STSW-IMG052: GUI for X-NUCLEO-53L9A1

Introduction

This document describes the VL53L9CX evaluation kit (EVK) and serves as an operational user manual.

The VL53L9CX EVK is a demonstration system from STMicroelectronics. It is based on a dToF (direct Time-of-Flight) sensor that produces depth maps. The VL53L9CX EVK embeds the VL53L9 dToF module reflowed on the X-Nucleo shield board and the Nucleo-H563ZI board.

Both sensor and hardware are controlled by software running on a computer. Software also controls a 3D reconstruction of grabbed images. The system can operate over short and long distances, for example autofocus mode and AR/VR mode respectively.

1 Acronyms and abbreviations

Acronym	Definition
AF	autofocus
AR	augmented reality
CS	customer samples
DSS	dynamic SPAD selection
dToF	direct Time-of-Flight
ES	engineering samples
EVK	evaluation kit
FoV	field of view
FPGA	field-programmable gate array
fps	frames per second
GPU	graphics processing unit
GUI	graphical user interface
HW	hardware
IPP	image postprocessing
LDD	laser diode driver
OTP	one-time programmable
PFM	portable floatmap
PGM	portable gray map
PLY	polygon file format
SPAD	single-photon avalanche diode
TNR	temporal noise reduction
ToF	Time-of-Flight
ULP	ultralow power mode
VHV	very high voltage
VR	virtual reality

2 Overview

The VL53L9CX EVK includes a physical component, and a GUI software.

2.1 Hardware content

The VL53L9CX GUI requires two physical components. Make sure to have the hardware listed below.

Figure 1. NUCLEO-H563ZI board



Refer to the dedicated page (https://www.st.com/en/evaluation-tools/nucleo-h563zi.html) for more information.

Figure 2. **X-NUCLEO-53L9A1 shield**



2.2 GUI software

The VL53L9CX EVK software is a graphical user interface (GUI). It is used to operate the VL53L9CX sensor, demonstrate functional performance, and allows the user to adjust the parameters that control the ranging capabilities and 3D video performances.

The VL53L9CX can range up to 100 FPS using a MIPI interface. As the H5 MCU does not have a MIPI interface, the data are read through the I3C communication interface. This is limiting the maximum frame rate to 30 FPS in full resolution. To achieve higher FPS the user can select another MCU (like the STM32N6) or any platform with a MIPI interface.

Note: The VL53L9CX EVK interface is Windows® compliant.

To ensure correct frame rate performance levels, the following minimum computer hardware/software configuration is recommended:

Table 1. System requirements

	Minimum specification
OS	Windows® 10
Processor	Intel® Core™ I5
Memory	8 Gbytes
Connectivity	USB3.0

Note: The software installer may require administrator privileges to be installed on your computer.

3 Laser safety

This product contains a laser emitter and corresponding drive circuitry. The laser output is designed to meet Class 1 laser safety limits under all reasonably foreseeable conditions including single faults in compliance with IEC 60825-1:2014.

Do not increase the laser output power by any means. Do not use any optics to focus the laser beam.

Caution: *Use of controls, adjustments, or procedures other than those specified herein may result in hazardous radiation exposure.*

Figure 3. Class 1 laser label



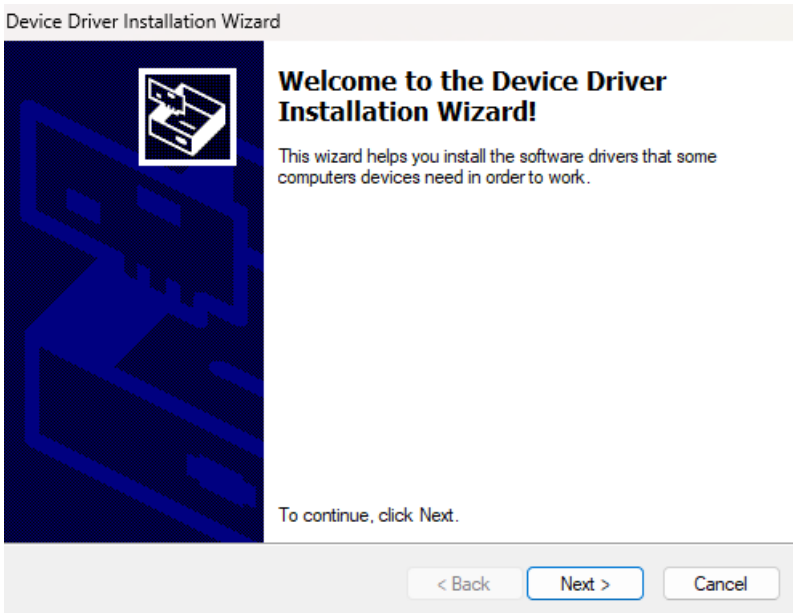
This product complies with:

- IEC 60825-1:2014
- 21 CFR 1040.10 and 1040.11, except for conformance with IEC 60825-1:2014 as described in the laser notice number 56, dated May 8, 2019.
- EN 60825-1:2014 including EN 60825-1:2014/A11:2021
- EN 50689:2021, however STMicroelectronics does not guarantee compliance with the requirement of clause 5 from EN50689 regarding child appealing products. If designing a child appealing product, contact STMicroelectronics' technical application support.

