
A Real Time Implementation of a Solid State Overcurrent Relay using DSP F2812

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ABSTRACT

This paper aims at fabricating and simulation of a solid state overcurrent relay using DSP F2812 Control desk software. The relay detects and trips the fault using wireless RF modules. The novelty lies in the use of wireless means of fault tripping and real time hardware implementation of the above. The results are verified by suitable software simulation.

Keywords

Signal Conditioning Circuit, DSP F2812, Solid State Tripping Circuit, solid state over current relay.

1 INTRODUCTION

Overcurrent describes a situation when there is excess current in a conductor or equipment than its rated capacity. Overcurrent is caused by three major factors, they are, Overload, short circuit faults, ground fault.

Overload: when excess load is connected to a network, it draws excess current.

Short circuit fault: Unintended contacts within an electrical system will lead to sudden drop in impedance to near zero. This lets abnormally large current to flow through the system, leading to overcurrent abnormalities.

Ground fault: inadvertent contact between an energized conductor and the ground is called a ground fault. If this condition occurs, the impedance of the fault point drops to absolute zero. This leads to serious overcurrent flow in the network.

2 SOLID STATE OVERCURRENT RELAY

The over current relay is a protective device. it is used for the purpose of safety of the devices in the circuit. This relay operates as a switch until the load current exceeds the pickup value. It performs as a breaker. The Solid Static relay has longer life-span, decreased noise when operates and faster response speed, low weight, Arc less switching, less power consumption.

2.1 CURRENT TRANSFORMER

It consists of a current transformer in series with the line for the current measurement. The primary of a current transformer is of a single turn, which is usually the transmission line itself. The secondary coil is wound around a hollow cylinder around the primary coil.

2.2 SIGNAL CONDITIONING CIRCUIT

The output of the secondary of the current transformer is fed to a rectifier to get a direct current (DC) which in turn is sent to a current to voltage converter. The I-V converter produces a proportional voltage value

as output corresponding to the input current. The components which are used $1\ \Omega$ 5w resistor, bridge rectifier, $1000\ \mu F$, $1000\ \Omega$ resistor, $100\ \Omega$ resistor, MCT2E opto coupler.

