Mini Project

on

“METAL DETECTOR”

For the partially fulfilment of the

Degree of Bachelor of Technology

In

Electronics & Communication Engineering

Submitted by: - **Deepak Pal**

University Roll no.: - **2100540310011**

Submitted to: -

Department of Electronics and Communication

Babu Banarasi Das Institute of Technology and Management, Lucknow

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Declaration

I hereby declare that the Mini Project Report entitled ("**Metal Detector**") is an authentic record of my own work as requirements of Mini Project during the period from _____ to_____ For the partially fulfilment of the of degree of B.Tech. Electronics and Communication engineering), Babu Banarasi Das Institute of Technology and Management, Lucknow.

Date: _____

Deepak Pal
(210050310011)

Acknowledgment

I would like to express my profound gratitude to **Dr. Shailendra Tahilyani (HOD)**of **Electronics and Communication Department** for his contributions to the completion of my project titled **Metal Detector**

I would like to express my special thanks to our mentor **Mrs. Keerti Mishra** and **Dr._Abhimanyu Kumar Yadav** for their time and efforts they provided throughout the year. Your useful advice and suggestions were really helpful to me during the project completion. In this aspect, I am very grateful to them.

I would like to acknowledge that this project was completed entirely by me and not by someone else.

Deepak Pal

(2100540310011)

Abstract

Metal detectors are fascination machines. Many of the people who use them are just as enthusiastic about extolling the virtues of their favourite metal detector as they are about setting off in search of buried treasure. This is the primary means by which we determine how well we are doing our jobs, and what sort of things we need to do better.

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Chapter 1

Introduction

A metal detector is a device which responds to metal that may not be readily apparent. The simplest form of a metal detector consists of an oscillator producing an alternating current that passes through a coil producing an alternating magnetic field. If a piece of electrically conductive metal is close to the coil, eddy currents will be induced in the metal, and this produces an alternating magnetic field of its own. If another coil is used to measure the magnetic field (acting as a magnetometer), the change in the magnetic field due to the metallic object can be detected. The first industrial metal detectors were developed in the 1960s and were used extensively for mining and other industrial applications. Uses include de-mining (the detection of land mines), the detection of weapons such as knives and guns, especially in airport security, geophysical prospecting, archaeology and treasure hunting. Metal detectors are also used to detect foreign bodies in food, and in the construction industry to detect steel reinforcing bars in concrete and pipes and wires buried in walls and floors.

Chapter 2

Principle of Operation

- In our circuit, the transistor having series capacitors in parallel with the inductor forms an Colpitts oscillator.
- First the capacitors get charged and as soon as it gets fully charged, it starts to discharge the energy to the inductor. The inductor gets energy and then again gives it to capacitor. This process repeats itself and makes oscillations and has a certain "Resonating frequency"
- This Resonant frequency of Oscillation is given by:

$$f_0 = \frac{1}{2\pi\sqrt{L\left(\frac{C_1 C_2}{C_1 + C_2}\right)}}$$

- If we increase L1's inductance it will cause the decrease in frequency and if we decrease this L1's inductance it will cause the increase in frequency
- The LC circuit activates the proximity sensor when it senses any metal close to it. This sensor glow the LED and makes a buzzer.

Chapter 3

Block Diagram

- First the search head or the coil is made to interact with the metal and then the oscillator fails to maintain the frequency, hence the metal is detected.
- Then the signal is amplified and given to LED and Buzzer to indicate the presence of a metal.
- Only those metal can be detected which can change the frequency to RF range.

