SIEMENS

Energy Automation

SICAM P850 Power Monitoring Device
SICAM P855 Power Monitoring Device and Power Quality Recorder

Answers for infrastructure and cities.

Contents – SICAM P850/P855

The new Power Monitoring Device and Power Quality Recorder

The most important prerequisite for continuously improving the power supply and its use is previous knowledge of local network conditions. Today there is also a greater awareness of energy efficiency and the need to monitor power and log supply quality – after all, one cannot improve what is not known. That's why monitoring of currents, voltages, harmonics and power is more urgently needed than ever. These parameters for network performance help plan networks and improve availability, efficiency and reliability. Highly accurate local monitoring is a crucial feature of current and future monitoring systems, as is open communications with the ability to integrate systems. And all these factors are the main reasons why Siemens develops power monitoring devices and power quality recorders.

The new SICAM P850/P855 multifunctional devices are used to collect, display and transmit measured electrical variables such as AC current, AC voltage, power types, harmonics, etc. The measurands and events are collected and processed according to the Power Quality Standard IEC 61000-4-30. The communications interfaces can be used to output the measurands to a PC and the control center or display them on a display.

In addition to the monitoring function, the SICAM P855 all-in-one device also provides a combined recording and evaluation function. It can record measurands at programmable time intervals, using a wide range of recorders, such as power quality and fault recorders. Long-term data and events are evaluated directly in the device according to the power quality standards (such as EN 50160) and output as reports.

Applications

SICAM P850/P855 devices are used in single-phase systems, three-phase systems and four-phase systems (with neutral conductors). They are used primarily in power utilities but also in other industrial and commercial applications.

The web server integrated into the device is used to configure the parameters and output measured values via HTML pages on a connected PC/laptop. In devices with displays, the parameters can also be configured with the function keys on the front of the device, and the measured values can be output to the display. The output variables can also be transmitted to control or other systems such as SICAM PQS V8.01 (planned) via the communications interfaces (Ethernet, e.g., IEC 61850) in the form of digital data.

Picture 1/1 SICAM P850/P855

Key features

- Robust and compact design according to IEC 62586-1, Class S (leading standard)
- Use of SICAM P850/P855 in the IT, TT and TN power systems
- Ethernet communication via the Modbus TCP or IEC 61850 Edition 2 protocol; serial communication via Modbus RTU and IEC 60870-5-103 via the RS485 interface is optional
- External time synchronization via the Network Time Protocol (NTP)
- The measurands and events are detected according to the Power Quality Standard IEC 61000-4-30. The measurement system corresponds to Class A. In terms of functional scope, measuring ranges and accuracy, SICAM P850/P855 are Class-S devices.*
- Additional measurands: Minimum/mean/maximum values, flicker, event detection, voltage dips (U_{dip}), voltage interruptions and overvoltages (swells) *
- Events are evaluated directly in HTML via the integrated web server *
- 2-GB memory for recording recorder data *
- Evaluations: Power quality reports and online viewer output directly on the HTML page *
- Data export: PQDIF and COMTRADE data *

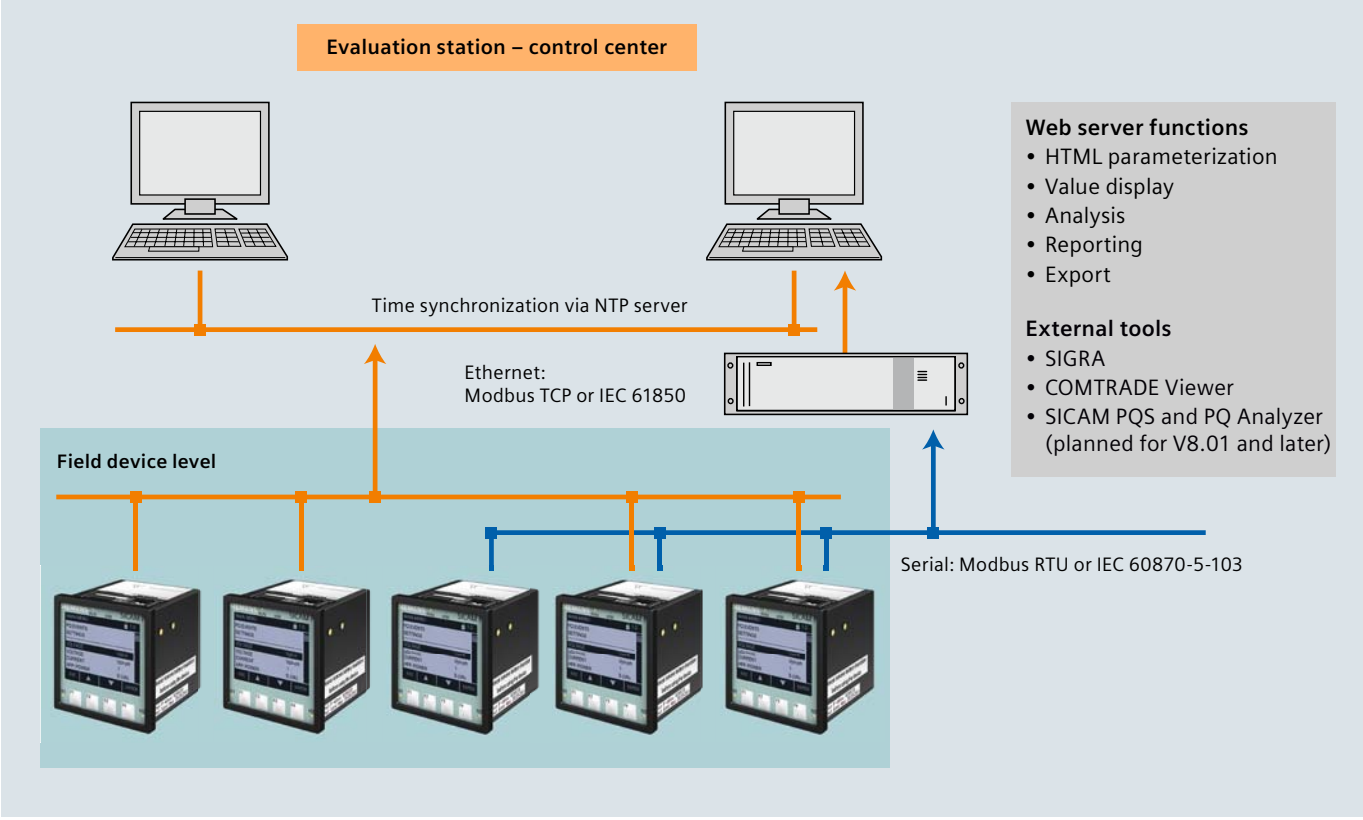
* for SICAM P855

Description

SICAM P850 and SICAM P855 system view

SICAM P850 and SICAM P855 can communicate flexibly with automation systems and evaluation stations via open protocols such as IEC 61850 and Modbus TCP.

With the SICAM P855, power quality and event recordings can be exported in open data formats such as PQDIF and COMTRADE in the form of error recordings. They are available directly from the device in the form of HTML pages on a connected PC. Additional programs such as SICAM PQS/SIGRA and COMTRADE Viewer provide other evaluation and reporting functions for SICAM P855.



Picture 1/2 Sample application

Function overview

Function overview

Device variants

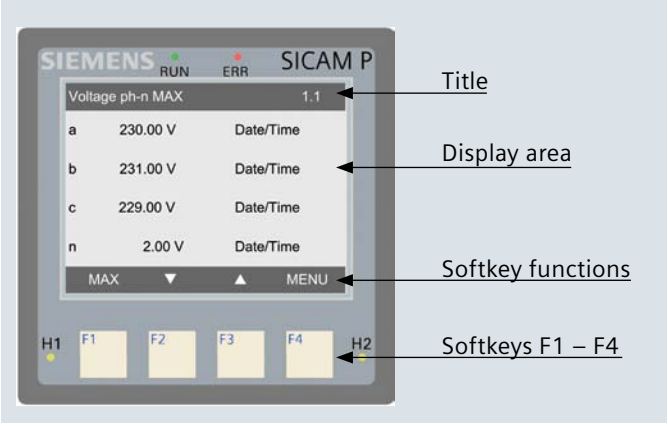
SICAM P850/P855 are designed as panel flush-mounted devices with a graphical display for displaying measured values and parameterization and come in two variants:

- SICAM P850 Power Monitoring Device (7KG850xxx) and
- SICAM P855 Multifunction Power Quality Measuring Device (7KG855xxx) with recorder functions and 2 GB of memory

Both models are also available as DIN rail devices without displays.

Ethernet communication uses the Modbus TCP or IEC 61850 communication protocol. Serial communication is optionally available with an RS485 interface via Modbus RTU or IEC 60870-5-103.

The front protection class is IP20 for DIN rail devices without displays. Devices for panel flush mounting with displays have protection class IP 40 or IP51.



