage value and the associated phase. The module sets the qualifier bit 2 ("Power quality voltage peak") for the phase in question. You can read the maximum voltage value, for example, in the data record DS 160 (Page 263).

Voltage peak detection is based on the function for recording swells of the supply voltage in accordance with IEC 61000-4-30. This function is used to record the maximum voltage value in the supply network. In three-phase systems this function is only useful if the system is symmetrical and when all phases show the same voltage transformers.

Accordingly, measurement always records only the peak value over all phases. In addition to the requirements of IEC 61000-4-30, the phase on which the peak value voltage occurred is detected.

For metrological reasons, only the phase concerned that shows this maximum value can be returned. This might mean that the maximum voltage values of the other phases remain "0". With a "reset power quality analysis" the analysis starts afresh and the current results are discarded.

Peak value detection of voltage

For technical reasons, both the "Detect peak value current" and "Detect peak value voltage" functions are activated at the same time internally to ensure the correct evaluation of the peak value detection of the voltage of a phase.

The AI Energy Meter HF always shows the phase that exhibits the highest instantaneous value for voltage respectively.

If peak values are displayed for several phases, you can correlate the available phase values to determine the maximum value of the module.

Peak value detection of the instantaneous values of voltage only works when the module is correctly connected to the corresponding phases selected for the connection type.

- For connection type 1P2W only phase 1 should be connected.
- For connection type 2P3W only the phases 1 and 2 should be connected.

Parameter assignment

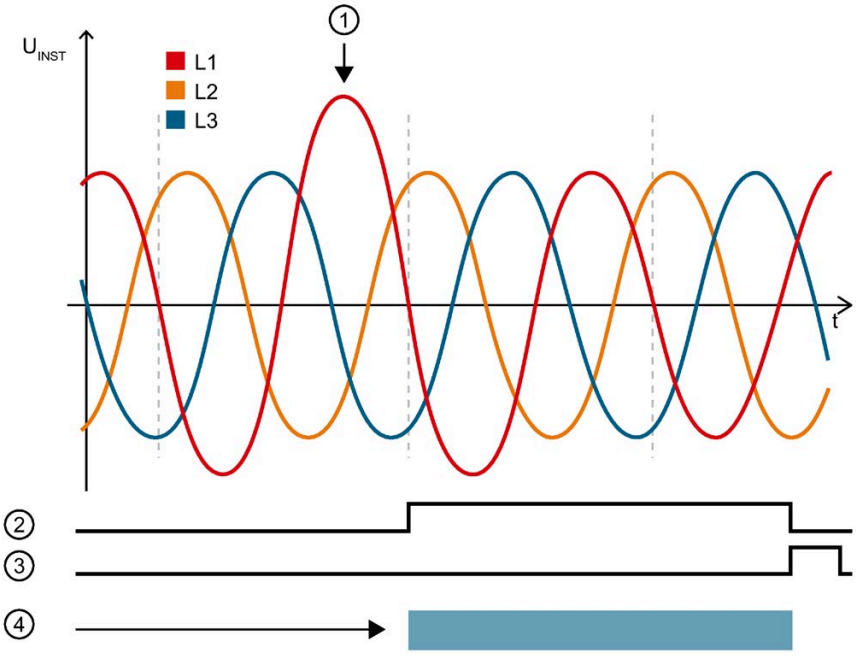
The following table shows the necessary parameters:

Table 14- 12 Parameter assignment

Parameter	
Power quality analysis function (module)	Enable
Determine peak value voltage (channel)	Enable

Example

The following figure is a schematic diagram of the principle of operation:



① Voltage peak in L1
② Status "Power quality voltage peak"
③ Bit "Reset status "power quality""
④ Max. voltage peaks instantaneous value can be read out

Figure 14-6 Example of principle of operation

The following table shows the parameter assignment for the example:

Table 14- 13 Parameter assignment

Parameter	
Power quality analysis functions	Enable
Determination of voltage peak value L1	Enable
Determination of voltage peak value L2	Enable
Determination of voltage peak value L3	Enable

The module detects the voltage peak in phase 1 and sets the qualifier bit 2 for phase 1. You can find the maximum voltage value, for example, in the data record DS 160 in bytes 174 to 177 ("Voltage peak value L1").

14.4.2 Current diagnostics

14.4.2.1 Diagnostics: Overload

Introduction

As long as one of the following conditions is met, the module reports the diagnostics "Overload" for each phase:

- If the tolerance value measured current parameterized for each phase is exceeded for the tolerance time overcurrent parameterized for each phase.
- If the maximum measured current of the AI Energy Meters HF is exceeded:
  - Secondary measured current: 12 A

Calculation of tolerance value measured current

The tolerance value measured current is calculated with the following formula:

Tolerance value measured current = "Nominal value current" + ("Tolerance factor overcurrent [%]" × "Nominal value current")

The "Nominal value current" is the primary current at the operating point.

Parameter assignment

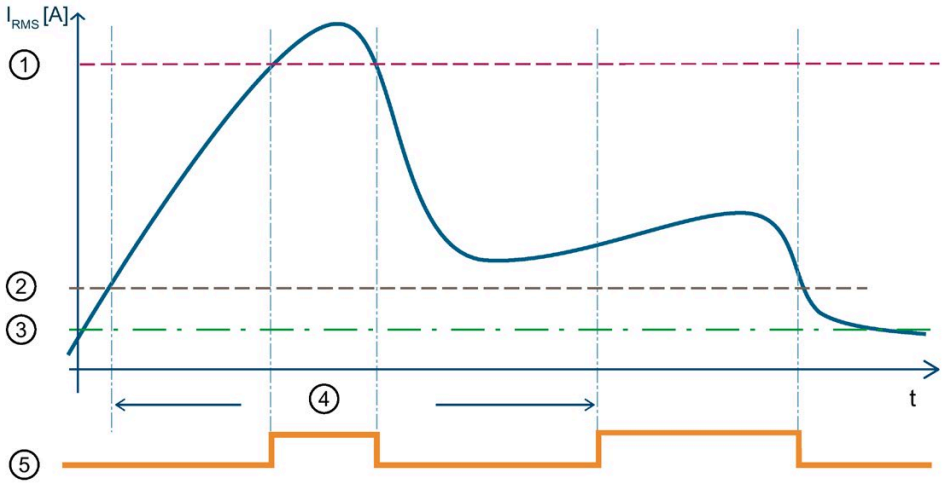
The following table shows the necessary parameters:

Table 14- 14 Parameter assignment

Parameter	
Diagnostics overload	Enable
Nominal value current	0 ... 99999 A
Current transformer primary current	1 ... 99999 A
Current transformer secondary current	5 A
Tolerance factor overcurrent	1 ... 6000%
Tolerance time overcurrent	0 ... 60000 ms

Example

The following figure is a schematic diagram of the principle of operation:



① Maximum measured current 12 A secondary current (CT) or 424 mV secondary voltage (RC)
② Tolerance value measured current
③ Nominal value current
④ Tolerance time
⑤ Diagnostics "overload"

Figure 14-7 Diagnostics "overload" of the effective current value

The following table shows the parameter assignment for the example:

Table 14- 15 Parameter assignment

Parameter	
Diagnostics overload	Enable
Nominal value current	2000 A
Current transformer primary current	5000 A
Current transformer secondary current	5 A
Tolerance factor overcurrent	20%
Tolerance time overcurrent	40000 ms

If the maximum measured current for the module (12000 A primary current) is exceeded, the module reports the diagnostics "Overload" as long as the maximum measured current is exceeded.

After the "Tolerance time overcurrent" of 40000 ms has expired, the module reports the diagnostics "Overload" as long as the configured "Tolerance value measured current" is exceeded.

14.4.2.2 Low limit for measuring current undershot

Introduction

With the function "Low limit for measuring current undershot" the AI Energy Meter HF monitors the low limit of the effective value of the current per phase.

If the low limit for measuring current is undershot, the module sets the current value to 0. Information as to which current measured values are set to 0 can be found under Basics for reading measured values (Page 41).

You activate the function by setting the parameter "Low limit for measuring current" > 0%.

Calculation of low limit for measuring current

The low limit for measuring current is calculated with the following formula:

Low limit measured current = "Nominal value current" × "Low limit for measuring current [%]"

The "Nominal value current" is the primary current at the operating point.

Parameter assignment

The following table shows the necessary parameters:

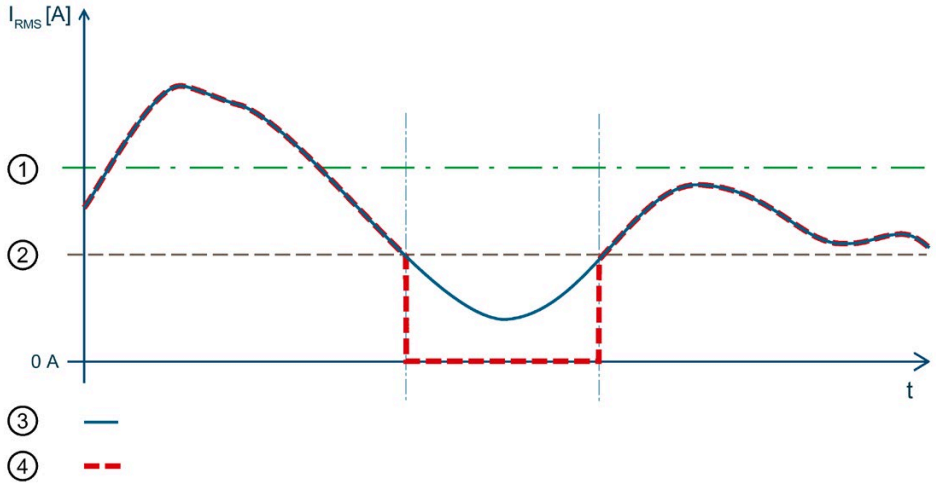
Table 14- 16 Parameter assignment

Parameter	
Nominal value current	0 ... 99999 A
Current transformer primary current	1 ... 99999 A
Current transformer secondary current	1 ... 16000 A
Low limit for current measurement	0 ... 20% *

* 0% means deactivation of the function

Example

The following figure is a schematic diagram of the principle of operation:



① Nominal current
② Low limit measured current
③ Measured value
④ Returned value

Figure 14-8 Behavior in the event of value falling below "Low limit for measuring current undershot"

The following table shows the parameter assignment for the example:

Table 14- 17 Parameter assignment

Parameter	
Nominal value current	2000 A
Current transformer primary current	5000 A
Current transformer secondary current	5 A
Low limit for current measurement	10%

In this example you define the "Low limit for measuring current" with 10%. This corresponds to an effective value of the primary voltage of 200 A.

If the value falls below the calculated low limit for current measurement, the module sets all current-dependent measured values (effective value current, active power, reactive power, apparent power, phase angle and power factor) to 0 A until the low limit for measuring current is exceeded again. The energy meters and operating hours counters are stopped during this time.

14.4.2.3 Peak values of the instantaneous values for current

Introduction

The AI Energy Meter HF determines the maximum instantaneous value for the current for up to three phases.

The function "Detect peak value current" returns the largest current value and the associated phase. The module sets the qualifier bit 3 ("Power quality current peak") for the phase in question. You can read the maximum current value, for example, in the data record DS 160 (Page 263).

Current peak detection is based on the function for recording swells of the supply voltage in accordance with IEC 61000-4-30. This function is used to record the maximum current value in the supply network. In three-phase systems this function is only useful if current recording is symmetrical and if all phases show the same current transformers.

Accordingly, measurement always records only the peak value over all phases. In addition to the requirements of IEC 61000-4-30, the phase on which the peak value current occurred is detected.

For metrological reasons, only the phase concerned that shows this maximum value can be returned. This might mean that the maximum current values of the other phases remain "0". With a "reset power quality analysis" the analysis starts afresh and the current results are discarded.

Peak value detection of current

For technical reasons, both the "Detect peak value current" and "Detect peak value voltage" functions are activated at the same time internally to ensure the correct evaluation of the peak value detection of the current of a phase.

The AI Energy Meter HF always shows the phase that exhibits the highest instantaneous value for current respectively.

If peak values are displayed for several phases, you can correlate the available phase values to determine the maximum value of the module.

Peak value detection of the instantaneous values of current only works when the module is correctly connected to the corresponding phases selected for the connection type.

- For connection type 1P2W only phase 1 should be connected.
- For connection type 2P3W only the phases 1 and 2 should be connected.

Parameter assignment

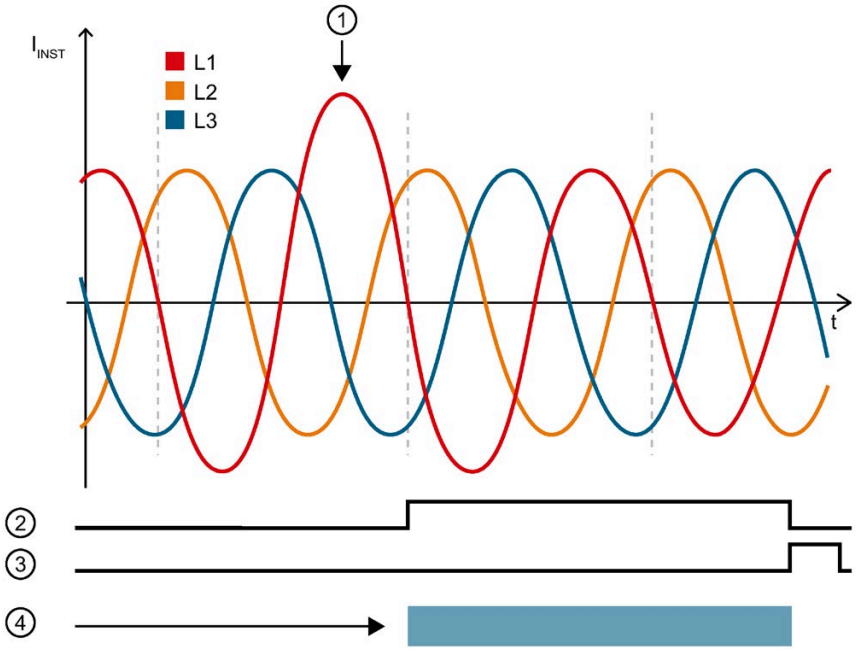
The following table shows the necessary parameters:

Table 14- 18 Parameter assignment

Parameter	
Power quality analysis function (module)	Enable
Determine peak value current (Channel)	Enable

Example

The following figure is a schematic diagram of the principle of operation:



① Current peak in L1
② Status "Power quality current peak"
③ Bit "Reset status "power quality""
④ Max. current peaks instantaneous value can be read out

Figure 14-9 Example of principle of operation

The following table shows the parameter assignment for the example:

Table 14- 19 Parameter assignment

Parameter	
Power quality analysis function	Enable
Determine peak value current (L1)	Enable
Determine peak value current (L2)	Enable
Determine peak value current (L3)	Enable

The module detects the peak value current in phase 1 and sets the qualifier bit 3 for phase 1. You can find the maximum current value, for example, in the data record DS 160 in bytes 186 to 189 ("Current peak value L1").

14.4.2.4 Overcurrent of the current half value

Introduction

The AI Energy Meter HF returns the maximum overcurrent value of the current half-wave value. If the value to be monitored is exceeded, the module reports the diagnostics "Power quality" and the qualifier bit 7 is set. The module also sets Bit 4 for the respective phase in data record DS 160 (Page 263). In the event that the current half-value is exceeded again, only the diagnostics "Power quality" is reported again and, if applicable, the maximum current swell value is updated.

Calculation of overcurrent limit

The overcurrent limit is calculated based on the following formula:

Overcurrent limit = "Nominal value current" + ("Threshold overcurrent [%]" × "Nominal value current")

The "Nominal value current" is the primary current at the operating point.

Parameter assignment

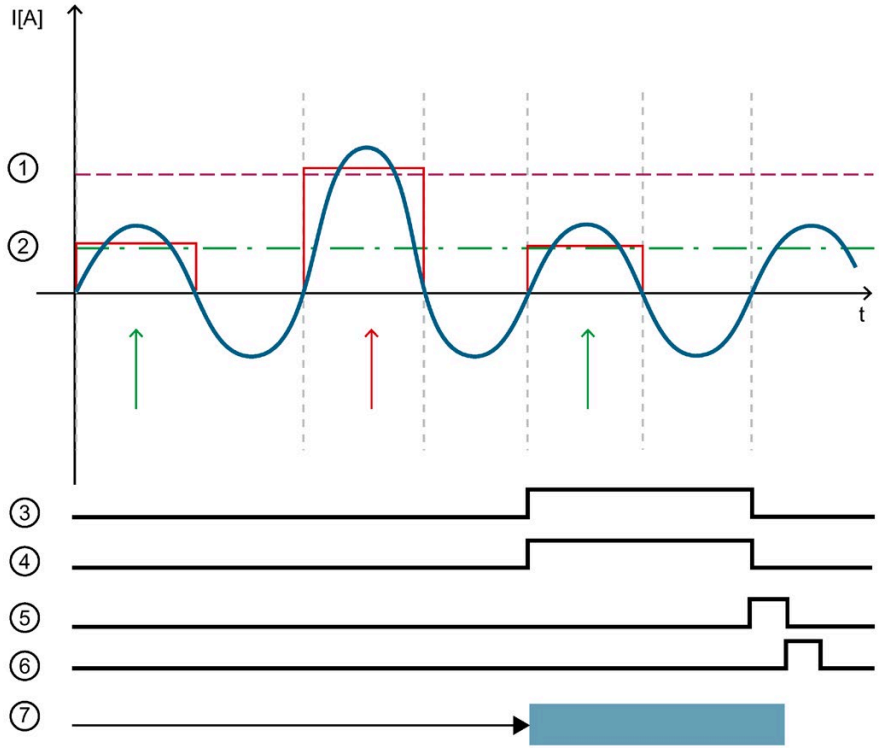
The following table shows the necessary parameters:

Table 14- 20 Parameter assignment

Parameter	
Power quality analysis functions	Enable
Diagnostics power quality	Enable
Determining the overcurrent	Enable
Nominal value current	0 ... 99999 A
Threshold overcurrent	1 ... 6000%

Example

The following figure is a schematic diagram of the principle of operation:



① Threshold overcurrent
② Nominal current
③ Qualifier Bit 7
④ Diagnostics power quality
⑤ Status "power quality overcurrent"
⑥ Bit "Reset status "power quality""
⑦ Max. overcurrent (half-wave) value can be read

Figure 14-10 Example of principle of operation

The following table shows the parameter assignment for the example:

Table 14- 21 Parameter assignment

Parameter	
Power quality analysis functions	Enable
Diagnostics power quality	Enable
Determining the overcurrent	Enable
Nominal value current	2000 A
Threshold overcurrent	100%

In this example you define the Threshold overcurrent of 100%. This corresponds to a primary current of 4000 A.

If the "Threshold overcurrent" is exceeded, the module sets Bit 4 "Overcurrent" for the phase in the data record DS 160.

As long as the "Threshold overcurrent" is exceeded, the module reports the diagnostics "Power quality" and the qualifier bit 7 is set.

Technical specifications 15

15.1 Technical specifications

Technical specifications of the AI Energy Meter HF

The following table shows the technical specifications as of 07/2018. You will find a data sheet including daily updated technical specifications on the Internet (https://support.industry.siemens.com/cs/ww/en/pv/6ES7134-6PA00-0CU0/td?dl=en).

Article number	6ES7134-6PA00-0CU0
General information	
Product type designation	AI Energy Meter 480 VAC/CT HF, PU 1
Firmware version	V6.0
• FW update possible	Yes
usable BaseUnits	BU type U0
Color code for module-specific color identification plate	CC20
Supported power supply systems	TT, TN, IT
Product function	
• Voltage measurement	Yes
– without voltage transformer	Yes
– with voltage transformer	Yes
• Current measurement	Yes
– without current transformer	No
– with current transformer	Yes; 1 A or 5 A current transformer
– with Rogowski coil	No
– with current/voltage transformer	No
• Energy measurement	Yes
• Frequency measurement	Yes
• Power measurement	Yes
• Active power measurement	Yes
• Reactive power measurement	Yes
• Power factor measurement	Yes
• Active factor measurement	Yes
• Reactive power compensation	Yes
• Line analysis	Yes

Article number	6ES7134-6PA00-0CU0
– Monitoring of instantaneous and half-wave values	Yes
– THD measurement for current and voltage	Yes
– Harmonics for current and voltage	Yes
– Voltage dip (DIP)	Yes
– Voltage swell	Yes
• I&M data	Yes; I&M0 to I&M3
• Isochronous mode	No
Engineering with	
• STEP 7 TIA Portal configurable/integrated as of version	STEP 7 V15 or higher
• STEP 7 configurable/integrated as of version	V5.5 SP3 or higher
• PROFIBUS as of GSD version/GSD revision	One GSD file each, Revision 3 and 5 and higher
• PROFINET as of GSD version/GSD revision	V2.3
Operating mode	
• Switching between operating modes in RUN	Yes; For module version 32 I/20 Q, it is possible to dynamically switch between 25 user data variants, 23 of which are pre-defined and 2 of which can be defined by the specific user
• Cyclic measured value access	Yes
• Acyclic measured value access	Yes
• Fixed measured value sets	Yes
• Freely definable measured value sets	Yes; For cyclic and acyclic measured value access
CiR – Configuration in RUN	
Reparameterization possible in RUN	Yes
Calibration possible in RUN	Yes
Installation type/mounting	
Mounting position	Any
Supply voltage	
Design of the power supply	DC
Type of supply voltage	24 V DC
permissible range, lower limit (DC)	19.2 V
permissible range, upper limit (DC)	28.8 V
Input current	
Current consumption (rated value)	12.5 mA
Current consumption, max.	17 mA
Power loss	
Power loss, typ.	1.4 W; 4x 5 A input current, 3x 230 V AC

Article number	6ES7134-6PA00-0CU0
Address area	
Address space per module	
• Inputs	256 byte
• Outputs	20 byte
Hardware configuration	
Automatic encoding	Yes
• Mechanical coding element	Yes
Selection of BaseUnit for connection variants	
• 2-wire connection	BU type U0
Time of day	
Operating hours counter	
• present	Yes
Analog inputs	
Cycle time (all channels), typ.	50 ms; Time for consistent update of all measured and calculated values (cyclic und acyclic data)
Cable length	
• shielded, max.	200 m
• unshielded, max.	200 m
Analog value generation for the inputs	
Sampling frequency, max.	2 048 kHz
Isochronous mode	
Isochronous operation (application synchronized up to terminal)	No
Interrupts/diagnostics/status information	
Alarms	
• Diagnostic alarm	Yes
• Limit value alarm	Yes
• Hardware interrupt	Yes; Monitoring of up to 16 freely selectable process values (exceeding or undershooting of value)
Diagnostic messages	
• Line quality	Yes
• Supply voltage	Yes
• Hardware interrupt lost	Yes
• Parameter assignment error	Yes
• Module fault	Yes
• Channel not available	Yes
• Overflow/underflow	Yes
• Overload current	Yes

Article number	6ES7134-6PA00-0CU0
Diagnostics indication LED	
• Monitoring of the supply voltage (PWR-LED)	Yes
• Channel status display	Yes; Green LED
• for channel diagnostics	Yes; red Fn LED
• for module diagnostics	Yes; green/red DIAG LED
Integrated Functions	
Measuring functions	
• Measuring procedure for voltage measurement	TRMS
• Measuring procedure for current measurement	TRMS
• Type of measured value acquisition	seamless
• Curve shape of voltage	Sinusoidal or distorted
• Buffering of measured variables	Yes
• Parameter length	128 byte
• Bandwidth of measured value acquisition	3.2 kHz; Harmonics: 63 / 50 Hz, 52 / 60 Hz
Measuring range	
– Frequency measurement, min.	45 Hz
– Frequency measurement, max.	65 Hz
Measuring inputs for voltage	
– Measurable line voltage between phase and neutral conductor	300 V
– Measurable line voltage between the line conductors	519 V
– Measurable line voltage between phase and neutral conductor, min.	3 V
– Measurable line voltage between phase and neutral conductor, max.	300 V
– Measurable line voltage between the line conductors, min.	6 V
– Measurable line voltage between the line conductors, max.	519 V
– Measurement category for voltage measurement in accordance with IEC 61010-2-030	CAT II
– Internal resistance line conductor and neutral conductor	1.5 MΩ
– Power consumption per phase	60 mW; 300 V AC
– Impulse voltage resistance 1,2/50µs	2.5 kV

Article number	6ES7134-6PA00-0CU0
Measuring inputs for current	
– measurable relative current (AC), min.	1 %; Relative to the secondary rated current 5 A
– measurable relative current (AC), max.	100 %; Relative to the secondary rated current 5 A
– Continuous current with AC, maximum permissible	5 A; 6 A permanent thermal overload
– Apparent power consumption per phase for measuring range 5 A	0.6 V·A
– Rated value short-time withstand current restricted to 1 s	100 A
– Input resistance measuring range 0 to 5 A	25 mΩ; At the terminal
– Zero point suppression	0 ... 20%, referred to the nominal current
– Surge strength	10 A; for 1 minute
Accuracy class according to IEC 61557-12	
– Measured variable voltage	0,2
– Measured variable current	0,2
– Measured variable apparent power	0.5
– Measured variable active power	0.5
– Measured variable reactive power	1
– Measured variable power factor	0.5
– Measured variable active energy	0.5
– Measured variable reactive energy	1
– Measured variable neutral current	0,2
– Measured variable phase angle	±0.5 °; not covered by IEC 61557-12
– Measured variable frequency	0.05
– Measured variable harmonic	1
– Measured variable THDU	1
– Measured variable THDI	1
Accuracy class line analysis acc. to IEC 61000-4-30	
– Measured variable voltage	Class S
– Measured variable current	Class S
– Measured variable frequency	Class S
– Measured variable voltage interruption	Class S
– Measured variable voltage dip and swell	Class S
– Measured variable harmonic voltage	Class S
– Measured variable harmonic current	Class S

Article number	6ES7134-6PA00-0CU0
Potential separation	
Potential separation channels	
• between the channels	No
• between the channels and backplane bus	Yes
• Between the channels and load voltage L+	Yes; Including FE
Isolation	
Isolation tested with	Between channels and backplane bus, 24 V supply: Routine test, 1 920 V AC, 2 s; between backplane bus and 24 V supply: Type test, 707 V DC
Ambient conditions	
Ambient temperature during operation	
• horizontal installation, min.	0 °C; On request: Ambient temperatures lower than 0 °C (without condensation)
• horizontal installation, max.	60 °C
• vertical installation, min.	0 °C; On request: Ambient temperatures lower than 0 °C (without condensation)
• vertical installation, max.	50 °C
Altitude during operation relating to sea level	
• Installation altitude above sea level, max.	3 000 m; Restrictions for installation altitudes > 2 000 m, see manual
Dimensions	
Width	20 mm
Height	73 mm
Depth	58 mm
Weights	
Weight (without packaging)	45 g
Other	
Data for selecting a voltage transformer	
• Secondary side, max.	300 V
Data for selecting a current transformer	
• Burden power current transformer x/1A, min.	As a function of cable length and cross section, see device manual
• Burden power current transformer x/5A, min.	As a function of cable length and cross section, see device manual

ATEX approval

In accordance with EN 60079-15 (Electrical apparatus for potentially explosive atmospheres; Type of protection "n") and EN 60079-0 (Electrical apparatus for potentially explosive gas atmospheres - Part 0: General Requirements)

II 3 G Ex nA IIC Tx Gc
DEKRA 12ATEX0038X

Dimension drawing

See ET 200SP BaseUnits (http://support.automation.siemens.com/WW/view/en/59753521) manual

Parameter data records

A

A.1 Configuration via parameter data records

The parameter data records of the module have an identical structure, regardless of whether you configure the module with PROFIBUS DP or PROFINET IO.

Overview of the parameter data records

- Parameter data record DS 128 for the complete module
- Parameter data record DS 129 for limit monitoring
- Parameter data records DS 130/131 for user data mapping
- Parameter data record DS 135 for data record mapping

Parameter assignment in the user program

You can reassign the module parameters in RUN mode, for example change the diagnostics behavior, define new limits or configure a modified user data mapping.

Changing parameters in RUN

The "WRREC" instruction is used to transfer the parameters to the module via the respective data record. The parameters set in STEP 7 do not change in the CPU, which means the parameters set in STEP 7 are still valid after a restart.

If you reconfigure a module (so that the user data size changes) and diagnostics are pending prior to the reconfiguration, these diagnostics are not signaled as "outgoing". The diagnostics "Supply voltage missing" is signaled as outgoing.

STATUS output parameter

If errors occur during the transfer of parameters with the WRREC instruction, the module continues operation with the previous parameter assignment. However, a corresponding error code is written to the STATUS output parameter.

The description of the WRREC instruction and the error codes is available in the STEP 7 online help.

A.2 Structure of the parameter data record 128 for the entire module

Structure of data record 128

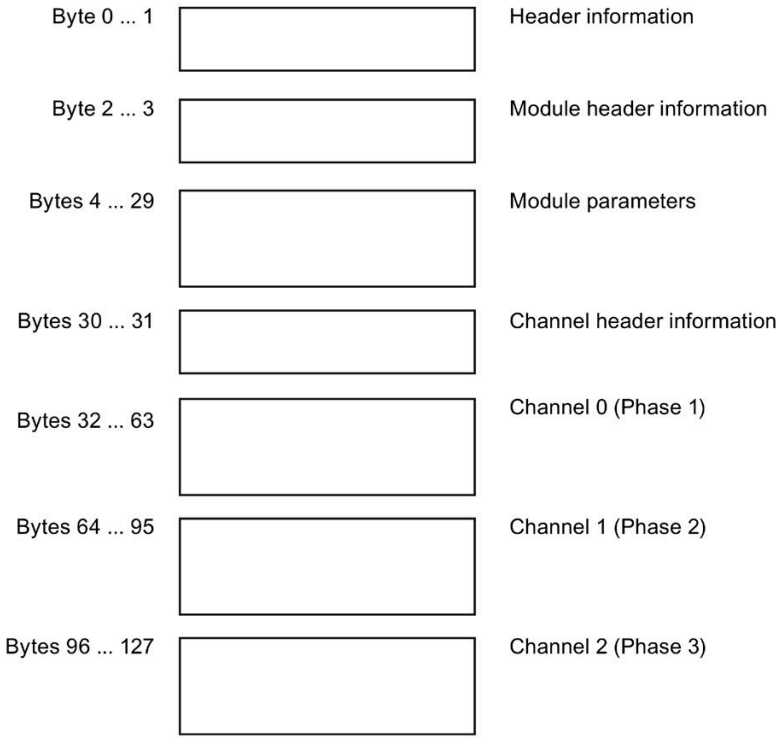


Figure A-1 Parameter data record 128

Header information

The figure below shows the structure of the header information.

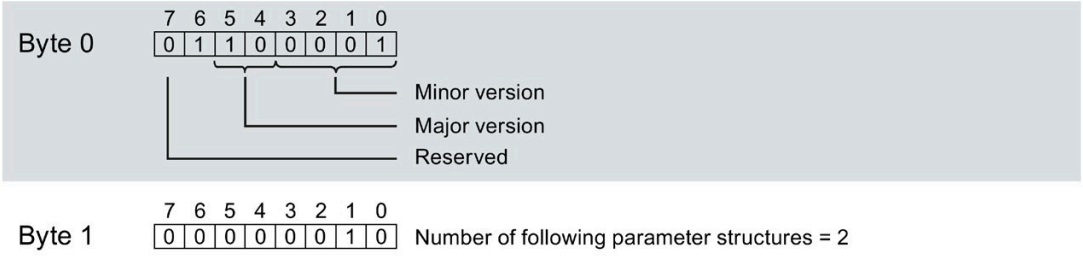


Figure A-2 Header information

Module header information

The figure below shows the structure of the header information for a module.

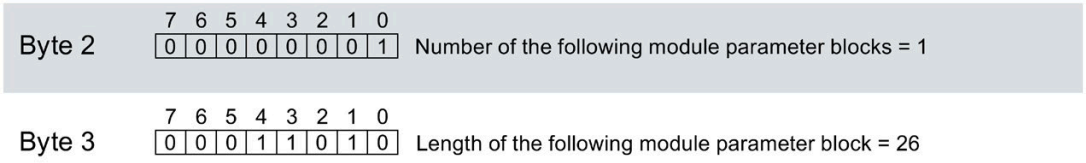
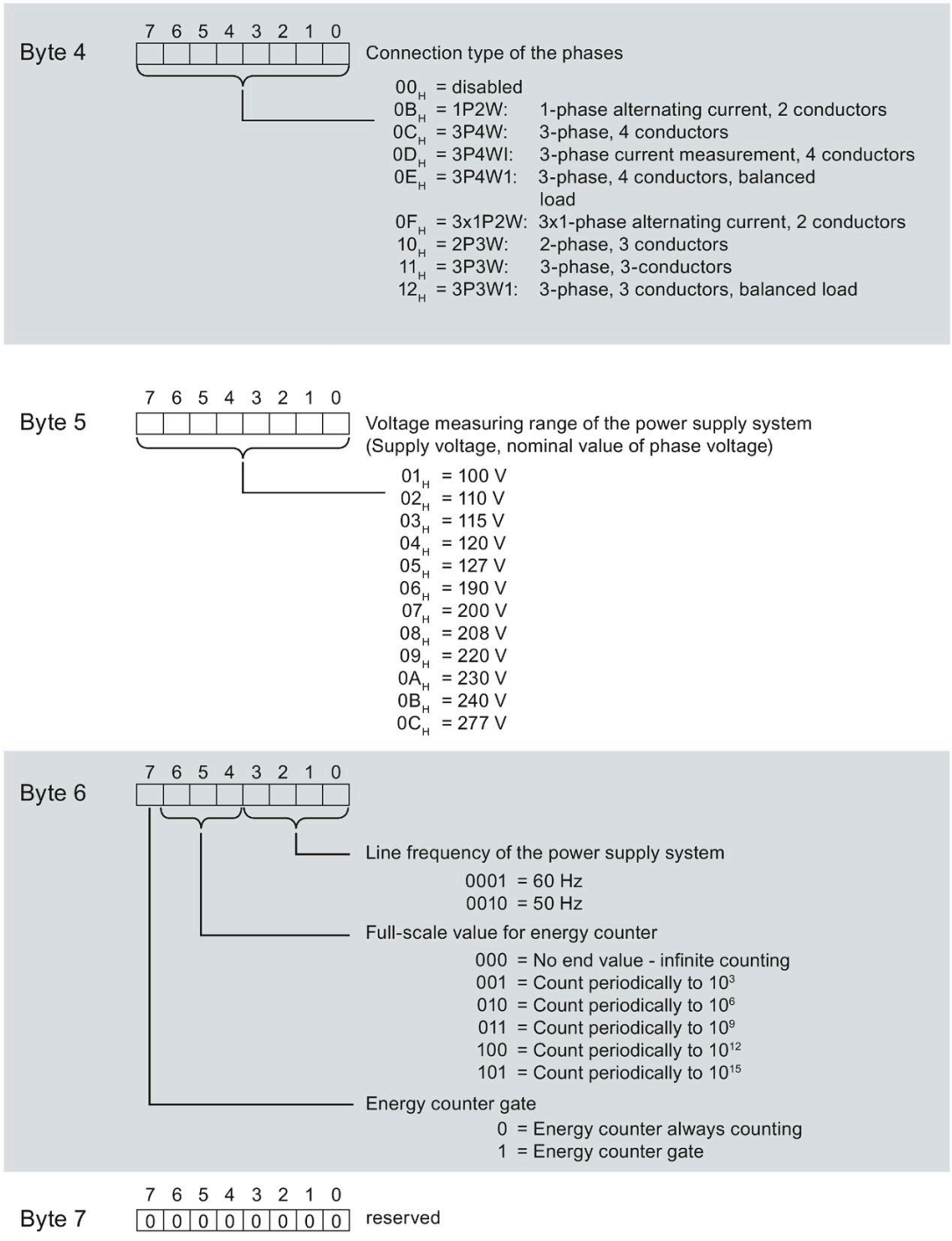


Figure A-3 Module header information

Module parameter block

The figure below shows the structure of the module parameter block.



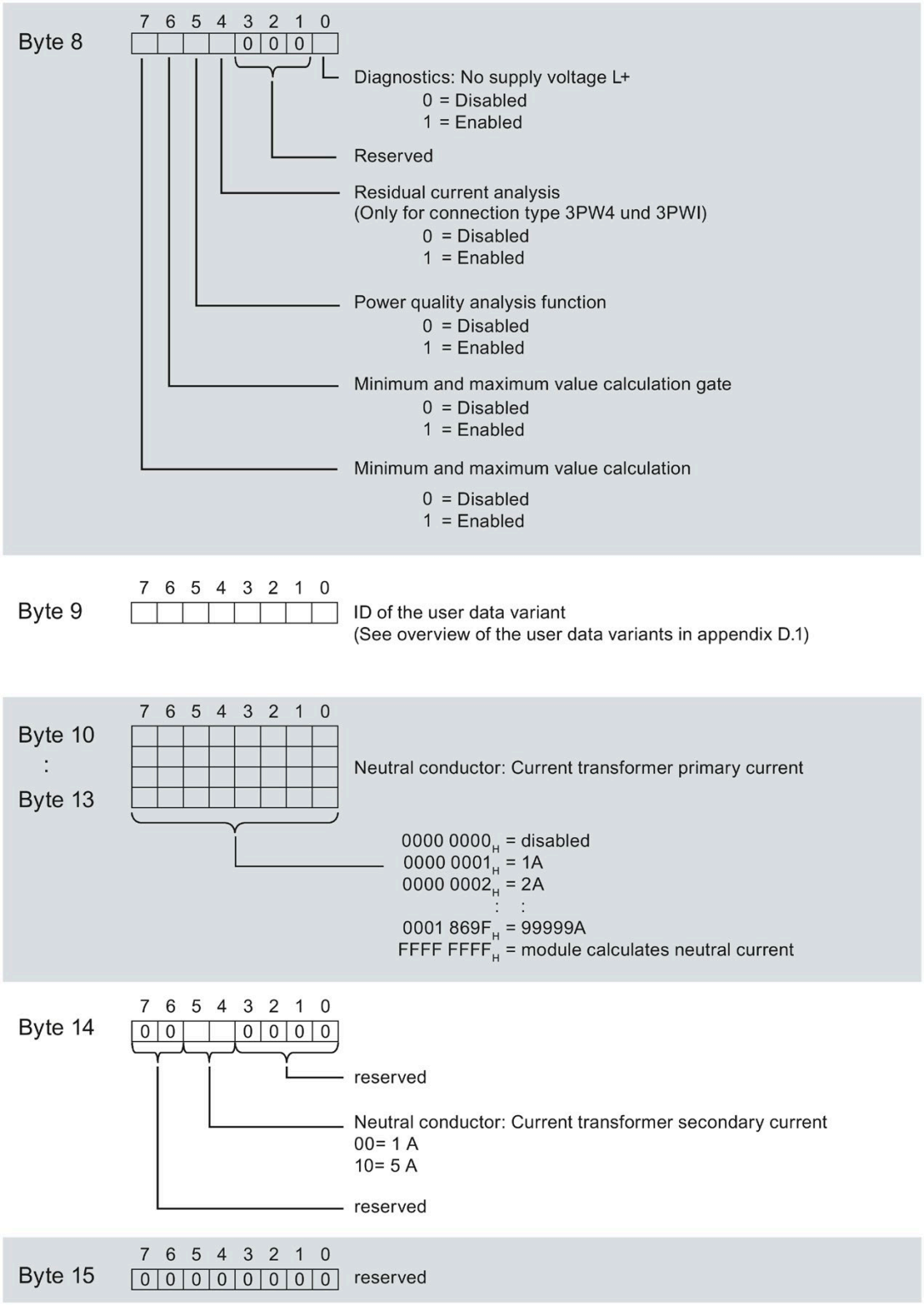


Figure A-4 Module parameter block

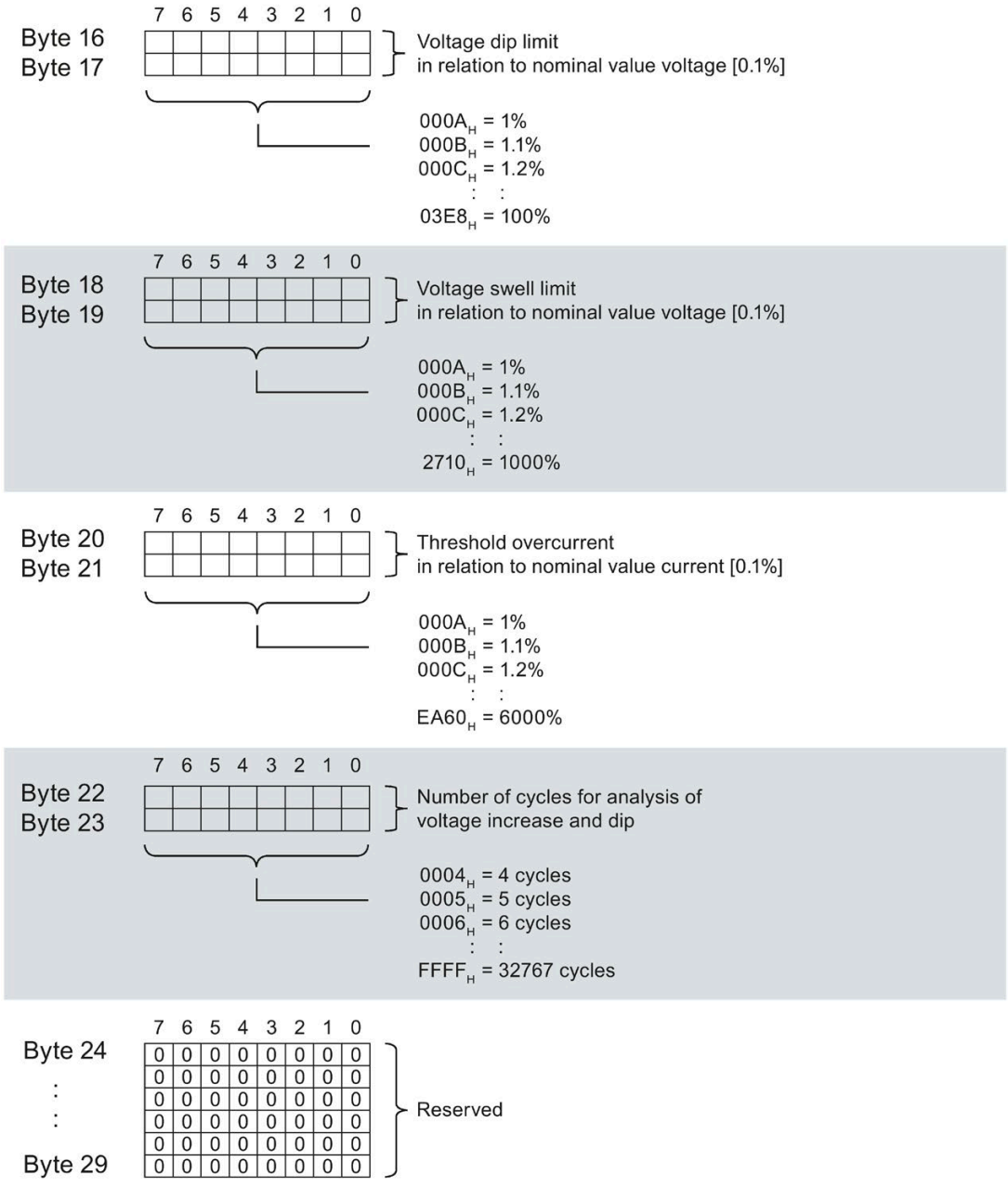


Figure A-5 Module parameter block

You can find the user data variant in the section Overview of the user data variants (Page 211).

Channel header information

The following figure shows the structure of the header information for a channel.

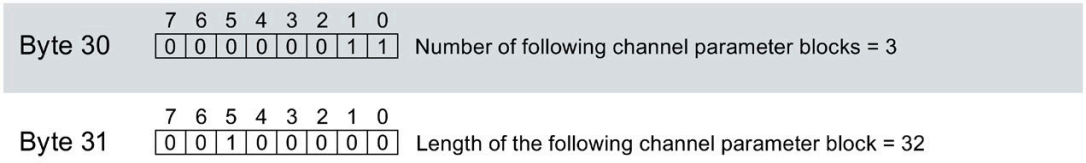
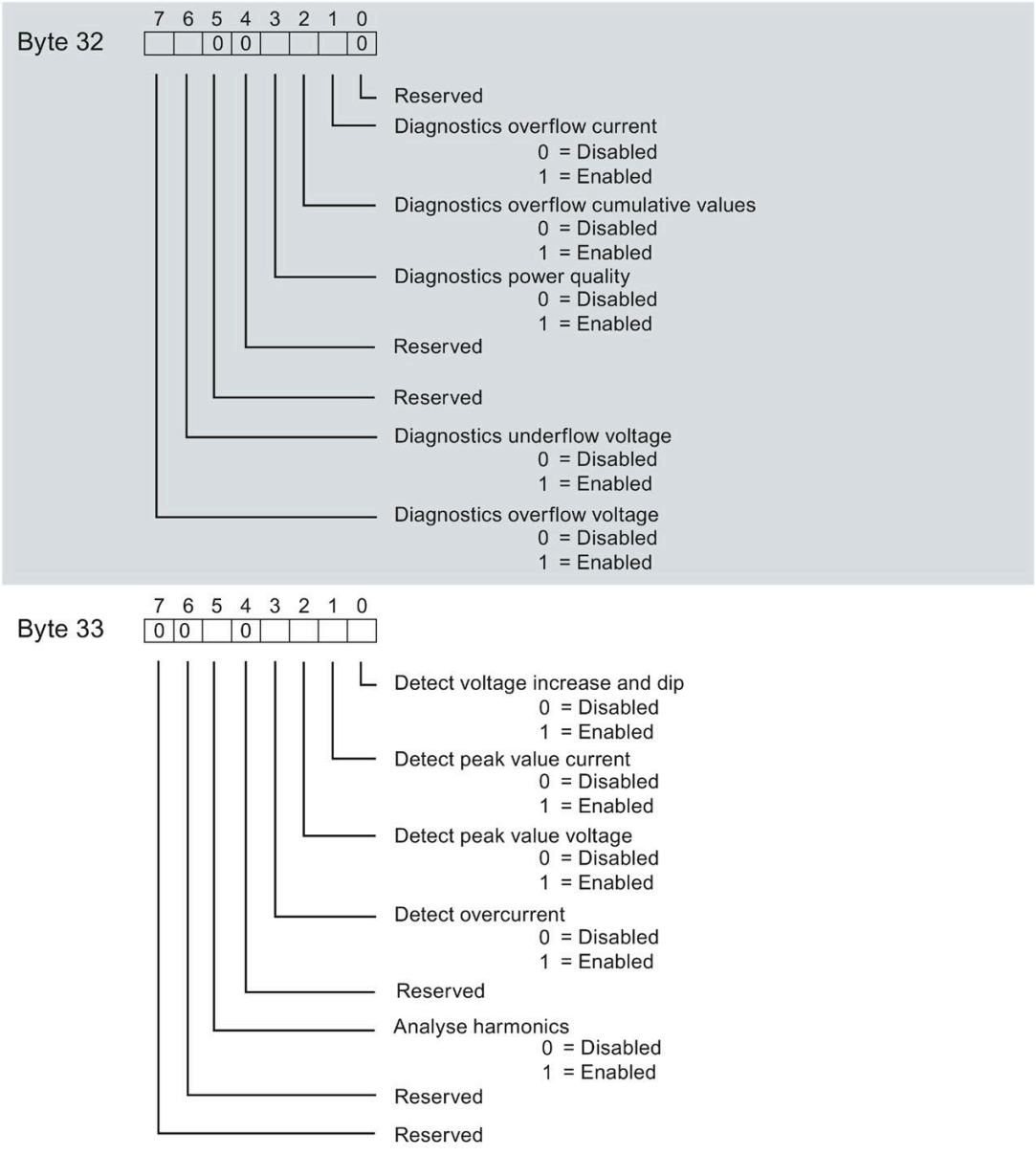


Figure A-6 Channel header information

Channel parameter block for channel 0 (Phase 1)

The following figure shows an example of the structure of the channel parameter block for channel 0 (phase 1, bytes 32 to 63).

