KEIm-CVSoC
Development Kit Rev.B
Startup Guide

Ver.1.1

Kondo Electronics Industry Co., Ltd.

Preface

Thank you for purchasing a KEIm product.

Read this manual and related documents thoroughly before using this product and observe the precautions for use.

Precautions for use

- The contents of this manual are subject to change without prior notice. Contact the Kondo Electronics Industry service center or check the Kondo Electronics Industry website for the latest information before using the product.
- This product contains general electronic components. Do not use the product for devices that require extremely high reliability (aerospace equipment, nuclear power equipment, medical equipment for life support, etc.).
- This product is developed and manufactured for use only in Japan. If this product or a product that incorporates this product is exported outside Japan, all the necessary procedures must be completed at the responsibility and expense of the customer in accordance with the Foreign Exchange and Foreign Trade Act and other export laws and regulations.
- Be sure to turn off the power before inserting or removing cables to connectors other than LAN and USB.
- Do not use this product in locations subject to large amounts of water, humidity, dust, or oil smoke.
- Using or copying all or any part of the contents of documents related to this product without the permission of Kondo Electronics Industry is prohibited.
- All company names and product names used in this manual and related documents are trademarks or registered trademarks of their respective companies.

Contact information

- For any questions about this product, contact the following email address:

contact us

Table of contents

1. Overview

This is a startup guide for designing software using the KEIm-CVSoC development kit.

1.1. Package contents

The table below shows the package contents of the KEIm-CVSoC development kit.

Item	Remarks
KEIm-CVSoC camera unit	Built-in KEIm-CVSoC SoM
AC adapter	12VDC, center plus
USB Micro B cable	For UART connection

2. Camera unit specifications

2.1. Basic specifications

Table 2-1 Basic specifications of the KEIm-CVSoC camera unit

Item		Description
SoM	SoC FPGA model name	5CSXFC6C6U23I7N
	DDR3L SDRAM (HPS)	2GByte, bus width (32bit) MT41K512M16VRN-107 IT (Micron) ×2
	QSPI Flash (HPS)	64MByte MT25QL512ABB8E12-0SIT (Micron)
	QSPI Flash (FPGA)	32MByte, for configuration MT25QL256ABA8E12-1SIT (Micron)
	Clock (HPS)	25MHz
	Clock (FPGA)	50MHz, 100MHz
	RTC	DS1339U-33+ (Maxim), I2C I/F
	EEPROM	24LC32A-I/ST (Microchip), 32kbit, I2C I/F
IO board	Camera input	Camera module OV5647 (OmniVision), MIPI CSI-2 2-Lane
	Video output	DVI transmitter TFP410, mini-HDMI
	Ethernet	10/100/1000Base-T, RJ45
	USB2.0	HighSpeed (480Mbps), OTG, USB Micro-AB
	UART	USB serial, USB Micro-B
	SD	MicroSD card slot
	M.2 slot	Mustang-M2BM-MX2 (sold separately) connectible
	LED	For users × 4, for power × 1
	Switch	DIP switch × 1 (4 contacts), push switch × 4 (for users × 2, for reset × 2), slide switch × 1 (for power)
	Debug I/F	JTAG 10-pin connector
Power supply		12±5%, provided through the supplied AC adapter
Power consumption		TBD
Operating temperature range		0 to 40°C
Dimensions		110 × 80 × 50mm (excluding the protuberance)

2.2. Part names

Figure 2-1 and Figure 2-2 show the external view of the camera unit.

Figure 2-1 Camera unit external view (front view)

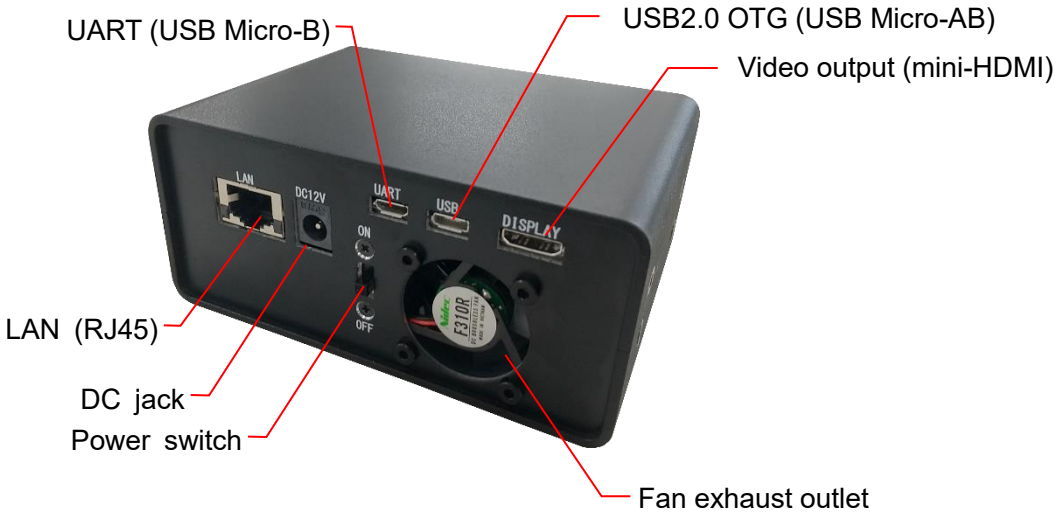


Figure 2-2 Camera unit external view (rear view)

2.3. Board configuration

The camera unit consists of the SoM, IO board, and camera module. This section describes the functional specifications of the board.

