Getting started with X-CUBE-6180A1 software for VL6180 proximity sensor

Introduction

STMicroelectronics has introduced various evaluation and development tools to facilitate the integration of the VL6180 sensor in customer's applications.

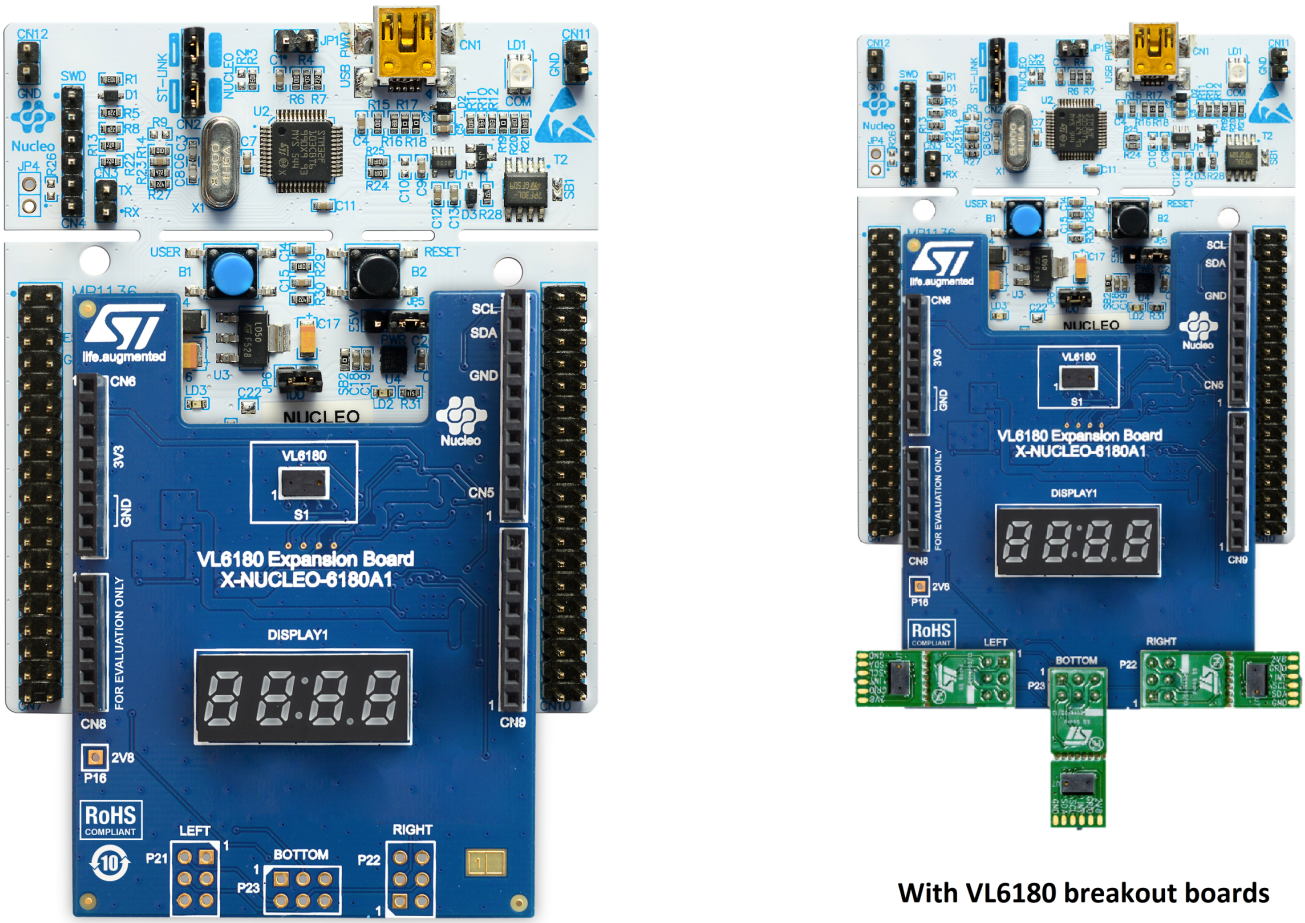
The VL6180 is a Time-of-Flight (ToF) sensor, based on ST patented FlightSense™ technology.

