

# *CA378-AOIS for Jetson Nano Software Setup Guide*

*Version 1.0.0*

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*Home Page <https://www.centuryarks.com/en/products/cm>*

Date	Version	Comment
2019/09/12	v1.0.0	Initial Release

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This document is for building kernel directly on a running Jetson Nano board and setup software.

Hardware :Jetson Nano(32G microSD)

OS :Ubuntu 18.04 LTS – JetPack 4.2(L4T 32.1)

CSI Hardware :CenturyArks CA378-AOIS(Sony IMX378)

The environment in which each command is executed is shown below.

\$...is executed on the host pc

#...is executed on the Jetson Nano

## 2. Environment configuration

★ Before installing the CA 378-AOIS driver, please implement the following environment.

- Prerequisites

1. Installing Jetpack 4.2 on Host PC (Linux for Tegra R32.1)
2. Setting sudo permissions

### Step 1. Install Jetpack 4.2 on Host PC

(1) Register as user at NVIDIA DEVELOPER site.

<https://developer.nvidia.com>

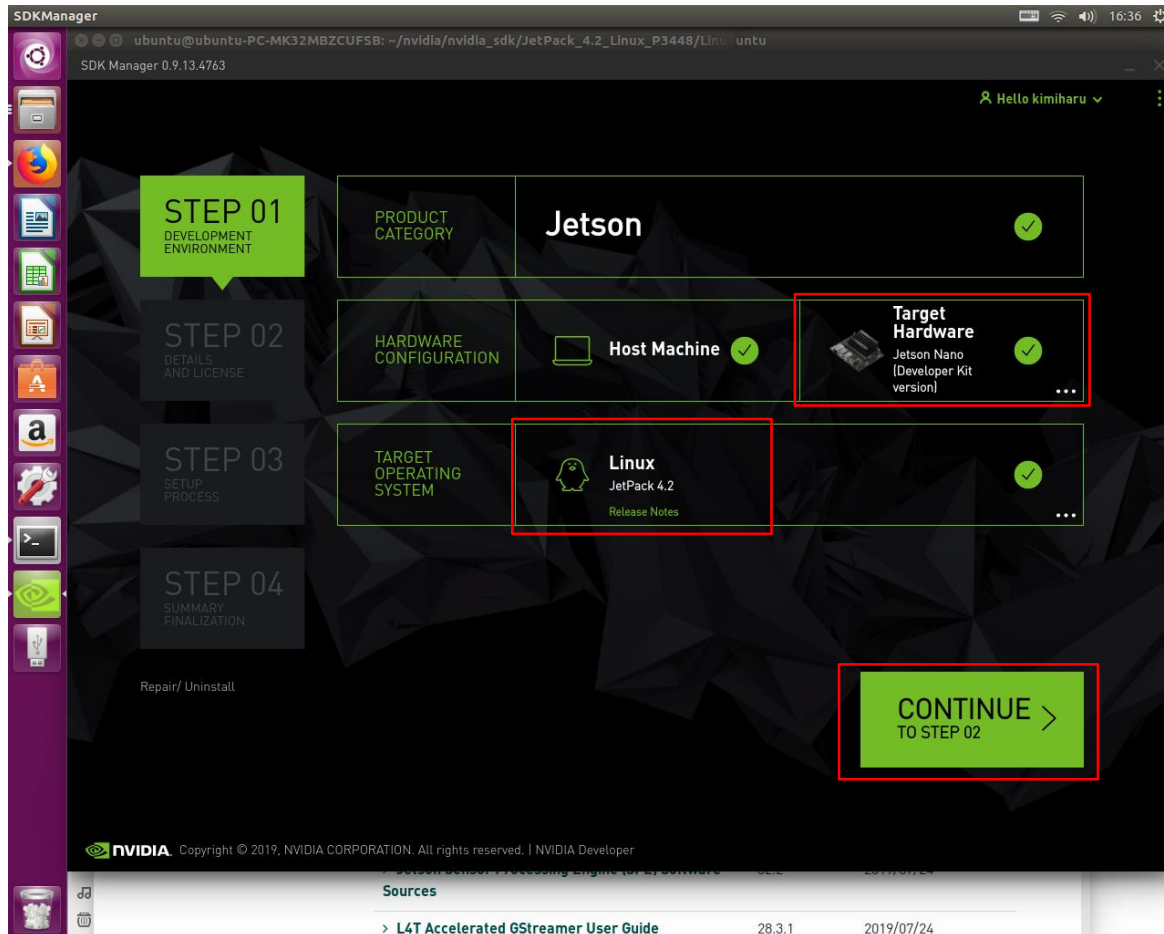
(2) Download and Install Nvidia SDK manager on host pc.

<https://developer.nvidia.com/nvidia-sdk-manager>

## 2. Environment configuration

(3) Set development environment on SDK Manager.

Target hardware is Jetson Nano(P3448), and target operating system is JetPack4.2.



