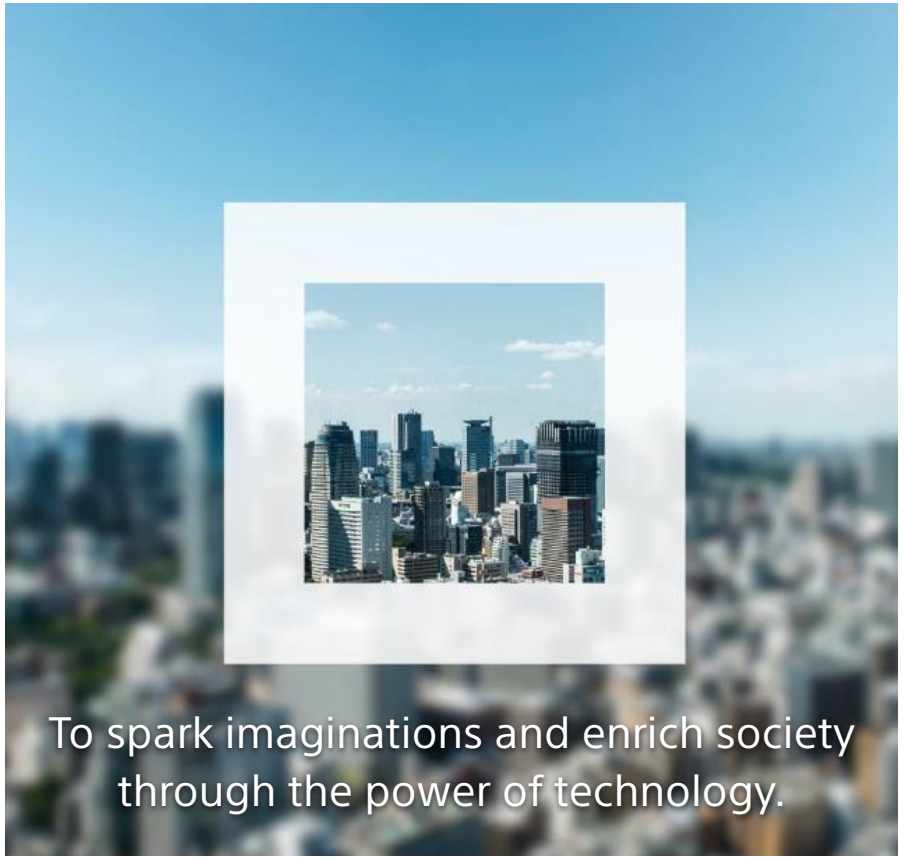
SONY

Sony LiDAR Viewer
USB mode
User manual

Rev 0.0.1 (draft version)

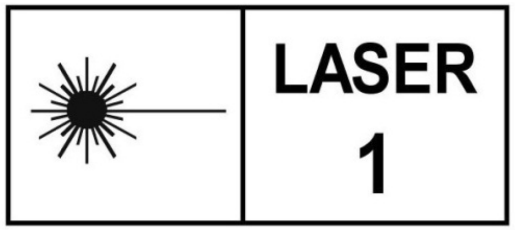


Sony Semiconductor Solutions Group

Outline

Precautions

- Safety precautions
  - Laser Safety
    - CLASS 1 LASER PROCUCT. The product fulfills the IEC60825-1:2014.



  - Mechanical & Electrical Safety
    - This kit is powered by 12V DC and contains a rapidly spinning assembly.

CAUTION - For your safety, do not open the cover.
CAUTION - Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

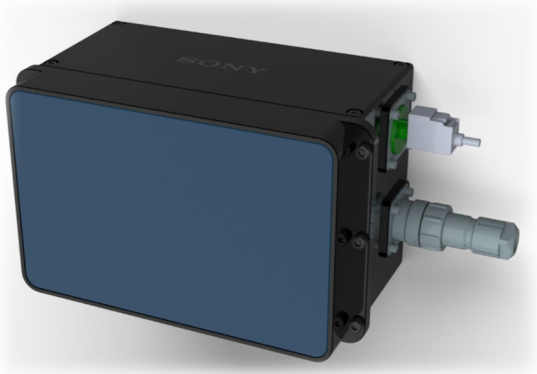
Precautions

- Set-up precautions
  - Set up the kit away from moving and vibration.
  - Keep the torque as 0.5Nm when fastening the kit with the backside screw hole
  - DO NOT set up the kit near any heat resources.
  - DO NOT disconnect any cable while power ON.
- Others
  - The kit is only aimed for basic evaluation of IMX459’s performance and characteristic. Currently it is impossible to obtain real value of internal signals

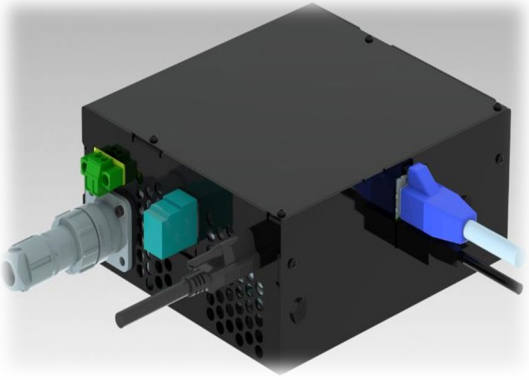
System Overview

- HW
  - The LiDAR PoC(SPD-M1) is a mechanical LiDAR kit with Sony's IMX459 SPAD sensor embedded, composed of sensor head unit and control box unit.
- SW
  - "Sony LiDAR Viewer" software is provided for the evaluation of LiDAR PoC(SPD-M1)

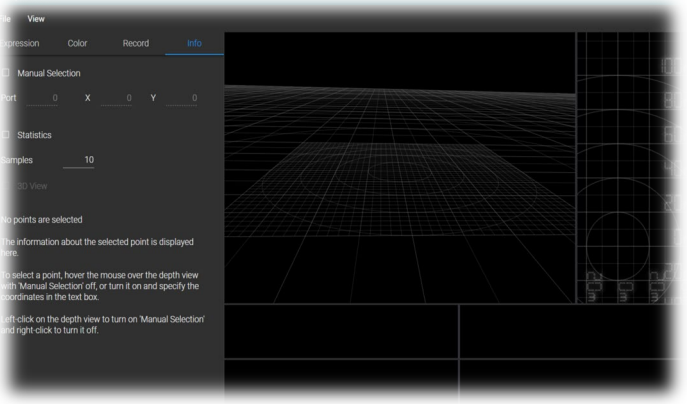
Sensor Head



Control Box



Sony LiDAR Viewer



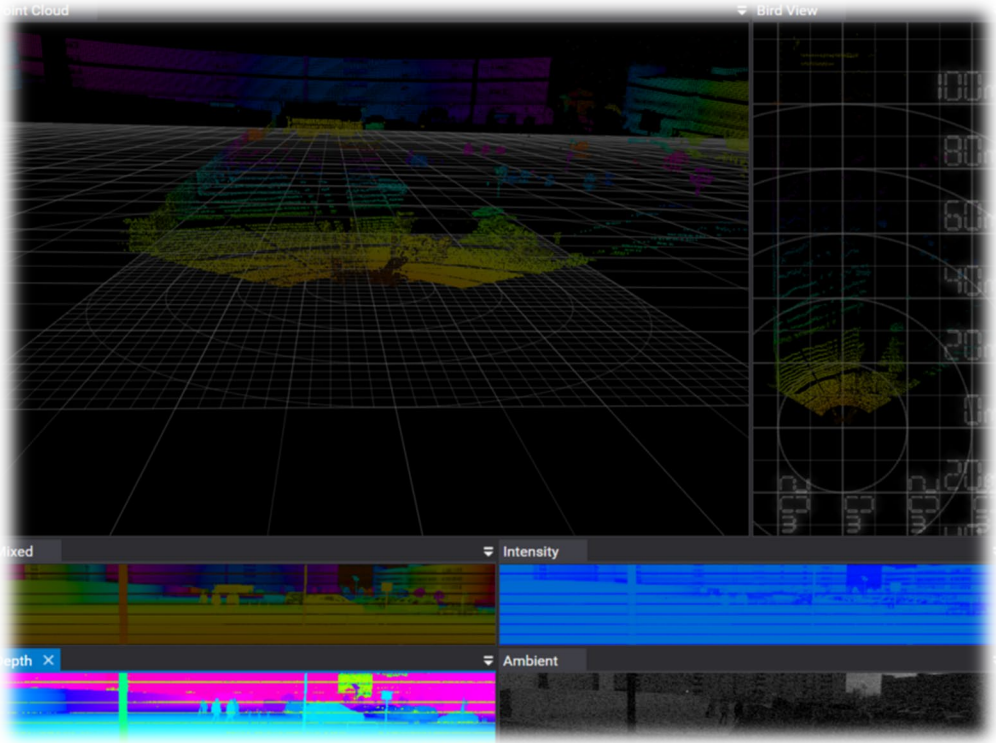
System Overview

- HW specification

Model name	SPD-M1
Measurable distance	10% reflectance : 110 m @100 klux Max : 300 m
Accuracy	< 15 cm* when not saturated
Field of View	H120°* V19.2°
Angular Resolution	H0.2°* V0.2° (H 600 column scan* V 96 dots)
Frame Rate	10 FPS
Laser	Class 1- Eye Safe, 905 nm
Power supply	USB-C PD3.0 or DC12V
Power Consumption	Sensor Head : 20W (typical) Control Box : 20W (typical)
Interface	USB3.0 or Ethernet IPv4
Operation temperature	Ta -20°C ~ +65°C
Waterproof	Sensor Head : IP66 Control Box : Not supported
Size	Sensor Head : W158 × D90 × H96 mm Control Box : W124 x D115 x H54 mm
Weight	Sensor Head : 1.3 kg Control Box : 660 g

System Overview

- Sony LiDAR Viewer main functions
  - Supported the following display mode
    - 3D point cloud (viewpoint can be changed)
    - 2D depth/intensity/mixed map
    - 2D ambient light image
  - Supported the following IMX459 operation mode
    - 1 Ranging mode (96pixel mode, 300m, 1GHz sampling, 5Echo)
    - 2 Ranging mode (192pixel mode, 150m, 1GHz sampling, 5Echo)
    - 3 Echo mode (only for data export, 74bin, 2Echo)
    - 4 Hist mode (only for data export, 242bin)
  - Supported multiple LiDAR POC
    - Up to 3 LiDAR POC
  - Supported the following status monitor
    - LiDAR status
    - Temperature, FPS
  - Supported data saving and playback
  - Supported display color change

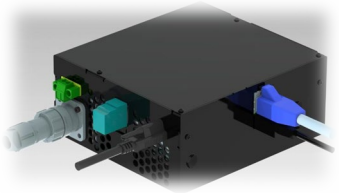


System Overview

- Item list

No.	Item	Detail	Note
1	Sensor head	LiDAR PoC module(inc.IMX459).	
2	Control box		
3	FAKRA cable	Communicate between sensor head and control box by MIPI I/F	
4	USB Type-C cable	Supply power to control box	PD3.0
5	4pin power cable	Supply power to sensor head via control box.	
6	Sony LiDAR Viewer	Software	The manual is based on version 8.4

Sensor Head



Control box

FAKRA Cable

Power supply cable

USB-C Cable

FAKRA Cable

System Overview

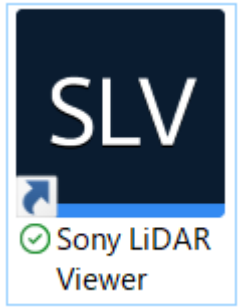
- Additional item list

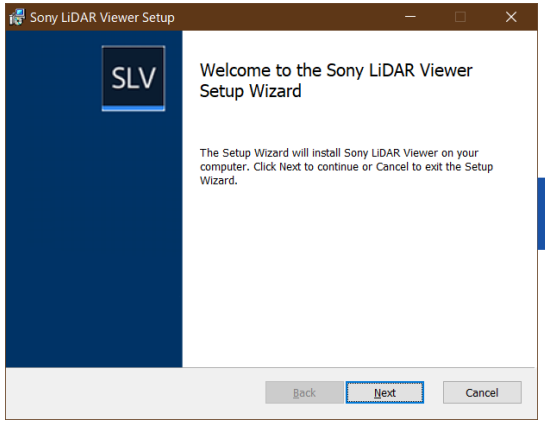
*User should prepare following items in advance

