

MLX90641-D55 Thermal Camera

Resources

Documents

- [MLX90640 Thermal Camera SchDoc.pdf](#)
- [MLX90640 Datasheet](#)

Demo codes

- [Demo codes](#)

The MLX90641-D55 Thermal Camera is a small size, non-contact, and low-cost IR array thermal imaging camera, with 16×12 pixels. It will detect the IR distribution of objects in the field of view, turn the data into the surface temperature of the objects by calculation, and then generate thermal images, for easy integration into miscellaneous industrial or intelligent control applications.

Features

- Adopts MLX90641 far-infrared thermal sensor array, 16×12 pixels
- Communicating via I2C interface, configurable to fast mode (up to 1MHz data rate)
- Noise Equivalent Temperature Difference (NETD) 0.1K RMS@4Hz refresh rate
- Onboard voltage translator, compatible with 3.3V/5V operating voltage
- Programmable frame rate 0.5~64Hz (0.25~32FPS)

Specification

- Operating voltage: 3.3V/5V
- Operating current: ≈12mA
- Communication interface: I2C (adds 0x33)
- Field of view (Horizontal×Vertical):55° x 35°
- Operating temperature: -40°C~125°C
- Target temperature: -40°C~300°C
- Resolution: ±2°C (ambient temp. 0~50°)
- Refresh rate: 0.5Hz~64Hz (programmable)
- Dimensions: 28mm×16 mm
- Mounting hole size: 2.0mm

Interface

- Vcc: Connect to 3,3V (MCU)
- GND: Connect to GND (MCU)

- SDA: Connect to SDA pin of I2C interface (MCU)
- SCL: Connect to SCL pin of I2C interface (MCU)

I2C

This camera use the I2C interface supports High-speed mode. The default I2C address is 0x33.

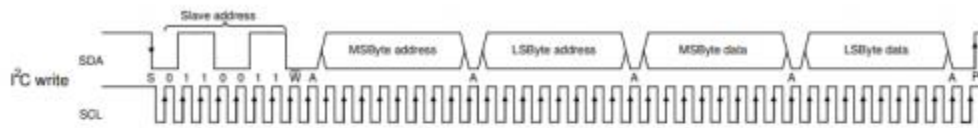


Figure 4 I²C write command format (default SA=0x33 is used)

