SIEMENS

Energy Automation

Power Quality and Measurements Product Catalog

Catalog SR 10 · Edition 2

Answers for infrastructure and cities.

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As of January 2012 some product names have been changed.
Modified names are **blue colored** in the table below.

Substation Automation	
old	**new**
SICAM PAS	SICAM PAS
SICAM PAS CC	**SICAM SCC** (Station Control Center)
SICAM Station Unit	SICAM Station Unit
SICAM Diamond	SICAM Diamond
SICAM PQ Analyzer (Incident Explorer)	SICAM PQ Analyzer (Incident Explorer)
SICAM TM 1703 mic	**SICAM MIC**
SICAM TM 1703 emic	**SICAM EMIC**
SICAM TM 1703 ACP	**SICAM TM**
SICAM AK 1703 ACP	**SICAM AK**
SICAM BC 1703 ACP	**SICAM BC**
Toolbox II	**SICAM TOOLBOX II**
SICAM DISTO	SICAM DISTO
SICAM Protocol Test System	SICAM Protocol Test System
I/O Unit	**SICAM I/O Unit**

Power Quality and Measurements	
old	**new**
SICAM PQS	SICAM PQS
SICAM PQ Analyzer	SICAM PQ Analyzer
SIMEAS T	SIMEAS T
SIMEAS P50/500/600	**SICAM P50/500/600**
SIMEAS P Par	**SICAM P Manager**
SIMEAS Q80	**SICAM Q80**
SIMEAS Q80 Manager	**SICAM Q80 Manager**
SIMEAS R	SIMEAS R
SENTRON T	**SICAM T**
DAKON PQS	DAKON PQS
SIGUARD PDP	SIGUARD PDP

Small Control Center	
old	**new**
SICAM 230	SICAM 230

Contents

Power Quality and Measurements Product Catalog

Energy Automation

Catalog SR 10 · Edition 2

Invalid: Catalog SR 10 · V1.0

ISO 9001
ISO 14001
DNV
Certified Company

OHSAS 18001
DNV
Certified Company

The products and systems described in this catalog are manufactured and sold according to a certified management system (acc. to ISO 9001, ISO 14001 and BS OHSAS 18001).

1

Make power quality visible – Smart grids always with power quality

Electrical power is becoming more important as an energy resource. The global demand for electrical energy is increasing day per day in the same time electrical power supply systems are facing new challenges. The increasing infeed of renewable energy resources such as wind, solar, hydro, and increasing demand of energy efficiency actions in order to meet environmental protection regulations, e.g. CO_2 reduction, in combination with regional power supply systems of different utilities and the liberalization of the energy market, are only a few challenges for our modern power supply networks.
To meet all these challenges, a lot of measures have to be taken into account:

- Power system automation, as in smart grids
- Load shedding and other load control techniques such as demand response mechanisms to manage a power system. (i. e. directing power where it is needed in real-time)
- Increasing the reliability of the power grid by detecting faults early, allowing for isolation of operative system, and the prevention of power outages.
- Increasing the power quality by precise analysis and automated correction of sources of system degradation.
- Wide area measurement and control, in wide area grids, regional transmission networks, and local distribution grids.

Evergy country or even every region has its specific behavior of the power grid. Therefore the key to an excellent power supply is, first of all, to know the relevant local system circumstances in detail. In this way, the system health can be determined, adapted and improved in a continuous process.
Using real-time information and reporting functions is essential to anticipate, detect, and respond to system and power quality problems, and service disruptions.
Therefore, reliable data assessment is the first priority in this scenario.
The varieties of available parameters that lead to a wide grid analysis and power excellence is large and can be grouped into the following disciplines:

Grid monitoring

The need for monitoring and recording at the transmission level has been recognized for a long time. The experience with centralized disturbance recording systems has shown how valuable this information is in order to allow for a better understanding of the steady-state and dynamic behavior of the system. Nevertheless, as already explained, the complexity of electrical power systems has increased, and in the actual interconnected power system influences an wide area monitoring has become essential.
Grid monitoring is therefore about the understanding what is going on in particular cases, considering the wide grid circumstances, where fault location, protection behavior and system stability, through phasors measurement monitoring are analyzed. Fault recorders and phasor measurement units (PMU) are devices used for this discipline.

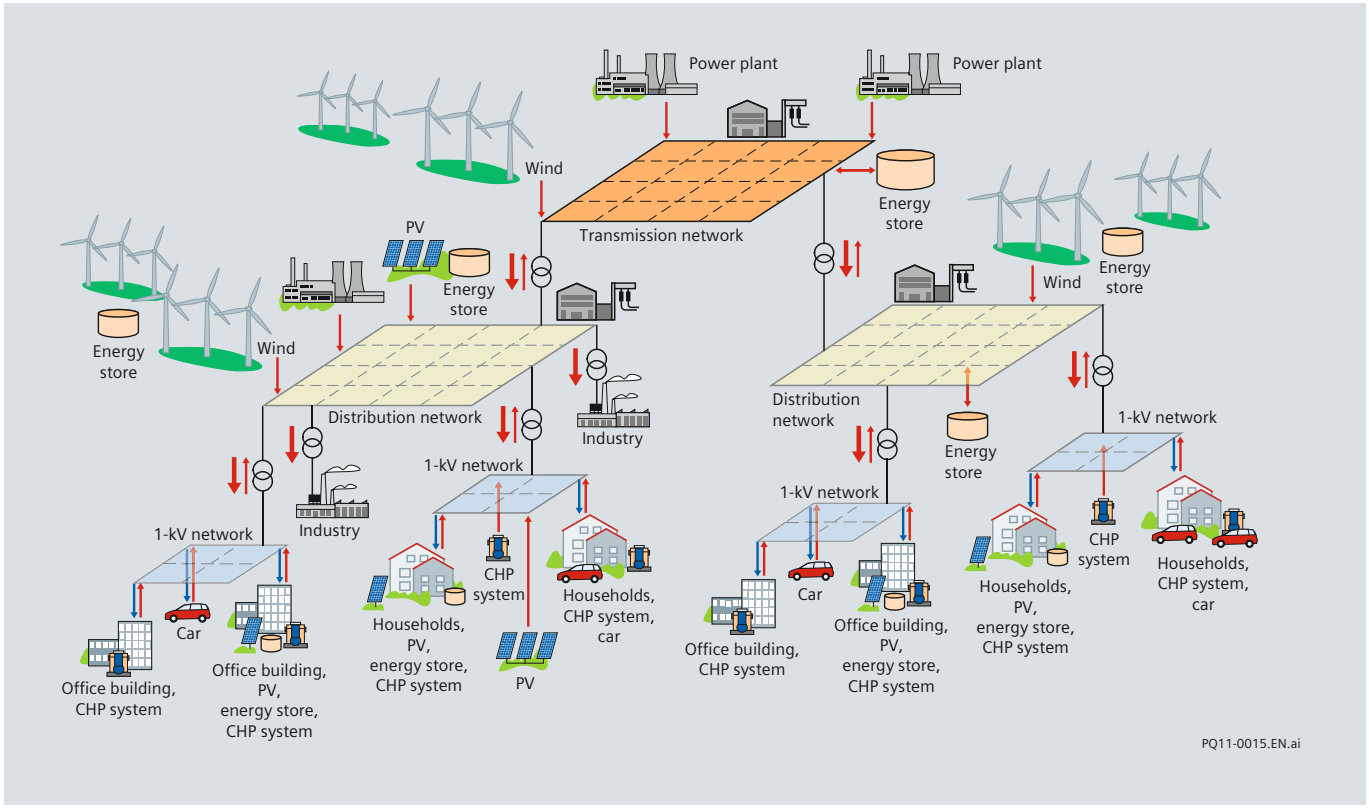

Fig. 1/1 The modern power grid

Power quality monitoring

Power quality is a technical term that has practical an impact on the connected equipment. The electrical power is defined with a certain voltage level, waveform (sinusoidal) and a specific frequency (e.g. 50 Hz), which is generated and transmitted and distributed to the individual load. These loads have an uncomely effect; they can change the quality of the electrical power by influencing the waveform, the frequency or the voltage magnitude, which has subsequently an impact on the connected equipment. In worst case a poor power quality can lead to a system malfunction. Power quality effects are mainly common or mainly produced through large loads (e.g. industrial applications) and/or changings of actual power system status (e.g. switching operations) as well as due to external influences (e.g. lightning). Power quality standards (e.g. EN 50160) are used to define the limits of the electrical quantities allowing connected equipment to work properly without significant loss of performance.

Power quality monitoring as an integral part of technical risk management requires measurement devices and applications to measure, record and evaluate necessary data. For that purpose, power quality recorders and specific evaluation applications are utilized making the power quality of an electrical power supply system visible.

Power monitoring

We use to distinguish power monitoring for operative proposals and economical proposals. Operative proposal is based to monitor energy not for direct billing proposal (e.g. costs per KWh), but electrical parameters for system controlling, e.g. voltage, current, power, power factor, etc. For these tasks, power monitoring devices (e.g. power meters, transducers) are mainly used for capturing interesting data whereby these devices are permanently installed and connected via standard communication interfaces to a monitoring system (control center, substation automation system).

Power monitoring systems support simple monitoring tasks as well as more complex tasks, such as power trending, controlling, and identification of sources of energy consumption and load profiles of power supply segments. They allow cost allocation, and further reduction of energy costs can be carefully targeted to specific equipment.

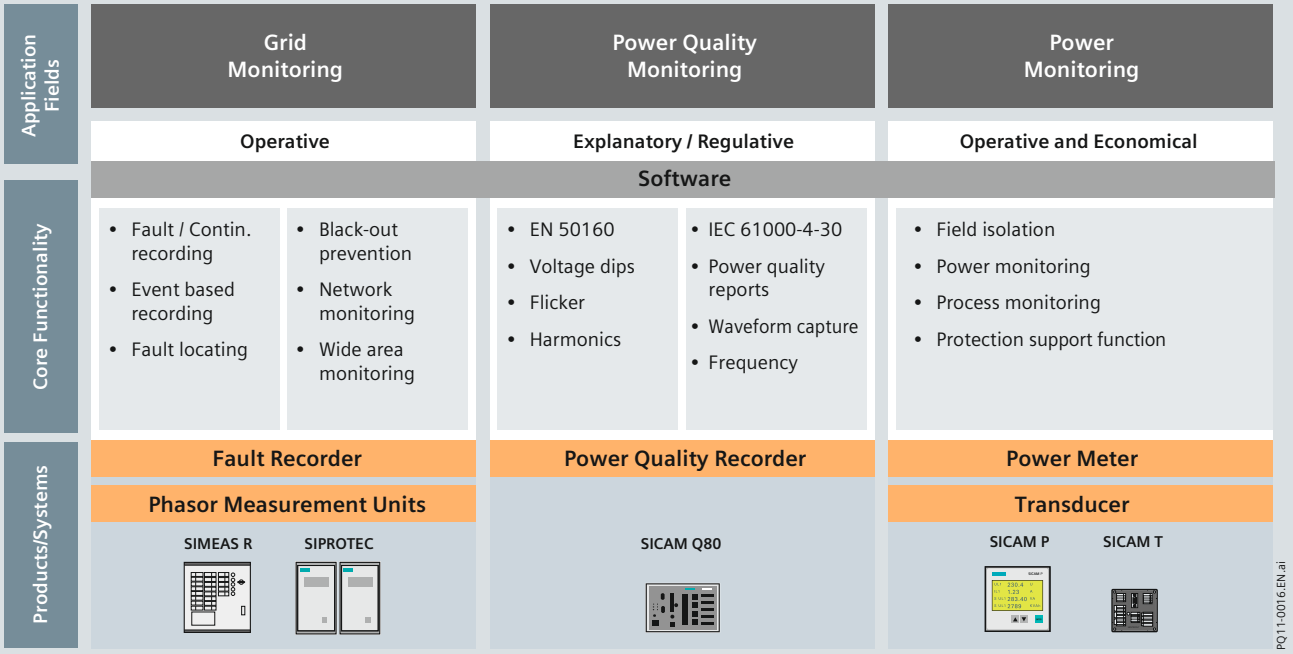

Fig. 1/2 Application and products

Product overview – Power monitoring

The world's increasing demand for electric power calls for highest efficiency and absolute reliability in power networks. Today, currents, voltages and performance values in power distribution systems are routinely measured in order to determine the load. It is important to ensure that no overloading occurs. However, the need for measuring currents, voltages and performance values for the purpose of increasing system availability are nowhere near exhausted. There is tremendous potential here for installing power meters and transducers to support the necessary measurement tasks.
Additionally, Smart Grid technology provides consistent answers to these challenges, but requires use of technologies that can respond to the requirements mentioned. E.g. fast controlling reaction, local monitoring, high accuracy, and open communication for system integration capabilities are essential features in this context.
Siemens power monitoring solutions are designed to match these applications. They are user-friendly, compatible with the latest communication standards, impart long-term reliability, and provide comprehensive power monitoring functionalities.

Fig. 1/4 SICAM T electrical measurement transducer

Power Meter – SICAM P
SICAM P is a power meter for panel or standard DIN-rail mounting that is used for acquiring and/or displaying measured values in electrical power supply systems. More than 100 values can be measured, including phase voltages and currents, active power, reactive power, apparent power, symmetry factor, voltage and current harmonics, energy output, as well as external signals and states. SICAM P shows this data on the graphic display and transfers it to a central computer system for further processing via either PROFIBUS DP or MODBUS RTU/ASCII and IEC 60870-5-103.

Fig. 1/3 SICAM P – Power meters

In addition, measured values, including time information, can be stored in the memory. This information can be read out with the SICAM P Manager parameterization software, displayed, evaluated, and converted to csv data or COMTRADE format.

Electrical measurement transducer – SICAM T
Power transducer applications are not new to electrical systems, but today more than ever they are required to deliver precise and fast measurement data. They need to be user-friendly, compatible with the latest communication standards, impart long-term reliability, and provide comprehensive functionality at a reasonable price. This is exactly what the Siemens SICAM T has to offer. It makes 60 measured or calculated parameters available, and any of these figures can be assigned to each of the SICAM T's four analog outputs with 120 ms response time for 50 Hz signals. Its comprehensive communication abilities make SICAM T the power transducer of first choice for utilities as well as for industry customers. They include MODBUS TCP, MODBUS RTU, IEC 60870-5-103 and IEC 61850, which allow seamless system and SCADA integration through Ethernet or RS485.
External time synchronization via Ethernet NTP or via field bus using MODBUS RTU or IEC 60870-5-103 is also available. Thanks to its comprehensive on-board parameterization and visualization tool, the user friendly SICAM T can easily be parameterized and operated through the Web browser of any PC or notebook without the need for any extra software installation.

Application area		Voltage	Current	Power	Frequency	Phase angle	Harmonics	Energy	Alarm	Internal cost allocation
Generation	Generator	●	●	●	●	●		●	●	
Transmission substation	Incoming line	●	●	●						
	Outgoing line	●	●	●						
Transformer substation	Incoming line	●	●	●						
	Bus	●			●			●		
	Feeder	●	●	●	●			●		
Transformer distribution	Incoming line	●	●	●	●		●	●		
	Bus	●			●			●		
	Feeder	●	●	●	●			●		
Processes / Applications	SCADA / EMS / DMS	●	●	●	●	●		●	●	
	Energy management	●	●	●	●	●	●	●	●	●
	Motors	●	●	●	●	●	●	●	●	●
	Commercial (e.g. air conditioning)	●	●	●					●	●

Table 1/1 Application examples

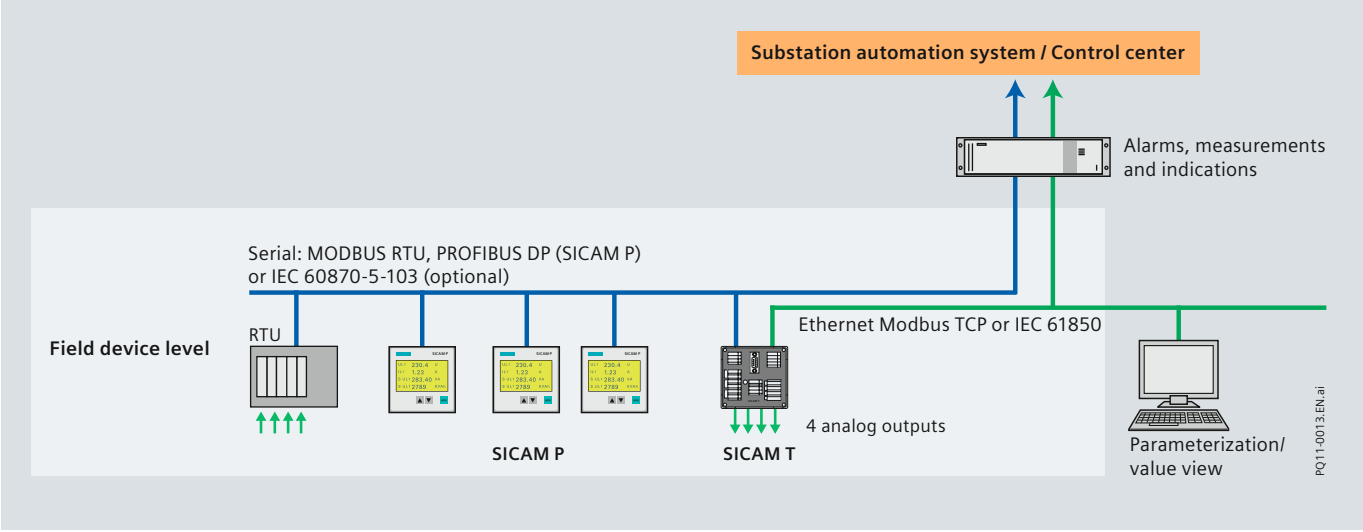

Fig. 1/5 System overview

Product overview – Power monitoring

	SICAM P		SICAM T
			
	P50	**P55**	**V2**
Applications	Power meter	Power meter	Transducer and data Generator
Display	●		
Parameterization and visualization	SICAM P Manager Software	SICAM P Manager Software	PC-Web browser
Housing in mm / inch	96 × 96 / 3.78 × 3.78	96 × 96 / 3.78 × 3.78	96 × 96 / 3.78 × 3.78
Mounting	Panel	Snap-on mounting on 35 mm/3.78 in. DIN rail	Snap-on mounting on 35 mm/3.78 in. DIN rail
Degree of protection	IP41 / IP65	IP20	IP20
Measurement methode			
True r.m.s.	Every 500 ms	Every 500 ms	Continuous
Measurement function			
Voltage, current, frequency active, reactive, apparent power and energy, phase angle, cos φ	●	●	●
Limit violation and logical grouping	Binary indication	Binary indication	Binary indication
Simple power quality	Harmonics (V, I) up to 19th, unbalanced, THD V/I	Harmonics (V, I) till 19th, unbalanced, THD V/I	
Osciloscope function	●	●	
Mean / min. / max. values in memory	●	●	
Energy	Counter	Counter	Counter
Log entries	●	●	●
Number of slots for additional modules	1	1	1
I/O options			
Binary outputs → standard + additional option	2 + 2	2 + 2	2
Binary input (option)	2	2	
Analog outputs (option)	2	2	4
Reaction of analog output	Up to 500 ms	Up to 500 ms	Up to 120 ms
Analog inputs (option)	2	2	
Relay outputs (option)	3	3	
Synchronization			
Real time clock	●	●	●
Field bus	●	●	●
NTP (Network Time Protocol)			●
Communication protocol RS485 Interface			
MODBUS RTU/ASCII	●	●	optional
PROFIBUS DP V1	●	●	
IEC 60870-5-103	●	●	optional
Ethernet			
MODBUS TCP			●
IEC 61850			●
UL listing			●

Table 1/2 Overview of power monitoring devices

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Energy Automation

SICAM P
Power Monitoring Devices

Answers for infrastructure and cities.

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Contents – SICAM P

Overview

SICAM P is a power meter for panel mounting with graphic display and background illumination, or for standard rail mounting, used for acquiring and/or displaying measured values in electrical power supply systems.
More than 100 values can be measured, including r.m.s. values of voltages (phase-to-phase and/or phase-to ground), currents, active, reactive and apparent power and energy, power factor, phase angle, harmonics of currents and voltages, total harmonic distortion per phase plus frequency and symmetry factor, energy output, as well as external signals and states.
SICAM P is available with mounting dimensions of 96 mm × 96 mm/3.78 in. x 3.78 in. and can be ordered with or without display.
The SICAM P comes standard with two binary outputs, which can be configured for energy counters, limit violations or status signals. By ordering, SICAM P can be fitted with 1 additional analog input or output module.
The unit is also able to trigger on settable limits. This function can be programmed for sampled or r.m.s. values. SICAM P generates a list of minimum, average and maximum values for currents, voltages, power, energy, etc. Independent settings for currents, voltages, active and reactive power, power factor, etc. are also possible. In case of a violation of these limits, the unit generates alarms. Up to 6 alarm groups can be defined using AND/OR for logical combinations. The alarms can be used to increase counter values, to trigger the oscilloscope function, to generate binary output pulses, etc.

Function overview

- Measurement of voltage, current, active & reactive power, frequency, active & reactive energy, power factor, symmetry factor, voltage and current harmonics up to the 21st, total harmonic distortion.
- Single-phase, three-phase balanced or unbalanced connection, four-wire connection
- Communications: PROFIBUS-DP, MODBUS RTU / ASCII or IEC 60870-5-103 communication protocol
- Simple parameterization via front key or RS485 communication port using SICAM P Manager software
- Graphic display with background illumination with up to 20 programmable screens
- Real-time clock: Measured values and states will be recorded with time stamps.
- 1 MB memory management: The allocation of the non-volatile measurement memory is programmable.
- Recording and display of limit value violations and log entries.
- Battery: Recordings like limit value violations or energy counter values stay safely in the memory up to 3 months in case of a blackout.

Fig. 2/1 SICAM P – power meter

Applications

Power monitoring systems with SICAM P, a permanently installed system, enables continuous logging of energy-related data and provides information on operational characteristics of electrical systems. SICAM P helps identify sources of energy consumption and time of peak consumption. This knowledge allows to allocate and reduce energy costs.
The major application area is power monitoring and recording at MV and LV level. The major information types are measured values, alarms and status information.

Description of SICAM P

Measuring functions

Measured input voltages and input currents are sampled for calculation of the corresponding r.m.s. values. All parameters derived from the measured values are calculated by a processor. They can be displayed on the screens and/or transmitted via the serial interface.
Measurement of voltage, current, active & reactive power, frequency, active & reactive energy, power factor, symmetry factor, voltage and current harmonics up to the 21st, total harmonic distortion are available.
With the SICAM P it is also possible to define several limit value groups with different limit values for the measured parameters. These can be combined with logical elements, such as AND, OR. Violations are counted and indicated on the screen or made available at the binary outputs. Triggering of the oscilloscope is possible as well.

Quality

Development and production of the device is carried out in accordance with ISO 9001, ensuring highest quality standard. That means high system reliability and product service life. Further characteristics are the constant high accuracy over years, CE designation, EMC strength, as well as the compliance with all relevant national and international standards.

Description

Technology
Powerful on-board microprocessors ensure fast registration and updating of measured parameters.
SICAM P can be connected to any power system configuration directly (up to 690 V systems) or via transformer – from single-phase to four-wire balanced or unbalanced three-phase systems. SICAM P can be connected to any power system configuration up to 1 or 5 A or via current transformer.
The power supply unit allows rated supply voltages from 24 to 250 V DC and 100 to 230 V AC.

Communication
As communication between field devices is becoming standard, the development of the SICAM P communication interface is focused on the universality and flexibility of the transmission protocol. It is connected via an RS485 port with standard 9-pin SUB-D connector.
The SICAM P comes with the following standard communication protocols:
- PROFIBUS-DP V1 in compliance with EN 50170 Volume 2 and MODBUS RTU/ASCII
- MODBUS RTU/ASCII and IEC 60870-5-103.

Limit values
Several limit value groups with up to 6 selectable parameters can be set in SICAM P. The values can be combined with logical elements such as AND/OR; limit value violations are counted, they are available at binary outputs or used for triggering the oscilloscope.

Inputs /Outputs
Figure 2/2 shows the I/O pin configuration of SICAM P. Depending on the type of power system, the non required inputs remain unassigned.

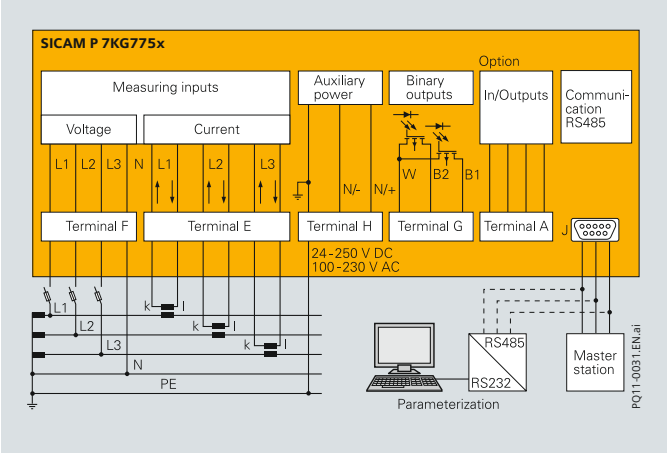
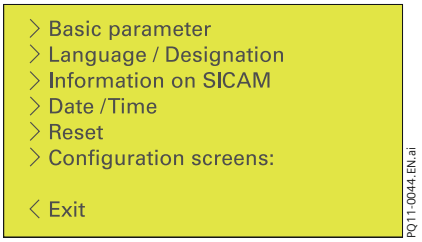
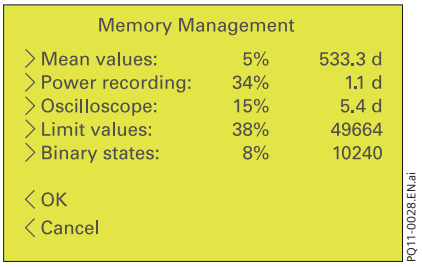


Fig. 2/2 SICAM P: Input/outputs

Configuration
Configuration of SICAM P is very easy. It can be done directly over the device display (if available) or over the SICAM P Manager parameterization software. Rapid configuration (even without consulting the manual) is possible due to detailed index and operation via cursor and enter key. Configuration and calibration settings are tamper-proof by password protection.



Memory management
Due to the memory capacity (1 Mbyte) and the implemented memory management, it is possible to freely configure the measurement memory for mean values, power recordings, oscilloscope, limit value violations and binary states.
After the assignment of the percentage, the corresponding record time will be calculated and shown on the display automatically.



Memory “read-out”
Recorded quantities and binary state information can be read out with the configuration software SICAM P Manager using the RS485 interface. This requires a separate cable together with an RS232/RS485 converter. The configuration software offers features for indication and evaluation of all saved measured values and binary information.
For further information, please refer to the chapter “SICAM P configuration software package”.

Display and screens

All parameters can be displayed on the SICAM P screens as required by the user. Up to 20 screens can be defined and selected with the front keys. Switching from one screen to another can be automatic or manual.

Clear designations as well as menu-driven configuration guarantee simple and easy operation of the SICAM P screens. Number, type, content and sequence of the screens are configurable, e.g.:

- 2, 3, 4 or 6 measured values in one screen
- One list screen for minimum, average and maximum values
- Screens for harmonics
- Screen serving as phasor (vector) diagram.

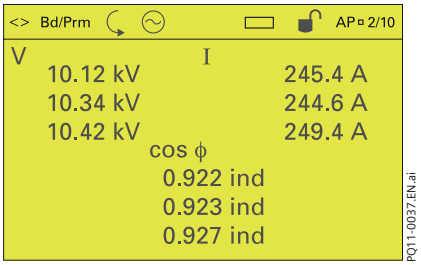
Due to a wider graphical display, some display functions such as analog screen, oscilloscope, r.m.s. curve, harmonic are available.

SICAM P is delivered with programmed default settings.

A status line displayed in the measured value screens indicates status, interfacing and diagnostic messages of SICAM P. The display is automatically refreshed every 1 s.

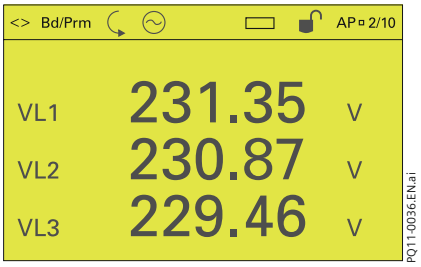
List of screens examples

3-phase screen values



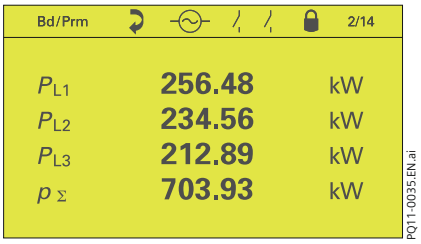
V, I, cos φ

Digital values screen



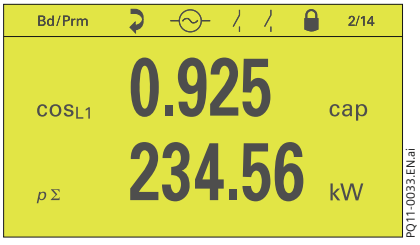
3 measured values
– digital / analog

Digital / Analog screen



4 measured values
– digital

Digital values screen



2 measured values
– digital

Measured values and tolerances

Measured values	Measuring path [1]	Output to	Tolerances [2]
Voltage	L1-N, L2-N, L3-N, (N-E)	▼ ■ ● ○	±0.1 % [2] / ±0.3 % [6]
Voltage	L1-L2, L2-L3, L3-L1, Σ [3]	▼ ■ ● ○	±0.1 % [2] / ±0.3 % [6]
Current	L1, L2, L3, N, Σ [3]	▼ ■ ● ○	±0.1 % [2] / ±0.3 % [6]
Active power P + import, - export	L1, L2, L3, Σ	▼ ■ ● ○	±0.5 %
Reactive power Q + cap, - ind	L1, L2, L3, Σ	▼ ■ ● ○	±0.5 %
Apparent power S	L1, L2, L3, Σ	▼ ■ ● ○	±0.5 %
Power factor $\lvert\cos\varphi\rvert$ [4]	L1, L2, L3, Σ	▼ ■ ● ○	±0.5 %
Active power factor $\lvert\cos\varphi\rvert$ [4]	L1, L2, L3, Σ	▼ ■ ● ○	±0.5 %
Phase angle [4]	L1, L2, L3, Σ	▼ ■ ● ○	±2 °
Frequency [5]	L1-N	▼ ■ ● ○	±10 mHz
Active energy demand	L1, L2, L3, Σ	▼ ■ ○	±0.5 %
Active energy supply	L1, L2, L3, Σ	▼ ■ ○	±0.5 %
Active energy, total	L1, L2, L3, Σ	▼ ■ ○	±0.5 %
Active energy Σ, total	Σ	▼ ■ ○	±0.5 %
Reactive energy, inductive	L1, L2, L3, Σ	▼ ■ ○	±0.5 %
Reactive energy, capacitive	L1, L2, L3, Σ	▼ ■ ○	±0.5 %
Reactive energy, total	L1, L2, L3, Σ	▼ ■ ○	±0.5 %
Apparent energy	L1, L2, L3, Σ	▼ ■ ○	±0.5 %
Unbalance voltage	four-wire system	▼ ■ ● ○	±0.5 %
Unbalance current	four-wire system	▼ ■ ● ○	±0.5 %
THD voltage	L1, L2, L3	▼ ■ ● ○	±0.5 %
THD current	L1, L2, L3	▼ ■ ● ○	±0.5 %
Harmonic voltage V 3rd, 5th, 7th, 11th, 13th, 17th, 19th, 21st	L1, L2, L3	▼ ■ ● ○	±0.5 %
Harmonic current I 3rd, 5th, 7th, 11th, 13th, 17th, 19th, 21st	L1, L2, L3	▼ ■ ● ○	±0.5 %
Limit value violations	counter 1, 2, 3, 4	▼ ■	
Analog inputs	external	▼ ■	
Binary inputs	external	▼ ■	

▼ Measured values can be displayed on measured-value screens
■ Measured values transmitted via communication protocols PROFIBUS DP + MODBUS
● Measured values selectable for list screens
○ Measured values transmitted via IEC 60870-5-103

1) Phases are displayed based on the type of connection.
2) Tolerances at reference conditions are applicable from 0.5 to 1.2 times nominal value.
3) Average value of all phases.
4) Measuring beginning with 2 % of the internal apparent power.
5) Measuring beginning with 30 % of the input voltage L1-N.
6) Limit values for the complete temperature range referring to: 0.1 to 1.2 times nominal range.

Table 2/1 Measured values and tolerances

SICAM P50/P55

Input and output modules

SICAM P50/P55 can be equipped with additional analog or digital input or output modules. SICAM P50/P55 comes with 1 slot where the module may be installed. For different application areas, 5 different modules are available.

Application

The input modules can be used for acquisition, display and further processing of external signals with a measurement range of 0 - 20 mA_{DC}.
Measured values can be shown together with their units on the display. Transmission of the current status of a measured signal to a central master station via PROFIBUS-DP V1, MODBUS RTU / ASCII or IEC 60870-5-103 is also possible.
In addition, mean values of all external analog channels as well as states of digital channels can be recorded and saved into the memory.
All recorded quantities and binary state information can be "read out" and evaluated with the configuration software SICAM P Manager.
Output modules can be used for conversion of any electrical quantity (current, voltage, etc.) into a 0 - 20 / 4 - 20 mA_{DC} output signal, generation of impulses for metering, indication of limit value violations, as well as for switching operations.

Module assignment

The assignment of the different analog/digital modules can only be done in the course of an order of a SICAM P.
A change or a retrofit of modules of an existing SICAM P is not possible.

Fig. 2/4 shows an example of extended I/O for various applications.

Fig. 2/3 SICAM P55

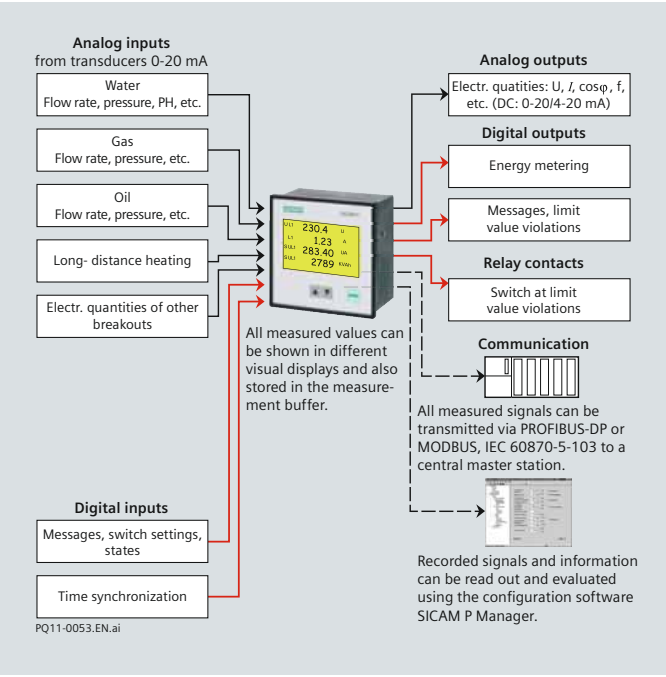


Fig. 2/4 SICAM P: Applications

Description of I/O modules

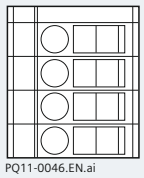
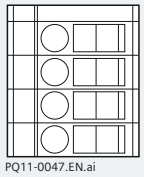
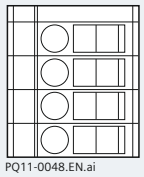
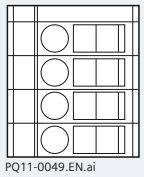
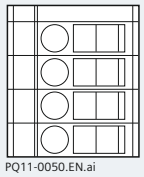
Description and applications	Terminal	Assignment
Analog input module SICAM P can be equipped with a maximum of 1 analog input module. Each module comes with 2 analog input channels, designed for a rated measurement range of 0 to 20 mA_{DC}. The modules themselves are galvanically isolated against the internal circuit. The two channels of the module are not galvanically isolated against each other. The analog input modules can be used for: – Acquisition and display of measured signals with a measurement range of 0 to 20 mA_{DC} – Registration of limit value violations	 PQ11-0046.EN.ai	1 AI1+ 2 AI1- 3 AI2+ 4 AI2-
Binary input module SICAM P can be equipped with a maximum of 1 binary input module. Each module comes with 2 galvanically isolated and rooted binary input channels. The input voltage will be transformed into a constant current. The binary input modules can be used for: – Registration of binary states/messages – Time synchronization of SICAM P	 PQ11-0047.EN.ai	1 BI1+ 2 BIR 3 BIR 4 BI2+
Analog output module SICAM P can be equipped with a maximum of 1 analog output module. The module comes with 2 channels, designed for a rated measurement range of 0 to 20 mA_{DC}. The module itself is galvanically isolated against the internal circuit. The two channels of the module are not galvanically isolated against each other. The analog output modules can be used for: – Output of electrical quantities (current, voltage, power φ, $\lvert\cos\varphi\rvert$, frequency, etc.) between a rated measurement range of 0 to 20 mA_{DC} or 4 to 20 mA_{DC}	 PQ11-0048.EN.ai	1 AO1+ 2 AO1- 3 AO2+ 4 AO2-
Binary output module SICAM P can be equipped with a maximum of 1 binary output module. The module comes with 2 rooted binary output channels, realized with 2 solid-state contacts. The binary output modules can be used for: – Generation of impulses for metering – Indication of limit value violations – Indication of the device status – Indication of the rotation vector	 PQ11-0049.EN.ai	1 BOR 2 BO1+ 3 BO2+ 4 unused
Relay output module SICAM P can be equipped with a maximum of one relay output module. The relay output module comes with 3 rooted electromechanical contacts. With these contacts, higher power can be switched which is not possible when using the solid-state contacts. The relay contacts can be configured in the same manner as the channels of the binary output module. The relay contacts can be used: – As a switch at limit value violations, e.g. compensation of reactive power	 PQ11-0050.EN.ai	1 RO1 2 RO2 3 RO3 4 ROR

Table 2/2 Description of I/O modules

Configuration software

Application

The SICAM P configuration software package enables a simple way to carry out the device settings. The package consists of the parameterizing software, a configuration cable with RS232/RS485 converter, as well as a plug-in power supply for the converter. The SICAM P can be connected to any standard PC via the RS232/RS485 converter by means of a 9-pin SUB-D connector.
The software runs with Windows 2000 and XP Professional edition.
The configuration software permits a faster configuration of the SICAM P devices. The user can set and store parameters even without having a unit by his side. The parameters are transferred to the SICAM P by using the "Send to unit" command. Thus, a number of SICAM P units can be configured with minimum effort. The stored set of parameters is simply reloaded when a unit has to be replaced. Furthermore, firmware updates can be reloaded by means of the SICAM P configuration software.
The configuration package supports all SICAM P units and is absolutely essential for the devices SICAM P55.

Configuration of the measurement memory

Devices with measurement buffer offer the opportunity to record measured quantities and state information. Therefore, the configuration software enables menu items for the determination of values and state information which should be recorded.

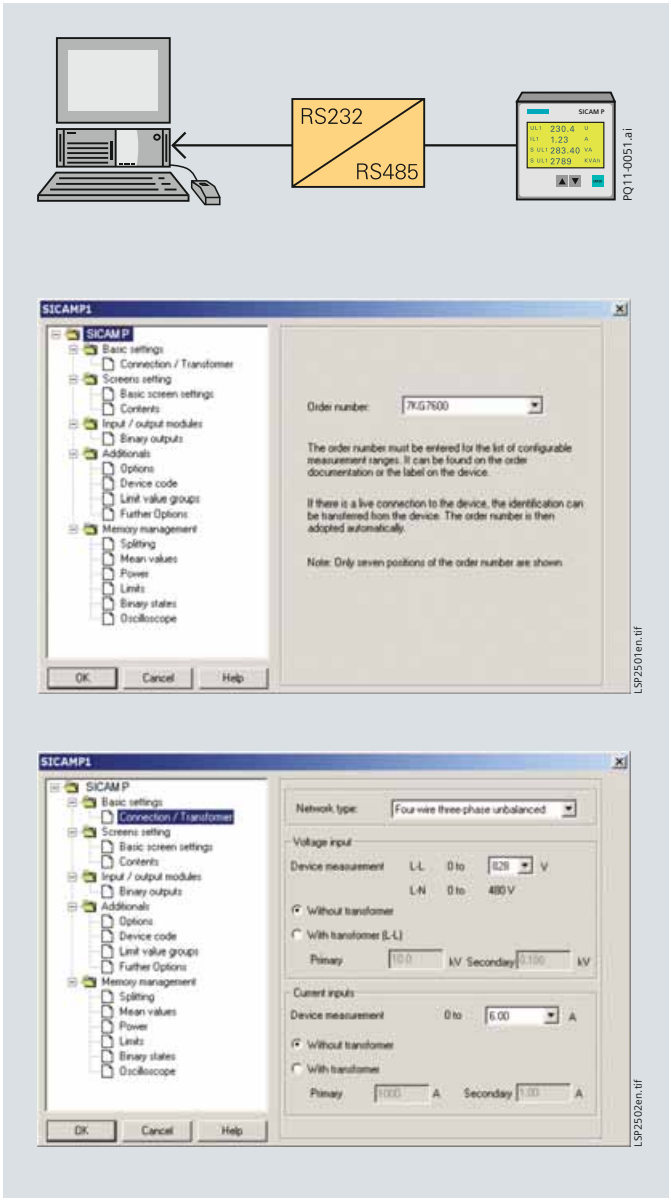


Fig. 2/5 Configuration

Memory read-out *(Fig. 2/6)*

Separate functions integrated in the configuration software, enable a read-out of the following information:

- Mean values
- Mean values of power
- Oscilloscope recordings
- State information of binary channels
- Limit value violations
- Log entries

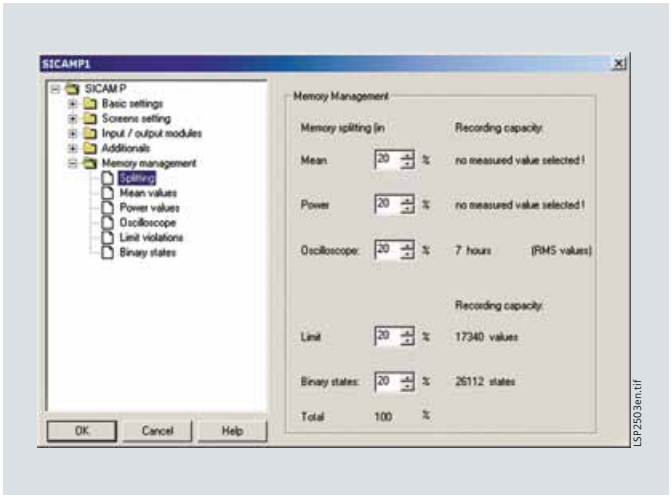


Fig. 2/6 Configuration of the measurement memory

Configuration software

Display and evaluation *(Fig. 2/7 / Fig. 2/8)*
All values and information read out via the software are shown automatically in tabular and graphical form together with the time stamp on the screen.
The context menu offers some functions (masking of signals, copy, zoom, measuring functions) for easy analysis of measured values and state information.
The following measured values can be shown in graphical form:

- Mean values of voltage and current
- Mean values of power
- Oscilloscope recordings
- State information of binary channels

The following information is shown in tabular form:

- Limit value violations
- Log entries

Export function
The software also enables a function for the export of transmitted values and state information into an ASCII file. This ASCII file can be used in other applications, e.g. MS-Excel. Oscilloscope recordings can be exported into COMTRADE formatted files.

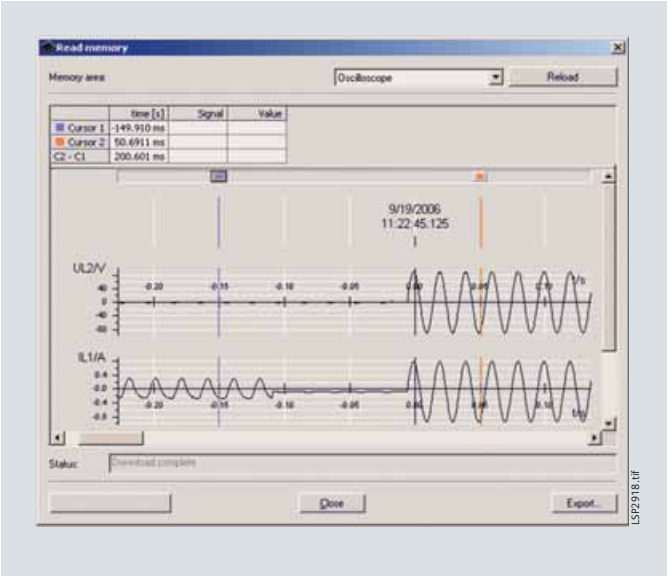


Fig. 2/7 Oscilloscope view for evaluation

Fig. 2/8 Display and evaluation

Application

Application example 1 *(Fig. 2/9)*
SICAM P as a panel-mounted device for direct electrical power monitoring.
With a very simple configuration, the display of measured values is adaptable to the specific requirements of the user.

Application example 2 *(Fig. 2/10)*
SICAM P as a panel-mounted or snap-on mounted device for use on a process bus.
Network linking is possible with the integrated RS485 port with the standard PROFIBUS-DP and MODBUS RTU/ASCII communication protocol. Furthermore, it is also possible to integrate SICAM P50 into communication networks with IEC 60870-5-103 as standard protocol. That allows several SICAM P measured parameters to be indicated, evaluated and processed at a central master station.
The major application area is the integration into PLC systems as a transducer.

Application example 3 *(Fig. 2/11)*
SICAM P can be ordered for snap-on mounting on a 35 mm/1.38 in. DIN rail. For carrying out the setting of the device, the configuration software is necessary.

Benefits
A properly designed and installed monitoring system with SICAM P has numerous benefits, including:

- Environment
  A better knowledge of how energy is used within a facility allows to identify an array of prospects to improve efficiency, minimize waste, and reduce energy consumption, thereby allowing the facility to be a better steward of its allotted natural resources.
- Reliability
  Assessment of data in the master station through PROFIBUS-DP, MODBUS RTU/ASCII or IEC 60870-5-103 protocols from the SICAM Ps can reveal existing or imminent issues that can affect the operation and product within a facility. Historical data from power monitoring systems can help locate and optimize the productivity.
- Safety
  Monitoring systems can limit the exposure of personnel to potentially hazardous electrical environments by providing remote status and operational parameters of equipment within hazardous areas. Some monitoring devices also offer a variety of additional parameters (temperature, pressure, flow rate, vibration, status indicators, etc.) through the use of I/O modules of the SICAM P.
- Financial
  Each benefit discussed above either directly or indirectly influences a business' bottom line. In most cases, the monetary impact from even one or two benefits can quickly justify the purchase and installation of a power monitoring system with SICAM P.

Fig. 2/9 SICAM P with graphic display for panel mounting

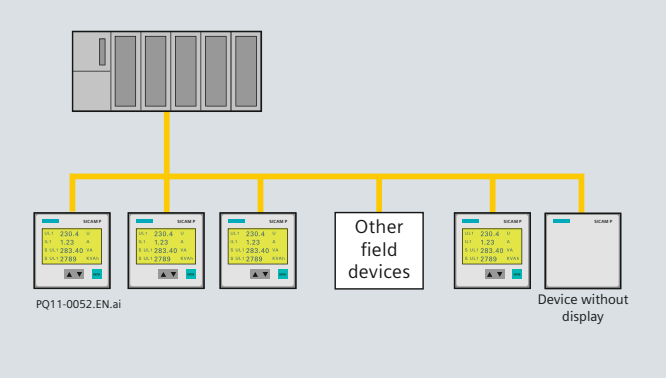


Fig. 2/10 SICAM P with PROFIBUS-DP, MODBUS and IEC 60870-5-103

Fig. 2/11 SICAM P55

Typical terminal assignments

Typical terminal assignments

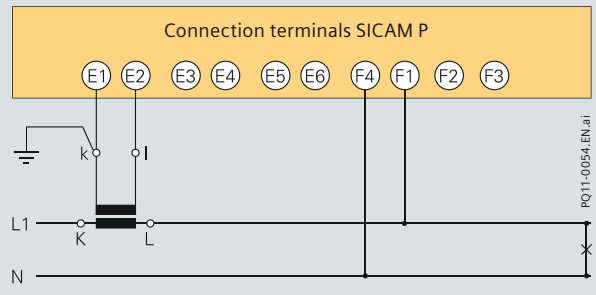


Fig. 2/12 Single-phase AC

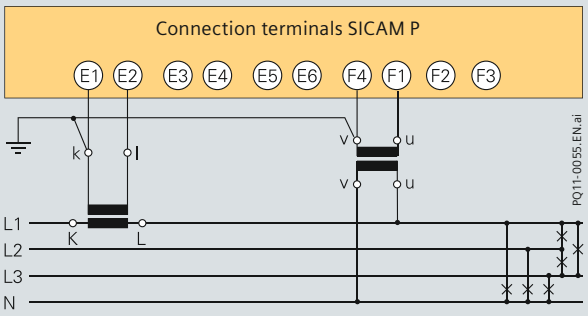


Fig. 2/13 4-wire 3-phase balanced

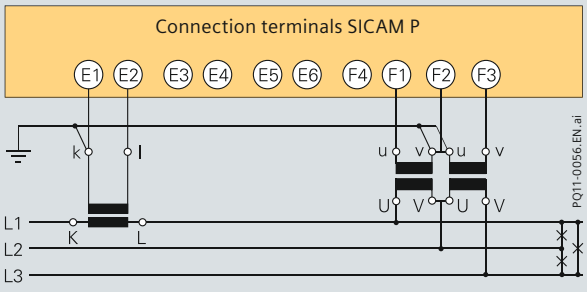


Fig. 2/14 3-wire 3-phase balanced

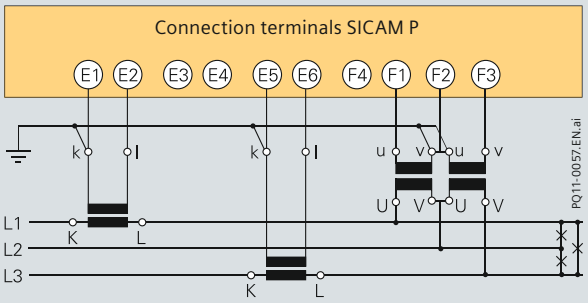


Fig. 2/15 3-wire 3-phase

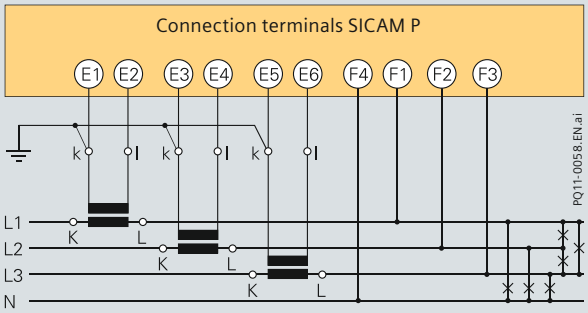


Fig. 2/16 4-wire 3-phase (low-voltage system) [1), 2)]

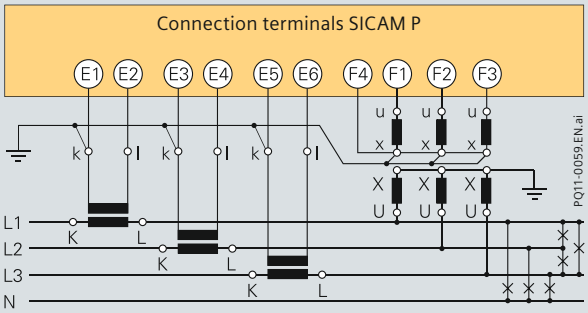


Fig. 2/17 4-wire 3-phase (high-voltage system)

The above-mentioned terminal assignments are just some configuration examples. Within the range of the permissible maximum current and voltage values, a current or voltage transformer is not compulsory.
On the other hand, Y or V-connected voltage transformers can be used.
All input or output terminals not required for measurement remain unassigned.

