Waveshare Thermal Camera MLX90640-D110 User Manual

MLX90640-D110 Thermal Camera

Contents

1 Instruction
2 Features
3 Specification
4 Interface
5 I2C
6 PIXEL POSITION
7 Address map
8 REM
9 EEPROM
10 Refresh rate
11 Reading patterns
12 Measure principle
13 Examples
14 Raspberry Pi
15 STM32
16 ESP32
17 Test result
18 FAQ
19 Documents / Resources
20 Related Posts

Instruction

This is a 32×24 pixel, 55° field of view, IR array thermal imaging camera, communicating via the I2C interface. It is compatible with 3.3V/5V operating voltage, supports host platforms such as Raspberry Pi/Arduino(ESP32)/STM32, etc.

Features

- Adopts MLX90640 far-infrared thermal sensor array, 32×24 pixels
- Communicating via I2C interface, configurable to fast mode (up to 1MHz data rate)
- Noise Equivalent Temperature Difference (NETD) 0.1K RMS @1Hz refresh rate
- Onboard voltage translator, compatible with 3.3V/5V operating voltage
- Comes with development resources and manual (examples for Raspberry Pi/Arduino(ESP32)/STM32)

Specification

Operating voltage: 3.3V/5V Operating current: 23mA Communication interface: I2C (address 0x33) Field of view (Horizontal×Vertical):

- MLX90640-D55 Thermal Camera: 55°×35° (narrow-angle FOV, suit for long-range measuring)
- MLX90640-D110 Thermal Camera: 110°×75° (wide angle FOV, suit for short-range measuring)
- Operating temperature: ˜ 4085
- Target temperature: ˜ 40300
- Resolution: ±1
- 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 uses the I2C interface that supports High-speed mode. The default I2C address is 0x33.

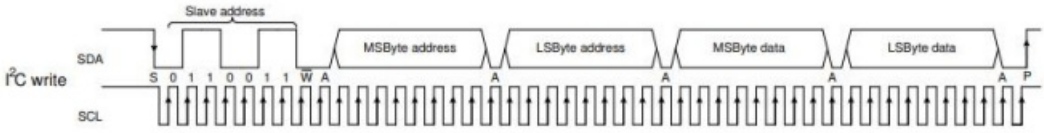


Figure 4 I^2C write command format (default SA=0x33 is used)

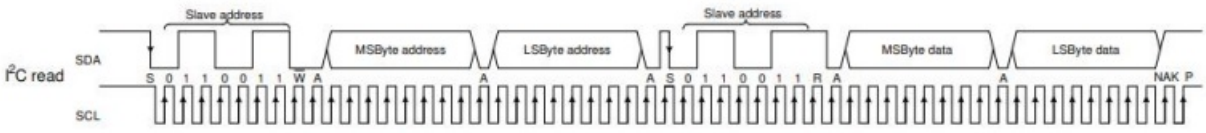
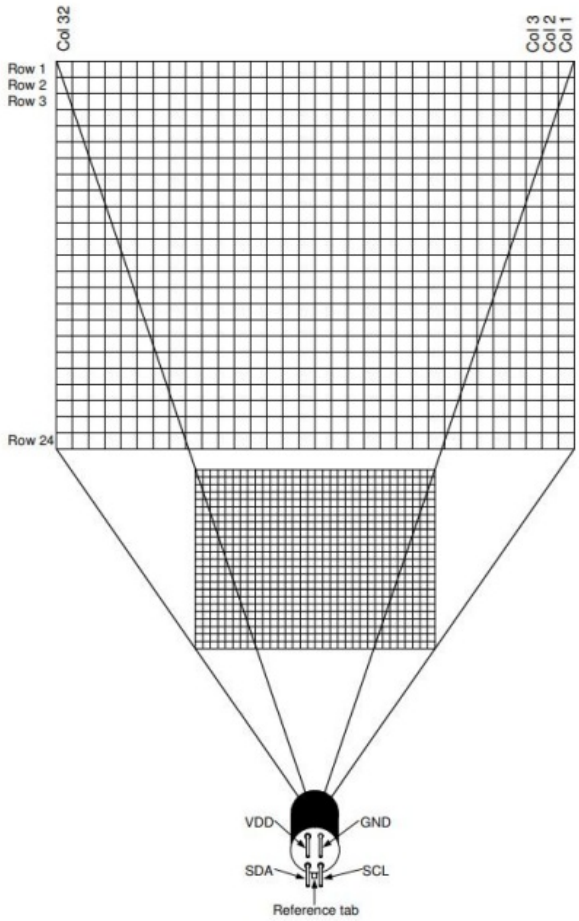


