

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

Garati	102103188
Iqman Singh Bhatia	102103189
Narinder Kaur	102103190
Jasleen Kaur	102103191
Jatinjot Singh	102103192

Submitted to
Dr. Debayani Ghosh



DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
THAPAR INSTITUTE OF ENGINEERING AND TECHNOLOGY, (A
DEEMED TO BE UNIVERSITY), PATIALA, PUNJAB
INDIA
JAN-JUNE 2023

TABLE OF CONTENT

Experiment No.	Objective
1	a) To design a schematic circuit diagram of PWM Receiver for Gantry using Eagle software tool.
	b) To design a Printed Circuit Board layout of PWM Receiver for Gantry using Eagle software tool.
2	a) To design a Schematic Circuit Diagram of IR Sensor Module circuit (which helps Buggy robot to move on a predefined path as a line follower) using Eagle software tool.
	b) To design a Printed Circuit Board layout of IR Sensor Module circuit (which helps Buggy robot to move on a predefined path as a line follower) using Eagle software tool.
3	a) To design a Schematic Circuit Diagram of PWM Transmitter (for generating specified pulse width waveforms) for Gantry using Eagle software tool.
	b) To design a Printed Circuit Board layout of PWM Transmitter (for generating specified pulse width waveforms) for Gantry using Eagle software tool.
4	a) To solder PWM Receiver circuit on a general-purpose PCB.
	b) To test the combined module of PWM transmitter and receiver circuits on Buggy Track with Gantry provision through supervisory control mode for bronze level.
5	a) To solder IR sensor module circuit on a general-purpose PCB.
	b) To test the output pulses of IR sensor module on predefined track as path follower.
6	a) To solder PWR Transmitter circuit on a general-purpose PCB.
	b) To write a Program and upload it on the ATtiny based microcontroller.
	c) To test the output pulses on CRO generated through PWM transmitter circuit.

EXPERIMENT – 1

- **Objective:**

- To design a schematic circuit diagram of PWM Receiver for Gantry using Eagle software tool.
- To design a Printed Circuit Board layout of PWM Receiver for Gantry using Eagle software tool.

- **Software Used:** AUTODESK Eagle Software

- **Components Used:**

S. No.	Name of Components	Value	Specification
1.	Resistor (4)	120k Ω	Carbon Resistor with 5% Tolerance
		100k Ω	
		22k Ω	
		1k Ω	
2.	Capacitor	100nF	Ceramic Capacitor
3.	LM311N		Operational Comparator
4.	MBD701		Schottky Diode
5.	22-23-2031		Molex

- **Theory:**

- 1. Resistor:** Resistors are electronic components that limit the flow of electric current when applied in a circuit. It helps to save the appliances from heavy current flow.

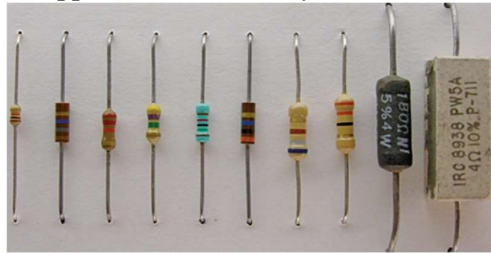


Fig. 1.1 Various types of resistors

- 2. Capacitor:** A capacitor is an electrical device that can store energy in the form of an electric charge. It consists of two electrical conductors that are separated by a distance. The ability of the capacitor to store charges is known as capacitance.



Fig. 1.2 Various types of capacitors

- 3. Operational Comparator (LM311N):** The LM 311 IC is a voltage comparator. The operating voltage of this IC ranges from -15Volts to 15Volts. This IC can also function with 5Volts for the logic systems.

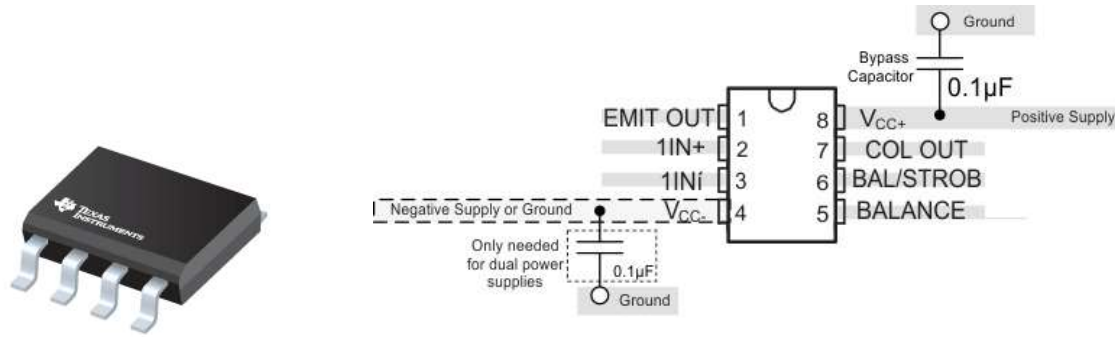


Fig. 1.3 Operational Comparator and its PIN Configuration

4. **Schottky Diode (MBD701):** A Schottky diode, also known as a hot carrier diode, is a semiconductor diode which has a low forward voltage drop and a very fast switching action. There is a small voltage drop across the diode terminals when current flows through a diode.



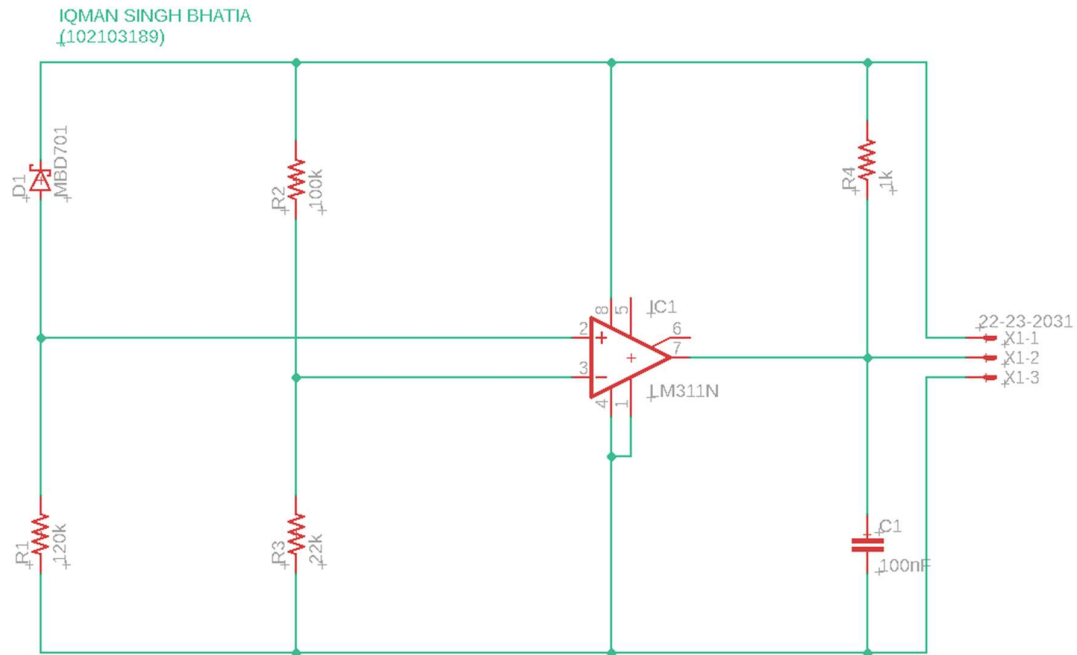
Fig. 1.4 MBD701

5. **Molex Connector (22-23-2031):** 22-23-2031 is a 3 circuit KK 254 solid header with friction lock mates with mates with 2695, 6471, 7880, 4455, 7720.

