SIEMENS

Digital Fault Recorder

SIMEAS R-PMU

V40.01

Manual

E50417-H1076-C360-A5

Information for your safety

> This manual does not represent a complete listing of all the safety measures required to operate the equipment (module, device) since specific operating conditions may make further measures necessary. However, it contains information which you have to observe in order to ensure your personal safety and in order to avoid material damage. The information is highlighted by a warning triangle and, depending on the degree of danger, is shown as follows:

DANGER

DANGER means that death or severe injury **will** result if the measures specified are not taken.

- Comply with all instructions, in order to avoid death or severe injuries.

WARNING

WARNING means that death or severe injury **can** result if the measures specified are not taken.

- Comply with all instructions, in order to avoid death or severe injuries.

CAUTION

CAUTION means that minor or moderate injury **may** occur if the measures specified are not taken.

- Comply with all instructions, in order to avoid moderate or minor injuries.

NOTICE

NOTICE means that material damage **can** result if the measures specified are not taken.

- Comply with all instructions, in order to avoid material damage.

Note

Important information about the product, product handling or a certain section of the documentation, which must be given particular attention.

Qualified personnel

Commissioning and operation of the equipment (module, device) described in this manual must be performed by qualified personnel only. As used in the safety notes contained in this manual, qualified personnel are those persons who are authorized to commission, release, ground, and tag devices, systems and electrical circuits in accordance with the safety standards.

Use as prescribed

The equipment (device, module) must not be used for any other purposes than those described in the Catalogue and the Technical Description. If it is used together with third party devices and components, these must be recommended or approved by Siemens.

Correct and safe operation of the product requires adequate transportation, storage, installation, and mounting as well as appropriate use and maintenance.

During operation of electrical equipment, it is unavoidable that certain parts of this equipment will carry dangerous voltages. Severe injury or damage to property can occur if the appropriate measures are not taken:

- Before making any connections at all, ground the equipment at the PE terminal.

- Hazardous voltages can be present on all switching components connected to the power supply.

- Even after the supply voltage has been disconnected, hazardous voltages can still be present in the equipment (capacitor storage).

- Equipment with current transformer circuits must not be operated while open.

- The limit values indicated in the manual must not be exceeded; that also applies to testing and commissioning.

Foreword

Purpose of the manual

This manual generally describes the installation, commissioning, parameterization and operation of a SIMEAS R-PMU device.

Target audience

This manual is intended for project engineers, commissioning and operating personnel in electrical systems and power plants.

Validity of the manual

This manual is valid for the SIMEAS R-PMU device.

Contact

For any questions concerning your system, please contact your local Siemens representative.

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Indication of conformity

$C\epsilon$	This product complies with the directive of the Council of the European Communities on the approximation of the laws of the Member States relating to electromagnetic compatibility (EMC Council Directive 2004/108/EC) and concerning electrical equipment for use within specified voltage limits (Low-voltage Directive 2006/95/EC).
	This conformity has been established by means of tests conducted by Siemens AG in accordance of the Council Directive in agreement with the generic standards EN 61000-6-2 and EN 61000-6-4 for the EMC directives, and with the standard EN 61010-1 for the low-voltage directive.
	The device has been designed and produced for industrial use.
	The product conforms to the standards IEEE Std C37.118-2005 and EN 60688.

Contents

Introduction **1**

Shortly after digital protection devices had been introduced, many experts predicted the soon to come end of digital fault recorders. However, things turned out rather different since the further development of the fault recorders provided completely new functions. The application of these functions facilitates a more transparent management of communications and distribution systems, as well as of power plants.

Modern digital fault recorders or "universal recording devices" are mainly installed for the following reasons today:

❑ Although the term "digital fault recorder" is still alive for historical reasons, it would be more appropriate to talk about "modern recording devices" because the new functions not only include the recording of faults but also of system and power plant conditions which are critical but do not necessarily cause a malfunction. Application engineers can use the recording of critical conditions such as power oscillations, frequency variations, ferromagnetic resonance effects etc., in order to implement countermeasures well in time.

❑ The triggered recording function Transient Phasor Recorder (TPR) can be used for the most exact recording of oscillations in active and reactive power, frequency, rms values of the currents and voltages. An analysis of the records makes it possible, for example, to assess the quality of the power plant control system.

❑ The continuous recorders such as Continuous Phasor Recorder (CPR) and various continuous mean value recorders can be used for a comprehensive analysis of long-term problems in voltage and frequency stability, power oscillations etc.

❑ With the application of the Phasor Measurement Unit function in power plants, as well as in high-voltage and extra high-voltage switching stations, the current load situation of the system can be determined and bottlenecks can be detected.

❑ In digital protection devices, the Transient Analog Recorder (TAR) function is almost exclusively triggered by internal, integrated protective functions. However, there are system conditions that do not cause a pickup of the protection devices but pose a danger in the long run. An example is the ferromagnetic resonance effect that is caused by the stray capacitance of a substation and the inductances of the voltage transformers and may lead to the explosion of the voltage transformers. Another example is the Ferranti effect occurring in long lines. There may be significant voltage increases at the end of a line without load.

❑ The scanning frequency of modern protection devices is 600 Hz to 1.2 kHz, in few cases higher. It is not rare that cables are laid unfavorably in the substation and thus cause stray capacitances of the cables, or the inductance of the voltage transformers leads to high-frequency fault signals in the voltage path in the event of a short-circuit. These can cause delayed reactions in the protection devices, sometimes even non-selective tripping. A similar effect can also be caused by capacitor voltage dividers. Fault recorders with a scanning frequency between 5 kHz and 10 kHz are used in order to exactly understand such problems and to develop appropriate countermeasures.

- ❏ Nowadays, most of the substations feature protection devices of different suppliers that even belong to different generations. If a system malfunction has occurred, the user often has to restart the corresponding PC software for each device, manually build up a connection, download the fault record and then perform the analyses. A fault recorder system with automatic communication and self-starting application programs offers an attractive alternative.

- ❏ All substations that are mainly equipped with electromagnetic protection devices should be provided with a modern recording system.

- ❏ Please note that false trippings of protection devices may occur frequently, especially in regions with a strong input to the system. In the majority of cases, the reason is a wrong parameterization. However, the settings of protection devices can be optimized by monitoring the TRIP commands of all protection devices and by recording the faults with modern recording devices.

The following chapter describes the most important applications of modern recording systems.

Applications

2

Contents

The following chapters introduce the most important applications and functions.

2.1 Recording Systems in Power Plants

The operating personnel in power plants want to analyze and understand the following problems:

❑ A short-circuit occurs on the generator during the start-up phase before the generator has reached the nominal frequency of the system voltage. During this period, the generator frequency ranges from 0 Hz up to the nominal value f_n . Only the Transient Analog Recorder function is required during this phase.

❑ The generator's circuit breaker is closed. Possible faults such as a wrong phase sequence or insufficient synchronization must be recorded during this period. The Transient Analog Recorder function is also necessary in this case.

❑ A short-circuit occurs on the generator or in the communications system, after the generator has been connected to the system and has been in operation without any problems. In this case, the Transient Analog Recorder function is also required. The records must be used to analyze the cause of the short-circuit at the generator.

❑ Local or inter-area oscillations occur: These oscillations can put an enormous load on the generator shaft, e. g., if no electronic stabilization measures (Power System Stabilizer, PSS) are provided or this electronic unit has not been adjusted appropriately. Such malfunctions can be recorded precisely with the Transient Phasor Recorder (TPR) and the Continuous Phasor Recorder (CPR). The process signal inputs are a special feature that can be used to record the electronic signals of the PSS and further important variables such as the generator's excitation current, the steam pressure etc. Afterwards, these signals can be compared to the rms value curves for voltage and current and an analysis can be performed.

❑ Oscillations between the power plant and the communications system can cause enormous damage to the generator, if they are not recognized and eliminated well in time. This is usually the field of application for distance protection devices. The "Transient Phasor Recorder (TPR)" function can be used to exactly record the system condition prior to, during and after the oscillation event. If the Transient Analog Recorder has also been activated, it can be clarified, e. g., whether a local or a distant short-circuit in the system caused the oscillation, or whether a load or generator shedding led to this system condition.

❑ The Phasor Measurement Unit function is used to monitor large communications systems. The system voltage, system current and system frequency phasors are calculated precisely and provided with a time stamp. Via a communication channel, the calculated data is continuously sent to a computer that is called the Phasor Data Concentrator (PDC). The data of several PMUs is processed in the PDC thus ensuring that bottlenecks in the communications system, line overloads etc. can be detected.

❑ In order to enable a detailed analysis of problems such as the long-term stability of the system voltage and system frequency, the functions Continuous Phasor Recorder (CPR), Continuous Frequency Recorder (CFR), Continuous RMS-value Recorder (CRR) and Continuous Power Recorder (CQR) must be used. These functions facilitate the recording of long-term curves for currents and voltages, active and reactive power curves, system frequency curves and curves of other important system variables. Recording functions such as Continuous Process Signal Recorder (CDR) and Event Recorder (ER) provide more extensive and detailed records.

As described above, the use of a modern recording device and the correct application of the corresponding functions allows for a most precise recording and subsequent analysis of the electrical events in and around the power plant.

2.2   **Recording Systems in Communications Systems**

Most of the digital recording systems are installed in the substations for communications systems. Although the main field of application is still the fault analysis and thus the use of the Transient Analog Recorder (TAR) function, the other functions are also used to an increasing degree, in order to understand stability problems of the power supply system and to work out appropriate countermeasures:

❑ Capacitor voltage dividers are used in several communications systems. In the event of a short-circuit in the line, high-frequency signals can occur in the voltage path that may cause failures to operate or unwanted operations of protection devices. Such transient events and the behavior of the protection devices can be analyzed in detail with the Transient Analog Recorder (TAR) function.

❑ Compensating reactors installed at the beginning and end of transmission lines form a resonant circuit with the line capacitance and/or a series capacitor. Sympathetic oscillations that last for several cycles can occur when a line is switched off. With single-pole auto-reclosings, these oscillations can significantly corrupt the measured values of protection devices and thus cause false trippings. This is why sympathetic oscillations that occur after the line has been switched off must be recorded and analyzed using a Transient Analog Recorder (TAR).

❑ Inductances of voltage transformers and stray capacitances in the substations (busbars, lines) may lead to ferromagnetic resonance effects. Under normal circumstances, these problems are not recorded by the protection devices. If such problems are not recognized in time and countermeasures are not taken, however, they may cause considerable damage to the substation such as, e. g., the explosion of voltage transformers. A Transient Analog Recorder (TAR) is required to record such events.

❑ Wide area measurements can be performed with the Transient Phasor Recorder (TPR) and the Phasor Measurement Unit (PMU). The purpose of the measurements is to recognize power oscillations, oscillation events, voltage and frequency stability problems.

❑ The use of Continuous Recorders is gaining more and more importance. These functions facilitate the detailed analysis of long-term stability problems. Such measurements provide a solid basis for expensive investments such as the purchase of compensation systems (SVC) etc.

2.3 Recording Systems in High-Voltage Direct Current Substations

The use of modern recording systems in high-voltage direct current (HVDC) transmission systems is completely different from the application in communications systems or power plants.

The classic Transient Analog Recorder (TAR) function is very important in conjunction with the process signal inputs. This combination allows you to record both alternating voltage and direct voltage variables at the same time. In some cases, it is even desired that the firing pulses for thyristors be recorded using the binary channels. This function may be used in Flexible Alternating Current Transmission Systems (FACTS) and in thyristor-controlled reactive power compensation systems.

It is to be expected that the Transient Phasor Recorder (TPR), Continuous Phasor Recorder (CPR) and Phasor Measurement Unit (PMU) functions will be used increasingly in the future, to supervise the function groups of the station in order to monitor the stability control of the network and to record disturbances.

2.4 Recording Systems in Distribution Systems and Industrial Complexes

Modern recording systems are also used in important transformer substations where transmission turns into distribution. Such transformer substations exist both in the power supply section and in industrial complexes. The most important function is the Transient Analog Recorder (TAR) for the recording of short-circuits.

System Overview

3

The SIMEAS R-PMU device is a component of the comprehensive fault recorder and recording system.
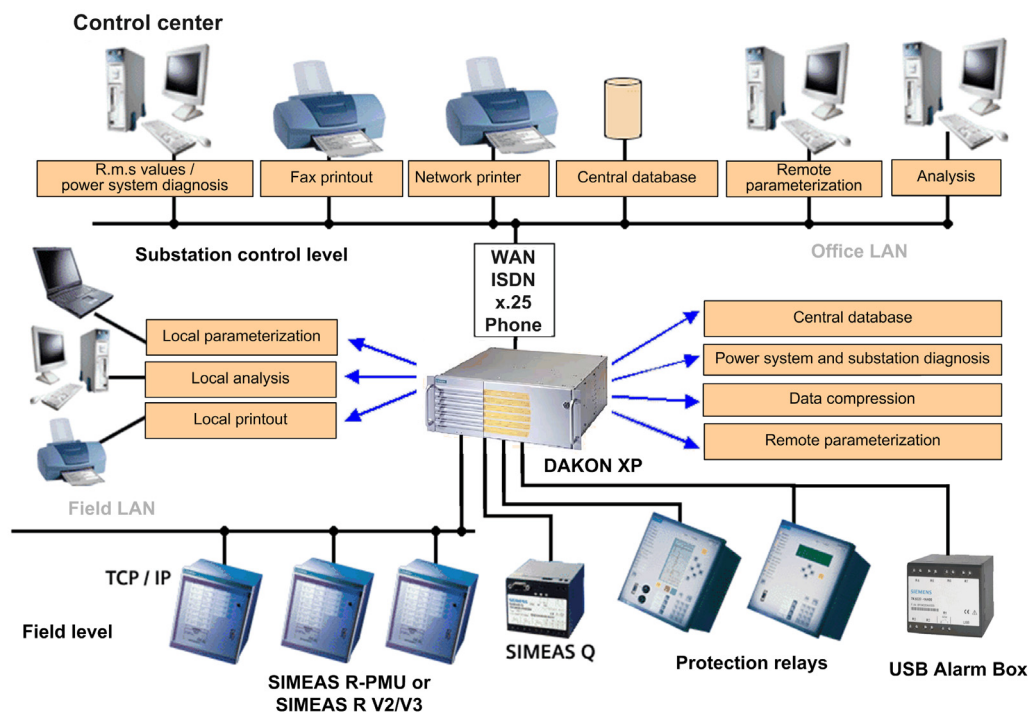
Figure 3-1   System overview

Digital fault recorder SIMEAS R-PMU

The SIMEAS R-PMU device includes the following functions:

❑ Phasor Measurement Unit (PMU)

❑ Fault recorders (Transient Analog Recorder and Transient Phasor Recorder)

❑ Continuous recorders

❑ Event recorder

The SIMEAS R-PMU records the data on an internal flash memory. Data transmission can be implemented via LAN (Local Area Network), serial interface or modem. A printer port is provided for the local output of fault records (TAR).

The self-monitoring function of the SIMEAS R-PMU constantly informs the user about the system status. Relay outputs can be used for remote signaling.

The SIMEAS R-PMU is available in two housing versions. The central unit ZE 8/16 (10" version) version can be equipped with a data acquisition unit (DAU); the central unit ZE 32/64 (19" version) with up to four units.

DAKON

The Data Concentrator (DAKON) is an industrial PC to which several SIMEAS R-PMU, SIMEAS R V2/V3, P531 and digital protection devices can be connected.

In the automatic mode, a DAKON can automatically collect data from the SIMEAS R devices and fault records from the protection devices and store them in its memory. A DAKON can forward the data automatically to a server PC.

This is a PC that runs in the "DAKON" mode on OSCOP P.

Server PC

Terminal devices and several DAKONs can be connected to a server PC. Several connected client PCs can collect and evaluate data from the server PC.

A server PC can forward the collected data to a higher-level server PC.

This is a PC that runs in the "server" mode on OSCOP P.

Evaluation PC

DAKON, SIMEAS R-PMU and SIMEAS Q can be connected to an evaluation PC. This operating mode is preferably intended for the parameterization at the site and for data evaluation. An evaluation PC can also be installed in the office and connected to a DAKON or a server PC.

This is a PC that runs in the "evaluation PC" mode on OSCOP P.

Client PC

A client PC is connected to a server PC using a network and is used for evaluating the data that has been stored in the server PC's database. Client PCs do not have any connection to the recording devices.

This is a PC that runs in the "client" mode on OSCOP P.

Phasor Data Concentrator (PDC)

The PMU data is sent to a computer that is called the Phasor Data Concentrator (PDC). The data of several PMUs is processed in the PDC thus ensuring that bottlenecks in the communications system, line overloads etc. can be detected.

Communication components

Communication between the recording devices, the DAKON and evaluation PCs can be implemented either via a wide-area network or a local-area network (TCP/IP protocol). Alternatively, the data can also be exchanged using analog/ISDN modems or star couplers.

Time synchronization

An exact time synchronization of all devices with the DAKON is necessary, in order to ensure that the records of fault recorders and protection devices in different locations can be compared to each other. This is done using additional components such as GPS receivers with support for the DCF77 protocol.

Parameterization and evaluation software OSCOP P

All the recorded data (except for the PMU data) can be transmitted and analyzed with the help of the parameterization and evaluation software OSCOP P. OSCOP P is also used for parameterizing the SIMEAS R-PMU and for archiving the data. The P531, SIMEAS R V2/V3 devices are also supported by OSCOP P.

The following work can be done either manually or automatically by OSCOP P:

❑ Collect measured data from connected devices and save them in the database

❑ Evaluate the data

❑ Visualize the results

❑ Output the results by a printer

❑ Archive the records.

The option "Import and export COMTRADE files" can be used to exchange fault records with other software components for analysis purposes.

The **Fault Locator** software module is an optional additional package for OSCOP P. It makes it possible to calculate the fault location on a line.

Device Overview

4

Contents

This chapter contains an overview of the design, time synchronization, interfaces and the voltage supply of the SIMEAS R-PMU.

4.1   Device Architecture

The SIMEAS R-PMU comprises a central processing unit module (CPU module), a power supply unit module and a communications bus.

The SIMEAS R-PMU can be equipped with five different modules for acquiring the measured values (DAUs) are provided. Depending on the type, the DAUs record AC voltage, AC current, DC process signals and / or binary data. The SIMEAS R-PMU ZE 8/16 can be equipped with one arbitrary DAU and the ZE 32/64 can be equipped with four arbitrary DAUs; for the ZE 32/64, there is no predefined sequence of the DAUs in the module slots. DAU type and DAU slot must correspond in the parameterization.

The power supply unit module for the SIMEAS R-PMU is optionally available with a battery package. This ensures an uninterruptible power supply.
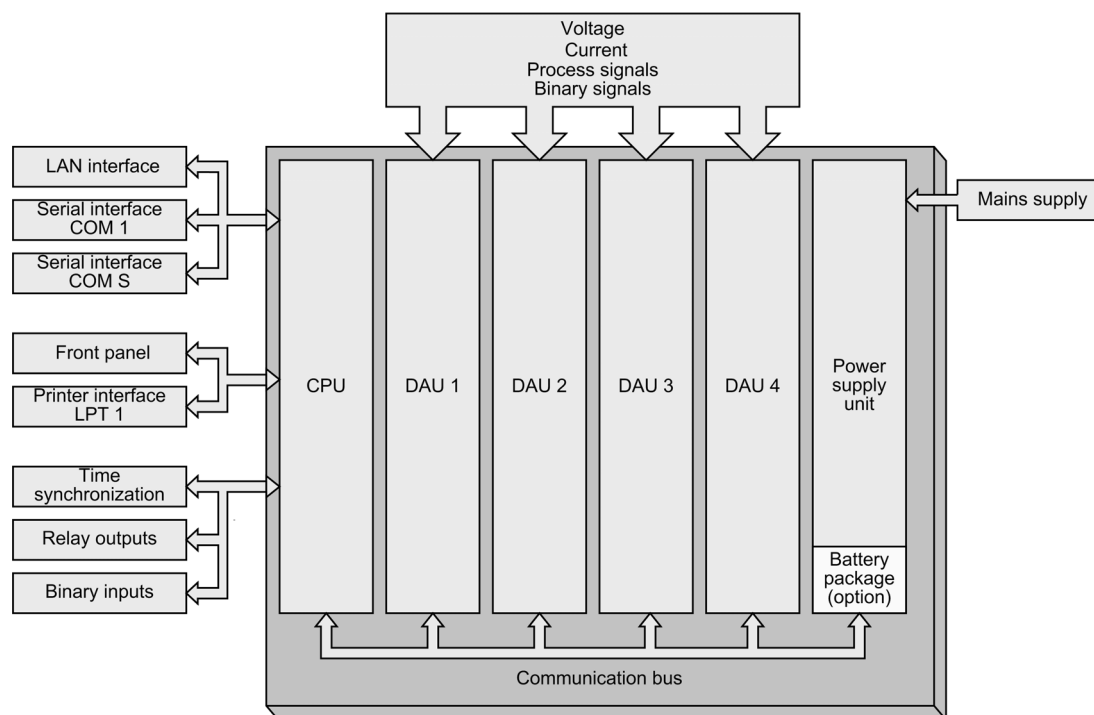
Figure 4-1   Device architecture overview

The processing module communicates with the DAUs via the communications bus.

A LAN interface and serial interfaces are provided for communication with OSCOP P. LAN or, alternatively, the serial interface at the rear panel can be used to transfer PMU data to a PDC.

The control panel displays error messages and operating conditions of the device. Keys can be used to set the operating mode of the device and to start manual triggers and reset alarms.

A parallel interface is provided for connecting a local printer where the TAR fault records can be printed automatically.

The CPU creates its own sync pulses (RTC, free running) or is synchronized externally.

4.2 Central Processing Module (CPU)

The central processing unit (CPU) communicates with the DAUs, stores data on the mass storage device (flash disk) and ensures the synchronization of the complete device. The core of the module is a 32-bit processor.
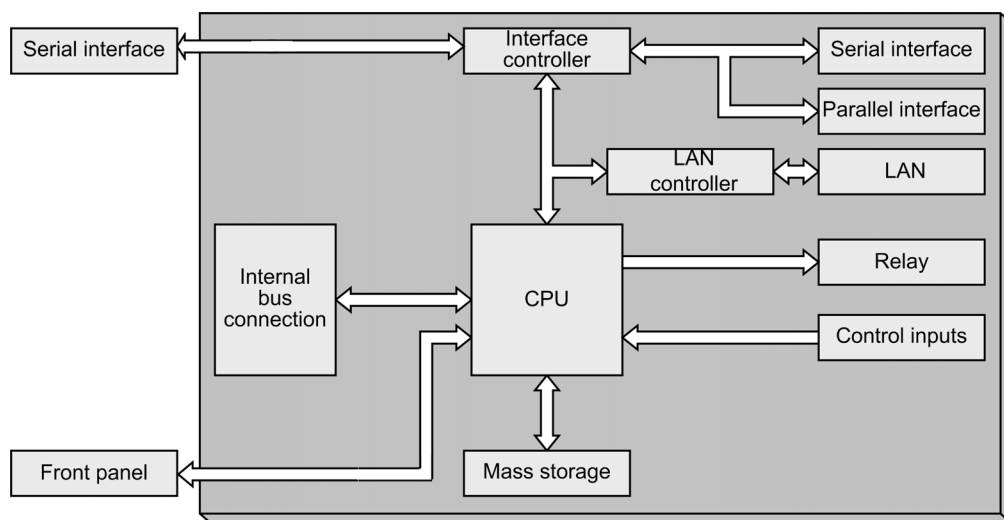
Figure 4-2   Central processing module (CPU)

The operating system and the parameterization and management data are stored on the mass storage device. The mass storage device configuration is parameterized with OSCOP P. This defines how the memory areas are used for the operating system and the individual recorders.

The memory areas are reserved as follows:

❑ Operating system

❑ Transient Analog Recorder (TAR)

❑ Transient Phasor Recorder (TPR)

❑ Continuous recorders for system and process variables (CR)

❑ Event recorder (ER) for binary channels

Two interface controllers control the communication with the connected assemblies. This includes one controller for supporting the front and rear serial interfaces and the parallel interface. The front interface is intended as a service interface. An additional controller supports the LAN connection.

The module is equipped with four voltage-free relay outputs, three of which can be parameterized for status signaling. The first relay is reserved for the life contact functions.

Furthermore, the central processing module has four control inputs available for application specific uses. The signals from the time synchronization unit are also forwarded to the CPU using one control input.

4.3 Data Acquisition Modules

4.3.1 Types and Design of Data Acquisition Modules

Different acquisition modules are provided for different measuring purposes.

- ❑ VCDAU: Recording of alternating voltage and current, binary signals
- ❑ VDAU: Recording of alternating voltage, binary signals
- ❑ CDAU: Recording of alternating current, binary signals
- ❑ DDAU: Recording of process signals (direct current / direct voltage)
- ❑ BDAU: Recording of binary signals

The signals are connected to the corresponding DAU using the rear terminals.

Note

The measuring inputs of the VCDAU, VDAU and VDAU are arranged in two groups of four analog inputs each.

Note

For the data acquisition modules VCDAU, VDAU and CDAU, in this manual sometimes the name AC DAU is used.

The DAU modules include the required modules for signal matchings: these are current and voltage transformers for the alternating signals, isolation amplifiers for the direct signals and optocouplers for binary signals.

In addition, the DAU includes the A/D conversion and the complete further digital processing. A Digital Signal Processor (DSP) is responsible for this type of processing.

Communication between the DAUs and with the CPU module is implemented via an internal bus that is used for synchronization, parameterization and data exchange.
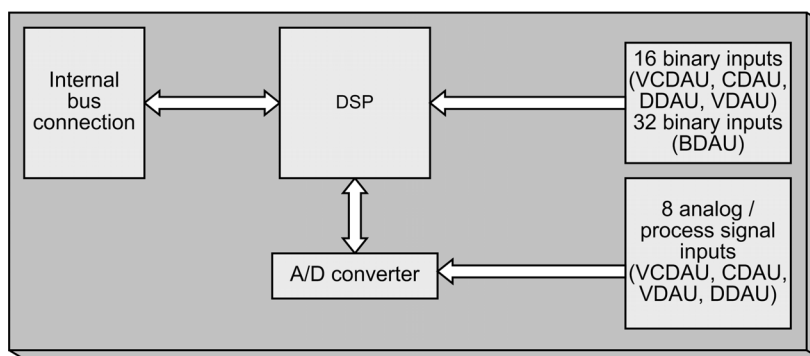
Figure 4-3   Principle design of data acquisition unit; BDAU doesn't contain any A/D converter

4.3.2   Features of the Individual Acquisition Modules (DAUs)

The SIMEAS R-PMU ZE 8/16 can be equipped with one arbitrary DAU and the ZE 32/64 can be equipped with four arbitrary DAUs; for the ZE 32/64, there is no predefined sequence of the DAUs in the module slots.

VCDAU (Voltage/Current Data Acquisition Unit)

8 analog (4 x voltage/4 x current) and 16 binary signals

The VCDAU is used for recording alternating current/voltage and binary signals. The typical application is monitoring a feeder or a transformer feeder bay. The calculated variables are derived from the input variables current and voltage.

Note

If a VCDAU is removed from the frame, the current terminals are automatically short-circuited. Nevertheless, you have to handle the secondary current transformer circuits with care.

VDAU (Voltage Data Acquisition Unit)

8 analog (8 x voltage) and 16 binary signals

This module is used for recording alternating voltages and binary signals. The typical application is recording busbar voltages.

CDAU (Current Data Acquisition Unit)

8 analog (8 x current) and 16 binary signals

The CDAU is used for recording alternating currents and binary signals. The typical application is monitoring two feeders. In connection with a VCDAU or a VDAU, it is also possible to calculate the powers.

Note

If a CDAU is removed from the frame, the current terminals are automatically short-circuited. Nevertheless, you have to handle the secondary current transformer circuits with care.

DDAU (DC Data Acquisition Unit)

8 analog (8 x process variables) and 16 binary signals

This module is used for recording process variables, e. g., direct currents in the range of DC ±20 mA, or direct voltages in the range of DC ±1 V or DC ±10 V.

Note

When a DDAU is pulled out, the 20 mA current input is opened: No short-circuiter is provided here so that current inputs which are connected in series will lose their measured value in this case.

BDAU (Binary Data Acquisition Unit)

32 binary channels

The module is used for recording binary signals. A total of 32 binary channels is provided on the module. The inputs can be designated for DC 24 V, DC 48 V to DC 60 V, DC 110 V to DC 125 V or DC 220 V to DC 250 V.

4.4   Time Synchronization

Time synchronization is an important feature of the SIMEAS R-PMU and must be performed with high precision. The phasor measurements in particular, require precise time stamping.

An exact time synchronization (<5 µs) of all devices is necessary, in order to ensure that the records of fault recorders in different locations can be compared to each other.

Time synchronization of SIMEAS R-PMU devices can be implemented by using either:

❑   DCF77 signal of a GPS clock

❑   Modified DCF77 signal of a Sync-Box

❑   Minute pulse

Note

The time synchronization function is parameterized using the parameter setting interface of OSCOP P. The GPS clock must be parameterized separately (See Chapter 8).

4.5 Interfaces

The central unit includes several communication interfaces.

LAN interface

The LAN interface can be used to establish a network connection between several SIMEAS R-PMU devices and one DAKON or PDC (Phasor Data Concentrator).
The Baud rate is 10/100 Mbit/s.

COM 1, the data interface

COM 1 is a serial interface according to the V.24 or RS232C standard and is located at the rear panel. It can be operated with Baud rates of 9,600 bit/s up to 115,200 bit/s (maximum cable length 10 m). This interface is suitable for a direct connection via a null modem cable or for connecting an external data transmission module.

COM S, the service interface

COM S is a serial interface on the front panel according to the V.24 or RS232 C standard. It has no control lines; thus, an operation only with software handshake is possible. The Baud rate is 19,200 bit/s.

The interface is located at the front panel and is used for service purposes.

Note

The transmission parameters (e. g., Baud rate) of the service interface are preset and cannot be changed.

Printer interface

The parallel interface LPT 1 is provided for connecting a printer.

For the currently enabled printer types, please refer to the Web site:

www.simeas.com -> Accessories > SIMEAS R printer

or call the Power Quality hotline. Complete information regarding the Power Quality Hotline is given in the Foreword.

4.6 Control Panel

21 LEDs are located at the front side of the SIMEAS R-PMU. These are used for the display of operating conditions and faults.

Five keys in the control panel (right side) can be used to execute simple commands such as resetting group alarms, setting operating modes and starting the manual recording of fault records.

Fault messages are indicated by red LEDs (boxes 1 to 8) and operational conditions by green LEDs (boxes 9 to 16).

With the OSCOP P, the default settings for indicating the messages can be adjusted depending on the user requirements.
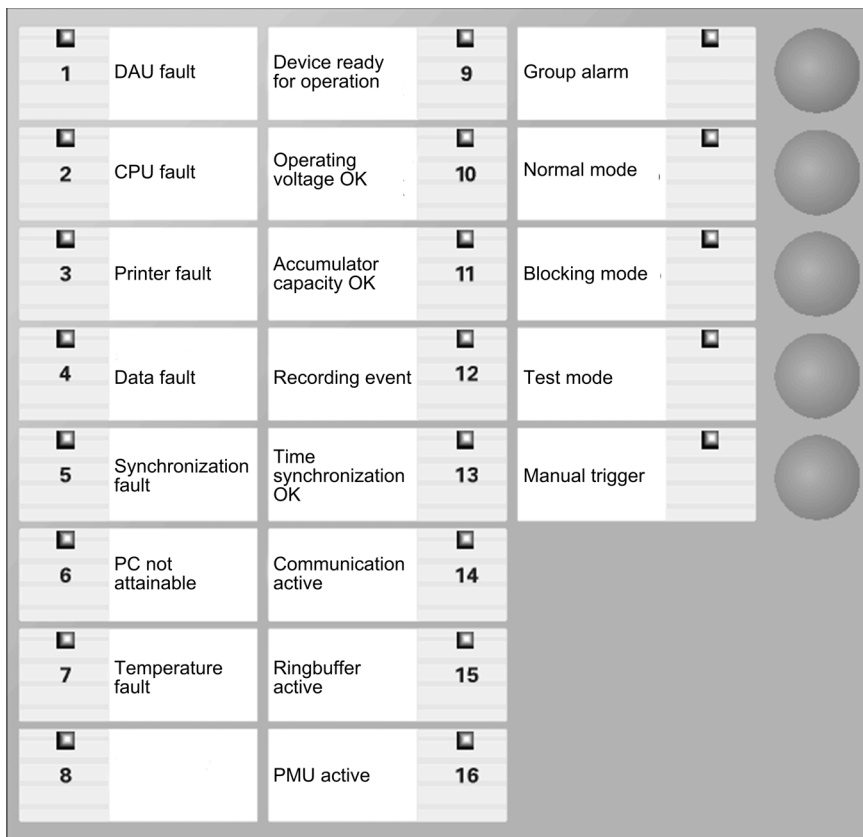
Figure 4-4   Control panel

4.7   Voltage Supply

One of the following two power supply units is used for the voltage supply of the SIMEAS R-PMU:

❑ Direct voltage in the range between DC 24 V and DC 60 V

❑ Direct voltage in the range between DC 110 V and DC 250 V and alternating voltage in the range between AC 115 V and AC 230 V

Storage capacitors

Storage capacitors ensure that operation is continued for at least one second in the event of a voltage failure. Thus the system can be shut down in a controlled manner.

Battery-buffered voltage supply

The power supply unit can be optionally equipped with a battery package. This allows for operation of at least ten minutes without external voltage supply.

The battery package is charged automatically and is subject to an automatic weekly load test. A faulty battery package is detected and reported by this self-monitoring function.

Note

The use of the battery-buffered voltage supply is recommended if the device is subject to unstable voltage supply conditions.

4.8 Housing Versions

Designs

The SIMEAS R-PMU is available in two different designs depending on the application.

❑ Central unit ZE 8/16 (10-inch housing) with 1 DAU slot, flush or surface mounted housing

❑ Central unit ZE 32/64 (19-inch housing) with 4 DAU slots, flush or surface mounted housing

Slot 1 is reserved for the CPU, always the last slot from the power supply unit. The remaining slots can be equipped with the different data acquisition units (DAUs).

The modules are installed vertically in the frame and can be changed from the front side. The terminals are located at the rear of the frame.

View

The front and the rear view of a ZE 8/16 with a CDAU are shown here as an example.
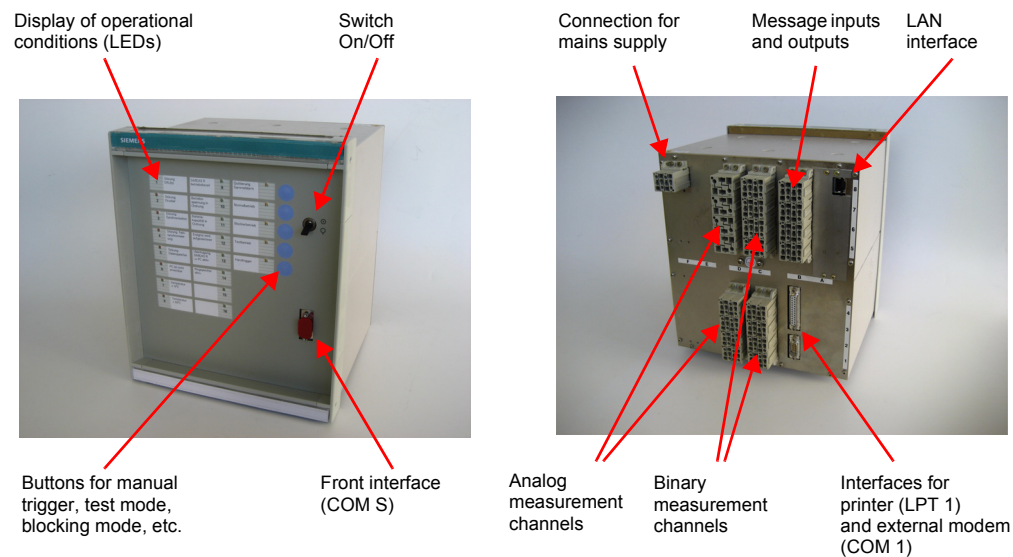
Figure 4-5   SIMEAS R-PMU (ZE 8/16): front and rear view (flush mounted housing)

Connection Principles

5

Contents

This chapter contains an overview of the connection principles of the SIMEAS R-PMU.

5.1 General

The SIMEAS R-PMU can be connected in star, delta or monophase.

The VCDAU, VDAU and CDAU data acquisition modules provide two measured value groups each for alternating values, channels 1 to 4 and channels 5 to 8.

A voltage channel group can be connected using the following connection modes:

❑ Three-phase star connection

❑ Three-phase delta connection

❑ Monophase

If a voltage group has been connected in star connection, the 4th and the 8th channel can be measured or calculated. When only three phases in star connection are measured and calculated, the star point voltage V_N or the current in the star point I_N, the result of the vector additions $\underline{V}_N = 1/3[\underline{V}_{L1} + \underline{V}_{L2} + \underline{V}_{L3}]$ or $\underline{I}_N = -[\underline{I}_{L1} + \underline{I}_{L2} + \underline{I}_{L3}]$ will be displayed as the 4th and/or the 8th channel.
With delta connection or monophase, the 4th and the 8th channel are always measured.

A current channel group can be connected using the following connection modes:

❑ Three-phase connection

❑ Monophase

If the current channel group is connected to the 3-phase system, the 4th and 8th channel can be measured or calculated. With monophase connection, the 4th and the 8th channel are always measured.

The following tables show the terminal assignment of the corresponding modules.

Table 5-1   VCDAU - voltage transformer connection

Channel	Star connection	Delta connection	Monophase
1	V_{L1}	V_{L12}	V_{L1}
2	V_{L2}	V_{L23}	V_{L2}
3	V_{L3}	V_{L31}	V_{L3}
4	V_N	V_4	V_{L4}

Table 5-2   VCDAU - current transformer connection

Channel	3-phase connection	Monophase
5	I_{L1}	I_{L1}
6	I_{L2}	I_{L2}
7	I_{L3}	I_{L3}
8	I_N	I_{L4}

Table 5-3   VDAU - voltage transformer connection

Channel	Star connection	Delta connection	Monophase
1	V_{L1-1}	V_{L12-1}	V_{L1}
2	V_{L2-1}	V_{L23-1}	V_{L2}
3	V_{L3-1}	V_{L31-1}	V_{L3}
4	V_{N-1}	V_4	V_{L4}
5	V_{L1-2}	V_{L12-2}	V_{L5}
6	V_{L2-2}	V_{L23-2}	V_{L6}
7	V_{L3-2}	V_{L31-2}	V_{L7}
8	V_{N-2}	V_8	V_{L8}

Table 5-4   CDAU - current transformer connection

Channel	3-phase connection	Monophase
1	I_{L1-1}	I_{L1}
2	I_{L2-1}	I_{L2}
3	I_{L3-1}	I_{L3}
4	I_{N4}	I_{L4}
5	I_{L1-2}	I_{L5}
6	I_{L2-2}	I_{L6}
7	I_{L3-2}	I_{L7}
8	I_{N8}	I_{L8}

The following sections include examples of the different connection modes.

5.2 Star Connection

The figures below show examples of star connection.
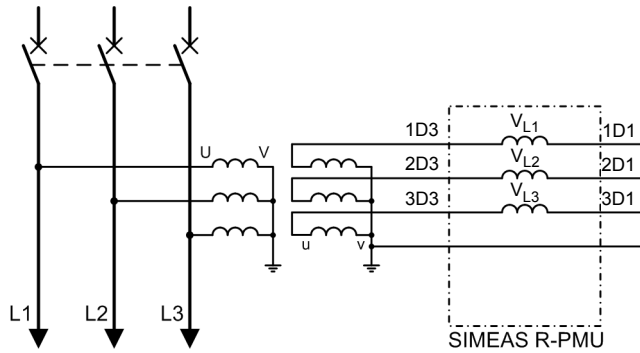
Figure 5-1   Connecting the voltage transformers for measuring the phase voltages
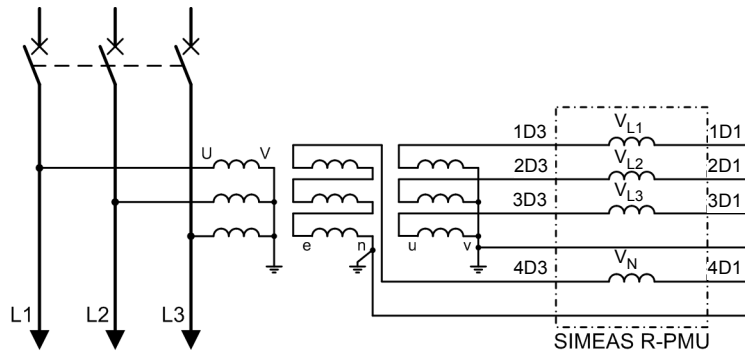
Figure 5-2   Connecting the voltage transformers for measuring the phase voltages with additional summation transformer
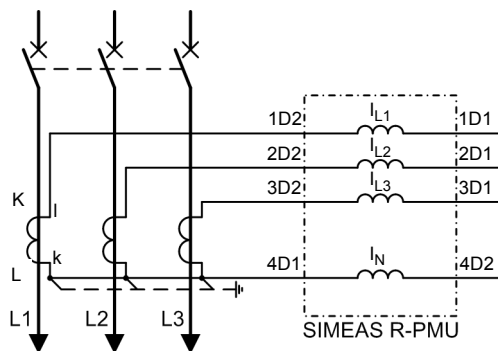
Figure 5-3   Connecting the current transformers with star point, measuring $3I_0$
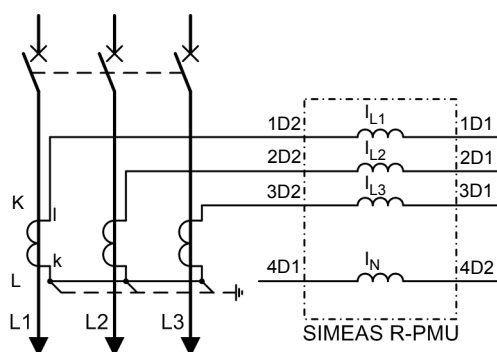
Figure 5-4   Connecting the current transformers with star point, calculating I_0

5.3 Delta Connection

The figures below show examples of delta connection.
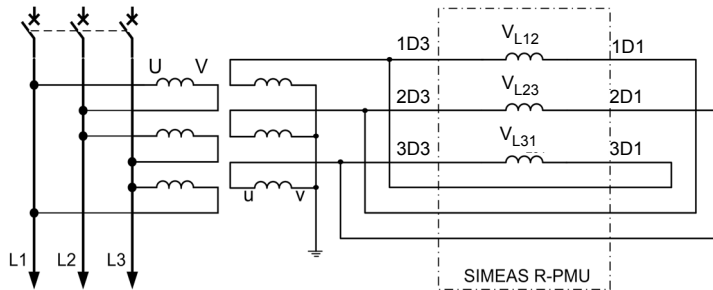
Figure 5-5 Connecting the voltage transformers for measuring the phase voltages
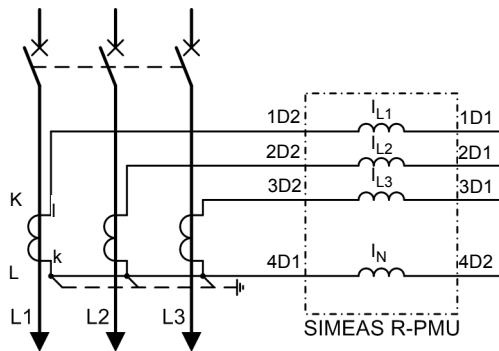
Figure 5-6 Connecting the current transformers with star point, measuring $3I_0$
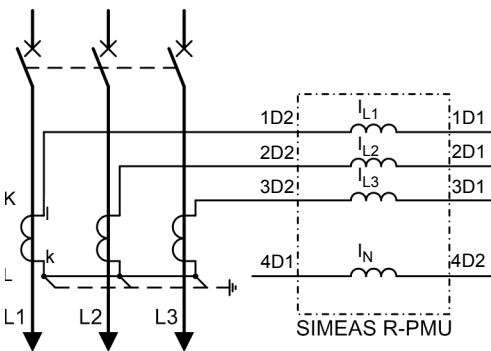
Figure 5-7 Connecting the current transformers with star point, calculating I_0

5.4 Monophase Connection

The figures below show examples of monophase connection.
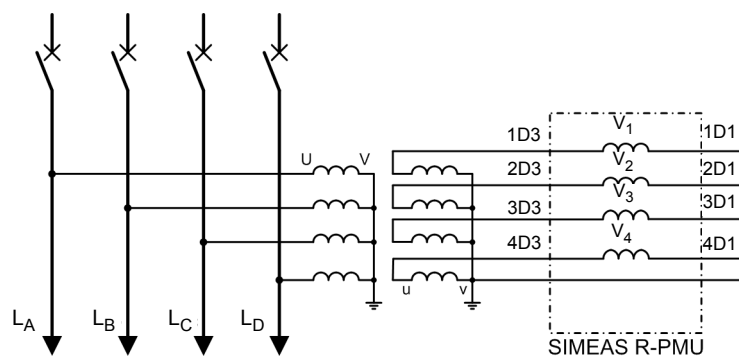
Figure 5-8   Connecting the voltage transformers
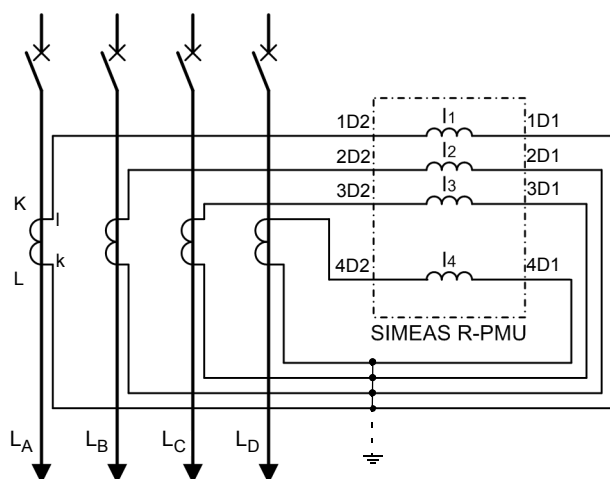
Figure 5-9   Connecting the current transformers

5.4 Monophase Connection

Measuring Principles

<div style="text-align: right; font-size: 3em;">**6**</div>

Contents

This chapter contains an overview of the connection principles of the SIMEAS R-PMU.

6.1   Measured Value Acquisition and Processing
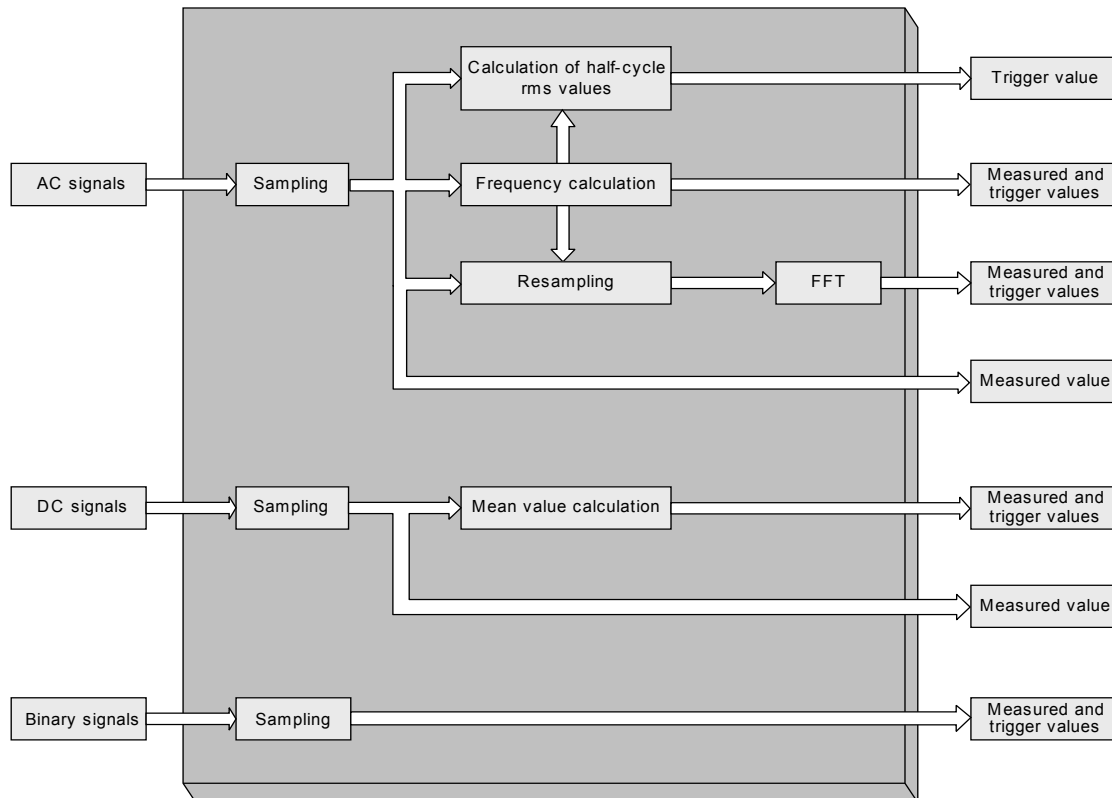
Figure 6-1   Measured value acquisition and processing

Sampling

AC and process signals of a data acquisition unit are digitized with a constant sampling rate of 192 sample values per nominal cycle. The binary signals are also read with a constant sampling rate of 2 kHz and stored.

For further processing, the frequency is calculated first and then used to resample the sample values.

This is not applicable for process values. Process values are zero-frequency values and are therefore processed separately.

Nominal cycle duration

The nominal cycle duration T_n is the reciprocal of the nominal system frequency f_n: $T_n = 1/f_n$.

With a nominal system frequency of, e. g., 50 Hz, the nominal cycle duration is 20 ms. The currently measured cycle may differ from the nominal cycle.

Sampling frequencies

The sampling frequencies of the different DAU types are shown in the table below.

Table 6-1   Sampling rates

Nominal frequency or binary signals	Sampling frequency	DAU type
50 Hz	9,600 Hz	Analog signals: VCDAU, VDAU, CDAU Process signals: DDAU
60 Hz	11,520 Hz	Analog signals: VCDAU, VDAU, CDAU Process signals: DDAU
Binary signals	2,000 Hz	BDAU Binary inputs: VCDAU, VDAU, CDAU, DDAU

Analog-to-digital converter

The analog-to-digital converter operates according to the sigma-delta principle. This method uses a single-bit converter. A separate analog-to-digital converter is provided for each measuring input to ensure that all measuring signals are processed simultaneously.

In order to avoid aliasing effects during the analog-to-digital conversion, the signal passes an anti-aliasing filter (low-pass filter) before being digitized. This ensures that frequency components in the signal to be sampled that exceed half of the sampling frequency will be suppressed.

Resolution

The analog measured values are sampled and converted into digital values with a resolution of 16 bit (max. 65,536 values). That means that 32,768 values and the "Null value" are possible for each polarity. The following table contains the resolution of the A/D converter:

Table 6-2   A/D converter resolution

Measured value	Measuring range	A/D converter resolution
Voltage	AC 1.5 V_{eff} to AC 200 V_{eff}	13.9 mV
	AC 3 V_{eff} to AC 400 V_{eff}	27 mV
Current	AC 5 mA_{eff} to AC 7 A_{eff}	0.321 mA
	AC 7 A_{eff} to AC 400 A_{eff}	36.9 mA
Process values	DC ±10 V	0.34 mV
	DC ±1 V	0.033 mV
	DC ±20 mA	0.65 µA

Reference frequency mode

The measured frequency is used as reference frequency for all cycle-based calculations. The reference frequency is distributed to the modules in the device by the internal frequency master. The following three setting options can be selected for the device using the OSCOP P parameterization software:

❑ *Auto mode:* Depending on the signal quality and the voltage/current level, a reference voltage/current channel is determined automatically from all DAUs that are located in the system. The reference frequency channel with the best signal quality (lowest total harmonic distortion (THD)) is determined automatically from this voltage/current group. All other voltage or current channels in the system use the reference frequency from the reference frequency channel.

❑ *Stand Alone* mode: Every DAU automatically determines its own reference voltage/current channel depending on the signal quality and signal level. Every further voltage or current channel of the corresponding DAU uses the reference frequency from the reference frequency channel.

❑ *Slot, channel group* mode: The user defines a reference voltage group for a VCDAU or VDAU in the device. The reference frequency channel with the best signal quality (lowest THD value) is determined automatically from this voltage group. All other voltage or current groups in the system use the reference frequency from the reference frequency channel. The reference frequency cannot be defined for a mere CDAU system.

If no channel with the required voltage/current level (<10 % of the nominal value) is provided in the selected reference voltage group, e. g., because a malfunction has occurred, the system automatically switches to the *Auto* mode (see above). The return to the *Slot, channel group* mode is also done automatically, as soon as the required voltage or current level (<10 % of the nominal value) is provided again.

Note

For the reference frequency modes *Auto* and *Slot, channel group* all DAUs have to be operated with one signal frequency (e. g. connected to one bus bar).

For the reference frequency mode *StandAlone*, the DAUs may be operated with different signal frequencies (e. g. DAU1 connected to an unsynchronized generator, DAU2 connected to the net). The power calculation of coupled DAUs does not make sense for different signal frequencies.

Frequency calculation

For the correct calculation of measured values and trigger values frequency is measured precisely. The measured frequency is determined per voltage or current group within the range of $f_n/2 < f < f_n + 10$. For this purpose, the THD is used to determine the channel of the group with the best signal quality periodically.

The group frequency is marked as invalid, if:

− all voltages or currents of the group are smaller than 10 % V_{nom} or I_{nom},

− all voltages or currents of the group change in form of a jump,

− the given frequency range is left.

When leaving the given frequency range the frequency measurement displays the last valid value.

The reference frequency will be marked as invalid if no valid group frequency is available (depending on the reference frequency mode).

Resampling

The constantly sampled measuring signal (192 sample values per nominal period) will be distributed based on the reference frequency onto 128 values per measured signal period.

Fast Fourier transformation

Fast Fourier transformation is used to create the phasors of the basic oscillation. All other values (e. g. effective power, reactive power, positive sequence system, negative sequence system) are calculated from the basic oscillation. The measured values are also used to derive the trigger conditions for the Transient Phasor Recorder (TPR).

6.2 Measured Values and Calculation Values

Table 6-3   SIMEAS R-PMU measured values

Measured value Calculation Value	Four-phase connection	Three-phase connection	Monophase
Voltage	V_{L1}, V_{L2}, V_{L3}, V_N V_{L12}, V_{L23}, V_{L31}, V_4	V_{L12}, V_{L23}, V_{L31}, V_4	V_{L1}, V_{L2}, V_{L3}, V_{L4}
Current	I_{L1}, I_{L2}, I_{L3}, I_N	I_{L1}, I_{L2}, I_{L3}, I_4	I_{L1}, I_{L2}, I_{L3}, I_{L4}
Voltage (vectorial)	$\underline{V}_{L1}$, $\underline{V}_{L2}$, $\underline{V}_{L3}$, $\underline{V}_N$ $\underline{V}_{L12}$, $\underline{V}_{L23}$, $\underline{V}_{L31}$, $\underline{V}_4$	$\underline{V}_{L12}$, $\underline{V}_{L23}$, $\underline{V}_{L31}$, $\underline{V}_4$	$\underline{V}_{L1}$, $\underline{V}_{L2}$, $\underline{V}_{L3}$, $\underline{V}_{L4}$
Current (vectorial)	$\underline{I}_{L1}$, $\underline{I}_{L2}$, $\underline{I}_{L3}$, $\underline{I}_N$	$\underline{I}_{L1}$, $\underline{I}_{L2}$, $\underline{I}_{L3}$, $\underline{I}_4$	$\underline{I}_{L1}$, $\underline{I}_{L2}$, $\underline{I}_{L3}$, $\underline{I}_{L4}$
Voltage (average)	$\overline{V}_{L1}$, $\overline{V}_{L2}$, $\overline{V}_{L3}$, $\overline{V}_N$ $\overline{V}_{L12}$, $\overline{V}_{L23}$, $\overline{V}_{L31}$, $\overline{V}_4$	$\overline{V}_{L12}$, $\overline{V}_{L23}$, $\overline{V}_{L31}$, $\overline{V}_4$	$\overline{V}_{L1}$, $\overline{V}_{L2}$, $\overline{V}_{L3}$, $\overline{V}_{L4}$
Current (average)	$\overline{I}_{L1}$, $\overline{I}_{L2}$, $\overline{I}_{L3}$, $\overline{I}_N$	$\overline{I}_{L1}$, $\overline{I}_{L2}$, $\overline{I}_{L3}$, $\overline{I}_4$	$\overline{I}_{L1}$, $\overline{I}_{L2}$, $\overline{I}_{L3}$, $\overline{I}_{L4}$
Positive-sequence system	V_1, I_1, φ_1	V_1, I_1, φ_1	–
Negative-sequence system	V_2, I_2, φ_2	V_2, I_2, φ_2	–
Zero-sequence system	V_0, I_0, φ_0	–	–
Frequency	f	f	f
Phase angle	φ	φ	φ
Active power	P	P	P
Reactive power	Q	Q	Q
Binary signals	B	B	B
Process signals	D	D	D

> **Note**
>
> With a three-phase connection, the powers are measured using the two-wattmeter method (Aron circuit).

> **Note**
>
> DDAUs record process signals. The values to be measured must be adjusted to the signal levels of the signal to be measured.
> Example: Process signals (e. g., -50 °C to +100 °C) can be assigned to a physical input range (e. g., DC -10 V to DC +10 V). It is also possible to define the neutral point.

6.3 Calculating Derived Values

The SIMEAS R-PMU does not measure all values directly, some of the values are calculated using the measured values. The following equations illustrate these calculations.

6.3.1 Voltage, Current and Power

Voltage

The Transient Analog Recorder (TAR) records the real signal curves, triggering is done using the rms value of the half-wave with all harmonics.

$$V_{rms} = \sqrt{\frac{1}{x} \sum_{n=1}^{x} v_n^2}$$

$x = 192/2$ for $f = f_n$

The Transient Phasor Recorder (TPR) and the Continuous Phasor Recorder (CPR) consider only the rms value of the fundamental component:

$$V_{FC}$$

FC: Fundamental Component (basic oscillation)

Current

The same applies to the calculation of the current rms value:

$$I_{rms} = \sqrt{\frac{1}{x} \sum_{n=1}^{x} i_n^2}$$

$x = 192/2$ for $f = f_n$

$$I_{FC}$$

FC: Fundamental Component (basic oscillation)

Active power

The active power is calculated using the rms value of the fundamental component:

$$P = V_{FC} \cdot I_{FC} \cdot \cos\varphi$$

Reactive power

The reactive power is calculated using the rms value of the fundamental component:

$$Q = V_{FC} \cdot I_{FC} \cdot \sin\varphi$$

6.3.2　Symmetrical Components

Star connection: phase-to-earth voltages and currents

With $a = e^{j(2\Pi/3)}$ and $a^2 = e^{j(-2\Pi/3)}$:

Positive-sequence system: $V_1 = \dfrac{1}{3} \cdot \left| (\underline{V}_{L1} + a \cdot \underline{V}_{L2} + a^2 \cdot \underline{V}_{L3}) \right|$

$$I_1 = \dfrac{1}{3} \cdot \left| (\underline{I}_{L1} + a \cdot \underline{I}_{L2} + a^2 \cdot \underline{I}_{L3}) \right|$$

Negative-sequence system: $V_2 = \dfrac{1}{3} \cdot \left| (\underline{V}_{L1} + a^2 \cdot \underline{V}_{L2} + a \cdot \underline{V}_{L3}) \right|$

$$I_2 = \dfrac{1}{3} \cdot \left| (\underline{I}_{L1} + a^2 \cdot \underline{I}_{L2} + a \cdot \underline{I}_{L3}) \right|$$

Zero-sequence system: $V_0 = \dfrac{1}{3} \cdot \left| (\underline{V}_{L1} + \underline{V}_{L2} + \underline{V}_{L3}) \right|$

$$I_0 = \dfrac{1}{3} \cdot \left| (\underline{I}_{L1} + \underline{I}_{L2} + \underline{I}_{L3}) \right|$$

Note

- ❑ The Continuous RMS-value Recorder (CRR) only records the absolute value of the symmetrical components.
- ❑ Triggering is also done using only the absolute value of the symmetrical components.
- ❑ The PMU transfers the positive-sequence system as complex values!

Delta connection: phase-to-phase voltages and currents

With $a = e^{j(2\Pi/3)}$ and $a^2 = e^{j(-2\Pi/3)}$:

Positive-sequence system:
$$V_1 = \left| \frac{\underline{V}_{L12} - a^2 \cdot \underline{V}_{L23}}{3} \right|$$

$$I_1 = \frac{1}{3} \cdot \left| (I_{L1} + a \cdot I_{L2} + a^2 \cdot I_{L3}) \right|$$

Negative-sequence system:
$$V_2 = \left| \frac{\underline{V}_{L12} - \underline{a} \cdot \underline{V}_{L23}}{3} \right|$$

$$I_2 = \frac{1}{3} \cdot \left| (I_{L1} + a^2 \cdot I_{L2} + a \cdot I_{L3}) \right|$$

Note

Only the absolute value of the symmetrical components is recorded.

Note

❑ The Continuous RMS-value Recorder (CRR) only records the absolute value of the symmetrical components.

❑ Triggering is also done using only the absolute value of the symmetrical components.

❑ The PMU transfers the positive-sequence system as complex values!

Recording Functions

<div style="text-align: right; font-size: 3em; font-weight: bold;">7</div>

Contents

This chapter contains an overview of the recording functions of the SIMEAS R-PMU.

7.1 Phasor Measurement Unit (PMU)

The SIMEAS R-PMU is equipped with an integrated Phasor Measurement Unit (PMU) according to the IEEE Std. C37.118 - 2005. Among other things, this standard defines among others PMU quality criteria and the data formats.

At absolute instants of time, which are defined by the reporting rate, the PMU determines the phasors from the measured values and sends them to a Phasor Data Concentrator (PDC).

The phasor measurement requires a highly precise time synchronization (<5 µs) of the SIMEAS R-PMU device; especially if phasors of different locations are to be compared to each other.

Phasor Data Concentrator (PDC)

A PDC continuously receives data from one or several PMU devices. The Phasor Data Concentrator can switch the PMU ON or OFF and read out its configurations and channel descriptions. The data received by the PDC is visualized and may be stored in a database if necessary.

