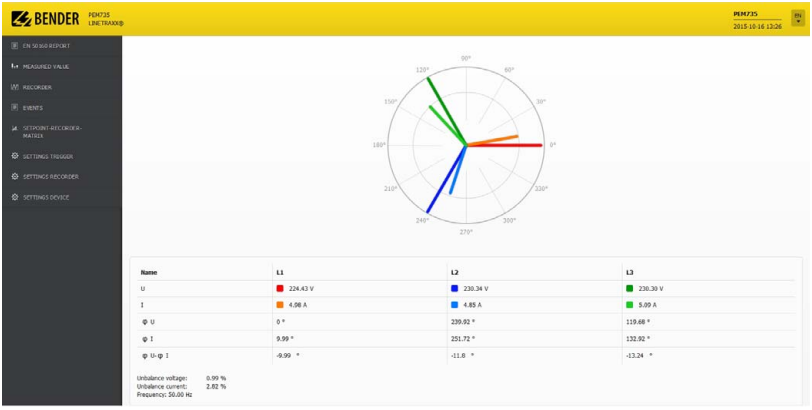
PEM735 - Webserver



Universal measuring device
100…690 V, 50 Hz
Software version 2.00.xx

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Table of Contents

1. General web application

This part of the manual describes the web application of the PEM735.
Via this web application, more measurement data can be retrieved and more extensive settings of the universal measuring device PEM735 can be made.

You can find initial commissioning instructions of the PEM735 and network settings in the manual of the PEM735.

Pay attention to the documentation of the PEM735 regarding connection and setting in order to receive valid measurement results!

1.1 Start page

Enter the network address of the PEM735 in the address field of the browser.
Example: 172.16.80.110
The start page is displayed. You will be able to return to this page at any time by clicking on the Bender logo.

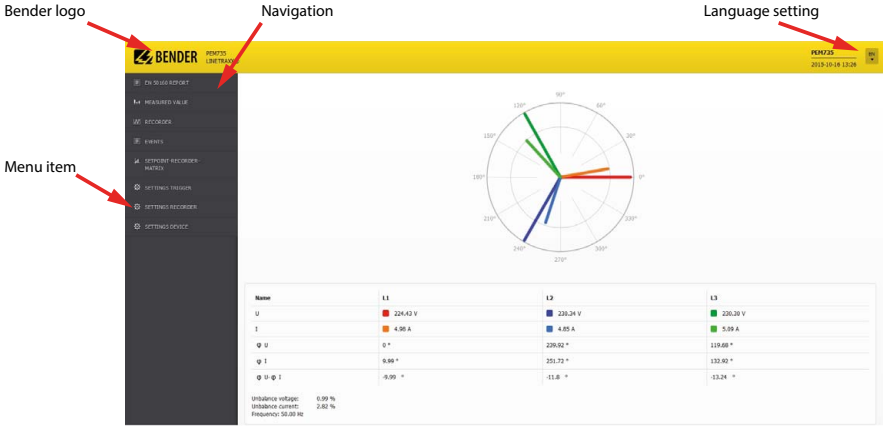


Fig. 1.1: Start page web application PEM735

1.2 Language settings

Setting possibilities: German or English

1.3 Navigation

In the left column you can find the menu items for navigation through the menu.

If there are any submenus, you can open them by clicking on an entry of the navigation column.

If you are using a small screen, you can hide the navigation in order to have more space available for the representation of the content (graphics, measured values…).

2. EN 50160 report

The results from the EN 50160 report can be displayed in an overview as well as in detail. No settings can be made at this point – except selecting the report to be viewed.

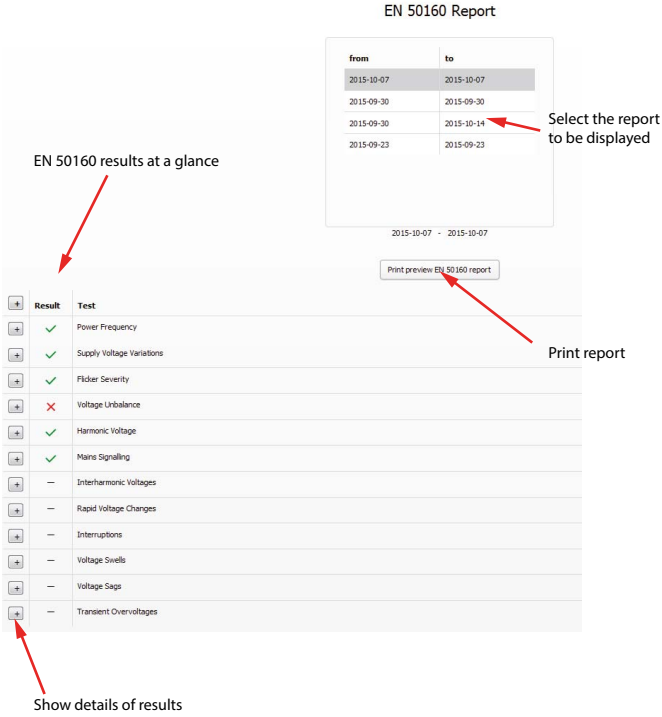


Fig. 2.1: Start page EN 50160 report

Notes for Fig. 2.1:

Results at a glance:

✓ Limit values EN 50160 have been complied with (PASSED)
X EN 50160 has not been complied with (FAILED)
— There are no limit values in the EN 50160

Selecting a report to display

The PEM735 can store up to 52 individual EN 50160 reports in a ring memory. These can be selected and displayed individually over the list.

Printing the report

The selected report can be printed out. This is also possible as a PDF if you have installed a PDF printer on your PC/tablet.
The calculation basis for the EN 50160 report can be found in the current device settings and printed in the reports.

Before modifying the connection parameters, *you should print remaining EN 50160 reports and erase the history of the EN 50160 memory.*
Otherwise, you will not be able to compare individual reports due to a different calculation basis.
The report that is generated during parameter modification cannot be used.

If the following parameters are modified, the existing EN50160 reports cannot be used:

- Frequency refresh cycle
- max. order harmonics for calculating of THD, TEHD, TOHD
- Start day EN50160 report
- Coupling (star or delta)
- PT primary
- PT secondary
- Nominal voltage, related to the secondary voltage
- Nominal frequency
- Flicker mode
- Mains signalling transmission voltage frequency 1…3
- Mains signalling transmission voltage swell threshold 1…3
- Time settings

Details of the results

By clicking on + you will get to detailed pages of the measurements.
There is an overview of the settings and results of the selected report in the detailed view of the measurements.
The result includes a list of percentage values and extreme values of the measurement.

2.1 Power frequency

Definition "Percentage value":
{Time period with correct measured values} / {entire measurement period}

Settings

f_n: The power frequency is 50 or rather 60 Hz.

Wide limit values: All measured values (= 100 % of the time) have to be in the interval f_n -6 /+ 4 %.

Narrow limit values: For systems with synchronous connection to an interconnected system, regarding the power frequency f_n the DIN EN 50160 requires an interval of 49.5…50.5 Hz for 99.5 % of a year.

Frequency refresh cycle: Has to be set to "10 s" for the necessary calculation of the average value (refer to page 66).

2.2 Voltage fluctuations

Settings

U_n: 400.00 V (U_n = Nominal line-to-line voltage)

Wide limit values (requested 100.00 % of the time)
All measured values of the year have to be within the interval 195.5…253.0 V (-15.00 % / +10.00 %).

Narrow limit values (requested 95.00 % of the time)
The voltage must not differ from the nominal voltage U_n by more than 10 % (±10.00 % or 207.0…253.0 V) during 95 % of the observation time (= one week).

To consider the voltage level, ***10-minute mean r.m.s. values of the voltage*** *are applied.*

2.3 Flicker severity

Voltage fluctuations cause changes in the luminance of lamps which can create the visual phenomenon called *flicker*. Above a certain threshold, flicker has a disturbing effect. The subjective disturbance grows very fast with the amplitude of the fluctuation. At certain repetition rates even very small amplitudes can be disturbing.

The intensity of flicker disturbance is evaluated by the following quantities:

- Short-term flicker severity (Perceptibility unit short term **Pst**), measured over a period of 10 minutes;
- Long-term flicker severity (Perceptibility unit long term **Plt**), calculated from a sequence of 12 Pst values (= two-hour interval) according to the following equation

$$P_{lt} = \sqrt[3]{\sum_{i=1}^{12} \frac{P_{sti}^{3}}{12}}$$

Settings

Limit values:	Plt must be ≤ 1 during each period of one week for 95% of the time.
Mode:	120 V or 230 V (Settings device > calculation settings > flicker mode)

Result

P95	95 % of all measured values are lower or equal to this value (95^{th} percentile)

2.4 Voltage unbalance

Under normal operating conditions, within an arbitrary week interval, 95 % of the 10-minute mean r.m.s. values of the negative sequence component of the supply voltage (related to the fundamental component) must be within the range 0…+2 % of the respective positive sequence component (related to the fundamental component).
In some areas with partly single-phase or two-phase connected network users' installations, unbalances up to about 3 % at three-phase supply terminals occur. The EN 50160 only considers the negative sequence component relevant for device errors.

2.5 Harmonic voltage

Within the observation period (1 week), 95 % of the 10-minute mean r.m.s. value of the voltage U_{rms} has to be lower or equal to the limit values from table 2.1. The total harmonic distortion THD (from HD2…40) cannot exceed 8 %.