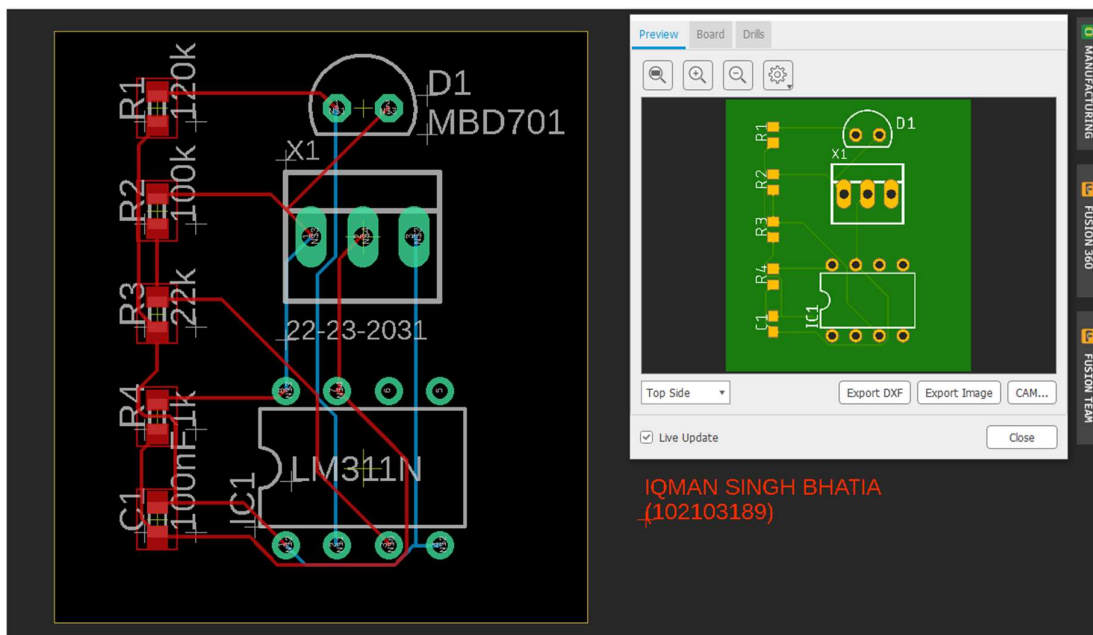


Fig. 1.5 Molex Connector (22-23-2031)

- Schematic diagram:**



- Printed Circuit Board Layout:**



- **Discussion:**

In this assignment, we learned to design PCB receiver circuit using various electrical components (resistor, voltage regulator, HLMP6 etc.) and connection configurations that will be used in determining the gantries.

- **Reference:**

- [1] <https://www.electronicsforu.com/technology-trends/learn-electronics/determine-resistor-values-circuit>
- [2] [https://en.wikipedia.org/wiki/Capacitor#/media/File:Capacitors_\(7189597135\).jpg](https://en.wikipedia.org/wiki/Capacitor#/media/File:Capacitors_(7189597135).jpg)
- [3] <https://udvabony.com/product/78l05-voltage-regulator/>
- [4] <https://www.microchip.com/en-us/product/PIC12F629>
- [5] https://www.alibaba.com/product-detail/dcj0202-dc-power-jack-DC-Power_62222568222.html
- [6] https://www.jameco.com/z/22-23-2031-Molex-Connector-Wire-to-Board-Header-3-Position-2-54mm-Solder-Straight-Thru-Hole-Color-may-vary-_232274.html

Signature of Faculty Member

EXPERIMENT – 2

- **Objective:**

- To design a Schematic Circuit Diagram of IR Sensor Module circuit (which helps Buggy robot to move on a predefined path as a line follower) using Eagle software tool.
- To design a Printed Circuit Board layout of IR Sensor Module circuit (which helps Buggy robot to move on a predefined path as a line follower) using Eagle software tool.

- **Software Used:** AUTODESK Eagle Software

- **Components Used:**

Sr. No	Name of Components	Value	Specification
1.	Resistor (6)	330 Ω (4)	Carbon Resistor with 5% Tolerance
		10k Ω (2)	
2.	LED3MM (2)		LED
3.	LMV358MM (2)		High Gain Operational Amplifier
4.	SFH482 (2)		IR Led
5.	BPX65 (2)		Photodiode
6.	Potentiometer (2)	10k	
7.	MTA02-100 (2)		AMP Connector

- **Theory:**

- 1. Resistor:** Resistors are electronic components that limit the flow of electric current when applied in a circuit. It helps to save the appliances from heavy current flow.

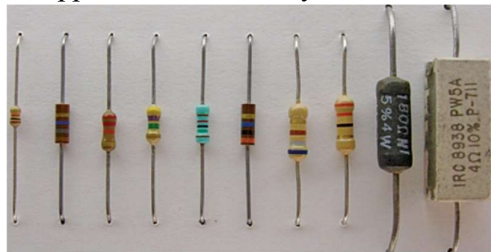


Fig. 2.1 Various types of resistors

- 2. LED:** LED stands for light emitting diode. It is an electronic device that produces light using light emitting-diodes. An electrical current pass through a microchip, which illuminates the tiny light sources producing visible light.

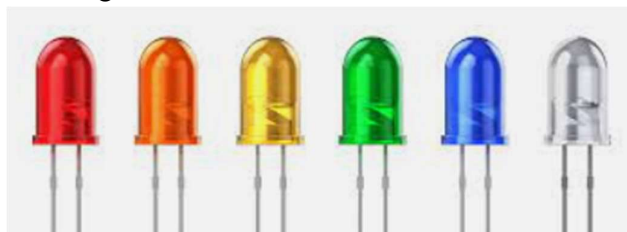


Fig. 2.2 Different coloured LEDs

3. **Operational Amplifier (LMV358):** It is an operational amplifier. It is a cost-effective solution for applications where low power consumption and space saving packages are critical. It consists of two parts. Each part has two input inverting pins, an output pin, a positive power supply pin and a negative power supply pin. They can operate with voltages as low as 2.7V. It's basic role is to amplify and output the voltage difference between the two input pins.

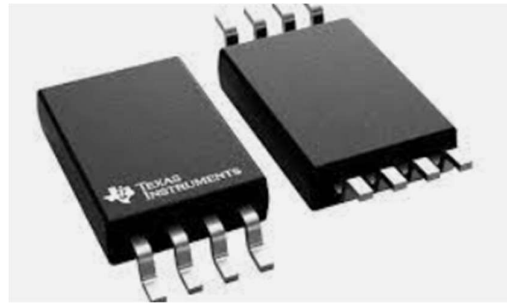


Fig. 2.3 LMV358- Operational Amplifier

4. **IR LED (SFH482):** SFH482 is a type of diode or simple semiconductor. Electric current is allowed to flow in only one direction in diodes. As the current flows, electrons fall from one part of the diode into holes on another part. In order to fall into these holes, the electrons must shed energy in the form of photons, which produce light. We used it in our project for the transmission thus to complete the receiver circuit.



Fig. 2.4 IR LED-SFH482

5. **Photodiode (BPX65):** The BPX65 is a 3-pin 1mm^2 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.



