

A Paper on Underground Cable Fault Detector

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ABSTRACT: Most of the worldwide run on the low voltage and medium voltage distribution lines underground cables from many decades cables were used. To deduce the sensitivity of distribution networks which cause environment influences high voltage underground cables are used more and more. This paper suggests model for underground power cable fault position using microcontroller. The purpose of this project is to determine the distance in kilometers between underground cable fault and base station. This project uses the simple notion of the law of ohm. If any short circuit-like fault occurs, the voltage drop can vary depending on the length of the cable fault, because the current varies. Therefore, a series of resistors are used to reflect the cable and a dc voltage is fed at one end, and the fault is identified by detecting the voltage shift using an analog to voltage converter and a microcontroller is used to make the calculations required to show the fault distance on the LCD monitor.

KEYWORDS: Fault location, fault detection, location method, microcontroller, Underground cable.

INTRODUCTION

For several decades underground cables have been used for most of the worldwide regulated low voltage and medium voltage distribution lines. Increasingly, subterranean high voltage cables are being used to reduce the vulnerability of distribution networks to environmental impact. Because of the advantages of underground communication, underground cables were commonly used in power distribution networks, providing more coverage in bad weather than overhead lines, less prone to damage by storms or lightning. It is cheaper for shorter distance, environmentally friendly and low maintenance. But if any fault happens in the wire, then the fault is hard to find. And this project is used for digitally detecting the location of the fault. The requirement to locate the defective point in an underground cable is to promote faster repair, increase reliability of the network and the failure period. The underground cable system is very useful for distribution, especially in metropolitan cities, airport services, and defense.



Figure 1: Picture Depicting The Fault In Underground Cables.

Faults in Cable

Fault in a cable is characterized as a physical condition that causes failure of a system, part, or item in a necessary manner. This may occur due to any flaws, deficiencies or non-homogeneity, or conductor breakdowns and insulation failures.

Power cable fault location techniques are used for precise pin pointing of fault locations in power grid. The advantages of exact location of the fault are:

- Quick repair to revive the power system back.
- Boost usability and efficiency of the system;
- Raising running costs and save time in poor weather, noisy environment and difficult terrain for the crew looking [1].

Types Of Faults In A Cable

A fault can be a bolted link, or within the fault association, some electrical resistance. The fault can actually be in two categories:

- Fault on open circuit:

Open circuit fault happens when the conducting path of a cable has a break. Such kinds of faults are comparatively stronger short circuit faults because the current flows through the cable becomes zero when these faults occur. Megger can detect the open-circuit fault by measuring the resistance between each conductor and the earth [2].

- Fault with short circuit:

An odd relation of comparatively low electrical resistance between two points of varying potential, whether accidentally or intentionally produced. When two multi-core cable conductors come into electrical contact with each other due to an insulation failure, it is therefore referred to as a short-circuit fault [3].

Classification of Faults Found In Cables

1. Open circuit: Open circuit faults are better than short circuit fault, because when the fault happens current flows through the cable becomes zero. This type of fault is triggered by path break. Such faults occur when one or more phase conductors break [5].
2. Short circuit failure: Further short circuit failure can be divided into two types:

(A) Symmetrical Fault: Three-phase Fault is called Symmetrical Fault. Short-circuited in all three phases.

(B) Unsymmetrical fault: In this fault current magnitude is not equal to 120 degrees displaced.

Fault Location Method

Methods for identifying faults can be listed as:

1. Online system: This system uses & processes measured voltages and current to assess the defect points. Online method for underground cables is less than overhead lines.

2. Offline method: Special instrument is used in this system to test cable service in field. There are two offline methods as follows:

Tracer method: Fault point is identified in this system by walking on the cable lines. Fault point is indicated by an audible signal or by an electromagnetic signal.

Example: (1) Current process tracing

(2) Coil Sheath Process

COMPONENTS USED

GSM Module

Most of the worldwide Electronic Toll Collection (ETC) schemes are introduced with Dedicated Short Range Communication Technology. The idea of the proposed system is automatic toll tax payment, and the amount of transaction information is transmitted via GSM modem technology to the motorists' mobile phones.

It's a groundbreaking technology for automated toll collection system on the expressway network. The frame formulates and operating flow of the system is defined in this paper and data information is also easily shared between the motorists and toll authorities. By reducing traffic and removing potential human errors it is more efficient and the automated toll collection system [4].

