



Sensors and Instrumentation

Project

Metal detector

Metal detector:

Metal detectors are used to identify metallic devices such as bombs, guns, for security purposes. To avoid any illegal or unauthorized entry of metallic objects, bombs, knives, guns within the luggage bags of the person carrying them in public places like theatres, shopping malls, parks, airports, hotels, railway stations. A security system is developed by using proximity sensor which is named as a metal detector. So, a metal detector is used in many robotic or electronic projects to detect any present metals which are nearby or the existence of hidden items within objects.

In the year 1960, the first metal detector was established and was used in industrial applications and mineral prospecting. A metal detector is an electronic device that comprises of an oscillator which generates an AC current that passes via a coil generating an alternating magnetic field. When a part of the metal is nearby to the coil, eddy current will be induced in the metal object & this generates a magnetic field of its own. If an extra coil is used to measure the magnetic field, the magnetic field can be changed and sensed due to the metal object. The metal detectors are used to sense the weapons and also used in the construction industry to identify the steel reinforcing bars in pipes, concrete, wires, pipes buried in walls & floors.

Metal detector types are classified into three types such as BFO (Beat Frequency Oscillation), TR (Transmitter or Receiver) and VLF (Very Low frequency)

Principle:

The metal detector working is, when the electromagnetic field is transmitted from the search coil into the earth. Metals in the electromagnetic field will become strengthened & resend an electromagnetic of their own. The metal detector comprises of a search coil which receives the retransmitted field & alarms the user by generating a response of the metal. Minelab metal detectors are accomplished by discriminating between dissimilar types of targets and can be fixed to ignore unwanted metal objects.

→Battery:-

The main purpose of the battery is to provide the power to the detector.

→Control Box

The control box comprises of the electronics of the detector. When the transmit signal is generated, the receive signal is processed and transformed into a target response.

→Search 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.

→Electromagnetic Field Transmission

The transmitted electromagnetic field energizes metal objects to allow them to be sensed.

→Target

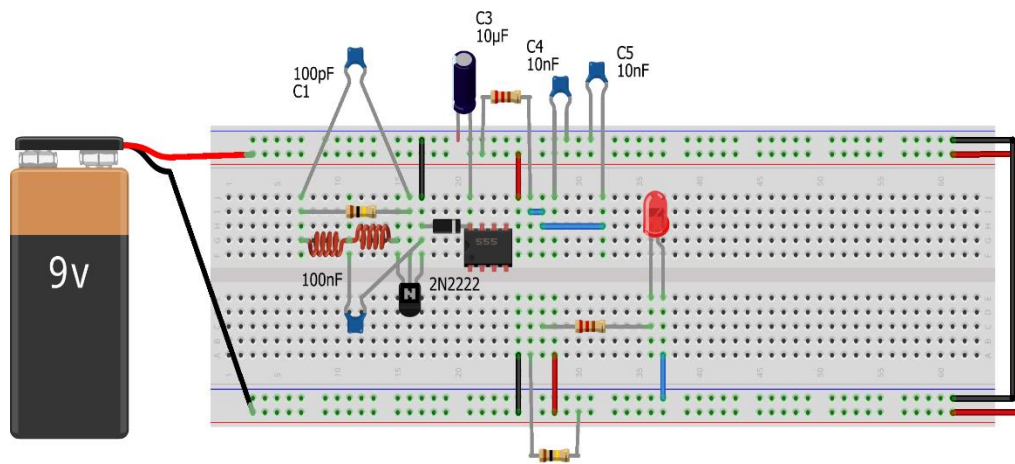
Here, a target is a metal object that can be sensed by a metal detector. In this, the target is treasure which is sensed and that is a good target.

Apparatus used:

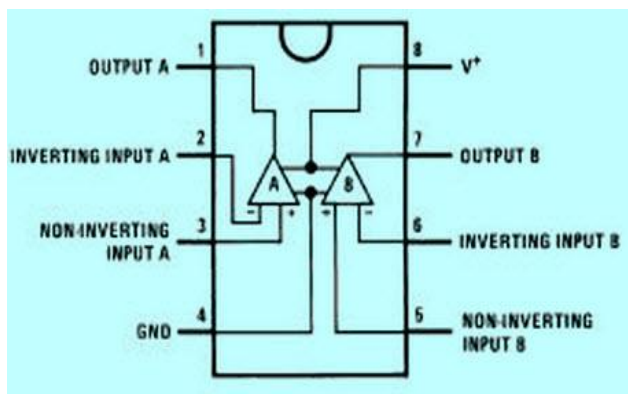
- 2n2222 transistor
- 100k resistors
- 100pF capacitors
- Copper Coil
- 100nF capacitors
- Lm358 IC

- 1k resistors
- 10k resistors
- 100k POTENTIOMETER
- LED
- Breadboard
- 9v battery

Model circuit:



Lm358IC:



It consists of two independent high gain operational amplifiers. The very important feature of this IC is we do not require independent power supply for the working of this IC. It can also be used as transducer amplifier. The abbreviation LM358 indicates an 8-pin integrated circuit, comprising two operational amplifiers at low power. The LM358 is designed for general use as amplifiers, high-pass filters, low band pass filters, and analog adders.

Working:

A battery in the top of the metal detector activates the transmitter circuit (red) that passes electricity down through a cable in the handle to the transmitter coil (red) at the bottom.

When electricity flows through the transmitter coil, it creates a magnetic field all around it.

If the detector is moved across a metal object (such as this old gray spanner), the magnetic field penetrates right through it.

The magnetic field makes an electric current flow inside the metal object.

This flowing electric current creates another magnetic field all around the object. The magnetic field cuts through the receiver coil (blue) moving about up above it. The magnetic field makes electricity flow around the receiver coil and up into the receiver circuit (blue) at the top, making a loudspeaker buzz and alerting you you've found something.

Applications of metal detectors:

Metal detectors aren't just used to find coins on the beach. You can see them in walk-through scanners at airports (designed to stop people carrying guns and knives onto airplanes or into other secure places such as prisons and hospitals) and in many kinds of scientific research. Archeologists often frown on untrained people using metal detectors to disturb important artifacts but, used properly and with respect, metal detectors can be valuable tools in historic research



Security Screening:

A series of aircraft hijackings led the United States in 1972 to adopt metal detector technology to screen airline passengers, initially using magnetometers that were originally designed for logging operations to detect spikes in trees. The Finnish company Outokumpu adapted mining metal detectors in the 1970s, still housed in a large cylindrical pipe, to make a commercial walk-through security detector. The development of these systems continued in a spin-off company and systems branded as Metor Metal Detectors evolved in the form of the rectangular gantry now standard in airports. In common with the developments in other uses of metal detectors both alternating current and pulse systems are used, and the design of the coils and the electronics has moved forward to improve the discrimination of these systems. In 1995 systems such as the Metor 200 appeared with the ability to indicate the approximate height of the metal object above the ground, enabling security personnel to more rapidly locate the source of the signal. Smaller hand-held metal detectors are also used to locate a metal object on a person more precisely.

Some applications:

Metal detectors are used for various applications in the food, plastics and pharmaceutical industries. Classic fields of application include the protection of machines, i.e., damage to tools, mills, automats etc., from metallic pieces, object counting or sensing in automated manufacturing. The use for quality control processes is quickly becoming more and more important in the plastics industry (control of purity of materials and products), in the food industry (consumer protection) and in the pharmaceutical industry.

These are used in shopping malls



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