## 2. Environment configuration

### (4) Put the board into force USB Recovery Mode

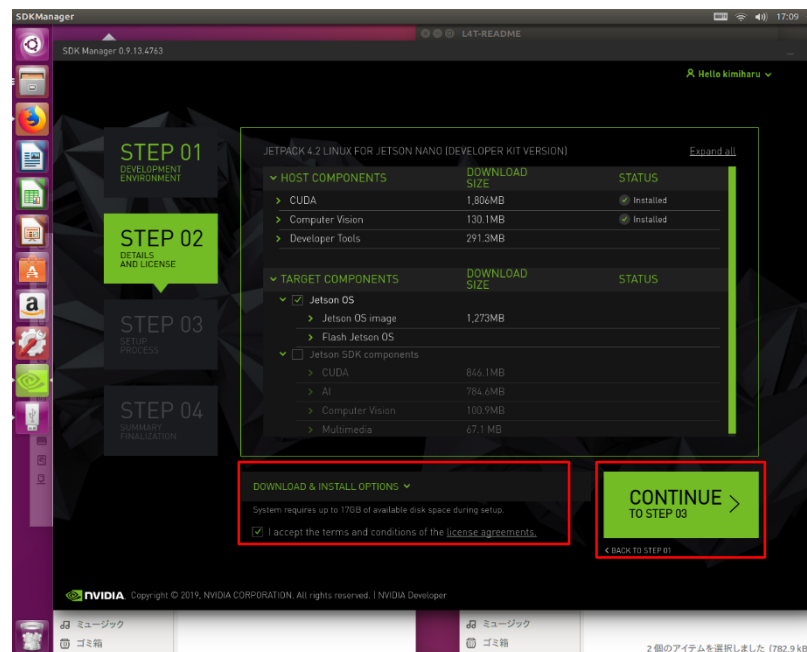
1. Power down the device. If connected, remove the AC adapter from the device. The device must be powered OFF, and not in a suspend or sleep state.
2. Jumper the Force Recovery pins (3 and 4) on J40 button header.
3. Connect the power adapter to the device.
4. The developer kit automatically powers on in Force Recovery mode.
5. Now that the developer kit is running, remove the Force Recovery pins' jumper.

### (5) Set details and license on SDK Manager.

Check accept license and click continue to install the OS.

But this os image has only 15G disk area.

(More space is required to build the kernel.)



## 2. Environment configuration

(6) Use the following command to create a 32G OS image.

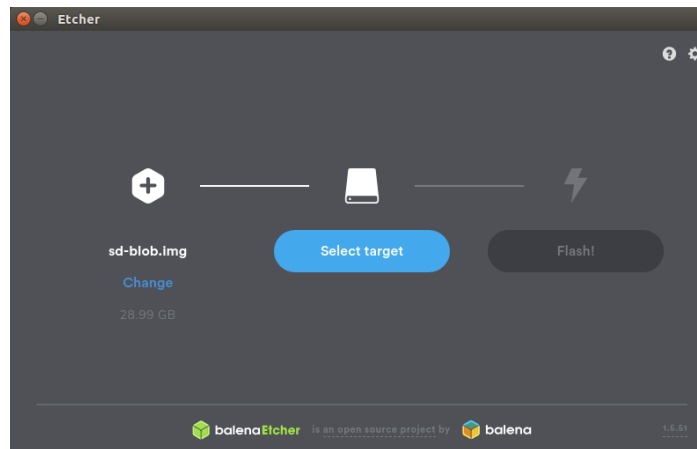
```
$ cd /home/nvidia/nvidia/nvidia_sdk/JetPack-4.2_Linux_GA_P3448/Linux_for_Tegra
$ sudo ./create-jetson-nano-sd-card-image.sh -o sd-blob.img -s 27G -r 100
```

References

<https://devtalk.nvidia.com/default/topic/1050105/jetson-nano/jetson-nano-sd-card-partitions-can-not-extend-/2>

(7) Format SD card with format tool.

(8) Write the OS image using the Etcher tool.



(9) Start Jetson with the created SD disc.

ID:nvidia

PASSWORD:nvidia



## 2. Environment configuration

### Step 2. Setting sudo permissions

(1) Execute the following command.

```
# sudo visudo
```

(2) Add the following red line.

```
# User privilege specification
root  ALL=(ALL:ALL) ALL
nvidia ALL=(ALL:ALL) ALL

# Members of the admin group may gain root privileges
%admin ALL=(ALL) ALL

# Allow members of group sudo to execute any command
%sudo  ALL=(ALL:ALL) ALL
%nvidia ALL=(ALL:ALL) NOPASSWD: ALL
```

(3) Reboot Jetson Nano.

```
# sudo reboot
```

# 3. Driver install

- Prerequisites

1. Prepare kernel source
2. Build and install new Linux kernel
3. Flash new Device Tree Binary(DTB)

## Step 1. Prepare kernel source

Download the attached file to home directory on JetsonNano and run the following command.