Remarks regarding low-voltage applications:

1) Up to V_{LN} = 480 V, the SICAM P can be connected directly without a transformer. In three- and four-phase systems, except for three-phase systems without neutral: SICAM P can also be connected directly without a transformer up to V_{LL} = 690 V.
2) In IT low-voltage systems SICAM P50 has to be connected via voltage transformer to avoid false alarm of isolator monitoring

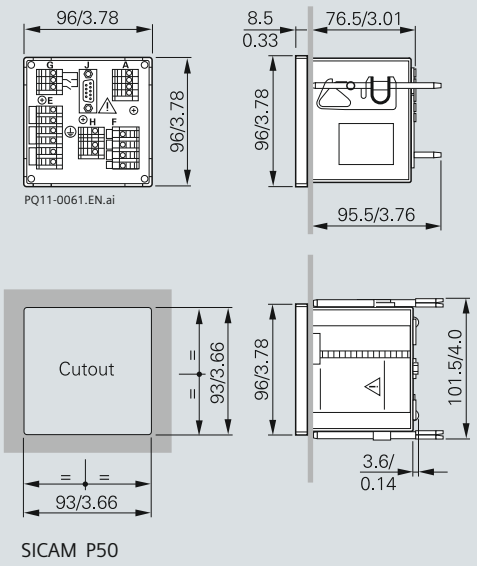
Input	for connection to AC systems only
Max. rated system voltage	Y 400 / Δ 690 V
Control range	1.2 V_{EN}/I_{EN}
Rated frequency f_{EN}	50 Hz; 60 Hz
Input frequency range f_E	±5 Hz, min >30 % V_{EN}
Waveform	sinusoidal or distorted up to the 21st harmonic
AC current input I_E	3 current inputs
Rated input current I_{EN}	1 A; 5 A
Continuous overload	10 A
Surge withstand capability	100 A for 1 s
Power consumption	83 µVA at 1 A; 2.1 mVA at 5 A
AC voltage input V_E	3 voltage inputs
Rated voltage V_{EN}	100 / 110 V; 190 V; 400 V; 690 V (phase-phase)
Continuous overload capacity	1.5 V_{EN}
Surge withstand capability	2.0 × V_{EN}
Input resistance	2.663 MΩ
Power consumption	120 mW (V_{LE} = 400 V)
Surge voltage category	acc. to DIN EN 61010 Part 1
V_{EN} to 400 V (phase-earth)	III
V_{EN} to 690 V (phase-phase)	II
Auxiliary power	multi-range power supply AC / DC
Rated range	24 to 250 V DC or 100 to 230 V AC
Total range	±20 % of rated range
Power consumption	
7KG775	max. 4 W or 10 VA
Binary outputs	via isolated solid-state relay
Permissible voltage	230 V AC; 400 V DC
Permissible current	100 mA continuous 300 mA for 100 s
Output resistance	50 Ω
Permissible switching frequency	10 Hz
Measurement functions	
Sampling rate	3.6 kHz
Resolution	12 bit
Battery	
7KG77	Varta CR2032, 3 V, Li-Mn or similar
Real-time clock	
Deviation	150 ppm
Communication interface	
Termination system	9-pin SUB D connector
Transmission rate	12 Mbit/sec max. with PROFIBUS, MODBUS RTU / ASCII
Transmission protocols parameterizable	RS485 internal – PROFIBUS-DP and IEC 60870-5-103 MODBUS RTU / ASCII
Ambient temperature	acc. to IEC 60688
Operating temperature range	0 °C to +55 °C
Storage / transportation temperature range	-25 °C to +70 °C
Climatic	EN 60721-3-3 rare easy dewfall
Utilization category	IR2 (environment)
Dielectric strength	
Acc. to IEC 60688	5 kV 1.2 / 50 µs

Table 2/3 Technical data

Unit design	
Housing construction 7KG7755	Housing for snap-on mounting on a 35 mm/1.38 in. rail according to DIN EN 50022. SICAM P55: IP 41 94 × 94 × 93.6 mm / 3.7 x 3.7 x 3.69 in. (W × H × D)
Housing construction 7KG7750	Panel-mounting housing according to DIN 43700. SICAM P50: IP 41 (front), IP 65 (option) 96 × 96 × 76.5 mm / 3.78 in. x 3.78 in. x 3.01 in. (W × H × D)
Connector elements	Degree of protection IP 20 (terminals)
Auxiliary power	Terminal for cable diameter 2.5 mm²/0.0039 sq in.
Voltage inputs	Terminal for cable diameter 2.5 mm²/0.0039 sq in.
Current inputs	Terminal for cable diameter 4.0 mm²/0.0062 sq in.
Binary outputs	Terminal for cable diameter 2.5 mm²/0.0039 sq in.
RS485 bus interface	9-pin SUB-D connector
Weight	
7KG7750/7KG7755	SICAM P50/P55: approx. 0.60 kg
with 1 I/O module	approx. 0.65 kg
Specification of analog/digital input and output modules	
	7KG775x
Analog input module	
Rated input current	0 - 20 mA_{DC}
Output range	0 - 24 mA_{DC}
Input impedance	50 Ω ± 0.1 %
Power consumption at I_N 0 24 mA	2 × 29 mW
Accuracy	0.5 % of measuring range limit
Binary input module	
Max. input voltage	300 V_{DC}
Max. current at high level	53 mA
Current consumption at high level	1.8 mA
Low level	≤ 10 V
High level	≤ 19 V
Time lag between low-high, high-low	max. 3 ms
Analog output module	
Rated output current	0 - 20 / 4 - 20 mA_{DC}
Output range	0 - 24 mA_{DC}
Max. load impedance	250 Ω
Accuracy	typ. 0.2 %; max. 0.5 % of nominal
Binary output module	
Permissible voltage	230 V_{AC} / 250 V_{DC}
Permissible current	100 mA
Permissible impulse current	300 mA for 100 ms
Output resistance	50 Ω
Triggering current	5 mA
Triggering power	25 mW
Permissible switching frequency	10 Hz
Relay module	
Permissible voltage	270 V_{AC} / 120 V_{DC}
Permissible current	5 A
Min. current	1 mA at 5 V_{DC}
Permissible power	5 A / 250 V_{AC} or 5 A / 30 V_{DC}
Output resistance	50 mΩ
Max. reaction time	10 ms
Max. drop-out time	7 ms

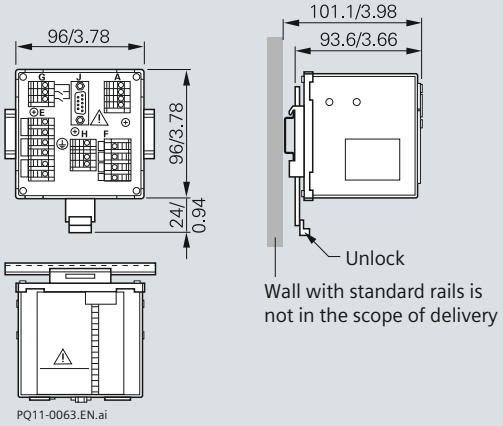
Dimension drawings

Dimension drawings in mm / inch



SICAM P50

Fig. 2/18 SICAM P50 series



SICAM P55

Fig. 2/19 SICAM P55 series

Description	Order No.
Power meter with display	
SICAM P50	**7KG7750-0□A0□-0AA□**
Built-in device for control panel 96 mm × 96 mm / 3.78 in. x 3.78 in., standard protocols: PROFIBUS DP + MODBUS [1]	
I/O module	
without (standard)	A
2 binary outputs	B
2 binary inputs	C
2 analog outputs (0 - 20 / 4 - 20 mA_{DC})	D
2 analog inputs (0 - 20 mA_{DC})	E
3 relay outputs	G
Degree of protection for front	
IP41 (standard)	1
IP65	3
Communication module [2]	
RS485 with PROFIBUS DP and MODBUS RTU / ASCII	0
RS485 with IEC 60870-5-103 and MODBUS RTU / ASCII	1
Power meter without display	
SICAM P55	**7KG7755-0□A00-0AA□**
Snap-on rail mounting device 96 mm × 96 mm (3.78 in. x 3.78 in.), degree of protection for front IP20, standard protocols: PROFIBUS + MODBUS	
I/O module	
without (standard)	A
2 binary outputs	B
2 binary inputs	C
2 analog outputs (0 - 20 / 4 - 20 mA_{DC})	D
2 analog inputs (0 - 20 mA_{DC})	E
3 relay outputs	G
Communication module [2]	
RS485 with PROFIBUS DP and MODBUS RTU / ASCII	0
RS485 with IEC 60870-5-103 and MODBUS RTU / ASCII	1
SICAM P configuration package	**7KG7050-8A□**
consisting of: – Software SICAM P Manager (for configuration, calibration of SICAM P units by means of a personal computer) – Cable connector for connecting SICAM P to a PC (length 5 m / 16.40 ft incl. RS232 / RS485 converter) Connector PC-side: 9-pin SUB D connector, female SICAM P side: 9-pin SUB D connector,male – Plug-in power supply unit for the converter	
Power supply	
230 V AC / 50 Hz	A
120 V AC / 60 Hz	B

1) Firmware V4 comprising MODBUS and IEC 60870-5-103 protocols is available for download on the Internet at www.sicam.com

2) Devices ordered with PROFIBUS DP and MODBUS RTU / ASC II (V3) can be upgraded to IEC 60870-5-103 and MODBUS RTU / ASC II (V4) protocols. Devices ordered IEC 60870-5-103 and MODBUS RTU / ASC II (V4) cannot be upgraded to PROFIBUS DP and MODBUS RTU / ASC II (V3) protocols option.

Table 2/4 Selection and ordering data

SIEMENS

Energy Automation

SICAM T
Digital Measurement Transducer

Answers for infrastructure and cities.

SIEMENS
siemens-russia.com

Contents – SICAM T

Device description
SICAM T is an digital measurement transducer that allows the measuring of electrical quantities in electrical networks in a single unit. In industries, power plants and substations, transducers are especially used for measurand (e.g. current, voltage, power, phase angle, energy or frequency) assignment into further processing through analog outputs or communication interface for precise control, notification or visualization tasks.

Device type
- Top-hat rail mounted device
- Plastic case 96 mm × 96 mm × 100 mm / 3.78 in. x 3.78 in. x 3.94 in. (W × H × D)
- Degree of protection IP20.

Input and output circuits
- 4 inputs for alternating voltage measurements
- 3 inputs for alternating current measurements up to 10 A continuous
- 4 optional DC analog outputs freely configurable:
  - Direct currents: 0 mA to 20 mA, 4 mA to 20 mA and -20 mA to 20 mA
  - Direct voltages: 0 V to 10 V and -10 V to 10 V
- Individually programmable binary outputs.

Signalization LEDs
Automatically monitor the functions of its hardware, software, and firmware components.

Communication
- Ethernet: IEC 61850 or MODBUS TCP communication protocol
- Optional serial RS485 interface that enables the device to communicate via the MODBUS RTU or the IEC 60870-5-103 communication protocol.

Measurands
The following measurands can be recorded or calculated from the measured quantities:
- TRMS (True RMS) for alternating voltage and current
- Active, reactive and apparent power
- Active, reactive and apparent energy
- Power frequency
- Phase angle
- Power factor and active power factor
- Voltage and current unbalance
  - Mean value of the 3 phase voltages: V_{avg}
  - Mean value of the 3 phase currents: I_{avg}.

Time synchronization
For a common time basis when communicating with peripheral devices and time stamping of the process data.
- External time synchronization via Ethernet NTP
- External time synchronization via field bus using the MODBUS RTU or the IEC 60870-5-103 communication protocol
- Internal time synchronization via RTC (if external time synchronization is not available).

Fig. 3/1 SICAM T digital measurement transducer

Response time for analog and binary outputs
The faster response time of the analog and binary output is a very important feature of SICAM T that enables a reliable reaction of the controlling applications. The response time of the device is 120 ms at 50 Hz and 100 ms at 60 Hz.

Applications
- Conversion and integration of measurands into substation automation, protection or SCADA process via RTU and/or via protocols IEC 61850 (for 7KG9662 variant), MODBUS TCP, IEC 60870-5-103 for further control and/or monitoring tasks
- Monitoring of lower voltage levels and heavy load control, e.g. air conditioning and motors
- Depending on the device type, the input circuits for voltage measurement are either designed as voltage dividers or they are galvanically isolated. Devices with galvanic isolation can be used without voltage transformers in the power systems IT, TT and TN. Devices with a voltage divider can also be used in these power systems; for IT power systems, however, an upstream voltage transformer is required.

Main features
- Design: Compact and robust for flexible application in industrial and utility environments
- Connections in 1-phase systems, in 3-wire and 4-wire systems
- Applications: Flexible for power utilities, industrial and commercial sector applications
- Measurements: up to 60 measured or calculated values available
- Temperature range: -25 °C to +55 °C/-13 °F to 131 °F
- Uncertainty: typically 0.1 % for voltage and current at rated input IEC 60688, and 0.2 s acc. to IEC 62053-21
- High EMC immunity: according to 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
- UL Certfication: This product is UL-certified to standard UL 61010-1.

Device description

Highlights

- Flexible current measurement range (up to 2 × I_n)
- 4 fast analog outputs (reaction approx. 120 ms at 50 Hz and 100 ms at 60 Hz) for reliable control
- 2 individual binary outputs for fast switching, indications (e.g., limit violation) and operation status monitoring
- 4 LEDs for local status visualization
- Ethernet communications via IEC 61850 and MODBUS TCP and serial interface via MODBUS RTU or IEC 60870-5-103
- Internal battery for real time clock and saving of energy counter values in case of a power outage
- User-friendly operation through Web server (no extra software for parameterization needed, no converters and extra cables)
- Real time clock (RTC), field bus synchronization or network synchronization possible via NTP.

Applications

Applications

SICAM T applications: Local monitoring or control purposes through assignment of up to 60 available electrical parameters to analog outputs, notifications through binary outputs or integration into SCADA/monitoring systems through communication interface, e.g. serial or Ethernet (Fig. 3/2; Table 3/1).

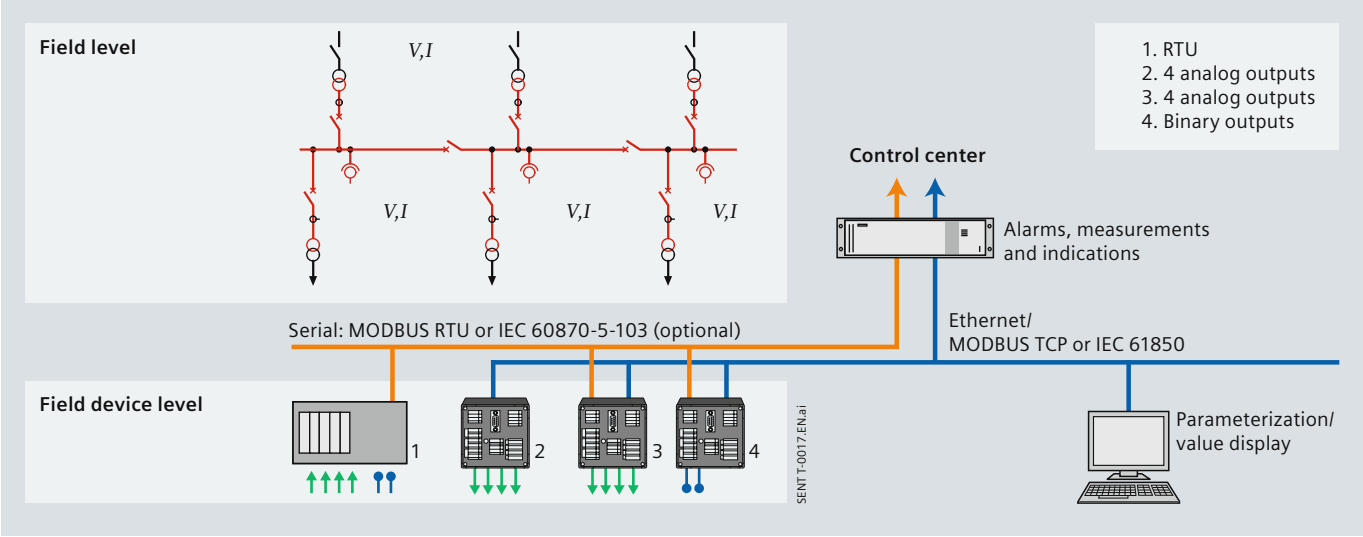


Fig. 3/2 2 SICAM T applications

Application area		Voltage	Current	Power	Frequency	Phase angle	Energy	Alarm	Internal cost allocation
Generation substation	Generator	■	■	■	■	■	■	■	
Transmission substation	Incoming line	■	■	■					
	Outgoing line	■	■	■					
Transformer substation	Incoming line	■							
	Bus	■	■	■	■		■		
	Feeder	■	■	■					
Transformer distribution	Incoming line	■							
	Bus	■	■	■	■		■		
	Feeder	■	■	■					
Process	SCADA / EMS / DMS	■	■	■	■	■	■		
	Energy management	■	■	■	■	■	■	■	■
	Motors	■	■	■	■	■		■	■
	Commercial (e.g. air conditioning)	■	■	■				■	■

Table 3/1 Selection and ordering data

Specific functions and design

Measurement process and connections

The measurements are obtained from the alternating quantities of current and voltage supplied to the different measuring inputs. Rated input alternating voltages up to $V_{ph\text{-}N}$ = 400 V and $V_{ph\text{-}ph}$ = 690 V can be fed in using internal resistive input voltage dividers.
The internal current transformers process rated input alternating currents up to 5 A. The circuits connected on the input side are isolated galvanically from the current transformers to ensure that the potential is decoupled. The input values are processed and then output as analog values or digital data by the corresponding interfaces, converted into direct currents and/or direct voltages depending on the parameter settings, or transmitted to peripheral devices for analysis.

Response time for analog outputs

The faster response time of the analog and binary output is a very important feature of SICAM T that enables a reliable reaction of the controlling applications. The response time of the device is 120 ms at 50 Hz and 100 ms at 60 Hz.

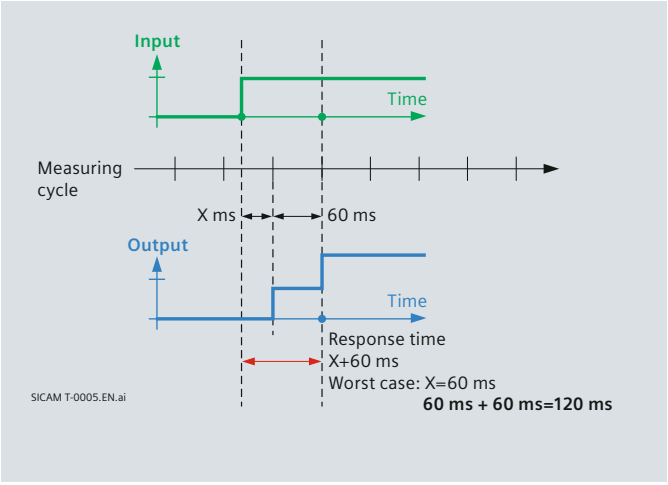


Fig. 3/3 Response time diagram

Communication

To communicate with the systems control and other process automation equipment, the device features an Ethernet interface, and if installed in the device model, an RS485 interface. Ethernet supports the device parameterization, the transmission of measured data, metered values and indications and the time synchronization via NTP. The communication protocols are HTTP, IEC 61850 (7KG9662) and MODBUS TCP. The RS485 interface supports the transmission of the measured data, metered values and indications, and the time synchronization. Depending on the device version, either the MODBUS RTU or the IEC 60870-5-103 communication protocol can be used.

Time synchronization

The following types of time synchronization can be executed:
- External time synchronization via Ethernet NTP (preferred)
- External time synchronization via field bus using the MODBUS RTU or the IEC 60870-5-103 communication protocol
- Internal time synchronization via RTC with quartz oscillator (if external time synchronization is not available).

Electrical assembly

SICAM T 7KG966 contains the following electrical modules depending on the device version:
- Digital signal processor (DSP)
- 4 inputs for AC voltage measurements
- 3 inputs for AC current measurements
- 4 DC analog outputs (optional)
- 2 binary outputs
- Supply voltage
- Serial RS485 interface (option for 7KG9661)
- Ethernet interface (standard).

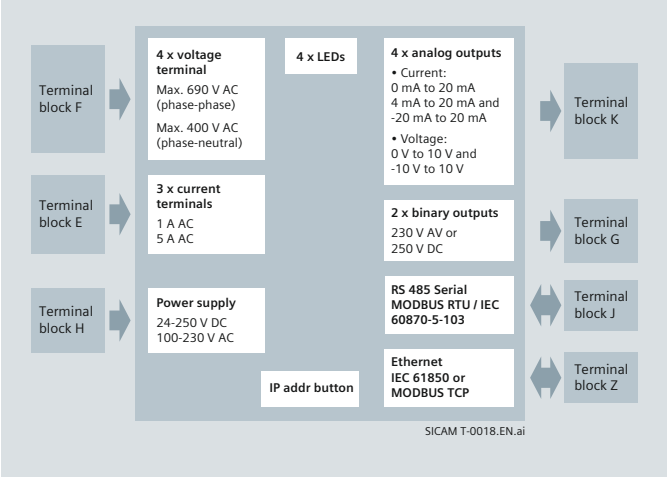


Fig. 3/4 Block diagram SICAM T 7KG9661

Mechanical design

The electrical modules are installed in a plastic case with the dimensions 96 mm × 96 mm × 100 mm / 3.78 in. x 3.78 in. x 3.94 in. (W × H × D). The case is prepared for mounting on a top-hat rail.
The top side of the device accommodates the RJ45 Ethernet connector with two LEDs and four additional LEDs.

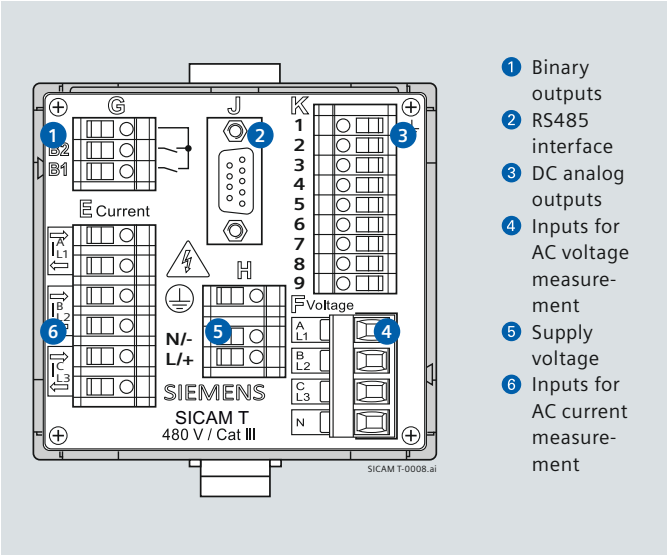


Fig. 3/5 Connectors on the device

Measurands

Measurand		Circuit	1-phase system	3-wire network (delta)			4-wire network (star)	
				balanced (1I)	unbal-anced (3I)	unbal-anced (2I)	balanced (1I)	unbal-anced (3I)
AC voltage	V_a	a-N	■				■	■
	V_b	b-N						■
	V_c	c-N						■
	V_{ab}, V_{bc}, V_{ca}	a-b, b-c, c-a		■	■	■		■
	V_N	a, b, c						■
	V_{avg}	a, b, c		$\Sigma V_{ph}/3$	$\Sigma V_{ph}/3$	$\Sigma V_{ph}/3$	a-N	$\Sigma V_{ph}/3$
	V_{unbal}	a-b, b-c, c-a		■	■	■		■
AC current	I_a	a	■	■	■	■	■	■
	I_b, I_c	b, c			■	■		■
	I_N	a, b, c			■			■
	I_{avg}	a, b, c			■	■		$\Sigma I_{ph}/3$
	I_{unbal}	a, b, c			■	■		■
Active power factor	cos φ (a)	a	■					■
	cos φ (b), cos φ (c)	b, c						■
	cos φ	a, b, c		■	■	■	■	■
Power factor	PF_a	a	■					■
	PF_b, PF_c	b, c						■
	PF	a, b, c		■	■	■	■	■
Phase angle	φ_a	a	■					■
	φ_b, φ_c	b, c						■
	φ	a, b, c		■	■	■	■	■
Frequency	f	a, b, c	■	■	■	■	■	■
Active power	P_a	a	■					■
	P_b, P_c	b, c						■
	P	a, b, c		■	■	■	■	■
Reactive power	Q_a	a	■					■
	Q_b, Q_c	b, c						■
	Q	a, b, c		■	■	■	■	■
Apparent power	S_a	a	■					■
	S_b, S_c	b, c						■
	S	a, b, c		■	■	■	■	■
Active energy – supply	$WP_{a\ supply}$	a	■					■
	$WP_{b\ supply}$, $WP_{c\ supply}$	b, c						■
	WP_{supply}	a, b, c		■	■	■	■	■
Active energy – demand	$WP_{a\ demand}$	a	■					■
	$WP_{b\ demand}$, $WP_{c\ demand}$	b, c						■
	WP_{demand}	a, b, c		■	■	■	■	■
Reactive energy – inductive	$WQ_{a\ inductive}$	a	■					■
	$WQ_{b\ inductive}$, $WQ_{c\ inductive}$	b, c						■
	$WQ_{inductive}$	a, b, c		■	■	■	■	■
Reactive energy – capacitive	$WQ_{a\ capacitive}$	a	■					■
	$WQ_{b\ capacitive}$, $WQ_{c\ capacitive}$	b, c						■
	$WQ_{capacitive}$	a, b, c		■	■	■	■	■
Apparent energy	WS_a	a	■					■
	WS_b, WS_c	b, c						■
	WS	a, b, c		■	■	■	■	■

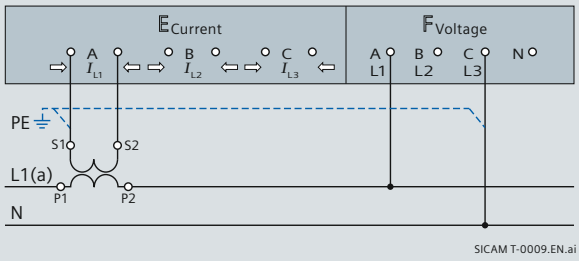
Table 3/2 Measurands according to the connection type: Power measurands in power systems

Connection types

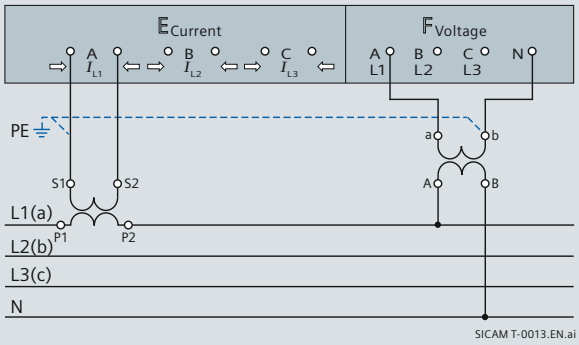
SICAM T 7KG9661 supports the following connection types:

- 1-phase system
- 3-wire network (balanced)
- 3-wire network (unbalanced), 2 current inputs
- 3-wire network (unbalanced), 3 current inputs
- 4-wire network (balanced)
- 4-wire network (unbalanced).

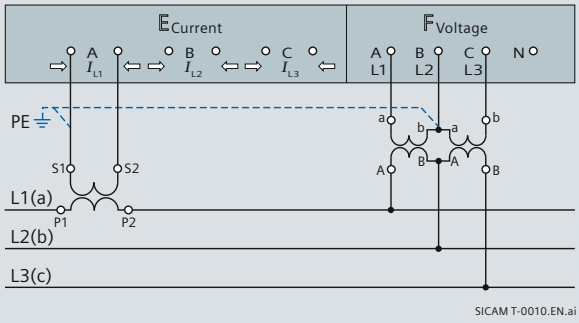
1-phase system, no voltage transformer



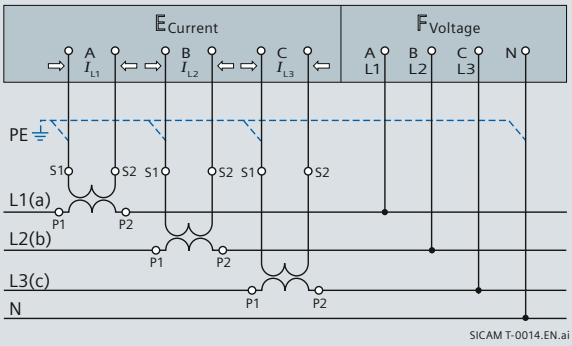
4-wire network, 1 voltage transformer and 1 current transformer, balanced



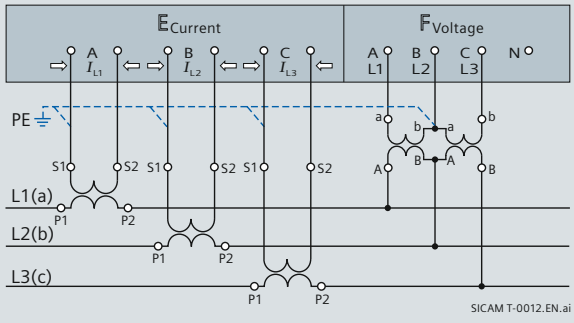
3-wire network, 2 voltage transformers and 1 current transformer, balanced*



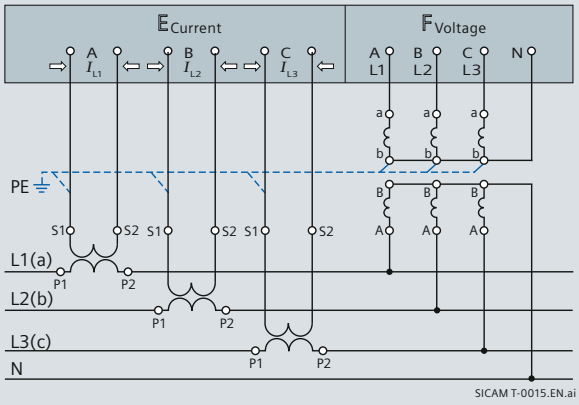
4-wire network, no voltage transformer and 3 current transformers, unbalanced



3-wire network, 2 voltage transformers and 3 current transformers, unbalanced*



4-wire network, 3 voltage transformers and 3 current transformers, unbalanced



* **Important:** The maximum secondary voltage for this connection example is 480 V AC. The maximum allowable voltage between phase and ground must not be exceeded. For IT network connection, please read carefully the devices manual for detailed description.

Fig. 3/6 Connection types

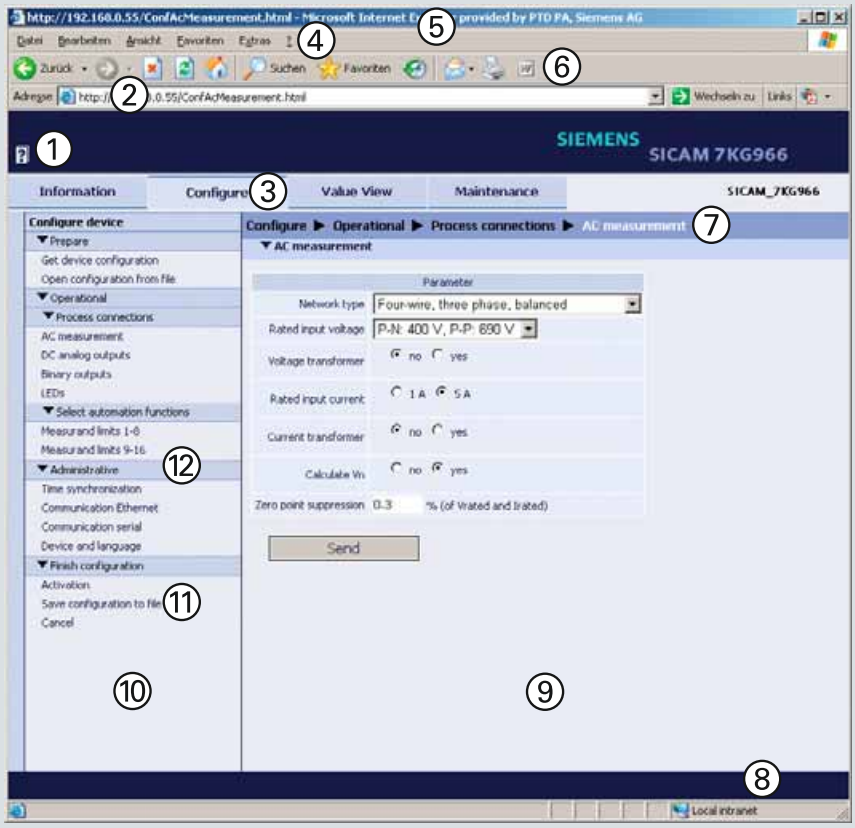
Graphical user interface

Graphical user interface

Parameterization and monitoring software

The device is configured from a connected PC or notebook only. The user interface SICAM T GUI (GUI = Graphical User Interface) is implemented in the device, meaning that for the whole operation and parameterization of the device no additional software is required. It is possible to navigate through the Microsoft Internet Explorer using the icons on the toolbar.

Device status, such as communication, parameterization, log files, value view and maintenance can be easily processed through SICAM T GUI interface.



① Online help
② Address bar
③ Tab
④ Menu bar
⑤ Microsoft Internet Explorer
⑥ Toolbar
⑦ Navigation bar
⑧ Status bar
⑨ Input/output window
⑩ Navigation window
⑪ Element
⑫ Menu

Fig. 3/7 Layout of the SICAM T GUI user interface

Information

The navigation window of the "Information" tab contains the device information, as well as operative and device logs. It offers the complete overview of the device status.

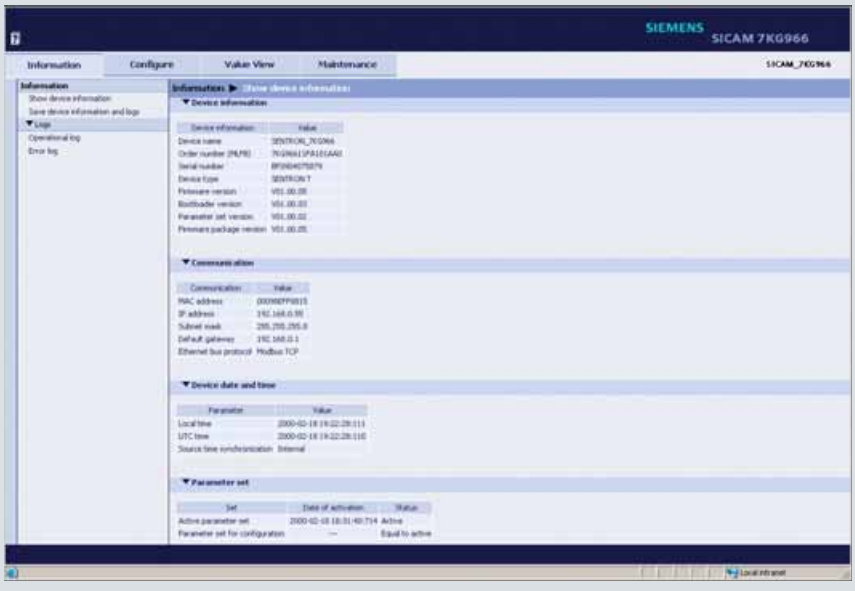


Fig. 3/8 Information tab, shows device information input/output window

Configuration
The configuration mode allows to set the device parameters. It is possible to tailor the process connections to the installation environment, specify the limits of the measuring ranges, parameterize the communication, and make various operational settings.

Analog outputs
The following types of characteristics are used for the transmission of measured values to the DC analog outputs:
Linear, Zoom, Live-Zero, Knee-point, Knee-point Zoom, Bipolar Linear, Bipolar Knee-point Zoom, Square Transfer Characteristic (U^2).

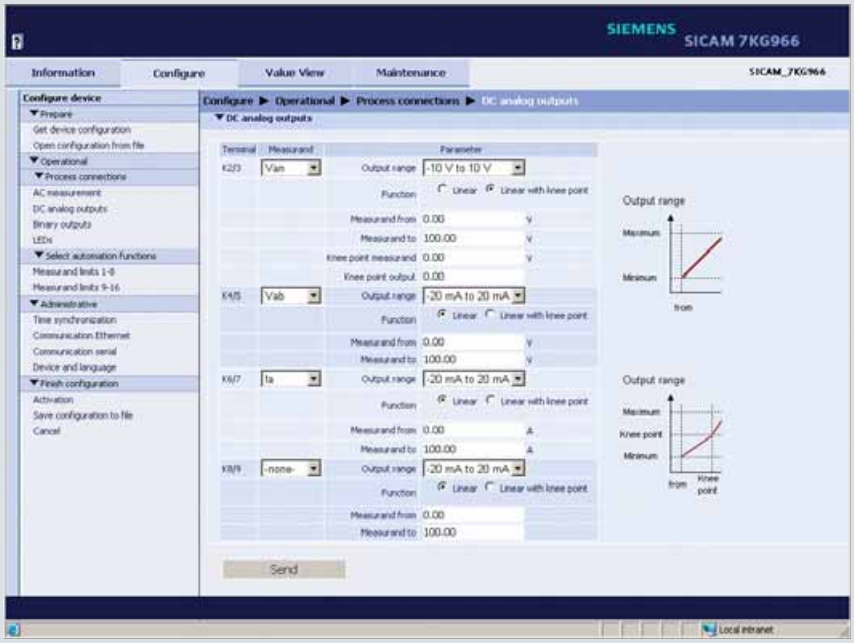


Fig. 3/9 DC analog outputs input/output window

Value View
The measured values are displayed in the "Value View" tab.
- AC operational values
- AC power and energy
- DC analog outputs
- Binary outputs
- Measurand limits

Depending on which operational parameters are selected, the input/output window displays the measured values of the measurands with the corresponding unit or indications in a tabular list that is updated every 5 s.

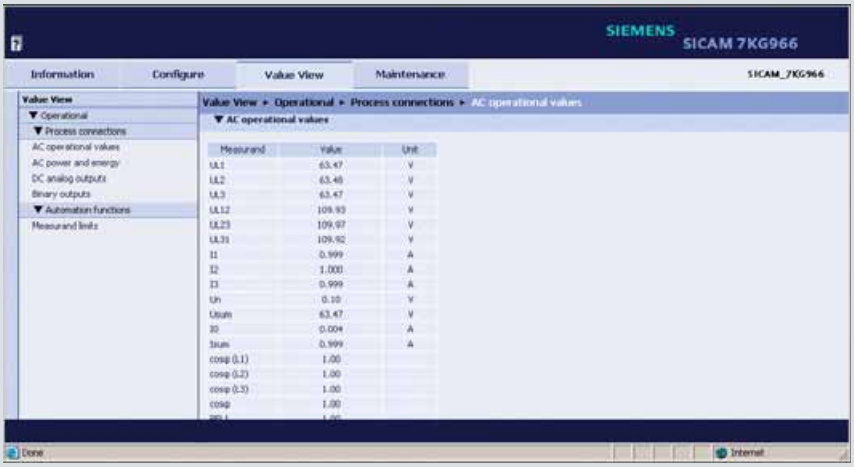


Fig. 3/10 Value View tab

Maintenance
The "Maintenance" tab allows to update the firmware, perform calibration, make various presettings, view and delete logs, and analyze protocol-specific communication data.

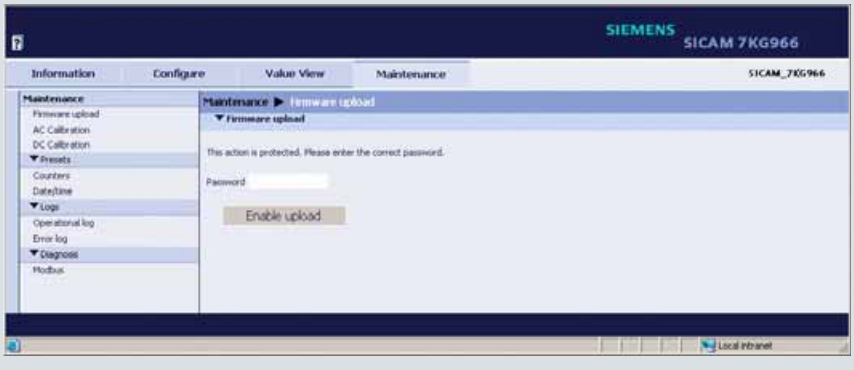


Fig. 3/11 Maintenance tab

Technical data

Electrical data / inputs

Inputs for alternating voltage measurements	
Rated input voltage (selectable via parameter)	ph-N: 63.5 V AC, ph-ph: 110 V AC ph-N: 110 V AC, ph-ph: 190 V AC ph-N: 230 V AC, ph-ph: 400 V AC ph-N: 400 V AC (max. 347 V at UL) ph-ph: 690 V AC (max. 600 V at UL)
Max. input voltage	1.2 × rated input voltage
Max. supply voltage phase-N/PE phase-phase	480 V 831 V
Power consumption per input for U_{rated} 400 V AC	38 mW
Permissible power frequency	45 Hz to 65 Hz
Input impedances a, b, c to N a, b, c, N to PE a-b, b-c, c-a	7.9 MΩ 3.9 MΩ 7.9 MΩ
Measuring error (with calibration) at 23 °C ±1 °C; 50 Hz or 60 Hz	typically 0.2 % at rated input voltage
Continuous overload capacity	1.5 × rated input voltage (600 V)
Surge overload capacity	2 × rated input voltage (800 V) according to IEC 60255-27

Inputs for alternating current measurements	
Rated input current ranges (selectable via parameter)	1 A, 5 A
Max. input current	2 × rated input current
Max. rated input voltage	150 V
Power consumption per input at 1 A AC at 5 A AC	 1 mVA 2.5 mVA
Permissible power frequency	45 Hz to 65 Hz
Measuring error (with calibration) at 23 °C ±1 °C; 50 Hz or 60 Hz:	typically 0.2 % at rated input current
Thermal stability	10 A continuous 100 A for max. 1 s according to IEC 60688

Electrical data / outputs

DC analog outputs	
Use as current outputs (direct current)	
Rated output current	±20 mA
Maximum output current	±24 mA
Maximum load impedance (incl. line impedance)	< 400 Ω
Short-circuit current (short-circuit proof)	±24 mA
No-load voltage (idling-proof)	15 V,
Measuring error (with calibration) at 23 °C ±1 °C	max. 0.1% at rated current
Response time	120 ms (50 Hz), 100 ms (60 Hz)

DC analog outputs	
Use as voltage outputs (direct voltage)	
Rated output voltage	±10 V
Maximum output voltage	±12 V
Minimum load impedance	1 kΩ
Short-circuit current (short-circuit proof)	±24 mA
Measuring error (with calibration) at 23 °C ±1 °C	max. 0.1 % at rated voltage
Response time	120 ms (50 Hz), 100 ms (60 Hz)

Binary outputs	
Maximum switching voltage Alternating voltage Direct voltage	 230 V 250 V
Maximum continuous contact current	100 mA
Maximum pulse current for 0.1 s	300 mA
Internal impedance	35 Ω
Admissible switching frequency	10 Hz
Number of switching cycles	unlimited

Table 3/3 Technical data

Tolerance limits

Measurands	Unit	Rated Value	Operat. measurem. uncertainty	
			acc. to IEC 61557-12	acc. to IEC 60688 [1]
Voltage V_{ph-ph} (delta) acc. to parameterization	V	110 V AC 190 V AC 400 V AC 690 V AC (max. 600 V AC for UL)	±0.2 %	±0.1 %
Voltage V_{ph-N} (star) acc. to parameterization	V	63.5 V AC 110 V AC 230 V AC 400 V AC (max. 347 V AC for UL)	±0.2 %	±0.1 %
Voltage unbalanced V_{unbal}	%	–	±0.15 %	±0.15 %
Current I acc. to parameterization	A	1 A AC 5 A AC	±0.2 %	±0.1 %
Current unbalanced I_{unbal}	%	–	±0.15 %	±0.15 %
Active power P + demand, -supply	W	–	±0.5 % 0.2 s acc. to IEC 62053-21	±0.2 %
Reactive power Q + inductive, -capacitive	var	–	±0.5 %	±0.2 %
Apparent power S	VA		±0.5 %	±0.2 %
Power factor PF [2]	–	–	±1.0 %	±0.5 %
Active power factor cos φ [2]	–	–	±1.0 %	±0.5 %
Phase angle φ [2]	Degree	–	±2°	±1°
Frequency f	Hz	50 Hz and 60 Hz	10 mHz (from 30 % to 120 % Urated)	10 mHz (from 30 % to 120 % Urated)
Active energy $WP_{\_demand}$	Wh	–	±0.5 %	±0.5 %
Active energy $WP_{\_supply}$	Wh	–	±0.5 %	±0.5 %
Reactive energy $WQ_{\_inductive}$	varh	–	±0.5 %	±0.5 %
Reactive energy $WQ_{\_capacitive}$	varh	–	±0.5 %	±0.5 %
Apparent energy WS	VAh	–	±0.5 %	±0.5 %

1) At reference conditions are applicable from 0.1 to 1.2 x nominal range.
2) Measurements from 2 % of the rated apparent power value onwards in the selected measuring range.
3) Valid for operating temperature.

General electrical data and reference conditions

Supply voltage	
Rated input voltages	110 V AC to 230 V AC or 24 V DC to 250 V DC
System frequency at AC	45 Hz to 65 Hz
Admissible input voltage tolerance (valid for all input voltages)	±20 %
Permitted ripple of the input voltage at 24 V DC, 48 V DC, 60 V DC, 110 V DC, 220 V DC, 250 V DC	15 %
Permitted harmonics at 115 V, 230 V	2 kHz
Max. inrush current at ≤ 110 V DC; ≤ 115 V AC at 220 V DC to 300 V DC; 230 V AC	 < 15 A ≤ 22 A (after 250 µs: < 5 A)
Maximum power consumption	6 W / 9 VA

Battery	
Type	CR2032
Voltage	3 V
Capacity	230 mAh

Degree of protection according to IEC 60529	
Device front	IP20
Device rear (connections)	IP20

Reference conditions for determining the test data (precision specifications under reference conditions)	
Rated input current	±1 %
Rated input voltage	±1 %
Frequency	45 Hz to 65 Hz
Curve shape sine, total harmonic distortion	≤ 5 %
Ambient temperature	23 °C ±1 °C
Supply voltage	VHN ±1 %
Warm-up time	≥ 15 min
Interfering fields	none

Table 3/4 Technical data

Technical data

Communication data

Ethernet	
Bus protocol	IEC 61850 Server or MODBUS TCP
Transmission rate	10/100 Mbit/s
Communication protocol	IEEE 802.3
Connection	100Base-T (RJ45)
Cable for 100Base-T	100 Ω to 150 Ω STP, CAT5
Maximum cable length 100Base-T	100 m (if well installed)
Voltage strength	700 V DC

Serial RS485 interface	
Connection	9-pin D-sub plug connector

Bus protocol MODBUS RTU	
Baud rate	9,600 bit/s, 19,200 bit/s, 38,400 bit/s, 57,600 bit/s
Parity	even, even (fixed) ,odd, no (1 or 2 stop bits)
Protocol	half-duplex
Max. cable length, depending on data rate	1,000 m
Transmission level	low: -5 V to -1.5 V high: +5 V to +1.5 V
Reception level	low: ≤ -0.2 V high: ≥ +0.2 V
Bus termination	not integrated, bus termination using plugs with integrated bus terminating resistors

Bus protocol IEC 60870-5-103	
Baud rate	9,600 bit/s, 19,200 bit/s, 38,400 bit/s
Max. cable length, depending on data rate	1,000 m
Transmission level	low: -5 V to -1.5 V high: +5 V to +1.5 V
Reception level	low: ≤ -0.2 V high: ≥ +0.2 V
Bus termination	not integrated, bus termination using plugs with integrated bus terminating resistors

Environmental data

Supply voltage	
Operating temperature continuous operation	 -25 °C to +55 °C / -13 °F to 131 °F
Temperature during transportation during storage	 -25 °C to +70 °C / -13 °F to 158 °F -25 °C to +70 °C / -13 °F to 158 °F
Maximum temperature gradient	20 K/h
Air humidity mean relative air humidity per year maximum relative air humidity	 ≤ 75 % 95 % 30 days a year
Condensation during operation during transportation and storage	 not permitted permitted

Regulations and standards

Climate	
Cold	IEC 60688-2-1 Test Ad IEEE C37.90
Dry heat during operation, storage, and transportation	IEC 60688-2-2 Test Bd IEEE C37.90
Damp heat	DIN EN 60688-2-78:2002-09 IEEE C37.90
Damp heat – cyclic	IEC 60688-2-30 Test Db
Change of temperature	IEC 60688-2-14 Tests Na and Nb
Individual gas test, industrial atmosphere, sequential gas test	IEC 60688-2-42 Test Kc IEC 60688-2-43
Flowing mixed gas	IEC 60688-2-60 Method 4
Salt fog test	IEC 60688-2-11 Test Ka

Mechanics	
Vibration during operation	IEC 60688-2-6 Test Fc IEC 60255-21-1

Table 3/5 Technical data

Connection diagram / dimension drawings

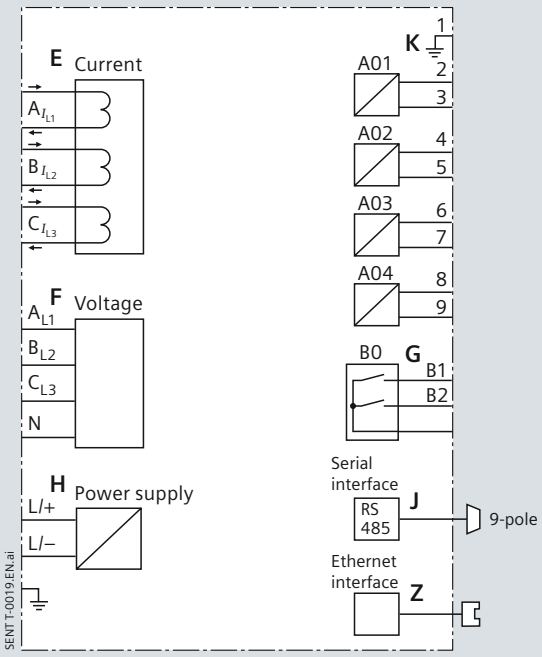
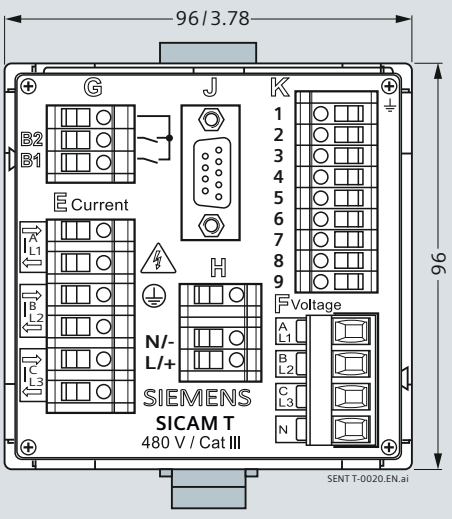


Fig. 3/12 Connection diagram



Dimensions in mm / in.

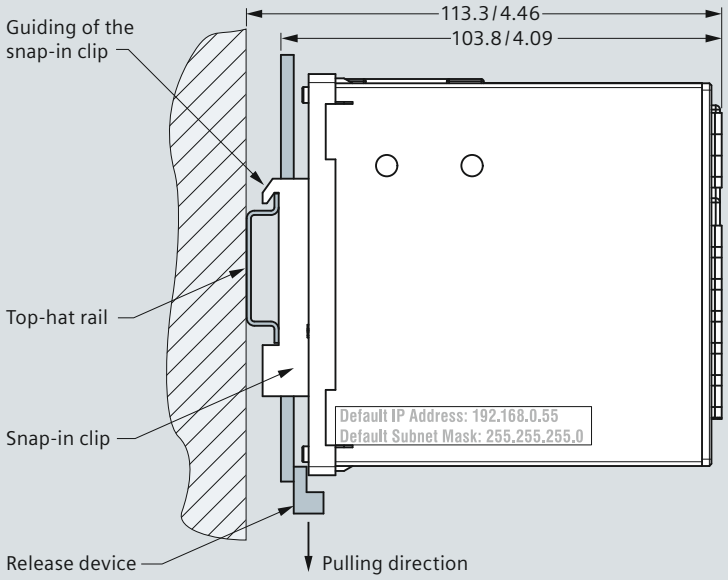


Fig. 3/13 Dimension drawings

Selection and ordering data

Description	Order No.
Multifunctional transducer	
SICAM T	**7KG9661 - □□A□0-1AA0**
Type – Snap-on mounting unit – Dimensions 96 mm x 96 mm x 100 mm / 3.78 in. x 3.78 in. x 3.94 in. (W x H x D) – 2 binary outputs – IP20 – Web server – UL-Certification – Measurements: *V, I, f, P, Q, S,* cos phi, energy – MODBUS TCP	
Input circuits	
Resistive divider	**1**
Galvanic isolated voltage transformer	**2**
I/O board or I/O module	
Without	**A**
4 analog outputs (-20_0_20 mA/ -10 V_0_10 V)	**F**
Serial interface and communication protocol	
Without	**0**
RS 485 - MODBUS RTU	**1**
RS 485 - IEC 60870-5-103 and MODBUS RTU	**3**

Description	Order No.
Multifunctional transducer	
SICAM T – IEC 61850	**7KG9662 - □□A00-2AA0**
Type – Snap-on mounting unit – Dimensions 96 mm x 96 mm x 100 mm / 3.78 in. x 3.78 in. x 3.94 in. (W x H x D) – 2 binary outputs – IP20 – Web server – UL-Certification – Measurements: *V, I, f, P, Q, S,* cos phi, energy – IEC 61850	
Input circuits	
Resistive divider	**1**
Galvanic isolated voltage transformer	**2**
I/O board or I/O module	
Without	**A**
4 analog outputs (-20_0_20 mA/ -10 V_0_10 V)	**F**
Ethernet patch cable for parameterization	**7KE6000-8GE00-3AA0**
With double shield (SFTP), cross-over connection, LAN connector at both ends, SICAM T <–> PC; length: 3 m / 9.84 in.	

