

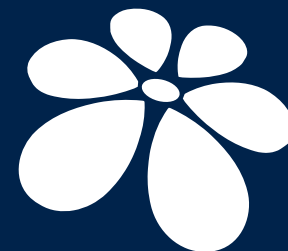


life.augmented

Quick Start Guide

Time-of-Flight expansion board based on the VL53L8 series for STM32 Nucleo

April 2024



**STM32 Open
Development
Environment**



Quick Start Guide Contents

Hardware Overview

Setup & Demo Examples

Documents & Related Resources

STM32 Open Development Environment: Overview



X-NUCLEO-53L8A1 Hardware Description

- The X-NUCLEO-53L8A1 is based on the VL53L8 series for the STM32 Nucleo board supporting VL53L8CX and VL53L8CH sensors based on ST **FlightSense™** patented technology
- The sensor communicates with the STM32 Nucleo developer board host microcontroller through an I²C or SPI link available on the Arduino UNO R3 connector.

Key Products on board

Noncommercial VL53L8CA super-sensor used for evaluation only

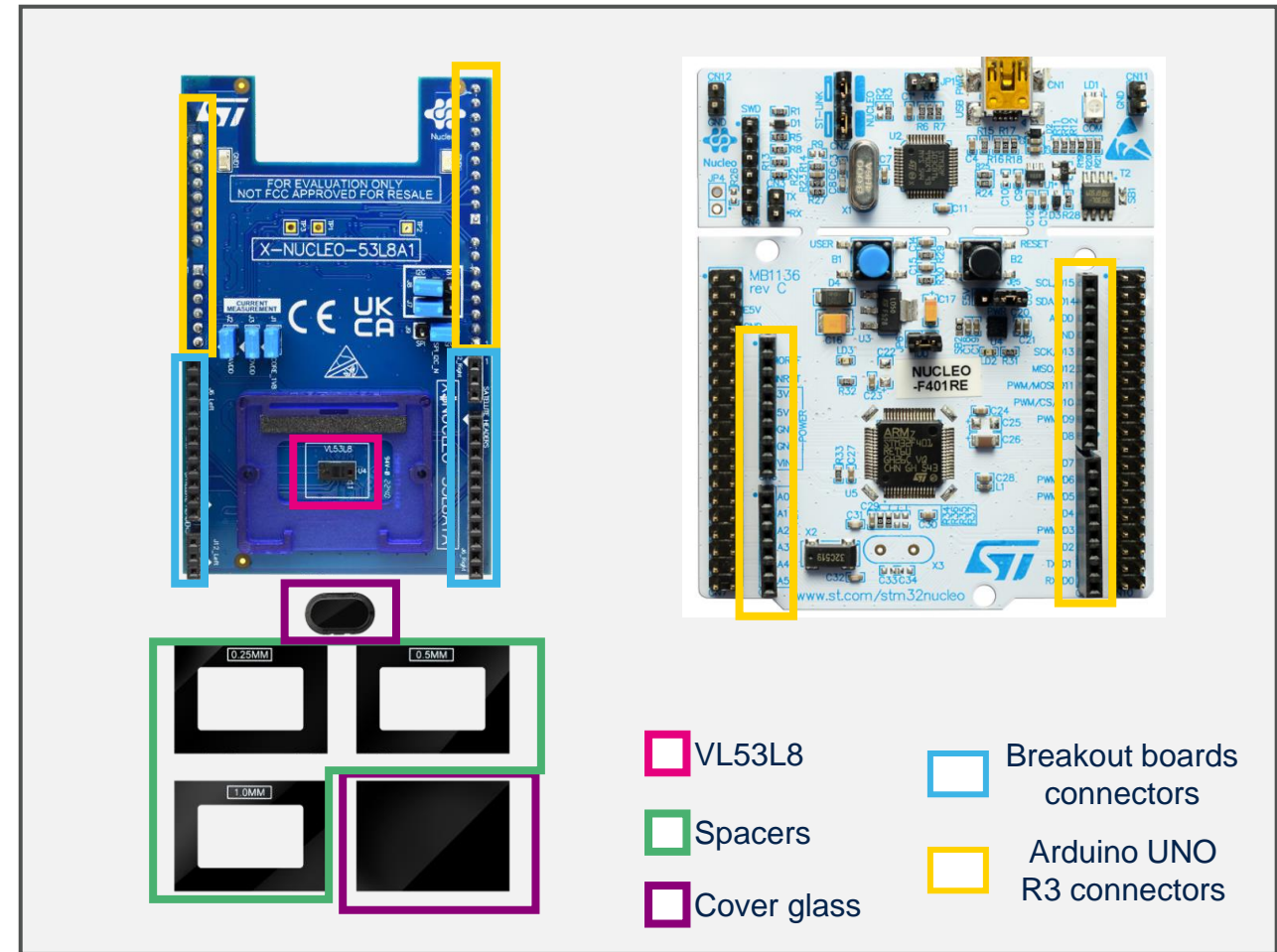
0.25, 0.5 and 1mm spacers to simulate air gaps, with the cover glasses

