Detection of Underground Cable Fault Using PIC 16F877A and GSM Module

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Abstract: The paper describes the faults and abnormalities occurring in underground cables using an PIC 16F877A. The basic idea behind the working of this project is ohms' law. At the feeder end, when a DC voltage is applied, based on the location of fault in the cable, the value of current also changes. So in case of a short circuit fault like L-G or L-L, fault the change in voltage value measured across the resistor is then fed to the in-built ADC of the PIC 16F877A. This value is processed by the microcontroller and the fault is calculated in terms of distance from the base station. This value is sent to the LCD interfaced to the PIC Microcontroller board and it displays exact location of the fault from the base station in kilo meters for all the three phases. This project is arranged with a set of resistors which represent the length of the cable. At every known kilo meter fault switches are placed to induce faults manually. Finally, the fault distance can be determined.

Keywords: PIC Microcontroller, Underground fault, Resistance, LCD.

1. Introduction

Underground cables are used for power applications where it is impractical, difficult, or dangerous to use the overhead lines. Electric power can be transmitted or distributed by underground cables. Underground power cables are growing continuously and their reliability getting more important than ever. Underground cables have been used for many decades because they are not influenced by weather conditions, heavy rain, storm, snow and pollution. However, cables can be easily damaged by incorrect installation or poorly executed jointing, while subsequent third party damage by civil works such as trenching or curb edging. If small fail occurs, it will interrupt the power supply for end user. A bundle of electrical conductors used for carrying electricity is known as a cable. An underground cable generally has one or more conductors with suitable insulation and a protective material. Commonly used materials for insulation are varnished cambric or impregnated paper. Fault in a cable can be any defect or non-homogeneity that diverts the path of current or affects the performance of the cable. So it is necessary to correct the fault.

Power Transmission can be done in both overhead as well as in underground cables. But unlike underground cables the overhead cables have the drawback of being easily prone to the effects of rainfall, snow, thunder, lightning etc. This requires cables with reliability, increased safety, ruggedness and greater service. So underground cables are preferred in many areas specially in urban places. When it is easy to detect and correct the faults in overhead line by mere observation, it is not possible to do so in an underground cable. As they are buried deep in the soil it is not easy to detect the abnormalities in them. Even when a fault is found to be present it is very difficult to detect the exact location of the fault. This leads to digging of the entire area to detect and correct the fault which in turn causes wastage of money and manpower. So it is necessary to know the exact location of faults in the underground cables. Whatever the fault is, the voltage of the cable has the tendency to change abruptly whenever a fault occurs [2]. We make use of this voltage change across the series resistors to detect the fault.

2. Proposed System

The proposed system deals with finding of exact fault. The project uses the conception of Ohm’s law where a commercial voltage (230v) is apply at the feeder end through step-down transformer. This step-down voltage goes to rectifier unit, which translate an AC supply into DC supply. In this project we were using bridge rectifier. This voltage moves to voltage regulator unit. The regulator maintains a unvarying voltage. This voltage is sufficient the resistor circuit to work.

The circuit consists of a power supply, 4-line display, Microcontroller and resistance measurement circuit. To induce faults manually in the kit, fault switches are used. About 12 fault switches are used which are arranged in three rows with each row having 4 switches. The 3 rows represent the 3 phases namely R, Y and B. The fault switches: have 2 positions-No fault position(NF) and fault position(F). Main component of the underground cable fault detection circuit is low value resistance measurement. It is constructed using a constant current source of 100mAmps. It can measure very low value resistance as the cables have around 0.01 Ohm/meter resistance. For 10meter cable resistance becomes 0.1 Ohm. This circuit can measure...
resistance up 50 Ohm, Maximum cable length it can check up to 4 kilometers.

So starting from the reference point 4 sets of resistances are placed in series. These 4 sets of resistances represent the three phases and the neutral. Short circuit faults, Symmetrical and unsymmetrical faults can be determined by this method. This project uses three set of resistances in series (i.e.) R10-R11-R12-R12, R17-R16-R14R21, R20-R19-R18-R25 one for each phase. Each series resistor represents the resistance of the underground cable for a particular distance and so here four resistances in series represent 1-4kms.Value of each resistance is 10kΩ.

One relay for each phase R, Y and B. three relays are used and the common points of the relays are grounded and the NO points are connected to the inputs of R17, R21 and R25 and being the three phase cable input. As supply needed for the relays is higher than that of the microcontroller. A 230V AC supply is applied to the transformer from where it is stepped down to 12V AC. From the transformer the alternating current gets converted into direct current when it passes through a Bridge wave rectifier. The 12V DC then goes to the voltage regulator where it gets converted from 12V DC to 5V DC. Voltage regulator is used also converts the variable Dc supply into constant DC voltage.

B. 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.

C. PIC Microcontroller

PIC is a peripheral interface microcontroller. These microcontrollers are very fast and easy to execute a program compared with other microcontrollers. PIC Microcontroller architecture is based on Hardware architecture. PIC microcontrollers are very popular due to their case of programming, wide availability, easy to interfacing with other peripherals, low cost, large user base and serial programming capability (reprogramming with flash memory), etc. Microcontroller is an integrated chip which consists of CPU, RAM, ROM, timers, and counters, etc. In the same way, PIC microcontroller architecture consists of RAM, ROM, CPU, timers, counters and supports the protocols are SPI, CAN, and UART for interfacing with other peripherals.
D. LCD

Liquid crystal display are interfacing to microcontroller 8051. Most commonly LCD used are 16*2 and 20*2 display. In 16*2 LCD display means, it represents 16 columns and 2 rows. LCDs are available to display arbitrary images or fixed images with low information content, which can be displayed or hidden, such as preset words, digits, and 7-segment displays as in a digital clock. The only disadvantage of LCD over Seven Segment display is robust display and can be visualized for a longer distance.

4. Conclusion

Thus the project on Underground cable fault detection using PIC Microcontroller was done and the fault in the individual phases R, Y and B is identified and Message through GSM to Mobile. Circuit can be tested with different resistor values to simulate various fault conditions. In this project faults up to a distance of 4km can be detected corresponding to that particular switch is considered as the faulty phase.

References