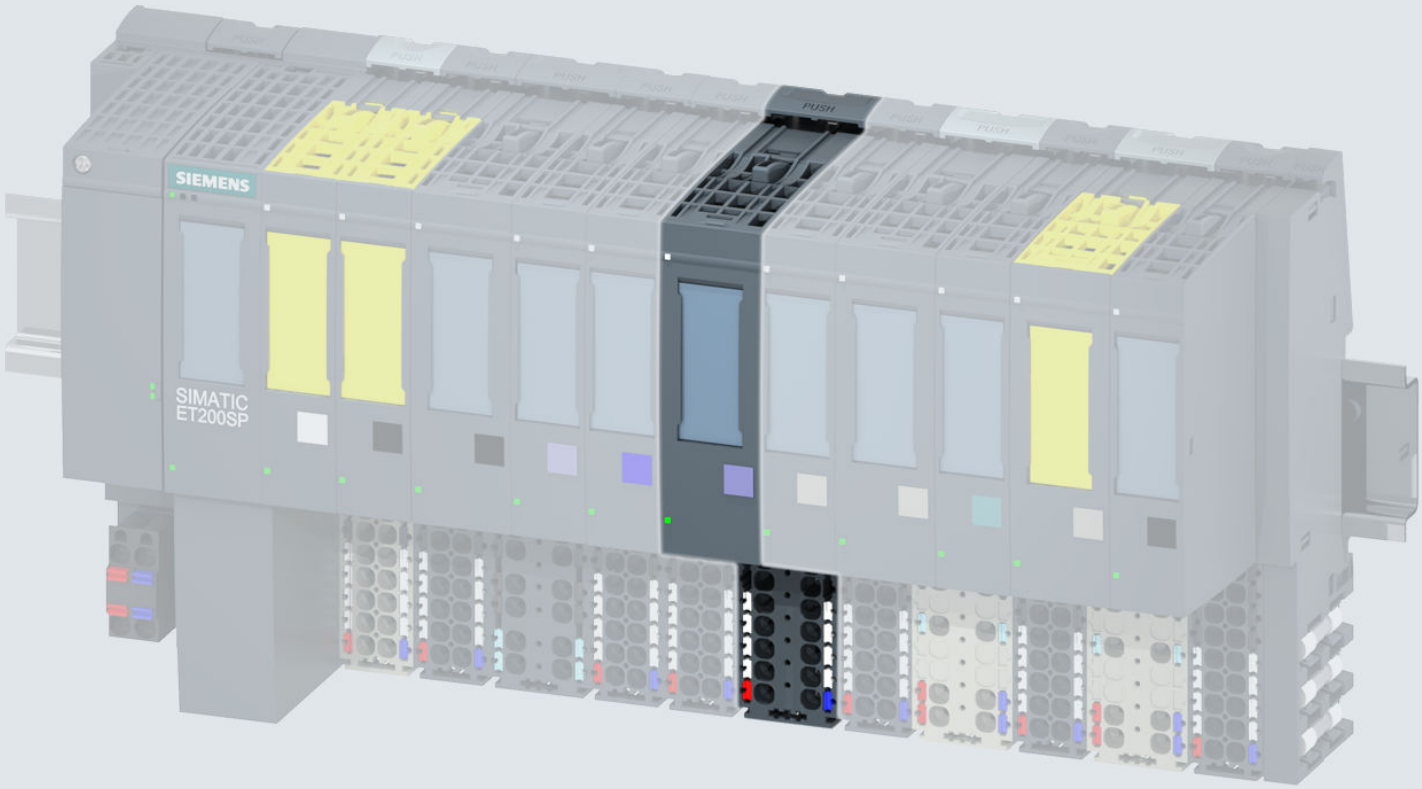
SIEMENS



Manual

SIMATIC

ET 200SP

Analog input module
AI Energy Meter CT HF
(6ES7134-6PA01-0CU0)

Edition 04/2022

support.industry.siemens.com

SIEMENS

SIMATIC

ET 200SP
Analog input module AI Energy Meter CT HF (6ES7134-6PA01-0CU0)

Equipment Manual

04/2022
A5E50150560-AB

ET 200SP Documentation Guide 1
Product overview 2
Wiring 3
Configuration / address space 4
Compatibility 5
Quick start 6
Reading and processing measured values 7
Energy counters 8
Operating hours counter 9
Limit monitoring 10
Minimum and maximum values 11
Measured value recorder 12
Power failure analysis 13
Power quality analysis functions 14
Phase-based measured values 15

Continued on next page

ET 200SP
Analog input module AI Energy Meter CT HF (6ES7134-6PA01-0CU0)

Equipment Manual

Continued

Parameters 16

Interrupts/diagnostic alarms 17

Technical specifications 18

Parameter data records A

Measured variables B

Module versions C

User data variants D

Measured value data records E

Tips and tricks F

Legal information

Warning notice system

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

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⚠ 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.

NOTICE

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

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

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The product/system described in this documentation may be operated only by **personnel qualified** for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

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Preface

Preface

Purpose of the documentation

This manual supplements the system manual ET 200SP (https://support.industry.siemens.com/cs/de/en/view/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.

Recycling and disposal

For environmentally friendly recycling and disposal of your old equipment, contact a certified electronic waste disposal company and dispose of the equipment according to the applicable regulations in your country.

Siemens provides products and solutions with industrial security functions that support the secure operation of plants, systems, machines and networks.

In order to protect plants, systems, machines and networks against cyber threats, it is necessary to implement – and continuously maintain – a holistic, state-of-the-art industrial security concept. Siemens' products and solutions constitute one element of such a concept.

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

Table of contents

1 ET 200SP Documentation Guide 12

1.1 ET 200SP Documentation Guide 12

1.2 SIMATIC Technical Documentation 13

1.3 Tool support 14

1.3.1 Tool support 14

2 Product overview 17

2.1 Properties of the AI Energy Meter CT HF 17

2.2 Area of application 19

2.3 Special considerations for use on the PROFIBUS DP and PROFINET IO 20

3 Wiring 23

3.1 Terminal and block diagram 23

3.2 Connection examples 26

3.3 Current transformer selection data 30

4 Configuration / address space 34

4.1 Configuring 34

4.2 Selecting the module versions 34

4.2.1 Module versions at configuration with STEP 7 35

4.2.2 Module versions at configuration with GSD file 36

4.2.3 Changing over the user data variant during operation 37

4.2.4 Recommendations for selecting the module version 38

4.3 Applicable modules 39

5 Compatibility 40

5.1 Compatibility of modules 40

6 Quick start 42

7 Reading and processing measured values 44

7.1 Basics for reading measured values 44

7.2 Quality information 46

7.2.1 Quality information in byte 1 of the user data 46

7.2.2 Quality information with measured value IDs 48

7.2.3 Operating quadrant 49

7.2.4 Notes for the detection of wiring errors and incorrect rotating field 50

7.3 Reading measured values from user data cyclically 50

7.4 Read out measured values acyclically using data records ... 52
7.5 Time-of-day synchronization and time stamp ... 53

8 Energy counters ... 55
8.1 Evaluate measured values for energy ... 55
8.2 Preset and apply start values for energy and overflow counters ... 57
8.2.1 Preset start values for the energy meters ... 57
8.2.2 Apply start values from data record DS 143 immediately ... 58
8.2.3 Apply start values from data record DS 143 with DQ bit ... 59
8.3 Starting and and stopping energy meters ... 62
8.4 Example of measuring and resetting an energy meter ... 64
8.5 What is the structure of the control and feedback interface for DS 143? ... 64

9 Operating hours counter ... 67
9.1 Evaluating operating hours counters ... 67
9.2 Preset and apply start values for operating hours counters ... 68
9.2.1 Preset start values for operating hours counters ... 68
9.2.2 Apply start values from data record DS 143 immediately ... 69
9.2.3 Apply start values from data record DS 143 with DQ bit ... 70
9.3 Starting and stopping operating hours counters ... 72

10 Limit monitoring ... 74
10.1 How limit monitoring works ... 74
10.2 Influence of hysteresis and delay time on limit monitoring ... 75
10.3 Reset, activate and deactivate counters for limit violation ... 77
10.4 Measured variables for limit monitoring ... 78

11 Minimum and maximum values ... 81
11.1 Minimum and maximum values ... 81
11.2 Resetting minimum and maximum values ... 82
11.3 Gate ... 84

12 Measured value recorder ... 86
12.1 How the measured value recorder works ... 86
12.2 Start, hold, continue, reset, restart and evaluate measurement ... 87
12.3 Example of measured value recording ... 90

13 Power failure analysis ... 91
13.1 Mode of operation of the power failure analysis ... 91

14 Power quality analysis functions 93
14.1 Power quality analysis status 94
14.2 Harmonics analysis 94
14.3 Reactive power compensation 95
14.4 Detection of residual current 95
14.5 Active factor and power factor 96
14.6 Neutral current In 96
14.7 Monitoring the instantaneous or half-wave values 97

15 Phase-based measured values 98

16 Parameters 100
16.1 Parameters 100
16.2 Explanation of parameters 103

17 Interrupts/diagnostic alarms 110
17.1 Status and error display 110
17.2 Interrupts 111
17.2.1 Hardware interrupts 111
17.2.2 Diagnostics interrupt 112
17.3 Diagnostic alarms 113
17.4 Diagnostics response 114
17.4.1 Voltage diagnostics 114
17.4.1.1 Diagnostics: Overflow/underflow 114
17.4.1.2 Voltage swell of the voltage half-wave value 116
17.4.1.3 Voltage dip of the voltage half-wave value 118
17.4.1.4 Peak values of the instantaneous values for voltage 120
17.4.2 Current diagnostics 123
17.4.2.1 Diagnostics: Overload 123
17.4.2.2 Low limit for measuring current undershot 124
17.4.2.3 Peak values of the instantaneous values for current 126
17.4.2.4 Overcurrent of the current half value 128

18 Technical specifications 130
18.1 Technical specifications 130

A Parameter data records 136
A.1 Configuration via parameter data records 136
A.2 Structure of the parameter data record 128 for the entire module 137
A.3 Structure of the parameter data record 129 for limit monitoring 147
A.4 Structure of the parameter data records 130/131 for user-data mapping 151
A.5 Structure of the parameter data record for measured value recording (DS 134) 154

A.6 Structure of the parameter data record 135 for data record mapping ... 159

B Measured variables ... 162

B.1 Measured variables for connection type ... 162

C Module versions ... 193

C.1 Module version "2 I / 2 Q" ... 193

C.2 Module version "32 I / 20 Q" ... 195

C.3 "User-specific" module version ... 201

C.4 Module version "EE@Industry measurement data profile E0 / E1 / E2 / E3" ... 203

D User data variants ... 206

D.1 User data variants with 32 bytes input data / 20 bytes output data ... 206

E Measured value data records ... 223

E.1 Overview of all measured value data records ... 223

E.2 Measured value data record for base measurements (DS 142) ... 223
E.2.1 Measured value data record for basic measured values (DS 142) version 2 ... 223
E.2.2 Measured value data record for basic measured values (DS 142) version 3 ... 226

E.3 Structure for energy counters (DS 143) ... 229

E.4 Measured value data record for maximum values (DS 144) ... 234

E.5 Measured value data record for minimum values (DS 145) ... 236

E.6 Measured value data record for phase-based measured values L1 (DS 147) ... 238
E.6.1 Measured value data record for phase-based measured values L1 (DS 147) version 0 ... 238
E.6.2 Measured value data record for phase-based measured values L1 (DS 147) version 1 ... 239

E.7 Measured value data record for phase-based measured values L2 (DS 148) ... 242
E.7.1 Measured value data record for phase-based measured values L2 (DS 148) version 0 ... 242
E.7.2 Measured value data record for phase-based measured values L2 (DS 148) version 1 ... 243

E.8 Measured value data record for phase-based measured values L3 (DS 149) ... 245
E.8.1 Measured value data record for phase-based measured values L3 (DS 149) version 0 ... 245
E.8.2 Measured value data record for phase-based measured values L3 (DS 149) version 1 ... 247

E.9 Measured value data record for advanced measurement and status values (DS 150) version 1 ... 249

E.10 Measured value data record of user-defined data record (DS 151) ... 250

E.11 Measured value data record for maximum values with time stamp (DS 154) ... 250

E.12 Measured value data record for minimum values with time stamp (DS 155) ... 253

E.13 Measured value data record for power quality analysis (DS 160) ... 256

E.14 Measured value data record for harmonics voltage (DS 161) ... 259

E.15 Measured value data record for harmonics current (DS 163) ... 262

E.16 Measured value data record for power failure analysis (DS 169) ... 266

E.17 Information data record on available measured values (DS 170)..... 267
E.18 Measured value data record for measured value recording 1 (DS 173)..... 268
E.19 Measured value data record for measured value recording 2 (DS 174)..... 269

F Tips and tricks..... 270
F.1 Tips and tricks..... 270

ET 200SP Documentation Guide

1

1.1 ET 200SP Documentation Guide



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.

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

Basic information



The System Manual describes 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.

Examples:

- ET 200SP System Manual
- System Manual ET 200SP HA/ET 200SP modules for devices used in a hazardous area
- Online help TIA Portal

Device information



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

Examples:

- Equipment Manuals CPUs
- Equipment Manuals Interface Modules
- Equipment Manuals Digital Modules
- Equipment Manuals Analog Modules
- Equipment Manuals Motor Starter
- BaseUnits Equipment Manuals
- Equipment Manual Server Module
- Equipment Manuals Communications Modules
- Equipment Manuals Technology Modules

General information



The function manuals contain detailed descriptions on general topics relating to the SIMATIC ET 200SP distributed I/O system.
Examples:

- Function Manual ET 200AL/ET 200SP Mixed Configuration
- Function Manual Diagnostics
- Function Manual Communication
- PROFINET Function Manual
- PROFIBUS Function Manual
- Function Manual Designing Interference-free Controllers
- MultiFieldbus Function Manual

Product Information

Changes and supplements to the manuals are documented in a Product Information. The Product Information takes precedence over the device and system manuals.
You can find the latest Product Information on the ET 200SP distributed I/O system on the Internet. (https://support.industry.siemens.com/cs/de/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.industry.siemens.com/cs/ww/en/view/84133942)

1.2 SIMATIC Technical Documentation

Additional SIMATIC documents will complete your information. You can find these documents and their use at the following links and QR codes.
The Industry Online Support gives you the option to get information on all topics. Application examples support you in solving your automation tasks.

Overview of the SIMATIC Technical Documentation

Here you will find an overview of the SIMATIC documentation available in SIOS:



Industry Online Support International
(https://support.industry.siemens.com/cs/ww/en/view/109742705)

Watch this short video to find out where you can find the overview directly in SIOS and how to use SIOS on your mobile device:



Quick introduction to the technical documentation of automation products per video (https://support.industry.siemens.com/cs/us/en/view/109780491)



YouTube video: Siemens Automation Products - Technical Documentation at a Glance (https://youtu.be/TwLSxxRQQsA)

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You can find "mySupport" on the Internet. (https://support.industry.siemens.com/My/ww/en)

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

1.3 Tool support

1.3.1 Tool support

The tools described below support you in all steps: from planning, over commissioning, all the way to analysis of your system.

TIA Selection Tool

The TIA Selection Tool tool supports you in the selection, configuration, and ordering of devices for Totally Integrated Automation (TIA).

As successor of the SIMATIC Selection Tools , it assembles the configuration editors for automation technology already familiar into a single 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 on various SIMATIC S7 stations as bulk operations independent of TIA Portal.
The SIMATIC Automation Tool offers a wide range of functions:

- Scanning of a PROFINET/Ethernet system network and identification of all connected CPUs
- Assignment of addresses (IP, subnet, Gateway) and device 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 through LED flashing
- Reading out of CPU error information
- Reading the CPU diagnostic 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) is a commissioning and diagnostic tool for PROFINET networks. PRONETA Basic has two core functions:

- The "Network analysis" offers a quick overview of the PROFINET topology. It is possible to make simple parameter changes (for example, to the names and IP addresses of the devices). In addition, a quick and convenient comparison of the real configuration with a reference system is also possible.
- The "IO test" is a simple and rapid test of the wiring and the module configuration of a plant, including documentation of the test results.

You can find SIEMENS PRONETA Basic on the Internet:
(https://support.industry.siemens.com/cs/ww/en/view/67460624)
SIEMENS PRONETA Professional is a licensed product that offers you additional functions. It offers you simple asset management in PROFINET networks and supports operators of automation systems in automatic data collection/acquisition of the components used through various functions:

- The user interface (API) offers an access point to the automation cell to automate the scan functions using MQTT or a command line.
- With PROFIenergy diagnostics, you can quickly detect the current pause mode or the readiness for operation of devices that support PROFIenergy and change these as needed.
- The data record wizard supports PROFINET developers in reading and writing acyclic PROFINET data records quickly and easily without PLC and engineering.

You can find SIEMENS PRONETA Professional on the Internet:
(https://www.siemens.com/proneta-professional)

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://new.siemens.com/global/en/products/automation/industrial-communication/profinet/sinetplan.html).

Product overview

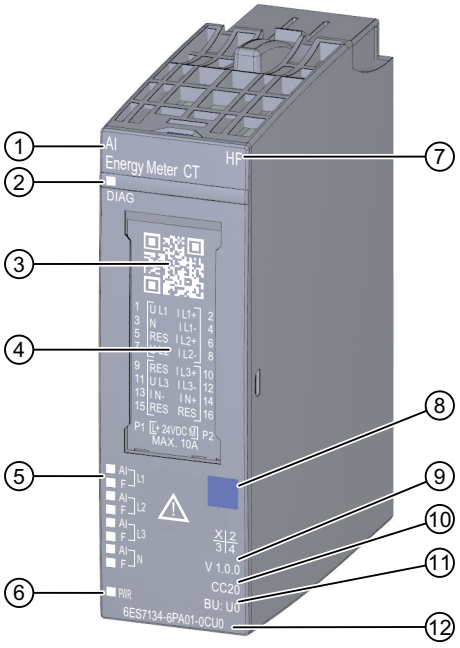
2

2.1 Properties of the AI Energy Meter CT HF

Article number

6ES7134-6PA01-0CU0

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 CT HF

Properties

The module has the following technical properties:

- Measurement of electrical variables from single-phase, two-phase and three-phase supply networks
- Current measurement using 1 A or 5 A current transformer
- Power quality data for voltages and currents
- Measured value recorder (10 ms)

- Max. voltage between two line conductors 519 V AC (with direct connection)
- 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

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	V8.0.0 or higher	V16 or higher with HSP0335 V17 or higher	X	---
Calibration in runtime	FS01	V8.0.0 or higher	V16 or higher with HSP0335 V17 or higher	---	---
Identification data I&M0 to I&M3	FS01	V8.0.0 or higher	V16 or higher with HSP0335 V17 or higher	X	X
Reconfiguration in RUN	FS01	V8.0.0 or higher	V16 or higher with HSP0335 V17 or higher	X	X
Diagnostic interrupts	FS01	V8.0.0 or higher	V16 or higher with HSP0335 V17 or higher	X	X
Hardware interrupts	FS01	V8.0.0 or higher	V16 or higher with HSP0335 V17 or higher	X	---

NOTE

The AI Energy Meter CT HF is released as of TIA Portal V16.0.0.4.

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 (https://support.industry.siemens.com/cs/ww/en/view/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 CT HF?

The AI Energy Meter CT HF is designed for machine-level deployment in an ET 200SP distributed I/O system. The AI Energy Meter CT 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 CT 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 CT 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 CT HF can be used in TN, TT and IT systems.

Measuring with the AI Energy Meter CT 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:

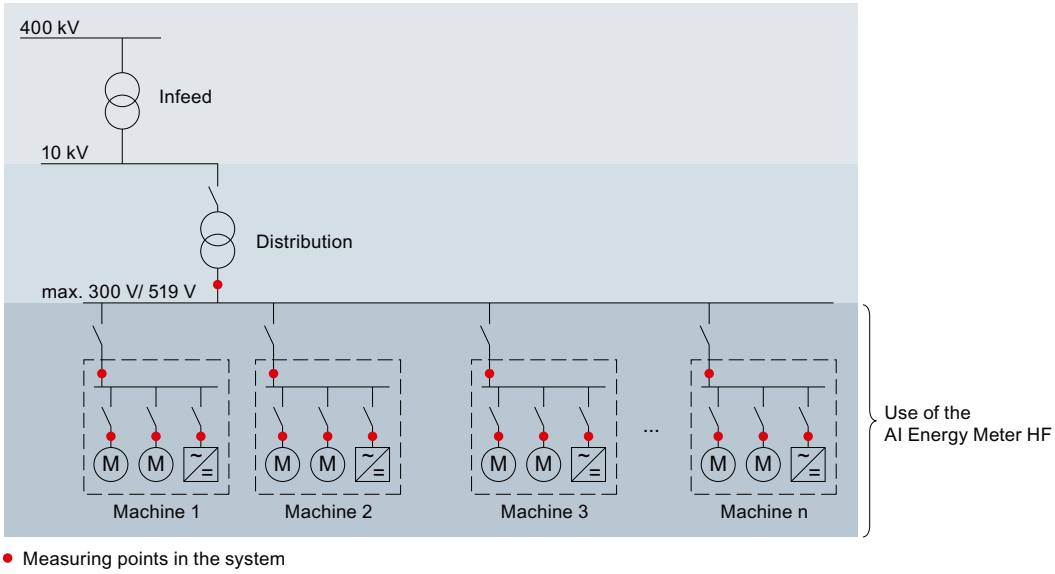


Figure 2-2 Properties of the AI Energy Meter CT HF

Properties of the AI Energy Meter CT HF

The AI Energy Meter CT HF offers the following benefits:

- Space-saving especially for use in control cabinet
- PROFINET IO or PROFIBUS DP (https://www.profibus.com/) (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 158).

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 and usvariants 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 payload 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.

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 CT HF and short-circuit the installed current transformers.

⚠ WARNING

Danger to life, dangerous system conditions and material damage possible

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

If you remove and insert the AI Energy Meter CT 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 CT 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 current transformer on the secondary side on removal.

Supplying the module

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

NOTE

Safe extra low voltage SELV/PELV

Ensure that all devices are connected to the SELV/PELV power supply (or equivalent).

Note the following to ensure the electrical safety of the Energy Meter and the ET 200SP station:
The voltage difference between the inputs for measuring the line voltage at the Energy Meter and the SELV/PELV supply voltages of the Energy Meter and the ET 200SP station must not exceed 300 V AC. This is guaranteed, for example, if the SELV/PELV supply is fed from the same grounded network as the voltage to be measured directly. If voltage transformers are used, they must be grounded on the secondary side.

Current transformer connection requirements

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

NOTE

Wiring current transformers

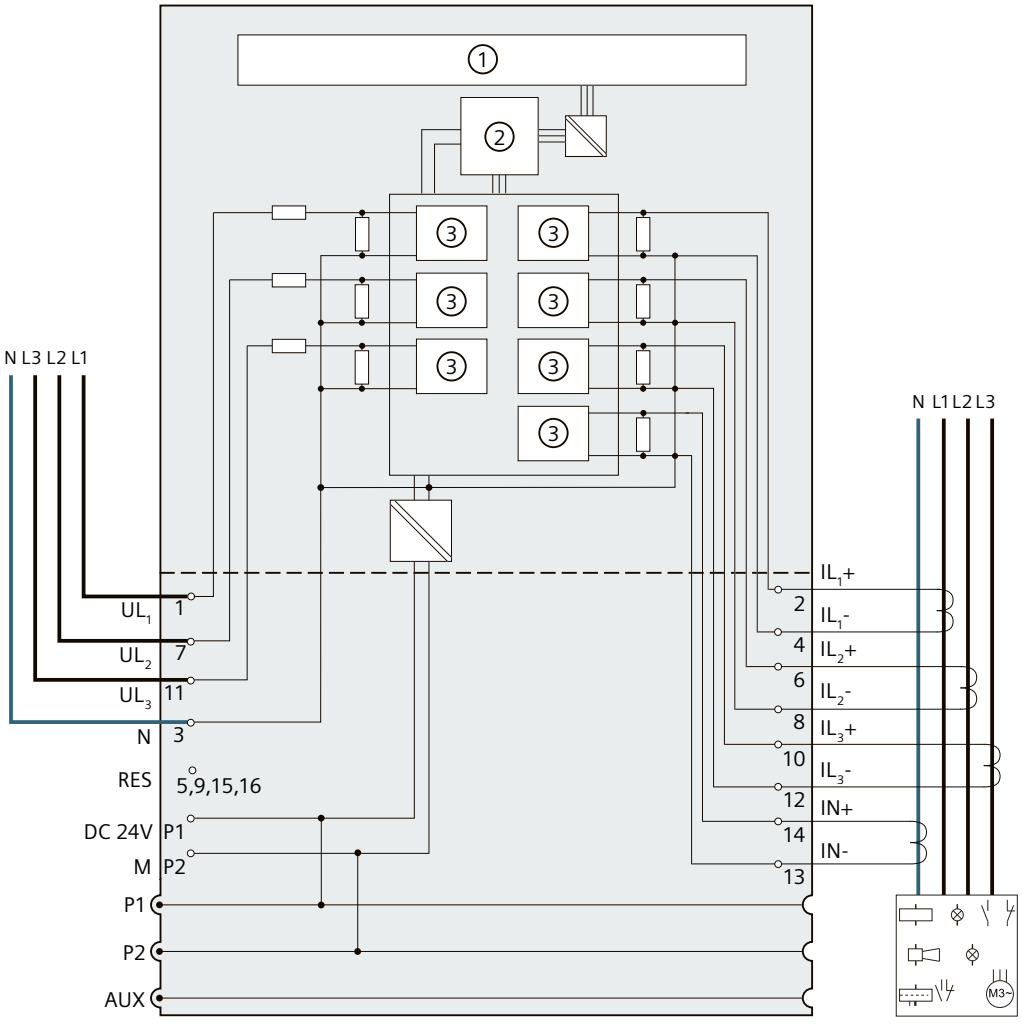
The secondary circuits of current transformers must not be grounded.

Guards must not be used in the secondary circuits of current transformers.

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 CT HF.

Terminal and block diagram



①	Backplane bus interface	UL_n	Connection voltage
②	Microcontroller	IL_n+ / IL_n-	Connection of current transformers
③	Analog-to-digital converter (ADC)	N, IN+ / IN-	Neutral
P1, P2, AUX	Internal self-assembling voltage buses Connection to left (dark BaseUnit) Connection to left interrupted (light BaseUnit)	RES	Reserve, must remain unused for future function extensions

Figure 3-1 Block diagram of the AI Energy Meter CT 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 CT 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 26).

Information on the selection of a current transformer is available in the section Data for selection of a current transformer (Page 30).

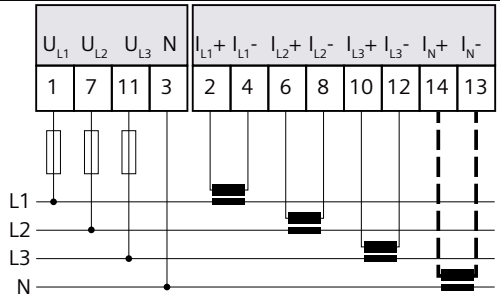
NOTE

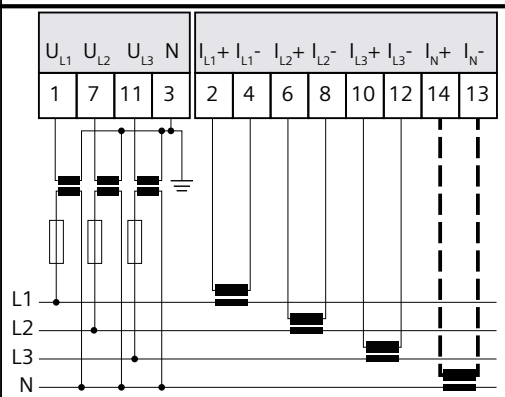
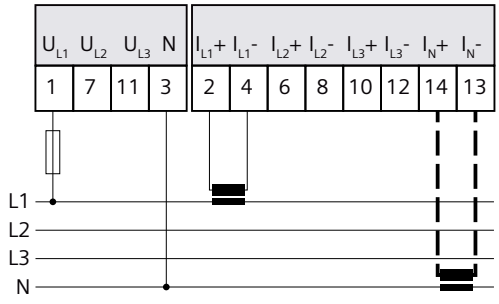
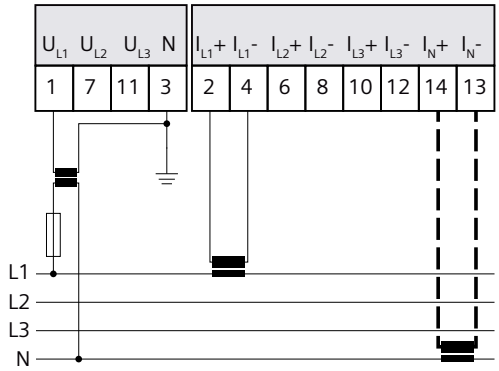
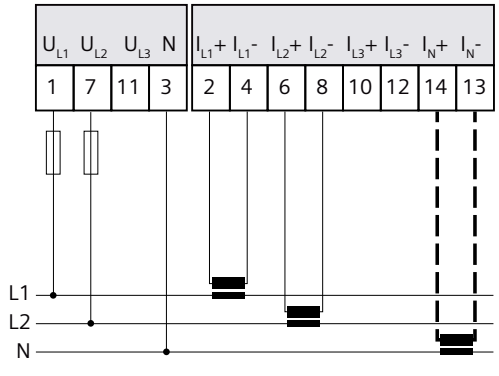
Measurement of other currents

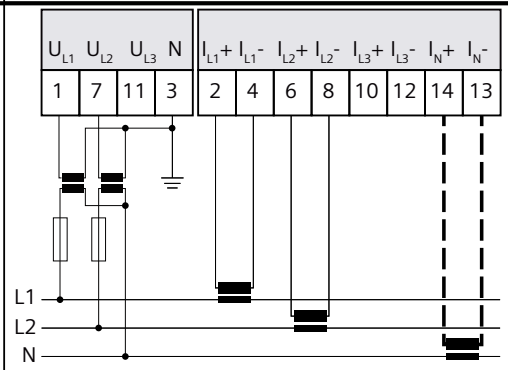
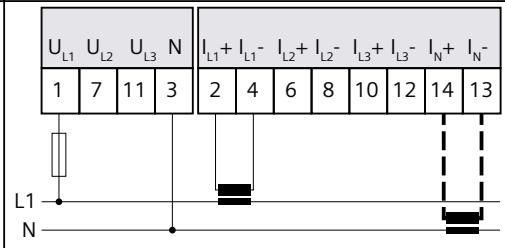
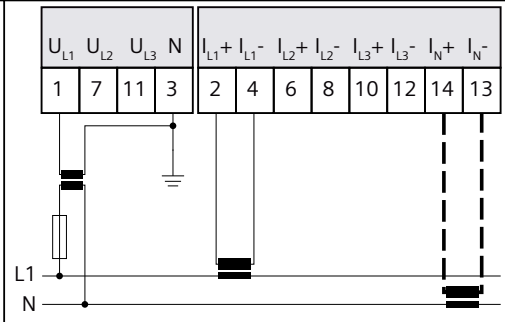
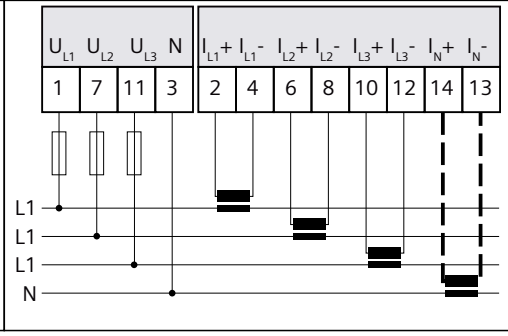
You can also use the connection for neutral current measurement to measure other currents.

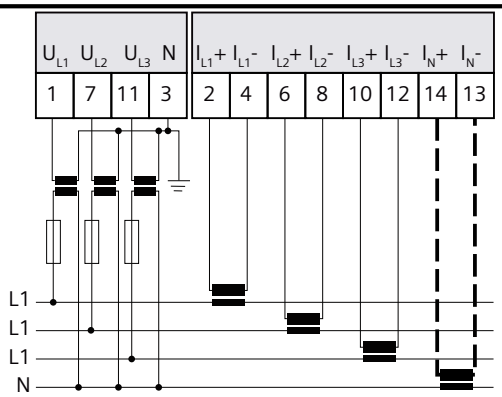
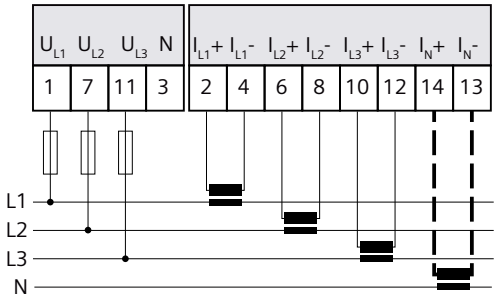
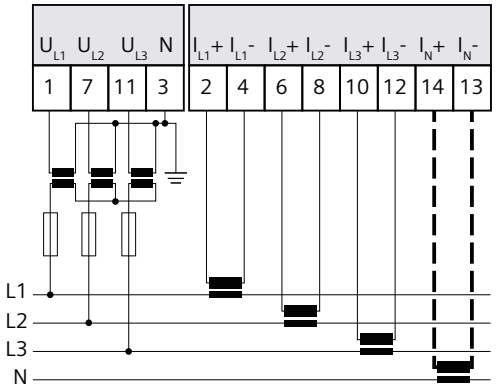
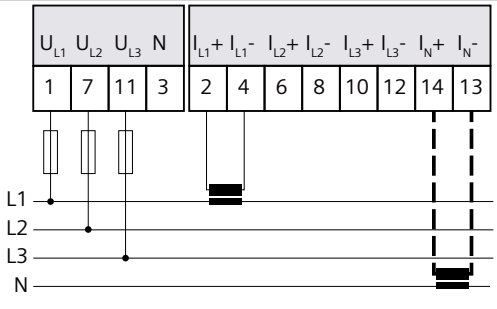
3.2 Connection examples

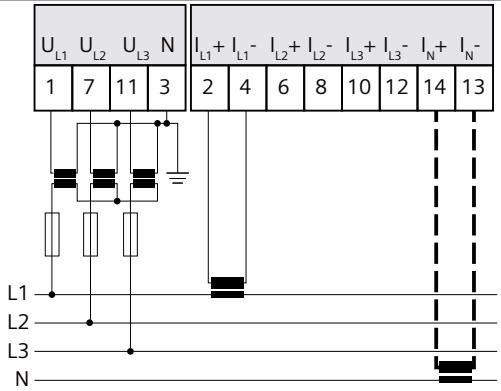
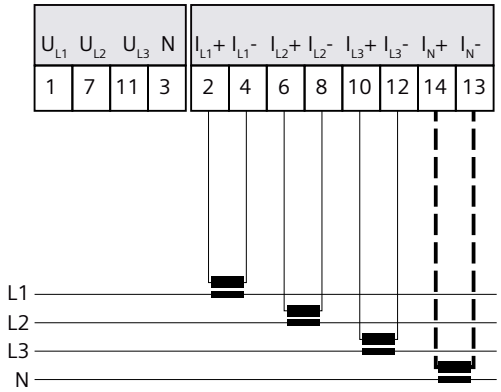
The following figures show the connection of the AI Energy Meter CT HF for three-phase, two-phase and single-phase measurements. Note that the AI Energy Meter CT HF must always be connected via a current transformer. The use of voltage transformers is optional.

