MIPI CSI-2 Video Output Board

[SVO-MIPI]

Software Manual

Rev.1.0

NetVision Co., Ltd.

Update History

Revision	Date	Note	
1.0	2018/05/07	New File (Equivalent to Japanese version 1.0)	S.Usuba

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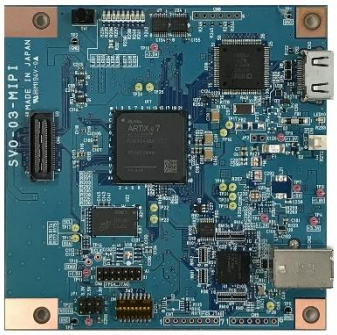
1. Outline



This document is a software Manual of "SVOGenerator" dedicated to the board "SVO-MIPI" to convert the video signal from USB 3.0 to the MIPI CSI-2 signal.

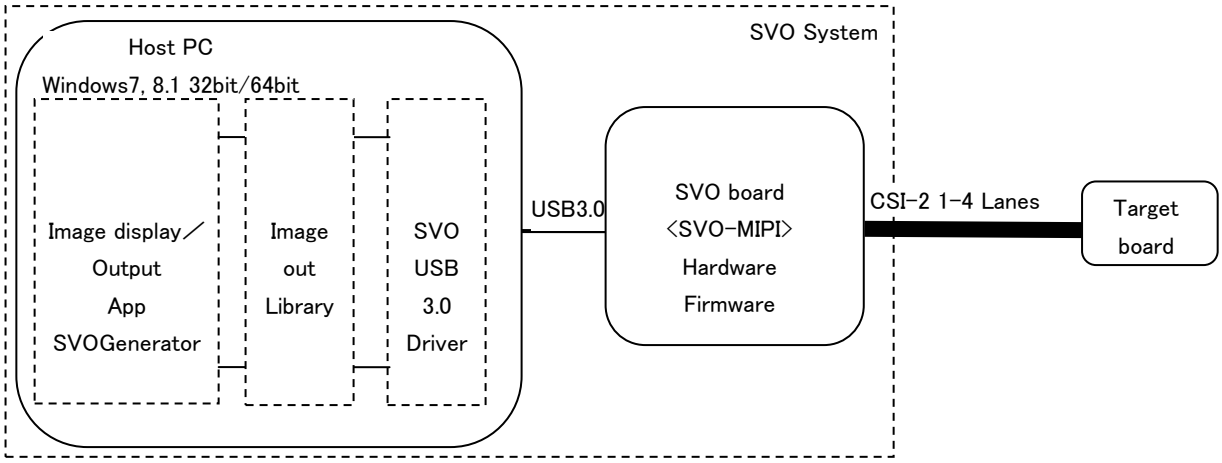
SVOGenerator (hereinafter referred to as the software) of the SVO-MIPI board is based on our existing board (SVO-03) SVOGenerator, and many of the user interfaces are common.

Although the software can control existing boards, it is not possible to control the SVO-03-MIPI using the SVOGenerator supplied with the existing board. If you have already installed SVOGenerator, you will need to install the software separately or replace the software.

The specifications for this document may be changed without prior notice. It also includes descriptions of the features that are not implemented in the product. In addition, there is an explanation of "HDMI version" in this document, but the "HDMI version" is an optional function, and it is under development now.

1.1. System Configuration Diagram

System Configuration Diagram



1.2. Operating Environment

OS : Windows7/8.1 64bit/32bit

Others : Our applications, Library

Device Driver(8.1 : 64bit only)

1.3. Software Required

The following software is provided for the operation of the SVO system.

・SVOGenerator.exe

This is an application for outputting video files stored on a PC to a SVO-MIPI/SVO-03 board.

・SVOUSB30.dll

The SVO video Output library is a dedicated USB 3.0 device driver for the SVO system.

You can also incorporate the library into customer's system without using the above application.

・SVOUSB30.sys、SVOUSB30.inf

32bit version of the SVO system dedicated USB 3.0 device driver file.

・SvoU3drv.dll、SvoUdrv.inf

64bit version of the SVO system dedicated USB 3.0 device driver file.

- After SVOGenerator is finished, the following files are generated.

・SVOGenerator.ini

Save the information in the File-option dialog mainly.

・SVOGenerator.svo

Save the information in the Device-Setting dialog mainly.

2. Installation

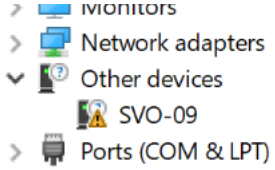
Contains the software required for the software CD-ROM that is shipped with the SVO-MIPI hardware. The contents of this CD-ROM are shown in the table below.

Folder	Contents
¥	readme.txt and version.txt
¥SVO-AP_x86	application and library related
¥SVO-AP_x64	the 64bit version above
¥Driver_x86	SVO dedicated USB 3.0 device driver-related
¥Driver_x64	the 64bit version above
¥DOC	various documents
¥Library	Video output library file
¥Tool	Frame file converter utility

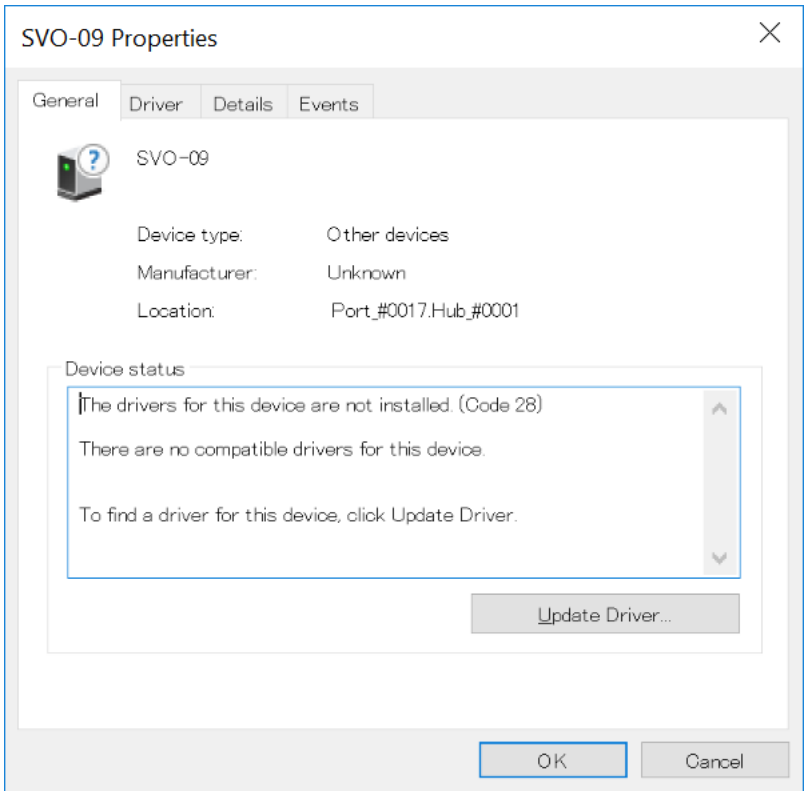
2.1. Installing the SVO dedicated USB 3.0 device driver

