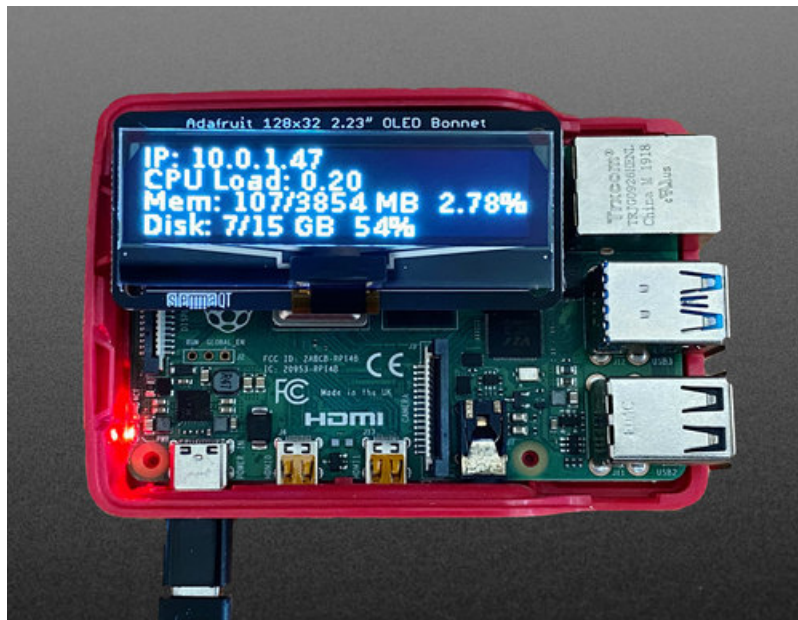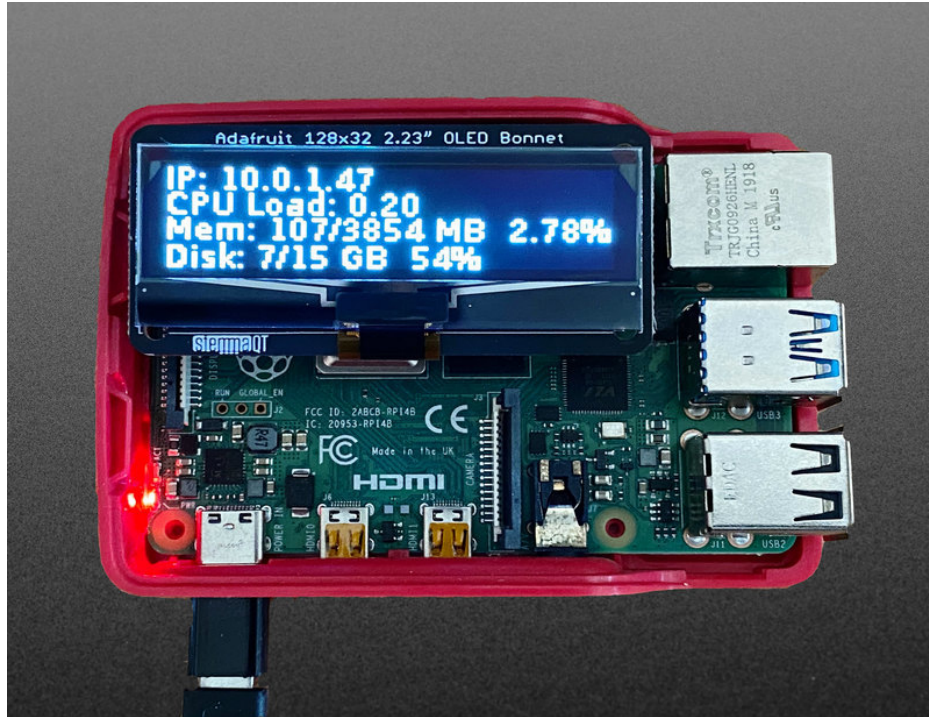# Adafruit 2.23" Monochrome OLED Bonnet

Created by Melissa LeBlanc-Williams


Last updated on 2020-08-17 12:05:23 PM EDT

If you're looking for a bright, readable OLED display for a Raspberry Pi (https://adafru.it/wF8) (most likely a Pi Zero (https://adafru.it/vIa)) project, this might be just the thing you need!