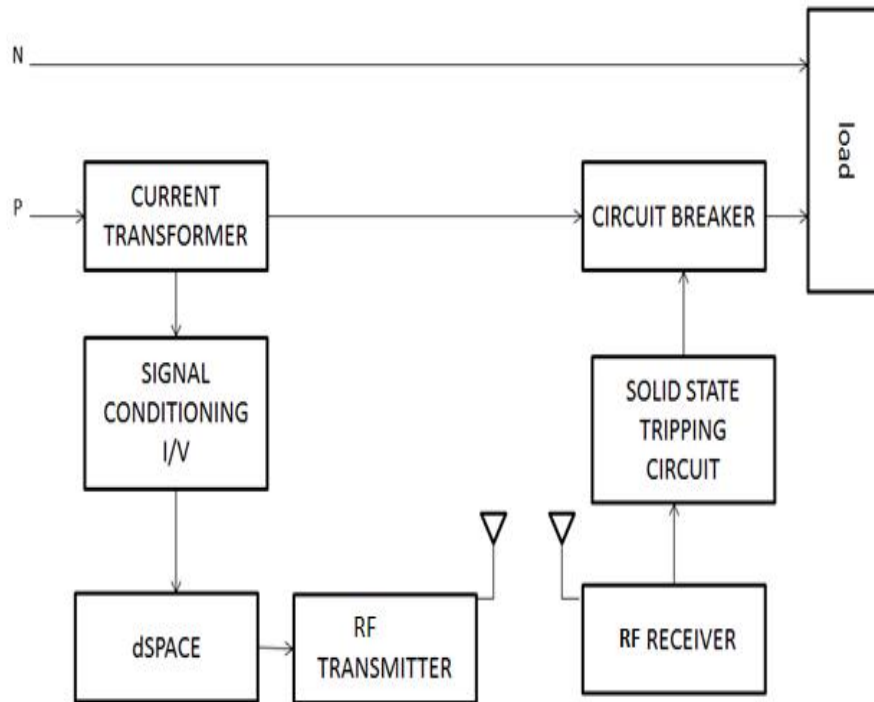


Fig1: Block diagram of solid state overcurrent relay

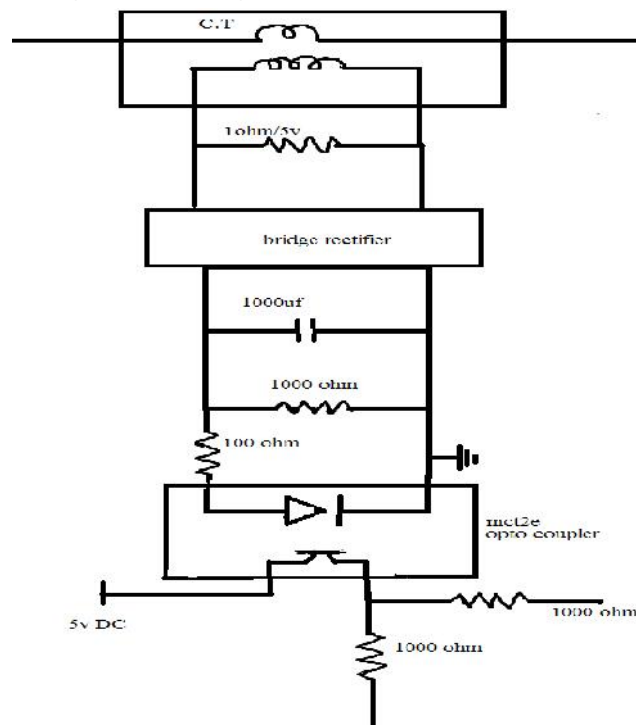


Fig 2: Block diagram of Signal Conditioning Circuit

2.3 DSP F2812

MATLAB embedded coder is used for real time implementation. There are modern DSP processor available in market which need code to function. So, a person with good knowledge in coding can work with these DSP processors. But, MATLAB embedded coder lets any person who have a basic knowledge on MATLAB to do all the functions that can be done with coding. So, in MATLAB we have to just simulate our circuit and have to build it. The MATLAB Simulink blocks will be converted into C codes by MATLAB embedded coder and dump it in TMS320F2812 controller board. Thus the signals created can be used for real time implementation in hardware.

3 RF MODULE

The RF module, as the name depicts, operates at Radio Frequency. The equivalent frequency range varies between 30 kHz & 300 MHz. In this Radio Frequency operating system, the digital data is represented in such a manner that it shows variations in the carrier wave. This kind of modulation is identified as Amplitude Shift Keying aka (ASK). Transmission through Radio Frequency is more good and better than IR (infrared). Firstly, signals through RF have the ability to travel through larger and vast distances making it good enough for long range and vast range applications. Also, while IR mostly operates based on technique called as line-of-sight mode, Radio Frequency signals can travel even when there is an obstruction between transmitter & receiver, which is an advantage over infrared sensor. Next, RF transmission is more strong and unswerving than IR transmission. RF communication uses a specific frequency unlike IR signals which are affected by other IR emitting sources. This RF module encompasses of an RF Transmitter and an RF Receiver.

3.1 RF TRANSMITTER

A transmitter (or radio transmitter) is an electronic device which produces radio waves with the help of an antenna. A transmitter generates a radio frequency current is enforced to the antenna, which in turn radiates radio waves. A transmitter generates radio waves for communication, radar and navigational purposes. The transmitter consists of an encoder with an integrated chip ICH12E whose work is to encode the data and transmit it to using Radio Frequency transmitter to the other side which is nothing but the receiver. The transmitter is used to transmit digital data through four pins, in the figure A0-A11 are encoder IC input pins and then D_{out} is the out pin where the encoded data is taken out.

The transmitter consists of dip switches which are used as the on and off in other words it is used as high bit or low bit that to be transmitted. The digital data is provided to the encoder IC in parallel the encoder IC which converts the data into serial data and sends it through the RF transmitter as shown in Figures encoding data using HT12E. The data which transmitted is received by the receiver on the other side. The four DIP switches decide the digital data that will get transferred to the receiver.