2.3.1. Board layout

Figure 2-3 and Figure 2-4 show the layout of the board.

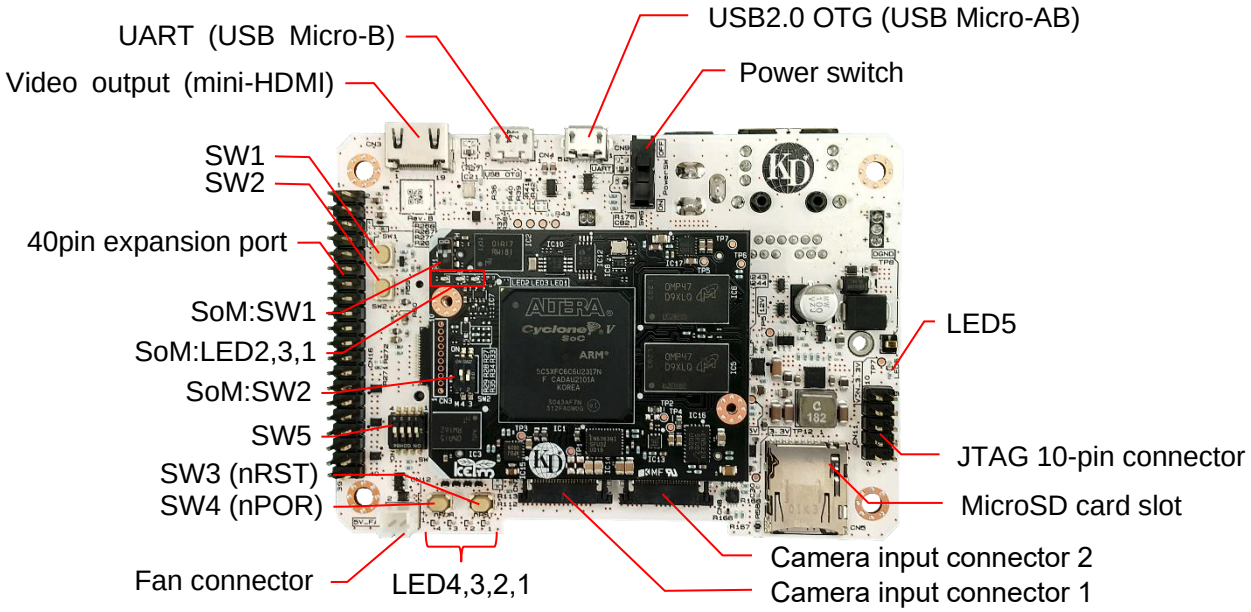


Figure 2-3 Board layout (top view)

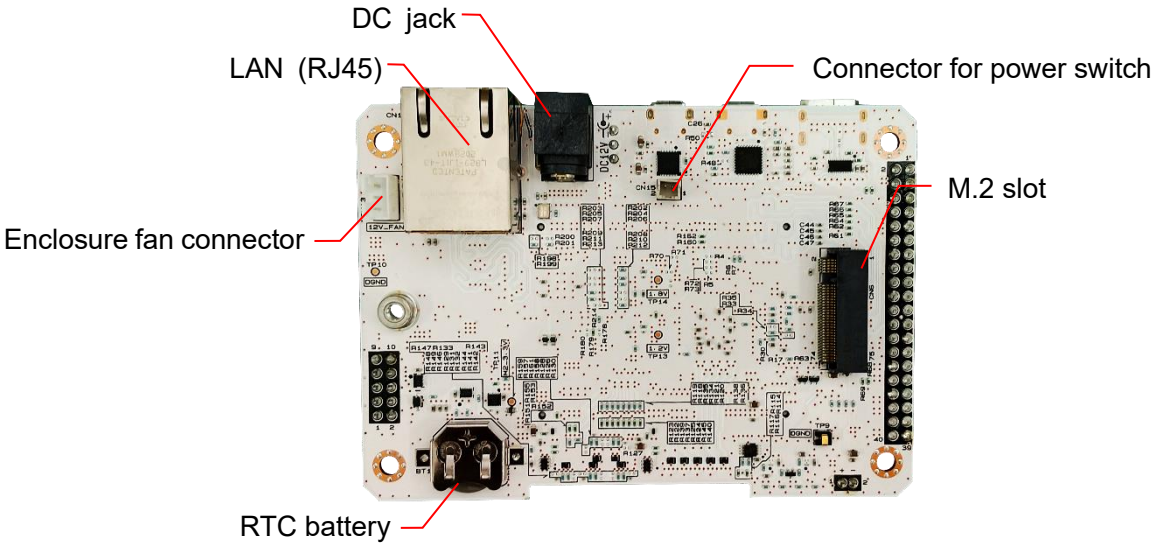


Figure 2-4 Board layout (bottom view)

2.3.2. Switches and LEDs

The SoM and the IO board have function setting and general-purpose (for users) switches and LEDs. This section describes the functions of the switches and LEDs.

2.3.2.1. Description of LED functions

Table 2-2 and Table 2-3 show the LED functions of the SoM and the IO board, respectively.

