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Identification of Phase Sequence of 3 Phase AC Source

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ABSTRACT: Now a days with increased productivity and consumption most industrial machines requires high input power. For this, these machines rely on 3 phase input supply. Most of these machines are designed to work on the positive sequence (RYB) of 3 phase supply. However if the phase sequence of the input is reversed the machine may cease to work properly. So the phase sequence of the three phase must be known to the operator. This paper provides a simple MATLAB based simulation model of a circuit that detects the sequence of three phase supply.

KEYWORDS: Zero Crossing detector, Monostable Multivibrator, Phase sequence.

I. INTRODUCTION

Identification of phase sequence and detection of phase reversal of a three phase ac supply ac supply is important routine test during installation and commissioning of three phase ac motor and chillers etc. Various circuits can be used for phase sequence detection. However the basic logic for finding the sequence remains the same. The sequence of the supply is determined at the time instant when the phase voltage crosses the zero level of voltage. This can be utilised by the aid of a Zero Crossing Detector (Z.C.D.) followed by a Multivibrator (M.V.). The whole project is based on the MATLAB Simulation model. The MATLAB simulation provides its own simulation library, which provides various simulatory blocks. For example 3 phase voltage source block, relational operator block, monostable block. MATLAB provides a feature that every element in it can be used with its ideal characteristics. So it does not require any need for the use of filters and transformer. The simulation provides a simple model of the actual circuit and help with its design.

II. SIMULATION MODEL

The simulation model is basically a tool provided by the MATLAB, which helps in designing virtual system which works in a manner similar to the actual system. Various blocks are provided by the MATLAB simulation, with predefined properties, by virtue of which, it function like a particular element like transformer, voltage source etc. Various block used in the project are discussed below.

A. Three Phase AC Voltage Source block

The Three-Phase Source block implements a balanced three-phase voltage source with internal R-L impedance. This is the source whose phase sequence we have to detect. The three voltage sources are connected in Y with a neutral connection that can be internally grounded or made accessible. The source internal resistance and inductance can be specified either directly by entering R and L values or indirectly by specifying the source inductive short-circuit level and X/R ratio. The general parameters of this block are

- Phase to phase RMS Voltage (400V)
- Frequency (50Hz)
- Type of connection (Yn)

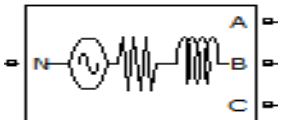

Fig. 1 Three phase AC Source

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B. Voltage Measurement Block

The Voltage Measurement block measures the instantaneous voltage between two electric nodes. The output provides a Simulink signal that can be used by other Simulink blocks. One input of this block is connected to the phase of 3 phase AC source, and other is connected to the neutral of the source block. So a single voltage measurement block measures the voltage of 1 phase of the three phase source. Each phase is provided with its own voltage measurement block. The output signal of this block can be further used for other operations or voltage waveform display purpose.

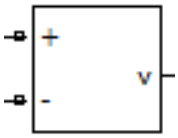

Fig. 2 Voltage Measurement

C. Relational Operator Block

This block can provide the basic function of a Zero Crossing Detector (Z.C.D.) when used in two input mode. By default, the Relational Operator block compares two inputs using the Relational operator parameter that is specified. The first input corresponds to the top input port and the second input to the bottom input port. The output of the block is a signal of amplitude 1 whenever the imposed condition satisfies. In this system, the output is high when the signal at the first input is greater than zero. This is achieved by connecting first input port to output of voltage measurement block and second input to a signal of zero magnitude.

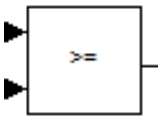

Fig. 3 Relational Operator (Z.C.D.)

D. Monostable Multivibrator

This block requires input as a rectangular wave shape. The block provides output when

- The edge of rectangular wave is rising.
- The edge of rectangular wave is falling.
- The edge of rectangular wave is either rising or falling

The time span of the pulse is user defined. It's chosen as 0.0012s for this project.

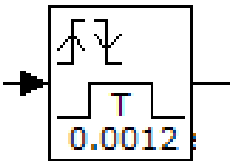

Fig. 4 Monostable Multivibrator

E. Scope

The scope acts as the main output device of the system. It displays the signals generated during the simulation and plot them against time. The scope can either display various signals on a same axis plot (by using Multiplexer) or various signals on different axis plot. The scale of the axis can be varied. Also the colour of different signals can also be changed.

