



OV7251 MIPI Camera Module

0.31MP Monochrome Global Shutter Camera

Module Datasheet

Rev 1.0, March 2019

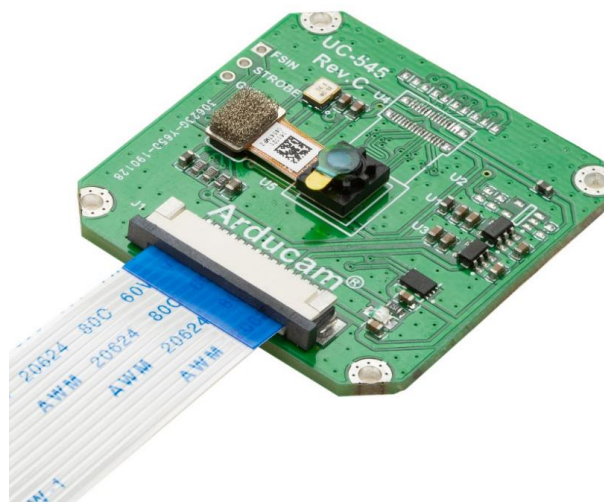


Table of Contents

1	Introduction	2
2	Key Specifications	3
3	Block Diagram	3
4	Application	4
5	Pin Definition	4
6	Mechanical Dimension	5
7	Installation for RPi	6
7.1	Hardware	6
7.2	Camera Driver	6
7.2.1	Important Note	6
7.2.2	Auto-Install	6
7.2.3	Manual Install	7
7.3	VLC Player Demo	8
7.3.1	Download the VLC player	8
7.3.2	Run the VLC player	8
7.3.3	V4L2 Control Functions	9

1 Introduction

The Arducam monochrome (B&W) global shutter VGA resolution OV7251 MIPI camera module is mainly designed for Raspberry Pi boards, and it can be connected directly to RPi's CSI-2 camera interface without additional hardware. This camera is based on a 1/7.5-inch Omnivision OV7251 image sensor which adopts OmniPixel3-GS technology to provide full-frame, sub-sampled, and windowed 8/10-bit MIPI images, and capable of operating at up to 100fps in VGA resolution with complete user control over image quality. The global shutter technology allows to reduce or eliminate unwanted image artifacts, which occur with traditional rolling shutter image sensors as a result of motion during image capture. The sensor's global shutter and excellent low-light sensitivity allow it to be used for any application that needs gesture detection, head and eye tracking, and depth and motion detection.

Leveraging the industry's smallest global shutter pixel, the black and white OV7251 is capable of capturing VGA (640x480) resolution video at 100 frames per second (fps), QVGA (320x240) at 180 fps with binning, and QQVGA (160x120) at 360 fps with binning and skipping. The OV7251's high frame rates make it an ideal solution for low-latency machine vision applications.