Table 2-2 LED functions of the SoM

No.	Name	Function
LED1	Configuration LED	Indicates the configuration status. ON: Configuration complete OFF: Configuration not complete yet
LED2	User LED (FPGA)	User LED. It is connected to IO on the FPGA. ON: The pin is set to Low. OFF: The pin is set to High.
LED3	User LED (HPS)	User LED. It is connected to GPIO0 on the HPS. ON: The pin is set to Low. OFF: The pin is set to High.

Table 2-3 LED functions of the IO board

No.	Name	Function
LED1-4	User LED (FPGA)	User LED. It is connected to IO on the FPGA. ON: The pin is set to Low. OFF: The pin is set to High.
LED5	Power LED	Indicates the power status. ON: The power is ON. OFF: The power is OFF.

2.3.2.2. Description of switch functions

Table 2-4 and Table 2-5 show the switch functions of the SoM and the IO board, respectively.

Table 2-4 Switch functions of the SoM

No.	Function	Setting	Setting mode
SW1	BSEL setting switch. Set the HPS boot mode.	 BSEL1 Set to High	QSPI boot mode
		 BSEL1 Set to Low	SD boot mode * Factory setting
SW2	MSEL setting switch. Set the FPGA configuration mode.	 MSEL4=1 MSEL3=0	Active Serial × 1 or × 4 mode
		 MSEL4=0 MSEL3=1	Fast Passive Parallel × 32 mode * Factory setting

Table 2-5 Switch functions of the IO board

No.	Signal name/function	Setting	Description
SW1	HPS_nRST	Push (ON)	Set nRST (Warm Reset) to Low on the HPS and perform a reset.
		Release (OFF)	Set nRST (Warm Reset) to High on the HPS and release a reset.
SW2	HPS_nPOR	Push (ON)	Set nPOR (Cold Reset) to Low on the HPS and perform a reset.
		Release (OFF)	Set nPOR (Cold Reset) to High on the HPS and release a reset.
SW3	PUSHSW1 (FPGA)	Push (ON)	Set the signal to Low.
		Release (OFF)	Set the signal to High.
SW4	PUSHSW2 (HPS)	Push (ON)	Set the signal to Low.
		Release (OFF)	Set the signal to High.
SW5	User switch	 ON	Set the signal to Low.
		 OFF	Set the signal to High. * Factory setting
SW6	Power switch	 ON	Power ON * Factory setting
		 OFF	Power OFF

3. CamView operation procedure

This section describes how to display a video captured with the camera module on the Linux terminal by executing the Linux application software CamView using the reference design (available for download on the Kondo Electronics Industry website).

3.1. Equipment to prepare

Table 3-1 shows items that need to be prepared, as well as this product, to run the program. Meanwhile, Table 3-2 lists PC tools required for operation.

Table 3-1 List of equipment to prepare

Item	Remarks
KEIm-CVSoC development kit	This unit. It contains the AC adapter and the USB Micro-B cable.
HDMI mini cable	
USB Micro-AB cable	
MicroSD card	
USB keyboard	
USB mouse	
USB hub	
Display	The display must have an HDMI port.
PC	Used to write data to the microSD card or for the UART terminal. It does not require high performance. However, if the PC has no SD card slot, you will need a USB or other type of SD card reader.

Table 3-2 List of PC tools

Item	Remarks
Win32 Disk Imager	Used to write the SD image to the SD card.
TeraTerm	Terminal software
Demo software SD image	Download it from the Kondo Electronics Industry website.

3.2. Downloading the SD image

Write the Linux image to a microSD card that is inserted into the KEIm-CVSoC camera unit. In this manual, Win32 Disk Imager is used as a write tool. Version 1.0 is available for download from the following website as of September 2020. Download and install it according to the installer instructions.

https://sourceforge.net/projects/win32diskimager/

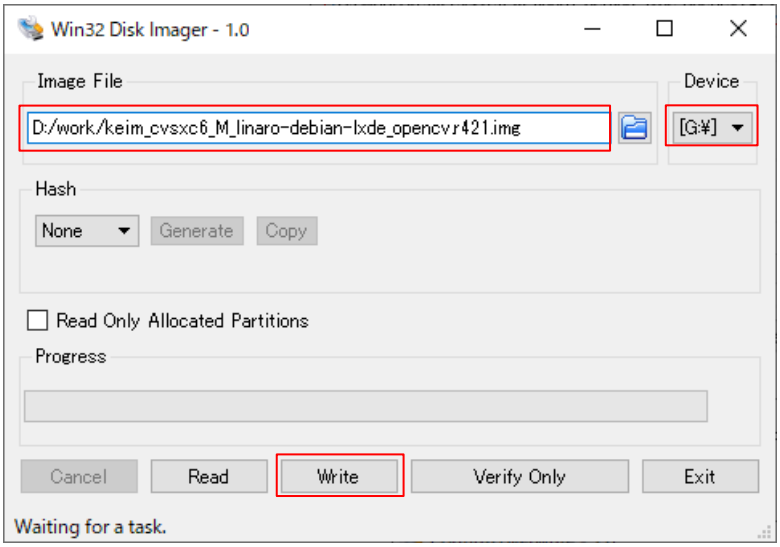
The SD image file “keim-cvsoc-b_devkit_gsrd.7z” is available for download from the following URL page of the Kondo Electronics Industry website. Download the latest version. The file is compressed in 7z format, so decompress it using 7zip to get the .img file.

https://kd-group.co.jp/download/

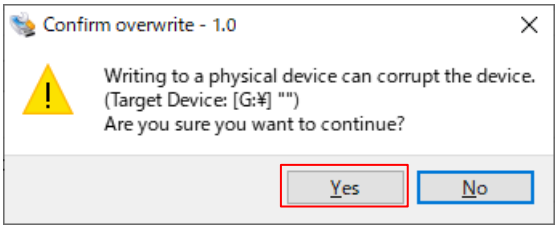
3.3. Procedure for writing the SD image

(1) Insert the microSD card into the PC. If the PC has no SD card slot, use a USB card reader.

