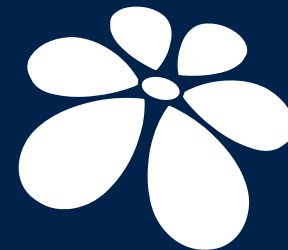


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# Quick Start Guide

Time-of-Flight high-accuracy proximity sensor  
based on the VL53L4CD expansion board for  
STM32 Nucleo

December 2021



**STM32 Open  
Development  
Environment**



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# High accuracy Time-of-Flight Sensor expansion board

## Hardware Overview (1/2)

### X-NUCLEO-53L4A1 Hardware Description

- The X-NUCLEO-53L4A1 is a High accuracy Time-of-Flight Sensor and development board designed around the VL53L4CD sensor based on ST FlightSense™ patented technology
- The VL53L4CD communicates with the STM32 Nucleo developer board host microcontroller through an I<sup>2</sup>C link available on the Arduino UNO R3 connector.

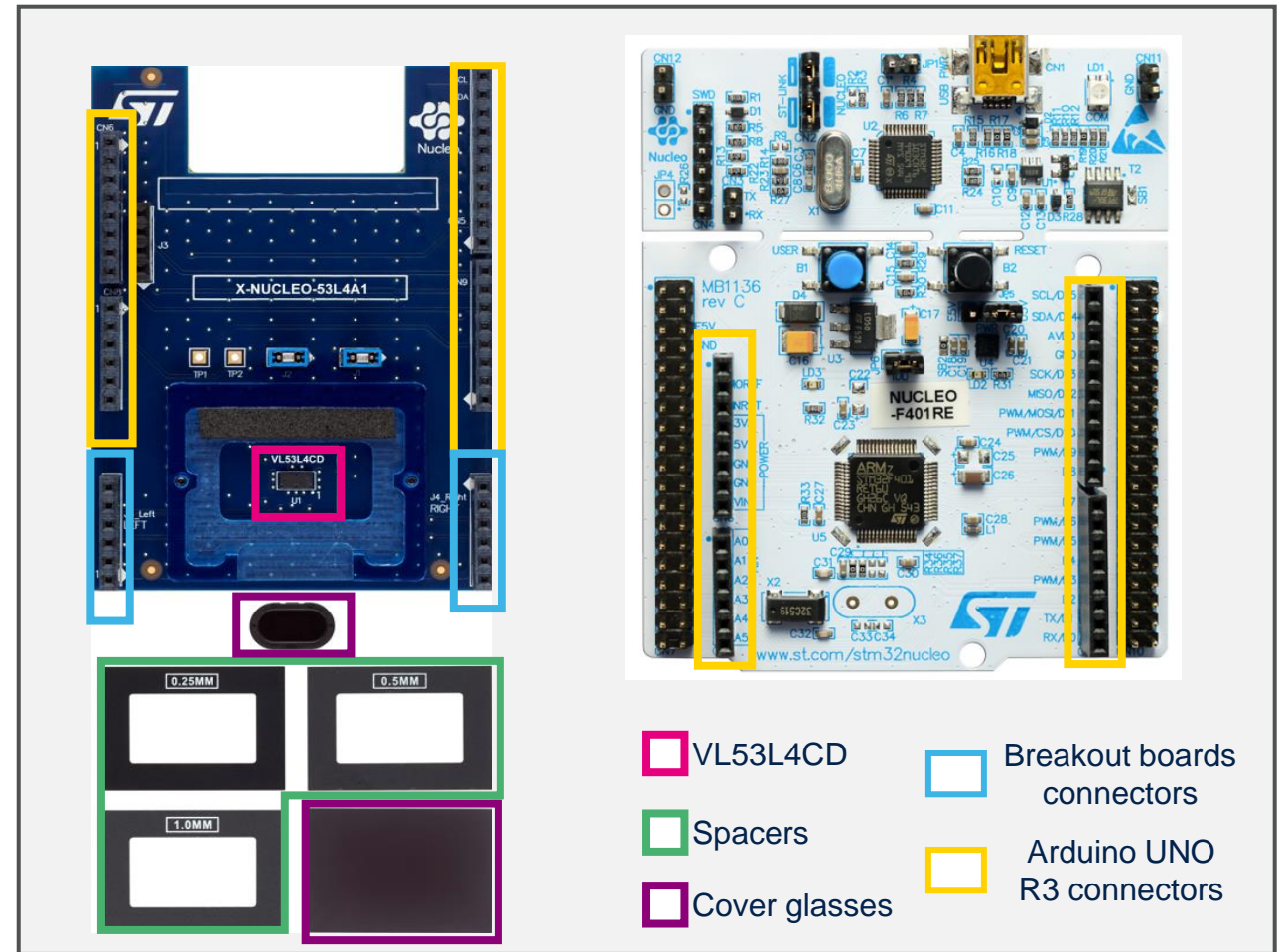
### Key Products on board

**VL53L4CD** High accuracy Time-of-Flight Sensor

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

