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Quick Start Guide

Time-of-Flight 8x8 multizone ranging sensor
with 90° FoV VL53L7CX expansion board for
STM32 Nucleo

October 2022



STM32 Open
Development
Environment



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STM32 Open Development Environment: Overview



VL53L7CX - 8x8 multizone ranging sensor with 90° FoV

Hardware Overview (1/2)

X-NUCLEO-53L7A1 Hardware Description

- The X-NUCLEO-53L7A1 is a 8x8 multizone ranging sensor with 90° FoV and development board designed around the VL53L7CX sensor based on ST **FlightSense™** patented technology
- The VL53L7CX communicates with the STM32 Nucleo developer board host microcontroller through an I²C link available on the Arduino UNO R3 connector.

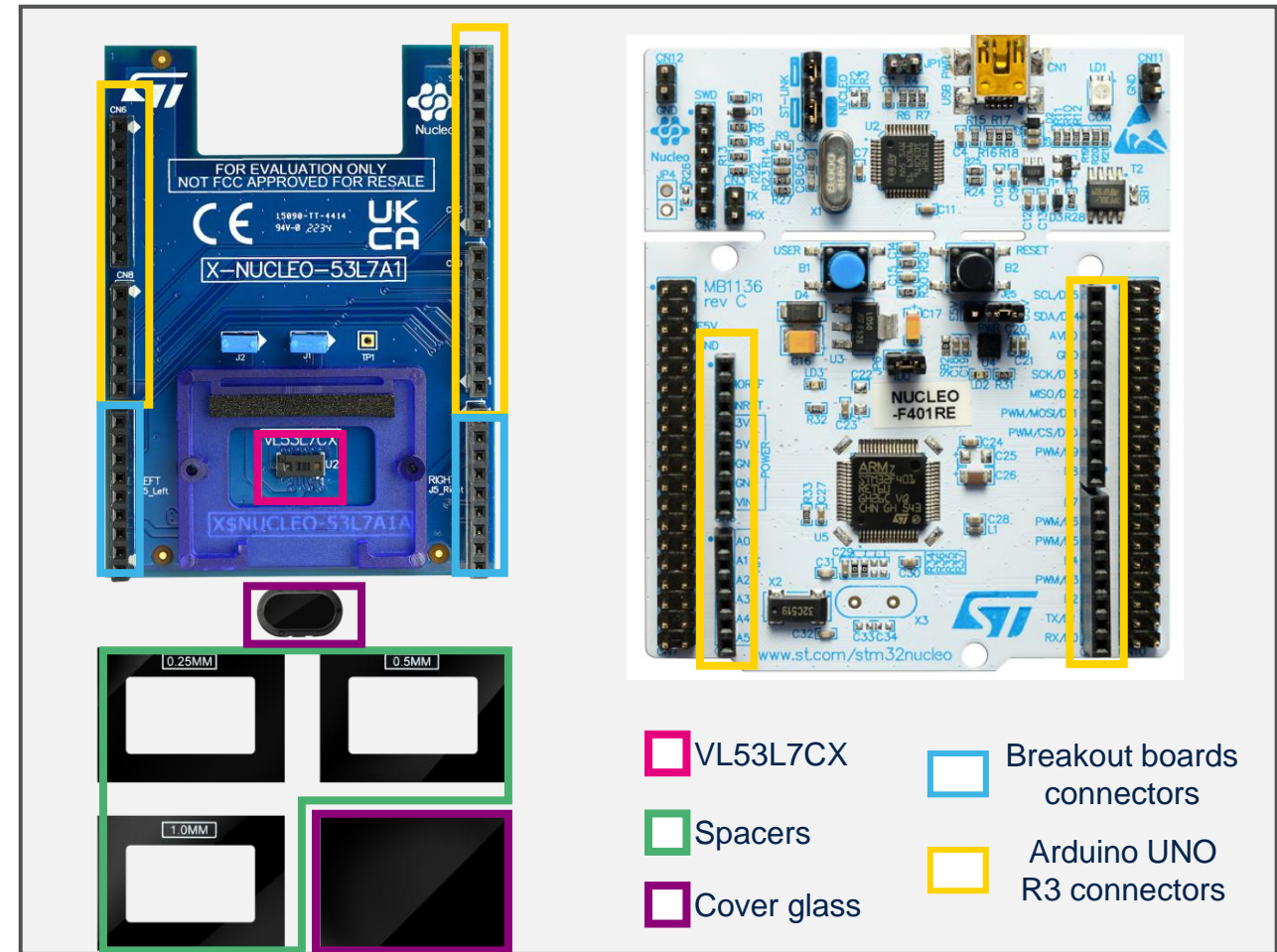
Key Products on board

VL53L7CX 8x8 multizone ranging sensor with 90° FoV

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

Breakout boards

