

2.23inch OLED HAT

From Waveshare Wiki

Jump to: navigation, search

Overview

Instruction

This is a 2.23inch OLED display with a controller. You can directly add it on Raspberry Pi by the 40 PIN pinheader, or connect it to another hardware platform via the IIC and SPI interfaces. The interface of 2.23inch OLED HAT is the default SPI, you can also switch to I2C by soldering the resistors on the back of the OLED.

Specification

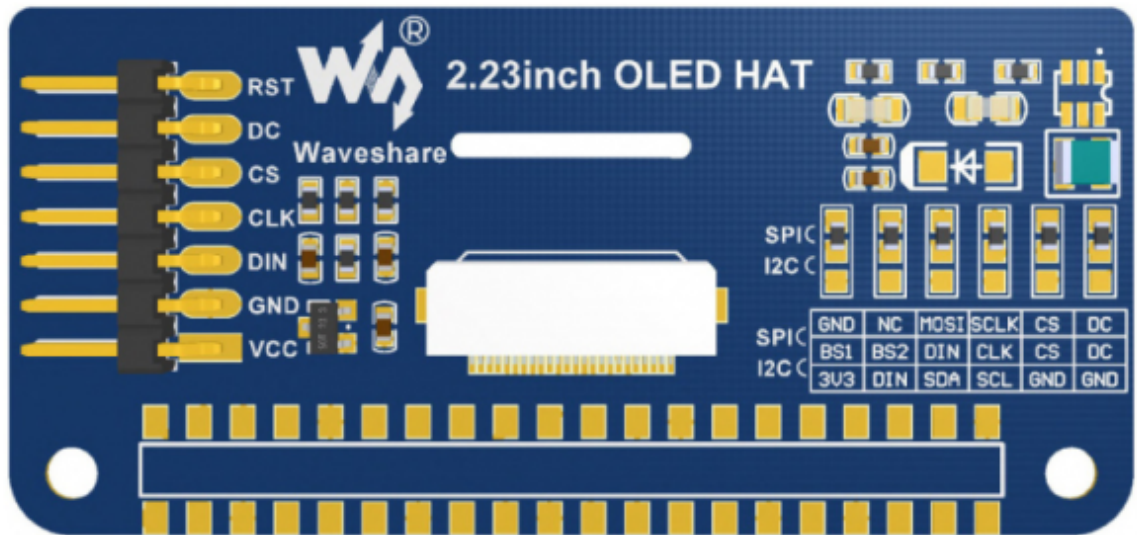
- Controller: SSD1305
- Interface: SPI/I2C/OLED
- Resolution: 128 * 32
- Display size: 2.23inch
- Pixel size: 0.41mm x 0.39mm
- Display color: White
- Working voltage: 3.3V
- Working temperature: -40~70°C

PINS

2.23inch OLED HAT



(<https://www.waveshare.com/2.23inch-oled-hat.htm>)



(/wiki/File:2.23inch-oled-hat-user-manual-01.png)

| PIN | Description |
|-----|---------------------------------|
| VCC | 3.3V/5V |
| GND | GND |
| DIN | Data input |
| CLK | Clock input |
| CS | Chip select (Low active) |
| DC | register / Data selection (SPI) |
| RST | Reset (Low active) |

The module uses the SPI communication mode by default, that is, BS1, BS2, DIN, CLK, CS, and DS connect the 0R resistor to the upper two pads by default. The welding method shown in the figure above is to select the I2C communication method. The specific hardware connection is shown in the following table: Note: The above picture is the welding on the hardware, the following table is the actual hardware connection.

| Communication | BS1 | BS2 | DIN | CLK | CS | DC |
|---------------|-----|-----|------|------|-----|-----|
| SPI | GND | NC | MOSI | SCLK | CS | DC |
| I2C | 3V3 | DIN | SDA | SCL | GND | GND |