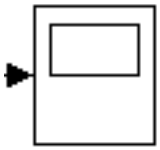

Fig. 5 Scope

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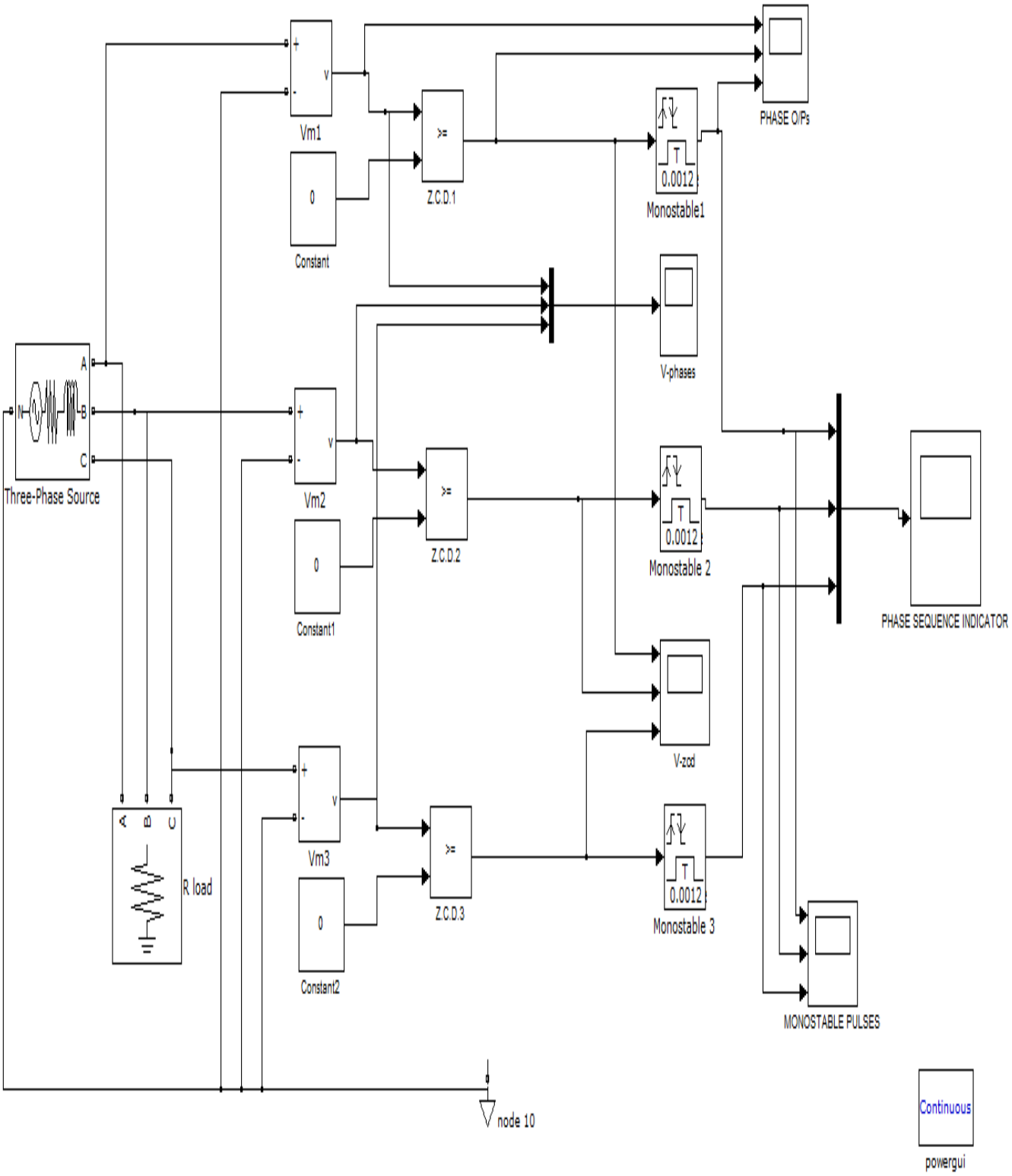

Fig.6 MATLAB Simulink Model for three phase sequence detection of three phase ac supply

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III. RESULT AND DISCUSSION

Figure 7& 9 shows the input wave shapes of positive and negative sequence 3 phase AC source respectively. Figure 8 & 10 shows the output of system indicating the phase sequence of the system. The colour Red, Yellow and blue of the signals depict their phase as 1, 2 & 3.

