CAM-MIPI296RAW User Manual

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/

Date	Revision	Change Details
2023/04/04	V1.0	First Released
2023/05/30	V1.1	Chapter 4.2.1,Preview command change
2023/6/9	V1.2	Chapter3.3,3.4,3.5,3.6 Add python code

Chapter 1 Description

CAM-MIPI296RAW is a Global Shutter Camera with IMX296LLR-C CMOS Sensor Module support 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.

- ***Support Raspberry Pi OS Build In Drivers totally compatible raspberry pi official gs camera module with libcamera tools for all pi boards***
- ***Support Innomaker driver with isolated hardware External Trigger And isolated Strobe function, control by v4l2-ctl -I tools.(InnoMaker Driver did not support libcamera and only support specify system version)***

Module Features:

- Support up to 60fps at 1456×1088 Pixels,Compatible with rasberry pi GS camera;
- Comes with 1x M12 Len-seat and 1xCS Len-Seat, 1x M12 wide angle Len;
- Support Pi 4B/Pi 3B+/Pi 3B/Pi 3A+/CM4/CM3+/CM3 Directly with libcamera tools;
- Output format Y10 with Resolution 1456*1088 up to 60fps (InnoMaker Driver);
- Output format YUV with Resolution 1456*1088 up to 60fps;(Raspberry PI OS Driver);

Sensor Features:

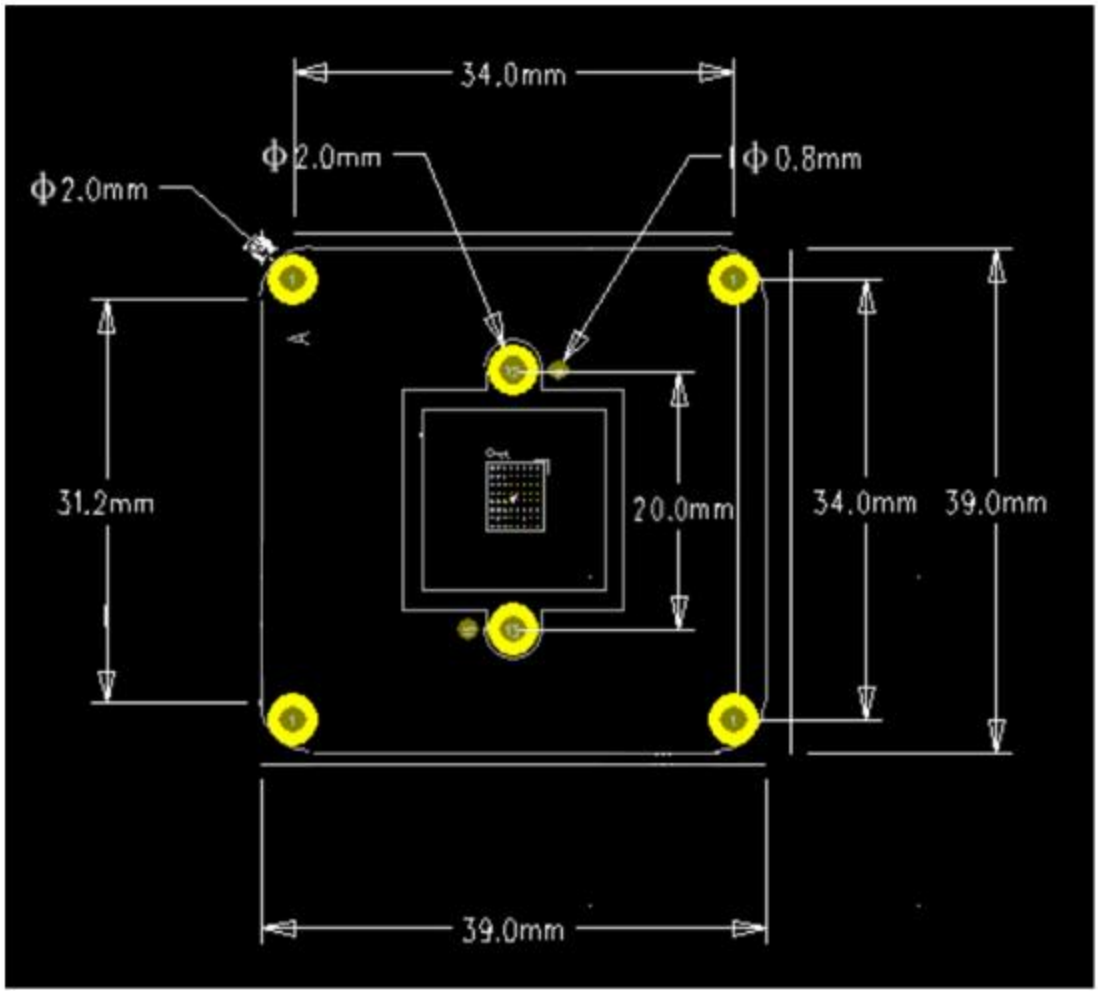
This chip operates with analog 3.3V, digital 1.2V, and interface 1.8V triple power supply :

