CHAUVIN ARNOUX

Harmonics: The Hidden Menace

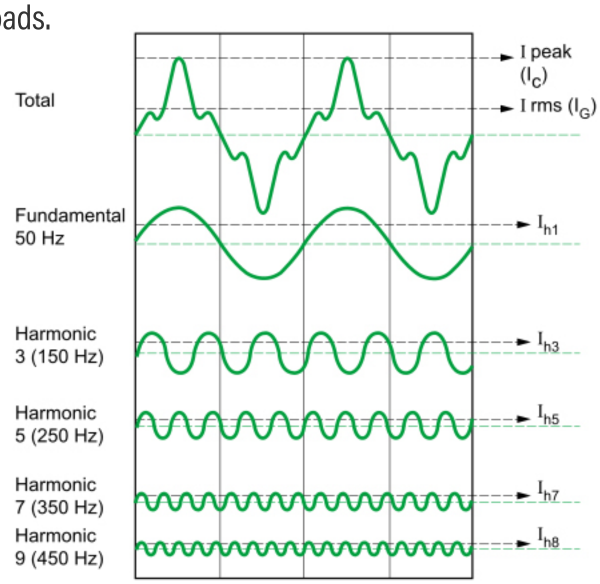
Harmonics only create problems in big industrial installations, right? Wrong, says **Julian Grant** of **Chauvin Arnoux**, who explains how harmonics can cause problems in any type of electrical system – including ordinary domestic installations.

Computers that don't work reliably, circuit protective devices that operate unexpectedly, motors that run noisily, cables and transformers that run hotter than they should – these are just a few of the problems that can occur if there's a high level of harmonics in an electrical system. In the past, harmonics were usually an issue only for electrical installations in large factories, but now they're everywhere, and no contractor can afford to ignore them.

But what are harmonics, where do they come from, why have they become such a problem, and what can be done about them?

Put simply, harmonics are currents in an electrical system at frequencies that are whole-number multiples of the supply frequency. In other words, if the supply is 50 Hz, the harmonics are currents at 2 x 50 Hz = 100 Hz, 3 x 50 Hz = 150 Hz, 4 x 50 Hz = 200 Hz and so on. The multiplier for a particular harmonic is called its 'order' so, for example, a harmonic at 150 Hz is a third-order harmonic. In theory, the orders can go on forever but harmonics above, say, the 50th order are usually so small they don't need to be considered.

To understand where harmonics come from, let's assume that the power delivered by an energy provider has a nice smooth sinewave voltage waveform. If this voltage is applied to a resistive load like a heating element, the current in the load will also be a nice smooth sinewave. But not all loads are resistive. Some, like computer power supplies and motor controllers are definitely not, and a sinewave voltage applied to these will produce a current that's a distorted version of a sinewave. Loads like this are called non-linear loads.



A distorted waveform is made up of multiple sine waves added together

There's some complicated maths which shows that the distorted current waveform produced by non-linear loads is, in fact, made up of current at the supply frequency plus currents at harmonic frequencies. In other words, non-linear loads produce harmonics. If you want more details – and a bit more maths – take a look at the Chauvin Arnoux UK free resource website: https://cauk.tv .

But why have harmonics become such a widespread issue in recent times? The answer is simple – we are now connecting many more non-linear loads to our electrical installations. Almost all electronic devices are non-linear loads. That includes computers, printers, modems, televisions, phone chargers, microwave cookers, fluorescent lamps and LED lighting. Washing machine motor speed controllers produce significant harmonics, and other domestic appliances like fridges and cookers increasingly use electronic controls. In addition to this, many homes and offices are now being equipped with EV charge points and have solar panels on the roof. Put simply, these days non-linear loads are everywhere, which means that harmonics are also everywhere.

Does this matter? Unfortunately, it does. Harmonics can disrupt the normal operation of electrical systems. They tend to produce excessive heat in conductors and components and can cause all sorts of issues with sensitive electronic equipment. They make lights flicker and motors buzz. And they're a common source of nuisance tripping in protective devices.

Harmonic currents can also badly affect the accuracy of measurements you make on an electrical system. This is particularly important if you're an electrician because you'll be using those measurements to certify that the installation complies with the IET Wiring Regulations and, for commercial installations, the Electricity at Work Regulations. The root of the measurement problem is that older clampmeters simply don't give reliable readings if significant levels of harmonics are present in the supply.

To provide an example of this, we recently made some measurements on a circuit supplying CFL (compact fluorescent lamp) luminaires. We used a "standard" clampmeter from a well-known manufacturer. It showed the RMS current as 2.9 A, whereas measurements carried out with a more capable clampmeter revealed the true RMS current to be 6.0 A. Would you be happy to choose protection devices and certify an installation based on measurements with this huge margin of error? Hopefully not, so you definitely need to make sure that the instruments you're using and, in particular, your clampmeters, are designed to give accurate results in the presence of harmonics.

- F407

- F607

Excellent examples of clampmeters that meet this requirement are the **F407** and **F607** from **Chauvin Arnoux**. These measure currents up to and including the 25th harmonic (1250 Hz), and they also feature true RMS measurement, which means that the accuracy of the results they deliver does not depend on the current or voltage being measured having a sinusoidal waveform.

In today's world, where almost everything seems to be controlled electronically, problems with harmonics are certainly not going away. Wise contractors are those who familiarise themselves with these problems and ensure that they're well-equipped to deal with them. Only in this way will they be able to have complete confidence in the certification they provide. As a bonus, they'll also avoid many hours of head scratching over seemingly inexplicable faults, saving themselves time and trouble while making their customers happy – which is, of course, the surest route to profitability!

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