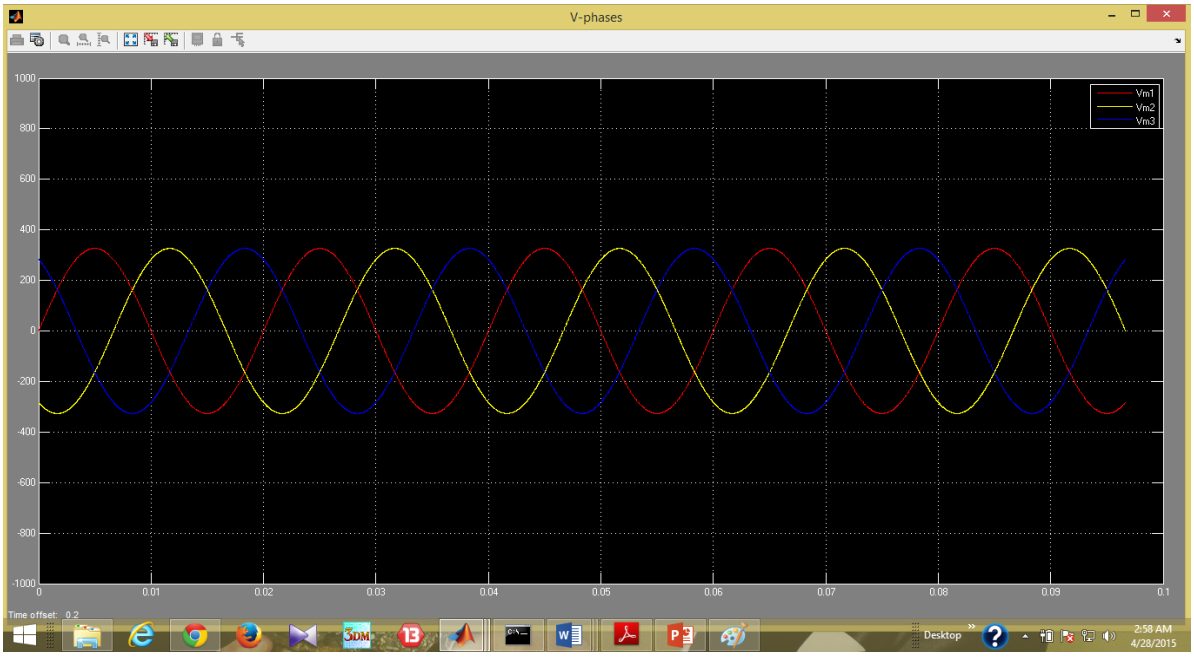

Fig. 7 Three Phase AC Source Waveform (+ Sequence, RYB)

