© 2017 IJSRSET | Volume 3 | Issue 2 | Print ISSN: 2395-1990 | Online ISSN : 2394-4099
Themed Section: Engineering and Technology

Analysis of Underground Cable Fault Distance Locator

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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 an 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. The project uses the simple concept of Ohm's 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.

Keywords: AT8051 Microcontroller, GSM Module, short circuit fault, Relay

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 is not affected by any adverse weather condition such as storm, snow, heavy rainfall as well as pollution. But when any fault occurs 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 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 affects 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:

A. Open Circuit Fault:

Open circuit faults are better than short circuit fault, because when these faults 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.

B. Short Circuit Fault:

Further short circuit fault can be categorized in two types:

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

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

II. METHODS AND MATERIAL

1. Existing Method

In the existing system, the underground cable fault is located using microcontroller. This system proposes only the detection of short circuit fault. 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 an analogy to voltage converter and a microcontroller is used to make necessary calculation so that the fault distance is in kilometres and displayed using a LCD display.

A. Drawbacks

The existing system provides only the detection of short circuit fault in the underground cable. Usage of 10bit ADC reduces the accuracy in locating the fault and precise values are not obtained. The location of fault in cable is employed only for a distance. Moreover, the systems support to cables ranging from 1kv to 500kv. It does not employ the other cable fault detection. It may increase the investment cost due to the application of various components.

2. Proposed Method

The proposed system also follows the same principle of Ohm's law. Here the detection of short circuit and open circuit fault. The project is assembled with a set of resistors representing the cable length in kilometres. The fault creation is made by the set of switches at every known KM to cross check the accuracy. The fault occurring at a distance and respective phase is displayed on the pc interfaced with the microcontroller AT8051 with a 12bit ADC interlinked by a low cost-low power wireless transceiver.

3. Fault Location Methods

Fault location methods can be classified as:

A. Online Method: This method utilizes process the sampled voltages& current to determine the fault points. Online method for underground cable is less than overhead lines.

B. 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

4. Block Diagram & Algorithm

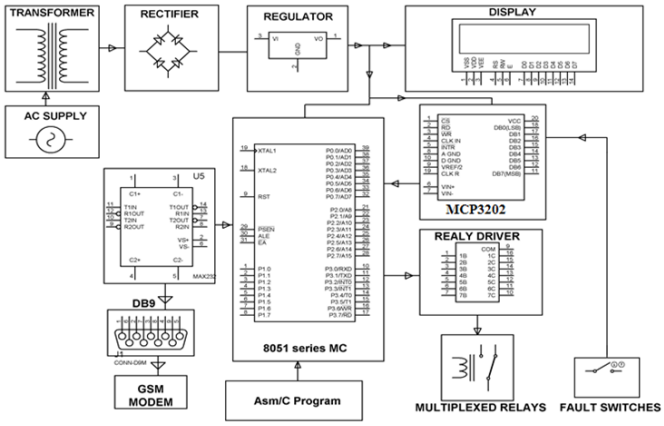

Figure 1. Block Diagram

A. 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, and 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 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 phase, in case of any fault.

B. 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.

III. RESULTS AND DISCUSSION

1. System Discretion

A. 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 AC. components present even after rectification. The filtered DC voltage is given to regulator to produce 12v constant DC voltage.

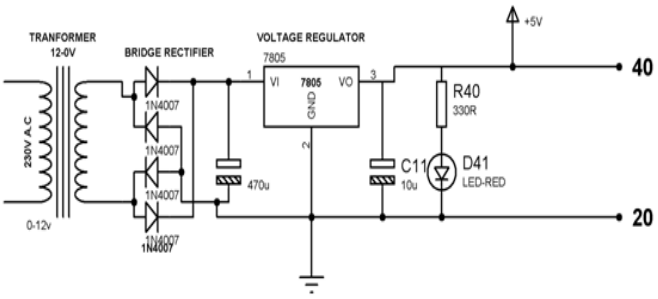

Figure 2. Power Supply Diagram

B. Transformer

Figure 3. Transformer

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

C. 8051 Micro-Controller

The AT89S52 is a low-power, high-performance CMOS 8-bit microcontroller with 8K bytes of in-system programmable Flash memory.The device is manufactured using Atmel's high-density non-volatile memory technology and is compatible with the industry standard 80C51 instruction set and pin out. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional non-volatile memory programmer. By combining a versatile 8-bit CPU with in-system programmable Flash on a monolithic chip, the Atmel AT89S52 is a powerful microcontroller which provides a highly-flexible and cost-effective solution to many embedded control applications.