Connection type	Wiring diagram	Comment
3P4W Three-phase measurement, 4 wires		Any load Connection with three current transformers

Connection type	Wiring diagram	Comment
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
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 The phase position L1-L2 is arbitrary. AI Energy Meter CT HF supplies the value "0" for all measured values of Phase 3 as well as for some cross-phase measured values.

Connection type	Wiring diagram	Comment
2P3W Two-phase measurement, 3 conductors		Any load Connection with two current transformers and two voltage transformers. AI Energy Meter CT 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 CT HF supplies the value "0" for all measured values of Phase 2 and 3 as well as for some cross-phase measured values.
1P2W Single-phase measurement, 2 conductors		Measuring the load in an AC network with one current transformer and one voltage transformer. AI Energy Meter CT 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. To reduce the number of fuses used, the voltage phases can also be bridged behind a fuse.

Connection type	Wiring diagram	Comment
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. To reduce the number of fuses used, the voltage phases can also be bridged behind a fuse.
3P3W Three-phase measurement		Any load Connection with three current transformers
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

Connection type	Wiring diagram	Comment
3P3W1 Three-phase measurement		Balanced load Connection with one current transformer and one voltage transformer.
3P4WI Three-phase measurement (only for current measurement)		Connection with three current transformers

Current transformer connection requirements

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

- However, if it mandatory to ground the secondary circuits of the current transformers; voltage transformers must be used to separate neutral conductor / neutral point and the protective conductor. Alternatively, the voltage measurement must be omitted.
- 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 CT 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 in 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 Meters CT HF (see figure below) must be below a certain resistance value (depending on Z_n and I_{max}).

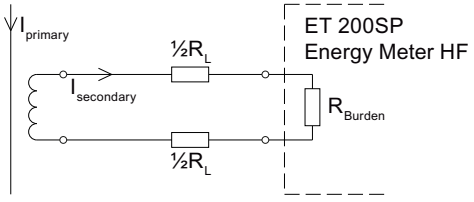


Figure 3-2 Maximum length of the connection cable

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 CT 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 CT 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 CT 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 ρ = 0.017857 Ω x 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 mm^2 upward.

Cross-section	AWG	Cable overview for copper				
		0.5 m	1 m	5 m	10 m	50 m
0.25 mm^2	24	35.7 mΩ	71.4 mΩ	357.1 mΩ	714.3 mΩ	3571.4 mΩ
0.34 mm^2	22	26.3 mΩ	52.5 mΩ	262.6 mΩ	525.2 mΩ	2626.0 mΩ
0.5 mm^2	21	17.9 mΩ	35.7 mΩ	178.6 mΩ	357.1 mΩ	1785.7 mΩ
0.75 mm^2	19/20	11.9 mΩ	23.8 mΩ	119.0 mΩ	238.1 mΩ	1190.5 mΩ
1.0 mm^2	18	8.9 mΩ	17.9 mΩ	89.3 mΩ	178.6 mΩ	892.9 mΩ
1.5 mm^2	16	6.0 mΩ	11.9 mΩ	59.5 mΩ	119.0 mΩ	595.2 mΩ
2.5 mm^2	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 mm^2 and a burden resistance of the AI Energy Meter CT 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:

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

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 130)

Configuration / address space

4

4.1 Configuring

Introduction

To configure the AI Energy Meter CT 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 CT HF in RUN via the user program.

Configuring

You configure the AI Energy Meter CT HF with:

- STEP 7 (TIA Portal) V16 or higher and HSP0335
- GSD file for PROFIBUS or PROFINET

NOTE

Consistency check of the parameter assignment only with STEP 7

If you configure the AI Energy Meter CT 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 CT HF using a GSD file, a consistency check is not performed. 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 CT HF.

The following instructions show the theoretical procedure for configuring the AI Energy Meter CT HF with STEP 7 (TIA Portal) V16 or higher with HSP0335.

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 CT HF.
4. Configure the AI Energy Meter CT 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 CT HF is running.

4.2 Selecting the module versions

Introduction

The AI Energy Meter CT 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 payload.

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

Influence of the module version on the address space

NOTE

Influence of the AI Energy Meter CT 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 CT HF is essentially influenced by the length of the payload supplied. The module version determines the length of the payload, which can be supplied by the AI Energy Meter CT HF at maximum.

4.2.1 Module versions at configuration with STEP 7

Module versions with fixed payload assignment

Module version	Payload	Address space	Comment
2 I / 2 Q	No cyclic payload. 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 "2 I / 2 Q" module version (Page 193).
EE@Industry E0	Payload 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 measured data profile E0 / E1 / E2 / E3" (Page 203).
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 payload variants

Module version	Payload	Address space	Comment
32 I / 20 Q	Payload selectable through defined payload variants	32-byte inputs / 20-byte outputs	You can change over the payload variant during operation. Information about the structure of the 32 I / 20 Q module version is available in the appendix "32 I / 20 Q" module version (Page 195). Information about the payload variants at 32 I / 20 Q is available in appendix Payload variants with 32 bytes input / 20 bytes output data.

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

* 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 payload assignment

Module version	Payload	Address space	Comment
2 I / 2 Q	No cyclic payload. 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 "2 I / 2 Q" module version (Page 193).
E0	Payload 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 measured data profile E0 / E1 / E2 / E3" (Page 203).
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 payload variants

Module version	Payload	Address space	Comment
32 I / 20 Q	Payload selectable through payload variants or through user-specific payload*	32-byte inputs / 20-byte outputs	You can change over the payload variant during operation. If you use user-specific payload, you write your measured value profile into the AI Energy Meter CT 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 payload mapping (Page 151).
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 payload does 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 payload variant in the output data of each payload variant in byte 0.
The following figure shows to which payload you can change over at various module versions during operation.

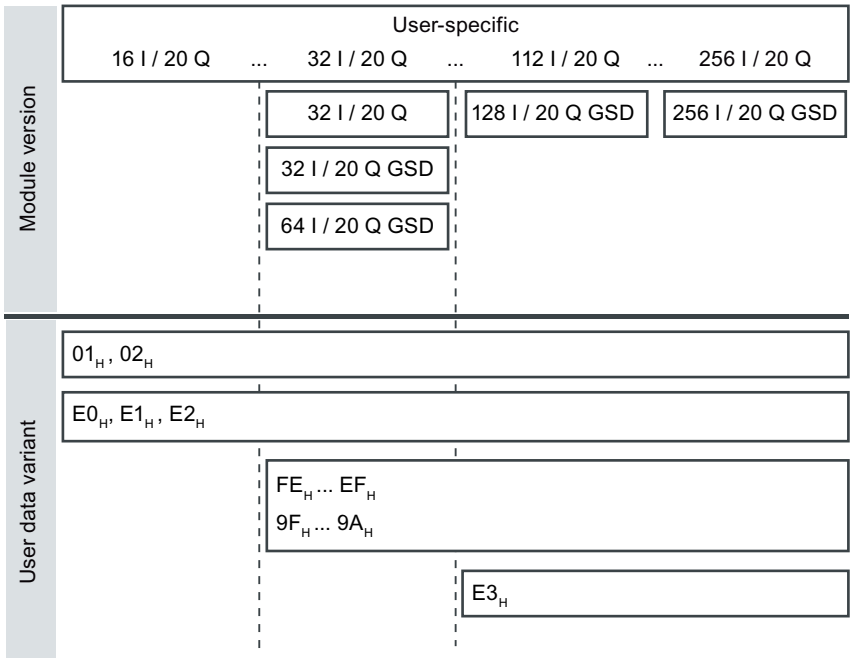


Figure 4-1 Possible payload variants

Requirement

- User program has been created.
- AI Energy Meter CT 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 payload variant.
2. Enter the payload 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 payload variant is switched with the next cycle.

NOTE
Information about payload changeover
The parameterized payload variant is set in the following cases:

- A "0" is written in byte 0 in the output data of a payload variant.
- Byte 0 in the output data of a payload variant contains an invalid value:
  - Coding of the payload variant not available
    or
  - Available address space is not sufficient for the selected payload 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 CT HF in an ET 200SP or when 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 payload 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 payload variants	• Quality information about the measured values is always available. • Depending on the payload variant, you must convert the measured values in the CPU to physical values using the supplied scaling factor. • One cycle elapses for each payload changeover. Measured values from the next payload 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	• Cyclic measurement of up to 64 measured values configurable • Flexibility by switching predefined payload variants	
With GSD configuration • 32 I / 20 Q • 64 I / 20 Q • 128 I / 20 Q • 256 I / 20 Q		

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

** Function setting the time 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		---	V4.0 or higher			---
IM 155-6 DP HF	v4.2 or higher		---	v4.2 or higher			---

Compatibility

5

5.1 Compatibility of modules

Compatibility

The module versions "AI Energy Meter CT ST" and "AI Energy Meter CT HF" are compatible. All module versions can run on the respective other configuration, whereby the CT and RC functionality cannot be swapped.

If you exchange or replace an AI Energy Meter, the following table shows the compatibilities.

	Energy Meter configured		
Energy Meter inserted	**AI Energy Meter CT ST**	**AI Energy Meter CT HF**	**AI Energy Meter 480 VAC CT HF**
AI Energy Meter CT ST	Yes	Yes*	Yes*
AI Energy Meter CT HF	Yes*	Yes	Yes**
AI Energy Meter 480 VAC CT HF	No	No	Yes

*In this case, the module only supports ST functions.

** In this case, the function measured value recorder cannot be configured. The measured values of the following IDs cannot be selected by configuration in the limit value monitoring or in the user-definable data records/payload: 61136, 61137, 61159, 62132, 62135, 62193, 62232, 62235, 62293, 62332, 62335, 62393.

NOTE

The smallest component from configuration and module type determines the resulting scope of functions. This means the ST functionality is supported when either an ST configuration is available, or the ST module is used. An HF functionality, therefore, is only available in case of an HF configuration and HF module.

NOTE

When you install an ST module and use an HF configuration, you must disable the following functions:

- Power quality analysis functions
- Residual current analysis
- Diagnostics power quality
- Overcurrent, detect voltage swell and dip
- Detect peak values of current and voltage
- Harmonics analysis

AI Energy Meter CT HF (6ES7134-6PA01-0CU0) with firmware version V8.0.0

If you want to exchange the hardware and the configuration of the AI Energy Meter 480VAC CT HF V6.0 modules against the corresponding AI Energy Meter CT HF V8.0 modules, then exchange

1. the configuration of V6.0 according to V8.0 and
2. the hardware

If the module does not start correctly after exchanging the AI Energy Meter 480 VAC HF V6.0 configuration to HF V8.0, then

- change one or more module or phase parameters (DS128) and send them to the module again or
- switch off the load voltage of the module at P1 and P2 for a short time and then switch it on again.

Quick start

6

Introduction

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

Requirement

You have already connected the AI Energy Meter CT HF to your network with one of the connection types shown in the section Connecting (Page 23). The AI Energy Meter CT HF has already been integrated into your configuration tool (such as STEP 7), or the AI Energy Meter CT HF has been integrated in the 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 CT 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 CT HF:
   - Connection type that you have used for the AI Energy Meter CT 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 current transformer used (e.g. 100 A and 1 A)
   - Primary and secondary voltages of the voltage transformer used (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 CT HF supplies the measured values for the "Total power L1L2L3" payload variant with the ID 254 or FE_H.
Read and check the measured values provided by the AI Energy Meter CT HF in the input data.

The table below shows the structure of the payload 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.

Table 6-1 Total power L1L2L3

Byte	Allocation	Data type	Unit	Value range	Measured value ID
0	Payload 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 out and processing measured values (Page 44).

Reading and processing measured values 7

7.1 Basics for reading measured values

Introduction

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

- Cyclic: Payload
- Acyclic: Measured value data records

Payload

Payload provide pre-defined or user-defined measured values depending on the configured payload variant. The supplied measured values are cyclically written to the process image of the CPU. With some payload 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 payload, the content of byte 0 is set to the selected payload 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 payload variant in the parameters of the hardware configuration. This remains in effect until a different payload variant is selected in the output data (byte 0). This

allows input payload to be modified dynamically according to the requirements of the process.
The payload 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 payload variant.
- Byte 0 in the output data of a payload variant contains an invalid value:
  - Coding of the payload variant not available, or
  - Available address space is not sufficient for the selected payload variant.
    See "Selecting the module version (Page 34)".

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 payload 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 and the power failure analysis are deleted.
- Minimum and maximum value calculation starts again with initial values.
- Measured values of the measured value recorder are deleted.

For the general reset, set bit 7 in byte 16 of the output payload. (Page 195)

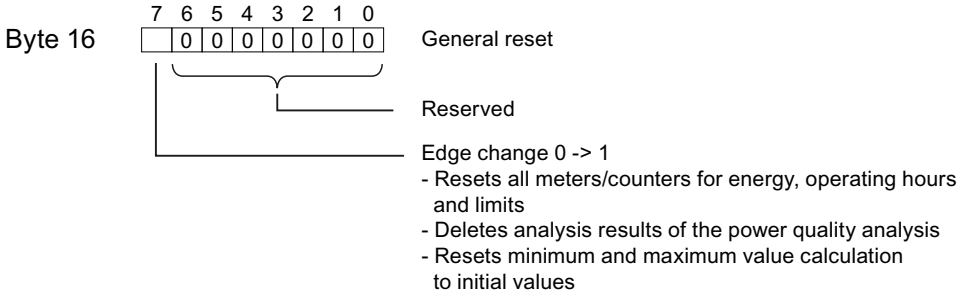


Figure 7-1 Control byte 16 in the output payload for general reset

Substitute value behavior

The substitute values for input values of the AI Energy Meter CT HF are "0".

See also

Reading measured values from user data cyclically (Page 50)

7.2 Quality information

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

The AI Energy Meter CT HF provides quality information:

- In byte 1 of the payload
- 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 195)

7.2.1 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.

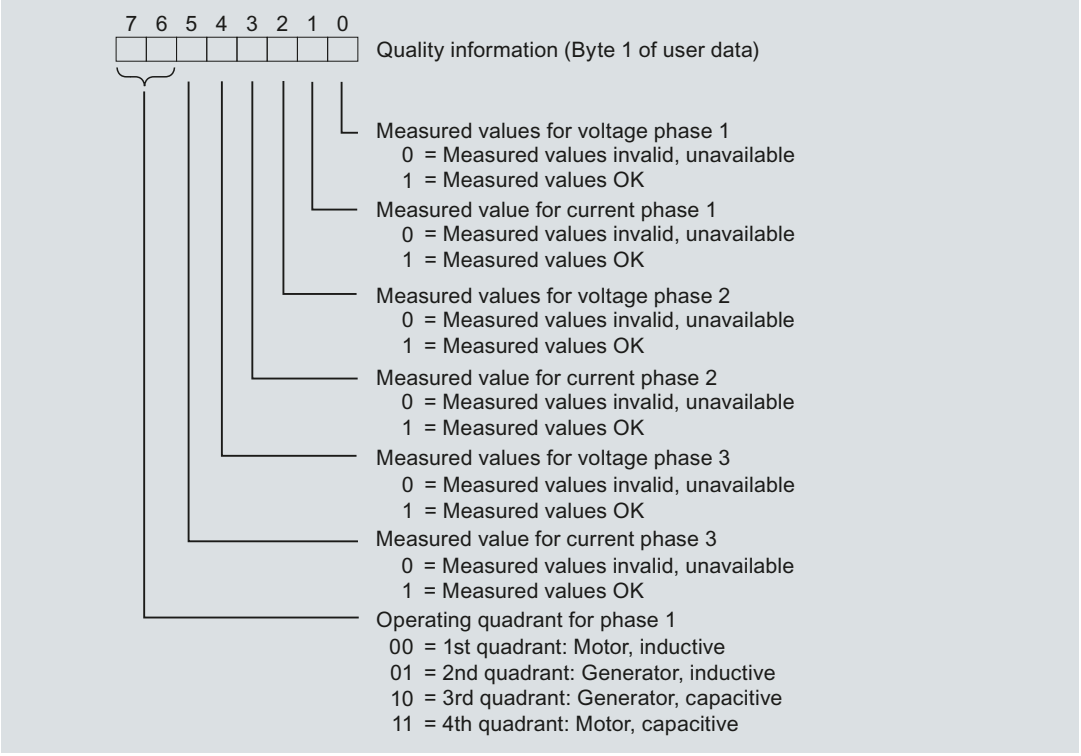


Figure 7-2 Assignment of byte 1 for user data variants ID 224 to ID 254

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.

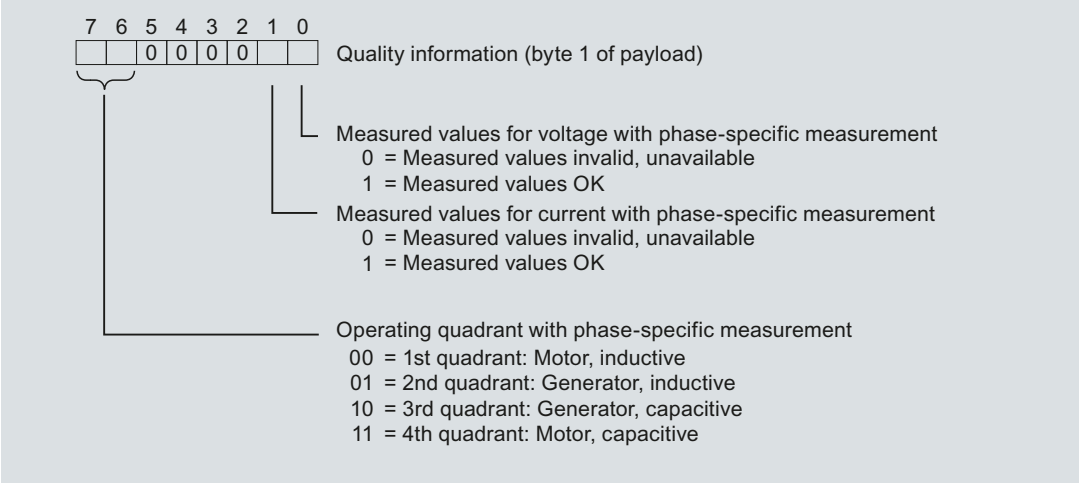


Figure 7-3 Byte 1 assignment for user data variants ID 154 to ID 159

7.2.2 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

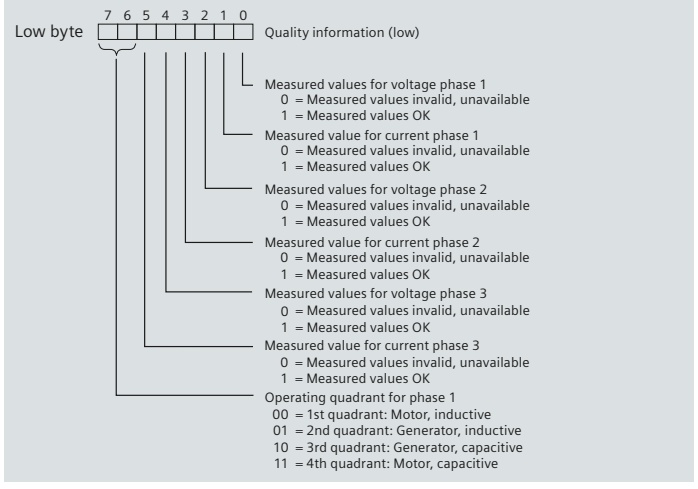
Quality information with measured value ID 65503 for 3-phase measurement

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



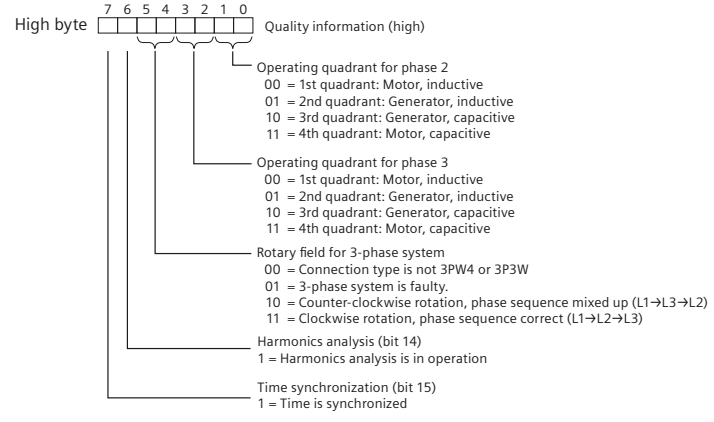


Figure 7-4 Quality information for low and high byte of the measured value ID 65503

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.

7.2.3 Operating quadrant

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

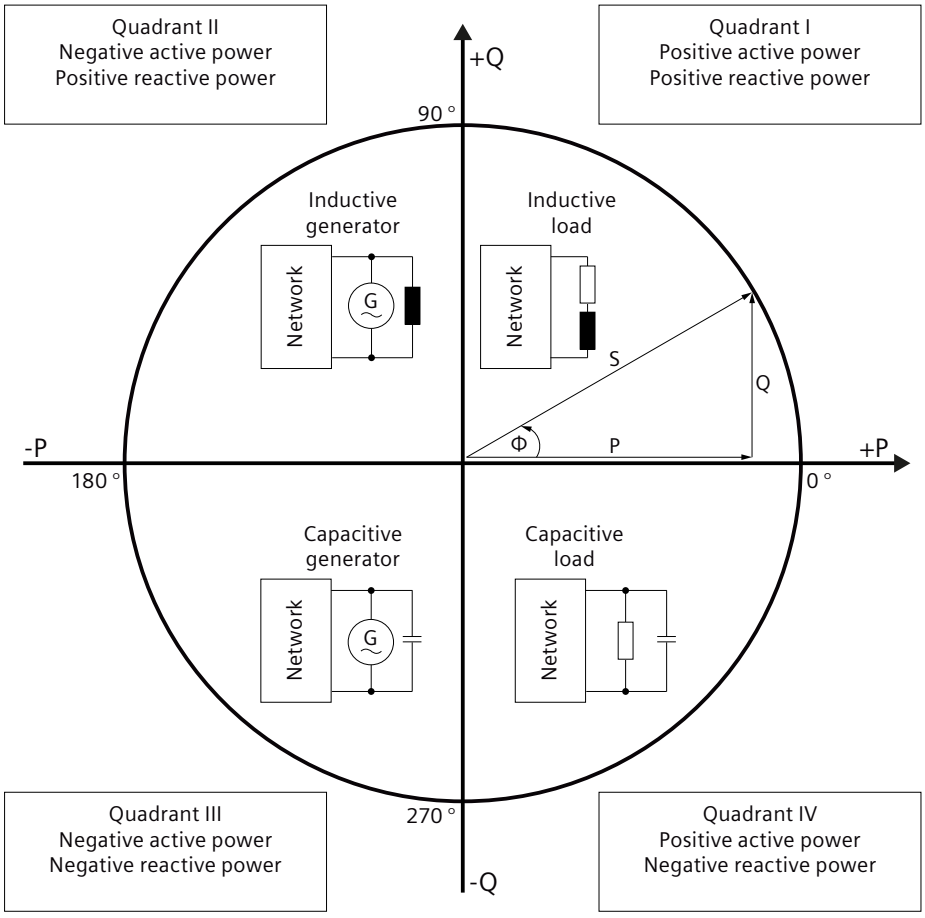


Figure 7-5 Quadrant in the quality bits

7.2.4 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.

Requirement

Detecting the rotating field requires 3-phase operation with 3P4W or 3P3W connection types.

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 49)

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.

7.3 Reading measured values from user data cyclically

Requirement

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

Scaling of measured values in the payload

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 payload 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 payload x $10^{\text{scaling factor}}$

Procedure

To read measured values from the payload 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 payload variant 254 (FE_H) "Total power L1L2L3" is configured on the AI Energy Meter CT HF. The measured value for "Current L1" should be read.

Table 7-1 Total power L1L2L3

Byte	Allocation	Data type	Unit	Value range	Measured value ID
0	Payload 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 payload 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 44)

7.4 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.

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	-	3	-
1	Reserved	UINT8	-	0	-
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	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 223)

7.5 Time-of-day synchronization and time stamp

The AI Energy Meter CT 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 (Page 91)).

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 (https://support.industry.siemens.com/cs/ww/en/view/109754890). 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.

Energy counters

8

Introduction

The AI Energy Meter CT 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)
- "Output" describes the regenerative operation of the connected system.
- "Reference" describes the motor operation of the connected system.

Retentivity

The AI Energy Meter CT 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 payload.

8.1 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 payload 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 Reading out measured values ayclically using data records (Page 52).

Name of the data record	Number of the data record	Comment
Data record for basic measured values (Page 223)	Data record 142	Measured values of the total energy L1L2L3
Data record for energy meter (Page 229)	DS 143	Measured values of energy and overflow counters for phases L1, L2 and L3
Data record for phase-specific measured values L1 (Page 238)	DS 147	Measured values of the phase-specific energy meters L1
Data record for phase-specific measured values L2 (Page 241)	DS 148	Measured values of the phase-specific energy meters L2
Measured value data record for phase-specific measured values L3 (Page 245)	DS 149	Measured values of the phase-specific energy meters L3

Payload variants for energy meters

You can read out measured values for energy and overflow meters in the following payload variants.
The evaluation of measured data using payload variants is described in section Reading measured values cyclically from payloads (Page 50).

Name of the payload variant	Number of the payload variant	Comment
Total energy L1 L2 L3	ID 249 or $F9_H$	Measured values of the total energy L1L2L3
Energy L1	ID 248 or $F8_H$	Measured values of the phase-specific energy meters L1
Energy L2	ID 247 or $F7_H$	Measured values of the phase-specific energy meters L2
Energy L3	ID 246 or $F6_H$	Measured values of the phase-specific energy meters L3
Basic variable quality measurement three-phase measurement	ID 240 or $F0_H$	Status on the overflow of the energy meters for phases L1, L2 and L3
Basic variables energy meter measurement (periodic) L1L2L3	ID 239 or EF_H	Number of counter overflows for energy of phases L1, L2 and L3
EE@Industry measurement data profile E3	ID 227 or $E3_H$	Measured values for total active energy and total reactive energy L1L2L3
EE@Industry measurement data profile E2	ID 226 or $E2_H$	Measured values for total active energy L1L2L3
Basic variables for phase-specific measurement L1	ID 159 or $9F_H$	Measured values for phase-specific active, reactive and apparent energy for phase L1
Basic variables for phase-specific measurement L1a	ID 158 or $9E_H$	Measured values for phase-specific active, reactive and apparent energy for phase L1
Basic variables for phase-specific measurement L2	ID 157 or $9D_H$	Measured values for phase-specific active, reactive and apparent energy for Phase L2
Basic variables for phase-specific measurement L2a	ID 156 or $9C_H$	Measured values for phase-specific active, reactive and apparent energy for Phase L2

Name of the payload variant	Number of the payload variant	Comment
Basic variables for phase-specific measurement L3	ID 155 or $9B_H$	Measured values for phase-specific active, reactive and apparent energy for Phase L3
Basic variables for phase-specific measurement L3a	ID 154 or $9A_H$	Measured values for phase-specific active, reactive and apparent energy for Phase L3
User-defined payload variant	ID 1 or 01_H and ID 2 or 02_H	Measured variables for energy can be selected in a user-defined manner

8.2 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.

For **all** 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 44).

8.2.1 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 of energy meters (DS 143) (Page 229).

Byte	Measured variable	Data type	Unit	Value range	Measured value ID
0	Version	BYTE	-	1	-
1	Reserved	BYTE	-	0	-

Byte	Measured variable	Data type	Unit	Value range	Measured value ID
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 of energy meters (DS 143) (Page 229).	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.

8.2.2 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.

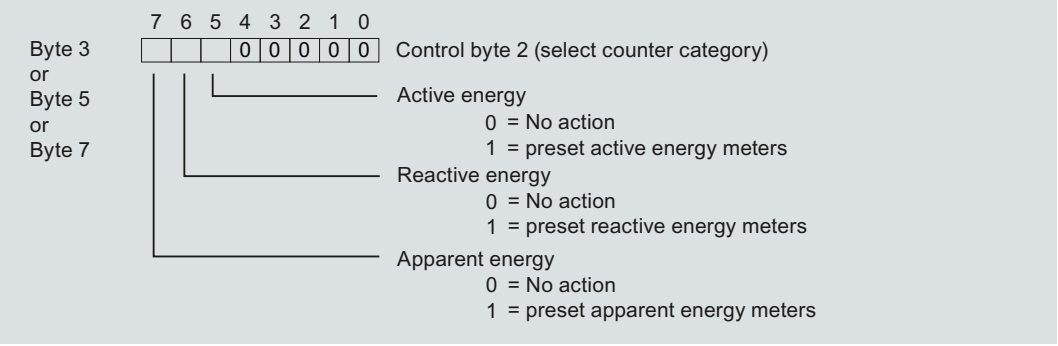


Figure 8-1 Assignment of control byte 2 in DS 143

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.

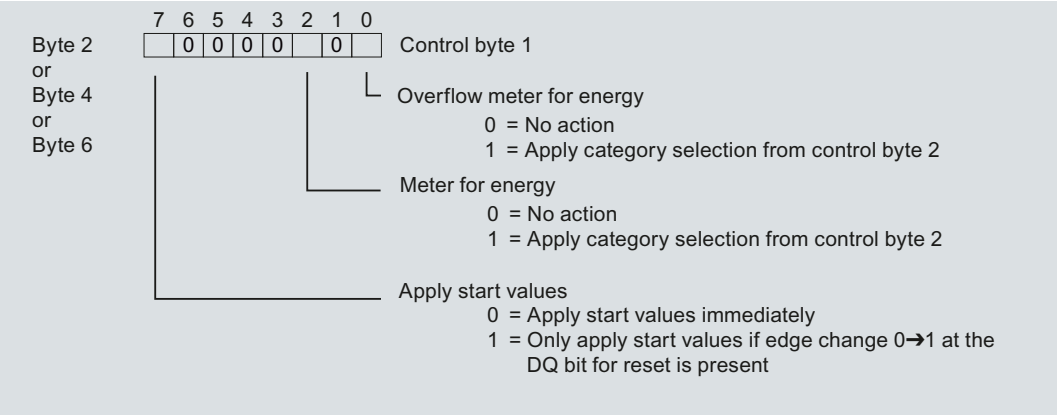


Figure 8-2 Assignment of control byte 1 in DS 143

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.

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 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 of energy meters (DS143) (Page 229).

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.

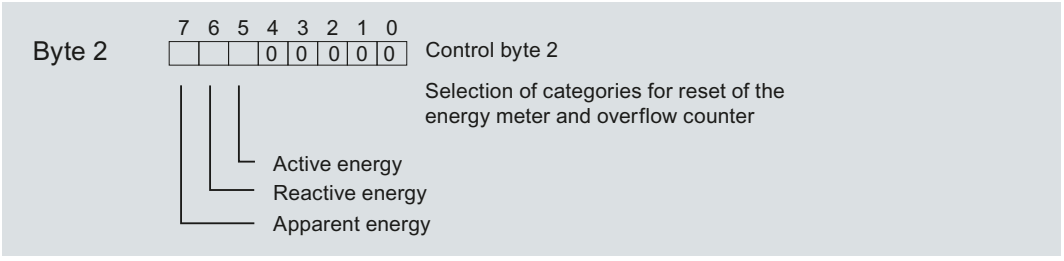


Figure 8-3 Selection of categories for reset

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

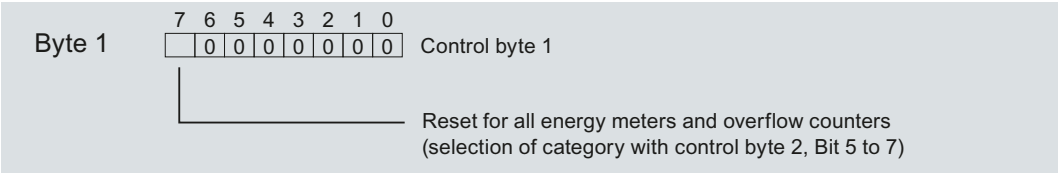


Figure 8-4 Reset bit for energy and overflow counter

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.

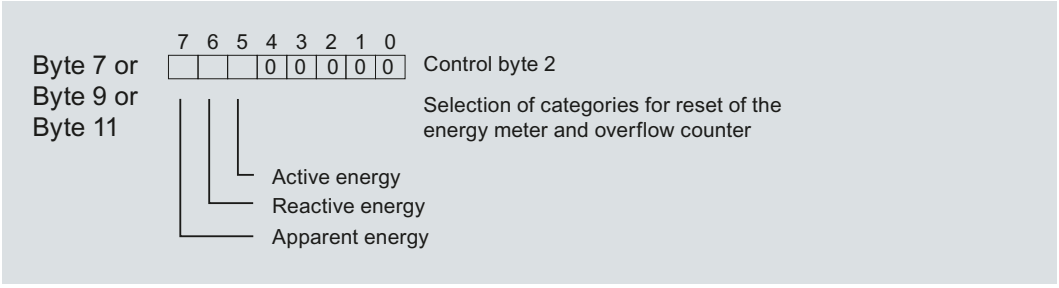


Figure 8-5 Selection of category

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

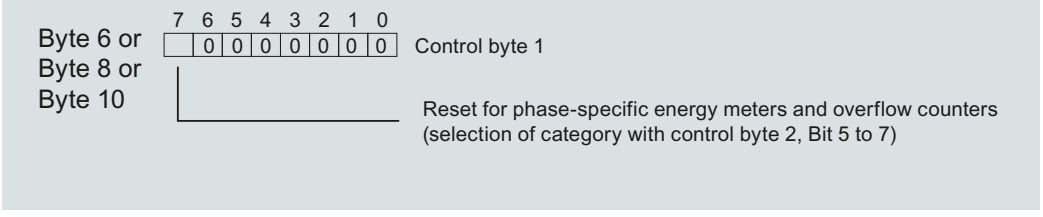


Figure 8-6 Reset bit for phase-specific energy and overflow counters

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.

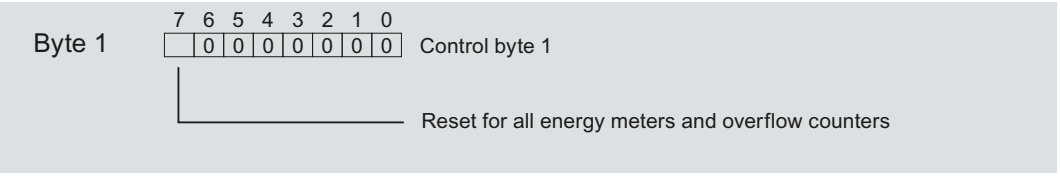


Figure 8-7 Reset bit for all energy and overflow counters

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.