1. Connect the SVO-MIPI board and PC's USB 3.0 port with a USB 3.0 cable.

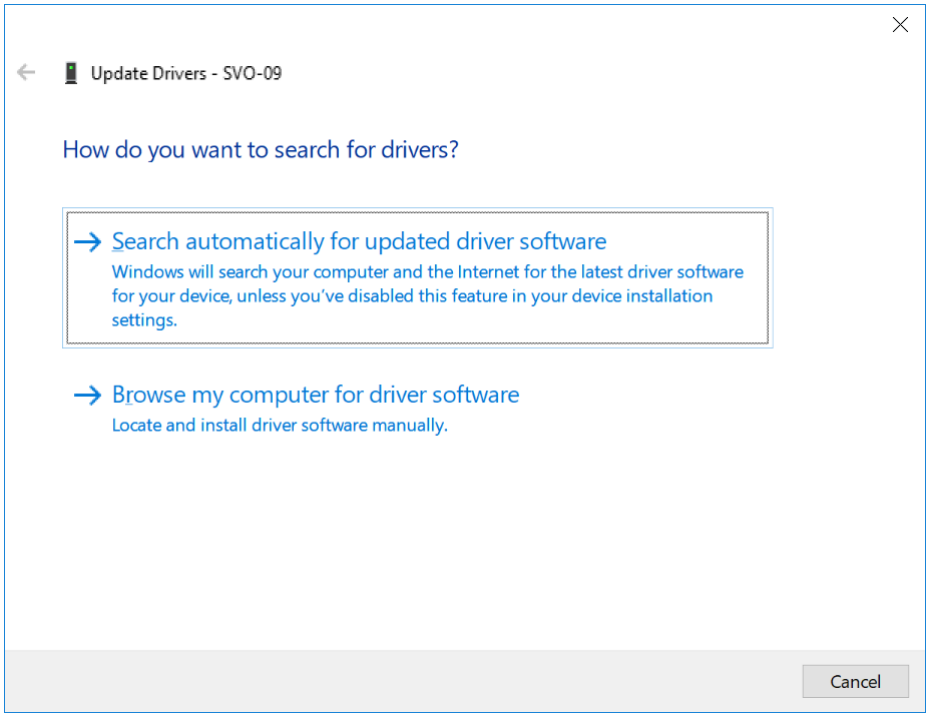
2. Start Device Manager, and then double-click "SVO-09" below "Other devices".



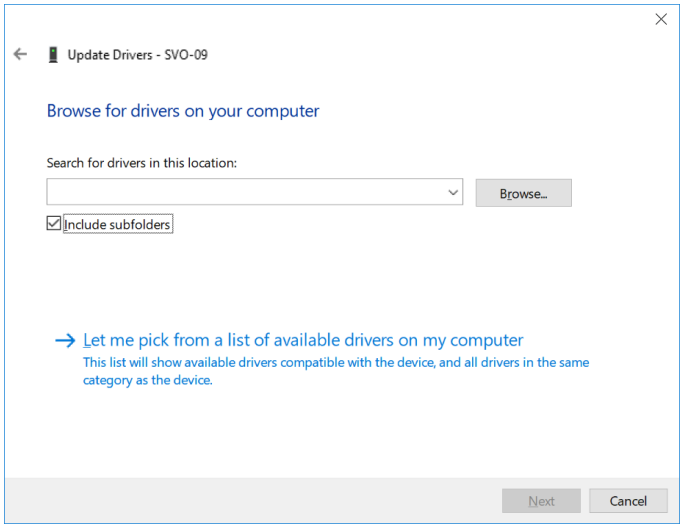
3. The "SVO-09 Properties" dialog will appear, so click the "Update Driver" button.



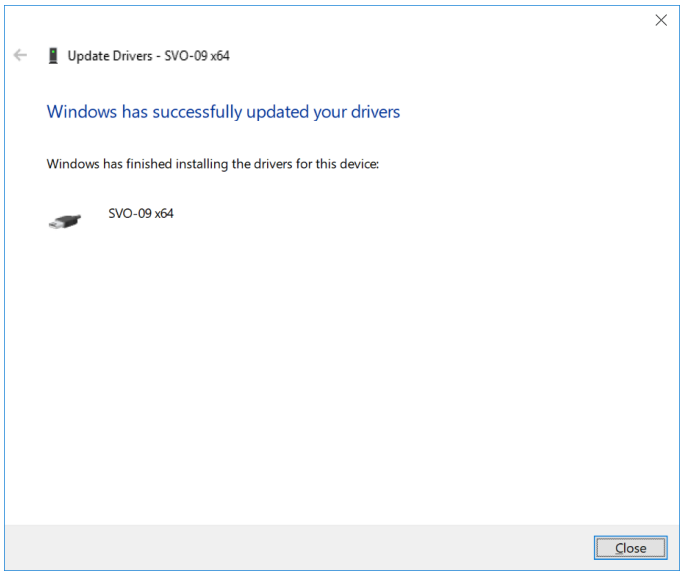
4. Click "Browse my computer for driver software".



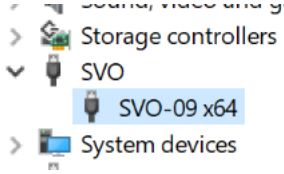
5. Insert the CD-ROM into the disc drive, select the "Driver_SVO¥Driver_x64" folder (when 64bit OS) with the "Browse" button, and click "Next".



6. After a while, the installation is finished.



7. After successful installation, "SVO-09" is created in the SVO class.



- Driver installation to 32bit OS should be used with device drivers stored below the CD-ROM SVO_Driver¥Driver_x86.

2.2. Application, library-related installation

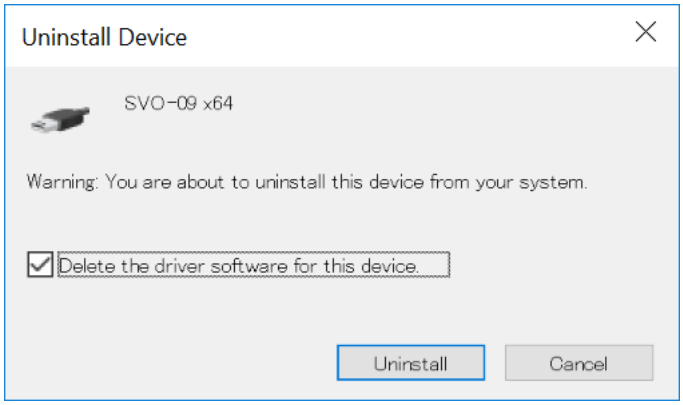
Copy the "SVO-AP_x64" folder from the CD-ROM to any location on your hard disk.
Please make sure that the attributes of the destination "SVO-AP_x64" folder are read/write.

- The Windows7 32bit version is stored in the CD-ROM "SVO-AP_x86" folder. The usage is identical.

3. Uninstall

3.1. Uninstalling device drivers

If you need to uninstall the SVO dedicated device driver, remove SVO-09 in Device Manager. Check "Delete the driver software for this device" as shown below.



3.2. Application, library-related uninstallation

Delete the copied SVO-AP_x64 or SVO-AP_x86 folder.

4. DIP Switch Setting

If more than one SVO board is connected to a PC, the state of DIP SW (SW2) on each board can be used to assign and identify the ID. DIP SW Status and ID assignment list are as follows:

