



# Servo Driver HAT

## User Manual

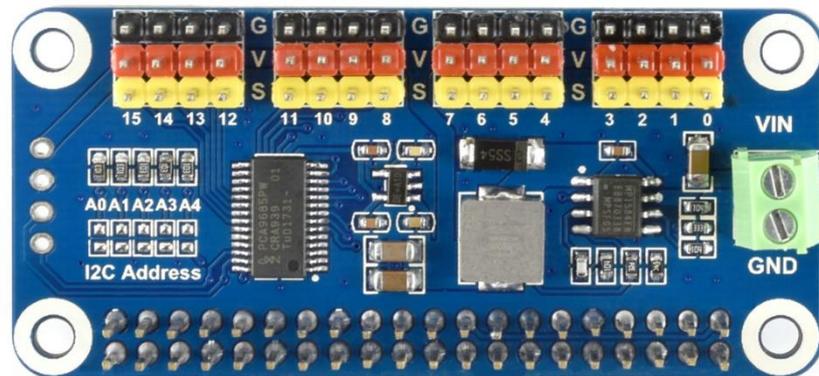
### OVERVIEW

This Servo Driver board is an PWM/servo expansion board for Raspberry Pi. Use PCA9685 chip, expands up to 16 channels and support 12-bits resolution for each channel. Using I2C interface. This board also integrates 5V regulator, up to 3A output current, can be powered from battery through VIN terminal. It could be used to for Robot applications.

### FEATURES

- Power supply: 6V~12V (VIN terminal)
- Servo voltage: 5V
- Logic voltage: 3.3V
- Driver: PCA9685
- Control interface: I2C
- Dimension: 65mm x 36mm
- Mounting hole size: 3.0mm

## HARDWARE



You can connect battery to the green socket VIN on the left for power supply, for VIM, voltage range 6V~12V. 5V regulator on board could output 3A (MAX) current. You can also connect 5V power supply to the POWER interface on the right, and it could power micro:bit via 3.3V regulator.

A0~A4 can be used to set devices address of I2C, supports multiple Servo Driver HAT connected at the same time.

GPIOs on top are interfaces of servo. Black pins are connected to GND (mostly connect to brown wire of servo). Red pins are VCC pin connected to 5V. Yellow GPIOs are signal wires of PWM, channel 0~15 supports 16 servos connected at the same time.

**【Note】**

1. If you only connect 5V power supply to USB interface, servo cannot be driven.
2. You should connect higher power supply for higher-power servo.
3. Make sure servo are connected properly, otherwise they will not move.

## HOW TO USE

### ENABLE I2C

1. Run this command on terminal to begin setting.

```
sudo raspi-config
```

2. Choose Interfacing Options ->I2C -> yes

```
Raspberry Pi Software Configuration Tool (raspi-config)

1 Change User Password Change password for the current user
2 Network Options      Configure network settings
3 Boot Options         Configure options for start-up
4 Localisation Options Set up language and regional settings to match your location
5 Interfacing Options  Configure connections to peripherals
6 Overclock            Configure overclocking for your Pi
7 Advanced Options    Configure advanced settings
8 Update               Update this tool to the latest version
9 About raspi-config  Information about this configuration tool

<Select>                                <Finish>
```

```
Raspberry Pi Software Configuration Tool (raspi-config)

P1 Camera      Enable/Disable connection to the Raspberry Pi Camera
P2 SSH         Enable/Disable remote command line access to your Pi using SSH
P3 VNC         Enable/Disable graphical remote access to your Pi using RealVNC
P4 SPI         Enable/Disable automatic loading of SPI kernel module
P5 I2C         Enable/Disable automatic loading of I2C kernel module
P6 Serial      Enable/Disable shell and kernel messages on the serial connection
P7 1-Wire      Enable/Disable one-wire interface
P8 Remote GPIO Enable/Disable remote access to GPIO pins

<Select>                                <Back>
```

```
Would you like the ARM I2C interface to be enabled?

<Yes>                                <No>
```

If errors occurs after running demo code:

- 1) Edit modules file:

```
sudo nano /etc/modules
```

- 2) Add these two statements to file opened and save:

```
i2c-dev
```

```
i2c-bcm2708
```

## RUNNING CODE

We provide both python2 and python3 demo code for this HAT, to test PCA9685, WIFI remote control and Bluetooth remote control.