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

Sony IMX296LLR Sensor	
FPS (Sensors):	60.3 fps
Pixel Size (Sensors):	3.4μm x 3.4μm
Resolution (Sensors):	1.58M
Scan/Series:	Pregius
Shutter (Sensors):	Global
Signal (Sensors):	Monochrome
Sensor Size	1 / 2.9

Chapter 2 Hardware

2.1 Module Size

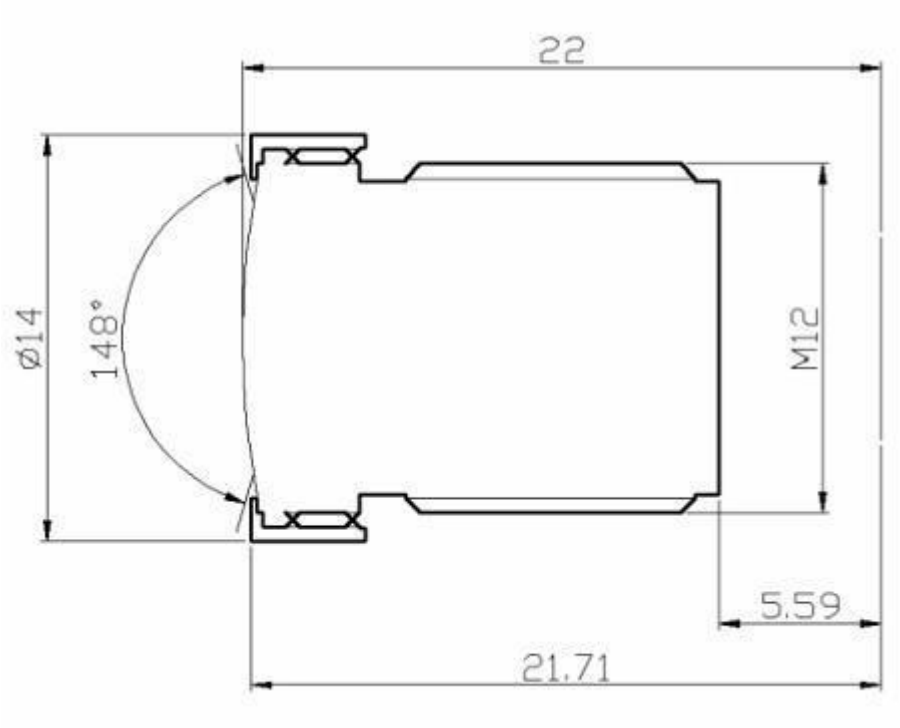


2.2 LEN Seat And LEN

M12 LEN Seat

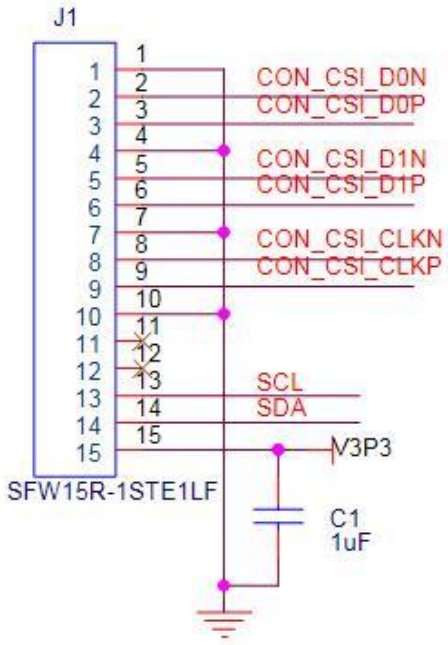
M12-CS Len Seat

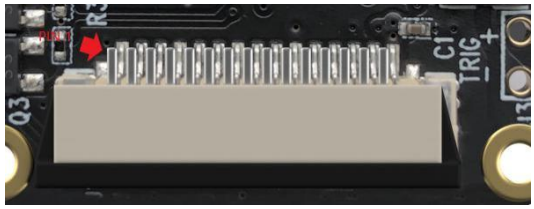
M12 LEN



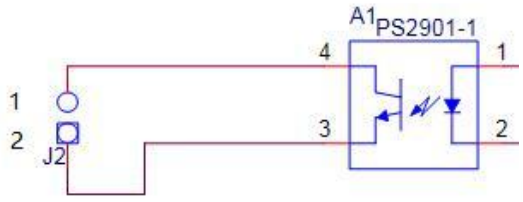
- Interface: M12
- Field of view Fov(D) = wide angle
- Focal Length 2.8 mm
- Focal Distance Adjustable
- TV DISTORTION <-17%
- F(N) /Aperture 2.2