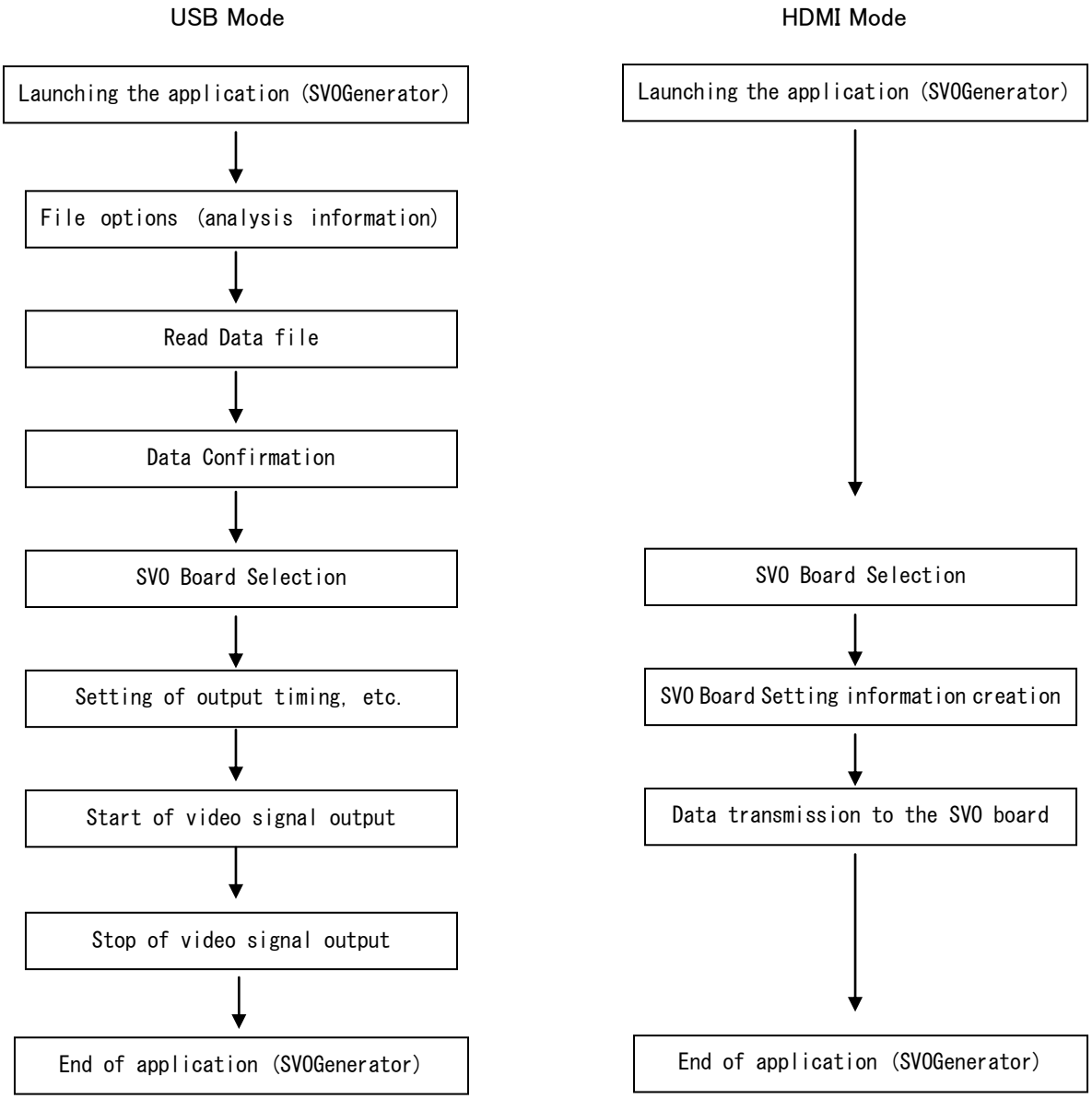
ID	#8	#7	#6	#5	#4	#3	#2	#1	Device-Select Display	About Dialog Display
0	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	0000	0000xxxx
1	OFF	OFF	OFF	OFF	ON	OFF	OFF	OFF	0001	0001xxxx
2	OFF	OFF	OFF	ON	OFF	OFF	OFF	OFF	0002	0002xxxx
3	OFF	OFF	OFF	ON	ON	OFF	OFF	OFF	0003	0003xxxx
4	OFF	OFF	ON	OFF	OFF	OFF	OFF	OFF	0004	0004xxxx
5	OFF	OFF	ON	OFF	ON	OFF	OFF	OFF	0005	0005xxxx
6	OFF	OFF	ON	ON	OFF	OFF	OFF	OFF	0006	0006xxxx
7	OFF	OFF	ON	ON	ON	OFF	OFF	OFF	0007	0007xxxx

5. How to operate the application

Describes the flow and individual operation of a basic application operation using SVOGenerator. See also application Help for more information on application items.

5.1. Application Operation Flow

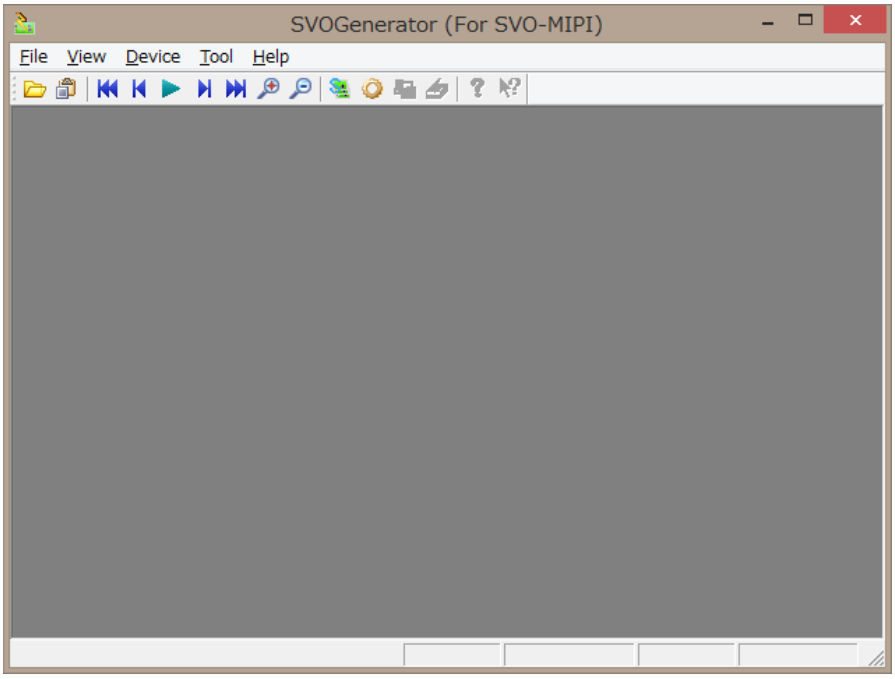
The basic flow from the SVO-MIPI board to the output of the video signal is shown below. The operation of each item is shown in 5.2 and above.



5.2. Launching the application (SVOGenerator)

① Run "SVOGenerator.exe" in the "SVO-AP_x??" folder that you copied in the "Applications, library-related Installation" section.

② The "SVOGenerator" screen appears, as shown in the figure below.

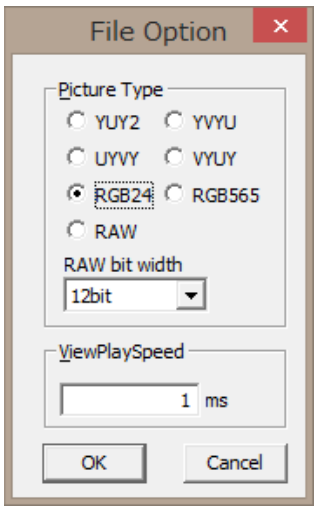


This is the end of the boot.

5.3. File options (analysis information) settings

① Click File-> Option or click the icon on the toolbar.

② The file Option dialog is displayed so that the settings corresponding to the video files to be read will be made.



- Picture Type: Specifies the pixel format of the video file.
- RAW bit width: Picture Type : When RAW, specifies a bit depth per pixel.
- ViewPlaySpeed: Specifies the video update interval when the data is checked.
  The frame rate of the output video data is not reflected.

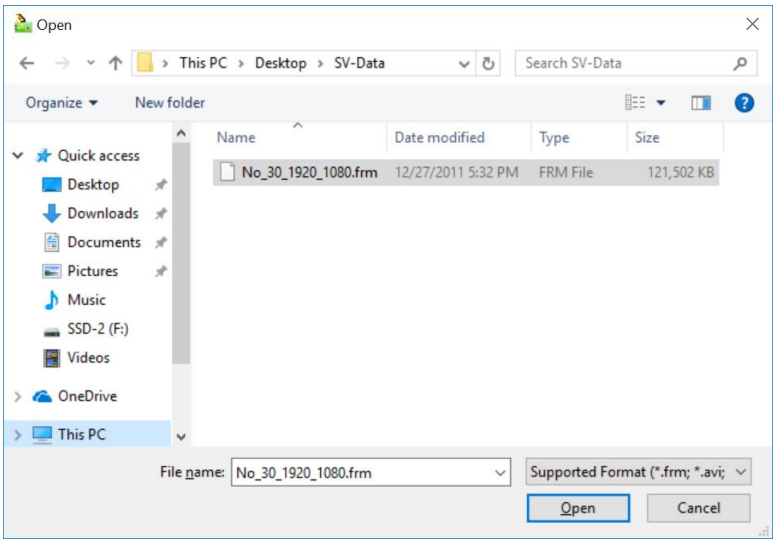
③When setting is finished, click the "OK" button.