SATEL-VL53L7CX breakout boards can be purchased separately



Order Code: **X-NUCLEO-53L7A1**

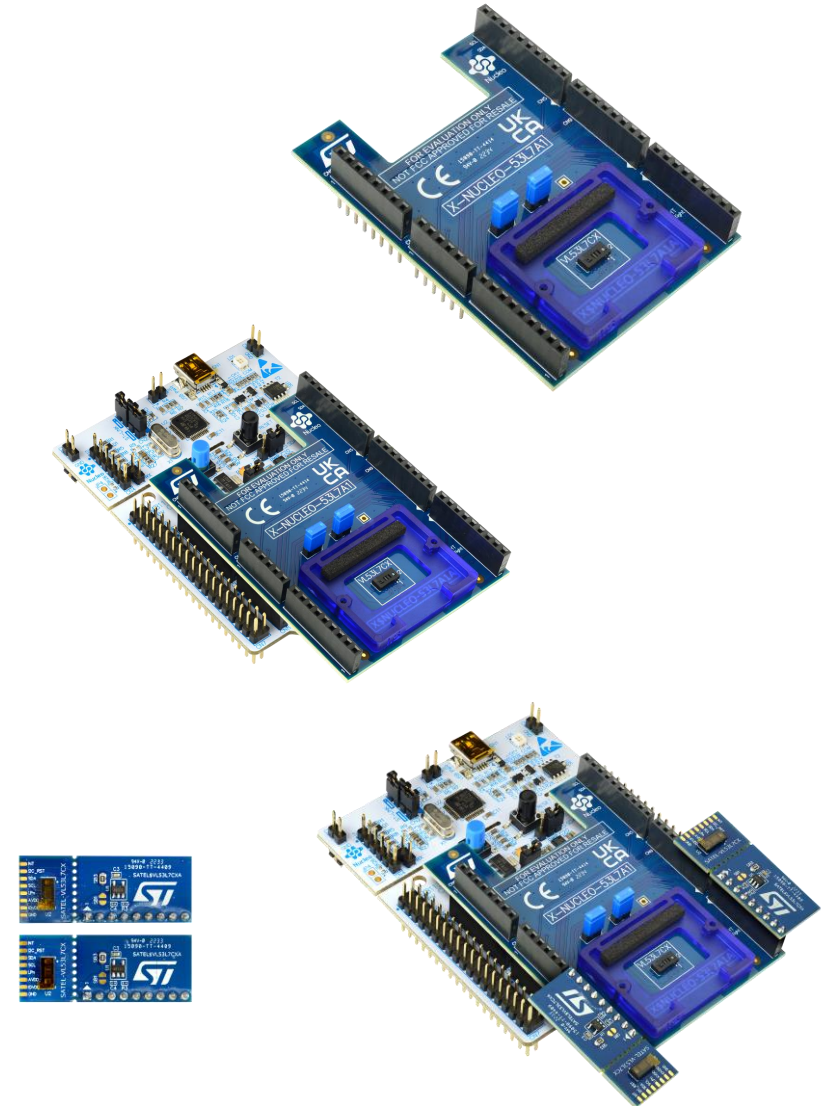
Latest info available at www.st.com
X-NUCLEO-53L7A1



VL53L7CX - 8x8 multizone ranging sensor with 90° FoV

Hardware Overview (2/2)

- X-NUCLEO-53L7A1 expansion board
 - VL53L7CX devices in custom applications can be integrated with expansion board, or external VL53L7CX breakout.
 - The breakout boards are delivered separately.
- X-NUCLEO-53L7A1 is also available as a NUCLEO Pack (P-NUCLEO-53L7A1)
 - The X-NUCLEO-53L7A1 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-53L7A1**:
X-NUCLEO-53L7A1 expansion board and NUCLEO-F401RE full features board.
- VL53L7CX breakout boards can be ordered separately
 - Order code: **SATEL-VL53L7CX**
 - 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-53L7A1) 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-53L7A1) plugged on top of an STM32 Nucleo development board (NUCLEO-F401RE or NUCLEO-L476RG).

