

Underground Cable Fault Distance Locator for Smart Cities

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ABSTRACT

This paper proposes fault location model for underground power cable using microcontroller. The aim of this project is to determine the distance of underground cable fault from base station in kilometers. This project uses the simple concept of ohm's law. When any fault like short circuit occurs, voltage drop will vary depending on the length of fault in cable, since the current varies. A set of resistors are therefore used to represent the cable and a dc voltage is fed at one end and the fault is detected by detecting the change in voltage using a analog to voltage converter and a microcontroller is used to make the necessary calculations so that the fault distance is displayed on the LCD display.

Keywords: Underground cable, fault location, fault detection, location methods, microcontroller

I. INTRODUCTION

Till last decades cables were made to lay overhead & currently it is lay to underground cable which is superior to earlier method. Because the underground cable are not affected by any adverse weather condition such as storm, snow, heavy rainfall as well as pollution. But when any fault occur in cable, then it is difficult to locate fault. So we will move to find the exact location of fault.

Now the world is become digitalized so the project is intended to detect the location of fault in digital way. The underground cable system is more common practice followed in many urban areas.

While 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 cable fault. Fault in cable is represented as:

- Any defect,
- Inconsistency,
- Weakness or non-homogeneity that affect performance of cable .
- Current is diverted from the intended path.
- Caused by breaking of conductor & failure of insulation

Fault in cable can be classified in two groups:

1) Open circuit fault:

Open circuit faults are better than short circuit fault, because when these fault occurs current flows through cable becomes zero. This type of fault is caused by break in conducting path. Such faults occur when one or more phase conductors break.

2) Short circuit fault: Further short circuit fault can be categorized in two types:

a) Symmetrical fault: Three-phase fault is called symmetrical fault. In this all three phases are short circuited.

b) Unsymmetrical fault: In this fault magnitude of current is not equal & not displaced by 120 degree.

II. FAULT LOCATION METHODS

Fault location methods can be classified as:

1) Online method: This method utilize & process the sampled voltages& current to determine the fault points. Online method for underground cable are less than overhead lines.

2) Offline method: In this method special instrument is used to test out service of cable in the field. There are two offline methods as following

1) Tracer method: In this method fault point is detected by walking on the cable lines. Fault point is indicated from audible signal or electromagnetic signal. It is used to pinpoint fault location very accurately.

Example:1) Tracing current method

2) Sheath coil method

2) Terminal method: It is a technique used to detect fault location of cable from one or both ends without tracing. This method use to locate general area of fault, to expedite tracing on buried cable.

Example:1) Murray loop method

2) Impulse current method

III. BLOCK DIAGRAM:

The project uses the simple concept of OHMs law where a low DC voltage is applied at the feeder end through a series resistor. The current would vary depending upon the length of fault of the cable in case there is a short circuit of LL or 3L or LG etc. The series resistor voltage drop changes accordingly which is then fed to an ADC to develop precise digital data which the programmed microcontroller would display the same in Kilo meters. The project is assembled with a set of resistors representing cable length in KMs and fault creation is made by a set of switches at every known KM to cross check the accuracy of the same.

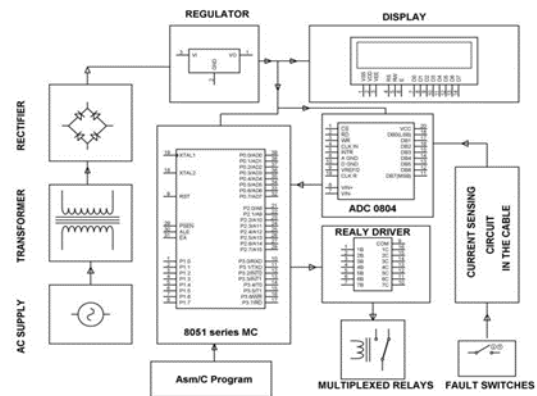


Fig 1: Block diagram

This is proposed model of underground cable fault distance locator using microcontroller. It is classified in four parts –DC power supply part, cable part, controlling part, display part. DC power supply part consist of ac supply of 230v is stepdown using transformer, bridge rectifier converts ac signal to dc & regulator is used to produce constant dc voltage. The cable part is denoted by set of resistors along with switches. Current sensing part of cable represented as set of resistors & switches are used as fault creators to indicate the fault at each location. This part senses the change in current by sensing the voltage drop. Next is controlling part which consist of analog to digital convertor which receives input from the current sensing circuit, converts this voltage into digital signal and feeds the microcontroller with the signal. The microcontroller also forms part of the controlling unit and makes necessary calculations regarding the distance of the fault. The microcontroller also drives a relay driver which in turn controls the switching of a set of relays for proper connection of the cable at each phase. The display part consists of the LCD display interfaced to the microcontroller which shows the status of the cable of each phase and the distance of the cable at the particular phase, in case of any fault.

IV. ALGORITHM & FLOWCHART

Algorithm:

Step1: Initialize the ports, declare timer, ADC, LCD functions.

Step2: Begin an infinite loop; turn on relay 1 by making pin 0.0 high.

Step3: Display “R:” at the starting of first line in LCD.