A transmitter is composed of:

- Power supply — it is main source of energy and electricity for the device. It is responsible for creating transmission of electricity.
- Electronic oscillator — Generates a graphical wave which is called as the carrier wave where the digital data is imposed and carried through the air.
- Modulator — the job of a modulator is to add the actual digital data into the carrier wave by making some variations in the carrier wave.

RF speaker — Increases the energy of the flag with a specific end goal to expand the range where the waves can achieve receiving wire tuner or impedance coordinating circuit — matches the impedance of the transmitter to that of the reception apparatus all together for the exchange of energy the radio wire to be proficient and keep a Condition called standing Waves, where power is reflected from the reception apparatus back to the Transmitter, squandering power or harming it..

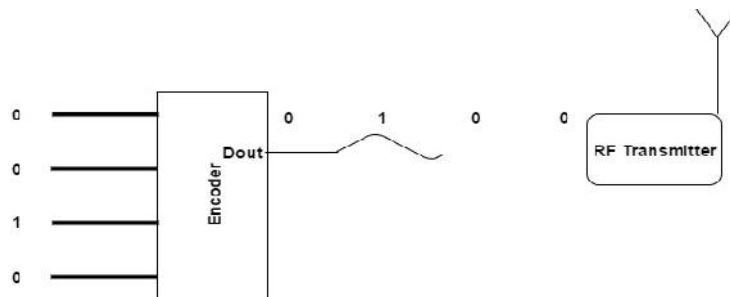


Fig 3: functional diagram of RF transmitter

3.2 RF RECEIVER

In radio communications and systems, a radio receiver circuit (commonly also known as radio) is an electronically operated device that receives radio wave signals and converts the information given by the waves carried by them to a form which can be extracted and used. It is used with an antenna.

The antenna intercepts and traps radio waves and converts them to small alternating currents which are applied to the receiver and the receiver analyses and takes the information which is needed. The receiver circuit uses electronic filters which does signal processing functions to abstract the needed radio frequency signal which is needed from all the other signals which are not necessary but are picked up by the antenna in the process, an electronic amplifier amplifies in order to increase and maximize the power of the signal to show progress in the processing, and finally recovers the desired information through demodulation.

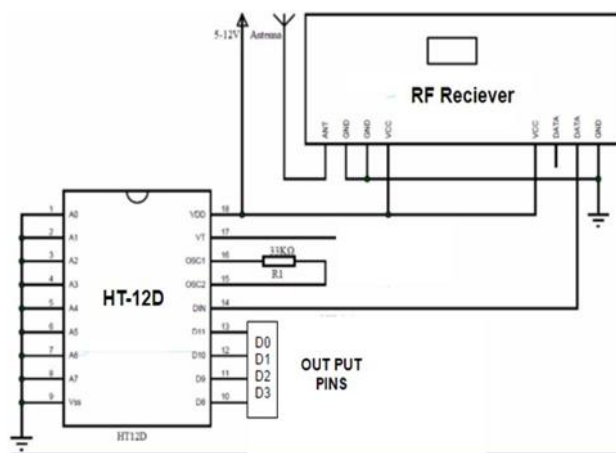


Fig 4: functional diagram of RF transmitter

The receiver is contained with Radio Frequency receiver module which is connected and interfaced with a decoder integrated chip IC HT-12D as shown in the figure below, the data which needs to be transmitted is received through antenna which is an electronically operated device and then the data extracted is given as the input to the HT-12D decoder IC where the data is decoded and outputs can be taken through the digital pins of the transmitter circuit as shown.

Based on the two boards the complete hardware setup is designed, mainly depending on the receiver board the overall circuit of the secondary side is designed

At the receiver side we got 4 digital out puts know using these four digital outputs the appliances are to be controlled, so for this purpose relay board is used. The VT that is the positive terminal shown in the above figure shows the availability of the transmitter in the latitude of receiver.

Solid state trip devices with them will reduce maintenance, increase reliability, reduce nuisance trips, and extend the functionality of older circuit breakers. Advanced power management features are also available. A circuit breaker is an automatically operated electrical switch designed to protect an electrical circuit from damage caused by excess current, typically resulting from an overload or short circuit. Its basic function is to interrupt current flow after a fault is detected. Unlike a fuse, which operates once and then must be replaced, a circuit breaker can be reset (either manually or automatically) to resume normal operation.