Fig. 2.5 Photodiode-BPX65

6. **Potentiometer:** The potentiometer is the three terminal device used for measuring the potential differences by manually varying resistances. It is an instrument which measures the unknown voltage by comparing it with the known voltage. It is essentially a voltage divider used for measuring electric potential (voltage). In our experiment we used potentiometer as a type of position sensor. They are used to measure displacement in any direction.

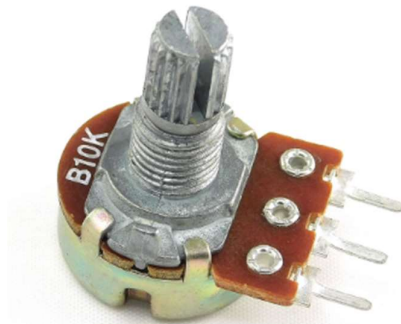


Fig. 2.6 Potentiometer

7. **MTA02-100(AMP Connector):** MTA 100 connector permit mass termination of wires for low applied costs. Available as a wire-to-board or wire-to-wire system, based on insulation displacement contact (IDC) technology which requires no stripping of wires, the connectors are color-coded to indicate wire gauge.

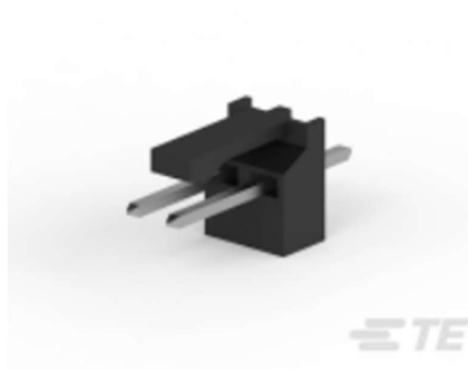
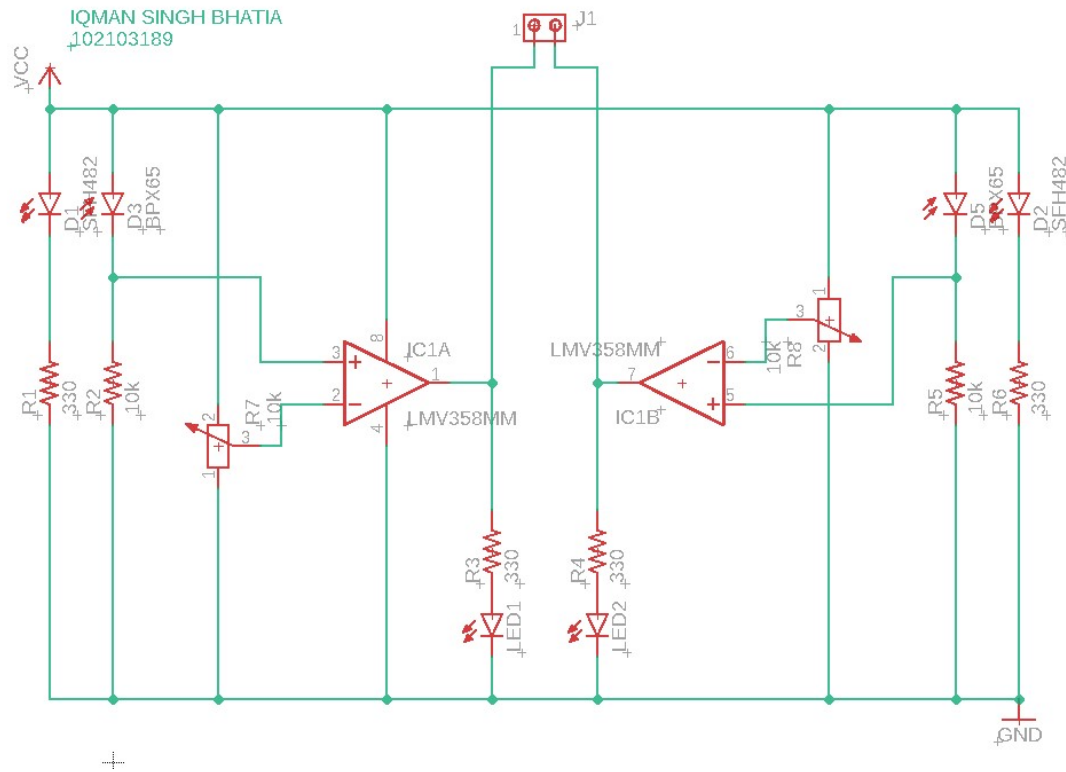
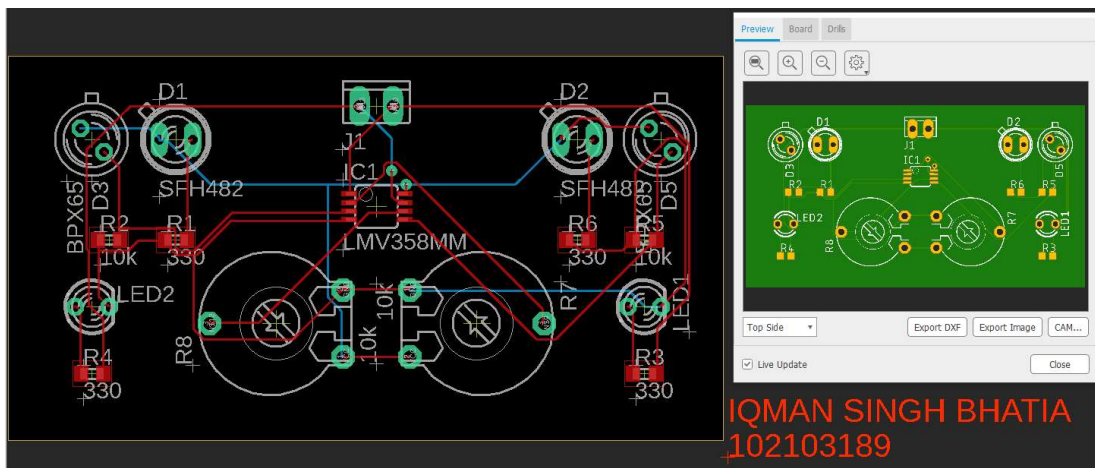


Fig. 2.7 MTA02-100

- Schematic diagram:**



- Printed Circuit Board Layout:**



- **Discussion:**

In this experiment we have learnt how the IR sensor module works. This module helps buggy to move on a defined path. We learned the use and functioning of various components that are required to make the circuit. We also made a PCB layout for the same circuit. In this experiment, we used EAGLE Software to draw and simulate the circuit.

- **Reference:**

- [1] <https://www.electronicsforu.com/technology-trends/learn-electronics/determine-resistor-values-circuit>
- [2] <https://www.ti.com/product/LMV358/part-details/LMV358QPWR>
- [3] [https://en.wikipedia.org/wiki/Capacitor#/media/File:Capacitors_\(7189597135\).jpg](https://en.wikipedia.org/wiki/Capacitor#/media/File:Capacitors_(7189597135).jpg)
- [4] <https://udvabony.com/product/78l05-voltage-regulator/>
- [5] <https://www.microchip.com/en-us/product/PIC12F629>
- [6] <https://in.element14.com/amp-te-connectivity/640445-4/connector-header-tht-3-96mm-4way/dp/589068>

Signature of Faculty Member

EXPERIMENT – 3

- **Objective:**

- To design a Schematic Circuit Diagram of PWM Transmitter for Gantry using Eagle software tool.
- To design a Printed Circuit Board layout of PWM Transmitter for Gantry using Eagle software tool.