8.3 Starting and and stopping energy meters

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

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

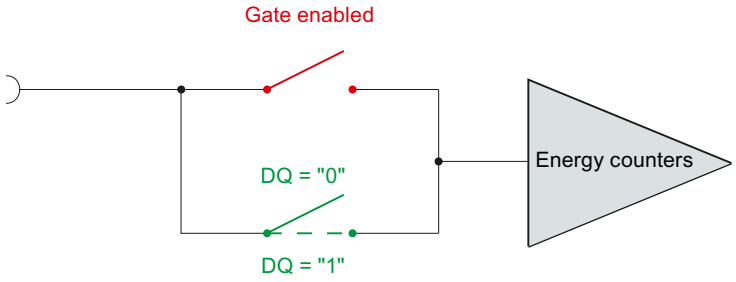


Figure 8-8 Gate enabled

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.

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)

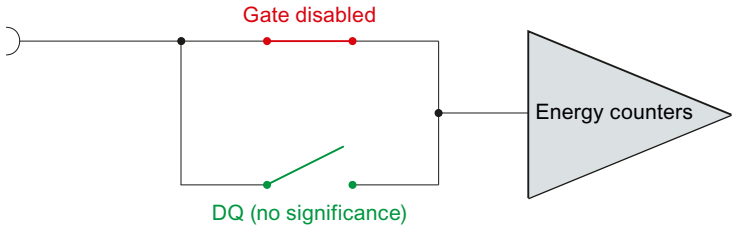
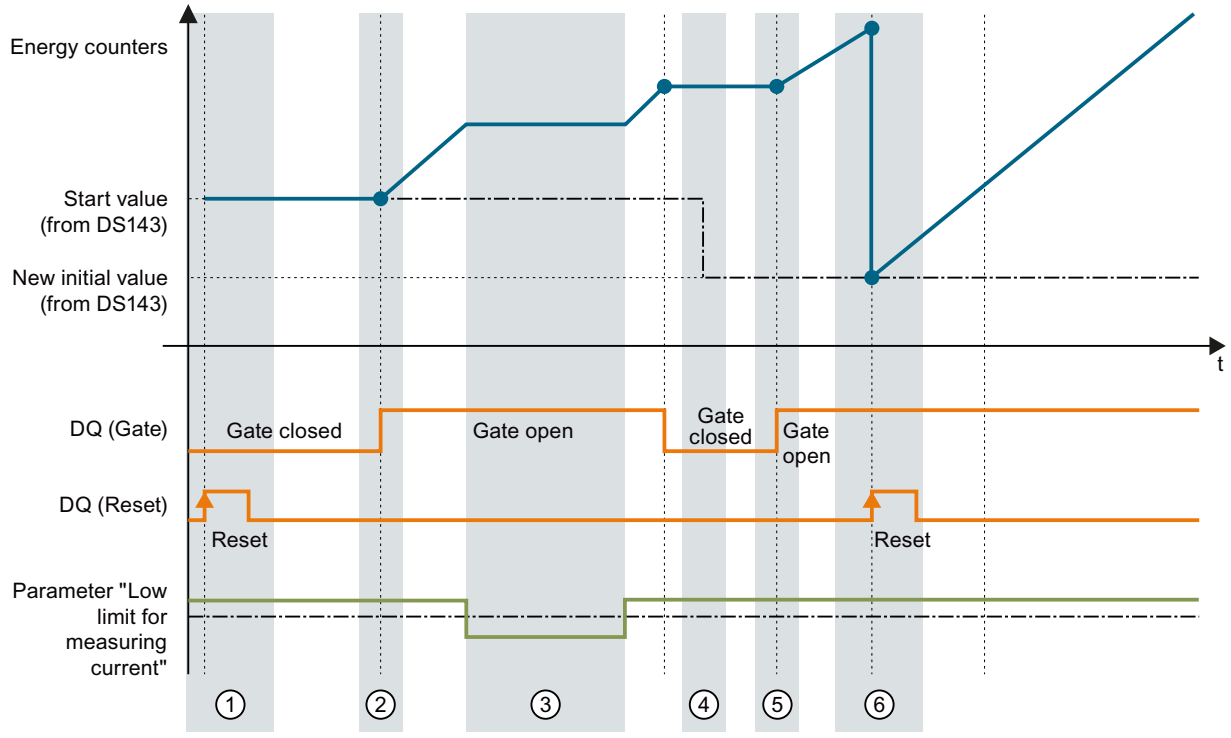


Figure 8-9 Gate disabled

8.4 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 229) 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 8-10 Example of an energy meter

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

Introduction

Bytes 2 to 7 of data record 143 (Page 229) 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.

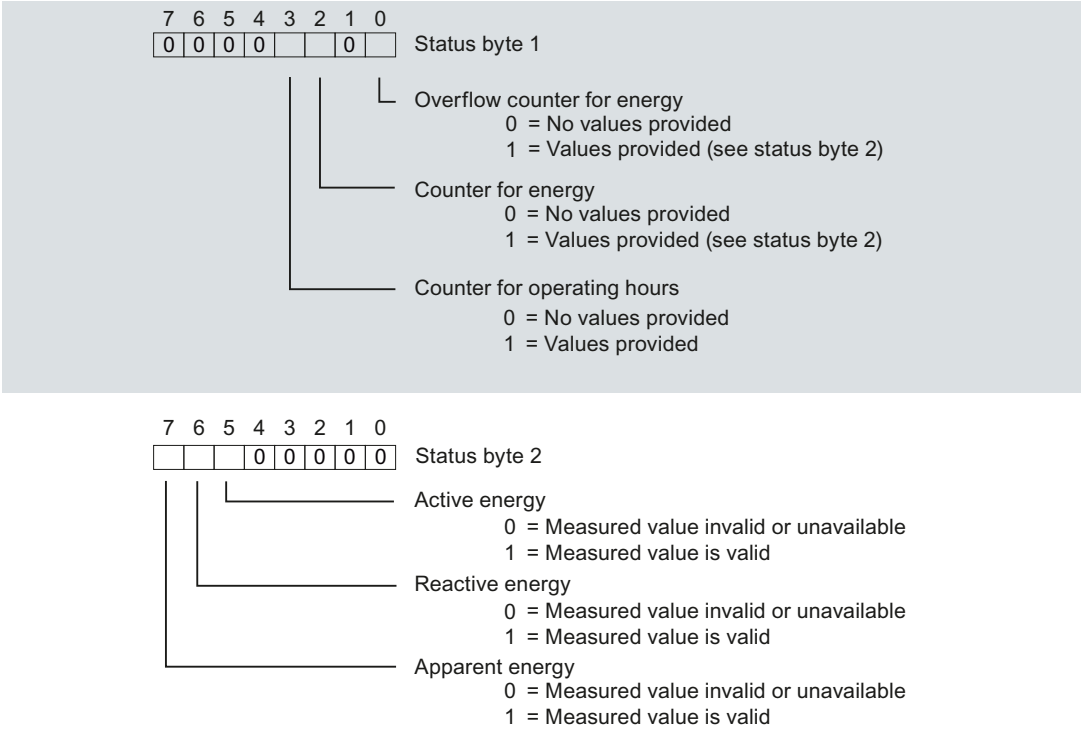


Figure 8-11 Status information DS 143 (read access)

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.

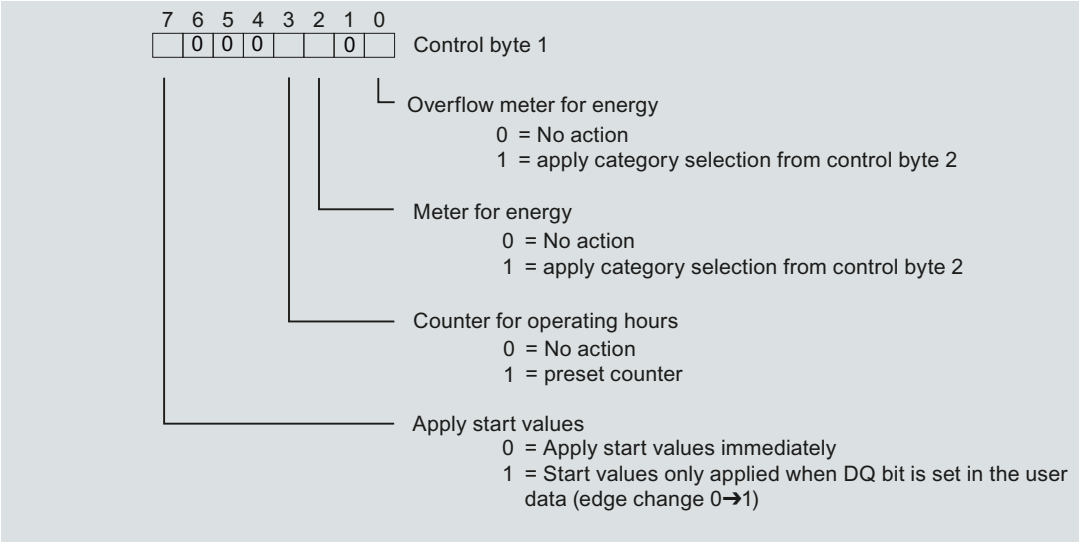


Figure 8-12 Control information DS 143, control byte 1 (write access)

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

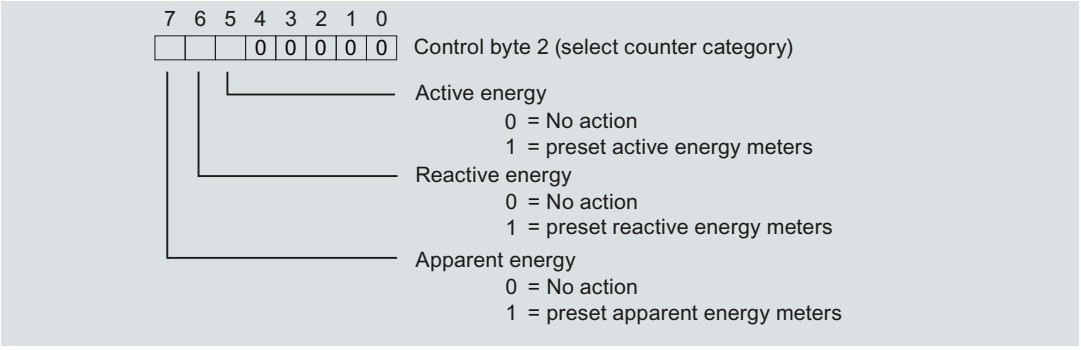


Figure 8-13 Control information DS 143, control byte 2 (write access)

Operating hours counter

9

Introduction

The AI Energy Meter CT 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 CT 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 payload

9.1 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 payload 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 out and processing measured values (Page 44).

Name of the data record	Number of the data record	Comment
Data record for energy meter (Page 229)	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	DS 150	
Measured value data record of user-defined data record (Page 250)	DS 151	Operating hours counters can be selected in a user-defined manner

Payload variants for operating hours counters

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

The evaluation of measured data using payload variants is described in section Payload variants (Page 206).

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

9.2 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.

For **all** 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 payload 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 44).

9.2.1 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 the data record 143 is available in section Structure of energy meters (DS 143) (Page 229).

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 of energy meters (DS 143) (Page 229).	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 floating-point number. The format corresponds to the data type REAL in S7-1200 and in S7-1500.

9.2.2 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.

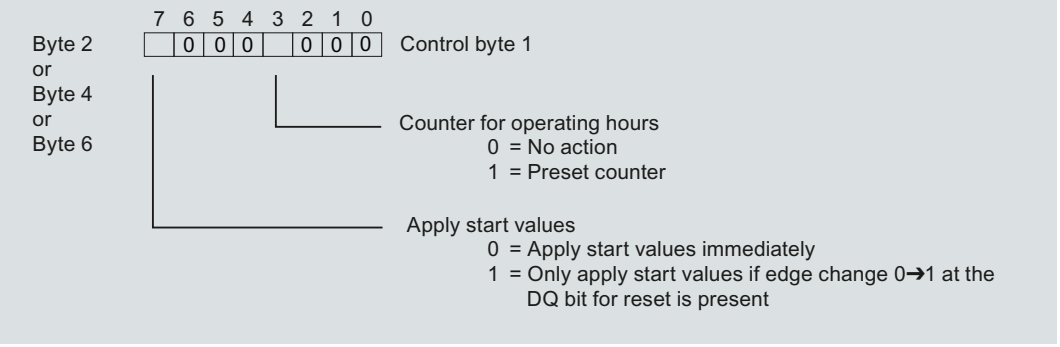


Figure 9-1 Allocation of the control bytes in DS 143 for operating hours

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

9.2.3 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 of energy meters (DS143) (Page 229).

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.

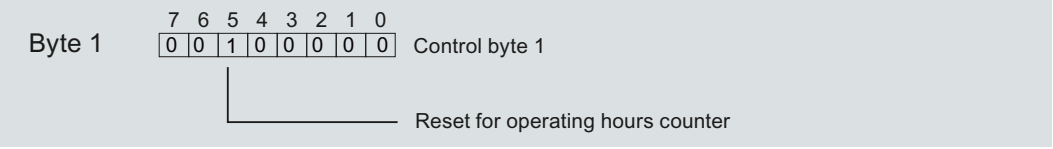


Figure 9-2 Control byte 1 Reset for all operating hours counters

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.

9.3 Starting and stopping operating hours counters

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

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

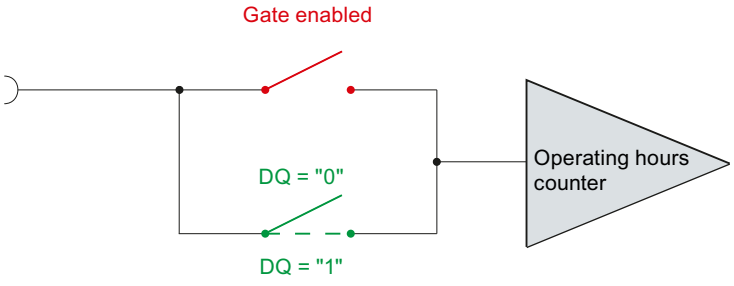


Figure 9-3 Gate enabled

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)

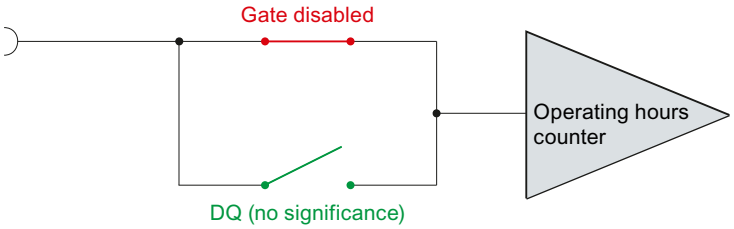


Figure 9-4 Gate disabled

Limit monitoring

10

10.1 How limit monitoring works

Introduction

The AI Energy Meter CT 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 payload variant 240 ($F0_H$) or via the user-defined payload 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 CT 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 111).

Controlling functions 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

10.2 Influence of hysteresis and delay time on limit monitoring

Delay time and hysteresis

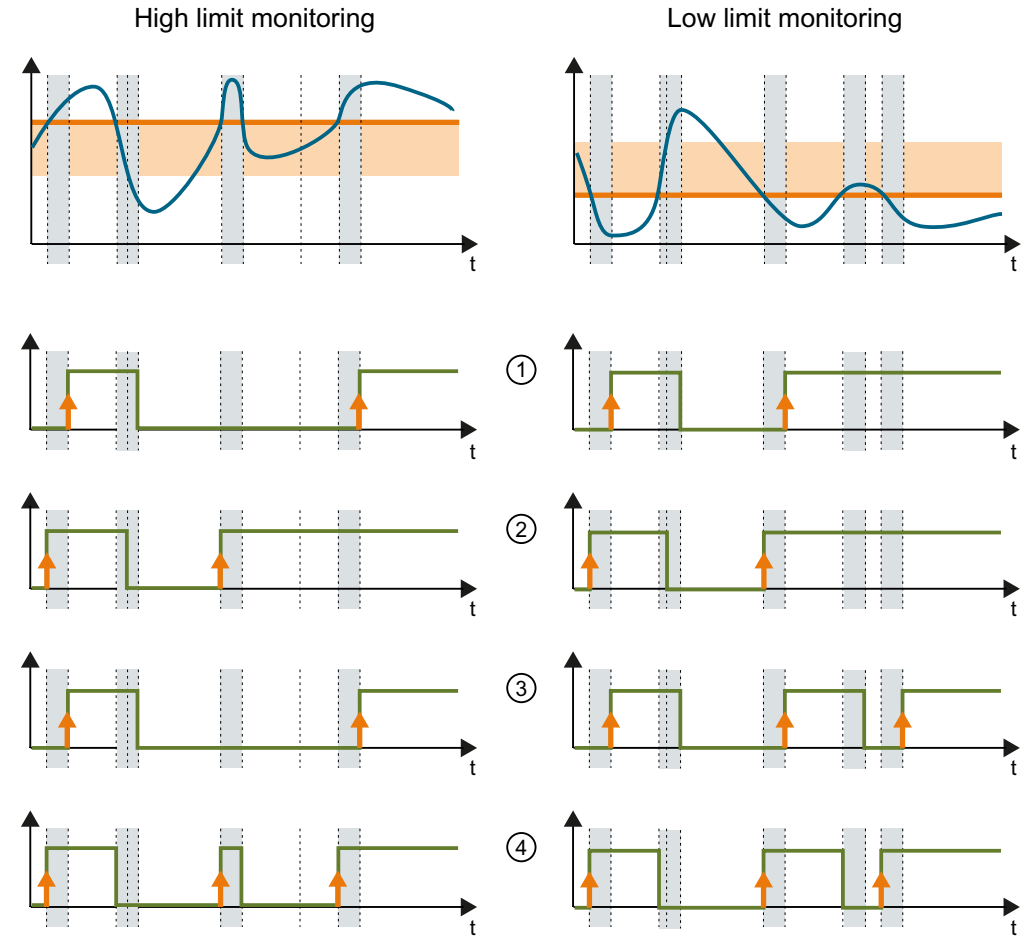
In order to prevent the triggering of limit violations with small fluctuations, you have the following configuration options in STEP 7:

- 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 and maximum values 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 10-1 Influence of hysteresis and delay time on the limit

See also

How limit monitoring works (Page 74)

10.3 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 CT 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.

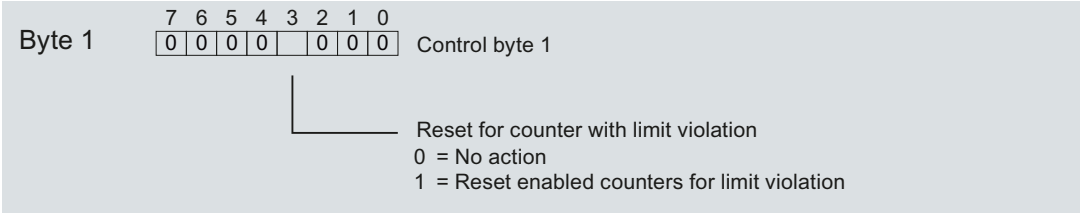


Figure 10-2 Resetting of the counters for limit violations

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.

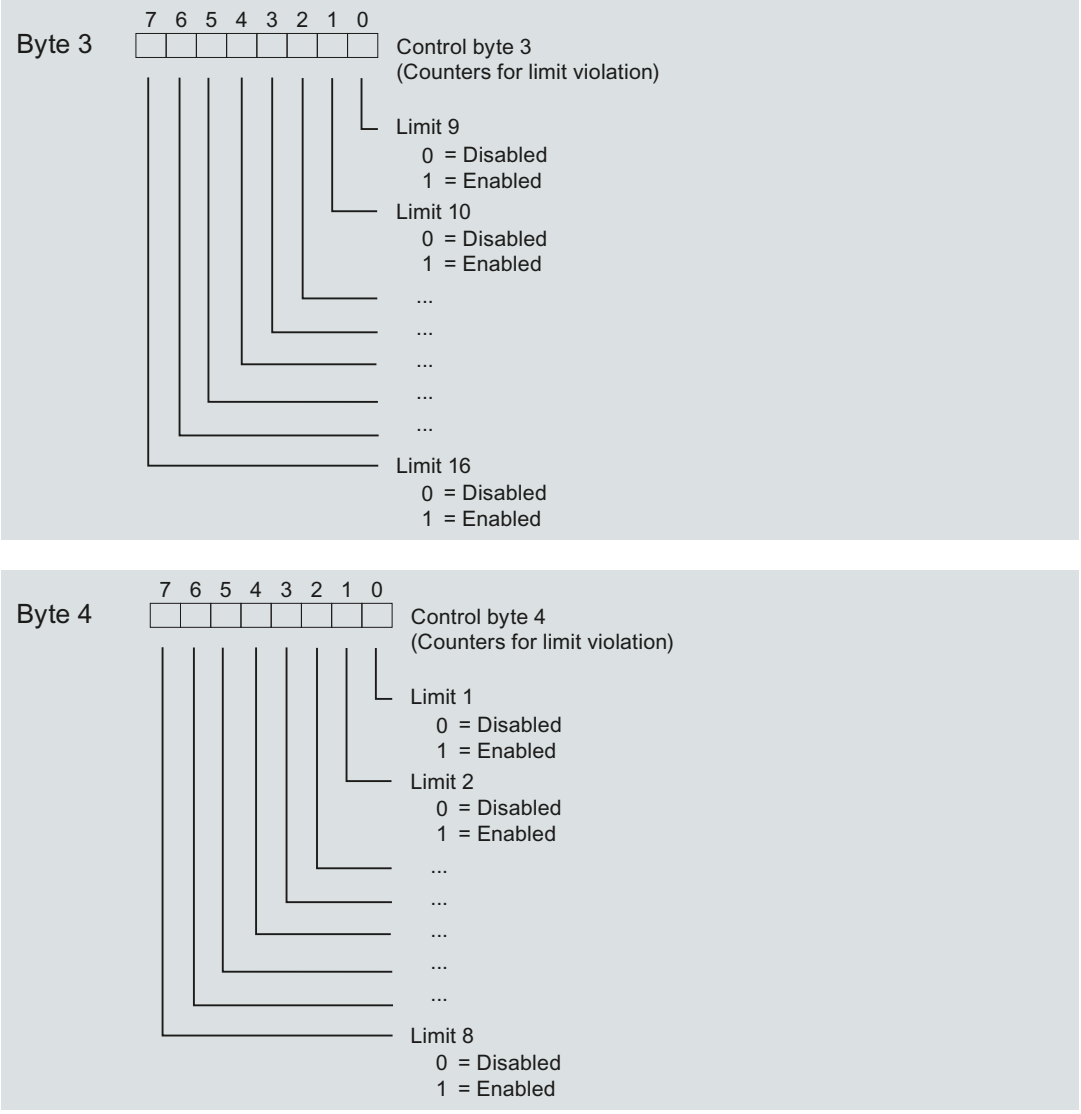


Figure 10-3 Activating / deactivating of the counters for limit violations

10.4 Measured variables for limit monitoring

You can use measured variables from the section Measured variables (Page 162) 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 11

11.1 Minimum and maximum values

Introduction

The AI Energy Meter CT 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 234), DS 145 (Page 236), DS 154 (Page 250) and DS 155 (Page 253).

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 CT 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

Controlling functions 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.

11.2 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 CT 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) (Page 234), Measured value data record for minimum values (DS 145) (Page 236), Measured value data record for maximum values with time stamp (DS 154) (Page 250) and Measured value data record for minimum values with time stamp (DS 155) (Page 253).

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.

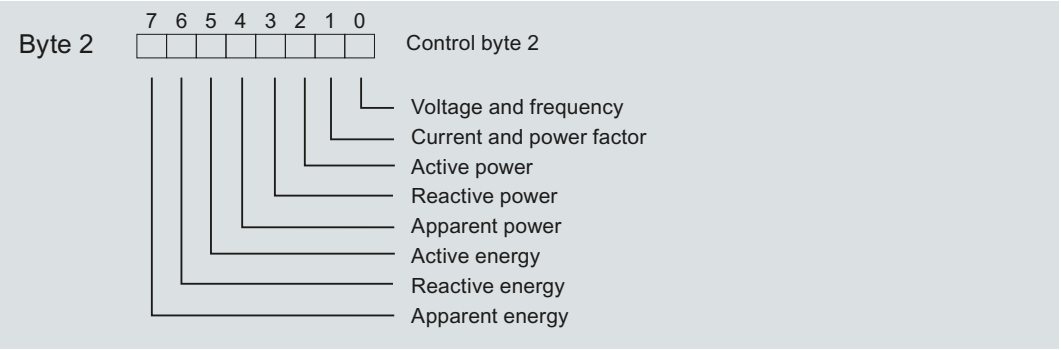


Figure 11-1 Selection of minimum and maximum value category

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.

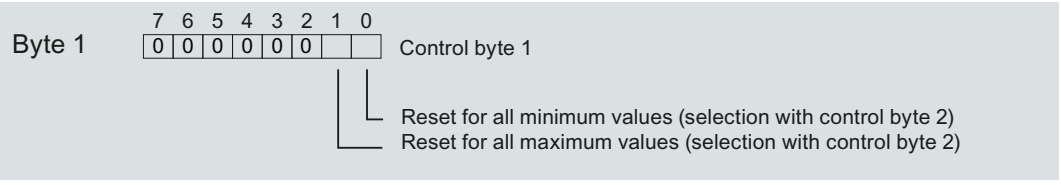


Figure 11-2 Reset bit for minimum and maximum values

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.

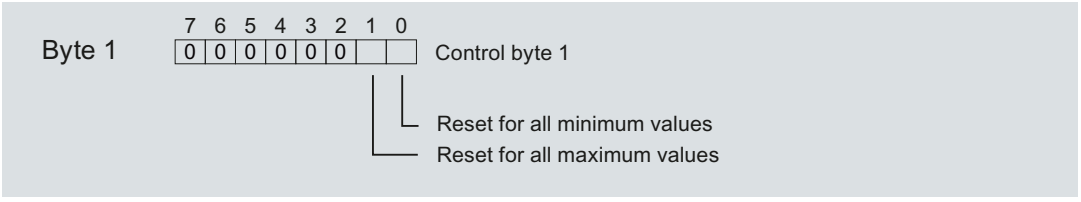


Figure 11-3 Resetting the minimum and maximum values at module version with 2 bytes of output data

11.3 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"

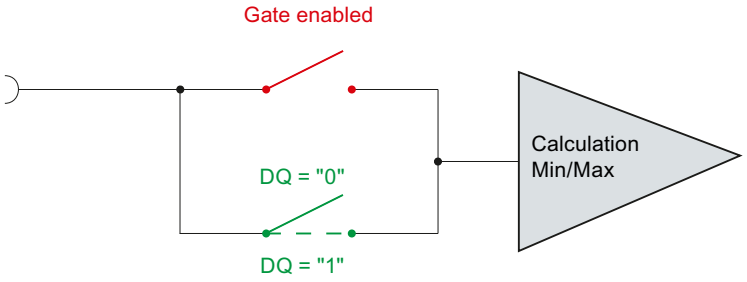


Figure 11-4 Gate enabled

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)

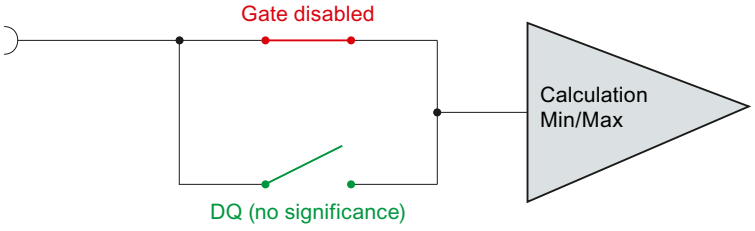


Figure 11-5 Gate disabled

Measured value recorder

12

12.1 How the measured value recorder works

Introduction

The measured value recorder can record up to 200 measured values at two data sources or 400 measured values at one data source. You can freely select the measured value you wish to record for each data source and easily start and stop the recording.

Two recording modes are available: once or in a continuous circular buffer.

You select the measured value you wish to record using its measured value ID. You control the recording using configurable start and stop triggers.

You can retrieve measured values at any time. For two data sources, there is one data record per data source. The measured values of the first data source are available in the DS 173; those of the second data source in the DS 174. If you are using only one data source, both data records DS 173 and DS 174 are written. With one-time recording, these data records are used one after the other as alternating buffers in circular buffer mode.

NOTE

Note that only the use of the alternating buffer can ensure that no data is lost in ring buffer mode.

Benefits

With the measured value recorder, you can record measured values at equidistant intervals of 10 ms to 10 min independently of any other processing and data transport times in the module or the PLC.

Configuration

You configure the following measured value recorder settings in STEP 7:

- Number of activated measured value recordings (1 or 2)
- ID of the measured value for the measured value recording 1 or 2
- Recording interval for the measured value recording 1 or 2
- Mode (once/circular buffer) for the measured value recording 1 or 2
- ID of the start trigger for the measured value recording 1 or 2
- ID of the stop trigger for the measured value recording 1 or 2

A more detailed parameter description of the DS 134 is available in section "Parameters". You can find detailed information on the start and stop triggers in the Appendix, Section A5.

Evaluation of the measurements

Within these measured value data records, the representation of the measured values is specified in REAL format only.

The reading of recordings is possible with data record reading once or cyclically. You can read out the recorded measured values from the following data records.

Name of the data record	Number of the data record
Data record for measured recorder data source 1	DS 173
Data record for measured recorder data source 2*	DS 174

*Or as second data record for data source 1 if you want to record 400 measured values

The data records are described in the section Measured value data record DS 173 (Page 267) (Appendix E18) or Measured value data record DS 174 (Page 268)(Appendix E19).

12.2 Start, hold, continue, reset, restart and evaluate measurement

Parameter assignment of the measurement

To use the measured value recorder function, send parameter data record 134 to the module either with the instruction WRREC (Write data record) or via the parameter assignment of STEP 7. If you want to use the recording of 400 measured values at a data source, the parameter assignment of MV recorder block 1 and MV recorder block 2 must be identical in all parameters. The number of activated measured value recordings must be set to "2".

You can find more information on the parameter data record 134 in the section Parameters and in Appendix A.5 (Page 153).

Starting the measurement

A "1" level at the activated start trigger starts the recording. With disabled start trigger, the recording starts immediately at the time of parameter assignment.

Hold measurement

A "0" level at the activated start trigger or a "1" level at the activated stop trigger stops the recording. If the stop trigger is disabled, the recording ends in the "once" mode after filling the buffer. 200 values are available in this case. Recording continues in "Circular buffer" mode and can only be ended by resetting the measurement.

Continue the measurement

A restart with "1" level at the start trigger and with a "0" level at the stop trigger continues the measurement.

Resetting the measurement for module version with 20 bytes of output data

You delete the recording with reset, general reset or re-parameterization. You can reset the measurements individually. You do this with two specified DQ bits at which you trigger a 0->1 edge.

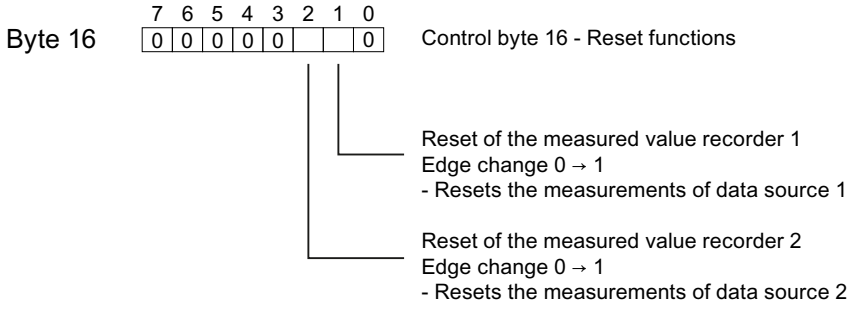


Figure 12-1 Resetting the measurement

Reset via byte 16 is only possible for the module version 20 bytes of output.

Resetting the measurement for module version with 2 bytes of output data

You delete the recording with re-parameterization.

Restarting the measurement

You can restart the measurement after completing a measurement and evaluating the results. We recommend to first disable the start event with level state 0, then reset the respective measurement and retrigger the start event with "1" level again.

Evaluating the measurement

The reading of recordings is possible with data record reading from DS173 and DS174 once or cyclically at any time. Within these measured value data records, the representation of the measured values is specified in REAL format only.

Depending on the application, it may be useful to evaluate the status of the recorders before reading all measured values:

- **Option 1**
  Using data record reading: Byte 1 contains the compressed status in form of 2 bits:
  - Byte 1 = 0x80: Recording ended
  - Byte 1 = 0x40: Recording in progress
  - Byte 1 = 0: No data can be retrieved

- **Option 2**
  Using data record reading: Byte 7 contains the complete recorder status:
  - 0: Initial status
  - 3: Recorder parameterized
  - 4: Recording in progress
  - 5: Recording ended
  - 6: Recording stopped

  NOTE

  To evaluate the status, you can read an abbreviated data record without the measured values. This reduces the runtime for faster cyclical evaluation of the recorder status. Only when the status is "Recording ended" must you read the complete data record.

- **Option 3**
  If the hardware interrupt is enabled in the parameters, a PRAL, whose information can be evaluated in OB4x, is triggered at the time of "Recording ended" (see 17.2.1).
  After evaluation of the PRAL information, the corresponding data record (DS173 or DS174) can be read.

Evaluating measured values for two data sources

If two data sources are used, a fixed assignment of the data records is specified for each data source:

- Recorder 1: DS173
- Recorder 2: DS174

Evaluating measured values for one data source

If the parameter assignment of recorder 1 and recorder 2 is the same, only one data source should be used. Both data records are used for this data source in this case:

- Recorder 1: DS173 (recording starts here) + DS174 (when DS173 is full, recording continues here)

In "once" mode, DS173 is filled first. When its status shows "Recording ended", it can be read. Recording is automatically switched to DS174. When its status also shows "Recording ended", the recording stops and the DS174 can be read as well. This means you have access to 400 measured values in two buffers.

NOTE

Intermediate reading is also available but not all measured values have been saved yet in this case.

In "Circular buffer" mode, DS173 is also used first. If the status shows "Recording ended", the buffer must be read. In the meantime, DS174 is filled automatically; when its status also shows "Recording ended", DS173 is deleted and recording in it starts anew. This process continues back and forth until recording is stopped.

NOTE

Intermediate reading is also available but not very useful because not all measured values have been saved yet resulting in gaps.

NOTE

At the smallest acquisition interval of 10 ms, one buffer is full every 200 *0.010 s = 2 s. You have two seconds to retrieve the buffer and save the measured values to a different storage, such as a data block.

