MCB Thermal Calibration And Verification Portable Unit

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ABSTRACT

Nowadays miniature circuit breaker (MCB) has become important part of protection of devices in household as well as in industries. In order to ensure its proper operation calibration as well as verification is done accordingly. A portable unit can be designed to calibrate as well as verify the MCB which can be used on domestic as well as industrial level

Keyword: - *MCB, calibration, verification, portable unit*

1. INTRODUCTION

Solar power has become central to the quest for clean, renewable energy. The use of photovoltaic panels and photo-thermal collectors is expanding rapidly as the world embraces a new era of "green" power. Widespread, efficient solar collection could have a significant impact in reducing greenhouse gas emissions, enhancing energy security, and creating jobs in countries that have abundant sunlight. At the present time, less than 0.04% of global energy is derived from the sun. [1].

Miniature Circuit Breaker (MCB) has become an important part of protection of circuits on domestic as well as industrial level. Their essential function is the interruption of current flow as a protective measure against conditions such as overloads and short circuits. They contain two different trip systems: a thermal unit, which protects against overloads and an electromagnetic unit, which interrupts power surges occur. In order to ensure safe working of the MCB two tests are conducted on a MCB namely thermal test and magnetic test. This paper mainly focusses on the thermal testing of the MCB.

2. THERMAL TESTING OF MCB

Thermal testing includes three main processes:-

1) Calibration

2) Verification 1

3) Verification 2

3. CALIBRATION

The calibration is carried out when the assembly of the MCB is done. Main component in this process is the calibration screw or the grub screw. Every MCB has a calibration screw which can be adjusted according to the specified trip time. This trip time depends on the rating of the MCB. This is one of the crucial processes as the working of the MCB is hugely influenced by this process. In this process generally current is passed which equal 2.55 times the rated value of the MCB. At the beginning of this process the screwdriver is inserted in the slot where the calibration screw is placed. The screwdriver is rotated 2-3 turns with the help of stepper motor. These turns are called as pre-calibration turns. These are normally employed to test the continuity of the circuit. The whole process is divided in four intervals namely 1t, 2t, 3t, 4t. The pre-calibration process comes under 1t, as mentioned above current equal to 2.55 times is passed and if the MCB trips within time interval 2t then the condition is known as 'Early Trip'. During the time interval 3t the screwdriver again starts rotating and adjusting the calibration screw. If the MCB trips during this time period the condition is known as 'Okay Trip'. The number of rotations of the screwdriver is dependent on the rating of the MCB. After 3t there is time interval 4t if MCB trips during this time period then the condition are known as 'Late Trip'. All the time intervals 1t, 2t, 3t, 4t are decided depending upon the rating of the MCB. It is taken care that calibration screw of all the MCBs is adjusted such that they trip in okay time interval i.e.3t.