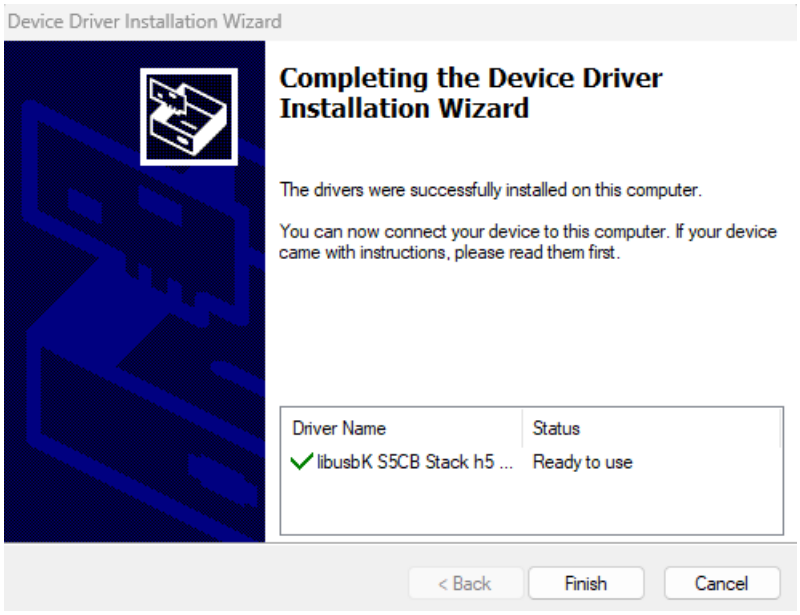
4 GUI software installation

4.1 Driver installation

1. Run the S5CBUsbDriver.exe installation wizard.



2. Click [**Next**] to install the driver.
3. Once the installation is complete, the following window appears. Click [**Finish**].



4.2 Firmware installation

Note: This procedure for flashing the firmware is required the first time the board is used. It is also required to flash the firmware every time the graphical interface is used after the Nucleo board has been used for another task.

Proceed as follows to flash the firmware:

1. Check that JP2 is fitted on STLK position to power the NUCLEO-H563ZI board (see Figure 1. NUCLEO-H563ZI board) with the USB STLINK port.
2. Check that the JP4 is fitted on 3V3 (NUCLEO-H563ZI board)
3. Check the board configuration is set as follows (see Figure 2. X-NUCLEO-53L9A1 shield):
   - J1: Fitted in configuration 3V3
   - J2/J3/J4/J5 are fitted.
   - J6: Fitted in configuration 1V8 (on the left)
   - SW1: position INT (bottom), 12 MHz on-board oscillator is used

Figure 4. JP2

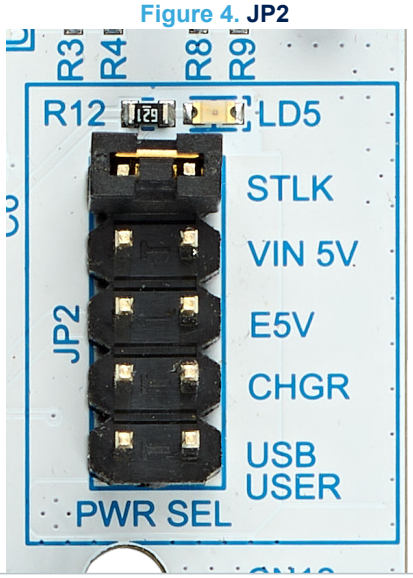
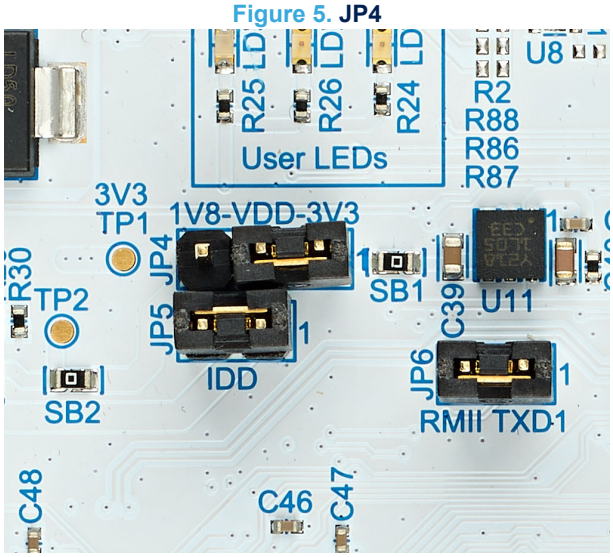
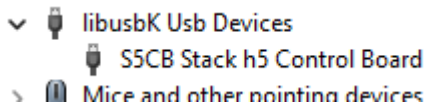


Figure 5. JP4



4. Connect the NUCLEO-H563ZI board to the computer USB ST-LINK port (top side).
5. Drag and drop the firmware `GrabRel_S573CBb.bin`.
6. Disconnect the USB from the STLINK port (top side).
7. Change the jumper position on JP2 to USB USER position, to power the board with the USB USER.
8. Connect the USB port to the USB USER port.
9. Check that the device manager the S5CB driver is present.

Figure 6. S5CB driver in device manager



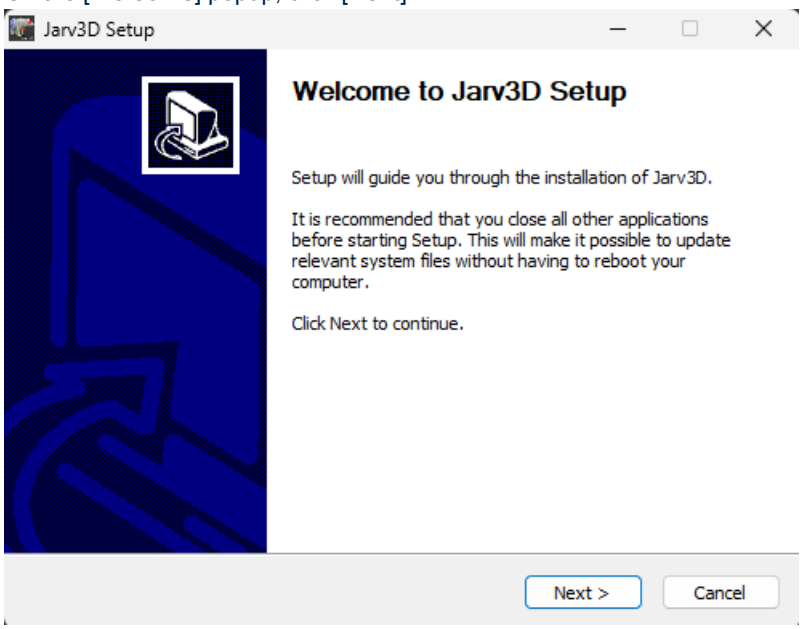
10. Once the firmware is flashed, the LED1 should blink every 3 seconds.