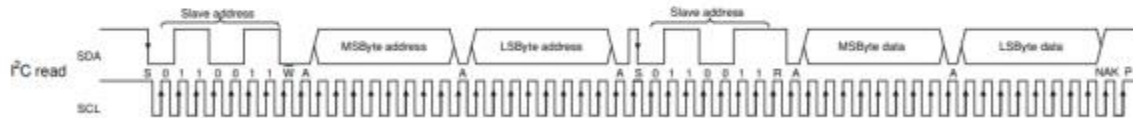
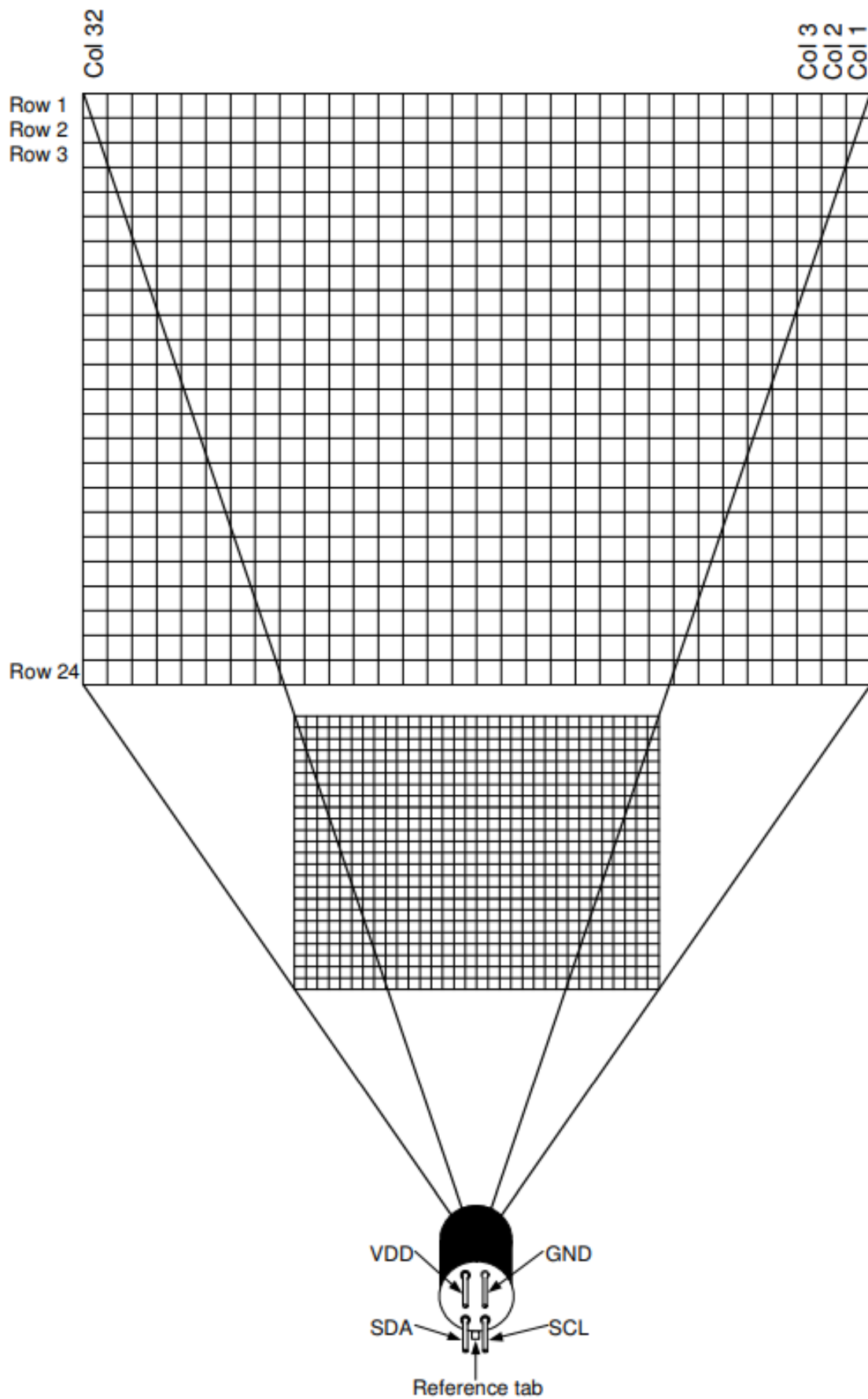


Figure 5 I²C read command format (default SA=0x33 is used)

Pixel position

MLX90641 consists of 768 IR sensors (also called pixels). Each pixel is identified with its row and column position as Pix(i, j) where i is its row number (from 1 to 24) and j is its column number (from 1 to 32)



It is normal that the sensor may have less than four bad pixels. Every bad pixel is marked in the EEPROM table. So the module you get may have bad pixels, it is normal and not covered by warranty. If the module you get has bad pixels, you can use the average value of the neighboring pixels.

Address map

0x0000	ROM
0x03FF	
0x0400	RAM
0x07FF	
0x2400	EEPROM
0x273F	
0x8000	Registers (MLX reserved)
0x800C	
0x800D	Registers
0x8010	
0x8011	Registers (MLX reserved)
0x8016	

