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

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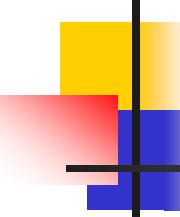


# **Engineering Design Project-II**

## **(UTA 024)**

# **Buggy Lab**

**Dr. Amit Mishra**



# **Index**

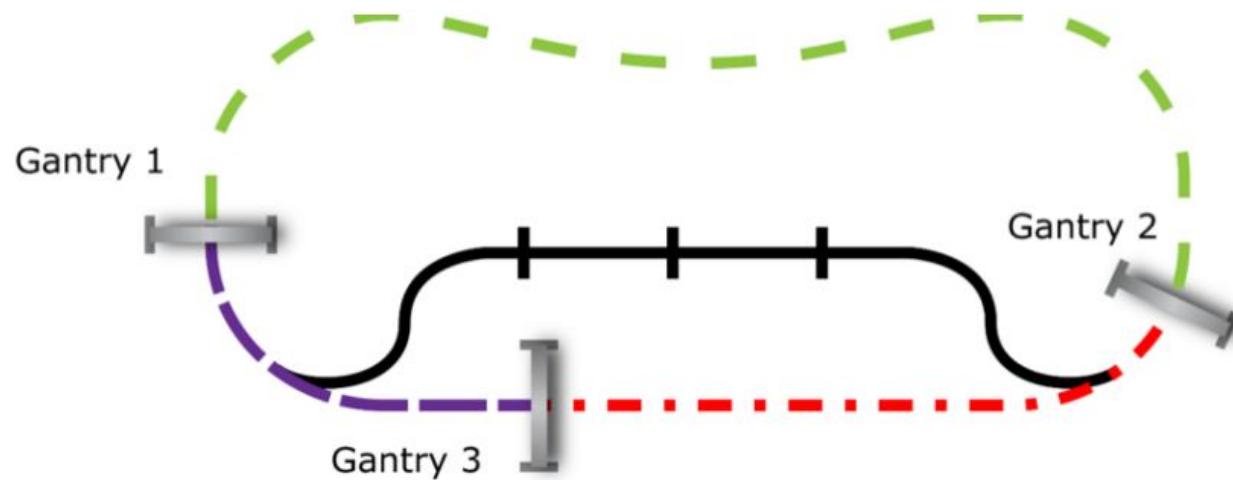
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- **Objective**
- **Transmitter Circuit schematic diagram**
- **Component list**
- **Design Specification and selection of components**
- **Programming of ATtiny-45**
- **Transmitter Circuit on PCB**
- **Transmitter Circuit testing**
- **References**

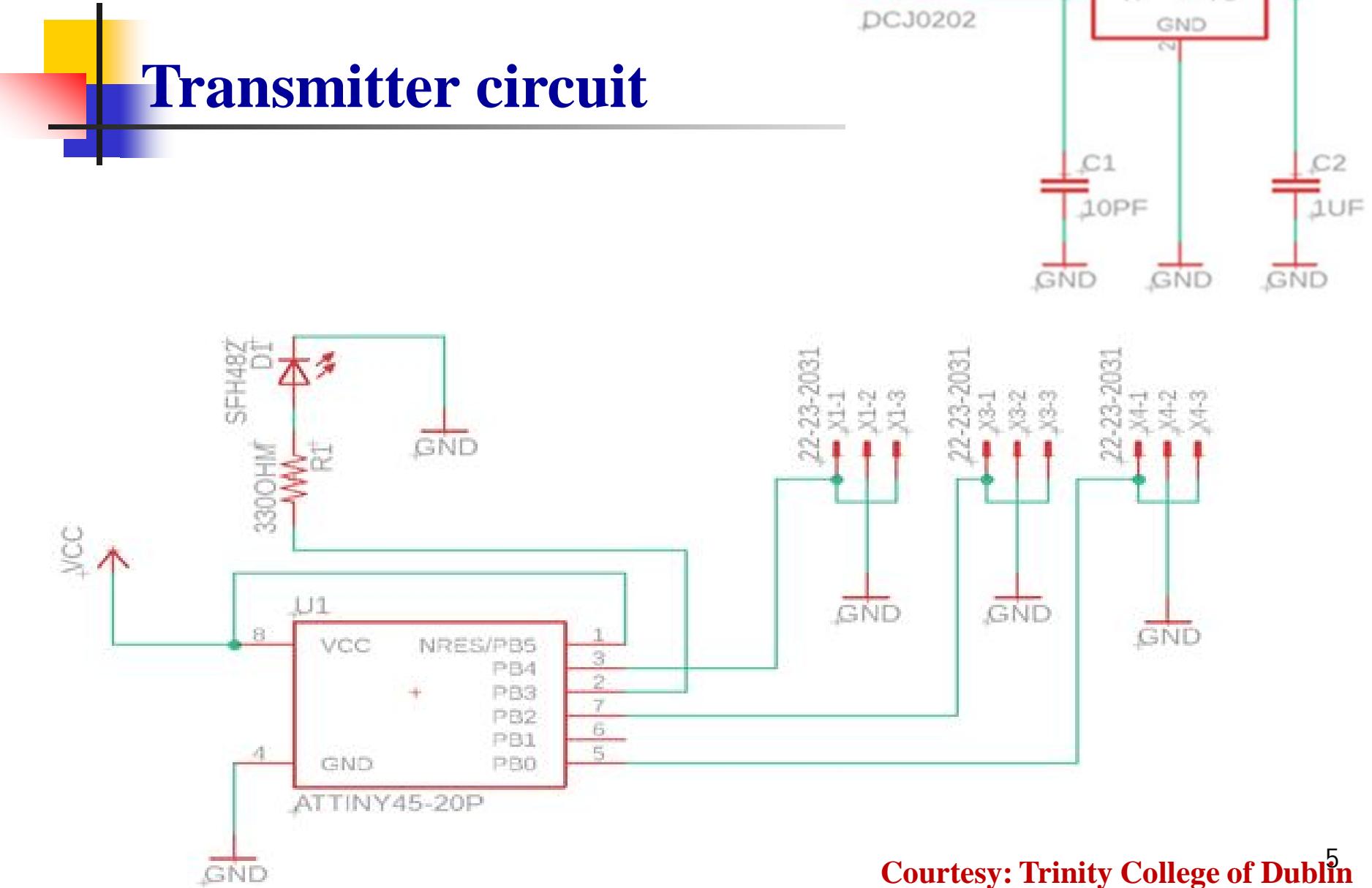
# Objective

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

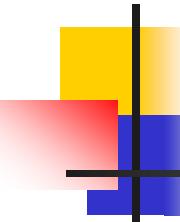
- ❖ To solder IR transmitter circuit on a general purpose PCB.
- ❖ To write a Program and upload it on the Attiny-45 based microcontroller through Arduino boot-loader circuit.
- ❖ To test the output pulses on CRO generated through IR transmitter circuit.



