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Underground Cable Fault Distance Locator

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Abstract: *This article is about cable fault distance locator by using microcontroller. The main of this project is to detect the distance of underground cable fault in kilometers. This project uses the simple concept of ohm's law. Faults like short circuits occur in the cable, voltage drop varies depending on the length of fault in the cable and hence the current varies. The resistors are used to represent the cable and the dc voltage is given at one end and the fault will detects by the change in voltage using analog to digital converter. Then the microcontroller makes the necessary calculations to display the fault location distance on the LCD display.*

Keywords: *Underground cable, fault location in distance, detection of fault, different location methods, microcontroller.*

I. Introduction

Few years ago the cables were made to be laid overhead and nowadays it is laid to be underground which more efficient method is. Because the underground cables are not affected by abnormal weather conditions like snowfall, heavy rains, thunder storms, and also pollution. But in case of any fault occurs in the cable, then it is not easy to detect the fault with the exact location. So in this project we will detect the fault with exact location.

Nowadays all the devices are becoming digital so the project is intended to detect the location of fault in digital method. When the fault occurs, at the time of repairing of the cable it is difficult to determine the exact fault location in the cable.

So it is necessary to correct the faults, fault can be any defects which diverts the path of current or effects on the performance of the cable.

II. Faults In Underground Cables

A] Open circuit faults

These faults occur because of failure of one or more conductors. Mainly the faults are due to failure in joints in the cables. And also one or more phases of circuit breaker also because of melting of fuse. Open circuit faults are also called as series faults. These are unbalanced type of faults except open circuit fault. Open circuit faults are better than short circuit faults because when the fault occurs in the cable the current becomes zero in the cable.

B] Short circuit faults

These faults are common and severe faults, because of high currents flowing through the transmission lines. These faults are also due to insulation failure between phase conductors. When fault occurs there is an sudden change in voltage. This change in voltage cause serious damages to the system if it is not solved or repaired within the time.

There are two types of short circuit faults:

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

b) Unsymmetrical fault: The magnitude of current is not equal and the angle is not displaced by 120 degree.

III. Fault Detection Methods

- **Online method:** This method processes the sampled voltages and current to determine the faults.
- **Offline method:** This offline method is divided into two types. They are tracer method and terminal method.

i) Tracer method: In tracer method the fault point is detected by walking on the cable lines. Fault point is detected by the electromagnetic signal. Tracer method is used to detect the accurate location of the fault.

ii) Terminal method: In this method the fault location will be detected by the cables from one or both ends without tracing. This method is used to detect the fault in general area, to expedite tracing on buried cable.

IV. 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.

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 step down 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 consists 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 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.

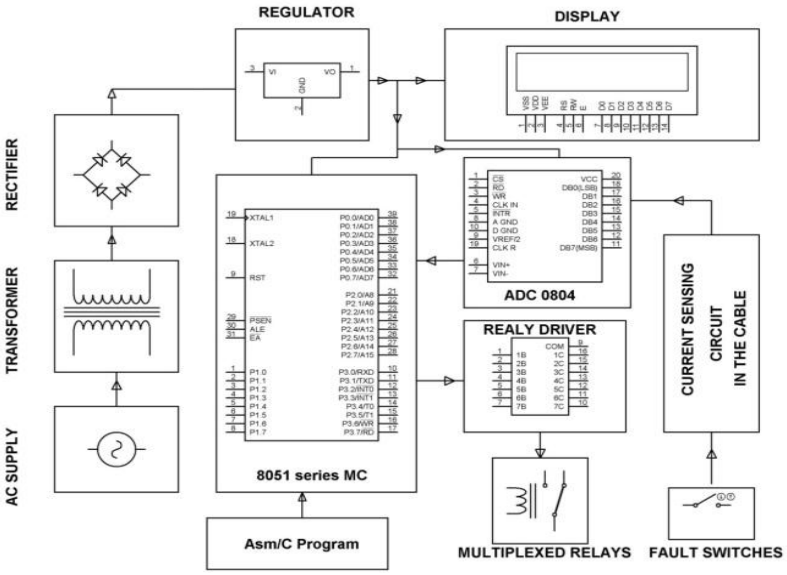

Fig1: Block Diagram of Underground Cable Fault Distance Locator.

V. Power Supply

The power supply circuit consists of step down transformer which is 230v step down to 12v.In this circuit 4diodes 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 another circuit with change in voltage or current without change in frequency .in this step down transformer is used. Usually DC voltages are required to operate various electronic equipment and these voltages are 5v, 9v or 12v.but this voltage cannot be obtained directly. Thus the AC input available at the main supply. i.e. 230v is to be brought down the required voltage level. This is done by transformer.

- **RECTIFIER :**

The output from the transformer is fed to the rectifier. It converts A.C. into pulsating D.C. The rectifier may be a half wave or a full wave rectifier. In this project, a bridge rectifier is used because of its merits like good stability .The circuit has four diodes connected to form a bridge. A rectifier is an electrical device that converts alternating current (AC), which periodically reverses direction, to direct current (DC), which flows in only one direction. The process is known as rectification. Rectifiers have many uses, but are often found serving as components of DC supplies and high-voltage direct current power transmission systems. Rectification may serve in roles other than to generate direct current for use as a source of power.

- **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.

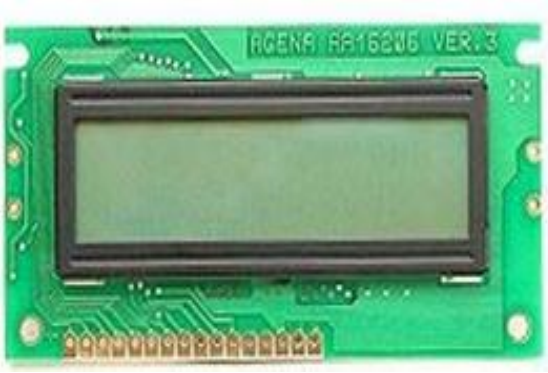

Fig 2: LCD

- **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. Relays are housed in panel in the control room.

VI. 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.

VII. 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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