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# Real Time Power Quality Data Monitoring at Customer end

Prathibha.E[1], Dr.A.Manjunath[2]

Assoc. Professor, Dept. of E&EE, Sri Krishna Institute of Technology, Bangalore, Karnataka, India[1]

Professor, Dept. of E&EE, Sri Krishna Institute of Technology, Bangalore, Karnataka, India[2]

**ABSTRACT:** Power quality disturbance is a one the challenging issues, where many researchers are gaining the attention towards it, now a day it is very much necessary to monitor power quality disturbances for analysis and other purpose. This paper presents an efficient monitoring of power qualities parameters. A power quality monitoring system can be developed by designing virtual instruments using Lab VIEW software, which is interface with hardware data acquisition system. The PQ Monitors are designed and installed at the customer level in order to trace the PQ disturbances generated by various nonlinear loads. The PQ Monitors are designed for multipurpose usage such as event recording, raw data collection and also further PQ analysis purpose.

**KEYWORDS:** Electric Power Quality Monitor, Power quality disturbance, Lab VIEW, Hardware data acquisition.

## I. INTRODUCTION

Now a day's electric utilities and end users of electric power are becoming increasingly concerned about the quality of electric power. There are four major reasons for the increased concern. Newer-generation load equipment, with microprocessor-based controls and power electronic devices, is more sensitive to power quality variations than was equipment used in the past. The increasing importance on taken as whole power system efficiency has resulted in continued growth in the application of devices for example adjustable-speed motor drives and shunt capacitors for power factor correction to reduce losses. This is resulting in increasing harmonic levels on power systems and has concerned about the future impact on system capabilities. End users have an increased awareness of power quality issues. Utility customers are becoming better informed about such issues as interruptions, sags, and switching transients and are challenging the utilities to improve the quality of power delivered. Many things are now inter connected in a network. [1][2].

## II. PQ MONITOR AT CUSTOMER SIDE

Power quality monitoring is the process of gathering, analyzing, and interpreting raw measurement data into useful information. The process of gathering data is usually carried out by continuous measurement of voltage and current over an extended period. In general, it is a fact that customers always demand information about the quality of the service and the product [3]. Customers would like to know everything about the power quality. If something goes in the wrong with the supply, Customers want to know what caused this fault and who is responsible. When this power quality problem causes damage in electronic equipment, financial responsibility becomes more and more important. Hence, it is always necessary to obtain and collect information about the quality of the power in the network at all levels; generation, transmission and distribution. Considering the power system in the Figure 1 there are many customers in the grid at the distribution level. The power monitoring device in this level should be simple and as cheap as possible so it is feasible to sacrifice evaluation of some parameters to make the device simple and cheaper. Many industrial and commercial customers have equipment that is sensitive to power disturbances, and, thereby it is more important to understand the quality of power being provided to the Sensitive customers like semiconductor, electronics manufacturing facilities, biotechnology and pharmaceutical laboratories, and financial data-processing centers [4].

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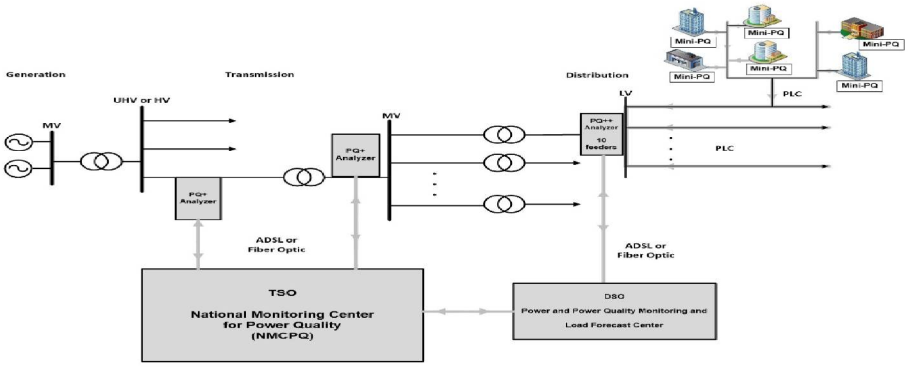


