

UM2853

User manual

How to use the VL53L3CX with STMicroelectronics' X-CUBE-TOF1 Time-of-Flight sensor software packages for STM32CubeMX

Introduction

The X-CUBE-TOF1 expansion software package for STM32Cube runs on the STM32 and includes drivers that recognize the sensors and perform simple ranging on single or multiple devices.

The expansion is built on STM32Cube software technology to ease portability across different STM32 microcontrollers.

The software comes with a sample implementation of the drivers running on different Time-of-Flight (ToF) sensor evaluation boards connected to a featured STM32 Nucleo development board.

This user manual focuses on the VL53L3CX ToF ranging sensor with multitarget detection. For further information on the ToF sensors supported by X-CUBE-TOF1, refer to the software page of www.st.com.

The VL53L3CX evaluation boards supported by the X-CUBE-TOF1 expansion software package include:

- X-NUCLEO-53L3A2 expansion board
- VL53L3CX-SATEL breakout boards

The X-CUBE-TOF1 software provides the following sample applications for the VL53L3CX:

- 53L3A2_SimpleRanging for X-NUCLEO-53L3A2 and optional cover glass for a calibration application
- 53L3A2_MultiSensorRanging for X-NUCLEO-53L3A2 and VL53L3CX-SATEL
- VL53L3CX_SimpleRanging for VL53L3CX-SATEL

Visit the STM32Cube ecosystem web page on www.st.com for further information.



1 Acronyms and abbreviations

Acronym	Definition
API	application programming interface
BSP	board support package
HAL	hardware abstraction layer
I2C	inter-integrated circuit
IDE	integrated development environment
MCU	microcontroller unit
NVIC	nested vector interrupt control
PCB	printed circuit board
SDK	software development kit
ToF	Time-of-Flight sensor
USB	universal serial BUS



2 X-CUBE-TOF1 software expansion for STM32Cube

2.1 Overview

The X-CUBE-TOF1 software package expands the STM32Cube functionality. The key features are:

- Complete software to build applications using the VL53L3CX evaluation boards listed in Section Introduction.
- Several application examples to show the innovative technology for the accurate distance ranging capability.
- Sample application to transmit real-time sensor data to a PC.
- Precompiled binaries available on all evaluation boards listed in Section Introduction connected to a NUCLEO-F401RE or NUCLEO-L476RG development board.
- Package compatible with STM32CubeMX, can be downloaded from, and installed directly into, STM32CubeMX.
- Easy portability across different MCU families, thanks to STM32Cube.
- Free, user-friendly license terms.

2.2 Architecture

This software is a fully compliant expansion of STM32Cube enabling development of applications using Time-of-Flight sensors.

The software is based on the hardware abstraction layer for the STM32 microcontroller, STM32CubeHAL. The package extends STM32Cube by providing a board support package (BSP) for the sensor expansion board, and a sample application for serial communication with a PC.

The software layers used by the application software to access the sensor expansion board are:

- The STM32Cube HAL driver layer. It provides a simple, generic, and multi-instance set of APIs (application programming interfaces) to interact with the upper layers (application, libraries, and stacks). It includes generic and extension APIs and is based on a generic architecture, which allows the layers built on it (such as the middleware layer) to implement their functionalities without dependence on the specific hardware configuration of a given microcontroller unit (MCU). This structure improves library code reusability and guarantees high portability across other devices.
- The BSP layer. It provides supporting software for the peripherals on the STM32 Nucleo board, except for the MCU. It has a set of APIs to provide a programming interface for certain board-specific peripherals (for example, the LED, the user button etc.), and allows identification of the specific board version. For the sensor expansion board, it provides the programming interface for various ToF sensors and provides support for initializing and reading sensor data.



Figure 1. X-CUBE-TOF1 software architecture

2.3 Folder structure

Figure 2. X-CUBE-TOF1 package folder structure

Documentation
 Drivers
 Projects
 STM32CubeMX
 _htmresc
 en.DM00484327.pdf
 readme.txt
 Release_notes.html
 Release_notes.md
 STMicroelectronics.X-CUBE-TOF1.pdsc

The following folders are included in the software package:

- The [**Documentation**] folder contains a compiled HTML file generated from the source code and detailed documentation regarding the software components and APIs.
- The [**Drivers**] folder contains the HAL drivers, the board-specific drivers for each supported board or hardware platform, including those for the on-board components and the CMSIS layer, which is a vendor-independent hardware abstraction layer for the Cortex-M processor series.
- The [**Projects**] folder contains several examples and applications for NUCLEO-L476RG and NUCLEO-F401RE platforms to show the use of sensor APIs provided with three development environments (IAR Embedded Workbench® for Arm[™], MDK-ARM microcontroller development kit, STM32CubeIDE).
- The [STM32CubeMX] folder contains all the templates used by the CubeMX ToF pack.

2.4 APIs

Detailed technical information about the APIs available to the user can be found in the compiled HTML file X-CUBE-TOF1.chm in the [**Documentation**] folder of the software package, where all the functions and parameters are fully described.



3

VL53L3CX sample application descriptions

In this section, a short overview of the sample applications included in the X-CUBE-TOF1 pack is provided. The sample applications:

- are ready-to-use projects that can be generated through the STM32CubeMX for any Nucleo board and using the X-NUCLEO-53L3A2 expansion board
- are ready-to-use projects that can be generated through the STM32CubeMX for any board equipped with an STM32 MCU and using the several supported ToF components.
- show the users how to use the APIs of the several ToF components to correctly initialize and use the ST ToF devices.

The precompiled binaries of the sample applications can

be found under C:\Users\username\STM32Cube\Repository\Packs\STMicroelectronics\X-CUBE-

TOF1\1.0.0\Projects\STM32F401RE-Nucleo\Examples\53L3A2\53L3A2_SimpleRanging\Binary as shown in the figure below. The user can directly use these binaries (which are built for the NUCLEO-F401RE and L476RG), or generate a new application for other STM32 Nucleo or STM32 MCU using the STM32CubeMX.

STM32Cube ÷ Example E Repository 🚊 📔 Packs .LocalPack STMicroelectronics 🗄 📘 X-CUBE-AI ± X-CUBE-BLE2 ±- X-CUBE-MEMS1 E X-CUBE-TOF1 in 1.0.0 🗄 📙 _htmresc 🗄 📜 Documentation Drivers 🗄 📕 Projects 🚊 📙 STM32F401RE-Nucleo Examples 🗄 🗌 53L3A2 🗄 📕 53L3A2_MultiSensorRanging 2 53L3A2_SimpleRanging 🗄 📙 Binary 53L3A2_SimpleRanging.bin <u>+</u>... EWARM 🗄 📃 Inc 🗄 📜 MDK-ARM 🗄 📕 Src 🗄 📙 STM32CubelDE MX 53L3A2_SimpleRanging.ioc E CUSTOM E- VL53L3CX_SimpleRanging Ė...] Binary VL53L3CX_SimpleRanging.bin ÷...] FWARM 🗄 🛛 🚺 Inc ÷...] MDK-ARM E Src 🗄 📙 STM32CubelDE WX VL53L3CX_SimpleRanging.ioc 主 ··· 📜 STM32L476RG-Nucleo

Figure 3. Precompiled projects location



3.1 53L3A2_SimpleRanging

This sample application shows how to use the X-NUCLEO-53L3A2 expansion board and a NUCLEO-F401RE or Nucleo L476RG to send the ranging data to a serial terminal, such as the Tera Term. In this example, the ranging data are displayed on the serial terminal.