For channel 1 (phase 2; bytes 64 to 95) and channel 2 (phase: 3; bytes 96 to 127), the structure is identical.



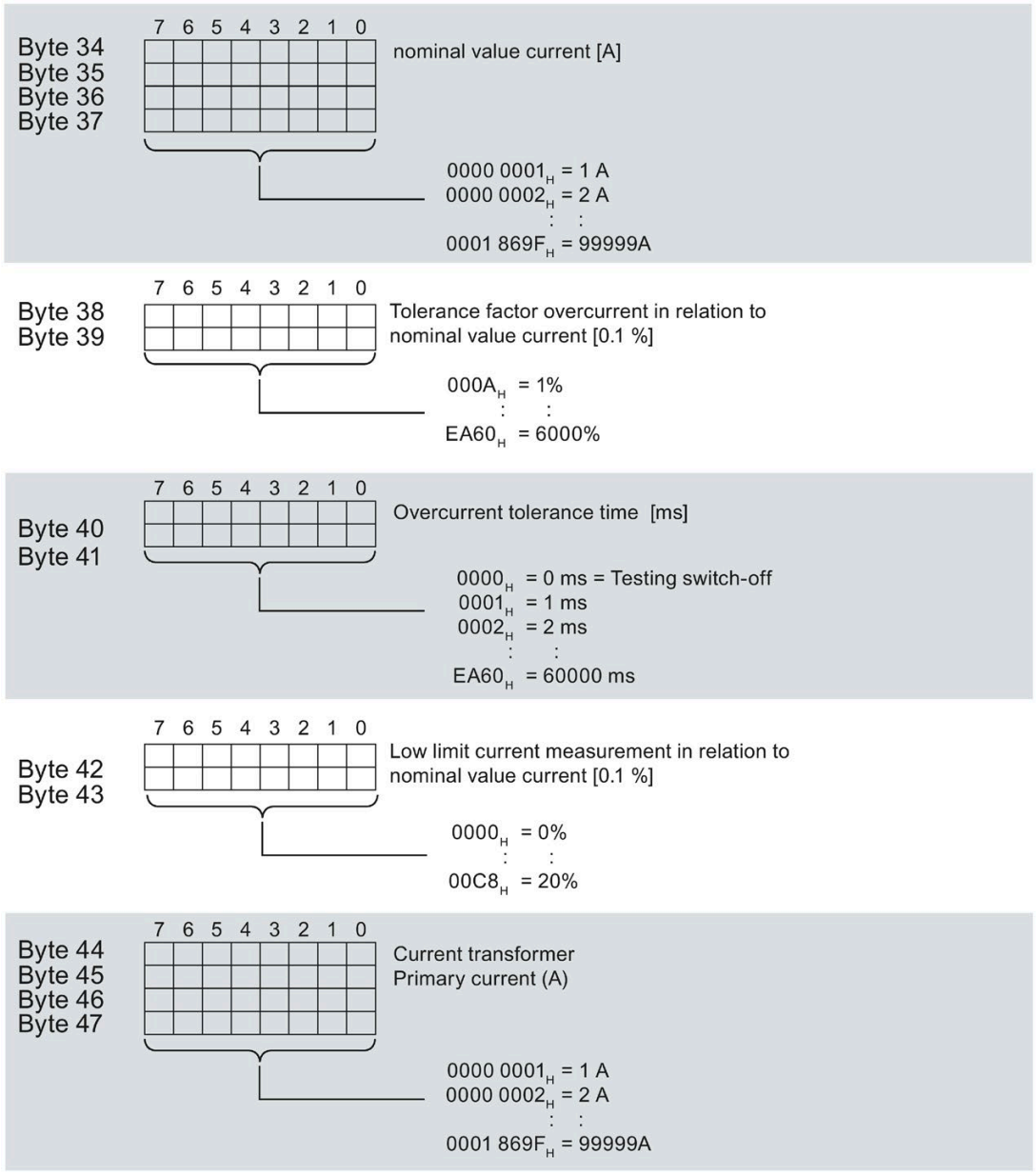
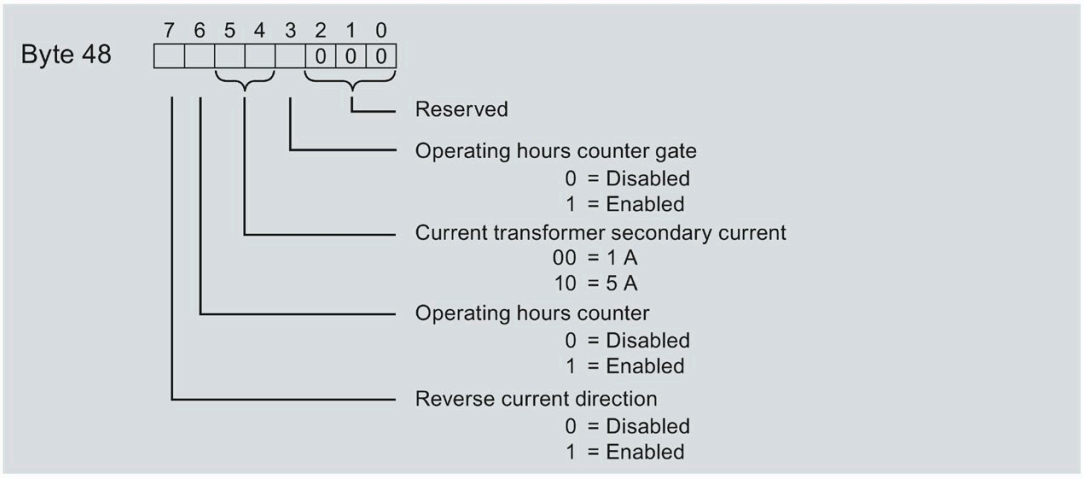
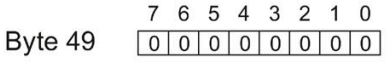
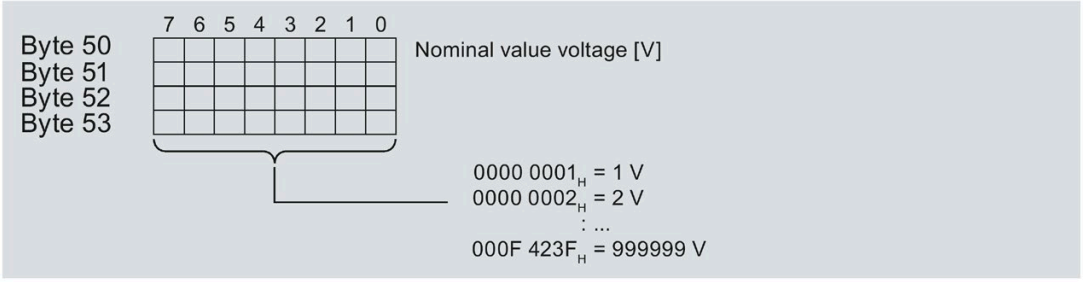
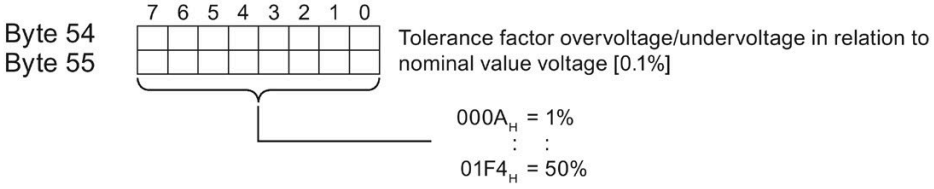


Figure A-7 Channel parameter block


Byte 48
7 6 5 4 3 2 1 0
0 0 0
Reserved
Operating hours counter gate
0 = Disabled
1 = Enabled
Current transformer secondary current
00 = 1 A
10 = 5 A
Operating hours counter
0 = Disabled
1 = Enabled
Reverse current direction
0 = Disabled
1 = Enabled


Byte 49
7 6 5 4 3 2 1 0
0 0 0 0 0 0 0 0
Reserved


Byte 50
Byte 51
Byte 52
Byte 53
7 6 5 4 3 2 1 0
Nominal value voltage [V]
0000 0001H = 1 V
0000 0002H = 2 V
: ...
000F 423FH = 999999 V


Byte 54
Byte 55
7 6 5 4 3 2 1 0
Tolerance factor overvoltage/undervoltage in relation to nominal value voltage [0.1%]
000AH = 1%
: :
01F4H = 50%

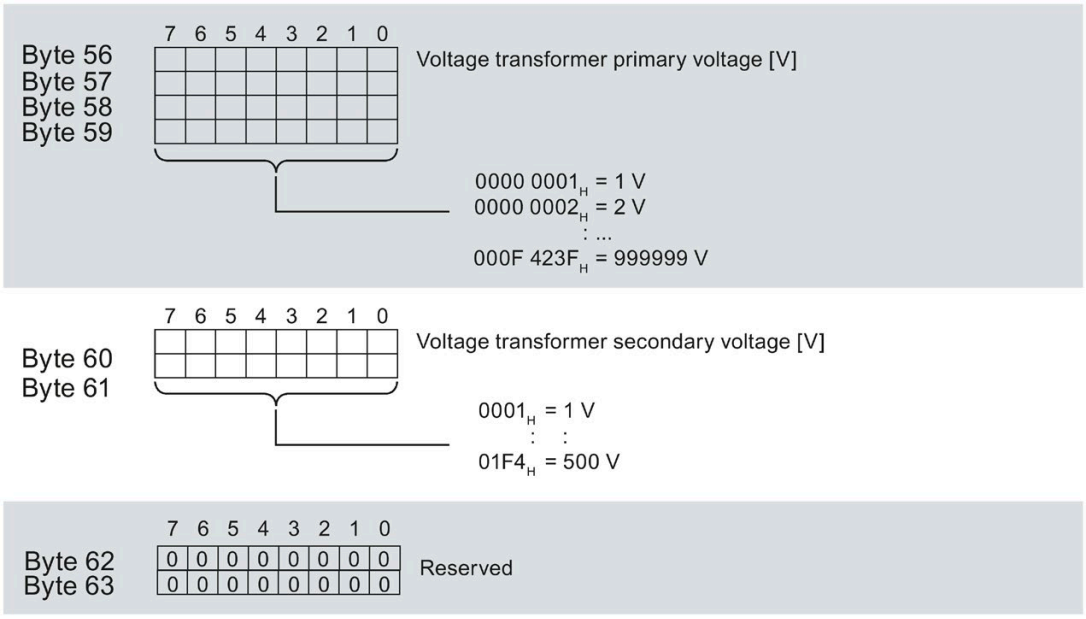


Figure A-8 Channel parameter block

Error while transferring the data record

The module always checks all the values of the transferred data record. Only if all the values were transferred without errors does the module apply the values from the data record.

The WRREC instruction for writing data records returns corresponding error codes when errors occur in the STATUS parameter.

The following table shows the module-specific error codes and their meaning for the parameter data record 128.

Error code in STATUS parameter (hexadecimal)				Meaning	Solution
Byte 0	Byte 1	Byte 2	Byte 3		
DF	80	B0	00	Number of the data record unknown	Enter a valid number for the data record.
DF	80	B1	01	Length of the data record incorrect	Enter a valid value for the data record length.
DF	80	B2	00	Slot invalid or cannot be accessed.	Check the station whether the module is plugged or drawn. Check the assigned values for the parameters of the WRREC instruction
DF	80	E0	01	Incorrect version	Check Byte 0. Enter valid values.
DF	80	E0	02	Error in the header information	Check bytes 1 to 3, 32, 33, 52, 53, 72 and 73. Correct the length and number of the parameter blocks.

Error code in STATUS parameter (hexadecimal)				Meaning	Solution
Byte 0	**Byte 1**	**Byte 2**	**Byte 3**		
DF	80	E1	01	Reserved bits are not 0.	Check bytes 7, 8, 14, 15, 24...29, 32, 33, 48, 49, 62...65, 80, 81, 94...97, 112, 113, 126, 127 and reset the reserved bits to 0.
DF	80	E1	05	"Voltage measuring range" invalid	Check Byte 5. Permitted values: 01_H to $0C_H$
DF	80	E1	20	"Connection type" invalid	Check Byte 4. Permitted values: 00_H, $0B_H$ ... 01_H
DF	80	E1	21	"User data variant" not possible or input data configuration not large enough	Check Byte 9. Select a different user data variant or change the configuration.
DF	80	E1	22	"User data variant" invalid	Check Byte 9. Select a valid code for the user data variant.
DF	80	E1	23	"Line frequency" invalid	Check Byte 6. Enter valid values.
DF	80	E1	29	"Tolerance factor overcurrent in relation to nominal value current [0.1%]" invalid	Check bytes 38...39, 70...71, 102...103. Enter valid values.
DF	80	E1	2A	"Tolerance time overcurrent" invalid	Check bytes 40...41, 72...73, 104...105 prüfen. Enter valid values.
DF	80	E1	2B	"Low limit current measurement" in relation to nominal value current [0.1%] invalid	Check bytes 42...43, 74...75, 106...107. Enter valid values.
DF	80	E1	2C	"Current transformer primary current [A]" invalid.	Check bytes 10...13, 44...47, 76...79, 108...111. Enter valid values.
DF	80	E1	2D	"Voltage transformer primary voltage [V]" invalid	Check bytes 56...59, 88...91, 120...123. Enter valid values.
DF	80	E1	2E	"Voltage transformer secondary voltage [V]" invalid	Check bytes 60, 61 and 92, 93 and 124, 125. Enter valid values.
DF	80	E1	2F	"End value energy meter" invalid	Check Bit 4...6 in Byte 6. Enter valid values.
DF	80	E1	30	Invalid data record number.	Check the data record number. Enter a valid data record number.
DF	80	E1	3E	Only for connection type 3P4W1 and 3P3W1. Current or voltage transformer parameters for the different phases are not identical.	Check bytes 44...47 and 76...79 and 108...111 or bits 4, 5 and 7 in bytes 48, 80 and 112 or 56...59 and 88...91 and 120...123 or 60, 61 and 92, 93 and 124, 125 for identical values. Enter identical values for current transformer (secondary current, primary current, direction of current) and voltage transformer (secondary voltage, primary voltage) at all three phases.
DF	80	E1	3F	"End value for energy meter" or transmission ratio (primary value, secondary value) of current and voltage too low.	Increase the end value of the energy meter or the ratio of primary to secondary current for current transformer and/or primary to secondary voltage for voltage transformer.
DF	80	E1	43	"Current transformer secondary current" for neutral or all three phases invalid	Check bits 4, 5 in byte 14, 48, 80 and 112. Enter valid values.
DF	80	E1	44	"Voltage dip limit value in relation to nominal value voltage [0.1%]" invalid	Check bytes 16...17. Enter valid values (voltage dip limit value must be smaller than the respective nominal voltage)

Error code in STATUS parameter (hexadecimal)				Meaning	Solution
Byte 0	Byte 1	Byte 2	Byte 3		
DF	80	E1	45	"Voltage swell limit value in relation to nominal value voltage [0.1%]" invalid	Check bytes 20...23. Enter valid values (voltage swell limit value must be greater than the respective nominal voltage)
DF	80	E1	46	"Threshold overcurrent in relation to nominal value current [0.1%]" invalid	Check bytes 24...27. Enter valid values (threshold overcurrent must be greater than primary current)
DF	80	E1	47	"Number of cycles for analysis of voltage swell/dip" invalid	Check bytes 28...29. Enter valid values.
DF	80	E1	49	Current transformer parameter for "residual current analysis" invalid	Only with connection type 3P4W and 3P4WI and if neutral current is measured. Current transformer primary current and secondary current and direction of current of the three phases must have identical parameters.
DF	80	E1	4 A	Voltage transformer parameters for voltage swell/dip invalid	Check the parameters secondary voltage, primary voltage, nominal value voltage. Enabled channels must have identical parameters.
DF	80	E1	4B	Current transformer parameter for "Detect overcurrent" invalid	Check the parameters secondary current, primary current, nominal value current and direction of current. Enabled channels must have identical parameters.
DF	80	E1	4C	Parameters for determining the neutral current invalid	Neutral current can only be determined with connection type 3P4W and 3P4WI Current transmission parameters primary current, secondary current, nominal value current and direction of current of the three phases must be identical.
DF	80	E1	4D	"Nominal value current [A]" invalid	The nominal value current must be measurable with the current transformer and must thus be smaller than the primary measured variable of the transformer (current transformer primary current). Check bytes 34...37, 66...69, 98...101. Enter valid values.
DF	80	E1	4E	"Nominal value voltage [V]" invalid	The nominal value voltage must be measurable with the voltage transformer and must thus be smaller than the primary measured variable of the transformer (voltage transformer primary voltage). Check bytes 50...53, 82...85, 114...117. Enter valid values.
DF	80	E1	4F	"Low limit current measurement in relation to nominal value current [0.1%]" invalid	Check bytes 42...43, 74...75, 106...107. Enter valid values.
DF	80	E1	50	The combination of "Nominal value voltage [V]" and "Voltage dip limit value in relation to nominal value voltage [0.1%]" invalid.	Select the permissible value in % so that the secondary measuring voltage of 0 V is not undershot.
DF	80	E1	51	The combination of "Nominal value voltage [V]" and "Voltage swell limit value in relation to nominal value voltage [0.1%]" invalid.	Select the permissible value in % so that the secondary measuring voltage of 300 V is not exceeded.

Error code in STATUS parameter (hexadecimal)				Meaning	Solution
Byte 0	**Byte 1**	**Byte 2**	**Byte 3**		
DF	80	E1	52	The combination of "Nominal value current [A]" and "Threshold overcurrent in relation to nominal value current [0.1%]" invalid	Select the permissible value in % so that the secondary measuring current of 6 A is not exceeded.
DF	80	E1	53	The combination of "Nominal value current [A]" and "Tolerance factor overcurrent in relation to nominal value current [0.1%]" invalid	Select the permissible value in % so that the secondary measuring current of 6 A is not exceeded.
DF	80	E1	54	The combination of "Nominal value voltage [V]" and "Tolerance factor overvoltage/undervoltage in relation to nominal value voltage [0.1%]" lies outside the permissible range.	Select the permissible value in % so that the secondary measuring voltage of 300 V is not exceeded.
DF	80	E1	55	"Nominal value current [A]" is too high. "Nominal value current" x transmission factor current generates a secondary current measured variable which exceeds its value range.	Select the permissible value in A so that the secondary measuring current of 6 A is not exceeded. The transmission factor current is calculated from "Current transformer primary current [A]" / "Current transformer secondary current [A]"
DF	80	E1	56	"Nominal value voltage [V]" is too high. "Nominal value voltage" x transmission factor voltage generates a secondary voltage measured variable which exceeds its value range.	Select the permissible value in V so that the secondary measuring voltage of 300 V is not exceeded. The transmission factor voltage is calculated from "Voltage transformer primary voltage [V]" / "Voltage transformer secondary voltage [V]"

A.3 Structure of the parameter data record 129 for limit monitoring

Structure of data record 129

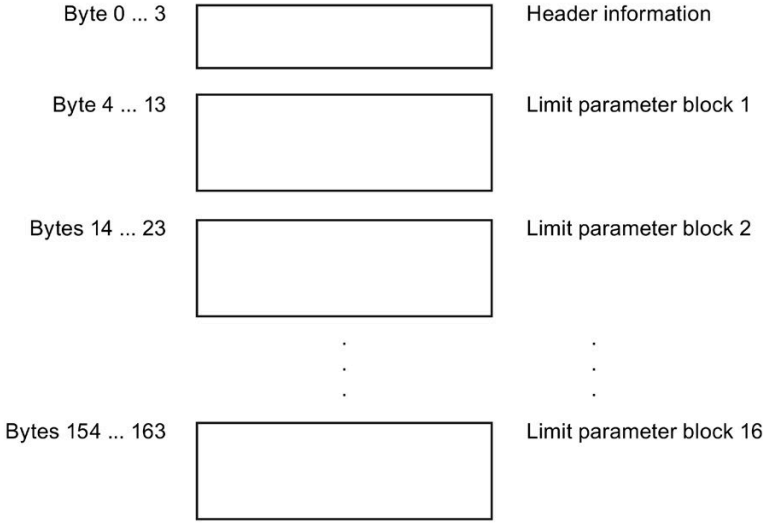


Figure A-9 Structure of data record 129

Header information

The figure below shows the structure of the header information.

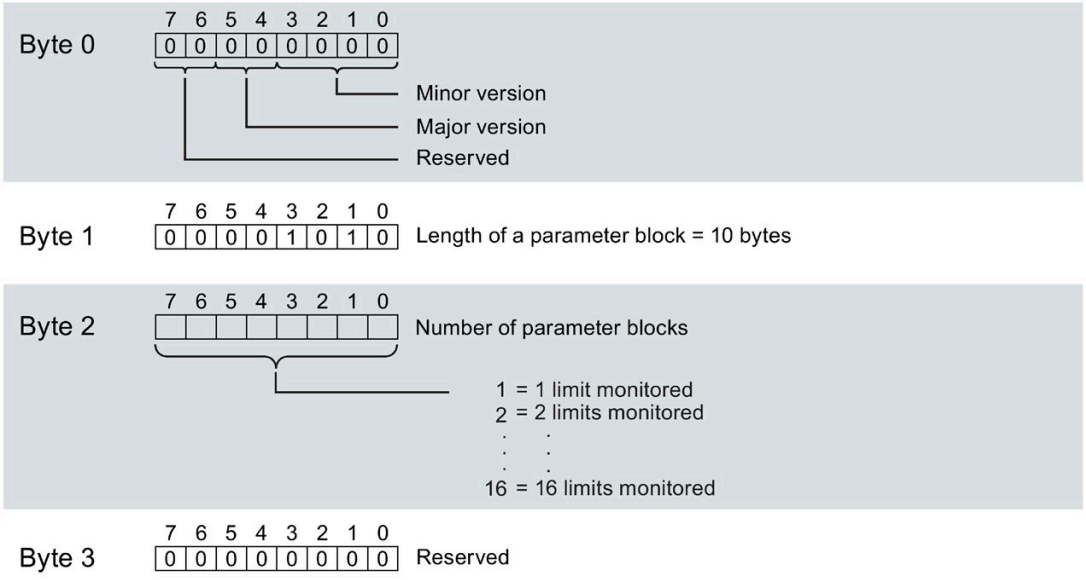
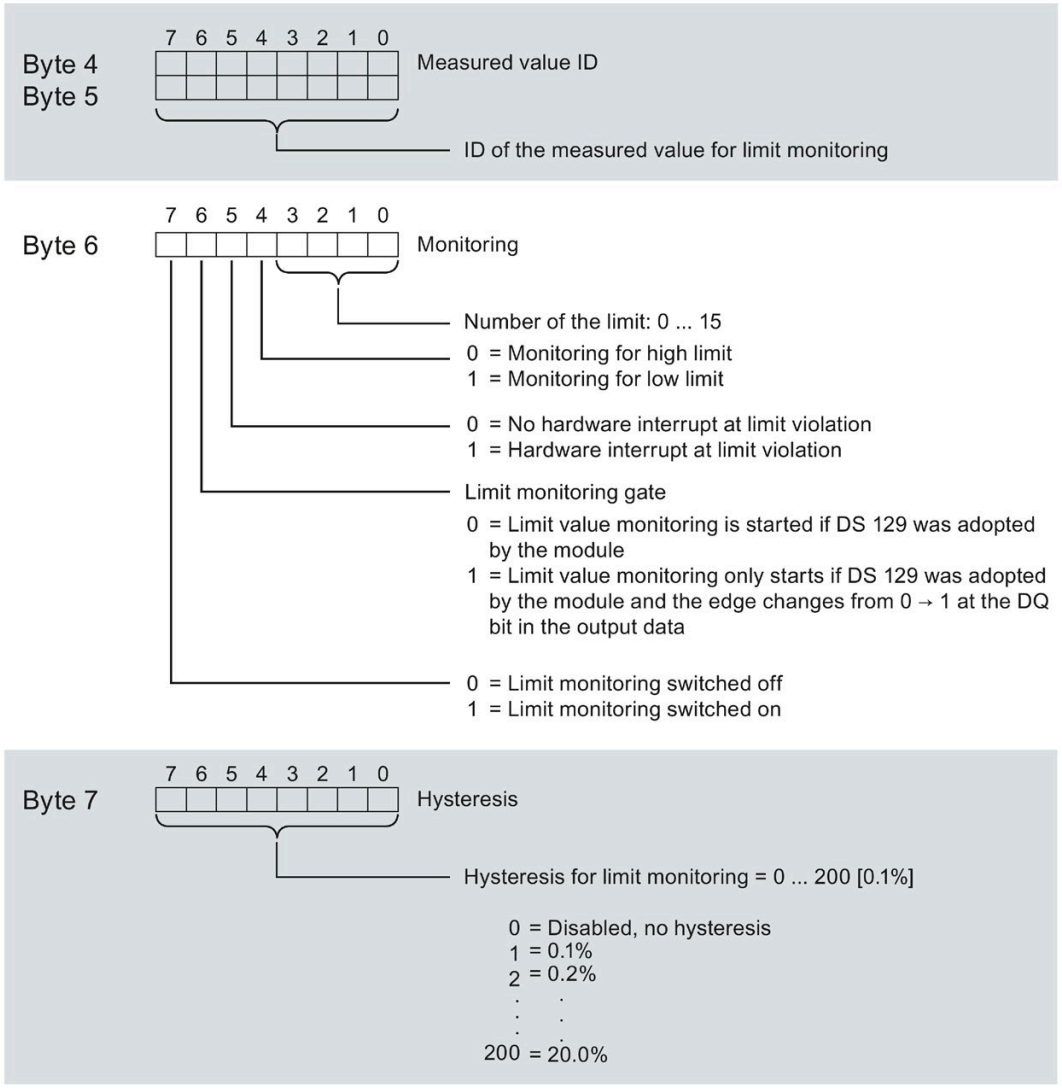


Figure A-10 Header information DS 129

Limit parameter block

The following diagram shows the structure of the parameter blocks for limit monitoring.



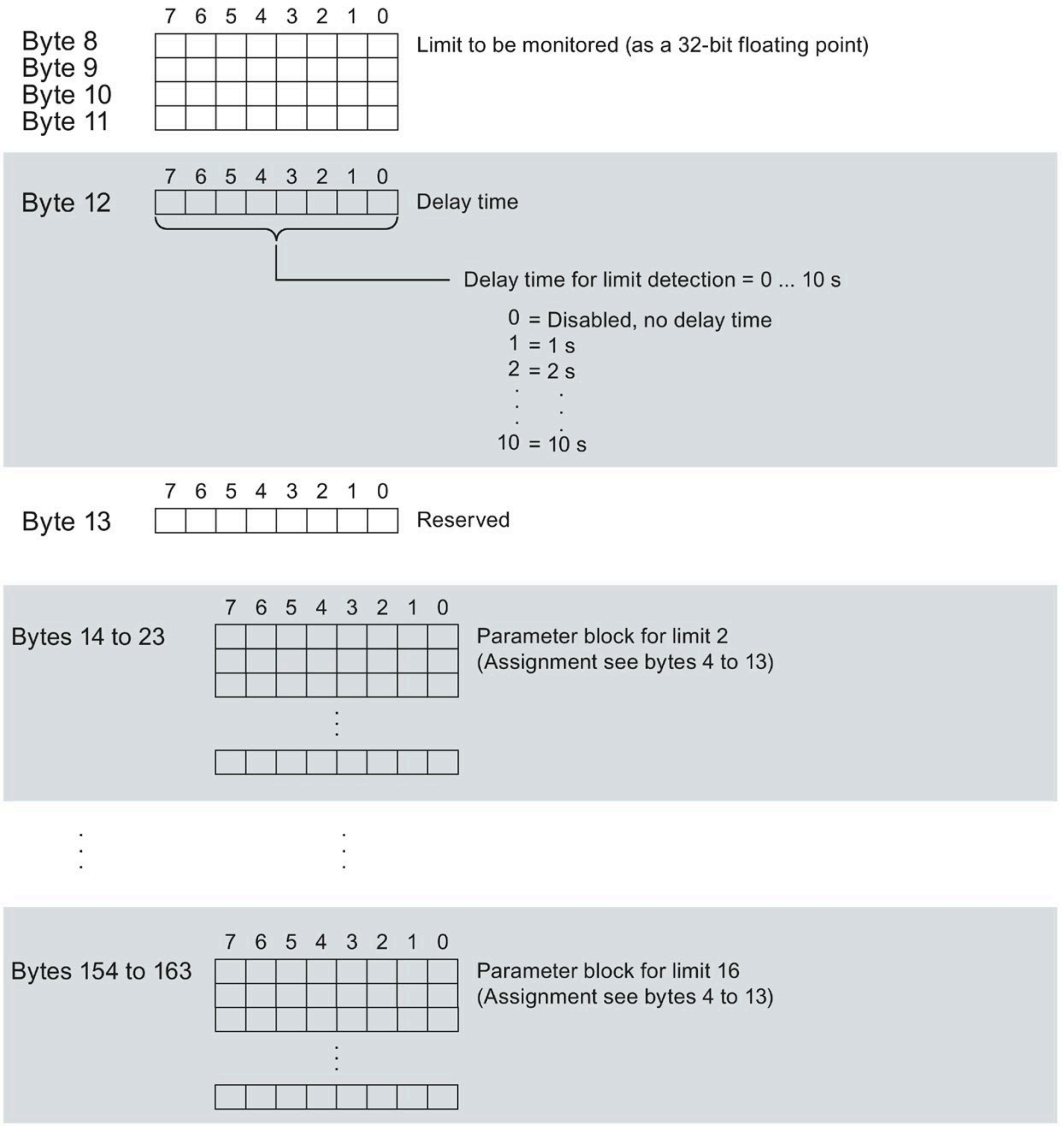


Figure A-11 Limit parameter data block

Error while transferring the data record

The module always checks all the values of the transferred data record. Only if all the values were transferred without errors does the module apply the values from the data record.

The WRREC instruction for writing data records returns corresponding error codes when errors occur in the STATUS parameter.

The following table shows the module-specific error codes and their meaning for the parameter data record 129.

Error code in STATUS parameter (hexadecimal)				Meaning	Solution
Byte 0	Byte 1	Byte 2	Byte 3		
DF	80	B0	00	Number of the data record unknown	Enter a valid number for the data record.
DF	80	B1	01	Length of the data record incorrect	Enter a valid value for the data record length.
DF	80	B2	00	Slot invalid or cannot be accessed.	Check the station whether the module is plugged or drawn. Check the assigned values for the parameters of the WRREC instruction
DF	80	E0	01	Incorrect version	Check Byte 0. Enter valid values.
DF	80	E0	02	Error in the header information	Check Bytes 1 and 2. Correct the length and number of the parameter blocks.
DF	80	E1	01	Reserved bits are not 0.	Check bytes 3, 13, 23, 33...163 and reset the reserved bits to 0.
DF	80	E1	31	"Length of the parameter block" invalid.	Length of the sent record incorrect. Note byte 2 ("number of parameter blocks").
DF	80	E1	32	"Number of parameter blocks" invalid.	Check Byte 2. Enter valid values.
DF	80	E1	33	"ID of the measured value for limit monitoring" invalid.	Check Bytes 4 and 5. Enter valid values.
DF	80	E1	34	Parameters for monitoring the limits invalid	Check bits 0...3 in Byte 6. Enter valid values.
DF	80	E1	35	"Number of limit" in 'Monitoring assigned multiple times' parameter	Check bits 0...3 in Byte 6. Do not use limit number several times.
DF	80	E1	36	"Hysteresis for limit monitoring" invalid	Check Byte 7. Enter valid values.
DF	80	E1	37	"Limit" invalid.	Check Byte 8...11. Enter valid values.
DF	80	E1	38	"Delay time for limit monitoring" invalid.	Check Byte 12. Enter valid values.

A.4 Structure of the parameter data records 130/131 for user-data mapping

Structure of data record 130/131

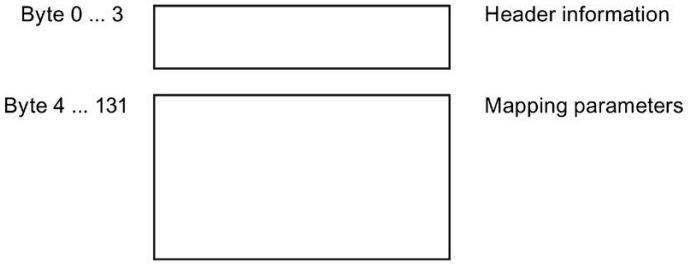


Figure A-12 Structure of data record 130/131

Header information

The figure below shows the structure of the header information.

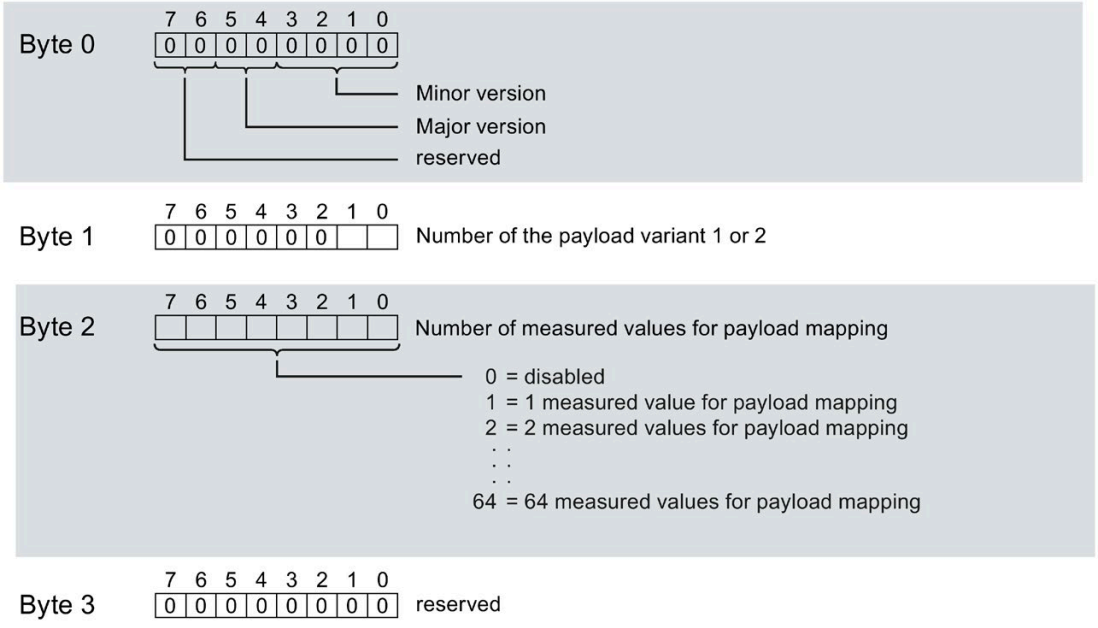


Figure A-13 Header information DS 130/131

Parameter block for user data mapping

The following diagram shows the structure of the parameter blocks for user data mapping.

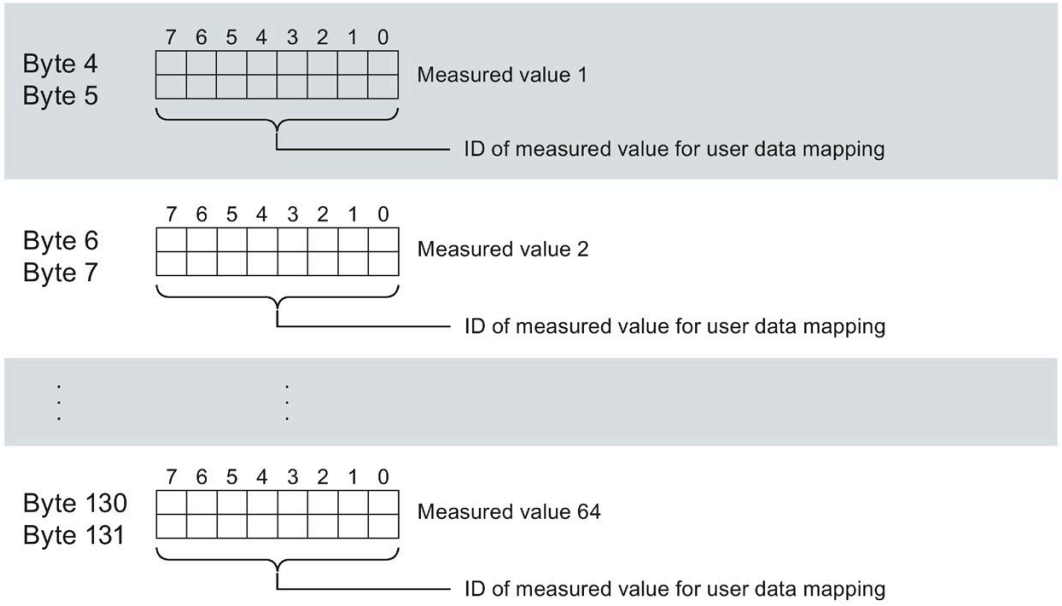


Figure A-14 Parameter block for user data mapping

Error while transferring the data record

The module always checks all the values of the transferred data record. Only if all the values were transferred without errors does the module apply the values from the data record.

The WRREC instruction for writing data records returns corresponding error codes when errors occur in the STATUS parameter.

The following table shows the module-specific error codes and their meaning for the parameter data record 130/131.

Error code in STATUS parameter (hexadecimal)				Meaning	Solution
Byte 0	Byte 1	Byte 2	Byte 3		
DF	80	B0	00	Number of the data record unknown	Enter a valid number for the data record.
DF	80	B1	01	Length of the data record incorrect	Enter a valid value for the data record length.
DF	80	B2	00	Slot invalid or cannot be accessed.	Check the station whether the module is plugged or drawn. Check the assigned values for the parameters of the WRREC instruction
DF	80	E0	01	Incorrect version	Check Byte 0. Enter valid values.
DF	80	E0	02	Error in the header information	Check Bytes 1 and 2. Correct the length and number of the parameter blocks.
DF	80	E1	01	Reserved bits are not 0.	Check Byte 3 and reset the reserved bits to 0.
DF	80	E1	21	"User data variant" not possible or input data configuration not large enough	Select a different user data variant or change the configuration.
DF	80	E1	30	Data record number invalid	Check the data record number. Enter a valid data record number.
DF	80	E1	31	"Length of the parameter block" invalid.	Length of the sent record incorrect. Note byte 2 ("number of measured values").
DF	80	E1	32	"Number of parameter blocks" invalid.	Check Byte 2. Enter valid values.
DF	80	E1	33	"ID of measured value for user data mapping" invalid.	Check Bytes 4 and 5. Enter valid values.
DF	80	E1	3B	"ID of the type of user data mapping" not permitted.	Check Byte 1. Number for user-specific user data variant has to be 01_H or 02_H.

Measured variables for user data mapping

You can find the measured variables under AUTOHOTSPOT. The following measured variables are not available to you for user data mapping:

- 220 to 226
- 62110 to 62116
- 62210 to 62216
- 62310 to 62316

A.5 Structure of the parameter data record 135 for data record mapping

Structure of data record 135

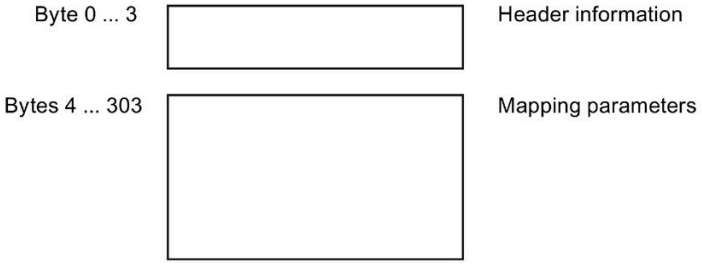


Figure A-15 Structure of data record 135

Header information

The figure below shows the structure of the header information.

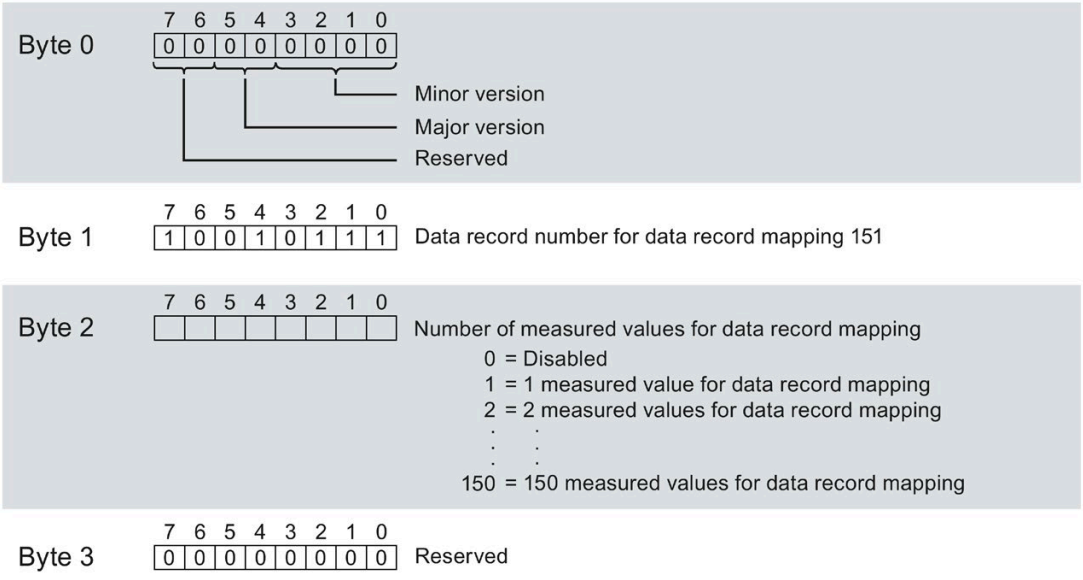


Figure A-16 Header information DS 135

Parameter block for data record mapping

The following diagram shows the structure of the parameter blocks for data record mapping.

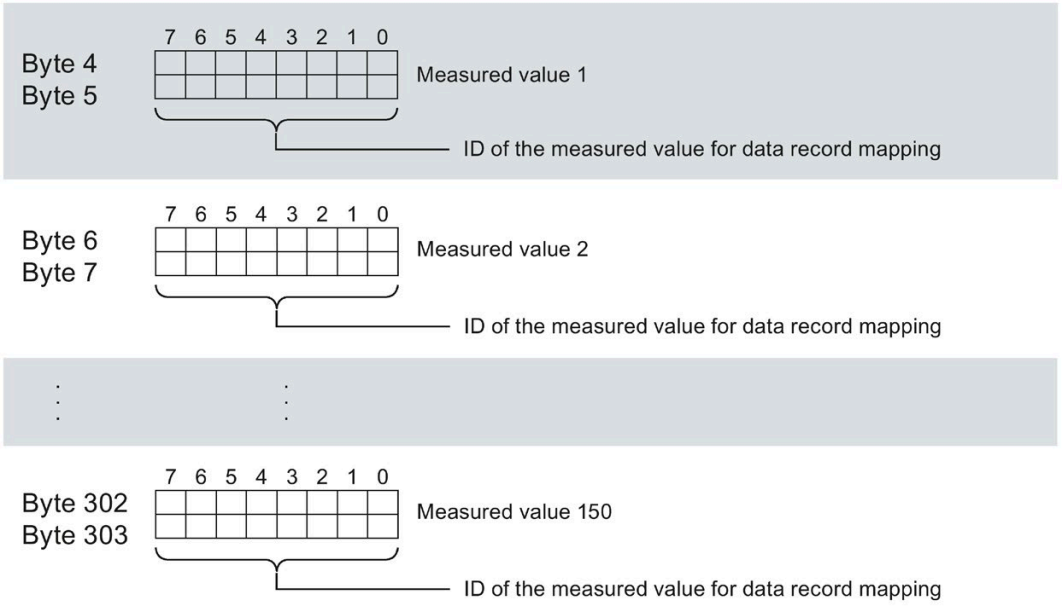


Figure A-17 Parameter block for data record mapping

Data record length DS 135 and DS151

The table below shows the data record lengths of the parameter data record DS 135 and the user-defined data record DS 151 (Page 262).

The length of the data records depends on the number and the format of the measured values.

Number Measured values	Data record length in bytes		
	REAL measured values		LREAL measured values
	DS 135	DS 151	DS 151
29	62	118	234
30	64	122	242 *
40	84	162	322 *
50	104	202	402 *
59	122	238	474 *
100	204	402 *	802 *
118	240	474 *	946 *
150	304*	602 *	1202 *

* not with PROFIBUS DP

Error while transferring the data record

The module always checks all the values of the transferred data record. Only if all the values were transferred without errors does the module apply the values from the data record.

The WRREC instruction for writing data records returns corresponding error codes when errors occur in the STATUS parameter.

The following table shows the module-specific error codes and their meaning for the parameter data record 130/131/135.

Error code in STATUS parameter (hexadecimal)				Meaning	Solution
Byte 0	**Byte 1**	**Byte 2**	**Byte 3**		
DF	80	B0	00	Number of the data record unknown	Enter a valid number for the data record.
DF	80	B1	01	Length of the data record incorrect	Enter a valid value for the data record length.
DF	80	B2	00	Slot invalid or cannot be accessed.	Check the station whether the module is plugged or drawn. Check the assigned values for the parameters of the WRREC instruction
DF	80	E0	01	Incorrect version	Check Byte 0. Enter valid values.
DF	80	E0	02	Error in the header information	Check Bytes 1 and 2. Correct the length and number of the parameter blocks.
DF	80	E1	01	Reserved bits are not 0.	Check Byte 3 and reset the reserved bits to 0.
DF	80	E1	21	"User data variant" not possible or input data configuration not large enough	Select a different user data variant or change the configuration.
DF	80	E1	30	Data record number invalid	Check the data record number. Enter a valid data record number.
DF	80	E1	31	"Length of the parameter block" invalid.	Length of the sent record incorrect. Note byte 2 ("number of parameter blocks").
DF	80	E1	32	"Number of parameter blocks" invalid.	Check Byte 2. Enter valid values.
DF	80	E1	33	"ID of the measured value for limit monitoring" invalid.	Check Bytes 4 and 5. Enter valid values.

Measured variables for data record mapping

You can find the measured variables under "Measured variables for connection type". The following measured variables are not available to you for data record mapping:

- 220 to 226
- 62110 to 62116
- 62210 to 62216
- 62310 to 62316

Measured variables

B

B.1 Measured variables for connection type

Measured variables for data records and user data

The following table provides an overview of all measured variables that are used in the data records and user data.