Step4: Call ADC Function, depending upon ADC output, displays the fault position.

Step5: Call delay.

Step6: Repeat steps 3 to 5 for other two phases.

Power supply: The power supply circuit consists of step down transformer which is 230v step down to 12v. In this circuit 4 diodes are used to form bridge rectifier which delivers pulsating dc voltage & then fed to capacitor filter the output voltage from rectifier is fed to filter to eliminate any a.c. components present even after rectification. The filtered DC voltage is given to regulator to produce 12v constant DC voltage.

Transformer: Transformer is static device which transfer electrical energy from one circuit to other circuit with change in voltage or current without change in frequency. In this step down transformer is used. Usually, DC voltage s are require d to operate various electronic equipment and these voltages are 5V, 9V o r 12V. But these voltages cannot be obtained directly. Thus the a.c input available at the mains supply i.e., 230V is to b e brought own the required volt ge level. This is done by a transformer. Principle of transformer is according to fara day's law o electromagnetic induction.

8051 microcontroller

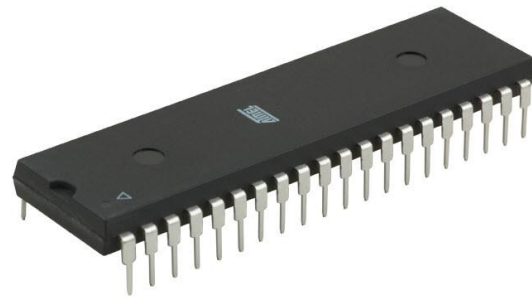


Fig 2: Microcontroller

Microcontroller is on chip true microcomputer. Intel 8051 is most popular microcontroller producing in world market. It ha 64kb external data memory, 64kb program memory, & 256 bytes internal data memory. It increases reliability. Hardware is less because of single chip microcomputer. Smaller access time & speed is high.

LCD: Liquid crystal display are interfacing to microcontroller 8051. Most commonly LCD used are 16*2 & 20*2 display. In 16*2 display means 16 represents column & 2 represents rows.

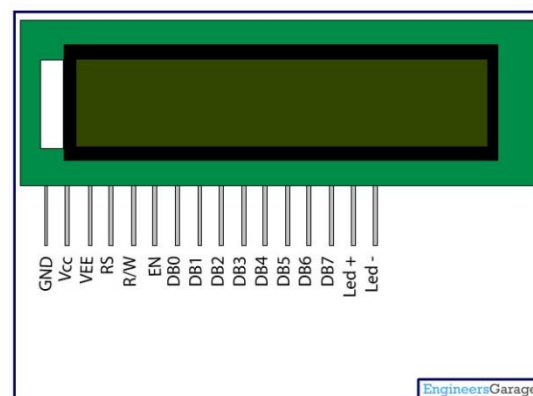


Fig 3: 16*2 LCD Display

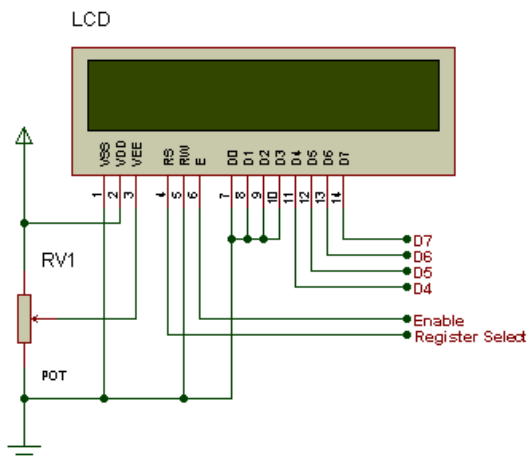


Fig 4: LCD pins description

Voltage Regulator:

A voltage regulator is an electrical regulator designed to automatically maintain a constant voltage level. In this project, power supply of 5V and 12V are required. In order to obtain these voltage levels, 7805 and 7812 voltage regulators are to be used. The first number 78 represents positive supply and the numbers 05, 12 represent the required output voltage levels. The L78xx series of three-terminal positive regulators is available

RELAY

Relay is sensing device which senses the fault & send a trip signal to circuit breaker to isolate the faulty section. A relay is automatic device by means of which an electrical circuit is indirectly controlled & is governed by change in the same or another electrical circuit. There are various types of relay: Numerical relay, Static relay & electromagnetic relay. Relay are housed in panel in the control room.

ADVANTAGES

- 1) Less maintenance
- 2) It has higher efficiency
- 3) Less fault occur in underground cable

4) Underground cable fault location model are applicable to all types of cable ranging from 1kv to 500kv & other types of cable fault such as-Short circuit fault, cable cuts, Resistive fault, Sheath faults, Water trees, Partial discharges.

5) Improved public safety.

CONCLUSION

In this paper we detect the exact location of short circuit fault in the underground cable from feeder end in km by using microcontroller 8051. For this we use simple concept of OHM's law so fault can be easily detected and repaired.

FUTURE SCOPE

In this project we detect only the location of short circuit fault in underground cable line, but we also detect the location of open circuit fault, to detect the open circuit fault capacitor is used in ac circuit which measure the change in impedance & calculate the distance of fault.

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