

IEC 61000-4-30

Standardised Power Quality measurement



Electrical appliances are designed to function with optimal performance from a constant voltage supply as close as possible to the rated value. Further to this, industrial equipment operating on a three-phase supply requires the three phase voltage levels to be equal and with a 120 degree phase separation.

Poor power supply quality can lead to the inefficient and potentially dangerous operation of electrical systems, and may cause damage to the equipment connected. There could also be increased risks of fire or electrocution, production losses and direct financial cost overruns. Accordingly, it is increasingly important to monitor power quality, particularly in modern electrical systems, making it a key element of tomorrow's smart networks.

The standard for such measurements, IEC 61000-4-30, not only states specific requirements in terms of power quality, a broad term which traditionally covers the voltage, frequency and waveform supplying an electrical installation, but also specifies the measurement methodology to ensure comparability of results across test instruments.

The IEC 61000-4-30 standard further defines the measurement methods, aggregation periods, and accuracy, for each power quality parameter. These include, frequency, the amplitude of the supply voltage, levels of "flicker", temporary voltage dips and swells, voltage outages, transient voltages, supply voltage unbalance, voltage harmonics and interharmonics, signals superimposed on the power supply voltage, fast voltage variations, and current measurements.

Electricity

Quality

Comparability

QUALISTAR
Class A

Measure up





IEC 61000-4-30 defines 3 performance classes, as follows:

- **Class A** - must comply with the highest performance and accuracy levels to obtain reproducible, comparable results.
- **Class S** - the accuracy levels are less strict. Class S power quality analysers can be used for statistical surveys and contractual applications for which comparable measurements are not required.
- **Class B** - this class was introduced in the 1st and 2nd editions of the standard to avoid making instruments obsolete. In this class, the standard required the measurement method and the accuracy to be specified by the manufacturer in the instrument's technical data sheet. In edition 3 of the standard, this performance class has been moved to an appendix.

Users should choose an instrument in the class they require, based on their application(s) and according to the issues encountered.

Power quality parameters defined in the standard

- Network frequency
- Amplitude of the supply voltage
- Amplitude of the current
- The Flicker (as per IEC 61000-4-15)
- Dips and swells
- Voltage interruptions
- Voltage unbalance
- Current unbalance
- Voltage harmonics (as per IEC 61000-4-7)
- Current harmonics (as per IEC 61000-4-7)
- Voltage interharmonics (as per IEC 61000-4-7)
- Current interharmonics (as per IEC 61000-4-7)
- Mains signals
- Rapid voltage changes (RVC)
- Current and voltage recording during events

The RMS values are measured and calculated using several test methods and durations.

RMS values refreshed every half-period

This involves voltage (or current) values measured over one period, beginning with a zero crossing of the fundamental component and refreshed every half-period.

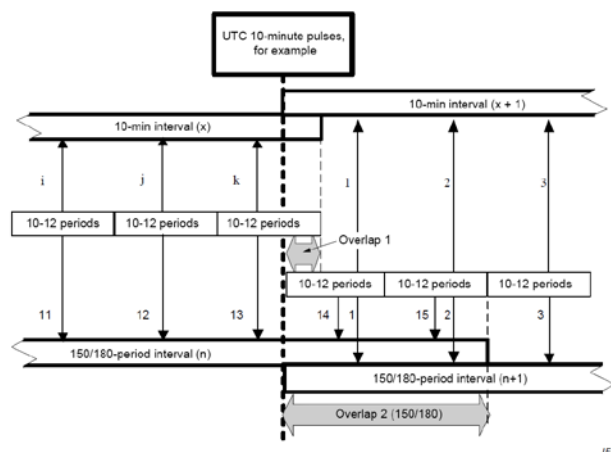
This technique is independent on each measurement channel and will produce RMS values at successive instants on each channel in the event of polyphase networks.

This value is only used for detecting and assessing voltage dips, temporary overvoltages at system frequency, outages and rapid voltage changes (RVC).

Measurement over 10/12 periods corresponds to an aggregation of the measurement time intervals.

The values over 10/12 periods are then aggregated on three additional intervals

- Intervals of 150/180 periods, or 3 seconds,
- Intervals of 10 minutes,
- Intervals of 2 hours for Plt measurements (flicker), which are aggregated from twelve 10-minute intervals.



Synchronization of the aggregation intervals for Class A, Source: IEC 61000-4-30

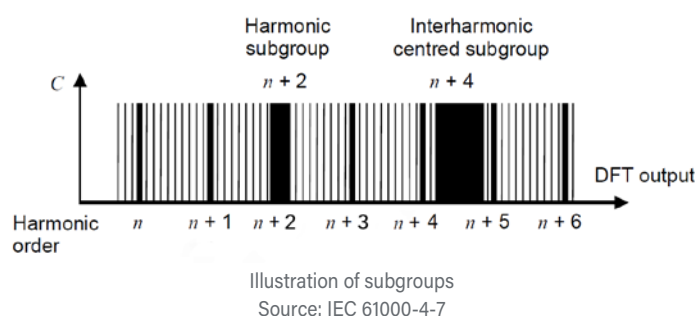


Harmonics and Interharmonics

IEC 61000-4-7 is applicable to instrumentation intended for measuring spectral components in the frequency range up to 9 kHz which are superimposed on the fundamental of the power supply system, and completes IEC 61000-4-30 concerning harmonics.