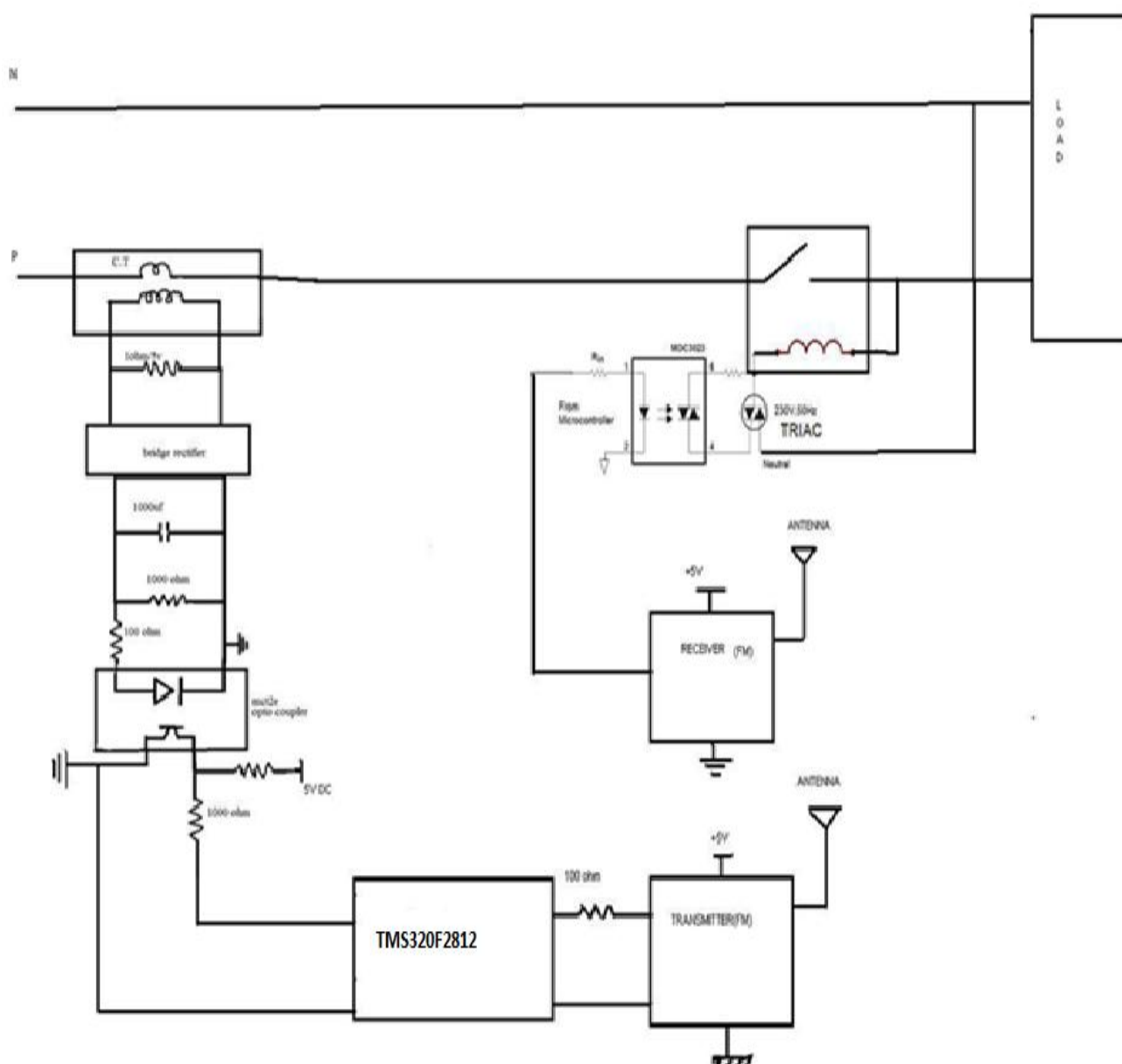


Fig 5: Circuit Diagram of Solid State Overcurrent Relay

RESULT AND DISCUSSION

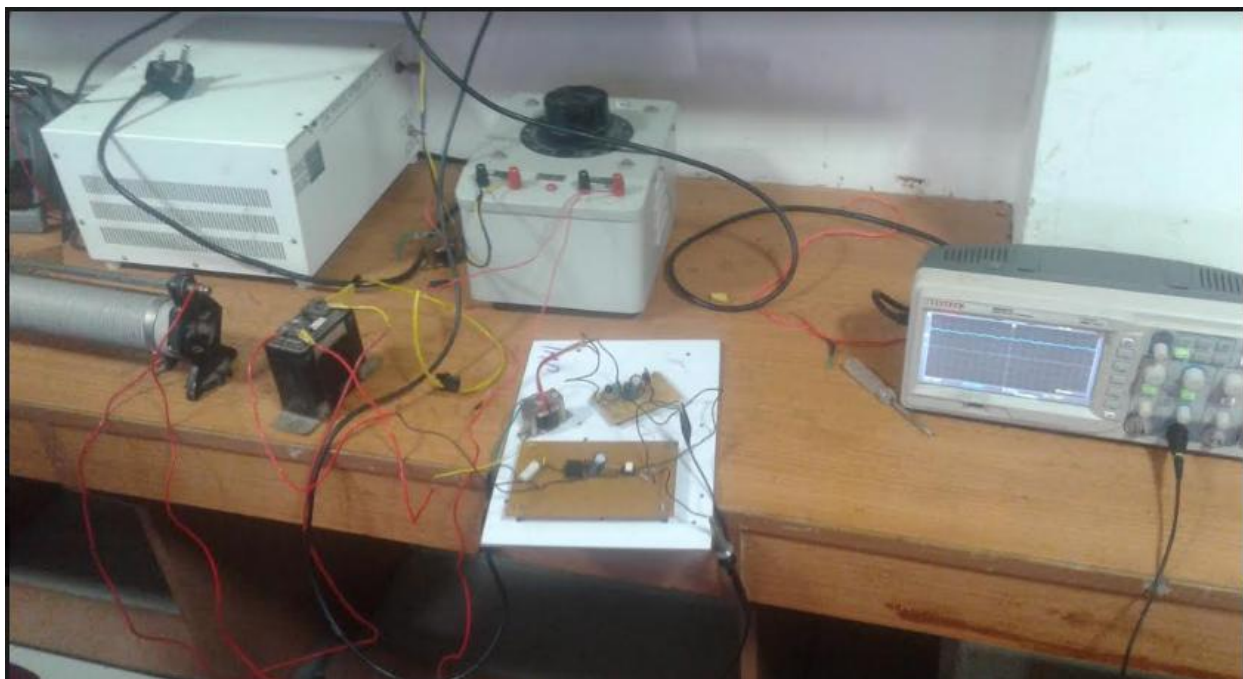


Fig 6: hardware component of signal conditioning

SIGNAL CONDITIONING OUTPUT

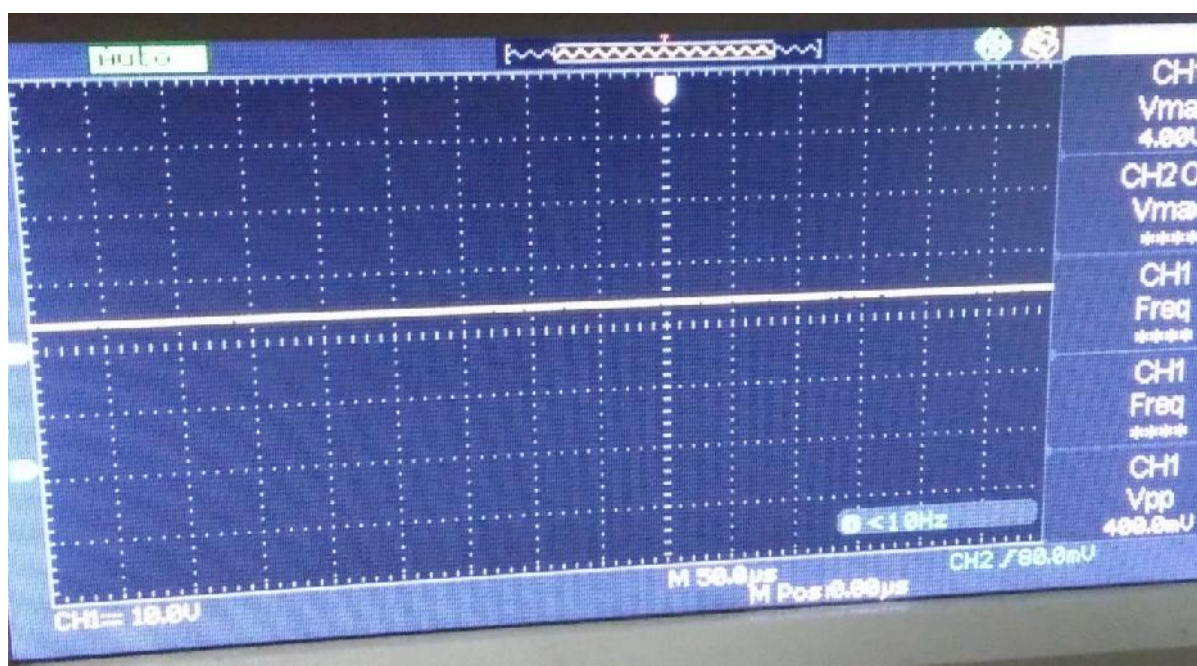


Fig 8 :output of signal conditioning