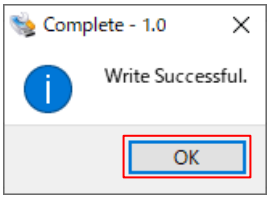
(2) Start Win32 Disk Imager. Specify the path of the prepared .img file in Image File. Also, select the SD card drive type from Device.



(3) When you click Write, the following (Confirm overwrite) dialog box appears. Click Yes to start writing the image.



(4) When the image write is complete, the Complete dialog box appears. Click OK.

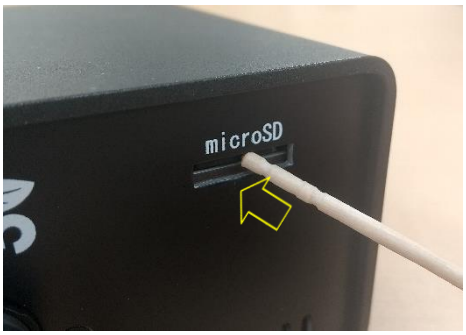


(5) Then, execute SD card ejection from the Windows task tray and remove the microSD card from the SD card slot.

* There has been a change to SD card partition recognition since the Windows update (20H2). If you try to overwrite the image to an SD card where the reference design is already written, it may fail. In such a case, delete the SD card partition using the Windows administrative tools or Diskpart tool and write the image again.

3.4. How to remove and insert a microSD card

To remove a microSD card from the camera unit, turn off the unit, push the microSD card gently using a thin stick, and remove it when it pops out a little bit. When inserting a microSD card, make sure that it is inserted until it clicks. At this time, the logo of the microSD card must be facing up.



3.5. Connection configuration

Figure 3-1 shows the connection configuration diagram. Be sure to cut the power from the AC adapter before connecting the camera unit. If the DC plug is inserted into the camera unit with the AC adapter ON, the unit is turned on. In this section, you will turn on the power after inserting the microSD card where the SD image is already written. A power strip with a switch would be useful.

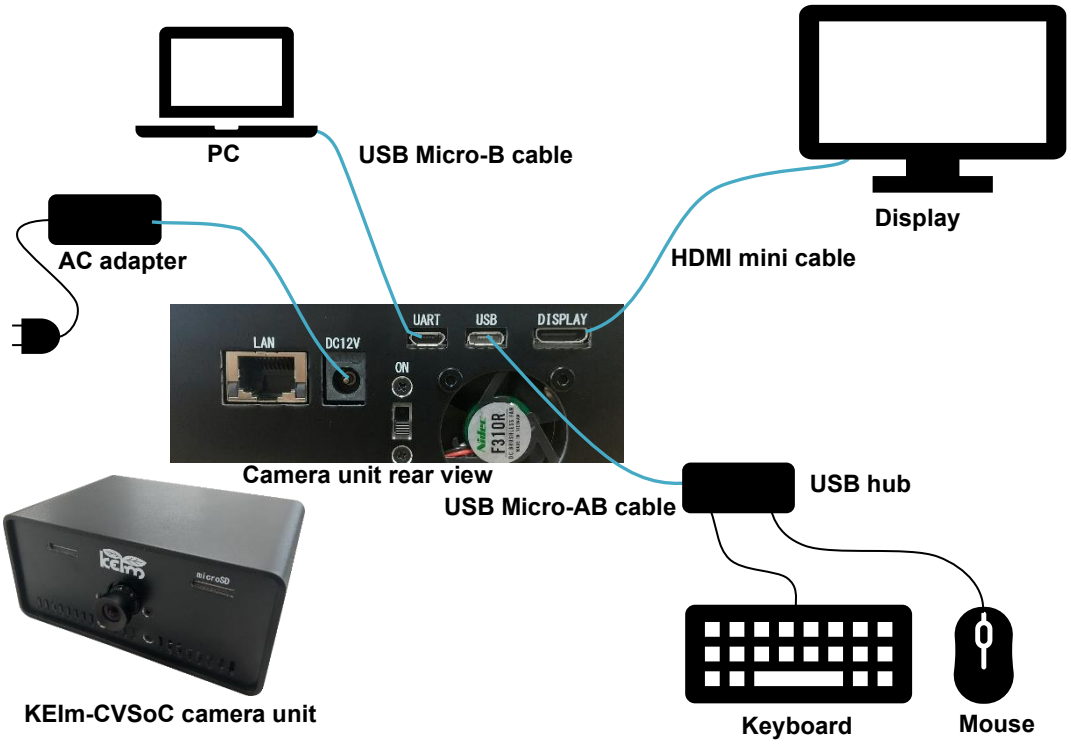


Figure 3-1 Connection configuration

3.6. Terminal connection

A terminal connection to the KEIm-CVSoC camera unit is established through USB serial CP2102N-A02-GQFN24 (Silicon Labs). To use this interface, you need to install the Silicon Labs Virtual COM Port driver (hereinafter referred to as VCP driver).

