

KNOWING IEC 61000-4-30 CLASS A

Power quality refers to a set of electrical boundaries defined by various documented rules designed to allow electrical equipment to function in its intended manner without significant loss of performance or life expectancy. This includes the steady and stable supply of electricity delivered by the grid. In order to achieve this goal it is necessary to constantly and vigilantly monitor the power conditions within an electrical network. There is a large number of parameters involved in this, but surprisingly, many power quality parameters have not been well defined which forced leading power monitoring device manufactures to develop their own methodologies resulting in incomparable values and rules between different instruments. This where the IEC 61000-4-30 comes in; it standardizes the measurement methodologies and creates the ability to directly compare results from different analyzers.

The IEC 61000-4-30 standard defines the measurement method, accuracy and time aggregation to variety of power quality parameters in 3 performance classes to obtain repeatable and comparable results. Additionally, the IEC 62586-1 defines EMC, safety and environmental requirement for **power quality analyzers** in different installation conditions and the IEC 62586-2 defines the test and uncertainty requirement to comply with IEC 61000-4-30 class A.

The standard is periodically updated as the industry evolves and new measurement scenarios are discovered or required. Since its introduction in 2003, the standard has been updated several times and is currently on its 3rd Edition.

IEC 61000-4-30 PERFORMANCE CLASSES

The IEC 61000-4-30 defines 3 performance classes as follow:

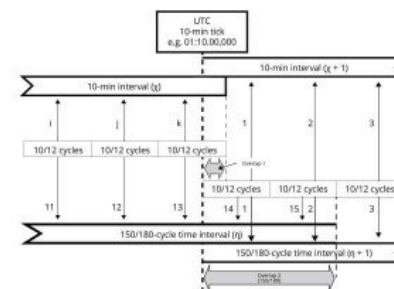
1. Class A – must comply to the highest performances and accuracy level to obtain repeatable and comparable results
2. Class S – accuracy levels are less stringent. Class S **Power quality analyzers** can be used for statistical surveys and contractual application where comparable measurements are not required.
3. Class B (obsolete) – This class was introduced at the 1st and 2nd editions of the standard to avoid making may instrument obsolete. In this class the standard required that the measurement method and accuracy will be defined by the manufacturer in the instrument datasheet. In the 3rd addition, this performance class was removed.

TIME AGGREGATION INTERVALS

The IEC 61000-4-30 class A defines several aggregation intervals:

- 10/12 cycles (~200ms) at 50/60Hz respectively. The interval time varies with actual frequency.
- 150/180cycles (~3sec) at 50/60Hz respectively. The interval time varies with actual frequency.
- 10min interval begins on an absolute 10min time
- 2 hours interval begins on an absolute even 2h time.

In the 2nd edition of the standard Re-synchronization technique was introduced to align the frequency-based aggregations (10/12 cycles, 150/180 cycles) with time-based aggregations (10min and 2 hours). The re-synchronization happens exactly every absolute 10min and deviation of the 10/12 cycles block are overlap as illustrated in the diagram.



POWER QUALITY PARAMETERS DEFINED IN THE STANDARD

Following are the parameters defined in the IEC 61000-4-30 standard:

- Power frequency
- Magnitude of supply voltage
- Flicker (by reference to IEC 61000-4-15)
- Supply **dips/swells**
- Voltage Interruptions
- Voltage unbalance
- Voltage harmonics (by reference to IEC 61000-4-7)
- Voltage Inter-harmonics (by reference to IEC 61000-4-7)
- Mains signaling
- Under- and over-deviation

In the 3rd addition the following parameter was introduced:

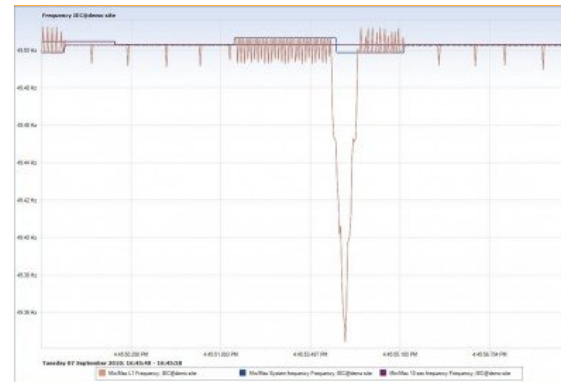
- Rapid voltage changes
- Flicker class F1
- Magnitude of the current
- Current unbalance
- Current harmonics (by reference to IEC 61000-4-7)
- Current interharmonics (by reference to IEC 61000-4-7)
- Recording of current along with voltage during events