Picture 1/3 Display and softkeys

Hardware design

SICAM P850/P855 contains the following electrical modules, depending on the device variant:

- Digital signal processor (DSP)
- Display and softkeys
- 4 inputs for AC voltage measurements
- 3 inputs for AC current measurements
- 2 binary outputs
- Power supply
- Ethernet interface
- RS485 interface (depending on variant ordered)

Measurands

The following measurands are collected or calculated by the device from the measured variables:

- True RMS AC voltage and AC current
- 2,048 sampled values, 10/12 periods
- Effective value measurement (TRMS) up to 100th harmonic
- Line frequency
- Active, reactive and apparent power
- Active, reactive and apparent energy
- Power factor and active power factor
- AC voltage and AC current unbalance
- Harmonics of AC voltage and AC current are stored up to the 40th order for evaluation
- THD (Total Harmonic Distortion) of AC voltage and AC current
- Phase angle
- Flicker

SICAM P855 recorder functionality

Both measurands and events can be recorded at different time intervals. The SICAM P855 device provides the following functions:

- **Measurand recorder**
  Records PQ measurands (voltage values, frequency, harmonics, flicker) and non-PQ measurands (e.g., current or power); the measurands and events are detected according to the power quality standards IEC 61000-4-30, IEC 61000-4-7 and IEC 61000-4-15
- **Trend recorder**
  Long-term recording and monitoring of effective values (1/2 periods) of voltage and optionally current
- **Fault recorder**
  Records voltage or current dips, swells and interruptions over a parameterized time segment within programmable tolerance ranges
- **Event recorder**
  Records voltage, frequency and voltage unbalance events according to a selectable standard, such as EN 50160

The device has a 2-GB memory for recording the recorder data. The stored data can be exported manually in COMTRADE or PQDIF format (IEEE standard 1159.3) or transmitted via IEC 61850.

Communication

An Ethernet interface and an optional RS485 interface are available for communicating with the control center and other process automation systems. The RS485 interface supports the transmission of operating measured values, counts and messages. The Modbus RTU or IEC 60870-5-103 communication protocol can be used, depending on the device variant.

The device parameterization, transmission of measured data, counts and messages/events as well as time synchronization with the Network Time Protocol (NTP) are supported over Ethernet.

The SICAM P850 and P855 devices support the transmission of operating measured values with the two Ethernet protocol options – via both Modbus TCP and IEC 61850.

With SICAM P855, it is also possible to transmit voltage events via Modbus TCP. The power quality data can also be exported via IEC 61850 (as standard PQDIF/COMTRADE data).

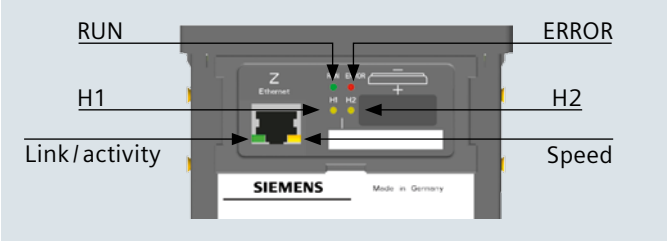
Time synchronization

The devices need to have the date and time during operation for all time-relevant processes. SICAM P850/P855 therefore uses time synchronization while communicating with peripheral devices to guarantee a common time basis and to permit time stamping of the process data. The following types of time synchronization can be carried out:

- **Time synchronization via Ethernet NTP (preferred)**
  SICAM P850/P855 has an SNTP client (Simple Network Time Protocol) that can be connected to two NTP servers (Network Time Protocol) for external time synchronization: the primary and secondary (redundant) NTP servers.
- **External time synchronization via the field bus**
  using the Modbus RTU or IEC 60870-5-103 communication protocol
- **Real Time Clock (RTC)**
  If external time synchronization is not possible, data can be synchronized with the time pulse of an internal clock.

LED signaling

SICAM P850/P855 automatically monitors the functions of its hardware/firmware components. LEDs signal the current device status.



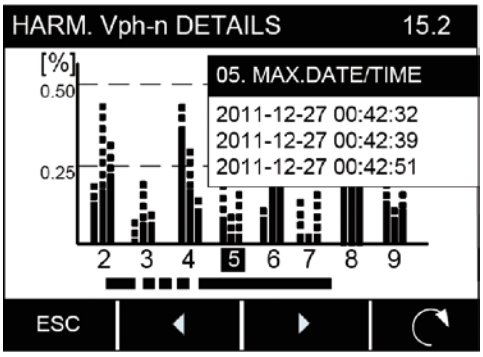
Picture 1/4 LED indicators

Display and softkeys

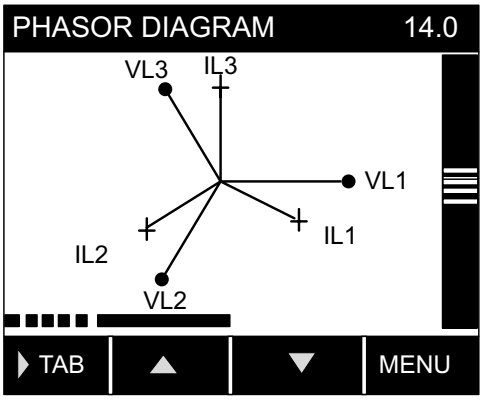
All SICAM P850/P855 models can be operated via HTML pages, using a connected PC. Devices with displays can also be operated using the function keys on the front of the display.

On panel flush-mounted devices, the front of the display accommodates four keys and four LEDs located at the bottom of the display. Of these LEDs, H1, H2 and ERROR can be parameterized. The ERROR LED can be parameterized only for error messages.

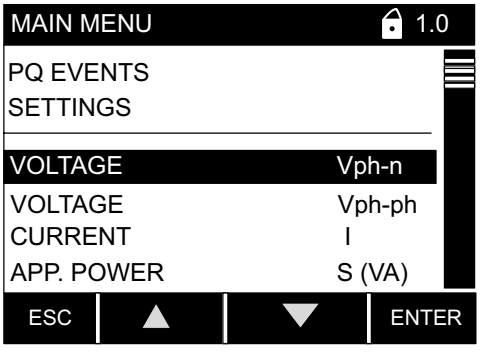
Parameter settings, measured values and graphics are displayed on the screen.



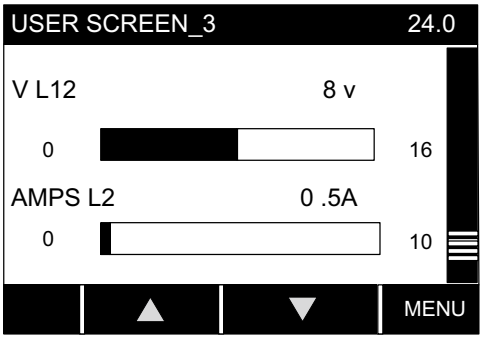
Picture 1/5 Harmonics display



Picture 1/6 Phasor diagram



Picture 1/7 Menu for displaying PQ events



Picture 1/8 User-defined view

Setup and display

Parameterization and visualization

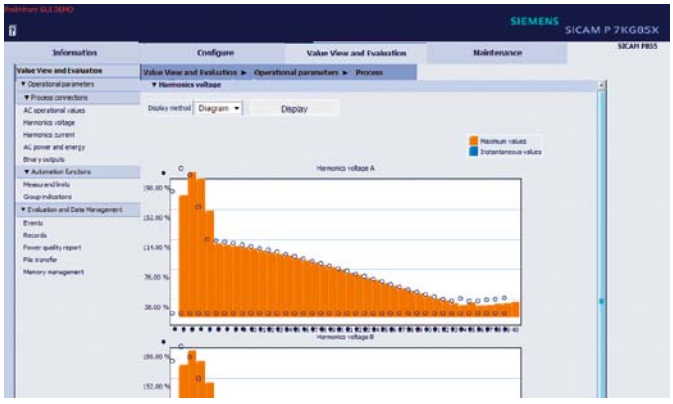
All SICAM P850/P855 devices are operated from a connected PC. An internal web browser with HTML pages is generally used for parameterization.

Picture 1/9 Parameterizing the process connections

Visualizing values

Depending on which operating parameters are selected, the input/output window displays measured values with the corresponding measurement units or a tabular list that is updated every 5 seconds.

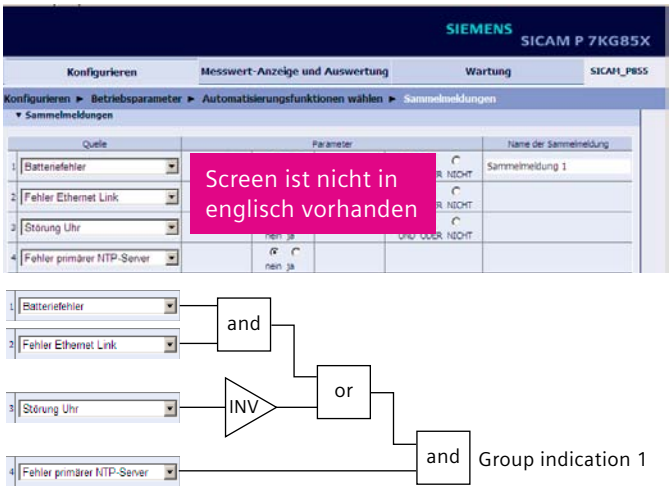
- Operating measured values
- Voltage harmonics
- Current harmonics
- Power and energy
- Binary outputs
- Limit values
- Group indications
- Flicker



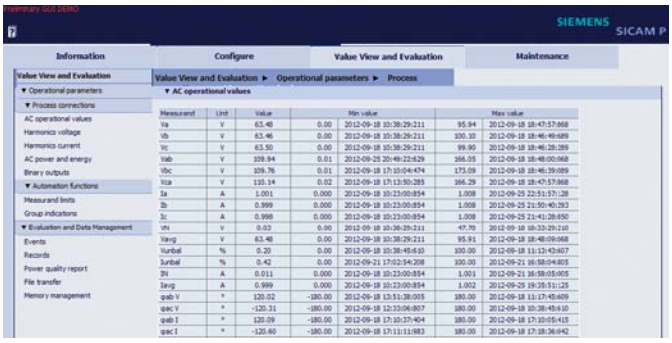
Picture 1/10 Graphical display of harmonics

Automation functions

Upper and lower limit values can be parameterized for up to 16 measured values. Alerts can be output if these limit values are exceeded. Up to four limit value violations are output on the device via the two binary outputs as well as the H1 and H2 LEDs. In addition, all 16 limit value violations can be sent to peripheral devices via Ethernet.