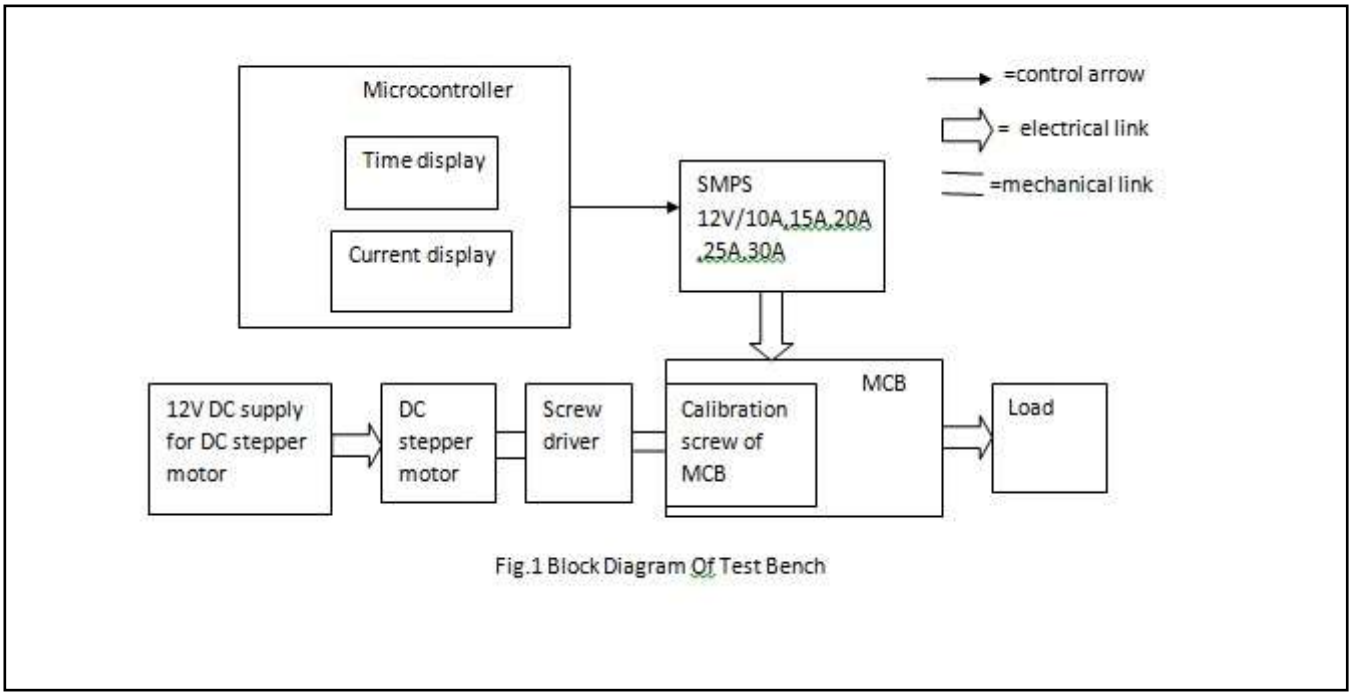

Fig.1 Block diagram of test bench

4.VERIFICATION

The process of verification is the last step after which the MCB is sent to packaging. It is done to ensure that the calibration of the MCB is done appropriately. Generally the verification is done twice denoted as V1 and V2. The steps carried out during V1and V2 are the same. The verification is done 45-50 minutes after the calibration process. The time gap is needed to cool down the bi-metallic strip. During the verification process current is passed through the MCB which is 2.55 times the rated value. The verification process is divided in three time intervals 1t, 2t and 3 t. If the MCB trips during 1t then the condition is known as 'early trip', if it trips during 2t then the condition is known as 'okay trip' and if the MCB trips during 3t then the condition is known as 'late trip'. The time periods 1t, 2t and 3t are specified according to the rating of the MCB. The verification V2 is carried out 45-50 minutes after V1 reason being the cooling of then bi-metallic strip. The trip time obtained at V1 andV2 should not have a difference of more than 2-3 seconds.

5. DESIGN OF PORTABLE UNIT

Materials required for the portable unit.

1) Dc stepper motor
2) Screw driver
3) Un-calibrated MCBs of 6A rating
4) Fixture for holding MCB
5) Fixture for movement of motor
6) Electrode for power input to MCB
7) Power supply for motor
8) Software for controlling the process
9) Ammeter to display current rating
10) Microcontroller with lcd to display time
11) Power supply for stepper motor

A 12v dc supply has to be provided to the stepper motor. Figure 1 shows the general procedure which occurs in the working of prototype. The crucial parts of the circuit are

1. Microcontroller: It is used to measure and display the current across the MCB, to conduct the linear motion of the motor fixture in order to engage the screwdriver into the calibration screw, to check whether the screw is properly engaged and to provide the stepper motor with appropriate signals so as to calibrate MCB accordingly. The micro controller used is PIC 18F4550.

