DESCRIPTION DOCUMENT FOR WIFI SINGLE DIMMER ONE AMPERE BOARD

HARDWARE REVISION 0.3

Department	Name	Signature	Date
Author			
Reviewer			
Approver			

Revision History

Rev	Description of Change	Effective Date
A	Initial Release	

ABSTRACT:

This document is a detailed product description that describes the effective features of the product. It includes a functional hardware description of the product with its internal block diagram and product images.

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1. ABBREVIATIONS

Term	Description
A	Ampere
AC	Alternating Current
COM	Communication
DC	Direct Current
GPIO	General Purpose Input Output
HTTP	Hypertext Transfer Protocol
Hz	Hertz
I2C	Inter Integrated Circuit
IDE	Integrated Development Environment
IP	Internet Protocol
LED	Light Emitting Diode
MCU	Microcontroller Unit
MQTT	Message Queue Telemetry Transport
PCB	Printed Circuit Board
PWM	Pulse Width Modulation
SPI	Serial Peripheral Interface
SSID	Service Set Identifier
UART	Universal Asynchronous Receiver Transmitter
V	Volts
ZCD	Zero Crossover Detection

2. REFERENCES

Company Website link	https://www.armtronix.in
Intractable's Weblink	http://www.instructables.com/id/ARMTRONIX-WIFI-SINGLE-Dimmer-Board-V02/
Github's Weblink	https://github.com/armtronix/Wifi-Single-Dimmer-Board

3. PURPOSE

The purpose of this document is to outline the design description for the Wifi Single TRIAC 1A Board. It provides a high level summary of the product.

4. SCOPE

This document describes system architecture which includes Power supply, Microcontroller, WiFi Module and Triac.

5. SAFETY AND WARNING

Note that, this board to be powered with AC 230V with required current. Work and handle carefully with AC power as it is harmful and danger for human beings. Touching live wire or board when it is ON is danger and not advisable, it may cause to death, please avoid it.

Even a 50 V AC supply is sufficient to kill you. Please Switch off the mains before you make or change connections, be very careful. If you are not sure of anything related to the AC supply lines, please call an electrician ask and him to help you with it. Do not attempt to interface to mains unless you have adequate training and access to appropriate safety equipment. Never work on high voltages by yourself when you are alone. Always ensure that you have a friend/partner who can see and hear you and who knows how to quickly

turn off power in case of an accident. Use a 2A Fuse in series with the input to the board as a safety measure. Basic Wiring diagram is available on our instructables page and github. Please refer it.

Fire Hazard: Making wrong connections, drawing more than rated power, contact with water or other conducting material, and other types of misuse/overuse/malfunction can all cause overheating and risk starting a fire. Test your circuit and the environment in which it is deployed thoroughly before leaving it switched on and unsupervised. Always follow all fire safety precautions.

6. INTRODUCTION

One Triac One Ampere board is a Wifi based remote control switch/dimmer product. Designed and developed to control light or fan. Using this board a light or fan can be controlled through Smartphone which you use regularly. This board is not just to switch ON/OFF a light, you can also vary an intensity of light from 0 to 100%. It also has feature to connect potentiometer as virtual to vary intensity in two way mode with respect to Smartphone.

7. PRODUCT FEATURES

- Works directly with AC power 100 - 240 V AC 50-60 Hz.
- Product firmware can be updated/reloaded/changed as per user requirement.
- One Triac outputs to control a light.
- It is Arduino IDE compatible.
- Triac output can handle up to 1 Amperes of current.
- WiFi with MQTT or HTTP protocol.
- A header is available on board can be used to connect Potentiometer/switch as virtual switch. It can also be used as GPIO.
- Basic Firmware to enter SSID and password to connect to the router
- Firmware has ability to control device through HTTP and MQTT mode.
- Push Button on board Provided to Reset the board.
- Does not require external neutral for output.
- Product comes with wall mount plastic enclosure.

8. PRODUCT DESCRIPTION

a. PHYSICAL DESCRIPTION

- AC to DC Power supply module
- Triac 1-Nos.
- Wifi Module
- Microcontroller

b. FUNCTIONAL DESCRIPTION

Block Diagram

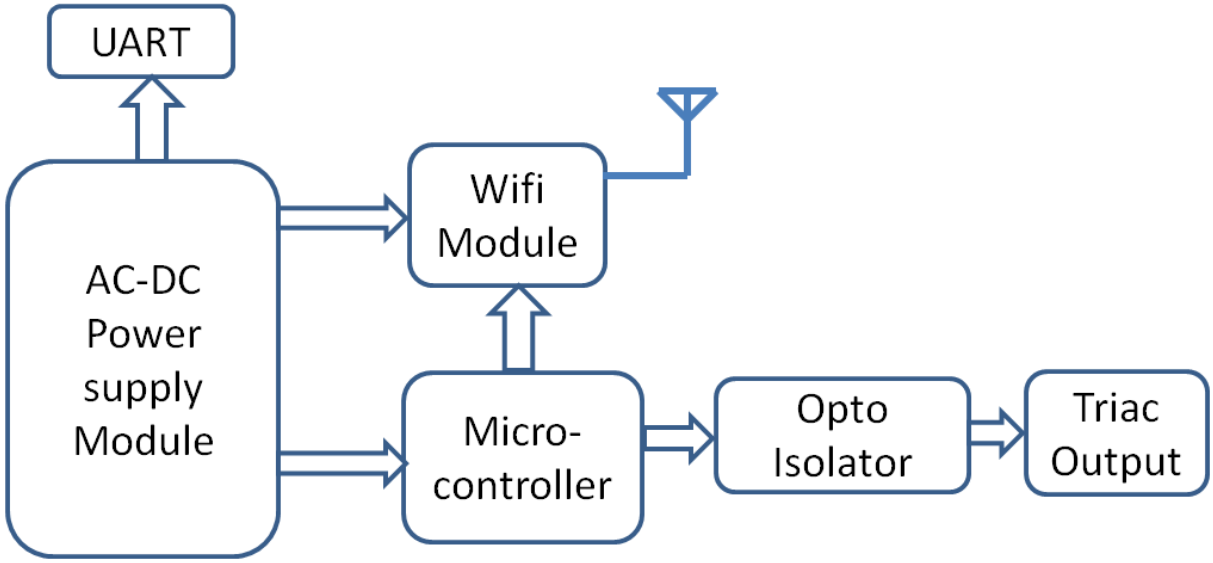


Figure 1: Block Diagram

One Triac one Ampere board has an on-board power supply module which takes standard AC power as input and provides required DC power as output. The DC power is used to power-up microcontroller and Wifi module incorporated on board to run a dimmer algorithm and to establish Wifi communication with Smartphone respectively. There is a triac used on board to control ON/OFF and dimming of light intensity from a Smartphone application using MQTT/HTTP protocol.

9. SYSTEM OVERVIEW

1. AC to DC Power supply module

   AC to DC converter is power supply module manufactured from Hi-Link part number HLK-PM01. This power supply module rectifies and regulates voltage from 230 V AC to 5 V DC with output current capacity of 0.6A DC. The power of HLK-PM01 is at maximum of 3W. The 5V output can be accessed to connect any external sensors.

   The DC-DC converter on board is used to regulate voltage from 5 V DC to 3.3 V DC to supply power to complete digital part.

2. Wifi Module

   Wifi module used on the board is ESP12 with all its required GPIOs are easily accessible to user for their own application. Wifi module is powered by through 3.3 V DC. It works on both MQTT / HTTP protocol.

3. Zero Crossover Detection

   Zero cross over detection is used to detect the zero crossing of AC phase to fire the Triac synchronously to get the smooth output. Optically isolated ZCD circuit is implemented to protect device from unwanted signals due t o AC lines.

4. Triac

   TRIAC is driven through optically isolated TRIAC drivers with reference to zero crossover

detection. Synchronous switching method is used to regulate the power to loads. PWM signal will drive the TRIACs, and switches AC mains power from 0% to 100% of its total cycle. The PWM signal pulses can be configured in code with respect to AC mains frequency and voltage level. BT136 Triac is used in this board to act as dimmer or switch.

5. Microcontroller

   The Microcontroller executes the dimmer algorithm to drive the TRIAC switch, by receiving ZCD signal. Along with this, it has three LEDs to indicate the status of loads. Controller communicates with Wifi module through UART mode of communication to send and receive data to-and-from respectively with connected Wifi network. ATmega328P microcontroller is used in the product to execute the algorithm, which is manufactured by Atmel incorporation and is compatible with Arduino.

   Control processor has the capability for software up-gradation through Arduino and contains enough memory to upgrade and store the software for its own application.

