SIEMENS

SIMEAS Q
Quality Recorder

POWER QUALITY

Catalog SR 10.2.5
1999

C E R T I F I C A T E

DQS Deutsche Gesellschaft zur Zertifizierung von Managementsystemen mbH

Qualitäts- und Umweltgutachter

hereby certifies that the company

SIEMENS AG

Power Transmission and Distribution Group (EV)

Protection and Substation Control Systems (EV S)

Humboldtstraße 59

D - 90459 Nürnberg

Wernerwerkdamm 5

D-13629 Berlin

Protection Relays, Substation Control
RemoteTerminal Units, Fault Recorders

has implemented and maintains a

quality system.

A quality audit, documented in an audit report, has verified that this quality system fulfills the requirements of the following standard

DIN EN ISO 9001

August 1994 edition

This certificate is valid until 2001-09-04

Certificate Registration No. 876-03

Frankfurt am Main, Berlin 1996-07-08

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SIMEAS Q
Quality Recorder

- DIN rail mounted rack instrument for measuring and recording all relevant data for analyzing the quality of the “Electricity” product.
- Compact construction in modular housing for mounting on top-hat DIN rails. Housing dimensions: 90x75x105 mm (WxHxD)
- Standard-compliant PROFIBUS-DP interface for the cyclic transfer of measurement data to central computer systems at transfer speeds of up to 1.5 Mbit/sec.
- Suitable for monitoring single and 3-phase power networks with 3- and 4-wire configurations.
- 3 converter inputs for voltages in the range 0 to 280 V (phase to ground) and 3 converter inputs for phase currents in the range 0 to 6 A.
- Continuous and/or event triggered recording of the following measurands:
  - RMS values of the phase voltages
  - Power frequency
  - Active, reactive, and apparent power, and power factors for each phase as well as the entire system
  - Symmetry factors for current and voltage
  - Flicker
  - Harmonic voltages and harmonic currents up to the 40th harmonic
  - Harmonic distortion (THD)
  - Active, reactive, and apparent energy of the entire system
- 2 relay outputs for energy pulses, indication of actual power demand or actual power supply, lower threshold violation of cos φ or pulse output for voltage drops on the Ph1, Ph2, or Ph3 phases.

Contents

SIMEAS Q
Quality Recorder

Range of application

SIMEAS® Q is an economic quality recorder that allows distributed monitoring of the power quality in energy supply networks. Power quality monitoring, especially of low voltage (up to 1 kV nominal voltage in accordance with EN 50160) and medium voltage (up to 35 kV nominal voltage in accordance with EN 50160) levels is becoming evermore important. This effect is due to the increased use of electronic devices in industry and in private households, which, because of influence on the power supply can severely degrade the power quality.

Frequent power disturbances also occur in industrial plants for example, when high power electric motors start up, when punch machines, welding machines, or induction ovens are used, or from regulators for pumps, conveyor belts, CNC machines, lifts, and rolling plants.
One or more SIMEAS Q devices can be used to monitor the power quality in closed areas such as a large building, an industrial plant, a switch gear, or the production line of a large plant. Depending on the requirements, a SIMEAS Q is applied to the relevant measuring points and connected to a central display unit, a Personal Computer, or a programmable logic controller (referred to as the PROFIBUS-DP Master in the following passages). The SIMEAS Q records and calculates the desired measurands such as RMS values of current and voltage, harmonic content (THD), individual harmonics, power, flicker, and energy, which can then be transferred to the master station on request.

For the purpose of data transfers, the Profibus network is used. This network is usually already installed, and offers the possibility of using cables or fibre optics, which allow transfer speeds of up to 1,5 Mbit/s.

Furthermore, distances of several hundred meters can be covered using the Profibus. The components required for Profibus operation such as connectors, optical link modules (OLM), repeaters, cables, fibre optic cables, etc., are offered at reasonable prices not only by Siemens, but also by other manufacturers. This allows users who are not yet equipped with Profibus to economically realize a network for monitoring power quality. For users who are already equipped with Profibus, the investment is even smaller since the existing network can be used.
For data transfers, SIMEAS Q uses the telegram traffic PROFIBUS-DP, in compliance with EN 50170 Volume 2 (previously DIN 19245 part 3). Information, such as measurement data read out of SIMEAS Q via Profi bus, is available to anybody. This means that data transfers can be realized between SIMEAS Q devices and all types of PROFIBUS-DP masters such as programmable logic controllers (PLC) or Personal Computers (with integrated PROFIBUS-DP hardware).
By using the open communication interface, the values recorded by SIMEAS Q can also be used for regulation and control purposes. Using the parameterizing program SICOP Q on a Personal Computer, each SIMEAS Q can be easily set up to perform the most diverse measuring tasks. The SIMEAS Q is factory set to record measurement data in accordance with the limits defined in the EN 50160 standard “Voltage characteristics in public electrical supply networks”. This allows the user to quickly obtain definitive information on the quality of power in the power supply being monitored without needing in-depth knowledge of either the standard or SIMEAS Q.

Functiuonality

Calculation of measurement data

In the measurement and recording mode, the Analog/Digital converter digitizes the input current and voltage signals at a sampling rate of 6.400 Hz (or 7.680 Hz for measurements in a 60 Hz power network) and feeds the digital values to the signal processor, which derives the RMS values for current and voltage over a half period (half sine-wave). Furthermore, based on these 10 ms RMS values, the signal processor calculates the measurands specified during parameterization such as power, cos φ, flicker, harmonics, etc., and computes them over the acquisition time, which is also specified during parameterization. These values are then stored in the measurement data memory.