Fig 1: Electrical Grid with Multiple customers PQ Monitors

The PQ Monitors are designed and installed in the customer level, which is at the end of the low voltage distribution power system. The PQ Monitors is designed for multipurpose usage such as event recording and raw data collection, in addition to the usual PQ analysis functions [5].The PQ Monitors collects data on the power line and sends them to the PC via serial port communication. The PQ Monitors can store all the data in a file.

- **General Block Diagram of PQ Monitor:**

In this section, basic power quality parameters and measurement methods used in this paper will be described in detail. Power quality parameters like power frequency, magnitude of the supply voltage, magnitude of the current, supply voltage dips and swells, voltage interruption etc can be measured using PQ monitor . In order to implement and test the performance of the PQ Monitor, a test setup has been installed .The digital information of PQ parameters such as RMS value of voltage, magnitude of the current, frequency value, apparent power, active power, voltage interruption and current interruption are displayed in the PC. General block diagram of the test setup is provided in the Figure 2. The test station, adopted for performance verification of the PQ Monitor consists of AC Supply, Data receiver unit, Laptop PC through Lab view interface and different load such as induction motor, bulb load, RL load, Hair dryer.

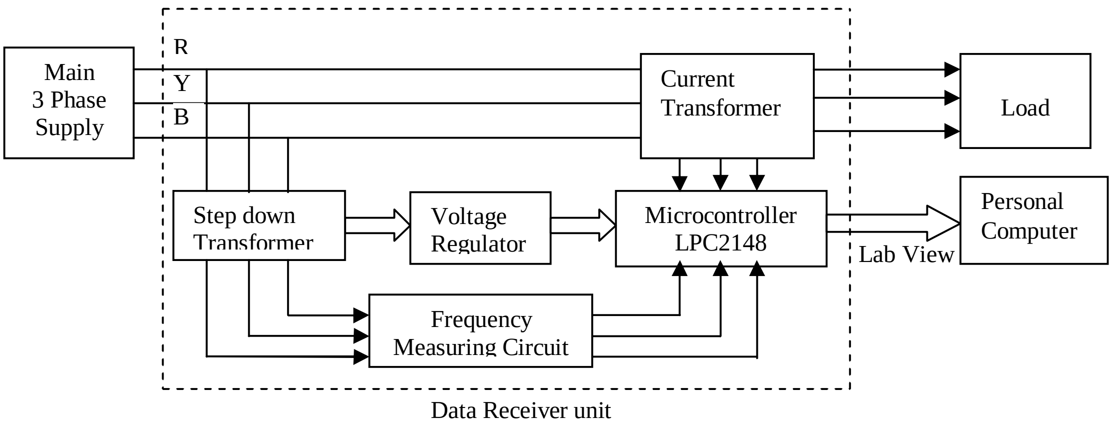


Fig 2: General Block Diagram of PQ Monitor with Lab View interfacing

Data receiver unit connected in between main supply and the load. From the main supply we are connecting to step down transformer which is to analyze the voltage data and the further working of voltage parameters is explained in voltage measuring circuit. From the step down transformer we are connecting to frequency measuring circuit as shown in fig 2 which helps us to collect the data of frequency. Current Transformer (CT) which is used for measuring the

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current. All the collected data's are fed to microcontroller by using voltage divider circuit. Thus by connecting to the microcontroller all the data's are displayed on the LED screen and that can be interface with labveiw software. All the PQ parameters are made to display on PC. The loads which we used are lamp load, Induction motor, Hair dryer etc.

