

**End of degree Project**

**INDUSTRIAL ENGINEER**

## **PLC PROYECT**

**“LASER AND AUDIBLE ALARM. LIGHT DETECTION.”**

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**DUMLUPINAR ÜNİVERSİTESİ**

## **PLC Project**

**Laser and audible  
alarm.**

**Light detection.**

- PLC Project
- Hugo Miguel Somacarrera Lavín
- Yilmaz Aslan

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# **Introduction**

The realization of this project will involve the construction of a light sensitive alarm. In this project are to distinguish two parts:

1. The first will consist of a written work. This paper will explain the operation of the alarms, as well as the different types of alarms in the world. In addition to explaining the different components of the alarm that is made for this project.
2. The second part of the project will consist in the physical installation of the alarm and its presentation.

Alarms are becoming more widespread due to the need for greater security. Until a few years ago, security systems were installed in specific locations, to preserve burglary, robbery or fire. Today it is used in homes, small businesses, factories, and high-risk locations, such as banks and jewelers.

A security system must not provide false alarms, since in practice it is so ineffective as one that can easily be violated. Prone to false alarm, besides not being insurance system tends to be ignored.

Legislation in this field requires certain establishments such as banks, savings and credit institutions in general, gun shops and jewelers to have in their facilities, systems, and these systems should be installed by approved companies for added security.

A good security system, to be successful, you must be connected via a telephone transmitter to a central station with 24 hour security. This is the only way to provide continuous security to the factory, warehouse, office or family housing in question.

Before installation it should take into account certain considerations very clear since they will define the installation to be carried out:

- What are we going to protect.
- Who we want to protect.
- State of the objects we wish to protect.
- Environment of these objects.
- Value objects.
- Existence of regulations which condition the installation.
- Budget that is available.

It should be noted that it is virtually impossible to make a proper fit, given existing in each own constraints and limitations of the equipment, because even come to a very high degree of reliability are always risks.

They can also install security systems for small private homes or small establishments, which do not require interfacing with the security company because they have warning systems and outdoor signage, and these are fairly simple constitution. However, the trend in Europe is to connect these small systems security certified security company, since it guarantees all the senses.

## *CONCEPT OF SECURITY SYSTEM*

In general we can define a security system as the set of elements and facilities needed to provide people and material goods existing in a given local, protection from harm, such as robbery, burglary and arson or sabotage.

Thus, in an incident in principle detect it, then signaled to subsequently initiate actions to reduce or extinguish the effects. (Pressing extinction mechanisms, communication with central station, connecting videotape cameras, etc...)

Security systems can be variable according to local needs and protect the available budget for this.

The market offers a wide range of (central, detectors, etc..) Technical features and components with different qualities, which make it can not establish when performing designs security systems.



LASER AND AUDIBLE ALARM. LIGHT DETECTION

## Classification System Security

The four large blocks of application security systems are stealing and robbery, anti-theft, fire and special systems.

1. Stealing and robbery

Sensors and control panels. Physical Defense. Notice to C.R.A. Signaling theft. Access devices. Closed circuit T.V.

2. Fire

Sensors and fire panels. Notice to C.R.A. Drive extinguishing equipment. Drive warning and signaling devices.

Manual extinction. Fire hydrants equipped. Pumping equipment. Fire doors. Emergency lighting.

3. Anti-theft

Protection of items of stores and small shops. Ray detector scanner (X). Explosives detector. Metal detector.

4. Special systems

Metal detector. Detector probe levels. Moisture detector probe. Chemical detector. Pressure sensor. Drug Detector. Gas detector.

Alarms according to their **degree of security** can be divided into:

- **Grade 1 alarms;** the expression under irrigation. At this level it is expected that the intruder have a vague knowledge of the intruder alarm and is a very limited degree.
- **Grade 2 alarms;** with moderate means, intruders this time have a slight knowledge of alarm systems, this degree covers most alarms installed, includes residential and business alarms without special risk characteristics. The offer of this website is directed toward this degree of security.
- **Grade 3 alarms** is meant by moderate to high degree, this time it is expected that the intruder has high knowledge of alarm systems, this degree could introduce for example, armories, government lotteries, jewelry, buy business gold, etc . Dining alarms this website is not applicable to this degree.
- **Grade 4 alarms;** the term high-risk facilities. On this occasion the intruders are expected to make a comprehensive planning and intrusion having specific regard to sabotage alarm installations. At this level we can include, military installations, biochemical risk etc.

## The alarm

The alarm that I build is a laser light sensitive alarm. This means that the alarm will be activated when the laser light is interrupted. It is an alarm that is fed by electric current, so I'm going to discuss the basic principles of electricity.

### *VOLTAGE*

The potential difference between two points (1 and 2) of an electric field is equal to the work done by the unit of positive charge to transport from point 1 to point 2. Voltage can be defined as the electromotive force that causes free electrons move.