10. TECHNICAL SPECIFICATION

a. ELECTRICAL SPECIFICATION

Input Specifications				
Description	**Min**	**Typ**	**Max**	**Unit**
Voltage AC	100	220	230	Volts
Current AC	0.6	2.6	-	Amps
Power AC	-	3	-	Watts
Frequency	50	-	60	Hz

Table 1: Input Specification

Triac Output Specifications (Maximum)				
Description	**Min**	**Typ**	**Max**	**Unit**
Voltage AC	-	-	240	Volts
Current AC	-	-	1	Amps
Power AC	-	-	240	Watts

Table 2: Triac Output Specification

b. MECHANICAL SPECIFICATION

- Mechanical Dimensions of PCB are approximately 62 x 32 x 18 mm (Length x Width x Height)
- Mounting Holes (M3) at distance of 4.5mm for edges of board

11. ELECTRICAL CONNECTIONS

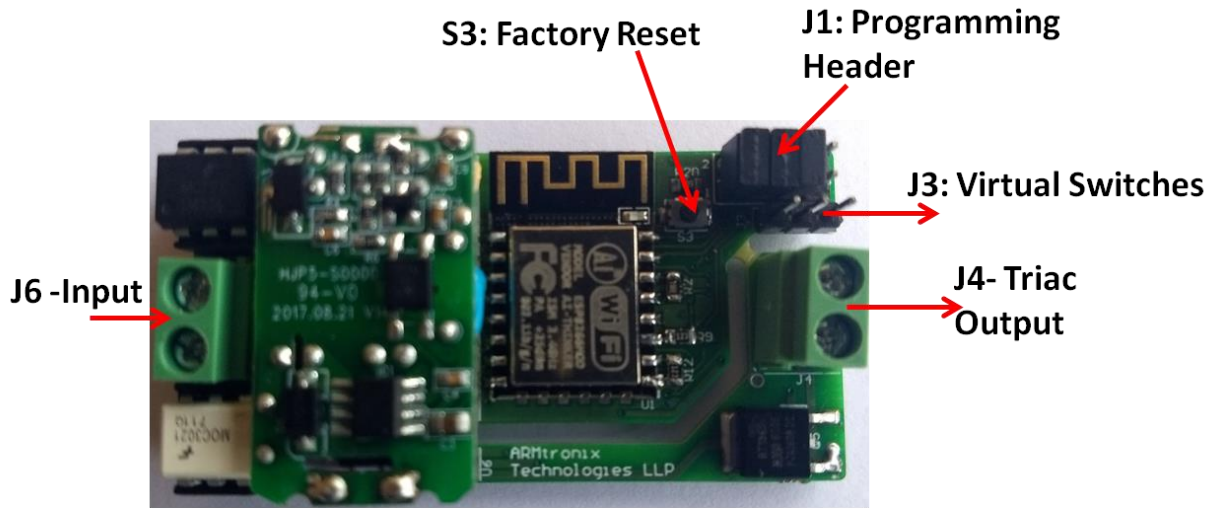


Figure 2: Header and Switch Details

Description of Header and Switches shown in Figure 2:

1. S3 Button is to reset the ESP and controller.
2. J1 UART programming header for both MCU and ESP.
3. J3 Header is for virtual switch
4. J4 Output Terminal Block.
5. J6 Input terminal block

Figure 3: AC Input connection

Figure 4: Triac pin-out

Figure 3, shows pinout and connection of AC Phase and Neutral connection to J6 input connector. Figure 4, shows J4 output load connector.

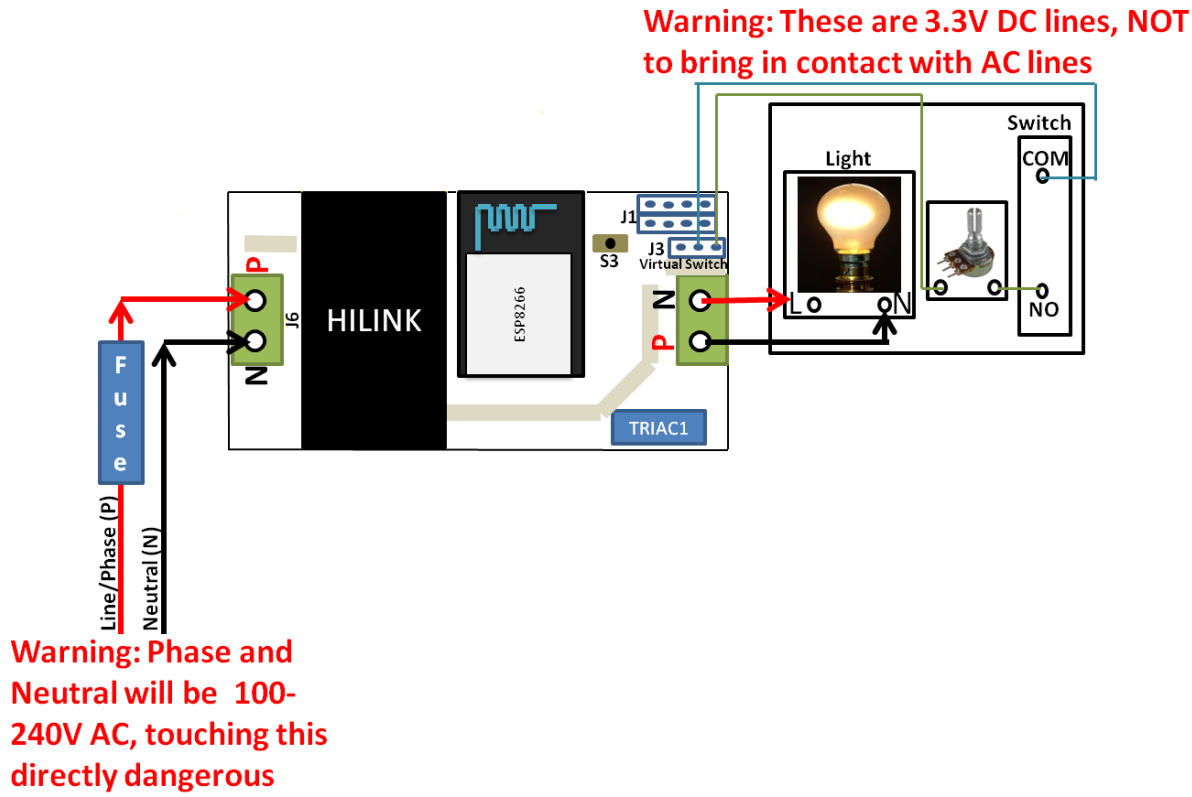
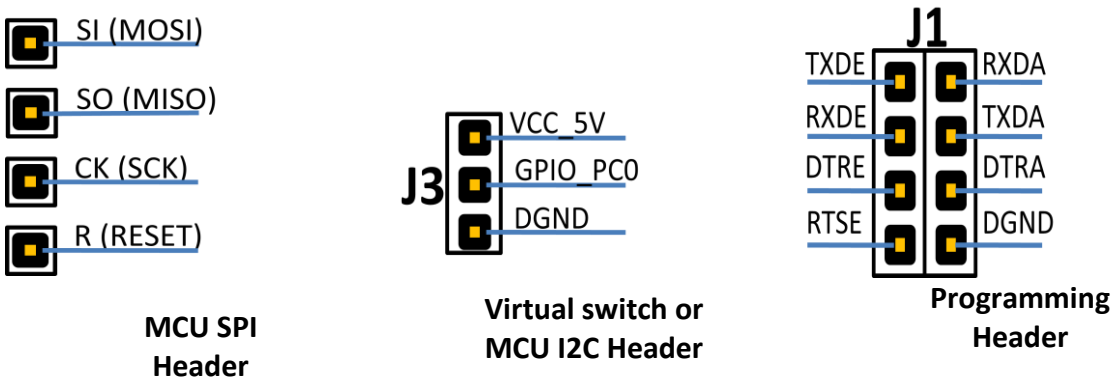


Figure 5: Load connection

Figure 5 represents about connection between load and triac output (J4) connector. Phase and neutral both are available at connector J4 for load connection.



MCU SPI Header

Virtual switch or MCU I2C Header

Programming Header

Figure 6: Other Header

Figure 6, shows the J3 and J1 headers in which J3 has GPIO and can be used for Virtual switch. J1 header is for programming purpose. Board also provides access to MCU SPI pins through open pads for loading boot-loader and any other purpose.