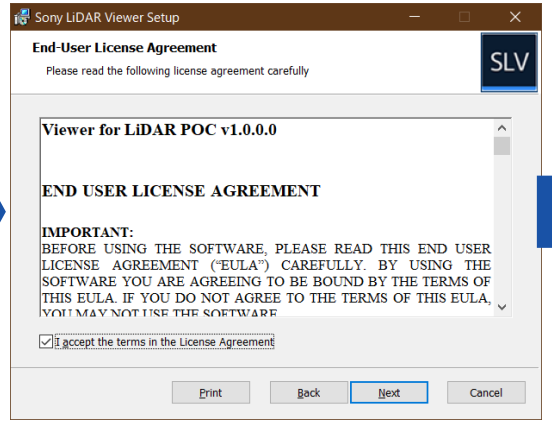
No.	Item	Requirement	Note
7	PC	OS : Win 10 CPU : Core i5 or greater Memory : 16G or more	
8	USB PD power adapter	PD3.0 90W (or more)	
9	USB 3.0 cable	TypeA – MicroB 3m or more recommended	Required for USB I/F connection

Quick start

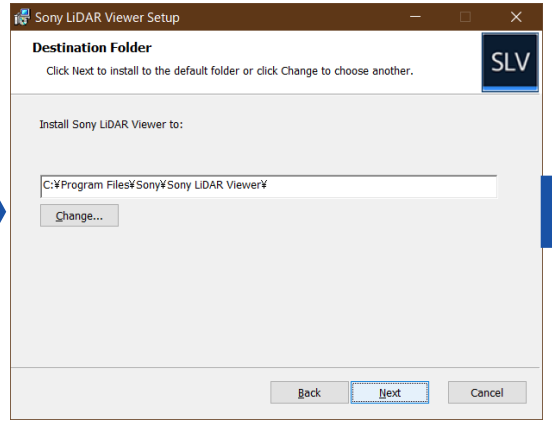
- Sony LiDAR Viewer installation
  - Open the installer : SonyLidarViewer_r8.4-custom.msi
  - Follow the explanation and finish the installation.
  - Viewer shortcut will be created at Desktop folder



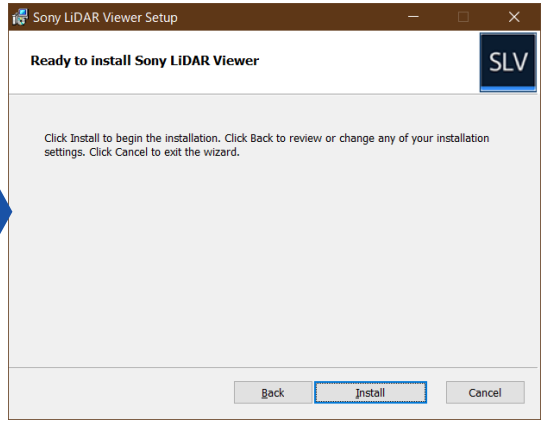




User Agreement

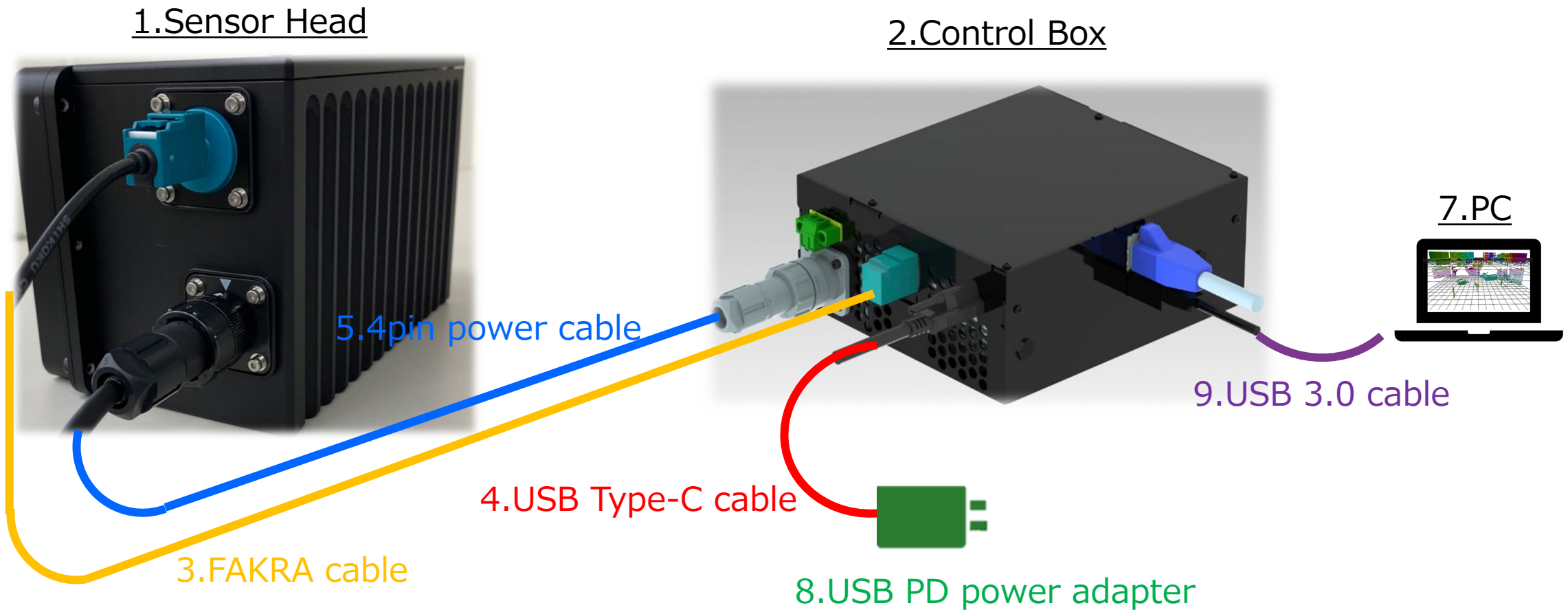


Installation path



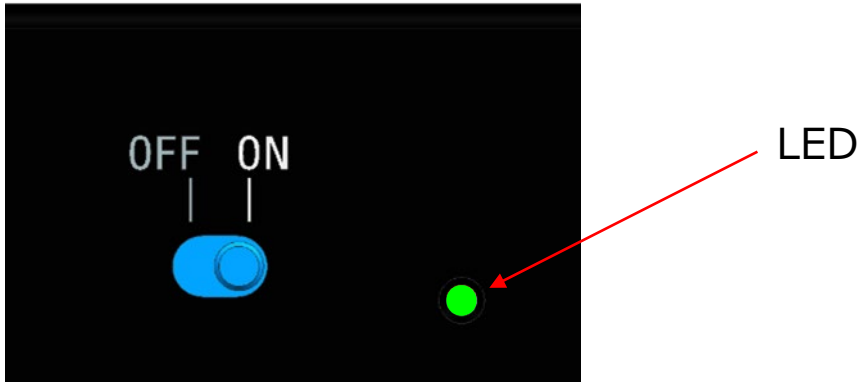
Quick start (USB connection)

- Hardware setup



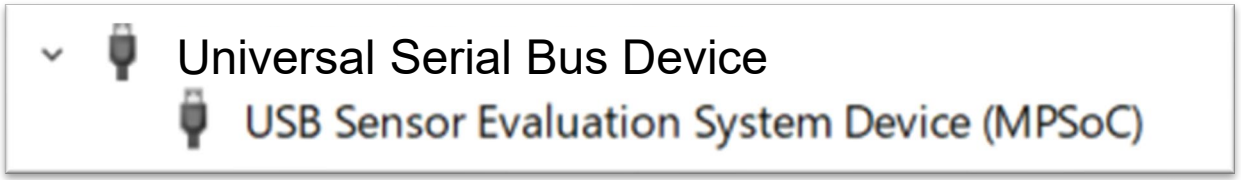
Quick start (USB connection)

- Turn on the power of the control box
- Check the LED lights up



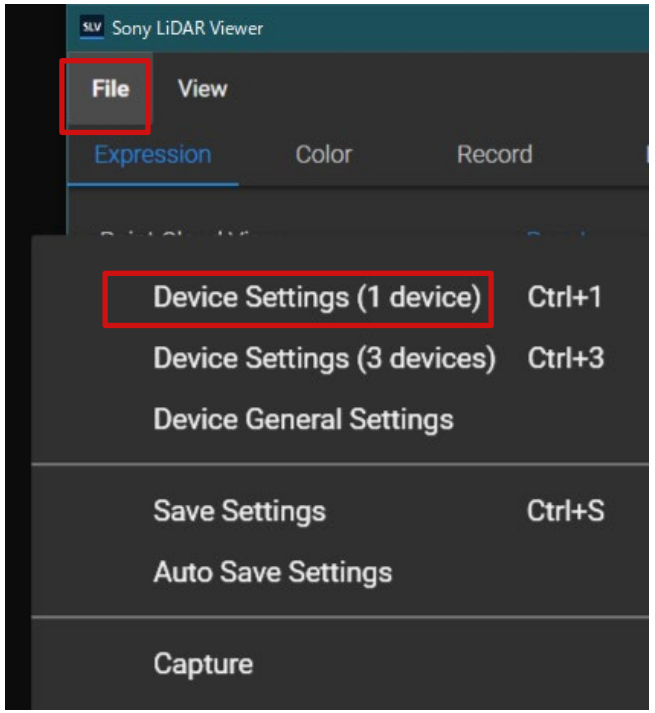
Quick start (USB connection)

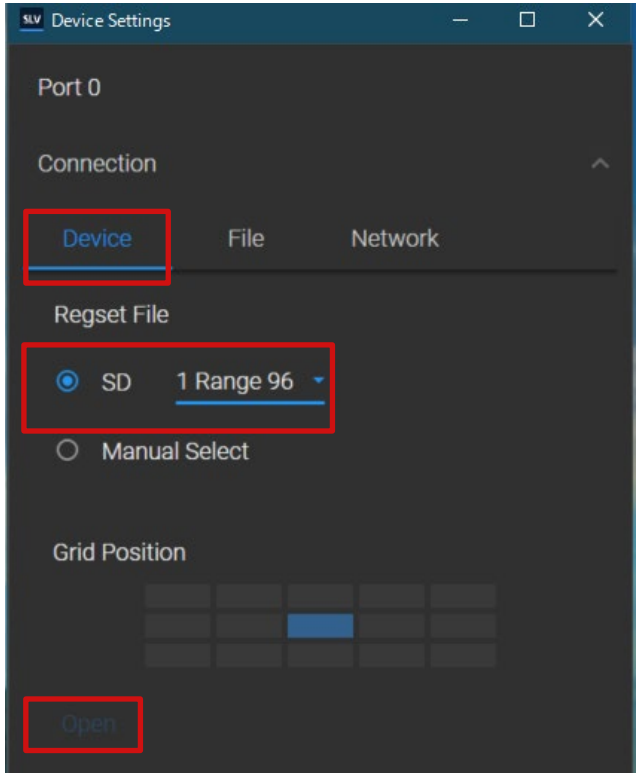
- Connect the control box with USB3.0 to PC.
- Install the POC (SSP-500) driver. The driver is included below.
  - (Windows10 64bit) : installed dir¥driver¥SSP500¥x64_Win10Release
- Confirm the device shows in device manager



Quick start (USB connection)

- Turn on
  - Execute LidarPocViewer.exe
  - Select **[File]** → **[Device Settings(1 device)]** to open “Device Setting” window
  - In the **[DEVICE]** tab, confirm that **[SD]** is checked and set to 1 range 96
  - Click **[Open]** and wait the play starting