This document provides detailed firmware installation guidelines for the standalone operation.

The following list of evaluation devices are available:

- The P-NUCLEO-6180A1 includes STM32F401RE Nucleo and X-NUCLEO-6180A1 expansion boards
- The X-NUCLEO-6180A1 expansion board, this board can be used with F401RE and L476RG Nucleo boards.
- The VL6180-SATEL: Includes two VL6180 breakout boards. Up to three VL6180 breakout boards can be connected on the X-NUCLEO-6180A1 expansion board.

Figure 1. P-NUCLEO-6180A1 Nucleo pack



1 Hardware description

The X-NUCLEO-6180A1 expansion board:

- Is compatible with Arduino™ UNO R3 connectors.
- Must be plugged into an STM32 Nucleo board.
- Can be used with all ST expansion boards, which allows, for example, to develop VL6180 applications with Bluetooth™ or Wifi interface.

The STM32 Nucleo board is connected to the PC via a mini USB connector.

2 STM32Cube description

STMCube™ represents an original initiative by STMicroelectronics to ease development effort, time and cost. STM32Cube covers the STM32 portfolio.

STM32Cube includes:

- STM32CubeMX, a graphical software configuration tool that allows the generation of C initialization code using graphical wizards
- A comprehensive embedded software platform, delivered per series (such as the STM32CubeF4 for STM32F4 series)
- STM32Cube HAL, an STM32 abstraction layer embedded software, ensuring maximized portability across the STM32 portfolio
  - A consistent set of middleware components, such as RTOS, USB, TCP/IP, graphics
  - All embedded software utilities, including a full set of examples

3 X-CUBE-6180A1 and STM32Cube

The X-CUBE-6180A1 software is based on the STM32CubeHAL, the hardware abstraction layer for the STM32 microcontroller. The package extends STM32Cube by providing a Board Support Package (BSP) for the X-NUCLEO-6180A1 expansion board and a VL6180 API component (in Drivers\BSP\Components\VL6180 directory) to program, control and get ranging values from the VL6180 device.

Several example projects are included in the Projects\Multi\Examples\VL6180 directory, the developer can use these examples to start experimenting with the code. These examples are ready to be compiled using Keil (MDK-ARM), IAR (EWARM) or STM32 Cube IDE:

- SimpleRanging example features
  - Ranging mode
  - Selectable scaling in ranging mode
  - Interrupt mode in ranging mode
  - Ranging measures displayed on 7-segment display
- RangingWithSatellites example features
  - Simultaneous ranging from main VL6180 plus up to 3 breakout boards
  - Ranging measures displayed on 7-segment display

4 VL6180 standalone demonstrations

4.1 Installing the VL6180 standalone operation

The VL6180 Nucleo pack provides various demonstration modes for ranging:

- Scale Factor Modes (1, 2 and 3), to demonstrate the extended ranging performance of the device, with the scale factors applied manually in isolation or automatically.
- Alarm threshold modes, to demonstrate alarm conditions, with the VL6180 sending an interrupt to the application host as range measurements cross pre-defined range threshold limits. The benefit of this interrupt mode is that the host can stay in stand-by mode, reducing power consumption of the system, and the VL6180 will automatically send an interrupt to the host when the thresholds are reached.
- Multiple VL6180 device operation.

These are described in more detail in the following sections.

To install VL6180 standalone demonstrations:

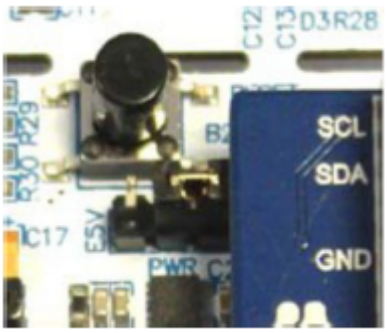
Note: If not already done, plug VL6180 expansion board onto the STM32 Nucleo board.