*When using the **EN 50160 report** the **maximum harmonics order for calculation of THD, TEHD and TOHD must be set to "40".***
{Settings device > Calculation settings > max. Order Harmonics for calculating THD, TEHD, TOHD}

Harmonics order	Percentage (%)	Harmonics order	Percentage (%)
2	2.0	**3**	*0.5*
4	1.0	**5**	6.0
6	*0.5*	**7**	5.0
8	0.5	**9**	*1.5*
10	0.5	**11**	3.5
12	*0.5*	**13**	3.0
14	0.5	**15**	*0.5*
16	0.5	**17**	2.0
18	*0.5*	**19**	1.5
20	0.5	**21**	*0.5*
22	0.5	**23**	1.5
24	*0.5*	**25**	1.5

Table 2.1: Limit values for harmonics

Note table 2.1:

The 3rd order harmonics are highlighted. They contribute significantly to the unwanted heating of the neutral conductor.

In EN 50160 are no values given for harmonics of order higher than 25, as they are usually low, but largely unpredictable due to resonance effects.

Explanations regarding the diagram of harmonic voltages, which is located below the table of the harmonic voltages:

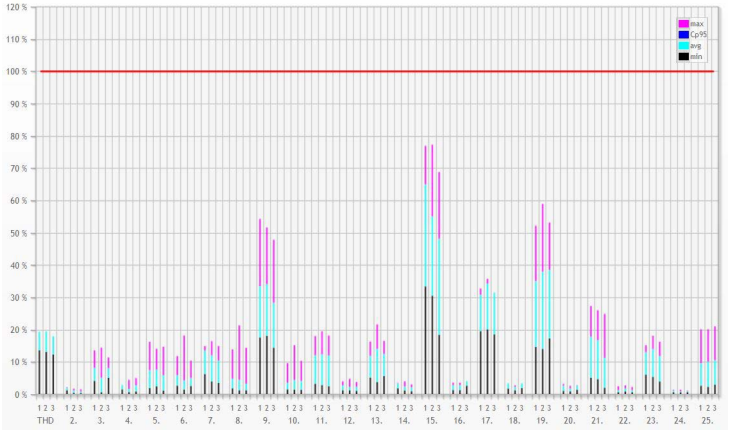


Fig. 2.2: Screenshot: Diagram of harmonic voltages

The red line corresponds to 100 % of the respective limit of the individual harmonic. The values represented in the diagram (maximum value, 95th percentile, average value and minimum value) are related to this value.
The individual harmonic voltages are divided according to the phase (1…3).

2.6 Mains signalling transmission voltage (ripple control signals)

Mains signalling transmission voltage on supply voltage/Ripple control signals are signals superimposed on the supply voltage for the purpose of transmission of information in the public supply network and to network users' premises. Signal voltages in the public supply network can be classified as follows (according to DIN EN 50160):

- Audio frequency ripple control signals: superimposed sinusoidal voltage signals in the frequency range 110…3,000 Hz;
- Mains marking signals: superimposed short time changes (transients) at selected points of the voltage waveform.

PEM735 can detect the voltage of signals in three different frequency ranges. The limits of the frequency ranges can be specified by the user. The frequency range is limited to 3 kHz.

Frequency settings under
Device settings > Calculation settings > Mains signalling voltage frequency 1…3
Swell thresholds setting under
Device settings > Calculation settings > Mains signalling voltage swell threshold 1…3

2.7 Interharmonic voltages

Interharmonics between the $(k-1)^{th}$ and k^{th} harmonic
There are no limit values to be complied with at the moment.
Interharmonics can cause flicker or interfere with the mains signalling transmission systems.

2.8 Rapid voltage changes

There are no limit values to be complied with at the moment. The number of these events during the observation period is recorded here.
Settings: see "chapter 7. Settings trigger"

2.9 Voltage interruptions

There are no limit values to be complied with at the moment. The number of these events during the observation period is recorded here.
Settings: see "chapter 7. Settings trigger"

2.10 Voltage swells

There are no limit values to be complied with at the moment.
The detailed pages offer an evaluation of the voltage swells according to duration and relative height.
Settings: see "chapter 7. Settings trigger"

2.11 Voltage sags

There are no limit values to be complied with at the moment.
The detailed pages offer an evaluation of the voltage sags according to duration and relative magnitude.
Settings: see "chapter 7. Settings trigger"

2.12 Transient voltages

There are no limit values to be complied with at the moment. Transient voltages can be overvoltages as well as undervoltages. The number of these events during the observation period is recorded here.
Settings: see "chapter 7. Settings trigger"

3. Measured value

3.1 Phasor diagram

The phasor diagram shows voltages and currents in relation to each other. The voltages and currents that belong together are depicted in similar colours (light-blue and dark-blue, light-green and dark-green, red and orange). Like this, phase angles between current and voltage can be easily assigned. The currents are depicted within the inner circle while the voltages are shown within the outer circle and each of them is standardised to the absolute highest current/voltage value.

If currents of 0 A are measured, the phase angle results in "n.a." (not applicable).

Phase shift angle φ in ° between voltage and current.

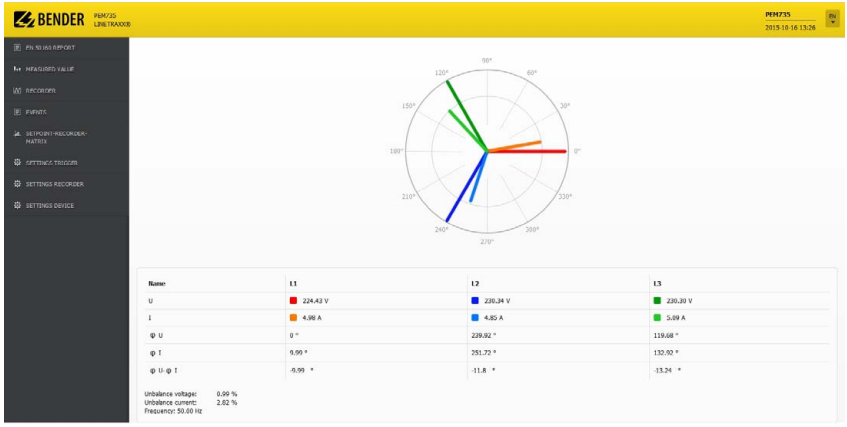


Fig. 3.1: Screenshot phasor diagram

3.2 Voltage U(L-N)

Voltage U_{LN}

Phase voltages as well as U_4 and average value as bar graphs.

If "Device settings/Connection" is set to "Delta", U(1-N), U(2-N), U(3-N), U(L-N)avg are not displayed.

Fig. 3.2: Screenshot phase voltages

3.3 Voltage U(L-L)

Voltage U_{LL}

Line-to-line voltages and average value as bar graph.

Fig. 3.3: Screenshot line-to-line voltages

3.4 Current

Currents, I_4 and average value as bar graphs.

Fig. 3.4: Screenshot current

3.5 Harmonic

Graphical and tabular representation of individual harmonics 2…63 divided into voltages and currents. For more clarity, the representation of the sources can be shown or hidden.
Tabular representation THD, TEHD, TOHD divided into currents and voltages.

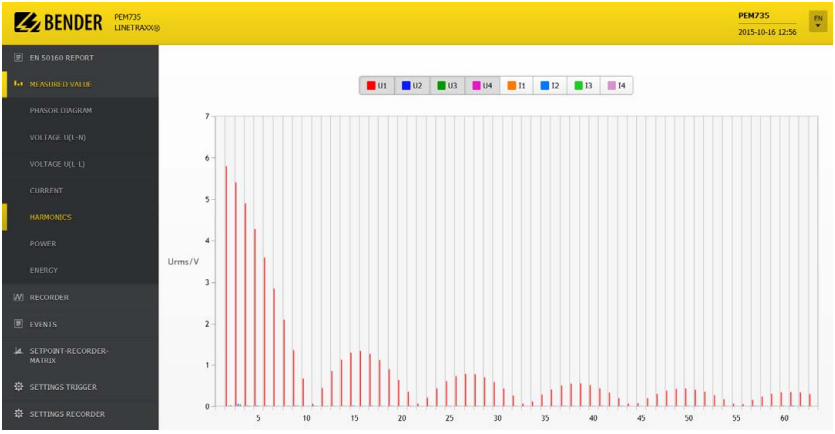


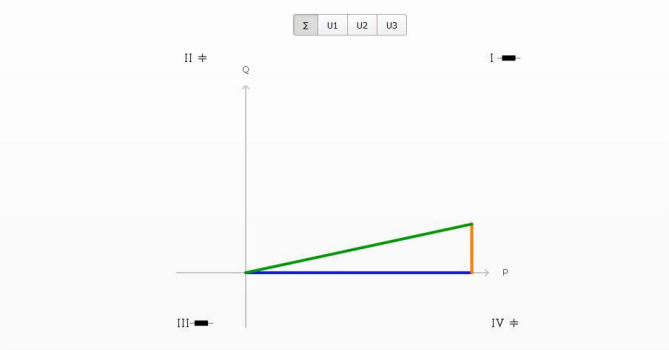
Fig. 3.5: Screenshot harmonics

The represented scale automatically adapts to the highest measured value.

Whether the representation is absolute or relative can be set under "Settings device > Calculation settings > Calculation k^{th} harmonic current" or "… voltage" (r.m.s. or distortion).

3.6 Power

Representation of the active and reactive power as measured values and as vectors in the quadrants Q1…4. The power values are displayed as total measurement (Σ) and for each individual phase $U_{1...3}$.