MATLAB MODEL WITH DSP F2812

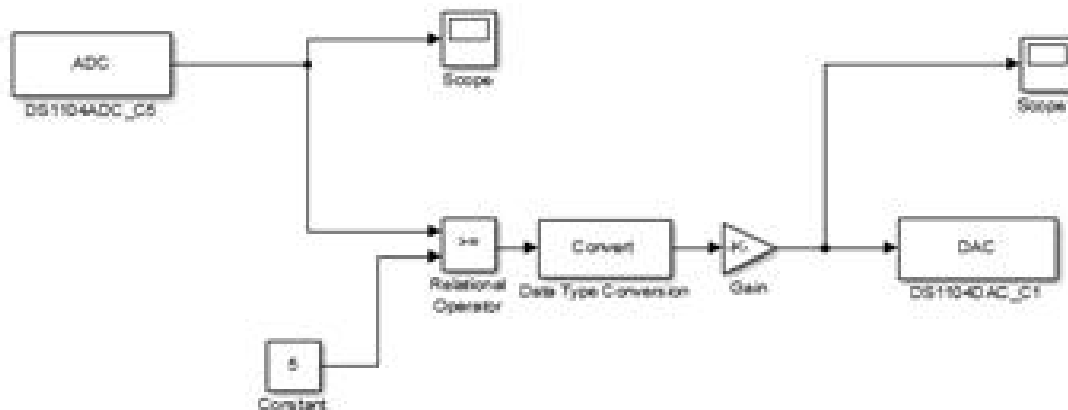


Fig 9: matlab model for DSP F2812

DSP F2812 OUTPUT FOR NORMAL CONDITION

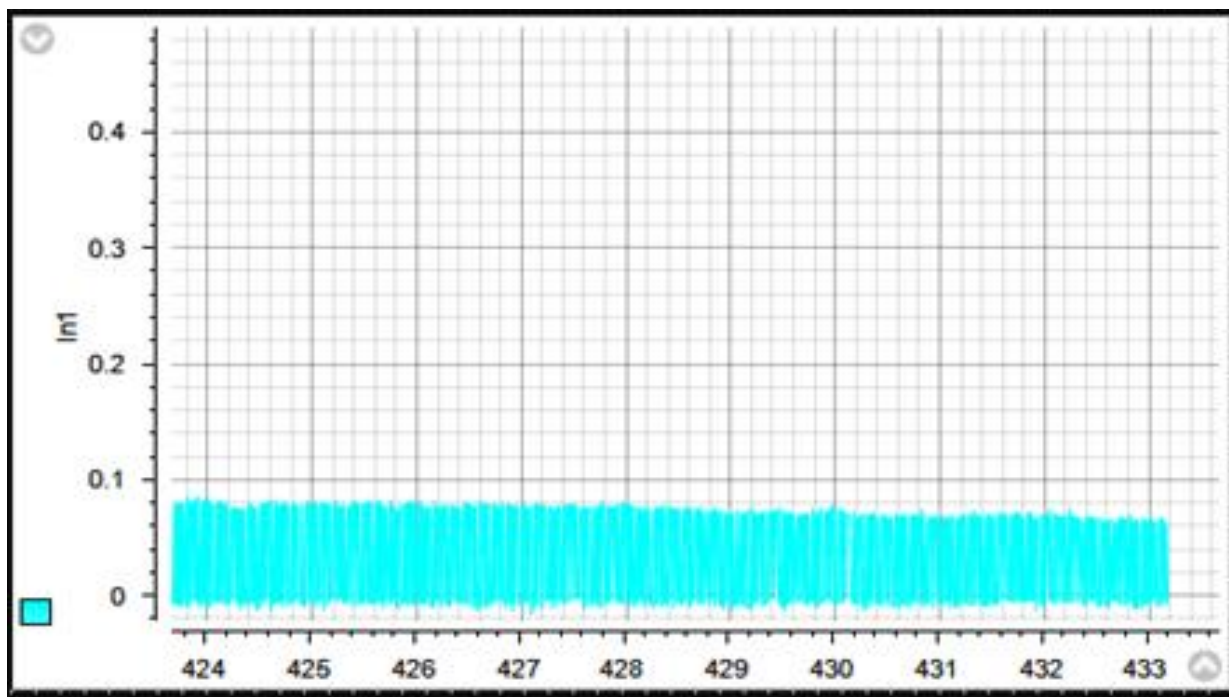


Fig 10: Normal condition DSP F2812 output

DSP F2812 OUTPUT FOR SHORT CIRCUIT CONDITION

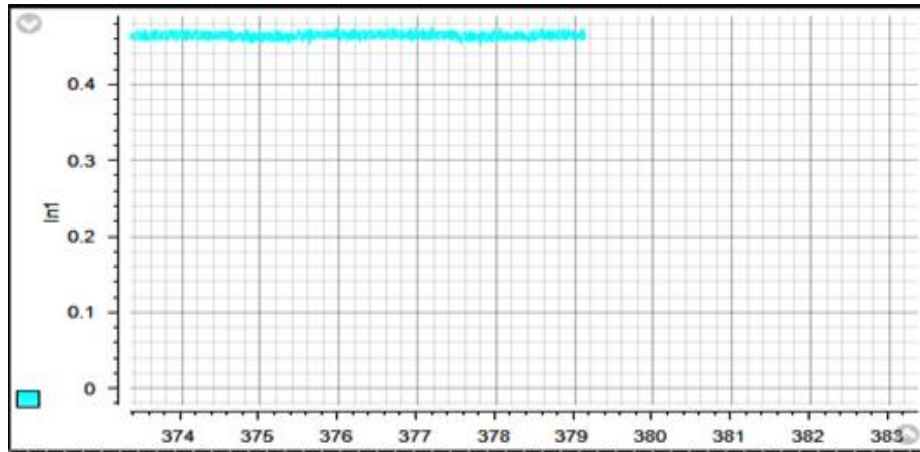