On the Internet (https://support.industry.siemens.com/cs/ww/en/view/109755917) you can find an overview of the assignment of the measured values to the user data variants and data records.

Table B- 1 Measured variables for data records and user data

Measured value ID	Measured variables	Data type	Unit	Value range	Connection type							
					1P 2W	2P 3W	3x 1P2W	3P 4W	3P 4W1	3P 3W	3P 3W1	3P 4WI
1	Voltage L1-N [1]	REAL	V	0.0 ... 1000000.0	✓	✓	✓	✓	✓	✓	✓	
2	Voltage L2-N [1]	REAL	V	0.0 ... 1000000.0		✓	✓	✓	✓	✓	✓	
3	Voltage L3-N [1]	REAL	V	0.0 ... 1000000.0			✓	✓	✓	✓	✓	
4	Voltage L1-L2 [2]	REAL	V	0.0 ... 1000000.0		✓		✓	✓	✓	✓	
5	Voltage L2-L3 [2]	REAL	V	0.0 ... 1000000.0				✓	✓	✓	✓	
6	Voltage L3-L1 [2]	REAL	V	0.0 ... 1000000.0				✓	✓	✓	✓	
7	Current L1 [1]	REAL	A	0.0 ... 100000.0	✓	✓	✓	✓	✓	✓	✓	✓
8	Current L2 [1]	REAL	A	0.0 ... 100000.0		✓	✓	✓	✓	✓	✓	✓
9	Current L3 [1]	REAL	A	0.0 ... 100000.0			✓	✓	✓	✓	✓	✓
10	Apparent power L1 [3]	REAL	VA	-3.0e+9 ... +3.0e+9	✓	✓	✓	✓	✓	✓	✓	
11	Apparent power L2 [3]	REAL	VA	-3.0e+9 ... +3.0e+9		✓	✓	✓	✓	✓	✓	
12	Apparent power L3 [3]	REAL	VA	-3.0e+9 ... +3.0e+9			✓	✓	✓	✓	✓	
13	Active power L1 [3]	REAL	W	-3.0e+9 ... +3.0e+9	✓	✓	✓	✓	✓	✓	✓	
14	Active power L2 [3]	REAL	W	-3.0e+9 ... +3.0e+9		✓	✓	✓	✓	✓	✓	
15	Active power L3 [3]	REAL	W	-3.0e+9 ... +3.0e+9			✓	✓	✓	✓	✓	
16	Reactive power Qn L1[3]	REAL	var	-3.0e+9 ... +3.0e+9	✓	✓	✓	✓	✓	✓	✓	
17	Reactive power Qn L2[3]	REAL	var	-3.0e+9 ... +3.0e+9		✓	✓	✓	✓	✓	✓	
18	Reactive power Qn L3[3]	REAL	var	-3.0e+9 ... +3.0e+9			✓	✓	✓	✓	✓	
19	Power factor λ L1 [3]	REAL	-	0.0 ... 1.0	✓	✓	✓	✓	✓	✓	✓	
20	Power factor λ L2 [3]	REAL	-	0.0 ... 1.0		✓	✓	✓	✓	✓	✓	
21	Power factor λ L3 [3]	REAL	-	0.0 ... 1.0			✓	✓	✓	✓	✓	
22	Reactive power Qtot L1 [3]	REAL	var	-3.0e+9 ... +3.0e+9	✓	✓	✓	✓	✓	✓	✓	
23	Reactive power Qtot L2 [3]	REAL	var	-3.0e+9 ... +3.0e+9		✓	✓	✓	✓	✓	✓	

Measured value ID	Measured variables	Data type	Unit	Value range	Connection type							
					1P 2W	2P 3W	3x 1P2W	3P 4W	3P 4W1	3P 3W	3P 3W1	3P 4WI
24	Reactive power Qtot L3 [3]	REAL	var	-3.0e+9 ... +3.0e+9			✓	✓	✓	✓	✓	
30	Frequency L1L2L3 [4]	REAL	Hz	45.0 ... 65.0	✓	✓	✓	✓	✓	✓	✓	✓
31	Average Voltage L-N (U_{sum}) [12]	REAL	V	0.0 ... 1000000.0	✓	✓	✓	✓	✓	✓	✓	
32	Average Voltage L-L [12]	REAL	V	0.0 ... 1000000.0				✓	✓	✓	✓	
33	Average Current L1L2L3 (I_{sum}) [12]	REAL	A	0.0 ... 100000.0	✓	✓	✓	✓	✓	✓	✓	✓
34	Active power L1L2L3 [5]	REAL	W	-3.0e+9 ... +3.0e+9	✓	✓	✓	✓	✓	✓	✓	
35	Reactive power Q_n L1L2L3 [5]	REAL	var	-3.0e+9 ... +3.0e+9	✓	✓	✓	✓	✓	✓	✓	
36	Apparent power L1L2L3 [5]	REAL	VA	-3.0e+9 ... +3.0e+9	✓	✓	✓	✓	✓	✓	✓	
37	Power factor λ L1L2L3 [6]	REAL	-	0.0 ... 1.0	✓	✓	✓	✓	✓	✓	✓	
38	Reactive power Qtot L1L2L3 [3] [5]	REAL	var	-3.0e+9 ... +3.0e+9	✓	✓	✓	✓	✓	✓	✓	
40	Max. voltage L1-N [14]	REAL	V	0.0 ... 1000000.0	✓	✓	✓	✓	✓	✓	✓	
41	Max. voltage L2-N [14]	REAL	V	0.0 ... 1000000.0		✓	✓	✓	✓	✓	✓	
42	Max. voltage L3-N [14]	REAL	V	0.0 ... 1000000.0			✓	✓	✓	✓	✓	
43	Max. voltage L1-L2 [14]	REAL	V	0.0 ... 1000000.0		✓		✓	✓	✓	✓	
44	Max. voltage L2-L3 [14]	REAL	V	0.0 ... 1000000.0				✓	✓	✓	✓	
45	Max. voltage L3-L1 [14]	REAL	V	0.0 ... 1000000.0				✓	✓	✓	✓	
46	Max. current L1 [14]	REAL	A	0.0 ... 100000.0	✓	✓	✓	✓	✓	✓	✓	✓
47	Max. current L2 [14]	REAL	A	0.0 ... 100000.0		✓	✓	✓	✓	✓	✓	✓
48	Max. current L3 [14]	REAL	A	0.0 ... 100000.0			✓	✓	✓	✓	✓	✓
49	Max. apparent power L1 [14]	REAL	VA	-3.0e+9 ... +3.0e+9	✓	✓	✓	✓	✓	✓	✓	
50	Max. apparent power L2 [14]	REAL	VA	-3.0e+9 ... +3.0e+9		✓	✓	✓	✓	✓	✓	
51	Max. apparent power L3 [14]	REAL	VA	-3.0e+9 ... +3.0e+9			✓	✓	✓	✓	✓	
52	Max. active power L1 [14]	REAL	W	-3.0e+9 ... +3.0e+9	✓	✓	✓	✓	✓	✓	✓	
53	Max. active power L2 [14]	REAL	W	-3.0e+9 ... +3.0e+9		✓	✓	✓	✓	✓	✓	
54	Max. active power L3 [14]	REAL	W	-3.0e+9 ... +3.0e+9			✓	✓	✓	✓	✓	
55	Max. reactive power Q_n L1 [14]	REAL	var	-3.0e+9 ... +3.0e+9	✓	✓	✓	✓	✓	✓	✓	
56	Max. reactive power Q_n L2 [14]	REAL	var	-3.0e+9 ... +3.0e+9		✓	✓	✓	✓	✓	✓	
57	Max. reactive power Q_n L3 [14]	REAL	var	-3.0e+9 ... +3.0e+9			✓	✓	✓	✓	✓	
58	Max. power factor λ L1 [14]	REAL	-	0.0 ... 1.0	✓	✓	✓	✓	✓	✓	✓	
59	Max. power factor λ L2 [14]	REAL	-	0.0 ... 1.0		✓	✓	✓	✓	✓	✓	
60	Max. power factor λ L3 [14]	REAL	-	0.0 ... 1.0			✓	✓	✓	✓	✓	
61	Max. frequency [14]	REAL	Hz	45.0 ... 65.0	✓	✓	✓	✓	✓	✓	✓	✓

Measured value ID	Measured variables	Data type	Unit	Value range	Connection type							
					1P 2W	2P 3W	3x 1P2W	3P 4W	3P 4W1	3P 3W	3P 3W1	3P 4WI
62	Max. mean voltage L-N [14]	REAL	V	0.0 ... 1000000.0	✓	✓	✓	✓	✓			
63	Max. mean voltage L-L [14]	REAL	V	0.0 ... 1000000.0				✓	✓	✓	✓	
64	Max. mean current L1L2L3 [14]	REAL	A	0.0 ... 100000.0	✓	✓	✓	✓	✓	✓	✓	✓
65	Max. active power L1L2L3 [14]	REAL	W	-3.0e+9 ... +3.0e+9	✓	✓	✓	✓	✓	✓	✓	
66	Max. reactive power Qn L1L2L3[14]	REAL	var	-3.0e+9 ... +3.0e+9	✓	✓	✓	✓	✓	✓	✓	
67	Max. apparent power L1L2L3 [14]	REAL	VA	-3.0e+9 ... +3.0e+9	✓	✓	✓	✓	✓	✓	✓	
68	Max. power factor λ L1L2L3 [14]	REAL	-	0.0 ... 1.0	✓	✓	✓	✓	✓	✓	✓	
70	Min. voltage L1-N [14]	REAL	V	0.0 ... 1000000.0	✓	✓	✓	✓	✓	✓	✓	
71	Min. voltage L2-N [14]	REAL	V	0.0 ... 1000000.0		✓	✓	✓	✓	✓	✓	
72	Min. voltage L3-N [14]	REAL	V	0.0 ... 1000000.0			✓	✓	✓	✓	✓	
73	Min. voltage L1-L2 [14]	REAL	V	0.0 ... 1000000.0		✓		✓	✓	✓	✓	
74	Min. voltage L2-L3 [14]	REAL	V	0.0 ... 1000000.0				✓	✓	✓	✓	
75	Min. voltage L3-L1 [14]	REAL	V	0.0 ... 1000000.0				✓	✓	✓	✓	
76	Min. current L1 [14]	REAL	A	0.0 ... 100000.0	✓	✓	✓	✓	✓	✓	✓	✓
77	Min. current L2 [14]	REAL	A	0.0 ... 100000.0		✓	✓	✓	✓	✓	✓	✓
78	Min. current L3 [14]	REAL	A	0.0 ... 100000.0			✓	✓	✓	✓	✓	✓
79	Min. apparent power L1 [14]	REAL	VA	-3.0e+9 ... +3.0e+9	✓	✓	✓	✓	✓	✓	✓	
80	Min. apparent power L2 [14]	REAL	VA	-3.0e+9 ... +3.0e+9		✓	✓	✓	✓	✓	✓	
81	Min. apparent power L3 [14]	REAL	VA	-3.0e+9 ... +3.0e+9			✓	✓	✓	✓	✓	
82	Min. active power L1 [14]	REAL	W	-3.0e+9 ... +3.0e+9	✓	✓	✓	✓	✓	✓	✓	
83	Min. active power L2 [14]	REAL	W	-3.0e+9 ... +3.0e+9		✓	✓	✓	✓	✓	✓	
84	Min. active power L3 [14]	REAL	W	-3.0e+9 ... +3.0e+9			✓	✓	✓	✓	✓	
85	Max. reactive power Q_n L1 [14]	REAL	var	-3.0e+9 ... +3.0e+9	✓	✓	✓	✓	✓	✓	✓	
86	Max. reactive power Q_n L2 [14]	REAL	var	-3.0e+9 ... +3.0e+9		✓	✓	✓	✓	✓	✓	
87	Max. reactive power Q_n L3 [14]	REAL	var	-3.0e+9 ... +3.0e+9			✓	✓	✓	✓	✓	
88	Min. power factor λ L1 [14]	REAL	-	0.0 ... 1.0	✓	✓	✓	✓	✓	✓	✓	
89	Min. power factor λ L2 [14]	REAL	-	0.0 ... 1.0		✓	✓	✓	✓	✓	✓	
90	Min. power factor λ L3 [14]	REAL	-	0.0 ... 1.0			✓	✓	✓	✓	✓	
91	Min. frequency [14]	REAL	Hz	45.0 ... 65.0	✓	✓	✓	✓	✓	✓	✓	✓
92	Min. mean voltage L-N [14]	REAL	V	0.0 ... 1000000.0	✓	✓	✓	✓	✓			

Measured value ID	Measured variables	Data type	Unit	Value range	Connection type							
					1P 2W	2P 3W	3x 1P2W	3P 4W	3P 4W1	3P 3W	3P 3W1	3P 4WI
93	Min. mean voltage L-L [14]	REAL	V	0.0 ... 1000000.0				✓	✓	✓	✓	
94	Min. mean current L1L2L3[14]	REAL	A	0.0 ... 100000.0	✓	✓	✓	✓	✓	✓	✓	✓
95	Min. active power L1L2L3 [14]	REAL	W	-3.0e+9 ... +3.0e+9	✓	✓	✓	✓	✓	✓	✓	
96	Min. reactive power Q_n L1L2L3 [14]	REAL	var	-3.0e+9 ... +3.0e+9	✓	✓	✓	✓	✓	✓	✓	
97	Min. apparent power L1L2L3 [14]	REAL	VA	-3.0e+9 ... +3.0e+9	✓	✓	✓	✓	✓	✓	✓	
98	Min. power factor λ L1L2L3 [14]	REAL	-	0.0 ... 1.0	✓	✓	✓	✓	✓	✓	✓	
166	Mean power factor λ L1L2L3[12]	REAL	-	0.0 ... 1.0	✓	✓	✓	✓	✓	✓	✓	
200	Active energy inflow L1L2L3 (Float) [6]	REAL	Wh	0.0 ... 3.4028e+38	✓	✓	✓	✓	✓	✓	✓	
201	Active energy outflow L1L2L3 (Float) [6]	REAL	Wh	0.0 ... 3.4028e+38	✓	✓	✓	✓	✓	✓	✓	
202	Reactive energy inflow L1L2L3 (Float) [6]	REAL	varh	0.0 ... 3.4028e+38	✓	✓	✓	✓	✓	✓	✓	
203	Reactive energy outflow L1L2L3 (Float) [6]	REAL	varh	0.0 ... 3.4028e+38	✓	✓	✓	✓	✓	✓	✓	
204	Apparent energy L1L2L3 (Float) [6]	REAL	VAh	0.0 ... 3.4028e+38	✓	✓	✓	✓	✓	✓	✓	
205	Total active energy L1L2L3 (Float) [6]	REAL	Wh	-3.4028e+38 ... +3.4028e+38	✓	✓	✓	✓	✓	✓	✓	
206	Total reactive energy L1L2L3 (Float) [6]	REAL	varh	-3.4028e+38 ... +3.4028e+38	✓	✓	✓	✓	✓	✓	✓	
210	Active energy inflow L1L2L3 [6]	LREAL	Wh	0.0 ... 1.7976e+308	✓	✓	✓	✓	✓	✓	✓	
211	Active energy outflow L1L2L3 [6]	LREAL	Wh	0.0 ... 1.7976e+308	✓	✓	✓	✓	✓	✓	✓	
212	Reactive energy inflow L1L2L3 [6]	LREAL	varh	0.0 ... 1.7976e+308	✓	✓	✓	✓	✓	✓	✓	
213	Reactive energy outflow L1L2L3 [6]	LREAL	varh	0.0 ... 1.7976e+308	✓	✓	✓	✓	✓	✓	✓	
214	Apparent energy L1L2L3 [6]	LREAL	VAh	0.0 ... 1.7976e+308	✓	✓	✓	✓	✓	✓	✓	
215	Total active energy L1L2L3 [6]	LREAL	Wh	-1.7976e+308 ... +1.7976e+308	✓	✓	✓	✓	✓	✓	✓	
216	Total reactive energy L1L2L3 [6]	LREAL	varh	-1.7976e+308 ... +1.7976e+308	✓	✓	✓	✓	✓	✓	✓	
220	Active energy inflow L1L2L3 (Int32) [6]	UDINT	Wh	0 ... 2147483647	✓	✓	✓	✓	✓	✓	✓	
221	Active energy outflow L1L2L3 (Int32) [6]	UDINT	varh	0 ... 2147483647	✓	✓	✓	✓	✓	✓	✓	
222	Reactive energy inflow L1L2L3 (Int32) [6]	UDINT	varh	0 ... 2147483647	✓	✓	✓	✓	✓	✓	✓	

Measured value ID	Measured variables	Data type	Unit	Value range	Connection type							
					1P 2W	2P 3W	3x 1P2W	3P 4W	3P 4W1	3P 3W	3P 3W1	3P 4WI
223	Reactive energy outflow L1L2L3 (Int32) [6]	UDINT	VAh	0 ... 2147483647	✓	✓	✓	✓	✓	✓	✓	
224	Apparent energy L1L2L3 (Int32) [6]	UDINT	Wh	0 ... 2147483647	✓	✓	✓	✓	✓	✓	✓	
225	Total active energy L1L2L3 (Int32) [6]	DINT	Wh	-2147483647 ... +2147483647	✓	✓	✓	✓	✓	✓	✓	
226	Total reactive energy L1L2L3 (Int32) [6]	DINT	varh	-2147483647 ... +2147483647	✓	✓	✓	✓	✓	✓	✓	
61138	Max. reactive power Qtot L1L2L3[3]	REAL	var	-3.0e+9 ... +3.0e+9	✓	✓	✓	✓	✓	✓	✓	
61139	Min. reactive power Qtot L1L2L3[3]	REAL	var	-3.0e+9 ... +3.0e+9	✓	✓	✓	✓	✓	✓	✓	
61140	Overflow counter active energy inflow L1L2L3 [6]	UINT	-	0 ... 65535	✓	✓	✓	✓	✓	✓	✓	
61141	Overflow counter active energy outflow L1L2L3 [6]	UINT	-	0 ... 65535	✓	✓	✓	✓	✓	✓	✓	
61142	Overflow counter reactive energy inflow L1L2L3 [6]	UINT	-	0 ... 65535	✓	✓	✓	✓	✓	✓	✓	
61143	Overflow counter reactive energy outflow L1L2L3 [6]	UINT	-	0 ... 65535	✓	✓	✓	✓	✓	✓	✓	
61144	Overflow counter apparent energy L1L2L3 [6]	UINT	-	0 ... 65535	✓	✓	✓	✓	✓	✓	✓	
61146	Fundamental cos φ active factor L1L2L3[17]	REAL	-	-1.0 ... 1.0	✓	✓	✓	✓	✓	✓	✓	
61147	Max. fundamental cos φ active factor L1L2L3[17]	REAL	-	-1.0 ... 1.0	✓	✓	✓	✓	✓	✓	✓	
61148	Min. fundamental cos φ active factor L1L2L3[17]	REAL	-	-1.0 ... 1.0	✓	✓	✓	✓	✓	✓	✓	
61149	Neutral current IN [1]	REAL	A	0.0 ... 100000.0	Z	Z	Z	✓	✓	Z	Z	✓
61150	Neutral current 10-12 cycles [1, 19]	REAL	A	0.0 ... 100000.0	Z	Z	Z	✓	✓	Z	Z	✓
61151	Neutral current half cycle [1, 16, 19]	REAL	A	0.0 ... 100000.0	Z	Z	Z	✓	✓	Z	Z	✓
61153	Total current IL1+IL2+IL3-IN [1]	REAL	A	-100000.0 ... 100000.0				✓				✓
61154	Reactive power (fundamental) L1L2L3[5]	REAL	var	-3.0e+9 ... +3.0e+9	✓	✓	✓	✓	✓	✓	✓	
61155	Max. reactive power (fundamental) L1L2L3[14]	REAL	var	-3.0e+9 ... +3.0e+9	✓	✓	✓	✓	✓	✓	✓	
61156	Min. reactive power (fundamental) L1L2L3[14]	REAL	var	-3.0e+9 ... +3.0e+9	✓	✓	✓	✓	✓	✓	✓	

Measured value ID	Measured variables	Data type	Unit	Value range	Connection type							
					1P 2W	2P 3W	3x 1P2W	3P 4W	3P 4W1	3P 3W	3P 3W1	3P 4WI
61157	Amplitude unbalance voltage U2 [2]	REAL	%	0 ... 100				✓	✓	✓	✓	
61158	Amplitude unbalance current Iunsym [2]	REAL	%	0 ... 100				✓	✓	✓	✓	✓
61180	Active energy inflow L1 [6]	LREAL	Wh	0.0 ... 1.7976e+308	✓	✓	✓	✓	✓	✓	✓	
61181	Active energy outflow L1 [6]	LREAL	Wh	0.0 ... 1.7976e+308	✓	✓	✓	✓	✓	✓	✓	
61182	Reactive energy inflow L1 [6]	LREAL	varh	0.0 ... 1.7976e+308	✓	✓	✓	✓	✓	✓	✓	
61183	Reactive energy outflow L1 [6]	LREAL	varh	0.0 ... 1.7976e+308	✓	✓	✓	✓	✓	✓	✓	
61184	Apparent energy L1 [6]	LREAL	VAh	0.0 ... 1.7976e+308	✓	✓	✓	✓	✓	✓	✓	
61185	Total active energy L1 [6]	LREAL	Wh	-1.7976e+308 ... +1.7976e+308	✓	✓	✓	✓	✓	✓	✓	
61186	Total reactive energy L1 [6]	LREAL	varh	-1.7976e+308 ... +1.7976e+308	✓	✓	✓	✓	✓	✓	✓	
61190	Overflow counter active energy inflow L1 [6]	UINT	-	0 ... 65535	✓	✓	✓	✓	✓	✓	✓	
61191	Overflow counter active energy outflow L1 [6]	UINT	-	0 ... 65535	✓	✓	✓	✓	✓	✓	✓	
61192	Overflow counter reactive energy inflow L1 [6]	UINT	-	0 ... 65535	✓	✓	✓	✓	✓	✓	✓	
61193	Overflow counter reactive energy outflow L1 [6]	UINT	-	0 ... 65535	✓	✓	✓	✓	✓	✓	✓	
61194	Overflow counter apparent energy L1 [6]	UINT	-	0 ... 65535	✓	✓	✓	✓	✓	✓	✓	
61195	Overflow counter total active energy L1 [6]	UINT	-	0 ... 65535	✓	✓	✓	✓	✓	✓	✓	
61196	Overflow counter total reactive energy L1 [6]	UINT	-	0 ... 65535	✓	✓	✓	✓	✓	✓	✓	
61198	Phase angle L2 [3]	REAL	°	0.0 ... 360.0		✓	✓	✓	✓	✓	✓	
61200	Active energy inflow L2 [6]	LREAL	Wh	0.0 ... 1.7976e+308		✓	✓	✓	✓	✓	✓	
61201	Active energy outflow L2 [6]	LREAL	Wh	0.0 ... 1.7976e+308		✓	✓	✓	✓	✓	✓	
61202	Reactive energy inflow L2 [6]	LREAL	varh	0.0 ... 1.7976e+308		✓	✓	✓	✓	✓	✓	
61203	Reactive energy outflow L2 [6]	LREAL	varh	0.0 ... 1.7976e+308		✓	✓	✓	✓	✓	✓	
61204	Apparent energy L2 [6]	LREAL	VAh	0.0 ... 1.7976e+308		✓	✓	✓	✓	✓	✓	
61205	Total active energy L2 [6]	LREAL	Wh	-1.7976e+308 ... +1.7976e+308		✓	✓	✓	✓	✓	✓	
61206	Total reactive energy L2 [6]	LREAL	varh	-1.7976e+308 ... +1.7976e+308		✓	✓	✓	✓	✓	✓	
61210	Overflow counter active energy inflow L2 [6]	UINT	-	0 ... 65535		✓	✓	✓	✓	✓	✓	

Measured value ID	Measured variables	Data type	Unit	Value range	Connection type							
					1P 2W	2P 3W	3x 1P2W	3P 4W	3P 4W1	3P 3W	3P 3W1	3P 4WI
61211	Overflow counter active energy outflow L2 [6]	UINT	-	0 ... 65535		✓	✓	✓	✓	✓	✓	
61212	Overflow counter reactive energy inflow L2 [6]	UINT	-	0 ... 65535		✓	✓	✓	✓	✓	✓	
61213	Overflow counter reactive energy outflow L2 [6]	UINT	-	0 ... 65535		✓	✓	✓	✓	✓	✓	
61214	Overflow counter apparent energy L2 [6]	UINT	-	0 ... 65535		✓	✓	✓	✓	✓	✓	
61215	Overflow counter total active energy L2 [6]	UINT	-	0 ...65535		✓	✓	✓	✓	✓	✓	
61216	Overflow counter total reactive energy L2 [6]	UINT	-	0 ...65535		✓	✓	✓	✓	✓	✓	
61218	Phase angle L3 [3]	REAL	°	0.0 ... 360.0			✓	✓	✓	✓	✓	
61220	Active energy inflow L3 [6]	LREAL	Wh	0.0 ... 1.7976e+308			✓	✓	✓	✓	✓	
61221	Active energy outflow L3 [6]	LREAL	Wh	0.0 ... 1.7976e+308			✓	✓	✓	✓	✓	
61222	Reactive energy inflow L3 [6]	LREAL	varh	0.0 ... 1.7976e+308			✓	✓	✓	✓	✓	
61223	Reactive energy outflow L3 [6]	LREAL	varh	0.0 ... 1.7976e+308			✓	✓	✓	✓	✓	
61224	Apparent energy L3 [6]	LREAL	VAh	0.0 ... 1.7976e+308			✓	✓	✓	✓	✓	
61225	Total active energy L3 [6]	LREAL	Wh	-1.7976e+308 ... +1.7976e+308			✓	✓	✓	✓	✓	
61226	Total reactive energy L3 [6]	LREAL	varh	-1.7976e+308 ... +1.7976e+308			✓	✓	✓	✓	✓	
61230	Overflow counter active energy inflow L3 [6]	UINT	-	0 ... 65535			✓	✓	✓	✓	✓	
61231	Overflow counter active energy outflow L3 [6]	UINT	-	0 ... 65535			✓	✓	✓	✓	✓	
61232	Overflow counter reactive energy inflow L3 [6]	UINT	-	0 ... 65535			✓	✓	✓	✓	✓	
61233	Overflow counter reactive energy outflow L3 [6]	UINT	-	0 ... 65535			✓	✓	✓	✓	✓	
61234	Overflow counter apparent energy L3 [6]	UINT	-	0 ... 65535			✓	✓	✓	✓	✓	
61235	Overflow counter total active energy L3 [6]	UINT	-	0 ...65535			✓	✓	✓	✓	✓	
61236	Overflow counter total reactive energy L3 [6]	UINT	-	0 ...65535			✓	✓	✓	✓	✓	
62110	Active energy inflow L1 (Int32) [6]	DINT	Wh	0 ... 2147483647	✓	✓	✓	✓	✓	✓	✓	
62111	Active energy outflow L1 (Int32) [6]	UDINT	Wh	0 ... 2147483647	✓	✓	✓	✓	✓	✓	✓	
62112	Reactive energy inflow L1 (Int32) [6]	UDINT	varh	0 ... 2147483647	✓	✓	✓	✓	✓	✓	✓	

Measured value ID	Measured variables	Data type	Unit	Value range	Connection type							
					1P 2W	2P 3W	3x 1P2W	3P 4W	3P 4W1	3P 3W	3P 3W1	3P 4WI
62113	Reactive energy outflow L1 (Int32) [6]	UDINT	varh	0 ... 2147483647	✓	✓	✓	✓	✓	✓	✓	
62114	Apparent energy L1 (Int32) [6]	UDINT	Wh	0 ... 2147483647	✓	✓	✓	✓	✓	✓	✓	
62115	Total active energy L1 (Int32) [6]	DINT	Wh	-2147483647 ... + 2147483647	✓	✓	✓	✓	✓	✓	✓	
62116	Total reactive energy L1 (Int32) [6]	DINT	varh	-2147483647 ... + 2147483647	✓	✓	✓	✓	✓	✓	✓	
62120	Total harmonic distortion (THD+N) voltage L1 [13]	REAL	1%	0 % bis 100 %	✓	✓	✓	✓	✓	✓	✓	
62121	Total harmonic distortion (THD+N) current L1 [13]	REAL	1%	0 % bis 100 %	✓	✓	✓	✓	✓	✓	✓	✓
62122	Fundamental voltage L1 [1]	REAL	V	0.0 ... 1000000.0	✓	✓	✓	✓	✓	✓	✓	
62123	Fundamental current L1 [1]	REAL	A	0.0 ... 100000.0	✓	✓	✓	✓	✓	✓	✓	✓
62124	Fundamental reactive power L1 [3]	REAL	var	-3.0e+9 ... +3.0e+9	✓	✓	✓	✓	✓	✓	✓	
62125	Fundamental apparent power L1 [3]	REAL	VA	-3.0e+9 ... +3.0e+9	✓	✓	✓	✓	✓	✓	✓	
62126	Fundamental active power L1 [3]	REAL	W	-3.0e+9 ... +3.0e+9	✓	✓	✓	✓	✓	✓	✓	
62127	Fundamental cos φ active factor L1 [17]	REAL	-	-1.0 ... 1.0	✓	✓	✓	✓	✓	✓	✓	
62130	Voltage L1 10-12 cycles [1, 19]	REAL	V	0.0 ... 1000000.0	✓	✓	✓	✓	✓	✓	✓	
62131	Voltage L1 half cycle [1, 16, 19]	REAL	V	0.0 ... 1000000.0	✓	✓	✓	✓	✓	✓	✓	
62133	Current L1 10-12 cycles [1, 19]	REAL	A	0.0 ... 100000.0	✓	✓	✓	✓	✓	✓	✓	✓
62134	Current L1 half cycle [1, 16, 19]	REAL	A	0.0 ... 100000.0	✓	✓	✓	✓	✓	✓	✓	✓
62136	Fundamental cos φ active factor L1 (SINT8) [17]	SINT	0.01	-100...100	✓	✓	✓	✓	✓	✓	✓	
62150	Max. total harmonic distortion (THD+N) voltage L1 [14]	REAL	1%	0 % bis 100 %	✓	✓	✓	✓	✓	✓	✓	
62151	Max. total harmonic distortion (THD+N) current L1 [14]	REAL	1%	0 % bis 100 %	✓	✓	✓	✓	✓	✓	✓	✓
62152	Max. fundamental voltage L1 [14]	REAL	V	0.0 ... 1000000.0	✓	✓	✓	✓	✓	✓	✓	
62153	Max. fundamental current L1 [14]	REAL	A	0.0 ... 100000.0	✓	✓	✓	✓	✓	✓	✓	✓
62154	Max. fundamental reactive power L1 [14]	REAL	var	-3.0e+9 ... +3.0e+9	✓	✓	✓	✓	✓	✓	✓	

Measured value ID	Measured variables	Data type	Unit	Value range	Connection type							
					1P 2W	2P 3W	3x 1P2W	3P 4W	3P 4W1	3P 3W	3P 3W1	3P 4WI
62155	Max. fundamental apparent power L1 [14]	REAL	VA	-3.0e+9 ... +3.0e+9	✓	✓	✓	✓	✓	✓	✓	
62156	Max. fundamental active power L1 [14]	REAL	W	-3.0e+9 ... +3.0e+9	✓	✓	✓	✓	✓	✓	✓	
62157	Max. fundamental cos φ active factor L1 [14]	REAL	-	-1.0 ... 1.0	✓	✓	✓	✓	✓	✓	✓	
62160	Max. reactive power Qtot L1 [3]	REAL	var	-3.0e+9 ... +3.0e+9	✓	✓	✓	✓	✓	✓	✓	
62170	Min. total harmonic distortion (THD+N) voltage L1 [14]	REAL	1%	0 % bis 100 %	✓	✓	✓	✓	✓	✓	✓	
62171	Min. total harmonic distortion (THD+N) current L1 [14]	REAL	1%	0 % bis 100 %	✓	✓	✓	✓	✓	✓	✓	✓
62172	Min. fundamental voltage L1 [14]	REAL	V	0.0 ... 1000000.0	✓	✓	✓	✓	✓	✓	✓	
62173	Min. fundamental current L1 [14]	REAL	A	0.0 ... 100000.0	✓	✓	✓	✓	✓	✓	✓	✓
62174	Min. fundamental reactive power L1 [14]	REAL	var	-3.0e+9 ... +3.0e+9	✓	✓	✓	✓	✓	✓	✓	
62175	Min. fundamental apparent power L1[14]	REAL	VA	-3.0e+9 ... +3.0e+9	✓	✓	✓	✓	✓	✓	✓	
62176	Min. fundamental active power L1 [14]	REAL	W	-3.0e+9 ... +3.0e+9	✓	✓	✓	✓	✓	✓	✓	
62177	Min. fundamental cos φ active factor L1[14]	REAL	-	-1.0 ... 1.0	✓	✓	✓	✓	✓	✓	✓	
62180	Min. reactive power Qtot L1 [3]	REAL	var	-3.0e+9 ... +3.0e+9	✓	✓	✓	✓	✓	✓	✓	
62194	Voltage dip - value L1 [16]	REAL	V	0.0 ... 1000000.0	✓	✓	✓	✓	✓	✓	✓	
62195	Voltage swell - value L1 [16]	REAL	V	0.0 ... 1000000.0	✓	✓	✓	✓	✓	✓	✓	
62196	Voltage peak value L1 [17]	REAL	V	0.0 ... 1000000.0	✓	✓	✓	✓	✓	✓	✓	
62197	Current peak value L1 [17]	REAL	A	0.0 ... 100000.0	✓	✓	✓	✓	✓	✓	✓	✓
62198	Overcurrent- value L1 [16]	REAL	A	0.0 ... 100000.0	✓	✓	✓	✓	✓	✓	✓	✓
62199	Voltage dip - duration L1 [16]	REAL	ms	0.0 ... 100000.0	✓	✓	✓	✓	✓	✓	✓	
62200	Voltage swell - duration L1 [16]	REAL	ms	0.0 ... 100000.0	✓	✓	✓	✓	✓	✓	✓	
62210	Active energy inflow L2 (Int32) [6]	DINT	Wh	0... 2147483647		✓	✓	✓	✓	✓	✓	
62211	Active energy outflow L2 (Int32) [6]	DINT	Wh	0... 2147483647		✓	✓	✓	✓	✓	✓	
62212	Reactive energy inflow L2 (Int32) [6]	DINT	varh	0... 2147483647		✓	✓	✓	✓	✓	✓	
62213	Reactive energy outflow L2 (Int32) [6]	DINT	varh	0... 2147483647		✓	✓	✓	✓	✓	✓	

Measured value ID	Measured variables	Data type	Unit	Value range	Connection type							
					1P 2W	2P 3W	3x 1P2W	3P 4W	3P 4W1	3P 3W	3P 3W1	3P 4WI
62214	Apparent energy L2 (Int32) [6]	DINT	VAh	0... 2147483647		✓	✓	✓	✓	✓	✓	
62215	Total active energy L2 (Int32) [6]	DINT	Wh	-2147483647...+2147483647		✓	✓	✓	✓	✓	✓	
62216	Total reactive energy L2 (Int32) [6]	DINT	varh	-2147483647...+2147483647		✓	✓	✓	✓	✓	✓	
62220	Total harmonic distortion (THD+N) voltage L2 [13]	REAL	1%	0 % bis 100 %		✓	✓	✓	✓	✓	✓	
62221	Total harmonic distortion (THD+N) current L2 [13]	REAL	1%	0 % bis 100 %		✓	✓	✓	✓	✓	✓	✓
62222	Fundamental voltage L2[2]	REAL	V	0.0 ... 1000000.0		✓	✓	✓	✓	✓	✓	
62223	Fundamental current L2 [1]	REAL	A	0.0 ... 100000.0		✓	✓	✓	✓	✓	✓	✓
62224	Fundamental reactive power L2 [3]	REAL	var	-3.0e+9 ... +3.0e+9		✓	✓	✓	✓	✓	✓	
62225	Fundamental apparent power L2 [3]	REAL	VA	-3.0e+9 ... +3.0e+9		✓	✓	✓	✓	✓	✓	
62226	Fundamental active power L2 [3]	REAL	W	-3.0e+9 ... +3.0e+9		✓	✓	✓	✓	✓	✓	
62227	Fundamental cos φ active factor L2 [17]	REAL	-	-1.0 ... 1.0		✓	✓	✓	✓	✓	✓	
62230	Voltage L2 10-12 cycles [1, 19]	REAL	V	0.0 ... 1000000.0		✓	✓	✓	✓	✓	✓	
62231	Voltage L2 half cycle [1, 16, 19]	REAL	V	0.0 ... 1000000.0		✓	✓	✓	✓	✓	✓	
62233	Current L2 10-12 cycles [1, 19]	REAL	A	0.0 ... 100000.0		✓	✓	✓	✓	✓	✓	✓
62234	Current L2 half cycle [1, 16, 19]	REAL	A	0.0 ... 100000.0		✓	✓	✓	✓	✓	✓	✓
62236	Fundamental cos φ active factor L2 (SINT8) [17]	SINT	0.01	-100...100		✓	✓	✓	✓	✓	✓	
62250	Max. total harmonic distortion (THD+N) voltage L2 [14]	REAL	1%	0 % bis 100 %		✓	✓	✓	✓	✓	✓	
62251	Max. total harmonic distortion (THD+N) current L2 [14]	REAL	1%	0 % bis 100 %		✓	✓	✓	✓	✓	✓	✓
62252	Max. fundamental voltage L2 [14]	REAL	V	0.0 ... 1000000.0		✓	✓	✓	✓	✓	✓	
62253	Max. fundamental current L2 [14]	REAL	A	0.0 ... 100000.0		✓	✓	✓	✓	✓	✓	✓
62254	Max. fundamental reactive power L2 [14]	REAL	var	-3.0e+9 ... +3.0e+9		✓	✓	✓	✓	✓	✓	

Measured value ID	Measured variables	Data type	Unit	Value range	Connection type							
					1P 2W	2P 3W	3x 1P2W	3P 4W	3P 4W1	3P 3W	3P 3W1	3P 4WI
62255	Max. fundamental apparent power L2 [14]	REAL	VA	-3.0e+9 ... +3.0e+9		✓	✓	✓	✓	✓	✓	
62256	Max. fundamental active power L2 [14]	REAL	W	-3.0e+9 ... +3.0e+9		✓	✓	✓	✓	✓	✓	
62257	Max. fundamental cos φ active factor L2 [14]	REAL	-	-1.0 ... 1.0		✓	✓	✓	✓	✓	✓	
62260	Max. reactive power Qtot L2 [3]	REAL	var	-3.0e+9 ... +3.0e+9		✓	✓	✓	✓	✓	✓	
62270	Min. total harmonic distortion (THD+N) voltage L2 [14]	REAL	1%	0 % bis 100 %		✓	✓	✓	✓	✓	✓	
62271	Min. total harmonic distortion (THD+N) current L2 [14]	REAL	1%	0 % bis 100 %		✓	✓	✓	✓	✓	✓	✓
62272	Min. fundamental voltage L2 [14]	REAL	V	0.0 ... 1000000.0		✓	✓	✓	✓	✓	✓	
62273	Min. fundamental current L2 [14]	REAL	A	0.0 ... 100000.0		✓	✓	✓	✓	✓	✓	✓
62274	Min. fundamental reactive power L2 [14]	REAL	var	-3.0e+9 ... +3.0e+9		✓	✓	✓	✓	✓	✓	
62275	Min. fundamental apparent power L2[14]	REAL	VA	-3.0e+9 ... +3.0e+9		✓	✓	✓	✓	✓	✓	
62276	Min. fundamental active power L2 [14]	REAL	W	-3.0e+9 ... +3.0e+9		✓	✓	✓	✓	✓	✓	
62277	Min. fundamental cos φ active factor L2[14]	REAL	-	-1.0 ... 1.0		✓	✓	✓	✓	✓	✓	
62280	Min. reactive power Qtot L2 [3]	REAL	var	-3.0e+9 ... +3.0e+9		✓	✓	✓	✓	✓	✓	
62294	Voltage dip - value L2 [16]	REAL	V	0.0 ... 1000000.0		✓	✓	✓	✓	✓	✓	
62295	Voltage swell - value L2 [16]	REAL	V	0.0 ... 1000000.0		✓	✓	✓	✓	✓	✓	
62296	Voltage peak value L2 [17]	REAL	V	0.0 ... 1000000.0		✓	✓	✓	✓	✓	✓	
62297	Current peak value L2 [17]	REAL	A	0.0 ... 100000.0		✓	✓	✓	✓	✓	✓	✓
62298	Overcurrent- value L2 [16]	REAL	A	0.0 ... 100000.0		✓	✓	✓	✓	✓	✓	✓
62299	Voltage dip - duration L2 [16]	REAL	ms	0.0 ... 100000.0		✓	✓	✓	✓	✓	✓	
62300	Voltage swell - duration L2 [16]	REAL	ms	0.0 ... 100000.0		✓	✓	✓	✓	✓	✓	
62310	Active energy inflow L3 (Int32) [6]	DINT	Wh	0... 2147483647			✓	✓	✓	✓	✓	
62311	Active energy outflow L3 (Int32) [6]	DINT	Wh	0... 2147483647			✓	✓	✓	✓	✓	
62312	Reactive energy inflow L3 (Int32) [6]	DINT	varh	0... 2147483647			✓	✓	✓	✓	✓	
62313	Reactive energy outflow L3 (Int32) [6]	DINT	varh	0... 2147483647			✓	✓	✓	✓	✓	

Measured value ID	Measured variables	Data type	Unit	Value range	Connection type							
					1P 2W	2P 3W	3x 1P2W	3P 4W	3P 4W1	3P 3W	3P 3W1	3P 4WI
62314	Apparent energy L3 (Int32) [6]	DINT	VAh	0... 2147483647			✓	✓	✓	✓	✓	
62315	Total active energy L3 (Int32) [6]	DINT	Wh	-2147483647...+2147483647			✓	✓	✓	✓	✓	
62316	Total reactive energy L3 (Int32) [6]	DINT	varh	-2147483647...+2147483647			✓	✓	✓	✓	✓	
62320	Total harmonic distortion (THD+N) voltage L3 [13]	REAL	1%	0 % bis 100 %			✓	✓	✓	✓	✓	
62321	Total harmonic distortion (THD+N) current L3 [13]	REAL	1%	0 % bis 100 %			✓	✓	✓	✓	✓	✓
62322	Fundamental voltage L3 [2]	REAL	V	0.0 ... 1000000.0			✓	✓	✓	✓	✓	
62323	Fundamental current L3 [1]	REAL	A	0.0 ... 100000.0			✓	✓	✓	✓	✓	✓
62324	Fundamental reactive power L3 [3]	REAL	var	-3.0e+9 ... +3.0e+9			✓	✓	✓	✓	✓	
62325	Fundamental apparent power L3 [3]	REAL	VA	-3.0e+9 ... +3.0e+9			✓	✓	✓	✓	✓	
62326	Fundamental active power L3[3]	REAL	W	-3.0e+9 ... +3.0e+9			✓	✓	✓	✓	✓	
62327	Fundamental cos φ active factor L3 [17]	REAL	-	-1.0 ... 1.0			✓	✓	✓	✓	✓	
62330	Voltage L3 10-12 cycles [1, 19]	REAL	V	0.0 ... 1000000.0			✓	✓	✓	✓	✓	
62331	Voltage L3 half cycle [1, 16, 19]	REAL	V	0.0 ... 1000000.0			✓	✓	✓	✓	✓	
62332	Voltage L3 - instantaneous value [17]	REAL	V	0.0 ... 1000000.0			✓	✓	✓	✓	✓	
62333	Current L3 10-12 cycles [1, 19]	REAL	A	0.0 ... 100000.0			✓	✓	✓	✓	✓	✓
62334	Current L3 half cycle [1, 16, 19]	REAL	A	0.0 ... 100000.0			✓	✓	✓	✓	✓	✓
62336	Fundamental cos φ active factor L3 (SINT8) [17]	SINT	0.01	-100...100			✓	✓	✓	✓	✓	
62350	Max. total harmonic distortion (THD+N) current L3 [14]	REAL	1%	0 % bis 100 %			✓	✓	✓	✓	✓	
62351	Max. total harmonic distortion (THD+N) voltage L3 [14]	REAL	1%	0 % bis 100 %			✓	✓	✓	✓	✓	✓
62352	Max. fundamental voltage L3[14]	REAL	V	0.0 ... 1000000.0			✓	✓	✓	✓	✓	
62353	Max. fundamental current L3[14]	REAL	A	0.0 ... 100000.0			✓	✓	✓	✓	✓	✓

Measured value ID	Measured variables	Data type	Unit	Value range	Connection type							
					1P 2W	2P 3W	3x 1P2W	3P 4W	3P 4W1	3P 3W	3P 3W1	3P 4WI
62354	Max. fundamental reactive power L3[14]	REAL	var	-3.0e+9 ... +3.0e+9			✓	✓	✓	✓	✓	
62355	Max. fundamental apparent power L3[14]	REAL	VA	-3.0e+9 ... +3.0e+9			✓	✓	✓	✓	✓	
62356	Max. fundamental active power L3[14]	REAL	W	-3.0e+9 ... +3.0e+9			✓	✓	✓	✓	✓	
62357	Max. fundamental cos φ active factor L3[14]	REAL	-	-1.0 ... 1.0			✓	✓	✓	✓	✓	
62360	Max. reactive power Qtot L3[3]	REAL	var	-3.0e+9 ... +3.0e+9			✓	✓	✓	✓	✓	
62370	Min. total harmonic distortion (THD+N) voltage L3 [14]	REAL	1%	0 % bis 100 %			✓	✓	✓	✓	✓	
62371	Min. total harmonic distortion (THD+N) current L3 [14]	REAL	1%	0 % bis 100 %			✓	✓	✓	✓	✓	✓
62372	Min. fundamental voltage L3[14]	REAL	V	0.0 ... 1000000.0			✓	✓	✓	✓	✓	
62373	Min. fundamental current L3 [14]	REAL	A	0.0 ... 100000.0			✓	✓	✓	✓	✓	✓
62374	Min. fundamental reactive power L3 [14]	REAL	var	-3.0e+9 ... +3.0e+9			✓	✓	✓	✓	✓	
62375	Min. fundamental apparent power L3[14]	REAL	VA	-3.0e+9 ... +3.0e+9			✓	✓	✓	✓	✓	
62376	Min. fundamental active power L3[14]	REAL	W	-3.0e+9 ... +3.0e+9			✓	✓	✓	✓	✓	
62377	Min. fundamental cos φ active factor L3[14]	REAL	-	-1.0 ... 1.0			✓	✓	✓	✓	✓	
62380	Min. reactive power Qtot L3[3]	REAL	var	-3.0e+9 ... +3.0e+9			✓	✓	✓	✓	✓	
62394	Voltage dip - value L3[16]	REAL	V	0.0 ... 1000000.0			✓	✓	✓	✓	✓	
62395	Voltage swell - value L3[16]	REAL	V	0.0 ... 1000000.0			✓	✓	✓	✓	✓	
62396	Voltage peak value L3[17]	REAL	V	0.0 ... 1000000.0			✓	✓	✓	✓	✓	
62397	Current peak value L3 [17]	REAL	A	0.0 ... 100000.0			✓	✓	✓	✓	✓	✓
62398	Overcurrent- value L3[16]	REAL	A	0.0 ... 100000.0			✓	✓	✓	✓	✓	✓
62399	Voltage dip - duration L3[16]	REAL	ms	0.0 ... 100000.0			✓	✓	✓	✓	✓	
62400	Voltage swell - dura-tion L3[16]	REAL	ms	0.0 ... 100000.0			✓	✓	✓	✓	✓	
Harmonics												
63000	Harmonics 1: Voltage L1 [18]	REAL	V	0.0 ... 1000000.0	✓	✓	✓	✓	✓	✓	✓	
63001	Harmonics 1: Current L1 [18]	REAL	A	0.0 ... 100000.0	✓	✓	✓	✓	✓	✓	✓	✓
63002	Harmonics 2: Voltage L1 [18]	REAL	V	0.0 ... 1000000.0	✓	✓	✓	✓	✓	✓	✓	