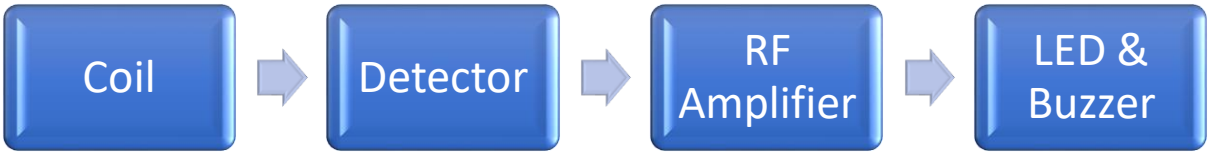


Figure 1

Chapter 4

Components Required

- 2 x 47nF Capacitors (Ceramic Capacitor code 473)
- 1 x 1 KΩ Resistor (1/4 Watt)
- 1 x 330 Ω Resistor (1/4 Watt)
- 1 x 100 Ω Resistor (1/4 Watt)
- 1 x 5 KΩ Potentiometer
- 1 x BC-547 (NPN Transistor)
- 27K Resistor
- 22k Resistor
- 270pF capacitor
- 12kpF capacitor
- Diode IN-4148
- Detector Coil
- Buzzer

Chapter 5

Components Description

5.1 Resistor:

The resistor is a passive electrical component that creates resistance in the flow of electric current. In almost all electrical networks and electronic circuits they can be found. The resistance is measured in ohms (Ω). An ohm is the resistance that occurs when a current of one ampere (A) passes through a resistor with a one volt (V) drop across its terminals. The current is proportional to the voltage across the terminal ends. This ratio is represented by Ohm's law:

$$R=V/I$$

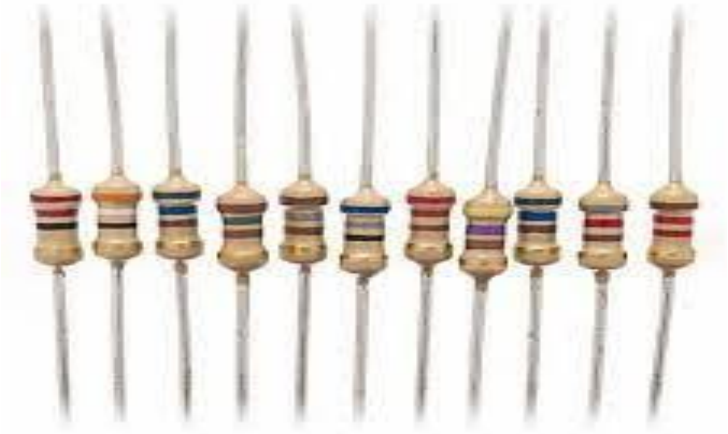


Figure 2

5.2 Capacitor:

*A **capacitor** is a device used to store electrical charge and electrical energy. It consists of at least two electrical conductors separated by a distance. (Note that such electrical conductors are sometimes referred to as "electrodes," but more correctly, they are "capacitor plates.") The space between capacitors may simply be a vacuum, and, in that case, a capacitor is then known as a "vacuum capacitor." However, the space is usually filled with an insulating material known as a **dielectric**. The amount of storage in a capacitor is determined by a property called capacitance.*

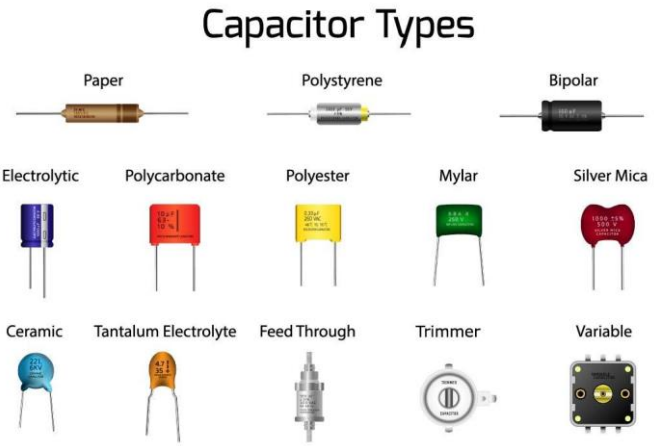


Figure 3

5.3 Potentiometer:

Potentiometer is an electronic device that measures the EMF (electromotive force) of a cell as well as the cell's internal resistance. It's also used to compare the EMFs of various cells. In most applications, it may also be used as a variable resistor.