### *ELECTRICAL CURRENT*

Is the electrical charge passing through a conductor section or unit of time. In the International System of Units is expressed in coulombs per second, unit called ampere.

If the current is constant over time is said that the current is continuous; otherwise called variable. If no storage or charge distribution occurs at any point of the conductor, the current is stationary. According to Ohm's law, the intensity of the current is equal to divided by the reluctance bodies voltage:

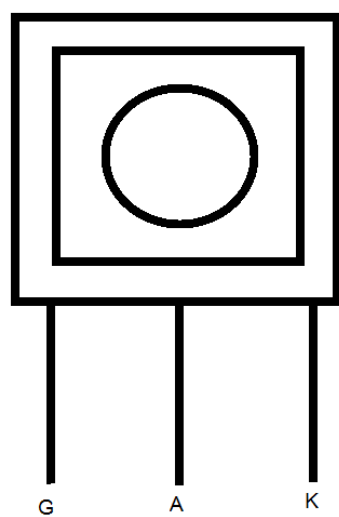
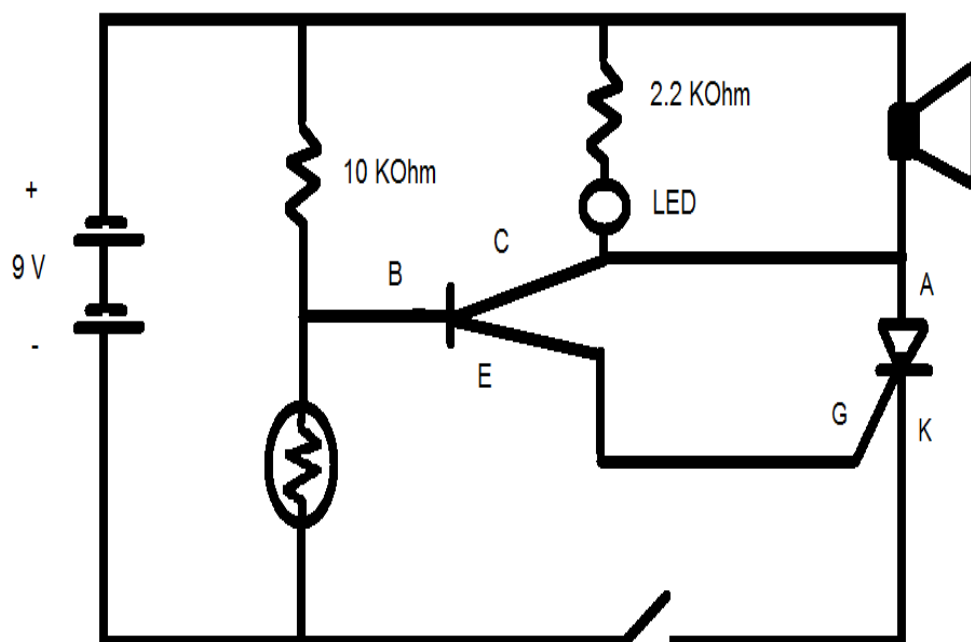
$$I = \frac{V}{R}$$

### *OHM'S LAW*

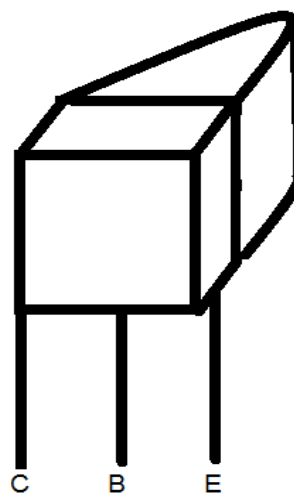
As the electrical resistance in a circuit is very important in determining the intensity of the flow of electrons, it is clear that it is also very important for the quantitative aspects of electricity. It was long ago discovered that, other things being equal, an increase in circuit resistance is accompanied by a decrease in current. A precise statement of this relationship had to wait until reasonably certain as instruments were developed. In 1820, Georg Simon Ohm, a teacher of German school, found that the current in a circuit was directly proportional to the potential difference produced by the current, and inversely proportional to the resistance limits the current. It is expressed mathematically as we have seen before.

- Voltage. Potential difference. (V). Volts.
- Intensity. (I). Amps.
- Resistance. (R). Ohms.

