

A Practical activity Report submitted
for Engineering Design Project-II (UTA-024)

by

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Submitted to

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INDIA

Jan-May 2023

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Experiment: 1

Objective:

- (a) To draw a schematic diagram of receiver to receive specified pulse width IR signals from gantries using CAD tool (Eagle).
- (b) To design a printed circuit board layout of receiver circuit using CAD tool (Eagle).

Software Used: Eagle Software

Component Used:

Sr. No	Name of Components	Value	Specifications
1.	Resistor	120k	Carbon Resistor with 5% Tolerance
2.	Resistor	100k	Carbon Resistor with 5% Tolerance
3.	Resistor	22k	Carbon Resistor with 5% Tolerance
4.	Resistor	1k	Carbon Resistor with 5% Tolerance
5.	Capacitor	100pf	Ceramic Capacitor
6.	LM311N		Voltage Comparator
7.	BPW41N		PIN Diode
8.	22-23-2031		PCB Header

Theory:

1. **Resistor:** Resistors are electronic components that limit or regulate the flow of electrical current in an electronic circuit, commonly made of either a carbon, metal, or metal-oxide film.

A thin film of conductive material is wrapped in a helix around and covered by an insulating material.

Resistors are passive components, meaning they only consume power.

They are usually added to circuits where they complement active components like op-amps, microcontrollers, and other integrated circuits.

Commonly resistors are used to limit current, divide voltages, and pull-up I/O lines. [1]

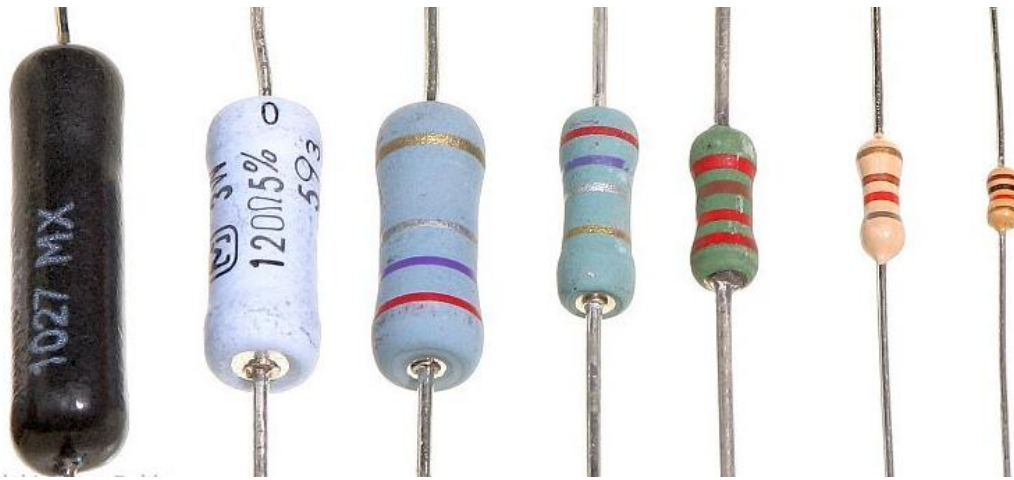


Fig. 1.1 Various types of resistors [1]

2. **Capacitor:** The capacitor is a component which has the ability to store energy in the form of electrical charges that creates a potential difference. The most basic design of a capacitor consists of two parallel conductors, separated with a dielectric material. When a voltage source is attached, the metallic plate attached to the positive terminal will be positively charged, and the plate attached to the negative terminal will be negatively charged. They are used for several things such as filters, energy storage systems, engine starters, signal processing devices, etc. [2]