The ranging data can be read by polling a register or triggering an interrupt. To select the data reading mode, refer to Section 4.2.1 How to generate the 53L3A2_SimpleRanging example with CubeMX.

This application can be run by loading the prebuilt binary 53L3A2_SimpleRanging.bin located as shown in Figure 3. Precompiled projects location or from a new project created with the STM32CubeMX.

1. After flashing the STM32 Nucleo board, either with the prebuilt binary file or from an IDE, open Tera Term and configure it with the settings below.

Fera Term: Serial port setu	¢2		×
Port:	COM4	~	ОК
Baud rate:	115200	\sim	
Data:	8 bit	\sim	Cancel
Parity:	none	\sim	
Stop:	1 bit	~	Help
Flow control:	none	~	
Transmit delay	lchar 0	mse	c/line

Figure 4. Tera Term, serial port setup

Figure 5. Tera Term, terminal setup

Terminal size	New-line	ОК
157 X 60	Receive: AUT0 v	
Term size = win size	Transmit: CR ~	Cancel
Auto window resize		Help
Ferminal ID: VT100 V	Local echo	
Answerback:	□ Auto switch (VT<->	тек)
Coding (receive)	Coding (transmit)	
UTF-8 ~	UTF-8 ~	



2. Place your hand in front of the sensor. The ranging data should be displayed on the serial terminal as shown below.

Figure 6. Ranging data

argets = 2 > Status = 7, Distance = 156 mm > Status = 0, Distance = 1429 mm	
argets = 2 => number of targets detected > Status = 0, Distance = 140 mm > Status = 0, Distance = 1444 mm	=> target #1 => target #2

Note: Remove the protective film from the top of the ToF before first use.



3.2 Offset and xtalk calibration applications

These sample applications show how to perform the calibrations (offset and crosstalk).

The sample applications are included in the 53L3A2_SimpleRanging application but they cannot be run directly from the prebuilt binary file. They can only be included only when generating a project with STM32CubeMX.

- 1. Select and configure the 53L3A2_SimpleRanging application in the software pack as described in Section 4.2 Use of expansion software with sample applications.
- 2. Complete the application configuration by selecting the calibration options as shown below.

STM32CubeMX	Untitled*:	STM32F401RETx NUCLEO	D-F401RE			
TM32 CubeMX		File	Wind	OW	Help	
Home 🔰 STM3	2F401RE1	Tx - NUCLEO-F401RE	Untitle	d - Pinout	& Configuration	,
Pinou	it & Con	figuration		Clock C	onfiguration	
			~	Software	e Packs	🗸 Pir
Q	~ Ø	STMicroelectro	onics.X-CUBE-1	TOF1.1.0.0 I	Node and Configuration	
Categories A->Z	L			Mode		
System Core	>	Board Extension 53L	3A2			
Analog	>	Device TOF1 Applica	tions			
Timers	>					
Connectivity	>		Con	figuration		
Multimedia	>	Reset Configuration				
Computing	>	Sector Settings ■ Sector Settings ■ Sector Sector Sector Settings ■ Sector	⊘ User Consta	ants 🛛 🛆 P	latform Settings	
Middleware	>	Q Search (CrtI+F)	ers : ()			0
Software Packs	~	 Basic Parameters Execution Mode 		Polling		
✓ STMicroelectro	◆ onics.	Offset Calibration Xtalk calibration		No Yes No	yes	~

Figure 7. STM32CubeMX, offset and xtalk calibration

3. To test these applications, the cover glass kit (rectangle cover glass and spacers) and a fix target at 100 mm for the offset calibration are required. The calibration distance can be changed in the source code.



4. Run the application from the project generated through the STM32CubeMX and follow the instructions displayed on the serial terminal as shown below to perform the calibrations.

BEGIN XTALK CALIBRATION	
Please remove all objects in fro Press the user button to continu	ont of the sensor
END OF XIALK CALIBRATION	
Please put a target at 100 mm	
Press the user button to continu	
Targets = Ø Ranging distance	before calibration
Targets = 1 > Status = 6, Distance =	79 mm
Targets = 1 > Status = 0, Distance =	78 mm
Targets = 1 > Status = 0, Distance =	79 mm
Targets = 1 I> Status = 0, Distance =	79 mm
Targets = 1 > Status = 0, Distance =	80 mm
Targets = 1 > Status = 0, Distance =	79 mm
Targets = 1 > Status = 0, Distance =	81 mm
Targets = 1 I> Status = 0, Distance =	80 mm
Targets = 1 > Status = 0, Distance = END OF OFFSET CALIBRATION	81 mm
Targets = 0	
Targets = 1 Ranging dis	tance after calibration
I> Status = 6, Distance =	97 mm
Targets = 1 I> Status = 0, Distance =	98 mm
Targets = 1 I> Status = 0, Distance =	98 mm
Targets = 1 > Status = 0, Distance =	98 mm

Figure 8. Calibration



3.3 53L3A2_MultiSensorRanging

This sample application shows how to make three ToFs run simultaneously.

To test this application, two breakout boards VL53L3CX-SATEL, an X-NUCLEO-53L3A2, and a NUCLEO-F401RE or Nucleo L476RG are required. In this example, the ranging data is displayed on the serial terminal as shown below. This application can be run by loading the prebuilt binary 53L3A2_MultiSensorRanging.bin or from a new project created with STM32CubeMX.

Note:

In this application, the ranging data is read by polling a register. No interrupt option is implemented.

CENTER $-$ => refers to the main sensor
I> Status = 0, Distance = 29 mm I> Status = 0, Distance = 1440 mm RIGHT - => refers to the right satellite sensor
Inference = 1 I> Status = 0, Distance = 1481 mm LEFT - => refers to the left satellite sensor
Targets = 1 > Status = 0, Distance = 1387 mm CENTER -
Targets = 2 > Status = 0, Distance = 18 mm > Status = 0, Distance = 1413 mm PIGHT -
Targets = 1 > Status = 0, Distance = 1468 mm LEFT -
Targets = 1 _l> Status = 0, Distance = 1389 mm

Figure 9. Multiple sensors ranging





3.4 VL53L3CX_SimpleRanging

This sample application shows how to range with the VL53L3CX_SATEL connected directly to the Nucleo F401RE or Nucleo L476RG without the expansion board.



Figure 10. VL53L3CX_SATEL connection

Note: Two resistors R [1.8K to 4.7K] must be added on SDA and SCL lines.

To test this application, one VL53L3CX-SATEL breakout board and one F401RE Nucleo are required. In this example, the ranging data is displayed on the serial terminal as shown in the figure below. This application can be run by flashing the Nucleo with the prebuilt binary VL53L3CX_SimpleRanging.bin from: C:\Users\user_name\STM32Cube\Repository\Packs\STMicroelectronics\X-CUBE-TOF1\2.0.0\Projects\NUCLEO-F401RE\Examples\CUSTOM\VL53L3CX_SimpleRanging\Binary. To begin testing, open the Tera Term and set the baud rate to 460800 as shown below.

