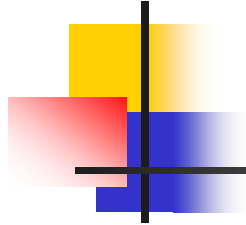




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## Engineering Design Project-II (UTA 024)

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THAPAR INSTITUTE  
OF ENGINEERING & TECHNOLOGY  
(Deemed to be University)



# **Engineering Design Project-II (UTA 024) Buggy Lab**

**Dr. Amit Mishra**



# Index

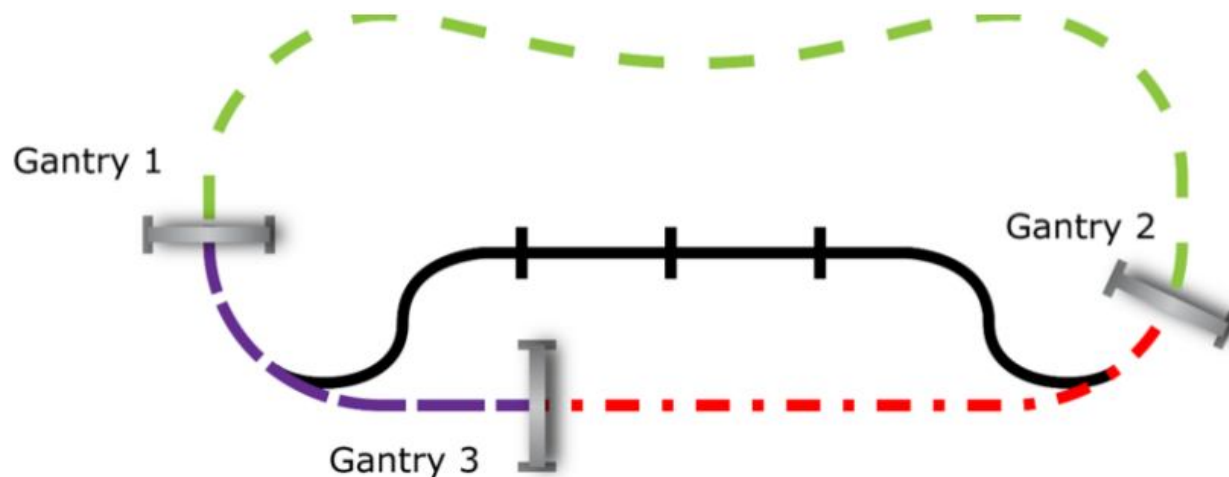
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- **Objective**
- **Transmitter Circuit schematic diagram**
- **Component list**
- **Design Specification and selection of components**
- **Programming of ATtiny-45**
- **Transmitter Circuit on PCB**
- **Transmitter Circuit testing**
- **References**

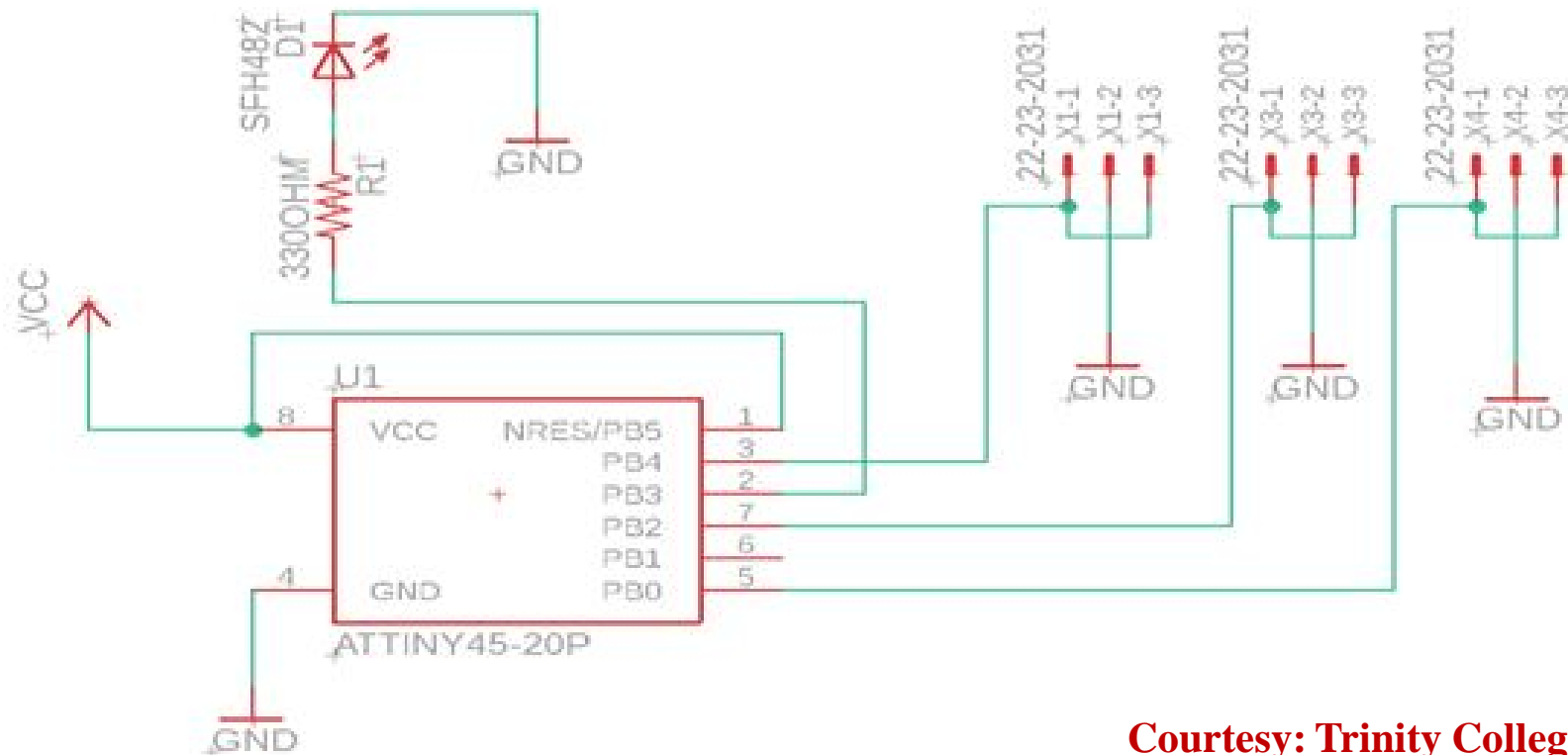
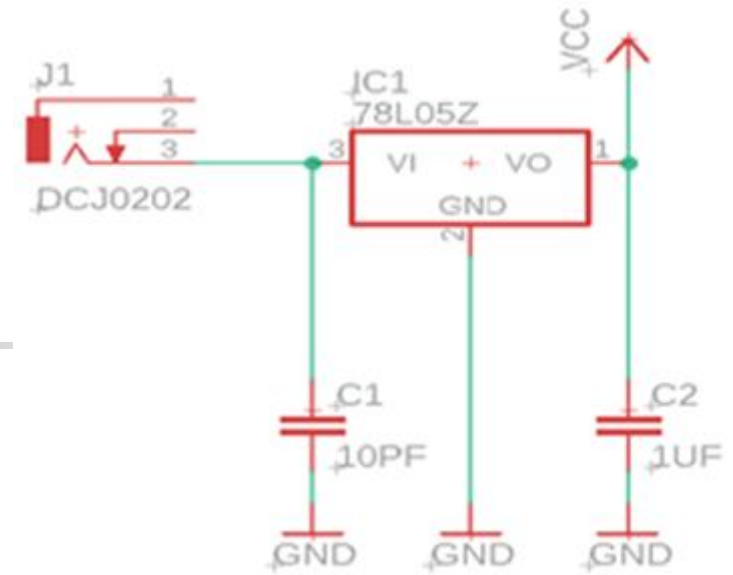
## Objective

**Design and testing of transmitter circuit which generates rectangular pulses of specific pulse width for IR emitter corresponding to each Gantry.**

- ❖ To solder IR transmitter circuit on a general purpose PCB.
- ❖ To write a Program and upload it on the Attiny-45 based microcontroller through Arduino boot-loader circuit.
- ❖ To test the output pulses on CRO generated through IR transmitter circuit.



