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The Grid Frequency Controller Using Micro-Controller

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Abstract:
This paper contains the problems related with frequency. It is one of the effective tools to maintain the reliability by controlling the grid frequency of the power system. The Grid frequency controller is used with microcontroller for individual load shedding purpose. Because of this, the nearby areas can not be affected. As the demand of electricity increases; at the generating stations there will be increase in the load and hence the decrease in the generating frequency can occur .To maintain the frequency in the decided range i.e. 49 to 51Hz lot of additional resources like coil, water etc are being used currently. If this goes out of control then MSEB will switch off the supply to the Grid and thus the Load Shading for whole area occurs commonly. Therefore no one will be able to have the electricity until the load demand reaches to its nominal value. By the time in generating stations the generation of electricity will not stop and it is only wastage. To avoid this lot of work is going on .Our present concept is a part of that. Its approach is at individuals instead of some particular area.

Key words: Grid frequency; Microcontroller; ADC (0808); Load shading

1. Inroduction

The Grid frequency controller is the tool or concept with which MSEB can control the power supplied to the customers. As the demand of electricity increases; at the generating stations there will be increase in the load and hence the decrease in the generating frequency can occur .To maintain the frequency in the decided range i.e. 49 to 51 Hz lot of additional resources like coil, water etc are being used currently. If this gone out of control then MSEB will switch off the supply to the Grid and thus the Load Shading for common man occurs. That means that as the load increases MSEB will shut the supply in the grid off and thereby for that grid no one will able to have the electricity until the load demand reaches to its nominal value. By the time in generating stations the generation of electricity will not stop and it is only wastage. To avoid this lot of work is going on .Our present concept is a part of that. Its approach is at individuals instead of some particular area.

In this project, for demonstration purpose we will store system power on readings of voltage and current across the load along with the real time clock. We have proposed to use the microcontroller, external memory and ADC for the respective data acquisition of load voltage and load current .For frequency monitoring we will use interrupt of microcontroller and for real time clock we will use battery backup RTC chip interfaced with microcontroller on I2C protocol. The control of load will be achieved through the relay. Required software will be in assembly language.

2. History

In present situation when there is increase or decrease in load which affect the behavior of the generator.

The Indian appliances designed to operate at 50 Hz. If this not maintained they will damage drawing high current. In case of faults or high loads, the following steps take place. Power delivered by the generator increases as the power input is constant (mechanically). The kinetic energy stored in rotor as speed decreases frequency tends to fall.

So in order to maintain the frequency, the extra load or fault has to be isolated from which under frequency relay are used. They work automatically.

When grid frequency falls below the limit, it senses & trip electrical equipments or generator in case of Thermal power station.

The operation of the relay can be based on the definite time principle, on the rate of frequency change principle, or on combination of these two principles.

In generation protection application the relay protects the generator & prime mover against hazardous over speeding or under speed. The relay can also be used from the network in the event of fault.

In substation under frequency or over frequency relay are installed. When there is any fault i.e. increase or decrease in frequency due to the load, the relay senses the fault and trips the circuit immediately and comes to ON position when the frequency comes to normal condition i.e. 50 Hz. During tripping the load shedding of that area is done till it comes to normal condition
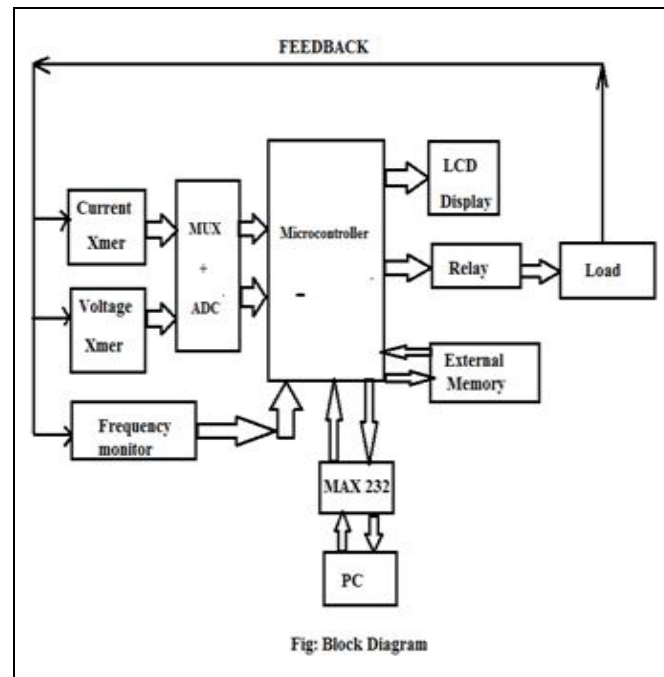
3. Block Diagram