12.3 Example of measured value recording

Example (for module version with 20 bytes of output data)

Starting with the default parameter assignment in STEP 7, activate the recording as follows:

1. Set the parameter "Number of activated measured value recordings" to 2.
2. Set both recording intervals to 100.
3. Set the start trigger 1 to 230 and the start trigger 2 to 231.
4. Load the changed parameters to the module.

Recording 1 starts after "1" is output to bit 5 from byte 17 of the output data; it records the voltage at phase 1 once every second with 200 measured values.

Recording 2 starts after "1" is output to bit 6 from byte 17 of the output data; it records the current at phase 1 once every second with 200 measured values.

If bit 5 or 6 is reset to "0" during recording, the respective recording comes to a stop. A renewed output of "1" continues the recording.

	Parameter	Value	Meaning
	Number of activated measured value recordings	2	2 recordings
Measured recorder data source 1	ID for measured value recording	1	UL1
	Recording interval for measured value recording	100	1 s
	Mode for measured value recording	0	Once
	ID for start trigger	0	Disabled
	ID for stop trigger	0	Disabled
Measured recorder data source 2	ID for measured value recording	7	IL1
	Recording interval for measured value recording	100	1 s
	Mode for measured value recording	0	Once
	ID for start trigger	0	Disabled
	ID for stop trigger	0	Disabled

Power failure analysis

13

Introduction

When the supply voltage of the system is interrupted, metering of energy and other processes are stopped. An analysis of the breakdown times thus represents an important function in a plant.

NOTE

Requirements

A useful evaluation of the saved breakdown and restart times is only possible when you set the time of the Energy Meter. If the time synchronization is not available, you can only evaluate the relative time between start and failure because the internal clock starts with the initial value of 01.01.1970, 0:00 and runs until the failure.

13.1 Mode of operation of the power failure analysis

Determination of the power failure time

To this end, the current system time is cyclically transferred to the retentive memory while the energy meter calculation is being processed. This means the time from the last calculation cycle is retained in case of a supply voltage failure.

Determination of the power return time

Once the supply voltage returns, the current time is also entered in the retentive memory during run-up of the module. This process waits for the synchronization of the clock.

NOTE

Formation of the restart time

The wait time for a time synchronization after a restart is 30 seconds. If it does not take place by then, the start time (1.1.1970, 0:00:00) is entered as the starting point. The entered time is decreased by the time that has expired in the module in the meantime (max. 30 seconds). Tip: Do not read the data immediately after the restart but wait for at least 60 seconds.

See also section Tips and tricks (Page 270), Time synchronization and time stamp.

Evaluation of the results of the power failure analysis in data record 169

Reading of DS169 returns the saved analysis data. The "Switch-off time/Switch-on time" pair of the stored times thus results in the failure time of the network. Up to nine pairs of switch-off/switch-on times are stored internally in a circular buffer. This means you will see up to nine failure times when reading DS169.

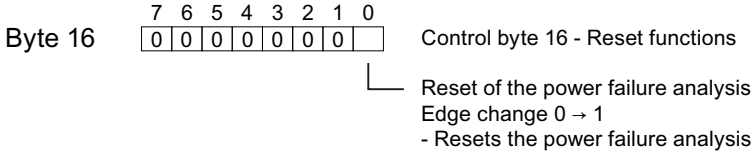


Figure 13-1 Resetting the power failure analysis measurement

For more detailed information, refer to section Measured value data record for power failure analysis (Page 266).

NOTE

Resetting the power failure analysis

Resetting of the power failure analysis is only possible with 32I / 20 O or by using the general reset.

Power quality analysis functions

14

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 CT HF provides you with the following power quality analysis functions in accordance with IEC 61000-4-30 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 49)).

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 195) 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 CT 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

14.1 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								

14.2 Harmonics analysis

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

The harmonics of the voltage are stored in the data record DS 161 (Page 258).

The harmonics of the current are stored in the data record DS 163 (Page 262).

In addition, you can incorporate the results on IDs with the parameter data records DS 130/DS 131 (Page 151) in the user-defined payload and DS 135 (Page 158) in the user-defined data record DS 151 (Page 250).
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 256) 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.

14.3 Reactive power compensation

Use the power factor of the fundamental for the reactive power compensation.
The power factor of the fundamental is available, among other things, in the measured value data record DS 142 (Page 223), in the measured value data record DS 160 (Page 256) or in the payload (Page 206).

14.4 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 value monitoring (Page 74)).

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.

14.5 Active factor and power factor

The AI Energy Meter CT 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

14.6 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" 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

14.7 Monitoring the instantaneous or half-wave values

You can enable the following functions:

- Voltage swell (Page 116)
- Voltage dip (Page 118)
- Voltage peaks (Page 120)
- Current peak value (Page 126)
- Overcurrent value (Page 128)

The results are mapped in the phase-specific data records DS 147 (Page 238), DS 148 (Page 241) and DS 149 (Page 245) and in the power quality analysis data record DS 160 (Page 256).

In addition, you can incorporate the results using IDs in the measured value data record of the user-defined data record DS 151 (Page 250) and in the user data variants 1/2.

You can monitor the results for limits (Page 74) and generate hardware interrupts.

Phase-based measured values

15

Introduction

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

- Through the payload variants
  - Phase-specific measurement phase L1 with payload variants 158 ($9E_H$) and 159 ($9F_H$)
  - Phase-specific measurement Phase L2 with payload variants 156 ($9C_H$) and 157 ($9D_H$)
  - Phase-specific measurement phase L3 with payload 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

Payload variants

Through the payload 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 payload variants in appendix Payload variants with 32 bytes of input data / 20 bytes of output data.

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

The structure of the measured value data record is available in the appendix E Measured value data record for phase-based measured values L1 (DS 147) version 1 (Page 239).

See also

Measured value data record for phase-based measured values L2 (DS 148) version 1 (Page 243)

Measured value data record for phase-based measured values L3 (DS 149) version 1 (Page 246)

Parameters 16

16.1 Parameters

Parameters of the AI Energy Meters CT HF

You will usually configure the AI Energy Meter CT 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 CT 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 Parameter assignment using parameter data records (Page 136)).

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

Table 16-1 Parameters AI Energy Meter CT HF (GSD file)

Parameters	Value range	Default setting
Hardware interrupts *	• Disable • Enable	Disable
Inputs		
Diagnostics: No supply voltage L+	• Disable • Enable	Disable
Connection type	• Disabled • 1P2W - 1 phase, 2 conductors • 3P4WI - 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

Parameters	Value range	Default setting
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 • 300 V	230 V
Line frequency	• 50 Hz • 60 Hz	50 Hz
Activate gate switch for energy meter	• Disable • Enable	Disable
End value energy counter	• No end value (count indefinitely) • 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 (count indefinitely)
Payload variant	See the table Overview of the payload variants	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 conductor: Current transformer primary current [A]	• 0 = Disabled • 1 ... 99999 = measuring • 4294967295 = Calculating	0
Neutral conductor: 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
Overcurrent threshold value 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

Parameters	Value range	Default setting
Diagnostics overflow current	• Disable • Enable	Disable
Diagnostics overflow voltage	• Disable • Enable	Disable
Diagnostics underflow voltage	• Disable • Enable	Disable
Diagnostics Totalized values overflow	• Disable • Enable	Disable
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
Activate operating hours counter gate	• 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		

Parameters	Value range	Default setting
Number of limit values	• 0 ... 16	0
Limit monitoring	• Disable • Enable	Disable
Measured variable	• Measured value ID, see Measured value data records	None
Activate gate switch for limit monitoring	• 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%]	10
Delay time for limit monitoring [s]	• None • 1 ... 10 s	None
Payload mapping I/II		
Number of measured values	• 0 ... 64	0
Measured variable	• Measured value ID, see Measured variables	None
Data record mapping		
Number of measured values	• 0 ... 150	0
Measured variable	• Measured value ID, see Measured variables	None
Measured value recorder		
Number of activated measured value recordings	• 0: No recording • 1: Recording 1 • 2: Recording 1 and 2	0
Measured variable	• Measured value ID, see Measured variables	ID1 = 1, ID2 = 7
Recording interval for measured value recording 1 or 2	• 1...60000 in the unit 10 ms	10 = 100 ms
Mode for measured value recording 1 or 2	• Once • Circular buffer	0 (once)
ID for start or stop trigger 1 and 2	See Structure of the parameter data record 134 for measured value recording (Page 153)	None
Hardware interrupt enable for DS173 (measured value recording 1) or DS174 (measured value recording 2) full	0x80: Trigger hardware interrupt 0x00: Trigger no hardware interrupt	0 (trigger no hardware interrupt)

* Reconfiguration in RUN is not possible.

16.2 Explanation of parameters

Basic parameters

Hardware interrupts

Enable the hardware interrupt for the entire module here.

Diagnostics: No supply voltage L+

Activate the diagnostics Missing load voltage L+. If there is no voltage or too little voltage at terminal 17, the message "Supply voltage missing" is output and a diagnostics interrupt is triggered.

Connection type

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

For more detailed information, refer to "Connection examples (Page 26)".

Voltage measuring range

Here you set the voltage measuring range in which the system connected to the AI Energy Meter CT HF works. This parameter is only required when calibrating the module.

Line frequency

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

Enable gate energy counter

Enable the gate for the energy counter When the gate is activated, 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.

Payload variant

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

Minimum and maximum value calculation

Activate 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 CT HF together with the time stamp.

Minimum and maximum value calculation gate

Activate the gate for minimum and maximum value calculation. When the gate is activated, 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 conductor current measurement".

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 = calculate neutral current (0xFFFF FFFF)

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.

Limit value voltage dip in relation to nominal value voltage [0.1 %]
Further information can be found under Voltage dip of the voltage half-wave value (Page 118).
Limit value voltage swell in relation to nominal value voltage [0.1 %]
Further information can be found under Voltage swell of the voltage half-wave value (Page 116).
Threshold overcurrent in relation to nominal value current [0.1%]
Further information can be found under Overcurrent of the current half value (Page 128).
Number of cycles for voltage swell and dip analysis
Further information can be found under Voltage swell of the voltage half-wave value (Page 116) and Voltage dip of the voltage half-wave value (Page 118).
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 diagnostics interrupt.
Diagnostics underflow voltage
The nominal values voltage are monitored for tolerance. An underflow triggers a diagnostics 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 diagnostics interrupt.
Detect voltage swell and dip
Activates the detection of voltage swell and dip. Further information can be found under Diagnostics: Overflow/underflow (Page 114).
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 126).
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 120).
Detect overcurrent
Activates the detection of overcurrent. Further information can be found under Overcurrent of the current half value (Page 128).
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 123).
Tolerance time overcurrent [ms]
Further information can be found under Diagnostics: Overload (Page 123).
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 generated 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 124).

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.

Activate operating hours counter gate

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 114).

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.

Limits

Number of limit values
Enter the number of measured values that you want to monitor for limits.
Limit monitoring
Activate 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 (Page 162) that you want to use for limit monitoring.
Activate gate switch for limit monitoring
Activate the gate switch for limit monitoring. When the gate is activated, the limit monitoring is only started when the corresponding bit of the associated output payload is set to "1".
Hardware interrupt
Activate 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 payload 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 payload 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 delay time is also taken into consideration during outgoing of the limit violation.

Payload mapping I/II

Number of measured values
Specify the number of measured values/variables that you want to use for the user-specific payload mapping.
Measured variable
Select the measured variable (with the measured value ID (Page 162)) that you want to use for the user-specific payload mapping.

Data record 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 (Page 162)) that you want to use for the user-specific data record mapping.

Measured value recorder

Number of activated measured value recordings:

- 0 (function disabled), 1 (MV recorder2 block is ignored) or 2 (MV recorder1 and MV recorder2 enabled).
- Factory setting: 0

NOTE

For a recording of 400 measured values at only one data source, set the "Number of activated measured value recordings" to 2 and all subsequent parameters for measured value recording 1 or with identical values.

ID for measured value recording 1 or 2:
All IDs that can be used with user-definable payload (DS130, DS131) and user-definable data records (DS135) are possible. Factory setting: ID1 = 1 (UL1) and ID2 = 7 (IL1).
Exception:

- PNIO_Time_type cannot be used (measured value ID 65497 is thus blocked)
- While use is possible for bit fields, their measured values cannot be displayed in a meaningful way because the format of the measured values is always REAL. This affects the IDs: 65496, 65500, 65501, 65502, 65503, 65508, 65509, 62193, 62293, 62393, 65495

NOTE

The use of measured values that are only generated upon request (e.g. from the analysis of the harmonic component started by command, IDs: 63000 ... 63879) does not make much sense.

NOTE

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.

Recording interval for measured value recording 1 or 2:

- Value range 1...60000 in the unit 10 ms
- Factory setting: 10 = 100 ms

NOTE

The shortest recording cycle is 10 ms (half-wave at 50 Hz line frequency). This short interval only makes sense for measured values that are generated that quickly. These are all half-wave and instantaneous values. Frequency measured values and THD values are measured every second; all other values (the majority of the measured values) are measured in a 50 ms cycle.

Mode for measured value recording 1 or 2:

- 0 (Factory setting): Once, which means the buffer is filled from the top. The recording stops when the buffer is full or when the recording is stopped.
- 1: Circular buffer. For circular buffer mode, the oldest element is always listed first, which means the buffer is filled from the bottom.

Hardware interrupt for measured value recording 1 or 2:

- 0 (Factory setting): Trigger no hardware interrupt
- 0x80: Trigger hardware interrupt when data record is full

ID for start or stop trigger 1 and 2:

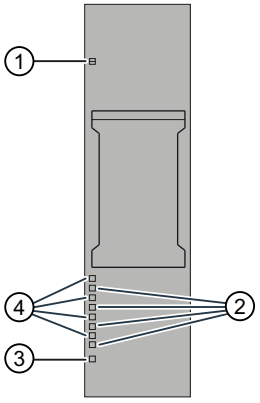
- "0": Start or stop trigger is not activated. "0" in the start trigger starts the measurement immediately after parameter assignment; "0" in the stop trigger ignores this function
- Factory setting: 0 = Not activated
- You can find additional information in the appendix A, Structure of the parameter data record D134 (Page 153).

Interrupts/diagnostic alarms

17

17.1 Status and error display

LED display



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

Figure 17-1 LED display

Meaning of the LED displays

The following table explains the meaning of the status and error displays. Corrective measures for diagnostics alarms can be found in the section Diagnostics alarms (Page 112).

DIAG LED

Table 17-1 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 17-2 Meaning of the Status LED

Status	Meaning
□ Off	Channel deactivated or error
■ On	Channel activated and no error

see also Neutral current In (Page 96)

Error LED

Table 17-3 Meaning of the Error LED

Status	Meaning
□ Off	Channel is OK
■ On	Channel is faulty

PWR LED

Table 17-4 Meaning of the PWR LED

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

17.2 Interrupts

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

17.2.1 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
- Measuring value recording of 200 measured values completed (DS173/ DS174 full)

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.

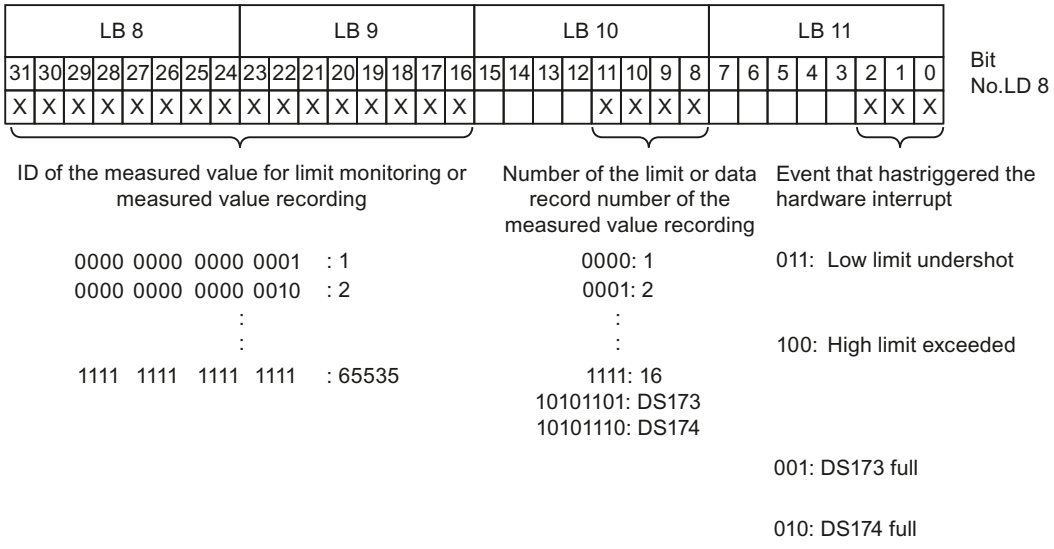


Figure 17-2 Start information of the organization block

17.2.2 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)

17.3 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 CT HF from phase "1" on.

Note the following assignment:

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

Table 17-5 Error types

Diagnostic message	Error code	Meaning	Solution
Undervoltage	2_H	Line voltage (measuring range) is monitored for tolerance. Violation leads to voltage overflow/underflow	Observe the line voltage range
Overvoltage	3_H		
Overload	4_H	• 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	9_H	Internal module error (diagnostic alarm on channel 0 applies to the entire module).	Replace the module
Parameter assignment error	10_H	• The module cannot evaluate parameters for the channel. • Incorrect parameter assignment.	Correct the parameter assignment
Load voltage missing	11_H	Missing or insufficient line voltage at terminal 17	Check supply
External fault	$1A_H$	Voltage swell/dip and overcurrent	see: • Voltage swell of the voltage half-wave value (Page 116) • Voltage dip of the voltage half-wave value (Page 118) • Overcurrent of the current half value (Page 128)
Channel is temporarily unavailable	$1F_H$	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

17.4 Diagnostics response

Diagnostics response

This section describes the response of the AI Energy Meters CT 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 measurement value of the current and all dependent variables are set to "0".

Input data to "0"

If the AI Energy Meter CT 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".

17.4.1 Voltage diagnostics

17.4.1.1 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

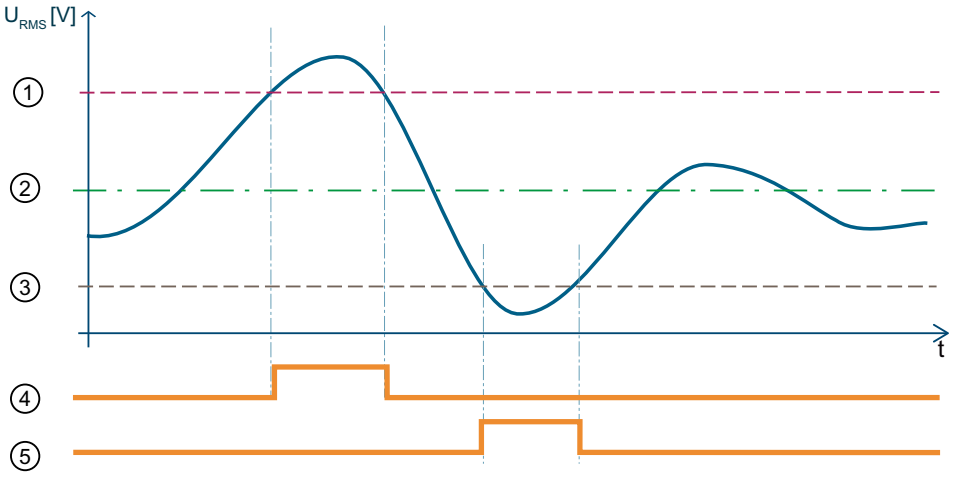
The following table shows the necessary parameters:

Table 17-6 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 17-3 "Overflow/Underflow" diagnostics of the effective voltage value

The following table shows the parameter assignment for the example:

Table 17-7 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 a voltage transformer is used with a ratio of 1000V/500V. The operating point of the application is set to 230 V via the Nominal Value Voltage parameter. The tolerance range in this example is ±20%, which corresponds to an effective value of primary voltage of ±46V.

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".

17.4.1.2 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 256). 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 CT 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 CT 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

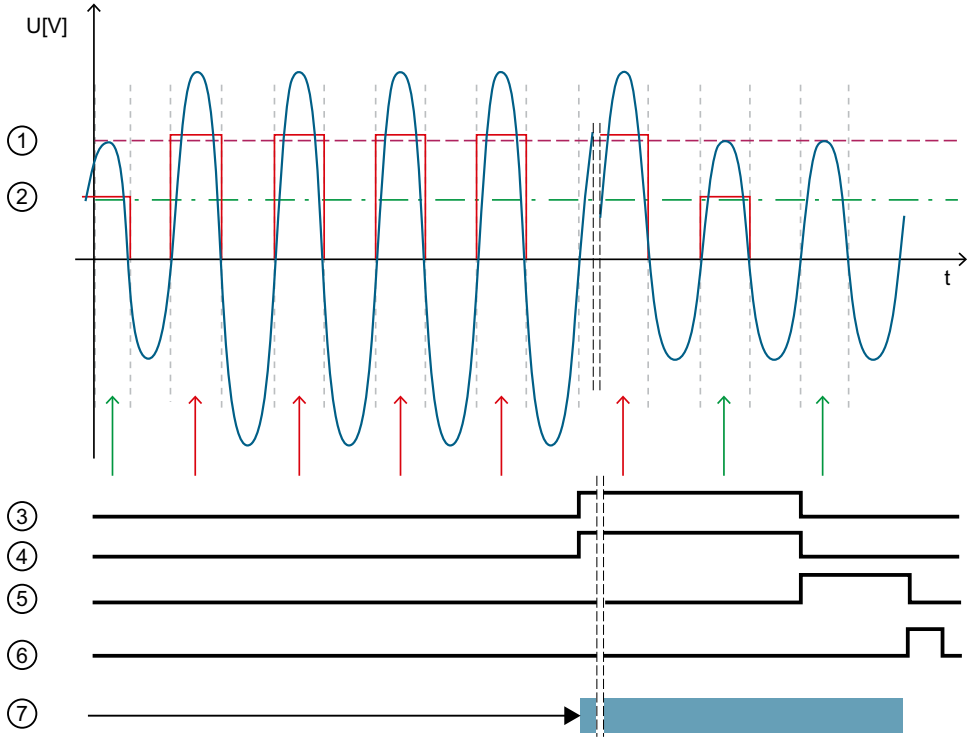
The following table shows the necessary parameters:

Table 17-8 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 17-4 Example of principle of operation

The following table shows the parameter assignment for the example:

Table 17-9 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"".

17.4.1.3 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 CT HF returns the maximum value and the duration of the voltage dip, e.g. in data record DS 160 (Page 256). 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 CT 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

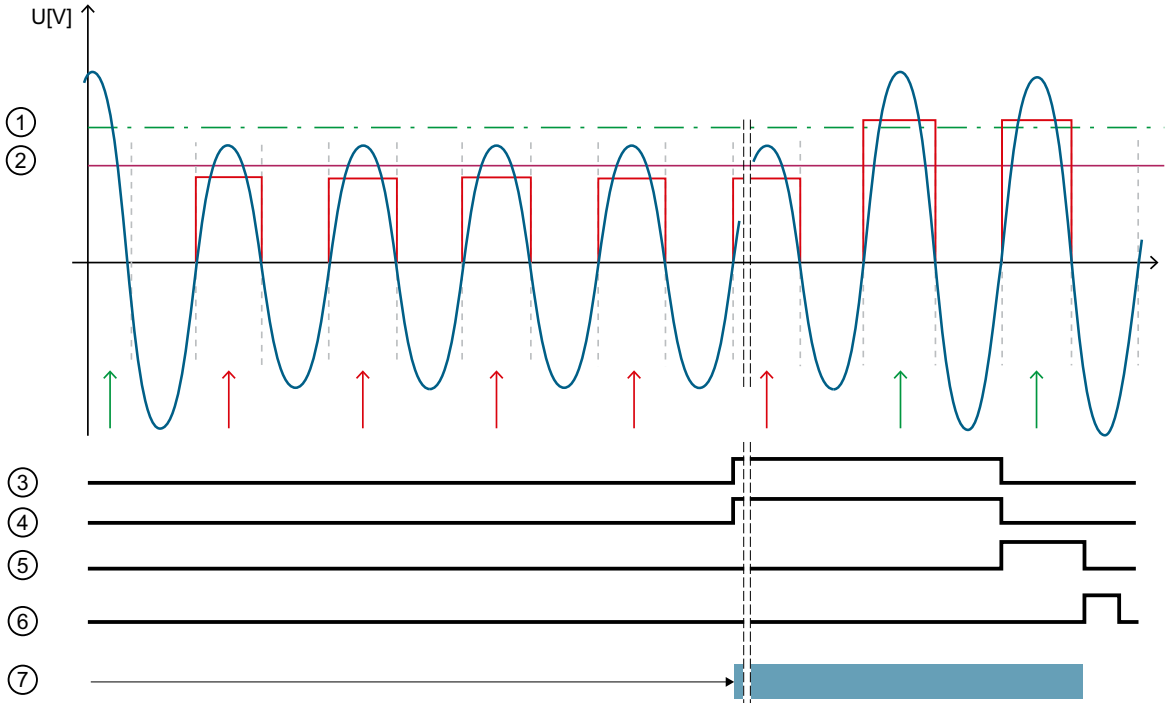
The following table shows the necessary parameters:

Table 17-10 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 17-5 Example of principle of operation

The following table shows the parameter assignment for the example:

Table 17-11 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"".

17.4.1.4 Peak values of the instantaneous values for voltage

Introduction

The AI Energy Meter CT 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 256).
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 CT 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

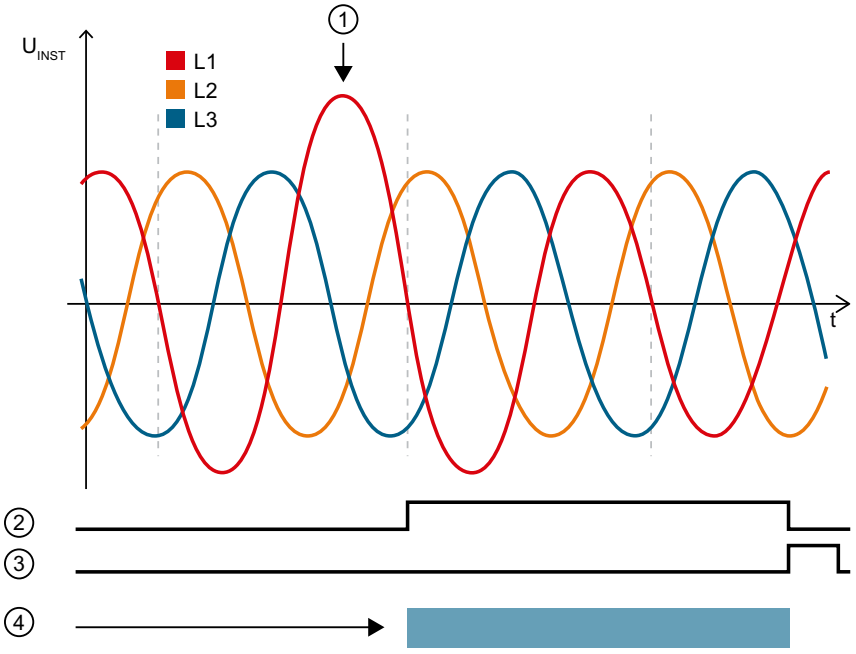
The following table shows the necessary parameters:

Table 17-12 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 17-6 Example of principle of operation

The following table shows the parameter assignment for the example:

Table 17-13 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").

17.4.2 Current diagnostics

17.4.2.1 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 CT 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

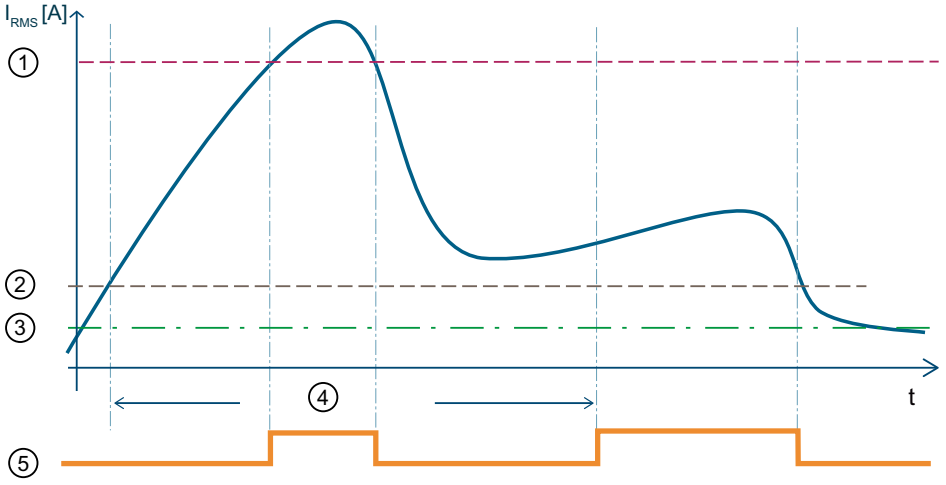
The following table shows the necessary parameters:

Table 17-14 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 17-7 Diagnostics "overload" of the effective current value

The following table shows the parameter assignment for the example:

Table 17-15 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.

17.4.2.2 Low limit for measuring current undershot

Introduction

With the function "Low limit for measuring current undershot" the AI Energy Meter CT 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 (zero point suppression). Information as to which current measured values are set to 0 can be found under Basics for reading measured values (Page 44).
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:

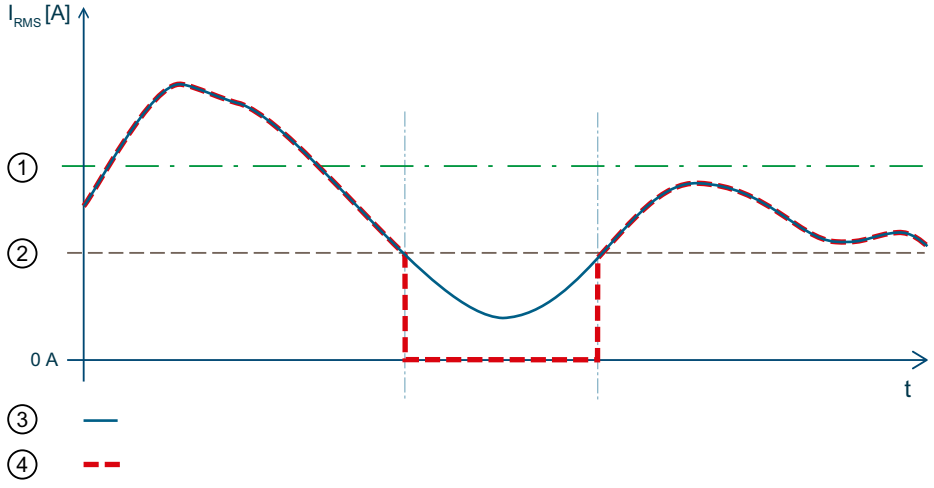
Table 17-16 Parameter assignment

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 17-8 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 17-17 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 (zero point suppression). The energy meters and operating hours counters are stopped during this time.

17.4.2.3 Peak values of the instantaneous values for current

Introduction

The AI Energy Meter CT 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 256).

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 CT 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

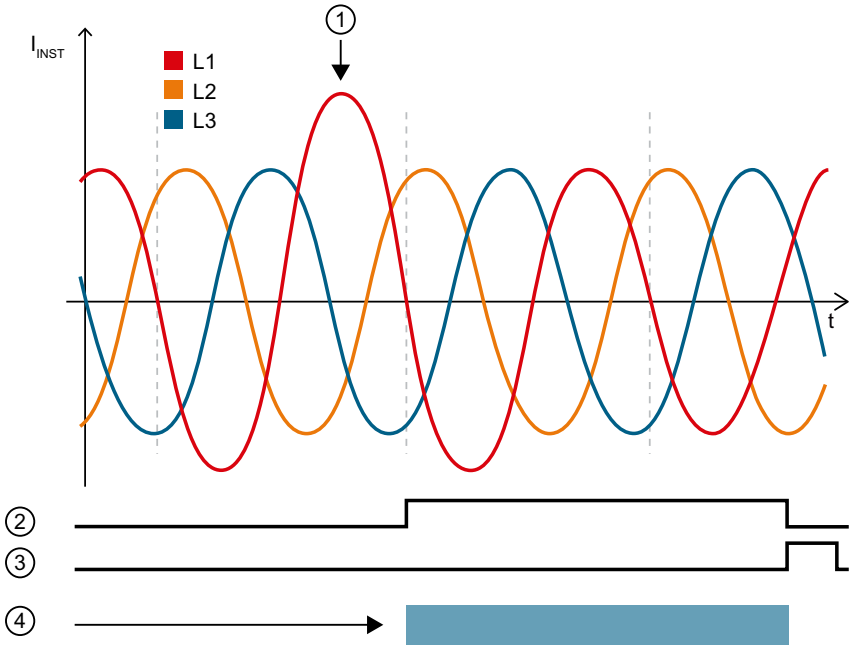
The following table shows the necessary parameters:

Table 17-18 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 17-9 Example of principle of operation

The following table shows the parameter assignment for the example:

Table 17-19 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").

17.4.2.4 Overcurrent of the current half value

Introduction

The AI Energy Meter CT 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 256). 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

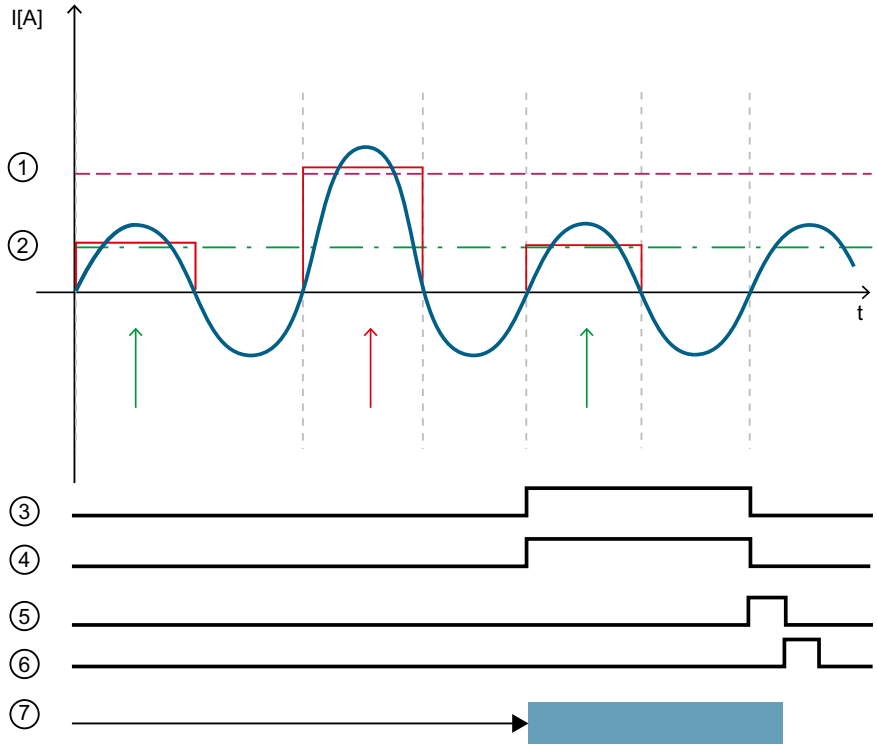
The following table shows the necessary parameters:

Table 17-20 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 17-10 Example of principle of operation

The following table shows the parameter assignment for the example:

Table 17-21 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

18

18.1 Technical specifications

Technical specifications of the AI Energy Meter CT HF

The following table shows the technical specifications as of 03/2021. You will find a data sheet including daily updated technical specifications on the Internet (https://support.industry.siemens.com/cs/ww/en/pv/6ES7134-6PA01-0CU0/td?dl=en).

