Experiment: Power Factor

1. Objectives

The purpose of this experiment is to learn about of the basic parameter of the power consuming equipment, which is a Power Factor (PF). This lab classes are based on measuring the power factor of electronic and electric equipment, observing the wave shape of voltage and current drawn by the equipment.

2. Components and instrumentation

To measure the power factor and other parameters of the tested receivers DW6090A Power Analyzer will be used. The equipment under test is connected to power through a network analyzer. From the Analyzer menu, select a power (kW) to measure the effective power and PF.

To observe the wave shape of the current and voltage a current and voltage transformer (CT and VT) are used. CT and VT diagrams are shown in the figures below.

To terminals A and B connect an oscilloscope probe, which will be measured (monitored on an oscilloscope) the voltage across a known resistor. The voltage according to Ohm's law is proportional to the current. P switch selects gear of CT (number of wire coils with measured current)

The second oscilloscope probe is connected to the terminals C and D. This is the output of the voltage transformer used for measuring and monitoring the test voltage of power supply.
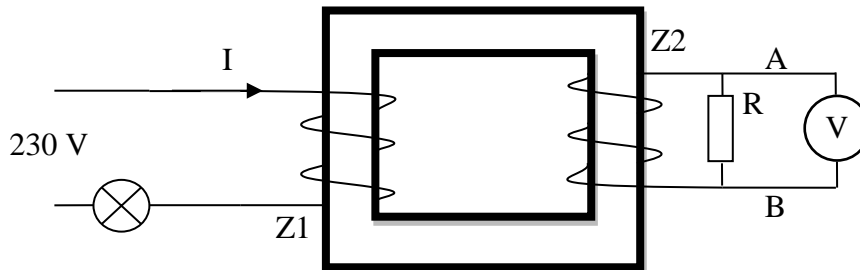
Fig.1. Schematic of current transformer
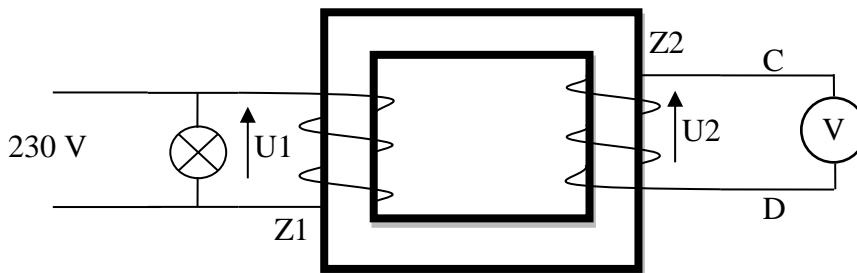

Fig.2. Schematic of voltage transformer

3. Preparation.

Estimated time to prepare for classes is 2 to 4 hours.

3.1.   Readings

Basic:

[1] Lectures notes ("Power Factor Correction")

[2] W. Tietze, Ch. Schenk, Electronic circuits – Handbook for Design and Application, Spriger, 2008. Chapter 22.4

Additional:

[3] Standard EN 61000-3-2
[4] Handouts: ON Semiconductors, International Rectifier (IOR); Analog Device; Texas Instrument; National Semiconductors; NXP.

3.2. Problems

1. Define: active (real), reactive and apparent power;
2. Define: power factor, the cosine of phase angle;
3. Derive the relation between THD vs. PF;
4. Define: RMS, average, maximum current;
5. What is the difference between Current and Voltage Transformer;

4. Content of report

4.1. Installation of the measuring system

Connect the equipment under test to the power supply through current-voltage transformer and a network analyzer. Connected a oscilloscope to the terminals A - B and C - D.

4.2. Data acquisition

1. Observe waveforms of voltage and current for several different equipment – record oscilloscope images;
2. Making use of the oscilloscope, measure the:
   - RMS current, voltage AND active power (average of U and I product) (take screen shot)
   - Harmonic content by using the oscilloscope FFT function (take screen shot)
3. Calculate the power factor
4. Using the network analyzer, measure:
   - Power consumed - determine the active, reactive and apparent powers
   - Determine power factor
5. Repeat the measurements for a few of units.
6. The results collect in a table.

   Final report should contain:
   a. Answers of 3.2 problems
   b. Tabularized results of measurements ,
   c. Oscilloscope prints of observed wave forms,
   d. Conclusions.

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Receivers	Oscilloscope					Power Analyzer				
	I_{RMS} [mA] U_{RMS}[V]	Apparent power S [VA]	Active power P[W]	PF	Figures: (1)U,I,power (2)FFT(I).	I_{RMS} [mA]	Active power P [W]	Reactive power Q [VAR]	Apparent power S [VA]	Power Factor
1										
2										
3										
4										
5										