## III. EXPERIMENTAL RESULTS

### ❖ Development Of Data Acquisition Hardware

The main aim is to develop an efficient monitoring of power qualities. An intelligent power monitoring system can be developed by designing virtual instruments using Lab VIEW software and DAQ system and sensors. The system shows fast response with accuracy in monitoring and analysis of the desired power qualities. Initially, the distortions have been simulated in the labs and measured with the help of the developed virtual instruments (VIs) using graphical programming in Lab VIEW. Different types of disturbances measurements are done with front panel created on PC monitor. The huge amount of acquired data has been analysed using quadratic discriminate analysis technique to determine the quality of the supply. The quadratic function is estimated treating a sample from the data as a training data. The data can be exported in different formats in a text file or directly in common software products like Excel etc. The test results of the simulated and the prototype system show the desired performance of the system and thus validate the proposed technique. The beauty of the system is that it can be used for monitoring of power qualities in both existing power system and sustainable energy systems with provisions for switching-over. In this application, we generate a graphical user interface through which the user can monitor and adjust different parameters to customize the monitoring tasks. On the other hand, a National Instruments Data Acquisition card is chosen to interface the analog AC signal as a second step after using step-down transformer along with voltage divider circuit for signal conditioning. For voltage measurements, magnetic voltage transformers are used (up to 5 KHz). However current probes and Hall Effect voltage transducers are employed to acquire voltage and current signals for accurate sensing. For the different load conditions such as inductive, resistive load like lamp and induction motor etc. PQ monitor can detect the different electrical parameter namely voltage, current and frequency as shown in the figure 3. There is a Continuous variation of voltage, current and frequency occurs due to non linear loads.

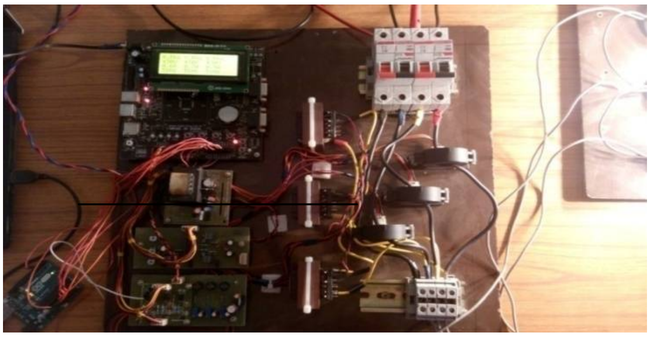

Fig 3 Hardware setup for data acquisition by Connecting Lamp as a Load

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### ❖ Experimental Setup For Different Load

The fig 4 shows the experimental setup for data acquisition by using prototype PQ monitor, which is been connected to induction motor along with lamp load and allowed to run for certain period . Real time data of voltage, current and frequency has been stored. These variations of all PQ parameter viewed through LCD display. The fig 5 shows the PQ monitor connected to induction motor through negative sequence relay. Figure 6 and figure 7 show the continuous variation of voltage and current with respect to time respectively.

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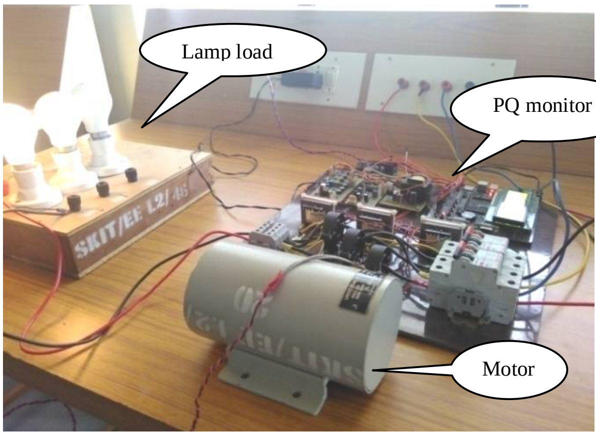


Fig 4: Data acquisition by connecting multiple Loads.