Measured value ID	Measured variables	Data type	Unit	Value range	Connection type							
					1P 2W	2P 3W	3x 1P2W	3P 4W	3P 4W1	3P 3W	3P 3W1	3P 4WI
63003	Harmonics 2: Current L1 [18]	REAL	A	0.0 ... 100000.0	✓	✓	✓	✓	✓	✓	✓	✓
63004	Harmonics 3: Voltage L1 [18]	REAL	V	0.0 ... 1000000.0	✓	✓	✓	✓	✓	✓	✓	
63005	Harmonics 3: Current L1 [18]	REAL	A	0.0 ... 100000.0	✓	✓	✓	✓	✓	✓	✓	✓
63006	Harmonics 4: Voltage L1 [18]	REAL	V	0.0 ... 1000000.0	✓	✓	✓	✓	✓	✓	✓	
63007	Harmonics 4: Current L1 [18]	REAL	A	0.0 ... 100000.0	✓	✓	✓	✓	✓	✓	✓	✓
63008	Harmonics 5: Voltage L1 [18]	REAL	V	0.0 ... 1000000.0	✓	✓	✓	✓	✓	✓	✓	
63009	Harmonics 5: Current L1 [18]	REAL	A	0.0 ... 100000.0	✓	✓	✓	✓	✓	✓	✓	✓
63010	Harmonics 6: Voltage L1 [18]	REAL	V	0.0 ... 1000000.0	✓	✓	✓	✓	✓	✓	✓	
63011	Harmonics 6: Current L1 [18]	REAL	A	0.0 ... 100000.0	✓	✓	✓	✓	✓	✓	✓	✓
63012	Harmonics 7: Voltage L1 [18]	REAL	V	0.0 ... 1000000.0	✓	✓	✓	✓	✓	✓	✓	
63013	Harmonics 7: Current L1 [18]	REAL	A	0.0 ... 100000.0	✓	✓	✓	✓	✓	✓	✓	✓
63014	Harmonics 8: Voltage L1 [18]	REAL	V	0.0 ... 1000000.0	✓	✓	✓	✓	✓	✓	✓	
63015	Harmonics 8: Current L1 [18]	REAL	A	0.0 ... 100000.0	✓	✓	✓	✓	✓	✓	✓	✓
63016	Harmonics 9: Voltage L1 [18]	REAL	V	0.0 ... 1000000.0	✓	✓	✓	✓	✓	✓	✓	
63017	Harmonics 9: Current L1 [18]	REAL	A	0.0 ... 100000.0	✓	✓	✓	✓	✓	✓	✓	✓
63018	Harmonics 10: Voltage L1 [18]	REAL	V	0.0 ... 1000000.0	✓	✓	✓	✓	✓	✓	✓	
63019	Harmonics 10: Current L1 [18]	REAL	A	0.0 ... 100000.0	✓	✓	✓	✓	✓	✓	✓	✓
63020	Harmonics 11: Voltage L1 [18]	REAL	V	0.0 ... 1000000.0	✓	✓	✓	✓	✓	✓	✓	
63021	Harmonics 11: Current L1 [18]	REAL	A	0.0 ... 100000.0	✓	✓	✓	✓	✓	✓	✓	✓
63022	Harmonics 12: Voltage L1 [18]	REAL	V	0.0 ... 1000000.0	✓	✓	✓	✓	✓	✓	✓	
63023	Harmonics 12: Current L1 [18]	REAL	A	0.0 ... 100000.0	✓	✓	✓	✓	✓	✓	✓	✓
63024	Harmonics 13: Voltage L1 [18]	REAL	V	0.0 ... 1000000.0	✓	✓	✓	✓	✓	✓	✓	
63025	Harmonics 13: Current L1 [18]	REAL	A	0.0 ... 100000.0	✓	✓	✓	✓	✓	✓	✓	✓
63026	Harmonics 14: Voltage L1 [18]	REAL	V	0.0 ... 1000000.0	✓	✓	✓	✓	✓	✓	✓	

Measured value ID	Measured variables	Data type	Unit	Value range	Connection type							
					1P 2W	2P 3W	3x 1P2W	3P 4W	3P 4W1	3P 3W	3P 3W1	3P 4WI
63027	Harmonics 14: Current L1 [18]	REAL	A	0.0 ... 100000.0	✓	✓	✓	✓	✓	✓	✓	✓
63028	Harmonics 15: Voltage L1 [18]	REAL	V	0.0 ... 1000000.0	✓	✓	✓	✓	✓	✓	✓	
63029	Harmonics 15: Current L1 [18]	REAL	A	0.0 ... 100000.0	✓	✓	✓	✓	✓	✓	✓	✓
63030	Harmonics 16: Voltage L1 [18]	REAL	V	0.0 ... 1000000.0	✓	✓	✓	✓	✓	✓	✓	
63031	Harmonics 16: Current L1 [18]	REAL	A	0.0 ... 100000.0	✓	✓	✓	✓	✓	✓	✓	✓
63032	Harmonics 17: Voltage L1 [18]	REAL	V	0.0 ... 1000000.0	✓	✓	✓	✓	✓	✓	✓	
63033	Harmonics 17: Current L1 [18]	REAL	A	0.0 ... 100000.0	✓	✓	✓	✓	✓	✓	✓	✓
63034	Harmonics 18: Voltage L1 [18]	REAL	V	0.0 ... 1000000.0	✓	✓	✓	✓	✓	✓	✓	
63035	Harmonics 18: Current L1 [18]	REAL	A	0.0 ... 100000.0	✓	✓	✓	✓	✓	✓	✓	✓
63036	Harmonics 19: Voltage L1 [18]	REAL	V	0.0 ... 1000000.0	✓	✓	✓	✓	✓	✓	✓	
63037	Harmonics 19: Current L1 [18]	REAL	A	0.0 ... 100000.0	✓	✓	✓	✓	✓	✓	✓	✓
63038	Harmonics 20: Voltage L1 [18]	REAL	V	0.0 ... 1000000.0	✓	✓	✓	✓	✓	✓	✓	
63039	Harmonics 20: Current L1 [18]	REAL	A	0.0 ... 100000.0	✓	✓	✓	✓	✓	✓	✓	✓
63040	Harmonics 21: Voltage L1 [18]	REAL	V	0.0 ... 1000000.0	✓	✓	✓	✓	✓	✓	✓	
63041	Harmonics 21: Current L1 [18]	REAL	A	0.0 ... 100000.0	✓	✓	✓	✓	✓	✓	✓	✓
63042	Harmonics 22: Voltage L1 [18]	REAL	V	0.0 ... 1000000.0	✓	✓	✓	✓	✓	✓	✓	
63043	Harmonics 22: Current L1 [18]	REAL	A	0.0 ... 100000.0	✓	✓	✓	✓	✓	✓	✓	✓
63044	Harmonics 23: Voltage L1 [18]	REAL	V	0.0 ... 1000000.0	✓	✓	✓	✓	✓	✓	✓	
63045	Harmonics 23: Current L1 [18]	REAL	A	0.0 ... 100000.0	✓	✓	✓	✓	✓	✓	✓	✓
63046	Harmonics 24: Voltage L1 [18]	REAL	V	0.0 ... 1000000.0	✓	✓	✓	✓	✓	✓	✓	
63047	Harmonics 24: Current L1 [18]	REAL	A	0.0 ... 100000.0	✓	✓	✓	✓	✓	✓	✓	✓
63048	Harmonics 25: Voltage L1 [18]	REAL	V	0.0 ... 1000000.0	✓	✓	✓	✓	✓	✓	✓	
63049	Harmonics 25: Current L1 [18]	REAL	A	0.0 ... 100000.0	✓	✓	✓	✓	✓	✓	✓	✓
63050	Harmonics 26: Voltage L1 [18]	REAL	V	0.0 ... 1000000.0	✓	✓	✓	✓	✓	✓	✓	

Measured value ID	Measured variables	Data type	Unit	Value range	Connection type							
					1P 2W	2P 3W	3x 1P2W	3P 4W	3P 4W1	3P 3W	3P 3W1	3P 4WI
63051	Harmonics 26: Current L1 [18]	REAL	A	0.0 ... 100000.0	✓	✓	✓	✓	✓	✓	✓	✓
63052	Harmonics 27: Voltage L1 [18]	REAL	V	0.0 ... 1000000.0	✓	✓	✓	✓	✓	✓	✓	
63053	Harmonics 27: Current L1 [18]	REAL	A	0.0 ... 100000.0	✓	✓	✓	✓	✓	✓	✓	✓
63054	Harmonics 28: Voltage L1 [18]	REAL	V	0.0 ... 1000000.0	✓	✓	✓	✓	✓	✓	✓	
63055	Harmonics 28: Current L1 [18]	REAL	A	0.0 ... 100000.0	✓	✓	✓	✓	✓	✓	✓	✓
63056	Harmonics 29: Voltage L1 [18]	REAL	V	0.0 ... 1000000.0	✓	✓	✓	✓	✓	✓	✓	
63057	Harmonics 29: Current L1 [18]	REAL	A	0.0 ... 100000.0	✓	✓	✓	✓	✓	✓	✓	✓
63058	Harmonics 30: Voltage L1 [18]	REAL	V	0.0 ... 1000000.0	✓	✓	✓	✓	✓	✓	✓	
63059	Harmonics 30: Current L1 [18]	REAL	A	0.0 ... 100000.0	✓	✓	✓	✓	✓	✓	✓	✓
63060	Harmonics 31: Voltage L1 [18]	REAL	V	0.0 ... 1000000.0	✓	✓	✓	✓	✓	✓	✓	
63061	Harmonics 31: Current L1 [18]	REAL	A	0.0 ... 100000.0	✓	✓	✓	✓	✓	✓	✓	✓
63062	Harmonics 32: Voltage L1 [18]	REAL	V	0.0 ... 1000000.0	✓	✓	✓	✓	✓	✓	✓	
63063	Harmonics 32: Current L1 [18]	REAL	A	0.0 ... 100000.0	✓	✓	✓	✓	✓	✓	✓	✓
63064	Harmonics 33: Voltage L1 [18]	REAL	V	0.0 ... 1000000.0	✓	✓	✓	✓	✓	✓	✓	
63065	Harmonics 33: Current L1 [18]	REAL	A	0.0 ... 100000.0	✓	✓	✓	✓	✓	✓	✓	✓
63066	Harmonics 34: Voltage L1 [18]	REAL	V	0.0 ... 1000000.0	✓	✓	✓	✓	✓	✓	✓	
63067	Harmonics 34: Current L1 [18]	REAL	A	0.0 ... 100000.0	✓	✓	✓	✓	✓	✓	✓	✓
63068	Harmonics 35: Voltage L1 [18]	REAL	V	0.0 ... 1000000.0	✓	✓	✓	✓	✓	✓	✓	
63069	Harmonics 35: Current L1 [18]	REAL	A	0.0 ... 100000.0	✓	✓	✓	✓	✓	✓	✓	✓
63070	Harmonics 36: Voltage L1 [18]	REAL	V	0.0 ... 1000000.0	✓	✓	✓	✓	✓	✓	✓	
63071	Harmonics 36: Current L1 [18]	REAL	A	0.0 ... 100000.0	✓	✓	✓	✓	✓	✓	✓	✓
63072	Harmonics 37: Voltage L1 [18]	REAL	V	0.0 ... 1000000.0	✓	✓	✓	✓	✓	✓	✓	
63073	Harmonics 37: Current L1 [18]	REAL	A	0.0 ... 100000.0	✓	✓	✓	✓	✓	✓	✓	✓
63074	Harmonics 38: Voltage L1 [18]	REAL	V	0.0 ... 1000000.0	✓	✓	✓	✓	✓	✓	✓	

Measured value ID	Measured variables	Data type	Unit	Value range	Connection type							
					1P 2W	2P 3W	3x 1P2W	3P 4W	3P 4W1	3P 3W	3P 3W1	3P 4WI
63075	Harmonics 38: Current L1 [18]	REAL	A	0.0 ... 100000.0	✓	✓	✓	✓	✓	✓	✓	✓
63076	Harmonics 39: Voltage L1 [18]	REAL	V	0.0 ... 1000000.0	✓	✓	✓	✓	✓	✓	✓	
63077	Harmonics 39: Current L1 [18]	REAL	A	0.0 ... 100000.0	✓	✓	✓	✓	✓	✓	✓	✓
63078	Harmonics 40: Voltage L1 [18]	REAL	V	0.0 ... 1000000.0	✓	✓	✓	✓	✓	✓	✓	
63079	Harmonics 40: Current L1 [18]	REAL	A	0.0 ... 100000.0	✓	✓	✓	✓	✓	✓	✓	✓
63400	Harmonics 1: Voltage L2 [18]	REAL	V	0.0 ... 1000000.0		✓	✓	✓	✓	✓	✓	
63401	Harmonics 1: Current L2 [18]	REAL	A	0.0 ... 100000.0		✓	✓	✓	✓	✓	✓	✓
63402	Harmonics 2: Voltage L2 [18]	REAL	V	0.0 ... 1000000.0		✓	✓	✓	✓	✓	✓	
63403	Harmonics 2: Current L2 [18]	REAL	A	0.0 ... 100000.0		✓	✓	✓	✓	✓	✓	✓
63404	Harmonics 3: Voltage L2 [18]	REAL	V	0.0 ... 1000000.0		✓	✓	✓	✓	✓	✓	
63405	Harmonics 3: Current L2 [18]	REAL	A	0.0 ... 100000.0		✓	✓	✓	✓	✓	✓	✓
63406	Harmonics 4: Voltage L2 [18]	REAL	V	0.0 ... 1000000.0		✓	✓	✓	✓	✓	✓	
63407	Harmonics 4: Current L2 [18]	REAL	A	0.0 ... 100000.0		✓	✓	✓	✓	✓	✓	✓
63408	Harmonics 5: Voltage L2 [18]	REAL	V	0.0 ... 1000000.0		✓	✓	✓	✓	✓	✓	
63409	Harmonics 5: Current L2 [18]	REAL	A	0.0 ... 100000.0		✓	✓	✓	✓	✓	✓	✓
63410	Harmonics 6: Voltage L2 [18]	REAL	V	0.0 ... 1000000.0		✓	✓	✓	✓	✓	✓	
63411	Harmonics 6: Current L2 [18]	REAL	A	0.0 ... 100000.0		✓	✓	✓	✓	✓	✓	✓
63412	Harmonics 7: Voltage L2 [18]	REAL	V	0.0 ... 1000000.0		✓	✓	✓	✓	✓	✓	
63413	Harmonics 7: Current L2 [18]	REAL	A	0.0 ... 100000.0		✓	✓	✓	✓	✓	✓	✓
63414	Harmonics 8: Voltage L2 [18]	REAL	V	0.0 ... 1000000.0		✓	✓	✓	✓	✓	✓	
63415	Harmonics 8: Current L2 [18]	REAL	A	0.0 ... 100000.0		✓	✓	✓	✓	✓	✓	✓
63416	Harmonics 9: Voltage L2 [18]	REAL	V	0.0 ... 1000000.0		✓	✓	✓	✓	✓	✓	
63417	Harmonics 9: Current L2 [18]	REAL	A	0.0 ... 100000.0		✓	✓	✓	✓	✓	✓	✓
63418	Harmonics 10: Voltage L2 [18]	REAL	V	0.0 ... 1000000.0		✓	✓	✓	✓	✓	✓	

Measured value ID	Measured variables	Data type	Unit	Value range	Connection type							
					1P 2W	2P 3W	3x 1P2W	3P 4W	3P 4W1	3P 3W	3P 3W1	3P 4WI
63419	Harmonics 10: Current L2 [18]	REAL	A	0.0 ... 100000.0		✓	✓	✓	✓	✓	✓	✓
63420	Harmonics 11: Voltage L2 [18]	REAL	V	0.0 ... 1000000.0		✓	✓	✓	✓	✓	✓	
63421	Harmonics 11: Current L2 [18]	REAL	A	0.0 ... 100000.0		✓	✓	✓	✓	✓	✓	✓
63422	Harmonics 12: Voltage L2 [18]	REAL	V	0.0 ... 1000000.0		✓	✓	✓	✓	✓	✓	
63423	Harmonics 12: Current L2 [18]	REAL	A	0.0 ... 100000.0		✓	✓	✓	✓	✓	✓	✓
63424	Harmonics 13: Voltage L2 [18]	REAL	V	0.0 ... 1000000.0		✓	✓	✓	✓	✓	✓	
63425	Harmonics 13: Current L2 [18]	REAL	A	0.0 ... 100000.0		✓	✓	✓	✓	✓	✓	✓
63426	Harmonics 14: Voltage L2 [18]	REAL	V	0.0 ... 1000000.0		✓	✓	✓	✓	✓	✓	
63427	Harmonics 14: Current L2 [18]	REAL	A	0.0 ... 100000.0		✓	✓	✓	✓	✓	✓	✓
63428	Harmonics 15: Voltage L2 [18]	REAL	V	0.0 ... 1000000.0		✓	✓	✓	✓	✓	✓	
63429	Harmonics 15: Current L2 [18]	REAL	A	0.0 ... 100000.0		✓	✓	✓	✓	✓	✓	✓
63430	Harmonics 16: Voltage L2 [18]	REAL	V	0.0 ... 1000000.0		✓	✓	✓	✓	✓	✓	
63431	Harmonics 16: Current L2 [18]	REAL	A	0.0 ... 100000.0		✓	✓	✓	✓	✓	✓	✓
63432	Harmonics 17: Voltage L2 [18]	REAL	V	0.0 ... 1000000.0		✓	✓	✓	✓	✓	✓	
63433	Harmonics 17: Current L2 [18]	REAL	A	0.0 ... 100000.0		✓	✓	✓	✓	✓	✓	✓
63434	Harmonics 18: Voltage L2 [18]	REAL	V	0.0 ... 1000000.0		✓	✓	✓	✓	✓	✓	
63435	Harmonics 18: Current L2 [18]	REAL	A	0.0 ... 100000.0		✓	✓	✓	✓	✓	✓	✓
63436	Harmonics 19: Voltage L2 [18]	REAL	V	0.0 ... 1000000.0		✓	✓	✓	✓	✓	✓	
63437	Harmonics 19: Current L2 [18]	REAL	A	0.0 ... 100000.0		✓	✓	✓	✓	✓	✓	✓
63438	Harmonics 20: Voltage L2 [18]	REAL	V	0.0 ... 1000000.0		✓	✓	✓	✓	✓	✓	
63439	Harmonics 20: Current L2 [18]	REAL	A	0.0 ... 100000.0		✓	✓	✓	✓	✓	✓	✓
63440	Harmonics 21: Voltage L2 [18]	REAL	V	0.0 ... 1000000.0		✓	✓	✓	✓	✓	✓	
63441	Harmonics 21: Current L2 [18]	REAL	A	0.0 ... 100000.0		✓	✓	✓	✓	✓	✓	✓
63442	Harmonics 22: Voltage L2 [18]	REAL	V	0.0 ... 1000000.0		✓	✓	✓	✓	✓	✓	

Measured value ID	Measured variables	Data type	Unit	Value range	Connection type							
					1P 2W	2P 3W	3x 1P2W	3P 4W	3P 4W1	3P 3W	3P 3W1	3P 4WI
63443	Harmonics 22: Current L2 [18]	REAL	A	0.0 ... 100000.0		✓	✓	✓	✓	✓	✓	✓
63444	Harmonics 23: Voltage L2 [18]	REAL	V	0.0 ... 1000000.0		✓	✓	✓	✓	✓	✓	
63445	Harmonics 23: Current L2 [18]	REAL	A	0.0 ... 100000.0		✓	✓	✓	✓	✓	✓	✓
63446	Harmonics 24: Voltage L2 [18]	REAL	V	0.0 ... 1000000.0		✓	✓	✓	✓	✓	✓	
63447	Harmonics 24: Current L2 [18]	REAL	A	0.0 ... 100000.0		✓	✓	✓	✓	✓	✓	✓
63448	Harmonics 25: Voltage L2 [18]	REAL	V	0.0 ... 1000000.0		✓	✓	✓	✓	✓	✓	
63449	Harmonics 25: Current L2 [18]	REAL	A	0.0 ... 100000.0		✓	✓	✓	✓	✓	✓	✓
63450	Harmonics 26: Voltage L2 [18]	REAL	V	0.0 ... 1000000.0		✓	✓	✓	✓	✓	✓	
63451	Harmonics 26: Current L2 [18]	REAL	A	0.0 ... 100000.0		✓	✓	✓	✓	✓	✓	✓
63452	Harmonics 27: Voltage L2 [18]	REAL	V	0.0 ... 1000000.0		✓	✓	✓	✓	✓	✓	
63453	Harmonics 27: Current L2 [18]	REAL	A	0.0 ... 100000.0		✓	✓	✓	✓	✓	✓	✓
63454	Harmonics 28: Voltage L2 [18]	REAL	V	0.0 ... 1000000.0		✓	✓	✓	✓	✓	✓	
63455	Harmonics 28: Current L2 [18]	REAL	A	0.0 ... 100000.0		✓	✓	✓	✓	✓	✓	✓
63456	Harmonics 29: Voltage L2 [18]	REAL	V	0.0 ... 1000000.0		✓	✓	✓	✓	✓	✓	
63457	Harmonics 29: Current L2 [18]	REAL	A	0.0 ... 100000.0		✓	✓	✓	✓	✓	✓	✓
63458	Harmonics 30: Voltage L2 [18]	REAL	V	0.0 ... 1000000.0		✓	✓	✓	✓	✓	✓	
63459	Harmonics 30: Current L2 [18]	REAL	A	0.0 ... 100000.0		✓	✓	✓	✓	✓	✓	✓
63460	Harmonics 31: Voltage L2 [18]	REAL	V	0.0 ... 1000000.0		✓	✓	✓	✓	✓	✓	
63461	Harmonics 31: Current L2 [18]	REAL	A	0.0 ... 100000.0		✓	✓	✓	✓	✓	✓	✓
63462	Harmonics 32: Voltage L2 [18]	REAL	V	0.0 ... 1000000.0		✓	✓	✓	✓	✓	✓	
63463	Harmonics 32: Current L2 [18]	REAL	A	0.0 ... 100000.0		✓	✓	✓	✓	✓	✓	✓
63464	Harmonics 33: Voltage L2 [18]	REAL	V	0.0 ... 1000000.0		✓	✓	✓	✓	✓	✓	
63465	Harmonics 33: Current L2 [18]	REAL	A	0.0 ... 100000.0		✓	✓	✓	✓	✓	✓	✓
63466	Harmonics 34: Voltage L2 [18]	REAL	V	0.0 ... 1000000.0		✓	✓	✓	✓	✓	✓	

Measured value ID	Measured variables	Data type	Unit	Value range	Connection type							
					1P 2W	2P 3W	3x 1P2W	3P 4W	3P 4W1	3P 3W	3P 3W1	3P 4WI
63467	Harmonics 34: Current L2 [18]	REAL	A	0.0 ... 100000.0		✓	✓	✓	✓	✓	✓	✓
63468	Harmonics 35: Voltage L2 [18]	REAL	V	0.0 ... 1000000.0		✓	✓	✓	✓	✓	✓	
63469	Harmonics 35: Current L2 [18]	REAL	A	0.0 ... 100000.0		✓	✓	✓	✓	✓	✓	✓
63470	Harmonics 36: Voltage L2 [18]	REAL	V	0.0 ... 1000000.0		✓	✓	✓	✓	✓	✓	
63471	Harmonics 36: Current L2 [18]	REAL	A	0.0 ... 100000.0		✓	✓	✓	✓	✓	✓	✓
63472	Harmonics 37: Voltage L2 [18]	REAL	V	0.0 ... 1000000.0		✓	✓	✓	✓	✓	✓	
63473	Harmonics 37: Current L2 [18]	REAL	A	0.0 ... 100000.0		✓	✓	✓	✓	✓	✓	✓
63474	Harmonics 38: Voltage L2 [18]	REAL	V	0.0 ... 1000000.0		✓	✓	✓	✓	✓	✓	
63475	Harmonics 38: Current L2 [18]	REAL	A	0.0 ... 100000.0		✓	✓	✓	✓	✓	✓	✓
63476	Harmonics 39: Voltage L2 [18]	REAL	V	0.0 ... 1000000.0		✓	✓	✓	✓	✓	✓	
63477	Harmonics 39: Current L2 [18]	REAL	A	0.0 ... 100000.0		✓	✓	✓	✓	✓	✓	✓
63478	Harmonics 40: Voltage L2 [18]	REAL	V	0.0 ... 1000000.0		✓	✓	✓	✓	✓	✓	
63479	Harmonics 40: Current L2 [18]	REAL	A	0.0 ... 100000.0		✓	✓	✓	✓	✓	✓	✓
63800	Harmonics 1: Voltage L3 [18]	REAL	V	0.0 ... 1000000.0			✓	✓	✓	✓	✓	
63801	Harmonics 1: Current L3 [18]	REAL	A	0.0 ... 100000.0			✓	✓	✓	✓	✓	✓
63802	Harmonics 2: Voltage L3 [18]	REAL	V	0.0 ... 1000000.0			✓	✓	✓	✓	✓	
63803	Harmonics 2: Current L3 [18]	REAL	A	0.0 ... 100000.0			✓	✓	✓	✓	✓	✓
63804	Harmonics 3: Voltage L3 [18]	REAL	V	0.0 ... 1000000.0			✓	✓	✓	✓	✓	
63805	Harmonics 3: Current L3 [18]	REAL	A	0.0 ... 100000.0			✓	✓	✓	✓	✓	✓
63806	Harmonics 4: Voltage L3 [18]	REAL	V	0.0 ... 1000000.0			✓	✓	✓	✓	✓	
63807	Harmonics 4: Current L3 [18]	REAL	A	0.0 ... 100000.0			✓	✓	✓	✓	✓	✓
63808	Harmonics 5: Voltage L3 [18]	REAL	V	0.0 ... 1000000.0			✓	✓	✓	✓	✓	
63809	Harmonics 5: Current L3 [18]	REAL	A	0.0 ... 100000.0			✓	✓	✓	✓	✓	✓
63810	Harmonics 6: Voltage L3 [18]	REAL	V	0.0 ... 1000000.0			✓	✓	✓	✓	✓	

Measured value ID	Measured variables	Data type	Unit	Value range	Connection type							
					1P 2W	2P 3W	3x 1P2W	3P 4W	3P 4W1	3P 3W	3P 3W1	3P 4WI
63811	Harmonics 6: Current L3 [18]	REAL	A	0.0 ... 100000.0			✓	✓	✓	✓	✓	✓
63812	Harmonics 7: Voltage L3 [18]	REAL	V	0.0 ... 1000000.0			✓	✓	✓	✓	✓	
63813	Harmonics 7: Current L3 [18]	REAL	A	0.0 ... 100000.0			✓	✓	✓	✓	✓	✓
63814	Harmonics 8: Voltage L3 [18]	REAL	V	0.0 ... 1000000.0			✓	✓	✓	✓	✓	
63815	Harmonics 8: Current L3 [18]	REAL	A	0.0 ... 100000.0			✓	✓	✓	✓	✓	✓
63816	Harmonics 9: Voltage L3 [18]	REAL	V	0.0 ... 1000000.0			✓	✓	✓	✓	✓	
63817	Harmonics 9: Current L3 [18]	REAL	A	0.0 ... 100000.0			✓	✓	✓	✓	✓	✓
63818	Harmonics 10: Voltage L3 [18]	REAL	V	0.0 ... 1000000.0			✓	✓	✓	✓	✓	
63819	Harmonics 10: Current L3 [18]	REAL	A	0.0 ... 100000.0			✓	✓	✓	✓	✓	✓
63820	Harmonics 11: Voltage L3 [18]	REAL	V	0.0 ... 1000000.0			✓	✓	✓	✓	✓	
63821	Harmonics 11: Current L3 [18]	REAL	A	0.0 ... 100000.0			✓	✓	✓	✓	✓	✓
63822	Harmonics 12: Voltage L3 [18]	REAL	V	0.0 ... 1000000.0			✓	✓	✓	✓	✓	
63823	Harmonics 12: Current L3 [18]	REAL	A	0.0 ... 100000.0			✓	✓	✓	✓	✓	✓
63824	Harmonics 13: Voltage L3 [18]	REAL	V	0.0 ... 1000000.0			✓	✓	✓	✓	✓	
63825	Harmonics 13: Current L3 [18]	REAL	A	0.0 ... 100000.0			✓	✓	✓	✓	✓	✓
63826	Harmonics 14: Voltage L3 [18]	REAL	V	0.0 ... 1000000.0			✓	✓	✓	✓	✓	
63827	Harmonics 14: Current L3 [18]	REAL	A	0.0 ... 100000.0			✓	✓	✓	✓	✓	✓
63828	Harmonics 15: Voltage L3 [18]	REAL	V	0.0 ... 1000000.0			✓	✓	✓	✓	✓	
63829	Harmonics 15: Current L3 [18]	REAL	A	0.0 ... 100000.0			✓	✓	✓	✓	✓	✓
63830	Harmonics 16: Voltage L3 [18]	REAL	V	0.0 ... 1000000.0			✓	✓	✓	✓	✓	
63831	Harmonics 16: Current L3 [18]	REAL	A	0.0 ... 100000.0			✓	✓	✓	✓	✓	✓
63832	Harmonics 17: Voltage L3 [18]	REAL	V	0.0 ... 1000000.0			✓	✓	✓	✓	✓	
63833	Harmonics 17: Current L3 [18]	REAL	A	0.0 ... 100000.0			✓	✓	✓	✓	✓	✓
63834	Harmonics 18: Voltage L3 [18]	REAL	V	0.0 ... 1000000.0			✓	✓	✓	✓	✓	

Measured value ID	Measured variables	Data type	Unit	Value range	Connection type							
					1P 2W	2P 3W	3x 1P2W	3P 4W	3P 4W1	3P 3W	3P 3W1	3P 4WI
63835	Harmonics 18: Current L3 [18]	REAL	A	0.0 ... 100000.0			✓	✓	✓	✓	✓	✓
63836	Harmonics 19: Voltage L3 [18]	REAL	V	0.0 ... 1000000.0			✓	✓	✓	✓	✓	
63837	Harmonics 19: Current L3 [18]	REAL	A	0.0 ... 100000.0			✓	✓	✓	✓	✓	✓
63838	Harmonics 20: Voltage L3 [18]	REAL	V	0.0 ... 1000000.0			✓	✓	✓	✓	✓	
63839	Harmonics 20: Current L3 [18]	REAL	A	0.0 ... 100000.0			✓	✓	✓	✓	✓	✓
63840	Harmonics 21: Voltage L3 [18]	REAL	V	0.0 ... 1000000.0			✓	✓	✓	✓	✓	
63841	Harmonics 21: Current L3 [18]	REAL	A	0.0 ... 100000.0			✓	✓	✓	✓	✓	✓
63842	Harmonics 22: Voltage L3 [18]	REAL	V	0.0 ... 1000000.0			✓	✓	✓	✓	✓	
63843	Harmonics 22: Current L3 [18]	REAL	A	0.0 ... 100000.0			✓	✓	✓	✓	✓	✓
63844	Harmonics 23: Voltage L3 [18]	REAL	V	0.0 ... 1000000.0			✓	✓	✓	✓	✓	
63845	Harmonics 23: Current L3 [18]	REAL	A	0.0 ... 100000.0			✓	✓	✓	✓	✓	✓
63846	Harmonics 24: Voltage L3 [18]	REAL	V	0.0 ... 1000000.0			✓	✓	✓	✓	✓	
63847	Harmonics 24: Current L3 [18]	REAL	A	0.0 ... 100000.0			✓	✓	✓	✓	✓	✓
63848	Harmonics 25: Voltage L3 [18]	REAL	V	0.0 ... 1000000.0			✓	✓	✓	✓	✓	
63849	Harmonics 25: Current L3 [18]	REAL	A	0.0 ... 100000.0			✓	✓	✓	✓	✓	✓
63850	Harmonics 26: Voltage L3 [18]	REAL	V	0.0 ... 1000000.0			✓	✓	✓	✓	✓	
63851	Harmonics 26: Current L3 [18]	REAL	A	0.0 ... 100000.0			✓	✓	✓	✓	✓	✓
63852	Harmonics 27: Voltage L3 [18]	REAL	V	0.0 ... 1000000.0			✓	✓	✓	✓	✓	
63853	Harmonics 27: Current L3 [18]	REAL	A	0.0 ... 100000.0			✓	✓	✓	✓	✓	✓
63854	Harmonics 28: Voltage L3 [18]	REAL	V	0.0 ... 1000000.0			✓	✓	✓	✓	✓	
63855	Harmonics 28: Current L3 [18]	REAL	A	0.0 ... 100000.0			✓	✓	✓	✓	✓	✓
63856	Harmonics 29: Voltage L3 [18]	REAL	V	0.0 ... 1000000.0			✓	✓	✓	✓	✓	
63857	Harmonics 29: Current L3 [18]	REAL	A	0.0 ... 100000.0			✓	✓	✓	✓	✓	✓
63858	Harmonics 30: Voltage L3 [18]	REAL	V	0.0 ... 1000000.0			✓	✓	✓	✓	✓	

Measured value ID	Measured variables	Data type	Unit	Value range	Connection type							
					1P 2W	2P 3W	3x 1P2W	3P 4W	3P 4W1	3P 3W	3P 3W1	3P 4WI
63859	Harmonics 30: Current L3 [18]	REAL	A	0.0 ... 100000.0			✓	✓	✓	✓	✓	✓
63860	Harmonics 31: Voltage L3 [18]	REAL	V	0.0 ... 1000000.0			✓	✓	✓	✓	✓	
63861	Harmonics 31: Current L3 [18]	REAL	A	0.0 ... 100000.0			✓	✓	✓	✓	✓	✓
63862	Harmonics 32: Voltage L3 [18]	REAL	V	0.0 ... 1000000.0			✓	✓	✓	✓	✓	
63863	Harmonics 32: Current L3 [18]	REAL	A	0.0 ... 100000.0			✓	✓	✓	✓	✓	✓
63864	Harmonics 33: Voltage L3 [18]	REAL	V	0.0 ... 1000000.0			✓	✓	✓	✓	✓	
63865	Harmonics 33: Current L3 [18]	REAL	A	0.0 ... 100000.0			✓	✓	✓	✓	✓	✓
63866	Harmonics 34: Voltage L3 [18]	REAL	V	0.0 ... 1000000.0			✓	✓	✓	✓	✓	
63867	Harmonics 34: Current L3 [18]	REAL	A	0.0 ... 100000.0			✓	✓	✓	✓	✓	✓
63868	Harmonics 35: Voltage L3 [18]	REAL	V	0.0 ... 1000000.0			✓	✓	✓	✓	✓	
63869	Harmonics 35: Current L3 [18]	REAL	A	0.0 ... 100000.0			✓	✓	✓	✓	✓	✓
63870	Harmonics 36: Voltage L3 [18]	REAL	V	0.0 ... 1000000.0			✓	✓	✓	✓	✓	
63871	Harmonics 36: Current L3 [18]	REAL	A	0.0 ... 100000.0			✓	✓	✓	✓	✓	✓
63872	Harmonics 37: Voltage L3 [18]	REAL	V	0.0 ... 1000000.0			✓	✓	✓	✓	✓	
63873	Harmonics 37: Current L3 [18]	REAL	A	0.0 ... 100000.0			✓	✓	✓	✓	✓	✓
63874	Harmonics 38: Voltage L3 [18]	REAL	V	0.0 ... 1000000.0			✓	✓	✓	✓	✓	
63875	Harmonics 38: Current L3 [18]	REAL	A	0.0 ... 100000.0			✓	✓	✓	✓	✓	✓
63876	Harmonics 39: Voltage L3 [18]	REAL	V	0.0 ... 1000000.0			✓	✓	✓	✓	✓	
63877	Harmonics 39: Current L3 [18]	REAL	A	0.0 ... 100000.0			✓	✓	✓	✓	✓	✓
63878	Harmonics 40: Voltage L3 [18]	REAL	V	0.0 ... 1000000.0			✓	✓	✓	✓	✓	
63879	Harmonics 40: Current L3 [18]	REAL	A	0.0 ... 100000.0			✓	✓	✓	✓	✓	✓
65496	Power quality analysis - Qualifier	UDINT	Bit track	0 ... 4294967295	✓	✓	✓	✓	✓	✓	✓	✓
65497	Current module time	PNIO	sec		✓	✓	✓	✓	✓	✓	✓	✓
65500	Qualifier L1	UINT	Bit track	0 ... 65535	✓	✓	✓	✓	✓	✓	✓	✓
65501	Qualifier L2	UINT	Bit track	0 ... 65535		✓	✓	✓	✓	✓	✓	✓

Measured value ID	Measured variables	Data type	Unit	Value range	Connection type							
					1P 2W	2P 3W	3x 1P2W	3P 4W	3P 4W1	3P 3W	3P 3W1	3P 4WI
65502	Qualifier L3	UINT	Bit track	0 ... 65535			✓	✓	✓	✓	✓	✓
65503	Qualifier L1L2L3	UINT	Bit track	0 ... 65535	✓	✓	✓	✓	✓	✓	✓	✓
65504	Operating hours counter L1L2L3 [5]	REAL	h	0.0 ... 3.4e+38	✓	✓	✓	✓	✓	✓	✓	✓
65505	Operating hours counter L1 [5]	REAL	h	0.0 ... 3.4e+38	✓	✓	✓	✓	✓	✓	✓	✓
65506	Operating hours counter L2 [5]	REAL	h	0.0 ... 3.4e+38		✓	✓	✓	✓	✓	✓	✓
65507	Operating hours counter L3 [5]	REAL	h	0.0 ... 3.4e+38			✓	✓	✓	✓	✓	✓
65508	Status of energy counter overflows	UINT	Bit track	0 ... 65535	✓	✓	✓	✓	✓	✓	✓	✓
65509	Status of limit violations 1...16	UINT	Bit track	0 ... 65535	✓	✓	✓	✓	✓	✓	✓	✓
65510	Counter for limit violations GW1 [5]	UDINT		0 ... 4294967295	✓	✓	✓	✓	✓	✓	✓	✓
65511	Counter for limit violations GW2 [5]	UDINT		0 ... 4294967295	✓	✓	✓	✓	✓	✓	✓	✓
65512	Counter for limit violations GW3 [5]	UDINT		0 ... 4294967295	✓	✓	✓	✓	✓	✓	✓	✓
65513	Counter for limit violations GW4 [5]	UDINT		0 ... 4294967295	✓	✓	✓	✓	✓	✓	✓	✓
65514	Counter for limit violations GW5 [5]	UDINT		0 ... 4294967295	✓	✓	✓	✓	✓	✓	✓	✓
65515	Counter for limit violations GW6 [5]	UDINT		0 ... 4294967295	✓	✓	✓	✓	✓	✓	✓	✓
65516	Counter for limit violations GW7 [5]	UDINT		0 ... 4294967295	✓	✓	✓	✓	✓	✓	✓	✓
65517	Counter for limit violations GW8 [5]	UDINT		0 ... 4294967295	✓	✓	✓	✓	✓	✓	✓	✓
65518	Counter for limit violations GW9 [5]	UDINT		0 ... 4294967295	✓	✓	✓	✓	✓	✓	✓	✓
65519	Counter for limit violations GW10 [5]	UDINT		0 ... 4294967295	✓	✓	✓	✓	✓	✓	✓	✓
65520	Counter for limit violations GW11 [5]	UDINT		0 ... 4294967295	✓	✓	✓	✓	✓	✓	✓	✓
65521	Counter for limit violations GW12 [5]	UDINT		0 ... 4294967295	✓	✓	✓	✓	✓	✓	✓	✓
65522	Counter for limit violations GW13 [5]	UDINT		0 ... 4294967295	✓	✓	✓	✓	✓	✓	✓	✓
65523	Counter for limit violations GW14 [5]	UDINT		0 ... 4294967295	✓	✓	✓	✓	✓	✓	✓	✓
65524	Counter for limit violations GW15 [5]	UDINT		0 ... 4294967295	✓	✓	✓	✓	✓	✓	✓	✓
65525	Counter for limit violations GW16 [5]	UDINT		0 ... 4294967295	✓	✓	✓	✓	✓	✓	✓	✓

The table below is relevant for the description of the user data variants:

Measured value ID	Measured variables	Data type	Unit	Value range	Connection type							
					1P 2 W	2P 3 W	3x 1P 2 W	3P 4 W	3P 4 W 1	3P 3 W	3P 3 W 1	3P 4 W I
66001	Voltage L1-N [1]	UINT	0.01 V	0 ... 65535	✓	✓	✓	✓	✓			
66002	Voltage L2-N [1]	UINT	0.01 V	0 ... 65535		✓	✓	✓	✓			
66003	Voltage L3-N [1]	UINT	0.01 V	0 ... 65535			✓	✓	✓			
66004	Voltage L1-L2 [2]	UINT	0.01 V	0 ... 65535		✓		✓	✓	✓	✓	
66005	Voltage L2-L3 [2]	UINT	0.01 V	0 ... 65535				✓	✓	✓	✓	
66006	Voltage L3-L1 [2]	UINT	0.01 V	0 ... 65535				✓	✓	✓	✓	
66007	Current L1 [1]	UINT	1 mA	0 ... 65535	✓	✓	✓	✓	✓	✓	✓	✓
66008	Current L2 [1]	UINT	1 mA	0 ... 65535		✓	✓	✓	✓	✓	✓	✓
66009	Current L3 [1]	UINT	1 mA	0 ... 65535			✓	✓	✓	✓	✓	✓
66010	Apparent power L1 [3]	INT	1 VA	-32768 ... 32767	✓	✓	✓	✓	✓	✓	✓	
66011	Apparent power L2 [3]	INT	1 VA	-32768 ... 32767		✓	✓	✓	✓	✓	✓	
66012	Apparent power L3 [3]	INT	1 VA	-32768 ... 32767			✓	✓	✓	✓	✓	
66013	Active power L1 [3]	INT	1 W	-32768 ... 32767	✓	✓	✓	✓	✓	✓	✓	
66014	Active power L2 [3]	INT	1 W	-32768 ... 32767		✓	✓	✓	✓	✓	✓	
66015	Active power L3 [3]	INT	1 W	-32768 ... 32767			✓	✓	✓	✓	✓	
66016	Reactive power Qn L1[3]	INT	1 var	-32768 ... 32767	✓	✓	✓	✓	✓	✓	✓	
66017	Reactive power Qn L2[3]	INT	1 var	-32768 ... 32767		✓	✓	✓	✓	✓	✓	
66018	Reactive power Qn L3[3]	INT	1 var	-32768 ... 32767			✓	✓	✓	✓	✓	
66019	Power factor λ L1 [3]	USINT	0.01	0 ... 100	✓	✓	✓	✓	✓	✓	✓	
66020	Power factor λ L2 [3]	USINT	0.01	0 ... 100		✓	✓	✓	✓	✓	✓	
66021	Power factor λ L3 [3]	USINT	0.01	0 ... 100			✓	✓	✓	✓	✓	
66022	Reactive power Qtot L1 [3]	INT	1 var	-32768 ... 32767	✓	✓	✓	✓	✓	✓	✓	
66023	Reactive power Qtot L2 [3]	INT	1 var	-32768 ... 32767		✓	✓	✓	✓	✓	✓	
66024	Reactive power Qtot L3 [3]	INT	1 var	-32768 ... 32767			✓	✓	✓	✓	✓	
66030	Frequency (Uint8) [4]	USINT	1 Hz	45 ... 65	✓	✓	✓	✓	✓	✓	✓	✓
66031	Frequency (Uint16) [4]	UINT	0.01 Hz	4500 ... 6500	✓	✓	✓	✓	✓	✓	✓	✓
66034	Active power L1L2L3 [5]	INT	1 W	-32768 ... 32767	✓	✓	✓	✓	✓	✓	✓	
66035	Reactive power Qn L1L2L3[5]	INT	1 var	-32768 ... 32767	✓	✓	✓	✓	✓	✓	✓	
66036	Apparent power L1L2L3 [5]	INT	1 VA	-32768 ... 32767	✓	✓	✓	✓	✓	✓	✓	

Meas-ured value ID	Measured variables	Data type	Unit	Value range	Connection type							
					1P 2 W	2P 3 W	3x 1P 2 W	3P 4 W	3P 4 W 1	3P 3 W	3P 3 W 1	3P 4 W I
66037	Power factor λ L1L2L3 [6]	USINT	0.01	0 ... 100	✓	✓	✓	✓	✓	✓	✓	
66038	Reactive power Qtot L1L2L3	INT	1 var	-32768 ... 32767	✓	✓	✓	✓	✓	✓	✓	✓

Z = additionally possible measured values in the current path (e.g. instead of neutral current)

1 Effective value

2 IEC 61557-12

3 floating arithmetic average value above 200 ms

4 floating arithmetic average value above 10 s, available for UL-N>3 V

5 Simple summation

6 Calculation from the start/restart (inflow and outflow values are positive numbers)

7 floating arithmetic average value above 3 s

8 floating arithmetic average value above 600 s

9 floating arithmetic average value above 900 s

10 Block measurement over 900 s

11 direct measurement of the signal wave at 8 ksps

12 Total of the parts / number of parts

13 THD (Total Harmonic Distortion) is calculated once per second by the RMS of the fundamental oscillation and the total effective value (IEEE standard 1459–2010)

14 Min./Max: Slave pointer function of the respective basic value from start/reset

15 Calculation according to DIN EN 61000-3-316 half-wave value

16 Half-wave value

17 Instantaneous value

18 FFT (Fast Fourier Transformation)

19 While pure RMS measured values only contain AC voltage components of the signal, 10/12 and half-wave measured values also show DC voltage components of the signal

20 ET 200SP Diagnostics:

Bit2: Voltage less than tolerance range (for diagnostics enable Voltage underflow)

Bit3: Voltage greater than tolerance range (for diagnostics enable Voltage overflow)

Bit4: Current value > Current maximum value longer than tolerance time (for diagnostics enable Current overflow)

Bit7: Calculated value > value range (for diagnostics enable Calculated value overflow)

Bit16: Parameter error

Bit17: Load voltage error (for diagnostics enable No supply voltage)

Bit22: PRAL lost

Bit26: Power quality error (for diagnostics enable Power quality)

Bit31: Calibration or firmware update

Format

Table B- 2 Format and its length in bytes

Format in STEP 7 (TIA Portal)	Format to IEEE	Length in bytes	Comment
BYTE	BYTE	1 byte	Bit field with 8 bit
WORD	WORD	2 bytes	Bit field with 16 bit
SINT	INT8 (signed)	1 byte	Fixed-point number 8 bits with sign
USINT	INT8 (unsigned)	1 byte	Fixed-point number 8 bits without sign
INT	INT (signed)	2 bytes	Fixed-point number 16 bits with sign
UINT	INT (unsigned)	2 bytes	Fixed-point number 16 bits without sign
UDINT	INT32 (unsigned)	4 bytes	Fixed-point number 32 bits without sign
DINT	INT32 (signed)	4 bytes	Fixed-point number, 32 bits with sign
REAL	Float32	4 bytes	Floating-point number 32 bits with sign
LREAL	Float64	8 bytes	Floating-point number 64 bits with sign

Module versions

C

C.1 Module version "2 I / 2 Q"

User data of the module

The module has 2 bytes of input user data and 2 bytes of output user data for status and control information. At this module version measured variables can be read solely via measured value data records (no measured variables can be evaluated via user data).