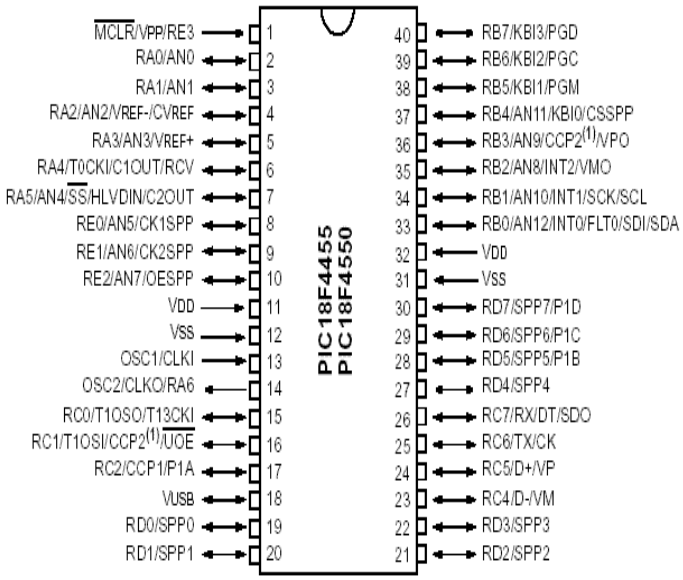

Fig.2 Pin diagram of PIC18F4550

2. DC stepper motor: The motor is required to rotate the screwdriver by the required number of turns in order to calibrate the MCB.
3. Screw driver: It is inserted in the calibration screw slot with the help of DC stepper motor and fixture on which the DC stepper motor is mounted. It is so because the screw driver is mounted on the DC stepper motor.
4. Uncalibrated MCB: It is main component of the circuit. It is to be made sure that MCB is uncalibrated and calibration screw is properly positioned.
5. Power supply for motor: A 12V DC power supply is designed for the motor.
6. Power supply for MCB: A SMPS system is used to give the MCB required current. The SMPS has variable output it's rating is 12V/2A, 5A, 10A, 20A.
7. Software for controlling the process: A GUI is designed and interfaced with the microcontroller so as to control the process. The GUI shows us the real time current flowing through the MCB; it shows the trip time and gives us the freedom to input the value of the current according to the rating of the MCB.

6.TRIP TIME

Technically trip time can be called as output of the MCB. The trip time which can be regarded safe for the operation of the MCB is determined from current-time characteristics of the MCB. The trip time varies according to the rating as well as type of the MCB.

The time-current curves show the amount of time requires by the circuit breaker to trip at a given overcurrent level. They are generally represented by the log-log plot where the continuous current rating is on the horizontal axis and the time is on the vertical axis. The fig below illustrates how to find the trip time for the given MCB provided that the current-time curves are given [1]

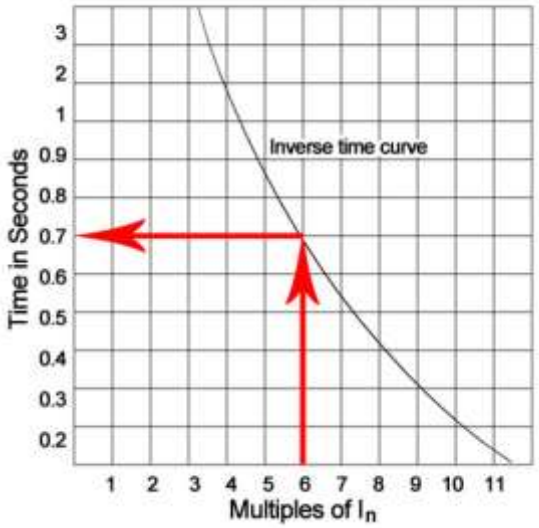

Fig 3: Current-Time curves[1]

The total clearing time or trip time of the MCB is sum of breaker's sensing time, unlatching time, mechanical operating time and arcing time. The curves are developed using fixed specifications such as operation at an ambient temperature of 40°C so we have to understand that actual operating conditions can cause variation in performance of the circuit breaker.

7. THE FAULTS

1) Mechanical faults
2) Electrical faults
3) Pneumatic valve problems

Mechanical faults:-these are easy to locate and understand but difficult to rectify as perfection is needed in mechanical parts.

The faults that we encountered was with the alignment of the fixtures. The screwdriver used for calibration was unable to rotate the calibration screw as its axis of rotation was not proper. the screwdriver is attached to a DC motor which rotates the screwdriver.

Electrical faults:-electrical faults are difficult to identify.

1) The DC motor was not rotating by the command of software.
2) The supply line to the MCBs was not functioning.

8. RECTIFICATION OF FAULTS

Mechanical part: The axis of screwdriver was made perfect, the electrode and holding part of motor was adjusted to get proper alignment of screwdriver with the calibration screw, also enough space for screwdriver was provided for its free movement.

Electrical part: The continuity of supply was checked using a multi-meter and fault was identified in line and solved. The communication port was changed.

9. CONCLUSION

Hence we have studied the design procedure of portable unit for calibration and verification of a MCB. The importance of trip time is stated.

10. APPLICATIONS

The portable unit which is designed can be used by manufacturers of the MCB such as Larsen & Toubro, Schiender Electric, Siemens etc. this unit can also be used on a domestic level in order to check working of an MCB.

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