## Circuit



Thyristor



Transistor



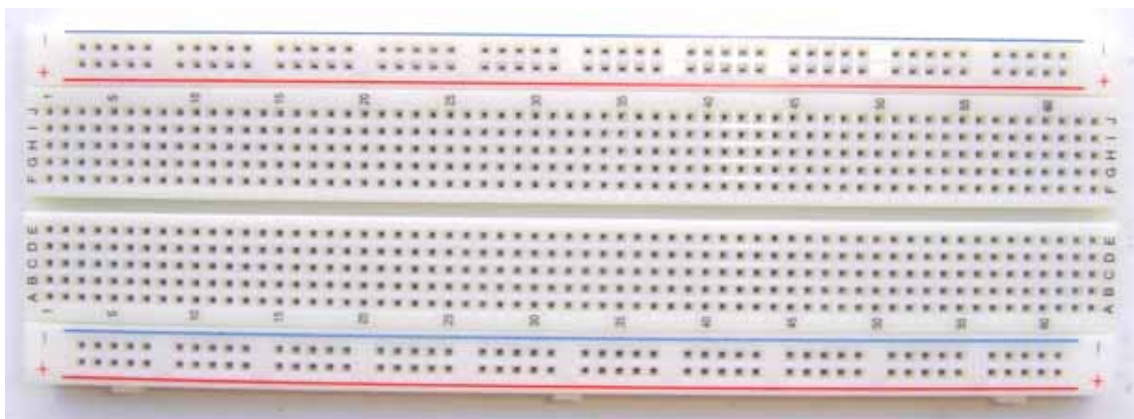
## *Circuit components.*

- **Connection board or protoboard**

This board, we will use the first part of the mounting system. Once we get the certainty that the system works properly, we can make the final connection, which will alarm inside a container. In this way this alarm will be portable.

A protoboard is a board with holes electrically connected together, usually in patterns of lines, which can be inserted and electronic components and wires for assembling electronic circuit prototyping and similar systems. It is made of two materials, insulation, usually a plastic, and a conductor connecting together the various holes. One of its main uses is the creation and testing of prototype electronic circuits before reaching the mechanical printing circuit in commercial production systems.

It is currently one of the most used test plates. Block is comprised of perforated plastic and numerous thin films of an alloy of copper, tin and phosphorous, joining said perforations, creating a series of parallel conducting lines. The lines intersect at the center of the block to ensure that integrated circuit devices such dual in-line package (DIP) can be inserted perpendicularly and without being touched by the supplier to the conductive lines. On the opposite side a liner with glue, which serves to seal and keep in place the metal strips is placed.



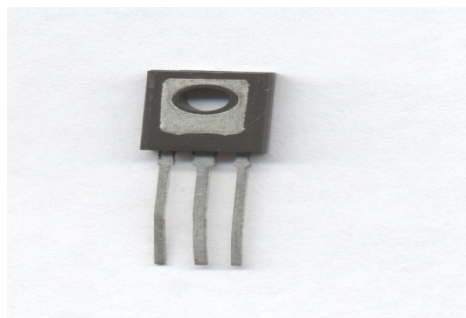
## • Thyristor TIC. 106-D

The thyristor is an electronic component formed by using semiconductor elements to produce an internal feedback switching. The materials of which it is composed are of semiconductor type, that is, depending on the temperature at which they are may function as insulators or conductors. Are unidirectional devices because they only transmit the flow in one direction. Is generally used for electric power control.

The device consists of an anode and a cathode, where the joints are of PNPN type there between. Therefore can be modeled as 2 typical NPN and PNP transistors, so it is also said that the thyristor works with voltage fed.

### ***Ways to activate a thyristor***

- Light: If a light beam is incident on the junctions of a thyristor, until the same silicon, the number of electron-hole pairs increase the thyristor can be turned on.
- Gate current: To a thyristor polarized directly, a current injection gate by applying a positive voltage between the gate and cathode active. If this gate current increases, the voltage will decrease direct blocking, reversing the activation of the device.
- Chill: A very high temperature in the thyristor causes an increase in the number of electron-hole pairs, so that will increase leakage currents , which the will increase the difference between anode and cathode, and thanks to the regenerative action, this current can be 1 and the thyristor can be triggered. Such activation may comprise a thermal runaway, usually when a design is set this method as a method of activation, this flight tends to be avoided.
- High Voltage: If the forward voltage from the anode to the cathode is greater than the direct breakdown voltage, leakage current is large enough to create activation starts with feedback. Normally this type of activation may damage the device, to the point of destroying it.
- Lift - anode cathode voltage: If the speed in raising this voltage is high enough, then the current of the junctions can be enough to trigger the thyristor. This method can also damage the device.



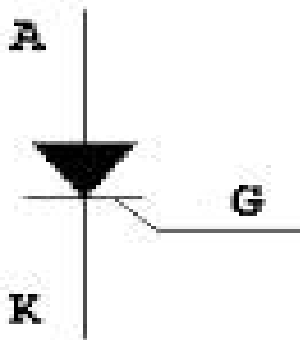
### ***Basic operation***

The thyristor is a bistable switch, ie, is the electronic equivalent of the mechanical switches; is therefore capable of passing fully or completely block the flow of current without any intermediate level, although they are not able to withstand high current overloads. This basic principle is also seen in the Shockley diode.