Fig 11: short circuit condition DSP F2812 output

DSP F2812 OUTPUT –TRIP SIGNAL

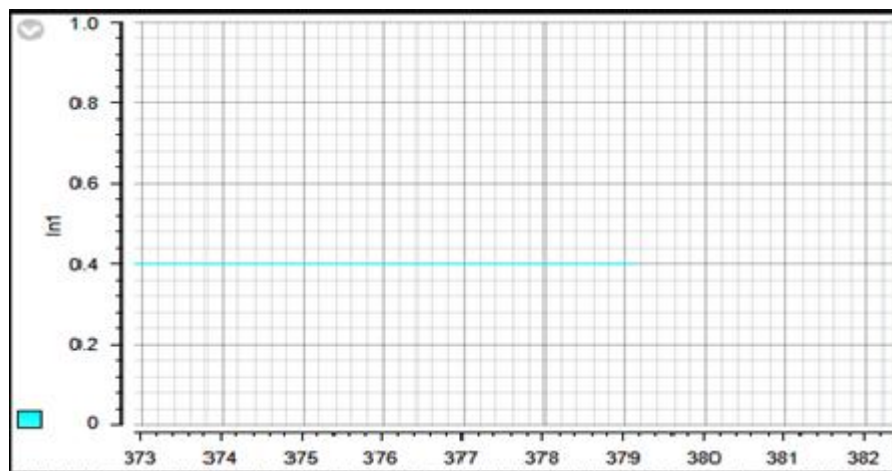


Fig 12 :DSP F2812 output for trip signal

TRIPPING ARRANGEMENT IN NORMAL CONDITION



Fig 13: circuit breaker in normal condition

TRIPPING ARRANGEMENT IN SHORT CIRCUIT CONDITION