Key features

- Driver layer (VL53L7CX ULD) for complete management of the VL53L7CX High accuracy ranging sensor integrated in the X-NUCLEO-53L7A1 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-53L7A1 (sense)

STM32 Nucleo development board

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



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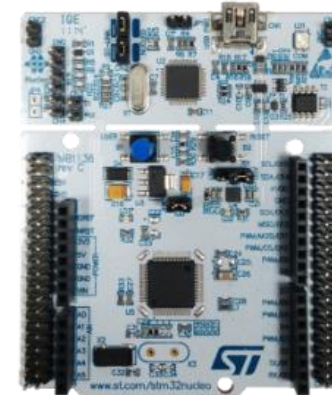
STM32 Open Development Environment: Overview



- 1x High accuracy ToF sensor expansion board based on VL53L7CX (**X-NUCLEO-53L7A1**).
- 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-53L7A1**):
 - X-NUCLEO-53L7A1 expansion board and NUCLEO-F401RE full features board delivered together.



X-NUCLEO-53L7A1



NUCLEO-F401RE

P-NUCLEO-53L7A1

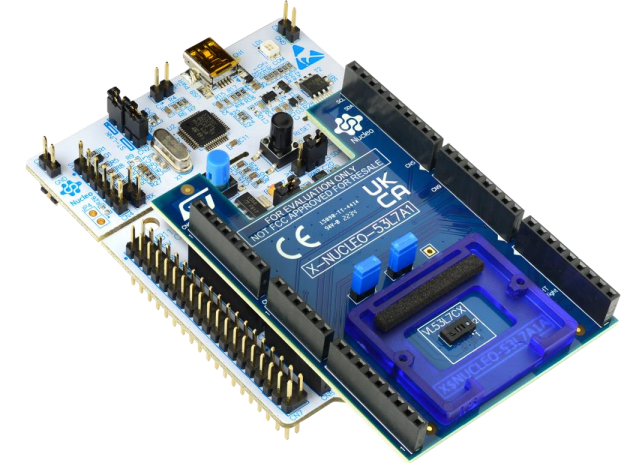
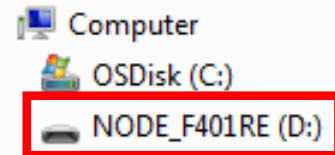




- **STSW-IMG036**: Ultra Lite Driver (ULD) for VL53L7CX
- **STSW-IMG037**: P-NUCLEO-53L7A1 Graphical User Interface (GUI) on Windows 7 and 10
- **STSW-IMG038**: Linux driver for VL53L7CX
- **X-CUBE-TOF1**: Time-of-Flight sensors software expansion for STM32Cube.
 - When you install the X-CUBE-TOF1 the 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\53L7A1\53L7A1_SimpleRanging.

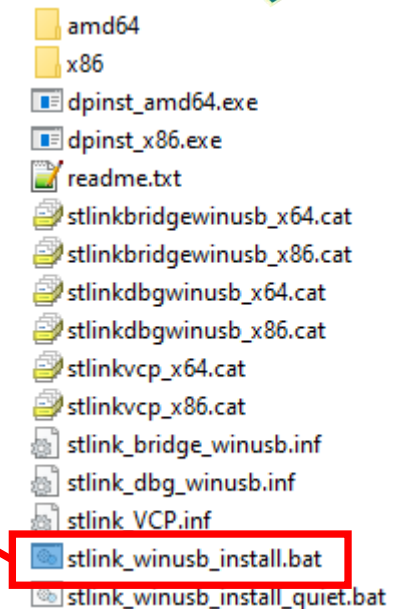
1. Connect the P-NUCLEO to the PC through USB

- 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 VL53L7CX expansion board + Nucleo F401RE to the PC
- Install the GUI SW for VL53L7CX Demo and configuration settings
 - **STSW-IMG037**, 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 VL53L7CX
- Display real time the data (distance, signal, ambient rate)
- Get data logging and replay a datalog (.csv file)