These potentiometers are widely employed in the production of electronics equipment that allows users to alter electrical circuits to achieve the desired outputs. Although its most obvious application must be for volume controls on radios and other audio-related electronic equipment.

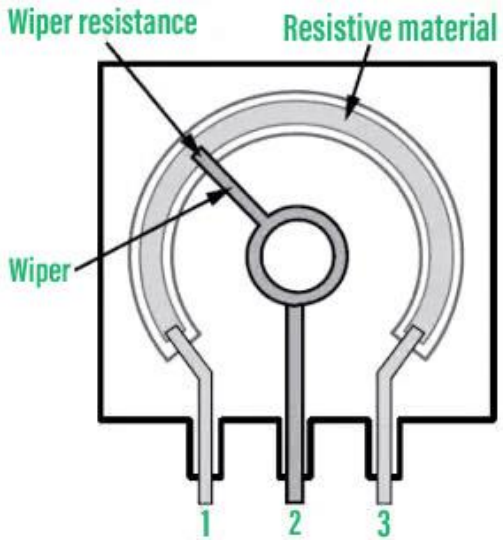


Figure 4

5.4 Diode1N-4148:

1N4148 diode is mainly used for quick switching purposes, so these are known as switching diodes. The main functionality of these diodes is the same as a normal switch. These diodes have high resistance under a fixed voltage whereas they have low resistance above the fixed voltage.

This kind of diode is easily available in a tiny size with less cost. So, the selection of this diode can be done based on its highest reverse recovery time as well as its power dissipation that ranges from 80milli Watts to 1kilo Watts.

It is frequently used in different switches which have a very quick operation for switching, high-speed rectification, protection of homes & telecommunication industries, etc.

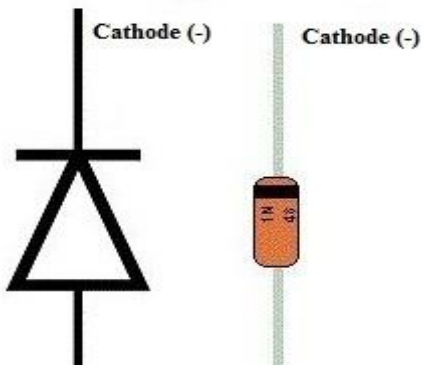
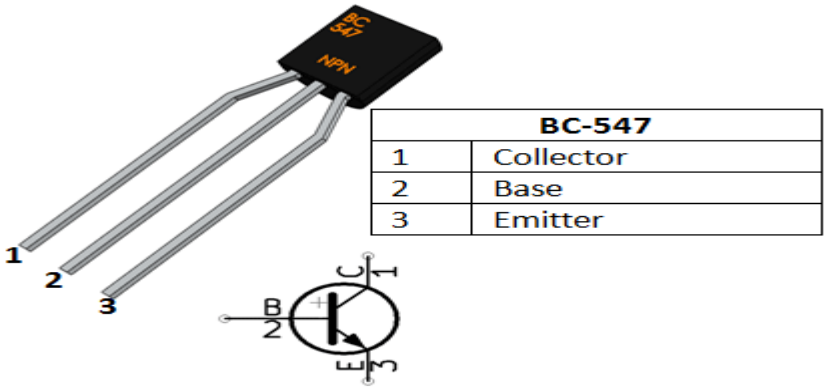


Figure 5

5.5 Transistor BC-547(NPN):

BC547 transistor has a gain value of 110 to 800, this value determines the amplification capacity of the transistor. The maximum amount of current that could flow through the Collector pin is 100mA, hence we cannot connect loads that consume more than 100mA using this transistor. To bias a transistor, we have to supply current to base pin, this current (I_B) should be limited to 5mA.

When this transistor is fully biased then it can allow a maximum of 100mA to flow across the collector and emitter. This stage is called **Saturation Region** and the typical voltage allowed across the Collector-Emitter (V_{CE}) or Base-Emitter (V_{BE}) could be 200 and 900 mV respectively. When base current is removed the transistor becomes fully off, this stage is called as the **Cut-off Region** and the Base Emitter voltage could be around 660 mV.