# Transmitter circuit



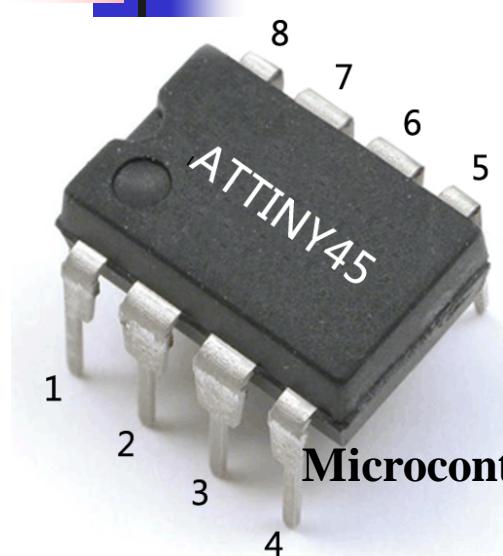
Courtesy: Trinity College of Dublin<sup>5</sup>



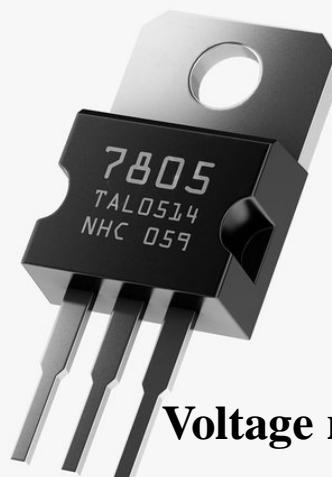
# Component List

Sr. no	Component	Count	specification
1	Microcontroller	01	ATtiny-45
2	Voltage regulator	01	7805
3	LED	01	Any colour
4	Resistor	01	330 Ω
5	Capacitors	02	10 pf, 1μf
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



Microcontroller



Voltage regulator



Capacitors

20



Resistor

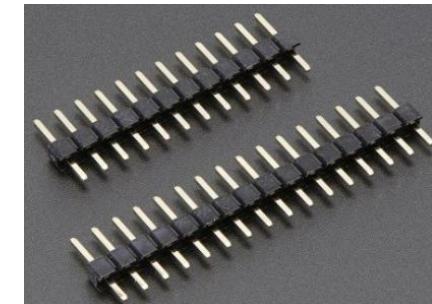
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LED



PCB (small piece)

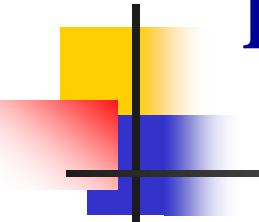


Male Header connector



DC battery

/



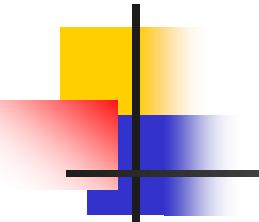
# Design Specification and selection of components

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



# Selection criterion of Voltage Regulator





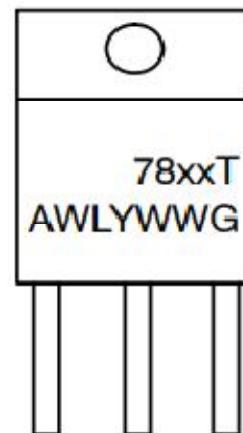
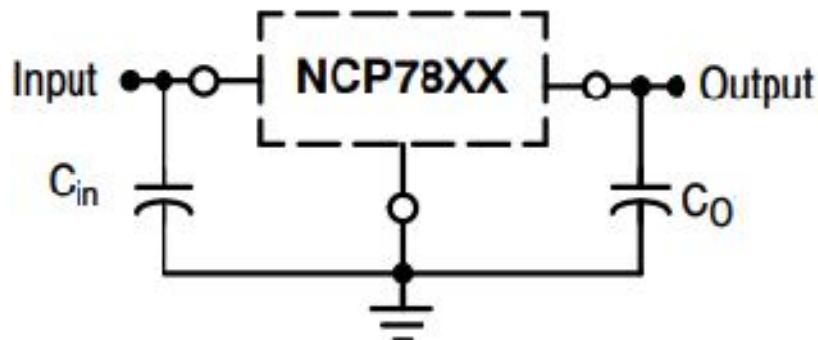
## 7800/7900 Voltage Regulator Variants

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		Ω
Peak output current @25°C		2.2		A

## Continued...



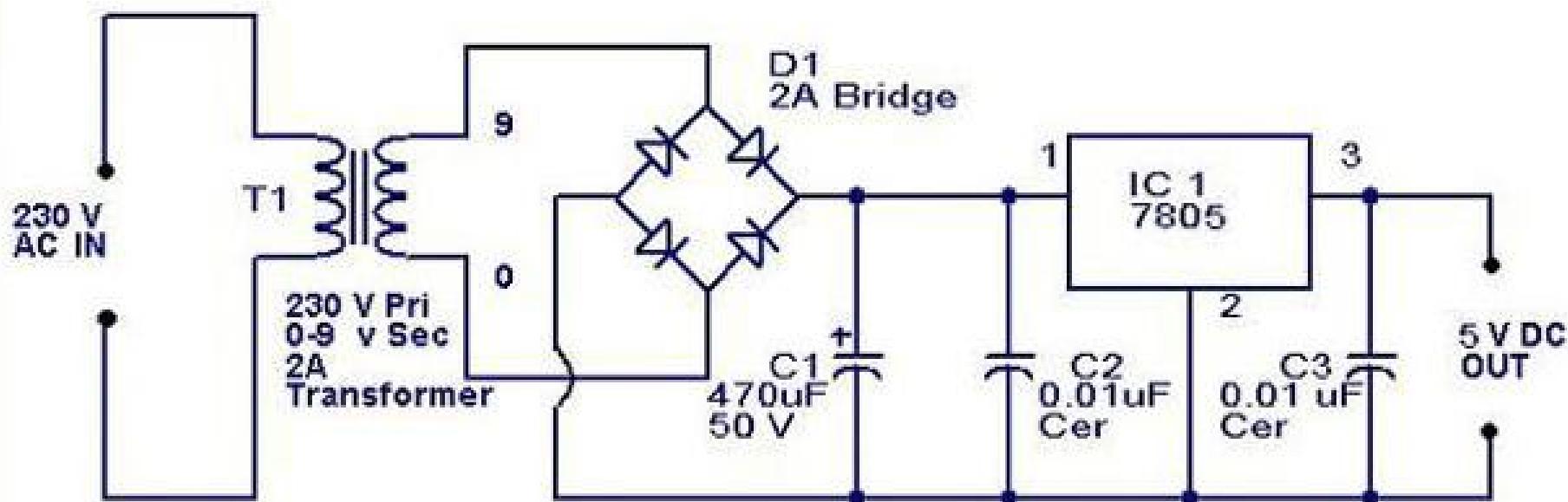
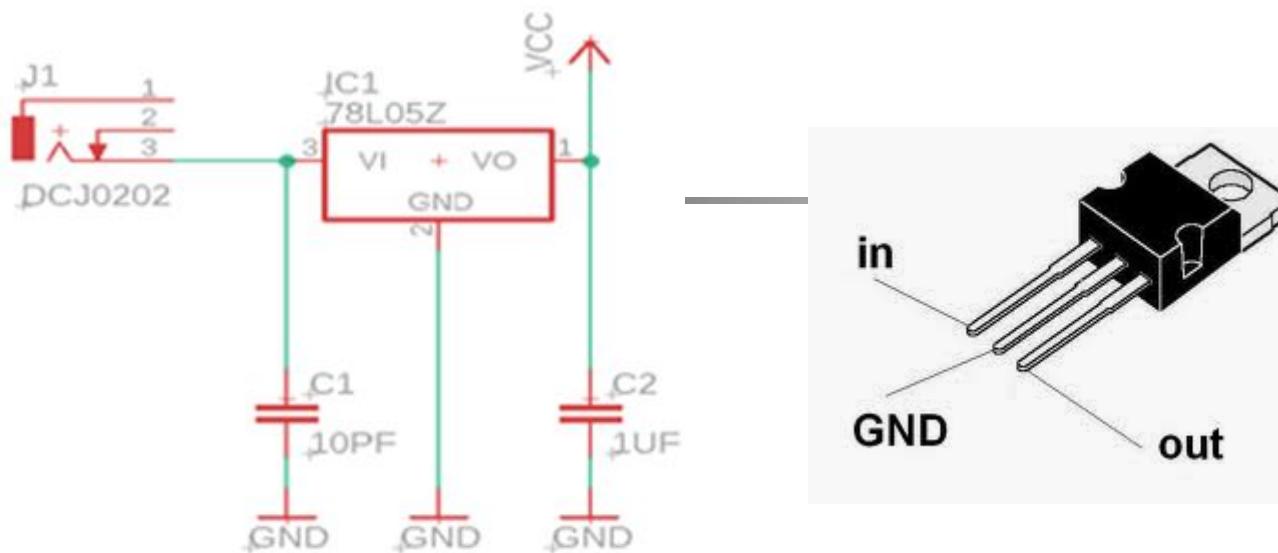
### MARKING DIAGRAM

