



A review on circuit breakers technology for short circuit and over voltage protection

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ABSTRACT

Electronic circuit breaker is designed to cut off the power supply whenever overload or short circuit occurs. This paper proposes an Electronic Circuit Breaker (ECB) designed using high sensitive current transformers, programming controller and triac. Circuit breaker designed using these high sensitive components trips the power supply instantaneously in overload conditions or short circuit conditions. Traditional circuit breaker like miniature circuit breaker is based on thermal bimetal lever trip mechanism. MCB is very slow and the trip time varies according to the Percentage of overload and surrounding temperature. The traditional MCB comes with fixed current ratings; therefore we can't change its current rating if it is necessary for some appliances. Second traditional solution to avoid short circuit is Fuse, Fuse is small filament which burn while overload. Fuse is not convenient as need to replace whole fuse or filament it increases cost and also time consuming. Modern world is using highly sensitive electronic equipment for home as well as industries, and are so much costly. Use of regular MCB, as MCB is depends on heat according to surrounding condition it gives false tripping or slow tripping. This proposed system in paper is overcome this by using high sensitive current transformer. Microcontroller continuous monitor the CT value and preset value, if it is above preset then send signal to Triac for cut power supply to load. This system is cost effective and has less wear and tear. Also we can adjust preset current rating according to load and its tripping not depends on surrounding temperature.

Keyword - Electronic Circuit Breaker, fast tripping time, overload protection, Current Transformers for multiple Voltage, Programmable

1.INTRODUCTION

This paper is proposed a system for protection of electrical system from overload condition and short circuits. Now days we are using very sensitive home appliances, gadgets and industrial instruments [2] [3]. Any type of power supply for them is designed to operate at particular value of current that is sufficient to run home appliances or industrial instruments. If any overload occurs, that is current flow above the rated current or short circuit, and then it may possible damages to home appliances or industrial instrument. So to avoid such damages and protect electrical appliances and instruments circuit breaker (CB) is used. A circuit breaker is a system



which automatic cut off supply of device if overload or short circuits. At normal condition circuit breaker are Normally Close (NC) switch and supply is continuous to appliances, but when overload condition or short circuit condition occurs then Circuit Breaker becomes Normally Open (NO) Switch and cut power or current flow to appliances to protect the electric appliances isolating the healthy and unhealthy part of circuit. Miniature Circuit Breaker (MCB), Air Circuit Breaker (ACB), Oil Circuit Breaker (OCB), etc are some main types of circuit breaker [2][11][13].

II.RELATED WORKS

The name circuit breaker indicates that the, device which breaks (Open) the circuit under abnormal condition and protect the system from hazards. Circuit breakers activates when trigger come from relay or sensors and break the contact. The medium used for to enclose that contact is fluid, gases, vacuumed, Air blast type [11]. Miniature Circuit Breaker (MCB) is mostly used solution now days. MCB detect the over current and after detection of over/fault current it operates and trips the electric circuit, so current flow is stop to appliances or instruments and are protectedfrom overload condition [1 - 10]. The MCB 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 10000 amps current but when current rating is exceeded by 1000 amps then MCB is not economical to use [2]. 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 [2].

These disadvantages of Miniature Circuit Breaker (MCB) can be eliminated by proposed Electronic Circuit Breaker (ECB). An electronic circuit breaker is an automatically-operated electrical switch designed to protect an electrical circuit or a power system from being damaged by overload or short circuit [9] [10]. MCB residence makes mechanical circuit breakers slow and may use for low voltage. Electronic circuit breakers are high sensitive and mostly used in high voltage. Circuit breaker designed with IGBT/IGCT/MOSFET work under high voltages and with the advantages of fast switching time, low costs, and stable operations[9][10][11]. This paper proposed one fast acting mechanism of electronic circuit breaker. The current passing through a series element is sensed and the resultant voltage and a preset voltage are compared using a level comparator to generate an output for the load to trip. The voltage drop occurs in the series element is proportional to the current value in load side normally a resistor with low value. The sensed voltage is converted to DC voltage and is set to a value through a level comparator whose output is given to a relay using MOSFET for activating tripping mechanism. In contradiction with other circuit breakers like MCB, Electronic Circuit Breakers has

- i) Fast tripping mechanism in overloading
- ii) Less maintenance cost
- iii) Manufactured using few electronic inexpensive components.