# Transmitter circuit





# Component List

| Sr. no | Component             | Count | specification                              |
|--------|-----------------------|-------|--|
| 1      | Microcontroller       | 01    | ATtiny-45                                  |
| 2      | Voltage regulator     | 01    | 7805                                       |
| 3      | LED                   | 01    | Any colour                                 |
| 4      | Resistor              | 01    | 330 $\Omega$                               |
| 5      | Capacitors            | 02    | 10 pf, 1 $\mu$ f                           |
| 6      | Male Header connector | 03    |  |
| 7      | DC battery            | 01    | 9V Hi-Watt Battery, Battery Clip Connector |
| 8      | PCB (small piece)     | 01    | General purpose                            |



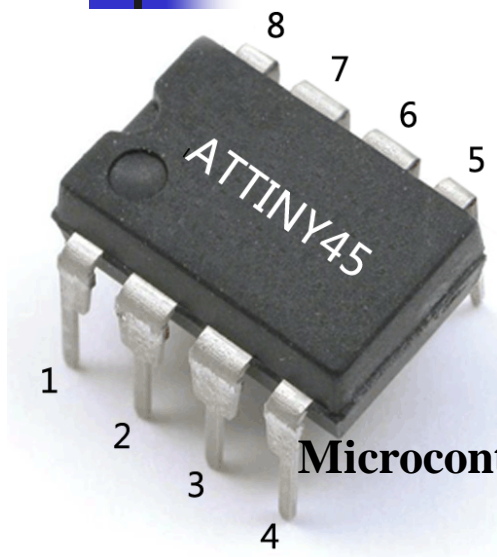
# Components Required



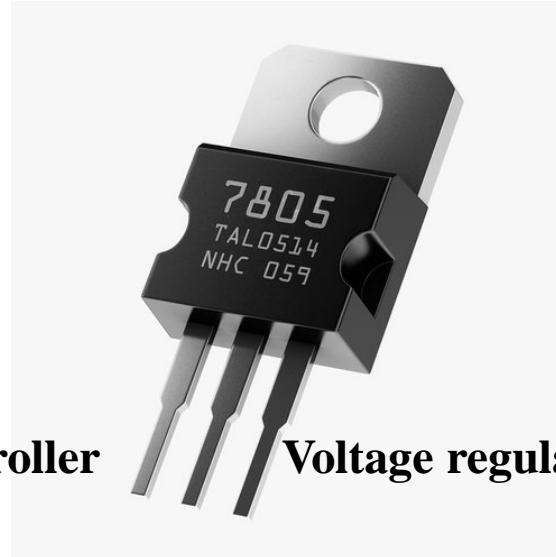
LED



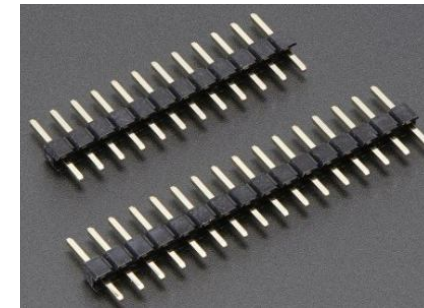
PCB (small piece)



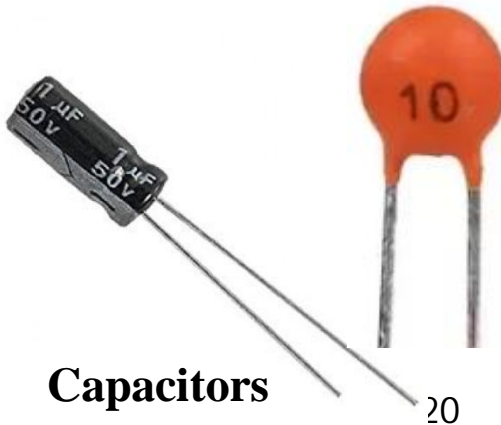
Microcontroller



Voltage regulator



Male Header connector



Capacitors



Resistor



DC battery

Image source: Google

/



# Design Specification and selection of components

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- ❖ Selection criterion for **voltage regulator**.
- ❖ Selection of a **microcontroller**



# Selection criterion of Voltage Regulator





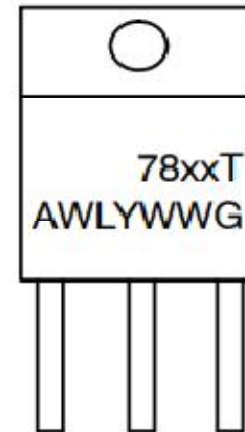
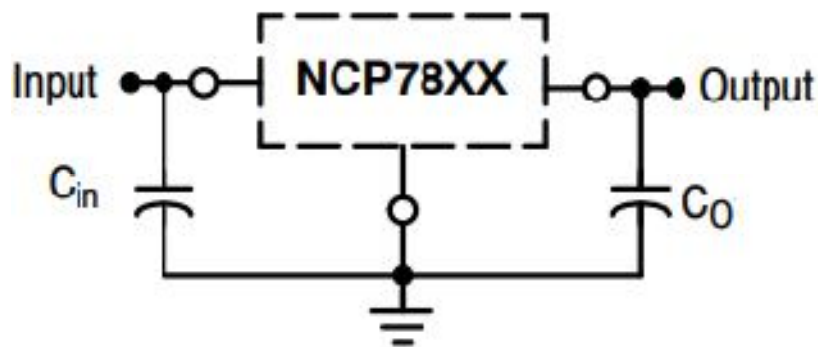
## 7800/7900 Voltage Regulator Variants

| PARAMETER     | IC NUMBER | MIN  | MAX | UNIT |
|---------------|-----------|------|-----|------|
| Input voltage | 7805      | 7    | 25  | V    |
|               | 7808      | 10.5 | 25  | V    |
|               | 7810      | 12.5 | 28  | V    |
|               | 7812      | 14.5 | 30  | V    |
|               | 7815      | 17.5 | 30  | V    |
|               | 7824      | 27   | 38  | V    |

## Specifications for 7800 Series Voltage Regulator

| PARAMETER & CONDITIONS                             | MIN  | TYPICAL | MAX  | UNIT     |
|--|------|---------|------|----------|
| Output voltage @ 25°C                              | 4.8  | 5.0     | 5.2  | V        |
| Output voltage 0°C to 125°C                        | 4.75 |         | 5.25 | V        |
| Input voltage regulation @° 25°C $V_I = 7V$ to 25V |      | 3       | 100  | mV       |
| Ripple rejection, $V_I$ 8V to 18V $f=120Hz$        | 62   | 78      |      | dB       |
| Output voltage regulation, $I_o$ 5mA to 1.5A       |      | 15      | 100  | mV       |
| Output resistance, $f=1kHz$                        |      | 0.017   |      | $\Omega$ |
| Peak output current @25°C                          |      | 2.2     |      | A        |