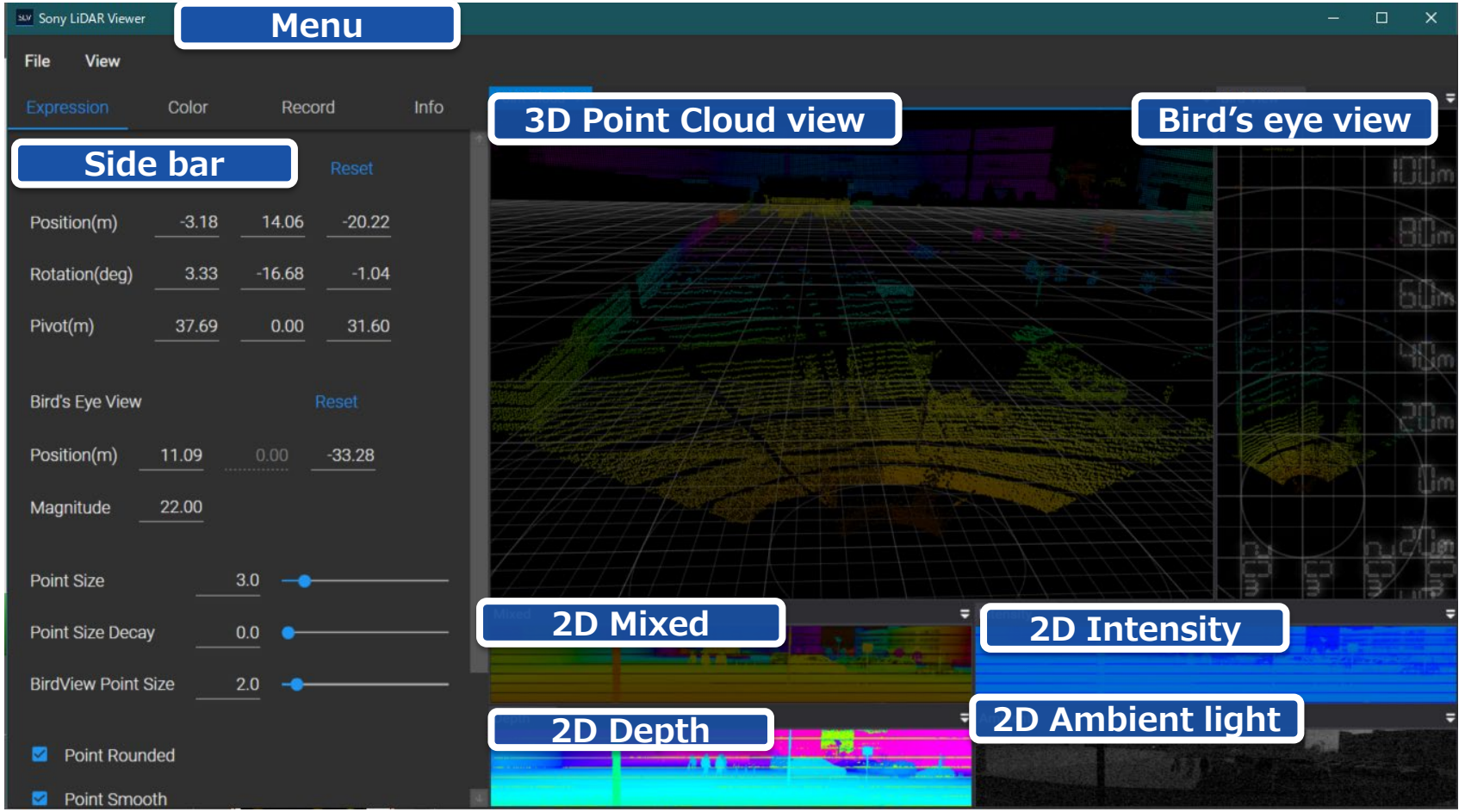




- Turn off
  - Close the viewer and turn off the control box
    - Please wait more than 3 seconds before re-turn it ON.

Sony LiDAR Viewer /View UI

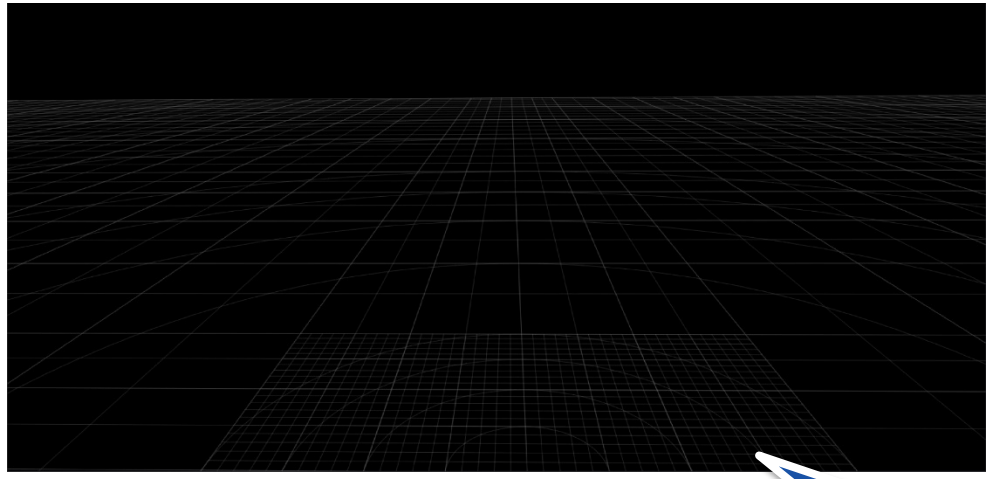
- Sony LiDAR Viewer main screen



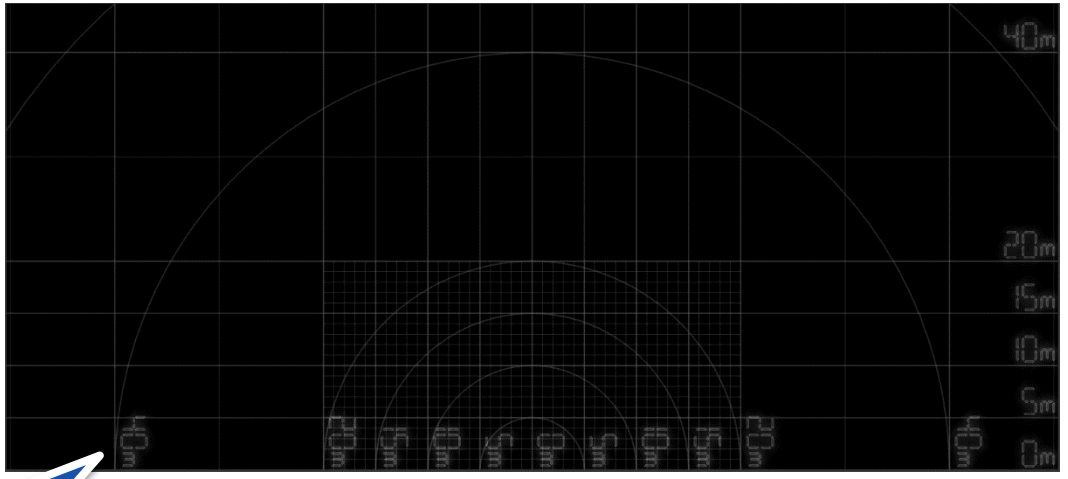
Sony LiDAR Viewer /View UI

- Grid in point cloud and eye bird view

Point cloud



Eye bird

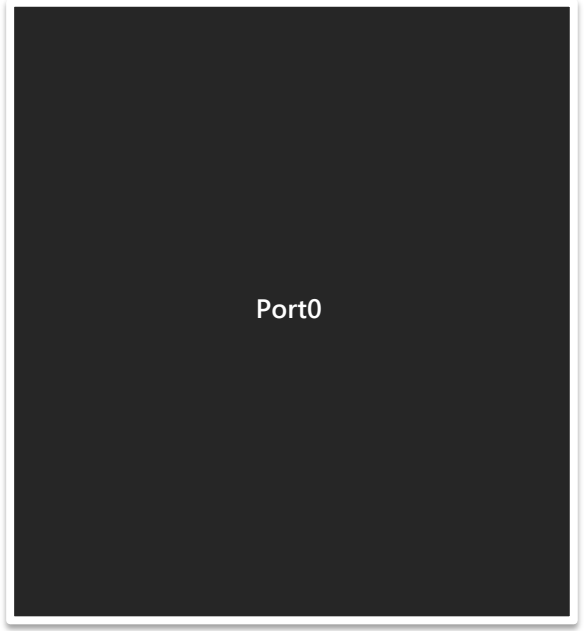


- Grid
  - Range:0-300m
  - 10mx10m
  - 1mx1m sub grid inside of 20mx20m

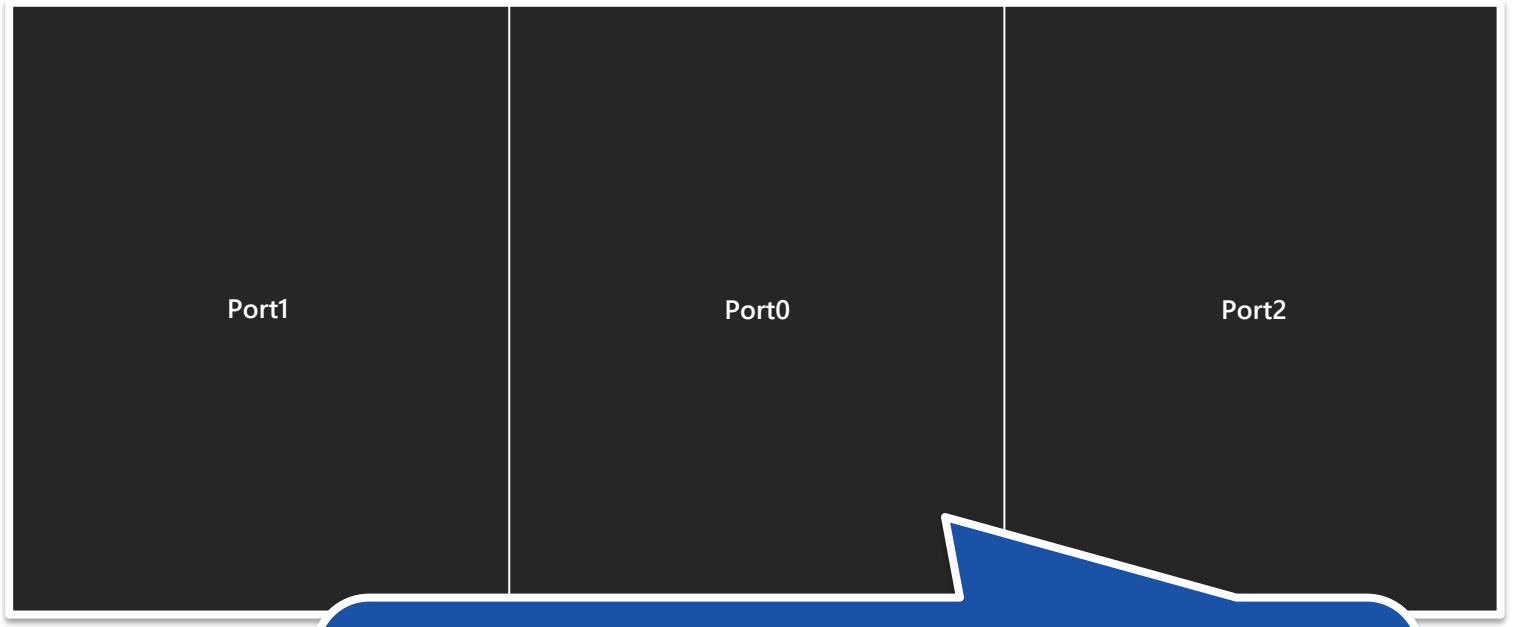
Sony LiDAR Viewer /View UI

- Depth/Intensity/Ambient view
  - The pages describes the layout of 2d view

1 device connected



3 devices connected

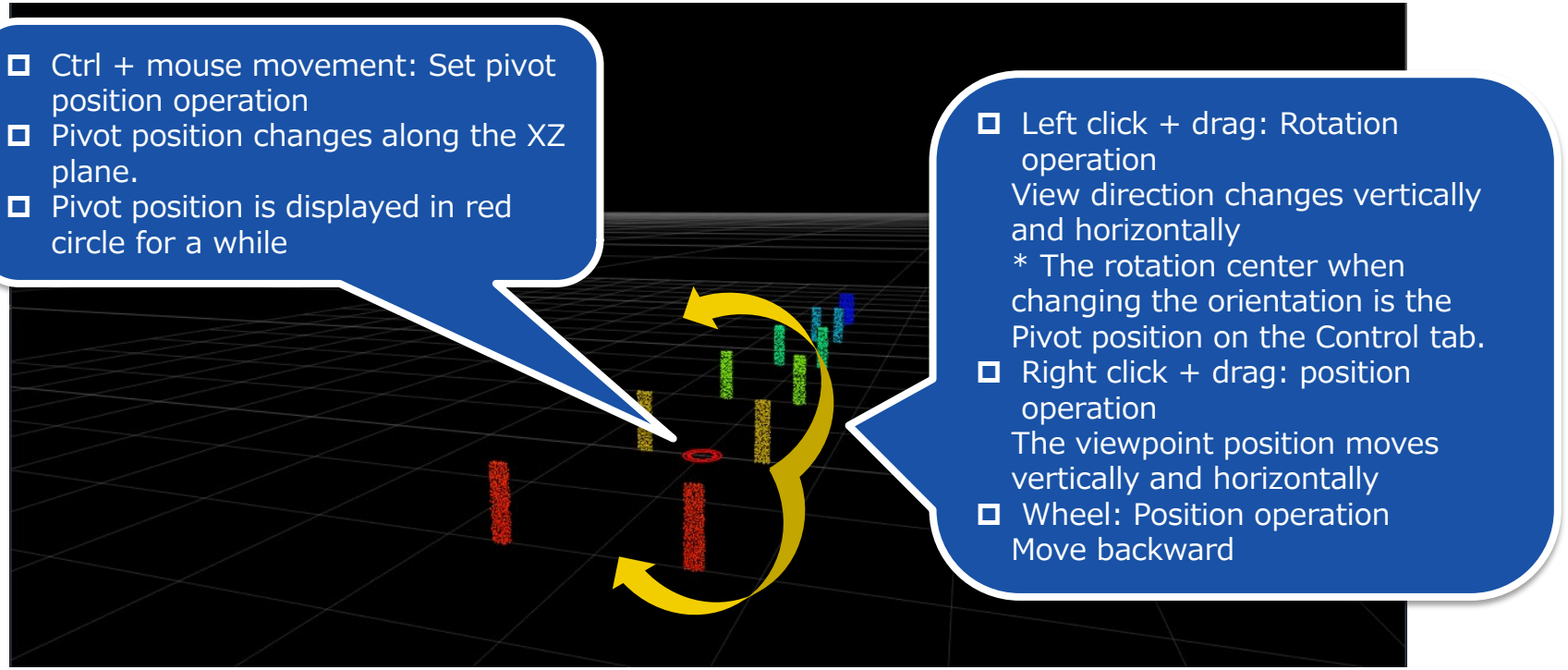


- If multi devices are connected, views will be merged horizontally.
  - Set position at grid position in device setting
  - Set size at display pixel range in device setting

