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MICRO-CONTROLLER MONITORED GRID SYNCHRONIZATION

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***Abstract*— Today's power grid is a huge and complex electrical network. As human require big demand of electrical energy for different purpose. So to fulfill huge power requirement, power grids are forms. In power grid different types of generating sources and load centers are connected to balance the power need at various locations. Synchronizing a generator or alternator to the ac network is very important task and should be done carefully. Conventional methods of synchronization such as dark lamp method, bright lamp method and synchronization using syncrono scope are not so effective this is because of the fact that the conventional, method calls for the operator and accuracy is less and it depends on the sense of correct judgment of the operator. In this paper the microcontroller based alternator synchronizer is used which is user friendly and requires less maintenance. Also it exploits the advantage of superior performance of the microcontroller like accuracy speed and reliability.**

***Keywords-P*ower Grid, Synchronization, Microcontroller.**

1. INTRODUCTION

The grid synchronization techniques play a major role in order to maintain the grid requirements in terms of power quality and the frequency of the grid voltage. This Synchronization requires an improved and efficient controller to control the distributed power generating systems. The information of grid voltage frequency, amplitude and the phase are the basic requirements for single-phase grid integration. For efficient estimation of these, various synchronization techniques have been proposed. Traditionally, generator control systems include a synchronizing panel. The synchronizing panel includes indications of voltage, angle, and slip that show what adjustments the operator needs to make to the governor and exciter and when it is acceptable for the operator to close the breaker. In many cases, the process is automated using an automatic synchronizer with manual control available as a backup. In generating facilities with more than a single generator or installations with multiple synchronizing breakers, complicated synchronizing circuits with many contacts are required to switch the Voltage Transformers and control signals between the operator and automatic controls and the high-voltage equipment. Maintaining proper isolation and safety grounding of sensing and control circuits often requires the use of problem-prone auxiliary relays and Voltage Transformers, which can reduce the reliability of the system. The frequency of a large electric power distribution system is established by the speed of rotation of many powerful alternators all connected by various tie-lines in the total network. The collective inertia and power of these generators is so great that there is no single load or disturbance which would be large enough to change their speed of rotation. The frequency of an electric system is, therefore, remarkably stable. An alternator can only deliver power to an existing electric power system if it operates at the same frequency as the system. A system whose frequency is 50 Hz cannot receive power from an alternator operating at 50.01 Hz. They must both operate at exactly the same frequency.

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2. HARDWARE IMPLEMENTATION

2.1 BLOCK DIAGRAM

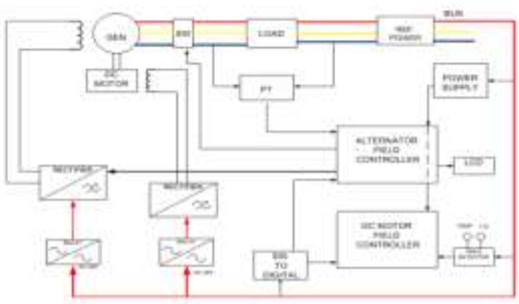

Fig. 1 Block Diagram

2.2 CIRCUIT DIAGRAM

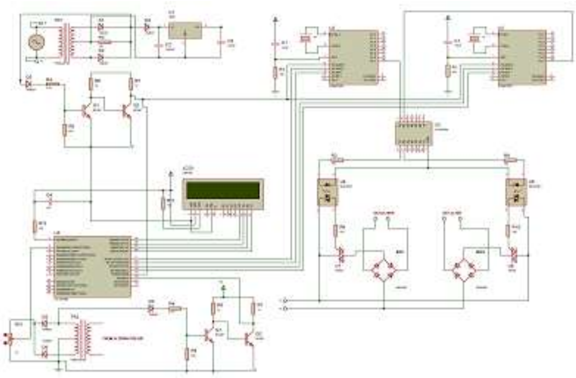

Fig. 2 Circuit Diagram

3.3 WORKING

The circuit consist micro-controller of 40 pins out of which 32 pins are usable.LCD is connected on port 1 .ADC is connected on port 3.6 and port 3.7ZCD is connected on port 3.2 . As micro-controller is worked on constant 5 volt hence we are used 7805 Regular IC which converts a constant 5 volts irrespective of any input voltage fluctuation between 6v to 28 volts.After getting start a circuit, ADC monitors a setting reference voltage and simultaneously monitors a voltage generated by alternator. As alternators generates a variable analog voltage, and micro-controllers reads only digital binary values , Hence , ADC get convert this values is 8 Bit Resolution. Whenever a zero signals reads by microcontroller gives a 5 volts triggering signal for thyristor module, but thyristor module requires a 12 volt pulse, hence we used a driver IC ULN2803 to convert this 5 volt signal to 12 volts. Hence we used a transistor as a switch to convert 5 volt into 12 volt In our circuit we are switching a high voltage device with the help of low voltage hence we used a opto-coupler to give a complete Galvanic Isolation between High Voltage and Low Voltage side. An opto-coupler Side PCB there is LED which indicate that the triggering signal carrying from microcontroller. Crystal oscillator is used to generate a clock pulses , as all the execution performs inside the microcontroller needs a clock pulses(Machine cycles) with this crystal Oscillator we need a 33 Picofarad ceramic capacitor , which maintain a 50% duty cycle of the clock pulses i.e. it maintain the ON and OFF time symmetrical equal. LCD of 16 character by 2 line to display input voltage i.e. reference voltage and voltage generated by alternator. Driver IC is used to convert 5 volt trigger signal to 12 volt. The automatic synchronization technique has been developed to carry out the following tasks related to the synchronization such as:

1) To check if frequency of incoming machine is equal to that of bus-bar and to adjust it to a value nearly equal to the - frequency.

2) To check machine voltage is equal to that of bus-bar and to adjust it to a value nearly equal to the bus-bar voltage.

Fig. 3 Hardware implementation

4. RESULT

Fig. 4 Result Shown on LCD

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4.1 VOLTAGE TESTING

Table I. Voltage Readings

Sr. No.	Voltage Measured from Busbar	Voltage Measured by Generator Output
01	209	210
02	210	211
03	209	210
04	209	210
05	209	210

Here is the volt meter measurement output for various input voltages which are viewed from the LCD display connected at the output terminal of the microcontroller

4.1 FREQUENCY TESTING

Table II. Frequency Readings

Sr.No.	Incoming frequency measured from bus bar (i.e. reference frequency)	Frequency Measured by Generator Output
01	50	49.5
02	50	51.5
03	50	50
04	49	49.5
05	50	51.1

5. CONCLUSION

Microcontroller based on an automatic synchronization unit has been developed for the parallel operation of Synchronous Generators "SG". The control unit reads calculates and evaluates the frequency, voltage, phase sequence of the received input signals and then provides the synchronization for the monitoring parallel connection conditions and parallel operation of generators. The program coded into the microcontroller was effectively developed to eliminate the interface electronic circuits from the system. However, this method does not consider the delay caused by the separation of the two generators.

The microcontroller based system of automatic synchronizer can be used more effectively compared to conventional methods of synchronization such as dark lamp method, bright lamp method and synchronization using syncronoscope this because of the fact that the conventional, method calls for the operator and accuracy is less and it depends on the sense of correct judgment of the operator. Moreover the microcontroller based alternator synchronizer is user friendly and requires less maintenance. Also it exploits the advantage of superior performance of the microcontroller like accuracy speed and reliability.

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