Block Diagram

The project makes use of the simple concept of OHMs law where a low DC voltage is applied through a series resistor at the feeder end. The current will differ depending on the duration of the cable's fault in case of an LL or 3L or LG short circuit etc. The voltage drop of the series resistor changes accordingly, which is then fed to an ADC to produce precise digital data which the programmed microcontroller will show the same in kilo meters. The project is installed with a set of resistors representing cable length in KMs and a set of switches is created at each known KM to test the accuracy of the same.

Using microcontroller this is proposed model of underground cable fault distance locator. This is divided into four parts – part of the DC power supply, part of the cable, part of the monitor, part of the display. DC power supply component consisting of 230v ac supply is stepdown using transformer, bridge rectifier converts ac signal to dc and controller is used to produce constant dc voltage. The cable portion is denoted by resistor set along with switches. The current sensing component of the cable depicted as a set of resistors & switches is used as fault creators to indicate the fault at each position.

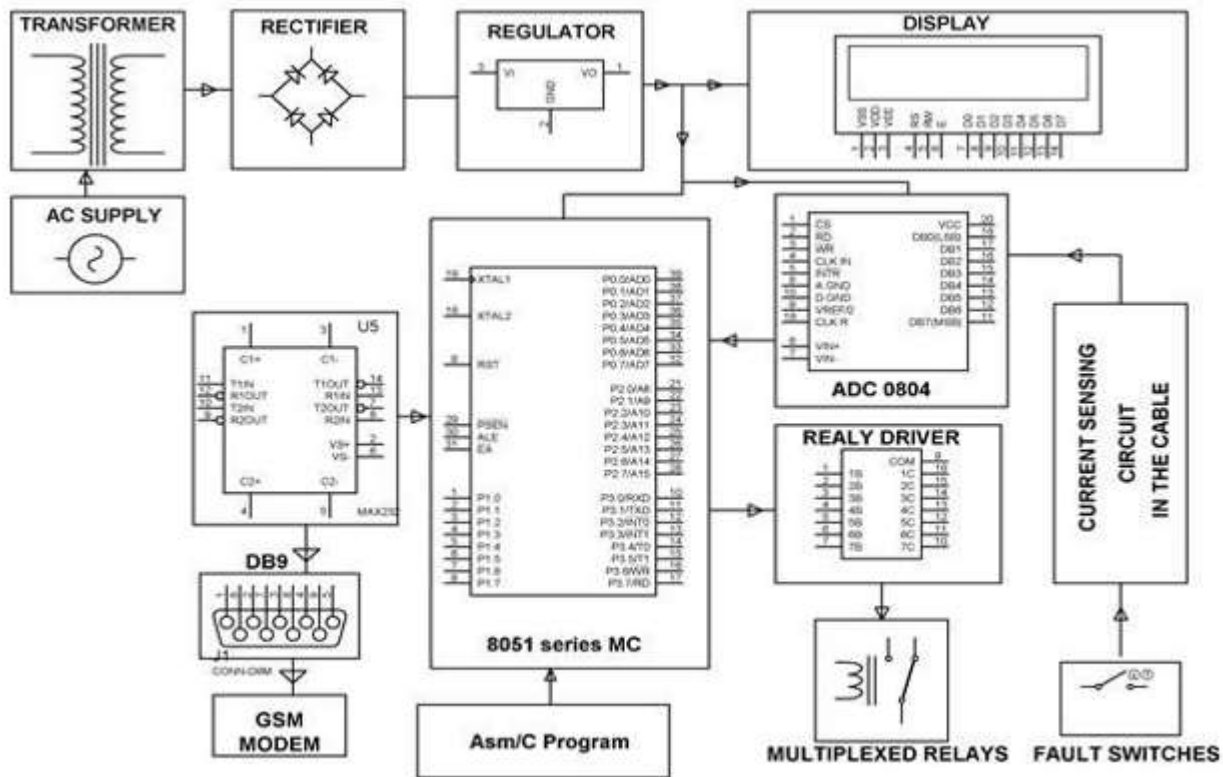


Figure 2: Block Diagram.

Next is controlling component consisting of analog to digital converter receiving input from the current sensing circuit, translating this voltage into digital signal and feeding the signal to the microcontroller? The microcontroller also forms part of the controlling unit and makes calculations concerning the distance of the fault possible. The microcontroller also drives a relay driver which in turn controls the switching of a set of relays at each phase for proper cable connection. The display part consists of the interfaced LCD display to the microcontroller which shows the cable status of each phase and the cable distance at the particular phase, if any fault occurs.