12. PWM Waveforms

Channel 1 Yellow Color: PWM
Channel 2 Yellow Color: AC

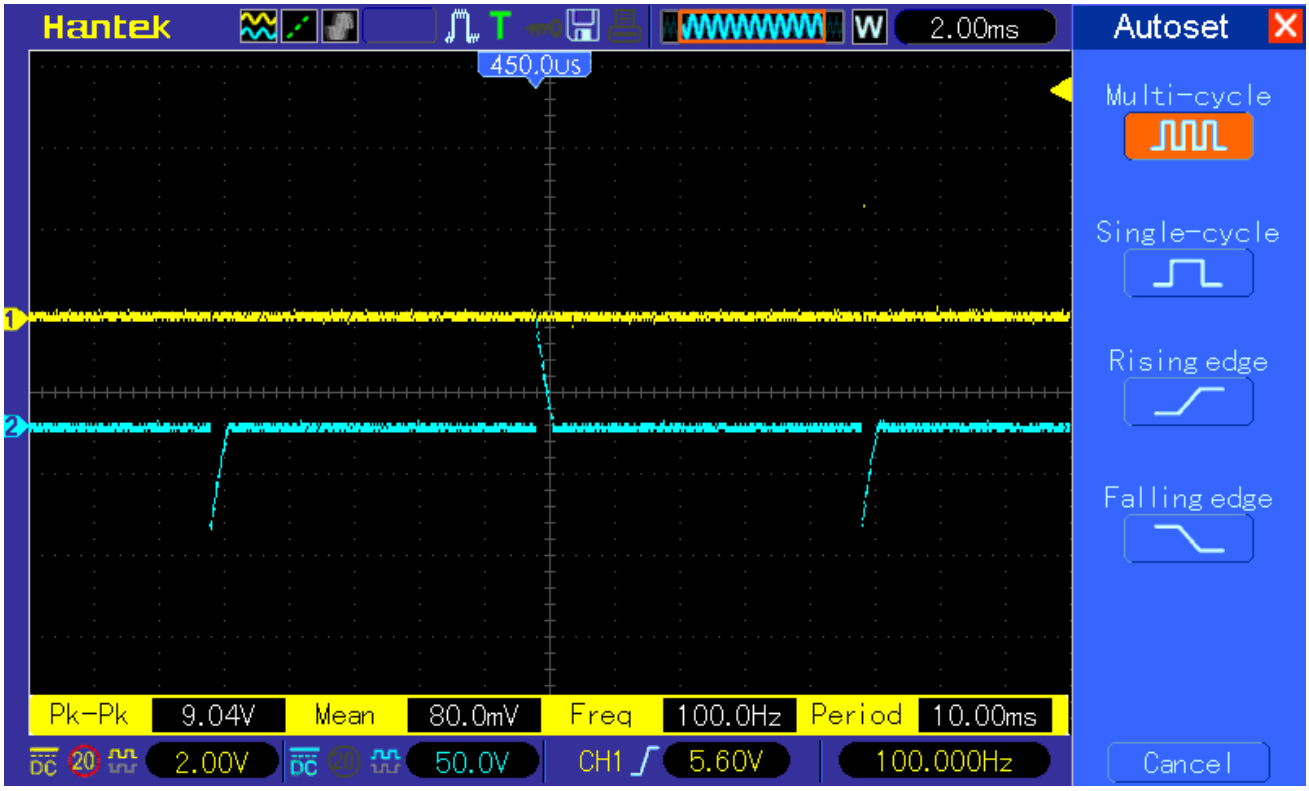


Figure 7: PWM at 0%

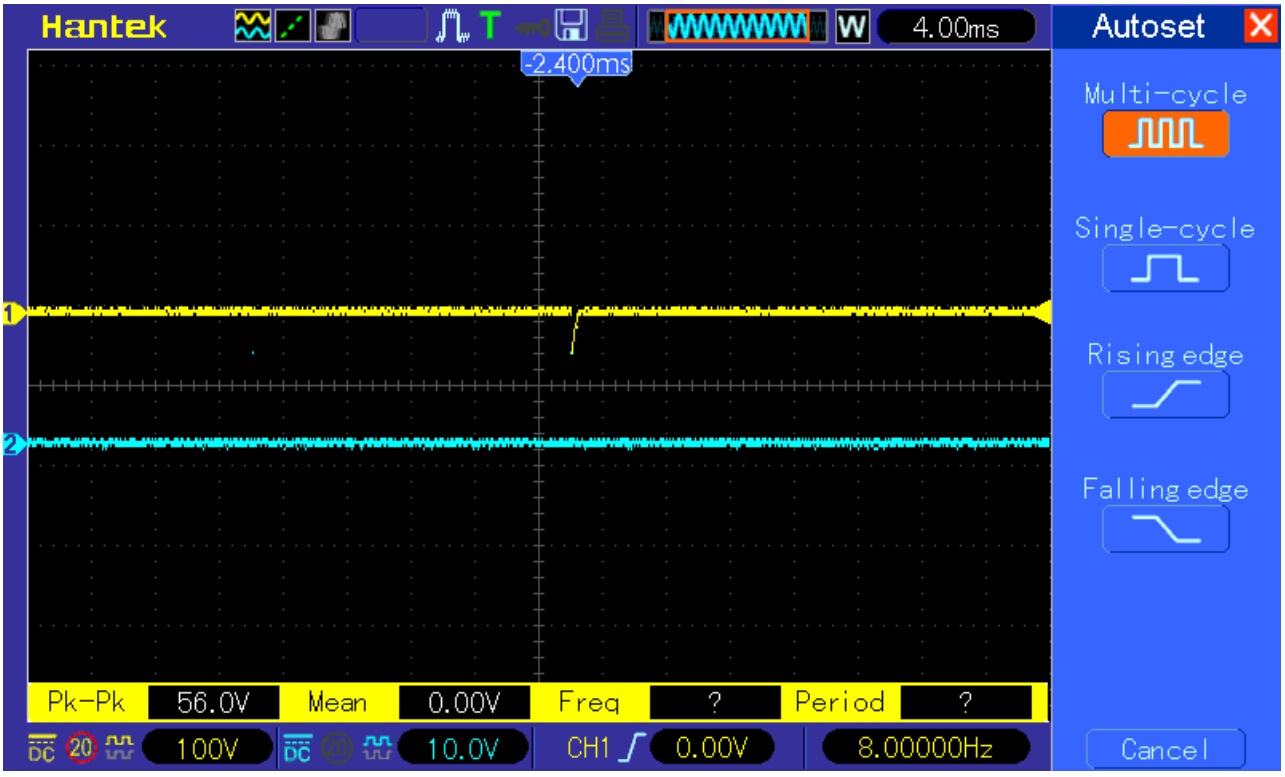


Figure 8: PWM at 5%

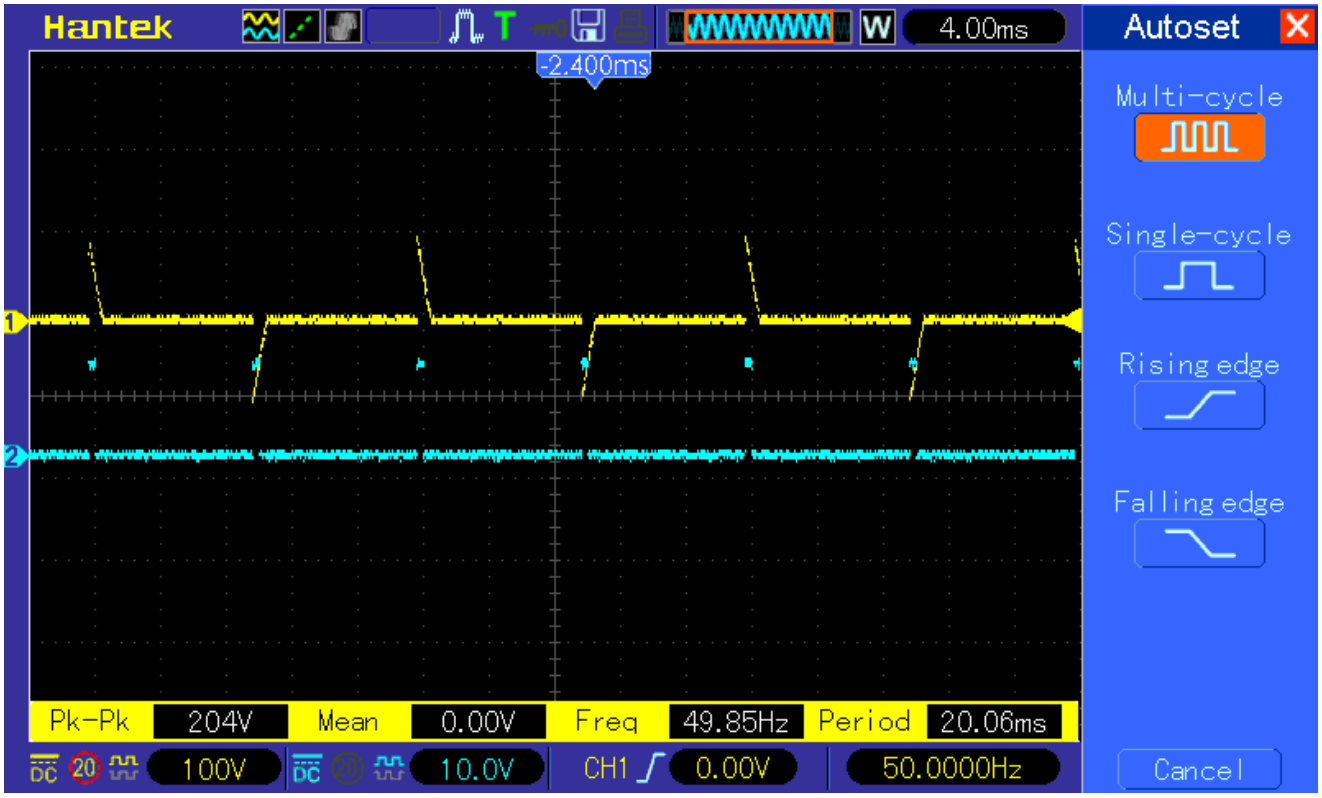


Figure 9: PWM at 10%

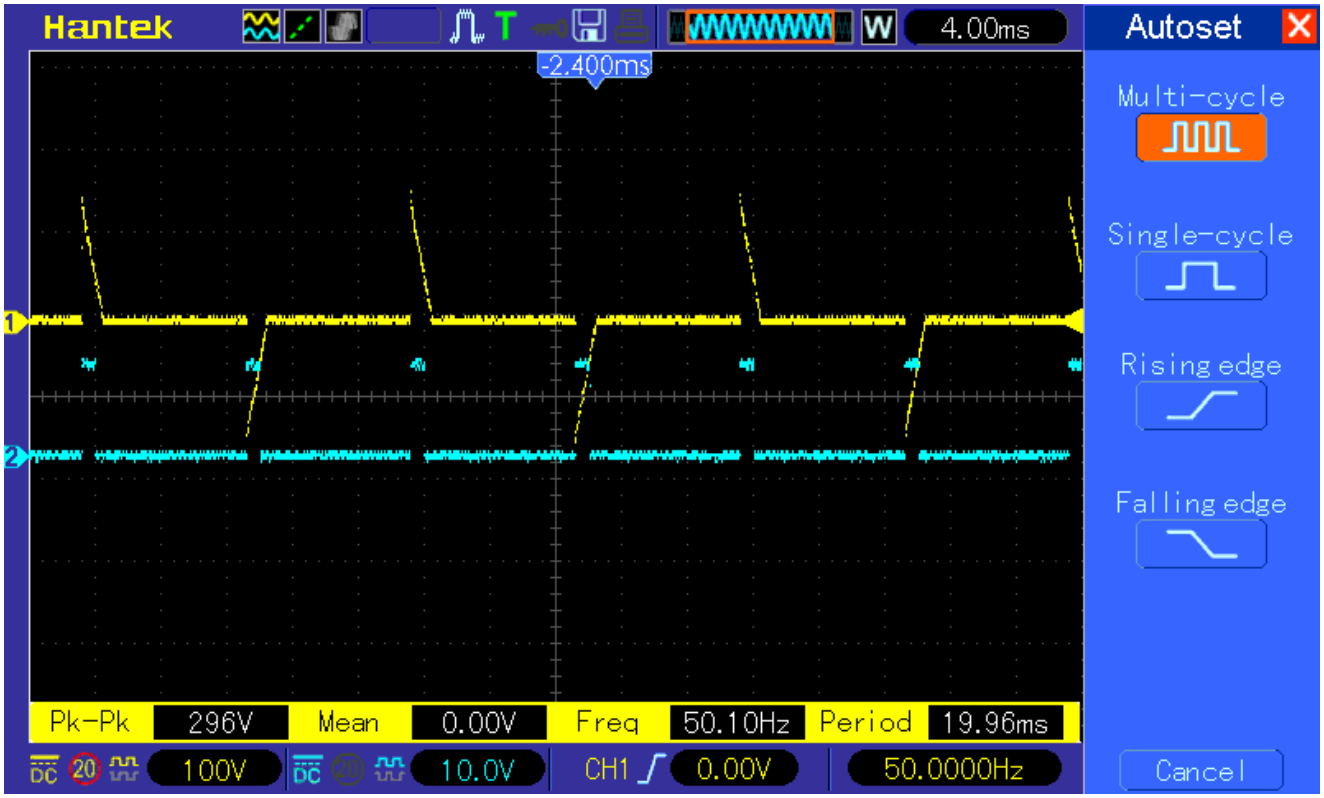


Figure 10: PWM at 15%

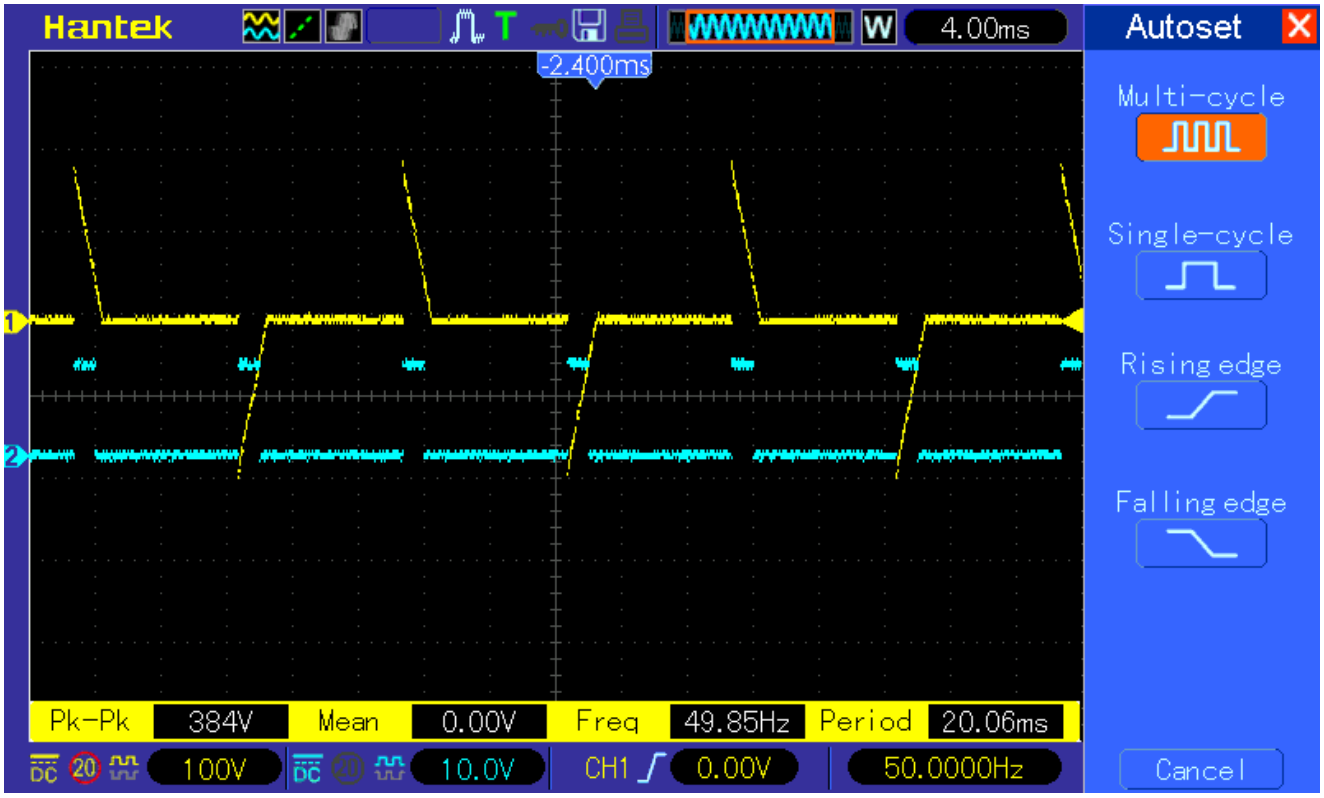


Figure 11: PWM at 20%

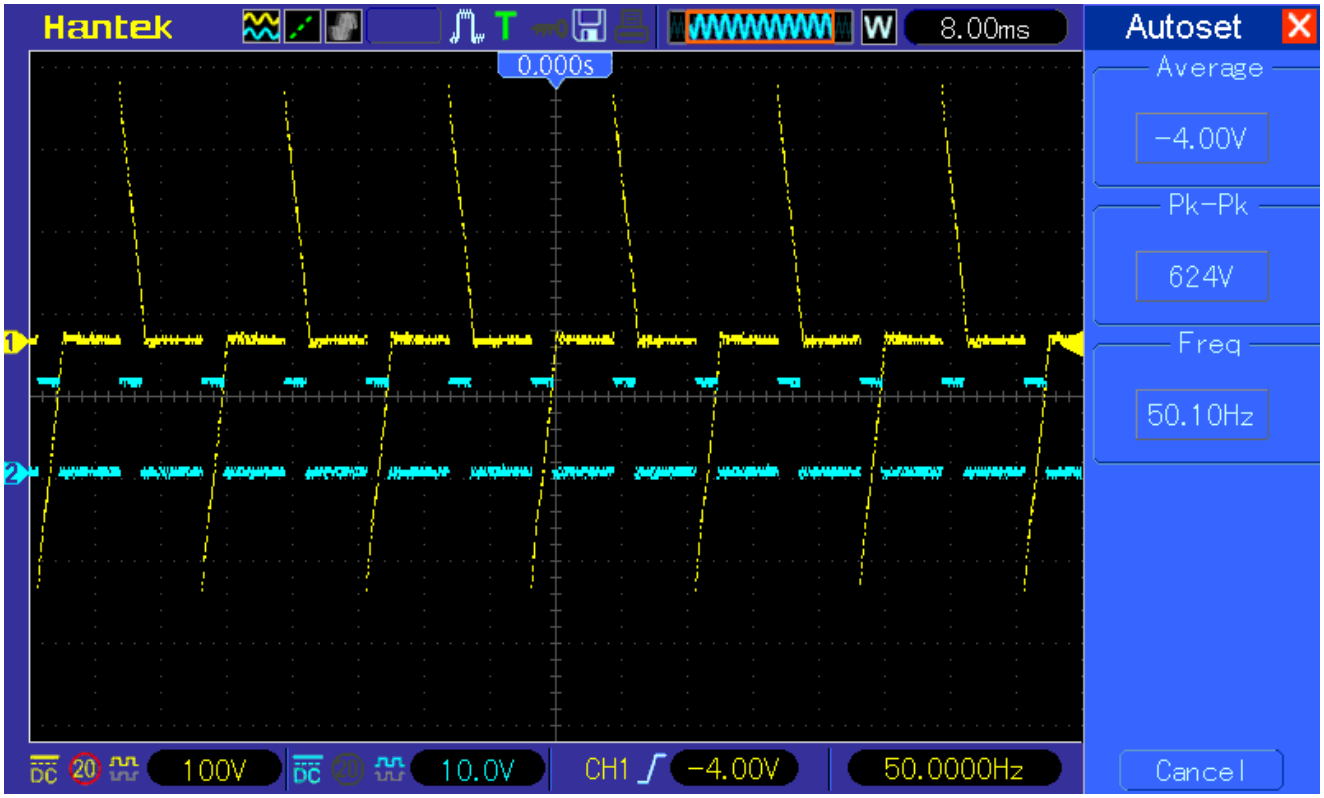


Figure 12 : PWM at 30%

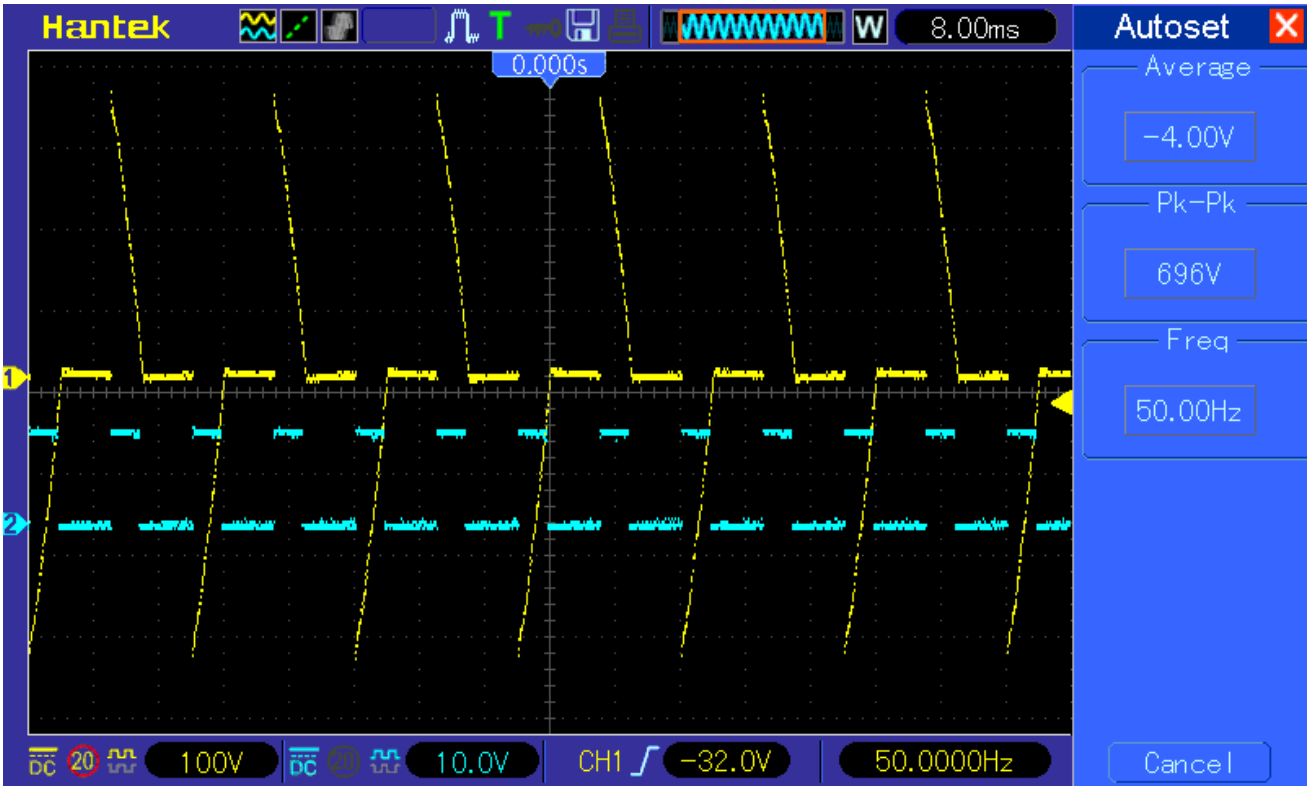


Figure 13: PWM at 40%

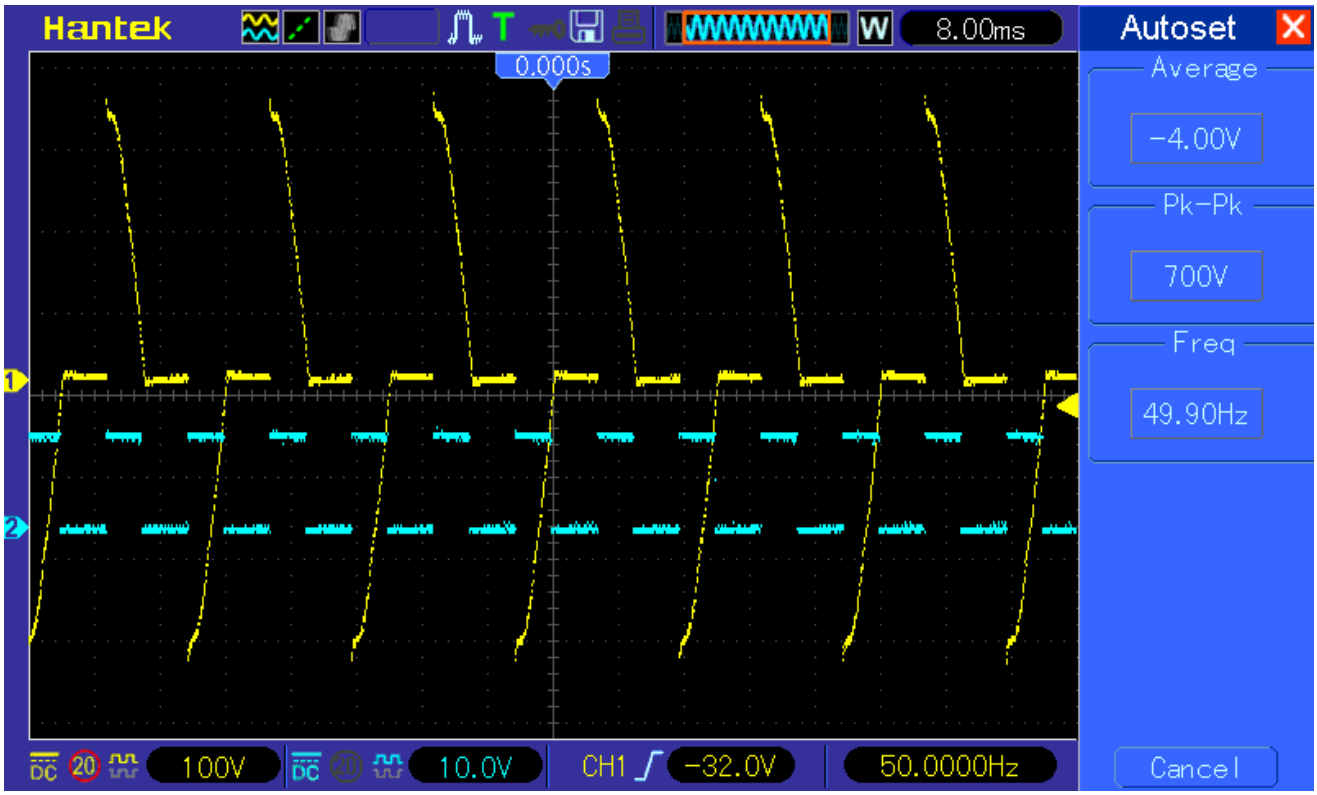


Figure 14: PWM at 50%

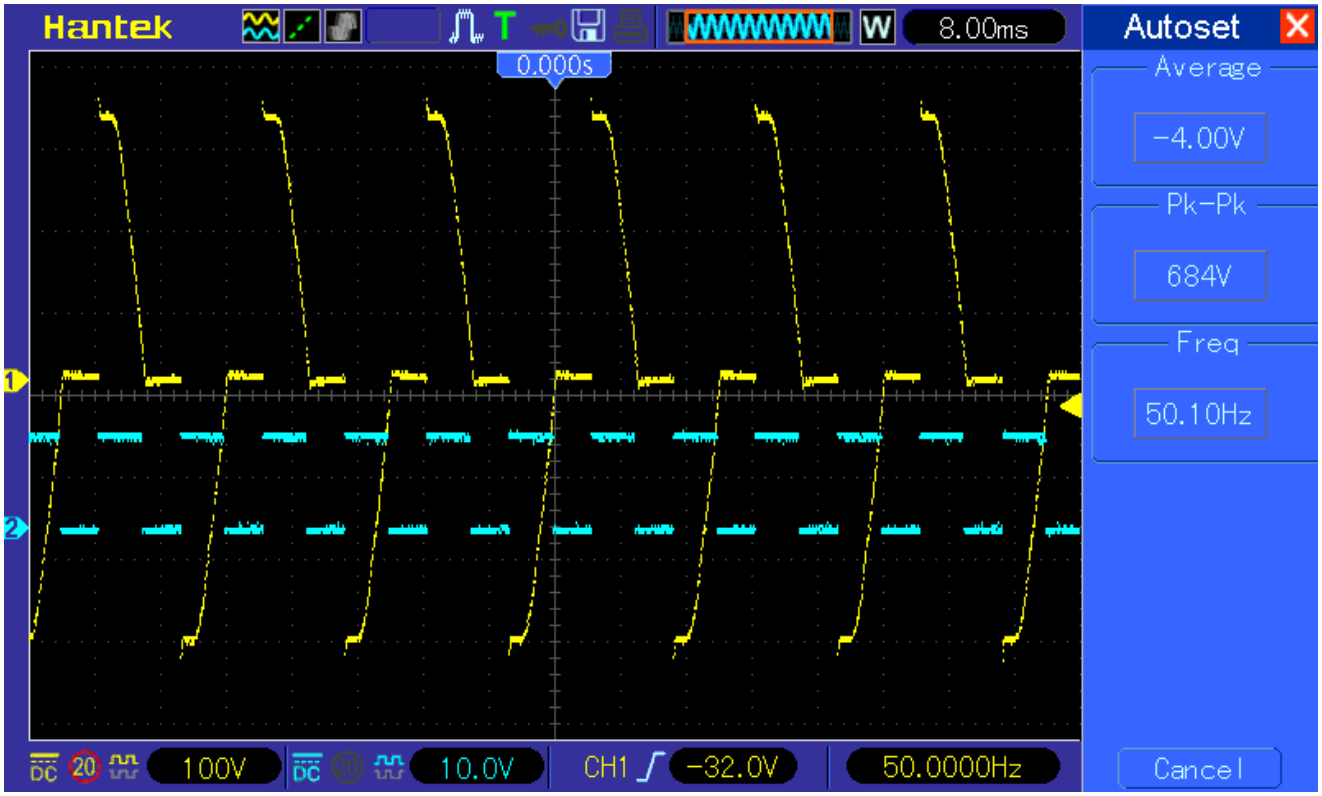