Article number	6ES7134-6PA01-0CU0
General information	
Product type designation	AI Energy Meter CT HF
Firmware version	V8.0
• FW update possible	Yes
usable BaseUnits	BU type U0
Supported power supply systems	TT, TN, IT
Product function	
• Voltage measurement	Yes
– without voltage transformer	Yes
– with voltage transformer	Yes
• Current measurement	Yes; Max. 4
– without current transformer	No
– with current transformer	Yes; 1 A or 5 A current transformer
– With Rogowski coil	No
– With current-voltage-converter	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
– Monitoring of instantaneous and half-wave values	Yes
– THD measurement for current and voltage	Yes

Article number	6ES7134-6PA01-0CU0
– 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 from version	STEP 7 V16 or higher with HSP
• STEP 7 configurable/integrated from version	V5.5 SP3 or higher
• PROFIBUS from GSD version/GSD revision	One GSD file each, Revision 3 and 5 and higher
• PROFINET from 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 6 A input current, 3x 230 V AC
Address area	
Address space per module	
• Inputs	256 byte
• Outputs	20 byte
Hardware configuration	
Automatic encoding	Yes

Article number	**6ES7134-6PA01-0CU0**
• 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
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)
Diagnoses	
• 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
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	

Article number	6ES7134-6PA01-0CU0
• 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.	40 Hz
– Frequency measurement, max.	70 Hz
Measuring inputs for voltage	
– Measurable line voltage between phase and neutral conductor	277 V
– Measurable line voltage between the line conductors	480 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
– 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
Measuring inputs for current	
– measurable relative current (AC), min.	1 %; Relative to measuring range; 1 A, 5 A
– measurable relative current (AC), max.	120 %; 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
– Surge strength	10 A; for 1 minute
– Zero point suppression	0 ... 20%, referred to the nominal current
Accuracy class according to IEC 61557-12	

Article number	**6ES7134-6PA01-0CU0**
– Measured variable apparent power	0.5
– Measured variable active power	0.5
– Measured variable power factor	0.5
– Measured variable active energy	0.5
– Measured variable phase angle	±0.5 °; not covered by IEC 61557-12
– Measured variable frequency	0.05; only valid for the permissible voltage measuring range
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
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.	-30 °C
• horizontal installation, max.	60 °C
• vertical installation, min.	-30 °C
• 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	

Article number	6ES7134-6PA01-0CU0
Weight, approx.	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

Dimension drawing

See ET 200SP BaseUnits (https://support.industry.siemens.com/cs/ww/en/view/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 payload mapping
- Parameter data record DS 134 for measured value recording
- 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 payload 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 payload 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.

A reconfiguration in run is not bumpless. It can take up to 1 second for all measured values to become stable.

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

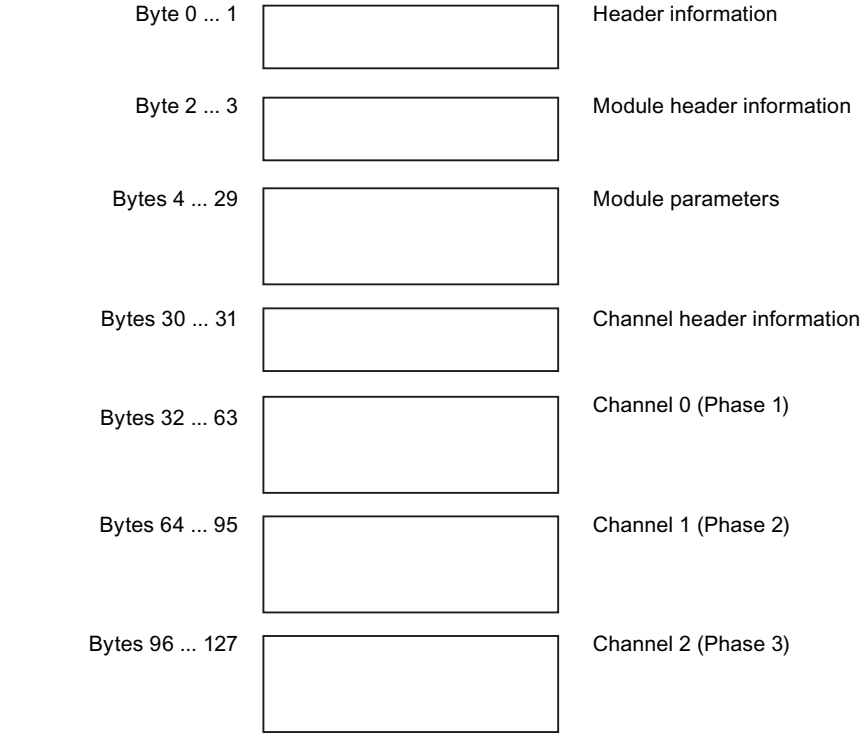


Figure A-1 Parameter data record 128

Header information

The figure below shows the structure of the header information.

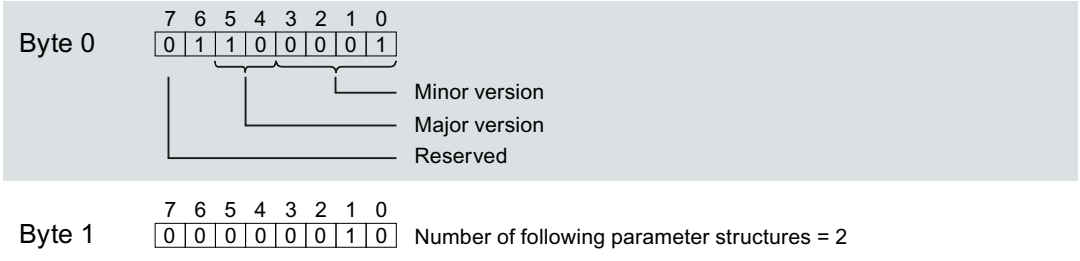


Figure A-2 Header information

Module header information

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

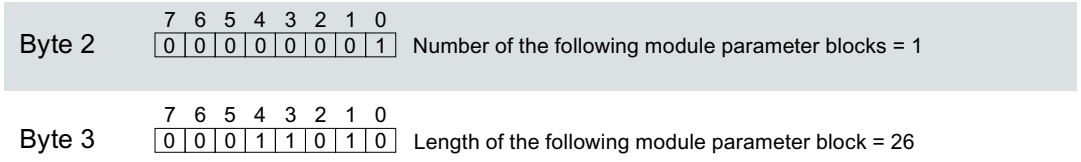
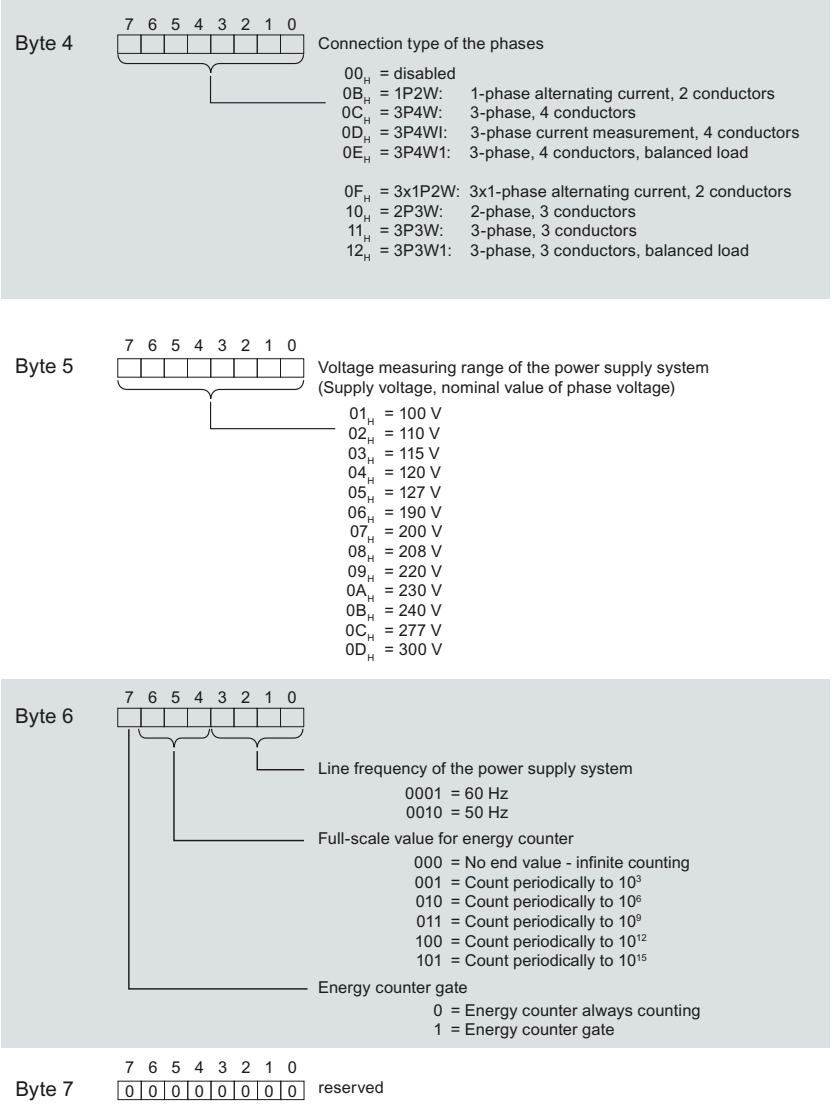


Figure A-3 Module header information

Module parameter block

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



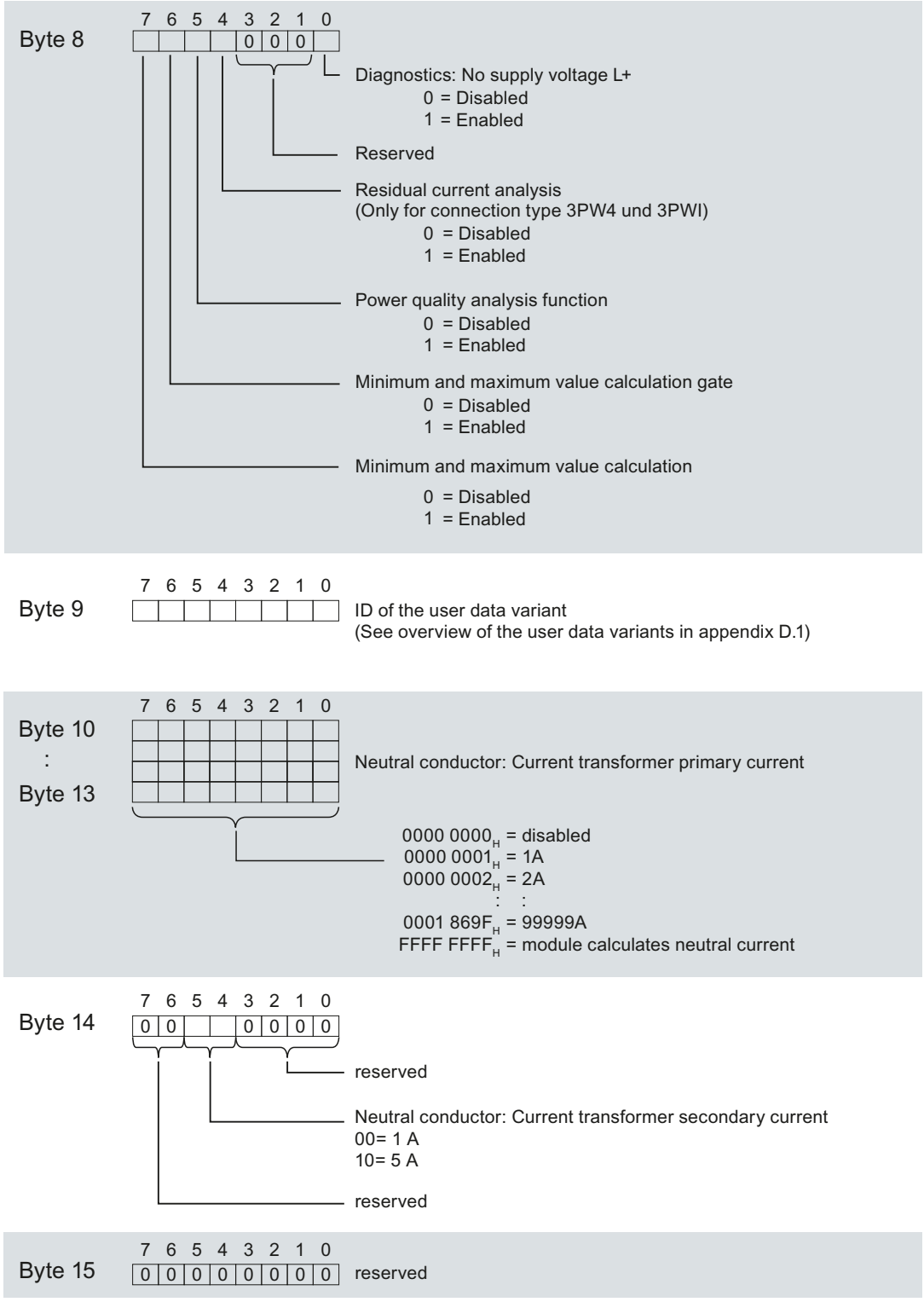


Figure A-4 Module parameter block

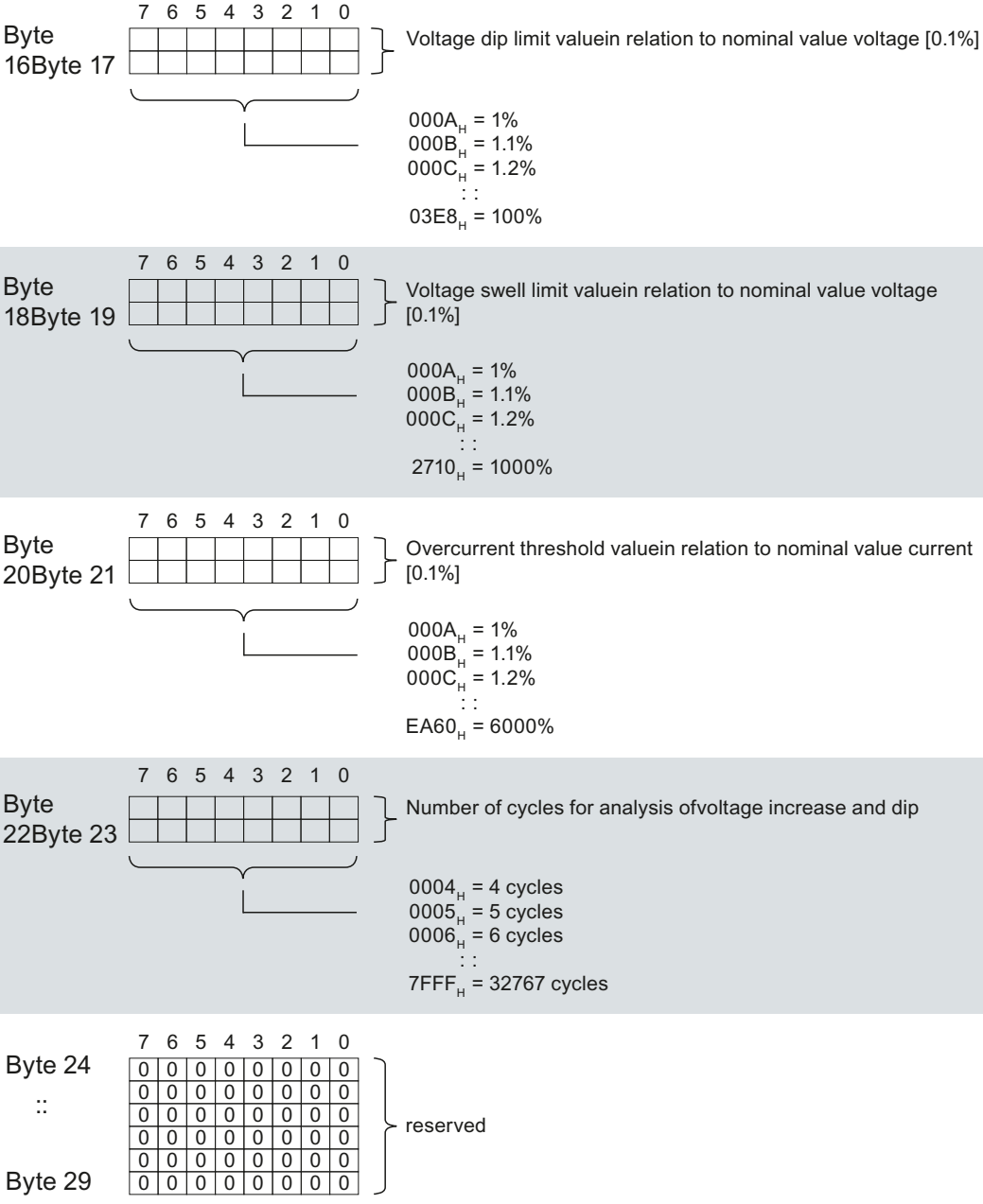


Figure A-5 Module parameter block

You can find the payload variant in the section Overview of the payload variants (Page 206).

Channel header information

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

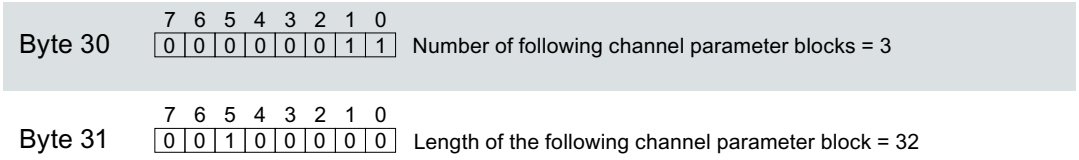
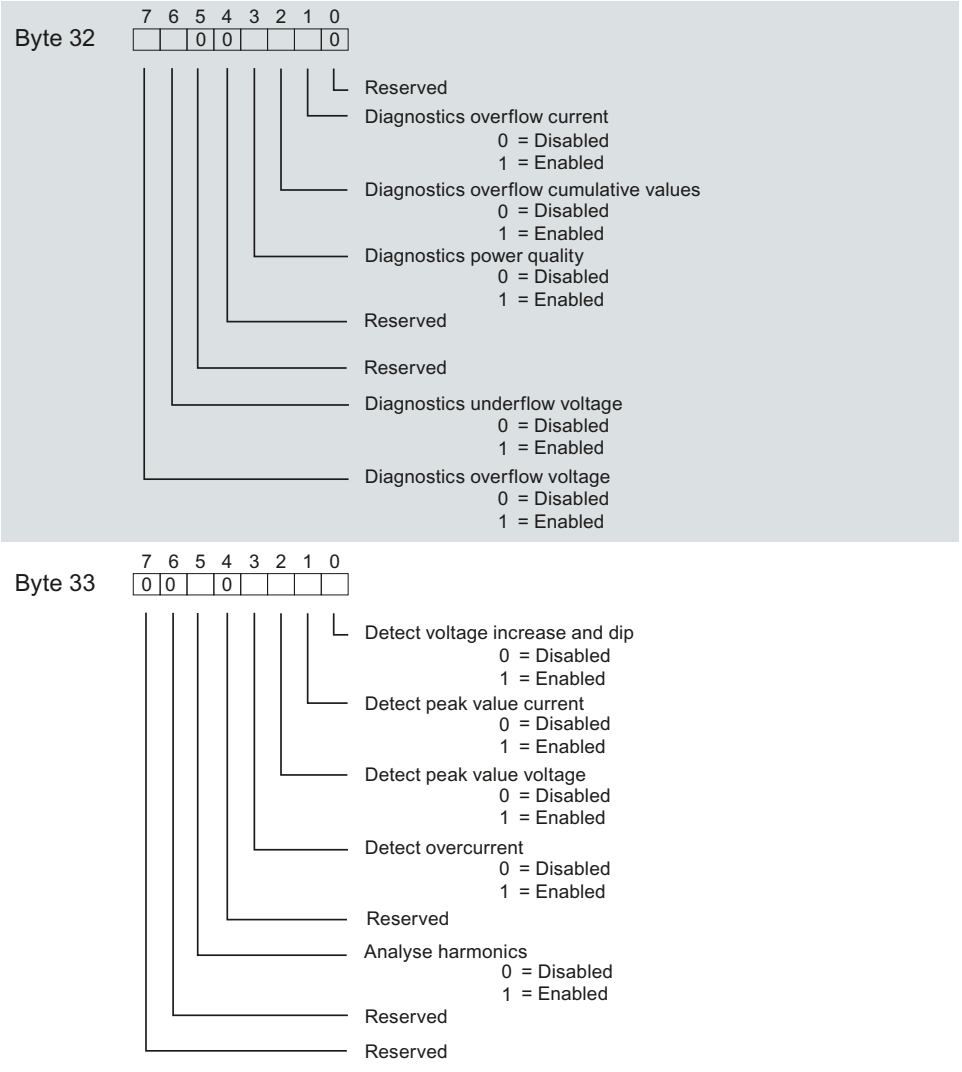


Figure A-6 Channel header information

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.



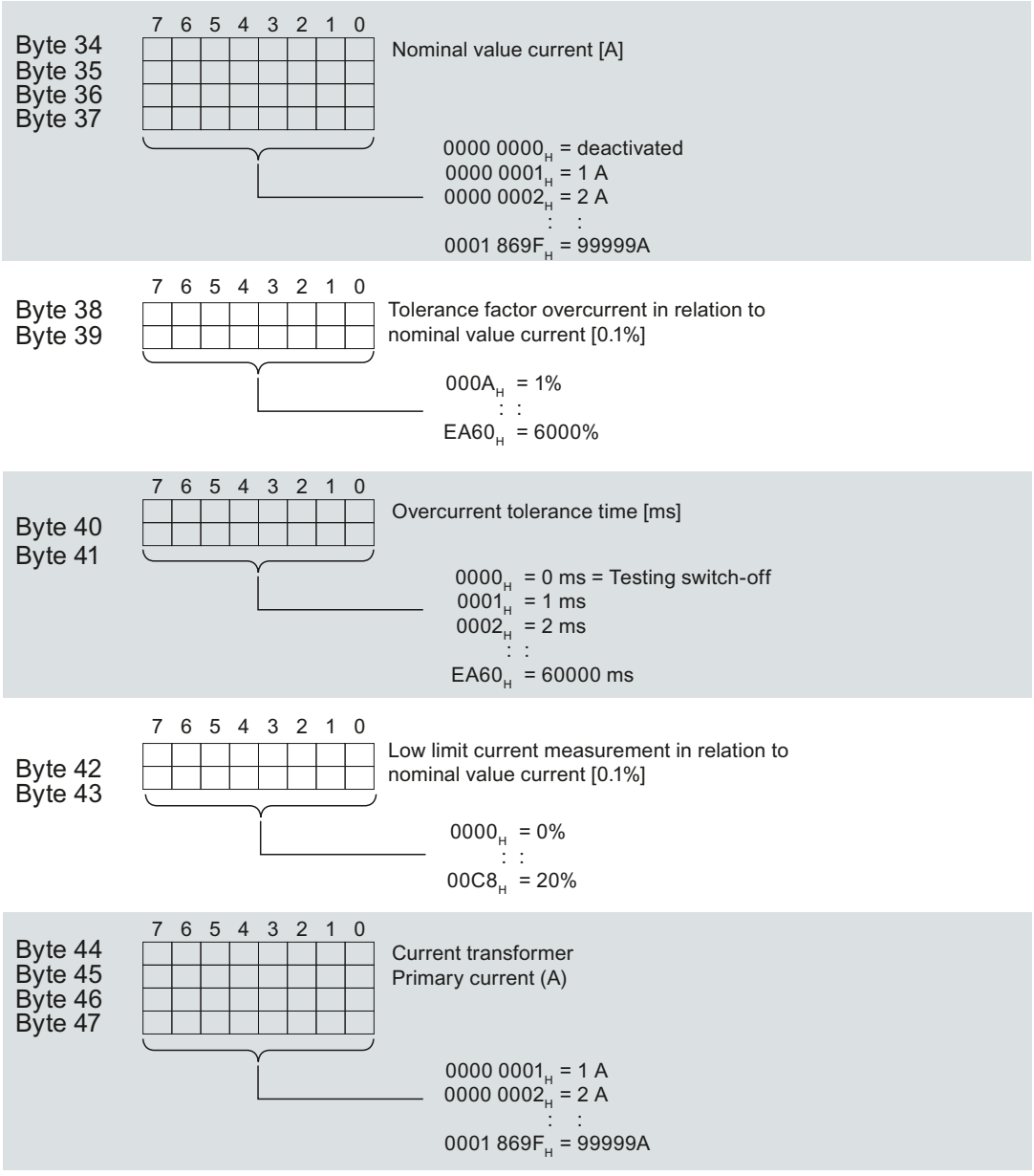
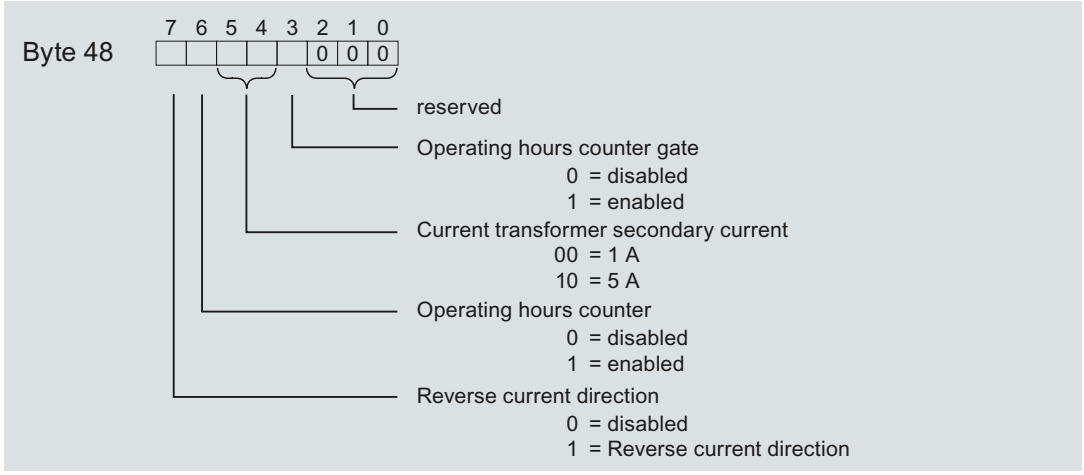
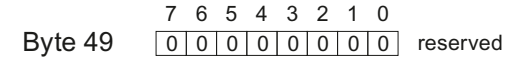
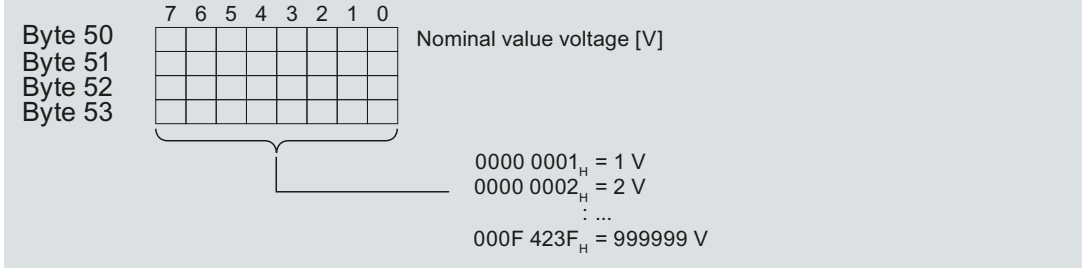
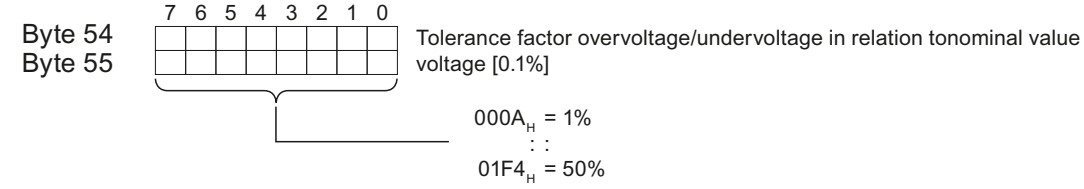


Figure A-7 Channel parameter block


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 = Reverse current direction


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 tonominal value voltage [0.1%]
000AH = 1%
: :
01F4H = 50%

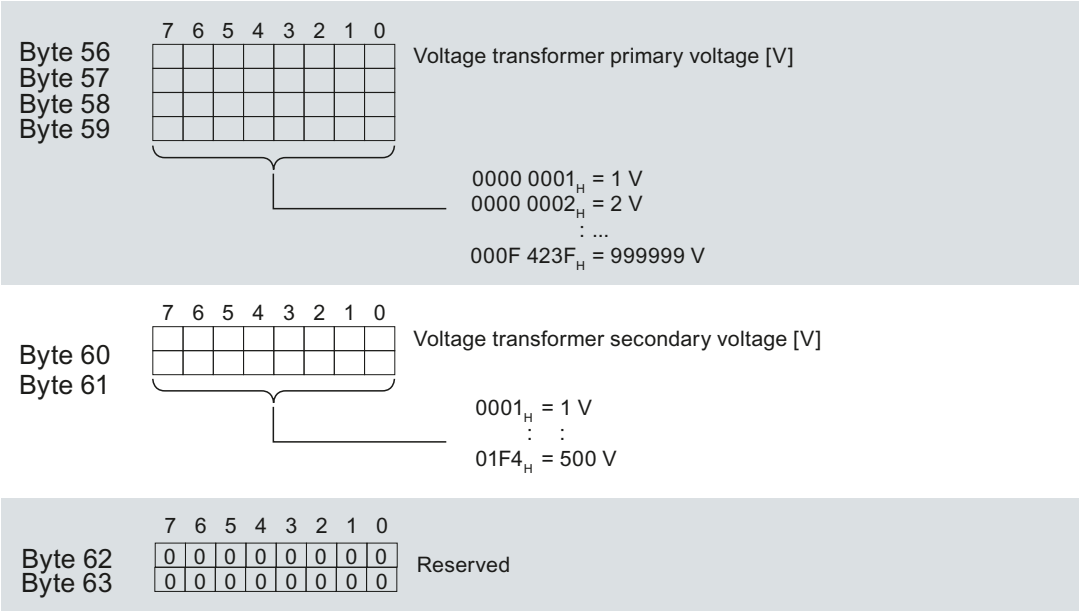


Figure A-8 Channel parameter block

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 ... 3, 30, 31. Correct the length and number of the parameter blocks.
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 $0D_H$

Error code in STATUS parameter (hexadecimal)				Meaning	Solution
Byte 0	Byte 1	Byte 2	Byte 3		
DF	80	E1	20	"Connection type" invalid	Check Byte 4. Permitted values: 00_H, $0B_H$...12_H
DF	80	E1	21	"Payload variant" not possible or input data configuration not large enough	Check Byte 9. Select a different payload variant or change the configuration.
DF	80	E1	22	"Payload variant" invalid	Check Byte 9. Select a valid code for the payload 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. 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. For all 3 phases, enter identical values for current transformer (secondary current, primary current, direction of current) and voltage transformer (secondary voltage, primary voltage).
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 conductor or all 3 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)
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)

Error code in STATUS parameter (hexadecimal)				Meaning	Solution
Byte 0	**Byte 1**	**Byte 2**	**Byte 3**		
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 converter 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 current value must be measurable with the current transformer and 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 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%]" is invalid.	Select the permissible value in % so that the secondary measuring voltage does not fall below 0 V.
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 over-voltage/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

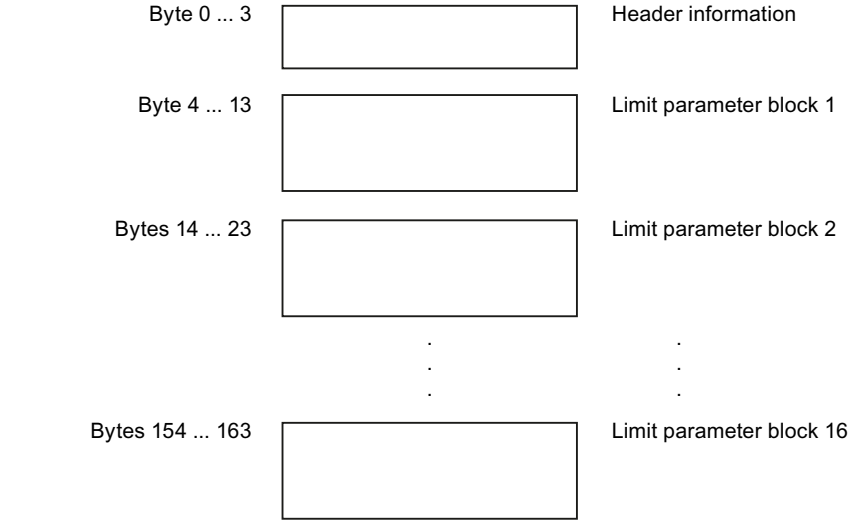


Figure A-9 Structure of data record 129

Header information

The figure below shows the structure of the header information.