The design of the thyristor enables it to quickly pass on to receive a momentary pulse of current in its control terminal, called door when a positive voltage between the anode and cathode, that is the voltage at the anode is greater than in the cathode. It can only be turned off with the interruption of the power supply, opening the circuit, or, by passing a current in the opposite direction by the device. If reverse biased thyristor exist a weak reverse leakage current until the point of maximum reverse voltage is reached, thereby causing the destruction of the item (for avalanche in the union).

For the device to pass the blocking state to the active state must generate a stream of positive engagement in the anode, and it must be a small current on the gate can cause an avalanche breakdown in the union to make the device leads. For the device remains in the active state should be induced from the anode current of support, much smaller than the coupling, without which the device would stop driving.

You can also make the thyristor starts to conduct current if there is no door, and anode-cathode voltage is greater than the blocking voltage.



The thyristor used in this project is a **TIC 106-D**

- **Transistor. BC 547**

The transistor is a semiconductor electronic device used to produce an output signal in response to another input signal. Acts as amplifier, oscillator, switch or rectifier. The term 'transistor' is an English contraction of transfer resistor ("transfer resistance"). Currently found in virtually all electronic equipment everyday: radios, televisions, audio and video, quartz watches, computers, fluorescent lights, scanners, cell phones, among others.

### **Types of transistors**

➤ **Point-contact transistor.**

Comprises a base germanium semiconductor then best known that combining copper-copper oxide, on which they rest, close together, two metal tips which constitute the emitter and collector. The base current is able to modulate the resistance "seen" in the manifold, hence the name transfer resistor. It is based on surface effects, little known in his day. It is difficult to manufacture (the tips were adjusted by hand), fragile (a blow could move the tips) and noisy. Today it has disappeared.

➤ **Bipolar Junction Transistor.**

The bipolar junction transistor, is made primarily on a single crystal of germanium, silicon or gallium arsenide, which have qualities of semiconductors, conductors as intermediate between metals and insulators as diamond. On the glass substrate, are contaminated in very controlled three zones, two of which are the same type, NPN or PNP, they formed two PN junctions being.

The N donor elements Nearby electrons (negative charges) and P acceptors area or "holes" (positive charges). Usually used as acceptors P elements to Indio (In), aluminum (Al) or gallium (Ga) and N donors Arsenic (As) or phosphorus (P).

The configuration of PN junctions, give as transistors result PNP or NPN, where the middle letter always corresponds to the characteristic of the base, and the other two to the emitter and collector, although they are the same type and opposite to the base, have different contamination between them (typically, the emitter is much more polluted than the collector).

The mechanism that represents the semiconductor behavior depends on such pollution, the associated geometry and type of technology pollution (gaseous diffusion, epitaxial, etc...). And the quantum behavior of the joint.

➤ Field Effect Transistor.

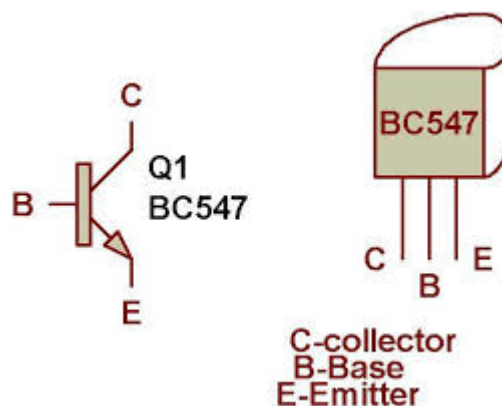
The field effect transistor junction (JFET), was the first field effect transistor in practice. It forms a bar of semiconductor material of N-type silicon or Q. terminal bar establishes an ohmic contact, and have a transistor of N-type field effect of the most basic form. If two P regions are disseminated in a bar of material N and connected externally to each other, a door will occur. One of these contacts will call another Supplier and drain. Applying positive voltage between the drain and the source and connecting door to the supplier, we will establish a stream, which we call zero drain current polarization. With a negative gate potential we call throttling voltage ceases conduction in the channel.

- Field Effect Transistor binding, JFET, built by a PN junction.
- Field effect transistor with insulated gate, IGFET in which the gate is insulated from the channel by a dielectric.
- MOS-effect transistor, MOSFET, where MOS means Metal oxide semiconductor in this case is the metal gate field is separated from the semiconductor channel by an oxide layer.

➤ Phototransistor

Phototransistors are sensitive to electromagnetic radiation at frequencies near the visible light; due to this the current flow can be regulated by means of the incident light. A phototransistor is in essence the same as a normal transistor, only can work in 2 different ways:

- As a typical transistor with the base current ( $I_B$ ) (common mode).
- As phototransistor when the light falling on this element acts as a base current. ( $I_P$ ) (illumination mode).