3.6.1. Installing the VCP driver

If you use a PC where the VCP driver is already installed, once you connect the KEIm-CVSoC camera unit to the PC through the USB Micro B cable, the USB serial driver will be automatically installed. Otherwise, install the Windows VCP driver from the following URL page of the Silicon Labs website.

https://www.silabs.com/products/development-tools/software/usb-to-uart-bridge-vcp-drivers

When the driver is successfully installed, the CP210x COM port is displayed in Windows Device Manager as shown in Figure 3-2.

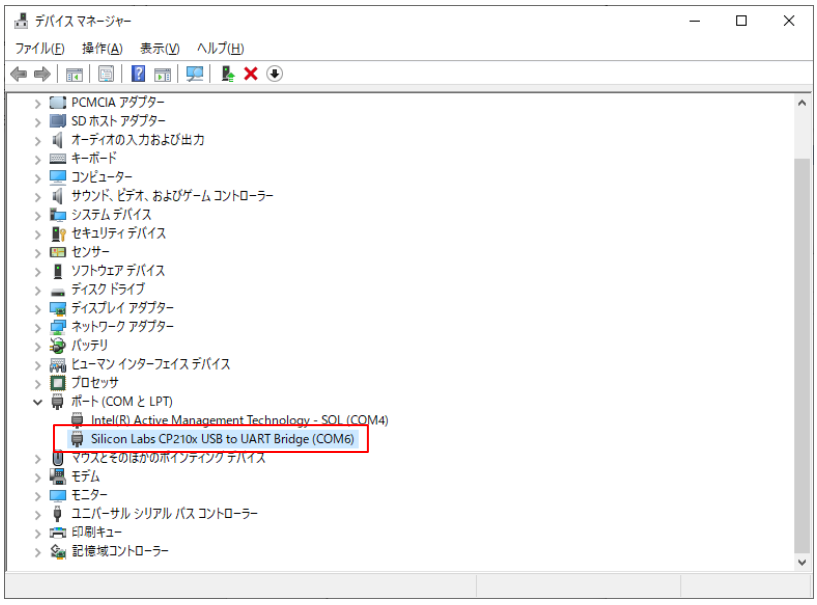


Figure 3-2 Device Manager

3.6.2. Communication format

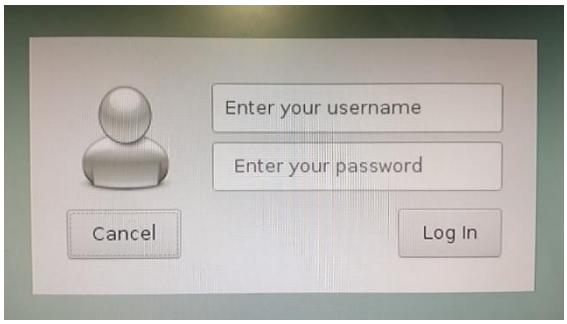
Table 3-3 shows the UART communication format for the reference design. Use the same communication settings for the terminal software, such as TeraTerm.

Table 3-3 Communication format

Item	Setting
Port	Set the COM number shown in Device Manager.
Speed	115200bps
Data	8bit
Parity	none
Stop bit	1bit
Flow control	None

3.7. Booting Linux

When the camera unit is turned on, Linux is booted with the login screen on the display as shown in the figure below. Enter "linaro" in both username and password fields and click the Log In button.



3.8. Executing CamView

From the start menu, select System Tools > LXterminal to launch the terminal, and then enter the following command:

```
$ cd ~/CamView/build/
$ ./CamView
```

The window appears as shown in Figure 3-3, displaying the video captured with the camera.

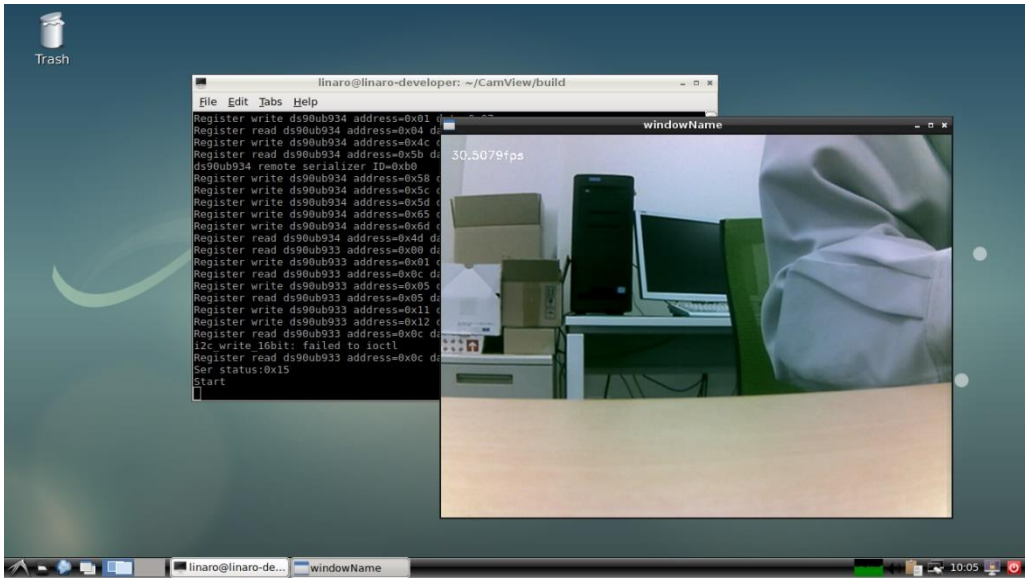


Figure 3-3 CamView execution result

To exit CamView, press the ESC key on the CamView window.