Figure 10 MXL90640 memory map

RAM

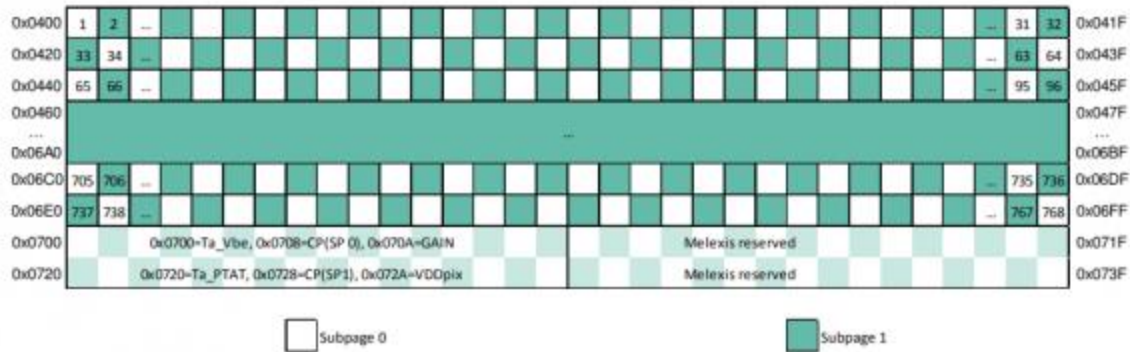


Figure 14 RAM memory map (Chess pattern mode) – factory default mode



Figure 15 RAM memory map (Interleaved mode)

EEPROM

The EEPROM is used to store the calibration constants and the configuration parameters of the device

EEPROM address	Access	Meaning
0x2400	Melexis	Melexis reserved
0x2401	Melexis	Melexis reserved
0x2402	Melexis	Melexis reserved
0x2403	Melexis	Configuration register
0x2404	Melexis	Melexis reserved
0x2405	Melexis	Melexis reserved
0x2406	Melexis	Melexis reserved
0x2407	Melexis	Device ID1
0x2408	Melexis	Device ID2
0x2409	Melexis	Device ID3
0x240A	Melexis	Device Options
0x240B	Melexis	Melexis reserved
0x240C	Customer	Control register_1
0x240D	Customer	Control register_2
0x240E	Customer	I2CConfReg
0x240F	Customer	Melexis reserved / I2C_Address

Table 7 Configuration parameters memory

Refresh rate

This module support 8 kinds of refresh rate, up to 64Hz. The refresh rate is configured by registers 1-0x800D

B15	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0																		
Melisox reserved			Flashing pattern		Resolution control		Refresh rate control			Select subpage			Enable subpages repeat		Enable data hold	Melisox reserved	Enable subpages mode	Control register 1 - 0x800D															
															0 No subpages, only one page will be measured	1 Subpage mode is activated (default)																	
															0 Keep this bit = "0" (default)	1 Transfer the data into storage RAM at each measured frame (default)	1 Transfer the data into storage RAM only if an_overwrite = 1 (check 0x8000)																
															0 Toggles between subpage "0" and subpage "1" if Enable subpages mode = "1" (default)	1 Select subpage determines which subpage to be measured if Enable subpages mode = "1"																	
															0 0 0 Subpage 0 is selected (default)	0 0 1 Subpage 1 is selected	0 1 0 Not Applicable	0 1 1 Not Applicable	1 0 0 Not Applicable	1 0 1 Not Applicable	1 1 0 Not Applicable	1 1 1 Not Applicable											
															0 0 0 IR refresh rate = 0.5Hz	0 0 1 IR refresh rate = 1Hz	0 1 0 IR refresh rate = 2Hz (default)	0 1 1 IR refresh rate = 4Hz	1 0 0 IR refresh rate = 8Hz	1 0 1 IR refresh rate = 16Hz	1 1 0 IR refresh rate = 32Hz	1 1 1 IR refresh rate = 64Hz											
															0 0 ADC set to 16 bit resolution	0 1 ADC set to 17 bit resolution	1 0 ADC set to 18 bit resolution (default)	1 1 ADC set to 19 bit resolution															
															0 Interleaved (TV) mode	1 Chess pattern (default)																	
															Melisox reserved																		

The refresh rate is defined by Bit 7, Bit 8 and Bit 9 of control registers 1-0x800D.