Channel description	Σ	U1	U2	U3
Active power	1.58 kW	584.76 W	497.58 W	495.47 W
Reactive power	359.98 var	120.18 var	137.88 var	101.92 var
Apparent power	1.62 kVA	596.98 VA	516.33 VA	505.84 VA
cos φ	0.97	0.98	0.96	0.98
△φ	12.85 °	11.61 °	15.49 °	11.62 °
Power factor	0.98	0.96	0.94	0.96

Fig. 3.6: Screenshot power

3.7 Energy

	active energy	reactive energy
Import	17.1982 MWh	831.9215 kvarh
Export	375.9581 kWh	3.1220 Mvarh
Net	16.8222 MWh	-2.2901 Mvarh
Total	17.5741 MWh	3.9540 Mvarh

apparent energy: 18.3634 MVAh

Fig. 3.7: Screenshot energy

Import	= Energy import
Export	= Energy export
Net	= Import – Export
Total	= Import + Export

4. Recorder

Three different recorders are available for representation of signal sequences:

- Data recorder
- High-speed data recorder
- Waveform recorder

These three recorder types can be configured in the menu "Recorder settings".

	Data recorder	High-speed data recorder	Waveform recorder
Minimum distance between two neighbouring data points	1 s	1 half cycle	1/25600 s
Maximum distance between two neighbouring data points	3456000 s (= 40 days)	120 half cycles	1/800 s
Maximum number of data points	65535	65535	10240
Maximum running time	7182 years (!)	50 Hz 78642 s (= 21 h, 50 min, 42 s) 60 Hz 65535 s (= 18 h, 12 min, 15 s)	12.8 s
Measuring quantities	54; refer to table 8.2	29: refer to table 8.3	4 x *U*, 4 x *I*
Measured values	Processed values like r.m.s., sums, average values, …	Processed values like r.m.s., sums, average values, …	Measured instantaneous values only

Table 4.1: Comparison recorder types

The following operating elements are available for detailed analysis:

Selecting measured quantity to be displayed

Initially, all measured quantities are shown. In order to achieve a more transparent and clear representation, the measured quantities should not be displayed on the screen simultaneously. By clicking on the corresponding button you can activate or deactivate the representation of the measured quantities.

Increasing a specific part of the wave

- Click the beginning of the section to be zoomed in.
- Hold the left mouse button.
- Drag the mouse pointer to the end of the section to be viewed (shaded in gray) and release.

A close-up view of the selected section will appear immediately.
Repeat the step for an even bigger zoom.

What?	How?
Selection measured value range	Move the mouse pointer **vertically** while holding the left mouse button
Selection time frame	Move the mouse pointer horizontally while holding the left mouse button
Select different time frame in the representation	Slide the wave representation with the mouse to the right or the left by holding the shift button
Indication of measured values (as numerical values)	In the wave representation, you can position the mouse on individual measuring points. For these, you will see the measured values as numerical values in the header of the diagram.
Return to initial representation	Double-click in the wave representation

Tab. 4.2: Details of the wave

4.1 Data recorder

Select one of the 4 high-speed data recorders or the 16 standard data recorders for indication.

Fig. 4.1: Indication data recorder

Depending on the setting of the values to be measured in the data recorder, the graphics have a totally different appearance.

Export: The values of the data recorder are exported as .csv file and can therefore be analysed in detail. Data are always entirely exported, even if the selection in the representation has been limited.

More
For faster indication, first only the recently stored measured values are displayed. If you want to display older data records you can use the buttons to load the next data "portion". This may take a few seconds.
All
All stored measured values of the DR are loaded and displayed. This may take several minutes.

4.2 Waveform recorder

The waveform recorder represents the measured values of voltages (left: indication in V) and currents (right: indication in A) on a common time axis.

Fig. 4.2: Screenshot waveform recorder

Start recording: Start waveform recorder 1 or 2 manually. This event appears after finishing a recording and refreshing the page using the button in the trigger and time stamp list.

Trigger and time stamp list

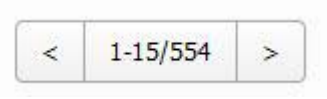
Under the wave representation, the triggers of both wave recorders are represented as a list with time stamp and cause in plain text format. The list can include up to 128 entries.

One click on a row in this list loads the data record and shows the waveform.

5. Events

5.1 SOE log (Sequence Of Events)

In the list of the SOE log, the most recent events appear on top. Up to 1024 events can be stored. If the history is not cleared, the 1025th event overwrites the first event (ring memory, FIFO principle: first in, first out).
The events can be displayed in groups of 15 entries. Selection is done via the buttons.



The complete SOE log can be exported as a .csv file.

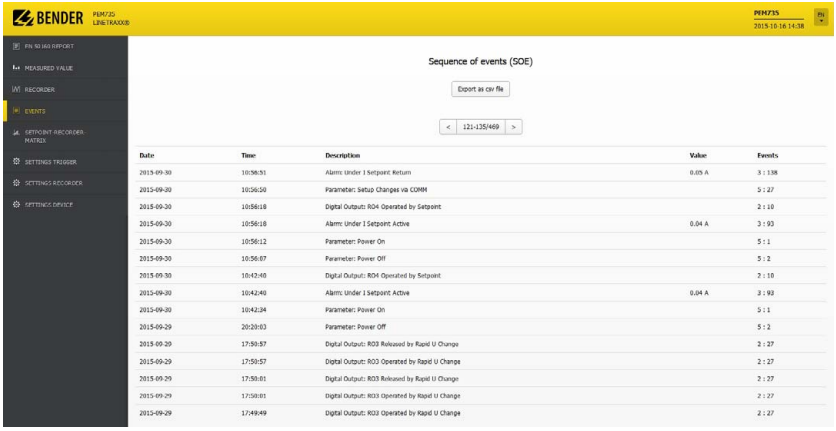


Fig. 5.1: Event protocol SOE

Events
Code x:y is the device-internal event code. In the following table, you can find the entire overview.

Overview of internal event codes of the device

1. Number: Overview of the event classification

Event classification	Description
1	DI status change
2	Function DO/RO
3	Alarm
4	Self-test
5	Parameter configuration via communication interface or device button
6	Trigger events
7	Status change <>-setpoint by harmonics 2…63 (voltage)
8	Status change <>-setpoint by harmonics 2…63 (current)

2. Number: Event subclassification

Event classification	Event sub-classification	Description
1	1	DI1 closed/open
	2	DI2 closed/open
	3	DI3 closed/open
	4	DI4 closed/open
	5	DI5 closed/open
	6	DI6 closed/open
	7	DI7 closed/open
	8	DI8 closed/open
2	1	RO1 energised/deenergised by communication interface
	2	RO2 energised/deenergised by communication interface
	3	RO3 energised/deenergised by communication interface
	4	RO4 energised/deenergised by communication interface
	5	DO1 closed/open by communication interface

Event classification	Event sub-classification	Description
2	6	DO2 closed/open by communication interface
	7	RO1 energised/deenergised by setpoint
	8	RO2 energised/deenergised by setpoint
	9	RO3 energised/deenergised by setpoint
	10	RO4 energised/deenergised by setpoint
	11	DO1 closed/open by setpoint
	12	DO2 closed/open by setpoint
	13	RO1 energised/deenergised by voltage sag/swell
	14	RO2 energised/deenergised by voltage sag/swell
	15	RO3 energised/deenergised by voltage sag/swell
	16	RO4 energised/deenergised by voltage sag/swell
	17	DO1 closed/open by voltage sag/swell
	18	DO2 closed/open by voltage sag/swell
	19	RO1 energised/deenergised by transient event
	20	RO2 energised/deenergised by transient event
	21	RO3 energised/deenergised by transient event
	22	RO4 energised/deenergised by transient event
	23	DO1 closed/open by transient event
	24	DO2 closed/open by transient event
	25	RO1 energised/deenergised by rapid voltage change
	26	RO2 energised/deenergised by rapid voltage change
	27	RO3 energised/deenergised by rapid voltage change
	28	RO4 energised/deenergised by rapid voltage change
	29	DO1 closed/open by rapid voltage change
	30	DO2 closed/open by rapid voltage change

Event classification	Event sub-classification	Description
2	31	RO1 energised/deenergised by device button
	32	RO2 energised/deenergised by device button
	33	RO3 energised/deenergised by device button
	34	RO4 energised/deenergised by device button
	35	DO1 closed/open by device button
	36	DO2 closed/open by device button
3	1	>-Setpoint U_{LN} activated
	2	>-Setpoint U_{LL} activated
	3	>-Setpoint I activated
	4	>-Setpoint U_4 activated
	5	>-Setpoint I_4 activated
	6	>-Setpoint Δf activated
	7	>-Setpoint P_{sum} activated
	8	>-Setpoint Q_{sum} activated
	9	>-Setpoint S_{sum} activated
	10	>-Setpoint λ_{sum} activated
	11	Close setpoint DI1 active
	12	Close setpoint DI2 active
	13	Close setpoint DI3 active
	14	Close setpoint DI4 active
	15	Close setpoint DI5 active
	16	Close setpoint DI6 active
	17	Close setpoint DI7 active
	18	Close setpoint DI8 active
	19	>-Setpoint demand P_{sum} activated

Event classification	Event sub-classification	Description
3	20	>-Setpoint demand Q_{sum} activated
	21	>-Setpoint demand S_{sum} activated
	22	>-Setpoint demand λ_{sum} activated
	23	>-Setpoint prognosis P_{sum} activated
	24	>-Setpoint prognosis Q_{sum} activated
	25	>-Setpoint prognosis S_{sum} activated
	26	>-Setpoint prognosis λ_{sum} activated
	27	>-Setpoint THD_U activated
	28	>-Setpoint $TOHD_U$ activated
	29	>-Setpoint $TEHD_U$ activated
	30	>-Setpoint THD_I activated
	31	>-Setpoint $TOHD_I$ activated
	32	>-Setpoint $TEHD_I$ activated
	33	>-Setpoint voltage unbalance U_2 activated
	34	>-Setpoint voltage unbalance U_0 activated
	35	>-Setpoint current unbalance I_2 activated
	36	>-Setpoint current unbalance I_0 activated
	37	>-Setpoint voltage deviation activated
	38	>-Setpoint phase reversal activated
	39…45	Reserved
	46	>-Setpoint U_{LN} reset
	47	>-Setpoint U_{LL} reset
	48	>-Setpoint I reset
	49	>-Setpoint U_4 reset
	50	>-Setpoint I_4 reset
	51	>-Setpoint Δf reset

