Three-Phase Power Analyzer using Labview

Muhammad Sulaiman Khan, Saleem Abbas, Nadeem Afridi

***Abstract**: An important requirement of power systems in this decade is the capability of power distribution among electrical devices and systems to improve power quality that depends on various factors, such as reactive, active, and apparent power. Virtual experiments and testing are considered important factors to achieve the best performance in this area. This research mainly aims to find low power factors and load to meet the requirements of electrical devices. Calculations are conducted on a real-time simulator LabVIEW to verify the effectiveness of linear and nonlinear values on the load to achieve the power factor.*

Key words: LabVIEW, power quality, load, low power factor

I. INTRODUCTION

In this modern era, the power distribution in electrical devices is extremely important for industrial equipment and electrical devices. Accurate calculation of power factor is vital for devices. With the advancement of technology, virtual experiments and testing are extremely important for researchers [1]. The distribution models for small and multiple sources are becoming noisy and dynamic, thereby increasing the cost and decreasing the power efficiency, accuracy, and measurements [2,3]. The literature demonstrates that LabVIEW is used in controlling and monitoring the variables in various electrical and industrial applications [4-9]. The power quality of electrical signals must be good to transfer from the load function with proper waveforms, magnitudes, and distortions. Therefore, power quality is an extremely important aspect of distribution systems that enables all equipment to operate in healthy condition [10-13]. Equipment malfunctioning will occur when these conditions are unsatisfied. Thus, data losses and machine problems occur at steady level voltage in limited range. Therefore, good power quality should be maintained in electrical flow to measure the power quality, possible effects, and risks in electrical installations. Harmonics, voltage dips, voltage current and current, electrical noise, flickers, and impulses are the commonly detected disturbances. The correct values of signal, voltage quality, and power factor are difficult to obtain because the distortion in parameters results in various errors. For high quality power equipment, Low power factor should be maintained to increase the versatility of the power system for achieving high power quality of equipment. In this paper, a scheme based on virtual equipment is proposed, Personal computers (PCs) and acquisition cards are used to convert signals, and programs are used to control and record the results and outputs on the basis of hardware data.

II. QUALITY PARAMETERS

The control of power quality parameters, such as frequency, waveform, and voltage, is extremely important. Contribution parameters, such as 3-voltage root-mean-square (RMS), three-current RMS, three-voltage and current waveforms, and three-frequency, are used in this study. With the help of virtual instruments, power is analyzed through manipulation and software development. Four steps are performed as follows: (I) Acquisition, analysis, and display of signals. (II) Sensors are used to measure the three-phase current and voltage. (III) A data acquisition (DAQ) card is used to interface the analog AC signal to the computer. (IV) The proposed virtual power analyzer is used to analyze the acquired signal and provide the desired output.

III. SIGNAL CONDITIONING

The signals from the transducer or sensor are suitable in data acquisition through two stages, namely, sensing and conditioning stages. In the sensing stage, the quantity of signals is measure with the help of special purpose sensors and transducers called current or voltage transducers. In the conditioning stage, the quantity of signals is sensed, and collected using an NI USB-6008. Data Acquisition: The data are conditioned and delivered from the DAQ card to the PC by converting the analog signal into a digital signal using an analog-to-digital converter. LabVIEW Interfacing: The DAQ card is attached to the PC to transmit and display the acquired signals on LabVIEW using the NI USB-6008. Signal Manipulation: The signal acquired by NI USB-6008 will be controlled on the basis of the requirements to achieve the desired values using many graphical equations.

Revised Manuscript Received on January 5, 2020

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Figures 1 and 2 show the functional diagrams.