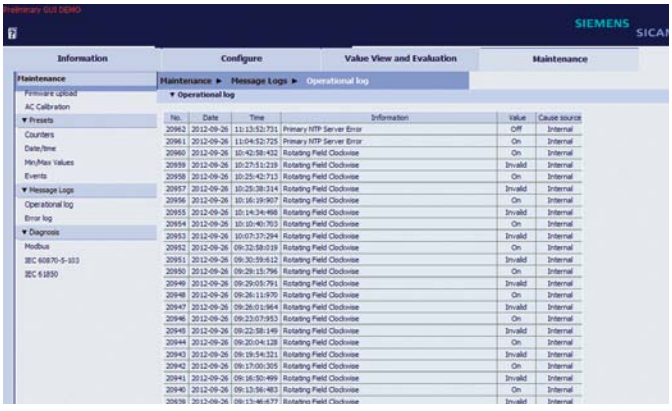


Picture 1/11 Linking alerts to a group indication



Picture 1/12 Visualisierung von Betriebsmesswerten

Other maintenance tasks, such as outputting operating logs and error messages as well as firmware updates, can also be carried out via the HTML pages.



Picture 1/13 Visualizing operating logs

Data availability of the operating measurands

		SICAM P850 and P855	SICAM P855					
	Data	Operating measured values (10/12 cycle)	Event evaluation (dips, swells, interruptions)	Fault recorder	Trend recorder (1/2 period RMS event recording)	Measurand recorder (30 s, 60 s, 10 min, 15 min, 30 min, 1 h, 2 h)		
	Interface	Modbus TCP, Modbus RTU, IEC 60870-5-103, IEC 61850, HTML and display	Modbus TCP, IEC 61850, HTML and display	IEC 61850, HTML	IEC 61850, HTML	– IEC 61850 protocol (PQDif – depending on measuring interval) – Modbus TCP protocol		
	Type	Values	Values	COMTRADE	PQDIF	Mean values	Max. values	Min. values
AC Voltage	$U_{L1, L2, L3}$	x	x[1]	x	x	x	x	x
	$U_{L12, 23, 31}$	x	x[1]	x	x	x	x	x
	U_N	x				x	x	x
	U_{sum}	x				x		
	U_{unsym}	x				x	x	x
AC Current	$I_{L1, L2, L3}$	x		x		x	x	x
	I_0	x				x		
	I_{sum}	x				x		
	I_{unsym}	x				x	x	x
Active Power Factor	cos φ (L1), (L2), (L3)	x				x	x	x
	cos φ	x				x	x	x
Power factor	PF_{L1}, PF_{L2}, PF_{L3}	x				x	x	x
	PF	x				x	x	x
Phase Angle	φ_{L1}, φ_{L2}, φ_{L3}	x				x	x	x
	φ	x				x	x	x
Frequency	f (System freq.)	x						
	10s-Freq (10-Freq.)					x[2]	x[2]	x[2]
Harmonics, Voltage, Magnitude	H_U_{L1-x}, U_{L2-x}, U_{L3-x} (x=1 bis 40)	x				x	x	
Harmonics, Current, Magnitude	H_I_{L1-x}, H_I_{L2-x}, H_I_{L3-x} (x=1 bis 40)	x				x	x	
THD, Voltage	THD_U_{L1}, THD_U_{L2}, THD_U_{L3}	x				x	x	x
THD, Current	THD_I_{L1}, THD_I_{L2}, THD_I_{L3}	x				x	x	x
Flicker (short)	P_{st1}, P_{st2}, P_{st3}					x[3]	x[3]	x[3]
Flicker (long)	P_{lt1}, P_{lt2}, P_{lt3}					x[4]	x[4]	x[4]
Active Power	P_{L1}, P_{L2}, P_{L3}	x				x	x	x
	P	x				x	x	x
Reactive Power	Q_{L1}, Q_{L2}, Q_{L3}	x				x	x	x
	Q	x				x	x	x
Apparent Power	S_{L1}, S_{L2}, S_{L3}	x				x	x	x
	S	x				x	x	x
Active Energy – Supply	WP_{L1}, WP_{L2}, WP_{L3}_ Supply	x						
	WP_ Supply	x						
Active Energy – Demand	WP_{L1}, WP_{L2}, WP_{L3}_ Demand	x						
	WP_ Demand	x						
Reactive Energy – Inductive	WQ_{L1}, WQ_{L2}, WQ_{L3}_ inductive	x						
	WQ_ inductive	x						
Reactive Energy - Capacitive	WQ_{L1}, WQ_{L2}, WQ_{L3}_ capacitive	x						
	WQ_ capacitive	x						
Apparent Energy	WS_{L1}, WS_{L2}, WS_{L3}	x						
	WS	x						

Table 1 / 1 Data availability

[1] Event information according to EN 50160, for example (Dip, swell, interruption)

[2] Frequency is permanently defined with a 10-second mean value recording

[3] IEC 61850: Flicker Pst is permanently defined with a 10-minute recording

[4] Flicker P_{lt} is permanently defined with a 2-hour recording

Measurement system according to IEC 61000-4-30 Ed. 2

Functions of the measurement system

SICAM P850 / P855 are devices for measuring voltage quality according to IEC 61000-4-30 Ed. 2 and other measurands in single-phase or multi-phase supply systems. The measurement system is implemented according to Class A. In terms of functional scope, measuring ranges and accuracy, SICAM P850 / P855 devices are Class-S measuring devices.

The basic measuring interval for determining the values of the variables (mains voltage, mains voltage harmonics and mains voltage unbalance) is a 10-period time interval for 50-Hz supply systems and a 12-period time interval for 60-Hz supply systems. The 10 / 12-period measurement is resynchronized to each RTC 10-minute limit.

The values for the 10/12-period time intervals are aggregated over additional time intervals.

10-minute interval (SICAM P855)

The value aggregated in a 10-minute interval is tagged with the absolute time (e.g., 01:10:00). The time is indicated at the end of the 10-minute aggregation as a time qualifier. The values for the 10-minute time interval are calculated without interruption from the 10 / 12-period time intervals.

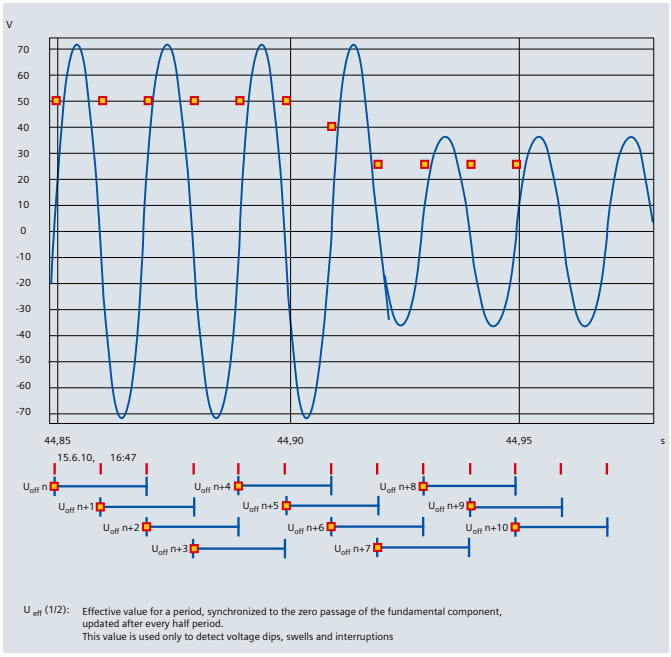
Tagging concept

During a voltage dip, swell or interruption, the measurement method may supply implausible values for other measurands (e.g., frequency measurement, voltage harmonics). The tagging concept therefore prevents an individual event from being accounted for multiple times for different measurands (e.g., an individual undervoltage as an undervoltage and simultaneously as a frequency change).

Measurands for evaluating voltage quality

Mains voltage level: The measurement determines the effective value of the mains voltage over a 10-period time interval for 50-Hz systems and a 12-period time interval for 60-Hz systems. All 10 / 12-period time intervals are detected without interruption or overlapping.

Voltage events – voltage interruptions, dips and swells: The basic measurement of the effective value U_{eff} of a voltage event is the determination of the effective value U_{eff} (1 / 2) for each individual measuring channel. The set threshold values for voltage, hysteresis and duration (t) for each individual measuring channel characterize one voltage event.



Picture 1 / 14 Representation of the measurement system concept, e.g., for a voltage dip

Mains voltage unbalance: Determined on the basis of the method for the symmetrical components. In the case of unbalance, both the positive-sequence component U_1 and the negative-sequence component U_2 are determined.

Mains voltage harmonics: Uninterrupted 10 / 12-period measurement of a harmonic subgroup $U_{sg,n}$ according to IEC 61000-4-7. The total distortion is calculated as the subgroup total distortion (THDS) according to IEC 61000-4-7. Measurements are performed up to the 40th harmonics order.