### Breakout boards

**SATEL-VL53L4CD** breakout boards can be purchased separately



Order Code: **X-NUCLEO-53L4A1**

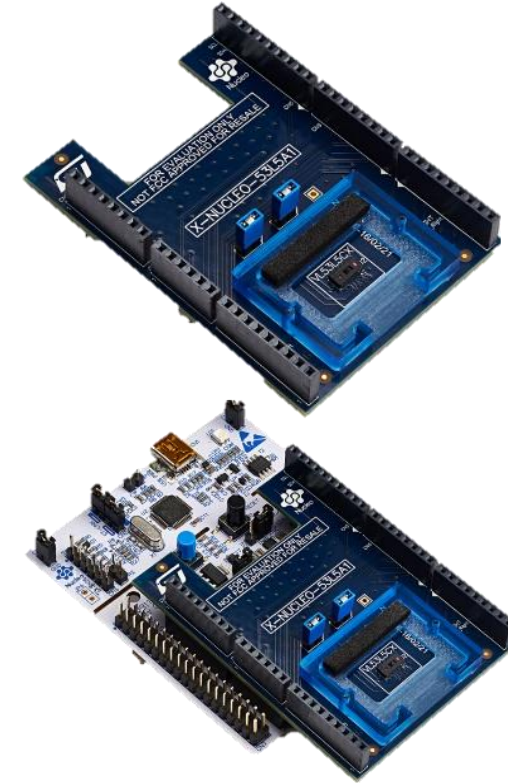
Latest info available at [www.st.com](http://www.st.com)  
**X-NUCLEO-53L4A1**



# High accuracy Time-of-Flight Sensor expansion board

## Hardware Overview (2/2)

- X-NUCLEO-53L4A1 expansion board
  - VL53L4CD devices in custom applications can be integrated with expansion board, or external VL53L4CD breakout.
  - The breakout boards are delivered separately.
- X-NUCLEO-53L4A1 is also available as a NUCLEO Pack (P-NUCLEO-53L4A1)
  - The X-NUCLEO-53L4A1 expansion board can also be ordered on [www.st.com](http://www.st.com) as part of a NUCLEO Pack with expansion board and STM32 NUCLEO board.
  - Order code: **P-NUCLEO-53L4A1**:  
X-NUCLEO-53L4A1 expansion board and NUCLEO-F401RE full features board.
- VL53L4CD breakout boards can be ordered separately
  - Order code: **SATEL-VL53L4CD**
  - The pack carry **two** breakout boards