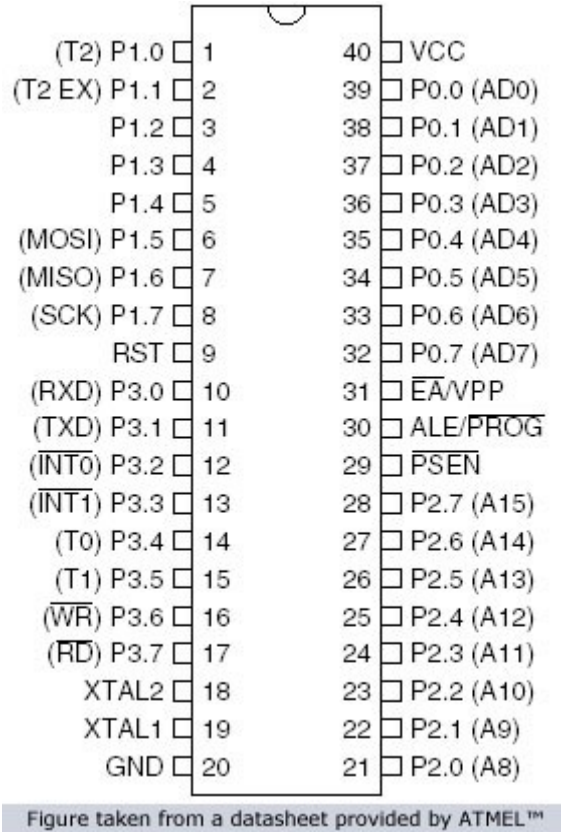

Figure 4. Pin Diagram

2. Importance of Micro Controllers rather than Pc's

- ✓ To meet the computing needs of the task efficiently and cost effectively.
- ✓ Speed the amount of ROM and RAM, the number of I/O ports and timers, size, packaging, power consumption, easy to upgrade, Cost per unit
- ✓ Availability of software development tools Assemblers, debuggers, C compilers, emulator, simulator, and technical support.
- ✓ Wide availability and reliable sources of the microcontrollers
- It is a 8-bit CSIC (complex instruction set controller).
- Its operating voltage is +5V DC.
- It has 8KB of flash reprogrammable memory, 256 bytes of internal memory.
- It consists of 32 I/O pins those are divided into 4 ports.
- Full Duplex serial data transmitter and receiver.
- Two 16 bit timers and in- built oscillator circuit.
- 64KB of external data memory space

D. LCD Display

Figure 5. LCD

Frequently, an 8051 program must interact with the outside world using input and output devices that communicate directly with a human being. One of the most common devices attached to an 8051 is an LCD display. Some of the most common LCDs connected to the 8051 are 16x2 and 20x2 displays. This means 16 characters per line by 2 lines and 20 characters per line by 2 lines, respectively. Fortunately, a very popular standard exists which allows us to communicate with the clear majority of LCDs regardless of their manufacturer. The standard is referred to as HD44780U, which refers to the controller chip which receives data from an external source (in this case, the 8051) and communicates directly with the LCD.

E. Voltage Regulator

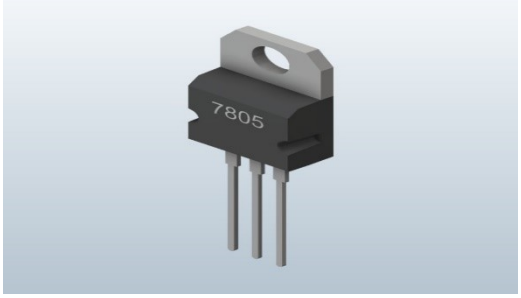

Figure 6. Voltage Regulator

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. 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.

F. Relay

Figure 7. 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 is housed in panel in the control room.

2. Working of Underground Cable Fault Distance Locator with GSM Module

The following steps were taken in connecting the GSM MODEM to the notice board:

- ✓ SIM card was installed in the GSM modular through sim slot.
- ✓ Felmale data bus(DB9) of GSM modular is connected to the male DB9 cable,where male DB9 is the connected to one end of microcontoller.
- ✓ When the supply was plugged in to GSM modem a red light glows which indicates modem is on position.
- ✓ The modem automatically searchs for network through antena which is installed near sim slot.
- ✓ As the MODEM was connected to the mobile, which is registered but does'not show any fault message unless somefault occurs in it then it passses a message directly to the registered mobile number.
- ✓ The registered mobile will recive the message.
- ✓ The message was started with a *DATA# character to distinguish it from unwanted

A. Advantages

- ✓ Less maintenance
- ✓ It has higher efficiency
- ✓ Less fault occurs in underground cable
- ✓ Underground cable fault location model is 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.
- ✓ Improved public safety

IV. CONCLUSION & FUTURE SCOPE

In this paper, we detect the exact location of short circuit fault in the underground cable from feeder end in km by using microcontroller8051.For this we use simple concept of OHM's law so fault can be easily detected and repaired. 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. 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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V. ACKNOWLEDGMENT

We express our thanks to the support given by management in completing our project. We also express our sincere gratitude & deep sense of respect to our guide Dr. G. Joga Rao, Associate professor of the Electrical Department. We are thankful to the teaching and non-teaching staff of Electrical department for their direct as well as indirect help in our project

VI. REFERENCES

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