Adafruit PCA9685 Library Documentation

Release 1.0

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Contents

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.

CHAPTER 6

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6.1 Simple test

Ensure your device works with this simple test.

Listing 1: examples/pca9685_simpletest.py

```
# SPDX-FileCopyrightText: 2021 ladyada for Adafruit Industries
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# This simple test outputs a 50% duty cycle PWM single on the 0th channel. Connect an␣
↪LED and
# resistor in series to the pin to visualize duty cycle changes and its impact on␣
↪brightness.

from board import SCL, SDA
import busio

# Import the PCA9685 module.
from adafruit_pca9685 import PCA9685

# Create the I2C bus interface.
i2c_bus = busio.I2C(SCL, SDA)

# Create a simple PCA9685 class instance.
pca = PCA9685(i2c_bus)

# Set the PWM frequency to 60hz.
pca.frequency = 60

# Set the PWM duty cycle for channel zero to 50%. duty_cycle is 16 bits to match␣
↪other PWM objects
# but the PCA9685 will only actually give 12 bits of resolution.
pca.channels[0].duty_cycle = 0x7FFF
```

Listing 2: examples/pca9685_calibration.py

```
# SPDX-FileCopyrightText: 2021 ladyada for Adafruit Industries
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# This advanced example can be used to compute a more precise reference_clock_speed.
↪Use an
# oscilloscope or logic analyzer to measure the signal frequency and type the results
↪into the
# prompts. At the end it'll give you a more precise value around 25 mhz for your
↪reference clock
# speed.

import time

from board import SCL, SDA
import busio

# Import the PCA9685 module.
from adafruit_pca9685 import PCA9685

# Create the I2C bus interface.
i2c_bus = busio.I2C(SCL, SDA)

# Create a simple PCA9685 class instance.
pca = PCA9685(i2c_bus)

# Set the PWM frequency to 100hz.
pca.frequency = 100

input("Press enter when ready to measure default frequency.")

# Set the PWM duty cycle for channel zero to 50%. duty_cycle is 16 bits to match
↪other PWM objects
# but the PCA9685 will only actually give 12 bits of resolution.
print("Running with default calibration")
pca.channels[0].duty_cycle = 0x7FFF
time.sleep(1)
pca.channels[0].duty_cycle = 0

measured_frequency = float(input("Frequency measured: "))
print()

pca.reference_clock_speed = pca.reference_clock_speed * (
    measured_frequency / pca.frequency
)
# Set frequency again so we can get closer. Reading it back will produce the real
↪value.
pca.frequency = 100

input("Press enter when ready to measure coarse calibration frequency.")
pca.channels[0].duty_cycle = 0x7FFF
time.sleep(1)
pca.channels[0].duty_cycle = 0
measured_after_calibration = float(input("Frequency measured: "))
print()

```

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```
reference_clock_speed = measured_after_calibration * 4096 * pca.prescale_reg

print("Real reference clock speed: {0:.0f}".format(reference_clock_speed))
```

Listing 3: examples/pca9685_servo.py

```
# SPDX-FileCopyrightText: 2021 ladyada for Adafruit Industries
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import time

from board import SCL, SDA
import busio

# Import the PCA9685 module. Available in the bundle and here:
#   https://github.com/adafruit/Adafruit_CircuitPython_PCA9685
from adafruit_motor import servo
from adafruit_pca9685 import PCA9685

i2c = busio.I2C(SCL, SDA)

# Create a simple PCA9685 class instance.
pca = PCA9685(i2c)
# You can optionally provide a finer tuned reference clock speed to improve the accuracy of the
# timing pulses. This calibration will be specific to each board and its environment. See the
# calibration.py example in the PCA9685 driver.
# pca = PCA9685(i2c, reference_clock_speed=25630710)
pca.frequency = 50

# To get the full range of the servo you will likely need to adjust the min_pulse and max_pulse to
# match the stall points of the servo.
# This is an example for the Sub-micro servo: https://www.adafruit.com/product/2201
# servo7 = servo.Servo(pca.channels[7], min_pulse=580, max_pulse=2350)
# This is an example for the Micro Servo - High Powered, High Torque Metal Gear:
#   https://www.adafruit.com/product/2307
# servo7 = servo.Servo(pca.channels[7], min_pulse=500, max_pulse=2600)
# This is an example for the Standard servo - TowerPro SG-5010 - 5010:
#   https://www.adafruit.com/product/155
# servo7 = servo.Servo(pca.channels[7], min_pulse=400, max_pulse=2400)
# This is an example for the Analog Feedback Servo: https://www.adafruit.com/product/1404
# servo7 = servo.Servo(pca.channels[7], min_pulse=600, max_pulse=2500)
# This is an example for the Micro servo - TowerPro SG-92R: https://www.adafruit.com/product/169
# servo7 = servo.Servo(pca.channels[7], min_pulse=500, max_pulse=2400)

# The pulse range is 750 - 2250 by default. This range typically gives 135 degrees of
# range, but the default is to use 180 degrees. You can specify the expected range if you wish:
# servo7 = servo.Servo(pca.channels[7], actuation_range=135)
servo7 = servo.Servo(pca.channels[7])

# We sleep in the loops to give the servo time to move into position.
```

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```
for i in range(180):
    servo7.angle = i
    time.sleep(0.03)
for i in range(180):
    servo7.angle = 180 - i
    time.sleep(0.03)

# You can also specify the movement fractionally.
fraction = 0.0
while fraction < 1.0:
    servo7.fraction = fraction
    fraction += 0.01
    time.sleep(0.03)

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

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