# Time-of-Flight sensors Software Environment

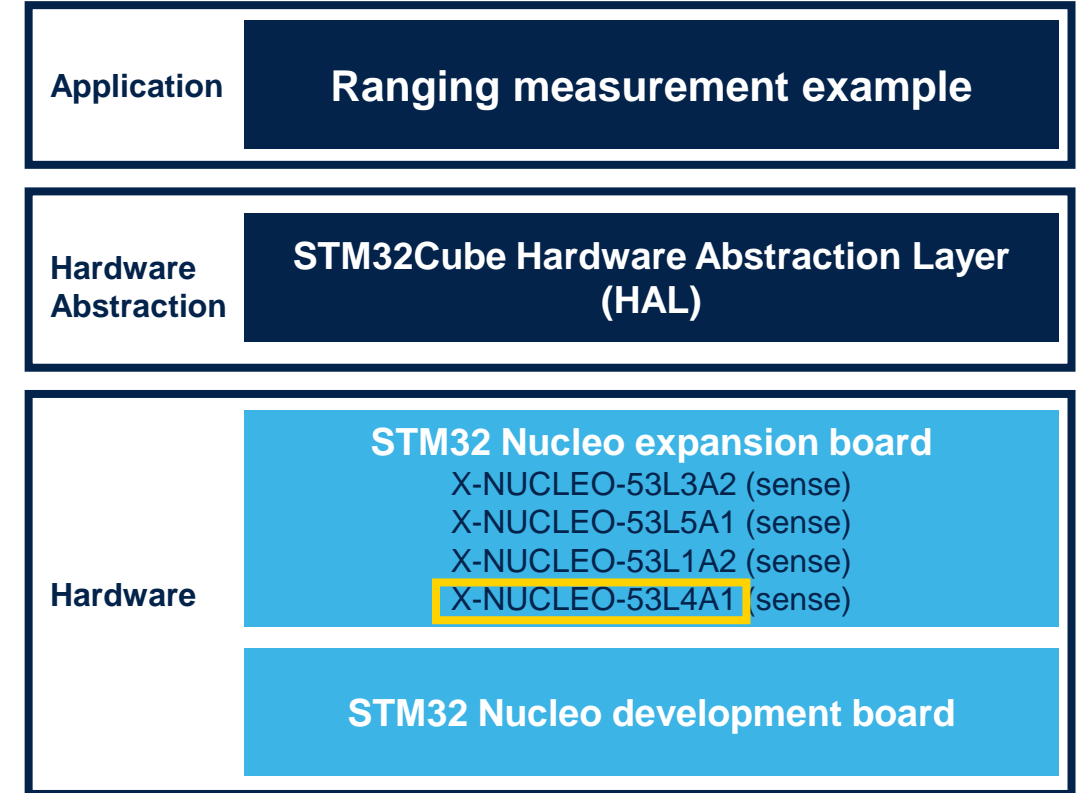
## STM32Cube Software Overview

### 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-53L4A1) 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-53L4A1) plugged on top of an STM32 Nucleo development board (NUCLEO-F401RE or NUCLEO-L476RG).

### Key features

- Driver layer (VL53L4CD ULD) for complete management of the VL53L4CD High accuracy ranging sensor integrated in the X-NUCLEO-53L4A1 expansion board.
- Easy portability across different MCU families, thanks to STM32Cube.
- Free, user-friendly license terms.
- Sample code for ranging measurement.



Latest SW available at [www.st.com](http://www.st.com)  
**X-CUBE-TOF1**



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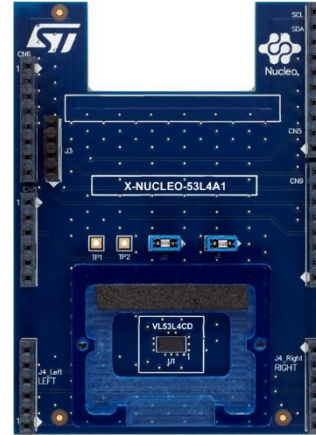




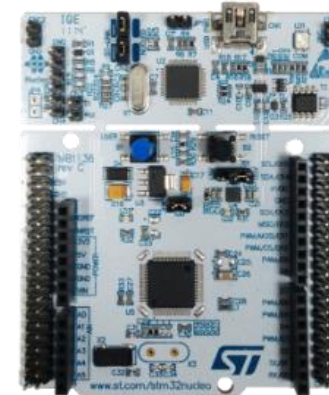
# Setup & Demo Examples

## HW prerequisites

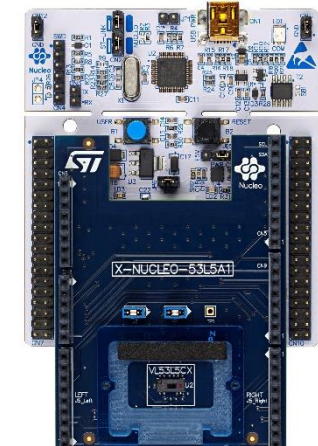
- 1x High accuracy ToF sensor expansion board based on VL53L4CD (**X-NUCLEO-53L4A1**).
- 1x STM32 Nucleo development board (**NUCLEO-F401RE** for example)
- 1x Laptop/PC with Windows
- 1x USB type A to Mini-B USB cable
- If you don't have an STM32 Nucleo development board, you can order a Nucleo pack (**P-NUCLEO-53L4A1**):
  - X-NUCLEO-53L4A1 expansion board and NUCLEO-F401RE full features board delivered together.