Note: Continue using the USB user port to use the GUI.

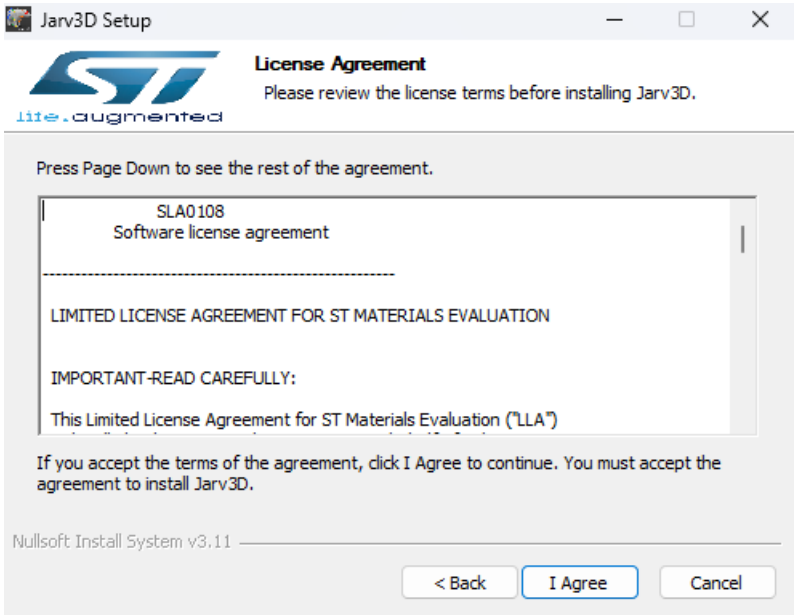
4.3 GUI software installer

This section describes the procedure for installing the GUI software.

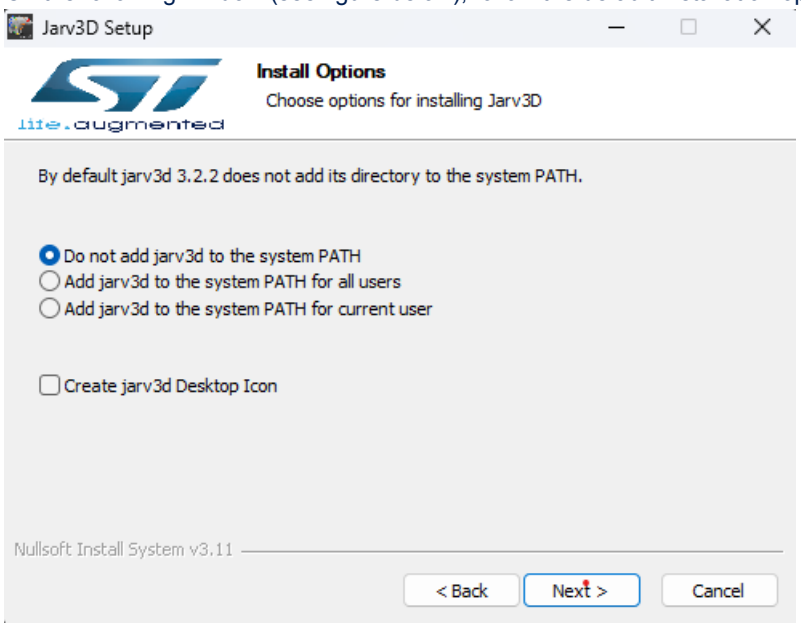
1. First, execute “jarv3d-x.x.x-win64.exe”
2. On the [**Welcome**] popup, click [**Next**].



