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# **Adafruit PCA9685 Library Documentation**

*Release 1.0*

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## Contents

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<b>1</b>	<b>Dependencies</b>	<b>3</b>
1.1	Installing from PyPI . . . . .	3
<b>2</b>	<b>Usage Example</b>	<b>5</b>
<b>3</b>	<b>Contributing</b>	<b>7</b>
<b>4</b>	<b>Building locally</b>	<b>9</b>
4.1	Sphinx documentation . . . . .	9
<b>5</b>	<b>Table of Contents</b>	<b>11</b>
5.1	Simple test . . . . .	11
5.2	adafruit_pca9685 . . . . .	13
5.2.1	Implementation Notes . . . . .	14
<b>6</b>	<b>Indices and tables</b>	<b>15</b>
	<b>Python Module Index</b>	<b>17</b>



Driver for the PCA9685, a 16-channel, 12-bit PWM chip



This driver depends on:

- [Adafruit CircuitPython](#)
- [Bus Device](#)
- [Register](#)

Please ensure all dependencies are available on the CircuitPython filesystem. This is easily achieved by downloading the Adafruit library and driver bundle.

## 1.1 Installing from PyPI

On supported GNU/Linux systems like the Raspberry Pi, you can install the driver locally [from PyPI](#). To install for current user:

```
pip3 install adafruit-circuitpython-pca9685
```

To install system-wide (this may be required in some cases):

```
sudo pip3 install adafruit-circuitpython-pca9685
```

To install in a virtual environment in your current project:

```
mkdir project-name && cd project-name
python3 -m venv .env
source .env/bin/activate
pip3 install adafruit-circuitpython-pca9685
```





## CHAPTER 2

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### Usage Example

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See `examples/pca9685_simpletest.py` for a demo of the usage.



## CHAPTER 3

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### Contributing

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Contributions are welcome! Please read our [Code of Conduct](#) before contributing to help this project stay welcoming.



## CHAPTER 4

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### Building locally

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To build this library locally you'll need to install the `circuitpython-build-tools` package.

```
python3 -m venv .env
source .env/bin/activate
pip install circuitpython-build-tools
```

Once installed, make sure you are in the virtual environment:

```
source .env/bin/activate
```

Then run the build:

```
circuitpython-build-bundles --filename_prefix adafruit-circuitpython-pca9685 --
↳library_location .
```

### 4.1 Sphinx documentation

Sphinx is used to build the documentation based on rST files and comments in the code. First, install dependencies (feel free to reuse the virtual environment from above):

```
python3 -m venv .env
source .env/bin/activate
pip install Sphinx sphinx-rtd-theme
```

Now, once you have the virtual environment activated:

```
cd docs
sphinx-build -E -W -b html . _build/html
```

This will output the documentation to `docs/_build/html`. Open the `index.html` in your browser to view them. It will also (due to `-W`) error out on any warning like Travis will. This is a good way to locally verify it will pass.



## 5.1 Simple test

Ensure your device works with this simple test.

Listing 1: examples/pca9685\_simpletest.py

```
1 # This simple test outputs a 50% duty cycle PWM single on the 0th channel. Connect an
  ↳ LED and
2 # resistor in series to the pin to visualize duty cycle changes and its impact on
  ↳ brightness.
3
4 from board import SCL, SDA
5 import busio
6
7 # Import the PCA9685 module.
8 from adafruit_pca9685 import PCA9685
9
10 # Create the I2C bus interface.
11 i2c_bus = busio.I2C(SCL, SDA)
12
13 # Create a simple PCA9685 class instance.
14 pca = PCA9685(i2c_bus)
15
16 # Set the PWM frequency to 60hz.
17 pca.frequency = 60
18
19 # Set the PWM duty cycle for channel zero to 50%. duty_cycle is 16 bits to match
  ↳ other PWM objects
20 # but the PCA9685 will only actually give 12 bits of resolution.
21 pca.channels[0].duty_cycle = 0x7fff
```

