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Sonargaon University (SU)
সোনারগাঁও ইউনিভার্সিটি (এসইউ)

Earth Fault And Overload Protection System Using GSM

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Declaration

It is declared hereby that this thesis paper or any part of it has not been submitted to anywhere else for the award of any degree.

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This is to certify that this project entitled "**Earth fault and overload protection system using GSM**" is done by the following students under my direct supervision. This project work has been carried out by them in the laboratories of the Department of Electrical and Electronic Engineering under the Faculty of Engineering, Sonargaon University (SU) in partial fulfillment of the requirements for the degree of Bachelor of Science in Electrical and Electronic Engineering.

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ABSTRACT

Automation in the distribution field permits utilities on actualize all the adaptable control for distribution systems, which can be used to upgrade efficiency, reliability, quality of electric service. Automation not only upgrade those qualities but also reduces human effort and saves time. Under and over voltage problem is one of the common type of problems which leads most of the insulation and appliance damage throughout our country. In this report we are going to show how under and over voltage problem leads a system into catastrophic situation and also describe how those problems can be minimized economically using automation with a GSM module followed by SMS alert in distribution system.

This paper presents an idea of fault locating method with highly computational method. The project also presents some guidelines for design of fault location and remote indication, for reducing power outages and reducing heavy loss of revenue. The paper proposes fault location model for underground power cable using microcontroller. The aim of this paper is to determine the distance of underground cable fault from base station in meters. This paper 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 a cable, as 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 digital converter and a microcontroller is used to make the necessary calculations so that the fault distance is calculated and will be displayed in the LCD display. In addition a message in the form of SMS about the fault location will be sent to the concern person mobile through the GSM modem which is also interfaced to the controller.

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CHAPTER-1

INTRODUCTION

1.1 INTRODUCTION

Generally when a fault occurs in Distribution or Transmission line, unless it is severe it is unseen. But gradually these minor faults can lead to damage of transformer. Automation in the distribution field permits utilities on actualize all the adaptable control for distribution systems, which can be used to upgrade efficiency, reliability, quality of electric service. Automation not only upgrade those qualities but also reduces human effort and saves time. Under and over voltage problem is one of the common type of problems which leads most of the insulation and appliance damage throughout our country.Automation is not only for upgrading the quality of a system it also reduces human effort as well as minimize time of production. We know that for over and under voltage problem many trouble happens in home and outdoor power system. For example insulation and appliance damage.

Our project will detect high & low voltage fault,overloads,over temperature,earth fault.When a fault Occurs in the system_then the system will be shutdown for each fault & will Provide protection for the whole system.When a fault accurs, send a warning message to the phone automatically.

1.2 Objective

The main objective of our project are given bellow,

- To detect and given protection of Earth fault & Overload fault.
- Using the GSM module,We can get Notification in our mobile.
- Understand the importance of earth fault protection for Eqipment.
- When fault detected in system then Automatically turn off the relay & When the problem is solved,the relay turn on Automatically.

1.3 Methodology

1. First the requirements of the project was carefully analyzed to design the earth fault overload system. A Micro-controller is a chip optimized to control electronic device.First we are doing 220V to 12V with step down Transformer from AC source.Both side of Transformer are AC. Then,we converted 12V AC to DC with Center tap Rectifier. After the Rectification,the pulsating DC is purified through a filtering capacitor. GSM,LCD,Micro-controller requires 5V supply. That,s why a regulator of 5V has been used here. After supplying 5V,Ardino will be acitve & continue to follow every command given in it.First cheak the inputs. What is the temperature,how many amperes is the load taking,what is the line voltage,Earthing connection ok or not.If any problem is found,the system will shutdown immediately & will alart by sending a message to the mobile for every fault in the system.

2.Information's were collected from references books and websites to find out the possible improvement

3. Required components have been purchased from local market.

1.4 Projects outline

Chapter-1: Introduction

Chapter-2: Literature review

Chapter-3: Design and Implementations

Chapter-4: Introduction

Chapter-5: Introduction

1.5 Summary

In this chapter we discuss about introduction, main objective of our project, methodology, and outline.

CHAPTER-2

LITERATURE REVIEW

2.1 INTRODUCTION

Generally when a fault occurs in Distribution or Transmission line, unless it is severe it is unseen. But gradually these minor faults can lead to damage of transformer. It may also initiate

For upgrading system efficiency automation is needed .besides for reliability and quality of electric service depends on automation nowadays .Automation is not only for upgrading the quality of a system it also reduces human effort as well as minimize time of production. We know that for over and under voltage problem many trouble happens in home and outdoor power system. For example insulation and appliance damage. In my report I will describe how over and under voltage problem creates problems to our system and also try to give a solution how to minimize this problem for three phase system by using automation which will be prepared by GSM module which will send sms alert for if fault occurs in system.

2.2 Classification of fault

The most common types of fault that occur in transmission cables are:

1. Open circuit fault.
2. Short circuit fault.
3. Earth fault.

2.2.1 Open circuit fault

When there is a break in the conductor of a cable, it is called open-circuit fault. The open-circuit fault can check by a merger. For this purpose, the three conductors of the 3 core cable at far end are shorted and earthed. Then resistance between each conductors and earth is measured by a merger. The mugger will indicate zero resistance in the circuit of the conductor that is not broken. However if a conductor is broken the muggers will indicate an infinite resistance.

2.2.2 Short-circuit fault

When two conductors of a multi core cable come in electrical contact with each other due to insulation failure, it is so called as short-circuit fault. Merger can also be used to check this fault. For this the two terminals of a megger are connected to any two conductors. If the mugger gives a zero reading it indicates short-circuit fault between these conductors. The same is repeated for other conductors taking two at a time.

2.2.3 Earth fault

When the conductor of a cable comes in contact with earth, it is called earth fault or ground fault. To identify this fault, one terminal of the megger is connected to the conductor and the other terminal connected to the earth. If the megger indicates zero reading, it means the conductor is earthed. The same procedure is repeated for other conductors of the cable. Finding the location of an underground cable fault doesn't have to be like finding a needle in a haystack. The common methods of locating faults are

2.2.3a Sectionalizing:

This procedure risks reducing cable reliability, because it depends on physically cutting and splicing the cable. Dividing the cable into successively smaller sections and measuring both ways with an ohmmeter or high-voltage insulation resistance (IR) tester enable to narrow down search for a fault. This laborious procedure normally involves repeated cable excavation.

2.2.3b Time domain reflectometry (TDR):

The TDR sends a low-energy signal through the cable, causing no insulation degradation. A theoretically perfect cable returns that signal in a known time and in a known profile. Impedance variations in a "real-world" cable alter both the time and profile, which the TDR screen or printout graphically represents. One weakness of TDR is that it does not pinpoint faults

2.2.3c Murray loop test:

It It is a bridge circuit used for locating faults in underground or underwater cables. It uses the principle used in potentiometer experiment. One end of the faulted cable is connected through a pair of resistors

to the voltage source. Also a null detector is connected. The other end of the cable is shorted. The bridge is brought to balance by changing the value of RB.

RA/RB=r=RC/RD = (2l-x)/x (1) And hence x= 2l/(r-1) (2) Where l is the length on each segment of wire, r is the ratio RA/RB and x is the length of faulty segment. The main disadvantage of this method assumes that only a single fault exists, a low resistance when compared with UG cable resistance and cable conductor have uniform resistance per unit length

2.2.3d Varley loop test:

If the fault resistance is high , the sensitivity in Murray bridge is reduced and Varelyoop may be more suitable but only a single fault exists. Except that here the ratio arms are fixed and a variable resistance is connected to the test end of the faulty cable. The drawbacks of the above methods can be overcome to certain extent by this method in which the concept of OHM's law is applied.

2.3 What is the purpose of Earth fault?

The primary purpose of earthling electrical systems is to provide protection against electrical faults. However, this was not realized until the 1970's. Until then, most commercial and industrial systems were ungrounded. Although ungrounded systems do not cause significant damage during the first ground fault, the numerous disadvantages associated with ground faults resulted in a change to the grounding philosophy. There are other advantages for a grounded system, such as reduction of shock hazards and protection against lightning.

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2.3.1 What are some issues that cause a ground-fault relay to trip accidentally?

Harmonics and higher-frequency noise, especially at the third harmonic, appear as fault current. Electrical noise is a growing problem as more users utilize variable frequency drives, inverters, battery storage/UPS, and even LED lighting. To avoid nuisance trips, select a high-quality ground-fault relay that removes harmonic frequencies and other noise from its measurements.

2.4 Summary

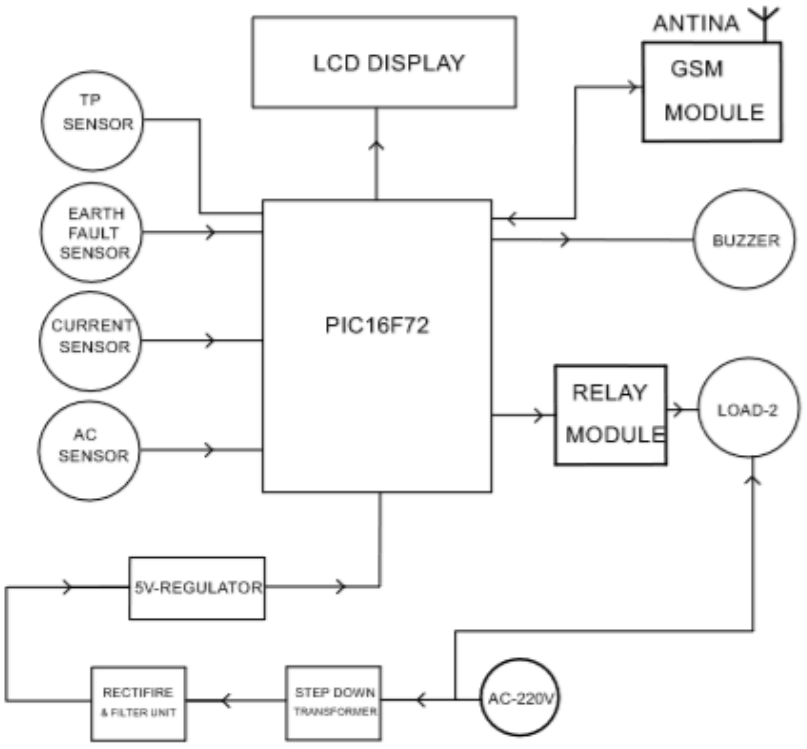
Electrical faults can be broken down into two categories: phase-to-phase faults and ground faults. Studies have shown that 98% of all electrical faults are ground faults (Source: Woodham, Jack, P.E. "The Basics of Grounding Systems" May 1, 2003). Where fuses can protect against phase-to-phase faults, additional protection, such as protection relays, are typically required to protect against ground faults.

CHAPTER-3

Design and Implementations

3.1 Introduction.

Earth fault protection is intended to protect equipment when an insulation fault occurs, for instance a direct contact between a life conductor and earth. In such a situation, great fault currents will flow back to the transformer through its neutral point when its connected to earth. This is not the case of earth



BLOCK DIAGRAM :EARTH FAULT DETECTION USING GSM

leakage protection, where faulty currents are generally much lower and the protection is dedicated, for

Figure 3. 1 Block Diagram of Earth fault and overload protection system

example, to avoid hazards to human beings or animals.3.2 Block Diagram Of Overload &Earth fault protection system.

