

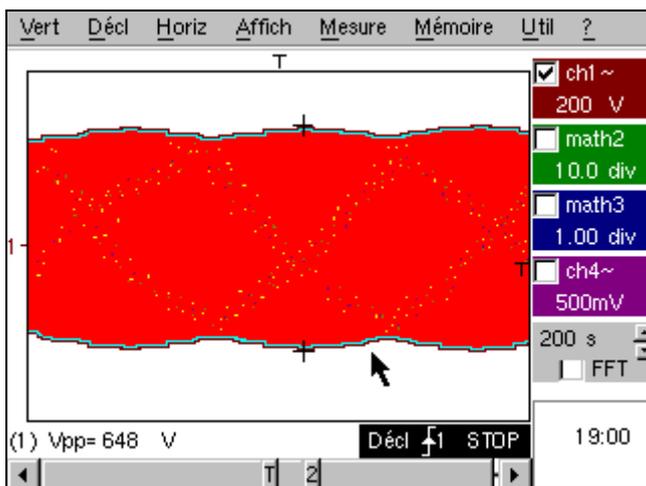
## Case Study: Flicker

### Electrical Network Quality and Human Health

#### 1/ What is flicker?

Flicker (term used by the IEC/EN standard) refers to variations in brightness due to small voltage fluctuations.

These fluctuations are caused by the operation of various types of equipment connected to the network, such as arc furnaces, welding machines, motors, etc.



Capture of voltage variation over a long period

#### 2/ Rapid, periodic voltage variations

These are due to loads (or a set of loads) which cause permanent power demand variations.

In some conditions, it has been shown that the presence of interharmonics in the power supply voltage also causes flicker. These variations can be viewed easily because their spectral breakdown is located in a band from 0.5 Hz to 25 Hz

#### 3/ The consequences of Flicker

The first people to investigate the consequences of this phenomenon were public health and safety organizations, because lighting affected by flicker causes both physical and psychological fatigue among users. The closer the lighting is to a load generating disturbances, the more severe the flicker becomes.

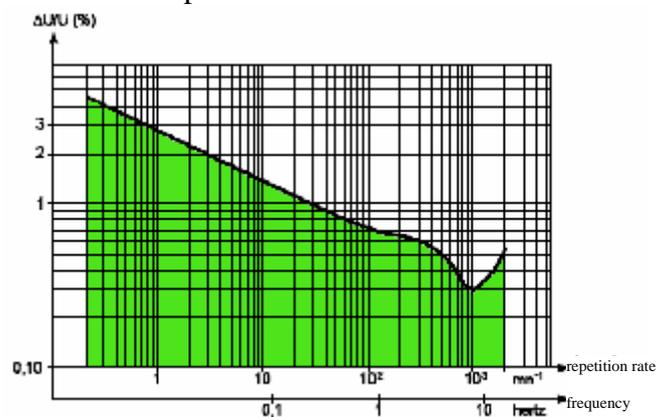
Furthermore, flicker mainly affects incandescent lighting. Its severity varies according to the type of light source.

The "**flicker dose**", the main parameter for flicker quantification used in France, was established on the basis of experiments:

- discomfort is proportional to the square of the amplitude and the duration of the voltage fluctuations
- people's average sensitivity to lighting flicker is highest at a frequency of 8.8 Hz

So, to find out whether the voltage is correct or not, the following parameters must be checked:

- The voltage variation
- The repetition rate



In this curve (50 Hz network), the acceptable measurement point should be located in the green area.

### 4/ Concrete example

**Context:** office building comprising a reception area, a meeting room, 2 offices and, at the end of the corridor, the toilets.

**Problem:** lighting flicker first observed several months previously, mainly visible in the toilets and the corridor. At the same time as the flicker, people have also noticed a slight crackling noise.

**Hypothesis:** the heating system equipment on the roof is suspected of being the cause

**Action:** monitoring of the voltage and current on the electrical switchboard installed near the toilets. On the basis of the voltage and current variations, it was then possible to calculate the approximate impedance of the power supply and of the load.

**Result:** the impedance of the load remained constant, whereas the power supply's impedance varied significantly.

**Conclusion:** the source of the problem is external to the measurement point and is therefore up-line.

**Corrective action:** contacting the energy supplier so that they could search for the cause of the problem on their side.

In the end, their inspection revealed that the cause was a faulty welding unit located in the same service area.

### 5/ Measurements to be carried out

According to the applicable standards, the level of Flicker is expressed by 2 parameters:

- **the Pst** short-term flicker;

Calculation of the Pst parameter, which is used to assess the level of flicker, is based on statistical processing of the voltage signal sampled. It is measured over a period of 10 minutes

- **the Plt** long-term flicker; this is a multiple of the Pst. It is measured over a period of 2 hours.

#### Terminology and Standards

##### IEC 61000-4-15

This standard specifies all the features which must be offered by any instrument intended for accurate flicker measurement with all the fluctuation waveforms encountered in practice. The applicable standards define the acceptable range for these voltage variations: period < 1 hour, low amplitudes (< 10 %) of the power supply voltage.

In France, the company RTE (ex-EDF Transport) imposes even lower values, with a Pst flicker of 0 to 1 (0 to 0.6 for HV).

### Chauvin Arnoux instruments offering flicker measurement



Qualistar



C.A 8230



C.A 8342



C.A 8352

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