4. boardTest operation procedure

This section describes how to access the peripherals of the internal SoM and IO board in the KEIm-CVSoC camera unit using boardTest, an application pre-installed in the reference design used in Chapter 3.

4.1. Procedure

(1) Launch the Linux desktop using the same procedure as in Section 3.8 in the previous chapter.

(2) Connect the LAN cable to the camera unit LAN port to build an Internet environment.

(3) Enter the following command to execute the boardcheck application:

```
$ cd ~/Check
$ ./boardTest
```

When the menu is displayed on the console, select the desired number.

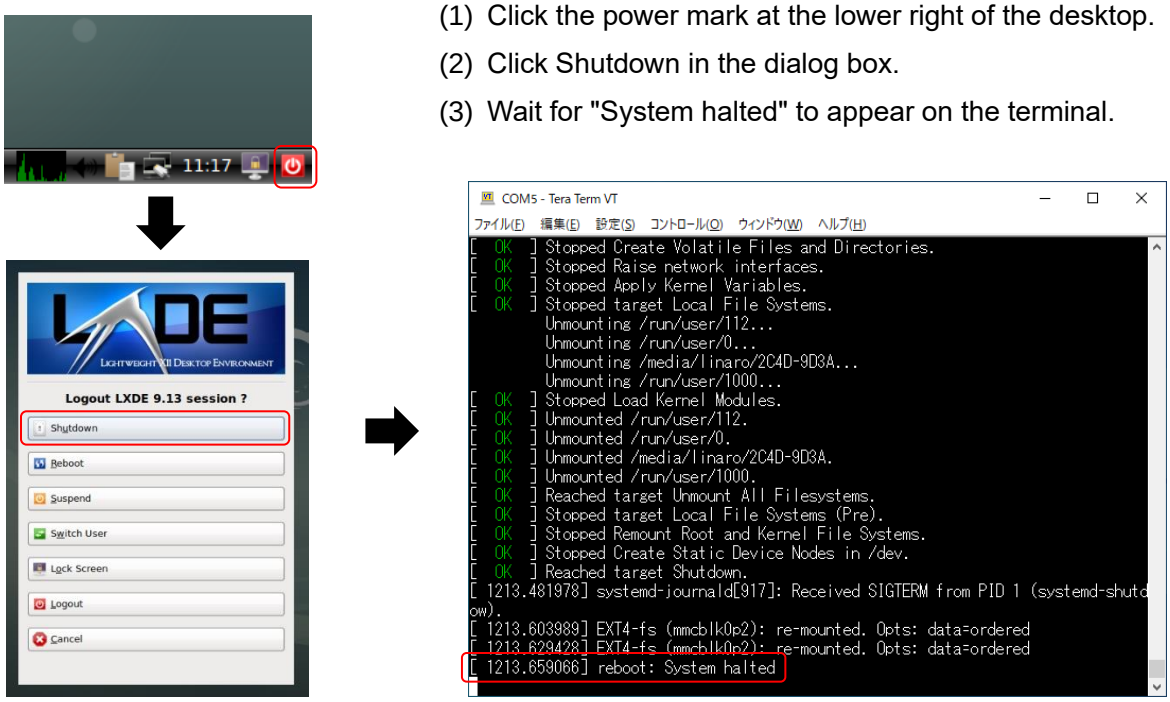
Table 4-1 shows the description of each process.

Table 4-1 Check menu list

No.	Item	Operation description
1	SDRAM memory check	Executes an SDRAM memory check.
2	RTC setting	Connects to the NTP server, and then writes the current time to the RTC after the time is synchronized.
3	EEPROM check	Writes test data to the EEPROM, and then reads and compares data.
4	QSPI flash check	Writes test data to the QSPI flash, and then reads and compares data.
5	LED check	Flashes the LEDs on the IO board.
6	Dip switch & Push switch check	Reads out the DIP switch and push switch on the IO board.
7	Exit the board test	Exits this program.

5. **Shutdown procedure**

If you turn off the camera unit while Linux is running, microSD card data may corrupt. Be sure to perform the shutdown process as shown in Figure 5-1 before turning off the power.



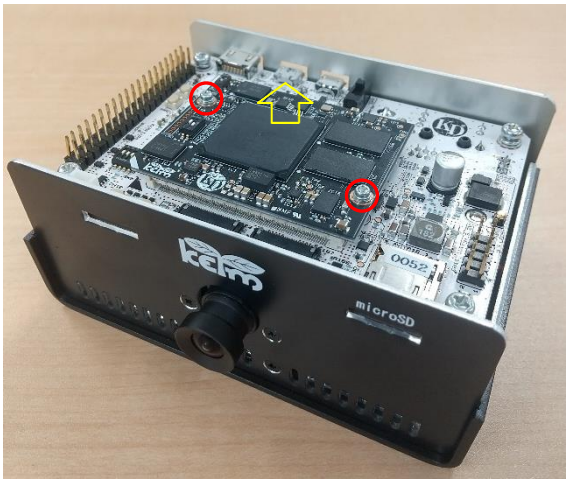
(1) Click the power mark at the lower right of the desktop.
(2) Click Shutdown in the dialog box.
(3) Wait for "System halted" to appear on the terminal.