3. Read and agree to the terms of the license, by clicking [**I Agree**].

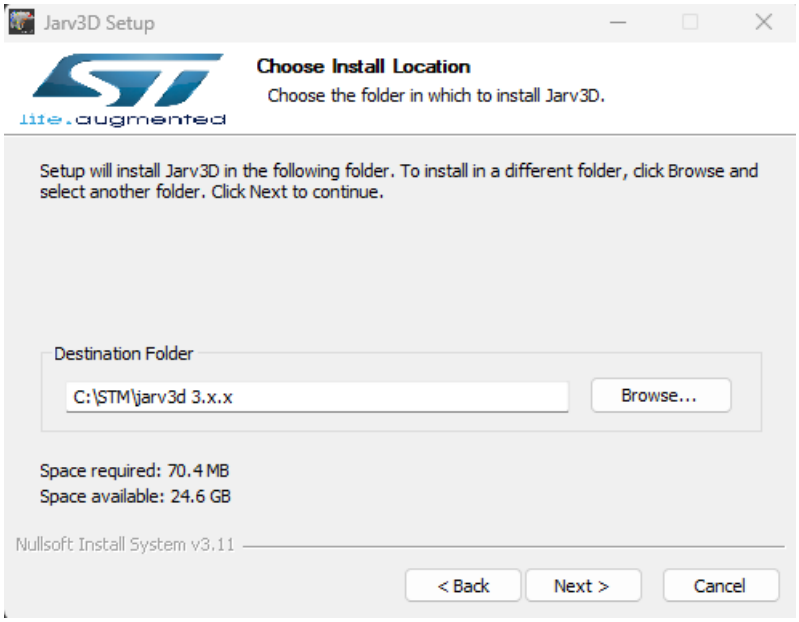


4. On the following window (see figure below), follow the default installation options.

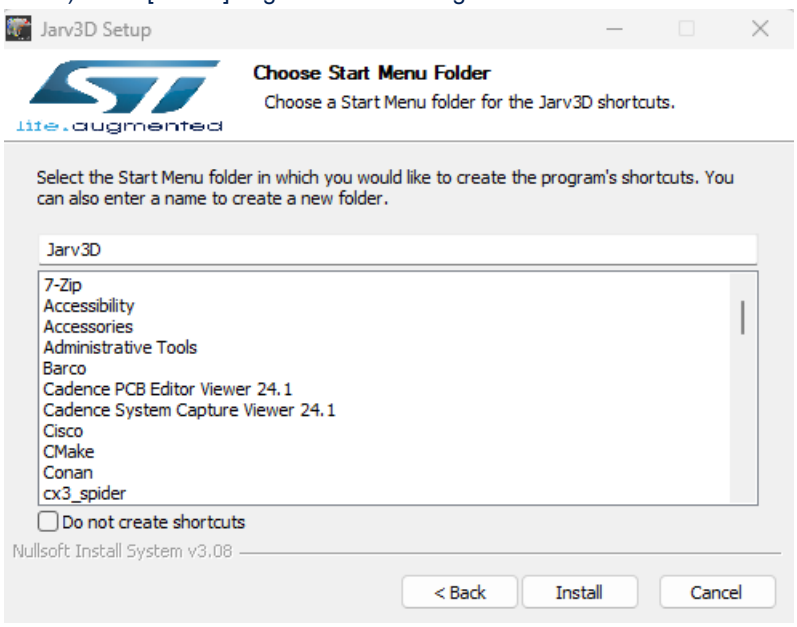


Click [**Next**].

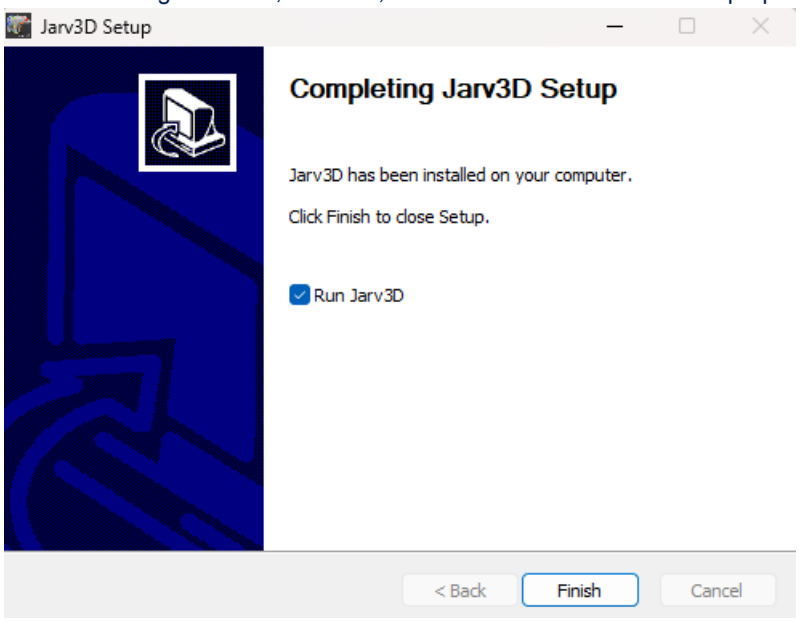
5. Choose the directory where the application is installed. Click [**Next**] to continue.



6. Select the name of the folder in which the application will be located, from the following window (see figure below). Click [**Install**] to get to the final stage.



7. Once the installation is complete, the following window appears. The application can start by default, as shown in the figure below; however, make sure that the hardware is properly connected and recognized.



5 EVK GUI user guide

5.1 EVK startup

To use the VL53L9CX EVK, follow the hardware startup procedure below:

1. Connect the USB 3.0 cable between the VL53L9CX EVK and a USB 3.0 port on the computer.
2. Install the VL53L9CX EVK GUI software, as described in Software Installation.
3. Click on the Jarv3D GUI software icon on the desktop.
4. Click on the [**START**] button to start the streaming.

5.2 GUI startup

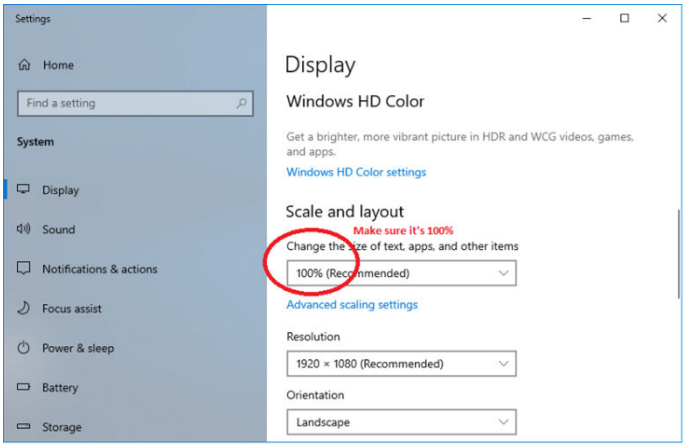
Once the EVK hardware and software are successfully set up the VL53L9CX EVK GUI software can be started by clicking the desktop icon.

