



IMX296 Sensor Module User Manual



 www.inno-maker.com	CAM-IMX296Mono-GS CAM-IMX296Color-GS Raspberry PI Global Shutter Camera Support Hardware Trigger and Strobe With Sony IMX296 Mono/Color Sensor
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Date	Revision	Change Details
2025/9/8	V2.0	First Released
2025/10/30	V2.0.1	Add external trigger mode,add eeprom

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Document Purpose

This Document is for innomaker imx296 mono version camera module and imx296 color version camera module.

Product Name	Sensor Name	Sensor Description
CAM-IMX296Mono-GS (Old Name: CAM-IMX296RAW)	IMX296LLR	Mono Sensor Sony Official Description
CAM-IMX296Color-GS	IMX296LQR	Color Sensor Sony Official Description

Normally We will update our development Mannual here
<https://github.com/INNO-MAKER/cam-imx296raw-trigger>
<https://www.inno-maker.com/product/cam-mipi296raw-trigger/>

1 Module Overview

InnoMaker IMX296 Sensor Module is a Global Shutter Camera with IMX296LLR-C CMOS Sensor Module for raspberry pi, compatible with raspberry pi build in driver. It supports up to 60fps at 1456×1088 Pixels operate with shorter exposure times down to 30μs, given enough light than a rolling shutter camera, which makes it useful for high-speed photography.

1.1 Module Features

- Support up to 60fps@1456×1088, totally Compatible with raspberry pi GS camera;
- Support M12 Len/ CS Len, comes with 1xM12 Wide angle lens/Cs Lens Seat.
- Support output format YUV with Resolution 1456*1088 up to 60fps.
- Support Hardware External Trigger.
- Support Strobe Function.


1.2 Sensor Overview:

This chip operates with analog 3.3V, digital 1.2V, and interface 1.8V triple power supply:

- **low power consumption.**

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Website: www.inno-maker.com
Github: <https://github.com/INNO-MAKER>

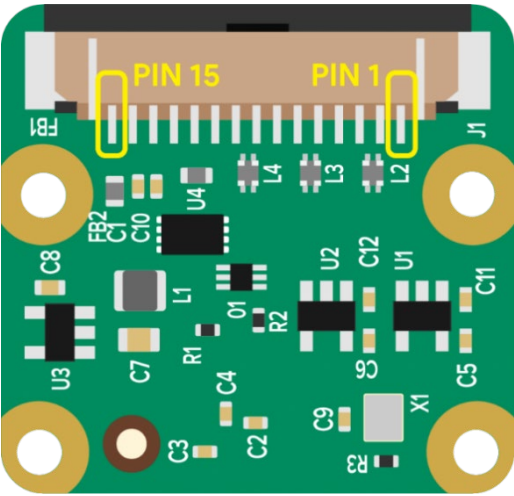
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- High sensitivity, low dark current and low PLS characteristics are achieved.
(Applications: Sensing)

IMX296LLR / IMX296LQR-C	
FPS (Sensors):	60.3 fps
Pixel Size (Sensors):	3.4μm x 3.4μm
Resolution (Sensors):	1.58M
Scan/Series:	Pregius
Shutter (Sensors):	Global Shutter
Signal (Sensors):	IMX296LLR Mono IMX296LQR Color
Sensor Size	1/2.9 Diagonal 6.3 mm