Breakout boards

SATEL-VL53L8 breakout boards can be purchased separately

Time-of-Flight expansion board based on the VL53L8 series for STM32 Nucleo

Hardware Overview (1/2)



Order Code: **X-NUCLEO-53L8A1**

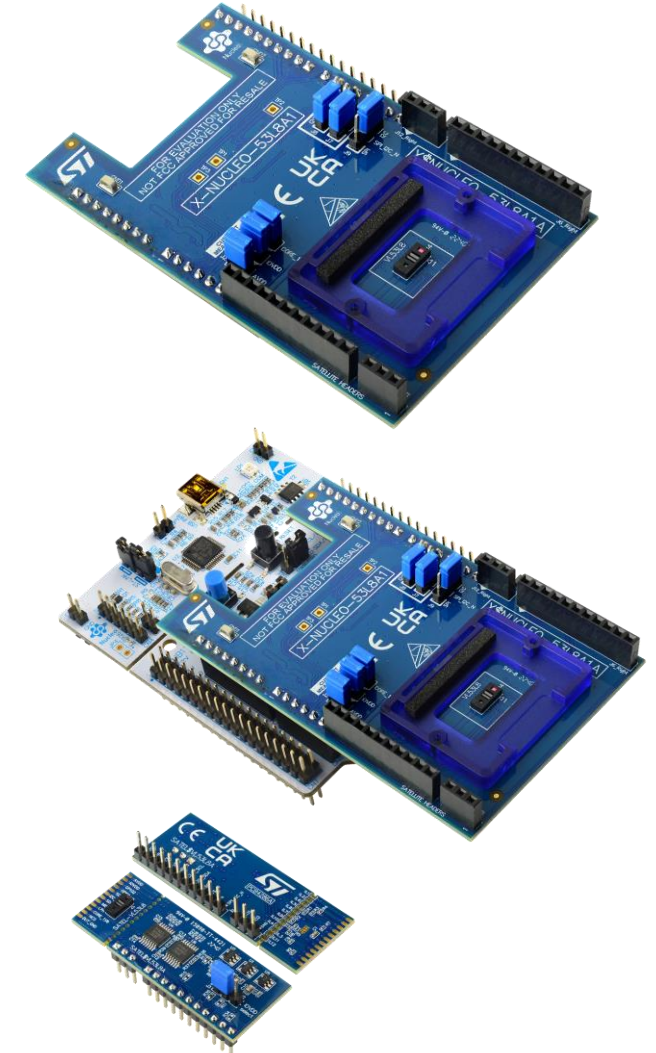
Latest info available at www.st.com
X-NUCLEO-53L8A1



Time-of-Flight expansion board based on the VL53L8 series for STM32 Nucleo

Hardware Overview (2/2)

- X-NUCLEO-53L8A1 expansion board
 - VL53L8 devices in custom applications can be integrated with expansion board, or external VL53L8 breakout.
 - The breakout boards are delivered separately.
- X-NUCLEO-53L8A1 is also available as a NUCLEO Pack (P-NUCLEO-53L8A1)
 - The X-NUCLEO-53L8A1 expansion board can also be ordered on www.st.com as part of a NUCLEO Pack with expansion board and STM32 NUCLEO board.
 - Order code: **P-NUCLEO-53L8A1**: X-NUCLEO-53L8A1 expansion board and NUCLEO-F401RE full features board.
- VL53L8 breakout boards can be ordered separately
 - Order code: **SATEL-VL53L8**
 - The pack carry **two** breakout boards





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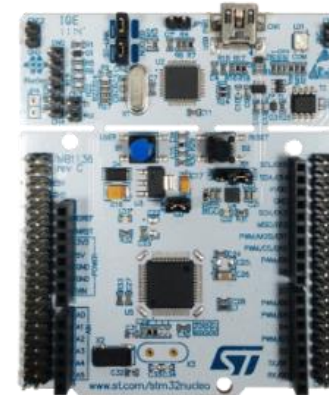
Documents & Related Resources

STM32 Open Development Environment: Overview

- 1x High accuracy ToF sensor expansion board based on VL53L8 series (**X-NUCLEO-53L8A1**).
- 1x STM32 Nucleo development board (**NUCLEO-F401RE** for example)
- 1x Laptop/PC with Windows
- 1x USB type A to Mini-B USB cable
- If you don't have an STM32 Nucleo development board, you can order a Nucleo pack (**P-NUCLEO-53L8A1**):
 - X-NUCLEO-53L8A1 expansion board and NUCLEO-F401RE full features board delivered together.



