

CA378-AOIS for TinkerBoard Software Setup Guide

Version 1.0.1

Dated: 2019/12/05

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

Date	Version	Comment
2019/10/25	v1.0.0	Initial Release
2019/12/05	V1.0.1	Update ISP file, Reverse streaming image, Update image size

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1. Notes

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

Hardware :TinkerBoard

OS :TinkerOS Debian9 v2.0.8

CSI Hardware :CenturyArks CA378-AOIS(Sony IMX378)

For inquiries regarding this document, please email below.

ca-qa@centuryarks.com

2. Environment configuration

There are two types of environment construction procedures.

1: Procedure for using kernel, driver and software installed TinkerOS image.

2: Manual installation procedure of kernel, driver and demo software.

2.1. Procedure for using kernel, driver and software installed TinkerOS image.

OS: TinkerOS Debian9 v2.0.8(Kernel v4.4.132)

Demo soft: v1.0.1

(1-1) Please download the following image.

https://www.centuryarks.com/images/product/sensor/2019-12-05-tinkeros-v1.0.1_CA378-AOIS.zip

(1-2) Write the image file to the SD card. For windows win32diskimager, for Linux balenaEtcher.

(1-3) Start Tinker board.

ID: linaro

PASSWORD: linaro

(1-4) This image file contains the kernel, drivers, and demo software, so the steps up to Chapter 4 are not necessary.

2. Environment configuration

2.2. Manual installation procedure of kernel, driver and demo software.

(2-1) Download and write TinkerOS image to SD card.

https://github.com/TinkerBoard/debian_kernel/releases/download/2.0.8/20181023-tinker-board-linaro-stretch-alip-v2.0.8.img.zip

(2-2) Start Tinker board.

ID:linaro

PASSWORD:linaro

3. Driver install

- Prerequisites

1. Prepare kernel source
2. Build and install new Linux kernel

Step 1. Prepare kernel source

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

[https://github.com/centuryarks/CA378-AOIS/releases/download/TINKER_v1.0.1_v4.4.132\(Debian9_v2.0.8\)/CA378_v1.0.1_TinkerOS_Debian_v2.0.8_src_build.tar.gz](https://github.com/centuryarks/CA378-AOIS/releases/download/TINKER_v1.0.1_v4.4.132(Debian9_v2.0.8)/CA378_v1.0.1_TinkerOS_Debian_v2.0.8_src_build.tar.gz)

```
# tar -zxvf CA378_v1.0.1_TinkerOS_Debian9_v2.0.8_src_build.tar.gz
# cd CA378_v1.0.1_TinkerOS_Debian9_v2.0.8_src_build
# ./PrepareKernelSources.sh
```

Step 2. Build and install new Linux kernel

Build and install kernel module with the following command

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

Reboot

```
# sudo reboot
```

4. Software install

Please install by the following procedure.

- Installation procedure

1. Download “demo_v1.0.1_tinker.tar.gz” from the following site.

[https://github.com/centuryarks/Sample/releases/download/TINKER_v1.0.1_v4.4.132\(Debian9_v2.0.8\)/demo_v1.0.1_tinker.tar.gz](https://github.com/centuryarks/Sample/releases/download/TINKER_v1.0.1_v4.4.132(Debian9_v2.0.8)/demo_v1.0.1_tinker.tar.gz)

```
# wget --no-check-certificate ¥  
“https://github.com/centuryarks/Sample/releases/download/TINKER_v1.0.1_v4.4.132(Debian9_v2.0.8)/demo_v1.0.1_tinker.tar.gz”
```