BC-547	
1	Collector
2	Base
3	Emitter

Figure 6

5.6 Detector Coil:

The electromagnetic field can be transferred by the search coil of the detector into the ground & receives the electromagnetic field return from a metal object.

Figure 7

Chapter 6

Circuit Diagram

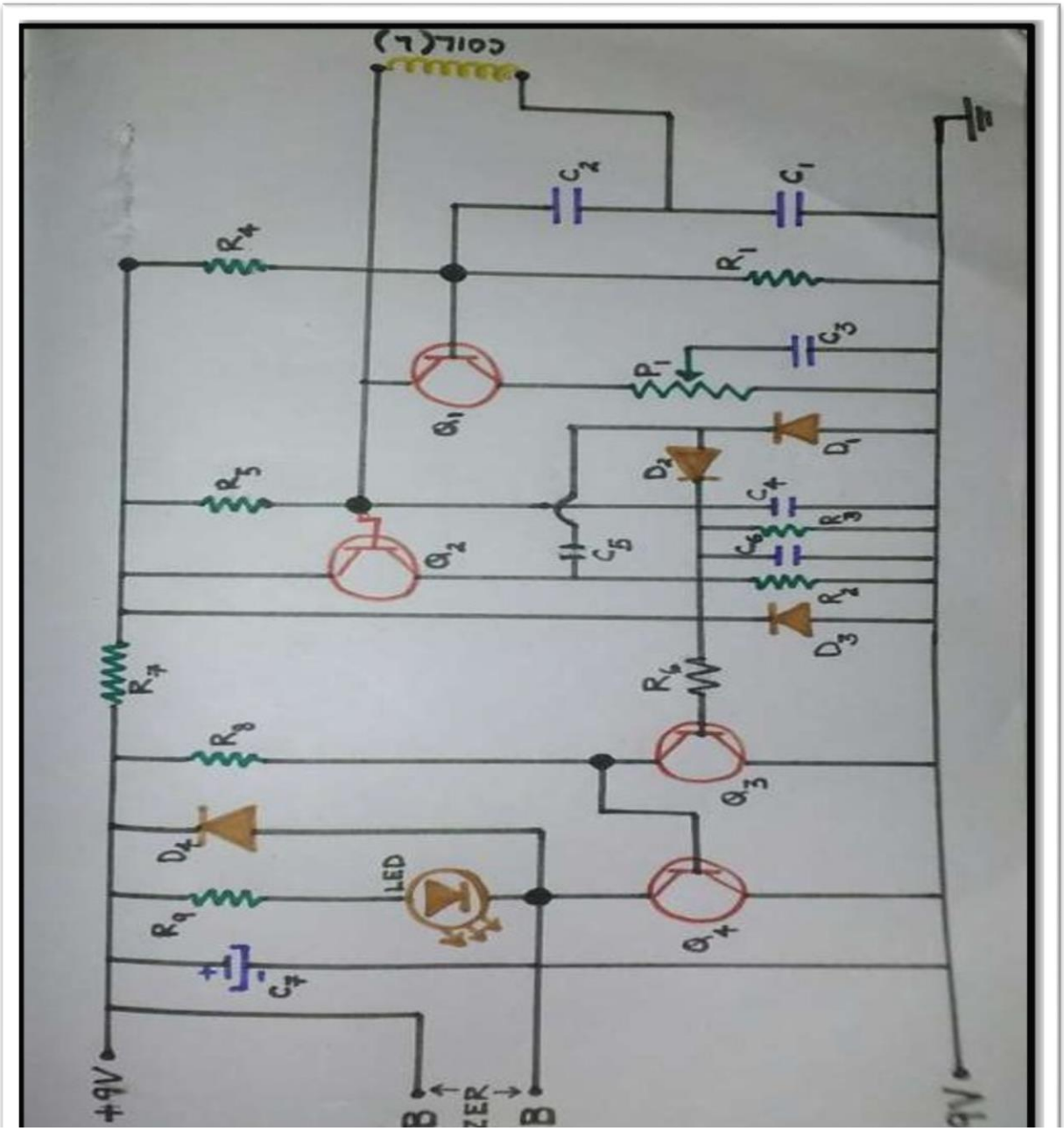


Figure 8(Circuit Diagram)