The **Adafruit 2.23" Monochrome OLED Bonnet for Raspberry Pi** is your chonky OLED pal, ready to snap onto any and all Raspberry Pi computers, to give you a vivid display. The Bonnet comes with a 2.13" diagonal monochrome 128x32 OLED, with sharp white pixels. The OLED the I2C pins plus GPIO #4 for reset, so you have plenty of GPIO connections available for buttons, LEDs, sensors, etc. It sits nice and flat, so many cases that have an open top can have this display inserted.
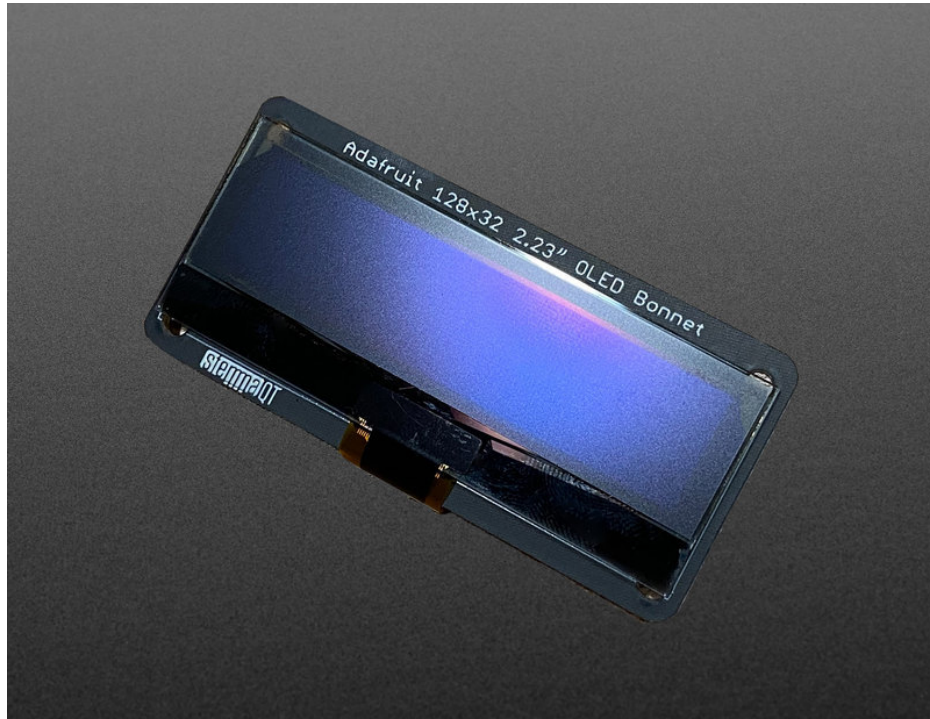
[Compared to our similar PiOLED display (https://adafru.it/wVd)](https://adafru.it/wVd), this OLED has the same resolution but is much larger, so it can be read from across the room. This screen is made of 128x32 individual white OLED pixels and because the display makes its own light, no backlight is required. This reduces the power required to run the OLED and is why the display has such high contrast; we really like OLED displays for their crispness!

Using the display is very easy, we have a Python library for the SSD1305 chipset. Our example code allows you to draw images, text, whatever you like, using the Python imaging library. Our tests showed 30 FPS update rates so you can do animations or simple video.
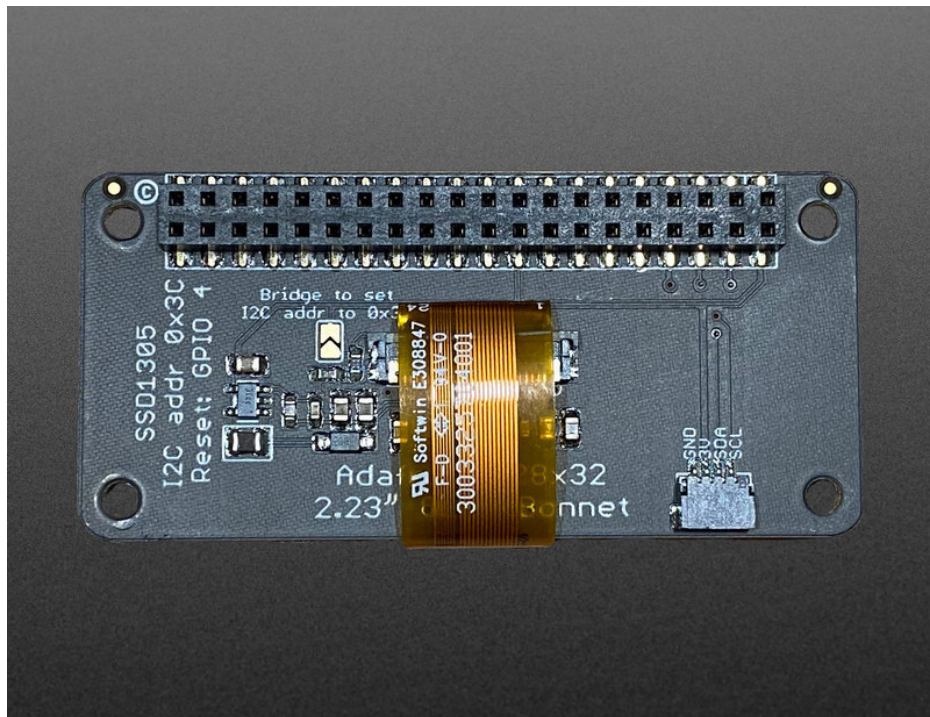
Comes completely pre-assembled and tested so you don't need to do anything but plug it in and install our Python code! **Works with any Raspberry Pi computer that has a 2x20 connector**, such as the Pi B+, Pi 2, Pi 3, Pi 4, and Pi Zero (and any others that have a 2x20 connector!)