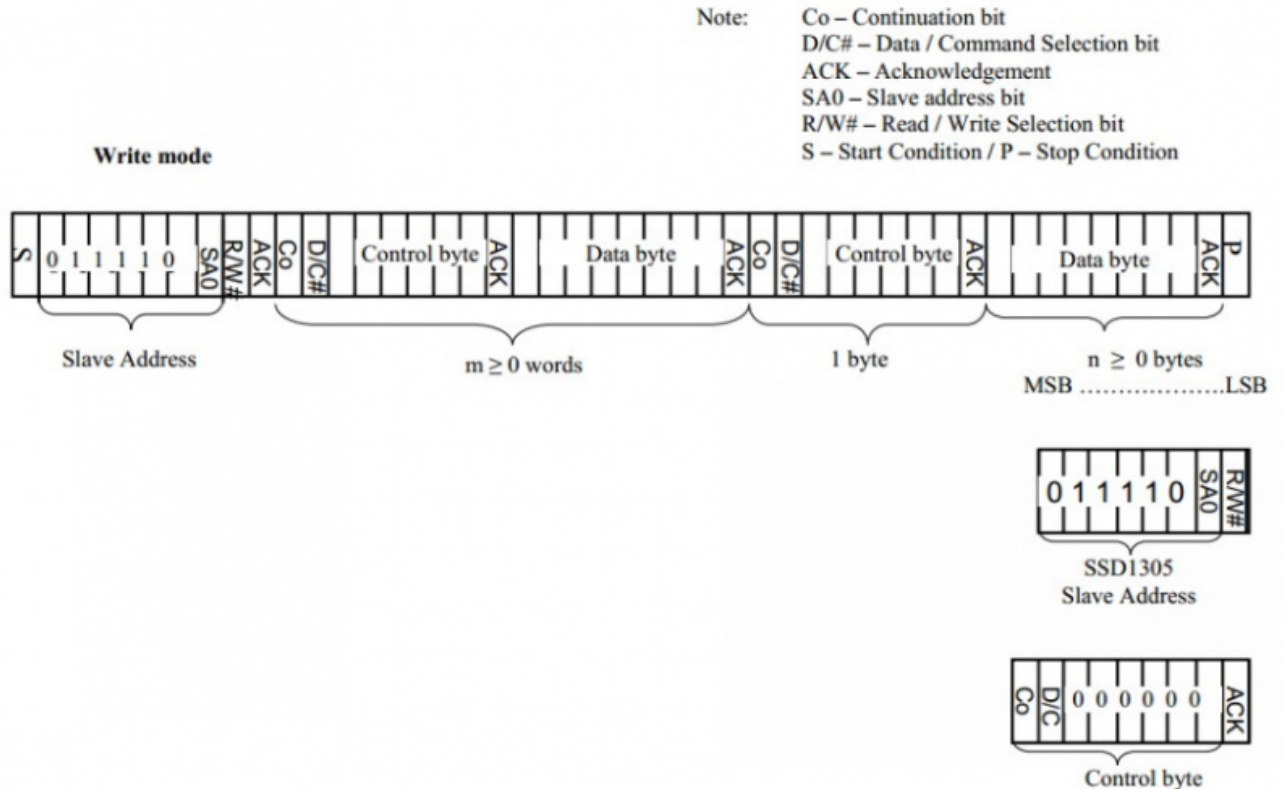
Working principle

- SSD1305 is a 132*64 pixel OLED controller, but the OLED only has 128*32 pixels, so the screen only uses the first part of the SSD1305 cache;

- The OLED supports 8bit 8080 parallel, SPI and I2C, and other communication methods, but considering the size of the module and saving the precious IO resources of the microcontroller, the 8bit 8080 parallel method is abandoned and supports the communication method of I2C and SPI.

Communication Protocol

I2C

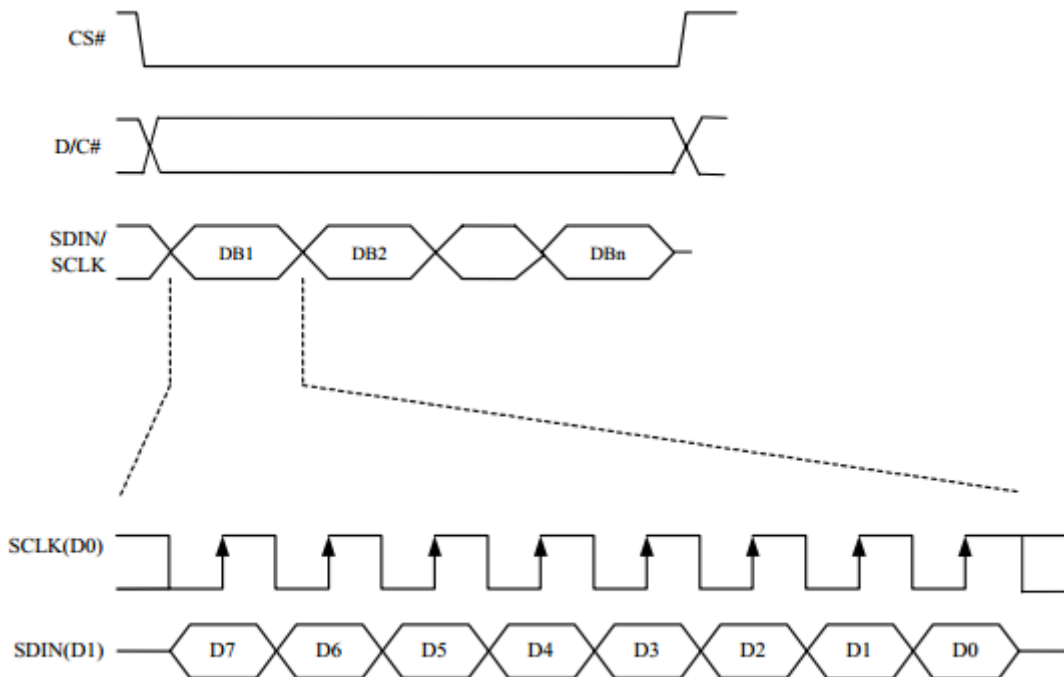


(/wiki/File:Proto.png)

- During I2C communication, first send a 7 bit slave device address + 1 bit read and write bit, and wait for the device's response.
- After the slave device responds, a control byte is sent, which determines whether the following byte is a command or data, and then waits for the slave device to respond.
- After the slave device replies again, if a command is sent, only a one-byte command is sent. If data is sent, only one byte can be sent, or multiple bytes of data can be sent together, depending on the situation.