X-NUCLEO-53L8A1



NUCLEO-F401RE



P-NUCLEO-53L8A1



VL53L8 - Time-of-Flight sensors Software Environment

STM32Cube Software Overview

X-CUBE-TOF1 software description

- The X-CUBE-TOF1 software package is a STM32Cube expansion for the expansion boards of the Time-of-Flight product family (including the X-NUCLEO-53L8A1) for STM32. The source code is based on STM32Cube to ease portability and code sharing across different STM32 MCU families. A sample implementation is available for the STM32 Nucleo ranging sensor expansion board (X-NUCLEO-53L8A1) plugged on top of an STM32 Nucleo development board (NUCLEO-F401RE or NUCLEO-L476RG).

Key features

- Driver layer (VL53L8CX ULD) for complete management of the VL53L8CX sensor integrated in the X-NUCLEO-53L8A1 expansion board.
- Easy portability across different MCU families, thanks to STM32Cube.
- Free, user-friendly license terms.
- Sample code for ranging measurement.

Application

Ranging measurement example

**Hardware
Abstraction**

**STM32Cube Hardware Abstraction Layer
(HAL)**

Hardware

STM32 Nucleo expansion board

X-NUCLEO-53L1A2 (sense)
X-NUCLEO-53L3A2 (sense)
X-NUCLEO-53L4A1 (sense)
X-NUCLEO-53L4A2 (sense)
X-NUCLEO-53L5A1 (sense)
X-NUCLEO-53L8A1 (sense)
X-NUCLEO-53L8A1 (sense)

STM32 Nucleo development board

Latest SW available at www.st.com
X-CUBE-TOF1



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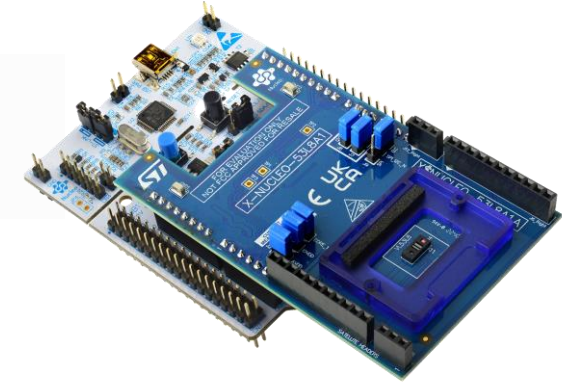
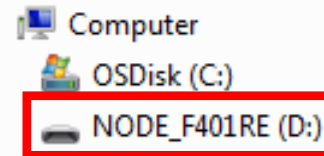
VL53L8CX - Setup & Demo Examples

SW prerequisites

- **STSW-IMG040:** Ultra Lite Driver (ULD) for VL53L8CX
- **STSW-IMG041:** Graphical User Interface (GUI) on Windows 7 and 10
- **STSW-IMG042:** Linux driver for VL53L8CX
- **X-CUBE-TOF1:** Time-of-Flight sensors software expansion for STM32Cube.
 - When you install the X-CUBE-TOF1 the installer install also the directory containing the example projects here for instance :
 - C:\Users\<user_name>\STM32Cube\Repository\Packs\STMicroelectronics\X-CUBE-TOF1\<version of the X-Cube-TOF1>\Projects\NUCLEO-F401RE\Examples\53L8A1\53L8A1_SimpleRanging.

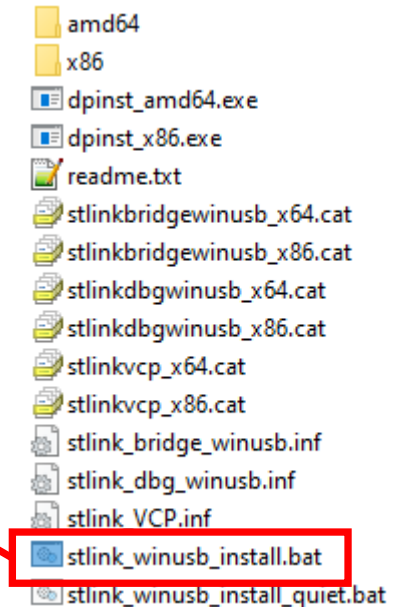
1. Connect the P-NUCLEO to the PC through USB

- Wait for the board to be recognized; the drivers are installed automatically)
- If Windows cannot install automatically the STLINK driver, please follow step 2



