



Reverse Engineering of a Remote Controller

By: Team 3383G

Introduction

Hello! We are Team 3383G from Orchard Hills Middle School in Irvine, California and we are excited to be participating in the VEX IQ competition as Team 3383G. Our team consists of Ram, Jinay, Leroy, Sahil, and Sujith. For our project, we have chosen the VEX IQ Reverse Engineering online challenge. Our main objective is to gain knowledge about the various electronic components present in this remote control (model RC-1002IR).



What kind of device did we choose to explore, and why?

Many electronic devices come with remote controls that provide various functionalities. In this project, we decided to explore a remote control due to our curiosity about how it works. Additionally since we use remotes in our daily lives our team would like to dive deeper into their workings.



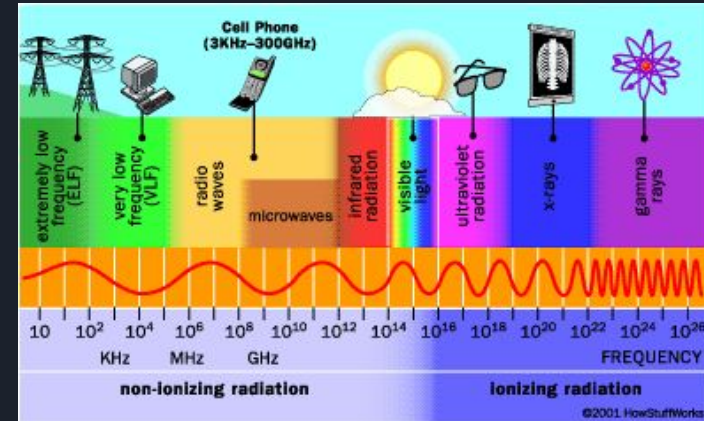
Remote - Theoretical background

How Remote Works

There are two major types of remote controls: (1) Infrared and (2) Radio Frequency (RF). The remote control we have chosen uses Infrared technology.

Earlier versions of remote controls used ultrasonic tones, but nowadays, most remote controls use infrared technology. These devices are used to control various functions such as power, volume, channels, playback, track change, heat, fan speed, and many other features. Remote controls for these devices are usually small, wireless, handheld objects with an array of buttons.

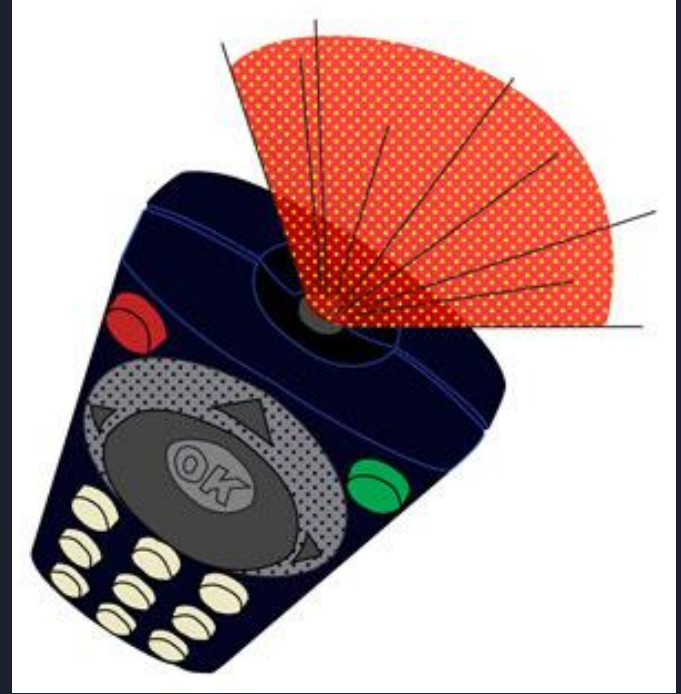
An infrared remote control works by sending an infrared signal (LED) using binary code to give the command to the DVD or TV. On the DVD or TV, there is an infrared light detector that converts the infrared light into an electrical signal.



Remote - Key component functionalities

We opened our old DVD player remote control. the remote control has key components listed below;

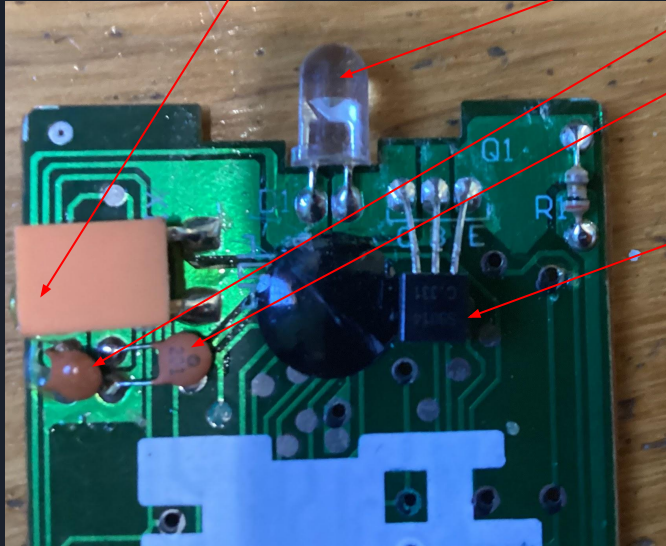
- AA batteries for power
- PCB(Printed Circuit Board)
- Integrated Circuit (IC)
- Capacitors (ceramic, electrolytic)
- Infrared transmitter/LED



What identifiable parts did we find during deconstruction?

