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# **Adafruit PCA9685 Library Documentation**

***Release 1.0***

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



# CHAPTER 1

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## Dependencies

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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](#).





## CHAPTER 2

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### Installing from PyPI

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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 3

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### Usage Example

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



## CHAPTER 4

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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 5

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### Documentation

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For information on building library documentation, please check out [this guide](#).





## 6.1 Simple test

Ensure your device works with this simple test.

Listing 1: examples/pca9685\_simpletest.py

```
1  # SPDX-FileCopyrightText: 2021 ladyada for Adafruit Industries
2  # SPDX-License-Identifier: MIT
3
4  # This simple test outputs a 50% duty cycle PWM signal on the 0th channel. Connect an_
   ↳ LED and
5  # resistor in series to the pin to visualize duty cycle changes and its impact on_
   ↳ brightness.
6
7  from board import SCL, SDA
8  import busio
9
10 # Import the PCA9685 module.
11 from adafruit_pca9685 import PCA9685
12
13 # Create the I2C bus interface.
14 i2c_bus = busio.I2C(SCL, SDA)
15
16 # Create a simple PCA9685 class instance.
17 pca = PCA9685(i2c_bus)
18
19 # Set the PWM frequency to 60hz.
20 pca.frequency = 60
21
22 # Set the PWM duty cycle for channel zero to 50%. duty_cycle is 16 bits to match_
   ↳ other PWM objects
23 # but the PCA9685 will only actually give 12 bits of resolution.
24 pca.channels[0].duty_cycle = 0x7FFF
```

Listing 2: examples/pca9685\_calibration.py

```

1  # SPDX-FileCopyrightText: 2021 ladyada for Adafruit Industries
2  # SPDX-License-Identifier: MIT
3
4  # This advanced example can be used to compute a more precise reference_clock_speed.
5  ↪ Use an
6  # oscilloscope or logic analyzer to measure the signal frequency and type the results
7  ↪ into the
8  # prompts. At the end it'll give you a more precise value around 25 mhz for your
9  ↪ reference clock
10 # speed.
11
12 import time
13
14 from board import SCL, SDA
15 import busio
16
17 # Import the PCA9685 module.
18 from adafruit_pca9685 import PCA9685
19
20 # Create the I2C bus interface.
21 i2c_bus = busio.I2C(SCL, SDA)
22
23 # Create a simple PCA9685 class instance.
24 pca = PCA9685(i2c_bus)
25
26 # Set the PWM frequency to 100hz.
27 pca.frequency = 100
28
29 input("Press enter when ready to measure default frequency.")
30
31 # Set the PWM duty cycle for channel zero to 50%. duty_cycle is 16 bits to match
32 ↪ other PWM objects
33 # but the PCA9685 will only actually give 12 bits of resolution.
34 print("Running with default calibration")
35 pca.channels[0].duty_cycle = 0x7FFF
36 time.sleep(1)
37 pca.channels[0].duty_cycle = 0
38
39 measured_frequency = float(input("Frequency measured: "))
40 print()
41
42 pca.reference_clock_speed = pca.reference_clock_speed * (
43     measured_frequency / pca.frequency
44 )
45 # Set frequency again so we can get closer. Reading it back will produce the real
46 ↪ value.
47 pca.frequency = 100
48
49 input("Press enter when ready to measure coarse calibration frequency.")
50 pca.channels[0].duty_cycle = 0x7FFF
51 time.sleep(1)
52 pca.channels[0].duty_cycle = 0
53 measured_after_calibration = float(input("Frequency measured: "))
54 print()
55

```

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```

51 reference_clock_speed = measured_after_calibration * 4096 * pca.prescale_reg
52
53 print("Real reference clock speed: {0:.0f}".format(reference_clock_speed))

```

Listing 3: examples/pca9685\_servo.py

```

1  # SPDX-FileCopyrightText: 2021 ladyada for Adafruit Industries
2  # SPDX-License-Identifier: MIT
3
4  # This example moves a servo its full range (180 degrees by default) and then back.
5
6  from board import SCL, SDA
7  import busio
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 # Import the PCA9685 module.
14 from adafruit_pca9685 import PCA9685
15
16 i2c = busio.I2C(SCL, SDA)
17
18 # Create a simple PCA9685 class instance.
19 pca = PCA9685(i2c)
20 pca.frequency = 50
21
22 # To get the full range of the servo you will likely need to adjust the min_pulse and
23 # ↪ max_pulse to
24 # match the stall points of the servo.
25 # This is an example for the Sub-micro servo: https://www.adafruit.com/product/2201
26 # servo7 = servo.Servo(pca.channels[7], min_pulse=580, max_pulse=2480)
27 # This is an example for the Micro Servo - High Powered, High Torque Metal Gear:
28 # https://www.adafruit.com/product/2307
29 # servo7 = servo.Servo(pca.channels[7], min_pulse=600, max_pulse=2400)
30 # This is an example for the Standard servo - TowerPro SG-5010 - 5010:
31 # https://www.adafruit.com/product/155
32 # servo7 = servo.Servo(pca.channels[7], min_pulse=600, max_pulse=2500)
33 # This is an example for the Analog Feedback Servo: https://www.adafruit.com/product/
34 # ↪ 1404
35 # servo7 = servo.Servo(pca.channels[7], min_pulse=600, max_pulse=2600)
36
37 # The pulse range is 1000 - 2000 by default.
38 servo7 = servo.Servo(pca.channels[7])
39
40 for i in range(180):
41     servo7.angle = i
42 for i in range(180):
43     servo7.angle = 180 - i
44 pca.deinit()

```

## 6.2 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

## 6.2.1 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 7

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### Indices and tables

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