- Be sure to set the file options before reading the video file.

5.4. Reading video files

① Click File-> Open or click the icon on the toolbar.

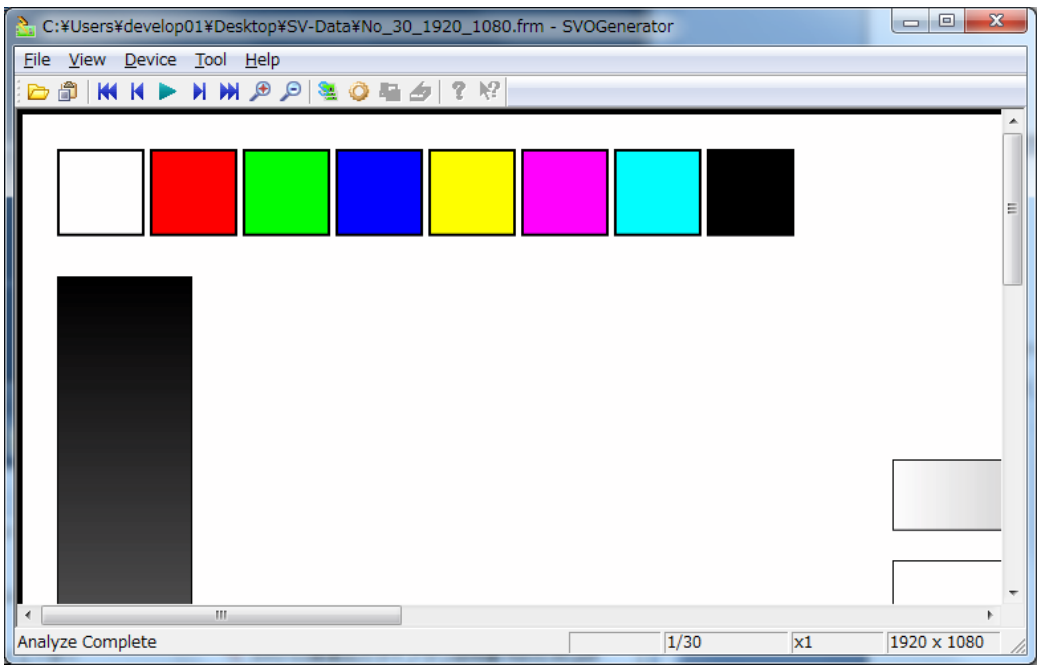
② The Open File dialog box appears, and then select the appropriate file.



Corresponds to the .frmt, .frm, .avi file extension.

If you open an AVI file, FourCC must be either "YUY2", "UYVY", "DIB ".

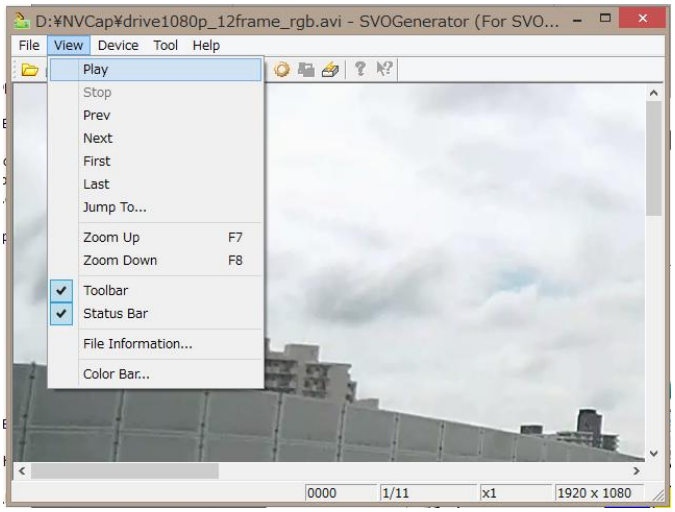
③ Analyze the data based on the File option setting. When analysis is finished, the image is displayed on the screen.



- "Analyze complete" appears in the status bar when the analysis completes successfully.
  The status bar displays "Analyze incomplete" If the analysis is prematurely terminated
- If the color is incorrect in YUV, please try to change the order in File-option.

5.5. Verifying video data

① View-> Play or select the icon on the toolbar to check the data one frame at a time.

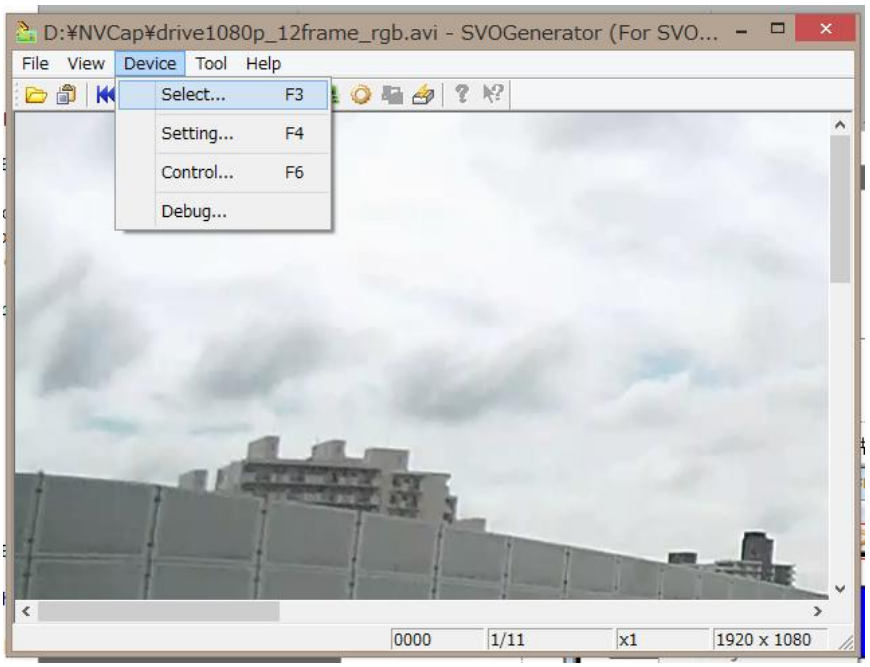


② The status bar displays the currently displayed frame number and image size.

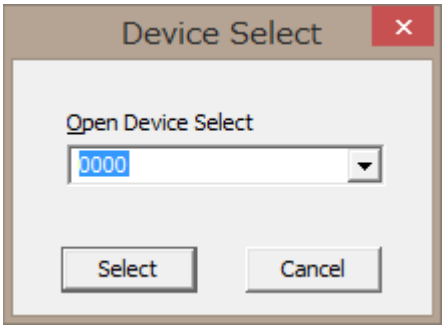
③ If you want to check the frame of the image data while skipping "view" -> "Jump to"
If you want to check the color of the image data "view"-> "Color Bar"
If you want to check the header information "view"-> "File information"
Please check.
For more information on the status bar and dialogs, see SVOGenerator Help.

5.6. SVO Board Selection

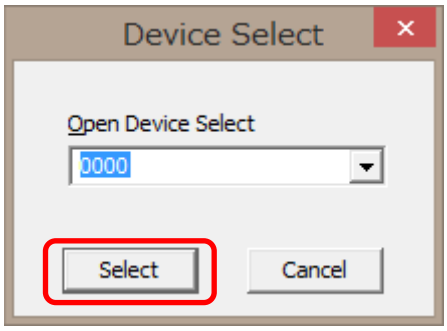
① Click Device-> Select, or press F3 on the keyboard or on the toolbar.



② "Device Select" dialog is displayed. The identification ID of the SVO board that is currently connected to the USB port is displayed in the drop-down list, so select the ID of the board you want to control.