Sony LiDAR Viewer /View UI

- Mouse + keyboard operation in view windows

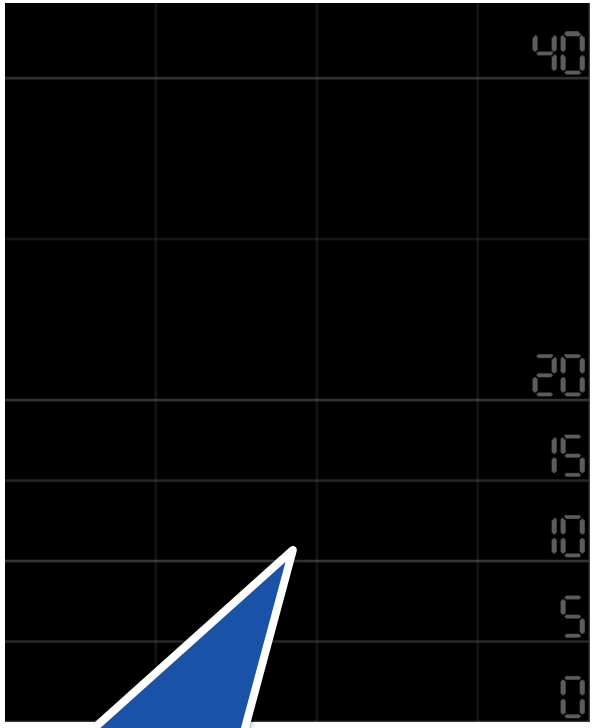
Point cloud



- Ctrl + mouse movement: Set pivot position operation
- Pivot position changes along the XZ plane.
- Pivot position is displayed in red circle for a while

- Left click + drag: Rotation operation
  View direction changes vertically and horizontally
  * The rotation center when changing the orientation is the Pivot position on the Control tab.
- Right click + drag: position operation
  The viewpoint position moves vertically and horizontally
- Wheel: Position operation
  Move backward

Brid's eye view

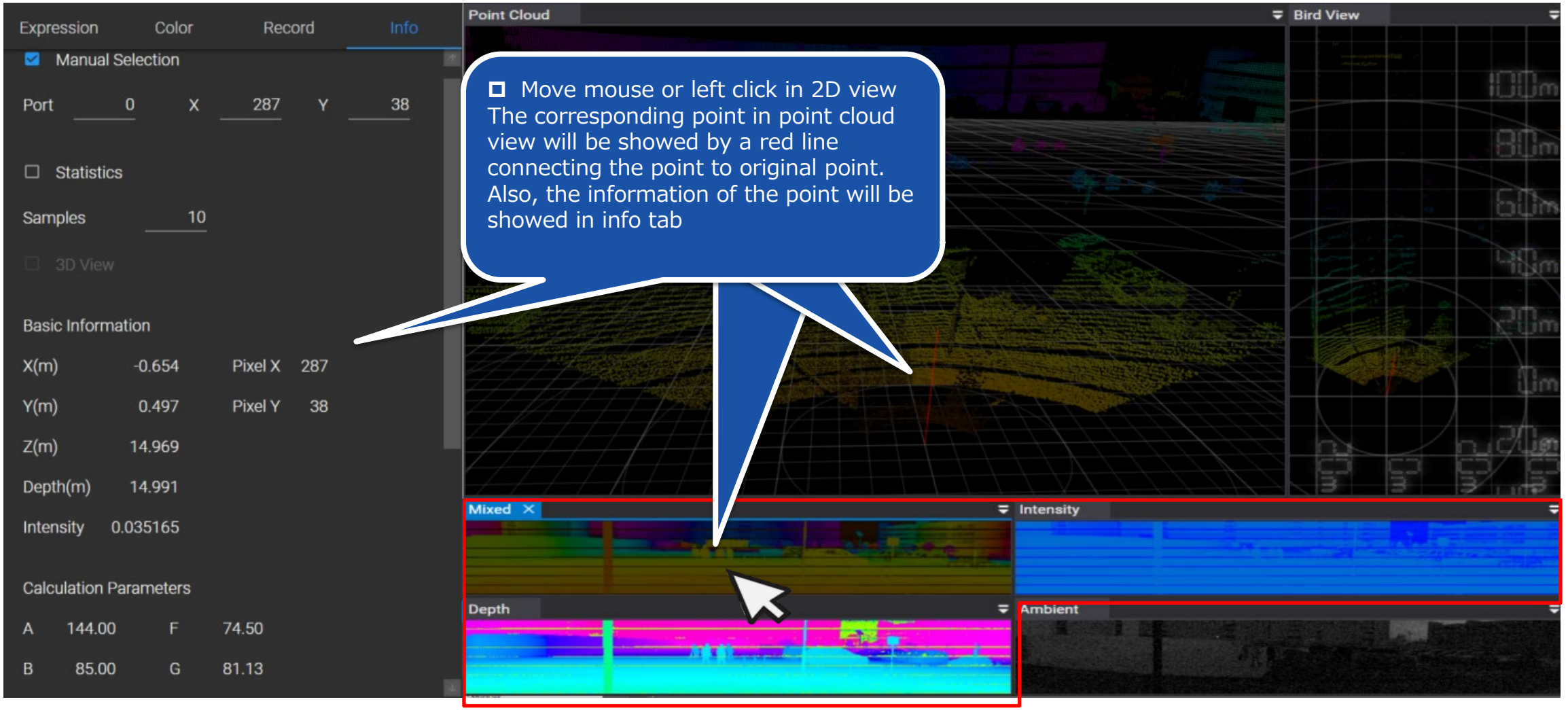


- Left click + drag: Position operation
  The viewpoint position moves vertically and horizontally
  * Direction is fixed
- Wheel: Zoom in / out

Sony LiDAR Viewer /View UI

- Mouse + keyboard operation in view windows

2D mixed/intensity/depth/ map

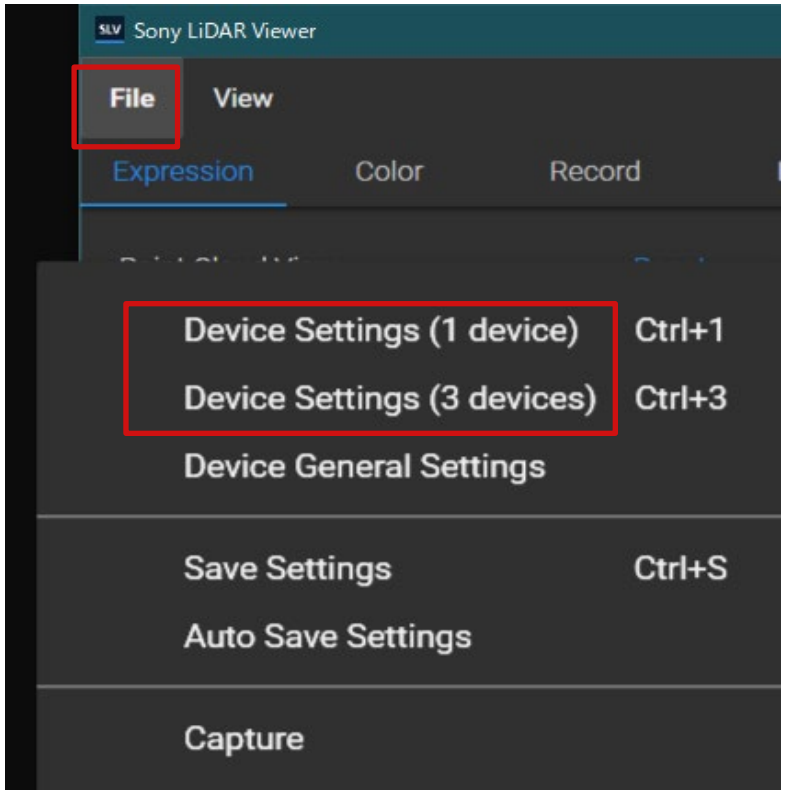


Notice

- For viewer setting, please read p21-36 sequentially.

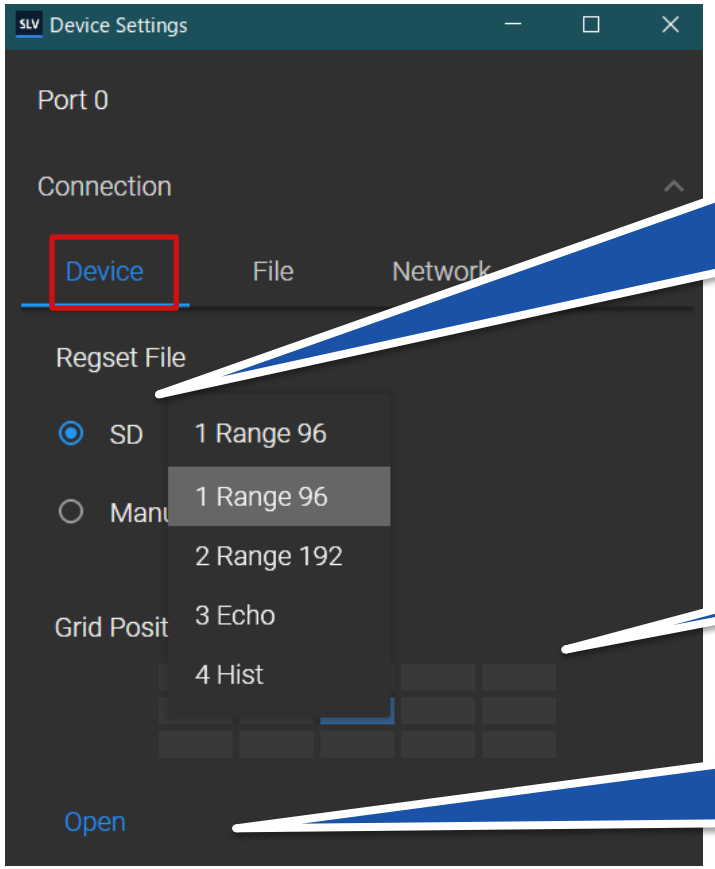
Sony LiDAR Viewer /Settings

- Menu
  - **[File] → [Device Settings(1/3 devices)]**
  - Choose 1/3 devices with your use-case
    *UI shows 3 same windows when 3devices selected.