2. Unzip “demo_v1.0.1_tinker.tar.gz” file.

```
# tar -zxvf demo_v1.0.1_tinker.tar.gz
```

3. Execute “Install.sh” in the extracted folder.

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

4. A shortcut is created on the desktop.

DEMO



5. Demonstration functions

5.1. Focus & OIS

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

5.3. Capture image

5.4. Movie recording

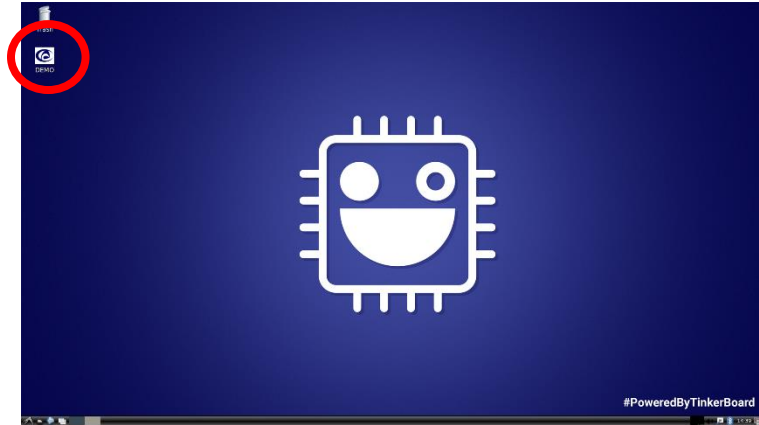
5.5. Build demo software

5.6 Reverse streaming image

5.1. Focus & OIS

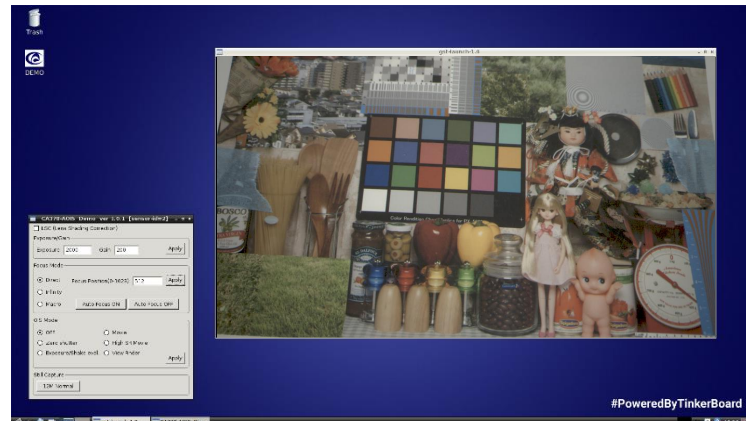
Procedure of starting Focus & OIS:

1. Click "DEMO" on the desktop.



2. Please change the distance of the object, or move the camera, confirm the function.

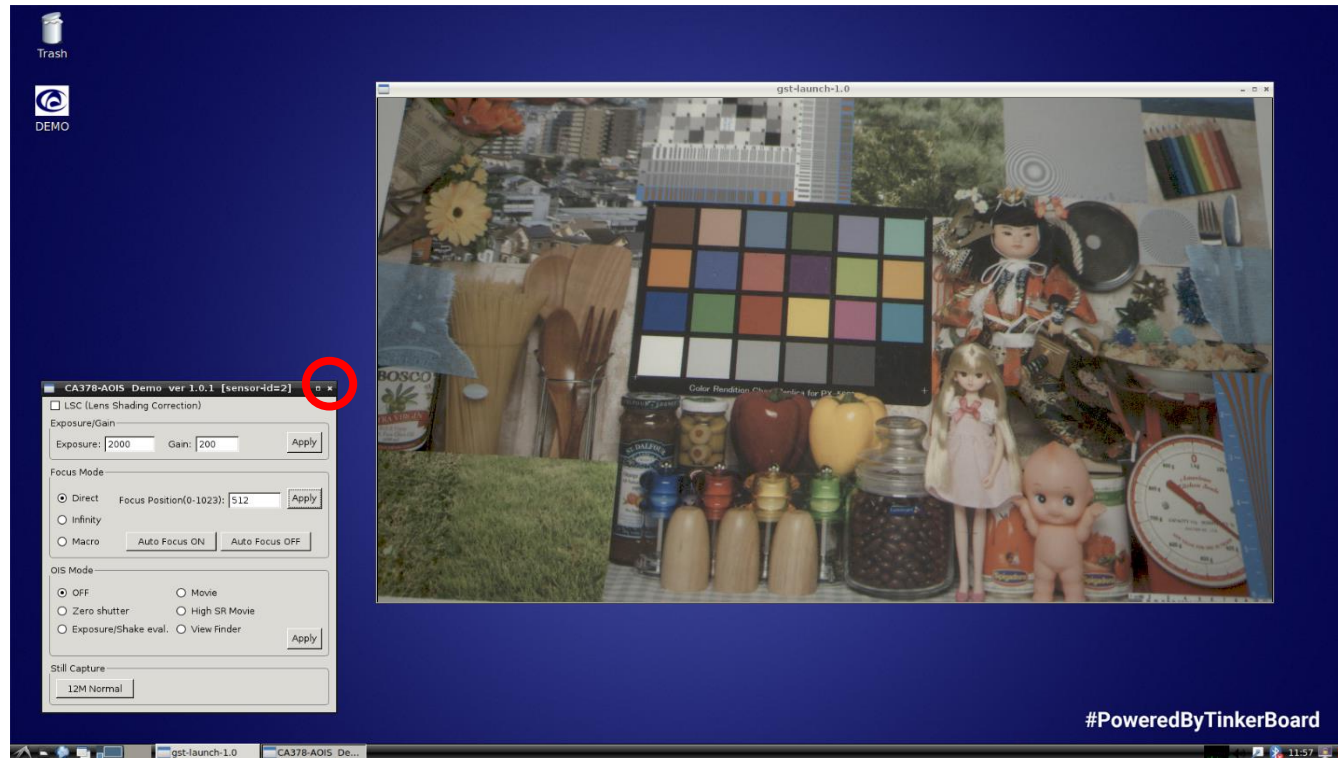
* For details of functions, refer to page 12.



5.1. Focus & OIS

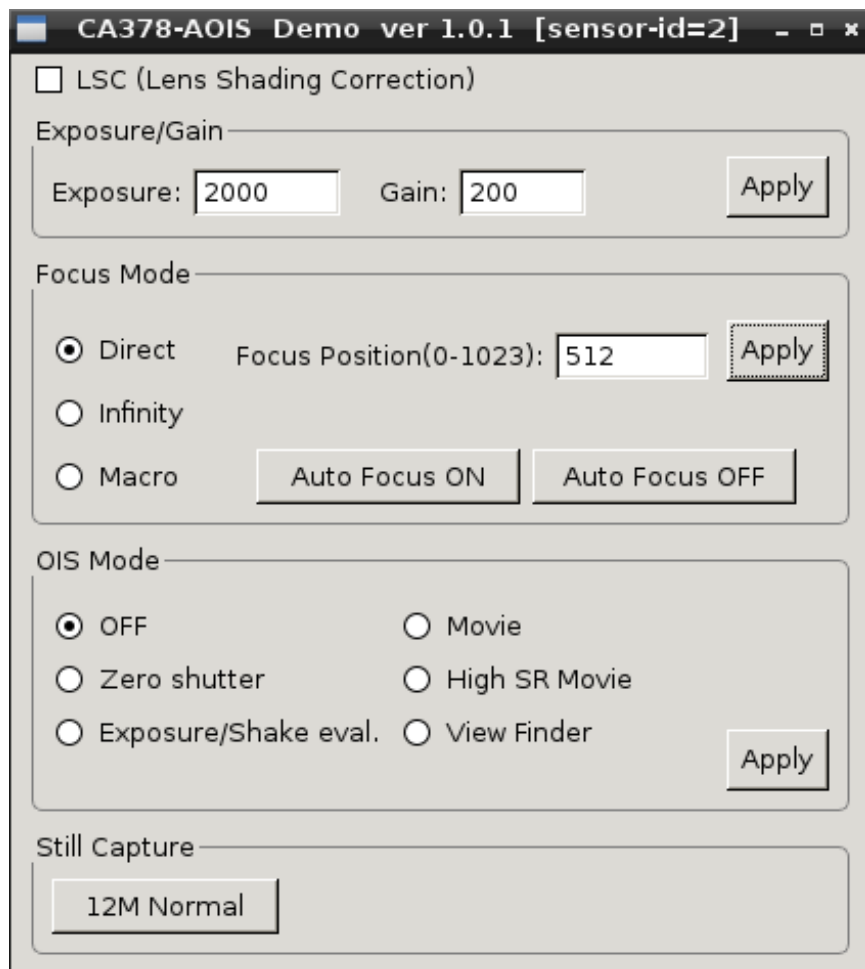
Procedure of finishing Focus & OIS:

1. Click the [x]



5.1. Focus & OIS

The following section describes each function of Focus & OIS.

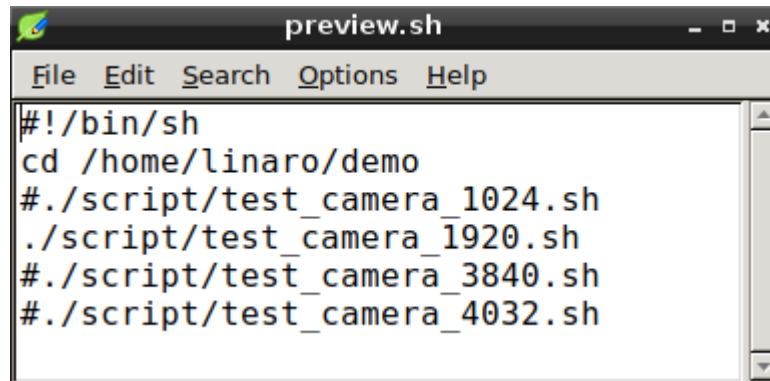


The screenshot shows the 'CA378-AOIS Demo ver 1.0.1 [sensor-id=2]' window. It contains several sections: 'LSC (Lens Shading Correction)' with an unchecked checkbox; 'Exposure/Gain' with input fields for 'Exposure: 2000' and 'Gain: 200', and an 'Apply' button; 'Focus Mode' with radio buttons for 'Direct' (selected), 'Infinity', and 'Macro', a 'Focus Position(0-1023): 512' input field, and 'Auto Focus ON'/'OFF' buttons; 'OIS Mode' with radio buttons for 'OFF' (selected), 'Movie', 'Zero shutter', 'High SR Movie', 'Exposure/Shake eval.', and 'View Finder', and an 'Apply' button; and 'Still Capture' with a '12M Normal' button.

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/preview.sh



```
#!/bin/sh
cd /home/linaro/demo
#./script/test_camera_1024.sh
./script/test_camera_1920.sh
#./script/test_camera_3840.sh
#./script/test_camera_4032.sh
```

Setting	Parameter
4032x3040	Width=4032, Height=3040, fps=15
3840x2160	Width=3840, Height=2160, fps=20
1920x1080	Width=1920, Height=1080, fps=80
1024x768	Width=1024, Height=768, fps=210