Measurement data can be recorded in 2 modes, which can also be used simultaneously.

- Continuous recording
- Fault recording

Continuous recording

With continuous recording, different acquisition times are specified for the various measurands. As can be seen in Table 1, with the exception of flicker measurements, the smallest possible acquisition time for continuous recording is 1 second. This is because the signal processor always computes voltage and current values over 1 second using the 10 RMS values. The continuous recording function can best be explained using the following example. During parameterizing, for example, it is specified that the 3 voltage phases should be recorded with an acquisition time of 1 second. Furthermore, the total actual power of the 3-phase supply should be recorded with an acquisition time of 15 minutes.

After the measurement is started, SIMEAS Q continually calculates the mean value of the RMS value for each individual phase voltage over a period of 1 minute by arithmetically averaging 60 1-second RMS values for phase voltage. After expiration of the 1-minute measuring period, the 3 derived voltage values, including the timestamp for the end of the measuring period, are stored in the measurement value memory and the calculation of the mean value for the next minute begins. Calculation of the total active power is performed in the same manner. In this case, the active power value is calculated over 1 second.

After the 15 minute measuring period expires, the arithmetic mean is derived for the 900 1-second active power values that were recorded, which is then also stored in the measurement data memory along with the timestamp. All measurement data stored in the memory can be retrieved at any time by the master station via the Profibus. The question "over what period can SIMEAS Q store measurement data?", is answered in more detail in the section "Transfer of data via PROFIBUS-DP".
The EN 50160 standard "Voltage characteristics in Public electrical supply networks" specifies, for example, the following acquisition times:

- Voltage
  Under normal operating conditions, 95 % of the 10-minute mean RMS values for supply voltage must lie within the range V_{nom} ± 10 % for any given weekly interval.
- Harmonic voltages
  Under normal operating conditions, 95% of the 10-minute mean RMS voltage value for each individual harmonic may not exceed the threshold specified in the standard for any given weekly interval.
  (e.g. 5th harmonic 6 % of V_{norm})

In the „continuous recording" mode, the maximum and minimum values of a measurand within the measuring period (acquisition time) can also be recorded by SIMEAS Q. Table 1 shows which measurands, depending on the type of network (4-wire, 3-wire, or single phase), can be recorded by SIMEAS Q in the continuous recording mode, what acquisition times are possible for each measurand, and for which measurands the maximum and minimum values can be recorded.

Measurand	Possible acquisition times	Max/min possible
RMS values of phase to earth voltages or phase to phase voltages.	1, 2, 5, 6, 10, 15, 30 sec 1, 2, 5, 6, 10, 15, 30, 60 min	yes
RMS value of phase current	1, 2, 5, 6, 10, 15, 30 sec 1, 2, 5, 6, 10, 15, 30, 60 min	yes
Power frequency (is always measured on the V_{Ph1} input)	1, 2, 5, 6, 10, 15, 30 sec 1, 2, 5, 6, 10, 15, 30, 60 min	yes
Active power per phase and total active power	1, 2, 5, 6, 10, 15, 30 sec 1, 2, 5, 6, 10, 15, 30, 60 min	yes
Reactive power per phase and total reactive power	1, 2, 5, 6, 10, 15, 30 sec 1, 2, 5, 6, 10, 15, 30, 60 min	yes
Apparent power per phase and total apparent power	1, 2, 5, 6, 10, 15, 30 sec 1, 2, 5, 6, 10, 15, 30, 60 min	yes
Power factor per phase and total power factor	1, 2, 5, 6, 10, 15, 30 sec 1, 2, 5, 6, 10, 15, 30, 60 min	yes
Voltage asymmetry	1, 2, 5, 6, 10, 15, 30 sec 1, 2, 5, 6, 10, 15, 30, 60 min	yes
Current asymmetry	1, 2, 5, 6, 10, 15, 30 sec 1, 2, 5, 6, 10, 15, 30, 60 min	yes
Short term flicker factor per phase voltage (A_{st} or P_{st})	10 min fixed according to the IEC 60868 standard and IEC 60868 A1 - Flicker Instruments	no
Long term flicker factor per phase voltage (A_{lt} or P_{lt})	120 min fixed according to the IEC 60868 standard and IEC 60868 A1 - Flicker Instruments	no
1th to 40th harmonic voltage per phase	1, 2, 5, 6, 10, 15, 30 sec 1, 2, 5, 6, 10, 15, 30, 60 min	yes
1th to 40th harmonic current per phase	1, 2, 5, 6, 10, 15, 30 sec 1, 2, 5, 6, 10, 15, 30, 60 min	yes
Harmonic distortion THD per phase	1, 2, 5, 6, 10, 15, 30 sec 1, 2, 5, 6, 10, 15, 30, 60 min	yes
Active energy input / Active energy output Reactive energy supply / Reactive energy absorbtion Apparent energy	1, 2, 5, 6, 10, 15, 30, 60 min	no

Table 1
Possible measurands for continuous recording

Functionality

Fault recording

The fault recording mode serves to record measurement data only when the mean value of a measurand violates one or more high or low limits (thresholds). An acquisition time must also be specified for each measurand. Additionally, the threshold values must be specified for each measurand (or group of measurands, e.g. phase voltages). Example: For the harmonic voltages, the acquisition time was set to 10 minutes. For the 5th harmonic, the 1st threshold was parameterized to 6 % while the 2nd threshold was parameterized to 12 %.