### ***What is BC547 transistor?***

A BC547 transistor is a negative-positive-negative (NPN) transistor that is used for many purposes. Together with other electronic components, such as resistors, coils, and capacitors, it can be used as the active component for switches and amplifiers. Like all other NPN transistors, this type has an emitter terminal, a base or control terminal, and a collector terminal. In a typical configuration, the current flowing from the base to the emitter controls the collector current. A short vertical line, which is the base, can indicate the transistor schematic for an NPN transistor, and the emitter, which is a diagonal line connecting to the base, is an arrowhead pointing away from the base.

There are various types of transistors, and the BC547 is a bipolar junction transistor (BJT). There are also transistors that have one junction, such as the junction field-effect transistor, or no junctions at all, such as the metal oxide field-effect transistor (MOSFET). During the design and manufacture of transistors, the characteristics can be predefined and achieved. The negative (N)-type material inside an NPN transistor has an excess of electrons, while the positive (P)-type material has a lack of electrons, both due to a contamination process called doping.

The BC547 transistor comes in one package. When several are placed in a single package, it is usually referred to as a transistor array. Arrays are commonly used in digital switching. Eight transistors may be placed in one package to make layout much easier, for example.

To make use of a transistor as an audio preamplifier, a direct current (DC) source is needed, such as a 12-volt (V) power supply. In a common emitter configuration, the negative side of the power supply is alternating current (AC)-coupled to the emitter via a capacitor. There is also a small resistance connecting the power supply to the emitter. The power supply is then connected to the collector via a resistor, which may be referred to as a limiting resistor. When the collector-to-emitter current flows, there will be a voltage drop in the limiting resistor, and in the idle state, the collector voltage is typically 6 V.

Transistor circuit design requires a thorough understanding of current-voltage ratings of various components, such as transistors and resistors. One goal is to keep the components from burning up, while another is to make the circuit work. Saving electricity is also important, such as in the case of battery-operated devices.

- **Photoresist.**

A photoresistor is an electronic component whose resistance varies as a function of light. The value of electrical resistance of a LDR is low when there is light shining on it (can drop to 50 ohms) and high when it is dark (several megohms).

Its operation is based on the photoelectric effect. A photoresistor is made of a high resistance semiconductor such as cadmium sulfide, CdS. If the light falling on the device is high-frequency photons are absorbed by the semiconductor elasticities giving the electrons enough energy to jump the conduction band. The resulting free electron and its associated gap, conduct electricity, so that the resistance decreases. Typical values range from 1 MW or more in the dark and 100  $\Omega$  in bright light.

The cadmium sulfide cells are based on the ability to vary its resistance according to the amount of light striking the cell. More light is incident, the lower the resistance. The cells are also capable of reacting to a broad range of frequencies, including infrared (IR), visible light, and ultraviolet (UV).

The variation of the resistance value has some delay, different if you go from dark to bright to dark or lit. This limits use LDR not in applications where the light signal varies rapidly. The typical response time of a LDR is on the order of a tenth of a second. This slowness gives advantage in some applications because rapid changes in lighting that could cause an unstable sensor (eg fluorescent tube powered by AC) are filtered. In other applications (whether it is day or night) slow detection is not important.

They are manufactured in different types and can be found in many consumer products such as cameras, light meters, clock radios, security alarms or systems on and off street lighting.

Operating within the lower range "infrared radiation" photoconductors (Cu Ge) are also produced.



## • Resistors

Resistor called electronic component designed to introduce a specific electrical resistance between two points of an electrical circuit. In the electrical and electronic slang itself, are known simply as resistors. In other cases, such as plates, heaters, etc... Resistors are used to produce heat exploiting the Joule effect.

It is a material comprising carbon and other resistive elements for decreasing the current passing. He opposes the passage of current. The maximum current and maximum potential difference across a resistor is determined by the maximum power that can dissipate your body. This power can be visually identified from the diameter without other indication is necessary. The most common values are 0.25 W, 0.5 W and 1 W.

There are variable value resistors, which are called potentiometers or Variable Resistors.

### Color code

To characterize a resistor requires three values: electrical resistance, high accuracy or dissipation and tolerance. These values are normally used in the encapsulation according to the type thereof; for axial type of encapsulation that seen in the photographs, these values are labeled with a code of colored stripes.

These values are indicated by a set of colored stripes on the body element. Three, four or five lines; leaving stripe tolerance (usually silver or gold) to the right, read from left to right. The last line indicates the tolerance (precision). Of the remainder, the last is the multiplier and the other figures indicate significant resistance value.

The electrical resistance value is obtained by reading the figures as a number of one, two or three digits; is multiplied by the multiplier and the result is obtained in Ohms ( $\Omega$ ). The temperature coefficient applies only high precision resistors or less tolerance of 1 %.