X-NUCLEO-53L4A1



NUCLEO-F401RE



P-NUCLEO-53L4A1

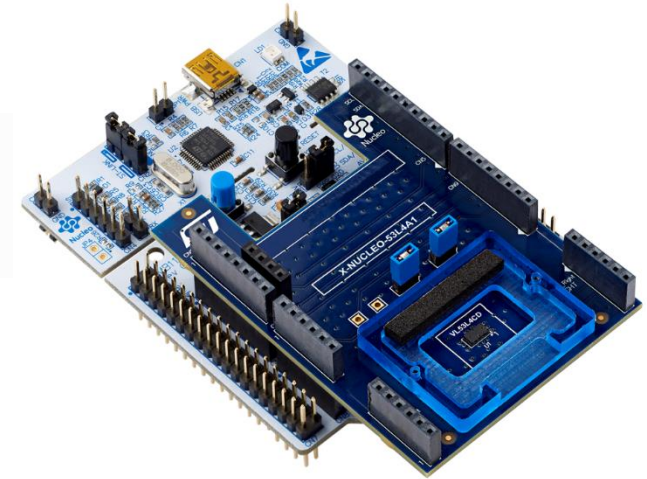
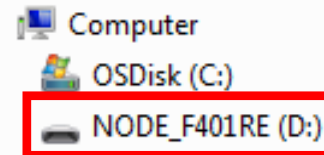


- **STSW-IMG026:** Ultra Lite Driver (ULD) for VL53L4CD
- **STSW-IMG027:** P-NUCLEO-53L4A1 Graphical User Interface (GUI) on Windows 7 and 10
- **STSW-IMG028:** Linux driver for VL53L4CD
- **X-CUBE-TOF1:** Time-of-Flight sensors software expansion for STM32Cube.
  - When you install the X-CUBE-TOF1 the installer install also the directory containing the example projects here for instance :
    - C:\Users\user\_name\STM32Cube\Repository\Packs\STMicroelectronics\X-CUBE-TOF1\4.0.0\Projects\STM32F401RE-Nucleo\Examples\53L4A1\53L4A1\_SimpleRanging.



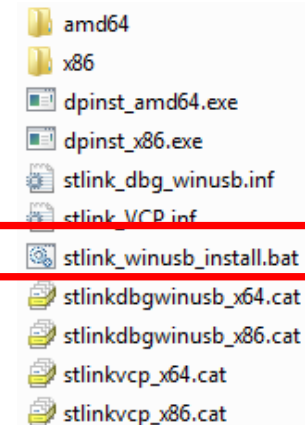
### 1. Connect the P-NUCLEO to the PC through USB

- 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](http://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 VL53L4CD expansion board + Nucleo F401RE to the PC
- Install the GUI SW for VL53L4CD Demo and configuration settings
  - **STSW-IMG027**, downloaded from [www.st.com](http://www.st.com)
  - **Run the installer with Admin privileges**