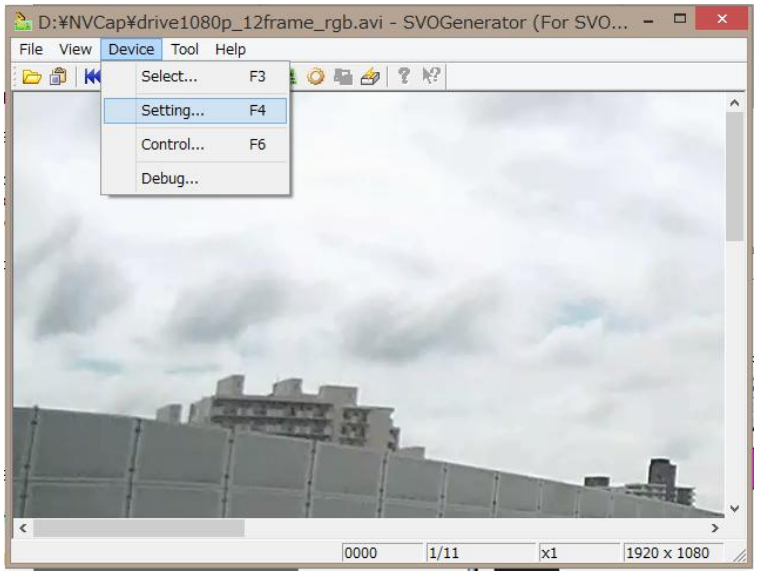


③ Press the "Select" button.

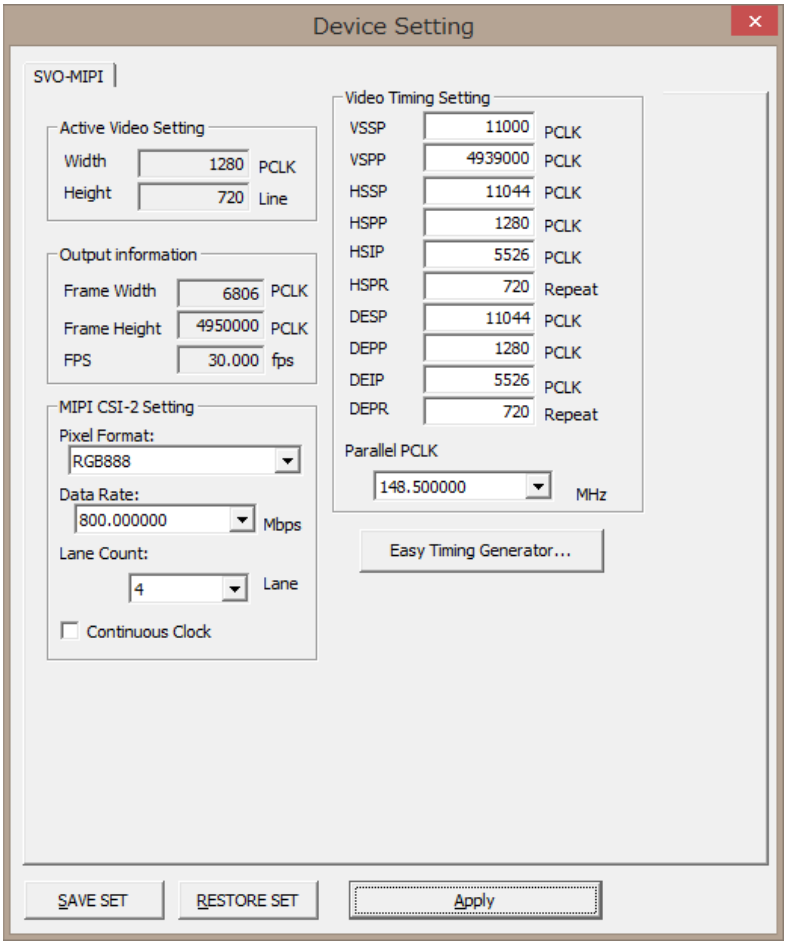


5.7. Setting the output timing, etc.

① Click Device-> Setting, or press F4 on the keyboard, or the icon on the toolbar.



② "Device Setting" dialog appears. Set each setting item. For configuration items, refer to "6 Device Setting dialog ".



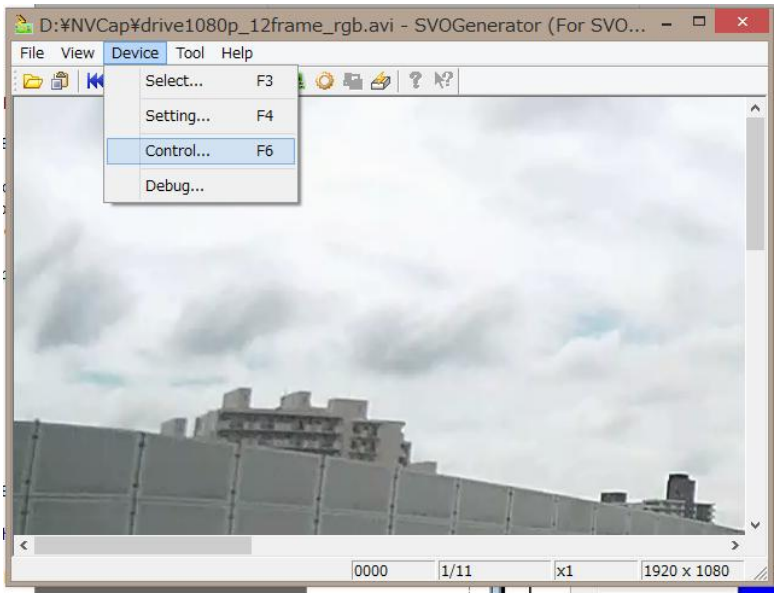
- Because the selected board has different settings, you must select the board from the "Device Select" dialog before displaying the "Device Setting" dialog.
- Press the "SAVE SET" button to save the current settings to any file.
- When you press the "RESTORE SET" button, you can read the settings saved by "SAVE SET".

③ When you're done, press the Apply button.

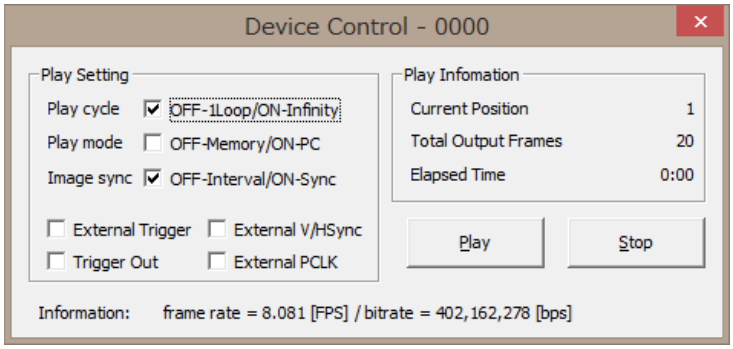
This is the end of the setup.

5.8. Video signal output control

① Click Device-> Control, or F6 on the keyboard, or the icon on the toolbar.



② When the "Device Control" dialog opens, the video frames are transferred to the DRAM on the board first. When the "Play" button is enabled, it is ready for transfer.



- Play cycle: If it is checked, repeat video output.

- Play mode: If it is checked, the entire AVI file in the PC will be output sequentially through the DRAM frame buffer on the board. If it is not checked, only the beginning of the AVI file is transferred to the DRAM on the board, and the DRAM contents are output repeatedly.

- Image sync: If it is checked, the SVOGenerator side screen is updated every second at the same time as the output.

- External Trigger: Video output start trigger input is enabled.

- External V/HSync: When the video is output, the output is synchronized to the V/Hsync signal of the external input.

- External PCLK: When the video is output, the output is synchronized to the PCLK signal of the external input.