Table 3/6 Selection and ordering data

CE, UL, IEC 61850 and IEC 60870-5-103 conformity certificate

CE conformity

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 according to 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 standard EN 60688.

This product is UL-certified to Standard UL 61010-1, based on the specification stated in chapter 3.10–3.12 (Technical Data).

UL File No.: E228586.

c UL us LISTED

Open-type Measuring Equipment
2UD1

UCA International Usersgroup

IEC 61850 Certificate Level A[1]

No. 74100726-MOC/INC 11-2049

Issued to:
Siemens A.G., PTD EA
Protection and Substation Control Systems
Wernerwerkdamm 5
D-13623 Berlin
Germany

For the product:
SENTRON T 7KG966 Multifunctional Transducer
Firmware V02.00.04

Issued by: KEMA

The product has not shown to be non-conforming to:

IEC 61850-6, 7-1, 7-2, 7-3, 7-4 and 8-1

Communication networks and systems in substations

The conformance test has been performed according to IEC 61850-10 with product's protocol, model and technical issue implementation conformance statements: "SIEMENS Multifunctional Transducer SENTRON T 7KG966 Device Manual, E50417-H1040-C493-A1" also including the product's extra information for testing.

The following IEC 61850 conformance blocks have been tested with a positive result (number of relevant and executed test cases / total number of test cases as defined in the UCA International Users Group Device Test procedures v2.2b):

1	Basic Exchange (15/24)	6	Buffered Reporting (15/20)
2	Data Sets (3/6)	6+	Enhanced Buffered Reporting (11/12)
5	Unbuffered Reporting (13/18)	13	Time Synchronization (3/5)

This Certificate includes a summary of the test results as carried out at KEMA in the Netherlands with UniCAsim 61850 version 3.21.02 with test suite 3.21.02 and UniCA 61850 analyzer 4.23.02. The test is based on the UCA International Users Group Device Test Procedures version 2.2b. This document has been issued for information purposes only, and the original paper copy of the KEMA report: No. 74100726-MOC/INC 11-2048 will prevail.

The test has been carried out on one single specimen of the product as referred above and submitted to KEMA by Siemens. The manufacturer's production process has not been assessed. This Certificate does not imply that KEMA has certified or approved any product other than the specimen tested.

Arnhem, 25 August 2011

M. Adriaensen
Regional Director Management & Operations Consulting

R. Schimmel
Certification Manager

1 Level A - Independent Test lab with certified ISO 9000 or ISO 17025 Quality System

Products – SICAM T

SIEMENS

Energy Automation

SICAM Q80
Power Quality Recorder

Answers for infrastructure and cities.

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Contents – SICAM Q80

Description

Power quality is a complex issue. The voltage quality is affected by all parties connected in the power system: Power utilities of transmission and distribution, power producers and consumers. Inadequate power quality has an adverse effect on the dependability of loads in the power supply system, and can have serious consequences.
SICAM Q80 is a compact and powerful recorder designed for utilities and industries to continuously monitor the power quality for regulatory purposes (e.g. evaluation against the standards) as well as event-based recordings for explanatory purposes (e.g. wave shape recording), from the generation plant to the last customer in the electrical supply chain.
With SICAM Q80, the quality of the power supply system can be continuously monitored. This can be based on the quality criteria defined in the European electricity supply system quality standard EN 50160 or other assessment criteria. Moreover, data that are above or below the defined threshold values are stored and can thus be used for a meaningful overall analysis.
It provides information that allows to see the whole electrical healthy of the power system!

Field of application of SICAM Q80

- Regulatory power quality application: Measurement, comparison, and profiling of power quality parameters at the individual electrical system interfaces: E.g. generation, transmission, subtransmission and distribution systems.
- Explanatory power quality application: Disturbance recording (e.g. waveform capture) support to understand the causes and consequences of power quality problems.

Benefits

- Customer satisfaction: Companies with a suitable power quality monitoring system are proven to be more reliable suppliers and users of energy.
- Asset protection: Early identification of disturbances and active response to them. Comprehensive information for enhancing the visibility and control of assets at the edge of the grid.
- In case of negotiations or disputes, power quality monitoring provides evidences to align interests and to support agreements between parts.
- Quality of supply is in the interests of power utilities, regulators, consumers, and the environment.

Function overview

Measurement of continuous phenomena and disturbances according to the necessary accuracy requirements, as stipulated in IEC 61000-4-15, IEC 61000-4-7 and IEC 61000-4-30 (Class A).

Fig. 4/1 SICAM Q80 Power Quality Recorder

Recording and evaluation

- Voltage frequency: Frequency deviation
- Slow voltage variation: Detection and monitoring of supply interruption
- Rapid voltage variations: Voltage dips, voltage swells, rapid voltage changes and voltage fluctuations (flicker)
- Power line signaling superimposed on the supply voltage
- Voltage waveshape: Harmonics (up to the 50th harmonic) and up to 10 interharmonics
- Flexible value limit and event definition
- Fault recording triggered by waveform and binary values
- Comparison and reporting of power quality profile according to EN 50160 or local standards.

Products – SICAM Q80

Description, function overview

Features

- Suitable for monitoring single-phase, 3- and 4-wire power systems (up to 1000 V_{rms})
- 4 voltage, 4 current, or 8 voltage measuring channels
- Standard: 4 binary inputs, 4 binary outputs
- Sampling rate 10 kHz for network analysis
- Measurement accuracy 0.1 % of the range
- High local storage capability: Removable compact flash (standard delivery 2 GB)
- Enhanced data compression process (power quality data)
- Automatic data transfer
- Automatic comparison and reporting of the power quality profile according to EN 50160 or local standards
- Automatic notification in case of a fault or violations by e-mail, SMS, and fax
- Export functions
- Ethernet and modem communication interfaces for parameterization, remote monitoring, and polling
- GPS / DCF-77 / IRIG-B and NTP for synchronization
- Network trigger system
- Simple operation, compact and robust design.

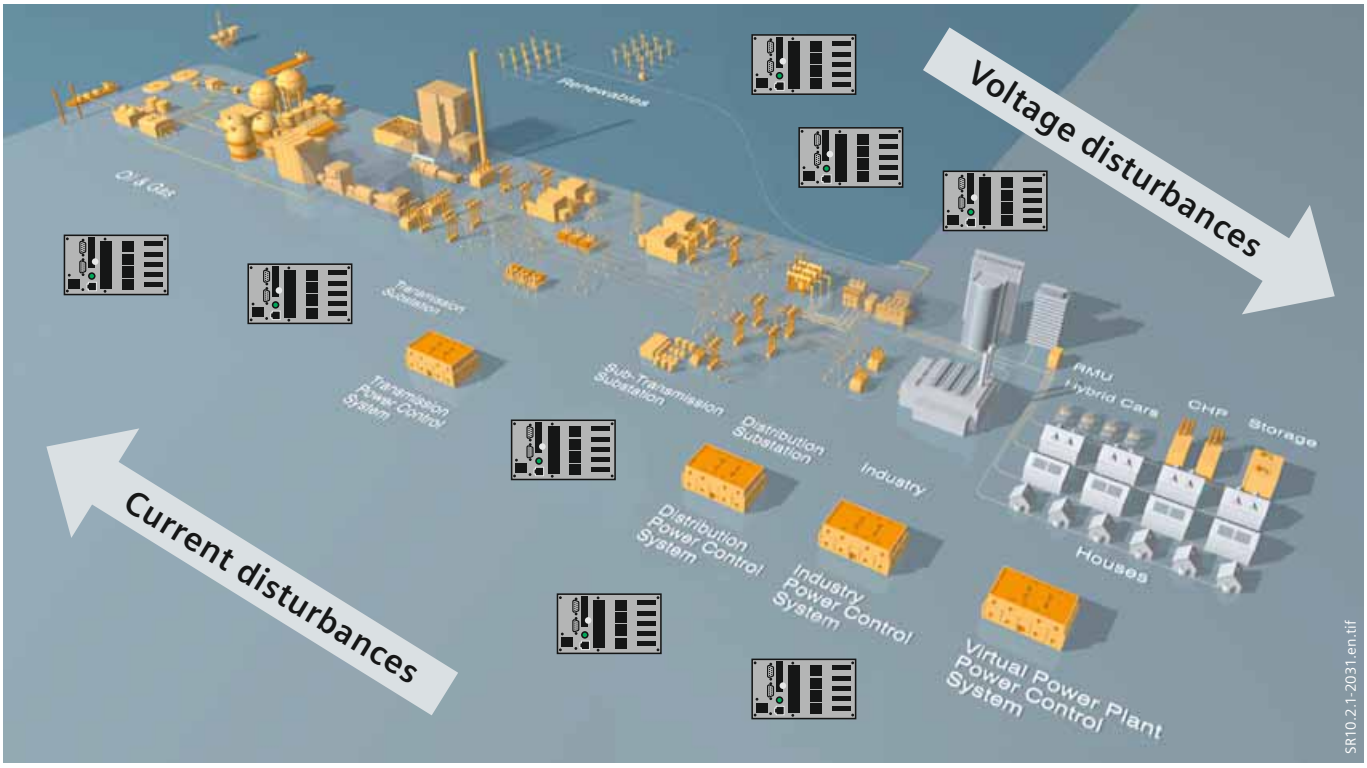


Fig. 4/2 Power quality monitoring provides value to everyone – to the local utility, to the consumer, to the local economy and to the environment

Supply quality

Quality is generally recognized as an important aspect of any electricity supply service. Customers care about high quality just as much as low prices. Price and quality are complementary. Together, they define the value that customers derive from the electrical supply service.
The quality of the electricity supply provided to final customers results from a range of quality factors, for which different sectors of the electricity industry are responsible. Quality of service in the electrical supply has a number of different dimensions, which can be grouped under three general headings: Commercial relationships between a supplier and a user, continuity of supply, and voltage quality.
To avoid the high cost of equipment failures, all customers must make sure that they obtain an electricity supply of satisfactory quality, and that their electrical equipment is capable of functioning as required even when small disturbances occur. In practice, the voltage can never be perfect.
Electrical supply is one of the most essential basic services supporting an industrial society. Electricity consumers require this basic service:

- To be available all the time (i.e. a high level of reliability)
- To enable all consumers' electrical equipment to work safely and satisfactorily (i.e. a high level of power quality).

Voltage quality

Voltage quality, also termed power quality (PQ), covers a variety of characteristics in a power system. Chief among these is the quality of the voltage waveform. There are several technical standards defining voltage quality criteria, but ultimately quality is determined by the ability of customers' equipment to perform properly. The relevant technical phenomena are: Variations in frequency, fluctuations in voltage magnitude, short-duration voltage variations (dips, swells, and short interruptions), long-duration voltage variations (overvoltages or undervoltages), transients (temporarily transient overvoltages), waveform distortion, etc.
In many countries, voltage quality is regulated to some extent, often using industry-wide accepted standards or practices to provide indicative levels of performance.

Everybody is now aware of the effects of poor power quality, but few really have it under control. The levels of power quality disturbances need to be monitored weekly, sometimes even daily, in order to trigger appropriate remedial measures before severe consequences occur.
The power utility therefore has an interest in monitoring the power quality, showing that it is acting correctly and improving its know-how about the system. This ensures customer satisfaction by providing electricity with quality and reliability.
The availability and quality of power is of even greater concern to distribution companies. The liberalization of the electricity market has put them in the uncomfortable position of being affected by other players' actions. This situation has been stabilizing and power quality is becoming a top priority issue in the restructuring process. With increasing customer awareness of energy efficiency, it is clear that the quality of supply will be receiving much attention.
Most power quality problems directly concern the end user, or are experienced at this level. End users have to measure the power quality and invest in local mitigation facilities. However, consumers often turn to the utility company, instead, and exert pressure to obtain the required supply quality.
The EN 50160 power quality standard describes the main characteristics of the voltage at the customer's supply terminals in public low, medium, and, in the near future, high-voltage systems, under normal operating conditions.

Power quality

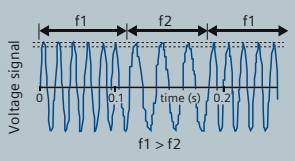
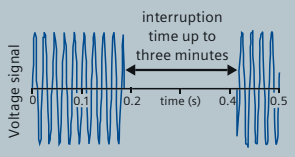
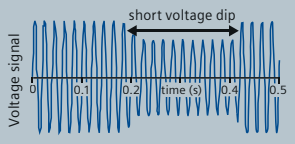
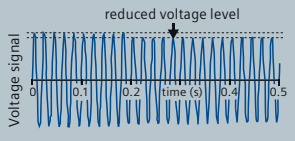
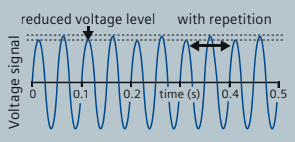
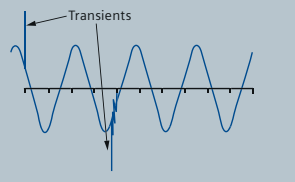
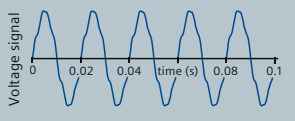
Problem	Description	Cause	Effect
 SR10.2.1-2032.en.ai	**Frequency distortions:** A frequency variation involves variation in frequency above or below the normally stable utility frequency of 50 or 60 Hz	• Start-up or shutdown of very large item of consumer equipment, e.g. motor • Loading and unloading of generator or small co-generation sites • Unstable frequency power sources	• Misoperation, data loss, system crashes and damage to equipment and motor • For certain kinds of motor load, such as in textile mills, tight control of frequency is essential
 SR10.2.1-2033.en.ai	**Supply interruption:** Planned or accidental total loss of power in a specific area, short interruptions lasting from a half second to 3 minutes and long interruptions lasting longer than 3 minutes	• Switching operations attempting to isolate an electrical problem and maintain power to the area concerned • Accidents, acts of nature, etc. • Fuses, actions by a protection function, e.g. automatic recloser cycle	• Sensible processes and system shutdown or damages • Loss of computer/controller memory • Production losses or damage
 SR10.2.1-2034.en.ai	**Voltage dip/sag or swell:** Any short-term (half cycle to 60 seconds) decrease (sag) or increase (swell) in voltage	• Start-up or shutdown of very large item of consumer equipment, e.g. motor • Short circuits (faults) • Underdimensioned electrical circuit • Utility equipment failure or utility switching	• Memory loss, data errors, dim or bright lights, shrinking display screens, equipment shutdown • Motors stalling or stopping and decreased motor life
 SR10.2.1-2035.en.ai	**Supply voltage variations:** Variation in the voltage level above or below the nominal voltage under normal operating conditions	• The line voltage amplitude may change due to normal changing load situations	• Equipment shutdown by tripping due to undervoltage or even overheating and/or damage to equipment due to overvoltage • Reduced efficiency or life of electrical equipment
 SR10.2.1-2036.en.ai	**Rapid voltage variations/ flicker:** Impression of unsteadiness of visual sensation induced by a light stimulus, the luminance or spectral distribution of which fluctuates with time	• Intermittent loads • Motor starting • Arc furnaces • Welding plants	• Changes in the luminance of lamps can result in the visual phenomenon called flicker on people, disturbing concentration, causing headaches, etc.
 SR10.2.1-2037.en.ai	**Transient:** A transient is a sudden change in voltage up to several thousand volts. It may be of the impulsive or oscillatory type (also termed impulse, surge, or spike) **Notch:** This is a disturbance of opposite polarity from the waveform	• Utility switching operations, starting and stopping heavy equipment, elevators, welding equipment static discharges, and lightning	• Processing errors • Data loss • Lock-up of sensitive equipment • Burned circuit boards
 SR10.2.1-2038.en.ai	**Noise:** This is an unwanted electrical signal of high frequency from other equipment **Harmonic:** Distortion is alteration of the pure sine wave due to non-linear loads on the power supply	• Noise is caused by electromagnetic interference from appliances, e.g. microwave, radio and TV broadcasts, arc welding, loose wiring, or improper grounding • Harmonic distortion is caused by non-linear loads	• Noise interferes with sensitive electronic equipment • It can cause processing errors and data loss • Harmonic distortion causes motors, transformers, and wiring to overheat • Improper operation of breakers, relays, or fuses

Table 4/1 Main problems with power quality

Who is responsible?

An interesting problem arises when the market fails to offer products that meet the customer's power quality needs. If a customer cannot find equipment that is designed to tolerate momentary power interruptions, the customer may, for example, pressure the power supplier and the regulator to increase the power quality of the overall distribution system. It may be in the supplier's interest to help the customer address the power quality and reliability problem locally. The electrical supply system can be considered a sort of open-access resource: In practice, almost everybody is connected to it and can "freely" feed into it. This freedom is now limited by standards, and / or agreements.

In European countries, the EN 50160 European standard is generally used as a basis for the voltage quality. There is currently no standard for the current quality at the point of common coupling (PCC), but only for equipment. The interaction between the voltage and current makes it hard to draw a line between the customer as "receiving" and the network company as "supplying" a certain level of power quality. The voltage quality (for which the network is often considered responsible) and the current quality (for which the customer is often considered responsible) affect each other in mutual interaction.

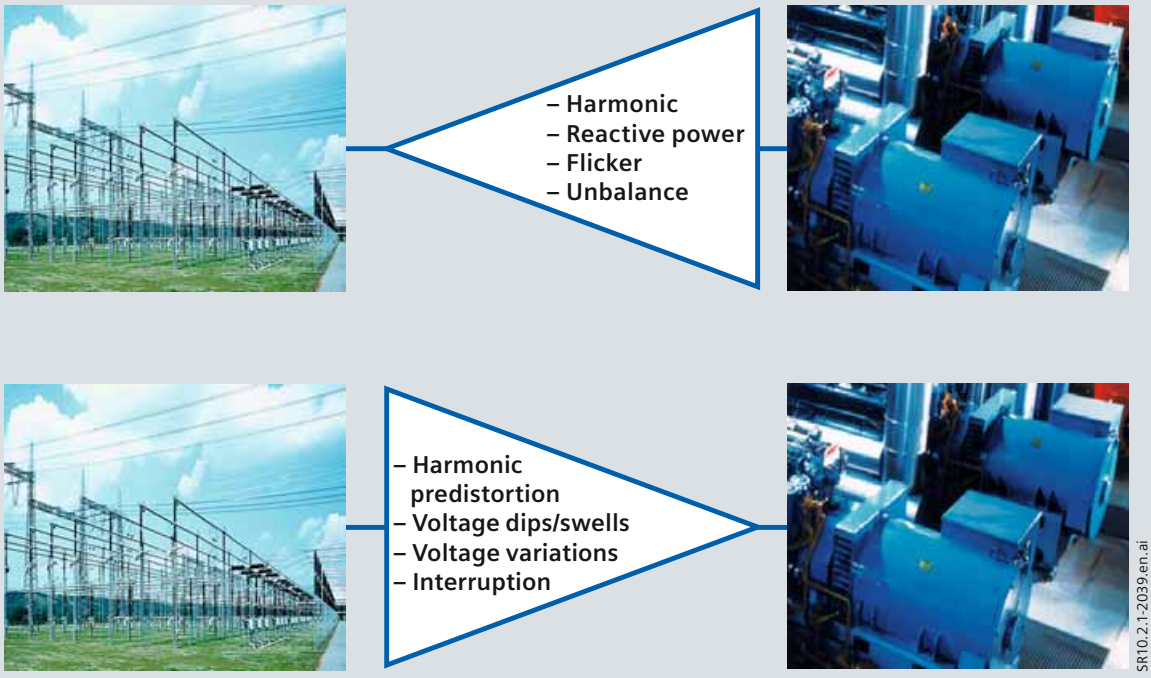


Fig. 4/3 Utility and industries, both are responsible for voltage quality

Power quality

Power quality monitoring applications

One of the keys to the success of profiling and defining the power quality system is understanding the applications. The following table suggests two applications based on gathering power quality data.
Regulatory application for continuous analysis and explanatory application for detailed data for event evaluation proposals.

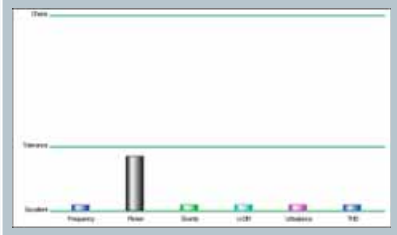
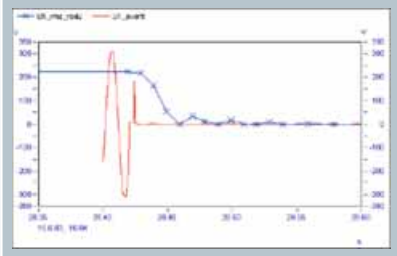
PQ application	Description	Hardware	Measurements	
Regulatory power quality:	Regulative PQ analysis approaches the comparison of the quality of voltage or power with recognized standards (e.g. EN 50160) or with the quality defined in power supply contracts. Periodically produces compliance reports.	Power Quality Recorders (mainly Class A)	Voltage quality parameters (at least) at selected system interfaces and customer supply points (e.g. EN 50160) for: Power system performance, planning levels (i.e. internal objectives), specific customer contracts	 SR10.2.1-2040.de.tif
Explanatory power quality:	Explanatory PQ analysis to provide an understanding of what is going on in particular cases, such as fault analysis, to support the wider aspects of system stability. It is a process that aims to document selected, observed power quality and maximize the level of understanding, possibly including knowledge of the cause and consequences and possible mitigation of power quality problems.	Power Quality Recorders Class A, S or B and fault recorder / PMU	$V+I_{rms}$, waveforms, status of binaries, power swing, MV transformers, busbars and loads	 SR10.2.1-2040.de.tif

Table 4/2 Power quality applications

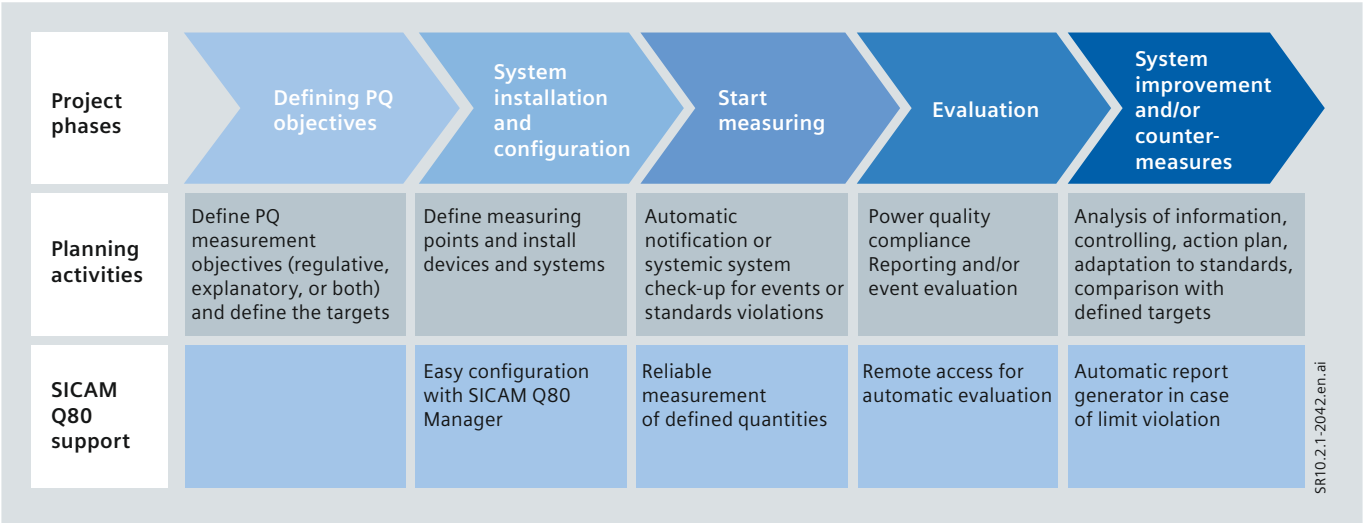


Fig. 4/4 Power quality recording in five steps

Standards and specifications

The purpose of power quality indexes and measurement objectives is to characterize power system disturbance levels. Such indexes may be defined as "voltage characteristics" and may be stipulated in a grid code that applies to electrical system interfaces. Power quality grid codes make use of existing standards or guidelines defining voltage and current indexes to be applied to interfaces in low, medium, or high-voltage systems, for example, EN 50160. This standard defines and describes the main characteristics of the voltage at the customer's supply terminals in public LV and MV electricity distribution systems. Indexes for HV-EHV will also be described in the new edition of EN 50160, planned to be released in 2011.

Since electrical systems among regions and countries are different, there are also many other regional or national recommendations, defining specific or adapted limit values. These local standards are normally the result of practical voltage quality measurement campaigns or the system experience, which are mostly acquired through a permanent and deep electrical system behavior know-how.

Measuring according to EN 50160 is, however, only part of the power quality measurement process. Another important standard for power quality measurement is IEC 61000-4-30, that defines the measurement methodology. From IEC 61000-4-30, also accuracy classes, Class A "higher accuracy" and Class S "lower accuracy", are derived. In other words, in a simple way, if EN 50160 defines "what" to measure, IEC 61000-430 defines "how" to measure it.

The end result of a measurement process is expected to be a fully automated, standard compliant documentation of all measurements.

Calculation of r.m.s. values after every half period is the touchstone of an IEC 61000-4-30 Class A measurement device. To define the range of normal voltage states, a hysteresis range is specified for event detection.

SICAM Q80 meets the precision requirements for a Class A measurement device according to the IEC 61000-4-30 standard.

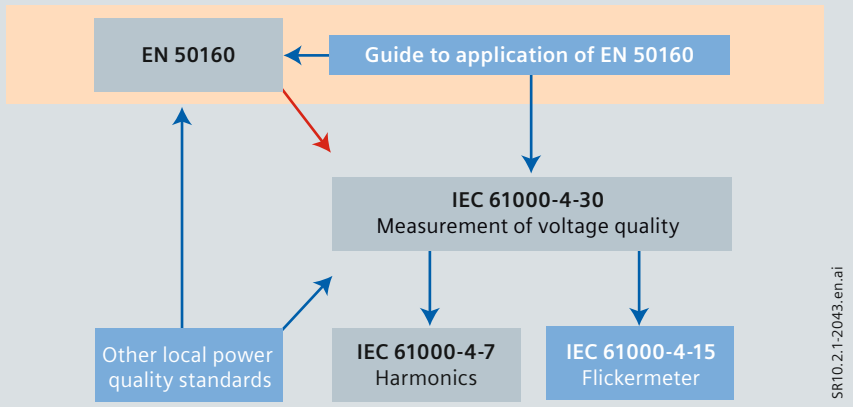


Fig. 4/5 Overview of international and national standards for power quality

Parameter	Supply voltage characteristics
Power frequency	LV, MV: Mean value of fundamental measured over 10 s ± 1 % (49.5 – 50.5 Hz) for 99.5 % of week – 6 % / + 4 % (47 – 52 Hz) for 100 % of week
Voltage magnitude variations	LV, MV: ± 10 % for 95 % of week, mean 10 minutes r.m.s. values (Fig. 6)
Rapid voltage changes	LV: 5 % normal 10 % infrequently Plt ≤ 1 for 95 % of week MV: 4 % normal 6 % infrequently Plt ≤ 1 for 95 % of week
Supply voltage dips	Majority: Duration < 1 s, depth < 60 %. Locally limited dips caused by load switching on: LV: 10 – 50 %, MV: 10 – 15 %
Short interruptions of supply voltage	LV, MV: (up to 3 minutes) few tens – few hundreds / year, duration 70 % of them < 1 s
Long interruption of supply voltage	LV, MV: (longer than 3 minutes) < 10 – 50 / year
Temporary power frequency overvoltages	LV: < 1.5 kV r.m.s. MV: 1.7 V_C (solid or impedance earth), 2.0 V_C (unearthed or resonant earth)
Transient overvoltages	LV: Generally < 6 kV, occasionally higher; rise time: µs to ms, MV: Not defined
Supply voltage unbalance	LV, MV: Up to 2 % for 95 % of week, mean 10 minutes r.m.s. values, up to 3 % in some locations
Harmonic voltage / THD	Harmonics LV, MV; THD
Interharmonic voltage	LV, MV: Under consideration

Table 4/3 Overview of EN 50160 parameters as well as some supply voltage characteristics and indicative values

Standards

Standards

IEC 61000-4-30, Ed. 2, 2008-10
Power Quality Measurement Methods: This standard defines the methods for measurement and interpretation of results for power quality parameters in AC supply systems.

IEC 61000-4-15:1997 + A1:2003
Flickermeter, Functional and Design Specifications: This section of IEC 61000 provides a functional and design specification for flicker measuring apparatus intended to indicate the correct flicker perception level for all practical voltage fluctuation waveforms.

IEC 61000-4-7, Ed. 2, 2002-08
General Guide on Harmonics and Interharmonics: This is a general guide on harmonics and interharmonics measurements and instrumentation, for power supply systems and equipment connected thereto.

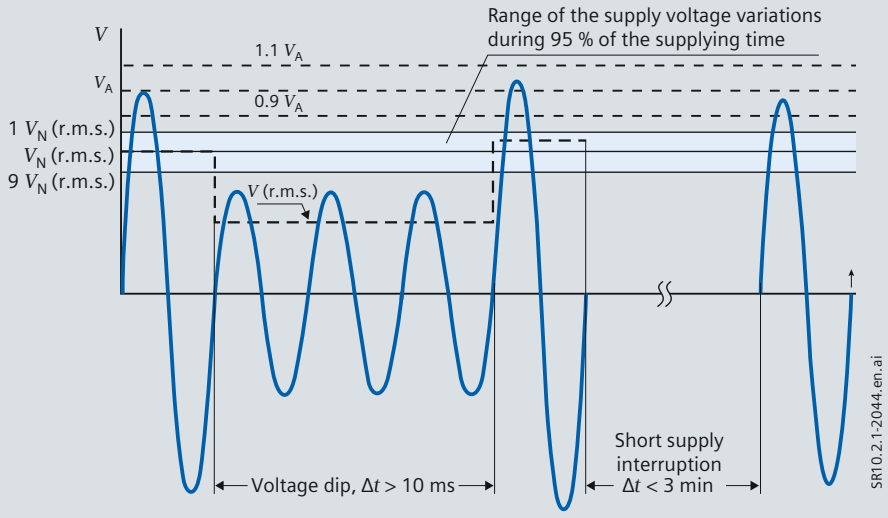


Fig. 4/6 Illustration of a voltage dip and a short supply interruption, classified according to EN 50160; V_N – nominal voltage of the supply system (r.m.s.), V_A – amplitude of the supply voltage, V(r.m.s.) – the actual r.m.s. value of the supply voltage

Odd harmonics				Even harmonics	
Not multiples of 3		Multiples of 3			
Order h	Relative voltage (%)	Order h	Relative voltage (%)	Order h	Relative voltage (%)
5	6	3	5	2	2
7	5	9	1.5	4	1
11	3.5	15	0.5	6 ... 24	0.5
13	3	21	0.5		
17	2				
19	1.5				
23	1.5				
25	1.5				

Table 4/4 Values of individual harmonic voltages at the supply terminals for orders up to 25, given in percent of V_N

Definition of a measurement point and power quality measurement objectives

Power quality measurements address the aspect of power performance by describing the quality of every individual interface in an electrical system and in the networks of its various customers. Identifying, defining, profiling the power quality measurement points are essential tasks in defining a power quality project. However, the electrical system is dynamic by nature, so optimizing the measurement points is a routine that is developed by day-to-day learning. This may not help predict changes, but will permit a more effective response to them.

Identification of measurement points

Measurement points may be located and defined as shown in table 4/5.

Measuring power quality requires not only an effective choice of measurement points, but also defined objectives for the PQ analysis at the measurement points.

We generally classify “power quality” monitoring as a mixture of data gathering technologies classified by their purpose or application.

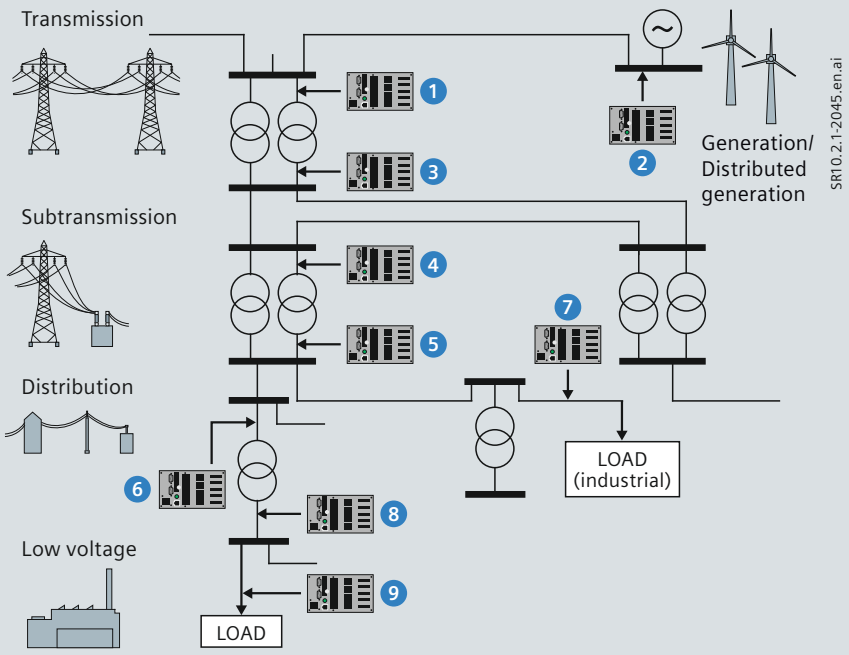


Fig. 4/7 General system online diagram

No.	Measurement points	Location
1	Transmission feeder (line or transformer)	Possibly busbar
2	Generation station / distributed generation	Busbar, transformer or generator connection
3	Subtransmission, line supply	Busbar (e.g. where the busbar is owned and operated by the transmission company)
4	Subtransmission feeder (line or transformer)	Remote line terminals (e.g. where the lines are owned and operated by the transmission company)
5	Distribution, line supply	Transformer secondary side or cable to neighbor’s substation
6	Distribution feeder (line or transformer)	Step-down transformers
7	Distribution load	Step-down transformers (e.g. where the transformers are owned by the distribution company)
8	LV supply	Transformer of the distribution company
9	LV load	Load or transformer at the customer

Table 4/5 Measurement points and system location

Device functions

Functions

SICAM Q80 implements the “complete recording” measurement philosophy. This means that all measured quantities are available for subsequent analysis even after the comparison with standards. This ensures that events that do not reach the defined thresholds but may still contain useful data can still be analyzed.
The “complete recording” principle provides the option of performing more extensive data processing than the completed EN-based measurement, meaning that SICAM Q80 has a far wider functional scope than that defined in the EN 50160 standards.

Continuous monitoring

The r.m.s. values for current and voltage are calculated every half cycle (10 ms / 50 Hz or 8.33 ms at 60 Hz) and using algorithms, as described in the IEC 61000-4-30 standard.
Fast changes in the r.m.s. value of voltage and the current are recorded as plot curves (see Fig. 4/9). This is done using a patented data reduction method. Within the tolerance range of a ± 5 % deviation from the measuring range, data reduction works with 1.5 % accuracy by default, while outside the tolerance range, twice the precision, namely 0.75 %, is used. These values can be parameterized in the software. The method is defined and parameterized to achieve a reduction factor of down to 1:20,000 without loss of relevant information, such as voltage dips, despite the fact that recording is continuous.
The advantage is that no thresholds have to be adjusted and there is no loss of information.

Fig. 4/8 SICAM Q80 Power Quality Recorder

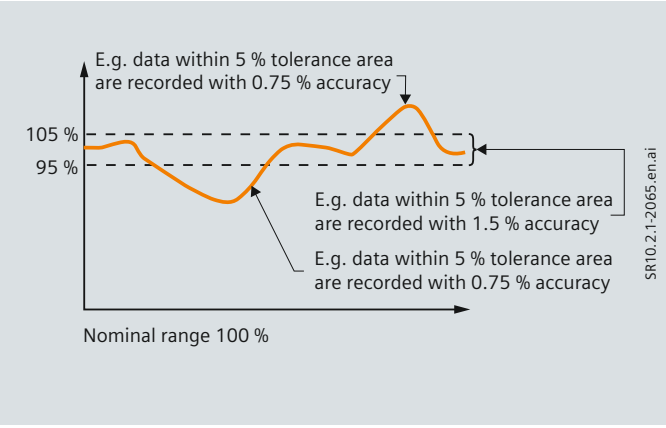


Fig. 4/9 Example of the the compression algorithm for continuous recording, e.g. for 5 % of the measurement range

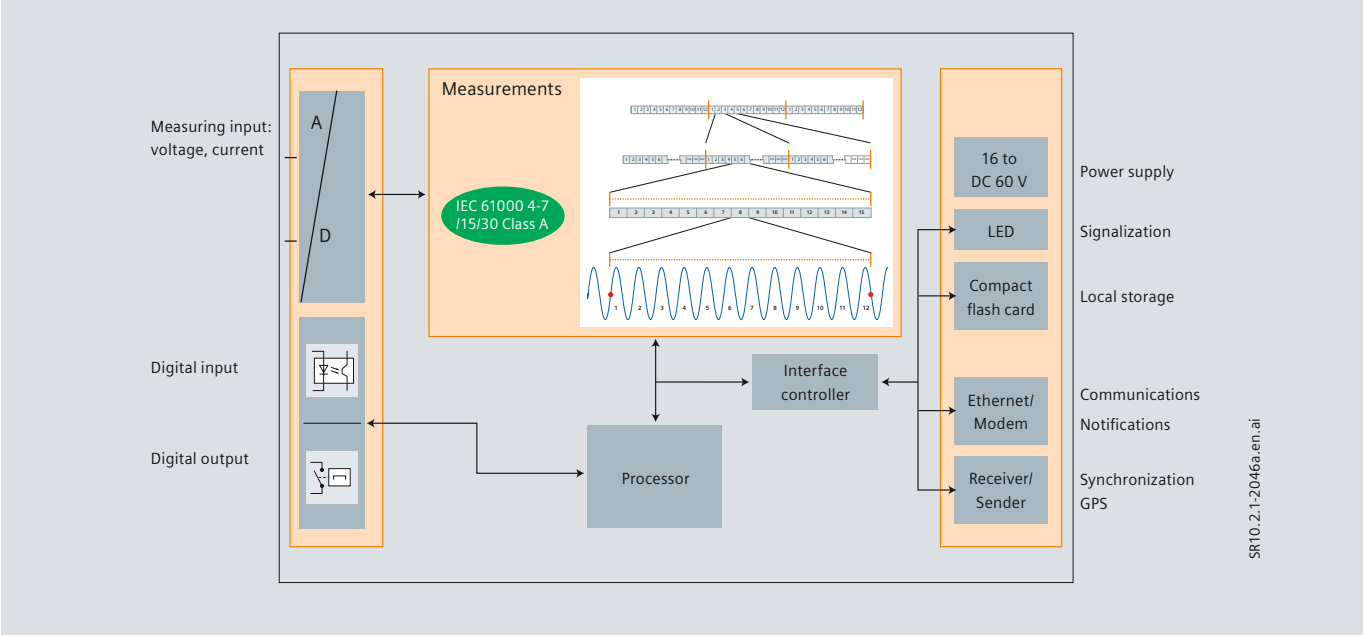


Fig. 4/10 Block diagram for data recording and online processing of SICAM Q80

Recording of events
The plots of the r.m.s. value curves are the basis for capturing events. A deviation of the r.m.s. in one direction results in a new data point in the reduced curves; an event is characterized and bounded by two transitions: One from the normal to the faulty voltage level and one from the faulty level back to the normal level. The normal-to-fault and back-to-normal transitions are defined as a standard ± difference from a definable hysteresis voltage. The duration of the event is measured between the two transitions. The depth of the result is determined from the minimum or maximum of the amplitude in the region affected by the fault. This assumes that the amplitude remains almost constant during the fault. According to the currently valid standard, every deviation > 10 % of the nominal voltage counts as an event. Depending on the duration and amplitude, further distinctions are made into dips and short / long interruptions.

Harmonics and interharmonics
The frequencies in the voltage, current, and therefore also in the power, are calculated by means of Fast Fourier Transform (FFT). The FFT is calculated seamlessly with a square window over each group of 10 periods. This corresponds to the specifications for measuring harmonics and interharmonics in power supply networks defined in EN 61000-4-7.

Flicker
Low-frequency amplitude fluctuations in the network, in turn, cause the luminous density in lamps to fluctuate. This is perceptible as flickering. Above a certain threshold of perceptibility, this is considered a nuisance. Such fluctuations can be measured using a flickermeter. The flicker is calculated with a sampling rate of 100 Hz according to the description of a flickermeter in the EN 61000-4-15 standard.

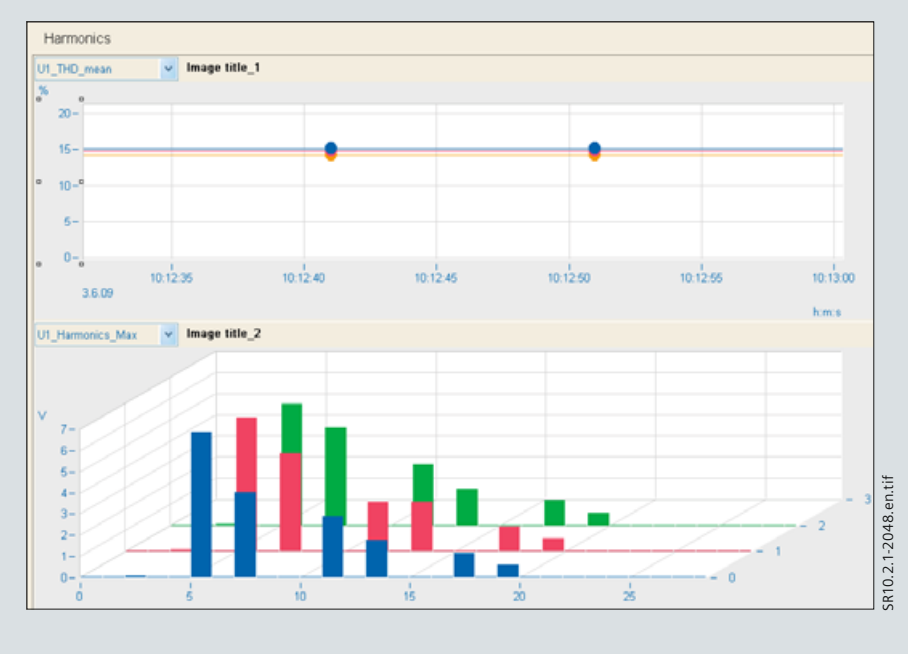


Fig. 4/11 Harmonics overview

4

Device functions

Triggers

Along with the conventional trigger mechanisms, responding to signals exceeding settable cutoff values, it is also possible to set triggering conditions depending on the signal deviating significantly from the expected waveform. For example, any sudden signal deviations occurring during long-term monitoring due to harmonics or brief voltage fluctuations (spikes) can be captured even if the magnitude of the deviation is much smaller than the nominal value itself.
The recording duration after and before an occurrence of a trigger event is configurable. The recording time is from 10 ms to 60 s and pre-trigger 100 ms to 30 s. Unlike in normal recording, triggered raw data recording uses a time resolution of 100 µs. There is also a trigger for signal frequencies. In this case, the input signal is band-pass-filtered before triggering. This enables visualization of the signal, whose amplitude is modulated over a signal frequency. The classic application for this are ripple control telegrams. Triggers responding to external binaries are also possible.

Ethernet trigger

SICAM Q80 can also send triggers over the Ethernet to other SICAM Q80 devices. These are termed network triggers. The other SICAM Q80 devices in the network receive this message and respond accordingly, so that an event or a disturbance at one network node results in instantaneous measured values at all other network nodes. This enables simultaneous analysis of the effect of this disturbance on the complete network.

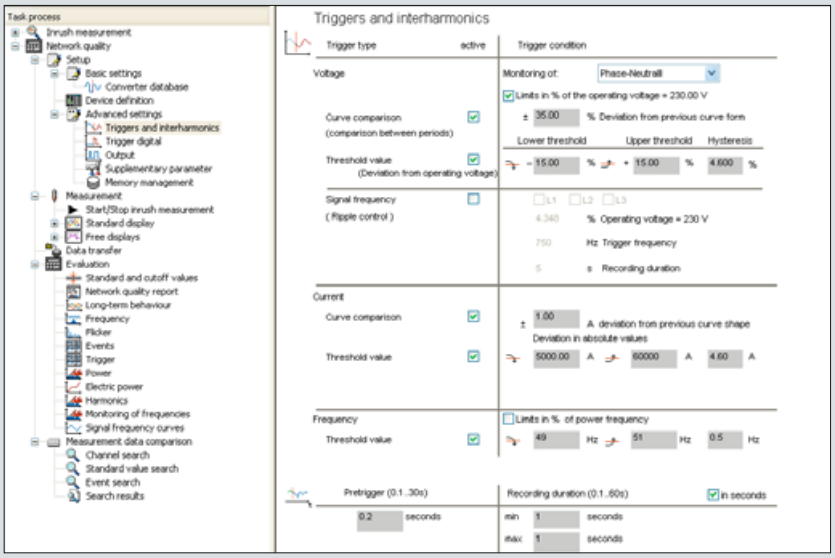


Fig. 4/12 Trigger parameterization

Trigger type	Condition parameterization
Voltage and current	Curve comparison, threshold
Main signaling frequency (ripple control)	% of voltage, frequency, recording duration
Frequency (threshold value)	Limits in % of power frequency
Digital trigger	Transitions –> 0 to 1 or 1 to 0

Table 4/6 Trigger type and parameterization conditions

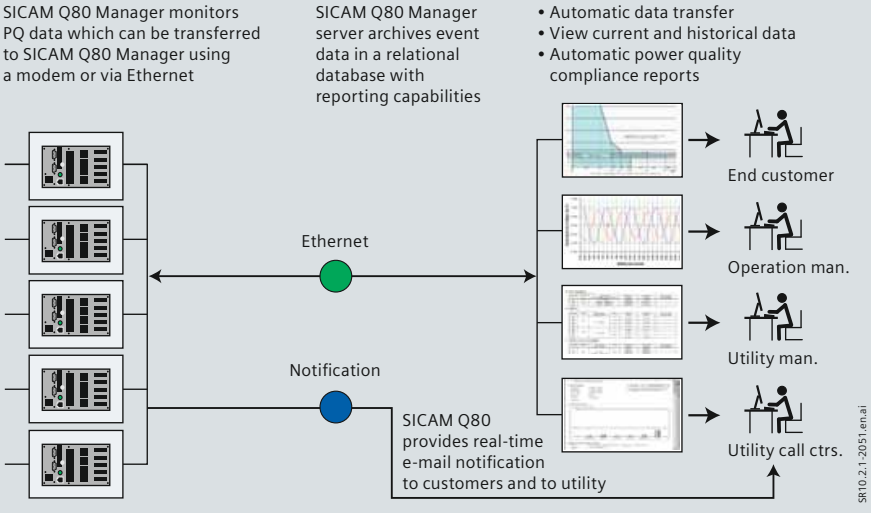


Fig. 4/13 SICAM Q80 – system overview

Notifications

SICAM Q80 supports the automatic transmission of notifications and messages in response to specific events. Such events may include voltage disturbances, lack of available storage space, or cyclic notification. One recipient can be defined for each message. The message types that can be chosen are e-mail, SMS, fax, or any combinations of these.

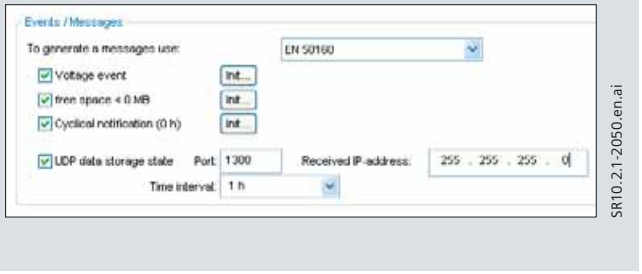


Fig. 4/14 Notification configuration

Internal memory capacity

The available storage medium is a compact flash card hard drive with a standard capacity of 2 GB. Optionally, compact flash cards can be used with capacities up to 16 GB. Intelligent memory management and effective data reduction enable storage of up to 130 weeks' (2.5 years) worth of data, in compliance with EN 50160.

Fig. 4/15 Standard supply: 2 GB CF card (can be upgraded to 16 GB)

System communication and configuration

System communication and configuration
SICAM Q80 units are installed at various points to record electrical quantities in order to analyze power quality or event recording. Different connection methods or system configurations are possible, depending on the application and existing infrastructure.

TCP/IP communications for flexible network configurations
The networking of single devices enables central parameter setting and administration as well as a complete, accurately timed recording of events and disturbances of all systems defined in the network.

Time synchronization
SICAM Q80 can be synchronized by Network Time Protocol (NTP), IRIG-B, DCF-77 and GPS real-time clock for absolute time synchronization. It is also possible to synchronize multiple SICAM Q80 devices even without a GPS real-time clock, and to plot their respective data jointly in the correct chronological relationship.

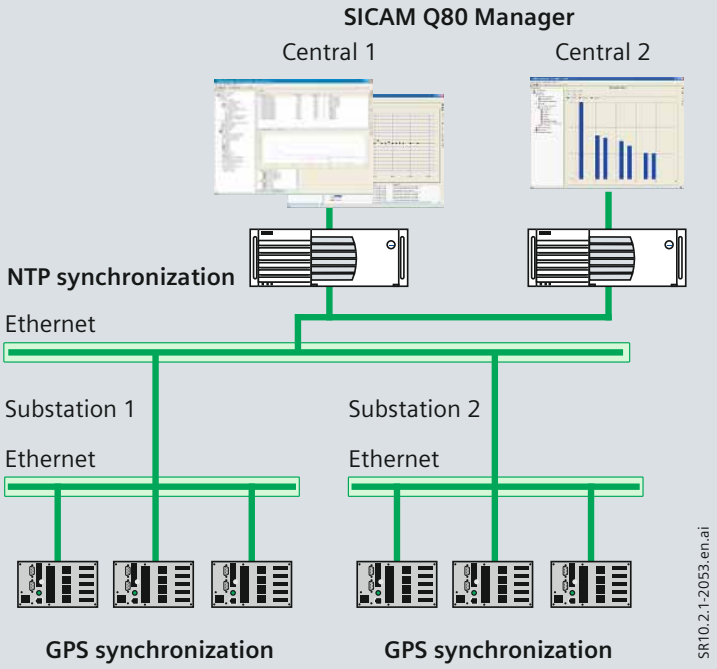


Fig. 4/16 Flexible networks with TCP/IP protocol for communications and synchronization

SICAM Q80 Manager

The SICAM Q80 Manager is a complete software tool for parameterization, system overview, evaluations and automatic analyses; it allows the analysis of more than 500 data sets from the SICAM Q80 Power Quality Recorder. It covers the whole chain of power quality analysis from measurement to the provision of important information, enabling remedial measures to be taken to improve power quality.

The SICAM Q80 Manager PC software enables user-friendly operation. Setting and other operations are performed in an intuitive manner. Despite the large number of functions available, the user interface is clearly organized, in a tree structure similar to the familiar Microsoft Explorer® tree structure. SICAM Q80 Manager runs under Microsoft Windows 2000, XP, or Vista.

For operation and analysis by the user, the SICAM Q80 Manager software enables central parameter setting of all devices without any special PC knowledge.

The SICAM Q80 Manager software is designed to guarantee easy handling of the applications. Conducting measurement according to industry standards requires no special instrumentation or computer skills. Its function and appearance resembles the familiar Windows-Explorer.

The standard software module includes all functions necessary for operation, display, analysis and documentation.