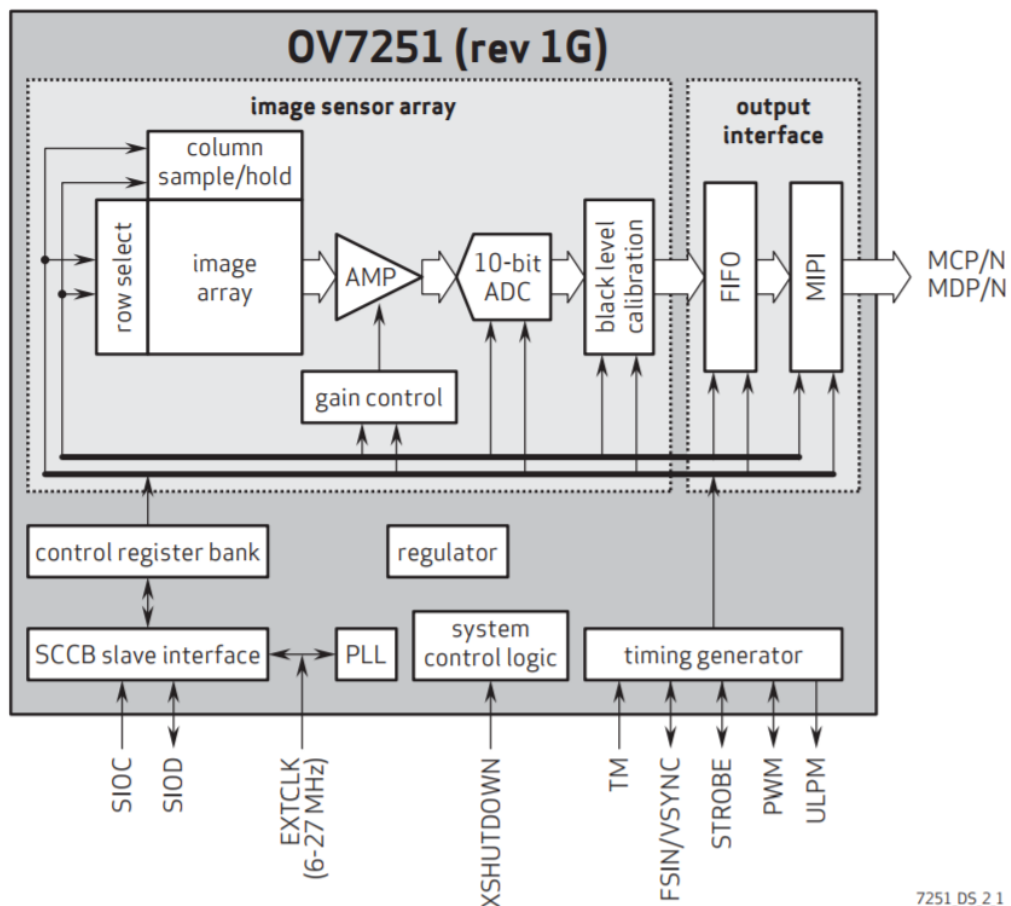
For Raspberry Pi platform, Arducam developed a proprietary camera driver which is V4L2 compliant and provides friendly compatibility to off-the-shelf video capture/playback software like VLC player or OpenCV image processing tools. The driver also provides V4L2-ctrl functions like manual exposure/gain, mirror/flip controls, and even the low-level sensor register access controls. Please note that this camera and RPI driver doesn't support ISP functions like AEC/AGC etc., and does not support hardware JPEG/H.264 encoding. It is useful for advanced users who need high frame rates and unprocessed RAW video for machine vision and is capable of doing image processing using OpenCV.

This MIPI camera module can be used on other ARM, FPGA, DSP, or Nvidia TX1/TX2 hardware platform as well.

2 Key Specifications

Parameter	Typical Value
Sensor	Monochrome global shutter OV7251
Pixel Size	3 μm x 3 μm
Active array size	640*480
Optical Size	1/7.5 inch
EFL	1.3
F.NO	2.2
FOV	D86.5° /H72.9° /V57.7°
Build-in IR cut filter	650nm
Focusing Range	65mm ~ infinite
Output interface	1-lane MIPI serial output
Output formats	8/10-bit BW RAW
Maximum image transfer rate	640 x 480: 100 fps
Board Size	40mm x 40mm

3 Block Diagram



7251_DS_2_1

4 Application

- Cellular phones
- Toys
- Tablets
- Machine vision
- ARM/FPGA/DSP based platforms

5 Pin Definition

The OV7251 module uses the standard Raspberry Pi camera pinout. The pin number is listed below.