Sony LiDAR Viewer /Settings

- Menu
  - **[File] → [Device Settings(1/3 devices)] → [Device]**
  - Set in the tab to connect the devices by USB



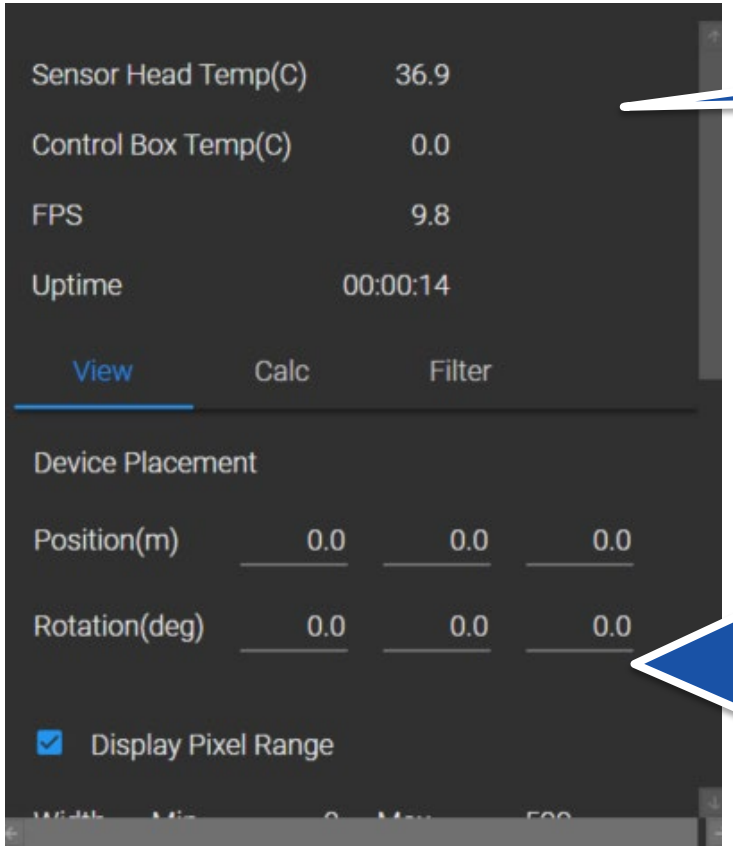
- SD
  - Check it to use Regset stored in SD card
    - 1 Ranging mode (96pixel mode, 300m, 1GHz sampling, 5Echo)
    - 2 Ranging mode (192pixel mode, 150m, 1GHz sampling, 5Echo)
    - 3 Echo mode (only for data export, 74bin, 2Echo)
    - 4 Hist mode (only for data export, 242bin)

- Position on device grid
- Select the position by left-click
  → It becomes the initial display position in the depth/ambient light view

- Open/Close: connect device and set registers by regset
- After open successfully, load any other reset manually and save parameter will be available

Sony LiDAR Viewer /Settings

- Menu
  - **[File] → [Device Settings(1/3 devices)] → [View]**
  - After Open successfully, system status and further setting will be available at the lower part

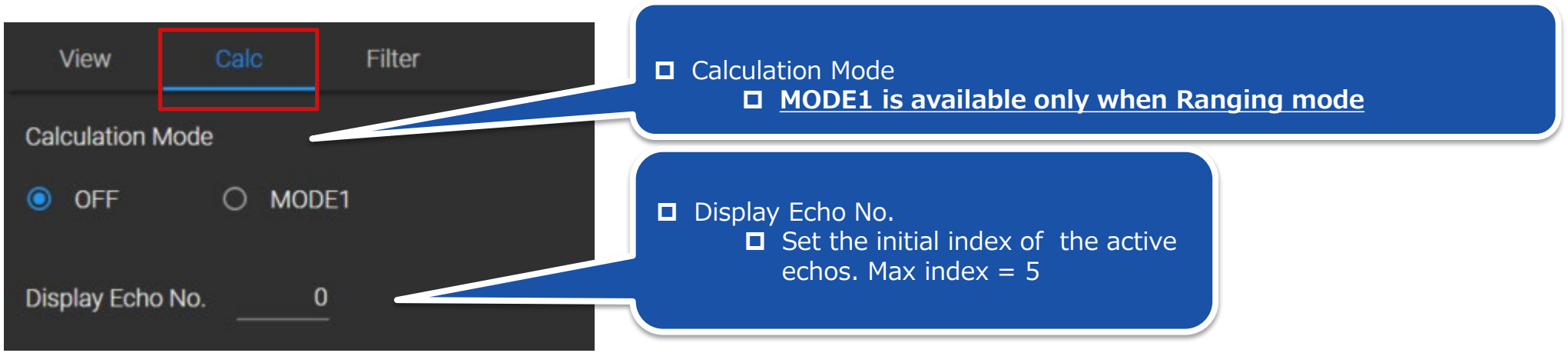


- System status

- View
  - Device Placement
    - Set position and rotation of the device in point cloud view
  - Display Pixel range
    - Check to turn on and adjust display ranging
  - Depth/Intensity Range
    - Set the min and max depth/intensity range

Sony LiDAR Viewer /Settings

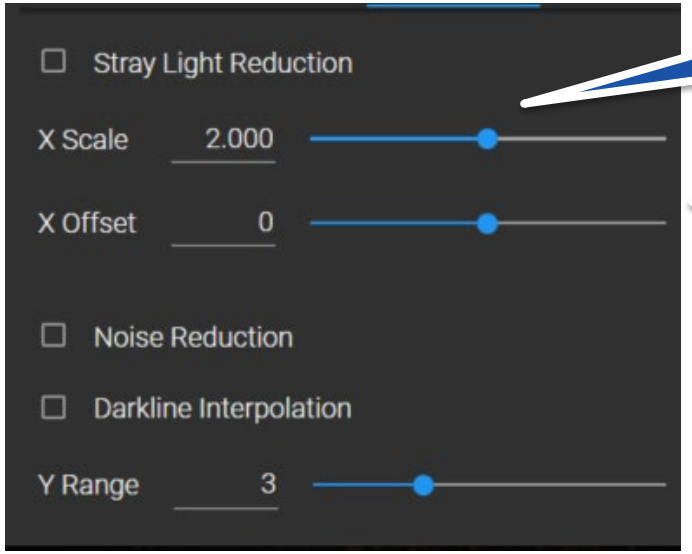
- Menu
  - **[File] → [Device Settings(1/3 devices)] → [Calc]**
  - After Open successfully, system status and further setting will be available at the lower part



CALC_MODE	Description
0(OFF)	Sensor output(Peak position/intensity) will be used directly.
1(MODE1)	Depth and intensity will not be calculated by peak position/intensity directly Calculation is based on FWHM

Sony LiDAR Viewer /Settings

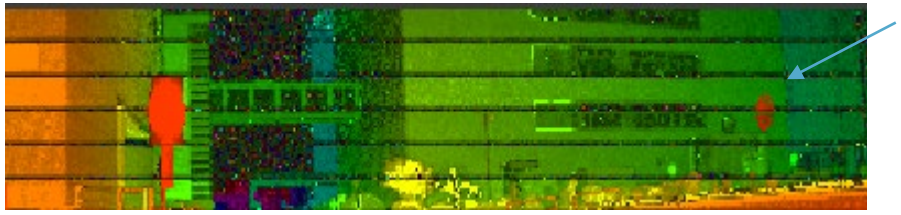
- Menu
  - **[File] → [Device Settings(1/3 devices)] → [Filter]**
  - After Open successfully, system status and further setting will be available at the lower part



- Stray Light reduction on/off
  - Reduce error of light repetitive reflection among lens

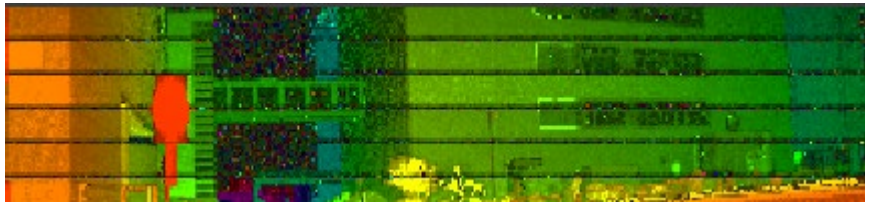
- Image filtered = X scale * image + X offset

OFF



Stray light of strongly reflecting object on the left side

ON



Sony LiDAR Viewer /Settings

- Menu
  - **[File] → [Device Settings(1/3 devices)] → [Filter]**
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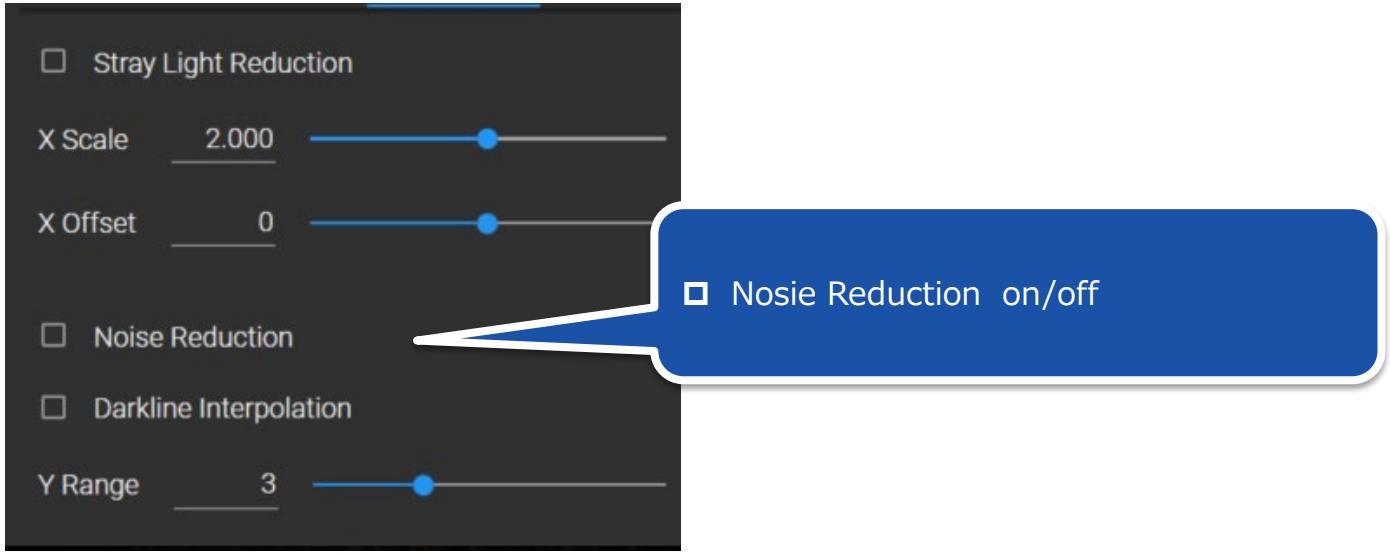
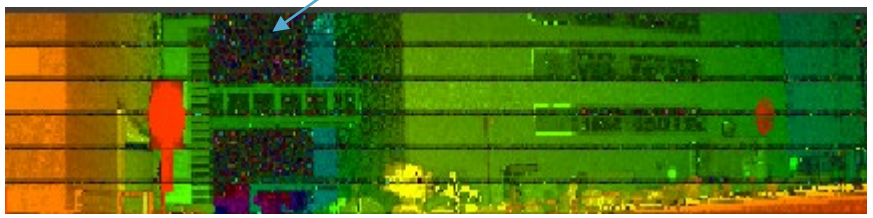
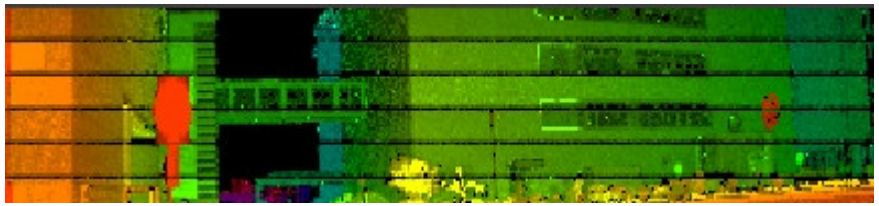


OFF

Noise

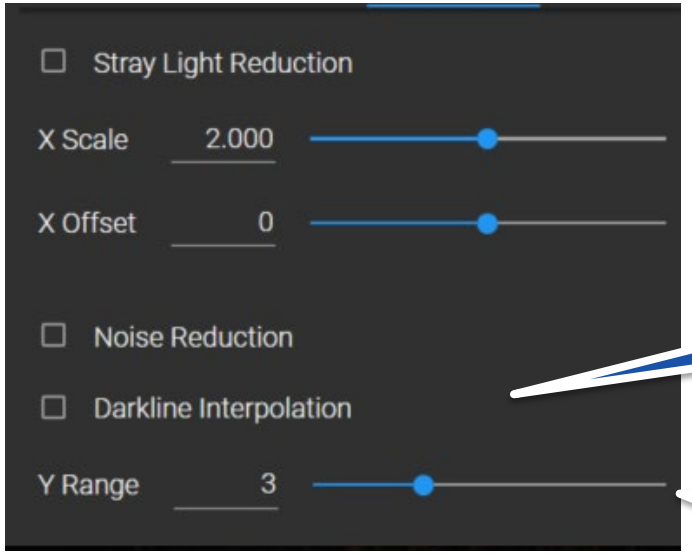


ON



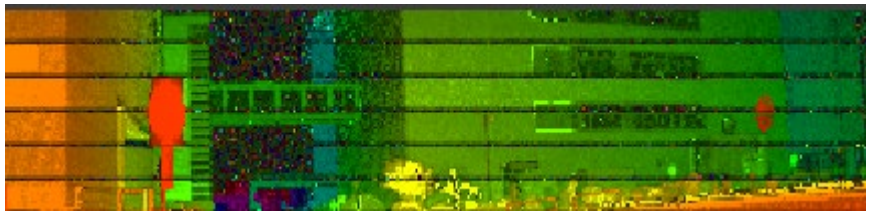
Sony LiDAR Viewer /Settings

- Menu
  - **[File] → [Device Settings(1/3 devices)] → [Filter]**
  - After Open successfully, system status and further setting will be available at the lower part