## Continued...



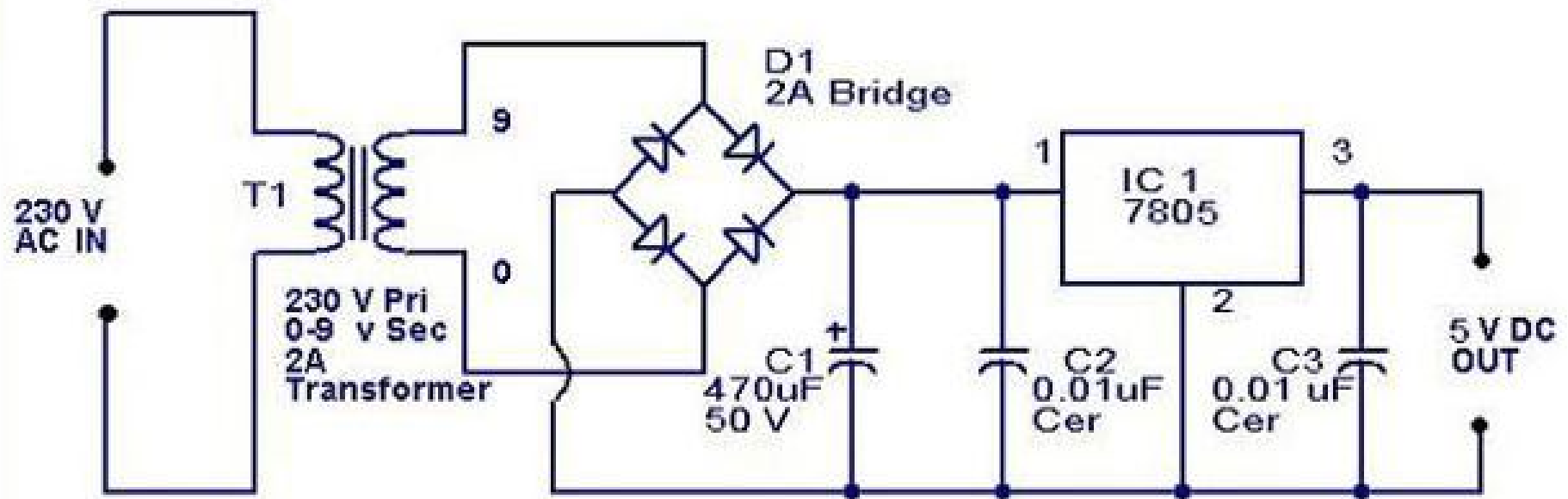
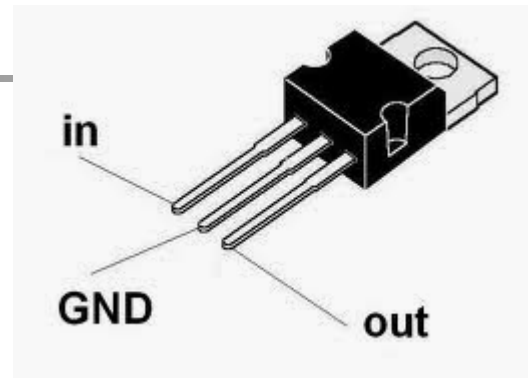
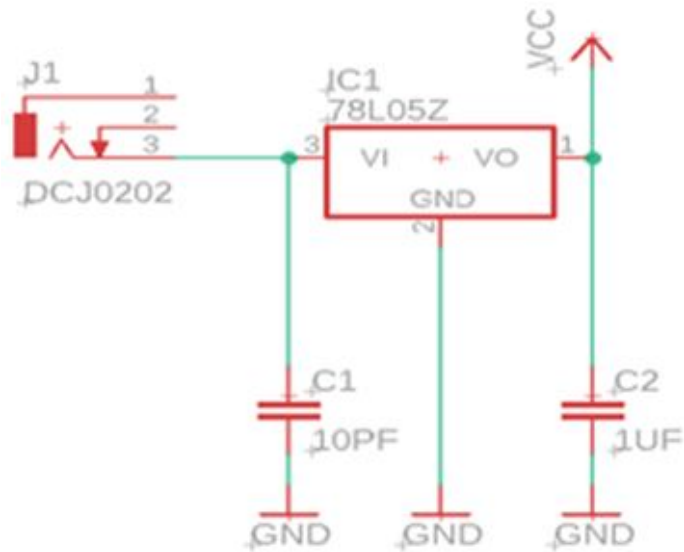
### MARKING DIAGRAM

xx = 05, 08, 12 or 15  
A = Assembly Location  
WL, L = Wafer Lot  
Y = Year  
WW = Work Week  
G = Pb-Free Device  
**T = Through hole packaging**

$C_{in}$  is required; if regulator is located an appreciable distance from power supply filter. Typical range of value vary from **0.33  $\mu$ F to 10 pF**.

$C_o$  is needed for stability; however, it does improve transient response. Values of less than **0.1  $\mu$ F** could cause instability.

# Voltage regulator using LM 7805

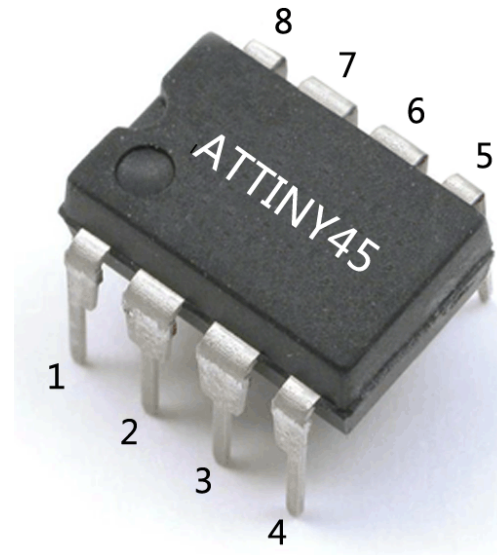


August 7, 2020

Image Source: Google



# Selection criterion of Microcontroller



# Microcontroller options available

❖ 8051 microcontroller

❖ PIC microcontroller

❖ ATtiny-AVR (Atmel tiny-Alf-Egil Bogen Vegard Wollan RISC)

❖ Arduino-ATmega328

| Parameter  | Microcontrollers      |                       |                           |  |
|--|-----------------------|-----------------------|---------------------------|--|
|  | 8051                  | PIC                   | AVR (ATtiny)              | ARM (Arduino-ATmega328)                    |
| Architecture type                                  | Harvard               | Harvard               | Harvard                   | von Neumann                                |
| Word size  | 8 bit                 | 8 bit                 | 8 bit                     | 16 and /or 32 bit                          |
| Memory space                                       | 128 byte              | Less than 128 byte    | Between 256 bytes to 32KB | SRAM:2 KB, EEPROM: 1KB, Flash memory:32 KB |
| Clock cycle required for Execution per instruction | Multiple clock cycles | Multiple clock cycles | single clock cycle        | single clock cycle                         |
| Power supply voltage                               | 5V                    | 5V                    | 1.8 to 5V                 | 3.3 V                                      |

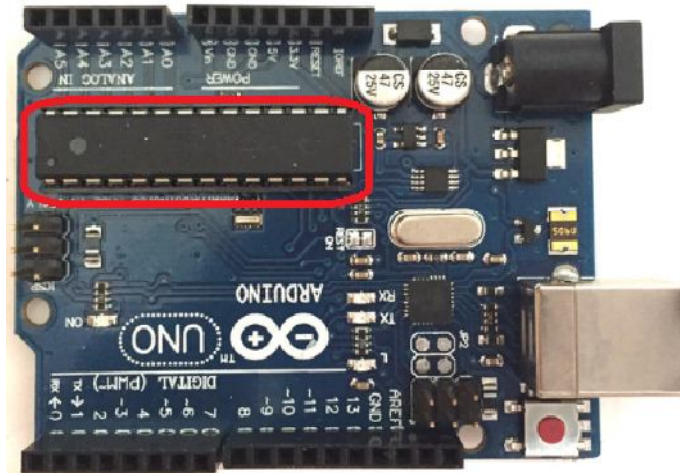
- Harvard architecture: separate space for RAM and program memory
- von Neumann architecture: program and RAM in the same space