Event classification	Event sub-classification	Description
3	52	>-Setpoint P_{sum} reset
	53	>-Setpoint Q_{sum} reset
	54	>-Setpoint S_{sum} reset
	55	>-Setpoint λ_{sum} reset
	56	Close setpoint DI1 reset
	57	Close setpoint DI2 reset
	58	Close setpoint DI3 reset
	59	Close setpoint DI4 reset
	60	Close setpoint DI5 reset
	61	Close setpoint DI6 reset
	62	Close setpoint DI7 reset
	63	Close setpoint DI8 reset
	64	>-Setpoint demand P_{sum} reset
	65	>-Setpoint demand Q_{sum} reset
	66	>-Setpoint demand S_{sum} reset
	67	>-Setpoint demand λ_{sum} reset
	68	>-Setpoint prognosis P_{sum} reset
	69	>-Setpoint prognosis Q_{sum} reset
	70	>-Setpoint prognosis S_{sum} reset
	71	>-Setpoint prognosis λ_{sum} reset
	72	>-Setpoint THD_U reset
	73	>-Setpoint $TOHD_U$ reset
	74	>-Setpoint $TEHD_U$ reset
	75	>-Setpoint THD_I reset
	76	>-Setpoint $TOHD_I$ reset
	77	>-Setpoint $TEHD_I$ reset

Event classification	Event sub-classification	Description
3	78	>-Setpoint voltage unbalance U_2 reset
	79	>-Setpoint voltage unbalance U_0 reset
	80	>-Setpoint current unbalance I_2 reset
	81	>-Setpoint current unbalance I_0 reset
	82	>-Setpoint voltage deviation reset
	83	>-Setpoint phase reversal reset
	84…90	Reserved
	91	<-Under setpoint U_{LN}
	92 2	<-Under setpoint U_{LL}
	93	<-Under setpoint I
	94	<-Under setpoint U_4
	95	<-Under setpoint I_4
	96	<-Under setpoint Δf
	97	<-Under setpoint P_{sum}
	98	<-Under setpoint Q_{sum}
	99	<-Under setpoint S_{sum}
	100	<-Under setpoint λ_{sum}
	101	Open setpoint DI1 active
	102	Open setpoint DI2 active
	103	Open setpoint DI3 active
	104	Open setpoint DI4 active
	105	Open setpoint DI5 active
	106	Open setpoint DI6 active
	107	Open setpoint DI7 active
	108	Open setpoint DI8 active
	109	<-Under setpoint demand P_{sum}

Event classification	Event sub-classification	Description
3	110	<-Under setpoint demand Q_{sum}
	111	<-Under setpoint demand S_{sum}
	112	<-Under setpoint demand λ_{sum}
	113	<-Under setpoint prognosis P_{sum}
	114	<-Under setpoint prognosis Q_{sum}
	115	<-Under setpoint prognosis S_{sum}
	116	<-Under setpoint prognosis λ_{sum}
	117	<-Under setpoint THD_U
	118	<-Under setpoint $TOHD_U$
	119	<-Under setpoint $TEHD_U$
	120	<-Under setpoint THD_I
	121	<-Under setpoint $TOHD_I$
	122	<-Under setpoint $TEHD_I$
	123	<-Under setpoint voltage unbalance U_2
	124	<-Under setpoint voltage unbalance U_0
	125	<-Under setpoint current unbalance I_2
	126	<-Under setpoint current unbalance I_0
	127	<-Under setpoint voltage deviation
	128…135	Reserved
	136	<-Setpoint U_{LN} reset
	137	<-Setpoint U_{LL} reset
	138	<-Setpoint I reset
	139	<-Setpoint U_4 reset
	140	<-Setpoint I_4 reset
	141	<-Setpoint Δf reset
	142	<-Setpoint P_{sum} reset

Event classification	Event sub-classification	Description
3	143	<-Setpoint Q_{sum} reset
	144	<-Setpoint S_{sum} reset
	145	<-Setpoint λ_{sum} reset
	146	Open setpoint DI1 reset
	147	Open setpoint DI2 reset
	148	Open setpoint DI3 reset
	149	Open setpoint DI4 reset
	150	Open setpoint DI5 reset
	151	Open setpoint DI6 reset
	152	Open setpoint DI7 reset
	153	Open setpoint DI8 reset
	154	<-Setpoint demand P_{sum} reset
	155	<-Setpoint demand Q_{sum} reset
	156	<-Setpoint demand S_{sum} reset
	157	<-Setpoint demand λ_{sum} reset
	158	<-Setpoint prognosis P_{sum} reset
	159	<-Setpoint prognosis Q_{sum} reset
	160	<-Setpoint prognosis S_{sum} reset
	161	<-Setpoint prognosis λ_{sum} reset
	162	<-Setpoint THD_U reset
	163	<-Setpoint $TOHD_U$ reset
	164	<-Setpoint $TEHD_U$ reset
	165	<-Setpoint THD_I reset
	166	<-Setpoint $TOHD_I$ reset
	167	<-Setpoint $TEHD_I$ reset
	168	<-Setpoint voltage unbalance U_2 reset

Event classification	Event sub-classification	Description
3	169	<-Setpoint voltage unbalance U_0 reset
	170	<-Setpoint current unbalance I_2 reset
	171	<-Setpoint current unbalance I_0 reset
	172	<-Setpoint voltage deviation reset
	173	Reserved
4	1	DSP fault
	2	AD fault
	3	Reserved
	4	Reserved
	5	NVRAM fault
	6	FRAM log fault
	7	System parameter fault
	8	Setpoint parameter fault
	9	Fault parameter of data recorder
	10	Fault parameter of waveform recorder
	11	Fault parameter of PQ log
	12	Fault parameter of energy log
	13	Fault parameter of EN 50160 log
	14	Reserved
	15	Fault parameter of disturbing signal recorder
	16	Reserved
	17	Fault internal parameter
	18	Fault parameter communication

Event classification	Event sub-classification	Description
5	1	Supply voltage on
	2	Supply voltage off
	3	Clock set via front panel
	4	Setup changed via device buttons
	5	Reserved
	6	Communication parameter changed via device button
	7…9	Reserved
	10	DI counter cleared via front panel
	11	Event log cleared via front panel
	12	PQ log cleared via device button
	13	Energy values cleared via front panel
	14	Data recorder cleared via front panel
	15	Waveform recorder cleared via front panel
	16	Reserved
	17	Reserved
	18	Energy log cleared via device buttons
	19	Max/Min value log of this month cleared via front panel
	20	Reserved
	21	Peak demand of this month cleared via front panel
	22…24	Reserved
	25	PQ event cleared via device buttons
	26	All logs and statistics cleared via device buttons
	27	Setup changed via communication interface
	28	Internal parameters set via communication interface
	29	Communication parameter set via communication interface

Event classification	Event sub-classification	Description
5	30	Counter DI set via communication interface
	31	Event log set via communication interface
	32	Reserved
	33	Counter DI cleared via communication interface
	34	Event log cleared via communication interface
	35	PQ log cleared via communication interface
	36	Energy values cleared via communication interface
	37	Data recorder cleared via communication interface
	38	Waveform recorder cleared via communication interface
	39	Reserved
	40	Transient log cleared via communication interface
	41	Energy log cleared via communication interface
	42	Max/Min value log of this month cleared via communication interface
	43	All max/min values cleared via communication interface
	44	Peak demand of this month cleared via communication interface:
	45	All peak demand values cleared via communication interface
	46	EN 50160 log cleared via communication interface
	47	Reserved
	48	PQ log cleared via communication interface
	49	All logs and statistics cleared via communication interface
	50	Reserved
	51	Reserved

Event classification	Event sub-classification	Description
6	1	Waveform recorder triggered via communication interface
	2	Waveform recorder triggered by setpoint
	3	Waveform recorder triggered by voltage sag/swell
	4	Waveform recorder triggered by transient
	5	Waveform recorder triggered by rapid voltage change
	6	Data recorder (standard) triggered by setpoint
	7	Data recorder (standard) triggered by voltage sag/swell
	8	Reserved
	9	Reserved
	10	Data recorder (high-speed) triggered by setpoint
	11	Data recorder (high-speed) triggered by voltage sag/swell
	12	Reserved
	13	Reserved
	14	Alarm e-mail triggered by setpoint
	15	Alarm e-mail triggered by voltage sag/swell
	16	Alarm e-mail triggered by transient
	17	Alarm e-mail triggered by rapid voltage change
	19…22	Reserved
	23	Disturbing signal recorder triggered by communication interface
	24	Disturbing signal recorder triggered by setpoint
	25	Disturbing signal recorder triggered by voltage sag/swell
	26	Disturbing signal recorder triggered by transient disturbance
	27	Disturbing signal recorder triggered by rapid voltage change
	28	Disturbing signal recorder recording finished

Event classification	Event sub-classification	Description
7	1	>-HD2$_U$ active
	…	
	62	>-HD63$_U$ active
	63	>-HD2$_U$ reset
	…	
	124	>-HD63$_U$ reset
	125	<-HD2$_U$ active
	…	
	186	<-HD63$_U$ active
	187	<-HD2$_U$ reset
	…	
	248	<-HD63$_U$ reset
8	1	>-HD2$_I$ active
	…	
	62	>-HD63$_I$ active
	63	>-HD2$_I$ reset
	…	
	124	>-HD63$_I$ reset
	125	<-HD2$_I$ active
	…	
	186	<-HD63$_I$ active
	187	<-HD2$_I$ reset
	…	
	248	<-HD63$_I$ reset

Table 5.1: Event subclassification (SOE)

5.2 PQ log (power quality)

In the list, the most recent PQ logs appear on top. Up to 1024 events can be stored. If the PQ log is not cleared, the event 1025 overwrites the first event (ring memory, FIFO principle: first in, first out).
The events can be displayed in groups of 15 entries. Selection is done via the buttons. In addition, the PQ log can be exported as a .csv file (comma separated values).