1. On www.st.com, search for X-CUBE-6180A1 under Products.
2. Click on Get Software.
3. Unzip the file.
4. The standalone demonstration software is located in one of the following directories:
   – \Projects\STM32F401RE-Nucleo\Examples\6180A1\SimpleRanging\Binary
   – \Projects\STM32F401RE-Nucleo\Examples\6180A1\RangingWithSatellites\Binary

   Each example code (SimpleRanging and RangingWithSatellites) can be compiled using one of the provided projects (MDK-ARM, EWARM, STM32CubeIDE) for each Nucleo board type: L476, F401

   Pre-compiled binaries are also provided in the Bin directories of each example.
   – VL6180_SimpleRanging.bin shows the behavior of a single VL6180 in ranging mode (see Section 4.2 SimpleRanging demonstration).
   – VL6180_RangingWithSatellites.bin shows the behavior of four VL6180 in ranging mode (see Section 4.3 RangingWithSatellites demonstration).
5. Drag and drop the .bin file you want to select to the F401RE or L476RG Nucleo board drive.
6. Press the black reset button (see Figure 2. Reset button) on the STM32 Nucleo board and release it, the Nucleo pack is now running in “standalone” mode, meaning no PC is required to control the Nucleo pack, USB connection is only used to power the Nucleo pack.
7. Move your hand or any object in front of VL6180 and read the value displayed on the 4 digit display.

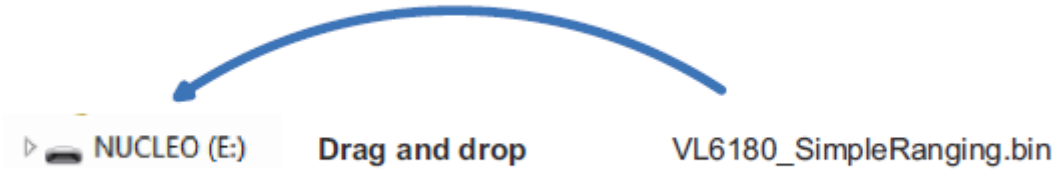
Figure 2. Reset button



4.2 SimpleRanging demonstration

Drag and drop the VL6180_SimpleRanging.bin file into the Nucleo board drive.

Figure 3. VL6180 standalone SimpleRanging installation



In this ranging mode the left digit displays the letter r during the ranging measurement.

Figure 4. Left display digit in ranging mode

When the USB cable is plugged, in the message “SF 1” is displayed for a few seconds. This message indicates that VL6180 scaler factor is set to 1. Consequently, range measurements between the VL6180 and the target are between 0 and 20 cm with a granularity of 1 mm.

Figure 5. SF1 message

There are two different types of modes available under SimpleRanging.

- A short press on the STM32 Nucleo board blue button will activate the Scale Factor mode.
- A long press on the STM32 Nucleo board blue button will activate the Alarm threshold mode.

Scale Factor mode

After the first short press on the blue button of the STM32 Nucleo board, the message “SF 2” is displayed for a few seconds (see the following figure). This message indicates that VL6180 scaler factor is set to 2. Consequently, range measurements between the VL6180 and the target are between 0 and 40 cm with a granularity of 2 mm.

Figure 6. **SF2 message**

At next short press on the blue button of the STM32 Nucleo board the message “SF 3” is displayed for a few seconds (see the following figure). This message indicates that VL6180 scaler factor is set to 3. Consequently, range measurements between the VL6180 and the target are between 0 and 60 cm with a granularity of 3 mm.