The SIMEAS Q continuously calculates the mean value of the 5th harmonic over a period of 10 minutes. If the 10-minute mean value is smaller than 6 %, no threshold violation has occurred, and there is no measurement data to store. The calculation for the next 10 minute mean value then begins. If this is now greater than 6 %, SIMEAS Q stores the total mean value (mean of all 10-minute mean values) and the time of the threshold violation. This means, the mean value between two threshold violations and the time of the threshold violation are always stored.

By inspecting this recorded information, the user can identify when a measurand left a measuring range bounded by the thresholds, how long the measurand lay outside of this measuring range, and what the mean value of the measurand was in the new measuring range.
The fault recording is used primarily to record voltage drops. According to the standard, voltage drops must be recorded with a resolution of 10 milliseconds. This is the reason that SIMEAS Q must first calculate the RMS voltage value over a half sine-wave.

For this purpose, the smallest possible “acquisition time” for voltage is set to 10 ms in SIMEAS Q. Furthermore, 5 thresholds can be set for voltage. These can also be set for current. For all other measurands, the smallest possible acquisition time is 1 second.

The following table shows which measurands can be recorded for fault recordings, what acquisition times can be set for each measurand, and how many thresholds per measurand can be specified.

Measurand	Possible acquisition times	Number of threshold values
RMS values of phase to earth voltages or phase to phase voltages.	10, 20, 50, 100, 500 msec 1, 2, 5, 6, 10, 15, 30 sec 1, 2, 5, 6, 10, 15, 30, 60 min	5
RMS value of phase current	10, 20, 50, 100, 500 msec 1, 2, 5, 6, 10, 15, 30 sec 1, 2, 5, 6, 10, 15, 30, 60 min	5
Power frequency (is always measured on the V_{Ph1} input)	1, 2, 5, 6, 10, 15, 30 sec 1, 2, 5, 6, 10, 15, 30, 60 min	5
Active power per phase and total active power	1, 2, 5, 6, 10, 15, 30 sec 1, 2, 5, 6, 10, 15, 30, 60 min	2
Reactive power per phase and total reactive power	1, 2, 5, 6, 10, 15, 30 sec 1, 2, 5, 6, 10, 15, 30, 60 min	2
Apparent power per phase and total apparent power	1, 2, 5, 6, 10, 15, 30 sec 1, 2, 5, 6, 10, 15, 30, 60 min	2
Power factor per phase and total power factor	1, 2, 5, 6, 10, 15, 30 sec 1, 2, 5, 6, 10, 15, 30, 60 min	2
Voltage asymmetry	1, 2, 5, 6, 10, 15, 30 sec 1, 2, 5, 6, 10, 15, 30, 60 min	2
Current asymmetry	1, 2, 5, 6, 10, 15, 30 sec 1, 2, 5, 6, 10, 15, 30, 60 min	2
1th to 40th harmonic voltage per phase	1, 2, 5, 6, 10, 15, 30 sec 1, 2, 5, 6, 10, 15, 30, 60 min	2 per harmonic
1th to 40th harmonic current per phase	1, 2, 5, 6, 10, 15, 30 sec 1, 2, 5, 6, 10, 15, 30, 60 min	2 per harmonic
Harmonic distortion THD per phase	1, 2, 5, 6, 10, 15, 30 sec 1, 2, 5, 6, 10, 15, 30, 60 min	2

Table 2
Possible maesurands for fault recordings

Transfer of data via the PROFIBUS-DP

The abbreviation DP that is appended to Profibus stands for Distributed Peripherals. The PROFIBUS-DP distinguishes itself by its fast cyclic communication for small volumes of data. A PROFIBUS-DP system consists basically of a PROFIBUS-DP master and a total of up to 125 different field devices called slaves. It is also possible to connect several PROFIBUS-DP masters to a Profibus network however, the various slaves are always directly subordinate to only one PROFIBUS-DP master (multi-master operation). For unique identification on the Profibus, each participant is assigned a bus address, which is always specified in the data transfer telegrams. In the so-called user data mode, the DP master polls its subordinate slaves, i.e. the slaves are cyclically addressed beginning with the slave with the lowest address. Once the data transfer with the slave having the highest address is finished, the DP master polls the slave with the lowest address and the cycle begins again. When exchanging data with a slave, the DP master always sends a request telegram, and receives an response telegram in reply. The length of each telegram in bytes can be different for each type of field device, however, it is fixed for communication purposes and cannot be dynamically changed. Because the Profibus is designed for fast communication, it is always desirable to structure the request and response telegrams so that they are as short as possible. For this reason a large number of PROFIBUS-DP slaves come with 8 bytes of input data (requests) and 8 bytes of output data (response). For larger volumes of data, the maximum length of 256 bytes can be used for both telegrams (12 bytes for the telegram header, 244 bytes for the user data).

Effects on communication

The cycle time is the period between two consecutive data exchanges with the same slave. When calculating the cycle time, if the maximum number of connected slaves, the common data transfer speed of 1,5 kbit/s, and the largest data volume of 256 bytes for the request and response telegrams are assumed, the result is that a cycle time of less than half a second is required. Whether the received data can be processed this fast is largely dependent on the performance of the master station computer. Even so, it is obvious that the exchange of data with a slave progresses at intervals of several hundred milliseconds.