Flicker: Uninterrupted detection according to IEC 61000-4-15. The following measurands are determined simultaneously for all three phase voltages: instantaneous flicker strength P_{inst} (10 / 12 measurement cycle), short-term flicker strength P_{st} (10 min) and long-term flicker strength P_{lt} (2 h).

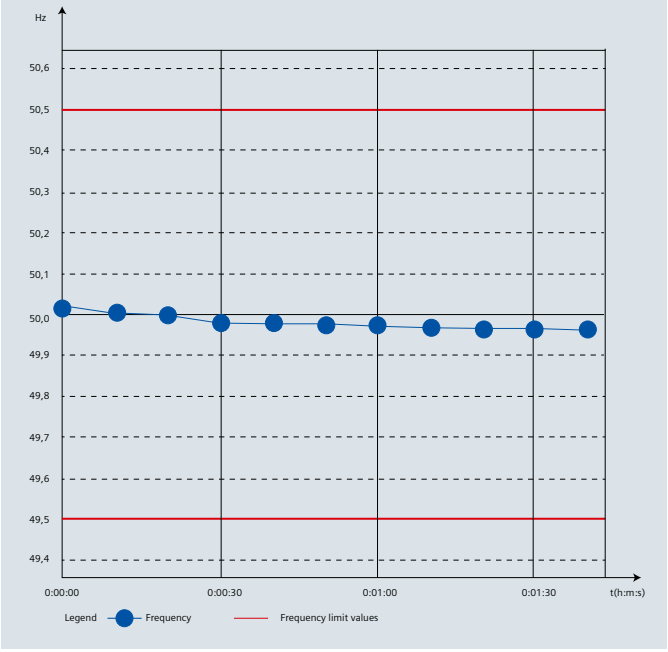
SICAM P855: Recording measured values and events

SICAM P855 provides a variety of recording options for monitoring and analyzing voltage quality.

Measurand recorder

The measurand recorder records not only measured values for determining the power quality but also various other measured values (e.g., minimum / maximum values). The recording of the following measurands can be parameterized in the user interface:

- PQ measurands for determining power quality:
  - Averaging intervals for frequency (permanently set to 10 s)
  - Averaging intervals for voltage, voltage unbalance and harmonics (30 s, 60 s, 10 min, 15 min, 30 min, 1 h, 2 h)
  - Flicker: Short-term flicker strength P_{st} (10 min) and long-term flicker strength P_{lt} (2 h)
- Additional data: Current, current unbalance, active power, apparent power, reactive power, THD of voltage, THD of current, power factor, active power factor, phase angle, energy values
- Recording of minimum values (mean values)
- Recording of maximum values (mean values)

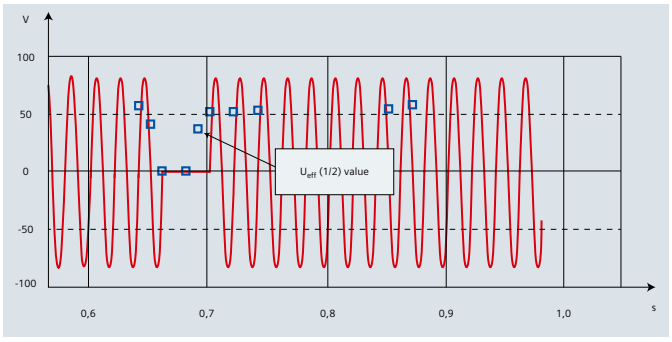


Picture 1 / 15 Functions of the PQ recorder: Measuring frequency

The measuring interval can be set in various increments from 30 seconds to 2 hours. The interval for measuring frequency is permanently set to 10 seconds.

Trend recorder

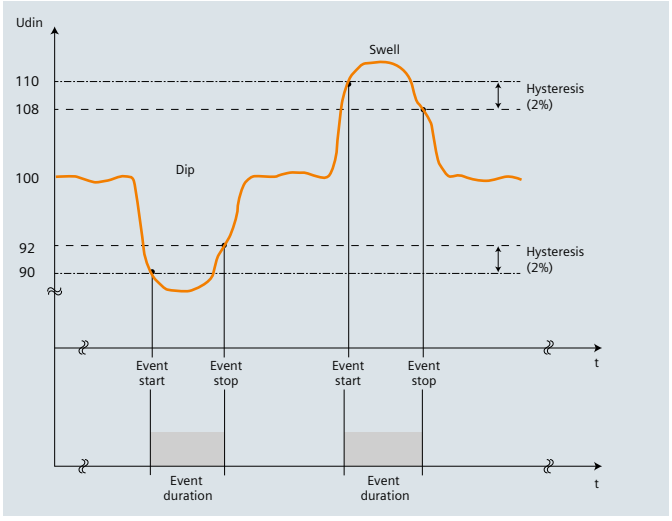
The trend recorder guarantees continuous detection and long-term monitoring of the voltage U_{eff} (1 / 2). If the measurand changes over the effective value last detected during the parameterized measuring interval, exceeding or falling below the set tolerance range, this new effective value is recorded.



Picture 1 / 16 Functions of the trend recorder: Voltage interruption

Event recorder

The event recorder records only PQ events (voltage, frequency and voltage unbalance events).



Picture 1 / 17 Recording of the event recorder: Voltage swells and dips

Fault recorder

With 2,048 sampled values per 10 / 12 period, the fault recorder records PQ events in programmable time units. The event duration is irrelevant. The current (I_{eff} (1 / 2 period)) can also be recorded. To improve the event analysis, a pretrigger time (pretrigger ratio in %) can be programmed, which allows the history of the measurand to be evaluated prior to fault inception. The agreed input voltage U_{din} is the reference variable for evaluating the faults.

Stored data transmission in SICAM P855

Data stored in the SICAM P855 can be output from the 2-GB memory and transmitted via IEC 61850 or exported or downloaded manually via HTTP. The following data formats are supported:

- COMTRADE (fault recorder data)
- PQDIF (measured value recorder and trend recorder data)

Recorder functions and applications

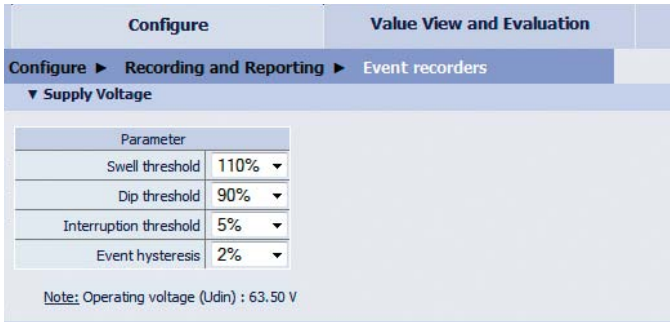
SICAM P855: Recordings and applications

Recording	Measurands	Storage interval/storage method	Application
Measurand recorder	Frequency	10 s (permanently set)	Long-term monitoring of power quality according to EN 50160 (10 min) and energy and power output monitoring (15 min)
	Flicker	P_{st} (10 min), P_{lt} (2 h)	
	Mains voltage level	30 s, 60 s, 10 min, 15 min, 30 min, 1 h, 2 h (2,048 sampled values per 10/12 period)	
	Mains voltage unbalance		
	Mains voltage harmonics		
	Additional data (power values, min/max values, etc.)		
Event recorder	Voltage dips, voltage interruptions	Residual voltage U_{eff} (1/2) and time stamp (duration)	Long-term monitoring of the power quality according to EN 50160, classification of voltage events, e.g., ITIC curve
	Voltage swells	Maximum voltage amplitude U_{eff} (1/2) and time stamp (duration)	
Trend recorder	U_{eff} (1/2)	For measured value changes (in percent or absolute) and cyclic (time interval)	Subsequent analysis of power quality (events) using any grid code
Fault recorder	Voltages, currents	Triggered by voltage events, programmable up to 3 s, > 204 sampled values per period	Analysis of the causes of power quality problems

Table 1/2 Recordings and applications

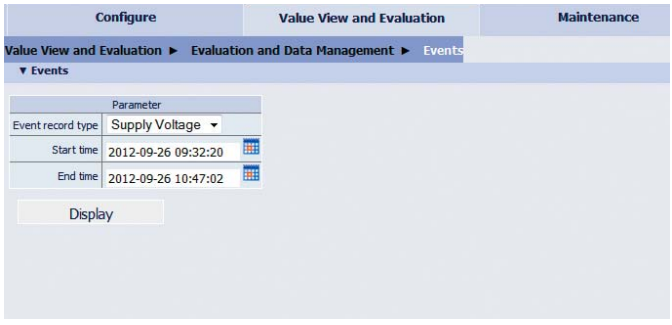
Voltage quality data

SICAM P855 provides additional settings, e.g., for recorder functions, evaluation standards, reporting according to EN 50160 and export functions.