Complex phasors

A phasor $\underline{v}(t) = \underline{V}e^{j\omega t}$ can be displayed as a pointer that rotates anticlockwise with the angular velocity ω in the complex plane. The voltage $v(t) = \mathrm{Re}\{\underline{v}(t)\}$ is a result of the projection of the phasor $\underline{v}(t)$ on the real axis.
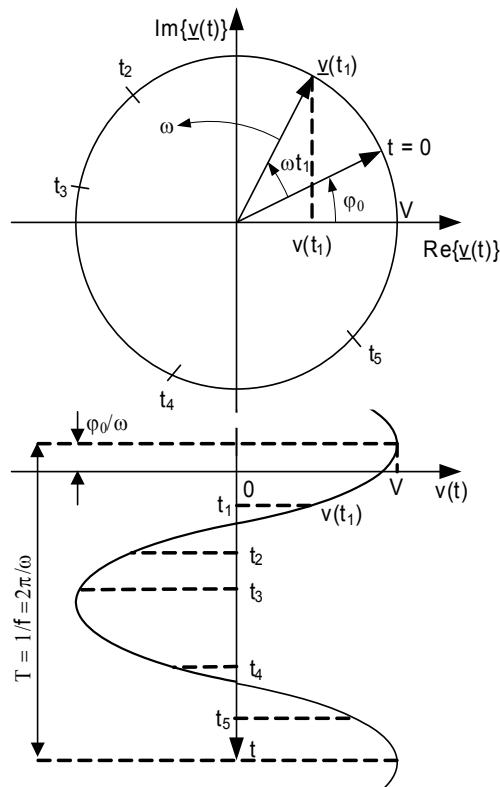
Figure 7-1 Geometrical illustration of a phasor

Data recording

The phase angle of signal X_m is calculated in relation to a cosine function with the nominal frequency that has been synchronized with the UTC time reference (UTC = Coordinated Universal Time) (see figure 7-2).
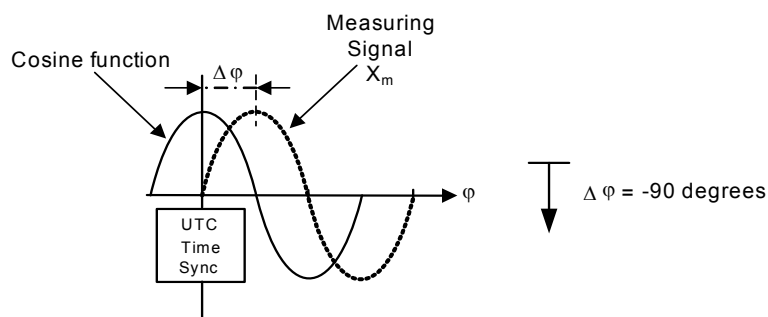
Figure 7-2   Determining the phase angle φ of the measuring signal X_m with regard to the cosine function

The reporting rate (see Page 54) defines the number of phasors transferred per second. If the defined sampling interval T_0 is unequal to the integer multiple of the measuring signal cycle duration T_m, the phasor's length remains constant, however, the phase angle is changed (see figure 7-3).
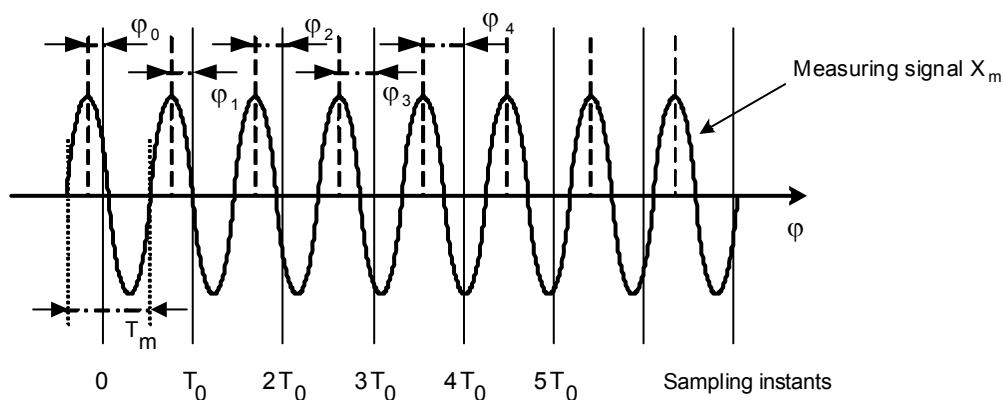
Figure 7-3   Sampling of the signal X_m; T_m unequal T_0

If the sampling interval T_0 corresponds to the integer multiple of the measuring signal X_m cycle duration, a constant phasor is determined during every sampling instant.

Reporting rate

The parameterizable reporting rate of the SIMEAS R-PMU defines the number of telegrams that are created and transferred to the PDC per second. It can be set depending on the nominal frequency and equally applies to all data acquisition units (DAU) in the SIMEAS R-PMU. When selecting the reporting rate, the available bandwidth of the data connection to the PDC should always be considered (see tables 7-4 to 7-8).

Table 7-1   PMU - Technical Data

Name	Description								
Nominal frequency	f_n = 50 Hz			f_n = 60 Hz					
Reporting rate in telegrams/s	10	25	50 *	10	12	15	20	30	60 *
Recorded values	VDAU, VCDAU, CDAU: phasors V, I or positive-sequence phasors, binary data DDAU: process values, binary data BDAU: binary data								

  * The reporting rates of 50 or 60 telegrams/second are not prescribed by the standard but are supported by the SIMEAS R-PMU.

Time synchronization

The synchronisation of the SIMEAS R-PMU device is very important if phasors of different locations are to be compared to each other. To be able to create the phasors at absolute instants of time, a highly precise GPS time signal is used for synchronizing the SIMEAS R-PMU.

Behaviour on error:

If the external timer malfunctions, the second pulse will be generated by the central processing unit of the SIMEAS R-PMU. PMU data will be marked as invalid (Flag *Data valid* = 1). Only after the external synchronization signal is provided and adjusted again will the PMU data be marked as valid again (*Data valid* = 0). The flag *PMU sync* displays the state of the GPS time signal. "1" means no valid signal available, and "0" valid signal available. See also "Time Synchronization" in chapter 8 of this manual.

Note

Every component that is connected between the timer and the SIMEAS R slightly delays the synchronization signal. This delay time must be compensated for by the SIMEAS R-PMU, in order not to exceed the maximum total vector error (TVE) of the PMU. Refer also to chapter 8.3.

Note

When Sync-Box 7KE6000-8HAx is used as a timer, the PMU data is marked as invalid due to low precision. See also chapter 8.3.

Total vector error (TVE)

The TVE describes the error between the actual and the measured value of the input signal. The standard IEEE 37.118 - 2005 defines among others the maximum threshold of 120 % V_n or I_n. Up to this threshold a TVE of 1 % must not be exceeded for steady signals. The standard defines two levels the influencing factors may not exceed and a TVE of 1 % must not be exceeded. SIMEAS R-PMU complies with level 1 defining the following influencing factors for a TVE of 1 %:

− Signal frequency (related to f_n): ±5 Hz

− Signal amplitude (related to 100 % nominal amplitude): 10 % to 120 %

− Phase angle (related to 0°) ±Π

− harmonic distortions (related to <0,2 % (THD): 10 % of each harmonic up to 50th harmonic

The TVE is defined as follows:

$$TVE = \sqrt{\frac{(X_{r(n)} - X_r)^2 + (X_{i(n)} - X_i)^2}{X_r^2 + X_i^2}}$$

where:
$X_{r(n)}$ = real part of measured signal X_r = real part of input signal
$X_{i(n)}$ = imaginary part of measured signal X_i = imaginary part of input signal

Values influencing the TVE:

❑ Amplitude error

❑ Phase error

❑ Synchronization accuracy (deviation from UTC)

The synchronization accuracy is influenced by the timer, e. g., the GPS timer, the correct setting of the latency (see chapter 8.3) and the optimum installation of the GPS antenna.

Note

For currents higher than AC 7 A, SIMEAS R-PMU switches internally to the high current range (AC 7 A to AC 400 A). For a current transformer with a transformation ratio 1000 A / 1 A or 1000 A / 5 A, this corresponds to a current of 700 % I_n or 140 % I_n. The high current range provides a lower measuring accuracy: Due to this fact, PMU data are marked as invalid in 16 bit integer format for currents higher than AC 7 A. Normally, this are short term events, caused by short circuits, for example. See chapter 16.1.4, current input (VCDAU or CDAU).

7.1.1   Recording Channels

The AC DAUs that have been activated for the PMU in the system transmit either the phasors of the measuring signals or the positive-sequence system. In case of the positive-sequence signal transmission the 4th and the 8th channels are not transmitted. No data is transmitted from DAUs that have been disabled.

In addition to the phasors, the frequency, the frequency change per second and the binary data of the data acquisition units are transmitted. DDAUs transmit Process values (DC values) as analog values in the PMU telegram. The frequency transmitted with DDAUs is the nominal frequency.

The data can be transmitted either in the 16 bit integer or the 32 bit floating point format. The 32 bit format allows for a higher resolution of the measured data, however, also requires higher data transfer rates. The 32 bit floating point is supported via LAN only in case of PMU data communication.

Note

In case of the 16 bit integer format DDAU, data is displayed with a zoom factor of 10^9 in the PDC and transmitted as pure measured values, even if no 1:1 ratio to process variables has been parameterized.

The x axis displacement and the amplification factor that can be parameterized in OSCOP P are not PMU relevant for AC DAUs and DDAUs. These two parameters are only relevant for the display module of OSCOP P.

For an overview of the transmission channels of the individual DAU types depending on the connection, please see Table 7-2 and 7-3.

Table 7-2   Recorded values of the DAUs for acquiring AC values depending on the input connection

	VCDAU	VDAU	CDAU
Star connection	$\underline{V}_{L1}$, $\underline{V}_{L2}$, $\underline{V}_{L3}$, $\underline{V}_{N}$ $\underline{V}_1$ $\underline{I}_{L1}$, $\underline{I}_{L2}$, $\underline{I}_{L3}$, $\underline{I}_{N}$ $\underline{I}_1$ f, Δf B_1 to B_{16}	$\underline{V}_{L1\text{-}1}$, $\underline{V}_{L2\text{-}1}$, $\underline{V}_{L3\text{-}1}$, $\underline{V}_{N4}$ $\underline{V}_1$ $\underline{V}_{L1\text{-}2}$, $\underline{V}_{L2\text{-}2}$, $\underline{V}_{L3\text{-}2}$, $\underline{V}_{N8}$ $\underline{V}_1$ f, Δf B_1 to B_{16}	$\underline{I}_{L1\text{-}1}$, $\underline{I}_{L2\text{-}1}$, $\underline{I}_{L3\text{-}1}$, $\underline{I}_{N4}$ $\underline{I}_1$ $\underline{I}_{L1\text{-}2}$, $\underline{I}_{L2\text{-}2}$, $\underline{I}_{L3\text{-}2}$, $\underline{I}_{N8}$ $\underline{I}_1$ f, Δf B_1 to B_{16}
Delta connection	$\underline{V}_{L12}$, $\underline{V}_{L23}$, $\underline{V}_{L31}$, $\underline{V}_4$ $\underline{V}_1$ $\underline{I}_{L1}$, $\underline{I}_{L2}$, $\underline{I}_{L3}$, $\underline{I}_4$ $\underline{I}_1$ f, Δf B_1 to B_{16}	$\underline{V}_{L12\text{-}1}$, $\underline{V}_{L23\text{-}1}$, $\underline{V}_{L31\text{-}1}$, $\underline{V}_4$ $\underline{V}_1$ $\underline{V}_{L12\text{-}2}$, $\underline{V}_{L23\text{-}2}$, $\underline{V}_{L31\text{-}2}$, $\underline{V}_8$ $\underline{V}_1$ f, Δf B_1 to B_{16}	$\underline{I}_{L1\text{-}1}$, $\underline{I}_{L2\text{-}1}$, $\underline{I}_{L3\text{-}1}$, $\underline{I}_4$ $\underline{I}_1$ $\underline{I}_{L1\text{-}2}$, $\underline{I}_{L2\text{-}2}$, $\underline{I}_{L3\text{-}2}$, $\underline{I}_8$ $\underline{I}_1$ f, Δf B_1 to B_{16}

Table 7-2   Recorded values of the DAUs for acquiring AC values depending on the input connection (Forts.)

Monophase	$\underline{V}_{L1}$, $\underline{V}_{L2}$, $\underline{V}_{L3}$, $\underline{V}_{L4}$ $\underline{I}_{L1}$, $\underline{I}_{L2}$, $\underline{I}_{L3}$, $\underline{I}_{L4}$ f, Δf B_1 to B_{16}	$\underline{V}_{L1}$, $\underline{V}_{L2}$, $\underline{V}_{L3}$, $\underline{V}_{L4}$ $\underline{V}_{L5}$, $\underline{V}_{L6}$, $\underline{V}_{L7}$, $\underline{V}_{L8}$ f, Δf B_1 to B_{16}	$\underline{I}_{L1}$, $\underline{I}_{L2}$, $\underline{I}_{L3}$, $\underline{I}_{L4}$ $\underline{I}_{L5}$, $\underline{I}_{L6}$, $\underline{I}_{L7}$, $\underline{I}_{L8}$ f, Δf B_1 to B_{16}

Table 7-3   Recorded values of the DAUs for acquiring process and binary signals

DDAU	BDAU
D_1, D_2, D_3, D_4 D_5, D_6, D_7, D_8 B_1 to B_{16}	B_1 to B_{32}

7.1.2   Data Communication of the SIMEAS R-PMU
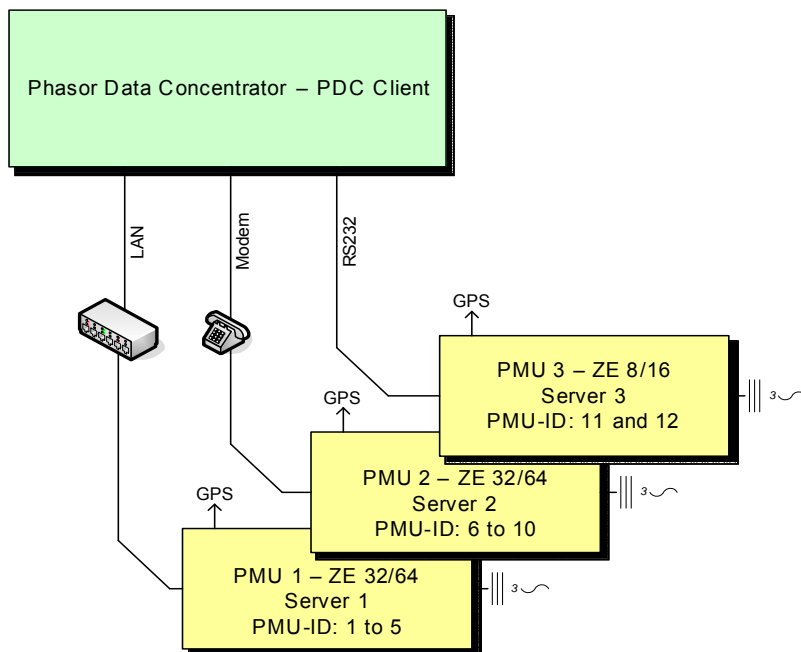
Figure 7-4   PDC Client and PMU Server (sample configuration)

The PMU communication is a client/server communication where the PDC (Phasor Data Concentrator) is the client and the SIMEAS R-PMU is the server. The PDC switches ON the measured data transmission of the SIMEAS R-PMU, requests the configuration and receives the measured data. Only one PDC can connect to the SIMEAS R-PMU simultaneously.

A PMU ID must be assigned for each SIMEAS R-PMU. The assigned PMU ID is valid for the central processing unit of the SIMEAS R-PMU. Since every DAU is regarded as an individual Phasor Measurement Unit that is subordinate to the central processing unit, the DAUs are automatically assigned the sequence numbers of the central processing unit as a PMU ID. See example in figure 7-4: The central processing unit of the SIMEAS R-PMU at bottom left is assigned the PMU ID 1 and its DAUs the PMU IDs 2 to 5.

> **Note**
>
> Depending on the number of DAUs in the PMU, a range between two and five PMU IDs must be reserved.

The PMU data can be transferred to the PDC either using LAN (UDP, TCP) or RS232 (null modem, modem). The parameterization is described in chapter 12.14.2.

PMU data communication via LAN (Local Area Network)

Ideally, the SIMEAS R-PMU is connected to the Phasor Data Concentrator via LAN (UDP or TCP) because of the high data volumes. This is the only case in which the required data transfer rates for all parameterizable reporting rates are supported. Furthermore, only the LAN interface supports the simultaneous data transmission with a PDC and OSCOP P.

The tables below give an overview of the data rates of the SIMEAS R-PMU depending on the device configuration and the reporting rate with UDP and TCP communication via LAN.

Table 7-4   UDP transmission via LAN:
            Data transfer rate depending on the configuration and reporting rate in kbit/s,
            data format 16 bit integer

Configuration	Type	Reporting rate (Hz)							
		10	12	15	20	25	30	50	60
1 AC DAU	Positive-sequence system	5	6	7	9	12	14	23	28
1 AC DAU	Phasors	7	8	10	13	16	20	33	39
2 AC DAUs	Positive-sequence system	6	7	9	12	15	18	30	36
2 AC DAUs	Phasors	10	12	15	19	24	29	48	58
4 AC DAUs	Positive-sequence system	8	10	13	17	21	25	42	51
4 AC DAUs	Phasors	16	19	24	32	40	48	80	96
1 DDAU	Process values	5	6	8	11	13	16	27	32
2 DDAUs	Process values	7	9	11	14	18	22	36	43
1 BDAU	Binary values	4	5	6	8	11	13	21	25
2 AC DAUs 2 DDAUs	Positive-sequence system/ process values	11	13	16	22	27	33	55	66
2 AC DAUs 1 DDAU 1 BDAU	Phasors / process values / binary values	12	15	19	25	31	37	62	74

Table 7-5   UDP transmission via LAN:
            Data transfer rate depending on the configuration and reporting rate in kbit/s,
            data format 32 bit float

Configuration	Type	Reporting rate (Hz)							
		10	12	15	20	25	30	50	60
1 AC DAU	Positive-sequence system	6	7	8	11	14	17	28	34
1 AC DAU	Phasors	9	11	14	19	23	28	47	56
2 AC DAUs	Positive-sequence system	8	9	12	16	20	23	39	47
2 AC DAUs	Phasors	15	18	23	31	38	46	77	92
4 AC DAUs	Positive-sequence system	12	15	18	24	30	37	61	73
4 AC DAUs	Phasors	27	33	41	54	68	82	136	163
1 DDAU	Process values	7	8	10	14	17	21	34	41
2 DDAUs	Process values	10	12	15	21	26	31	52	62
1 BDAU	Binary values	5	5	7	9	11	14	23	27
2 AC DAUs 2 DDAUs	Positive-sequence system/ process values	15	18	22	29	37	44	73	88
2 AC DAUs 1 DDAU 1 BDAU	Phasors / process values / binary values	20	24	30	40	50	60	99	119

Table 7-6   TCP transmission via LAN:
Data transfer rate depending on the configuration and reporting rate in kbit/s,
data format 16 bit integer

Configuration	Type	Reporting rate (Hz)							
		10	12	15	20	25	30	50	60
1 AC DAU	Positive-sequence system	6	7	8	11	14	17	28	34
1 AC DAU	Phasors	8	9	11	15	19	23	38	45
2 AC DAUs	Positive-sequence system	7	8	10	14	17	21	34	41
2 AC DAUs	Phasors	11	13	16	21	27	32	53	64
4 AC DAUs	Positive-sequence system	9	11	14	19	23	28	47	56
4 AC DAUs	Phasors	17	20	25	34	42	51	84	101
1 DDAU	Process values	6	8	9	13	16	19	31	38
2 DDAUs	Process values	8	10	12	16	20	24	41	49
1 BDAU	Binary values	5	6	8	10	13	15	26	31
2 AC DAUs 2 DDAUs	Positive-sequence system/ process values	12	14	18	24	30	36	59	71
2 AC-DAUs 1 DDAU 1 BDAU	Phasors / process values / binary values	13	16	20	27	33	40	66	80

Table 7-7   TCP transmission via LAN:
             Data transfer rate depending on the configuration and reporting rate in kbit/s,
             data format 32 bit float

Configuration	Type	Reporting rate (Hz)							
		10	12	15	20	25	30	50	60
1 AC DAU	Positive-sequence system	7	8	10	13	16	20	33	39
1 AC DAU	Phasors	10	12	15	21	26	31	52	62
2 AC DAUs	Positive-sequence system	9	11	13	18	22	26	44	53
2 AC DAUs	Phasors	16	20	24	33	41	49	81	98
4 AC DAUs	Positive-sequence system	13	16	20	26	33	39	66	79
4 AC DAUs	Phasors	28	34	42	56	70	84	141	169
1 DDAU	Process values	8	9	12	16	20	23	39	47
2 DDAUs	Process values	11	14	17	23	28	34	56	68
1 BDAU	Binary values	5	7	8	11	14	16	27	33
2 AC DAUs 2 DDAUs	Positive-sequence system/ process values	16	19	23	31	39	47	78	94
2 AC-DAUs 1 DDAU 1 BDAU	Phasors / process values / binary values	21	25	31	42	52	62	104	125

PMU data communication via RS232

The COM 1 port at the rear panel has been provided for the connection of a PDC with RS232 or, alternatively, with a modem/null modem.

> **Note**
>
> If the PMU functionality of the SIMEAS R-PMU is used via a modem or null modem connection, another connection to the SIMEAS R-PMU is required for the access to the remaining device functions using OSCOP P. Only the LAN interface enables the simultaneous transmission of PMU data and the communication via OSCOP P.

Table 7-8 provides an overview of the data volume of the SIMEAS R-PMU depending on the device configuration and the reporting rate for RS232 communication.

The data rates possible for modem communication restrict the reporting rates to be set. Optimum conditions allow up to 33 kbit/s. Depending on quality of the telephone network extremely lower data rates can be expected. During parameterization, OSCOP P calculates the expected data rate and generates corresponding warning messages. If the configuration parameterized by the user leads to data rates higher than 9 kbit/s, a message is given that PMU data may be lost. For data rates higher than 32 kbit/s a message is given that data will be lost.

Measures to reduce the data rate.

− Decreasing the reporting rate

− Transfer of 16 bit integer data instead of 32 bit floating point data

− Transfer of positive sequence system data instead of phasors

− Deactivating one DAU for PMU measurements

Table 7-8   Serial or modem transmission:
              Data transfer rate depending on the configuration and reporting rate in kbit/s,
              data format 16 bit integer

Configuration	Type	Reporting rate (Hz)							
		10	12	15	20	25	30	50	60
1 AC DAU	Positive-sequence system	3	4	5	6	8	9	15	18
1 AC DAU	Phasors	5	6	7	10	12	15	25	30
2 AC DAUs	Positive-sequence system	4	5	6	9	11	13	21	26
2 AC DAUs	Phasors	8	10	12	16	20	24	40	48
4 AC DAUs	Positive-sequence system	7	8	10	14	17	20	34	41
4 AC DAUs	Phasors	14	17	21	29	36	43	71	86
1 DDAU	Process values	4	4	6	7	9	11	18	22
2 DDAUs	Process values	6	7	8	11	14	17	28	33
1 BDAU	Binary values	3	3	4	5	6	8	13	15
2 AC DAUs 2 DDAUs	Positive-sequence system/ process values	9	11	14	19	23	28	46	56
2 AC-DAUs 1 DDAU 1 BDAU	Phasors / process values / binary values	11	13	16	21	27	32	54	64

Note

The 32 bit floating point data format is not supported for the PMU data communication via RS232.

7.2 Fault Recorders

Memory areas are reserved on the SIMEAS R-PMU flash disk for the TAR and TPR records (see chapter 12.6 for parameterization). Each record is written to a single file. The files are stored in ring buffer mode. If the total of files equals to 90% of the memory reserved, the oldest recordings will be deleted, thus ensuring that the occupancy level is no more than 80%.

Note

Records have to be transferred to OSCOP P cyclically to avoid the loss of fault recorder data. For more information, refer to the OSCOP P manual.

7.2.1 Transient Analog Recorder (TAR)

The use of the Transient Analog Recorder (TAR) enables the analysis of transient events (high-frequency interferences in the power supply system, e. g., caused by switching operations) and the behaviour of protection devices. Possible applications are described in chapter 2, *Applications,* of this manual.

The TAR records the curves for voltages, currents, process and binary signals in the form of sample values when a fault occurs. For this purpose, the user defines trigger limits and recording times using the OSCOP P parameterization software. The input signals are analyzed according to the preset trigger conditions and recorded if the limit values are exceeded or not reached. The fault record contains the prefault time, the trigger time and the recorded fault. The trigger cause is also stored.

The following trigger functions can be parameterized for the Transient Analog Recorder:

❑ Level trigger Min/Max

❑ Gradient trigger

❑ Binary trigger

❑ Logical trigger

❑ Cross trigger

❑ Manual trigger

❑ External trigger

❑ Network trigger

The fault records are stored on the mass storage device of the SIMEAS R-PMU. The maximum memory space on the storage device for storing the fault records is defined in the parameterization. Once 90% of the parameterized memory capacity have been reached, the oldest recordings will be deleted, thus ensuring that the occupancy level is no more than 80%. The size of the mass storage device ensures that up to several hundred fault records can be stored depending on the configuration.

7.2.1.1 Recording Channels

The sampled curves of all analog and process signals that have been created are recorded. The constant sampling rate is 192 samples per nominal cycle. The binary changes are recorded with a resolution of 1 kHz and a maximum of 250 changes per second and DAU.

The channels of all active DAUs are always recorded in the fault record, even if there is no limit value violation for the channel.

Depending on the DAU different measured values are recorded:

❑ Alternating voltage with VCDAUs and VDAUs

❑ Alternating current with VCDAUs and CDAUs

❑ Process signals (direct voltage/direct current) with DDAUs

❑ Binary signals with VCDAUs, VDAUs, CDAUs, DDAUs and BDAUs

❑ Quality tracks with VCDAUs, VDAUs, CDAUs, DDAUs and BDAUs

Tables 7-9 and 7-10 give an overview of the recorded values of the DAUs.

Table 7-9   Recorded values of the VCDAU, VDAU and CDAU depending on the input connection

	VCDAU	**VDAU**	**CDAU**
Star connection	V_{L1}, V_{L2}, V_{L3}, V_N I_{L1}, I_{L2}, I_{L3}, I_N B_1 to B_{16}	V_{L1-1}, V_{L2-1}, V_{L3-1}, V_{N4} V_{L1-2}, V_{L2-2}, V_{L3-2}, V_{N8} B_1 to B_{16}	I_{L1-1}, I_{L2-1}, I_{L3-1}, I_{N4} I_{L1-2}, I_{L2-2}, I_{L3-2}, I_{N8} B_1 to B_{16}
Delta connection	V_{L12}, V_{L23}, V_{L31}, V_4 I_{L1}, I_{L2}, I_{L3}, I_4 B_1 to B_{16}	V_{L12-1}, V_{L23-1}, V_{L31-1}, V_4 V_{L12-2}, V_{L23-2}, V_{L31-2}, V_8 B_1 to B_{16}	I_{L1-1}, I_{L2-1}, I_{L3-1}, I_4 I_{L1-2}, I_{L2-2}, I_{L3-2}, I_8 B_1 to B_{16}
Monophase	V_{L1}, V_{L2}, V_{L3}, V_{L4} I_{L1}, I_{L2}, I_{L3}, I_{L4} B_1 to B_{16}	V_{L1}, V_{L2}, V_{L3}, V_{L4} V_{L5}, V_{L6}, V_{L7}, V_{L8} B_1 to B_{16}	I_{L1}, I_{L2}, I_{L3}, I_{L4} I_{L5}, I_{L6}, I_{L7}, I_{L8} B_1 to B_{16}

Table 7-10   Recorded values of the DDAU and BDAU

DDAU	**BDAU**
D_1, D_2, D_3, D_4 D_5, D_6, D_7, D_8 B_1 to B_{16}	 B_1 to B_{32}

Quality tracks (binary tracks)
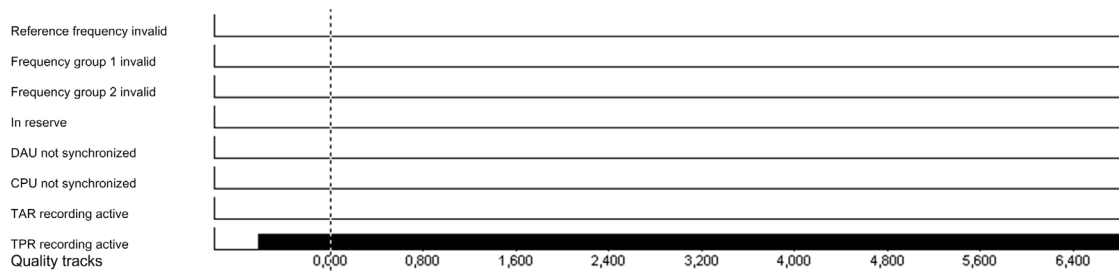
All tracks including quality tracks are recorded by SIMEAS R-PMU, evaluated by OSCOP P and presented in the form of a diagram with eight tracks (one track not used). Depending on the status, a bar (logical 1) or no bar (logical 0) is recorded.

The following status information is displayed for the recording period of time that is set on OSCOP P:

❑ **Reference frequency invalid:** The reference is invalid (insufficient signal quality), the measured values based on the reference frequency are also invalid.

0: Reference frequency valid

1: Reference frequency invalid

❑ **Frequency group 1 invalid:** The frequency measurement of group 1 of the evaluated DAU is not possible or faulty, e. g., because of missing signals.

0: Frequency measurement valid

1: Frequency measurement invalid

❑ **Frequency group 2 invalid:** The frequency measurement of group 2 of the evaluated DAU is not possible or faulty, e. g., because of missing signals.

0: Frequency measurement valid

1: Frequency measurement invalid

❑ **DAU not synchronized:** Synchronization of the evaluated DAU is not (yet) possible because, for example, the system has not (yet) completed the transient recovery phase after the GPS signal has been cut-off and returned, or after the SIMEAS R has been restarted.

0: Time synchronized in DAU

1: Time not synchronized in DAU

❑ **CPU not synchronized:** The CPU is not or not yet synchronized and is thus free-running based on RTC (DCF77 signal provided only approx. 2 minutes after start-up).

0: Time synchronized in CPU

1: Time not synchronized in CPU

❑ **TAR recording active:** displays the current recording of the TAR

0: inactive: no recording

1: active: recording active

❑ **TPR recording active:** displays the current recording of the TPR

0: inactive: no recording

1: active: recording active

7.2.1.2 Trigger Functions

Several trigger limits and recording times can be parameterized for the Transient Analog Recorder. The input signals are analyzed according to the trigger conditions and start the fault recording if the trigger condition is met. The duration of the fault record depends on the parameterized recording times and can be prolonged by a repeated limit value violation (retriggering) within the recording time. The recording time is limited to a maximum of 30 s plus 1 s prefault time for each TAR fault record.

The tables 7-11 and 7-12 show the values that the Transient Analog Recorder can trigger to, depending on the data acquisition modules (the powers in the CDAU column are applicable only for coupled CDAUs).

Table 7-11   Trigger values of the VCDAU, VDAU and CDAU depending on the input connection (the length of dt is two periods for the TAR)

	VCDAU	VDAU	CDAU
Star connection	V_{L1}, V_{L2}, V_{L3}, V_N dV_{L1}/dt, dV_{L2}/dt dV_{L3}/dt, dV_N/dt V_1, V_2, V_0 I_{L1}, I_{L2}, I_{L3}, I_N dI_{L1}/dt, dI_{L2}/dt dI_{L3}/dt, dI_N/dt I_1, I_2, I_0 B_1 to B_{16}	V_{L1-1}, V_{L2-1}, V_{L3-1}, V_{N4} dV_{L1-1}/dt, dV_{L2-1}/dt dV_{L3-1}/dt, dV_{N4}/dt V_{1-1}, V_{2-1}, V_{0-1} V_{L1-2}, V_{L2-2}, V_{L3-2}, V_{N8} dV_{L1-2}/dt, dV_{L2-2}/dt dV_{L3-2}/dt, dV_{N8}/dt V_{1-2}, V_{2-2}, V_{0-2} B_1 to B_{16}	I_{L1-1}, I_{L2-1}, I_{L3-1}, I_{N4} dI_{L1-1}/dt, dI_{L2-1}/dt dI_{L3-1}/dt, dI_{N4}/dt I_{1-1}, I_{2-1}, I_{0-1} I_{L1-2}, I_{L2-2}, I_{L3-2}, I_{N8} dI_{L1-2}/dt, dI_{L2-2}/dt dI_{L3-2}/dt, dI_{N8}/dt I_{1-2}, I_{2-2} B_1 to B_{16}
Delta connection	V_{L12}, V_{L23}, V_{L31}, V_4 dV_{L12}/dt, dV_{L23}/dt dV_{L31}/dt, dV_4/dt V_1, V_2 I_{L1}, I_{L2}, I_{L3}, I_4 dI_{L1}/dt, dI_{L2}/dt dI_{L3}/dt, dI_4/dt I_1, I_2 B_1 to B_{16}	V_{L12-1}, V_{L23-1}, V_{L31-1}, V_4 dV_{L12-1}/dt, dV_{L23-1}/dt dV_{L31-1}/dt, dV_4/dt V_{1-1}, V_{2-1} V_{L12-2}, V_{L23-2}, V_{L31-2}, V_8 dV_{L12-2}/dt, dV_{L23-2}/dt dV_{L31-2}/dt, dV_8/dt V_{1-2}, V_{2-2} B_1 to B_{16}	I_{L1-1}, I_{L2-1}, I_{L3-1}, I_4 dI_{L1-1}/dt, dI_{L2-1}/dt dI_{L3-1}/dt, dI_4/dt I_{1-1}, I_{2-1}, I_{0-1} I_{L1-2}, I_{2L-2}, I_{L3-2}, I_8 dI_{L1-2}/dt, dI_{L2-2}/dt dI_{L3-2}/dt, dI_8/dt I_{1-2}, I_{2-2} B_1 to B_{16}
Monophase	V_{L1}, V_{L2}, V_{L3}, V_{L4} dV_{L1}/dt, dV_{L2}/dt dV_{L3}/dt, dV_{L4}/dt I_{L1}, I_{L2}, I_{L3}, I_{L4} dI_{L1}/dt, dI_{L2}/dt dI_{L3}/dt, dI_{L4}/dt B_1 to B_{16}	V_{L1}, V_{L2}, V_{L3}, V_{L4} dV_{L1}/dt, dV_{L2}/dt dV_{L3}/dt, dV_{L4}/dt V_{L5}, V_{L6}, V_{L7}, V_{L8} dV_{L5}/dt, dV_{L6}/dt dV_{L7}/dt, dV_{L8}/dt B_1 to B_{16}	I_{L1}, I_{L2}, I_{L3}, I_{L4} dI_{L1}/dt, dI_{L2}/dt dI_{L3}/dt, dI_{L4}/dt I_{L5}, I_{L6}, I_{L7}, I_{L8} dI_{L5}/dt, dI_{L6}/dt dI_{L7}/dt, dI_{L8}/dt B_1 to B_{16}

Note: dt is always 2 nominal cycles with the TAR.

Table 7-12   Trigger values of the DAUs for acquiring process and binary signals
(the length of dt is two periods for the TAR)

DDAU	BDAU
D_1, D_2, D_3, D_4 dD_1/dt, dD_2/dt dD_3/dt, dD_4/dt D_5, D_6, D_7, D_8 dD_5/dt, dD_6/dt dD_7/dt, dD_8/dt	
B_1 to B_{16}	B_1 to B_{32}

Prefault time

The measured values are recorded continuously and stored in a ring buffer with a capacity of up to one second. In case of a fault, the prefault of the trigger event will be written to the beginning of the recording (see figure 7-5). The prefault time is applied in the same way for all trigger causes.
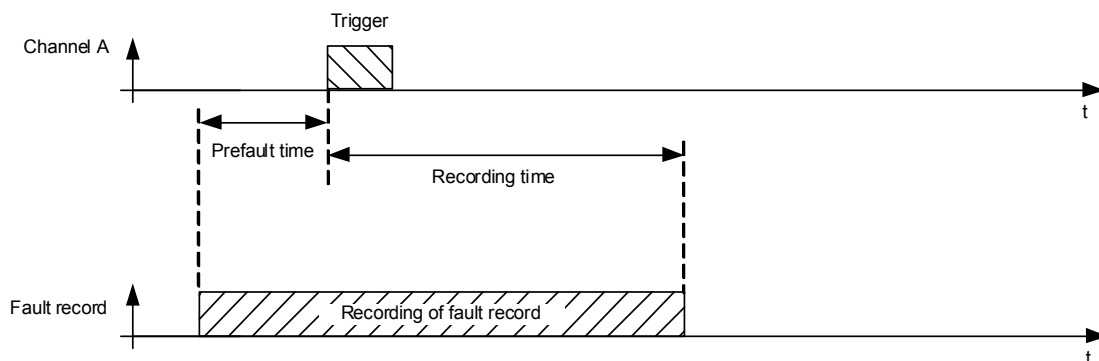
Figure 7-5   Composition of the fault record of prefault time, trigger and recording time

Recording time

The parameterizable recording time of the TAR is maximum 30 s, it is equal for all trigger causes.

The recording time for manual triggers can be adjusted separately. For external triggers, the recording time cannot be parameterized. Recording is continued, as long as the external signal is provided. The maximum recording time is 30 s.

If a trigger condition is detected, the SIMEAS R-PMU starts recording.

The recording time is restarted by retriggering (trigger 2) during recording, thus the fault record will be extended to a maximum of 30 s (see figure 7-6).
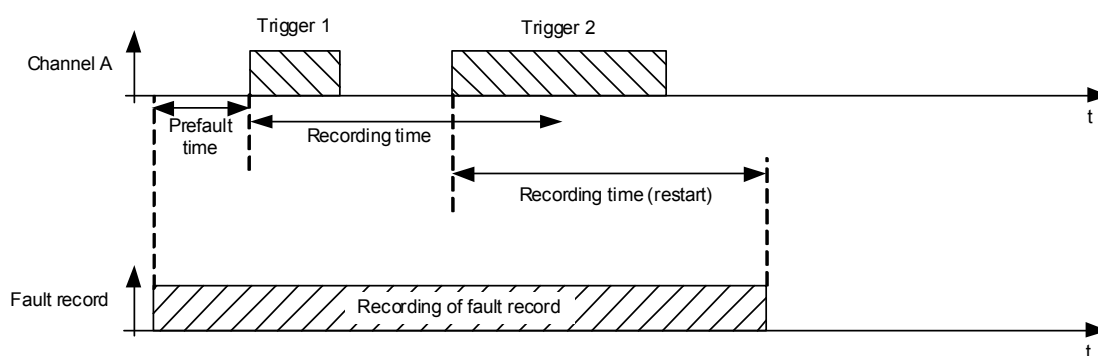
Figure 7-6   Retriggering during recording

If a trigger event (trigger 3) occurs shortly after the end of a fault recording (fault record 1), the prefault time of the second recording (fault record 2) overlaps with the first recording (see figure 7-7).
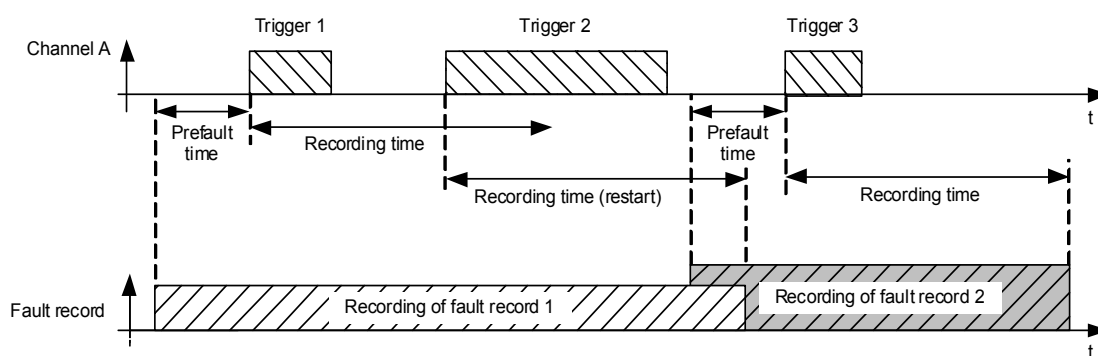
Figure 7-7   Overlap of two fault recordings in the prefault time range

7.2.1.2.1 Analog Signal Triggers

The TAR processes analog input signals (direct and alternating signals) in different ways:

Table 7-13   Options of analog signal triggering

Measured value	Triggering
AC values	Half-wave rms value
DC values	Arithmetic mean of a nominal cycle

The level and gradient trigger can also be applied to analog signals.

Retrigger blocking for analog signals

To avoid repeated triggering of the device due to limit value violations within the shortest time, a retrigger blocking can be parameterized.

The retrigger blocking time for analog signals is started simultaneously with the recording time and acts for each individual channel. If a limit value violation occurs again for the same channel within the retrigger blocking time, this will not extend the fault record but only restart the channel-specific retrigger blocking time (see figure 7-8). All other channels can start retriggering (see figure 7-9). The retrigger blocking time can be activated separately for every analog input.

Note

If the retrigger blocking time is defined longer than the recording, time no trigger events are recognized during this time.
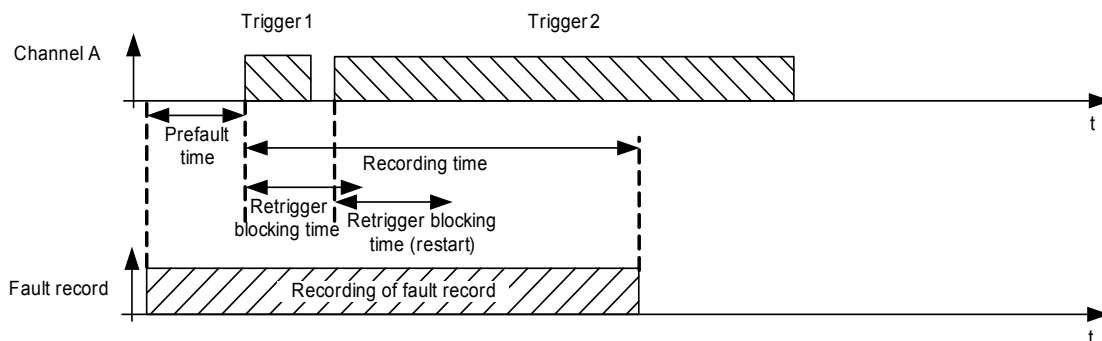
Figure 7-8   Trigger 2 does not extend the recording time due to retrigger blocking
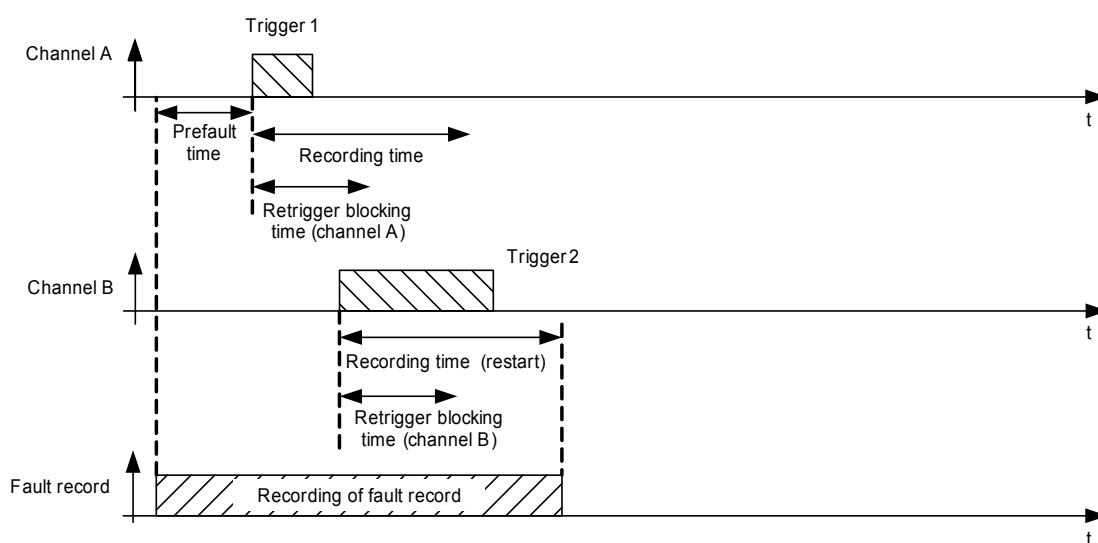
Figure 7-9   Channel B can extend (retrigger) the fault record within the retrigger blocking time of channel A; retrigger blocking is valid for the given channel only

7.2.1.2.1.1   Level Trigger (Min/Max)

Level triggers monitor the measured values for observance of parameterizable min/max limits. Triggering is started, as soon as the measured value exceeds the parameterized threshold. These triggers can be parameterized for all analog values and symmetrical components (see table 7-11 and 7-12). The Min. level trigger cannot be selected for negative-sequence and zero-sequence systems.

Hysteresis

If a measured value reaches exactly the limit value, this may lead to unwanted fault recordings even with the smallest possible fluctuations. A hysteresis amounting to 2 % of the parameterized nominal value of the corresponding channel is therefore applicable for all level trigger values. If the level trigger value is set smaller than the given hysteresis, it will be set to 25 % of the parameterized trigger value. After a limit value violation has occurred, the signal must leave the hysteresis range first before another triggering is possible if the limit value is exceeded again (see figure 7-10).
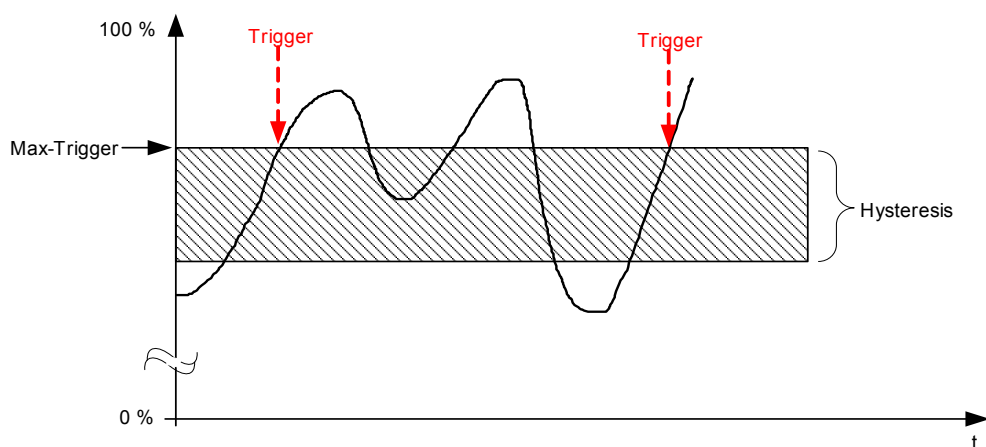
Figure 7-10   Functioning of the hysteresis for min and max level triggers

7.2.1.2.1.2   Gradient Trigger (±dM/dt)

The gradient of a signal is the level change per time. For the TAR the trigger condition for alternating signals is met, when the difference of two half cycle rms values is higher than the parameterized threshold for a distance of two periods. For DDAUs, the arithmetic means are compared for a distance of two periods. A distinction is made between rising gradients (+dM/dt, i. e. positive difference) and falling gradients (-dM/dt, i. e. negative difference).

They can be parameterized for all analog signals from tables 7-11 and 7-12 (not for symmetrical components).

7.2.1.2.2   Binary Trigger

Status changes of the binary DAU inputs can be defined as trigger conditions. Thus, a record can be started if a sensor changes to or leaves from the alarm state or for each state change.

The correspondence between physical and logical state change depends on the sensor type (see table 7-14 and chapter 12.11.1).

Table 7-14   Sensor types

Sensor	Logical state change	Physical state change
Make contact	Change to alarm state	Low → High
	Change from alarm state	High → Low
Break contact	Change to alarm state	High → Low
	Change from alarm state	Low → High

For the definition of high and low levels, refer to chapter 16.1.4.

Retrigger blocking for binary signals

The retrigger blocking can be activated separately for every binary input. It is used to suppress repeated recordings in the event of fast successive binary signal changes while recording. The corresponding binary trigger is disabled for the preset retrigger blocking time. If the same binary input is retriggered within the retrigger blocking time, the retrigger blocking will be restarted for this input. All other active channels can retrigger the TAR and thus extend the fault record.

Note

The retrigger blocking time can be defined longer than the recording time. In case of a wrong configuration, this may unintentionally avoid recordings.

7.2.1.2.3 Logical Trigger

A logical trigger can comprise two to eight single triggers combined by a logical AND.

A maximum of 8 logical triggers can be defined in a SIMEAS R-PMU. In a parameterization dialog, logical triggers are named **Pattern** or **Logical Group** (see chapter 12.12.5).

Time window for logical triggers

The trigger conditions for a logical trigger do not have to be met simultaneously. It is sufficient if they occur within the parameterized time window (time frame for logical trigger). The first trigger starts the time frame for logical trigger. If all conditions of a logical trigger are met within this time window, the recording will be started after this time has elapsed (see figure 7-11). The record is provided with the trigger time stamp at the end of the time frame for the logical trigger.
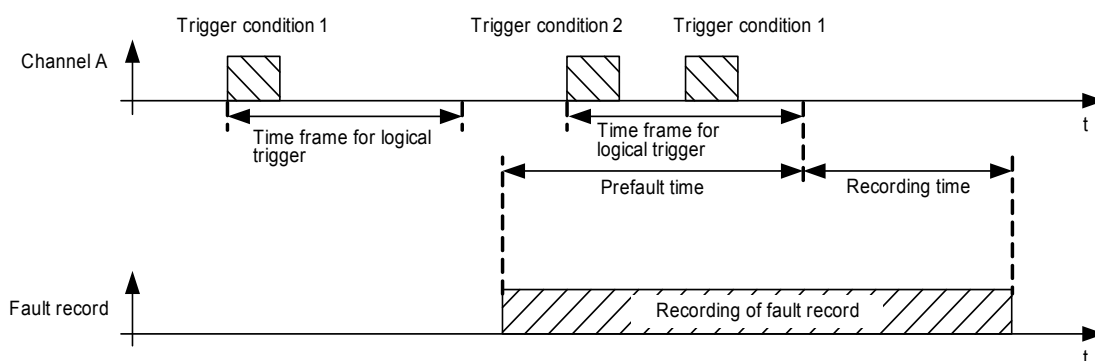
Figure 7-11   Recording of a fault record when all conditions of a logical trigger are met during the time frame

> **Note**
>
> All channels used in a/an (active) logical trigger pattern are inactive as single triggers.

7.2.1.2.4 Cross Trigger

If the cross trigger has been activated for the Transient Analog Recorder, recording by the Transient Analog Recorder will be started as soon as the Transient Phasor Recorder has been triggered. In this case, the prefault time corresponds to the recording time that has been parameterized for the Transient Analog Recorder. An extension (retriggering) of the TAR fault record can only be initiated by the Transient Analog Recorder and not by another cross trigger of the Transient Phasor Recorder.

7.2.1.2.5 Manual Triggers

There are several options for triggering the Transient Analog Recorder manually. The duration of the manually triggered fault record depends on the values parameterized under **Manual recording time** and **Prefault time**. If a manual trigger is started, the SIMEAS R-PMU does not send any network signal.

If a manual trigger starts a record, the record will be restarted if it is retriggered due to a disturbance. Since the disturbance recording time is set independently of the manual trigger recording time, this may change the total recording time.

Manual trigger on the control panel

Actuating the "Manual trigger" button on the control panel starts a fault recording.

Manual trigger via OSCOP P

Alternatively, the manual trigger can be started with the OSCOP P evaluation and parameterization software. For detailed information on this topic, see the OSCOP P manual, the chapter on *Transmitting data*.

7.2.1.2.6 External Trigger

With the Transient Analog Recorder, the fault record can be started externally via a binary input at the central processing unit of the SIMEAS R-PMU. Recording is continued as long as the external control signal is provided. The recording time is limited to a maximum of 30 s plus 1 s prefault time. If the external trigger is set, SIMEAS R-PMU sends no network trigger signal.

If an external trigger starts a fault record, the record will be restarted if it is retriggered due to a disturbance. Since the disturbance recording time is different from the external trigger duration, this may change the total recording time.

7.2.1.2.7 Network Trigger

If several SIMEAS R-PMU are combined to form a local network (LAN), the triggered device can use the network to send UDP broadcast telegrams to the other SIMEAS R-PMU devices and start a TAR fault recording there. The subnet is defined via **IP Address SIMEAS R-PMU** and **Subnet Mask SIMEAS R-PMU**, see chapter 12.7.2 and chapter 10.2.2.

You can set separately, whether the SIMEAS R-PMU is to send network trigger signals or to evaluate incoming network trigger requests. If incoming network trigger requests are evaluated, only the TAR is able to start a retrigger. Retriggering is not possible via a new network trigger. If SIMEAS R-PMU receives a network trigger, the trigger time stamp indicates the receipt time of the network trigger.

If SIMEAS R V2/3 devices are also used in the same network, the SIMEAS R-PMU can evaluate a network trigger received from these devices and start its own record. The opposite case, i. e., that the SIMEAS R V2/3 device starts a fault record upon receipt of a trigger from a SIMEAS R-PMU device, is only possible if both devices refer to the same time base.

7.2.2   **Transient Phasor Recorder (TPR)**

The use of the Transient Phasor Recorder (TPR) enables the analysis of oscillations of electrical characteristic values (e. g., fluctuations of the active and reactive power in power supply systems). Possible applications are described in chapter 2, *Applications*, of this manual.

The TPR records the voltage and current curves, the derived values (e. g, active and reactive power) of the fundamental component, binary signals and process values in cycles when a fault occurs. For this purpose, the user defines trigger limits and recording times using the OSCOP P parameterization software. The input signals are analyzed according to the preset trigger conditions and recorded if the limit values are exceeded or not reached.

The essential difference to the Transient Analog Recorder is the cycle-based determination of the measured and derived values, as well as a longer recording time. The fault record contains the prefault time, the trigger time and the recorded fault. The trigger cause is also stored.

The following trigger functions can be parameterized for the Transient Phasor Recorder:

❑ Level trigger Min/Max

❑ Gradient trigger

❑ Binary trigger

❑ Cross trigger

❑ Manual trigger

❑ External trigger

❑ Network trigger

The fault records are stored on the mass storage device of the SIMEAS R-PMU. The maximum memory space on the storage device for storing the fault records is defined in the parameterization. Once 90 % of the parameterized memory capacity have been reached, the oldest recordings will be deleted, thus ensuring that the occupancy level is no more than 80 %. The size of the mass storage device ensures that up to several hundred fault records can be stored depending on the configuration.

7.2.2.1 Recording Channels

A fault record that has been recorded by the Transient Phasor Recorder contains signal tracks for AC values, phase angles, symmetrical components, active and reactive power, frequencies, process, binary signals, and quality tracks. Because of a parameterizable recording interval, the frequency and the phasor are recorded every 1 to 5 nominal cycles for AC values. The phasors are then used to calculate the AC and the derived values. The recorded phasors, rms values, triggers and derived values are determined based on the fundamental component of the signal only.

The same recording interval of 1 to 5 nominal cycles is used for process values, however, a mean value is calculated over the complete recording interval.

Note

As the Transient Analog Recorder uses the fundamental component of the measured signal to record total rms values, the Transient Phasor Recorder can display a lower fundamental component rms value for current and voltage in the event of signals with a high harmonic component.

Analogously to the Transient Analog Recorder, the binary changes are recorded with a resolution of 1 kHz and a maximum of 250 signal changes per second and DAU.

All channels of the active DAUs are always recorded, even if there is no limit value violation for the channel.

Tables 7-15 and 7-16 give an overview of the recorded values of the DAUs.

Table 7-15   Recorded values of the VCDAU, VDAU and CDAU depending on the input connection

	VCDAU	VDAU	CDAU
Star connection	$\underline{V}_{L1}$, $\underline{V}_{L2}$, $\underline{V}_{L3}$, $\underline{V}_N$ φ_{L1-1}, φ_{L2-1}, φ_{L3-1}, φ_{VN} V_1, V_2, V_0 φ_{1-1}, φ_{2-1}, φ_{0-1} f_1 $\underline{I}_{L1}$, $\underline{I}_{L2}$, $\underline{I}_{L3}$, $\underline{I}_N$ φ_{L1-2}, φ_{L2-2}, φ_{L3-2}, φ_{IN} I_1, I_2, I_0 φ_{1-2}, φ_{2-2}, φ_{0-2} f_2 P_Σ, Q_Σ, P_4, Q_4 B_1 to B_{16}	$\underline{V}_{L1-1}$, $\underline{V}_{L2-1}$, $\underline{V}_{L3-1}$, $\underline{V}_{N4}$ φ_{L1-1}, φ_{L2-1}, φ_{L3-1}, φ_{N4} V_{1-1}, V_{2-1}, V_{0-1} φ_{1-1}, φ_{2-1}, φ_{0-1} f_1 $\underline{V}_{L1-2}$, $\underline{V}_{L2-2}$, $\underline{V}_{L3-2}$, $\underline{V}_{N8}$ φ_{L1-2}, φ_{L2-2}, φ_{L3-2}, φ_{N8} V_{1-2}, V_{2-2}, V_{0-2} φ_{1-2}, φ_{2-2}, φ_{0-2} f_2 B_1 to B_{16}	$\underline{I}_{L1-1}$, $\underline{I}_{L2-1}$, $\underline{I}_{L3-1}$, $\underline{I}_{N4}$ φ_{L1-1}, φ_{L2-1}, φ_{L3-1}, φ_{N4} I_{1-1}, I_{2-1}, I_{0-1} φ_{1-1}, φ_{2-1}, φ_{0-1} f_1 {$P_{\Sigma1}$, $Q_{\Sigma1}$, P_4, Q_4} $\underline{I}_{L1-2}$, $\underline{I}_{L2-2}$, $\underline{I}_{L3-2}$, $\underline{I}_{N8}$ φ_{L1-2}, φ_{L2-2}, φ_{L3-2}, φ_{N8} I_{1-2}, I_{2-2}, I_{0-2} φ_{1-2}, φ_{2-2}, φ_{0-2} f_2 {$P_{\Sigma2}$, $Q_{\Sigma2}$, P_8, Q_8} B_1 to B_{16}
Delta connection	$\underline{V}_{L12}$, $\underline{V}_{L23}$, $\underline{V}_{L31}$, $\underline{V}_4$ φ_{L1-1}, φ_{L2-1}, φ_{L3-1}, φ_{V4} V_1, V_2, V_0 φ_{1-1}, φ_{2-1}, φ_{0-1} f_1 $\underline{I}_{L1}$, $\underline{I}_{L2}$, $\underline{I}_{L3}$, $\underline{I}_4$ φ_{L1-2}, φ_{L2-2}, φ_{L3-2}, φ_{I4} I_1, I_2, I_0 φ_{1-2}, φ_{2-2}, φ_{0-2} f_2 P_Σ, Q_Σ, P_4, Q_4 B_1 to B_{16}	$\underline{V}_{L12-1}$, $\underline{V}_{L23-1}$, $\underline{V}_{L31-1}$, $\underline{V}_4$ φ_{L1-1}, φ_{L2-1}, φ_{L3-1}, φ_4 V_{1-1}, V_{2-1}, V_{0-1} φ_{1-1}, φ_{2-1}, φ_{0-1} f_1 $\underline{V}_{L12-2}$, $\underline{V}_{L23-2}$, $\underline{V}_{L31-2}$, $\underline{V}_8$ φ_{L1-2}, φ_{L2-2}, φ_{L3-2}, φ_8 V_{1-2}, V_{2-2}, V_{0-2} φ_{1-2}, φ_{2-2}, φ_{0-2} f_2 B_1 to B_{16}	$\underline{I}_{L1-1}$, $\underline{I}_{L2-1}$, $\underline{I}_{L3-1}$, $\underline{I}_4$ φ_{L1-1}, φ_{L2-1}, φ_{L3-1}, φ_4 I_{1-1}, I_{2-1}, I_{0-1} φ_{1-1}, φ_{2-1}, φ_{0-1} f_1 {$P_{\Sigma1}$, $Q_{\Sigma1}$, P_4, Q_4} $\underline{I}_{L1-2}$, $\underline{I}_{L2-2}$, $\underline{I}_{L3-2}$, $\underline{I}_8$ φ_{L1-2}, φ_{L2-2}, φ_{L3-2}, φ_8 I_{1-2}, I_{2-2}, I_{0-2} φ_{1-2}, φ_{2-2}, φ_{0-2} f_2 {$P_{\Sigma2}$, $Q_{\Sigma2}$, P_8, Q_8} B_1 to B_{16}

Table 7-15   Recorded values of the VCDAU, VDAU and CDAU depending on the input connection (Forts.)

	VCDAU	VDAU	CDAU
Monophase	$\underline{V}_{L1}$, $\underline{V}_{L2}$, $\underline{V}_{L3}$, V_{L4} $\varphi_{L1\text{-}1}$, $\varphi_{L2\text{-}1}$, $\varphi_{L3\text{-}1}$, $\varphi_{L4\text{-}1}$ f_1	$\underline{V}_{L1}$, $\underline{V}_{L2}$, $\underline{V}_{L3}$, $\underline{V}_{L4}$ φ_{L1}, φ_{L2}, φ_{L3}, φ_{L4} f_1	$\underline{I}_{L1}$, $\underline{I}_{L2}$, $\underline{I}_{L3}$, $\underline{I}_{L4}$ φ_{L1}, φ_{L2}, φ_{L3}, φ_{L4} f_1 $\{P_1, P_2, P_3, P_4\}$ $\{Q_1, Q_2, Q_3, Q_4\}$
	$\underline{I}_{L1}$, $\underline{I}_{L2}$, $\underline{I}_{L3}$, $\underline{I}_{L4}$ $\varphi_{L1\text{-}2}$, $\varphi_{L2\text{-}2}$, $\varphi_{L3\text{-}2}$, $\varphi_{L4\text{-}2}$ f_2 P_1, P_2, P_3, P_4 Q_1, Q_2, Q_3, Q_4 B_1 to B_{16}	$\underline{V}_{L5}$, $\underline{V}_{L6}$, $\underline{V}_{L7}$, $\underline{V}_{L8}$ φ_{L5}, φ_{L6}, φ_{L7}, φ_{L8} f_2 B_1 to B_{16}	$\underline{I}_{L5}$, $\underline{I}_{L6}$, $\underline{I}_{L7}$, $\underline{I}_{L8}$ φ_{L5}, φ_{L6}, φ_{L7}, φ_{L8} f_2 $\{P_5, P_6, P_7, P_8\}$ $\{Q_5, Q_6, Q_7, Q_8\}$ B_1 to B_{16}

Note: Recorded values in {...} are applicable for coupled CDAUs. The current inputs of the CDAU are coupled to a voltage group, e. g., a VDAU or VCDAU, for power measurement.