Figure 7. **SF3 message**

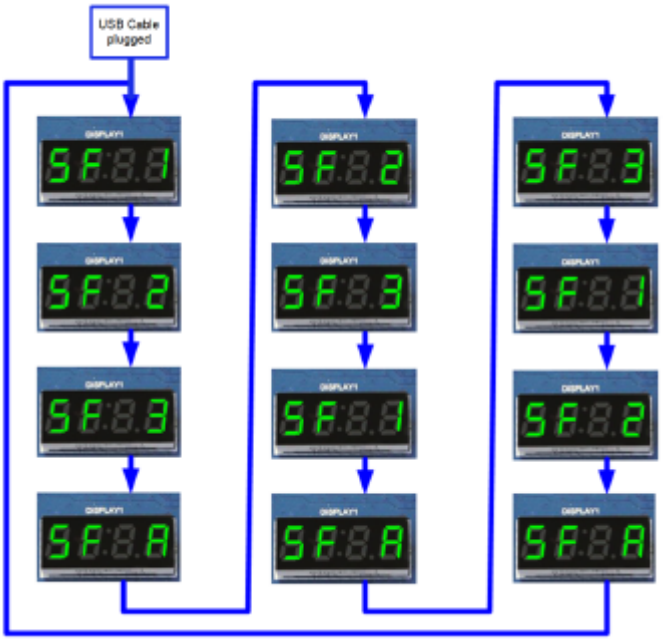
At next short press on the blue button of the STM32 Nucleo board, the message “SF A” is displayed for a few seconds (see the following figure). This message indicates that VL6180 scaler factor is set to automatic mode, resulting in range measurements between the VL6180 and the target are in the range of 0 to 60 cm with a granularity of:

- 1 mm for range measurements between 0 and 20 cm
- 2 mm for range measurements between 20 and 40 cm
- 3 mm for range measurements between 40 and 60 cm

Figure 8. **SFA message**

Starting from a USB cable connection, the sequence linked to sequential short presses on the blue button of the STM32 Nucleo board is described in the following figure.

Figure 9. **SF sequence**



Alarm threshold mode

At any time, the user can perform a long press on the blue button of the STM32 Nucleo board.

A long press on the blue button of the STM32 Nucleo board will activate the Alarm threshold mode. The message “rb” (Release Button) (see the following figure) will be displayed for as long as the button is pressed to indicate that the button must be released to proceed to the various alarm threshold modes.

Figure 10. **RB message**

When the blue button of the STM32 Nucleo board is released, the message “A-Lo” (Alarm Low) is displayed for a few seconds (see the following figure) to indicate the transition to the low range threshold mode.

Figure 11. **A-Lo message**

This mode indicates the range measurement has gone below a pre-defined lower range threshold. For this demonstration mode, this limit is set at 10 cm. In a real application use case, the value of this threshold can be programmed through the VL6180 registers:

- Range measurements of targets above the threshold will result in the message “L”
- Range measurements of targets below the threshold will result in the message “L---” to indicate the alarm state

Figure 12. L and L--- message

Target above ~10 cm from the VL6180

Target below ~10 cm from the VL6180

With the device in the Alarm Low mode, a subsequent short press on the blue button of the STM32 Nucleo board will transition to the Alarm High mode, resulting in the message “A-hi” being displayed for a short duration (see the following figure).

Figure 13. A-Hi message

This mode indicates range measurements have gone beyond a pre-defined upper range threshold. For this demonstration, this limit is set to 25 cm. In a real application use case, the value of this threshold can be programmed through VL6180 registers:

- Range measurements of targets above the threshold will result in the message “H”
- Range measurements of targets above the threshold will result in the message “H---” to indicate the alarm state

Figure 14. **H and H--- message**

With the device in the Alarm High mode, a subsequent short press on the blue button will transition to the Dual Alarm mode, resulting in the message “A-Oo” being displayed for a short period (see the following figure). Therefore, moving targets may trigger up to two lower and upper range measurement thresholds.

Figure 15. **A-Oo message**

If the target is below the pre-defined lower threshold (10 cm), or above the pre-defined upper threshold (25 cm), the message “O---” will be displayed to indicate the alarm state.

Otherwise, if the target is within the upper and lower thresholds, the message “O” is displayed.

Figure 16. **O and O--- message**

At next short press on the blue button of the STM32 Nucleo board, the “A-Lo” is displayed.

A subsequent long press on the blue button of the STM32 Nucleo board will exit the alarm mode. The message “rb” is displayed for the duration of the press and, following release, the mode will exit Alarm mode and return to Ranging SF-1.

4.3 RangingWithSatellites demonstration

Drag and drop the VL6180_RangingWithSatellites.bin file, which one you select will depend if you use a L053R8, a F401RE, or a L476RG STM32 Nucleo board.