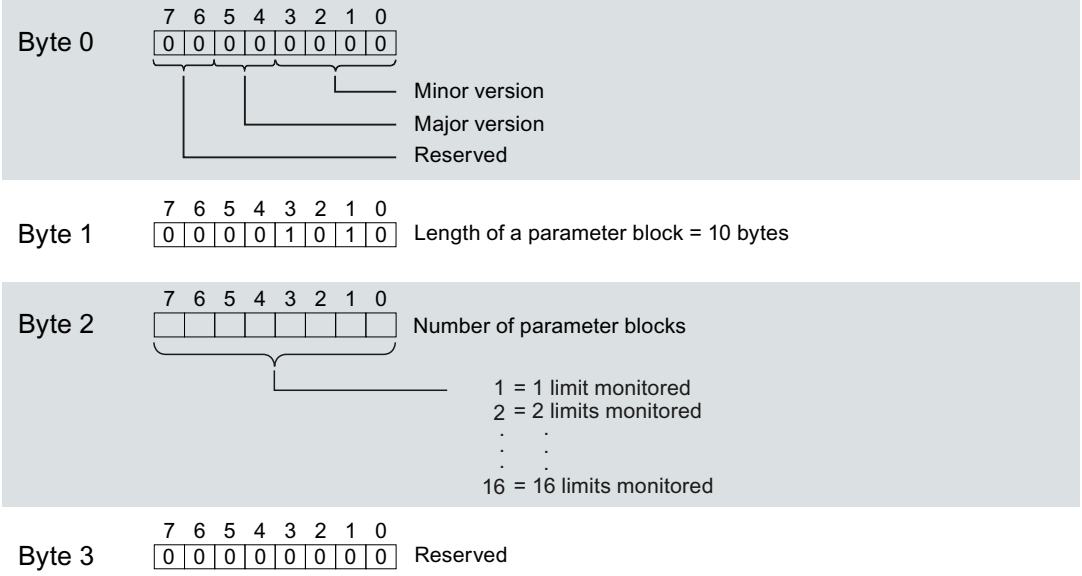
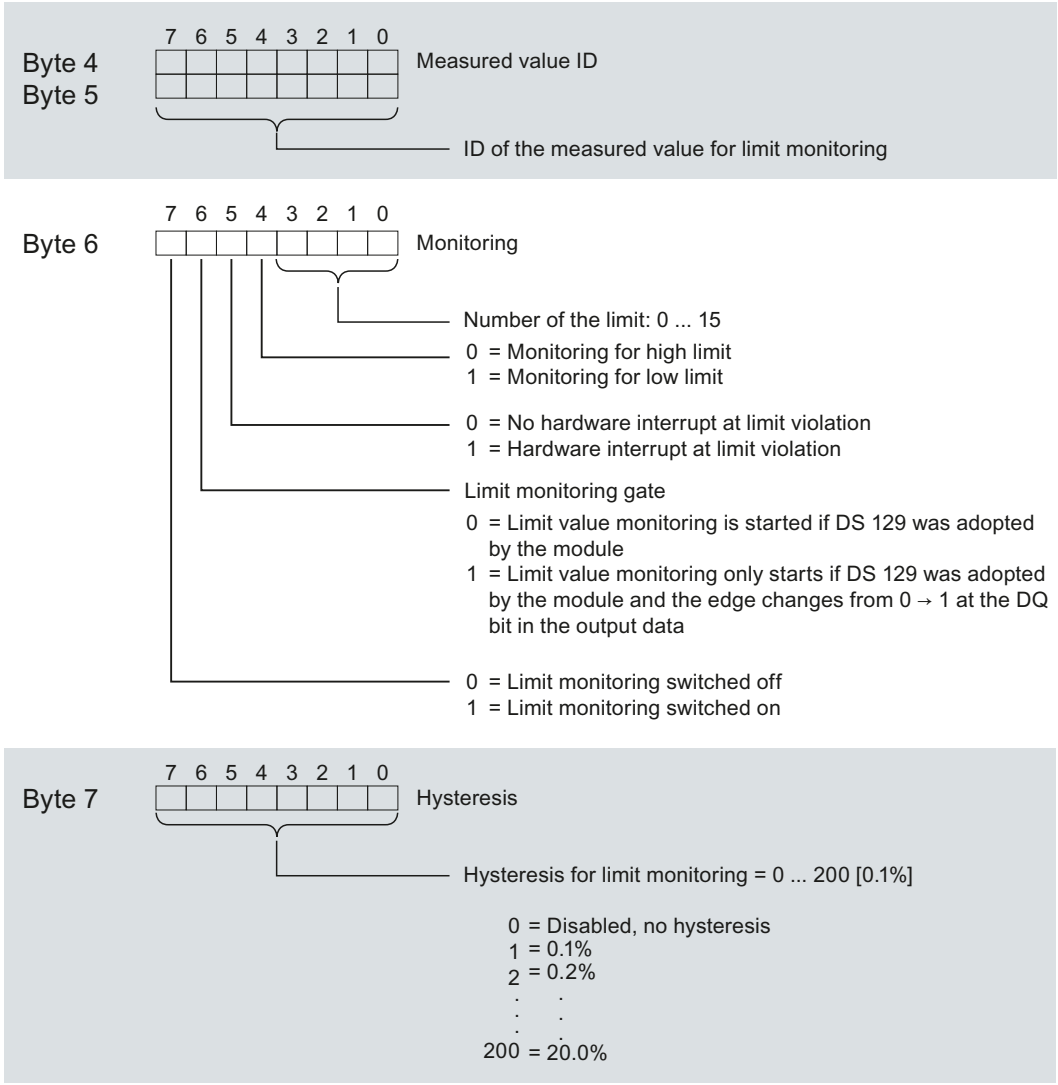


Figure A-10 Header information DS 129

Limit parameter block

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



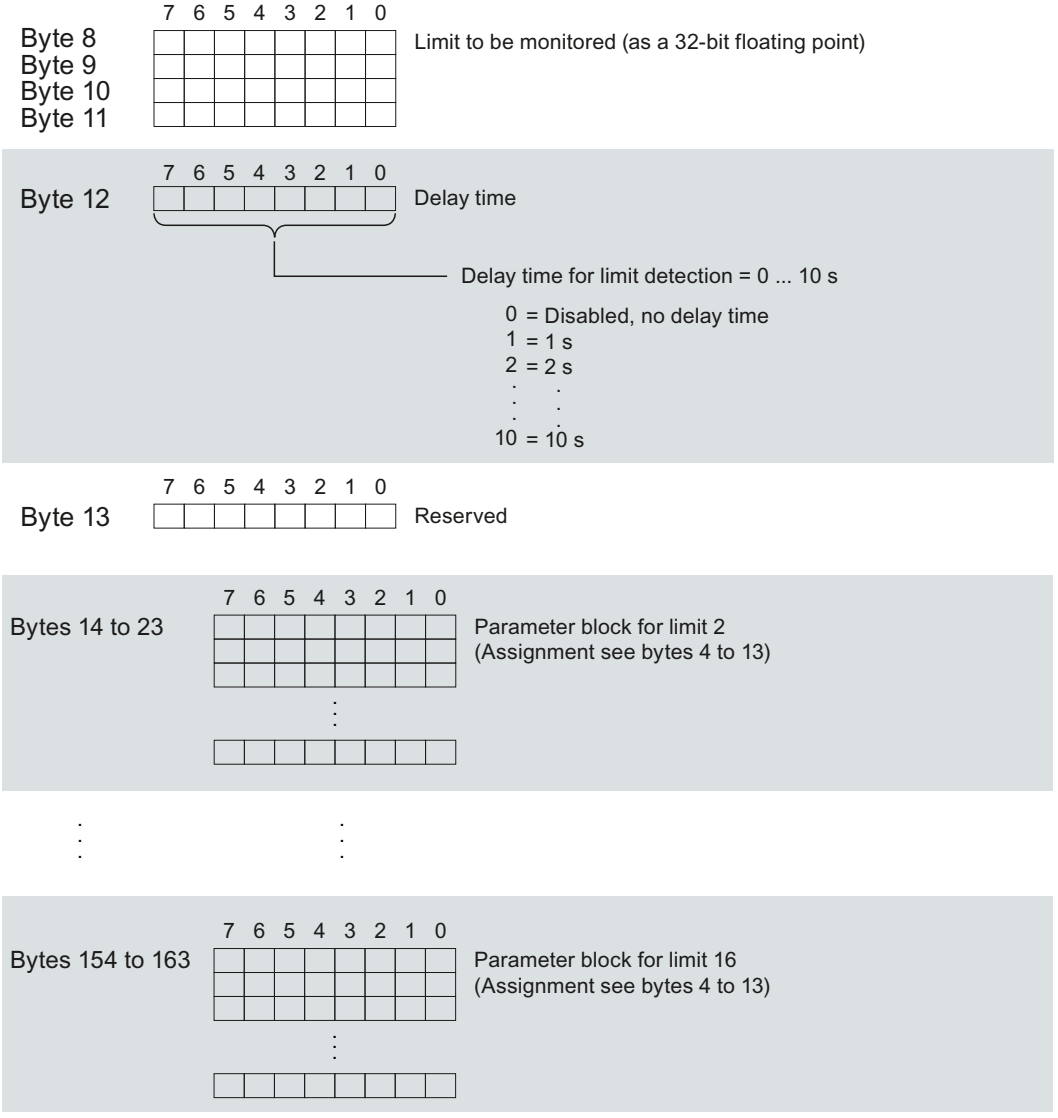


Figure A-11 Limit parameter data block

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 set the reserved bits back 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

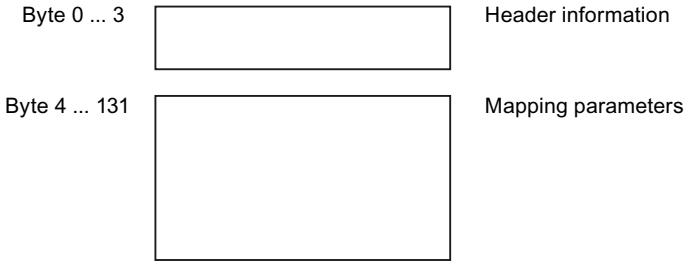


Figure A-12 Structure of data record 130/131

Header information

The figure below shows the structure of the header information.

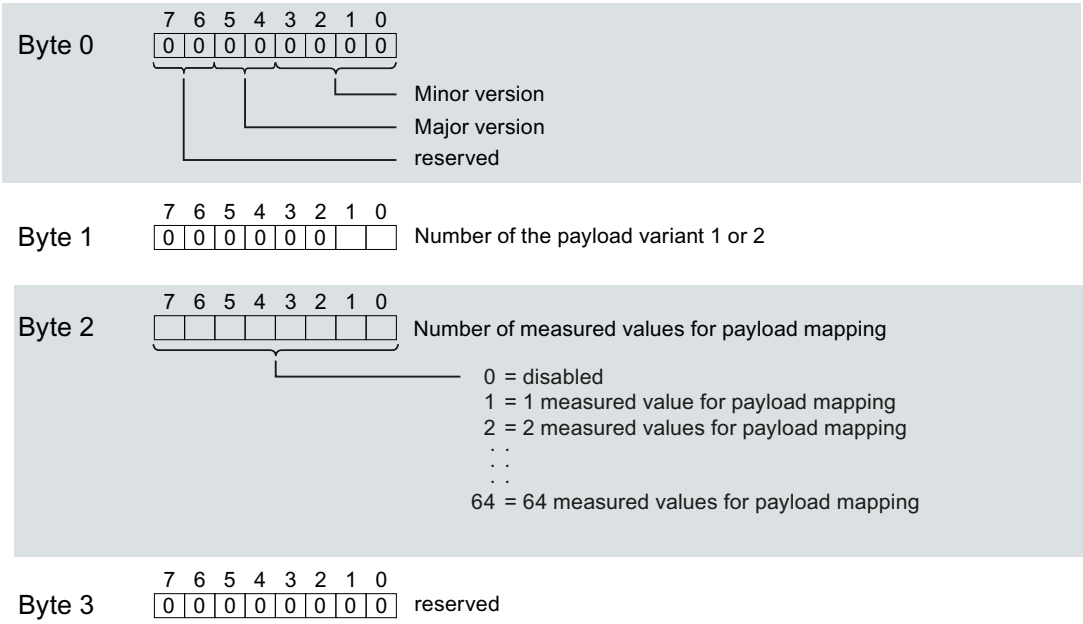


Figure A-13 Header information DS 130/131

Parameter block for payload mapping

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

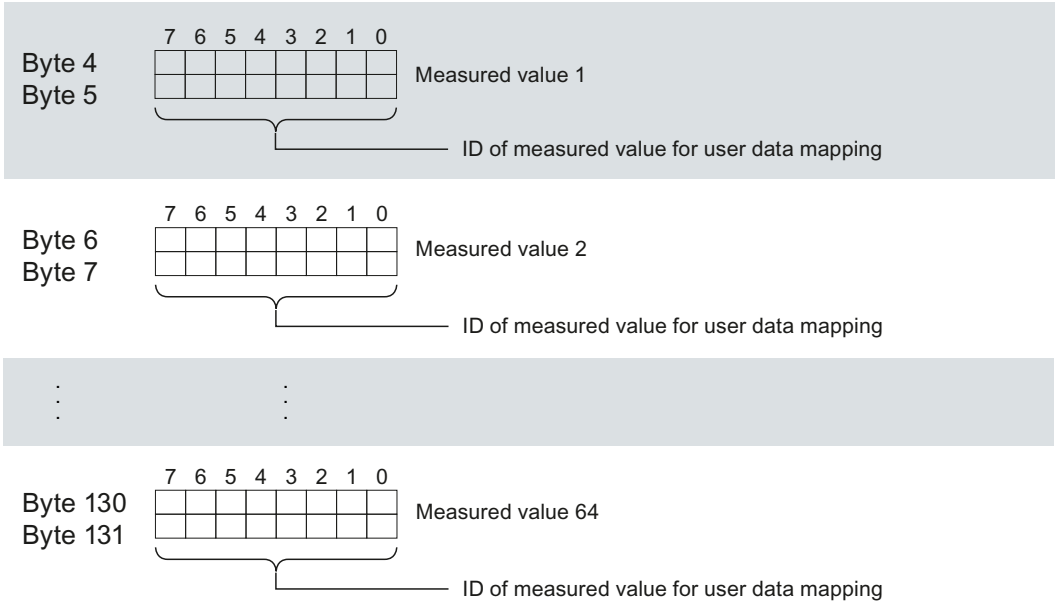


Figure A-14 Parameter block for payload mapping

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 set reserved bits back to 0.
DF	80	E1	21	"Payload variant" not possible or input data configuration not large enough	Select a different payload 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 payload mapping" invalid.	Check Bytes 4 and 5. Enter valid values.
DF	80	E1	3B	"ID of the type of payload mapping" not permitted.	Check Byte 1. Number for user-specific payload variant has to be 01_H or 02_H.

Measured variables for payload mapping

You can find the measured variables under "Measured variables for connection type". The following measured variables are not available to you for payload mapping:

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

A.5 Structure of the parameter data record for measured value recording (DS 134)

Structure of data record 134

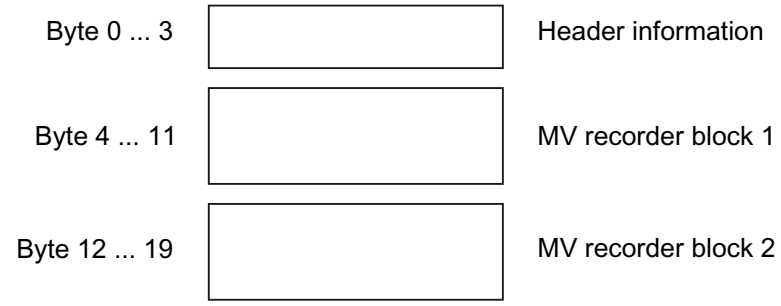


Figure A-15 Structure of data record 134

Header information

The figure below shows the structure of the header information.

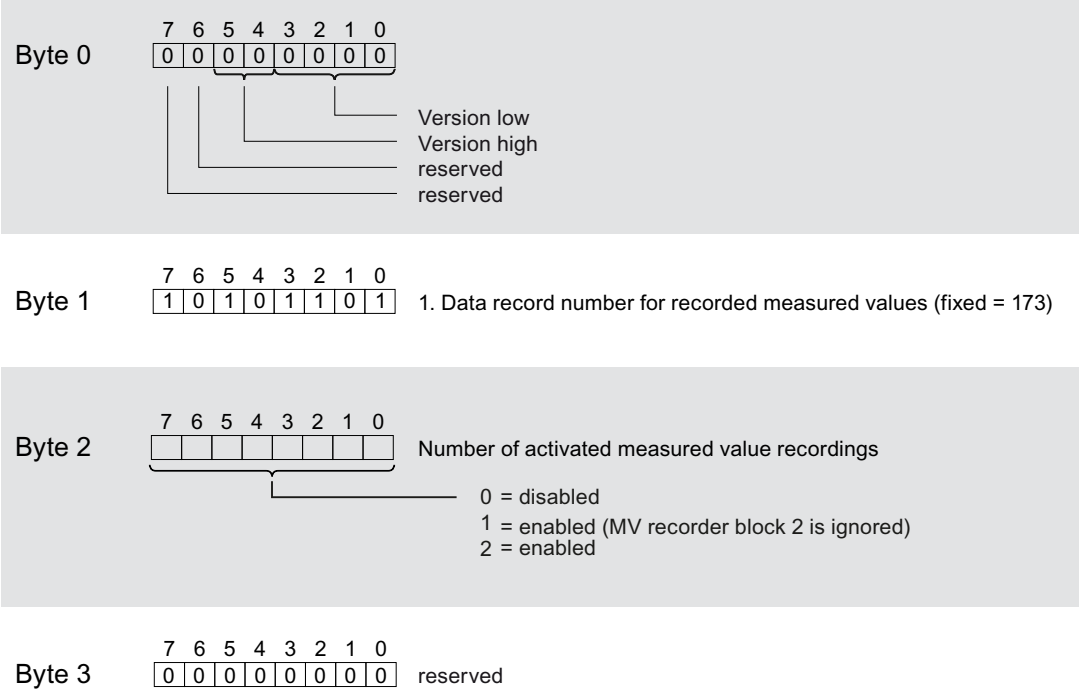


Figure A-16 Header information DS 134

Parameter block

The following figures show the structure of the parameter blocks for measured value recording.

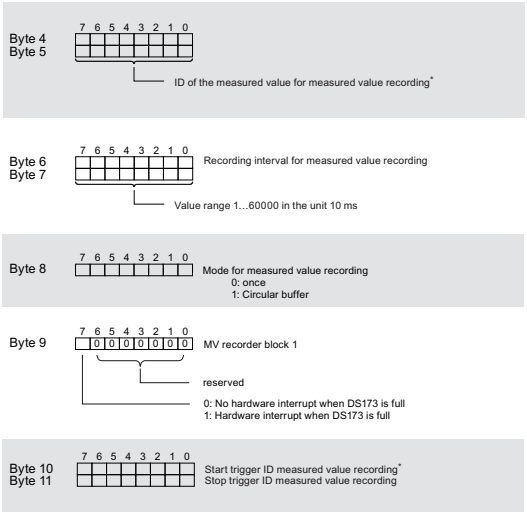
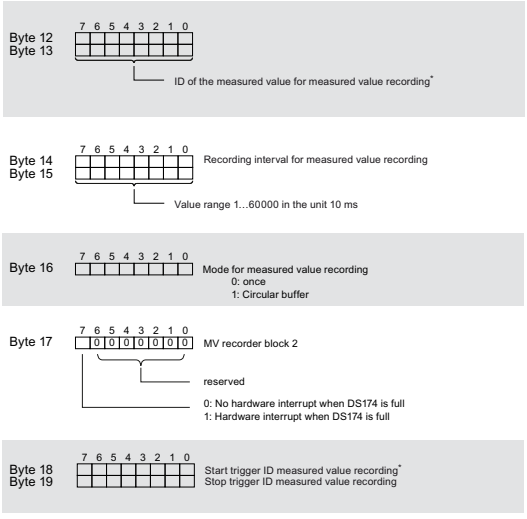


Figure A-17 MV record block 1



* You can find additional information in Appendix B.

Figure A-18 MV record block 2

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 134.

Error code in STATUS parameter (hexadecimal)				Meaning	Solution
Byte 0	**Byte 1**	**Byte 2**	**Byte 3**		
DF	80	B0	00	Data record unknown	Enter the valid number for the data record.
DF	80	B1	01	Incorrect length during writing	Enter the permissible value for the data record length.
DF	80	B2	00	Slot/Subslot unknown	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	Version faulty	Enter the valid values.
DF	80	E0	02	Error in the header information	Check byte 1 and byte 2. Correct the number of parameter blocks.
DF	80	E1	01	Reserved bits are not 0	Set byte 4 or byte 6 in the measured value block to 0.
DF	80	E1	59	Measurement interval too long	Set bytes 7/8 or 13/14: Measuring interval 〈 60000.
DF	80	E1	58	Incorrect measuring mode	Byte 9 or 15: Only mode 0 or 1 is possible.
DF	80	E1	31	"Length of the parameter block" invalid	Length does not match the set number of records.
DF	80	E1	32	"Number of parameter blocks" invalid	Check byte 3. Number must be ≤ 2.
DF	80	E1	33	"ID of the measured value for measured value recording" invalid	Byte 5/6 or 11/12 has faulty measured value ID. Enter valid values.
DF	80	E1	30	Data record 134 is not supported on this module type	Do not send the data record.
DF	80	E1	5a	The function is not supported on this module type	Do not send the data record.
DF	80	E1	60	Start or stop trigger ID is invalid	Check the trigger IDs and eliminate the error.

Start/Stop trigger IDs

Power quality analysis qualifier

	Bit 31	**Bit 30**	**Bit 29**	**Bit 28**	**Bit 27**	**Bit 26**	**Bit 25**	**Bit 24**
Phase	L3							
	Overcurrent L3 (event active)	Voltage swell L3 (event active)	Voltage dip L3 (event active)	Overcurrent L3 (event occurred)	Current peak L3 (event occurred)	Voltage peak L3 (event occurred)	Voltage swell L3 (event occurred)	Voltage dip L3 (event occurred)

Trigger ID	32	31	30	29	28	27	26	25
	Bit 23	**Bit 22**	**Bit 21**	**Bit 20**	**Bit 19**	**Bit 18**	**Bit 17**	**Bit 16**
Phase	L2							
	Overcurrent L2 (event active)	Voltage swell L2 (event active)	Voltage dip L2 (event active)	Overcurrent L2 (event occurred)	Current peak L2 (event occurred)	Voltage peak L2 (event occurred)	Voltage swell L2 (event occurred)	Voltage dip L2 (event occurred)
Trigger ID	24	23	22	21	20	19	18	17
	Bit 15	**Bit 14**	**Bit 13**	**Bit 12**	**Bit 11**	**Bit 10**	**Bit 9**	**Bit 8**
Phase	L1							
	Overcurrent L1 (event active)	Voltage swell L1 (event active)	Voltage dip L1 (event active)	Overcurrent L1 (event occurred)	Current peak L1 (event occurred)	Voltage peak L1 (event occurred)	Voltage swell L1 (event occurred)	Voltage dip L1 (event occurred)
Trigger ID	16	15	14	13	12	11	10	9
	Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Phase	L1L2L3							
	reserved	reserved	Status of harmonics analysis Bit 5	Status of harmonics analysis Bit 4	Status of harmonics analysis Bit 3	Status of harmonics analysis Bit 2	Status of harmonics analysis Bit 1	Status of harmonics analysis Bit 0
Trigger ID	8	7	6	5	4	3	2	1

Qualifier Lx

	Bit 7	**Bit 6**	**Bit 1**	**Bit 0**
	Operating quadrant Lx (high)	Operating quadrant Lx (low)	ILx (ok)	ULx (ok)
L1	48	47	34	33
L2	64	63	50	49
L3	80	79	66	65

Qualifier L1L2L3

	Bit 15	**Bit 14**	**Bit 13**	**Bit 12**	**Bit 11**	**Bit 10**	**Bit 9**	**Bit 8**
Phase	L1L2L3				L3		L2	
	Time synchronization (ok)	Analysis of harmonic component	Rotating field status (high)	Rotating field status (low)	Operating quadrant L3 (high)	Operating quadrant L3 (low)	Operating quadrant L2 (high)	Operating quadrant L2 (low)
Trigger ID	96	95	94	93	92	91	90	89
	Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Phase	L1		L3		L2		L1	
	Operating quadrant L1 (high)	Operating quadrant L1 (low)	Measured values IL3 (ok)	Measured values UL3 (ok)	Measured values IL2 (ok)	Measured values UL2 (ok)	Measured values IL1 (ok)	Measured values UL1 (ok)
Trigger ID	88	87	86	85	84	83	82	81

Status of energy counter overflows

	Bit 15	**Bit 14**	**Bit 13**	**Bit 12**	**Bit 11**	**Bit 10**	**Bit 9**	**Bit 8**
Phase	reserved	L3					L2	
	---	Overflow apparent energy L3	Overflow reactive energy outflow L3	Overflow reactive energy inflow L3	Overflow active energy outflow L3	Overflow active energy inflow L3	Overflow apparent energy L2	Overflow reactive energy outflow L2
Trigger ID	112	111	110	109	108	107	106	105

	Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Phase	L2			L1				
	Overflow reactive energy inflow L2	Overflow active energy outflow L2	Overflow active energy inflow L2	Overflow apparent energy L1	Overflow reactive energy outflow L1	Reactive energy inflow L1	Overflow active energy outflow L1	Overflow active energy inflow L1
Trigger ID	104	103	102	101	100	99	98	97

Status of limits

	Bit 15	**Bit 14**	**Bit 13**	**Bit 12**	**Bit 11**	**Bit 10**	**Bit 9**	**Bit 8**
	Limit violation LV16	Limit violation LV15	Limit violation LV14	Limit violation LV13	Limit violation LV12	Limit violation LV11	Limit violation LV10	Limit violation LV9
Trigger ID	128	127	126	125	124	123	122	121
	Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
	Limit violation LV8	Limit violation LV7	Limit violation LV6	Limit violation LV5	Limit violation LV4	Limit violation LV3	Limit violation LV2	Limit violation LV1
Trigger ID	120	119	118	117	116	115	114	113

32-bit diagnostic bit track ET200SP diagnostics

	Bit 31	**Bit 26**	**Bit 22**	**Bit 17**	**Bit 16**	**Bit 7**	**Bit 4**	**Bit 3**	**Bit 2**
	Channel temporarily not available	Power quality	Hardware interrupt lost	Supply voltage missing	Parameter error	Overflow of the calculation values	Overload	Overflow voltage	Underflow voltage
Trigger ID L1	160	155	151	146	145	136	133	132	131
Trigger ID L2	192	187	183	178	177	168	165	164	163
Trigger ID L3	224	219	215	210	209	200	197	196	195

DQ control measured value acquisition

	Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
	DQ address 17 (control byte 8)							
Trigger ID	232	231	230	229	228	27	226	225

A.6 Structure of the parameter data record 135 for data record mapping

Structure of data record 135

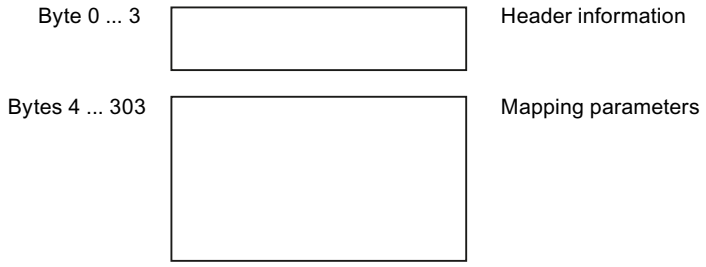


Figure A-19 Structure of data record 135

Header information

The figure below shows the structure of the header information.

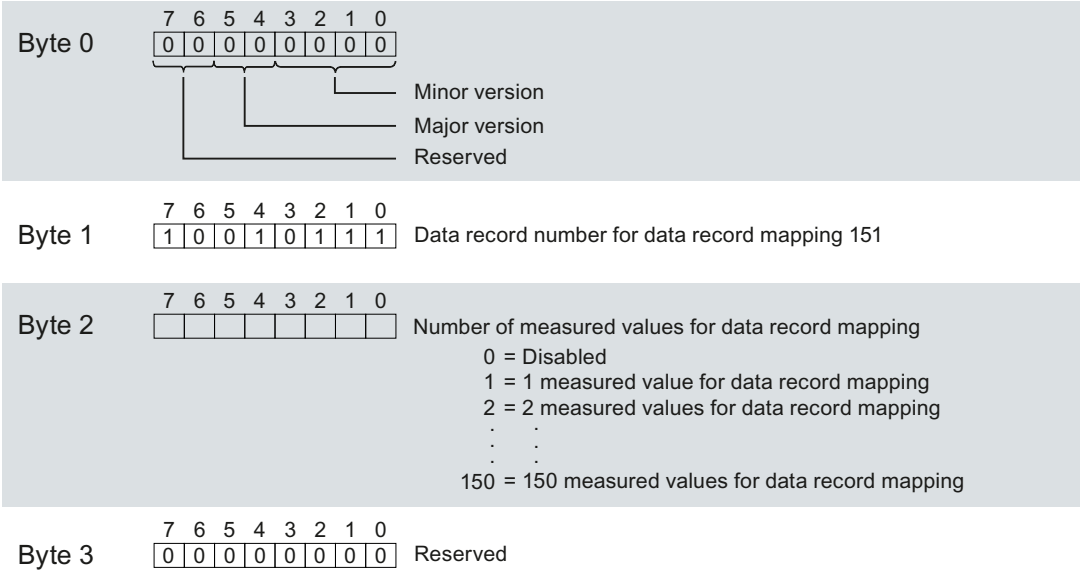


Figure A-20 Header information DS 135

Parameter block for data record mapping

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

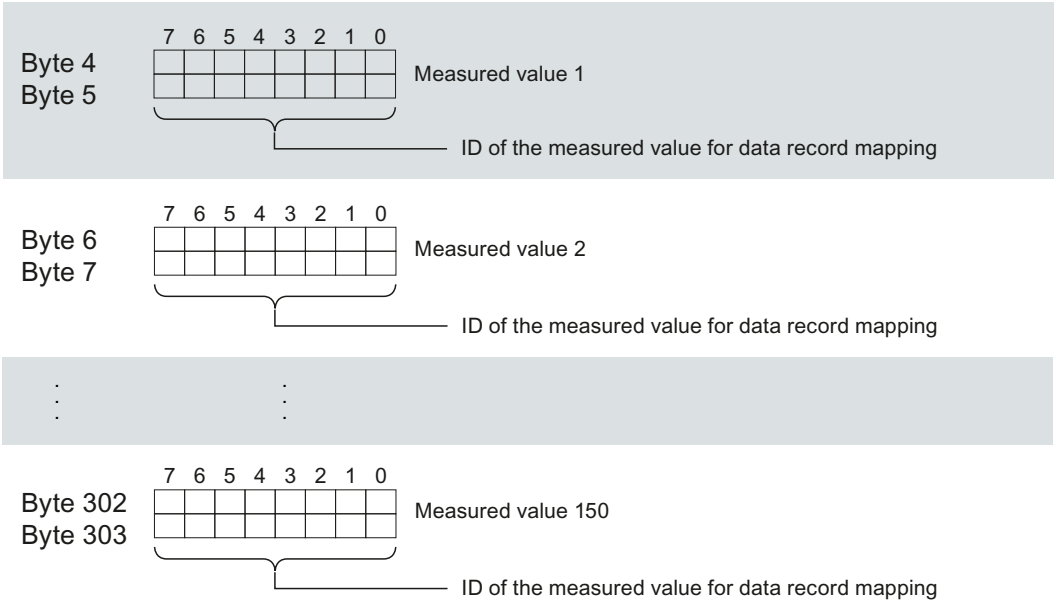


Figure A-21 Parameter block for data record mapping

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 250).

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 set reserved bits back to 0.
DF	80	E1	21	"Payload variant" not possible or input data configuration not large enough	Select a different payload 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 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 payload

The following table provides an overview of all measured variables that are used in the data records and payload.

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 payload variants and data records.