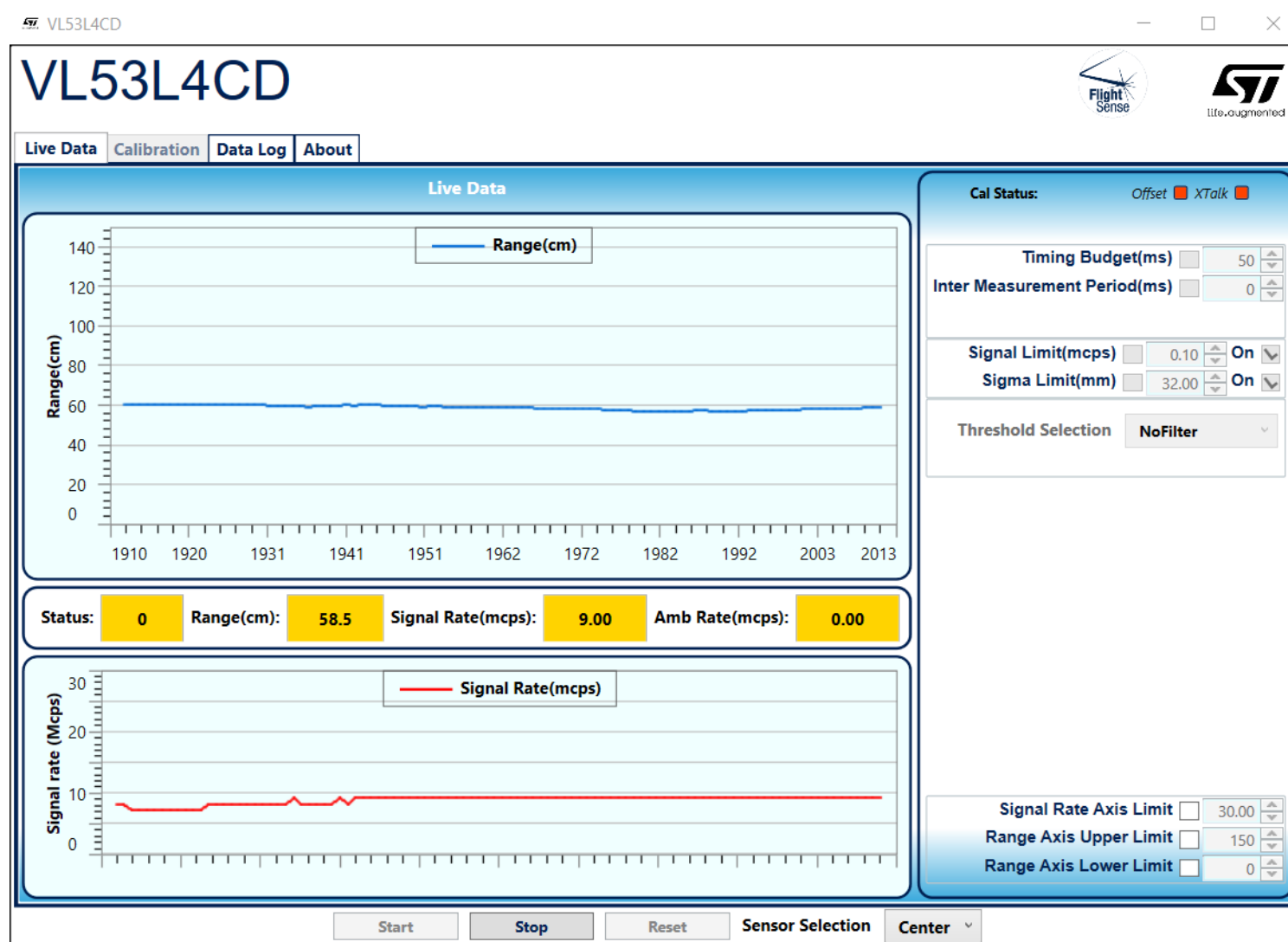
The Graphical User Interface can:

- Perform the offset and Xtalk calibration and visualize calibration data
- Change key parameters of VL53L4CD
- Display real time the data (distance, signal, ambient rate)
- Get data logging and replay a datalog (.csv file)