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

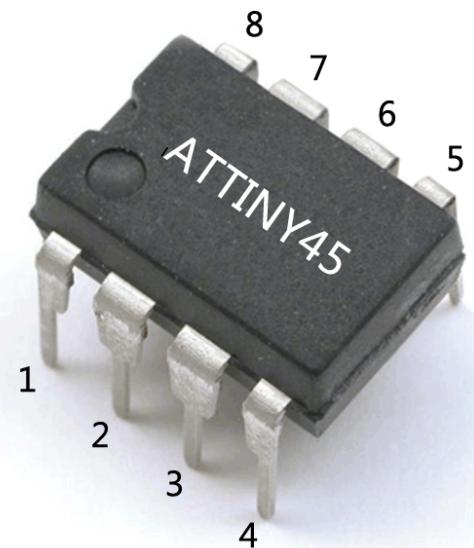


August 7, 2020

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

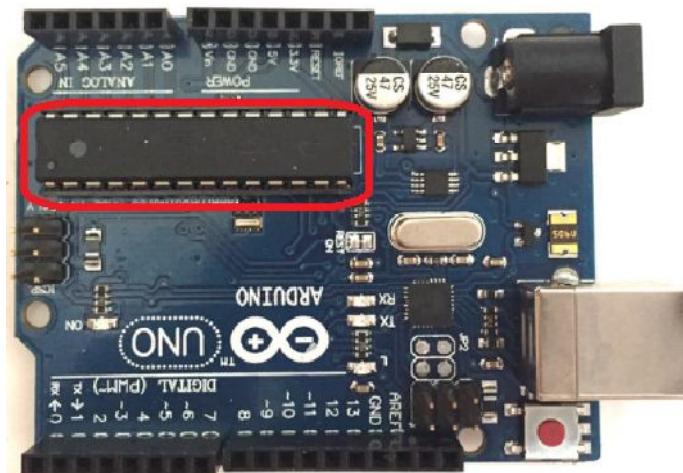
- Harvard architecture: separate space for RAM and program memory
- von Neumann architecture: program and RAM in the same space

# Selection criterion of Microcontroller

8051 microcontroller



Arduino-ATmega328



PIC microcontroller



Attiny-45

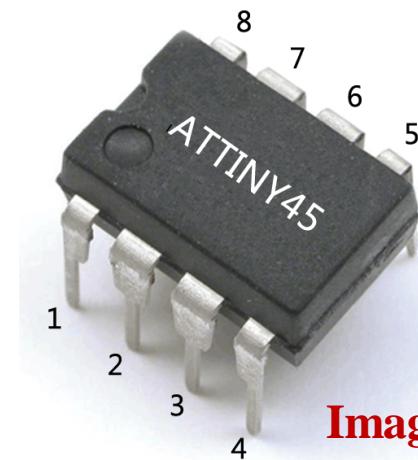


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## Drawbacks of Using an Arduino

- ❖ 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.

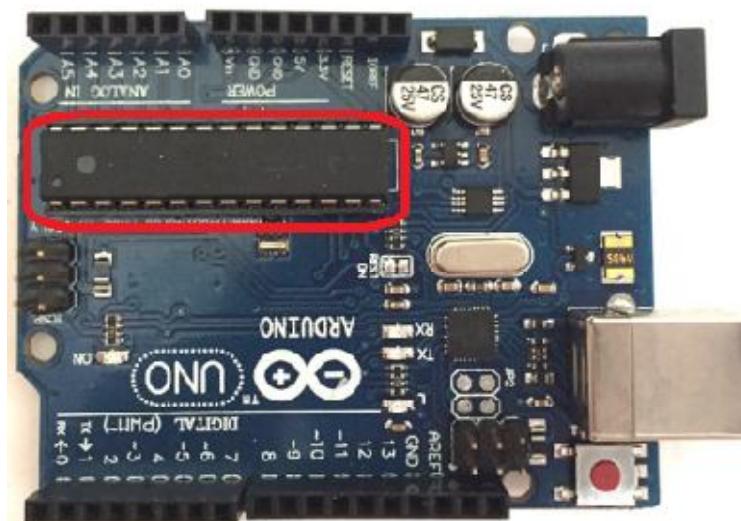
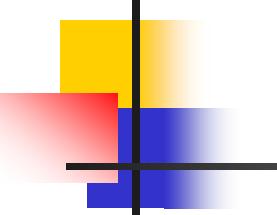
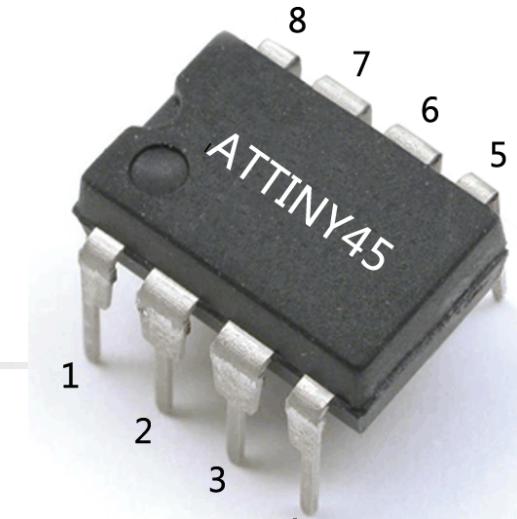