Table B-1 Measured variables for data records and payload

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	✓	✓	✓	✓	✓	✓	✓	

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
23	Reactive power Qtot L2 [3]	REAL	var	-3.0e+9 ... +3.0e+9		✓	✓	✓	✓	✓	✓	
24	Reactive power Qtot L3 [3]	REAL	var	-3.0e+9 ... +3.0e+9			✓	✓	✓	✓	✓	
30	Frequency L1L2L3 [4]	REAL	Hz	40.0 ... 70.0	✓	✓	✓	✓	✓	✓	✓	✓
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		✓	✓	✓	✓	✓	✓	

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
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	40.0 ... 70.0	✓	✓	✓	✓	✓	✓	✓	✓
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		✓	✓	✓	✓	✓	✓	

Meas-ured 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
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	40.0 ... 70.0	✓	✓	✓	✓	✓	✓	✓	✓
92	Min. mean voltage L-N [14]	REAL	V	0.0 ... 1000000.0	✓	✓	✓	✓	✓			
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	✓	✓	✓	✓	✓	✓	✓	

Meas-ured 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
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	✓	✓	✓	✓	✓	✓	✓	
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	✓	✓	✓	✓	✓	✓	✓	
61130	Phase angle UL1-UL2 [3]	REAL	°	0.0 ... 360.0	✓	✓	✓	✓	✓	✓	✓	
61131	Phase angle UL2-UL3 [3]	REAL	°	0.0 ... 360.0	✓	✓	✓	✓	✓	✓	✓	
61132	Phase angle UL3-UL1 [3]	REAL	°	0.0 ... 360.0	✓	✓	✓	✓	✓	✓	✓	
61133	Phase angle IL1-IL2 [3]	REAL	°	0.0 ... 360.0	✓	✓	✓	✓	✓	✓	✓	✓
61134	Phase angle IL2-IL3 [3]	REAL	°	0.0 ... 360.0	✓	✓	✓	✓	✓	✓	✓	✓
61135	Phase angle IL3-IL1 [3]	REAL	°	0.0 ... 360.0	✓	✓	✓	✓	✓	✓	✓	✓
61136	Max. neutral current [14]	REAL	A	0.0 ... 100000.0	✓	✓	✓	✓	✓	✓	✓	✓
61137	Min. neutral current [14]	REAL	A	0.0 ... 100000.0	✓	✓	✓	✓	✓	✓	✓	✓
61138	Max. reactive power Qtot L1L2L3[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
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	✓	✓	✓	✓	✓	✓	✓	
61157	Amplitude unbalance voltage U2 [2]	REAL	%	0 ... 100				✓	✓	✓	✓	
61158	Amplitude unbalance current Iunsym [2]	REAL	%	0 ... 100				✓	✓	✓	✓	✓
61159	Instantaneous value line frequency [17]	REAL	Hz	40.0 ... 70.0	✓	✓	✓	✓	✓	✓	✓	✓
61178	Phase angle L1 [3]	REAL	°	0.0 ... 360.0	✓	✓	✓	✓	✓	✓	✓	
61180	Active energy inflow L1 [6]	LREAL	Wh	0.0 ... 1.7976e+308	✓	✓	✓	✓	✓	✓	✓	

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
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	✓	✓	✓	✓	✓	✓	✓	

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
62112	Reactive energy inflow L1 (Int32) [6]	UDINT	varh	0 ... 2147483647	✓	✓	✓	✓	✓	✓	✓	
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	✓	✓	✓	✓	✓	✓	✓	
62132	Voltage L1 - instantaneous value [17]	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	✓	✓	✓	✓	✓	✓	✓	✓
62135	Current L1 - instantaneous value [17]	REAL	A	0.0 ... 100000.0	✓	✓	✓	✓	✓	✓	✓	✓
62136	Fundamental cos φ active factor L1 (SINT8) [17]	SINT	0.01	-100...100	✓	✓	✓	✓	✓	✓	✓	

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
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	✓	✓	✓	✓	✓	✓	✓	
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	✓	✓	✓	✓	✓	✓	✓	
62193	Diagnostics L1 [20]	DWORD	Bit track	0 ... 4294967295	✓	✓	✓	✓	✓	✓	✓	✓
62194	Voltage dip - value L1 [16]	REAL	V	0.0 ... 1000000.0	✓	✓	✓	✓	✓	✓	✓	
62195	Voltage swell - value L1 [16]	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
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		✓	✓	✓	✓	✓	✓	
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		✓	✓	✓	✓	✓	✓	

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
62231	Voltage L2 half cycle [1, 16, 19]	REAL	V	0.0 ... 1000000.0		✓	✓	✓	✓	✓	✓	
62232	Voltage L2 - instantaneous value [17]	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		✓	✓	✓	✓	✓	✓	✓
62235	Current L2 - instantaneous value [17]	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		✓	✓	✓	✓	✓	✓	
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		✓	✓	✓	✓	✓	✓	

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
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		✓	✓	✓	✓	✓	✓	
62293	Diagnostics L2 [20]	DWORD	Bit track	0 ... 4294967295		✓	✓	✓	✓	✓	✓	✓
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			✓	✓	✓	✓	✓	
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			✓	✓	✓	✓	✓	

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
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			✓	✓	✓	✓	✓	✓
62335	Current L3 - instantaneous value [17]	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			✓	✓	✓	✓	✓	✓
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			✓	✓	✓	✓	✓	

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
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			✓	✓	✓	✓	✓	
62393	Diagnostics L3 [20]	DWORD	Bit track	0 ... 4294967295			✓	✓	✓	✓	✓	✓
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 - duration 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	✓	✓	✓	✓	✓	✓	✓	
63003	Harmonics 2: Current L1 [18]	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
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	✓	✓	✓	✓	✓	✓	✓	✓

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
63026	Harmonics 14: Voltage L1 [18]	REAL	V	0.0 ... 1000000.0	✓	✓	✓	✓	✓	✓	✓	
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	✓	✓	✓	✓	✓	✓	✓	

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
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	✓	✓	✓	✓	✓	✓	✓	
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	✓	✓	✓	✓	✓	✓	✓	

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
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	✓	✓	✓	✓	✓	✓	✓	
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		✓	✓	✓	✓	✓	✓	✓

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
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		✓	✓	✓	✓	✓	✓	
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		✓	✓	✓	✓	✓	✓	✓

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
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		✓	✓	✓	✓	✓	✓	
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		✓	✓	✓	✓	✓	✓	

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
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		✓	✓	✓	✓	✓	✓	
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		✓	✓	✓	✓	✓	✓	

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
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			✓	✓	✓	✓	✓	
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			✓	✓	✓	✓	✓	✓

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
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			✓	✓	✓	✓	✓	
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			✓	✓	✓	✓	✓	✓

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
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			✓	✓	✓	✓	✓	✓
65495 [21]	DQ control measured value acquisition [17]	BYTE	Bit track	0 ... 255	✓	✓	✓	✓	✓	✓	✓	✓

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
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		✓	✓	✓	✓	✓	✓	✓
65502	Qualifier L3	UINT	Bit track	0 ... 65535			✓	✓	✓	✓	✓	✓
65503	Qualifier L1L2L3 [22]	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	✓	✓	✓	✓	✓	✓	✓	✓

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
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 payload 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-WI
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		✓	✓	✓	✓	✓	✓	

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-WI
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	40 ... 70	✓	✓	✓	✓	✓	✓	✓	✓
66031	Frequency (Uint16) [4]	UINT	0.01 Hz	4000 ... 7000	✓	✓	✓	✓	✓	✓	✓	✓
66034	Active power L1L2L3 [5]	INT	1 W	-32768 ... 32767	✓	✓	✓	✓	✓	✓	✓	
66035	Reactive power Qn L1L2L3[5]	INT	1 var	-32768 ... 32767	✓	✓	✓	✓	✓	✓	✓	

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-WI
66036	Apparent power L1L2L3 [5]	INT	1 VA	-32768 ... 32767	✓	✓	✓	✓	✓	✓	✓	
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 mean value above 10 s, available for UL-N>3 V. Frequencies outside the measuring range of lower than 40 Hz or higher than 70 Hz cannot be displayed. In these cases, the configured frequency (50 Hz or 60 Hz) is displayed and is used in further calculations.

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

21 ID 65495 is only available for triggers of the measured value acquisition (not for limit monitoring and user-defined payload or data records)

22 Only available for connection types 3PxW/only available for 3-phase system

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
DWORD	DWORD	4 bytes	Bit field with 32 bits
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

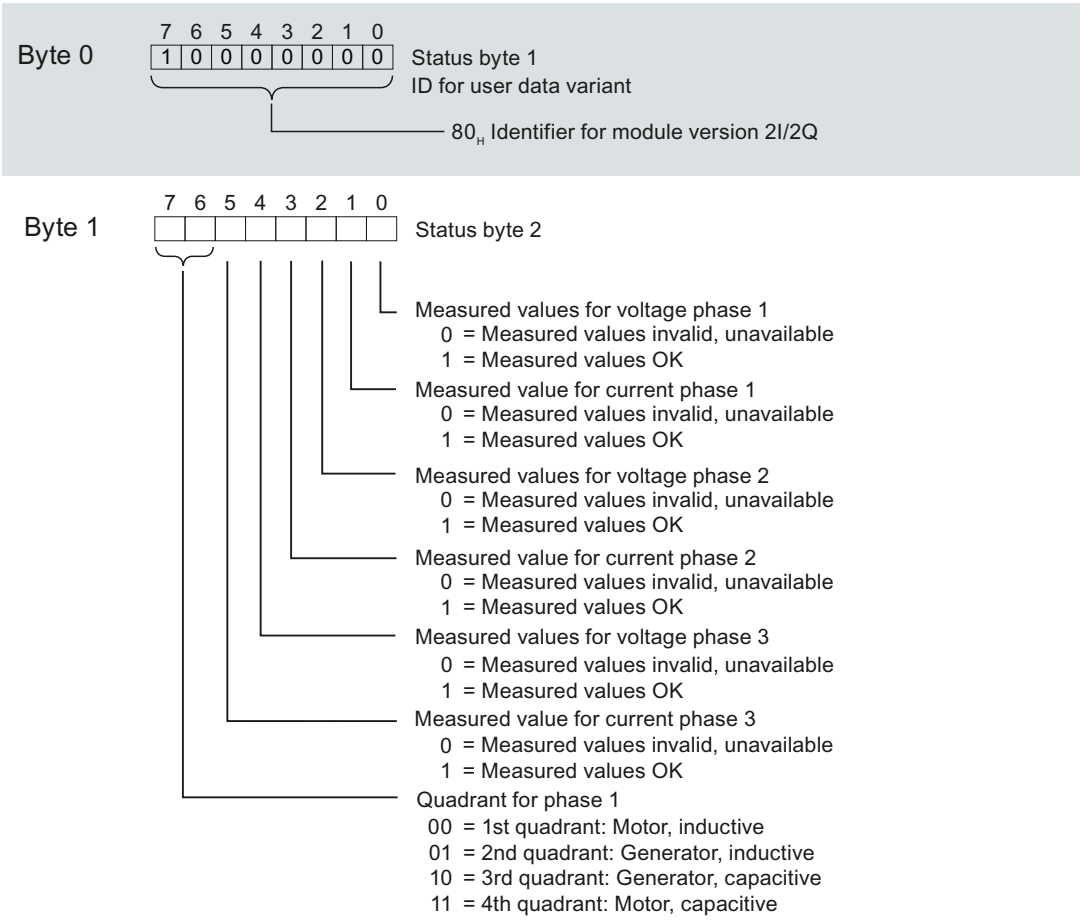


Figure C-1 Allocation of the status bytes in the input user data (2 bytes)

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.

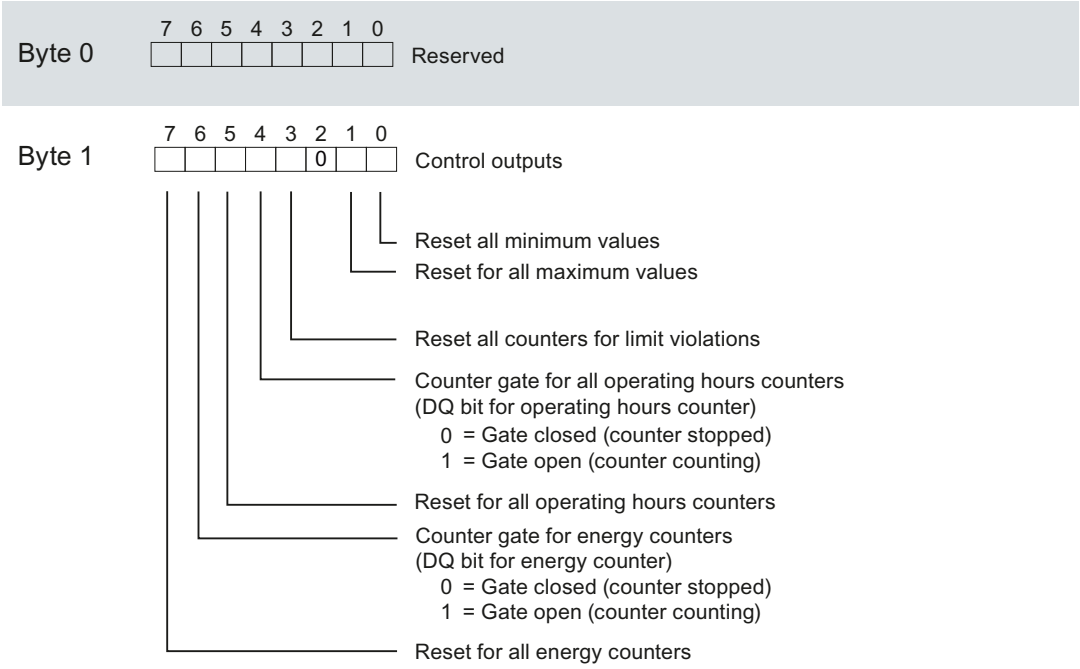


Figure C-2 Allocation of the control byte in the output user data (1 byte)

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"

Payload of the module

The module occupies 32 bytes of input payload and 20 bytes of output payload. 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 payload (Bytes 2 to 31) or acyclically via measured value data records

Structure of input payload

You can set the contents of the input payload dynamically. You can choose between different payload variants.

Table C-3 Structure of input payload (32 bytes)

Byte	Validity	Designation	Comment
0	Module	Payload 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 payload variant

Allocation of the input payload

You can change the measured variables during operation. You can choose between different payload variants.

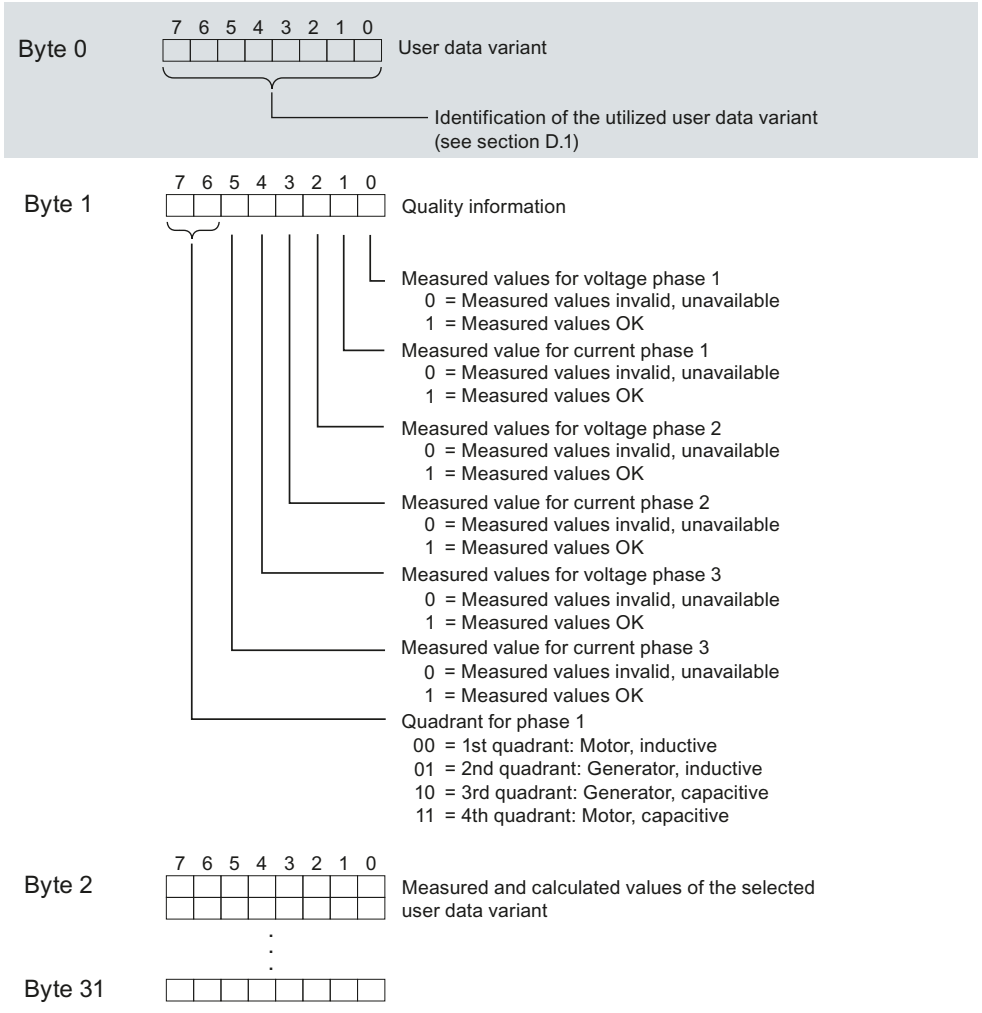


Figure C-3 Assignment of the input payload (32 bytes)

Structure of output payload

The structure of the output payload is fixed and is the same at all the selectable payload variants.

Via the output payload 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 payload (20 bytes)

Byte	Validity	Designation	Comment
0	Module	Payload variant	Control byte for switching the payload variant
1	Module	Control byte 1	Global resetting of values and counters, gate Selection of the energy counter to be reset
2	Module	Control byte 2	
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 Reset of measured value recorders 1 and 2, reset of the power failure analysis
17	Module	Control byte 17	Bit 0 = 0->1: Measured value recorder start/stop trigger ID 225 Bit 1 = 0->1: Measured value recorder start/stop trigger ID 226 Bit 2 = 0->1: Measured value recorder start/stop trigger ID 227 Bit 3 = 0->1: Measured value recorder start/stop trigger ID 228 Bit 4 = 0->1: Measured value recorder start/stop trigger ID 229 Bit 5 = 0->1: Measured value recorder start/stop trigger ID 230 Bit 6 = 0->1: Measured value recorder start/stop trigger ID 231 Bit 7 = 0->1: Measured value recorder start/stop trigger ID 232
18	Reserved		
19	Reserved		

Control bytes for payload variant

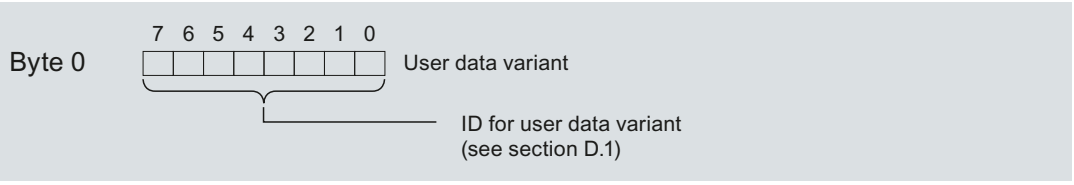


Figure C-4 Allocation of the control bytes for payload variant (Byte 0)

Control bytes for all three phases

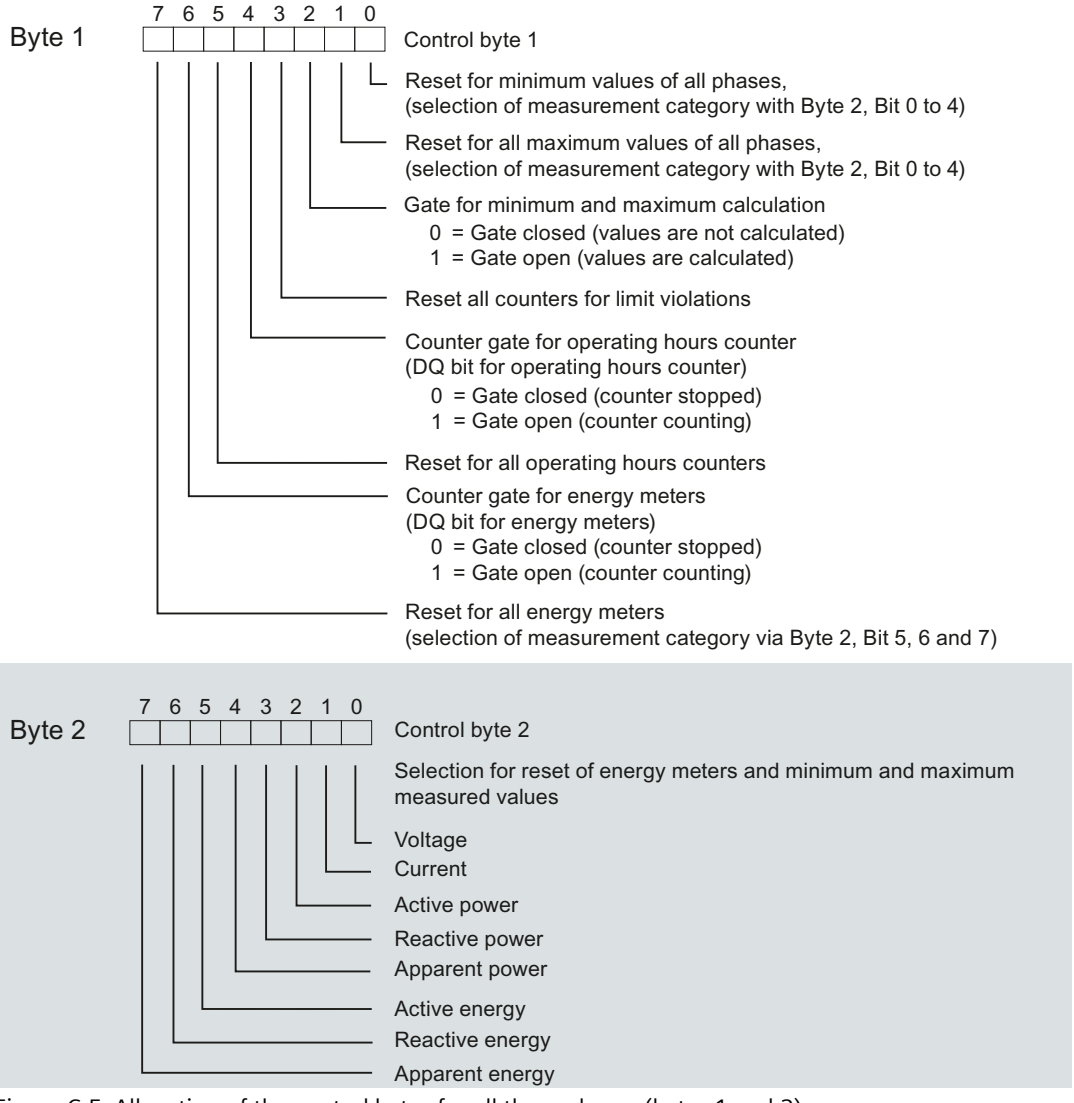


Figure C-5 Allocation of the control bytes for all three phases (bytes 1 and 2)

Control bytes for limit monitoring

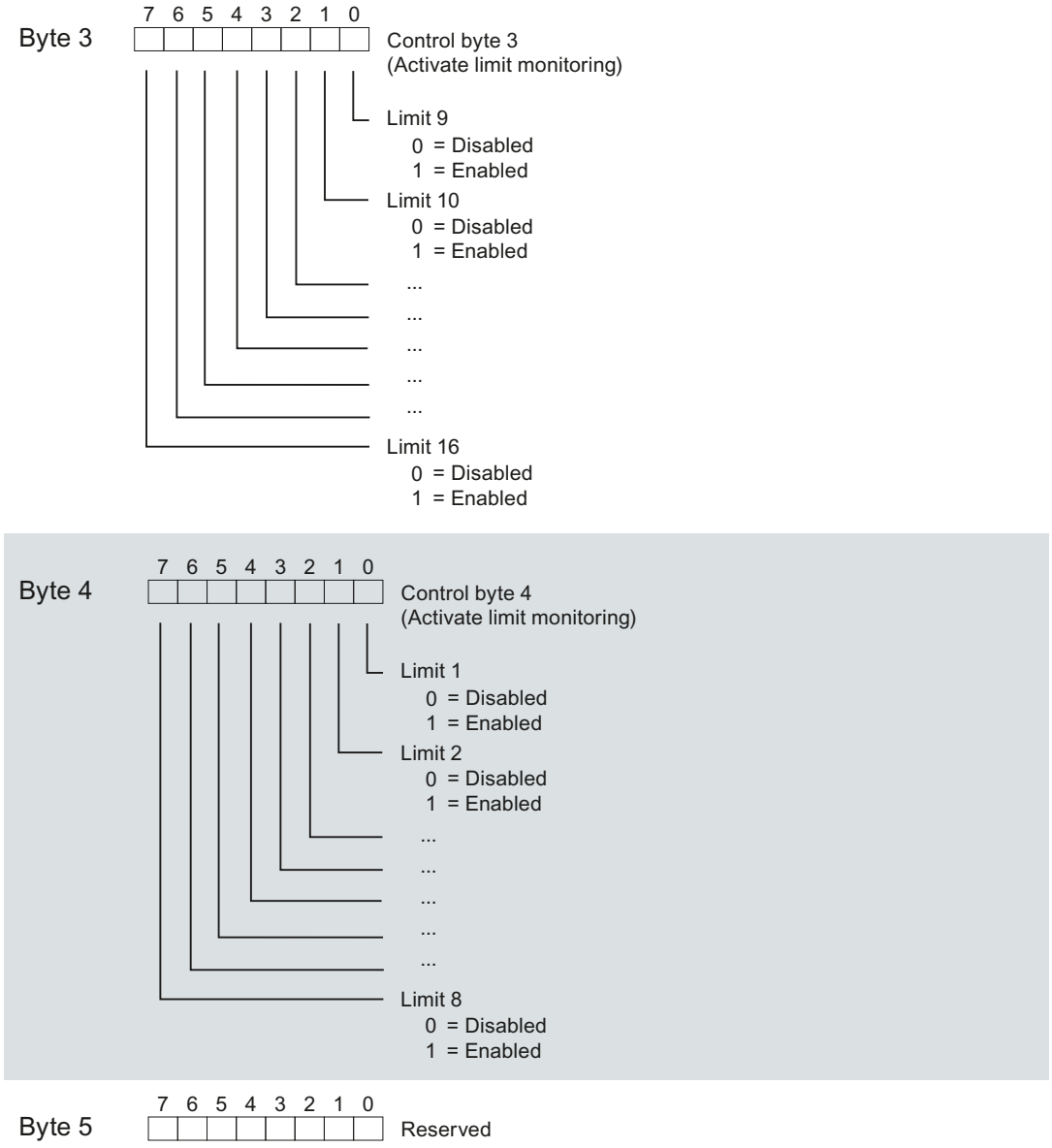


Figure C-6 Allocation of the control bytes for limit monitoring (bytes 3 to 5)

Control bytes for each individual phase

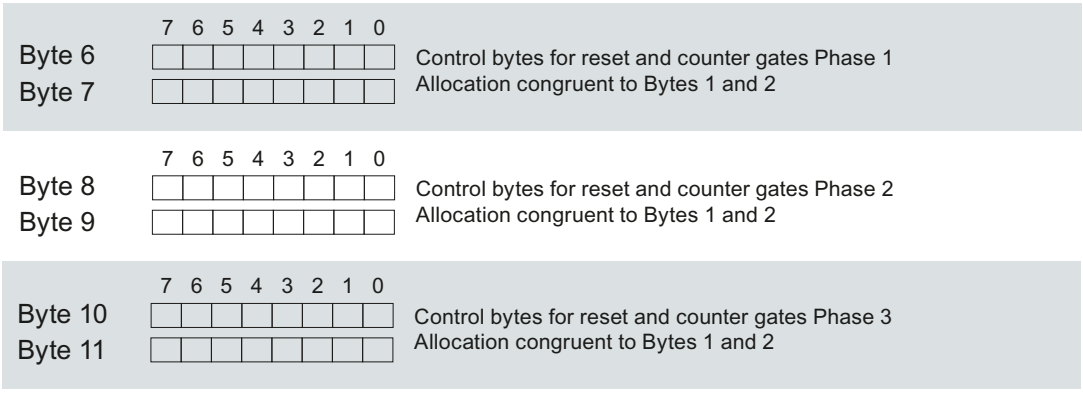


Figure C-7 Allocation of the control bytes for each individual phase (bytes 6 to 11)

Control byte 12 Power quality analysis

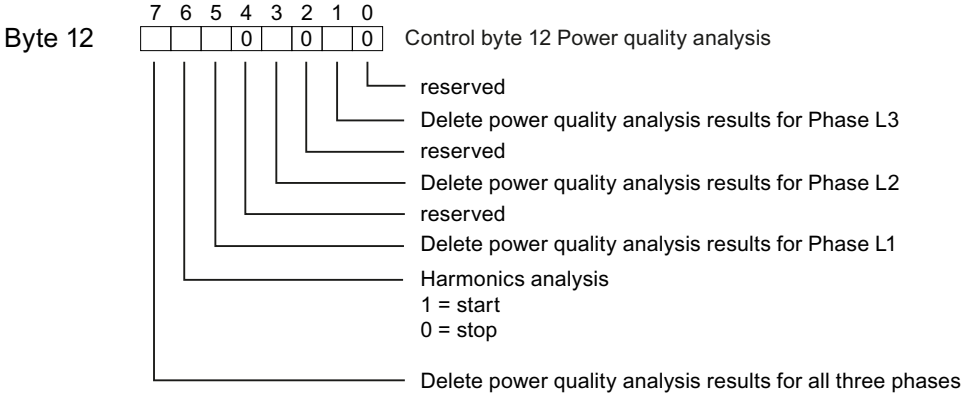


Figure C-8 Control byte 12 Power quality analysis

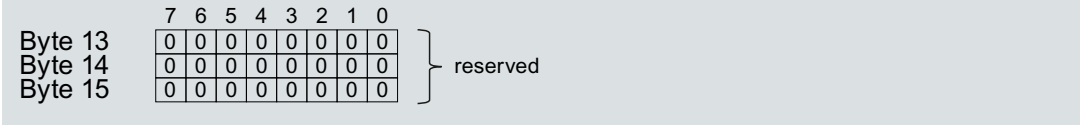


Figure C-9 Allocation of the control bytes for each individual phase (bytes 13 to 15)

Control byte reset functions

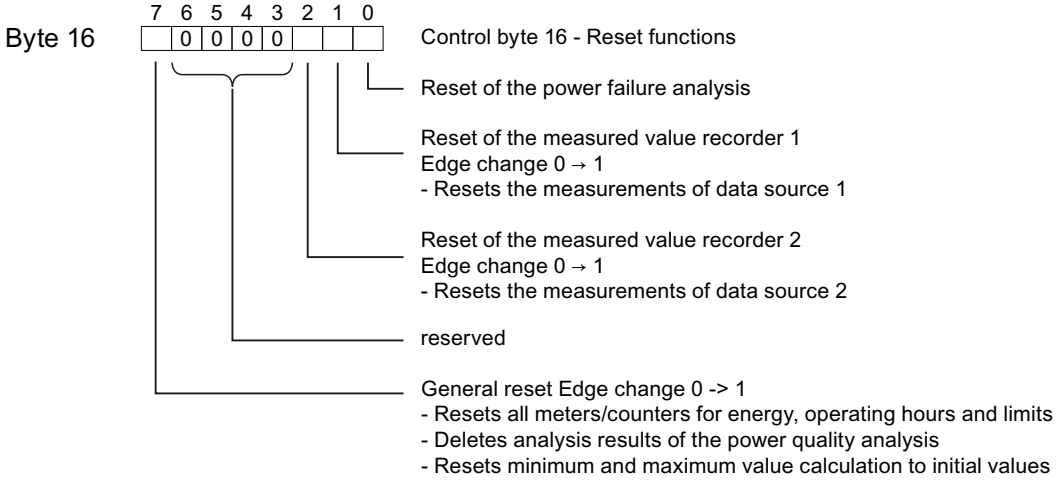


Figure C-10 Allocation of the control bytes for reset functions (byte 16)

Control byte measured value recorder trigger

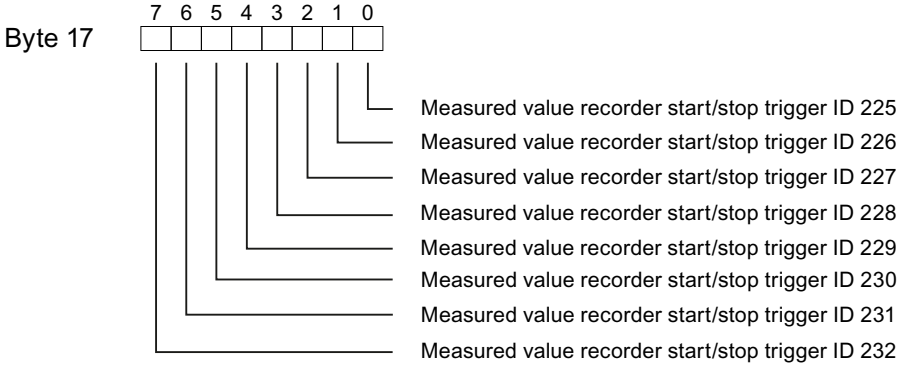


Figure C-11 Allocation of the control bytes for measured value recorder trigger (byte 17)

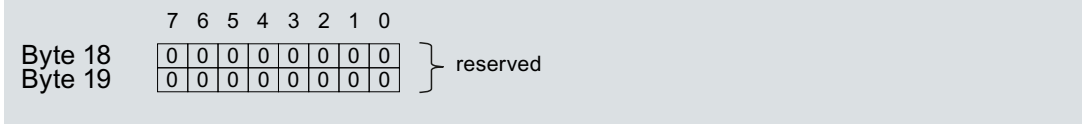


Figure C-12 Allocation of the control bytes for each individual phase (bytes 18 to 19)

C.3 "User-specific" module version

Payload of the module

The module occupies between 16 and 256 bytes of input payload and 20 bytes of output payload. 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 payload (as of Byte 2) or acyclically via measured value data records

Structure of input payload

You configure the structure of the input payload starting at Byte 2 at this module version itself. An input payload length of 32 bytes also allows you to set the input payload dynamically. You can choose between different payload variants.

Table C-5 Structure of input payload (16 to 256 bytes)

Byte	Validity	Designation	Comment
0	Module	Payload 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 payload is calculated automatically. • With configuration via the GSD file the size of the input payload 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 payload

You can change the measured variables during operation. You can choose between different payload 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 195).

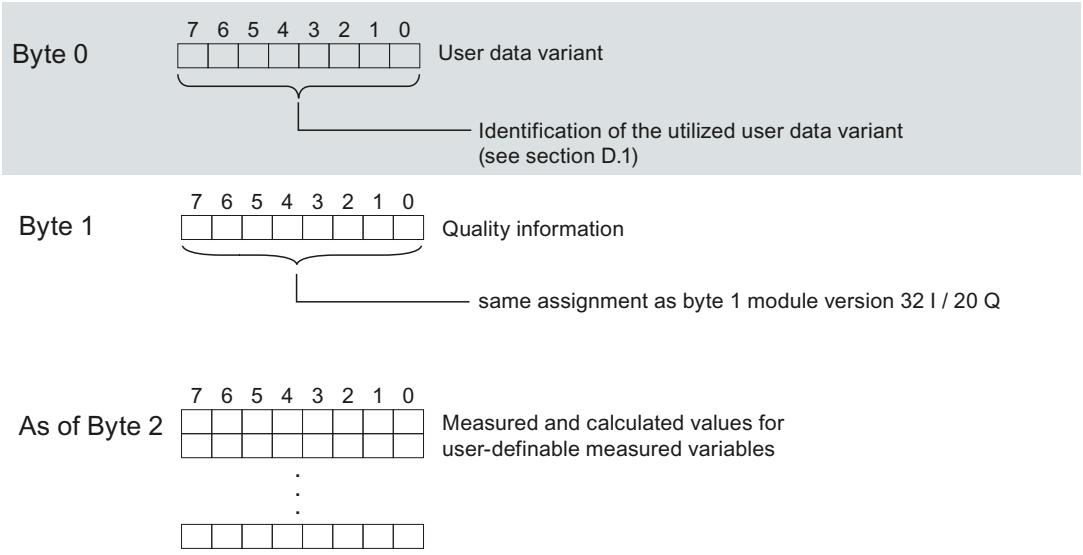


Figure C-13 Allocation of the input payload ("User-specific" module version"

NOTE

Behavior at switchover in case of the input payload being too small

If the configured size of the variable input payload is smaller than the sized of the fixed payload 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 payload variant: No switchover and no error message.

Structure of output payload

The structure of the 20-byte output payload is fixed and is identical to the output payload (control bytes) of the Module version "32 I / 20 Q" (Page 195).

C.4 Module version "EE@Industry measurement data profile E0 / E1 / E2 / E3"

Payload of the module

The four versions according to EE@Industry use between 4 and 104 bytes of input payload and 20 bytes of output payload. A dynamic switchover of the input payload is not possible.

Structure of input payload

The structure of the input payload 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 inflow L1L2L3 (Float)	REAL	1 Wh	0.0 ... 3.4028e+38	200
8...11	Active energy outflow L1L2L3 (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 inflow L1L2L3	LREAL	1 Wh	0.0 ... 1.7976e+308	210
32...39	Active energy outflow L1L2L3	LREAL	1 Wh	0.0 ... 1.7976e+308	211
40...47	Reactive energy inflow L1L2L3	LREAL	1 varh	0.0 ... 1.7976e+308	212

Byte	Allocation	Data type	Unit	Value range	Measured value ID
48...55	Reactive energy outflow L1L2L3	LREAL	1 varh	0.0 ... 1.7976e+308	213
56...59	Voltage L1-N	REAL	1 V	0.0 ... 1000000.0	1
60...63	Voltage L2-N	REAL	1 V	0.0 ... 1000000.0	2
64...67	Voltage L3-N	REAL	1 V	0.0 ... 1000000.0	3
68...71	Voltage L1-L2	REAL	1 V	0.0 ... 1000000.0	4
72...75	Voltage L2-L3	REAL	1 V	0.0 ... 1000000.0	5
76...79	Voltage L3-L1	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 λ L1	REAL	-	0.0 ... 1.0	19
96...99	Power factor λ L2	REAL	-	0.0 ... 1.0	20
100...-103	Power factor λ L3	REAL	-	0.0 ... 1.0	21

Structure of output payload

The structure of the 20-byte output payload is fixed and is identical to the output payload (control bytes) of the Module version "32 I / 20 Q" (Page 195).