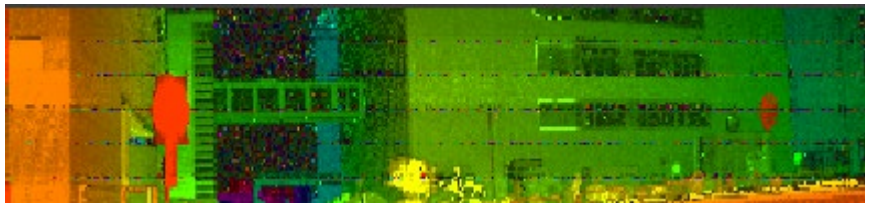
- Darkline interpolation on/off
- Range Y
  - Set range of the around pixels in Y direction

OFF



Dark lines due to laser configuration

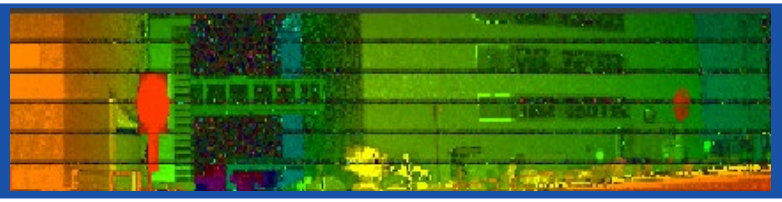
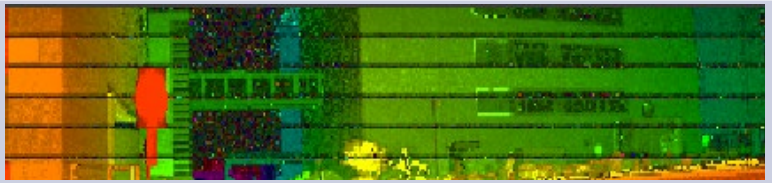
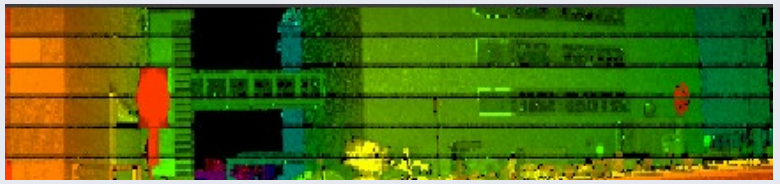
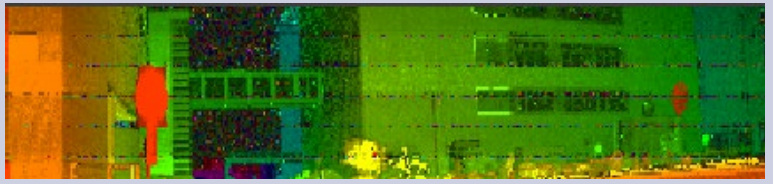
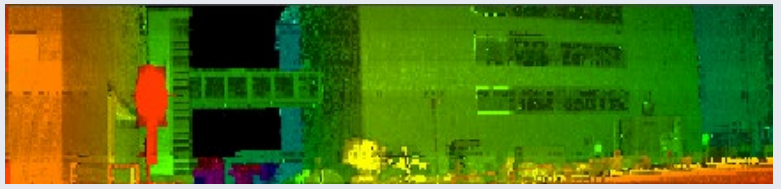
ON



Sony LiDAR Viewer /Settings

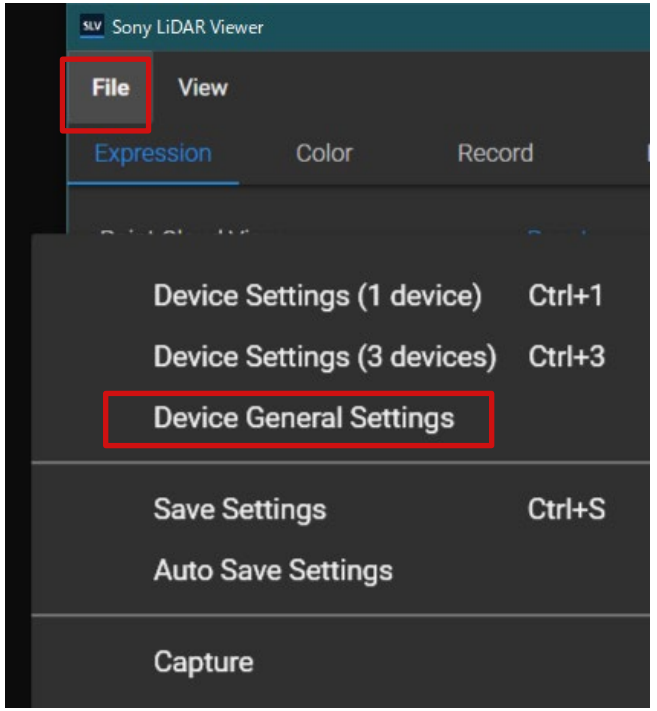
- Menu
  - **[File] → [Device Settings(1/3 devices)] → [Filter]**

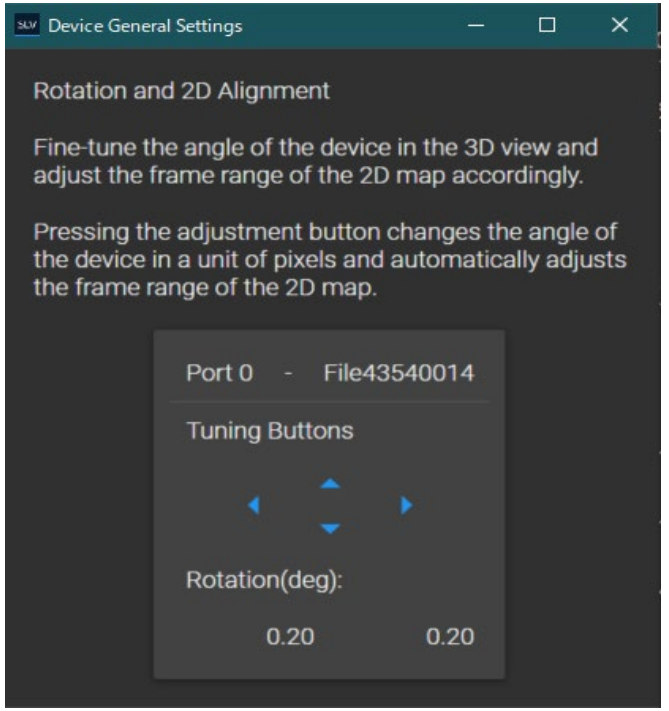
Filter comparison

Filter OFF	
Stray light reduction ON	
Noise reduction ON	
Darkline interpolation ON	
3 Filter ON	

Sony LiDAR Viewer /Settings

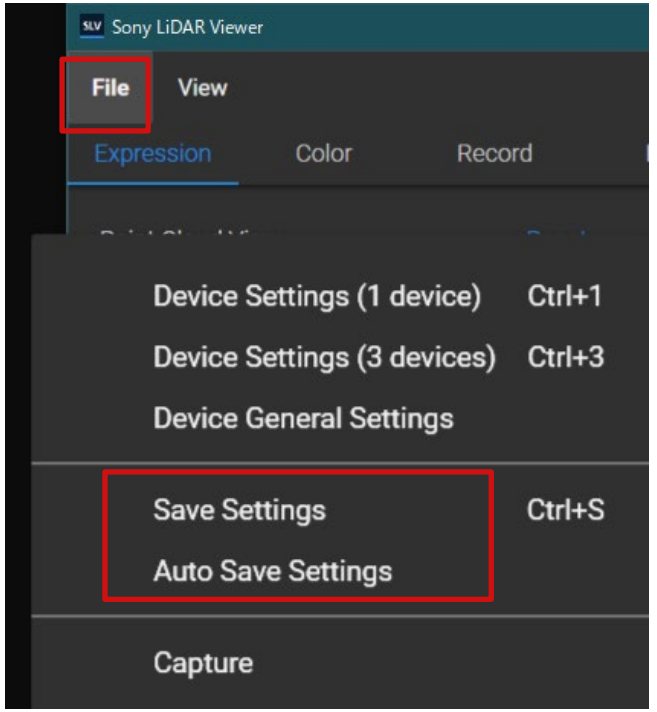
- Menu
  - **[File] → [Device General Settings]**
  - Fine-tune angles of the 2D/3D view by click direction button.
  - Refer the details in the window





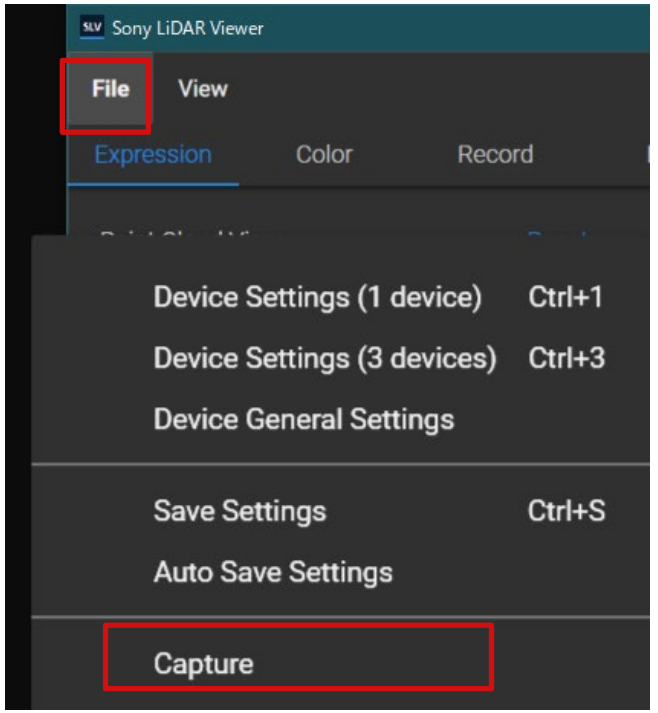
Sony LiDAR Viewer /Settings

- Menu
  - **[File] → [Save Settings] or [Auto Save Settings]**
  - **[Save Settings]**
    - Click it to save settings manually
  - **[Auto Save Settings]**
    - Check it and settings will be saved automatically after viewer is closed



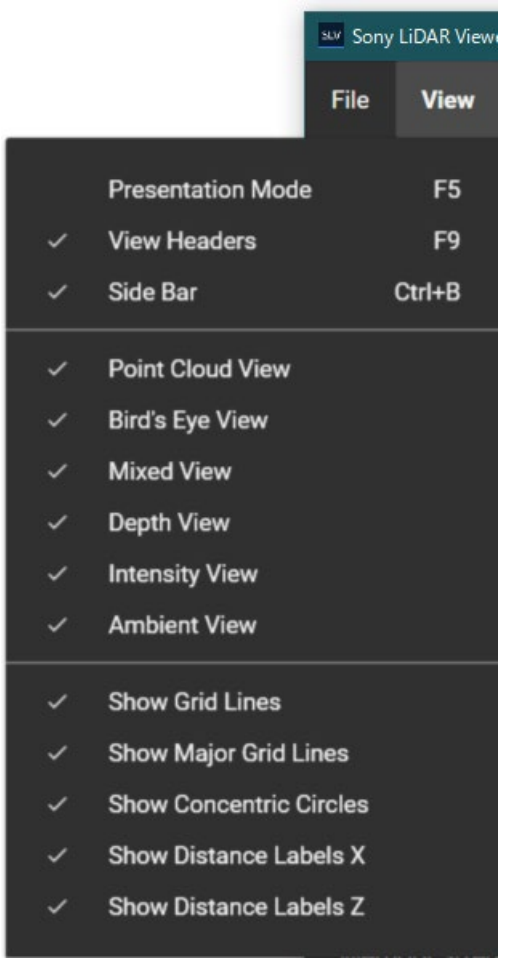
Sony LiDAR Viewer /Settings

- Menu
  - **[File] → [Capture]**
  - 2D view will be captured with .bmp format in installed dir¥bin¥capture folder