To test WiFi and Bluetooth demo code, you should first install APP to your phone, which only support Android.

Download demo code from our Wiki, then extract and copy it to Raspberry Pi.

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## PCA9685 LIBRARIES TESTING

Running PCA9685 demo code with commands:

```
cd Servo_Driver_HAT/python
```

```
sudo python PCA9685.py
```

**Expected Result:** Connect servo to channel 0, servo keeps rotating from 0 degree to 180 degree then turning to 0 again.

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## WIFI REMOTE CONTRLLING

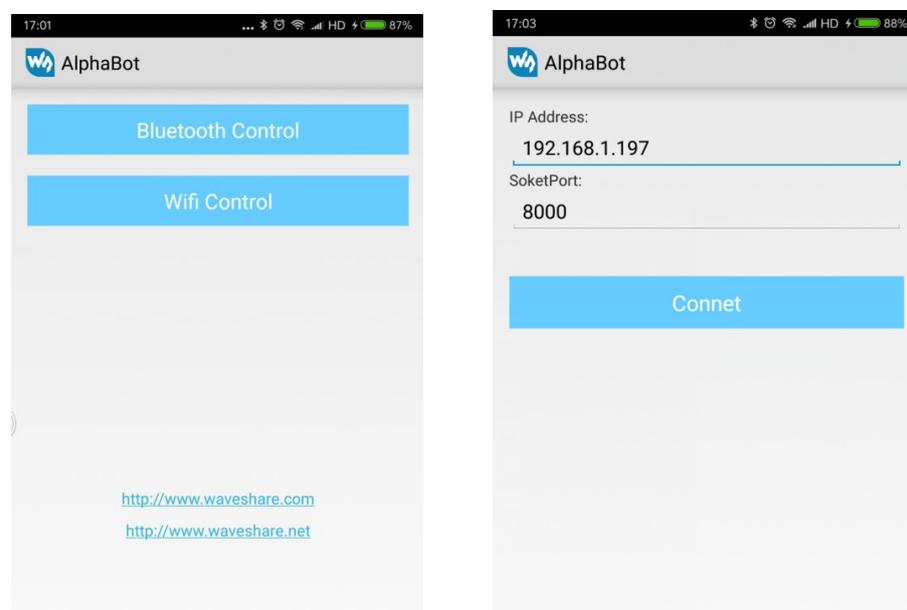
Running the demo code:

```
cd Servo_Driver_HAT/python/Wifi-Control
```

```
sudo python main.py
```

**Expected result:** Sender (Phone or PC) and receiver (Raspberry Pi) should be connected to the same LAN. This demo code uses TCP protocol for data transmitting. After running demo code, IP address of Raspberry Pi and the socket port 8000 will be printed.

Open the APP on your phone, choose WiFi Control, input ip address of Raspberry Pi and SokerPort, click Connect:



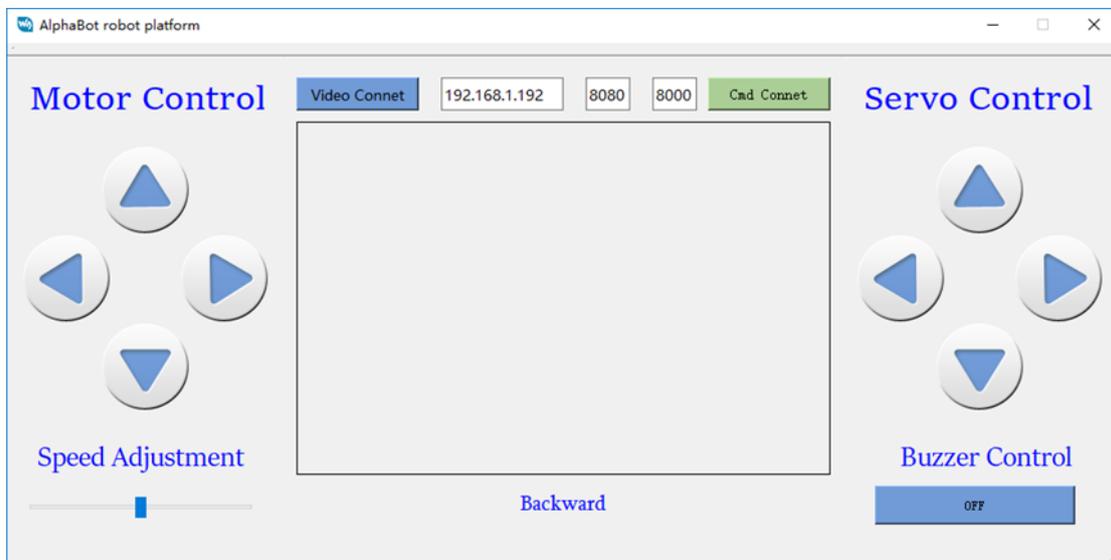
After connecting, it will enter the control page, click buttons could control servos from channel 0 to channel 4



```
pi@raspberrypi:~/Servo_Driver_HAT/python/Wifi-Control $ sudo python main.py
start
192.168.1.192

server is running...
('got connection from ', ('192.168.1.184', 59089))
Forward
Stop
Backward
Stop
```

You can also use the software (QT) on PC as below:



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## BLUETOOTH REMOTE CONTROLLING

1. Update and install tools for Bluetooth communication

```
sudo apt-get update
```

```
sudo apt-get upgrade -y
```

```
sudo apt-get dist-upgrade -y
```

```
sudo apt-get install pi-bluetooth bluez bluez-firmware blueman
```

2. Add user pi to group bluetooth

```
sudo usermod -G bluetooth -a pi
```

3. Restart Raspberry Pi

```
sudo reboot
```

4. Enable/add SPP, enable Bluetooth devices

```
sudo vi /etc/systemd/system/dbus-org.bluez.service
```

modify the statements as below:

```
1 [Unit]
2 Description=Bluetooth service
3 Documentation=man:bluetoothd(8)
4
5 [Service]
6 Type=dbus
7 BusName=org.bluez
8 ExecStart=/usr/lib/bluetooth/bluetoothd -C
9 ExecStartPost=/usr/bin/sdptool add SP
10 NotifyAccess=main
11 #WatchdogSec=10
12 #Restart=on-failure
13 CapabilityBoundingSet=CAP_NET_ADMIN CAP_NET_BIND_SERVICE
14 LimitNPROC=1
15
16 [Install]
17 WantedBy=bluetooth.target
18 Alias=dbus-org.bluez.service
```

- Restart Raspberry Pi, check Bluetooth services y hciconfig command:

```
pi@raspberrypi:~ $ sudo hciconfig
hci0:  Type: BR/EDR  Bus: UART
      BD Address: B8:27:EB:2D:00:87  ACL MTU: 1021:8  SCO MTU: 64:1
      UP RUNNING
      RX bytes:717 acl:0 sco:0 events:42 errors:0
      TX bytes:1532 acl:0 sco:0 commands:42 errors:0
```

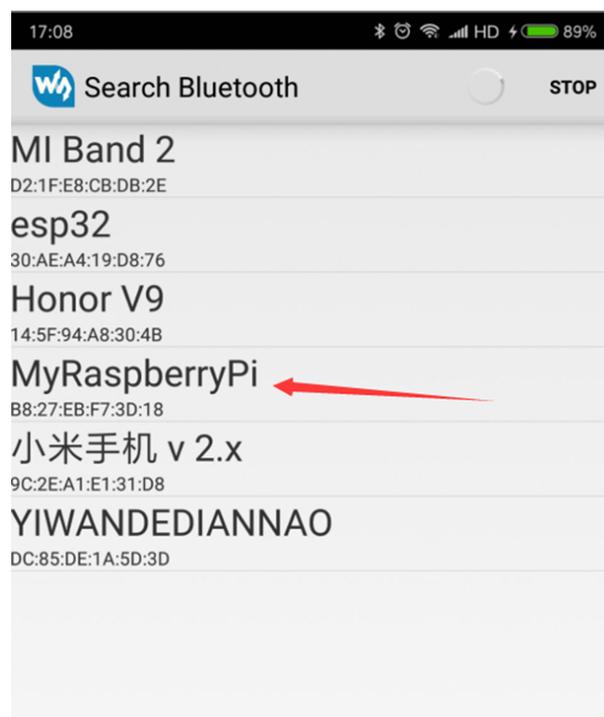
- If hci0 device is recognized, Bluetooth is working normally, otherwise Raspberry Pi doesn' t Bluetooth and you need to check the steps above.