They are calculated on 10/12-period windows, with a resolution (bins) of 5Hz. These are called harmonic subgroups.

And between 2 harmonic subgroups, there is an interharmonic subgroup.



The measurements must be performed at least once up to the 50th order.

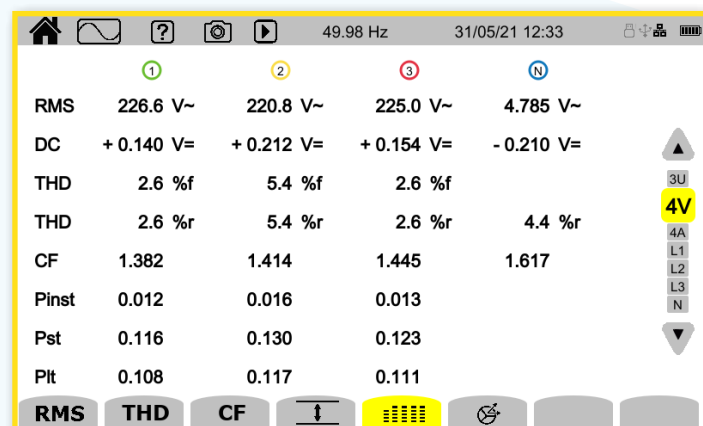
An interharmonic centred subgroup without discontinuities, called $Y_{\text{isg,h}}$, must be measured over 10/12 periods.

Events

Swells, dips, outages, transients and RVCs must be measured in a sliding one-period window refreshed every half-period and synchronized at the zero crossing.

Each event is specified on the basis of the voltage and its duration. The instant when it starts must be time-stamped with the Urms start time on the channel where the event originated, and the instant when the dip ends must be stamped with the end time of the Urms value which terminated the event.

The duration of the event is the difference between the start time and the end time.



Voltage thresholds must be defined to capture events. In the same way, a cutoff threshold must also be defined.

In polyphase networks, a dip starts when the Urms voltage of one or more channels falls below the dip threshold and ends when the Urms voltage on all the channels measured is equal to or greater than the dip threshold plus the hysteresis voltage.

Flagged data

Throughout any measurement interval during which outages, voltage dips or temporary overvoltages occur, the results will be flagged with the measurements of all the other parameters made during the time interval in question.

Flicker

This involves network voltage modulation. In terms of lighting, it gives a visual impression of instability due to a light stimulus whose luminance or spectral distribution fluctuates over time.

There are 2 parameters calculated on the basis of the network voltage.

- P_{st} which is a short-term evaluation based on a 10-minute observation period
- P_{lt} which is a long-term evaluation, usually over a 2-hour observation period

Unbalance

Unbalance measurements apply only to three-phase networks. The power supply voltage unbalance is assessed using the symmetrical components method. In the event of unbalance, as well as the positive component U1, at least one of the following components is added: negative component U2 and/or zero sequence component U0.

Mains signalling voltages on the power supply

The transmission voltage of the signals known as "centralized remote-control signals" in some applications, is a burst of signals, often applied to non-harmonic frequencies, which remotely controls industrial equipment, meters and other appliances.

The IEC 61000-4-30 standard defines the measurements for remote-control frequencies below 3kHz. The signal transmission voltage measurement must be based on an RMS value of the corresponding ray of interharmonics over 10/12 periods.



Coordinated universal time (UTC)

This is the time scale used as the basis for coordinated radio distribution of the standard calibration frequencies and time signals, which advances at the same rate as international atomic time (TAI) but is deferred by a whole number of seconds.

The concept of flagging helps to avoid counting a given event several times in different parameters and indicates that the aggregated value may be doubtful. If a value is flagged during a given time interval, the aggregated values including this value must be flagged and recorded.

The standard therefore specifies the methods and accuracies for the measured parameters useful for correct qualification of the voltage. A measuring instrument can measure all or some of the parameters identified in the IEC 61000-4-30 standard, preferably using the same class for all the parameters.

Measuring instrument manufacturers must perform the tests indicated in the IEC 62586 standard before stating that its instrument complies with the IEC 61000-4-30 standard.

For full information, the texts can be obtained from Cenelec or other national standardization organizations.

With the CA 8345, Chauvin Arnoux provides a simple, reliable solution for checking your voltage and your overall power quality to IEC 61000-4-30 Class A.



Reading this Case Study is not under any circumstances a substitute for carefully reading the whole standard.