- See Datasheet Page22 Figure 8-6 for details

SPI Communication Timing



(/wiki/File:1.54inch-e-paper-manual-1.png)

- As shown in the figure above, the data on SDIN is shifted into an 8-bit shift register on each rising edge of SCLK in MSB first LSB last order.
- D/C# is sampled at every 8th clock, and the data in the shift register is written to the Graphics Display Memory (GDDRAM) or command register, at the same count clock.
- In serial mode, only write operations are allowed. Write operation process in 4-wireSPI mode.
- See Figure 8-5 on Datasheet Page21 for details.

Raspberry Pi

Provides C and Python demo

- Open the Raspberry Pi terminal and enter the following command to enter the configuration interface

Enable SPI Interface

```
sudo raspi-config
chooseInterfacing Options -> SPI -> Yes Open SPI Interface
```

```

1 Change User Password Change password for the current user
2 Network Options      Configure network settings
3 Boot Options         Configure options for start-up
4 Localisation Options Set up language and regional settings to match your location
5 Interfacing Options  Configure connections to peripherals
6 Overclock            Configure overclocking for your Pi
7 Advanced Options     Configure advanced settings
8 Update               Update this tool to the latest version
9 About raspi-config   Information about this configuration tool

```

```

P1 Camera      Enable/Disable connection to the Raspberry Pi Camera
P2 SSH         Enable/Disable remote command line access to your Pi using SSH
P3 VNC         Enable/Disable graphical remote access to your Pi using RealVNC
P4 SPI         Enable/Disable automatic loading of SPI kernel module
P5 I2C         Enable/Disable automatic loading of I2C kernel module
P6 Serial      Enable/Disable shell and kernel messages on the serial connection
P7 1-Wire      Enable/Disable one-wire interface
P8 Remote GPIO Enable/Disable remote access to GPIO pins

```

Would you like the SPI interface to be enabled?

<Yes>

<No>

(/wiki/File:R01.png)