# Setup & Demo Examples

## VL53L4CD GUI software installation



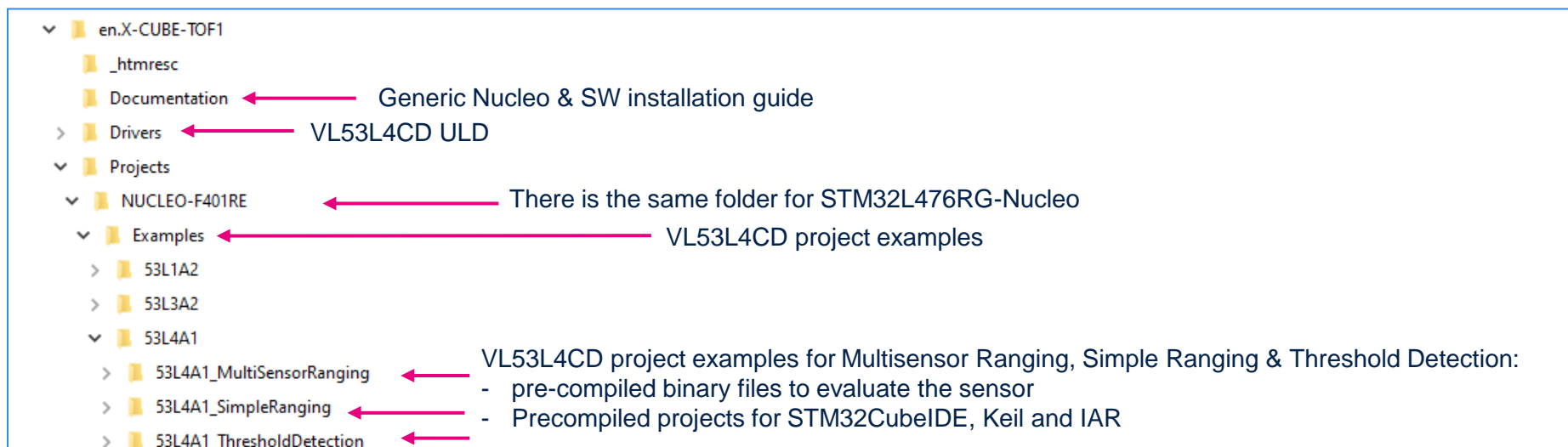


# Setup & Demo Examples

## X-CUBE-TOF1 software installation

- Perform HW installation and connect the NUCLEO kit ( P-NUCLEO-53L4A1) to the PC
- Install the X-CUBE-TOF1 SW package
  - **X-CUBE-TOF1 rev 4.0.0 or newer**, downloaded from [www.st.com](http://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\4.0.0-B1\Projects\STM32F401RE-Nucleo\Examples\53L4A1\53L4A1\_SimpleRanging

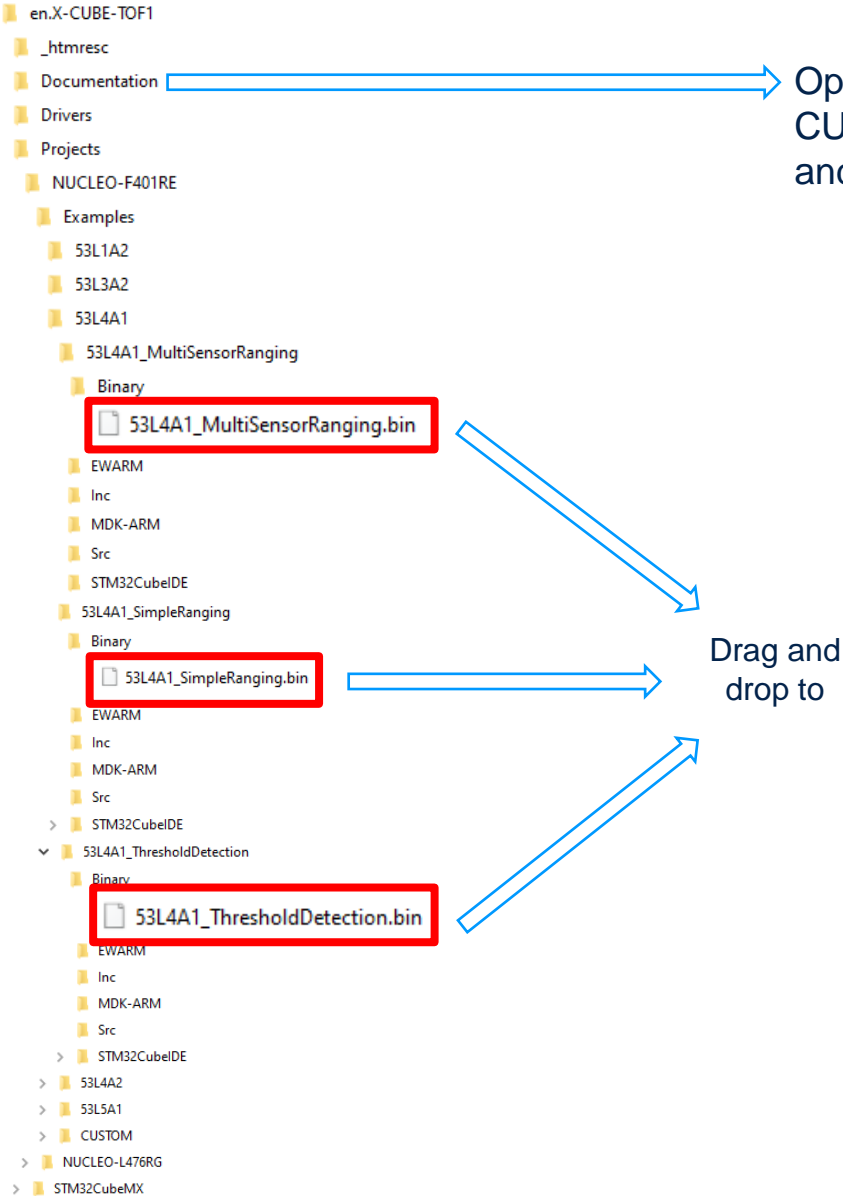
### X-CUBE software package contents: API SW + SW examples