Table 7-16   Recorded values of the DDAU and BDAU

DDAU	BDAU
D_1, D_2, D_3, D_4 D_5, D_6, D_7, D_8 B_1 to B_{16}	 B_1 to B_{32}

Quality tracks

Status information is evaluated with the OSCOP P evaluation and parameterization software and displayed in the form of a diagram with eight tracks under the designation "Quality tracks". The meaning of this status information is described in chapter 7.2.1.1.

7.2.2.2 Trigger Functions

Several trigger limits and recording times can be parameterized for the Transient Phasor Recorder. The input signals are analyzed according to the trigger conditions and start the fault recording if the trigger condition is met. The duration of the fault record depends on the parameterized recording times and can be extended (retriggered) up to the maximum recording time by a repeated limit value violation. The recording time is 900 s per TPR fault record (50 Hz nominal frequency) and 750 s (60 Hz nominal frequency) plus prefault time.

Please see tables 7-17 and 7-18 below for the values to be triggered to by the Transient Phasor Recorder depending on the acquisition modules.

Table 7-17   Trigger values of the VCDAU, VDAU and CDAU depending on the input connection (dt is the filter time for the TPR)

	VCDAU	VDAU	CDAU
Star connection	$\underline{V}_{L1}$, $\underline{V}_{L2}$, $\underline{V}_{L3}$, $\underline{V}_{N}$ $d\underline{V}_{L1}/dt$, $d\underline{V}_{L2}/dt$ $d\underline{V}_{L3}/dt$, $d\underline{V}_{N}/dt$ V_1, V_2, V_0 f_1, df_1/dt	$\underline{V}_{L1\text{-}1}$, $\underline{V}_{L2\text{-}1}$, $\underline{V}_{L3\text{-}1}$, $\underline{V}_{N4}$ $d\underline{V}_{L1\text{-}1}/dt$, $d\underline{V}_{L2\text{-}1}/dt$ $d\underline{V}_{L3\text{-}1}/dt$, $d\underline{V}_{N4}/dt$ $V_{1\text{-}1}$, $V_{2\text{-}1}$, $V_{0\text{-}1}$ f_1, df_1/dt	$\underline{I}_{L1\text{-}1}$, $\underline{I}_{L2\text{-}1}$, $\underline{I}_{L3\text{-}1}$, $\underline{I}_{N4}$ $d\underline{I}_{L1\text{-}1}/dt$, $d\underline{I}_{L2\text{-}1}/dt$ $d\underline{I}_{L3\text{-}1}/dt$, $d\underline{I}_{N4}/dt$ $I_{1\text{-}1}$, $I_{2\text{-}1}$, $I_{0\text{-}1}$ $\{P_{\Sigma1}, Q_{\Sigma1}, P_4, Q_4\}$ $\{dP_{\Sigma1}/dt, dQ_{\Sigma1}/dt\}$ $\{dP_4/dt, dQ_4/dt\}$
	$\underline{I}_{L1}$, $\underline{I}_{L2}$, $\underline{I}_{L3}$, $\underline{I}_{N}$ $d\underline{I}_{L1}/dt$, $d\underline{I}_{L2}/dt$ $d\underline{I}_{L3}/dt$, $d\underline{I}_{N}/dt$ I_1, I_2, I_0 P_{Σ}, Q_{Σ}, P_4, Q_4 dP_{Σ}/dt, dQ_{Σ}/dt dP_4/dt, dQ_4/dt B_1 to B_{16}	$\underline{V}_{L1\text{-}2}$, $\underline{V}_{L2\text{-}2}$, $\underline{V}_{L3\text{-}2}$, $\underline{V}_{N8}$ $d\underline{V}_{L1\text{-}2}/dt$, $d\underline{V}_{L2\text{-}2}/dt$ $d\underline{V}_{L3\text{-}2}/dt$, $d\underline{V}_{N8}/dt$ $V_{1\text{-}2}$, $V_{2\text{-}2}$, $V_{0\text{-}2}$ f_2, df_2/dt B_1 to B_{16}	$\underline{I}_{L1\text{-}2}$, $\underline{I}_{L2\text{-}2}$, $\underline{I}_{L3\text{-}2}$, $\underline{I}_{N8}$ $d\underline{I}_{L1\text{-}2}/dt$, $d\underline{I}_{L2\text{-}2}/dt$ $d\underline{I}_{L3\text{-}2}/dt$, $d\underline{I}_{N8}/dt$ $I_{1\text{-}2}$, $I_{2\text{-}2}$, $I_{0\text{-}2}$ $\{P_{\Sigma2}, Q_{\Sigma2}, P_8, Q_8\}$ $\{dP_{\Sigma2}/dt, dQ_{\Sigma2}/dt\}$ $\{dP_8/dt, dQ_8/dt\}$ B_1 to B_{16}

Table 7-17   Trigger values of the VCDAU, VDAU and CDAU depending on the input connection (Forts.)(dt is the filter time for the TPR)

	VCDAU	VDAU	CDAU
Delta connection	$\underline{V}_{L12}$, $\underline{V}_{L23}$, $\underline{V}_{L31}$, $\underline{V}_4$ $d\underline{V}_{L12}/dt$, $d\underline{V}_{L23}/dt$ $d\underline{V}_{L31}/dt$, $d\underline{V}_4/dt$ V_1, V_2, V_0 f_1, df_1/dt	$\underline{V}_{L12\text{-}1}$, $\underline{V}_{L23\text{-}1}$, $\underline{V}_{L31\text{-}1}$, $\underline{V}_4$ $d\underline{V}_{L12\text{-}1}/dt$, $d\underline{V}_{L23\text{-}1}/dt$ $d\underline{V}_{L31\text{-}1}/dt$, $d\underline{V}_4/dt$ $V_{1\text{-}1}$, $V_{2\text{-}1}$, $V_{0\text{-}1}$ f_1, df_1/dt	$\underline{I}_{L1\text{-}1}$, $\underline{I}_{L2\text{-}1}$, $\underline{I}_{L3\text{-}1}$, $\underline{I}_4$ $d\underline{I}_{L1\text{-}1}/dt$, $d\underline{I}_{L2\text{-}1}/dt$ $d\underline{I}_{L3\text{-}1}/dt$, $d\underline{I}_4/dt$ $I_{1\text{-}1}$, $I_{2\text{-}1}$, $I_{0\text{-}1}$ $\{P_{\Sigma1}, Q_{\Sigma1}, P_4, Q_4\}$ $\{dP_{\Sigma1}/dt, dQ_{\Sigma1}/dt\}$ $\{dP_4/dt, dQ_4/dt\}$
	$\underline{I}_{L1}$, $\underline{I}_{L2}$, $\underline{I}_{L3}$, $\underline{I}_4$ $d\underline{I}_{L1}/dt$, $d\underline{I}_{L2}/dt$ $d\underline{I}_{L3}/dt$, $d\underline{I}_4/dt$ I_1, I_2, I_0 P_{Σ}, Q_{Σ}, P_4, Q_4 dP_{Σ}/dt, dQ_{Σ}/dt dP_4/dt, dQ_4/dt B_1 to B_{16}	$\underline{V}_{L12\text{-}2}$, $\underline{V}_{L23\text{-}2}$, $\underline{V}_{L31\text{-}2}$, $\underline{V}_8$ $d\underline{V}_{L12\text{-}2}/dt$, $d\underline{V}_{L23\text{-}2}/dt$ $d\underline{V}_{L31\text{-}2}/dt$, $d\underline{V}_8/dt$ $V_{1\text{-}2}$, $V_{2\text{-}2}$, $V_{0\text{-}2}$ f_2, df_2/dt B_1 to B_{16}	$\underline{I}_{L1\text{-}2}$, $\underline{I}_{L2\text{-}2}$, $\underline{I}_{L3\text{-}2}$, $\underline{I}_8$ $d\underline{I}_{L1\text{-}2}/dt$, $d\underline{I}_{L2\text{-}2}/dt$ $d\underline{I}_{L3\text{-}2}/dt$, $d\underline{I}_8/dt$ $I_{1\text{-}2}$, $I_{2\text{-}2}$, $I_{0\text{-}2}$ $\{P_{\Sigma2}, Q_{\Sigma2}, P_8, Q_8\}$ $\{dP_{\Sigma2}/dt, dQ_{\Sigma2}/dt\}$ $\{dP_8/dt, dQ_8/dt\}$ B_1 to B_{16}

Table 7-17   Trigger values of the VCDAU, VDAU and CDAU depending on the input connection (Forts.)(dt is the filter time for the TPR)

	VCDAU	VDAU	CDAU
Monophase	$\underline{V}_{L1}$, $\underline{V}_{L2}$, $\underline{V}_{L3}$, $\underline{V}_{L4}$ $d\underline{V}_{L1}/dt$, $d\underline{V}_{L2}/dt$ $d\underline{V}_{L3}/dt$, $d\underline{V}_{L4}/dt$ f_1, df_1/dt	$\underline{V}_{L1}$, $\underline{V}_{L2}$, $\underline{V}_{L3}$, $\underline{V}_{L4}$ $d\underline{V}_{L1}/dt$, $d\underline{V}_{L2}/dt$ $d\underline{V}_{L3}/dt$, $d\underline{V}_{L4}/dt$ f_1, df_1/dt	$\underline{I}_{L1}$, $\underline{I}_{L2}$, $\underline{I}_{L3}$, $\underline{I}_{L4}$ $d\underline{I}_{L1}/dt$, $d\underline{I}_{L2}/dt$ $d\underline{I}_{L3}/dt$, $d\underline{I}_{L4}/dt$ $\{P_1, P_2, P_3, P_4\}$ $\{dP_1/dt, dP_2/dt\}$ $\{dP_3/dt, dP_4/dt\}$ $\{Q_1, Q_2, Q_3, Q_4\}$ $\{dQ_1/dt, dQ_2/dt\}$ $\{dQ_3/dt, dQ_4/dt\}$
	$\underline{I}_{L1}$, $\underline{I}_{L2}$, $\underline{I}_{L3}$, $\underline{I}_{L4}$ $d\underline{I}_{L1}/dt$, $d\underline{I}_{L2}/dt$ $d\underline{I}_{L3}/dt$, $d\underline{I}_{L4}/dt$ P_1, P_2, P_3, P_4 dP_1/dt, dP_2/dt dP_3/dt, dP_4/dt Q_1, Q_2, Q_3, Q_4 dQ_1/dt, dQ_2/dt dQ_3/dt, dQ_4/dt B_1 to B_{16}	$\underline{V}_{L5}$, $\underline{V}_{L6}$, $\underline{V}_{L7}$, $\underline{V}_{L8}$ $d\underline{V}_{L5}/dt$, $d\underline{V}_{L6}/dt$ $d\underline{V}_{L7}/dt$, $d\underline{V}_{L8}/dt$ f_2, df_2/dt B_1 to B_{16}	$\underline{I}_{L5}$, $\underline{I}_{L6}$, $\underline{I}_{L7}$, $\underline{I}_{L8}$ $d\underline{I}_{L5}/dt$, $d\underline{I}_{L6}/dt$ $d\underline{I}_{L7}/dt$, $d\underline{I}_{L8}/dt$ $\{P_5, P_6, P_7, P_8\}$ $\{dP_5/dt, dP_6/dt\}$ $\{dP_7/dt, dP_8/dt\}$ $\{Q_5, Q_6, Q_7, Q_8\}$ $\{dQ_5/dt, dQ_6/dt\}$ $\{dQ_7/dt, dQ_8/dt\}$ B_1 to B_{16}

Note: Recorded values in {...} are applicable for coupled CDAUs. The current inputs of the CDAU are coupled to a voltage group, e. g., a VDAU or VCDAU, for power measurement.

Table 7-18   Trigger values of the DAUs for acquiring process and binary signals
(dt is the filter time for the TPR)

DDAU	BDAU
D_1, D_2, D_3, D_4 $dD_1/dt, dD_2/dt$ $dD_3/dt, dD_4/dt$ D_5, D_6, D_7, D_8 $dD_5/dt, dD_6/dt$ $dD_7/dt, dD_8/dt$	
B_1 to B_{16}	B_1 to B_{32}

Prefault time

The measured values are recorded continuously and stored in a ring buffer with a capacity of up to 30 s. If a fault occurs, the prefault time of the trigger event is put at the beginning of the record (see figure 7-12).
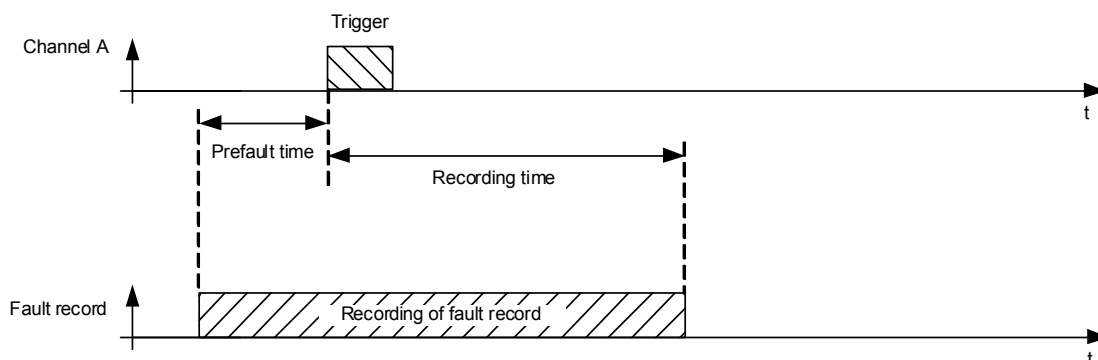
Figure 7-12   Composition of the fault record of prefault time, trigger and recording time

Recording time

The maximum recording time depends on the parameterized nominal frequency and is equal for all trigger causes of the Transient Phasor Recorder.

Table 7-19   Recording times of the Transient Phasor Recorder

Parameterized nominal frequency	50 Hz	60 Hz
Maximum prefault time	30 s	25 s
Maximum recording time	900 s	750 s

The recording time for manual triggers can be adjusted separately. For external triggers, the recording time cannot be parameterized. Recording is continued as long as the external control signal is provided.

If a trigger condition is detected, the SIMEAS R-PMU starts recording.

The recording time is restarted by retriggering (trigger 2) during recording, thus the fault record is extended (see figure 7-13).
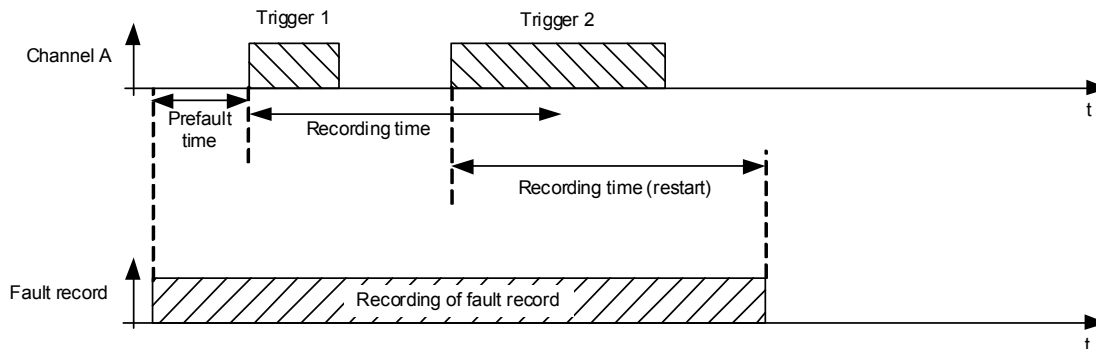
Figure 7-13   Retriggering during recording

If a trigger event (trigger 3) occurs shortly after the end of a fault recording (fault record 1), the prefault time of the second recording (fault record 2) overlaps with the first recording (see figure 7-14).
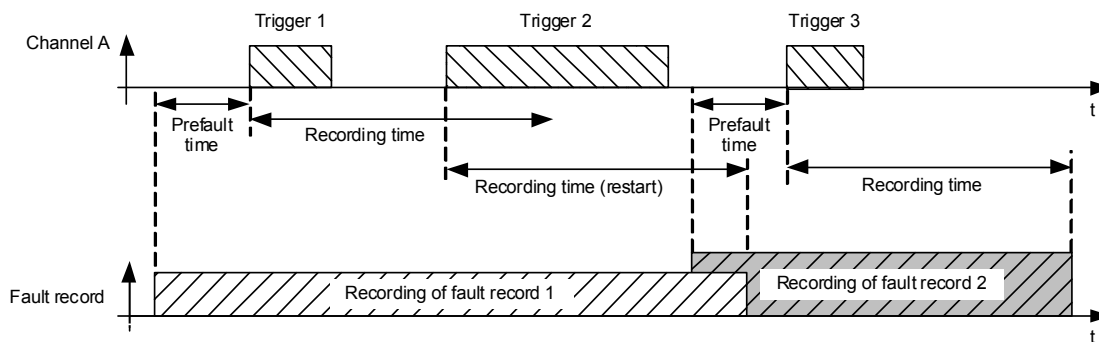
Figure 7-14   Overlap of two fault recordings in the prefault time range

7.2.2.2.1   Analog Signal Triggers

The Transient Phasor Recorder provides several options for triggering to analog input signals.

Table 7-20   Options of analog signal triggering

Measured value	Triggering
AC values	rms value of one period
DC values	Arithmetic mean over the complete recording interval

The level and gradient trigger can also be applied to analog signals.

Retrigger blocking for analog signals

To avoid repeated triggering of the device due to limit value violations within the shortest time, a retrigger blocking can be parameterized.

The retrigger blocking is started simultaneously with the recording time and acts for each individual channel. If a limit value violation occurs again for the same channel within the retrigger blocking time, this will not extend the fault record but only restart the channel-specific retrigger blocking time (see figure 7-15). All other channels can start retriggering (see figure 7-16). The retrigger blocking can be activated separately for every analog input.

> **Note**
>
> If the retrigger blocking time is defined longer than the recording time, no trigger events are recognized during this time.
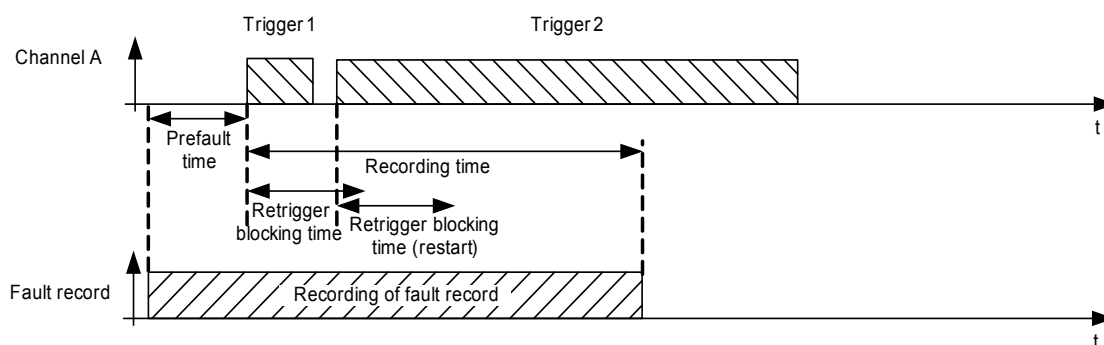
Figure 7-15   Trigger 2 does not extend the recording time due to retrigger blocking
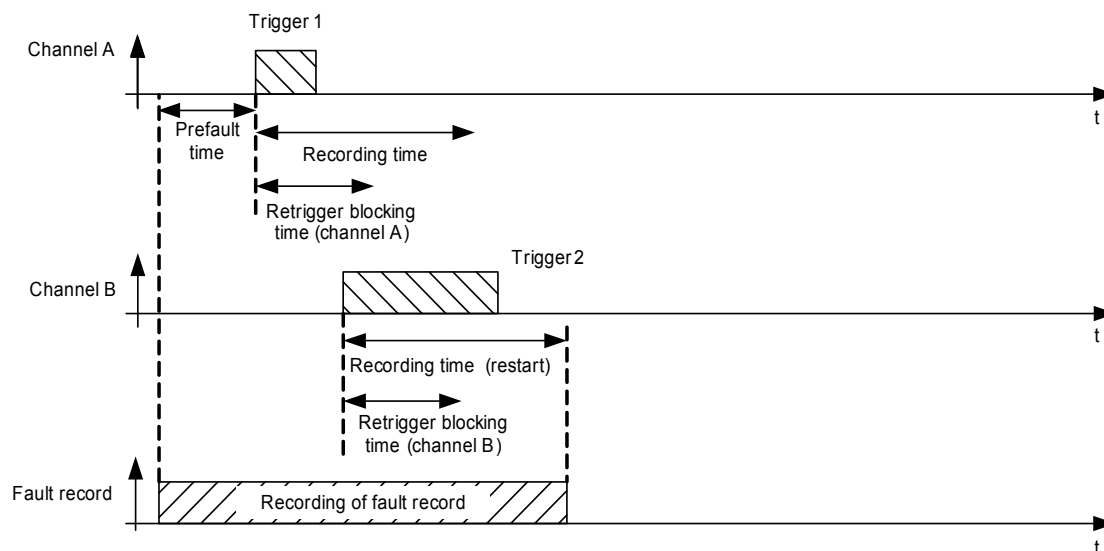
Figure 7-16   Channel B can extend (retrigger) the fault record within the retrigger blocking time of channel A; retrigger blocking is valid for the given channel only

7.2.2.2.1.1 Level Trigger (Min/Max)

Level triggers monitor the measured values for observance of min/max limits. Triggering is started, as soon as the measured value exceeds the parameterized permissible range. The level trigger can be parameterized for all analog and calculated values, as well as for symmetrical components from Table 7-18. The Min. level trigger cannot be selected for negative-sequence and zero-sequence systems.

Hysteresis

If a measured value reaches exactly the limit value, this may lead to unwanted fault recordings even with the smallest possible fluctuations. A hysteresis amounting to 2 % (at frequencies 0.2 %) of the parameterized nominal value of the corresponding channel is therefore applicable for all level trigger values.
If the level trigger value is set smaller than the given hysteresis, it will be set to 25 % of the parameterized trigger value. After a limit value violation has occurred, the signal must leave the hysteresis range first before another triggering is possible if the limit value is exceeded again (see figure 7-17).
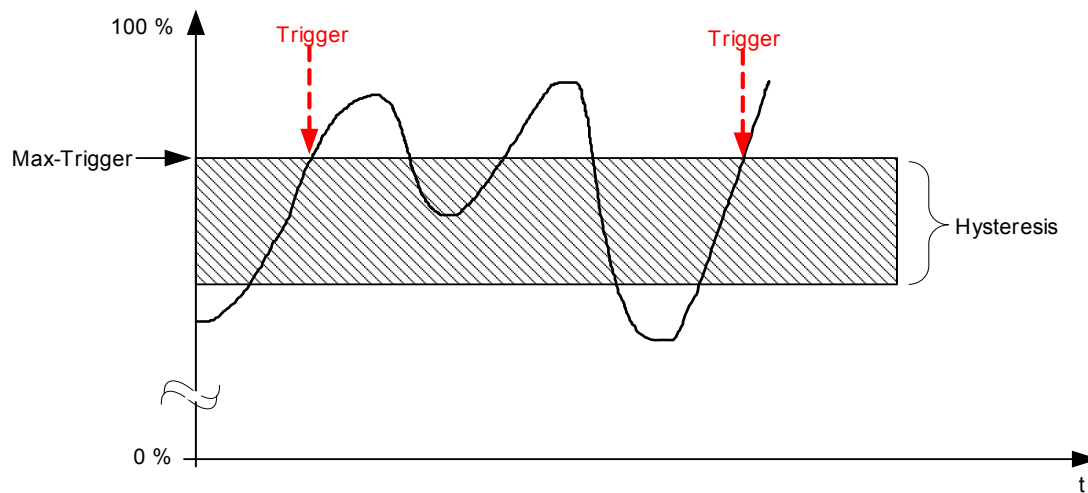
Figure 7-17   Functioning of the hysteresis for min and max level triggers

7.2.2.2.1.2 Gradient Trigger (±dM/dt)

A signal gradient describes the level changes within a set time. For the TPR, gradient trigger conditions for alternating signals are met, if the difference of two rms values of the basic oscillation averaged for t_m is higher than the parameterized threshold. For DDAUs, the arithmetic means with the distance of the filter time are compared. The averaging time t_m is equivalent to the parameterized recording rate of 1 to 5 nominal cycles.

There are two different types of gradients: Rising gradient (+dM/dt, i. e. positive difference) and falling gradient (-dM/dt, i. e. negative difference). Gradient triggers may be set for the signals listed in the tables 7-17 and 7-18 (not for symmetrical components). In order to avoid unrequested recordings due to short term signal oscillations, the filter time can be set so high that only signal gradients of a certain level generate a trigger. Figure 7-18 shows a typical measuring signal.

dt is the filter time, t_m the averaging time.
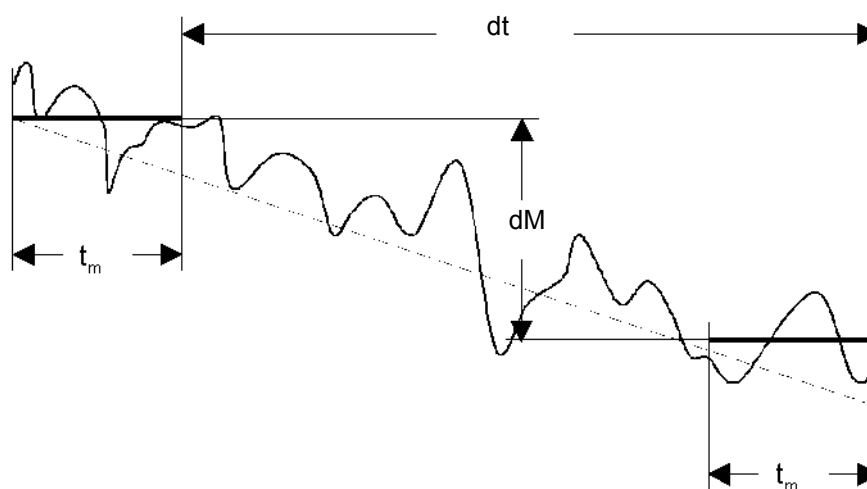
Figure 7-18 Effect of the gradient trigger

Filter time

The filter time is indicated in seconds and defines the reference time of the gradient trigger. The duration of the filter time should be adapted to the recording rate.

The figures 7-19 to 7-21 show the functioning of the filter time for a signal that is normalized to the nominal frequency.

> **Note**
>
> The longer the selected recording rate, the more signal peaks are no longer detected.

The signal peaks are filtered out during a long recording rate (see Figure 7-21). To ensure that the trigger event is clearly recorded despite the signal change, the filter time must be parameterized accordingly low.

Recording rate= 1 nominal cycle
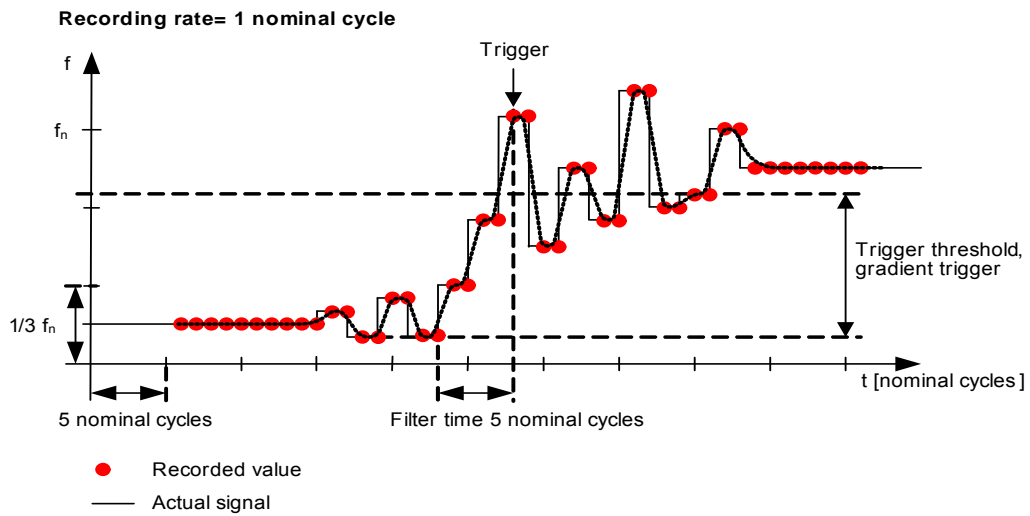
Figure 7-19 Triggering with recording rate = 1 nominal cycle

Recording rate= 3 nominal cycles
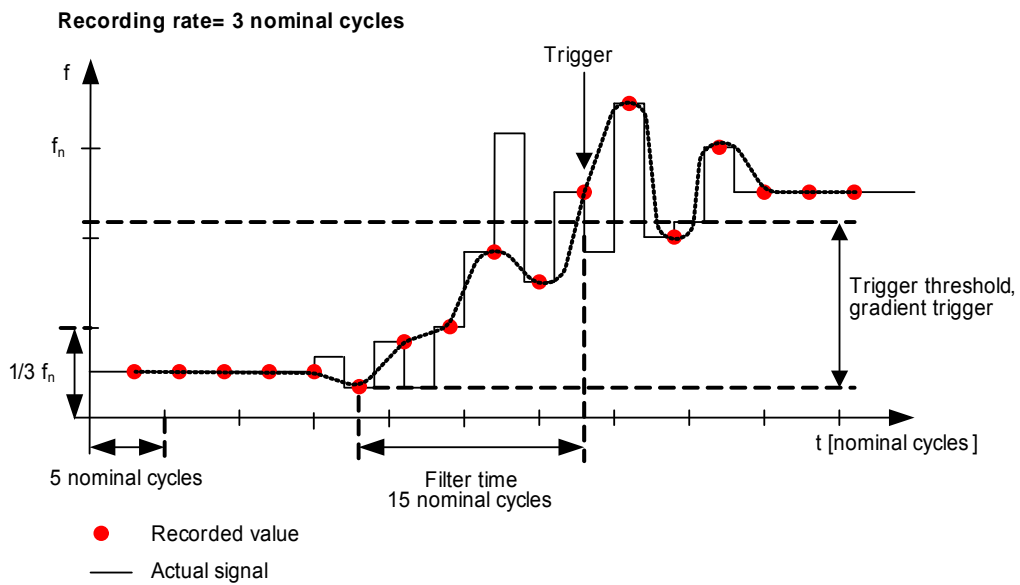
Figure 7-20 Triggering with recording rate = 3 nominal cycles
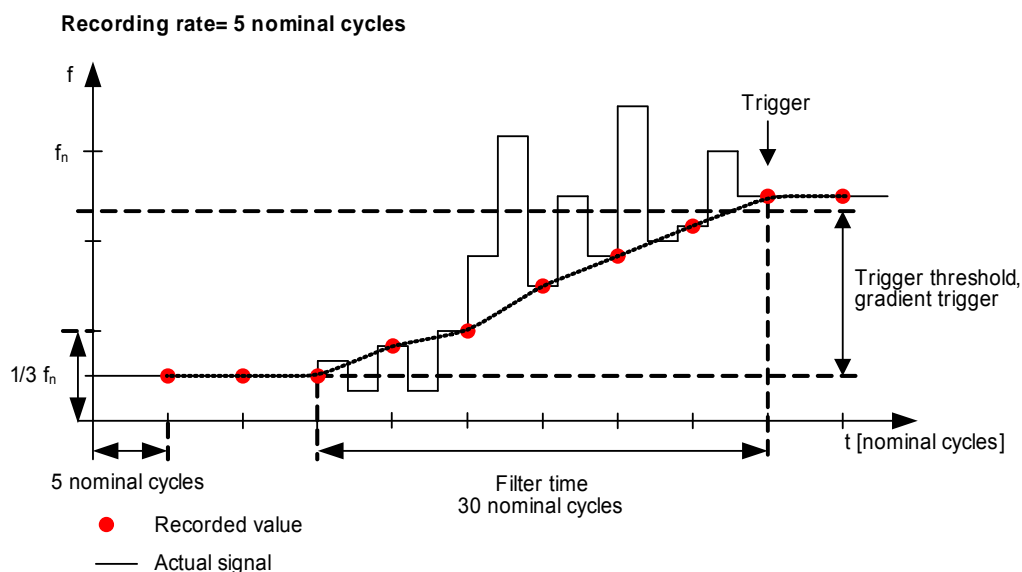
Figure 7-21 Triggering with recording rate = 5 nominal cycles

7.2.2.2.2   Binary Trigger

Status changes of the binary DAU inputs can be defined as trigger conditions. Thus, a record can be started, if a sensor changes to or leaves from the alarm state or for each state change.

The correspondence between physical and logical state change depends on the sensor type (see table 7-14 and chapter 12.11.1).

Table 7-21   Sensor types

Sensor	Logical state change	Physical state change
Make contact	Change to alarm state	Low $\rightarrow$ High
	Change from alarm state	High $\rightarrow$ Low
Break contact	Change to alarm state	High $\rightarrow$ Low
	Change from alarm state	Low $\rightarrow$ High

For the definition of high and low levels, refer to chapter 16.1.5.

Retrigger blocking for binary signals

The retrigger blocking can be activated separately for every binary input. It is used to suppress repeated recordings in the event of fast successive binary signal changes while recording. The corresponding binary trigger is disabled for the preset retrigger blocking time. If the same binary input is retriggered within the retrigger blocking time, the retrigger blocking will be restarted for this input. All other active channels can retrigger the TPR and thus extend the fault record.

> **Note**
>
> The retrigger blocking time can be defined longer than the recording time to avoid unwanted recording in the event of a wrong configuration.

7.2.2.2.3 Cross Trigger

If the cross trigger has been activated for the Transient Phasor Recorder, recording by the Transient Phasor Recorder will be started as soon as the Transient Analog Recorder has been triggered. In this case, the prefault time corresponds to the recording time that has been parameterized for the Transient Phasor Recorder. An extension (retriggering) of the TPR fault record can only be initiated by the Transient Phasor Recorder and not by another cross trigger of the Transient Analog Recorder.

7.2.2.2.4 Manual Triggers

There are several options for triggering the Transient Phasor Recorder manually. The duration of the manually triggered fault record depends on the values parameterized under **Manual recording time** and **Prefault time**. If a manual trigger is started, the SIMEAS R-PMU does not send any network signal.

If a manual trigger starts a record, the record will be restarted if it is retriggered due to a disturbance. Since the disturbance recording time is set independently of the manual trigger recording time, this may change the total recording time.

Manual trigger on the control panel

Actuating the "Manual trigger" button on the control panel starts a fault recording.

Manual trigger via OSCOP P

Alternatively, the manual trigger can be started with OSCOP P. For detailed information on this topic, see the OSCOP P manual, the chapter on *Transmitting data*.

7.2.2.2.5 External Trigger

For the Transient Phasor Recorder, the fault record can be started externally via a binary input at the central processing unit of the SIMEAS R-PMU. Recording is continued as long as the external control signal is provided. The recording time is limited to a maximum of 15 min plus 30 s prefault time at 50 Hz or 12.5 min plus 25 s prefault time at 60 Hz. If the external trigger is set, SIMEAS R-PMU sends no network trigger signal.

If an external trigger starts a record, the record will be restarted if it is retriggered due to a disturbance Since the disturbance recording time is derived differently than the external trigger recording time, this may change the total recording time.

7.2.2.2.6   Network Trigger

If several SIMEAS R-PMU are combined to form a local network (LAN), the triggered device can use the network to send UDP broadcast telegrams to the other SIMEAS R-PMU devices and start a TAR fault recording there. The subnet is defined via **IP Address SIMEAS R-PMU** and **Subnet Mask SIMEAS R-PMU**, see chapter 12.7.2 and chapter 10.2.2.

You can set separately, whether the SIMEAS R-PMU is to send network trigger signals or to evaluate incoming network trigger requests. If incoming network trigger requests are evaluated, only the TAR is able to start a retrigger. Retriggering is not possible via a new network trigger. If SIMEAS R-PMU receives a network trigger, the trigger time stamp indicates the receipt time of the network trigger.

If SIMEAS R V2/3 devices are also used in the same network, the SIMEAS R-PMU can evaluate a network trigger received from these devices and start its own record. The opposite case, i. e., that the SIMEAS R V2/3 device starts a fault record upon receipt of a trigger from a SIMEAS R-PMU device, is only possible if both devices refer to the same time base.

7.3 Continuous Recorder

The SIMEAS R-PMU features six continuous recorders: 5 Continuous Recorders (CR) and the Event Recorder (ER). Continuous Recorders are used for data acquisition of the analog values over longer periods of time, in order to be able to perform long-term analyses of the system behaviour. The Event Recorder records the state changes of binary signals. Table 7-22 provides an exact overview of the available recorders.

Table 7-22   Continuous recorder overview

Designation	Recorded values	Recording interval (to be parameterized)
Continuous Phasor Recorder (CPR)	Phasors, frequencies	Cycle time: 1 s to 10 min
Continuous Frequency Recorder (CFR)	Frequencies Arithmetic mean value	Averaging time: 1 s to 10 min
Continuous RMS-value Recorder (CRR)	rms values (V, I) Arithmetic mean value	
Continuous Power Recorder (CQR)	Active and reactive powers Arithmetic mean value	
Continuous DC Recorder (CDR)	Process signals Arithmetic mean value	
Event Recorder (ER)	Binary signals	Event-controlled

The individual recorders use different methods of data acquisition:

❑ The CPR records the values as instantaneous values at the end of the parameterized recording interval.

❑ The CFR, CRR, CQR and CDR recorders calculate the arithmetic mean of the cycle-based measured values using the averaging interval (see figure 7-22).
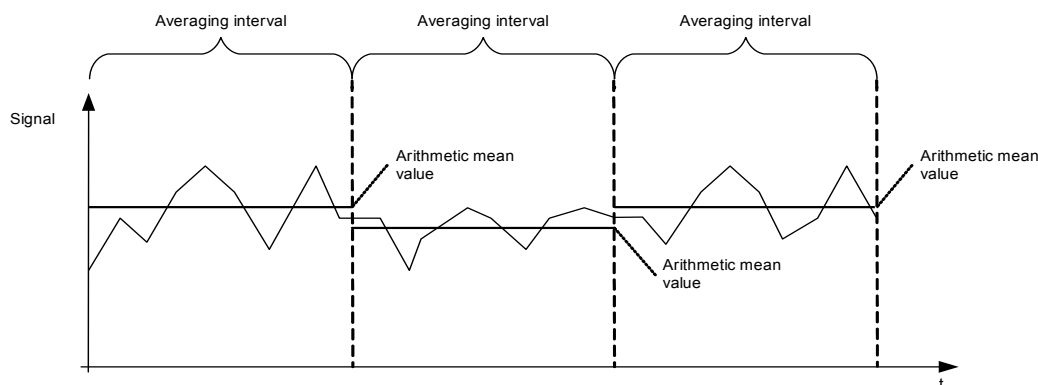
Figure 7-22   Calculating the arithmetic mean at the end of each averaging interval for CFR, CRR, CQR and CDR

❑ The CDR calculates the arithmetic mean using the averaging time.

❑ The Event Recorder collects the data records in an event-controlled manner, independent of any recording time.

The values recorded by the CPR, CFR, CRR and CQR continuous recorders are determined on the basis of the measured cycle. This also applies to frequency measured values, however, these values are not determined for each channel but for all VCDAUs, VDAUs and CDAUs groups. The frequency of the signal with the best signal quality (THD: total harmonic distortion) within the measured value group is used for this purpose.

Every continuous recorder can be activated separately. The memory space is organized as a ring buffer and when the parameterized maximum size is reached, the oldest records are automatically overwritten.

Note

Records must be transferred cyclically to OSCOP P to avoid loss of continuous recorder data. For more information, refer to the OSCOP P manual.

Note

The required memory space depends on how the DAU has been equipped. After the DAU parameters of the device have been changed, the data of all recorders will be deleted by the SIMEAS R-PMU. This is why the data must be backed up before changing the DAU configuration or the recorder sizes.

The continuous recorders have a parameterizable recording interval (cycle time or averaging time). The collected data of the recorder is continuously transmitted from the DAUs to the CPU and buffered in the cache. The contents of the cache memory are written in the flash memory every 10 minutes.

If the operator switches the device OFF before 10 minutes have elapsed or the external power supply malfunctions, the data that is not yet in the flash memory will be lost.

Note

A battery-buffered power supply unit that can be optionally delivered ensures a safe data backup even in case of a power supply failure.

Quality tracks

Status information is evaluated with the OSCOP P evaluation and parameterization software and presented in the form of a diagram with eight tracks under the designation "Quality tracks". The meaning of this status information is described in chapter 7.2.1.1. The quality tracks can be recorded with all long-term recorders that are described in the following chapters 7.3.1 and 7.3.5.

7.3.1   Continuous Phasor Recorder (CPR)

The continuous recorder for complex phasors – Continuous Phasor Recorder (CPR) – stores the frequency and the complex phasors of currents and voltages of the fundamental component as an instantaneous value at the end of the parameterized cycle time. No averaging is performed.
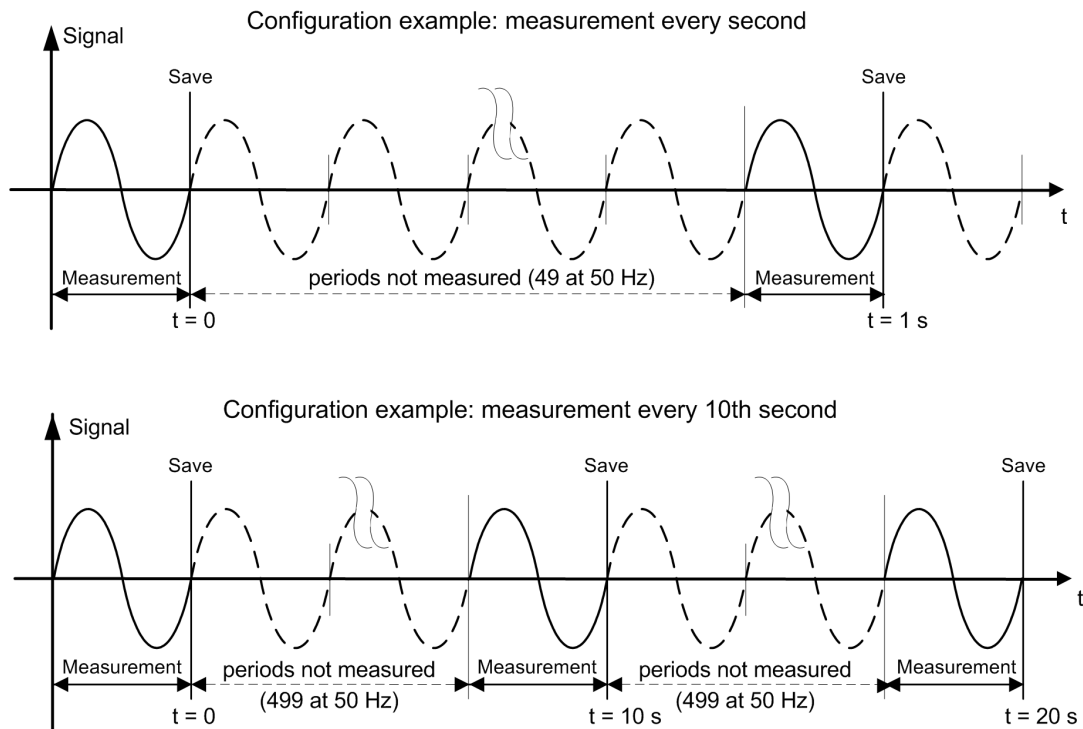
Figure 7-23   Principle of storing the instantaneous values with the CPR

The phasors are used to calculate the derived values for the corresponding recording time with OSCOP P.

Table 7-23   CPR – summary of technical data

Recording time	Continuously
Cycle time	1 s, 2 s, 5 s, 10 s, 30 s, 60 s, 120 s, 240 s, 300 s, 360 s, 480 s, 600 s
Usable DAUs	VCDAU, VDAU, CDAU
Recorded values	Phasors, frequencies, powers, symmetrical components

Note

Only one frequency per measured value group of a DAU is stored even if monophase has been configured.

Table 7-24   Recorded values of the CPR

	VCDAU	VDAU	CDAU
Star connection	$\underline{V}_{L1}$, $\underline{V}_{L2}$, $\underline{V}_{L3}$, $\underline{V}_N$	$\underline{V}_{L1\text{-}1}$, $\underline{V}_{L2\text{-}1}$, $\underline{V}_{L3\text{-}1}$, $\underline{V}_{N4}$	$\underline{I}_{L1\text{-}1}$, $\underline{I}_{L2\text{-}1}$, $\underline{I}_{L3\text{-}1}$, $\underline{I}_{N4}$
	$\varphi_{L1\text{-}1}$, $\varphi_{L2\text{-}1}$, $\varphi_{L3\text{-}1}$, φ_{VN}	$\varphi_{L1\text{-}1}$, $\varphi_{L2\text{-}1}$, $\varphi_{L3\text{-}1}$, φ_{N4}	$\varphi_{L1\text{-}1}$, $\varphi_{L2\text{-}1}$, $\varphi_{L3\text{-}1}$, φ_{N4}
	V_1, V_2, V_0	$V_{1\text{-}1}$, $V_{2\text{-}1}$, $V_{0\text{-}1}$	$I_{1\text{-}1}$, $I_{2\text{-}1}$, $I_{0\text{-}1}$
	$\varphi_{1\text{-}1}$, $\varphi_{2\text{-}1}$, $\varphi_{0\text{-}1}$	$\varphi_{1\text{-}1}$, $\varphi_{2\text{-}1}$, $\varphi_{0\text{-}1}$	$\varphi_{1\text{-}1}$, $\varphi_{2\text{-}1}$, $\varphi_{0\text{-}1}$
	f_1	f_1	f_1
			$\{P_{\Sigma1}, Q_{\Sigma1}, P_4, Q_4\}$
	$\underline{I}_{L1}$, $\underline{I}_{L2}$, $\underline{I}_{L3}$, $\underline{I}_N$	$\underline{V}_{L1\text{-}2}$, $\underline{V}_{L2\text{-}2}$, $\underline{V}_{L3\text{-}2}$, $\underline{V}_{N8}$	$\underline{I}_{L1\text{-}2}$, $\underline{I}_{L2\text{-}2}$, $\underline{I}_{L3\text{-}2}$, $\underline{I}_{N8}$
	$\varphi_{L1\text{-}2}$, $\varphi_{L2\text{-}2}$, $\varphi_{L3\text{-}2}$, φ_{IN}	$\varphi_{L1\text{-}2}$, $\varphi_{L2\text{-}2}$, $\varphi_{L3\text{-}2}$, φ_{N8}	$\varphi_{L1\text{-}2}$, $\varphi_{L2\text{-}2}$, $\varphi_{L3\text{-}2}$, φ_{N8}
	I_1, I_2, I_0	$V_{1\text{-}2}$, $V_{2\text{-}2}$, $V_{0\text{-}2}$	$I_{1\text{-}2}$, $I_{2\text{-}2}$, $I_{0\text{-}2}$
	$\varphi_{1\text{-}2}$, $\varphi_{2\text{-}2}$, $\varphi_{0\text{-}2}$	$\varphi_{1\text{-}2}$, $\varphi_{2\text{-}2}$, $\varphi_{0\text{-}2}$	$\varphi_{1\text{-}2}$, $\varphi_{2\text{-}2}$, $\varphi_{0\text{-}2}$
	f_2	f_2	f_2
	P_Σ, Q_Σ, P_4, Q_4		$\{P_{\Sigma2}, Q_{\Sigma2}, P_8, Q_8\}$
Delta connection	$\underline{V}_{L12}$, $\underline{V}_{L23}$, $\underline{V}_{L31}$, $\underline{V}_4$	$\underline{V}_{L12\text{-}1}$, $\underline{V}_{L23\text{-}1}$, $\underline{V}_{L31\text{-}1}$, $\underline{V}_4$	$\underline{I}_{L1\text{-}1}$, $\underline{I}_{L2\text{-}1}$, $\underline{I}_{L3\text{-}1}$, $\underline{I}_4$
	$\varphi_{L1\text{-}1}$, $\varphi_{L2\text{-}1}$, $\varphi_{L3\text{-}1}$, φ_{V4}	$\varphi_{L1\text{-}1}$, $\varphi_{L2\text{-}1}$, $\varphi_{L3\text{-}1}$, φ_4	$\varphi_{L1\text{-}1}$, $\varphi_{L2\text{-}1}$, $\varphi_{L3\text{-}1}$, φ_4
	V_1, V_2, V_0	$V_{1\text{-}1}$, $V_{2\text{-}1}$, $V_{0\text{-}1}$	$I_{1\text{-}1}$, $I_{2\text{-}1}$, $I_{0\text{-}1}$
	$\varphi_{1\text{-}1}$, $\varphi_{2\text{-}1}$, $\varphi_{0\text{-}1}$	$\varphi_{1\text{-}1}$, $\varphi_{2\text{-}1}$, $\varphi_{0\text{-}1}$	$\varphi_{1\text{-}1}$, $\varphi_{2\text{-}1}$, $\varphi_{0\text{-}1}$
	f_1	f_1	f_1
			$\{P_{\Sigma1}, Q_{\Sigma1}, P_4, Q_4\}$
	$\underline{I}_{L1}$, $\underline{I}_{L2}$, $\underline{I}_{L3}$, $\underline{I}_4$	$\underline{V}_{L12\text{-}2}$, $\underline{V}_{L23\text{-}2}$, $\underline{V}_{L31\text{-}2}$, $\underline{V}_8$	$\underline{I}_{L1\text{-}2}$, $\underline{I}_{L2\text{-}2}$, $\underline{I}_{L3\text{-}2}$, $\underline{I}_8$
	$\varphi_{L1\text{-}2}$, $\varphi_{L2\text{-}2}$, $\varphi_{L3\text{-}2}$, φ_{I4}	$\varphi_{L1\text{-}2}$, $\varphi_{L2\text{-}2}$, $\varphi_{L3\text{-}2}$, φ_8	$\varphi_{L1\text{-}2}$, $\varphi_{L2\text{-}2}$, $\varphi_{L3\text{-}2}$, φ_8
	I_1, I_2, I_0	$V_{1\text{-}2}$, $V_{2\text{-}2}$, $V_{0\text{-}2}$	$I_{1\text{-}2}$, $I_{2\text{-}2}$, $I_{0\text{-}2}$
	$\varphi_{1\text{-}2}$, $\varphi_{2\text{-}2}$, $\varphi_{0\text{-}2}$	$\varphi_{1\text{-}2}$, $\varphi_{2\text{-}2}$, $\varphi_{0\text{-}2}$	$\varphi_{1\text{-}2}$, $\varphi_{2\text{-}2}$, $\varphi_{0\text{-}2}$
	f_2	f_2	f_2
	P_Σ, Q_Σ, P_4, Q_4		$\{P_{\Sigma2}, Q_{\Sigma2}, P_8, Q_8\}$
Monophase	$\underline{V}_{L1}$, $\underline{V}_{L2}$, $\underline{V}_{L3}$, $\underline{V}_{L4}$	$\underline{V}_{L1}$, $\underline{V}_{L2}$, $\underline{V}_{L3}$, $\underline{V}_{L4}$	$\underline{I}_{L1}$, $\underline{I}_{L2}$, $\underline{I}_{L3}$, $\underline{I}_{L4}$
	$\varphi_{L1\text{-}1}$, $\varphi_{L2\text{-}1}$, $\varphi_{L3\text{-}1}$, $\varphi_{L4\text{-}1}$	φ_{L1}, φ_{L2}, φ_{L3}, φ_{L4}	φ_{L1}, φ_{L2}, φ_{L3}, φ_{L4}
	f_1	f_1	f_1
			$\{P_1, P_2, P_3, P_4\}$
			$\{Q_1, Q_2, Q_3, Q_4\}$
	$\underline{I}_{L1}$, $\underline{I}_{L2}$, $\underline{I}_{L3}$, $\underline{I}_{L4}$	$\underline{V}_{L5}$, $\underline{V}_{L6}$, $\underline{V}_{L7}$, $\underline{V}_{L8}$	$\underline{I}_{L5}$, $\underline{I}_{L6}$, $\underline{I}_{L7}$, $\underline{I}_{L8}$
	$\varphi_{L1\text{-}2}$, $\varphi_{L2\text{-}2}$, $\varphi_{L3\text{-}2}$, $\varphi_{L4\text{-}2}$	φ_{L5}, φ_{L6}, φ_{L7}, φ_{L8}	φ_{L5}, φ_{L6}, φ_{L7}, φ_{L8}
	f_2	f_2	f_2
	P_1, P_2, P_3, P_4		$\{P_5, P_6, P_7, P_8\}$
	Q_1, Q_2, Q_3, Q_4		$\{Q_5, Q_6, Q_7, Q_8\}$

This Table 7-24 provides an exact overview of the values recorded by the DAUs depending on the input connection.

The cycle time for the Continuous Phasor Recorder can be set separately. The following equation is used to calculate the maximum recording time until the oldest data record will be overwritten:

$$t_{max} = \frac{R \cdot M}{D} \cdot 0.132 \frac{1}{MByte}$$

where:
t_{max} = maximum recording time in days
R = cycle time in seconds
M = parameterized memory space in megabytes (MByte)
D = number of active VCDAUs, VDAUs and CDAUs

7.3.2 Continuous Mean Value Recorder for Frequencies (CFR)

The continuous mean value recorder for frequencies – Continuous Frequency Recorder (CFR) – is a mean value recorder and stores the arithmetic mean of the frequencies of the fundamental component for every recording interval. The mean value is always calculated over the complete recording interval.

Table 7-25   CFR – summary of technical data

Recording time	Continuously
Averaging times	1 s, 2 s, 5 s, 10 s, 30 s, 60 s, 120 s, 240 s, 300 s, 360 s, 480 s, 600 s
Usable DAUs	VCDAU, VDAU, CDAU
Recorded values	Frequencies

Note

Only one frequency mean value per measured value group of a DAU is stored if monophase has been configured.

Table 7-26 provides an exact overview of the values recorded by the DAUs depending on the input connection.

Table 7-26   Recorded values of the CFR

	VCDAU	VDAU	CDAU
Star connection	$\bar{f}_1$ $\bar{f}_2$	$\bar{f}_1$ $\bar{f}_2$	$\bar{f}_1$ $\bar{f}_2$
Delta connection	$\bar{f}_1$ $\bar{f}_2$	$\bar{f}_1$ $\bar{f}_2$	$\bar{f}_1$ $\bar{f}_2$
Monophase	$\bar{f}_1$ $\bar{f}_2$	$\bar{f}_1$ $\bar{f}_2$	$\bar{f}_1$ $\bar{f}_2$

The maximum recording time can be calculated using the following equation:

$$t_{max} = \frac{R \cdot M}{D} \cdot 0.607 \, \frac{1}{MByte}$$

where:
t_{max} = maximum recording time in days
R = averaging time in seconds
M = parameterized memory space in megabytes (MByte)
D = number of active VCDAUs, VDAUs and CDAUs

7.3.3 Continuous Mean Value Recorder for RMS-values (CRR)

The continuous mean value recorder for rms values – Continuous RMS-value Recorder (CRR) – stores the arithmetic mean of the fundamental component rms values of currents, voltages and symmetrical components for every recording interval. The mean value is always calculated over the complete averaging time.

Table 7-27   CRR – summary of technical data

Recording time	Continuously
Averaging times	1 s, 2 s, 5 s, 10 s, 30 s, 60 s, 120 s, 240 s, 300 s, 360 s, 480 s, 600 s
Usable DAUs	VCDAU, VDAU, CDAU
Recorded values	Fundamental component rms values, symmetrical components

Table 7-28 provides an exact overview of the values recorded by the DAUs depending on the input connection.

Table 7-28   Recorded values of the CRR

	VCDAU	VDAU	CDAU
Star connection	$\overline{V}_{L1}, \overline{V}_{L2}, \overline{V}_{L3}, \overline{V}_{N}$ $\overline{V}_{1}, \overline{V}_{2}, \overline{V}_{0}$ $\overline{I}_{L1}, \overline{I}_{L2}, \overline{I}_{L3}, \overline{I}_{N}$ $\overline{I}_{1}, \overline{I}_{2}, \overline{I}_{0}$	$\overline{V}_{L1\text{-}1}, \overline{V}_{L2\text{-}1}, \overline{V}_{L3\text{-}1}, \overline{V}_{N4}$ $\overline{V}_{1\text{-}1}, \overline{V}_{2\text{-}1}, \overline{V}_{0\text{-}1}$ $\overline{V}_{L1\text{-}2}, \overline{V}_{L2\text{-}2}, \overline{V}_{L3\text{-}2}, \overline{V}_{N8}$ $\overline{V}_{1\text{-}2}, \overline{V}_{2\text{-}2}, \overline{V}_{0\text{-}2}$	$\overline{I}_{L1\text{-}1}, \overline{I}_{L2\text{-}1}, \overline{I}_{L3\text{-}1}, \overline{I}_{N4}$ $\overline{I}_{1\text{-}1}, \overline{I}_{2\text{-}1}, \overline{I}_{0\text{-}1}$ $\overline{I}_{L1\text{-}2}, \overline{I}_{L2\text{-}2}, \overline{I}_{L3\text{-}2}, \overline{I}_{N8}$ $\overline{I}_{1\text{-}2}, \overline{I}_{2\text{-}2}, \overline{I}_{0\text{-}2}$
Delta connection	$\overline{V}_{L12}, \overline{V}_{L23}, \overline{V}_{L31}, \overline{V}_{4}$ $\overline{V}_{1}, \overline{V}_{2}$ $\overline{I}_{L1}, \overline{I}_{L2}, \overline{I}_{L3}, \overline{I}_{4},$ $\overline{I}_{1}, \overline{I}_{2}, \overline{I}_{0}$	$\overline{V}_{L12\text{-}1}, \overline{V}_{L23\text{-}1}, \overline{V}_{L31\text{-}1}, \overline{V}_{4}$ $\overline{V}_{1\text{-}1}, \overline{V}_{2\text{-}1}$ $\overline{V}_{L12\text{-}2}, \overline{V}_{L23\text{-}2}, \overline{V}_{L31\text{-}2}, \overline{V}_{8}$ $\overline{V}_{1\text{-}2}, \overline{V}_{2\text{-}2}, \overline{V}_{0\text{-}2}$	$\overline{I}_{L1\text{-}1}, \overline{I}_{L2\text{-}1}, \overline{I}_{L3\text{-}1}, \overline{I}_{4}$ $\overline{I}_{1\text{-}1}, \overline{I}_{2\text{-}1}$ $\overline{I}_{L1\text{-}2}, \overline{I}_{L2\text{-}2}, \overline{I}_{L3\text{-}2}, \overline{I}_{8}$ $\overline{I}_{1\text{-}2}, \overline{I}_{2\text{-}2}, \overline{I}_{0\text{-}2}$
Monophase	$\overline{V}_{L1}, \overline{V}_{L2}, \overline{V}_{L3}, \overline{V}_{L4}$ $\overline{I}_{L1}, \overline{I}_{L2}, \overline{I}_{L3}, \overline{I}_{L4}$	$\overline{V}_{L1}, \overline{V}_{L2}, \overline{V}_{L3}, \overline{V}_{L4}$ $\overline{V}_{L5}, \overline{V}_{L6}, \overline{V}_{L7}, \overline{V}_{L8}$	$\overline{I}_{L1}, \overline{I}_{L2}, \overline{I}_{L3}, \overline{I}_{L4}$ $\overline{I}_{L5}, \overline{I}_{L6}, \overline{I}_{L7}, \overline{I}_{L8}$

The maximum recording time can be calculated using the following equation:

$$t_{max} = \frac{R \cdot M}{D} \cdot 0.178 \; \frac{1}{MByte}$$

where:
t_{max} = maximum recording time in days
R   = averaging time in seconds
M   = parameterized memory space in megabytes (MByte)
D   = number of active VCDAUs, VDAUs and CDAUs

7.3.4 Continuous Mean Value Recorder for Active and Reactive Power (CQR)

The continuous mean value recorder for active and reactive powers – Continuous Power Recorder (CQR) – stores the arithmetic mean of the active and reactive powers calculated from the fundamental components for every recording interval. The mean value is always calculated over the complete averaging time.

Table 7-29   CQR – summary of technical data

Recording time	Continuously
Averaging intervals	1 s, 2 s, 5 s, 10 s, 30 s, 60 s, 120 s, 240 s, 300 s, 360 s, 480 s, 600 s
Usable DAUs	VCDAU, coupled CDAU
Recorded values	Active powers, reactive powers

Table 7-30 provides an exact overview of the values recorded by the DAUs depending on the input connection.

Table 7-30   Recorded values of the CQR

	VCDAU	**Coupled CDAU***
Star connection		$\overline{P}_{\Sigma1}, \overline{Q}_{\Sigma1}, \overline{P}_4, \overline{Q}_4$
	$\overline{P}_\Sigma, \overline{Q}_\Sigma, \overline{P}_4, \overline{Q}_4$	$\overline{P}_{\Sigma2}, \overline{Q}_{\Sigma2}, \overline{P}_8, \overline{Q}_8$
Delta connection		$\overline{P}_{\Sigma1}, \overline{Q}_{\Sigma1}, \overline{P}_4, \overline{Q}_4$
	$\overline{P}_\Sigma, \overline{Q}_\Sigma, \overline{P}_4, \overline{Q}_4$	$\overline{P}_{\Sigma2}, \overline{Q}_{\Sigma2}, \overline{P}_8, \overline{Q}_8$
Monophase		$\overline{P}_1, \overline{P}_2, \overline{P}_3, \overline{P}_4$ $\overline{Q}_1, \overline{Q}_2, \overline{Q}_3, \overline{Q}_4$
	$\overline{P}_1, \overline{P}_2, \overline{P}_3, \overline{P}_4$ $\overline{Q}_1, \overline{Q}_2, \overline{Q}_3, \overline{Q}_4$	$\overline{P}_5, \overline{P}_6, \overline{P}_7, \overline{P}_8$ $\overline{Q}_5, \overline{Q}_6, \overline{Q}_7, \overline{Q}_8$

* Coupled CDAU: The current inputs of the CDAU are coupled to a voltage group, e. g., a VDAU or VCDAU, for power measurement. For detailed information, please refer to the "Parameterization" chapter.