<div> <div>0 1 2 3 4 5 6 7 8 9</div> <div> <div>0 Black</div> <div>1 Brown</div> <div>2 Red</div> <div>3 Orange</div> <div>4 Yellow</div> <div>5 Green</div> <div>6 Blue</div> <div>7 Purple</div> <div>8 Grey</div> <div>9 White</div> </div> </div> <div> <div>±1% Brown</div> <div>±2% Red</div> <div>±5% Gold</div> <div>±10% Silver</div> </div>	<div> <div>±1% ±2% ±5% ±10%</div> <div> <div>0 0 x1</div> <div>1 1 x10</div> <div>2 2 x100</div> <div>3 3 x1000</div> <div>4 4 x10000</div> <div>5 5 x100000</div> <div>6 6 x1000000</div> <div>7 7 x10</div> <div>8 8 x100</div> <div>9 9</div> </div> </div>	<div> <div>±1% ±2% ±5% ±10%</div> <div> <div>0 0 x1</div> <div>1 1 x10</div> <div>2 2 x100</div> <div>3 3 x1000</div> <div>4 4 x10000</div> <div>5 5 x100000</div> <div>6 6 x1000000</div> <div>7 7 x10</div> <div>8 8 x100</div> <div>9 9</div> </div> </div>	<div> <div>±1% ±2% ±5% ±10%</div> <div> <div>0 0 x1</div> <div>1 1 x10</div> <div>2 2 x100</div> <div>3 3 x1000</div> <div>4 4 x10000</div> <div>5 5 x100000</div> <div>6 6 x1000000</div> <div>7 7 x10</div> <div>8 8 x100</div> <div>9 9</div> </div> </div>
Color Codes	4 Band Resistors	5 Band Resistors	6 Band Resistors

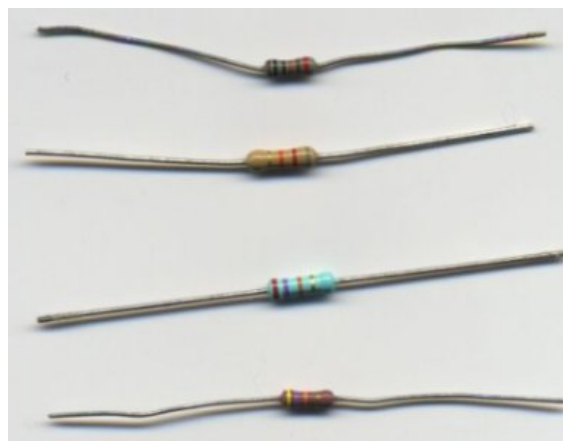


### **Precision resistors**

Precision resistors or metal sheets , also known by its English name foil resistors are those whose value is adjusted with errors 100 parts per million or less and also have a very small variation with temperature of the order of 10 parts per million between 25 and 125 degrees Celsius. This component has a special use in analog circuits with very tight specifications settings. The resistance achieved such high precision in value, and temperature specification, because it must be considered as a system, where materials that behave interact to achieve stability. A very thin metal sheet is glued to an insulator such as glass or ceramic, as the temperature increases, the thermal expansion of metal is higher than that of glass or ceramic and being attached to the insulator, the metal produces a force that compressed by reducing the electrical resistance, and the coefficient of variation of resistance with temperature of the metal is almost always positive, the almost linear sum of these factors, the resistance does not change or do so minimally.

This component has its origin in several countries and at different times. By the 50s, some companies and academic centers of technology, especially in the United States, began to investigate new techniques for components to adapt to the emerging semiconductor industry. The new electronic system should be more stable and more compact and industry of that time placed more emphasis on the accuracy and stability of the behavior with temperature changes. In the technology were two emerging types resistors, the resistors can made of very thin metal films deposited on insulating substrates such as glass or ceramics, and which reservoir is performed with metal evaporation techniques.

Then there were resistors made from metal sheets whose thicknesses were greater than those made with metal films. The metal sheets were glued to insulating substrates such as glass or ceramics.



- **Boozer**

A loudspeaker is an electroacoustic transducer used for sound reproduction. One or more speakers may form a baffle

Transduction is a double process: electro- mechanical -acoustic. In the first stage converts electric waves into mechanical energy, and the second converts mechanical energy into acoustic wave frequency. It is therefore the door where the sound comes from the external apparatus that enabled amplification, transmission by telephone or broadcast media, or treatment.

Sound is transmitted through sound waves, in this case, through the air. The ear picks up and converts these waves into nerve impulses to the brain and become signs that identify with things like music, sounds and onomatopoeia. If you have a voice recording, music on magnetic or digital media, or if these radio signals is received, will be available at the output of the apparatus of electrical signals must be converted into sounds; for this speaker is used.

Boozer features.