Figure 5 I^2C read command format (default SA=0x33 is used)

PIXEL POSITION

MLX90640 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

ox0000 Ox03FF	ROM
0x0400 Ox07FF	RAM
0x2400 Ox273F	EEPROM
Ox8000 Ox800C	Registers (MLX reserved)
Ox800D 0x8010	Registers
0x8011 0x8016	Registers (MLX reserved)

Figure 10 MXL90640 memory map

REM

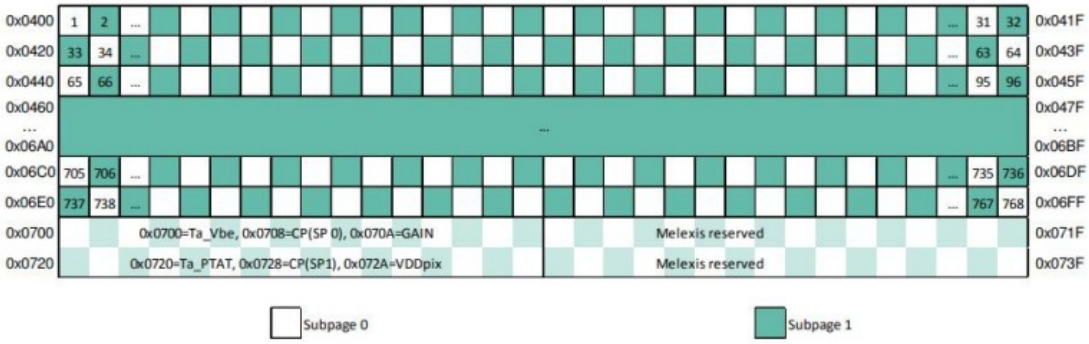


Figure 14 RAM memory map (Chess pattern mode) – factory default mode

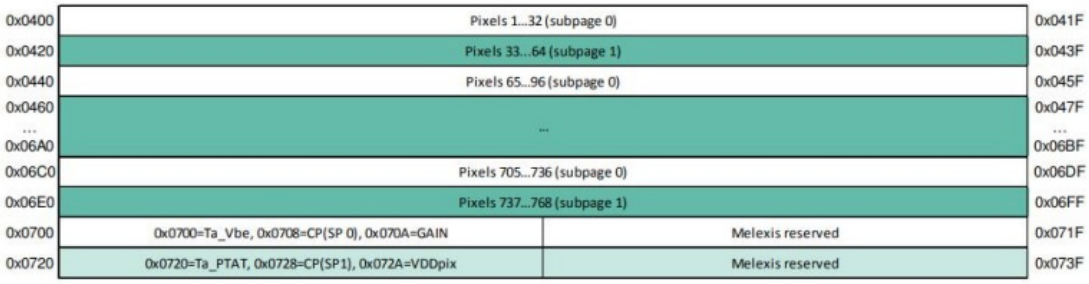


Figure 15 RAM memory map (Interleaved mode)

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 **102**
0x2409	Melexis	Device **1D3**
Ox240A	Melexis	Device Options
0x240B	Melexis	Melexis reserved
Ox240C	Customer	Control register_1
Ox240D	Customer	Control register _2
Ox240E	Customer	12CConf Reg
Ox240F	Customer	Melexis reserved / 12C 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	Control register 1 - 0x800D
Melexis reserved			Reading pattern	Resolution control		Refresh rate control			Select subpage			Enable subpages repeat	Enable data hold	Melexis reserved	Enable subpages mode	
															0	No subpages, only one page will be measured
															1	Subpade mode is activated (default)
														0		Keep this bit = "0" (default)
													0			Transfer the data into storage RAM at each measured frame (default)
													1			Transfer the data into storage RAM only if en_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)
-	-	-														Melexis 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)