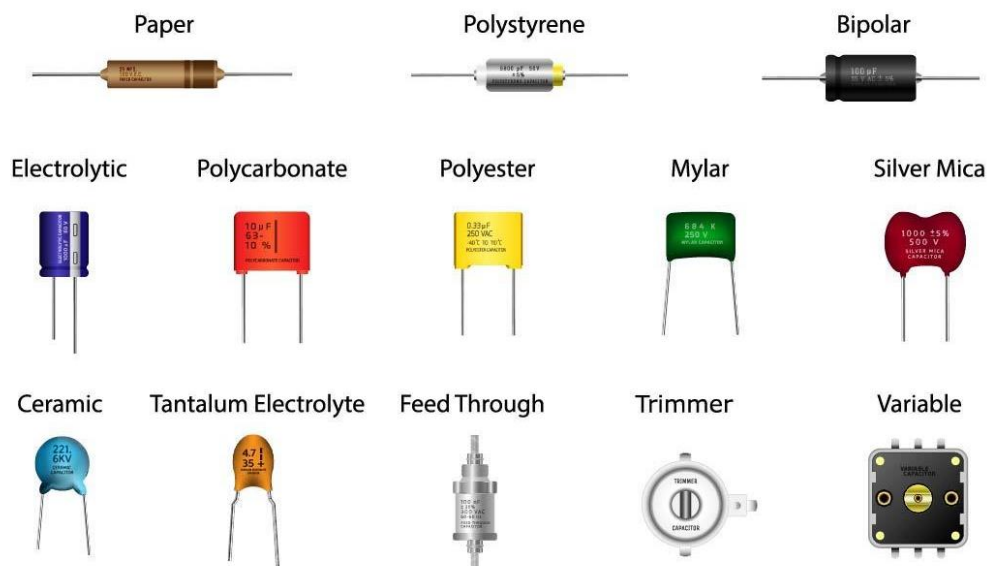


Fig. 1.2 Various types of capacitors [2]

3. **LM311N**: LM311N is a Voltage Comparator with a low input current. It is also designed to operate over a wide range of power supply voltage range: standard $\pm 15\text{V}$ operational amplifier power supply is as low as a single. The $+5\text{V}$ power supply is used for IC logic.[3]



Fig. 1.3 LM311N [3]

4. **BPW41N**: This is a PIN Diode with high speed and is highly sensitive in a flat side view plastic package. Its filter bandwidth is matched with 900 nm to 950 nm IR emitters. Suitable applications for the BPW41N include: IR radiation detectors, IR remote control and air data transmission systems.[4]

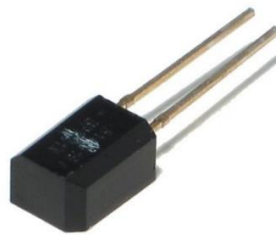


Fig. 1.4 BPW41N [4]

5. **22-23-2031**: 22-23-2031 is a 2.54 mm pitch wire to board connectors with pins that are crimped onto the end of each wire. The pins lock inside the housing and the housing fits onto the header. The connector is polarized, meaning it will only fit one way, and has a “locking ramp” which helps stop the connector from disconnecting unexpectedly. This header has 3 pins and fits works with the 3 Pin Housing and 2600 Series Pins.[5]

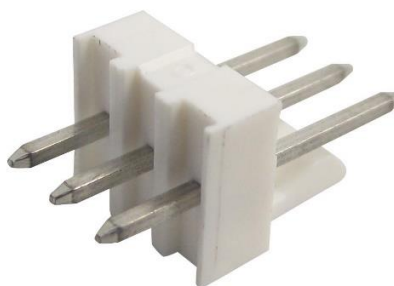


Fig. 1.5 22-23-2031[5]

Schematic diagram:

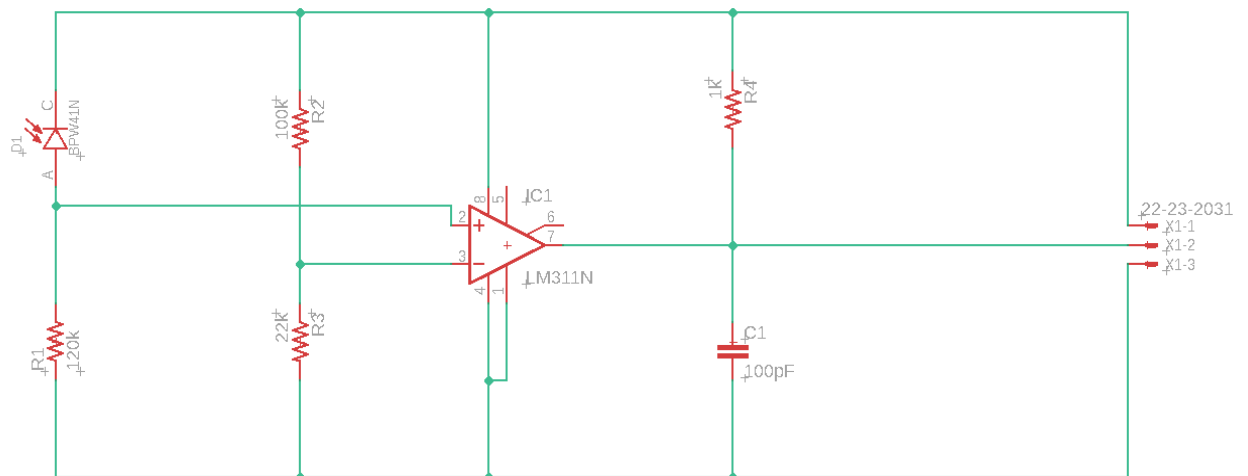


Fig. 1.6 Schematic diagram of Receiver circuit

Printed Circuit Board layout:

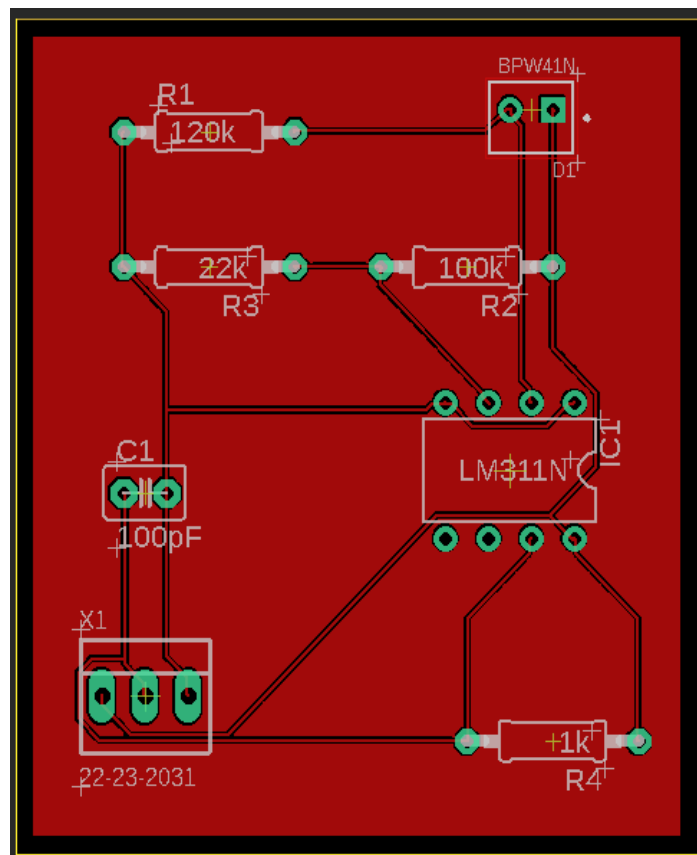


Fig. 1.7 PCB layout of Receiver circuit

Discussion:

In this experiment, we have learnt how to integrate the mentioned components to create a receiver circuit using EAGLE , which is used in the buggy. The receiver receives different signals from different gantries. A Schottky diode is used for low turn-on voltage, capable of rectifying a current by facilitating a quick transition from conducting to blocking state. An operational amplifier (op-amp) amplifies the difference in voltage between two inputs.

References:

- [1] <https://bvjus.com/physics/resistor/>
- [2] <https://www.learn.sparkfun.com>
- [3] <https://www.techtarget.com>
- [4] <https://www.electronics4u.com>
- [5] <https://www.mouser.com>

Signature of Faculty member

Experiment: 2

Objective:

- (a) To draw a schematic diagram of IR sensor module circuit (required to move Buggy module on a predefined the path) using CAD tool (Eagle).
- (b) To design a printed circuit board layout of IR sensor module circuit using CAD tool (Eagle).

Software Used: Eagle Software

Component Used:

Sr. No	Name of Components	Value	Specifications
1.	Resistor	330 Ω	Carbon Resistor with 5% Tolerance
2.	LED	3mm	Diode
3.	SFH482		Infrared Emitters
4.	BPX65		Photodiode
5.	LMV358MM		Voltage Amplifier
6.	Potentiometers		Potentiometer PT-10
7.	MTA02-100		AMP Connector

Theory:

1. **Resistor:** Resistors are electronic components that limit or regulate the flow of electrical current in an electronic circuit, commonly made of either a carbon, metal, or metal-oxide film. Commonly resistors are used to limit current, divide voltages, and pull-up I/O lines.