Figure 15: PWM at 60%

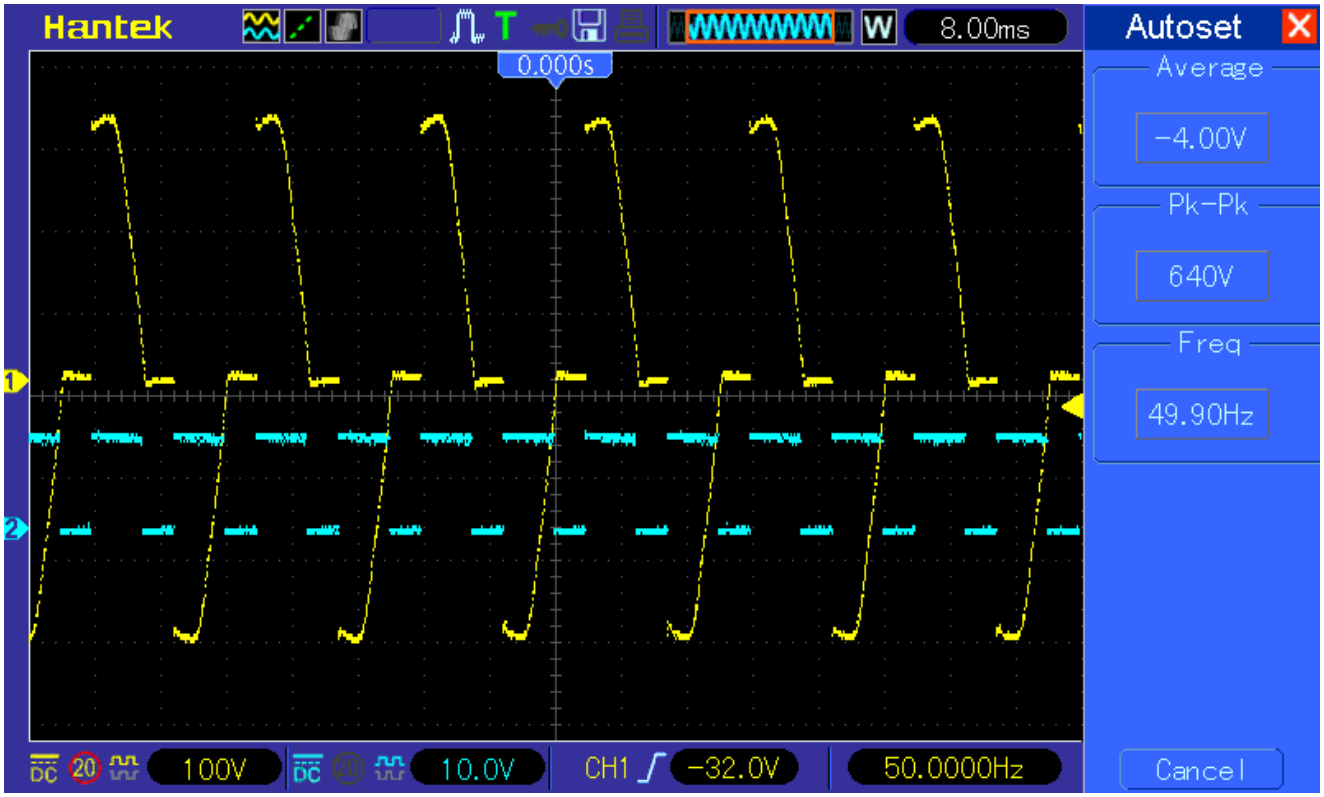


Figure 16: PWM at 70%

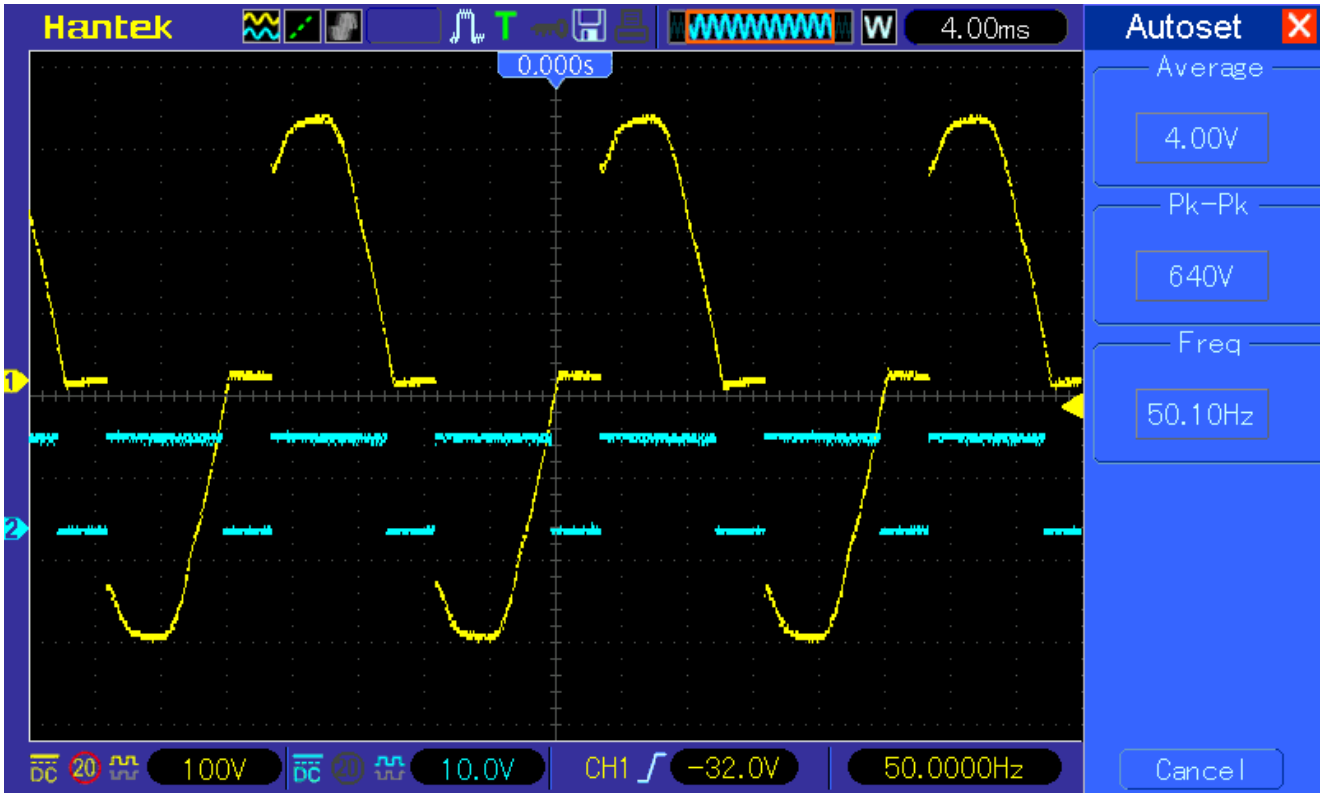


Figure 17: PWM at 80%

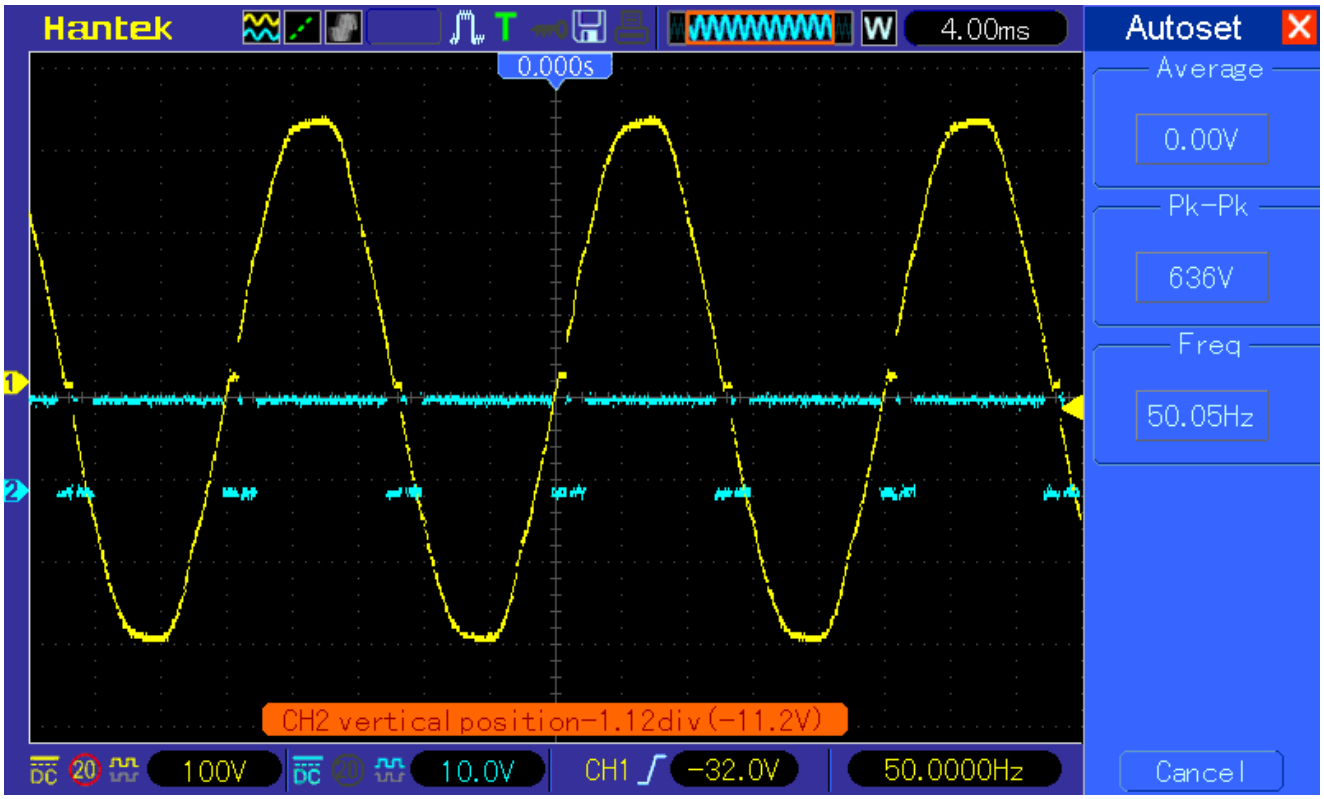


Figure 18: PWM at 90%

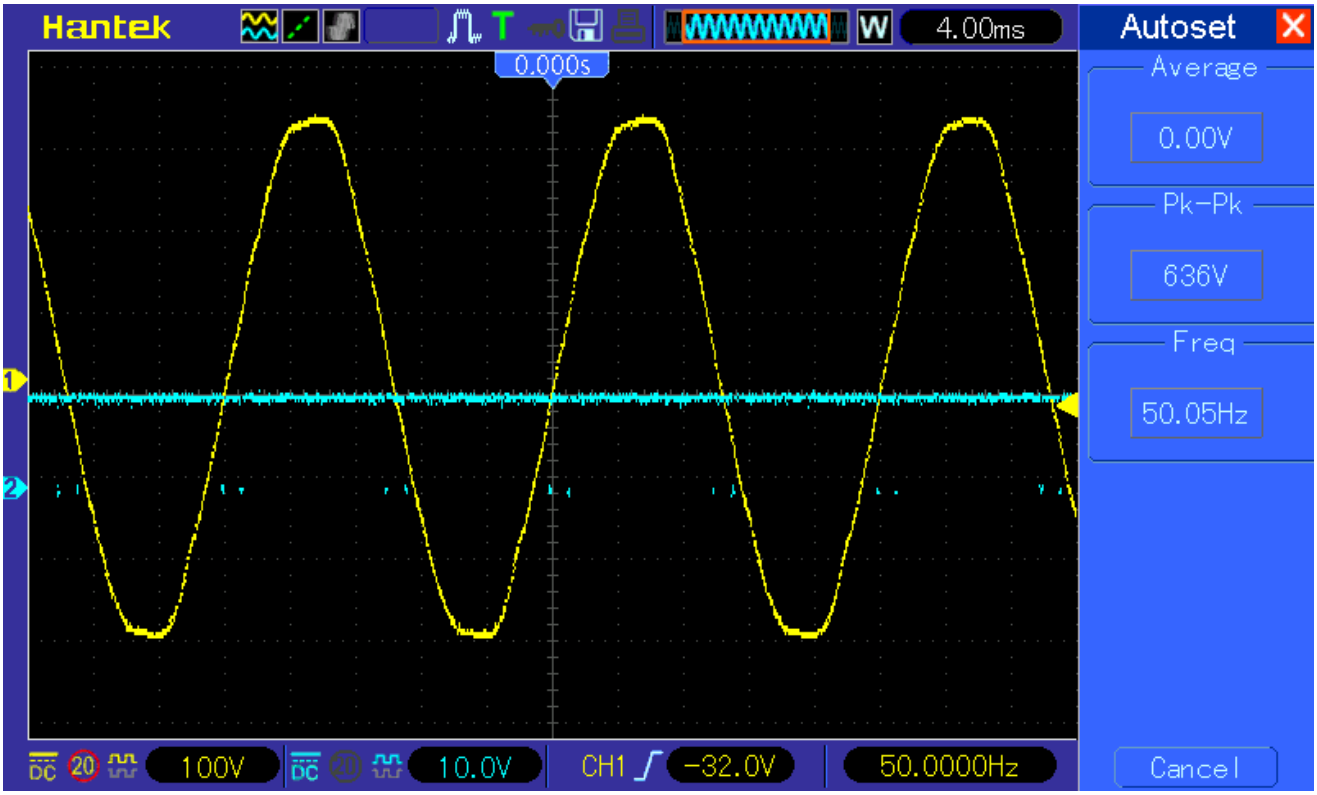


Figure 19: PWM at 99%

13. HOW TO USE THE PRODUCT

Power ON the device, so that, it will host the access point as shown in Figure 7,

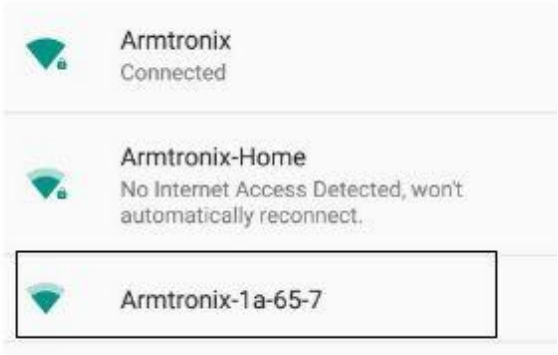


Figure 20: Device hosting Access point

Connect the mobile to access point with Armtronix-(MAC ID). EX: Armtronix-1a-65-7 as shown in Figure 8.

Figure 21: Access point name