2 Hardware Description

2.1 Pins Out Table(J1)

		
Pin #	Name	Description
1	GND	Ground

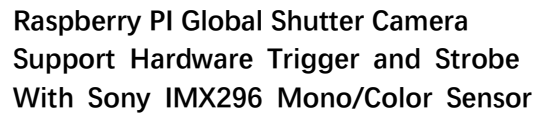


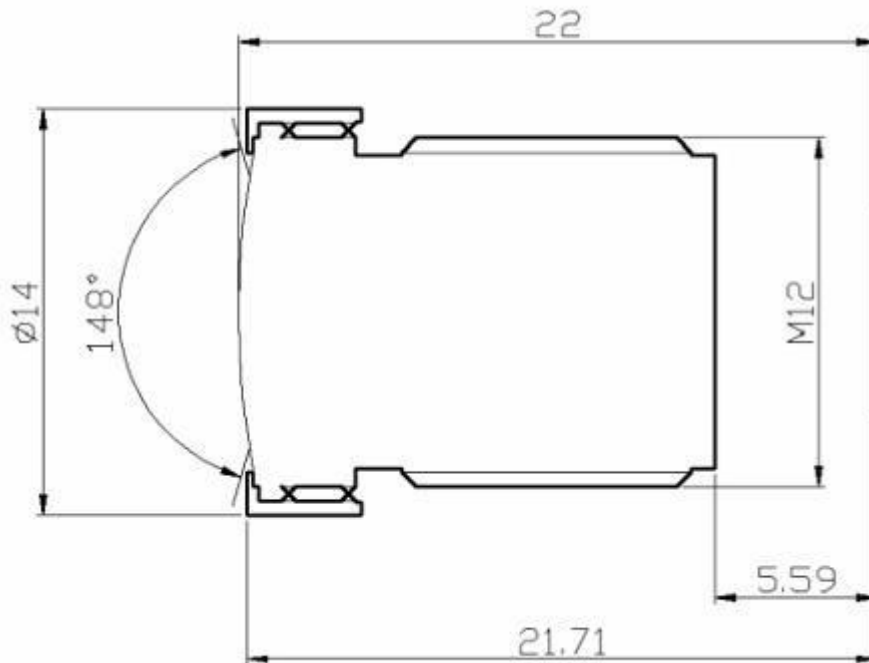
CAM-IMX296Mono-GS

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Raspberry PI Global Shutter Camera
Support Hardware Trigger and Strobe
With Sony IMX296 Mono/Color Sensor

2	CAM_D0_N	MIPI Data Lane 0 Negative
3	CAM_D0_P	MIPI Data Lane 0 Positive
4	GND	Ground
5	CAM_D1_N	MIPI Data Lane 1 Negative
6	CAM_D1_P	MIPI Data Lane 1 Positive
7	GND	Ground
8	CAM_CK_N	MIPI Clock Lane Negative
9	CAM_CK_P	MIPI Clock Lane Positive
10	GND	Ground
11	CAM_IO0	Power Enable
12	CAM_IO1	LED Indicator
13	CAM_SCL	I2C SCL
14	CAM_SDA	I2C SDA
15	CAM_3V3	3.3V Power Input





- Interface: M12
- Field of view Fov(D) = wide angle
- Focal Length 2.8 mm
- Focal Distance Adjustable
- TV DISTORTION <-17%
- F(N) /Aperture 2.2
- IR-Filter
 - Yes for Color Version
 - No for Mono Version

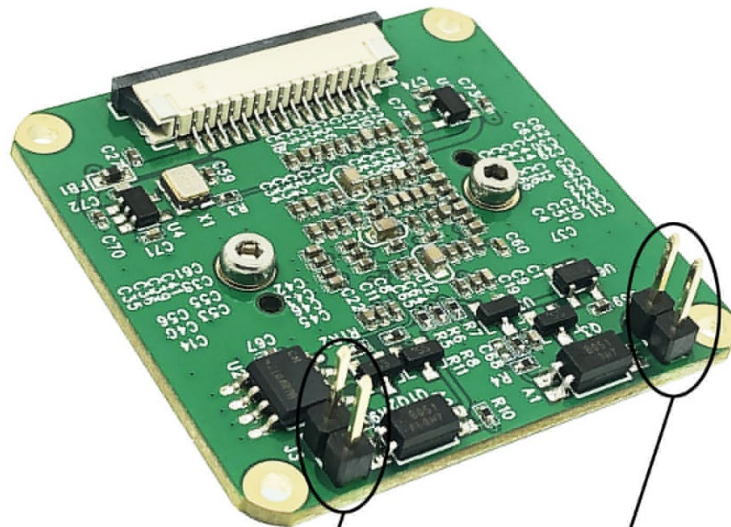
M12 LEN Seat



CS Len Seat



2.4 Flash Strobe Pins(J2)



External Trigger


Isolated Trigger and Strobe signal,
Trigger the capture in the falling
edge of external trigger signal

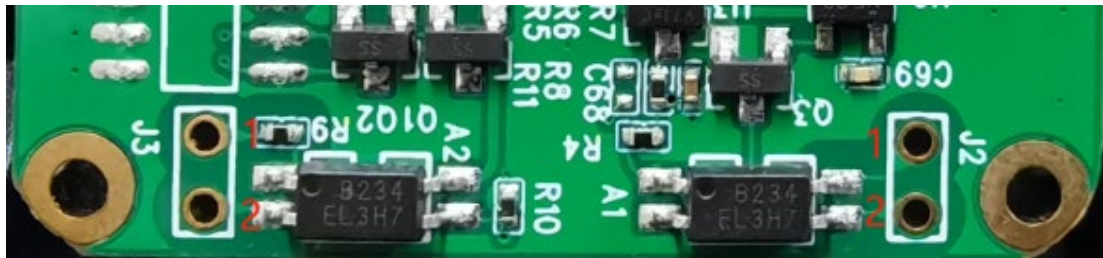
Flash Strobe

Only support stream mode.