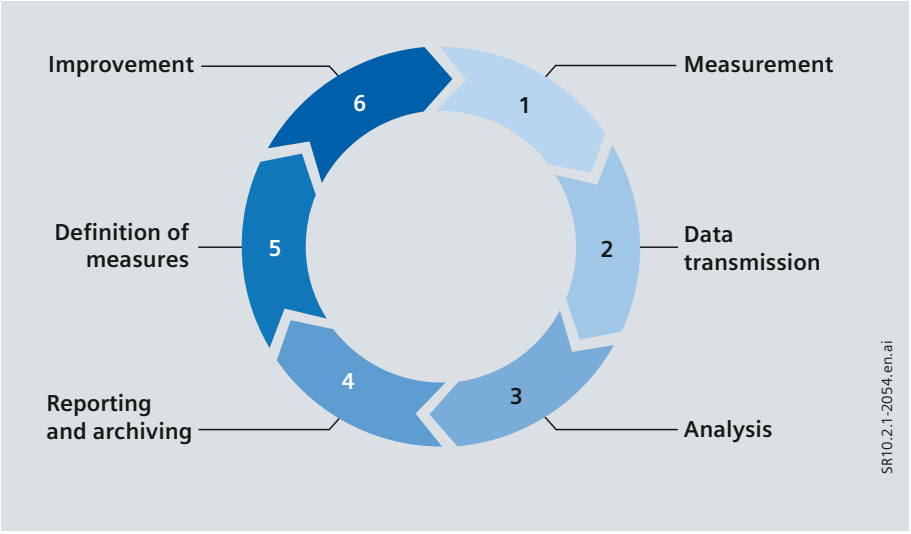


Fig. 4/17 Power quality cycle

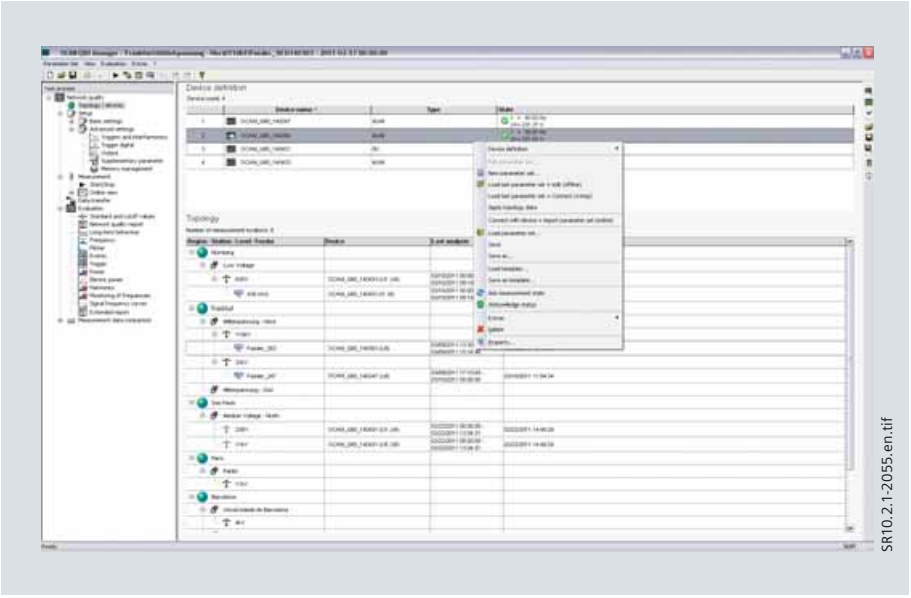


Fig. 4/18 Measurement overview

Measurement system overview

A topology structure can be created in SICAM Q80 Manager, so that the user can have a clear measurement system structure, with regions, station, voltage level, measurement location and device name information. For each device, the measurement status is reported, so that the last measurement time information is available.

Defining your own grid code with user-friendly advanced settings

The process of setting up measurements, data analysis and documentation is streamlined. In SICAM Q80, the EN 50160 measurements are predefined and require only very few additional settings, so SICAM Q80 is easy to use even for operators without any special know-how or training. However, the user can freely define and save special measurements, value limits, analyses and documentation to be reused later if needed.

Software

Online measurement

SICAM Q80 Manager enables connection with a device for the purpose of visualizing and monitoring online measurements over the network from a central PC at any time.
Further possibilities for online display are: Representation of currents and voltage in a vector diagram, online voltage and current harmonics, power direction of each phase and, in total, progression of r.m.s. value, recorded events.

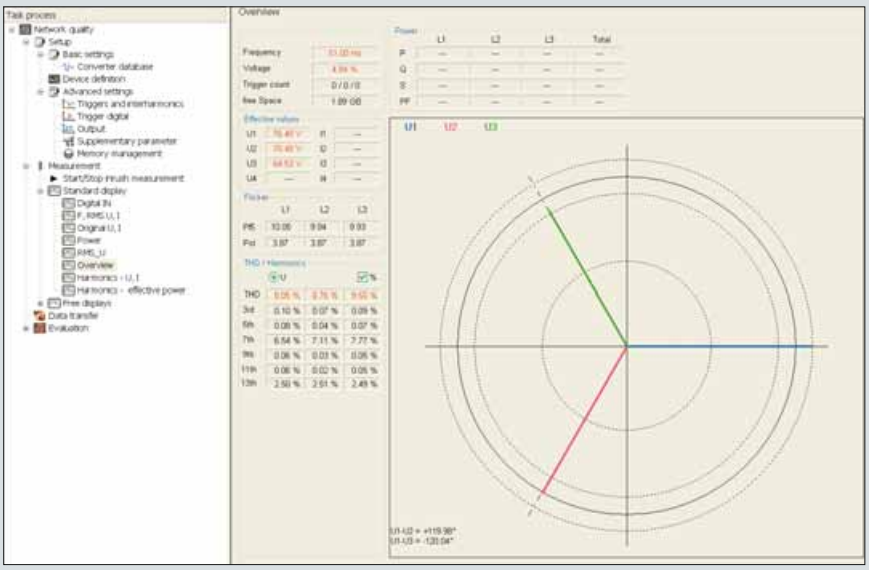


Fig. 4/19 Online visualization – phaser diagram

Data evaluation

With the help of the database module, the user can search for any events, measurement channels, or deviations from standards. The data found or chosen can be displayed or compared at the touch of a button.

Limit configuration

The value limits stipulated in the EN 50160 standard serve as the basis for the power quality report. A single form displays all values in relation to the user-selected value limits. Depending on the particular quality demands, they can be changed and saved with names chosen by the user. Either the analysis can be based on user-defined data, or default value limits can be selected.
Analysis is followed by fully automated compilation of documentation of the overall measurement, in accordance with industry standards.

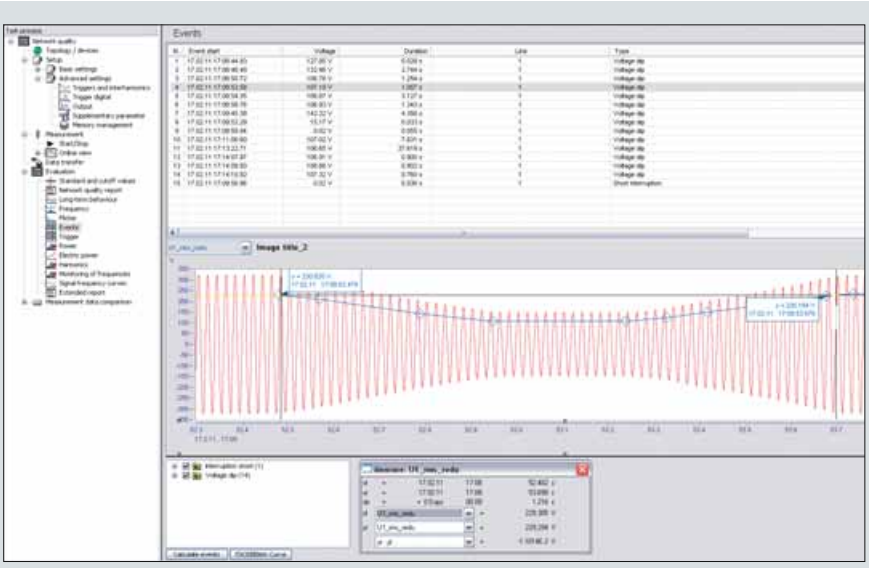


Fig. 4/20 Trigger analysis

Data polling – Auto Transfer

With the automatic data transfer program – Auto Transfer – part of delivery of the SICAM Q80 Manager, it is possible to get data automatically from the remote devices.
The Auto Transfer software can be installed and parameterized independently of the SICAM Q80 Manager, in distinct places in the network or PCs. It is very helpful for reaching the flexibility of installing client server architectures.
The Auto Transfer can work with time cyclical data polling, or data are sent from the device as soon as they are available. E.g., the data availability depends on the voltage quality measurement interval or events. The data transfer intervals can be parameterized for power quality data, e.g. from 2 hours until 4 weeks duration. So, when they are completed, the automatic data collection can begin, e.g. from the device to the server or evaluation station. In case of events, e.g. voltage triggers are matched, this data can be automatically transferred to the evaluation station independently of the measurement interval.

Data and information organization

For analysis purposes, over 500 waveforms per measurement are available. To make them manageable, e.g. evaluations to be applied to other management reporting tasks, the data can be exported to Excel or CSV files.

Report generator
The report generator is used to create graphical reports to document the measurement and analysis results. Unlike the print function of the curve window, which prints out the current curve plot, the report can be made up of a layout comprising curve plots, text, tables and other graphical objects.
The report generator has a multi-document user interface on which multiple reports can be edited at one time. The usual editing operations, such as multiple selection, copy, paste, move, orientation, etc. are all provided.
The properties of the objects, such as colors, fonts, etc. can be changed in various ways, even in groups.
An undo function, seamless zooming, a freely definable grid with a snap-function, and context sensitive online help round off the support tools available to the user for rapid compilation of complex reports.
The report generator can be used to give every report and log its own layout:

- Automation of documentation
- The quick way to get measurement results as a hard copy
- Creation of document templates
- Insertion of measurement plots of any length
- Insertion of measurement value tables
- Insertion of elements via the MS Windows Clipboard
- Text, pixel graphics, vector graphics, OLE objects
- Texts in any font, color or format
- Structural elements
- Lines, frames, fields, arrows
- Grid functions for millimeter-precise layouts (e.g. 1 V corresponds to 10 mm / 0.39 in.).

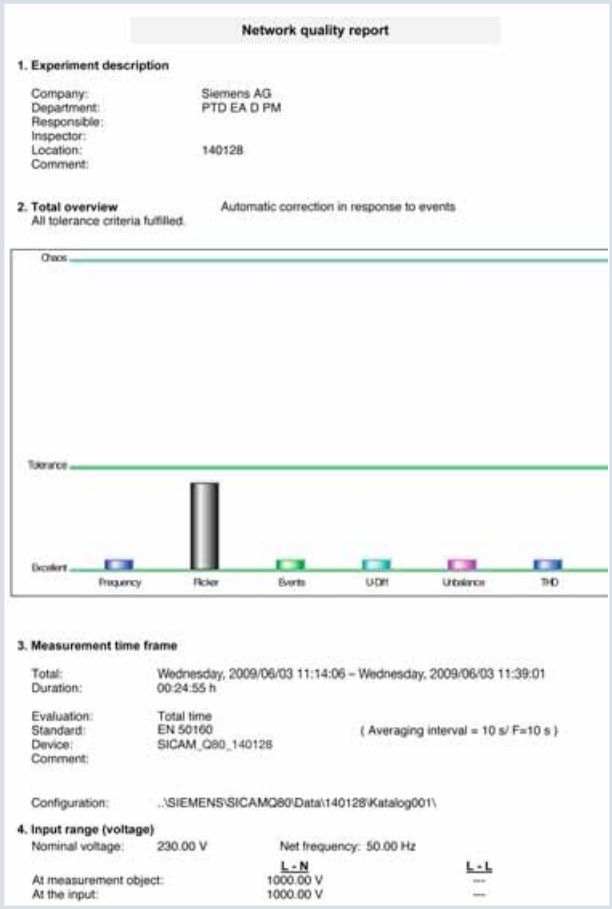


Fig. 4/21 Network quality report

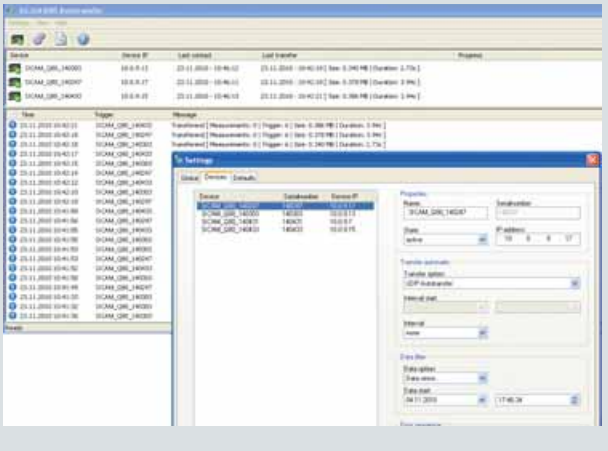


Fig. 4/22 Automatic data transfer program

Automatic power quality reporting – Auto Report
Jointly with Windows Scheduler Program, the Auto Report performs automatically scheduled power quality reports. The users just need to define the task and its interval, and where the reports have to be available.

Through the measurement overview option in the SICAM Q80 Manager, the user can access the reports, e.g. in PDF files, over the reports status windows, which already contain the brief status information, pass or fail.

Software

Measurements overview

All values relevant to power quality are monitored, recorded and evaluated according to international and national standards for power quality (e.g. the European standard EN 50160).

Measurement standards	IEC 61000-4-30; IEC 61000-4-15; IEC 61000-4-7
Standards for voltage quality analysis	Voltage quality in accordance with EN 50160 or according to individually defined criteria
Voltage, current	Curve plots of r.m.s. values after every half period (reduced half-period r.m.s. values)
Flicker	Short-term (Pst), long-term (Plt) and momentary values (Pf5)
Frequency	40 to 70 Hz
Harmonics	Voltage, current up to 50th harmonic, THD
Interharmonics	Up to 10 frequencies (5 to 3,000 Hz, resolution 5 Hz)
Symmetry	Zero / positive / negative phase-sequence system / asymmetry
Power calculation as per DIN 40110-1 and CE2	1-, 2-, 3-phase, total (active, apparent, reactive power)
Phase angle	< 1° up to 2.5 kHz
Trigger functionality	For voltage and current: R.m.s. trigger, curve form trigger, signal frequency trigger
Transients	Recording of instantaneous release of trigger values at 10 kHz

Table 4/7 Measurement specification

Time resolution

Many network quality attributes (e.g. voltage dips) require very detailed display while for others (e.g. slow changes), averages over 10 minutes are adequate. There may be five different resolution levels in total, depending on the calculation technique used.

Resolution	Significance	Examples
10 min	Values over the selected averaging interval (default 10 min)	Mean values, flicker
10 to 12 cycles	Values over the selected averaging interval *f* (default = 10 s)	Frequency
Half cycle	Sample of the demodulated impulse sequence (filter result of the amplitude modulated signal frequency)	Main voltage signaling
10 ms	r.m.s. value every half cycle	r.m.s. values
100 µs	Input samples and derived quantities without data reduction	Recording of instantaneous value (curve shape)

Table 4/8 Time resolution of data

Measurement overview

Measurement	Measurement intervals and comments	3-phase current 4-wire	3-phase current 3-wire	Single-line
Voltage	3 s, 10 s, 1 min, 5 min, **10 min**, 15 min, 30 min, 1 h, 2 h	■	■	■
$V_{x\_rms\_mean}$	Mean of the voltage r.m.s. value	■	■	■
$V_{x\_rms\_min}$	Minimum in the averaging interval	○	○	○
$V_{x\_rms\_max}$	Maximum in the averaging interval	○	○	○
$V_{x\_rms\_redu}$	Reduced time plot (maximum resolution: 10 ms)	■	■	■
$V_{x\_THD\_mean}$	THD (Voltage total harmonic distortion)	■	■	■
$V_{x\_harmn\_mean}$ with x = 1...8; n = 1...50	Voltage harmonics	■	■	■
$V_{x\_frz\_mean}$ with z = 1...10	Monitoring of any fixed frequencies (e.g. interharmonics)	○	○	○
Current	3 s, 10 s, 1 min, 5 min, 10 min, 15 min, 30 min, 1 h, 2 h	○	○	○
$I_{x\_rms\_mean}$	Mean value of the current r.m.s. value	●	●	●
$I_{x\_rms\_min}$	Minimum in the averaging interval	○	○	○
$I_{x\_rms\_max}$	Maximum in the averaging interval	○	○	○
$I_{x\_rms\_redu}$	Reduced time plot	●	●	●
$I_{x\_THD\_mean}$	THD (Current total harmonic distortion)	●	–	●
$I_{x\_harmn\_mean}$ with x = 1...4; n = 1...50	Upper harmonic for current	●	–	●
$I_{x\_frz\_mean}$ with z = 1...10	Monitoring of any fixed frequencies	○	○	○
Frequency	3 s, **10 s**, 30 s, 1 min, 5 min, 10 min	■	■	■
Frequency	System frequency	■	■	■
Frequency$_{_histogram}$	Frequency histogram	■	■	■
Frequency$_{_redu}$		■	■	■
Symmetry	3 s, 10 s, 1 min, 5 min, 10 min, 15 min, 30 min, 1 h, 2 h	■	■	–
Unbalance$_{_rms}$		■	■	–
SymmetryZero$_{_rms}$	Zero sequence system	■		–
SymmetryPositive$_{_rms}$	Positive sequence system	■	■	–
SymmetryNegative$_{_rms}$	Negative sequence system	■	■	–
Flicker	3 s, 10 s, 1 min, 5 min, 10 min, 15 min, 30 min, 1 h, 2 h			
$V_{x\_rms\_pst}$	Plt computed from 12 Pst values	●	■	■
$V_{x\_rms\_plt}$ with x = 1...3		●	■	■
Power	3 s, 10 s, 1 min, 5 min, 10 min, 15 min, 30 min, 1 h, 2 h	○	○	○
$P_{\_P\_mean}$	Active power for the overall system	●	●	–
$P_{\_Q\_mean}$	Reactive power for the overall system	●	●	–
$P_{\_S\_mean}$	Apparent power for the overall system	●	●	–
$P_{\_Lambda\_mean}$	Power factor	●	●	–
$P_{x\_P\_mean}$	Active power for one channel	●	–	●
$P_{x\_Q\_mean}$	Reactive power for one channel	●	–	●
$P_{x\_S\_mean}$	Apparent power for one channel	●	–	●
$P_{x\_Lambda\_mean}$	Power coeficient for one channel	●	–	●
$P_{x\_P\_harmn\_mean}$	Active power of the harmonics	●	–	●
$P_{x\_Q\_harmn\_mean}$	Reactive power of the harmonics	●	–	●
$P_{x\_S\_harmn\_mean}$	Apparent power of the harmonics	●	–	●
$P_{x\_Phase\_harmn\_mean}$ with: x = 1...4; n = 1...50	Phase power of harmonic	●	–	●
$P_{x\_P\_frz\_mean}$	Active power of the monitored frequencies	●	–	●
$P_{x\_Q\_frz\_mean}$	Reactive power of the monitored frequencies	○	–	○

■ = always present ● = present if current is measured ○ = can be switched on / off (optional) – = not present

Note: Measurement intervals: The interval written in bold print is to be used for compliance with the EN 50160 standard, e.g. 10 min.
Specifications refer to a 50 Hz and a 60 Hz system. For all channels, subsequent calculation of a histogram and the cumulative frequency is possible.

Table 4/9 Selection of measurement and metering values (contin. on p. 4/22)

Measurement overview

Measurement	Measurement intervals and comments	3-phase current 4-wire	3-phase current 3-wire	Single-line
$P_{x\_Q\_frz\_mean}$	Reactive power of the monitored frequencies	○	–	○
$P_{x\_S\_frz\_mean}$	Apparent power of the monitored frequencies	○	–	○
$P_{x\_Phase\_frz\_mean}$ with: x = 1...4; z = 1...10	Phase power of monitored frequencies	○	–	○
Trigger	Measurement duration 200 ms. Resolution 100 µs	○	○	○
V_{x_event}	R.m.s. trigger, curve shape trigger	▲	▲	▲
I_{x_event} with: x = 1...4	R.m.s. trigger, curve shape trigger	▲	▲	▲
Signal frequency trigger	Mean values: 3 s, 10 s, 1 min, 5 min, 10 min, 15 min, 30 min, 1 h, 2 h	▲	▲	▲
$V_{x\_signal\_mean}$	Mean of the voltage	○	○	○
$V_{x\_signal\_redu}$	Reduced time plot	▲	▲	▲
$V_{x\_signal\_event}$	High resolution signal voltage trigger (10 ms)	▲	▲	▲
$P_{x\_P\_signal\_mean}$	Active power	▲	▲	▲
$P_{x\_Q\_signal\_mean}$	Reactive power	▲ ●	▲ ●	▲ ●
$P_{x\_S\_signal\_mean}$	Apparent power	▲ ●	▲ ●	▲ ●
$P_{x\_Phase\_signal\_mean}$ with: x = 1...3	Phase power	▲ ●	▲ ●	▲ ●
Channels during measurement (online monitoring)				
Voltage		■	■	■
V_x	100 µs (no averaging, original signal)	■	■	■
V_{x_rms}	R.m.s. every 10 ms	■	■	■
$V_{x\_FFT\_}$	Voltage harmonics (1^{st} – 50^{th})	■	■	■
Phase				
$V_1 - V_2$		■	■	■
$V_1 - V_3$		■	■	■
$V_x - I_x$ with: x = 1...3		●	●	●
Current	100 µs	○	○	○
I_x	100 µs (no averaging, original signal)	●	●	●
I_{x_rms}	R.m.s. every 10 ms	●	●	●
I_{x_FFT} with: x = 1...3	Upper harmonics (1^{st} – 50^{th})	●	●	●
$P_{x\_P\_harmonics\_}$ with: x = 1...3	Harmonic real power (1^{st} – 50^{th})	●	●	●
Overview display during measurement				
V_x	R.m.s. over one period	■	■	■
THD	of every 10 periods	■	■	■
V-harmonics (in % of fundamental frequency or *V*) with: x = 1...3	FFT over 10 periods	■	■	■
I_x	R.m.s. over one period	●	●	●
THD	of every 10 periods	●	●	●
I-harmonics (in % of fundamental frequency or A) with: x = 1...3	FFT over 10 periods			
Unsymmetry	of every 10 periods	■	■	■
Instantaneous flicker of V_x with: x = 1...3	of every 10 periods	■	■	■
Power				
P_x, Q_x, S_x, power factor		●	–	●
For the overall system with: x = 1...3		●	●	–
Addtional information	Free storage space in the measurement device	■	■	■
	Number of recorded trigger events	■	■	■

■ = always present ● = present if current is measured ▲ = present if the associated trigger was activated ○ = can be switched on / off (optional) – = not present

Note: Measurement intervals: the interval written in bold print is to be used for compliance with the EN 50160 standard, e.g. 10 min.
Specifications refer to a 50 Hz and a 60 Hz system. For all channels, subsequent calculation of a histogram and the cumulative frequency is possible.

Table 4/9 Selection of measurement and metering values (contin. from p. 4/21)

Connection examples

Four-wire connection (star circuit)

- V_1, V_2, V_3 → Lines 1, 2, 3, V_4, PE (protection ground)
- N → Neutral
- I_1, I_2, I_3, I_4 → connected or unconnected (V_4, I_4 can be measured optionally)

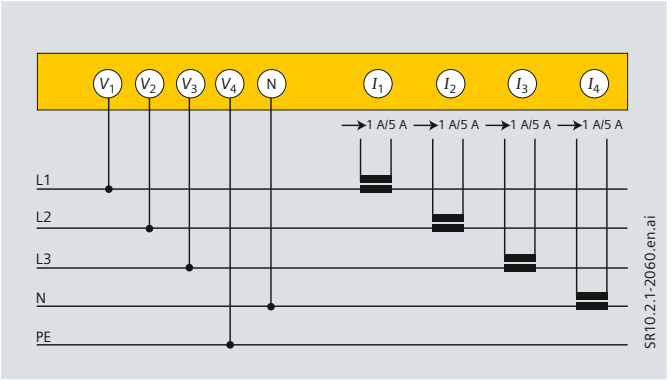


Fig. 4/23 Four-wire connection

Eight-voltage connection

System 1:

- V_1, V_2,V_3 → Lines 1, 2, 3, V_4, PE (protection ground)
- N → Neutral

System 2:

- V_5, V_6, V_7 → Lines 5, 6, 7, V_8, PE (protection ground)
- N → Neutral

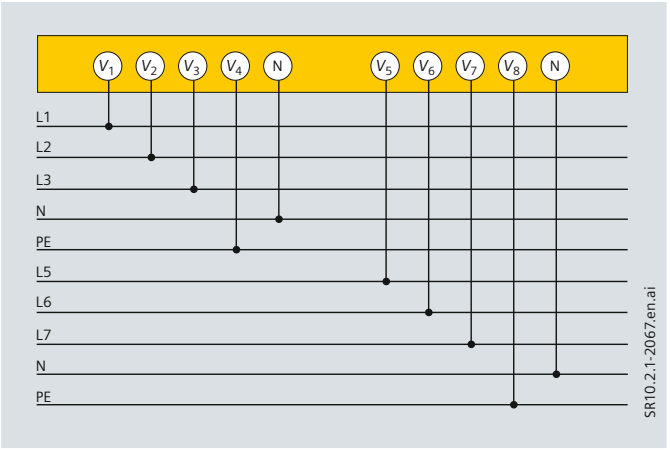


Fig. 4/24 Eight-voltage connection

Three-wire connection 3 × V / 3 × I or 2 × I (delta connection)

- V_1, V_3 → Lines 1 and 3
- N → Line 2
- I_1, I_3 → Lines 1 and 3
- I_2 → Line 2 optionally possible

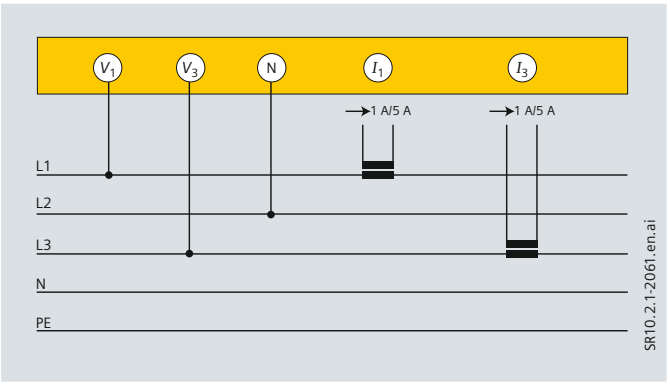


Fig. 4/25 Three-wire connection (delta connection)

Single-phase connection

- V_1 → Line 1
- N → Neutral

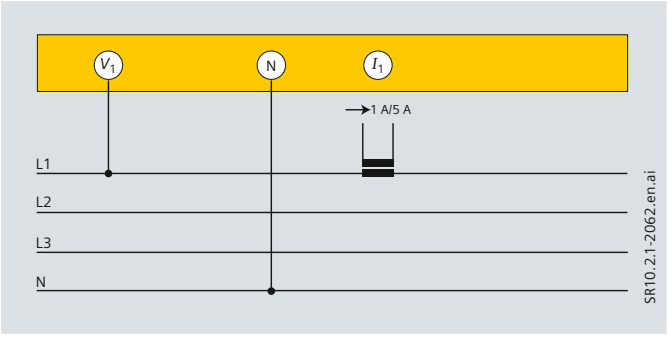


Fig. 4/26 Single-phase connection

Technical data

General data

Parameter	Typical value	Min./max.	Test conditions/remarks
Ambient conditions	The normal ambient conditions according to EN 61010-1 apply		
Signal inputs	4 × current [*I*] 4 × voltage [*V*] and 8 × voltage [*V*]		
Digital input/output	4 binary inputs 4 relay outputs		
Power consumption		< 10 W < 12 W	Permanent operation After power-on (to recharge the UPS)
Power supply		DC 10 to 60 V or AC 100 V to 240 V / DC 110 V to 320 V	
UPS capacitor	Back-up time: ≤ 1 second		Factory settings
EMC Interference immunity/ Transient emissions	Class A		According to IEC/EN 61326-1
Degree of protection	IP 20		According to EN 60529
Weight	Approx. 1.9 kg		
Dimensions	166 mm × 105 mm × 126 mm 6.53 in. × 4.13 in. × 4.96 in.		(W × H × D) without mounting rail
Ambient temperature range	–10 °C to 55 °C/50 °F to 131 °F		Without condensation
Storage temperature	–40 °C to 90 °C/–40 °F to 194 °F		Within temperatures ≤ 15 °C or > 55 °C/≤ 59 °F or > 131 °F only for short time
Communication interfaces	Ethernet, Modem		TCP/IP DSUB
Memory capacity	CF card	Min. 2 GB, Max. 16 GB	Standard accessory: 2 GB CF card up to 16 GB possible
Internal clock and external synchronization	± 1 s/day GPS DCF 77 or via other SICAM Q80		Battery backed GPS input Sync input

Table 4/10 Technical data

Voltage inputs

Parameter	Typical value	Min./max.	Test conditions/remarks
Input	4 or 8 channels for voltage measurement		Single end, isolation for each group
Sampling rate per channel		10 kHz	Network analysis
Bandwidth		0 to 4.1 kHz	– 3 dB, network analysis
Terminal connections	Screw terminal 0.5 to 6 mm²/0.008 to 0.009 sqin. 10 to 20 AWG (American Wire Gauge)		Screw terminal for rigid or flexible line with 0.5 to 6 mm²/0.008 to 0.009 sqin. cross-section
Electrical safety Rating		 300 V/CAT IV	 In accordance with EN 61010-1
Measurement category Degree of pollution		600 V/CAT III 2	Voltage inputs V_1 to V_4 or V_1 to V_8 in accordance with IEC 60664
Insulation test voltage		5.4 kV_{rms}	50 Hz, 1 min
Measurement ranges	up to 1000 V_{rms}		Automatic range setting
Overload resistance		1.5 kV_{rms}	DC and 50 Hz, permanent
Input impedance	2.5 MΩ	± 1 %	Differential
Measurement uncertainty Drift	0.04 % ± 8 ppm/$K \times \Delta T_a$	≤ 0.1 % ± 40 ppm/$K \times \Delta T_a$	of ranges $\Delta T_a = \lvert T_a - 25\,°C \rvert$ / $\Delta T_a = \lvert T_a - 13\,°F \rvert$ ambient temperature T_a
Isolation suppression		 > 110 dB > 71 dB > 47 dB	Isolation voltage 1000 V_{rms} DC 50 Hz 1 kHz
Channel crosstalk		 ≤ 110 dB ≤ 85 dB ≤ 60 dB	Test voltage: 1000 V_{rms} DC 50 Hz 1 kHz
Strain voltage (RTI)	20 mV_{rms}		± 100 V, bandwidth: 0.1 Hz to 10 kHz

Current inputs

Parameter	Typical value	Min./max.	Test conditions/remarks
Input	4 channels for current measurement with current probes		Differential, isolated
Terminal connections	Screw terminal 0.25 to 2.5 mm²/ 0.0004 to 0.004 sqin. 14 to 24 AWG (American Wire Gauge)		Screw terminal for rigid or flexible line with 0.25 to 2.5 mm²/0.0004 to 0.004 sqin. cross-section
Electrical safety Rating		 300 V/CAT IV	 In accordance with EN 61010-1
Measurement category Degree of pollution		600 V/CAT III 2	Current inputs I_1 to I_4 in accordance with IEC 60664
Insulation test voltage		5.4 kV_{rms}	50 Hz, 1 min
Measurement ranges	> 1 A ≤ 1 A		5 A connection 1 A connection
Bandwidth		0 to 4.1 kHz	–3 dB, network analysis
Sampling rate per channel		10 kHz	Network analysis
Overmodulation limit		145 % of range	
Overload strength 5 A terminal 1 A terminal		 ≤ 20 A ≤ 100 A ≤ 10 A ≤ 100 A	 Continuous 1 s Continuous 1 s
Input impedance 5 A terminal 1 A terminal		 ≤ 10 mΩ ≤ 20 mΩ	 Differential
Measurement tolerance	0.06 % ± 8 ppm/$K \times \Delta T_a$	≤ 0.1 % ± 60 ppm/$K \times \Delta T_a$	of input range $\Delta T_a = \lvert T_a - 25\,°C \rvert$ / $\Delta T_a = \lvert T_a - 13\,°F \rvert$ ambient temperature T_a
Phase uncertainty		0 to 2.5 kHz	< ± 1 °

Table 4/10 Technical data

Technical data

Digital inputs

Parameter	Typical value	Min./max.	Test conditions/remarks
Channels/bits	4 digital inputs		Each isolated
Terminal connections	Screw terminal 0.25 to 2.5 mm²/ 0.0004 to 0.004 sqin. 14 to 24 AWG (American Wire Gauge)		Screw terminal for rigid or flexible line with 0.25 to 2.5 mm²/0.0004 to 0.004 sqin. cross-section
Electrical safety Rating	250 V/CAT III		In accordance with EN 61010-1
Measurement category Degree of pollution	2		In accordance with IEC 60664
Insulation test voltage	3.6 kV_{rms}		50 Hz, 10 sec Between channels and chassis
Max. input level V_e		≤ 600 V	Peak-to-peak or DC voltage
Nom. input level V_e	DC 230 V_{rms}/350 V		
Switching level V_S Unipolar low Unipolar high	< 16 V > 16.8 V	> 14 V > 18 V	Schmitt-Trigger-characteristics Hysteresis 0.04 V typ.
Current input	280 µA	< 500 µA	V_e = – 600 V to + 600 V
Circuit time Low → high High → low	70 µs 23 µs	< 180 µs < 40 µs	

Digital outputs

Parameter	Typical value	Min./max.	Test conditions/remarks
Channel/bits	4 relay outputs		Mechanical closer
Terminal connection	Screw terminal 0.25 to 2.5 mm²/ 0.0004 to 0.004 sqin. 14 to 24 AWG (American Wire Gauge)		Screw terminal for rigid or flexible line with 0.25 to 2.5 mm²/0.0004 to 0.004 sqin. cross-section
Electrical safety Rating	250 V/CAT III		In accordance with EN 61010-1
Measurement category Degree of pollution	2		In accordance with IEC 60664
Insulation test voltage	3.6 kV_{rms}		Between channels and chassis
Switching time	5 ms	< 8 ms	
Max. switching power		< 1000 VA	
Switching voltage	> 1 V DC	< 250 V_{rms}	Min. switching voltage at 1 mA
Max. switching current		< 1 A < 4 A	AC 250 V cos ϕ = 1.0 to 0.4 AC 250 V cos ϕ = 1.0
Contact impedance		< 50 mΩ	
Fuse protection Nominal current (I_N)	5 A	I_N 2 I_N	t_{fuse} ≥ 4 h 30 s > t_{fuse} > 1 s

Table 4/10 Technical data

Calibration conditions

Parameter	Typical value	Test conditions/remarks
Temperature	25 °C/77 °F	± 5 °C/± 41 °F
Humidity	40 %	± 30 %
Power supply	24 V	60 W power adapter
Input signal	± 1,000 V_{rms}/sine 50 Hz ± 1 A_{rms}/sine 50 Hz	Voltage inputs Current inputs

Evaluations according to standards		
Standard specification	Voltage quality per EN 50160	IEC 61000-4-30, IEC 61000-4-15, IEC 61000-4-7 Power calculation per DIN 40110-1 and -2
	Data search and data comparison across multiple measurements	Optional software module

Synchronization and time base

Parameter	Typical value	Min./max.	Remarks
Time base per device without external synchronization			
Balanced (default)		± 10 ppm	at 25 °C/77 °F (accuracy of internal time base)
Drift	± 20 ppm	± 50 ppm	– 40 °C/–40 °F to + 85 °C/185 °F operating temperature
Ageing		± 10 ppm	at 25 °C/77 °F, 10 years

Parameter	GPS	DCF77	IRIG-B	NTP
Time base per device without external synchronization				
Supported format			B002 B000, B001, B003*	Version 4 (downwards compatible)
Precision	± 1 µs →	→	→	< 5 ms after ca. 12 h
Jitter (max.)	± 8 µs →	→	→	
Voltage level	TTL	5 V TTL level LOW active	5 V TTL level	–
Input resistance	1 kΩ (pull up)	20 kΩ (pull up)		–
Input connector	DSUB-9	BNC connector "SYNC" short-circuit proof, not isolated →	→	Ethernet
Shield potential input		System ground →	→	–

Parameter	Typical value	Min./max.	Remarks
Synchronization with DCF 77 for several devices (Master/Slave)			
Max. cable length		200 m	BNC cable RG58
Max. number of devices		20	Slaves only
Common mode	0 V		These devices must have the same ground voltage level, otherwise signal quality problems (signal edges) may result.
Voltage level	5 V		
DCF input/output	Connector "SYNC" →	→	BNC
Shield potential, IRIG-input	System ground →	→	

Table 4/10 Technical data

* Using BCD information only

Connection diagrams, dimension drawings

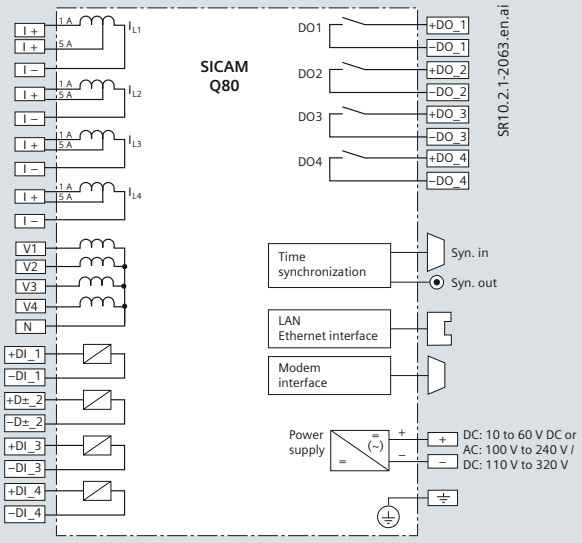


Fig. 4/27 7KG8080 – four-wire connection

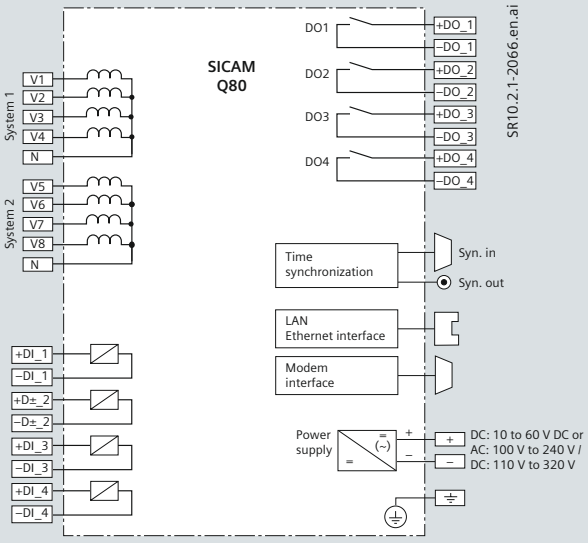


Fig. 4/30 7KG8080 – eight-voltage connection

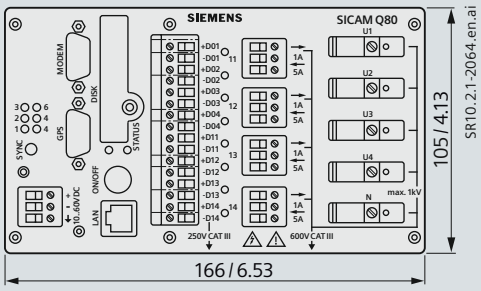


Fig. 4/28 Four-voltage / four-current connection: front view

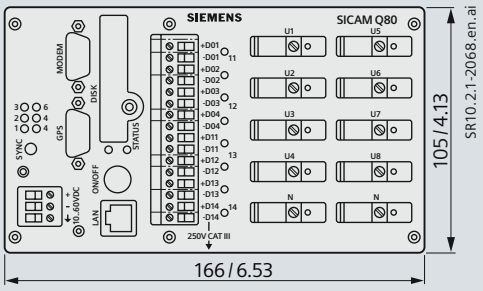


Fig. 4/31 7KG8080 – eight-voltage connection: front view

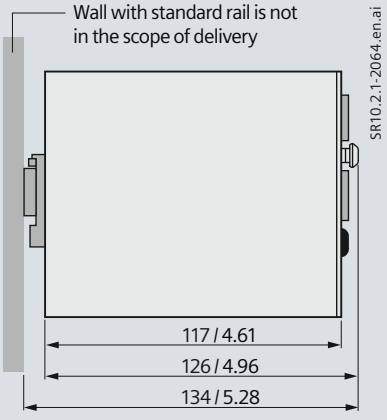


Fig. 4/29 7KG8080: side view

Description	Order No.
SICAM Q80 Power Quality Recorder	**7KG8080-□□A00-0AA0**
– IEC 61000-4-30/Class A – 2 GB compact flash – 4 binary inputs and 4 binary outputs – Synchronization: DCF77/GPS/IRIG-B/NTP Sync. – Ethernet interface – SICAM Q80 Manager – Operating instructions: English and German We suggest the following GPS accessories: – Garmin (18 LVC-5Hz), or – Hopf Receiver 6875-FW7.0: 7XV5664-0CA00 (see SIPROTEC price list) **Inputs:** 4 currents/4 voltages 8 voltages **Power supply:** DC 24/60 V V_{aux} AC: 100 V to 240 V/V_{aux} DC: 110 V to 320 V	 **0** **1** **A** **B**
SICAM Q80 – Manager Software for	**7KG8081-1AA00-0AA0**
– Device parameterization – System topology – Online measurement – Power quality reports (e.g. according to EN 50160) – Automatic power quality reporting (Windows schedule) – Excel/ASC II export – Software language: English/German – Operating instructions and system manual: English/German as PDF	
Extra printed system manual	
German English	**E50417-H1000-C420-A1** **E50417-H1076-C420-A1**
Ethernet patch cable	**7KE6000-8GE00-3AA0**
With double shield (SFTP), cross-over connection, with LAN connector on both ends, SICAM Q80 <CE> PC	

Table 4/11 Selection and ordering data

CE conformity and disclaimer of liability

CE conformity

This product conforms to the directives of the Council of the European Communities on the approximation of the laws of the Member States relating to electromagnetic compatibility (EMC Council Directive 89/336/EEC) and concerning electrical equipment for use within specified voltage limits (Low-Voltage Directive 73/23/EEC).
This product conforms to the international standard IEC 61000-4 and the European standard EN 50160 for voltage characteristics.
The product is designed for use in an industrial environment according to the EMC standard specification as per IEC 61326-1.
Conformity is proved by tests performed by Siemens AG in line with article 10 of the Council Directives in accordance with the generic standard EN 50160 and IEC 61000-4-30 for Class A measurement.

Disclaimer of liability

This document has been subjected to rigorous technical review before being published. It is revised at regular intervals, and any modifications and amendments are included in the subsequent issues. The content of this document has been compiled for information purposes only. Although Siemens AG has made best efforts to keep the document as precise and up-to-date as possible, Siemens AG shall not assume any liability for defects and damage which result through use of the information contained herein. This content does not form part of a contract or of business relations; nor does it change these. All obligations of Siemens AG are stated in the relevant contractual agreements. Siemens AG reserves the right to revise this document from time to time.
Document version: 02
Release status: 02.2011
Version of the product described: V2.0

Certificate of Conformity

IEC 61000-4-30 Class A

Siemens SIMEAS Q80
equipped with Garmin GPS18x LVC
(or other GPS receiver with equivalent accuracy and functionality)

IEC 61000-4-30 Ed. 2
230V, 50/60 Hz, L-N U_{din}

61000-4-30 Section	Power Quality Parameter	Class A Compliance	Class S Compliance	Class B Compliance	Remarks
5.1	Power frequency	Yes	Yes	Yes	
5.2	Magnitude of the supply voltage	Yes	Yes	Yes	
5.3	Flicker	Yes	Yes	(N/A)	See Note 1 below
5.4	Supply voltage dips and swells	Yes	Yes	Yes	
5.5	Voltage interruptions	Yes	Yes	Yes	
5.7	Supply voltage unbalance	Yes	Yes	Yes	
5.8	Voltage harmonics	Yes	Yes	Yes	
5.9	Voltage interharmonics	Yes	Yes	Yes	
5.10	Mains signaling voltage	Yes	Yes	Yes	
5.12	Underdeviation and overdeviation	-	-	-	See Note 2 below
4.4	Measurement aggregation intervals	Yes	No	Yes	Class A and Class S are mutually exclusive
4.6	Time-clock uncertainty	Yes	Yes	Yes	
4.7	Flagging	Yes	Yes	(N/A)	
6.1	Transient influence quantities	Yes	(N/A)	(N/A)	See Note 3 below

(N/A) – Not Applicable. There is no requirement in the Standard.
Note 1: Flicker is only defined at 230V, 50Hz and 120V, 60Hz. EUT meets Class A requirements at 230V, 50Hz.
Note 2: Overdeviation and underdeviation parameters are not measured by the Siemens SIMEAS Q80.
Note 3: Transients applied to EUT measuring terminals and power terminals.

This certificate summarizes the results of the PSL IEC 61000-4-30 Power Quality Measurement Methods Compliance Report, document # PSL SIEMENS-009-30, dated 27 August 2009. PSL tested two samples, S/N 140148 and 140149 at 230VAC, 50/60 Hz. Manufacturer states that these samples are representative of the SIMEAS Q80 series.

Siemens SIMEAS Q80

Alex McEachern 27 August 2009
Alex@PowerStandards.com

Statement of IEC 61000-4-30 Compliance

SIEMENS

Energy Automation

SIMEAS R-PQ
Digital Fault and Power Quality Recorder

Answers for infrastructure and cities.

SIEMENS

siemens-russia.com

Contents – SIMEAS R-PQ

5

Digital fault recorder with integrated Power Quality (PQ) measurement

SIMEAS R-PQ is a powerful disturbance (transient) recorder with integrated power quality measurement functionality based on EN50160 PQ standard. SIMEAS R-PQ offers the following features: Powerful disturbance (transient) recorder, power quality monitoring unit, power and frequency recording system, and event recorder.
The disturbance recorder with a high sampling rate and excellent frequency response enables precise analysis of network disturbances. These records can be evaluated with SICAM PQS. The power quality monitoring system for recording of voltage and current r.m.s. values, frequency, real and reactive power, power factor, current and voltage harmonics, voltage sages and swells, voltage flicker, etc. is a reliable tool to monitor and archive power quality related events. The power and frequency recording system is an important equipment in power plants to understand stability problems and analyze related topics like the response of generator excitation control systems. With an event recorder, various digital signals like the status of a breaker, isolator, and trip contacts of protection relays, etc. can be observed and recorded for further analysis. As a field unit, SIMEAS R-PQ forms a powerful disturbance recording system together with the SICAM PQS software installed on a DAKON PC (personal computer for data collection). One DAKON PC can communicate with several SIMEAS R units and collect all recorded data.
With a flash memory for each SIMEAS R-PQ and practically unlimited storage capability on DAKON PCs, as well as with a powerful database, the recording system enables excellent archiving possibilities.
The data obtained by SIMEAS R-PQ is written to a high-capacity internal bulk storage medium. Under normal conditions in substations, power plants and industrial systems, this type of storage takes months to fill up. When storage is full, it functions as a "ring buffer", overwriting the oldest values with the latest figures.
With a high sampling rate, this unit records all relevant information for further analysis of short-circuits, breaker opening and closing behavior, reaction of CTs and VTs on network disturbances, etc. With a recording capability of 32 analog and 64 binary channels of each unit, and with real-time synchronization capability, the system can observe and monitor a huge number of feeders and power equipment.
SIMEAS R-PQ is a recorder meeting all electromagnetic compatibility requirements like all Siemens numerical relays. High level of hardware and software quality and precise self diagnosis of each unit is a guarantee for the investment of our customers.

Fig. 5/1 SIMEAS R-PQ

Function overview
Disturbance recorder for applications in substations at MV/HV/EHV level and in power plants
- Power and frequency recorder for applications in power plants
- Power quality recorder for analysis and recording/archiving of power quality problems of all power applications
- Event recorder for binary signals for observation of the status of various primary components like breakers, isolators, etc.
- Test recorder for commissioning and system test
- Evaluation based on EN 50160.

Powerful recording system
- The field units SIMEAS R-PQ and the PC software SICAM PQS form a powerful disturbance recording and power quality monitoring system. With a DAKON PC (personal computer for data collection), a powerful data collection and archiving capability leads to very short analysis times
- Communication capability via Ethernet (LAN or WAN structure) in accordance with Ethernet 802.3 using TCP/IP protocol, communication via telephone network using ISDN or analog modem, or direct communication using copper (RS232) or fiber-optic channels
- Various installation possibilities of the PC software SICAM PQS in server, client and evaluation mode meet all requirements, like visualization, analysis for parameterization, commissioning, test, automatic data collection, data archiving
- Precise fault location capability using SICAM PQS software
- Detailed power quality analysis information using SICAM PQ Analyzer.

Powerful hardware
- Modular hardware system with up to 32 analog and 64 binary inputs in a 19-inch rack
- Flash memory.

System overview

System overview

The DAKON is an industrial PC to which two or more SIMEAS R-PQ and numerical relays with the IEC 60870-5-103 and IEC 61850 protocols can be connected. A DAKON can automatically fetch both data from SIMEAS R-PQ or SIMEAS R-PMU and the fault recordings from protection equipment, and write these to its own storage. Communication between SIMEAS R-PQ, a DAKON and evaluation PCs is possible in various ways, for example via a wide area network (WAN) or local area network, with the TCP/IP protocol and electric or optical cables, as well as with converters and switches. As an alternative, communication via analog or ISDN modems is also possible.

Time synchronization

To enable a comparison of recordings from fault recorders and protection equipment at different locations, precise time synchronization of all SIMEAS R-PQ and DAKON devices is necessary. This is ensured by the use of additional components, such as GPS receiver and sync transceiver.
More details at the document "Application Note Time Synchronization" www.siemens.com/powerquality

Analysis and evaluation software

All data recorded with SIMEAS R-PQ can be analyzed with the SICAM PQS software package.
SICAM PQS is also used for parameterizing the SIMEAS R-PQ, and archiving the fault recordings and mean values.
The SICAM PQS software also offers the ability to work out the location of a fault in a line. Depending on data availability, the program can use fault recordings made at either end of a line to determine the fault location.
The measured values recorded with the "mean value and power quality recorder" function can be analyzed with the SICAM PQ Analyzer, which is an optional software package of SICAM PQS.
For example, information can be obtained about the system voltage quality on a specific feeder.

Design and data acquisition units

The SIMEAS R-PQ recorder is available in two different housings. The smaller type (ZE8/16) can be equipped with one data acquisition unit (DAU). The larger type (ZE32/64) provides space for up to 4 DAUs. A selection of different DAUs enables flexible arrangement of inputs for current, voltage and DC voltage:

- VDAU (8 voltage channels)
- CDAU (8 current channels)
- VCDAU (4 voltage and 4 current channels)
- DDAU (8 voltage or 8 current channels).

All data acquisition units described also feature 16 binary channels. If a larger number of binary signals is to be recorded, the recorder can optionally be equipped with a BDAU with 32 binary channels.

Fig. 5/2 SIMEAS R-PQ, compact housing

Fig. 5/3 SIMEAS R-PQ, front view.
A DAU can be seen in the middle slot

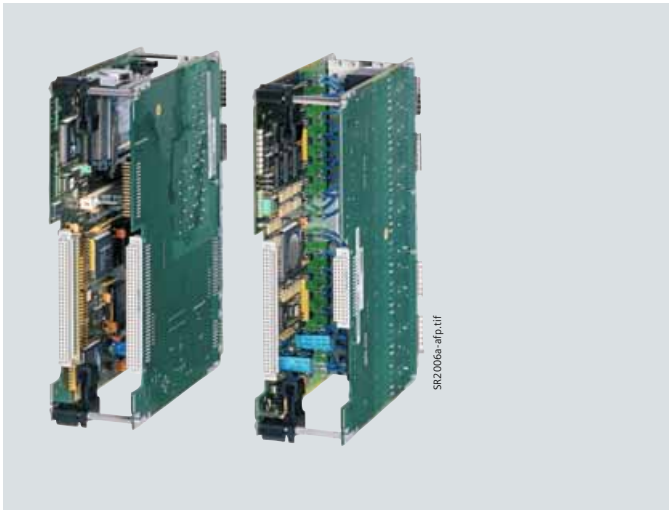


Fig. 5/4 DAUs

Dynamic fault recorder for analog and binary channels
The "fault recorder" function includes recording of analog and digital signals. These signals are continuously recorded and simultaneously compared with the parameterized trigger criteria. On triggering, all channels are recorded concurrently as well as with a pre-fault, variable fault progression, and post-fault, depending on the parameter settings for recording.

Recording alternating current and voltage
Three different data acquisition units are available for recording currents and voltages:
- VCDAU with 4 voltage and 4 current inputs
- CDAU with 8 current inputs
- VDAU with 8 voltage inputs.

The SIMEAS R-PQ sampling rate is 256 × system frequency. For a system frequency of 50 Hz, the sampling rate is therefore 12.8 kHz (for 60 Hz, 15.36 kHz per channel).

Recording of the process variables
DC signals are measured via the DDAU data acquisition unit, which has 8 signal inputs. The DDAU can be ordered for an input range of -1 V to +1V, -10 V to +10 V or -20 mA to +20 mA. These inputs can be assigned to one process signal each, e.g. display of temperature in K, speed of rotation in rpm, voltage in kV, current in kA.

Recording of binary signals
The recording of binary channels is fully synchronized with recording of analog channels. The sampling rate is 2 kHz. A group of 16 binary inputs can record up to 250 state changes per second.

Flexible triggering
With its numerous settable trigger conditions, SIMEAS R-PQ can be precisely adapted to the specific requirements of an application:

– Triggering on the r.m.s. value of an analog channel (min. / max. triggering)
For triggering, the recorder calculates a measured value corresponding to the r.m.s. value of a current or voltage (I, V) continuously at intervals of half a system cycle. The values sampled over half a system cycle are used to calculate this measured value.
Triggering occurs (i.e. recording is started) when the measured value either exceeds a positive maximum limit or falls below a positive minimum limit.
One practical example of this is triggering on a maximum value of the r.m.s. current and on a minimum value of an r.m.s. voltage.