➤ **Frequency response.**

The frequency response of the speaker is not flat. The ideal speaker should give a uniform response, ie, equal power at all frequencies, but the speaker does not exist. In the technical specifications is indicated the frequency response:

- High quality speakers are those with a range of variation of 6 dB for the audible range between 20 and 20.000 Hz.
- Outside the high quality systems, are also acceptable variations 3dB in a range of 100 to 15.000 Hz, because in practice the human audibility range never reaches 20.000 Hz.

Conflicting band is the bass, therefore the measurement is started in the 20-30 Hz, but this figure rises to 80 Hz.

The technical specifications also often come the frequency response curve, but keep in mind that manufacturers probably have made their measurements under the most favorable conditions, so that actual results will usually be lower.

➤ **Power**

Refers to the electrical power that supports the speaker (not the acoustic power). The amount of power (in watts) that can be inserted into the speaker before it distorts too much or it can be damaged. Within the power difference between nominal output and power handling.

### ➤ **Rated power**

Maximum power, continuous duty, which can withstand without damage the speaker. If the speaker is operated above this power will permanently damage the speaker since it can not dissipate the heat produced by electric current flowing through the coil and this can melt the insulation covering the wire which form causing shorts or cutting back by melting the copper wire.

The formula for the electrical input power required is:

$$P = I^2 \cdot Z$$

### ➤ **Impedance**

The impedance, conceptually, is the opposition that has any element or device to pass an alternating current (sinusoidal), in this case the audio source is a mixture of various frequencies with which the impedance will not have the same value throughout the frequency range. The impedance is expressed in ohms.

As in the speaker impedance varies with the frequency, each speaker model for the technical specifications will curve with this ratio different impedance - frequency. The speaker impedance is specified for a particular frequency as a reference, usually 1 kHz, unless the manufacturer indicates another value.

If you want to achieve maximum energy transfer between the sound source ( the amp) and speaker impedances between them should be the same or failing the minimum accepted by the amplifier.

The impedances normalized speaker is 2, 3.2, 4, 6, 8, 16 and 32 ohms, but the most common are 4 in car audio, 6 for mini component systems, 8 for hi-fi systems, 16 for systems surround (surround) and headphones.

### ➤ **Sensitivity**

The degree of efficiency in the electroacoustic transduction. It measures the relationship between the electrical input level to the speaker and the sound pressure obtained.

Usually given in dB / W, measured at 1 m distance and applying a power of 1 W to the speaker (2.83 V above 8  $\Omega$ ).

Speakers are electroacoustic transducers with very poor sensitivity. This is because most of the rated power input to a loudspeaker is dissipated as heat.

In speakers, unlike the microphone sensitivity is not indicative of "sound quality", as practice has shown that lower sensitivity speakers produce better "sound coloration."

### ➤ **Distortion**

The speaker is one of the audio systems having more distortion, so manufacturers do not provide the consumer usually figures distortion from your speakers. The distortion has many causes: airgap flux, partial vibrations, frequency modulation on the diaphragm, linearity of the suspensions, etc...

- Most of the distortion is concentrated in the second and third harmonic, so it will affect more to the bass. It is a distortion of around 10%.
- In mid and high frequencies this distortion is proportionately much smaller and is less than 1%, although the throats of high frequency speakers this distortion reaches a margin of 10 to 15%.

