



Programming of Ultra Fast Acting Electronic Circuit Breaker

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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. Here, the research work has been carried out to design a power supply which shuts down when it is overloaded by using a super-fast electronic circuit breaker.

The concept of electronic circuit breaker came into focus realizing that the conventional circuit breakers such as MCBs take longer time to trip. Therefore, for sensitive loads, it is very important to activate a tripping mechanism at the shortest possible time, preferably instantaneously. The electronic circuit breaker is based on the voltage drop across a series element proportional to the load current, typically a low -value resistor. This voltage is sensed and rectified to DC, and then is compared with a preset voltage by a level comparator to generate an output that drives a relay through the MOSFET to trip the load. The relay use in place of a semiconductor switch is preferred because such solid state switches would invariably fail in case of accidental short circuits. It uses the arduino into which program is dumped for the operation, The unit is extremely fast and overcomes 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 arduino to generate an output that drives a relay through a MOSFET to trip the load very fastly.

Keywords: Arduino, Current transformer, comparator IC, MOSFET, relay, transistor, voltage regulator.

I. INTRODUCTION

An electrical system can be protected from the overload 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 overload, through this project we are going to protect the system from overload conditions [7].

In this research paper work for generating high current or overload 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 arduino. When overload occurred 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 overcurrent condition first we have to measure the total load current[11]. 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 arduino will detect that and it will trip the total load by using relay through MOSFET which acts as switching circuit [1].

II. SYSTEM MODEL AND EXPLANATION

The main power supply is given directly to load through CT and step down transformer. 230 volt is Step down to 12v and supplied to regulated supply unit which consist of bridge rectifier to convert ac to dc and passed through 7805 regulator to get 5v supply for working of arduino, capacitor filters are used to remove the ripples to get pure constant dc voltage[8]. The current passing to load is sensed by the current transformer and output of CT will be in analog form is given to the ADC pin of arduino for converting the analog output to digital data. The current sensed is compared with the inbuilt comparator of arduino which as pre-set reference value[10].

If the current sensed is less than the pre-set value than MOSFET will be in OFF state and relay will not trip the supply to load. As we increase the load current drawn is more so if the current is increased than the pre-set value than MOSFET will turn ON and energizes the relay. Thus LED used as an indicator is properly biased, and it glows. The relay coil gets energized, causing the armature to shift its position to the normal open point from the normal closed point[2]. The AC supply to the load is thus cut off from the load and the load is tripped. Once the circuit is tripped it must be reset for further use using reset button. In either case, the arduino is programmed so as to show the status of the output on the LCD interfaced to it. In case of normal operation arduino will pin will receive 5v dc from regulator and accordingly displays the status on the LCD[9].

III. LITERATURE SURVEY

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[5].

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 [6]. 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[4].

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[3].

IV. HARDWARE IMPLEMENTATION

The figure 2 shows the hardware implementation of ultra fast acting electronic circuit breaker using arduino. The unit is extremely fast and overcomes 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 arduino to generate an output that drives a relay through a MOSFET to trip the load very fastly.

Comprehensive experiments conducted by constructing the necessary circuit yielded successful results. The main advantage of this circuit is that over all tripping time is less as compare to conventional circuit breaker. It was proved that electronic circuit breaker is very useful circuit for sensitive loads. The experiment is successful and energy saving. Further research on improving the load capacity and tripping time is being undertaken.

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