Figure 7. GUI desktop icon



*Note: Make sure that window scaling is not performed, or it could lead to a truncated display of buttons and labels. To ensure this, go to the display settings and check that the [**Scale and layout**] parameter is set to 100%, as illustrated below.*

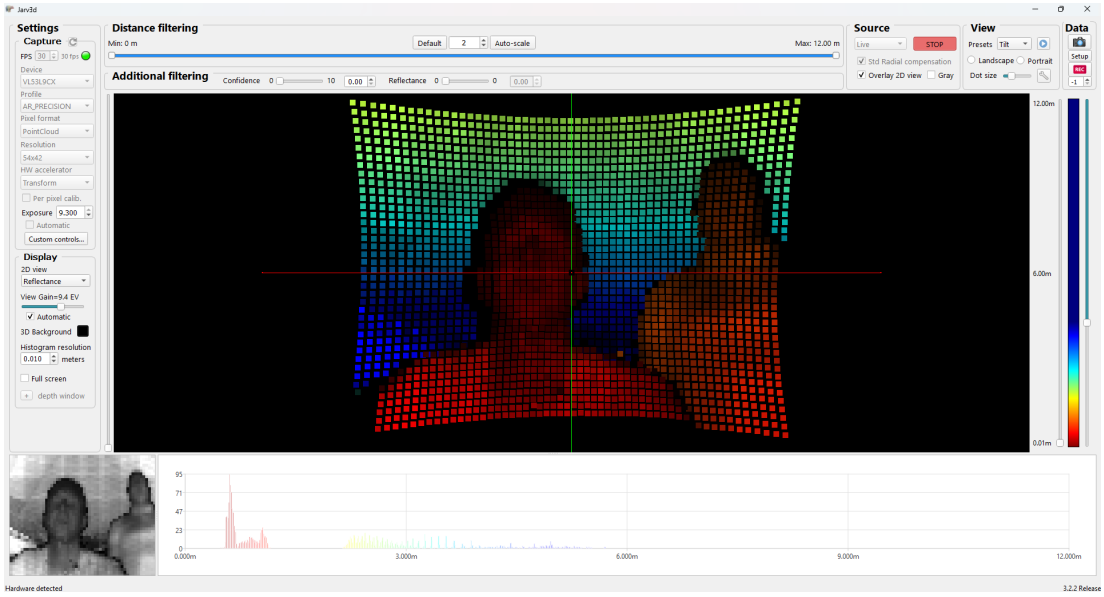
Figure 8. Windows display scaling



5.3 Software usage

The Jarv3D GUI is a simple graphical user interface used to configure the device and display the data.

Figure 9. Jarv3D GUI overview

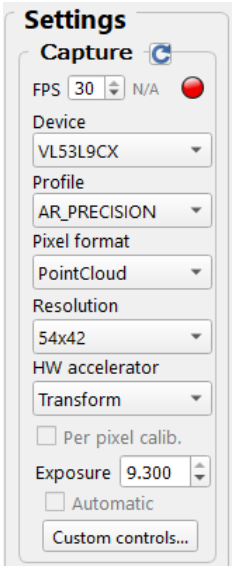


Device control

Device configurations are possible using the [**Settings**] on the left. The GUI defines several profiles and the user can set some configurations (see below).

Note: The device (VL53L9CX) should be displayed in this window. If not, check the USB connection and push the refresh button.

Figure 10. Settings options



From the [**Settings**] menu set:

- FPS: Frames per second
- Devices: All connected devices are displayed here. Select VL53L9CX.
- Profiles: All available profiles are listed here (see Section 6: Profile examples for details).
- Pixel format:
  - Depth32: Depth data that are encoded in float on 32 bits.
  - PointCloud (Default): Depth data are encoded in Android Point Cloud format.

Note: The point cloud representation can appear stretched in the corners of the image. This is a normal behavior caused by the receiver lens distortion, as the corner-zones capture light at wider angles. The point cloud conversion compensates for the distortion on X and Y coordinates.

- Resolution: Information based on the profile selection (the number of SPADs per zone is automatically adapted).
- Hardware accelerator: Depending on the PC hardware, the graphic card is displayed here. “Transform” means that the post processing code is compiled and executed by the CPU.
- Exposure: The exposure information (in milliseconds) can be set by the user during live streaming.
- Custom control menu (see below): Displays extra sensor controls.
  - Sensor configuration tab:
    - Dithering: Configures the dither blank to reduce wraparound and interference issues.
    - Crop mode: Enables the crop mode.
    - Crop configuration:
      - X size
      - Y size
      - X offset
      - Y offset
  - Calibration tab: Displays all calibration data read in OTP (the one-time programmable memory).
    - Global offset
    - X/Y optical offsets: Lens centering encoded in macro SPAD.
    - X/Y residual offsets: Lens centerings encoded in half SPAD
    - Radial gain: Radial to perpendicular gain.
    - Correction offsets: The per pixel calibration offsets.
  - Parameters tab: Algorithm activation
    - bypass-r2p-algo: Disables the radial to perpendicular conversion algorithm
    - bypass-tnr-algo: Disables the temporal noise reduction algorithm.
    - bypass-r2p-filter: Disables the radial to perpendicular filter
    - bypass-conf-algo: Disables the confidence filter algorithm
    - bypass-refl-algo: Disables the reflectance filter algorithm
    - bypass-sharpener-algo: Disables the sharpener algorithm
    - bypass-fp-algo: Disables the flicker pixel filter algorithm
    - cover-glass: Enables cover glass mode during the IPP

The 2D display can also be configured. In the bottom left of the GUI, choose between the amplitude, ambient, confidence, reflectance, or custom maps to be displayed.