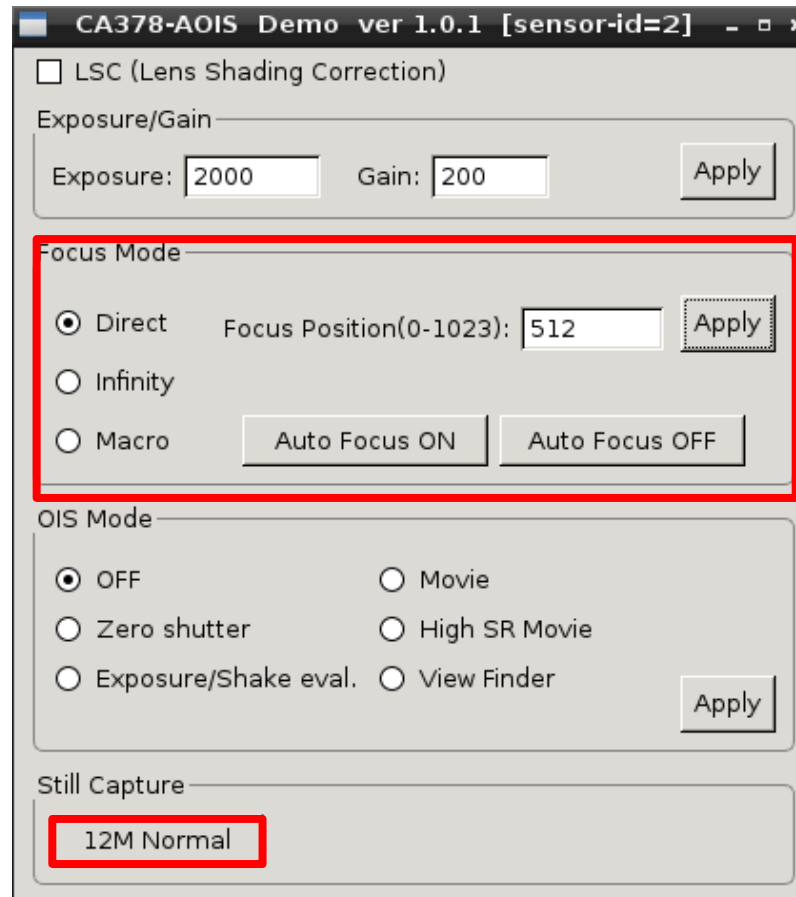
5.2. 12Mpixel still image capturing

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



The screenshot shows the 'CA378-AOIS Demo ver 1.0.1 [sensor-id=2]' window. The 'Focus Mode' section is highlighted with a red rectangle. It contains three radio buttons: 'Direct' (selected), 'Infinity', and 'Macro'. Next to 'Direct' is a 'Focus Position(0-1023):' field with the value '512' and an 'Apply' button. Below these are 'Auto Focus ON' and 'Auto Focus OFF' buttons. The 'OIS Mode' section has five radio buttons: 'OFF' (selected), 'Zero shutter', 'Exposure/Shake eval.', 'Movie', 'High SR Movie', and 'View Finder'. An 'Apply' button is at the bottom right of this section. The 'Still Capture' section at the bottom has a '12M Normal' button highlighted with a red rectangle.

CA378-AOIS Demo ver 1.0.1 [sensor-id=2]

☐ LSC (Lens Shading Correction)

Exposure/Gain

Exposure: Gain:

Focus Mode

☒ Direct Focus Position(0-1023):