Figure 5-1 Shutdown process

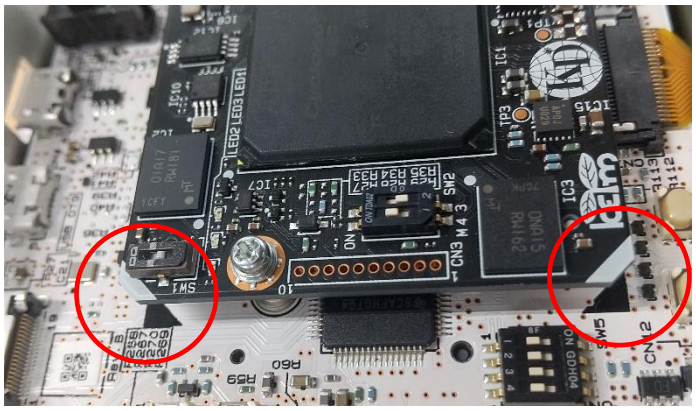
6. **Appendix**

6.1. Precautions on mounting and removing the SoM.

To remove the SoM from the IO board in the KEIm-CVSoC camera unit, remove the screws indicated by the red circles in the figure below and pull out the SoM vertically.



To mount the SoM again, align the diagonally-cut corner with the mark indicated by the red circle in the figure below first, and then push it down firmly and vertically.



6.2. Modify ISP settings for camera module

The camera module's CIS (CMOS Image Sensor) into the KEIm-CVSoC development kit, OV5647 (OmniVision) are equipped with image processing and adjustment functions such as AEC (Auto Exposure Control), AGC (Auto Gain Control), and AWB (Auto White Balance). An application cam_set.py is provided in the reference design to adjust the settings, so abailable it when you want to adjust the image from the camera.

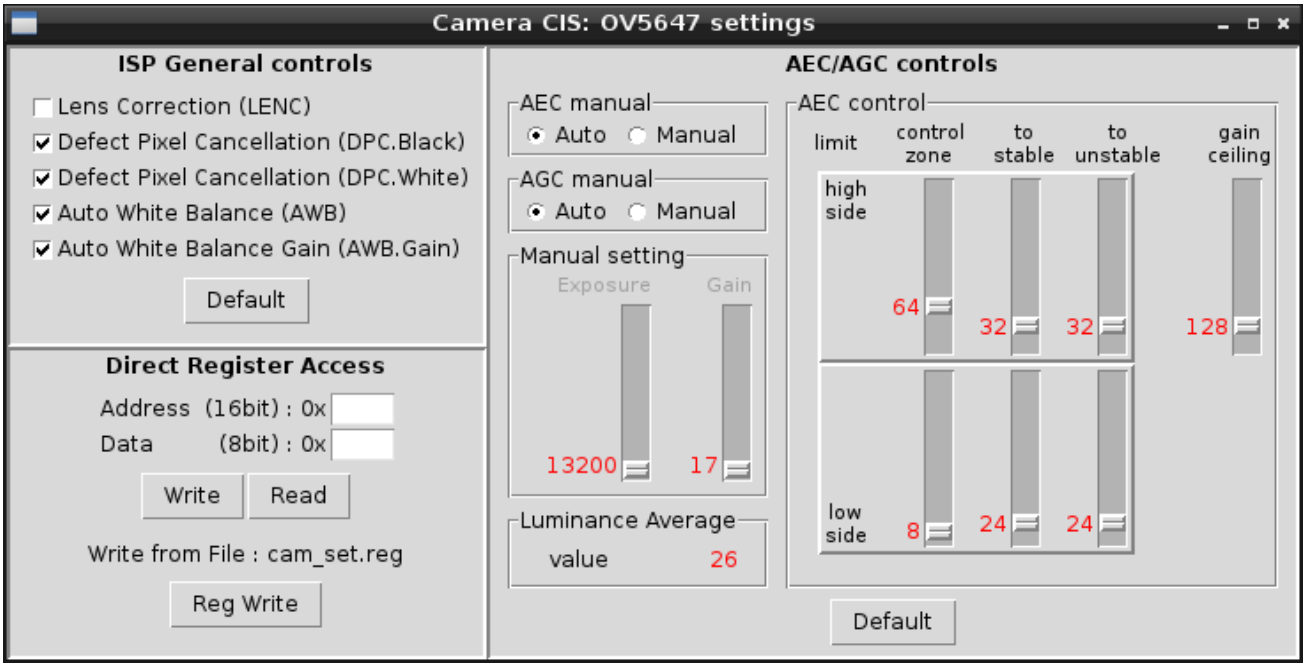
The usage is as follows.

First, launch the CamView application. (CIS is started by executing CamView and register access will be possible. If CIS is not running, this application will not start with an error.)

Next, launch the cam_set.py application with the following command.

```
$ cd ~/CamView/
$ python3 pysrc/cam_set.py
```

The following GUI will be launched.



This application accesses the CIS register to modify and retrieve the setting value.

Please refer to CIS datasheet for details on each function and register.