Figure 11. **Custom controls (Parameters tab)**

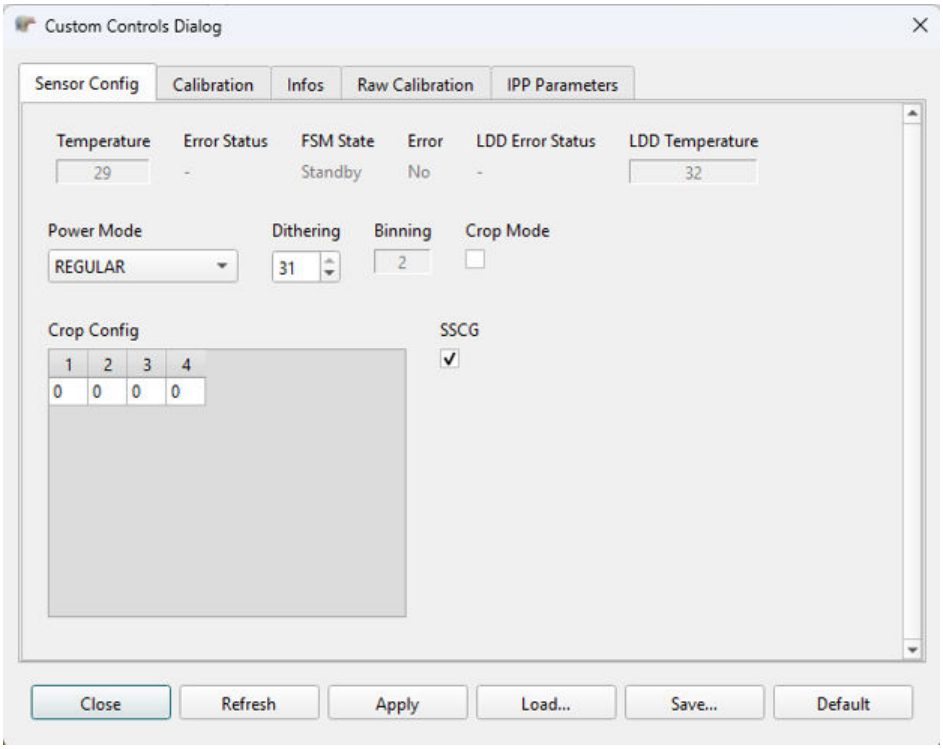
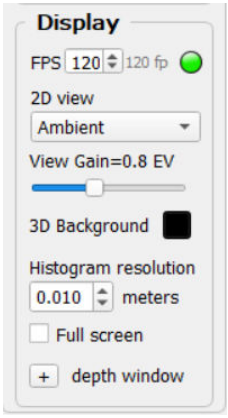
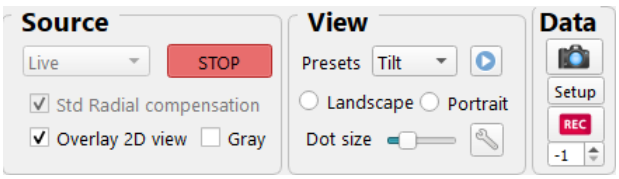


Figure 12. **Display options**



Once the configuration is complete, click [**START**] to launch the streaming, and [**STOP**] to end it.

Figure 13. **Streaming controls**



Filters

Some filters (distance and confidence) are available at the top of the GUI.
The display adapts to the filters. The distance color scale can be changed to match the distance selection.

Figure 14. Filters

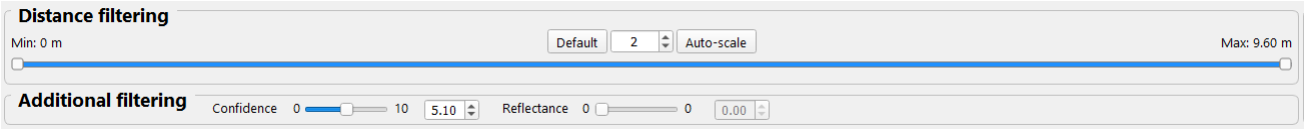
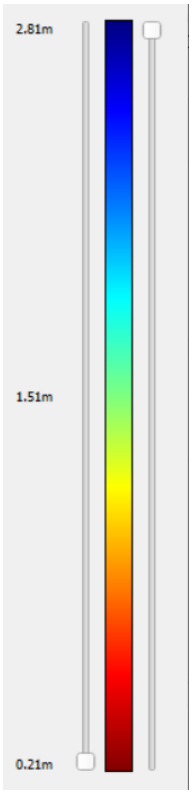


Figure 15. Distance color scale



Displays

There are three displays on the GUI for the data.

- 3D data: The main display shows the distance in 3D point cloud.
- 2D data: A small 2D display on the bottom left displays the signal or ambient data in the image.
- Distance distribution displays the repartition of the data

Figure 16. 3D point cloud

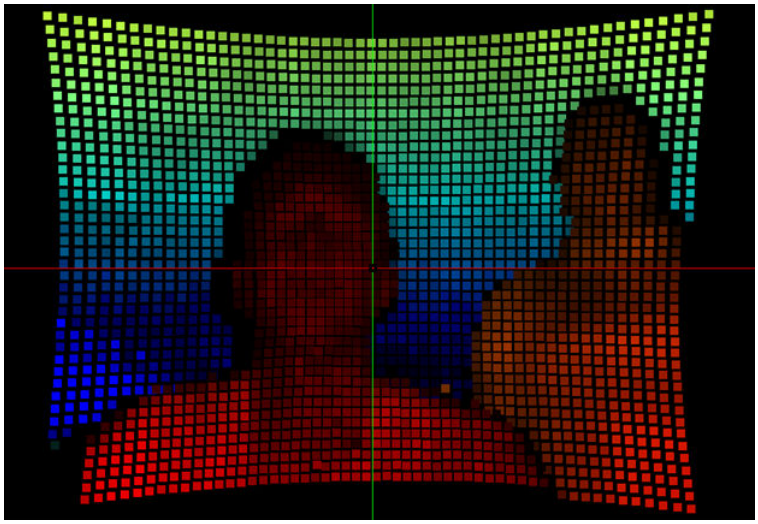
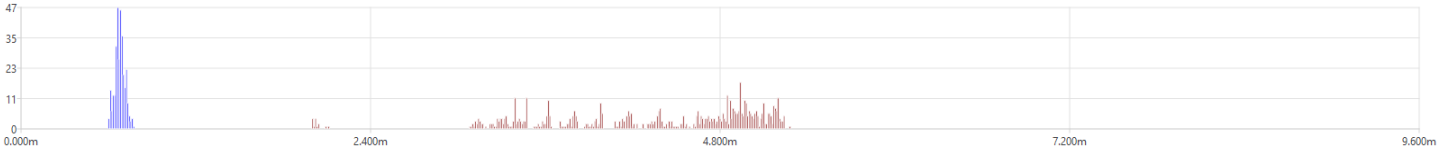


Figure 17. Data distribution



5.4 Capturing data

Data can be captured using the GUI menu.