☐ Infinity

☐ Macro

OIS Mode

☒ OFF ☐ Movie

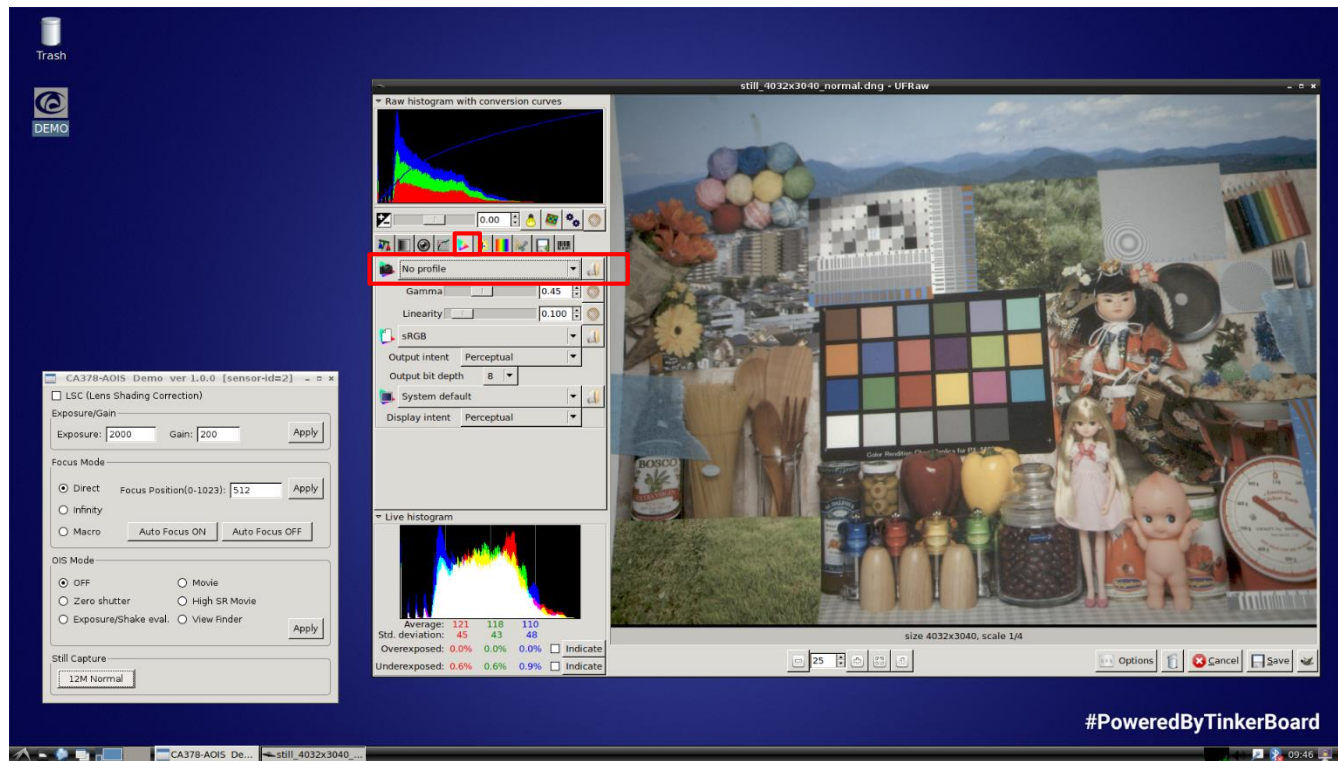
☐ Zero shutter ☐ High SR Movie

☐ Exposure/Shake eval. ☐ View Finder

Still Capture

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

```
stillCapture12M_Normal.sh
# /bin/sh
cd /home/linaro/demo
#W=1024
#H=768
#media-ctl -d /dev/media0 --set-v4l2 "imx378 2-001a":0[fmt:SBGGR10/1024x768]'
#media-ctl -d /dev/media0 --set-v4l2 "rkisp1-isp-subdev":0[fmt:SBGGR10/1024x768]' #sink
#media-ctl -d /dev/media0 --set-v4l2 "rkisp1-isp-subdev":0[fmt:SBGGR10/1024x768]' --set-
#media-ctl -d /dev/media0 --set-v4l2 "rkisp1-isp-subdev":2[fmt:SBGGR10/1024x768]' #sourc
#media-ctl -d /dev/media0 --set-v4l2 "rkisp1-isp-subdev":2[fmt:SBGGR10/1024x768]' --set-
#W=1920
#H=1080
#media-ctl -d /dev/media0 --set-v4l2 "imx378 2-001a":0[fmt:SBGGR10/1920x1080]'
#media-ctl -d /dev/media0 --set-v4l2 "rkisp1-isp-subdev":0[fmt:SBGGR10/1920x1080]' #sink
#media-ctl -d /dev/media0 --set-v4l2 "rkisp1-isp-subdev":0[fmt:SBGGR10/1920x1080]' --set-
#media-ctl -d /dev/media0 --set-v4l2 "rkisp1-isp-subdev":2[fmt:SBGGR10/1920x1080]' #sour
#media-ctl -d /dev/media0 --set-v4l2 "rkisp1-isp-subdev":2[fmt:SBGGR10/1920x1080]' --set-
#W=3840
#H=2160
#media-ctl -d /dev/media0 --set-v4l2 "imx378 2-001a":0[fmt:SBGGR10/3840x2160]'
#media-ctl -d /dev/media0 --set-v4l2 "rkisp1-isp-subdev":0[fmt:SBGGR10/3840x2160]' #sink
#media-ctl -d /dev/media0 --set-v4l2 "rkisp1-isp-subdev":0[fmt:SBGGR10/3840x2160]' --set-
#media-ctl -d /dev/media0 --set-v4l2 "rkisp1-isp-subdev":2[fmt:SBGGR10/3840x2160]' #sour
#media-ctl -d /dev/media0 --set-v4l2 "rkisp1-isp-subdev":2[fmt:SBGGR10/3840x2160]' --set-
#W=4032
#H=3040
#media-ctl -d /dev/media0 --set-v4l2 "imx378 2-001a":0[fmt:SBGGR10_1X10/4032x3040]'
#media-ctl -d /dev/media0 --set-v4l2 "rkisp1-isp-subdev":0[fmt:SBGGR10_1X10/4032x3040]' #
#media-ctl -d /dev/media0 --set-v4l2 "rkisp1-isp-subdev":0[fmt:SBGGR10_1X10/4032x3040]' -
#media-ctl -d /dev/media0 --set-v4l2 "rkisp1-isp-subdev":2[fmt:SBGGR10_1X10/4032x3040]' #
#media-ctl -d /dev/media0 --set-v4l2 "rkisp1-isp-subdev":2[fmt:SBGGR10_1X10/4032x3040]' -
filename=still_${W}x${H}_normal
v4l2-ctl -d /dev/video1 --set-ctrl exposure=${2} --set-ctrl gain=${3} --set-selection=tar
./bin/raw2dng -i $filename.raw -o $filename.dng -w ${W} -h ${H} -bit 10 -gain 1.0 1.0 1.0
ufraw $filename.dng
```