– Triggering on a change in the r.m.s. value of an analog channel (dM/dt triggering)
Each time the measured value described above (V, I) is calculated, the difference is formed between two measured values one system cycle apart. This difference is compared with the set rate-of-change (dM/dt) limit, e.g. 10 kV / 20 ms. This permits triggering on a positive or negative change to the r.m.s. value of a voltage or current input.

– Triggering on the r.m.s. value of the positive or negative sequence system (min. / max. triggering)
The recorder can be parameterized to treat the analog inputs of a data acquisition unit as single, independent channels, or assign them to a three-phase system. In the latter case, positive and negative sequence components can be calculated both for current and voltage channels and used for triggering. Calculation of the measured quantities and of the triggering is performed as described under "Triggering on the r.m.s. value of an analog channel, min. / max. triggering".

Examples of logic gating:
- Voltage min. trigger threshold, recording reached, and current max.
- Binary contact channel 1 high recording and current max. trigger reached
- Binary contact 1.

– Triggering on the limit of a DC channel (min. / max. triggering)
Triggering is performed when the sampled value of the DC signal exceeds the max. limit or falls below the min. limit.

– Triggering on the gradient of a DC channel (gradient triggering)
For the gradient trigger, the difference is calculated between two sampled values of a DC signal in a settable time interval.
Triggering can be performed on a positive or negative gradient.

– Triggering on binary channels
Triggering to state (high or low), or on the positive or negative signal edge, or on a binary input change is possible.

– Logic gating of trigger conditions
Analog and binary trigger conditions can be ANDed. The logic gating of triggers serves, for example, to distinguish a fault from an intentional line disconnection.
The logic operation is applied to a settable time window from 0 to 1 s. If the triggering conditions are detected as "true" during this time window, recording starts. A total of 8 patterns with 8 start selectors each can be parameterized as trigger criteria.

– Triggering via the front panel (manual trigger)
This function is especially useful for commissioning work. It permits testing of the polarity of current and voltage channels and testing of phase angle offsets.

– Network trigger
This triggering applies to devices communicating via an Ethernet network.
Triggering is performed either from the PC for all connected SIMEAS R-PQ recorders, or sent from a SIMEAS R-PQ to further devices.

– External trigger
A recording start can be triggered externally via a separate binary input. Recording is limited to 10 s and is performed for as long as a voltage is applied to this input.

System overview

Flexible triggering (cont.)

The duration of the recording and the pre- and post-faults can be parameterized.
Smart sequence control monitors the trigger conditions during recording.
If retriggering is permitted and the maximum fault recording length is reached, a dynamic fault recording length is reached. For external triggering, time synchronization of all SIMEAS R-PQ devices in the system is required to ensure the fault records have the same time reference.

Power and frequency recorder
The frequency and power recorder calculates and stores the active and reactive power and the power factor plus the frequency (P, Q, PF ($\cos\varphi$) and f). This function is used, for example, to record the load conditions before, during and after a fault in a power plant.
Power swings in the power system and the frequency curve over a long time can be recorded.
One special application is recording of the properties of primary control in a power plant. For example, if a power plant unit is shut down at another location in a grid, the frequency of the power system will drop.
This causes a considerable change in the power output of the power plant in which recording is taking place.
Because all channels are recorded simultaneously, the user can establish a power balance, e.g. at the infeed points in substations.

Recording principle
The variables active power, reactive power, power factor and frequency (P, Q, PF ($\cos\varphi$) and f) are continuously calculated at intervals of one system cycle, and stored in a buffer. If the parameter "averaging time" is set to "1", the calculation interval of the frequency and power recorder is one system cycle. The values in the fault recording therefore correspond to the values in the buffer. Other settings of the "averaging time" parameter can reduce the recorder's calculation interval. For example, if the "averaging time" parameter is set to "4", a mean value is formed over the 4 values of the variables (P, Q, PF ($\cos\varphi$), f) last calculated and written to the buffer after 4 system cycles have elapsed. This means that the calculation interval of the fault recording is 4 system cycles. The "averaging time" parameter can be set in the range 1 to 250.
The number of calculated values before the trigger point (pre-fault) can be selected in the range of 0 to 500.
The system frequency is measured via a voltage channel if the unit is equipped with an appropriate module (VDAU, VCDAU); if not, the frequency is measured via a current channel of a CDAU by automatic determination of the current signal with the highest amplitude and the lowest harmonic distortion.

Power quality recorder and mean value recorder
The mean value recorder and power quality recorder functions store the signals continuously. The averaging time for the groups listed below can be freely parameterized in the range of 10 s to one hour.
The following electrical quantities are measured, stored and displayed in the evaluation program:
- Voltage and current
- Active and reactive power
- Frequency, positive and negative sequence system
- Weighted and unweighted THD
- Current and voltage harmonic
- Process variables
- Voltage dips
- Flicker.

With this function it is possible to monitor a substation or part of a substation (e.g. feeder) continuously and to evaluate its power quality. The measurement is used for monitoring the r.m.s. current progression as well as the active and reactive power. This enables the energy requirement of a feeder to be averaged over a long period. Moreover, an analysis of the r.m.s. voltage, the current harmonic progression, the THD, the progression of voltage dips and flicker effects (P_{st} and P_{lt} value) provides information about the quality of the power supply on a feeder. Existing fault sources can thus be located and countermeasures taken.

Functions	SIMEAS R-PQ	SIMEAS R-PMU
Transient Recorder	■	■
Disturbance Recorder	■	■
Event Recorder	■	■
Power and Frequency Recorder	■	■
Power Quality Recorder	based on EN 50160	–
Phasor Measurement	–	acc. to IEEE C37.118
Mass Storage	512 Mbyte	1 GByte
Software		
Configuration Software	SIMEAS R PAR	SIMEAS R PAR
Fault Record Evaluation	SICAM PQS / SICAM PQ Analyzer, SIGRA	SICAM PQS / SICAM PQ Analyzer, SIGRA
Power Quality Evaluation	SICAM PQS / SICAM PQ Analyzer	–
Phasor Measurement	–	SIGUARD PDP (Phasor Data Processing System)

Table 5/1 SIMEAS R – Overview

Functions

Event recorder

With the independent "event recorder" function, SIMEAS R-PQ continuously records the status of the binary inputs and stores them in an event memory. This permits analysis of the state changes of the binary inputs over a long time, for example, several months. This is relevant, for example, for examining faults that occur on switching. The described independent recording functions "analog and binary recorder, frequency and power recorder, mean value and power quality recorder and event recorder" can run in parallel depending on the parameter settings.

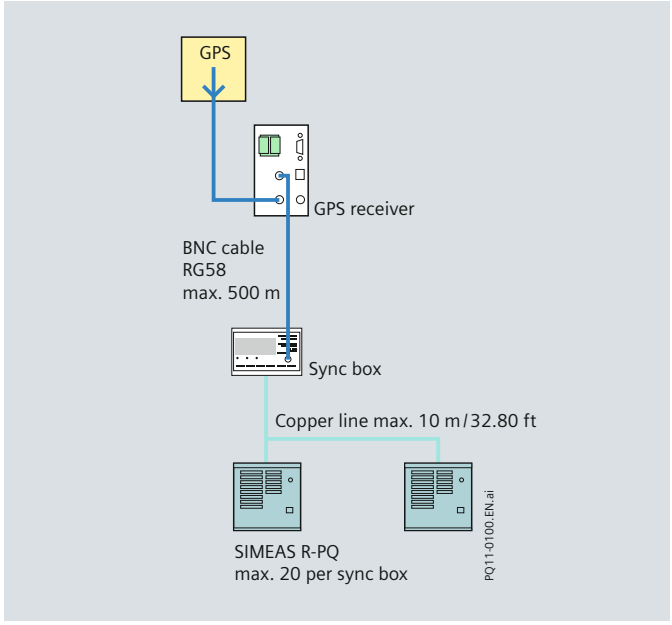


Fig. 5/5 Time synchronization SIMEAS R-PQ

Bulk storage

SIMEAS R-PQ features a bulk storage in flash technology to ensure the required high degree of reliability. During commissioning, it is possible to allocate separate areas to the various recorder functions, depending on the importance of the individual functions for the application.
The unit automatically reserves the memory range required for the operating system and firmware. Each memory range for recordings (a to d) is organized as a "circulating memory". As soon as a memory range is 90 % full after several recordings, the procedure is as follows: the "latest fault record" is written to memory first, then the oldest recordings are deleted until the free capacity in this range reaches 80 % of the allotted memory size.

Data compression

Even if fast modem cards or a LAN/WAN connection are used, data compression is essential in a fault recorder to achieve:

- Efficient use of the device's internal bulk storage as a distributed data archive
- Fast transmission of the fault recordings to a DAKON or an evaluation PC to enable a fault analysis to be performed immediately after the fault
- Acceptable transmission times when using slow transmission media, e.g. an analog modem
- Coping with LAN/WAN "bottlenecks", which are particularly frequent in large-scale networks.

Functions, hardware

Time synchronization for SIMEAS R-PQ
Time synchronization is achieved via a special input of the processor module to which a synchronization box (7KE6000-8HA*) is connected externally.
Depending on implementation, the synchronization box can pick up the time signal from various receiver types, for example, via a GPS, DCF77 or IRIG-B.
Synchronization with a GPS signal is the usual method. This requires special receivers that generally output a modulated telegram (DCF77, IRIG-B). This time telegram is passed on to the synchronization box.
When configuring a fault recorder system, it is important to ensure that the right synchronization box is ordered for the receiver type. It decodes the receiver signal and sends a time telegram to the SIMEAS R-PQ with an internal protocol.
Independently of this synchronization, it is also possible to synchronize with a minute pulse via a binary input.
This feature can be used to reset the second hand of the SIMEAS R-PQ's internal clock to zero on each pulse.
If external synchronization fails, all the data acquisition units (DAUs) of a recorder are synchronized by the internal clock. The time is adjusted automatically on recovery of the synchronization telegram.

If two or more recorders are used at a single mounting location, the signal from the synchronization box is wired to the control input of the various recorders in parallel.

If the synchronization signal has to be distributed via optical cables due to a substantial distance between the various SIMEAS R-PQ recorders, the following additional components are required:
- Sync FO distributor: converts the 24 V signal of the synchronization box to 8 FO outputs (7KE6000-8AH/8AJ).
- Sync transceiver: converts the FO signal to 24 V (7KE6000-8AK/8AL).

Communication interfaces and components
SIMEAS R-PQ features the following communication interfaces:
- COMS interface
  This RS232 interface on the front panel is for direct communication with an evaluation PC. This interface can be used to parameterize and test the recorder during commissioning. It has fixed communication parameters.
- COM1 interface

  This serial interface (RS232) is located on the rear of the recorder. This interface enables the recorder to communicate via an external analog or ISDN modem. The recorder can then be connected to a telephone network, but a direct modem-to-modem connection is also possible.

The communication parameters of this interface can be set.
- Ethernet interface
  This integrated interface is used to connect the recorder to a LAN (local area network) IEEE 802.3 (10 Mbps Ethernet) with the TCP/IP protocol. (Please note that recorders delivered up to about February 2003 have a PCMCIA slot for an Ethernet card at the rear).

- Ethernet structure
  The network used to connect to an evaluation PC or a DAKON has star topology.
  One or more connection nodes (switches) can be used. To improve the reliability of communication channels, optical cables can be used for the network.

The following components can be used to set up an optical network:
- Transceiver (7KE6000-8AF/8AG)
  Converter from 10BASE-T ports with copper cable to 10BASE-FL with optical cable. The unit has an FO and a 10BASE-T network port. Housing: DIN rail mounting.
- Multiport repeater, or switch
  This switch enables connection to two or more Ethernet cable segments. The unit has one FO and six 10BASE-T network ports. Housing: DIN rail mounting.

Hardware

Housing
Two types of housing are available for SIMEAS R-PQ:
- 1/2 19-inch rack with 3 slots and
- 19-inch rack with 6 slots

The first slot is filled by the CPU module, the last slot of each rack by the PSU. The remaining slots can be filled with various data acquisition units (DAUs). The modules are slotted into the rack vertically, and the terminals are located at the rear of the rack.

Central processor
The central processor coordinates the data acquisition units, communication via the interfaces, and manages the database for the various fault records and mean values. It also monitors the entire hardware.

Power supply
The power supply is drawn from two different units (PSUs), depending on the supply voltage:
- 24 V – 60 V DC
- 110 V – 250 V DC and 115 – 230 V AC

In the event of a sudden power failure, the recorder continues to function, drawing its power from a storage capacitor (for details such as duration, see "Technical Data").
This allows time for a controlled reset if the power supply fails during operation. The PSU can optionally be equipped with a battery. The battery ensures operation for up to 10 minutes. The battery is loaded automatically and its charge state is monitored by an independent circuit. With a weekly automatic load test, the memory effect of the battery is reduced. Use of the battery is especially recommended if the recorder is powered from an AC source without PSU back-up.

Data Acquisition Units (DAUs)
The following data acquisition units are available for the unit:
- VCDAU: 4 current / 4 voltage channels and 16 binary channels
- VDAU: 8 voltage channels and 16 binary channels
- CDAU: 8 current channels and 16 binary channels
- DDAU: 8 channels for process variables and 16 binary channels
- BDAU: 32 binary channels.

Analog-to-digital converters
Each analog channel has a 16-bit analog-to-digital converter (ADC) with an integrated dynamic anti-aliasing filter. This obviates use of an external anti-aliasing filter. The anti-aliasing filter automatically adapts to the network environment because the recorder sampling rate and therefore the sampling rate of the ADC are set with the parameter for the rated system frequency.

Dynamics of the current channels
The CDAU comprises eight (and the VCDAU four) current channels. Each current channel has two independent ADCs. The first ADC is connected to an inductive current transformer (CT) that is optimized for the current range of 0 to 7 A (r.m.s. value) and dimensioned for very high precision. If a higher current is measured, the recorder automatically switches over to the input of the second CT. This CT is connected to a hall generator that measures the same current as the inductive transformer but is optimized for the 0 to 600 A range (high dynamics). Because the hall generator also transmits DC, its frequency range does not have a lower limit. Use of two different transformer principles ensures that the recorder measures very accurately in the nominal range of the line current and, in the event of a fault, records current curves with high amplitude and sustained DC component without any loss of information.

Current terminals
If a CDAU or VCDAU is removed from the rack, the current terminals are automatically shorted out to avoid damaging the connected CT.

Channels for process signals
The sampling rate of a DDAU is a fixed 10 kHz if other DAU types are used in the recorder. However, if a recorder contains only DDAUs, sampling rates of 10 Hz / 100 Hz / 1 kHz / 10 kHz can be parameterized.
A low sampling rate setting is recommended for monitoring slowly varying process variables (to keep the recorded data volume manageable). These channels can be connected to ±10 V, ±1 V or ±20 mA, depending on the type.

Configuration notes
The PCMCIA memory and communication cards used for the modem or Ethernet in PCCARD technology are constantly undergoing further development. Because they are used in substations, where CE markings are prescribed, only cards approved by Siemens may be used in the system. In particular, the system noise immunity stipulated by the applicable IEC regulations and the high ambient temperature range necessitate special cards. The planning department should be consulted about selecting the correct PCs and correctly setting up the overall system.

Fig. 5/6 Layout of a SIMEAS R-PQ

Fig. 5/7 Rear view

Hardware

Modes

SIMEAS R-PQ has three operating modes:

- Normal mode
  In normal mode all functions are active.
- Blocked mode
  In blocked mode, the recording functions "dynamic recorder for analog and binary channels" and "power and frequency recorder" are inactive, i.e. no fault records are recorded. If this mode is selected, only the functions "mean value and power quality recorder" and "event recorder" are active. The mode is used, for example, to test equipment connection during commissioning.
- Test mode
  In test mode, all functions are active, but recorded events are entered with "test" as their cause. The "event recorded" alarm relay does not pick up. "Test mode" is used to check the functionality of the SIMEAS R-PQ. The different modes can be selected on the keyboard. Remote control via Value Viewer of SICAM PQS is possible at any time.

LEDs on the front panel of the recorder

The front panel of the recorder contains 8 red and 8 green parameterizable LEDs assigned as follows:

8 green LEDs

- Recorder in operation
- Operating voltage OK
- Battery capacity OK
- Event recorded
- Data transmission to the PC
- Circulating memory active
- Two further LEDs freely programmable.

8 red LEDs

- Fault DAU(s)
- Fault printer
- Fault time synchronization
- Fault fine synchronization
- Fault data memory
- PC not accessible
- Temperature ≤ 5 °C / 41 °F
- Temperature ≥ 55 °C / 131 °F.

and 5 LEDs permanently assigned to the control buttons listed below:

Control buttons

The recorder has the following control buttons that are located on the front panel:

- Acknowledge group alarm
- Normal mode
- Blocked mode
- Test mode
- Manual trigger.

Control inputs

There are four contact inputs at the rear of the recorder:

- Acknowledge group alarm
- System reset
- External start
- Time synchronization.

LSP2824.tif

Fig. 5/8 LEDs and control buttons

Alarm outputs

The recorder has four alarm outputs. The first is permanently connected to the processor watchdog. The other three can be freely programmed and are pre-assigned as follows:

- Watchdog
- Ready to run
- Event being recorded
- Group alarm.

Group alarm

- Fault DAU(s)
- Fault printer
- Fault synchronization
- Fault data memory.

Mechanical design	
ZE 8/16 *1/2 19" version*	
Dimensions (W × H × D)	223 mm × 266 mm × 300 mm / 8.78 in. x 10.47 in. x 11.81 in.
Number of slots	3
Slot 1: CPU PCCard-Slot	Slot 0 type I and II Slot 1 type I to III
Slot 2: DAU	See "Analog and binary inputs and outputs"
Slot 3: Power supply unit	
ZE 32/64 *19" version*	
Dimensions (W × H × D)	445 mm × 266 mm × 300 mm / 17.52 inch x 10.47 in. x 11.81 in.
Number of slots	6
Slot 1: CPU	Approx 1.5 mA / input
Slot 2 - 5: DAU	See "Analog and binary inputs and outputs"
Slot 6: Power supply unit	

Auxiliary voltage		
Low-voltage version		
DC voltage		
Rated auxiliary DC voltage V_{aux}	24 / 28 / 60 V DC	
Permissible voltage ranges	19.2 to 72 V DC	
High-voltage version		
DC voltage		
Rated auxiliary DC voltage V_{aux}	110 / 125 / 220 / 250 V DC	
Permissible voltage ranges	88 to 300 V DC	
AC voltage 50 / 60 Hz		
Rated auxiliary AC voltage V_{aux}	115 / 230 V AC	
Permissible voltage ranges	92 to 276 V AC	
Voltage stability without back-up battery		
Bridging time	Measured times, central unit ZE8/16	 ZE32/64
for V_{aux} = 24 V DC	≥ 400 ms	≥ 150 ms
for V_{aux} = 60 V DC	≥ 450 ms	≥ 170 ms
for V_{aux} = 110 V DC	≥ 500 ms	≥ 180 ms
for V_{aux} = 250 V DC	≥ 700 ms	≥ 200 ms
for V_{aux} = 115 V AC	≥ 500 ms	≥ 200 ms
for V_{aux} = 230 V AC	≥ 800 ms	≥ 348 ms
Optionally with back-up battery		
Power failure bridging time up to 10 min with all functions operating		
Power consumption		
1/2 19" version 8 analog / 16 binary channels	24 to 60 V DC 110 to 250 V DC 115 to 230 V AC	20 W 18 W 30 VA
19" version 32 analog / 64 binary channels	24 to 60 V DC 110 to 250 V DC 115 to 230 V AC	45 W 40 W 70 VA

Analog and binary inputs and outputs			
Slot 2 (1/2 19" version)	To be equipped according to table "Equipping version"		
Slot 2 to 5 (19" version)	To be equipped according to table "Equipping version"		
Equipping versions			
VCDAU	8 analog (4 current / 4 voltage) and 16 binary channels		
CDAU	8 analog (8 current) and 16 binary channels		
VDAU	8 analog (8 voltage) and 16 binary channels		
BDAU	32 binary channels		
DDAU	8 analog (8 current ±20 mA, or 8 voltage ±1 V or ±10 V) and 16 binary channels		
SIMEAS R-PQ			
VCDAU, CDAU and VDAU If a recorder contains only DDAUs, it is possible to parameterize the sampling rates 10 Hz / 100 Hz / 1 kHz / 10 kHz. If the recorder also contains other DAUs, the sampling rate of the DC signals is always 10 kHz.	Sampling frequency 4.3 kHz 12.8 kHz 15.36 kHz 64 times oversampling	Rated frequency 16.7 Hz 50 Hz 60 Hz	Frequency range 12 to 20 Hz 40 to 60 Hz 50 to 70 Hz
Voltage input (VDAU or VCDAU)			
Measuring range 1	1.5 to 200 V_{rms}		
Impedance	> 100 kΩ		
Resolution	15 mV		
Overvoltage	Max. 300 V_{rms} for 5 s		
Accuracy (at 23 °C ± 1 °C / 73.4 °F ± 33.8 °F and rated frequency)	Class 0.3, ±0.25 % of measured value ±30 mV		
Frequency response	3 to 5500 Hz (5 %)		
Number of analog-digital converters per channel	1		
Measuring range 2	3 to 400 V_{rms}		
Impedance	> 200 kΩ		
Resolution	30 mV		
Overvoltage	Max. 600 V_{rms} for 5 s		
Accuracy (at 23 °C ± 1 °C / 73.4 °F ± 33.8 °F and rated frequency)	Class 0.3, ±0.25 % of measured value ±30 mV		
Frequency response	3 to 5500 Hz (5 %)		
Number of analog-digital converters per channel			
Voltage channel	1		
Current channel	2		

Table 5/2 Technical data

Technical data

Analog and binary inputs and outputs (cont.)	
Current input (CDAU or VCDAU)	
Dynamic AD and converter switching	
Measuring range	5 mA to 400 A_{rms}
Accuracy range	5 mA to 7 A_{rms}
Resolution (at 23 °C ± 1 °C / 73.4 °F ± 33.8 °F and rated frequency)	0.5 mA, Class 0.5, ± 0.5 % of measured value ± 0.5 mA
Frequency response	3 to 5500 Hz (5 %)
Range	> 7 A_{rms} to 200 A_{rms}
Resolution (at 23 °C ± 1 °C / 73.4 °F ± 33.8 °F and rated frequency)	30 mA, Class 1.5, ± 1.5 % of measured value ± 30 mA
Frequency response	0 to 5500 Hz (5 %)
Range	> 200 A_{rms} to 400 A_{rms}
Resolution (at 23 °C ± 1 °C / 73.4 °F ± 33.8 °F and rated frequency)	30 mA, Class 3.5, ± 3.5 % of measured value
Frequency response	0 to 5500 Hz (5 %)
Continuous	20 A
Overload	100 A, 30 s 500 A, 1 s 1200 A, half-wave
Recording	200 A, plus 100 % displacement
Burden	< 0.1 VA
DC inputs (DDAU)	
Input range (depending on the order no.)	± 20 mA (50 Ω) ± 1 V / ± 10 V (> 40 kΩ / > 400 kΩ)
Accuracy (at 23 °C ± 1 °C / 73.4 °F ± 33.8 °F)	Class 0.5
Range 1 V	± 0.5 % measured value ± 1 mV
Range 10 V	± 0.5 % measured value ± 10 mV
Range 20 mA	± 0.5 % measured value ± 20 µA
Sampling frequency	10 Hz, 100 Hz, 1 kHz, 10 kHz per module (parameterizable) (if used together with a VCDAU, CDAU, or VDAU, the DC channels are recorded in parallel. Only a sampling rate of 10 kHz per channel is permitted.) Processing of higher DC voltages via isolation amplifier (e.g. SICAM T)

Analog and binary inputs and outputs (cont.)			
Binary inputs (BDAU, VCDAU, DDAU, CDAU und VDAU)			
Sampling frequency	2 kHz		
Principle of storage	Only status changes are stored with real time and a resolution of 1 ms		
Storage capacity	250 status changes per 16 inputs, within 1 s, total storage capacity depends on the parameter setting (typically approx. 100,000 status changes)		
Voltage ranges of control inputs according to components installed	Input voltage (V)	L level (V)	H level (V)
	24	≤ 7	≥ 18
	48 to 60	≤ 14	≥ 36
	110 to 125	≤ 28	≥ 75
	220 to 250	≤ 56	≥ 165
	Input current 1 mA		
	Input voltage (V)	Overload (V)	
	24	28.8	
	48 to 60	72	
	110 to 125	150	
	220 to 250	300	

Analog and binary inputs and outputs			
Control inputs			
Input 1	Input for time synchronization for connection to the synchro box or a station clock with minute pulse 24 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 of control inputs according to components installed	Input voltage (V)	L level (V)	H level (V)
	24	≤ 7	≥ 18
	48 to 60	≤ 14	≥ 36
	110 to 125	≤ 28	≥ 75
	220 to 250	≤ 56	≥ 165
	Input current 1 mA		
	Input voltage (V)	Input 1 Overload (V)	Input 2 to 4 Overload (V)
	24	28.8	28.8
	48 to 60	72	72
	110 to 125	150	150
	220 to 250	300	300

Table 5/2 Technical data

Analog and binary inputs and outputs (cont.)	
Signal outputs	
	4 signal outputs with isolated main contact, signal output 1 hard-wired to watchdog, 3 signals outputs freely allocatable.
Switching capacity	MAKE 30 W/VA BREAK 20 VA 30 W resistive 25 W for L/R ≤ 50 ms
Switching voltage	250 V
Permissible current	1 A continuous
Allocation of the signal outputs and status of LEDs	SIMEAS R ready for operation Operating voltage OK Normal mode Test mode Locked mode Transmission SIMEAS R – PC active Recording event DAU fault Printer fault Time synchronization error Computer not available Data memory fault Data memory full Cyclic storage active Battery capacity OK Temperature monitoring < -5 °C/23 °F Temperature monitoring > +55 °C/131 °F Fine synchronization error Group alarm Relay 1 – not allocatable; watchdog Relay 2 – not allocatable Relay 3 – not allocatable Relay 4 – not allocatable

Communication interfaces	
Slot 1 – CPU	
LPT 1	Printer interface, Centronics, for connection of a laser printer (Emulation Postscript level 2)
COM 2/COM S	RS232 serial interface, on front side for connection of a PC, 19.2 kBd
COM 1	RS232 serial interface, on rear for connection of e.g. an additional modem, 300 Bd to 57.6 Bd or an external ISDN terminal adapter
Ethernet	Compatible acc. to IEEE 802.3 Software TCP/IP Twisted pair (10BaseT), RJ45 connector
Slot 0 data transmission	
Modem	Transmission rate up to 56 kBps Dialing method audio and pulse CCIT V.21, V.22, V.22 to V.23, V.32, V.32 to V.34, V.90 Certified in all European countries

Climatic stress	
Temperatures	
Transport and storage	-25 °C to +70 °C/-13 °F to 158 °F
Operation	
for cubicle/panel flush mounting	-5 °C to +55 °C/23 °F to 131 °F (condensation not permissible)
for panel surface mounting	0 °C to +40 °C/32 °F to 104 °F
Humidity	
	95 % without condensation

SIMEAS R-PQ	
Mass storage: 512 MB Flash Card	
Available recorder	
Triggered recorder	***V, I:*** $V_{L,N}$; $I_{L,N}$; B; D ***f, P:*** P; Q; $\cos\varphi$; f
Continuous recorder	***V, I:*** $V_{L,N}$ [1]; $I_{L,N}$ [1] ***P, Q:*** Q [1], P [1] ***f, sym:*** f [1], $V_{1,2}$ [1]; $I_{1,2}$ [1] ***DC:*** D [1] (±20 mA; ±1 V; ±10 V) ***ER:*** B ***THD:*** THD (%) ***Harm:*** V, I up to 50. V_{Dip}: threshold violation ***Flicker***
1) Root mean square values	

Further technical information on **www.siemens.com/powerquality**

Table 5/2 Technical data

Dimension drawings

Dimension drawings in mm / inch

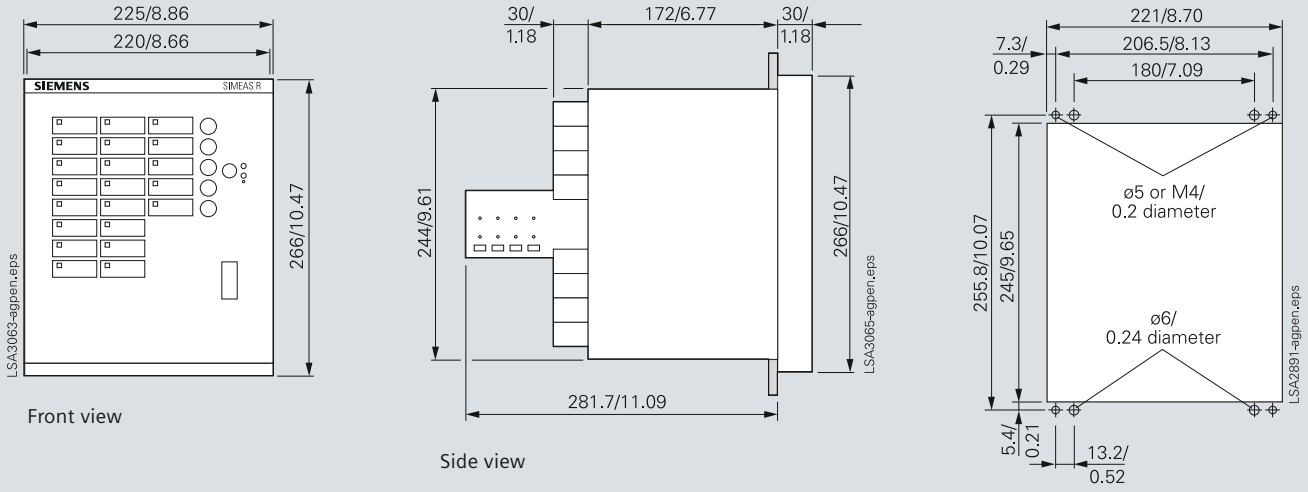
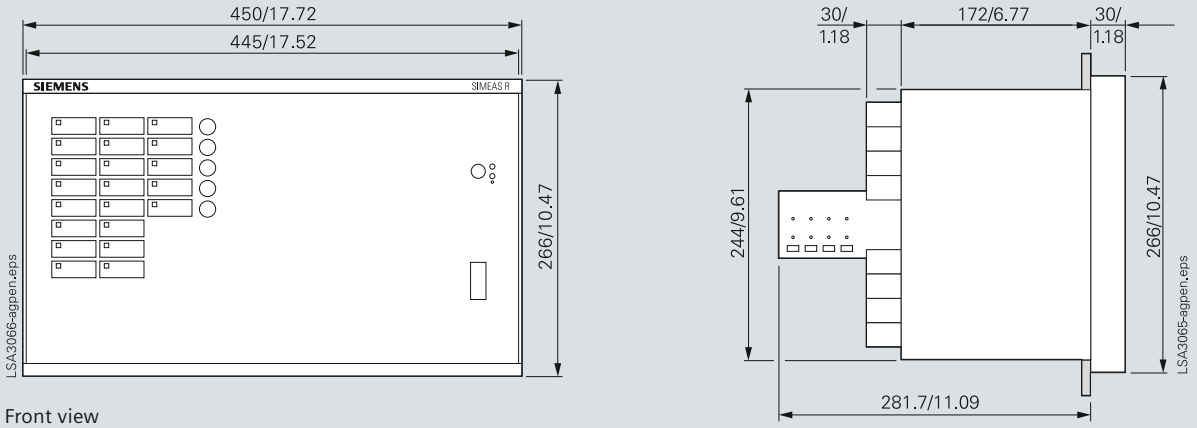


Fig. 5/9 7KE6000 SIMEAS R
1/2 x 19" with 7XP20 housing for panel flush mounting



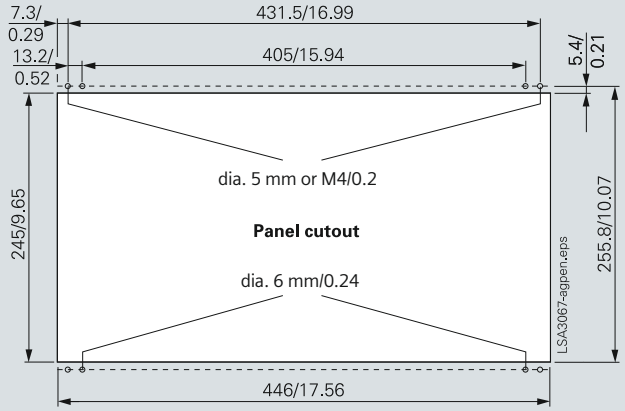
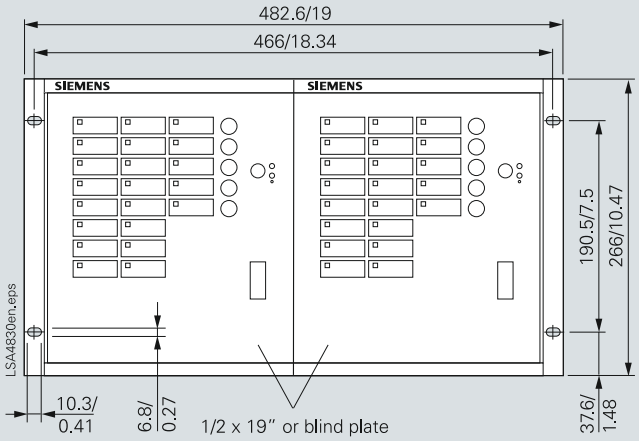
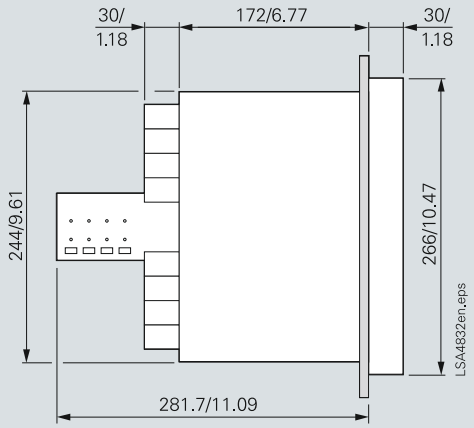


Fig. 5/10
7KE6000-1 SIMEAS R 1/1 × 19" unit in 7XP20 housing for panel flush mounting

Dimension drawings in mm / inch

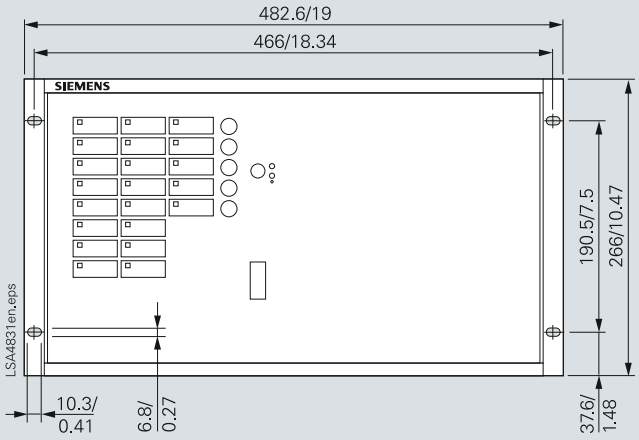


Front view

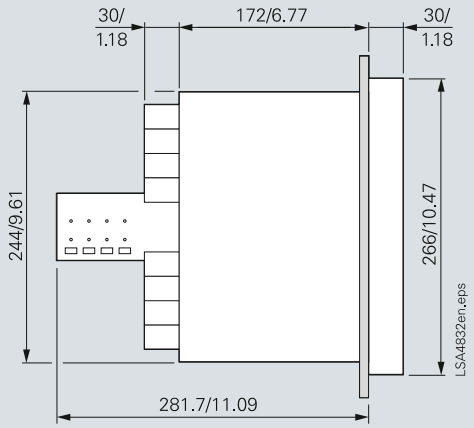


Side view

Fig. 5/11 7KE6000-0 SIMEAS R-PQ 19" frame mounting



Front view



Side view

Fig. 5/12 7KE6000-1 SIMEAS R-PQ 19" frame mounting

5

Selection and ordering data

Description	Order No.
Central unit V3 ZE8/16 with integrated Ethernet port [1]	**7KE6000-0□□4□-□□□□**
With one data acquisition unit, remote data transmission to DAKON or evaluation PC, case ½ × 19", usage of COM1 or COM2 or Ethernet/Standard **Note:** Cables must be ordered separately	
Housing	
For panel flush mounting (perforated housing)	D
For surface mounting	E
For 19" assembly (perforated housing)	F
Measurement at	
16.7 Hz network	C
50 Hz network	D
60 Hz network	E
Terminals [2]	
Standard	1
US design	2
Signal voltages of the CPU and the binary inputs [3]	
24 V DC, all binary inputs + CPU binary input 1	1
48 V to 60 V DC, all binary inputs + CPU binary input 1	2
110 V to 125 V DC, all binary inputs + CPU binary input 1	3
220 V to 250 V DC, all binary inputs + CPU binary input 1	4
48 V to 60 V DC, all binary inputs – CPU binary input 1: 24 V DC	5
110 V to 125 V DC, all binary inputs – CPU binary input 1: 24 V DC	6
220 V to 250 V DC, all binary inputs – CPU binary input 1: 24 V DC	7
Data acquisition unit DAU	
VDAU (8 *V*/16 binary inputs)	A
CDAU (8 *I*/16 binary inputs)	B
VCDAU (4 *V* / 4 *I*/16 binary inputs)	C
BDAU (32 binary inputs)	D
DDAU 20 mA	F
DDAU 1 V	G
DDAU 10 V	H
Auxiliary power	
24 V to 60 V DC without battery	G
24 V to 60 V DC with battery	H
50/60 Hz, 115/230 V AC or 110 V to 250 V DC without battery	J
50/60 Hz, 115/230 V AC or 110 V to 250 V DC with battery	K
Manual	
German	1
English	2
French	3
Spanish	4
Italian	5
Portuguese	7

1) Digital disturbance recorder (DFR) with one slot for a data acquisition unit (DAU), ½-19" rack. The basic unit has two RS232 ports (COMS and COM1), one Ethernet and one printer port. Only two communication ports can be supported in parallel.
2) Housing for surface mounting is not available with US terminals
3) This ordering position defines the input voltage level of the binary inputs of the central processor unit (CPU) board and the binary inputs of the DAU unit. Please note that the binary input No. 1 of the CPU unit is reserved for external time synchronization.
For the device 7KE6000-0** or 7KE6100-0** the voltage level of this input must be 24 V DC, if you connect this input to the synchronization unit 7KE6000-8HA** or together with a GPS receiver 7XV5664-0AA00 via FO to the Sync-transceiver 7KE6000-8AK/L.

Example: SIMEAS R will be installed in a substation with 110 V DC voltage battery system and GPS time synchronization (= Hopf receiver + synch-box). In this case, this MLFB position (No. 13) must be "6".

Attention: The 24 V DC input has the range of 24 V to 60 V DC.

Table 5/3 Selection and ordering data

Description	Order No.
Central unit V3 ZE32/64 with integrated Ethernet port [1]	**7KE6000-1□□4□-□□□□**
With four data acquisition units, case 19", communication port to DAKON or evaluation PC, usage of COM1 or COM2 or Ethernet/Standard **Note:** Cables must be ordered separately	
Housing [2]	
For panel flush mounting (perforated housing)	D
For surface mounting	E
For 19" assembly (perforated housing)	F
Measurement at	
16.7 Hz network	C
50 Hz network	D
60 Hz network	E
Terminals [3]	
Standard	1
US design	2
Signal voltages of the CPU and the binary inputs [4]	
24 V DC, all binary inputs + CPU binary inputs 1	1
48 V to 60 V DC, all binary inputs + CPU binary input 1	2
110 V to 125 V DC, all binary inputs + CPU binary input 1	3
220 V to 250 V DC, all binary inputs + CPU binary input 1	4
48 V to 60 V DC, all binary inputs - CPU binary input 1: 24 V DC	5
110 V to 125 V DC, all binary inputs - CPU binary input 1: 24 V DC	6
220 V to 250 V DC, all binary inputs - CPU binary input 1: 24 V DC	7
Data acquisition unit DAU	
2 VCDAU; units (8 *V*/8 *I*/32 binary inputs)	A
4 VCDAU; units (16 *V*/16 *I*/64 binary inputs)	B
1 VCDAU; unit (4 *V*/4 *I*/16 binary inputs) and 3 CDAU; units (24 *I*/48 binary inputs)	C
Data Aquisition Units (DAUs) for free assembly [5]	D
Auxiliary power	
24 V to 60 V DC without battery	G
24 V to 60 V DC with battery	H
50/60 Hz, 115/230 V AC or 110 V to 250 V DC without battery	J
50/60 Hz, 115/230 V AC or 110 V to 250 V DC with battery	K
Manual	
German	1
English	2
French	3
Spanish	4
Italian	5
Portuguese	7

For footnotes, see page 5/19

Table 5/3 Selection and ordering data

Selection and ordering data

Description	Order No.
SIMEAS R, assembly of the central unit ZE32/64	**7KE6000-4□□66-6□□0**
Please apply only for free assembly. The central unit includes 4 slots for free population with data acquisition units (DAUs). Preparation of the slots with the correspondig terminals and assembly with DAUs	
Slot 1	
VCDAU to be equipped in the factory [1]	J
CDAU to be equipped in the factory [1]	K
VDAU to be equipped in the factory [1]	L
BDAU to be equipped in the factory [1]	M
DDAU to be equipped in the factory [1]	N
not prepared / plate only	P
VCDAU prepared for a VCDAU [2]	Q
CDAU prepared for a CDAU [2]	R
VDAU prepared for a VDAU [2]	S
BDAU prepared for a BDAU [2]	T
DDAU prepared for a DDAU [2]	U
Slot 2	
VCDAU to be equipped in the factory [1]	A
CDAU to be equipped in the factory [1]	B
VDAU to be equipped in the factory [1]	C
BDAU to be equipped in the factory [1]	D
DDAU to be equipped in the factory [1]	E
not prepared / plate only	F
VCDAU prepared for a VCDAU [2]	G
CDAU prepared for a CDAU [2]	H
VDAU prepared for a VDAU [2]	J
BDAU prepared for a BDAU [2]	K
DDAU prepared for a DDAU [2]	L
Slot 3	
VCDAU to be equipped in the factory [1]	A
CDAU to be equipped in the factory [1]	B
VDAU to be equipped in the factory [1]	C
BDAU to be equipped in the factory [1]	D
DDAU to be equipped in the factory [1]	E
not prepared / plate only	F
VCDAU prepared for a VCDAU [2]	G
CDAU prepared for a CDAU [2]	H
VDAU prepared for a VDAU [2]	J
BDAU prepared for a BDAU [2]	K
DDAU prepared for a DDAU [2]	L
Slot 4	
VCDAU to be equipped in the factory [1]	A
CDAU to be equipped in the factory [1]	B
VDAU to be equipped in the factory [1]	C
BDAU to be equipped in the factory [1]	D
DDAU to be equipped in the factory [1]	E
not prepared / plate only	F
VCDAU prepared for a VCDAU [2]	G
CDAU prepared for a CDAU [2]	H
VDAU prepared for a VDAU [2]	J
BDAU prepared for a BDAU [2]	K
DDAU prepared for a DDAU [2]	L

Please use this table only for the free configuration of the DAU units. The configuration data is required for the definition of the location of the DAU units and the population of the rack with adequate terminals. The population of the rack with DAU units must be from left to right.

1) Please specify and order the module 7KG6000-2*.
2) For future use.

Table 5/3 Selection and ordering data

Description	Order No.
Data acquisition units for free assembly of the central unit ZE32/64 or as spare parts	**7KE6000-2□□□□**
Also available for 7KE6000-0; 7KE6100-0; 7KE6000-1 and 7KE6100-1	
VDAU (8 *V*/16 binary inputs)	**A**
CDAU (8 *I*/16 binary inputs)	**B**
VCDAU (4 *V*/4 *I*/16 binary inputs)	**C**
BDAU (32 binary inputs)	**D**
Signal voltages of the binary inputs	
24 V DC	**A**
48 to 60 V DC	**B**
110 V to 125 V DC	**C**
220 V to 250 V DC	**D**
Terminals	
Standard (only necessary for spare part DAU)	**1**
US design (only necessary for spare part DAU)	**2**
Without terminals, the central unit is already equipped with terminals	**3**
Network frequency	
No frequency information in case of order number position 9 = **D**	**0**
16.7 Hz (not available for (7KE6100-0xx and 7KE6100-1xx)	**1**
50 Hz	**2**
60 Hz	**3**
Acquisition units for free assembly or as spare parts	**7KE6000-2□□□□**
Also available for 7KE6000-0; 7KE6100-0; 7KE6000-1 and 7KE6100-1	
DDAU (8 DC/16 binary inputs)	**E**
Terminals	
Standard (only necessary for spare part DAU)	**A**
US design (only necessary for spare part DAU)	**B**
Without terminals, the central unit is already equipped with terminals	**C**
Analog channels	
20 mA	**1**
1 V	**2**
10 V	**3**
Signal voltages for binary inputs	
24 V DC	**1**
48 V to 60 V DC	**2**
110 V to 125 V DC	**3**
220 V to 250 V DC	**4**

Footnotes for page 5/17

1) Digital Disturbance Recorder (DFR) with four slots for Data Acquisition Units (DAU), 19" rack. The basic unit has two RS-232 ports (COM-S and COM-1), one Ethernet and one printer port. Only two communication ports can be supported in parallel.
2) For the surface mounting housing, the number of the possible measurement channels must be clarified in the factory.
3) Housing for surface mounting is not available with US terminals
4) Following considerations are required for the definition of this MLFB position:
You want to order a standard unit with pre defined DAU boards (MLFB position 14 = "A", "B" or "C"). This MLFB position defines the input voltage level of the binary inputs of the Central Processor Unit (CPU) board and the binary inputs of the DAU units. Please note that the binary input No. 1 of the CPU unit is reserved for external time synchronization. This MLFB position defines the input voltage level of the binary inputs of the Central Processor Unit (CPU) board and the binary inputs of the DAU unit. Please note that the binary input No. 1 of the CPU unit is reserved for external time synchronization. For the device 7KE6000-1** or 7KE6100-1** the voltage level of this input must be 24 V DC, if you connect this input to the synchronization unit **7KE6000-8HA**** or together with a GPS receiver **7XV5664-0AA00** via FO to the Sync-Transceiver **7KE6000-8AK/L**.
Example: SIMEAS R will be installed in a substation with 110 V DC voltage battery system and GPS time synchronization (= Hopf Receiver + Sync-Box). In this case, this (MLFB position 13) must be "6".
Attention: The 24 V DC input has the range of 24-60 V DC.
You want to order a unit with free configuration of the DAU boards (MLFB position 14= "D"):
This MLFB position defines the input voltage level of the binary inputs of the Central Processor Unit (CPU) board. The input voltage level of the Data Acquisition Units (DAUs) is later defined separately with the ordering code of the DAU boards
Example: A SIMEAS R with free configuration of the DAU boards (MLFB position 14= "D") is for a voltage level of 220 V DC projected. With the selection "7" of this MLFB position, the input voltage level of the 1. binary input of the Central Processor Unit (CPU) board is fixed to 24 V DC and the voltage level of the further binary inputs of the CPU are fixed to 220-250 V DC.
5) If you want to order a unit with free configuration of the DAU boards (MLFB position 14 = "D"), following further steps are required:
→ Please define at first the Voltage level for the binary inputs of the CPU board (MLFB position 13 → please see also (4)) and than the ordering code **7KE6000-4*** for which DAU slots the rack must be prepared, for example the assembly of the adequate terminals according to the DAU boards. With this step, following definitions are also required:
a) If a defined DAU position must also be equipped with a DAU board, then please order the according DAU board using the ordering code **7KE6000-2***
b) Or, the according slot will be equipped with a blind plate
c) Or, a defined DAU slot will only be prepared for a DAU, without ordering the specific DAU. For example, you already have a DAU or you will order the DAU some time later)

Attention: A SIMEAS R and SIMEAS R-PMU must be equipped from left to right.

Table 5/3 Selection and ordering data

Selection and ordering data

Description	Order No.
SIMEAS R spare parts	
Spare Flash memory for CPU-486 with firmware 2.1.xx PCMCIA Flash memory and firmware 2.1.xx *) with standard parameterization	**7KE6000-3HA**
Spare Flash memory for CPU-486 with firmware 2.3.xx PCMCIA Flash memory with installed firmware 2.3.xx **), with additional features "Recording of flicker and voltage sags" Valid only for units with RAM memory of 32 MB with standard parameterization	**7KE6000-3HB**
512 MB Flash memory for ELAN CPU + firmware 3.0.xx IDE Flash memory 2.5 inch and firmware 3.0.xx with standard parameterization	**7KE6000-3HC1**
1024 MB Flash memory for ELAN CPU + firmware 4.0.xx (PMU) IDE Flash memory 2.5 inch and firmware 4.0.xx with standard parameterization	**7KE6100-3HC3**

Description	Order No.
Central processor unit (ELAN-CPU) for SIMEAS R V3 1)	**7KE6000-2L□1**
with IDE Flash memory 2.5 inch (512 MB) and current firmware with standard parameterization	
Input signal voltage	
24 V DC, all binary inputs + CPU binary input 1	**A**
48 V to 60 V DC, all binary inputs + CPU binary input 1	**B**
110 V to 125 V DC, all binary inputs + CPU binary input 1	**C**
220 V to 250 V DC, all binary inputs + CPU binary input 1	**D**
48 V to 60 V DC, all binary inputs – CPU binary input 1 24 V DC	**E**
110 V to 125 V DC, all binary inputs – CPU binary input 1 24 V DC	**F**
220 V to 250 V DC, all binary inputs – CPU binary input 1 24 V DC	**G**
Power supply for central processor unit	**7KE6000-2G□**
24 V to 60 DC without battery	**G**
24 V to 60 DC with battery	**H**
50/60 Hz, 115/230 V AC or 110 V to 250 V DC without battery	**J**
50/60 Hz, 115/230 V AC or 110 V to 250 V DC with battery	**K**

*) xx: Current version of the firmware 2.1.xx
**) xx: Current version of the firmware 2.3.xx

1) For connecting a synchronization unit 7KE6000-8HA, the binary input 1 of the CPU has to be dimensioned for 24 V DC (24 V DC input necessary for connection to sync. tranceiver, 24 V DC input is able to handle 24 V to 60 V DC)

Table 5/3 Selection and ordering data

Description	Order No.
Synchronization unit[2]	**7KE6000-8HA□□**
In the housing with snap-on attachment for 35 mm top-hat rail according to DIN EN 50022 with connection cable for SIMEAS R	
Receiver/decoder module for time synchronization	
Decoder for DCF77 signal	2
For connection to a GPS receiver with DCF77 output signal (for example to a HOPF 6875 GPS receiver); or for terrestrial antenna This is the best choice for all applications **worldwide**	
Decoder for Meinberg or ZERA signal	3
Decoder for Patek - Philippe signal	4
Decoder for IRIG B signal (e.g. of GPS receiver)[1]	5
Decoder for telenorma signal	6
Decoder for demodulated IRIG B signal, TTL level	7
Decoder for demodulated DCF77 signal, open collector connection	8
Connection via serial port 1 (connection via terminals 11, 12, 13)	
Auxiliary power	
24 V to 60 V DC	1
110 V to 250 V DC or 115 V to 230 V AC, 50/60 Hz	2
GPS time synchronization unit	**7XV5664-0AA00**
With GPS antenna and 25 m/82.02 ft antenna cable Time receiver with 2 optical outputs (programable) ST plugs for 62.5/125 µm multi-mode fiber. Output: IRIG-B or DCF77 time telegram Auxiliary voltage 24 to 48 V DC For other auxiliary voltage ranges 7XV5810-0BA00 is required	
DC-AC/DC converter	**7XV5810-0□A00**
Input: 24 V to 250 V DC, 115/230 V AC Output: 24 V DC	B
Rugged switch RSG2100	**7KE6000-8AP□0-□AB**
12 × 10BaseFL ports with ST plug 2 × 100BaseFX ports 2 × 10/100BaseFT ports with RJ45 plug (uplink function)	
Power supply	
24 V DC	0
48 V DC	1
88 V to 300 V DC/85 V to 264 V AC	2
FO option for 2 × 100BaseFX ports	
1310 nm, multi-mode, 2 km/1.24 miles with ST plug	0
1310 nm, single mode, 20 km/12.43 miles km with LC plug	1
Components for Ethernet communication	
Ethernet transceiver 24 V DC (18 V to 36 V DC) with ST connector Rugged MC – RMC – Ethernet media converter	**7KE6000-8AF**
Ethernet transceiver 88 V to 300 V DC or 85 V to 264 V AC with ST connector Rugged MC – RMC – Ethernet media converter	**7KE6000-8AG**
Components for time synchronization	
SIMEAS Sync fibre optic multiplexer (24 V to 60 V DC)	**7KE6000-8AH**
SIMEAS Sync fibre optic multiplexer (110 V to 230 V DC/AC; 45 to 65 Hz)	**7KE6000-8AJ**
Sync transceiver (24 V to 60 V DC)	**7KE6000-8AK**
Sync transceiver (110 V to 230 V DC/AC; 45 to 65 Hz)	**7KE6000-8AL**

1) The IRIG B signal has the following disadvantages: the year is not indicated, there is no switchover from summer to winter, there is no relative time (not orientated towards time zones).
2) Only for SIMEAS R devices with FW V2 or V3, not for V4 PMU. The control input 1 of the CPU has to be dimensioned for 24 V DC to connect a time synchronization unit 7KE6000-8HA. When ordering the central unit 7KE6000-XXXXX-ZXX, please make sure that Z=1,5,6 or 7, depending on the control voltage for the binary inputs.