Before capturing any data, open the capture settings in the [**Data**] menu.

Figure 18. Capture button

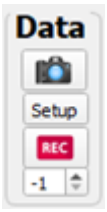
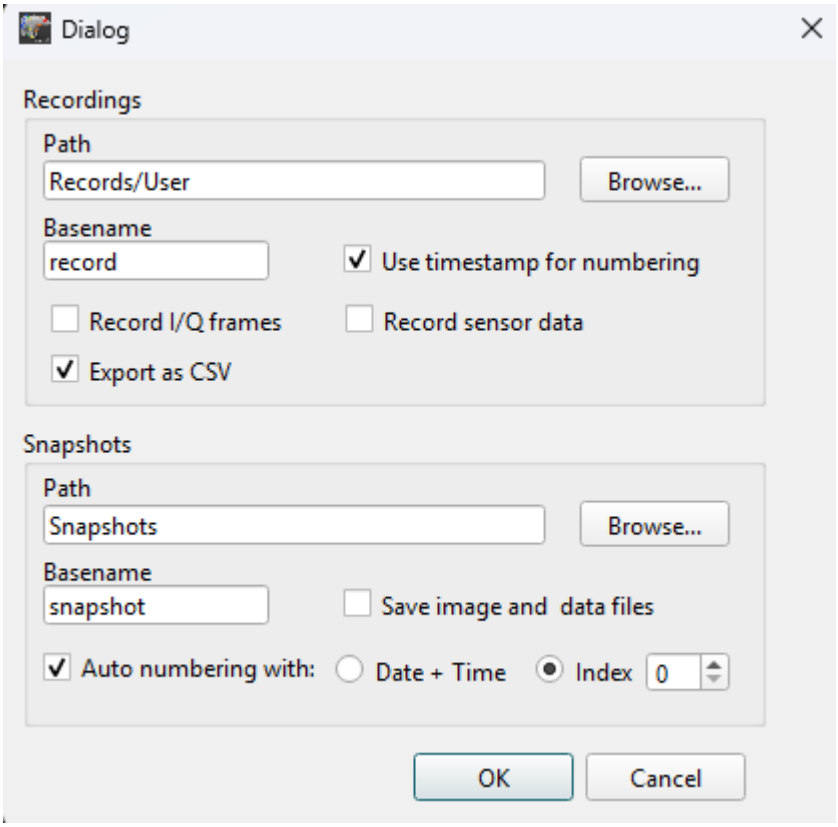


Figure 19. Capture menu



Configure the folder where the capture file should be saved. Users can select options to save the frame in csv format or PGM/PFM. PGM and PFM formatting are described below.

The frames are saved in PGM format into the folder specified. The [**Depthmap**], [**Amplitudemap**], [**Ambientmap**], and [**Confidencemap**] are saved in separate files.

If the [**Android Point Cloud**] pixel format is selected in the capture settings, the depthmap is replaced by a [**Pointcloudmap**] in the record folder.

Table 2. Map and format details

Map	Format	Bytes per pixel	Endianness	Type
Depthmap	PGM (P5)	4	Custom (B2 B1 B4 B3)	Float
Amplitudemap	PFM (Pf)	4	Big endian	Float
Ambientmap	PFM (Pf)	4	Big endian	Float
Confidencemap	PFM (Pf)	4	Big endian	Float
Sensor CSI	Binary	2	Little endian	uint16_t

Figure 20. PGM format

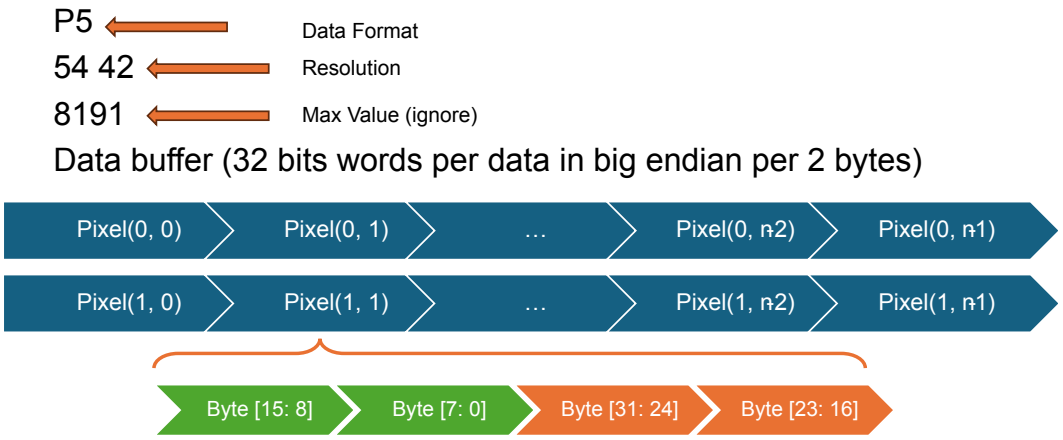
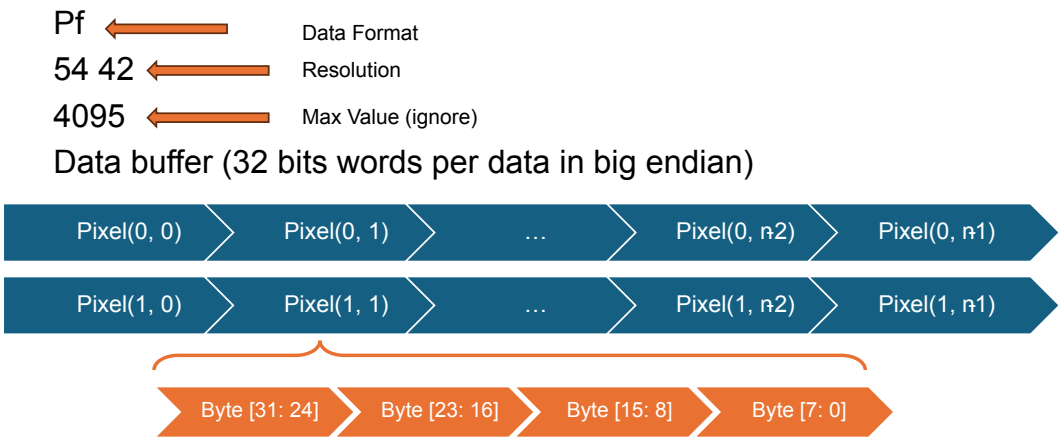