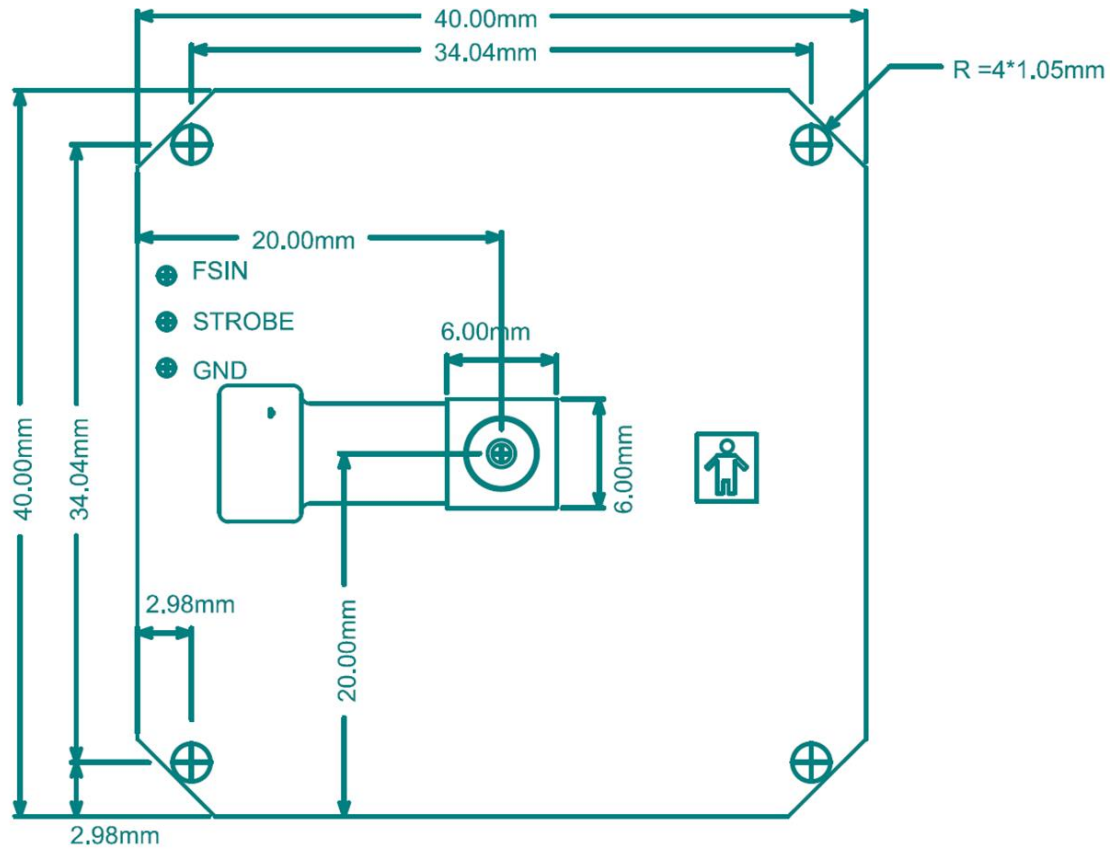
Table 1 J1 Connector Pin Definition

Pin No.	PIN NAME	TYPE	DESCRIPTION
1	DGND	Ground	Power ground
2	MDN0	Output	Pixel Data Lane0 Negative
3	MDP0	Output	Pixel Data Lane0 Positive
4	DGND	Ground	Power ground
5	MDN1	Output	Pixel Data Lane1 Negative
6	MDP1	Output	Pixel Data Lane1Positive
7	DGND	Ground	Power ground
8	MCN	Output	Pixel Clock Output Form Sensor Negative
9	MCP	Output	Pixel Clock Output Form Sensor Positive
10	DGND	Ground	Power ground
11	POWER-EN	Output	Power Enable
12	LED-EN	I/O	Led Enable
13	SCL	Input	SCCB serial interface clock input
14	SDA	I/O	SCCB serial interface data I/O
15	VCC	Power	3.3V Power supply

Table 1 J2 Connector Pin Definition

Pin No.	PIN NAME	TYPE	DESCRIPTION
1	FSIN	Input	Frame Sync Input
2	STROBE	Output	LED Strobe Output
3	GND	Ground	Ground