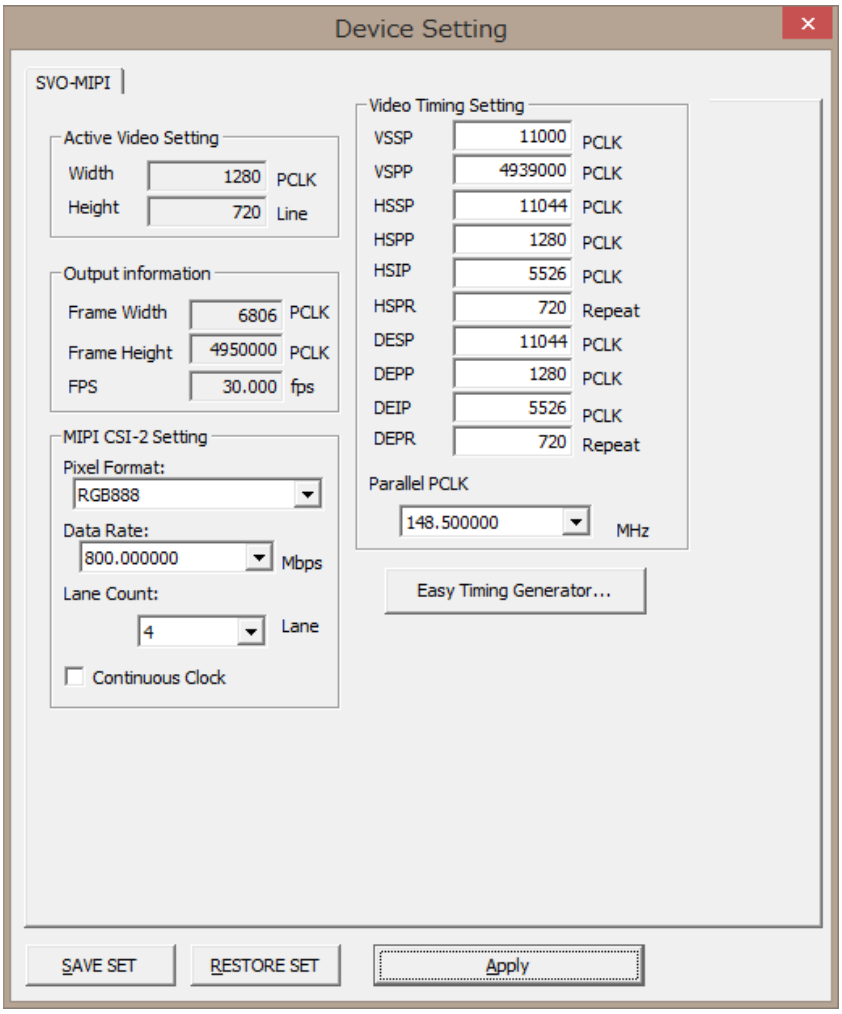
- Trigger Out: Outputs a video output trigger signal to be used for multiple ch simultaneous output.

③ Press the "Play" button to start the video output.

④ When the video output starts, the "Play" button is disabled and the "Current Position" is counted up to "Total output Frames".

You can stop the video output by pressing the "Stop" button during the video output. Once all the files have been transferred, the "Play" button is enabled again.

6. Device Setting Dialog (SVO-MIPI)

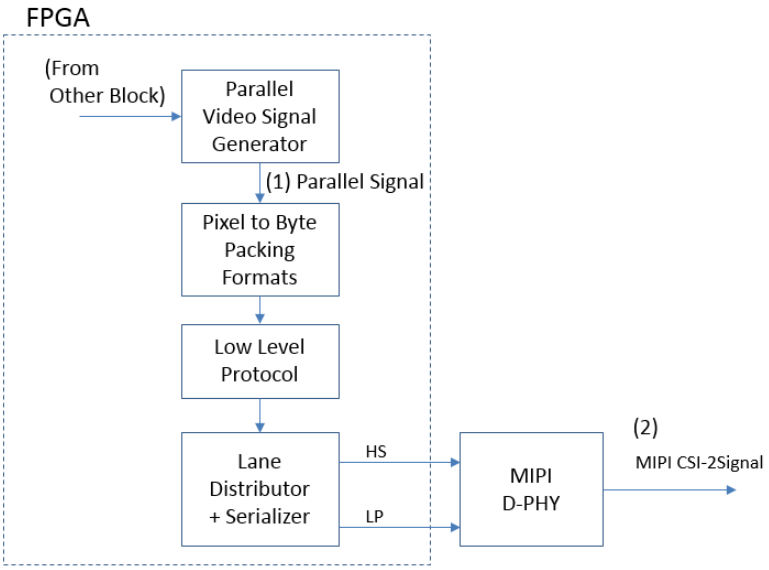


- Press the "SAVE SET" button to save the current settings to any file.
- When you press the "RESTORE SET" button, you can read the settings saved by "SAVE SET".
- Press the "Easy Timing Generator..." button to open a dialog that allows you to easily set the "Video Timing Setting" setting.
- When you press the "Apply" button, the current settings are sent to the board.

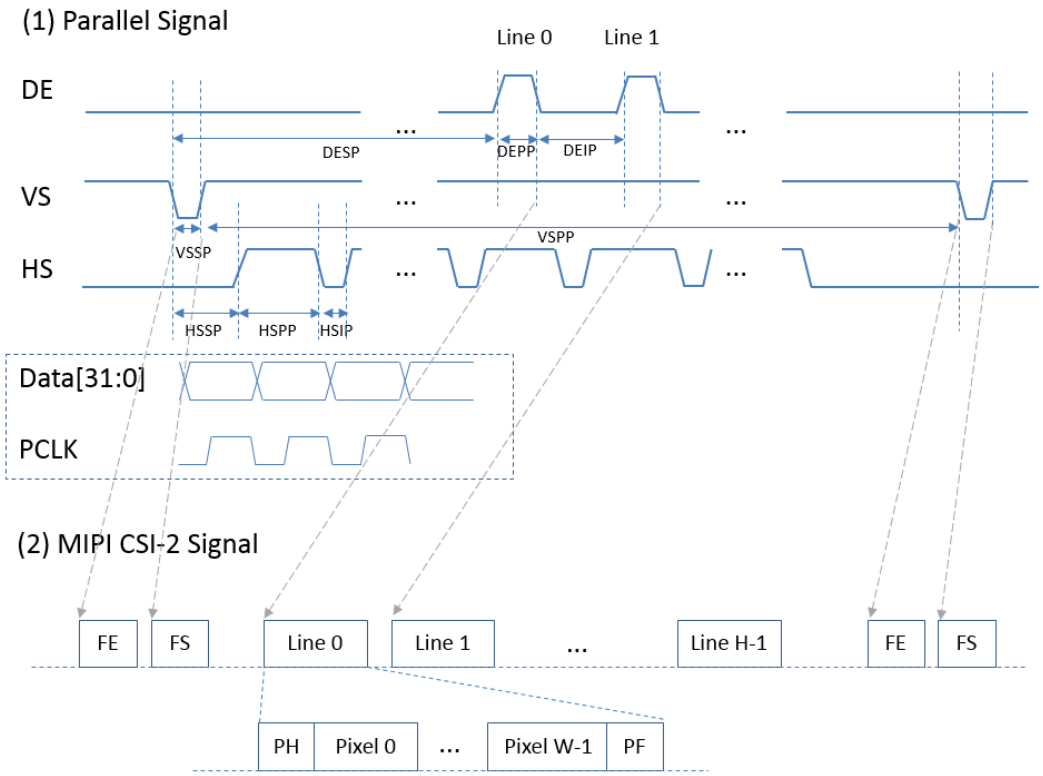
When you click the Device Setting menu with the SVO-MIPI board selected in the Board Select dialog, you will see a device Setting dialog like the one above. This dialog setting allows you to set the timing and format of the video signal. In order to properly set the output timing of the SVO-MIPI, it is necessary to understand the video output configuration of the board to some extent.

As shown below, the SVO-MIPI board has a two-stage video output block inside the FPGA. The first stage video signal

generator generates a 32-bit parallel video signal, and the second stage MIPI signal converter Serializes the parallel video signal to the serial signal. The serial signal is outputted outside the board as a MIPI CSI-2 signal via the MIPI D-PHY. The timing relationship between the parallel signal and MIPI CSI-2 signal is shown below.



