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ELECTRONIC CIRCUIT BREAKER FOR OVERLOAD PROTECTION

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Abstract - *The steadily increasing population has more demand and consumption of electric energy in the market as raised and that of equipment's used like electrical and electronics are also costlier.*

So to protect the electrical system from overload or short circuit here is one possibility, which is by ultrafast acting electronic circuit breaker.

A circuit breaker is automatic operated switch designed to shut down the power supply when overloaded. The tripping depends on the current passing through the CT's which is connected in series with load.

It uses the PIC- microcontroller into which program is dumped for the operation. The unit is extremely fast and over comes the drawback of thermal type circuit breaker like MCB based on a thermal bimetal lever-trip mechanism which is very slow.

Here an electronic circuit breaker is designed which is based on the current sensing across a series element typically a CT (current Transformer).

The current sensed which is compared against the preset value proportional to the voltage by comparator which is inbuilt in PIC Micro controller to generate an output that drives a relay through a MOSFET to trip the load very fastly.

***Key Words*: Miniature circuit breaker, Metal oxide semiconductor field effect transistor, Alternating current, Direct current, Integrated circuit, Liquid crystal display, Light emitting diode.**

1. INTRODUCTION

In this project electrical system can be protected from the over load condition. Industrial instruments or home appliances failures have many causes and one of the main causes is over load.

The primary of the distribution transformer or any other transformer is designed to operate at certain specific current, if that current flowing through that instrument is more than the rated

current, then immediately the System may burn because of over load, through this project we are going to protect the system from over load condition.

In this project work for generating high current or over load current more loads are applied to the circuit; so that the current will be increased.

Whenever the over current is drawn by load the circuit will be tripped. To trip the circuit we are using one relay which will be controlled through PIC microcontroller.

When over load occured the relay will trip the total circuit. And it will be monitored on the LCD. LCD displays are used to display the status of circuit breaker.

For protection from over current condition first we have to measure the total load current. Here we are using CT for measuring the load current and the output of CT is given to ADC for converting analog output of CT into digital data.

Hence ADC output is given for monitoring purpose. When current increases behind certain limit then we are going to trip the load by using relay.

In this project we are using 230v bulbs as a load.

We are going to increase the load by increasing the number of bulbs ON.

When we ON more bulbs it causes over load condition and microcontroller will detect that and it will trip the total load by using relay through MOSFET which acts as switching circuit.

Miniature Circuit Breaker (MCB) detect the fault current and after detection of fault current it operate and trip the electric circuit and protect the electric circuit form overload condition.

It contain bimetallic strip due to which wearing of this strip is to be happen and this leads to slow response when electric circuit is overloaded.

That mean it takes more time to trip the circuit when over load condition occur.

This Miniature Circuit Breaker (MCB) is capable of handling 1000 amps current but when current rating is exceeded by 1000 amps then MCB is not economical to use.

MCB operate on temperature when overload occurs current Flowing through bimetallic strip increases then heat is also increases which cause the deformation of bimetallic strip and open circuit is to be happen in this way it protect the circuit but change in temperature reduces current capacity of circuit breaker .

These disadvantages of Miniature Circuit Breaker (MCB) can be eliminated by Ultrafast responding Electronic Circuit Breaker (ECB).

The trip mechanism of ultra-fast acting electronic circuit breaker is very fast as compared to mechanical circuit breaker i.e. Miniature Circuit Breaker (MCB). Electronic Circuit Breaker (ECB) contain level comparator that sense the current flowing through series element and resultant voltage value is compared with preset voltage value.

This resultant voltage or drop in voltage is proportional to over load current. Sensed voltage is converted to DC voltage and output of level comparator is given to microcontroller, MOSFET is operated through microcontroller and operation of relay is done through MOSFET.

This Electronic Circuit breaker (ECB) is very useful for protection of sensitive load

1.1 INTRODUCTION

The history of power electronics is very much connected to the development of switching devices and it emerged as a separate discipline when high-power and MOSFET devices were introduced in the 1960s and 1970s.

Since then, the introduction of new devices has been accompanied by dramatic improvement in power rating and switching performance. Because of their functional importance, drive complexity, fragility, and cost, the power electronic design engineer must be equipped with a thorough understanding of the device operation, limitation, drawbacks, and related reliability and efficiency issues.

In the 1980s, the development of power semiconductor devices took an important turn when new process technology was developed that allowed integration of MOS and bipolar junction transistor (BJT) technologies on the same chip.

Thus far, two devices using this new technology have been introduced: insulated bipolar transition (IGBT) and MOS controlled thyristor (MCT).