- **Software Used:** AUTODESK Eagle Software

- **Components Used:**

Sr. No	Name of Components	Value	Specifications
1.	Resistor	220 Ω	Carbon Resistor with 5% Tolerance
2.	Capacitor	1000nF 10nF	Electrolytic Capacitor
3.	DCJ0202		DC Power Jack
4.	LED3MM		LED
5.	IC 7805T		Positive Voltage Regulator
6.	22-23-2031		Molex (3)
7.	ATMEL ATTINY 85 20P		Microcontroller

- **Theory:**

- 1. Resistor:** Resistors are electronic components that limit the flow of electric current when applied in a circuit. It helps to save the appliances from heavy current flow.

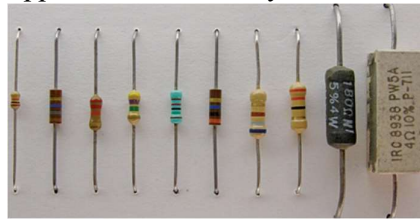


Fig. 3.1 Various types of resistors

- 2. Capacitor:** A capacitor is a device that stores electrical energy in an electric field. It is a passive electronic component with two terminals. Two conductors of positive and negative charge are separated with insulator between them.



Fig. 3.2 Various types of capacitors

- 3. DC connector (DCJ0202):** A DC connector (or DC plug), is an electrical connector for supplying direct current (DC) power. DCJ0202 is a common barrel-type DC Connector

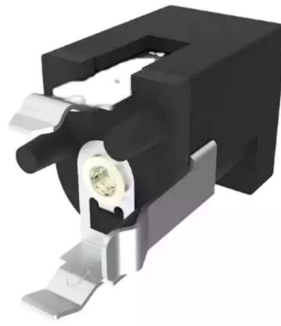


Fig. 3.3 DCJ0202

4. **LED (LED3MM):** LED stands for light emitting diode. It is an electronic device that produces light using light emitting-diodes. An electrical current pass through a microchip, which illuminates the tiny light sources producing visible light.

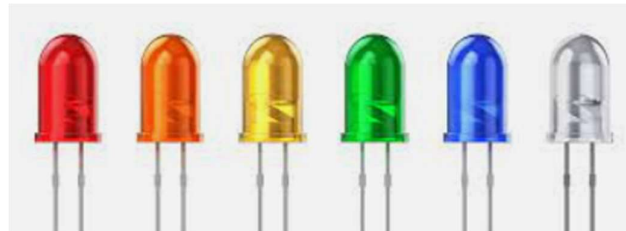


Fig. 3.4 Different coloured LEDs

5. **Positive Voltage Regulator (IC 7805T):** The 7805T voltage regulator IC is part of the 78xx voltage regulator IC series. It is a linear voltage regulator with a fixed output. The xx in 78xx represents the value of the fixed output voltage provided by the specific IC. It is a +5V DC controlled power supply for the 7805 integrated circuit. It can work with both AC and DC voltages.

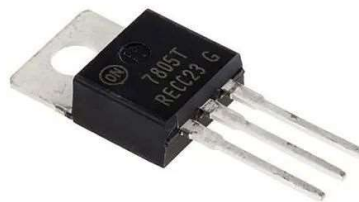


Fig. 3.5 Voltage regulator 7805T

6. **ATMEL ATTINY 85 20P Microcontroller:** ATtiny85 microcontroller is a small & high-performance based AVR microcontroller and it uses a RISC CPU. This microcontroller is available in two packages which are mainly used for interfacing & controlling between different sensors & devices. Some of the main functions of this microcontroller include timers, SPI communication, I2C

communication, BOD (Brown Out Reset), Interrupt & ADC. This ATtiny85 microcontroller includes different memories like FLASH, EEPROM & SRAM.

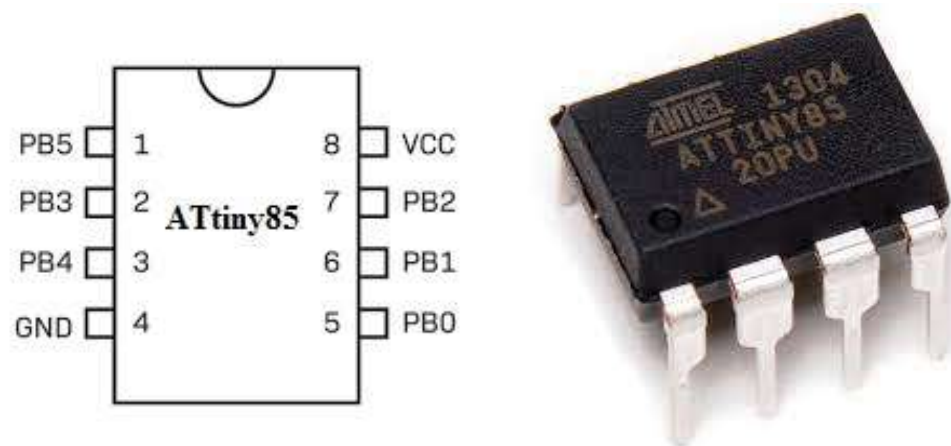


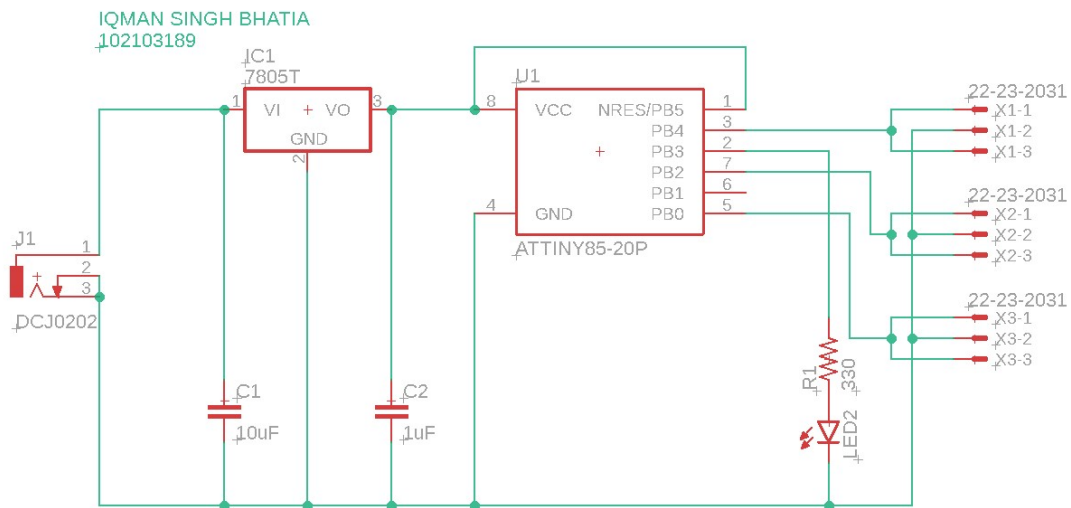
Fig. 3.6 ATMEL ATTINY 85 Pin Configuration and Microcontroller

7. **Molex Connector (22-23-2031):** 22-23-2031 is a 3 circuit KK 254 solid header with friction lock mates with mates with 2695, 6471, 7880, 4a455, 7720.