Note

For power measurement with a CDAU, all channels 1 to 8 are coupled with the 1st voltage group (channels 1 to 4) of a VCDAU or VDAU. Since the CDAU only measures phase-to-phase currents, the connection type of the coupled voltage group that has been parameterized for the VDAU or VCDAU is used for calculating the powers. If star or delta connection have been configured, the total powers of the first three channels of each group are determined.

The maximum recording time can be calculated using the following equation:

$$t_{max} = \frac{R \cdot M}{(A \cdot 2{,}31 + B \cdot 4{,}61 + C \cdot 9{,}23)\text{MByte}}$$

where:
t_{max}	= maximum recording time in days
R	= averaging time in seconds
M	= parameterized memory space in megabytes (MByte)
A	= number of VCDAUs activated in the device with star/delta parameterization
B	= number of VCDAUs activated in the device with monophase parameterization plus the coupled CDAUs with star/delta parameterization
C	= number of CDAUs activated in the device with monophase parameterization

7.3.5 Continuous Mean Value Recorder for Process Values (CDR)

The continuous mean value recorder for process values – Continuous DC Recorder (CDR) – is a mean value recorder and stores the arithmetic mean of the process values for every recording interval. The mean value is always calculated over the complete averaging time.

Table 7-31 CDR – summary of technical data

Recording time	Continuously
Averaging intervals	1 s, 2 s, 5 s, 10 s, 30 s, 60 s, 120 s, 240 s, 300 s, 360 s, 480 s, 600 s
Usable DAUs	DDAU
Recorded values	Process values

The maximum recording time can be calculated using the following equation:

$$t_{max} = \frac{R \cdot M}{D} \cdot 0.276 \frac{1}{MByte}$$

where:
t_{max} = maximum recording time in days
R = averaging time in seconds
M = parameterized memory space in megabytes (MByte)
D = number of DDAUs activated in the device

7.4 Event Recorder

The Event Recorder (ER) records the state changes of binary signals. The binary signals are sampled with a resolution of 1 kHz and a maximum of 250 state changes per second and DAU.

A separate ring buffer, each with a common parameterizable memory size, is set up for each DAU. This division ensures that a DAU with many binary changes does not influence the data of other DAUs.

The registered state changes of the binary signals are collected and stored on the mass storage device of the SIMEAS R-PMU after one second has elapsed.

Every state change of a binary signal is stored together with a time stamp with a precision of 0.5 ms. In this way, the exact sequence of that occur in quick succession can be detected. The binary state changes can be allocated to the analog records in the visualization feature of the evaluation software.

With an assigned memory capacity of 5 Mbyte, each DAU can save up to 4.19 million binary signal conditions. This is equivalent to at least 16,384 binary event sequences.

Time Synchronization

8

Contents

This chapter contains an overview of the time synchronization of the SIMEAS R-PMU.

8.1   General

To ensure that the records of several SIMEAS R-PMU in different locations are comparable in correct phase sequence, the devices must be synchronized using appropriate timers.

The time stamp and the measurement system synchronization of an unsynchronized SIMEAS R-PMU are derived from the internal real-time clock (RTC). This clock has a maximum error of 30 ppm at 25 °C. After 24 hours, the time-base error is max. ±2.6 s at a constant temperature. The time-base error may be larger with deviating temperatures.

An external timer must be connected to the SIMEAS R-PMU to compensate for the real-time clock drift. A minute pulse or a signal according to the DCF77 protocol can be used as a synchronizing signal. When using the recording function Phasor Measurement Unit only the DCF77 signal of a GPS clock is allowed.

Note

The automatic time setting of the SIMEAS R-PMU by OSCOP P running in the automatic mode is not a synchronization! The RTC of the SIMEAS R-PMU is set cyclically in steps and the synchronization error is considerably larger than the error obtained by external synchronization. To prevent the measuring system from being impaired by too frequent time setting procedures, the minimum cycle time for automatic time setting is 4 hours.

Note

Additional and more detailed information on time synchronization in the Application Description „Time Synchronization SIMEAS R/SIMEAS R-PMU", order number E50417-X1074-C403, can be found under www.simeas.com.

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8.2   Synchronization Types

8.2.1   Minute Pulse Synchronization

The minute pulse synchronization corrects the drift of the SIMEAS R-PMU real-time clock every minute. For this purpose, the SIMEAS R-PMU adjusts the RTC in such a way that the minute change exactly matches the synchronization pulse. Time information (date, time) is not sent together with the minute pulse. This is why the device time must be set manually during commissioning and after a longer pulse failure (several days). See chapter 9, *Setting the Time*.

As the drift may be ±1.8 ms within one minute at a temperature of 25 °C, the minute pulse synchronization is not suitable for the operation of the SIMEAS R-PMU Phasor Measurement Unit. The DCF77 synchronization is the only suitable method for this application.

8.2.2   GPS Synchronization via DCF77 Second Signal

The GPS synchronization allows precise synchronizing of the SIMEAS R-PMU and correct time stamping of the records. The pulse-width modulated digital DCF77 second signal of the timer contains the date, time (UTC = Coordinated Universal Time) and further information which is required for setting the time on the device automatically.

Leap seconds (additionally inserted second(s) for synchronizing the "mean solar time") are also announced via DCF77 and processed by the SIMEAS R-PMU. The PMU data is marked according to the standard during leap seconds.

The operation of the Phasor Measurement Unit of the SIMEAS R-PMU puts high demands on timer accuracy. The total vector error (TVE) of the PMU amounting to ≤1 % can only be observed if the synchronization signal has a precision of 5 μs. It is therefore recommended only to use the GPS timer mentioned in the following chapter and to carefully observe the adjustment instructions.

8.3 Timers and Time Delay

Timers

As PMU time stamps refer to UTC, a precise GPS radio clock that provides a digital DCF77 output signal must be used.

The GPS satellite radio clock Hopf 6875 with modified SIPROTEC firmware (7XV5664-0AA00)) meets this requirement. This clock obtains the time information via GPS (Global Positioning System) and has the appropriate accuracy that is required for the Phasor Measurement Unit.

If another timer is to be used, the specifications outlined in chapter 16.1.6, *Technical Data* must be observed. Proper functioning of the PMU can only be guaranteed with the Siemens approved accessories.
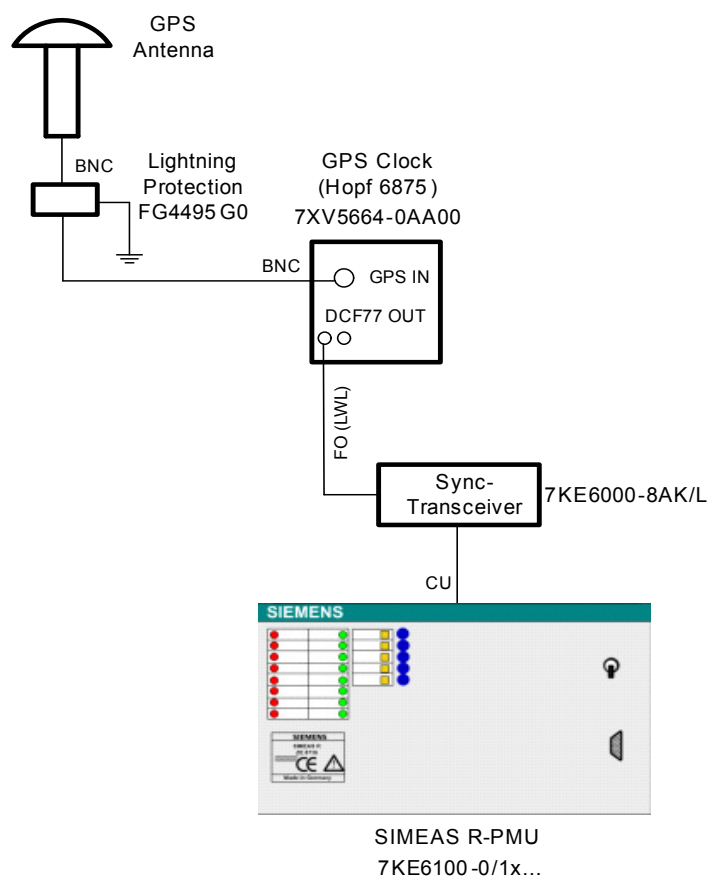
Figure 8-1   Example configuration

> **Note**
>
> Depending on SIMEAS R-PMU firmware version V40.01, the Sync-Box 7KE6000-8HAx recommended for the synchronization of the SIMEAS R V2/V3 (7KE6000-0/1x) can also be used for the synchronization of the SIMEAS R-PMU. Due to the lower precision, however, this configuration is not recommended. Please note that the PMU data is marked as invalid when using the Sync-Box.

Time delays of the synchronization components

Every component that is connected between the timer and the SIMEAS R-PMU slightly delays the synchronization signal. This delay time (latency) must be compensated for by the SIMEAS R-PMU, in order not to exceed the maximum total vector error of the PMU. The total delay time must be entered in the OSCOP P parameterization mask **"SIMEAS R-PMU"** → **Control panel** → **Time synchronization** under **External delay time, sync pulse**.

8.4 Commissioning

The synchronization signal must be connected to the synchronization input of the SIMEAS R-PMU (terminals 7B1 and 7B2, see chapter 14.3.4.1) observing the correct polarity. The signal must have a level of DC 24 V.

Note

Observe that due to your order of the SIMEAS R-PMU the synchronization input is always designed for the level of the synchronization signal even if the nominal level of the remaining binary inputs of the CPU is different! The polarity of the synchronization signal must be observed even if the other binary inputs are bipolar!

Select **GPS/DCF77**, **Sync-Box** or **Minute pulse** in the OSCOP parameterization mask **"SIMEAS R-PMU"** → **Control panel** → **Time synchronization**. The synchronization latency must be entered under **"External delay time, synchronization pulse"**. 0 µs can be entered for the test mode.

After the initial start of the device, watch LED 5 "Synchronization error" and LED 13 "Device synchronized" at the front panel. As soon as LED 13 starts flashing, a valid synchronization signal has been detected. If LED 13 is permanently lits, the measuring system has been adapted to the synchronization signal and the device is synchronized.

Note

The functions "Synchronization error" (LED 5) and "Device synchronized" (LED 13) have been set on delivery, but another parameterization may be used.

Note

Synchronization adjustment of the measuring system can take up to 45 minutes!

In the event of a permanent synchronization signal fault, LED 5 "Synchronization error" lights up. An analysis of the log recorder data and evaluation of the SIMEAS R-PMU status messages may be helpful during the fault location. See also chapter 8.5, *"Fault Handling"*.

8.5 Fault Handling

Evaluate the log recorder (chapter 13) and the device status (chapter 12.1) for fault analysis in the event of synchronization faults.

During fault handling, a distinction is always made between non-critical and critical synchronization faults. A non-critical fault is logged, but does not trigger the message „synchronization malfunction". A critical fault is logged and simultaneously triggers the message „synchronization malfunction".

After the synchronization has failed (LED 13 is OFF or flashing), the SIMEAS R-PMU waits for a valid synchronization signal. As soon as LED 13 starts flashing, a valid synchronization signal has been detected. If LED 13 is permanently lits, the measuring system has locked to the synchronization signal and the device is synchronized.

Note

Synchronization adjustment of the measuring system can take up to 45 minutes!

8.5.1 Minute Pulse

Non-critical fault

❑ Minute pulse failure for one minute

Critical faults

❑ Minute pulse failure for more than one minute

❑ Wrong minute pulse distance

8.5.2   GPS/DCF77 and Sync-Box

Non-critical faults

- ❑ Failure of one or two second pulses. SIMEAS R-PMU does not switch over to internal synchronization, the device remains synchronized. PMU data is not marked as faulty.

- ❑ Failure of second pulses for 3 seconds up to 5 minutes. SIMEAS R-PMU switches over to internal synchronization, the device is no longer synchronized. PMU data is marked as faulty.

Critical faults

- ❑ Second pulse failure for more than 5 minutes

- ❑ Wrong second pulse distance

- ❑ Wrong second pulse widths

- ❑ DCF77 parity error

- ❑ Minute mark missing

- ❑ More than 5 non-critical faults within 10 minutes

With critical faults, the SIMEAS R always switches over to internal synchronization, the device is not longer synchronized. PMU data is marked as faulty.

8.5.3   Fault Elimination

Due to impaired GPS reception properties of the timer, non-critical synchronization faults may sometimes occur in the normal mode. If there are a lot of non-critical or some critical faults, you have to check the clock master and all synchronization components.

Setting the Time

<div style="text-align: right; font-size: large;">**9**</div>

Time and date are required to create the time stamp for data recording.

The SIMEAS R-PMU is equipped with an internal real-time clock (RTC). This clock provides the necessary information for the time stamp.

The evaluation and parameterization software OSCOP P V 6.60 (or higher) can be used to set time and date.

Note

When you set **GPS/DCF77 or Sync-Box** in the OSCOP P parameterization dialog „**SIMEAS R-PMU**" → **System Control** → **Time synchronization** under **Synchronization**, SIMEAS R-PMU will be synchronized automatically. Setting the time is not possible then.

Manual setting of date and time

The date and time are set manually.

To get to this menu item, select **Parameterize devices** in the OSCOP P module after you have selected the SIMEAS R, then select the menu command **Parameters** → **Date, time**.

Figure 9-1   Date and time

The following functions are available after selection:

❑ **Load time from device**
If a data connection has been set up, date and time are transferred from the SIMEAS R-PMU and displayed.

❑ **Send manual time settings**
Once the user has entered **Date** and **Time**, the settings will be transferred to the SIMEAS R-PMU and set in the device.

❑ **Send PC system time**
    Clicking this button transfers the PC time displayed in this menu to the SIMEAS R-PMU.

The minimum interval for setting the time has been limited to 4 hours; otherwise the measurement system might be disturbed. During this interval, the time can be set manually by pressing the buttons **Test mode** or **Lock mode** at the front panel and executing the **Send PC system time** command.

Automatic mode

Note

The **Time setting in automatic mode** function is available in the server mode of OSCOP P!

In the automatic mode, date and time of the SIMEAS R-PMU are set cyclically at parameterizable intervals. The cyclical time setting ensures that deviations of the unsynchronized RTC are kept at a minimum.

Table 9-1   Maximum time drift of the unsynchronized RTC

Period	Max. time drift
1 second	±30 µs
1 minute	±1.8 ms
1 hour	±108 ms
1 day	±2.592 s
1 week	±18.144 s
1 month	±77.760 s
1 year	±946.080 s

To go to the input mask **Automatic timing settings**, select the menu command **Settings** → **Automatic mode** → **Setting the time** in the OSCOP P module (DAKON mode) **Transfer**.
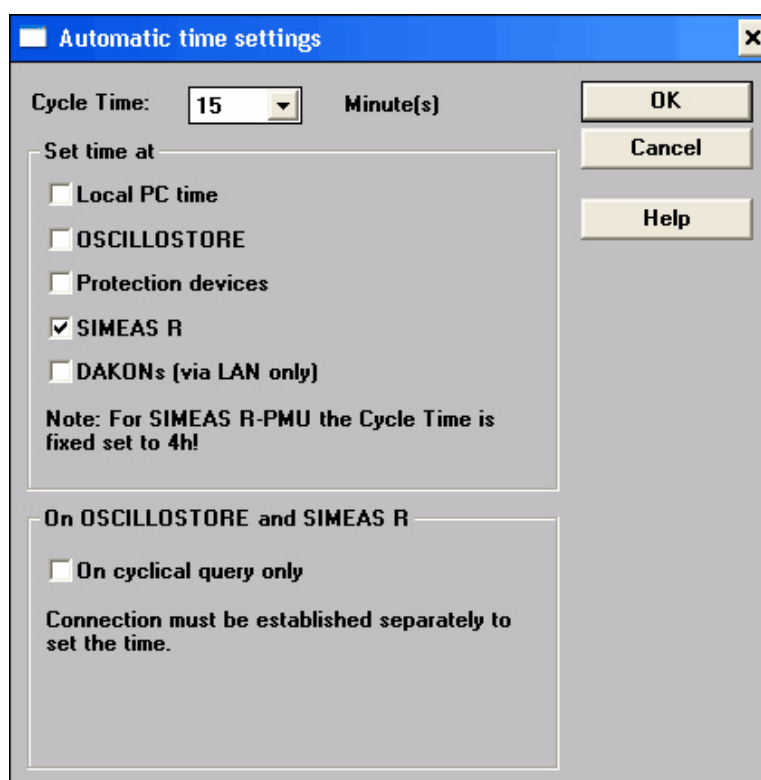
Figure 9-2   Automatic time settings

Then select the menu item **SIMEAS R** in the **Set time at** section and enter the **Cycle Time**. The cycle time defines the time intervals at which the SIMEAS R-PMU is set to PC time.

The SIMEAS R-PMU time can be set in connection with the cyclical data query. It is not necessary to set up a separate connection for time setting.

Note

Time setting does not meet high precision requirements because time deviations occur due to the unsynchronized RTC. The highest accuracy achieved is ±1 s. This is why an external synchronization using a GPS timer or the minute pulse is recommended.

Note

To prevent the measuring system from being impaired by too frequent time setting procedures, the minimum cycle time for automatic time setting is 4 hours.

Communication Options and Connections **10**

10.1 General

> **Note**
>
> More detailed information on communication can be found in the Application Description „Communication SIMEAS R/SIMEAS R-PMU", or number E50417-X1074-C402, under www.simeas.com.

10.2 LAN Communication

10.2.1 Connection

A LAN interface is integrated in the SIMEAS R-PMU in accordance with IEEE 802.3, 10Base-T/100Base-T with a Baud rate of 10 Mbit/s or 100 Mbit/s.
This interface allows SIMEAS R-PMU to communicate with OSCOP P in Client, Evaluation, DAKON or Server mode via TCP/IP.

Hub/Switch

If several SIMEAS R-PMU or SIMEAS R devices are to be included in a network, a switch is recommended. When a message is transferred, the switch automatically detects the recipient device of the message. Thus the switch sends the message only to the device that it is intended for. This avoids unnecessary load on other devices (receipt of message, processing of message). Additionally, this ensures that time-critical data (e. g. network trigger, PMU data or time stamp telegrams) is transferred without delays if possible.

Evaluation PCs/DAKONs with OSCOP P and PDCs can be connected directly to the network or in another network connected to the SIMEAS R network via one or more routers.

Following are some examples for the creation of such networks.
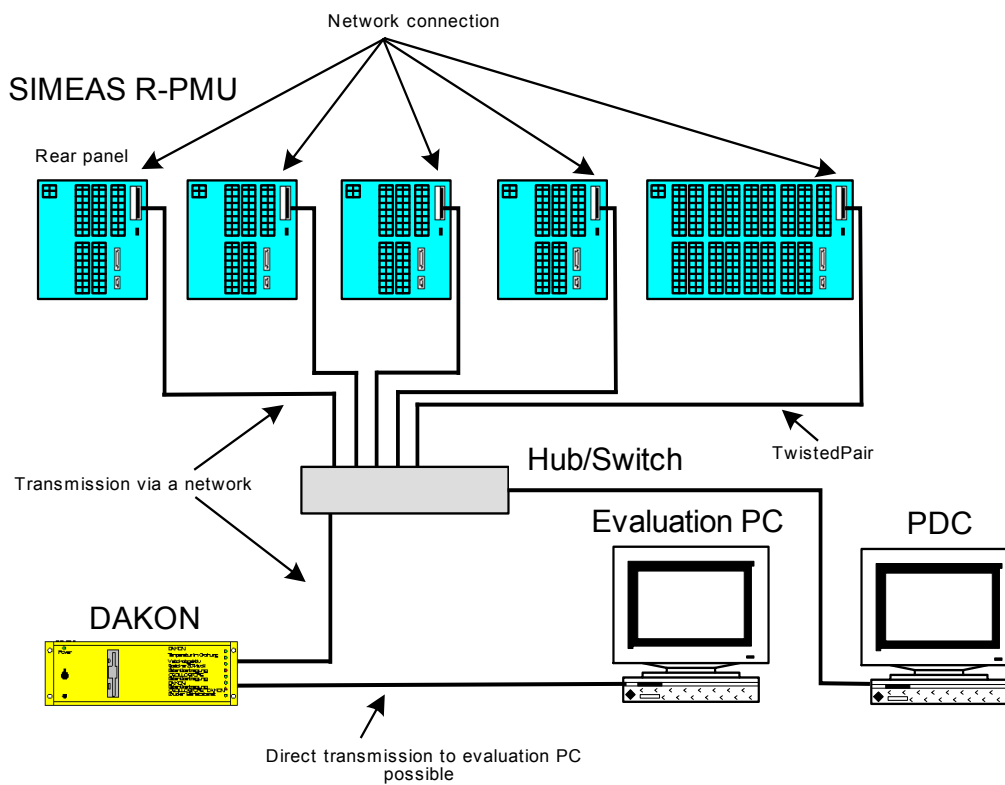
Figure 10-1 Example of a LAN with hub/switch, evaluation PC, DAKON and PDC
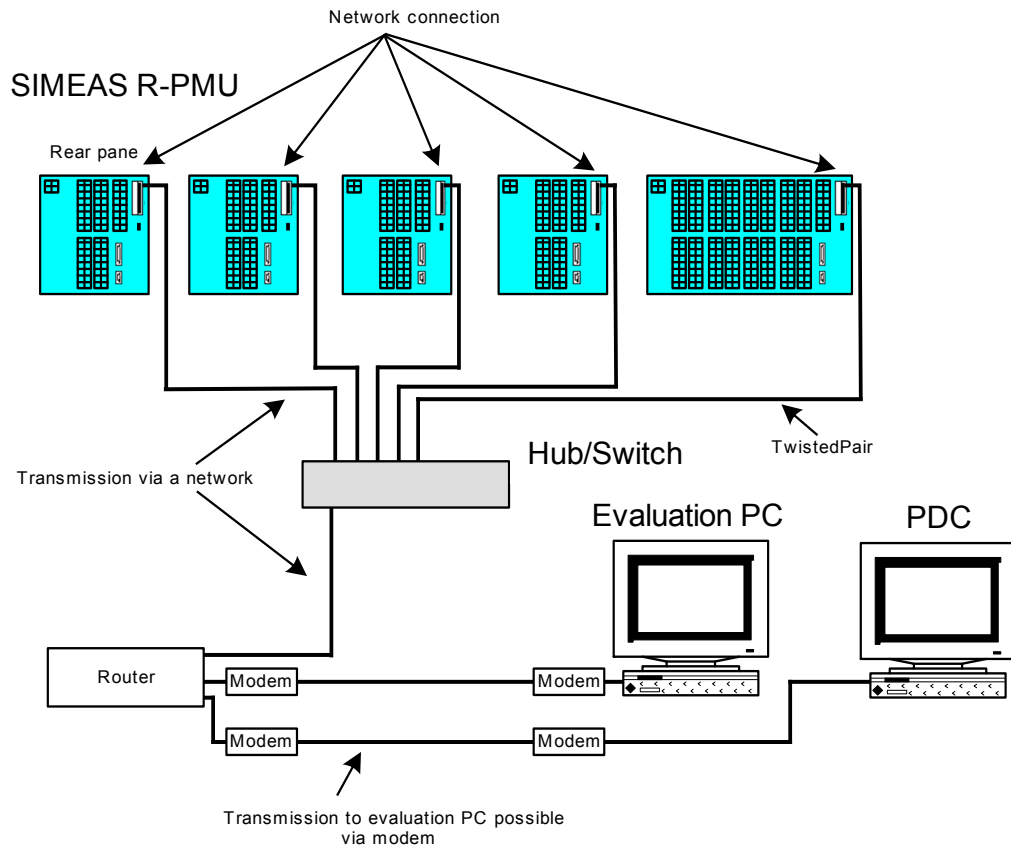
Figure 10-2 Example of a LAN with hub/switch and router
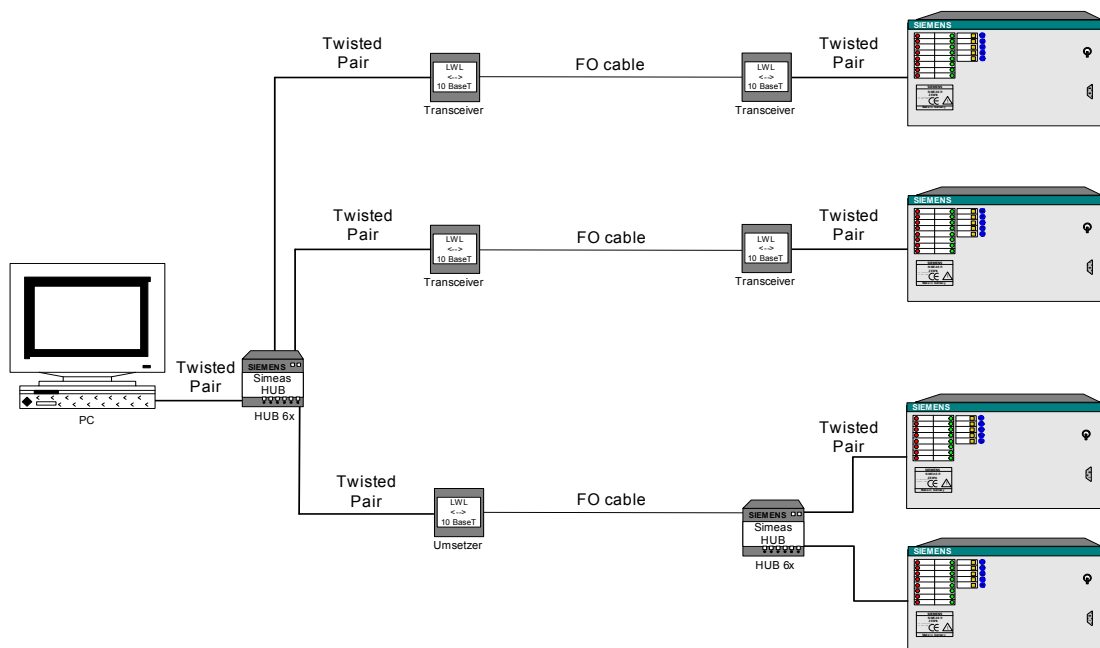
Figure 10-3 Connection example with hub and FO transceiver with evaluation PC and SIMEAS R-PMU

Note

The accessories of the SIMEAS R-PMU have a baud rate of 10 Mbit/s because they are based on the 10BaseT/FL standard.

Cable lengths

In order to minimize signal faults the following cable lengths should not be exceeded:

❑ Twisted Pair between PC and Hub: 20 m

❑ Twisted Pair between Hub and router: 20 m

❑ Twisted Pair between router and SIMEAS R-PMU: 20 m

❑ Twisted Pair between Hub and SIMEAS R-PMU: 20 m

❑ FO cable (fibre 62,5 / 125 μm) between routers: 1,500 m

❑ FO cable (fibre 62,5 / 125 μm) between router and Hub: 1,500 m
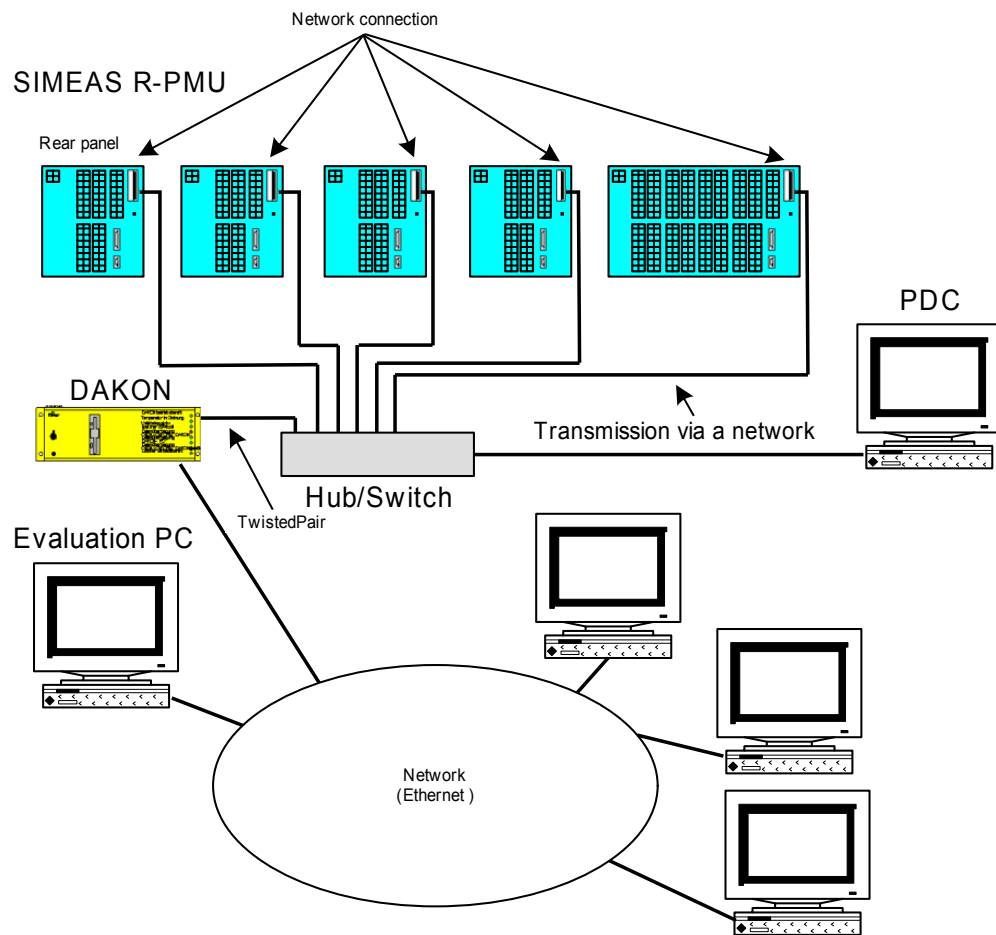
Figure 10-4 Example of a LAN with hub/switch, evaluation PC, DAKON and PDC

10.2.2   Settings

IP addresses are generally subdivided into different classes:

Table 10-1   SIMEAS R-PMU and network

Class	Range of network numbers	Subnet mask
A	1.x.x.x to 126.x.x.x	255.0.0.0
B	128.0.x.x to 191.255.x.x	255.255.0.0
C	192.0.0.x to 223.255.255.x	255.255.255.0

SIMEAS R-PMU also supports Classless Inter-Domain Routing (CIDR). In the following paragraphs, Class C IP addresses are used to explain the settings. Class C addresses can be used to define a total of 254 subnetworks with 254 devices each. Existing SIMEAS R networks with SIMEAS R V21.xx, 23.xx and V30.xx can be extended with SIMEAS R-PMU devices.

Please also note that the Internet Assigned Numbers Authority may have already assigned several address ranges of the possible network numbers for public networks. The following address ranges can be used freely:

Class A: 10.0.0.0 to 10.255.255.255
Class B: 172.16.0.0 to 172.31.255.255
Class C: 192.168.0.0 to 192.168.255.255

The numbers 255 and 0 are used as broadcast addresses in networks or as identifiers for the complete subnetwork and being allowed to not be used.

In this example, the following IP addresses are used:

192.168.subnet.device (subnet: 1 to 254 and device: 1 to 254)

The following regulations for the assignment of IP addresses are made (see also figure 10-5):

❑ Every network card in the DAKON, to which the SIMEAS R-PMU devices have been connected, forms a separate subnetwork.

❑ Every DAKON is assigned the device address 1.

❑ Every router is always assigned the device address 2 within a subnetwork.

❑ Every PDC is assigned the device address 3. The PDC is located in the same subnetwork as the SIMEAS R-PMU.

❑ All hubs/switches connected to a network card are located in the same subnetwork.

❑ Device addresses between 100 and 200 must be assigned to the networked SIMEAS R-PMU for every subnetwork.

❑ If a router is used, the dynamically assigned addresses must be parameterized to the addresses between 230 and 254 (router address band).

Example for the IP address assignment
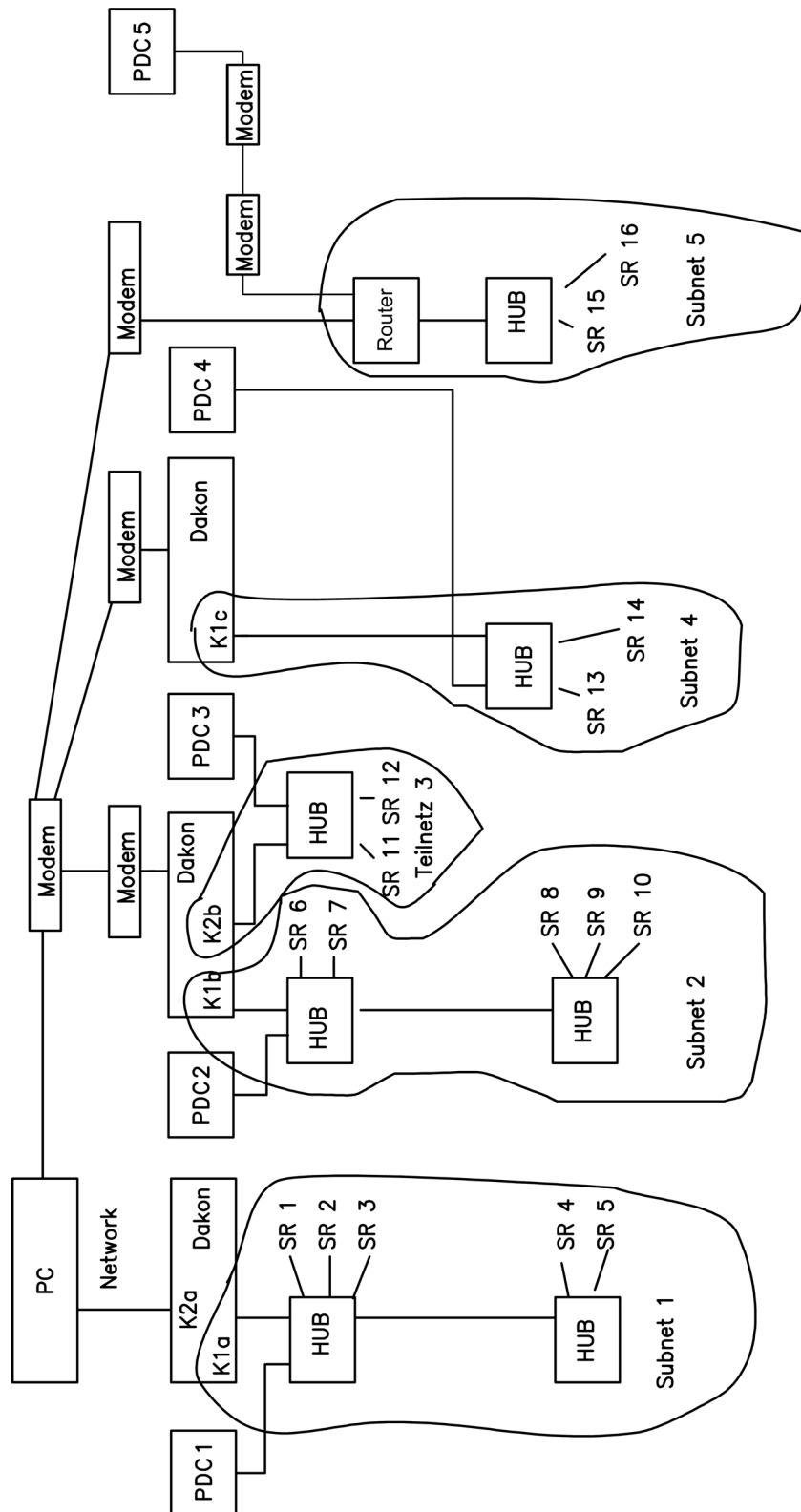
Figure 10-5 Example for the IP address assignment

Addresses:

K1a:	Network card 1 of DAKON 1	192.168.1.1
PDC1	Phasor Data Concentrator 1	192.168.1.3
SR1:	SIMEAS R-PMU no. 1	192.168.1.100
SR2:	SIMEAS R-PMU no. 2	192.168.1.101
SR3:	SIMEAS R-PMU no. 3	192.168.1.102
SR4:	SIMEAS R-PMU no. 4	192.168.1.103
SR5:	SIMEAS R-PMU no. 5	192.168.1.104
K1b:	Network card 1 of DAKON 2	192.168.2.1
PDC2:	Phasor Data Concentrator 2	192.168.2.3
SR6:	SIMEAS R-PMU no. 6	192.168.2.100
SR7:	SIMEAS R-PMU no. 7	192.168.2.101
SR8:	SIMEAS R-PMU no. 8	192.168.2.102
SR9:	SIMEAS R-PMU no. 9	192.168.2.103
SR10:	SIMEAS R-PMU no. 10	192.168.2.104
K2b:	Network card 2 of DAKON 2	192.168.3.1
PDC3:	Phasor Data Concentrator 3	192.168.3.3
SR11:	SIMEAS R-PMU no. 11	192.168.3.100
SR12:	SIMEAS R-PMU no. 12	192.168.3.101
K1c:	Network card 1 of DAKON 3	192.168.4.1
PDC4:	Phasor Data Concentrator 4	192.168.4.3
SR13:	SIMEAS R-PMU no. 13	192.168.4.100
SR14:	SIMEAS R-PMU no. 14	192.168.4.101
R1:	Router no. 1	192.168.5.2
PDC5:	Phasor Data Concentrator 5	10.0.0.1 (PPP connection)
SR15:	SIMEAS R-PMU no. 15	192.168.5.100
SR16:	SIMEAS R-PMU no. 16	192.168.5.101

10.3   COM S - Maintenance Interface (Service Interface)

The serial interface COM S at the front side is the interface for parameterization. But it can also be used for the transfer of measured data. A PDC cannot be connected to the service interface of the SIMEAS R-PMU.

The interface parameters have been set as follows and cannot be changed:

Baud rate: 19,200 bit/s
Data bits: 8
Stop bit: 1
Parity: none
Hardware-Handshake: not supported

Note

The maintenance interface supports only the null modem connection to OSCOP P. Modem, X.25 and star coupler connections and connections to PDCs are not supported.
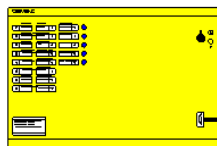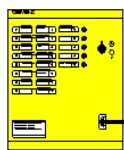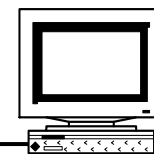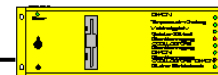
Figure 10-6 Serial data transmission (service interface)

10.4 COM 1 Interface

10.4.1 Serial Direct Connection

Use the 9-pin RS232 connection at the rear panel of the SIMEAS R-PMU for the serial transmission of parameters and measured data. This serial interface can be used to set variable baud rates.

Baud rate: 9,600 bit/s to 115,200 bit/s
Data bits: 8
Stop bit: 1
Parity: none

For communication between the SIMEAS R-PMU and PC/notebook or PDC, the data line must be connected both to the data interface at the rear panel of the SIMEAS R-PMU and to the corresponding COM port of the evaluation PC/DAKON or the PDC.

Note

❑ Note that while using the serial connection (null modem) for transferring PMU data to the PDC a concurrent communication to OSCOP P (Evaluation PC/DAKON) is not possible.

❑ For null modem communication to the PDC, the PPP protocol is used (see section 12.14.2).

Then set the corresponding interface parameters in the **Parameterize PC** module of the OSCOP P software.
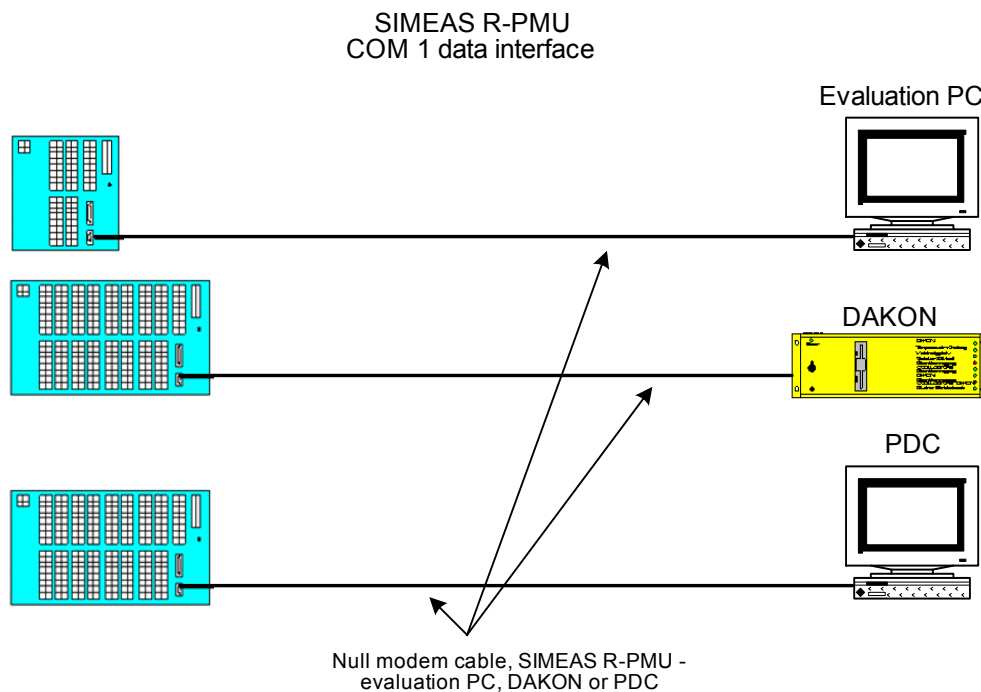
Figure 10-7 Serial data transmission (data interface)

10.4.2 Communication via External Modem

For the connection between the SIMEAS R-PMU and the evaluation PC, DAKON or PDC an external analog or ISDN modem (Hayes mode) can be used.

The COM 1 data interface is used for connecting external modems.

Note

❑ The SIMEAS R-PMU supports modems with the Hayes command set.

❑ As the modem settings are becoming more and more comprehensive and complex, we kindly ask you to use only the modems that we have tested and recommended for operation. For information regarding the currently enabled modems, please refer to the Internet address: www.simeas.com

❑ Note that while using the serial connection (null modem) for transferring PMU data to the PDC, a concurrent communication to OSCOP P (Evaluation PC/DAKON) is not possible.

❑ For null modem communication to the PDC, the PPP protocol is used (see section 12.14.2).

Connection

On the other side, a connection between the second modem and the evaluation PC, DAKON or PDC is built up.

Both modems are then connected to the telephone network. The modems must also be connected to the power supply. Once the installation is complete, the corresponding parameters must be set in OSCOP P.

Please connect the components as shown below:
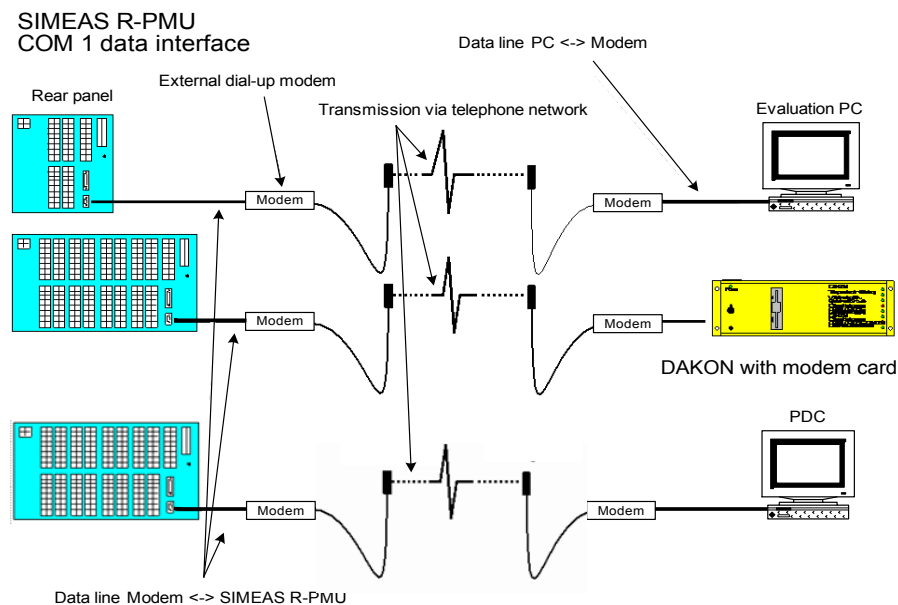
Figure 10-8 Data transmission via external dial-up modem (analog or ISDN)

10.4.3 Star Coupler

The star coupler enables the connection of several SIMEAS R-PMU devices to an evaluation PC or DAKON using the optical interfaces. Only passive star couplers (e. g. mini star coupler 7XV5450...) are supported. The connection between the SIMEAS R-PMU and the evaluation PC or DAKON using optical fibres can thus be established without interferences.

The optical star coupler distributes the messages of the OSCOP P software to all connected SIMEAS R-PMU devices. If the star couplers are cascaded, even more SIMEAS R-PMU devices can be addressed. The messages are provided with an address, thus ensuring that only the addressed SIMEAS R-PMU will respond.

Note

A star coupler address has to be assigned to the SIMEAS R-PMU, see section 12.7.1.

Note

The connection of a SIMEAS R-PMU to a PDC via external star couplers is not supported.

Please connect the components as shown below:

SIMEAS R-PMU
COM 1 data interface
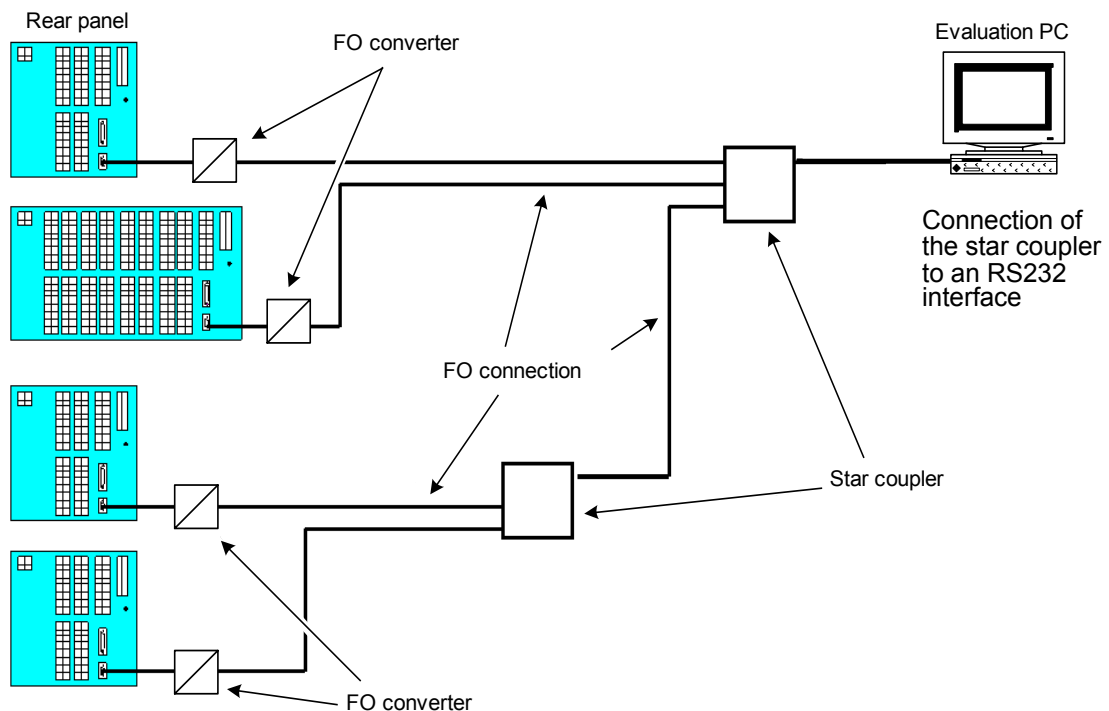
Figure 10-9 Connection via star coupler

10.4.4 X.25 Communication

X.25 data networks are public switched systems and are based on the internationally standardized packet switching protocol X.25. These systems enable access to all other national X.25 packet switching services that exist all over the world. The PADs (Packet Assembly Disassembly) are required to disassemble the files into packets during sending or to reassemble them to the source files upon receipt.

Figure 10-10 Connection via X.25 packet switching service

Local Printer

11

The local printer is used for the automatic, graphical output of TAR records. The printer provides the operating personnel with an overview of the cause of the fault record. The printout can be used for a first analysis of the fault event and also for documentation purposes.

Even after it has been printed, all measured data remains in the memory as a fault record. This can be called up with the OSCOP P analysis program at a later point in time.

Apart from the header data (device name and location), the printout contains the following information:

❑ a channel legend,

❑ the trigger cause,

❑ the trigger time stamp and

❑ the analog and binary channels.

The printout of a fault record comprises a maximum of 5 seconds of the parameterized recording time.

Note

The time axis of the printout shows generally the UTC time stamp, irrespectively of the parameterized time zone.

Note

The printer must be equipped with the maximum possible memory, in order to ensure trouble-free functioning. The minimum memory size is 32 Mbyte.

Enabled printers

For a list with the printers recommended for connection, please refer to the Internet URL www.simeas.com. This list is regularly updated.

Printer connection (parallel port)

The parallel interface PRINTER (LPT 1) is provided for the connection of a printer.

Connection method

25-pin standard D-SUB plugs can be used as connectors.

Digital Fault Recorder, SIMEAS R-PMU, Manual
E50417-H1076-C360-A5, Release 10.2012

Parameterization via OSCOP P

12

Contents

12.1 General

The evaluation and parameterization program OSCOP P is a program package for the transmission, archiving and output of measured value files that have been recorded using different SIEMENS quality recorders or digital protection devices. It features extensive functions and calculation algorithms for the analysis and evaluation of processes in the system.

The parameters for the digital fault recorder SIMEAS R-PMU are set in the OSCOP P module **Parameterize device**. You define the device functions, configuration, channel assignment, signal outputs, calculation parameters, interfaces, fault recording functions, print functions etc. Before you can do this, you must have created the SIMEAS R-PMU device in the **Parameterize PC** module.

For further information regarding this topic and the other OSCOP P modules, please refer to the OSCOP P manual.

Parameterization

Proceed as follows to parameterize your SIMEAS R-PMU:

❑ Click **Siemens Energy** → **OSCOP P** → **Parameterize Devices** in the Windows Start menu to start the **Parameterize device** module.

Password query

❑ Enter your password in the **Access authority request** dialog box.
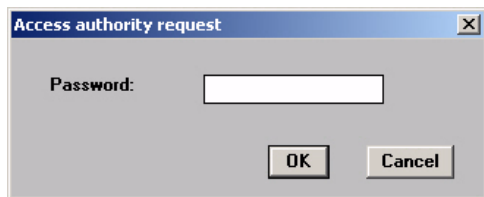
Figure 12-1 Authorization request

❑ Confirm the entered password with **OK**.

If your password is not authorized, the message **Wrong password** appears.

❑ Correct your entry and confirm again.

> **Note**
> - The number of retries is not limited.
> - When calling up the module for the first time, enter the standard password OSCOP.
> - Please make sure you enter the character sequence in capitals.

Selecting Device

❑ In the basic dialog box, select the SIMEAS R-PMU that you have created before in the **Parameterize PC** module.

❑ Click **OK**. The dialog for setting the SIMEAS R-PMU parameters opens. The status boxes on the right side of the dialog box describe the device design and contain information on the firmware version.

Note

When you parameterize a device for the first time, you will be asked if you want to create a new parameter set or load the parameters from the device. Depending on your choice, the following dialog displays no entries or the default device data.

❑ Enter the hard disk capacity if you want to parameterize a SIMEAS R-PMU offline, i. e. without connection to the device.
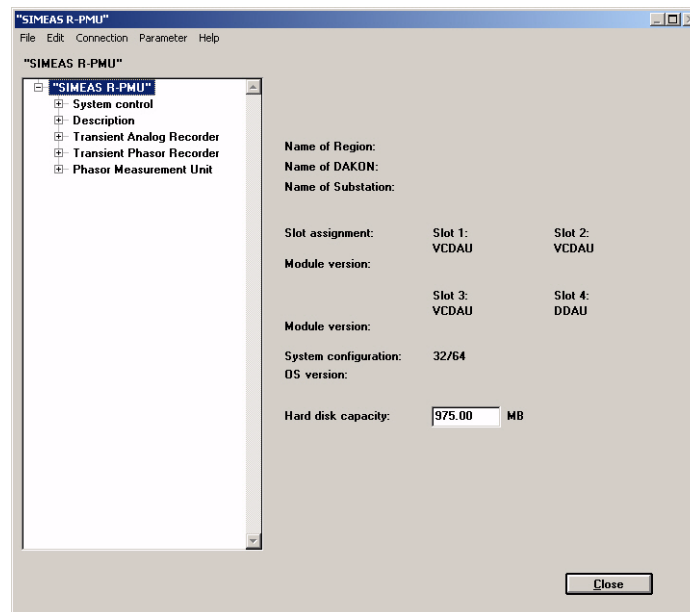
Figure 12-2 Dialog box for setting the SIMEAS R-PMU parameters

Note

The manufacturers of mass memories set the memory capacity 1 MByte = 1,000,000 bytes. The real conversion is 1 MByte = 1,048,576 bytes, instead: You have to make sure to enter the correct value under **Hard disk capacity**. Enter 970 MByte for a 1 GByte flash disk and 480 MByte for a 512 MByte flash disk.

To determine the flash disk size exactly, load the SIMEAS R-PMU parameters before starting with the parameterization (see **Load from device** in this chapter). You will not be able to change the parameter **Hard disk capacity**, when you determine the hard disk size this way.

The menu bar with the following commands is on top of the dialog box:

❑ Copy device parameters
❑ Build up a connection between the evaluation PC and the device
❑ Transfer parameters into and from the device, read out status, send date and time, etc.
❑ Load parameters from the DAKON/server
❑ Load parameters from the database/store parameters in the database
❑ Import/export parameters

Copy SIMEAS R-PMU

If you want to copy a SIMEAS R-PMU including the parameters:

❑ Open the device to be copied.

❑ Select the menu item **Edit → Copy → Device**.

❑ Enter the name of the new device in the **Copy device** dialog box.
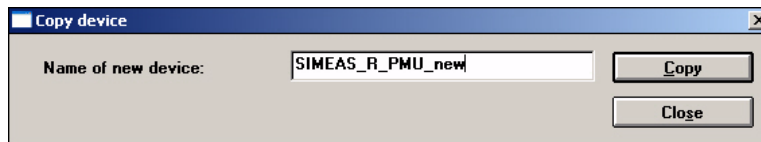
Figure 12-3 Copy device dialog

❑ Click **Copy**. A message appears when the copying process is complete.

Note

All settings from the **Parameterize PC** module are transferred during copying. If necessary, the communication parameters for the new device must be adjusted (e. g., IP addresses, serial interface, modem connection etc.).

Copy slot

If you want to copy the slot parameters from one SIMEAS R-PMU to another:

❑ Open the device (see Figure 12-2) from which you want to copy the slot.

❑ Select the menu item **Edit → Copy → Slot → Slot number**.

❑ Enter the name of the target device in the Copy slot dialog box. The parameters of the selected slot are copied to this device.
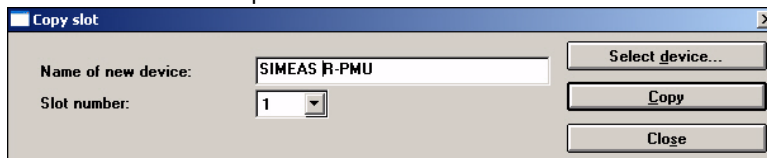
Figure 12-4 Copy slot dialog

❑ Enter the name of the target device and the slot number to which the parameters of the selected slot are to be copied.

Note

If the slot of the target device has already been parameterized, these parameters will be over-written without warning!

❑ Click **Copy**. A message appears when the copying process is complete.

Load parameters from the device
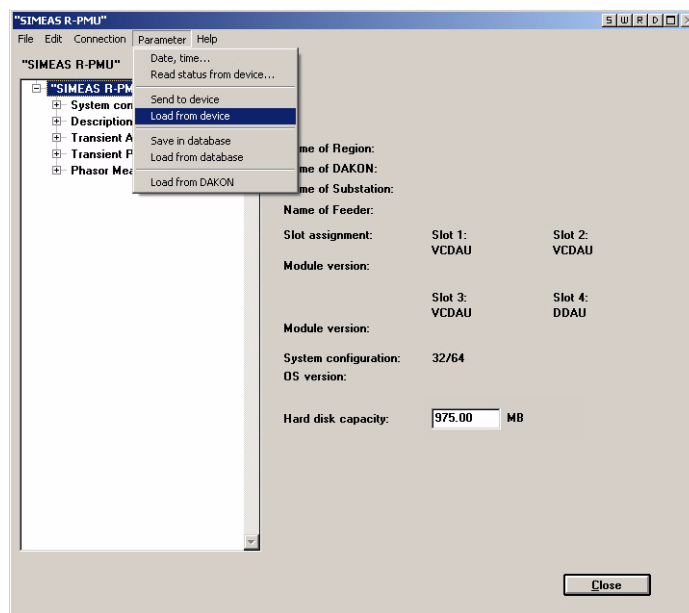
Figure 12-5 Load parameters from the device

You can transfer the complete parameter settings from the SIMEAS R-PMU with the menu command **Parameter** → **Load from device** to OSCOP P. The parameters can be edited after the transfer in OSCOP P. This function requires an existing data connection to the device.

Transfer parameters to the device

You can transfer the existing parameters from OSCOP P to the SIMEAS R-PMU with the menu command **Parameter** → **Send to device**. An existing data connection to the device is required for the transfer of the parameter data.

Device status

You can get information on the SIMEAS R-PMU status with the menu command **Parameter** → **Read status from device...** and check settings, analyse faults, etc. (if necessary).

Save SIMEAS R-PMU parameters on your PC
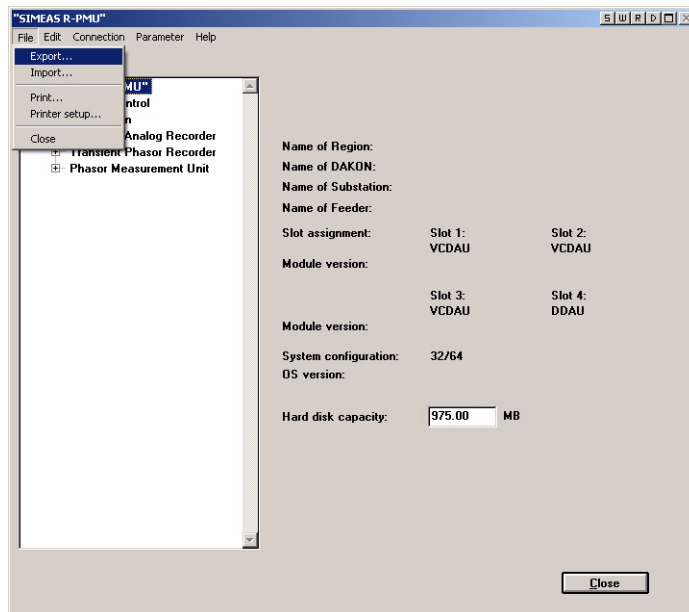
Figure 12-6 Save SIMEAS R-PMU parameters on your PC

You can save the existing parameters of the SIMEAS R-PMU as an *.srp file on the PC using the menu command **File → Export...**. To do so, select the storage location and enter a file name.

Access to stored SIMEAS R-PMU parameters

You can load parameter settings for the SIMEAS R-PMU that have been stored on the PC with the menu command **File → Import...**. To do so, select the storage location and the name of the *.srp file. The parameters can be edited after the import.

Parameterize SIMEAS R-PMU

The parameterization dialog is structured as follows:
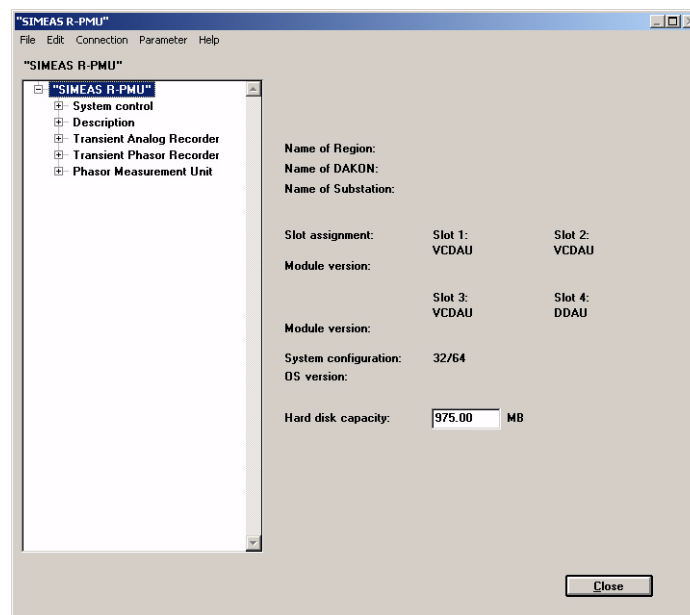
Figure 12-7 Dialog box for setting the SIMEAS R-PMU parameters

❑ **System control** with the tabs **Configuration, Local printer, Time synchronization** and **SIMEAS R-PMU calling Master Station**

  ❑ **Device Function** with the tabs **Continuous Recorder** and **Fault recorder**

  ❑ **Interfaces** with the tabs **Data Interface**, **LAN Interface** and **Service Interface**

  ❑ **LEDs/Relays** with the tabs **LED**, **Relay** and **Group Alarm**

❑ **Description**

  ❑ **Slot assignment 1 to 4** with the tabs **Analog Channels**, **Power/Frequency**, **Symmetrical Components** and **Binary channels**

❑ **Transient Analog Recorder** with tab **Time settings**

  ❑ **Trigger** with the tabs **Analog Trigger**, **Binary Trigger**, **External/Network**, **Pattern** and **DC Trigger**

❑ **Transient Phasor Recorder** with tab **Time settings**

  ❑ **Trigger** with the tabs **Analog Trigger**, **Binary Trigger**, **External/Network** and **DC Trigger**

❑ **Phasor Measurement Unit** with tab **Phasor Measurement Unit**

  ❑ **PMU interface**

❑ To select the function, click on the entry in the directory structure (navigation pane, left) and select the corresponding tab in the right-hand pane of the dialog box.

Note

The dialogs and tabs are shown or hidden depending on the parameterization of the device.

