Technical Sheet

The EN50160 -Standard

The title of the EN50160-Standard is "*Voltage characteristics of electricity supplied by public distribution systems".* The CENELEC group BTTF68-6 prepared this European Standard that was first published November 1994. It covers medium and low voltage three-phase networks and specifies quality criteria for voltage frequency, amplitude, waveform and symmetry.

The standard defines a maximum non conformity level (generally 5%) for each specified parameter. Most parameters are characterised by:

- a campaign period duration
- a measurement reference interval
- an individual threshold

Voltage parameters with definite thresholds

Parameter	Minimum OK %	Campaign duration	Thresholds
Frequency	95% 100%	1 week	50 Hz±1% (95%) 50 Hz+4-6% (100%)
Slow voltage variation	95%	1 week	Un±10%
Flicker	95%	1 week	Plt ≤1
Unbalance	95%	1 week	2%
Harmonics (up to 40th)	95%	1 week	individual thresholds (refer to standard)
Interharmonics (up to 40th)	TBD	1 week	TBD
Signalling voltages	99%	1 day	frequency dependent (refer to standard)

Voltage parameters with indicative thresholds

- Voltage dips (threshold <90% Un)
- Short interruptions (<1% Un, duration ≤ 3 min)
- Long interruptions (<1% Un, duration > 3min)
- Temporary and transient overvoltages

The EN50160 does not specify how to qualify voltage dips and interruptions. Further to some practical experiments, a group of experts from the UNIPEDE *(International Union of Producers and Distributors of Electrical Energy)* published an application guide to the EN50160 including a recommended classification for dips and interruptions according to their depth and duration. This table, as shown in the table below, has 24 classes where each dip/interruption is reported for the duration of the measurement campaign (1-year).

Depth		Duration					
%of nominal voltage		(ms)	(ms)	(s)	(s)	(s)	(s)
From	To less than	10<100	100<500	0.5<1	1<3	3<20	20<60
10	30						
30	60						
60	99						
99	100						

Records of the last row (shaded) are referred to as interruptions.

The same principle applies to swells that the UNIPEDE recommends to split in 15 classes.

EN50160 Counters

In order to check the 5% non conformity level, the standard defines for each parameter at least two counters N and N_n. N is the number of times that the parameter has been sampled *(as far as the actual rms voltage is within Un–15%)*. N_n is the number of times the parameter was not in accordance with the thresholds defined by the standard *(still as far as the actual rms voltage is within Un–15%).* Some parameters have several non-conformity counters so that N_n is actually N_1 for the first one and N_2 , N_3 , etc … for the other ones.

It is the ratio N_n/N that defines the compliance or not with the standard. In most cases, the requirement of the standard is fulfilled if:

$$N_n/N \leq 5\%$$

(except for frequency and signalling voltages)

The QWave® increments the N and N_n counters for all the parameters of the standard. For the parameters having only indicative threshold, the QWave® increments counters according the guidelines of the UNIPEDE recommendation.

The QWave® increments the counters N and N_n for the duration of the campaign (typically 1 week). Once the campaign is completed, the counters are saved in a quality log. The quality log of the QWave® has a storing capacity of 52 weeks.

As an example, the measurement of voltage harmonics happens as follows:

1. Observation of each individual harmonic for a period of one week (campaign) divided in measurement intervals of 10 min.

2. Determination of N being the number of 10 min intervals during which the actual rms voltage was within Un +/-15%. N is basically the sample size (N is common to all harmonics).

3. Determination of the N_1's for each individual harmonic, being the number of 10 min intervals during which the actual rms voltage was within Un +/-15% **and** the individual harmonic threshold was exceeded (for example >6% for H_5). N_1 is the number of outbound samples (one N_1 counter per harmonic).

4. Determination of N_2 being the number of 10 min intervals during which the actual rms voltage was within Un +/-15% **and** the THD was exceeding its 8% threshold. N_2 is the number of samples with THD non-conformity (one N_2 counter only).

5. At the end of the campaign, compliance to the rule $N_n/N \leq 5\%$ can be checked externally by software applications like *QuickView* or *QTouch.* Furthermore, all the counters are saved for one year in a quality log to allow historical analysis and reset to zero before starting the new campaign.

Electrical values	Campaign	ΔT	Quality Flag
Frequency	1 week	10 sec	N,N1,N2
Voltage variation	1 week	10 min	N,N1
Flicker P_{lt}	1 week	10 min	N,N1
Voltage dips	1 year	-	Nxx
Short/long voltage int.	1 year	-	N1,N2,N3
Overvoltage	1 year	-	Nxx
Unbalance	1 week	10 min	N,N1
Harmonics	1 week	10 min	N,N1,N2
InterHarmonics	TBD	TBD	TBD
Signalling voltages (3)	1 day	3 sec	N,N1

EN50160 parameters controlled by the QWave®:

Monitoring

Very short term (200 ms) and 10 min statistical values can be queried through a serial link connection and visualised with software applications like *QuickView* for Excel (part of the basic QWave® package) and *QTouch* for Intouch from Wonderware (optional SCADA package).

EN50160-related event logging

Please refer to TSE007 *"Event logging & Recordings"* for more details. An event is logged and a counter is incremented each time a parameter exceeds an individual threshold defined by the EN50160. The information contained in the event is:

- the nature of the fault (dip, harmonic, etc …)
- the phase on which the fault occurred
- the date, and time tag of the outage start
- the max (or min) value
- the time to max (or min)
- the total fault duration

Events are stored in the QWave® as long as they are not downloaded. They are available for analysis through the *QBrowser* software application.

User configurable recordings (optional)

Please refer to TSE007 *"Event logging & Recordings"* for more details. With the optional module *"user configurable"* the user can trigger incremental recordings of any electrical parameter with pre- and post trig. This is possible either on EN50160 thresholds or on user defined thresholds. The table shown below describes how the user configurable detection is working. When a condition is fulfilled (a detection threshold is exceeded, left column), different electrical parameters are recorded (right column).

Detector	Recorder
H3>5%	THD, H3,H7
Hi3>7%	THD, TDD, Active Power
I rms>2500A	Urms,power factor,…

Summary

The *EN50160 module* of the QWave® features:

Automatic compliance control with the requirements of the EN 50160 standard through computation of counters
(available both on and off line).

Automatic event logging triggered by standard defined thresholds