[https://github.com/centuryarks/CA378-AOIS/releases/download/JSNano\\_v1.0.0\\_L4T32.1\(Jetpack4.2\)/CA378\\_v1.0.0\\_Jetpack4.2\\_Nano\\_src\\_build.tar.gz](https://github.com/centuryarks/CA378-AOIS/releases/download/JSNano_v1.0.0_L4T32.1(Jetpack4.2)/CA378_v1.0.0_Jetpack4.2_Nano_src_build.tar.gz)

```
# tar -zxvf CA378_v1.0.0_Jetpack4.2_Nano_src_build.tar.gz
# cd CA378_v1.0.0_Jetpack4.2_Nano_src_build
# ./PrepareKernelSources.sh
```

## Step 2. Build and install new Linux kernel

Build and install kernel module with the following command

```
# ./BuildKernelSources.sh
```

# 3. Driver install

## Step 3. Flash new Device Tree Binary(DTB)

(1)Copy compiled dtb file to the host PC

```
# cd ~/nvidia/nvidia_sdk/JetPack_4.2_Linux_P3448/Linux_for_Tegra/  
# sudo sshpass -p 'nvidia' scp -o StrictHostKeyChecking=no nvidia@192.168.xxx.xxx:/boot/*.dtb ./kernel/dtb/  
# nvidia@192.168.xxx.xxx is IP address on JetsonNano.
```

(2)Put the board into force USB Recovery Mode

1. Power down the device. If connected, remove the AC adapter from the device. The device must be powered OFF, and not in a suspend or sleep state.
2. Jumper the Force Recovery pins (3 and 4) on J40 button header.
3. Connect the power adapter to the device.
4. The developer kit automatically powers on in Force Recovery mode.
5. Now that the developer kit is running, remove the Force Recovery pins' jumper.

(3)Flash dtb partition

```
# cd ~/nvidia/nvidia_sdk/JetPack_4.2_CA_Linux_P3448/Linux_for_Tegra/  
# sudo ./flash.sh -r -k DTB jetson-nano-qspi-sd mmcblk0p1
```

# 4. Software install

Please install by the following procedure.

- Installation procedure

1. Install package.

```
# sudo apt-get install v4l-utils ufw -y  
# sudo apt-get install libgstreamer1.0-0 gstreamer1.0-plugins-base gstreamer1.0-plugins-good gstreamer1.0-plugins-bad  
gstreamer1.0-plugins-ugly gstreamer1.0-libav gstreamer1.0-doc gstreamer1.0-tools
```

2. Download “demo\_v1.0.0\_nano.tar.gz” from the following site.

[https://github.com/centuryarks/Sample/releases/download/JSNano\\_v1.0.0\\_L4T32.1\(Jetpack4.2\)/demo\\_v1.0.0\\_nano.tar.gz](https://github.com/centuryarks/Sample/releases/download/JSNano_v1.0.0_L4T32.1(Jetpack4.2)/demo_v1.0.0_nano.tar.gz)

```
# wget --no-check-certificate ¥  
https://github.com/centuryarks/Sample/releases/download/JSNano_v1.0.0_L4T32.1(Jetpack4.2)/demo_v1.0.0_nano.tar.gz
```

3. Unzip "demo\_v1.0.0\_nano.tar.gz" file.

```
# tar -zxvf demo_v1.0.0_nano.tar.gz
```

4. Execute "Install.sh" in the extracted folder.

```
# cd demo  
# ./Install.sh
```

5. A shortcut is created on the desktop.(Once you launch the app, an icon will appear)

DEMO



# 4. Software install

Jetson has a limiter of 120fps at isp when streaming.  
When streaming at 120fps or higher, it is necessary to cancel the limiter.  
Please cancel FPS limiter by the following procedure.

## References

<https://devtalk.nvidia.com/default/topic/1056210/jetson-nano/nvarguscamerasrc-frame-rate-limit/>

### 1. Download library file.

<https://devtalk.nvidia.com/cmd/default/download-comment-attachment/79559/>

### 2. Unzip and copy file.

```
# tar -zxvf devtalk1056210_Jun26_v2.tar.gz  
# cd devtalk1056210_Jun26_v2  
# sudo cp libgstnvarguscamerasrc.so /usr/lib/aarch64-linux-gnu/gstreamer-1.0/libgstnvarguscamerasrc.so
```