Design Overview

Complete blue print of the planned project is a block diagram. Within a single block diagram the overall meaning and function of the project is represented. It portrays the pictorial representation of a project's working method. Block diagram is something that's offering a project summary. The block diagram is composed of the following elements:

- 3 POWER SUPPLIES
- MICRO CONTROLLER
- GSM MODEM
- GPS MODULE
- LCD
- KEYPAD

Micro Controller

The AT89S52 it absorbs, high performance, low-power. It is an 8-bit CMOS microcontroller with programmable Flash memory bytes of 8K. The system is manufactured using the high-density, non-volatile memory technology from Atmel and is compatible with the 80C51 instruction set and pin-out. The Flash on-chip allows reprogramming of the application memory in the device or traditional non-volatile memory programmer. It will combine a flexible 8-bit CPU on a monolithic

chip, the Atmel AT89S52 is a powerful microcontroller inside a system-programmable Flash. In many embedded control applications, it is a highly scalable and cost-effective solution [5].

GSM

GSM is the acronym for Global Mobile Communications System, which was initially created by Group Special Mobile, a standard developed by the European Telecommunications Standards Institute. Mobile phones used protocols for second-generation wireless cellular networks. GSM supports data transfer and voice calls. The GSM speeds up to 9.6 kbps, as well as with SMS transmission. GSM uses a multiple access time division (TDMA). It is the most commonly used of the three TDMA, GSM, and CDMA digital wireless telephony technologies. GSM digitizes and compresses data, then sends a channel with two additional consumer data sources, each in its own time slot. GSM will also work with other technologies; this is a part of the development of modern wireless telecommunications. This also includes HSCSD), GPRS (Enhanced Data GSM Environment), and UMTS (Universal Mobile Telecommunications Service). It is a narrow band method using TDMA; it is 30 kHz long and within the range 6.7 Milliseconds wide. It split up time-wise into three time slots.

Narrow band means channels for one-third of the time every conversation receives the radio. This is possible due to the voice data translated into digital content, which is compressed to take up considerably less room for transmission. Finally the TDMA has the capacity of an analog system which uses the same number of channels three times. TDMA is the GSM module's principal access process. GSM systems have a range of useful features: using encryption to make network telephone calls more secure, data networking, SMS (Short Message Service) for text messages and paging, call forwarding, call ID, call waiting and multi-party meeting [6].

SIM 300

This is a GSM modem plug and play with a simple serial interface to interface. It is used by PIC microcontrollers and computers to send SMS, make and receive calls, and perform other GSM operations by controlling it via simple AT commands. For its operations it uses the common module SIM300. It comes with a basic RS232 interface which can be used to conveniently connect microcontrollers and computers with the GSM modem. The modem consists of all the external circuits required to start experiments with the SIM 300 module, such as power control, external antenna, SIM holder, etc.

Voltage Regulator

A voltage regulator is an electric controller designed to maintain a constant voltage level automatically. A 5V and 12V power supply are required in this project. The 7805 and 7812 voltage regulators are to be used to obtain these voltage levels. First number 78 represents a positive supply and the 05, 12 numbers reflect the appropriate voltage output levels. The L78xx series of three-terminal positive controllers Electronic voltage regulators are used in devices such as computer power supplies where the DC voltages used by the processor and other components are stabilized. Voltage regulators control the plant's output in automobile alternators and central power station generator plants. Voltage regulators may be mounted in an electrical grid at a substation or along distribution lines so that all consumers receive steady voltage irrespective of how much power is drawn from the pole [7].

Relay

Relay is a sensing system that detects the fault and sends the circuit breaker a trip signal to isolate the defective portion. A relay is an electronic system that indirectly regulates an electrical circuit

& is controlled by a change in the same or another electrical circuit. There are different types of relay: numerical relay, electromagnetic relay & static relay. Relay in the control room is housed in a stand.

Power Supply

The power supply circuit consists of a step-down transformer that is 230v step down to 12v. 4 diodes are used in this circuit to form a bridge rectifier that delivers pulsating dc voltage and then fed to the condenser to filter the rectifier output voltage to filter to remove any motion. Also after rectification there are components present. The filtered DC voltage is supplied to the regulator to produce constant DC voltage of 12v.

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. Furthermore, this project can be improved by using a condenser in an AC circuit to test the impedance and can also locate the open circuited cable, unlike the short circuit failure using only DC circuit resistors as follows in the project suggested above. This includes aesthetics, higher public acceptance, and perceived benefits of protection against electromagnetic field radiation (which is still present in underground lines), fewer interruptions, and lower maintenance costs. Failure rates of overhead lines and underground cables vary widely, but typically underground cable outage rates are about half of their equivalent overhead line types.

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