Table 5/3 Selection and ordering data

Selection and ordering data

Description	Order No.
Communication Cable COM1 to external modem	**7KE6000-8AC**
Modem side 25-pole / pin, length 10 m / 32.81 ft	
Communication Cable COM1 to PC	**7KE6000-8B** ☐
incl. adapter set	
COM1 or 2 - PC, length 10 m / 32.81 ft	A
COM1 or 2 - PC, length 5 m / 16.40 ft	B
Printer cable, Centronics	**7KE6000-8DA**
Length 3 m / 9.84 ft, SIMEAS R or PC - printer	
Ethernet patch cable with double shield (SFTP), LAN connector on both sides SIMEAS R ↔ switch, switch ↔ PC	
Length 0.5 m / 1.64 ft	**7KE6000-8GD00-0AA5**
Length 1 m / 3.28 ft	**7KE6000-8GD00-1AA0**
Length 2 m / 6.56 ft	**7KE6000-8GD00-2AA0**
Length 3 m / 9.84 ft	**7KE6000-8GD00-3AA0**
Length 5 m / 16.40 ft	**7KE6000-8GD00-5AA0**
Length 10 m / 32.81 ft	**7KE6000-8GD01-0AA0**
Length 15 m / 49.21 ft	**7KE6000-8GD01-5AA0**
Length 20 m / 65.62 ft	**7KE6000-8GD02-0AA0**
Ethernet patch cable with double shield (SFTP), cross-over connection, LAN connector on both sides switch ↔ switch, SIMEAS R ↔ PC	
Length 0.5 m / 1.64 ft	**7KE6000-8GE00-0AA5**
Length 1 m / 3.28 ft	**7KE6000-8GE00-1AA0**
Length 2 m / 6.56 ft	**7KE6000-8GE00-2AA0**
Length 3 m / 9.84 ft	**7KE6000-8GE00-3AA0**
Length 5 m / 16.40 ft	**7KE6000-8GE00-5AA0**
Length 10 m / 32.81 ft	**7KE6000-8GE01-0AA0**
Length 15 m / 49.21 ft	**7KE6000-8GE01-5AA0**
Length 20 m / 65.62 ft	**7KE6000-8GE02-0AA0**

Table 5/3 Selection and ordering data

Description	Order No.
Connection cable for current inputs **8-core flexible cable, 2.5 mm²/0.004 sq in., for 4 current channels**	**7KE6000-8GA00-0□□□**
Please note: Minimum length 2 m/6.56 ft	
Without pre-assembled cables	A
With end sleeve ferrule	B
With end sleeve ferrule on both sides	C
Without core identification	A
With core identification	B
Cable length in m (X = 2 ... 8, 9 = special length)	X
Connection cable for voltage inputs **8-core flexible cable, 0.75 mm²/0.001 sq in., for 4 voltage channels**	**7KE6000-8GB00-0□□□**
Please note: Minimum length 2 m/6.56 ft	
Without pre-assembled cables	A
With end sleeve ferrule on one side	B
With end sleeve ferrule on both sides	C
Without core identification	A
With core identification	B
Cable length in m (X = 2 ... 8, 9 = special length)	X
Connection cable for binary inputs **32-core flexible cable, 0.25 mm²/0.0004 sq in.**	**7KE6000-8GC00-0□□□**
Please note: Minimum length 2 m/6.56 ft	
Without pre-assembled cables	A
With end sleeve ferrule on one side	B
With end sleeve ferrule on both sides	C
Without core identification	A
With core identification	B
Cable length in m (X = 2 ... 8, 9 = special length)	X
Manual for firmware version SIMEAS R-PQ	
English	**E50417-B1076-C209-A2**
German	**E50417-B1000-C209-A4**
French	**E50417-B1077-C209-A1**
Spanish	**E50417-B1078-C209-A1**
Italian	**E50417-B1072-C209-A1**
Portuguese	**E50417-B1079-C209-A1**
USB alarm box	**7KE6020-1AA00**
Monitoring unit for DAKON XP with USB connection, own watchdog and 7 alarm contacts	

Table 5/3 Selection and ordering data

SIEMENS

Energy Automation

SIMEAS R-PMU Digital Fault Recorder and Phasor Measurement Units

Answers for infrastructure and cities.

SIEMENS

siemens-russia.com

Contents – SIMEAS R-PMU

Digital fault recorder with integrated Phasor Measurement Unit (PMU)

SIMEAS R-PMU is a powerful disturbance (transient) and certified (see TÜV certificate, page 6/24) recorder with an integrated Phasor Measurement Unit (PMU) according to IEEE C37.118.
SIMEAS R-PMU offers the following features: powerful disturbance (transient) recorder, event recorder and phasor measurement. The disturbance recorder with a high sampling rate and excellent frequency response enables precise analysis of network disturbances. With the integrated Phasor Measurement Unit (PMU), vector quantities of voltages and currents with high accuracy with regard to amplitude, phase angle and time synchronization are measured. It is possible to send the phasors to a Phasor Data Concentrator (PDC) in real time, and record them simultaneously with internal recorders (like SIGUARD PDP).
The power and frequency recording system is an important equipment in power plants to understand stability problems and analyze related topics like the response of generator excitation control systems. With an event recorder, various digital signals like the status of a breaker, isolator, and trip contacts of protection relays, etc. can be observed and recorded for further analysis. As a field unit, SIMEAS R-PMU forms a powerful disturbance recording system together with the SICAM PQS software installed on a DAKON PC (personal computer for data collection). One DAKON PC can communicate with several SIMEAS R-PMU using various communication channels. One DAKON PC can communicate with several SIMEAS R units and collect all recorded data.
With a flash memory for each SIMEAS R-PMU and practically unlimited storage capability on DAKON PCs, as well as with a powerful database, the recording system enables excellent archiving possibilities.
The data obtained by SIMEAS R-PMU is written to a high-capacity internal bulk storage medium. Under normal conditions in substations, power plants and industrial systems, this type of storage takes months to fill up. When the storage is full, it functions as a "ring buffer", overwriting the oldest values with the latest figures.
With a high sampling rate, this unit records all relevant information for further analysis of short-circuits, breaker opening and closing behavior, reaction of CTs and VTs on network disturbances, etc. With a recording capability of 32 analog and 64 binary channels of each unit, and with real-time synchronization capability, the system can observe and monitor a huge number of feeders and power equipment.
SIMEAS R-PMU is a recorder meeting all electromagnetic compatibility requirements like all Siemens numerical relays. High level of hardware and software quality and precise self diagnosis of each unit is a guarantee for the investment of our customers.

Function overview

Disturbance recorder for applications in substations at MV / HV / EHV level and in power plants

- Power and frequency recorder for applications in power plants

Fig. 6/1 SIMEAS R-PMU

- Event recorder for binary signals for observation of the status of various primary components like breakers, isolators, etc.
- Transient recorder for DC signals
- Test recorder for commissioning and system test
- PMU according to IEEE C37.118
- Measurement of vector quantities of voltages and currents with high accuracy with regard to amplitude, phase angle and time synchronization
- According to IEEE C37.118, internal recording of phasors via transient and continuous phasor recorder, and parallel provision of measured phasors to a phasor data concentrator (like SIGUARD PDP).

Powerful recording system

- The field units SIMEAS R-PMU and the PC software SICAM PQS form a powerful disturbance recording system. With a DAKON PC (personal computer for data collection) in automatic mode, a powerful data collection and archiving capability leads to very short analysis times
- Communication capability via Ethernet (LAN or WAN structure) in accordance with Ethernet 802.3 using TCP/IP protocol, communication via telephone network using ISDN or analog modem, or direct communication using copper (RS232) or fiber-optic channels
- Various installation possibilities of the PC software SICAM PQS in server, client and evaluation mode meet all requirements, like visualization, analysis for parameterization, commissioning, test, automatic data collection, data archiving
- Precise fault location capability using SICAM PQS.
- Monitoring and analysis of phasor measurements with SIGUARD PDP (Phasor Data Processing) or any other phasor data evaluation system.

Powerful hardware

- Modular hardware system with up to 2 analog and 64 binary inputs in a 19-inch rack
- Flash memory.

Description, function and system overview

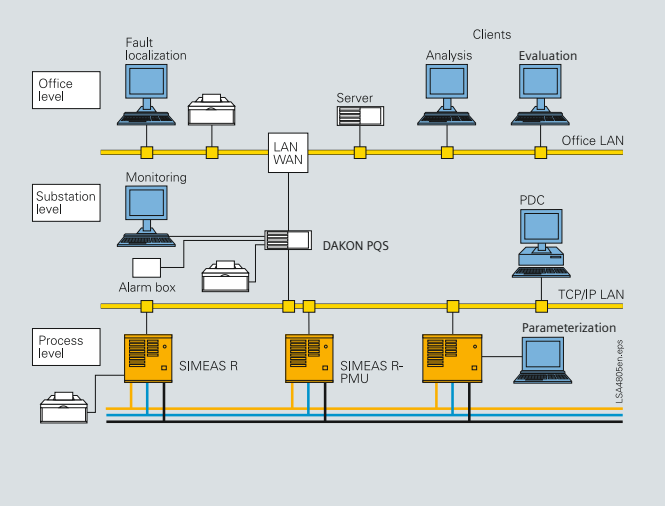


Fig. 6/2 System overview

Function overview (cont.)

System overview

DAKON is an industrial PC to which two or more SIMEAS R-PMU and numerical relays with the IEC 60870-5-103 protocol can be connected. A DAKON can automatically fetch both data from SIMEAS R-PMU and the fault recordings from protection equipment, and write these to its own storage. Communication between SIMEAS R-PMU, a DAKON and evaluation PCs is possible in various ways, for example via a wide area network (WAN) or local area network, with the TCP/IP protocol and electric or optical cables, as well as with converters and switches. As an alternative, communication via analog or ISDN modems with a star coupler is also possible.

Time synchronization

To enable a comparison of recordings from fault recorders and protection equipment at different locations, precise time synchronization of all SIMEAS R-PMU and DAKON devices is necessary. This is ensured by the use of additional components, such as GPS receiver and sync transceiver.
For more details, see the document "Application Note Time Synchronization" under www.powerquality.de

Analysis and evaluation software

All data recorded with SIMEAS R-PMU can be analyzed with the SICAM PQS software package and monitored with SICAM PQ Analyzer.
SICAM PQS is also used for parameterizing SIMEAS R-PMU, and archiving the fault recordings and mean values. The SICAM PQS software also offers the ability to work out the location of a fault in a line. Depending on data availability, the program can use fault recordings made at either end of a line to determine the fault location.

Design and data acquisition units

SIMEAS R-PMU is available in two different housings. The smaller type (ZE8/16) can be equipped with one data acquisition unit (DAU). The larger type (ZE32/64) provides space for up to 4 DAUs. A selection of different DAUs enables flexible arrangement of inputs for current, voltage and DC voltage:

- VDAU (8 voltage channels)
- DAU (8 current channels)
- VCDAU (4 voltage and 4 current channels)
- DDAU (8 DC channels).

All data acquisition units described also feature 16 binary channels. If a larger number of binary signals is to be recorded, the recorder can optionally be equipped with a BDAU with 32 binary channels.

Transient Analog Recorder (TAR)

The TAR records the curves for voltages, currents, symmetrical components, 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 parameterizing tool R-Par integrated in the SICAM PQS 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.

Functions

Event recorder

With the independent "event recorder" function, SIMEAS R-PMU continuously records the status of the binary inputs and stores them in an event memory. This permits analysis of the state changes of the binary inputs over a long time, for example, several months. This is relevant, e. g., for examining faults that occur on switching.
The described independent recording functions "analog and binary recorder, frequency and power recorder, mean value and power quality recorder, and event recorder" can run in parallel depending on the parameter settings.

Bulk storage

SIMEAS R-PMU features a bulk storage in flash technology to ensure the required high degree of reliability. During commissioning, it is possible to allocate separate areas to the various recorder functions, depending on the importance of the individual functions for the application.
The unit automatically reserves the memory range required for the operating system and firmware. Each memory range for recordings (a to d) is organized as a "circulating memory". As soon as a memory range is 90 % full after

Bulk storage (cont.)
several recordings, the procedure is as follows: the "latest fault record" is written to memory first, then the oldest recordings are deleted until the free capacity in this range reaches 80 % of the allotted memory size.

Data compression
Even if fast modem cards or a LAN/WAN connection are used, data compression is essential in a fault recorder to achieve:
- Efficient use of the device's internal bulk storage as a distributed data archive
- Fast transmission of the fault recordings to a DAKON or an evaluation PC to enable a fault analysis to be performed immediately after the fault
- Acceptable transmission times when using slow transmission media, e.g. an analog modem
- Coping with LAN/WAN "bottlenecks", which are particularly frequent in large-scale networks.

Time synchronization (Fig. 6/3)
The SIMEAS R-PMU Phasor Measurement Unit (PMU) requires a standard-compliant precise time signal for phasor measurement. A GPS receiver provides the required precision. As an alternative, SIMEAS R-PMU can be synchronized via minute impulse. This mode does not provide the accuracy of the GPS synchronization. Particularly the PMU cannot be used in this mode. For very complex networks, a passive star coupler has to be used. This device allows to use 5 fibre-optic cables instead of 1.
Note: SIMEAS R-PMU uses the original DCF77 protocol for synchronization. A synchronization box 7KE6000-8HAxx is not required, and cannot be used for SIMEAS R-PMU. If GPS time synchronisation via DCF77 protocol is used, the synchronization input (binary input 1) of the SIMEAS R-PMU CPU board has to be designed for 24 V DC (7KE6100-xx xxx 1xxx, 7KE6100-xx xxx 5xxx, 7KE6100-xx xxx 6xxx, or 7KE6100-xx xxx 7xxx).
Note: If the PMU functionality is not used, SIMEAS R-PMU can be also synchronized like SIMEAS R-PQ, see page 6/4.

Communication interfaces and components
SIMEAS R-PMU features the following communication interfaces:
- COMS interface
  This RS232 interface on the front panel is for direct communication with an evaluation PC. This interface can be used to parameterize and test the recorder during commissioning. It has fixed communication parameters.
- COM1 interface
  This serial interface (RS232) is located on the rear of the recorder. This interface enables the recorder to communicate via an external analog or ISDN modem. The recorder can then be connected to a telephone network, but a direct modem-to-modem connection is also possible. The communication parameters of this interface can be set.
- Ethernet interface
  This integrated interface is used to connect the recorder to a LAN (local area network) IEEE 802.3 (10 Mbps Ethernet) with the TCP/IP protocol. (Please note that recorders delivered up to about February 2003 have a PCMCIA slot for an Ethernet card at the rear).
- Ethernet structure
  The network used to connect to an evaluation PC or a DAKON has star topology.
  One or more connection nodes (switches) can be used. To improve the reliability of communication channels, optical cables can be used for the network.
  The following components can be used to set up an optical network:
  – Transceiver (7KE6000-8AF/8AG)
  Converter from 10BASE-T ports with copper cable to 10BASE-FL with optical cable. The unit has an FO and a 10BASE-T network port. Housing: DIN rail mounting.
  – Multiport repeater, or switch
  This switch enables connection to two or more Ethernet cable segments. The unit has one FO and six 10BASE-T network ports. Housing: DIN rail mounting.

Dynamic fault recorder for analog and binary channels
The "fault recorder" function includes recording of analog and digital signals. These signals are continuously recorded and simultaneously compared with the parameterized trigger criteria. On triggering, all channels are recorded concurrently as well as with a pre-fault, variable fault progression, and post-fault, depending on the parameter settings for recording.

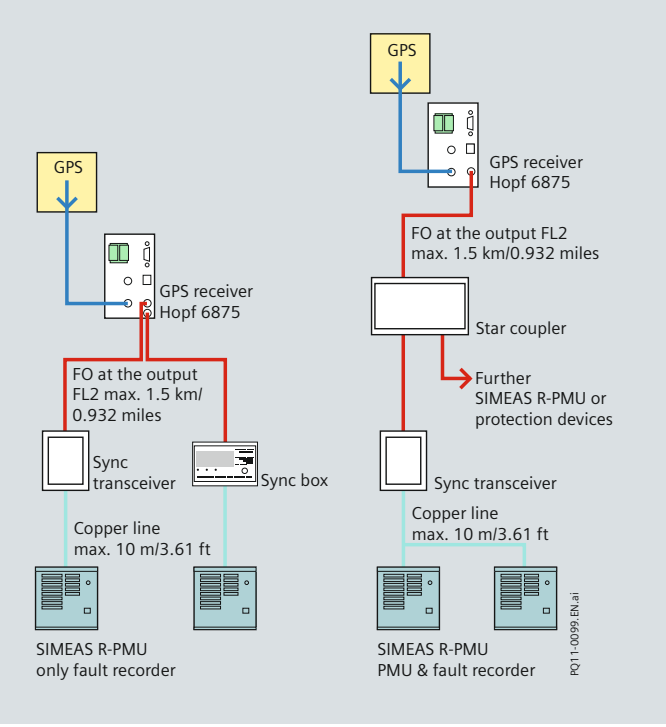


Fig. 6/3 Time synchronization SIMEAS R-PMU

Functions

Recording alternating current and voltage

Three different data acquisition units are available for recording currents and voltages:

- VCDAU with 4 voltage and 4 current inputs
- CDAU with 8 current inputs
- VDAU with 8 voltage inputs.

The sampling rate of SIMEAS R-PMU is constant at 192 samples. For a system frequency of 50 Hz (frequency range 25 to 60 Hz), the sampling rate is constant at 9,600 Hz, and for 60 Hz (frequency range 30 to 70 Hz), the sampling rate is constant at 11,520 Hz (see table 6/1, page 6/11).

Recording of the process variables

DC signals are measured via the DDAU data acquisition unit, which has 8 signal inputs. The DDAU can be ordered for an input range of -1 V to +1V, -10 V to +10 V, or -20 mA to +20 mA. These inputs can be assigned to one process signal each, e.g. display of temperature in K, speed of rotation in rpm, voltage in kV, current in kA.

Recording of binary signals

The recording of binary channels is fully synchronized with recording of analog channels. The sampling rate is 2 kHz. A group of 16 binary inputs can record up to 250 state changes per second.

Flexible triggering

With its numerous settable trigger conditions, SIMEAS R-PMU can be precisely adapted to the specific requirements of an application:

– Triggering on the r.m.s. value of an analog channel (min. / max. triggering)

For triggering, the recorder calculates a measured value corresponding to the r.m.s. value of a current or voltage (I, V) continuously at intervals of half a system cycle. The values sampled over half a system cycle are used to calculate this measured value.
Triggering occurs (i.e. recording is started) when the measured value either exceeds a positive maximum limit or falls below a positive minimum limit.
One practical example of this is triggering on a maximum value of the r.m.s. current and on a minimum value of an r.m.s. voltage.

– Triggering on a change in the r.m.s. value of an analog channel (dM/dt triggering)

Each time the measured value described above (V, I) is calculated, the difference is formed between two measured values one system cycle apart. This difference is compared with the set rate-of-change ($\mathrm{d}M/\mathrm{d}t$) limit, e.g. 10 kV / 20 ms. This permits triggering on a positive or negative change to the r.m.s. value of a voltage or current input.

– Triggering on the r.m.s. value of the positive or negative sequence system (min. / max. triggering)

The recorder can be parameterized to treat the analog inputs of a data acquisition unit as single, independent channels, or assign them to a three-phase system. In the latter case, positive and negative sequence components can be calculated both for current and voltage channels, and used for triggering. Calculation of the measured

Fig. 6/4 SIMEAS R-PMU, compact housing

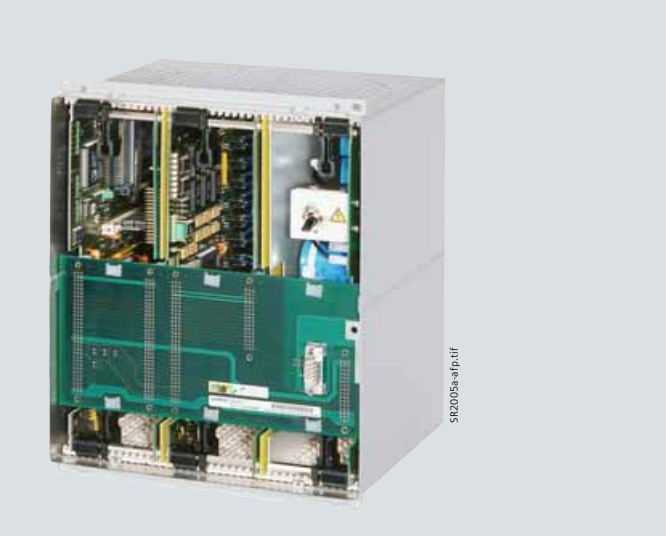


Fig. 6/5 SIMEAS R-PMU, front view.
A DAU can be seen in the middle slot

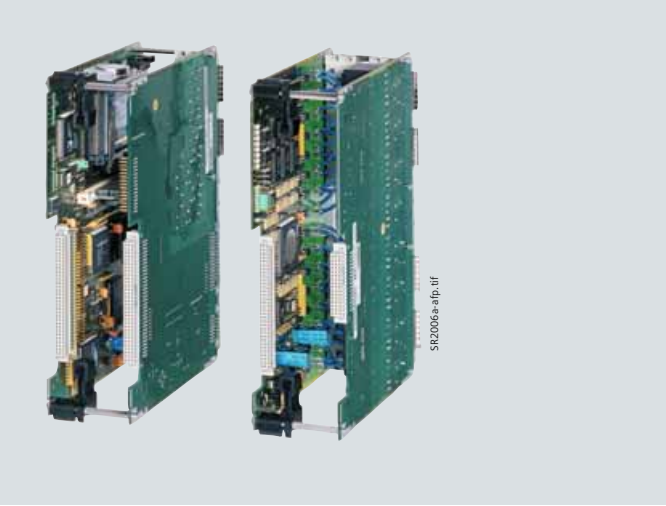


Fig. 6/6 DAUs

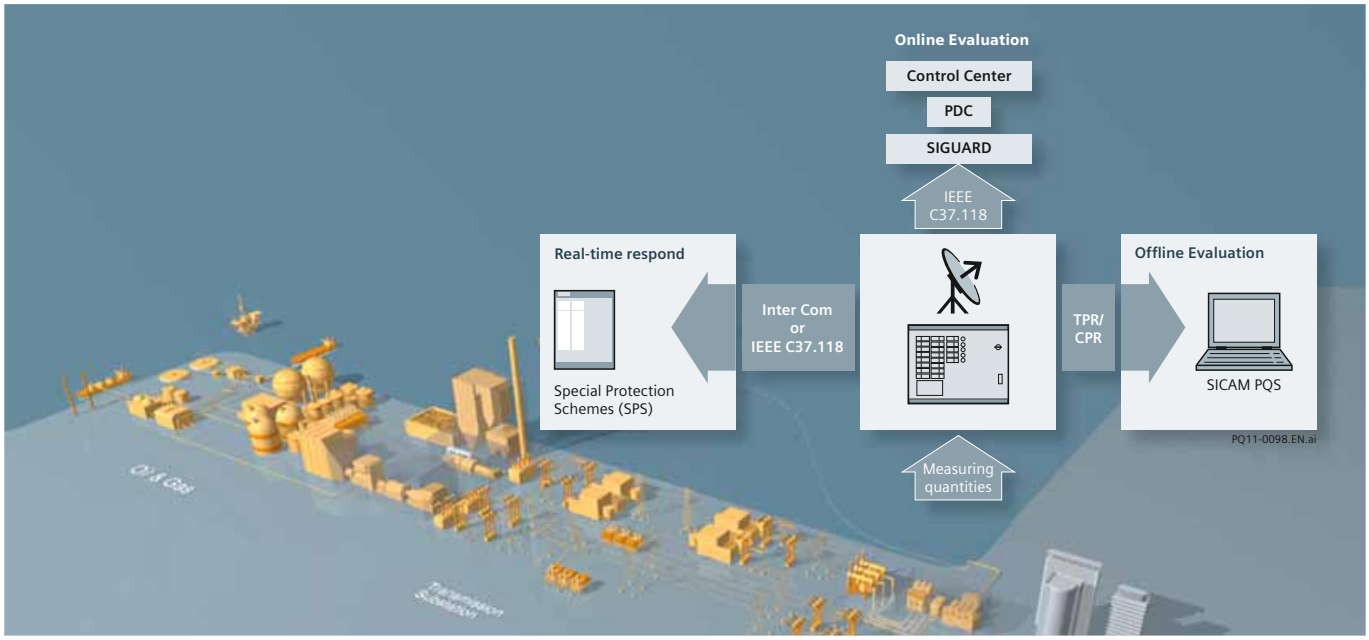


Fig. 6/7 Phasor measurement application

quantities and of the triggering is performed as described under "Triggering on the r.m.s. value of an analog channel, min. / max. triggering".

Examples of logic gating:

– Voltage min. trigger threshold, recording reached, and current max.
– Binary contact channel 1 high recording and current max. trigger reached
– Binary contact 1,
– Triggering on the limit of a DC channel (min. / max. triggering)

Triggering is performed when the sampled value of the DC signal exceeds the max. limit or falls below the min. limit.

– Triggering on the gradient of a DC channel (gradient triggering)

For the gradient trigger, the difference is calculated between two sampled values of a DC signal in a settable time interval. Triggering can be performed on a positive or negative gradient.

– Triggering on binary channels

Triggering to state (high or low), or on the positive or negative signal edge, or on a binary input change is possible.

– Logic gating of trigger conditions

Analog and binary trigger conditions can be ANDed. The logic gating of triggers serves, for example, to distinguish a fault from an intentional line disconnection. The logic operation is applied to a settable time window from 0 to 1 s. If the triggering conditions are detected as "true" during this time window, recording starts. A total of 8 patterns with 8 start selectors each can be parameterized as trigger criteria.

– Triggering via the front panel (manual trigger)

This function is especially useful for commissioning work. It permits testing the polarity of current and voltage channels, and testing phase angle offsets.

– Triggering via PC

This triggering is identical with the manual triggering, but activated from the PC via the SICAM PQS software.

– Network trigger

This triggering applies to devices communicating via an Ethernet network.

Triggering is performed either from the PC for all connected SIMEAS R-PMU recorders, or sent from a SIMEAS R-PMU to further devices.

– External trigger

A recording start can be triggered externally via a separate binary input. Recording is limited to 10 s and is performed for as long as a voltage is applied to this input.

The duration of the recording and the pre- and post-faults can be parameterized.

Smart sequence control monitors the trigger conditions during recording.

If retriggering is permitted and the maximum fault recording length is reached, a dynamic fault recording length is reached. For external triggering, time synchronization of all SIMEAS R-PMU devices in the system is required to ensure the fault records have the same time reference.

– Cross trigger

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

Functions, Hardware

Phasor Measurement Unit (PMU)

SIMEAS R-PMU is equipped with an integrated Phasor Measurement Unit (PMU) according to IEEE C37.118 – 2005. Among other things, this standard defines the 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 $v(t) = Ve^{j\omega t}$ can be displayed as a pointer that rotates anticlockwise with the angular velocity ω in the complex plane.
The voltage $v(t) = \mathrm{Re}\{v(t)\}$ is a result of the projection of the phasor $v(t)$ on the real axis.

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).

Reporting

The reporting rate 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 phasors length remains constant, however, the phase angle is changed.
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 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 SIMEAS R-PMU. When selecting the reporting rate, the available bandwidth of the data connection to the PDC should always be considered.

Transient Phasor Recorder (TPR)

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 parameterizing tool R-Par integrated of SICAM PQS. 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 pre-fault 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.

Hardware

Housing

Two types of housing are available for SIMEAS R-PMU:
- 1/2 19-inch rack with 3 slots and
- 19-inch rack with 6 slots

The first slot is filled by the CPU module, the last slot of each rack by the PSU. The remaining slots can be filled with various data acquisition units (DAUs). The modules are slotted into the rack vertically, and the terminals are located at the rear of the rack.

Central processor

The central processor coordinates the data acquisition units, communication via the interfaces, and manages the database for the various fault records and mean values. It also monitors the entire hardware.

Power supply

The power supply is drawn from two different units (PSUs), depending on the supply voltage:
- 24 V – 60 V DC
- 110 V – 250 V DC and 115 – 230 V AC

In the event of a sudden power failure, the recorder continues to function, drawing its power from a storage capacitor (for details such as duration, see “Technical Data”).

This allows time for a controlled reset if the power supply fails during operation. The PSU can optionally be equipped with a battery. The battery ensures operation for up to 10 minutes. The battery is loaded automatically and its charge state is monitored by an independent circuit. With a weekly automatic load test, the memory effect of the battery is reduced. Use of the battery is especially recommended if the recorder is powered from an AC source without PSU back-up

Data Acquisition Units (DAUs).

The following data acquisition units are available for the unit:
- VCDAU: 4 current / 4 voltage channels and 16 binary channels
- VDAU: 8 voltage channels and 16 binary channels
- CDAU: 8 current channels and 16 binary channels
- DDAU: 8 channels for process variables and 16 binary channels
- BDAU: 32 binary channels.

Analog-to-digital converters
Each analog channel has a 16-bit analog-to-digital converter (ADC) with an integrated dynamic anti-aliasing filter. This obviates use of an external anti-aliasing filter. The anti-aliasing filter automatically adapts to the network environment because the recorder sampling rate and therefore the sampling rate of the ADC are set with the parameter for the rated system frequency.

Dynamics of the current channels
The CDAU comprises eight (and the VCDAU four) current channels. Each current channel has two independent ADCs. The first ADC is connected to an inductive current transformer (CT) that is optimized for the current range of 0 to 7 A (r.m.s. value) and dimensioned for very high precision. If a higher current is measured, the recorder automatically switches over to the input of the second CT. This CT is connected to a hall generator that measures the same current as the inductive transformer but is optimized for the 0 to 600 A range (high dynamics). Because the hall generator also transmits DC, its frequency range does not have a lower limit. Use of two different transformer principles ensures that the recorder measures very accurately in the nominal range of the line current and, in the event of a fault, records current curves with high amplitude and sustained DC component without any loss of information.

Current terminals
If a CDAU or VCDAU is removed from the rack, the current terminals are automatically shorted out to avoid damaging the connected CT.

Channels for process signals
SIMEAS R-PMU:
The sampling rate of a DDAU in SIMEAS R-PMU is fixed to 192 samples per cycle. For a nominal frequency of 50 Hz (frequency range 0 to 500 Hz), the sampling rate is 9,600 Hz, and for a nominal frequency of 60 Hz (frequency range 0 to 500 Hz), the sampling rate is 11,520 Hz.

Configuration notes
The PCMCIA memory and communication cards used for the modem or Ethernet in PCCARD technology are constantly undergoing further development. Because they are used in substations, where CE markings are prescribed, only cards approved by Siemens may be used in the system. In particular, the system noise immunity stipulated by the applicable IEC regulations and the high ambient temperature range necessitate special cards. The planning department should be consulted about selecting the correct PCs and correctly setting up the overall system.

Fig. 6/8 Layout of a SIMEAS R-PMU

Fig. 6/9 Rear view

Hardware

Modes

SIMEAS R-PMU has three operating modes:

- Normal mode
  In normal mode all functions are active.
- Blocked mode
  In blocked mode, the recording functions “dynamic recorder for analog and binary channels” and “power and frequency recorder” are inactive, i.e. no fault records are recorded. If this mode is selected, only the functions “mean value and power quality recorder” and “event recorder” are active. The mode is used, for example, to test equipment connection during commissioning.
- Test mode
  In test mode, all functions are active, but recorded events are entered with “test” as their cause. The “event recorded” alarm relay does not pick up. “Test mode” is used to check the functionality of SIMEAS R-PMU. The different modes can be selected on the keyboard. Remote control via SICAM PQS is possible at any time.

LEDs on the front panel of the recorder

The front panel of the recorder contains 8 red and 8 green parameterizable LEDs assigned as follows:

- Recorder in operation
- Operating voltage OK
- Battery capacity OK
- Event being recorded
- Recorder synchronized
- Circulating memory active
- PMU active
- DAU error
- Printer fault
- Data memory fault
- Synchronization fault
- PC not accessible
- Temperature fault
- Spare (freely parameterizable),

and 5 LEDs permanently assigned to the control buttons listed below.

Control buttons

The recorder has the following control buttons that are located on the front panel:

- Acknowledge group alarm
- Normal mode
- Blocked mode
- Test mode
- Manual trigger.

Control inputs

There are four contact inputs at the rear of the recorder:

- Acknowledge group alarm
- System reset
- External start
- Time synchronization.

Fig. 6/10 LEDs and control buttons

Alarm outputs

The recorder has four alarm outputs. The first is permanently connected to the processor watchdog. The other three can be freely parameterized and are pre-assigned as follows:

- Watchdog (permanent, not parameterizable)
- E.g. ready to run (parameterizable)
- E.g. event being recorded (parameterizable)
- E.g. group alarm (parameterizable).

Group alarm

Here is an example of how the group alarm can be parameterized. Up to 5 signals can be parameterized for the group alarm:

- DAU fault
- Printer fault
- Synchronization fault
- CPU fault
- Data fault.

Mechanical design	
1/2 19" version	
Dimensions (W × H × D)	223 mm × 266 mm × 300 mm / 8.78 in. x 10.47 in. x 11.81 in.
Number of slots	3
Slot 1: CPU	
Slot 2: DAU	See "Analog and binary inputs and outputs"
Slot 3: Power supply unit	
19" version	
Dimensions (W × H × D)	445 mm × 266 mm × 300 mm / 17.52 in. x 10.47 in. x 11.81 in.
Number of slots	6
Slot 1: CPU	Approx 1.5 mA / input
Slot 2 - 5: DAU	See "Analog and binary inputs and outputs"
Slot 6 Power supply unit	

Auxiliary voltage		
Low-voltage version		
DC voltage		
Rated auxiliary DC voltage V_{aux}	24 / 28 / 60 V DC	
Permissible voltage ranges	19.2 to 72 V DC	
High-voltage version		
DC voltage		
Rated auxiliary DC voltage V_{aux}	110 / 125 / 220 / 250 V DC	
Permissible voltage ranges	88 to 300 V DC	
AC voltage 50 / 60 Hz		
Rated auxiliary AC voltage V_{aux}	115 / 230 V AC	
Permissible voltage ranges	92 to 276 V AC	
Voltage stability without back-up battery		
Bridging time	Measured times, central unit ZE8/16	ZE32/64
for V_{aux} = 24 V DC	≥ 400 ms	≥ 150 ms
for V_{aux} = 60 V DC	≥ 450 ms	≥ 170 ms
for V_{aux} = 110 V DC	≥ 500 ms	≥ 180 ms
for V_{aux} = 250 V DC	≥ 700 ms	≥ 200 ms
for V_{aux} = 115 V AC	≥ 500 ms	≥ 200 ms
for V_{aux} = 230 V AC	≥ 800 ms	≥ 348 ms
Optionally with back-up battery		
Power failure bridging time up to 10 min with all functions operating		
Power consumption		
1/2 19" version 8 analog / 16 binary channels	24 to 60 V DC 110 to 250 V DC 115 to 230 V AC	20 W 18 W 30 VA
19" version 32 analog / 64 binary channels	24 to 60 V DC 110 to 250 V DC 115 to 230 V AC	45 W 40 W 70 VA

Analog and binary inputs and outputs				
Slot 2 (1/2 19" version)	To be equipped according to table "Equipping version"			
Slot 2 to 5 (19" version)	To be equipped according to table "Equipping version"			
Equipping versions				
VCDAU	8 analog (4 current / 4 voltage) and 16 binary channels			
CDAU	8 analog (8 current) and 16 binary channels			
VDAU	8 analog (8 voltage) and 16 binary channels			
BDAU	32 binary channels			
DDAU	8 analog (8 current ±20 mA, or 8 voltage ±1 V or ±10 V) and 16 binary channels			
SIMEAS R-PMU				
DAU type	Rated frequency	Frequency range	Sampling frequency	Sampling rate
VCDAU;VDAU;CDAU	50 Hz	25 to 60 Hz	9,500 Hz	192
DDAU	50 Hz	0 to 500 Hz		
VCDAU;VDAU;CDAU	60 Hz	30 to 70 Hz	11,520 Hz	
DDAU	60 Hz	0 to 500 Hz		
Voltage input (VDAU or VCDAU)				
Measuring range 1	1.5 to 200 V_{rms}			
Impedance	>100 kΩ			
Resolution	15 mV			
Overvoltage	Max. 300 V_{rms} for 5 s			
Accuracy (at 23 °C ± 1 °C / 73.4 °F ± 33.8 °F and rated frequency)	Class 0.3, ±0.25 % of measured value ±30 mV			
Frequency response	3 to 5500 Hz (5 %)			
Number of analog-digital converters per channel	1			
Measuring range 2	3 to 400 V_{rms}			
Impedance	>200 kΩ			
Resolution	30 mV			
Overvoltage	Max. 600 V_{rms} for 5 s			
Accuracy (at 23 °C ± 1 °C / 73.4 °F ± 33.8 °F and rated frequency)	Class 0.3, ±0.25 % of measured value ±30 mV			
Frequency response	3 to 5500 Hz (5 %)			
Number of analog-digital converters per channel				
Voltage channel	1			
Current channel	2			

Table 6/1 Technical data

Technical data

Analog and binary inputs and outputs (cont.)	
Current input (CDAU or VCDAU)	
Dynamic AD and converter switching	
Measuring range	5 mA to 400 A_{rms}
Accuracy range	5 mA to 7 A_{rms}
Resolution (at 23 °C ± 1 °C/ 73.4 °F ± 33.8 °F and rated frequency)	0.5 mA, Class 0.5, ± 0.5 % of measured ± 0.5 mA
Frequency response	3 to 5500 Hz (5 %)
Range	> 7 A_{rms} to 200 A_{rms}
Resolution (at 23 °C ± 1 °C/ 73.4 °F ± 33.8 °F and rated frequency)	30 mA, Class 1.5, ± 1.5 % of measured value ± 30 mA
Frequency response	0 to 5500 Hz (5 %)
Range	> 200 A_{rms} to 400 A_{rms}
Resolution (at 23 °C ± 1 °C/ 73.4 °F ± 33.8 °F and rated frequency)	30 mA, Class 3.5, ± 3.5 % of measured value
Frequency response	0 to 5500 Hz (5 %)
Continuous	20 A
Overload	100 A, 30 s 500 A, 1 s 1200 A, half-wave
Recording	200 A, plus 100 % displacement
Burden	< 0.1 VA
DC inputs (DDAU)	
Input range (depending on the order no.)	± 20 mA (50 Ω) ± 1 V / ± 10 V (> 40 kΩ / > 400 kΩ)
Accuracy (at 23 °C ± 1 °C/ 73.4 °F ± 33.8 °F)	Class 0.5
Range 1 V	± 0.5 % measured value ± 1 mV
Range 10 V	± 0.5 % measured value ± 10 mV
Range 20 mA	± 0.5 % measured value ± 20 µA
Sampling frequency	10 Hz, 100 Hz, 1 kHz, 10 kHz per module (parameterizable) (if used together with a VCDAU, CDAU, or VDAU, the DC channels are recorded in parallel. Only a sampling rate of 10 kHz per channel is permitted.) Processing of higher DC voltages via isolation amplifier (e.g. SICAM T)

Analog and binary inputs and outputs (cont.)			
Binary inputs (BDAU, VCDAU, DDAU, CDAU und VDAU)			
Sampling frequency	2 kHz		
Principle of storage	Only status changes are stored with real time and a resolution of 1 ms		
Storage capacity	250 status changes per 16 inputs, within 1 s, total storage capacity depends on the parameter setting (typically approx. 100,000 status changes)		
Voltage ranges of control inputs according to components installed	Input voltage (V)	L level (V)	H level (V)
	24	≤ 7	≥ 18
	48 to 60	≤ 14	≥ 36
	110 to 125	≤ 28	≥ 75
	220 to 250	≤ 56	≥ 165
	Input current 1 mA		
	Input voltage (V)	Overload (V)	
	24	28.8	
	48 to 60	72	
	110 to 125	150	
	220 to 250	300	

Analog and binary inputs and outputs			
Control inputs			
Input 1	Input for time synchronization for connection to the synchro box or a station clock with minute pulse 24 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 of control inputs according to components installed	Input voltage (V)	L level (V)	H level (V)
	24	≤ 7	≥ 18
	48 to 60	≤ 14	≥ 36
	110 to 125	≤ 28	≥ 75
	220 to 250	≤ 56	≥ 165
	Input current 1 mA		
	Input voltage (V)	Input 1 Overload (V)	Input 2 to 4 Overload (V)
	24	28.8	28.8
	48 to 60	72	72
	110 to 125	150	150
	220 to 250	300	300

Table 6/1 Technical data

Analog and binary inputs and outputs (cont.)	
Signal outputs	
	4 signal outputs with isolated main contact, signal output 1 hard-wired to watchdog, 3 signals outputs freely allocatable.
Switching capacity	MAKE 30 W/VA BREAK 20 VA 30 W resistive 25 W for L/R ≤ 50 ms
Switching voltage	250 V
Permissible current	1 A continuous
Allocation of the signal outputs and status of LEDs	SIMEAS R ready for operation Operating voltage OK Normal mode Test mode Locked mode Transmission SIMEAS R – PC active Recording event DAU fault Printer fault Time synchronization error Computer not available Data memory fault Data memory full Cyclic storage active Battery capacity OK Temperature monitoring < -5 °C/-13 °F Temperature monitoring > +55 °C/+131 °F Fine synchronization error Group alarm Relay 1 – not allocatable; watchdog Relay 2 – not allocatable Relay 3 – not allocatable Relay 4 – not allocatable

Communication interfaces	
Slot 1 – CPU	
LPT 1	Printer interface, Centronics, for connection of a laser printer (Emulation Postscript level 2)
COM 2/COM S	RS232 serial interface, on front side for connection of a PC, 19.2 kBd
COM 1	RS232 serial interface, on rear for connection of e.g. an additional modem, 300 Bd to 57.6 Bd or an external ISDN terminal adapter
Ethernet	Compatible acc. to IEEE 802.3 Software TCP/IP Twisted pair (10BaseT), RJ45 connector
Slot 0 data transmission	
Modem	Transmission rate up to 56 kBps Dialing method audio and pulse CCIT V.21, V.22, V.22 to V.23, V.32, V.32 to V.34, V.90 Certified in all European countries

Climatic stress	
Temperatures	
Transport and storage	-25 °C to +70 °C/-13 °F to +158 °F
Operation	
for cubicle/panel flush mounting	-5 °C to +55 °C/+23 °F to +131 °F (condensation not permissible)
for panel surface mounting	0 °C to +40 °C/+32 °F to +104 °F
Humidity	
	95 % without condensation

SIMEAS R-PMU	
Mass storage: 1 GB Flash Card	
Available recorder	
PMU according to IEEE C37.118 and parallel	
Triggered recorder	*Transient Analog Rec (TAR):* $\underline{V}_{L,N}$; $\underline{I}_{L,N}$; $\underline{V}_{1,2,0}$; $\underline{I}_{1,2,0}$; B; D *Transient Phasor Rec.(TPR):* $\underline{V}_{L,N}$; $\underline{I}_{L,N}$; $\underline{V}_{1,2,0}$; $\underline{I}_{1,2,0}$; B; D; f; P; Q
Continuous recorder	*Cont. RMS Rec (CRR):* $\underline{V}_{L,N}$ [1]; $\underline{I}_{L,N}$ [1]; $\underline{V}_{1,2,0}$ [1]; $\underline{I}_{1,2,0}$ [1] *Cont. Q (Power) Rec. (CQR):* Q [1], P [1] *Cont. Frequency Rec. (CFR):* f [1] *Cont. DC Rec. (CDR):* D [1] (±20 mA; ±1 V; ±10 V) *Event Rec. (ER):* B *Cont. Phasor Rec. (CPR):* $\underline{V}_{L,N}$; $\underline{I}_{L,N}$; f
1) Root mean square values	

Further technical information on **www.siemens.com/powerquality**

Table 6/1 Technical data

Dimension drawings

Dimension drawings in mm / inch

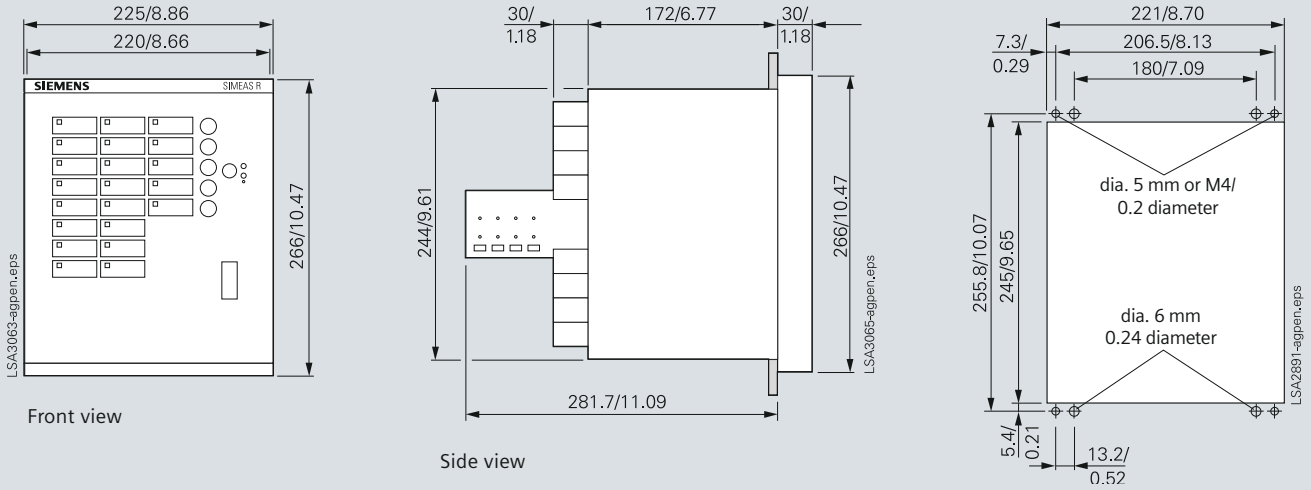
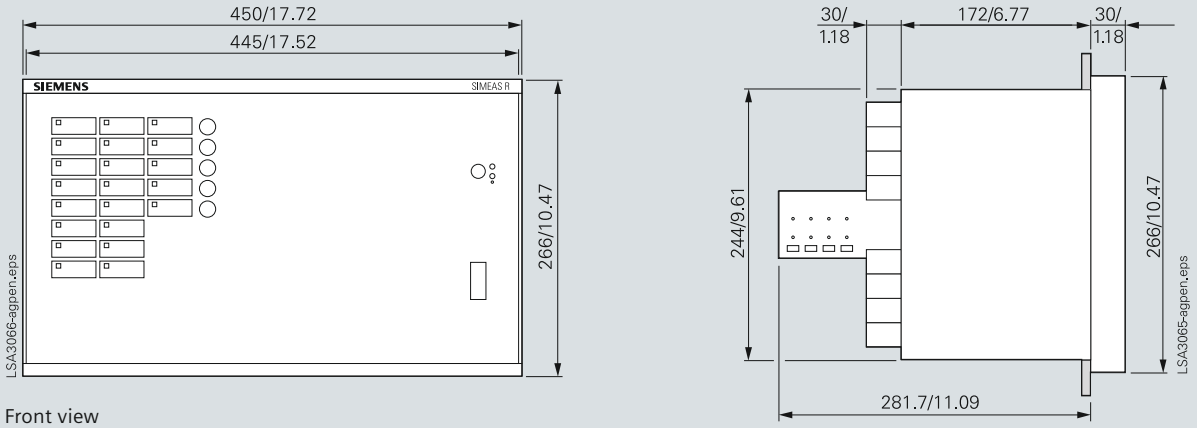


Fig. 6/11 7KE6100 SIMEAS R
1/2 x 19" with 7XP20 housing for panel flush mounting



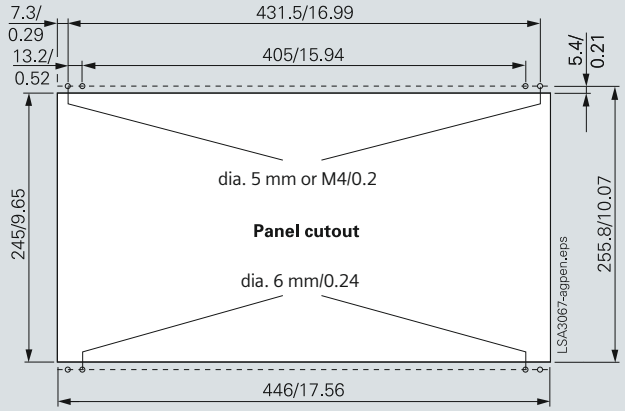
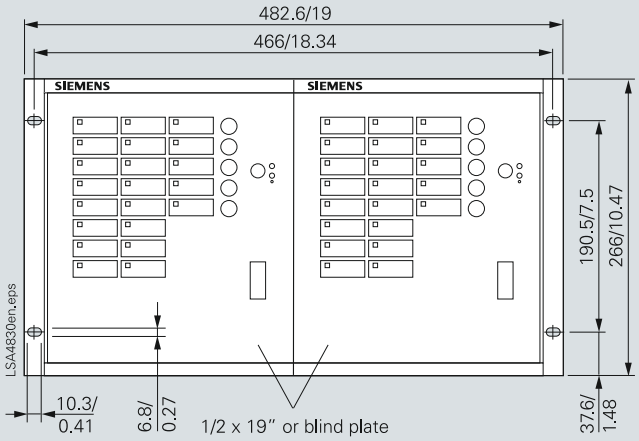
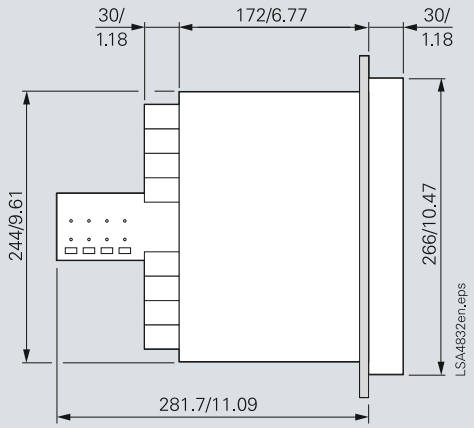


Fig. 6/12
7KE6100-1 SIMEAS R 1/1 × 19" unit in 7XP20 housing for panel flush mounting

Dimension drawings in mm / inch

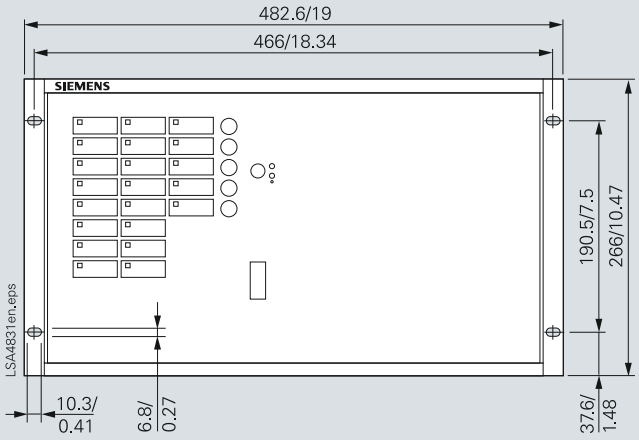


Front view

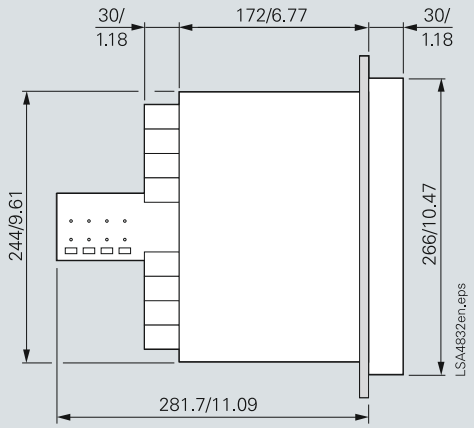


Side view

Fig. 6/13 7KE6100-0 SIMEAS R-PMU 19" frame mounting



Front view



Side view

Fig. 6/14 7KE6100-1 SIMEAS R-PMU 19" frame mounting

Selection and ordering data

Description	Order No.
Central unit PMU (V4) ZE8/16 with integrated Ethernet port [1]	**7KE6100-0□□4□-□□□□**
With one data acquisition unit, remote data transmission to DAKON or evaluation PC, case ½ × 19", usage of COM1 or COM2 or Ethernet/Standard	
Housing	
For panel flush mounting (perforated housing)	D
For surface mounting	E
For 19" assembly (perforated housing)	F
Measurement at	
16.7 Hz network	C
50 Hz network	D
60 Hz network	E
Terminals [2]	
Standard	1
US design	2
Signal voltages of the CPU and the binary inputs [3]	
24 V DC, all binary inputs + CPU binary input 1	1
48 V to 60 V DC, all binary inputs + CPU binary input 1	2
110 V to 125 V DC, all binary inputs + CPU binary input 1	3
220 V to 250 V DC, all binary inputs + CPU binary input 1	4
48 V to 60 V DC, all binary inputs – CPU binary input 1: 24 V DC	5
110 V to 125 V DC, all binary inputs – CPU binary input 1: 24 V DC	6
220 V to 250 V DC, all binary inputs – CPU binary input 1: 24 V DC	7
Data acquisition unit DAU	
VDAU (8 V/16 binary inputs)	A
CDAU (8 I/16 binary inputs)	B
VCDAU (4 V/4 I/16 binary inputs)	C
BDAU (32 binary inputs)	D
DDAU 20 mA	F
DDAU 1 V	G
DDAU 10 V	H
Auxiliary power	
24 to 60 V DC without battery	G
24 to 60 V DC with battery	H
50/60 Hz, 115/230 V AC or 110 V to 250 V DC without battery	J
50/60 Hz, 115/230 V AC or 110 V to 250 V DC with battery	K
Manual	
German	1
English	2
French	3
Spanish	4
Italian	5

Note: Cables must be ordered separately

1) Digital disturbance recorder (DFR) with one slot for a data acquisition unit (DAU), ½-19" rack. The basic unit has two RS232 ports (COMS and COM1), one Ethernet and one printer port. Only two communication ports can be supported in parallel.
2) Housing for surface mounting is not available with US terminals
3) This ordering position defines the input voltage level of the binary inputs of the central processor unit (CPU) board and the binary inputs of the DAU unit. Please note that the binary input No. 1 of the CPU unit is reserved for external time synchronization.
   For the device 7KE6000-0** or 7KE6100-0** the voltage level of this input must be 24 V DC, if you connect this input to the synchronization unit 7KE6000-8HA** or together with a GPS receiver 7XV5664-0AA00 via FO to the Sync-transceiver 7KE6000-8AK/L.