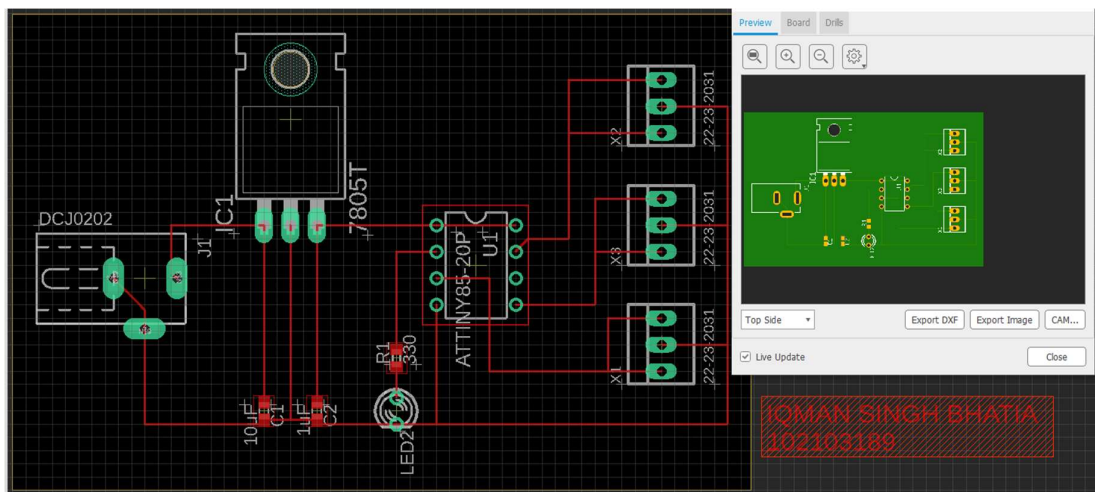


Fig. 3.7 Molex Connector (22-23-2031)

- Schematic diagram:**



- Printed Circuit Board Layout:**



- **Discussion:**

In this experiment, we had to build a PWM (pulse width modulation) Transmitter circuit using the various electrical components we had previously used. A DC jack is used to convert AC voltage to DC voltage. Then, this value is changed to 5 V using the voltage controller of the 7805T microcontroller. Additionally, we learned how to create circuit schematics and PCB layouts using the Autodesk Eagle software.

- **Reference:**

- [1] <https://www.electronicsforu.com/technology-trends/learn-electronics/determine-resistor-values-circuit>
- [2] <https://www.ti.com/product/LMV358/part-details/LMV358QPWR>
- [3] [https://en.wikipedia.org/wiki/Capacitor#/media/File:Capacitors_\(7189597135\).jpg](https://en.wikipedia.org/wiki/Capacitor#/media/File:Capacitors_(7189597135).jpg)
- [4] <https://udvabony.com/product/78l05-voltage-regulator/>
- [5] <https://www.microchip.com/en-us/product/PIC12F629>
- [6] https://www.alibaba.com/product-detail/dcj0202-dc-power-jack-DC-Power_62222568222.html
- [7] <https://in.element14.com/amp-te-connectivity/640445-4/connector-header-tht-3-96mm-4way/dp/589068>

Signature of Faculty Member

EXPERIMENT - 4

- **Objective:**

Design and testing of PWM Receiver circuit which can sense the signal of a specific pulse width and able to recognize the corresponding Gantry.

- c) To solder PWM Receiver circuit on a general-purpose PCB.
- d) To test the combined module of PWM transmitter and receiver circuits on Buggy Track with Gantry provision through supervisory control mode for bronze level.

- **Component Used:**

Sr. No	Name of Components	Value	Specifications
1.	Resistor	120K Ω	Carbon Resistor with 5% Tolerance
2.		100K Ω	Carbon Resistor with 5% Tolerance
3.		22 K Ω	Carbon Resistor with 5% Tolerance
4.		1 K Ω	Carbon Resistor with 5% Tolerance
5.	Capacitor	100nF	Ceramic Capacitor
6.	LM311D		Voltage Comparator
7.	MBD701		Schottky diode

- **Components used for soldering:**

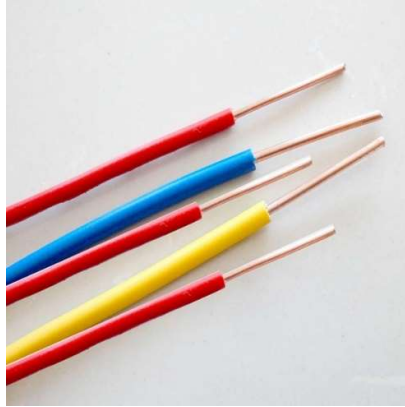
1. **Solder Iron:** A soldering iron is a **hand tool used to heat solder**, usually from an electrical supply at high temperatures above the melting point of the metal alloy. This allows for the solder to flow between the workpieces needing to be joined.



2. **Solder wire:** Solder wires are wires with a low melting point which can melt along with the soldering iron. Depending on the application and soldering temperature, many different types of soldering wires are available.



3. Connecting wires:



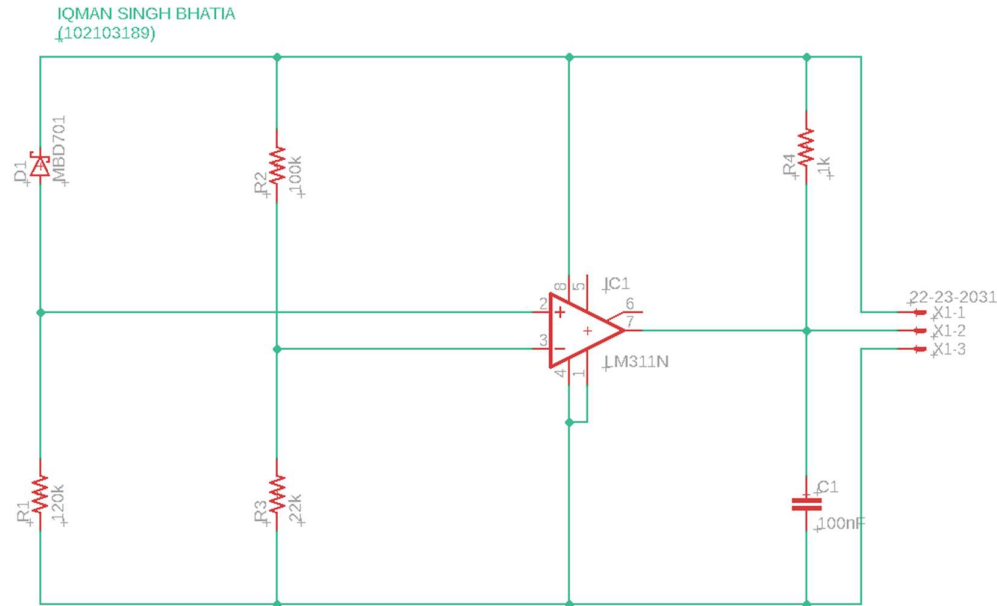
4. **Wire Cutter:** A wire stripper/cutter is a small, hand-held device used to strip the electrical insulation from electric wires.



5. **Suction Pump:** Vacuum pump for desoldering. When pump is triggered, the piston creates a vacuum in the front desoldering head and allows entering the air only from the hole on the tip. As the piston moves speedily, the sudden vacuum draws the air next to the tip and with the air the molten solder is also drawn.