Structure of input user data

The structure of the input user data is fixed.

Table C- 1 Structure of input user data (2 bytes)

Byte	Validity	Designation	Comment
0	Module	User data variant	Constant = 0x80
1	Module	Quality information	Quality bits to describe the quality of the basic measured values

Allocation of the input user data

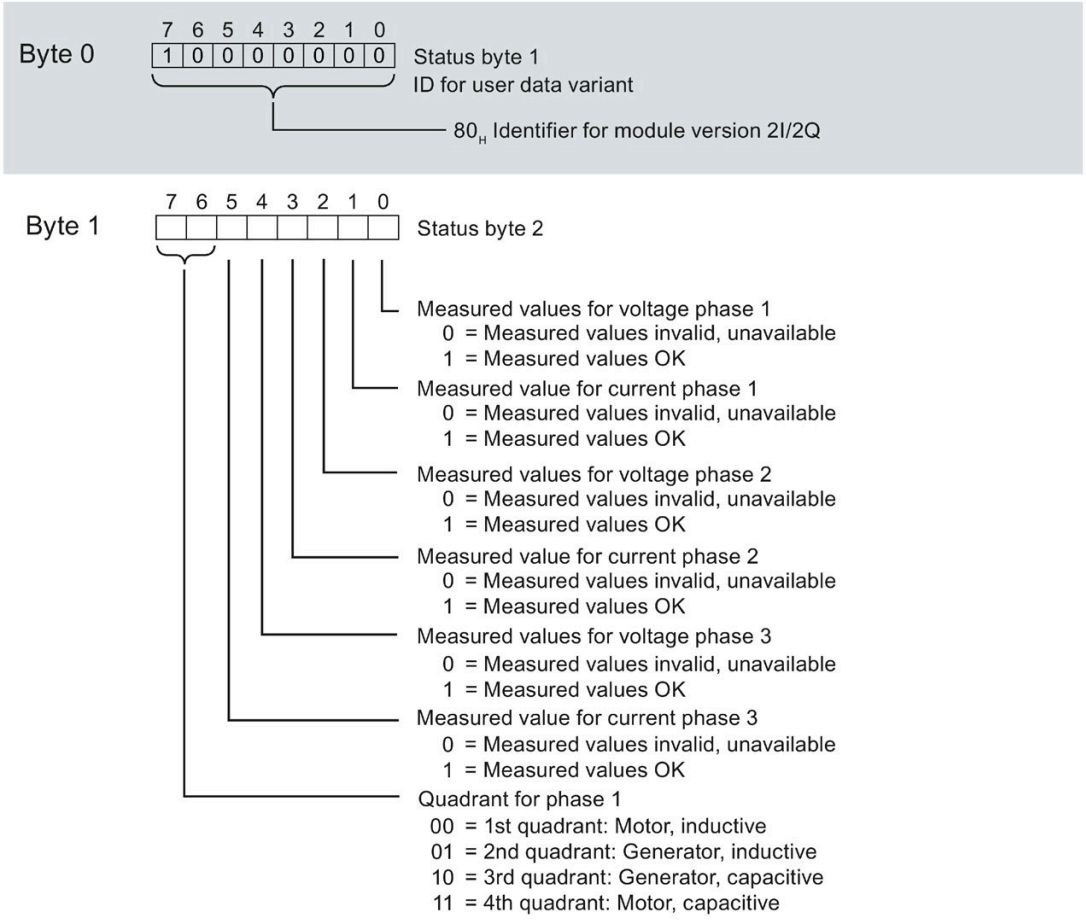


Figure C-1 Allocation of the status bytes in the input user data (2 bytes)

Structure of output user data

The structure of the output user data is fixed.

Table C- 2 Structure of output user data (2 bytes)

Byte	Validity	Designation	Comment
0	Module	Reserved	Reserved
1	Module	Control outputs	Reset of values and counters, gate

Assignment of the output user data

Via the output user data you control for all phases

- Resetting for all minimum values, maximum values, limits, operating hours counter and energy meters.
- The counter gates for operating hours counter and energy counters.

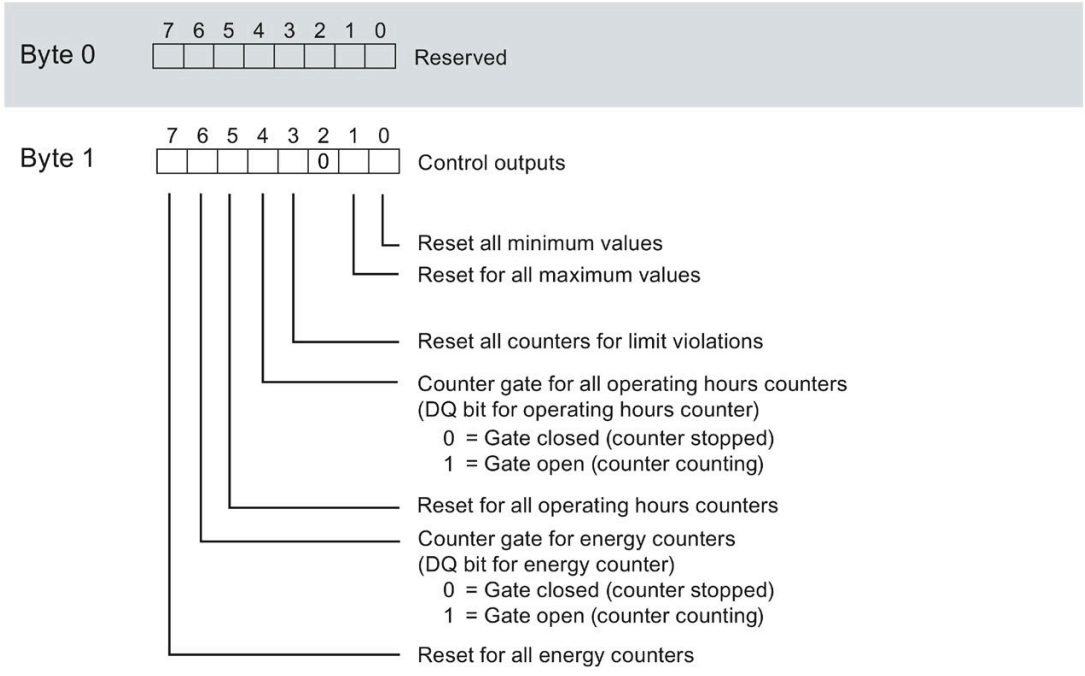


Figure C-2 Allocation of the control byte in the output user data (1 byte)

Note

For module version 2 I / 2 Q, a reset of the selected variables always acts on **all** measured values/counter levels of the three phases.

- Reset energy counter: Acts on all active, reactive and apparent energies of all phases
- Reset operating hours counter: Acts on the counters of Phases 1 to 3
- Reset minimum / maximum values: Acts on the minimum and maximum value calculations of Phases 1-3
- Reset all counters for limit violations: Acts on all 16 limit values.

C.2 Module version "32 I / 20 Q"

User data of the module

The module occupies 32 bytes of input user data and 20 bytes of output user data. Of these the module uses 2 bytes input data for status information and 20 bytes output data for control information. Measured variables can be read cyclically via user data (Bytes 2 to 31) or acyclically via measured value data records

Structure of input user data

You can set the contents of the input user data dynamically. You can choose between different user data variants.

Table C- 3 Structure of input user data (32 bytes)

Byte	Validity	Designation	Comment
0	Module	User data variant	-
1	Module	Quality information	Quality bits to describe the quality of the basic measured values
2 ... 31	Module or phase	Data	2 or 4 byte measured values or cumulative values according to user data variant

Allocation of the input user data

You can change the measured variables during operation. You can choose between different user data variants.

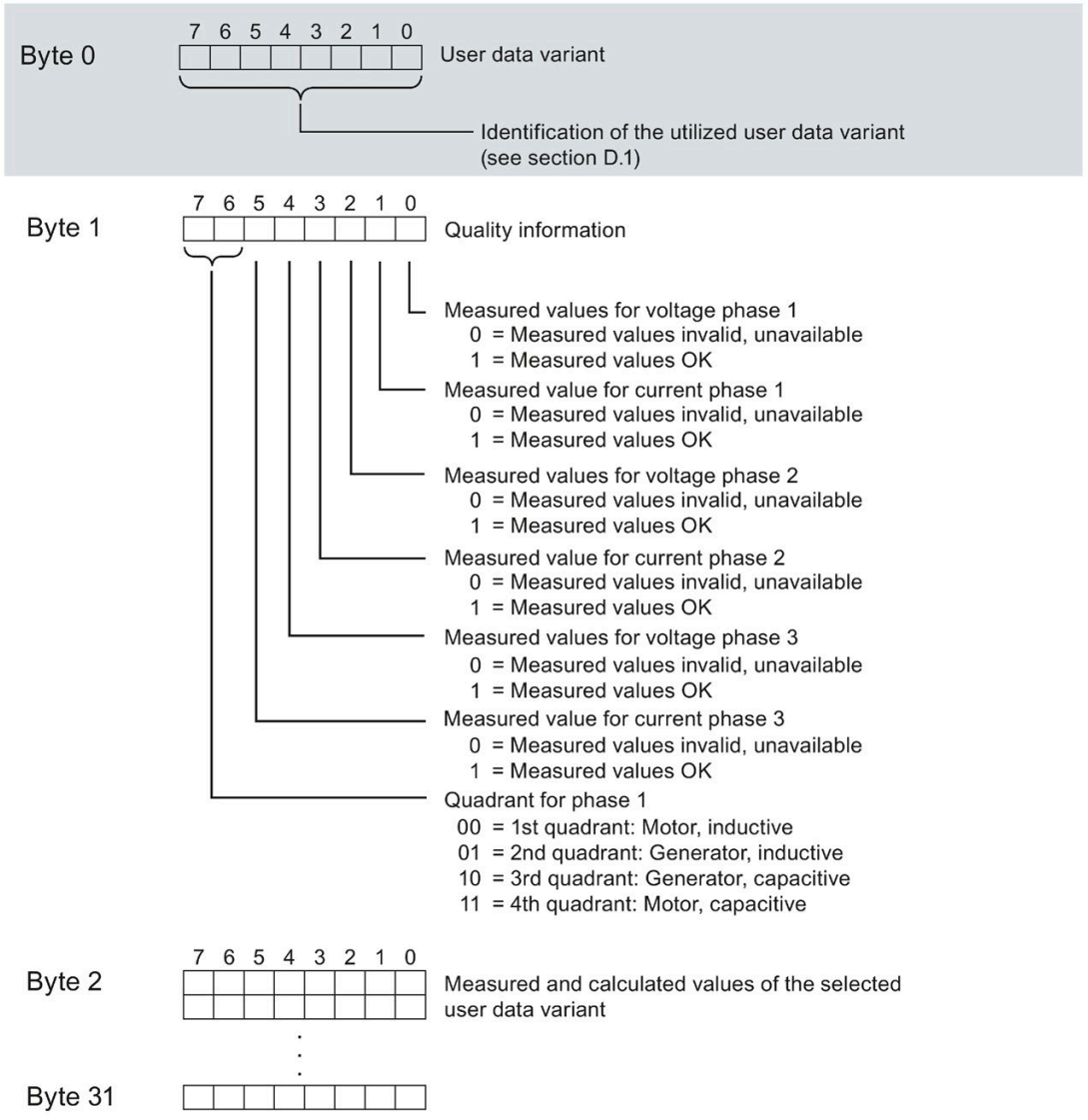


Figure C-3 Assignment of the input user data (32 bytes)

Structure of output user data

The structure of the output user data is fixed and is the same at all the selectable user data variants.

Via the output user data you control globally or phase-specifically

- Resetting for minimum values, maximum values, limits, operating hours counter and energy meters.
- The counter gates for operating hours counter and energy counters.
- Gate for limits, minimum values and maximum values.

Table C- 4 Structure of output user data (20 bytes)

Byte	Validity	Designation	Comment
0	Module	User data variant	Control byte for switching the user data variant
1	Module	Control byte 1	Global resetting of values and counters, gate
2	Module	Control byte 2	Selection of the energy counter to be reset
3	Module	Control byte 3	Control of the limit monitoring of limit values 9 to 16
4	Module	Control byte 4	Control of the limit monitoring of limit values 1 to 8
5	Module	Reserved	-
6	Phase L1	Control byte 6	Phase-specific resetting of values and counters, gate for Phase L1
7	Phase L1	Control byte 7	
8	Phase L2	Control byte 8	Phase-specific resetting of values and counters, gate for Phase L2
9	Phase L2	Control byte 9	
10	Phase L3	Control byte 10	Phase-specific resetting of values and counters, gate for Phase L3
11	Phase L3	Control byte 11	
12	Module and phases L1, L2, L3	Control byte 12	Deletion of power quality analysis results or starting/stopping the analysis of harmonics
13	Reserved		
14	Reserved		
15	Reserved		
16	Module and phases L1, L2, L3	Control byte 16	General reset (Page 41)
17	Reserved		
18	Reserved		
19	Reserved		

Control bytes for user data variant

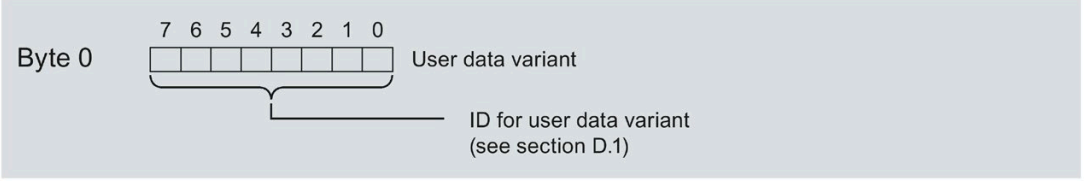


Figure C-4 Allocation of the control bytes for user data variant (Byte 0)

Control bytes for all three phases

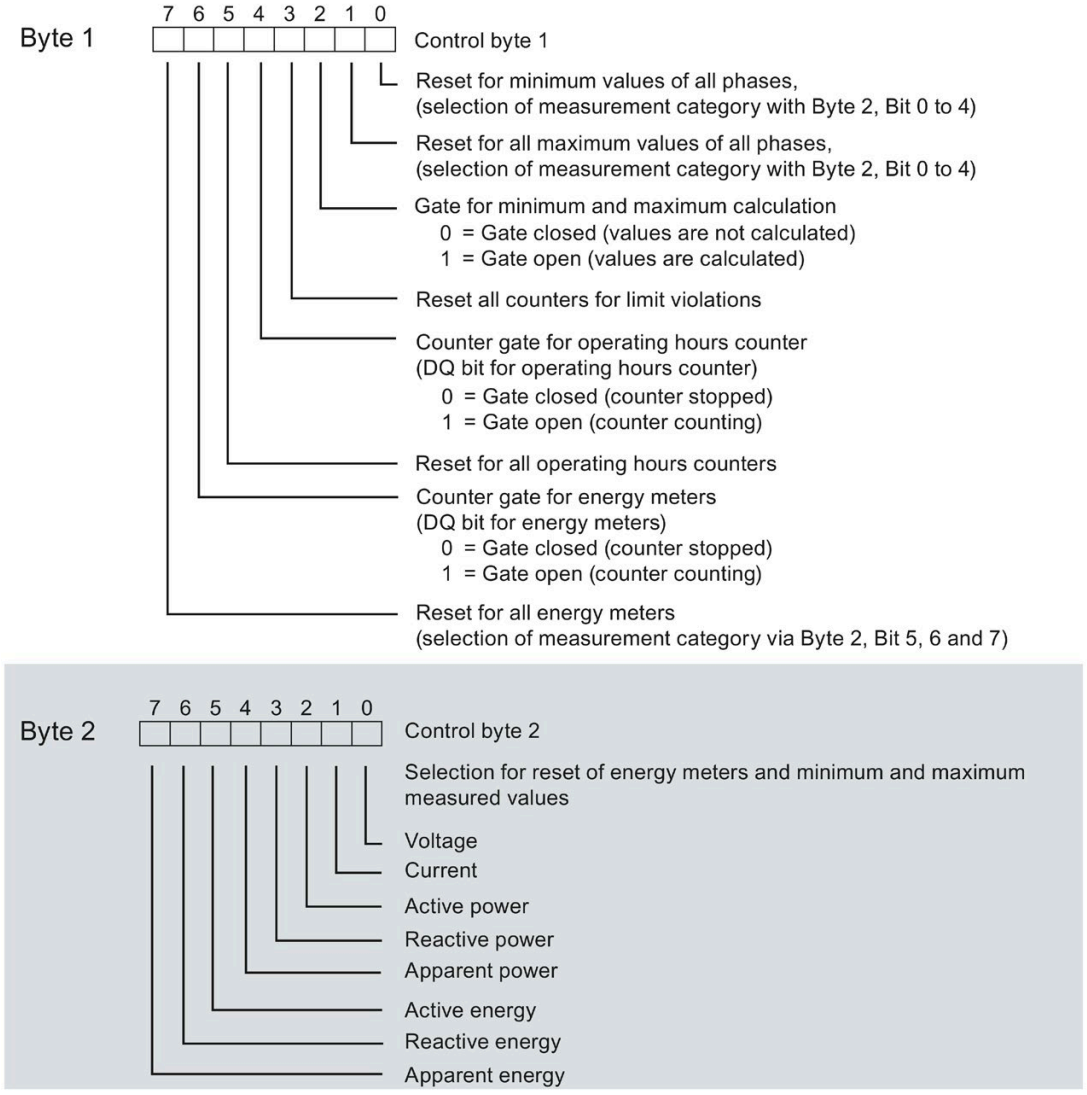


Figure C-5 Allocation of the control bytes for all three phases (bytes 1 and 2)

Control bytes for limit monitoring

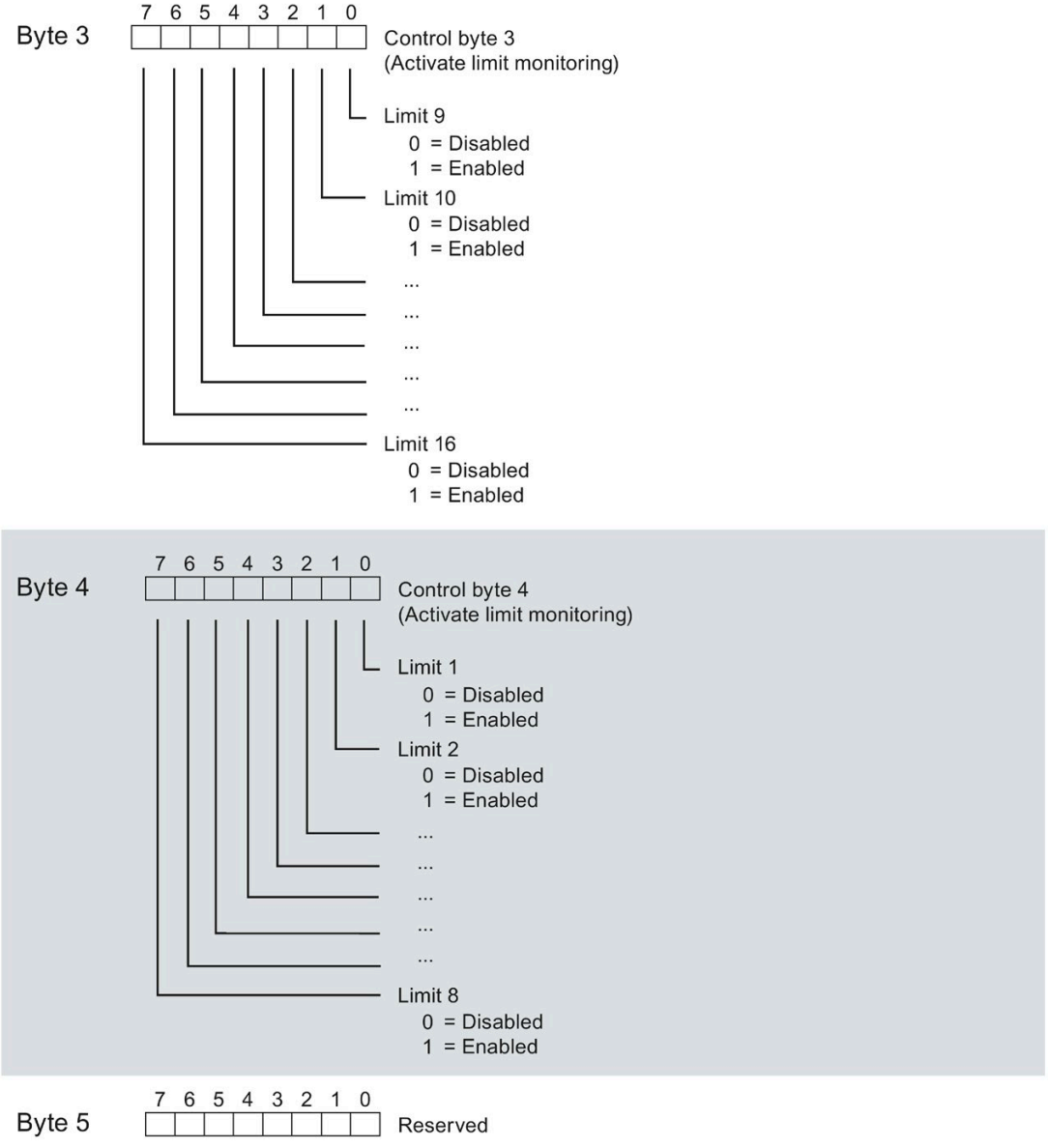


Figure C-6 Allocation of the control bytes for limit monitoring (bytes 3 to 5)

Control bytes for each individual phase

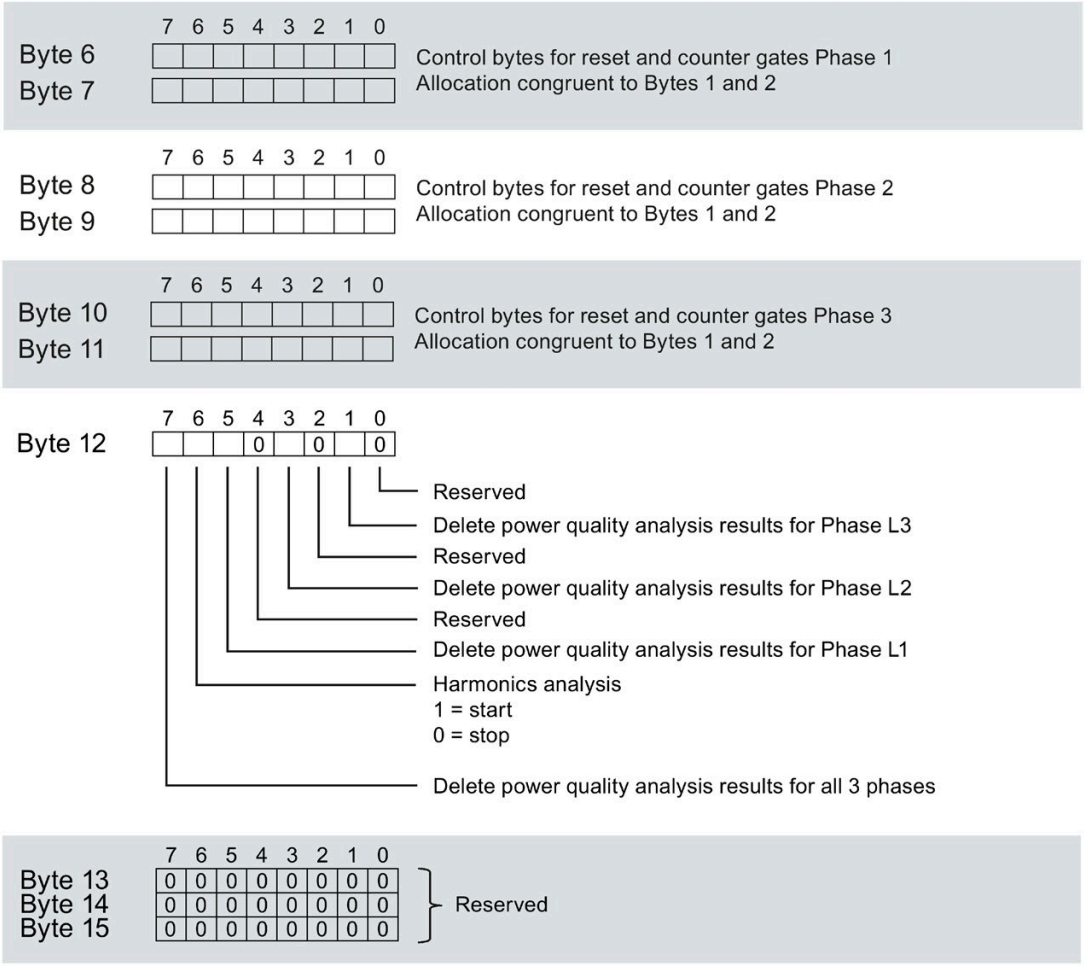


Figure C-7 Allocation of the control bytes for each individual phase (bytes 6 to 15)

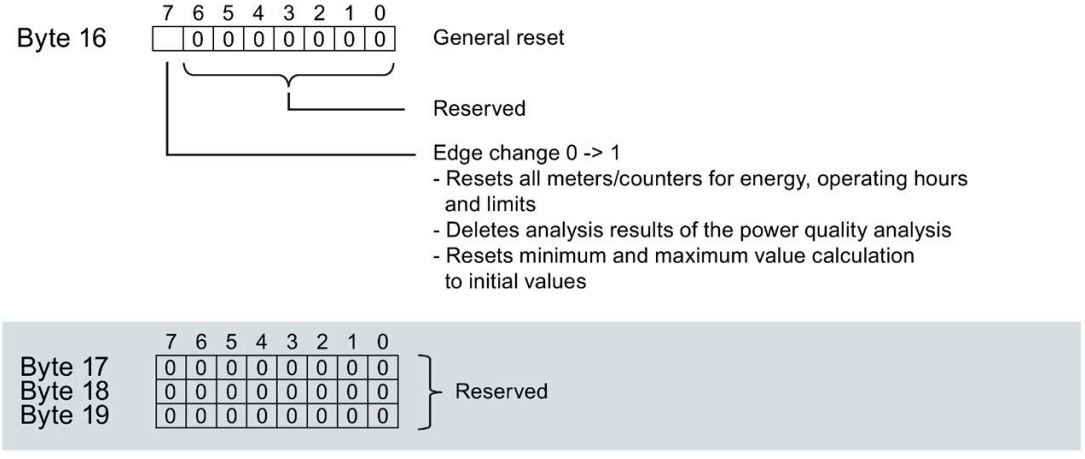


Figure C-8 Allocation of the control bytes for each individual phase (bytes 16 to 19)

C.3 "User-specific" module version

User data of the module

The module occupies between 16 and 256 bytes of input user data and 20 bytes of output user data. Of these the module uses 2 bytes input data for status information and 20 bytes output data for control information. Measured variables can be read cyclically via user data (as of Byte 2) or acyclically via measured value data records

Structure of input user data

You configure the structure of the input user data starting at Byte 2 at this module version itself. An input user data length of 32 bytes also allows you to set the input user data dynamically. You can choose between different user data variants.

Table C- 5 Structure of input user data (16 to 256 bytes)

Byte	Validity	Designation	Comment
0	Module	User data variant	-
1	Module	Quality information	Quality bits to describe the quality of the basic measured values
2 ... 255	Module or phase	Data	Measured values or calculated values in accordance with their configuration: • At configuration in STEP 7 the size of the input user data is calculated automatically. • With configuration via the GSD file the size of the input user data amounts to 32, 64, 128 or 256 bytes. The memory area has to be sufficiently large for the measured variables defined in parameter data record 130 or 131.

Allocation of the input user data

You can change the measured variables during operation. You can choose between different user data variants.

The allocation of the status information in bytes 0 and 1 corresponds to the module version 32 I / 20 Q, see appendix Module version "32 I / 20 Q" (Page 201).

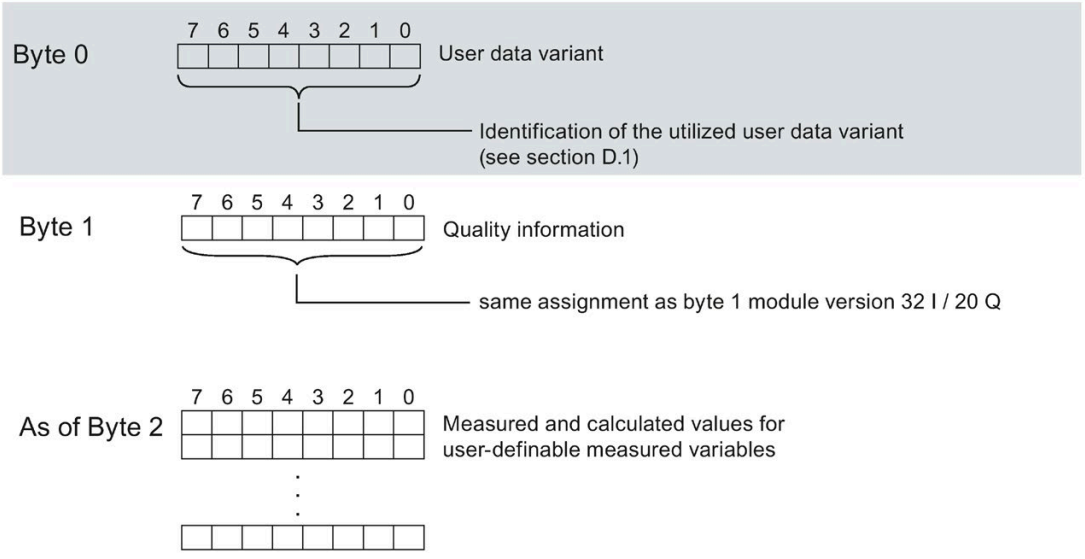


Figure C-9 Allocation of the input user data ("User-specific" module version"

Note

Behavior at switchover in case of the input user data being too small

If the configured size of the variable input user data is smaller than the sized of the fixed user data variant, the response depends on the type of switchover:

- Re-assigning parameters via parameter data records DS 128 / DS 130 / DS 131: Output of a parameter assignment error (33). No switchover.
- Switchover using output byte 0 of a user data variant: No switchover and no error message.

Structure of output user data

The structure of the 20-byte output user data is fixed and is identical to the output user data (control bytes) of the Module version "32 I / 20 Q" (Page 201).

C.4 Module version "EE@Industry measurement data profile E0 / E1 / E2 / E3"

User data of the module

The four versions according to EE@Industry use between 4 and 104 bytes of input user data and 20 bytes of output user data. A dynamic switchover of the input user data is not possible.

Structure of input user data

The structure of the input user data for the module versions according to the EE@Industry standard is fixed and depends on the selected measurement data profile.

Table C- 6 Measurement data profile E0

Byte	Allocation	Data type	Unit	Value range	Measured value ID
0...3	Current L1	REAL	1 A	0.0 ... 100000.0	7
4...7	Current L2	REAL	1 A	0.0 ... 100000.0	8
8...11	Current L3	REAL	1 A	0.0 ... 100000.0	9

Table C- 7 Measurement data profile E1

Byte	Allocation	Data type	Unit	Value range	Measured value ID
0...3	Active power L1L2L3	REAL	1 W	-3.0e+9 ... +3.0e+9	34

Table C- 8 Measurement data profile E2

Byte	Allocation	Data type	Unit	Value range	Measured value ID
0...3	Active power L1L2L3	REAL	1 W	-3.0e+9 ... +3.0e+9	34
4...7	Active energy L1L2L3, inflow (Float)	REAL	1 Wh	0.0 ... 3.4028e+38	200
8...11	Active energy L1L2L3, outflow (Float)	REAL	1 Wh	0.0 ... 3.4028e+38	201

Table C- 9 Measurement data profile E3

Byte	Allocation	Data type	Unit	Value range	Measured value ID
0...3	Active power L1	REAL	1 W	-3.0e+9 ... +3.0e+9	13
4...7	Active power L2	REAL	1 W	-3.0e+9 ... +3.0e+9	14
8...11	Active power L3	REAL	1 W	-3.0e+9 ... +3.0e+9	15
12...15	Reactive power Qtot L1	REAL	1 var	-3.0e+9 ... +3.0e+9	22
16...19	Reactive power Qtot L2	REAL	1 var	-3.0e+9 ... +3.0e+9	23
20...23	Reactive power Qtot L3	REAL	1 var	-3.0e+9 ... +3.0e+9	24
24...31	Active energy L1L2L3, inflow	LREAL	1 Wh	0.0 ... 1.7976e+308	210
32...39	Active energy L1L2L3, outflow	LREAL	1 Wh	0.0 ... 1.7976e+308	211
40...47	Reactive energy L1L2L3, inflow	LREAL	1 varh	0.0 ... 1.7976e+308	212
48...55	Reactive energy L1L2L3, outflow	LREAL	1 varh	0.0 ... 1.7976e+308	213
56...59	Voltage UL1-N	REAL	1 V	0.0 ... 1000000.0	1
60...63	Voltage UL2-N	REAL	1 V	0.0 ... 1000000.0	2
64...67	Voltage UL3-N	REAL	1 V	0.0 ... 1000000.0	3
68...71	Voltage UL1-UL2	REAL	1 V	0.0 ... 1000000.0	4
72...75	Voltage UL2-UL3	REAL	1 V	0.0 ... 1000000.0	5
76...79	Voltage UL3-UL1	REAL	1 V	0.0 ... 1000000.0	6
80...83	Current L1	REAL	1 A	0.0 ... 100000.0	7
84...87	Current L2	REAL	1 A	0.0 ... 100000.0	8
88...91	Current L3	REAL	1 A	0.0 ... 100000.0	9
92...95	Power factor L1	REAL	-	0.0 ... 1.0	19
96...99	Power factor L2	REAL	-	0.0 ... 1.0	20
100...103	Power factor L3	REAL	-	0.0 ... 1.0	21

Structure of output user data

The structure of the 20-byte output user data is fixed and is identical to the output user data (control bytes) of the Module version "32 I / 20 Q" (Page 201).

User data variants

D

User data

The following table shows the existing user data variants.

Table D- 1 Overview of the user data variants

User data	User data variant
Total power L1L2L3	254 (FE$_H$) - default setting
Active power L1L2L3	253 (FD$_H$)
Reactive power L1L2L3	252 (FC$_H$)
Apparent power L1L2L3	251 (FB$_H$)
Basic measured values L1L2L3	250 (FA$_H$)
Total energy L1L2L3	249 (F9$_H$)
Energy L1	248 (F8$_H$)
Energy L2	247 (F7$_H$)
Energy L3	246 (F6$_H$)
Basic variables three-phase measurement L1L2L3	245 (F5$_H$)
Reactive power compensation	244 (F4$_H$)
Quality values three-phase measurement	240 (F0$_H$)
Energy measurement (periodic) overflow counter	239 (EF$_H$)
EE@Industry measurement data profile E3	227 (E3$_H$)
EE@Industry measurement data profile E2	226 (E2$_H$)
EE@Industry measurement data profile E1	225 (E1$_H$)
EE@Industry measurement data profile E0	224 (E0$_H$)
Basic variables phase-specific measurement L1	159 (9F$_H$)
Single-phase measurement L1 with voltage scaling value	158 (9E$_H$)
Basic variables phase-specific measurement L2	157 (9D$_H$)
Single-phase measurement L2 with voltage scaling value	156 (9C$_H$)
Basic variables phase-specific measurement L3	155 (9B$_H$)
Single-phase measurement L3 with voltage scaling value	154 (9A$_H$)
User-defined user data structure I	1 (01$_H$)
User-defined user data structure II	2 (02$_H$)

Information on using and dynamic switching of the user data variants can be found under "Selecting the module versions (Page 32)".

Total power L1L2L3 (ID 254 or FE$_H$)

Table D- 2 Total power L1L2L3

Byte	Allocation	Data type	Unit	Value range	Measured value ID
0	User data variant	BYTE	-	254 (FE$_H$)	-
1	Quality information = QQ$_1$ I$_3$ U$_3$ I$_2$ U$_2$ I$_1$ U$_1$	BYTE	Bit string	qq xx xx xx	-
2 ... 3	Current L1	UINT	1 mA	0 ... 65535	66007
4 ... 5	Current L2	UINT	1 mA	0 ... 65535	66008
6 ... 7	Current L3	UINT	1 mA	0 ... 65535	66009
8 ... 9	Active power L1L2L3	INT	1 W	-32768 ... 32767	66034
10 ... 11	Reactive power Qtot L1L2L3	INT	1 var	-32768 ... 32767	66038
12 ... 13	Apparent power L1L2L3	INT	1 VA	-32768 ... 32767	66036
14 ... 17	Total active energy L1L2L3 (Int32)	DINT	1 Wh	-2147483647... +2147483647	225
18 ... 21	Total reactive energy L1L2L3 (Int32)	DINT	1 varh	-2147483647... +2147483647	226
22	Reserved	BYTE	-	0	-
23	Power factor λ L1L2L3	USINT	0.01	0 ... 100	66037
24	Scaling current L1	USINT	-	0 ... 255	-
25	Scaling current L2	USINT	-	0 ... 255	-
26	Scaling current L3	USINT	-	0 ... 255	-
27	Scaling active power L1L2L3	USINT	-	0 ... 255	-
28	Scaling reactive power L1L2L3	USINT	-	0 ... 255	-
29	Scaling apparent power L1L2L3	USINT	-	0 ... 255	-
30	Scaling total active energy L1L2L3	USINT	-	0 ... 255	-
31	Scaling total reactive energy L1L2L3	USINT	-	0 ... 255	-

Active power L1L2L3 (ID 253 or FD$_H$)

Table D- 3 Active power L1L2L3

Byte	Allocation	Data type	Unit	Value range	Measured value ID
0	User data variant	BYTE	-	253 (FD$_H$)	-
1	Quality information = QQ$_1$ I$_3$ U$_3$ I$_2$ U$_2$ I$_1$ U$_1$	BYTE	Bit string	qq xx xx xx	-
2 ... 3	Current L1	UINT	1 mA	0 ... 65535	66007
4 ... 5	Current L2	UINT	1 mA	0 ... 65535	66008
6 ... 7	Current L3	UINT	1 mA	0 ... 65535	66009
8 ... 9	Active power L1	INT	1 W	-32768 ... 32767	66013
10 ... 11	Active power L2	INT	1 W	-32768 ... 32767	66014
12 ... 13	Active power L3	INT	1 W	-32768 ... 32767	66015

Byte	Allocation	Data type	Unit	Value range	Measured value ID
14 ... 15	Active power L1L2L3	INT	1 W	-32768 ... 32767	66034
16 ... 19	Total active energy L1L2L3 (Int32)	DINT	1 Wh	-2147483647... +2147483647	225
20	Power factor λ L1	USINT	0.01	0 ... 100	66019
21	Power factor λ L2	USINT	0.01	0 ... 100	66020
22	Power factor λ L3	USINT	0.01	0 ... 100	66021
23	Power factor λ L1L2L3	USINT	0.01	0 ... 100	66037
24	Scaling current L1	USINT	-	0 ... 255	-
25	Scaling current L2	USINT	-	0 ... 255	-
26	Scaling current L3	USINT	-	0 ... 255	-
27	Scaling active power L1	USINT	-	0 ... 255	-
28	Scaling active power L2	USINT	-	0 ... 255	-
29	Scaling active power L3	USINT	-	0 ... 255	-
30	Scaling active power L1L2L3	USINT	-	0 ... 255	-
31	Scaling total active energy L1L2L3	USINT	-	0 ... 255	-

Reactive power L1L2L3 (ID 252 or FC_H)

Table D- 4 Reactive power L1L2L3

Byte	Allocation	Data type	Unit	Value range	Measured value ID
0	User data variant	BYTE	-	252 (FC_H)	-
1	Quality information = QQ_1 I_3 U_3 I_2 U_2 I_1 U_1	BYTE	Bit string	qq xx xx xx	-
2 ... 3	Current L1	UINT	1 mA	0 ... 65535	66007
4 ... 5	Current L2	UINT	1 mA	0 ... 65535	66008
6 ... 7	Current L3	UINT	1 mA	0 ... 65535	66009
8 ... 9	Reactive power Qtot L1	INT	1 var	-32768 ... 32767	66022
10 ... 11	Reactive power Qtot L2	INT	1 var	-32768 ... 32767	66023
12 ... 13	Reactive power Qtot L3	INT	1 var	-32768 ... 32767	66024
14 ... 15	Reactive power Qtot L1L2L3	INT	1 var	-32768 ... 32767	66038
16 ... 19	Reactive energy inflow L1L2L3 (Int32)	DINT	1 varh	-2147483647... +2147483647	222
20	Power factor λ L1	USINT	0.01	0 ... 100	66019
21	Power factor λ L2	USINT	0.01	0 ... 100	66020
22	Power factor λ L3	USINT	0.01	0 ... 100	66021
23	Power factor λ L1L2L3	USINT	0.01	0 ... 100	66037
24	Scaling current L1	USINT	-	0 ... 255	-
25	Scaling current L2	USINT	-	0 ... 255	-
26	Scaling current L3	USINT	-	0 ... 255	-
27	Scaling reactive power L1	USINT	-	0 ... 255	-

Byte	Allocation	Data type	Unit	Value range	Measured value ID
28	Scaling reactive power L2	USINT	-	0 ... 255	-
29	Scaling reactive power L3	USINT	-	0 ... 255	-
30	Scaling reactive power L1L2L3	USINT	-	0 ... 255	-
31	Scaling total reactive energy L1L2L3	USINT	-	0 ... 255	-

Apparent power L1L2L3 (ID 251 or FB_H)

Table D- 5 Apparent power L1L2L3

Byte	Allocation	Data type	Unit	Value range	Measured value ID
0	User data variant	BYTE	-	251 (FB_H)	-
1	Quality information = QQ_1 I_3 U_3 I_2 U_2 I_1 U_1	BYTE	Bit string	qq xx xx xx	-
2 ... 3	Current L1	UINT	1 mA	0 ... 65535	66007
4 ... 5	Current L2	UINT	1 mA	0 ... 65535	66008
6 ... 7	Current L3	UINT	1 mA	0 ... 65535	66009
8 ... 9	Apparent power L1	INT	1 VA	-32768 ... 32767	66010
10 ... 11	Apparent power L2	INT	1 VA	-32768 ... 32767	66011
12 ... 13	Apparent power L3	INT	1 VA	-32768 ... 32767	66012
14 ... 15	Apparent power L1L2L3	INT	1 VA	-32768 ... 32767	66036
16 ... 19	Apparent energy L1L2L3 (Int32)	DINT	1 VAh	0 to 2147483647	224
20	Power factor λ L1	USINT	0.01	0 ... 100	66019
21	Power factor λ L2	USINT	0.01	0 ... 100	66020
22	Power factor λ L3	USINT	0.01	0 ... 100	66021
23	Power factor λ L1L2L3	USINT	0.01	0 ... 100	66037
24	Scaling current L1	USINT	-	0 ... 255	-
25	Scaling current L2	USINT	-	0 ... 255	-
26	Scaling current L3	USINT	-	0 ... 255	-
27	Scaling apparent power L1	USINT	-	0 ... 255	-
28	Scaling apparent power L2	USINT	-	0 ... 255	-
29	Scaling apparent power L3	USINT	-	0 ... 255	-
30	Scaling apparent power L1L2L3	USINT	-	0 ... 255	-
31	Scaling total apparent energy L1L2L3	USINT	-	0 ... 255	-

Basic measured values L1L2L3 (ID 250 or FA$_H$)

Table D- 6 Basic measured values L1L2L3

Byte	Allocation	Data type	Unit	Value range	Measured value ID
0	User data variant	BYTE	-	250 (FA$_H$)	-
1	Quality information = QQ$_1$ I$_3$ U$_3$ I$_2$ U$_2$ I$_1$ U$_1$	BYTE	Bit string	qq xx xx xx	-
2 ... 3	Current L1	UINT	1 mA	0 ... 65535	66007
4 ... 5	Current L2	UINT	1 mA	0 ... 65535	66008
6 ... 7	Current L3	UINT	1 mA	0 ... 65535	66009
8 ... 9	Voltage L1-N	UINT	0.01 V	0 ... 65535	66001
10 ... 11	Voltage L2-N	UINT	0.01 V	0 ... 65535	66002
12 ... 13	Voltage L3-N	UINT	0.01 V	0 ... 65535	66003
14 ... 15	Voltage L1-L2	UINT	0.01 V	0 ... 65535	66004
16 ... 17	Voltage L2-L3	UINT	0.01 V	0 ... 65535	66005
18 ... 19	Voltage L3-L1	UINT	0.01 V	0 ... 65535	66006
20	Power factor λ L1	USINT	0.01	0 ... 100	66019
21	Power factor λ L2	USINT	0.01	0 ... 100	66020
22	Power factor λ L3	USINT	0.01	0 ... 100	66021
23	Power factor λ L1L2L3	USINT	0.01	0 ... 100	66037
24	Scaling current L1	USINT	-	0 ... 255	-
25	Scaling current L2	USINT	-	0 ... 255	-
26	Scaling current L3	USINT	-	0 ... 255	-
27	Scaling voltage UL1-N (UL1-UL2)	USINT	-	0 ... 255	-
28	Scaling voltage UL2-N (UL2-UL3)	USINT	-	0 ... 255	-
29	Scaling voltage UL3-N (UL3-UL1)	USINT	-	0 ... 255	-
30 ... 31	Frequency (Uint16)	UINT	0.01 Hz	4500 ... 6500	66031

Total energy L1L2L3 (ID 249 or F9H)