3.3 Circuit Diagram of Earth fault and overload protection system:

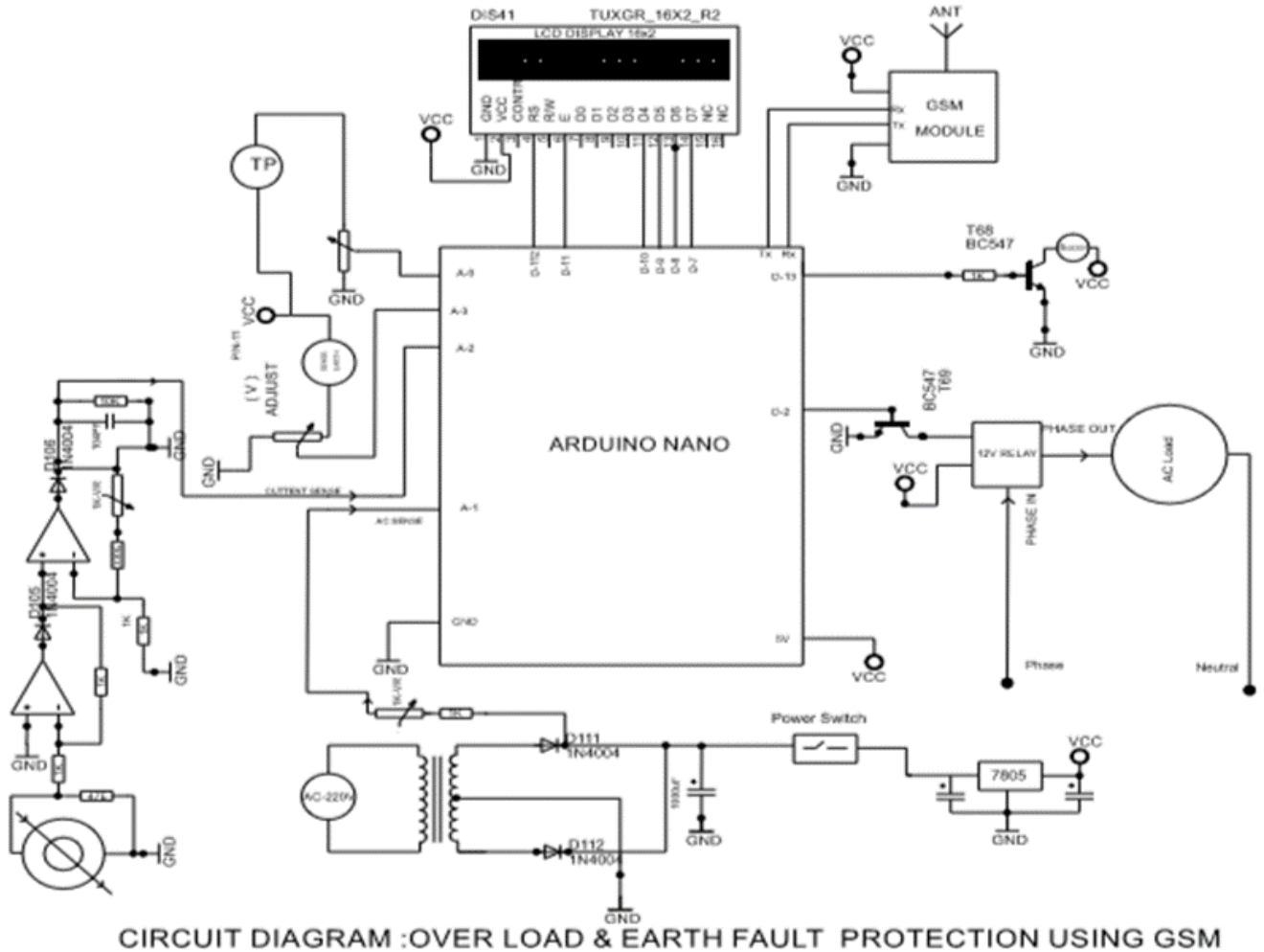


Figure 3. 2 Circuit Diagram of Overload & Earth fault protection

3.4 Working Principle

One of the major concerns of an ungrounded system is the risk of transient overvoltage. An intermittent or arcing ground fault can result in a buildup of voltage on the system, stressing and deteriorating insulation and resulting in voltages as much as 6 times higher than the nominal system voltage. Another benefit of a grounded system is the ease of locating a ground fault. Ungrounded systems do not allow ground-fault current to flow on the first fault, but instead reduce the voltage on the faulted phase across the entire system. Grounded systems can utilize current-based ground-fault relays to locate exactly where the fault is.

In terms of faults, how many kinds of faults can there be?

There are 3 different types of faults: phase to phase faults, three phase faults and ground faults. Phase to phase faults or “short circuits” are found within a device when an overloaded electrical current flows through a wire and burns it out. According to the Dunki-Jacobs textbook 95% of faults are ground faults, 4% are considered phase to phase faults, and 1% are considered three phase faults.

What do ground-fault relays do?

In electrical circuits, current returns to its source. A current-based ground-fault relay may look for ground-fault current in one of two ways: 1.) Zero sequence. Here, the relay looks at the phase conductors to ensure that all current coming from the source returns on those same conductors. If some of the current is returning to the source through a different path (usually ground), the ground-fault relay will detect this difference and, if it exceeds a pre-determined amount for a pre-determined amount of time, the ground-fault relay will operate. 2.) Direct measurement. A ground-fault relay can also read the current in the connection between the transformer neutral and ground (even with a neutral grounding resistor). A ground fault anywhere in the system will return current through this path.

3.5 Summary

In this chapter we discuss about our circuit diagram, block diagram and flow chart. Block diagram show the power flow and input output. And circuit diagram show point to point connection.

CHAPTER-4

Hardware Descriptions

4.1 Introduction

To begin with the project, let's get the idea of all the components that we used for the project. It is very important to know all the information about both hardware and software specifications. The components we are using are as follows:

4.2 List of Component with Price

SL No	Component Name	Quantity	Price
1	Arduino Nano	1	400
2	16X2 LCD	1	200
5	Step Down X-former	2	200
7	GSM MODULE	1	500
8	LM-358	2	20
9	7805 Regulator	4	30
10	Capacitor 1000MFD/35V	1	30
11	Capacitor 470MFD/35V	2	40
12	Power Switch	1	20
13	Diode 4007	3	30
14	AC BULBE	2	100
15	Some Resister		20
16	12V RELAY	1	30
17	TEMPERATURE SENSOR	1	50
18	Copper transmission Line		50
20	CT	1	20
21	IC Bess	2	50
27	PROJECT BOARD	1	500

Total Price	**2290**

Table 4. 1 Table of component with price

4.2 Arduino Nano Microcontroller Board

4.2.1 Defining Arduino Nano

An Arduino is actually a microcontroller based kit which can be either used directly by purchasing from the vendor or can be made at home using the components, owing to its open source hardware feature. It is basically used in communications and in controlling or operating many devices. It was founded by Massimo Banzi and David Cuartielles in 2005.

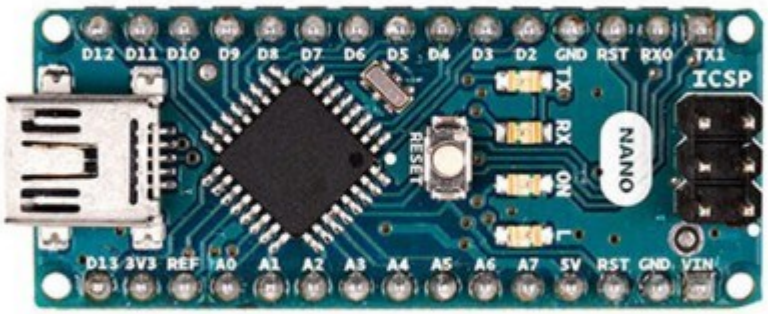


Figure 4. 1 Arduino NANo

4.2.2 Arduino Architecture:

Arduino’s processor basically uses the Harvard architecture where the program code and program data have separate memory. It consists of two memories- Program memory and the data memory.The code is stored in the flash program memory, whereas the data is stored in the data memory. The Atmega328 has 32 KB of flash memory for storing code (of which 0.5 KB is used for the bootloader), 2 KB of SRAM and 1 KB of EEPROM and operates with a clock speed of 16MHz.

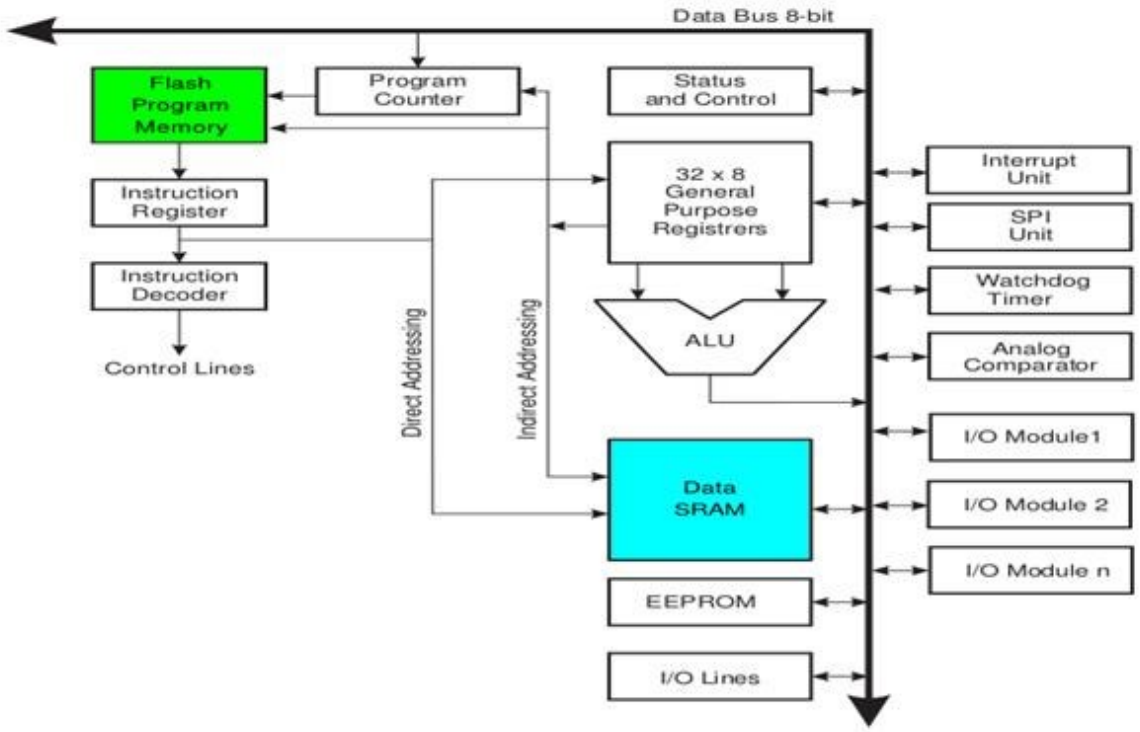


Figure 4. 2 Arduino Architecture

4.2.3 Arduino Pin Diagram

A typical example of Arduino board is Arduino Uno. It consists of ATmega328- a 28 pin microcontroller.

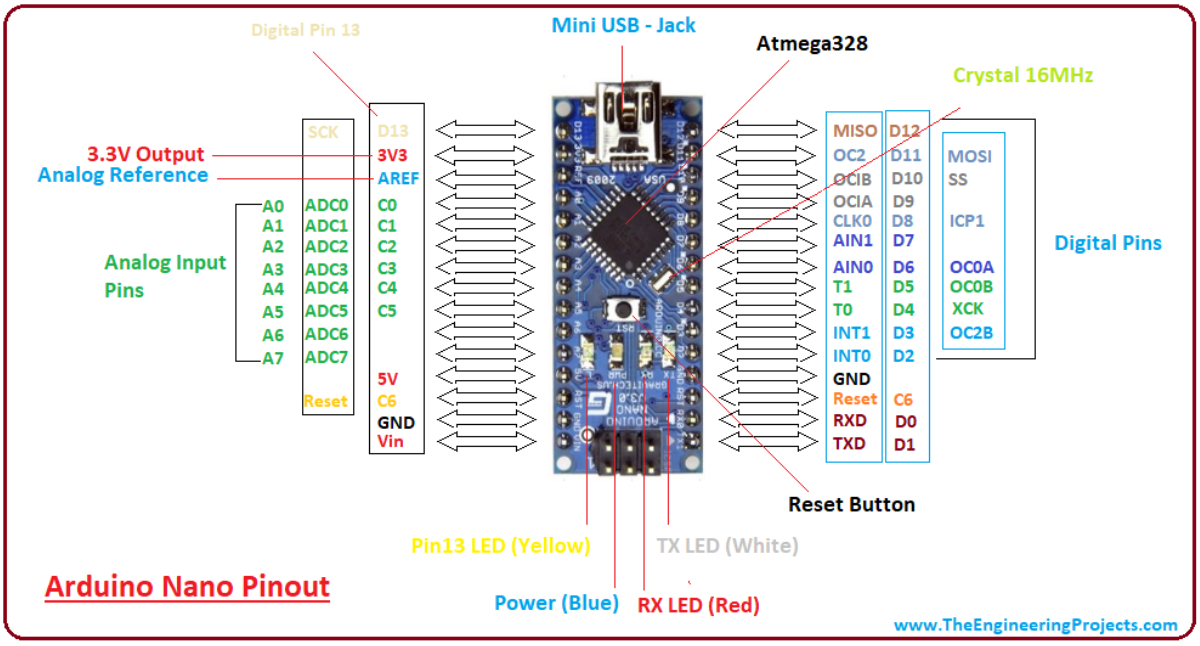


Figure 4. 3 Arduino pin diagram

Power Jack: Arduino can be power either from the pc through a USB or through external source like adaptor or a battery. It can operate on a external supply of 7 to 12V. Power can be applied externally through the pin Vin or by giving voltage reference through the IORef pin.

Digital Inputs: It consists of 14 digital inputs/output pins, each of which provide or take up 40mA current. Some of them have special functions like pins 0 and 1, which act as Rx and Tx respectively , for serial communication, pins 2 and 3-which are external interrupts, pins 3,5,6,9,11 which provides pwm output and pin 13 where LED is connected.

