Energy meters testing under non sinusoidal conditions

Calmet
Calibration

(remarks according to the article “Static Energy Meter Errors Caused by Conducted Electromagnetic Interference”)

Application Note

Calmet, 22.03.2017

1. As reference energy meters for test, were used typical electromechanical energy meters with generally unknown accuracy for distorted voltage and especially current characteristics. Using, available on market, Portable Working Standards would be highly recommended (eg. Calmet TE30 tester and analyzer).

2. Many new, electronic energy meters are produced with connection between voltage and current circuit, without possibility of disconnection during testing – such called **“closed IP-link”**. This connection doesn’t make problem during testing one energy meter at time. In case of more energy meters (2, 3, 4 or more), there is additional current flow because of U – I connection (IP-link), what can make some additional errors during measurement – see in Fig.1. The additional error is on level from 0.1% to 0.5% or even more for very low testing currents. Generally it depends on value of load and testing current. It seems, that many of tests were made at small load, around and below I_{MIN} current (usually 5% of I_{REF} or I_{BASE} defined in standards like IEC 65052, -53, EN50470 and MID directive).
Conclusion: through each meter under test flows different current. It is systematical error, especially high for low loads. Comparison between each meter indication is made not at the same load .

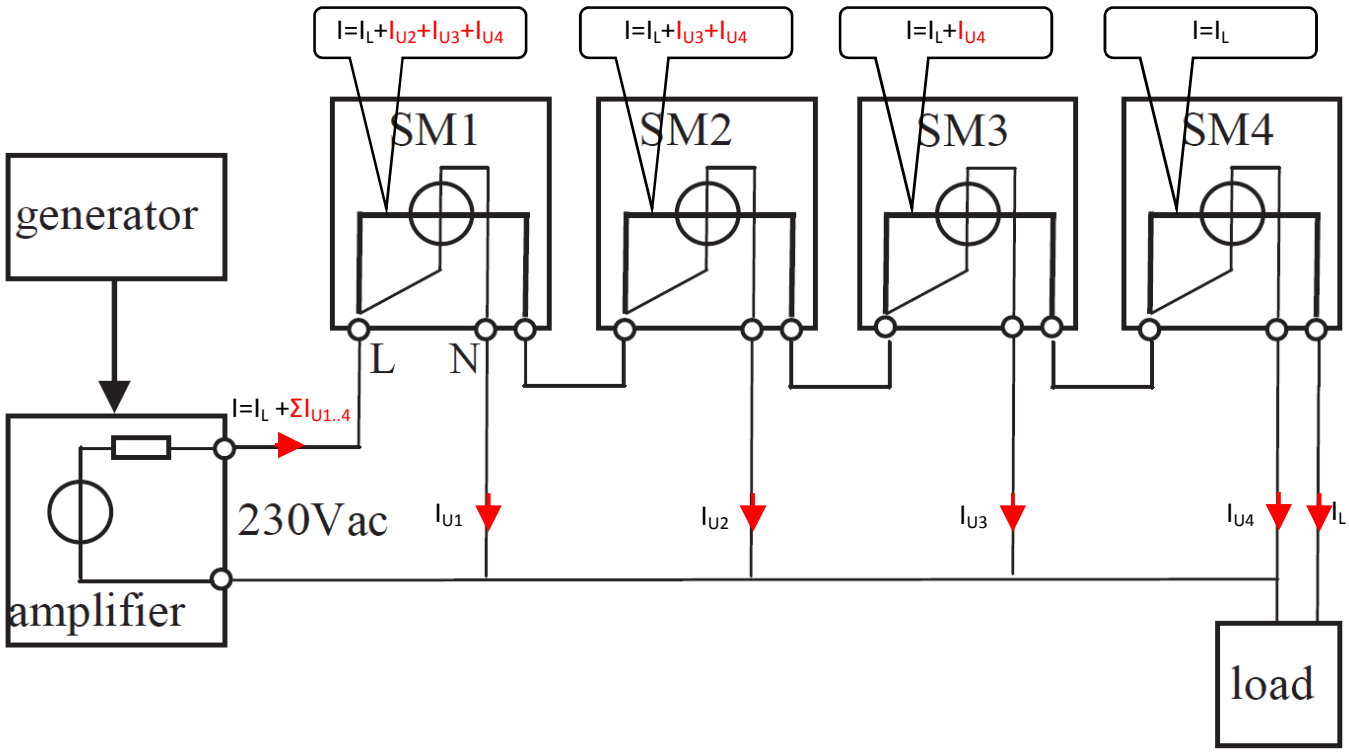

Fig.1 Current flow in multi energy meter testing system.

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For example, assuming that in modern, electronic energy meter with closed IP-link, the power consumption in voltage circuit, is on level of 1VA – the current flow will be about 4.3mA (I= P/U; I=1VA/230V=4.3mA) for the second and next connected meters. This current will make additional error of about 0.1% for testing current lower than 5A ($\varepsilon=[I_{link} / I_{test}]*100\%$= 4.3mA/5A*100%= 0.086%). In case of four energy meters tested at the same time, the error can be increased to (4-1) * 0.1%=0.3% for currents lower than 5A. Of course for higher currents than 5A, the error decreases, for example at 10A, this additional error can be on 0.15% level. On the other hand, for presented in article loads (in the picture 20 LED bulbs by eg. 5W each) ~ 100W or 360W (mentioned in text) the load current is on 0.43A (100W/230V)or 1.56A (360W/230V) level, what can make additional error on 1% (4.3mA/0.43A*100%) or 0.28% level respectively, for the second meter and increased for every next connected meter.