Figure 17. VL6180 RangingWithSatellites demonstration installation

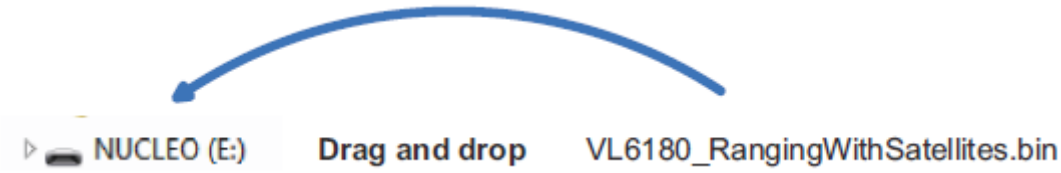
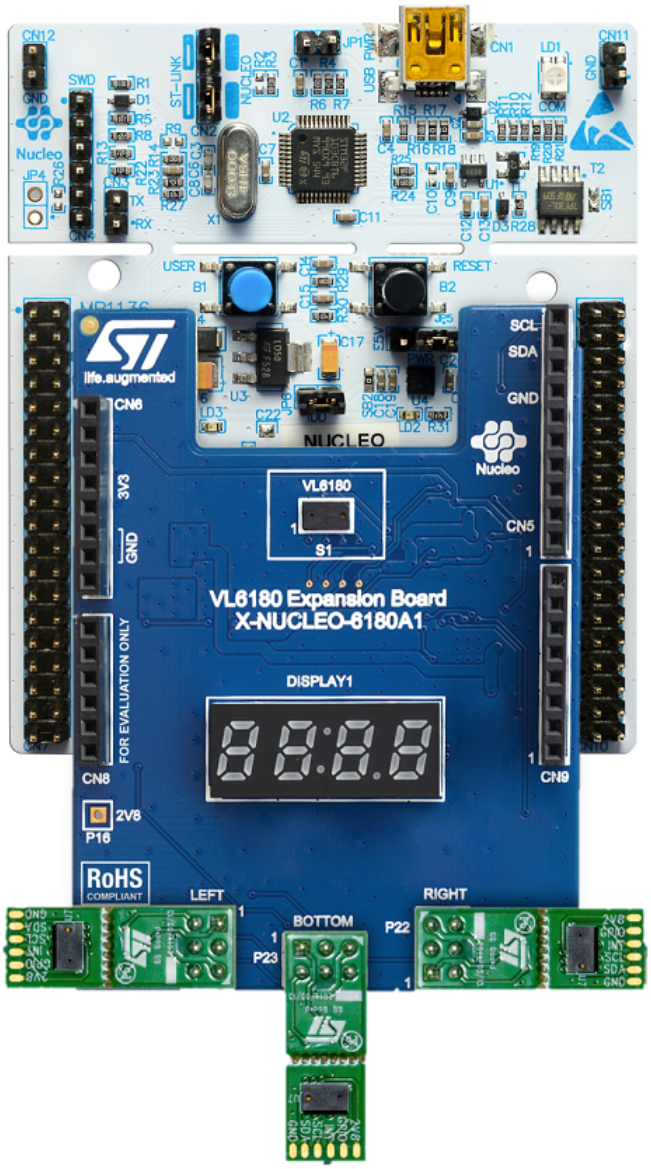


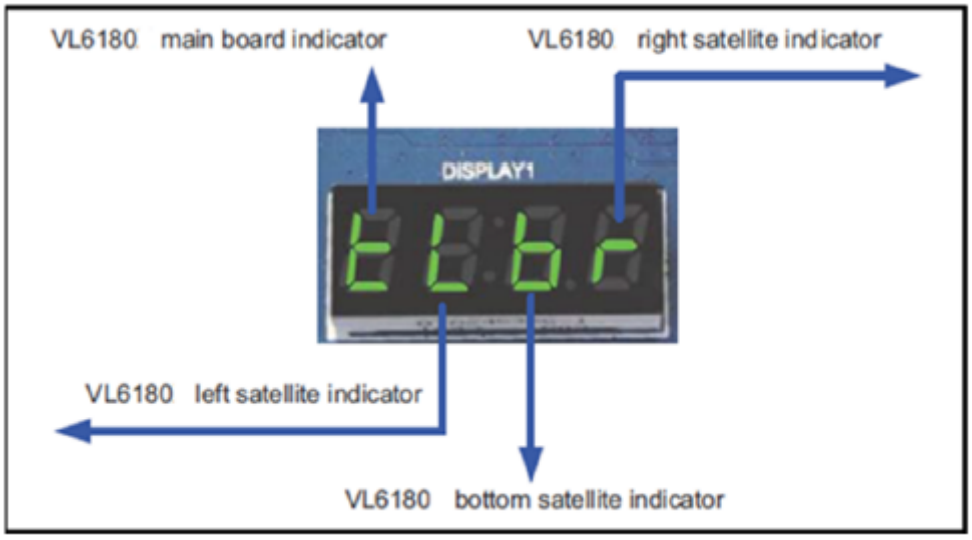
Figure 18. STM32 Nucleo, VL6180 expansion and VL6180 breakout boards - RangingWithSatellites configuration