Analog inputs: It has 6 analog input/output pins, each providing a resolution of 10 bits.

ARef: It provides reference to the analog inputs

Reset: It resets the microcontroller when low.

4.2.4 How to program an Arduino?

The most important advantage with Arduino is the programs can be directly loaded to the device without requiring any hardware programmer to burn the program.

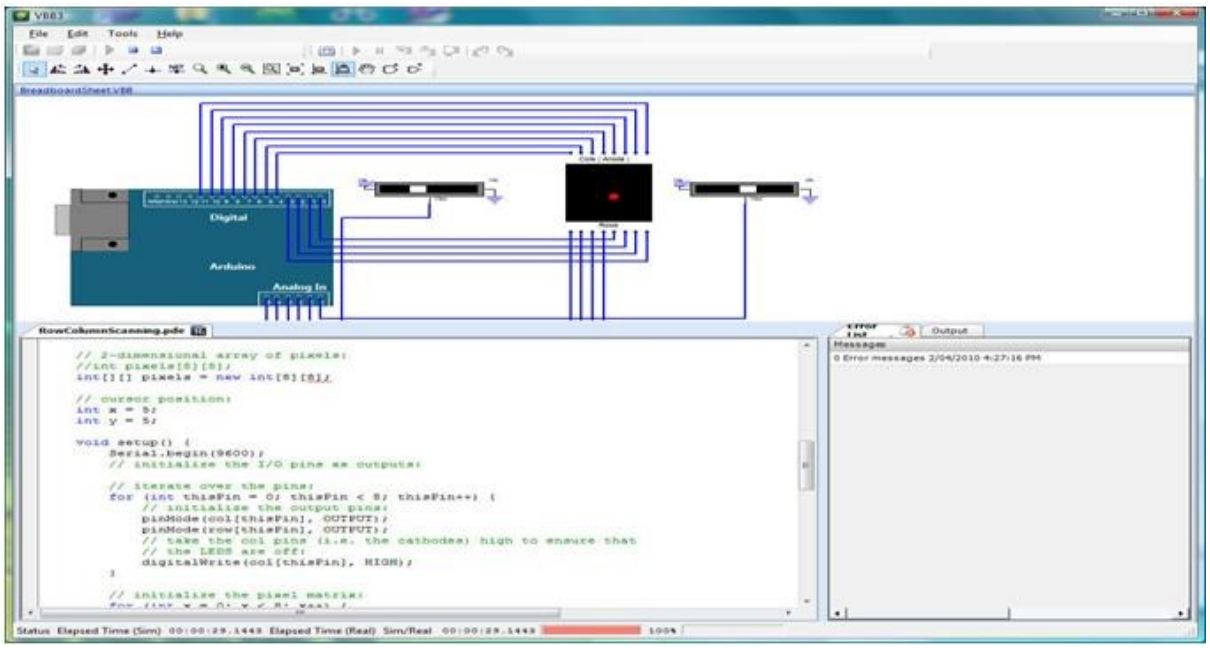


Figure 4. 4 Arduino programming process

This is done because of the presence of the 0.5KB of Bootloader which allows the program to be burned into the circuit. All we have to do is to download the Arduino software and writing the code.

The Arduino tool window consists of the toolbar with the buttons like verify, upload, new, open, save, serial monitor. It also consists of a text editor to write the code, a message area which displays the feedback like showing the errors, the text console which displays the output and a series of menus like the File, Edit, Tools

4.2.5 5 Steps to program an Arduino

Programs written in Arduino are known as sketches. A basic sketch consists of 3 parts

1. Declaration of Variables
2. Initialization: It is written in the setup () function.
3. Control code: It is written in the loop () function.

The sketch is saved with .ino extension. Any operations like verifying, opening a sketch, saving a sketch can be done using the buttons on the toolbar or using the tool menu.

The sketch should be stored in the sketchbook directory.

Chose the proper board from the tools menu and the serial port numbers.

Click on the upload button or chose upload from the tools menu. Thus the code is uploaded by the bootloader onto the microcontroller.

4.2.6 Few of basic Adruino functions are:

digitalRead(pin): Reads the digital value at the given pin.

digitalWrite(pin, value): Writes the digital value to the given pin.

pinMode(pin, mode): Sets the pin to input or output mode.

analogRead(pin): Reads and returns the value.

analogWrite(pin, value): Writes the value to that pin.

serial.begin(baud rate): Sets the beginning of serial communication by setting the bit rate.

4.2.7 How to Design your own Arduino?

We can also design our own Arduino by following the schematic given by the Arduino vendor and also available at the websites. All we need are the following components- A breadboard, a led, a power jack, a IC socket, a microcontroller, few resistors, 2 regulators, 2 capacitors.

The IC socket and the power jack are mounted on the board.

Add the 5v and 3.3v regulator circuits using the combinations of regulators and capacitors.

Add proper power connections to the microcontroller pins.

Connect the reset pin of the IC socket to a 10K resistor.

Connect the crystal oscillators to pins 9 and 10

Connect the led to the appropriate pin.

Mount the female headers onto the board and connect them to the respective pins on the chip.

Mount the row of 6 male headers, which can be used as an alternative to upload programs.

Upload the program on the Microcontroller of the readymade Adruino and then pry it off and place back on the user kit.

4.2.8 7 Reasons why Arduino is being preferred these days

4.2.8a It is inexpensive

It comes with an open source hardware feature which enables users to develop their own kit using already available one as a reference source.

The Arduino software is compatible with all types of operating systems like Windows, Linux, and Macintosh etc.

It also comes with open source software feature which enables experienced software developers to use the Arduino code to merge with the existing programming language libraries and can be extended and modified.

4.2.8a It is easy to use for beginners.

We can develop an Arduino based project which can be completely stand alone or projects which involve direct communication with the software loaded in the computer.

It comes with an easy provision of connecting with the CPU of the computer using serial communication over USB as it contains built in power and reset circuitry.

4.3 Power Supply

A power supply is an electronic device that supplies electric energy to an electrical load. The primary function of a power supply is to convert one form of electrical energy to another. As a result, power supplies are sometimes referred to as electric power converters. Some power supplies are discrete, stand-alone devices, whereas others are built into larger devices along with their loads. Examples of the latter include power supplies found in desktop computers and consumer electronics devices. The source of this power can come from different source like the main AC voltage ,a battery or even from a renewable power source like solar panel wind turbine or fuel cell to name just a few. The most common source of power is usually the main AC

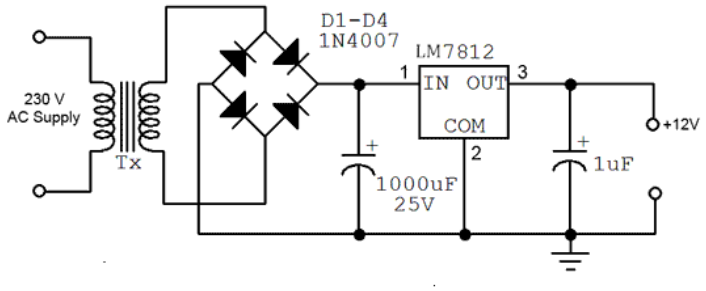


Figure 4. 5 AC-DC Power Supply & Circuit Diagram.

4.3.1 Transformer

A transformer is a device consisting of two closely coupled coils called primary and secondary coils. An AC voltages applied to the primary appears across the secondary with a voltage multiplication proportion to the turn ratio of the transformer and a current multiplication inversely proportional to the turn ratio power is conserved

turn ration = VP/VS=NP/Ns and power out = power in or Vs

4.3.2 Working of this Transformer

The two voltages, between line 1 and neutral and between neutral and line 2 can be named as VA and VB

respectively.

Then the mathematical relation of these two voltages shows that they are dependent upon the primary voltage as well as the turn ration of the transformer.
Diagram of transformer

VA = (NA / NP) * VP
VB = (NB / NP) * VP

One thing that should be noted here is that both the outputs VA and VB respectively are equal in magnitude but opposite in direction, which means that they are 180 degrees out of phase with each other. For this purpose, we also use a full wave rectifier with a center tapped transformer, to make both the voltages in phase with each other.

4.4 Diode

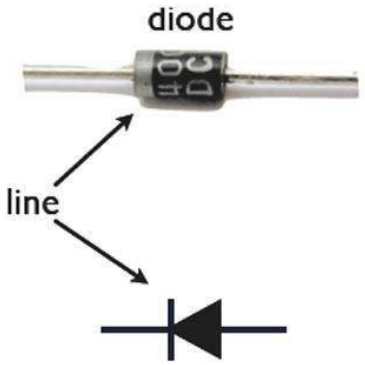
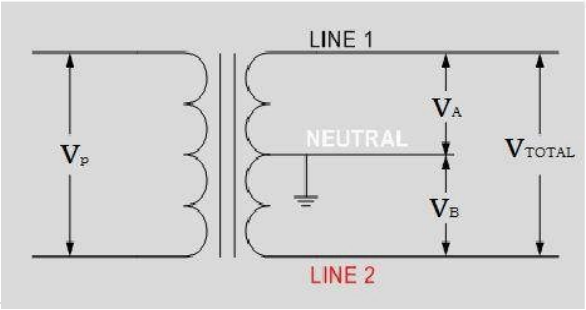


Figure 4. 6 Diode and symbol

The term diode usually implies a small signal device with current typically in the milliamp range. A semiconductor diode consists of a PN unction and has two (2) terminals, an anode (+) and cathode (-) current flows from anode to cathode within the diode. Diodes are semiconductor device that might be described as passing current in one direction only. The latter part of that statement applies equally vacuum tube diodes. Diodes however are far more extremely versatile in fact. Diode can be used as



rectifier, voltage regulators, turning devices in radio frequency tuned circuit, frequency multiplying device in radio frequency circuit, mixing devices application or can be used to make logic decision in digital circuit.

4.4.1 Characteristics curve of diode

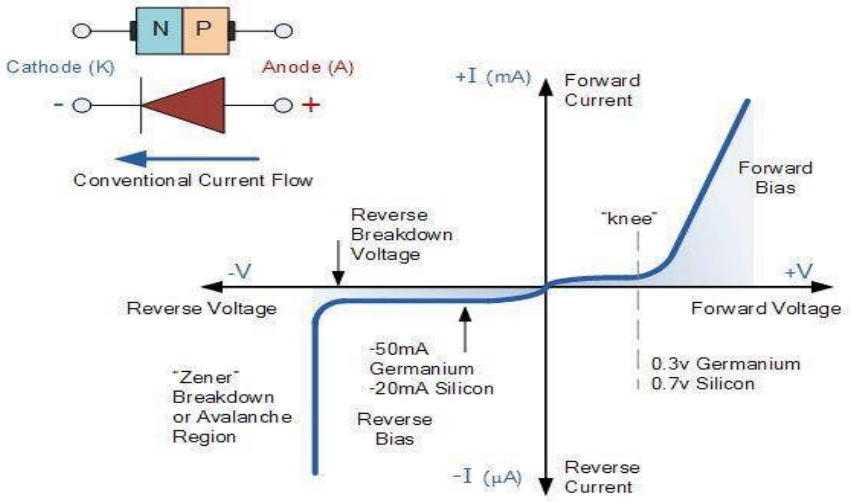


Figure 4. 7 Junction diode symbol and static I-V characteristics

There are two operating regions and three possible "biasing" conditions for the standard Junction Diode and these are:

1. Zero Bias – No external voltage potential is applied to the PN junction Diode

2. Reverse Bias – The voltage potential is connected negative, (-ve) to the P type material and positive, (+ve) to the N-type material across the diode which has the effect of Increasing the PN junction diode's width.

3. Forward Bias – The voltage potential is connected positive, (+ve) to the P type material and negative, (-ve) to the N-type material across the diode which has the effect of Decreasing the PN junction diodes width.

4.4.2 Full-Wave Rectifiers

A rectifier is an electronic circuit that converts AC voltage to DC voltage. It can be implemented using a capacitor diode combination. The unique property of diodes, permitting the current to flow in a single direction is utilized in here. It converts an ac voltage into a pulsating dc voltage using both half cycles of the applied ac voltage. Bridge rectifier is a full wave rectifier circuit using the combination of four diodes to form a bridge. It has the advantage that it converts both the half cycles of AC input into DC output.