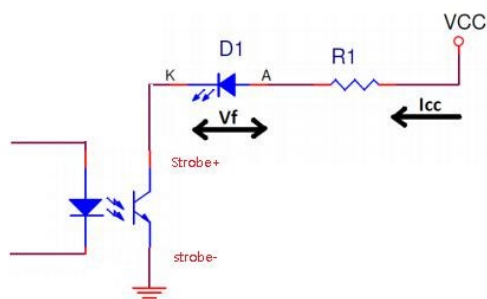
ISO FLASH

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J2 PIN	Symbol
1	STROB+
2	STROB-

2.4.1 Reference Circuit



On-board TLP281 optocoupler isolation, Notice the max collector current is 50mA.

Output Specifications

S. No	Parameter	Test Condition	Value			Unit
			Min	Typ	Max	
1	Driver Voltage (VCC)			12	24	V
2	Drive current (Icc)			10	50	mA
3	Collector Emitter Breakdown Voltage				80	V
4	Collector Emitter Saturation Voltage	Icc = 1 mA		0.1	0.2	V
5	Power Dissipation				150	mW

Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	$I_F = 10mA, I_C = 1mA$		0.1	0.2	V
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So, if the current required to drive the Flash LED is no more than 50mA

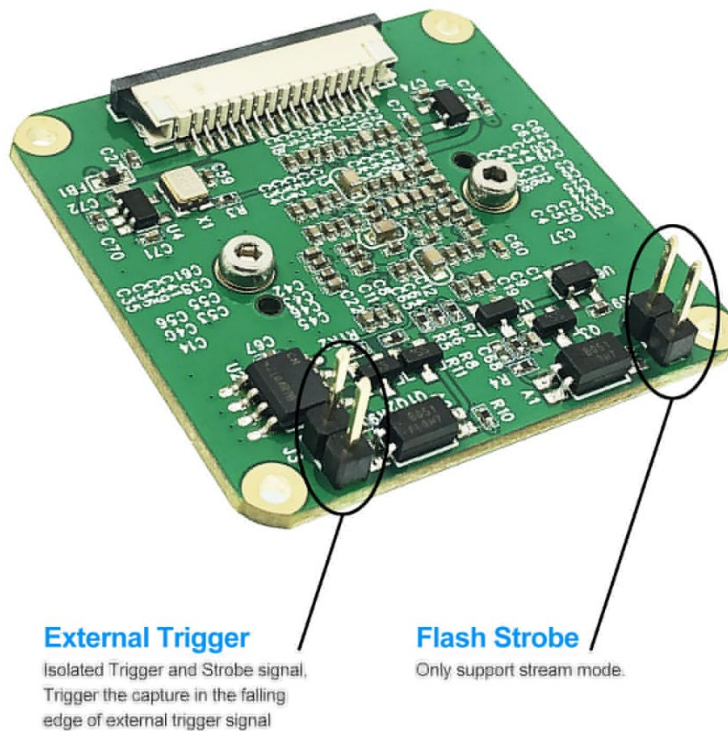
The value of series resistor: $R1 = (VCC - V_f - V_{CE}) / I_f$

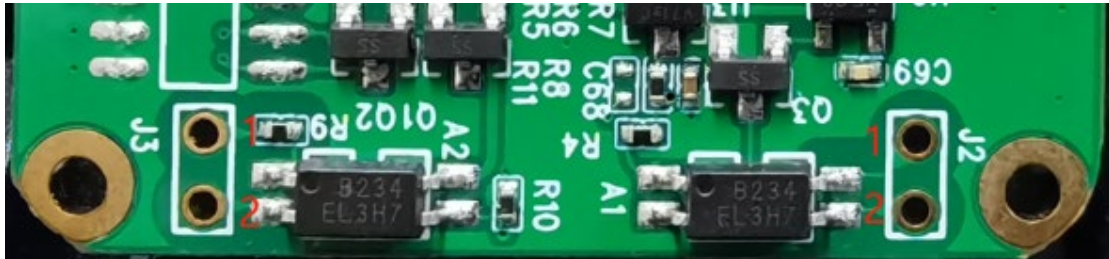
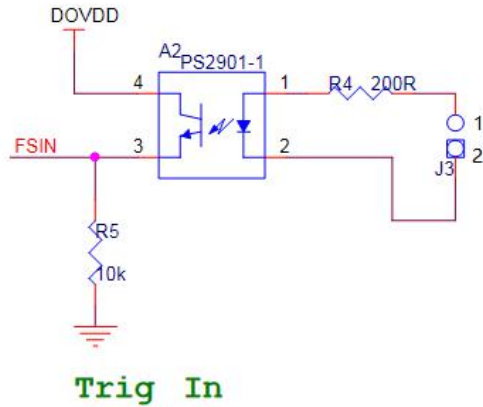
- VCC: system Voltage
- V_f : Forward voltage of Flash LED for current I_{cc}
- V_{CE} : Collection Emitter voltage, typical:0.1V