# Selection criterion of Microcontroller

8051 microcontroller



Arduino-ATmega328



PIC microcontroller



Attiny-45

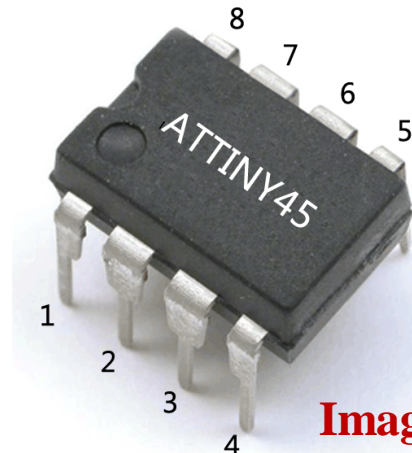
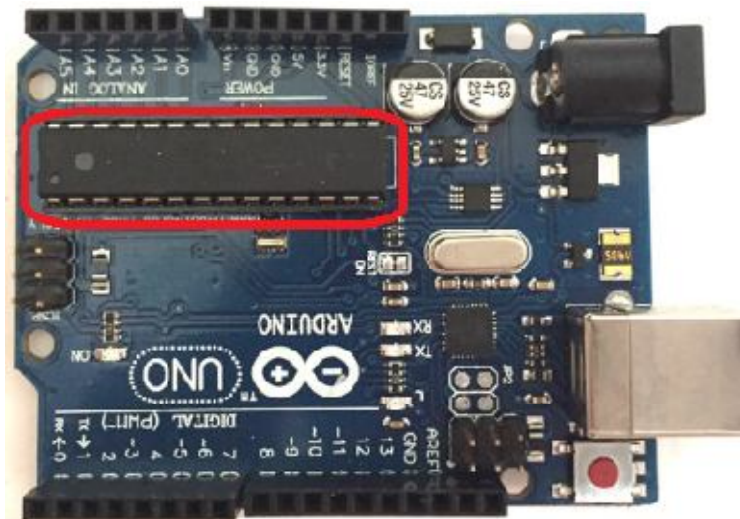


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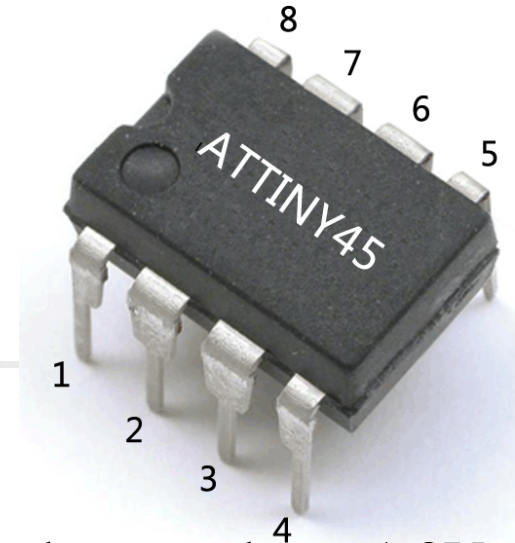
## Continued...

### Drawbacks of Using an Arduino

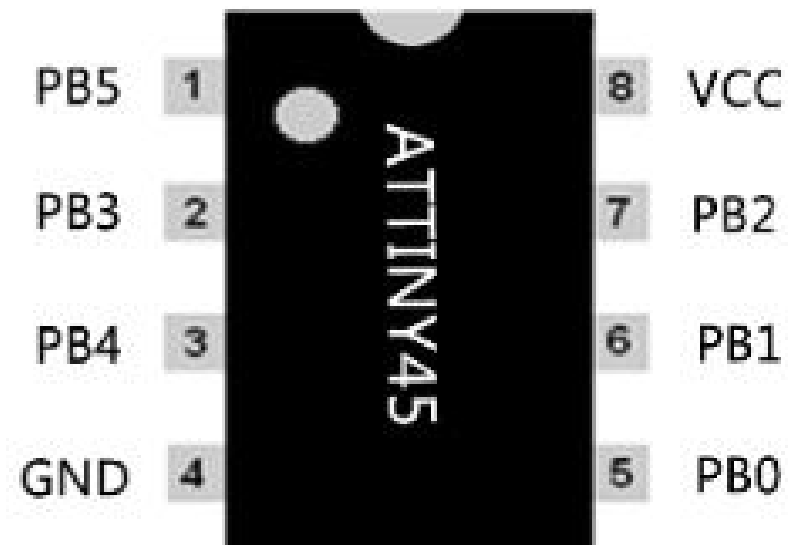
- ❖ First, compared to the microcontroller IC itself, Arduino boards are **very large**. This makes it **difficult to integrate** or embed Arduino boards into projects.
- ❖ Second, Arduino boards are **relatively expensive**, compared to the cost of building a custom board with a microcontroller IC and associated passive components.



## ATtiny45 PU20 Technical Specifications



- ❖ Low current consumption 300uA in use & 0.1uA in sleep mode on 1.8V.
- ❖ Operating voltage as low as 1.8V DC to 5.5V DC max.
- ❖ Total six analog I/O pins
- ❖ built in 4 Kbytes of flash memory
- ❖ built in 256b of SRAM
- ❖ Built in 256b of EEPROM
- ❖ Circuitry contains 32 Registers
- ❖ Universal Serial Interface feature