Table D- 7 Total energy L1L2L3

Byte	Allocation	Data type	Unit	Value range	Measured value ID
0	User data variant	BYTE	-	249 (F9H)	-
1	Quality information = QQ1 I3 U3 I2 U2 I1 U1	BYTE	Bit string	qq xx xx xx	-
2	Reserved	BYTE	-	0	-
3	Reserved	BYTE	-	0	-
4 ... 7	Active energy inflow L1L2L3 (Int32)	UDINT	1 Wh	0 ... 2147483647	220
8 ... 11	Active energy outflow L1L2L3 (Int32)	UDINT	1 Wh	0 ... 2147483647	221
11 ... 15	Reactive energy inflow L1L2L3 (Int32)	UDINT	1 varh	0 ... 2147483647	222
16 ... 19	Reactive energy outflow L1L2L3 (Int32)	UDINT	1 varh	0 ... 2147483647	223
20 ... 23	Apparent energy L1L2L3 (Int32)	UDINT	1 VAh	0 ... 2147483647	224
24	Reserved	BYTE	-	0	-
25	Scaling active energy, inflow	USINT	-	0 ... 255	-
26	Scaling active energy, outflow	USINT	-	0 ... 255	-
27	Scaling reactive energy, inflow	USINT	-	0 ... 255	-
28	Scaling reactive energy, outflow	USINT	-	0 ... 255	-
29	Scaling apparent energy	USINT	-	0 ... 255	-
30	Reserved	BYTE	-	0	-
31	Power factor λ L1L2L3	USINT	0.01	0 ... 100	66037

Energy L1 (ID 248 or F8H)

Table D- 8 Energy L1

Byte	Allocation	Data type	Unit	Value range	Measured value ID
0	User data variant	BYTE	-	248 (F8H)	-
1	Quality information = QQ1 I3 U3 I2 U2 I1 U1	BYTE	Bit string	qq xx xx xx	-
2 ... 3	Current L1	UINT	1 mA	0 ... 65535	66007
4 ... 7	Active energy inflow L1 (Int32)	UDINT	1 Wh	0 ... 2147483647	62110
8 ... 11	Active energy outflow L1 (Int32)	UDINT	1 Wh	0 ... 2147483647	62111
11 ... 15	Reactive energy inflow L1 (Int32)	UDINT	1 varh	0 ... 2147483647	62112
16 ... 19	Reactive energy outflow L1 (Int32)	UDINT	1 varh	0 ... 2147483647	62113
20 ... 23	Apparent energy L1 (Int32)	UDINT	1 VAh	0 ... 2147483647	62114
24	Scaling current L1	USINT	-	0 ... 255	-
25	Scaling active energy inflow L1	USINT	-	0 ... 255	-
26	Scaling active energy outflow L1	USINT	-	0 ... 255	-
27	Scaling reactive energy inflow L1	USINT	-	0 ... 255	-
28	Scaling reactive energy outflow L1	USINT	-	0 ... 255	-
29	Scaling apparent energy L1	USINT	-	0 ... 255	-
30	Reserved	BYTE	-	0	-
31	Power factor λ L1	USINT	0.01	0 ... 100	66019

Energy L2 (ID 247 or F7H)

Table D- 9 Energy L2

Byte	Allocation	Data type	Unit	Value range	Measured value ID
0	User data variant	BYTE	-	247 (F7H)	-
1	Quality information = QQ1 I3 U3 I2 U2 I1 U1	BYTE	Bit string	qq xx xx xx	-
2 ... 3	Current L2	UINT	1 mA	0 ... 65535	66008
4 ... 7	Active energy inflow L2 (Int32)	UDINT	1 Wh	0 ... 2147483647	62210
8 ... 11	Active energy outflow L2 (Int32)	UDINT	1 Wh	0 ... 2147483647	62211
11 ... 15	Reactive energy inflow L2 (Int32)	UDINT	1 varh	0 ... 2147483647	62212
16 ... 19	Reactive energy outflow L2 (Int32)	UDINT	1 varh	0 ... 2147483647	62213
20 ... 23	Apparent energy L2 (Int32)	UDINT	1 VAh	0 ... 2147483647	62214
24	Scaling current L2	USINT	-	0 ... 255	-
25	Scaling active energy inflow L2	USINT	-	0 ... 255	-
26	Scaling active energy outflow L2	USINT	-	0 ... 255	-
27	Scaling reactive energy inflow L2	USINT	-	0 ... 255	-
28	Scaling reactive energy outflow L2	USINT	-	0 ... 255	-
29	Scaling apparent energy L2	USINT	-	0 ... 255	-
30	Reserved	BYTE	-	0	-
31	Power factor λ L2	USINT	0.01	0 ... 100	66020

Energy L3 (ID 246 or F6H)

Table D- 10 Energy L3

Byte	Allocation	Data type	Unit	Value range	Measured value ID
0	User data variant	BYTE	-	246 (F6H)	-
1	Quality information = QQ1 I3 U3 I2 U2 I1 U1	BYTE	Bit string	qq xx xx xx	-
2 ... 3	Current L3	UINT	1 mA	0 ... 65535	66009
4 ... 7	Active energy inflow L3 (Int32)	UDINT	1 Wh	0 ... 2147483647	62310
8 ... 11	Active energy outflow L3 (Int32)	UDINT	1 Wh	0 ... 2147483647	62311
11 ... 15	Reactive energy inflow L3 (Int32)	UDINT	1 varh	0 ... 2147483647	62312
16 ... 19	Reactive energy outflow L3 (Int32)	UDINT	1 varh	0 ... 2147483647	62313
20 ... 23	Apparent energy L3 (Int32)	UDINT	1 VAh	0 ... 2147483647	62314
24	Scaling current L3	USINT	-	0 ... 255	-
25	Scaling active energy inflow L3	USINT	-	0 ... 255	-
26	Scaling active energy outflow L3	USINT	-	0 ... 255	-
27	Scaling reactive energy inflow L3	USINT	-	0 ... 255	-
28	Scaling reactive energy outflow L3	USINT	-	0 ... 255	-
29	Scaling apparent energy L3	USINT	-	0 ... 255	-
30	Reserved	BYTE	-	0	-
31	Power factor λ L3	USINT	0.01	0 ... 100	66021

Basic variables three-phase measurements (ID 245 or F5H)

Table D- 11 Basic variables three-phase measurements

Byte	Allocation	Data type	Unit	Value range	Measured value ID
0	User data variant	BYTE	-	245 (F5H)	-
1	Quality information = QQ1 I3 U3 I2 U2 I1 U1	BYTE	Bit string	qq xx xx xx	-
2 ... 5	Active power L1L2L3	REAL	1 W	-3 x 10^9 ... +3 x 10^9	34
6 ... 9	Active energy outflow L1L2L3	REAL	1 Wh	0.0 ... 3.4 x 10^{38}	201
10 ... 13	Active energy inflow L1L2L3	REAL	1 Wh	0.0 ... 3.4 x 10^{38}	200
14 ... 17	Current L1	REAL	1 A	0.0 ... 100000.0	7
18 ... 21	Current L2	REAL	1 A	0.0 ... 100000.0	8
22 ... 25	Current L3	REAL	1 A	0.0 ... 100000.0	9
26 ... 27	Voltage L1-N	UINT	0.01 V	0 ... 65535	66001
28 ... 29	Voltage L2-N	UINT	0.01 V	0 ... 65535	66002
30 ... 31	Voltage L3-N	UINT	0.01 V	0 ... 65535	66003

Reactive power compensation (ID 244 or F4H)

Table D- 12 Reactive power compensation

Byte	Allocation	Data type	Unit	Value range	Measured value ID
0	User data variant	BYTE	-	244 (F4H)	-
1	Quality information = QQ1 I3 U3 I2 U2 I1 U1	BYTE	Bit string	qq xx xx xx	-
2	Fundamental cos φ active factor L1 (SINT8)	BYTE	0.01	-100 ... 100	62136
3	Fundamental cos φ active factor L2 (SINT8)	BYTE	0.01	-100 ... 100	62236
4	Fundamental cos φ active factor L3 (SINT8)	BYTE	0.01	-100 ... 100	62336
5	Reserved	BYTE	-	0	-
6 ... 9	Fundamental reactive power L1	REAL	var	-3 x 10^9 ... +3 x 10^9	62124
10 ... 13	Fundamental reactive power L2	REAL	var	-3 x 10^9 ... +3 x 10^9	62224
14 ... 17	Fundamental reactive power L3	REAL	var	-3 x 10^9 ... +3 x 10^9	62324

Basic variables quality values three-phase measurement (ID 240 or F0H)

Table D- 13 Basic variables quality values three-phase measurement

Byte	Allocation	Data type	Unit	Value range	Measured value ID
0	User data variant	BYTE	-	240 (F0H)	-
1	Quality information = QQ_1 I_3 U_3 I_2 U_2 I_1 U_1	BYTE	Bit string	qq xx xx xx	-
2 ... 3	Status limit violation GW 1 ... 16 (*)	WORD	Bit string	xxxx xxxx xxxx xxxx	65509
4 ... 5	Status of the energy counter overflows (**)	WORD	Bit string	xxxx xxxx xxxx xxxx	65508
6 ... 7	Qualifier L1L2L3	WORD	Bit string	xxxx xxxx xxxx xxxx	65503
8 ... 11	Power quality analysis - Qualifier	UDINT	Bit string	xxxx xxxx xxxx xxxx xxxx xxxx xxxx xxxx	65496
12 ... 13	Reserved	WORD	-	0	-
14 ... 15	Reserved	WORD	-	0	-
16 ... 17	Reserved	WORD	-	0	-
18 ... 19	Reserved	WORD	-	0	-
20 ... 21	Reserved	WORD	-	0	-
22 ... 23	Reserved	WORD	-	0	-
24 ... 25	Reserved	WORD	-	0	-
26 ... 27	Reserved	WORD	-	0	-
28 ... 29	Reserved	WORD	-	0	-
30 ... 31	Reserved	WORD	-	0	-

(*) Limit violation in:
Bit 0 = limit 1 to bit 15 = limit 16

(**) Energy counter count periodically - counter overflow at:
Bit 0 = 1: Active energy inflow L1
Bit 1 = 1: Active energy outflow L1
Bit 2 = 1: Reactive energy inflow L1
Bit 3 = 1: Reactive energy outflow L1
Bit 4 = 1: Apparent energy L1
Bit 5 = 1: Active energy inflow L2
Bit 6 = 1: Active energy outflow L2
Bit 7 = 1: Reactive energy inflow L2
Bit 8 = 1: Reactive energy outflow L2
Bit 9 = 1: Apparent energy L2
Bit 10 = 1: Active energy inflow L3
Bit 11 = 1: Active energy outflow L3
Bit 12 = 1: Reactive energy inflow L3
Bit 13 = 1: Reactive energy outflow L3
Bit 14 = 1: Apparent energy L3
Bit 15: Reserved

Basic variables energy counter measurement (periodic) overflow counter (ID 239 or EF$_H$)

Table D- 14 Basic variables energy counter measurement (periodic) overflow counter

Byte	Allocation	Data type	Unit	Value range	Measured value ID
0	User data variant	BYTE	-	239 (EFH)	-
1	Quality information = QQ$_1$ I$_3$ U$_3$ I$_2$ U$_2$ I$_1$ U$_1$	BYTE	Bit string	qq xx xx xx	-
2 ... 3	Overflow counter active energy inflow L1	UINT	-	0 ... 65535	61190
4 ... 5	Overflow counter active energy outflow L1	UINT	-	0 ... 65535	61191
6 ... 7	Overflow counter reactive energy inflow L1	UINT	-	0 ... 65535	61192
8 ... 9	Overflow counter reactive energy outflow L1	UINT	-	0 ... 65535	61193
10 ... 11	Overflow counter apparent energy L1	UINT	-	0 ... 65535	61194
12 ... 13	Overflow counter active energy inflow L2	UINT	-	0 ... 65535	61210
14 ... 15	Overflow counter active energy outflow L2	UINT	-	0 ... 65535	61211
16 ... 17	Overflow counter reactive energy inflow L2	UINT	-	0 ... 65535	61212
18 ... 19	Overflow counter reactive energy outflow L2	UINT	-	0 ... 65535	61213
20 ... 21	Overflow counter apparent energy L2	UINT	-	0 ... 65535	61214
22 ... 23	Overflow counter active energy inflow L3	UINT	-	0 ... 65535	61230
24 ... 25	Overflow counter active energy outflow L3	UINT	-	0 ... 65535	61231
26 ... 27	Overflow counter reactive energy inflow L3	UINT	-	0 ... 65535	61232
28 ... 29	Overflow counter reactive energy outflow L3	UINT	-	0 ... 65535	61233
30 ... 31	Overflow counter apparent energy L3	UINT	-	0 ... 65535	61234

Basic variables measurement data profile (ID 227 or E3$_H$)

Table D- 15 Basic variables measurement data profile Energy E3

Byte	Allocation	Data type	Unit	Value range	Measured value ID
0	User data variant	BYTE	-	227 (E3$_H$)	-
1	Quality information = QQ$_1$ I$_3$ U$_3$ I$_2$ U$_2$ I$_1$ U$_1$	BYTE	Bit string	qq xx xx xx	-
2 ... 5	Active power L1	REAL	1 W	-3 x 10^9 ... +3 x 10^9	13
6 ... 9	Active power L2	REAL	1 W	-3 x 10^9 ... +3 x 10^9	14
10 ... 13	Active power L3	REAL	1 W	-3 x 10^9 ... +3 x 10^9	15
14 ... 17	Reactive power Qtot L1	REAL	1 var	-3 x 10^9 ... +3 x 10^9	22
18 ... 21	Reactive power Qtot L2	REAL	1 var	-3 x 10^9 ... +3 x 10^9	23
22 ... 25	Reactive power Qtot L3	REAL	1 var	-3 x 10^9 ... +3 x 10^9	24
26 ... 33	Active energy inflow L1L2L3	LREAL	1 Wh	0.0 ... 1.8 x 10^{308}	210
34 ... 41	Active energy outflow L1L2L3	LREAL	1 Wh	0.0 ... 1.8 x 10^{308}	211
42 ... 49	Reactive energy inflow L1L2L3	LREAL	1 varh	0.0 ... 1.8 x 10^{308}	212

Byte	Allocation	Data type	Unit	Value range	Measured value ID
50 ... 57	Reactive energy outflow L1L2L3	LREAL	1 varh	0.0 ... 1.8 x 10^{308}	213
58 ... 61	Voltage L1-N	REAL	1 V	0.0 ... 1000000.0	1
62 ... 65	Voltage L2-N	REAL	1 V	0.0 ... 1000000.0	2
66 ... 69	Voltage L3-N	REAL	1 V	0.0 ... 1000000.0	3
70 ... 73	Voltage L1-L2	REAL	1 V	0.0 ... 1000000.0	4
74 ... 77	Voltage L2-L3	REAL	1 V	0.0 ... 1000000.0	5
78 ... 81	Voltage L3-L1	REAL	1 V	0.0 ... 1000000.0	6
82 ... 85	Current L1	REAL	1 A	0.0 ... 100000.0	7
86 ... 89	Current L2	REAL	1 A	0.0 ... 100000.0	8
90 ... 93	Current L3	REAL	1 A	0.0 ... 100000.0	9
94 ... 97	Power factor λ L1	REAL	-	0.0 ... 1.0	19
98 ... 101	Power factor λ L2	REAL	-	0.0 ... 1.0	20
102 ... 105	Power factor λ L3	REAL	-	0.0 ... 1.0	21

Basic variables measurement data profile (ID 226 or E2H)

Table D- 16 Basic variables measurement data profile Energy E2

Byte	Allocation	Data type	Unit	Value range	Measured value ID
0	User data variant	BYTE	-	226 (E2H)	-
1	Quality information = QQ_1 I_3 U_3 I_2 U_2 I_1 U_1	BYTE	Bit string	qq xx xx xx	-
2 ... 5	Active power L1L2L3	REAL	1 W	-3.0 x 10^9 ... + 3.0 x 10^9	34
6 ... 9	Active energy inflow L1L2L3 (Float)	REAL	1 W	3.0 x 10^9	200
10 ...13	Active energy outflow L1L2L3 (Float)	REAL	1 W	3.0 x 10^9	201

Basic variables measurement data profile (ID 225 or E1H)

Table D- 17 Basic variables measurement data profile Energy E1

Byte	Allocation	Data type	Unit	Value range	Measured value ID
0	User data variant	BYTE	-	225 (E1H)	-
1	Quality information = QQ1 I3 U3 I2 U2 I1 U1	BYTE	Bit string	qq xx xx xx	-
2 ... 5	Active power L1L2L3	REAL	1 W	-3.0×10^9 ... $+ 3.0 \times 10^9$	34

Basic variables measurement data profile (ID 224 or E0H)

Table D- 18 Basic variables measurement data profile Energy E0

Byte	Allocation	Data type	Unit	Value range	Measured value ID
0	User data variant	BYTE	-	224 (E0H)	-
1	Quality information = QQ1 I3 U3 I2 U2 I1 U1	BYTE	Bit string	qq xx xx xx	-
2 ... 5	Current L1	REAL	1 A	0.0 ... 100000.0	7
6 ... 9	Current L2	REAL	1 A	0.0 ... 100000.0	8
10 ...13	Current L3	REAL	1 A	0.0 ... 100000.0	9

Basic variables phase-specific measurement (ID 159 or 9FH)

Table D- 19 Basic variables phase-specific measurement L1

Byte	Allocation	Data type	Unit	Value range	Measured value ID
0	User data variant	BYTE	-	159 (9FH)	-
1	Quality information = Q Q_1 0 0 0 0 I_1 U_1	BYTE	Bit string	qq 00 00 xx	-
2 ... 3	Current L1	UINT	1 mA	0 ... 65535	66007
4 ... 5	Voltage L1-N	UINT	0.01 V	0 ... 65535	66001
6 ... 7	Active power L1	INT	1 W	-32768 ... 32767	66013
8 ... 9	Reactive power Qtot L1	INT	1 var	-32768 ... 32767	66022
10 ... 11	Apparent power L1	INT	1 VA	-32768 ... 32767	66010
12 ... 15	Total active energy L1 (Int32)	DINT	1 Wh	-2147483647... +2147483647	62115
16 ... 19	Total reactive energy L1 (Int32)	DINT	1 varh	-2147483647... +2147483647	62116
20 ... 23	Apparent energy L1 (Int32)	UDINT	1 VAh	0 ... 2147483647	62114
24	Scaling current L1	USINT	-	0 ... 255	-
25	Scaling active power L1	USINT	-	0 ... 255	-
26	Scaling reactive power L1	USINT	-	0 ... 255	-
27	Scaling apparent power L1	USINT	-	0 ... 255	-
28	Total scaling active energy L1	USINT	-	0 ... 255	-
29	Total scaling reactive energy L1	USINT	-	0 ... 255	-
30	Scaling apparent energy L1	USINT	-	0 ... 255	-
31	Power factor λ L1	USINT	0.01	0 ... 100	66019

Basic variables phase-specific measurement (ID 158 or 9EH)

Table D- 20 Single-phase measurement L1 with voltage scaling value

Byte	Allocation	Data type	Unit	Value range	Measured value ID
0	User data variant	BYTE	-	158 (9EH)	-
1	Quality information = Q Q_1 0 0 0 0 I_1 U_1	BYTE	Bit string	qq 00 00 xx	-
2 ... 3	Current L1	UINT	1 mA	0 ... 65535	66007
4 ... 5	Voltage L1-N	UINT	0.01 V	0 ... 65535	66001
6 ... 7	Active power L1	INT	1 W	-32768 ... 32767	66013
8 ... 9	Reactive power Qtot L1	INT	1 var	-32768 ... 32767	66022
10 ... 11	Apparent power L1	INT	1 VA	-32768 ... 32767	66010
12 ... 15	Total active energy L1	UDINT	1 Wh	0 ... 4294967295	62115
16 ... 19	Total reactive energy L1	UDINT	1 varh	0 ... 4294967295	62116
20 ... 23	Apparent energy L1 (Int32)	UDINT	1 VAh	0 ... 4294967295	62114
24	Scaling current L1	USINT	-	0 ... 255	-
25	Scaling active power L1	USINT	-	0 ... 255	-
26	Scaling reactive power L1	USINT	-	0 ... 255	-
27	Scaling apparent power L1	USINT	-	0 ... 255	-
28	Total scaling active energy L1	USINT	-	0 ... 255	-
29	Total scaling reactive energy L1	USINT	-	0 ... 255	-
30	Scaling apparent energy L1	USINT	-	0 ... 255	-
31	Scaling voltage L1-N	USINT	-	0 ... 255	-

Basic variables phase-specific measurement (ID 157 or 9D$_H$)

Table D- 21 Basic variables phase-specific measurement L2

Byte	Allocation	Data type	Unit	Value range	Measured value ID
0	User data variant	BYTE	-	157 (9D$_H$)	-
1	Quality information = Q Q$_1$ 0 0 0 0 I$_2$ U$_2$	BYTE	Bit string	qq 00 00 xx	-
2 ... 3	Current L2	UINT	1 mA	0 ... 65535	66008
4 ... 5	Voltage L2-N	UINT	0.01 V	0 ... 65535	66002
6 ... 7	Active power L2	INT	1 W	-32768 ... 32767	66014
8 ... 9	Reactive power Qtot L2	INT	1 var	-32768 ... 32767	66023
10 ... 11	Apparent power L2	INT	1 VA	-32768 ... 32767	66011
12 ... 15	Total active energy L2 (Int32)	DINT	1 Wh	-2147483647... +2147483647	62215
16 ... 19	Total reactive energy L2 (Int32)	DINT	1 varh	-2147483647... +2147483647	62216
20 ... 23	Apparent energy L2 (Int32)	UDINT	1 VAh	0 ... 2147483647	62214
24	Scaling current L2	USINT	-	0 ... 255	-
25	Scaling active power L2	USINT	-	0 ... 255	-
26	Scaling reactive power L2	USINT	-	0 ... 255	-
27	Scaling apparent power L2	USINT	-	0 ... 255	-
28	Total scaling active energy L1	USINT	-	0 ... 255	-
29	Total scaling reactive energy L1	USINT	-	0 ... 255	-
30	Scaling apparent energy L2	USINT	-	0 ... 255	-
31	Power factor λ L2	USINT	0.01	0 ... 100	66020

Basic variables phase-specific measurement (ID 156 or 9CH)

Table D- 22 Single-phase measurement L2 with voltage scaling value

Byte	Allocation	Data type	Unit	Value range	Measured value ID
0	User data variant	BYTE	-	156 (9CH)	-
1	Quality information = Q Q_1 0 0 0 0 I_2 U_2	BYTE	Bit string	qq 00 00 xx	-
2 ... 3	Current L2	UINT	1 mA	0 ... 65535	66008
4 ... 5	Voltage UL2-N	UINT	0.01 V	0 ... 65535	66002
6 ... 7	Active power L2	INT	1 W	-32768 ... 32767	66014
8 ... 9	Reactive power Qtot L2	INT	1 var	-32768 ... 32767	66023
10 ... 11	Apparent power L2	INT	1 VA	-32768 ... 32767	66011
12 ... 15	Total active energy L2 (Int32)	DINT	1 Wh	-2147483647... +2147483647	62215
16 ... 19	Total reactive energy L2 (Int32)	DINT	1 varh	-2147483647... +2147483647	62216
20 ... 23	Apparent energy L2 (Int32)	UDINT	1 VAh	0 ... 2147483647	62214
24	Scaling current L2	USINT	-	0 ... 255	-
25	Scaling active power L2	USINT	-	0 ... 255	-
26	Scaling reactive power L2	USINT	-	0 ... 255	-
27	Scaling apparent power L2	USINT	-	0 ... 255	-
28	Total scaling active energy L2	USINT	-	0 ... 255	-
29	Total scaling reactive energy L2	USINT	-	0 ... 255	-
30	Scaling apparent energy L2	USINT	-	0 ... 255	-
31	Scaling voltage L2-N	USINT	-	0 ... 255	-

Basic variables phase-specific measurement (ID 155 or 9BH)

Table D- 23 Basic variables phase-specific measurement L3

Byte	Allocation	Data type	Unit	Value range	Measured value ID
0	User data variant	BYTE	-	155 (9BH)	-
1	Quality information = Q Q1 0 0 0 0 I3 U3	BYTE	Bit string	qq 00 00 xx	-
2 ... 3	Current L3	UINT	1 mA	0 ... 65535	66009
4 ... 5	Voltage L3-N	UINT	0.01 V	0 ... 65535	66003
6 ... 7	Active power L3	INT	1 W	-32768 ... 32767	66015
8 ... 9	Reactive power Qtot L3	INT	1 var	-32768 ... 32767	66024
10 ... 11	Apparent power L3	INT	1 VA	-32768 ... 32767	66012
12 ... 15	Total active energy L3 (Int32)	DINT	1 Wh	-2147483647... +2147483647	62315
16 ... 19	Total reactive energy L3 (Int32)	DINT	1 varh	-2147483647... +2147483647	62316
20 ... 23	Apparent energy L3 (Int32)	UDINT	1 VAh	0 ... 2147483647	62314
24	Scaling current L3	USINT	-	0 ... 255	-
25	Scaling active power L3	USINT	-	0 ... 255	-
26	Scaling reactive power L3	USINT	-	0 ... 255	-
27	Scaling apparent power L3	USINT	-	0 ... 255	-
28	Total scaling active energy L3	USINT	-	0 ... 255	-
29	Total scaling reactive energy L3	USINT	-	0 ... 255	-
30	Scaling apparent energy L3	USINT	-	0 ... 255	-
31	Power factor L3	USINT	0.01	0 ... 100	66021

Basic variables phase-specific measurement (ID 154 or 9A$_H$)

Table D- 24 Single-phase measurement L3 with voltage scaling value

Byte	Allocation	Data type	Unit	Value range	Measured value ID
0	User data variant	BYTE	-	154 (9A$_H$)	-
1	Quality information = Q Q_1 0 0 0 0 I_3 U_3	BYTE	Bit string	qq 00 00 xx	-
2 ... 3	Current L3	UINT	1 mA	0 ... 65535	66009
4 ... 5	Voltage L3-N	UINT	0.01 V	0 ... 65535	66003
6 ... 7	Active power L3	INT	1 W	-32768 ... 32767	66015
8 ... 9	Reactive power Qtot L3	INT	1 var	-32768 ... 32767	66024
10 ... 11	Apparent power L3	INT	1 VA	-32768 ... 32767	66012
12 ... 15	Total active energy L3 (Int32)	DINT	1 Wh	-2147483647... +2147483647	62315
16 ... 19	Total reactive energy L3 (Int32)	DINT	1 varh	-2147483647... +2147483647	62316
20 ... 23	Apparent energy L3 (Int32)	UDINT	1 VAh	0 ... 2147483647	62314
24	Scaling current L3	USINT	-	0 ... 255	-
25	Scaling active power L3	USINT	-	0 ... 255	-
26	Scaling reactive power L3	USINT	-	0 ... 255	-
27	Scaling apparent power L3	USINT	-	0 ... 255	-
28	Total scaling active energy L3	USINT	-	0 ... 255	-
29	Total scaling reactive energy L3	USINT	-	0 ... 255	-
30	Scaling apparent energy L3	USINT	-	0 ... 255	-
31	Scaling voltage L3-N	USINT	-	0 ... 255	-

Measured value data records

E

E.1 Overview of all measured value data records

The AI Energy Meter HF writes the measured values in several data records that you can read acyclically using the RDREC instruction in the user program.

The following tables show the structure of the individual data records:

- Data record DS 142 for basic measured values version 2 (read only).
- Data record DS 142 for basic measured values version 3 (read only).
- Data record DS 143 for energy counters (read and write).
- Data record DS 144 for basic measured values version 1 (read only).
- Data record DS 154 for maximum values with time stamp (read only).
- Data record DS 145 for minimum values version 1 (read only).
- Data record DS 155 for minimum values with time stamp (read only).
- Data record DS 147 for phase-specific measured values L1 version 0 (read only).
- Data record DS 147 for phase-specific measured values L1 version 1 (read only).
- Data record DS 148 for phase-specific measured values L2 DS version 0 (read only).
- Data record DS 148 for phase-specific measured values L2 DS version 1 (read only).
- Data record DS 149 for phase-specific measured values L3 DS version 0 (read only).
- Data record DS 149 for phase-specific measured values L3 DS version 1 (read only).
- Data record DS 150 for advanced measurement and status values version 1 (read only).
- Data record DS 151 for user-defined data record (read only).
- Data record DS 160 for power quality analysis (read only).
- Data record DS 161 for harmonics voltage (DS 161) (read only).
- Data record DS 163 for harmonics current (DS 163) (read only).
- Data record DS 170 information data record on available measured values.

Note

- The cumulative value of the energy counters in 3-phase operation is obtained from the sums of the respective individual values of the phases.
- Inflow and outflow energy meters are always positive values.
- The operating hours counter for the entire module is calculated from the maximum of the operating hours of the individual phases.

See also

Structure of the parameter data record 135 for data record mapping (Page 168)

E.2 Measured value data record for base measurements (DS 142)

E.2.1 Measured value data record for basic measured values (DS 142) version 2

Measured variables of the module

The following table provides an overview of all the measured variables that data record 142 supplies. Please note that, depending on the connection type used the display of some measured variables does not make sense and that the module deletes measured values that are not relevant.

The measured value identification (measured value ID) is an index which references the overview table of the measured variables in Appendix Measured variables for connection type (Page 171).

Table E- 1 Data record 142

Byte	Measured variable	Data type	Unit	Value range	Measured value ID
0	Version = 2	UINT8	-	2	-
1	Reserved	UINT8	-	0	-
2...5	Voltage L1-N	REAL	V	0.0 ... 1000000.0	1
6...9	Voltage L2-N	REAL	V	0.0 ... 1000000.0	2
10...13	Voltage L3-N	REAL	V	0.0 ... 1000000.0	3
14...17	Voltage L1-L2	REAL	V	0.0 ... 1000000.0	4
18...21	Voltage L2-L3	REAL	V	0.0 ... 1000000.0	5
22...25	Voltage L3-L1	REAL	V	0.0 ... 1000000.0	6
26...29	Current L1	REAL	A	0.0 ... 100000.0	7
30...33	Current L2	REAL	A	0.0 ... 100000.0	8
34...37	Current L3	REAL	A	0.0 ... 100000.0	9
38...41	Power factor λ L1	REAL	-	0.0 ... 1.0	19
42...45	Power factor λ L2	REAL	-	0.0 ... 1.0	20
46...49	Power factor λ L3	REAL	-	0.0 ... 1.0	21
50...53	Power factor λ L1L2L3	REAL	-	0.0 ... 1.0	37
54...57	Frequency L1L2L3	REAL	1 Hz	45.0 ... 65.0	30
58...61	Amplitude unbalance voltage U_2	REAL	%	0 ... 100	61157
62...65	Amplitude unbalance current I_{asym}	REAL	%	0 to 100	61158
66...69	Apparent power L1	REAL	VA	-3.0×10^9 ... $+3.0 \times 10^9$	10
70...73	Apparent power L2	REAL	VA	-3.0×10^9 ... $+3.0 \times 10^9$	11
74...77	Apparent power L3	REAL	VA	-3.0×10^9 ... $+3.0 \times 10^9$	12
78...81	Apparent power L1L2L3	REAL	VA	-3.0×10^9 ... $+3.0 \times 10^9$	36
82...85	Reactive power Qtot L1	REAL	var	-3.0×10^9 ... $+3.0 \times 10^9$	22
86...89	Reactive power Qtot L2	REAL	var	-3.0×10^9 ... $+3.0 \times 10^9$	23
90...93	Reactive power Qtot L3	REAL	var	-3.0×10^9 ... $+3.0 \times 10^9$	24

Byte	Measured variable	Data type	Unit	Value range	Measured value ID
94...97	Reactive power Qtot L1L2L3	REAL	var	-3.0 x 10^9 ... +3.0 x 10^9	38
98...101	Active power L1	REAL	W	-3.0 x 10^9 ... +3.0 x 10^9	13
102...105	Active power L2	REAL	W	-3.0 x 10^9 ... +3.0 x 10^9	14
106...109	Active power L3	REAL	W	-3.0 x 10^9 ... +3.0 x 10^9	15
110...113	Active power L1L2L3	REAL	W	-3.0 x 10^9 ... +3.0 x 10^9	34
114...117	Phase angle L1	REAL	°	0.0 ... 360.0	61178
118...121	Phase angle L2	REAL	°	0.0 ... 360.0	61198
122...125	Phase angle L3	REAL	°	0.0 ... 360.0	61218
126...129	Apparent energy L1L2L3 (Float)	REAL	VAh	0.0 ... 3.4 x 10^{38}	204
130...133	Total reactive energy L1L2L3 (Float)	REAL	varh	-3.4 x 10^{38} to +3.4 x 10^{38}	206
134...137	Total active energy L1L2L3 (Float)	REAL	Wh	-3.4 x 10^{38} to +3.4 x 10^{38}	205
138...141	Reactive energy inflow L1L2L3 (Float)	REAL	varh	0.0 ... 3.4 x 10^{38}	202
142...145	Reactive energy outflow L1L2L3 (Float)	REAL	varh	0.0 ... 3.4 x 10^{38}	203
146...149	Active energy inflow L1L2L3 (Float)	REAL	Wh	0.0 ... 3.4 x 10^{38}	200
150...153	Active energy outflow L1L2L3 (Float)	REAL	Wh	0.0 ... 3.4 x 10^{38}	201
154...161	Apparent energy L1L2L3	LREAL	VAh	0.0 ... 1.8 x 10^{308}	214
162...169	Total reactive energy L1L2L3	LREAL	varh	-1.8 x 10^{308} to +1.8 x 10^{308}	216
170...177	Total active energy L1L2L3	LREAL	Wh	-1.8 x 10^{308} to +1.8 x 10^{308}	215
178...185	Reactive energy inflow L1L2L3	LREAL	varh	0.0 ... 1.8 x 10^{308}	212
186...193	Reactive energy outflow L1L2L3	LREAL	varh	0.0 ... 1.8 x 10^{308}	213
194...201	Active energy inflow L1L2L3	LREAL	Wh	0.0 ... 1.8 x 10^{308}	210
202...209	Active energy outflow L1L2L3	LREAL	Wh	0.0 ... 1.8 x 10^{308}	211
210...213	Neutral current IN	REAL	A	0.0 ... 100000.0	61149

Neutral current

If you operate the AI Energy Meter HF with connection type 3P4W, 3P4W1 or 3P3W, the neutral current is also calculated under the following conditions:

- Transmission factors of all phase currents (primary and secondary currents) are identical.
- Measured phase currents are greater than the value of the "Low limit for measuring current parameter.
- The parameter "Reverse current direction" must be the same on all phases.

If one of the conditions is not met, 0 is entered as the value for the neutral current. You can read the neutral current calculated using measured value data record 142.

Procedure

Data record 142 is located on the AI Energy Meter HF. Use the RDREC instruction to read out the data record from the module. This system function block is stored in the STEP 7 library.

E.2.2 Measured value data record for basic measured values (DS 142) version 3

Measured variables of the module

The following table provides an overview of all the measured variables that data record 142 supplies. Note that, depending on the connection type used the display of some measured variables does not make sense and that the module deletes measured values that are not relevant.

The measured value identification (measured value ID) is an index which references the overview table of the measured variables in Appendix Measured variables for connection type (Page 171).

Table E- 2 Data record 142

Byte	Measured variable	Data type	Unit	Value range	Measured value ID
0	Version = 3	BYTE	-	3	-
1	Reserved	BYTE	-	0	-
2...5	Voltage L1-N	REAL	V	0.0 ... 1000000.0	1
6...9	Voltage L2-N	REAL	V	0.0 ... 1000000.0	2
10...13	Voltage L3-N	REAL	V	0.0 ... 1000000.0	3
14...17	Voltage L1-L2	REAL	V	0.0 ... 1000000.0	4
18...21	Voltage L2-L3	REAL	V	0.0 ... 1000000.0	5
22...25	Voltage L3-L1	REAL	V	0.0 ... 1000000.0	6
26...29	Current L1	REAL	A	0.0 ... 100000.0	7
30...33	Current L2	REAL	A	0.0 ... 100000.0	8
34...37	Current L3	REAL	A	0.0 ... 100000.0	9
38...41	Power factor λ L1	REAL	-	0.0 ... 1.0	19
42...45	Power factor λ L2	REAL	-	0.0 ... 1.0	20
46...49	Power factor λ L3	REAL	-	0.0 ... 1.0	21
50...53	Power factor λ L1L2L3	REAL	-	0.0 ... 1.0	37
54...57	Frequency L1L2L3	REAL	1 Hz	45.0 ... 65.0	30
58...61	Amplitude unbalance voltage U_2	REAL	%	0 ... 100	61157
62...65	Amplitude unbalance current I_{asym}	REAL	%	0 ... 100	61158
66...69	Apparent power L1	REAL	VA	-3.0×10^9 ... $+3.0 \times 10^9$	10
70...73	Apparent power L2	REAL	VA	-3.0×10^9 ... $+3.0 \times 10^9$	11
74...77	Apparent power L3	REAL	VA	-3.0×10^9 ... $+3.0 \times 10^9$	12
78...81	Apparent power L1L2L3	REAL	VA	-3.0×10^9 ... $+3.0 \times 10^9$	36
82...85	Reactive power Qtot L1	REAL	var	-3.0×10^9 ... $+3.0 \times 10^9$	22
86...89	Reactive power Qtot L2	REAL	var	-3.0×10^9 ... $+3.0 \times 10^9$	23
90...93	Reactive power Qtot L3	REAL	var	-3.0×10^9 ... $+3.0 \times 10^9$	24
94...97	Reactive power Qtot L1L2L3	REAL	var	-3.0×10^9 ... $+3.0 \times 10^9$	38
98...101	Active power L1	REAL	W	-3.0×10^9 ... $+3.0 \times 10^9$	13
102...105	Active power L2	REAL	W	-3.0×10^9 ... $+3.0 \times 10^9$	14
106...109	Active power L3	REAL	W	-3.0×10^9 ... $+3.0 \times 10^9$	15

Byte	Measured variable	Data type	Unit	Value range	Measured value ID
110...113	Active power L1L2L3	REAL	W	-3.0 x 10^9 ... +3.0 x 10^9	34
114...117	Phase angle L1	REAL	°	0.0 ... 360.0	61178
118...121	Phase angle L2	REAL	°	0.0 ... 360.0	61198
122...125	Phase angle L3	REAL	°	0.0 ... 360.0	61218
126...129	Apparent energy L1L2L3 (Float)	REAL	VAh	0.0 ... 3.4 x 10^{38}	204
130...133	Total reactive energy L1L2L3 (Float)	REAL	varh	-3.4 x 10^{38} to +3.4 x 10^{38}	206
134...137	Total active energy L1L2L3 (Float)	REAL	Wh	-3.4 x 10^{38} to +3.4 x 10^{38}	205
138...141	Reactive energy inflow L1L2L3 (Float)	REAL	varh	0.0 ... 3.4 x 10^{38}	202
142...145	Reactive energy outflow L1L2L3 (Float)	REAL	varh	0.0 ... 3.4 x 10^{38}	203
146...149	Active energy inflow L1L2L3 (Float)	REAL	Wh	0.0 ... 3.4 x 10^{38}	200
150...153	Active energy outflow L1L2L3 (Float)	REAL	Wh	0.0 ... 3.4 x 10^{38}	201
154...161	Apparent energy L1L2L3	LREAL	VAh	0.0 ... 1.8 x 10^{308}	214
162...169	Total reactive energy L1L2L3	LREAL	varh	-1.8 x 10^{308} to +1.8 x 10^{308}	216
170...177	Total active energy L1L2L3	LREAL	Wh	-1.8 x 10^{308} to +1.8 x 10^{308}	215
178...185	Reactive energy inflow L1L2L3	LREAL	varh	0.0 ... 1.8 x 10^{308}	212
186...193	Reactive energy outflow L1L2L3	LREAL	varh	0.0 ... 1.8 x 10^{308}	213
194...201	Active energy inflow L1L2L3	LREAL	Wh	0.0 ... 1.8 x 10^{308}	210
202...209	Active energy outflow L1L2L3	LREAL	Wh	0.0 ... 1.8 x 10^{308}	211
210...213	Neutral current IN	REAL	A	0.0 ... 100000.0	61149
214...217	Neutral current 10-12 cycles	REAL	A	0.0 ... 100000.0	61150
218...221	Reactive power Qn L1	REAL	var	-3.0 x 10^9 ... +3.0 x 10^9	16
222...225	Reactive power Qn L2	REAL	var	-3.0 x 10^9 ... +3.0 x 10^9	17
226...229	Reactive power Qn L3	REAL	var	-3.0 x 10^9 ... +3.0 x 10^9	18
230...233	Reactive power Qn L1L2L3	REAL	var	-3.0 x 10^9 ... +3.0 x 10^9	35
234...237	Average voltage load LN (Utot)	REAL	V	0.0 ... 300.0	31
238...241	Average voltage L-L	REAL	V	0.0 ... 600.0	32
242...245	Average current L1L2L3 (Itot)	REAL	A	0.0 ... 100000.0	33
246...249	Mean power factor λ L1L2L3	REAL	-	0.0 ... 1.0	166
250...253	Fundamental voltage L1	REAL	V	0.0 ... 440.0	62122
254...257	Fundamental voltage L2	REAL	V	0.0 ... 440.0	62222
258...261	Fundamental voltage L3	REAL	V	0.0 ... 440.0	62322
262...265	Fundamental current L1	REAL	A	0.0 ... 100000.0	62123
266...269	Fundamental current L2	REAL	A	0.0 ... 100000.0	62223
270...273	Fundamental current L3	REAL	A	0.0 ... 100000.0	62323
274...277	Fundamental apparent power L1	REAL	VA	-3.0 x 10^9 ... +3.0 x 10^9	62125
278...281	Fundamental apparent power L2	REAL	VA	-3.0 x 10^9 ... +3.0 x 10^9	62225
282...285	Fundamental apparent power L3	REAL	VA	-3.0 x 10^9 ... +3.0 x 10^9	62325
286...289	Fundamental reactive power L1	REAL	var	-3.0 x 10^9 ... +3.0 x 10^9	62124
290...293	Fundamental reactive power L2	REAL	var	-3.0 x 10^9 ... +3.0 x 10^9	62224
294...297	Fundamental reactive power L3	REAL	var	-3.0 x 10^9 ... +3.0 x 10^9	62324
298...301	Fundamental active power L1	REAL	W	-3.0 x 10^9 ... +3.0 x 10^9	62126
302...305	Fundamental active power L2	REAL	W	-3.0 x 10^9 ... +3.0 x 10^9	62226
306...309	Fundamental active power L3	REAL	W	-3.0 x 10^9 ... +3.0 x 10^9	62326

Byte	Measured variable	Data type	Unit	Value range	Measured value ID
310...313	Fundamental cos φ active factor L1	REAL	-	-1.0 ... 1.0	62127
314...317	Fundamental cos φ active factor L2	REAL	-	-1.0 ... 1.0	62227
318...321	Fundamental cos φ active factor L3	REAL	-	-1.0 ... 1.0	62327
322...325	Total harmonic distortion (THD+N) voltage L1	REAL	1%	0% to 100%	62120
326...329	Total harmonic distortion (THD+N) voltage L2	REAL	1%	0% to 100%	62220
330...333	Total harmonic distortion (THD+N) voltage L3	REAL	1%	0% to 100%	62320
334...337	Total harmonic distortion (THD+N) current L1	REAL	1%	0% to 100%	62121
338...341	Total harmonic distortion (THD+N) current L2	REAL	1%	0% to 100%	62221
342...345	Total harmonic distortion (THD+N) current L3	REAL	1%	0% to 100%	62321
346...357	Current module time	PNI-OTime	sec	-	65497

Neutral current

If you operate the AI Energy Meter HF with connection type 3P4W, 3P4W1 or 3P3W, the neutral current is also calculated under the following conditions:

- Transmission factors of all phase currents (primary and secondary currents) are identical.
- Measured phase currents are greater than the value of the "Low limit for measuring current" parameter.
- The parameter "Reverse current direction" must be the same on all phases.

If one of the conditions is not met, 0 is entered as the value for the neutral current. You can read the neutral current calculated using measured value data record 142.

Procedure

Data record 142 is located on the AI Energy Meter HF. Use the RDREC instruction to read out the data record from the module. This system function block is stored in the STEP 7 library.

E.3 Structure for energy counters (DS 143)

Energy meter data record 143 for different actions

The energy meter data record 143 includes all energy meters available on the module phase-by-phase. The data record can be used for different actions:

- Reset the energy meters to user-specific value (e.g. "0")
- Reading the current values of the energy counters
- Reading the overflow counters
- Reading the operating hours

Energy meter data record 143

Table E- 3 Energy meter data record 143

Byte	Measured variable	Data type	Unit	Value range	Measured value ID
0	Version	BYTE	-	1	-
1	Reserved	BYTE	-	0	-
2	Status / control byte 1 - L1	BYTE	Bit string	-	-
3	Status / control byte 2 - L1	BYTE	Bit string		
4	Status / control byte 1 - L2	BYTE	Bit string		
5	Status / control byte 2 - L2	BYTE	Bit string		
6	Status / control byte 1 - L3	BYTE	Bit string		
7	Status / control byte 2 - L3	BYTE	Bit string		
8...15	Active energy inflow (initial value) L1	LREAL	Wh	During reading: 0.0...1.8 x 10^{308} During writing For continuous counting: 0.0...3.4 x 10^{12} During writing For periodic counting: 0...configured full-scale value (10^3 ...10^{15})	61180
16...23	Active energy outflow (initial value) L1	LREAL	Wh		61181
24...31	Reactive energy inflow (initial value) L1	LREAL	varh		61182
32...39	Reactive energy outflow (initial value) L1	LREAL	varh		61183
40...47	Apparent energy (initial value) L1	LREAL	VAh		61184
48...55	Active energy inflow (initial value) L2	LREAL	Wh		61200
56...63	Active energy outflow (initial value) L2	LREAL	Wh		61201
64...61	Reactive energy inflow (initial value) L2	LREAL	varh		61202
72...79	Reactive energy outflow (initial value) L2	LREAL	varh		61203
80...87	Apparent energy (initial value) L2	LREAL	VAh		61204
88...95	Active energy inflow (initial value) L3	LREAL	Wh		61220
96...103	Active energy outflow (initial value) L3	LREAL	Wh		61221
104...111	Reactive energy inflow (initial value) L3	LREAL	varh		61222

Byte	Measured variable	Data type	Unit	Value range	Measured value ID
112...119	Reactive energy outflow (initial value) L3	LREAL	varh		61223
120...127	Apparent energy (initial value) L3	LREAL	VAh		61224
128...129	Overflow counter active energy inflow L1	UINT	-	During reading: 0...65535 During writing for continuous counting: 0 During writing for periodic counting: 0...65500	61190
130..131	Overflow counter active energy outflow L1	UINT	-		61191
132...133	Overflow counter reactive energy inflow L1	UINT	-		61192
134...135	Overflow counter reactive energy outflow L1	UINT	-		61193
136...137	Overflow counter apparent energy L1	UINT	-		61194
138...139	Overflow counter active energy inflow L2	UINT	-		61210
140...141	Overflow counter active energy outflow L2	UINT	-		61211
142...143	Overflow counter reactive energy inflow L2	UINT	-		61212
144...145	Overflow counter reactive energy outflow L2	UINT	-		61213
146...147	Overflow counter apparent energy L2	UINT	-		61214
148...149	Overflow counter active energy inflow L3	UINT	-		61230
150...151	Overflow counter active energy outflow L3	UINT	-		61231
152...153	Overflow counter reactive energy inflow L3	UINT	-		61232
154...155	Overflow counter reactive energy outflow L3	UINT	-		61233
156...157	Overflow counter apparent energy L3	UINT	-		61234
158...161	Operating hours counter L1 (initial value)	REAL	h	During reading: 0...3.4×10^{38} During writing: 0...10^9	65505
162...165	Operating hours counter L2 (initial value)	REAL	h		65506
166...169	Operating hours counter L3 (initial value)	REAL	h		65507

Status information

When data record 143 is read with the RDREC instruction, Bytes 2 to 7 supply phase-specific status information for energy counters, overflow counters and operating hours counters.