12.2 Configuration

❑ In the System control dialog, Configuration tab, you define the slot assignment of your SIMEAS R-PMU.
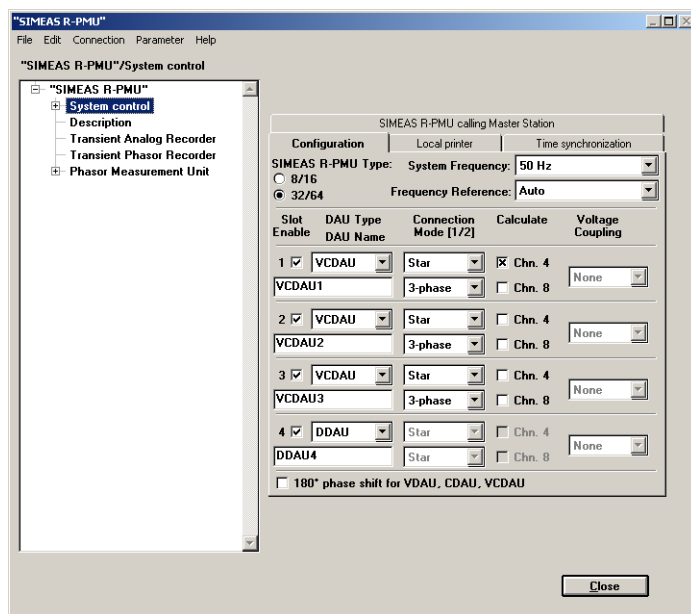
Figure 12-8 Configuration tab

Proceed as follows to set the parameters:

❑ Click **8/16** in the **SIMEAS R-PMU Type** box for a 10" device, or click **32/64** for a 19" device.

Note

For the SIMEAS R-PMU type 8/16, only slot 1 can be parameterized. The slots 2 to 4 are deactivated.

❑ Select the nominal frequency from the drop-down menu of the **System Frequency** box and the source of the reference frequency for the internal signal calculation in the **Frequency Reference** box.

❑ Activate the DAUs of the individual slots by checking the **Slot Enable** checkbox.

Deactivate one or more slots, if you want to run your SIMEAS R-PMU temporarily without some DAUs. the deactivated DAus can remain in your device or may be removed, e. g. for recalibration. In any case, the parameters of these DAUs are preserved. After activation of a DAU, the connection between current and voltage channels has to be done again.

Note

If you deactivate a DAU and remove it from the device, the event recorder does not display the data for this module slot any more. After re-insertion and activation of the DAU, these data are visible again.

❑ Select the type of the DAU from the drop-down menu of the **DAU Type** box.

❑ Enter the **DAU Name** consisting of max. 8 characters that is to be used for recording the events of the DAU.

❑ Select the connection mode from the drop-down menu of the **Connection Mode [1/2]** field to define how the measuring signals are recorded locally, e. g., STAR. You can set separate recording types for the first and the second group of measured values. This specification is not possible with BDAU and DDAU modules.
The following reference values are valid for connecting the measuring signals:
Star   **Phase-to-ground** values
Delta   **Phase-to-phase** values
Monophase/1-phase   **Phase** values
3-phase   **Phase** currents

❑ Check the appropriate **Calculate** checkbox if you want to measure only three phases in star connection and have the starpoint voltage V_n or the starpoint current I_n calculated.

The result of the vector additions: $\underline{V}_n = \frac{1}{3}[\underline{V}_{L1} + \underline{V}_{L2} + \underline{V}_{L3}]$ or $\underline{I}_n = -[\underline{I}_{L1} + \underline{I}_{L2} + \underline{I}_{L3}]$

is then shown as the 4th and/or 8th channel.

❑ For CDAU modules, select from the drop-down menu of the **Voltage Coupling** box a VCDAU or a VDAU to establish a link between VCDAU voltage channels and CDAU current channels for power calculation. If a CDAU is coupled to a voltage channel, both reference groups of the CDAU are always set either for three-phase or for single-phase measurement depending on the voltage channel connection (star/3-phase or 1-phase).

Table 12-1   Settings of voltage and current groups for a VCDAU

Voltage group	Current group	Power calculation
Star	3 phase	yes
Delta	3 phase	yes
Monophase	1 phase	yes
Star	1 phase	no
Delta	1 phase	no
Monophase	3 phase	no

❑ Activate the **180° phase shift for VCDAU, CDAU, VCDAU** checkbox if you have connected the voltage and current channels according to the SIMEAS R V2/V3 connection diagrams.

12.3 Local Printer

With the SIMEAS R-PMU you can output events on a printer which is directly connected to the device.

Select the **Local printer** tab in the System control.
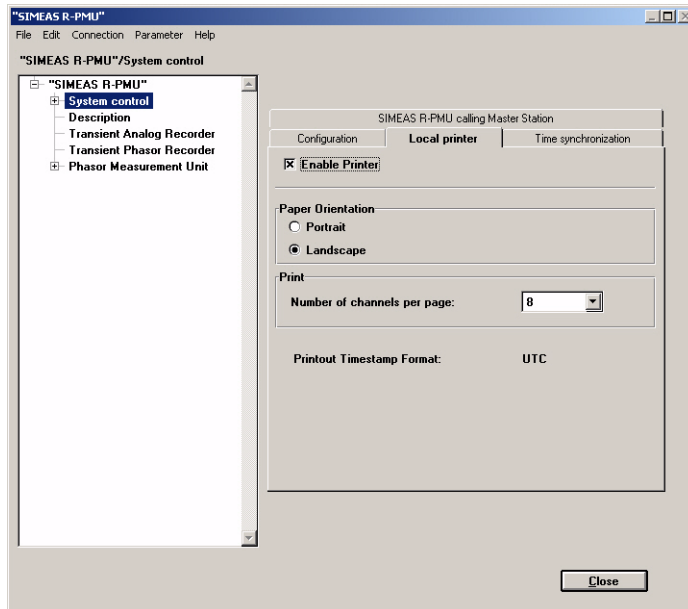
Figure 12-9 Local printer tab

❑ Check the **Enable Printer** checkbox if you want to output events on the local printer.

❑ Select the **Paper Orientation** (**Portrait** or **Landscape**).

❑ Define the **Number of channels per page** in the **Print** group box. You can set a maximum of 8 channels per page.

The printout of a fault record comprises all channels of the selected DAUs, except for quality tracks (see chapter 7.2.1.1)

Note

The maximum recording length of a fault record to be printed is 5 s.

Note

The **Printout Timestamp Format** to be output is fixed to UTC.

12.4   Time Synchronization

You can use the **Time synchronization** tab in the **System control** dialog to set the type of synchronization for your SIMEAS R-PMU.
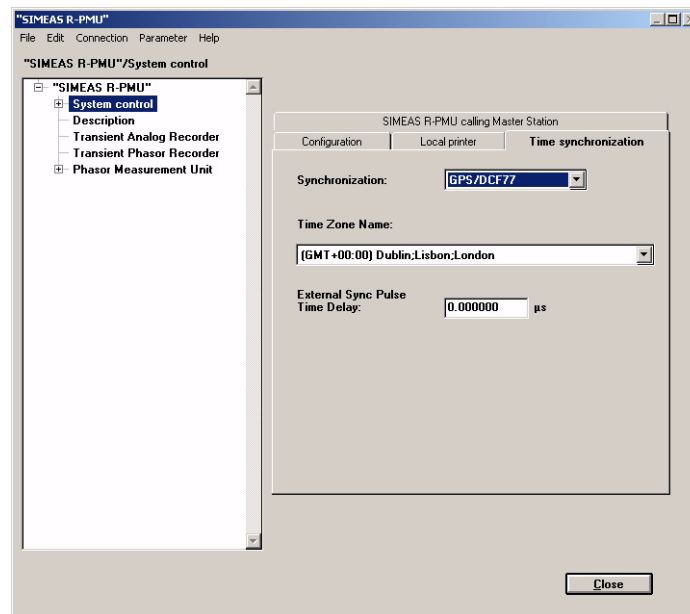
Figure 12-10 Time synchronization tab

❑ Select the type of time synchronization of the device from the drop-down menu of the **Time synchronization** box.

> **Note**
>
> When you change the synchronization signal, you have to modify the parameterization according to the new synchronization type. Sending the device parameters will cause a device restart automatically.

❑ Select the time zone that the SIMEAS R-PMU is to be assigned to under **Time Zone Name**.

❑ You can only meet the required TVE (Total Vector Error) if you consider the run time of all signals. To do so, you can enter the **External Sync Pulse Time Delay** in μ seconds. The **External Sync Pulse Time Delay** describes the total sum of signal delays caused by the use of, e. g., a synchronization transceiver for the transmission of the DCF77 time signal.

> **Note**
>
> You will find information on the delay times of the synchronization components recommended by Siemens in the Application Description "Time Synchronization SIMEAS R/SIMEAS R-PMU", order number E50417-X1074-C403, under www.simeas.com.
>
> Additional information on the accessories recommended by Siemens is also given on the internet under the address www.simeas.com.

12.5   SIMEAS R-PMU Calling Master Station

Use the **SIMEAS R-PMU calling Master Station** tab in the **System control** dialog to select the callback function. When the callback function is activated and TAR or TPR are active, SIMEAS R-PMU establishes a connection to an OSCOP P PC running in automatic mode. This action triggers a callback request and the connection is then terminated. OSCOP P establishes a connection to SIMEAS R-PMU to load all recordings not yet downloaded. For the required configuration, refer to the OSCOP P manual.
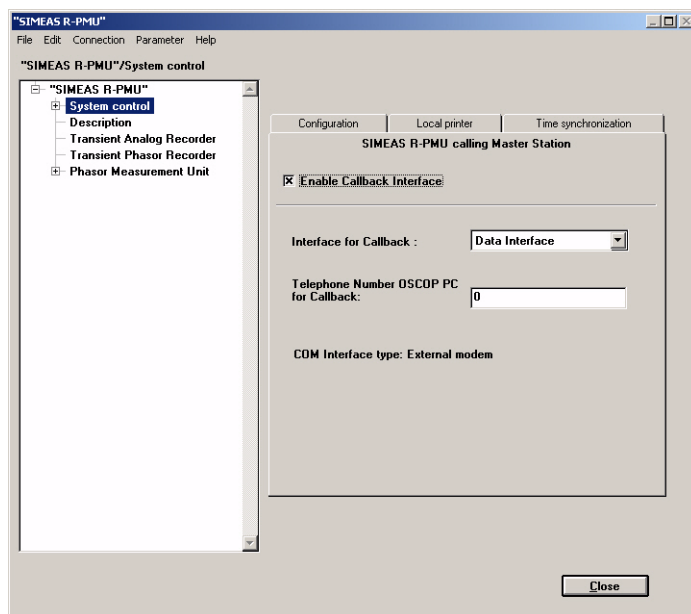
Figure 12-11 SIMEAS R-PMU calling Master Station tab

❑ Check the **Enable Callback Interface** checkbox and select the interface from the drop-down menu. Callback is possible via LAN, Modem or X.25.

❑ Depending on the selected interface, enter the **IP address**, **Telephone number** or the **X.25 address** of the OSCOP P PC in the next box.

Note

If you want to use a LAN for the callback function, you have to parameterize a valid gateway IP address, if the OSCOP P PC is not in the same subnet (Chapter 12.7.2).

12.6   Device Function

The **Device Function** menu item contains the **Continuous Recorder** and **Fault Recorder** tabs.

Here you can define the device functions to be used or the measured values to be recorded with the device. Furthermore, you can allocate storage space to each function.

Continuous recorder

❏ Select the **Continuous Recorder** tab.
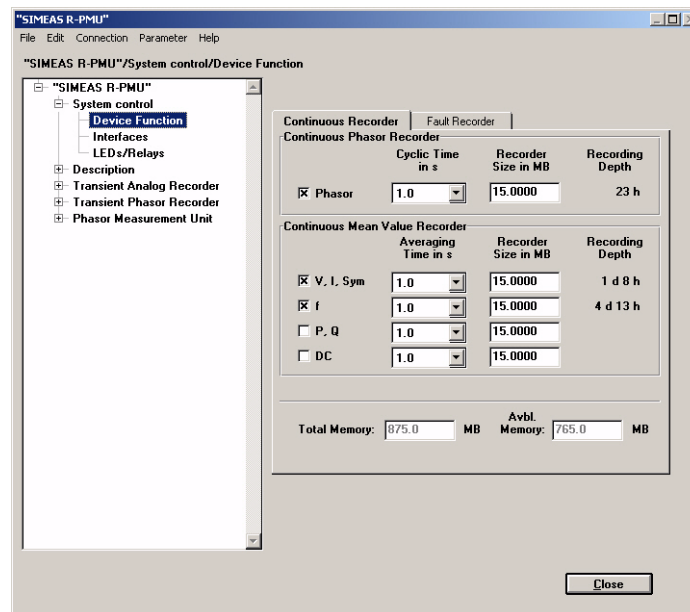
Figure 12-12 Device Function, Continuous Recorder tab

❏ Activate the **Phasor** checkbox in the **Continuous Recorder** menu item to switch on the continuous recorder for complex phasors and frequencies.

   ❏ The **Cycle Time in s** defines the frequency of data recording.

   ❏ The **Recorder Size in MB** defines the size of the physical memory area for the Continuous Phasor Recorder (CPR).

❏ Furthermore, you can parameterize the following long-term recorders under **Continuous Mean Value Recorder**:

   ❏ **V, I, Sym**
   Continuous mean value recorder (CRR) and symmetrical components

   ❏ **f**
   Continuous mean value recorder for frequencies (CFR)

   ❏ **P, Q**
   Continuous mean value recorder for active and reactive power (CQR)

   ❏ **DC**
   Continuous mean value recorder for process variables (CDR)

   Check the appropriate checkbox to select the function and enter the averaging times (in s) and the allocated memory space in the corresponding boxes.

❏ **Averaging Time in s**
   Period of time (in seconds) during which a mean value is calculated and stored in the memory.

❑ **Recorder Size in MB**
Size of the physical memory area in Mbytes for each recorder.

❑ **Recording Depth**
Recording time in days (d) and hours (h) - it is calculated from the recording times, the number of active channels and the configuration components

❑ **Total Memory**
Total memory capacity of the parameterized recorders.

❑ **Avbl. Memory**
Memory that can be allocated freely.

Note

Changes in the memory allocation will delete all data recordings in the device. No warning is given during parameterization.

OSCOP P monitors the allocation of memory space.

If the memory capacity is not sufficient for a continuous mean value recorder and the overall memory capacity of the device has been reached, please proceed as follows:

❑ Reduce the memory capacity of another recorder.

Note

Please note that unchecking a checkbox does not automatically deallocate memory space.

❑ Increase the memory capacity of the continuous mean value recorder by the memory space that has been deallocated beforehand.

❑ Allocate a memory area of at least 1.5 MByte to each recorder.

For system data 100 MByte are reserved. This has to be considered for the hard disk size. OSCOP P considers this fact automatically when calculating the available memory.

Fault recorder
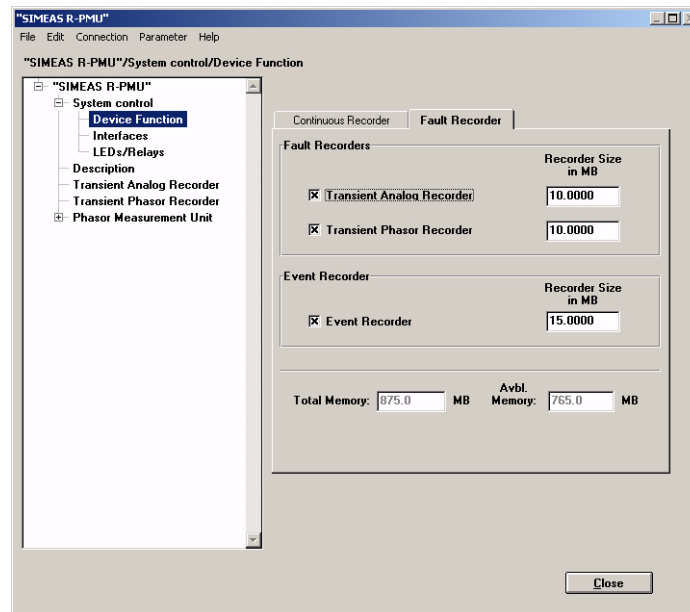
Figure 12-13 Device Function, Fault Recorder tab

❑ You can use the **Fault Recorder** tab to define the size of the memory areas of the device in its function as a fault recorder.

❑ Activate the required recorder and enter the corresponding memory space in MBytes under **Recorder Size in MB**.

❑ **Transient Analog Recorder**
Conventional analog fault recorder

❑ **Transient Phasor Recorder**
Analog fault recorder for complex phasors and derived variables

❑ **Event Recorder**
Binary event recorder

❑ **Total Memory**
Total memory capacity of the SIMEAS R-PMU

❑ **Avbl. Memory**
Memory that can be allocated freely.

For system data 100 MByte are reserved. This has to be considered for the hard disk size. OSCOP P considers this fact automatically when calculating the available memory.

12.7 Interfaces

The SIMEAS R-PMU features the following communication interfaces:

❑ Data interface

❑ LAN interface

❑ Service interface

12.7.1 Data Interface

The 9-pin serial data interface at the rear panel of your SIMEAS R-PMU can be used for direct connection, modem connection, X.25 or star coupler. A PDC can be connected directly or via modem.

❑ Select the **Data Interface** tab under **System control** → **Interfaces**.
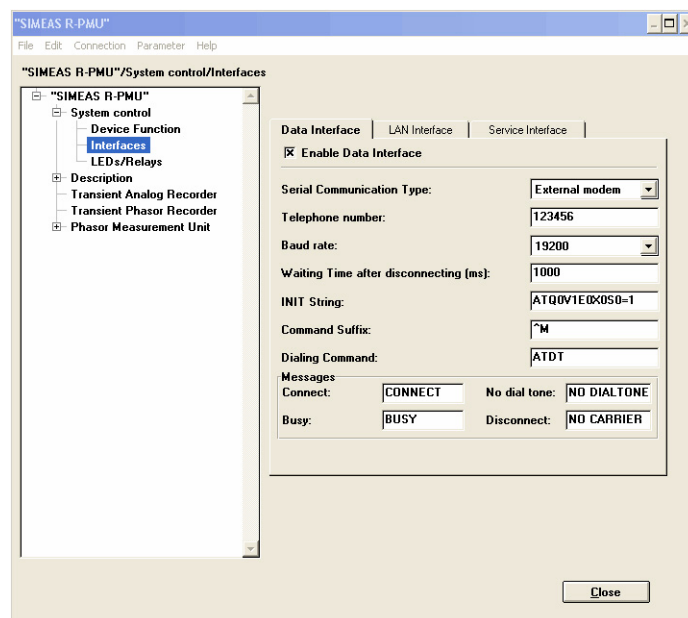
Figure 12-14 Interfaces, Data Interface tab

❑ Check the **Enable Data Interface** checkbox and select the interface type from the drop-down menu **Serial Communication Type**.

❑ Enter the telephone number for modem transmission or **X.25 Address** for an X.25 connection in the **Telephone number** box. The **Telephone Number** is for documentation purposes only and can be left empty.

❑ Enter the **Star coupler address** for the **Star coupler** under Serial Communication Type.

❑ Select the Baud rate of the interface from the drop-down menu of the **Baud rate** box.

❑ In the **Wait Time after disconnecting (ms)** box you can enter a period of time that the SIMEAS R-PMU will allow to elapse after disconnecting the modem before using the interface again. This ensures that even slow modems have sufficient time for disconnecting.

A waiting time of 1000 ms has been preset.

Note

If the data interface is used for the PMU, the baud rate is set to 115,200 bit/s (fixed). You can only parameterize **Direct** and **HAYES Modem**. By activating the PMU, the baud rate will be set to 115,200 bit/s automatically. Your previous baud rate parameterization will be lost.

- ❑ Adjust the **INIT String** to suit your modem if necessary. It depends on the modem type that is used. The default setting of the INIT string is: **ATQ0V1E0X0S0=1.**

- ❑ Enter the supplementary command for an AT command in the **Command Suffix** box. The default setting of the supplementary command is: **^M**

- ❑ Enter the command for the end of the command line in the **Dialing Command** box. The default setting of the command is **ATDT** for tone dialing and **ATDP** for impulse dialing.

- ❑ If a modem is used, check the message texts for the following conditions: **Connect**, **Busy**, **No dial tone** and **Disconnect** and adjust them if necessary.

Note

Set the same baud rate for the SIMEAS R-PMU and the PC or DAKON.

Note

Always enter an INIT string for dial-up modems.

12.7.2   LAN Interface

The LAN interface is located at the rear panel of the SIMEAS R-PMU.

❑   Select the **LAN Interface** tab under **System control** → **Interfaces**.
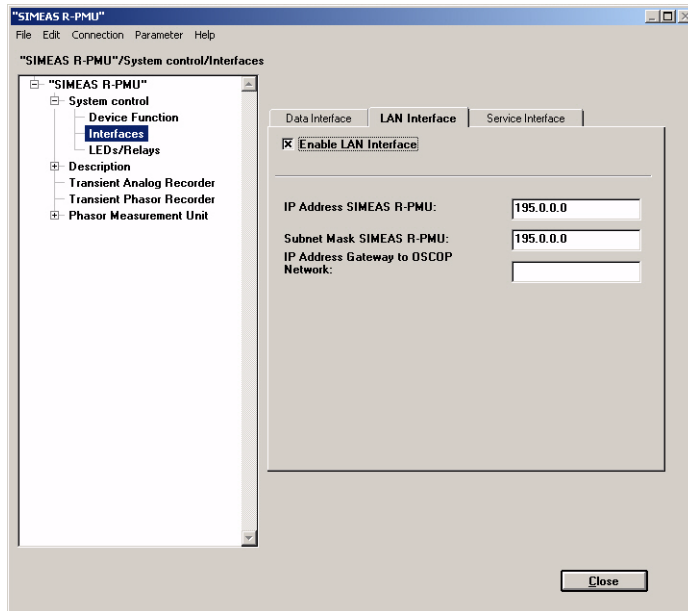
Figure 12-15 Interfaces, LAN Interface tab

❑   Check the **Enable LAN Interface** checkbox to use the interface.

❑   Enter the **IP Address SIMEAS R-PMU** and the **Subnet Mask SIMEAS R-PMU** of the SIMEAS R-PMU, and, if necessary, the **IP Address Gateway to OSCOP Network** in the appropriate boxes.

The **Gateway** box can be left blank if the evaluation PC or the DAKON are in the same network as the SIMEAS R-PMU. It is only required for the function **SIMEAS R-PMU calling Master Station** (see chapter 12.5).

12.7.3 Service Interface

The 9-pin service interface is located at the front of the SIMEAS R-PMU. The transmission parameters of this interface are fixed and are displayed in the **Service Interface** box.
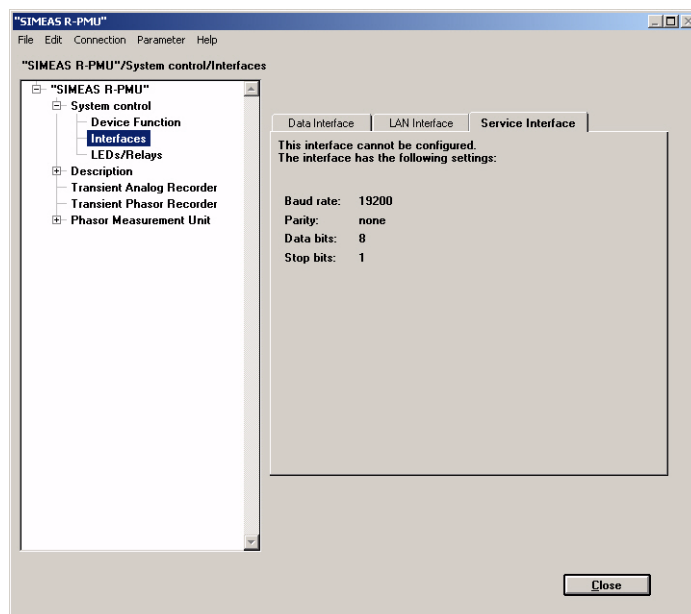
Figure 12-16 Interfaces, Service Interface tab

12.8   LED Indications

During operation, the SIMEAS R-PMU creates 19 different operation and fault messages that are displayed using 16 LEDs on the control panel.

Up to five messages can be linked using OR functions and assigned to one of the LEDs.

❑   Select the **LED** tab under **System control** → **LEDs/Relays**.
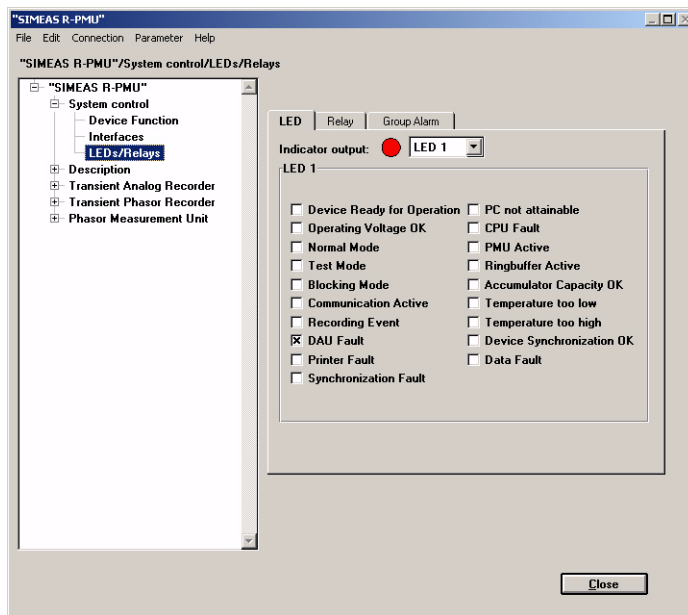
Figure 12-17 LED tab

❑   If you want to change the default settings, select the corresponding LED from the drop-down menu **Indicator output** and check the control boxes of the individual messages to assign them to the LED.

12.9 Relay Indications

The SIMEAS R-PMU provides the option of combining up to five messages by OR and assigning them to relay 2, 3 or 4. The relays are designed as normally open contacts. Relay 1 is permanently linked to the watchdog monitoring function (Chapter 13) of the SIMEAS R-PMU and designed as a normally closed contact.

Note

A **Group alarm** is assigned to a relay exclusively and cannot be combined with other messages.

❑ Select the **Relay** tab under **System control** → **LEDs/Relays**.
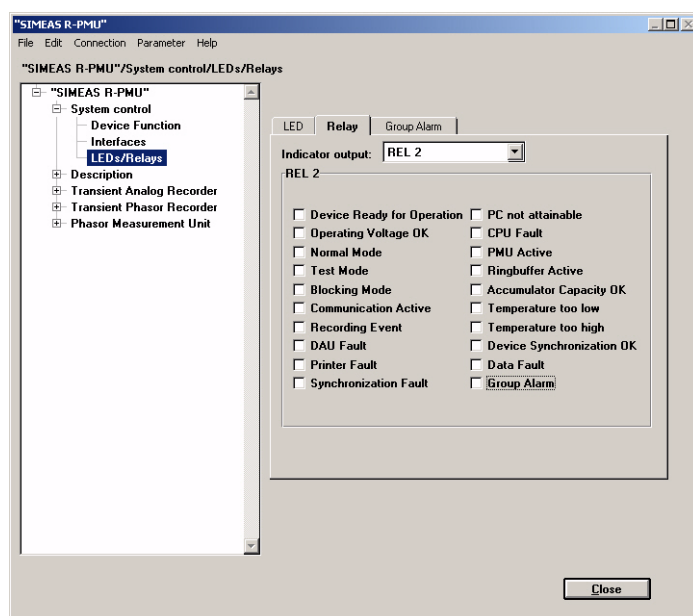
Figure 12-18 Relay tab

❑ If you want to change the default settings, select the corresponding relay from the **Indicator output** drop-down menu and check the control boxes of the individual messages to assign them to the corresponding relay.

12.10 Group Alarm

Select the 5 messages that will be OR combined in a group alarm in the **Group Alarm** tab.

❑ Select the **Group Alarm** tab under **System control** → **LEDs/Relays**.
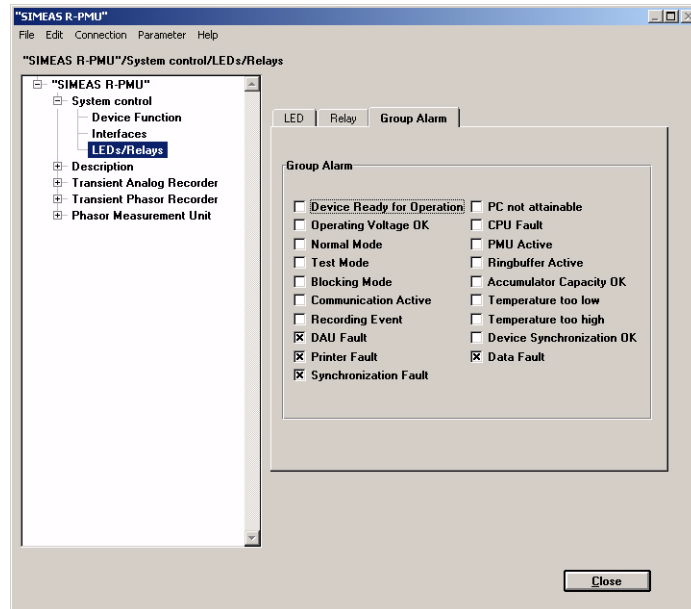
Figure 12-19 Group Alarm tab

❑ If you want to change the default settings, check the checkboxes of the individual messages that you wish to combine in a group alarm.

Note

Messages which are not error messages („positive messages") should not be allocated to the group alarm.

12.11 Slot Description

A SIMEAS R-PMU can be equipped with a maximum of four DAU modules (1 DAU for a ZE 8/ 16 and 4 DAUs for a ZE 32/64). In the **Description** dialog box, the channel assignment of the individual slots is parameterized.
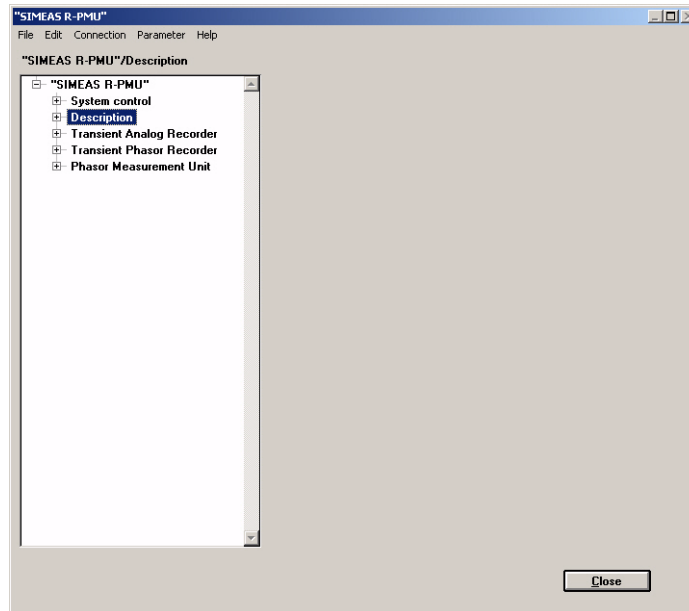
Figure 12-20 Description dialog

❑ Click on a slot (1 to 4) and select the following tabs one after the other to set the individual parameters:

   ❑ Binary channel
   ❑ Analog Channels
   ❑ Power/Frequency
   ❑ Positive/negative sequence
   ❑ DC channels (for DDAUs only)

Note

Only the tabs that are relevant for the DAU types in use are displayed.

12.11.1 Binary Channels

The **Binary Channel** tab is provided for all DAU types.
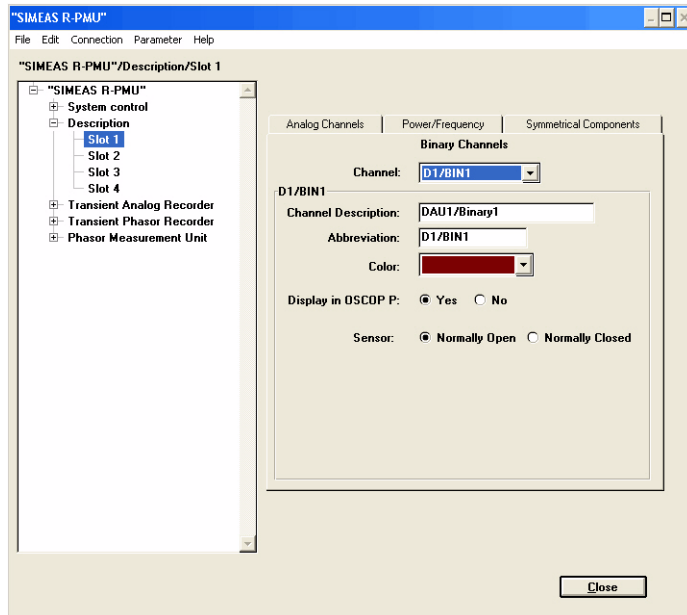
Figure 12-21 Binary channels tab

❑ Select the channel of the DAU from the drop-down menu of the **Channel** box. VCDAU, VDAU, CDAU and DDAU are equipped with 16, BDAU modules with 32 binary channels.

❑ The **Channel Description** and the **Abbreviation** are specified by default but can be adjusted depending on the user requirements.

❑ In the **Color** box, you can select one of 16 colors for displaying the values in the OSCOP P module Evaluate.

❑ Select under **Display in OSCOP P** whether the values of the channel are to be displayed in the OSCOP P Evaluate module.

❑ Select if a **Sensor** of type **Normally Open** or **Normally Closed** is connected (see chapter 7.2.1.2.2).

12.11.2 Analog Channels

The **Analog Channels** tab is provided for VCDAU, VDAU and CDAU modules.
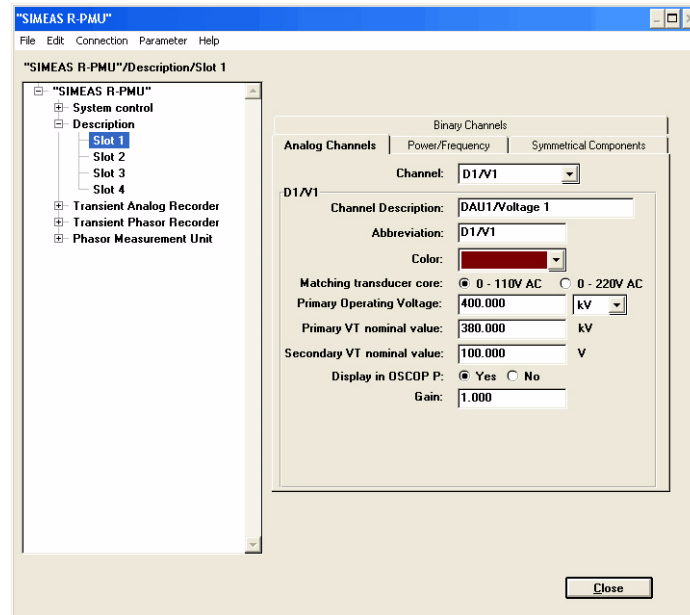
Figure 12-22 Analog Channels tab

You can parameterize the following channels depending on the DAU type:

❑ VCDAU   Voltages V1 to V4 and currents I1 to I4

❑ VDAU   Voltages V1 to V8

❑ CDAU   Currents I1 to I8

❑ Select one of the 8 channels from the drop-down menu of the **Channel** box.

❑ Change the **Channel Description** and **Abbreviation** and select a **Color** (if necessary).

❑ Select with **Matching Transducer Core** the input voltage range for the VCDAU or VDAU.

❑ Select the input voltage range for the VDAU or VCDAU under **Primary Operating Voltage**.

❑ Enter the nominal voltage as phase-to-phase voltage and select the primary dimension of the measured values (e. g. kV).
  Enter the transformation ratio of the transducer in the **Primary VT nominal value** and **Secondary VT nominal value** and select the appropriate primary-side dimension of the measured value unit from the drop-down menu.
  The following reference values are valid for the connection of the measuring signals:

Star	**Phase-to-ground** values
Delta	**Phase-to-phase** values
Monophase/1-phase	**Phase** values
3-phase	**Phase** currents

> **Note**
>
> Digits following a point are regarded as decimal places.

- ❑ Select under **Display in OSCOP P** whether the values of the channel are to be displayed in the OSCOP P Evaluate module.

- ❑ The display curve for low measured values can be improved by a gain factor that acts like a zoom in the y direction. Enter the value in the **Gain** box.
  Default setting: 1, i. e. no gain; digits following the point are regarded as decimal places.

> **Note**
>
> On the basis of the **Nominal transducer values**, OSCOP P calculates the standard trigger values (nominal value ±20 %) and stores them for each channel of the analog fault recorders.

12.11.3 Power/Frequency

The **Power/Frequency** tab is provided for VCDAUs, coupled CDAUs and, with certain restrictions, for VDAUs.
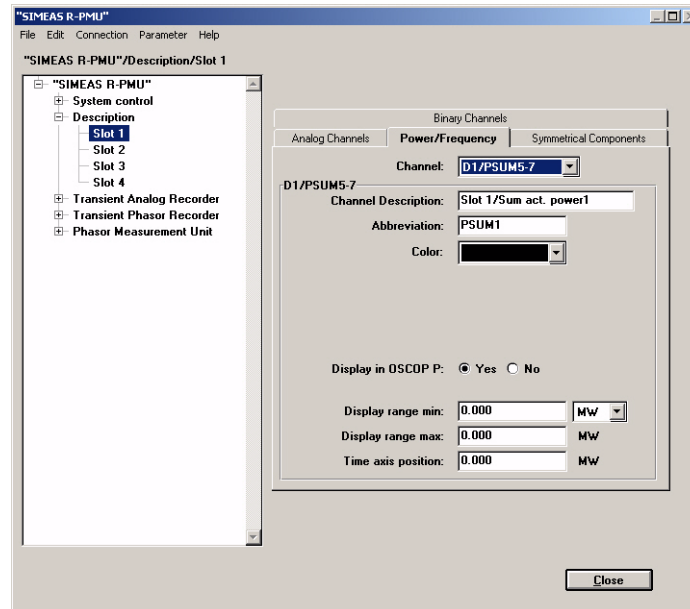
Figure 12-23 Power/Frequency tab

You can parameterize the following channels depending on the DAU type:

❑ VCDAU and coupled CDAU at single-phase connection

❑	P1 to P4	Active powers group 1 of the coupled CDAU
❑	P5 to P8	Active powers of VCDAU and group 2 of the coupled CDAU
❑	Q1 to Q4	Reactive powers group 1 of the coupled CDAU
❑	Q5 to Q8	Reactive powers of VCDAU and group 2 of the coupled CDAU
❑	FREQ1	Frequency calculated using the best signal of the first recording group (channels 1 to 4) of the DAU
❑	FREQ2	Frequency calculated using the best signal of the second recording group (channels 5 to 8) of the DAU

Powers are calculated from the corresponding current/voltage pairs V1/I1 to V4/I4 (VCDAU and group 1of the coupled CDAU) and V1/I5 to V4/I8 (group 2 of the coupled CDAU).

❑ VCDAU and coupled CDAU at star and delta connection

❑ PSUM1-3	Total active power group 1 of the coupled CDAU
❑ PSUM5-7	Total active power of VCDAU and group 2 of the coupled CDAU
❑ P4	Active power of channel 4 group 1 of the coupled CDAU
❑ P8	Active power of channel 4 of VCDAU and group 2 of the coupled CDAU
❑ QSUM1-3	Total reactive power group 1 of the coupled CDAU
❑ QSUM5-7	Total reactive power of VCDAU and group 2 of the coupled CDAU
❑ Q4	Reactive power of channel 4 group 1 of the coupled CDAU
❑ Q8	Reactive power of channel 4 of VCDAU and group 2 of the coupled CDAU
❑ FREQ1	Frequency calculated using the best signal of the first measured value recording group (channels 1 to 4) of the DAU
❑ FREQ2	Frequency calculated using the best signal of the second measured value recording group (channels 5 to 8) of the DAU

Total powers are calculated from the first 3 channels of a group.

❑ VDAU and not coupled CDAU

❑ FREQ1	Frequency calculated using the best signal of the first measured value recording group (channels 1 to 4) of the DAU
❑ FREQ2	Frequency calculated using the best signal of the second measured value recording group (channels 5 to 8) of the DAU

❑ Select one calculated values from the drop-down menu of the **Channel** box.

❑ Enter the **Channel Description** and **Abbreviation** and select a **Color**.

❑ Select under **Display in OSCOP P** whether the values of the channel are to be displayed in the OSCOP P Evaluate module.

❑ Use the **Display range min** and **Display range max** boxes to set the lowest or highest respectively measured value to be displayed in the OSCOP P Evaluate module. Select the measured value dimension.

Note

Digits following the points are regarded as decimal places.

❑ Set the value for the zero crossing in the **Time axis position** box for evaluating the measured values in the OSCOP P Evaluate module. Negative values are allowed.

12.11.4 Symmetrical Components

The **Symmetrical Components** tab is provided for VCDAU, VDAU and CDAU modules at star and delta connection.
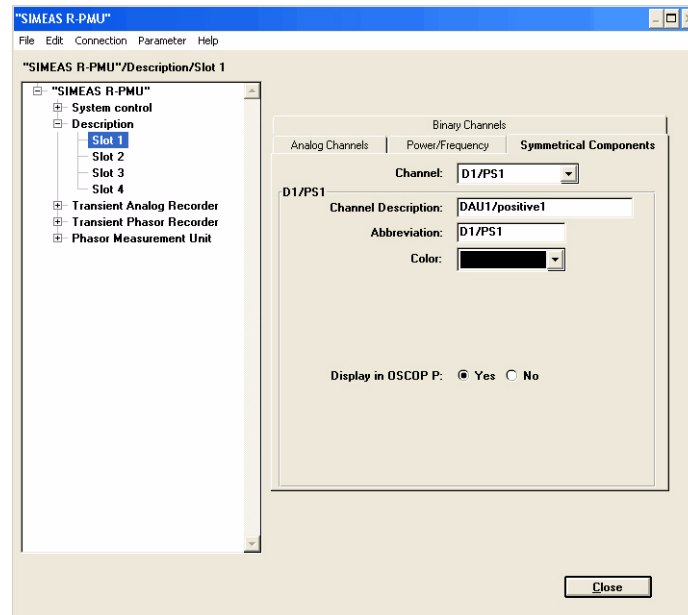
Figure 12-24 Symmetrical components tab

❑ Select one of the calculated values from the drop-down menu of the **Channel** box.
You can choose between the positive-sequences PS1/2, the negative-sequences NS1/2 and the zero-sequence systems ZS1/2.

Note

„1" and „2" for positive, negative and zero-sequence system refer to the 1st current/voltage group (channels 1 to 4) and the 2nd current/voltage group (channels 5 to 8).

❑ Enter the **Channel description** and **Abbreviation** and select a **Color**.

❑ Select under **Display in OSCOP P** whether the values of the channel are to be displayed in the OSCOP P Evaluate module.

12.11.5 DC Channels

The **DC channels** tab is only provided for DDAU modules. This tab is used to parameterize operational data and information regarding the display of values in OSCOP P.

> **Note**
>
> DDAUs are manufactured for input ranges of DC ±1 V, DC ±10 V or DC ±20 mA. Please check the type of DDAUs used and make sure you parameterize the input signal variables according to their intended use.
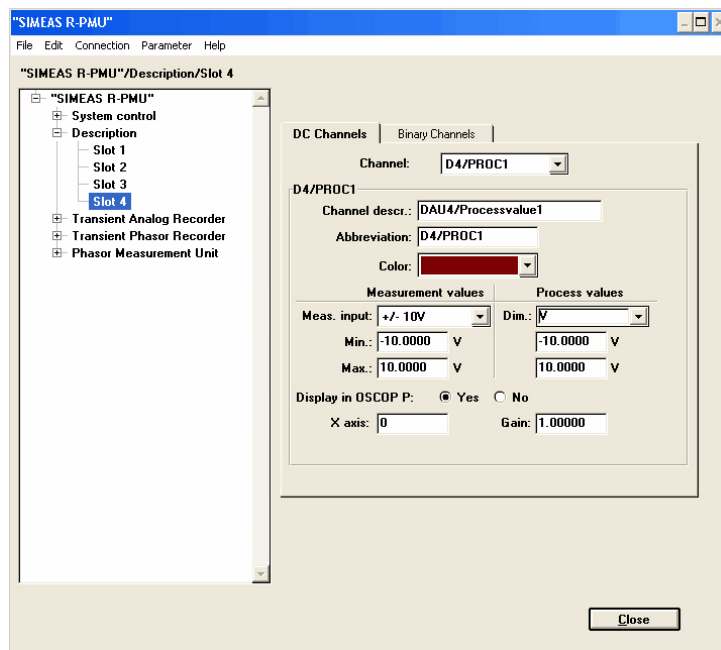
Figure 12-25 DC channels tab

❑ Select one of the analog channels from the drop-down menu of the **Channel** box.

❑ Enter the **Channel descr.** and **Abbreviation** and select a **Color**.

> **Note**
>
> For DC channels, a mapping for measured values to process signals can be parameterized. Example: The measurement range DC 0 V to DC +10 V is mapped to the process signals -50 °C to +100 °C.

❑ Select the secondary signal variable that is provided on the input terminals of the DDAU from the drop-down menu **Meas. input** under **Measurement values**.

❑ Enter the minimum and maximum of the secondary signal variable into the **Min.** and **Max.** boxes.

❑ Use the drop-down menu **Dim.** under **Process values** to select the dimension of the measured value to be displayed as a y-axis label in the OSCOP P Evaluate module, or enter a string consisting of maximum six characters. Enter the minimum and maximum of the converted process variable into the **Min.** and **Max.** boxes.

❑ Select under **Display in OSCOP P** whether the values of the channel are to be displayed in the OSCOP P Evaluate module.

❑ In the **X axis** box you can enter the process variable value at which the time axis is to appear in the OSCOP P Evaluate module.

❑ The display curve for low measured values can be improved by a **Gain** factor that acts like a zoom in the y direction. Enter the value in the Gain box.

Note

The parameters **Display in OSCOP P**, **X axis** and **Gain** do not influence the display of PMU data in OSCOP P.

12.12 Transient Analog Recorder (TAR)

12.12.1 Time settings

❑ First of all, select the dialog **Transient Analog Recorder** to set the time parameters for the device.
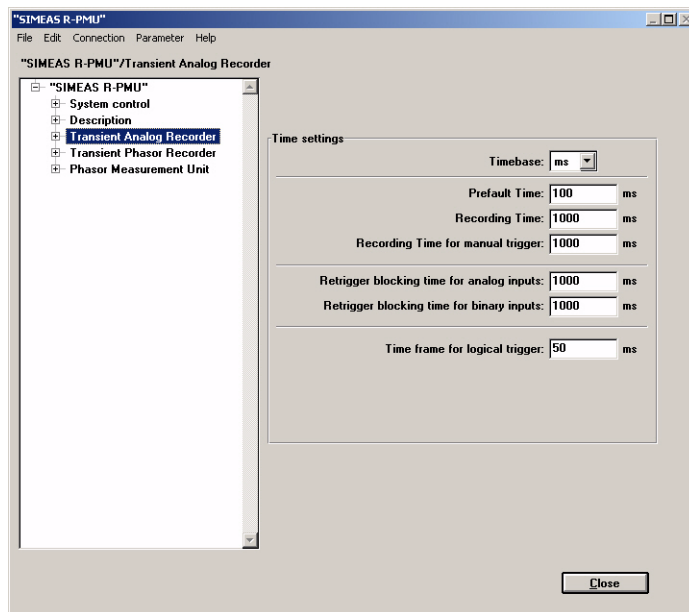
Figure 12-26 Transient Analog Recorder, time settings

Note

A time must be entered in every input field.

❑ Select the dimension of the run times to be set from the drop-down menu of the **Timebase** box.
For reasons of clarity, all times are displayed in the same unit of time. When the unit of time is changed, all times will be readjusted.

❑ Enter the recording time of the events preceding the fault in the **Prefault Time** box.

❑ Define the length of a record starting from a specific trigger time in the **Recording Time** box.

❑ Enter the recording time for a manual trigger in the **Recording Time for manual trigger** box.

❑ In the **Retrigger blocking time for analog inputs** you can enter the blocking time for analog channels. During this period, no other trigger condition is recognized for this channel.

❑ In the **Retrigger blocking time for binary inputs** you can enter the blocking time for binary channels. During this period, no other trigger condition is recognized for this channel.

❑ In the **Time frame for logical trigger** box, you can enter the interval during which the conditions for logical operations must be met.

12.12.2 Analog Triggers

All measurement inputs of VCDAUs, VDAUs and CDAUs can be used as analog trigger values.
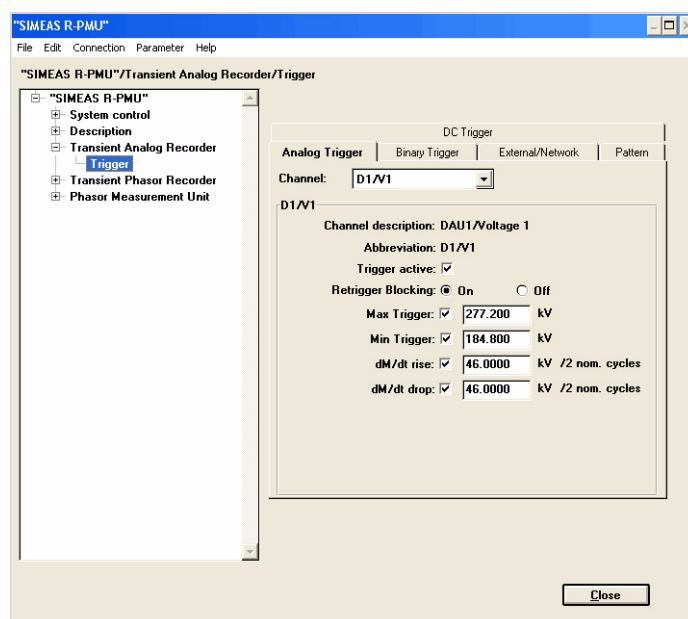
Figure 12-27 TAR, Analog Trigger tab

❑ Select the channel from the drop-down menu of the **Channel** box.
The **Channel description** and the **Abbreviation** that you have parameterized before are displayed in the parameter box of the channel.

❑ Activate the trigger function of the channel by checking the **Trigger active** checkbox.

❑ Activate or deactivate the **Retrigger Blocking** by clicking the appropriate radio button.

❑ Activate the required trigger functions of the channel by checking the appropriate checkbox **Max Trigger**, **Min Trigger**, etc.

❑ In the fields **Max Trigger** or **Min Trigger** enter the primary values, for which a recording is to be generated.

❑ Set the value dM (delta of nominal value) for the Gradient trigger in the **dM/dt rise** or **dM/dt drop** boxes. The timebase dt is permanently set to the double of the cycle. If the current rms value exceeds the maximum or minimum limit value, there will be the corresponding gradient triggering. A Gradient trigger cannot be set for positive, negative and zero-sequence channels.

12.12.3 Binary Triggers

All binary inputs of VCDAUs, VDAUs, CDAUs, DDAUs and BDAUs can be used as binary trigger values.

Figure 12-28 TAR, Binary Trigger tab

❑ Select the channel from the drop-down menu of the **Channel** box.
The **Channel description** and the **Abbreviation** that you have parameterized before are displayed in the parameter box.

❑ Activate or deactivate the **Retrigger Blocking** by clicking the appropriate radio button.

❑ Activate the checkboxes **Change to normal state** and/or **Change to alarm state**.

Note

Change to alarm state means: A normally open contact (connected to an input parameterized as normally open contact) is closed or a normally closed contact (connected to an input parameterized as normally closed contact) is opened.
Change to normal state means: A normally open contact (connected to an input parameterized as normally open contact) returns to open or a normally closed contact (connected to an input parameterized as normally closed contact) returns to closed.

12.12.4 Network and Cross Triggers

You can use the **External/Network** tab to set the behavior of the Transient Analog Recorder (TAR) with regard to the network and cross trigger function.

The network trigger checkboxes are only selectable if you have enabled the LAN interface under **Interfaces** → **LAN Interface** previously.
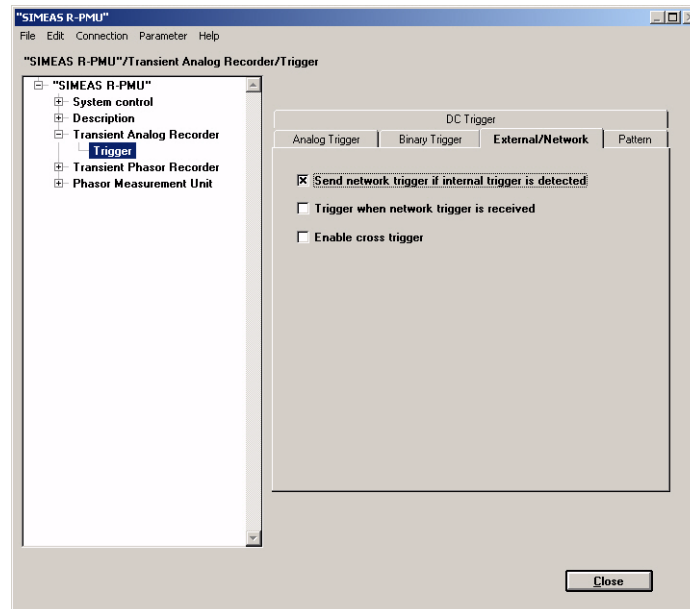
Figure 12-29 TAR, External/Network tab

❑ Select by checking the appropriate checkbox(es) whether the Transient Analog Recorder (TAR) is to trigger a network trigger via the LAN, or whether the recorder itself is to trigger when a network trigger is received via the LAN.

❑ Select by checking the **Enable cross trigger** checkbox whether the Transient Analog Recorder (TAR) is to also trigger when the Transient Phasor Recorder has been triggered.

12.12.5 Trigger Pattern

A SIMEAS R-PMU allows you to combine up to eight channel-related trigger criteria by a logical AND. The combination of several trigger criteria is referred to as a pattern in the following. A maximum of 8 patterns can be parameterized.

To select a channel in a trigger connection, you have to activate this trigger as individual trigger. After the activation of the pattern, the trigger is no longer valid as individual trigger.
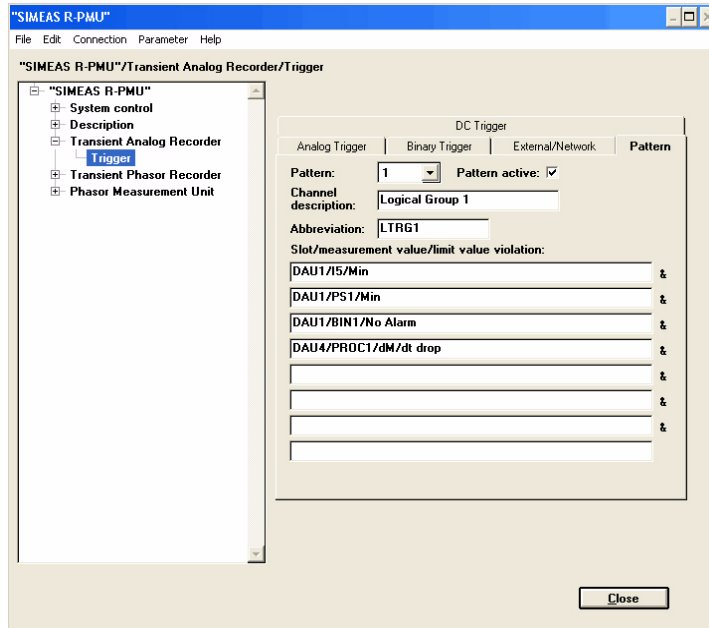
Figure 12-30 TAR, Pattern tab

❑ Select one of the eight possible patterns from the drop-down menu of the **Pattern** box.

❑ Enter a pattern name with up to 20 characters in the **Channel description** box and the pattern abbreviation with up to 8 characters in the **Abbreviation** box.

❑ Select whether the pattern is to be activated by checking the **Pattern active** checkbox. To activate a pattern, at least two triggers have to be combined.

❑ To enter the conditions of the logical operation, click the individual boxes of the **Slot/ measurement value/limit value violation** group box and select the relevant DAUS and channels in the dialog box that appears next.

12.12.6 DC Triggers

All measuring inputs of the DDAUs can be used as DC trigger values.
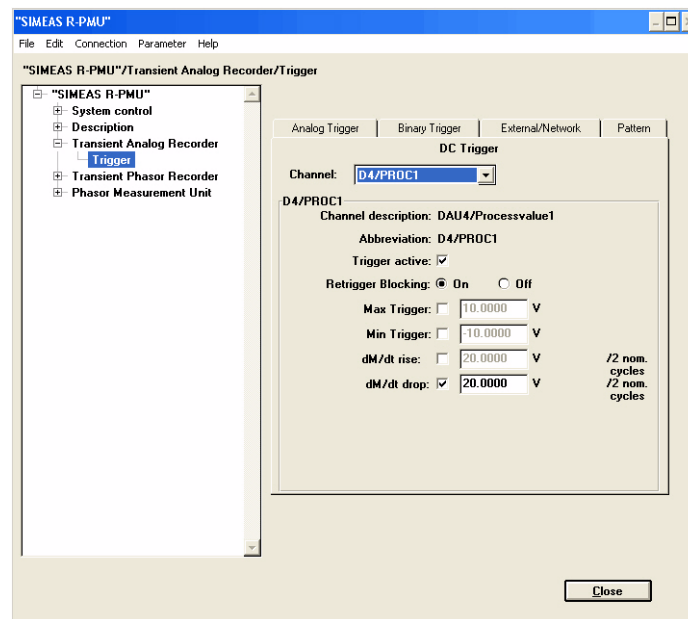
Figure 12-31 TAR, DC Trigger tab

❑ Select the channel from the drop-down menu of the **Channel** box.
   The **Channel description** and the **Abbreviation** that you have parameterized before are displayed in the parameter box of the channel.

❑ Activate the trigger function of the channel by checking the **Trigger active** checkbox.

❑ Activate or deactivate the **Retrigger Blocking** by clicking the appropriate radio button.

❑ Enter in **Max Trigger** or **Min Trigger** respectively, the limit values that are to generate a limit violation with Max or Min as the cause.

❑ Set the value dM (delta of nominal value) for the gradient trigger in the **dM/dt rise** or **dM/dt drop** boxes. The timebase is permanently set to the double of the cycle.
   If the current arithmetic mean value exceeds the maximum or minimum limit value, there will be the corresponding gradient triggering.

Note

To avoid wrong trigger settings, trigger values are checked for plausibility. If the plausibility checks fail, the value is rejected and a message with the valid input range is displayed.

12.13 Transient Phasor Recorder (TPR)

12.13.1 Time Settings

❑ First of all, select the dialog **Transient Phasor Recorder** to set the run time parameters for the device.
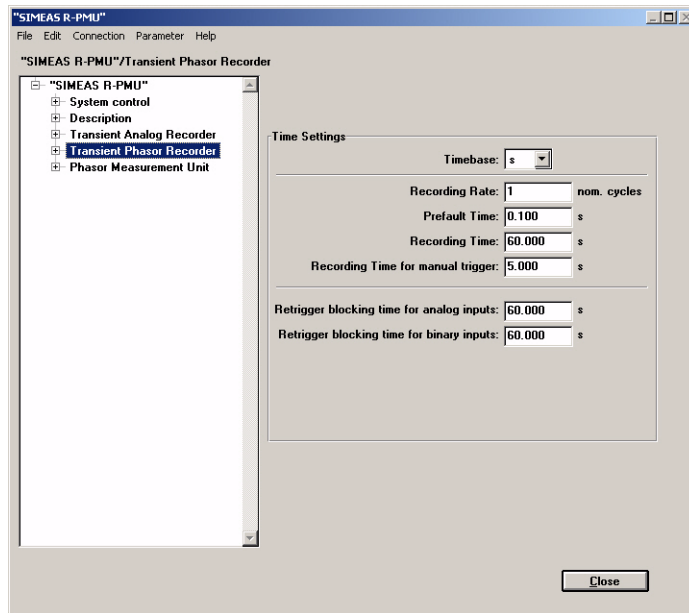
Figure 12-32 TPR, Time Settings tab

> **Note**
>
> A time must be entered in every input field.

❑ Select the dimension of the run times to be set from the drop-down menu of the **Timebase** box. For reasons of clarity, all times are displayed in the same dimension. When the unit of time is changed, all times will be readjusted.

❑ Enter in the **Recording Rate** box an integer between 1 and 5 for the recording rate in nominal cycles.

❑ Enter the recording time of the events preceding the fault in the **Prefault Time** box.

❑ Define the length of a record starting from the trigger time in the **Recording Time** box.

❑ Enter the recording time for a manual trigger in the **Recording time for manual trigger** box.

❑ Enter the blocking time for manual channels in the **Retrigger blocking time for analog inputs** box. During this period, no other trigger condition is recognized for this channel.

❑ Enter the blocking time for binary inputs in the **Retrigger blocking time for binary inputs** box. During this period, no other trigger condition is recognized for this channel.

12.13.2 Analog Triggers

All measuring inputs of VCDAUs, VDAUs and CDAUs can be used as analog trigger values.
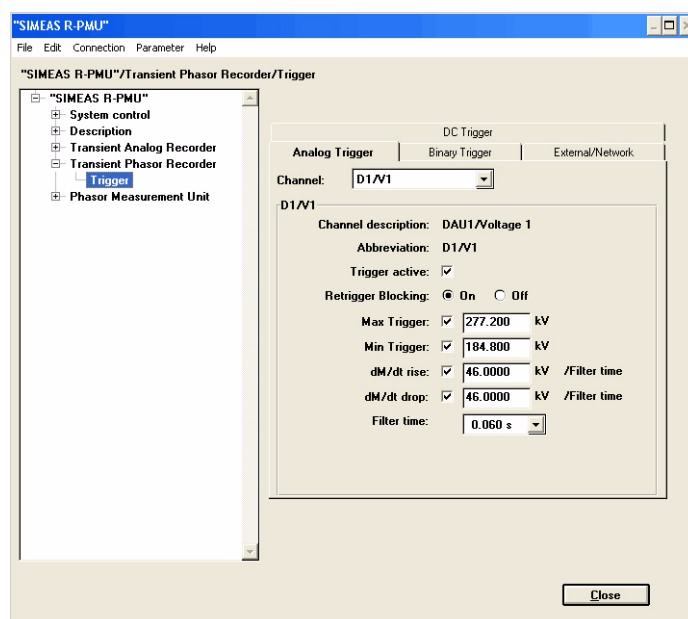
Figure 12-33 TPR, Analog Trigger tab

- ❑ Select the channel from the drop-down menu of the **Channel** box.
  The **Channel description** and the **Abbreviation** that you have parameterized before are displayed in the parameter box of the channel.