Figure 21. PFM format



6 Profile examples

6.1 Ranging modes

The VL53L9CX has two ranging modes:

- Precision mode: This mode provides ranging data with higher precision and accuracy. The device can range down to 50 mm and up to 9.6 m depending on the ambient light conditions and exposure duration.
- Range mode: This mode is more adapted to high ambient light conditions. It is tuned to maximize the ranging distance and minimize the cover glass crosstalk effect. The device can detect close targets, but the data are accurate only above 400 mm. The maximum ranging distance can reach 5 m even under strong sunlight conditions.

6.2 Resolution options

The VL53L9CX supports six different resolutions:

- 54 x 42
- 24 x 20
- 18 x 14
- 12 x 10
- 8 x 6
- 4 x 4

6.3 Profile descriptions

The use cases presented in this section are for reference only. They provide some examples of how to set up the demo. They are not the only settings that can be applied to achieve good results.

Table 3. Use case examples

Profile	Comment	Resolution	Frame rate (fps)	Exposure (ms)	Power mode	DSS	Min. distance (mm)
AR_PRECISION	Augmented reality	54 x 42	30	9.3	Regular	Yes	<50
AR_DETECTION	Sensitive augmented reality	54 x 42	30	8.0	Regular	Yes	<100
AR_RANGE	Long ranging for AR	54 x 42	30	8.0	Regular	Yes	400
AF	Autofocus	24 x 20	40	4.0	ULP	Yes	<50
AF_RANGE	Long ranging AF	24 x 20	40	5.0	ULP	Yes	400
AF_18x14	Balanced range/power	18 x 14	40	5.0	ULP	Yes	<50
AF_12x10	Power optimized mode	12 x 10	40	5.0	ULP	Yes	<50
DETECTION	Detection mode under ambient	8 x 6	40	2.0	ULP	Yes	400
SENSOR	Sensing mode under ambient	4 x 4	40	2.0	ULP	Yes	400
INDUSTRIAL	High frame rate profile	54 x 42	30	4.0	Regular	No	<50
XTALK_CHECK	Profile to check the crosstalk	54 x 42	30	4.0	Regular	No	0
XTALK_CHARAC	Profile to characterize the crosstalk	54 x 42	30	4.0	Regular	No	0

7 GUI shortcuts

Table 4. **Shortcut list for GUI**

Shortcut	Function
R	Reset position
PgDn + S	Zoom in
PgUp + X	Zoom out
→	Move right
←	Move left
↑	Move up
↓	Move down
Ctrl + D	Depth window
Ctrl + U	Update hardware
Ctrl + S	Snapshot
Ctrl + R	Record
Ctrl + M	Mirror vertically
Ctrl + C	Show/hide crosshair
Shift	During startup resets settings to default values
F11	Toggle Fullscreen
F	Toggle Frame of 2D view
V	Cycle through 2D view
Esc + F5	Start/Stop VP animation
F8	Record VP animation

8 Known limitations

8.1 Software limitations

The H5 does not have a MIPI interface, and the max frame rate is limited to 30 FPS.

8.2 Evaluation kit limitations

If the GUI no longer works and/or the board is not detected, reset the Nucleo board using the B2 reset button, then restart the GUI.

Revision history

Table 5. **Document revision history**

Date	Version	Changes
18-May-2026	1	Initial release
21-May-2026	2	Renamed the document. Section 2.2: GUI software: Added a note indicating that the software installer may require administrator privileges to be installed on the computer. Section 4.2: Firmware installation: • Added a note indicating when the firmware flashing procedure is required. • Updated text on the board configuration setting. • Added text indicating that the LED1 should blink every 3 seconds after the firmware is flashed. Updated: Section 8.1: Software limitations. Added: Section 8.2: Evaluation kit limitations
16-Jul-2026	3	Renamed *VL53L9CX X-NUCLEO shield* to Figure 2. X-NUCLEO-53L9A1 shield. Section 2.2: GUI software: Updated limiting the maximum frame rate to 40 FPS in full resolution to 30 FPS in full resolution. Section 4.2: Firmware installation: Modified note for more clarity, and updated steps 1 and 2. Section 4.3: GUI software installer: Updated procedure with new screen captures. Section 5.3: Software usage: Updated procedure and screen captures. Section 5.4: Capturing data: Updated Figure 19. Capture menu. Section 6.3: Profile descriptions: Updated Table 3. Use case examples.
21-Oct-2026	4	Updated Table 3. Use case examples.

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