Figure 11. Tera Term: serial port setup

1

Port:	COM109	~	ок
Baud rate:	460800	~	
Data:	8 bit	~	Cancel
Parity:	none	~	
Stop:	1 bit	~	Help
D	none		

Figure 12. Ranging result displayed on a terminal

Targets = 1 > Status		Ø,	Distance	=	41	mm	Ambient	Ш	3.92	kcps/spad,	Signal		18.66	kcps/spad
Targets = 1 > Status	Т	Ø,	Distance		37	mm	Ambient	=	3.96	kcps/spad,	Signal	I	20.54	kcps/spad
Targets = 1 I> Status	П	Ø,	Distance	-	46	mm	Ambient	=	3.96	kcps/spad.	Signal	I	19.99	kcps/spad
Targets = 1 > Status		ø,	Distance		40	mm	Ambient	П	3.88	kcps/spad,	Signal	Ш	22.25	kcps/spad



4 VL53L3CX configuration steps

The X-NUCLEO-53L3A2 interfaces with the STM32 microcontroller via the I2C pin. If a user wants to interface the X-NUCLEO-53L3A2 expansion board with an STM32 Nucleo 64 pins board (for example, a NUCLEO-F401RE), no particular hardware modification must be done. The X-NUCLEO-53L3A2 pin out is shown in Figure 14. X-NUCLEO-53L3A2 pinout.



Figure 13. STM32 Nucleo 64 pins and X-NUCLEO-53L3A2







4.1 Use of expansion software without sample applications

This section describes how to configure STM32CubeMX with the X-NUCLEO-53L3A2 when the use of the sample applications is not required. With such a setup, only the driver layers are configured.

1. To add the X-CUBE-TOF1 SW pack to the project, click on the [Software Packs] button then [Select Components].

STM32Cu	beMX Untitled: STM32F401RETx NUCLEO-F4	401RE			
STM32	File	Window	Help		
Home >	STM32F401RETx - NUCLEO-F401RE	> Untitled - Pinout	& Configuration	>	
	Pinout & Configuration		с	lock Configuration	
			-		
				▲ Software Packs	✓ Pinout

Figure 15. Select components

2. From the [Software Packs Component Selector] window, select only the [Board Extension] class.

Figure 16. Select board extension only

Software Packs Component Selector			2
Pack / Bundle / Component	Status	Version	Selection
> STMicroelectronics.X-CUBE-AI		5.2.0 ڬ 🗸 🗸	Install
> STMicroelectronics.X-CUBE-ALGOBUILD		1.1.0 🛛 🕒	Install
> STMicroelectronics.X-CUBE-BLE1		6.1.0 👜	Install
> STMicroelectronics.X-CUBE-BLE2		3.1.0	
> STMicroelectronics.X-CUBE-DISPLAY	0	1.0.0 🖻	Install
> STMicroelectronics.X-CUBE-EEPRMA1		3.0.0 😐	Install
> STMicroelectronics.X-CUBE-GNSS1		5.1.0 😐	Install
> STMicroelectronics.X-CUBE-MEMS1		8.2.0	
> STMicroelectronics.X-CUBE-NFC4		2.0.1 😐	Install
> STMicroelectronics.X-CUBE-SFXS2LP1		2.0.0 🙁 🕒	Install
> STMicroelectronics.X-CUBE-SUBG2		3.0.1 🛛 🕒 🗸 🗸	Install
 STMicroelectronics.X-CUBE-TOF1 	\odot	1.0.0	
Board Extension 53L3A2	\odot	1.0.0	
Board Part Ranging / VL53L3CX		1.0.0	
Device TOF1_Applications		1.0.0	
Application			Not selected



3. Enable I2C1 as shown below.

	Pi	nout & Configuration	Clock Configura
			✓ Software
2	~	I2C1 Mode and Configuration	
Categories A-	>Z	Mode	
System Core	>	I2C Disable	~
Analog	>	ISONE IZC SMBus Alot mode	
Timers	>	SMBus-two-wire-Interface	
Connectivity	~		
12C1			

Figure 17. I2C configuration

4. From the [Software Packs] drop-down menu, select [STMicroelectronics.X-CUBE-TOF1].

2F401RETx NUCLEC
File
NUCLEO-F401RE
Configuration
0
>
>
>
>
>
>
>
~
F1.1.0.0

Figure 18. Software packs



5. From the [Mode] view, select the [Board Extension 53L3A2].

Figure 19. Mode view

I STM32Cu	beMX Untitled*: S1	M32F401RETx NUCLEO-F4	401RE		
STM32 CubeMX		File	Window	Help	
Home >	STM32F401RET	- NUCLEO-F401RE	> Untitled - Pinout	& Configuration	>
	Pinout	& Configuration		CI	ock Configuration
					✓ Software Packs
Q	~	0	STMicroelect	ronics X-CUBE-TOF1.1.	0.0 Mode and Configuration
Categories	A->Z			Mode	
System C	Core	>	Board Extension	53L3A2	

6. From the [**Configuration window**], enable the I2C1.

Figure 20. Configuration window

STM32CubeM	IX Untitled*: STM	32F401RETx NUCLEO-	F401RE			
		File	Window	Help		
Home > ST	M32F401RETx	NUCLEO-F401RE	➢ Untitled - Pin	out & Configuration	\rangle	
	Pinout &	Configuration			Clock Configura	ation
					🗸 Software	e Packs 🔷 💊
Q	~	٥	S	TMicroelectronics X-CUE	E-TOF1.1.0.0 Mode an	nd Configuration
Categories A-	>Z				Mode	
System Core		>	Board Extension	sion 53L3A2		
Analog		>				
Timers		>			Configuration	
Connectivity		~	Reset Configurat	ion		
			😔 Parameter Setti	ngs 🛛 🛕 Platform Setti	ngs	
 I2C1 I2C2 I2C3 SDIO SPI1 			Platform proposal – BSP – – – – – – – – – – – – – – – – – – –	IPs or Components	Found Solutions	I2C Addr BSP API
SPI2 SPI3				The set of the set of the set	Undefined I2C1	



7. Once all the steps above have been performed, click on [**Project Manager**] to name the project and select the Toolchain/IDE for which codes to generate.

TM32 CubeMX	File Window	Help	
lome 🔰 STM32	F401RETx - NUCLEO-F401RE $>$ Untitled - Pr	oject Manager >	
	Pinout & Configuration	Clock Configuration	Project Manage
	Project Settings Project Name Esst Project Location C: Vitit Application Structure Advanced V	Do not generate the main()	
	Tockhain Folder Location	Cenerate Under Root	
dvanced Settings	MDK-ARM SW4STM22 TruesTUDIO STM32CubeIDE Data Stackberg (200200		

Figure 21. Project manager

8. Generate the source code of the project using the X-CUBE-TOF1 software by clicking on the [GENERATE CODE] button.

Figure 22. Generate code

∎ SIM32Cu	beMX Untitled*: STM32F401RE1x NUCLEO	+401KE		-	ыx
IM32	File	Window Help		🐵 📑 🕒 🎽	* 5
Horme >	STM32F401RETx - NUCLEO-F401RE	VIntitled - Project Manager		GENERATE CODE	12
	Pinout & Configuration	Clock Configuration	Project Manager	Tools	





4.2 Use of expansion software with sample applications

This section describes how to configure STM32CubeMX with X-NUCLEO-53L3A2 when the use of the sample applications is desired. With such a setup, all the components of the expansion software package, including applications, are properly configured.