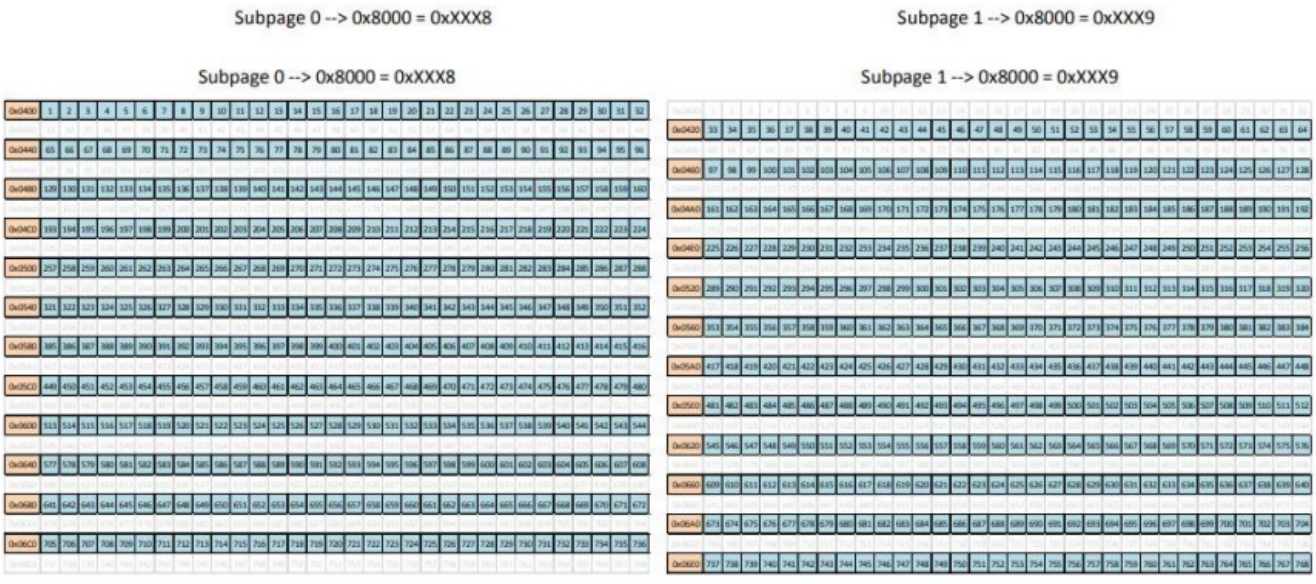


Figure 8 TV mode reading pattern (only highlighted cells are updated)

TV interleave mode

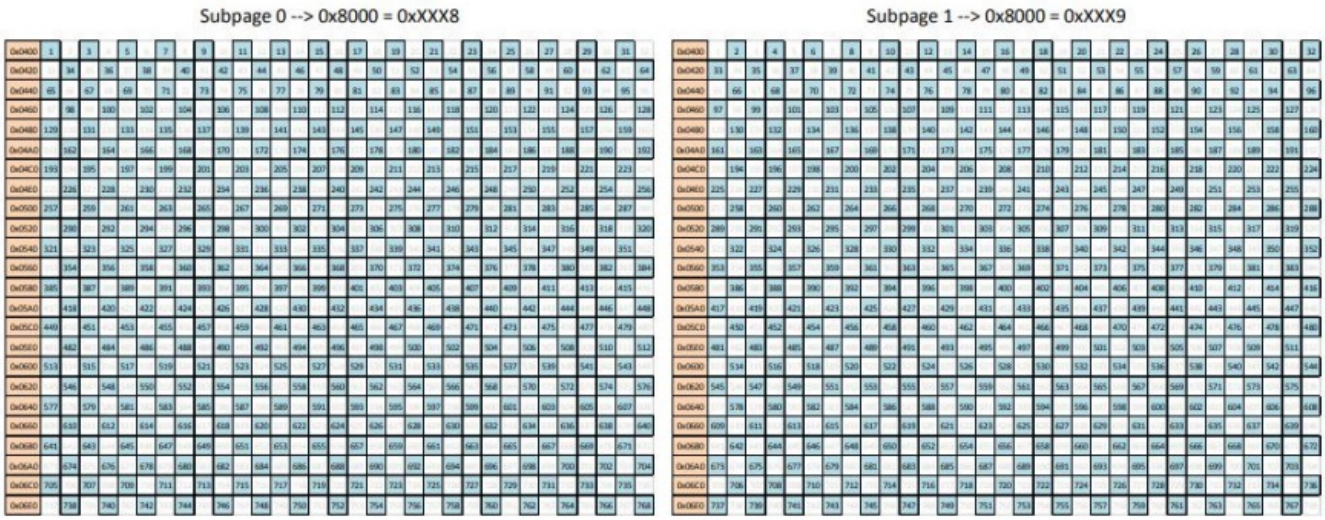


Figure 9 Chess reading pattern (only highlighted cells are updated)