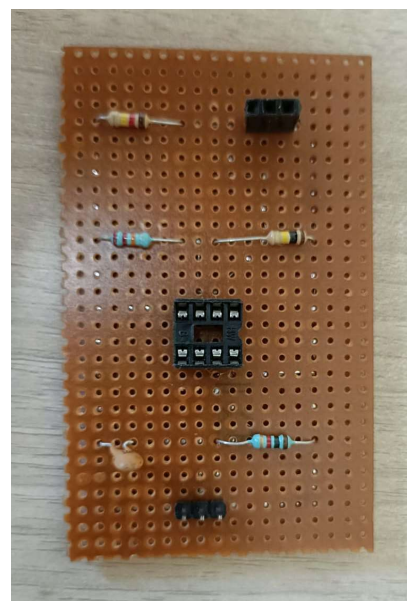
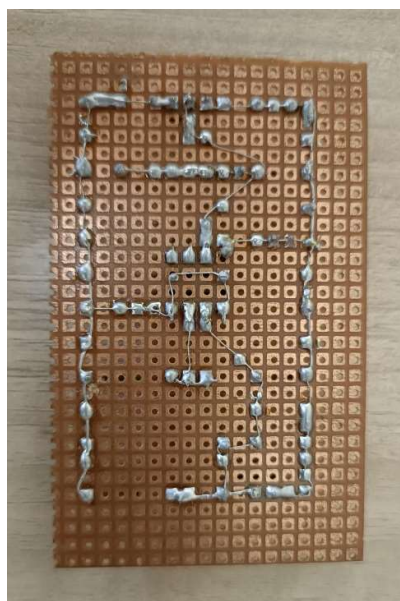
• Schematic Diagram:



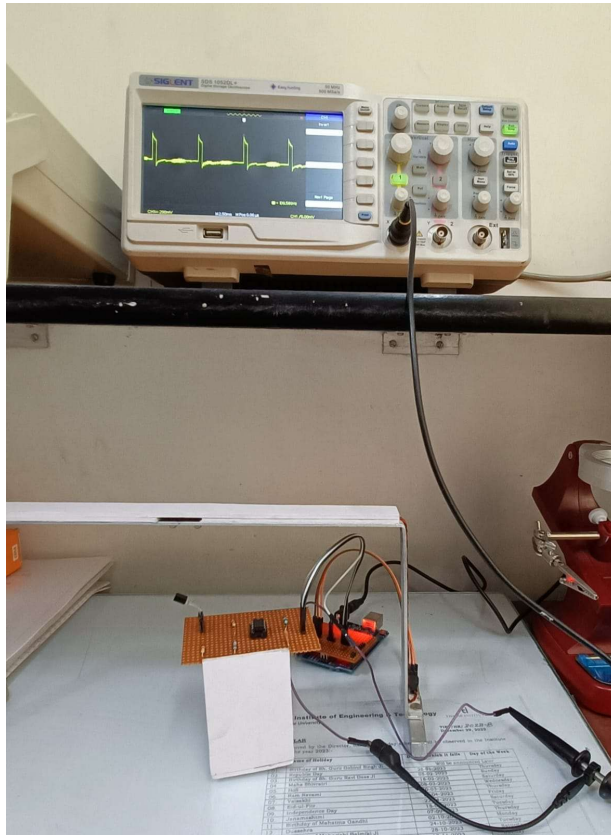
• Working of Circuit:

Receiver circuit is placed on buggy which receives the IR pulses from gantry. We use voltage comparator to compare the two voltages and give the desired output. At first when the buggy is not under the gantry, the diode is reverse bias, acting as an open circuit, therefore forcing the current to go through the R1 resistor and thus give a HIGH on inverting input of the voltage 15 comparator. But when infrared light falls on the diode from the transmitter connected to a gantry, then the depletion layer starts diminishing, thus allowing the current to go through the least restricted path and give a high on the non-inverting input of the voltage comparator.

• Circuit Images:



- **Testing and output waveform:**



- **Conclusion:**

In this experiment we learned to construct a receiver circuit by soldering on a PCB board.

Signature of Faculty member

EXPERIMENT - 5

- **Objective:**

Design and testing of IR sensor module circuit which helps Buggy robot to move on a predefined path as a line follower.

- To solder IR sensor module circuit on a general-purpose PCB.
- To test the output pulses of IR sensor module on predefined track as path follower.

- **Component Used:**

Sr. No	Name of Components	Value	Specification
1.	Resistor (6)	330 Ω (4)	Carbon Resistor with 5% Tolerance
		10k Ω (2)	
2.	LED3MM (2)		LED
3.	LMV358MM (2)		High Gain Operational Amplifier
4.	SFH482 (2)		IR Led
5.	BPX65 (2)		Photodiode
6.	Potentiometer (2)	10k	
7.	MTA02-100 (2)		AMP Connector

- **Components used for soldering:**

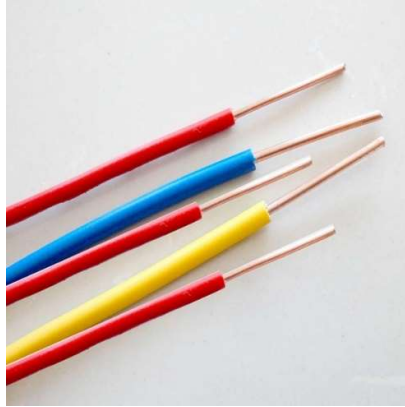
1. **Solder Iron:** A soldering iron is a **hand tool used to heat solder**, usually from an electrical supply at high temperatures above the melting point of the metal alloy. This allows for the solder to flow between the workpieces needing to be joined.



2. **Solder wire:** Solder wires are wires with a low melting point which can melt along with the soldering iron. Depending on the application and soldering temperature, many different types of soldering wires are available.



3. Connecting wires:



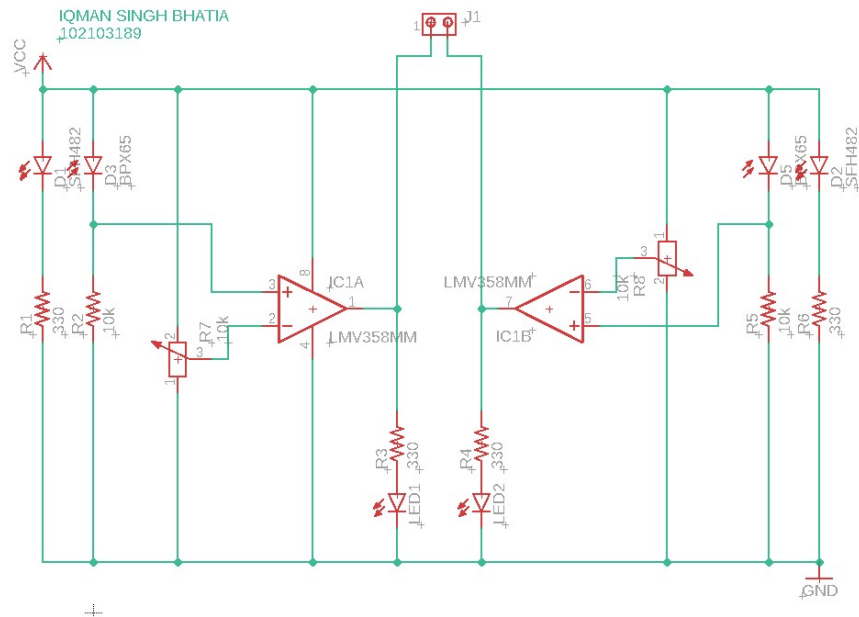
4. **Wire Cutter:** A wire stripper/cutter is a small, hand-held device used to strip the electrical insulation from electric wires.