Many integrated circuit (IC) processing methods as well as equipment have been adapted for the development of power devices. However, unlike microelectronic ICs, which process information, power device ICs process power and so their packaging and processing techniques are quite different.

Power semiconductor devices represent the heart"" of modern power electronics, with two major desirable characteristics of power semiconductor devices guiding their development:

1. *Switching speed (turn-on and turn-off times)*
2. *Power handling capabilities (voltage blocking and current carrying capabilities)*

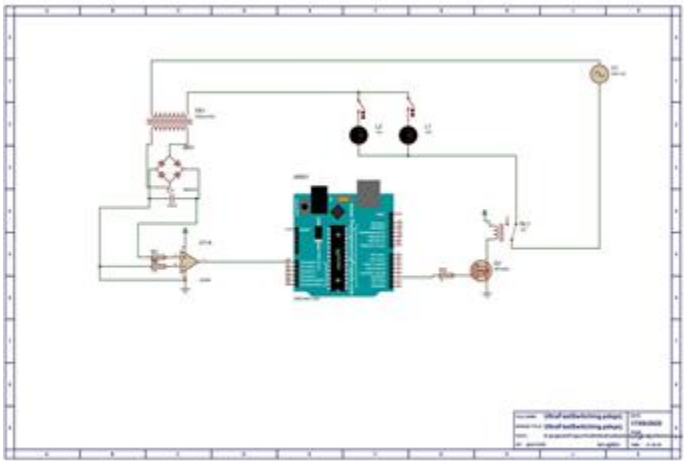
Improvements in both semiconductor processing technology and manufacturing and packaging techniques have allowed power semiconductor development for high-voltage and high current ratings and fast turn-on and turn-off characteristics.

Today switching devices are manufactured with amazing power handling capabilities and switching speeds as will be shown later.

The availability of different devices with different switching speeds, power handling capabilities, size, cost etc., makes it possible to cover many power electronics applications.

As a result, trade-offs are made when it comes to selecting power devices.

1. CIRCUIT DIAGRAM



The electronic circuit breaker is represented in Fig.1

The main power supply is directly connected to load and Step down transformer step down 230v ac to12v ac supply and supplied to regulated supply unit which consists of bridge rectifier that convert this 12v ac supply into 12v dc supply and passed through 7805 regulator to get 5vdc supply for working of aurdino uno.

This 5v dc supply is transferred to Aurdino uno by regulator IC. This Aurdino uno produced the signal to operate relay.

A comparator compare preset voltage with input voltage a logic 0 signal is send to Aurdino uno when input voltage is less than preset voltage hence the relay is not operated and circuit is not trip.

A logic 1 is send to Aurdino uno when input voltage greater than preset voltage when this happen relay is operated immediately, circuit is trip and protect from over load.

ECB and MCB are both used to protect electric circuit automatically from over load as well as short circuit condition.

But there are some disadvantages while using the MCB in electric circuit they are

a) It required more maintenance.

b) It takes more time to trip the circuit when overload occurs.

c) It is not economical when current rating is more than 1000 amps.

d) Current capacity of MCB reduced because of change in temperature.

ECB A coil of relay is energized through 5v dc supply during normal operation MOSFET is inactive and coil of relay is not operated and LED is not glow.

The relay is switch which is connected in series with load.

With the help of potential divider arrangement reference voltage is to be set and this reference voltage is given to the inverting terminal of comparator.

Input voltage is given to the non-inverting terminal of comparator.

Resistor is connected in series with load this resistor drop the voltage and current through load is sensed.

During over load inverting reference voltage is less than non-inverting input voltage the comparator output will be high that result in ON condition of MOSFET that operate the relay coil is energized and LED is glow that indicates the protection of system.

The ac supply is cut off tripping the breaker a 5v dc is supply to the I/O pin of the Aurdino uno the status of the output which is display on the LCD by programmed Aurdino uno as soon as the status of the normal operation is also displayed on the LCD.

A 5v dc from the regulator is supply to the pin of the Aurdino uno.

3. CONCLUSIONS

This arrangement is designed for the immediate tripping of circuit breaker in the situation of any kind of faulty conditions or abnormal conditions like short circuits and burden condition.

The proposed electronic circuit breaker is cheap with ultrafast tripping system compared to slow acting convectional thermal bimetallic miniature circuit breakers.

FAECB's can be better further by using advanced Thyristors family

ADVANTAGE

*The ultra-fast acting electronic circuit breakers tripping time is less as compared to existing system.i.e 0.012*10^-6*

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