Capture command

```
# v4l2-ctl -d /dev/video1
--set-ctrl exposure=2000
--set-ctrl gain=200
--set-selection=target=crop,top=0,left=0,width=4032,height=3040
--set-fmt-video=width=4032,height=3040,pixelformat=BG10
--stream-mmap=8 --stream-to=temp.raw --stream-count=1
```

Setting	Parameter
4032x3040	Width=4032, Height=3040
3840x2160	Width=3840, Height=2160
1920x1080	Width=1920, Height=1080
1024x768	Width=1024, Height=768

5.4. Movie recording

Secure recording memory area

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

Movie recording(mp4)

```
# cd ~/demo/script/  
# ./mp4_recording.sh /mnt/ram/test 1920 1080 10 40
```

Argument	Description
arg1	Movie file name
arg2	Width
arg3	Height
arg4	Fps
arg5	Capture frame num

Movie viewer(mp4)

```
# cd ~/demo/script/  
# mplayer -fps 10 /mnt/ram/test.mp4
```

5.5. Build demo software

Procedure of build software

```
# cd ~/demo/src/  
# ./MakeDomo.sh  
# mv GUI/DemoGUI /home/linaro/demo/bin
```

※If an error occurs with qmake, install it with the following command.

```
# sudo apt install qt4-default
```

5.6 Reverse streaming image

To reverse the image when streaming, follow the steps below.

1. Edit demo script file.

- Edit as shown in the red part below.(~/demo/script/test_camera_1920.sh)

```
#!/bin/sh
export DISPLAY=:0.0
media-ctl --set-v4l2 '"imx378 2-001a":0[fmt:SRGGB10_1X10/1920x1080]'
media-ctl -d /dev/media0 --set-v4l2 '"rkisp1-isp-subdev":0[fmt:SRGGB10_1X10/1920x1080]' #sink
media-ctl -d /dev/media0 --set-v4l2 '"rkisp1-isp-subdev":0[fmt:SRGGB10_1X10/1920x1080]' --set-v4l2 '"rkisp1-isp-subdev":0[crop:(0,0)/1920x1080]'
media-ctl -d /dev/media0 --set-v4l2 '"rkisp1-isp-subdev":2[fmt:YUYV8_2X8/1920x1080]' #source
media-ctl -d /dev/media0 --set-v4l2 '"rkisp1-isp-subdev":2[fmt:YUYV8_2X8/1920x1080]' --set-v4l2 '"rkisp1-isp-subdev":2[crop:(0,0)/1920x1080]'
v4l2-ctl --set-ctrl=vertical_flip=0 --set-ctrl=horizontal_flip=0
gst-launch-1.0 rkcamsrc device=/dev/video1 io-mode=4 isp-mode=2A tuning-xml-path=./script/IMX378_1022.xml ! videoconvert ! video/x-raw,format=NV12,width=1280,height=720 ! rkximagesink
```