Effects on SIMEAS Q

In accordance with guidelines and standards, data relevant to power quality is calculated over measuring periods of several minutes. Furthermore, 19 measurement values can be stored in one SIMEAS Q response telegram. If, for example, a user wants:

- the 3 phase voltages (3 measurement values)
- the 3 phase currents (3 measurement values)
- the power frequency (1 measurement values)
- the active power per phase and total active power (4 measurement values)
- the reactive power per phase and total reactive power (4 measurement values)
- the apparent power per phase and total apparent power (4 measurement values)
- The harmonic distortion factor per phase (3 measurement values)
- all harmonics for the voltage on phase 1 (40 measurement values)

i.e. a total recording of 62 measurement values, he could theoretically set the acquisition time for all values to 2 seconds (4 cycles are required to retrieve 62 measurement values - 4 x 0,5 sec = 2 sec) and the measurement values can be seamlessly displayed without a memory overflow occurring in the SIMEAS Q since the recorded data is requested faster by DP master than it is recorded in SIMEAS Q.

The requirement of the guidelines and standards to record data relevant to power quality in minute cycles can therefore be satisfactorily met. If one also considers that;

- usually, less than 125 slaves are assigned to a Profibus master
- the SIMEAS Q input data (request telegrams) only require a few bytes
- less than 20 measurands need monitoring
- most Profibus slaves require less bytes for input and output data

then it is obvious that the cycle time is usually in the range of a few milliseconds, which justifies the smallest configurable acquisition time of 1 second for SIMEAS Q. From the above observations, it can be seen that the size of the measurement data memory in SIMEAS Q is not so important. The measurement data memory is designed to accommodate 10.000 measurement values including time information. Assuming that the DP master operates continuously, a memory overflow can never occur. On the other hand, if one assumes that 20 measurands need recording with the 10 minute acquisition time specified in the standards, then the memory capacity is sufficient to accommodate 500 measurement values per measurand, which corresponds to a period of 5.000 minutes, or nearly 3 ½ days.

The relay outputs

The SIMEAS Q is equipped with 2 relay outputs (optical relays), each of which can be independently assigned to one of the following functions:

- Device active (switched on)
- Energy pulse per configurable energy value for
  - Active energy input
  - Active energy output
  - Reactive energy supply
  - Reactive energy absorbtion
  - Apparent energy
- Active power drain (contact open)/source (contact Threshold for closed)
- Threshold for cos φ (contact closed as long as cos φ less than set threshold value)
- Pulse for voltage drop (contact closed for 500 ms if the first lower threshold below the nominal value is violated)

Three terminals are provided for the relay output (see page 12, Terminals). The contact potential for both relays is applied to the middle terminal 21. Terminal 20 is the output for binary channel 1, while the terminal 22 is for binary channel 2.

Functionality

The LEDs

The 3 LEDs BF (bus fault), DIA (diagnosis) and RUN serve to directly indicate the SIMEAS Q operational states listed below:

- No supply voltage
- SIMEAS Q is transferring data via Profibus and recording measurement values
- SIMEAS Q is transferring data via Profibus but is not recording any measurement values
- Error in Profibus configuration telegram
- Fault in SIMEAS Q
  - wrongly parameterized
  - memory overflow
  - input signal too high
  - wrong or faulty input signal connection (e.g. SIMEAS Q should record active power for phase 1 but voltage for phase 1 is missing)
- SIMEAS Q received a wrong DP parameter telegram or the bus protocol is faulty
- SIMEAS Q is starting up
- SIMEAS Q is searching for the correct baud rate on the Profibus (start up)

Function	Comments
Setting the PROFIBUS-DP address	Only possible using the "SIMEAS Q Parameterizing" software with a point-to-point connection.
Calibration of current and voltage inputs	Only possible using the "SIMEAS Q Parameterizing" software with a point-to-point connection.
Updating the SIMEAS Q device firmware	Only possible using the „SIMEAS Q Parameterizing" software with a point-to-point connection. The device firmware is stored in a flash EPROM inside SIMEAS Q. In the event that the device firmware needs updating, the customer receives a diskette containing the new firmware, which is then installed in the SIMEAS Q via the serial interface.
Reading the identification data	Identification data is: • Order no.: • Manufacturing number • Firmware version number • Last calibration date and time only possible using the "SIMEAS Q Parameterizing" software with a point-to-point connection • Profibus address • Power frequency
Displaying measurement values from the current and voltage inputs	To check the calibration. Also possible via PROFIBUS-DP
Setting the date and time in the SIMEAS Q	Also possible via PROFIBUS-DP
Setting the measuring parameters	Necessary settings to perform a measurement: Basic settings • Type of power network (4-wire, 3-wire, single phase) • Power frequency, 50 or 60 Hz • Power voltage • Conversion ration of the external voltage converter if used • Conversion ration of the external current converter if used • Functions for both relay outputs Continuous recording • Choice of which measurands should be continuously recorded, and whether the minimum/maximum values should be stored • The acquisition time for each measurand Fault recording • Choice of which measurands should be recorded when a fault occurs • The acquisition time for each measurand • The threshold values for each measurand Also possible via PROFIBUS-DP

Table 3
Settings and functions that can be parameterized using Software "SIMEAS Q-Parameterizing"