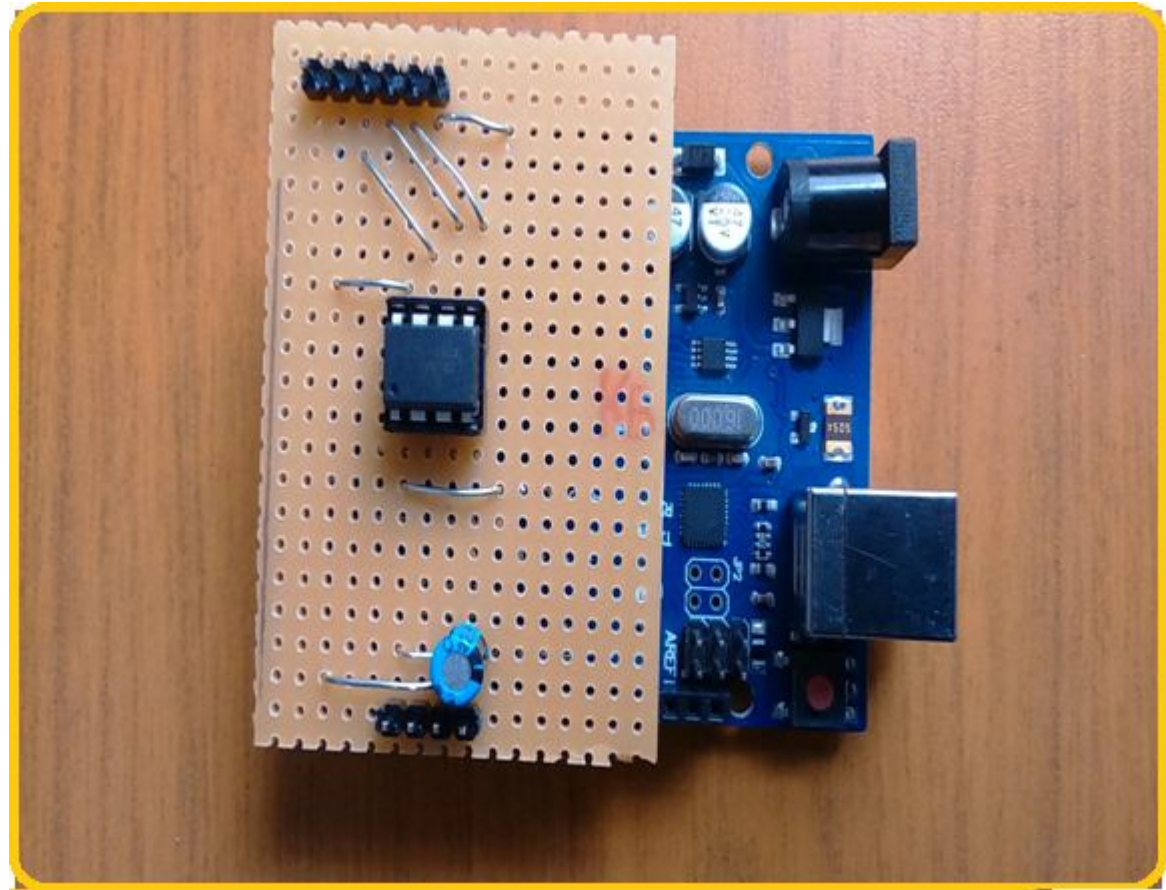
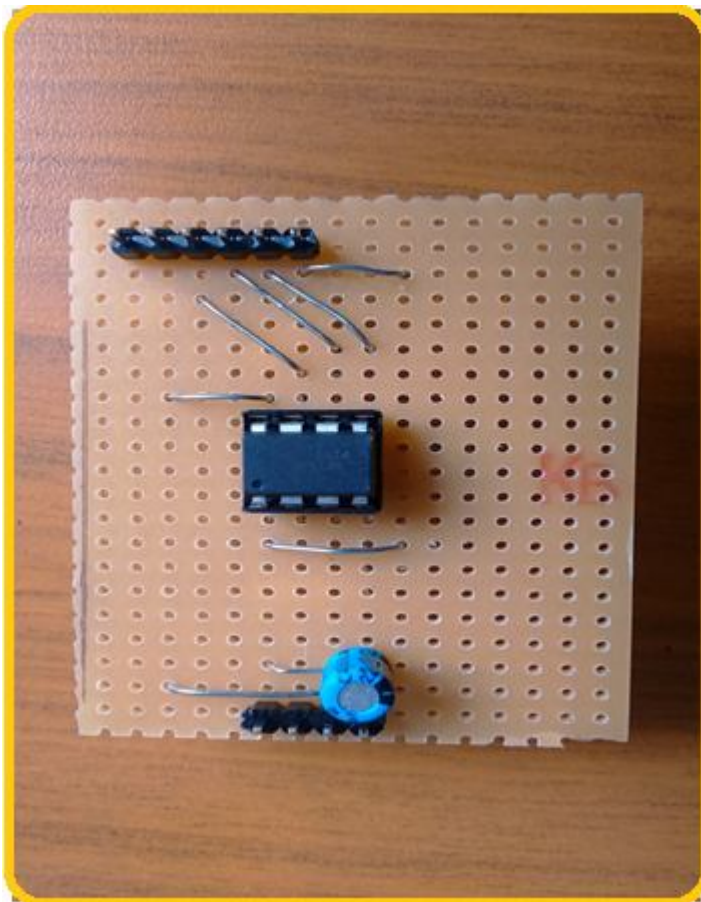


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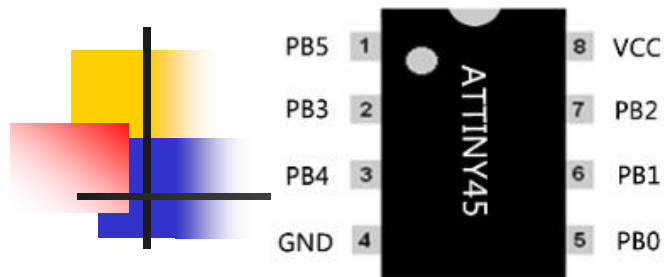


# Programming of ATtiny-45 using Boot loader/Shield circuit for transmitter module



August 9, 2020

# PWM generation using ATtiny45



```
const int gantryPin1 = 0;  
const int gantryPin2 = 2;  
const int gantryPin3 = 4;  
const int gantryPin4 = 3;  
  
void setup() {  
  pinMode(gantryPin1,OUTPUT);  
  pinMode(gantryPin2,OUTPUT);  
  pinMode(gantryPin3,OUTPUT);  
  pinMode(gantryPin4,OUTPUT);  
}
```

```
void loop() {  
  digitalWrite(gantryPin1,HIGH);  
  digitalWrite(gantryPin2,HIGH);  
  digitalWrite(gantryPin3,HIGH);  
  digitalWrite(gantryPin4,HIGH);
```

```
  delayMicroseconds(1000);
```

