
Adafruit PCA9685 Library Documentation

Release 1.0

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

CHAPTER 1

Dependencies

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

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 3

Usage Example

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

CHAPTER 4

Contributing

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

CHAPTER 5

Documentation

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  import time
5
6  from board import SCL, SDA
7  import busio
8
9  # Import the PCA9685 module. Available in the bundle and here:
10 #   https://github.com/adafruit/Adafruit_CircuitPython_PCA9685
11 from adafruit_motor import servo
12 from adafruit_pca9685 import PCA9685
13
14 i2c = busio.I2C(SCL, SDA)
15
16 # Create a simple PCA9685 class instance.
17 pca = PCA9685(i2c)
18 # You can optionally provide a finer tuned reference clock speed to improve the
19 #   ↳ accuracy of the
20 #   ↳ timing pulses. This calibration will be specific to each board and its environment.
21 #   ↳ See the
22 #   ↳ calibration.py example in the PCA9685 driver.
23 #   ↳ pca = PCA9685(i2c, reference_clock_speed=25630710)
24 #   ↳ pca.frequency = 50
25
26 # To get the full range of the servo you will likely need to adjust the min_pulse and
27 #   ↳ max_pulse to
28 #   ↳ match the stall points of the servo.
29 #   ↳ This is an example for the Sub-micro servo: https://www.adafruit.com/product/2201
30 #   ↳ servo7 = servo.Servo(pca.channels[7], min_pulse=580, max_pulse=2350)
31 #   ↳ This is an example for the Micro Servo - High Powered, High Torque Metal Gear:
32 #   ↳ https://www.adafruit.com/product/2307
33 #   ↳ servo7 = servo.Servo(pca.channels[7], min_pulse=500, max_pulse=2600)
34 #   ↳ This is an example for the Standard servo - TowerPro SG-5010 - 5010:
35 #   ↳ https://www.adafruit.com/product/155
36 #   ↳ servo7 = servo.Servo(pca.channels[7], min_pulse=400, max_pulse=2400)
37 #   ↳ This is an example for the Analog Feedback Servo: https://www.adafruit.com/product/
38 #   ↳ 1404
39 #   ↳ servo7 = servo.Servo(pca.channels[7], min_pulse=600, max_pulse=2500)
40 #   ↳ This is an example for the Micro servo - TowerPro SG-92R: https://www.adafruit.com/
41 #   ↳ product/169
42 #   ↳ servo7 = servo.Servo(pca.channels[7], min_pulse=500, max_pulse=2400)
43
44 # The pulse range is 750 - 2250 by default. This range typically gives 135 degrees of
45 #   ↳ range, but the default is to use 180 degrees. You can specify the expected range if
46 #   ↳ you wish:
47 #   ↳ servo7 = servo.Servo(pca.channels[7], actuation_range=135)
48 servo7 = servo.Servo(pca.channels[7])
49
50 # We sleep in the loops to give the servo time to move into position.

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```
45 for i in range(180):
46     servo7.angle = i
47     time.sleep(0.03)
48 for i in range(180):
49     servo7.angle = 180 - i
50     time.sleep(0.03)
51
52 # You can also specify the movement fractionally.
53 fraction = 0.0
54 while fraction < 1.0:
55     servo7.fraction = fraction
56     fraction += 0.01
57     time.sleep(0.03)
58
59 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
- Adafruit's Register library: 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

Indices and tables

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