The status information enables you can see which counters are returning their values in the data record 143. If energy counters return their values in the status byte 1, you can determine the type of energy counter with status byte 2.

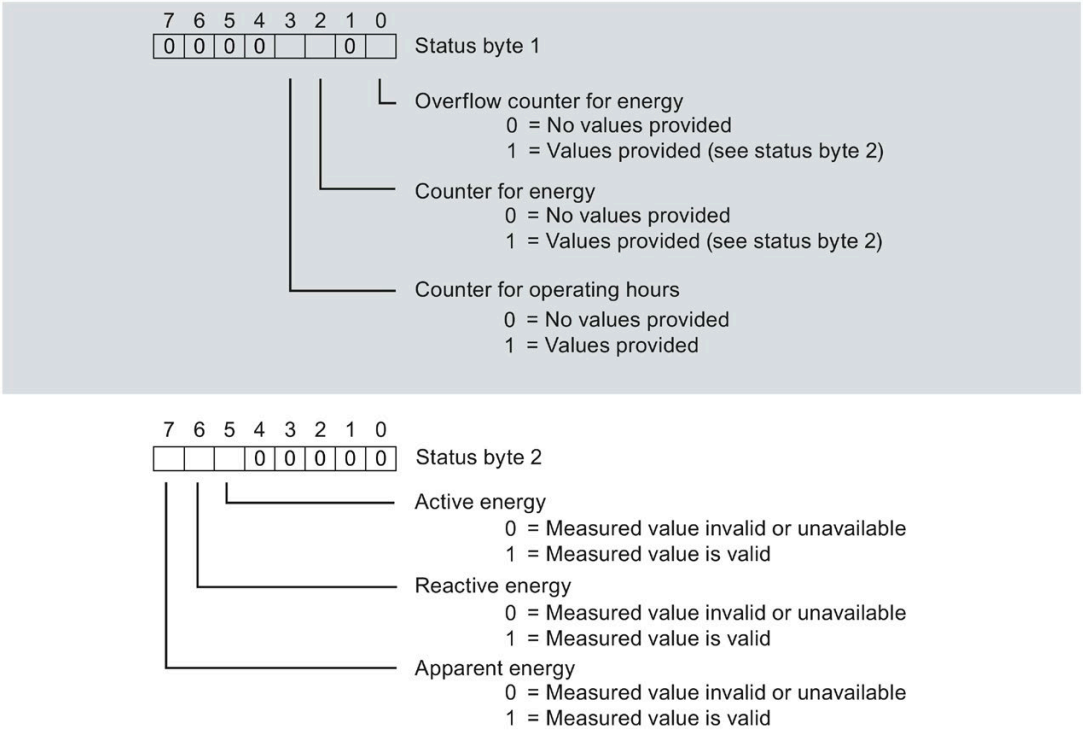


Figure E-1 Status information DS 143 (read access)

Control information

When data record 143 is written with the WRREC instruction, Bytes 2 to 7 are used as phase-specific control information for energy counters, overflow counters and operating hours counter. The length of the control information amounts to 2 bytes for each phase:

- In control byte 1 you determine which counter you want to reset and the time at which counters are reset.
- In Control byte 2 you determine which energy counters and which overflow counters you want to reset.

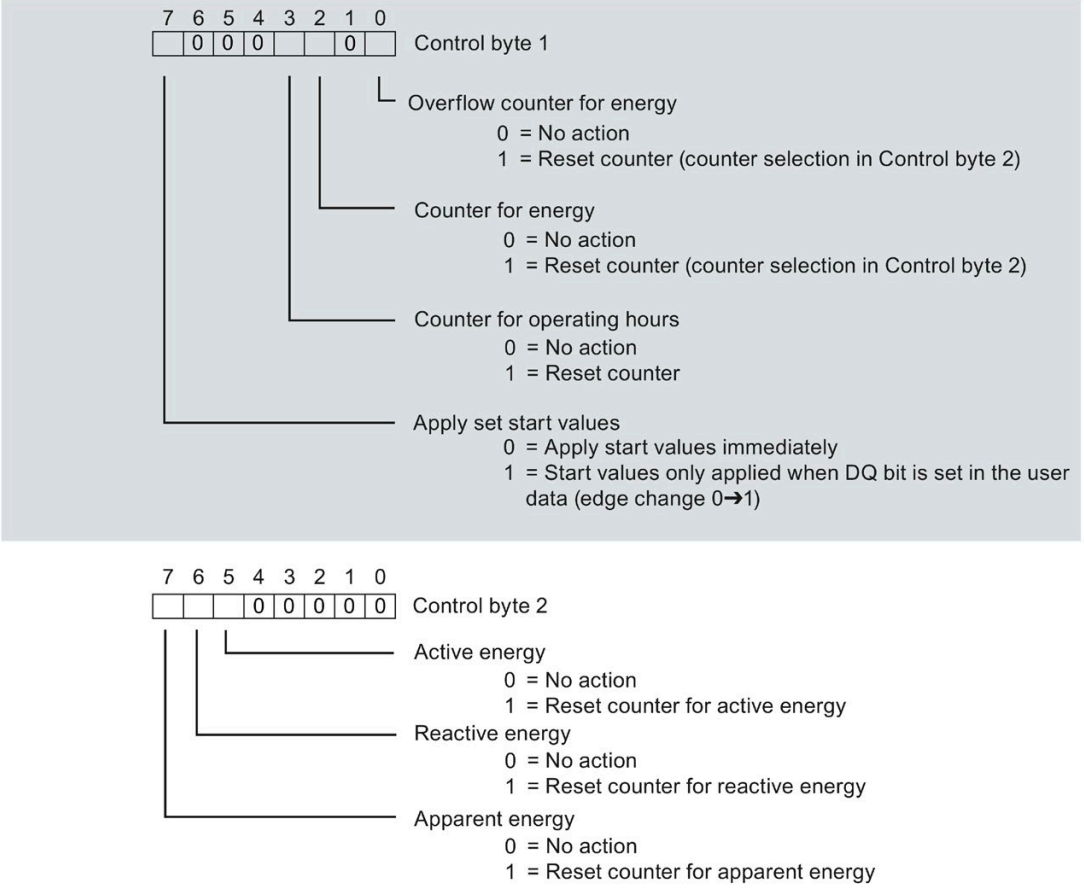


Figure E-2 Control information DS 143 (write access)

Error while transferring the data record

The module always checks all the values of the transferred data record. Only if all the values were transferred without errors does the module apply the values from the data record.

The WRREC instruction for writing data records returns corresponding error codes when errors occur in the STATUS parameter.

The following table shows the module-specific error codes and their meaning for the measured value data record 143:

Error code in STATUS parameter (hexadecimal)				Meaning	Solution
Byte 0	Byte 1	Byte 2	Byte 3		
DF	80	B0	00	Number of the data record unknown	Enter a valid number for the data record.
DF	80	B1	00	Length of the data record incorrect	Enter a valid value for the data record length.
DF	80	B2	00	Slot invalid or cannot be accessed.	Check the station whether the module is plugged or drawn. Check the assigned values for the parameters of the WRREC instruction
DF	80	E1	01	Reserved bits are not 0.	Check Byte 2...7 and reset the reserved bits to 0.
DF	80	E1	39	Incorrect version entered.	Check Byte 0. Enter a valid version.
DF	80	E1	3A	Incorrect data record length entered.	Check the parameters of the WRREC instruction. Enter a valid length.
DF	80	E1	3C	At least one start value is invalid.	Check Bytes 8...103 and Bytes 158...169. The start values may not be negative.
DF	80	E1	3D	At least one start value is too large	Check Bytes 8...103 and Bytes 158...169. Observe the ranges of values for start values.

E.4 Measured value data record for maximum values (DS 144)

E.4.1 Measured value data record for maximum values (DS 144) version 1

Measured variables of the module

The largest values ever measured or calculated from the time AI Energy Meter HF was started are stored in this data record.

The measured value identification (measured value ID) is an index which references the overview table of the measured variables in Appendix B Measured variables for connection type (Page 171).

Byte	Measured variable	Data type	Unit	Default	Measured value ID
0	Version	UINT8	-	2	-
1	Reserved	UINT8	-	0	-
2...5	Max. voltage L1-N	REAL	V	0	40
6...9	Max. voltage L2-N	REAL	V	0	41
10...13	Max. voltage L3-N	REAL	V	0	42
14...17	Max. voltage L1-L2	REAL	V	0	43
18...21	Max. voltage L2-L3	REAL	V	0	44
22...25	Max. voltage L3-L1	REAL	V	0	45
26...29	Max. current L1 [1]	REAL	A	0	46
30...33	Max. current L2 [1]	REAL	A	0	47
34...37	Max. current L3 [1]	REAL	A	0	48
38...41	Max. apparent power L1	REAL	VA	0	49
42...45	Max. apparent power L2	REAL	VA	0	50
46...49	Max. apparent power L3	REAL	VA	0	51
50...53	Max. active power L1	REAL	W	-3.0×10^9	52
54...57	Max. active power L2	REAL	W	-3.0×10^9	53
58...61	Max. active power L3	REAL	W	-3.0×10^9	54
62...65	Max. reactive power Qtot L1	REAL	var	-3.0×10^9	62160
66...69	Max. reactive power Qtot L2	REAL	var	-3.0×10^9	62260
70...73	Max. reactive power Qtot L3	REAL	var	-3.0×10^9	62360
74...77	Max. power factor λ L1	REAL	-	0	58
78...81	Max. power factor λ L2	REAL	-	0	59
82...85	Max. power factor λ L3	REAL	-	0	60
86...89	Max. frequency	REAL	Hz	45	61
90...93	Max. apparent power L1L2L3	REAL	VA	0	67
94...97	Max. active power L1L2L3	REAL	W	-3.0×10^9	65
98...101	Max. reactive power Qtot L1L2L3	REAL	var	-3.0×10^9	61138
102...105	Max. power factor λ L1L2L3	REAL	-	0	68
106...109	Max. reactive power Qn L1	REAL	var	-3.0×10^9	55

Byte	Measured variable	Data type	Unit	Default	Measured value ID
110...113	Max. reactive power Qn L2	REAL	var	-3.0 x 10^9	56
114...117	Max. reactive power Qn L3	REAL	var	-3.0 x 10^9	57
118...121	Max. mean voltage L-N	REAL	V	0	62
122...125	Max. mean voltage L-L	REAL	V	0	63
126...129	Max. mean current L1L2L3	REAL	A	0	64
130...133	Max. fundamental voltage L1	REAL	V	0	62152
134...137	Max. fundamental voltage L2	REAL	V	0	62252
138...141	Max. fundamental voltage L3	REAL	V	0	62352
142...145	Max. fundamental current L1	REAL	A	0	62153
146...149	Max. fundamental current L2	REAL	A	0	62253
150...153	Max. fundamental current L3	REAL	A	0	62353
154...157	Max. fundamental apparent power L1	REAL	VA	-3.0 x 10^9	62155
158...161	Max. fundamental apparent power L2	REAL	VA	-3.0 x 10^9	62255
162...165	Max. fundamental apparent power L3	REAL	VA	-3.0 x 10^9	62355
166...169	Max. fundamental reactive power L1	REAL	var	-3.0 x 10^9	62154
170...173	Max. fundamental reactive power L2	REAL	var	-3.0 x 10^9	62254
174...177	Max. fundamental reactive power L3	REAL	var	-3.0 x 10^9	62354
178...181	Max. fundamental active power L1	REAL	W	-3.0 x 10^9	62156
182...185	Max. fundamental active power L2	REAL	W	-3.0 x 10^9	62256
186...189	Max. fundamental active power L3	REAL	W	-3.0 x 10^9	62356
190...193	Max. fundamental cos φ active factor L1	REAL	-	-1	62157
194...197	Max. fundamental cos φ active factor L2	REAL	-	-1	62257
198...201	Max. fundamental cos φ active factor L3	REAL	-	-1	62357
202...205	Max. total harmonic distortion (THD+N) voltage L1	REAL	1%	0	62150
206...209	Max. total harmonic distortion (THD+N) voltage L2	REAL	1%	0	62250
210...213	Max. total harmonic distortion (THD+N) voltage L3	REAL	1%	0	62350
214...217	Max. total harmonic distortion (THD+N) current L1	REAL	1%	0	62151
218...221	Max. total harmonic distortion (THD+N) current L2	REAL	1%	0	62251
222...225	Max. total harmonic distortion (THD+N) current L3	REAL	1%	0	62351

[1] The values reference the amount of the current measured value

E.5 Measured value data record for maximum values with time stamp (DS 154)

Measured variables of the module

The largest values ever measured or calculated from the time AI Energy Meter HF was started are stored in this data record.

The measured values (REAL 4 bytes) are each followed by a time stamp (PNIO Time 12 bytes).

The measured value identification (measured value ID) is an index which references the overview table of the measured variables in Appendix B Measured variables for connection type (Page 171).

Byte	Measured variable	Data type	Unit	Default	Measured value ID
0	Version	UINT8	-	2	-
1	Reserved	UINT8	-	0	-
2...17	Max. voltage L1-N	REAL + PNIO Time	V	0	40
18...33	Max. voltage L2-N	REAL + PNIO Time	V	0	41
34...49	Max. voltage L3-N	REAL + PNIO Time	V	0	42
50...65	Max. voltage L1-L2	REAL + PNIO Time	V	0	43
66...81	Max. voltage L2-L3	REAL + PNIO Time	V	0	44
82...97	Max. voltage L3-L1	REAL + PNIO Time	V	0	45
98...113	Max. current L1[1]	REAL + PNIO Time	A	0	46
114...129	Max. current L2[1]	REAL + PNIO Time	A	0	47
130...145	Max. current L3[1]	REAL + PNIO Time	A	0	48
146...161	Max. apparent power L1	REAL + PNIO Time	VA	0	49
162...177	Max. apparent power L2	REAL + PNIO Time	VA	0	50
178...193	Max. apparent power L3	REAL + PNIO Time	VA	0	51
194...209	Max. active power L1	REAL + PNIO Time	W	-3.0×10^9	52
210...225	Max. active power L2	REAL + PNIO Time	W	-3.0×10^9	53
226...241	Max. active power L3	REAL + PNIO Time	W	-3.0×10^9	54
242...257	Max. reactive power Qtot L1	REAL + PNIO Time	var	-3.0×10^9	62160

Byte	Measured variable	Data type	Unit	Default	Measured value ID
258...273	Max. reactive power Qtot L2	REAL + PNIO Time	var	-3.0 x 10^9	62260
274...289	Max. reactive power Qtot L3	REAL + PNIO Time	var	-3.0 x 10^9	62360
290...305	Max. power factor λ L1	REAL + PNIO Time	-	0	58
306...321	Max. power factor λ L2	REAL + PNIO Time	-	0	59
322...337	Max. power factor λ L3	REAL + PNIO Time	-	0	60
338...353	Max. frequency	REAL + PNIO Time	Hz	45	61
354...369	Max. apparent power L1L2L3	REAL + PNIO Time	VA	0	67
370...385	Max. active power L1L2L3	REAL + PNIO Time	W	-3.0 x 10^9	65
386...401	Max. reactive power Qtot L1L2L3	REAL + PNIO Time	var	-3.0 x 10^9	61138
402...417	Max. power factor λ L1L2L3	REAL + PNIO Time	-	0	68
418...433	Max. reactive power Qn L1	REAL + PNIO Time	var	-3.0 x 10^9	55
434...449	Max. reactive power Qn L2	REAL + PNIO Time	var	-3.0 x 10^9	56
450...465	Max. reactive power Qn L3	REAL + PNIO Time	var	-3.0 x 10^9	57
466...481	Max. mean voltage L-N	REAL + PNIO Time	V	0	62
482...497	Max. mean voltage L-L	REAL + PNIO Time	V	0	63
498...513	Max. sum mean value current L1L2L3	REAL + PNIO Time	A	0	64
514...529	Max. fundamental voltage L1	REAL + PNIO Time	V	0	62152
530...545	Max. fundamental voltage L2	REAL + PNIO Time	V	0	62252
546...561	Max. fundamental voltage L3	REAL + PNIO Time	V	0	62352
562...577	Max. fundamental current L1	REAL + PNIO Time	A	0	62153
578...593	Max. fundamental current L2	REAL + PNIO Time	A	0	62253
594...609	Max. fundamental current L3	REAL + PNIO Time	A	0	62353
610...625	Max. fundamental apparent power L1	REAL + PNIO Time	VA	-3.0 x 10^9	62155
626...641	Max. fundamental apparent power L2	REAL + PNIO Time	VA	-3.0 x 10^9	62255

Byte	Measured variable	Data type	Unit	Default	Measured value ID
642...657	Max. fundamental apparent power L3	REAL + PNIO Time	VA	-3.0 x 10^9	62355
658...673	Max. fundamental reactive power L1	REAL + PNIO Time	var	-3.0 x 10^9	62154
674...689	Max. fundamental reactive power L2	REAL + PNIO Time	var	-3.0 x 10^9	62254
690...705	Max. fundamental reactive power L3	REAL + PNIO Time	var	-3.0 x 10^9	62354
706...721	Max. fundamental active power L1	REAL + PNIO Time	W	-3.0 x 10^9	62156
722...737	Max. fundamental active power L2	REAL + PNIO Time	W	-3.0 x 10^9	62256
738...753	Max. fundamental active power L3	REAL + PNIO Time	W	-3.0 x 10^9	62356
754...769	Max. fundamental cos φ active factor L1	REAL + PNIO Time	-	-1	62157
770...785	Max. fundamental cos φ active factor L2	REAL + PNIO Time	-	-1	62257
786...801	Max. fundamental cos φ active factor L3	REAL + PNIO Time	-	-1	62357
802...817	Max. total harmonic distortion (THD+N) voltage L1	REAL + PNIO Time	1%	0	62150
818...833	Max. total harmonic distortion (THD+N) voltage L2	REAL + PNIO Time	1%	0	62250
834...849	Max. total harmonic distortion (THD+N) voltage L3	REAL + PNIO Time	1%	0	62350
850...865	Max. total harmonic distortion (THD+N) current L1	REAL + PNIO Time	1%	0	62151
866...881	Max. total harmonic distortion (THD+N) current L2	REAL + PNIO Time	1%	0	62251
882...897	Max. total harmonic distortion (THD+N) current L3	REAL + PNIO Time	1%	0	62351

[1] The values reference the amount of the current measured value

Structure of time stamp

The table below shows the structure of the time stamp:

Byte	PNIO Time	Format	Length
0	Status 0: Synchronization from system time master available 1: local synchronization available 2: no synchronization	UINT16	2 bytes
2	Seconds high	UINT16	2 bytes
4	Seconds low	UINT32	4 bytes
8	Nanoseconds	UINT32	4 bytes

The start value (initial value) is 01.01.1970, 0:00

Note

If you use the FAQ from the section Time-of-day synchronization and time stamp (Page 53), the status is always 2.

E.6 Measured value data record for minimum values (DS 145)

E.6.1 Measured value data record for minimum values (DS 145) version 1

Measured variables of the module

The smallest values ever measured or calculated from the time AI Energy Meter HF was started are stored in this data record.

The measured value identification (measured value ID) is an index which references the overview table of the measured variables in Appendix B Measured variables for connection type (Page 171).

Byte	Measured variable	Data type	Unit	Default	Measured value ID
0	Version	UINT8	-	2	-
1	Reserved	UINT8	-	0	-
2...5	Min. voltage L1-N	REAL	V	1000000	70
6...9	Min. voltage L2-N	REAL	V	1000000	71
10...13	Min. voltage L3-N	REAL	V	1000000	72
14...17	Min. voltage L1-L2	REAL	V	1800000	73
18...21	Min. voltage L2-L3	REAL	V	1800000	74
22...25	Min. voltage L3-L1	REAL	V	1800000	75
26...29	Min. current L1 [1]	REAL	A	100000	76
30...33	Min. current L2 [1]	REAL	A	100000	77
34...37	Min. current L3 [1]	REAL	A	100000	78
38...41	Min. apparent power L1	REAL	VA	$+3.0 \times 10^9$	79
42...45	Min. apparent power L2	REAL	VA	$+3.0 \times 10^9$	80
46...49	Min. apparent power L3	REAL	VA	$+3.0 \times 10^9$	81
50...53	Min. active power L1	REAL	W	$+3.0 \times 10^9$	82
54...57	Min. active power L2	REAL	W	$+3.0 \times 10^9$	83
58...61	Min. active power L3	REAL	W	$+3.0 \times 10^9$	84
62...65	Min. reactive power Qtot L1	REAL	var	$+3.0 \times 10^9$	62180
66...69	Min. reactive power Qtot L2	REAL	var	$+3.0 \times 10^9$	62280
70...73	Min. reactive power Qtot L3	REAL	var	$+3.0 \times 10^9$	62380

Byte	Measured variable	Data type	Unit	Default	Measured value ID
74...77	Min. power factor λ L1	REAL	-	1	88
78...81	Min. power factor λ L2	REAL	-	1	89
82...85	Min. power factor λ L3	REAL	-	1	90
86...89	Min. frequency	REAL	Hz	65	91
90...93	Min. apparent power L1L2L3	REAL	VA	$+3.0 \times 10^9$	97
94...97	Min. active power L1L2L3	REAL	W	$+3.0 \times 10^9$	95
98...101	Min. reactive power Qn L1L2L3	REAL	var	$+3.0 \times 10^9$	61139
102...105	Min. power factor λ L1L2L3	REAL	-	1	98
106...109	Min. reactive power Qn L1	REAL	var	$+3.0 \times 10^9$	85
110...113	Min. reactive power Qn L2	REAL	var	$+3.0 \times 10^9$	86
114...117	Min. reactive power Qn L3	REAL	var	$+3.0 \times 10^9$	87
118...121	Min. mean voltage L-N	REAL	V	1000000	92
122...125	Min. mean voltage L-L	REAL	V	1800000	93
126...129	Min. mean current L1L2L3	REAL	A	100000	94
130...133	Min. fundamental voltage L1	REAL	V	0	62172
134...137	Min. fundamental voltage L2	REAL	V	0	62272
138...141	Min. fundamental voltage L3	REAL	V	0	62372
142...145	Min. fundamental current L1	REAL	A	1000000	62173
146...149	Min. fundamental current L2	REAL	A	1000000	62273
150...153	Min. fundamental current L3	REAL	A	1000000	62373
154...157	Min. fundamental apparent power L1	REAL	VA	$+3.0 \times 10^9$	62175
158...161	Min. fundamental apparent power L2	REAL	VA	$+3.0 \times 10^9$	62275
162...165	Min. fundamental apparent power L3	REAL	VA	$+3.0 \times 10^9$	62375
166...169	Min. fundamental reactive power L1	REAL	var	$+3.0 \times 10^9$	62174
170...173	Min. fundamental reactive power L2	REAL	var	$+3.0 \times 10^9$	62274
174...177	Min. fundamental reactive power L3	REAL	var	$+3.0 \times 10^9$	62374
178...181	Min. fundamental active power L1	REAL	W	$+3.0 \times 10^9$	62176
182...185	Min. fundamental active power L2	REAL	W	$+3.0 \times 10^9$	62276
186...189	Min. fundamental active power L3	REAL	W	$+3.0 \times 10^9$	62376
190...193	Min. fundamental cos φ active factor L1	REAL	-	1	62177
194...197	Min. fundamental cos φ active factor L2	REAL	-	1	62277
198...201	Min. fundamental cos φ active factor L3	REAL	-	1	62377
202...205	Min. total harmonic distortion (THD+N) voltage L1	REAL	1%	100	62170
206...209	Min. total harmonic distortion (THD+N) voltage L2	REAL	1%	100	62270
210...213	Min. total harmonic distortion (THD+N) voltage L3	REAL	1%	100	62370
214...217	Min. total harmonic distortion (THD+N) current L1	REAL	1%	100	62171
218...221	Min. total harmonic distortion (THD+N) current L2	REAL	1%	100	62271
222...225	Min. total harmonic distortion (THD+N) current L3	REAL	1%	100	62371

[1] The values reference the amount of the current measured value

E.7 Measured value data record for minimum values with time stamp (DS 155)

Measured variables of the module

The smallest values ever measured or calculated from the time AI Energy Meter HF was started are stored in this data record.

The measured values (REAL 4 bytes) are each followed by a time stamp (PNIO Time 12 bytes).

The measured value identification (measured value ID) is an index which references the overview table of the measured variables in Appendix B Measured variables for connection type (Page 171).

Byte	Measured variable	Data type	Unit	Default	Measured value ID
0	Version	UINT8	-	2	-
1	Reserved	UINT8	-	0	-
2...17	Min. voltage L1-N	REAL + PNIO Time	V	1000000	70
18...33	Min. voltage L2-N	REAL + PNIO Time	V	1000000	71
34...49	Min. voltage L3-N	REAL + PNIO Time	V	1000000	72
50...65	Min. voltage L1-L2	REAL + PNIO Time	V	1800000	73
66...81	Min. voltage L2-L3	REAL + PNIO Time	V	1800000	74
82...97	Min. voltage L3-L1	REAL + PNIO Time	V	1800000	75
98...113	Min. current L1[1]	REAL + PNIO Time	A	100000	76
114...129	Min. current L2[1]	REAL + PNIO Time	A	100000	77
130...145	Min. current L3[1]	REAL + PNIO Time	A	100000	78
146...161	Min. apparent power L1	REAL + PNIO Time	VA	$+3.0 \times 10^9$	79
162...177	Min. apparent power L2	REAL + PNIO Time	VA	$+3.0 \times 10^9$	80

Byte	Measured variable	Data type	Unit	Default	Measured value ID
178...193	Min. apparent power L3	REAL + PNIO Time	VA	+3.0 x 10^9	81
194...209	Min. active power L1	REAL + PNIO Time	W	+3.0 x 10^9	82
210...225	Min. active power L2	REAL + PNIO Time	W	+3.0 x 10^9	83
226...241	Min. active power L3	REAL + PNIO Time	W	+3.0 x 10^9	84
242...257	Min. reactive power Qtot L1	REAL + PNIO Time	var	+3.0 x 10^9	62180
258...273	Min. reactive power Qtot L2	REAL + PNIO Time	var	+3.0 x 10^9	62280
274...289	Min. reactive power Qtot L3	REAL + PNIO Time	var	+3.0 x 10^9	62380
290...305	Min. power factor λ L1	REAL + PNIO Time	-	1	88
306...321	Min. power factor λ L2	REAL + PNIO Time	-	1	89
322...337	Min. power factor λ L3	REAL + PNIO Time	-	1	90
338...353	Min. frequency	REAL + PNIO Time	Hz	65	91
354...369	Min. apparent power L1L2L3	REAL + PNIO Time	VA	+3.0 x 10^9	97
370...385	Min. active power L1L2L3	REAL + PNIO Time	W	+3.0 x 10^9	95
386...401	Min. reactive power Qn L1L2L3	REAL + PNIO Time	var	+3.0 x 10^9	61139
402...417	Min. power factor λ L1L2L3	REAL + PNIO Time	-	1	98
418...433	Min. reactive power Qn L1	REAL + PNIO Time	var	+3.0 x 10^9	85
434...449	Min. reactive power Qn L2	REAL + PNIO Time	var	+3.0 x 10^9	86

Byte	Measured variable	Data type	Unit	Default	Measured value ID
450...465	Min. reactive power Qn L3	REAL + PNIO Time	var	+3.0 x 10^9	87
466...481	Min. mean voltage L-N	REAL + PNIO Time	V	1000000	92
482...497	Min. mean voltage L-L	REAL + PNIO Time	V	1800000	93
498...513	Min. mean current L1L2L3	REAL + PNIO Time	A	100000	94
514...529	Min. fundamental voltage L1	REAL + PNIO Time	V	0	62172
530...545	Min. fundamental voltage L2	REAL + PNIO Time	V	0	62272
546...561	Min. fundamental voltage L3	REAL + PNIO Time	V	0	62372
562...577	Min. fundamental current L1	REAL + PNIO Time	A	1000000	62173
578...593	Min. fundamental current L2	REAL + PNIO Time	A	1000000	62273
594...609	Min. fundamental current L3	REAL + PNIO Time	A	1000000	62373
610...625	Min. fundamental apparent power L1	REAL + PNIO Time	VA	+3.0 x 10^9	62175
626...641	Min. fundamental apparent power L2	REAL + PNIO Time	VA	+3.0 x 10^9	62275
642...657	Min. fundamental apparent power L3	REAL + PNIO Time	VA	+3.0 x 10^9	62375
658...673	Min. fundamental reactive power L1	REAL + PNIO Time	var	+3.0 x 10^9	62174
674...689	Min. fundamental reactive power L2	REAL + PNIO Time	var	+3.0 x 10^9	62274
690...705	Min. fundamental reactive power L3	REAL + PNIO Time	var	+3.0 x 10^9	62374
706...721	Min. fundamental active power L1	REAL + PNIO Time	W	+3.0 x 10^9	62176

Byte	Measured variable	Data type	Unit	Default	Measured value ID
722...737	Min. fundamental active power L2	REAL + PNIO Time	W	+3.0 x 10^9	62276
738...753	Min. fundamental active power L3	REAL + PNIO Time	W	+3.0 x 10^9	62376
754...769	Min. fundamental cos φ active factor L1	REAL + PNIO Time	-	1	62177
770...785	Min. fundamental cos φ active factor L2	REAL + PNIO Time	-	1	62277
786...801	Min. fundamental cos φ active factor L3	REAL + PNIO Time	-	1	62377
802...817	Min. total harmonic distortion (THD+N) voltage L1	REAL + PNIO Time	1%	100	62170
818...833	Min. total harmonic distortion (THD+N) voltage L2	REAL + PNIO Time	1%	100	62270
834...849	Min. total harmonic distortion (THD+N) voltage L3	REAL + PNIO Time	1%	100	62370
850...865	Min. total harmonic distortion (THD+N) current L1	REAL + PNIO Time	1%	100	62171
866...881	Min. total harmonic distortion (THD+N) current L2	REAL + PNIO Time	1%	100	62271
882...897	Min. total harmonic distortion (THD+N) current L3	REAL + PNIO Time	1%	100	62371

[1] The values reference the amount of the current measured value

E.8 Measured value data record for phase-based measured values L1 (DS 147)

E.8.1 Measured value data record for phase-based measured values L1 (DS 147) version 0

Measured variables of the module

The measured value identification (measured value ID) is an index which references the overview table of the measured variables in Appendix B Measured variables for connection type (Page 171).

Byte	Measured variable	Data type	Unit	Value range	Measured value ID
0	Version	BYTE	-	0	-
1	Reserved	BYTE	-	0	-
2...3	Qualifier L1	WORD	Bit field	0b 00 00 00 00 0b qq 00 00 xx	65500
4...7	Voltage L1-N	REAL	V	0.0 ... 1000000.0	1
8...11	Current L1	REAL	A	0.0 ... 100000.0	7
12...15	Apparent power L1	REAL	VA	-3.0×10^9 ... $+3.0 \times 10^9$	10
16...19	Active power L1	REAL	W	-3.0×10^9 ... $+3.0 \times 10^9$	13
20...23	Reactive power Qtot L1	REAL	var	-3.0×10^9 ... $+3.0 \times 10^9$	22
24...27	Power factor λ L1	REAL	-	0.0 ... 1.0	19
28...31	Phase angle L1	REAL	°	0.0 ... 360.0	61178
32...39	Apparent energy L1	LREAL	VAh	0.0 ... 1.8×10^{308}	61184
40...47	Total active energy L1	LREAL	Wh	-1.8×10^{308} ... $+1.8 \times 10^{308}$	61185
48...55	Total reactive energy L1	LREAL	varh	-1.8×10^{308} ... $+1.8 \times 10^{308}$	61186
56...59	Max. voltage L1-N	REAL	V	0.0 ... 1000000.0	40
60...63	Max. current L1	REAL	A	0.0 ... 100000.0	46
64...67	Max. apparent power L1	REAL	VA	-3.0×10^9 ... $+3.0 \times 10^9$	49
68...71	Max. active power L1	REAL	W	-3.0×10^9 ... $+3.0 \times 10^9$	52
72...75	Max. reactive power Qtot L1	REAL	var	-3.0×10^9 ... $+3.0 \times 10^9$	62160
76...79	Max. power factor λ L1	REAL	-	0.0 ... 1.0	58
80...83	Min. voltage L1-N	REAL	V	0.0 ... 1000000.0	70
84...87	Min. current L1	REAL	A	0.0 ... 100000.0	76
88...91	Min. apparent power L1	REAL	VA	-3.0×10^9 ... $+3.0 \times 10^9$	79
92...95	Min. active power L1	REAL	W	-3.0×10^9 ... $+3.0 \times 10^9$	82
96...99	Min. reactive power Qtot L1	REAL	var	-3.0×10^9 ... $+3.0 \times 10^9$	62180
100...103	Min. power factor λ L1	REAL	-	0.0 ... 1.0	88

E.8.2 Measured value data record for phase-based measured values L1 (DS 147) version 1

Measured variables of the module

The measured value identification (measured value ID) is an index which references the overview table of the measured variables in Appendix B Measured variables for connection type (Page 171).

Byte	Measured variable	Data type	Unit	Value range	Measured value ID
0	Version	UINT8	-	1	-
1	Reserved	UINT8	-	0	-
2...3	Qualifier L1	WORD	Bit field	0b 00 00 00 00 0b qq 00 00 xx	65500
4...7	Voltage L1-N	REAL	V	0.0 ... 1000000.0	1
8...11	Current L1	REAL	A	0.0 ... 100000.0	7
12...15	Apparent power L1	REAL	VA	-3.0×10^9 ... $+3.0 \times 10^9$	10
16...19	Active power L1	REAL	W	-3.0×10^9 ... $+3.0 \times 10^9$	13
20...23	Reactive power Qtot L1	REAL	var	-3.0×10^9 ... $+3.0 \times 10^9$	22
24...27	Power factor λ L1	REAL	-	0.0 ... 1.0	19
28...31	Phase angle L1	REAL	°	0.0 ... 360.0	61178
32...39	Apparent energy L1	LREAL	VAh	0.0 ... 1.8×10^{308}	61184
40...47	Total active energy L1	LREAL	Wh	-1.8×10^{308} ... $+1.8 \times 10^{308}$	61185
48...55	Total reactive energy L1	LREAL	varh	-1.8×10^{308} ... $+1.8 \times 10^{308}$	61186
56...59	Max. voltage L1-N	REAL	V	0.0 ... 1000000.0	40
60...63	Max. current L1	REAL	A	0.0 ... 100000.0	46
64...67	Max. apparent power L1	REAL	VA	-3.0×10^9 ... $+3.0 \times 10^9$	49
68...71	Max. active power L1	REAL	W	-3.0×10^9 ... $+3.0 \times 10^9$	52
72...75	Max. reactive power Qtot L1	REAL	var	-3.0×10^9 ... $+3.0 \times 10^9$	62160
76...79	Max. power factor λ L1	REAL	-	0.0 ... 1.0	58
80...83	Min. voltage L1-N	REAL	V	0.0 ... 1000000.0	70
84...87	Min. current L1	REAL	A	0.0 ... 100000.0	76
88...91	Min. apparent power L1	REAL	VA	-3.0×10^9 ... $+3.0 \times 10^9$	79
92...95	Min. active power L1	REAL	W	-3.0×10^9 ... $+3.0 \times 10^9$	82
96...99	Min. reactive power Qtot L1	REAL	var	-3.0×10^9 ... $+3.0 \times 10^9$	62180
100...103	Min. power factor λ L1	REAL	-	0.0 ... 1.0	88
104...107	Reactive power Qn L1	REAL	var	-3.0×10^9 ... $+3.0 \times 10^9$	16
108...111	Current L1 10-12 cycles	REAL	V	0.0 ... 760.0	62130
112...115	Current L1 10-12 cycles	REAL	A	0.0 ... 100000.0	62133
116...119	Max. reactive power Qn L1	REAL	var	-3.0×10^9 ... $+3.0 \times 10^9$	55
120...123	Min. reactive power Qn L1	REAL	var	-3.0×10^9 ... $+3.0 \times 10^9$	85
124...127	Fundamental voltage L1	REAL	V	0.0 ... 440.0	62122
128...131	Fundamental current L1	REAL	A	0.0 ... 100000.0	62123
132...135	Fundamental apparent power L1	REAL	VA	-3.0×10^9 ... $+3.0 \times 10^9$	62125

Byte	Measured variable	Data type	Unit	Value range	Measured value ID
136...139	Fundamental reactive power L1	REAL	var	-3.0 x 10^9 ... +3.0 x 10^9	62124
140...143	Fundamental active power L1	REAL	W	-3.0 x 10^9 ... +3.0 x 10^9	62126
144...147	Fundamental cos φ active factor L1	REAL	-	-1.0 ... 1.0	62127
148...151	Max. fundamental voltage L1	REAL	V	0.0 ... 760.0	62152
152...155	Max. fundamental current L1	REAL	A	0.0 ... 100000.0	62153
156...159	Max. fundamental apparent power L1	REAL	VA	-3.0 x 10^9 ... +3.0 x 10^9	62155
160...163	Max. fundamental reactive power L1	REAL	var	-3.0 x 10^9 ... +3.0 x 10^9	62154
164...167	Max. fundamental active power L1	REAL	W	-3.0 x 10^9 ... +3.0 x 10^9	62156
168...171	Max. fundamental cos φ active factor L1	REAL	-	-1.0 ... 1.0	62157
172...175	Min. fundamental voltage L1	REAL	V	0.0 ... 440.0	62172
176...179	Min. fundamental current L1	REAL	A	0.0 ... 100000.0	62173
180...183	Min. fundamental apparent power L1	REAL	VA	-3.0 x 10^9 ... +3.0 x 10^9	62175
184...187	Min. fundamental reactive power L1	REAL	var	-3.0 x 10^9 ... +3.0 x 10^9	62174
188...191	Min. fundamental active power L1	REAL	W	-3.0 x 10^9 ... +3.0 x 10^9	62176
192...195	Min. fundamental cos φ active factor L1	REAL	-	-1.0 ... 1.0	62177
196...199	Total harmonic distortion (THD+N) voltage L1	REAL	1%	0% to 100%	62120
200...203	Total harmonic distortion (THD+N) current L1	REAL	1%	0% to 100%	62121
204...207	Max. total harmonic distortion (THD+N) voltage L1	REAL	1%	0% to 100%	62150
208...211	Max. total harmonic distortion (THD+N) current L1	REAL	1%	0% to 100%	62151
212...215	Min. total harmonic distortion (THD+N) voltage L1	REAL	1%	0% to 100%	62170
216...219	Min. total harmonic distortion (THD+N) current L1	REAL	1%	0% to 100%	62171
220...223	Voltage dip - value L1	REAL	V	0.0 ... 440.0	62194
224...227	Voltage dip - duration L1	REAL	ms	0.0 ... 100000.0	62199
228...231	Voltage swell - value L1	REAL	V	0.0 ... 440.0	62195
232...235	Voltage swell - duration L1	REAL	ms	0.0 ... 100000.0	62200
236...239	Voltage peak value L1	REAL	V	0.0 ... 440.0	62196
240...243	Current peak value L1	REAL	A	0.0 ... 100000.0	62197
244...247	Overcurrent value L1	REAL	A	0.0 ... 100000.0	62198

E.9 Measured value data record for phase-based measured values L2 (DS 148)

E.9.1 Measured value data record for phase-based measured values L2 (DS 148) version 0

Measured variables of the module

The measured value identification (measured value ID) is an index which references the overview table of the measured variables in Appendix B Measured variables for connection type (Page 171).

Byte	Measured variable	Data type	Unit	Value range	Measured value ID
0	Version	BYTE	-	0	-
1	Reserved	BYTE	-	0	-
2...3	Qualifier L2	WORD	Bit field	0b 00 00 00 00 0b qq 00 00 xx	65501
4...7	Voltage L1-N	REAL	V	0.0 ... 1000000.0	2
8...11	Current L2	REAL	A	0.0 ... 100000.0	8
12...15	Apparent power L2	REAL	VA	-3.0×10^9 ... $+3.0 \times 10^9$	11
16...19	Active power L2	REAL	W	-3.0×10^9 ... $+3.0 \times 10^9$	14
20...23	Reactive power Qtot L2	REAL	var	-3.0×10^9 ... $+3.0 \times 10^9$	23
24...27	Power factor λ L2	REAL	-	0.0 ... 1.0	20
28...31	Phase angle L2	REAL	°	0.0 ... 360.0	61198
32...39	Apparent energy L2	LREAL	VAh	0.0 ... 1.8×10^{308}	61204
40...47	Total active energy L2	LREAL	Wh	-1.8×10^{308} to $+1.8 \times 10^{308}$	61205
48...55	Total reactive energy L2	LREAL	varh	-1.8×10^{308} to $+1.8 \times 10^{308}$	61206
56...59	Max. voltage L2-N	REAL	V	0.0 ... 1000000.0	41
60...63	Max. current L2	REAL	A	0.0 ... 100000.0	47
64...67	Max. apparent power L2	REAL	VA	-3.0×10^9 ... $+3.0 \times 10^9$	50
68...71	Max. active power L2	REAL	W	-3.0×10^9 ... $+3.0 \times 10^9$	53
72...75	Max. reactive power Qtot L2	REAL	var	-3.0×10^9 ... $+3.0 \times 10^9$	62260
76...79	Max. power factor λ L2	REAL	-	0.0 ... 1.0	59
80...83	Min. voltage L2-N	REAL	V	0.0 ... 1000000.0	71
84...87	Min. current L2	REAL	A	0.0 ... 100000.0	77
88...91	Min. apparent power L2	REAL	VA	-3.0×10^9 ... $+3.0 \times 10^9$	80
92...95	Min. active power L2	REAL	W	-3.0×10^9 ... $+3.0 \times 10^9$	83
96...99	Min. reactive power Qtot L2	REAL	var	-3.0×10^9 ... $+3.0 \times 10^9$	62280
100...103	Min. power factor λ L2	REAL	-	0.0 ... 1.0	89

E.9.2 Measured value data record for phase-based measured values L2 (DS 148) version 1

Measured variables of the module

The measured value identification (measured value ID) is an index which references the overview table of the measured variables in Appendix B Measured variable for connection type (Page 171).

Byte	Measured variable	Data type	Unit	Value range	Measured value ID
0	Version	UINT8	-	1	-
1	Reserved	UINT8	-	0	-
2...3	Qualifier L2	WORD	Bit field	0b 00 00 00 00 0b qq 00 00 xx	65501
4...7	Voltage L2-N	REAL	V	0.0 ... 1000000.0	2
8...11	Current L2	REAL	A	0.0 ... 100000.0	8
12...15	Apparent power L2	REAL	VA	-3.0×10^9 ... $+3.0 \times 10^9$	11
16...19	Active power L2	REAL	W	-3.0×10^9 ... $+3.0 \times 10^9$	14
20...23	Reactive power Qtot L2	REAL	var	-3.0×10^9 ... $+3.0 \times 10^9$	23
24...27	Power factor λ L2	REAL	-	0.0 ... 1.0	20
28...31	Phase angle L2	REAL	°	0.0 ... 360.0	61198
32...39	Apparent energy L2	LREAL	VAh	0.0 ... 1.8×10^{308}	61204
40...47	Total active energy L2	LREAL	Wh	-1.8×10^{308} ... $+1.8 \times 10^{308}$	61205
48...55	Total reactive energy L2	LREAL	varh	-1.8×10^{308} ... $+1.8 \times 10^{308}$	61206
56...59	Max. voltage L2-N	REAL	V	0.0 ... 1000000.0	41
60...63	Max. current L2	REAL	A	0.0 ... 100000.0	47
64...67	Max. apparent power L2	REAL	VA	-3.0×10^9 ... $+3.0 \times 10^9$	50
68...71	Max. active power L2	REAL	W	-3.0×10^9 ... $+3.0 \times 10^9$	53
72...75	Max. reactive power Qtot L2	REAL	var	-3.0×10^9 ... $+3.0 \times 10^9$	62260
76...79	Max. power factor λ L2	REAL	-	0.0 ... 1.0	59
80...83	Min. voltage L2-N	REAL	V	0.0 ... 1000000.0	71
84...87	Min. current L2	REAL	A	0.0 ... 100000.0	77
88...91	Min. apparent power L2	REAL	VA	-3.0×10^9 ... $+3.0 \times 10^9$	80
92...95	Min. active power L2	REAL	W	-3.0×10^9 ... $+3.0 \times 10^9$	83
96...99	Min. reactive power Qtot L2	REAL	var	-3.0×10^9 ... $+3.0 \times 10^9$	62280
100...103	Min. power factor λ L2	REAL	-	0.0 ... 1.0	89
104...107	Reactive power Qn L2	REAL	var	-3.0×10^9 ... $+3.0 \times 10^9$	17
108...111	Current L2 10-12 cycles	REAL	V	0.0 ... 760.0	62230
112...115	Current L2 10-12 cycles	REAL	A	0.0 ... 100000.0	62233
116...119	Max. reactive power Qn L2	REAL	var	-3.0×10^9 ... $+3.0 \times 10^9$	56
120...123	Min. reactive power Qn L2	REAL	var	-3.0×10^9 ... $+3.0 \times 10^9$	86
124...127	Fundamental voltage L2	REAL	V	0.0 ... 440.0	62222
128...131	Fundamental current L2	REAL	A	0.0 ... 100000.0	62223
132...135	Fundamental apparent power L2	REAL	VA	-3.0×10^9 ... $+3.0 \times 10^9$	62225

Byte	Measured variable	Data type	Unit	Value range	Measured value ID
136...139	Fundamental reactive power L2	REAL	var	-3.0 x 10^9 ... +3.0 x 10^9	62224
140...143	Fundamental active power L2	REAL	W	-3.0 x 10^9 ... +3.0 x 10^9	62226
144...147	Fundamental cos φ active factor L2	REAL	-	-1.0 ... 1.0	62227
148...151	Max. fundamental voltage L2	REAL	V	0.0 ... 760.0	62252
152...155	Max. fundamental current L2	REAL	A	0.0 ... 100000.0	62253
156...159	Max. fundamental apparent power L2	REAL	VA	-3.0 x 10^9 ... +3.0 x 10^9	62255
160...163	Max. fundamental reactive power L2	REAL	var	-3.0 x 10^9 ... +3.0 x 10^9	62254
164...167	Max. fundamental active power L2	REAL	W	-3.0 x 10^9 ... +3.0 x 10^9	62256
168...171	Max. fundamental cos φ active factor L2	REAL	-	-1.0 ... 1.0	62257
172...175	Min. fundamental voltage L2	REAL	V	0.0 ... 440.0	62272
176...179	Min. fundamental current L2	REAL	A	0.0 ... 100000.0	62273
180...183	Min. fundamental apparent power L2	REAL	VA	-3.0 x 10^9 ... +3.0 x 10^9	62275
184...187	Min. fundamental reactive power L2	REAL	var	-3.0 x 10^9 ... +3.0 x 10^9	62274
188...191	Min. fundamental active power L2	REAL	W	-3.0 x 10^9 ... +3.0 x 10^9	62276
192...195	Min. fundamental cos φ active factor L2	REAL	-	-1.0 ... 1.0	62277
196...199	Total harmonic distortion (THD+N) voltage L2	REAL	1%	0% to 100%	62220
200...203	Total harmonic distortion (THD+N) current L2	REAL	1%	0% to 100%	62221
204...207	Max. total harmonic distortion (THD+N) voltage L2	REAL	1%	0% to 100%	62250
208...211	Max. total harmonic distortion (THD+N) current L2	REAL	1%	0% to 100%	62251
212...215	Min. total harmonic distortion (THD+N) voltage L2	REAL	1%	0% to 100%	62270
216...219	Min. total harmonic distortion (THD+N) current L2	REAL	1%	0% to 100%	62271
220...223	Voltage dip - value L2	REAL	V	0.0 ... 440.0	62294
224...227	Voltage dip - duration L2	REAL	ms	0.0 ... 100000.0	62299
228...231	Voltage swell - value L2	REAL	V	0.0 ... 440.0	62295
232...235	Voltage swell - duration L2	REAL	ms	0.0 ... 100000.0	62300
236...239	Voltage peak value L2	REAL	V	0.0 ... 440.0	62296
240...243	Current peak value L2	REAL	A	0.0 ... 100000.0	62297
244...247	Overcurrent value L2	REAL	A	0.0 ... 100000.0	62298

E.10 Measured value data record for phase-based measured values L3 (DS 149)

E.10.1 Measured value data record for phase-based measured values L3 (DS 149) version 0

Measured variables of the module

The measured value identification (measured value ID) is an index which references the overview table of the measured variables in Appendix B Measured variables for connection type (Page 171).