- ❑ Activate the trigger function of the channel by checking the **Trigger active** checkbox.

- ❑ Activate or deactivate the **Retrigger Blocking** by clicking the appropriate radio button.

- ❑ Activate the individual trigger functions of the channel by checking the appropriate checkbox **Max trigger**, **Min trigger**, etc.

- ❑ Enter in **Max trigger** or **Min trigger** respectively, the primary values that are to generate a recording.

- ❑ Set the value dM for the Gradient Trigger in the **dM/dt rise** or **dM/dt drop** boxes.

- ❑ The filter time of the Gradient trigger can be parameterized in seconds.
  If the measured value exceeds the limit value dMax or dMin within the filter time, there will be the corresponding Gradient triggering.
  A Gradient trigger is not provided for positive, negative and zero-sequence channels.

12.13.3 Binary Triggers

All binary inputs of VCDAUs, VDAUs, CDAUs, DDAUs and BDAUs modules can be used as binary trigger values.
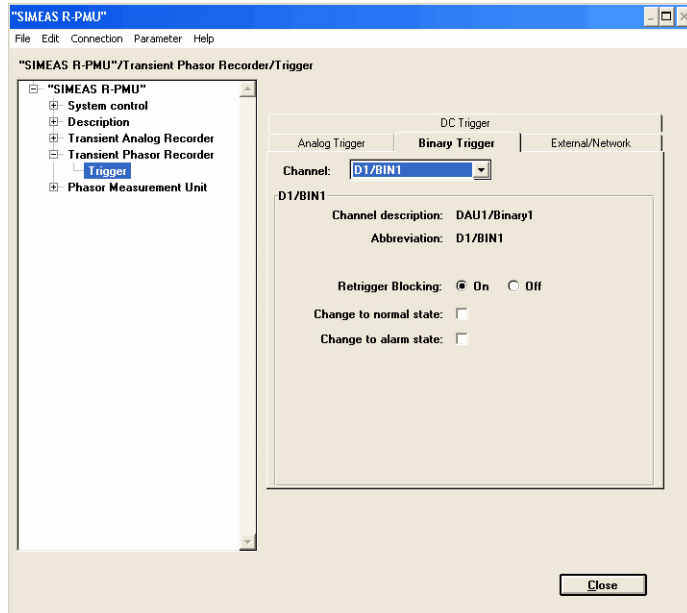
Figure 12-34 TPR, Binary Trigger tab

❑ Select the channel from the drop-down menu of the **Channel** box.

The **Channel description** and the **Abbreviation** that you have parameterized before are displayed in the parameter box of the channel.

❑ Activate or deactivate the **Retrigger Blocking** by clicking the appropriate radio button.

❑ Activate the checkboxes **Change to normal state** and/or **Change to alarm state**.

> **Note**
>
> **Change to alarm state** means: A normally open contact (connected to an input parameterized as normally open contact) is closed or a normally closed contact (connected to an input parameterized as normally closed contact) is opened.
> **Change to normal state** means: A normally open contact (connected to an input parameterized as normally open contact) returns to open or a normally closed contact (connected to an input parameterized as normally closed contact) returns to closed.

12.13.4 Network and Cross Triggers

You can use the **External/Network** tab to set the behavior of the Transient Phasor Recorder with regard to the network and cross trigger function.

The **External/Network** tab is only shown if you have previously selected **Network** as interface type under **Interfaces** → **LAN interface**.
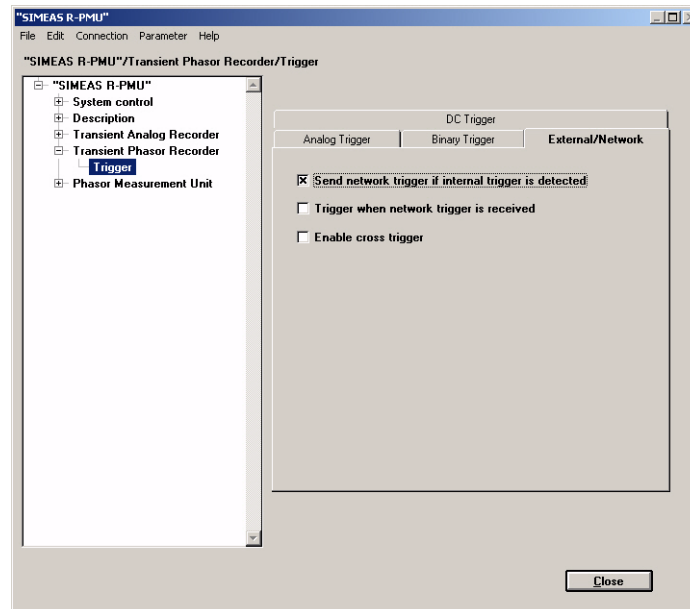
Figure 12-35 TPR, External/Network tab

❑ Select by checking the appropriate checkbox(es) whether the TPR is to trigger a network trigger via the LAN, or whether the Transient Phasor Recorder (TPR) itself is to trigger when a network trigger is received via the LAN.

❑ Select by checking the **Enable cross trigger** checkbox whether the Transient Phasor Recorder (TPR) is also to trigger when the Transient Analog Recorder (TAR) has been triggered.

12.13.5 DC Triggers

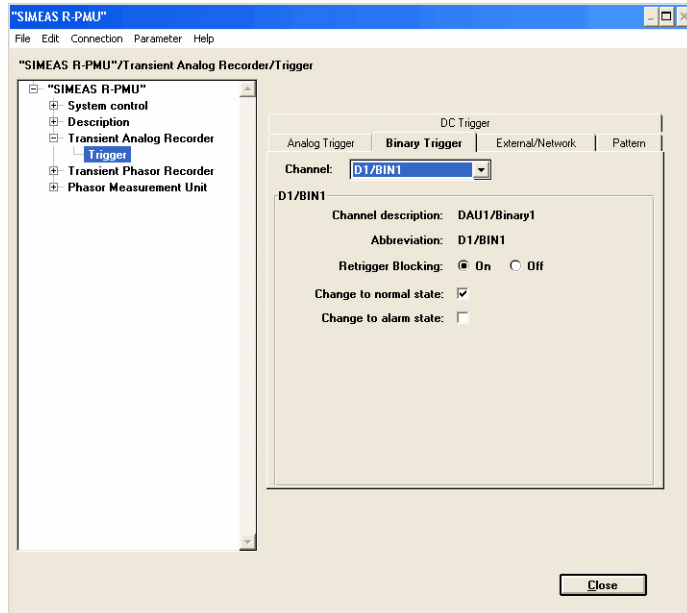All measuring inputs of DDAUs can be used as DC trigger values.
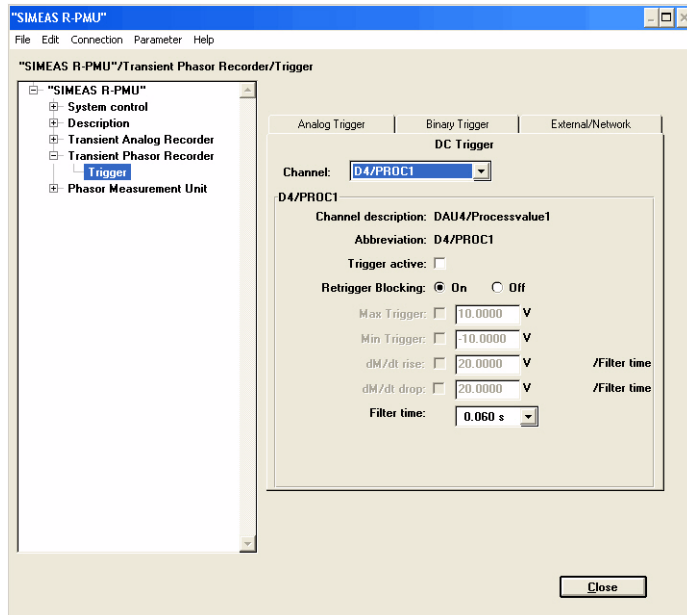
Figure 12-36 TPR, DC Trigger tab

❑ Select the channel from the drop-down menu of the **Channel** box.
The **Channel description** and the **Abbreviation** that you have parameterized before are displayed in the parameter box of the channel.

❑ Activate the trigger function of the channel by checking the **Trigger active** checkbox.

❑ Activate or deactivate the **Retrigger Blocking** by clicking the appropriate radio button.

❑ Enter in **Max Trigger** or **Min Trigger** respectively, the limit values that are to generate a limit violation with **Max** or **Min** as the cause.

❑ Set the value dM (delta of nominal value) for the Gradient trigger in the **dM/dt rise** or **dM/dt drop** boxes. The timebase dt can be parameterized in nominal cycles.
If the currently measured value exceeds the limit value dMax or dMin, there will be the corresponding Gradient triggering.

12.14 Phasor Measurement Unit (PMU)

12.14.1 PMU Settings

❑ First of all, select the dialog **Phasor Measurement Unit** to set the parameters for the PMU.
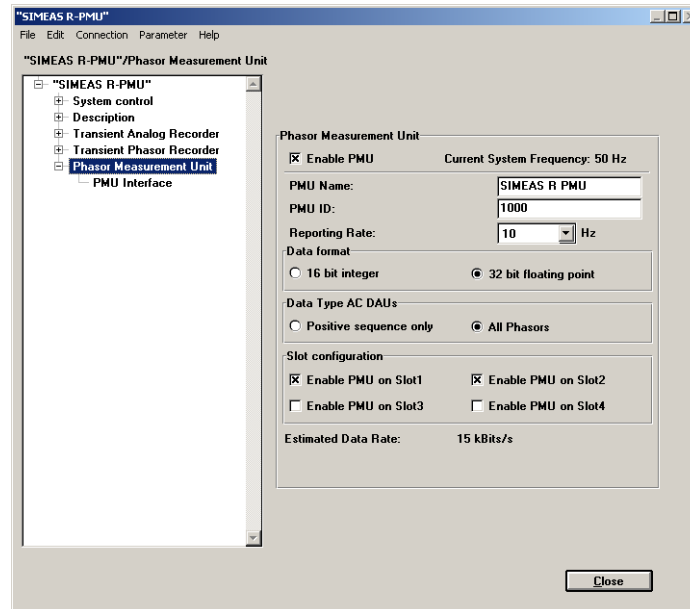
Figure 12-37 Phasor Measurement Unit dialog

❑ Activate the PMU by checking the **Enable PMU** checkbox.
The currently set nominal frequency is displayed.

❑ Assign a name (**PMU Name**) and a unique **PMU ID** to the SIMEAS R-PMU.

Note

The assigned PMU ID is valid for the central processing unit of the SIMEAS R-PMU. Since every DAU is regarded as an individual Phasor Measurement Unit that is subordinate to the central processing unit, the DAU modules are automatically assigned the sequence numbers of the central processing unit as a PMU ID.

Depending on the design of the SIMEAS R-PMU type (ZE 8/16 or ZE 32/64), a range between two and five PMU IDs is required. Please bear this in mind when assigning the PMU IDs.

❑ Depending on the nominal frequency, you can select the sampling rate from the drop-down menu **Reporting Rate**.

❑ In the **Data format** field, you can define either the **16 bit integer** or the **32 bit floating point** format.

❑ In the **Data Type AC DAUs** box, you can choose between the transmission of the **All Phasors** or the **Positive sequence only**.

❑ Activate the PMU functions for every slot that is equipped with a DAU by checking the appropriate checkbox under **Slot configuration**.

12.14.2 PMU Interface

❑ Then select the dialog **Phasor Measurement Unit** → **PMU Interface** to set the parameters for the interface characteristics.
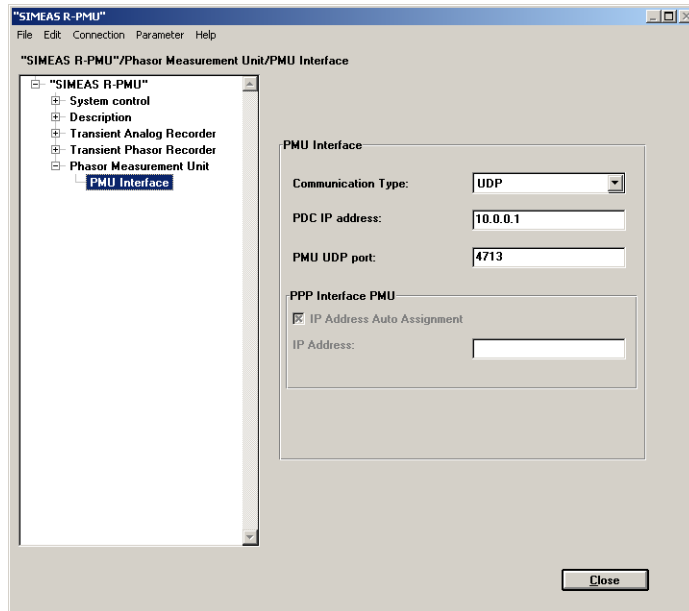
Figure 12-38 Phasor Measurement Unit, PMU Interface

❑ Select the **Communication Type** to be used for communication between your SIMEAS R-PMU and the PDC.

❑ Enter the IP address of the PDC under **PDC IP address**.

❑ Enter the port number to be used by the SIMEAS R-PMU under **PMU UDP port** or **PMU TCP port**. The default setting is 4712/TCP or 4713/UDP. Please note that the PPP protocol is used for null modem and modem communication and that a PDC IP address and a port number have to be configured in this case as well.

Note

For further information on the communication between the SIMEAS R-PMU and a PDC, please refer to the Application Description "Communication SIMEAS R/SIMEAS R-PMU", order no. E50417-X1074-C402 under www.simeas.com.

❑ When you select modem or null modem communication, under **PPP Interface PMU** the automatic IP address assignment from PDC to SIMEAS R-PMU can be switched off. In this case, deactivate **IP Address Auto Assignment** and enter the IP address to be used for the PMU interface in the **IP Address** field.

System Monitoring

13

13.1 System Monitoring

The SIMEAS R-PMU automatically monitors the operation of its own firmware and the functions of important hardware components. This self-monitoring function records all system events and is always active in the background. LEDs at the control panel, signal relays and records of the log recorder give a permanent overview of the device status.

13.2   Operator and Error Messages

13.2.1   General

The SIMEAS R-PMU records operator and error messages in different ways:

❑ Recorded in the log recorder: The log entries can be read out and evaluated using OSCOP P.

❑ Signaling via signal contacts (CPU relay contacts)

❑ Display via LEDs at the control panel

❑ Device state (see chapter 12.1)

Light-emitting diodes (LEDs)

There are 21 LEDs at the control panel:

❑ LED 1 to 8 (red): Fault displays

❑ LED 9 to 16 (green): Status information

❑ LED 17 to 21 (yellow): Displaying general device messages.

> **Note**
>
> LEDs 1 to 16 can be parameterized freely. Up to five messages can be assigned to each LED. If a message is provided, the LED that has been parameterized for this message will light up (OR link).
>
> LEDs 17 to 21 cannot be parameterized, they are permanently allocated.

Table 13-1 shows the allocation of LEDs 1 to 8 at delivery and describes the meaning of the individual error messages.

Table 13-1   Error messages via LEDs

LED no.	Message	Definition
1	DAU error	DAU booting error or DAU failure (self-monitoring)
2	CPU error	Error during reading or writing of the flash disk, internal recorder fault, malfunction of the communication processor
3	Printer error	Malfunction of the local printer *Possible cause:* paper tray empty, paper jam, printer not ready or printer connection malfunction
4	Data error	DAU data consistency error or time-out during DAU transmission
5	Synchronization error	Synchronization signal failed or faulty
6	PC not available	Evaluation PC or DAKON not available in call-back mode
7	Temperature error	Operating temperature outside permissible temperature range of -5 °C to +55 °C exceeded or not reached
8	In reserve	–

Table 13-2 shows the allocation of LEDs 9 to 21 at delivery and describes the meaning of the individual operator messages.

Table 13-2   Operator messages via LEDs

LED no.	Message	Definition
9	Device ready for operation	Device is ready for operation, no malfunctions
10	Supply voltage OK	Supply voltage is present
11	Battery buffer OK	Battery buffer operating without malfunctions (optional)
12	Recording active	Is lit for the duration of a triggered fault recording (TAR or TPR) - not with trigger cause "external start"
13	Device synchronized	*LED flashes:* a valid synchronization signal has been detected, however, the device is not synchronized yet; *LED lights up:* device is synchronized
14	Communication active	A communication has been set up by OSCOP P
15	Ring buffer active	Records are deleted because ≥90 % of the reserved memory space has been reached
16	PMU active	*LED flashes:* PMU recording is active, however, no PMU data is transferred to the PDC; *LED lights up:* PMU recording is active and PMU data is transferred to the PDC
17	Group alarm	Device has malfunctioned
18	Normal mode	Device is in normal mode, all triggers are active
19	Lock mode	Device is in lock mode, all triggers are deactivated
20	Test mode	Device is in test mode, all triggers are active; "Test" is entered as trigger cause
21	Manual triggers	Manual triggering of a record; "Manual" is entered as trigger cause

Signal outputs

Four signal outputs are provided for sending messages to an alarm or telecontrol system.

The first signal output (life contact) is firmly connected to the process monitoring circuit (watchdog) and signals serious faults that prevent the SIMEAS R-PMU from functioning properly.

The remaining three outputs can be assigned to any error or status messages. Except for the first one (watchdog alarm), the signal outputs have been designed as NO contacts. That means that they are open when the device is OFF.

Messages can be combined to form a group alarm by parameterization. The messages mentioned in Table 13-1 can be allocated to the relays.

One exception is the live contact that is permanently connected to relay 1 and cannot be changed.

Live contact

Relay 1 (live contact; fixed assignment) provides information about the device status.

Table 13-3   Relay 1 (live contact)

Relay no.	Message	Remark
1	System OK	Contact open
	System malfunction/system OFF	Contact closed

Table 13-4   Preset error and operator messages via relay 2 to 4

Relay no.	Message	Remark
2	Device ready for operation	Contact closed
3	Recording active	Contact closed
4	Group alarm	Contact closed

CAUTION

Caution about missing spark suppressor.

Nonobservance of the safety instructions means that moderately severe or slight injuries can occur.

- The signal outputs are **not** equipped with a spark suppressor. Appropriate external protection measures must therefore be ensured if inductive loads are connected.

Log recorder

All system messages are written in a log file. The log file is designed as a ring buffer. Once the ring buffer mode has been reached (a maximum of 10,000 messages can be logged), the oldest messages will be overwritten.

Contents of a system message:

❑ Consecutive number

❑ Time/date stamp

❑ Device name

❑ Error text

❑ Additional text

❑ Error class

❑ Error level

Note

See the Appendix for a list of all log messages.

Note

We recommend backing up the log file before restarting the device. This measure simplifies a future fault diagnosis.

Group alarm

A group alarm will be tripped, when one or several messages (alarm reasons) arrive. These messages can be parameterized by the user, see chapter 12.10. In addition, the following reasons trigger a group alarm:

❑ Device self-monitoring detects a severe fault during start-up or during operation.

❑ The device changes to blocking mode due to a high amount of data. In blocking mode all triggers are deactivated.

❑ One DAU is provided with a wrong calibrating frequency.

The group alarm relay contact closes, when an alarm occurs and opens after the alarm is reset. The group alarm LED blinks, when a group alarm is triggered and will be extinguished once the group alarm is reset and all assigned messages are in normal mode. If the group alarm is reset and not all assigned messages are in normal mode, the group alarm LED lights permanently.

The group alarm may be reset: Via control panel (button **Group alarm**), via control input 4 and via remote control (OSCOP P).

Table 13-5   Behaviour of the group alarm

Condition	Relay Group alarm	LED Group alarm
Group alarm	Closed	Blinking
Group alarm reset, alarm cause(s) still provided	Open	On
Group alarm reset, alarm cause(s) eliminated	Open	Off

13.2.2   Behaviour with Critical Faults

The SIMEAS R-PMU not only records events but independently detects faults that prevent the SIMEAS R-PMU from functioning properly.

The following monitoring features trigger a restart:

Monitoring

The SIMEAS R-PMU monitors all running processes in real time. The device records if a process is not carried out properly. A watchdog timer signals a system restart if the watchdog is not triggered regularly.

Status message

The CPU receives a status message from the individual data acquisition units (DAUs) every 60 seconds. This verifies the proper functioning of every DAU. A DAU failure triggers a device restart. When a DAU status message fails, the measuring system is restarted. If this happens three times within 10 minutes, the measuring system is switched off and the device remains in group alarm state.

Watchdog timer

The CPU module is monitored by a process monitoring circuit (watchdog timer). The watchdog timer checks whether the internal device messages arrive in time. With each correct arrival the watchdog timer is restarted. If the timer is not restarted, the watchdog triggers a device restart after 8 seconds have elapsed.

Note

If the device still malfunctions after restarting, the restart will be interrupted after two further unsuccessful attempts. In this case, contact our hotline.

Installation and Commissioning

14

Contents

This section is intended for experienced commissioning technicians. The personnel must be thoroughly familiar with the installation and commissioning of fault recorders of the SIMEAS R-PMU type, the management of power systems and with the relevant safety rules and standards.

14.1 Getting Started

This chapter describes the first steps that you should take after receiving your SIMEAS R-PMU. After unpacking, please check whether the design and rated data of the device match your requirements.

For an electrical check, you can now navigate in the user interface without any measured values for the first time. Furthermore, you can connect the device to a notebook or a personal computer and operate it using OSCOP P.

In the last section you will find hints on what to observe for the long-term transport and storage of the system.

14.1.1 Unpacking and Repacking the Device

The devices are packed appropriately at the factory for transport. Unpacking and repacking must be performed with the usual care, without force and only with the aid of suitable tools. Visually check the device immediately upon arrival for correct mechanical condition.

Please observe further notes that may have been attached.

The shipping packaging can be reused in the same manner for further shipment. The storage packaging of individual devices is not sufficient for shipping.

If other packaging is used, it must be ensured that the transport requirements are met.

The device must be in the final operating area for a minimum of two hours before the power source is first applied. This time allows the device to attain temperature equilibrium, and dampness and condensation are avoided.

14.1.2 Device Inspections upon Receipt

14.1.2.1 Check of the Rated Data

First of all, check the complete ordering code (MLFB) and the delivery note to ensure that the version delivered complies with the required rated data and functions, and that the necessary and desired accessories are complete.

14.1.2.2 Electrical Check

Please observe the operating conditions according to VDE0100 and VDE0105 part 1.

The device must be in the final operating area for a minimum of two hours before the power source is first applied. This time allows the device to attain temperature equilibrium, and dampness and condensation are avoided.

WARNING

Warning about dangerous voltages.

Nonobservance of the safety instructions means that death, heavy injuries or considerable material damages can occur.

- Electric checks may be performed only by qualified personnel who are familiar with and adhering to safety requirements and precautionary measures, may perform these steps.

For a first electrical check of the device, it is sufficient to ensure reliable earthing and to connect the auxiliary supply voltage:

❑ Connect the earthing electrode of the device to the protective earthing. The earthing screws are positioned at the rear panel in the case of cubicle mounting and panel flush mounting. In the case of surface mounting, an earthing terminal is used.

❑ Wire the supply voltage to the device inputs observing the correct height and polarity of the supply voltage (see chapter 16.1).

❑ Switch the device on using the mains switch.

❑ All LEDs at the front of the device are active during booting. After approx. ten seconds, all LEDs are extinguished. If a battery package has been installed, the battery test is started with the **Accumulator capacity OK** LED blinking, which is complete after 30 seconds. The device is ready for operation, as soon as the **Device ready for operation**, **Operating voltage OK** and the **Normal mode** LEDs light up. If the **Accumulator capacity OK** LED is blinking, the battery package is being charged.

14.1.3 Operation with OSCOP P

You can operate the digital fault recorder SIMEAS R-PMU using the system software OSCOP P. For detailed information, please refer to the Chapter 12.

14.1.4 Transport

Transport the SIMEAS R-PMU only in its original packaging or in another appropriate packaging. The packaging materials must ensure protection against shock and impact, as well as against electrostatic charge (ESDS measures).

Make sure that no objects or fluids can enter the device during transportation. This especially goes for the interface connectors.

Condensation may occur when the device is brought from a cold environment into the operating room. Wait at least for two hours until the device has adjusted its temperature and is absolutely dry before putting it into operation.

CAUTION

Caution with defective devices with transport damage.
Nonobservance of the safety instructions means that moderately severe or slight injuries can occur.

- Devices that have been damaged during transport must not, under any circumstances, be connected and put into service.

Note

Please bear in mind that such measures apply both for complete devices and individual modules.

14.1.5 Storage

If the device is not to be used immediately, it can be stored.

Please observe the following:

SIMEAS R-PMU devices must be stored in dry and clean rooms. The device and its replacement modules must be stored within the temperature range of -25 °C to +70 °C (see Chapter 16).

To avoid premature aging of the electrolyte capacitors used in the power supply, a limited temperature range of +10 °C to +35 °C is recommended for storage.

The relative humidity must not lead to condensation or ice formation.

With battery-buffered devices, it must be ensured that the battery is not damaged by total discharge due to long storage times.

After extended storage, the power supply of the device should be energized, approximately every two years, for one or two days to regenerate the electrolytic capacitors in the power supply unit. This should also be done before the device is put into service.

The device must be in the final operating room for a minimum of two hours before the power source is first applied after storage. This allows the device to attain temperature equilibrium, and dampness and condensation are avoided.

CAUTION

Caution with defective devices with transport damage.
Nonobservance of the safety instructions means that moderately severe or slight injuries can occur.

- Devices that have been damaged during transport must not, under any circumstances, be connected and put into service.

Note

Please bear in mind that such measures apply both for complete devices and individual modules.

14.2 Installation and Connection

	CAUTION

Caution about wrong transport, storage, installation and mounting of the device.

Nonobservance of the safety instructions means that moderately severe or slight injuries can occur.

- The trouble-free and safe use of this device depends on proper transport, storage, installation and mounting of the device taking into account the warnings and instructions in this manual.

- In particular, the general mounting and safety regulations (e. g. IEC, DIN, VDE, EN or other national and international standards) for work with power current equipment must be observed.

Notes

- The prescribed sequence of operations must be considered and observed when commissioning the SIMEAS R-PMU.

- Adjustment of the individual data acquisition units at the site is **not** necessary for the SIMEAS R-PMU because the device has already been adjusted in the factory.

- For initial delivery, the SIMEAS R-PMU is equipped with the ordered components. Depending on how communication with a PC or DAKON is planned, the corresponding interface must be parameterized and put into service.

- If components are installed subsequently in the SIMEAS R-PMU, the respective installation instructions can be found in Chapter 14.3. After the components have been connected, the parameters are set for the system.

- To ensure proper functioning, all parameterizations steps described in Chapter 12 must be carried out.

- The basic parameters are set by default before the SIMEAS R-PMU is delivered. The following chapters describe the procedure for commissioning the SIMEAS R-PMU.

14.2.1   Installation

There are two housing sizes:

❑ ZE 8/16 (10-inch housing)

❑ ZE 32/64 (19-inch housing)

The device can be operated at the front side. All connections (except for the COM S service interface) are located at the rear panel.

The SIMEAS R-PMU can be delivered for panel flush mounting, panel surface mounting (surface-mounted housing) or for 19-inch mounting.

With ZE 32/64 design, every SIMEAS R-PMU housing is equipped with a special frame for fastening the housing in a 19-inch rack using four screws.

Panel flush mounting

With panel flush mounting, the corresponding panel cut-out must be made in the corresponding panel first. The installation into the cut-out can be done without any further installation material by fastening the SIMEAS R-PMU using the appropriate fastening materials (4 screws) to the panel. The external bores of the housing's mounting stop are used for this purpose (see dimensional drawing in Chapter 8.2).

Panel surface mounting

With panel surface mounting (surface-mounted housing), the surface-mounted housing must only be attached to the intended mounting position using appropriate fastening material (depending on the surface). Four mounting plates at the corners of the housing are used for fastening. For detailed fastening dimensions, please refer to the attached documents for the surface-mounted housing.

Installation in a cabinet

Devices delivered in a cabinet are complete with internal wiring and the connections usually mounted on terminal strips.

The D-SUB connectors, the RJ45 Ethernet connector, the connection modules (cubic plug) and the screw-threads for the installation of metal levers for cable clamping and shield contact are provided at the rear of the 7XP20 housing.

Extensions

If communication components are extended, please observe the notes in Chapter 14.3.

The dimensions of the devices and the specifications regarding mounting bores and the panel cut-out can be found in the dimensional drawings in Chapter 15.2. For weights and environmental conditions, please refer to the Technical Data.

14.2.2 Connecting Cables

The cables with analog signals (current, voltage), with the binary signals (signal inputs), the control signals and the power supply are always connected from the back to the rear panel.

Cable shield

For all cables connected to SIMEAS R-PMU, you have to use copper shielded cables.

The cables are fastened to the shield contact using clamps. To ensure interference immunity, the cable insulation must be removed in the clamp area. This provides a reliable connection between the shield and the shield contact. The cables leading to a printer, modem or PC are also connected to the rear panel. The connection of external devices within a cabinet that meets EMC requirements does not necessarily require earthing.

Note

The protection against interference emission, however, is significantly increased when the cable shield is connected to the shield contact.

14.2.3 Earthing, Shielding and Connecting Peripheral Devices

The SIMEAS R-PMU is an electronic device with a very high interference immunity.

In order to ensure EMC properties and a safe operation of the SIMEAS R-PMU, the following measures must be observed:

❑ Install cable shields and clamps as shown in Figure 14-1.

❑ Place the cable shield on both sides (at the beginning **and** end of the cable).

Earthing a cabinet:

❑ The earth conductor of a SIMEAS R-PMU cabinet must be mounted at the appropriate earthing point at the cabinet's base and led to the central earthing point using the shortest path.

❑ This conductor must have a minimum wire gauge of 16 mm^2.

Earthing central units:

❑ The earth conductor must be fastened to the earthing points at the rear panel and led to the central earthing point or to the metal frame of the cabinet using the shortest path.
This conductor must have a minimum wire gauge of 16 mm^2.
The 19-inch device features **two** earthing points at the rear panel (on the left and on the right). A **separate** earth conductor must be connected to each of the earthing points.

❑ Only peripheral devices (e. g., modems) with a CE mark can be connected to the SIMEAS R-PMU.

Note

These measures apply to all connecting cables to the SIMEAS R-PMU, even those that are only connected during commissioning.

Shield contact

Cable shield

Cable clamp
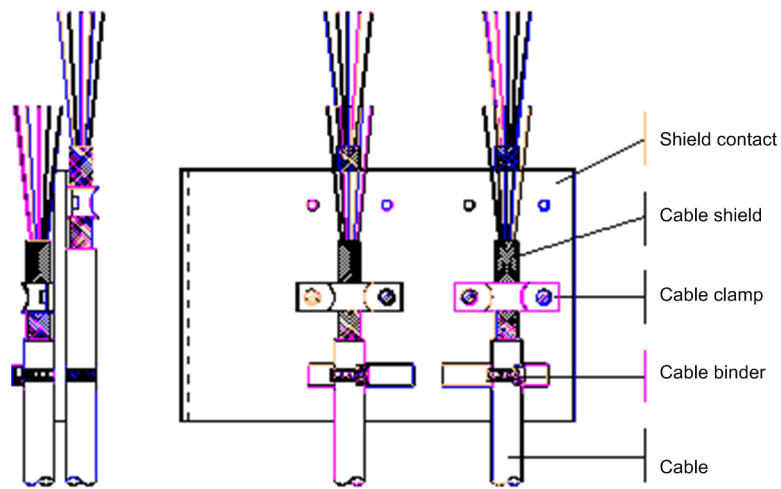
Cable binder

Cable

Cable clamping at the shield contact

Accessories:
4 pcs. cable clamps B70 (8-9.2 mm)
4 pcs. cable clamps B80 (9.2-10.1 mm)
4 pcs. cable clamps B100 (11-12.8 mm)
10 pcs. pan head screw M3x6
2 pcs. cable binders T50R (5 mm)

Figure 14-1   Cable clamp and shield contact

14.2.4 Connecting Cables (Power Supply, Signals, Measurement Circuits)

The following table shows the connected loads of the connection modules and examples for the corresponding cable types. Every connection point of the connection modules is available both as a screw terminal and a plug-in contact (crimp contact).

Table 14-1   Crimp contacts

1	0.5 mm^2 to 1 mm^2	for plug-in module III, Comp. Weidmüller, no. 162553
	1.5 mm^2 to 2.5 mm^2	for plug-in module III, Comp. Weidmüller, no. 162551
2	1.5 mm^2 to 2.5 mm^2	for plug-in module I, Comp. Grote u. Hartmann, no. 26457.331.410
Stripping length:	5 mm	
Tools:	Comp. Harting FC3, no. 09990000077	

Note

The connection and assignment diagrams of the individual modules are shown in detail in Chapter 15.

Detailed technical information, for example, regarding the switching capacity of the signal outputs can be found in Chapter 16.

If the connection wires are designed as finely-stranded wires, the wire ends must be flattened with a wire end ferrule. Screw connections are to be preferred; plug-in connections require special tools and are allowed for line wiring only if reliable strain relief is provided.

Screw terminals can be used without wire end ferrule. Terminal pins must not be used. Make sure the stripping length of the conductors is sufficient: approx. 15 mm, however, not less than 10 mm.

14.2.4.1 Connecting the Power Supply to the Power Supply Unit

The power supply and the protective conductor are connected to the connection module (plug-in module III) of the power supply unit. A shielded conductor must be used.

Wire gauges to be used:

❑ 1.5 mm^2 (AWG 15) stranded (with wire end ferrule), or

❑ 2.5 mm^2 (AWG 13) single-wire

The maximum current consumption in the nominal range and with maximum system configuration is 2 A. The value of the internal miniature fuse in the power supply unit is 3.15 A inert. To maintain the selectivity in the fuse chain, a 6 A circuit-breaker must be installed in the network lead.

14.2.4.2 Connecting Signals to the CPU

Connection modules (plug-in module III) are used for the connection at the rear of the CPU.

Maximum wire gauges to be used:

❑ 1.5 mm^2 (AWG 15) stranded

❑ 2.5 mm^2 (AWG 13) single-wire

❑ Cable, e. g., signal cable LIYEB-CY 4 x 2 x 0.75 mm^2

❑ Crimp contacts: see 1 in Table 14-1.

14.2.4.3 Connecting Data Acquisition Modules VCDAU, VDAU, CDAU

The measurement circuits are connected using connection modules (plug-in module I for currents, plug-in module III for voltages and binary channels) at the rear of the DAU.

Maximum wire gauges to be used for analog current channels:

❑ 2.5 mm^2 (AWG 13) stranded

❑ 4 mm^2 (AWG 11) single-wire

❑ Cable, e. g., LIYEB-CY 4 x 2 x 2.5 mm^2

❑ Crimp contacts: see 2 in Table 14-1.

Maximum wire gauges to be used for analog voltage channels:

❑ 1.5 mm^2 (AWG 15) stranded

❑ 2.5 mm^2 (AWG 13) single-wire

❑ Cable, e. g., LIYEB-CY 4 x 2 x 0.75 mm^2

❑ Crimp contacts: see 1 in Table 14-1.

Maximum wire gauges to be used for binary channels:

❑ 1.5 mm^2 (AWG 15) stranded

❑ 2.5 mm^2 (AWG 13) single-wire

❑ Cable, e. g., LIYEB-CY 16 x 2 x 0.25 mm^2

❑ Crimp contacts: see 1 in Table 14-1.

14.2.4.4 Connecting the Data Acquisition Module DDAU

The measurement circuits are connected using connection modules (plug-in module III) at the rear of the DAU.

Maximum wire gauges to be used for analog channels:

- ❑ 1.5 mm^2 (AWG 15) stranded
- ❑ 2.5 mm^2 (AWG 13) single-wire
- ❑ Cable, e. g., LIYEB-CY 4 x 2 x 0.75 mm^2
- ❑ Crimp contacts: see 2 in Table 14-1.

Maximum wire gauges to be used for binary channels:

- ❑ 1.5 mm^2 (AWG 15) stranded
- ❑ 2.5 mm^2 (AWG 13) single-wire
- ❑ Cable, e. g., LIYEB-CY 16 x 2 x 0.25 mm^2
- ❑ Crimp contacts: see 2 in Table 14-1.

14.2.4.5 Connecting the Data Acquisition Module BDAU

The binary inputs are connected using connection modules (plug-in module III) at the rear of the BDAU.

Maximum wire gauges to be used for binary channels:

- ❑ 1.5 mm^2 (AWG 15) stranded
- ❑ 2.5 mm^2 (AWG 13) single-wire
- ❑ Cable, e. g., LIYEB-CY 16 x 2 x 0.25 mm^2
- ❑ Crimp contacts: see 2 in Table 14-1.

14.2.5 Connecting the Cables (Data Transmission)

The standard interfaces for data transmission of the SIMEAS R-PMU are listed below.

14.2.5.1 Connecting the PC, PDC or Notebook via LAN

A RJ45 LAN connector is used for connection. The connection supports 10BaseT/100BaseT and is located at the rear panel.

14.2.5.2 Connecting the PC or Notebook to COM S

A 9-pin D-SUB connection COM S (service interface) is used for connection at the front of the device.

14.2.5.3 Connecting the PC, PDC or External Modem to COM 1

A 9-pin D-SUB connection COM 1 (data interface) is used for connection at the rear panel.

14.2.5.4 Connecting the Printer to the PRINTER Port

A 25-pin D-SUB connection PRINTER is used for connection at the rear panel.

14.2.6 Cable Assemblies for Connection

Cable assemblies can be ordered for connecting the measuring signals for binary and analog signals.

Several data cables are available for connecting external devices. The data cables include adapters that can be used for connecting different types of personal computers.

For more information on cable assemblies for connection, please refer to the order data in the Internet under www.simeas.com.

14.3 Extending the Existing Hardware

General

The following ways of adjusting or extending the hardware of existing SIMEAS R-PMU systems are distinguished:

❑ Extending a SIMEAS R-PMU by additional data acquisition modules

❑ Replacement of data acquisition modules of different types

❑ Extending a SIMEAS R-PMU by external communication components.

Note

The procedure for different extension methods is described below.

WARNING

Warning about dangerous voltages in electrical equipment after turning off the device.

Nonobservance of the safety instructions means that death, heavy injuries or considerable material damages can occur.

• Make sure that the device is de-energized before opening the housing! Please bear in mind that any process variables provided must also be separated from the device.

14.3.1 Extending a SIMEAS R-PMU by Additional Data Acquisition Modules

This extension method is intended for a SIMEAS R-PMU with ZE 32/64. An extension is possible only when not all of the four slots are equipped with data acquisition modules. A fully equipped device cannot be extended by additional data acquisition modules.

Proceed as follows to extend a SIMEAS R-PMU:

1. Switch the device off using switch S1.

2. De-energize the device.

3. Unscrew the cover.

4. Unscrew the knurled nut from switch S1.

5. Unscrew the front plate. Only loosen the lower screws, totally remove the top screws.

6. Remove the connection line (ribbon cable) between the front plate and the CPU module at the CPU module.

7. Carefully remove the bus board from the plug-in modules. Make sure you do not bend the bus board.

8. Remove the dummy plates from the slot where the new acquisition module is to be plugged in at the rear panel.

9. Once you have removed the dummy plates, screw on the appropriate adapter for the new data acquisition module at the rear panel.

10. Now insert the new module from the front side into the free slot. Make sure the module is properly engaged.

⚠️ **WARNING**

Warning about deformed or damaged EMC springs.

Nonobservance of the safety instructions means that death, heavy injuries or considerable material damages can occur.

-   Before inserting a new module, check the EMC springs on the rear side. EMC springs must not be deformed or damaged.

-   Deformed or damaged EMC springs have to be replaced.

-   Take care that the EMC springs do not get stuck at the vertical covers between the slots while inserting the module to avoid deformations or damage.

---

11. Carefully reattach the bus board to the individual modules. Make sure you do not bend the bus board.

12. Plug the connecting line (ribbon cable) between the front plate and the CPU module into the CPU module.

13. Screw the front plate back to the device. Be careful not to pinch the ribbon cable when mounting the front plate.

14. Screw the knurled nut to switch S1.

15. Screw the cover back into place.

16. Connect the measuring signals to the new adapters.

17. Apply the supply voltage to the device.

18. Switch the device on using switch S1.

19. Connect a notebook to the service interface COM S at the front of the device for parameterization.

20. Enable the new module using the OSCOP P system program and set the parameters for the individual channels. For detailed information regarding the parameterization, please refer to Chapter 12.
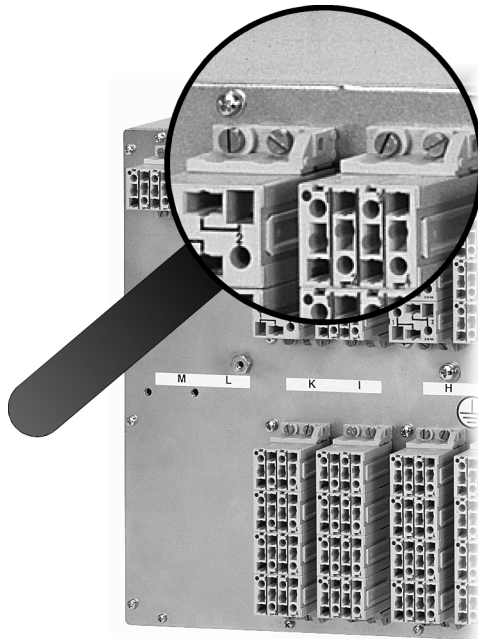
Figure 14-2 View of the adapters

Figure 14-3 Open central unit (ZE 8/16)
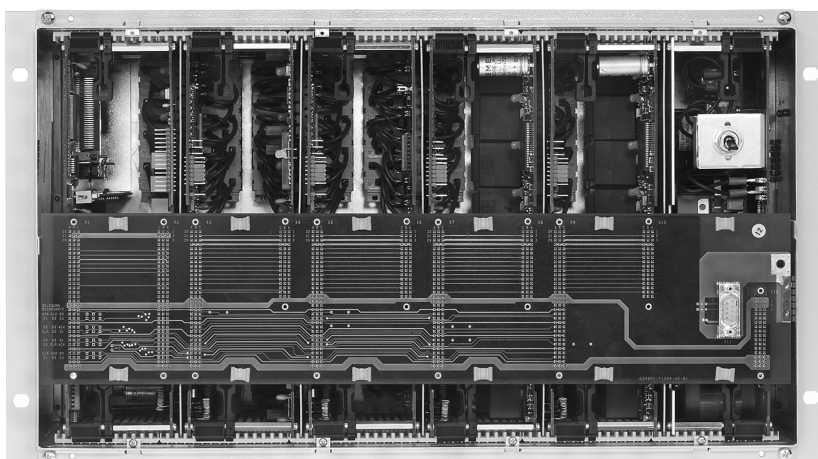
Figure 14-4 Open central unit (ZE 32/64)

14.3.2   Replacing Data Acquisition Modules of Different Types

If a parameterized data acquisition module is to be replaced by a module of a different type, care must be taken that this module is deleted in the system parameters before being physically replaced. If an acquisition module is replaced by a module of the same type, the individual parameterization steps can be omitted.

Proceed as follows to replace the module:

1. Switch the SIMEAS R-PMU on using switch S1.

2. Connect a notebook to the service interface COM S at the front of the device.

3. Use the OSCOP P system program to remove the acquisition module to be replaced from the system parameters. That means that you remove all channel assignments that might be provided for this module and parameterize the slot as **Deactivated**. For detailed information regarding the parameterization, please refer to Chapter 12.

4. Disconnect the notebook from the service interface COM S.

5. Switch the SIMEAS R-PMU off using switch S1.

6. De-energize the device.

7. Unscrew the cover.

8. Unscrew the knurled nut from switch S1.

9. Unscrew the front plate. Only loosen the lower screws and totally remove the top screws.

10. Remove the connecting line (ribbon cable) between the front plate and the CPU module at the CPU module.

11. Carefully remove the bus board from the plug-in modules. Make sure you do not bend the bus board.

12. Pull the acquisition module to be removed out of the device from the front.

13. Remove the signal lines and the dummy plates from the slot where the new acquisition module is to be plugged in at the rear panel.

14. Once you have removed the old adapters, screw on the appropriate adapter for the new module at the rear panel.

15. Now insert the new module from the front side into the free slot. Make sure the module is properly engaged.

WARNING

Warning about deformed or damaged EMC springs.

Nonobservance of the safety instructions means that death, heavy injuries or considerable material damages can occur.

*   Before inserting a new module, check the EMC springs on the rear side. EMC springs must not be deformed or damaged.

*   Deformed or damaged EMC springs have to be replaced.

*   Take care that the EMC springs do not get stuck at the vertical covers between the slots while inserting the module to avoid deformations or damage.

---

16. Carefully reattach the bus board to the individual modules. Make sure you do not bend the bus board.

17. Plug the connecting line (ribbon cable) between the front plate and the CPU module into the CPU module.

18. Screw the front plate back to the device. Be careful not to pinch the ribbon cable when mounting the front plate.

19. Screw the knurled nut to switch S1.

20. Screw the cover back into place.

21. Connect the measuring signals to the new adapters.

22. Apply the supply voltage to the device.

23. Switch the device on using switch S1.

24. Connect a notebook to the service interface COM S at the front of the device.

25. Enable the new module using the OSCOP P system program and set the parameters for the individual channels. For detailed information regarding the parameterization, please refer to Chapter 12.

14.3.3 Extending a SIMEAS R-PMU by Communication Components

Communication components are analog or ISDN modems or X.25-PAD modules. They are connected to the COM 1 interface at the rear panel of the SIMEAS R-PMU.

1. Switch the SIMEAS R-PMU off using switch S1.

2. Connect the data end device to the COM 1 interface at the rear panel of the SIMEAS R-PMU using the appropriate cable.

3. Build up a connection between the data end device and the telephone socket.

4. Switch the data end device on.

5. Switch the SIMEAS R-PMU on using switch S1.

6. Connect a notebook to the service interface COM S at the front side of the SIMEAS R-PMU.

7. Enable the new modem using the OSCOP P system program and set the connection parameters. For detailed information regarding the parameterization, please refer to Chapter 12.
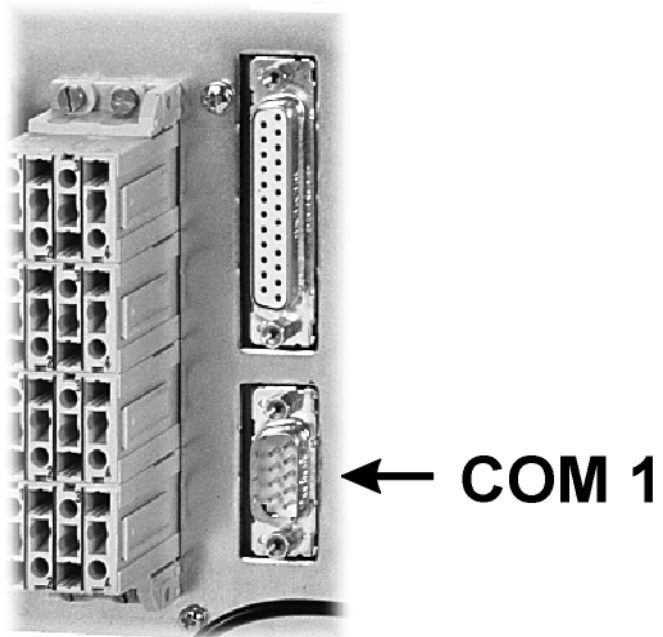
Figure 14-5 COM 1 interface

14.3.4 Extending a SIMEAS R-PMU by External Modules

The following external devices are provided for extending the functions of the SIMEAS R-PMU.

14.3.4.1 Clock

To connect the clock, proceed as follows:

1. Switch the SIMEAS R-PMU off using switch S1.

2. Connect the cable of the clock to the terminals 7B1(+) and 7B2(-) at the rear panel of the SIMEAS R-PMU.

3. Connect the SIMEAS R-PMU to the clock using the delivered connecting cable.

4. Switch the clock on.

5. Switch the SIMEAS R-PMU on using switch S1.

6. Connect the notebook to the service interface COM S at the front side of the SIMEAS R-PMU.

7. Switch the SIMEAS R-PMU to external time synchronization using the OSCOP P system program. For detailed information regarding the parameterization, please refer to Chapter 12.
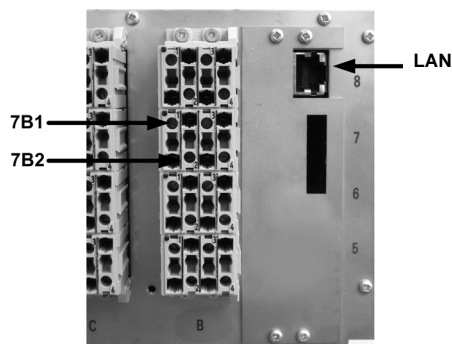
Figure 14-6 View of the synchronization connection

Note

The clock is parameterized with an operating program that is also included in the supplied materials. For further information on the parameterization, please refer to the Internet under www.simeas.com in the Application Description "Time synchronization SIMEAS R/SIMEAS R-PMU", order no. E50417-X1074-C403.

14.3.4.2 Printer

To connect the printer, proceed as follows:

1. Switch the SIMEAS R-PMU off using switch S1.

2. Connect the printer connecting cable to the parallel interface PRINTER (LPT 1) at the rear panel of the SIMEAS R-PMU (25-pin socket).

3. Connect the cable to the printer.

4. Connect the supply voltage to the printer.

5. Switch the printer on.

6. Switch the SIMEAS R-PMU on using switch S1.

7. Connect the notebook to the service interface COM S at the front side of the SIMEAS R-PMU.

8. Enable the local print output using the OSCOP P system program. For detailed information regarding the parameterization, please refer to Chapter 12.
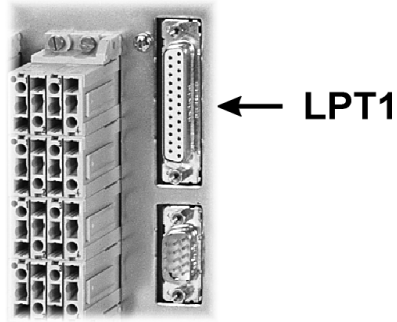
Figure 14-7 LPT 1 interface

14.4   Commissioning

WARNING

Warning about dangerous voltages in electrical equipment during operation of the device.

Nonobservance of the safety instructions means that death, heavy injuries or considerable material damages can occur.

- Only qualified personnel should work on and around this equipment. They must be thoroughly familiar with all warnings and safety notices in this instruction manual as well as with the applicable safety steps, safety regulations, and precautionary measures. Particular attention must be drawn to the following:

- Before making any connections, the device must be earthed.

- Dangerous voltages can arise in all switching components connected with the power supply and with the measuring and test voltages.

- Hazardous voltages can be present in the device even after the power supply voltage has been removed (capacitors can still be charged).

- The limit values given in Technical Data must not be exceeded, this must also be taken into account during inspection and commissioning.

14.4.1   Start-up of the SIMEAS R-PMU

Note

The SIMEAS R-PMU is delivered with standard parameterization! Information regarding the standard parameterization can be found in the Appendix.

Booting

If the SIMEAS R-PMU is switched on or booted after the parameters have been set, the 16 LEDs at the front side of the SIMEAS R-PMU indicate different operating conditions during booting.

When a parameterized device is switched on, all 16 LEDs of the front panel light up for approx. two minutes. During this time, the operating system and the firmware are loaded. Depending on the parameters set, all or most of these 16 LEDs are extinguished. The directory of the incorporated flash memory is read and the DAUs are prepared for measurement. This process lasts for approx. one and a half minute. Afterwards, the **Device ready for operation** LED lights up and the device is ready for measurement.

The following deviations are possible during booting:

Deleting memory areas (red LEDs are blinking)

After the SIMEAS R-PMU has been switched on, all 16 LEDs are lit for approx. 25 seconds (dependent on configuration). During this time, the operating system and the firmware are being loaded. Depending on the parameters set, all or most of these 16 LEDs are extinguished. The eight red LEDs start blinking. That means that a memory area (e. g., the mean value memory for current and voltage) is being deleted on the flash memory. This can last several minutes depending on the size.

> **Note**
>
> The complete data in the memory will be deleted.

Creation of memory areas (green LEDs are blinking)

After the deletion the eight green LEDs start blinking. That means that a memory area (e. g., the mean value memory for current and voltage) is created. This can last several minutes depending on the size. Then the directory of the incorporated flash memory is read and the DAU is prepared for measurement. This process lasts for approx. a further ten seconds.

Afterwards, the **Device ready for operation** LED lights up and the device is ready for measurement.

Battery-buffered power supply unit

While the SIMEAS R-PMU is booted, the battery is checked for proper functioning and capacity. During this time, the **Accumulator capacity OK** LED blinks.

If it is detected during the test that the battery's capacity is not sufficient to properly shut down the system, the SIMEAS R-PMU is not enabled for operation and charging is started.

The battery is checked for its charge level during charging. If it is detected that the battery's capacity is sufficient to properly shut down the system but is not fully charged yet, the SIMEAS R-PMU is enabled for operation and charging is continued. The **Accumulator capacity OK** LED continues blinking throughout the complete charging process.

Up-/Downgrade: SIMEAS R V30 to SIMEAS R-PMU

Once the firmware has been upgraded/downgraded, the parameter data is deleted (except for communication parameters). This condition is signaled by the blinking of the **Device ready for operation** and the LED **Group alarm** LEDs at the device during booting.

> **Note**
>
> In this case, the device must be reparameterized with OSCOP P. After a downgrade, the device can only be addressed using the COM S service interface.

Update: SIMEAS R-PMU

After a firmware update all parameter data remain unchanged.

14.4.2 Parameterization of the SIMEAS R-PMU

The OSCOP P system software is used to parameterize the SIMEAS R-PMU. A parameterization of the SIMEAS R-PMU without OSCOP P is not possible.

Note

For a description of the parameterization of the SIMEAS R-PMU, refer to Chapter 12.

14.4.3 Operation of the SIMEAS R-PMU

Once all connections have been wired to suit the existing modules and connection diagrams, the SIMEAS R-PMU is ready for operation.

When the SIMEAS R-PMU has been switched on using the mains switch S1, the device goes to its normal operating condition after a start-up time of approx. 90 seconds.

The normal operating condition is indicated when the **Device ready for operation**, **Operating voltage OK** and **Normal mode** are lit.

All parameterized functions are now ready for operation.

Operating modes

Normal mode

In normal mode all functions and triggers are active. In case of a limit value violation, pre-fault time, fault data and post-fault time will be recorded.

Blocking mode

In blocking mode no records will be generated for any trigger event. All triggers are inactive, message relays will not be activated. The device works as Phasor Measurement Unit and Mean Value Recorder only. This operating mode is selected to avoid unrequested recordings, e. g. if feeders connected to the SIMEAS R-PMU are subject to maintenance activities.

Test mode

In test mode – as for normal mode – all functions and triggers are active. All recorded events are marked with cause "Test". The message relay "Recording active" will not be closed. This operating mode can be selected while checking the SIMEAS R-PMU.

Design

15

Contents

This chapter shows you the design details for different versions of the SIMEAS R-PMU.

15.1 **Device Overview**

The digital fault recorder SIMEAS R-PMU is available in two housing versions:

ZE 8/16

This version (10-inch housing) is equipped with one data acquisition unit (DAU).

ZE 32/64

This version (19-inch housing) provides space for up to 4 data acquisition units.