User data variants

D

D.1 User data variants with 32 bytes input data / 20 bytes output data

Payload

The following table shows the existing payload variants.

Table D-1 Overview of the payload variants

Payload	Payload 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 payload structure I	1 (01_H)
User-defined payload structure II	2 (02_H)

Information on using and dynamic switching of the payload variants can be found under "Selection of the module version (Page 34)".

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	Payload 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	Payload 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

Byte	Allocation	Data type	Unit	Value range	Measured value ID
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
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	Payload 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

Byte	Allocation	Data type	Unit	Value range	Measured value ID
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	-
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	Payload 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	-

Byte	Allocation	Data type	Unit	Value range	Measured value ID
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	Payload 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	4000 ... 7000	66031

Total energy L1L2L3 (ID 249 or $F9_H$)

Table D-7 Total energy L1L2L3

Byte	Allocation	Data type	Unit	Value range	Measured value ID
0	Payload variant	BYTE	-	249 ($F9_H$)	-
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	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 $F8_H$)

Table D-8 Energy L1

Byte	Allocation	Data type	Unit	Value range	Measured value ID
0	Payload variant	BYTE	-	248 ($F8_H$)	-
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 ... 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	-

Byte	Allocation	Data type	Unit	Value range	Measured value ID
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 $F7_H$)

Table D-9 Energy L2

Byte	Allocation	Data type	Unit	Value range	Measured value ID
0	Payload variant	BYTE	-	247 ($F7_H$)	-
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 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 $F6_H$)

Table D-10 Energy L3

Byte	Allocation	Data type	Unit	Value range	Measured value ID
0	Payload variant	BYTE	-	246 ($F6_H$)	-
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 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 $F5_H$)

Table D-11 Basic variables three-phase measurements

Byte	Allocation	Data type	Unit	Value range	Measured value ID
0	Payload variant	BYTE	-	245 ($F5_H$)	-
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 L1L2L3	REAL	1 W	-3×10^9 ... $+3 \times 10^9$	34
6 ... 9	Active energy outflow L1L2L3	REAL	1 Wh	0.0 ... 3.4×10^{38}	201
10 ... 13	Active energy inflow L1L2L3	REAL	1 Wh	0.0 ... 3.4×10^{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 $F4_H$)

Table D-12 Reactive power compensation

Byte	Allocation	Data type	Unit	Value range	Measured value ID
0	Payload variant	BYTE	-	244 ($F4_H$)	-
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	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	-3×10^9 ... $+3 \times 10^9$	62124
10 ... 13	Fundamental reactive power L2	REAL	var	-3×10^9 ... $+3 \times 10^9$	62224
14 ... 17	Fundamental reactive power L3	REAL	var	-3×10^9 ... $+3 \times 10^9$	62324

Basic variables quality values three-phase measurement (ID 240 or $F0_H$)

Table D-13 Basic variables quality values three-phase measurement

Byte	Allocation	Data type	Unit	Value range	Measured value ID
0	Payload 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 of the limit violations 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	-

Byte	Allocation	Data type	Unit	Value range	Measured value ID
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	Payload 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

Byte	Allocation	Data type	Unit	Value range	Measured value ID
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	Payload 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	-3×10^9 ... $+3 \times 10^9$	13
6 ... 9	Active power L2	REAL	1 W	-3×10^9 ... $+3 \times 10^9$	14
10 ... 13	Active power L3	REAL	1 W	-3×10^9 ... $+3 \times 10^9$	15
14 ... 17	Reactive power Qtot L1	REAL	1 var	-3×10^9 ... $+3 \times 10^9$	22
18 ... 21	Reactive power Qtot L2	REAL	1 var	-3×10^9 ... $+3 \times 10^9$	23
22 ... 25	Reactive power Qtot L3	REAL	1 var	-3×10^9 ... $+3 \times 10^9$	24
26 ... 33	Active energy inflow L1L2L3	LREAL	1 Wh	0.0 ... 1.8×10^{308}	210
34 ... 41	Active energy outflow L1L2L3	LREAL	1 Wh	0.0 ... 1.8×10^{308}	211
42 ... 49	Reactive energy inflow L1L2L3	LREAL	1 varh	0.0 ... 1.8×10^{308}	212
50 ... 57	Reactive energy outflow L1L2L3	LREAL	1 varh	0.0 ... 1.8×10^{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 $E2_H$)

Table D-16 Basic variables measurement data profile Energy E2

Byte	Allocation	Data type	Unit	Value range	Measured value ID
0	Payload variant	BYTE	-	226 ($E2_H$)	-
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 L1L2L3	REAL	1 W	-3.0×10^9 ... $+ 3.0 \times 10^9$	34
6 ... 9	Active energy inflow L1L2L3 (Float)	REAL	1 W	3.0×10^9	200
10 ...13	Active energy outflow L1L2L3 (Float)	REAL	1 W	3.0×10^9	201

Basic variables measurement data profile (ID 225 or $E1_H$)

Table D-17 Basic variables measurement data profile Energy E1

Byte	Allocation	Data type	Unit	Value range	Measured value ID
0	Payload variant	BYTE	-	225 ($E1_H$)	-
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 L1L2L3	REAL	1 W	-3.0×10^9 ... $+ 3.0 \times 10^9$	34

Basic variables measurement data profile (ID 224 or $E0_H$)

Table D-18 Basic variables measurement data profile Energy E0

Byte	Allocation	Data type	Unit	Value range	Measured value ID
0	Payload variant	BYTE	-	224 ($E0_H$)	-
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	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 9F$_H$)

Table D-19 Basic variables phase-specific measurement L1

Byte	Allocation	Data type	Unit	Value range	Measured value ID
0	Payload 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 9E$_H$)

Table D-20 Single-phase measurement L1 with voltage scaling value

Byte	Allocation	Data type	Unit	Value range	Measured value ID
0	Payload 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

Byte	Allocation	Data type	Unit	Value range	Measured value ID
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	Payload 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 $9C_H$)

Table D-22 Single-phase measurement L2 with voltage scaling value

Byte	Allocation	Data type	Unit	Value range	Measured value ID
0	Payload 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 $9B_H$)

Table D-23 Basic variables phase-specific measurement L3

Byte	Allocation	Data type	Unit	Value range	Measured value ID
0	Payload variant	BYTE	-	155 ($9B_H$)	-
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

Byte	Allocation	Data type	Unit	Value range	Measured value ID
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	Payload 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	-

Byte	Allocation	Data type	Unit	Value range	Measured value ID
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 CT 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 maximum values (read only).
- Data record DS 154 for maximum values with time stamp (read only).
- Data record DS 145 for minimum values (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 (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 169 for power failure analysis (read only).
- Data record DS 170 information data record on available measured values (read only).
- Data record DS 173 for measured value recording recorder channel 1 (read only).
- Data record DS 174 for measured value recording recorder channel 2 (read only).

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).

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	40.0 ... 70.0	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
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

Byte	Measured variable	Data type	Unit	Value range	Measured value ID
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 CT 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 CT 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 162)).

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	40.0 ... 70.0	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

Byte	Measured variable	Data type	Unit	Value range	Measured value ID
86...89	Reactive power Qtot L2	REAL	var	-3.0 x 10^9 ... +3.0 x 10^9	23
90...93	Reactive power Qtot L3	REAL	var	-3.0 x 10^9 ... +3.0 x 10^9	24
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
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

Byte	Measured variable	Data type	Unit	Value range	Measured value ID
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
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

Byte	Measured variable	Data type	Unit	Value range	Measured value ID
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	PNIOTime	sec	-	65497

Neutral current

If you operate the AI Energy Meter CT 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 CT 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

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.

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...1-03	Active energy outflow (initial value) L3	LREAL	Wh		61221
104...-111	Reactive energy inflow (initial value) L3	LREAL	varh		61222
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	61190
130..1-31	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

Byte	Measured variable	Data type	Unit	Value range	Measured value ID
138...-139	Overflow counter active energy inflow L2	UINT	-	During writing for periodic counting: 0...65500	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: $0...3.4x10^{38}$ 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.

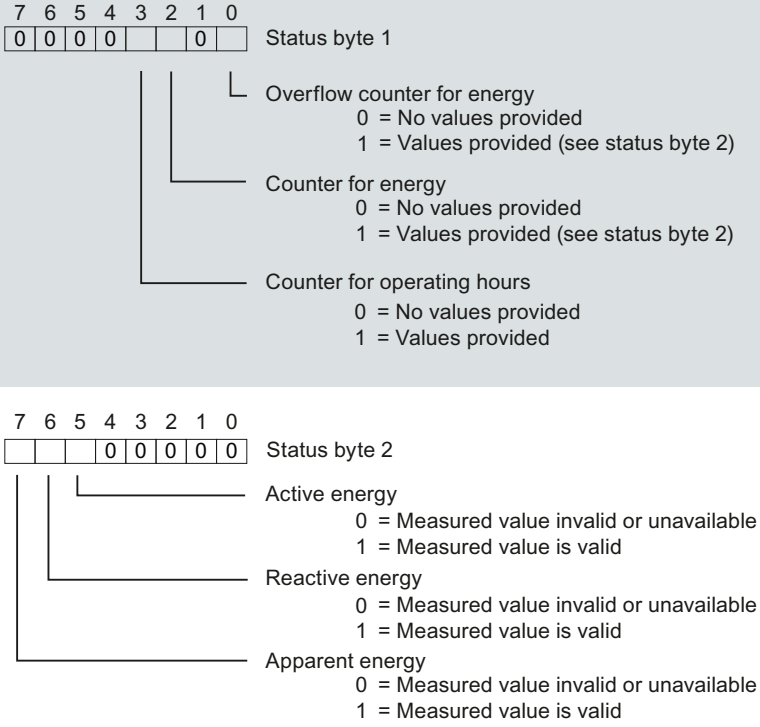


Figure E-1 Status information DS 143 (read access)

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.

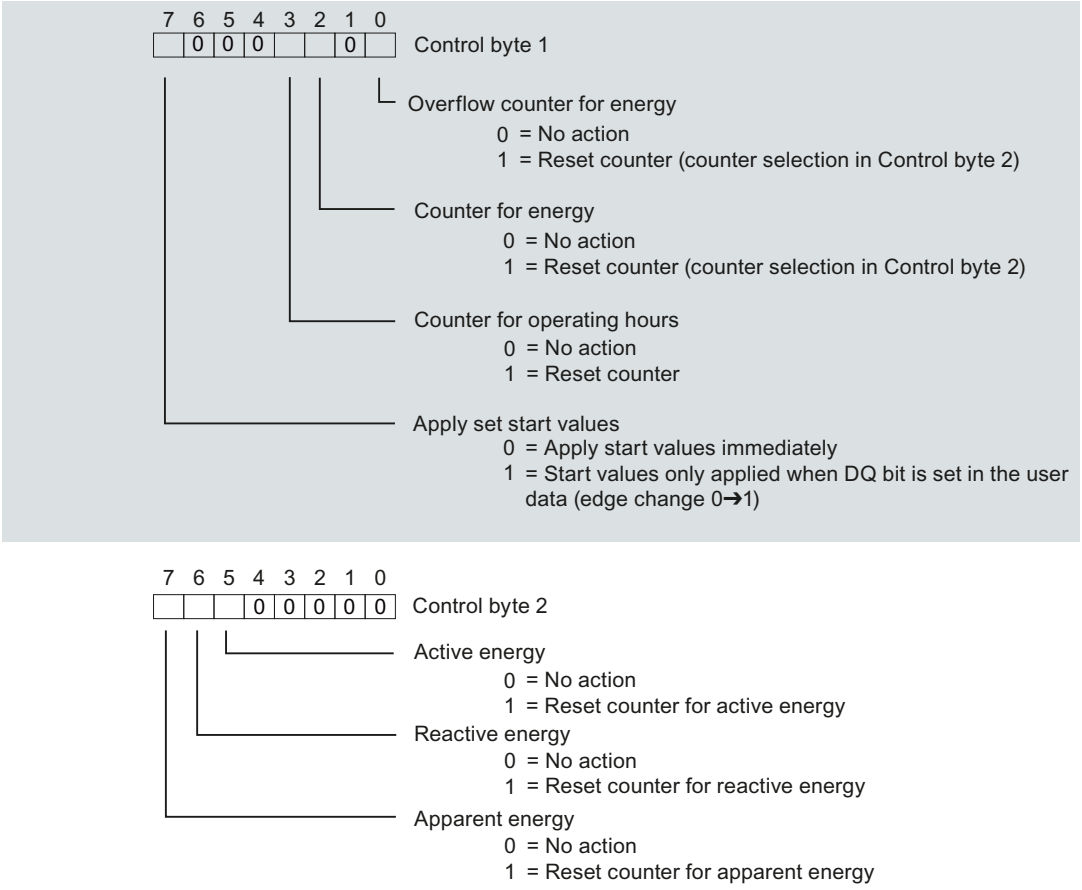


Figure E-2 Control information DS 143 (write access)

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 set the reserved bits back to 0.

Error code in STATUS parameter (hexadecimal)				Meaning	Solution
Byte 0	**Byte 1**	**Byte 2**	**Byte 3**		
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)

Measured variables of the module

The largest values ever measured or calculated from the time the 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 162)).

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

Byte	Measured variable	Data type	Unit	Default	Measured value ID
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	40	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
110...113	Max. reactive power Qn L2	REAL	var	-3.0×10^9	56
114...117	Max. reactive power Qn L3	REAL	var	-3.0×10^9	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	-3.0×10^9	62155
158...161	Max. fundamental apparent power L2	REAL	VA	-3.0×10^9	62255
162...165	Max. fundamental apparent power L3	REAL	VA	-3.0×10^9	62355
166...169	Max. fundamental reactive power L1	REAL	var	-3.0×10^9	62154
170...173	Max. fundamental reactive power L2	REAL	var	-3.0×10^9	62254
174...177	Max. fundamental reactive power L3	REAL	var	-3.0×10^9	62354
178...181	Max. fundamental active power L1	REAL	W	-3.0×10^9	62156
182...185	Max. fundamental active power L2	REAL	W	-3.0×10^9	62256
186...189	Max. fundamental active power L3	REAL	W	-3.0×10^9	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

Byte	Measured variable	Data type	Unit	Default	Measured value ID
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
226...229	Max. neutral current	REAL	A	0	61136

[1] The values reference the amount of the current measured value

E.5 Measured value data record for minimum values (DS 145)

Measured variables of the module

The smallest values ever measured or calculated from the time the 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 162)).

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

Byte	Measured variable	Data type	Unit	Default	Measured value ID
66...69	Min. reactive power Qtot L2	REAL	var	+3.0 x 10^9	62280
70...73	Min. reactive power Qtot L3	REAL	var	+3.0 x 10^9	62380
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	70	91
90...93	Min. apparent power L1L2L3	REAL	VA	+3.0 x 10^9	97
94...97	Min. active power L1L2L3	REAL	W	+3.0 x 10^9	95
98...101	Min. reactive power Qn L1L2L3	REAL	var	+3.0 x 10^9	61139
102...105	Min. power factor λ L1L2L3	REAL	-	1	98
106...109	Min. reactive power Qn L1	REAL	var	+3.0 x 10^9	85
110...113	Min. reactive power Qn L2	REAL	var	+3.0 x 10^9	86
114...117	Min. reactive power Qn L3	REAL	var	+3.0 x 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 x 10^9	62175
158...161	Min. fundamental apparent power L2	REAL	VA	+3.0 x 10^9	62275
162...165	Min. fundamental apparent power L3	REAL	VA	+3.0 x 10^9	62375
166...169	Min. fundamental reactive power L1	REAL	var	+3.0 x 10^9	62174
170...173	Min. fundamental reactive power L2	REAL	var	+3.0 x 10^9	62274
174...177	Min. fundamental reactive power L3	REAL	var	+3.0 x 10^9	62374
178...181	Min. fundamental active power L1	REAL	W	+3.0 x 10^9	62176
182...185	Min. fundamental active power L2	REAL	W	+3.0 x 10^9	62276
186...189	Min. fundamental active power L3	REAL	W	+3.0 x 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

Byte	Measured variable	Data type	Unit	Default	Measured value ID
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
226...229	Min. neutral current	REAL	A	100000.0	61137

[1] The values reference the amount of the current measured value

E.6 Measured value data record for phase-based measured values L1 (DS 147)

E.6.1 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).

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

Byte	Measured variable	Data type	Unit	Value range	Measured value ID
48...55	Total reactive energy L1	LREAL	varh	-1.8 x 10^{308} ... +1.8 x 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 x 10^9 ... +3.0 x 10^9	49
68...71	Max. active power L1	REAL	W	-3.0 x 10^9 ... +3.0 x 10^9	52
72...75	Max. reactive power Qtot L1	REAL	var	-3.0 x 10^9 ... +3.0 x 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 x 10^9 ... +3.0 x 10^9	79
92...95	Min. active power L1	REAL	W	-3.0 x 10^9 ... +3.0 x 10^9	82
96...99	Min. reactive power Qtot L1	REAL	var	-3.0 x 10^9 ... +3.0 x 10^9	62180
100...103	Min. power factor λ L1	REAL	-	0.0 ... 1.0	88

E.6.2 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).

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 x 10^9 ... +3.0 x 10^9	10
16...19	Active power L1	REAL	W	-3.0 x 10^9 ... +3.0 x 10^9	13
20...23	Reactive power Qtot L1	REAL	var	-3.0 x 10^9 ... +3.0 x 10^9	22
24...27	Power factor λ L1	REAL	-	0.0 ... 1.0	19

Byte	Measured variable	Data type	Unit	Value range	Measured value ID
28...31	Phase angle L1	REAL	°	0.0 ... 360.0	61178
32...39	Apparent energy L1	LREAL	VAh	0.0 ... 1.8 x 10^{308}	61184
40...47	Total active energy L1	LREAL	Wh	-1.8 x 10^{308} ... +1.8 x 10^{308}	61185
48...55	Total reactive energy L1	LREAL	varh	-1.8 x 10^{308} ... +1.8 x 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 x 10^{9} ... +3.0 x 10^{9}	49
68...71	Max. active power L1	REAL	W	-3.0 x 10^{9} ... +3.0 x 10^{9}	52
72...75	Max. reactive power Qtot L1	REAL	var	-3.0 x 10^{9} ... +3.0 x 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 x 10^{9} ... +3.0 x 10^{9}	79
92...95	Min. active power L1	REAL	W	-3.0 x 10^{9} ... +3.0 x 10^{9}	82
96...99	Min. reactive power Qtot L1	REAL	var	-3.0 x 10^{9} ... +3.0 x 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 x 10^{9} ... +3.0 x 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 x 10^{9} ... +3.0 x 10^{9}	55
120...123	Min. reactive power Qn L1	REAL	var	-3.0 x 10^{9} ... +3.0 x 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 x 10^{9} ... +3.0 x 10^{9}	62125
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

Byte	Measured variable	Data type	Unit	Value range	Measured value ID
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.7 Measured value data record for phase-based measured values L2 (DS 148)

E.7.1 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).

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

Byte	Measured variable	Data type	Unit	Value range	Measured value ID
88...91	Min. apparent power L2	REAL	VA	-3.0 x 10^9 ... +3.0 x 10^9	80
92...95	Min. active power L2	REAL	W	-3.0 x 10^9 ... +3.0 x 10^9	83
96...99	Min. reactive power Qtot L2	REAL	var	-3.0 x 10^9 ... +3.0 x 10^9	62280
100...103	Min. power factor λ L2	REAL	-	0.0 ... 1.0	89

E.7.2 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 variables for connection type).

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 x 10^9 ... +3.0 x 10^9	11
16...19	Active power L2	REAL	W	-3.0 x 10^9 ... +3.0 x 10^9	14
20...23	Reactive power Qtot L2	REAL	var	-3.0 x 10^9 ... +3.0 x 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 x 10^{308}	61204
40...47	Total active energy L2	LREAL	Wh	-1.8 x 10^{308} ... +1.8 x 10^{308}	61205
48...55	Total reactive energy L2	LREAL	varh	-1.8 x 10^{308} ... +1.8 x 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 x 10^9 ... +3.0 x 10^9	50
68...71	Max. active power L2	REAL	W	-3.0 x 10^9 ... +3.0 x 10^9	53

Byte	Measured variable	Data type	Unit	Value range	Measured value ID
72...75	Max. reactive power Qtot L2	REAL	var	-3.0 x 10^9 ... +3.0 x 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 x 10^9 ... +3.0 x 10^9	80
92...95	Min. active power L2	REAL	W	-3.0 x 10^9 ... +3.0 x 10^9	83
96...99	Min. reactive power Qtot L2	REAL	var	-3.0 x 10^9 ... +3.0 x 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 x 10^9 ... +3.0 x 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 x 10^9 ... +3.0 x 10^9	56
120...123	Min. reactive power Qn L2	REAL	var	-3.0 x 10^9 ... +3.0 x 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 x 10^9 ... +3.0 x 10^9	62225
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

Byte	Measured variable	Data type	Unit	Value range	Measured value ID
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.8 Measured value data record for phase-based measured values L3 (DS 149)

E.8.1 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).

Byte	Measured variable	Data type	Unit	Value range	Measured value ID
0	Version	BYTE	-	0	-
1	Reserved	BYTE	-	0	-

Byte	Measured variable	Data type	Unit	Value range	Measured value ID
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.8.2 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).

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

Byte	Measured variable	Data type	Unit	Value range	Measured value ID
100...103	Min. power factor λ L3	REAL	-	0.0 ... 1.0	90
104...107	Reactive power Qn L3	REAL	var	-3.0 x 10^9 ... +3.0 x 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 x 10^9 ... +3.0 x 10^9	57
120...123	Min. reactive power Qn L3	REAL	var	-3.0 x 10^9 ... +3.0 x 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 x 10^9 ... +3.0 x 10^9	62325
136...139	Fundamental reactive power L3	REAL	var	-3.0 x 10^9 ... +3.0 x 10^9	62324
140...143	Fundamental active power L3	REAL	W	-3.0 x 10^9 ... +3.0 x 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 x 10^9 ... +3.0 x 10^9	62355
160...163	Max. fundamental reactive power L3	REAL	var	-3.0 x 10^9 ... +3.0 x 10^9	62354
164...167	Max. fundamental active power L3	REAL	W	-3.0 x 10^9 ... +3.0 x 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 x 10^9 ... +3.0 x 10^9	62375
184...187	Min. fundamental reactive power L3	REAL	var	-3.0 x 10^9 ... +3.0 x 10^9	62374
188...191	Min. fundamental active power L3	REAL	W	-3.0 x 10^9 ... +3.0 x 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

Byte	Measured variable	Data type	Unit	Value range	Measured value ID
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.9 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).

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

Byte	Measured variable	Data type	Unit	Value range	Measured value ID
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
88...91	Power quality analysis - Qualifier	UDINT	Bit string	-	65496
92...103	Current module time	PNIOTime	sec	-	65497

[1] Energy counters count periodically - counter overflow at:

E.10 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 158).

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.11 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 the 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).
More detailed information about the structure of time stamps is available in section Time synchronization and time stamp (Page 53).

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
258...273	Max. reactive power Qtot L2	REAL + PNIO Time	var	-3.0×10^9	62260
274...289	Max. reactive power Qtot L3	REAL + PNIO Time	var	-3.0×10^9	62360
290...305	Max. power factor λ L1	REAL + PNIO Time	-	0	58

Byte	Measured variable	Data type	Unit	Default	Measured value ID
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	40	61
354...369	Max. apparent power L1L2L3	REAL + PNIO Time	VA	0	67
370...385	Max. active power L1L2L3	REAL + PNIO Time	W	-3.0×10^9	65
386...401	Max. reactive power Qtot L1L2L3	REAL + PNIO Time	var	-3.0×10^9	61138
402...417	Max. power factor λ L1L2L3	REAL + PNIO Time	-	0	68
418...433	Max. reactive power Qn L1	REAL + PNIO Time	var	-3.0×10^9	55
434...449	Max. reactive power Qn L2	REAL + PNIO Time	var	-3.0×10^9	56
450...465	Max. reactive power Qn L3	REAL + PNIO Time	var	-3.0×10^9	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	-3.0×10^9	62155
626...641	Max. fundamental apparent power L2	REAL + PNIO Time	VA	-3.0×10^9	62255
642...657	Max. fundamental apparent power L3	REAL + PNIO Time	VA	-3.0×10^9	62355

Byte	Measured variable	Data type	Unit	Default	Measured value ID
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
898...913	Max. neutral current	REAL + PNIO Time	A	0	61136

[1] The values reference the amount of the current measured value

E.12 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 the 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).

More detailed information about the structure of time stamps is available in section Time synchronization and time stamp (Page 53).

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
178...193	Min. apparent power L3	REAL + PNIO Time	VA	$+3.0 \times 10^9$	81
194...209	Min. active power L1	REAL + PNIO Time	W	$+3.0 \times 10^9$	82
210...225	Min. active power L2	REAL + PNIO Time	W	$+3.0 \times 10^9$	83
226...241	Min. active power L3	REAL + PNIO Time	W	$+3.0 \times 10^9$	84
242...257	Min. reactive power Qtot L1	REAL + PNIO Time	var	$+3.0 \times 10^9$	62180
258...273	Min. reactive power Qtot L2	REAL + PNIO Time	var	$+3.0 \times 10^9$	62280
274...289	Min. reactive power Qtot L3	REAL + PNIO Time	var	$+3.0 \times 10^9$	62380
290...305	Min. power factor λ L1	REAL + PNIO Time	-	1	88

Byte	Measured variable	Data type	Unit	Default	Measured value ID
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	70	91
354...369	Min. apparent power L1L2L3	REAL + PNIO Time	VA	$+3.0 \times 10^9$	97
370...385	Min. active power L1L2L3	REAL + PNIO Time	W	$+3.0 \times 10^9$	95
386...401	Min. reactive power Qn L1L2L3	REAL + PNIO Time	var	$+3.0 \times 10^9$	61139
402...417	Min. power factor λ L1L2L3	REAL + PNIO Time	-	1	98
418...433	Min. reactive power Qn L1	REAL + PNIO Time	var	$+3.0 \times 10^9$	85
434...449	Min. reactive power Qn L2	REAL + PNIO Time	var	$+3.0 \times 10^9$	86
450...465	Min. reactive power Qn L3	REAL + PNIO Time	var	$+3.0 \times 10^9$	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	$+3.0 \times 10^9$	62175
626...641	Min. fundamental apparent power L2	REAL + PNIO Time	VA	$+3.0 \times 10^9$	62275
642...657	Min. fundamental apparent power L3	REAL + PNIO Time	VA	$+3.0 \times 10^9$	62375
658...673	Min. fundamental reactive power L1	REAL + PNIO Time	var	$+3.0 \times 10^9$	62174

Byte	Measured variable	Data type	Unit	Default	Measured value ID
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
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
898...913	Min. neutral current	REAL + PNIO Time	A	100000.0	61137

[1] The values reference the amount of the current measured value

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).

Byte	Measured variable	Data type	Unit	Value range	Measured value ID
0	Version	BYTE	-	0	-
1	Reserved	BYTE	-	0	-

Byte	Measured variable	Data type	Unit	Value range	Measured value ID
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 x 10^9 ... +3.0 x 10^9	61154
18...21	Max. (fundamental) reactive power L1L2L3	REAL	var	-3.0 x 10^9 ... +3.0 x 10^9	61155
22...25	Min. (fundamental) reactive power L1L2L3	REAL	var	-3.0 x 10^9 ... +3.0 x 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 x 10^9 ... +3.0 x 10^9	62124
34...37	Fundamental reactive power L2	REAL	var	-3.0 x 10^9 ... +3.0 x 10^9	62224
38...41	Fundamental reactive power L3	REAL	var	-3.0 x 10^9 ... +3.0 x 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

Byte	Measured variable	Data type	Unit	Value range	Measured value ID
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
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 unbalance voltage U_2	REAL	%	0 ... 100	61157
214...217	Amplitude unbalance current I_{asym}	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).

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

Byte	Measured variable	Data type	Unit	Value range	Measured value ID
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
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

Byte	Measured variable	Data type	Unit	Value range	Measured value ID
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
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

Byte	Measured variable	Data type	Unit	Value range	Measured value ID
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
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	PNIOTime	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).

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

Byte	Measured variable	Data type	Unit	Value range	Measured value ID
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
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

Byte	Measured variable	Data type	Unit	Value range	Measured value ID
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
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

Byte	Measured variable	Data type	Unit	Value range	Measured value ID
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
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

Byte	Measured variable	Data type	Unit	Value range	Measured value ID
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	PNIOTime	sec	-	65497

E.16 Measured value data record for power failure analysis (DS 169)

Evaluation of the results of the power failure analysis in data record 169

The "Switch-off time/Switch-on time" pair of the stored times is the result of the module failure time. The "Overflow" cell shows the number of overflows of this list. This will inform you about how much information is no longer stored in the module. The "Next index" cell is a pointer to the new list index for the next entry and thus does not contain any information or the oldest information form the last potential overflow. Note that "Next index" as list index has the value range from 0 to 8 and thus shows, for example, "Next index = 1" to the pair "2: Switch-off time/ 2: Switch-on time". The cell "Current time" provides the module time as of the time when the DS169 was read.

You can find the description of the function "Power failure analysis" in the section Power failure analysis (Page 91).

Data record 169

Byte	Measured variable	Data type	Unit	Value range
0	Version	BYTE	-	0
1	Reserved	BYTE	-	0
2	Next index	BYTE	-	0 ... 8
3	Overflow	BYTE	-	0 ... 255
4 ... 15	1: Switch-off time	PNIOTime	sec	-
16 ... 27	1: Switch-on time	PNIOTime	sec	-
28 ... 39	2: Switch-off time	PNIOTime	sec	-
40 ... 51	2: Switch-on time	PNIOTime	sec	-

Byte	Measured variable	Data type	Unit	Value range
52 ... 63	3: Switch-off time	PNIOTime	sec	-
64 ... 75	3: Switch-on time	PNIOTime	sec	-
76 ... 87	4: Switch-off time	PNIOTime	sec	-
88 ... 99	4: Switch-on time	PNIOTime	sec	-
100 ... 111	5: Switch-off time	PNIOTime	sec	-
112... 123	5: Switch-on time	PNIOTime	sec	-
124 ... 135	6: Switch-off time	PNIOTime	sec	-
136 ... 147	6: Switch-on time	PNIOTime	sec	-
148 ... 159	7: Switch-off time	PNIOTime	sec	-
160 ... 171	7: Switch-on time	PNIOTime	sec	-
172 ... 183	8: Switch-off time	PNIOTime	sec	-
184 ... 195	8: Switch-on time	PNIOTime	sec	-
196 ... 207	9: Switch-off time	PNIOTime	sec	-
208 ... 219	9: Switch-on time	PNIOTime	sec	-
220 ... 231	Current module time	PNIOTime	sec	-

E.17 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	-	-

E.18 Measured value data record for measured value recording 1 (DS 173)

Measured variables of the module

The following table provides an overview of all the measured variables from the measured value recorder, record 1 (see section Measuring value recorder). 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.

Table E-4 Data record 173

Byte	Measured variable	Data type	Unit	Value range
0	Version	BYTE	-	0
1	Status bits	BYTE	-	80h: Recording ended 40h: Recording in progress 00h: Evaluating data not useful
2 ... 3	Number of measured values	UINT16	-	0 ... 200
4 ... 5	Stop index	UINT16		0 ... 199
6	Overflow	BYTE	-	0 ... 255
7	Recorder status	BYTE	-	0: Initial status 3: Recorder parameterized 4: Recording in progress 5: Recording ended 6: Recording stopped
8 ... 19	Current module time	PNIO Time	sec	-
20 ... 23	Measured value 1	REAL	Depending on measured value	Depending on measured value
24 ... 27	Measured value 2	REAL	Depending on measured value	Depending on measured value
...	...	...	...	...
816 ... 819	Measured value 200	REAL	Depending on measured value	Depending on measured value

In "Circular buffer" mode, the "Stop index" always shows the last recorded element during the ongoing recording. Note that the "Stop index" serves as an index in the measured value list and can therefore take on the values from 0 to 199. If the circular buffer is filled once, the current element is always the last one in the buffer ("Stop index" = 199). The "Overflow" measured variable displays the number of circular buffer overflows. If the function is stopped, the "Stop index" points to the measured value at the stop trigger event. In "once" mode, the "Stop index" will initially stop during a restart until the next stop. This makes the last recording interruption visible in the data. The time information "Current module time" corresponds to the time of the last measured value recording.

E.19 Measured value data record for measured value recording 2 (DS 174)

Measured variables of the module

The following table provides an overview of all the measured variables from the measured value recorder, record 2 (see section Measuring value recorder). 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.

Table E-5 Data record 174

Byte	Measured variable	Data type	Unit	Value range
0	Version	BYTE	-	0
1	Status bits	BYTE	-	80h: Recording ended 40h: Recording in progress 00h: Evaluating data not useful
2 ... 3	Number of measured values	UINT16	-	0 ... 200
4 ... 5	Stop index	UINT16		0 ... 199
6	Overflow	BYTE	-	0 ... 255
7	Recorder status	BYTE	-	0: Initial status 3: Recorder parameterized 4: Recording in progress 5: Recording ended 6: Recording stopped
8 ... 19	Current module time	PNIO Time	sec	-
20 ... 23	Measured value 1	REAL	Depending on measured value	Depending on measured value
24 ... 27	Measured value 2	REAL	Depending on measured value	Depending on measured value
...	...	...	...	...
816 ... 819	Measured value 200	REAL	Depending on measured value	Depending on measured value

In "Circular buffer" mode, the "Stop index" always shows the last recorded element during the ongoing recording. Note that the "Stop index" serves as an index in the measured value list and can therefore take on the values from 0 to 199. If the circular buffer is filled once, the current element is always the last one in the buffer ("Stop index" = 199). The "Overflow" measured variable displays the number of circular buffer overflows. If the function is stopped, the "Stop index" points to the measured value at the stop trigger event. In "once" mode, the "Stop index" will initially stop during a restart until the next stop. This makes the last recording interruption visible in the data. The time information "Current module time" corresponds to the time of the last measured value recording.

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 CT HF can be processed further and visualized.
You can find this application example on the Internet (https://support.industry.siemens.com/cs/ww/en/view/86299299).

Overview of the measurement data with update time

We provide you with an overview of the assignment of the measured values to the payload 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 CT HF and work with measured values with time stamps.
You can find this application example on the Internet (https://support.industry.siemens.com/cs/ww/en/view/109754890).

Rotating field

To recognize wiring errors and evaluate the generated rotating field, you use the combined measurement functions from the section Notes for the recognition of wiring errors and incorrect rotating field (Page 49).

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 (https://support.industry.siemens.com/cs/ww/en/view/56600676).