4.2.1 How to generate the 53L3A2_SimpleRanging example with CubeMX

1. Open STM32-CubeMX and click on [ACCESS TO BOARD SELECTOR].

STM32CubeMX Ur	ntitled: STM32F401RETx NUCLEO-F4	01RE		
STM32	File	Window	Help	
Home > STM32	F401RETx - NUCLEO-F401RE	Untitled - Pinout &	Configuration	\rangle
Existing Proje	ects			New Project
Recent Oper	ned Projects			I need to :
test_tof1_re	ev2.ioc date : 14/06/2021 16:50:34		MX	Start My project from MCU
cube_tof1_ Last modified	2_4.ioc date : 14/06/2021 16:00:33		MX	ACCESS TO MCU SELECTOR
test_cube_ Last modified	tof1_3.ioc date : 14/06/2021 15:45:27		MX	Start My project from ST Board ACCESS TO BOARD SELECTOR
test_cube_ Last modified	2_2.ioc date : 14/06/2021 15:31:16		MX	Start My project from Example
Other Projec	ts		दिव	

Figure 23. Access to board selector

2. Search and select the F401RE board.



Figure 24. F401RE board



3. Click on [Select Components].

Figure 25. Select components

STM32CubeMX Untitled: STM32F401RETx NUCLEO-F401RE

STM32 CubeMX	File	Window	Help			
Home	STM32F401RETx - NUCLEO-F401RE	Untitled - P	Pinout & Configuration	\rangle		
	Pinout & Configuration		c	lock Configuration		
				▲ Software Packs		✓ Pinout
Q Categories	✓ Ø A>Z			Select Components Manage Softwar Packs Add pack so	At-0 ABJI tware comp	Pinout view onent to the project

4. Click on [X-CUBE-TOF1]. Select [53L3A2 Board Extension], then select [53L3A2_SimpleRanging]. Click OK.

STMicroelectronics X-CUBE-TOF1	0	2.0.0				
Board Extension 53L3A2	0	2.0.0	_	52		
Board Extension 53L5A1		1.0.0				
Board Part Ranging / VL53L3CX		2.0.0				
Board Part Ranging / VL53L5CX		1.0.0				
V Device TOF1_Applications	0	1.0.0		101		
Application	0			53L3A2_SimpleRanging	~	1
> Board Support STM32Cube_Custom_BSP_D	6	1.0.0				
TMicroelectronics X-CUBE-TOUCHGFX		4 17.0 🖻	×	Patal I		
offSSLI-CUBE-woffSSL		480 😐		Vistal		
FreeRTOS	G					
HAL Drivers	G					
	177.					

Figure 26. 53L3A2_SimpleRanging



5. Click on [Software Packs], select [STMicroelectronics X-CUBE-TOF1], select the [Board Extension 53L3A2] box, then select the [Device TOF1 Applications] box.

Pinout & Configuration	Clock Configuration	
	✓ Software Packs	✓ Pinout
Q 💿	STMicroelectronics.X-CUBE-TOF1.2.0.0 Mode and Configura	ation
Categories A->Z	Mode	
System Core >	Board Extension 53L3A2	
Analog >	Device TOF1 Applications	
Timers		
Connectivity		
Multimedia >		
Computing >		
Middleware >		
Software Packs	Configuration	
STMicroplectronics V CUBE TOE1 200	Reset Configuration	
♥ STMICIVERCIUNICS.X-CODE-TOPT.2.0.0	🛛 Parameter Settings 🛛 🥥 User Constants 🛛 🔥 Platform Settings	

Figure 27. Device TOF1 applications

6. Configure the GPIOs for the application.

Figure 28. GPIO configuration

		Configuration		
Reset Configuration				
Parameter Settings	User Constants	🝐 Platform Settings		
Platform proposal —— Application ———				
Name IPs or	Components F	Found Solutions	I2C Addr	BSP
TOF_INT_PIN GPIO:E	XTI V	Indefined PA4		Unknow
TOF_INT_PIN GPIO:E BSP Name	X∏ ∽ U IPs or Components	Indefined PA4	I2C Addr	BSP API
TOF_INT_PIN GPIO:E BSP Name BSP BUTTON	X∏ ✓ U IPs or Components GPI0:EXTI ✓	Indefined PA4 Found Solutions Undefined	I2C Addr	BSP API
TOF_INT_PIN GPIO:E BSP Name BSP BUTTON 53L3A2 BUS IO driver	XTI ~ U IPs or Components GPIO:EXTI ~ I2C.12C ~	Found Solutions Undefined No solution PB8 and	I2C Addr	BSP API



7. Select the GPIO pins.



8. Link the GPIOs to the corresponding pin names.

Figure 30. GPIO and pin name correspondence

		Configuration		
Reset Cor	nfiguration		R	
Parameter	er Settings 🛛 🥺 User Constant	s 🔥 Platform Settings		
Platform prop Application Name	IPs or Components	Found Solutions	I2C Addr	BSP API
TOF_INT_PI	N GPIO:EXTI	∽ PA4		V Unknown



9. Click on GPIO to open the GPIO configuration window.

Figure 31. GPIO configuration window



10. Name and configure the pins as shown below.

Group By Perip	herals						~
Sepio Sepio	Single Mapped	Signals 🛛 🔮 RC(C 😔 SYS 🛛	🥺 USART 🛛 🥝	NVIC		
Search Signals	; 7					Show only	/ Modified Pin
Pin Name	Signal on Pin	GPIO output level	GPIO mode	GPIO Pull-up/P	Maximum outpu	User Label	Modified
PA4	n/a	n/a	External Interru	No pull-up and n.	n/a	TOF_INT	V
PA5	n/a	Low	Output Push Pull	No pull-up and n.	Low	LD2 [Green Led]	~
C13-ANTI_T	n/a	n/a	External Interru	No pull-up and n.	n/a	B1 [Blue PushB	~
					يا ا	ś	
PA4 Configurat	ion :						
GPIO mode		Ex	ternal Interrupt Mo	de with Falling ed	ge trigger detecti	on	~
GPIO Pull-up/P	ull-down	No	pull-up and no pu	ill-down			~
User Label		то	F_INT				

Figure 32. Pin names and configuration

11. Activate the NVIC interrupt vector as shown below.

Figure 33. Activation of NVIC interrupt vector

Config	uration		
Group By Peripherals			~
I © GPIO ◎ RCC ◎ SYS ◎ USART ◎ NVIC			
NVIC Interrupt Table	Enabled	Preemption Priority	Sub Priority
EXTI line4 interrupt		0	0
EXTI line[15:10] interrupts	C12	0	0