- Running demo code:

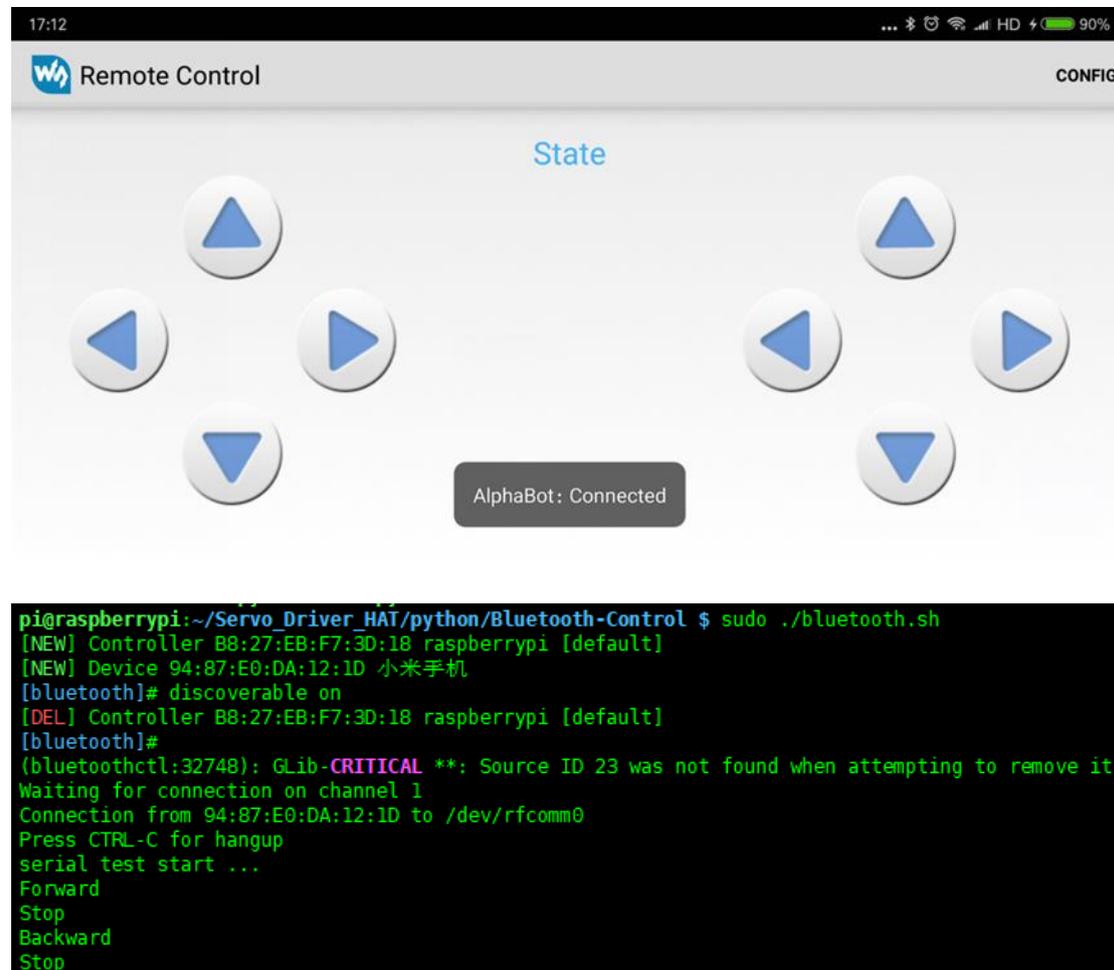
```
cd Servo_Driver_HAT/python/Bluetooth-Control
```

```
sudo ./Bluetooth.sh
```

Expected result: After running demo code, it will prompt waiting for Bluetooth connecting. Open APP on your phone, click scanning, and connect Raspberry Pi device.