2. Install the PC USB port driver to detect the Nucleo board

- Download **STSW-LINK009** from www.st.com
- Unzip and double click on “**stlink_winusb_install.bat**” to install the driver





GUI is generally the first and easy tool to evaluate the device

- Perform HW installation and connect the X-NUCLEO-53L8A1 expansion board + Nucleo F401RE to the PC
- Install the GUI SW for VL53L8CX Demo and configuration settings
 - **STSW-IMG041**, downloaded from www.st.com
 - **Run the installer with Admin privileges**

The Graphical User Interface can:

- Perform the offset and Xtalk calibration and visualize calibration data
- Change key parameters of VL53L8CX
- Display real time the data (distance, signal, ambient rate)
- Get data logging and replay a datalog (.csv file)



VL53L8CX - Setup & Demo Examples

VL53L8CX GUI software installation

VL53L8CX

Flight Sense

STMicroelectronics

Mini Depth-Map

Calibration

Data Log

About

R:1989	R:1969	R:1944	R:1923	R:1902	R:1891	R:1871	R:1850
R:1985	R:1977	R:1962	R:1949	R:1927	R:148	R:135	R:130
R:2000	R:1989	R:1965	R:1958	R:155	R:140	R:133	R:132
R:2013	R:1999	R:1973	R:1960	R:155	R:144	R:136	R:134
R:2030	R:2002	R:1993	R:1974	R:152	R:147	R:138	R:134
R:2030	R:2010	R:165	R:1970	R:152	R:148	R:139	R:135
R:2064	R:2020	R:153	R:158	R:151	R:151	R:145	R:136
R:2065	R:2031	R:143	R:150	R:147	R:145	R:143	R:140

Device Control

Zone Mode: 8x8

Power Mode: Continuous

Target Order: Closest

Ranging Rate(Hz): 15

Integration Time: 5

Sharpener(%): 3

CoverGlass On: ☐

Rotation: None

Save Above Settings: Save

Rate from Device(Hz): 14.63

Start Stop

Display Control

Range Gradient Min(mm): 10

Range Gradient Max(mm): 2000

Median Range(mm): ☒

Peak Signal Rate(kcps/spad): ☐

Ambient Signal Rate(kcps/spad): ☐

Target Status: ☐

Zone Number: ☐



VL53L8CX - Setup & Demo Examples

X-CUBE-TOF1 software installation

- Perform HW installation and connect the NUCLEO kit (P-NUCLEO-53L8A1) to the PC
- Install the X-CUBE-TOF1 SW package
 - **X-CUBE-TOF1 rev 3.2.0 or newer**, downloaded from www.st.com
 - The X-CUBE-TOF1 is installed through STM32CubeMx, manage software installation section.
 - Once the X-CUBE-TOF1 is installed. Go to
 - C:\Users\<user_name>\STM32Cube\Repository\Packs\STMicroelectronics\X-CUBE-TOF1\<version of the X-Cube-TOF1>\Projects\NUCLEO-F401RE\Examples\53L8A1\53L8A1_SimpleRanging

X-CUBE software package contents: API SW + SW examples

The screenshot shows the directory structure of the X-CUBE-TOF1 software package. The following table summarizes the annotations:

Directory/Item	Description
Documentation	Compiled HTML file generated from the source code
Drivers	VL53L8CX ULD
Projects\NUCLEO-F401RE	There is the same folder for STM32L476RG-Nucleo
Examples	VL53L8CX project examples
53L8A1	VL53L8CX project examples for Simple Ranging & Threshold Detection:
53L8A1_SimpleRanging	- pre-compiled binary files to evaluate the sensor
53L8A1_ThresholdDetection	- Pre-compiled projects for STM32CubeIDE, Keil and IAR



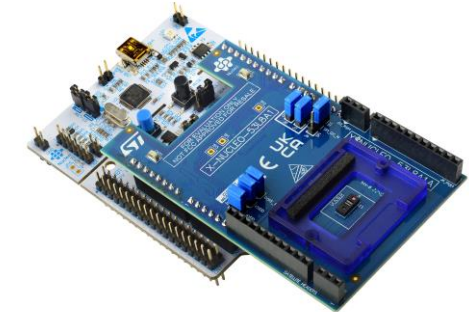
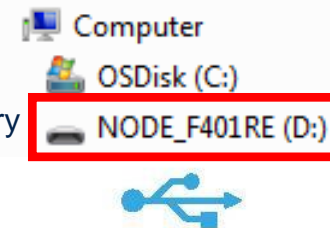
VL53L8CX - Setup & Demo Examples