On the bottom, we have a Qwiic/STEMMA QT connector for I2C sensors and devices so you can plug and play any of our STEMMA QT devices (https://adafru.it/GfR).

> This guide assumes you have your Raspberry Pi all set up with an operating system, network connectivity and SSH!

Install CircuitPython

This guide assumes that you've gotten your Raspberry Pi up and running, and have CircuitPython installed. If not, check out the guide:

https://adafru.it/Deo

https://adafru.it/Deo

To install the library for the Pi OLED (https://adafru.it/Glf), enter the following into the terminal:

```
sudo pip3 install adafruit-circuitpython-ssd1305
```

If that complains about pip3 not being installed, then run this first to install it:

```
sudo apt-get install python3-pip
```

We also need PIL to allow using text with custom fonts. There are several system libraries that PIL relies on, so installing via a package manager is the easiest way to bring in everything:

```
sudo apt-get install python3-pil
```

Enable I2C

To enable i2c, you can follow our detailed guide on configuring the Pi with I2C support here. (https://adafru.it/Deo)

After you've enabled I2C you will need to shutdown with `sudo shutdown -h now`

Once the Pi has halted, plug in the PiOLED. Now you can power the Pi back up, and log back in. Run the following command from a terminal prompt to scan/detect the I2C devices

`sudo i2cdetect -y 1`

You should see the following, indicating that address **0x3c** (the OLED display) was found

```
pi@raspberrypi: ~
pi@raspberrypi:~ $ sudo i2cdetect -y 1
     0  1  2  3  4  5  6  7  8  9  a  b  c  d  e  f
00:          -- -- -- -- -- -- -- -- -- -- -- -- --
10: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
20: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
30: -- -- -- -- -- -- -- -- -- -- -- -- 3c -- -- --
40: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
50: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
60: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
70: -- -- -- -- -- -- -- --
pi@raspberrypi:~ $
```
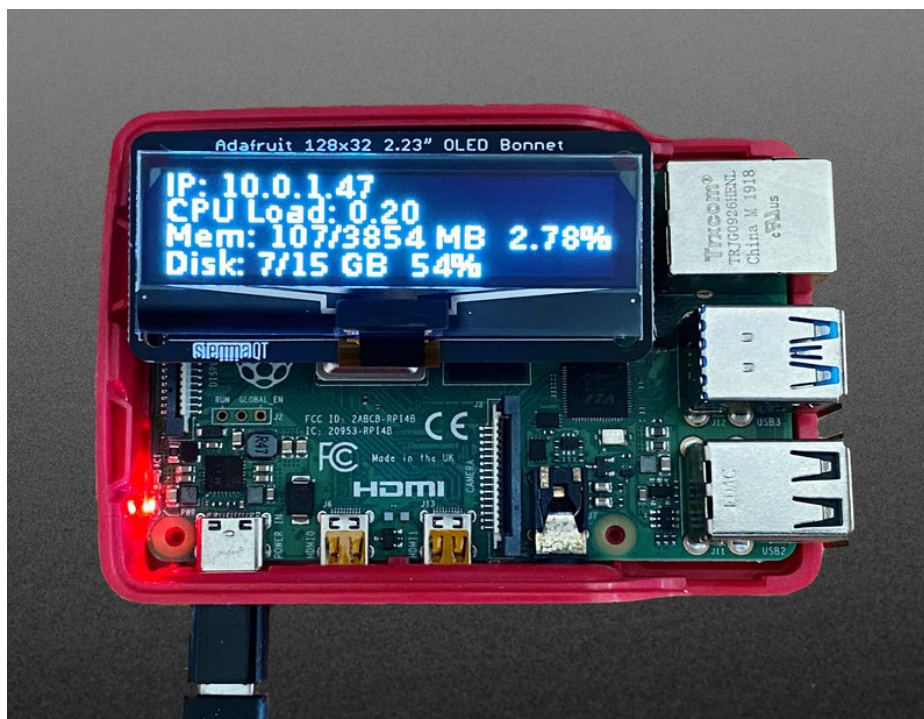
Verify I2C Device

You can run our stats example, which will query the Pi for details on CPU load, disk space, etc. and print it on the OLED.