Sony LiDAR Viewer /Settings

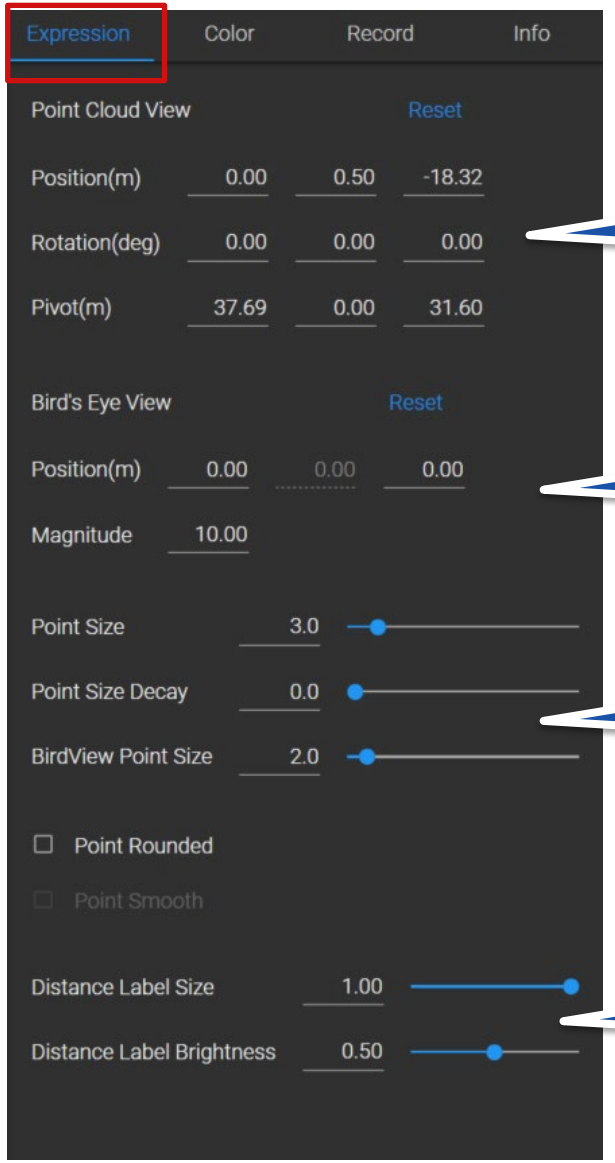
- Menu
  - **[View]**
  - On/off every view element



- Presentation Mode: Viewer shows in full screen without menu and side bar

Sony LiDAR Viewer /Settings

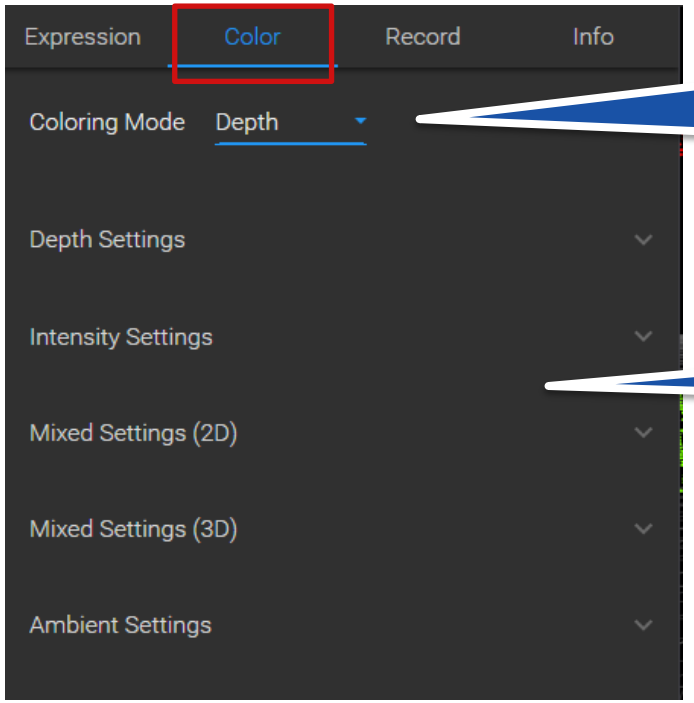
- Side bar
  - **[Expression]**



- Set camera viewpoint in point cloud view
- Set camera viewpoint in point bird eye view
- Set point property in point cloud view
- Set label property in bird eye view

Sony LiDAR Viewer /Settings

- Side bar
  - **[Color]**

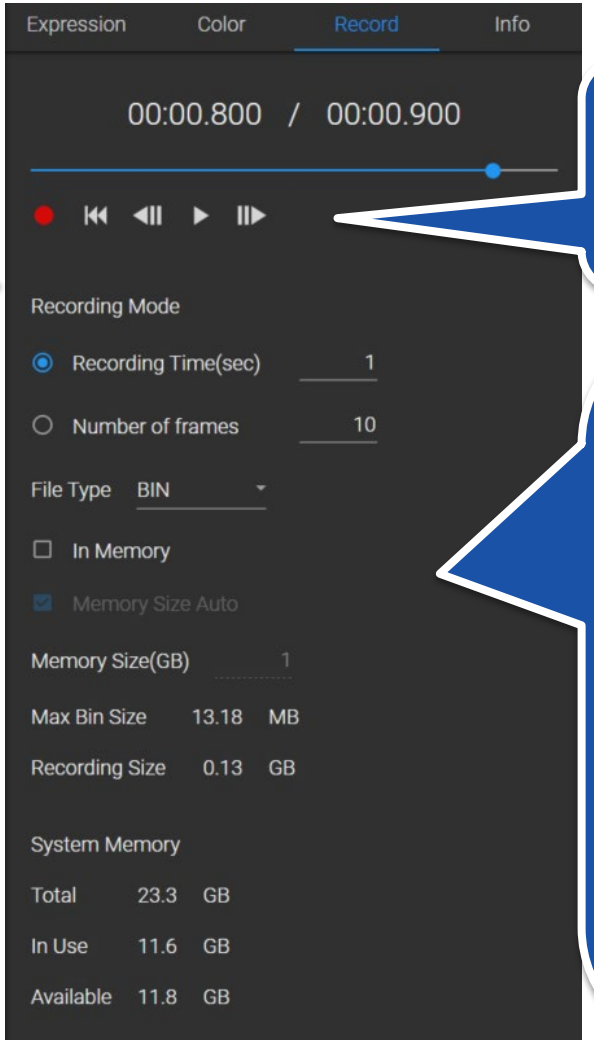


□ Set coloring mode
・Depth : point colored according to depth
・Intensity : point colored according to intensity
・Mixed : point colored according to depth/intensity

□ Adjust color pattern for each view

Sony LiDAR Viewer /Settings

- Side bar
  - **[Record]**



- Record start. Data will be save in installed dir¥bin¥recored.X (X is the number of port)
- Record files will be saved in installed dir¥bin¥output
- Parameter JSON file will also be saved

- Replay
  - If bin files is loaded in the device setting, use those buttons to play, pause, step forward, etc. Record button is used as home

- Recording Mode
  - Recoding Time
    - Check to record by setting time length
    - Check to record by setting frames number
  - File type
    - Set saved file type. Refer next page
  - In memory
    - Every frame will be saved in memory until record stop to avoid frame dropping
  - Memory size auto
    - Check to set memory size automatically for in memory function, otherwise set it manually

- Reference of bin size and current recorded size

- Current memory statue

Sony LiDAR Viewer /Settings

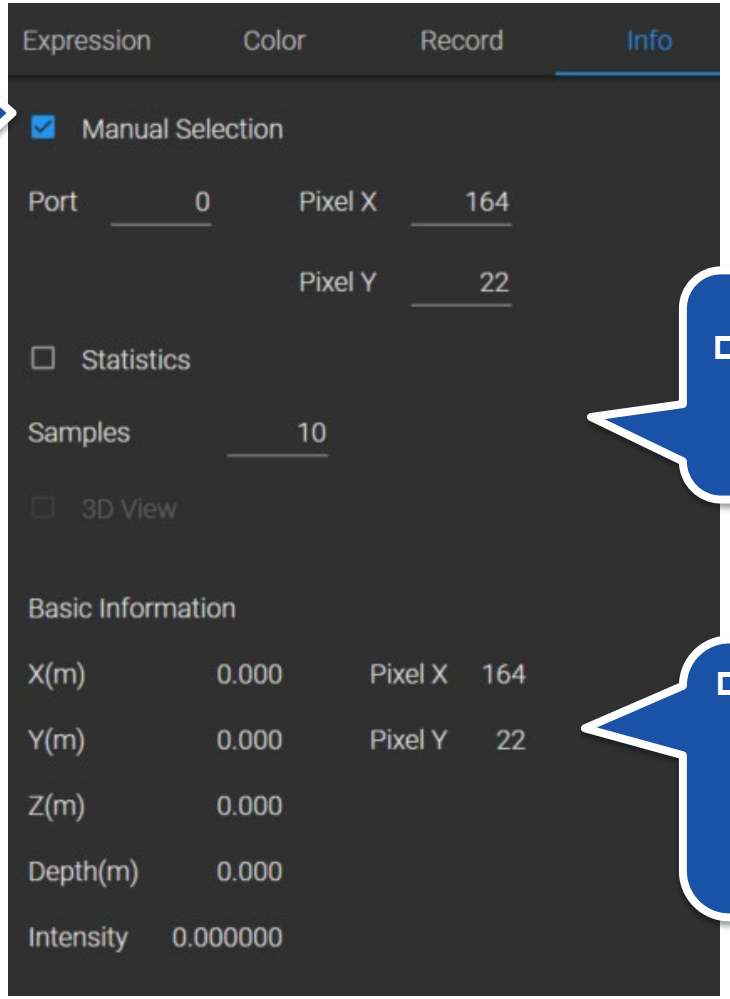
- **Record file type**

File type	Details	Features
BIN	MIPI output of a single frame with header information	The basic format. It can be used as-is for analysis.
BIGBIN	A format that combines multiple BINs into a single file	Even if the number of frames is large, the access overhead to the file system is small.
ZIP	Compressed BIN file in ZIP format	File size can be reduced. Can be compressed and decompressed using standard OS functions.
LZ4BIN	Compressed BIN file in LZ4 format	The CPU load for compression/decompression is very low. The compression ratio is not very high.
ZSTDBIN	Compressed BIN file in ZSTD format	The compression ratio is about the same as ZIP format, and the CPU load is small.

Sony LiDAR Viewer /Settings

- Side bar
  - **[info]**

- Manual Selection
  - Check it to set a point manually, or click in 2D view to grab the position automatically
  - Uncheck it to set point automatically. Move mouse cursor inside 2D view to show information automatically

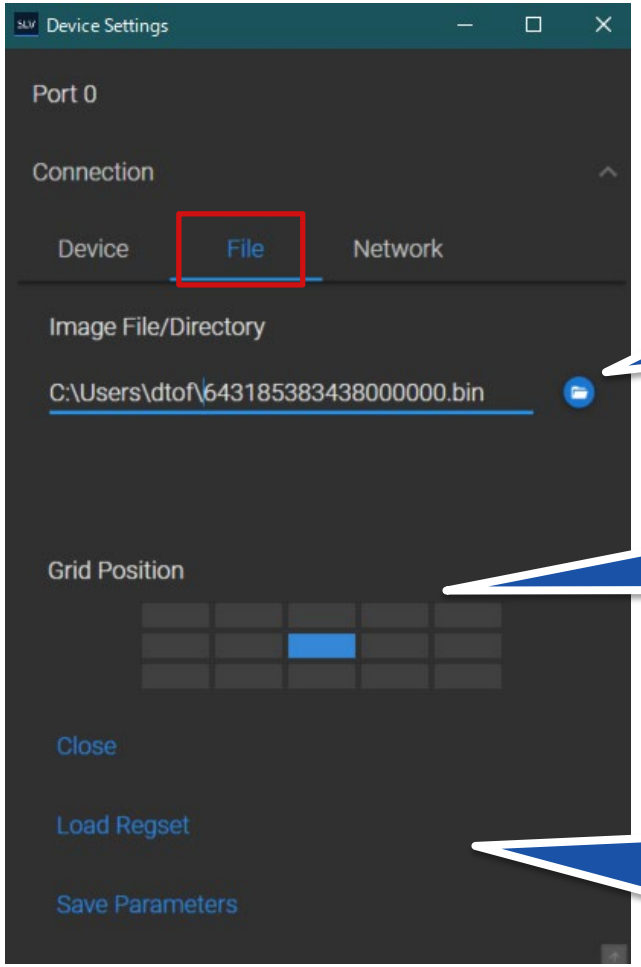


- Statistics
  - Show the mean and standard deviation of selected point

- Basic information
  - X,Y,Z: position in point cloud map
  - Pixel X,Y: corresponding position in pixel coordinate system
  - Depth: distance(m)
  - Intensity: signal intensity

Sony LiDAR Viewer /Settings

- Menu
  - **[File] → [Device Settings(1/3 devices)] → [File]**
  - Set in the tab to replay saved bin file



- Browser and select bin file.
  Select anyone and every bin file in the folder will be load
- Position on device grid
- Select the position by left-click
  → It becomes the initial display position in the depth/ambient light view
- Open/Close: replay bin file
- After open successfully, loading any other additional regset manually and saving parameters will be available.