You can find the explanation of the event classifications (x:y) in table 5.2.

PQ log classification

The device classifies the PQ logs into 4 classes, which in turn are divided into subclasses. The table shows the possible PQ event classifications.

PQ log classification

PQ log Classification	Sub-classification	Description
1. Voltage swell/ voltage sag	1	Start of voltage swell
	2	End of voltage swell
	3	Start of voltage sag
	4	End of voltage sag
	5	Start of voltage interruption
	6	End of voltage interruption
	7	Cause of disturbance
2. Transient event	1	Transient event was recorded
3. Rapid voltage change	1	Rapid voltage change U_{L1}
	2	Rapid voltage change U_{L2}
	3	Rapid voltage change U_{L3}
4. Mains signalling transmission voltage	1	Start of mains signalling voltage, frequency 1
	2	End of mains signalling voltage, frequency 1
	3	Start of mains signalling voltage, frequency 2
	4	End of mains signalling voltage, frequency 2
	5	Start of mains signalling voltage, frequency 3
	6	End of mains signalling voltage, frequency 3

Table 5.2: PQ log event classification

6. Setpoint recorder matrix

In the setpoint recorder matrix the settings for the

- Waveform recorders WFR1…2
- High-speed data recorders HS-DR1…4
- Data recorders DR1…16
- Relay outputs RO1…4
- Digital outputs DO1…2

are displayed. With this it becomes clear if there are any contradictions in the settings.

Settings Recorder > Data Recorder or
High-speed Data Recorder or
Waveform Recorder

All triggers (standard setpoint, high-speed setpoint, voltage sag and swell, transients, rapid voltage changes) can activate recorders and/or outputs if the specified conditions are complied with. The conditions can be specified under the menu item "Settings trigger".

Used symbols in the setpoint recorder matrix

Element	Description
	Red row: setpoint is deactivated
	Configuration not possible
	Switch to settings of the setpoints/recorders
	Recorder settings are correct
	Recorder settings are incorrect
T	Trigger: timer
SP	Trigger: setpoint
off	Recorder is not activated

Table 6.1: Symbols in the setpoint recorder matrix

Example Setpoint Recorder Matrix

Fig. 6.1: Example Setpoint Recorder Matrix

Explanation Fig. 6.1:

In the example, the setpoint recorder matrix shows a configuration error of the setpoints and the recorders.

- Setpoint SAG/SWELL cannot trigger DR2 because DR2 is turned off.
- High-speed setpoint 2 cannot trigger HS DR4 because HS DR4 is turned off.
- High-speed setpoint 4 cannot trigger HS DR2 because HS DR2 is turned off.
- Standard setpoint 2 cannot trigger DR1 because DR1 is set as timer.
- Standard setpoint 3 cannot trigger HS DR2 because HS DR2 is turned off.
- Standard setpoint 6 is correctly configured for DR10 and DR12 but turned off.

7. Settings trigger

As soon as a trigger (standard setpoint, high-speed setpoint, voltage swell, sag and interruption, transients, rapid voltage changes) has to activate a DO, the mode "Remote control/alarm" has to be set for this DO.

7.1 Standard setpoints

The PEM735 features 24 user-programmable standard setpoints which provide extensive control by allowing a user to initiate an action in response to a specific event. Typical applications for setpoints are: alarms, fault detection and power quality indication (PQ monitoring).

First, select the standard setpoint 1…24. For each setpoint the following settings are possible:

Function

Specifies the type of evaluation:

- Setpoint deactivated
- Over setpoint >
- Under setpoint <

Parameters

Specifies the measured quantities to be monitored. Setting possibilities:

U_{LN}	U_{LL}	I
U_4	I_4	*Frequency deviation*
P_{sum}	Q_{sum}	S_{sum}
λ_{sum}	*DI1…8*	
Demand P_{sum}	*Demand* Q_{sum}	*Demand* S_{sum}
Demand λ_{sum}	*Prognosis* P_{sum}	*Prognosis* Q_{sum}
Prognosis S_{sum}	*Prognosis* λ_{sum}	THD_U
$TOHD_U$	$TEHD_U$	THD_I
$TOHD_I$	$TEHD_I$	*Unbalance U: negative sequence*
Unbalance U: zero sequence	*Unbalance I: negative sequence*	*Unbalance I: zero sequence*
Voltage deviation	*Phase sequence*	

Table 7.1: Measured quantities standard setpoint

Upper limit

Set upper limit for setpoint.

Lower limit

Set lower limit for setpoint.

The value of the upper limit must always be higher than the value of the lower limit!

Active delay t_{on}

Specifies the minimum period that a threshold must have been violated before an action is triggered.
Each status change of a setpoint generates an event that is stored in the event log. The range of the response delay can be 0…9,999 seconds for standard setpoints.

Inactive delay t_{off}

Specifies the minimum period that the setpoint return condition must have met before returning to normal condition.
Each status change of a setpoint generates an event that is stored in the event log. The range of the delay on release is 0…9,999 seconds for standard setpoints.

Trigger 1…2

Setting possibilities:

- off
- Relay 1…4
- DO 1…2
- High-speed data recorder 1…4
- Standard data recorder 1…16
- Waveform recorder 1…2

7.2 High-speed setpoint

The PEM735 features 8 user-programmable high-speed setpoints which provide extensive control by allowing a user to initiate an action in response to a specific event.
Typical applications for setpoints are alarms, fault detection and power quality indication (PQ monitoring).

First, select the high-speed setpoint 1…8. For each setpoint the following settings are possible:

Function

Specifies the type of evaluation:

- Setpoint deactivated
- Over setpoint >
- Under setpoint <

Parameters

Specifies the measured quantities to be monitored. Setting possibilities:

U_{LN}	U_{LL}	I
U_4	I_4	
Frequency deviation	P_{sum}	Q_{sum}
S_{sum}	λ_{sum}	*DI1…8*

Table 7.2: Measured quantities High-speed Data Recorder

Upper limit

Set upper limit for setpoint.

Lower limit

Set lower limit for setpoint.

The value of the upper limit must always be higher than the value of the lower limit!

Response delay t_{on}

Specifies the minimum period that a threshold must have been violated before an action is triggered. Each status change of a setpoint generates an event that is stored in the event log. For high speed setpoints 0…9,999 cycles are possible.

Delay on release t_{off}

Specifies the minimum period that the setpoint return condition must have met before returning to normal condition. Each status change of a setpoint generates an event that is stored in the event log.For high speed setpoints 0…9,999 cycles are possible.

Trigger 1…2

Setting possibilities:

- off
- Relay 1…4
- DO 1…2
- High-speed data recorder 1…4
- Standard data recorder 1…16
- Waveform recorder 1…2

7.3 SAG/SWELL

Monitoring undervoltage/overvoltage

Setting possibilities: on, off

Voltage reference

Setting possibilities: Nominal voltage, sliding reference voltage

***Nominal voltage**: Nominal line-to-line voltage*
***Sliding reference voltage:** The sliding reference is calculated using a first order filter with a 1-minute time constant.*

Limit overvoltage

Setting possibilities: 101…200 %

Hysteresis overvoltage

Setting possibilities: 0.1…100 %

Limit undervoltage

Setting possibilities: 1…99 %

Hysteresis undervoltage

Setting possibilities: 0.1…100 %

Interruption voltage limit

Setting possibilities: 0…50 %

Interruption voltage hysteresis

Setting possibilities: 0.1…100 %

Trigger 1…2

Setting possibilities:

- off
- Relay 1…4
- DO 1…2
- High-speed data recorder 1…4
- Standard data recorder 1…16
- Waveform recorder 1…2