After connecting, it will enter control page, you can click buttons to control servos now.



#### 【Note】

- If commands received are wrong, you can config the command of buttons for press and release states.
- Raspberry Pi could only be scanned for 180s by default. If you want to let Raspberry Pi could be scanned and paired all the time, you should change setting as below:

```
sudo vi /etc/bluetooth/main.conf
```

uncomment statements as image:

```
# Defaults to 'BlueZ X.YZ'
#Name = BlueZ

# Default device class. Only the major and minor device class bits are
# considered. Defaults to '0x000000'.
#Class = 0x000100

# How long to stay in discoverable mode before going back to non-discoverable
# The value is in seconds. Default is 180, i.e. 3 minutes.
# 0 = disable timer, i.e. stay discoverable forever
DiscoverableTimeout = 0

# How long to stay in pairable mode before going back to non-discoverable
# The value is in seconds. Default is 0.
# 0 = disable timer, i.e. stay pairable forever
PairableTimeout = 0

# Automatic connection for bonded devices driven by platform/user events.
# If a platform plugin uses this mechanism, automatic connections will be
# enabled during the interval defined below. Initially, this feature
# intends to be used to establish connections to ATT channels. Default is 60.
#AutoConnectTimeout = 60
```

The demo code is compatible with python3, you can just change the command python to python3.

For more details about Raspberry Pi WIFI and Bluetooth Controlling, please refer to Alphabot2:

<https://www.waveshare.com/wiki/AlphaBot2>

## PCA9685 LIBRARIES

There are some functions included in driver library PCA9685.py, you can use them when you write your own application code.

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### INITIALIZE NEW OBJECT

You can create a new object for every HAT

```
pwm = PWM(0x40)
```

pwm is the object we created, PWM(0x40) is creating. by default, the I2C device address of the module is 0x40. If you have changed the I2C address, you could use other address to create new object.

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### SET PWM FREQUENCY

```
setPWMFreq(self, freq)
```

Used to set PWM frequency. This value defines the time of every pulse, that is cycle.

#### Parameters:

- **freq**: numbers (Hz), in range: 40~1000.

If you use PWM to control servo, the frequency should be 5Hz as below:

#### Example:

```
pwm.setPWMFreq(50)
```

---

## SET PWM PULSE WIDTH

### **setPWM(self,channel,on,off)**

This function is used to set PWM pulse in certain channel, set its high level being (on) and finish (off) time.

#### **Parameter:**

- **channel:** PWM channel (0~15)
- **on:** When the signal change from Low to High (0~4095)
- **off:** When the signal changed from High to Low (0~4095)

#### **Example:**

The example is set channel 15 begin to output High level at 0 and finish at 1024. That is the High level (0-1024) duty rate is 25%, and Low level (1024-4095) duty rate is 57%, cycle is (1/freq).

```
pwm.setPWM(15 ,0 ,1024)
```

---

## SET SERVO PULSE

### **setServoPulse (self,channel, pulse)**

This function is used to set the pulse of servo.

【Note】 Before this function, you should set PWM frequency to 50Hz first, otherwise servo works improperly.

#### Parameters:

- **channel:** PWM channel (0-`5)
- **pulse:** pulse width outputted, unit is us (500~2500)

#### Examples

This example will output 1500us PWM signal to channel 0. That is rotate the servo 90 degree.

**`pwm. setServoPulse (0,1500)`**

The relationship between pulse and degree are:

500	-----	0 °
1000	-----	45 °
1500	-----	90 °
2000	-----	135 °
2500	-----	180 °