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Design Implementation and Analysis of non linear system based power quality using LabVIEW.

Nandan N[1], A M Nagaraj[2], Nagaraja B S[3]

[1,2,3] *Assistant Professor, Department of Electrical & Electronics Engineering, DSCE*

Abstract:
In the present scenario the increasing existence of nonlinear loads and the increasing number of distributed generation power systems in electrical grids change the characteristics of voltage and current waveforms, which differ from pure sinusoidal wave. Poor power qualities affect functioning of utilities, different industrial units, productions, customer services and other system performance and operating costs. Monitoring of power quality is essential to maintain proper functioning of utilities, customer services and equipment's. The target here is to design measuring systems and display the system parameters under distorted system conditions. Harmonics are measured and displayed using LabVIEW. The voltage and current are sensed using sensors for various loads, which are then interfaced with the PC using DAQ (Data Acquisition) card and displayed using LabVIEW. The Hardware implementation includes setting up of test systems such as diode bridge rectifier and thyristor-based converter with various loads.
Key word: DAQ, LabVIEW, Power qualities, Harmonics.

Introduction

The aim of the power system has always been to supply electrical energy to customers. Earlier the consumers of electrical energy were mere acceptors. Interruptions and other voltage disturbances were part of the deal. But today electric power is viewed as a product with certain characteristics which can be measured, predicted, guaranteed, improved etc. Moreover, it has become an integral part of our life. Modern world is heavily dependent on the constant and reliably availability of electrical power supply. In the recent years, users of electric power have detected an increasing number of drawbacks caused by electric power quality variations. These variations already existed on the electrical system but only recently they are causing serious problems. This is due to the increased sensitivity of equipment's and devices used by customers. This end user equipment's are more interconnected in networks and industrial processes, that the impact of a problem with any piece of equipment is much more severe.

Now the quality of this power supply is becoming more important due to increasing sensitivity of the equipment's and devices used by the customers. Also, power quality of power systems affects all connected electrical and electronic equipment's and is a measure of deviations in voltage, current, frequency, temperature, force, and torque of particular supply systems and their components.

Sustainable Energy is the provision of energy such that it meets the needs of the future without compromising the ability of future generations to meet their own needs. It is required to have more efficient means of converting and utilizing these energies. This will depend on the quality of power supplied and the impact of end user equipment's on that power

Power quality monitoring can help to identify the cause of power system disturbances and even help to identify problem conditions before they cause interruptions or disturbances. Hence to improve power quality with adequate solutions, it is necessary to know what kinds of disturbances occurred.

Design & Implementation:

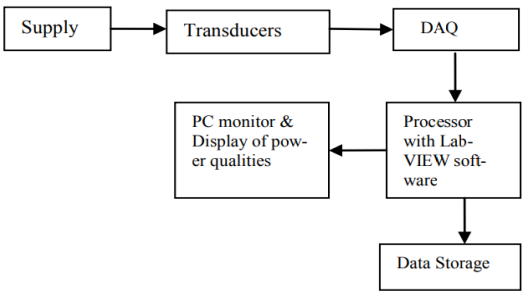


Figure 1: Block diagram

The developed Power Quality Monitor consists of a standard Personal Computer including LABVIEW software, data acquisition system/card (National Instruments USB DAQ 6009), and a Custom-made hardware module consisting of current transducer or sensor, voltage transducer or sensor, regulated power supply of -12V to +12V or -15V to +15v for both current and voltage sensors and single phase 260V autotransformer