6 Mechanical Dimension

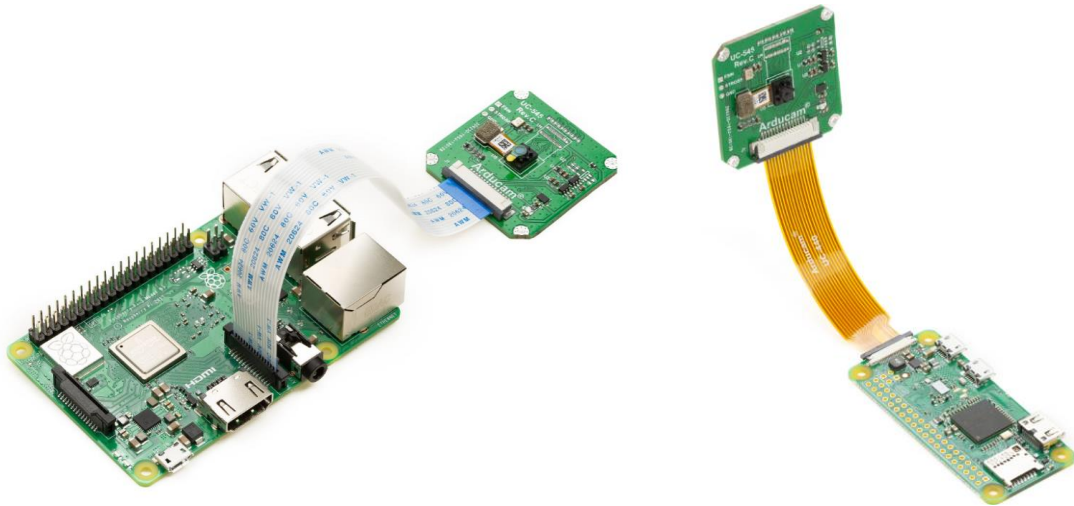


7 Installation for RPi

7.1 Hardware

For RPi 1B/2B/3B/3B+ boards, please connect 15pin to 15pin FPC cable on each side.

For RPi Zero or RPi compute module, please connect the FPC cable 22pin side to RPi and 15pin side to the camera board.



7.2 Camera Driver

7.2.1 Important Note

The camera driver should match your current Raspbian OS kernel version.

For Raspberry Pi A/A+, B/B+, Pi Zero/W, Compute module V1, you need pi1 suffix version driver, for Raspberry pi 2B/3B/3B+, Compute module V3, you need pi3 suffix version driver.

7.2.2 Auto-Install

Run the bash script `./preprocess.sh`, and choose yes to reboot. This step is only needed for once.

After the reboot, run the bash script `./loaddriver.sh` with the RPi board version parameter. This step should be done every time you reboot the Raspbian OS. For example:

```
./loaddriver.sh pi1
```

Or

```
./loaddriver.sh pi3
```

7.2.3 Manual Install

Manual install the driver is explained here if you want to investigate the details or fix the problem during the driver installation.

Add the following code to the last line of /boot/config.txt file

```
dtparam=i2c_vc=on
```

Save the file and probe the i2c driver using the command below:

```
sudo modprobe i2c-dev
```

Compile the device tree for the OV7251 camera

```
sudo dtc -I dts -O dtb -o /boot/overlays/arducam-ov7251.dtbo arducam-ov7251.dts
```

Add the following code to the last line of /boot/config.txt file, only one Arducam camera driver allowed here.

```
dtoverlay=arducam-ov7251
```

Save the /boot/config.txt then reboot. The above steps only need to be done for once.

Every time you reboot the board or run after raspivid/raspistill command, you have to run the following commands