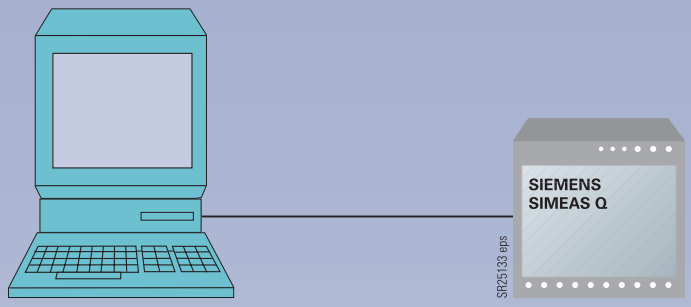


Figure 1
Parameterizing the SIMEAS Q via a point-to point connection using a PC

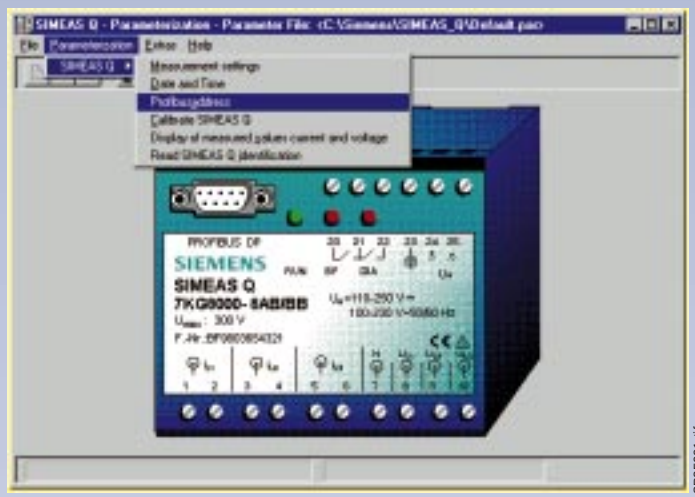


Figure 2
Software "SIMEAS Q Parameterization" – main menu

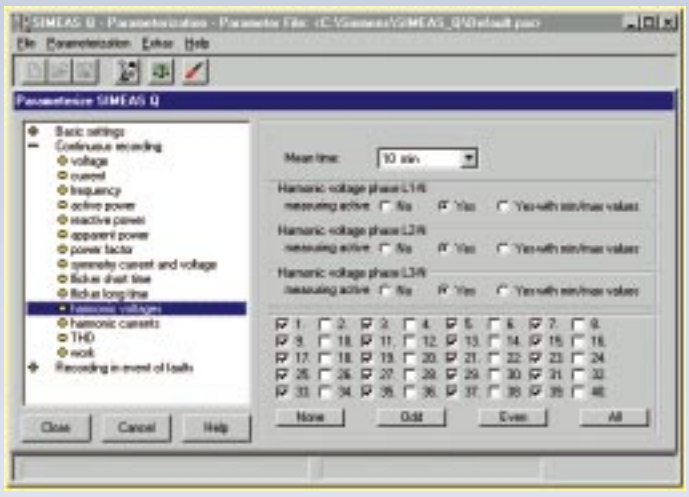


Figure 3
Software "SIMEAS Q-Parameterization" Example of parameterizing the continuous recording of harmonic voltages

Parametenzing SIMEAS Q

The PC program "SIMEAS Q Parametenzing" is available for parameterizing the SIMEAS Q. This is done by connecting the 9-pin connector on the SIMEAS Q device to the serial interface on a commercially available PC or Notebook PC with a cable. The cable is a serial interface cable with an RS232/RS485 converter. If the SIMEAS Q is now switched on, it recognizes that it is directly connected to a PC and does not hang on a Profibus network.

"SIMEAS Q Parameterization" allows the settings and functions listed in Table 3 to be performed on the SIMEAS Q:

SIMEAS Q
Quality Recorder

Functionality

SIMEAS Q on the PROFIBUS-DP

The data recorded with SIMEAS Q can be retrieved by a master station such as a programmable logic controller via the PROFIBUS DP Before any connection to the Profibus network is made, each SIMEAS Q must be set up to record the desired measurement values using the parameterization software. In addition to the Profibus address, all measurement settings must also be specified. In order to use the SIMEAS Q measurement values in the master station, its application software for telegram traffic must be realized for the measurands to be transferred. To do this, a request command can be used that retrieves the measurement values stored in the measurement memory of the SIMEAS Q.

In response to the request command for measurement values, the SIMEAS Q sends up to 19 measurement values including time information in its response telegram. The measurement values are marked with an identity, which allows the master station to determine the measurands to which the measurement values apply. If the SIMEAS Q has no measurement values in its memory, it responds with an empty telegram. Furthermore, there are control commands such as “start recording” or “end recording”. The parameterization for SIMEAS Q can also be read and written via the Profibus connection.

The user now has access to an instrument that, due to its wide range of recordable measurands, can be used for a wide variety of different tasks and application.

In addition to pure monitoring tasks, applications can also be implemented that perform control and regulating tasks based on the measurement data recorded by SIMEAS Q. It is possible, for example, to realize a system to optimize energy demand. Using SIMEAS Q devices, 15-minute energy values are recorded, which are cyclically retrieved by a programmable logic controller (PLC}. Based on these energy values, the PLC switches consumers connected to the power network on or off, ensuring an optimum energy demand.