Figure 1: Block diagram of grid frequency controller using microcontroller

4. Working of Block Diagram
As the load demand changes inversely supply frequency can be changes. In the block diagram there are different types of equipments are connected each other.

From the load, there are three parameters taken. Which are namely as voltage, current & frequency. Those parameters should be in limit. The voltage & current are applied to the ADC for analog to digital conversion purpose. And frequency applied to comparator through microcontroller. Therefore current transformer provides current rating& potential transformer voltage rating in the analog form to the ADC (0808).

After that, digital signal is applied to different ports of the microcontroller as per the limit of frequency; the microcontroller executed the control action to the relay. For switch OFF and switch ON the load. If the frequency is in limit, then only load switch ON continuously. Otherwise it will cut off & which is known as load shedding from the supply side.

In the Grid Frequency Controller, there are three reading taken out. Which are at the time of starting, during fault and restored. Those readings are stored in external memory. When the upload key is pressed at that time with help of MAX 232 with the TTL compatibility, reading can be display on PC. All the data can be serially transmitted over the PC by using the RS232 cable with help of DB9 connector.

For monitoring purpose, the LCD display is used. This shows the current, voltage, time, frequency at the different instants. The LCD can be programmed for that indication. For the reliable operation of the circuit there are no. of capacitor, diodes are used.

There are also one reset key provided on the PCB for reset the microcontroller. If in case it produces a garbage value then by pressing that key we can reset the microcontroller
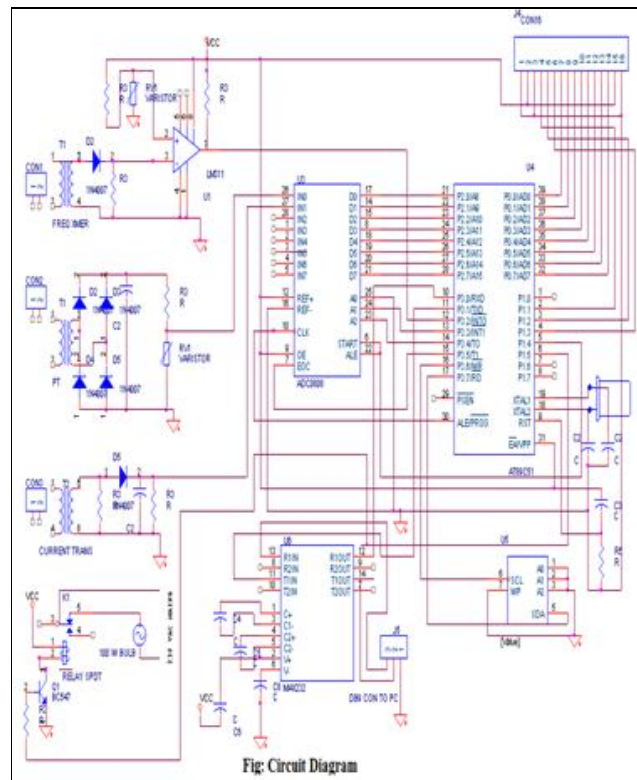
5. Main Circuit

Figure 2: Circuit diagram of grid frequency controller using microcontroller

6. Working of Circuit Diagram

Now days because of load increasing for some particular area, the total load demand can be increasing on generating side. This situation can be occurring due to the load increasing due to the individual consumer. That will affect the total load demand. Therefore load shedding can be occurring. These difficulties can be overcome, by individual load shedding method. Because of that, the Frequency can be controlled by Grid Frequency controller by using microcontroller. This is the effective frequency control method.