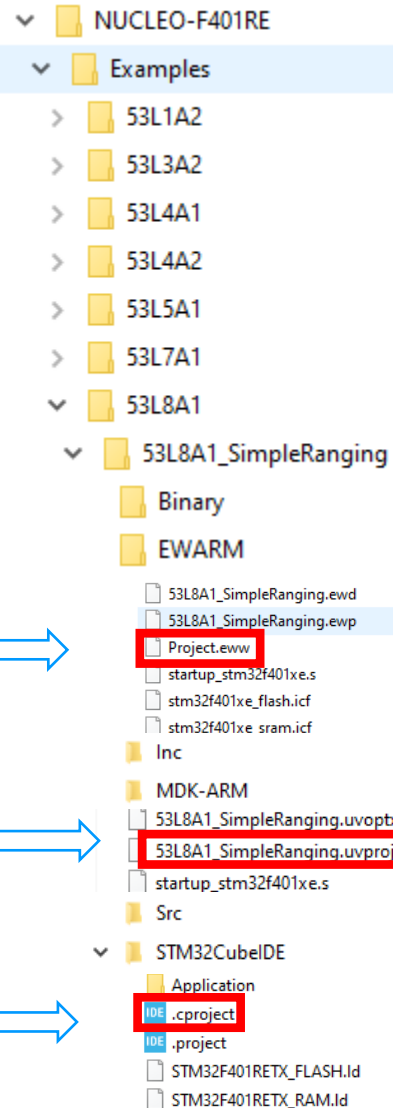
Start programming with code examples using X-CUBE-TOF1 and a NUCLEO Pack

Follow the instructions from the [UM3108](#) (Getting started with the STMicroelectronics X-CUBE-TOF1, Time-of-Flight sensors, software package for STM32CubeMX) that can be found on [st.com](#)

- ▼ X-CUBE-TOF1
 - > 3.2.0
 - ▼ 3.3.0
 - _htmresc
 - Documentation
 - > Drivers
 - ▼ Projects
 - ▼ NUCLEO-F401RE
 - ▼ Examples
 - > 53L1A2
 - > 53L3A2
 - > 53L4A1
 - > 53L4A2
 - > 53L5A1
 - > 53L7A1
 - ▼ 53L8A1
 - ▼ 53L8A1_SimpleRanging
 - Binary
 - EWARM
 - Inc
 - MDK-ARM
 - Src
 - > STM32CubeIDE
 - ▼ 53L8A1_ThresholdDetection
 - Binary
 - EWARM
 - Inc
 - MDK-ARM
 - Src
 - > STM32CubeIDE
 - > CUSTOM

Drag and
Drop .bin files
from the directory
to





VL53L8CX - Setup & Demo Examples

Start programming with code examples using X-CUBE-TOF1 and a NUCLEO Pack

Follow the instructions from the [UM3108](#) (Getting started with the STMicroelectronics X-CUBE-TOF1, Time-of-Flight sensors, software package for STM32CubeMX)) that can be found on st.com

Open project example for Simple Ranging
And modify, build application SW

- Same folders exist for Threshold Detection projects
- Same folders exist for L476RG board



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Setup & Demo Examples for the VL53L8CH

Documents & Related Resources

STM32 Open Development Environment: Overview



VL53L8CH - Setup & evaluation software

SW prerequisites

- **STSW-IMG043:** Software package for the VL53L7CH and VL53L8CH artificial intelligence enabler multizone Time-of-Flight sensors
 - Software package contains :
 - **STSW-IMG043_ULD** : Ultra lite driver (ULD) source code
 - **STSW-IMG043_EVK** : System designed to help customers to evaluate the VL53L7CH and VL53L8CH ToF sensors
 - **STSW-IMG043_LNX** : Linux driver based on the ULD
 - **STSW-IMG043_F401** : STM32 project source code, running on the STM32F401
 - **STSW-IMG043_PY** : Python script examples



VL53L8CH - Setup & evaluation software

VL53L8CH GUI software installation

GUI is generally the first and easy tool to evaluate the device

- Perform HW installation and connect the X-NUCLEO-53L8A1 expansion board + Nucleo F401RE to the PC
- Install the GUI SW for VL53L8CX Demo and configuration settings
 - **STSW-IMG043_EVK**, downloaded from www.st.com
 - **Run the installer with Admin privileges**

The Graphical User Interface can:

- View live of zone and histogram data.
- Capture of data logs for subsequent offline processing.
- View of previous captured data logs and editing of embedded Ground Truth data.
- Custom configuration of the VL53L8CH sensor to suit customers application requirements