Niobium Capacitor

Infrared Transmitter

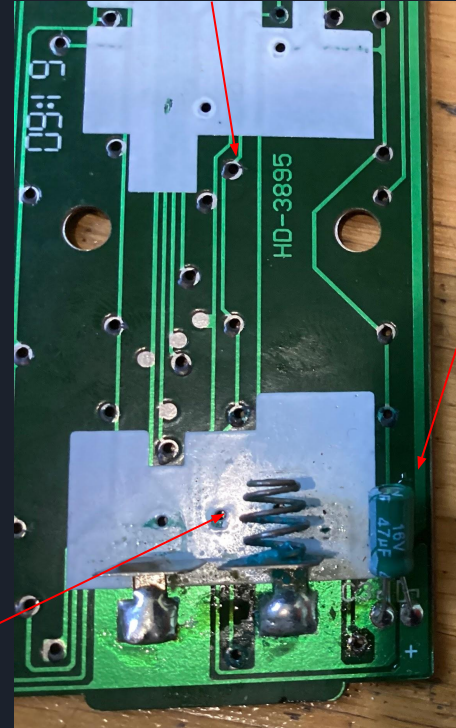


Ceramic Capacitor

IC

AA batteries holder

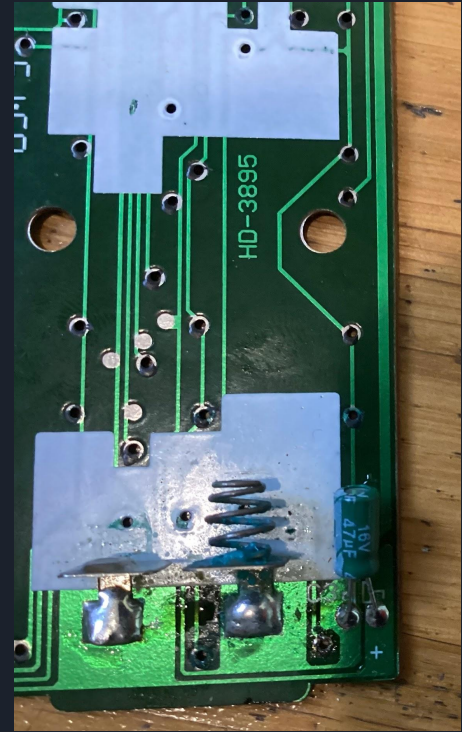
PCB



Electrolytic Capacitor

Printed Circuit Board

Printed Circuit Boards (PCBs) are essential components in almost all electronic devices. They serve to establish a connection between all the wired components of a gadget. The first PCB was invented by Paul Eisler in the UK in 1936 when he was working on a radio set. However, during its early days, this invention was not used to make things easier. Instead, Americans utilized PCBs during WW2 to develop proximity fuses that would explode just before impact. After the war, PCBs were finally utilized by Americans to create electronic devices. The small PCB found in a remote may seem insignificant, but it has a lot of power as it can be used to start a CD player.



The Disadvantageous Part Of The PCB

Although PCBs have several benefits, they have negative impacts on the environment. The chemicals present in PCBs cause greenhouse emissions that contribute to global warming. However, scientists have become aware of this issue and are now developing biodegradable PCBs that possess the same abilities as non-biodegradable ones.

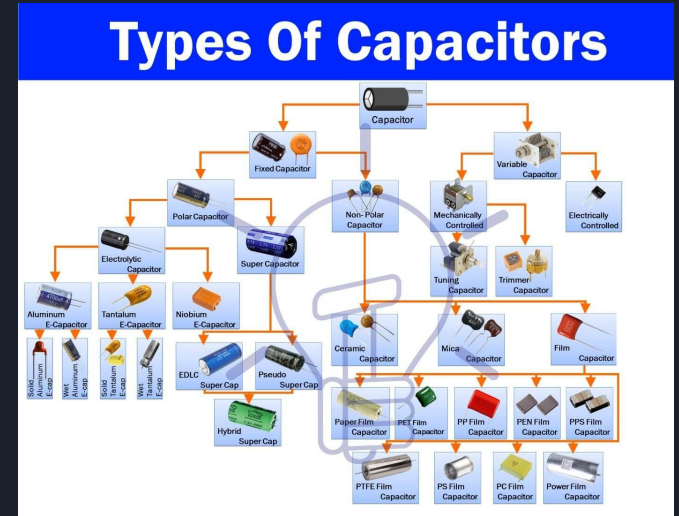


CAPACITOR

Capacitors are essential components of electronic devices, as they store electrical energy by collecting charges from two surfaces that are placed close to each other. Capacitors are made of at least two electrical conductors. Today, we will be discussing two types of capacitors, namely, the Ceramic Capacitor and the Electrolytic Capacitor.