In the grid frequency controller frequency can be controlled with the help of microcontroller. There are number of equipments use in this control method. This is one of the important control actions in the power system.

There are three main section of grid frequency controller using microcontroller.

- Input section
- Converter section
- Control section
- Output section

6.1. Input Section

In input section, the supply can be given to the circuit. We are giving the AC voltage at the input side .At that point we are connected the step down transformer, which gives the 12 V ac output. This voltage is applied across the full wave bridge rectifier .Which convert the ac voltage to dc voltage .The second input is current transformer. That step down current can be converted into voltage signal. The third one is frequency, which is load frequency .This frequency can be given to the comparator (LM 211) for zero crossing detectors and for ripple free operation.

6.2. Converter Section

In converter section, analog to digital converter (ADC 0808) is used. This is having 28 pins. In which 11, 13 pins is used for VCC and ground purposes and the analog input is connected. The output of input section of voltage signal is connected to IN0 & IN1. There are 7 pins for input .We is using only two pins hence other pins are kept open. For channel selection there are 3 pins available in ADC ie.A0, A1, A2. These pins are connected to reference, port 3.2/ INT1& port 3.4/T0 respectively .The output of the ADC is in digital form which is connected to the microcontroller. This only reads digital sign

6.3. Control Section

In the control section, with the help of microcontroller, the control action executed through relay. The timer & memory also use for control section.

A microcontroller having 40 pins in control circuit, microcontroller 89V51 is used. This is from 8051 family. This has various features for controlling point of view. The microcontroller having 4 ports, in which port 2 is use for input, this input is output of the ADC. The port 0 is used for the output of microcontroller. And port 3 is use for various functions for e.g. Interrupt, Timer, Transmit, Receive, Read& Write etc. The XTAL1 & XTAL2 points are used for crystal oscillator purpose. The main operation the microcontroller is to monitor & control. The program can be downloaded in the microcontroller for different purposes like control operation. In this program, the frequency limit is 47 to 53 Hz is installed. As the load frequency crosses this limit, then load shut down from the supply. This is individual load shedding.

As the load frequency crosses this limit, microcontroller sends the control action to the relay. Relay gets the control signal in 0&1 form. For that purpose sugar cube relay utilized. In which transistor act as switch. When microcontroller sends the signal to the base, that time because of VCC, controller side is always high. Therefore there is no potential difference & coil cannot energize. Because of that load is kept in operated with supply side. When there is 1 at the base reverse control action take place & coil energized. The load will be open.

The external memory is used to store the reading of current, voltage & frequency at the different time. There are starting, during fault & after restored the supply like three reading are stored in memory (DS1307- which having 56 byte, battery backup, non volatile RAM for data storage)The real time clock is used to show the actual time for the continuous operation of timer even the kit is off for that battery arrangement is used. This is continuously supply to timer. This all come in controlling action.

6.4. Output

The output monitoring is by using the LCD. When upload key is press, after that by using DB9 port we can see the all the readings on the PC for monitoring purpose LCD (16*2) module used. From the port 2 of microcontroller input is given to the LCD. On the LCD screen, current, voltage, frequency, time can be display. This all function of LCD done with help of programming. The output can be seen on the PC with the help of upload key. The MAX 232 is used for TTL compatible purpose because microcontroller language not read by computer; for that MAX 323 is used with the help of RS 232 serially data can be transmitted over PC. For monitoring purpose Windows XP must be available, with the help of hyperlink port all reading can be display.

7. Conclusion

With the help of this installation in individual area of high load users (end user) we can avoid the conventional way of complete load shading to that area and the individual load shading can be done. This will not harm the rest users as only the user who is having maximum load will be cut for some time from the supply until he minimizes the load on his side and rest will be unaffected. This will avoid wastage at both the generation side and also to production side.

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