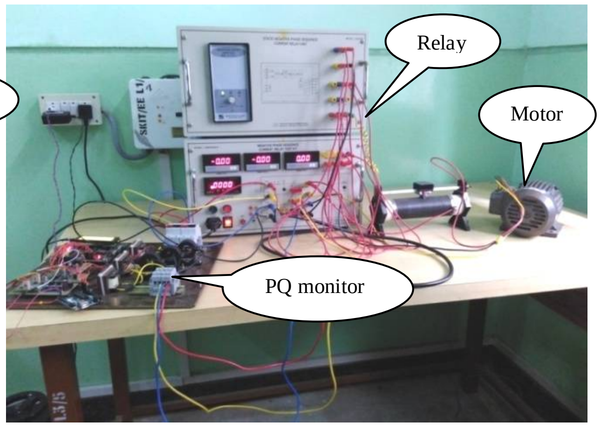


Fig 5: PQ monitor connected motor through relay.

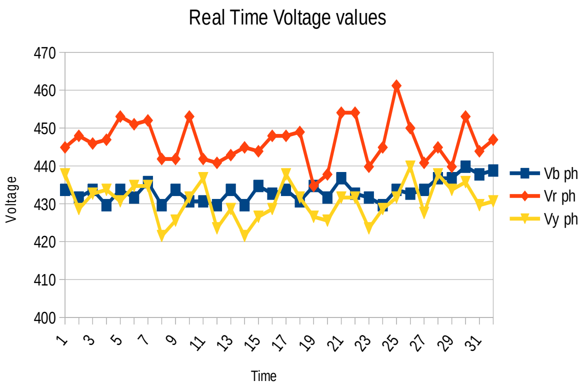


Fig 6: Continuous variation of voltage in time

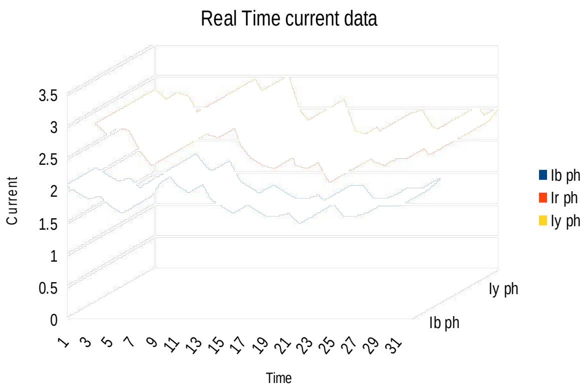


Fig 7: Continuous variation of current in time

### IV. HARDWARE DATA ACQUISITION WITH LAB VIEW INTERFACING.

Lab view is a programming language use for acquiring signal, data representation and measurement analysis. The lab view platform provides models and specific tools to solve application ranging from signal processing algorithm to voltage measurement, targeting member of platforms interfacing desktop and embedded devices. Virtual instrument represents a traditional hardware centered system of software centered systems that exploit connectivity capabilities of work station and desktop computer [6].

Lab VIEW programs are called virtual instruments. Lab VIEW contains a comprehensive set of tools for acquiring, analyzing, displaying, and storing data. In Lab VIEW, we build a user interface, or front panel, with controls and indicators. Controls are knobs, push buttons, dials, and other input mechanisms. Indicators are graphs, LEDs, and other output displays. After you build the front panel, you add code using VIs and structures to control the front panel objects. The block diagram contains this code. Front panel objects as terminals on the block diagram. Double-click a block diagram terminal to highlight the corresponding control or indicator on the front panel. Terminals are entry and exit ports that exchange information between the front panel and block diagram. Data we enter into the front panel controls enter the block diagram through the terminals. During executions, the output data flow to the indicator terminals, where they exit the block diagram, re-enter the front panel, and appear in front panel indicators.we can use Lab VIEW to communicate with hardware such as data acquisition, vision, and motion control devices, as well as GPIB, PXI, VXI, RS232, and RS485 instruments[7].