12. Configure the I2C and BSP

Figure 34. Configuration of I2C and BSP

BSP					
Name	IPs or Components		Found Solutions	I2C Addr	BSP API
53L5A1 BUS IO driver	I2C:I2C	\sim	No solution	N/A	BSP_BUS_DRIVER
BSP BUTTON	GPIO:EXTI	~	Undefined	84	BSP_COMMON_DRIVER
BSP USART	USART:Asynchronous	~	Undefined	0	BSP_COMMON_DRIVER

13. Select PB9 and PB8 for SDA and SCL.

Figure 35. PB9 and PB8 selection (for SDA and SCL)



14. Click on [Connectivity]. Select [I2C1], enable the I2C, and select [Fast Mode].

Figure 36. Fast mode selection





15. Return to the [Software Pack] view and configure the I2C and BSP as shown below.

		Configuration		
Reset Configu	uration			
Parameter S	ettings 🛛 😒 User Constants	Platform Settings		
Platform proposa	al			
Application — Name I	IPs or Components	Found Solutions	I2C Addr	BSP API
TOF INT PIN	GPIO:EXTI	PA4 ITOF INTI		V Unknown
BSP				
Name	IPs or Components	Found Solutions	I2C Addr	BSP API
BSP BUTTON	GPIO:EXTI	V PC13-ANTI_TAMP [B1 [Blu	e PushButton]]	BSP_COMMON_DRIVER
53L3A2 BUS IO	driver I2C:I2C	∽ I2C1	✓ 0	BSP_BUS_DRIVER
BSP USART	USART Asynchronous	V USART2		BSP COMMON DRIVER

Figure 37. Configuration of I2C and BSP

- Note: The ranging distance data can be read by polling a register or triggering an interrupt on pin PA4.
 - 16. Select either polling or interrupt. By default, polling is selected.

Figure 38. Selection of polling or interrupt

Confi	guration
Reset Configuration	
🧇 Parameter Settings 🛛 📀 User Const	ants 🛛 📀 Platform Settings
Configure the below parameters :	
Search (Crtl+F)	0
✓ Basic Parameters	
Ranging Mode	Polling
Offset Calibration	Interrupt
Xtalk Calibration	Polling

17. Click on [**Project Manager**].

Figure 39. Project manager

STM32CubeMX Unititled*: STM32F401RETx NUCLEO-F401RE

File Window Help

CobeMX
Horme STM32F401RETx - NUCLEO-F401RE Unititled - Pinout & Configuration

Pinout & Configuration
Clock Configuration
Project Manager

Software Packs V Pinout



18. Name the project by selecting [**Toolchain**] and then selecting [**Generate Code**].

Figure 40. Project name

STM32CubeMX Unti	led*: STM32F401RETx NUCLEO-F4	DIRE				-
STM32	File	Window	Help			🥸 🖪 🕨 🎽
Hame > STM32F4	01RETx - NUCLEO-F401RE	Untitled - Project	Manager 🔪			GENERATE CODE
F	inout & Configuration		Clock Configuration		Project Manager	Tools
Project	/Project Settings Project Name for_um Project Location [Crish/ Application Structure			Browse		
Code Generator	Advanced Toolchain Folder Location C 107/Mar.um/s Toolchain / IDE STM32CubeIDE	~	Do not generate the main() G G	anerate Under Root		D ₂

19. Click [Open Project] on the pop-up window when code generation is complete.

Figure 41. Open the project

ode Generat	tion	×	-
			A
The Code	is successfully ge	enerated under :	wn
C:/titi/for_u	ım		wn
Project lang	guage : C		wn
Open Folder	Open Project	Close	
	ode Genera The Code C:/titi/for_u Project lang Open Folder	Ode Generation The Code is successfully ge C:/titi/for_um Project language : C Open Folder	tode Generation X The Code is successfully generated under : C:/titi/for_um Project language : C Open Folder Open Project Close

- 20. Build and run the project. The results should look as shown below.
 - Figure 42. Build and run the project

53L3A2 Simple Rangi	ng demo applic	cation		
Targets = 0				
Targets = 1 > Status = 6,	Distance =	62 mm ,	Ambient = 0.83 kcps/spad,	Signal = 34.33 kcps/spad
Targets = 1 > Status = 0,	Distance =	69 mm ,	Ambient = 0.83 kcps/spad,	Signal = 34.59 kcps/spad
Targets = 1 > Status = 0,	Distance =	65 mm ,	Ambient = 0.79 kcps/spad,	Signal = 34.59 kcps/spad
Targets = 1 > Status = 0,	Distance =	69 mm ,	Ambient = 0.79 kcps/spad,	Signal = 34.73 kcps/spad
Targets = 1 > Status = 0,	Distance =	65 mm ,	Ambient = 0.76 kcps/spad,	Signal = 34.48 kcps/spad



4.2.2 How to generate the 53L3A2_MultipleSensorRanging example with CubeMX

1. Open STM32-CubeMX and click on [ACCESS TO BOARD SELECTOR].

Figure 43. Access to board selector

2 BMX	File	Window	Help	
e 🔪 STM32F4	01RETx - NUCLEO-F401RE	E 🔰 Untitled - Pinout	& Configuration	
Existing Project	s			New Project
Recent Opened	l Projects			I need to :
test_tof1_rev2 Last modified dat	lioc le : 14/06/2021 16:50:34		MX	Start My project from MCU
cube_tof1_2_ Last modified dat	4.ioc te : 14/06/2021 16:00:33		MX	ACCESS TO MCU SELECTOR
test_cube_tof Last modified dat	1_3.ioc le : 14/06/2021 15:45:27		MX	Start My project from ST Board
test_cube_2_ Last modified dat	2.ioc le : 14/06/2021 15:31:16		MX	Start My project from Example
Other Projects			R	

2. Search and select the F401RE board.



Figure 44. F401RE board

3. Click on [Select Components].

Figure 45. Select components

STM32Cu	beMX Untitled: STM32F401RETx NUCLEO-F4	DIRE			
STM32	File	Window	Help		
Home >	STM32F401RETx - NUCLEO-F401RE	Untitled - F	inout & Configuration	\rangle	
	Pinout & Configuration		(Clock Configuration	
				▲ Software Packs	✓ Pinout
Q Categories	✓ Ø \$			Select Components A Manage Software Add packs software	8-0 Pinout view



4. Click on [X-CUBE-TOF1]. Select [53L3A2 Board Extension] then select [53L3A2_MultiSensorRanging]. Click [OK] (in the bottom right-hand corner).

 STMicroelectronics.X-CUBE-TOF1 	\odot	2.0.0 ~	
Board Extension 53L3A2	\odot	2.0.0	~
Board Extension 53L5A1		1.0.0	
Board Part Ranging / VL53L3CX		2.0.0	
Board Part Ranging / VL53L5CX		1.0.0	
✓ Device TOF1_Applications	\odot	1.0.0	
Application	\odot		53L3A2_MultiSensorRanging ~

Figure 46. 53L3A2_MultiSensorRanging

5. Click on [Software Packs]. Select [STMicroelectronics X-CUBE-TOF1], select the [Board Extension 53L3A2] box, and then select the [Device TOF1 Applications] box.