Fig. 2.1 Various types of resistors [1]

2. **LED:** or light emitting diode, is a type of semi-conductor device which emits light when an electric current is passed through it. They are widely used as indicators in electronic devices, as lighting in homes and vehicles, and as display backlights for digital devices such as smartphones and televisions.[2]



Fig. 2.2 LEDs [2]

3. **SFH482:** A family of Infrared (IR) LEDs, from OSRAM Opto Semiconductors, the SFH 482 series are high-brightness, high-power LEDs that are commonly used for various lighting applications, such as automotive lighting and backlight displays.[3]



Fig. 2.3 SFH482[3]

4. **BPX65:** The BPX65 is a 3-pin 1mm² High Speed Detector features high sensitivity. It has been used for encoder designs and with MIL SPEC release at the heart of advanced laser warning systems. [4]



Fig. 2.4 BPX65 [4]

5. **LMV358MM**: The LMV358MM is a single operational amplifier (op-amp) integrated circuit (IC) produced by Texas Instruments. It is a low-power, low-voltage device that is capable of operating from a single supply voltage as low as 2.7 V. [5]



Fig. 2.5 LMV358MM [5]

6. **Potentiometer**: A potentiometer is defined as a 3 terminal variable resistor in which the resistance is manually varied to control the flow of electric current. A potentiometer acts as an adjustable voltage divider. [6]



Fig. 2.6 Potentiometer [6]

7. **MTA02-100**: MTA 100 connectors provide both wire-to-board and wire-to-wire systems based on insulation displacement contact (IDC) technology. [7]



Fig. 2.7 MTA02-100 [7]

Schematic diagram:

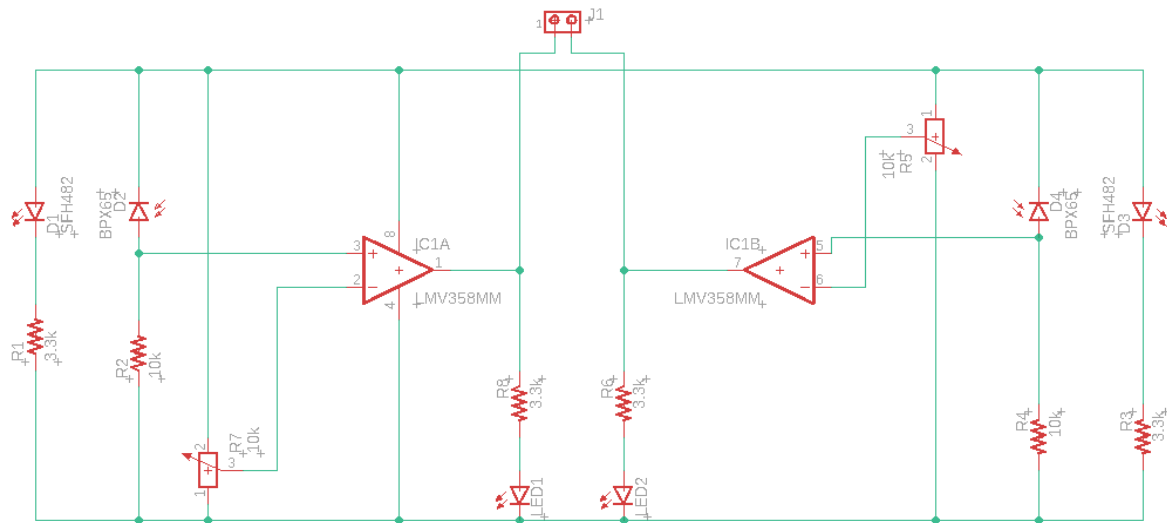


Fig. 2.8 Schematic diagram of IR sensor module circuit

Printed Circuit Board layout:

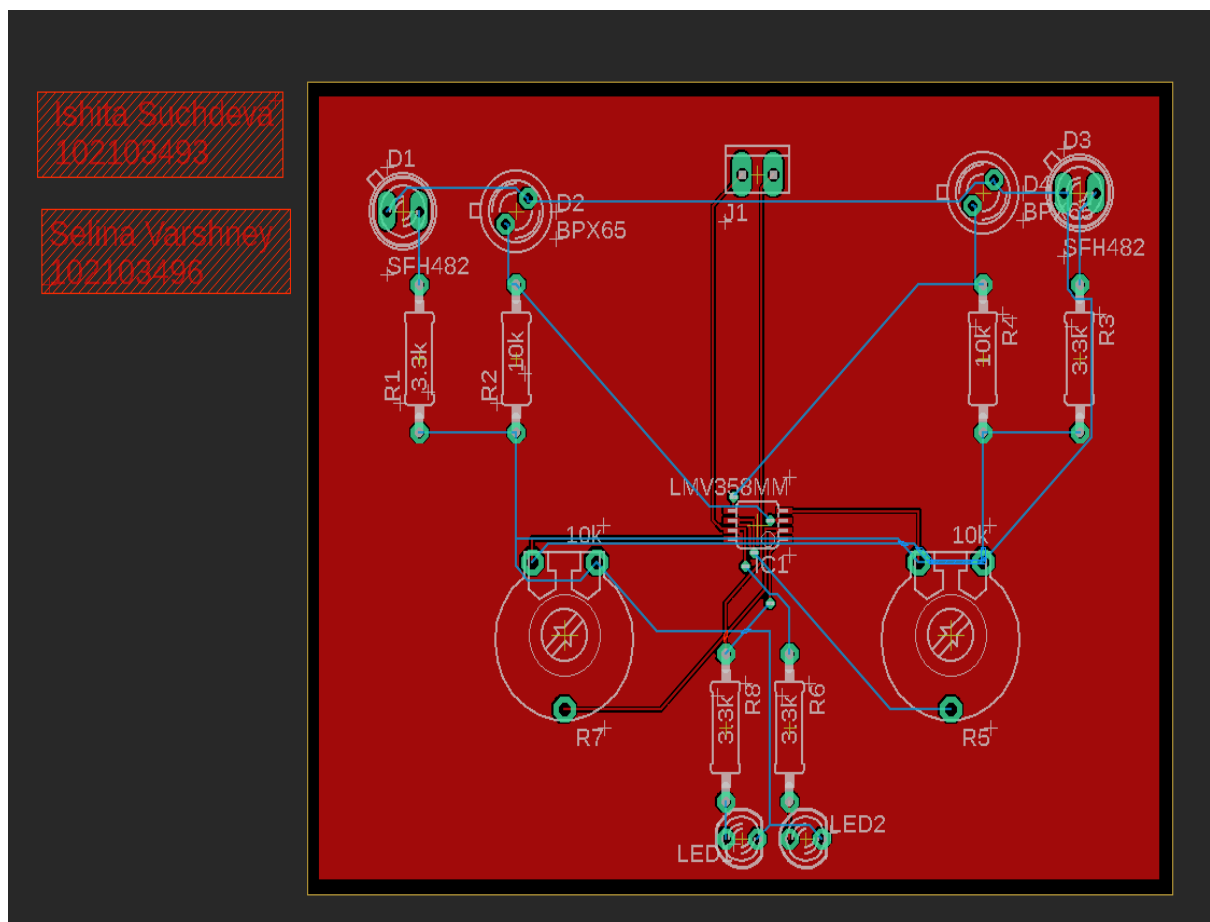


Fig. 2.9 PCB layout

Discussion:

The infrared sensor module is an electronic device, that emits and/ or detects some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. It is mounted on the buggy and detects the IR signals from the gantries and converts them into electrical signals that can be processed by the microcontroller.

References:

- [1] <https://byjus.com/physics/resistor/>
- [2] <https://www.learn.sparkfun.com/led>
- [3] <https://sg.rs-online.com/web/p/ir-leds/6655552>
- [4] <https://in.element14.com/centronic/bpx65/photodiode/dp/327451>
- [5] <https://www.ti.com/product/LMV358-N/part-details/LMV358MM/NOP>
- [6] <https://www.electrical4u.com/potentiometer/>
- [7] <https://www.mouser.in/new/te-connectivity/te-connectivity-mta/>

Signature of Faculty member

Experiment: 3

Objective:

- (a) To draw a schematic diagram of pulse width modulation (PWM) based transmitter for generating specified pulse width waveforms for gantries placed at different locations on the path using CAD tool (Eagle).
- (b) To design a printed circuit board layout of pulse width modulation (PWM) based transmitter circuit using CAD tool (Eagle).

Software Used: Eagle Software

Component Used:

Sr. No	Name of Components	Value	Specifications
1.	Resistor	330 Ω	Carbon Resistor with 5% Tolerance
2.	Capacitor	1uF	Electrolytic Capacitor
3.	Capacitor	10uF	Electrolytic Capacitor
4.	DCJ0202		DC Power Jack
5.	IC7805T		Voltage regulator
6.	LED	3mm	Diode
7.	22-23-2031		PCB Header
8.	IC:ATTINY85-20P		Microcontroller

Theory:

1. **Resistor:** Resistors are electronic components that limit or regulate the flow of electrical current in an electronic circuit, commonly made of either a carbon, metal, or metal-oxide film. A thin film of conductive material is wrapped in a helix around and covered by an insulating material. Resistors are passive components, meaning they only consume power. They are usually added to circuits where they complement active components like op-amps, microcontrollers, and other integrated circuits. Commonly resistors are used to limit current, divide voltages, and pull-up I/O lines. [1]