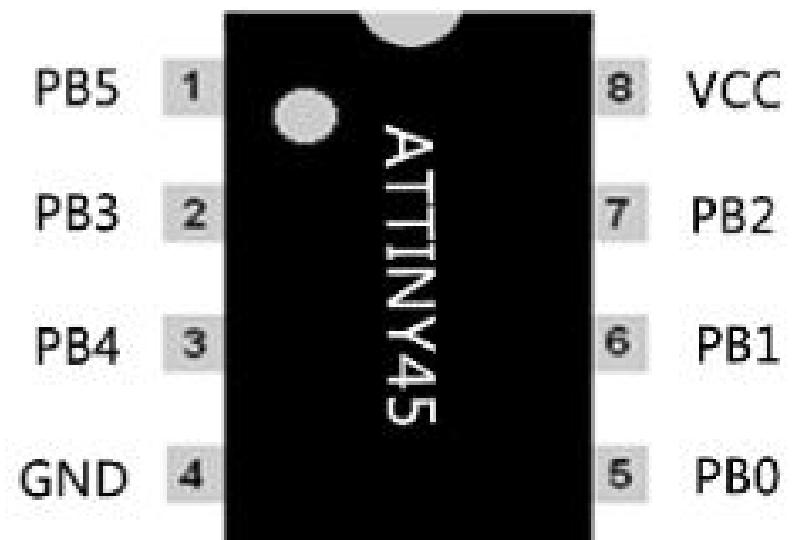
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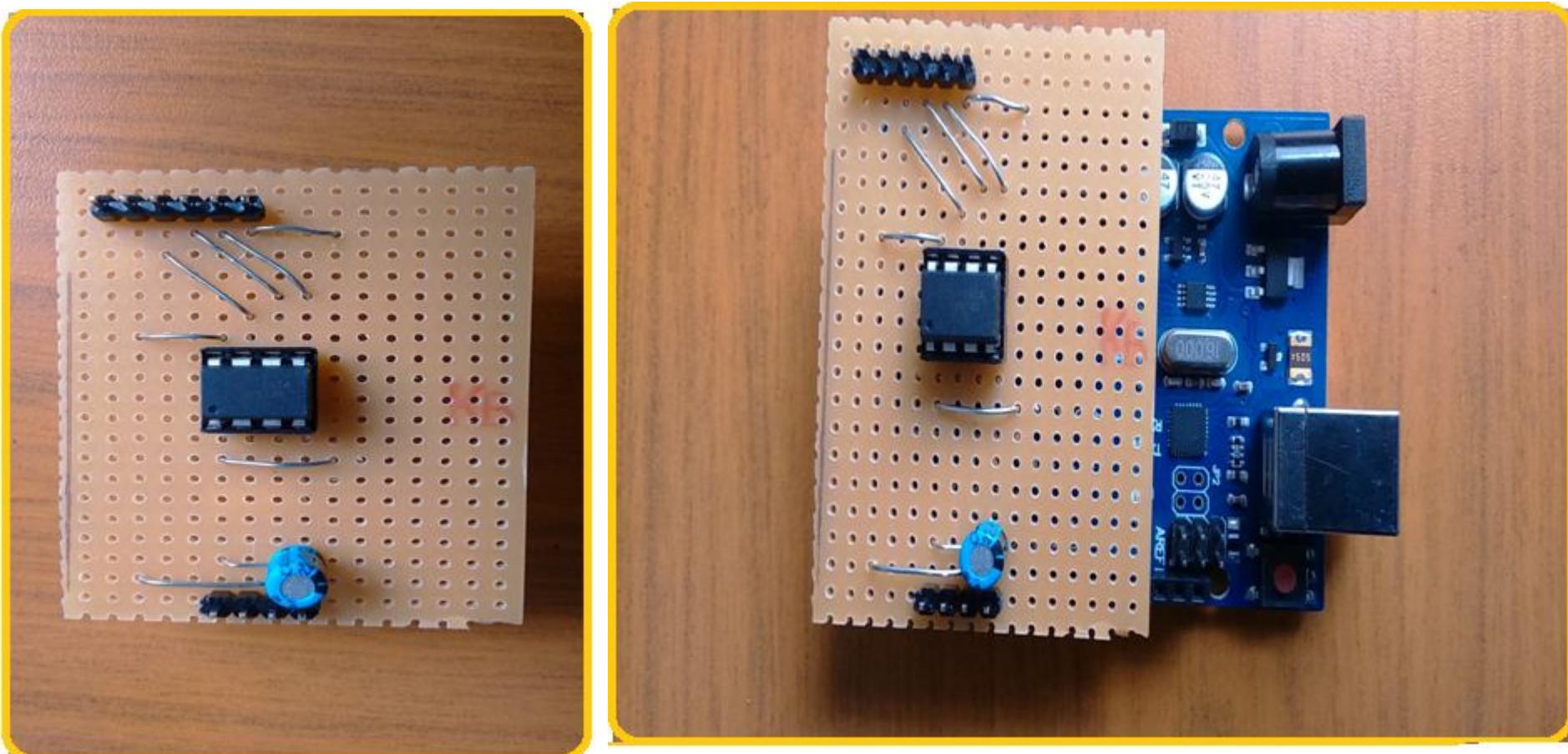
## ATtiny45 PU20 Technical Specifications



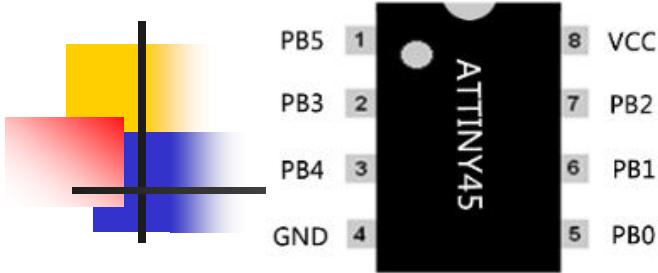
- ❖ Low current consumption 300uA in use & 0.1uA in sleep mode<sup>4</sup> on 1.8V.
- ❖ Operating voltage as low as 1.8V DC to 5.5V DC max.
- ❖ Total six analog I/O pins
- ❖ built in 4 Kbytes of flash memory
- ❖ built in 256b of SRAM
- ❖ Built in 256b of EEPROM
- ❖ Circuitry contains 32 Registers
- ❖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



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



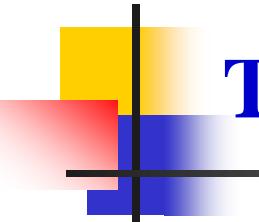
# PWM generation using ATtiny45



```
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);
```