The timing relationship between the parallel signal and MIPI CSI-2 signal is shown below. In the figure below The timing parameter shown in the timing chart of the (1)Parallel Signal reflects the setting item of the same name in the "Device Setting" dialog. The names and functions of these timing parameters are the same as those of the parallel SVO-03 board.



- FE: Frame End, FS: Frame Start, PH: Packet Header, PF: Packet Footer

6.1. Device Setting Dialog Configuration Items

The settings for the "Video Timing Setting" set the timing of the parallel signal. MIPI output Timing settings are all done by timing adjustment of these parallel signals.

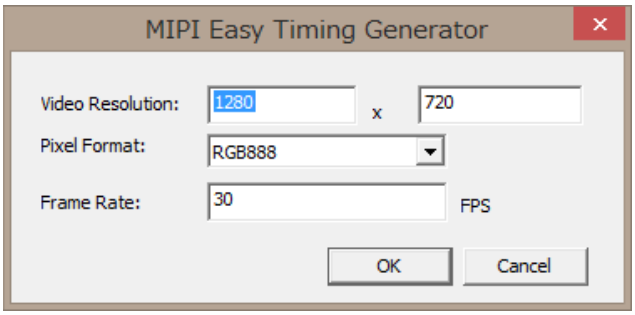
Setting items	Description	Unit
VSSP	(See above figure)	PCLK
VSPP	(See above figure)	PCLK
HSSP	(See above figure)	PCLK
HSPP	(See above figure)	PCLK
HSIP	(See above figure)	PCLK
HSPR	Specifies the number of repetitions of the HSync signal.	
DESP	(See above figure)	PCLK
DEPP	(See above figure) If the pixel format is YUV4:2:2 8bit, RAW10, RAW12, you must specify half the width of the input video file. If the pixel format is RGB888, RAW20, you must specify a value equal to the width of the input video file.	PCLK
DEIP	(See above figure)	PCLK
DEPR	Specifies the number of repetitions of the Data Enable signal. You must specify the same value as the height of the input video file.	
Parallel PCLK	Specifies the pixel clock for the parallel signal.	MHz

- If you want to set the number of clocks set to Parallel PCLK from other than the set value in the list box, please contact us separately.
- If you set the wrong timing, the output of the video signal may not be performed.
- For more information about timing, see the hardware specifications for the SVO-MIPI board.

"MIPI CSI-2 Setting" configuration item sets the parameters and pixel format of the MIPI CSI-2 signal.

Setting items	Description	Unit
Pixel Format	Specifies the pixel format.	
Data Rate	Specifies the bit rate per lane. Specify a value that satisfies the board's specifications.	Mbps
Lane Count	Specifies the number of lanes.	Lane
Continuous Clock	When it is checked, the CLK Lane is output with HS fixed. usually uncheck.	

Press the "Easy Timing Generator..." button to open the dialog (MIPI Easy Timing Generator dialog) to easily set settings for "Video Timing Setting".

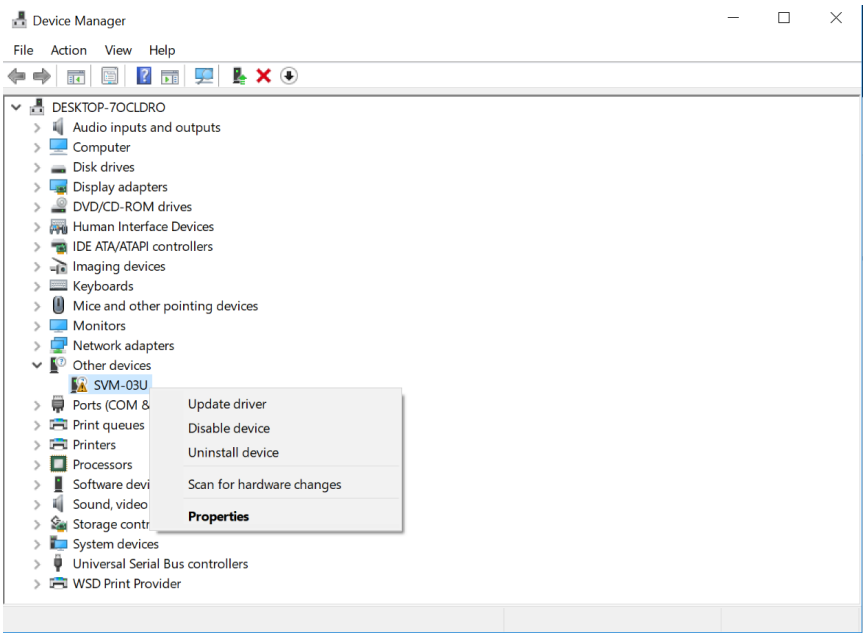


When you press the OK button above, the timing of the parallel signal is automatically generated based on the input video resolution, pixel format, and frame rate, and set to the item of the original dialog.

7. Update the Board

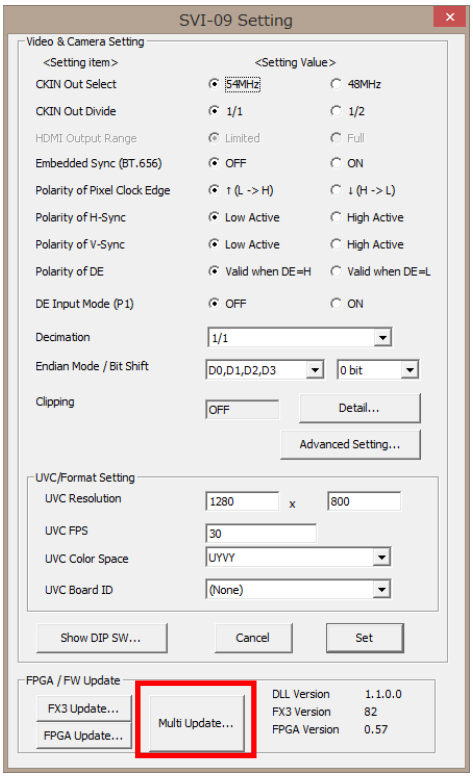
The SVO-03-MIPI board can update firmware and FPGA configurations via USB. The update procedure is as follows.

1. Connect the SVO-03-MIPI board to the PC, with DIP SW (SW1) number 7 ON and number 8 OFF.
2. Because it works with a different driver than the USB mode, you should install the driver manually from Device Manager when you first start it.
    1. "Other Devices" → "SVM-03U" and click "Update driver"



    2. Click "Browse your computer to find driver software"
    3. Select the driver folder (Driver_SVI or Driver_SVM) and click "Next".
3. Start "SVMCtl" and click "SVM Setting...".

4. Select "Multi Update..." and select the update image to start the update.



5. The update will take several minutes. Do not unplug the USB cable or turn off the PC.
6. When the update message exits, exit "SVMCtl" and unplug the USB cable.
7. The DIP SW is restored and the update is complete.