# 5. Demonstration functions

5.1. Focus & OIS

5.2. 4K3K-resolution(12Mpixel) still image capturing

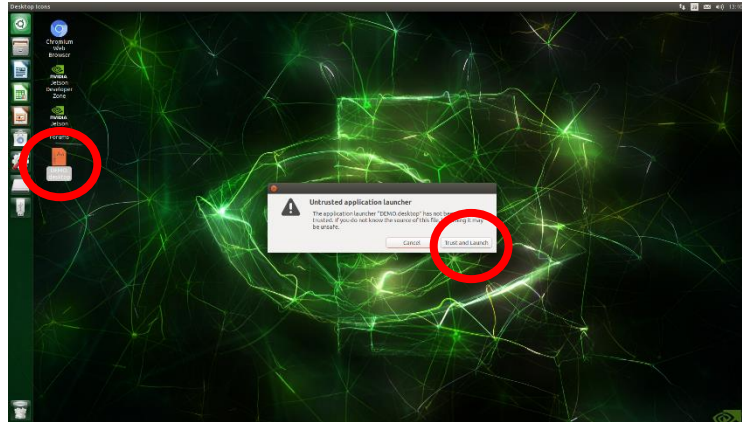
5.3. Capture image

5.4. Movie recording

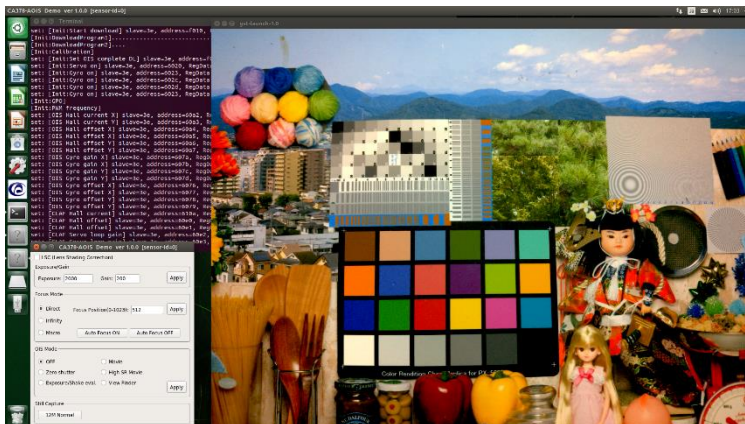
# 5.1. Focus & OIS

Procedure of starting Focus & OIS:

1. Click "DEMO.desktop" on the desktop and click "Trust and Launch" on the dialog.



2. After a while the GUI screen will be displayed and the app icon changes.
  3. Please change the distance of the object, or move the camera, confirm the function.
- \* For details of functions, refer to page 17-18.

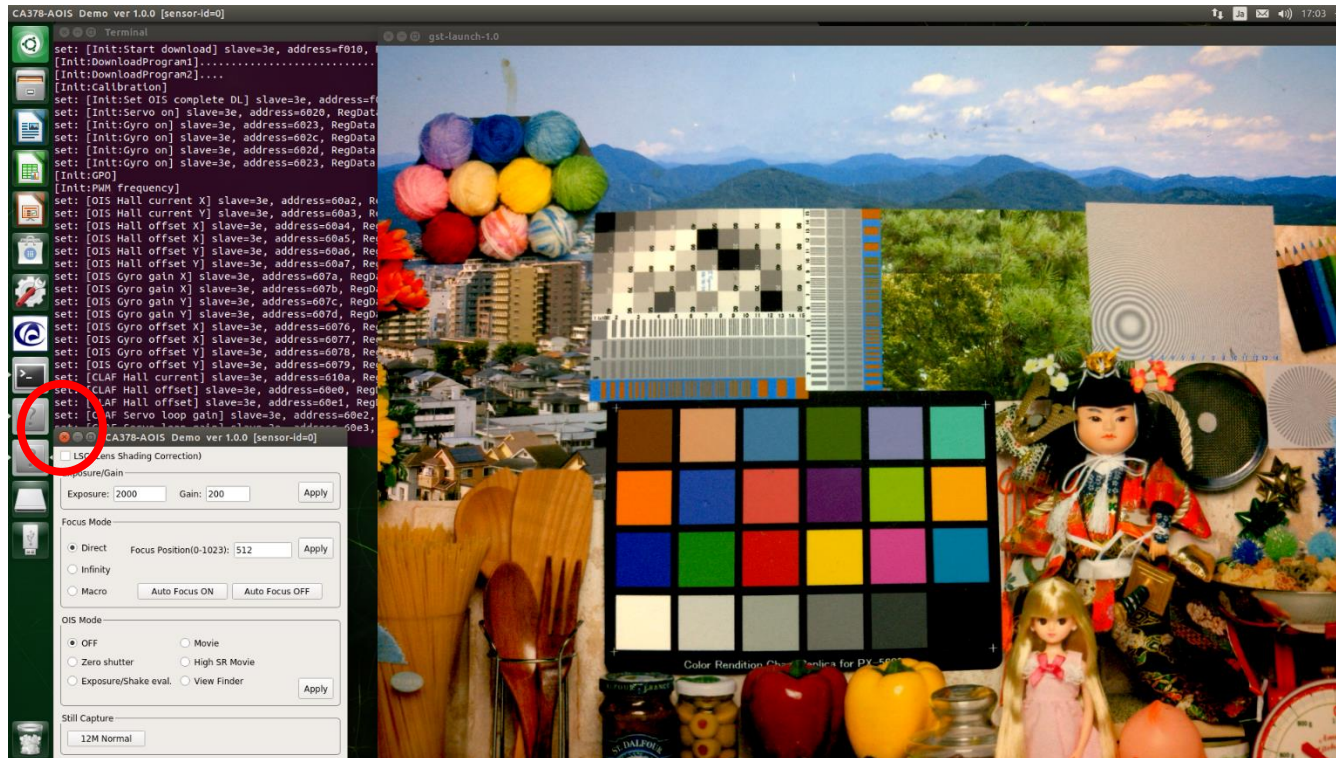




# 5.1. Focus & OIS

Procedure of finishing Focus & OIS:

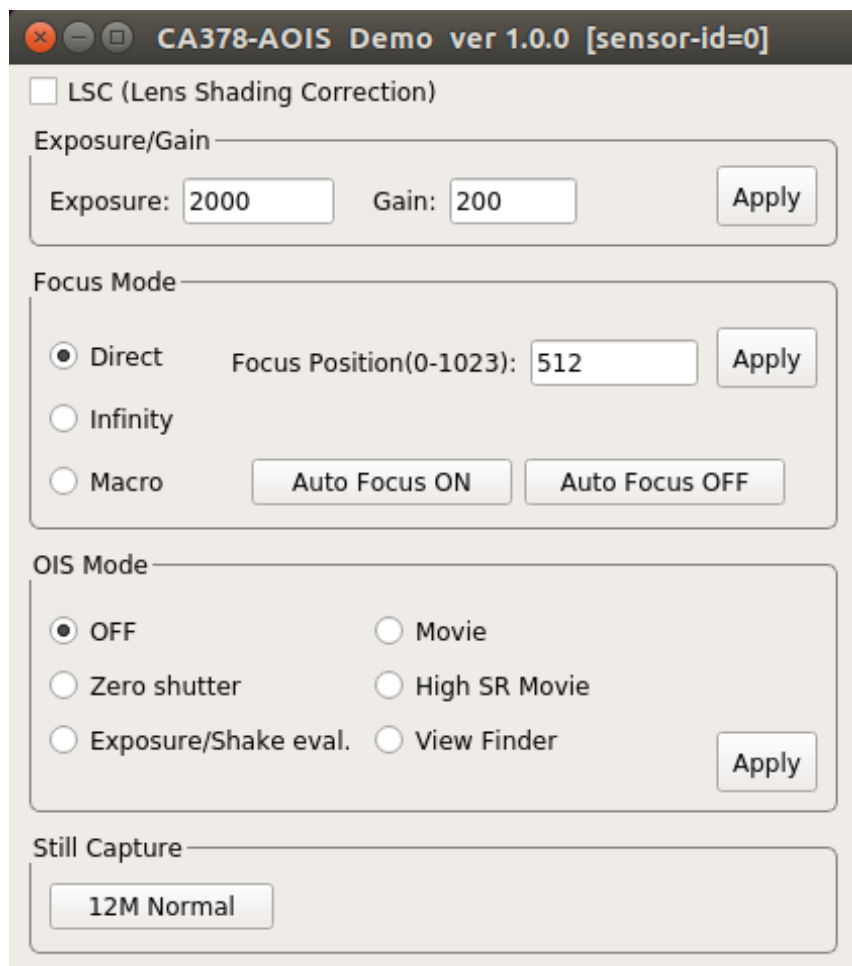
1. Click the [x]





# 5.1. Focus & OIS

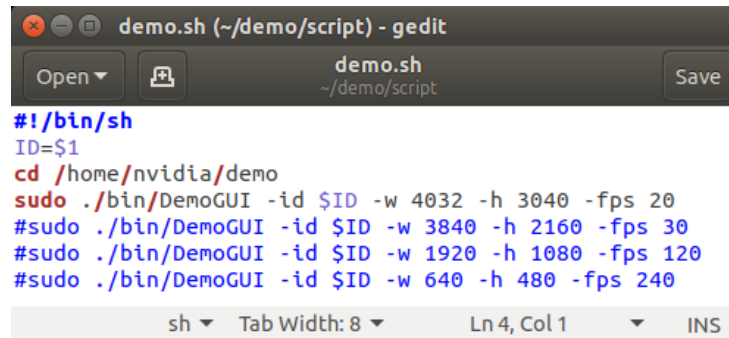
The following section describes each function of Focus & OIS.



Function	Description
LSC	Check to enable shading correction. ※ Theoretical values have been set.
Exposure/Gain	Exposure: Set the exposure time.(1-65515) Gain: Set the gain parameter.(100-2200) Apply: Apply the settings.
Focus Mode	Direct: Directly specify the focus position. Infinity: Set the focus position to infinity. Macro: Set the focus position to the short distance. Focus Position: Focus position. Apply: Apply the settings. Auto Focus ON: Enable auto focus. Auto Focus OFF: Disable auto focus. * Current debug control is for demo.
OIS Mode	OFF: Disable OIS. It corresponds to each OIS mode. Zero Shutter Exposure / Shake eval. Movie High SR Movie View Finder Apply: Apply the settings.
Still Capture	12M Normal: Capture 12Mpixel normal still image.

# 5.1. Focus & OIS

To change the streaming size, change the parameters of the following files.  
~/demo/script/demo.sh



```
demo.sh (~/.demo/script) - gedit
Open demo.sh Save
~/demo/script
#!/bin/sh
ID=$1
cd /home/nvidia/demo
sudo ./bin/DemoGUI -id $ID -w 4032 -h 3040 -fps 20
#sudo ./bin/DemoGUI -id $ID -w 3840 -h 2160 -fps 30
#sudo ./bin/DemoGUI -id $ID -w 1920 -h 1080 -fps 120
#sudo ./bin/DemoGUI -id $ID -w 640 -h 480 -fps 240
sh Tab Width: 8 Ln 4, Col 1 INS
```

Setting	Parameter
4032x3040	Width=4032, Height=3040, fps=20
3840x2160	Width=3840, Height=2160, fps=30
1920x1080	Width=1920, Height=1080, fps=120
640x480	Width=640, Height=480, fps=240