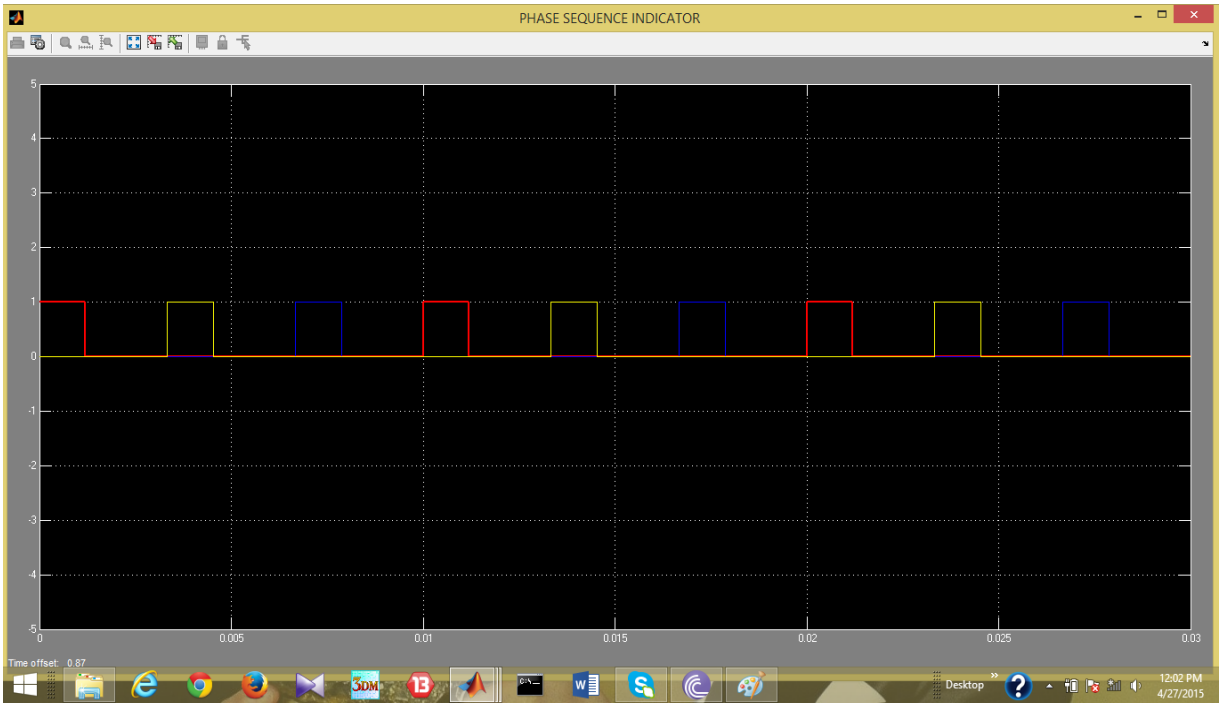

Fig. 8 Output of Sequence Indicator (R, Y, B)

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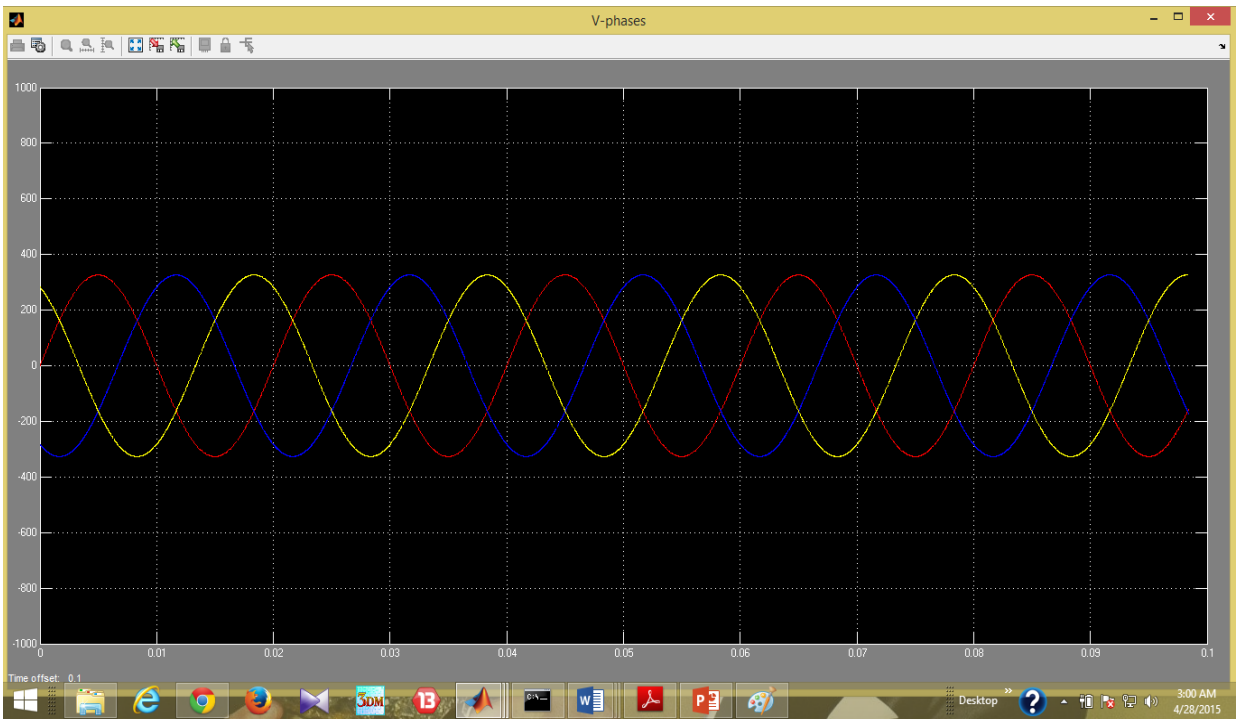