Listing 2: examples/pca9685\_calibration.py

```

1  # This advanced example can be used to compute a more precise reference_clock_speed.
   ↳Use an
2  # oscilloscope or logic analyzer to measure the signal frequency and type the results.
   ↳into the
3  # prompts. At the end it'll give you a more precise value around 25 mhz for your
   ↳reference clock
4  # speed.
5
6  import time
7
8  from board import SCL, SDA
9  import busio
10
11 # Import the PCA9685 module.
12 from adafruit_pca9685 import PCA9685
13
14 # Create the I2C bus interface.
15 i2c_bus = busio.I2C(SCL, SDA)
16
17 # Create a simple PCA9685 class instance.
18 pca = PCA9685(i2c_bus)
19
20 # Set the PWM frequency to 100hz.
21 pca.frequency = 100
22
23 input("Press enter when ready to measure default frequency.")
24
25 # Set the PWM duty cycle for channel zero to 50%. duty_cycle is 16 bits to match
   ↳other PWM objects
26 # but the PCA9685 will only actually give 12 bits of resolution.
27 print("Running with default calibration")
28 pca.channels[0].duty_cycle = 0x7fff
29 time.sleep(1)
30 pca.channels[0].duty_cycle = 0
31
32 measured_frequency = float(input("Frequency measured: "))
33 print()
34
35 pca.reference_clock_speed = pca.reference_clock_speed * (measured_frequency / pca.
   ↳frequency)
36 # Set frequency again so we can get closer. Reading it back will produce the real
   ↳value.
37 pca.frequency = 100
38
39 input("Press enter when ready to measure coarse calibration frequency.")
40 pca.channels[0].duty_cycle = 0x7fff
41 time.sleep(1)
42 pca.channels[0].duty_cycle = 0
43 measured_after_calibration = float(input("Frequency measured: "))
44 print()
45
46 reference_clock_speed = measured_after_calibration * 4096 * pca.prescale_reg
47
48 print("Real reference clock speed: {0:.0f}".format(reference_clock_speed))

```



Listing 3: examples/pca9685\_servo.py

```

1 # This example moves a servo its full range (180 degrees by default) and then back.
2
3 from board import SCL, SDA
4 import busio
5
6 # Import the PCA9685 module.
7 from adafruit_pca9685 import PCA9685
8
9 # This example also relies on the Adafruit motor library available here:
10 # https://github.com/adafruit/Adafruit_CircuitPython_Motor
11 from adafruit_motor import servo
12
13 i2c = busio.I2C(SCL, SDA)
14
15 # Create a simple PCA9685 class instance.
16 pca = PCA9685(i2c)
17 pca.frequency = 50
18
19 # To get the full range of the servo you will likely need to adjust the min_pulse and
20 # ↪max_pulse to
21 # match the stall points of the servo.
22 # This is an example for the Sub-micro servo: https://www.adafruit.com/product/2201
23 # servo7 = servo.Servo(pca.channels[7], min_pulse=580, max_pulse=2480)
24 # This is an example for the Micro Servo - High Powered, High Torque Metal Gear:
25 # https://www.adafruit.com/product/2307
26 # servo7 = servo.Servo(pca.channels[7], min_pulse=600, max_pulse=2400)
27 # This is an example for the Standard servo - TowerPro SG-5010 - 5010:
28 # https://www.adafruit.com/product/155
29 # servo7 = servo.Servo(pca.channels[7], min_pulse=600, max_pulse=2500)
30 # This is an example for the Analog Feedback Servo: https://www.adafruit.com/product/
31 # ↪1404
32 # servo7 = servo.Servo(pca.channels[7], min_pulse=600, max_pulse=2600)
33
34 # The pulse range is 1000 - 2000 by default.
35 servo7 = servo.Servo(pca.channels[7])
36
37 for i in range(180):
38     servo7.angle = i
39 for i in range(180):
40     servo7.angle = 180 - i
41
42 pca.deinit()

```

## 5.2 adafruit\_pca9685

Driver for the PCA9685 PWM control IC. Its commonly used to control servos, leds and motors.