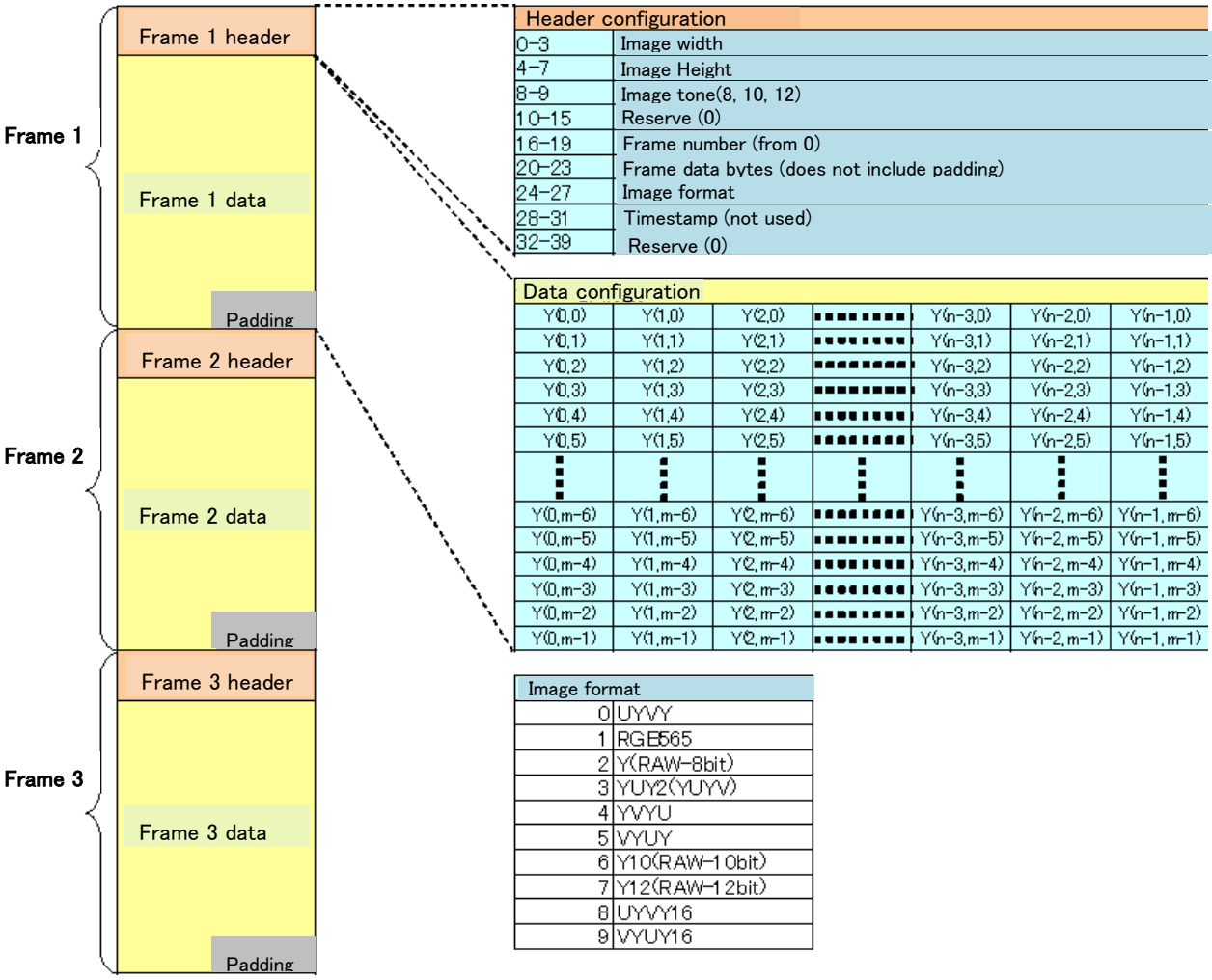
8. FRM Format data format

The corresponding image data in the SVO system is general AVI format or the FRM format created by the SVI system.

The FRM format is the data output from the camera module or image sensor, with a 40-byte header appended to each frame. The header is recorded at the beginning of the frame.

The data part records the output from the camera. However, the padding data is appended so that the number of bytes in the frame portion is divisible by 64.

The following are the details of the FRM format image File format:



Header configuration	
0-3	Image width
4-7	Image Height
8-9	Image tone(8, 10, 12)
10-15	Reserve (0)
16-19	Frame number (from 0)
20-23	Frame data bytes (does not include padding)
24-27	Image format
28-31	Timestamp (not used)
32-39	Reserve (0)

Data configuration

Y(0,0)	Y(1,0)	Y(2,0)	■■■■■■■■	Y(n-3,0)	Y(n-2,0)	Y(n-1,0)
Y(0,1)	Y(1,1)	Y(2,1)	■■■■■■■■	Y(n-3,1)	Y(n-2,1)	Y(n-1,1)
Y(0,2)	Y(1,2)	Y(2,2)	■■■■■■■■	Y(n-3,2)	Y(n-2,2)	Y(n-1,2)
Y(0,3)	Y(1,3)	Y(2,3)	■■■■■■■■	Y(n-3,3)	Y(n-2,3)	Y(n-1,3)
Y(0,4)	Y(1,4)	Y(2,4)	■■■■■■■■	Y(n-3,4)	Y(n-2,4)	Y(n-1,4)
Y(0,5)	Y(1,5)	Y(2,5)	■■■■■■■■	Y(n-3,5)	Y(n-2,5)	Y(n-1,5)
⋮	⋮	⋮	⋮	⋮	⋮	⋮
Y(0,m-6)	Y(1,m-6)	Y(2,m-6)	■■■■■■■■	Y(n-3,m-6)	Y(n-2,m-6)	Y(n-1,m-6)
Y(0,m-5)	Y(1,m-5)	Y(2,m-5)	■■■■■■■■	Y(n-3,m-5)	Y(n-2,m-5)	Y(n-1,m-5)
Y(0,m-4)	Y(1,m-4)	Y(2,m-4)	■■■■■■■■	Y(n-3,m-4)	Y(n-2,m-4)	Y(n-1,m-4)
Y(0,m-3)	Y(1,m-3)	Y(2,m-3)	■■■■■■■■	Y(n-3,m-3)	Y(n-2,m-3)	Y(n-1,m-3)
Y(0,m-2)	Y(1,m-2)	Y(2,m-2)	■■■■■■■■	Y(n-3,m-2)	Y(n-2,m-2)	Y(n-1,m-2)
Y(0,m-1)	Y(1,m-1)	Y(2,m-1)	■■■■■■■■	Y(n-3,m-1)	Y(n-2,m-1)	Y(n-1,m-1)

Image format	
0	UYVY
1	RGB565
2	Y(RAW-8bit)
3	YUY2(YUYV)
4	YVYU
5	VYUY
6	Y10(RAW-10bit)
7	Y12(RAW-12bit)
8	UYVY16
9	VYUY16

Example) dump the top 112 bytes of FRM format data at Raw-10bit

```
          +0 +1 +2 +3 +4 +5 +6 +7 +8 +9 +A +B +C +D +E +F  0123456789ABCDEF
0000:0000 B4 02 00 00 07 02 00 00-0A 00 00 00 00 00 00 00  ......          
0000:0010 00 00 00 00 00 F6 0A 00-06 00 00 00 8C 00 00 00  ................
0000:0020 00 00 00 00 00 00 00 00-FE 00 BE 00 FE 00 BE 00  ................
0000:0030 7E 00 7E 00 7E 00 BE 00-FE 01 BE 01 BE 00 BE 00  ~.~.~...........
0000:0040 FE 00 BE 00 3E 00 7E 00-FE 00 FE 00 BE 00 BE 00  ....>.~.........
0000:0050 FE 00 3E 00 BE 00 FE 00-7E 01 3E 01 FE 00 BE 01  ..>.....~.>.....
0000:0060 7E 01 FE 01 FE 00 FE 00-BE 00 FE 00 FE 00 BE 00  ~...............
```

Header ......

Data ......

The image has 10-bit, 12-bit, 16-bit bytes, and is big-endian.

The FRM file has a limit of 2GB, so if it is more than one FRM file, then use the FRMT file to manage it. The FRMT file is a text format that records the FRM file name with an absolute path.

Example) if you have two FRM files in a folder called Data under C drive

```
C:¥Data¥data0001.frm
C:¥Data¥data0002.frm
```

Because the FRMT file is in text format, you can edit it in a text editor such as Notepad. Even if there are only two FRM files, it is possible to output for a long time by selecting multiple lines of the same FRM file as follows. The output will be output in the order as described in the FRMT file.

Example) if you have two FRM files in a folder called Data under C drive, and you copy the same file three

times to respond to long-term output

```
C:¥Data¥data0001.frm
C:¥Data¥data0002.frm
C:¥Data¥data0001.frm
C:¥Data¥data0002.frm
C:¥Data¥data0001.frm
C:¥Data¥data0002.frm
C:¥Data¥data0001.frm
C:¥Data¥data0002.frm
```