Then reboot Raspberry Pi:

```
sudo reboot
```

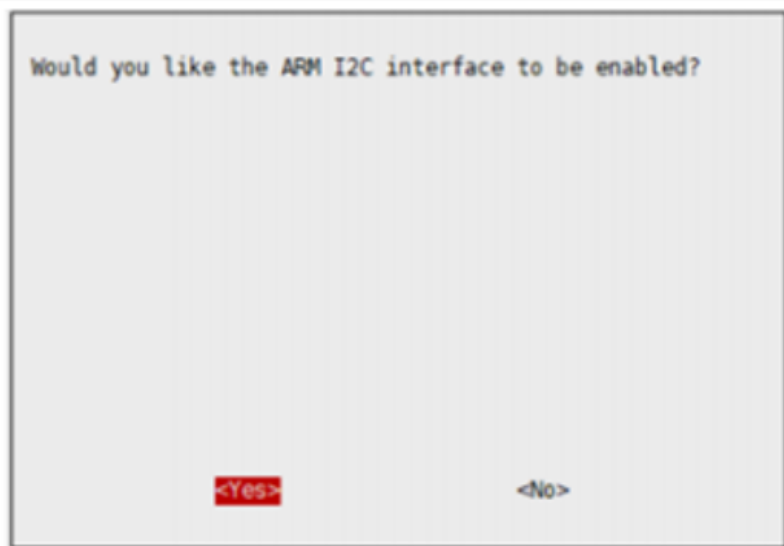
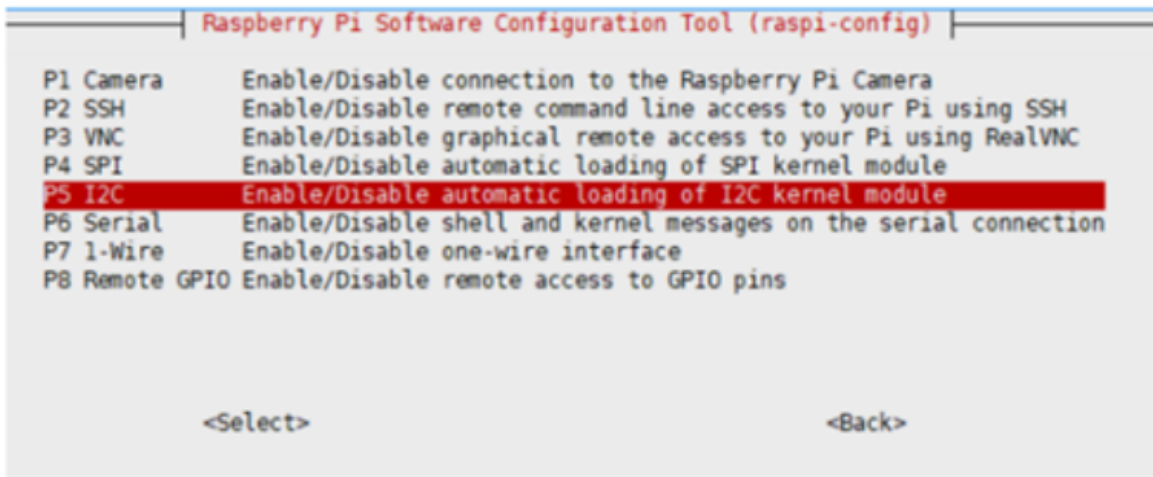
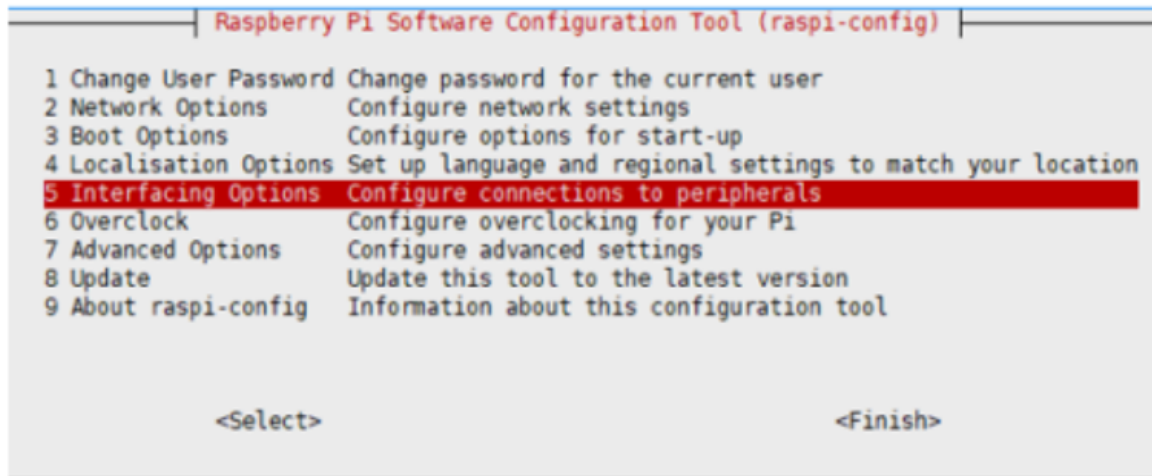
Please make sure the SPI is not occupied by other devices, you can check in the middle of /boot/config.txt

Enable I2C Interface

- Open the Raspberry Pi terminal and enter the following command to enter the configuration interface.

```
sudo raspi-config
```

```
choose Interfacing Options -> I2C ->yes Start the i2C kernel driver
```



(/wiki/File:R02.png)

Then reboot Raspberry Pi:

```
sudo reboot
```

Install Function

BCM2835

```
#Open the Raspberry Pi terminal and run the following command
wget http://www.airspayce.com/mikem/bcm2835/bcm2835-1.71.tar.gz
tar zxvf bcm2835-1.71.tar.gz
cd bcm2835-1.71/
sudo ./configure && sudo make && sudo make check && sudo make install
# For more information, please refer to the official website: http://www.airspayce.c
om/mikem/bcm2835/
```

wiringPi

```
#Open the Raspberry Pi terminal and run the following command
sudo apt-get install wiringpi
#For Raspberry Pi systems after May 2019 (earlier than before), an upgrade may be r
equired:
wget https://project-downloads.drogon.net/wiringpi-latest.deb
sudo dpkg -i wiringpi-latest.deb
gpio -v
# Run gpio -v and version 2.52 will appear. If it does not appear, the installation
is wrong.

#Bullseye branch system uses the following command:
git clone https://github.com/WiringPi/WiringPi
cd WiringPi
./build
gpio -v
# Run gpio -v and version 2.60 will appear. If it does not appear, the installation
is wrong.
```

python

```
#Open the Raspberry Pi terminal and run the following command
#python2
sudo apt-get update
sudo apt-get install python-pip
sudo apt-get install python-pil
sudo apt-get install python-numpy
sudo pip install RPi.GPIO
sudo pip install spidev
sudo pip install Adafruit-PureIO
```



```
#python3
sudo apt-get update
sudo apt-get install python3-pip
sudo apt-get install python3-pil
sudo apt-get install python3-numpy
sudo pip3 install RPi.GPIO
sudo pip3 install spidev
sudo pip3 install Adafruit-PureIO
```