The array frame is divided into two subpages and depends on bit 12 in “Control register 1” (0x800D). As a standard the MLX90640 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.

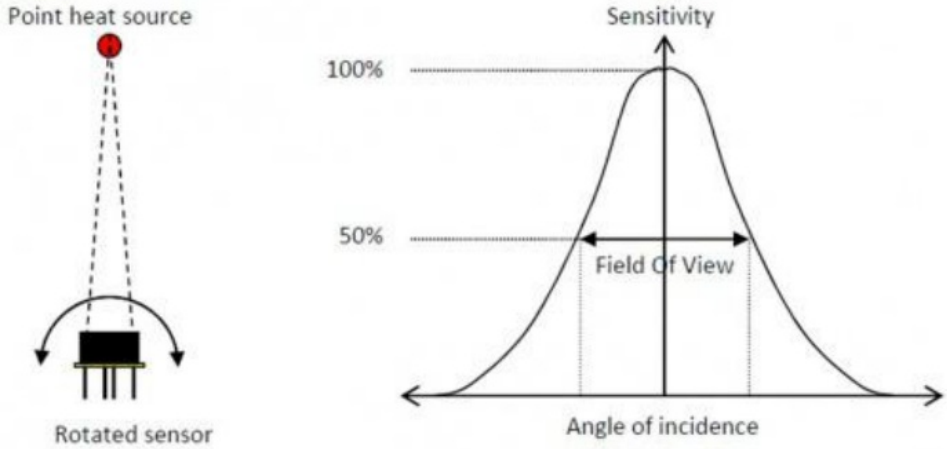


Figure 24: Field Of View measurement

Examples

Raspberry Pi

Hardware connection

Raspberry Pi	MLX90640 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 RaspberriPi/C++display shows/
tar -xvf MLX90640_Thermal_Camera_SDL2.tar.gz
cd MLX90640_Thermal_Camera_SDL2/
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
```

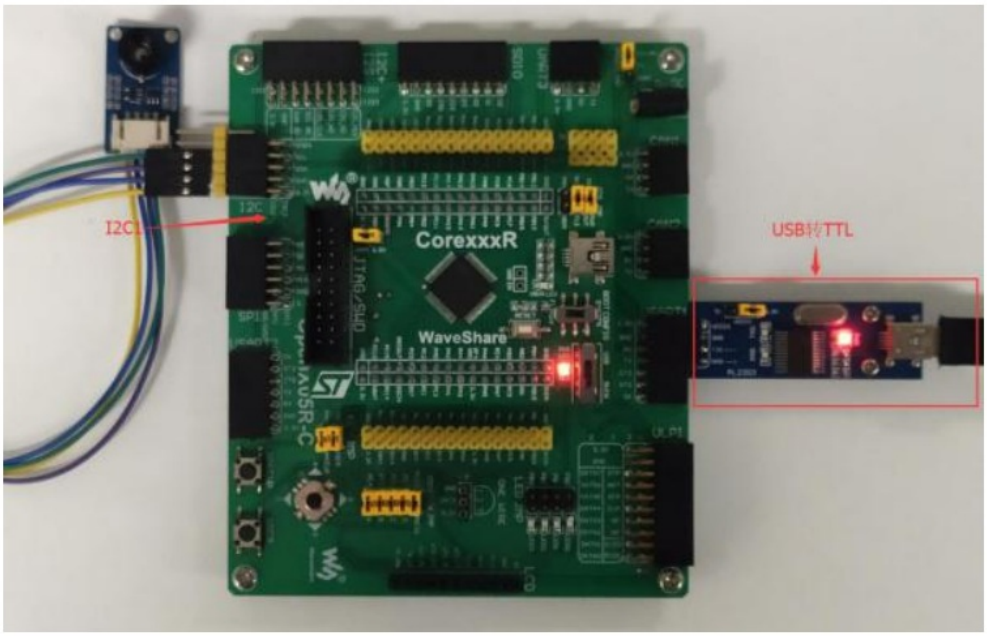
Add the line below to the config.txt file, reboot and check it again