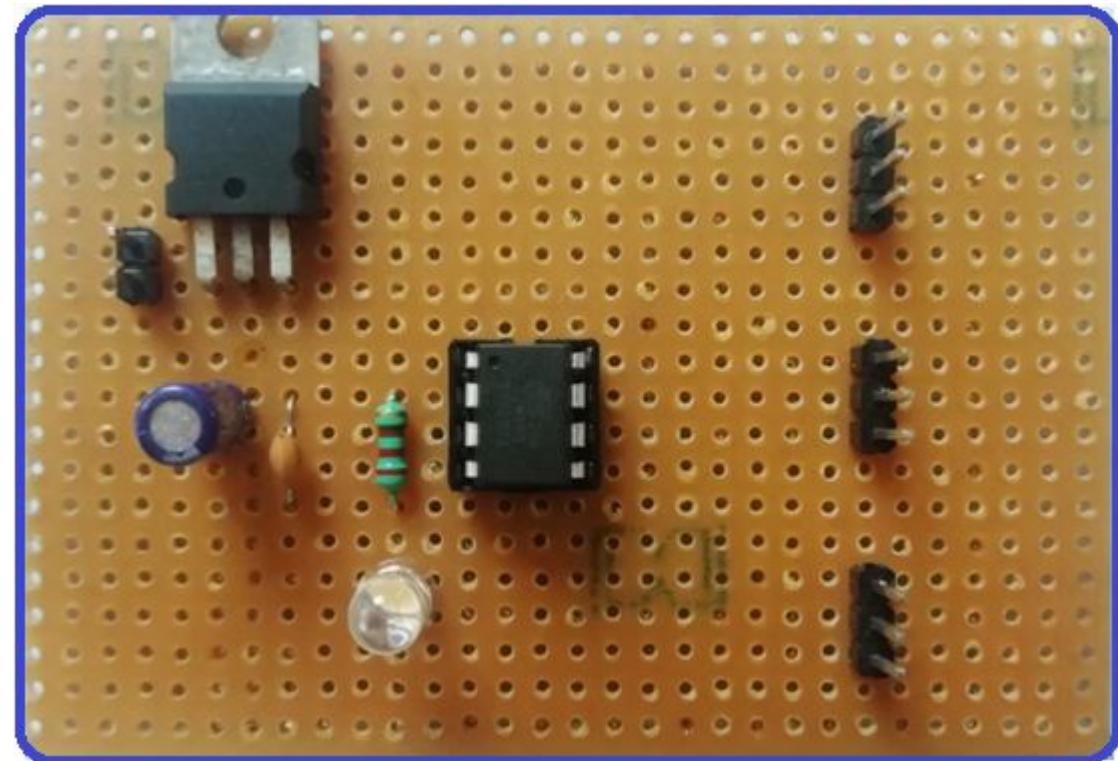
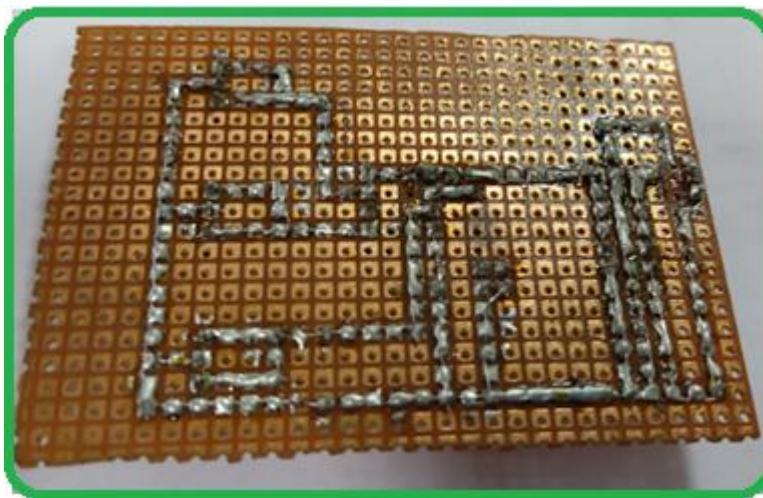
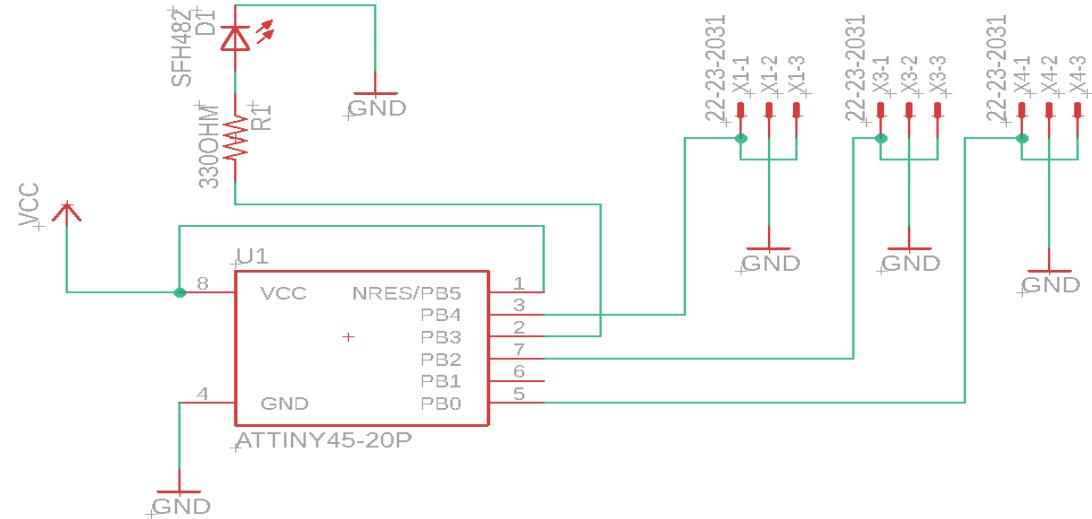
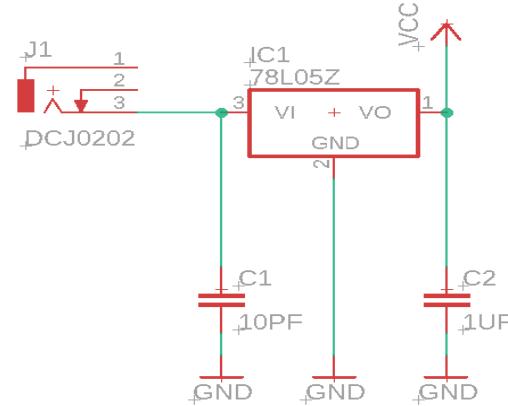
```
    delayMicroseconds(1000);  
  
    digitalWrite(gantryPin1,LOW);  
    delayMicroseconds(1000);  
    digitalWrite(gantryPin2,LOW);  
    delayMicroseconds(1000);  
    digitalWrite(gantryPin3,LOW);  
    delayMicroseconds(1000);  
    digitalWrite(gantryPin4,LOW);  
