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Underground Cable Fault Locator

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Abstract: The objective of this project is to determine the distance of underground cable fault from base station in kilometers. While a fault occurs for some reason, at that time the repairing process related to that particular cable is difficult due to not knowing the exact location of the cable fault. The proposed system is to find the exact location of the fault.

Keywords: Underground Cable, Fault, Open circuit, Short circuit.

I. INTRODUCTION

The project uses the standard concept of Ohms law i.e., when a low DC voltage is applied at the feeder end through a series resistor (Cable lines), then current would vary depending upon the location of fault in the cable. In case there is a short circuit (Line to Ground), the voltage across series resistors changes accordingly, which is then fed to an ADC to develop precise digital data which the programmed microcontroller of 8051 family would display in kilometers.
The project is assembled with a set of resistors representing cable length in KM's and fault creation is made by a set of switches at every known KM to cross check the accuracy of the same. The fault occurring at a particular distance and the respective phase is displayed on a LCD interfaced to the microcontroller.

II. UNDERGROUND CABLE FAULT DISTANCE LOCATOR

Before attempting to find underground cable faults on direct hidden primary cable, it is essential to know where the cable is situated and what direction it takes. If the fault occurs on the secondary cable, then knowing the exact route is even more critical. Since it is extremely difficult to find a cable fault without knowing where the cable is, it makes sense to master cable locating and tracking before start the fault locating process.

Types of Faults

A fault in a cable can be classified into different types such as

Open Circuit Fault:

This type of fault is better than short circuit fault, because when the open circuit fault occurs, then the flow of current through an underground cable becomes zero. This fault can be occurred by disruption in conducting path. Such faults occur when one or more phase conductors break.

Short Circuit Fault

Short circuit fault can be divided into two types, namely symmetrical and unsymmetrical faults

1) In symmetrical fault, three phases are short circuited in this type of fault. This type of fault is also called as three phase fault due to this reason.
2) In unsymmetrical fault, the magnitude of the current is not equal and displaced by 120 degrees.

III. DIFFERENT METHODS OF FAULT LOCATION

Free location methods can be classified into different types that are discussed below.

Online Method

Online method uses and process the sampled current and voltages to determine the fault points. This method for underground cable are less than above lines.

Offline Method

This method uses a special instrument to test out service of cable in the field. Offline method is classified into two methods such as tracer method and terminal method.

Tracer Method

In this method fault of the cable can be detected by walking on the cable lines. Fault location is denoted from electromagnetic signal or audible signal. This method is used to find the fault location very accurately.

Terminal Method

Terminal method is used to detect the location of the fault in a cable from one end or both the ends without tracking. This method is used to find general areas of the fault to accelerate tracking on buried cable.

Underground Cable Fault Distance Locator Circuit

The main concept of this project is to find the distance of underground cable fault from the base station in kilometers. In many urban areas, cable fault is a common problem. When a fault occurs due to some reason, the process of fault tracking without knowing the location related to that particular cable is very difficult. The proposed system is designed to track the exact location of the fault occurred in the cable. This project uses Ohms

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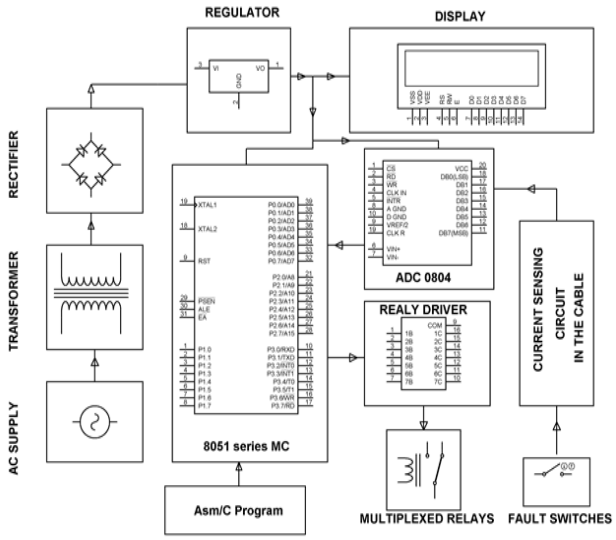
Law concept, when a low voltage DC is applied to the feeder end through a series resistor, then the current would differ based on the location of fault occurred in the cable. In case is there any short circuit occurred from line to ground, then the voltage across series resistor alters accordingly, then it is fed to an analog to digital converter to develop exact data, which the pre programmed 8051 microcontroller will display in kilometers.

The proposed system is designed with a set of resistors to signifying the length of a cable in kilometers, and the fault creation is designed with a set of switches at every known kilometer (KM) to cross check the exactness of the same. The fault happening at a specific distance and the particular phase is displayed on an LCD interfaced to the 8051 microcontroller.