EXAMPLES OF IEC 61000-4-30 CLASS A REQUIREMENTS

POWER FREQUENCY

Measurement resolution of Power frequency is set to 10sec with uncertainty of 10mHz over measuring ranges of 42.5 – 57.5Hz/51 – 69Hz at 50/60Hz respectively. Aggregation intervals are not mandatory for this section. In some application the required resolution is not sufficient and higher resolution as 1 cycle (power generation), 10/12 cycles (wind turbines) and 1 second (in some national standard) are required. The Image on the right, taken from Elspec's **power quality analyzer**, shows reading variations of the same signal measured in different resolution (1 cycle – light red, 10 cycles – blue and 10sec – purple).

Note that the **IEEE C37.118.1** suggest different method to calculate power frequency at higher resolution.



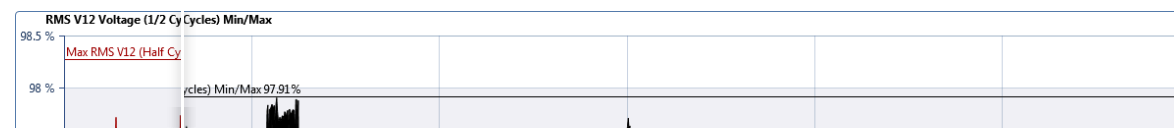
MAGNITUDE OF SUPPLY VOLTAGE

The magnitude of the supply voltage is the RMS values over 10/12 cycles (~200msec) time interval for a 50/60 Hz power systems respectively. Aggregations of 150/180 cycles (~3sec), 10min and 2 hours are also required. Measurement uncertainty is set to 0.1% of U_{din} (the declared input voltage) over the range of 10 – 150 % of U_{din} .

It is important to note that the standard does not specify any requirement for the recording resolution. Hence, it is highly important to look at the manufacturer specifications to verify its recording capability. In a typical PQA (**Power Quality Analyzer**) without a **continuous waveform recording**, the recording period depends on the recording resolution. For example, recording of 1 week can be done at 10min resolution. Increasing the resolution to 10/12 cycle will shorten the recording period to a few minutes only.

It is also important to note that this measurement method is used for quasi-stationary signals and not for the detection of power quality events such **dips** (Sags), **swells**, interruptions, transient and RVC (Rapid Voltage Changes).

In The example below: the left side shows 1/2 cycle RMS values (colored in red), the right side shows 10 cycles RMS values (colored in black). Move the handle to see the influence of the resolution on the measurement outputs:



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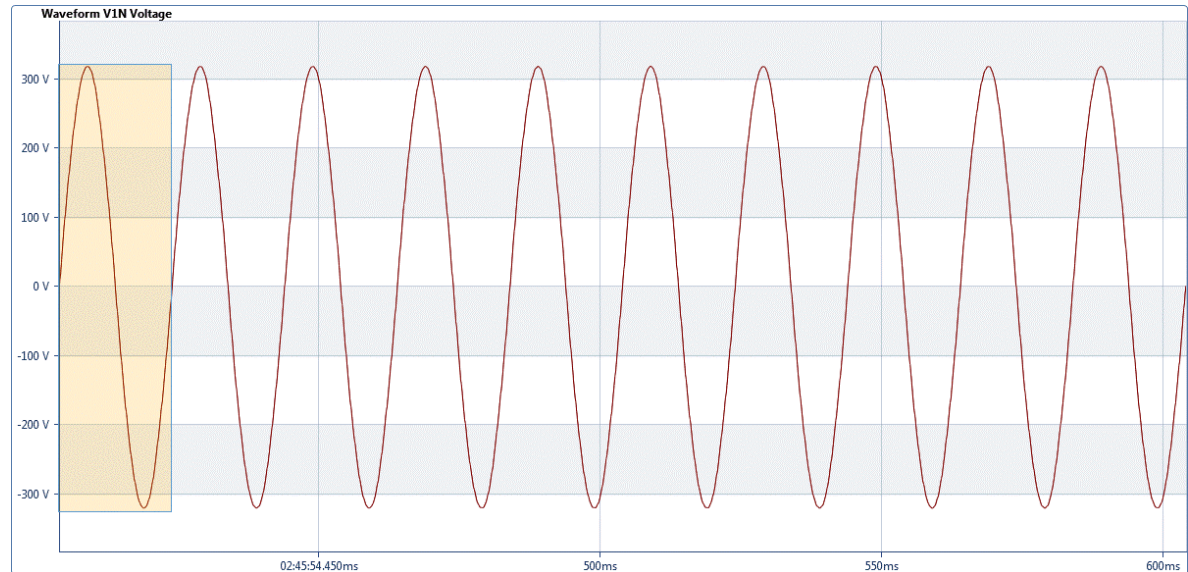
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POWER QUALITY EVENTS

Dips (Sags), swells, interruptions, transient and RVC events must be measured in a sliding window of 1 cycle width updated every 1/2 cycle and synchronized to zero crossing as illustrated below:



Events evaluation is made by two parameters: voltage deviation from the reference voltage and duration.

The IEC 61000-4-30 standard doesn't specify what should be recorded when event happens or the recording duration before and after the event.

When looking at manufacturers' specification it is important to understand what the instrument recording capabilities are. For instance, low cost PQAs will only record the $U_{RMS(1/2)}$ of the effected phase for a very short duration, while more advanced analyzers will record both the $U_{RMS(1/2)}$ and $I_{RMS(1/2)}$ of all phases (both phase to phase and phase to ground). Furthermore, in many cases it is important to record the waveform signal itself before during and after the event. In this instance, it is important to understand what the waveform recording resolution capabilities are, and how long such high resolution recording can hold.

Having a power quality analyzer with a continuous waveform recording eliminate the need to set any trigger or threshold to capture the event and recording both $RMS_{1/2}$ and waveform at high resolution continuously.

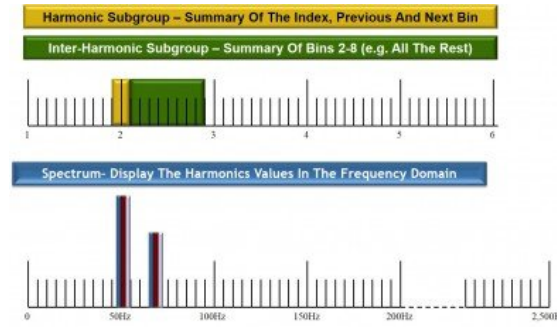
The recent IEEE 1668 standard Recommended Practice for Voltage Sag and Short Interruption Ride-Through Testing for End-Use Electrical Equipment Rated Less than 1000V draws the lines for dealing with this kind of events. This allows software packages, such as Sapphire, the

ability to translate the data to an easy view and simple graphs. Using this kind of software, combined with power quality meters/power quality analyzers that monitor and record the waveform continuously, enables to gather a full record of voltage dips, swells and other power disturbances.

HARMONICS AND INTERHARMONICS

IEC 61000-4-30 adopt the 10/12 cycles gapless harmonic subgroup measurement from the IEC 61000-4-7. It means that the FFT window is 10/12 cycle and the harmonic components output (bins) are at 5Hz resolution. The output component for each 5Hz bin is grouped according to the image on right.

It means that the actual output have 50 harmonics values and 50 inter-harmonics values. Aggregations of 150/180 cycles (~3sec), 10min and 2 hours are also required.