If the current required to drive the flash exceeds 50mA,

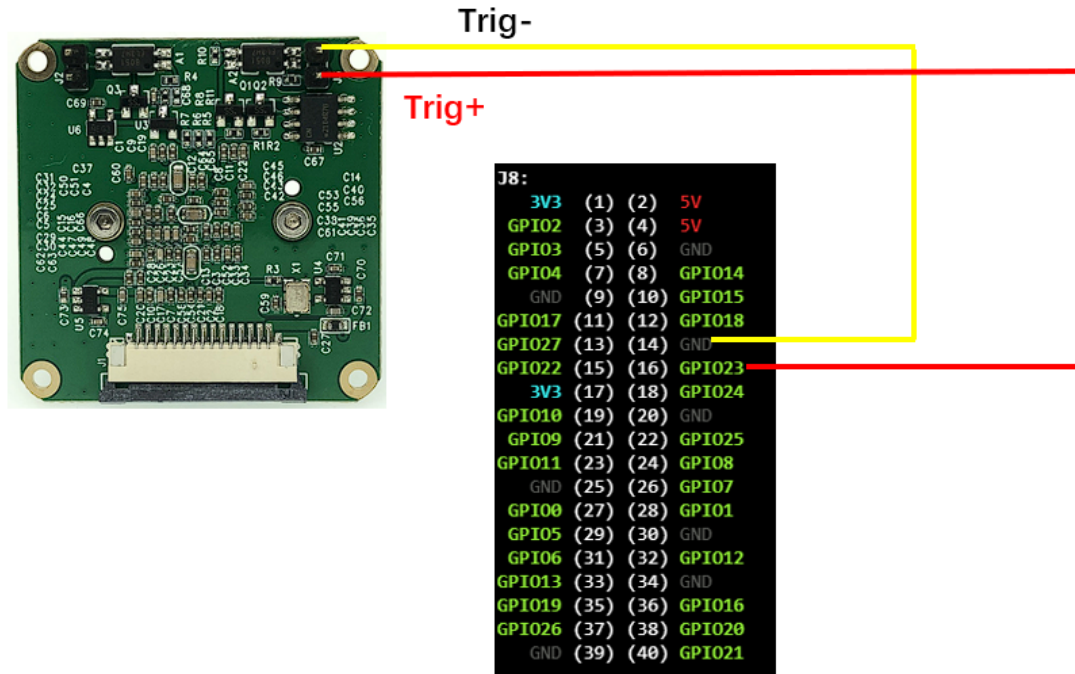
- then it is required to drive it with the help of LED driver circuit, and LED driver circuit can be controlled by using the strobe output pin.

2.5 External TRIG Pins(J3)

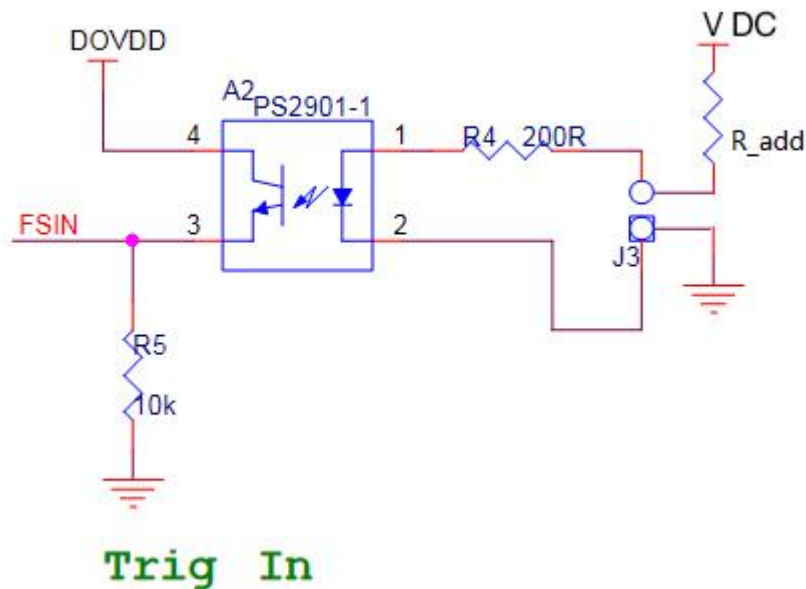




J3 PIN	Symbol	Description
1	TRIG+	3.3V-5.0V External Trigger Input
2	TRIG-	External GND



2.5.1 Reference Circuit



For example, VCC = 12V, Vf = 1.25V

The calculations done here are based on 12VDC. Please do follow these calculations for other voltages like 24VDC.