After connecting, open browser and enter 192.168.4.1 IP address, it will open the web server as shown in the Figure 9,

Figure 22: Web server

fill the SSID and password and select HTTP, if user wants to connect to MQTT then he has to select MQTT radio button, enter MQTT broker IP address, enter MQTT publish topic then MQTT subscribe topic and submit.

After submitting configuration, the ESP 8266 will connect to the router and router assigns IP address to the ESP. Open that IP address in the browser to control the switch (Relay).

Without configuring the SSID and Password we can control the Wifi Switch by connecting to the access point of the device and open the IP address of device i.e 192.168.4.1 the web server page will show the link with the name Control GPIO as shown in the Figure 8, by clicking this link we can control the Wifi Switch board but the response will be slow.

14. HOW TO CUSTOMISE FIRMWARE

You can program this board using Arduino IDE. Please follow the below steps to program the board by yourself with easy steps as mentioned below:

a. STEPS TO LOAD PROGRAM TO ESP8266:

1. Use external USB-UART converter between computer and this board.
2. Connect VCC of converter to “Pin-1.VCC_5V” of J3.
3. Connect RX pin of converter to “Pin-1.TXDE” of J1.
4. Connect TX pin of converter to “Pin-3.RXDE” of J1.
5. Connect DTR pin of converter to “Pin-5.DTRE” of J1.
6. Connect RTS pin of converter to “Pin-7.RTSE” of J1.
7. Connect GND of converter to “Pin-8.DGND” of J1.
8. Open your code in Arduino IDE as shown.
9. Click on Tools Tab, move mouse pointer on “Board: xxxxxxxxxx” and click on “NodeMCU0.9 (ESP-12 Module)” as shown in figure 10.

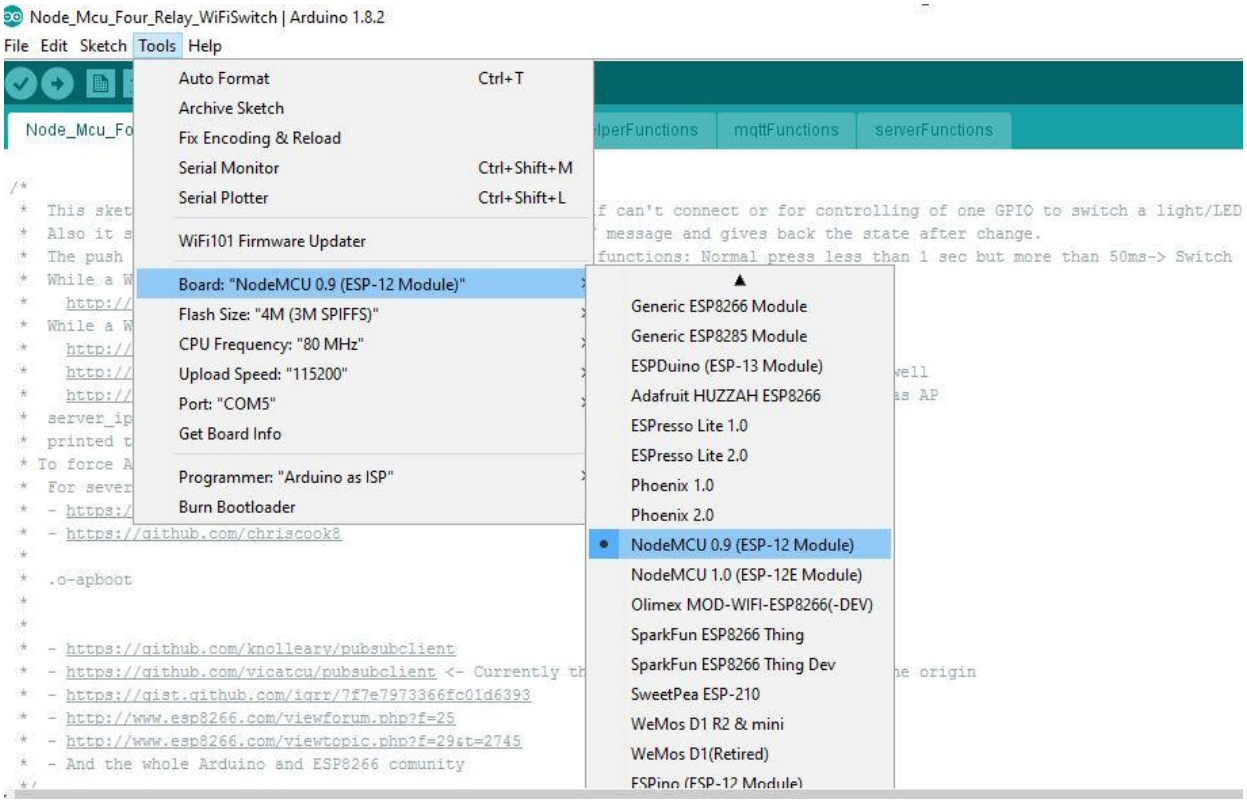


Figure 23: Board Selection

10. Click on tools tab, move mouse pointer to “Programmer: “Arduino as ISP’”, under this click on “Arduino as ISP” to select. Refer to figure 11.