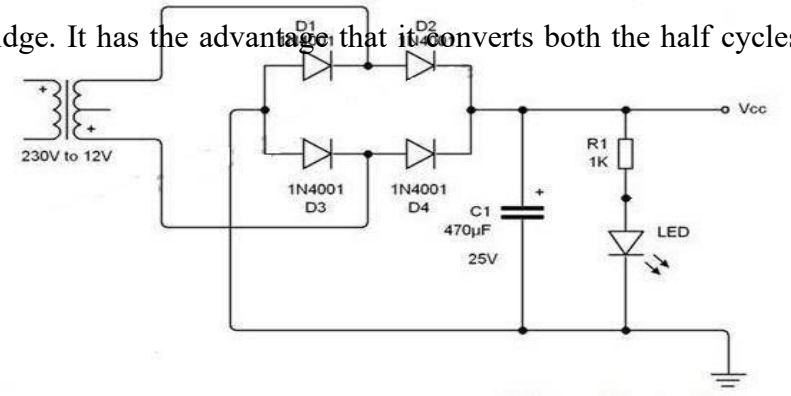


Figure 4. 8 Bridge rectifier circuit

4.4.3 Working of a Bridge Rectifier

•During the positive half cycle of secondary voltage, diodes D2 and D3 are forward biased and diodes D1 and D4 are reverse biased. Now the current flows through D2– >Load–>D3.

•During the negative half cycle of the secondary voltage, diodes D1 and D4 are forward biased and rectifier diodes D2 and D3 are reverse biased. Now the current flows through D4–>Load>D1 .

•In both the cycles, load current flows in the same direction. Hence we get a pulsating DC voltage as shown in fig (3.5,3.6).

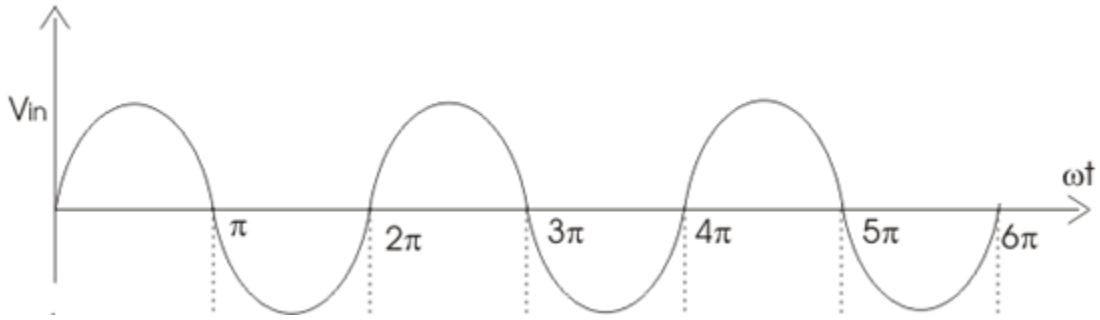


Figure 4. 9 Input sine wave

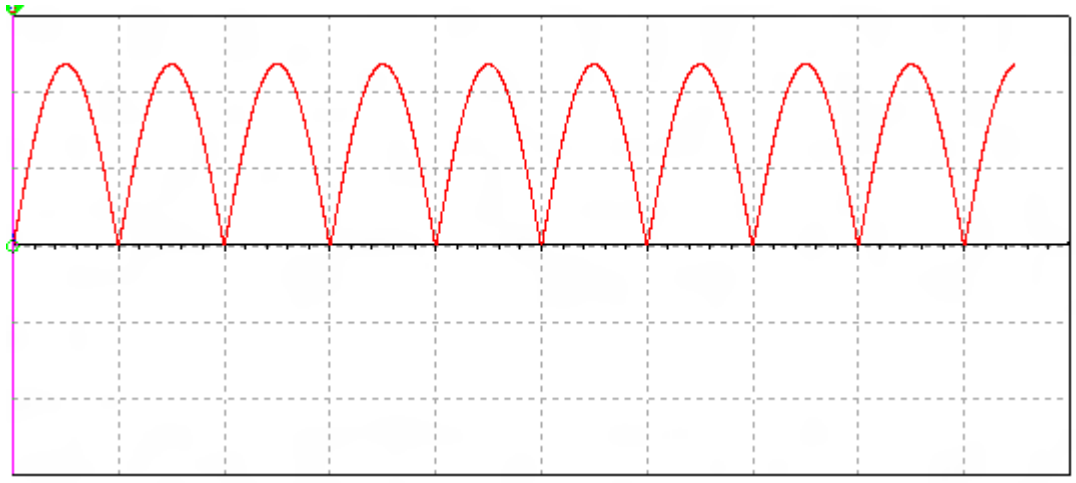


Figure 4. 10 Pulsating DC output

•Addition of a capacitor at the output converts the pulsating DC voltage to fixed DC voltage.

•Up to a time period of t=1s input voltage is increasing, so the capacitor charges up to peak value of the input. After t=1s input starts to decrease, then the voltage across the capacitor reverse biases the diodes D2 and D4 and therefore it will not conduct. Now capacitor discharges through the load, then voltage across the capacitor decreases.

•When the peak voltage exceeds the capacitor voltage, diodes D2 or D4 forward biases and as a result capacitor again charges to the peak value. This process continues. Hence we get almost smooth DC voltage as shown in fig (3.7).

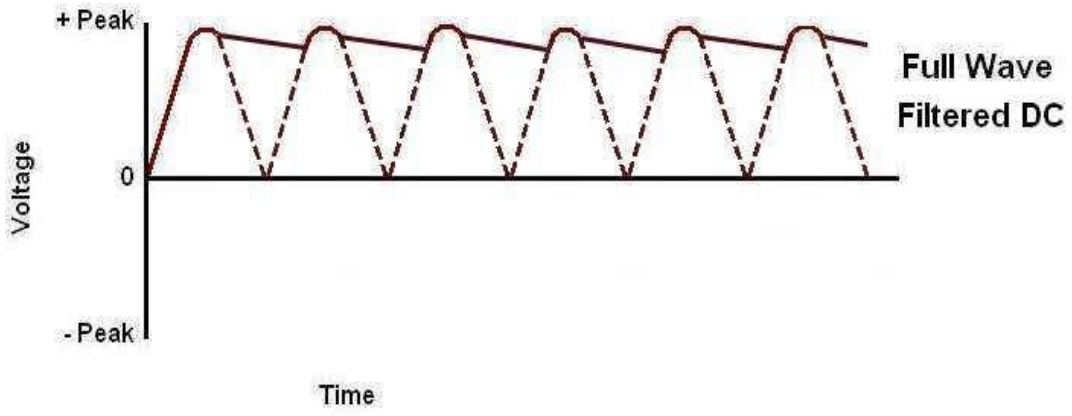
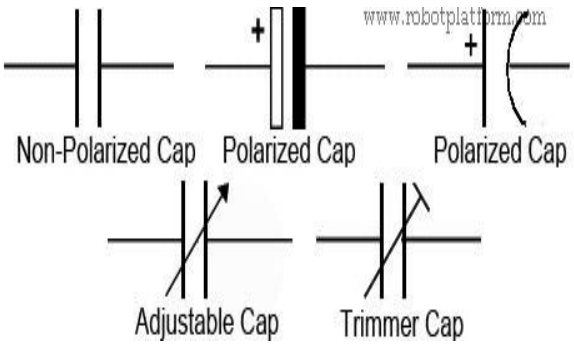


Fig. 3.10 Filtered output

4.5 Capacitor

Capacitor is a passive two-terminal electrical component used to store energy in an electric field. The forms of practical capacitors vary widely, but all contain at least two conductors separated by a non-conductor. Capacitors used as parts of electrical systems, for example consist of metal soils separated by a layer of insulating film. A capacitor is passive



electronic component consisting of a pair of conductors separated by a dielectric (insulator) when there is a potential difference (voltage) across the detected on one plate and negative charge on the other plate. Energy is stored in the electrostatic field and is measured in farads.

Figure 4. 11 Capacitors & Capacitor symbols.

4.5.1 Theory of Operation

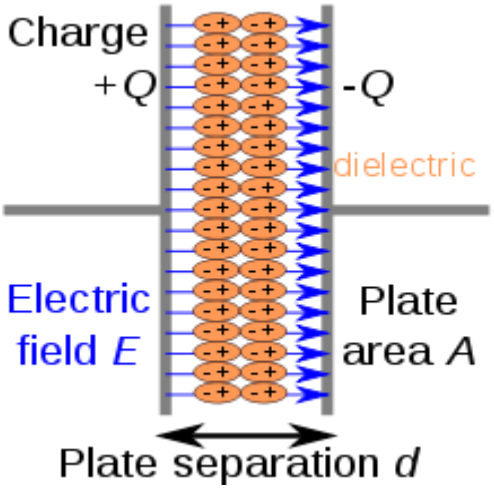


Figure 4. 12 Internal constriction of capacitors

A capacitor consists of two conductors separated by a non-conductive region. The non-conductive region is called the dielectric. In simpler terms, the dielectric is just an electrical insulator. Examples of dielectric media are glass, air, paper, vacuum, and even a semiconductor depletion region chemically identical to the conductors. A capacitor is assumed to be self-contained and isolated, with no net electric charge and no influence from any external electric field. The conductors thus hold equal and opposite charges on their facing surfaces, and the dielectric develops an electric field. In SI units, a capacitance of one farad means that one coulomb of charge on each conductor causes a voltage of one volt across the device.

An ideal capacitor is wholly characterized by a constant capacitance C, defined as the ratio of charge ±Q on each conductor to the voltage V between them:

$$\boldsymbol{C=QV}$$

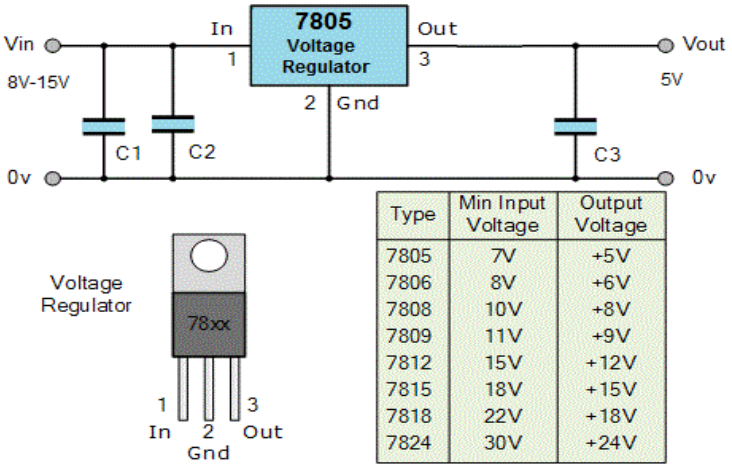
Because the conductors (or plates) are close together, the opposite charges on the conductors attract one another due to their electric fields, allowing the capacitor to store more charge for a given voltage than if the conductors were separated, giving
the capacitor a large capacitance.
Sometimes charge build-up affects the capacitor mechanically, causing its capacitance to vary. In this case, capacitance is defined in terms of incremental changes:

$$\boldsymbol{C=dQdV}$$

4.6 Voltage Regulator

A voltage regulator is a system designed to automatically maintain a constant voltage level. A voltage regulator may use a simple feed-forward design or may include negative feedback. It may use an electromechanical mechanism, or electronic components.

4.6.1 Voltage Regulators Output Voltages



Type	Min Input Voltage	Output Voltage
7805	7V	+5V
7806	8V	+6V
7808	10V	+8V
7809	11V	+9V
7812	15V	+12V
7815	18V	+15V
7818	22V	+18V
7824	30V	+24V

Figure 4. 13 Voltage regulator output voltages.

4.7 SIM 800L GSM MODULE

4.7.1 Introduction:

This document describes SIM800L hardware interface in great detail. This document can help user to quickly understand SIM800L interface specifications, electrical and mechanical details. With the help of

this document and other SIM800L application notes, user guide, users can use SIM800L to design various applications quickly

4.7.2 SIM800L Overview:

SIM800L is a quad-band GSM/GPRS module, that works on frequencies GSM850MHz, EGSM900MHz, DCS1800MHz and PCS1900MHz. SIM800L features GPRS multi-slot class 12/ class 10 (optional) and supports the GPRS coding schemes CS-1, CS-2, CS-3 and CS-4.

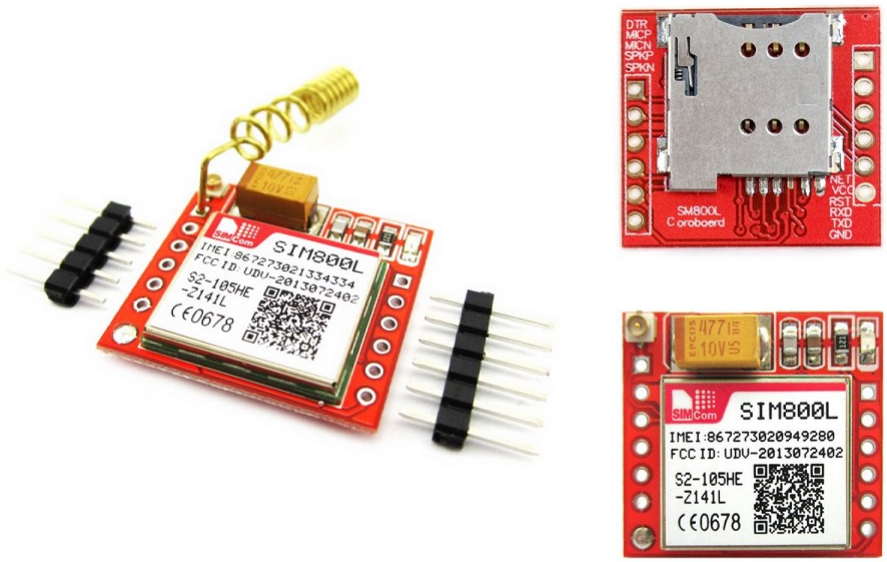


Figure 4. 14 Overview of SIM800L GSM Module

With a tiny configuration of 15.8*17.8*2.4mm, SIM800L can meet almost all the space requirements in user applications, such as smart phone, PDA and other mobile devices.