Fig. 3.1 Various types of resistors [1]

2. **Capacitor**: The capacitor is a component which has the ability to store energy in the form of electrical charges that creates a potential difference. The most basic design of a capacitor consists of two parallel conductors, separated with a dielectric material. When a voltage source is attached, The metallic plate attached to the positive terminal will be positively charged, and the plate attached to the negative terminal will be negatively charged. They are used for several things such as filters, energy storage systems, engine starters, signal processing devices, etc. [2]

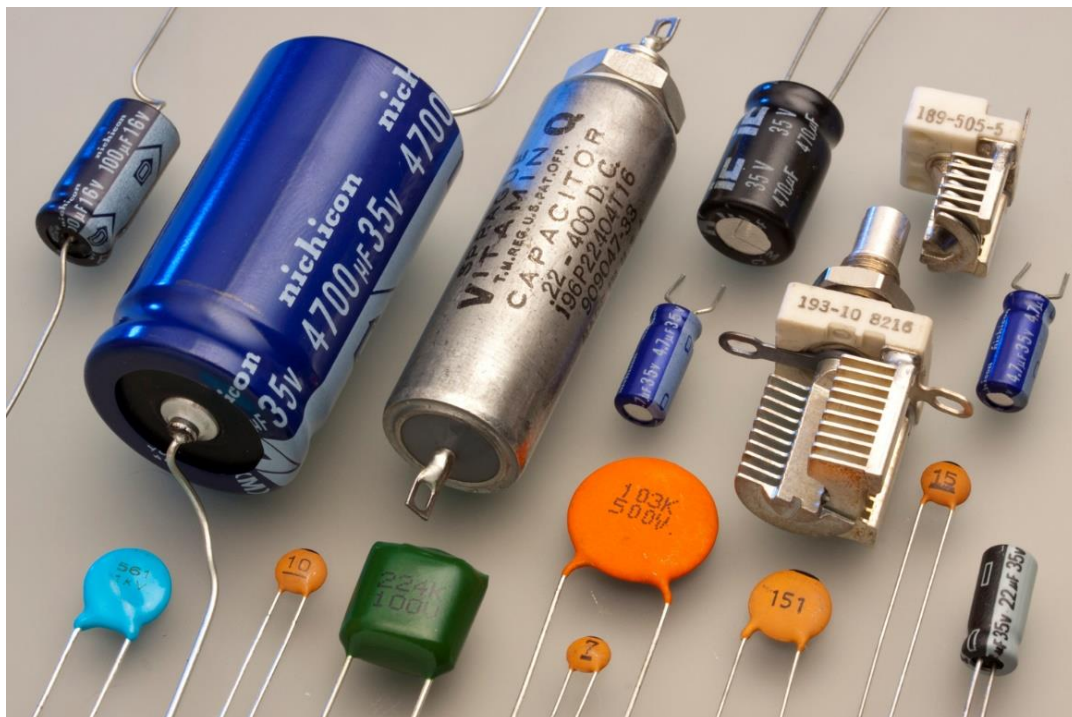


Fig. 3.2 Various types of capacitors [2]

3. **DCJ0202:** It is a power jack/connector. This is a common barrel-type power jack for DC wall supplies. These are compatible with our DC wall supplies and have a 5.5 mm jack with a 2.1 mm centre pole diameter. [3]



Fig. 3.3 DCJ0202 [3]

4. **IC 7805T:** A voltage regulator IC maintains the output voltage at a constant value. 7805 Voltage Regulator, a member of the 78xx series of fixed linear voltage regulators used to maintain such fluctuations, is a popular voltage regulator integrated circuit (IC). [4]

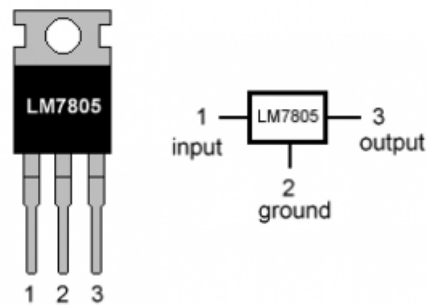


Fig. 3.4 IC 7805T [4]

5. **LED:** or light emitting diode, is a type of semi-conductor device which emits light when an electric current is passed through it. They are widely used as indicators in electronic devices, as lighting in homes and vehicles, and as display backlights for digital devices such as smartphones and televisions. [5]



Fig. 3.5 LEDs [5]