Pinout & Co	onfiguration		Clock Configura	ation		Project Manager
			✓ Software Paci	ks 🗸 F	Pinout	
٤	~ ©		STMicroelectronic	s X-CUBE-TOF1.2.0.0 Mode	and Configuration	
Categories A->Z		19		Mode		
System Core	>	Board Extension	153L3A2			
Analog	>	Device TOF1 A	oplications			
Timers	>					
Connectivity	>				De	
Multimedia	>					
Computing	>					
Middleware	>					
Software Packs	~			Configuration		
¢		Reset Configuration				
 STMicroelectronics X-CUE 	3E-TOF1.2.0.0	Parameter Setting	A Platform Settings			
		Platform proposal				
		Name	IPs or Components	Found Solutions	I2C Addr	BSP API
		53L3A2 BUS IO driver	12C12C	✓ No solution	~ N/A	BSP_BUS_DRIVER
		BSP USART	USART:Asynchronous	V Undefined		BSP COMMON DRIV

Figure 47. Device TOF1 applications

Note:

Only the I2C is needed to setup.



6. Select PB9 and PB8 for SDA and SCL.

Figure 48. PB9 and PB8 selection (for SDA and SCL)



7. Click on [Connectivity].

Figure 49. Connectivity

STM32CubeMX Untitled*: STM32F STM32 CubeMX STM32F401RETx - N Home Σ Pinout & Co \sim Ø a > System Core > Analog > Timers Connectivity >



8. Select[I2C1]. Enable the I2C and select [Fast mode].

Figure 50. Fast mode selection

STM32CubeMX for_um	.ioc*: STM32F401RETx NUCLE	EO-F401RE			
TM32 CubeMX	File	Window	Help		
Home > STM32F401	IRETx - NUCLEO-F401RE	> for_um.ioc - Pinor	ut & Configuration	\rangle	
Pin	nout & Configuration		Clo	ock Configuration	
				✓ Software Packs	🗸 Pino
2 ~	0			I2C1 Mode and Configuration	
Categories A->Z		16		Mode	
Contraction of the local division of the loc	120	100			
System Core	~ 120	120			
÷					
DMA					
GPIO				Configuration	
NVIC	Re	set Configuration			
✓ RCC	1004				
ASYS	S P	arameter Settings 🛛 🥥 Us	er Constants 🛛 🕑 NVI	C Settings S DMA Settings S C	SPIO Settings
WWDG	Config	ure the below parameters :			
	Q Se	arch (Citl+F)	D		
Analog	> V Ma	aster Features			
		I2C Speed Mode		Fast Mode	
Timers	>	East Mode Duty Custe		Auto cucle Tiew(Thigh =	2
Connectivity	~ ~ SI	ave Features		Duty Cycle How High -	2
Connectivity		Clock No Stretch Mode		Disabled	
A local		Primary Address Lengtl	h selection	7-bit	
01201		Dual Address Acknowle	edged	Disabled	
12C3		Primary slave address		0	
A SDIO		General Call address de	etection	Disabled	
Ø SPI1					

9. Return to the [Software Pack] view and configure the I2C and BSP as shown below.

Figure 51. Configuration of I2C and BSP

		Configuration		
Reset Configura	ation			
Parameter Set	tings 🛛 🤗 Platform Settings			
Platform proposal BSP				
Name	IPs or Components	Found Solutions	I2C Addr	BSP API
53L3A2 BUS IO d	river I2C:I2C	~ I2C1	~ 0	BSP_BUS_DRIVER
BSP USART	USART:Asynchronous	V USART2		BSP_COMMON_DRIVER

10. Click on [Project Manager].

Figure 52. Project manager

STM32Cu	beMX Untitled*: STM32F401RETx NUCLEO-F4	401RE				
STM32	File	Window	Help			
Home >	STM32F401RETx - NUCLEO-F401RE	> Untitled - Pi	nout & Configuration	\rangle		
	Pinout & Configuration			Clock Configuration		Project Manager
				Software Packs	V Pinout	



11. Name the project by selecting [**Toolchain**] and then selecting [**Generate Code**].

Figure 53. Project name

STM32CubeMX U	ntitled*: STM32F401RETx NUCLEO-F40	1RE				-
STM32	File	Window	Help			🥸 🖪 🕨 🎽
Hame > STM32	F401RETx - NUCLEO-F401RE	Untitled - Project	t Manager 🔪			GENERATE CODE
	Pinout & Configuration		Clock Configuration		Project Manager	Tools
Project	Project Settings Project Name for um Project Location [C'ttb) Application Structure			Browse		
Code Generator	Advanced Toolchain Folder Location C 32016r.com/ Toolchain / IDE STM32CubeIDE	~	De not generate the main()	rate Under Root		D.

12. Click [Open Project] on the pop-up window when the code generation is complete.

Figure 54. Open the project

Code Genera	tion	×	
The Code	is successfully ge	enerated under :	v
C:/titi/for_u	ım		V
Project lang	guage : C		N
Open Folder	Open Project	Close	ľ
	Code Genera The Code C:/titi/for_t Project lang Open Folder	Code Generation The Code is successfully ge C:/titi/for_um Project language : C Open Folder Open Project	Code Generation × The Code is successfully generated under : C:/titl/for_um Project language : C Open Folder Open Project Close

13. Build and run the project. The results should look as shown below.

Figure 55. Build and run the project

LEFT	- Status =	600,	Distance =	1643	mm
CENTER	- Status =		Distance =	1687	mm
RIGHT	- Status =		Distance =	1687	mm
LEFT	- Status =	0,	Distance =	1687	mm
CENTER	- Status =	0,	Distance =	1627	mm
RIGHT	- Status =	12,	Distance =	1645	mm
LEFT	- Status = 1	12,	Distance =	1645	mm
CENTER	- Status =	Ø,	Distance =	1660	mm
RIGHT	- Status =	Ø,	Distance =	1648	mm





How to generate the VL53L3_SimpleRanging example with CubeMX

In this example, the following material is required:

- A NUCLEO-F401RE
- VL53L3CX-SATEL
- Dupont wires

Note:

4.2.3

Only the green VL53L3CX-SATEL PCB version works. The blue PCB cannot be used in this example. To operate this example, the breakout board is connected directly to the NUCLEO-F401RE board without the X-NUCLEO-53L3A2 expansion board.