7.4 Transients

Setting possibilities: off, on

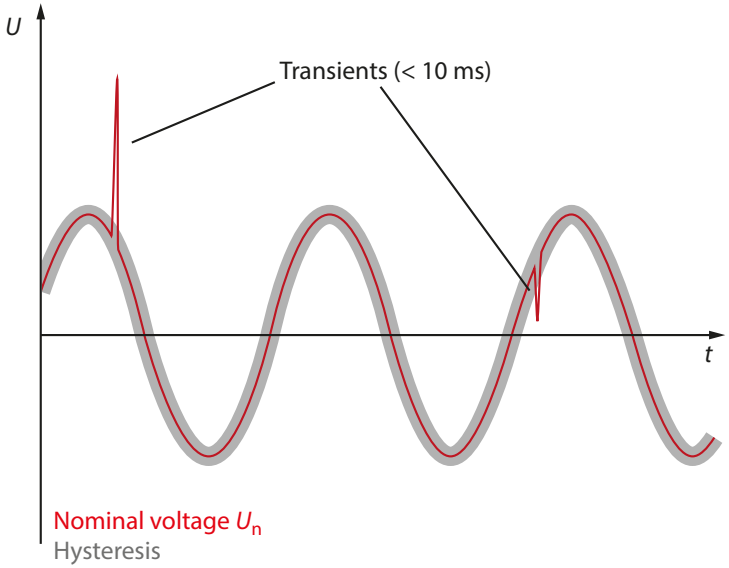


Fig. 7.1: Schematic representation transients

Transients limit

Setting possibilities: 5…500 %

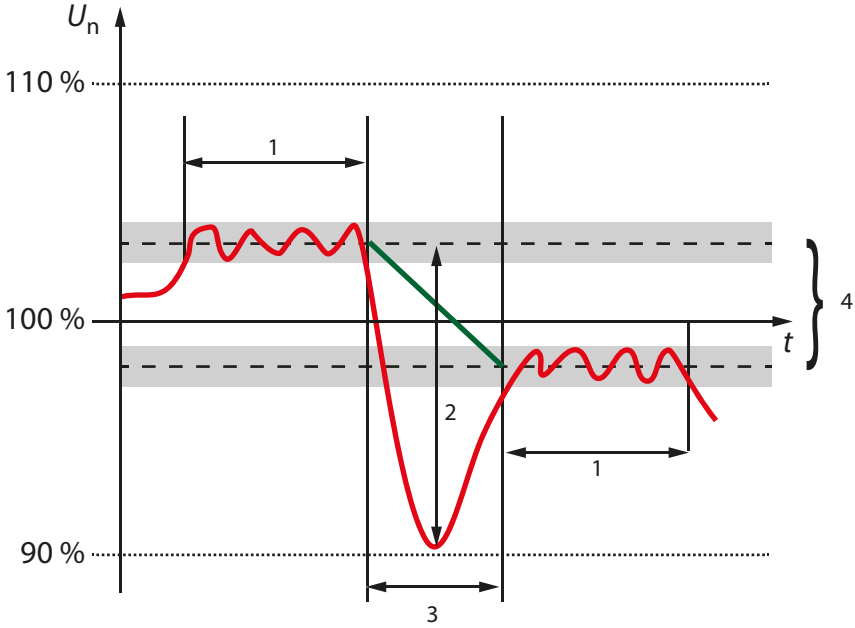
Trigger 1…2

Setting possibilities:

- off
- Relay 1…4
- DO 1…2
- Waveform recorder 1…2

7.5 Rapid voltage changes

Setting possibilities: off, on



1: Steady state
2: Max. voltage change
3: Transition time
4: Δ U > min. voltage change step
: Voltage tolerance
: Rate of change

Fig. 7.2: Rapid voltage changes

Minimum voltage change rate

Setting possibilities: 0…100 % U_n/s

Steady-state duration

Setting possibilities: 0.1…5 s

Minimum voltage change steps

Setting possibilities: 0…100 %

Voltage tolerance

Setting possibilities: 0…100 %

Detection mode

Setting possibilities:

- Steady state
- Maximum voltage change

Trigger 1…2

Setting possibilities:

- off
- Relay 1…4
- DO 1…2
- Waveform recorder 1…2

8. Settings recorder

8.1 Data recorder

First, select the data recorder DR1…16 to be configured.

Duration

The total recording time results from the current configuration of the data recorder.

Triggered by

Set trigger;
Selection possibilities: disabled, timer, digital setpoint

When data recorder is set to "Triggered by digital setpoint" the corresponding data recorder has to be selected in the setpoint settings (see trigger settings) as well!

Overwrite

Overwrite oldest entries with new entries when memory is full (FIFO)?
Selection possibilities: yes, no

Triggered by	Overwriting: yes	Overwriting: no
Digital set-point	Setpoint active: Recording Setpoint inactive: Recording stops Setpoint active: Recording Setpoint inactive: Recording stops and so on. Time gaps possible between data points!	Setpoint active: Recording Setpoint inactive: Recording Recording stops when the set number of data points has been reached. No time gaps possible between data points
timer	Timer reached: Recording Recording stops when data recorder is deactivated	Timer reached: Recording Recording stops when the set number of data points has been reached

Table 8.1: Behaviour data recorder when "Overwrite yes/no"

Data points

Number of measurements recorded per measured quantity. Setting range 0…65535

Interval

Period between two data points
1…3456000 s

Delay

A delay can only be set for "Triggered by timer".
A delay must always be less than the selected interval.

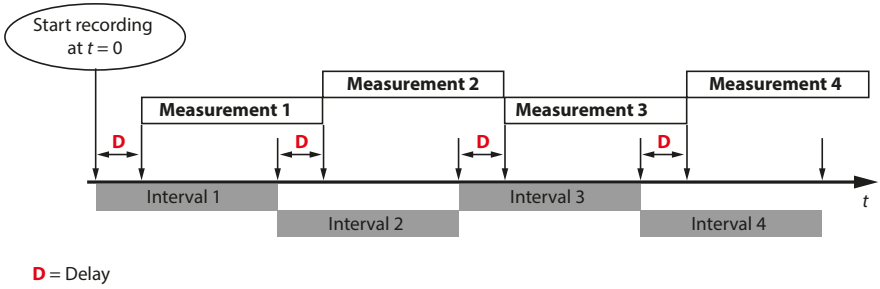


Fig. 8.1: Schematic representation: Delay data recorder

Number of parameters

Set number of measured quantities that are to be recorded.
Setting range 0…16.

Parameters 1…16

Here you can set which measured quantities are to be recorded.
Selection possibilities:

$U_{L1…3}$	$U_{LN\ avg}$	U_{L1L2}	U_{L2L3}
U_{L3L1}	$U_{LL\ avg}$	$I_{1…3}$	I_{AVG}
U_4	I_4	$P_{1…3}$	P_{sum}
$Q_{1…3}$	Q_{sum}	$S_{1…3}$	S_{sum}
$\lambda_{1…3}$	λ_{sum}	f	Demand $I_{1…3}$
Demand I_{avg}	Demand $_{I4}$	Demand P_{sum}	Demand Q_{sum}
Demand S_{sum}	Active energy import	Active energy export	Total active energy
Active energy net amount	Reactive energy import	Reactive energy export	Total reactive energy
Reactive energy net amount	Apparent energy	Pst $_{1…3}$	Plt $_{1…3}$

Table 8.2: Measured quantities data recorder

8.2 High-speed data recorder

First, select the high-speed data recorder HS-DR1…4 for configuration.

Duration

The total recording time results from the current configuration of the high-speed data recorder.

Triggered by

Set trigger;
Selection possibilities: disabled, timer, digital setpoint

When high-speed data recorder is set to "Triggered by digital setpoint" the corresponding high-speed data recorder has to be selected in the setpoint settings (see trigger settings) as well!

Data points

Number of measurements recorded per measured quantity. Setting range 0…65535

Interval

Half cycles per data point
1…120

Delay

A delay can only be set for "Triggered by timer".

Set delay of high-speed data recorders on deactivated recorders only!
Deactivate recorder:
Recorder settings > High-speed data recorder > Triggered by > "Disabled"

The set delay elapses once. After this time period the number of configured data points are recorded with the intervals. An automatic overwriting (as with the standard recorders) is not possible in this case.

If the high-speed data recorder has been used before, old data may still remain on it. These can be displayed until the start of the recording (under "Recorder > Data recorder").

Number of parameters
Set number of measured quantities that are to be recorded.
Setting range 0…16.

Parameters 1…16

Here you can set which measured quantities are to be recorded.
Selection possibilities:

$U_{L1…3}$	$U_{LN\ avg}$	U_{L1L2}	U_{L2L3}	U_{L3L1}
$U_{LL\ avg}$	$I_{1…3}$	I_{avg}	U_4	I_4
$P_{1…3}$	P_{sum}	$Q_{1…3}$	Q_{sum}	$S_{1…3}$
S_{sum}	$\lambda_{1…3}$	λ_{sum}	f	

Table 8.3: Measured quantities high-speed data recorder

8.3 Waveform recorder

The PEM735 provides two waveform recorders (WFR) capable of recording independently from one another, which together can store 128 entries. Each waveform recorder can simultaneously record 4-phase voltage and current channels at a maximum resolution of 512 samples per cycle.

Waveform recorders can be triggered by

- Setpoints
- Voltage sag, swell and interruption
- Transient events
- Communication interface (manually)

During this process the control via communication interface has the highest priority. Other WFR triggers will be ignored until recording is completed.

Storage works according to FIFO principle (first in, first out) for each waveform recorder separately. If a WFR has reached its maximum recording number, the next recording overwrites the oldest recording stored.

WFR data is stored in a non-volatile memory and will not suffer any loss in the event of power failure.

Duration

The total recording time results from the current configuration of the waveform recorder.

The following setup parameters are supported

Waveform recorders 1…2: Entries

Recordings WFR1 + recordings WFR2 ≤ 128
The remaining possible recordings are automatically adjusted as soon as a value for WFR has been set.

Waveform recorders 1…2: Pre-cycles

Setting possibilities: 2…192

Waveform recorders 1…2: Cycles

Setting possibilities: 20, 40, 80, 160, 320, 640

Cycles per record	Sampling frequencies	Data points per cycle	Cycles before the event	Recording duration
20	25600 Hz	512	2…6	0.4 s
40	12800 Hz	256	2…12	0.8 s
80	6400 Hz	128	2…24	1.6 s
160	3200 Hz	64	2…48	3.2 s
320	1600 Hz	32	2…96	6.4 s
640	800 Hz	16	2…192	12.8 s

Table 8.4: Configuration WFR

If the settings of a waveform recorder are changed, the assigned history is deleted.