2.3 PIN Out Connector J1



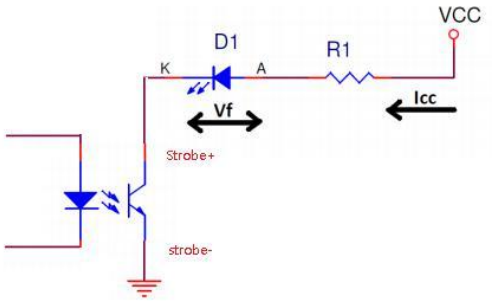


2.4 STROB Connector J2



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

So If the current required to drive the Flash LED is no more than 50mA

The value of series resistor: R1 = (VCC- Vf - VCE) / If

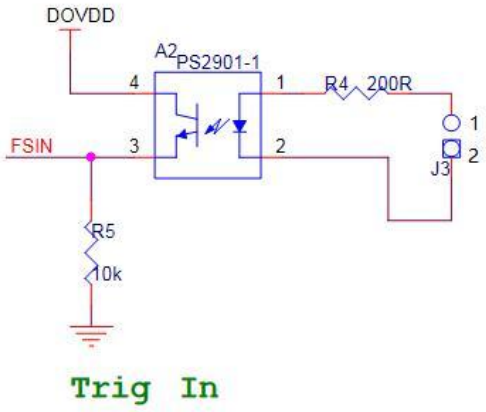
VCC: system Voltage

Vf: Forward voltage of Flash LED for current Icc

VCE: Collection Emitter voltage, typical:0.1V

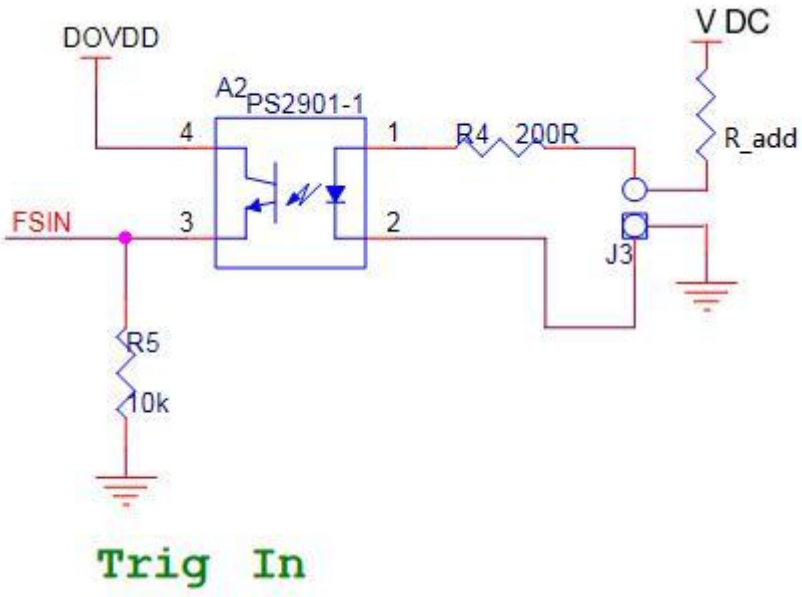
If the current required to drive the flash exceeds 50mA, then it is required to drive it with the help of LED driver circuit, and LED driver circuit can be controlled by using the strobe output pin.

2.5 EXT TRIG Connector 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 = 20mA.
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 $R_1 > I_f^2 * R_1 = 0.02^2*537.5 = 0.215W$
Wattage of the resistor R_1 selected should be greater than 0.215W.

And there is a resistor on board(R4 = 200Ω), So the R_add = R1 - R4 = 537.5 - 200 = 337.5Ω

Chapter 3 Innomaker Driver Usage

3.1 Description

3.1.1 Working Mode

CAM-MIPI296RAW innomaker driver support 2 working mode.Trigger the capture in the falling edge of external trigger signal.