1. Open STM32-CubeMX and click on [ACCESS TO BOARD SELECTOR].

Figure 56. Access to board selector

STM32CubeMX Untitled: STM32F401RETx NUCLEO-F401RE STM32 File Window Help Home > STM32F401RETx - NUCLEO-F401RE > Untitled - Pinout & Configuration Existing Projects New Project Recent Opened Projects I need to : test_tof1_rev2.ioc МΧ Start My project from MCU Last modified date : 14/06/2021 16:50:34 cube tof1 2 4.ioc МΧ Last modified date : 14/06/2021 16:00:33 Start My project from ST Board test_cube_tof1_3.ioc MX Last modified date : 14/06/2021 15:45:27 МΧ test_cube_2_2.ioc Start My project from Example Last modified date : 14/06/2021 15:31:16 SS TO EXAMPLE SELE Other Projects 2

2. Search and select the F401RE board.



Figure 57. F401RE board



3. Click on [Select Components].

Figure 58. Select components

✓ Pinout

4. Click on [X-CUBE-TOF1]. Select [53L3A2 Board Extension] and then select [VL53L3CX_SimpleRanging]. Click [OK].

v S	TMicroelectronics X-CUBE-TOF1	\odot	2.0.0			
	Board Extension 53L3A2	-	2.0.0			
	Board Extension 53L5A1		1.0.0			
	Board Part Ranging / VL53L3CX	\odot	2.0.0			
	Board Part Ranging / VL53L5CX		1.0.0			
~	Device TOF1_Applications	\odot	1.0.0			
	Application	\odot		VL53L3CX_SimpleRanging	~	
~	Board Support STM32Cube_Custom_BSP_D	\odot	1.0.0			
	Custom / RANGING SENSOR	\odot				

Figure 59. VL53L3CX_SimpleRanging

5. Click on [Software Packs]. Select [STMicroelectronics X-CUBE-TOF1], [Board Part Ranging] box, then [Device TOF1 Applications] and [Board Support STM32Cube Custom BSP Drivers].

Figure 60. Board support STM32Cube custom BSP drivers

ategories A->Z					Mode			
System Core Analog	>	Board Part Ra Device TOF1	nging Applications	SD Draw				
Timers	>	Doard Suppor	COTINUE CODE COSICILI D	or Dim	65	R		
Connectivity	>	1			Configuration			
Mutimedia	>	Reset Configurati	n					
Computing	>	 Parameter Settin Platform proposal — 	gs 📔 🔿 User Constant	s 🔺	Platform Settings			
Middleware	>	Application	IPs or Components		Found Solutions	I2C Addr		BSP AP
Software Packs	~	VL53L3CX_XSHUT	GPIO.Output	~	Undefined		Ŷ	Unknown
	-	TOE INT DIV	GPIO EXTI	~	Undefined		~	Unknown



6. Implement the connections shown below.

Figure 61. Connections 1

	_		Configuration			
Reset Configuration	n					
Parameter Setting	gs 🛛 📀 User Constants 🗾 🤞	Platfo	rm Settings			
Platform proposal —						
Application	IPs or Components	For	und Solutions	I2C Addr		BSP API
VL53L3CX_XSHUT	GPIO:Output ~	Und	efined PC0/A5		V	Unknown
TOF_INT_PIN	GPIO:EXTI ~	Und	efined PC1/A4		V	Unknown
				La		
Name	IPs or Components		Found Solutions	I2C Addr	BSP API	
BSP USART	USART:Asynchronous	\sim	Undefined	V	BSP_COMM	ION_DRIVE
	100-120	~	No solution DC9/DC9	NIA	RCD BUS	

Figure 62. Connections 2





7. Link the GPIOs to the corresponding pin names.

Figure 63. GPIO and pin name correspondence

	Parameter Setting	gs 🛛 🥺 User Constants		Platform Settings			
ſ	Platform proposal —						
	Name	IPs or Components		Found Solutions	I2C Addr		BSP API
	VL53L3CX_XSHUT	GPIO:Output	\sim	PC0		\sim	Jnknown
	TOF_INT_PIN	GPIO:EXTI	\sim	PC1		\sim	Jnknown
				ß			•

8. Click on [System Core], then on [GPIO] to open the GPIO configuration window.

Figure 64. GPIO configuration window



9. Name and configure the GPIO pins as shown below.

Figure 65. GPIO pin name and configuration

S GPIO	Single Mappe	d Signals 🛛 🥹	RCC 🛛 🔮 SYS	S USART	NVIC		
Search Signal	ls F)					Show only	Modified Pir
Pin Name 🌲	Signal on Pin	GPIO output le	GPIO mode	GPIO Pull-up/	Maximum outp.	User Label	Modified
PA5	n/a	Low	Output Push P	No pull-up and .	Low	LD2 [Green L	V
PC0	n/a	High	Output Push P	Pull-up	Low	TOF_RST	\checkmark
001	n/a	n/a	External Interru	No pull-up and .	. n/a	TOF_INT	
101							



10. Activate the NVIC interrupt vector as shown below.

Figure 66. Activation of NVIC interrupt vector

		Configu	ration			
Group By Peripherals						~
GPIO Single Mapped Signals	S RCC	🔮 SYS	😔 USAR	₹T	NVIC	
NVIC Interrupt Table			Enabled		Preemotion Priority	Sub Priority
EXTI line1 interrupt			Z	0		0
EXTI line[15:10] interrupts				0		0

11. Configure the I2C and BSP

Figure 67. Configuration of I2C and BSP

IPs or Components		Found Solutions	I2C Addr		BSP API
USART:Asynchronous	\sim	Undefined		~	BSP_COMMON_DRIVER
12C:12C	\vee	No solution V	N/A		BSP_BUS_DRIVER
	IPs or Components USART:Asynchronous	IPs or Components USART:Asynchronous	IPs or Components Found Solutions USART:Asynchronous Undefined r I2C:12C No solution	IPs or Components Found Solutions I2C Addr USART:Asynchronous V Undefined r I2C:12C V No solution N/A	IPs or Components Found Solutions I2C Addr USART:Asynchronous V Undefined V r I2C:12C V No solution N/A

12. Select PB9 and PB8 for SDA and SCL.

Figure 68. PB9 and PB8 selection (for SDA and SCL)





13. Click on [Connectivity]. Select [I2C1] and enable the I2C, then select [Fast mode].

STM32CubeMX for_un	n.ioc*: STM32F401RETx NUCI	LEO-F401RE			
TM32 CubeMX	File	Window	Help		
Home > STM32F40	1RETx - NUCLEO-F401RE	for_um.ioc - Pine	out & Configuration	\rangle	
Pi	nout & Configuration		CI	ock Configuration	
				✓ Software Packs	🗸 Pino
Q ~	0			I2C1 Mode and Configuration	
Categories A->Z		1.9		Mode	
Product of the		00 000			
System Core	~	10 [20			
0					
DMA					
IWDG				Configuration	
NVIC		Reset Configuration			
✓ RCC					
ASYS		Parameter Settings 🛛 🥥 U	ser Constants 📔 🔮 NV	1C Settings S DMA Settings C	SPIO Settings
111100	Confi	gure the below parameters :			
	QS	earch (Crti+F)	0		
Analog	> ~ N	laster Features			
		I2C Speed Mode		Fast Mode	
Timers	>	East Mode Duty Cuck		Putty cycle Tlow/Thigh =	2
Connectivity	~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~	lave Features		Buty cycle now might	2
Connectivity		Clock No Stretch Mod	e	Disabled	
A 1004		Primary Address Leng	th selection	7-bit	
0 1201		Dual Address Acknow	ledged	Disabled	
12C3		Primary slave address		0	
A SDIO		General Call address of	detection	Disabled	
Ø SPI1					

Figure 69. Fast mode selection

14. Return to the [Software Pack] view and configure the I2C and BSP as shown below.

Figure 70. Configuration of I2C and BSP

BSP					
Name	IPs or Components		Found Solutions	I2C Addr	BSP API
BSP USART	USART:Asynchronous	~	USART2		✓ BSP_COMMON_DRIVER
VL53L3CX BUS IO driver	12C:12C	~	I2C1	~ 0	BSP_BUS_DRIVER