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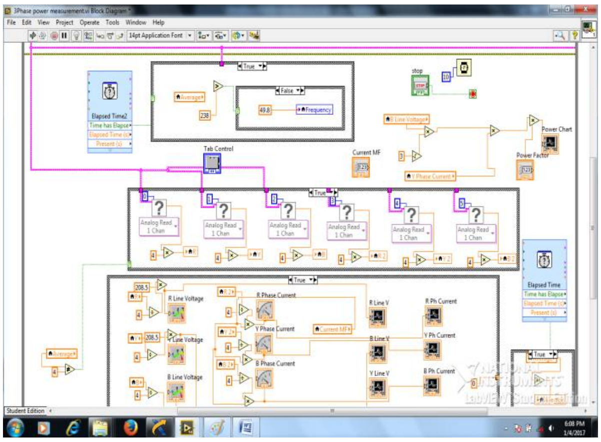

Fig 8: Block diagram of Lab View Simulation.

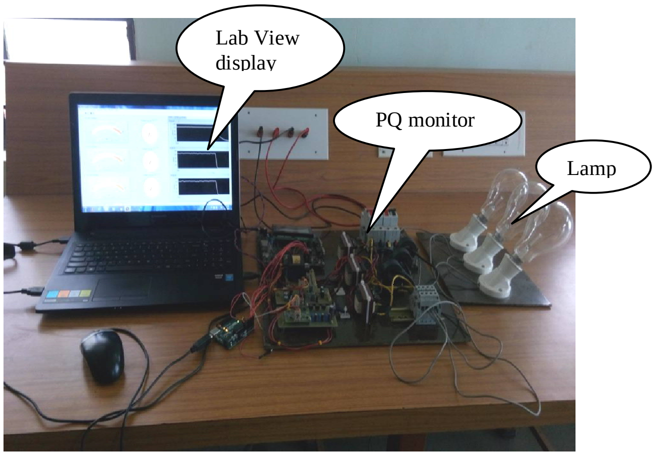


Fig 9: PQ monitors interfacing with Lab View

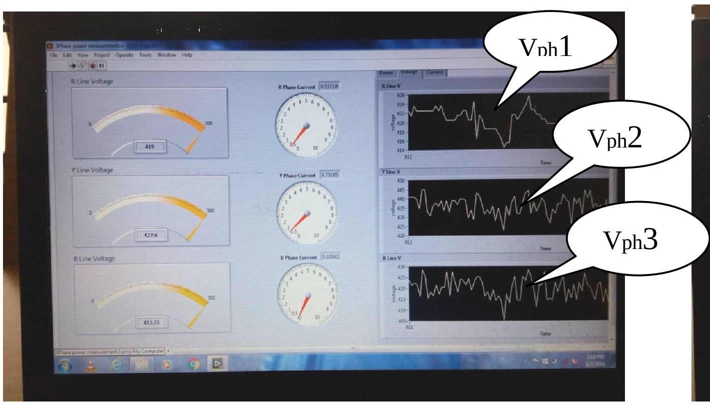


Fig 10: Voltage Waveform Obtained in the Lab VIEW With controls and indicators


Fig 11. Current Waveform Obtained in LAB View with controls and indicators

Block diagram of lab view contains structures, controls and indicators Shows in Fig 8. Fig 9 shows the Simulation Model of the lab view, which is communicate with hardware such as data acquisition.Figure10 and 11 shows the output obtained in the lab view when power quality monitor (Data Acquisition) is interfaced and 3 phase voltage and current of the real time data are display along with indicator respectively.

## V. CONCLUSION

This paper concludes the monitoring and analysis of real time power quality parameters. Hardware Data acquisition in combination with Lab VIEW software is implemented. This module is used for measurement and analyzes of different power quality disturbances obtained from different types of loads. All power quality parameters like voltage, current and frequency are being continuously measured and recorded in text files for further analysis during offline.

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