Fig. 9 Three Phase AC Source Waveform (- Sequence, RBY)

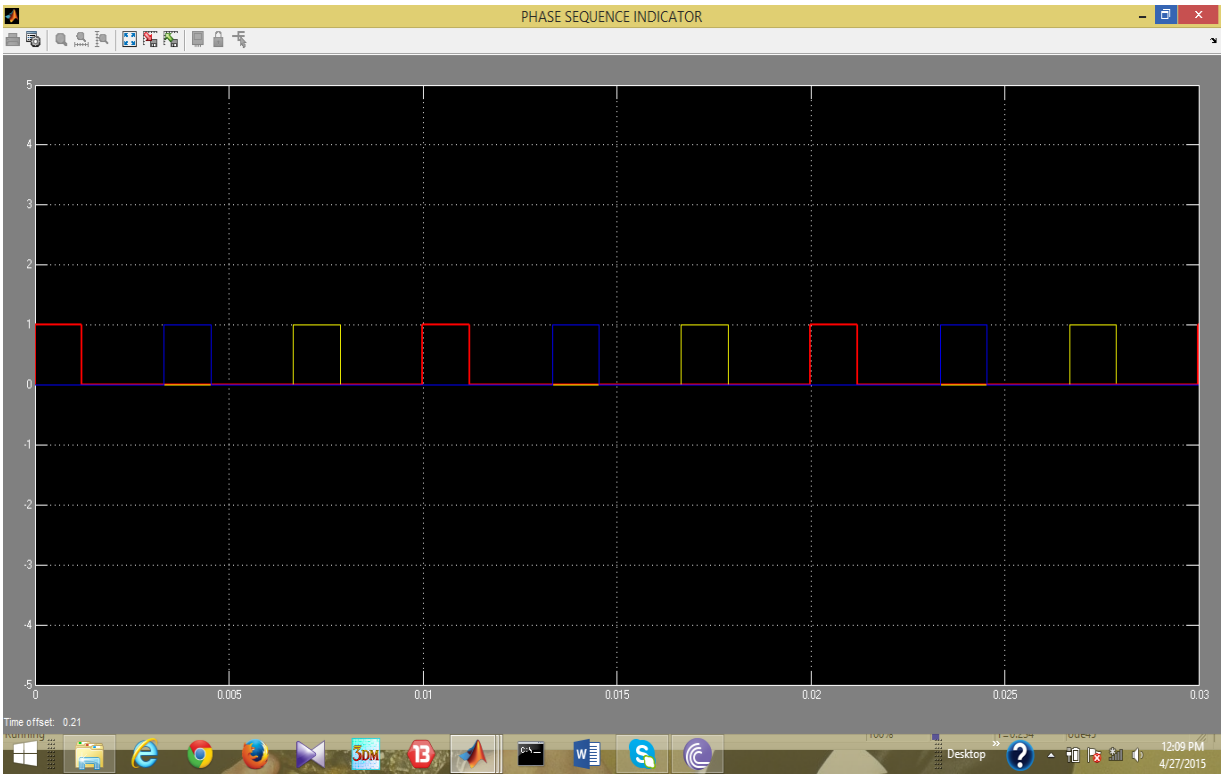

Fig. 10 Output of Sequence Indicator (R, B, Y)

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IV. CONCLUSIONS

The output of the project is studied and found satisfactory. This model can be easily implemented on the hardware. However some additional changes are required. Filter circuits will be needed to remove noise and ripples. Step down transformer will be required as electronic circuits require low voltage levels. The final sequence indication can be provided by the help of LEDs.

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