Mode	*Description*	*array*	*Frame rate*
0	Stream,Flash Strobe	1456×1088	60fps
1	Fast trigger	1456×1088	EXT_TRIG

3.1.2 Support System Version

Innomaker driver support Specify Raspberry Pi system make optimization, if you need to support systems up to date, please kindly contact with sales@inno-maker.com for an update.

- **Linux_5.4.51**

https://downloads.raspberrypi.org/raspios_full_armhf/images/raspios_full_armhf-2020-08-24/

- **Linux_5.10.17**

https://downloads.raspberrypi.org/raspios_full_armhf/images/raspios_full_armhf-2021-03-25/

- **Linux_6.1.21 Latest**

3.2 Driver Install Guide

3.2.1 Download Drivers

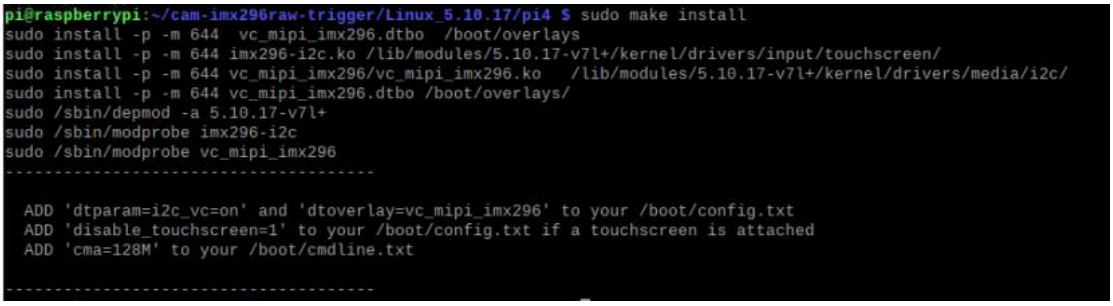
```
$sudo git clone https://github.com/INNO-MAKER/cam-imx296raw-trigger.git
```

According to your hardware and sysem,select drivers for Specify Hardware And System

- Use command "uname -a" get kernel version.We take raspberry pi4 with system kernel
- We take pi4 on version Linux_5.10.17 as example.

```
$cam-imx296raw-trigger
$sudo chmod -R a+rwx *
$cd Linux_5.10.17/pi4
$sudo make install
```

Driver install succeed as below figure shows.