### See also:

The [Adafruit CircuitPython Motor library](#) can be used to control the PWM outputs for specific uses instead of generic duty\_cycle adjustments.

- Author(s): Scott Shawcroft

## 5.2.1 Implementation Notes

### Hardware:

- Adafruit 16-Channel 12-bit PWM/Servo Driver - I2C interface - PCA9685 (Product ID: 815)

### Software and Dependencies:

- Adafruit CircuitPython firmware for the ESP8622 and M0-based boards: <https://github.com/adafruit/circuitpython/releases>
- Adafruit's Bus Device library: [https://github.com/adafruit/Adafruit\\_CircuitPython\\_BusDevice](https://github.com/adafruit/Adafruit_CircuitPython_BusDevice)
- Adafruit's Register library: [https://github.com/adafruit/Adafruit\\_CircuitPython\\_Register](https://github.com/adafruit/Adafruit_CircuitPython_Register)

**class** `adafruit_pca9685.PCA9685` (*i2c\_bus*, \*, *address=64*, *reference\_clock\_speed=25000000*)  
 Initialise the PCA9685 chip at address on *i2c\_bus*.

The internal reference clock is 25mhz but may vary slightly with environmental conditions and manufacturing variances. Providing a more precise *reference\_clock\_speed* can improve the accuracy of the frequency and *duty\_cycle* computations. See the `calibration.py` example for how to derive this value by measuring the resulting pulse widths.

#### Parameters

- ***i2c\_bus*** (*I2C*) – The I2C bus which the PCA9685 is connected to.
- ***address*** (*int*) – The I2C address of the PCA9685.
- ***reference\_clock\_speed*** (*int*) – The frequency of the internal reference clock in Hertz.

**channels = None**

Sequence of 16 *PWMChannel* objects. One for each channel.

**deinit ()**

Stop using the *pca9685*.

**frequency**

The overall PWM frequency in Hertz.

**reference\_clock\_speed = None**

The reference clock speed in Hz.

**reset ()**

Reset the chip.

**class** `adafruit_pca9685.PCAChannels` (*pca*)

Lazily creates and caches channel objects as needed. Treat it like a sequence.

**class** `adafruit_pca9685.PWMChannel` (*pca*, *index*)

A single PCA9685 channel that matches the *PWMOut* API.

**duty\_cycle**

16 bit value that dictates how much of one cycle is high (1) versus low (0). 0xffff will always be high, 0 will always be low and 0x7fff will be half high and then half low.

**frequency**

The overall PWM frequency in Hertz (read-only). A *PWMChannel*'s frequency cannot be set individually. All channels share a common frequency, set by *PCA9685.frequency*.

## CHAPTER 6

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### Indices and tables

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- `genindex`
- `modindex`
- `search`



**a**

[adafruit\\_pca9685](#), 13



## A

adafruit\_pca9685 (*module*), 13

## C

channels (*adafruit\_pca9685.PCA9685 attribute*), 14

## D

deinit () (*adafruit\_pca9685.PCA9685 method*), 14

duty\_cycle (*adafruit\_pca9685.PWMChannel attribute*), 14

## F

frequency (*adafruit\_pca9685.PCA9685 attribute*), 14

frequency (*adafruit\_pca9685.PWMChannel attribute*), 14

## P

PCA9685 (*class in adafruit\_pca9685*), 14

PCAChannels (*class in adafruit\_pca9685*), 14

PWMChannel (*class in adafruit\_pca9685*), 14

## R

reference\_clock\_speed  
(*adafruit\_pca9685.PCA9685 attribute*), 14

reset () (*adafruit\_pca9685.PCA9685 method*), 14