Data acquisition units

Different data acquisition units can be used for a flexible assignment of current, voltage and DC variable inputs:

- ❑ VCDAU (4 voltage and 4 current channels, 16 binary channels)
- ❑ VDAU (8 voltage channels, 16 binary channels)
- ❑ CDAU (8 current channels, 16 binary channels)
- ❑ DDAU (8 DC channels, 16 binary channels)
- ❑ BDAU (32 binary channels)

15.2   Housing Versions

15.2.1 Panel Flush Mounting; ZE 8/16
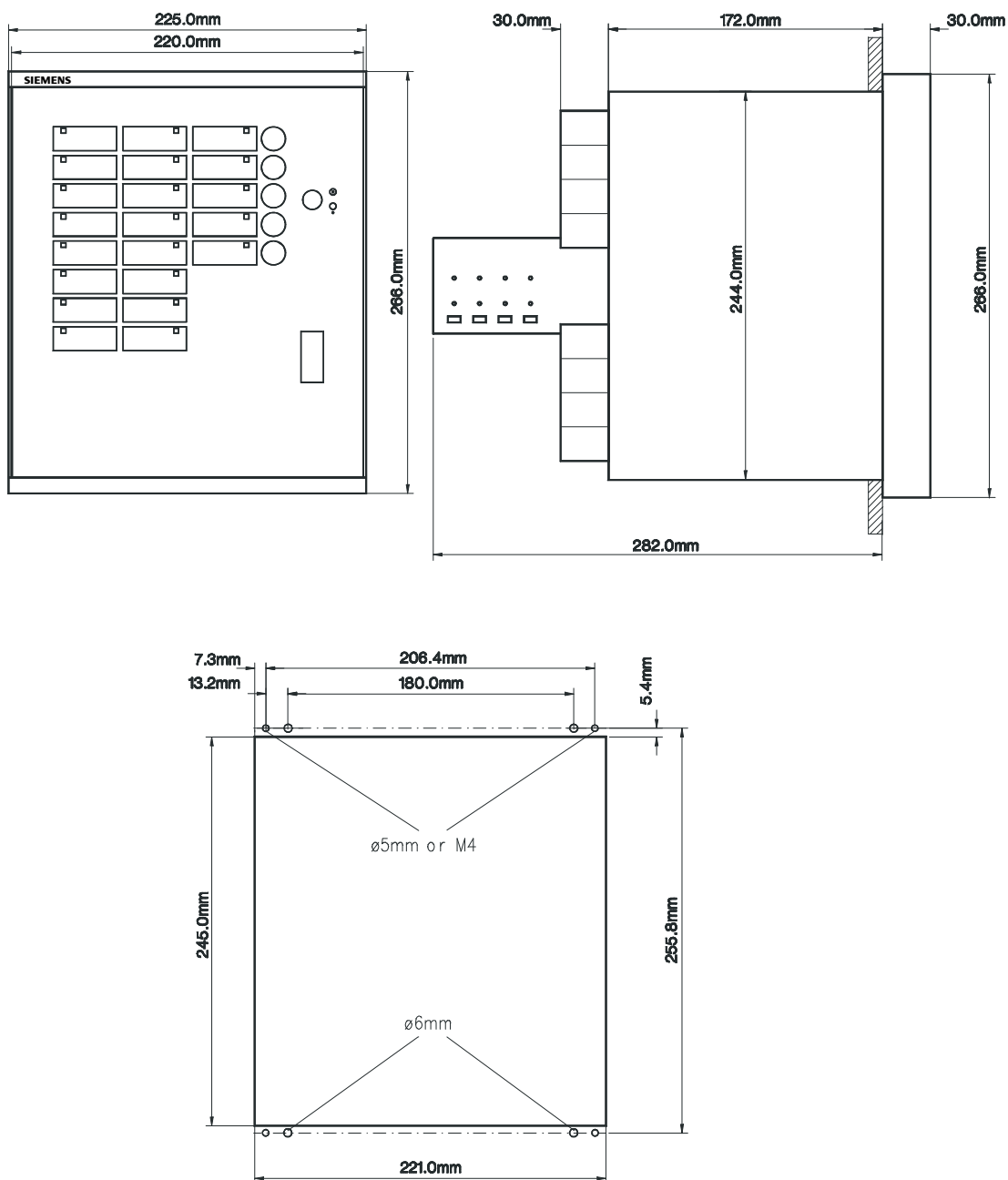
Figure 15-1 Dimensional drawing, panel flush mounting; ZE 8/16

15.2.2   19-Inch Frame; ZE 8/16
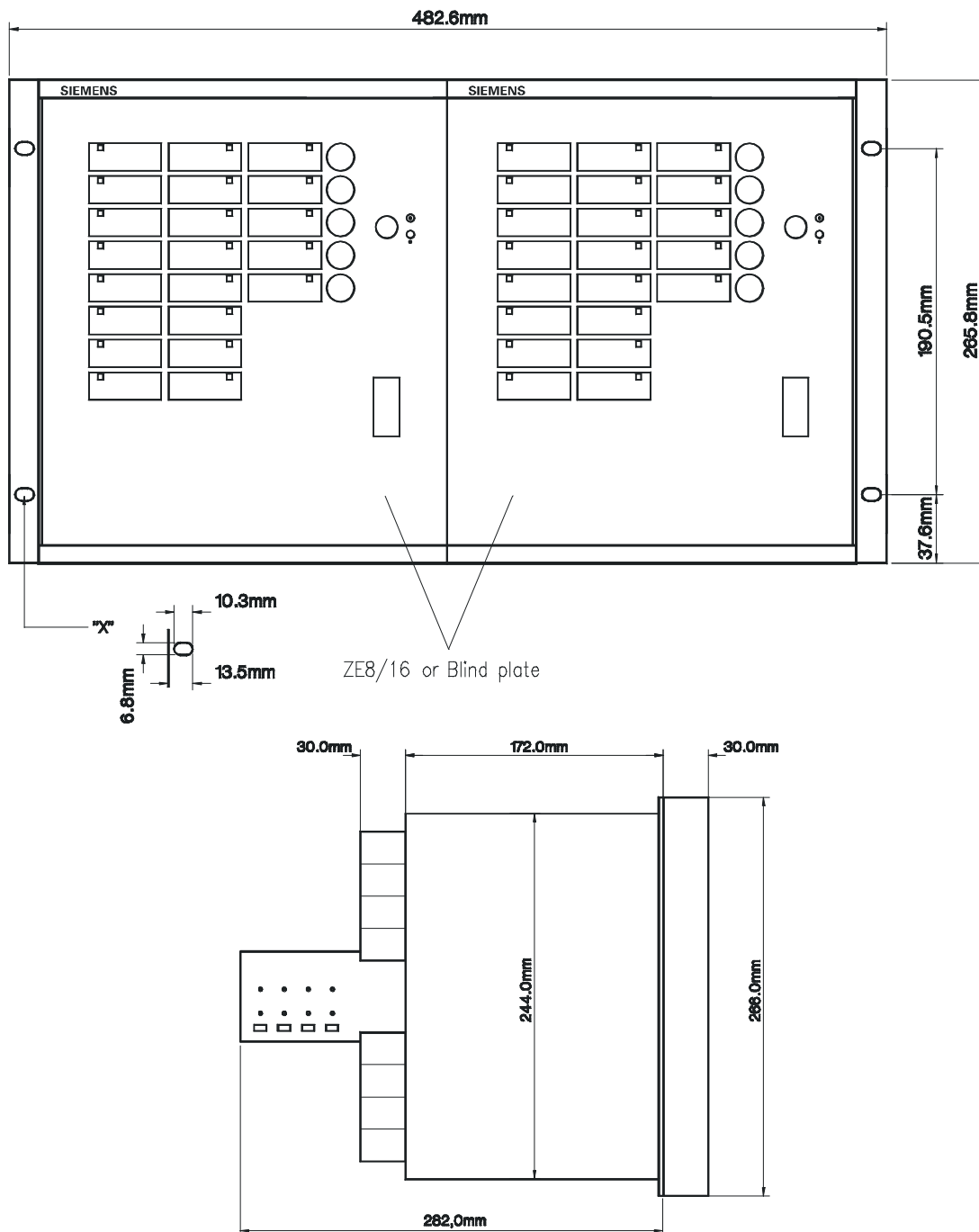
Figure 15-2 Dimensional drawing, 19-inch frame; ZE 8/16

15.2.3 Panel Flush Mounting (ZE 32/64)
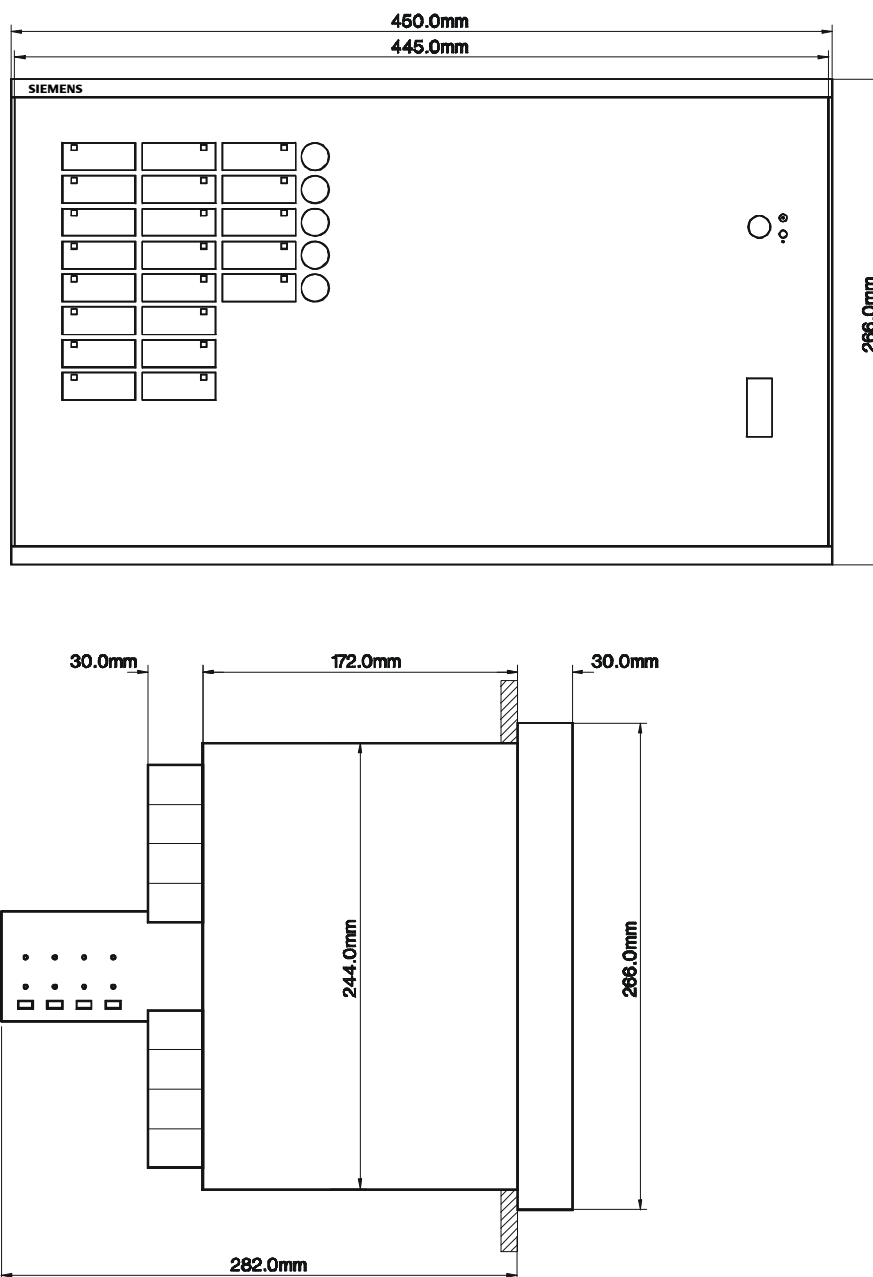
Figure 15-3 Dimensional drawing, panel flush mounting; ZE 32/64 (1)
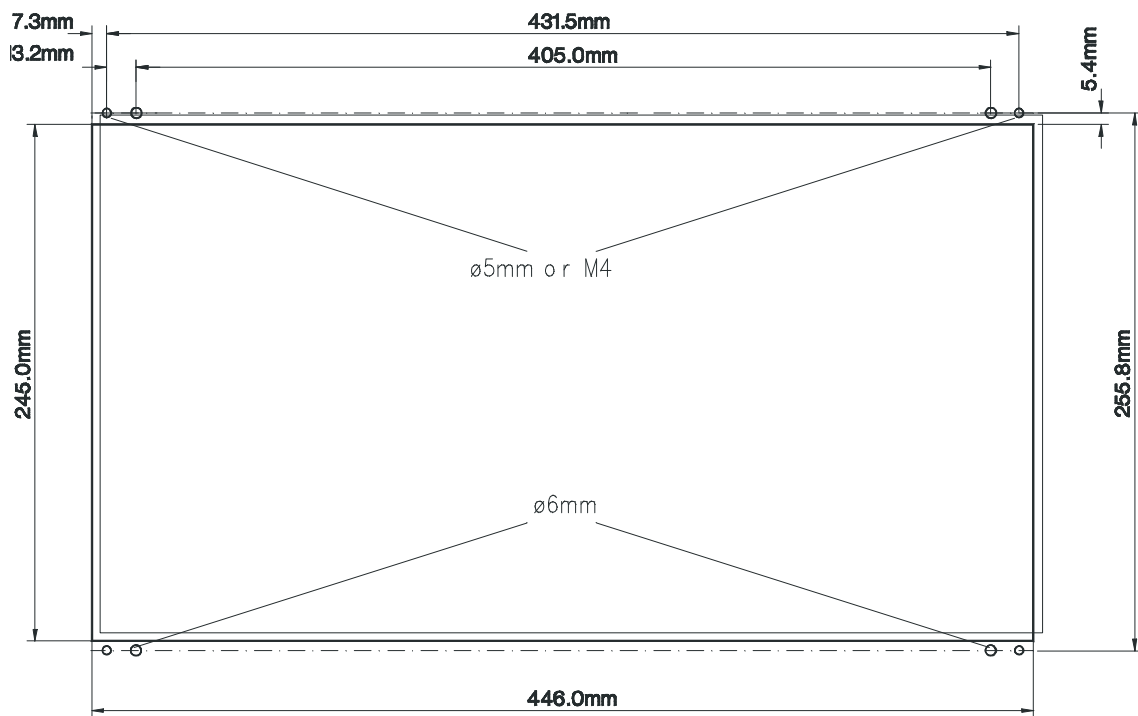
Figure 15-4 Dimensional drawing, panel flush mounting; ZE 32/64 (2)

15.2.4   19-Inch Frame; ZE 32/64
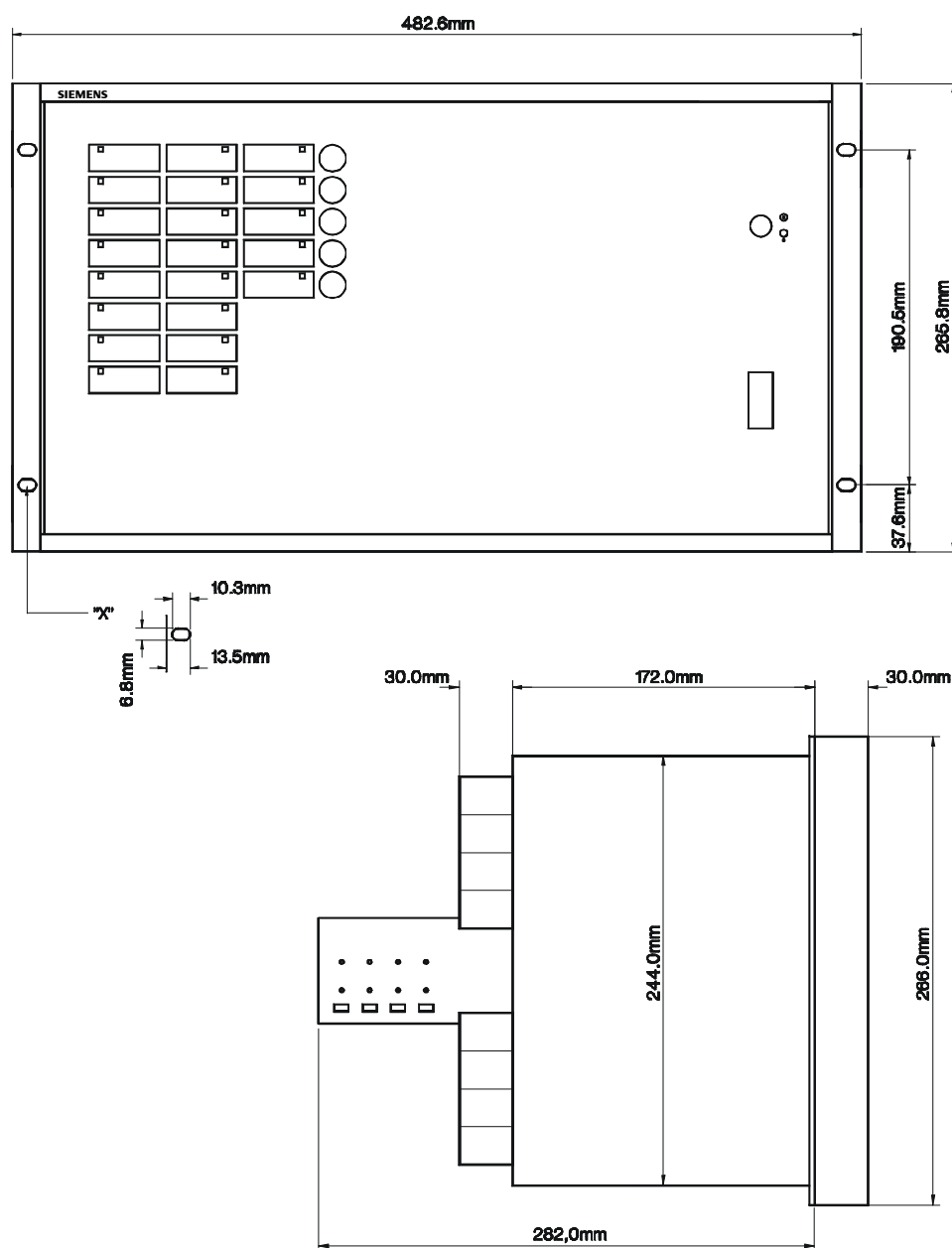
Figure 15-5 Dimensional drawing, 19-inch frame; ZE 32/64

15.2.5 Surface Mounting; ZE 8/16

7KE6000-0_0.emf

Figure 15-6 Dimensional drawing, surface mounting; ZE 8/16

15.2.6 Surface Mounting; ZE 32/64
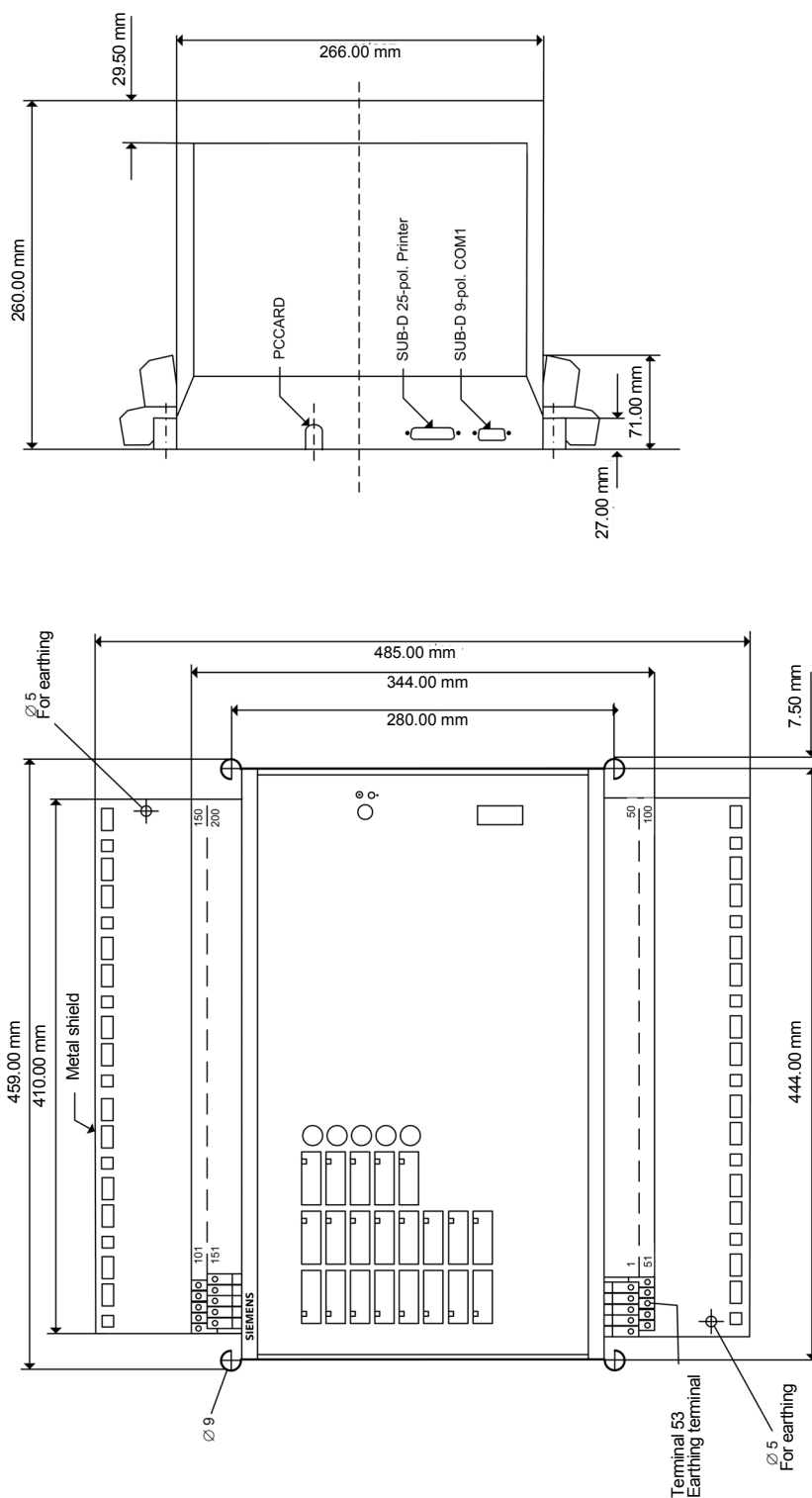
Figure 15-7 Dimensional drawing, surface mounting; ZE 32/64

15.2.7 Ordering Information and Accessories

The current order data for the SIMEAS R-PMU device can be found under www.simeas.com.

15.3 Location Diagrams

15.3.1 Location Diagram, ZE 8/16 with VCDAU

Beispiel: 7KE6100-0FD71-3CJ1

Einbauplatz Location	Type Type	Bemerkungen Remarks
1	CPU	Meldespannung Signaleingänge DC 110V
2	VCDAU	Meldespannung binär DC 110V
3	NT	115 - 230 V AC oder 110 - 250 V DC

1) Blindplatte oder Blindmodul / Dummy panel or dummy plug

Anschlußbezeichnung   1 C 2
Terminal markings
　　　　　　　　　　　　　　　Klemmen–Nr. / Terminal–No.
　　　　　　　　　　　　　　　Vertikale Position / Vertical position
　　　　　　　　　　　　　　　Horizontale Position / Horizontal position

Figure 15-8 Location diagram, ZE 8/16 with VCDAU (1)

Folientastatur / Membrane keyboard
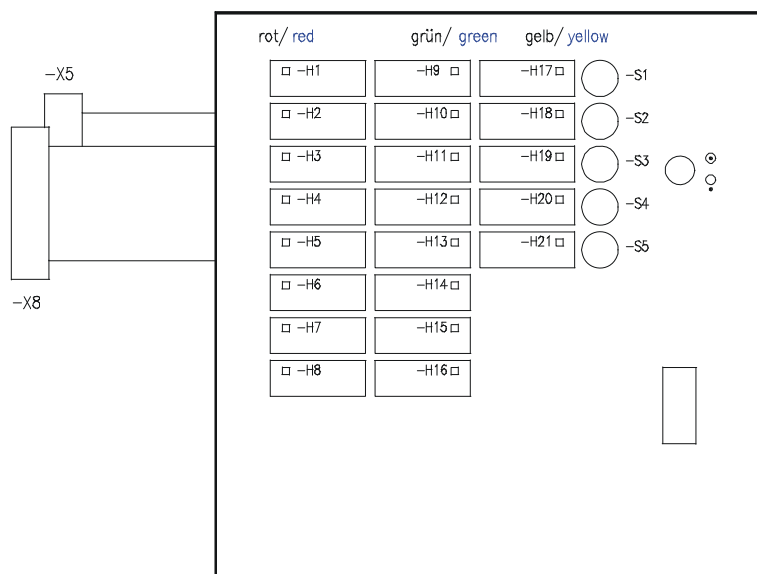
Figure 15-9 Location diagram, ZE 8/16 (2)

15.3.2   Location Diagram, ZE 8/16 with VDAU

Beispiel: 7KE6100-0FD71-3AJ1

Einbauplatz Location	Type Type	Bemerkungen Remarks
1	CPU	Meldespannung Signaleingänge DC 110V
2	VDAU	Meldespannung binär 110VDC
3	NT	115 - 230 V AC oder 110 - 250 V DC

1) Blindplatte oder Blindmodul / Dummy panel or dummy plug

Anschlußbezeichnung   1 C 2
Terminal markings
                                    Klemmen—Nr. / Terminal—No.
                                    Vertikale Position / Vertical position
                                    Horizontale Position / Horizontal position

Figure 15-10 Location diagram, ZE 8/16 with VDAU

15.3.3 Location Diagram, ZE 8/16 with CDAU

Beispiel: 7KE6100-0FD71-3BJ1

Einbauplatz Location	Type Type	Bemerkungen Remarks
1	CPU	Meldespannung Signaleingänge DC 110V
2	CDAU	Meldespannung binär 110VDC
3	NT	115 - 230 V AC oder 110 - 250 V DC

1) Blindplatte oder Blindmodul / Dummy panel or dummy plug

```
Anschlußbezeichnung      1 C 2
Terminal markings
                              └── Klemmen–Nr. / Terminal–No.
                            └──── Vertikale Position / Vertical position
                          └────── Horizontale Position / Horizontal position
```


Figure 15-11 Location diagram, ZE 8/16 with CDAU

15.3.4   Location Diagram, ZE 8/16 with BDAU

Beispiel: 7KE6100-0FD71-3DJ1

Einbauplatz Location	Type Type	Bemerkungen Remarks
1	CPU	Meldespannung Signaleingänge DC 110V
2	BDAU	Meldespannung binär 110VDC
3	NT	115 - 230 V AC oder 110 - 250 V DC

1) Blindplatte oder Blindmodul / Dummy panel or dummy plug

Anschlußbezeichnung   1 C 2
Terminal markings

Klemmen−Nr. / Terminal−No.
Vertikale Position / Vertical position
Horizontale Position / Horizontal position

Figure 15-12 Location diagram, ZE 8/16 with BDAU

15.3.5 Location Diagram, ZE 8/16 with DDAU

Beispiel: 7KE6100-0FD71-3FJ1

Einbauplatz Location	Type Type	Bemerkungen Remarks
1	CPU	Meldespannung Signaleingänge DC 110V
2	DDAU	Meldespannung binär 110VDC
3	NT	115 - 230 V AC oder 110 - 250 V DC

1) Blindplatte oder Blindmodul / Dummy panel or dummy plug

Anschlußbezeichnung   1 C 2
Terminal markings
                            Klemmen−Nr. / Terminal−No.
                         Vertikale Position / Vertical position
                         Horizontale Position / Horizontal position

Figure 15-13 Location diagram, ZE 8/16 with DDAU

15.3.6 Location Diagram, ZE 32/64 with VDAU, CDAU, DDAU, BDAU

Beispiel: 7KE6100-1FD71-3DJ1
Bestückung: 7KE6000-4LB66-6EK0

Einbauplatz Location	Type Type	Bemerkungen Remarks
1	CPU	Meldespannung Signaleingänge 110 V DC
2	VDAU	Meldespannung binär 110 V DC
3	CDAU	Meldespannung binär 110 V DC
4	DDAU	Meldespannung binär 110 V DC
5	BDAU	Meldespannung binär 110 V DC
6	NT	115 - 230 V AC oder 110 - 250 V DC

1) Blindplatte oder Blindmodul / Dummy panel or dummy plug

Anschlußbezeichnung   1 C 2
Terminal markings
                    Klemmen–Nr. / Terminal–No.
                    Vertikale Position / Vertical position
                    Horizontale Position / Horizontal position

Figure 15-14 Location diagram, ZE 32/64 with VDAU, CDAU, DDAU and BDAU (1)
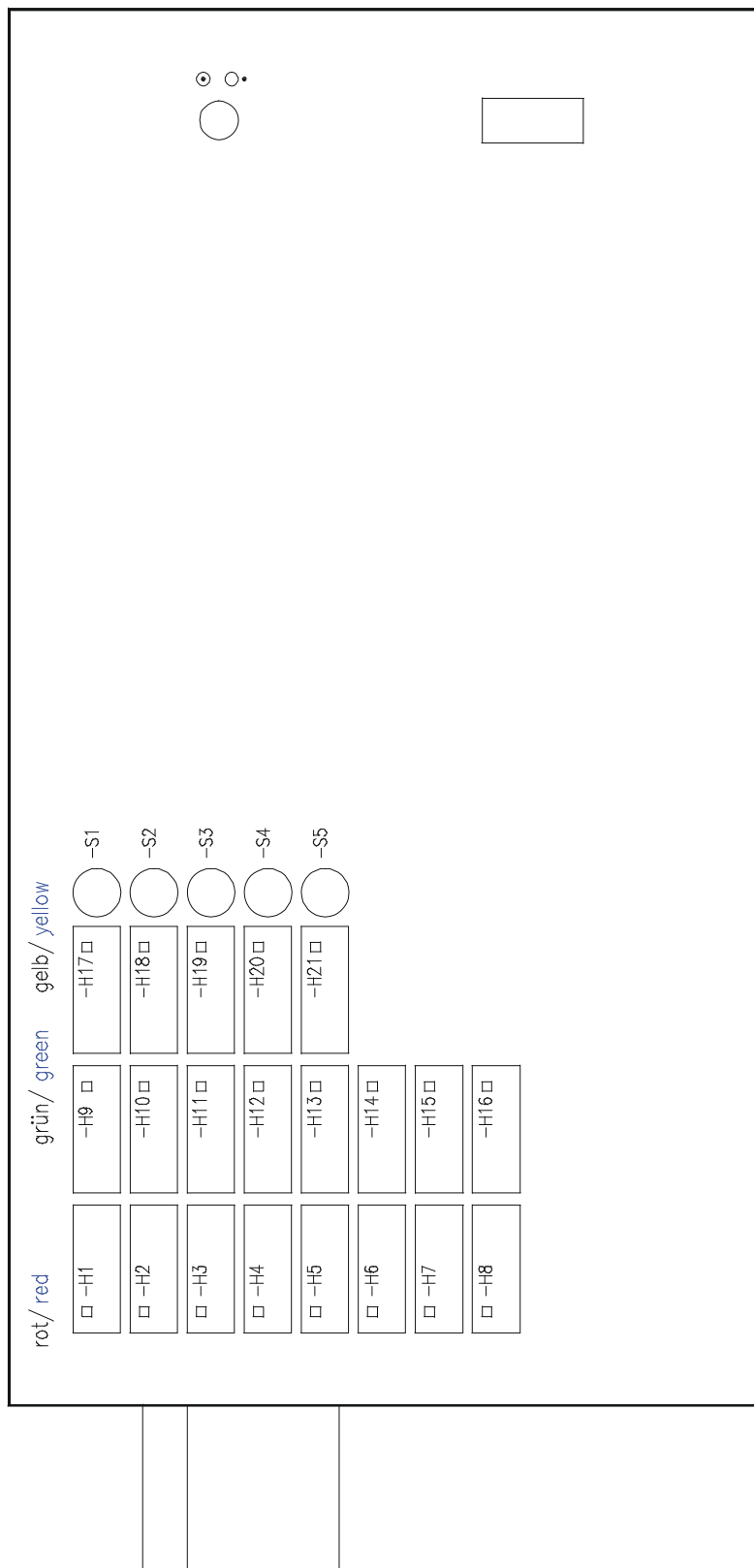
Figure 15-15 Location diagram, ZE 32/64 with VDAU, CDAU, DDAU and BDAU (2)

15.3.7　Location Diagram, ZE 32/64 with 2 x VCDAU

Beispiel: 7KE6100-0FD71-3AJ1

Einbauplatz Location	Type Type	Bemerkungen Remarks
1	CPU	Meldespannung Signaleingänge 110 V DC
2	VCDAU	Meldespannung binär 110VDC
3	VCDAU	Meldespannung binär 110VDC
4		Freier Steckplatz 1)
5		Freier Steckplatz 1)
6	NT	115 - 230 V AC oder 110 - 250 V DC

1) Blindplatte oder Blindmodul / Dummy panel or dummy plug

Anschlußbezeichnung　　　1 C 2
Terminal markings
　　　　　　　　　　　　　　Klemmen-Nr. / Terminal-No.
　　　　　　　　　　　　　　Vertikale Position / Vertical position
　　　　　　　　　　　　　　Horizontale Position / Horizontal position

Figure 15-16 Location diagram, ZE 32/64 with 2 x VCDAU

15.3.8 Location Diagram, ZE 32/64 with 4 x VCDAU

Beispiel: 7KE6100-0FD71-3BJ1

Einbauplatz Location	Type Type	Bemerkungen Remarks
1	CPU	Meldespannung Signaleingänge 110 V DC
2	VCDAU	Meldespannung binär 110VDC
3	VCDAU	Meldespannung binär 110VDC
4	VCDAU	Meldespannung binär 110VDC
5	VCDAU	Meldespannung binär 110VDC
6	NT	115 - 230 V AC oder 110 - 250 V DC

1) Blindplatte oder Blindmodul / Dummy panel or dummy plug

Anschlußbezeichnung   1 C 2
Terminal markings
                            └── Klemmen-Nr. / Terminal-No.
                        └── Vertikale Position / Vertical position
                    └── Horizontale Position / Horizontal position

Figure 15-17 Location diagram, ZE 32/64 with 4 x VCDAU

15.3.9 Location Diagram, ZE 32/64 with 1 x VCDAU and 3 x CDAU

Beispiel: 7KE6100-0FD71-3AJ1

Einbauplatz Location	Type Type	Bemerkungen Remarks
1	CPU	Meldespannung Signaleingänge 110 V DC
2	VCDAU	Meldespannung binär 110VDC
3	CDAU	Meldespannung binär 110VDC
4	CDAU	Meldespannung binär 110VDC
5	CDAU	Meldespannung binär 110VDC
6	NT	115 - 230 V AC oder 110 - 250 V DC

1) Blindplatte oder Blindmodul / Dummy panel or dummy plug

Anschlußbezeichnung   1 C 2
Terminal markings
— Klemmen–Nr. / Terminal–No.
— Vertikale Position / Vertical position
— Horizontale Position / Horizontal position

Figure 15-18 Location diagram, ZE 32/64 with 1 x VCDAU and 3 x CDAU

15.4 Connection Diagrams (Power Supply, Signals, Measurement Circuits)

15.4.1 CPU and Power Supply Unit

10-Zoll-Gehäuse
10" housing

NT		Einbauplatz 3 Location
Signal Signal		Anschlußklemme Terminal
Hilfsenergie Auxiliary supply	L / + N / −	8F1 8F2
Schutzleiter PE protective conductor	PE	8F3

Gehäuserückseite
Rear panel

8

Einbauplatz : 3 = F
Location

Anschlußklemme 8F3
Terminal
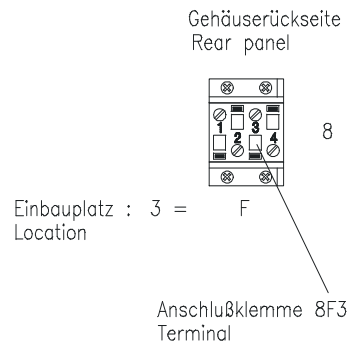
19-Zoll-Gehäuse
19" housing

NT		Einbauplatz 6 Location
Signal Signal		Anschlußklemme Terminal
Hilfsenergie Auxiliary supply	L / + N / −	8M1 8M2
Schutzleiter PE protective conductor	PE	8M3

Gehäuserückseite
Rear panel

8

Einbauplatz : 6 = M
Location

Anschlußklemme 8M3
Terminal
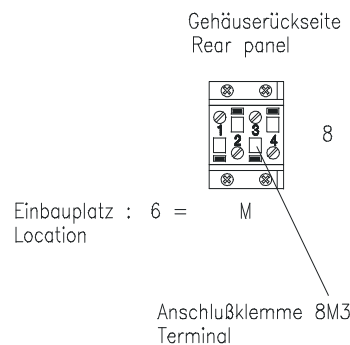
CPU		Einbauplatz 1 Location
Signal Signal		Anschlußklemme Terminal
Meldeausgang 1: Watchdog Alarm output 1: Watchdog		5B1 5B2
Meldeausgang 2: Alarm output 2:		5B3 5B4
Meldeausgang 3: Alarm output 3:		6B1 6B2
Meldeausgang 4: Alarm output 4:		6B3 6B4
Steuereingang 1: Externe Synchronisation Control input 1: external synchronisation	IN + OUT −	7B1 7B2
Steuereingang 2: Externer Start Control input 2: external start	IN OUT	7B3 7B4
Steuereingang 3: System Reset Control input 3: system reset	IN OUT	8B1 8B2
Steuereingang 4: Quittierung Sammelalarm Control input 4: acknowledged group alarm	IN OUT	8B3 8B4

Gehäuserückseite
Rear panel

8
7
6
5

Einbauplatz : 1 = B
Location

Anschlußklemme 5B3
Terminal
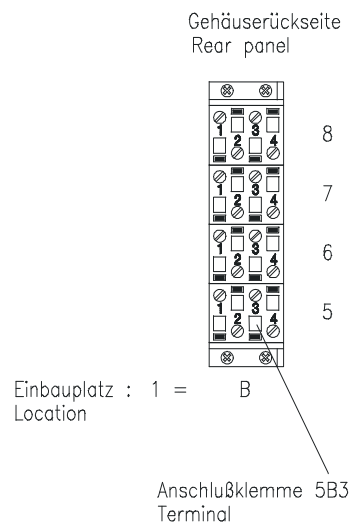
Figure 15-19 Connection diagram, CPU and power supply unit

15.4.2　CDAU

Erfassungsmodul: CDAU Acquisition modul			Einbauplatz Location			
Kanal /Channel			2	3	4	5
Analog Analog	Binär Binary	Signal Signal	Anschlußklemme Terminal			
	1 2	IN OUT IN OUT	1C1 1C2 1C3 1C4	1E1 1E2 1E3 1E4	1G1 1G2 1G3 1G4	1I1 1I2 1I3 1I4
	3 4	IN OUT IN OUT	2C1 2C2 2C3 2C4	2E1 2E2 2E3 2E4	2G1 2G2 2G3 2G4	2I1 2I2 2I3 2I4
	5 6	IN OUT IN OUT	3C1 3C2 3C3 3C4	3E1 3E2 3E3 3E4	3G1 3G2 3G3 3G4	3I1 3I2 3I3 3I4
	7 8	IN OUT IN OUT	4C1 4C2 4C3 4C4	4E1 4E2 4E3 4E4	4G1 4G2 4G3 4G4	4I1 4I2 4I3 4I4
	9 10	IN OUT IN OUT	5C1 5C2 5C3 5C4	5E1 5E2 5E3 5E4	5G1 5G2 5G3 5G4	5I1 5I2 5I3 5I4
	11 12	IN OUT IN OUT	6C1 6C2 6C3 6C4	6E1 6E2 6E3 6E4	6G1 6G2 6G3 6G4	6I1 6I2 6I3 6I4
	13 14	IN OUT IN OUT	7C1 7C2 7C3 7C4	7E1 7E2 7E3 7E4	7G1 7G2 7G3 7G4	7I1 7I2 7I3 7I4
	15 16	IN OUT IN OUT	8C1 8C2 8C3 8C4	8E1 8E2 8E3 8E4	8G1 8G2 8G3 8G4	8I1 8I2 8I3 8I4
1		OUT I IN I	1D1 1D2	1F1 1F2	1H1 1H2	1K1 1K2
2		OUT I IN I	2D1 2D2	2F1 2F2	2H1 2H2	2K1 2K2
3		OUT I IN I	3D1 3D2	3F1 3F2	3H1 3H2	3K1 3K2
4		OUT I IN I	4D1 4D2	4F1 4F2	4H1 4H2	4K1 4K2
5		OUT I IN I	5D1 5D2	5F1 5F2	5H1 5H2	5K1 5K2
6		OUT I IN I	6D1 6D2	6F1 6F2	6H1 6H2	6K1 6K2
7		OUT I IN I	7D1 7D2	7F1 7F2	7H1 7H2	7K1 7K2
8		OUT I IN I	8D1 8D2	8F1 8F2	8H1 8H2	8K1 8K2

Gehäuserückseite
Rear panel
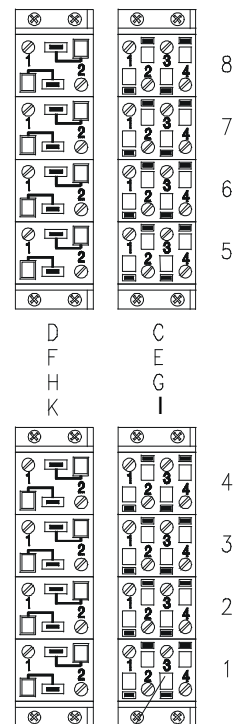
Einbauplatz :
Location
2 = 　D　　C
3 = 　F　　E
4 = 　H　　G
5 = 　K　　I

Beispiel:
Example:

Anschlußklemme 1G3, wenn CDAU
in Einbauplatz 4 eingebaut ist.

terminal 1G3, if CDAU is
installed in slot 4

Figure 15-20 Connection diagram CDAU

15.4.3 DDAU

Erfassungsmodul: DDAU Acquisition modul			Einbauplatz Location			
Kanal /Channel			2	3	4	5
Analog Analog	Binär Binary	Signal Signal	Anschlußklemme Terminal			
	1 2	IN OUT IN OUT	1C1 1C2 1C3 1C4	1E1 1E2 1E3 1E4	1G1 1G2 1G3 1G4	1I1 1I2 1I3 1I4
	3 4	IN OUT IN OUT	2C1 2C2 2C3 2C4	2E1 2E2 2E3 2E4	2G1 2G2 2G3 2G4	2I1 2I2 2I3 2I4
	5 6	IN OUT IN OUT	3C1 3C2 3C3 3C4	3E1 3E2 3E3 3E4	3G1 3G2 3G3 3G4	3I1 3I2 3I3 3I4
	7 8	IN OUT IN OUT	4C1 4C2 4C3 4C4	4E1 4E2 4E3 4E4	4G1 4G2 4G3 4G4	4I1 4I2 4I3 4I4
	9 10	IN OUT IN OUT	5C1 5C2 5C3 5C4	5E1 5E2 5E3 5E4	5G1 5G2 5G3 5G4	5I1 5I2 5I3 5I4
	11 12	IN OUT IN OUT	6C1 6C2 6C3 6C4	6E1 6E2 6E3 6E4	6G1 6G2 6G3 6G4	6I1 6I2 6I3 6I4
	13 14	IN OUT IN OUT	7C1 7C2 7C3 7C4	7E1 7E2 7E3 7E4	7G1 7G2 7G3 7G4	7I1 7I2 7I3 7I4
	15 16	IN OUT IN OUT	8C1 8C2 8C3 8C4	8E1 8E2 8E3 8E4	8G1 8G2 8G3 8G4	8I1 8I2 8I3 8I4
1		IN ±1V IN ±10V IN ±20mA OUT COM	1D1 1D2 1D3 1D4	1F1 1F2 1F3 1F4	1H1 1H2 1H3 1H4	1K1 1K2 1K3 1K4
2		IN ±1V IN ±10V IN ±20mA OUT COM	2D1 2D2 2D3 2D4	2F1 2F2 2F3 2F4	2H1 2H2 2H3 2H4	2K1 2K2 2K3 2K4
3		IN ±1V IN ±10V IN ±20mA OUT COM	3D1 3D2 3D3 3D4	3F1 3F2 3F3 3F4	3H1 3H2 3H3 3H4	3K1 3K2 3K3 3K4
4		IN ±1V IN ±10V IN ±20mA OUT COM	4D1 4D2 4D3 4D4	4F1 4F2 4F3 4F4	4H1 4H2 4H3 4H4	4K1 4K2 4K3 4K4
5		IN ±1V IN ±10V IN ±20mA OUT COM	5D1 5D2 5D3 5D4	5F1 5F2 5F3 5F4	5H1 5H2 5H3 5H4	5K1 5K2 5K3 5K4
6		IN ±1V IN ±10V IN ±20mA OUT COM	6D1 6D2 6D3 6D4	6F1 6F2 6F3 6F4	6H1 6H2 6H3 6H4	6K1 6K2 6K3 6K4
7		IN ±1V IN ±10V IN ±20mA OUT COM	7D1 7D2 7D3 7D4	7F1 7F2 7F3 7F4	7H1 7H2 7H3 7H4	7K1 7K2 7K3 7K4
8		IN ±1V IN ±10V IN ±20mA OUT COM	8D1 8D2 8D3 8D4	8F1 8F2 8F3 8F4	8H1 8H2 8H3 8H4	8K1 8K2 8K3 8K4

Gehäuserückseite
Rear panel

Einbauplatz : 2 =   D   C
Location   3 =   F   E
   4 =   H   G
   5 =   K   I

Beispiel:
Example:

Anschlußklemme 1G3, wenn DDAU in Einbauplatz 4 eingebaut ist.

terminal 1G3, if DDAU is installed in slot 4

Figure 15-21 Connection diagram DDAU

15.4.4 BDAU

Erfassungsmodul: BDAU Acquisition modul			Einbauplatz Location			
Kanal /Channel			2	3	4	5
Analog Analog	Binär Binary	Signal Signal	Anschlußklemme Terminal			
	1 2	IN OUT IN OUT	1C1 1C2 1C3 1C4	1E1 1E2 1E3 1E4	1G1 1G2 1G3 1G4	1I1 1I2 1I3 1I4
	3 4	IN OUT IN OUT	2C1 2C2 2C3 2C4	2E1 2E2 2E3 2E4	2G1 2G2 2G3 2G4	2I1 2I2 2I3 2I4
	5 6	IN OUT IN OUT	3C1 3C2 3C3 3C4	3E1 3E2 3E3 3E4	3G1 3G2 3G3 3G4	3I1 3I2 3I3 3I4
	7 8	IN OUT IN OUT	4C1 4C2 4C3 4C4	4E1 4E2 4E3 4E4	4G1 4G2 4G3 4G4	4I1 4I2 4I3 4I4
	9 10	IN OUT IN OUT	5C1 5C2 5C3 5C4	5E1 5E2 5E3 5E4	5G1 5G2 5G3 5G4	5I1 5I2 5I3 5I4
	11 12	IN OUT IN OUT	6C1 6C2 6C3 6C4	6E1 6E2 6E3 6E4	6G1 6G2 6G3 6G4	6I1 6I2 6I3 6I4
	13 14	IN OUT IN OUT	7C1 7C2 7C3 7C4	7E1 7E2 7E3 7E4	7G1 7G2 7G3 7G4	7I1 7I2 7I3 7I4
	15 16	IN OUT IN OUT	8C1 8C2 8C3 8C4	8E1 8E2 8E3 8E4	8G1 8G2 8G3 8G4	8I1 8I2 8I3 8I4
	17 18	IN OUT IN OUT	1D1 1D2 1D3 1D4	1F1 1F2 1F3 1F4	1H1 1H2 1H3 1H4	1K1 1K2 1K3 1K4
	19 20	IN OUT IN OUT	2D1 2D2 2D3 2D4	2F1 2F2 2F3 2F4	2H1 2H2 2H3 2H4	2K1 2K2 2K3 2K4
	21 22	IN OUT IN OUT	3D1 3D2 3D3 3D4	3F1 3F2 3F3 3F4	3H1 3H2 3H3 3H4	3K1 3K2 3K3 3K4
	23 24	IN OUT IN OUT	4D1 4D2 4D3 4D4	4F1 4F2 4F3 4F4	4H1 4H2 4H3 4H4	4K1 4K2 4K3 4K4
	25 26	IN OUT IN OUT	5D1 5D2 5D3 5D4	5F1 5F2 5F3 5F4	5H1 5H2 5H3 5H4	5K1 5K2 5K3 5K4
	27 28	IN OUT IN OUT	6D1 6D2 6D3 6D4	6F1 6F2 6F3 6F4	6H1 6H2 6H3 6H4	6K1 6K2 6K3 6K4
	29 30	IN OUT IN OUT	7D1 7D2 7D3 7D4	7F1 7F2 7F3 7F4	7H1 7H2 7H3 7H4	7K1 7K2 7K3 7K4
	31 32	IN OUT IN OUT	8D1 8D2 8D3 8D4	8F1 8F2 8F3 8F4	8H1 8H2 8H3 8H4	8K1 8K2 8K3 8K4

Gehäuserückseite
Rear panel

Einbauplatz : 2 = D   C
Location   3 = F   E
4 = H   G
5 = K   I

Beispiel:
Example:

Anschlußklemme 1G3, wenn BDAU
in Einbauplatz 4 eingebaut ist.

terminal 1G3, if BDAU is
installed in slot 4

Figure 15-22 Connection diagram BDAU

15.4.5 VCDAU

Erfassungsmodul: VCDAU Acquisition modul			Einbauplatz Location			
Kanal /Channel			2	3	4	5
Analog Analog	Binär Binary	Signal Signal	Anschlußklemme Terminal			
	1 2	IN OUT IN OUT	1C1 1C2 1C3 1C4	1E1 1E2 1E3 1E4	1G1 1G2 1G3 1G4	1I1 1I2 1I3 1I4
	3 4	IN OUT IN OUT	2C1 2C2 2C3 2C4	2E1 2E2 2E3 2E4	2G1 2G2 2G3 2G4	2I1 2I2 2I3 2I4
	5 6	IN OUT IN OUT	3C1 3C2 3C3 3C4	3E1 3E2 3E3 3E4	3G1 3G2 3G3 3G4	3I1 3I2 3I3 3I4
	7 8	IN OUT IN OUT	4C1 4C2 4C3 4C4	4E1 4E2 4E3 4E4	4G1 4G2 4G3 4G4	4I1 4I2 4I3 4I4
	9 10	IN OUT IN OUT	5C1 5C2 5C3 5C4	5E1 5E2 5E3 5E4	5G1 5G2 5G3 5G4	5I1 5I2 5I3 5I4
	11 12	IN OUT IN OUT	6C1 6C2 6C3 6C4	6E1 6E2 6E3 6E4	6G1 6G2 6G3 6G4	6I1 6I2 6I3 6I4
	13 14	IN OUT IN OUT	7C1 7C2 7C3 7C4	7E1 7E2 7E3 7E4	7G1 7G2 7G3 7G4	7I1 7I2 7I3 7I4
	15 16	IN OUT IN OUT	8C1 8C2 8C3 8C4	8E1 8E2 8E3 8E4	8G1 8G2 8G3 8G4	8I1 8I2 8I3 8I4
1		OUT COM IN 110V IN 220V	1D1 1D2 1D3 1D4	1F1 1F2 1F3 1F4	1H1 1H2 1H3 1H4	1K1 1K2 1K3 1K4
2		OUT COM IN 110V IN 220V	2D1 2D2 2D3 2D4	2F1 2F2 2F3 2F4	2H1 2H2 2H3 2H4	2K1 2K2 2K3 2K4
3		OUT COM IN 110V IN 220V	3D1 3D2 3D3 3D4	3F1 3F2 3F3 3F4	3H1 3H2 3H3 3H4	3K1 3K2 3K3 3K4
4		OUT COM IN 110V IN 220V	4D1 4D2 4D3 4D4	4F1 4F2 4F3 4F4	4H1 4H2 4H3 4H4	4K1 4K2 4K3 4K4
5		OUT I IN I	5D1 5D2	5F1 5F2	5H1 5H2	5K1 5K2
6		OUT I IN I	6D1 6D2	6F1 6F2	6H1 6H2	6K1 6K2
7		OUT I IN I	7D1 7D2	7F1 7F2	7H1 7H2	7K1 7K2
8		OUT I IN I	8D1 8D2	8F1 8F2	8H1 8H2	8K1 8K2

Gehäuserückseite
Rear panel

Einbauplatz : 2 =   D   C
Location   3 =   F   E
               4 =   H   G
               5 =   K   I

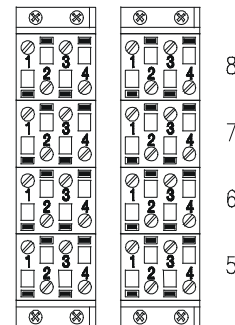Beispiel:
Example:

Anschlußklemme 1G3, wenn VCDAU in Einbauplatz 4 eingebaut ist.

terminal 1G3, if VCDAU is installed in slot 4

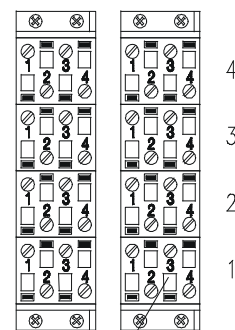Figure 15-23 Connection diagram VCDAU

15.4.6 VDAU

Erfassungsmodul: VDAU / Acquisition modul			Einbauplatz / Location			
Kanal /Channel			2	3	4	5
Analog / Analog	Binär / Binary	Signal / Signal	Anschlußklemme / Terminal			
1 2		IN OUT IN OUT	1C1 1C2 1C3 1C4	1E1 1E2 1E3 1E4	1G1 1G2 1G3 1G4	1I1 1I2 1I3 1I4
3 4		IN OUT IN OUT	2C1 2C2 2C3 2C4	2E1 2E2 2E3 2E4	2G1 2G2 2G3 2G4	2I1 2I2 2I3 2I4
5 6		IN OUT IN OUT	3C1 3C2 3C3 3C4	3E1 3E2 3E3 3E4	3G1 3G2 3G3 3G4	3I1 3I2 3I3 3I4
7 8		IN OUT IN OUT	4C1 4C2 4C3 4C4	4E1 4E2 4E3 4E4	4G1 4G2 4G3 4G4	4I1 4I2 4I3 4I4
9 10		IN OUT IN OUT	5C1 5C2 5C3 5C4	5E1 5E2 5E3 5E4	5G1 5G2 5G3 5G4	5I1 5I2 5I3 5I4
11 12		IN OUT IN OUT	6C1 6C2 6C3 6C4	6E1 6E2 6E3 6E4	6G1 6G2 6G3 6G4	6I1 6I2 6I3 6I4
13 14		IN OUT IN OUT	7C1 7C2 7C3 7C4	7E1 7E2 7E3 7E4	7G1 7G2 7G3 7G4	7I1 7I2 7I3 7I4
15 16		IN OUT IN OUT	8C1 8C2 8C3 8C4	8E1 8E2 8E3 8E4	8G1 8G2 8G3 8G4	8I1 8I2 8I3 8I4
	1	OUT COM IN 110V IN 220V	1D1 1D2 1D3 1D4	1F1 1F2 1F3 1F4	1H1 1H2 1H3 1H4	1K1 1K2 1K3 1K4
	2	OUT COM IN 110V IN 220V	2D1 2D2 2D3 2D4	2F1 2F2 2F3 2F4	2H1 2H2 2H3 2H4	2K1 2K2 2K3 2K4
	3	OUT COM IN 110V IN 220V	3D1 3D2 3D3 3D4	3F1 3F2 3F3 3F4	3H1 3H2 3H3 3H4	3K1 3K2 3K3 3K4
	4	OUT COM IN 110V IN 220V	4D1 4D2 4D3 4D4	4F1 4F2 4F3 4F4	4H1 4H2 4H3 4H4	4K1 4K2 4K3 4K4
	5	OUT COM IN 110V IN 220V	5D1 5D2 5D3 5D4	5F1 5F2 5F3 5F4	5H1 5H2 5H3 5H4	5K1 5K2 5K3 5K4
	6	OUT COM IN 110V IN 220V	6D1 6D2 6D3 6D4	6F1 6F2 6F3 6F4	6H1 6H2 6H3 6H4	6K1 6K2 6K3 6K4
	7	OUT COM IN 110V IN 220V	7D1 7D2 7D3 7D4	7F1 7F2 7F3 7F4	7H1 7H2 7H3 7H4	7K1 7K2 7K3 7K4
	8	OUT COM IN 110V IN 220V	8D1 8D2 8D3 8D4	8F1 8F2 8F3 8F4	8H1 8H2 8H3 8H4	8K1 8K2 8K3 8K4

Gehäuserückseite
Rear panel

Einbauplatz : 2 = D C
Location 3 = F E
4 = H G
5 = K I

Beispiel:
Example:

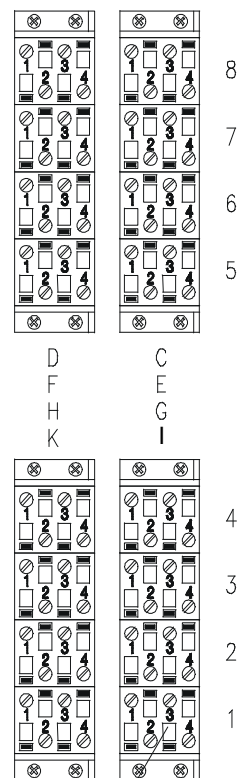Anschlußklemme 1G3, wenn VDAU in Einbauplatz 4 eingebaut ist.

terminal 1G3, if VDAU is installed in slot 4

Figure 15-24 Connection diagram VDAU

15.5 Channel Assignment Diagrams

15.5.1 Channel Assignment Diagram, ZE 8/16 with VCDAU

Einbauebene / Install layer		–EH1
Einbauplatz / Location		2
Erfassungsmodul / Acquisition		VCDAU

Kanal / Channel		Meßgröße / Measured quantity	Feldbezeichnung / Field designation
Analog / Analog	Binär / Binary		
1		DC 110V	
2		DC 110V	
3		DC 110V	
4		DC 110V	
5		DC 110V	
6		DC 110V	
7		DC 110V	
8		DC 110V	
9		DC 110V	
10		DC 110V	
11		DC 110V	
12		DC 110V	
13		DC 110V	
14		DC 110V	
15		DC 110V	
16		DC 110V	
1		AC 57,7V	
2		AC 57,7V	
3		AC 57,7V	
4		AC 57,7V	
5		AC 1A	
6		AC 1A	
7		AC 1A	
8		AC 1A	

Figure 15-25 Channel assignment diagram, ZE 8/16 with VCDAU

15.5.2 Channel Assignment Diagram, ZE 32/64 with VDAU, CDAU, DDAU, BDAU

Einbauebene / Install layer	−EH1
Einbauplatz / Location	3
Erfassungsmodul / Acquisition	CDAU

Kanal / Channel		Meßgröße / Measured quantity	Feldbezeichnung / Field designation
Analog / Analog	Binär / Binary		
1		DC 110V	
2		DC 110V	
3		DC 110V	
4		DC 110V	
5		DC 110V	
6		DC 110V	
7		DC 110V	
8		DC 110V	
9		DC 110V	
10		DC 110V	
11		DC 110V	
12		DC 110V	
13		DC 110V	
14		DC 110V	
15		DC 110V	
16		DC 110V	
1		AC 1A	
2		AC 1A	
3		AC 1A	
4		AC 1A	
5		AC 1A	
6		AC 1A	
7		AC 1A	
8		AC 1A	

Einbauebene / Install layer	−EH1
Einbauplatz / Location	2
Erfassungsmodul / Acquisition	VDAU

Kanal / Channel		Meßgröße / Measured quantity	Feldbezeichnung / Field designation
Analog / Analog	Binär / Binary		
1		DC 110V	
2		DC 110V	
3		DC 110V	
4		DC 110V	
5		DC 110V	
6		DC 110V	
7		DC 110V	
8		DC 110V	
9		DC 110V	
10		DC 110V	
11		DC 110V	
12		DC 110V	
13		DC 110V	
14		DC 110V	
15		DC 110V	
16		DC 110V	
1		AC 57,7V	
2		AC 57,7V	
3		AC 57,7V	
4		AC 57,7V	
5		AC 57,7V	
6		AC 57,7V	
7		AC 57,7V	
8		AC 57,7V	

Figure 15-26 Channel assignment diagram, ZE 32/64 with VDAU, CDAU, DDAU, BDAU (1)

Einbauebene Install layer	−EH1
Einbauplatz Location	5
Erfassungsmodul Acquisition	BDAU

Kanal /Channel			Meßgröße Measured quantity	Feldbezeichnung Field designation
Analog Analog	Binär Binary			
	1		DC 110V	
	2		DC 110V	
	3		DC 110V	
	4		DC 110V	
	5		DC 110V	
	6		DC 110V	
	7		DC 110V	
	8		DC 110V	
	9		DC 110V	
	10		DC 110V	
	11		DC 110V	
	12		DC 110V	
	13		DC 110V	
	14		DC 110V	
	15		DC 110V	
	16		DC 110V	
	17		DC 110V	
	18		DC 110V	
	19		DC 110V	
	20		DC 110V	
	21		DC 110V	
	22		DC 110V	
	23		DC 110V	
	24		DC 110V	
	25		DC 110V	
	26		DC 110V	
	27		DC 110V	
	28		DC 110V	
	29		DC 110V	
	30		DC 110V	
	31		DC 110V	
	32		DC 110V	

Einbauebene Install layer	−EH1
Einbauplatz Location	4
Erfassungsmodul Acquisition	DDAU

Kanal /Channel			Meßgröße Measured quantity	Feldbezeichnung Field designation
Analog Analog	Binär Binary			
	1		DC 110V	
	2		DC 110V	
	3		DC 110V	
	4		DC 110V	
	5		DC 110V	
	6		DC 110V	
	7		DC 110V	
	8		DC 110V	
	9		DC 110V	
	10		DC 110V	
	11		DC 110V	
	12		DC 110V	
	13		DC 110V	
	14		DC 110V	
	15		DC 110V	
	16		DC 110V	
1			DC ±1V	
2			DC ±1V	
3			DC ±1V	
4			DC ±1V	
5			DC ±1V	
6			DC ±1V	
7			DC ±1V	
8			DC ±1V	

Figure 15-27 Channel assignment diagram, ZE 32/64 with VDAU, CDAU, DDAU, BDAU (2)

Technical Data

<div style="text-align: right; font-size: 3em; font-weight: bold;">16</div>

Contents

This chapter contains an overview of the Technical Data of the SIMEAS R-PMU and its components.

16.1   Technical Data of the SIMEAS R-PMU

16.1.1 Construction

ZE 8/16

Dimensions (W x H x D)	223 mm x 266 mm x 300 mm
Number of slots	3
Slot 1:	CPU
Slot 2:	DAU
Slot 3:	Power supply unit

ZE 32/64

Dimensions (W x H x D)	445 mm x 266 mm x 300 mm
Number of slots	6
Slot 1:	CPU
Slots 2 to 5:	DAU
Slot 6:	Power supply unit

16.1.2 Supply Voltage

Low-voltage version

Direct voltage

Nominal direct supply voltage	DC 24 V / DC 48 V / DC 60 V
Permissible voltage ranges	DC 19.2 V to DC 72 V

High-voltage version

Direct voltage

Nominal direct supply voltage	DC 110 V / DC 125 V / DC 220 V / DC 250 V
Permissible voltage ranges	DC 88 V to DC 300 V

Alternating voltage (50 Hz / 60 Hz)

Nominal alternating supply voltage	AC 115 V / AC 230 V
Permissible voltage ranges	AC 92 V to AC 276 V
Frequency range	45 Hz to 65 Hz

Power failure bridging

- without battery

Table 16-1   Power failure bridging times acc. to IEC 60255-11/1979 and VDE 0435 part 303/ 09.84

Power failure bridging time	ZE 8/16	ZE 32/64
for DC 24 V	$\geq$ 400 ms	$\geq$ 150 ms
for DC 60 V	$\geq$ 450 ms	$\geq$ 170 ms
for DC 110 V	$\geq$ 500 ms	$\geq$ 180 ms
for DC 250 V	$\geq$ 700 ms	$\geq$ 200 ms
for AC 115 V	$\geq$ 500 ms	$\geq$ 200 ms
for AC 230 V	$\geq$ 800 ms	$\geq$ 350 ms

- with battery

Power failure bridging	over 10 minutes if all functions are in operation and the battery is fully charged

Power input

ZE 8/16
8 analog / 16 binary channels	DC 24 V to DC 60 V	20 W
	DC 110 V to DC 250 V	18 W
	AC 115 V to AC 230 V	30 VA

ZE 32/64
32 analog / 64 binary channels	DC 24 V to DC 60 V	45 W
	DC 110 V to DC 250 V	40 W
	AC 115 V to AC 230 V	70 VA

16.1.3 Phasor Measurement Unit (PMU)

General data

Protocol	IEEE C37.118-2005
Total vector error (TVE)	≤ 1 %
Compliance level	1
Data transfer rate (reporting rate)	10, 25, 50 messages/s with f_n = 50 Hz 10, 12, 15, 20, 30, 60 messages/s with f_n = 60 Hz
Communication:	TCP and UDP via LAN (Ethernet), PPP via RS232 (modem, null modem)
Ethernet settings	Ports freely parameterizable default setting 4712/TCP or 4713/UDP
RS232 settings	PPP network protocol TCP transport protocol Port freely parameterizable, default setting 4712/TCP Modem / null modem 115,200 bit/s fix CHAP authentification (user: simeasr, the password is the same as the SIMEAS R-PMU password, see chapter 4.7.2 in the OSCOP P manual) No data coding No data compression LCP extensions Van Jacobson TCP/IP header compression IP address auto negotiation or fixed IP address allocation

16.1.4 Analog and Binary Inputs and Outputs

Slot 2
(ZE 8/16, one DAU)   Can be equipped as per Table 16-2

Slots 2 to 5
(ZE 32/64, up to four DAUs)   Can be equipped as per Table 16-2

Table 16-2   Configuration options

VCDAU	8 analog (4 current/4 voltage) and 16 binary channels
VDAU	8 analog (8 voltage) and 16 binary channels
CDAU	8 analog (8 current) and 16 binary channels
DDAU	8 analog (8 current DC ±20 mA or 8 voltage DC ±1 V or DC ±10 V) and 16 binary channels
BDAU	32 binary channels

Measured value processing

A/D converter: 16 bit, 64 times oversampling, 92 dB dynamic range

Table 16-3   VCDAU, VDAU and CDAU

Nominal frequency	Sampling frequency	Frequency range	Samples/cycle
50 Hz	9,600 Hz	25 Hz to 60 Hz	192
60 Hz	11,520 Hz	30 Hz to 70 Hz	192

Table 16-4   DDAU

Nominal frequency	Sampling frequency	Frequency range	Samples/cycle
50 Hz	9,600 Hz	0 Hz to 500 Hz	192
60 Hz	11,520 Hz	0 Hz to 500 Hz	192

Voltage input (VCDAU or VDAU)

All precision data refer to the rms value in stationary operation mode at nominal frequency and at 23 °C ±1 °C.

Measuring range 1	**AC 1.5 V to AC 200 V**
Impedance	>100 kΩ
Resolution	15 mV
Overvoltage	max. AC 300 V for 5 s
Precision	class 0.3
	±0.25 % of measured value ±30 mV
Frequency response	3 Hz to 5500 Hz (5 %)
Number of A/D converters per channel	1

Measuring range 2	**AC 3 V to AC 400 V**
Impedance	>200 kΩ
Resolution	30 mV
Overvoltage	max. AC 600 V for 5 s
Precision	class 0.3
	±0.25 % of measured value ±30 mV
Frequency response	3 Hz to 5500 Hz (5 %)
Number of A/D converters per	
voltage channel	1
current channel	2
Electrical isolation	up to 3.25 kV, 50 Hz
Frequency accuracy at f_n ±5 Hz	5 mHz

Current input (VCDAU or CDAU)

All precision data refer to the rms value in stationary operation mode at nominal frequency and at 23 °C ±1 °C.