3.2.2 Config.txt Setup For PI4/PI3+/PI3/PI2

edit /boot/config.txt

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

Add below content to the last line and reboot

```
dtparam=i2c_vc=on
dtoverlay=vc_mipi_imx296
```

edit /boot/cmdline.txt

```
cma=128M
```

Reboot

```
$sudo reboot
```

Check camera module status

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

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

3.2.2 Working Mode Selection Method

```
$cd cam-imx296raw-trigger/Linux_5.10.17/pi4/
$sudo make setmode1     # can be 0 1
```

```
pi@raspberrypi:~/cam-imx296raw-trigger/Linux_5.10.17/pi4 $ sudo make setmode1
sudo /sbin/modprobe -r bcm2835-unicam
sudo /sbin/modprobe -r vc_mipi_imx296
sudo /sbin/modprobe bcm2835-unicam debug=3
sudo /sbin/modprobe vc_mipi_imx296 sensor_mode=1
#sudo dmesg -c
```

Get camera module work mode information:

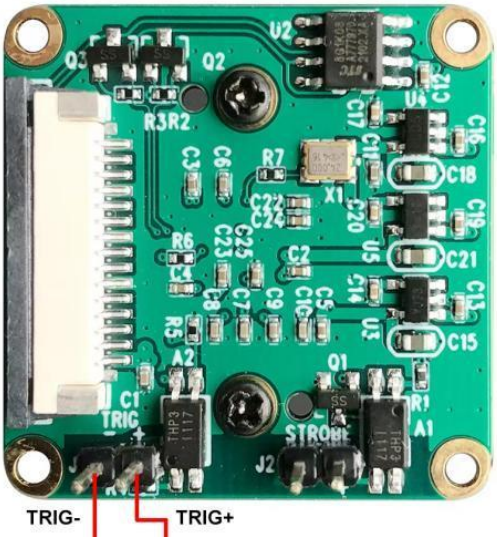
```
$modinfo vc_mipi_imx296
```

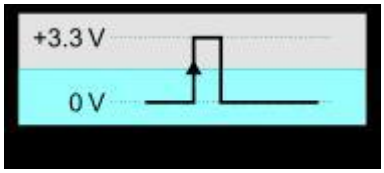
```
pi@raspberrypi:~/cam-imx296raw-trigger/Linux_5.10.17/pi4 $ modinfo vc_mipi_imx296
filename:       /lib/modules/5.10.17-v7l+/kernel/drivers/media/i2c/vc_mipi_imx296.ko
license:        GPL v2
author:         Jack Yang <jack@inno-maker.com>
description:    InnoMaker IMX296 Camera module driver
srcversion:     6EBF14E67D59346C3395AC8
alias:          of:N*T*Csony,imx296C*
alias:          of:N*T*Csony,imx296
alias:          i2c:imx296
depends:        videodev,mc,regmap-i2c,imx296-i2c
name:           vc_mipi_imx296
vermagic:       5.10.17-v7l+ SMP mod_unload modversions ARMv7 p2v8
parm:           sensor_mode:IMX296 Sensor Mode: 0=10bit_stream 1=10bit_ext_trig (int)
```

3.3 Hardware Trigger

3.3.1 Wire connection

You can connect the TRIG- to the GND Pin and connect the TRIG+ to 3.3V Pin of Raspberry Pi to simulate a trigger signal. This test function will comes with repeated trigger signal sometime.





Step1 : set camera work in external trigger mode.

For example set the module work in mode0

```
$ sudo make setmode0
```

Step2: Put external trigger signal through TRIG pin head.

3.3.2 Give 3.3V GPIO Trigger Signal to J1

For example a 3.3v gpio rising edge signal will trigger the frame output.

```
$cd cam-imx296raw-trigger/tools
$sudo ./gpio-sysfs
```

3.4 Python Code

We recommend use python.

```
$cd 2-python_code_innomake_driver_only
$sudo python3 demo1.py
$sudo python3 demo2.py
```

3.5 C_Code

InnoMaker drivers for Global shutter cameras support v4l2-ctl tools under linux and we released many series.