Setup & Demo Examples

VL53L7CX GUI software installation

VL53L7CX

Mini Depth-Map Calibration Data Log About

| | | | | | | | |
|--------|--------|--------|--------|-------|--------|--------|--------|
| R:1957 | R:1886 | R:199 | R:1939 | R:200 | R:1952 | R:1949 | |
| R:1903 | R:202 | R:197 | R:197 | R:191 | R:1966 | R:1968 | R:2023 |
| R:1877 | R:210 | R:204 | R:195 | R:193 | R:217 | | R:2007 |
| R:1883 | R:1896 | R:202 | R:197 | R:185 | R:186 | R:1979 | R:1983 |
| R:1892 | R:218 | R:194 | R:191 | R:181 | R:173 | R:1941 | R:1994 |
| R:1869 | R:211 | R:174 | R:171 | R:171 | R:167 | R:2006 | R:1990 |
| R:1871 | R:1883 | R:208 | R:173 | R:168 | R:161 | R:175 | R:2021 |
| R:1878 | R:1897 | R:1940 | R:1957 | R:175 | R:156 | R:154 | |

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): 15.53
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 ☐



Setup & Demo Examples

X-CUBE-TOF1 software installation

- Perform HW installation and connect the NUCLEO kit (P-NUCLEO-53L7A1) 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\53L7A1\53L7A1_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 |
|---------------------------|-------------------------------------------------------------------------------------------|
| en.X-CUBE-TOF1 | Root directory of the software package |
| _htmresc | Compiled HTML file generated from the source code |
| Documentation | Documentation files |
| Drivers | VL53L7CX ULD |
| Projects | Project folders |
| NUCLEO-F401RE | There is the same folder for STM32L476RG-Nucleo |
| Examples | VL53L7CX project examples |
| 53L1A2 | Example project |
| 53L3A2 | Example project |
| 53L4A1 | Example project |
| 53L4A2 | Example project |
| 53L5A1 | Example project |
| 53L7A1 | Example project |
| 53L7A1_MultiSensorRanging | VL53L7CX project examples for Multi Sensor Ranging, Simple Ranging & Threshold Detection: |
| 53L7A1_SimpleRanging | - pre-compiled binary files to evaluate the sensor |
| 53L7A1_ThresholdDetection | - Pre-compiled projects for STM32CubeIDE, Keil and IAR |
| CUSTOM | Custom project |



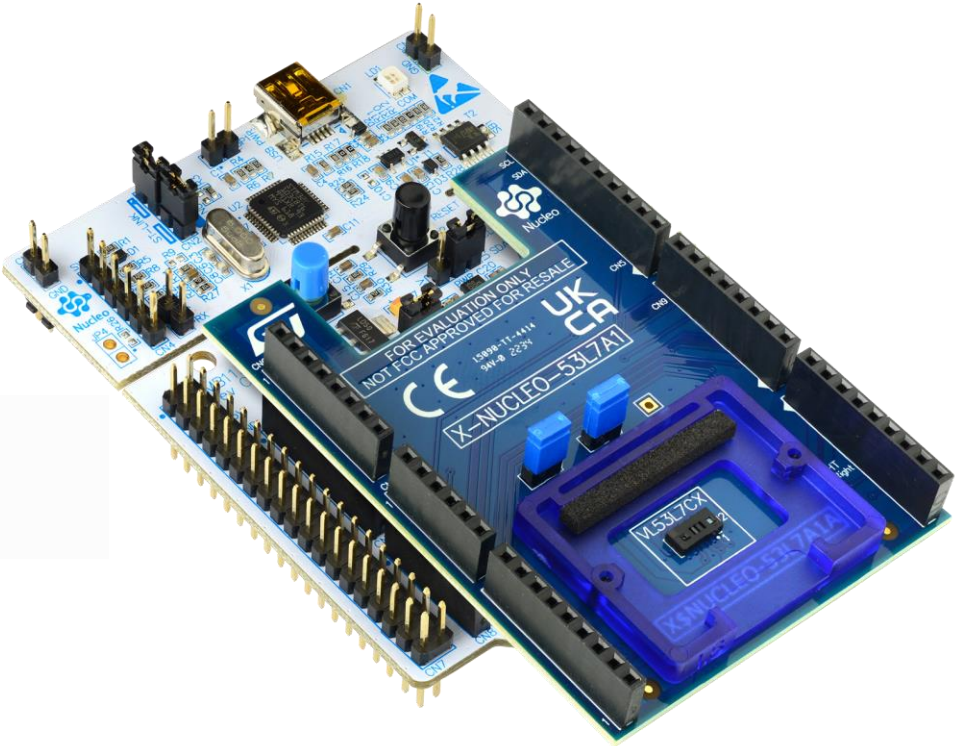
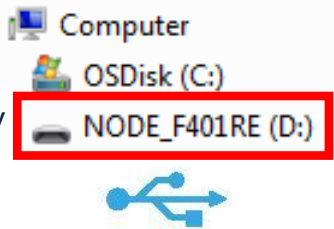
VL53L7CX - 8x8 multizone ranging sensor with 90° FoV