When the USB cable is connected, a set of letters is displayed.
Each letter indicates one of the four potential VL6180 devices in operation:

- “t” indicates VL6180 on the main board
- “L” indicates VL6180 on the left breakout board
- “b” indicates VL6180 on the bottom breakout board
- “r” indicates VL6180 on the right breakout board

Figure 19. **Letters indicating VL6180 breakout board connection**

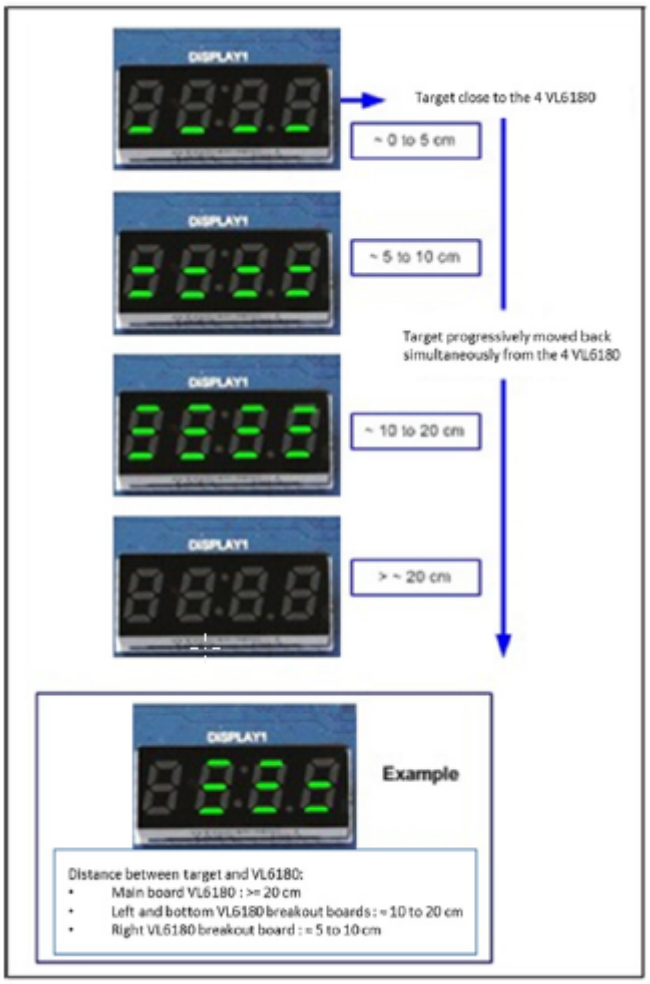


After a short press on the blue button of the STM32 Nucleo board, horizontal bar segments are displayed on the LCD digits to indicate various ranging distances. Each digit corresponds to one of up to four VL6180 devices attached, as illustrated in the following figure:

- If the target is within short range of a VL6180 device, a single bar segment is displayed on its digit.
- When the target is in medium or long range of the VL6180 device, two and three bars are displayed, respectively, on the corresponding digit.

Once the target exceeds a pre-defined maximum limit the corresponding digit for the VL6180 device has an empty display.

Figure 20. **Bar-graph display indicating the distance between the target and the VL6180 device**



Revision history

Table 1. **Document revision history**

Date	Version	Changes
10-Sep-2020	1	Initial release

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