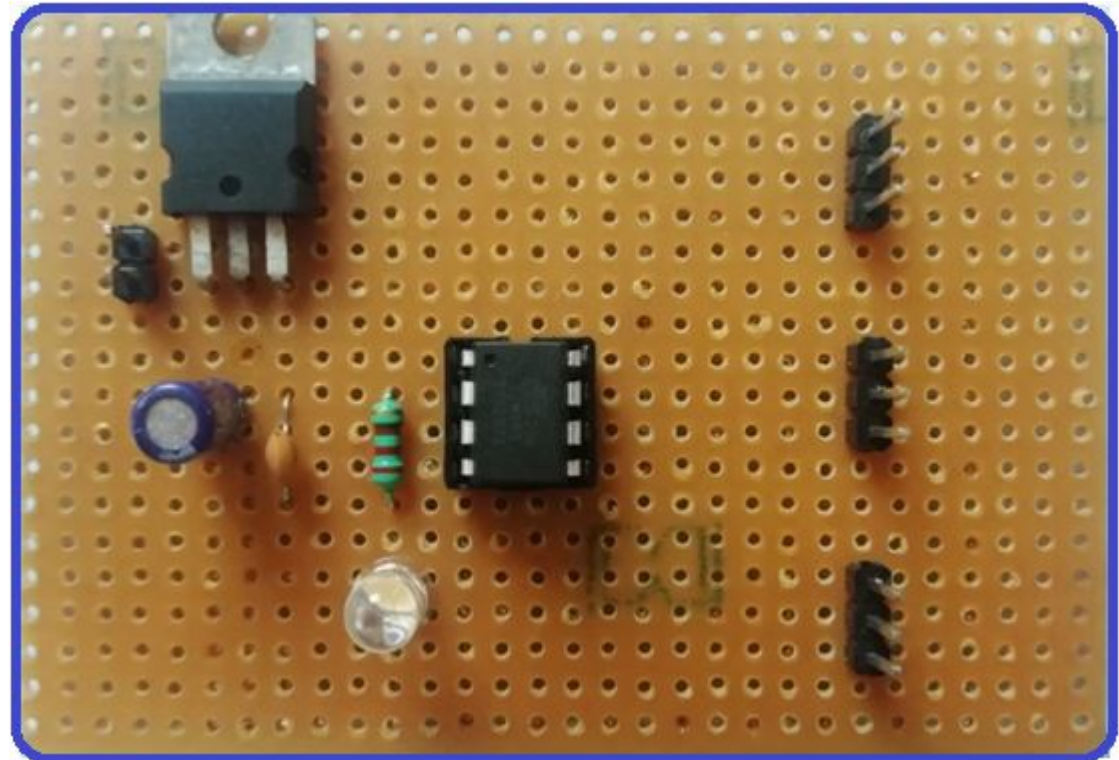
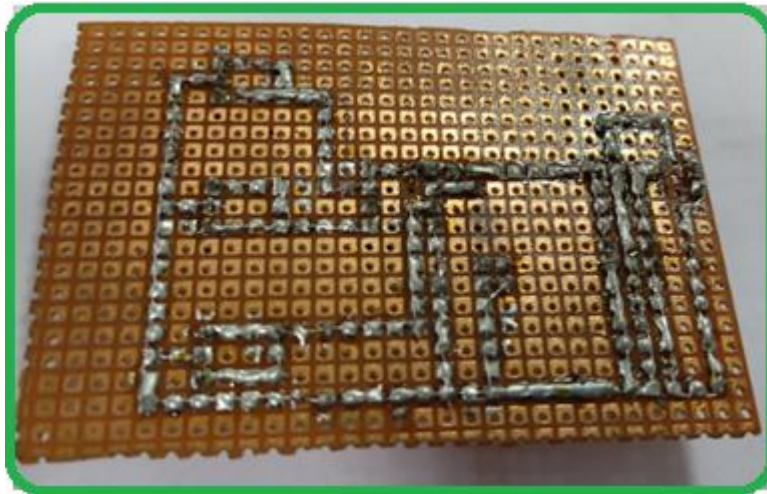
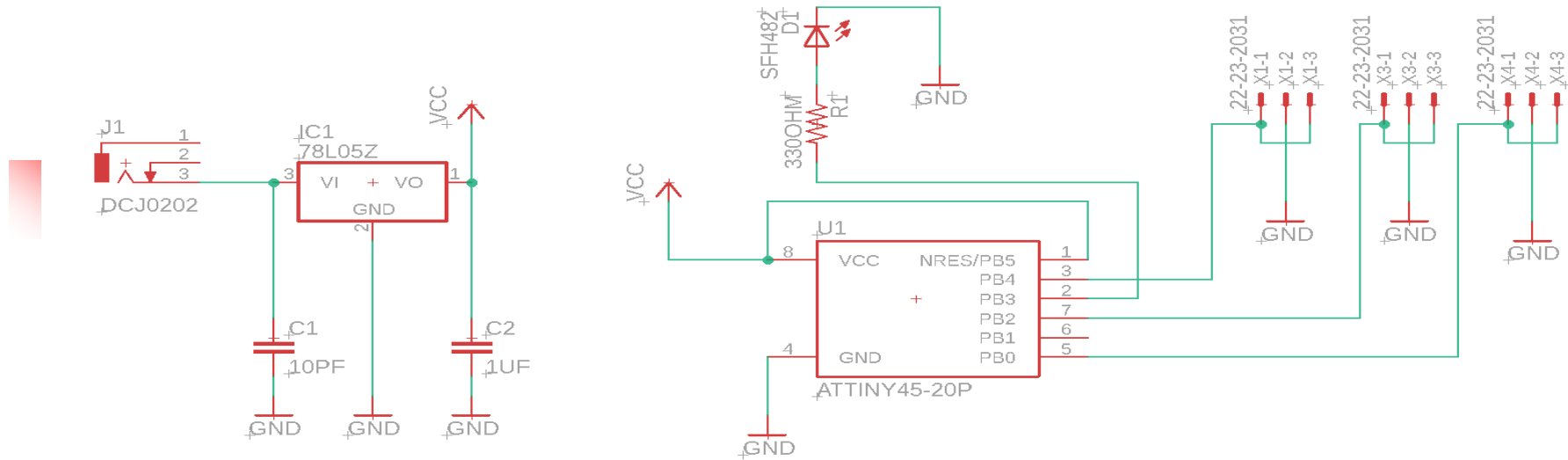
```
  digitalWrite(gantryPin1,LOW);  
  delayMicroseconds(1000);  
  digitalWrite(gantryPin2,LOW);  
  delayMicroseconds(1000);  
  digitalWrite(gantryPin3,LOW);  
  delayMicroseconds(1000);  
  digitalWrite(gantryPin4,LOW);  
  delayMicroseconds(1000);  
}
```