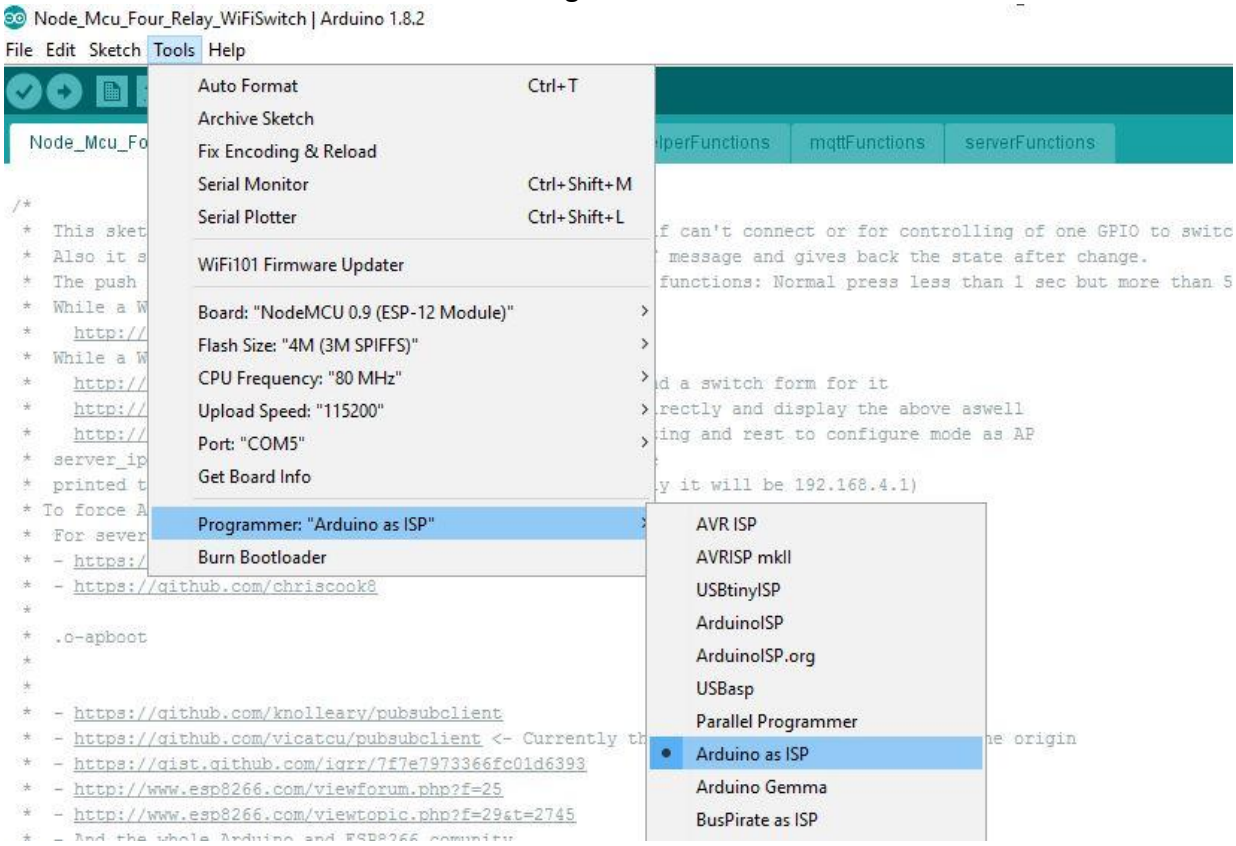


Figure 24: IDE Selection

11. Click on tools tab, move mouse pointer to “Port: “COMx”, under this click on “COMx” to select. (“x” refers to port number available in your computer) Refer to figure 12.

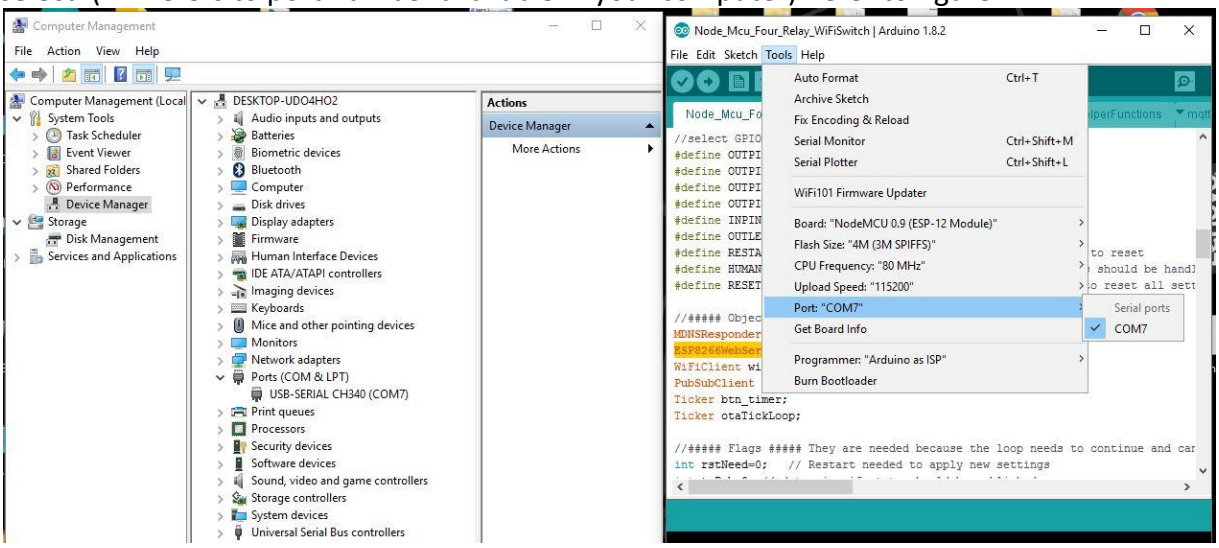


Figure 25: COM port selection.

12. Run the program. Refer to Figure 13.

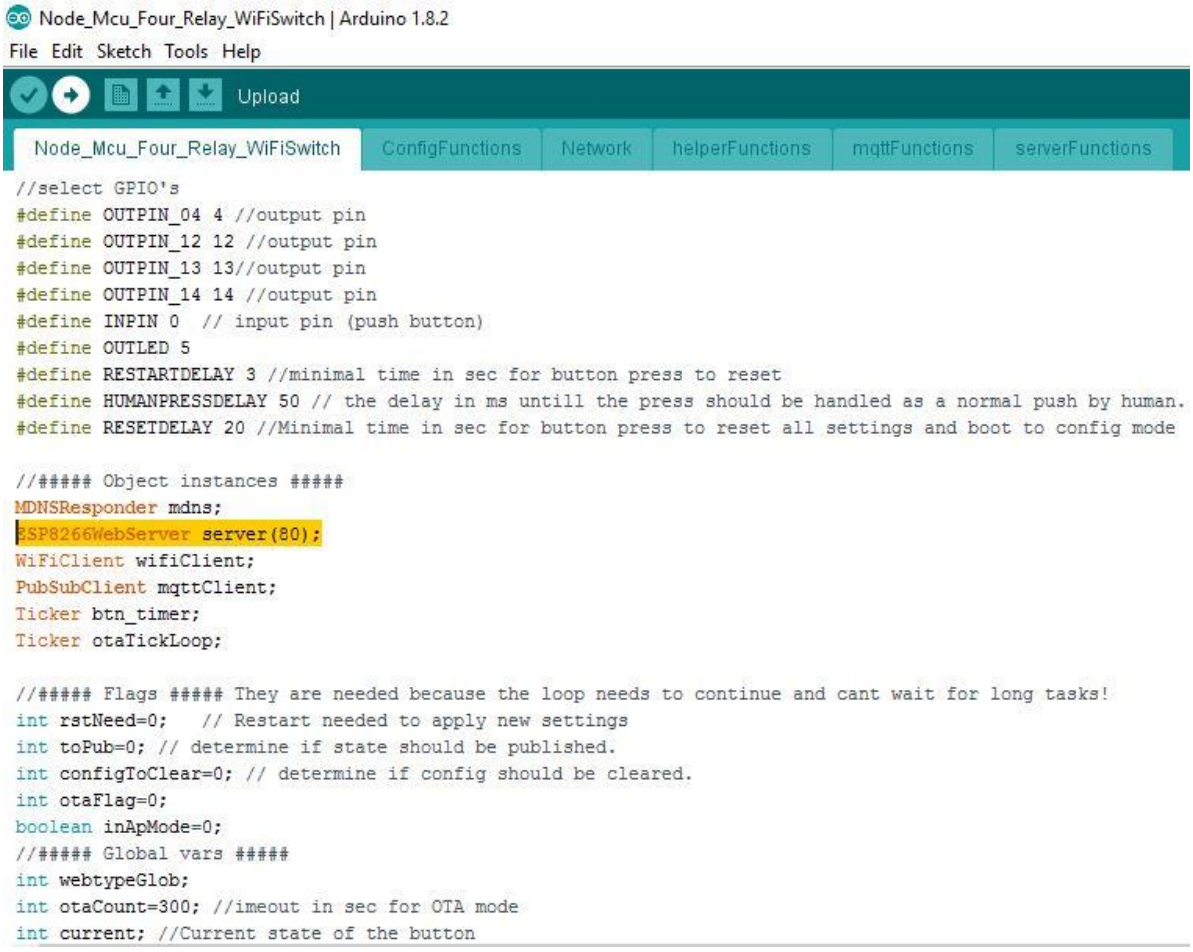


Figure 26: Executing code

b. STEPS TO LOAD PROGRAM TO ATMEGA328P:

1. Use external USB-UART converter between computer and this board.
2. Connect VCC of converter to “Pin-1.VCC_5V” of J3.
3. Connect TX pin of converter to “Pin-2.RXDA” of J1.
4. Connect RX pin of converter to “Pin-4.TXDA” of J1.
5. Connect DTR pin of converter to “Pin-6.DTRA” of J1.
6. Connect GND of converter to “Pin-8.DGND” of J1.
7. Follow same steps as shown in section from “13.a Steps to Load Program to ESP8266”, except Step 10. In step 2, you need to select “Arduino Uno” instead of “NodeMCU0.9 (ESP-12 Module)”. Follow the remaining steps as they are.

Once your loading of program is completed, disconnect converter from board and short Pin-1.TXDE to Pin-2.RXDA, short Pin-3.RXDE to Pin-4.TXDA, to check the board functionality and use. If the board is working as per your code, then you can install it for your application.

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