Download demo

Run the following command in the Raspberry Pi terminal

```
sudo apt-get install p7zip-full
wget https://www.waveshare.com/w/upload/c/c5/2.23inch-OLED-HAT-Code.7z (https://www.
waveshare.com/w/upload/c/c5/2.23inch-OLED-HAT-Code.7z)
7z x 2.23inch-OLED-HAT-Code.7z
sudo chmod 777 -R 2.23inch-OLED-HAT-Code
cd 2.23inch-OLED-HAT-Code/
```

- Raspberry Pi demo use (the following SPI routine is used as an example)
- The scrolling display is to enable all the pixels in the RAM of SSD1305 (132X64) and display it on the screen (128X32) by scrolling.
- The scrolling routine provides two scrolling methods, you can only choose one or none of them, set it to '1'.

```
#define VERTICAL 1
#define HORIZONTAL 0
```

Based on the use of BCM2835

```
#normal display
cd Without scrolling/Raspberry\ Pi/SPI/bcm2835
make clean
make
sudo ./oled
# scroll display
cd Scroll/Raspberry\ Pi/SPI/bcm2835
make clean
make
sudo ./oled
```

Based on the use of Wiring Pi


```
#normal display
cd Without scrolling/Raspberry\ Pi/SPI/wiringPi
make clean
make
sudo ./oled
#scroll display
cd Scroll/Raspberry\ Pi/SPI/wiringPi
make clean
make
sudo ./oled
```

Based on the use of Python

```
#normal display
cd Without scrolling/Raspberry\ Pi/SPI/python
sudo python3 stats.py
sudo ./oled
#scroll display
cd Scroll/Raspberry\ Pi/SPI/python
sudo python3 stats.py
```

Precautions

The WiringPi and Python demo operate by reading and writing the device files of the linux system, while the BCM2835 is a library function of the Raspberry Pi cpu chip, which operates on registers. Therefore, if the BCM2835 library is used first, the WiringPi and Python demo will fail to use, in this case, you need to restart the system and run it again.

Arduino

Hardware Configuration

The expansion board for the demo: UNO PLUS

IIC Connection

| Pin Function | Expansion Board |
|--------------|-----------------|
| VCC | 3.3V |
| GND | GND |
| DIN | SDA/D14 |
| SCL | D15 |

SPI Connection

| Pin Function | Expansion Board |
|--------------|-----------------|
| VCC | 3.3V |
| GND | GND |
| DIN | D11(MOSI) |
| CLK | D13(SCK) |
| CS | D10 |
| DC | D8 |
| RST | D9 |

Software Configuration

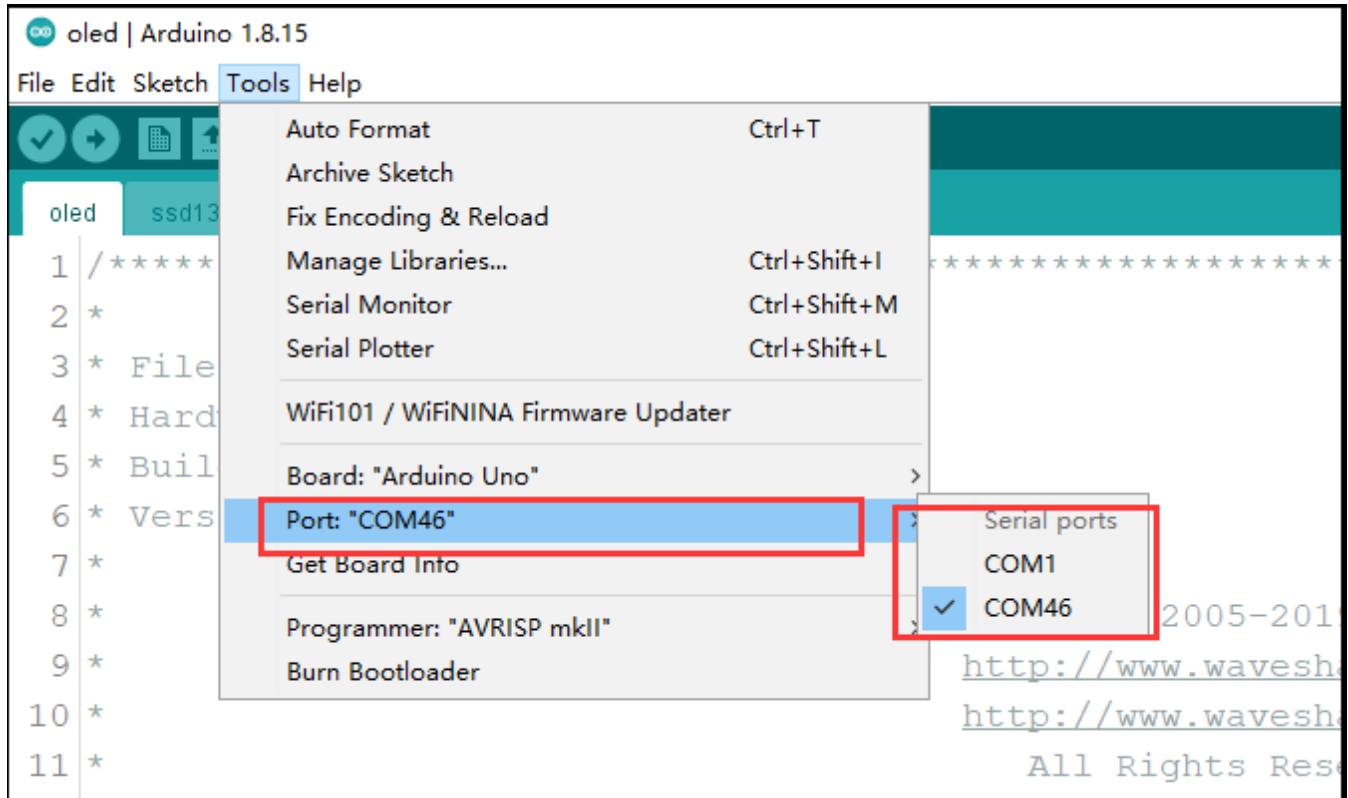
Install Compilation Software (Windows Tutorial)