VL53L8CH GUI software installation

Step 1: Software unpacking

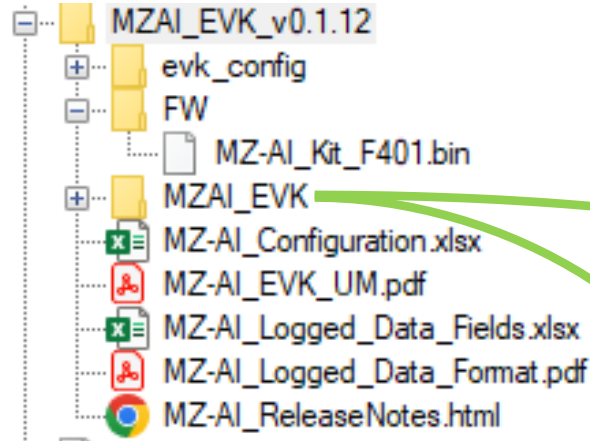
The MZAI EVK software is distributed as ZIP file containing application executable, configuration files and documentation.

The file name is **en.STSW-IMG043_EVK.zip**

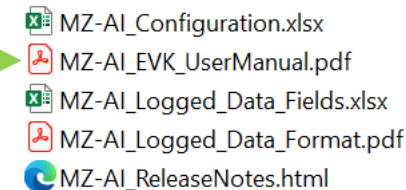
Unzipping the file results in the directory structure below:

Compatible operating system:

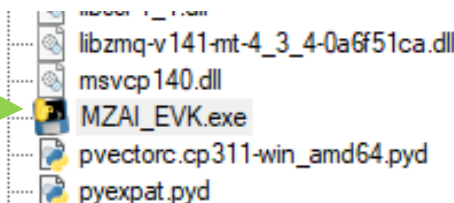
- Windows



Follow the instructions from the MZAI-EVK User Guide This file is located within the **MZAI_EVK** sub-directory.



To run the MZAI application the **MZAI_EVK.exe** file will be executed. This file is located within the **MZAI_EVK** sub-directory

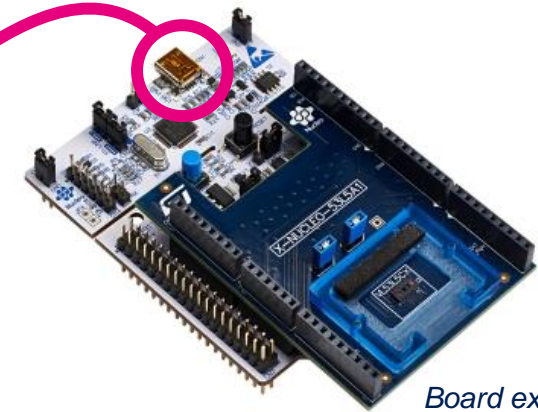


VL53L8CH GUI software installation

Step 2: Hardware setup



Connect the board to the PC
via a **USB to Micro-USB** cable



Board example

Compatible operating system:

- Windows

Compatible boards:

- P-NUCLEO-53L8A1 Expansion pack (NUCLEO-F401RE, X-NUCLEO-53L8A1)

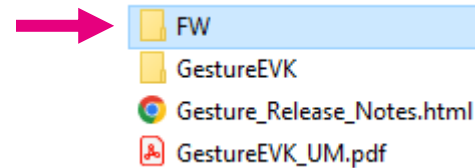


VL53L8CH GUI software installation

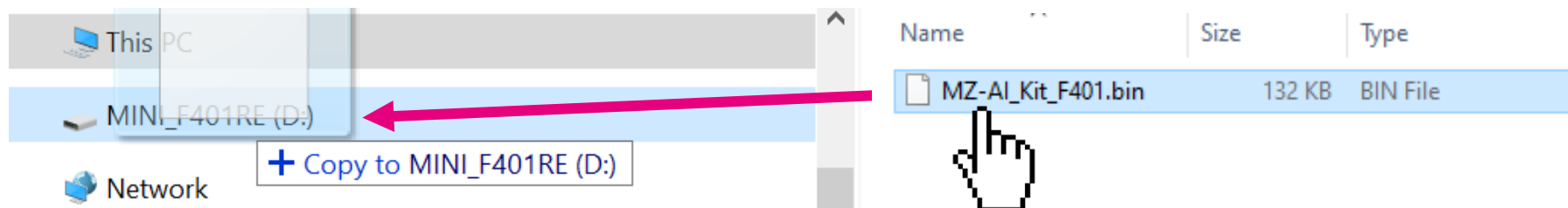
Step 3: Firmware loading

Open the **.FW** folder in the MZAI EVK installation directory to find the firmware binary that must be flashed on the STM32 F401RE.

The FW binary supports both the X-NUCLEO-53L7A1 and X-NUCLEO-53L8A1 boards.



