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# STUDY OF "AUTO-SYNCHRONIZER"

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**Abstract**- Now a days, Load demand is increasing due to increasing use of electric power. Existing system may not be sufficient to meet with the demand and hence additional units of alternators to be added to satisfy the increased demand. Synchronizing a generator to the power system must be done carefully in order to prevent damage to the generator and disturbances to the power system. Traditionally, power plants include an indicator to indicate what adjustments the operator should make to the governor and exciter to close the breaker. Here we are using embedded system for automatic synchronization between the generators and power system (grid).The developed automatic synchronization unit is fast, cost-effective, reliable and precise to be used for monitoring, measuring and parallel operations of the synchronous generators.

**Keywords**: Synchronization, Auto synchroniser, Alternator, Bus bar, Microcontroller.

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## INTRODUCTION

Synchronizing a generator to the power system must be done carefully. The frequency and voltage of generator must be closely matched to power system, and the rotor angle must be close to the instantaneous power system for closing the generator breaker to connect the isolated generator to the power system.

Poor synchronizing can:

1. Damage the generator and the prime mover.
2. Damage the generator and step-up transformer windings caused by high currents.
3. Cause disturbances such as power oscillations and voltage deviations.
4. Protective relay elements interpret the condition as an abnormal operating condition and trip the generator.

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.

## AUTOMATIC SYNCHRONIZING SYSTEMS

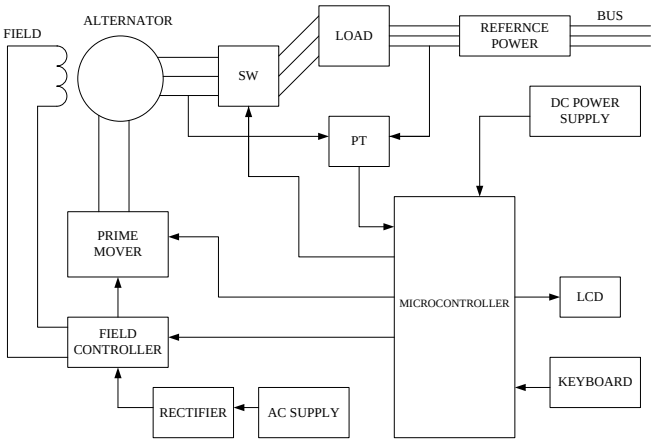



**Fig.(a) Block diagram of Auto Synchroniser**

An automatic synchronizer is a device that can perform all or part of the functions required to synchronize agenerator. It can provide control signals to the generator and exciter to match the frequency and voltage to the system, and it can close the breaker. An autosynchroniser is a device that can perform all or part of function required to a generator automatically and the complete process is called as automatic synchronization.

In auto synchronization, auto synchroniser is use to perform all operation like excitation of field, control of prime mover speed etc. which is required for the synchronization of an alternator with another alternator or the infinite bus bar automatically. The manual synchronization process consists of large amount of wiring and different measuring instrument. Reducing this complexity is one of the main contributions of this project by making a microcontroller based synchronization system.

**Voltage measurement And SYNCHRONIZATION circuit**

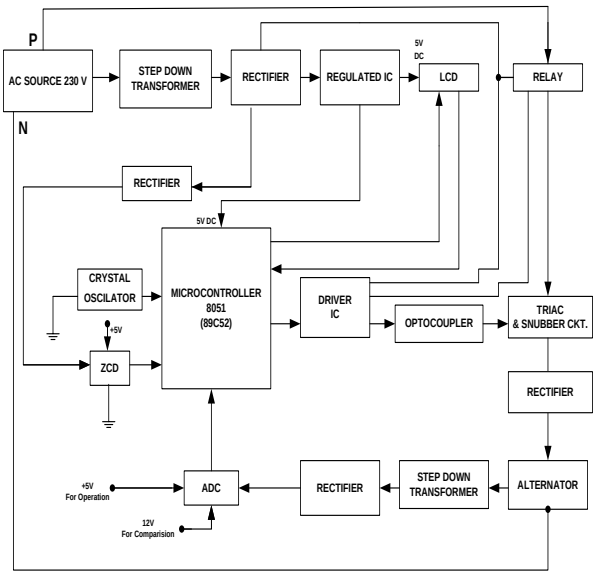



**Fig.(b) Block diagram of voltage synchronization**

There are several ways to measure the terminal voltages. Here we are using potential transformer for measuring voltage. The 220v ac supply is given to step down transformer T-1. Output of this transformer is connected to rectifier which convert ac into dc. The IC 7805 maintain constant 5v dc, which is use for microcontroller and LCD. Microcontroller compares the output voltage of an alternator with reference voltage.