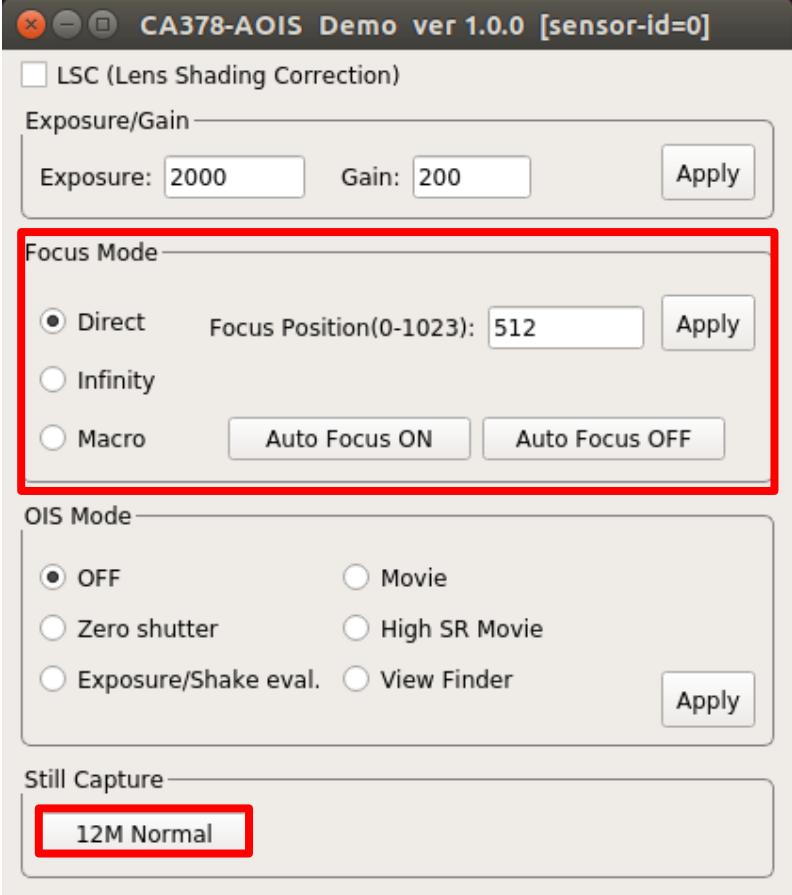
## 5.2. 12Mpixel still image capturing

Procedure of capturing 12Mpixel still image:

1. Adjust the focus.

(It is useful to turn on Auto Focus and turn Auto Focus OFF when focus is on)

2. Click the [12M Normal] button



CA378-AOIS Demo ver 1.0.0 [sensor-id=0]

☐ LSC (Lens Shading Correction)

Exposure/Gain

Exposure: 2000 Gain: 200 Apply

Focus Mode

☒ Direct Focus Position(0-1023): 512 Apply

☐ Infinity

☐ Macro Auto Focus ON Auto Focus OFF

OIS Mode

☒ OFF ☐ Movie

☐ Zero shutter ☐ High SR Movie

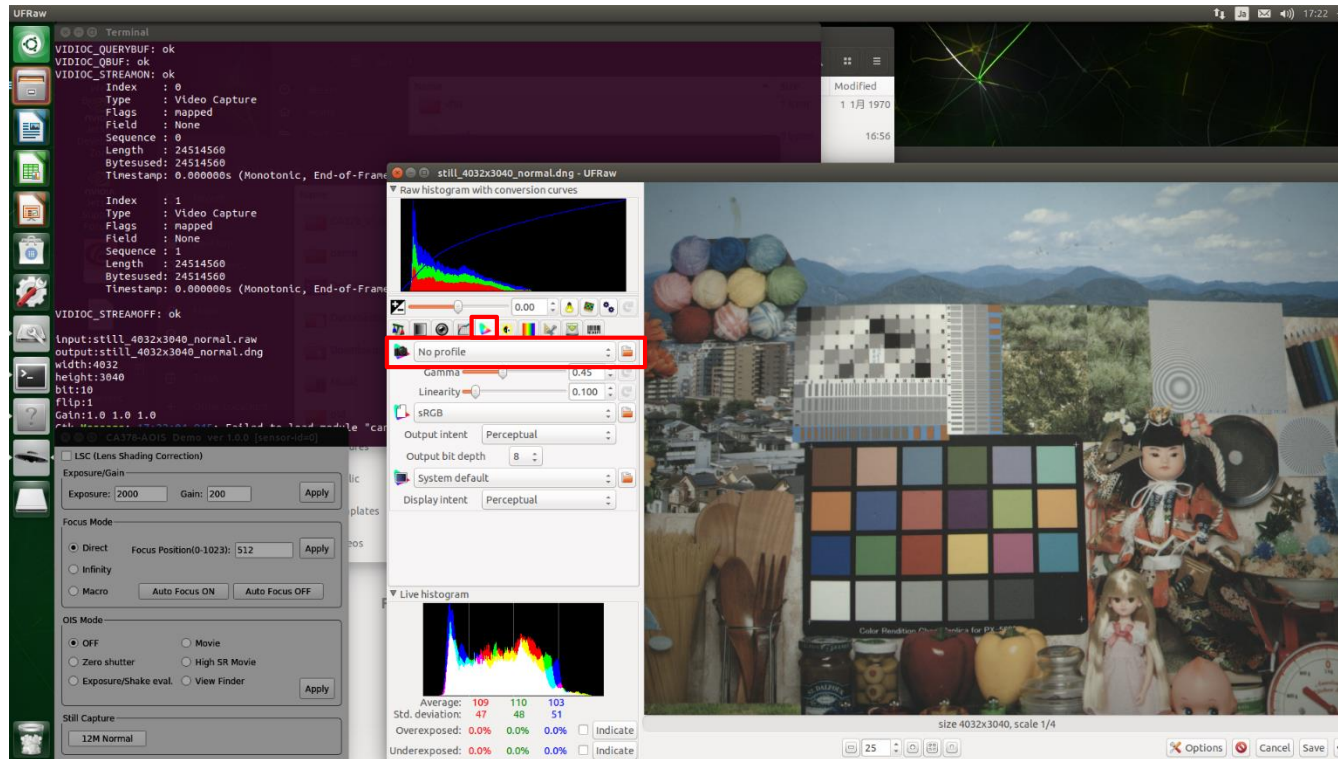
☐ Exposure/Shake eval. ☐ View Finder Apply