Arduino_IDE_Installation_Steps (https://www.waveshare.com/wiki/Template:Arduino_IDE_Installation_Steps)

Program

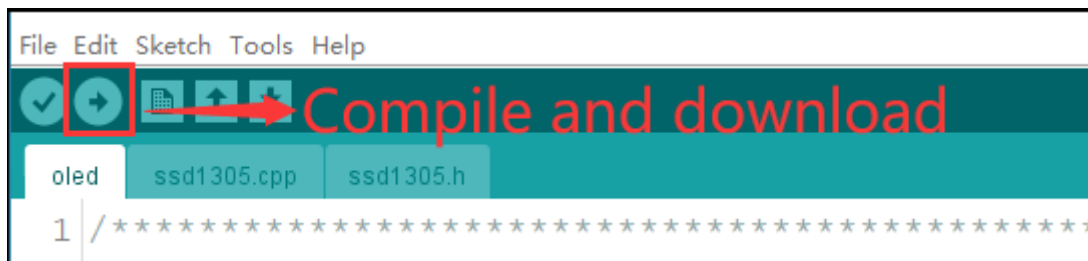
- Normal Display
 - Download the program in the information we provided, unzip it, and then enter the 2.23inch-OLED-HAT-Code\Without scrolling\Arduino\SPI\oled directory

Double-click to open the oled.ino file. Select your development board, and the corresponding port.



(/wiki/File:Arduino1.png)