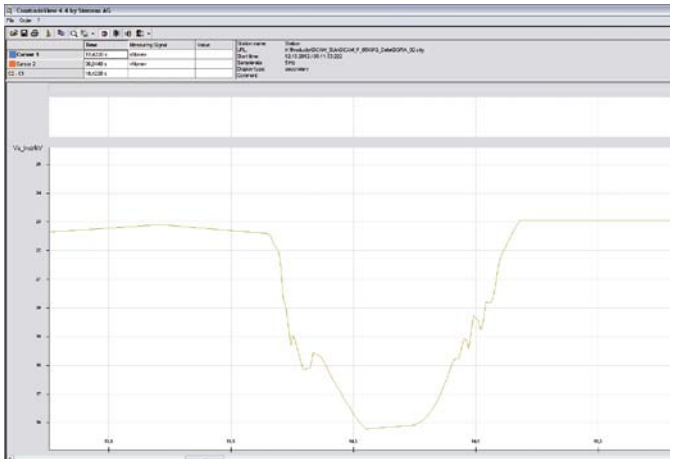


Picture 1/18 Settings for detecting voltage events

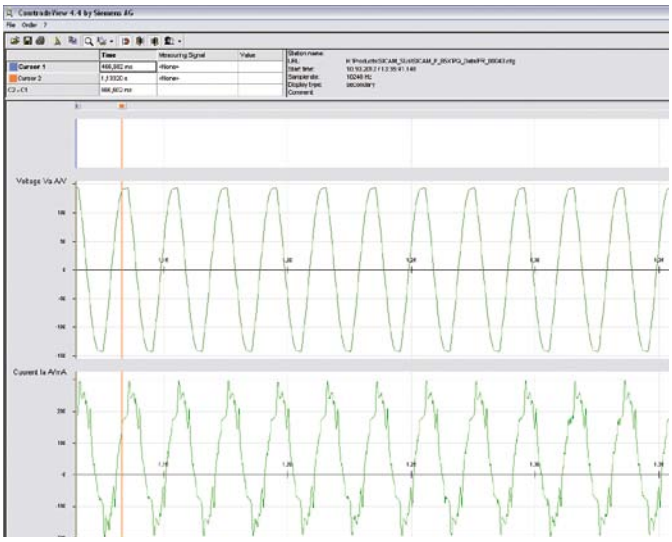
In SICAM P855, the evaluation of the recorded voltage events (e.g., voltage dips, interruptions and swells) as well as the preparation of the power quality report, data transmission and memory management are carried out directly in the device via HTML. A calendar function can be used to set the start and end times for the power quality report; the report can be created, printed, saved and edited directly from the SICAM P855 HTML page.



Picture 1/19 Evaluating voltage events



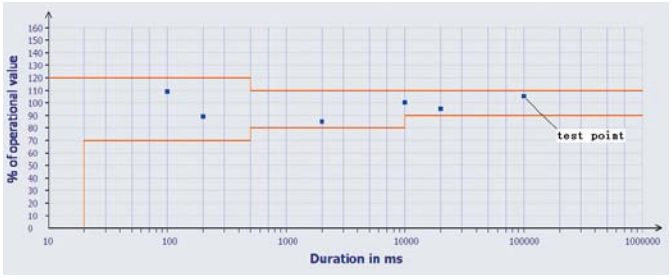
Picture 1/20 Analyzing voltage events



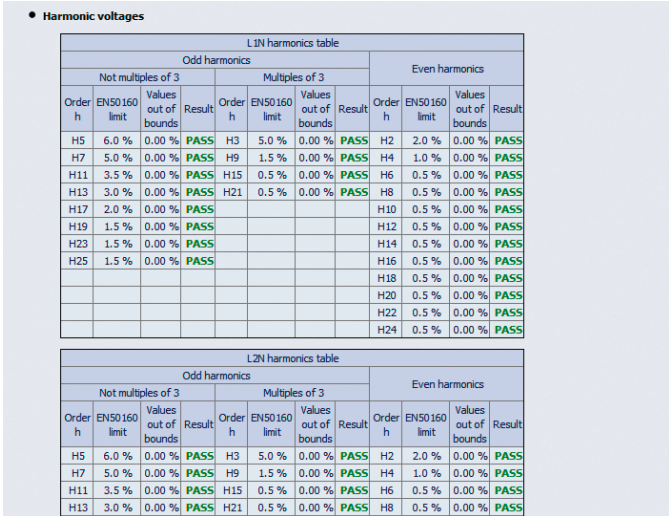
Picture 1/21 Fault recorder view with COMTRADE Viewer

Configuring reports

The report configuration function in SICAM P855 allows you to program the PQ threshold values. You can customize the process links to the installation environment and make various settings, e.g., create standardized reports according to EN 50160 LV&MV, EN 50160 HV or create user-defined reports.



Picture 1/22 Evaluating voltage events



- **Harmonic voltages**

L1N harmonics table

Odd harmonics								Even harmonics			
Not multiples of 3				Multiples of 3							
Order h	EN50160 limit	Values out of bounds	Result	Order h	EN50160 limit	Values out of bounds	Result	Order h	EN50160 limit	Values out of bounds	Result
H5	6.0 %	0.00 %	PASS	H3	5.0 %	0.00 %	PASS	H2	2.0 %	0.00 %	PASS
H7	5.0 %	0.00 %	PASS	H9	1.5 %	0.00 %	PASS	H4	1.0 %	0.00 %	PASS
H11	3.5 %	0.00 %	PASS	H15	0.5 %	0.00 %	PASS	H6	0.5 %	0.00 %	PASS
H13	3.0 %	0.00 %	PASS	H21	0.5 %	0.00 %	PASS	H8	0.5 %	0.00 %	PASS
H17	2.0 %	0.00 %	PASS					H10	0.5 %	0.00 %	PASS
H19	1.5 %	0.00 %	PASS					H12	0.5 %	0.00 %	PASS
H23	1.5 %	0.00 %	PASS					H14	0.5 %	0.00 %	PASS
H25	1.5 %	0.00 %	PASS					H16	0.5 %	0.00 %	PASS
								H18	0.5 %	0.00 %	PASS
								H20	0.5 %	0.00 %	PASS
								H22	0.5 %	0.00 %	PASS
								H24	0.5 %	0.00 %	PASS

L2N harmonics table

Odd harmonics								Even harmonics			
Not multiples of 3				Multiples of 3							
Order h	EN50160 limit	Values out of bounds	Result	Order h	EN50160 limit	Values out of bounds	Result	Order h	EN50160 limit	Values out of bounds	Result
H5	6.0 %	0.00 %	PASS	H3	5.0 %	0.00 %	PASS	H2	2.0 %	0.00 %	PASS
H7	5.0 %	0.00 %	PASS	H9	1.5 %	0.00 %	PASS	H4	1.0 %	0.00 %	PASS
H11	3.5 %	0.00 %	PASS	H15	0.5 %	0.00 %	PASS	H6	0.5 %	0.00 %	PASS
H13	3.0 %	0.00 %	PASS	H21	0.5 %	0.00 %	PASS	H8	0.5 %	0.00 %	PASS

Picture 1/23 Power quality report according to EN 50160

Measurement uncertainty/accuracy

Operating measurement uncertainty

Class S and standards IEC 61000-4-30, Ed. 3, IEC 61000-4-7 and IEC 61000-4-15

Measurands and their operating measurement uncertainty according to the IEC 62586-1, Class S product standard

Measurands	Unit	Rated Value	Operat. measurem. uncertainty acc. to IEC 62586-1, Class S, IEC 61000-4-30, IEC 61000-4-7
Voltage V_{ph-ph} (delta) Acc. to parameterization	V	AC 110 V AC 190 V AC 400 V AC 690 V max. AC 600 V for UL condition	0,2 %
Voltage V_{ph-N} (star) Acc. to parameterization	V	AC 63,5 V AC 110 V AC 230 V AC 400 V max. AC 347 V for UL condition	0,2 %
Voltage V_N	V	AC 63,5 V AC 110 V AC 230 V AC 400 V max. AC 347 V for UL condition	0,2 %
Voltage unbalance V_{unbal}	%	–	0,2 %
Frequency f	Hz	50 Hz (± 7.5 Hz) 60 Hz (± 9 Hz)	50 mHz (see Table Accuracy of the frequency measurement)
Harmonics of voltage H_xV_{ph}	% or V	–	Condition: $V_m \geq 3\,\% V_{rated}$ Maximum error: ± 5 % V_m Condition: $V_m \geq 3\,\% V_{rated}$ Maximum error: ± 0.15 % V_{rated}
Flicker (SICAM P855 only) Short-term flicker and long-term flicker	P_{st} and P_{lt}	–	Acc. to IEC 61000-4-15/30

Table 1/3 Measurement uncertainty according to IEC 62586-1

Measurands and operating measurement uncertainty according to IEC 61557-12

Measurands	Unit	Rated Value	Operat. measurem. uncertainty acc. to IEC 61557-12[1]
Current I Acc. to parameterization	A	AC 1 A AC 5 A	± 0,2 %
Current unbalance I_{unbal}	%	–	± 0,2 %
Active power P + demand, – supply	W	–	± 0,5 %, 0,2 S acc. to IEC 62053-21
Reactive power Q + inductive, – capacitive	var	–	± 0,5 %
Apparent power S	VA	–	± 0,5 %
Power factor PF [2]	–	–	± 1 %
Active power factor cos φ [2]	–	–	± 1 %
Phase angle φ [2]	Degree	–	± 2 °
Active energy WP demand	Wh	–	± 0,5 %
Active energy WP supply	Wh	–	± 0,5 %
Reactive energy WQ inductive	varh	–	± 0,5 %
Apparent energy WS	varh	–	± 0,5 %
Total harmonics distortion of voltage THD V_{ph}	%	–	± 0,5 %
Total harmonics distortion of current THD I_{ph}	%	–	± 0,5 %
Harmonics of current H_xI_{ph}	A	–	Condition: $I_m \geq 10\,\% I_{rated}$ Maximum error: ± 5 % I_m Condition: $I_m < 10\,\% I_{rated}$ Maximum error: ± 0,5 % I_{rated}

