

Technical Specification for a Power-Quality Measurement Device - (PQI-DE)

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Electricity as a product corresponds to certain qualities.

It is one of the major challenges of network operation to offer the quality characteristics described in EN50160 by optimizing the development of the networks and at the same time to keep the costs for operation, maintenance and expansion low. Measurement data from grid operation have become an indispensable part of forecasting and verification of calculation results.

▶ **Requirement - Hardware:**

Measurement inputs:

- Four voltages and four currents for the recording of 3 x phase voltages, 1 x displacement voltage / U_{NE}, 3 x currents and 1 x star point current / N conductor current
- Sampling rate: 40.96 kHz synchronous over all channels
- Temperature input for KTY, PT100, PT1000
- Differential current input optional
- The instrument can analyse frequencies for voltage and current up to 20kHz.
- The meter must meet 100% of the requirements of IEC 61000-4-30 Ed. 3 (2015) for Class A meters. Compliance with the standard must be demonstrated by a certificate from an independent certification body
- Frequency accuracy equal to or less than 0,1mHz

The **Input voltage channels** must meet the following criteria:

- Measuring voltage up to 690V (AC/DC) Conductor/Conductor
- Accuracy of the voltage inputs < 0.1%.
- CAT IV/300V

The **Input current channels** must meet the following criteria:

- Accuracy of the current inputs < 0.1%.
- current input 0 - 10A (AC)
- Overcurrent resistance 500A for 1 second (measuring circuit / protective circuit)

The power analyzer must have eight freely programmable digital inputs and four programmable output relays. These should be designed as potential-free relay contacts and designed for voltages of AC and DC up to 230 V.

In the event of a disturbance, the devices must automatically report the event to a PC via existing Ethernet connection. Every fault or power quality event must be in the database within one minute.

It must be possible to record all voltage events in parallel, both phase to phase and phase to earth, as the device is to replace existing voltage recorders and evaluate the EN50160 parameters.

Disturbing records are recorded at two different speeds. (Oscilloscope records with 40,96kHz and half period RMS values).

The prehistory and recording duration must be freely adjustable. The unit automatically adjusts the recording time to the duration of the malfunction. The fault logs can be automatically extended by the power analyzer if the fault persists for longer than the set recording time.

The device is required as a panel-mounted device for breakout dimension 144x144 and must comply with IP54 when installed.

Time synchronization must support the following options:

IEEE1344 / IRIG-B000... 007; GPS (NMEA +PPS); DCF77; NTP

The supply voltage should be optionally available from 18V DC to 280V DC or 85V AC to 264V AC.

The device must be equipped with a memory of at least 1 GByte. The network analyzer can be extended to 32GByte data memory via a memory card

The measuring instrument shall be capable of displaying all essential measurement data and events on site on a built-in high-resolution 5-inch colour display. Operation and instrument parameterisation is carried out via keys on the instrument or via the software and is available and ready for use over the full temperature range from -25°C to +55°.

The dimensions of the device must not be larger than: 144 x 150 x 110mm incl. clamps.

The temperature range of the device must cover the range -25°C to +55°C.

- Communication with the measuring instruments

The devices must be able to offer the following communication options:

- Ethernet connection for connection with database software parallel to all other communication interfaces!
- USB Interface – Type C
- IEC61850 (6 x Clients in parallel)
- Modbus TCP (4 x Clients in parallel)
- Modbus RTU
- IEC60870-5-104
- SD card function for fast data readout without software and PC and memory extension

▶ **Measurement parameter:**

It must be possible to measure the following PQ parameters:

All parameters of EN 50160 according to IEC 61000-4-30, class A Ed. 3 (version 2015)

The different recording intervals must be able to be recorded in parallel without restriction.

Measuring intervals: 2h, 10 min, 1 min, 3 sec, 200 ms, additionally 2 freely programmable measuring intervals from 1 sec to 60 sec and 1 min to 60 min.