   Example: SIMEAS R will be installed in a substation with 110 V DC voltage battery system and GPS time synchronization (= Hopf receiver + synch-box). In this case, this MLFB position (No. 13) must be "6".

   Attention: The 24 V DC input has the range of 24 V to 60 V DC.

Table 6/2 Selection and ordering data

Description	Order No.
Central unit PMU (V4) ZE32/64 with integrated Ethernet port [1]	**7KE6100-1□□4□-□□□□**
With four data acquisition units, case 19", communication port to DAKON or evaluation PC, usage of COM1 or COM2 or Ethernet/Standard	
Housing [2]	
For panel flush mounting (perforated housing)	D
For surface mounting (see note)	E
For 19" assembly (perforated housing)	F
Measurement at	
50 Hz network	D
60 Hz network	E
Terminals [3]	
Standard	1
US design	2
Signal voltages of the CPU and the binary inputs for units without free assembly of the DAUs [4]	
24 V DC, all binary inputs + CPU binary input 1	1
48 V to 60 V DC, all binary inputs + CPU binary input 1	2
110 V to 125 V DC, all binary inputs + CPU binary input 1	3
220 V to 250 V DC, all binary inputs + CPU binary input 1	4
48 V to 60 V DC, all binary inputs – CPU binary input 1: 24 V DC	5
110 V to 125 V DC, all binary inputs – CPU binary input 1: 24 V DC	6
220 V to 250 V DC, all binary inputs – CPU binary input 1: 24 V DC	7
Data acquisition unit DAU	
Note: The population of the DAUs is from left to right	
2 VCDAU units (8 *V*/8 *I*/32 binary inputs)	A
4 VCDAU units (16 *V*/16 *I*/64 binary inputs)	B
1 VCDAU unit (4 *V*/4 *I*/16 binary inputs) and 3 CDAU units (24 *I*/48 binary inputs)	C
Data acquisition units (DAUs) for free assembly [5]	D
Auxiliary power	
24 V to 60 V DC without battery	G
24 V to 60 V DC with battery	H
50/60 Hz, 115/230 V AC or 110 V to 250 V DC without battery	J
50/60 Hz, 115/230 V AC or 110 V to 250 V DC with battery	K
Manual	
German	1
English	2
French	3
Spanish	4
Italian	5

1) Digital disturbance recorder (DFR) with four slots for data acquisition units (DAU), 19" rack. The basic unit has two RS232 ports (COMS and COM1), one Ethernet and one printer port. Only two communication ports can be supported in parallel.
2) For the surface mounting housing, the number of the possible measurement channels must be clarified in the factory.
3) Housing for surface mounting is not available with US terminals.
4) The following considerations are required for the definition of this MLFB position:
You want to order a standard unit with predefined DAU boards (MLFB position 14 = "A", "B" or "C"). This MLFB position defines the input voltage level of the binary inputs of the central processor unit (CPU) board and the binary inputs of the DAU units. Please note that the binary input No. 1 of the CPU unit is reserved for external time synchronization.
For the device 7KE6000-1** or 7KE6100-1** the voltage level of this input must be 24 V DC, if you connect this input to the synchronization unit **7KE6000-8HA**** or together with a GPS receiver **7XV5664-0AA00** via FO to the sync transceiver **7KE6000-8AK/L**.
Example: SIMEAS R will be installed in a substation with 110 V DC voltage battery system and GPS time synchronization (= Hopf receiver + sync box). In this case, this (MLFB position 13) must be "6".
Attention: The 24 V DC input has the range of 24 V to 60 V DC.
You want to order a unit with free configuration of the DAU boards (MLFB position 14 = "D"): This MLFB position defines the input voltage level of the binary inputs of the central processor unit (CPU) board. The input voltage level of the data acquisition units (DAUs) is later defined separately with the ordering code of the DAU boards
Example: A SIMEAS R with free configuration of the DAU boards (MLFB position 14 = "D") is for a voltage level of 220 V DC projected. With the selection "7" of this MLFB position, the input voltage level of the 1. binary input of the central processor unit (CPU) board is fixed to 24 V DC and the voltage level of the further binary inputs of the CPU are fixed to 220 V to 250 V DC.
5) If you want to order a unit with free configuration of the DAU boards (MLFB position 14 = "D"), following further steps are required:
→ Please define at first the voltage level for the binary inputs of the CPU board (MLFB position 13 → please see also (4)) and than the ordering code **7KE6000-4*** for which DAU slots the rack must be prepared, for example the assembly of the adequate terminals according to the DAU boards. With this step, the following definitions are also required:
a) If a defined DAU position must also be equipped with a DAU board, then please order the according DAU board using the ordering code **7KE6000-2***
b) Or, the according slot will be equipped with a blind plate
c) Or, a defined DAU slot will only be prepared for a DAU, without ordering the specific DAU. (For example, you already have a DAU or you will order the DAU some time later)

Attention: A SIMEAS R and SIMEAS R-PMU must be equipped from left to right.

Table 6/2 Selection and ordering data

Selection and ordering data

Description	Order No.
SIMEAS R, assembly of the central unit ZE32/64	**7KE6000-4□□66-6□□0**
Please apply only for free assembly. The central unit includes 4 slots for free population with data acquisition units (DAUs). Preparation of the slots with the correspondig terminals and assembly with DAUs	
Slot 1	
VCDAU to be equipped in the factory [1]	J
CDAU to be equipped in the factory [1]	K
VDAU to be equipped in the factory [1]	L
BDAU to be equipped in the factory [1]	M
DDAU to be equipped in the factory [1]	N
not prepared / plate only	P
VCDAU prepared for a VCDAU [2]	Q
CDAU prepared for a CDAU [2]	R
VDAU prepared for a VDAU [2]	S
BDAU prepared for a BDAU [2]	T
DDAU prepared for a DDAU [2]	U
Slot 2	
VCDAU to be equipped in the factory [1]	A
CDAU to be equipped in the factory [1]	B
VDAU to be equipped in the factory [1]	C
BDAU to be equipped in the factory [1]	D
DDAU to be equipped in the factory [1]	E
not prepared / plate only	F
VCDAU prepared for a VCDAU [2]	G
CDAU prepared for a CDAU [2]	H
VDAU prepared for a VDAU [2]	J
BDAU prepared for a BDAU [2]	K
DDAU prepared for a DDAU [2]	L
Slot 3	
VCDAU to be equipped in the factory [1]	A
CDAU to be equipped in the factory [1]	B
VDAU to be equipped in the factory [1]	C
BDAU to be equipped in the factory [1]	D
DDAU to be equipped in the factory [1]	E
not prepared / plate only	F
VCDAU prepared for a VCDAU [2]	G
CDAU prepared for a CDAU [2]	H
VDAU prepared for a VDAU [2]	J
BDAU prepared for a BDAU [2]	K
DDAU prepared for a DDAU [2]	L
Slot 4	
VCDAU to be equipped in the factory [1]	A
CDAU to be equipped in the factory [1]	B
VDAU to be equipped in the factory [1]	C
BDAU to be equipped in the factory [1]	D
DDAU to be equipped in the factory [1]	E
not prepared / plate only	F
VCDAU prepared for a VCDAU [2]	G
CDAU prepared for a CDAU [2]	H
VDAU prepared for a VDAU [2]	J
BDAU prepared for a BDAU [2]	K
DDAU prepared for a DDAU [2]	L

Please use this table only for the free configuration of the DAU units. The configuration data is required for the definition of the location of the DAU units and the population of the rack with adequate terminals. The population of the rack with DAU units must be from left to right.

1) Please specify and order the module 7KG6000-2*.
2) For future use.

Table 6/2 Selection and ordering data

Description	Order No.
Data acquisition units for free assembly of the central unit ZE32/64 or as spare parts	**7KE6000-2□□□□**
Also available for 7KE6000-0; 7KE6100-0; 7KE6000-1 and 7KE6100-1	
VDAU (8 *V*/16 binary inputs)	**A**
CDAU (8 *I*/16 binary inputs)	**B**
VCDAU (4 *V*/4 *I*/16 binary inputs)	**C**
BDAU (32 binary inputs)	**D**
Signal voltages of the binary inputs	
24 V DC	**A**
48 to 60 V DC	**B**
110 V to 125 V DC	**C**
220 V to 250 V DC	**D**
Terminals	
Standard (only necessary for spare part DAU)	**1**
US design (only necessary for spare part DAU)	**2**
Without terminals, the central unit is already equipped with terminals	**3**
Network frequency	
No frequency information in case of order number position 9 = **D**	**0**
16.7 Hz [1)]	**1**
50 Hz	**2**
60 Hz	**3**
Acquisition units for free assembly or as spare parts	**7KE6000-2□□□□**
Also available for 7KE6000-0; 7KE6100-0; 7KE6000-1 and 7KE6100-1	
DDAU (8 DC/16 binary inputs)	**E**
Terminals	
Standard (only necessary for spare part DAU)	**A**
US design (only necessary for spare part DAU)	**B**
Without terminals, the central unit is already equipped with terminals	**C**
Analog channels	
20 mA	**1**
1 V	**2**
10 V	**3**
Signal voltages for binary inputs	
24 V DC	**1**
48 V to 60 V DC	**2**
110 V to 125 V DC	**3**
220 V to 250 V DC	**4**

1) The frequency for SIMEAS R – PMU (7KE6100-0xx and 7KE6100-1xx) is not available.

Table 6/2 Selection and ordering data

Selection and ordering data

Description	Order No.
SIMEAS R spare parts	
Spare Flash memory für CPU-486 with firmware 2.1.xx *) PCMCIA Flash memory and firmware 2.1.xx *) with standard parameterization	**7KE6000-3HA**
Spare Flash memory for CPU-486 with firmware 2.3.xx **) PCMCIA Flash memory with installed firmware 2.3.xx **), with additional features "Recording of flicker and voltage sags" Valid only for units with RAM memory of 32 MB with standard parameterization	**7KE6000-3HB**
512 MB Flash memory for ELAN CPU + firmware 3.0.xx IDE Flash memory 2.5 inch and firmware 3.0.xx with standard parameterization	**7KE6000-3HC1**
1024 MB Flash memory for ELAN CPU + firmware 4.0.xx (PMU) IDE Flash memory 2.5 inch and firmware 4.0.xx with standard parameterization	**7KE6100-3HC3**

Description	Order No.
Central processor unit (ELAN-CPU) for SIMEAS R-PMU V4	**7KE6100-2L□1**
with IDE Flash memory 2.5 inch (1 GB) and current firmware with standard parameterization	
Input signal voltage	
24 V DC, all binary inputs + CPU binary input 1	A
48 V to 60 V DC, all binary inputs + CPU binary input 1	B
110 V to 125 V DC, all binary inputs + CPU binary input 1	C
220 V to 250 V DC, all binary inputs + CPU binary input 1	D
48 V to 60 V DC, all binary inputs - CPU binary input 1 24 V DC	E
110 V to 125 V DC, all binary inputs - CPU binary input 1 24 V DC	F
220 V to 250 V DC, all binary inputs - CPU binary input 1 24 V DC	G
Power supply for central processor unit	**7KE6000-2G□**
24 V to 60 DC without battery	G
24 V to 60 DC with battery	H
50/60 Hz, 115/230 V AC or 110 V to 250 V DC without battery	J
50/60 Hz, 115/230 V AC or 110 V to 250 V DC with battery	K

*) xx: Current version of the firmware 21.xx
**) xx: Current version of the firmware 23.xx

1) For connecting a synchronization unit 7KE6000-8HA, the binary input 1 of the CPU has to be dimensioned for 24 V DC (24 V DC input necessary for connection to sync. tranceiver, 24 V DC input is able to handle 24 V to 60 V DC)

Table 6/2 Selection and ordering data

Description	Order No.
Synchronization unit [2]	**7KE6000-8HA□□**
In the housing with snap-on attachment for 35 mm/1.38 in. top-hat rail according to DIN EN 50022 with connection cable for SIMEAS R	
Receiver/decoder module for time synchronization	
Decoder for DCF77 signal	2
For connection to a GPS receiver with DCF77 output signal (for example to a HOPF 6875 GPS receiver); or for terrestrial antenna This is the best choice for all applications **worldwide**	
Decoder for Meinberg or ZERA signal	3
Decoder for Patek - Philippe signal	4
Decoder for IRIG B signal (e.g. of GPS receiver) [1]	5
Decoder for telenorma signal	6
Decoder for demodulated IRIG B signal, TTL level	7
Decoder for demodulated DCF77 signal, open collector connection	8
Connection via serial port 1 (connection via terminals 11, 12, 13)	
Auxiliary power	
24 V to 60 V DC	1
110 V to 250 V DC or 115 V to 230 V AC, 50/60 Hz	2
GPS time synchronization unit	**7XV5664-0AA00**
With GPS antenna and 25 m/82.02 ft antenna cable Time receiver with 2 optical outputs (programable) ST plugs for 62.5/125 µm multi-mode fiber. Output: IRIG-B or DCF77 time telegram Auxiliary voltage 24 to 48 V DC For other auxiliary voltage ranges 7XV5810-0BA00 is required	
DC-AC/DC converter	**7XV5810-0□A00**
Input: 24 V to 250 V DC, 115/230 V AC Output: 24 V DC	B
Rugged switch RSG2100	**7KE6000-8AP□0-□AB**
12 × 10BaseFL ports with ST plug 2 × 100BaseFX ports 2 × 10/100BaseFT ports with RJ45 plug (uplink function)	
Power supply	
24 V DC	0
48 V DC	1
88 V to 300 V DC/85 V to 264 V AC	2
FO option for 2 × 100BaseFX ports	
1310 nm, multi-mode, 2 km/1.24 miles with ST plug	0
1310 nm, single mode, 20 km/12.43 miles km with LC plug	1
Components for Ethernet communication	
Ethernet transceiver 24 V DC (18 V to 36 V DC) with ST connector Rugged MC – RMC – Ethernet media converter	**7KE6000-8AF**
Ethernet transceiver 88 V to 300 V DC or 85 V to 264 V AC with ST connector Rugged MC – RMC – Ethernet media converter	**7KE6000-8AG**
Components for time synchronization	
SIMEAS Sync fibre optic multiplexer (24 V to 60 V DC)	**7KE6000-8AH**
SIMEAS Sync fibre optic multiplexer (110 V to 230 V DC/AC; 45 to 65 Hz)	**7KE6000-8AJ**
Sync transceiver (24 V to 60 V DC)	**7KE6000-8AK**
Sync transceiver (110 V to 230 V DC/AC; 45 to 65 Hz)	**7KE6000-8AL**

1) The IRIG B signal has the following disadvantages: the year is not indicated, there is no switchover from summer to winter, there is no relative time (not orientated towards time zones).
2) Only for SIMEAS R devices with FW V2 or V3, not for V4 PMU. The control input 1 of the CPU has to be dimensioned for 24 V DC to connect a time synchronization unit 7KE6000-8HA. When ordering the central unit 7KE6000-XXXXX-ZXX, please make sure that Z=1,5,6 or 7, depending on the control voltage for the binary inputs.

Table 6/2 Selection and ordering data

Selection and ordering data

Description	Order No.
Communication Cable COM1 to external modem	**7KE6000-8AC**
Modem side 25-pole / pin, length 10 m / 32.81 ft	
Communication Cable COM1 to PC	**7KE6000-8B** ☐
incl. adapter set	
COM1 or 2 - PC, length 10 m / 32.81 ft	A
COM1 or 2 - PC, length 5 m / 16.40 ft	B
Printer cable, Centronics	**7KE6000-8DA**
Length 3 m / 9.84 ft, SIMEAS R or PC - printer	
Ethernet patch cable with double shield (SFTP), LAN connector on both sides SIMEAS R ↔ switch, switch ↔ PC	
Length 0.5 m / 1.64 ft	**7KE6000-8GD00-0AA5**
Length 1 m / 3.28 ft	**7KE6000-8GD00-1AA0**
Length 2 m / 6.56 ft	**7KE6000-8GD00-2AA0**
Length 3 m / 9.84 ft	**7KE6000-8GD00-3AA0**
Length 5 m / 16.40 ft	**7KE6000-8GD00-5AA0**
Length 10 m / 32.81 ft	**7KE6000-8GD01-0AA0**
Length 15 m / 49.21 ft	**7KE6000-8GD01-5AA0**
Length 20 m / 65.62 ft	**7KE6000-8GD02-0AA0**
Ethernet patch cable with double shield (SFTP), cross-over connection, LAN connector on both sides switch ↔ switch, SIMEAS R ↔ PC	
Length 0.5 m / 1.64 ft	**7KE6000-8GE00-0AA5**
Length 1 m / 3.28 ft	**7KE6000-8GE00-1AA0**
Length 2 m / 6.56 ft	**7KE6000-8GE00-2AA0**
Length 3 m / 9.84 ft	**7KE6000-8GE00-3AA0**
Length 5 m / 16.40 ft	**7KE6000-8GE00-5AA0**
Length 10 m / 32.81 ft	**7KE6000-8GE01-0AA0**
Length 15 m / 49.21 ft	**7KE6000-8GE01-5AA0**
Length 20 m / 65.62 ft	**7KE6000-8GE02-0AA0**

Table 6/2 Selection and ordering data

Selection and ordering data

Description	Order No.
Connection cable for current inputs **8-core flexible cable, 2.5 mm²/0.004 sq in., for 4 current channels**	**7KE6000-8GA00-0□□□**
Please note: Minimum length 2 m/6.56 ft	
Without pre-assembled cables	A
With end sleeve ferrule	B
With end sleeve ferrule on both sides	C
Without core identification	A
With core identification	B
Cable length in m (X = 2 ... 8, 9 = special length)	X
Connection cable for voltage inputs **8-core flexible cable, 0.75 mm²/0.001 sq in., for 4 voltage channels**	**7KE6000-8GB00-0□□□**
Please note: Minimum length 2 m/6.56 ft	
Without pre-assembled cables	A
With end sleeve ferrule on one side	B
With end sleeve ferrule on both sides	C
Without core identification	A
With core identification	B
Cable length in m (X = 2 ... 8, 9 = special length)	X
Connection cable for binary inputs **32-core flexible cable, 0.25 mm²/0.0004 sq in.**	**7KE6000-8GC00-0□□□**
Please note: Minimum length 2 m/6.56 ft	
Without pre-assembled cables	A
With end sleeve ferrule on one side	B
With end sleeve ferrule on both sides	C
Without core identification	A
With core identification	B
Cable length in m (X = 2 ... 8, 9 = special length)	X
Manual for firmware version SIMEAS R-PMU	
English	**E50417-B1076-C360-A1**
German	**E50417-B1000-C360-A1**
French	**E50417-B1077-C360-A2**
Spanish	**E50417-B1078-C360-A2**
Italian	**E50417-B1072-C360-A2**
USB alarm box	**7KE6020-1AA00**
Monitoring unit for DAKON XP with USB connection, own watchdog and 7 alarm contacts	

Table 6/2 Selection and ordering data

Certificate

CERTIFICATE

TÜV NORD

TÜV NORD CERT GmbH
certifies herewith

Siemens AG
Energy Sector
E D EA
Humboldstraße 59
90459 Nürnberg
Germany

that the below named product has successfully pass through the test procedure of the professorship **Electrical Networks and Alternative Energies of the Otto-von-Guericke University Magdeburg** for Phasor Measurement Units (PMU) and is authorised to be denote with:

Verified Measuring System according to PMU-test procedure, Level 2

TÜV NORD
TÜV NORD CERT GmbH
Verified Measuring System
Certification according to PMU-test procedure
IEEE C37.118
Level 2
LENA

Description of the product:

SIMEAS R-PMU

Certified according: Test instruction PMU with GPS-Synchronisation Vers. 1.1.0:18.08.2008 and IEEE C37.118

Test Report Nr: LENA01/08B from 2008-08-22
Reference number: 2.4-176/08

Valid until: 2013-09-11
Registry-Nr.: 44 799 08 361173

Essen, 2008-09-11

Certification body for product safety
TÜV NORD CERT GmbH
(Prof. Dr.-Ing. U. Adolph)

Magdeburg, 2008-09-11

Otto-von-Guericke University Magdeburg
Professorship Electrical Networks and Alternative Energies
(Prof. Dr.-Ing. Z. Styczynski)

SIEMENS

Energy Automation

SICAM PQS Fault Record and Power Quality Analysis System

Answers for infrastructure and cities.

SIEMENS

siemens-russia.com

Contents – SICAM PQS

Description

Siemens SICAM PQS allows all fault records and power quality data to be analyzed in one system.

The protection of power distribution equipment is crucial in assuring a reliable power supply. Customers expect maximum availability of electrical power, reflecting a consistently high standard of quality. For example, in power system protection, it is becoming increasingly difficult to distinguish between critical load cases and short circuits with minimal fault currents. The demands on optimum use and the corresponding parameterization of protective devices are rising. Intensive evaluation of available information from secondary equipment (using fault recorders) is therefore essential. Only this way can today's high levels of reliability and availability in power transmission and distribution networks be ensured for the future as well. There is also concern that the growing use of power electronics often has a noticeable impact on voltage quality. The resulting inadequate voltage quality leads to interruptions, production losses and high consequential costs. Compliance with the generally valid quality criteria for power supply systems as defined in the European standard EN 50160 is therefore vital. The basis must be reliable recording and assessment of all quality parameters. Weak spots and potential fault sources can be identified early on and systematically eliminated. With the software solution SICAM PQS, Siemens is setting new benchmarks here: For the first time, it is now possible with an integrated software solution to evaluate and archive centrally and vendor-neutral all power quality data from the field. This gives you a quick and uncomplicated overview of the quality of your system. With SICAM PQS, you can keep an eye on all relevant data, including fault records as well as all power quality measurement data. SICAM PQS can also be easily expanded to create a station control system for combined applications.

Benefit

- Secured voltage quality for the supply of your station
- Fast, transparent analysis of the cause and development of a network fault
- Efficient deployment of troubleshooting personnel
- User-friendliness
- Evidence of compliance with normalized standards in utilities
- Online comparison of captured PQ data with standard-specific and customer-specific grid code templates
- Immediate notification of power quality criteria violations
- Automatic determining of the fault location
- Automatic analysis and reporting of power quality criteria violations
- Structured representation and structured access to archived data
- Cumulative summary of all PQ data to a state criterion (PQ index)
- Spatially distributed options for the monitoring and evaluation of PQ measuring data
- Archiving of PQ data (measured values, fault records, PDR records)
- Different communication standards and interfaces for device connection and for detection of process data (Ethernet TCP/IP, serial interfaces)
- Automatic import of third-party devices in PQDIF and COMTRADE format
- Ethernet network monitoring, e.g. based on SNMP
- Data exchange via OPC for the connection to office desktop computers
- Secured data access via a user administration tool
- Redundant structure of the system on different levels
- Test and diagnostic functions.

Function overview

- Central PQ archive for:
  - Fault records
  - PQ data
  - Reports
- Variety of protocols
  - IEC 61850
  - IEC 60870-5-103
  - SIMEAS R Master
  - SICAM Q80 Master
- Third-party devices connected via COMTRADE / PQ DIF import
- Single or double-end fault locator with option of double or parallel line compensation
- Grid code evaluation: Online evaluation of recorded PQ data with limits of grid code templates:
  - Standards: EN 50160 MV, EN 50160 LV, IEC 61000
  - User-defined
- Automatic generation of daily, weekly, monthly or yearly PQ reports accurately describing the network quality
- Server/client structure for centralized and flexible evaluation.

Applications

The following is an overview of the individual components and their tasks.

SICAM PQS UI – Configuration

The system component SICAM PQS UI – Configuration supports you in the following tasks:

- Configuration and parameterization of your station
- Exchange of configuration data.

In the different views, you can specify the type and the transmission modes of your communication links. Additionally, you can define which devices, substations, control centers or HMIs are connected. For each of the connected system components, you can specify what information is evaluated in SICAM PAS / PQS. Furthermore, you can define what information is available for communication with higher-level control centers and for system management via SICAM SCC (Station Control Center) or SICAM DIAMOND. You can individually structure your system data in a topological view to map your operating conditions, and also assign individual switching permissions. In this view, you can also define parameters for fault location calculation, e.g. the line data, double line, maximum load current or the starpoint position.

Applications

SICAM PQS UI – Configuration (cont.)

In addition, you select the measuring channels whose PQ measuring data must be used for the fault locator. In order to be able to evaluate the quality of PQ measuring data, so-called grid codes must be assigned to the individual topological levels. Predefined device-specific and project-specific templates, templates for scheduled reports and grid codes, along with import/export and copy functions, facilitate and accelerate the configuration and parameterization of your system.

Configuration

In this view (Fig. 7/1), you specify the components of your SICAM PQS system. These include:

- Systems
  - Full server
  - DIP
- Applications
  - IED protocols, e.g. IEC 61850, IEC 60870-5-103
  - SICAM Q80, SIMEAS R
  - PQS automatic import
  - Archive
  - PQS scheduled reports
  - PQS automatic fault location
  - PDR recorder
  - OPC
  - Network monitoring via SNMP
- Interfaces
  - Serial interfaces
  - Ethernet TCP/IP
  - PROFIBUS
- Devices
  - PQ devices
  - Fault recorders
  - Protection devices.

The configured components are represented in a tree structure; the parameters of the selected component are displayed in the input area. Additionally, a description of permissible setting options is displayed for the parameter currently selected. Erroneous inputs are marked and explained in an error field. The two parameterization tools for SIMEAS R and SICAM Q80 can also be opened directly from this view and the devices parameterized (Fig. 7/2).

Mapping

In the mapping view (Fig. 7/4), which is mainly for expansion into a substation automation system, all the status / process information for each device are mapped in the monitoring and command directions, for forwarding to the control center / SICAM SCC (Station Control Center) or SICAM Soft PLC.

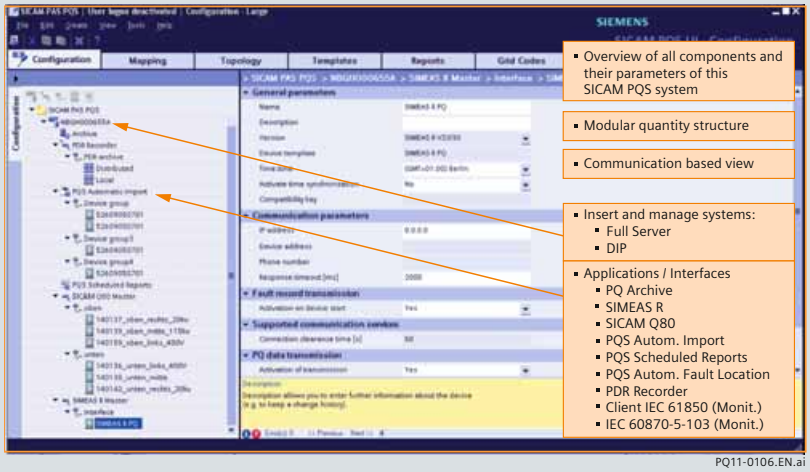


Fig. 7/1 SICAM PQS UI – Configuration – Configuration

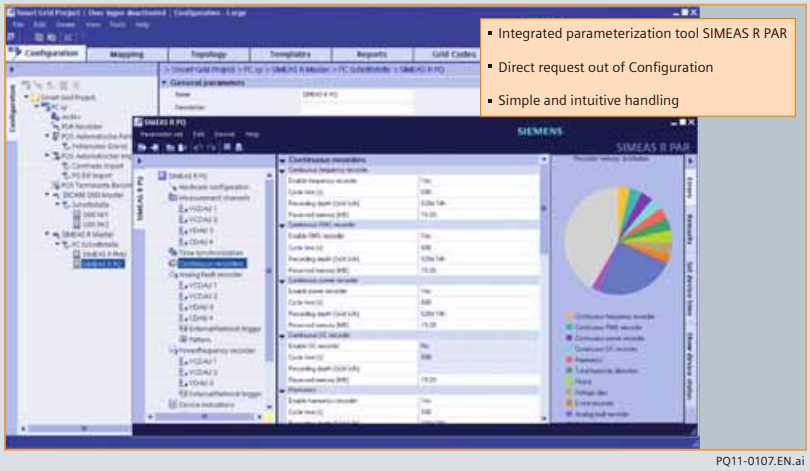


Fig. 7/2 SICAM PQS UI – Configuration – Configuration – R Par

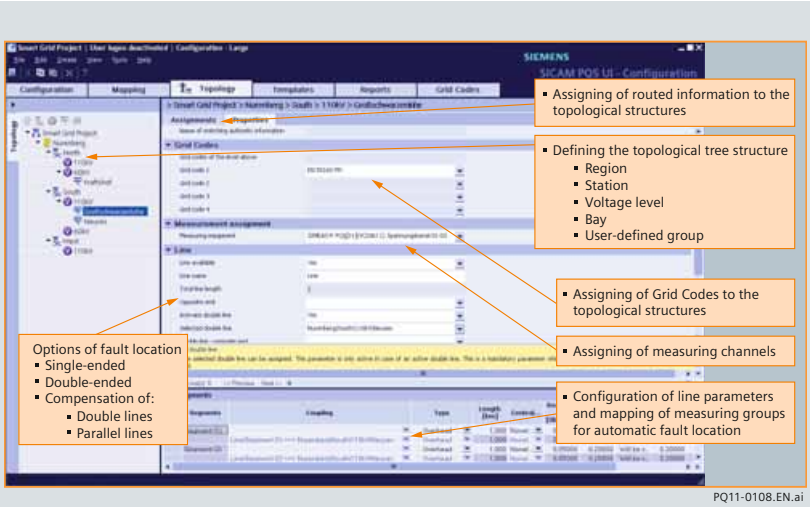


Fig. 7/3 SICAM PQS UI – Configuration – Topology

Topology

The Configuration view focuses on your station's communication requirements, but you can create a system view focusing on the primary technological topology in the Topology view (Fig. 7/3). The topological structure consists of different levels, including the region, station, voltage level, bay and user-defined groups. You assign these structure levels to the corresponding items of information. You can also assign the measuring channels to the topological structure here, for subsequent more targeted analysis of the PQ measured data (via the topology) in the PQ Analyzer. And you can assign one or more grid codes to the individual structure levels in order to validate the PQ measured data and define your power system.

In this view, you also parameterize the line data for fault location. For the PQS Automatic Fault Location function, you assign the measuring groups to those devices whose measuring data is used for calculating the fault location. The measuring groups specify e.g. the assignment of the measuring channels and phases of the fault records used.

Templates

In this view (Fig. 7/4), you can also define the measuring groups and recording channels for import of PQDIF and COMTRADE data from the virtual devices. Virtual devices are used for the connection of third-party devices which do not communicate via a protocol supported by SICAM PQS.

Reports

In the Reports view (Fig. 7/5), you insert the templates for scheduled reports.

The reports contain measured data for determining the power quality. Their content is freely configurable. For each template, you can define when the report is to be created (for example daily, weekly, monthly or yearly).

You can also insert various diagrams of measured and evaluated PQ data, and assign the measuring groups and grid codes required for evaluation.

Grid codes

In this view (Fig. 7/6), the grid codes are imported and adapted where necessary. The grid codes include standardized or customer-defined limit values for checking measured data.

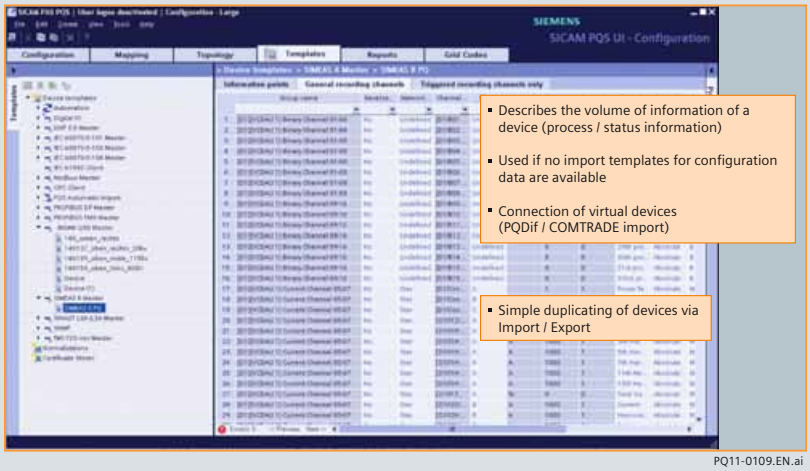


Fig. 7/4 SICAM PQS UI – Configuration – Templates

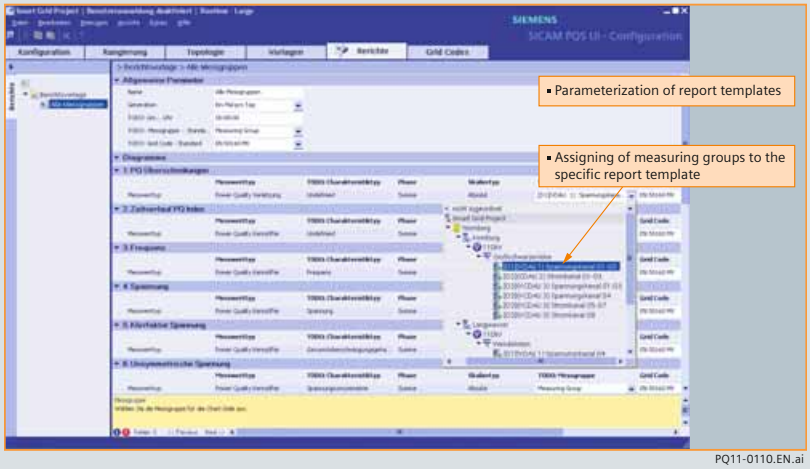


Fig. 7/5 SICAM PQS UI – Configuration – Reports

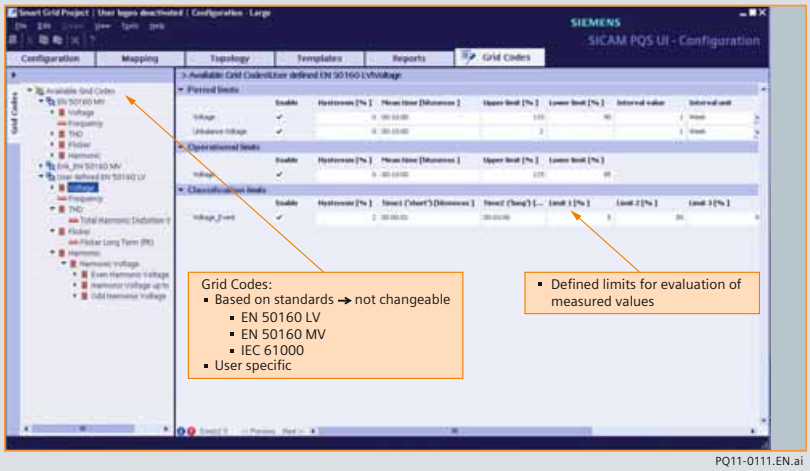


Fig. 7/6 SICAM PQS UI – Configuration – Grid Codes

Applications

Grid codes (cont.)

The grid codes included in the scope of delivery and based on standards (e.g. EN50160LV, EN50160MV) cannot be modified. For grid codes which can be altered to meet customer-specific requirements, however, the scope of delivery includes a template which can be edited in this view. By monitoring compliance with these limits, SICAM PQS ensures a fast, compact overview of the power network quality.

SICAM PQS UI – Operation

SICAM PQS UI – Operation provides you with an overview of the runtime status of your station (Fig. 7/7). The configuration is displayed in tree structure. The different colors show the status of interfaces, devices or other applications.

SICAM PQS – Value Viewer

The SICAM PQS Value Viewer (Fig. 7/8) is an important tool for the project phases of configuration, testing, commissioning and operation. Without any additional configuration expenditure, it enables the visualization of process and system information, and informs you on the current status of your station.

SICAM PQS – User Administration

Via a User Administration tool you can assign passwords in order to define which persons can access individual working areas and functions. Users can be assigned one of the following roles: Administrator / System Engineer / Data Engineer / Switch Operator / Guest User

SICAM PQS – Feature Enabler

Use the SICAM PQS Feature Enabler to enable SICAM PQS system components which you require in your project or on the corresponding computer.

SICAM PQ – Analyzer

The SICAM PQ Analyzer provides comprehensive evaluation options for archived PQ measuring data and fault records. In addition to clearly structured fault record analysis, the fault locator facilitates and accelerates the elimination of faults in the power network. PQ violation reports provide a quick and comprehensive overview of limit value violations. Scheduled reports provide an overview of the development of measuring data over selectable time ranges.

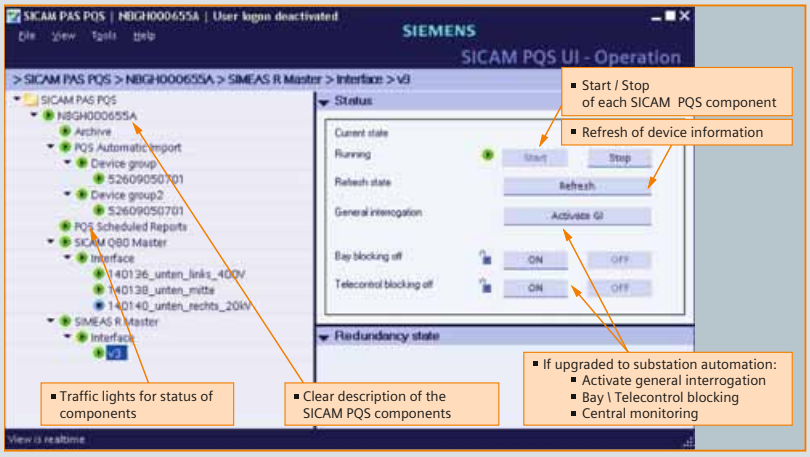


Fig. 7/7 SICAM PQS UI – Operation

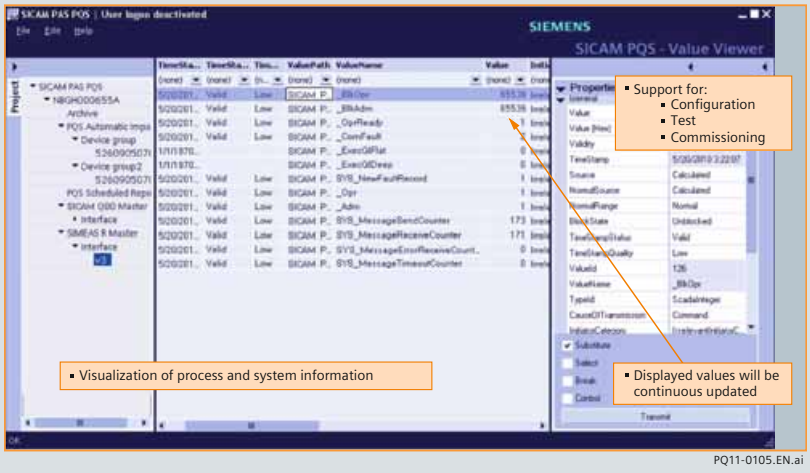


Fig. 7/8 SICAM PQS Value Viewer

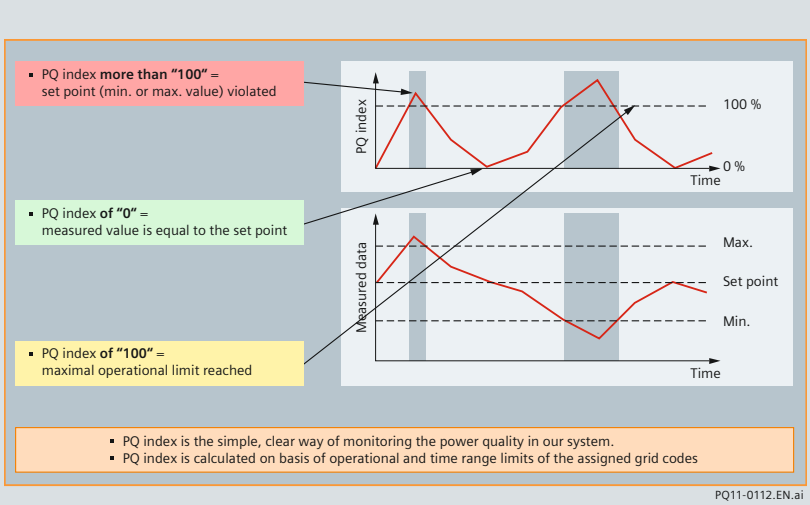


Fig. 7/9 PQ index for one characteristic

SICAM PQ – Analyzer (cont.)
With the aid of a calendar tool available in all views, you can quickly and easily select any time range over which data is to be displayed in a diagram.
The calculated PQ index delivers concise information on the quality of your network (Fig. 7/9). The following various views of the SICAM PQ Analyzer provide the means for evaluation of PQ measuring data and system disturbances.

Incident Explorer (Fig. 7/10)
The Incident Explorer provides an overview of all faults stored in the archive. It enables time-related evaluation, and provides a topological and communication view of:
- Fault records
- Fault location reports
- PQ violation reports
- PDR records

The topological structure of the archive data corresponds to the structure which you defined when configuring the SICAM PQS station.
The Incident Explorer serves for the following tasks:
- Reading the events (confirm)
- Calling up the evaluation programs
- Deleting the events from the archive overview

Various filter options are available for the selection of events in the power network
- Selecting the time range from the archive
- Filtering for events

PQ Inspector
The PQ Inspector provides the operator with a quick overview of the station's power network quality based on the PQ index. Archived data is analyzed over freely selectable time ranges, and the operator can immediately detect the causes for discrepancies between measured values and grid codes.
The PQ Inspector is subdivided into the following 3 views:
- Select time range
  Definition of the period under observation and identification of influencing factors for deviations from the specifications via a stoplight model of the self-defined measurements/ characteristics groups
- Select diagrams
  Selection of the characteristics of a measuring point and definition of the diagram for data representation.

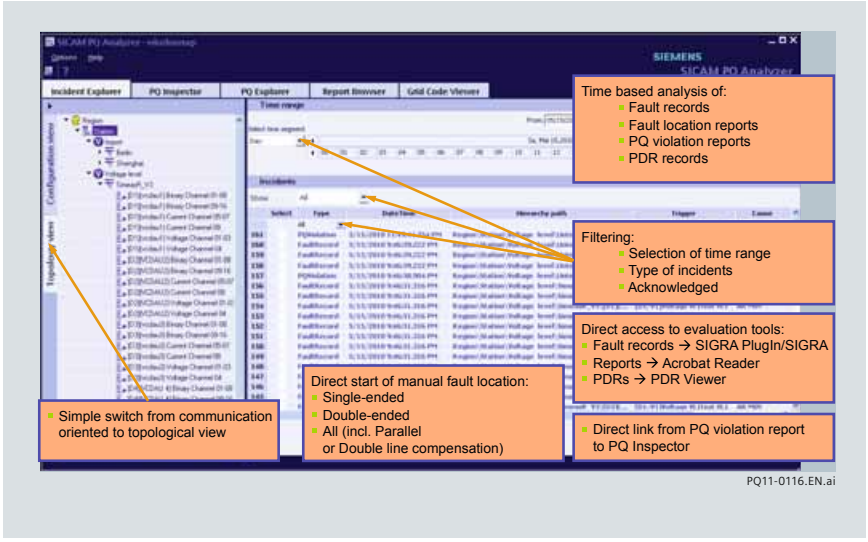


Fig. 7/10 SICAM PQ Incident explorer

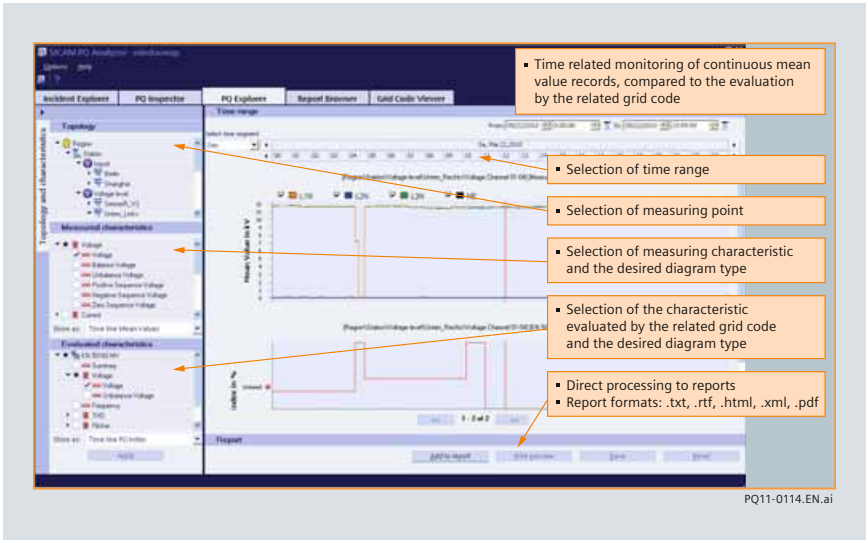


Fig. 7/11 SICAM PQ Analyzer: PQ explorer

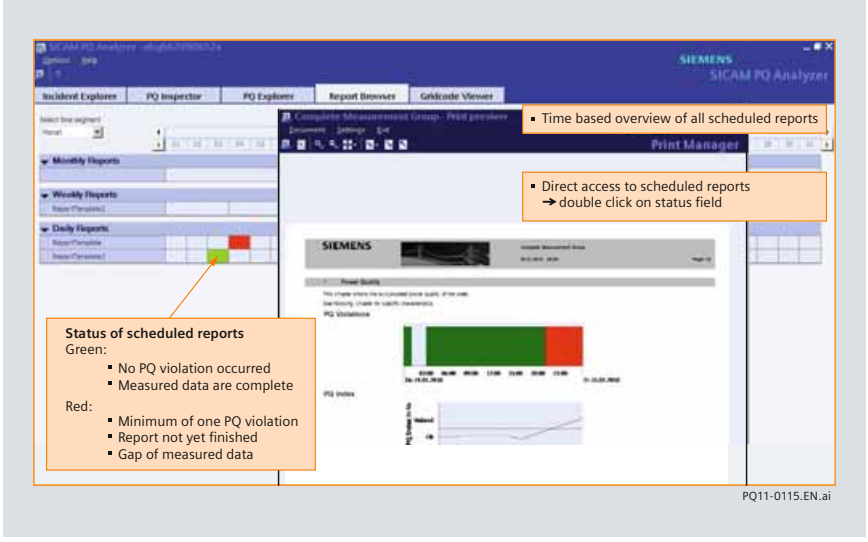


Fig. 7/12 SICAM PQ Analyzer: Report browser

Applications, SICAM PQ Analyzer collector

PQ Inspector (cont.)

- Finalize report
  Finalization of the report. These views assist you in the step-by-step creation of a manual report.

PQ Explorer

The PQ Explorer (Fig. 7/11) provides access to all PQ data stored in the archive. It provides a topological view of the measuring points in your station. Measured and calculated PQ data is evaluated via PQ diagrams. The following diagram types are supported in the process (see table 7/1).

Report browser

The Report browser (Fig. 7/12) provides an overview of those scheduled reports and their status, which are created automatically at specified time intervals (daily, weekly, monthly or yearly). Any desired report can simply be selected for opening and subsequent printing.

Grid code viewer

The grid code viewer provides the overview required for a supporting analysis:

- Which grid codes are available?
- To which elements in the topology have the grid codes been assigned?
- What characteristics do the grid codes contain?
- What limits have been defined?

SICAM PQ Analyzer collector

The SICAM PQ Analyzer collector gathers the archive data from the individual (source) archives together in a central (collector) archive. Depending on the system configuration, the SICAM PQ analyzer accesses the data of the (source) archives or (collector) archives for archive evaluation.
The example illustrates the configuration with

- Full server with (source) archive
- Archive computer with (collector) archive and licenses for the SICAM PQ Analyzer and collector
- 1 to 5 SICAM PQ Analyzer clients.

In redundant archive systems, the two SICAM PQ collectors are connected. In order to accelerate the determining of archive data, the data stored in the two archives is initially compared. The data from that partner archive is integrated which has already received this data from the connected devices. Afterwards, the SICAM PQ collector retrieves data from the connected devices, and only transfers data from those devices for which no data has been received via the partner computer.

General data

Table / diagram type	Typical use
Properties	– Overview of the grid codes that are assigned to a PQ device – Overview of the PQ devices assigned to a particular node in the topology

Tables and diagrams for measured characteristics

Table / diagram type	Typical use
Time characteristic minimum values, maximum values, average values	– Overview of the progress of a measured characteristic
Table minimum values, maximum values, average values	– Display of the values of a characteristic transferred by a PQ device
Bar graph P95 / min / average / max	– Fast detection of static outliers over a long period – Suitable for monthly reports
Fingerprint diagram	– Overview of static distribution of measured harmonic overvoltages of different orders
Fingerprint table	– View of the data that are used to create fingerprint diagrams
Harmonics spectrum	– Comparison of harmonic overvoltages of different orders

Tables and diagrams for evaluated characteristics

Table / diagram type	Typical use
Fingerprint diagram	– Overview of the static distribution of the PQ index from several characteristics
Fingerprint table	– View of the data that are used to create fingerprint diagrams
Harmonics spectrum	– Comparison of the PQ index of different orders
Time characteristic PQ index	– Quick overview of the PQ index over a long period
Time characteristic power quality	– Title page of a monthly report (PQ violations are immediately recognizable)
Time characteristic measurement gaps	– Title page of monthly report (measurement gaps are immediately detectable)
Bar graph PQ statistics	– Comparison or the PQ index of several characteristics over longer period

Diagram for measured events

Table / diagram type	Typical use
Time characteristic event values	– Overview of measured events that have occurred

Table and diagram of evaluated events

Table / diagram type	Typical use
Time characteristic event values	– Overview of events that have occurred
ITI (CBEMA)	– Overview of voltage rises, voltage dips and voltage interruptions acc. to ITI / CBEMA requirements
ESKOM	– Overview of voltage dips and voltage interruptions acc. to EKOM requirements
Voltage event list	– Overview of voltage-specific events

Table 7/1 Diagram types

SICAM PQ Analyzer collector, architecture and configuration

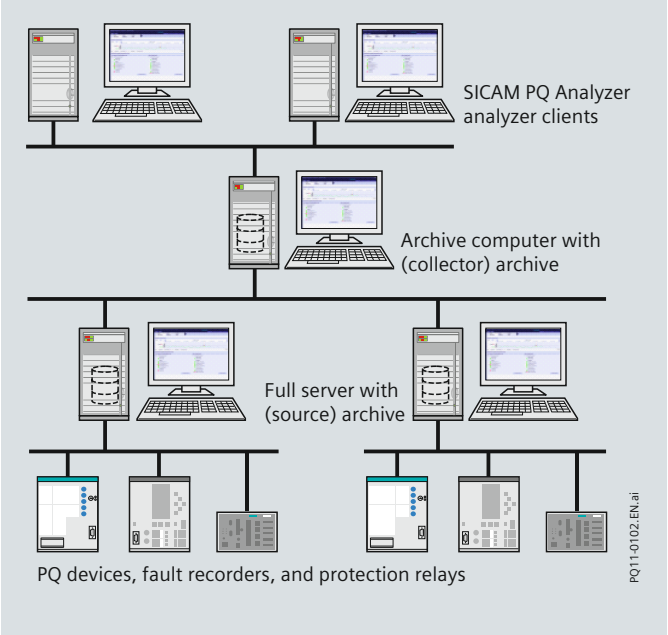


Fig. 7/13 Architecture

Architecture

Thanks to its modular system structure, SICAM PQS is suitable for multiple use in power supply utilities or industrial facilities.
SICAM PQS can be set up in many variants:

- Full server with (source) archive and SICAM PQ Analyzer
- System with
  – Full servers with (source) archive
  – SICAM PQ Analyzer clients
- System with
  – Full servers
  – Archive computers with (collector) archive
  – SICAM PQ Analyzer clients.