15. Select either polling or interrupt. By default, [Polling] is selected.

Figure 71. Selection of polling or interrupt

Parameter Settings	User Constants	Platform Settings	
Configure the below param	neters :		
Q Search (CrtI+F)	0 0		0
 Basic Parameters 			
Ranging Mode		Polling	~
		Interrupt	
		Polling	



16. Click on [Project Manager].

Figure 72. Project manager

STM32Cu	beMX Untitled*: STM32F401RETx NUCLEO-F4	401RE			
STM32	File	Window	Help		•
Home >	STM32F401RETx - NUCLEO-F401RE	Untitled - Pinou	t & Configuration	\rangle	
	Pinout & Configuration			Clock Configuration	Project Manager

17. Name the project by selecting [Toolchain] and then selecting [Generate Code].

		Figure 73. F	Project name	
eshold_um.ioc: STM32F401RETx N	JCLEO-F401RE			
File	Window Help			- 🧐 📑 🕒 🔪
401RETx - NUCLEO-F401RE	threshold_um.ioc - Project N	lanager 🔪		GENERATE CODE
Pinout & Configuration		Clock Configuration	Project Manager	Tools
Project Settings Project Tabus Investidad units Project Location IC 165 Application Structure Advanced Toolchain Folder Location IC Stothain Folder Location		Or not generate the main()		
Toskhain / IDE S11K32Cube/DE	<u></u>	🖬 Generate Under Root		

18. Click [Open Project] on the pop-up window when the code generation is complete.

Figure 74. Open the project



19. Build and run the project. The results should look as shown below.

Figure 75. Build and run the project

COM124 - Tera Term VT	
File Edit Setup Control Window Help	
Targets = 1 > Status = 0, Distance =	1632 mm , Ambient = 6.35 kcps/spad, Signal = 2.54 kcps/spad
Targets = 1 I> Status = 0, Distance =	1641 mm , Ambient = 6.35 kcps/spad, Signal = 2.47 kcps/spad
Targets = 1 > Status = 0, Distance =	1634 mm , Ambient = 6.39 kcps/spad, Signal = 2.57 kcps/spad
Targets = 1 > Status = 0, Distance =	1640 mm , Ambient = 6.39 kcps/spad, Signal = 2.47 kcps/spad
Targets = 1 > Status = 0, Distance =	1641 mm , Ambient = 6.35 kcps/spad, Signal = 2.57 kcps/spad
Targets = 1 > Status = 0, Distance =	1644 mm , Ambient = 6.35 kcps/spad, Signal = 2.43 kcps/spad

5 System setup guide

5.1 Hardware description

5.1.1 STM32 Nucleo

STM32 Nucleo development boards provide an affordable and flexible way for users to test solutions and build prototypes with any STM32 microcontroller line.

The Arduino® connectivity support and ST morpho connectors make it easy to expand the functionality of the STM32 Nucleo open development platform with a wide range of specialized expansion boards to choose from. The STM32 Nucleo board does not require separate probes as it integrates the ST-LINK/V2-1 debugger/ programmer.

The STM32 Nucleo board comes with the comprehensive STM32 software HAL library together with various packaged software examples for different IDEs (IAR EWARM, Keil® MDK-ARM, STM32CubeIDE, Mbed[™], and GCC/LLVM).

All STM32 Nucleo users have free access to the Mbed[™] online resources (compiler, C/C++ SDK and developer community) at www.mbed.org to build complete applications easily.



Figure 76. STM32 Nucleo board

Information regarding the STM32 Nucleo board is available at www.st.com/stm32nucleo.



5.1.2 VL53L3CX boards

5.1.2.1 X-NUCLEO-53L3A2 expansion board

The X-NUCLEO-53L3A2 is an expansion board for any Nucleo 64 development board. It provides a complete evaluation kit allowing anyone to learn, evaluate, and develop their applications using the VL53L3CX, ranging sensor with multitarget detection.

The X-NUCLEO-53L3A2 expansion board is delivered with a cover glass holder in which three different spacers of 0.25, 0.5, and 1 mm height can be fitted below the cover glass to simulate various air gaps.

Two VL53L3CX breakout boards can be connected using two 10-pin connectors.

The X-NUCLEO-53L3A2 expansion board is compatible with the STM32 Nucleo board family, and with the Arduino® UNO R3 connector layout.



Figure 77. X-NUCLEO-53L3A2 expansion board



5.1.2.2 VL53L3CX-SATEL breakout boards

The VL53L3CX-SATEL breakout boards can be used for easy integration into customer devices.

Thanks to the voltage regulator and level shifters, the VL53L3CX breakout boards can be used in any application with a 2.8 V to 5 V supply.

The PCB section supporting the VL53L3CX module is perforated so that developers can break off the mini PCB for use in a 2.8 V supply application using flying leads. This makes it easier to integrate the VL53L3CX-SATEL breakout boards into development and evaluation devices due to their small form factor.

Figure 78. VL53L3CX-SATEL breakout board





5.2 Software description

The following software components are required in order to establish a suitable development environment for creating applications for the STM32 Nucleo equipped with the sensor expansion board:

- X-CUBE-TOF1: an STM32Cube expansion for sensor application development. The X-CUBE-TOF1 firmware and associated documentation is available on www.st.com.
- Development tool-chain and compiler: The STM32Cube expansion software supports the three following environments:
 - IAR Embedded Workbench for Arm® (EWARM) toolchain + STLINK
 - RealView microcontroller development kit (MDK-ARM-STR) toolchain + STLINK
 - STM32CubeIDE for STM32 + STLINK

5.3 Hardware setup

The following hardware components are required:

- One STM32 Nucleo development platform (suggested order code: NUCLEO-F401RE or NUCLEO-L476RG)
- An X-NUCLEO-53L3A2 expansion board or a VL53L3CX-SATEL breakout board
- One USB type A to mini-B USB cable to connect the STM32 Nucleo to a PC

5.4 Software setup

To set up the SDK, run the sample testing scenario based on the GUI utility and customize applications, select one of the integrated development environments supported by the STM32Cube expansion software and follow the system requirements and setup information provided by the IDE provider.



5.5 STM32 Nucleo and sensor expansion board setup

The STM32 Nucleo board integrates the ST-LINK/V2-1 debugger/programmer. Developers can download the relevant version of the ST-LINK/V2-1 USB driver by searching STSW-LINK008 or STSW-LINK009 (depending on your version of Windows®) on www.st.com.

The X-NUCLEO expansion boards can be easily connected to the STM32 Nucleo board through the Arduino® UNO R3 extension connector. It can interface with the external STM32 microcontroller on the STM32 Nucleo via the inter-integrated circuit (I²C) transport layer.

Figure 79. Sensor expansion board plugged to STM32 Nucleo board



Revision history

Table 1. Document revision history

Date	Version	Changes
27-Oct-2021	1	Initial release
30-Jan-2023	2	Updated Figure 10. VL53L3CX_SATEL connection and added note after figure.



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