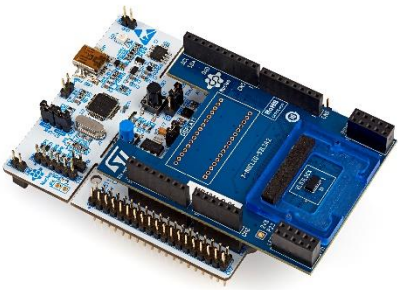
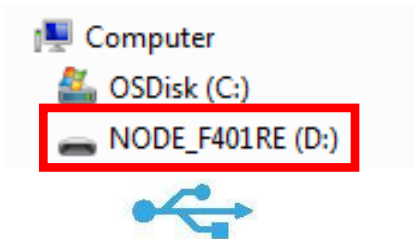


# High accuracy Time-of-Flight Sensor expansion board

## Evaluation code example (.bin) using X-CUBE-TOF1 and a NUCLEO Pack



Open: **UM2931** (How to use the VL53L4CD with STMicroelectronics' X-CUBE-TOF1 Time-of-Flight sensor software packages for STM32CubeMX) and **follow the instructions**





# VL53L4CD High accuracy Time-of-Flight Sensor expansion board

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

- en.X-CUBE-TOF1
  - \_htmresc
  - Documentation
  - Drivers
  - Projects
    - NUCLEO-F401RE
      - Examples
        - 53L1A2
        - 53L3A2
        - 53L4A1
          - 53L4A1\_MultiSensorRanging
          - 53L4A1\_SimpleRanging
            - Binary
            - EWARM
              - 53L4A1\_SimpleRanging.ewd
              - 53L4A1\_SimpleRanging.ewp
              - Project.eww
              - startup\_stm32f401xe.s
              - stm32f401xe\_flash.icf
              - stm32f401xe\_sram.icf
            - Inc
            - MDK-ARM
              - 53L4A1\_SimpleRanging.uvoptx
              - 53L4A1\_SimpleRanging.uvprojx
              - startup\_stm32f401xe.s
            - Src
            - STM32CubeIDE
              - .cproject
              - .project
              - STM32F401RETX\_FLASH.ld
              - STM32F401RETX\_RAM.ld
          - 53L4A1\_ThresholdDetection
          - 53L4A2
          - 53L5A1
          - CUSTOM
        - NUCLEO-L476RG
        - STM32CubeMX

Open: **UM2931** (How to use the VL53L4CD with STMicroelectronics' X-CUBE-TOF1 Time-of-Flight sensor software packages for STM32CubeMX) and **follow the instructions**



Open project example for  
Multi Sensor ranging  
And modify, build application SW

Same folders as above but for another project example

We find same folders and same files as above





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# Documents & Related Resources