Reading patterns

Chess pattern mode (factory default)

Subpage 0 --> 0x8000 = 0x0008

Subpage 1 --> 0x8000 = 0x0009

Subpage 0 --> 0x8000 = 0x0008

Subpage 1 --> 0x8000 = 0x0009

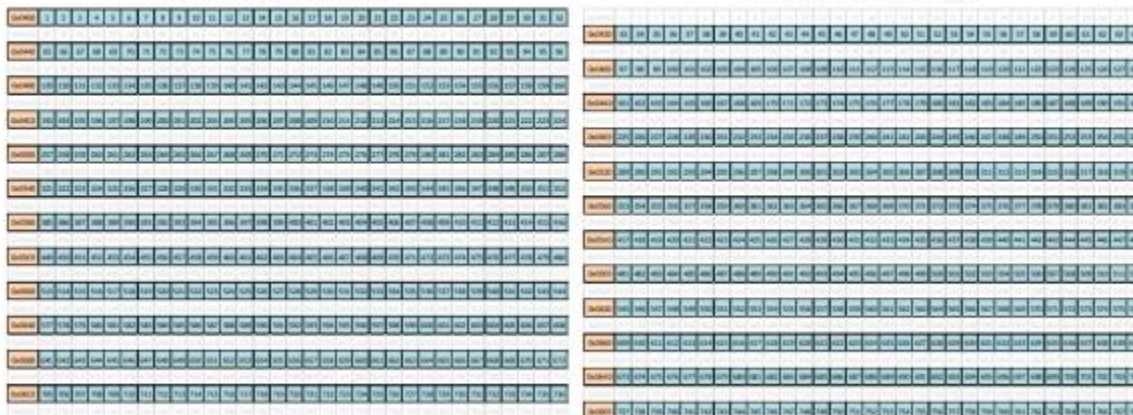


Figure 8 TV mode reading pattern (only highlighted cells are updated)

TV interleave mode

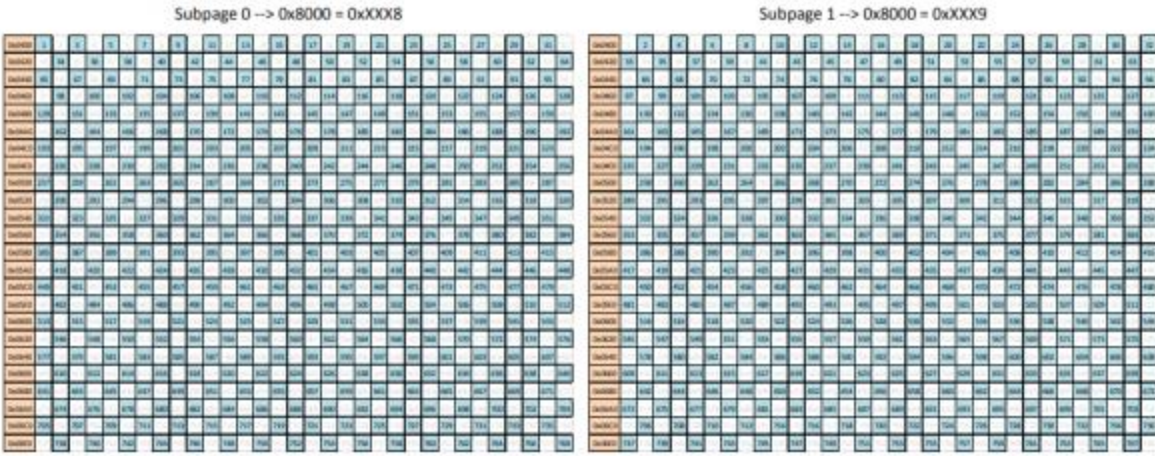


Figure 9 Chess reading pattern (only highlighted cells are updated)

The array frame is divided into two subpages and depending on bit 12 in "Control register 1" (0x800D). As a standard the MLX90641 is calibrated in Chess pattern mode, this results in better-fixed pattern noise behavior of the sensor when in chess pattern mode. For best results, we advise using chess pattern mode.

Measure principle

The FOV of this module is determined by a 50% radiation signal which is received by the thermopile, it is also influenced by the main axis of the sensor. The temperature measured is the weighted average of the detected object's temperature in FOV. To improve the accuracy, you should make sure that the detected object is in the FOV totally.