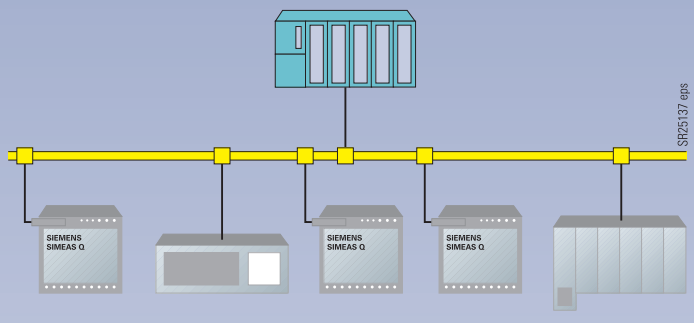


Figure 4
SPS SIMATIC S7
??????????????????
PROFIBUS-DP-Slaves

Construction

During the development of the SIMEAS Q, the guidelines specified in IEC/EN standard 61000 (Electromagnetic Compatibility) part 4 for the design of instruments to record power quality were used as a basis. All SIMEAS Q components are contained in a small housing for top-hat rail mounting that has the dimensions 90 x 75 x 105 mm (W x H x D). This compact construction is extremely space saving, and therefore economic. A 9-pin D4ype plug for connecting the Profibus cable is mounted on the front side of the housing, along with 3 LEDs for indicating the different operational states. On the top front edge of the SIMEAS Q, three terminals are provided for two relay outputs, each of which can be independently assigned to different functions during device parameterization. Furthermore, the two terminals for connecting the supply voltage to SIMEAS Q are also mounted on the top front edge of the housing. The SIMEAS Q is available in two versions with different multi-range power supply units for 24 to 60 V DC and 110 to 250 V DC - 50/60 Hz 100 to 230 V AC. The10 terminals for connecting the currents and voltages are mounted on the lower front edge of the housing. From these, 6 terminals are provided for the 3-phase currents I_{Ph1}, I_{Ph2} and I_{Ph3} of a 3-phase network. The remaining 4 terminals are for the 3-phase voltages V_{Ph1}, V_{Ph2} and V_{Ph3} and the star point U_N. This enables the SIMEAS Q to monitor the power quality in 4-wire systems. By connecting 2 phase currents and the corresponding phase to phase voltage, it is also possible take measurements in a 3-wire system. For recordings in a single phase network, only the current input I_{L1} and the terminals for the phase-ground voltage U_{L1} are used.

All SIMEAS Q components are distributed between the following 5 modules:

- Power supply unit
- Connection module
- Converter module
- Bus module
- Processor module

The power supply unit

The power supply unit converts the external supply voltage into the necessary internal supply voltages of + 3.3 V and + 5 V and contains the battery that buffers the real time clock.

The connection module

This contains the two terminal for connecting the power supply and the 10 terminals for the current and voltage inputs.

The converter module

The converter module is equipped with 3 current and 3 voltage converters, all of which have electrically isolated inputs. The voltage converter enables voltage measurements in the range 0 - 280 V. Using the current converter, currents up to 6 A can be measured.

The bus module

The bus module connects the processor module, power supply units, and converter module with one another.

The processor module

The processor module contains the

- A/D converter
- Input filter (anti-aliasing filter 8th order)
- RS485 interface with the PROFIBUS-DP controller (Siemens ASIC SPC4) and a 9-pin D-type connecting socket
- 3 status LEDs
- two relay outputs
- clock
- microprocessor (signal processor)
- program memory
- memory for setup parameters and calibration data
- memory for the measurement data

Connection examples

The input connections are only examples. The maximum permissible current and voltage values can be connected without the need for current or voltage converters. Voltage converters can be connected in star or V configurations. All inputs not required for the measurement remain unconnected.

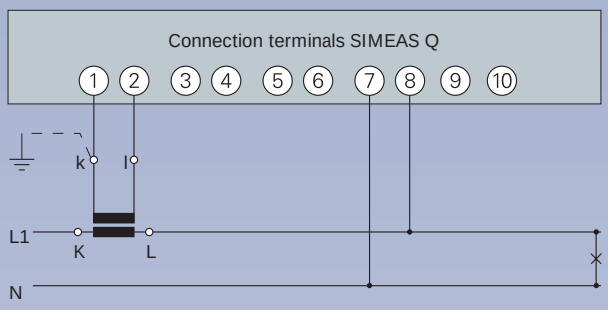


Figure 5
Single phase - alternating current

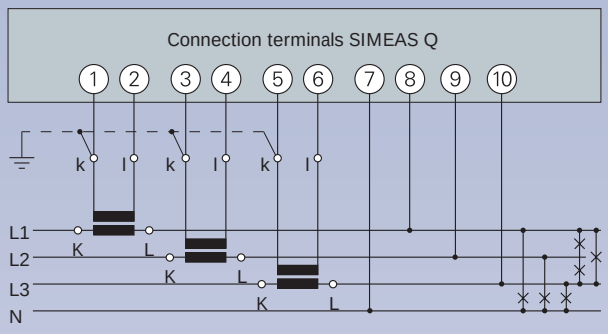


Figure 6
4-wire – 3-phase with any load (low voltage network)

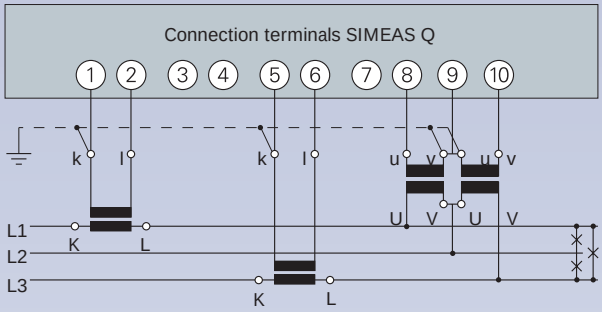


Figure 7
3-wire – 3-phase with any load

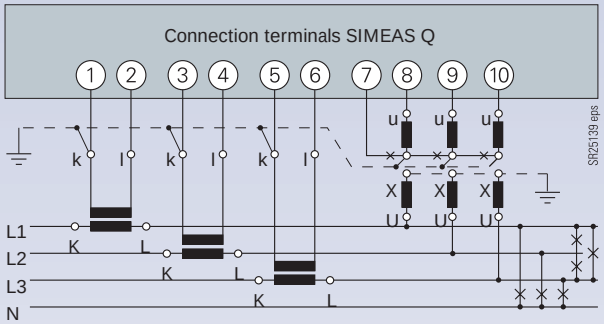


Figure 8
4-wire – 3-phase with any load (high voltage network)