Dynamic AD and converter switching	
Complete measuring range	AC 5 mA to AC 400 A

Measuring range	**AC 5 mA to AC 7 A**
Resolution	0.5 mA
Precision	class 0.5
	0.5 % of measured value ±0.5 mA
Frequency response	3 Hz to 5500 Hz (5 %)

Measuring range	**>AC 7 A to AC 200 A**
Resolution	30 mA
Precision	class 1.5
	1.5 % of measured value ±100 mA
Frequency response	0 Hz to 5500 Hz (5 %)

Measuring range	**>AC 200 A to AC 400 A**
Resolution	30 mA
Precision	class 3.5
	±3.5 % of measured value
Frequency response	0 Hz to 5500 Hz (5 %)

Permanently	AC 20 A
Overload	AC 100 A, 30 s
	AC 500 A, 1 s
	AC 1200 A, half-wave

Recording	200 A, plus 100 % displacement
Load	<0.1 VA
Electrical isolation	up to 3.25 kV, 50 Hz
Frequency accuracy at f_n ±5 Hz	5 mHz

Active power measurement

Precision
(at 23 °C ±1 °C,
typical at 100 V, 5 A,
Power factor = 1, nominal frequency)   class 0.3

Reactive power measurement

Precision
(at 23 °C ±1 °C,
typical at 100 V, 5 A,
Power factor = 0, nominal frequency)   class 0.3

DC inputs (DDAU)

Input range (depending on the MLFB)	DC ±20 mA (50 Ω)
	DC ±1 V /DC ±10 V (>40 kΩ / >400 kΩ)
Precision at 23 °C ±1 °C	class 0.5
Range ±1 V	±0.5 % of measured value ±1 mV
Range ±10 V	±0.5 % of measured value ±10 mV
Range ±20 mA	±0.5 % of measured value ±20 µA
Electrical isolation	up to 2.0 kV

Processing of higher DC voltages using isolation amplifier (e. g., SIMEAS T)

Binary inputs (BDAU, VCDAU, DDAU, CDAU and VDAU)

Sampling frequency	2 kHz
Storage principle	State changes with a resolution of 1 ms are stored
Memory capacity	Max. 250 state changes within 1 s up to a signal frequency of 500 Hz, total memory capacity depending on the configuration (typical approx. 100,000 state changes)

Voltage ranges
depending on the configuration

Input voltage	L level	H level
DC 24 V	≤7 V	≥18 V
DC 48 V to DC 60 V	≤14 V	≥36 V
DC 110 V to DC 125 V	≤28 V	≥75 V
DC 220 V to DC 250 V	≤56 V	≥165 V

Input current 1 mA

Input voltage	Overload
DC 24 V	DC 28.8 V
DC 48 V to DC 60 V	DC 72 V
DC 110 V to DC 125 V	DC 150 V
DC 220 V to DC 250 V	DC 300 V

Electrical isolation up to 2.2 kV, 50 Hz.

All binary DAU inputs are bipolar.

Binary inputs (CPU)

Control inputs	4
Input 1	Time synchronization input for connection to a GPS timer, a Sync-Box or a station clock with minute pulse 24 V to 60 V, filter time >2 µs >110 V, filter time <5 µs
Input 2	External start, filter time 50 ms
Input 3	External reset, filter time 50 ms
Input 4	External group alarm, filter time 50 ms

Voltage ranges
depending on the configuration

Input voltage	L level	H level
DC 24 V	≤7 V	≥18 V
DC 48 V to DC 60 V	≤14 V	≥36 V
DC 110 V to DC 125 V	≤28 V	≥75 V
DC 220 V to DC 250 V	≤56 V	≥165 V

Input current 1 mA

Input voltage	Overload
DC 24 V	DC 28.8 V
DC 48 V to DC 60 V	DC 72 V
DC 110 V to DC 125 V	DC 150 V
DC 220 V to DC 250 V	DC 300 V

Electrical isolation up to 2.2 kV, 50 Hz.

Input 1 of the CPU is unipolar, all other inputs are bipolar.

Binary outputs (CPU)

Signal outputs	Relay 1: Break contact (NC contact), permanently allocated to watchdog (live contact)
	Relays 2 to 4 make contact (NO contact), configurable
	Default setting: Relay 2: Device ready for operation Relay 3: Recording active Relay 4: Group alarm
Switching capacity ON	30 W resistive
	30 VA inductive / capacitive
Switching capacity OFF	30 W resistive
	25 VA inductive / capacitive ≤50 ms
Switching voltage	250 V
Permissible current	1 A continuous

Flash Disk

Flash Disk interface	IDE/ATA-1
Data rate	1.2 MByte/s
Capacity	512 MByte or 1 GByte
File system	FAT16

16.1.5 Communication Interfaces

Slot 1 – CPU

LPT 1	Printer port, Centronics IEEE 1284 for connecting a laser printer (PostScript level 2)
COM S	RS232 interface, at the front for connecting a PC, service interface 19.2 kbit/s, 8N1
COM 1	RS232 interface, at the back for connecting, e. g., a PC, modem or star coupler 9.6 kbit/s to 115.2 kbit/s, 8N1
LAN (Ethernet)	IEEE 802.3 10Base-T/100Base-T 10/100 Mbps full / half duplex

Communication ports

OSCOP P communication	2010/TCP
SIMEAS R network trigger	6000/UDP
PDC/PMU communication	freely parameterizable
	Default setting: 4712/TCP or 4713/UDP

16.1.6 Time Synchronization

Synchronization

Precision of GPS/DCF77 synchronization (not via Sync-Box):

incl. phases accuracy measuring system; typically: ±10 µs

Precision of minute pulse synchronization: ±100 ms

Precision of "Time setting" via OSCOP P:

in automatic mode, cycle time 4 hours: ±1 s

RTC drift: 30 ppm at 25 °C

Current consumption, synchronization input 7B1/7B2 at DC 24 V: DC 2 mA

Timer requirements

Precision: 5 µs

Synchronization signal level or optical output with conversion via Sync-Transceiver 7KE6000-8AK/L: DC 24 V

Pulse width DCF77 low pulse: 100 ms ±20 ms

Pulse width DCF77 high pulse: 200 ms ±20 ms

Pulse width minute pulse: 200 ms to 1000 ms

In the event of an antenna failure, the DCF77 signal is cut off

Time basis: UTC

16.1.7 Electrical Tests

Safety regulation		IEC 61010-1; EN 61010-1	
Protection class		IEC 61140; EN 61140	
Degree of protection Flush-mounted housing:		IEC 60529	

Equipment:	Front	IP31
	Terminals	IP21 (standard terminal)
	Terminals	IP11 (US terminal)
	Housing	IP20
Operator protection:		IP2x (standard terminal)
		IP1x (US terminal)

Surface-mounted housing:

Equipment:	Front	IP31
	Terminals	IP21
	Housing	IP21
Operator protection:		IP2x

Clearances and creepage distances	IEC 61010-1; EN 61010-1
Overvoltage category	III
Pollution degree	2

Insulation tests

Voltage test (routine test)	IEC 61010-1; EN 61010-1
Supply voltage	DC 3.1 kV
Voltage/current inputs (VCDAU, VDAU, CDAU)	3.25 kV, 50 Hz
DC inputs	DC 2.0 kV
Binary inputs and messages	2.2 kV, 50 Hz
Impulse voltage test (type test)	IEC 60255-5 1.2/50 μs; 0.5 J
Supply voltage and voltage/current inputs (VCDAU, VDAU, CDAU)	6 kV
DC inputs, binary inputs and messages	4 kV

Electromagnetic compatibility

Electromagnetic HF field amplitude-modulated	IEC 61000-4-3 Test level 3, 10 V/m 80 MHz to 1000 MHz, 80 % amplitude modulation
Electromagnetic HF field single frequencies	IEC 60255-22-3 Test level 3, 10 V/m Frequencies: 80 MHz ±0.4 MHz 160 MHz ±0.8 MHz 450 MHz ±2.25 MHz 900 MHz ±5 MHz 80 % amplitude modulation 900 MHz ±5 MHz 50 % pulse modulation
Magnetic field with power system frequency	IEC 61000-4-8; EN 61000-4-8 Permanent field Test level 5, 100 A/m
Electrostatic discharge	IEC 61000-4-2; EN 61000-4-2 Contact discharge Test level 4, test voltage 8 kV Air discharge Test level 4, test voltage 15 kV
High frequency, unsymmetrical amplitude-modulated	IEC 61000-4-6; EN 61000-4-6 Test level 3 Voltage level 10 V Frequency range 150 kHz to 80 MHz
Fast transients (bursts)	IEC 61000-4-4; EN 61000-4-4
Power supply AC/DC	Test level 4, test voltage 4 kV, direct coupling
Signal lines, control and communications lines, data and printer lines Repetition frequency	Test level 4, test voltage 2 kV, coupling, cap. data link 5 kHz
System frequency, unsymmetrical	IEC 60770 Test level 10 V and Test level 250 V (customer-specific)
1 MHz HF test Power supply, system and communications lines Signal lines, data and printer lines	IEC 60255-22-1 Direct and differential-mode voltage 2.5 kV Common-mode voltage 2.5 kV Differential-mode voltage 1.0 kV

Surge	IEC 61000-4-5 extended as per customer requirements
Power supply, control and communications lines	Common mode 4 kV, Differential mode 2 kV (extended 4 kV)
Damped oscillation Damped oscillation	IEC 61000-4-18; EN 61000-4-18 Test level 3, Common mode 2.5 kV Differential mode 1 kV Repetition rate 100 kHz and 1 MHz
Voltage dips and short interruptions	IEC 61000-4-11; EN 61000-4-11 IEC 60255-11 Short interruption 100 % to 0 % for 50 ms Short interruption 100 % to 50 % for 100 ms
Voltage fluctuations AC/DC power supply unit	IEC 61000-4-11; EN 61000-4-11 to 80 %, 120 % permanently, to 40 %, dynamic 2 s, operation 2 s to 0 %, dynamic 2 s, operation 1 s
Voltage interruptions AC power supply unit	IEC 61000-4-11; EN 61000-4-11 to 0 % for 5 s with 50 Hz / 60 Hz ±5 % switch OFF and automatic restart
Voltage dips AC power supply unit	IEC 61000-4-11; EN 61000-4-11 to 0 % for 10 ms to 40 % for 100 ms to 70 % for 200 ms with 50 Hz / 60 Hz ±5 % Function not affected
Interference emission	IEC/EN 61000-6-4
Interference field strength	EN55011/CISPR11 Class A
Radio interference voltage	EN55011/CISPR11 Class A
Harmonics AC supply voltage AC power supply unit	IEC 61000-3-2; EN 61000-3-2 Class A

16.1.8 Mechanical Stress Tests

Vibration	IEC 60068-2-6; IEC 60255-21-1
1. Basic test	Vibration test under function
	- Frequency range: 10 Hz to 150 Hz
	- Transition frequency: 58 Hz to 60 Hz
	- Deflection: 0.035 mm
	- Acceleration: 0.5 g
	- Number of sweep cycles: 1
	- Stress direction:
	3 orthogonal axes
	Continuous stress test
	- Frequency range: 10 Hz to 150 Hz
	- Transition frequency: 58 Hz to 60 Hz
	- Acceleration: 1 g
	- Number of sweep cycles: 20
	- Stress direction:
	3 orthogonal axes
2. Extended test as per customer requirements	Vibration test under function
	- Frequency range: 10 Hz to 150 Hz
	- Transition frequency: 58 Hz to 60 Hz
	- Deflection: 0.075 mm
	- Acceleration: 1 g
	- Number of sweep cycles: 1
	- Stress direction:
	3 orthogonal axes
Shock	IEC 60068-2-27; IEC 60255-21-2
	Acceleration: 5 g
	Pulse duration: 11 ms
	Number of pulses per direction: 3
	Acceleration: 15 g
	Pulse duration: 11 ms
	Number of pulses per direction: 3
	Acceleration: 10 g
	Pulse duration: 16 ms
	Number of pulses per direction: 1000
Resistance to earthquakes	IEC 60068-3-3; IEC 60255-21-3 class 1
	Work instruction KWU DD/7080.09
	dd. 05.07.1993

16.1.9   Climatic Tests

Cold and dry heat	IEC 60068-2-1 and IEC 60068-2-2
Transport and storage	-25 °C to +70 °C
During operation	-5 °C to +55 °C
Air humidity	95 % without condensation
Humid heat	IEC 60068-2-3
Temperature change	IEC 60068-2-14
Maximum height above sea level	2000 m (according to IEC 61010-1)

Note

The only permissible operating temperature range for surface-mounted housings is from 0 °C to 40 °C.

16.2 Packaging

Ex works

The devices are packed at the factory to meet the requirements of IEC 60255-21.

Transport

If other packaging is used, the transport requirements according to IEC 60255-21-1 Class 2 and IEC 60255-21-2 Class 1 must be met.

16.3 Mass and Device Dimensions

Module mass

Power supply unit	approx. 1 kg
Power supply unit with battery	approx. 1.2 kg
CPU	approx. 1 kg
VCDAU	approx. 1.1 kg
VDAU	approx. 1 kg
CDAU	approx. 1.2 kg
BDAU	approx. 0.6 kg
DDAU	approx. 0.7 kg

Total mass

ZE 32/64, equipped with 4 DAUs	approx. 15 kg
ZE 8/16, equipped with 1 DAU	approx. 8 kg

Dimensions

ZE 8/16	3 slots
Dimensions (W x H x D)	223 mm x 266 mm x 300 mm
ZE 32/64	6 slots
Dimensions (W x H x D)	445 mm x 266 mm x 300 mm

16.4   Technical Data of the Battery

Type	Sanyo Cadnica N-1200SCK; NiCd
Nominal voltage	DC 12 V
Nominal capacity	1.2 Ah
Useful power reserve	12 Wh
Temperature range	-20 °C to +70 °C
Service life	3 years (at an ambient temperature of 55 °C)
Order number	50812410063

Note

Please observe the notes on storage and transport contained in the maintenance manual for the SIMEAS R-PMU, order number E50417-H1074-C364-A1.

Frequently Asked Questions (FAQ) 17

A collection of answers to frequently asked questions on products from the Power Quality, Protection and Control Devices sections is provided on our FAQ site:

www.siemens.com/energy-support/faq-en

Any further questions?

Hotline

Please contact us:

Telephone: +49 1805 24 8437

Fax: +49 1805 24 2471

Email: support.ic@siemens.com

Overview of Functions

18

Contents

The following chapters briefly introduce the most important functions of the digital fault recorder SIMEAS R-PMU as well as the main technical data.

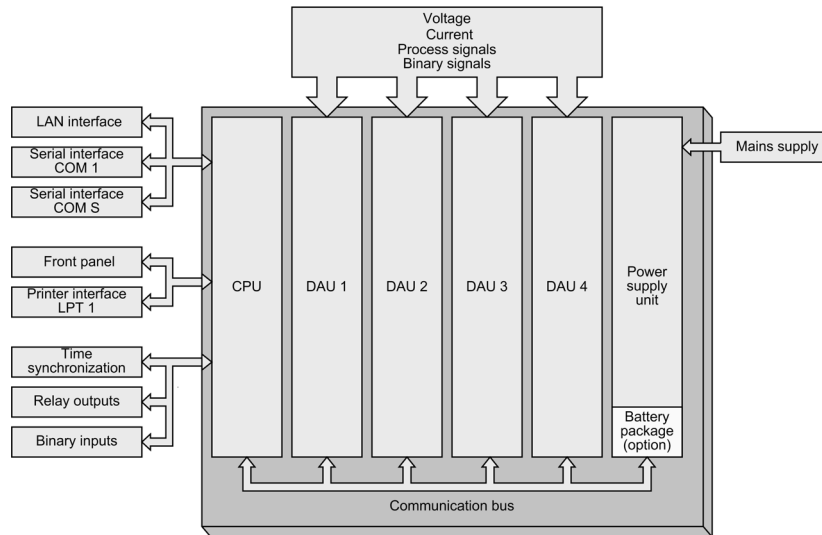## 18.1 Modules of the SIMEAS R-PMU

Interaction between the modules

Figure 18-1 Device architecture, internal / external communication and power supply

Functions of the modules

❑ CPU: Control of all device-internal processes, the communication with external devices and the data processing

❑ DAUs: Measured value acquisition and processing of measured values in lines connected to the DAUs

❑ Power supply unit and battery package (option): Infeed of the supply voltage, distribution in the SIMEAS R-PMU and optional uninterruptible power supply

External communication interfaces

❑ LAN (rear panel): Network connection (LAN) for the data transmission between SIMEAS R-PMU and evaluation PC, DAKON or PDC

❑ COM 1 (rear panel): Serial interface for the transmission of parameters and measured data between SIMEAS R-PMU and evaluation PC, DAKON or PDC

  – via direct coupling

  – via external analog modem / ISDN modem

  – via FO converter and star coupler if several devices are connected (no connection to PDC possible)

  – via X.25 communication (no connection to PDC possible)

❑ COM S (front panel): Serial service interface for the parameterization and transmission of measured data from the SIMEAS R-PMU to the evaluation PC or DAKON

❑ LPT 1 (rear panel): Parallel printer interface

❑ 7B1(+), 7B2(-) (rear panel): Connection for the GPS timer for synchronization

❑ Binary and relay outputs (rear panel)

Communication interfaces

Table 18-1   **LAN: Ethernet class C** (recommended)

Class	Range of network numbers	Subnet mask
C	192.0.0.x to 223.255.255.x	255.255.255.0

Recommended for SIMEAS R-PMU: 192.168.subnet.device (subnet: 1 to 254 and device: 1 to 254)

Table 18-2   **COM 1 setting**

	Setting
Baud rate	9,600 bit/s to 115,200 bit/s
Data bits	8
Stop bits	1
Parity	none

Table 18-3   **COM S setting**

	Setting
Baud rate	19,200 bit/s
Data bits	8
Stop bits	1
Parity	none

Supply voltage

Normal operation

Table 18-4   Supply voltages

Voltage type	Rated voltages	Permissible range
DC (low-voltage)	DC 24 V / DC 48 V / DC 60 V	DC 19.2 V to DC 72 V
DC (high-voltage)	DC 110 V / DC 125 V / DC 220 V / DC 250 V	DC 88 V to DC 300 V
AC (50 Hz / 60 Hz)	AC 115 V / AC 230 V	AC 92 V to AC 276 V; 45 Hz to 65 Hz

Emergency operation with battery package:

Table 18-5   Battery package (NiCd)

	Values
Rated direct voltage	DC 12 V
Rated capacity	1.2 Ah
Duration of emergency power operation	at least 10 min
Useful power reserve	12 Wh
Temperature range	-20 °C to +70 °C
Service life	3 years (at an ambient temperature of 55 °C)

18.2   Data Acquisition Units (DAU)

DAU types

Table 18-6   DAU types

Type	Application	Number of channels	Measuring ranges (overview)
VCDAU	Recording of voltage, current and binary signals	- 8 analog (4 voltage <u>and</u> 4 current) - 16 binary	V: AC 1.5 V to AC 400 V I: AC 5 mA to AC 400 A binary: Table 18-8
VDAU	Recording of voltages and binary signals	- 8 analog (voltage) - 16 binary	V: AC 1.5 V to AC 400 V binary: Table 18-8
CDAU	Recording of currents and binary signals	- 8 analog (current) - 16 binary	I: AC 5 mA to AC 400 A binary: Table 18-8
DDAU	Recording of process values and binary signals	- 8 analog (8 voltage <u>or</u> 8 current) - 16 binary	V: DC ±1 V / DC ±10 V (>40 kΩ / >400 kΩ) I: DC ±20 mA (50 Ω) binary: Table 18-8
BDAU	Recording of binary signals	- 32 binary	binary: Table 18-8

Measured value processing of the DAU types (in detail)

Table 18-7   Measuring ranges and important parameters (without binary inputs)

Type	Measuring ranges / accuracy	Parameters
VCDAU	*Voltage measuring range AC 1.5 V to AC 200 V* Accuracy [*]: ±0.25 % of measured value ±30 mV Frequency behaviour: 3 Hz to 5,500 Hz (5 %) *Voltage measuring range AC 3 V to AC 400 V* Accuracy *: ±0.25 % of measured value ±30 mV Frequency behaviour: 3 Hz to 5,500 Hz (5 %) *Entire current measuring range:* *AC 5 mA to AC 400 A* *Current measuring range AC 5 mA to AC 7 A* Accuracy *: ±0.5 % of measured value ±0.5 mA Frequency behaviour: 3 Hz to 5,500 Hz (5 %) *Current measuring range: >AC 7 A to AC 200 A* Accuracy *: ±1.5 % of measured value ±100 mA Frequency behaviour: 0 Hz to 5,500 Hz (5 %) *Current measuring range >AC 200 A to AC 400 A* Accuracy *: ±3.5 % of measured value Frequency behaviour: 0 Hz to 5,500 Hz (5 %)	Impedance: >100 kΩ Overvoltage: 300 V max. for 5 s Impedance: >200 kΩ Overvoltage: 600 V max. for 5 s

Table 18-7   Measuring ranges and important parameters (without binary inputs) (Forts.)

Type	Measuring ranges / accuracy	Parameters
VDAU	*Voltage measuring range AC 1.5 V to AC 200 V* Accuracy *: ±0.25 % of measured value ±30 mV Frequency behaviour: 3 Hz to 5,500 Hz (5 %) *Voltage measuring range AC 3 V to AC 400 V* Accuracy *: ±0.25 % of measured value ±30 mV Frequency behaviour: 3 Hz to 5,500 Hz (5 %)	Impedance: >100 kΩ Overvoltage: 300 V max. for 5 s Impedance: >200 kΩ Overvoltage: 600 V max. for 5 s
CDAU	*Entire current measuring range:* *AC 5 mA to AC 400 A* *Current measuring range AC 5 mA to AC 7 A* Accuracy *: ±0.5 % of measured value ±0.5 mA Frequency behaviour: 3 Hz to 5,500 Hz (5 %) *Current measuring range: >AC 7 A to AC 200 A* Accuracy *: ±1.5 % of measured value ±100 mA Frequency behaviour: 0 Hz to 5,500 Hz (5 %) *Current measuring range >AC 200 A to AC 400 A* Accuracy *: ±3.5 % of measured value Frequency behaviour: 0 Hz to 5,500 Hz (5 %)	
DDAU	*Input range (depending on the version):* DC ±20 mA (50 Ω) DC ±1 V / DC ±10 V (> 40 kΩ / > 400 kΩ) Accuracy (at 23 °C ±1 °C): Range 1 V: ±0.5 % of measured value ±1 mV Range 10 V: ±0.5 % of measured value ±10 mV Range 20 mA: ±0.5 % of measured value ±20 μA	

* All precision data refer to the rms value in stationary operation mode at nominal frequency and at
   23 °C ±1 °C.

Table 18-8   Binary inputs of VCDAU, VDAU, CDAU, DDAU, and BDAU

Input voltage	L-level	H-level	Overload (at 1 mA input current)
DC 24 V	≤7 V	≥18 V	DC 28.8 V
DC 48 V to DC 60 V	≤14 V	≥36 V	DC 72 V
DC 110 V to DC 125 V	≤28 V	≥75 V	DC 150 V
DC 220 V to DC 250 V	≤56 V	≥165 V	DC 300 V

Table 18-9   Sampling frequency

DAU type	Rated frequency	Frequency range	Sampling frequency	Sample values per period
VCDAU; VDAU; CDAU	50 Hz	25 Hz to 60 Hz	9,600 Hz	192
DDAU	50 Hz	0 Hz to 500 Hz		
VCDAU; VDAU; CDAU	60 Hz	30 Hz to 70 Hz	11,520 Hz	
DDAU	60 Hz	0 Hz to 500 Hz		

With **binary signals**, the sampling frequency for all DAU types is consistently 2 000 Hz.

Frequency accuracy at f_n ±5 Hz

VCDAU: 5 mHz

VDAU: 5 mHz

CDAU: 5 mHz

18.3   Recording Functions

Note

The measured values used in this chapter are described in Chapter 6.2.

For more detailed information on the recording functions, please refer to Chapter 7.

Note

The following tables state all measured values which can be recorded by the PMU or the respective recorder. Depending on the input connection (star connection, delta connection, or monophase), only a certain selection of measured values can be recorded by the PMU or the respective recorder. See the details in Chapter 7 for more information.

Phasor measurement unit (PMU)

Reporting rate

Table 18-10   Technical data

Name	Data								
Nominal frequency	f_n = 50 Hz			f_n = 60 Hz					
Reporting rate in telegrams/s	10	25	50	10	12	15	20	30	60
Recorded values	VCDAU, VDAU, CDAU: Phasors V, I, or positive-sequence phasors, binary data DDAU: Process values, binary data BDAU: Binary data								

Table 18-11   Recorded values of the DAUs

VCDAU	VDAU	CDAU	DDAU	BDAU
$\underline{V}_L$, $\underline{V}_N$, $\underline{V}$	$\underline{V}_L$, $\underline{V}_N$, $\underline{V}$			
$\underline{V}_1$	$\underline{V}_1$			
$\underline{I}_L$, $\underline{I}_N$, $\underline{I}$		$\underline{I}_L$, $\underline{I}_N$, $\underline{I}$		
$\underline{I}_1$		$\underline{I}_1$		
f, Δf	f, Δf	f, Δf		
			D	
B	B	B	B	B

Transient phasor recorder (TPR)

A fault record that has been recorded contains signal tracks for AC values, phase angles, symmetrical components, active and reactive power, frequencies, process and binary signals.

General data

❑ Recording rate: 1 to 5 nominal cycles

❑ Resolution of the binary changes: 1 kHz and a maximum of 250 changes per second and DAU

❑ Recording of the history: up to 30 s at 50 Hz and up to 25 s at 60 Hz before the occurrence of the fault

❑ Recording time:

via OSCOP P parameterization, 900 s max. at 50 Hz, 750 s max. at 60 Hz

separate setting for manual or logical trigger

in the case of an external triggering at the binary input: for the duration of the pending external signal (900 s max. at 50 Hz, 750 s max. at 60 Hz)

Recorded values of the DAUs

Table 18-12   Recorded values of the DAUs

VCDAU	VDAU	CDAU	DDAU	BDAU
$\underline{V}_L$, $\underline{V}_N$, $\underline{V}$	$\underline{V}_L$, $\underline{V}_N$, $\underline{V}$			
φ_L, φ_{VN}	φ_L, φ_{VN}			
V_1, V_2, V_0	V_1, V_2, V_0			
φ_1, φ_2, φ_0	φ_1, φ_2, φ_0			
f	f			
$\underline{I}$, $\underline{I}_N$		$\underline{I}$, $\underline{I}_N$		
φ_L, φ_{IN}		φ_L, φ_{IN}		
I_1, I_2, I_0		I_1, I_2, I_0		
φ_1, φ_2, φ_0		φ_1, φ_2, φ_0		
f		f		
P_Σ, Q_Σ, P, Q		$\{P_\Sigma, Q_\Sigma, P, Q\}$		
			D	
B	B	B	B	B

Note: Recorded values in {...} are applicable for coupled CDAUs. The current inputs of the CDAU are coupled to a voltage group, e. g., a VDAU or VCDAU, for power measurement.

Configurable trigger functions

Level trigger min/max:

Monitoring of the analog measured values for observance of min/max limit values. Triggering is started as soon as the measured value exceeds or falls below the parameterized limit value.

Gradient trigger for analog signals:

The gradient trigger condition for AC values is met when the difference between two fundamental component rms values averaged over the averaging time t_m is larger than the parameterized threshold at the interval of the filter time. With DDAUs, the average values are compared at the interval of the filter time. The averaging time t_m corresponds to the parameterized recording rate of 1 to 5 nominal cycles.

Binary trigger:

State changes at the binary DAU inputs can be parameterized as trigger conditions. Thus, a recording can be started when a transducer changes into the alarm state or leaves the alarm state or at any state change.

Cross trigger:

If the cross trigger for the TPR is activated, a recording of the TPR is started when the TAR is triggered. The history and recording time of the parameterization correspond to the TPR.

Manual trigger / External trigger:

The manual triggering can be started **via the manual trigger** on the control panel or via OSCOP P. For a manual trigger, SIMEAS R-PMU does not send a network trigger signal. An **external** start of fault recording via a binary input of the SIMEAS R-PMU is possible.

Network trigger:

If there are several SIMEAS R-PMU located in a LAN sub-network, the triggered device can send UDP broadcast telegrams to other SIMEAS R-PMU devices via the network and start a recording of the transient phasor recorder there. The sub-network is determined via the IP address and the subnet mask of the SIMEAS R-PMU.

Trigger values of the DAUs

Table 18-13   Trigger values of the DAUs

VCDAU	VDAU	CDAU	DDAU	BDAU
$\underline{V}_L$, $\underline{V}_N$, $\underline{V}$ $d\underline{V}_L$/dt, $d\underline{V}_N$/dt, $d\underline{V}$/dt V_1, V_2, V_0 f, df/dt $\underline{I}_L$, $\underline{I}_N$, $\underline{I}$ $d\underline{I}_L$/dt, $d\underline{I}_N$/dt I_1, I_2, I_0 P_Σ, Q_Σ, P, Q dP_Σ/dt, dQ_Σ/dt dP/dt, dQ/dt	$\underline{V}_L$, $\underline{V}_N$, $\underline{V}$ $d\underline{V}_L$/dt, $d\underline{V}_N$/dt, $d\underline{V}$/dt V_1, V_2, V_0 f, df/dt	$\underline{I}_L$, $\underline{I}_N$, $\underline{I}$ $d\underline{I}_L$/dt, $d\underline{I}_N$/dt I_1, I_2, I_0 $\{P_\Sigma$, Q_Σ, P, Q$\}$ $\{dP_\Sigma$/dt, dQ_Σ/dt$\}$ $\{dP$/dt, dQ/dt$\}$	D dD/dt	
B	B	B	B	B

Note: Recorded values in {...} are applicable for coupled CDAUs. The current inputs of the CDAU are coupled to a voltage group, e. g., a VDAU or VCDAU, for power measurement.

Transient analog recorder (TAR)

Recording of the course of voltages, currents, process and binary signals in the form of sampling values in the case of a violation of parameterized trigger limit values.

General data

❑ Sampling rate (constant): 192 sampling values per nominal cycle

❑ Resolution of the binary changes: 1 kHz and a maximum of 250 changes per second and DAU

❑ Recording of the history: up to 1 s before the occurrence of the fault

❑ Recording time:

via OSCOP P parameterization 30 s max.

separate setting for manual or logical trigger

in the case of an external triggering at the binary input: for the duration of the pending external signal (30 s max.)

Recorded values of the DAUs

Table 18-14   Recorded values of the DAUs

VCDAU	VDAU	CDAU	DDAU	BDAU
V_L, V_N, V I_L, I_N, I	V_L, V_N, V	I_L, I_N, I		
			D	
B	B	B	B	B

Configurable trigger functions

Level trigger min/max:

Monitoring of the analog measured values for observance of min/max limit values. Triggering is started as soon as the measured value exceeds or falls below the parameterized limit value.

Gradient trigger:

The gradient trigger condition for AC values is met when the difference between two half-cycle rms values at the interval of two cycles is larger than the parameterized threshold. With DDAUs, the arithmetic means are compared at the interval of two nominal cycles. A differentiation is made between the rising and the falling gradient.

Binary trigger:

State changes at the binary DAU inputs can be parameterized as trigger conditions. Thus, a recording can be started when a transducer changes into the alarm state or leaves the alarm state or at any state change.

Logical trigger:

A logical trigger can be composed of up to eight individual trigger conditions which are all elements of one logical AND relation. Altogether, eight logical triggers can be defined in the SIMEAS R-PMU.

<u>Cross trigger:</u>

If the cross trigger for the TAR is activated, a recording of the TAR is started when the TPR is triggered. The history and recording time correspond to the parameterization of the TAR.

<u>Manual trigger / External trigger:</u>

The manual triggering can be started **via the manual trigger** on the control panel or via OSCOP P. For a manual trigger, SIMEAS R-PMU does not send a network trigger signal. An **external** start of fault recording via a binary input of the SIMEAS R-PMU is possible.

<u>Network trigger:</u>

If there are several SIMEAS R-PMUs located in a LAN sub-network, the triggered device can send UDP broadcast messages to other SIMEAS R-PMUs via the network and start a recording of the transient analog recorder there. The sub-network is determined via the IP address and the subnet mask of the SIMEAS R-PMU.

Trigger values of the DAUs

Table 18-15   Trigger values of the DAUs

VCDAU	VDAU	CDAU	DDAU	BDAU
V_L, V_N, V dV_L/dt, dV_N/dt, dV/dt V_1, V_2, V_0 I_L, I_N, I dI_L/dt, dI_N/dt, dI/dt I_1, I_2, I_0	V_L, V_N, V dV_L/dt, dV_N/dt, dV/dt V_1, V_2, V_0	I_L, I_N, I dI_L/dt, dI_N/dt, dI/dt I_1, I_2, I_0	D dD/dt	
B	B	B	B	B

Continuous phasor recorder (current / voltage) and frequency (rms values)

Recording procedure: continuously

Cycle time: 1 s, 2 s, 5 s, 10 s, 30 s, 60 s, 120 s, 240 s, 300 s, 360 s, 480 s, 600 s

Table 18-16   Recorded values of the DAUs

VCDAU	VDAU	CDAU
$\underline{V}_L$, $\underline{V}_N$, $\underline{V}$ $\underline{I}_L$, $\underline{I}_N$, $\underline{I}$ φ_L, φ_{VN}, φ_{IN}, φ f P_Σ, Q_Σ, P, Q	$\underline{V}_L$, $\underline{V}_N$, $\underline{V}$ φ_L, φ_N, φ f	$\underline{I}_L$, $\underline{I}_N$, $\underline{I}$ φ_L, φ_N, φ f P_Σ, Q_Σ, P, Q

Continuous mean value recorder for frequencies

Recording procedure: continuously

Averaging time: 1 s, 2 s, 5 s, 10 s, 30 s, 60 s, 120 s, 240 s, 300 s, 360 s, 480 s, 600 s

Table 18-17   Recorded values of the DAUs

VCDAU	VDAU	CDAU
$\bar{f}$	$\bar{f}$	$\bar{f}$

Continuous mean value recorder for fundamental component rms values of current and voltage

Recording procedure: continuously

Averaging time: 1 s, 2 s, 5 s, 10 s, 30 s, 60 s, 120 s, 240 s, 300 s, 360 s, 480 s, 600 s

Table 18-18   Recorded values of the DAUs

VCDAU	VDAU	CDAU
$\bar{V}_L, \bar{V}_N, \bar{V}$ $\bar{V}_1, \bar{V}_2, \bar{V}_0$ $\bar{I}_L, \bar{I}_N, \bar{I}$ $\bar{I}_1, \bar{I}_2, \bar{I}_0$	$\bar{V}_L, \bar{V}_N, \bar{V}$ $\bar{V}_1, \bar{V}_2, \bar{V}_0$	$\bar{I}_L, \bar{I}_N, \bar{I}$ $\bar{I}_1, \bar{I}_2, \bar{I}_0$

Continuous mean value recorder for active and reactive power

Recording procedure: continuously

Averaging time: 1 s, 2 s, 5 s, 10 s, 30 s, 60 s, 120 s, 240 s, 300 s, 360 s, 480 s, 600 s

Table 18-19   Recorded values of the DAUs

VCDAU	coupled CDAU
$\bar{P}_\Sigma, \bar{Q}_\Sigma, \bar{P}, \bar{Q}$	$\bar{P}_\Sigma, \bar{Q}_\Sigma, \bar{P}, \bar{Q}$

Continuous mean value recorder for process values

Recording procedure: continuously

Averaging time: 1 s, 2 s, 5 s, 10 s, 30 s, 60 s, 120 s, 240 s, 300 s, 360 s, 480 s, 600 s

Usable DAU: DDAU

Recorded values: process values $\bar{D}$

Event recorder (ER)

Recording of state changes of the binary signals (1 data set per binary change)

Sampling values: 1 kHz resolution, 250 state changes per second

Accuracy of the time stamping of recorded state changes: 1 ms

18.4 Time Synchronization

Types of time synchronization

- Minute pulse synchronization: no time information
- GPS/DCF77 synchronization: second signal with date, time (UTC), etc
- Synchronization using Sync-Box 7KE6000-8HAx: second signal with date, time (UTC) etc.

Technical data

- Minute pulse synchronization

  Drift per minute at 25 °C up to ±1.8 ms

- GPS/DCF77 synchronization

  Accuracy of the synchronization signal acc. to example configuration figure 18-2: 5 µs

  Signal voltage at the Sync-Transceiver output: DC 24 V

Recommended GPS timer

GPS satellite radio clock Hopf 6875 with modified SIPROTEC firmware (7XV5664-0AA00); connection to the SIMEAS R-PMU via FO cable. Please observe the Application Description "Time Synchronization SIMEAS R/SIMEAS R-PMU" under www.simeas.com.
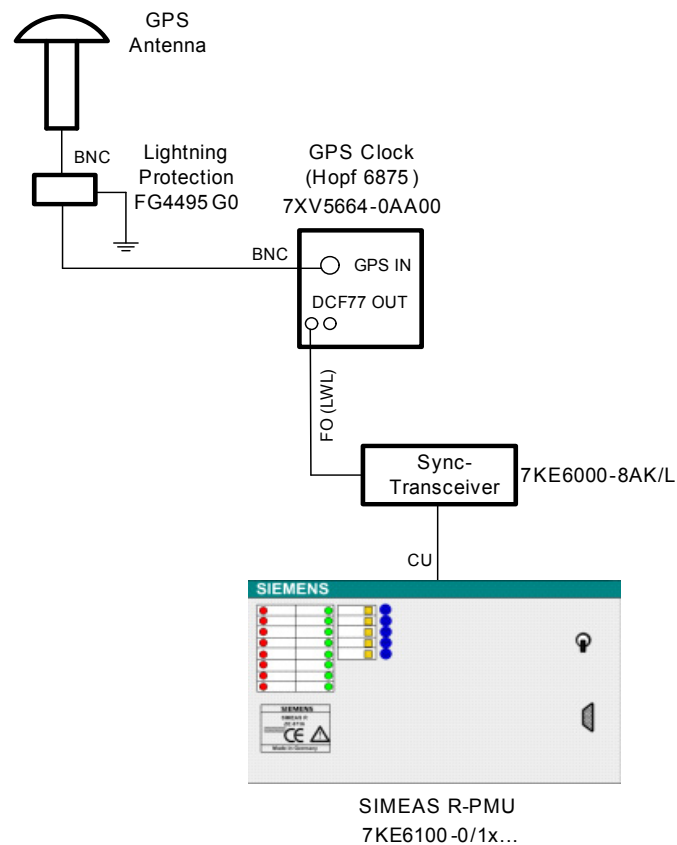
Figure 18-2 Example configuration

18.4 Time Synchronization

Appendix A

Contents

A.1   Product information SIMEAS R

Scope of supply

With this consignment you have received one of the following products:

Firmware SIMEAS-R

- V21.66 for 486-CPU with 16 MB memory
- V23.16 for 486-CPU with 32 MB memory
- V30.16 for Elan-CPU

Note

To upgrade the SIMEAS R firmware, please refer to the installation instructions (document number: E50417-X1074-C306-A3).

Restrictions

Please notice the following restrictions using SIMEAS R:

- **Compatible OSCOP P versions**

  This firmware is compatible with OSCOP P V6.40 or higher.

- **Actions needed after firmware update**

  a) After a firmware update, you have to use the parameterization software OSCOP P to decrease all memory sizes for the analog fault recorder, the power and frequency recorder, the mean value writer and for voltage dips by 1 MB.
  This action is necessary for an update from **V2.1.64** or lower to **V21.66**, from **V2.3.14** or lower to **V23.16** and from **V3.0.14** or lower to **V30.16**!
  This action is **not** necessary for an update from **V2.1.65** to **V21.66**, from **V2.3.15** to **V23.16** and from **V3.0.15** to **V30.16**!

Note

Decreasing the memory sizes will reorganize the database. The device will then be reset: During the reset, all data will be deleted in the memory and the memory segments will be created again. This action will be displayed by blinking LEDs on the front panel.
Do not switch off the SIMEAS R during this activity!

Save all SIMEAS R data before changing the memory sizes.

b) The log system of the current firmware was extended. To allow OSCOP P < V6.60 to display all log messages in plain text, you have to replace text files in the OSCOP P installation directory.
Proceed as follows:
Exit OSCOP P. Load the file **OSCOP_P_V6.50_SIMEAS_R_Logs_Patch_1.zip** from the website http://www.powerquality.de --> Software --> OSCOP P.
Save the file in the OSCOP P installation directory. Uncompress the file. Confirm that the files

may be overwritten. Replacing the log texts is now completed.

- **New standard password**

  The devices will be delivered with a **default password "siemens"** defined for the SIMEAS R system. This password will also be used under OSCOP P as a standard password. The older default password "kennwort" and user-defined passwords are still valid.

- **Memory size for the function "Voltage dips" (V23.16 and V30.16 only)**

  The memory size for the Voltage dips function must not be set smaller than 10 MB.

- **Logical triggers**

  a) In the OSCOP Transfer module, "logical" appears as the source of triggering if a logical trigger triggered a fault record. This entry does not provide any information about the number of the logical trigger.
  b) Do not parameterize more than two logical triggers. The combination of 8 logical triggers mentioned in the manuals SIMEAS R (E50417-B1076-C209-A4) chapter 1.4.5.7 and OSCOP P (E50417-H1000-C170-A2) chapter 6.12.4 is not correct.

- **SIMEAS R in a Network**

  The device can be used in a network if you meet the following preconditions
  a) **No port scans** are used in the network.
  b) The network is protected against **attacks of hackers**.
  c) The network is not operated with the „**IP Security Protocol**". This protocol may be activated in networks running under Windows 2000 or Windows XP.

- **Trigger source f/P recorder with high averaging time**

  If a very high averaging time (e.g. 250 cycles) is set in the f/P recorder, transient measured values are not visible in the fault record because of the averaging. For this reason the transients cannot be detected as the trigger source in the f/P fault record.

- **Trigger source (+dM/dt, MAX) for f/P recorder**

  If the response thresholds in the frequency-power recorder for the MAX trigger and the +dM/dt trigger are chosen, for example, to meet the conditions for both types of trigger after a sudden change in current, MAX trigger may be indicated as the source of triggering although the record was triggered by +dM/dt trigger.

- **Trigger for positive-/negative-sequence system**

  The analog fault recorder can only be triggered for positive-/negative-sequence system, if the mean value recorder f,sym is activated.

- **Averaging time power and frequency recorder**

  The averaging time of the power and frequency recorder must always be $\leq$ 5 periods.

- **Frequency triggering of the power and frequency recorder**

  Frequency triggering is only possible when the voltage input signal of a VDAU or VCDAU is at least 20 V_{rms} (applies to both 110 V and 220 V input).

- **Missing entries in the log file on February 28th**
  If log messages are selected on February 28th of the same day, these messages will not be transferred. By repeating the selection next day or later the messages will be transferred correctly.

Note

No log messages will be lost!

- **Auto polling in OSCOP P automatic mode**

  Minimum time between the polling for records must not be less than 5 minutes.

  OSCOP P module **Transfer**: Configuration --> Automatic mode --> Sequential control --> Select device --> General --> Minimum time between intervals.

- **Function "Automatic time setting" in OSCOP P automatic mode (DAKON)**

  The cycle time of the function "Automatic time setting" must not be less than 20 minutes. Do not activate this function for SIMEAS R synchronized via a Sync-Box. "Automatic time setting" is only available if OSCOP P runs in DAKON mode.

  OSCOP P module Transfer:
  Configuration --> Automatic mode --> Synchronization --> Cycle time.

- **ISDN terminal adapter**

  When using an ISDN terminal adapter connected to SIMEAS R, configure the modem type as **HAYES**, not as **ISDN** in OSCOP P < V6.60.

A.2 Error Messages

OSCOP P displays the following error messages if the communication to SIMEAS R-PMU is active:

Message ID	Error/Message	Comment
800	Unknown command received	Firmware or OSCOP update recommended, contact hotline if necessary
801	Incorrect password or command not executable	Firmware or OSCOP update recommended, contact hotline if necessary
802	Command not executed	Firmware or OSCOP update recommended, contact hotline if necessary
803	Command executed with error status	Firmware or OSCOP update recommended, contact hotline if necessary
804	Illegal or invalid command parameter	Firmware or OSCOP update recommended, contact hotline if necessary
805	Command executed on inactive recorder	Unable to execute command: Recorder not active or parameterized.
807, 810 - 812	File access error	Query table of contents again and check if the record has been deleted via ring buffer mode, contact hotline if necessary
808	Directory access error	Contact hotline
814	Database query outside time range	There are no records/entries for the given interval.
815	Database transmission overwritten by measure	The requested record of a continuous recorder was overwritten in ring buffer mode.
818	Error during compilation of system parameters	Firmware or OSCOP update recommended, contact hotline if necessary
819	Error during compilation of DAU parameters	Firmware or OSCOP update recommended, contact hotline if necessary
820	Error during parameterization, file does not contain system data	Firmware or OSCOP update recommended, contact hotline if necessary
821	Parameterization error, slot not occupied	Firmware or OSCOP update recommended, contact hotline if necessary
822	Parameter file update error	Firmware or OSCOP update recommended, contact hotline if necessary
823	Error during firmware update	Check the communication link, contact hotline if necessary
824	Error setting system information	Firmware or OSCOP update recommended, contact hotline if necessary
825	Data transmission canceled	-
830	Time setting via the PC interface is not allowed with synchronization type GPS	Time setting via the PC interface is not allowed with synchronization type GPS/DCF77.
831	Time setting via the PC interface can be performed only every 4 hours	Set a cycle time of at least 4 hours for automatic time setting.
832	V2/V3 command rejected	You tried to access the SIMEAS R-PMU with device type **SIMEAS R**. Create a device in OSCOP P Parameterize PC with device type **SIMEAS R-PMU**. This device type is available in OSCOP P 6.60.
833	Incorrect password	Parameterize the correct password, refer to chapter 12.1. In general, the password may be overwritten in the first 3 minutes after new start of the device.

A.3   System Messages

The table below contains all messages that the SIMEAS R-PMU logs in the log file:

Legend:

Type 0: Malfunction
Type 1: Warning / important message
Type 2: Operating message

Log No.	Type	Class	Description	Comment
258	1	BOOT	Reboot initiated	-
260	0	BOOT	Fault: Task monitor initiating reboot	Hotline
262	1	SYSTEM	Create system data OK	Reorganization of system internal data, e. g. after upgrade or update
263	0	SYSTEM	Create system data canceled with fault	Hotline
265	1	SYSTEM	Read system data OK	-
266	1	SYSTEM	System data missing or wrong, new file written	Reorganization of system internal data, e. g. after upgrade
267	1	SYSTEM	Write system data OK	-
268	1	SYSTEM	Shutdown measurement system	Possible reasons: Change to service mode, DAU error or device is being shut down
269	0	SYSTEM	Restart due to critical system fault (deadlock). Fault time:	Hotline
270	0	SYSTEM	Restart due to critical system fault (deadlock). Task:	Hotline
273	1	SYSTEM	DAU not plugged	Status message
274	0	SYSTEM	DAU boot fault	Several possible reasons: DAU and CPU software version do not match, firmware update recommended; DAU hardware error; contact hotline if necessary
277	2	SYSTEM	Self-monitoring	-
278	0	SYSTEM	Fault: Cannot start self-monitoring	Hotline
279	2	SYSTEM	Self-monitoring: New MD5 checksum file created	Checksum file is created again after each firmware update
280	0	SYSTEM	Self-monitoring fault: Cannot write MD5 checksum file	Hotline
281	0	SYSTEM	Self-monitoring fault: Critical checksum fault	Flash disk fault; Hotline
282	1	SYSTEM	Firmware update	-
283	0	SYSTEM	Firmware update failed	Hotline
284	1	SYSTEM	Communication subsystem not started. Reason:	Hotline
285	1	SYSTEM	Measurement system not started. Reason:	Possibly an error message after an upgrade, otherwise firmware or OSCOP P update recommended; contact hotline if necessary
286	1	SYSTEM	Number of device restarts due to critical system faults:	For further information on this fault, refer to detailed log entries.
287	0	SYSTEM	Fault writing the restart counter	Hotline
288	0	SYSTEM	Last restart due to critical system fault	Hotline
289	2	SYSTEM	Restart information written	-
290	2	SYSTEM	Fault writing the restart information	Hotline

Log No.	Type	Class	Description	Comment
291	2	SYSTEM	Restart cause: File system cannot be initialized	Flash disk fault; Hotline
292	2	SYSTEM	Restart cause: Log recorder cannot be initialized. Time stamp:	Flash disk fault; Hotline
293	2	SYSTEM	Restart cause: Folder tree structure cannot be initialized. Time stamp:	Flash disk fault; Hotline
294	2	SYSTEM	Restart cause: Battery fault. Time stamp:	Replace battery pack
295	2	SYSTEM	Restart cause: Fault in log recorder queue. Time stamp:	Hotline
296	2	SYSTEM	Restart cause: Log recorder cannot be opened. Time stamp:	Hotline
297	2	SYSTEM	Restart cause: Invalid log recorder format. Time stamp:	Hotline
298	2	SYSTEM	Critical system fault: Task suspended. Task no.:	Hotline
299	2	SYSTEM	Critical system fault: Recorder task suspended. Task no.:	Hotline
300	0	SYSTEM	Self-monitoring: DAU fault	DAU hardware/software fault; Hotline
384	0	BOOT	Mismatch fault: DAU found but not configured	All plugged in DAUs must be parameterized. DAUs not needed can be deactivated.
386	1	BOOT	Fault: DAU configured but not plugged in	Parameterized DAUs must be plugged in
387	0	BOOT	Fault booting the DAU	Hotline
388	1	BOOT	Mismatch fault: Incorrect DAU configured	Wrong DAU type parameterized
389	0	BOOT	Fault configuring the DAU	Several possible reasons: DAU and CPU software version do not match, firmware update recommended; DAU hardware error; contact hotline if necessary
390	0	BOOT	Fault setting the DAU time	Hotline
393	0	BOOT	Fault starting DAU	Hotline, DAU hardware error
395	2	BOOT	DAU type slot 1	-
396	2	BOOT	DAU type slot 2	-
397	2	BOOT	DAU type slot 3	-
398	2	BOOT	DAU type slot 4	-
399	2	BOOT	Device booting with firmware version:	-
400	0	BOOT	Fault booting the communication processor. Internal fault number:	Hotline, CPU or DAU hardware fault
401	1	BOOT	DAU deactivated	-
402	1	BOOT	Initialization finished	Possibly an error message after an upgrade; otherwise hotline (consider additional texts)
403	1	BOOT	DAU calibration frequency 16.66 Hz, type not supported	SIMEAS R-PMU supports 50 Hz and 60 Hz DAU types only. Nevertheless, the device is ready for work generating wrong measured values.
404	1	BOOT	Wrong DAU calibration frequency of 50 Hz for 60 Hz system	Only 60 Hz DAU types are allowed for 60 Hz nominal frequency. Nevertheless, the device is ready for work generating wrong measured values.
405	1	BOOT	Wrong DAU calibration frequency of 60 Hz for 50 Hz system	Only 50 Hz DAU types are allowed for 50 Hz nominal frequency. Nevertheless, the device is ready for work generating wrong measured values.
406	1	BOOT	Unknown DAU calibration frequency	Hotline, DAU hardware fault

Log No.	Type	Class	Description	Comment
640	0	PARSER	System parameter file fault	Hotline, install SIMEAS R-PMU firmware or OSCOP P update
641	0	PARSER	Fault: System parameter file not available	Hotline
642	0	PARSER	Unsupported V30.xx parameters	After a firmware upgrade there are still V30.xx parameters on the device, you have to parameterize the device (overwriting the old parameters).
643	0	PARSER	Fault: Unknown system parameter file version	Hotline
644	0	PARSER	Slot parameter file fault	Hotline, install SIMEAS R-PMU firmware or OSCOP P update
645	0	PARSER	Fault: Slot parameter file not available	Hotline
646	2	PARSER	Slot parameter check OK	-
647	2	PARSER	System parameter check OK	-
769	0	PRINTER	Printer not connected	-
770	0	PRINTER	Printer switched off	-
771	2	PRINTER	Printer not ready	-
772	0	PRINTER	No printer paper	-
774	0	PRINTER	Printer queue: Can not open fault record. File number:	Unable to print a fault record: The file is damaged or deleted in ring buffer mode.
1056	0	DAU	Incomplete TAR recording. File number:	TAR record cannot be used due to inconsistent DAU data.
1057	0	DAU	Incomplete TPR recording. File number:	TPR record cannot be used due to inconsistent DAU data.
1059	0	DATABASE	Fault writing into the database. Recorder type:	Hotline
1060	0	DATABASE	Database access fault. Recorder type:	Hotline
1061	0	DAU	Wrong data block ID. Recorder type:	TAR/TPR record cannot be used due to inconsistent DAU data.
1062	0	DATABASE	Fault in message queue. Recorder type:	Hotline
1063	0	DATABASE	Could not copy recording. Recorder type:	Hotline
1064	0	DATABASE	Could not create database. Recorder type:	Hotline
1065	1	DATABASE	Deleting recordings. Recorder type:	-
1066	1	DATABASE	Log recorder created	Log recorder created due to a firmware upgrade.
1067	0	DATABASE	Database overflow, recorder type:	Hotline
1068	1	DATABASE	Database initialized, recorder type:	A new database created due to new parameterization or a firmware upgrade.
1069	1	DATABASE	Deleting recordings. Recorder type:	-
1070	1	DATABASE	Database initialized. Recorder type:	A new database created due to new parameterization or a firmware upgrade.
1071	0	DATABASE	TAR recording deleted. File number:	TAR record cannot be used due to inconsistent DAU data.
1072	0	DATABASE	TPR recording deleted. File number:	TPR record cannot be used due to inconsistent DAU data.
1281	2	CALL_PC	Callback PC started. Interface:	-

Log No.	Type	Class	Description	Comment
1282	2	CALL_PC	Callback PC was acknowledged by OSCOP P. Interface:	-
1283	1	CALL_PC	Callback PC repeated. Interface:	Make sure that OSCOP P runs in automatic mode and was parameterized to be able to receive callbacks from this device. Check the communication link and the callback communication parameters if necessary.
1536	2	BATTERY	Start of battery monitoring process	Cyclical battery test (will be started even without battery)
1537	2	BATTERY	Start of battery monitoring after startup. Test time:	-
1538	2	BATTERY	Battery monitoring after startup OK	-
1539	0	BATTERY	Fault in battery monitoring after startup. Remaining time:	-
1542	0	BATTERY	Fault in battery monitoring during operation. Remaining time:	-
1543	2	BATTERY	Continuous charging started. Charging time:	-
1545	0	BATTERY	Unable to charge battery or time-out	-
1547	1	BATTERY	Battery fully discharged	-
1548	0	BATTERY	Power supply failure, battery operation active	-
1549	1	SYSTEM	Reset initiated	-
1793	2	PANEL	Panel button pressed	-
1807	1	PANEL	External reset triggered	Reset trigger via control input 3
1808	1	PANEL	Recording interrupted, as data can no longer be disposed of	-
1810	1	SYSTEM	Device ready	Note: Some functions are ready for operation with a delay (manual trigger, network trigger)
1811	1	SYSTEM	Power supply OK	-
1812	2	SYSTEM	OSCOP P communication	-
1813	2	SYSTEM	TAR/Analog fault recorder: Recording event	-
1814	2	SYSTEM	TPR/Frequency power recorder: Recording event	-
1815	0	SYSTEM	DAU fault	DAU boot fault or DAU failure (self-monitoring), hotline
1816	0	SYSTEM	Printer fault	Check printer, printer connection; fault disappears after correction (takes approx. 5 minutes)
1818	1	SYSTEM	PC unreachable	Make sure that OSCOP P runs in automatic mode and was parameterized to be able to receive callbacks from this device. Check the communication link and the callback communication parameters if necessary.
1820	1	SYSTEM	Ring buffer active	90 % of the reserved TAR or TPR memory size is reached, the oldest data will be deleted up to 80 %.
1821	0	SYSTEM	Temperature has risen above permissible value of +55 °C	-
1822	0	SYSTEM	Temperature has dropped below permissible value of -5 °C	-

Log No.	Type	Class	Description	Comment
1824	0	SYSTEM	Common alarm	A general common alarm occurred. For further information on this fault, refer to detailed log entries.
1825	0	SYSTEM	CPU fault	Several possible reasons: DAU and CPU software version do not match, firmware update recommended; CPU hardware error; contact hotline if necessary
1826	1	SYSTEM	Data fault	TAR/TPR record cannot be used due to inconsistent DAU data. Check via external or manual trigger if recording is now possible without errors. LED *Data fault* must now be off, if not contact hotline.
1827	0	SYSTEM	OSCOP P communication aborted. Fault no.:	Communication is terminated if there is no user activity for 10 minutes. Otherwise, check the communication link.
2049	0	DAU	Invalid link command requested. Cmd number:	Hotline, install SIMEAS R-PMU firmware or OSCOP P update
2050	2	DAU	Measurement system time set	Measurement system time was set due to change of RTC time. Message appears on device start, too.
2051	1	DAU	Measurement system time could not be set	Hotline
2056	2	DAU	Measurement system started	Measurement system was started after a device start or after the termination of the service mode.
2057	0	DAU	Unable to start measurement system	Hotline
2058	1	DAU	Measurement system stopped	Measurement system was stopped when changing to service mode or due to a hardware fault.
2059	0	DAU	Unable to stop measurement system	Hotline
2064	2	DAU	Recording initiated by manual trigger	-
2065	0	DAU	Recording not initiated by manual trigger	Hotline
2066	2	DAU	Recording initiated by OSCOP P trigger	-
2067	0	DAU	Recording not initiated by OSCOP P trigger	Hotline
2068	2	DAU	Recording initiated by external start	-
2069	0	DAU	Recording not initiated by external start	Hotline
2070	2	DAU	Recording terminated by external start	-
2071	0	DAU	Recording not terminated by external start	Hotline
2072	2	DAU	Recording initiated by network trigger	-
2073	0	DAU	Recording not terminated by external start	Hotline
2074	2	DAU	Change to normal mode OK	-
2075	0	DAU	Fault during change to normal mode	Hotline
2076	2	DAU	Change to test mode OK	-
2077	0	DAU	Fault during change to test mode	Hotline
2078	2	DAU	Change to lock mode OK	SIMEAS R-PMU can change to lock mode automatically or via control panel or via OSCOP P. Check further log messages for details.
2079	0	DAU	Fault during change to lock mode	Hotline
2306	0	OSCOP	Login could not be performed	Hotline, install SIMEAS R-PMU firmware or OSCOP P update
2307	2	OSCOP	RTC set. New time stamp:	RTC was set via OSCOP P.
2310	2	OSCOP	Test mode activated by OSCOP P	-
2311	0	OSCOP	Fault during change to test mode by OSCOP P	Hotline
2312	2	OSCOP	Normal mode activated by OSCOP P	-

Log No.	Type	Class	Description	Comment
2313	0	OSCOP	Fault during change to normal mode by OSCOP P	Hotline
2314	2	OSCOP	Lock mode activated by OSCOP	-
2315	0	OSCOP	Fault during change to lock mode by OSCOP P	Hotline
2316	1	OSCOP	OSCOP P communication request via V20/ V30 protocol rejected	Make sure to use OSCOP P, version 6.60 or higher and set device type „SIMEAS R-PMU".
2561	2	OSCOP	Logon service mode	Switching from normal mode to service mode; possible reason: Firmware update rejected, parameter or password change rejected
2562	0	OSCOP	Unable to logon for service mode	Hotline
2563	2	OSCOP	Logoff service mode	-
2564	1	OSCOP	Logoff service mode with device reboot	Switching from normal mode to service mode; possible reason: Deleting fault records via OSCOP P, firmware update or parameter changes
2566	1	OSCOP	Incorrect password	-
3120	2	SYNC	External synchronization pulse OK	-
3121	2	SYNC	Device synchronized	-
3122	0	SYNC	Synchronization fault: Pulse loss	Synchronization signal lost. Check the clock incl. antenna, antenna cable and the synchronization signal cable.
3123	1	SYNC	Synchronization: Non-critical pulse failure	Synchronization signal lost for a short time. Check the clock incl. antenna, antenna cable and the synchronization signal cable if this error occurs repeatedly.
3124	0	SYNC	Synchronization fault: Too many non-critical pulse losses	Synchronization signal lost for a short time several times. Check the clock incl. antenna, antenna cable and the synchronization signal cable.
3125	0	SYNC	Synchronization fault: Pulse width invalid	Pulse width of the synchronization signal does not meet the specification. Check parameterization of clock master.
3126	0	SYNC	Synchronization fault: Pulse distance invalid	Pulse gap must be 1 s for GPS/DCF77 or 60 s for minute pulse. Check parameterization of clock master.
3127	0	SYNC	Synchronization fault: DCF77 minute mark not found	No valid DCF77 signal detected. Check parameterization of clock master.
3128	0	SYNC	DCF77 synchronization parity fault:	Check clock master and synchronization signal cable; no valid DCF77 signal detected.
3129	0	SYNC	Synchronization fault: Non-supported Sync-Box 7KE6000-8H* connected	The Sync-Box is supported as of SIMEAS R-PMU firmware V40.01.
3184	2	SYSTEM	DCF77 synchronization-supported	-
3185	1	SYSTEM	Synchronization fault: Manual time setting rejected	Time setting via OSCOP P is not allowed if SIMEAS R-PMU is synchronized via GPS signal.
3186	1	SYSTEM	Manual time setting rejected, minimum distance not observed	Time gap between two time setting commands must be at least 4 hours.
3187	1	SYNC	Leap second announcement received	-
3188	1	SYNC	Leap second	-
3189	2	SYNC	System time zone changed	Device time zone was changed due to a new parameterization or a firmware upgrade.

Log No.	Type	Class	Description	Comment
3216	1	PMU	PMU active	-
3217	2	PMU	PDC communication	-
3218	2	PMU	PMU configuration has changed	-
3220	0	PMU	PMU fault	Hotline
4294967294	1	LOG	Log recorder stopped	-
4294967295	1	LOG	Shutdown log recorder	-

A.4 Abbreviations

AWG	American Wire Gauge
B	Binary
BDAU	Binary Data Acquisition Unit
C	Current
CDAU	Current Data Acquisition Unit
CDR	Continuous DC Recorder
CFR	Continuous Frequency Recorder
CH	Channel
CPR	Continuous Phasor Recorder
CQR	Continuous Power Recorder
CPU	Central Processing Unit
CR	Continuous Recorder
CRR	Continuous RMS-value Recorder
CT	Current Transformer
D	Digital
DAKON	Data Concentrator
DDAU	DC Data Acquisition Unit
ER	Event Recorder
f	Frequency
FACTS	Flexible Alternating Current Transmission System
GPS	Global Positioning System

HVDC	High Voltage Direct Current
ID	Identificator
LAN	Local Area Network
LED	Light-Emitting Diode
FO	Fibre-optic cable
P	Active Power
PAD	Packet Assembly Disassembly
PDC	Phasor Data Concentrator
PMU	Phasor Measurement Unit
Q	Reactive Power
Sym	Symmetrical Components
TAR	Transient Analog Recorder
TPR	Transient Phasor Recorder
TVE	Total Vector Error
UDP	User Datagram Protocol
UTC	Universal Time Coordinated
V	Voltage
VCDAU	Voltage/Current Data Acquisition Unit
VDAU	Voltage Data Acquisition Unit
VT	Voltage Transformer
WAN	Wide Area Network

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Literature

/1/   SIMEAS R-PMU, Maintenance Manual
        E50417-X1074-C364-A1

/2/   OSCOP P, Manual
        E50417-H1076-C171-A1

/3/   SIMEAS R V2/V3, Manual
        E50417-B1076-C209-A1

Index