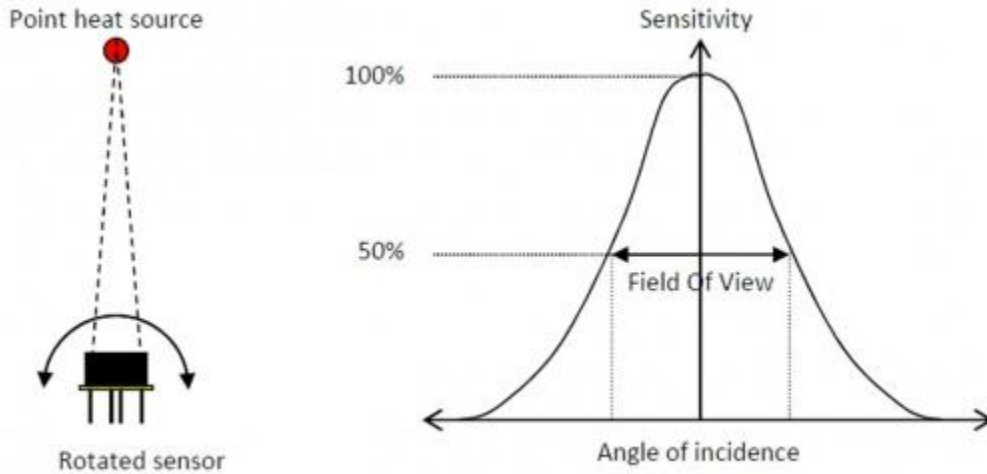


Figure 24: Field Of View measurement

Examples

Raspberry Pi

1. When using the sensor, please pay attention to avoid direct contact with the onboard IC devices by your hands, Pay attention to prevent static electricity and check the power supply to prevent reverse connection before powering on.

2. When the sensor is working, please avoid excessive vibration and do not plug or unplug cables. Since the core device, MLX90641 has EEPROM, which will easily be damaged by vibration and hotplug.

Hardware connection



Raspberry Pi	MLX90641 Thermal Camera
5V	5V
GND	GND
SDA(BCM2)	SDA
SCL(BCM3)	SCL

Download the demo codes and use it.

```
cd ~
wget
http://www.waveshare.net/w/upload/5/56/MLX90640_Thermal_Camera_Code.
7z
sudo apt-get install p7zip
```



```
p7zip --uncompress MLX90640_Thermal_Camera_Code.7z
cd RaspberryPi/cpp/
chmod +x install.sh
sudo ./install.sh
make
sudo ./main
```

If the detecting has delay, you can try to modify the i2c speed in config.txt file

```
sudo nano /boot/config.txt
```

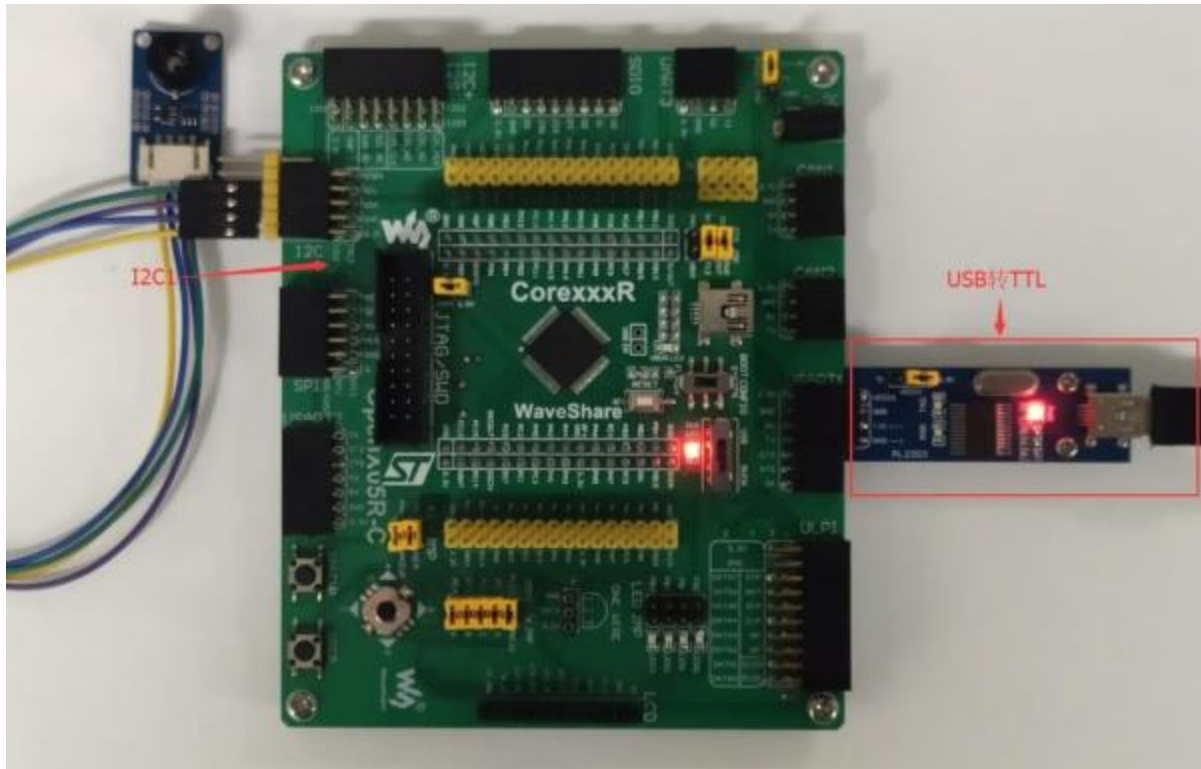
Add the line below to the config.txt file, reboot and check it again

```
dtparam=i2c1_baudrate=1000000
```