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

Follow the instructions from the **UM3108** (How to use the VL53L7CX with STMicroelectronics' X-CUBE-TOF1 Time-of-Flight sensor software packages for STM32CubeMX) that can be found on st.com

- en.X-CUBE-TOF1
 - _htmresc
 - Documentation
 - Drivers
 - Projects
 - NUCLEO-F401RE
 - Examples
 - 53L1A2
 - 53L3A2
 - 53L4A1
 - 53L4A2
 - 53L5A1
 - 53L7A1
 - 53L7A1_MultiSensorRanging
 - Binary
 - EWARM
 - Inc
 - MDK-ARM
 - Src
 - STM32CubeIDE
 - 53L7A1_SimpleRanging
 - Binary
 - EWARM
 - Inc
 - MDK-ARM
 - Src
 - STM32CubeIDE
 - 53L7A1_ThresholdDetection
 - Binary
 - EWARM
 - Inc
 - MDK-ARM
 - Src
 - STM32CubeIDE

Drag and Drop .bin files from the directory to

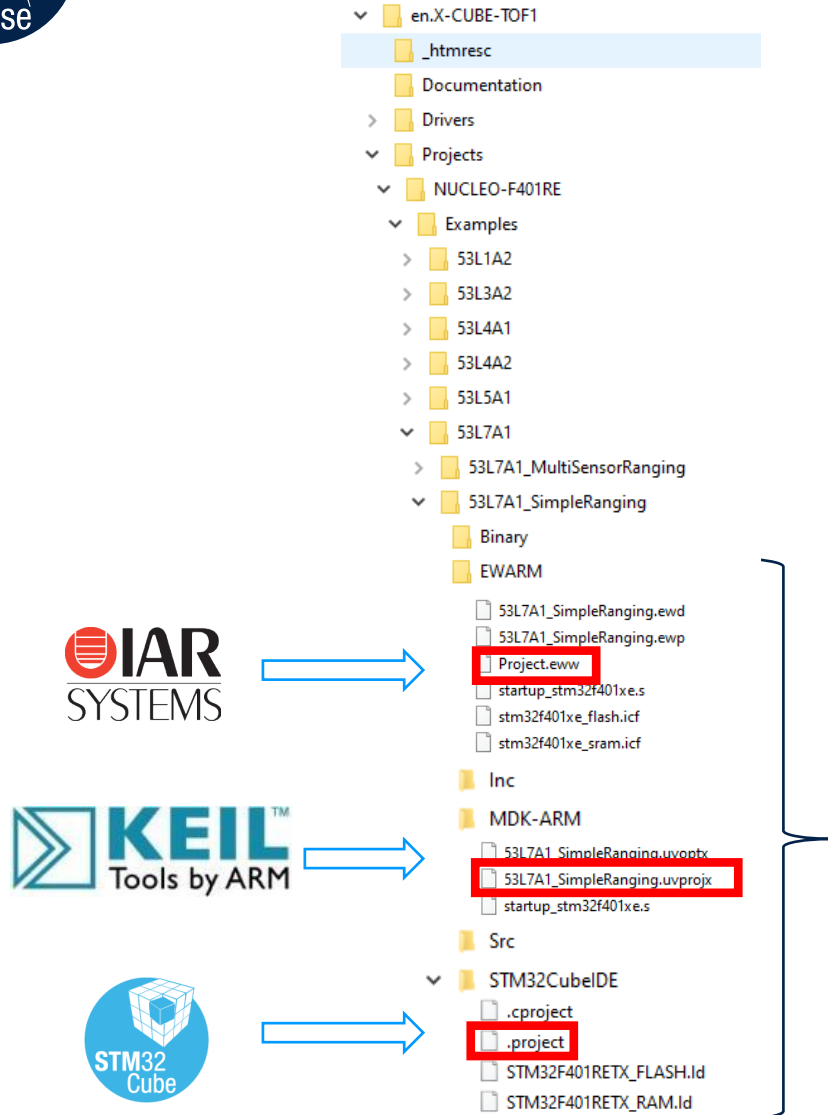




VL53L7CX - 8x8 multizone ranging sensor with 90° FoV

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

Follow the instructions from the **UM3108** (How to use the VL53L7CX with STMicroelectronics' X-CUBE-TOF1 Time-of-Flight sensor software packages for STM32CubeMX) that can be found on [st.com](https://www.st.com)