    delayMicroseconds(1000);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



## Transmitter circuit on PCB

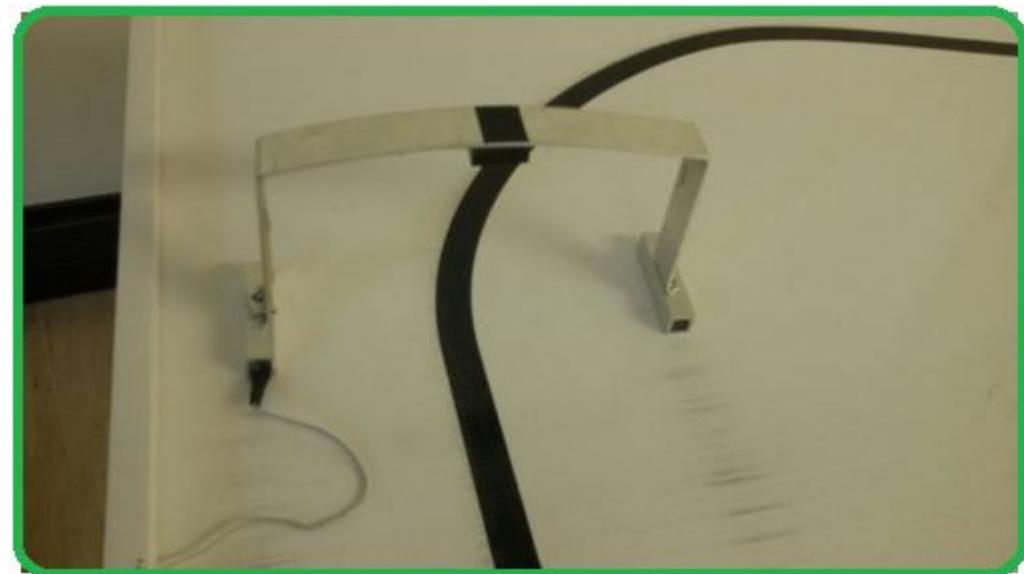
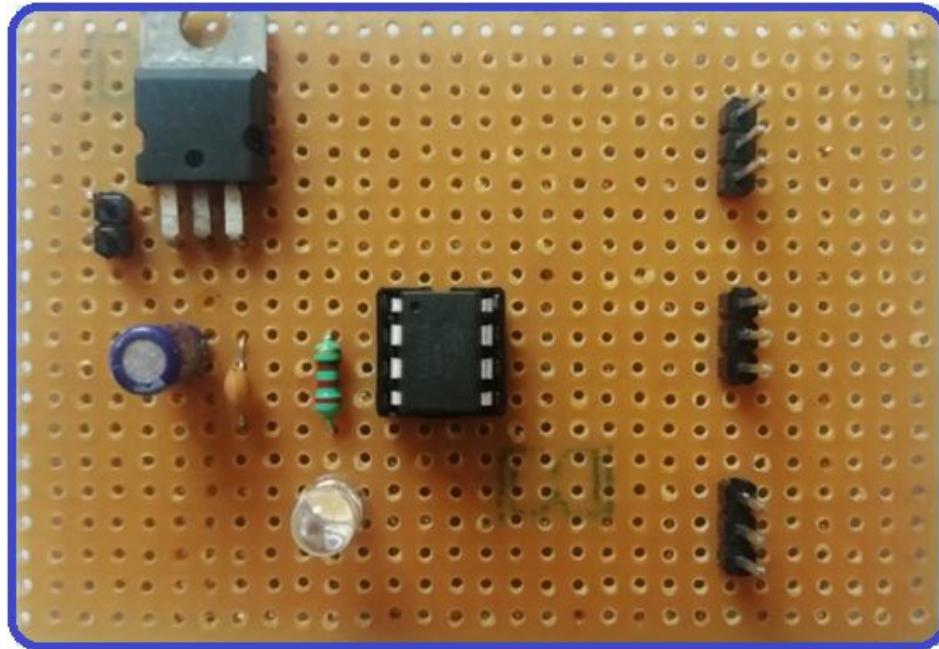


# Transmitter circuit on PCB



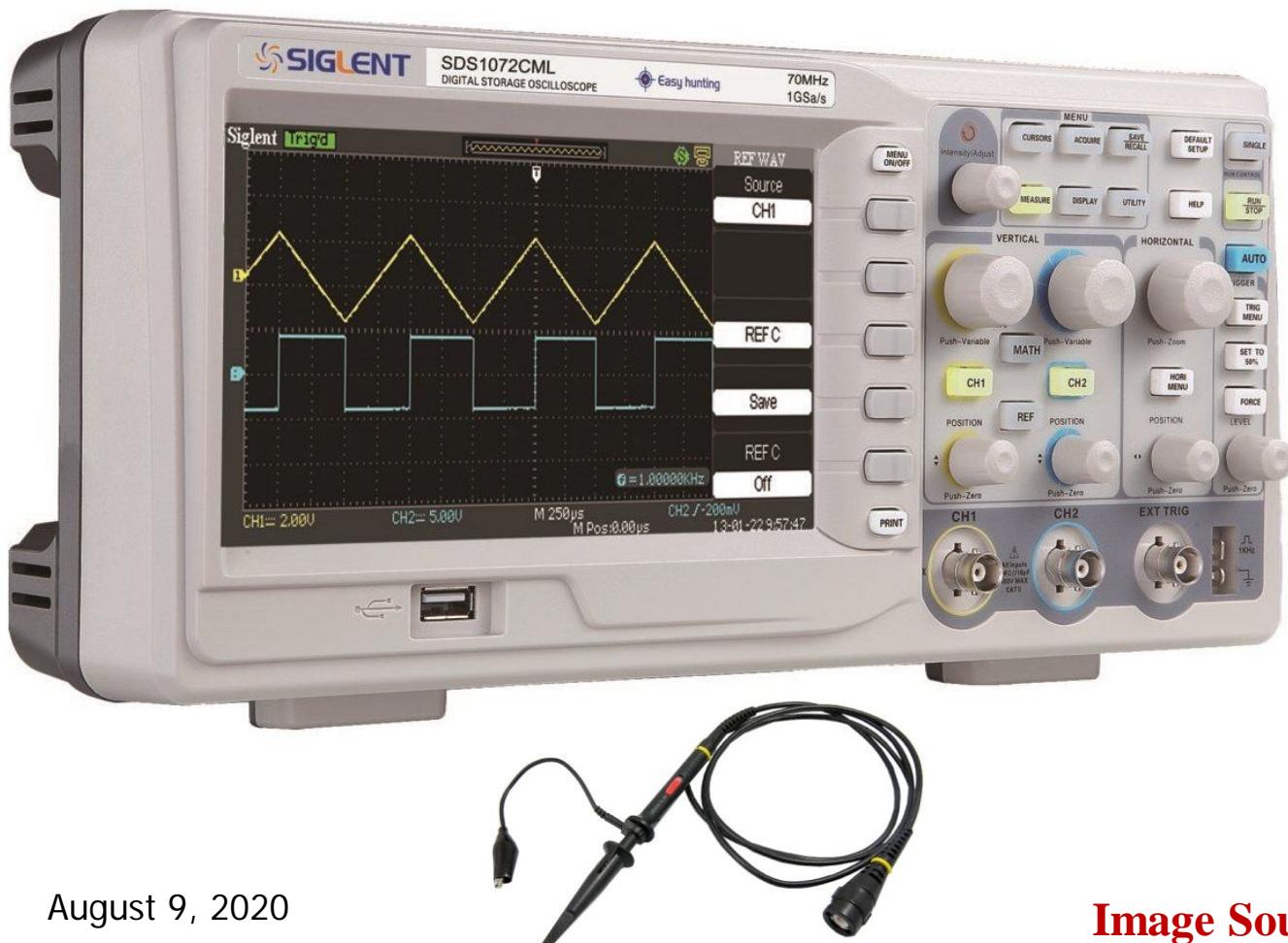
August 9, 2020

# Transmitter circuit with Attiny-45 and Gantry



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# Transmitter circuit Testing