Let's take the current through IR LED $I_f = 20\text{mA}$.

Voltage drop across the IR LED = 1.25V

The value of Resistor $R_1 = (V_{cc} - V_f) / I_f = (12 - 1.25) / 0.02 = 537.5 \Omega$

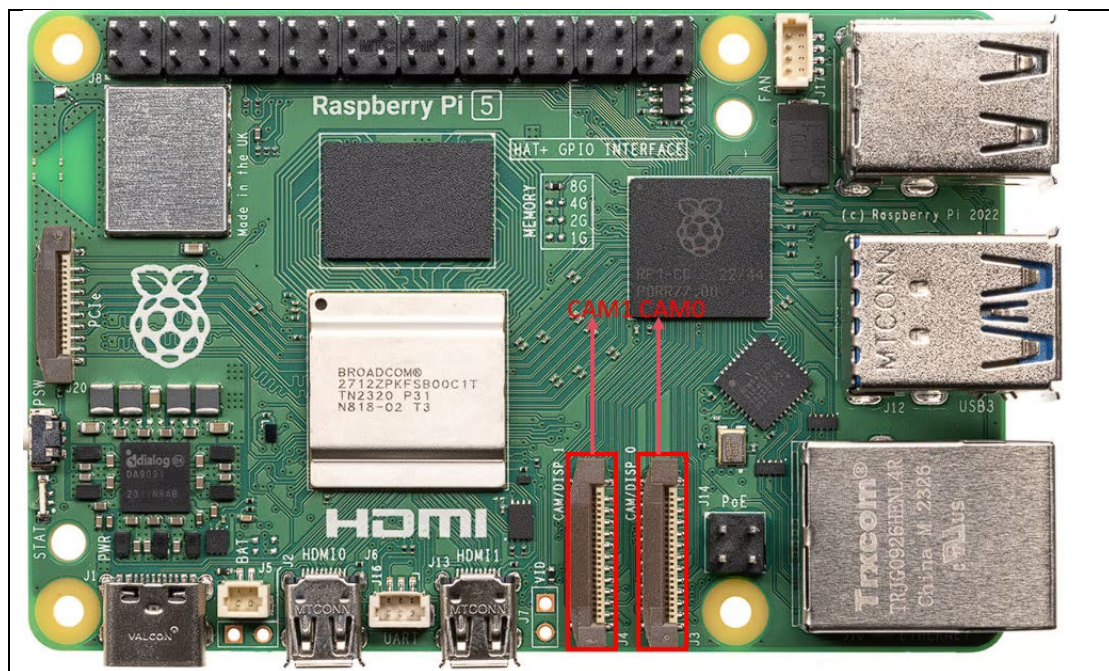
Wattage of resistor $R_1 > I_f^2 * R_1 = 0.02^2 * 537.5 = 0.215\text{W}$

Wattage of the resistor R_1 selected should be greater than 0.215W.

And there is a resistor on board ($R_4 = 200\Omega$), So the $R_{\text{add}} = R_1 - R_4 = 537.5 - 200 = 337.5\Omega$

3 Quick Start Guide

Connection



3.1 Modify config.txt

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

older os it should be `sudo nano /boot/ config.txt`


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3.2 Add dtoverlay

For CAM1 Interface

```
dtoverlay=imx296, cam1
```

For CAM0 Interface

```
dtoverlay=imx296, cam0
```

Change `camera_auto_detect=1` to `camera_auto_detect=0`

Save file and reboot.

3.2 Preview

Reboot and check camera Status

```
$ls /dev/video*
```

```
pi@raspberrypi:~ $ ls /dev/video*
/dev/video0 /dev/video11 /dev/video13 /dev/video14
/dev/video10 /dev/video12 /dev/video14 /dev/video15
pi@raspberrypi:~ $
```

```
$libcamera-vid --width 1456 --height 1088 -t 0
```