Byte	Measured variable	Data type	Unit	Value range	Measured value ID
0	Version	BYTE	-	0	-
1	Reserved	BYTE	-	0	-
2...3	Qualifier L3	WORD	Bit field	0b 00 00 00 00 0b qq 00 00 xx	65502
4...7	Voltage L3-N	REAL	V	0.0 ... 1000000.0	3
8...11	Current L3	REAL	A	0.0 ... 100000.0	9
12...15	Apparent power L3	REAL	VA	-3.0×10^9 ... $+3.0 \times 10^9$	12
16...19	Active power L3	REAL	W	-3.0×10^9 ... $+3.0 \times 10^9$	15
20...23	Reactive power Qtot L3	REAL	var	-3.0×10^9 ... $+3.0 \times 10^9$	24
24...27	Power factor λ L3	REAL	-	0.0 ... 1.0	21
28...31	Phase angle L3	REAL	°	0.0 ... 360.0	61218
32...39	Apparent energy L3	LREAL	VAh	0.0 ... 1.8×10^{308}	61224
40...47	Total active energy L3	LREAL	Wh	-1.8×10^{308} to $+1.8 \times 10^{308}$	61225
48...55	Total reactive energy L3	LREAL	varh	-1.8×10^{308} to $+1.8 \times 10^{308}$	61226
56...59	Max. voltage L3-N	REAL	V	0.0 ... 1000000.0	42
60...63	Max. current L3	REAL	A	0.0 ... 100000.0	48
64...67	Max. apparent power L3	REAL	VA	-3.0×10^9 ... $+3.0 \times 10^9$	51
68...71	Max. active power L3	REAL	W	-3.0×10^9 ... $+3.0 \times 10^9$	54
72...75	Max. reactive power Qtot L3	REAL	var	-3.0×10^9 ... $+3.0 \times 10^9$	62360
76...79	Max. power factor λ L3	REAL	-	0.0 ... 1.0	60
80...83	Min. voltage L3-N	REAL	V	0.0 ... 1000000.0	72
84...87	Min. current L3	REAL	A	0.0 ... 100000.0	78
88...91	Min. apparent power L3	REAL	VA	-3.0×10^9 ... $+3.0 \times 10^9$	81
92...95	Min. active power L3	REAL	W	-3.0×10^9 ... $+3.0 \times 10^9$	84
96...99	Min. reactive power Qtot L3	REAL	var	-3.0×10^9 ... $+3.0 \times 10^9$	62380
100...103	Min. power factor λ L3	REAL	-	0.0 ... 1.0	90

E.10.2 Measured value data record for phase-based measured values L3 (DS 149) version 1

Measured variables of the module

The measured value identification (measured value ID) is an index which references the overview table of the measured variables in Appendix B Measured variables for connection type (Page 171).

Byte	Measured variable	Data type	Unit	Value range	Measured value ID
0	Version	UINT8	-	1	-
1	Reserved	UINT8	-	0	-
2...3	Qualifier L3	WORD	Bit field	0b 00 00 00 00 0b qq 00 00 xx	65502
4...7	Voltage L3-N	REAL	V	0.0 ... 1000000.0	3
8...11	Current L3	REAL	A	0.0 ... 100000.0	9
12...15	Apparent power L3	REAL	VA	-3.0×10^9 ... $+3.0 \times 10^9$	12
16...19	Active power L3	REAL	W	-3.0×10^9 ... $+3.0 \times 10^9$	15
20...23	Reactive power Qtot L3	REAL	var	-3.0×10^9 ... $+3.0 \times 10^9$	24
24...27	Power factor λ L3	REAL	-	0.0 ... 1.0	21
28...31	Phase angle L3	REAL	°	0.0 ... 360.0	61218
32...39	Apparent energy L3	LREAL	VAh	0.0 ... 1.8×10^{308}	61224
40...47	Total active energy L3	LREAL	Wh	-1.8×10^{308} ... $+1.8 \times 10^{308}$	61225
48...55	Total reactive energy L3	LREAL	varh	-1.8×10^{308} ... $+1.8 \times 10^{308}$	61226
56...59	Max. voltage L3-N	REAL	V	0.0 ... 1000000.0	42
60...63	Max. current L3	REAL	A	0.0 ... 100000.0	48
64...67	Max. apparent power L3	REAL	VA	-3.0×10^9 ... $+3.0 \times 10^9$	51
68...71	Max. active power L3	REAL	W	-3.0×10^9 ... $+3.0 \times 10^9$	54
72...75	Max. reactive power Qtot L3	REAL	var	-3.0×10^9 ... $+3.0 \times 10^9$	62360
76...79	Max. power factor λ L3	REAL	-	0.0 ... 1.0	60
80...83	Min. voltage L3-N	REAL	V	0.0 ... 1000000.0	72
84...87	Min. current L3	REAL	A	0.0 ... 100000.0	78
88...91	Min. apparent power L3	REAL	VA	-3.0×10^9 ... $+3.0 \times 10^9$	81
92...95	Min. active power L3	REAL	W	-3.0×10^9 ... $+3.0 \times 10^9$	84
96...99	Min. reactive power Qtot L3	REAL	var	-3.0×10^9 ... $+3.0 \times 10^9$	62380
100...103	Min. power factor λ L3	REAL	-	0.0 ... 1.0	90
104...107	Reactive power Qn L3	REAL	var	-3.0×10^9 ... $+3.0 \times 10^9$	18
108...111	Current L3 10-12 cycles	REAL	V	0.0 ... 760.0	62330
112...115	Current L3 10-12 cycles	REAL	A	0.0 ... 100000.0	62333
116...119	Max. reactive power Qn L3	REAL	var	-3.0×10^9 ... $+3.0 \times 10^9$	57
120...123	Min. reactive power Qn L3	REAL	var	-3.0×10^9 ... $+3.0 \times 10^9$	87
124...127	Fundamental voltage L3	REAL	V	0.0 ... 440.0	62322
128...131	Fundamental current L3	REAL	A	0.0 ... 100000.0	62323
132...135	Fundamental apparent power L3	REAL	VA	-3.0×10^9 ... $+3.0 \times 10^9$	62325

Byte	Measured variable	Data type	Unit	Value range	Measured value ID
136...139	Fundamental reactive power L3	REAL	var	-3.0×10^9 ... $+3.0 \times 10^9$	62324
140...143	Fundamental active power L3	REAL	W	-3.0×10^9 ... $+3.0 \times 10^9$	62326
144...147	Fundamental cos φ active factor L3	REAL	-	-1.0 ... 1.0	62327
148...151	Max. fundamental voltage L3	REAL	V	0.0 ... 760.0	62352
152...155	Max. fundamental current L3	REAL	A	0.0 ... 100000.0	62353
156...159	Max. fundamental apparent power L3	REAL	VA	-3.0×10^9 ... $+3.0 \times 10^9$	62355
160...163	Max. fundamental reactive power L3	REAL	var	-3.0×10^9 ... $+3.0 \times 10^9$	62354
164...167	Max. fundamental active power L3	REAL	W	-3.0×10^9 ... $+3.0 \times 10^9$	62356
168...171	Max. fundamental cos φ active factor L3	REAL	-	-1.0 ... 1.0	62357
172...175	Min. fundamental voltage L3	REAL	V	0.0 ... 440.0	62372
176...179	Min. fundamental current L3	REAL	A	0.0 ... 100000.0	62373
180...183	Min. fundamental apparent power L3	REAL	VA	-3.0×10^9 ... $+3.0 \times 10^9$	62375
184...187	Min. fundamental reactive power L3	REAL	var	-3.0×10^9 ... $+3.0 \times 10^9$	62374
188...191	Min. fundamental active power L3	REAL	W	-3.0×10^9 ... $+3.0 \times 10^9$	62376
192...195	Min. fundamental cos φ active factor L3	REAL	-	-1.0 ... 1.0	62377
196...199	Total harmonic distortion (THD+N) voltage L3	REAL	1%	0% to 100%	62320
200...203	Total harmonic distortion (THD+N) current L3	REAL	1%	0% to 100%	62321
204...207	Max. total harmonic distortion (THD+N) voltage L3	REAL	1%	0% to 100%	62350
208...211	Max. total harmonic distortion (THD+N) current L3	REAL	1%	0% to 100%	62351
212...215	Min. total harmonic distortion (THD+N) voltage L3	REAL	1%	0% to 100%	62370
216...219	Min. total harmonic distortion (THD+N) current L3	REAL	1%	0% to 100%	62371
220...223	Voltage dip - value L3	REAL	V	0.0 ... 440.0	62394
224...227	Voltage dip - duration L3	REAL	ms	0.0 ... 100000.0	62399
228...231	Voltage swell - value L3	REAL	V	0.0 ... 440.0	62395
232...235	Voltage swell - duration L3	REAL	ms	0.0 ... 100000.0	62400
236...239	Voltage peak value L3	REAL	V	0.0 ... 440.0	62396
240...243	Current peak value L3	REAL	A	0.0 ... 100000.0	62397
244...247	Overcurrent value L3	REAL	A	0.0 ... 100000.0	62398

E.11 Measured value data record for advanced measurement and status values (DS 150)

E.11.1 Measured value data record for advanced measurement and status values (DS 150) version 1

Measured variables of the module

The measured value identification (measured value ID) is an index which references the overview table of the measured variables in Appendix B Measured variables for connection type (Page 171).

Byte	Measured variable	Data type	Unit	Value range	Measured value ID
0	Version	BYTE	-	1	-
1	Reserved	BYTE	-	0	-
2...5	Operating hours counter L1L2L3	REAL	h	0.0 ... 3.4 x 10^{38}	65504
6...9	Operating hours counter L1	REAL	h	0.0 ... 3.4 x 10^{38}	65505
10...13	Operating hours counter L2	REAL	h	0.0 ... 3.4 x 10^{38}	65506
14...17	Operating hours counter L3	REAL	h	0.0 ... 3.4 x 10^{38}	65507
18...19	Status limit violation GW 1...16	WORD	Bit string	xxxx xxxx xxxx xxxx	65509
20...21	Status of energy counter overflows [1]	WORD	Bit string	xxxx xxxx xxxx xxxx	65508
22...25	Counter limit violation GW 1	UDINT	-	0 ... 4294967296	65510
26...29	Counter limit violation GW 2	UDINT	-	0 ... 4294967296	65511
30...33	Counter limit violation GW 3	UDINT	-	0 ... 4294967296	65512
34...37	Counter limit violation GW 4	UDINT	-	0 ... 4294967296	65513
38...41	Counter limit violation GW 5	UDINT	-	0 ... 4294967296	65514
42...45	Counter limit violation GW 6	UDINT	-	0 ... 4294967296	65515
46...49	Counter limit violation GW 7	UDINT	-	0 ... 4294967296	65516
50...53	Counter limit violation GW 8	UDINT	-	0 ... 4294967296	65517
54...57	Counter limit violation GW 9	UDINT	-	0 ... 4294967296	65518
58...61	Counter limit violation GW 10	UDINT	-	0 ... 4294967296	65519
62...65	Counter limit violation GW 11	UDINT	-	0 ... 4294967296	65520
66...69	Counter limit violation GW 12	UDINT	-	0 ... 4294967296	65521
70...73	Counter limit violation GW 13	UDINT	-	0 ... 4294967296	65522
74...77	Counter limit violation GW 14	UDINT	-	0 ... 4294967296	65523
78...81	Counter limit violation GW 15	UDINT	-	0 ... 4294967296	65524
82...85	Counter limit violation GW 16	UDINT	-	0 ... 4294967296	65525
86...87	Qualifier L1L2L3	WORD	Bit string	xxxx xxxx xxxx xxxx	65503

Byte	Measured variable	Data type	Unit	Value range	Measured value ID
88...91	Power quality analysis - Qualifier	UDINT	Bit string	-	65496
92...103	Current module time	PNI-OTime	sec	-	65497

[1] Energy counters count periodically - counter overflow at:
Bit 0 = 1: Active energy inflow L1
Bit 1 = 1: Active energy outflow L1
Bit 2 = 1: Reactive energy inflow L1
Bit 3 = 1: Reactive energy outflow L1
Bit 4 = 1: Apparent energy L1
Bit 5 = 1: Active energy inflow L2
Bit 6 = 1: Active energy outflow L2
Bit 7 = 1: Reactive energy inflow L2
Bit 8 = 1: Reactive energy outflow L2
Bit 9 = 1: Apparent energy L2
Bit 10 = 1: Active energy inflow L3
Bit 11 = 1: Active energy outflow L3
Bit 12 = 1: Reactive energy inflow L3
Bit 13 = 1: Reactive energy outflow L3
Bit 14 = 1: Apparent energy L3
Bit 15: Reserved

E.12 Measured value data record of user-defined data record (DS 151)

The length and structure of the data record DS 151 depends on the parameter assignment of the data record DS 135 (Page 168).

Byte	Measured variable	Data type	Unit	Value range
0	Version	UINT8	-	0
1	Number of measured values	UINT8	-	0 ... 150
2	Measured value 1 corresponding to measured value ID 1 in DS135	Depending on the corresponding measured value ID		
3	Measured value 2 corresponding to measured value ID 2 in DS135	Depending on the corresponding measured value ID		
...	...	Depending on the corresponding measured value ID		
... m	Measured value n corresponding to measured value ID n in DS135	Depending on the corresponding measured value ID		

E.13 Measured value data record for power quality analysis (DS 160)

Measured variables of the module

The measured value identification (measured value ID) is an index which references the overview table of the measured variables in Appendix B Measured variables for connection type (Page 171).

Byte	Measured variable	Data type	Unit	Value range	Measured value ID
0	Version	BYTE	-	0	-
1	Reserved	BYTE	-	0	-
2...5	Neutral current IN	REAL	A	0.0 ... 100000.0	61149
6...9	Neutral current 10-12 cycles	REAL	A	0.0 ... 100000.0	61150
10...13	Total current IL1+IL2+IL3-IN	REAL	A	-100000.0 ... 100000.0	61153
14...17	(Fundamental) reactive power L1L2L3	REAL	var	-3.0×10^9 ... $+3.0 \times 10^9$	61154
18...21	Max. (fundamental) reactive power L1L2L3	REAL	var	-3.0×10^9 ... $+3.0 \times 10^9$	61155
22...25	Min. (fundamental) reactive power L1L2L3	REAL	var	-3.0×10^9 ... $+3.0 \times 10^9$	61156
26...29	Power factor λ L1L2L3	REAL	-	0.0 ... 1.0	37
30...33	Fundamental reactive power L1	REAL	var	-3.0×10^9 ... $+3.0 \times 10^9$	62124
34...37	Fundamental reactive power L2	REAL	var	-3.0×10^9 ... $+3.0 \times 10^9$	62224
38...41	Fundamental reactive power L3	REAL	var	-3.0×10^9 ... $+3.0 \times 10^9$	62324
42...45	Fundamental cos φ active factor L1	REAL	-	-1.0 ... 1.0	62127
46...49	Fundamental cos φ active factor L2	REAL	-	-1.0 ... 1.0	62227
50...53	Fundamental cos φ active factor L3	REAL	-	-1.0 ... 1.0	62327
54...57	Total harmonic distortion (THD+N) voltage L1	REAL	1%	0% to 100%	62120
58...61	Total harmonic distortion (THD+N) voltage L2	REAL	1%	0% to 100%	62220
62...65	Total harmonic distortion (THD+N) voltage L3	REAL	1%	0% to 100%	62320
66...69	Total harmonic distortion (THD+N) current L1	REAL	1%	0% to 100%	62121
70...73	Total harmonic distortion (THD+N) current L2	REAL	1%	0% to 100%	62221
74...77	Total harmonic distortion (THD+N) current L3	REAL	1%	0% to 100%	62321
78...81	Max. total harmonic distortion (THD+N) voltage L1	REAL	1%	0% to 100%	62150
82...85	Max. total harmonic distortion (THD+N) voltage L2	REAL	1%	0% to 100%	62250
86...89	Max. total harmonic distortion (THD+N) voltage L3	REAL	1%	0% to 100%	62350
90...93	Max. total harmonic distortion (THD+N) current L1	REAL	1%	0% to 100%	62151
94...97	Max. total harmonic distortion (THD+N) current L2	REAL	1%	0% to 100%	62251
98...101	Max. total harmonic distortion (THD+N) current L3	REAL	1%	0% to 100%	62351
102...105	Min. total harmonic distortion (THD+N) voltage L1	REAL	1%	0% to 100%	62170
106...109	Min. total harmonic distortion (THD+N) voltage L2	REAL	1%	0% to 100%	62270
110...113	Min. total harmonic distortion (THD+N) voltage L3	REAL	1%	0% to 100%	62370
114...117	Min. total harmonic distortion (THD+N) current L1	REAL	1%	0% to 100%	62171
118...121	Min. total harmonic distortion (THD+N) current L2	REAL	1%	0% to 100%	62271
122...125	Min. total harmonic distortion (THD+N) current L3	REAL	1%	0% to 100%	62371
126...129	Voltage dip - value L1	REAL	V	0 ... 440.0	62194
130...133	Voltage dip - duration L1	REAL	ms	0.0 ... 100000.0	62199

Byte	Measured variable	Data type	Unit	Value range	Measured value ID
134...137	Voltage dip - value L2	REAL	V	0 ... 440.0	62294
138...141	Voltage dip - duration L2	REAL	ms	0.0 ... 100000.0	62299
142...145	Voltage dip - value L3	REAL	V	0 ... 440.0	62394
146...149	Voltage dip - duration L3	REAL	ms	0.0 ... 100000.0	62399
150...153	Voltage increase - value L1	REAL	V	0 ... 440.0	62195
154...157	Voltage increase - duration L1	REAL	ms	0.0 ... 100000.0	62200
158...161	Voltage increase - value L2	REAL	V	0 ... 440.0	62295
162...165	Voltage increase - duration L2	REAL	ms	0.0 ... 100000.0	62300
166...169	Voltage increase - value L3	REAL	V	0 ... 440.0	62395
170...173	Voltage increase - duration L3	REAL	ms	0.0 ... 100000.0	62400
174...177	Voltage peak value L1	REAL	V	0 ... 440.0	62196
178...181	Voltage peak value L2	REAL	V	0 ... 440.0	62296
182...185	Voltage peak value L3	REAL	V	0 ... 440.0	62396
186...189	Current peak value L1	REAL	A	0.0 ... 100000.0	62197
190...193	Current peak value L2	REAL	A	0.0 ... 100000.0	62297
194...197	Current peak value L3	REAL	A	0.0 ... 100000.0	62397
198...201	Overcurrent value L1	REAL	A	0.0 ... 100000.0	62198
202...205	Overcurrent value L2	REAL	A	0.0 ... 100000.0	62298
206...209	Overcurrent value L3	REAL	A	0.0 ... 100000.0	62398
210...213	Amplitude symmetry Voltage U_2	REAL	%	0 ... 100	61157
214...217	Amplitude symmetry Current I_{unsym}	REAL	%	0 ... 100	61158
218...221	Power quality analysis - Qualifier	UDINT	Bit string	-	65496
222...233	Current module time	PNIO Time	sec	-	65497

E.14 Measured value data record for harmonics voltage (DS 161)

Measured variables of the module

The measured value identification (measured value ID) is an index which references the overview table of the measured variables in Appendix B Measured variables for connection type (Page 171).

Byte	Measured variable	Data type	Unit	Value range	Measured value ID
0	Version	BYTE	-	0	-
1	Reserved	BYTE	-	0	-
2...5	Total harmonic distortion (THD+N) voltage L1	REAL	1%	0% to 100%	62120
6...9	Voltage L1-N	REAL	V	0.0 ... 440.0	1
10...13	Harmonics 1: Voltage L1	REAL	V	0.0 ... 760.0	63000
14...17	Harmonics 2: Voltage L1	REAL	V	0.0 ... 760.0	63002
18...21	Harmonics 3: Voltage L1	REAL	V	0.0 ... 760.0	63004
22...25	Harmonics 4: Voltage L1	REAL	V	0.0 ... 760.0	63006
26...29	Harmonics 5: Voltage L1	REAL	V	0.0 ... 760.0	63008
30...33	Harmonics 6: Voltage L1	REAL	V	0.0 ... 760.0	63010
34...37	Harmonics 7: Voltage L1	REAL	V	0.0 ... 760.0	63012
38...41	Harmonics 8: Voltage L1	REAL	V	0.0 ... 760.0	63014
42...45	Harmonics 9: Voltage L1	REAL	V	0.0 ... 760.0	63016
46...49	Harmonics 10: Voltage L1	REAL	V	0.0 ... 760.0	63018
50...53	Harmonics 11: Voltage L1	REAL	V	0.0 ... 760.0	63020
54...57	Harmonics 12: Voltage L1	REAL	V	0.0 ... 760.0	63022
58...61	Harmonics 13: Voltage L1	REAL	V	0.0 ... 760.0	63024
62...65	Harmonics 14: Voltage L1	REAL	V	0.0 ... 760.0	63026
66...69	Harmonics 15: Voltage L1	REAL	V	0.0 ... 760.0	63028
70...73	Harmonics 16: Voltage L1	REAL	V	0.0 ... 760.0	63030
74...77	Harmonics 17: Voltage L1	REAL	V	0.0 ... 760.0	63032
78...81	Harmonics 18: Voltage L1	REAL	V	0.0 ... 760.0	63034
82...85	Harmonics 19: Voltage L1	REAL	V	0.0 ... 760.0	63036
86...89	Harmonics 20: Voltage L1	REAL	V	0.0 ... 760.0	63038
90...93	Harmonics 21: Voltage L1	REAL	V	0.0 ... 760.0	63040
94...97	Harmonics 22: Voltage L1	REAL	V	0.0 ... 760.0	63042
98...101	Harmonics 23: Voltage L1	REAL	V	0.0 ... 760.0	63044
102...105	Harmonics 24: Voltage L1	REAL	V	0.0 ... 760.0	63046
106...109	Harmonics 25: Voltage L1	REAL	V	0.0 ... 760.0	63048
110...113	Harmonics 26: Voltage L1	REAL	V	0.0 ... 760.0	63050
114...117	Harmonics 27: Voltage L1	REAL	V	0.0 ... 760.0	63052
118...121	Harmonics 28: Voltage L1	REAL	V	0.0 ... 760.0	63054
122...125	Harmonics 29: Voltage L1	REAL	V	0.0 ... 760.0	63056
126...129	Harmonics 30: Voltage L1	REAL	V	0.0 ... 760.0	63058
130...133	Harmonics 31: Voltage L1	REAL	V	0.0 ... 760.0	63060

Byte	Measured variable	Data type	Unit	Value range	Measured value ID
134...137	Harmonics 32: Voltage L1	REAL	V	0.0 ... 760.0	63062
138...141	Harmonics 33: Voltage L1	REAL	V	0.0 ... 760.0	63064
142...145	Harmonics 34: Voltage L1	REAL	V	0.0 ... 760.0	63066
146...149	Harmonics 35: Voltage L1	REAL	V	0.0 ... 760.0	63068
150...153	Harmonics 36: Voltage L1	REAL	V	0.0 ... 760.0	63070
154...157	Harmonics 37: Voltage L1	REAL	V	0.0 ... 760.0	63072
158...161	Harmonics 38: Voltage L1	REAL	V	0.0 ... 760.0	63074
162...165	Harmonics 39: Voltage L1	REAL	V	0.0 ... 760.0	63076
166...169	Harmonics 40: Voltage L1	REAL	V	0.0 ... 760.0	63078
170...173	Total harmonic distortion (THD+N) voltage L2	REAL	1%	0% to 100%	62220
174...177	Voltage L2-N	REAL	V	0.0 ... 440.0	2
178...181	Harmonics 1: Voltage L2	REAL	V	0.0 ... 760.0	63400
182...185	Harmonics 2: Voltage L2	REAL	V	0.0 ... 760.0	63402
186...189	Harmonics 3: Voltage L2	REAL	V	0.0 ... 760.0	63404
190...193	Harmonics 4: Voltage L2	REAL	V	0.0 ... 760.0	63406
194...197	Harmonics 5: Voltage L2	REAL	V	0.0 ... 760.0	63408
198...201	Harmonics 6: Voltage L2	REAL	V	0.0 ... 760.0	63410
202...205	Harmonics 7: Voltage L2	REAL	V	0.0 ... 760.0	63412
206...209	Harmonics 8: Voltage L2	REAL	V	0.0 ... 760.0	63414
210...213	Harmonics 9: Voltage L2	REAL	V	0.0 ... 760.0	63416
214...217	Harmonics 10: Voltage L2	REAL	V	0.0 ... 760.0	63418
218...221	Harmonics 11: Voltage L2	REAL	V	0.0 ... 760.0	63420
222...225	Harmonics 12: Voltage L2	REAL	V	0.0 ... 760.0	63422
226...229	Harmonics 13: Voltage L2	REAL	V	0.0 ... 760.0	63424
230...233	Harmonics 14: Voltage L2	REAL	V	0.0 ... 760.0	63426
234...237	Harmonics 15: Voltage L2	REAL	V	0.0 ... 760.0	63428
238...241	Harmonics 16: Voltage L2	REAL	V	0.0 ... 760.0	63430
242...245	Harmonics 17: Voltage L2	REAL	V	0.0 ... 760.0	63432
246...249	Harmonics 18: Voltage L2	REAL	V	0.0 ... 760.0	63434
250...253	Harmonics 19: Voltage L2	REAL	V	0.0 ... 760.0	63436
254...257	Harmonics 20: Voltage L2	REAL	V	0.0 ... 760.0	63438
258...261	Harmonics 21: Voltage L2	REAL	V	0.0 ... 760.0	63440
262...265	Harmonics 22: Voltage L2	REAL	V	0.0 ... 760.0	63442
266...269	Harmonics 23: Voltage L2	REAL	V	0.0 ... 760.0	63444
270...273	Harmonics 24: Voltage L2	REAL	V	0.0 ... 760.0	63446
274...277	Harmonics 25: Voltage L2	REAL	V	0.0 ... 760.0	63448
278...281	Harmonics 26: Voltage L2	REAL	V	0.0 ... 760.0	63450
281...285	Harmonics 27: Voltage L2	REAL	V	0.0 ... 760.0	63452
286...289	Harmonics 28: Voltage L2	REAL	V	0.0 ... 760.0	63454
290...293	Harmonics 29: Voltage L2	REAL	V	0.0 ... 760.0	63456
294...297	Harmonics 30: Voltage L2	REAL	V	0.0 ... 760.0	63458
298...301	Harmonics 31: Voltage L2	REAL	V	0.0 ... 760.0	63460
302...305	Harmonics 32: Voltage L2	REAL	V	0.0 ... 760.0	63462

Byte	Measured variable	Data type	Unit	Value range	Measured value ID
306...309	Harmonics 33: Voltage L2	REAL	V	0.0 ... 760.0	63464
310...313	Harmonics 34: Voltage L2	REAL	V	0.0 ... 760.0	63466
314...317	Harmonics 35: Voltage L2	REAL	V	0.0 ... 760.0	63468
318...321	Harmonics 36: Voltage L2	REAL	V	0.0 ... 760.0	63470
322...325	Harmonics 37: Voltage L2	REAL	V	0.0 ... 760.0	63472
326...329	Harmonics 38: Voltage L2	REAL	V	0.0 ... 760.0	63474
330...333	Harmonics 39: Voltage L2	REAL	V	0.0 ... 760.0	63476
334...337	Harmonics 40: Voltage L2	REAL	V	0.0 ... 760.0	63478
338...341	Total harmonic distortion (THD+N) voltage L3	REAL	1%	0% to 100%	62320
342...345	Voltage L3-N	REAL	V	0.0 ... 440.0	3
346...349	Harmonics 1: Voltage L3	REAL	V	0.0 ... 760.0	63800
350...353	Harmonics 2: Voltage L3	REAL	V	0.0 ... 760.0	63802
354...357	Harmonics 3: Voltage L3	REAL	V	0.0 ... 760.0	63804
358...361	Harmonics 4: Voltage L3	REAL	V	0.0 ... 760.0	63806
362...365	Harmonics 5: Voltage L3	REAL	V	0.0 ... 760.0	63808
366...369	Harmonics 6: Voltage L3	REAL	V	0.0 ... 760.0	63810
370...373	Harmonics 7: Voltage L3	REAL	V	0.0 ... 760.0	63812
374...377	Harmonics 8: Voltage L3	REAL	V	0.0 ... 760.0	63814
378...381	Harmonics 9: Voltage L3	REAL	V	0.0 ... 760.0	63816
382...385	Harmonics 10: Voltage L3	REAL	V	0.0 ... 760.0	63818
386...389	Harmonics 11: Voltage L3	REAL	V	0.0 ... 760.0	63820
390...393	Harmonics 12: Voltage L3	REAL	V	0.0 ... 760.0	63822
394...397	Harmonics 13: Voltage L3	REAL	V	0.0 ... 760.0	63824
398...401	Harmonics 14: Voltage L3	REAL	V	0.0 ... 760.0	63826
402...405	Harmonics 15: Voltage L3	REAL	V	0.0 ... 760.0	63828
406...409	Harmonics 16: Voltage L3	REAL	V	0.0 ... 760.0	63830
410...413	Harmonics 17: Voltage L3	REAL	V	0.0 ... 760.0	63832
414...417	Harmonics 18: Voltage L3	REAL	V	0.0 ... 760.0	63834
418...421	Harmonics 19: Voltage L3	REAL	V	0.0 ... 760.0	63836
422...425	Harmonics 20: Voltage L3	REAL	V	0.0 ... 760.0	63838
426...429	Harmonics 21: Voltage L3	REAL	V	0.0 ... 760.0	63840
430...433	Harmonics 22: Voltage L3	REAL	V	0.0 ... 760.0	63842
434...437	Harmonics 23: Voltage L3	REAL	V	0.0 ... 760.0	63844
438...441	Harmonics 24: Voltage L3	REAL	V	0.0 ... 760.0	63846
442...445	Harmonics 25: Voltage L3	REAL	V	0.0 ... 760.0	63848
446...449	Harmonics 26: Voltage L3	REAL	V	0.0 ... 760.0	63850
450...453	Harmonics 27: Voltage L3	REAL	V	0.0 ... 760.0	63852
454...457	Harmonics 28: Voltage L3	REAL	V	0.0 ... 760.0	63854
458...461	Harmonics 29: Voltage L3	REAL	V	0.0 ... 760.0	63856
462...465	Harmonics 30: Voltage L3	REAL	V	0.0 ... 760.0	63858
466...469	Harmonics 31: Voltage L3	REAL	V	0.0 ... 760.0	63860
470...473	Harmonics 32: Voltage L3	REAL	V	0.0 ... 760.0	63862
474...477	Harmonics 33: Voltage L3	REAL	V	0.0 ... 760.0	63864

Byte	Measured variable	Data type	Unit	Value range	Measured value ID
478...481	Harmonics 34: Voltage L3	REAL	V	0.0 ... 760.0	63866
482...485	Harmonics 35: Voltage L3	REAL	V	0.0 ... 760.0	63868
486...489	Harmonics 36: Voltage L3	REAL	V	0.0 ... 760.0	63870
490...493	Harmonics 37: Voltage L3	REAL	V	0.0 ... 760.0	63872
494...497	Harmonics 38: Voltage L3	REAL	V	0.0 ... 760.0	63874
498...501	Harmonics 39: Voltage L3	REAL	V	0.0 ... 760.0	63876
502...505	Harmonics 40: Voltage L3	REAL	V	0.0 ... 760.0	63878
506...517	Current module time	PNI-OTime	sec	-	65497

E.15 Measured value data record for harmonics current (DS 163)

Measured variables of the module

The measured value identification (measured value ID) is an index which references the overview table of the measured variables in Appendix B Measured variables for connection type (Page 171).

Byte	Measured variable	Data type	Unit	Value range	Measured value ID
0	Version	BYTE	-	0	-
1	Reserved	BYTE	-	0	-
2...5	Total harmonic distortion (THD+N) current L1	REAL	1%	0% to 100%	62121
6...9	Current L1	REAL	A	0.0 ... 100000.0	7
10...13	Harmonics 1: Current L1	REAL	A	0.0 ... 100000.0	63001
14...17	Harmonics 2: Current L1	REAL	A	0.0 ... 100000.0	63003
18...21	Harmonics 3: Current L1	REAL	A	0.0 ... 100000.0	63005
22...25	Harmonics 4: Current L1	REAL	A	0.0 ... 100000.0	63007
26...29	Harmonics 5: Current L1	REAL	A	0.0 ... 100000.0	63009
30...33	Harmonics 6: Current L1	REAL	A	0.0 ... 100000.0	63011
34...37	Harmonics 7: Current L1	REAL	A	0.0 ... 100000.0	63013
38...41	Harmonics 8: Current L1	REAL	A	0.0 ... 100000.0	63015
42...45	Harmonics 9: Current L1	REAL	A	0.0 ... 100000.0	63017
46...49	Harmonics 10: Current L1	REAL	A	0.0 ... 100000.0	63019
50...53	Harmonics 11: Current L1	REAL	A	0.0 ... 100000.0	63021
54...57	Harmonics 12: Current L1	REAL	A	0.0 ... 100000.0	63023
58...61	Harmonics 13: Current L1	REAL	A	0.0 ... 100000.0	63025
62...65	Harmonics 14: Current L1	REAL	A	0.0 ... 100000.0	63027
66...69	Harmonics 15: Current L1	REAL	A	0.0 ... 100000.0	63029

Byte	Measured variable	Data type	Unit	Value range	Measured value ID
70...73	Harmonics 16: Current L1	REAL	A	0.0 ... 100000.0	63031
74...77	Harmonics 17: Current L1	REAL	A	0.0 ... 100000.0	63033
78...81	Harmonics 18: Current L1	REAL	A	0.0 ... 100000.0	63035
82...85	Harmonics 19: Current L1	REAL	A	0.0 ... 100000.0	63037
86...89	Harmonics 20: Current L1	REAL	A	0.0 ... 100000.0	63039
90...93	Harmonics 21: Current L1	REAL	A	0.0 ... 100000.0	63041
94...97	Harmonics 22: Current L1	REAL	A	0.0 ... 100000.0	63043
98...101	Harmonics 23: Current L1	REAL	A	0.0 ... 100000.0	63045
102...105	Harmonics 24: Current L1	REAL	A	0.0 ... 100000.0	63047
106...109	Harmonics 25: Current L1	REAL	A	0.0 ... 100000.0	63049
110...113	Harmonics 26: Current L1	REAL	A	0.0 ... 100000.0	63051
114...117	Harmonics 27: Current L1	REAL	A	0.0 ... 100000.0	63053
118...121	Harmonics 28: Current L1	REAL	A	0.0 ... 100000.0	63055
122...125	Harmonics 29: Current L1	REAL	A	0.0 ... 100000.0	63057
126...129	Harmonics 30: Current L1	REAL	A	0.0 ... 100000.0	63059
130...133	Harmonics 31: Current L1	REAL	A	0.0 ... 100000.0	63061
134...137	Harmonics 32: Current L1	REAL	A	0.0 ... 100000.0	63063
138...141	Harmonics 33: Current L1	REAL	A	0.0 ... 100000.0	63065
142...145	Harmonics 34: Current L1	REAL	A	0.0 ... 100000.0	63067
146...149	Harmonics 35: Current L1	REAL	A	0.0 ... 100000.0	63069
150...153	Harmonics 36: Current L1	REAL	A	0.0 ... 100000.0	63071
154...157	Harmonics 37: Current L1	REAL	A	0.0 ... 100000.0	63073
158...161	Harmonics 38: Current L1	REAL	A	0.0 ... 100000.0	63075
162...165	Harmonics 39: Current L1	REAL	A	0.0 ... 100000.0	63077
166...169	Harmonics 40: Current L1	REAL	A	0.0 ... 100000.0	63079
170...173	Total harmonic distortion (THD+N) current L2	REAL	1%	0% to 100%	62221
174...177	Current L2	REAL	A	0.0 ... 100000.0	8
178...181	Harmonics 1: Current L2	REAL	A	0.0 ... 100000.0	63401
182...185	Harmonics 2: Current L2	REAL	A	0.0 ... 100000.0	63403
186...189	Harmonics 3: Current L2	REAL	A	0.0 ... 100000.0	63405
190...193	Harmonics 4: Current L2	REAL	A	0.0 ... 100000.0	63407
194...197	Harmonics 5: Current L2	REAL	A	0.0 ... 100000.0	63409
198...201	Harmonics 6: Current L2	REAL	A	0.0 ... 100000.0	63411
202...205	Harmonics 7: Current L2	REAL	A	0.0 ... 100000.0	63413
206...209	Harmonics 8: Current L2	REAL	A	0.0 ... 100000.0	63415
210...213	Harmonics 9: Current L2	REAL	A	0.0 ... 100000.0	63417
214...217	Harmonics 10: Current L2	REAL	A	0.0 ... 100000.0	63419
218...221	Harmonics 11: Current L2	REAL	A	0.0 ... 100000.0	63421
222...225	Harmonics 12: Current L2	REAL	A	0.0 ... 100000.0	63423
226...229	Harmonics 13: Current L2	REAL	A	0.0 ... 100000.0	63425
230...233	Harmonics 14: Current L2	REAL	A	0.0 ... 100000.0	63427
234...237	Harmonics 15: Current L2	REAL	A	0.0 ... 100000.0	63429
238...241	Harmonics 16: Current L2	REAL	A	0.0 ... 100000.0	63431

Byte	Measured variable	Data type	Unit	Value range	Measured value ID
242...245	Harmonics 17: Current L2	REAL	A	0.0 ... 100000.0	63433
246...249	Harmonics 18: Current L2	REAL	A	0.0 ... 100000.0	63435
250...253	Harmonics 19: Current L2	REAL	A	0.0 ... 100000.0	63437
254...257	Harmonics 20: Current L2	REAL	A	0.0 ... 100000.0	63439
258...261	Harmonics 21: Current L2	REAL	A	0.0 ... 100000.0	63441
262...265	Harmonics 22: Current L2	REAL	A	0.0 ... 100000.0	63443
266...269	Harmonics 23: Current L2	REAL	A	0.0 ... 100000.0	63445
270...273	Harmonics 24: Current L2	REAL	A	0.0 ... 100000.0	63447
274...277	Harmonics 25: Current L2	REAL	A	0.0 ... 100000.0	63449
278...281	Harmonics 26: Current L2	REAL	A	0.0 ... 100000.0	63451
281...285	Harmonics 27: Current L2	REAL	A	0.0 ... 100000.0	63453
286...289	Harmonics 28: Current L2	REAL	A	0.0 ... 100000.0	63455
290...293	Harmonics 29: Current L2	REAL	A	0.0 ... 100000.0	63457
294...297	Harmonics 30: Current L2	REAL	A	0.0 ... 100000.0	63459
298...301	Harmonics 31: Current L2	REAL	A	0.0 ... 100000.0	63461
302...305	Harmonics 32: Current L2	REAL	A	0.0 ... 100000.0	63463
306...309	Harmonics 33: Current L2	REAL	A	0.0 ... 100000.0	63465
310...313	Harmonics 34: Current L2	REAL	A	0.0 ... 100000.0	63467
314...317	Harmonics 35: Current L2	REAL	A	0.0 ... 100000.0	63469
318...321	Harmonics 36: Current L2	REAL	A	0.0 ... 100000.0	63471
322...325	Harmonics 37: Current L2	REAL	A	0.0 ... 100000.0	63473
326...329	Harmonics 38: Current L2	REAL	A	0.0 ... 100000.0	63475
330...333	Harmonics 39: Current L2	REAL	A	0.0 ... 100000.0	63477
334...337	Harmonics 40: Current L2	REAL	A	0.0 ... 100000.0	63479
338...341	Total harmonic distortion (THD+N) current L3	REAL	1%	0% to 100%	62321
342...345	Current L3	REAL	A	0.0 ... 100000.0	9
346...349	Harmonics 1: Current L3	REAL	A	0.0 ... 100000.0	63801
350...353	Harmonics 2: Current L3	REAL	A	0.0 ... 100000.0	63803
354...357	Harmonics 3: Current L3	REAL	A	0.0 ... 100000.0	63805
358...361	Harmonics 4: Current L3	REAL	A	0.0 ... 100000.0	63807
362...365	Harmonics 5: Current L3	REAL	A	0.0 ... 100000.0	63809
366...369	Harmonics 6: Current L3	REAL	A	0.0 ... 100000.0	63811
370...373	Harmonics 7: Current L3	REAL	A	0.0 ... 100000.0	63813
374...377	Harmonics 8: Current L3	REAL	A	0.0 ... 100000.0	63815
378...381	Harmonics 9: Current L3	REAL	A	0.0 ... 100000.0	63817
382...385	Harmonics 10: Current L3	REAL	A	0.0 ... 100000.0	63819
386...389	Harmonics 11: Current L3	REAL	A	0.0 ... 100000.0	63821
390...393	Harmonics 12: Current L3	REAL	A	0.0 ... 100000.0	63823
394...397	Harmonics 13: Current L3	REAL	A	0.0 ... 100000.0	63825
398...401	Harmonics 14: Current L3	REAL	A	0.0 ... 100000.0	63827
402...405	Harmonics 15: Current L3	REAL	A	0.0 ... 100000.0	63829
406...409	Harmonics 16: Current L3	REAL	A	0.0 ... 100000.0	63831
410...413	Harmonics 17: Current L3	REAL	A	0.0 ... 100000.0	63833

Byte	Measured variable	Data type	Unit	Value range	Measured value ID
414...417	Harmonics 18: Current L3	REAL	A	0.0 ... 100000.0	63835
418...421	Harmonics 19: Current L3	REAL	A	0.0 ... 100000.0	63837
422...425	Harmonics 20: Current L3	REAL	A	0.0 ... 100000.0	63839
426...429	Harmonics 21: Current L3	REAL	A	0.0 ... 100000.0	63841
430...433	Harmonics 22: Current L3	REAL	A	0.0 ... 100000.0	63843
434...437	Harmonics 23: Current L3	REAL	A	0.0 ... 100000.0	63845
438...441	Harmonics 24: Current L3	REAL	A	0.0 ... 100000.0	63847
442...445	Harmonics 25: Current L3	REAL	A	0.0 ... 100000.0	63849
446...449	Harmonics 26: Current L3	REAL	A	0.0 ... 100000.0	63851
450...453	Harmonics 27: Current L3	REAL	A	0.0 ... 100000.0	63853
454...457	Harmonics 28: Current L3	REAL	A	0.0 ... 100000.0	63855
458...461	Harmonics 29: Current L3	REAL	A	0.0 ... 100000.0	63857
462...465	Harmonics 30: Current L3	REAL	A	0.0 ... 100000.0	63859
466...469	Harmonics 31: Current L3	REAL	A	0.0 ... 100000.0	63861
470...473	Harmonics 32: Current L3	REAL	A	0.0 ... 100000.0	63863
474...477	Harmonics 33: Current L3	REAL	A	0.0 ... 100000.0	63865
478...481	Harmonics 34: Current L3	REAL	A	0.0 ... 100000.0	63867
482...485	Harmonics 35: Current L3	REAL	A	0.0 ... 100000.0	63869
486...489	Harmonics 36: Current L3	REAL	A	0.0 ... 100000.0	63871
490...493	Harmonics 37: Current L3	REAL	A	0.0 ... 100000.0	63873
494...497	Harmonics 38: Current L3	REAL	A	0.0 ... 100000.0	63875
498...501	Harmonics 39: Current L3	REAL	A	0.0 ... 100000.0	63877
502...505	Harmonics 40: Current L3	REAL	A	0.0 ... 100000.0	63879
506...517	Current module time	PNI-OTime	sec	-	65497

E.16 Information data record on available measured values (DS 170)

Measured variables of the module

Byte	Name	Data type	Unit	Value range
0	Version	BYTE	-	0
1	Reserved	BYTE	-	0
2...3	Number of IDs	UINT16	-	599
4...5	ID measured value 1	UINT16	-	-
5...6	ID measured value 2	UINT16	-	-
...	...	...	-	-
1200 ... 1201	ID measured value 599	UINT16	-	-

Tips and tricks

F

F.1 Tips and tricks

Processing and visualizing energy data

On the basis of an application example we show you how the measured values of the AI Energy Meter can be processed further and visualized.

You can find this application example on the Internet (http://support.automation.siemens.com/WW/view/en/86299299).

Overview of the measuring data

We provide you with an overview of the assignment of the measured values to the user data variants and data records in an Excel file.

You will find the Excel file on the Internet (https://support.industry.siemens.com/cs/ww/en/view/109755917).

Time-of-day synchronization and time stamp

In an application example we show you how to synchronize the time with the AI Energy Meter HF and work with measured values with time stamps.

You can find this application example on the Internet (http://support.automation.siemens.com/WW/view/en/109754890).

Rotating field

To recognize wiring errors and evaluate the generated rotating field, use the combined measurement functions from the section Notes for the recognition of wiring errors and incorrect rotating field (Page 48).

For more information, search in SIOS (http://support.automation.siemens.com/WW/view/en/109755917) for the FAQ "Notes on the recognition of wiring errors and incorrect rotating field".

Measured values in STEP 7 as of V5.5

Measured values are represented as negative values in STEP 7 as of V5.5 if the value range of the integer format (32767 dec) is exceeded. This is not an error in the measured value. Solution: Select hexadecimal representation.

Conversion of 64-bit floating-point numbers

If you cannot process 64-bit floating-point numbers in your automation system, we recommend conversion to 32-bit floating-point numbers. Note the conversion can cause loss of accuracy. For a description of the conversion of the 64-bit floating-point numbers (data type LREAL) into 32-bit floating-point numbers (data type REAL) please refer to the Internet (http://support.automation.siemens.com/WW/view/en/56600676).