Go to <https://www.st.com/en/imaging-and-photonics-solutions/VL53L4CD>  
All documents are available in the Documentation tab of the related products webpage

VL53L4CD: Product Folder

- **DS13812** : High accuracy Time-of-Flight Sensor - **data sheet**

X-NUCLEO-53L4A1: Product Folder

- **DB4623** : High accuracy Time-of-Flight Sensor expansion board based on VL53L4CD for STM32 Nucleo – **data brief**
- **X-NUCLEO-53L4A1 Quick start guide** : High accuracy Time-of-Flight Sensor - **this document**
- **UM2972** : Getting started with X-NUCLEO-53L4A1 High accuracy Time-of-Flight sensor based on the VL53L4CD for STM32 Nucleo - **user manual**

P-NUCLEO-53L4A1: Product Folder

- **DBxxxx** : VL53L4CD Nucleo pack with X-NUCLEO-53L4A1 expansion board and STM32F401RE Nucleo board– **data brief**

SATEL-VL53L4CD: Product Folder

- **DB4629** : VL53L4CD breakout board High accuracy Time-of-Flight Sensor – **data brief**

STSW-IMG023: Ultra Lite Driver (ULD) for VL53L4CD folder

- **DB4579** : Ultra lite driver (ULD) application programming interface (API) for the VL53L4CD – **data brief**

STSW-IMG026: Graphical User Interface (GUI) Folder

- **DB4580** : P-NUCLEO-53L4A1 pack graphical user interface (GUI) – **data brief**
- **Software setup file**

X-CUBE-TOF1: Software package for STM32Cube

- **DB4449** : Time-of-Flight sensors software expansion for STM32Cube – **data brief**
- **UMxxxx** : Getting started with the STMicroelectronics X-CUBE-TOF1, Time-of-Flight sensors, software package for STM32CubeMX - **User Manual**
- **Software setup file**



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## FAST, AFFORDABLE PROTOTYPING AND DEVELOPMENT

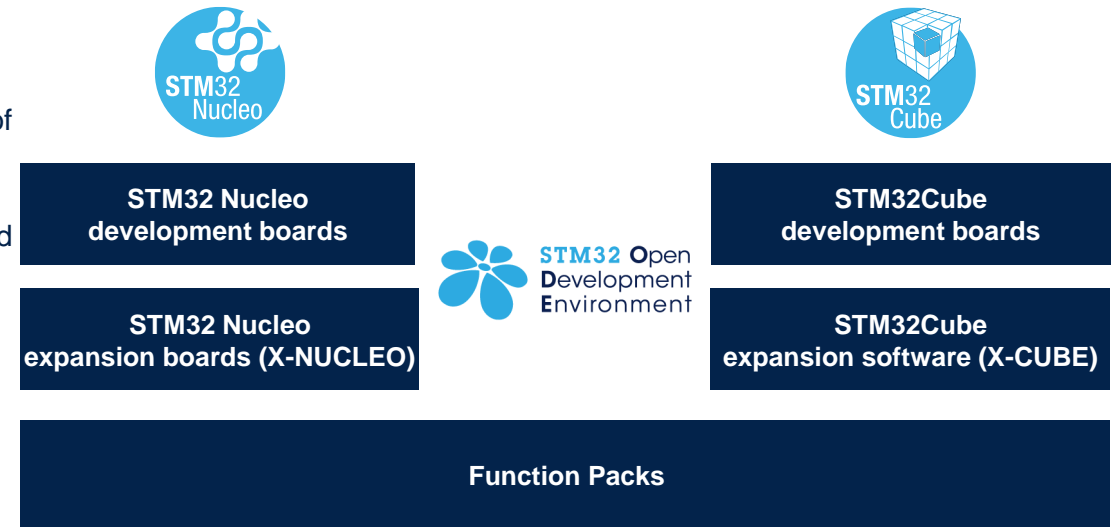
The STM32 Open Development Environment (ODE) is an **open, flexible, easy** and **affordable** way to develop innovative devices and applications based on the STM32 32-bit microcontroller family combined with other state-of-the-art ST components connected via expansion boards. It enables fast prototyping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