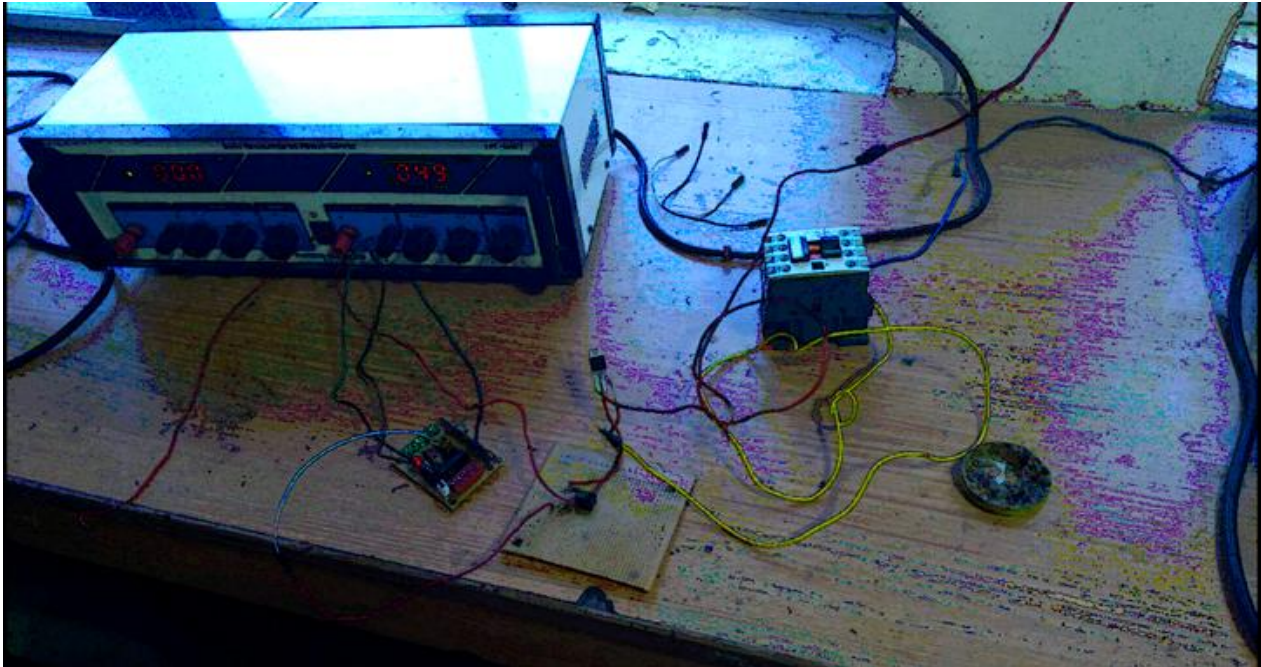


Fig 14 :circuit breaker in abnormal condition(after tripping)

5 CONCLUSION

An attempt has been made to detect and communicate faults in a solid state overcurrent relay using DSP F2812. The results indicate that the hardware is able to detect and display short circuit condition. In addition a trip signal is generated to rectify and isolate the fault quickly. This has been implemented using wireless FM modules and successfully simulated using DSP F2812. In future this operation would be completely automated by suitable algorithm.

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