# Transmitter circuit on PCB



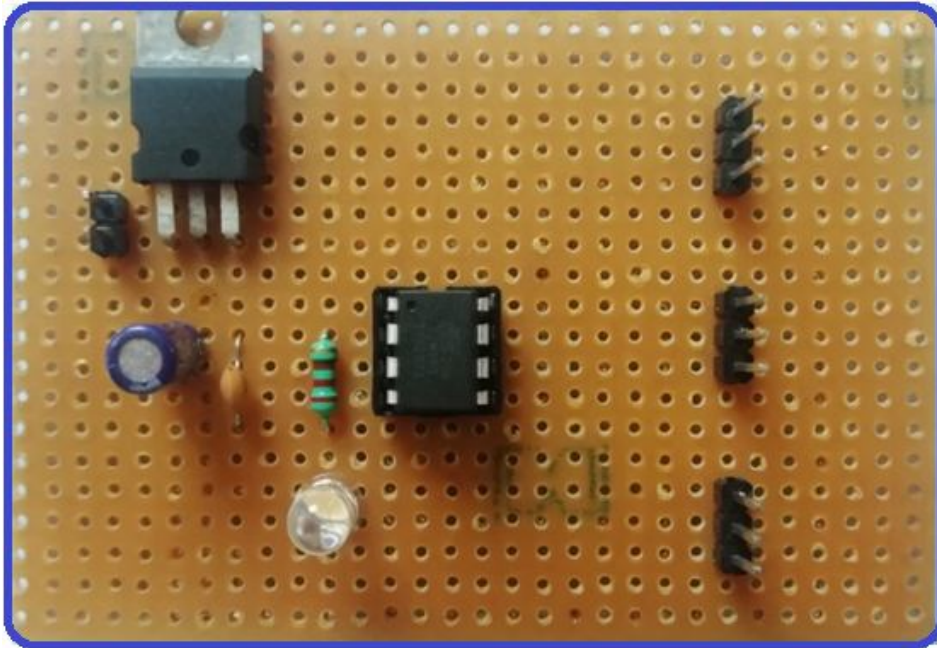


# Transmitter circuit on PCB



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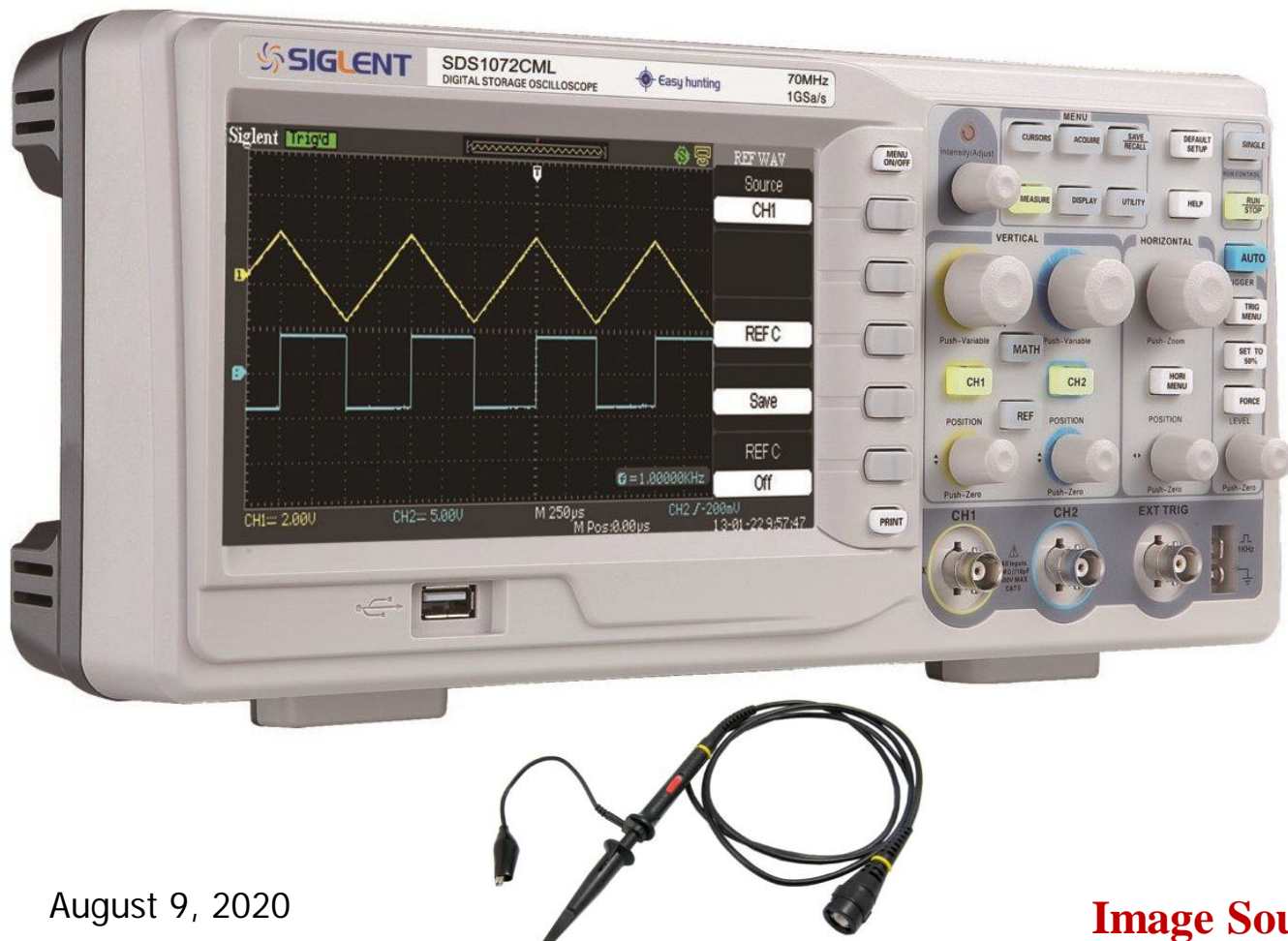
# Transmitter circuit with Attiny-45 and Gantry



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# Transmitter circuit Testing