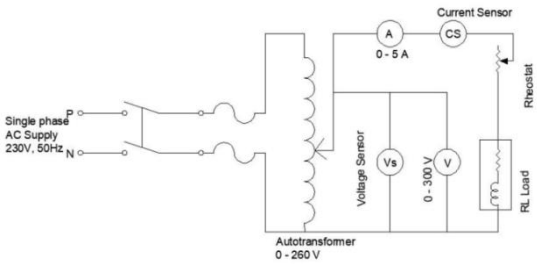


Figure 2: Circuit diagram for PQM for resistive load

- The figure 2 shows the circuit diagram of hardware setup for power quality monitoring connected for the linear load.
- In the above shown circuit diagram for linear resistive load, the connections are given as from main voltage supply of single phase AC supply 230V,50Hz.
- From the supply it is connected to an autotransformer of rating 0-260V, which is to be kept at 0 position at initial and further the voltage is gradually raised to the required voltage.
- Now through the autotransformer it is connected to the ammeter(A) of current rating from 0-2A or 0-5A and to the current sensor to sense the analog current sensor(CS) and from the current sensor to the rheostat further to the linear resistive load.
- Voltmeter(V) and voltage sensor(VS) are connected parallel to the autotransformer to read the voltage as shown in figure 2

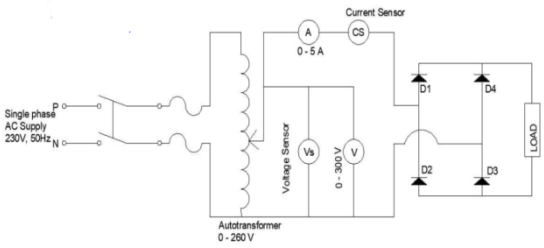
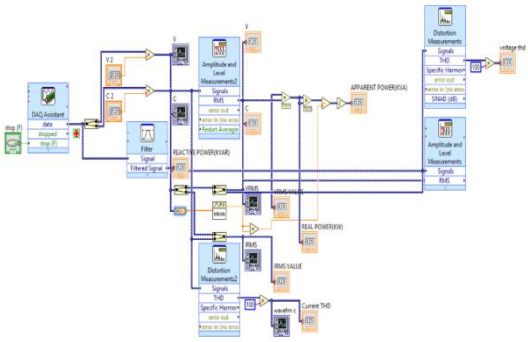


Figure 3: Circuit diagram for PQM for non-linear load

- The above figure 3 shows the circuit diagram of hardware setup for power quality monitoring connected for the linear load.
- In the above shown circuit diagram for linear resistive load, the connections are given as from main voltage supply of single phase AC supply 230V,50Hz.
- From the supply it is connected to an autotransformer of rating 0-260V , which is to be kept at 0 position at initial and further the voltage is gradually raised to the required voltage.
- Now through the autotransformer it is connected to the ammeter(A) of current rating from 0-2A or 0-5A and to the current sensor to sense the analog current sensor(CS) and from the current sensor to the bridge rectifier circuit which contains four diodes to form a bridge rectifier to load, where bridge rectifier makes the circuit as non-linear and thus used as non-linear load.
- Voltmeter(V) and voltage sensor(VS) are connected parallel to the autotransformer to read the voltage as shown in figure 3

The use of LabVIEW software platform for power quality detection and interpreted system characteristics harmonic detection, voltage, current waveforms which includes their deviations is proposed. The design of a multifunctional Virtual monitoring system which monitors the power quality and then implemented in LabVIEW environment is designed