The Ceramic Capacitor is a fixed-value capacitor, which is constructed using ceramic layers and a metal plate layer that acts as the electrodes. This type of capacitor is known for its high stability and low losses, which helps electronic devices perform at a high level.

On the other hand, the Electrolytic Capacitor is a polarized capacitor that has a much higher capacitance-voltage (CV) than the Ceramic Capacitor. They are primarily used for decoupling and noise filtering in power supplies.

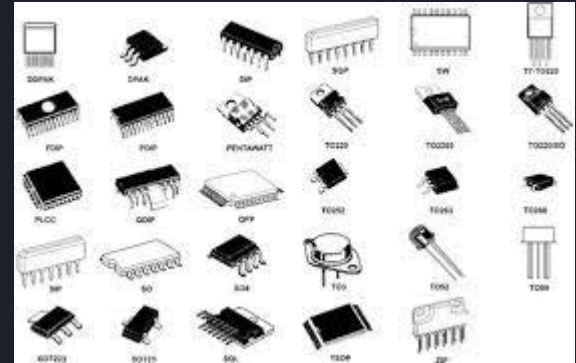


Integrated Circuit

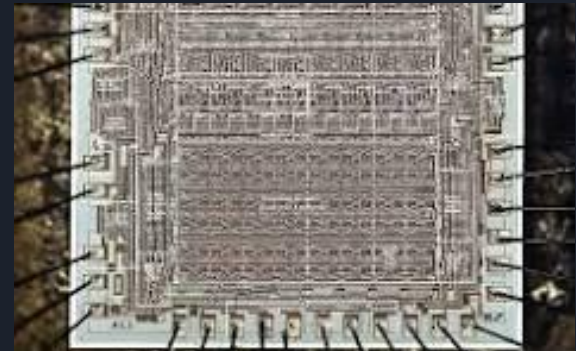
An integrated circuit, also known as IC, is a small electronic device that contains multiple interconnected electronic components such as transistors, resistors, and capacitors. These components are etched onto a small piece of semiconductor material, typically made of silicon. Integrated circuits are used in various electronic devices, including computers, smartphones, and televisions, to perform various functions such as processing and storing information. The primary function of an IC is to interpret which button has been pressed and generate the appropriate signal.

When you press a button on a remote control, it sends binary codes to an integrated circuit. The IC then converts these binary codes to a format that the DVD or TV can easily understand. The infrared LED (Light Emitting Diode) sends binary codes using infrared radiation. Each button on a remote control has a unique binary code to represent its function.

IC Types



Microscope image of IC



Infrared Transmitter/ LED (Light Emitting Diode)

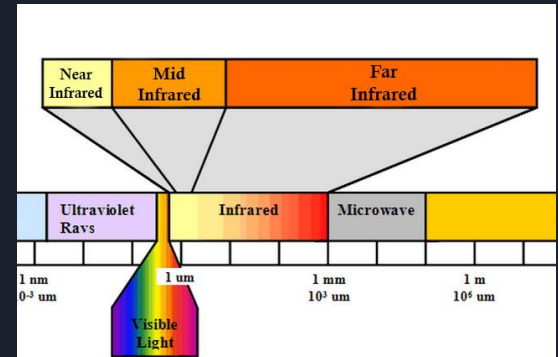
LEDs, or light-emitting diodes, are semiconductor devices that emit light when electricity passes through them. The energy released by the combination of electrons and electron holes in the semiconductor material produces photons, which determine the color of the light emitted. The band gap of the semiconductor determines the energy required for electrons to cross, which determines the color of the light.

Infrared LEDs, which emit low-intensity infrared light, were first introduced as electronic components in 1962. These LEDs are commonly used for remote-control circuits, such as those found in various consumer electronics.

LED Image



Infrared Frequency Range



Summary of what we learned about our electronic device

As part of our reverse engineering project, we acquired knowledge about the electrical core components, design concepts, and the process of assembling a product. We conducted research and gained an understanding of the communication protocol using Infrared technology. Additionally, during the project, we gained knowledge of Integrated Circuit (IC), Battery, Printed Circuit Board (PCB), Light Emitting Diode (LED), and Capacitor. We learned about the functionality of these key components and their everyday applications, such as how the PCB is used to establish a connection between the various parts of a device. Overall, working on this project was a lot of fun.



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**SO,
WHAT DID WE LEARN?**