3.5.1 User Controls

```
$v4l2-ctl -l
```

```
User Controls
exposure 0x00980911 (int): min=29 max=15534389 step=1 default=10000 value=10000
gain 0x00980913 (int): min=0 max=480 step=1 default=0 value=0
Image Source Controls
vertical_blanking 0x009e0901 (int): min=30 max=1047487 step=1 default=30 value=30
Image Processing Controls
pixel_rate 0x009f0902 (int64)    : min=112200000 max=119800000 step=1
default=118800000 value=118800000 flags=read-only
test_pattern 0x009f0903 (menu)     : min=0 max=9 default=0 value=0
```

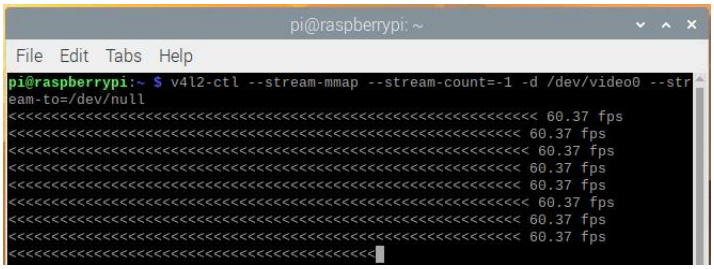

```
$v4l2-ctl --help
```

```
pi@raspberrypi:~/cam-imx296raw-trigger/tools $ v4l2-ctl --help

General/Common options:
  --all             display all information available
  -C, --get-ctrl <ctrl>[,<ctrl>...]
                    get the value of the controls [VIDIOC_G_EXT_CTRLS]
  -c, --set-ctrl <ctrl>=<val>[,<ctrl>=<val>...]
                    set the value of the controls [VIDIOC_S_EXT_CTRLS]
  -D, --info        show driver info [VIDIOC_QUERYCAP]
  -d, --device <dev> use device <dev> instead of /dev/video0
                    if <dev> starts with a digit, then /dev/video<dev> is used
  -e, --out-device <dev> use device <dev> for output streams instead of the
                    default device as set with --device
                    if <dev> starts with a digit, then /dev/video<dev> is used
  -h, --help        display this help message
  --help-all        all options
```