The IEC 61000-4-30 puts special attention to the amount of data generated by this measurement method:

- “This measurement method generates a large amount of data, which, depending on the application, may need to be stored, transmitted, analyzed, and/or archived. Depending on the application, the amount of data may be reduced. To reduce the amount of data, consider applying statistical methods at the measuring location, or storing only extreme and average values, or storing detailed data only when trigger thresholds are exceeded, or other methods.” [Electromagnetic compatibility (EMC) – Part 4-30: Testing and measurement techniques – Power quality measurement methods. Para 5.8.1 NOTE 2]
- “To minimize storage requirements, after aggregation has been completed it may be practical to discard the source data (such as 10/12-cycle or 150/180-cycle data) if it is no longer required.” [Electromagnetic compatibility (EMC) – Part 4-30: Testing and measurement techniques – Power quality measurement methods. Para 5.8.4 NOTE]

3 main factors affect the amount of required data:

1. The number of harmonics to be evaluated. In many application, 50 harmonics are not enough and you can find significant harmonic component up to the 100th.
2. Recording resolution – the latest edition of the [IEEE 519](#) required a daily and weekly harmonic evaluation of both voltage and current at 150/180 cycles (~3sec) resolution per phase.
3. Spectral resolution – in some application it is required to record the 5Hz bins (raw data) itself rather than the 50Hz subgrouping output. This multiply the amount of data by 10.

For instance, your application required harmonic evaluation as defined in the [IEEE 519-2014](#) edition. It means that the [power quality analyzer](#) required to record 50 harmonics per phase at resolution of 3 seconds for a minimum period of 1 week. Assuming that every sample take 3 Bytes of memory. The required memory space is 3(Bytes/sample) X 50(harmonics) X 6(3 phase voltages + 3 phase currents) X 20(samples/min) X 60 (min/hour) X 24 (hours/day) X 7 (days/week) = ~180Mb/week. For interharmonics this should be double and to have the bins it should multiply by 10.

CONCLUSIONS

Standards were created to provide an equal starting point to the [power quality analysis](#) by obtaining repeatable and comparable results from various meters regardless its brand/manufacturer. However, limiting the meter capabilities to the standard requirements may result in insufficient data for enhanced failure investigation and root [cause analysis](#).

Elspec's [power quality analyzers](#) are equipped with the revolutionary PQZIP patent algorithm for continuous waveform recording. These power quality analyzers are able to record and store all electrical waveform continuously at a resolution of 1,024 samples/Cycle. In addition, more than 5,000 power parameters are available at almost any given resolution for display and reporting purposes. These analyzers offer a clear and comprehensive picture of the conditions before, during, and after an event and are far surpassing the IEC-61000-4-30 class A requirements.

BEYOND THE IEC 61000-4-30 CLASS A

Elspec offers power quality analyzers that gives you:

- Superior accuracy level to obtain repeatable and comparable results
- Continues waveform recording to ensure data availability and root

cause analysis for any incidence.

- Easy in-depth post processing within Elspec's PQSCADA Sapphire

ADVANCED POWER QUALITY ANALYZERS



RELATED POSTS

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Accurate time synchronization is critical for professional power quality analysis. It's the backbone that allows us to compare data accurately, correlate events effectively, and understand the sequence of occurrences in the power system [...]

Flicker and Voltage Fluctuations in Power Quality Systems

Flicker refers to the perceived fluctuation in light intensity that occurs when voltage fluctuations impact lighting systems. It is often caused by rapidly changing loads in the electrical network. Flicker can be visually discomforting and can affect the performance and lifespan of sensitive equipment, especially in industries that rely heavily on precise lighting conditions or use sensitive equipment[...]

What are Inter-harmonics?

Inter-harmonics can be defined as the non-integer multiple of the fundamental frequency. Many nonlinear loads that produce harmonics also produce Inter-harmonics. Learn about Inter-harmonics sources, their effects on power systems, how to measure Inter-harmonics and the reference to IEEE 519 and IEC 61000-4-30 standards for power quality [...]

Power Harmonics in Electrical Systems

Power Harmonics in electrical systems refer to the distortion of a waveform that results from the presence of multiple frequencies in systems that utilize non-linear loads such as: battery chargers, personal computers, laser printers, variable speed motors & drives, and switch-mode power supplies. A load is said to be non-linear when the current does not have the same waveform as the supply voltage [...]



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