1) Tolerance limits apply to the entire nominal operating range
2) Measurement of 2 % or more of the nominal value of the apparent power within the selected measuring range

Table 1/4 Measurement uncertainty according IEC 61557-12

Accuracy of the frequency measurement

Circuit	Accuracy
Voltage to V_{a-N}	0 % to 15 % V_{rated}: ungültig
	15 % to 30 % V_{rated}: 40 mHz
	30 % to 120 % V_{rated}: 10 mHz
Voltage to V_{b-N}	0 % to 15 % V_{rated}: invalid
	15 % to 30 % V_{rated}: 40 mHz
	30 % to 50 % V_{rated}: 30 mHz
	50 % to 120 % V_{rated}: 20 mHz
Voltage to V_{c-N}	0 % to 15 % V_{rated}: ungültig
	15 % to 30 % V_{rated}: 40 mHz
	30 % to 120 % V_{rated}: 10 mHz

Table 1/5 Accuracy of the frequency measurement

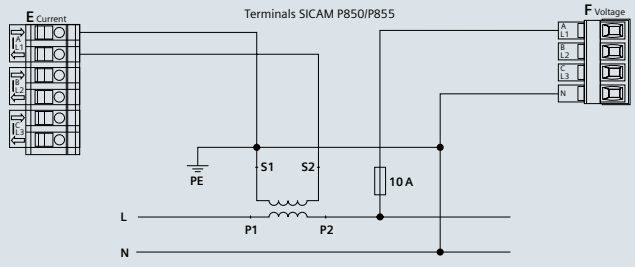
SICAM P850/P855 in various power systems

If SICAM P850/P855 is used in the IT, TT and TN power systems, no special operating conditions need to be observed.

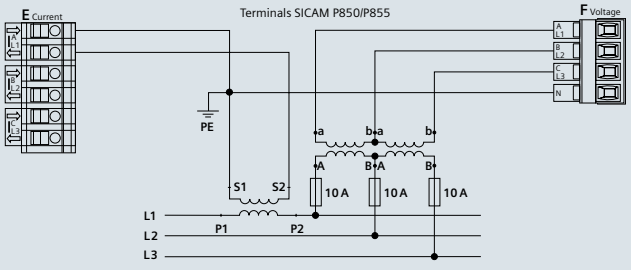
Connection types

The possible connection types in SICAM P850/P855 are:

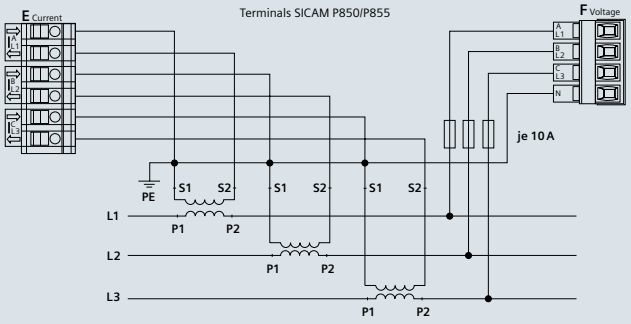
- Single-phase system
- Three-conductor system with equal (balanced) load
- Three conductor system with any (unbalanced) load (2 current inputs)
- Three conductor system with any (unbalanced) load (3 current inputs)
- Four-conductor system with equal (balanced) load
- Four-conductor system with any (unbalanced) load



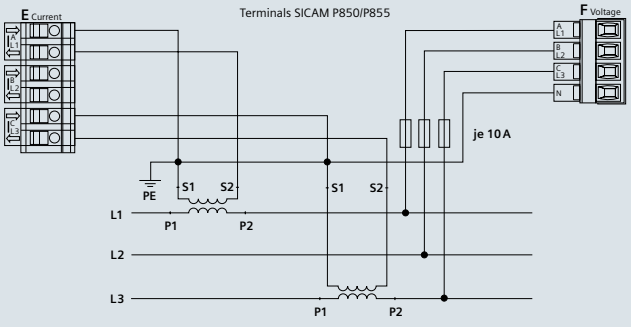
Picture 1/24 Connection example: single-phase system, 1 voltage converter



Picture 1/25 Connection example: three-conductor system, 2 voltage converters and 1 current converter, equal load

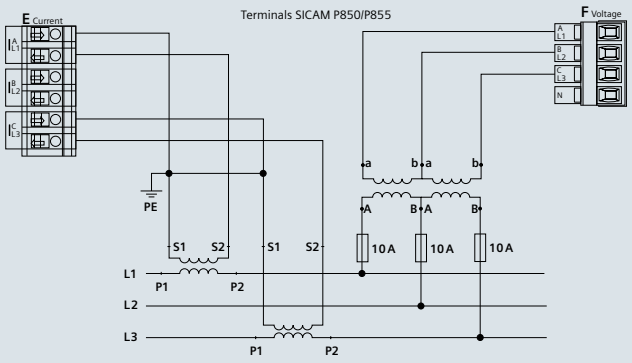


Picture 1/26 Connection example: three-conductor system, no voltage converter and 3 current converters, any load

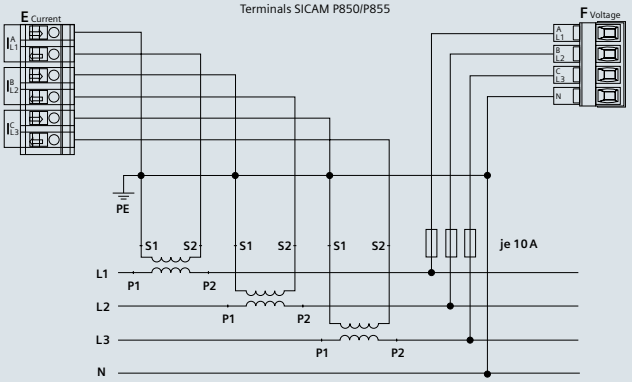


Picture 1/27 Connection example: three-conductor system, no voltage converter and 2 current converters, any load

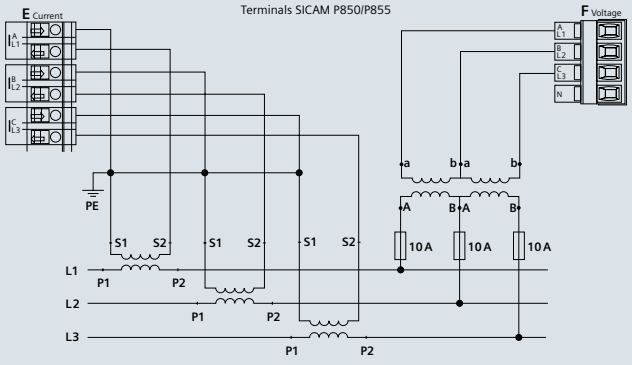
Connection types and connection examples



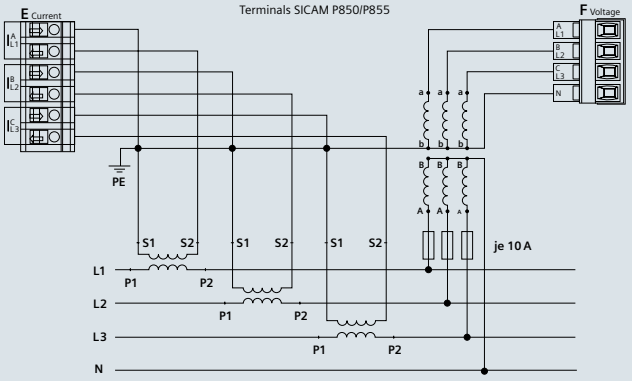
Picture 1/28 Connection example: three-conductor system, 2 voltage converters and 2 current converters, any load



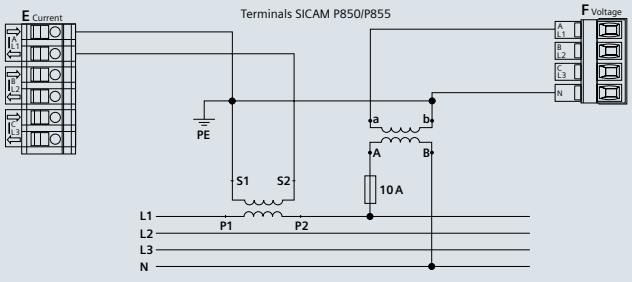
Picture 1/29 Connection example: four-conductor system, no voltage converter and 3 current converters, any load



Picture 1/30 Connection example: three-conductor system, 2 voltage converters and 3 current converters, any load

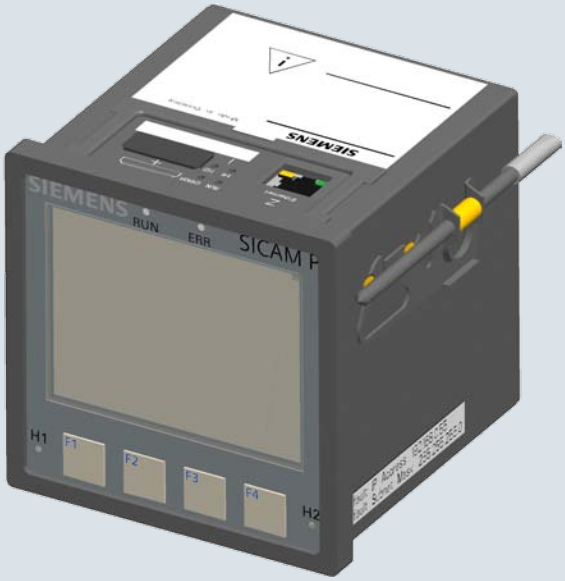


Picture 1/31 Connection example: four-conductor system, 3 voltage converters and 3 current converters, any load