SIM800L has 88pin pads of LGA packaging, and provides all hardware interfaces between the module and customers' boards.

- Support 5*5*2 keypads
- One full modem serial port, user can configure two serial ports
- One USB, the USB interfaces can debug, download software
- Audio channel which includes two microphone input; a receiver output and a speaker output
- Programmable general purpose input and output.
- A SIM card interface
- Support FM
- Support one PWM

SIM800L is designed with power saving technique so that the current consumption is as low as 0.7mA in sleep mode.

4.7.3 SIM800L Key Features:

Feature	Implementation
Power supply	3.4V ~4.4V
Power saving	typical power consumption in sleep mode is 0.7mA (AT+CFUN=0)
Frequency bands	• Quad-band: GSM 850, EGSM 900, DCS 1800, PCS 1900. SIM800L can search the 4 frequency bands automatically. The frequency bands can also be set by AT command "AT+CBAND". For details, please refer to document[1]. • Compliant to GSM Phase 2/2+
Transmitting power	• Class 4 (2W) at GSM 850 and EGSM 900 • Class 1 (1W) at DCS 1800 and PCS 1900
GPRS connectivity	• GPRS multi-slot class 12（default） • GPRS multi-slot class 1~12 (option)
Temperature range	• Normal operation: -40°C ~ +85°C

	• Storage temperature -45°C ~ +90°C
Data GPRS	• GPRS data downlink transfer: max. 85.6 kbps • GPRS data uplink transfer: max. 85.6 kbps • Coding scheme: CS-1, CS-2, CS-3 and CS-4 • PAP protocol for PPP connect • Integrate the TCP/IP protocol. • Support Packet Broadcast Control Channel (PBCCH) • CSD transmission rates：2.4，4.8，9.6，14.4 kbps
CSD	• Support CSD transmission
USSD	• Unstructured Supplementary Services Data (USSD) support
SMS	• MT, MO, CB, Text and PDU mode • SMS storage: SIM card
SIM interface	Support SIM card: 1.8V, 3V
External antenna	Antenna pad
Audio features	Speech codec modes: • Half Rate (ETS 06.20) • Full Rate (ETS 06.10) • Enhanced Full Rate (ETS 06.50 / 06.60 / 06.80) • Adaptive multi rate (AMR) • Echo Cancellation • Noise Suppression
Serial port and debug port	**Serial port:** • Full modem interface with status and control lines, unbalanced, asynchronous. • 1200bps to 115200bps. • Can be used for AT commands or data stream. • Support RTS/CTS hardware handshake and software ON/OFF flow control. • Multiplex ability according to GSM 07.10 Multiplexer Protocol. • Autobauding supports baud rate from 1200 bps to 57600bps. • upgrading firmware **Debug port:** • USB_DM and USB_DP • Can be used for debugging and upgrading firmware.
Phonebook management	Support phonebook types: SM, FD, LD, RC, ON, MC.
SIM application toolkit	GSM 11.14 Release 99
Real time clock	Support RTC
Timing functions	Use AT command set
Physical characteristics	Size:15.8*17.8*2.4mm Weight:1.35g
Firmware upgrade	Main serial port or USB port.

Table 4. 2 SIM800L Key Features:

Table 4. 3 SIM800L function:

Mode	Function	
Normal operation	GSM/GPRS SLEEP	Module will automatically go into sleep mode if the conditions of sleep mode are enabling and there is no on air and no hardware interrupt (such as GPIO interrupt or data on serial port). In this case, the current consumption of module will reduce to the minimal level. In sleep mode, the module can still receive paging message and SMS.
	GSM IDLE	Software is active. Module is registered to the GSM network, and the module is ready to communicate.
	GSM TALK	Connection between two subscribers is in progress. In this case, the power consumption depends on network settings such as DTX off/on, FR/EFR/HR, hopping sequences, antenna.
	GPRS STANDBY	Module is ready for GPRS data transfer, but no data is currently sent or received. In this case, power consumption depends on network settings and GPRS configuration.
	GPRS DATA	There is GPRS data transfer (PPP or TCP or UDP) in progress. In this case, power consumption is related with network settings (e.g. power control level); uplink/downlink data rates and GPRS configuration (e.g. used multi-slot settings).
Power down	Normal power down by sending AT command “AT+CPOWD=1” or using the PWRKEY. The power management unit shuts down the power supply for the baseband part of the module, and only the power supply for the RTC is remained. Software is not active. The serial port is not accessible. Power supply (connected to VBAT) remains applied.	
Minimum functionality mode	AT command “AT+CFUN” can be used to set the module to a minimum functionality mode without removing the power supply. In this mode, the RF part of the module will not work or the SIM card will not be accessible, or both RF part and SIM card will be closed, and the serial port is still accessible. The power consumption in this mode is lower than normal mode.	

4.7.4 Coding schemes and maximum net data rates over air interface

Coding scheme	1 timeslot	2 timeslot	4 timeslot
CS-1	9.05kbps	18.1kbps	36.2kbps
CS-2	13.4kbps	26.8kbps	53.6kbps
CS-3	15.6kbps	31.2kbps	62.4kbps
CS-4	21.4kbps	42.8kbps	85.6kbps

4.7.5 Table 4. 4 Operating Mode

The table below summarizes the various operating modes of SIM800L.

4.7.6 Functional Diagram

The following figure shows a functional diagram of SIM800L:

- GSM baseband
- GSM RF
- Antenna interface
- Other interface

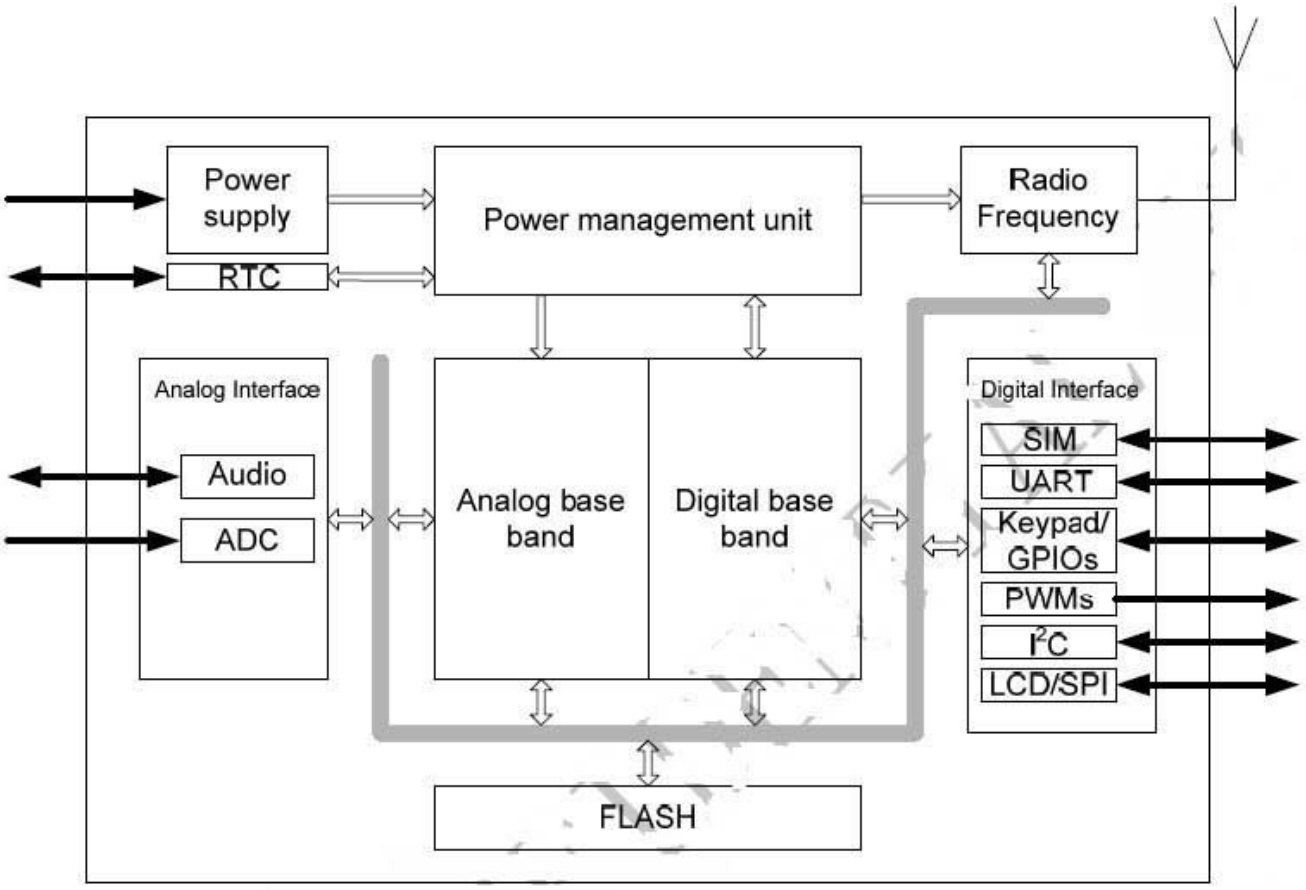


Figure 4. 15 Package Information

4.7.6 Pin out Diagram

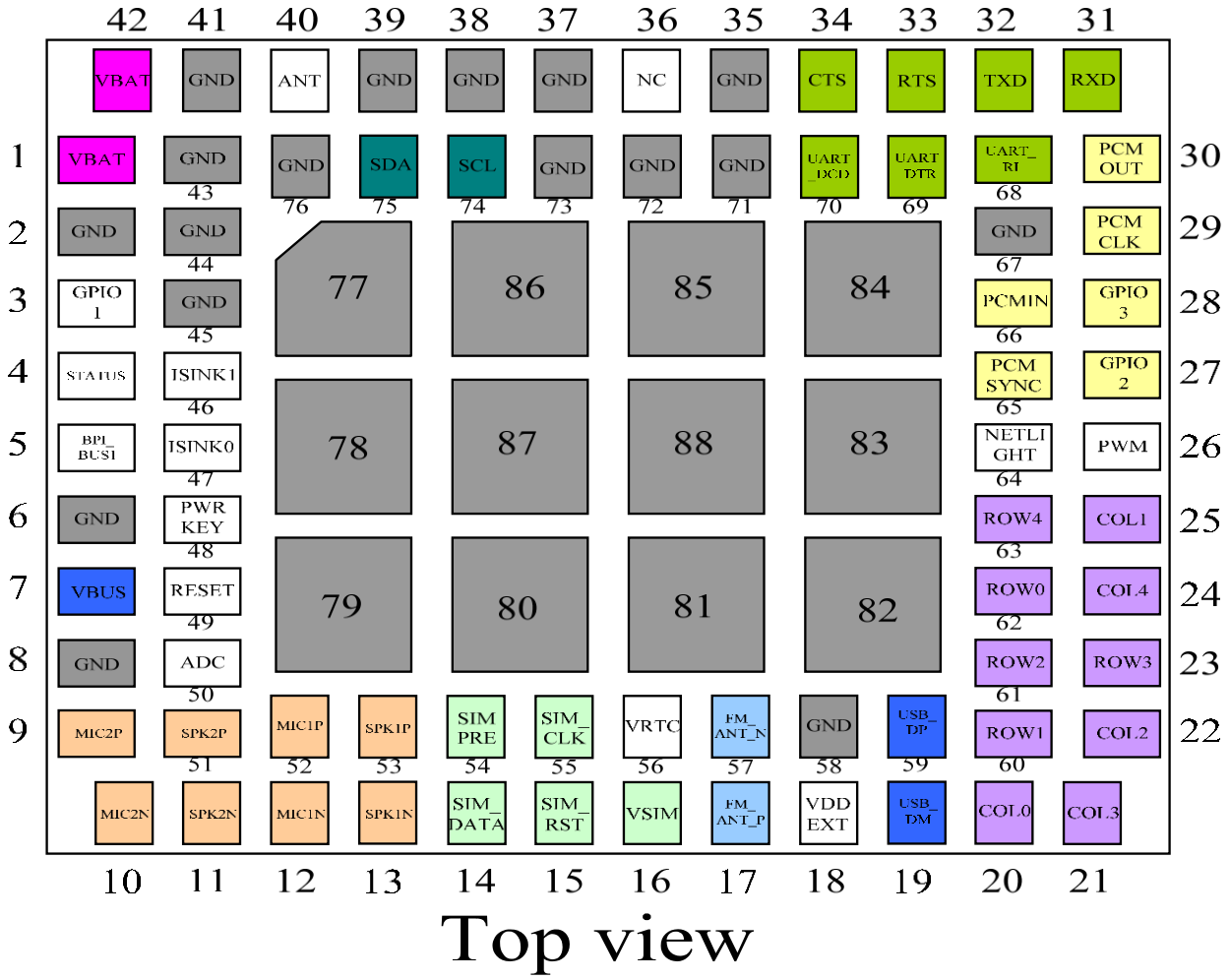


Figure 4. 16 SIM800L Pin out diagram

4.7.7 Pin Description

Pin name	Pin number	I/O	Description	Comment
Power supply				
VBAT	1,42	I	Power supply	
VRTC	56	I/O	Power supply for RTC	It is recommended to capacitor (e.g. 4.7uF).
VEXT	18	O	2.8V power output	If these pins are unused, keep open.
GND	2,6,8,35,37,38,39, 41,43,44,45,58,67 ,71,72,73,76,77,78,79,80,81,82,83, 84,85,86,87,88		Ground	GND for VBAT recommend to use 2,43,44,45pin
Power on/down				
PWRKEY	48	I	PWRKEY should be pulled low at least 1 second and then released to power on/down the module.	Internally pulled up to
Audio interfaces				
MIC1P	52	I	Differential audio input	If these pins are unused, keep open.
MIC1N	12			
SPK1P	53	O	Differential audio output	
SPK1N	13			
MIC2P	9	I	Differential audio input	
MIC2N	10			
SPK2P	51	O	Differential audio output	
SPK2N	11			
PCM interface				
PCMCLK	29	O	PCM interface for audio	If these pins are unused, keep open.
PCMOUT	30	O		
PCMSYNC	65	O		
PCMIN	66	I		
Keypads interface				

COL4	24	I	Support up to 50 buttons (5*5*2)	If these pins are unused, keep open.（Pin number 20 external cannot be pulled down）
COL3	21	I		
COL2	22	I		
COL1	25	I		
COL0	20	I		
ROW4	63	O		
ROW3	23	O		

ROW2	61	O		
ROW1	60	O		
ROW0	62	O		
GPIO				
GPIO1	3	I/O	Programmable general purpose input and output	
GPIO2	27	I/O		
GPIO3	28	I/O		
NETLIGHT	64	O	Network status	
STATUS	4	O	Power on status	
Serial port				
UART_DTR	69	I	Data terminal ready	If these pins are unused, keep open.
UART_RI	68	O	Ring indicator	
UART_DCD	70	O	Data carrier detect	
CTS	34	O	Request to send	
RTS	33	I	Clear to send	
TXD	32	O	Transmit data	
RXD	31	I	Receive data	
Debug interface				
VBUS	7	I	Debug and download	If these pins are unused, keep open.
USB_DP	59	I/O		
USB_DM	19	I/O		
ADC				
ADC	50	I	10bit general purpose analog to digital converter	If these pins are unused, keep open.
PWM				
PWM	26	O	Pulse-width modulation	If these pins are unused, keep open.
I²C				
SDA	75	I/O	I²C serial bus data	Need external pulled up
SCL	74	O	I²C serial bus clock	
SIM card interface				
VSIM	16	O	Voltage supply for SIM card. Support 1.8V or 3V SIM card	All signals of SIM interface should
SIM_DAT	14	I/	SIM data input/output	

A		O		be protected against ESD with a TVS diode array.
SIM_CLK	55	O	SIM clock	
SIM_RST	15	O	SIM reset	
SIMPRE	54	I	SIM card detection	Reservation function
Antenna interface				
ANT	40	I/O	Connect GSM antenna	
FM_ANT_P	17	I	Differential antenna for FM	
FM_ANT_N	57	I		
Synchronizing signal of RF				
BPI_BUS1	5	O	Synchronizing signal of RF	
Other				
RESET	49	I	Reset input(Active low)	
ISINK1	46	I	Drive keypad backlight	
ISINK0	47	I	Drive LCD backlight	
NC				
NC	36			

Table 4. 5 SIM800l Pin Description

4.7.8 Power Supply

The power supply range of SIM800L is from 3.4V to 4.4V.Recommended voltage is 4.0V.The transmitting burst will cause voltage drop and the power supply must be able to provide sufficient current up to 2A. For the VBAT input, a bypass capacitor (low ESR) such as a 100 μF is strongly recommended.

Increase the 33PF and 10PF capacitors can effectively eliminate the high frequency interference. A 5.1V/500mW Zener diode is strongly recommended, the diode can prevent chip from damaging by the voltage surge. These capacitors and Zener diode should be placed as close as possible to SIM800L VBAT pins.

Recommended Zener diode

	Vendor	Part number	Power(watts)	Packages
1	On semi	MMSZ5231BT1G	500mW	SOD123
2	Prisemi	PZ3D4V2H	500mW	SOD323
3	Prisemi	PZ5D4V2H	500mW	SOD523
4	Vishay	MMSZ4689-V	500mW	SOD123
5	Crownpo	CDZ55C5V1SM	500mW	0805

Table 4. 6 Random zener diade

The following figure is the reference design of +5V input power supply. The designed output for the power supply is 4.1V, thus a linear regulator can be used.

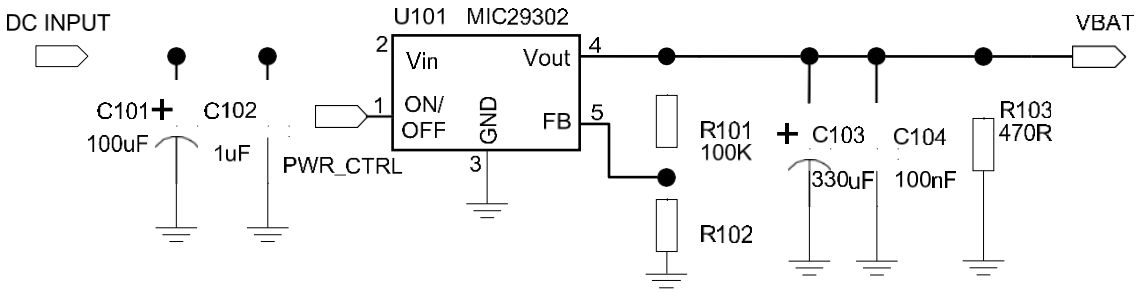


Figure 4. 17 Reference circuit of the DC-DC power supply

The single 3.7V Li-ion cell battery can be connected to SIM800L VBAT pins directly. But the Ni-Cd or Ni-MH battery must be used carefully, since their maximum voltage can rise over the absolute maximum voltage of the module and damage it

When battery is used, the total impedance between battery and VBAT pins should be less than 150mΩ.
The following figure shows the VBAT voltage drop at the maximum power transmit phase,

and the test condition is as following:
VBAT=4.0V,

A VBAT bypass capacitor C_A=100μF tantalum capacitor (ESR=0.7Ω), Another VBAT bypass capacitor C_B=1μF.

4.7.9 **Power supply pin**

Pin 1 and Pin 42 are VBAT input, Pins 2,43,44,45 are GND of power supply, VRTC pin is power supply of the RTC cicuit in the module.VDD_EXT output 2.8V when module is in normal operation mode.

When designing the power supply in user's application, pay special attention to power losses. Ensure that the input voltage never drops below 3.0V even when current consumption rises to 2A in the transmit burst. If the power voltage drops below 3.0V, the module may be shut down automatically. The PCB traces from the VBAT pins to the power supply must be wide enough (at least 60mil) to decrease voltage drops in the transmit burst. The power IC and the bypass capacitor should be placed to the module as close as possible.

Monitoring Power Supply

AT command "AT+CBC" can be used to monitor the VBAT voltage. For detail, please refer to document [1].

Power on/down Scenarios

4.7.9a Power on SIM800L

User can power on SIM800L by pulling down the PWRKEY pin for at least 1 second and release. This pin is already pulled up to VBAT in the module internal, so external pull up is not necessary. Reference circuit is shown as below.

4.8 LCD Display

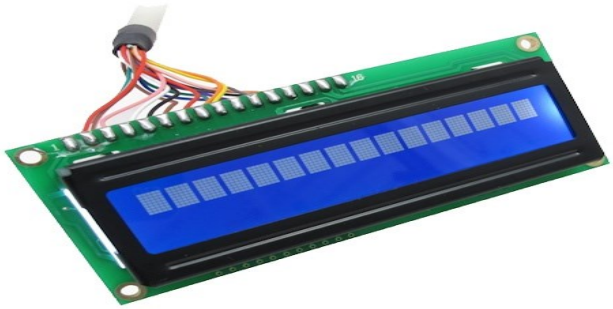


Figure 4. 18 16x2 LCD (Liquid Crystal Display)

LCD (Liquid Crystal Display) screen is an electronic display module

These modules are preferred over seven segments and other multi segment LEDs

LCDs are economical

Construction and Working Principle of LCD Display

4.8.1 What is a LCD(Liquid Crystal Display)?

A liquid crystal display or LCD draws its definition from its name itself. It is combination of two states of matter, the solid and the liquid. LCD uses a liquid crystal to produce a visible image. Liquid crystal displays are super-thin technology display screen that are generally used in laptop computer screen, TVs, cell phones and portable video games. LCD's technologies allow displays to be much thinner when compared to cathode ray tube (CRT) technology.

Liquid crystal display is composed of several layers which include two polarized panel filters and electrodes. LCD technology is used for displaying the image in notebook or some other electronic devices like mini computers. Light is projected from a lens on a layer of liquid crystal. This combination of colored light with the grayscale image of the crystal (formed as electric current flows through the crystal) forms the colored image. This image is then displayed on the screen.

An LCD is either made up of an active matrix display grid or a passive display grid. Most of the Smartphone's with LCD display technology uses active matrix display, but some of the older displays still make use of the passive display grid designs. Most of the electronic devices mainly depend on liquid crystal display technology for their display. The liquid has a unique advantage of having low power consumption than the LED or cathode ray tube.

Liquid crystal display screen works on the principle of blocking light rather than emitting light. LCD's requires backlight as they do not emits light by them. We always use devices which are made up of LCD's displays which are replacing the use of cathode ray tube. Cathode ray tube draws more power compared to LCD's and are also heavier and bigger.

4.8.1 How LCDs are Constructed?

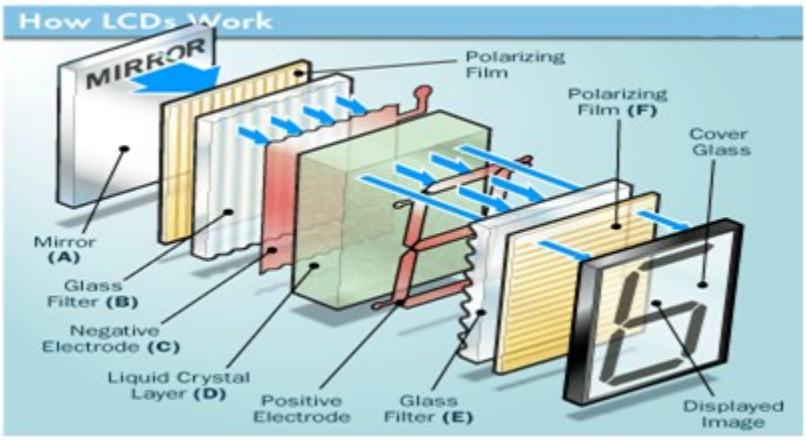


Figure 4. 19 Simple facts that should be considered while making an LCD:

The basic structure of LCD should be controlled by changing the applied current.

We must use a polarized light.

Liquid crystal should able be to control both of the operation to transmit or can also able to change the polarized light.

As mentioned above that we need to take two polarized glass pieces filter in the making of the liquid crystal. The glass which does not have a polarized film on the surface of it must be rubbed with a special polymer which will create microscopic grooves on the surface of the polarized glass filter. The grooves must be in the same direction of the polarized film. Now we have to add a coating of pneumatic liquid phase crystal on one of the polarized filter of the polarized glass. The microscopic channel cause the first layer molecule to align with filter orientation. When the right angle appears at the first layer piece, we should add a second piece of glass with the polarized film. The first filter will be naturally polarized as the light strikes it at the starting stage.

