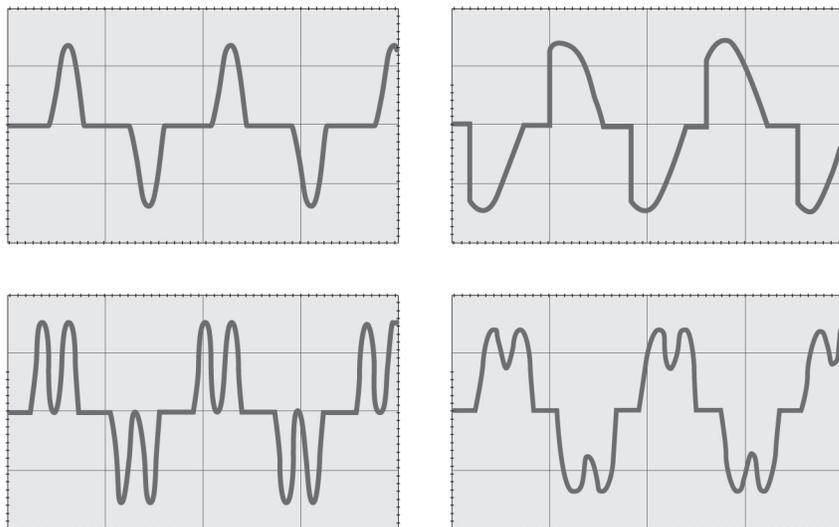


# Symptoms and diagnostics



Harmonics could cause loss of capacitors, decrement on electrical efficiency, malfunction of equipment and heat which could reduce the life of the installation. This whitepaper includes general guidelines to detect and measure harmonics.

As a rule of thumb, if more than 10% of the loads (in capacity) in any power distribution system are non-linear, the probability of a harmonics problem is considerable. There are additional indicators that harmonics problems may be present. These include:

### Loss of PF correction capacitors

Capacitors are the natural path of harmonics and therefore suffer the effects. Due to the overload and increment in losses caused by harmonics' high frequency, capacitors are often damaged and require frequent replacement.

### Unusual noise in motors and transformers

Harmonics cause pulsing torques in motors which increase vibrations and audible noise. Similar effects are present in transformers, reactors and, in general, any magnetic-based equipment. Non-characteristic noise in magnetic equipment could be an indicator of harmonics.

### Inexplicable breaker trips

As a result of the overheating caused by harmonics or malfunction of the breaker electronic card, they can trip at a level that is below their rated current when high harmonics content is present in the system.

In order to verify that harmonic content, it is necessary to measure it. A harmonics analyzer is the best tool for this task because it provides the complete harmonics profile. However, some modern power meters are able to measure the THD, which is an excellent starting point.

The question is, where to measure? Capacitors concentrate or attract harmonics, so they are the obvious point to measure. Additionally, if certain equipment exhibits problems, it's wise to measure the bus feed.

In order to have a reliable profile, ABB recommends monitoring the harmonics for at least a week. In normal situations this is considered adequate because the equipment will experience all standard activities and loads within that time. Timed measurements are not recommended because the harmonics profile depends on the load level, which can change rapidly.

A good reference of distortion limits can be found in the IEEE 519 standard. This standard establishes a compromise between utilities and users to keep harmonic distortion under control. Utilities agree to maintain voltage distortion below acceptable limits and users agree to manage current distortion similarly.

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