3. Testing of non-sinusoidal voltage and current influence for electricity meters accuracy, can be also made in faster and easier way, by means of single and 3-phase programmable power calibrators. Below is presented method of using power quality analyzer (eg. Calmet TE30) to measure voltage / current bulb characteristics (see Fig2.) and then, this characteristics is simulated by power calibrator (eg. Calmet C300B see Fig.3.) connected to the meter under test and programmed (see Fig.4) with required shape (up to 64th harmonic in voltage and current). In this way, first pure sinusoidal waveform and then distorted one can be applied to the meter, and by means of built in reference meter with impulse input, checked accuracy energy meter. The procedure can be made in full automatic way for many variations of distorted signals and different values of loads.

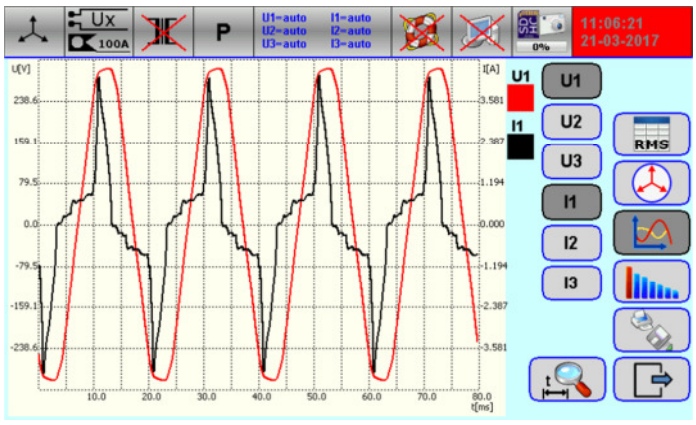

Fig.2. Characteristic of different LED bulbs switched together inside building.

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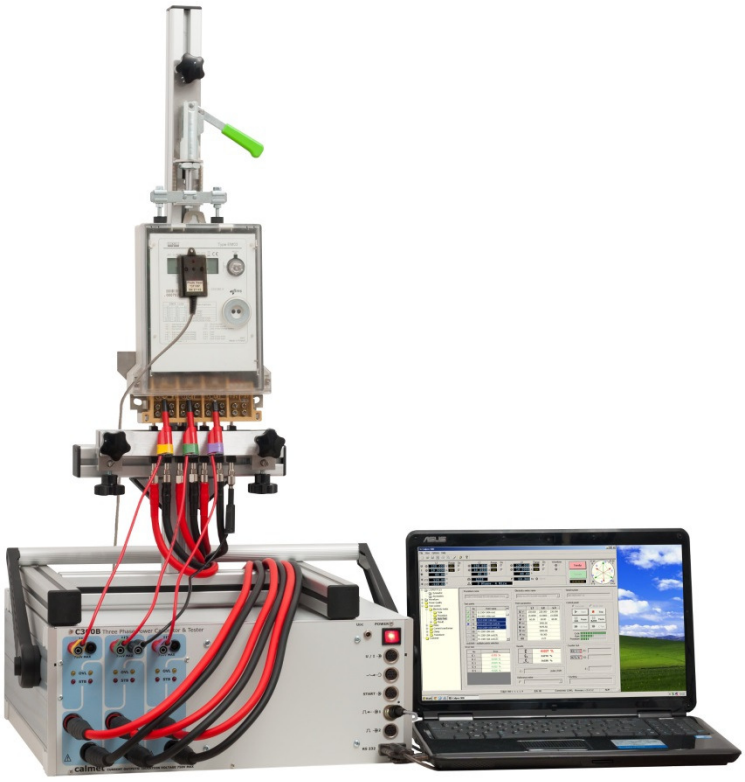

Fig.3. 3-Phase Power Calibrator Calmet C300B with Energy Meter under test.

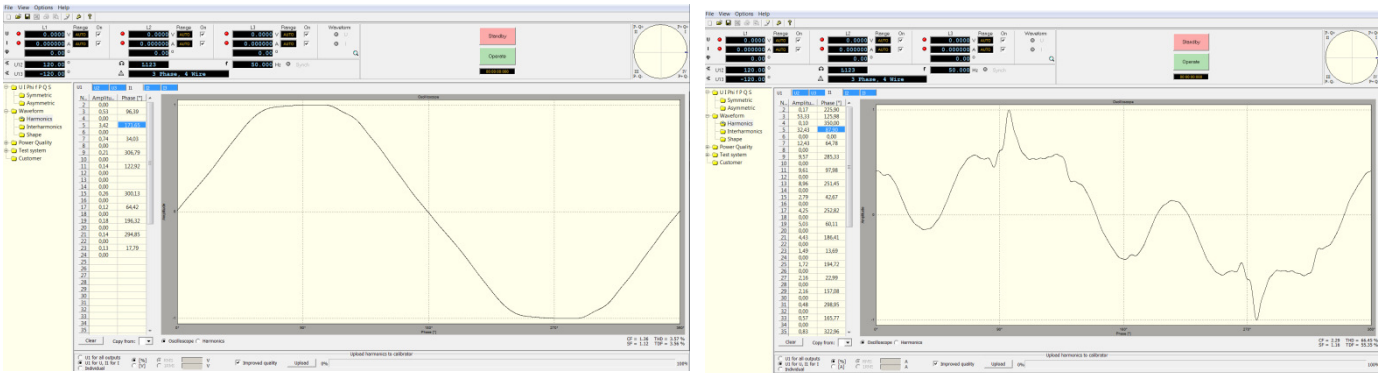

Fig.4. One period of Voltage and Current shapes programmed in 3-Phase Power Calibrator Calmet C300B by entering the level of individual harmonic and its phase shift .

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