Create a new file with **nano ~pi/stats.py** and paste this code below in! Then save it.

```
Temporarily unable to load content:
```

Run `sudo python3 stats.py` and you should see something like the following image:

Running Stats on Boot

You can pretty easily make it so this handy program runs every time you boot your Pi.

The fastest/easiest way is to put it in **/etc/rc.local**

Run **sudo nano /etc/rc.local** and add the line

`sudo python3 /home/pi/stats.py &`

on its own line right before **exit 0**

Then save and exit. Reboot to verify that the screen comes up on boot!

```
GNU nano 2.7.4                    File: /etc/rc.local

#!/bin/sh -e
#
# rc.local
#
# This script is executed at the end of each multiuser runlevel.
# Make sure that the script will "exit 0" on success or any other
# value on error.
#
# In order to enable or disable this script just change the execution
# bits.
#
# By default this script does nothing.

# Print the IP address
_IP=$(hostname -I) || true
if [ "$_IP" ]; then
  printf "My IP address is %s\n" "$_IP"
fi

sudo python3 /home/pi/stats.py &

exit 0
```

[For more advanced usage, check out our linux system services guide (https://adafru.it/wFR)](https://adafru.it/wFR)

Library Usage

In the [examples subdirectory of the Adafruit_CircuitPython_SSD1305 repository (https://adafru.it/LDg)](https://adafru.it/LDg), you'll find examples which demonstrate the usage of the library.

To help you get started, I'll walk you through the **stats.py** code you ran earlier, that way you can use this file as a basis of a future project.

```python
import time
import subprocess
from board import SCL, SDA, D4
import busio
import digitalio
from PIL import Image, ImageDraw, ImageFont
import adafruit_ssd1305
```

First, a few Python modules are imported. This includes the `adafruit_ssd1305` module which contains the OLED driver classes.

To draw images, shapes, and text/fonts, the code imports some of the **P**ython **I**maging **L**ibrary's modules like **Image** , **ImageDraw** , and **ImageFont** .

```
# Define the Reset Pin
oled_reset = digitalio.DigitalInOut(D4)

# Create the I2C interface.
i2c = busio.I2C(SCL, SDA)

# Create the SSD1305 OLED class.
# The first two parameters are the pixel width and pixel height.  Change these
# to the right size for your display!
disp = adafruit_ssd1305.SSD1305_I2C(128, 32, i2c, reset=oled_reset)
```

Since the PiOLED is a 128x32 I2C only device, the screen size, reset pin, and the i2c interface are passed to the `adafruit_ssd.SSD1305_I2C` class.

```
# Clear display.
disp.fill(0)
disp.show()

# Create blank image for drawing.
# Make sure to create image with mode '1' for 1-bit color.
width = disp.width
height = disp.height
image = Image.new('1', (width, height))

# Get drawing object to draw on image.
draw = ImageDraw.Draw(image)

# Draw a black filled box to clear the image.
draw.rectangle((0, 0, width, height), outline=0, fill=0)
```

The next chunk of code clears the display by inverting its fill with `fill(0)` and then writing to the display with `show()`.

Then it will configure a PIL drawing class to prepare for drawing graphics. Notice that the image buffer is created in 1-bit mode with the `'1'` parameter, this is important because the display only supports black and white colors.

We then re-draw a large black rectangle to clear the screen. In theory we don't have to clear the screen again, but its a good example of how to draw a shape!

```
# Draw some shapes.
# First define some constants to allow easy resizing of shapes.
padding = -2
top = padding
bottom = height-padding
# Move left to right keeping track of the current x position for drawing shapes.
x = 0


# Load default font.
font = ImageFont.load_default()

# Alternatively load a TTF font.  Make sure the .ttf font file is in the
# same directory as the python script!
# Some other nice fonts to try: http://www.dafont.com/bitmap.php
#font = ImageFont.truetype('/usr/share/fonts/truetype/dejavu/DejaVuSans.ttf', 9)
```

Once the display is initialized and a drawing object is prepared, you can draw shapes, text and graphics using PIL's drawing commands (https://adafru.it/dfH). We'll define some constraints based on the height and width of the display to allow for easy resizing of shapes.