5. **Suction Pump:** Vacuum pump for desoldering. When pump is triggered, the piston creates a vacuum in the front desoldering head and allows entering the air only from the hole on the tip. As the piston moves speedily, the sudden vacuum draws the air next to the tip and with the air the molten solder is also drawn.



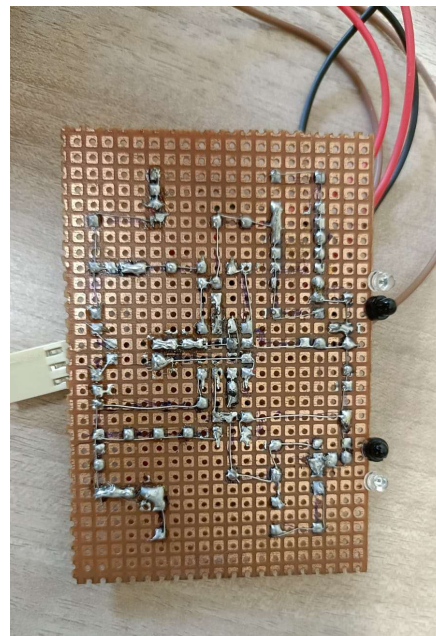
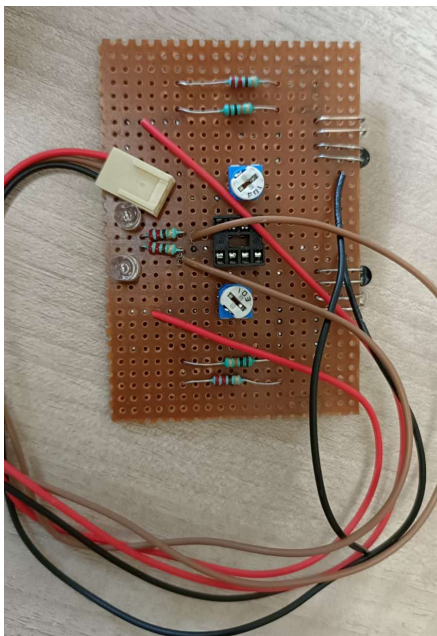
- Schematic diagram:**



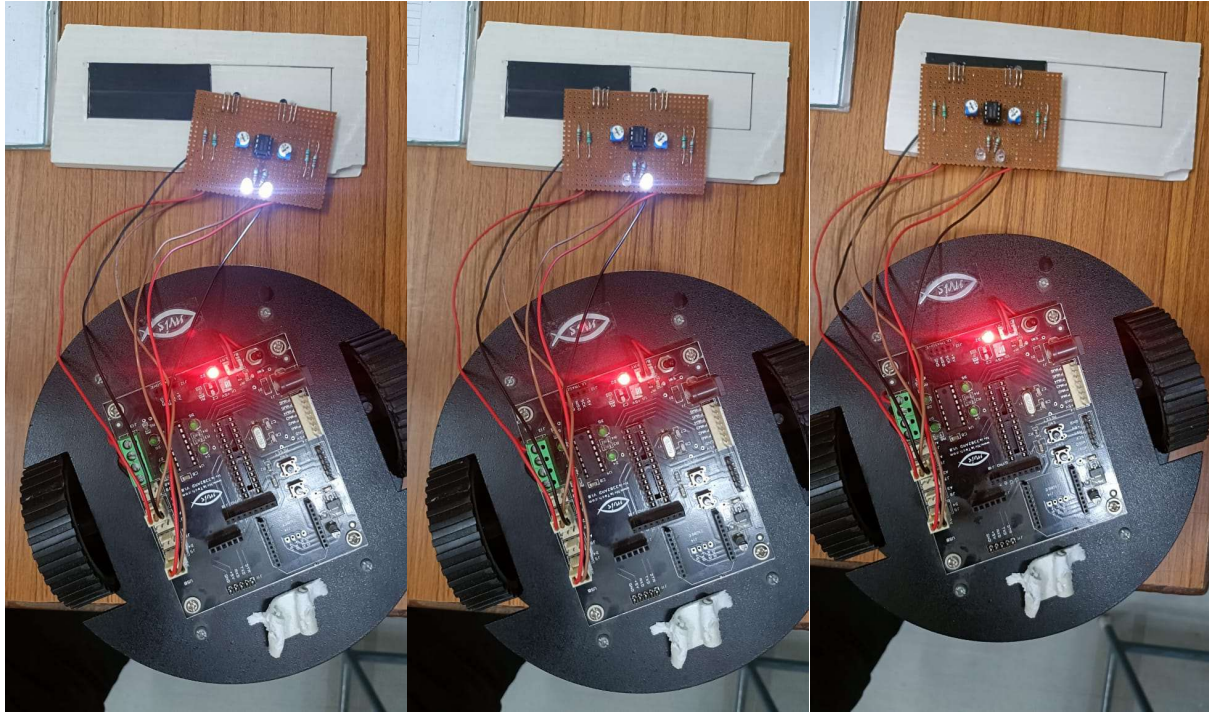
- Working:**

IR Sensor circuit is responsible for movement of buggy along the black path. It contains 2 IR sensor pairs consisting IR transmitter which emits IR light and IR receiver which receives the light. Light falling on the white surface is reflected back and is received by the IR receiver and the circuit is in ON state and helps buggy move but when the light falls on the black surface, it is absorbed and the receiver does not receive the light and at that time the pair is in OFF state which stops the particular wheel, it basically allows correct movement of buggy on right or left turns.

- Circuit Images:**



- **Testing:**



- **Conclusion:**

In this experiment we learnt IR Sensor Module circuit which helps our buggy to move in a specified path

Signature of Faculty member

EXPERIMENT - 6

- **Objective:**

Design and testing of PWM Transmitter circuit which generates rectangular pulses of specific pulse width for corresponding Gantry.

- a) To solder PWR Transmitter circuit on a general-purpose PCB.
- b) To write a Program and upload it on the ATtiny based microcontroller.
- c) To test the output pulses on CRO generated through PWM transmitter circuit.

- **Component Used:**

Sr. No	Name of Components	Value	Specifications
1.	Resistor	220 Ω	Carbon Resistor with 5% Tolerance
2.	Capacitor	1000nF 10nF	Electrolytic Capacitor
3.	DCJ0202		DC Power Jack
4.	LED3MM		LED
5.	IC 7805T		Positive Voltage Regulator
6.	22-23-2031		Molex (3)
7.	ATMEL ATTINY 85 20P		Microcontroller

- **Components used for soldering:**

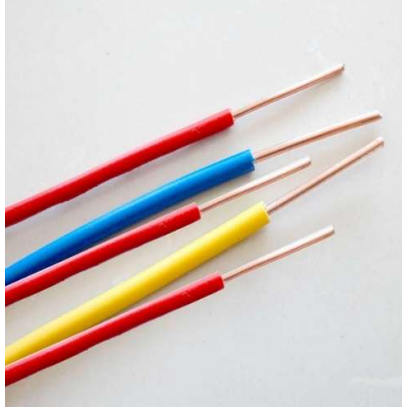
1. **Solder Iron:** A soldering iron is a **hand tool used to heat solder**, usually from an electrical supply at high temperatures above the melting point of the metal alloy. This allows for the solder to flow between the workpieces needing to be joined.