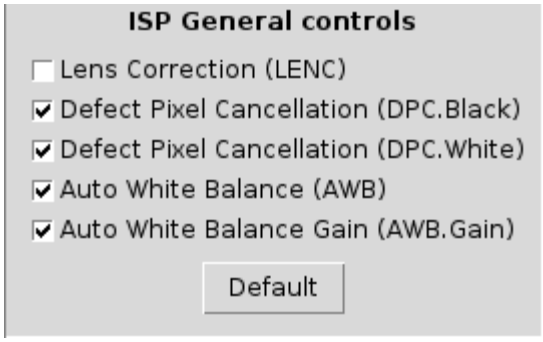
The settings from this GUI are saved in the cam_set.ini file and restored at startup.

If you want to restore the default settings, click the "Defalt" button on the GUI, or delete the above .ini file before starting up. Also, please note that registers changed by writing with "Direct Register Access" will need to be written back to their initial values again, or CamView will need to be restarted.

This section describes each function that can be set in this application.

① ISP General controls

This function controls ON (Enable) or OFF (Disable) of each ISP function.



The functions are below.

- Correction of lens distortion（LENC）
- Cancelation of black defect pixel（DPC.Black）
- Cancelation of white defect pixel（DPC.White）
- Control of white balance（AWB）
- Gain control of white balance（AWB Gain）

For details on each function, refer to the CIS datasheet.

② Direct Register Access

This function allows free register access. Write and read access is possible.

Input “Address (16 bits)” and “Data (8 bits)”, press the “Write” button to write to the register.
Input “Address (16bit)” and press the “Read” button to display the register read value in “Data (8bit)”.
The input and display here should be hexadecimal, “Address (16bit)” should be 4 digits, and “Data (8bit)” should be 2 digits. Please note that there is no input checking or correction function.
Please refer to the CIS datasheet for details on the addresses and attributes of each register.

Batch writing is also possible from the register setting file. Prepare the register setting file cam_set.reg in the current directory, and click the Reg Write button to write it. The file format is described below.

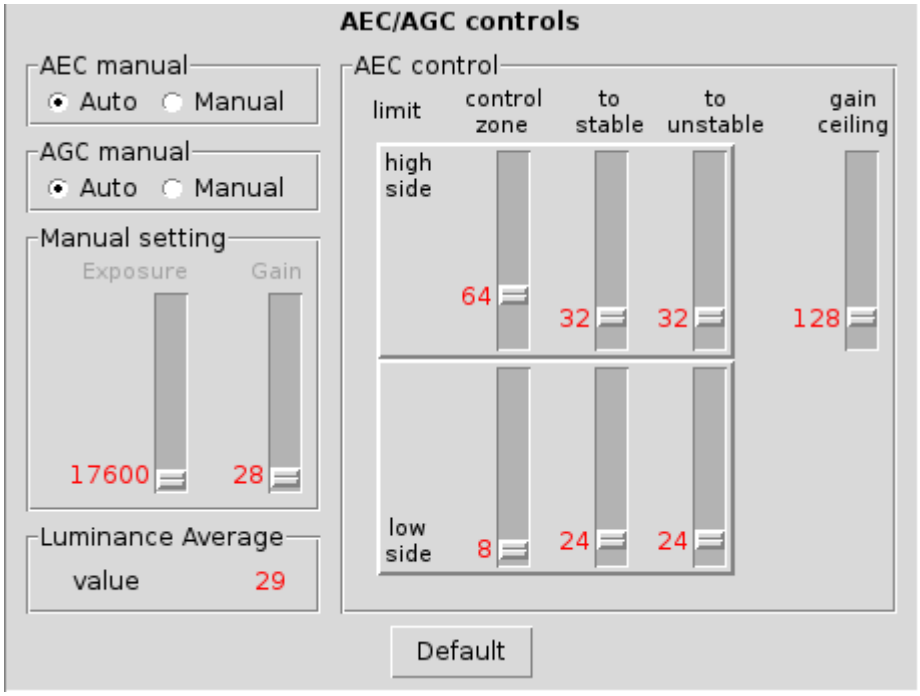
```
0x4000,0x89
0x4002,0x45
0x4005,0x18
#0x503d,0x80
```

Describe the registers to be written in hexadecimal notation in the order of Address (16 bits) and Data (8 bits) on a single line, using commas (,) as separators. Use a comma (,) as a delimiter. Use a sharp (#) to comment out.

③ AEC/AGC controls

It controls the exposure and gain to adjust the brightness of the image. AEC (Auto Exposure Control) and AGC (Auto Gain Control) are the automatic control mechanisms.

The displayed values are in decimal.



- AEC/AGC manual — Automatic or manual switch settings for exposure and gain control.
- Manual setting — Exposure and gain settings for manual selection.
  When auto selection, the setting is not available, read only and display.
- Luminance Average — Brightness of the image. An average value calculated internally.
- AEC control — Automatic convergence control settings. (Cannot be set in manual.)
  It is controlled by the upper limit (high side) and lower limit (low side) settings of the boundary value (limit), and the brightness is converged (stable) within the range. "Luminance Average" is the brightness.
  “to stable” and “to unstable” are the boundary settings for state transitions.
  "control zone" controls the fast AEC range, and "gain ceiling" is the upper limit of the gain. Please refer to the CIS datasheet for details.

7. Revision history

Ver.	Date	Contents of revision
1.0	2020/8/31	First version
1.1	2021/11/24	Added "6.2 Modify ISP settings for camera module" to the Appendix