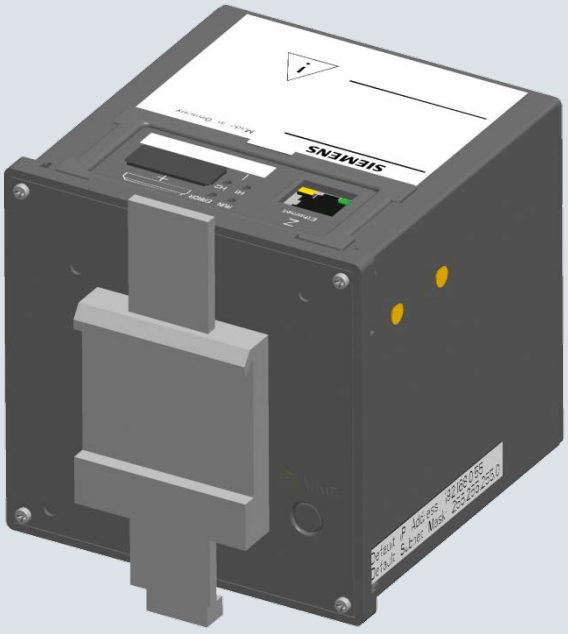
Picture 1/32 Connection example: three-conductor system, 1 voltage converter and 1 current converter, any load

SICAM P850/P855 variants

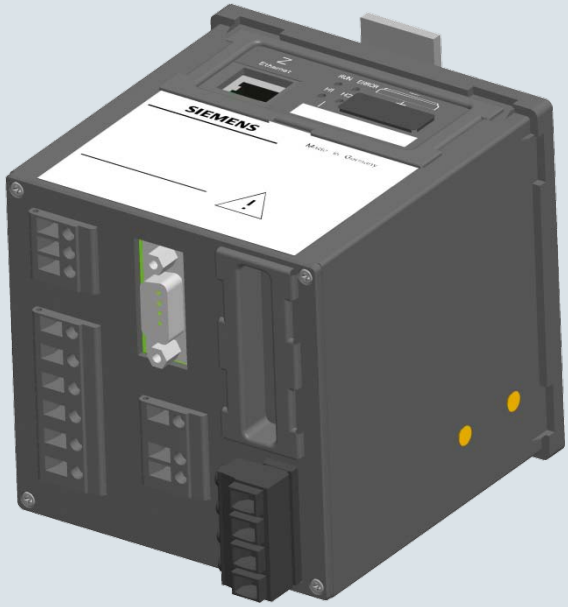


Picture 1/33 SICAM P850/P855 for panel flush mounting, display side

Picture 1/34 SICAM P850/P855 for panel flush mounting, terminal side with RS485 interface



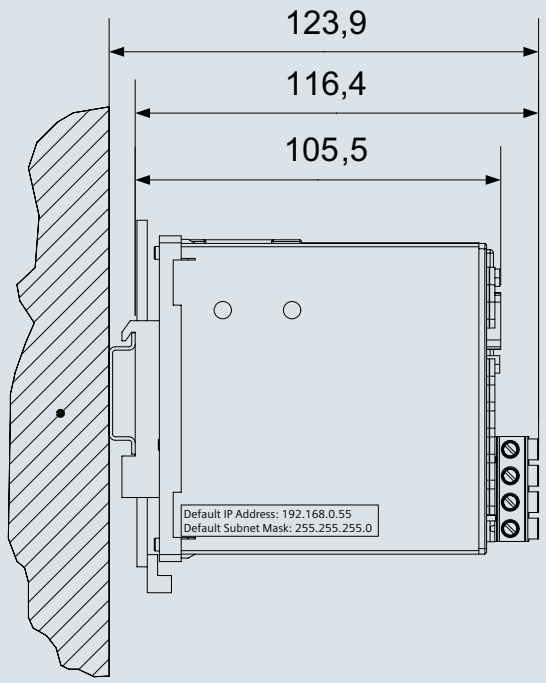
Picture 1/35 SICAM P850/P855 as a DIN rail device, DIN rail side



Picture 1/36 SICAM P850/P855 as a DIN rail device, terminal side with RS485 interface

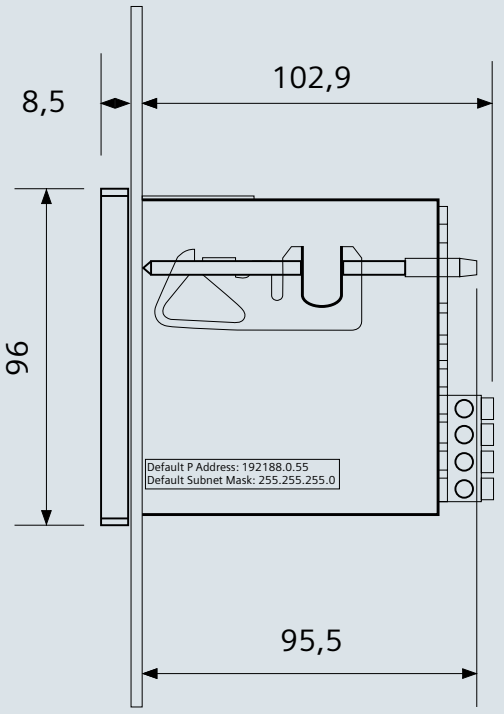
Variants and dimensions

Dimensions



DIN rail mounting

Mass	Device without display: approx. 0.49 kg Device with display, without door: approx. 0.52 kg Device with display and door: approx. 0.6 kg



Panel flush mounting

Sectional drawing for panel flush mounting (WxH)	92 (+0.8) mm x 92 (+0.8) mm (+0.8 mm = upper limit dimension)
Dimension (W x H x D)	96 mm x 96 mm x 100 mm 3.78 inch x 3.78 inch x 3.94 inch

Picture 1/37 Dimensions

Power supply

Direct voltage	
Rated input voltages	24 V to 250 V
Admissible input voltage tolerance	± 20 %
Permitted ripple of the input voltage	15 %
Maximum inrush current	
At ≤ 110 V	< 15 A
At 220 V to 300 V after 250 µs:	≤ 22 A; after 250 µs: < 5 A
Maximum power consumption	3 W

Alternating voltage	
Rated input voltages	110 V to 230 V
System frequency at AC	50 Hz / 60 Hz
Admissible input voltage tolerance	± 20 %
Permitted harmonics at AC 115 V and AC 230 V	2 kHz
Maximum inrush current	
At ≤ 115 V	< 15 A
At 230 V	≤ 22 A; after 250µs: < 5 A
Maximum power consumption	6 VA

Table 1 / 6 Power supply

Inputs and outputs

Inputs for alternating voltage measurements (connector block F)	
Rated input AC voltages (parameterizable)	
Phase-N/PE	63.5 V 110 V 230 V 400 V (max. 347 V for UL condition) Operating measurement uncertainty according to IEC 60688: ± 0,1%
Phase-phase	110 V 190 V 400 V 690 V (max. 600 V for UL condition) Operating measurement uncertainty IEC 60688: ± 0,1%
Maximum input AC voltage (depending on the parameterization)	1.2 x rated input AC voltage
Maximum input AC voltage	
Phase-N/PE	480 V (max. 347 V for UL condition)
Phase-phase	831 V (max. 600 V for UL condition)
Input impedances	
a, b, c to N	6,0 MΩ
a-b, b-c, c-a	6,0 MΩ
Further information about the voltage measurement inputs	
Power consumption per input for V_{rated} 400 V	38 mW
Permissible power frequency	42.5 Hz to 69.0 Hz
Measuring error (with calibration) at 23 °C ± 1 °C 50 Hz or 60 Hz	typically 0.1 % for reference conditions according to IEC 60888

Table 1 / 7 Inputs and outputs

Technical data

Inputs for alternating current measurements (connector block E)	
Input AC currents	
Rated input current range (parametrierbar)	1 A 5 A Betriebsmessunsicherheit gemäß IEC 60688 ±0.1 %
Max. input current	2x rated input AC current
Power consumption per input	
At 1 A	1 mVA
At 5 A	2.5 mVA
Further information about the current measurement inputs	
Zulässige Frequenz	42.5 Hz bis 69.0 Hz
Max. rated input voltage	150 V
Measuring error (with calibration) at 23 °C ± 1 °C 50 Hz or 60 Hz	Typically 0.1 % at reference conditions
Thermal stability	10 A continuous 100 A for max. 1 s according to IEC 60688

Table 1/8 Inputs for alternating current measurements

Binary outputs (connector block G)	
Maximum switching voltage	
Alternating voltage	230 V
Direct voltage	250 V
Maximum currents	
Maximum pulse current for 0.1 s	300 mA
Further information about the binary outputs	
Internal impedance	35 Ω
Admissible switching frequency	10 Hz
Number of switching cycles	Unlimited

Table 1/9 Binary outputs

Communication interfaces

Ethernet (connector Z)	
Ethernet, electrical	
Connection	Device top side RJ45 connector socket 10/100Base-T acc. to IEEE802.3 LED yellow: 10/100 Mbit/s (off/on) LED green: – flashing: active – on: not active – off: no connection
Protocols	Modbus TCP IEC 61850 Server
Voltage strength	DC 700 V
Transmission rate	10/100 MBit/s
Cable for 10/100Base-T	100 Ω to 150 Ω STP, CAT5
Maximum cable length 10/100Base-T	100 m, if well installed