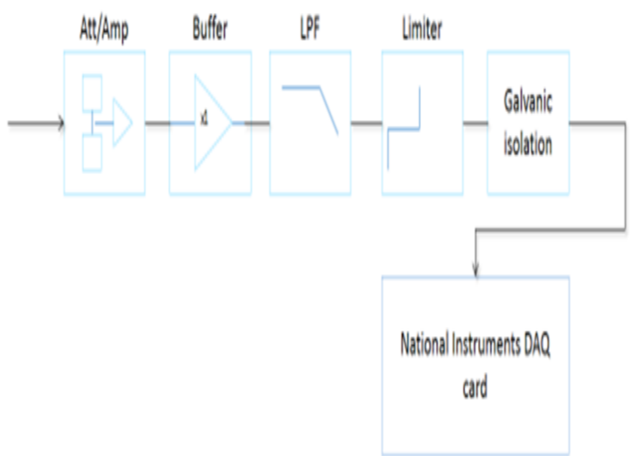


Fig. 1. Potential divider block diagram

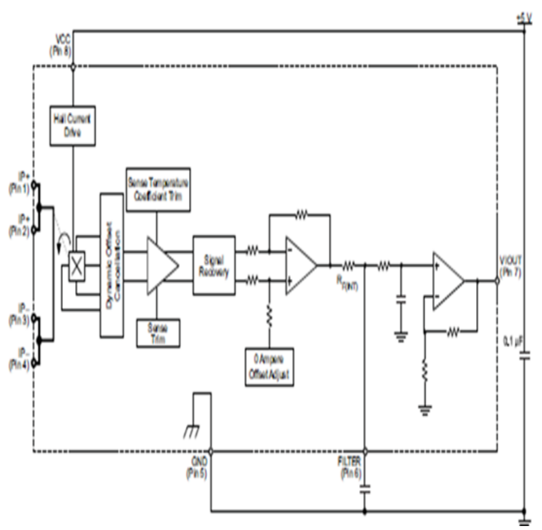


Fig. 2. Functional diagram

IV. SIGNAL CONDITIONING CIRCUIT

The potentiometer is set to 1 k for offset compensation. The signal conditioning circuit for voltage is simulated at the AC input of 220 V (RMS). The value of voltage transducer output is given to the signal conditioning circuit. The magnitude of the AC voltage source is 0.6 Vrms, and 0.85 V peak of potential divider output as the transducer gain is 0.2.

V. SIMULATION CIRCUIT SIGNAL CONDITIONING

The desired output of real-time voltage is 0.85 V, which is obtained in the processing of conditioning circuits using the NI USB-6008 at the peak-to-peak voltage of 13 V with positive and negative voltage of 6.6 V. This value is the per peak step-up voltage using an operational amplifier or dual amplifier to amplify the peak-to-peak voltage to 13 V on the basis of the DAQ requirements, where 0.2 is the gain value of potential divider output, as shown in Figures 2 and 3.

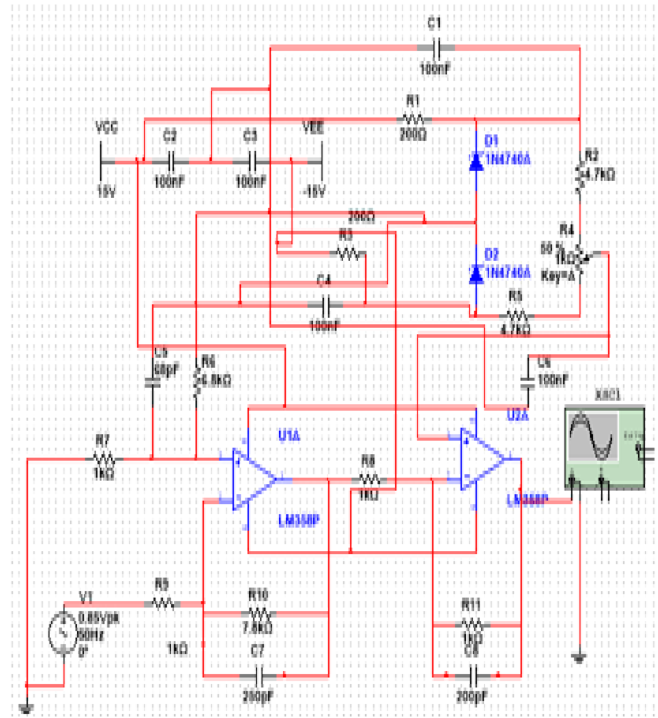


Fig. 3. Pure potential divider circuit on NI Ultiboard

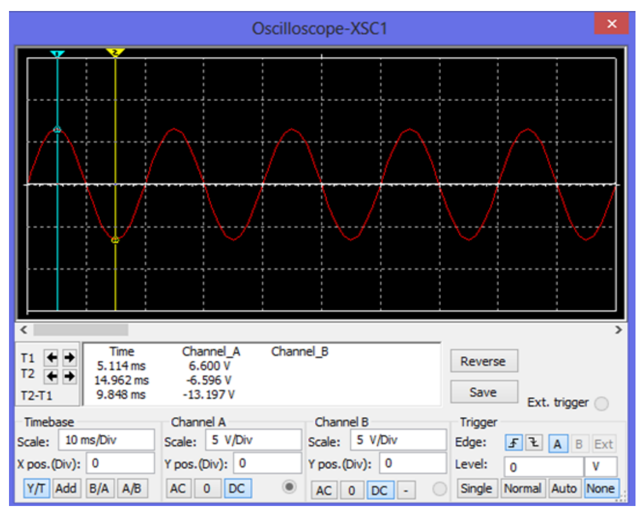
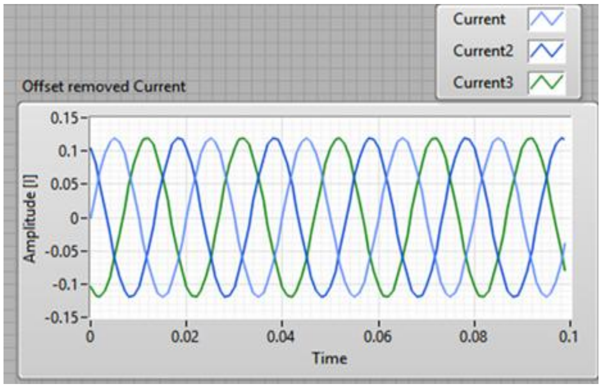