SIMEAS Q
Quality Recorder

Technical Data

Input	Only for connection to an alternating current system
Maximum nominal power voltage	Y 230 /Δ 400 V
Permissible dynamic range	V_Y = 280 V; I_E = 6 A
Nominal frequency f_{EN}	50 Hz; 60 Hz
Frequency range f_E	± 5 Hz
Wave form	Sine or distorted up to 40th harmonic
Alternating current inputs I_E	
Nominal input current I_E	min. 1 A, max. 6 A
Power consumption for each current path	approx. 0,06 VA at I_E = 6 A
Continuous loading	12 A
Surge overload	200 A compliant with IEC/EN 60688
Alternating voltage inputs U_E	
Power consumption	0.02 W at $V_{E\text{-}N}$ = 100 V/$\sqrt{3}$
Input to ground	0.22 W at $V_{E\text{-}N}$ = 230 V
Nominal voltage U_{EN}	max. 230 V (3 phasig)
Continuous overload	1,2 x V_{Nom} = 280 V
Surge overload	2 x V_{Nom} = 460 V compliant with IEC/EN 60688
Power supply	Multi-range AC/DC power supply unit
Nominal voltage - version 1	24 to 60 V DC
Nominal voltage - version 2	110 to 250 V DC and 100 to 230 V AC/ 45 to 65 Hz
Permissible range of tolerance	± 20 % of the nominal voltage
Power consumption	approx. 2,5 W depending on connection
Binary outputs	2 outputs via optical relays
Permissible voltage	± 100 V AC/DC
Permissible current	150 mA continuous 500 mA for 100 ms
Internal resistance	10 Ω
Permissible switching frequency	10 Hz
Measurement functions	
Number of channels	3 voltage inputs 3 current inputs
Calculation method	Fast Fourier transformation
Sampling rate	6.400 Hz at 50 Hz power frequency 7.680 Hz at 60 Hz power frequency per voltage or current input
Resolution	14 bit
Voltage	
Measuring range	0 - 280 V
Measuring fault	typically ≤ 0,1 % of the measuring range full scale value
Storage	continuous – selectable acquisition time 1 - 3600 s – storage of max, min and mean values and/or for threshold violations – selectable acquisition time 10 ms - 3600 s 5 configurable threshold values
Current	
Measuring range	0 - 6 A
Measuring fault	typically ≤ 0,1 % of the measuring range full scale value
Storage	continuous – selectable acquisition time 1 - 3600 s – storage of max, min and mean values and/or for threshold violations – selectable acquisition time 10 ms - 3600 s 5 configurable threshold values

Measurement functions (continued)	
Active power, apparent power, reactive power	
Measuring fault	typically ≤ 0,2 % of the measuring range full scale value
Storage	continuous – selectable acquisition time 1 - 3600 s – storage of max, min, and mean values and/or for threshold violations – selectable acquisition time 1 - 3600 s 2 configurable threshold values
Power factor	
Measuring fault	typically ≤ 0,2 %
Storage	continuous – selectable acquisition time 1 - 3600 s – storage of max, min, and mean values and/or for threshold violations – selectable acquisition time 1 - 3600 s 2 configurable threshold values
Symmetry	
Measurement	For measurements in 3-phase power networks voltage and current
Measuring fault	typically ≤ 0,2 %
Storage	continuous – selectable acquisition time 1 - 3600 s – storage of max, min, and mean values and/or for threshold violations – selectable acquisition time 1 - 3600 s 2 configurable threshold values
Frequency	
Measuring fault	≤ 5 mHz
Storage	continuous – selectable acquisition time 1 - 3600 s – storage of max, min, and mean values and/or for threshold violations – selectable acquisition time 1 - 3600 s 2 configurable threshold values
Harmonics	
Frequency range	Up to the 40th harmonic for each voltage or current input
Measuring fault	according to IEC 61000-4-7 Class B
Storage	continuous – selectable acquisition time 1 - 3600 s – storage of max, min, and mean values and/or for threshold violations – selectable acquisition time 1 - 3600 s 2 configurable threshold values per harmonic
Flicker factor	
Measurement	A_{st} /A_{lt} or P_{st} /P_{lt} per voltage input
Measuring fault	according to EC 61000-4-15 (IEC 868)
Storage	continuous acquisition times A_{st} and P_{st} 10 min acquisition times A_{lt} and P_{lt} 120 min
Active energy input Active energy output Reactive energy supply Reactive energy absorbtion Apparent energy	
Measuring fault	typically ≤ 0,2 %
Storage	continuous – selectable acquisition time 1 - 60 min

Other technical data

Voltage endurance	Compliant with IEC/EN 61010-1
Measurements inputs against power supply, relay outputs, and serial interface	Type test V = 5,5 kV, 50 Hz, 1 min Surge voltage 10,2 kV, 1,2/50 µsec Sample test V = 3,25 kV, 50 Hz
Power supply relay outputs, and serial interface against one another	Type test V = 3,7 kV, 50 Hz, 1 min Surge voltage 6,8 kV, 1,2/50 µs Sample test V = 2,2 kV, 50 Hz
Permissible ambient temperature	Compliant with IEC/EN 60688 User group III - 10 °C to 55 °C no condensation during operation
Mechanical strength against falling, knocks, and vibration	Compliant with IEC/EN 61010-1
Fire resistance class	V0 compliant with UL 94