Microcontroller needs machine cycles for performing various operation and those machine cycles are generated by crystal oscillator having 50% duty cycle which is maintain by two capacitor of equal rating. ZCD is the section which is use to check delay time and for that counting it will count how much time voltage waveform cross the zero point of waveform and according to that it will count time. ZCD is the section which is use to check delay and for that counting it will count how much time voltage waveform will cross the zero point of waveform and according to that it will count time. ZCD is the combination of 2 npn

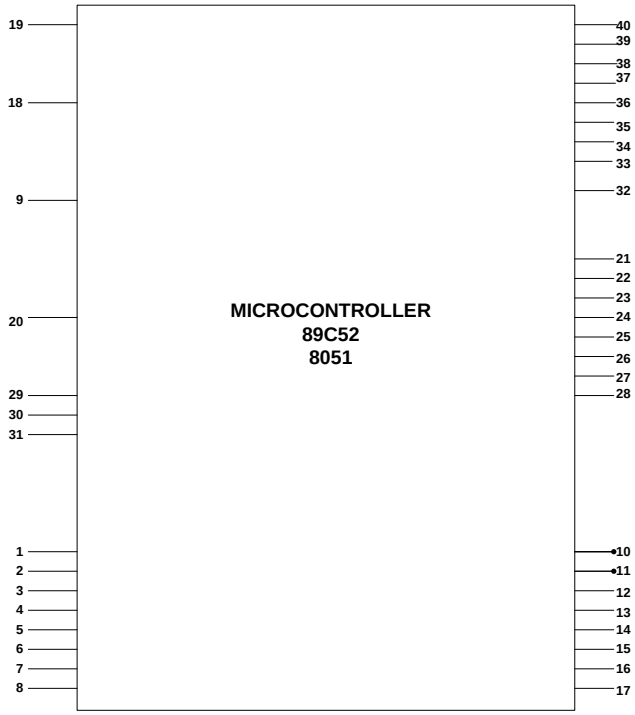
transistor and it is connected to it will stop other task and gives 1st priority to interrupt the signal i.e. signal from ZCD and it will calculate time.

ADC converts analog signal to its equivalent digital signal which is given to microcontroller. If the output voltage of alternator is not equal to reference voltage the microcontroller gives signal to optocoupler through will glow and those radiation will fall on photodiac. The pulse coming from photodiac is given to gate terminal of TRIAC and it will glow ON. Due to this, excitation voltage across field very until it will match with the reference voltage.

Relay will conduct until the alternator voltage match with the reference voltage. Once the voltage is matched, microcontroller will give signal to driver IC to give active low signal to the second terminal of relay such that it will provide return to relay. Due to this relay coil will energised and it will trip the circuit.

The result is displayed on the 16*4 LCD display. A step down transformer along with full wave rectifier circuit is used to provide 5V dc supply to the PIC and LCD display. LM 7805 is used as voltage regulator IC to provide constant voltage to the PIC.

**Basic components working**




Microcontroller is the main component of our project. We are using 89C52 microcontroller which is the family of 8051 microcontroller. It controls all peripherals device connected to it. The +5V dc supply is given through pin no. 40 and pin no. 20 is grounded. But to perform all operations , microcontroller requires machine cycle or clock pulses which is generated

by crystal oscillator and it is connected to pin no. 19 and 18 as XTAL1 and XTAL2 respectively.

This microcontroller is dedicatedly work for its interrupt i.e. its priority for interrupt is very high means if it get some interrupt signal from pin no.13 (ZCD signal) then it will stop other functions. Resetting of data is very important in microcontroller and it will done by RST pin (RESET pin) pin no.9. Because when some task is performed or here we measures the voltage at very instant and that value is only useful for that instant of time. So after that, there is no use of that value, and it will erase after some time. RESET is to clear the previous value, because after turn ON, data is in random fashion.

Microcontroller reset with logic 0 and logic 1 i.e. +5V and 0V is given to the pin no. 9 (RESET pin). Capacitor across RESET pin will maintain high transient and low transient with their charging and discharging process.

Pin no. 10 and 11 is used for Receiving and Transmitting data (RXD and TXD) respectively. There are 4 ports in microcontroller .out of which we use 3 ports for operations as per requirement we programmed it. Data signal is given and taken by microcontrollers with the LCD is done through pin no. 33, 34, 35 and 36. Data is send or received in the form of 4 bit data and in the form of MSB and LSB sequence. Pin no. 37, 38 and 39 is also by LCD. Driver IC (LN2003A) take +5V signal from pin no. 21 of microcontroller. ZCD signal is given to microcontroller from pin no. 12 i.e. INTO interrupt pin. ADC is connected to microcontroller through the pin no. 16 and 17 of microcontroller. Pin no.16 is WR and pin no. 17 is RD which is for writing and reading of data from analog to digital convertor.

Crystal oscillator is use for producing clock pulses or machine cycle which is required for working of microcontroller. Temperature stability of crystal oscillator is also good. It can work from -40 to 85 degree Celsius. Capacitor connected to connected to crystal oscillator are C3 and C4 and they have equal value because for maintaining of 50% duty cycle i.e. Ton=Toff (C3 and C4 value is 1nF). Capacitors are also known as suppress capacitor. R,L and C are temperature dependent so they are work up to certain time and temperature . And hence crystal oscillator is used for thermal stability.

ZCD is the Zero Cross Detector section which is use to check delay time and for that it will count that how many times busbar voltage waveform cross zero point of wave form and according to that it will count time. ZCD is not the separate device, it is the combination of two NPN transistors.

Regulator IC 7805 is used to keep the voltage across circuit components. It will keep constant +5V dc. It has 3 terminals input, output and ground. In this IC, we give 12 V input supply and with the help of capacitors we will maintain 5V at output terminal irrespective of load. In regulator IC there is Short circuit protection. Zener diode gives 5V at output and it will not change for any input change up to 28 V.

## CONCLUSION

The automatic synchronization of two alternator can be achieved by satisfying synchronizing parameter by making voltage, frequency and phase sequence of the incoming alternator equal to the voltage, frequency and phase sequence of the reference alternator. This synchronizing system is desired to control the voltage and frequency of the incoming alternator. The frequency can be varied manually as well by increasing or decreasing the speed of the prime mover.

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