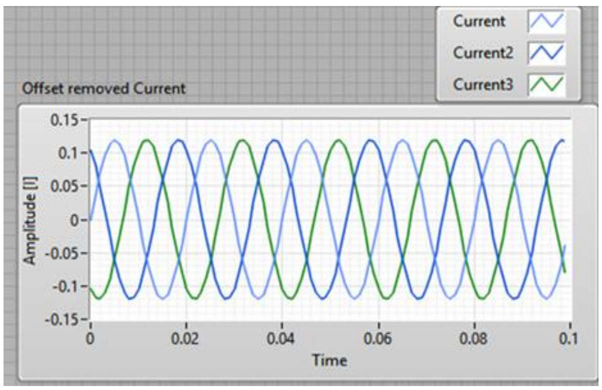
Fig. 4. Required output of potential divider circuit

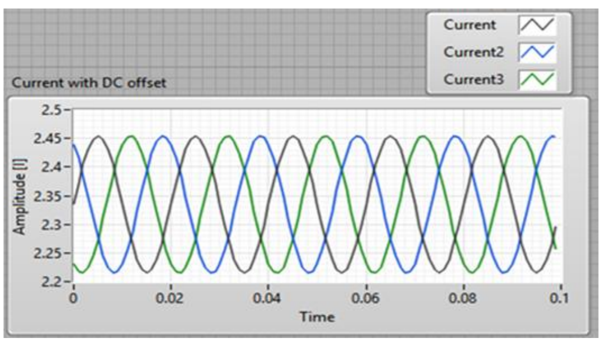
VI. SIMULATIONS RESULTS

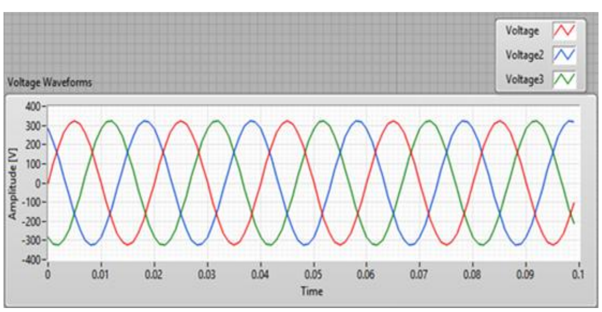
The desired output of real-time voltage is 0.85 V, which is obtained through the processing of conditioning circuits using the NI USB-6008 at peak-to-peak voltage of 13 V with positive and negative voltage of 6.6 V. This value is the per peak step-up voltage using an operational amplifier or dual amplifier to amplify the peak-to-peak voltage to 13 V on the basis of the DAQ requirements, where 0.2 is the gain value of potential divider output.

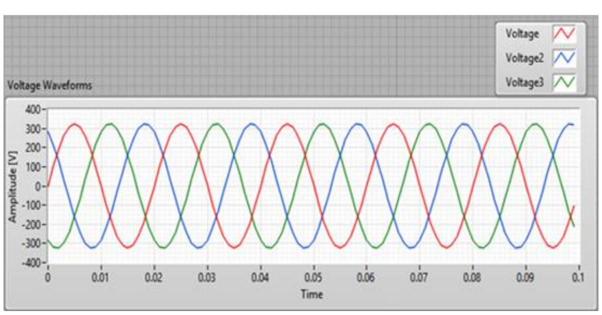
The simulation results are provided as follows.

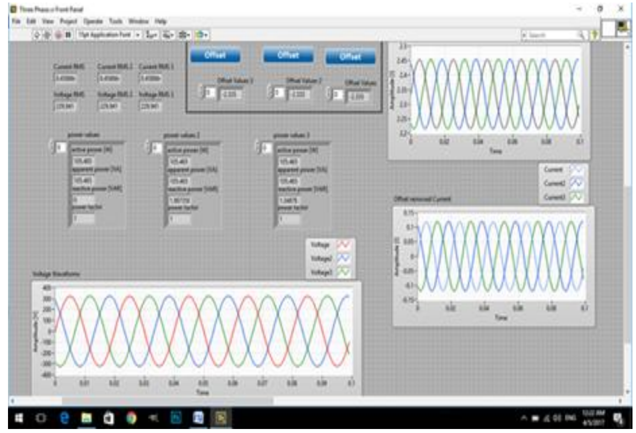












VII. CONCLUSION

In this study, a three-phase power quality analyzer prototype based on NI LabVIEW simulator is presented to analyze the power factor quality on the basis of linear and nonlinear functions and the disturbances in power quality runtime environment. The disturbances are removed using the proposed analyzer.

ACKNOWLEDGEMENT:

All the authors work equally in this manuscript

CONFLICT ON INTEREST:

The authors have no conflict of interest regarding this publication

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