3.3 libcamera-apps

More about libcamera and libcamera-apps Please

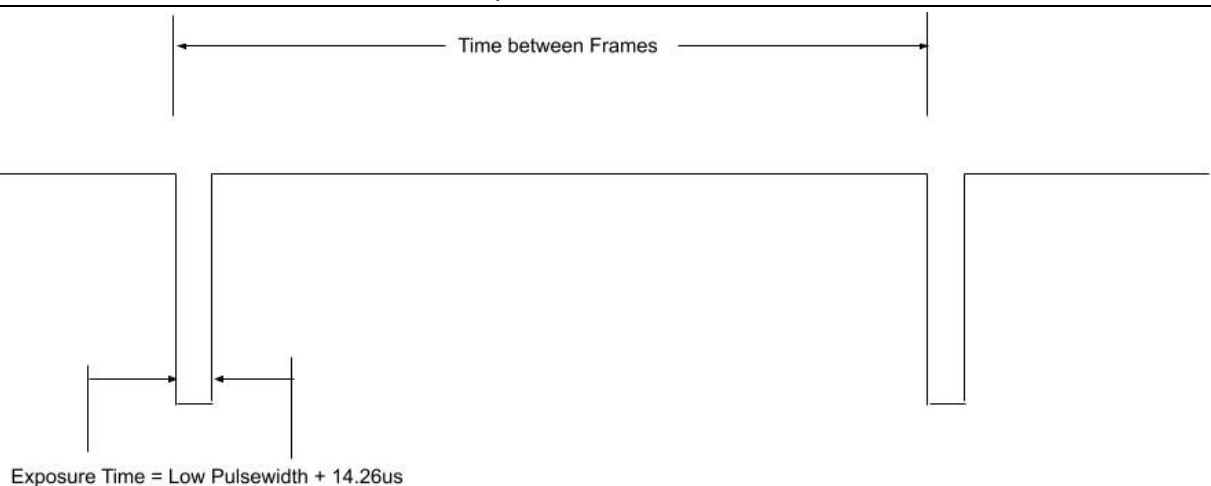
Refer:

https://www.raspberrypi.com/documentation/computers/camera_software.html#libcamera-and-libcamera-apps

4 External Trigger Mode

4.1 Description

- The Global Shutter (GS) camera can be triggered externally by pulsing the external trigger (denoted on the board as XTR (Trig+) ,GND(Trig-)) connection on the board. Multiple cameras can be connected to the same pulse, allowing for an alternative way to synchronize two cameras.
- The exposure time is equal to the low pulse-width time plus an additional 14.26us. i.e. a low pulse of 10000us leads to an exposure time of 10014.26us. Framerate is directly controlled by how often you pulse the pin. A PWM frequency of 30Hz will lead to a framerate of 30 frames per second.



External Trigger Function



CAM-IMX296Mono-GS

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Raspberry PI Global Shutter Camera

Support Hardware Trigger and Strobe

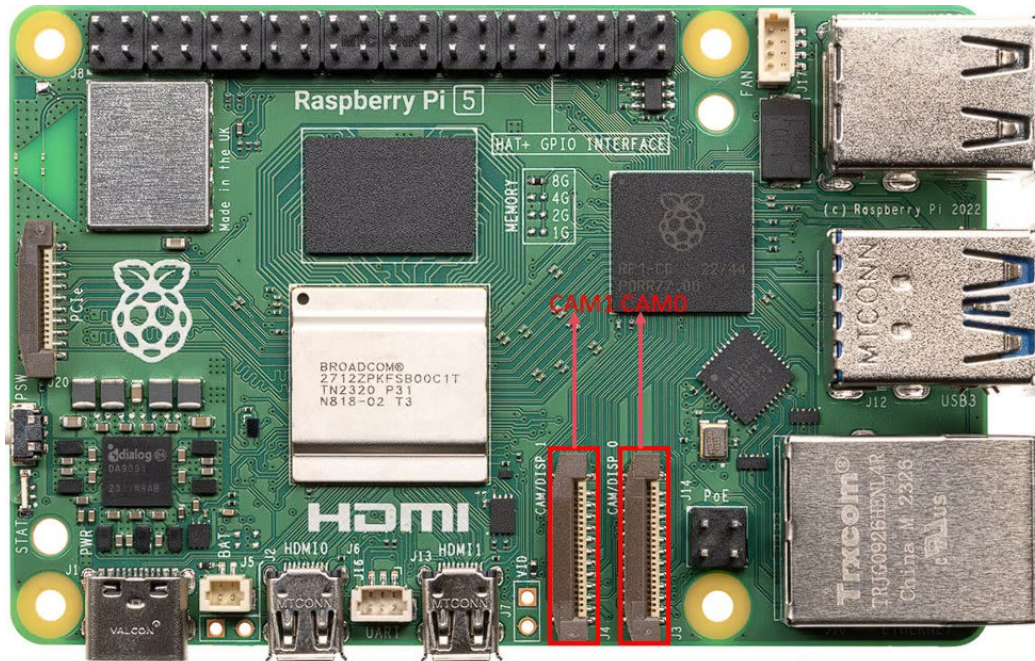
With Sony IMX296 Mono/Color Sensor

PULSE2_EN_NOR	79h (3079h)	[0]	0	Pulse2 enable in normal mode 0: disable 1: enable
PULSE2_EN_TRIG		[1]	0	Pulse2 enable in trigger mode 0: disable 1: enable
PULSE2_POL		[2]	0	Pulse2 polarity selection 0: High active 1: Low active
		[3]	0	Fixed to 1
PULSE2_UP [19:0]	7Ch (307Ch)	[7:0]	00000h	Pulse2 active period start timing setting Designated in line units from reference point
	7Dh (307Dh)	[7:0]		
	7Eh (307Eh)	[3:0]		
PULSE2_DN [19:0]	80h (3080h)	[7:0]	00000h	Pulse2 active period end timing setting Designated in line units from reference point
	81h (3081h)	[7:0]		
	82h (3082h)	[3:0]		