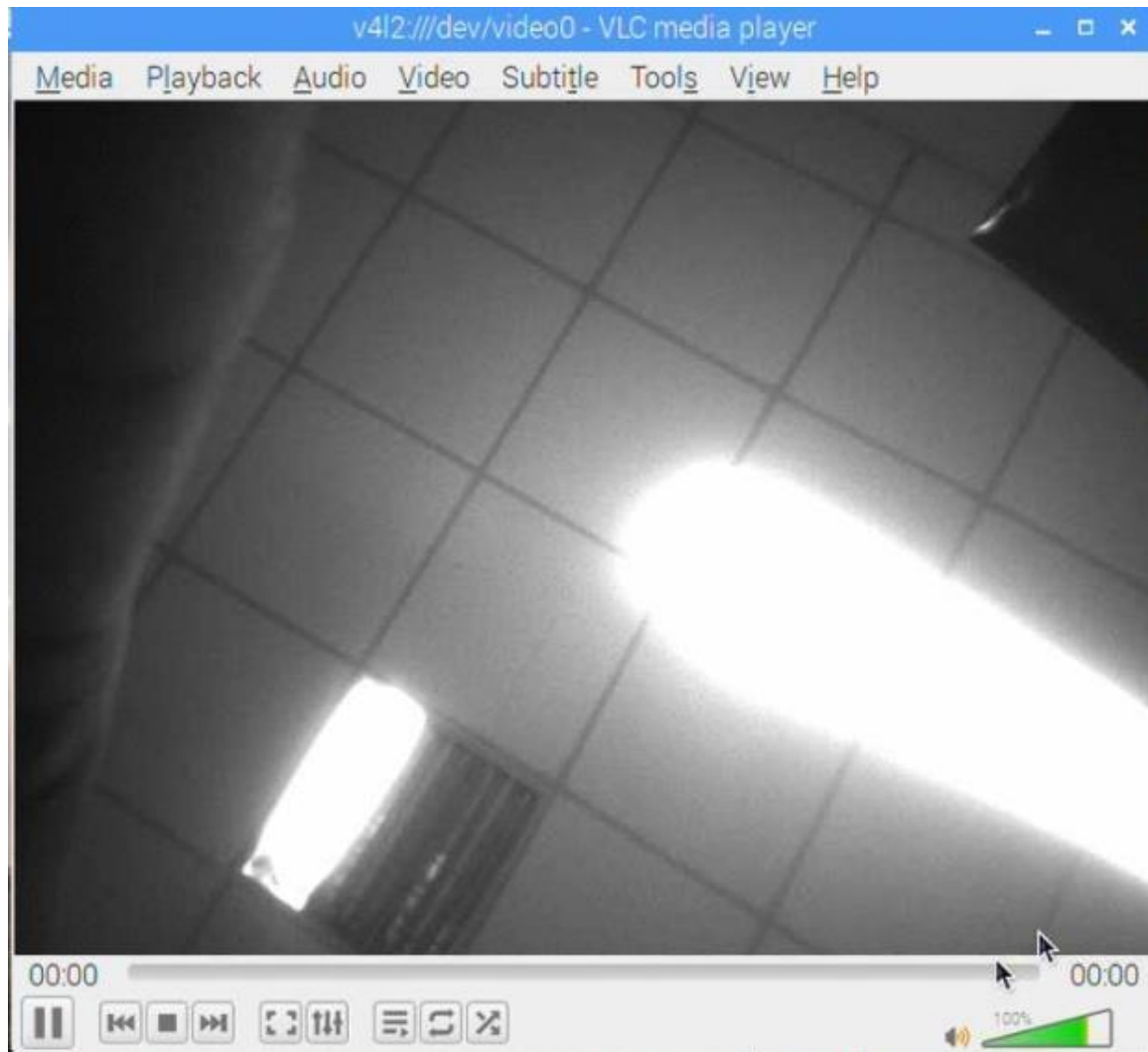
```
sudo chmod +x camera_i2c  
sudo chmod +x rpi3-gpiovirtbuf  
./camera_i2c
```

Install the kernel driver using the following command

```
./loaddepends.sh  
sudo insmod arducam-ov7251-v4l2-pi3.ko (or sudo insmod  
arducam-ov7251-v4l2-pi1.ko)
```

After this step, you should find a new video device like /dev/video0.

7.3 VLC Player Demo



7.3.1 Download the VLC player

You can download the vlc player (sudo apt-get install vlc) to open the camera for fast evaluation easily.

7.3.2 Run the VLC player

Run the VLC player by the following command

```
vlc v4l2:///dev/video0
```

7.3.3 V4L2 Control Functions

ArduCam OV7251 camera driver supports a list of V4L2 control functions, and you can check the supported functions using the following commands:

1. Check supported resolution

```
v4l2-ctl --list-formats-ext
```

2. Check the supported controls

```
v4l2-ctl -l
```

3. Manual Exposure Setting

```
v4l2-ctl -c exposure=0x50
```

4. Manual Gain Setting

```
v4l2-ctl -c gain=0x02
```

5. Mirror

```
v4l2-ctl -c horizontal_flip=1
```

6. Flip

```
v4l2-ctl -c vertical_fli=1
```

7. Sensor Register Access

First, you have to set the address of the register to be accessed, for example, 0x0202 in our case

```
v4l2-ctl -c register_addr=0x0202
```

Read the value from 0x0202 register

```
v4l2-ctl -C register_val
```

Write the value to 0x0202 register

```
v4l2-ctl -c register_val=0x01
```