SIMULATION RESULTS

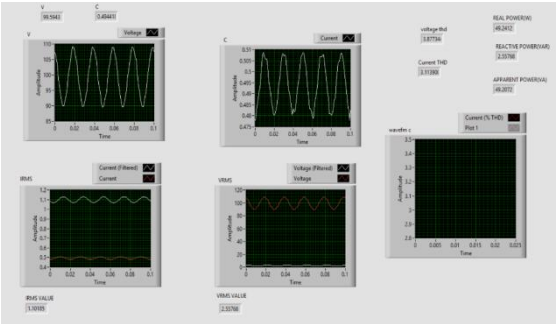


Figure simulated output for non-linear incandescent bulbs 200W load for 100V

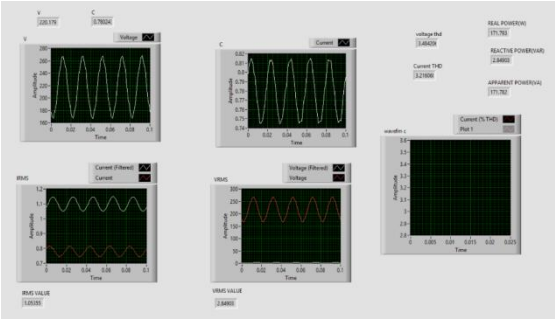


Figure simulated output for non-linear incandescent bulbs 200W load for 220V

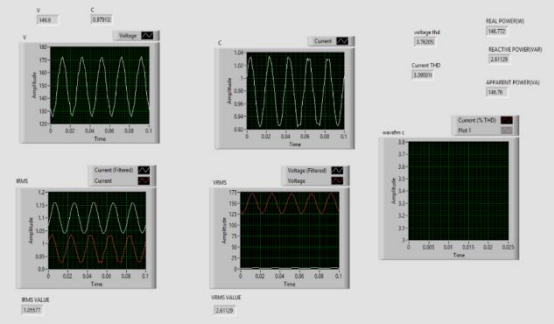


Figure simulated output for non-linear incandescent bulbs 300W load for 150V

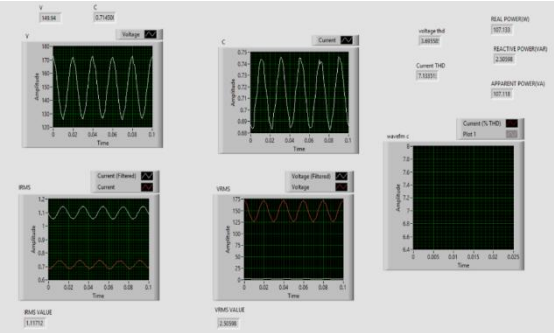


Figure simulated output for non-linear Inductive load 200W load for 150V

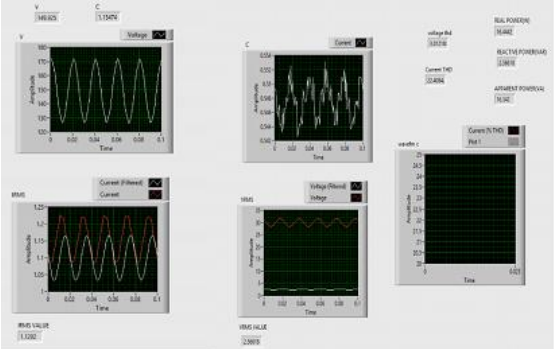


Figure simulated output for non-linear Inductive load 300W load for 150V

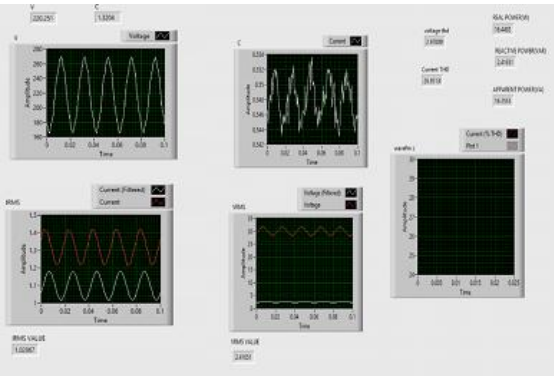


Figure simulated output for non-linear Inductive load 300W load for 220V

CONCLUSION

Non-linear loads introduce harmonics that has many undesirable effects such as increased losses, thermal stress and reduced lifetime of the equipment on the power system. Hence power quality analysis / monitoring should be done in any system to avoid undesirable effects due to harmonics and avoid some of the factors such as electromagnetic compatibility, voltage sag, flickers, transients, notching and interruptions. LabVIEW program for power quality analysis is formulated and its performance is verified with non-linear loads. NI LabVIEW is an open environment designed to make interfacing with any measurement hardware simple. It combines data acquisition, analysis, and presentation tools into one software program. With interactive assistants, code generation, and connectivity to thousands of devices, LabVIEW makes gathering data as simple as possible. Because Lab VIEW provides connectivity to virtually any measurement device, you can easily incorporate new Lab VIEW applications into existing systems without losing your hardware investment. Regardless of your hardware requirements, Lab VIEW provides an interface to make connecting to your I/O easy.

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