2. Edit driver file.

- Edit as shown in the red part below.
 - (~/CA378_v1.0.1_TinkerOS_Debian9_v2.0.8_src_build/debian_kernel_cp/drivers/media/i2c/imx378.c)

```
1450line
    fmt->format.code = MEDIA_BUS_FMT_SRGGB10_1X10;

1492line
    fmt->format.code = MEDIA_BUS_FMT_SRGGB10_1X10;
```

3. Build and install kernel.

- Build and install the kernel with the following commands.

```
cd ~/CA378_v1.0.1_TinkerOS_Debian9_v2.0.8_src_build
./BuildKernelSources.sh
```

5.6 Reverse streaming image

4. Edit Raw2Dng file.
 - Edit as shown in the red part below.
 - (~demo/src/tool/raw2dng.c)

```
201line  
TIFFSetField (tif, TIFFTAG_CFAPATTERN, 4, "¥00¥01¥01¥02");
```

5. Build and update demo tool.
 - Build and update demo tool with the following commands.

```
cd ~/demo/src  
./MakeDemo.sh
```

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
│   ├── raw2dng
│   └── raw2hdr
├── script
│   ├── demo.sh
│   ├── IMX378_I030_XGA_LSC.xml
│   ├── IMX378_I205.xml
│   ├── mp4_recording.sh
│   ├── preview.sh
│   ├── ramdisk.sh
│   ├── stillCapture12M_Normal.sh
│   ├── test_camera_I024.sh
│   ├── test_camera_I920.sh
│   ├── test_camera_3840.sh
│   └── test_camera_4032.sh
├── src
│   ├── GUI
│   │   ├── af_control.c
│   │   ├── af_control.h
│   │   ├── communication.h
│   │   ├── communication_tinker.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
│   │   ├── libtiff.patch
│   │   ├── Makefile
│   │   ├── raw2dng.c
│   │   ├── raw2hdr.c
│   │   └── tools.h
│   └── MakeDemo.sh
```

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.

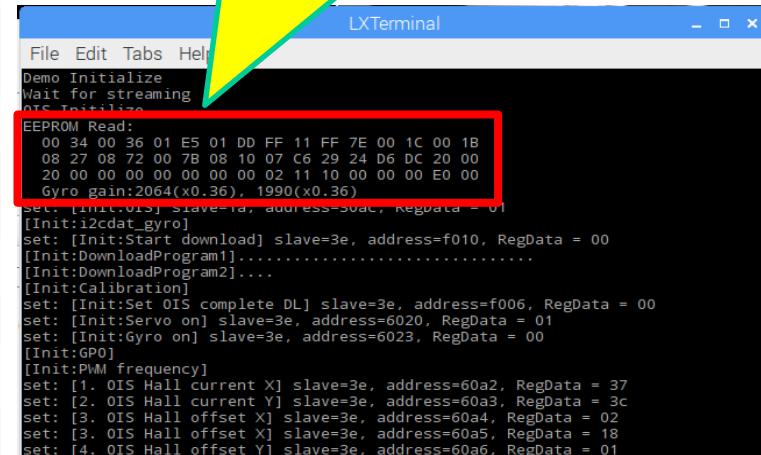
A.2. About the setting file

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

```
# DEMO Setting
preview = /home/linaro/demo/script/preview.sh
stillCapture12M_Normal = /home/linaro/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=30a0, 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
```