Compile and download

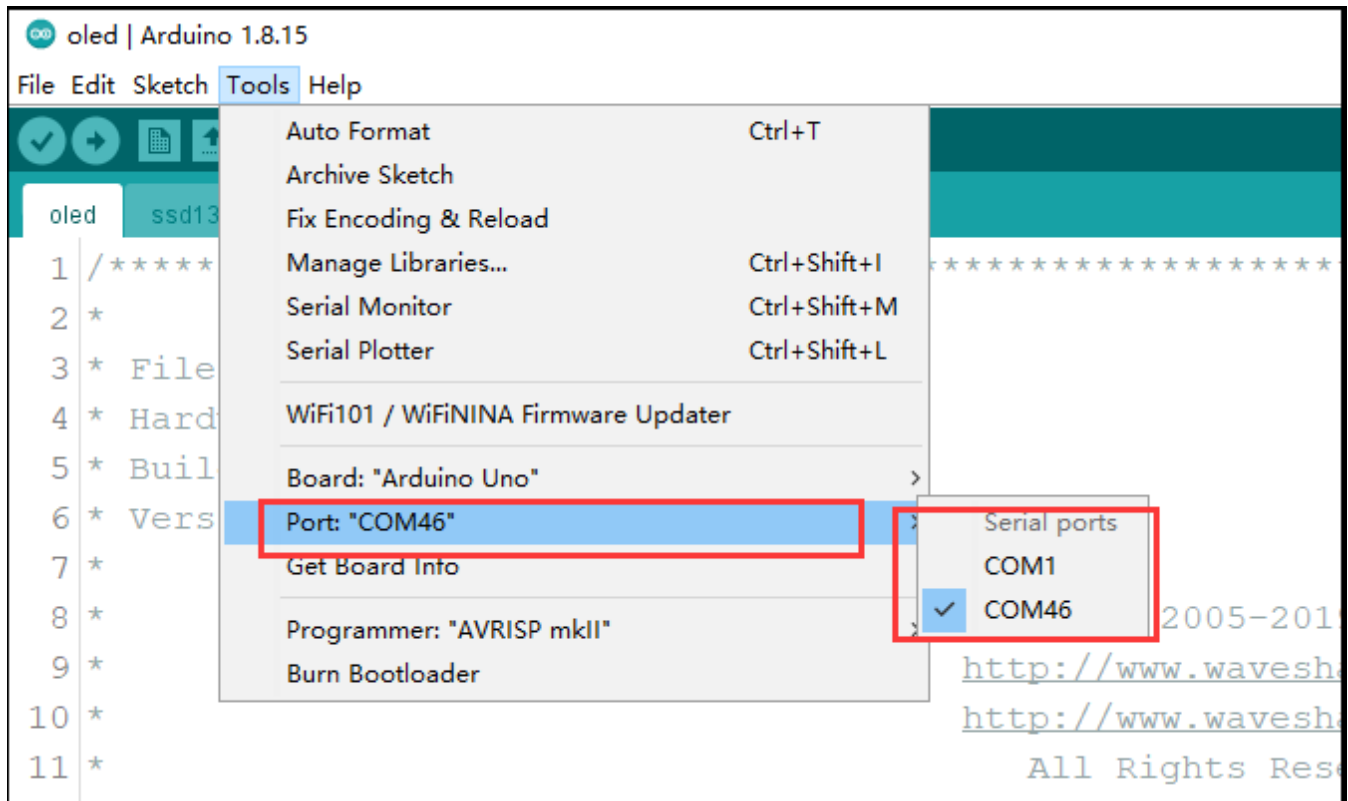


(/wiki/File:Arduino2.png)

After the download is successful, the screen will display normally.

- scroll
 - Download the program in the information we provided, unzip it, and then enter the 2.23inch-OLED-HAT-Code\Scroll\Arduino\SPI\oled directory

Double-click to open the oled.ino file. Select your development board, and the corresponding port.



(/wiki/File:Arduino1.png)

Compile and download



(/wiki/File:Arduino2.png)

After the download is successful, the screen will scroll.

How to create image data

- Open Image2Lcd software
- Set Data type: *c
- Scanning type: Horizontal
- Grey Scale: Monochrome
- Max height and width: 128 32

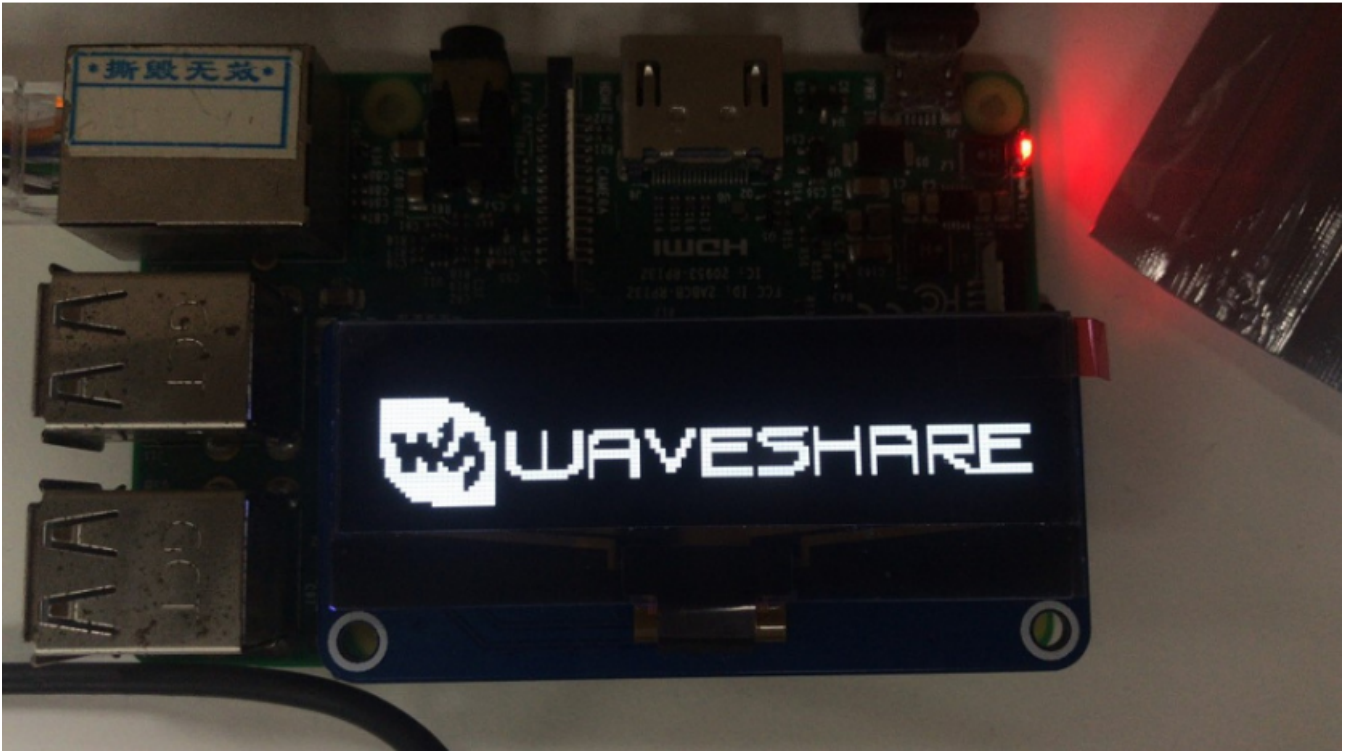


(/wiki/File:2.23inch-oled-hat-user-manual-4.png)