6. **ICATTINY85-20P**: ATtiny (also known as TinyAVR) is a subfamily of the popular 8-bit AVR microcontrollers, which typically has fewer features, fewer I/O pins, and less memory than other AVR series chips. The ATtiny85 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. [6]



Fig. 3.6 ICATTINY85-20P [6]

7. **22-23-2031**: 22-23-2031 is a 2.54 mm pitch wire to board connectors with pins that are crimped onto the end of each wire. The pins lock inside the housing and the housing fits onto the header. The connector is polarized, meaning it will only fit one way, and has a “locking ramp” which helps stop the connector from disconnecting unexpectedly. This header has 3 pins and fits works with the 3 Pin Housing and 2600 Series Pins. [7]

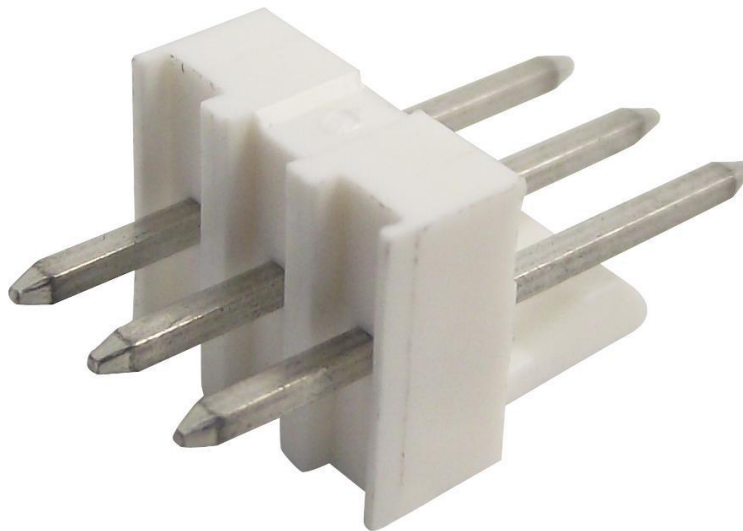


Fig. 3.7 22-23-2031[7]

Schematic diagram:

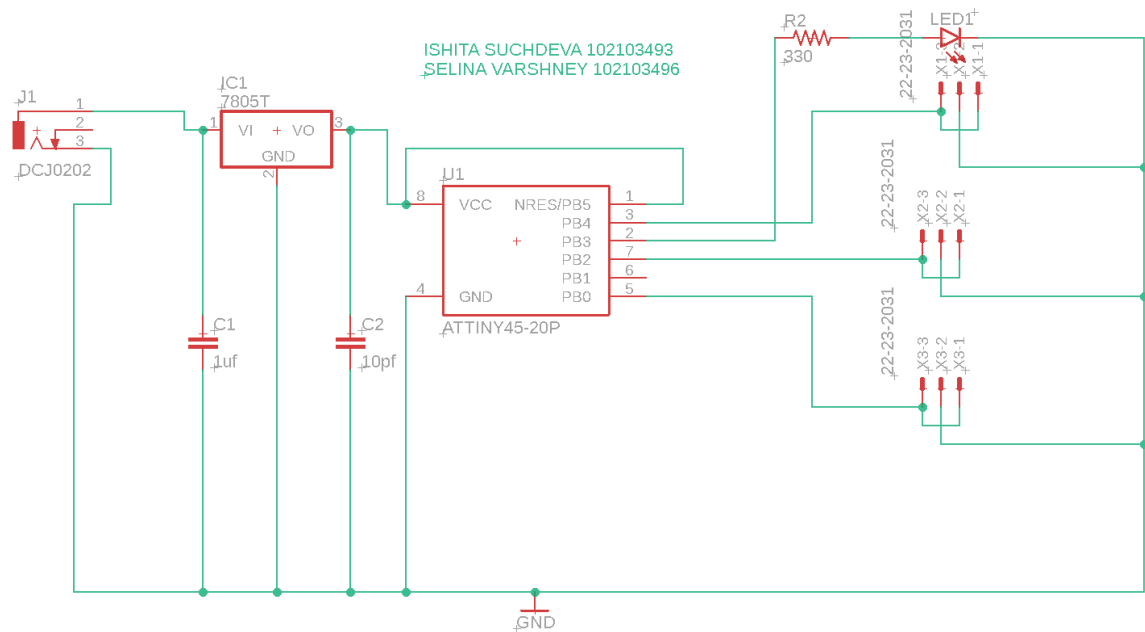


Fig. 3.8 Schematic diagram of Transmitter circuit

Printed Circuit Board layout:

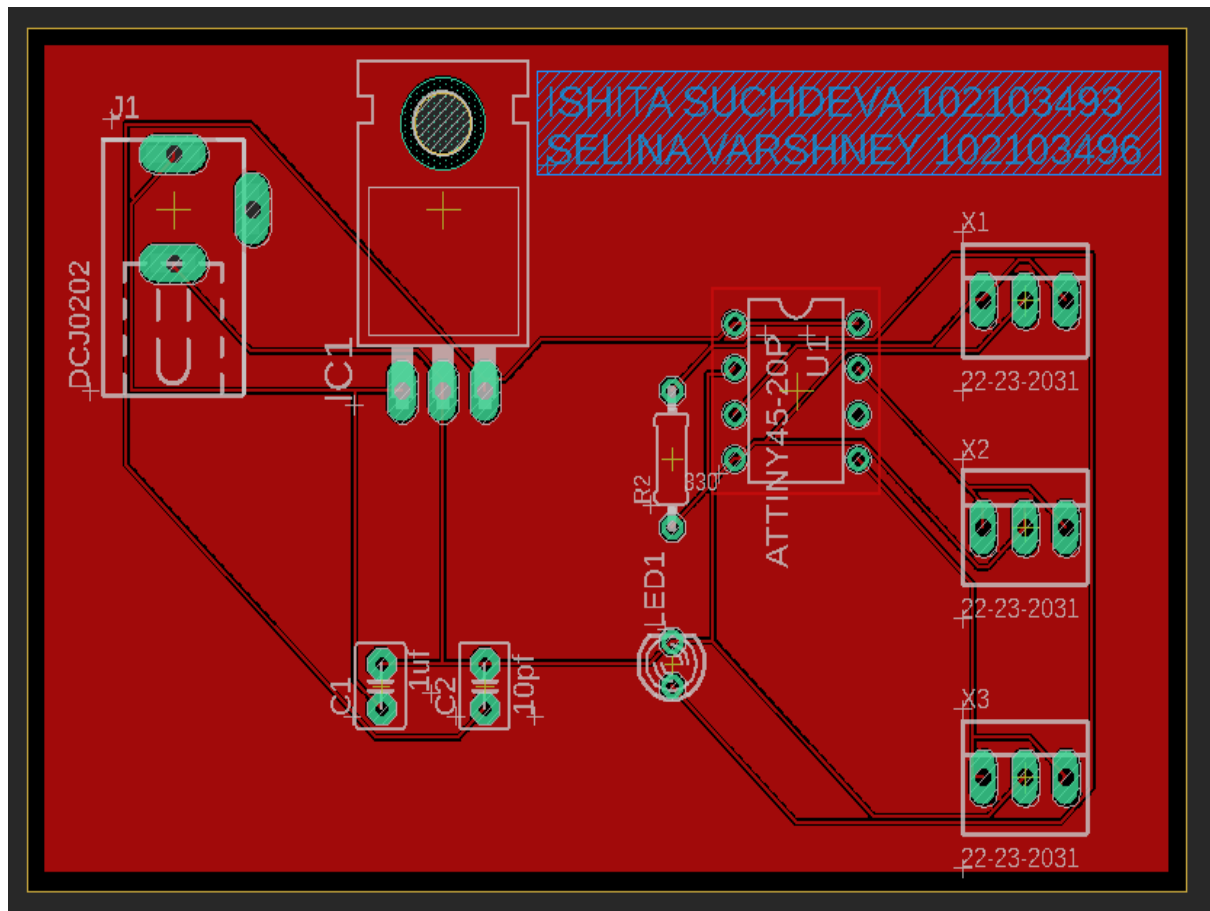


Fig. 3.9 PCB layout of Transmitter circuit

Discussion:

Pulse width modulation (PWM) is a widely used technique for controlling the amount of power delivered to an electrical load. In the case of a PWM-based transmitter, the signal being transmitted is a series of pulses that vary in width, hence the name pulse width modulation. The width of each pulse represents a specific value, and the sequence of pulses is used to control the behaviour of a system.

References:

- [1] <https://byjus.com/physics/resistor/>
- [2] <https://www.learn.sparkfun.com/>
- [3] <https://cdn.sparkfun.com/datasheets/Prototyping/ADC-H-028-1.pdf>
- [4] <https://www.futurlec.com/Linear/7805Tpr.shtml>
- [5] <https://www.learn.sparkfun.com/led/>
- [6] <https://www.ICfever.com/ICATTINY85-20P/>
- [7] <https://www.mouser.in>

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