Drag and drop the **.bin file** to flash the F401RE board

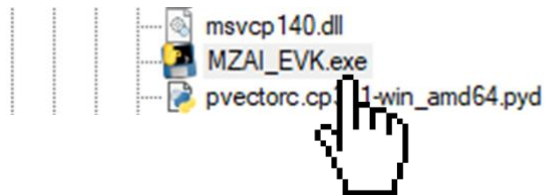




VL53L8CH GUI software installation

Step 4: Start the EVK GUI

Double click the .exe file in the .\MZAI_EVK sub-directory to start.

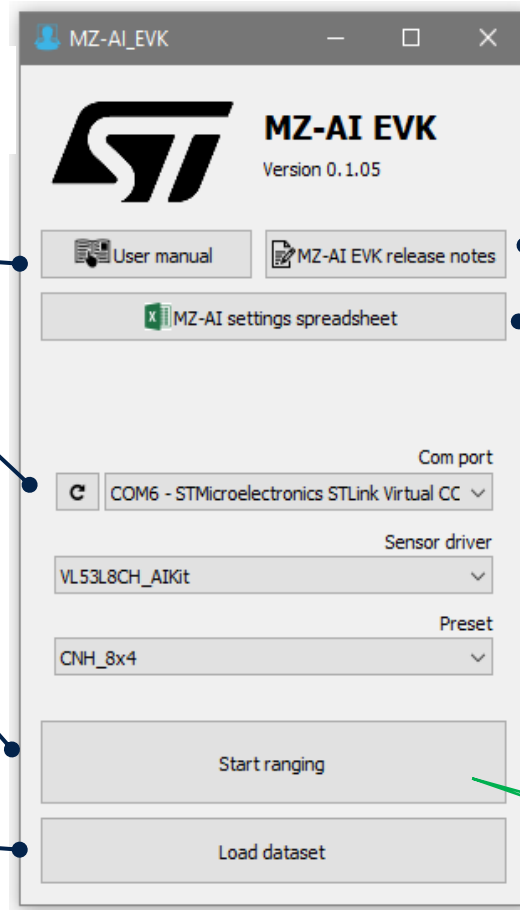


Click to open this user manual

Refresh com port list

Starts the device ranging and displays range data in GUI

The tool supports the replay of a dataset that has been previously logged with MZ-AI EVK.



Click to open release notes

Click to open MZ-AI configuration spreadsheet

- Select com port to which Nucleo board is connected. Nucleo firmware must be already loaded.
- Select corresponding sensor type.
- Select a preset (configuration that will be applied on start).

VL53L7CH- VL53L7CH_AIKit
VL53L8CH -VL53L8CH_AIKit

Once the correct PORT, DRIVER and PRESET have been selected press **START RANGING**



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All documents are available in the Documentation tab of the related products webpage

X-NUCLEO-53L8A1:

- Data Brief [DB4921](#) : Time-of-Flight expansion board based on the VL53L8 series for STM32 Nucleo
- User Manual [UM3120](#) : Getting started with the X-NUCLEO-53L8A1 Time-of-Flight expansion board based on the VL53L8 series for STM32 Nucleo
- [X-NUCLEO-53L8A1 SCHEMATIC](#)
- [X-NUCLEO-53L8A1 GERBER](#)

P-NUCLEO-53L8A1:

- Data Brief [DB4958](#) : STM32 Nucleo pack with X-NUCLEO-53L8A1 expansion board and NUCLEO-F401RE development board

SATEL-VL53L8:

- Data Brief [DB4924](#) : Breakout board based on the VL53L8 series Time-of-Flight sensors
- [SATEL-VL53L8 SCHEMATIC](#)
- [SATEL-VL53L8 GERBER](#)

X-CUBE-TOF1: Software package for STM32Cube

- Data Brief [DB4449](#): Time-of-Flight sensors software expansion for STM32Cube
- User Manual [UM3108](#): Getting started with the STMicroelectronics X-CUBE-TOF1, Time-of-Flight sensors, software package for STM32CubeMX



All documents are available in the Documentation tab of the related products webpage

VL53L8CX:

- Datasheet [DS14161](#): Low-power high-performance 8x8 multizone Time-of-Flight sensor
- Data Brief [DB4884](#): Low-power high-performance 8x8 multizone Time-of-Flight sensor

VL53L8CH:

- Datasheet [DS14310](#): Artificial intelligence enabler, high performance 8x8 multizone Time-of-Flight (ToF) sensor
- Data Brief [DB5046](#): Artificial intelligence enabler, high performance 8x8 multizone Time-of-Flight (ToF) sensor