Table 1/10 Ethernet

Serial interface (connector J), optional		
RS485		
Connection	RS485 port, terminal side, 9 pin D-Sub socket	
Protocol	Modbus RTU (optional)	IEC 60870-5-103 (optional)
Baud rate (adjustable)	Min. 1200 Bit/s Max. 115 200 Bit/s	Min. 9600 Bit/s Max. 38 400 Bit/s
Maximum distance of transmission	Max. 1 km (depending on data rate)	
Transmission level	Low: -5 V to -1,5 V High: +1,5 V to +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	

Table 1/11 Serial interface

EMC tests for immunity (type tests)	
Standards	IEC EN 61000-6-2 For more standards see also individual functions
Electrostatic discharge, Class III IEC 61000-4-2	6 kV contact discharge; 8 kV air discharge, both polarities; 150 pF; R_i = 330 Ω with connected Ethernet cable
Radio frequency electromagnetic field, amplitude-modulated, Class III IEC 61000-4-3	10 V/m; 80 MHz to 3 GHz 80 % AM; 1 kHz
Fast transient bursts, Class III IEC 61000-4-4	2 kV; 5 ns/50 ns; 5 kHz; Burst length = 15 ms; Repetition rate 300 ms; Both polarities; R_i = 50 Ω; Test duration 1 min
High energy surge voltages (SURGE), Installation Class III IEC 61000-4-5	Impulse: 1.2 µs/50 µs
Auxiliary voltage	Common mode: 2 kV; 12 Ω; 9 µF Diff. mode: 1 kV; 2 Ω; 18 µF
Measuring inputs, binary inputs and relay outputs	Common mode: 2 kV; 42 Ω; 0.5 µF Diff. mode: 1 kV; 42 Ω; 0.5 µF
HF on lines, amplitude-modulated, Class III IEC 61000-4-6	10 V; 150 kHz to 80 MHz; 80 % AM; 1 kHz
Power system frequency magnetic field IEC 61000-4-8, Class IV;	30 A/m continuous; 300 A/m für 3 s
1 MHz test, Class III, IEC 61000-4-18	2.5 kV (peak); 1 MHz; τ = 15 µs; 400 Stöße je s; Prüfdauer 1 min; R_i = 200 Ω

Table 1/12 EMC tests for immunity

EMC tests for electromagnetic interference (type test)	
Standard	IEC EN 61000-6-4
Radio noise voltage to lines, only auxiliary voltage IEC-CISPR 22	150 kHz to 30 MHz Limit Class A
Interference field strength IEC-CISPR 22	30 MHz to 1000 MHz Limit Class A

Table 1/13 EMC tests for electromagnetic interference

Mechanical tests

Vibration and shock stress in stationary use	
Standards	IEC 60068
Oscillation IEC 60068-2-6 test Fc	Sinusoidal 10 Hz to 60 Hz: ±0,075 mm amplitude; 60 Hz to 150 Hz: 1 g acceleration Frequency sweep rate 1 octave/min 20 cycles in 3 orthogonal axes
Shock IEC 60068-2-27 test Ea	Semi-sinusoidal 5 g acceleration, duration 11 ms, each 3 shocks in both directions of the 3 axes
Seismic Vibration IEC 60068-3-3 test Fc	Sinusoidal 1 Hz to 8 Hz: ±7.5 mm amplitude (horizontal axis) 1 Hz to 8 Hz: ±3.5 mm amplitude (vertical axis) 8 Hz to 35 Hz: 2 g acceleration (horizontal axis) 8 Hz to 35 Hz: 1 g acceleration (vertical axis) Frequency sweep 1 octave/min 1 cycle in 3 orthogonal axes

Table 1/14 Vibration and shock stress in stationary use

Vibration and shock stress during transport	
Standards	IEC 60068
Oscillation IEC 60068-2-6 test Fc	Sinusoidal 5 Hz to 8 Hz: ±7.5 mm amplitude; 8 Hz to 150 Hz: 2 g acceleration Frequency sweep 1 octave/min 20 cycles in 3 orthogonal axes
Shock IEC 60068-2-27 test Ea	Semi-sinusoidal 15 g acceleration, duration 11 ms, each 3 shocks (in both directions of the 3 axes)
Continuous Shock IEC 60068-2-29 test Eb	Semi-sinusoidal 10 g acceleration, duration 16 ms, each 1000 shocks (in both directions of the 3 axes)
Free fall IEC 60068-2-32 test Ed	0.5 m

Table 1/15 Vibration and shock stress during transport

Technical data

Test data

Reference conditions according to IEC 62586-1 for determining the test data	
Ambient temperature	23 °C ± 2 °C
Relative humidity	40 % to 60 % RH
Supply voltage	V_{PS} ± 1 %
Phases (3-wire network)	3
External continuous magentic fields	DC field: ≤ 40 A/m
	AC field: ≤ 3 A/m
DC components V/I	none
Signal waveform	sinus
Frequency	50 Hz ± 0.5 Hz
	60 Hz ± 0.5 Hz
Voltage magnitude	V_{din} ± 1 %
Flicker	Pst < 0.1 %
Unbalance (all channels)	100 % ± 0.5 % of V_{din}
Harmonic	0 % to 3 % of V_{din}
Interharmonic	0 % to 0.5 % of V_{din}

Electrical tests

Standards	
Standards	IEC EN 61000-6-2 IEC EN 61000-6-4 IEC EN 61010-1 IEC EN 61010-2-030

Insulation test according to IEC 61010-1 and IEC EN 61010-2-030				
Inputs/Outputs	**Insulation**	**Rated Voltage**	**ISO Test Voltage**	**Category**
Current measuring inputs	Reinforced	150 V	AC 2.3 kV	Cat. III
Voltage measuring inputs	Reinforced	480 V	Stoßspannung 9.76 kV	Cat. III
Supply voltage	Reinforced	300 V	DC 3.125 kV	Cat. III
Binary outputs	Reinforced	300 V	AC 3.536 kV	Cat. III
Ethernet interface	Function	< 50 V	DC 700 V	Cat. III
RS485 interface	Function	< 50 V	DC 700 V	Cat. III

Environmental conditions

Temperature data	
Operating temperature Devices with display: the legibility of the display is impaired at temperatures < 0 °C (+32 °F).	-25 °C to +55 °C
Temperature during transport	-40 °C to +70 °C
Temperatur during storage	-40 °C to +70 °C
Maximum temperature gradient	20 K/h

Air humidity data	
Mean relative air humidity per year	≤ 75 %
Maximum relative air humidity	95 %, 30 days a year
Condensation during operation	Not permitted
Condensation during transport and storage	Permitted

Altitude	
Max. altitude above sea level	2000 m

General data

Battery	
Type	PANASONIC CR2032 VARTA 6032 101 501
Voltage	3 V
Capacity	230 mAh
Typical life	For operation with permanently applied supply voltage: 10 years
	For operation with sporadically interrupted supply voltage: a total of 2 months over a 10-year period

Internal memory	
Capacity	2 GB

DIN rail housing	IP20
Panel flush mounting (front)	IP40 (with display, without door) IP51 (with display and door)
Terminals	IP2x

Climate stress tests

Standards: IEC 60068
Dry cold: IEC 60068-2-1 test Ad
Dry heat during operation, storage and transport: IEC 60068-2-2 test Bd
Damp heat: IEC 60068-2-78 test Ca
Change of temperature: IEC 60068-2-14 test Na and Nb

Safety standards

Standards: IEC EN 61010
IEC EN 61010-1, IEC EN 61010-2-30

Table 1/16 Further technical data

Technical data

Please refer to the manual for the technical data for SICAM P850 and SICAM P855.

Description	Order-No.
Multifunctional Power Meter, Power Quality Recorder	
SICAM P850/P855	**7KG85□□-0AA□□-□AA0**
Device type	
Dimensions 96 mm x 96 mm x 100 mm 4 Inputs for AC voltage measurements 3 Inputs for AC current measurements 2 Binary outputs Galvanic isolated voltage measurement inputs Web server for parameterization and visualization und Datenverwaltung Messungen nach Norm IEC 61000-4-30, Class S	
Measurement functions	
Basic measurements: V, I, f, P (class 0.2S), Q, S, cos phi, limit violations, energy measurements measurements till 40th harmonics Transmission measurement values via communication protocols	**0**
Basic measurements and advanced measurements and Aufzeichnungen auf internen 2-GB-SD-Speicher: Power Quality instrument Measurement min/max/mean values Recorder for Power Quality measurements Various recorders for other measurements Event detection (e.g. V_{dip}), visualisation Online PQ reporting e .g. according EN 50160	**5**
Housing	
Snap on mounting unit without graphical display	**0**
Panel mounted instrument with graphical display	**1**
Serial Communication Interface	
Without	**0**
RS485 – Modbus RTU	**1**
RS485 – IEC 60870-5-103 and Modbus RTU	**3**
Front protection class	
IP20 (Position 7 = 0)	**0**
IP40 (Position 7 = 1)	**1**
IP51 (Position 7 = 1)	**2**
Ethernet Interface and Communication protocol, RJ45	
Modbus TCP	**0**
Modbus TCP and IEC 61850 Server	**2**

Table 1/17 Selection and ordering data

Products – SICAM P850/P855