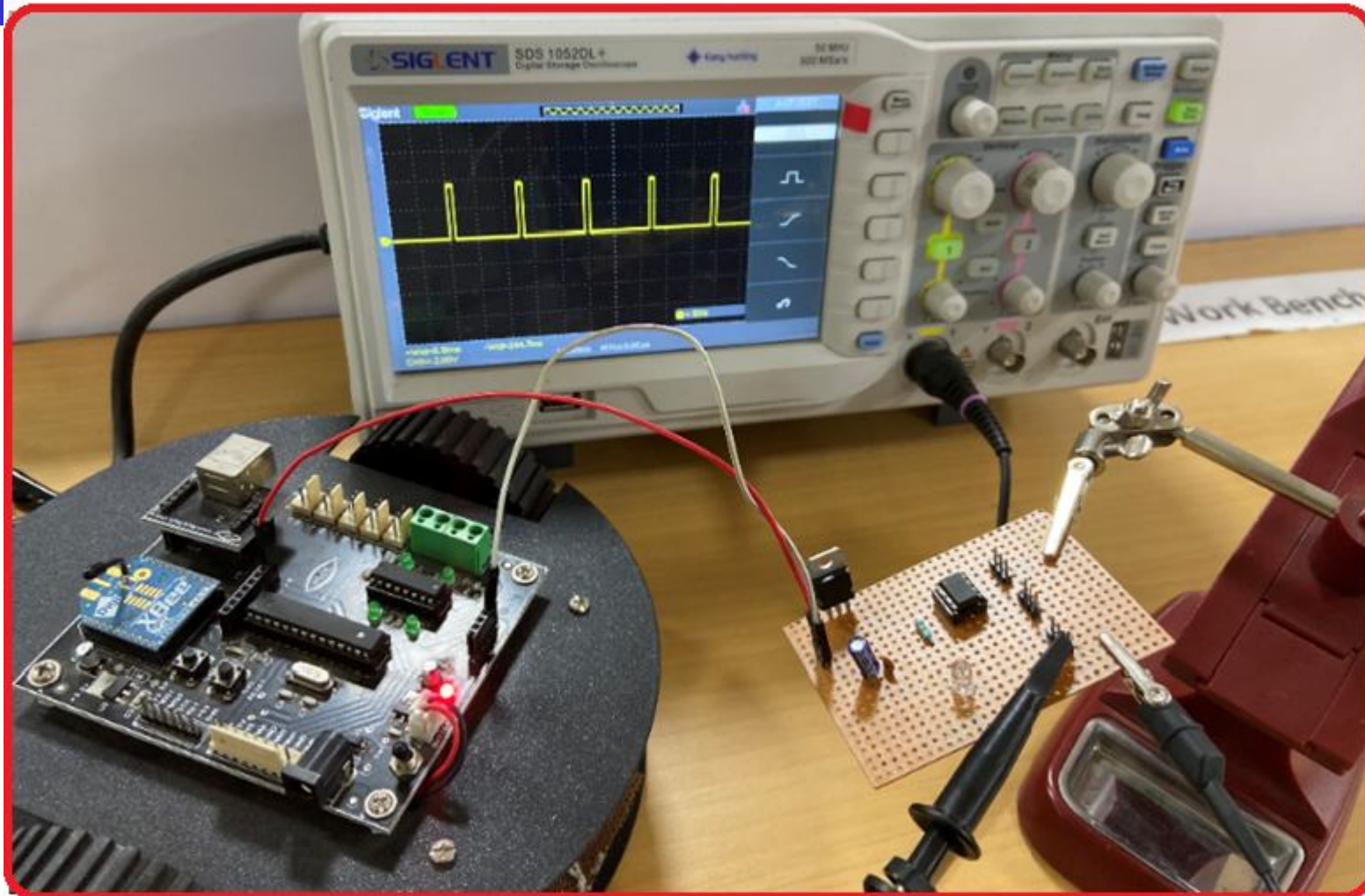


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Image Source: Google 24

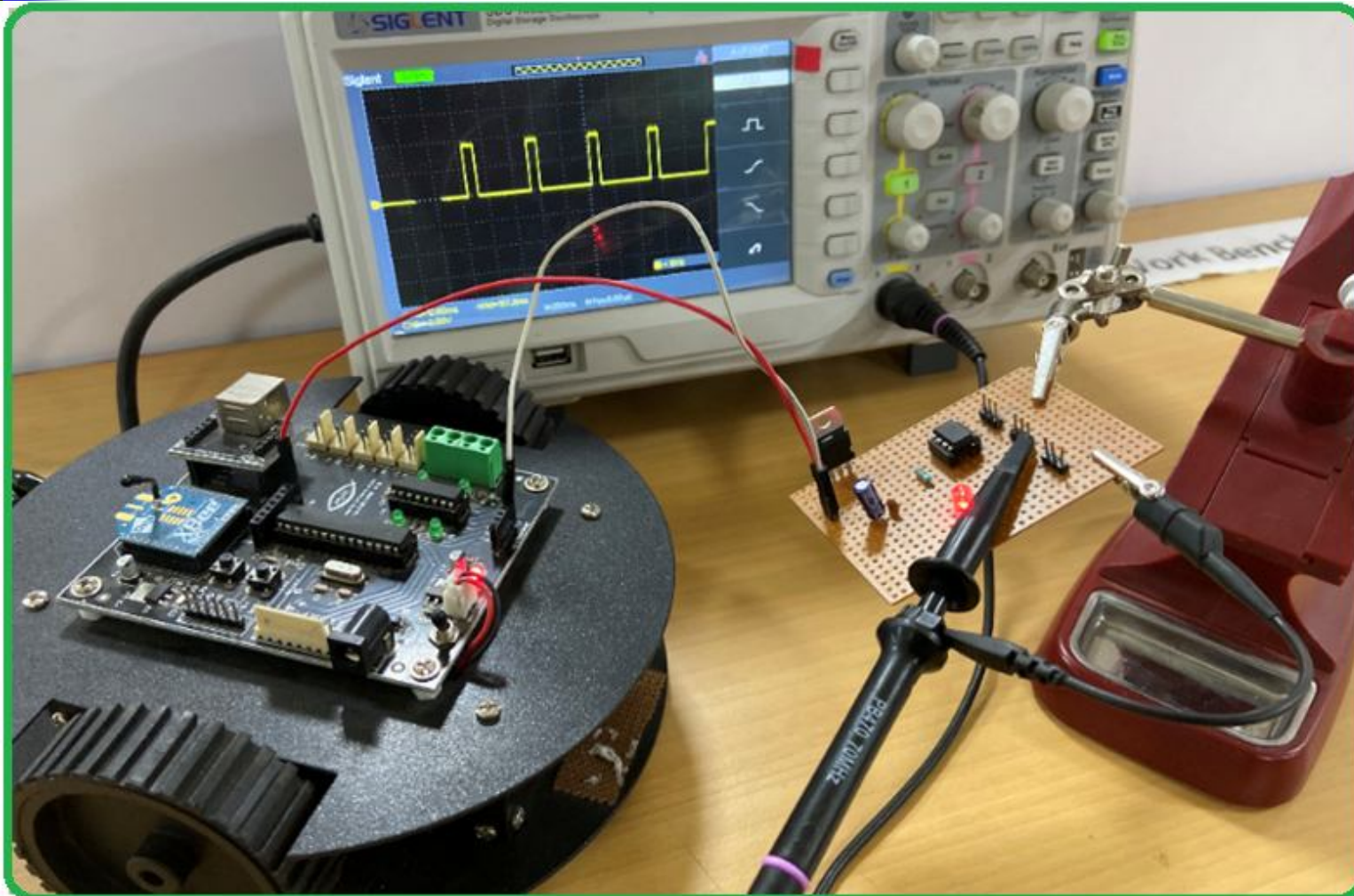
# Testing: Transmitter Circuit

## Gantry-1

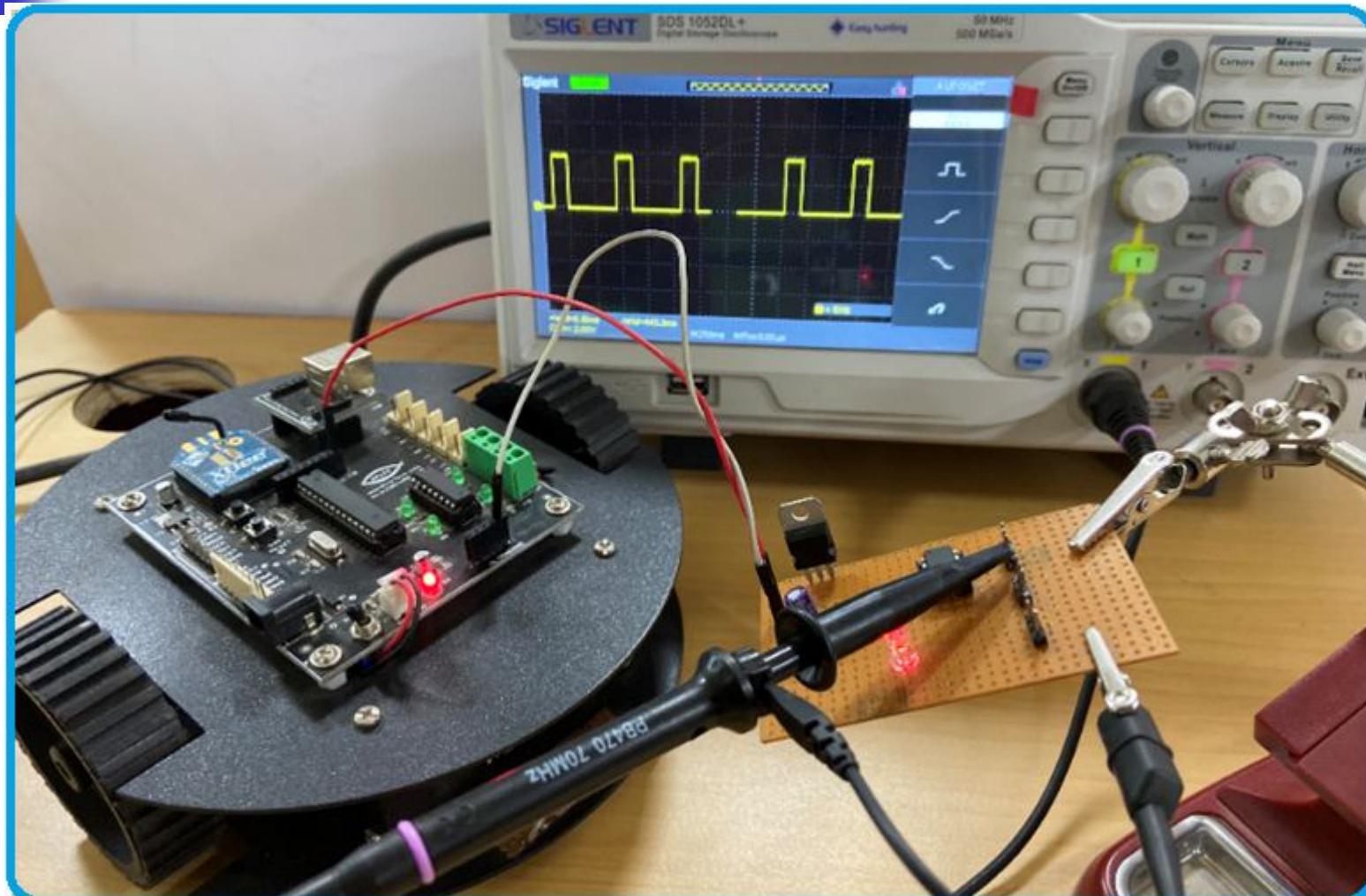




## Gantry-2



## Gantry-3



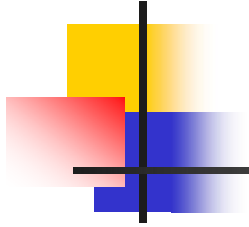


## References

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- ❖ [http://ww1.microchip.com/downloads/en/devicedoc/atmel-2586-avr-8-bit-microcontroller-attiny25-attiny45-attiny85\\_datasheet-summary.pdf](http://ww1.microchip.com/downloads/en/devicedoc/atmel-2586-avr-8-bit-microcontroller-attiny25-attiny45-attiny85_datasheet-summary.pdf)
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# Thanks !