3.5.2 Framerate test

```
$v4l2-ctl --stream-mmap --stream-count=-1 -d /dev/video0 --stream-to=/dev/null
```



3.5.3 InnoMaker v4l2-ctl C Code

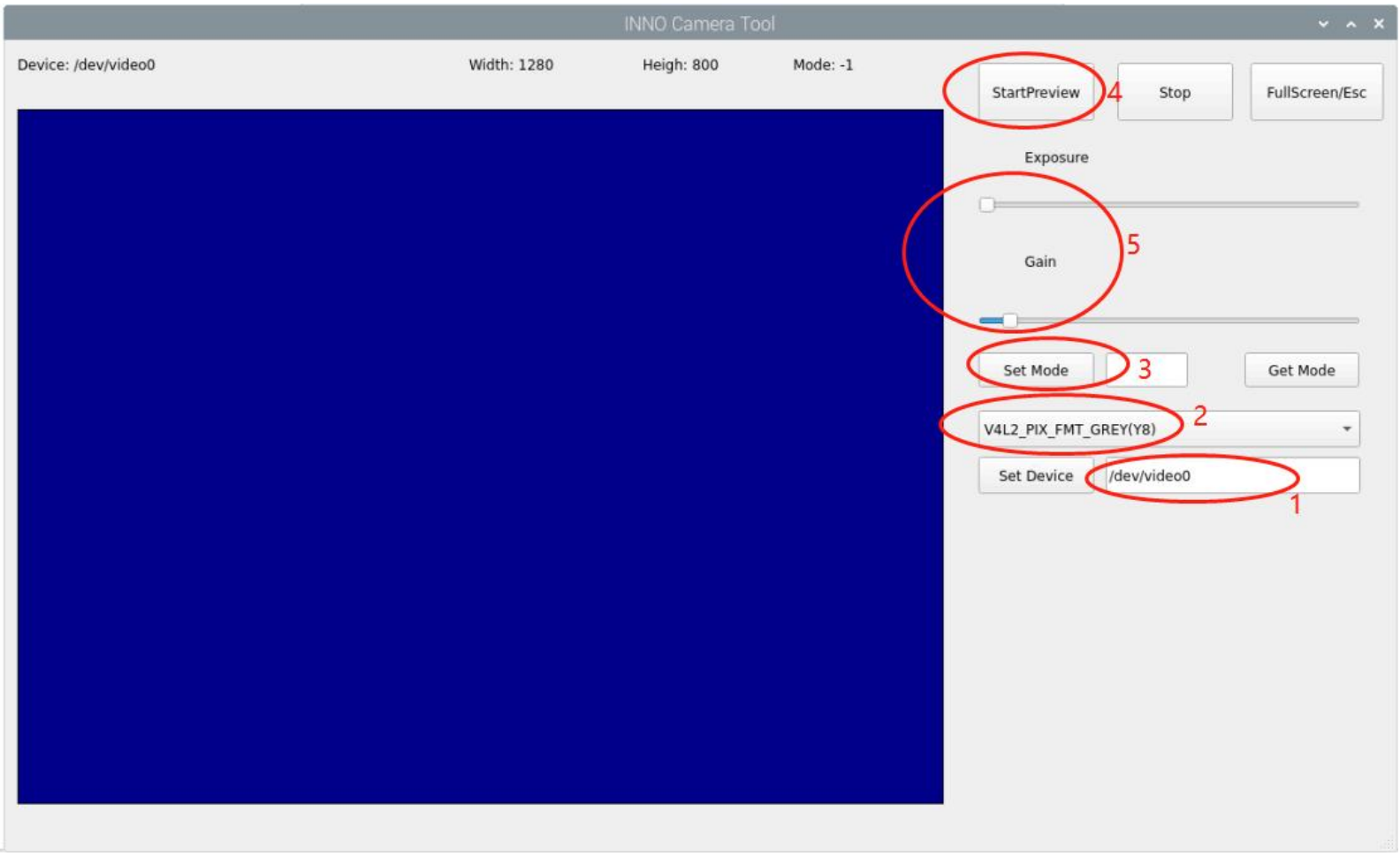
You can find tools from cam-imx296raw-trigger/tools/source-code

3.6 INNOCAM

(Current Not Support CAM-MIPI296RAW, we'll keep update soon)

Run the INNOCAM Software

```
$cd cam-imx296raw-trigger/tools
$tar -xzvf innocam_v20220820.tar.gz
$cd innocam_v20220820
$sudo ./innocam.sh
```



1, Check if video0 exist;
2, Choose Y8 Mode
3, Set working mode as 1
4,Press StartPreview button
5,Adjust Exposure and Gain value according to working scene.

Chapter 4 PI OS Driver Usage

Only Need below setting to enable Raspberry Pi Os BuildIn Driver,
No need to follow Chapter 3

4.1 Simple Setup of config.txt

Update system to latest version

```
$sudo apt-get update
```

```
$sudo apt-get dist-upgrade
```

Edit /boot/config.txt

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

Add below content to the last line and reboot

```
dtoverlay=imx296
```

edit /boot/cmdline.txt

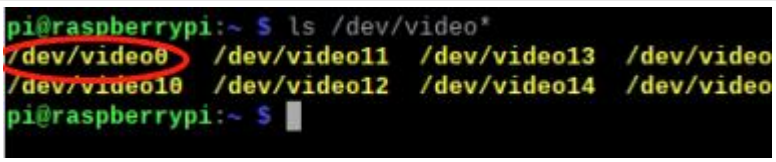
```
cma=128M
```

Reboot

```
$sudo reboot
```

Check camera module status after reboot

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



4.2 Libcamera

4.2.1Preview

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