Safety

Protective measures Protection class	Compliant with IEC/EN 61010-1 Plastic housing, after installation, the entire terminal area must be covered. Only than is the device sufficiently guarded against inadvertent contact of voltage carrying pants.
Overvoltage category	III
Degree of contamination	2

Eletcromagnetic compatibility

Interference radiation	Compliant with technical standard DIN EN 50081-1
Interference immunity	Compliant with technical standard EN 50082-2

Communication interfaces

Interface	
Type of connection Transfer rate	9-pin D-type connector up to 9,6 kbit/s, up to 1,5 Mbit/s
Transfer protocol	Profibus DP

Dat storage

Memory for measurement data	1 Mbyte RAM memory for up to 10000 measurements, each with time information
Program memory	256 kByte Flash EPROM

Internal real time clock

Format	Year, month, day, hour, minute, second
Deviation	100 ppm
Buffering	With a Lithium battery
Synchronization and adjustment	Via Profibus interface

Dimensions and housing

Dimensions	90 x 75 x 105 mm (W x H x D)
Housing version	Snap-in housing for top-hat rail mounting Protection type IP 40
Connecting elements	Protection type IP 20
Power supply	Terminals for max. 2,5 mm^2
Voltage inputs	Terminals for max. 2,5 mm^2
Current inputs	Terminals for max. 4,5 mm^2
Binary outputs	Terminals for max. 2,5 mm^2
RS485 bus interface	9-pin D-type connector

Weight

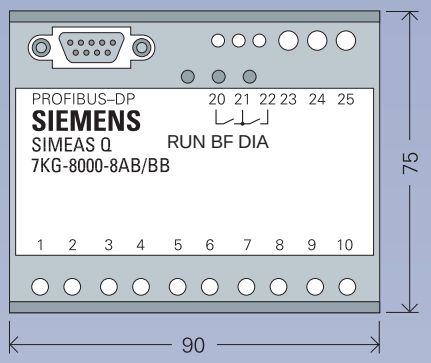
Approx. 0,7 kg

SIMEAS Q
Quality Recorder

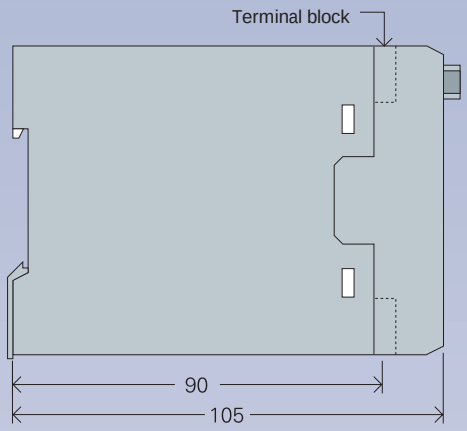
Selection and ordering

Designation	Order No.	
SIMEAS Q **with PROFIBUS-DP interface**	**7KG8000-8A**	
Power supply		
24 to 60V DC		A
110 to 250 V DC and 100 to 230 V AC, 45 to 65 Hz		B
SIMEAS Q User Guide **for SIMEAS Q with the** **PROFIBUS-DP interface** Detailed description of the SIMEAS Q functions and the PROFIBUS-DP-communication	**7KG8000-2A**	
Languages		
german		A
english		B
french		C
spanish		D
GSD-File for SIMEAS Q Device-specific file compliant with EN 50170 standard, volume 2 For the configuration of Profibus networks delivered on a 3½-inch diskette	**7KG8000-6AA**	
SIMEAS Q Parameterization package	**7KG8050-8A 00**	
Consisting of:		
• Software SIMEAS Q Parameterization for parameterizing and calibrating of SIMEAS Q devices with a Personal computer		
• Connection cable SIMEAS Q to PC length 4 m incl. RS232/RS485 converter		
Connector:		
PC-Side: 9-pin D-type connector - female		
SIMEAS Q-Side: 9-pin D-type connector - male		
Power supply unit:		
230 V AC, 50 Hz		A
110 V AC, 60 Hz		B

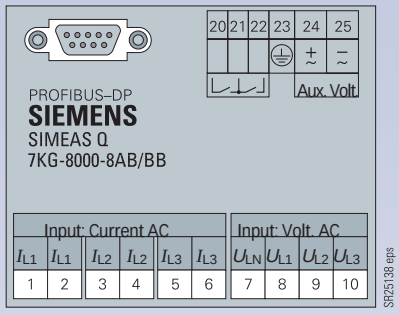
Dimensions



SIMEAS Q
Front view



SIMEAS Q
Side view



SIMEAS Q
Connection
terminals

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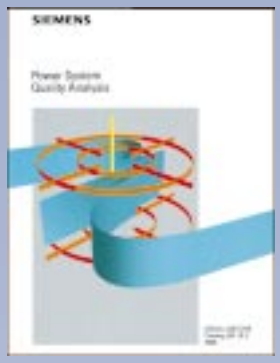

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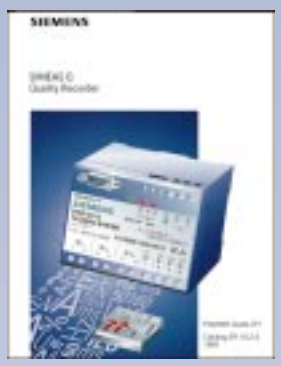

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