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

- Same folders exist for Multi Sensor Ranging and Threshold Detection projects
- Same folders exist for L476RG board



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

X-NUCLEO-53L7A1:

- Data Brief [DB4808](#): Time-of-Flight 8x8 multizone ranging sensor with 90° FoV expansion board based on the VL53L7CX for STM32 Nucleo
- User Manual [UM3067](#): Getting started with X-NUCLEO-53L7A1 High accuracy Time-of-Flight sensor based on the VL53L7CX for STM32 Nucleo
- [X-NUCLEO-53L7A1 SCHEMATICS](#)
- [X-NUCLEO-53L7A1 GERBER](#)

P-NUCLEO-53L7A1:

- Data Brief [DB4871](#): VL53L7CX Nucleo pack with X-NUCLEO-53L7A1 expansion board and STM32F401RE Nucleo board

SATEL-VL53L7CX:

- Data Brief [DB4809](#): VL53L7CX breakout board High accuracy Time-of-Flight Sensor
- [SATEL-VL53L7CX SCHEMATIC](#)
- [SATEL-VL53L7CX 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

VL53L7CX:

- Datasheet [DS13865](#): Time-of-Flight 8x8 multizone ranging sensor with 90° FoV
- Data Brief [DB4796](#): Time-of-Flight 8x8 multizone ranging sensor with 90° FoV

STSW-IMG036:

- Data Brief [DB4810](#): Ultra lite driver (ULD) application programming interface (API) for the VL53L7CX Time-of-Flight 8x8 multizone ranging sensor with 90° FoV

STSW-IMG037:

- Data Brief [DB4811](#): P-NUCLEO-53L7A1 pack graphical user interface (GUI)



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FAST, AFFORDABLE PROTOTYPING AND DEVELOPMENT

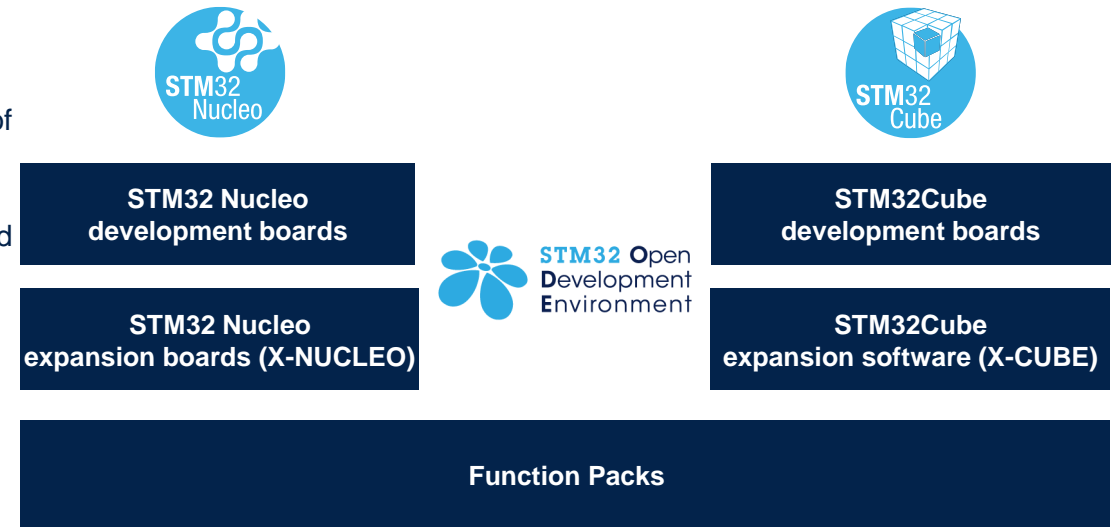
The STM32 Open Development Environment (ODE) is an **open, flexible, easy** and **affordable** way to develop innovative devices and applications based on the STM32 32-bit microcontroller family combined with other state-of-the-art ST components connected via expansion boards. It enables fast prototyping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