Thus the light travels through each layer and guided on the next with the help of molecule. The molecule tends to change its plane of vibration of the light in order to match their angle. When the light reaches to the far end of the liquid crystal substance, it vibrates at the same angle as that of the final layer of the molecule vibrates. The light is allowed to enter into the device only if the second layer of the polarized glass matches with the final layer of the molecule.

4.8.2 How LCDs Work?

The principle behind the LCD's is that when an electrical current is applied to the liquid crystal molecule, the molecule tends to untwist. This causes the angle of light which is passing through the molecule of the polarized glass and also cause a change in the angle of the top polarizing filter. As a result a little light is allowed to pass the polarized glass through a particular area of the LCD. Thus that particular area will become dark compared to other. The LCD works on the principle of blocking light. While constructing the LCD's, a reflected mirror is arranged at the back. An electrode plane is made of indium-tin oxide which is kept on top and a polarized glass with a polarizing film is also added on the bottom of the device. The complete region of the LCD has to be enclosed by a common electrode and above it should be the liquid crystal matter.

Next comes to the second piece of glass with an electrode in the form of the rectangle on the bottom and, on top, another polarizing film. It must be considered that both the pieces are kept at right angles. When there is no current, the light passes through the front of the LCD it will be

reflected by the mirror and bounced back. As the electrode is connected to a battery the current from it will cause the liquid crystals between the common-plane electrode and the electrode shaped like a rectangle to untwist. Thus the light is blocked from passing through. That particular rectangular area appears blank.

4.8.2a Advantages of an LCD's:

- LCD's consumes less amount of power compared to CRT and LED
- LCD's are consist of some microwatts for display in comparison to some mill watts for LED's
- LCDs are of low cost
- Provides excellent contrast
- LCD's are thinner and lighter when compared to cathode ray tube and LED

4.8.2b **Disadvantages of an LCD's:**

- Require additional light sources
- Range of temperature is limited for operation
- Low reliability
- Speed is very low
- LCD's need an AC drive

4.8.3Applications of Liquid Crystal Display

- Liquid crystal technology has major applications in the field of science and engineering as well on electronic devices.
- Liquid crystal thermometer
- Optical imaging
- The liquid crystal display technique is also applicable in visualization of the radio frequency waves in the waveguide
- Used in the medical applications

4.9 Current sensor

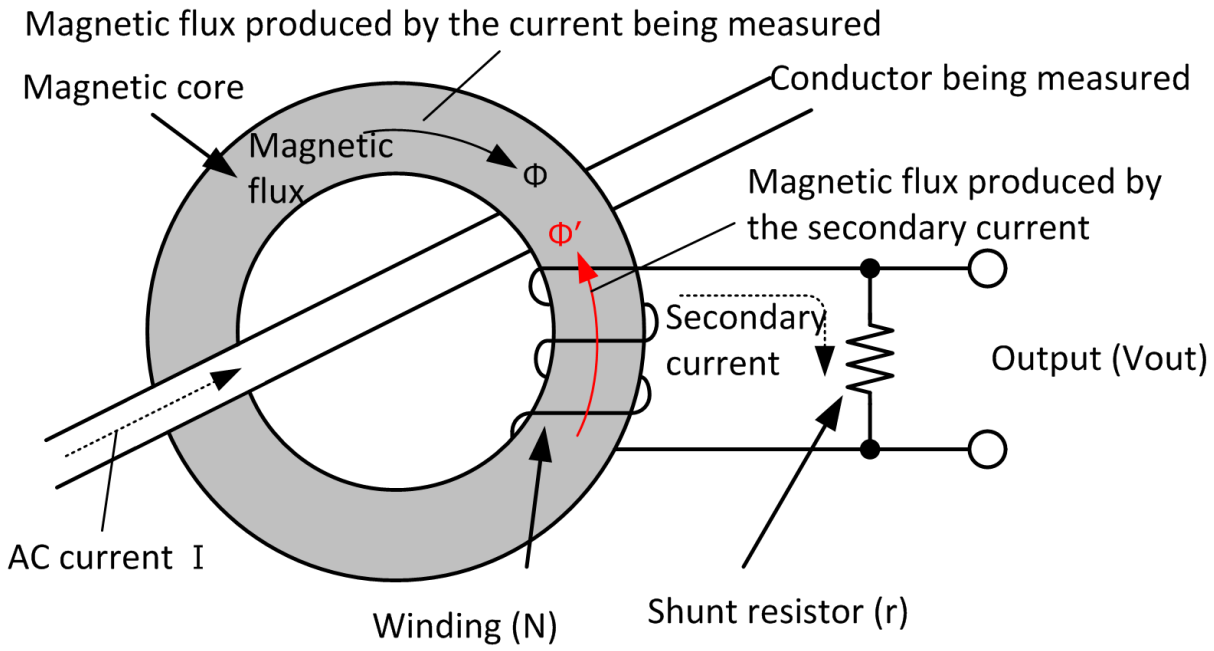


Figure 4. 20 Current Transformer

The Current Transformer (C.T.), is a type of "instrument transformer" that is designed to produce an alternating current in its secondary winding which is proportional to the current being measured in its primary. Current transformers reduce high voltage currents to a much lower value and provide a convenient way of safely monitoring the actual electrical current flowing in an AC transmission line using a standard ammeter. The principal of operation of a basic current transformer is slightly different from that of an ordinary voltage transformer.

Unlike the voltage or power transformer looked at previously, the current transformer consists of only one or very few turns as its primary winding. This primary winding can be of either a single flat turn, a coil of heavy duty wire wrapped around the core or just a conductor or bus bar placed through a central hole as shown.

Due to this type of arrangement, the current transformer is often referred too as a "series transformer" as the primary winding, which never has more than a very few turns, is in series with the current carrying conductor supplying a load.

The secondary winding however, may have a large number of coil turns wound on a laminated core of low-loss magnetic material. This core has a large cross-sectional area so that the magnetic flux density created is low using much smaller cross-sectional area wire, depending upon how much the current must be stepped down as it tries to output a constant current, independent of the connected load.

The secondary winding will supply a current into either a short circuit, in the form of an ammeter, or into a resistive load until the voltage induced in the secondary is big enough to saturate the core or cause failure from excessive voltage breakdown.

Unlike a voltage transformer, the primary current of a current transformer is not dependent of the secondary load current but instead is controlled by an external load. The secondary current is usually rated at a standard 1 Ampere or 5 Amperes for larger primary current ratings.

There are three basic types of current transformers: **wound**, **toroidal** and **bar**.

Wound Current Transformer – The transformers primary winding is physically connected in series with the conductor that carries the measured current flowing in the circuit. The magnitude of the secondary current is dependent on the turns ratio of the transformer.

Toroidal Current Transformer – These do not contain a primary winding. Instead, the line that carries the current flowing in the network is threaded through a window or hole in the toroidal transformer. Some current transformers have a "split core" which allows it to be opened, installed, and closed, without disconnecting the circuit to which they are attached.

Bar-type Current Transformer – This type of current transformer uses the actual cable or bus-bar of the main circuit as the primary winding, which is equivalent to a single turn. They are fully insulated from the high operating voltage of the system and are usually bolted to the current carrying device.

Current transformers can reduce or "step-down" current levels from thousands of amperes down to a standard output of a known ratio to either 5 Amps or 1 Amp for normal operation. Thus, small and accurate instruments and control devices can be used with CT's because they are insulated away from any high-voltage power lines. There are a variety of metering applications and uses for current transformers such as with Wattmeter's, power factor meters, watt-hour

Generally current transformers and ammeters are used together as a matched pair in which the design of the current transformer is such as to provide a maximum secondary current corresponding to a full-scale deflection on the ammeter. In most current transformers an approximate inverse turns ratio exists between the two currents in the primary and secondary windings. This is why calibration of the CT is generally for a specific type of ammeter.

Most current transformers have a the standard secondary rating of 5 amps with the primary and secondary currents being expressed as a ratio such as 100/5. This means that the primary current is 20 times greater than the secondary current so when 100 amps is flowing in the primary conductor it will result in 5 amps flowing in the secondary winding. A current transformer of say 500/5, will produce 5 amps in the secondary for 500 amps in the primary conductor, 100 times greater.

By increasing the number of secondary windings, Ns, the secondary current can be made much smaller than the current in the primary circuit being measured because as Ns increases, Is goes down by a proportional amount. In other words, the number of turns and the current in the primary and secondary windings are related by an inverse proportion.

A current transformer, like any other transformer, must satisfy the amp-turn equation and we know from our tutorial on double wound voltage transformers that this turns ratio is equal to:

$$T.R. = n = \frac{N_P}{N_S} = \frac{I_S}{I_P}$$

from which we get:

$$\text{secondary current, } I_S = I_P\left(\frac{N_P}{N_S}\right)$$

Figure 4. 21 Low of Current transformer

The current ratio will sets the turns ratio and as the primary usually consists of one or two turns whilst the secondary can have several hundred turns, the ratio between the primary and

secondary can be quite large. For example, assume that the current rating of the primary winding is 100A. The secondary winding has the standard rating of 5A. Then the ratio between the primary and the secondary currents is 100A-to-5A, or 20:1. In other words, the primary current is 20 times greater than the secondary current.

It should be noted however, that a current transformer rated as 100/5 is not the same as one rated as 20/1 or subdivisions of 100/5. This is because the ratio of 100/5 expresses the “input/output current rating” and not the actual ratio of the primary to the secondary currents. Also note that the number of turns and the current in the primary and secondary windings are related by an inverse proportion.

But relatively large changes in a current transformers turns ratio can be achieved by modifying the primary turns through the CT’s window where one primary turn is equal to one pass and more than one pass through the window results in the electrical ratio being modified.

So for example, a current transformer with a relationship of say, 300/5A can be converted to another of 150/5A or even 100/5A by passing the main primary conductor through its interior window two or three times as shown. This allows a higher value current transformer to provide the maximum output current for the ammeter when used on smaller primary current lines.

Figure 4. 22 Current Transformer

4.10 LM358 OPERATIONAL AMPLIFIER IC

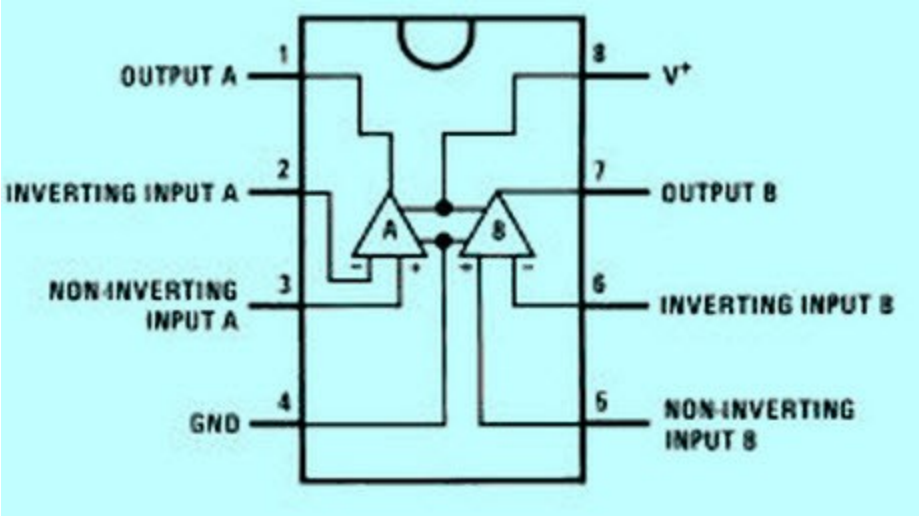


Figure 4. 23 LM 358 OP-AMP

4.10.1 Know all about LM358 IC and their Applications

The IC or integrated circuit is a little black chip, it is a root of modern electronics, and also an essential component in many electronic circuits. The applications of integrated circuits involve in each and every electronic circuit board, embedded systems and various electronic projects. An integrated circuit is a set of various electrical and electronic components like resistors, capacitors, transistors.

All these components are integrated onto a single chip. They are available in various forms like 555 timers, single circuit logic gates, microprocessors, microcontrollers, voltage regulators and op-amps like IC 741, LM324 IC, LM358 IC, LM339 IC and many more.

4.10.2 What is LM358 IC?

The LM358 IC is a great, low power and easy to use dual channel op-amp IC. It is designed and introduced by national semiconductor. It consists of two internally frequency compensated, high gain, independent op-amps.

This IC is designed for specially to operate from a single power supply over a wide range of voltages. The LM358 IC is available in a chip sized package and applications of this op amp include conventional op-amp circuits, DC gain blocks and transducer amplifiers.