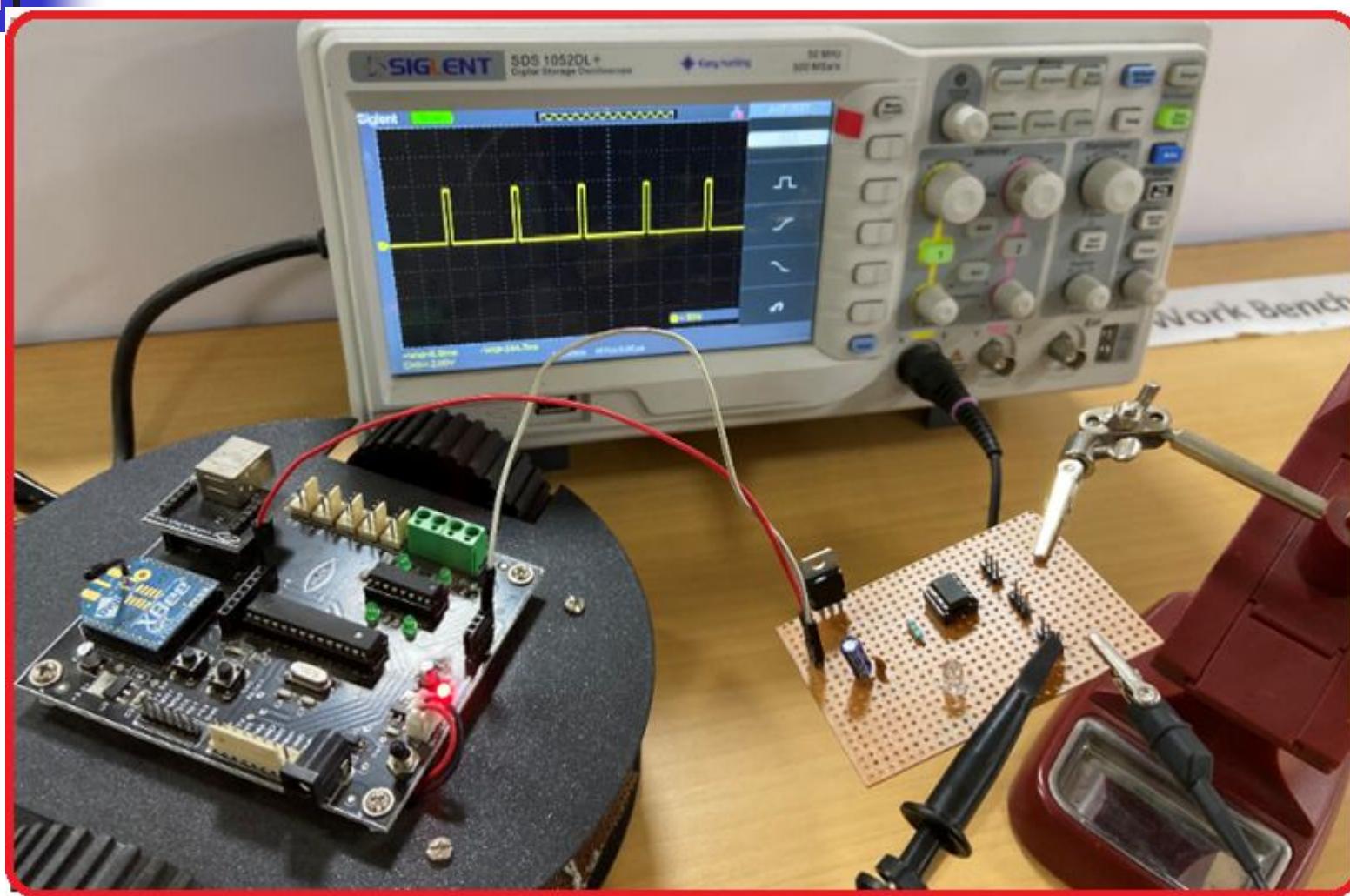


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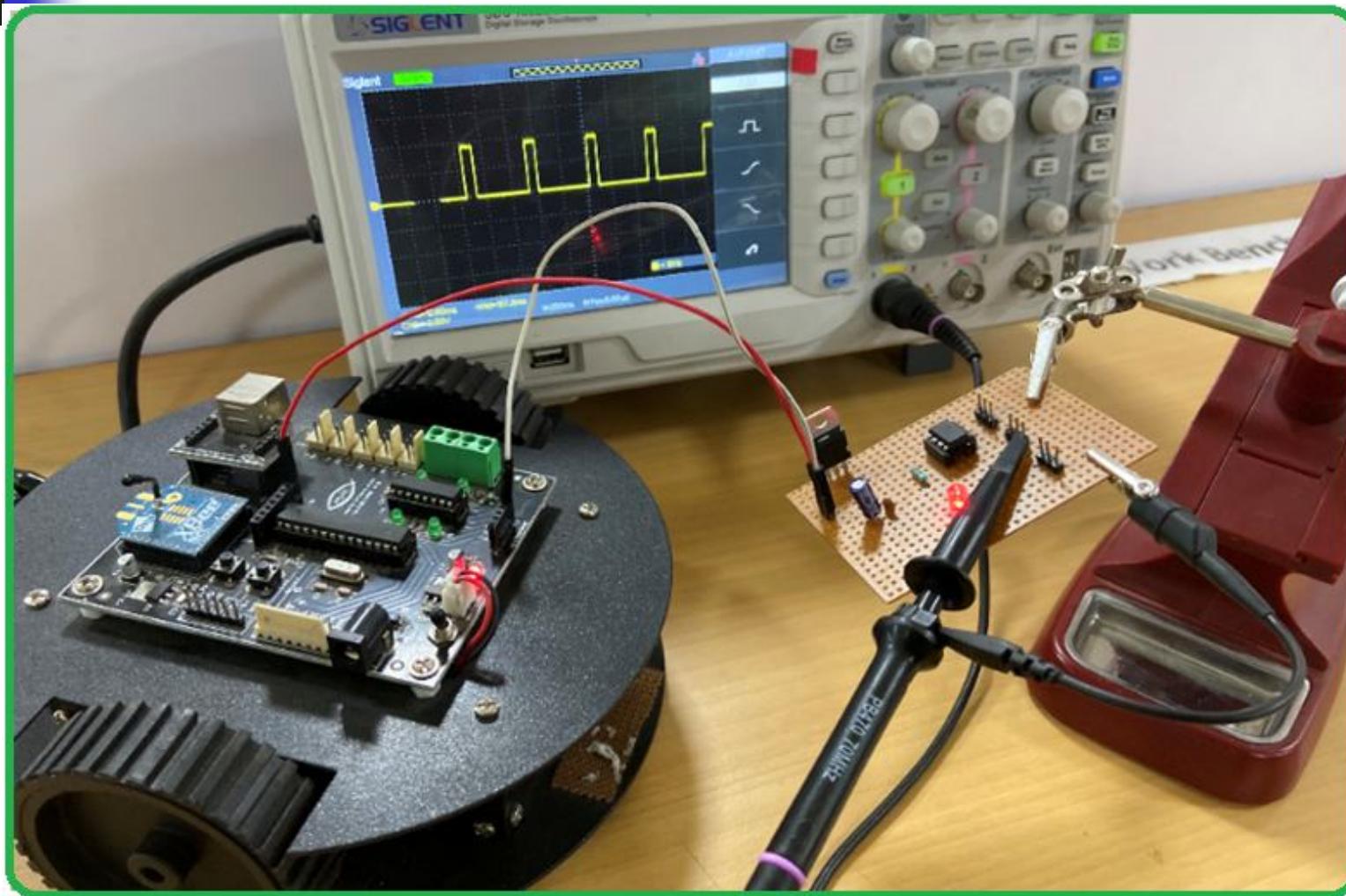
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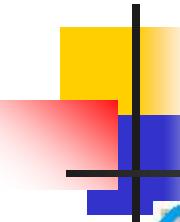
# Testing: Transmitter Circuit

Gantry-1

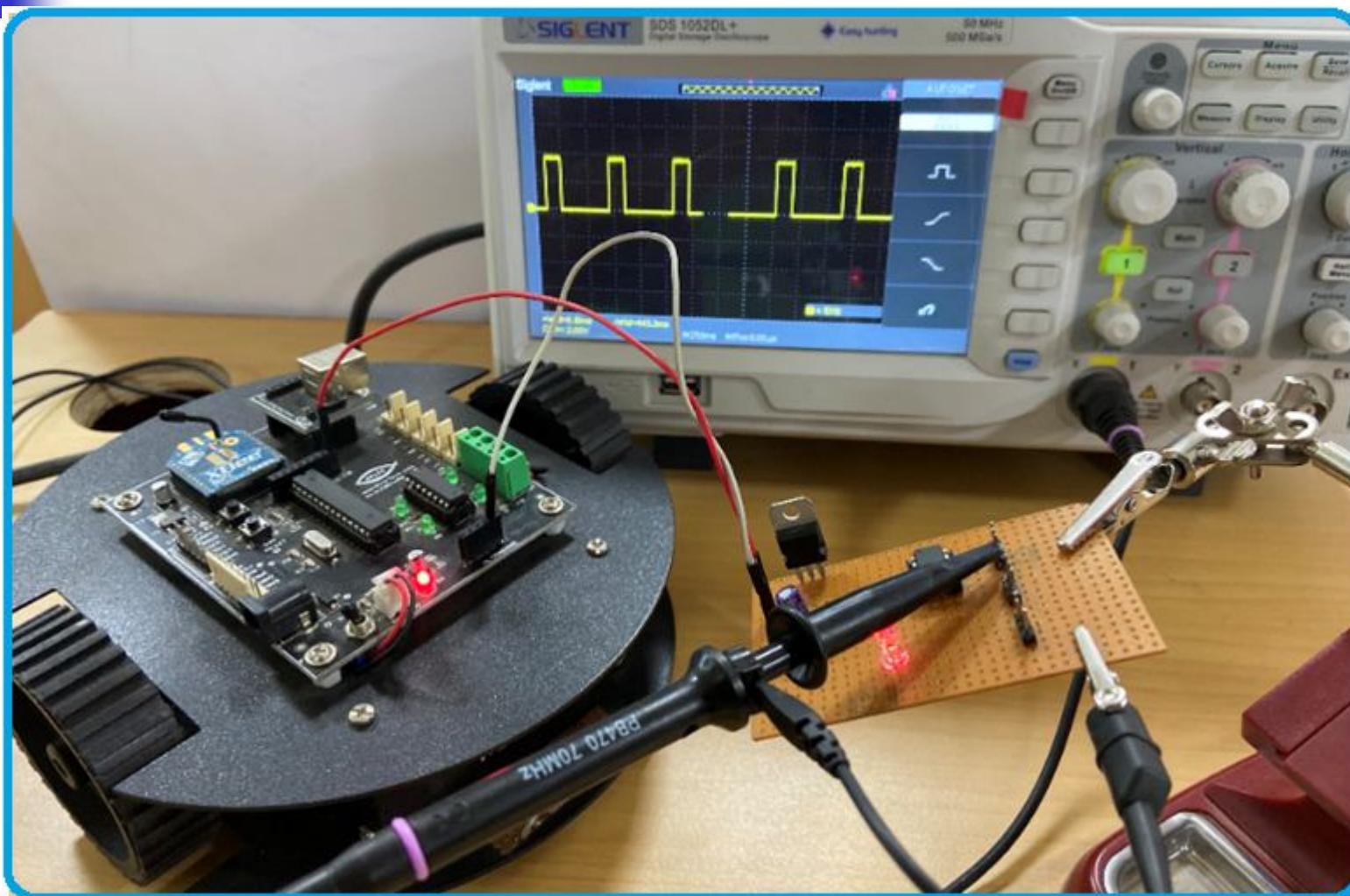


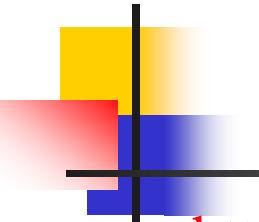
## Gantry-2





## Gantry-3





## References

- ❖ <https://www.onsemi.com/pub/Collateral/NCP7800-D.PDF>
- ❖ [https://www.electronics-notes.com/articles/analogue\\_circuits/power-supply-electronics/7805-7812-voltage-regulator.php](https://www.electronics-notes.com/articles/analogue_circuits/power-supply-electronics/7805-7812-voltage-regulator.php)
- ❖ [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)
- ❖ <https://maker.pro/custom/tutorial/attiny-microcontrollers-a-low-cost-arduino-alternative>



# Thanks !