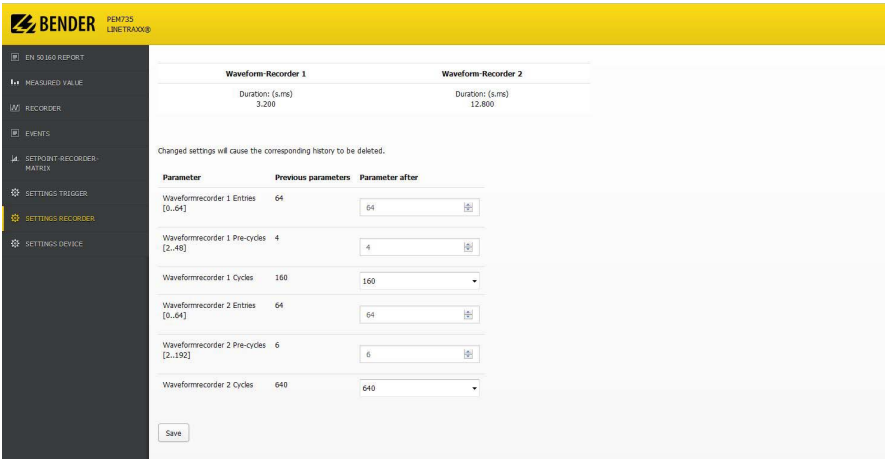


Fig. 8.2: Screenshot: Settings recorder > Waveform recorder

9. Settings device

The calculation basis for the EN 50160 report can be found in the current device settings and printed in the reports.

Before modifying the connection parameters, *you should print remaining EN 50160 reports and erase the history of the EN 50160 memory.*
Otherwise, you will not be able to compare individual reports due to a different calculation basis.
The report that is generated during parameter modification cannot be used.

If the following parameters are modified, the existing EN50160 reports cannot be used:

- Frequency refresh cycle
- max. order harmonics for calculating of THD, TEHD, TOHD
- Start day EN50160 report
- Coupling (star or delta)
- PT primary
- PT secondary
- Nominal voltage, related to the secondary voltage
- Nominal frequency
- Flicker mode
- Mains signalling transmission voltage frequency 1…3
- Mains signalling transmission voltage swell threshold 1…3
- Time settings

9.1 Delete

Delete the following recorder manually

- History waveform recorder 1
- history waveform recorder 2
- SOE log
- PQ log
- History EN 50160 report
- All minimum and maximum values of the current month
- Energy meter reading

9.2 Digital input

Select the input to be configured DI1…8.

Mode

Setting possibilities:

- Normal
- Pulse counter
- Demand synchronisation
- Pulses per second

For DI1…8

- *a maximum of one DI can be set to "Demand synchronisation"*
- *a maximum of one DI can be set to "Pulses per second"*

Debounce time

Time period a signal must be pending at DI until it can be detected.
Setting possibilities: 1…1000 ms

Pulse weight (for mode "Pulse counter"only)

Specifies the incremental value for each received pulse.
Setting possibilities: 0…1,000,000

9.3 Digital output

Mode DO1…2

Setting possibilities:

- Remote control/alarm
- RMS kWh import
- Fundamental kWh import
- Harmonics kWh import
- RMS kWh export
- Fundamental kWh export
- Harmonics kWh export

As soon as a trigger (standard setpoint, high-speed setpoint, voltage swell, sag and interruption, transients, rapid voltage changes) has to activate a DO, the mode "Remote control/alarm" has to be set for this DO.
This DO will then not be available for any other setting.

Pulse width DO1…2

Setting possibilities 0…600 s

Pulse width RO1…4

Setting possibilities 0…600 s

9.4 Connection

Note when using EN 50160 reports:

Before modifying the connection parameters, *you should print remaining EN 50160 reports and erase the history of the EN 50160 memory.*
Otherwise, you will not be able to compare individual reports due to a different calculation basis.
The report that is generated during parameter modification cannot be used.

If the following parameters are modified the existing **EN50160 reports cannot be used** anymore:

- Frequency refresh cycle
- max. order harmonics for calculating of THD, TEHD, TOHD
- Start day EN50160 report
- Coupling (star or delta)
- PT primary
- PT secondary
- Nominal voltage, related to the secondary voltage
- Nominal frequency
- Flicker mode
- Mains signalling transmission voltage frequency 1…3
- Mains signalling transmission voltage swell threshold 1…3
- Time settings

Coupling

When starting to work with the PEM735, select the corresponding coupling.
Possible setting values:

- DEMO
- Star
- Delta

When DEMO is selected, no measurement is done. Merely random values are indicated. Application: Product presentation.

PT primary
Setting values: 1…1,000,000 V

PT secondary
Setting values: 1…690 V

CT primary
Setting values: 1…30,000 A

CT secondary
Setting values: 1…5 A

U4 primary
Setting values: 1…1,000,000 V

U4 secondary
Setting values: 1…400 V

I4 primary
Setting values: 1…30,000 A

I4 secondary
Setting values: 1…5 A

Nominal voltage
Setting values: 1…700 V

Nominal frequency
Setting values: 50 or 60 Hz

CT 1…4 switch polarity
You can switch the polarity for each of the four connected measuring current transformers from normal ("off") to reversed ("on").

9.5 Calculation settings

Power factor λ convention

Setting possibilities: IEC, IEEE, -IEEE

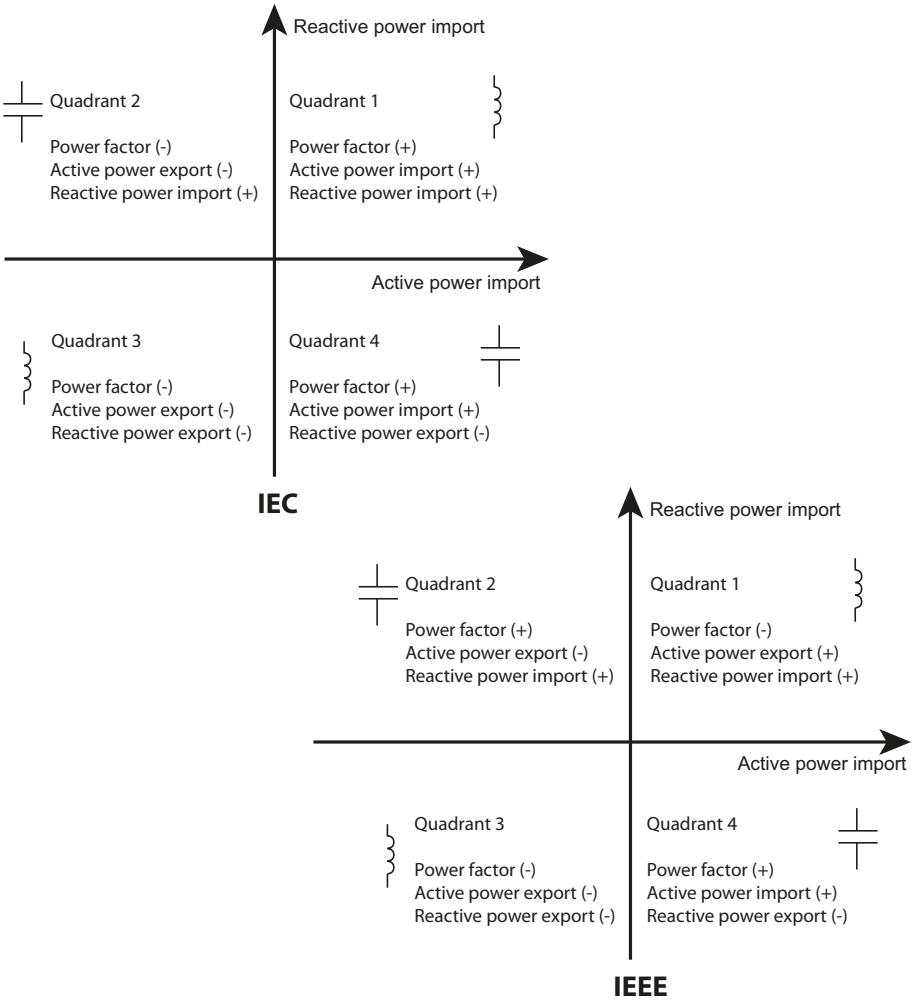


Fig. 9.1: Power factor λ rules

The only difference between "IEEE" and "–IEEE" are opposite signs.

Mode of calculation

Setting possibilities: vector, scalar

There are two ways of calculating the apparent power:

Vector method V:

$$S_{ges} = \sqrt{P_{ges}^{\,2} + Q_{ges}^{\,2}}$$

Scalar method S:

$$S_{ges} = S_{L1} + S_{L2} + S_{L3}$$

HD calculation

Setting possibilities:

% of the fundamental component

THD calculation of an individual harmonic (related to the fundamental component U_1 or I_1)

$$\text{THD}_{U(k)} = \frac{U_k}{U_1} \times 100\ \%$$

$$\text{THD}_{I(k)} = \frac{I_k}{I_1} \times 100\ \%$$

% of the r.m.s. value

Distortion factor calculation of an individual harmonic (THF, related to the total value U_{sum} or I_{sum})

$$\text{THF}_{U(k)} = \frac{U_k}{\sqrt{\sum_{k=1}^{63} U_k^2}} \times 100\ \%$$

$$\text{THF}_{I(k)} = \frac{I_k}{\sqrt{\sum_{k=1}^{63} I_k^{\,2}}} \times 100\ \%$$

Harmonics calculation type

Settings: group, subgroup

Current Kth Harmonic Calculation

Settings: distortion, RMS

When "RMS" is selected, the harmonics are displayed as r.m.s. values (V or A). When "Distortion" is selected, the harmonics are indicated as a percentage based on the set "Harmonics calculation", that means as a percentage related to the fundamental component (% of fundamental component), or as a percentage related to the r.m.s. value (% of the r.m.s. value).