The number of components which can be used in a system depends on the individual license.

(Source) archive

The full server collects PQ measuring data and fault records from connected devices, and stores them in its local (source) archive. This archive data can be directly evaluated by one or more SICAM PQ Analyzers.

(Collector) archive

In distributed systems with one or more full servers, the data of the (source) archives is collected by the SICAM PQ Analyzer collector and stored in a central (collector) archive on an archive computer.
This archive data is evaluated by one or more SICAM PQ Analyzer(s).

Configuration

Operating systems

The following operating systems are supported:

- Windows XP Professional SP3 (32-Bit)
- Windows Server 2003 R2 Standard SP2 (32-Bit)
- Windows 7 Professional SP1 (32-Bit or 64-Bit)
  – only in Windows-classic design
- Windows Server 2008 Standard SP2 (32-Bit) without Hyper-V – only in Windows-classic design
- Windows Server 2008 R2 Standard SP1 (64-Bit)
  – only in Windows-classic design
- Windows Embedded Standard
  (SICAM Station Unit V2.20, 32-Bit).

Hardware requirements

Computer with

- Processor
  – At least Intel Pentium Celeron 1.86 GHz
  – Recommended for SICAM PQS Intel Core Duo 2 GHz
  – Engineering for large installations Intel Core 2 Duo 3 GHz
- RAM size
  – At least 2 GB
  – Recommended for SICAM PQS 4 GB
  – Engineering of large installations 4 GB
- Hard disk capacity
  – At least 2 GB not including archive size
- Graphics card:
  – At least SVGA (16 MB), 1024 × 768
  – Recommended SXGA (32 MB), 1280 × 1024
- Monitor matching graphics card
- DVD drive
- Keyboard
- Mouse
- USB port for dongle
- Network interface.

Note:
Computers with multi-core processors are supported.
Computers with multi-processor main boards are only supported in single-processor operation.

Selection and ordering data

Description	Order No.	Precondition
SICAM PQS V7.0 Bundles Base package plus one application. Base packages & Bundles will be delivered with USB dongles (MLFB position 8="1")		
Supporting up to 4 devices		
SICAM PQS (SICAM Q80)	**7KE9000-1RA10-7BA0**	
SICAM PQS (SIMEAS R)	**7KE9000-1RA10-7CA0**	
SICAM PQS (IEC 61850 (monitoring direction))	**7KE9000-1RA10-7DA0**	
Supporting up to 15 devices		
SICAM PQS (SICAM Q80)	**7KE9000-1MA10-7BA0**	
SICAM PQS (SIMEAS R)	**7KE9000-1MA10-7CA0**	
SICAM PQS (IEC 61850 (monitoring direction))	**7KE9000-1MA10-7DA0**	
Supporting more than 15 devices		
SICAM PQS (SICAM Q80)	**7KE9000-1AA10-7BA0**	
SICAM PQS (SIMEAS R)	**7KE9000-1AA10-7CA0**	
SICAM PQS (IEC 61850 (monitoring direction))	**7KE9000-1AA10-7DA0**	
SICAM PQS V7.0 upgrades		
Functional upgrades with respect to number of supported devices		
"Full Server" (Runtime) (up to 15 devices)	**6MD9004-0RA10-7AA0**	**7KE9000-1RA10-7.A0**
"Full Server" (Runtime) (more than 15 devices)	**6MD9004-0MA10-7AA0**	**7KE9000-1MA10-7.A0**
SICAM PQS V7.0 options & addons		
Master protocols Power Quality		
SIMEAS R Master	**7KE9000-0CB11-7AA0**	
SICAM Q80	**7KE9000-0CB12-7AA0**	
Master protocols Power Automation (monitoring direction)		
IEC 60870-5-103 Master (monitoring direction)	**6MD9000-0CB00-7MA0**	
Client IEC 61850 (monitoring direction)	**6MD9000-0CE00-7MA0**	
Applications power quality		
Automatic Comtrade Import	**7KE9000-0BA60-7AA0**	
Automatic Comtrade Export	**7KE9000-0BA61-7AA0**	
Automatic PQDIF Import	**7KE9000-0BA62-7AA0**	
Automatic PQDIF Export	**7KE9000-0BA63-7AA0**	
Automatic Report Export	**7KE9000-0BA64-7AA0**	
Automatic Fault Location	**7KE9000-0BA65-7AA0**	
Notification (E-Mail, SMS)	**7KE9000-0BA66-7AA0**	
Automatic Grid Code Evaluation	**7KE9000-0BA67-7AA0**	
Scheduled PQ Reports *	**7KE9000-0BA68-7AA0**	

* only makes sense in combination with the following license:
Automatic GridCode Evaluation

Note:
The SICAM PQS system can be extended with SICAM PAS applications.
For configuring such a system a configuration license is needed.
Either the existing runtime license can be expanded with a configuration license [→ a)]
or the configuration can be done on a separate configuration PC [→ b)]

Table 7/2 Selection and ordering data

Description	Order No.	Precondition
SICAM PAS base packages		
Configuration		
b) Configuration (up to 15 devices or up to 2000 master information objects)	**6MD9000-1MA20-7AA0**	
b) Configuration (more than 15 devices)	**6MD9000-1AA20-7AA0**	
SICAM PAS upgrades		
Functional upgrades – from "Runtime" to "Runtime & configuration"		
a) Configuration upgrade ≤ 15 (Runtime already available)	**6MD9004-0AA24-7AA0**	**7KE9000-1MA10-7.A0**
a) Configuration upgrade >15 (Runtime already available)	**6MD9004-0AA23-7AA0**	**7KE9000-1AA10-7.A0**
Functional upgrades with respect to number of supported devices		
"Full server" (Runtime & configuration) (more than 15 devices)	**6MD9004-0MA00-7AA0**	**7KE9000-1MA10-7.A0 and 6MD9004-0AA24-7AA0**
Configuration (more than 15 devices)	**6MD9004-0MA20-7AA0**	**6MD9000-1MA20-7AA0**
SICAM PAS options & addons		
Applications (power automation)		
Automation	**6MD9000-0BA50-7AA0**	
PDR recorder (post disturbance review)	**6MD9000-0BA70-7AA0**	
Addons (power automation)		
SICAM PAS applications (f-based load shedding, GIS monitoring, transformer monitoring)	**6MD9000-0PA01-7AA0**	
Secure communication (for TCP/IP-based communication T104 Slave, DNP 3 Slave, DNP 3 Master)	**6MD9000-0SC00-7AA0**	
Master protocols (bay devices, RTUs)		
Client IEC 61850	**6MD9000-0CE00-7AA0**	
IEC 60870-5-101 Master	**6MD9000-0CD00-7AA0**	
IEC 60870-5-103 Master	**6MD9000-0CB00-7AA0**	
IEC 60870-5-104 Master	**6MD9000-0CD04-7AA0**	
DNP V3.00 Master (incl. over IP)	**6MD9000-0CB07-7AA0**	
MODBUS Master	**6MD9000-0CB05-7AA0**	
Driver module for PROFIBUS DP	**6MD9000-0CB01-7AA0**	
Driver module for PROFIBUS FMS (UPF)	**6MD9000-0CB02-7AA0**	
SINAUT LSA - ILSA	**6MD9000-0CB03-7AA0**	
OPC Client	**6MD9000-0BA40-7AA0**	
Slave protocols for control center connection		
IEC 60870-5-101 Slave	**6MD9000-0CC00-7AA0**	
IEC 60870-5-104 Slave	**6MD9000-0CC04-7AA0**	
IEC 61850 Server (Control Center Com.)	**6MD9000-0CF00-7AA0**	
DNP V3.00 Slave (serial and TCP/IP)	**6MD9000-0CC07-7AA0**	
MODBUS Slave (serial and TCP/IP)	**6MD9000-0CC05-7AA0**	
CDT Slave (serial)	**6MD9000-0CC08-7AA0**	
TG8979 Slave (serial)	**6MD9000-0CC10-7AA0**	
OPC XML-DA server	**6MD9000-0CA41-7AA0**	
Functional upgrades for communication applications supporting just monitoring direction		
IEC 60870-5-103 Master (support additionally control direction)	**6MD9004-0CB00-7AA0**	**6MD9000-0CB00-7MA0**
Client IEC 61850 (support additionally control direction)	**6MD9004-0CE00-7AA0**	**6MD9000-0CE00-7MA0**

Table 7/2 Selection and ordering data (cont.)

Selection and ordering data

Description	Order No.
SICAM PQ Analyzer V2.0	
Incident Explorer for evaluation of fault records	
Usage on SICAM PAS fullserver	**6MD5530-0AA10-2AA0**
Up to 5 clients, archive transfer from 1 server/fullserver	**6MD5530-0AA10-2BA0**
Up to 5 clients, archive transfer from up to 5 server/fullserver	**6MD5530-0AA10-2BB0**
Up to 5 clients, archive transfer from more than 5 server/fullserver	**6MD5530-0AA10-2BC0**
More than 5 clients, archive transfer from 1 server/fullserver	**6MD5530-0AA10-2CA0**
More than 5 clients, archive transfer from up to 5 server/fullserver	**6MD5530-0AA10-2CB0**
More than 5 clients, archive transfer from more than 5 server/fullserver	**6MD5530-0AA10-2CC0**
Hints: – two redundant PAS/PQS Fullserver count as 1 Server. – SIMEAS R provides not only fault records but also continuous records which are managed with the PQ Explorer. –> for a complete evaluation of SIMEAS R-data at least the usage of PQ Basic is recommended.	
PQ Basic [1]	
including Incident Explorer for evaluation of fault records and **PQ Explorer**	
Usage on SICAM PAS fullserver	**7KE9200-0BA10-2AA0**
Up to 5 clients, archive transfer from 1 server/fullserver	**7KE9200-0BA10-2BA0**
Up to 5 clients, archive transfer from up to 5 server/fullserver	**7KE9200-0BA10-2BB0**
Up to 5 clients, archive transfer from more than 5 server/fullserver	**7KE9200-0BA10-2BC0**
More than 5 clients, archive transfer from 1 server/fullserver	**7KE9200-0BA10-2CA0**
More than 5 clients, archive transfer from up to 5 server/fullserver	**7KE9200-0BA10-2CB0**
More than 5 clients, archive transfer from more than 5 server/fullserver	**7KE9200-0BA10-2CC0**
PQ Standard [1) 2)]	
including PQ Basic and **enhanced PQ Explorer and Report Browser**	
Usage on SICAM PAS fullserver	**7KE9200-0CA10-2AA0**
Up to 5 clients, archive transfer from 1 server/fullserver	**7KE9200-0CA10-2BA0**
Up to 5 clients, archive transfer from up to 5 server/fullserver	**7KE9200-0CA10-2BB0**
Up to 5 clients, archive transfer from more than 5 server/fullserver	**7KE9200-0CA10-2BC0**
More than 5 clients, archive transfer from 1 server/fullserver	**7KE9200-0CA10-2CA0**
More than 5 clients, archive transfer from up to 5 server/fullserver	**7KE9200-0CA10-2CB0**
More than 5 clients, archive transfer from more than 5 server/fullserver	**7KE9200-0CA10-2CC0**
PQ Professional [1) 2)]	
including PQ Standard and **PQ Inspector**	
Usage on SICAM PAS fullserver	**7KE9200-0DA10-2AA0**
Up to 5 clients, archive transfer from 1 server/fullserver	**7KE9200-0DA10-2BA0**
Up to 5 clients, archive transfer from up to 5 server/fullserver	**7KE9200-0DA10-2BB0**
Up to 5 clients, archive transfer from more than 5 server/fullserver	**7KE9200-0DA10-2BC0**
More than 5 clients, archive transfer from 1 server/fullserver	**7KE9200-0DA10-2CA0**
More than 5 clients, archive transfer from up to 5 server/fullserver	**7KE9200-0DA10-2CB0**
More than 5 clients, archive transfer from more than 5 server/fullserver	**7KE9200-0DA10-2CC0**
Hint for all SICAM PQ Analyzer packages: SICAM PQ Analyzer can be extended with SIGRA (separate ordering) for enhanced fault record analysis	
Functional upgrades	
Power Quality – features	
From Incident Explorer to PQ Basic	**7KE9200-4BA00-2AA0**
From PQ Basic to PQ Standard	**7KE9200-4CB00-2AA0**
From PQ Basic to PQ Professional	**7KE9200-4DB00-2AA0**
From PQ Standard to PQ Professional	**7KE9200-4DC00-2AA0**
Number of clients	
Up to 5 clients	**6MD5530-4AA00-2BA0**
More than 5 clients	**6MD5530-4AA00-2CA0**
Number of fullserver	
Up to 5 fullserver	**6MD5530-4AA00-2AB0**
More than 5 fullserver	**6MD5530-4AA00-2AC0**
Version upgrade	
Version upgrade to SICAM PQ Explorer V2.0 (from SICAM Recpro V6.0)	**6MD5530-3AA00-2AA0**

1) Recommended SICAM PAS/PQS options: "Automatic Grid Code Evaluation" <–> 7KE9000-0BA67-7AA0
2) Recommended SICAM PAS/PQS options: "Scheduled PQ Reports" <–> 7KE9000-0BA68-7AA0

Table 7/2 Selection and ordering data

SIEMENS

Energy Automation

SIGUARD PDP
Phasor Data Processing

Answers for infrastructure and cities.

SIEMENS
siemens-russia.com

Contents – SIGUARD PDP

SIGUARD PDP – Reliable system operation with wide area monitoring

The load on electricity supply systems has increased continuously over the past few years. There are many reasons for this:

- Increased cross-border power trading in Europe, for example, is placing new demands on the tie lines between control areas. For example, power transmission on tie lines in the European grid increased almost 6-fold from 1975 to 2008 (source: Statistical Yearbook of the ENTSO-E 2008)
- Increased input of wind power and the planned shutdown of existing power plants will extend the transmission distances between generation and consumers.
- Severe weather and storms can put important lines out of operation, for a short time exposing the remaining grid to increased load quickly.

This means that the power system is increasingly operated closer to its stability limit and new load flows arise that are unfamiliar to network control center operators.

This is where SIGUARD PDP (Phasor Data Processor) comes in.

This system for network monitoring using synchrophasors helps with fast appraisal of the current system situation. Power swings and transients are indicated without delay to help the control center personnel find the causes and take countermeasures.

Highlights

- Phasor data processor per IEEE C37.118 standard
- 2 selectable monitoring modes:
  – Online mode
  – Offline mode (analysis of past events)
- Vector view or time chart view can be selected for all phasors
- Calculation and display of the power system status curve
- System monitoring, incl. communication links and PMU status
- Geographic overview (based on Google Earth)
- Basis for fast reporting after faults
- Flexible analysis with formula editor for calculations based on measured values
- Limit values that can be changed online
- Runs under Windows XP and Windows 7, as a pure PDC (without user interface) also under Windows Server 2008.

Applications

- Analysis of the power flows in the system
  SIGUARD PDP can display a clear and up-to-date image of the current power flows in the system with just a few measured values from widely distributed phasor measurement units (PMU). This requires no knowledge of the network topology. The power flows are shown by means of phase angle differences.

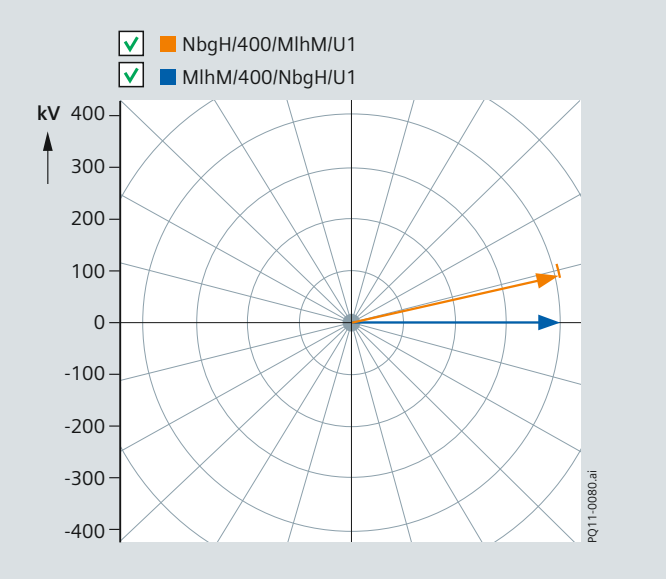


Fig. 8/1 Voltage vector of two measurement points in the network

- Power Swing Recognition
  All measured values from PMUs can be displayed and monitored with easy-to-configure phasor diagrams and time charts. Any power swings that occur are quickly and reliably detected. The zone being monitored can be flexibly adjusted to the current situation in terms of time, geography, and content.
- Evaluation of the damping of power swings
  Using the function "Power Swing Recognition" (available as from Version V2.1), an incipient power swing is detected and the appropriate damping determined. Detection of a power swing and, if applicable, its insufficient or non-existent damping is signaled (alarm list).
- There are two detections of a power swing:
  – based of angle differences between two voltages (two PMU´s necessary)
  – based of power swing recognition of the active power (one PMU for current and voltage measured values is adequate).

Fig. 8/2 SIGUARD PDP UI-Map

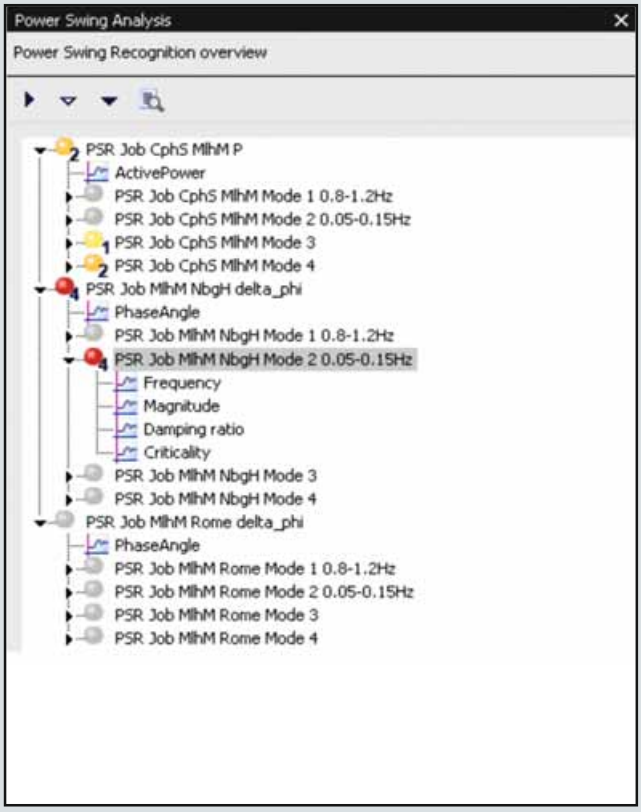


Fig. 8/3 Power Swing Analysis

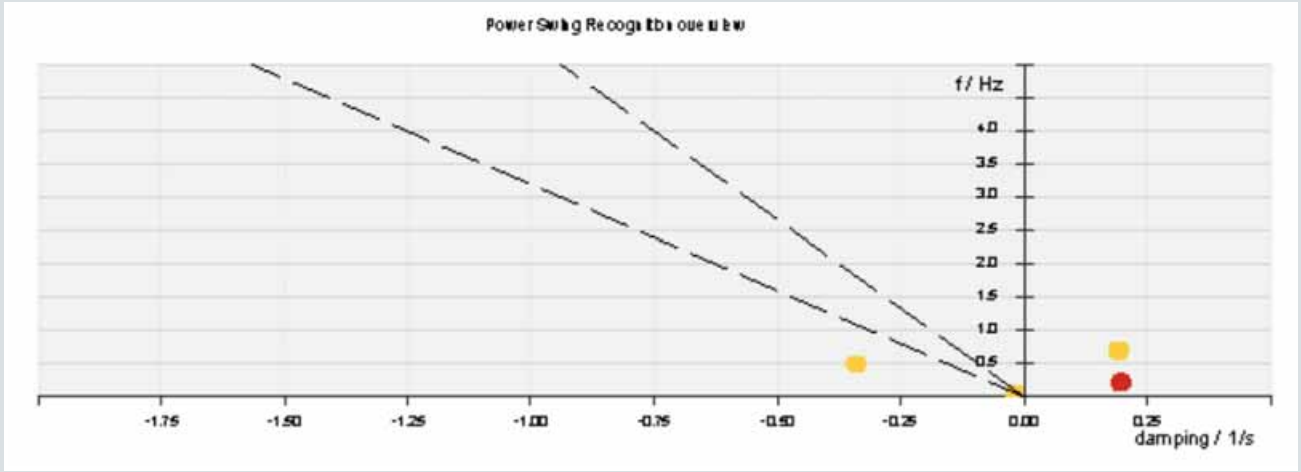


Fig. 8/4 Power Swing Recognition overview

Applications (cont.)

- Monitoring of the load on transmission corridors.
  The voltage-stability curve is especially suitable for displaying the instantaneous load on a transmission corridor. The currently measured operating point is shown on the work curve of the line (voltage as a function of the transmitted power). In this way, the remaining reserve can be shown at any time. This requires PMUs at both ends of the line.

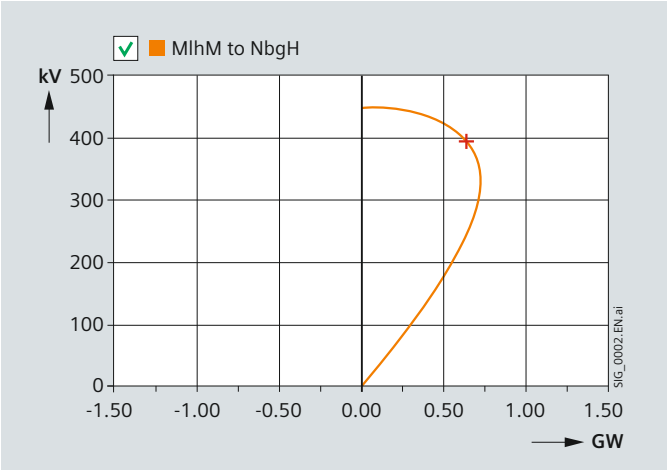


Fig. 8/5 Voltage stability curve

- Island state detection
  This function automatically indicates if parts of the network become detached from the rest of the network. For this purpose, frequency differences and rates of frequency changes can be automatically monitored. If islands are detected, warnings and event messages are output. Additionally, the area of the islands are marked in color in the graphic overview.

11:09:52....	2010-...	Island detection	ISD potential network subsplit	appearing
11:09:52....	2010-...	Island detection	ISD network subsplit	appearing
11:09:52....	2010-...	Island detection	ISD potential network subsplit	disap-pearing

- Retrospective event analysis
  SIGUARD PDP is ideal for analyzing critical events in the network. After switchover to offline mode, the entire archive can be systematically analyzed and the events played back as often as necessary. This makes dynamic events transparent, and reports can be quickly and precisely compiled. Simply copy the informative diagrams from SIGUARD PDP into your reports.
- Alarming on limit value violation with an alarm list and color change in the geographic network overview map. This allows you to locate the position and cause of the disturbance quickly. This function is also available for analyzing the archive.
- Display of the power system status as a characteristic value for the stability of the power system.
  Due to the constant availability of the power system status curve in the upper part of the screen, the operator is constantly informed about trends in system dynamics and any remaining reserves. This curve shows a weighted average of the distances of all measured values, to their limit values.

Synchrophasor technology, PMU

Synchrophasor technology

Synchrophasors are vector measured values, that is, the magnitude and phase of the current and voltage are measured and transmitted. Applying a time stamp to the transmitted vector measured values allows a comparison of the measured values from different locations in the network. The figure 8/7 shows how vector measured values are collected from different regions in the network and brought together at a central location.

To enable further processing of the information obtained from the synchrophasors, time stamping must be extremely precise. For that reason, the PMUs feature GPS-based time synchronization.

Basic differences from "conventional" measuring points (substation automation, RTU):

Measured values from substation automation systems or a remote terminal unit	Synchrophasor from a PMU
Slower updating cycle (e.g. typically once every 5 sec)	Continuous updating (measured value stream), for example, typically 10 values per second (reporting rate)
Measured values without time stamp	Each measured value with precise time stamp
R.m.s. values without phase angle	Current and voltage are supplied as a vector value with amplitude and phase

With these characteristics, the synchrophasors can provide a dynamic view in real-time of power swings and other phenomena in network operation.

Fig. 8/6 SIMEAS R-PMU

Phasor Measurement Units (PMU)

A phasor measurement unit (PMU, figure 8/6) is a device for measuring and transmitting synchrophasors. The frequency and the frequency change (*df*/*dt*) are also detected. A PMU can be an independent device, or integrated in a protection unit, or in a fault recorder. For this purpose, Siemens offers SIMEAS R-PMU, a fault recorder with integrated PMU functionality. SIMEAS R-PMU complies with the IEEE C37.118 standard that primarily describes the communication protocol of the synchrophasors. A supplement to this standard with dynamic requirements for the PMUs is being prepared.

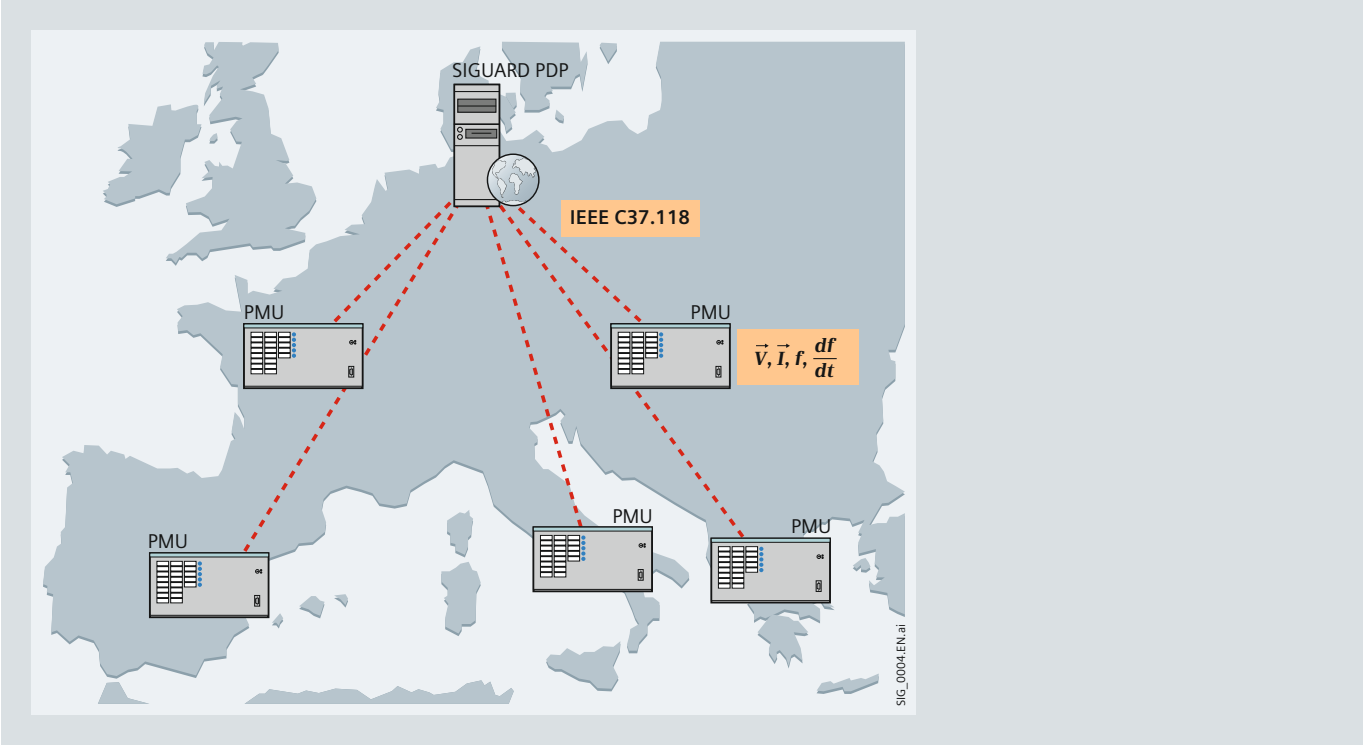


Fig. 8/7 Principle of geographically distributed measured values

SIGUARD PDP system
The SIGUARD Phasor Data Processing (PDP) system has a modular structure and can be distributed over multiple computers. The system structure is shown in figure 8/8.

SIGUARD PDP server
The central component of SIGUARD PDP is the server. It is used both as the communication switch and the archive link. It also provides basic services such as system monitoring. The configuration can include multiple operator stations (SIGUARD PDP UI), which can be remote from the server or operated on the same computer.
In a typical configuration, the server will run on a server computer with a backed-up power supply (UPS) while the operator station is located in an office environment or in the network control center.

SIGUARD PDP UI operator station
The operator station is normally remote from the Phasor Data Concentrator (PDC). Multiple operator stations can be connected. On an operator station, the measured values can be viewed in online mode. In offline mode, significant events can be replayed for precise analysis. All windows run concurrently. Figures 8/9 and 8/10 show examples of the operator interface.

The operator interface can be quickly and simply adapted during operation. The power system status curve (upper portion of the screen) shows the weighted sum of the distances of all measured values from their limits, thus providing a view of the network status and the trend. If the curve exceeds the limit value, it will be colored red. Network areas that are in a critical state are displayed in the lower part of the screen in a geographic overview. Next to this is the work area in which phasor diagrams, time charts and application curves (e.g. voltage stability curves) can be positioned. Further windows show the selection of measured values, pending messages, or the formula editor. The operator interface can be distributed over multiple screens, if necessary.

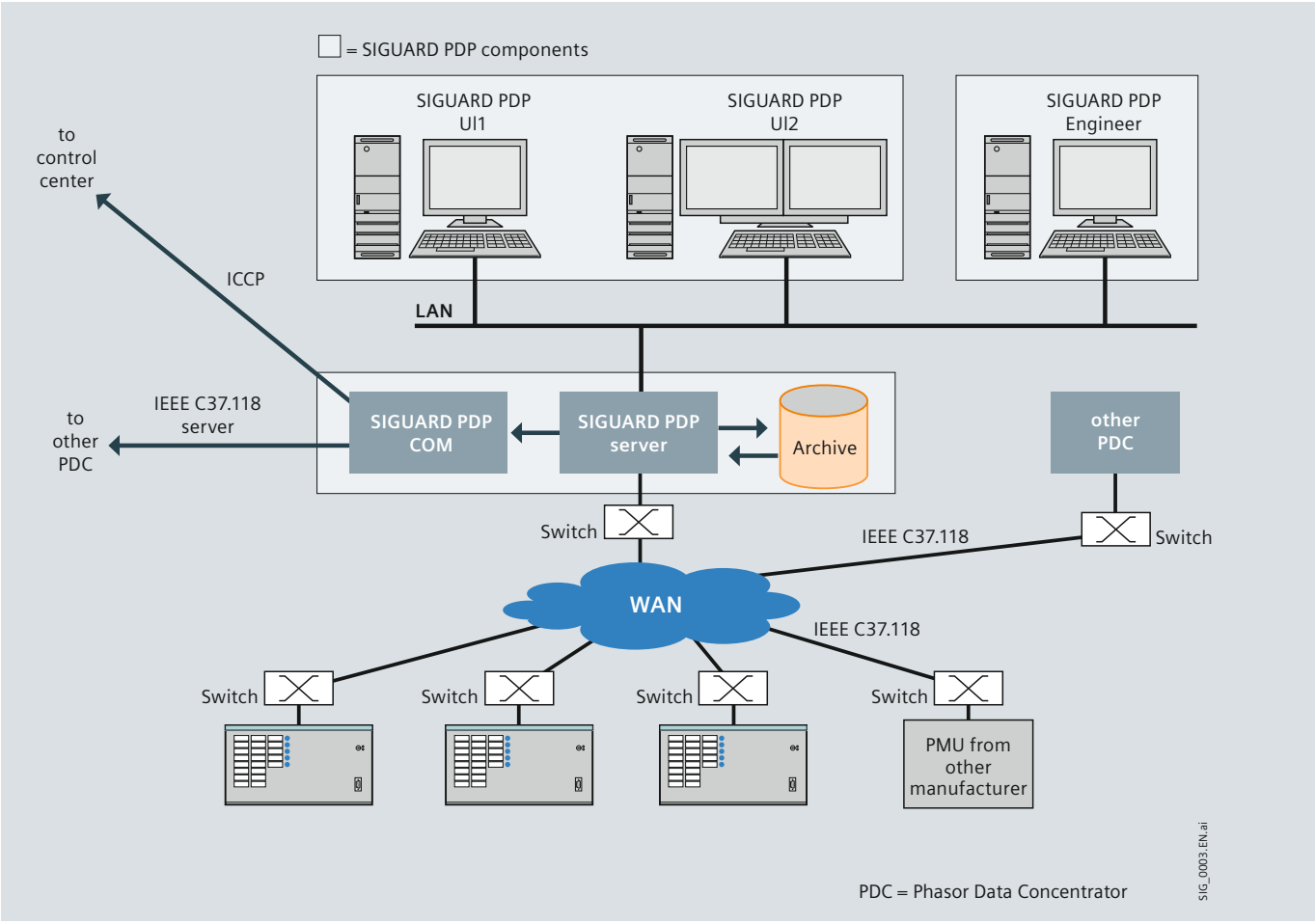


Fig. 8/8 Structure of the SIGUARD Phasor Data Processing system

SIGUARD system structure

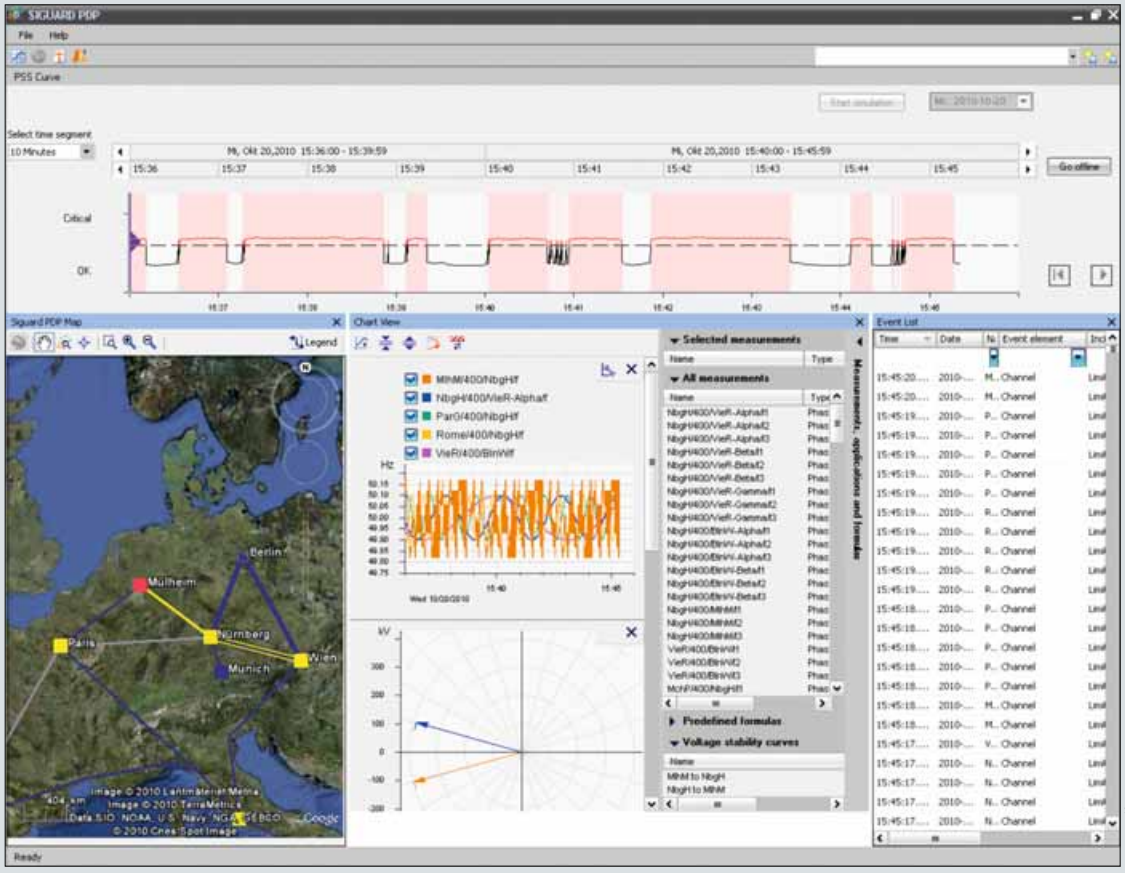


Fig. 8/9 User interface of SIGUARD PDP (example 1, online)

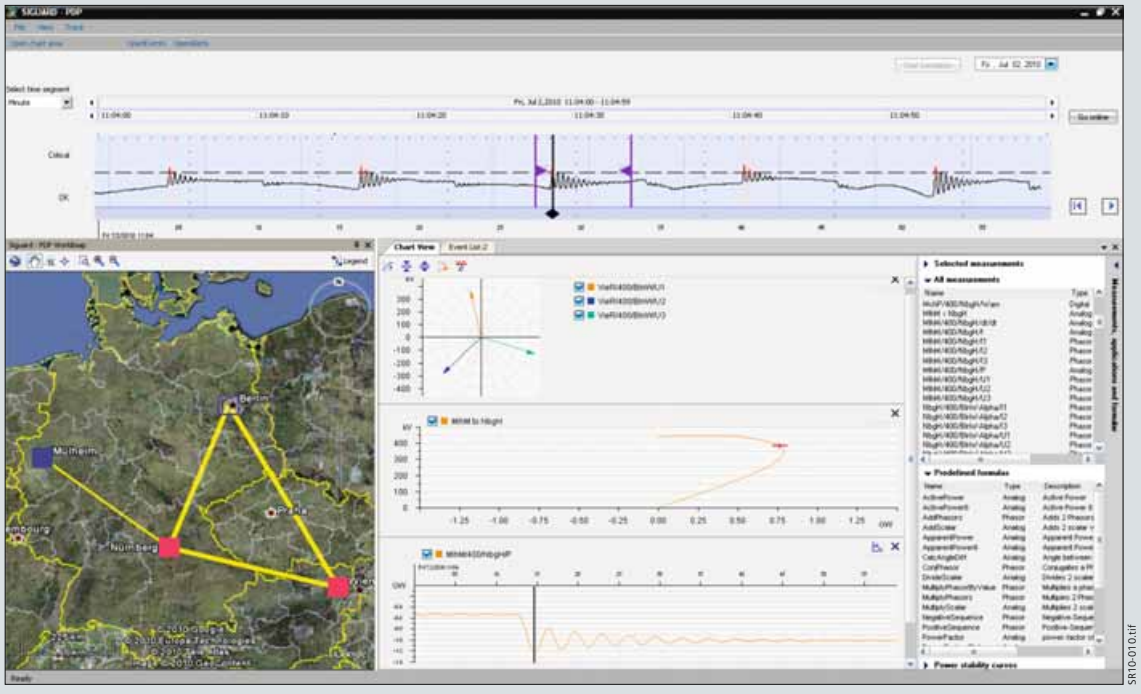


Fig. 8/10 Operator interface of SIGUARD PDP (example 2, offline)

SIGUARD PDP COM

This system module provides the communications link to the other PDCs. Again, protocol IEEE C37.118 is used. SIGUARD PDP COM sends the configured data to up to five recipients at a settable transmission rate (frames per second). The transmission rates can be set separately, and the measured values to be transmitted can be selected from all the available PMU measured values for each channel.

SIGUARD PDP Engineer

SIGUARD PDP Engineer is a user-friendly configuration tool for the entire SIGUARD PDP system. The five work areas on the main screen clearly designate the task groups:

- PMU configuration
- Mathematical calculations
- Graphics for the geographical overview
- Applications (voltage stability curve, island state detection)
- Communication, data distribution.

An integrated plausibility check ensures the consistency of the configuration.

Power swing recognition

Power swing recognition analyzes the progression of the active power curve and outputs alarm messages if damping is too low or negative.

Communication links

- IEEE C37.118 server / client
- OPC-to-OPC clients (application: automation functions)
- ICCP (to network control centers).

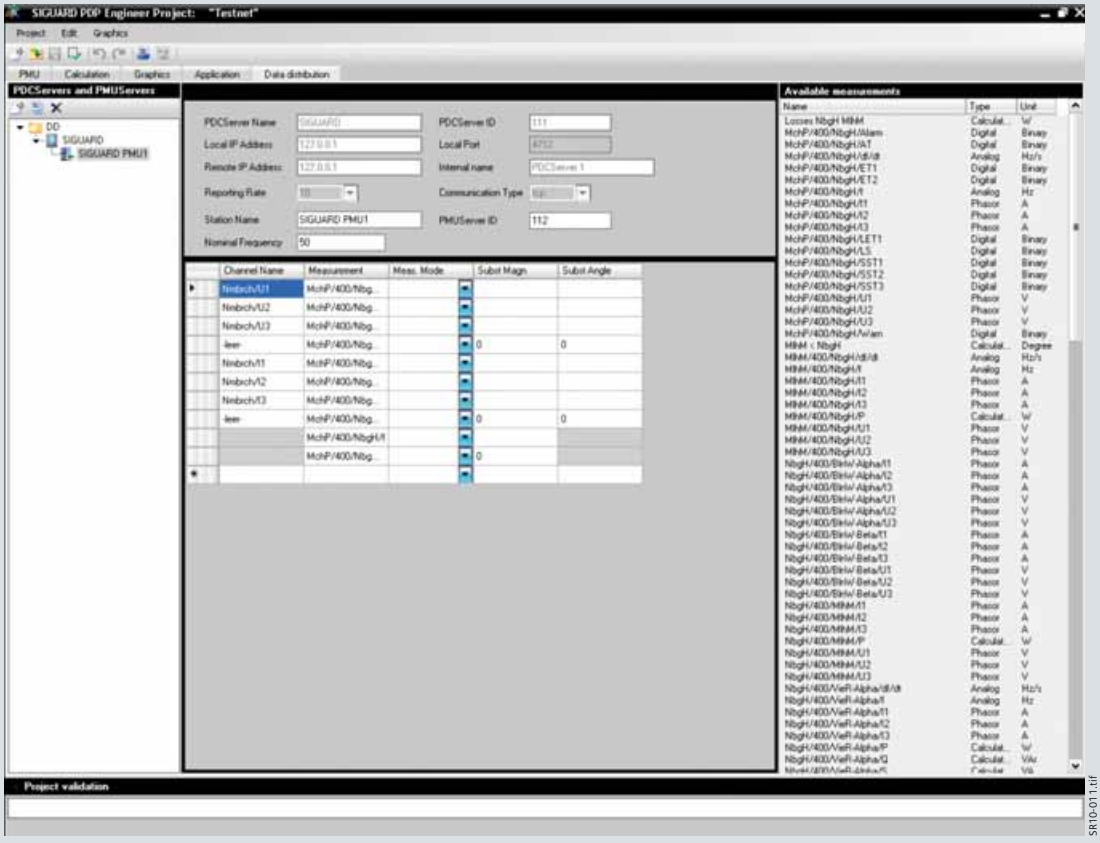


Fig. 8/11 SIGUARD PDP Engineer

Selection and ordering data

SIGUARD PDP is offered in a compact version "Substation PDC" as a communications machine, or in its full user interface with the applications "Enhanced PDC."
A tailor-made solution can also be selected from these product families.

Basically you can order three several versions of SIGUARD PDP:

Version	MLFB body number	Description
SIGUARD PDP – Substation PDC	7KE6041	Low-cost PDC version, without operating station; no application such as e.g. island state detection possible. Use in the substation as data node for synchrophasor measured values.
SIGUARD PDP – Enhanced PDC	7KE6042	Full version including all options for connecting operating stations and using the applications
SIGUARD PDP – Functions upgrade	7KE6040	By upgrades, the desired options can exactly be added to a basic license or a pre-defined combination.

Table 8/1 Selection and ordering data

The following table shows the complete order numbers of the basic licenses, pre-defined combinations and the function upgrades.

Order No.	Designation	Description
7KE6041-0AA00-2AA0	Basic license "SIGUARD PDP Substation PDC"	Substation PDC, no UI and no application possible, max. 5 PMUs, max. 2 PDC connections
7KE6042-0AA00-2AA0	Basic license "SIGUARD PDP Enhanced PDC"	Enhanced PDC, 2 UIs, max. 5 PMUs, max. 2 PDC connections
7KE6041-0BA00-2AA0	Pre-defined combination "SIGUARD PDP Substation PDC"	Substation PDC, no UI and no application possible, max. 14 PMUs, max. 2 PDC connections
7KE6042-0CB10-2AA0	Pre-defined combination "SIGUARD PDP Enhanced PDC"	Enhanced PDC, max. 100 PMUs, max. 3 PDC connections, 3 UIs
7KE6042-0CD21-2AA0	Pre-defined combination "SIGUARD PDP Enhanced PDC"	Enhanced PDC, max. 100 PMUs, max. 5 PDC connections, 5 UIs, application "island state detection", (full functionality of version V2.0)
7KE6042-0CD42-2DA0	Pre-defined combination "SIGUARD PDP Enhanced PDC"	Enhanced PDC, max. 100 PMUs, max. 5 PDC connections, 8 UIs, application "island state detection", "Power Swing Recognition", ICCP, OPC , (full functionality of version V2.1)
7KE6040-0BA00-2AA0	Function upgrade "6 to 14 PMUs"	Connection of 6 to 14 PMUs
7KE6040-0CA00-2AA0	Function upgrade "15 to 100 PMUs"	Connection of 15 to 100 PMUs
7KE6040-0AB00-2AA0	Function upgrade "max. 3 PDCs"	Connection to up to 3 other PDCs as PDC server
7KE6040-0AC00-2AA0	Function upgrade "max. 4 PDCs"	Connection to up to 4 other PDCs as PDC server
7KE6040-0AD00-2AA0	Function upgrade "max. 5 PDCs"	Connection to up to 5 other PDCs as PDC server
7KE6040-0AA10-2AA0	Function upgrade "max. 3 UIs"	Connection of up to 3 operating stations
7KE6040-0AA20-2AA0	Function upgrade "max. 5 UIs"	Connection of up to 5 operating stations
7KE6040-0AA30-2AA0	Function upgrade "max. 7 UIs"	Connection of up to 7 operating stations
7KE6040-0AA40-2AA0	Function upgrade "max. 8 UIs"	Connection of up to 8 operating stations
7KE6040-0AA01-2AA0	Function upgrade "island state detection"	Release of the application "island state detection" (only possible with existing UI)
7KE6040-0AA02-2AA0	Function upgrade "island state detection" and "Power Swing Recognition"	Release of the application "island state detection" and "Power Swing Recognition" (only possible with existing UI)
7KE6040-0AA00-2BA0	Function upgrade "ICCP communication"	Release of the communication acc. to ICCP protocol
7KE6040-0AA00-2CA0	Function upgrade "OPC communication"	Release of the communication acc. to OPC protocol
7KE6040-0AA00-2DA0	Function upgrade "ICCP and OPC communication"	Release of the communication acc. to ICCP and OPC protocol

Table 8/2 Selection and ordering data

SIEMENS

Energy Automation

DAKON PQS
Data Concentrator for SICAM PQS

Answers for infrastructure and cities.

SIEMENS
siemens-russia.com

Contents – DAKON PQS

Description

The DAKON PQS (based on SIMATIC IPC847C) is a rugged and extremely expandable industrial PC in 19" design (4 HMs). It offers high investment protection thanks to outstanding long-term availability, and ensures reliable operation in particularly harsh industrial environments, e.g. with high dust, temperature and shock loads.
Due to its high computing power and PCI-Express technology, the DAKON PQS is the perfect platform for high-performance applications.
The DAKON PQS is extremely flexible and expandable due to its 8 free PCI / PCI-Express slots:
- 7 × PCI, 1 × PCIe ×16.

For maximum system availability and data security, the DAKON PQS is equipped with the following:
- 2 × 500 GB hard disks in a RAID1 group for optimum memory space utilization
- Hot swap frame for replacement of hard disks during operation.

The minimal enclosure depth enables space-saving installation in 19" cabinets of 500 mm.

DAKON PQS – Platform with many advantages:
- Maximum performance and extremely short system response times:
  – Intel core processor Core i7
  – High-performance onboard HD graphics integrated in the CPU
  – DDR3-storage technology
- Very high system availability and data security due to
  – Onboard RAID controller
  – ECC-RAM, work memory with error correction
- High data transmission rates and redundancy thanks to teaming-capable Gigabit Ethernet connections
- 7 × Hi-Speed USB 2.0 ports, two of which on the front and one internal port, e.g. for a software dongle
- Energy-efficient industrial PCs:
  – Low power consumption due to state-of-the-art mobile technology
  – Wake-on-LAN functionality for targeted booting of the IPCs from a central location via a network, e.g. after a weekend without production.

Fig. 9/1 DAKON PQS (based on SIMATIC IPC847C) in 19" design

Special features of DAKON PQS

Special features of DAKON PQS

- Rugged and with long-term availability
- High-quality industrial design and very easy to service:
  - The front fan can be replaced without tools
  - Only one screw needs to be removed to quickly open the enclosure
  - Removable 19" supports so that it can be used as desktop IPC.
- Additional internal USB interface with protection against unauthorized removal, e.g. for a software dongle
- Front USB interface concept: An inserted USB flash drive can also be operated with the front door closed, e.g. as software dongle, and is thus protected against misuse in the same way as the drives and the ON/OFF or reset button accessible from the front.
- Front LED display for efficient self-diagnostics, e.g. for simple identification of a faulty hard disk in the RAID5 group by HDD1 or HDD2-ALARM.

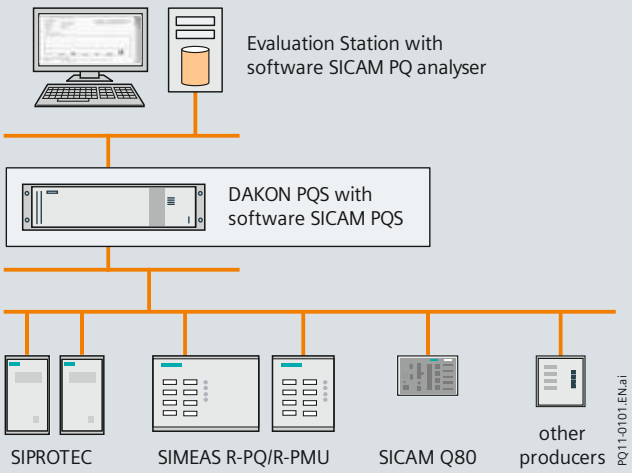


Fig. 9/2 Application example

Selection and ordering data

Description	Order No.
DAKON PQS (SIMATIC Rack PC)	**7KE6020-0CC0**
PENTIUM Core i7-610E (2C/4T, 2,53 GHz, 4 MB Cache) 4 GB DDR3 1066 SDRAM (2 × 2 GB), DIMM, Dual Channel RAID1 2 × 500 GB HDD SATA (Removable & Mirrored Hard Disk, Hot-swap) DVD +/- RW Graphics onboard (Intel® BD82QM57 integrated in chipset) 1 × DVI-I Port or (optional) VGA Port via Adapter 2 × PS/2 Ports 1 × Parallel Port (LPT) 2 × Serial Ports (COM1 and COM2 onboard) 7 × USB 2.0 Port (4 × Rear, 2 × Front and 1 × Internal) 2 × Ethernet Ports (RJ45, 10/100/1000 Mbit/s) 8 × Expansions Slots (7 × PCI, 1 × PCIe ×16) Temperature and Fan Monitoring, Watchdog Industrial Power Supply 110/230V AC, 50/60 Hz European Power Connector Pre-installed and activated operating system WINDOWS 7 Ultimate Multi Language, 32 bit (EN, GER, FR, IT, SP) All-metal 19" housing (4HU) for mechanical robustness and EM compatibility	

Table 9/1 Description and ordering data

Legal Notice

CE conformity

CE 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 according to 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 standard EN 60688.

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Version of the product described: Edition 2

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