IV. BLOCK DIAGRAM

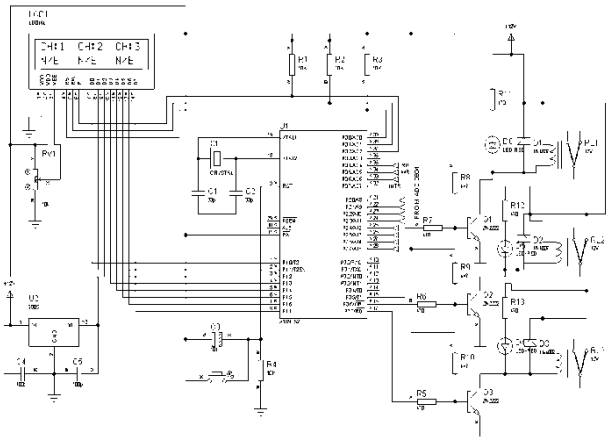


V. WORKING PRINCIPLE

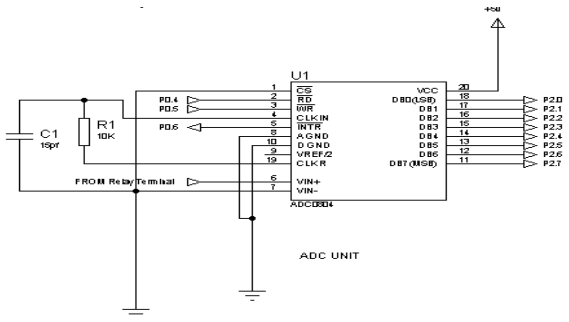
To detect the fault we are implementing the method of voltage drop through resistance network. When a particular media is grounded at different location it provides us different level of analog signal(voltage). The analog signal has to be convert into digital form so that it can be represent with numerical value. To interface the 0804 total 11 I/O pins are required. The 8 I/O pin to transfer digital data from ADC to microcontroller, one I/O pin for RD, one I/O pin for WR and one I/O pin for interrupt. When we ask the ADC to convert a analog signal to digital it assume a specific amount of time i.e we can get actual result only after 100% conversion. The INTR pin solve the problem for us. The program executing the microcontroller continuously monitors the interrupt pin and read the data from port 2 only after 100% conversion. The program executing in the microcontroller is responsible for converting the ADC value to resistance value and the resistance value is converted into distance of fault.

We are using a single channel ADC. Hence a change over circuit is necessary to monitor a specific line at a specific time. To do so we have create 3 way exchanger switch with the help of switching transistor SPDT electromagnetic relay and fly diode to protect from reverse current. The 3 relays are driven by relay driver circuit based on 2N2222 from Philips. The base of the transistors are connected to pin number 15, 16 & 17 i.e P3.5, P3.6 & P3.7 . As 8051 cannot gives us effective high, it is not possible to activate the driver without external pull up. Hence 4.7K pull resistance is connected across base and Vcc. When there is no presence of effective high voltage, the internal resistance between emitter and collector are high and it will not allow to flow current. But when the base have a effective high positive voltage the internal resistance between emitter and collector drops and current flows from collector to emitter. One terminal of the relay coil is connected with the collector of the transistor and other terminals of coils are connected with +12V. As we are using electromagnetic relay. The transistor will be effected by reverse current which will effect the driver circuit. As to protect the reverse current a rectified diode IN4007 is connected parallel to the relay coil as fly diode. The program executed in the microcontroller is controlling the relay driver circuit in specific sequence to connect with the specific ground cable and to read the ADC value, to get the information about prospective fault.

VI. CIRCUIT DIAGRAMS



a) Main Circuit



b) ADC Unit Circuit

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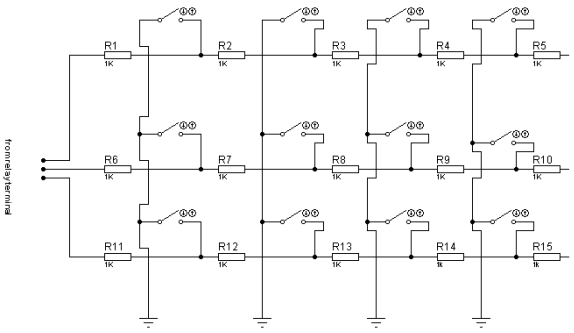

C) Test Board Circuit

VII. CONCLUSION

The hardware model of Underground Cable Fault Locator is implemented and favorable results were brought forward. This hardware model can locate the exact fault location in an underground cable.
Further this project can be enhanced by using capacitor in an AC circuit to measure the impedance which can even locate the open circuited cable, unlike the short circuited fault only using resistors in DC circuit as followed in the above proposed project.

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