Then, the code loads the `default` font, which works fine, but there's other fonts you can load.

Next the code loads a built-in default font and draws a few lines of text. You can also load your own TrueType font and use it to render fancy text in any style you like

```
while True:

    # Draw a black filled box to clear the image.
    draw.rectangle((0, 0, width, height), outline=0, fill=0)

    # Shell scripts for system monitoring from here:
    # https://unix.stackexchange.com/questions/119126/command-to-display-memory-usage-disk-usage-and-
cpu-load
    cmd = "hostname -I | cut -d\' \' -f1"
    IP = subprocess.check_output(cmd, shell=True).decode("utf-8")
    cmd = "top -bn1 | grep load | awk '{printf \"CPU Load: %.2f\", $(NF-2)}'"
    CPU = subprocess.check_output(cmd, shell=True).decode("utf-8")
    cmd = "free -m | awk 'NR==2{printf \"Mem: %s/%s MB  %.2f%%\", $3,$2,$3*100/$2 }'"
    MemUsage = subprocess.check_output(cmd, shell=True).decode("utf-8")
    cmd = "df -h | awk '$NF==\"/\"{printf \"Disk: %d/%d GB  %s\", $3,$2,$5}'"
    Disk = subprocess.check_output(cmd, shell=True).decode("utf-8")

    # Write four lines of text.

    draw.text((x, top+0), "IP: "+IP, font=font, fill=255)
    draw.text((x, top+8), CPU, font=font, fill=255)
    draw.text((x, top+16), MemUsage, font=font, fill=255)
    draw.text((x, top+25), Disk, font=font, fill=255)

    # Display image.
    disp.image(image)
    disp.show()
    time.sleep(.1)
```

Using the subprocess class, python can utilize linux commands to access the Pi's system information. This loop updates the screen at 10 times a second.
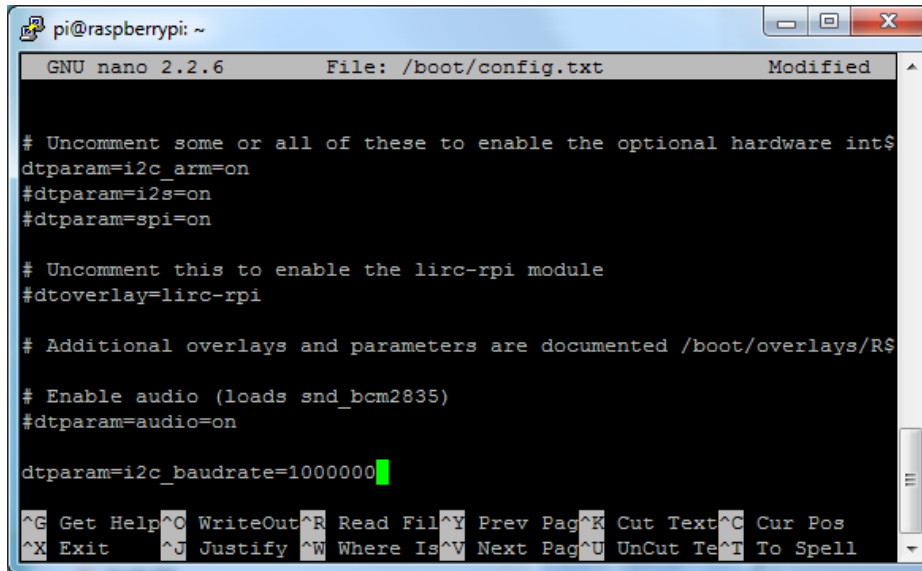
That's all there is to the **stats.py** code!

Speeding up the Display

For the best performance, especially if you are doing fast animations, you'll want to tweak the I2C core to run at 1MHz. By default it may be 100KHz or 400KHz

To do this edit the config with **sudo nano /boot/config.txt**

and add to the end of the file

dtparam=i2c_baudrate=1000000

Downloads

Files

- EagleCAD PCB files on GitHub (https://adafru.it/LDh)
- UG-2832ALBCG01 (https://adafru.it/LDi) Datasheet
- SSD1305 (https://adafru.it/LDj) Datasheet
- Fritzing object in Adafruit Fritzing Library (https://adafru.it/c7M)

Schematic & Fabrication Print