STM32

- 1. When using the sensor, please pay attention to avoid directly contact with the onboard IC devices by your hands, Pay attention to prevent static electricity and check the power supply to prevent reverse connection before powering on.**
- 2. When the sensor is working, please avoid excessive vibration and do not plug or unplug cables. Since the core device MLX90641 has EEPROM, which will easily damaged by vibration and hot plug.**

Hardware connection



STM32	MLX90641 Thermal Camera
5V	5V
GND	GND
SDA(PB11)	SDA
SCL(PB10)	SCL

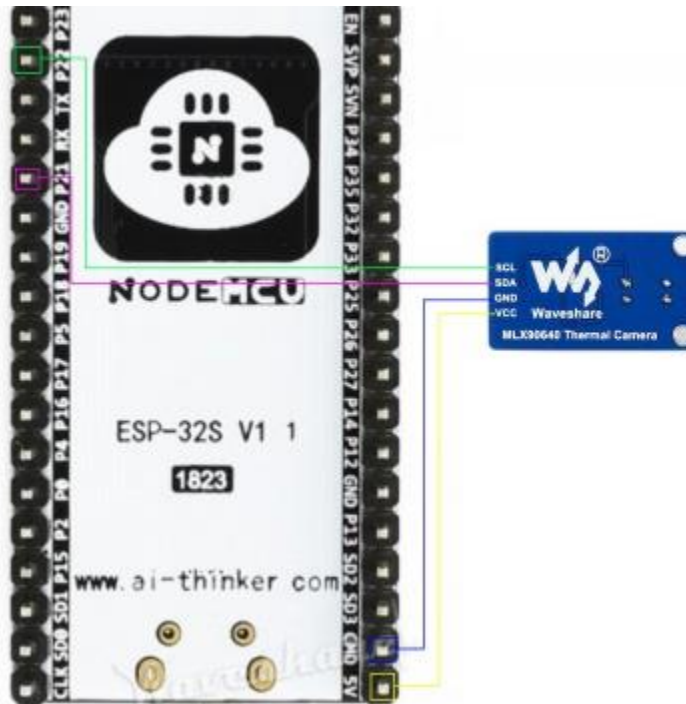
ESP32

1. When using the sensor, please pay attention to avoid directly contact with the onboard IC devices by your hands, Pay attention to prevent static electricity and check the power supply to prevent reverse connection before powering on.

2. When the sensor is working, please avoid excessive vibration and do not plug or unplug cables. Since the core device

MLX90641 has EEPROM, which will easily damaged by vibration and hot plug.

Hardware connection



ESP32	MLX90641 Thermal Camera
5V	5V
GND	GND
SDA(P21)	SDA
SCL(P22)	SCL