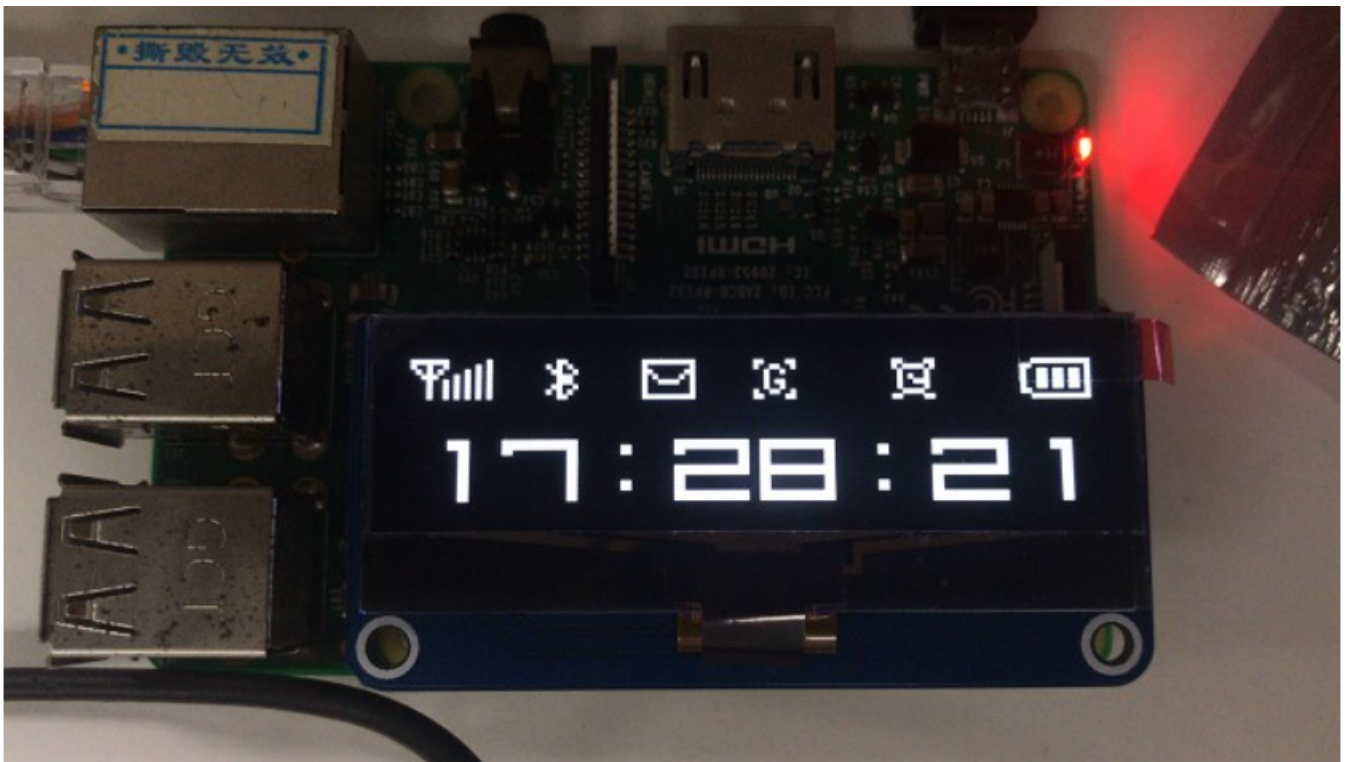
The expected result:



(/wiki/File:Image0.png)



(/wiki/File:Image1.png)



(/wiki/File:Image2.png)



(/wiki/File:Image3.png)

Resource

Documents

- Schematic (<https://www.waveshare.com/w/upload/3/35/2.23inch-OLED-HAT-Schematic.pdf>)
- Datasheet of 2.23inch OLED HAT (https://www.waveshare.com/w/upload/e/e3/2.23inch-OLED-HAT-Datasheet_.pdf)
- Datasheet of SSD1305 (https://www.waveshare.com/w/upload/b/b5/SSD1305-Revision_1.8.pdf)

Demo codes

- Demo codes of 2.23inch OLED HAT (<https://www.waveshare.com/w/upload/c/c5/2.23inch-OLED-HAT-Code.7z>)

Software

- lcd (<https://www.waveshare.com/wiki/File:LcmZimo.zip>)