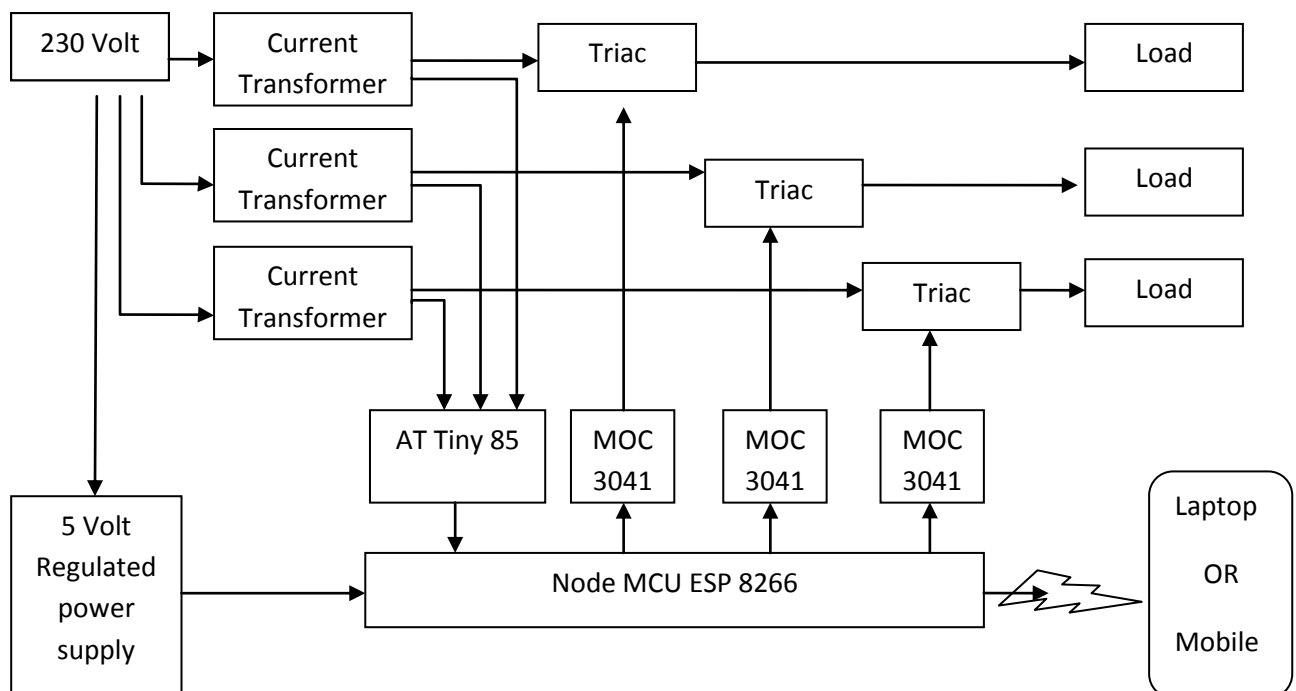
One of the other electronic circuit breaker structures involve power unit and control unit. Here power unit consist Step down Transformer, Rectifiers, filter, and voltage regulators. Control unit consist microcontroller, comparator, sensor, MOSFET, Relay driver like ULN and relay. In this structure preset voltage is programmed in microcontroller and continuously monitor with input voltage. If input voltage is higher than preset then controller send signal to ULN and relay/MOSFET is cut the supply from appliances. [3] [5] [6] [12]

III.PROPOSED MODEL

Here in proposed model we are using current transformer (CT) to sense the flow of current. ATtiny 85 has preset values of current and continuously monitors current rating from current transformer. If current sensed by current transformer is high than preset value then controller send signal to triac driver MOC which drives the Triac. As MOC 3041 get signal from controller to cut the supply to load, MOC drives the triac to cut off supply to load. Node MCU ESP 8266 used to communicate with Smart Phone, PC or laptop, so anybody can monitor, control, and set current and other parameters of system.

We are using three sets of Current transformer, MOC 3041 and Triac, so we can use three isolated load in single circuit or single hardware. So we can say its multiple isolated MCBs integrated in single hardware.

IV.BLOCK DIAGRAM



V.COMPONENT LIST

1. Current Transformer (1:1000) up to 10 amp
2. AT Tiny 85 Controller
3. Node MCU ESP 8266

4. MOC 3041 Driver for Trick

VI.BLOCK DESCRIPTION

In this project current is sensed by current transformer and then compared with a preset value present in microcontroller to generate an output for MOC3041 driver that drives a triac to trip the load within microsecond. Tripping is extremely fast and overcomes the limitation of the thermal type in overload condition. It is the switch which automatically turns off when current flowing through it passes the maximum preset limit. This is mainly design to protect against over current and over temperature. Whenever the over current is drawn by the load the circuit will be tripped. To trip the circuit we are using TRIAC which will be controlled through microcontroller. For the protection from over current condition first we have to measuring the total load current. For measuring the total load current the output of Current Transformer is used. The inbuilt ADC converts analog output of Current Transformer into digital data. When current rating increases above threshold limit, controller trips the load by using triac.

As mentioned above the traditional MCB comes with fixed rating and user can't change it. So in such case user needs to change the MCB. This problem is overcome in our system. There will be provision for setting current limit of MCB. We can configure the current limit of circuit breaker from any mobile or laptop by connecting to network. For networking we will use NodeMCU a low-cost Wi-Fi chip with full TCP/IP stack and MCU (microcontroller unit) capability produced by Espressif Systems. The ESP8285 is an ESP8266 with 1 MB of built-in flash, allowing for single-chip devices capable of connecting to Wi-Fi.

VII.CONCLUSION

In this paper we proposed system that instantaneous triptakes place in case of overload condition. This system has been several advantage compared to the MCB and ECB. Avoid longer trip time, does not affect by environmental conditions. It is very conventional to set preset voltage as per appliances or load. The most interesting advantage of this proposed ECB is multiple loads are connected to single circuit to protect them from overload, high current, or short circuit hazards.

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