LM358 IC is a good, standard operational amplifier and it is suitable for your needs. It can handle 3-32V DC supply & source up to 20mA per channel. This op-amp is apt, if you want to operate two separate op-amps for a single power supply. It's available in an 8-pin DIP package

- Pin Configuration of LM358 IC
- The pin diagram of LM358 IC comprises of 8 pins, where
- Pin-1 and pin-8 are o/p of the comparator
- Pin-2 and pin-6 are inverting i/ps
- Pin-3 and pin-5 are non inverting i/ps
- Pin-4 is GND terminal
- Pin-8 is VCC+

The features of the LM358 IC are

It consists of two op-amps internally and frequency compensated for unity gain

The large voltage gain is 100 dB

Wide bandwidth is 1MHz

Range of wide power supplies includes single and dual power supplies

Range of Single power supply is from 3V to 32V

Range of dual power supplies is from + or -1.5V to + or -16V

The supply current drain is very low, i.e., 500 μA

2mV low i/p offset voltage

Common mode i/p voltage range comprises ground

The power supply voltage and differential i/p voltages are similar

o/p voltage swing is large.

Applications of LM358 IC

LM358 IC based Dark Sensor Circuit

This dark sensor IC LM358 circuit is used to test a light dependent resistor, a photo diode and a photo transistor. But, you need to change a photo diode and the photo transistor in place of LDR. The dark sensor circuit using LDR and LM358 IC is shown below. The required components to build the following circuit is LDR, LM358 IC, 9V battery, resistors R1-330R, R2-1K, R3-10K, variable resistor VR1-10K, transistor Q1-C547.

In the following simple dark sensor circuit. If you stop light falling on the light dependent resistor, then immediately the LM358 IC turns on the LED.

When a photodiode is placed in placed of LDR, then it works immediately. Depending upon the level of the light in your room, you need to adjust the variable resistor to adjust the circuit's sensitivity.

When a photo transistor is placed in placed of LDR, then it works immediately. Depending upon the level of the light in your room, you need to adjust the variable resistor to adjust the circuit's sensitivity.

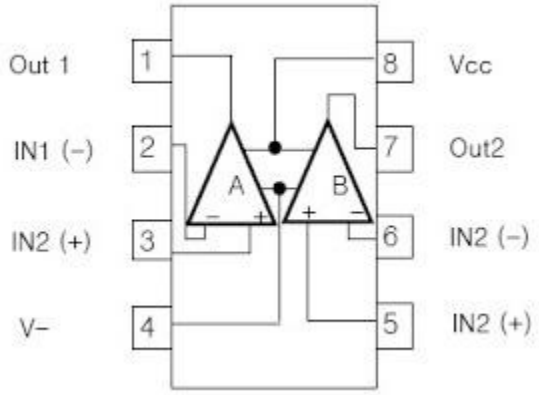


Figure 4. 24 Construction and Working Principle of LCD Display

CHAPTER-5

Result and Discussing

5.1 Introduction

This chapter is more important for our project. Because here we show our projects output. We show SMS that we got from our project and every result by creating fault.

5.2 Result

5.2.1 Earth fault result

When we disconnect earth sense from arduino then Arduino automatically shut down output relay, show lcd “EARTH FAULT” and send SMS to our mobile. That show on bellow,

Figure 5. 1 Earth fault result

5.2.2 Temperature result:

When we increase temperature then Arduino automatically shut down output relay, show lcd “HI TEMPERATURE” and send SMS to our mobile. That show on bellow,

Figure 5. 2 Temperature result

5.2.3 Hi Voltage Result

When we increase line voltage then Arduino automatically shut down output relay, show lcd “HI VOLTAGE” and send SMS to our mobile. That show on bellow,

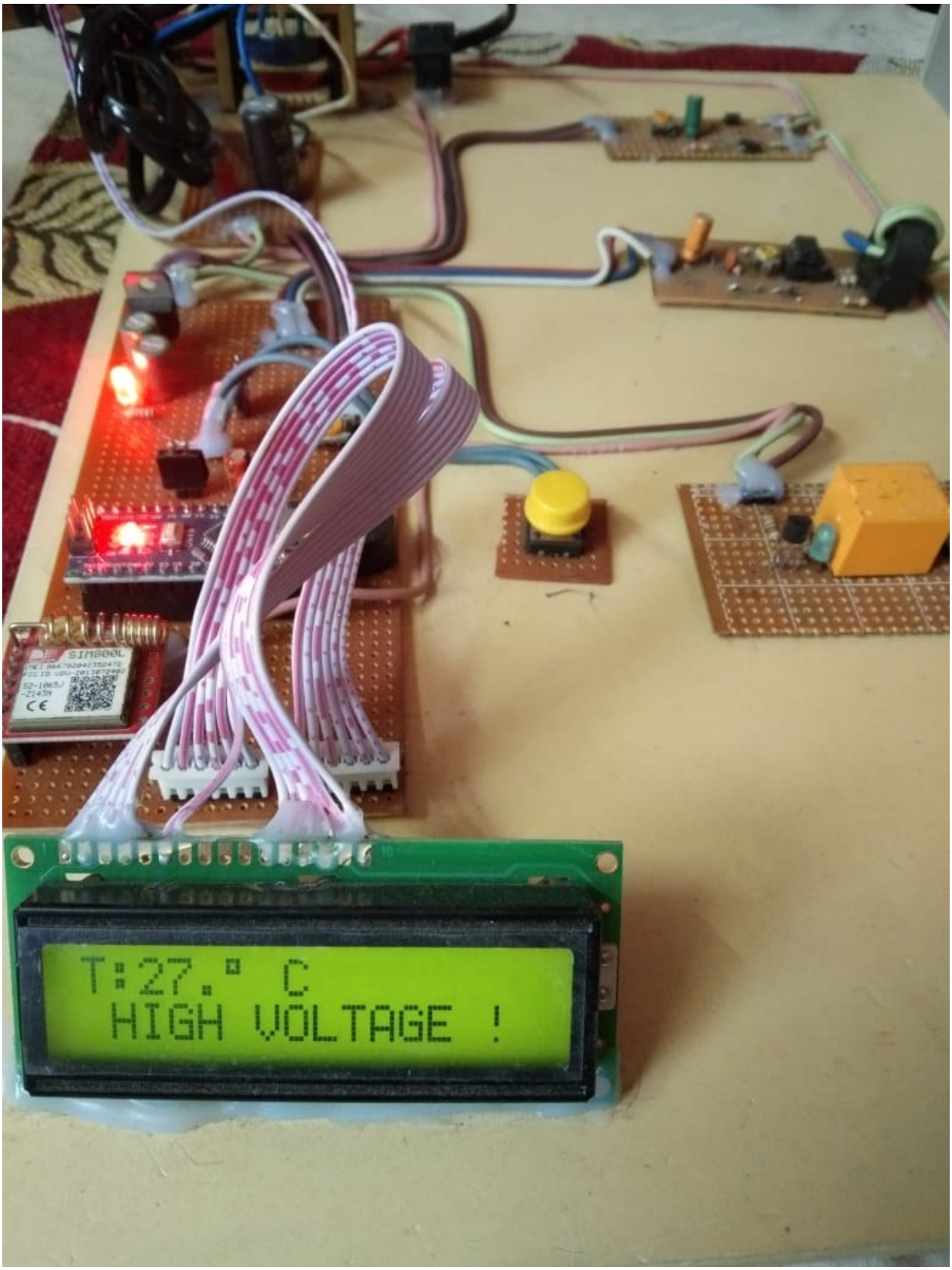


Figure 5. 3 Hi Voltage Result

5.2.4 Low Voltage Result

When we decrease line voltage then Arduino automatically shut down output relay, show lcd “LOW VOLTAGE” and send SMS to our mobile. That show on bellow,

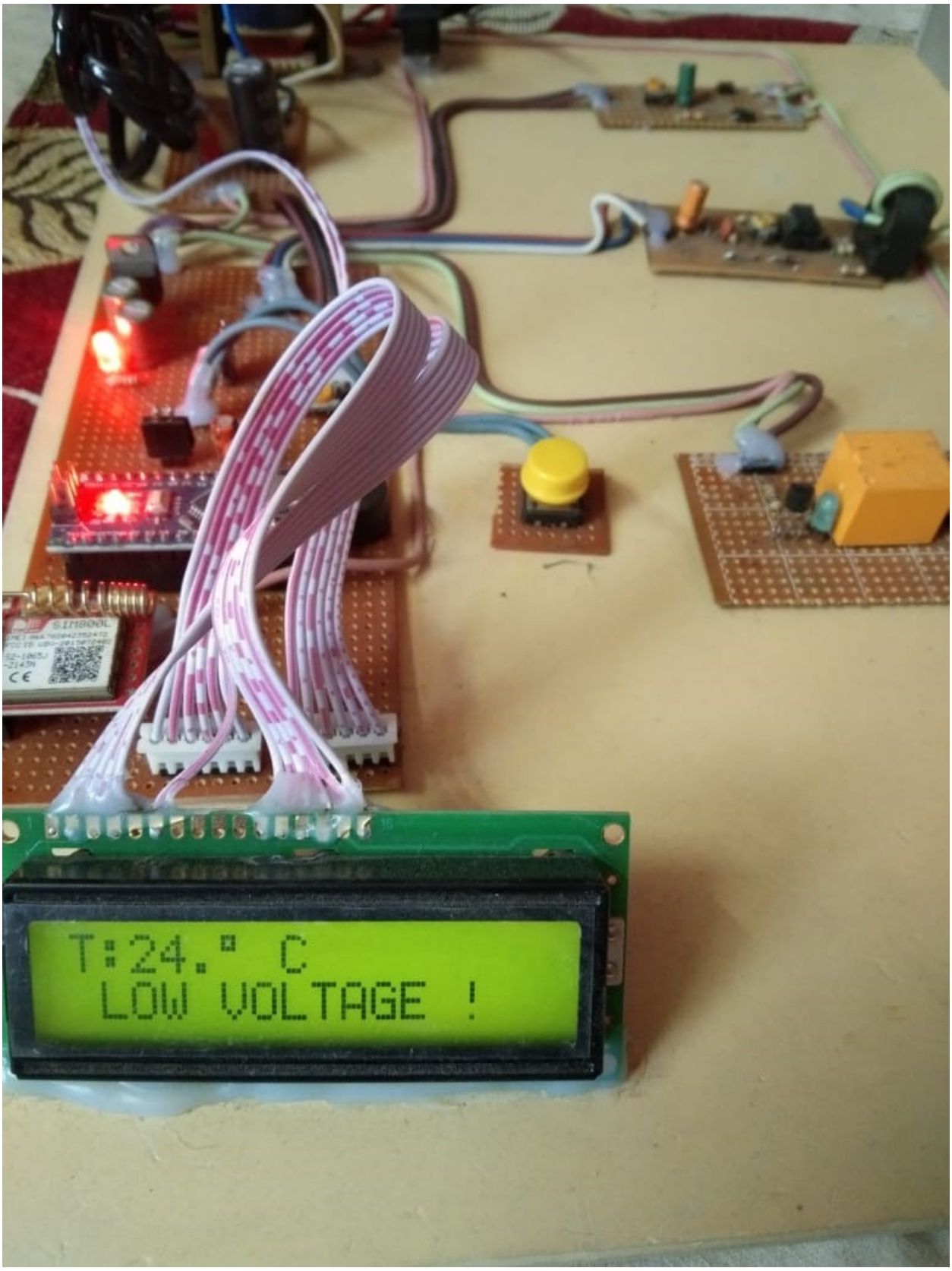


Figure 5. 4 Low Voltage Result

5.3 Summary

We got all result successfully got SMS In our mobile and shut down relay automatically and on automatically when problem resolve.

CHAPTER-6

Conclusions

6.1 Introduction

In this chapter we discussed about applications, advantages, disadvantages, future work and conclusion of our project.

6.2 Applications

This project is used for protecting Bus bars in sub stations, generating stations etc.Used for Industrial appliances protection.This system can be used to sending notification and controlling the home appliances.So for such cases this project is very helpful as the distance at which the fault has occurred can be calculated and then further action regarding the fault can be taken to overcome them.

6.3 Advantages

Advantages of our projects are given bellow,

- We can detect earth fault easily.
- We can detect temperature fault easily.
- Save our electrical and electronics devices from Hi/Low Voltage & earthing fault and short circuit
- Easy to control(on/off) relay.

6.4 Disadvantages

There have some disadvantages

- Complex to write code.
- We can’t get SMS if GSM have insufficient balance.

6.5 Future work

In the future, we will add Cable fault detection system. And add GPS from getting cable fault location.By include mobile apps with internet server this project can be modified, to get information of overhead system in easy way.By include finger print security system this project could be improved to electrical device security.

6.6 CONCLUSION

In our project we studied a design for controlling the system from overload and earth fault.In this project we designed a system in such way it will monitor and control the load continuously and that information send to user mobile number using GSM technology.This project is extremely helpful for substation because Substation maintaining will be easy.Automatic maintenance will be required & man effort will be less.

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