Still Capture

12M Normal

## 5.2. 12Mpixel still image capturing

3. Images can be captured in RAW and DNG format.
4. Set the camera profile for color management to No profile.

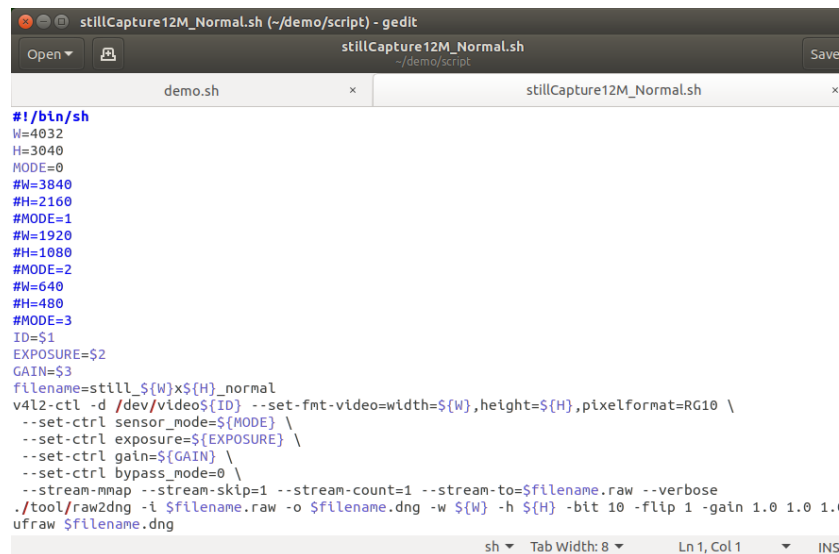


## 5.3. Capture image

To capture an image by specifying the image size, change the Still script and press the app's capture button, or execute the capture command.

### Still script

~/demo/script/stillCapture12M\_Normal.sh



```
#!/bin/sh
W=4032
H=3040
MODE=0
#W=3840
#H=2160
#MODE=1
#W=1920
#H=1080
#MODE=2
#W=640
#H=480
#MODE=3
ID=$1
EXPOSURE=$2
GAIN=$3
filename=still_${W}x${H}_normal
v4l2-ctl -d /dev/video${ID} --set-fmt-video=width=${W},height=${H},pixelformat=RG10 \
--set-ctrl sensor_mode=${MODE} \
--set-ctrl exposure=${EXPOSURE} \
--set-ctrl gain=${GAIN} \
--set-ctrl bypass_mode=0 \
--stream-mmap --stream-skip=1 --stream-count=1 --stream-to=${filename}.raw --verbose
./tool/raw2dng -i ${filename}.raw -o ${filename}.dng -w ${W} -h ${H} -bit 10 -flip 1 -gain 1.0 1.0 1.0
ufraw ${filename}.dng
```

### Capture command

```
#v4l2-ctl -d /dev/video0 --set-fmt-video=width=[Width],height=[Height],pixelformat=RG10 ¥
--set-ctrl sensor_mode=[Mode] ¥
--set-ctrl exposure=1000 ¥
--set-ctrl gain=200 ¥
--set-ctrl bypass_mode=0 ¥
--stream-mmap --stream-skip=1 --stream-count=1 --stream-to=image.raw --verbose
```

Setting	Parameter
4032x3040	Width=4032, Height=3040, Mode=0
3840x2160	Width=3840, Height=2160, Mode=1
1920x1080	Width=1920, Height=1080, Mode=2
640x480	Width=640, Height=480, Mode=3

# 5.4. Movie recording

## Secure recording memory area

```
#cd ~/demo/script/  
#./ramdisk.sh
```

## Movie capture(yuv)

```
#cd ~/demo/script/  
#./yuv_capture.sh /mnt/ram/test 0 4032 3040 20 40
```

Argument	Description
arg1	Movie file name
arg2	Sensor id(Specify 0)
arg3	Width
arg4	Height
arg5	Fps
arg6	Capture frame num