Voltage Kth Harmonic Calculation

Settings: distortion, RMS

When "RMS" is selected, the harmonics are displayed as r.m.s. values (in V). When "Distortion" is selected, the harmonics are indicated as a percentage based on the set "Harmonics calculation", that means as a percentage related to the fundamental component (% of fundamental component), or as a percentage related to the r.m.s. value (% of the r.m.s. value).

Max. order harmonics for calculating THD, TEHD, TOHD

Specify the number of harmonics that should be used to determine THD, TEHD and TOHD.
Setting possibilities: 2…63

When using EN 50160 reports, it has to be set to "40".

Frequency refresh cycle

Setting possibilities: 1 s, 10 s

When using EN 50160 reports, it has to be set to "10 s".

Flicker mode

Setting possibilities: 230 V, 120 V

Mains signal voltage frequency 1…3
Setting possibilities 60…3000 Hz

Mains signal voltage limit 1…3
Setting possibilities 0.3…100 %

Mains signalling transmission voltage are signals superimposed on the supply voltage for the purpose of transmission of information in the public supply network and to network users' premises.
PEM735 can detect the voltage of signals in three different frequency ranges. The limits of the frequency ranges can be specified by the user. The frequency range is limited to 3 kHz.

EN 50160 Start day
Set on what day of the week the EN 50160 report should start.
Setting possibilities Sunday…Saturday

9.6 Serial port

COM1…2 protocol
Setting values: Modbus, time

With the setting "Time" GPS and IRIG-B time sources can be connected. These time sources must be configured via Modbus TCP, refer to corresponding documentation.

COM1…2 UnitId
Setting values: 1…247

COM1…2 baud rate
Setting values:
1200
2400
4800
9600
19200
38400

The baud rate is the symbol rate (symbol rate) of the interface. It indicates how many symbols are transferred per second. ***The baud rate settings have to be identical for receiver and sender.***

COM1…2 parity

Setting values: 8N2, 8O1, 8E1, 8N1, 8E2, 8O2

Faulty transmitted data words can be recognised over the parity control. Regarding the different setting possibilities, the

- first number indicates the length of the data word (8 bits),
- the letter indicates the parity
  N: No parity;
  E: Even parity;
  O: Odd parity
- the second number, the amount of stop bits.

in this case it is important that the ***setting is identical for the receiver and the sender.***

9.7 Ethernet

Fixed IP address

Enter IP address.
DHCP is not supported.

Subnet mask

Standard gateway

9.8 Clock

Set time zone and time.

9.9 Info/Update

Info

- Web version
- Hardware
- ARM firmware
- DSP firmware
- Firmware date
- Serial no.

Update

In order to update the firmware use "Select file" to search the update file, select it and click on "Update".

10. Glossary and terms

Abbreviation/ term	Long form	Description
COMM	Communication	
Debounce time		Time period a signal must be pending at DI until it can be detected.
Demand		Also: present demand; average consumption values over the last fixed demand period
DI	Digital Input	Digital input (2.4 mA, DC 24 V)
Dip (British English)		= sag (American English)
DMD	Present Demand	Present demand
DO	Digital Output	Digital output (max. 50 mA, max. 80 V)
DR	Data Recorder	Data recorder
FIFO	First In First Out	Ring memory: When the memory is full, the oldest entries will be overwritten by the new values.
Flagged data		Flagged measured values: Measurement results (measured or aggregated), which were flagged to indicate that the results may be influenced by interruptions, voltage swells or voltage sags.
Float		Floating point number, register size 4 bytes
Fund.	Fundamental	Fundamental wave
GB	Giga Byte	
GPS	Global Positioning System	
Harmonic factor		see THF

Abbreviation/ term	Long form	Description
HS	High speed	High speed
Interharmonic		Interharmonic between the (n-1)th and nth harmonic
k-factor		The k-factor refers to the capability of distorted currents to generate power loss in transformers, for example.
LCD	Liquid Crystal Display	
MB	Mega Byte	
P		Active power in kW
P95	Measured value of the 95^{th} percentile	95. percentile: 95 % of the values are less than or equal to this measured value.
Percentile:		Percentile rank divides the set of data into 100 equal parts.
Plt	Perceptibility unit long term	Long term flicker (2-hour value, cubic average of 12 Pst)
PPS	Pulse Per Second	Pulse per second
PQ	Power Quality	
Predicted demand		Extrapolated average power consumption values of the current period, which is not yet concluded
Pst	Perceptibility unit short term	Short term flicker; 10-minute value
Pulse width		Time during which DO or RO remains active
Q		Reactive power

Abbreviation/ term	Long form	Description
r.m.s. value		Square root of the arithmetic mean of the squares of the instantaneous values of a quantity taken over a given interval of time and a specified bandwidth.
Resolution of setting		Value which is written to the register per impulse; register content/resolution of setting = number of measured impulses
Ripple control signal		Mains signalling voltages on electrical low-voltage systems, called "ripple control signal", are a burst of signals, often applied at a non-harmonic frequency. Are intended for remote control of industrial equipment, revenue meters and other devices. f < 3 kHz;
rms	Root mean square	r.m.s. value
RO	Relay output	Relay output
S		Apparent power
Sag (American English)		= dip (British English)
SOE	Sequence Of Events	Events
Supply voltage unbalance		Unequal r.m.s. values of the line-to-line voltages (fundamental component) or the phase angles of consecutive line conductors; only apply to three-phase systems
Swell		Voltage swell
SYNC DI	Demand Sync Input	Digital input demand synchronisation
TEHD	Total Even Harmonic Distortion	Total even harmonic distortion
THD	Total Harmonic Distortion	Total harmonic distortion

Abbreviation/ term	Long form	Description
THF	Total Harmonic Factor	(= harmonic factor) Calculation of an individual harmonic factor related to the total r.m.s. value U_{ges} or I_{ges}
TOHD	Total Odd Harmonic Distortion	Total odd harmonic distortion
Transients		Short term voltage variations superimposed on the supply voltage
U_0		Zero sequence component
u_0		Zero sequence component (ratio expressed as a percentage) $u_0 = (U_0/U_1)$ x 100 %
U_0 / I_0		Zero sequence component voltage/current
U_0 / I_0 Unb		Unbalance zero sequence component voltage/ current
U_1		Positive sequence component
U_1 / I_1		Positive sequence component voltage/current
U_2		Negative sequence component
u_2		Negative sequence component ratio expressed as a percentage $u_2 = (U_2/U_1)$ x 100 %
U2 / I2		Negative sequence component voltage/current
U2 / I2 Unb		Negative sequence component unbalance voltage/current
U_{din}	Declared input voltage	Value calculated from the declared supply voltage on the basis of the transformer ratio.
UINT16	Unsigned integer 16 bit	Unsigned integer, register size 2 bytes (high byte, low byte)

Abbreviation/ term	Long form	Description
UINT32	Unsigned integer 32 bit	unsigned integer, register size 4 bytes (HiWord, LoWord)
unb	Unbalance	Unbalance
U_{res}	Residual voltage	Minimum value of $U_{rms(1/2)}$ {class A} recorded during a voltage sag or interruption; the residual voltage (related to the declared voltage) is expressed as a value in volts, as a percentage or per unit value.
$U_{rms(1)}$		Value of the r.m.s. voltage measured over one cycle and refreshed each cycle.
$U_{rms(1/2)}$	Half-cycle r.m.s. voltage	Value of the r.m.s. voltage refreshed each half-cycle (r.m.s. value measured over one cycle, commencing at a fundamental zero crossing)
U_{sr}	Sliding reference voltage	Sliding reference voltage, is prinicipally not used in low-voltage systems; is calculated using a first order filter with a 1-min time constant. This filter is given by $U_{sr(n)} = 0.9967 \times U_{sr(n-1)} + 0.0033 \times U_{rms}$ where $U_{sr(n)}$ = present value of the sliding reference voltage $U_{sr(n-1)}$ = previous value of the sliding reference voltage U_{rms} = most recent r.m.s. value
Voltage sag		Transitory reduction of the voltage below the specified threshold of 90 % of U_n with a hysteresis of 2 %; voltage interruptions are special voltage sags.

Abbreviation/ term	Long form	Description
Voltage interruption (polyphase system)		Begins when the U_{rms} voltage on all measured channels falls below the voltage interruption threshold; ends when the U_{rms} voltage on any channel is equal to, or greater than, the interruption threshold plus the hysteresis. Typically, the voltage interruption thresholds are 5 % or 10 % of U_{din}; typically, the hysteresis is equal to 2 % of U_{din}.
Voltage interruption (single-phase system)		Begins when the U_{rms} voltage falls below the voltage interruption threshold; ends when the U_{rms} voltage is equal to or greater than the voltage interruption threshold plus the hysteresis. Typically, the voltage interruption thresholds are 5 % or 10 % of U_{din}; typically, the hysteresis is equal to 2 % of U_{din}.
Voltage swell (polyphase system)		Begins when the U_{rms} voltage of at least one channel is above the swell threshold; ends when the U_{rms} voltage on all measured channels is equal to or below the swell threshold minus the hysteresis voltage. Typically, the swell thresholds are > 110 % of U_{din}; typically, the hysteresis is equal to 2 % of U_{din}.
Voltage swell (single-phase system)		Begins when the U_{rms} voltage rises above the swell threshold; ends when the U_{rms} voltage is equal to or below the swell threshold minus the hysteresis voltage. Typically, the swell thresholds are > 110 % of U_{din}; Typically, the hysteresis is equal to 2 % of U_{din}.
WF	Waveform	Waveform
WFR	Waveform recorder	Waveform recorder

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