4.2 Download source from our GitHub

We use raspberry pi5 as example, showing dual Camera in free working:

```
sudo git clone https://github.com/INNO-MAKER/cam-imx296raw-trigger.git
cd cam-imx296raw-trigger
sudo chmod -R a+rw * *
```



4.3 Setting config.txt

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

Add below content to last line follow [all]

```
dtoverlay=imx296,always-on,cam0  
dtoverlay=imx296,always-on,cam1
```

4.4 Timeout Setting

```
sudo cp /usr/share/libcamera/pipeline/rpi/pisp/example.yaml timeout.yaml
```

Edit `timeout.yaml` by `sudo nano timeout.yaml`

delete the `#` (comment) from the `"camera_timeout_value_ms":` line, and change the number from 0 to `60000`,



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```
GNU nano 7.2                                timeout.yaml
# Override any request from the IPA to drop a number of startup
# frames.
#
# "disable_startup_frame_drops": false,

# Custom timeout value (in ms) for camera to use. This overrides
# the value computed by the pipeline handler based on frame
# durations.
#
# Set this value to 0 to use the pipeline handler computed
# timeout value.
#
"camera_timeout_value_ms": 60000,

# Disables temporal denoise functionality in the ISP pipeline.
# Disabling temporal denoise avoids allocating 2 additional
# Bayer framebuffers required for its operation.
#
# "disable_tdn": false,

# Disables multiframe HDR functionality in the ISP pipeline.
# Disabling multiframe HDR avoids allocating 2 additional Bayer
# framebuffers required for its operation.
#

^G Help      ^O Write Out  ^W Where Is   ^K Cut        ^T Execute    ^C Location
^X Exit      ^R Read File  ^N Replace    ^U Paste      ^J Justify    ^_ Go To Line
```

Then run below command

```
export LIBCAMERA_RPI_CONFIG_FILE=timeout.yaml
```

4.5 libcamera Tool


To make two cameras work in free running mode

for example:

```
libcamera-hello -t 0 --camera 0
libcamera-hello -t 0 --camera 1
```

4.6 Trigger Tool

This tool can enable imx296 trigger mode individually.

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```
./imx296_trigger [i2c bus] [on/off]
```

Note: on pi5

```
camera1 i2c bus =4
camera0 i2c bus =6
on=1 off=0
```

Example:

```
camera 1 trigger on:
./imx296_trigger 4 1

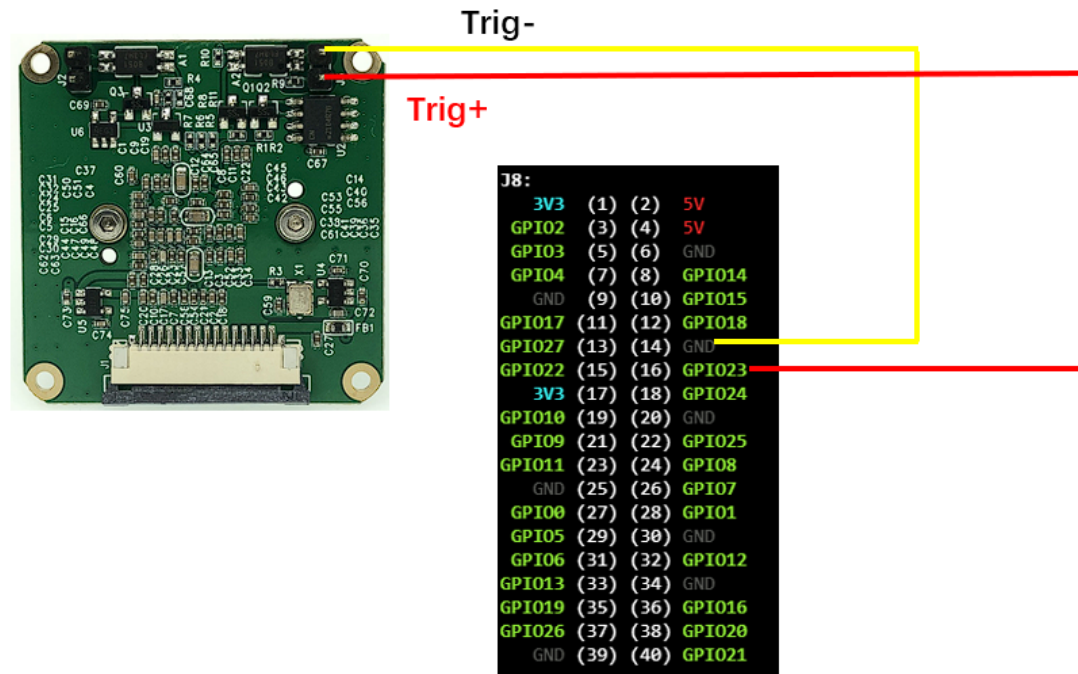
camera 1 trigger off:
./imx296_trigger 4 0

camera 0 trigger on:
./imx296_trigger 6 1

camera 0 trigger off:
./imx296_trigger 6 0
```