Notice

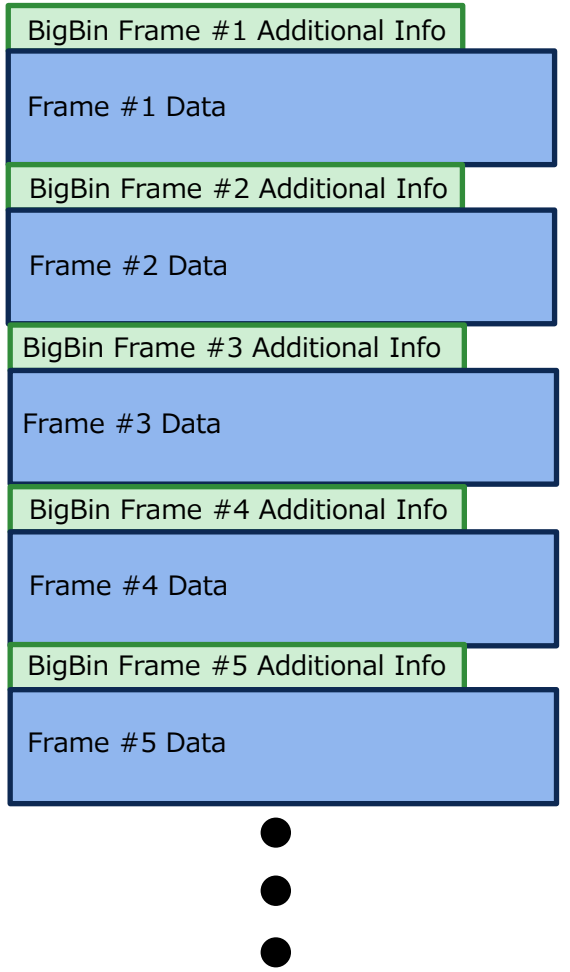
- For recorded data format, please read p.38-41 sequentially.

- P41-43 describes the data format for ranging mode. Please contact SSS if required data format for Echo/Histogram mode.

Sony LiDAR Viewer / Recorded data format

Bin File format

BigBin File format



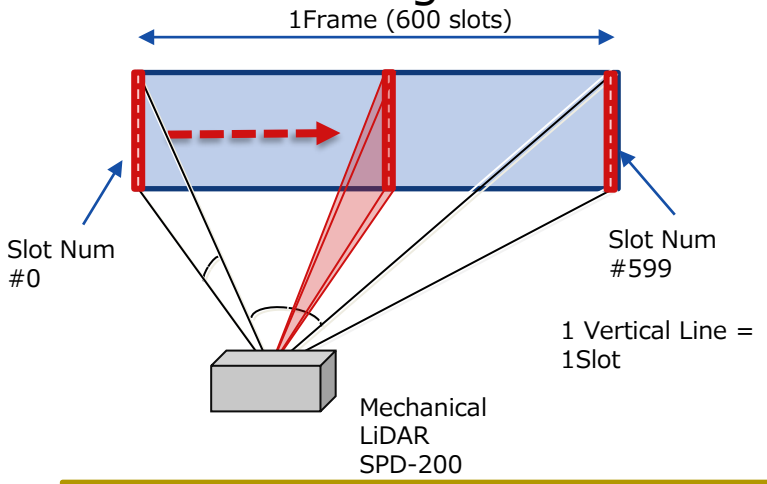
- Bin file stores 1 frame data.
- BigBin file stores multi-frame data in chronological order.
- No explanation here about the compressed file :Zip, LZ4BIN, ZSTDBIN
- 2 major components in bin or BigBin
  - Additional information depending on the file type. See next pages
  - Frame data. See next pages

The page describes the format of recorded file about the overall structure

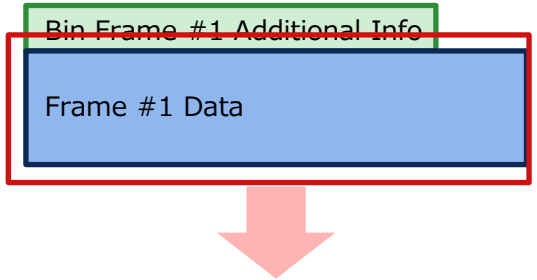
Sony LiDAR Viewer / Recorded data format

File type	Additional info		Frame data
Bin	[Width of frame data] [Height of frame data]	2byte 2byte	Slots
BigBin	[Timestamp] [Width of frame data] [Height of frame data]	8byte 2byte 2byte	Slots

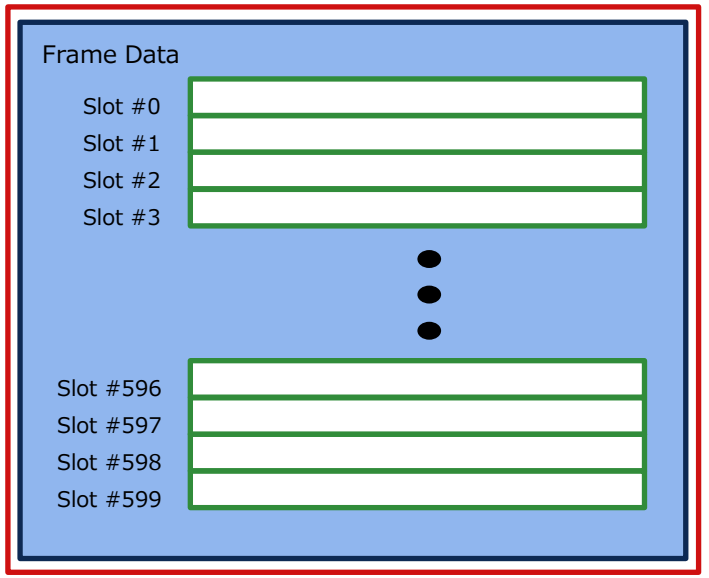
- 1 Frame data is composed of 600 data slots.
- Slot means 1 vertical scanning to read 1 column pixels(default 96).



Bin File data



Frame data



The page describes the format of recorded file about the additional info and frame data structure

Sony LiDAR Viewer / Recorded data format

- The frame data format is based on MIPI output format
- MIPI FS/FE/PH/PF/Blanking will not be saved.
- Every line is composed of 768 Words. If the data is less than 768Words, blanking data will be added at the tail
- Each line (Active area) is composed of 8 pixels
  - In case of vertical 96pixel mode, total active line are 12 lines.
  - In case of vertical 192pixel mode, total active line are 24 lines.

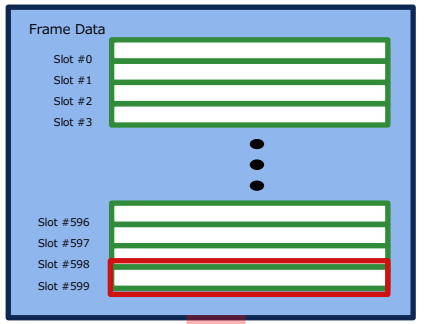
- RAW12 data is padding as 2Bytes.
- Refer application note for more details

Active area(96pixel mode)

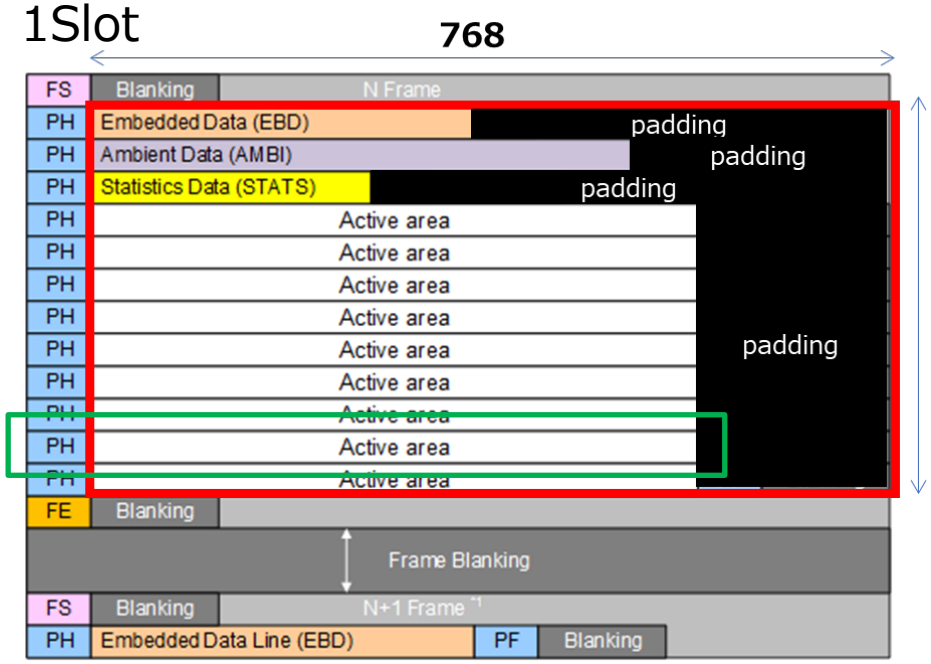
Pix No.1	Pix No.2	Pix No.3	Pix No.4	Pix No.5	Pix No.6	Pix No.7	Pix No.8

The page describes the format of recorded file about the slot structure

Frame data



1Slot

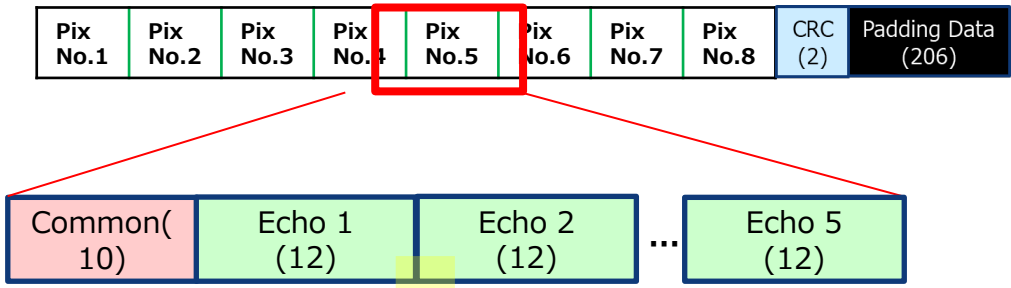


IMX459 MIPI output Format

Sony LiDAR Viewer / Recorded data format

- Every pixel contains common and echo information with 70 Bytes.
- Refer application note for more details

Active area(96pixel mode)



画素No	画素情報	エコーNo	出力データ	Unit	Bit	On/Offレジスタ名
0	共通情報	-	画素番号	U12.0	[11:0]	G_OUTPUT_HEAD_0
			エコー検出閾値	U12.0	[11:0]	
			エコー判定閾値1	U12.0	[11:0]	G_OUTPUT_HEAD_1
			エコー判定閾値2	U12.0	[11:0]	
			Bn	U8.0	{4'b0, [7:0]}	G_OUTPUT_HEAD_2
			SUM_Bi	U12.0	[11:0]	
			参照光最大信号強度	U8.0	{4'b0, [7:0]}	G_OUTPUT_HEAD_3
			参照光最大位置	U12.0	[11:0]	
			遠距離最大信号強度	U12.0	{4'b0, [7:0]}	G_OUTPUT_HEAD_4
			MAX_Bi	U8.0	{4'b0, [7:0]}	
	個別情報	1	ピーク信号強度	U12.0	[11:0]	G_OUTPUT_RANGE_PEAK
			ピーク位置	U12.0	[11:0]	
			半値幅開始位置（整数）	U12.0	[11:0]	G_OUTPUT_RANGE_HALF
			半値幅開始位置（小数）	U4.0	{8'b0, [3:0]}	
			半値幅終了位置（整数）	U12.0	[11:0]	
			半値幅終了位置（小数）	U4.0	{8'b0, [3:0]}	
			エコー開始位置	U12.0	[11:0]	G_OUTPUT_RANGE_ECHO
			エコー終了位置	U12.0	[11:0]	
			谷最小信号強度	U12.0	[11:0]	G_OUTPUT_RANGE_OTHER
			遠距離ピーク位置	U12.0	[11:0]	
			ピーク最小信号強度	U12.0	[11:0]	
			各種フラグ [11:8]エコー番号 [7:6]Reserved [5]ピーク値複数回発生, [4]後尾ピーク割れ, [3]先頭ピーク割れ [2]終了位置異常, [1]開始位置異常, [0]エコー有効	U12.0	[11:0]	G_OUTPUT_RANGE_FLAG
		・・・	・・・		・・・	
		10	ピーク信号強度	U12.0	[11:0]	
			・・・		・・・	
			各種フラグ [11:8]エコー番号 [7:6]Reserved [5]ピーク値複数回発生, [4]後尾ピーク割れ, [3]先頭ピーク割れ [2]終了位置異常, [1]開始位置異常, [0]エコー有効	U12.0	[11:0]	
	CRC	-	CRC(複数画素パッキングした場合は1行の	U16.0	{4'b0,CRC[7:0]}	-
		-	最後の画素のみ出力)		{4'b0,CRC[15:8]}	-
1		・・・	・・・		・・・	
2		・・・	・・・		・・・	
・・・		・・・	・・・		・・・	
N-1		・・・	・・・		・・・	

N=48,96,192　※G_OUTPUT_NUM_ECHOで1画素あたりのエコー数を設定可能

The page describes the format of recorded file about the active area

Revision History

Revision	Date	Remarks
0.0.1	2022/3/18	Draft version