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FAST, AFFORDABLE PROTOTYPING AND DEVELOPMENT

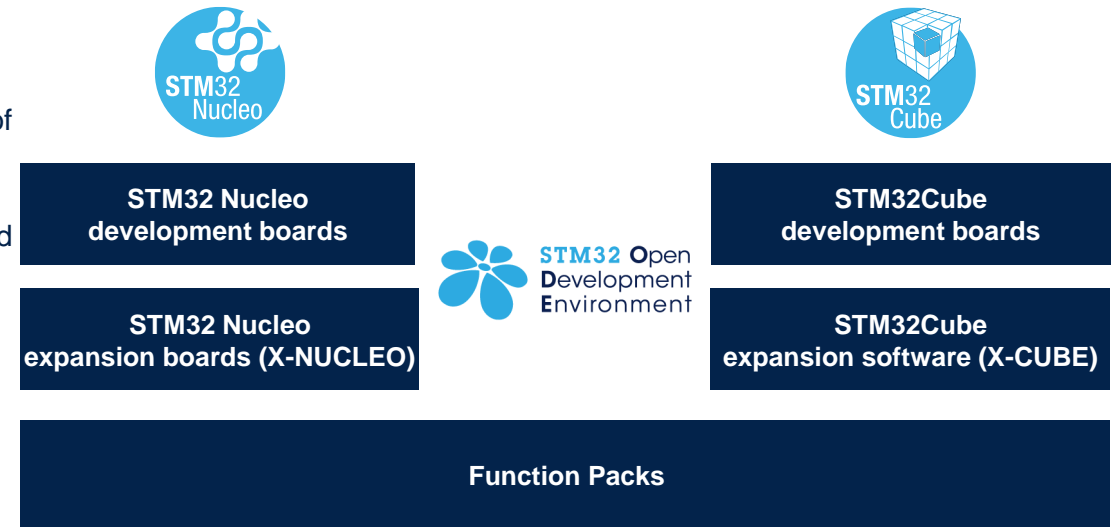
The STM32 Open Development Environment (ODE) is an **open, flexible, easy** and **affordable** way to develop innovative devices and applications based on the STM32 32-bit microcontroller family combined with other state-of-the-art ST components connected via expansion boards. It enables fast prototyping with leading-edge components that can quickly be transformed into final designs.

The STM32 ODE includes the following five elements:

- STM32 Nucleo development boards. A comprehensive range of affordable development boards for all STM32 microcontroller series, with unlimited unified expansion capability, and with integrated debugger/programmer
- STM32 Nucleo expansion boards. Boards with additional functionality to add sensing, control, connectivity, power, audio or other functions as needed. The expansion boards are plugged on top of the STM32 Nucleo development boards. More complex functionalities can be achieved by stacking additional expansion boards
- STM32Cube software. A set of free-of-charge tools and embedded software bricks to enable fast and easy development on the STM32, including a Hardware Abstraction Layer, middleware and the STM32CubeMX PC-based configurator and code generator
- STM32Cube expansion software. Expansion software provided free of charge for use with STM32 Nucleo expansion boards, and compatible with the STM32Cube software framework
- STM32Cube Function Packs. Set of function examples for some of the most common application cases built by leveraging the modularity and interoperability of STM32 Nucleo development boards and expansions, with STM32Cube software and expansions.

The STM32 Open Development Environment is compatible with a wide range of development environments including STM32CubeIDE, IAR EWARM, Keil MDK-ARM, and GCC/LLVM-based IDEs, with the possibility to integrate the various components such as STM32CubeMX, STM32CubeProgrammer or STM32CubeMonitor.

STM32 ODE Ecosystem





STM32 Open Development Environment: all that you need

The combination of a broad range of expandable boards based on leading-edge commercial products and modular software, from driver to application level, enables fast prototyping of ideas that can be smoothly transformed into final designs.

To start your design:

- Choose the appropriate STM32 Nucleo development board (NUCLEO) and expansion (X-NUCLEO) boards (sensors, connectivity, audio, motor control etc.) for the functionality you need.
- Select your development environment (IAR EWARM, Keil MDK and GCC/LLVM-based IDEs) and use the free STM32Cube tools and software such as STM32CubeMX, STM32CubeProgrammer, STM32CubeMonitor or STM32CubeIDE.
- Download all the necessary software to run the functionality on the selected STM32 Nucleo expansion boards.
- Compile your design and upload it to the STM32 Nucleo development board.
- Then start developing and testing your application.

Software developed on the STM32 Open Development Environment prototyping hardware can be directly used in an advanced prototyping board or in an end product design using the same commercial ST components, or components from the same family as those found on the STM32 Nucleo boards.