```
dtparam=i2c1_baudrate=1000000
```

STM32

Hardware connection

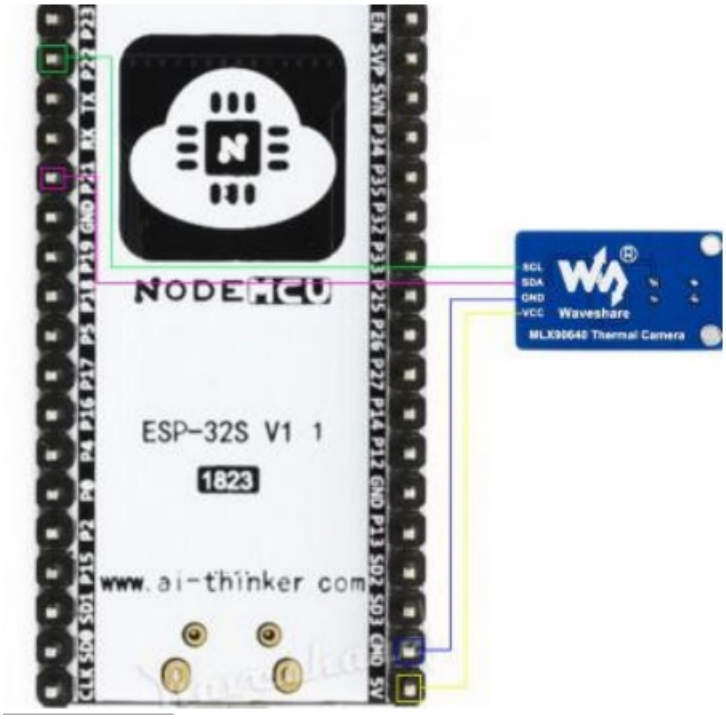
STM32 MLX90640 Thermal Camera



STM32	MLX90640 Thermal Camera
5V	**5V**
GND	**GND**
SDA(BCM2)	**SDA**
SCL(BCM3)	**SCL**

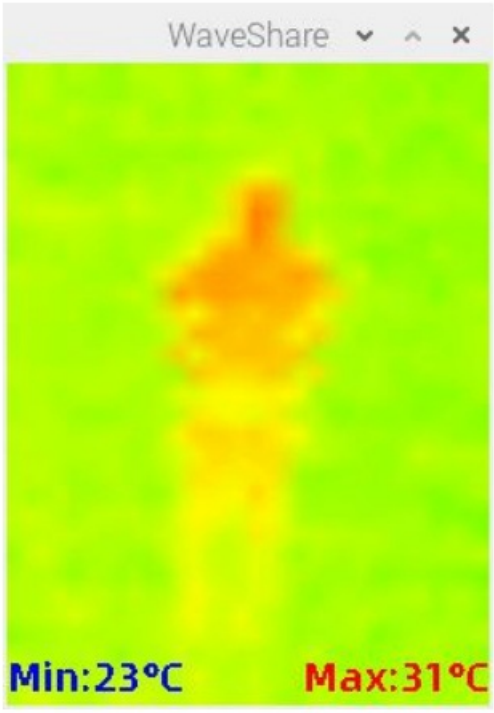
ESP32

Hardware connection



STM32	MLX90640 Thermal Camera
5V	**5V**
GND	**GND**
SDA(BCM2)	**SDA**
SCL(BCM3)	**SCL**

Test result



FAQ

Question: What is the measurement distance of the MLX90640-D110, and what is the max frame rate?

[Collapse] Answer:
A tester is 178cm tall, stands 1M far, shakes his hand backward. The focus disappears when the tester is farther than 9M. When the test away to 2M far, the camera loses the body contour. The Camera supports a Maximum 64Hz.

Documents / Resources

	Waveshare Thermal Camera MLX90640-D110 [pdf] User Manual Waveshare, Thermal Camera, MLX90640