● **Voltage, current**

Each RMS, 10ms maximum, 10ms minimum values within one storage period

Measurement of effective value of voltage L1-L2, L2-L3, L3-L1

Measurement RMS value of voltage L1-N, L2-N, L3-N, N-E

● **Power:** P, Q, S, cosPhi, power factor Pf,

Max, Min and average value within a storage period.

● **Frequency:** Min-maximum, mean and minimum values

● **Unbalance:** counter-system, co-system, zero system

● **Flicker meter according to IEC 61000-4-15 (2010) Class F1**

10-Min-values according to IEC 61000-4-15

Measurement of flicker short time level (10 min) L1-L2, L2-L3, L3-L1 (MS/HS)

Measurement of flicker Short time level (10 min) L1, L2, L3 (NS/HS)

Plt long-term flicker value according to IEC 61000-4-15

PF5 (output 5 of the flicker meter)

● **Harmonics** of voltage and current according to IEC 61000-4-7

- 10-minute maximum and mean values Analysis window 200 ms/interval 200 ms
- Measurement of harmonics of voltages L1-L2, L2-L3, L3-L1 up to the 50th harmonic.
- Measurement of interharmonic harmonics of voltages L1-L2, L2-L3, L3-L1 up to the 50th harmonic.
- Measurement of harmonics of voltages L1-N, L2-N, L3-N up to the 50th harmonic.
Measurement of interharmonic harmonics of voltages L1-N, L2-N, L3-N according to groups according to EN 61000-4-30 up to the 50th harmonic.
- THD
- Measurement of phase angles of voltage and current harmonics up to 40th order. (the reference of the phase angles of all voltage and current harmonics must be the fundamental oscillation of the voltage)

- **harmonics 2kHz to 9kHz** according to IEC61000-4-7

Spectral analysis 2 kHz... 9 kHz (35 frequency bands, BW = 200Hz) of voltages and currents according to (IEC 61000-4-7)

- **Event writing**

Trigger criteria 10/20 ms RMS value for overvoltage and undervoltage in % of supply voltage parameterisable 10 ms Half-wave RMS values are to be recorded at intervals of 10 ms and added to the write each time there is a change between parameterisable classes.

- Fast voltage fluctuations
- voltage dips
- Voltage interruptions (separation >/< 3 minutes)
- voltage increases

(Duration and amount)

- **Fault recording** function: Oscilloscope recordings /10ms RMS Recording

Trigger arguments / Activation via individual phases:

- External trigger input signal via binary inputs,
- U, Delta U, (Phase to Phase and Phase to Neutral)
- Displacement voltage
- Frequency (over and under-deviation), frequency jump
- envelope trigger / transient trigger
- I (upper and lower limit), Delta I,
- IN or N-conductor
- Logical connections (binary inputs)

- ▶ Pre/post time freely adjustable

► **Requirements to the evaluation system:**

The evaluation software must be able to manage > 500 measuring instruments in a database. It should be user-friendly and easy to manage the measurement data.

The software must be client-server compliant. Several workstations can communicate with the database in parallel.

For the evaluation of the voltage quality it is necessary to record all parameters of EN50160 and IEC61000-2-2 (-2-12) permanently and to compare them with the compatibility level.

Reports on the voltage quality standard EN50160 and IEC61000-2-2 /-2-12 must be generated and archived automatically by the system in tabular and graphical form.

In the event of a disturbance, the devices report automatically, the evaluation system generates reports which are automatically forwarded to network drives and or e-mail addresses which can be managed in groups.

Measurement data must be exported in the following formats:

- COMTRADE format for fault messages
- PQDIF format for jamming and long-term data
- -XML format
- CSV format
- TXT format
- NeQual Export

The entire user interface and documentation must be written in German or English.

Free and simple software must be available for parameterization and analysis of the measurement data on site and via network. This license-free software can be installed on any number of PCs.