4.6 Trigger Pins Wire

Follow Chapter 2.5



4.7 Trigger Signal

We use Raspberry PI5 PIN23,GND GPIO as trigger signal and send signal by below script, Script code is as below, save it to .sh file.

```
while true;do
    gpioset gpiochip0 23=1
    sleep 1.9999
    gpioset gpiochip0 23=0
    sleep 0.0033
done
```

Open another terminal window to run the script

```
pi@raspberrypi:~/cam-imx296raw-trigger $ ./imx296.sh
```

5 On Board EEPROM

InnoMaker provide on board EEPROM, TYPE: FT24C08A(1KBYTE)



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Raspberry PI Global Shutter Camera

Support Hardware Trigger and Strobe

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5.1 Operation env:

Hardware type: rpi5 ARCH64 OS , I2c bus on CSI : 4

5.2: Detect EEPROM on i2c bus:

```
i2cdetect -y 4
```

```
pi@raspberrypi:~$ i2cdetect -y 4
   0  1  2  3  4  5  6  7  8  9  a  b  c  d  e  f
00:  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --
10:  --  --  --  --  --  --  --  --  --  --  UU  --  --  --  --  --
20:  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --
30:  --  --  --  --  --  --  --  37  --  --  --  --  --  --  --  --
40:  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --
50: 50 51 52 53  --  --  --  --  --  --  --  --  --  --  --  --
60:  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --
70:  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --
```

There should be 4 devices with address 0x50 0x51 0x52 0x53 detected.
Each device have 256 byte content.

5.3: Read EEPROM content

Take device address 0x51 sub address 0x00 as a example:

```
i2cget -y 4 0x51 0x00
```

```
pi@raspberrypi:~$ i2cget -y 4 0x51 0x00
0xff
```

5.4: Write EEPROM and read the content

```
i2cset -y 4 0x51 0x00 0xaa
i2cget -y 4 0x51 0x00
```




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```
pi@raspberrypi:~ $ i2cset -y 4 0x51 0x00 0xaa
pi@raspberrypi:~ $ i2cget -y 4 0x51 0x00
0xaa
```

6 Strobe Mode

6.1 I2c tools download

[i2c-tools-arch32.zip](#)

[i2c-tools-arch64.zip](#)

6.2 Description

IMX296 official driver that provide by RPI default kernel not enable strobe by default.

Imx296 can output strobe while work in normal or fast trigger mode, We can enable strobe by i2c tools.

- **Imx296 I2c address: 0x1a**
- **Pi5 csi1 i2c bus address : i2c-4**

Note: strobe setting must be done while camera stream is off.

Regs and setting values

0x3026: 0x0F

0X3029:0x21

0x306D: 0X02(trigger mode strobe enable) /0x01(normal mode strobe enable)

Strobe start point 3byte:

0x3070 :0x00

0x3071 :0x00

0x3072 :0x00

Strobe end point 3byte:

0x3074:0x2c

0x3075:0x01

0x3076:0x00

0x3079: 0X0A(trigger mode strobe enable) /0x09(normal mode strobe enable)



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Strobe start point 3byte:

0x307c :0x00

0x307d :0x00

0x307e :0x00

Strobe end point 3byte:

0x3080 :0x2c

0x3081 :0x01

0x3082 :0x00

I2c tools write register:

`./i2c_write 4 0x1a <reg addr> <reg val>`

I2c tools read register:

`./i2c_read 4 0x1a <reg addr> <num of regs to read>`

7 Official Software Manual

- https://www.raspberrypi.com/documentation/computers/camera_software
- <https://github.com/raspberrypi/documentation/tree/develop/documentation/asciidoc/accessories/camera>

8 Preset System IMAGE

This is preset system IMG for raspberry pi 5.

https://www.jianguoyun.com/p/DY_2JXYQpdSrBxj-nf4FIAA

(Password : o1drfz)