2. **Solder wire:** Solder wires are wires with a low melting point which can melt along with the soldering iron. Depending on the application and soldering temperature, many different types of soldering wires are available.



3. Connecting wires:



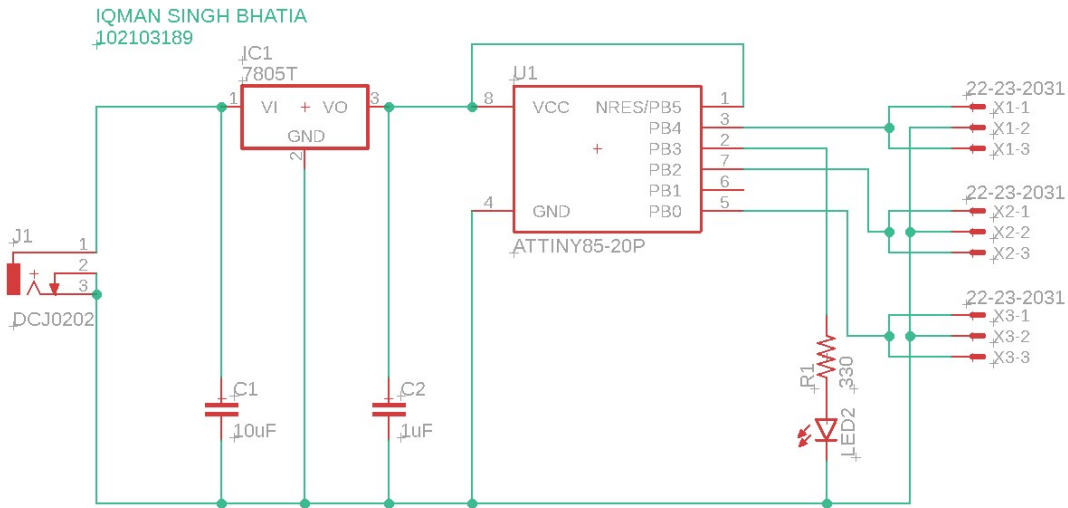
4. **Wire Cutter:** A wire stripper/cutter is a small, hand-held device used to strip the electrical insulation from electric wires.



5. **Suction Pump:** Vacuum pump for desoldering. When pump is triggered, the piston creates a vacuum in the front desoldering head and allows entering the air only from the hole on the tip. As the piston moves speedily, the sudden vacuum draws the air next to the tip and with the air the molten solder is also drawn.



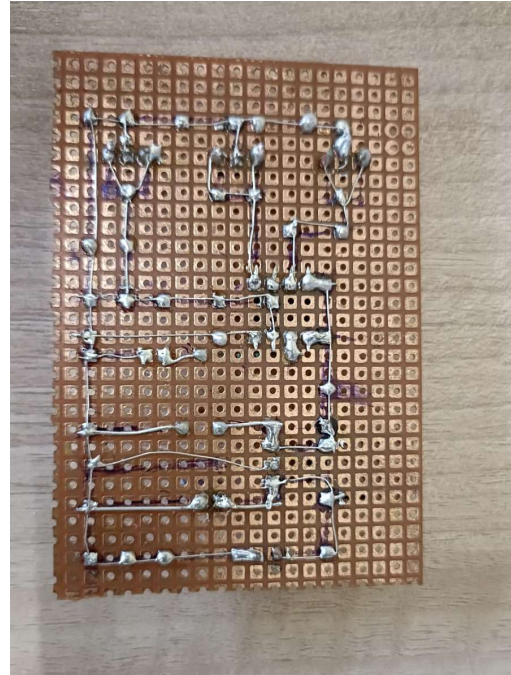
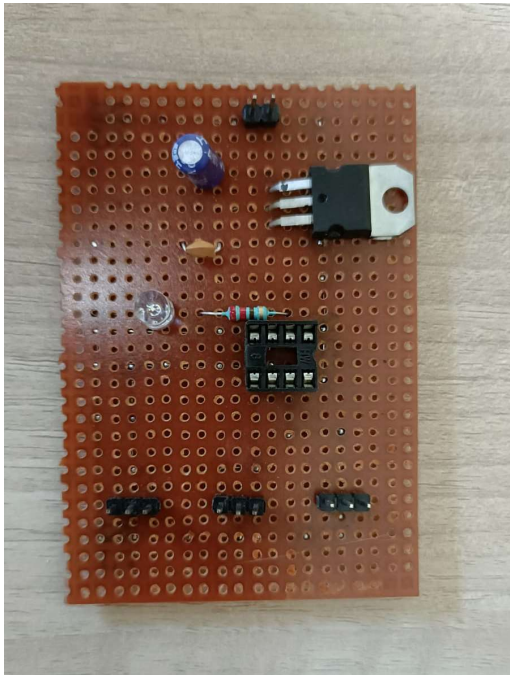
- Schematic diagram:**



- Working:**

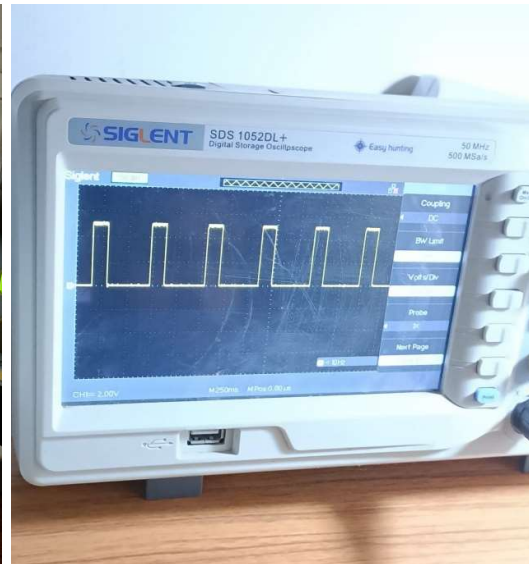
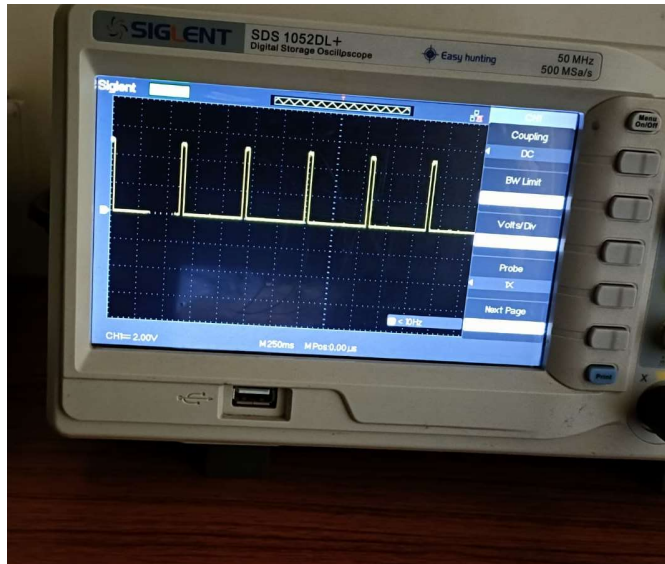
A transmitter circuit in a buggy is responsible for sending signals from the remote control to the receiver circuit in the buggy. The transmitter circuit typically consists of several components that work together to ensure reliable and accurate transmission of signals.

- Circuit Images:**



Group 2 C07

- **Testing:**



- **Conclusion:**

In this experiment we learned to construct a transmitter circuit by soldering on a PCB board.

.

Signature of Faculty member