6.1 Working of Circuit:

- Initially the circuit is tuned to a fixed resonating frequency decided by the combination of capacitance (C1 & C2) and Inductance (L) value.
- A metal detector consists of an LC oscillator (COLPITTS OSC) which produces current in the copper coil & hence a magnetic field is produced around it. (BLUE LINES)

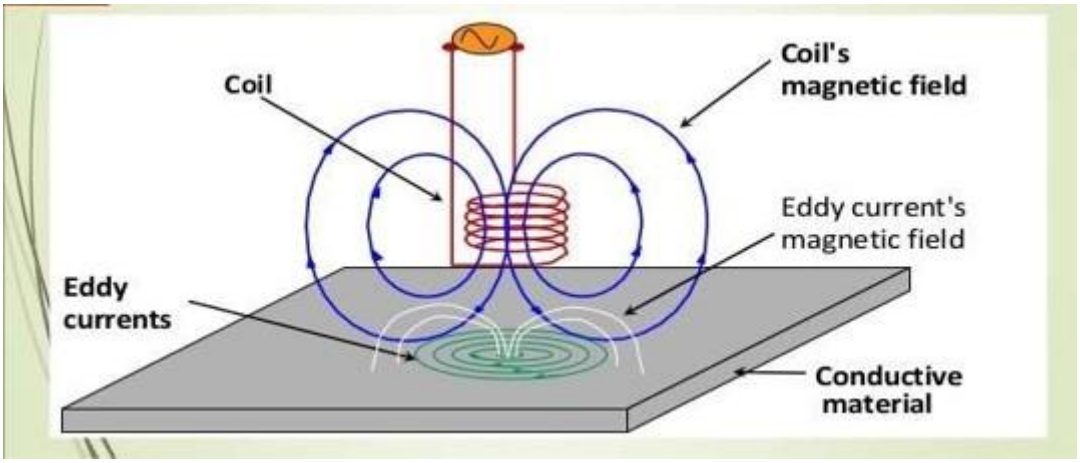


Figure 9

- When the metal detector circuit is placed near to a metal object, these rapidly changing magnetic field lines (due to current flowing in the coil) penetrate through metal's surface & produces circulating currents called **"Eddy currents"** on the metal surface. (GREEN LINES).

- This eddy currents will create its "own new magnetic field" that affects the original one. (WHITE LINES)

- Metal detectors can contain 1 or more, Inductor coils (Copper coils) used to interact with metallic elements.
- This Reverse magnetic energy is absorbed back changes the Inductance of the copper coil and so do the frequency of oscillations.
- Now the two frequency will be different & thus the oscillator fails to maintain the original resonating frequency.
- Then the final transistor conducts, hence the Buzzer and the LED is activated. & thus a hissing sound is produced.

Chapter 7

Metal Detector Circuit Application

- This simple Metal Detector can be used to identify metals like iron, gold, silver etc.
- Since it is a simple project, we can use this in our home to scan for nails, metal scraps etc. which are not easily spottable by naked eye.

Chapter 8

Merits & Demerits

8.1Merits

- The Proximity Detector IC TDA0161 based Metal Detector Circuit is a very simple and easy to construct metal detector that can be used to detect small metals in our homes, offices and gardens.
- There is need for any microcontroller as the Proximity Sensor will be sufficient to implement the project.

8.2Demerit

- The main disadvantage of this Metal Detector Circuit is the range of detection. The metal object has to be at a distance of 10mm for the detector to detect it.

Chapter 9

Conclusion

After designing, simulating, assembling, soldering and testing the circuit, I came to the conclusion that my circuit of the metal detector is working satisfactorily and has negligible amount of unexpected functioning.

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