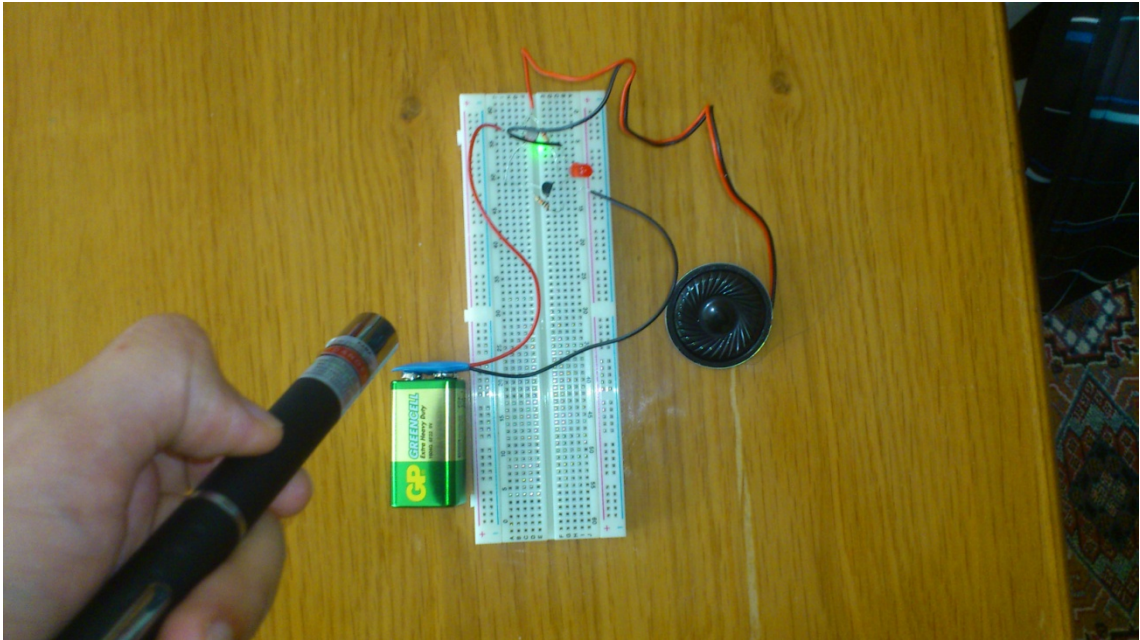
### Types of boozer

- Dynamic speaker or speaker voice coil: The electrical input signal acts on the voice coil that creates a magnetic field that varies in accordance with said direction signal. The magnetic flux interacts with a second magnetic flux normally generated by a permanent magnet which is part of the speaker body, producing a magnetic attraction or repulsion which moves the voice coil and hence the diaphragm adhered thereto. By vibrating the diaphragm moves air that has in front of him, thus creating pressure variations on the same or vibrations, or what is the same, sound waves.

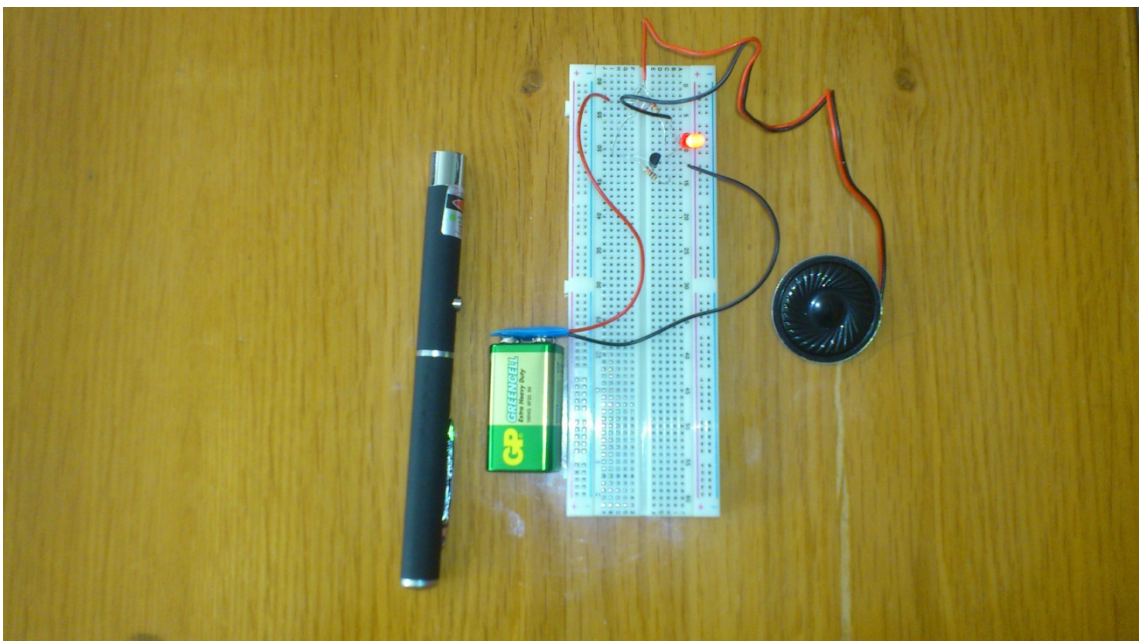
- Electrostatic loudspeaker or capacitor: These speakers have a capacitor structure with a fixed and a movable plate (diaphragm), including the stored electrical energy supplied by a voltage source. When the stored energy between the plates is increased, a force of attraction or repulsion power is produced between them, resulting in that the movable plate moves, creating a useful pressure.
- Piezoelectric Speaker: These speakers engine is a piezoelectric material, which upon receiving a voltage difference between its metallic surfaces undergoes elongation and compression. If you join one side a flared cone, it will suffer displacement able to produce an audible frequency radiated pressure.
- Ribbon Speaker: The speaker tape has a similar performance dynamic speaker, but with notable differences. Most obviously, instead of winding, the core is a corrugated ribbon.
- Speaker panel or distributed mode loudspeaker: Your electrical, mechanical and acoustic properties differ drastically from conventional speakers and using the principle of optimal distribution of modes of vibration of a thin stiff sheet that have been excited by a small transducer on a point of the panel. This is achieved radiate a wide frequency range in all directions with a considerable degree of pressure and very low distortion
- Active speaker. Speaker type characterized by the use of active filters (digital or analog), rather than passive filters to divide the audio spectrum into intervals compatible with transducers employees. The signal is amplified after the division of frequencies having a dedicated amplifier for each transducer.



## Photos *On*



## *Off*



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