## Movie viewer(yuv)

```
#cd ~/demo/script/  
#./yuv_viewer.sh /mnt/ram/test0.yuv 4032 3040 20
```

Argument	Description
arg1	Movie file path
arg2	Width
arg3	Height
arg4	Fps

# Appendix

# A.1. About the directory structure

The following section describes the directory structure of the software.

```
demo
├── appicon.png
├── Install.sh
├── bin
│   ├── demo.ini
│   ├── DemoGUI
│   └── preview
├── script
│   ├── demo.sh
│   ├── preview.sh
│   ├── ramdisk.sh
│   ├── raw_capture.sh
│   ├── stillCapture12M_Normal.sh
│   ├── yuv_capture.sh
│   └── yuv_viewer.sh
├── src
│   ├── af_control.c
│   ├── af_control.h
│   ├── communication.h
│   ├── communication_jetson.c
│   ├── debug_util.h
│   ├── demo_control.c
│   ├── demo_control.h
│   ├── DemoGUI.pro
│   ├── lsc_control.c
│   ├── lsc_control.h
│   ├── main.cpp
│   ├── mainwindow.cpp
│   ├── mainwindow.h
│   ├── mainwindow.ui
│   ├── Makefile
│   ├── ois_control.c
│   ├── ois_control.h
│   ├── slave_address.h
│   └── types_util.h
└── tool
    ├── Makefile
    ├── preview.c
    ├── raw2dng
    ├── raw2dng.c
    ├── raw2hdr
    ├── raw2hdr.c
    └── tools.h
```

Function	Description
bin	DemoGUI: Demonstration software Demo.ini: Demonstration software setting file
script	Script files are described. It can be customized according to specifications. demo.sh preview.sh stillCapture12M_Normal.sh
src	It is a set of demo software source code.
tool	Image file conversion tools are described.



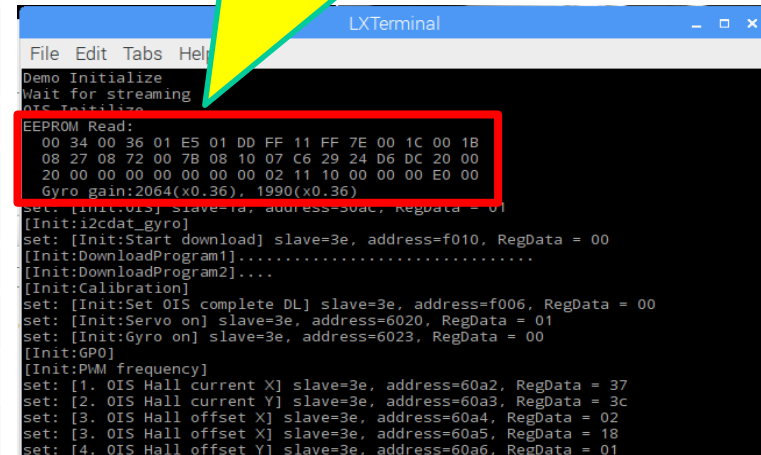
## A.2. About the setting file

The following section describes the "demo.ini" of the setting file.

```
# DEMO Setting
preview = /home/pi/demo/script/preview.sh
stillCapture12M_Normal = /home/pi/demo/script/stillCapture12M_Normal.sh
gyroGainRateX=1.00
gyroGainRateY=1.00
autoFocusGain=2.0
autoFocusConfidenceThreshold=10
autoFocusMoveLimit=100
AutoFocusAverageNum=1
Exposure=1000
Gain=200
```

Function	Description
preview	Script path for preview
stillCapture12M_Normal	Script path for capturing 12M normal still images
gyroGainRateX gyroGainRateY	It is valid only when OIS calibration result is written in EEPROM.
autoFocusGain	Adjust the autofocus gain.
autoFocusConfidenceThreshold	Specify the threshold value of the confidence level of Phase Difference.
autoFocusMoveLimit	Limit the amount of focus movement at one time.
AutoFocusAverageNum	Adjust the average amount of autofocus.
Exposure	Adjust the exposure time.
Gain	Adjust the gain.

If OIS calibration is already done,  
The following log is output to Terminal.



```
LXTerminal
File Edit Tabs Help
Demo Initialize
Wait for streaming
OIS Initialize
EEPROM Read:
00 34 00 36 01 E5 01 DD FF 11 FF 7E 00 1C 00 1B
08 27 08 72 00 78 08 10 07 C6 29 24 D6 DC 20 00
20 00 00 00 00 00 00 02 11 10 00 00 00 E0 00
Gyro_gain:2064(x0.36), 1990(x0.36)
set: [Init:OIS] slave=3e, address=30a2, RegData = 01
[Init:i2cdat_gyro]
set: [Init:Start download] slave=3e, address=f010, RegData = 00
[Init:DownloadProgram1].....
[Init:DownloadProgram2]....
[Init:Calibration]
set: [Init:Set OIS complete DL] slave=3e, address=f006, RegData = 00
set: [Init:Servo on] slave=3e, address=6020, RegData = 01
set: [Init:Gyro on] slave=3e, address=6023, RegData = 00
[Init:GPO]
[Init:PWM frequency]
set: [1. OIS Hall current X] slave=3e, address=60a2, RegData = 37
set: [2. OIS Hall current Y] slave=3e, address=60a3, RegData = 3c
set: [3. OIS Hall offset X] slave=3e, address=60a4, RegData = 02
set: [3. OIS Hall offset X] slave=3e, address=60a5, RegData = 18
set: [4. OIS Hall offset Y] slave=3e, address=60a6, RegData = 01
```